FCC Test Report (Part 15C)

NFC

Test report no.:	EMC_BO_002300 (v1.0)	**Date of report:**	14-May-2020
Number of pages:	34	**Project support engineer:**	Oliver Flecke
Test period:	07-Apr to 08-May-2020		

Applicant:	Molex CVS Dabendorf GmbH, Märkische Straße 72, 15806 Zossen, Germany, Mr. Michael Schmidt		
Manufacturer:	Molex CVS Dabendorf GmbH, Märkische Straße 72, 15806 Zossen, Germany		
EUT identification:	Wireless Mobile Interface (WMI), WCH-302 (WCH-302a, WCH-302b, WCH-302c, WCH-302d, WCH-302e, WCH-302f, WCH-302g, WCH-302h, WCH-302i)		
FCC ID:	RK7WCH-302	**ISED ID:**	4774A-WCH302

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:	Jürgen Mitterer	**Technical review:**	Frank Wittmann
Title:	Validation and Test Engineering Manager	**Title:**	Senior Test Engineer EMC
Signature:		**Signature:**	

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Version History

Report Number	Date	Comment
EMC_BO_002300 (v1.0)	14-May-2020	1st approved version
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1. Summary for FCC Part 15C Test Report

Date of receipt	07-Apr-2020
Testing completed	08-May-2020
The customer's contact person	Mr. Michael Schmidt
Test samples / setup pictures	RK7302-00_EUT_&_Test_Setup_Photos_1.0.pdf
HW change / difference document	2.1_WCH-302_Difference_document_1.0.pdf
Notes	none

1.1. EUT and accessory information

OP1, OP2:

The EUT is an inductive wireless power transfer device (wireless charger) with RFID system (NFC) operating at 13.56 MHz. The EUT is tested with a commercially available mobile phone with a continuous NFC data read/write cycle (duty cycle of > 95 %). This test is performed with the integrated NFC antenna (OP1: loop antenna included in charging pad) and in addition with the external NFC antenna (OP2: separate loop antenna), which cannot be used simultaneously.

OP3, OP4:

In addition, the EUT is tested without mobile phone in a continuous NFC transmission mode with active modulation, configured via UART interface (duty cycle of 100 %). As well this test is performed with the integrated NFC antenna (OP3: loop antenna included in charging pad) and in addition with the external NFC antenna (OP4: separate loop antenna), which cannot be used simultaneously.

The following test samples provided by the customer were tested.

ID	Description	Manufacturer	Model	S/N	HW Version	SW Version
DAB200448E	WMI	Molex	WCH-302a	000002511C02	V16	RC36+
DAB200449E	WMI	Molex	WCH-302a	000002511C03	V16	RC36+
DAB200490E	WMI	Molex	WCH-302a	000002511C04	V16	RC36+

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
DAB191879E	System Cable	Molex	-	-	-	-
DAB191878E	System Cable	Molex	-	-	-	-
DAB16069E	RF Cable + Bias-T (100k)	Molex	-	-	-	-
DAB16071E	RF Cable + Bias-T (100k)	Molex	-	-	-	-
DAB200463E	External NFC Antenna	-	-	-	-	-
DAB191907E	External NFC Antenna	-	-	-	-	-
Galaxy S10	Mobile Phone	Samsung	Galaxy S10	RF8N11GL RPK	-	-

1.2. Technical characteristics

Power Supply [V]	Lead-acid battery (vehicle regulated) – 12 V DC		
Voltage Range [V]	U_{nom} = 12.0	U_{min} = 10.2	U_{max} = 13.8
Charging cut-off Voltage [V]	$U_{cut\text{-}off}$ = 6.2 (NFC is stopped for U < $U_{cut\text{-}off}$)		
Temperatures Range [°C]	-40 - +85		
Radio Type	NFC transceiver		
Operating Frequency [MHz]	13.56		
Operating Channels	Not channelized		
Antenna Type	Integral (1x internal, 1x external)		
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	-	May-2020
ANSI C63.10	-	Jun-2013
ISED RSS-Gen	Issue 5 + AMD1	Mar-2019
ISED RSS-210	Issue 10	Dec-2019

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	±3.6 x 10^{-7}	±1 x 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 °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

In this test report the measurement uncertainty is not included in the test result.

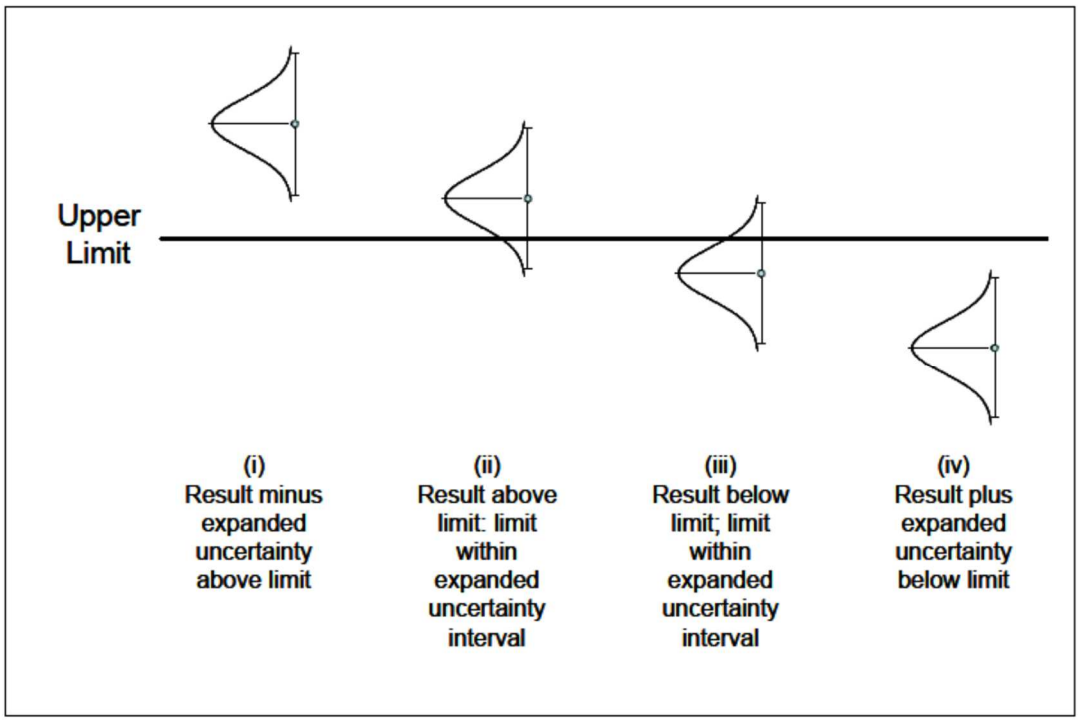


Figure 1: Assessment of Compliance with an Upper Limit (Source: EURACHEM/CITAC Guide: Use of uncertainty information in compliance assessment; First edition 2007)

(i) measurement value is clearly above the limit, result is failed
(ii) measurement value is above the limit, result is failed
(iii) measurement value is below the limit, result is passed
(iv) measurement value is clearly below the limit, result is passed

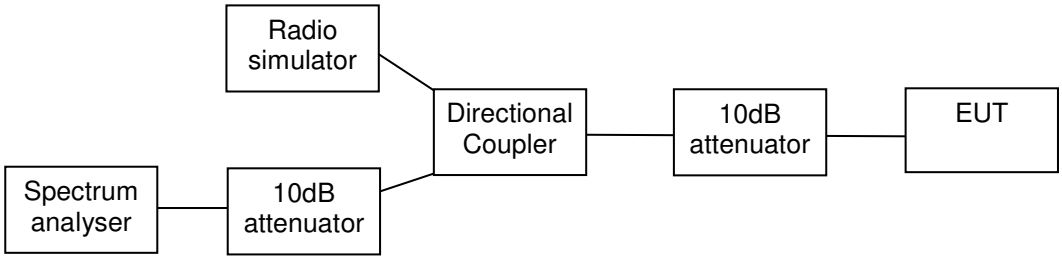
1.6. Summary of test results

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
4	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

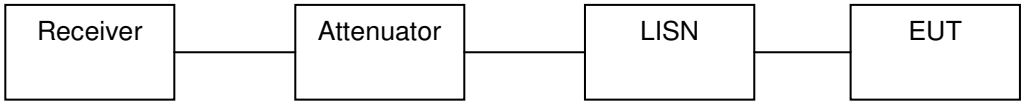
PASSED: The EUT complies with the essential requirements in the standard.
FAILED: The EUT does not comply with the essential requirements in the standard.
NP: The test was not performed.
NA: The test was not applicable.

2. Test setups

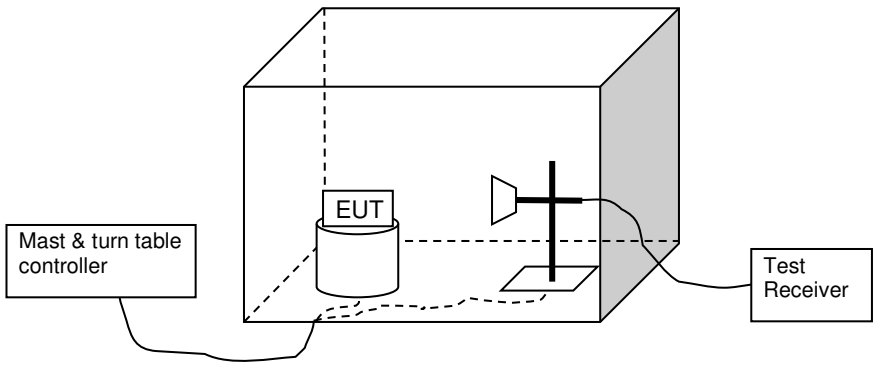
2.1. Conducted RF test setup (Setup 1)



2.2. Conducted AC power line emissions test setup (Setup 2)



2.3. Radiated emissions test setup (Setup 3)



3. Field strength in the 13.56 MHz band

EUT with DUT number	DAB200448E, DAB200449E
Accessories with DUT numbers	DAB191879E, DAB16069E, DAB200463E, Galaxy S10
Operation voltage [V] / [Hz]	12 V / DC
Result	PASSED
Remarks	OP1, OP2, OP3, OP4
Temp [°C] / humidity [%RH]	22.9 °C / 41.0 %
Date of measurement	07-Apr to 28-Apr-2020
Test engineer	Frank Wittmann
Test system SW version	V1.7.1

3.1. Test method and limit

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

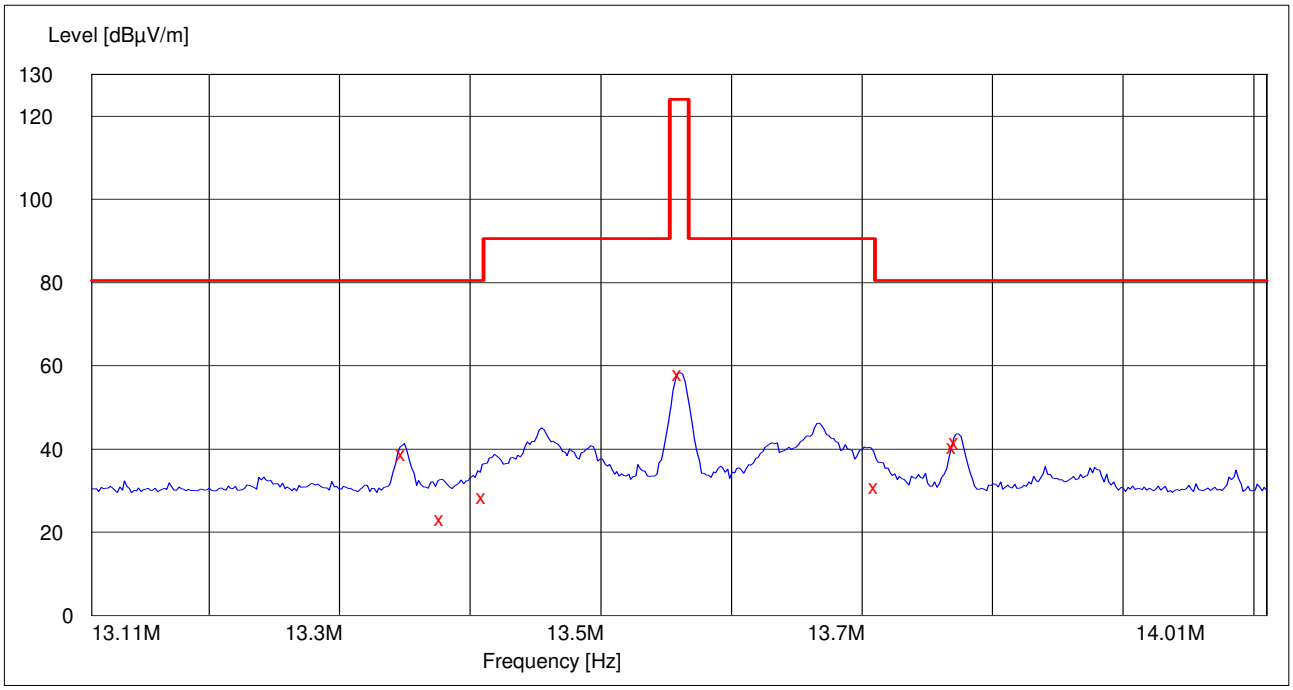
- ⇨ The measurement distance is 3 m with a shielded loop antenna. The magnetic field to electric field conversion factor is 51.5 dB (dBµA/m = dBµV/m – 51.5 dB).
- ⇨ The Limit has been adjusted with the distance correction factor according to 15.31(f)(2). (+40 dB for 30 m distance and +80 dB for 300 m 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 fixed height using a 2-axis EUT position system, set on the turntable, which is rotated by 360 degrees.
- ⇨ 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 [dBµV/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}).

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

Frequency range [MHz]	Limit [dBµA/m]	Limit [dBµV/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)

OP1: Peak detector (RBW 10 kHz)

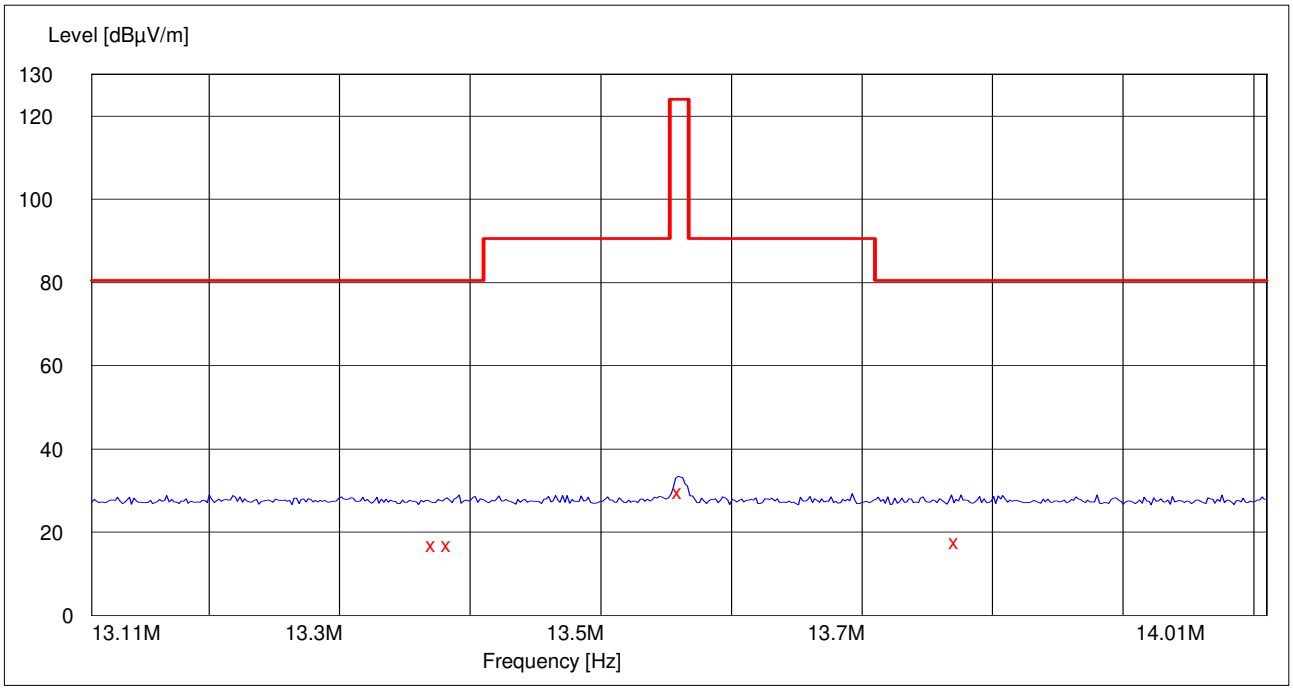


Quasi-Peak detector (RBW 9 kHz)

Frequency [MHz]	Level [dBµV/m]	Transducer [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Azimuth [deg]	Polarisation	Result
13.348500	38.90	23.40	80.50	41.60	170.0	40.00	VERTICAL	PASSED
13.378000	23.40	23.40	80.50	57.10	170.0	224.00	VERTICAL	PASSED
13.410000	28.70	23.40	80.50	51.80	170.0	23.00	VERTICAL	PASSED
13.560000	58.20	23.40	124.00	65.80	170.0	35.00	VERTICAL	PASSED
13.711000	31.10	23.40	80.50	49.40	170.0	34.00	VERTICAL	PASSED
13.770500	40.60	23.40	80.50	39.90	170.0	44.00	VERTICAL	PASSED

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

OP2: Peak detector (RBW 10 kHz)

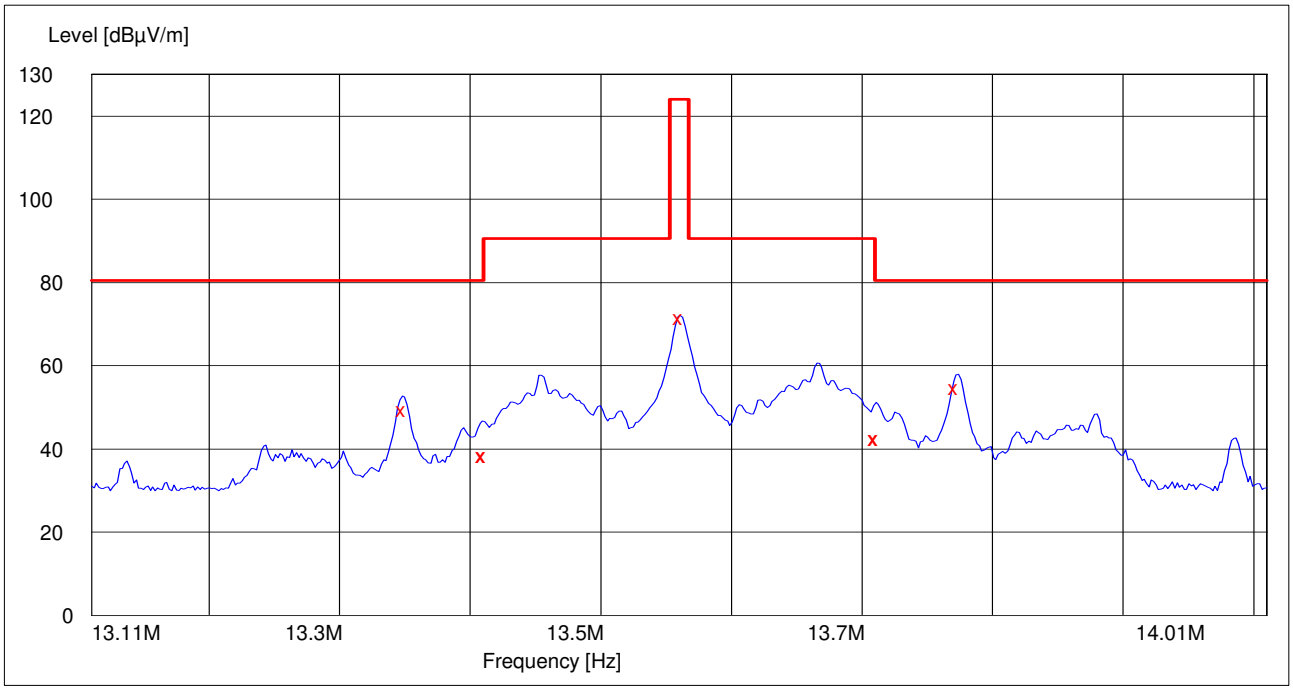


Quasi-Peak detector (RBW 9 kHz)

Frequency [MHz]	Level [dBµV/m]	Transducer [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Azimuth [deg]	Polarisation	Result
13.372000	17.00	23.40	80.50	63.50	170.0	26.00	VERTICAL	PASSED
13.383500	17.00	23.40	80.50	63.50	170.0	335.00	VERTICAL	PASSED
13.560000	29.90	23.40	124.00	94.10	170.0	116.00	VERTICAL	PASSED
13.772500	17.90	23.40	80.50	62.60	170.0	311.00	VERTICAL	PASSED
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

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

OP3: Peak detector (RBW 10 kHz)

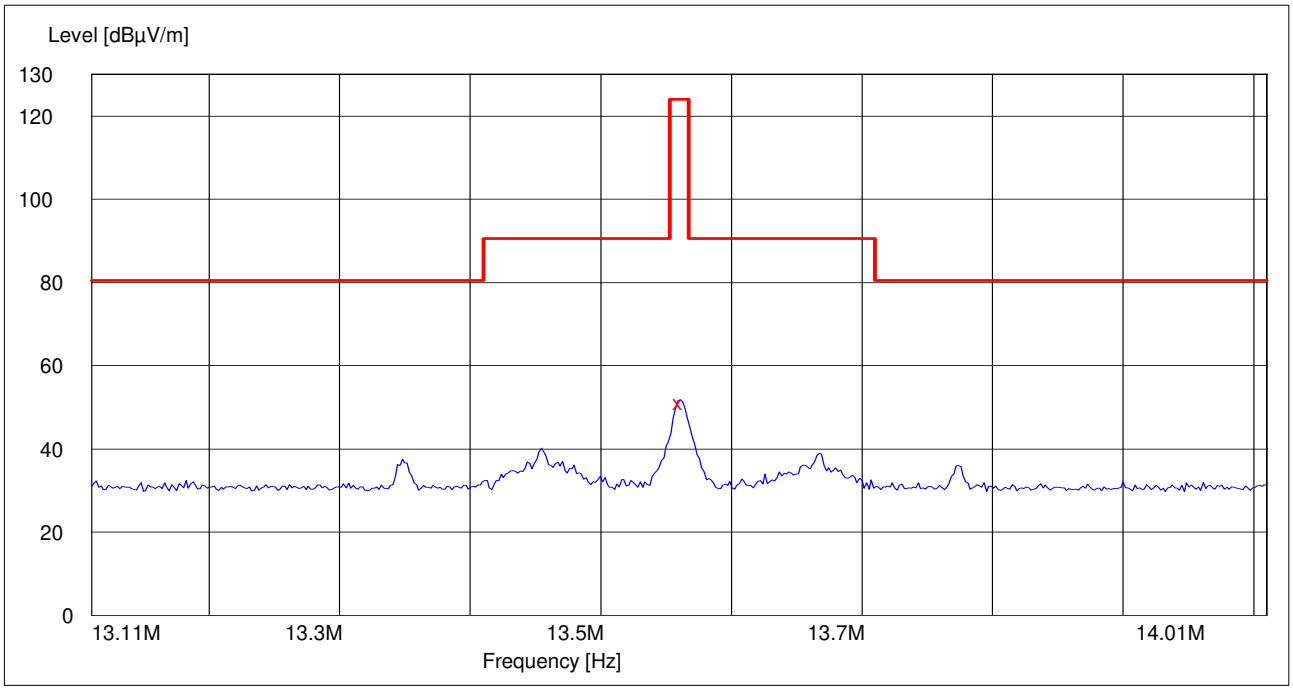


Quasi-Peak detector (RBW 9 kHz)

Frequency [MHz]	Level [dBµV/m]	Transducer [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Azimuth [deg]	Polarisation	Result
13.348500	49.40	23.40	80.50	31.10	170.0	31.00	VERTICAL	PASSED
13.409500	38.60	23.40	80.50	41.90	170.0	33.00	VERTICAL	PASSED
13.410000	38.50	23.40	80.50	42.00	170.0	30.00	VERTICAL	PASSED
13.560500	71.60	23.40	124.00	52.40	170.0	35.00	VERTICAL	PASSED
13.710500	42.50	23.40	80.50	38.00	170.0	36.00	VERTICAL	PASSED
13.711000	42.50	23.40	80.50	38.00	170.0	32.00	VERTICAL	PASSED

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

OP4: Peak detector (RBW 10 kHz)



Quasi-Peak detector (RBW 9 kHz)

Frequency [MHz]	Level [dBµV/m]	Transducer [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Azimuth [deg]	Polarisation	Result
13.560500	51.10	23.40	124.00	72.90	170.0	232.00	VERTICAL	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	DAB200448E, DAB200449E
Accessories with DUT numbers	DAB191879E, DAB16069E, DAB200463E, Galaxy S10
Operation voltage [V] / [Hz]	12 V / DC
Result	PASSED
Remarks	OP1, OP2, OP3, OP4
Temp [°C] / humidity [%RH]	22.9 °C / 41.0 %
Date of measurement	07-Apr to 28-Apr-2020
Test engineer	Frank Wittmann
Test system SW version	V1.7.1

4.1. Test method and limit

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

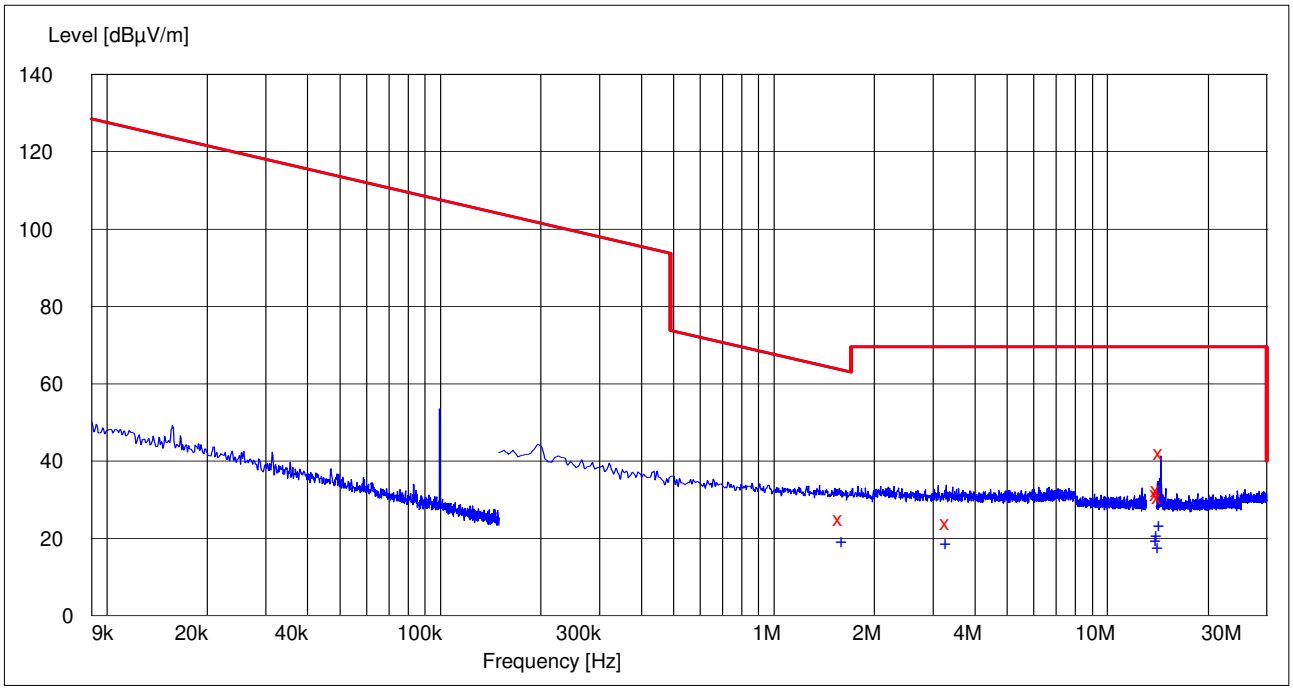
- ⇨ The measurement distance is 3 m with a shielded loop antenna. The magnetic field to electric field conversion factor is 51.5 dB (dBµA/m = dBµV/m – 51.5 dB).
- ⇨ The Limit has been adjusted with the distance correction factor according to 15.31(f)(2). (+40 dB for 30 m distance and +80 dB for 300 m 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 fixed height using a 2-axis EUT position system, set on the turntable, which is rotated by 360 degrees.
- ⇨ 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 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 [dBµV/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}).

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

Frequency range [MHz]	Limit [µV/m]	Limit [dBµV/m]	Detector
0.009 - 0.09	10000 * 2400 / f[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[kHz]	73.8 - 63.0	QP
1.705 - 30.0	100 * 30	69.5	QP

4.2. Test results (FCC/ISED)

OP1: 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]	Transducer [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Azimuth [deg]	Polarisation	Result
1.575500	25.10	23.10	63.70	38.60	170.0	275.00	VERTICAL	PASSED
3.317000	24.00	23.20	69.50	45.50	170.0	165.00	VERTICAL	PASSED
14.090000	31.50	23.40	69.50	38.00	170.0	25.00	VERTICAL	PASSED
14.196500	32.70	23.40	69.50	36.80	170.0	37.00	VERTICAL	PASSED
14.300500	30.90	23.40	69.50	38.60	170.0	51.00	VERTICAL	PASSED
14.408000	42.20	23.40	69.50	27.30	170.0	210.00	VERTICAL	PASSED

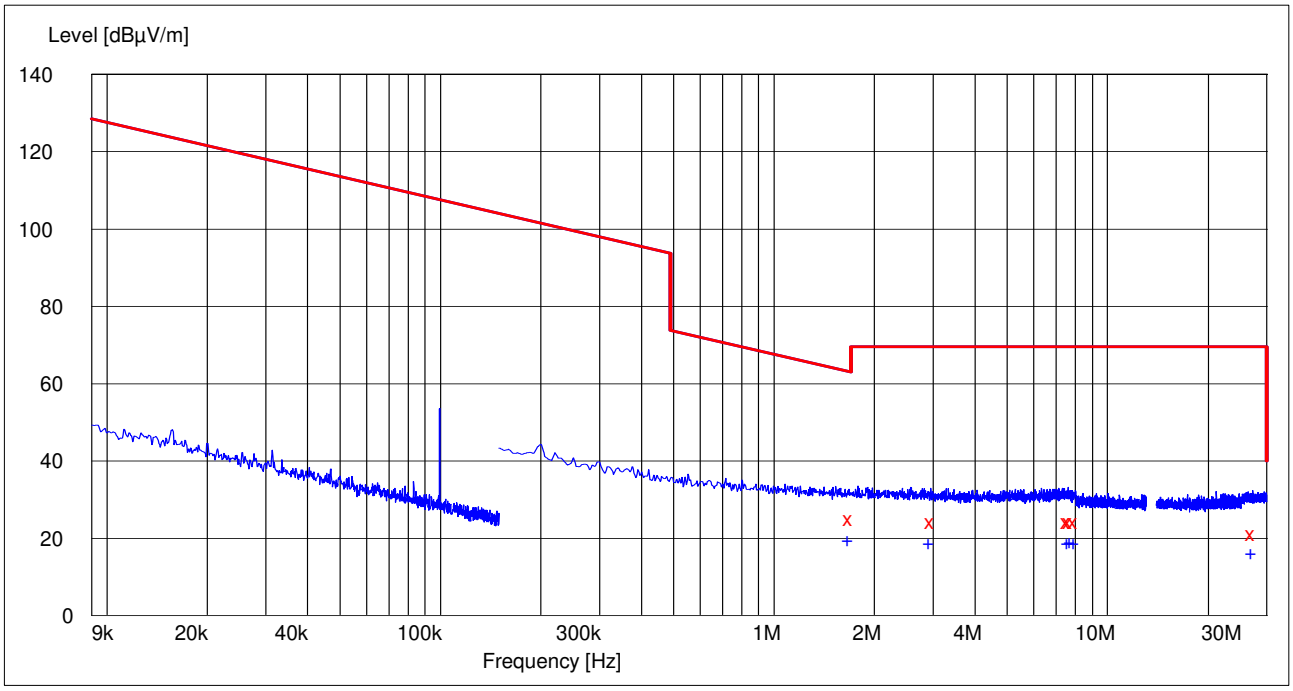
No further emissions found less than 20 dB to the regulatory limit and no emission found in the restricted bands of operation.

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

Frequency [MHz]	Level [dBµV/m]	Transducer [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Azimuth [deg]	Polarisation	Result
1.612000	19.80	23.10	63.50	43.70	170.0	254.00	VERTICAL	PASSED
3.313000	19.10	23.20	69.50	50.40	170.0	176.00	VERTICAL	PASSED
14.090000	19.90	23.40	69.50	49.60	170.0	19.00	VERTICAL	PASSED
14.196000	21.20	23.40	69.50	48.30	170.0	37.00	VERTICAL	PASSED
14.303000	18.20	23.40	69.50	51.30	170.0	55.00	VERTICAL	PASSED
14.408500	23.70	23.40	69.50	45.80	170.0	204.00	VERTICAL	PASSED

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

OP2: 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]	Transducer [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Azimuth [deg]	Polarisation	Result
1.696000	25.10	23.10	63.00	37.90	170.0	344.00	VERTICAL	PASSED
2.975000	24.40	23.10	69.50	45.10	170.0	217.00	VERTICAL	PASSED
7.605500	24.40	23.50	69.50	45.10	170.0	123.00	VERTICAL	PASSED
7.725500	24.40	23.50	69.50	45.10	170.0	61.00	VERTICAL	PASSED
8.015000	24.40	23.50	69.50	45.10	170.0	74.00	VERTICAL	PASSED
27.213500	21.10	23.70	69.50	48.40	170.0	131.00	VERTICAL	PASSED

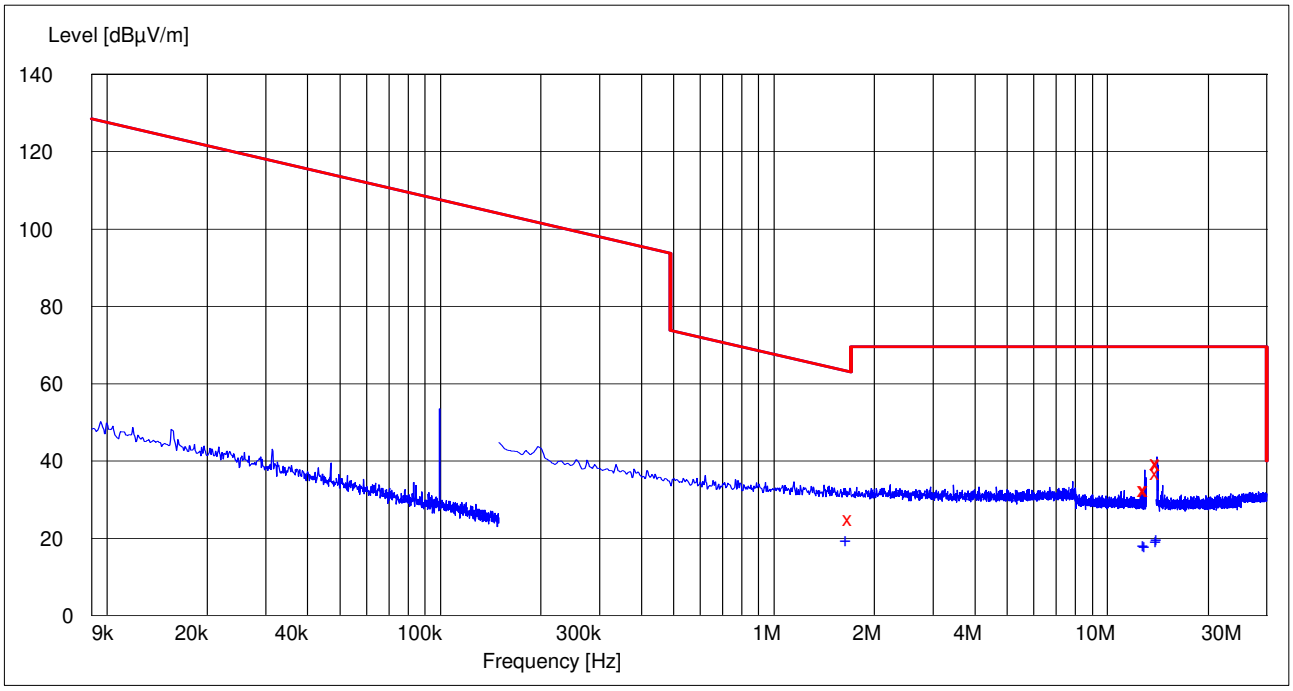
No further emissions found less than 20 dB to the regulatory limit and no emission found in the restricted bands of operation.

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

Frequency [MHz]	Level [dBµV/m]	Transducer [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Azimuth [deg]	Polarisation	Result
1.678500	19.80	23.10	63.10	43.30	170.0	320.00	VERTICAL	PASSED
2.940500	19.20	23.10	69.50	50.30	170.0	198.00	VERTICAL	PASSED
7.639000	19.30	23.50	69.50	50.20	170.0	107.00	VERTICAL	PASSED
7.774500	19.40	23.50	69.50	50.10	170.0	44.00	VERTICAL	PASSED
8.011000	19.30	23.50	69.50	50.20	170.0	90.00	VERTICAL	PASSED
27.253000	16.60	23.70	69.50	52.90	170.0	106.00	VERTICAL	PASSED

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

OP3: 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]	Transducer [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Azimuth [deg]	Polarisation	Result
1.683500	25.10	23.10	63.10	38.00	170.0	108.00	VERTICAL	PASSED
12.924500	32.70	23.40	69.50	36.80	170.0	43.00	VERTICAL	PASSED
13.031000	32.70	23.40	69.50	36.80	170.0	27.00	VERTICAL	PASSED
14.090000	39.60	23.40	69.50	29.90	170.0	218.00	VERTICAL	PASSED
14.090500	37.10	23.40	69.50	32.40	170.0	255.00	VERTICAL	PASSED
14.196500	39.40	23.40	69.50	30.10	170.0	194.00	VERTICAL	PASSED

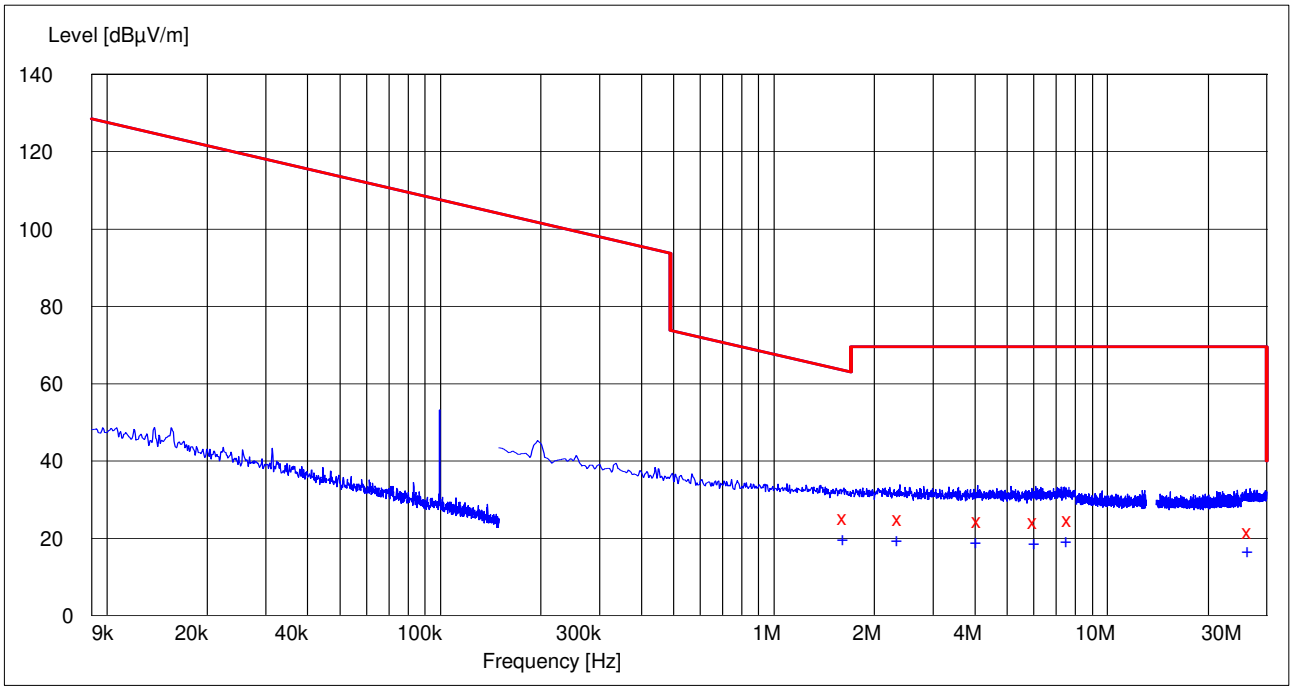
No further emissions found less than 20 dB to the regulatory limit and no emission found in the restricted bands of operation.

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

Frequency [MHz]	Level [dBµV/m]	Transducer [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Azimuth [deg]	Polarisation	Result
1.659500	20.00	23.10	63.20	43.20	170.0	125.00	VERTICAL	PASSED
12.925000	18.70	23.40	69.50	50.80	170.0	44.00	VERTICAL	PASSED
13.031000	18.30	23.40	69.50	51.20	170.0	39.00	VERTICAL	PASSED
14.090000	19.60	23.40	69.50	49.90	170.0	206.00	VERTICAL	PASSED
14.196000	20.30	23.40	69.50	49.20	170.0	195.00	VERTICAL	PASSED
1.659500	20.00	23.10	63.20	43.20	170.0	125.00	VERTICAL	PASSED

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

OP4: 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]	Transducer [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Azimuth [deg]	Polarisation	Result
1.625000	25.50	23.10	63.40	37.90	170.0	134.00	VERTICAL	PASSED
2.381500	25.10	23.10	69.50	44.40	170.0	0.00	VERTICAL	PASSED
4.115000	24.60	23.30	69.50	44.90	170.0	75.00	VERTICAL	PASSED
6.050000	24.30	23.40	69.50	45.20	170.0	264.00	VERTICAL	PASSED
7.702500	24.80	23.50	69.50	44.70	170.0	96.00	VERTICAL	PASSED
26.639000	21.70	23.70	69.50	47.80	170.0	106.00	VERTICAL	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 200 Hz, > 150 kHz: RBW 9 kHz)

Frequency [MHz]	Level [dBµV/m]	Transducer [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Azimuth [deg]	Polarisation	Result
1.628000	20.30	23.10	63.40	43.10	170.0	104.00	VERTICAL	PASSED
2.360000	20.00	23.10	69.50	49.50	170.0	351.00	VERTICAL	PASSED
4.082000	19.40	23.30	69.50	50.10	170.0	99.00	VERTICAL	PASSED
6.110000	19.30	23.40	69.50	50.20	170.0	266.00	VERTICAL	PASSED
7.629500	19.70	23.50	69.50	49.80	170.0	96.00	VERTICAL	PASSED
26.640000	17.00	23.70	69.50	52.50	170.0	111.00	VERTICAL	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	DAB200448E, DAB200449E
Accessories with DUT numbers	DAB191879E, DAB16069E, DAB200463E, Galaxy S10
Operation voltage [V] / [Hz]	12 V / DC
Result	PASSED
Remarks	OP1, OP2, OP3, OP4
Temp [°C] / humidity [%RH]	22.9 °C / 41.0 %
Date of measurement	07-Apr to 28-Apr-2020
Test engineer	Frank Wittmann
Test system SW version	V1.7.1

5.1. Test method and limit

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

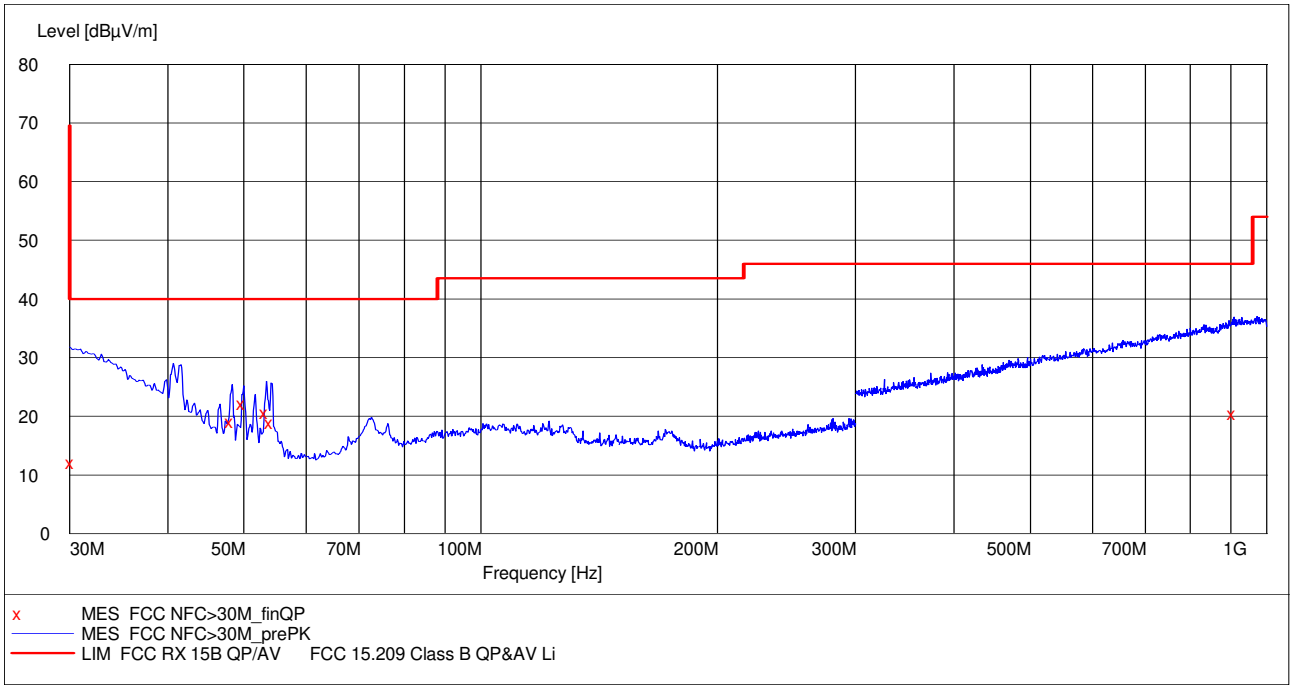
- ⇨ The EUT is placed on a nonconductive plate in the centre of the turntable.
- ⇨ The measurement is divided into the Preliminary Measurement and the Final Measurement.
  The Preliminary Measurement and the Final Measurement is performed in 3 m distance without floor absorbers by rotating the turntable 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 [dBµV/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}).

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

Frequency range [MHz]	Limit [µV/m]	Limit [dBµV/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)

OP1: Peak detector (< 300 MHz: RBW 300 kHz, > 300 MHz: RBW 1 MHz)

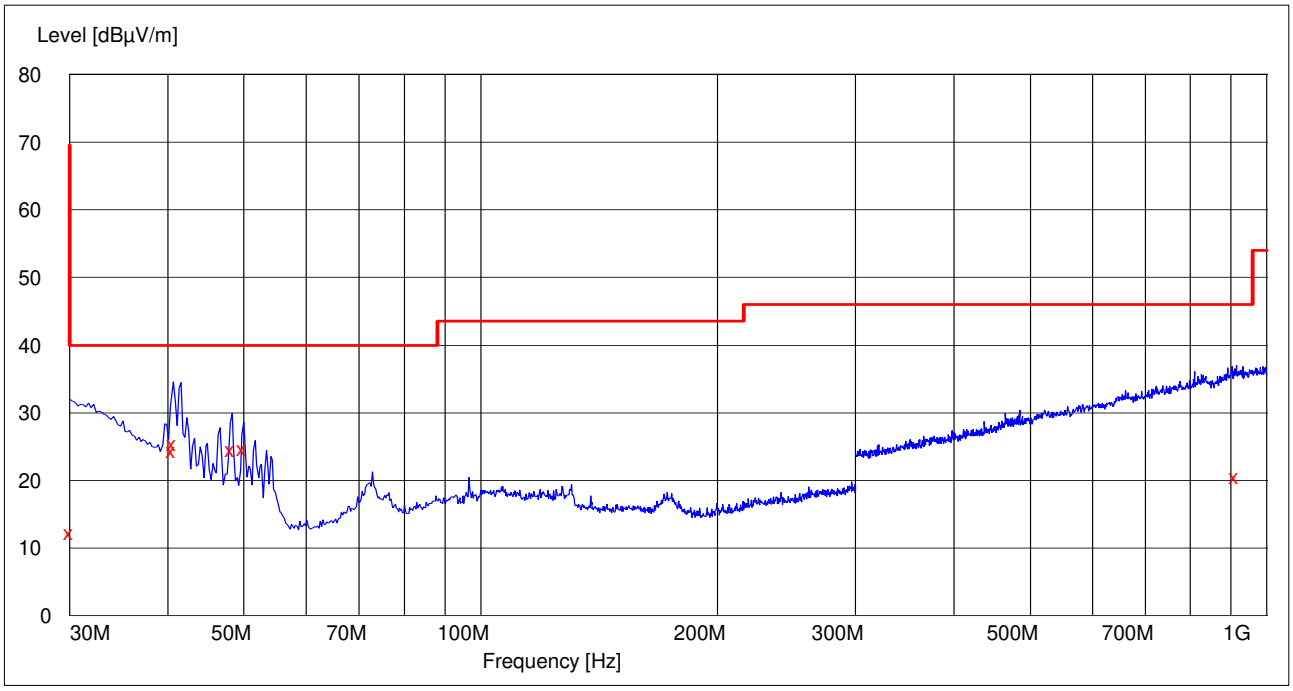


Quasi-Peak detector (RBW 120 kHz)

Frequency [MHz]	Level [dBµV/m]	Transducer [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Azimuth [deg]	Polarisation	Result
30.300000	12.20	-17.30	40.00	27.80	326.0	275.00	HORIZONTAL	PASSED
48.276553	19.20	-25.00	40.00	20.80	126.0	49.00	VERTICAL	PASSED
49.959920	22.20	-25.50	40.00	17.80	98.0	345.00	VERTICAL	PASSED
53.426653	20.70	-26.30	40.00	19.30	123.0	120.00	VERTICAL	PASSED
54.248096	18.90	-26.50	40.00	21.10	98.0	60.00	VERTICAL	PASSED
909.617635	20.50	-16.20	46.00	25.50	223.0	273.00	VERTICAL	PASSED

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

OP2: Peak detector (< 300 MHz: RBW 300 kHz, > 300 MHz: RBW 1 MHz)

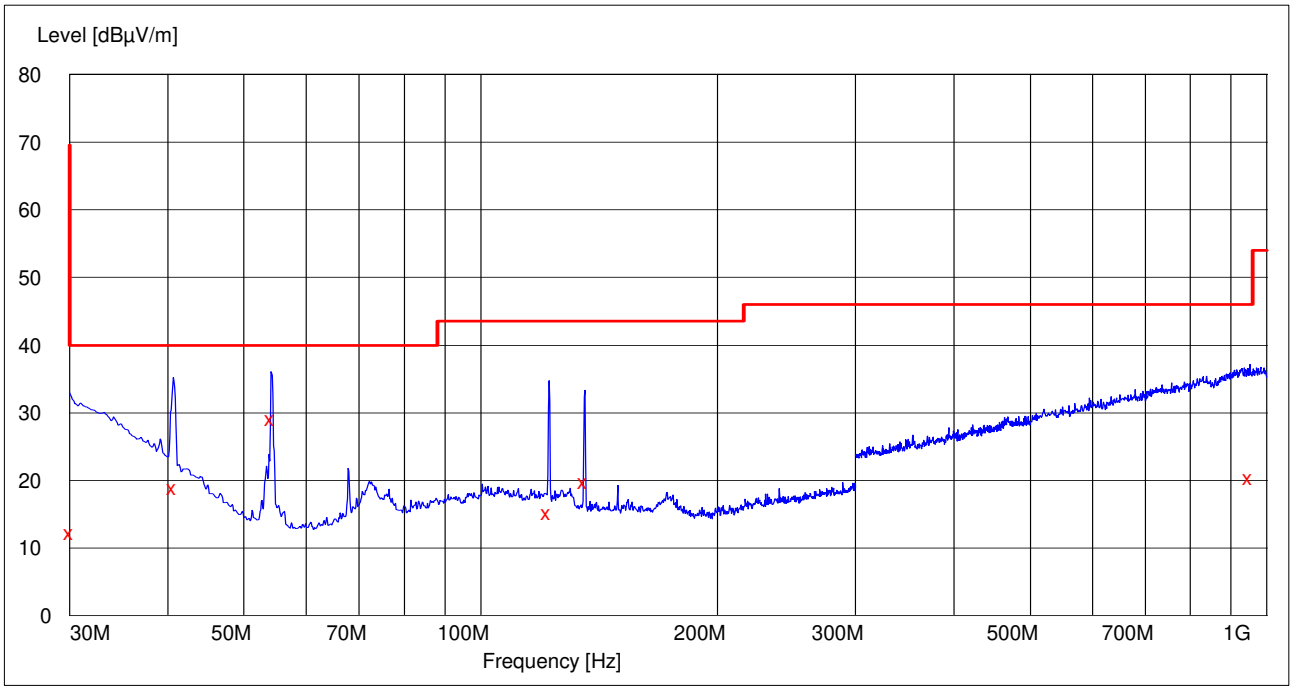


Quasi-Peak detector (RBW 120 kHz)

Frequency [MHz]	Level [dBµV/m]	Transducer [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Azimuth [deg]	Polarisation	Result
30.100000	12.30	-17.20	40.00	27.70	313.0	142.00	VERTICAL	PASSED
40.643086	24.40	-22.30	40.00	15.60	98.0	222.00	VERTICAL	PASSED
40.681162	25.40	-22.30	40.00	14.60	101.0	194.00	VERTICAL	PASSED
48.276553	24.60	-25.00	40.00	15.40	124.0	195.00	VERTICAL	PASSED
49.959920	24.70	-25.50	40.00	15.30	98.0	93.00	VERTICAL	PASSED
915.629659	20.60	-16.00	46.00	25.40	176.0	195.00	VERTICAL	PASSED

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

OP3: Peak detector (< 300 MHz: RBW 300 kHz, > 300 MHz: RBW 1 MHz)

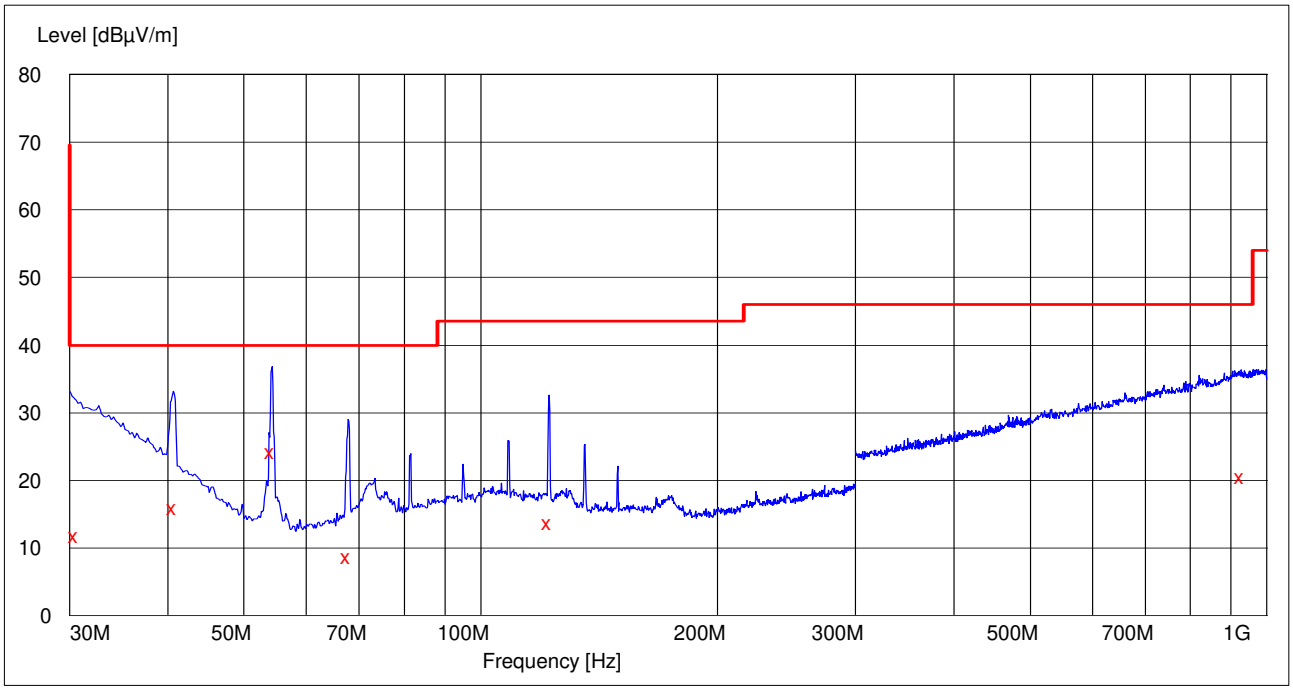


Quasi-Peak detector (RBW 120 kHz)

Frequency [MHz]	Level [dBµV/m]	Transducer [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Azimuth [deg]	Polarisation	Result
30.100000	12.30	-17.20	40.00	27.70	316.0	75.00	VERTICAL	PASSED
40.681162	18.90	-22.30	40.00	21.10	101.0	247.00	VERTICAL	PASSED
54.248096	29.10	-26.50	40.00	10.90	98.0	14.00	VERTICAL	PASSED
122.004208	15.30	-28.40	43.50	28.20	101.0	338.00	VERTICAL	PASSED
135.611623	19.80	-27.70	43.50	23.70	98.0	143.00	VERTICAL	PASSED
952.703808	20.40	-16.00	46.00	25.60	323.0	98.00	VERTICAL	PASSED

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

OP4: Peak detector (< 300 MHz: RBW 300 kHz, > 300 MHz: RBW 1 MHz)



Quasi-Peak detector (RBW 120 kHz)

Frequency [MHz]	Level [dBµV/m]	Transducer [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Azimuth [deg]	Polarisation	Result
30.500000	11.90	-17.40	40.00	28.10	376.0	107.00	HORIZONTAL	PASSED
40.681162	16.00	-22.30	40.00	24.00	101.0	253.00	VERTICAL	PASSED
54.288577	24.30	-26.50	40.00	15.70	98.0	19.00	VERTICAL	PASSED
67.755511	8.70	-28.50	40.00	31.30	123.0	340.00	VERTICAL	PASSED
122.104208	13.80	-28.40	43.50	29.70	101.0	94.00	VERTICAL	PASSED
928.355711	20.60	-16.00	46.00	25.40	276.0	285.00	HORIZONTAL	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	DAB200490E, DAB200449E
Accessories with DUT numbers	DAB191878E, NOV16037E, DAB16071E
Operation voltage [V] / [Hz]	12 V / DC
Result	PASSED
Remarks	OP3, OP4
Temp [°C] / humidity [%RH]	23 °C / 34.5 %
Date of measurement	06-May to 08-May-2020
Test engineer	Bhushan Pawar
Test system SW version	V1.7

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 and ISED limits for frequency stability, temperature variation measurements

Frequency Deviation [%]
+\- 0.01

6.2. Test results (FCC, ISED)

OP3:

Temperature [°C]	Time [min]	Frequency [MHz]	Deviation [%]	Result
50	0	13.56089	0.007%	PASSED
	2	13.56092	0.007%	PASSED
	5	13.56096	0.007%	PASSED
	10	13.56081	0.006%	PASSED
40	0	13.56096	0.007%	PASSED
	2	13.56087	0.006%	PASSED
	5	13.56096	0.007%	PASSED
	10	13.56085	0.006%	PASSED
30	0	13.56100	0.007%	PASSED
	2	13.56100	0.007%	PASSED
	5	13.56100	0.007%	PASSED
	10	13.56094	0.007%	PASSED
20	0	13.56104	0.008%	PASSED
	2	13.56100	0.007%	PASSED
	5	13.56100	0.007%	PASSED
	10	13.56104	0.008%	PASSED
10	0	13.56092	0.007%	PASSED
	2	13.56104	0.008%	PASSED
	5	13.56118	0.009%	PASSED
	10	13.56108	0.008%	PASSED
0	0	13.56112	0.008%	PASSED
	2	13.56110	0.008%	PASSED
	5	13.56108	0.008%	PASSED
	10	13.56110	0.008%	PASSED
-10	0	13.56114	0.008%	PASSED
	2	13.56110	0.008%	PASSED
	5	13.56122	0.009%	PASSED
	10	13.56108	0.008%	PASSED
-20	0	13.56110	0.008%	PASSED
	2	13.56110	0.008%	PASSED
	5	13.56116	0.009%	PASSED
	10	13.56110	0.008%	PASSED
-30	0	13.56118	0.009%	PASSED
	2	13.56108	0.008%	PASSED
	5	13.56112	0.008%	PASSED
	10	13.56112	0.008%	PASSED

OP4:

Temperature [°C]	Time [min]	Frequency [MHz]	Deviation [%]	Result
50	0	13.56089	0.007%	PASSED
	2	13.56089	0.007%	PASSED
	5	13.56089	0.007%	PASSED
	10	13.56089	0.007%	PASSED
40	0	13.56096	0.007%	PASSED
	2	13.56092	0.007%	PASSED
	5	13.56094	0.007%	PASSED
	10	13.56092	0.007%	PASSED
30	0	13.56100	0.007%	PASSED
	2	13.56096	0.007%	PASSED
	5	13.56100	0.007%	PASSED
	10	13.56096	0.007%	PASSED
20	0	13.56108	0.008%	PASSED
	2	13.56104	0.008%	PASSED
	5	13.56104	0.008%	PASSED
	10	13.56100	0.007%	PASSED
10	0	13.56106	0.008%	PASSED
	2	13.56110	0.008%	PASSED
	5	13.56104	0.008%	PASSED
	10	13.56104	0.008%	PASSED
0	0	13.56110	0.008%	PASSED
	2	13.56106	0.008%	PASSED
	5	13.56108	0.008%	PASSED
	10	13.56114	0.008%	PASSED
-10	0	13.56108	0.008%	PASSED
	2	13.56110	0.008%	PASSED
	5	13.56112	0.008%	PASSED
	10	13.56114	0.008%	PASSED
-20	0	13.56110	0.008%	PASSED
	2	13.56110	0.008%	PASSED
	5	13.56108	0.008%	PASSED
	10	13.56110	0.008%	PASSED
-30	0	13.56110	0.008%	PASSED
	2	13.56114	0.008%	PASSED
	5	13.56112	0.008%	PASSED
	10	13.56112	0.008%	PASSED

7. Frequency stability, voltage variation

EUT with DUT number	DAB200490E, DAB200449E
Accessories with DUT numbers	DAB191878E, NOV16037E, DAB16071E
Operation voltage [V] / [Hz]	12 V / DC
Result	PASSED
Remarks	OP3, OP4
Temp [°C] / humidity [%RH]	23 °C / 34.5 %
Date of measurement	06-May to 08-May-2020
Test engineer	Bhushan Pawar
Test system SW version	V1.7

7.1. Test reference and limit

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

- ⇨ The EUT is connected to an adjustable power supply.
- ⇨ The frequency stability was measured at nominal voltage and at 85 % and 115 %.

FCC and ISED limits for frequency stability, voltage variation measurements

Frequency Deviation [%]
+\- 0.01

7.2. Test results (FCC, ISED)

OP3:

Voltage [V]	Frequency [MHz]	Deviation [%]	Result
Nominal (12.0)	13.56092	0.007%	PASSED
Minimum (10.2)	13.56094	0.007%	PASSED
Maximum (13.8)	13.56087	0.006%	PASSED

OP4:

Voltage [V]	Frequency [MHz]	Deviation [%]	Result
Nominal (12.0)	13.56096	0.007%	PASSED
Minimum (10.2)	13.56092	0.007%	PASSED
Maximum (13.8)	13.56096	0.007%	PASSED

8. Occupied bandwidth

EUT with DUT number	DAB200490E, DAB200449E
Accessories with DUT numbers	DAB191878E, NOV16037E, DAB16071E
Operation voltage [V] / [Hz]	12 V / DC
Result	PASSED
Remarks	OP3, OP4
Temp [°C] / humidity [%RH]	23 °C / 34.5 %
Date of measurement	06-May to 08-May-2020
Test engineer	Bhushan Pawar
Test system SW version	V1.7

8.1. Test method and limit

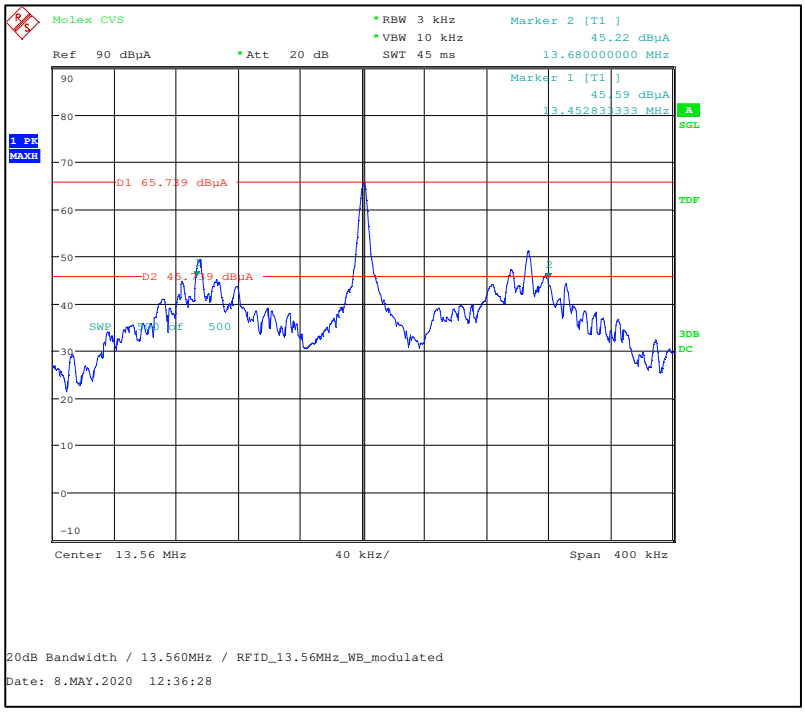
The measurement is made according to FCC 15.215(c) and RSS-Gen.

FCC and ISED limits for occupied bandwidth measurements

20 dB Bandwidth Limit [MHz]	99 % Bandwidth Limit [MHz]
-	-

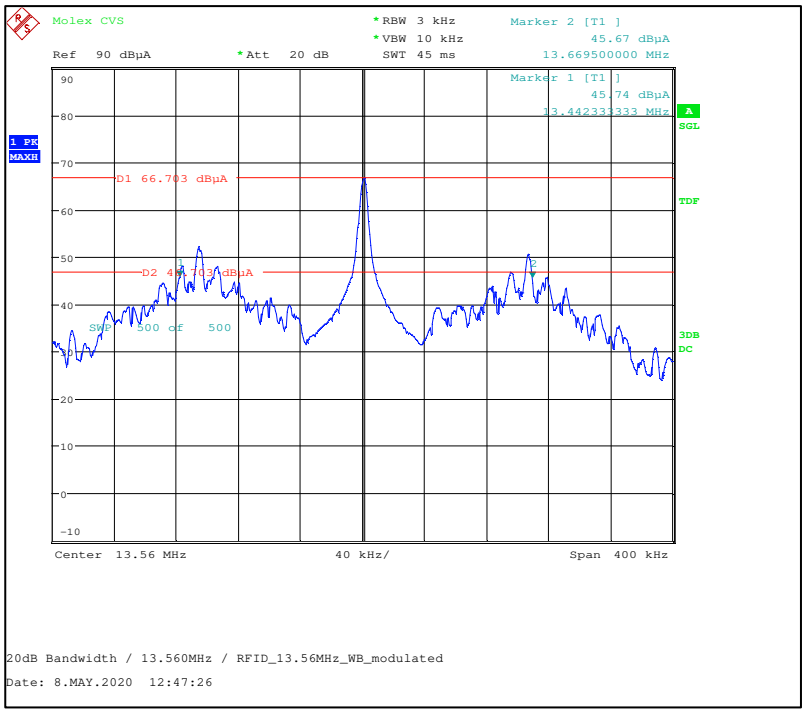
8.2. Test results (FCC)

OP3:



Frequency [MHz]	20 dB Bandwidth [kHz]	Result
13.56	227.20	PASSED

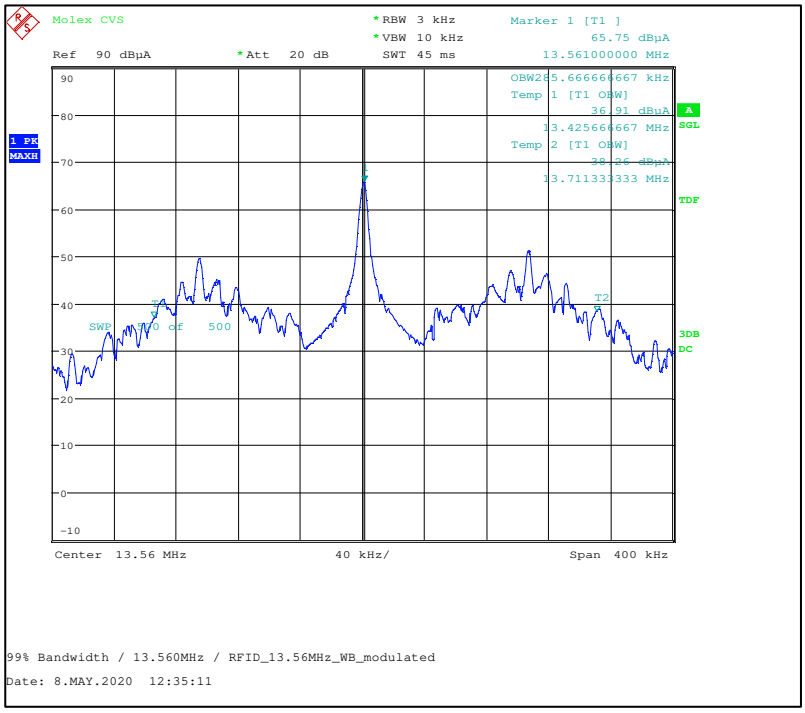
OP4:



Frequency [MHz]	20 dB Bandwidth [kHz]	Result
13.56	227.17	PASSED

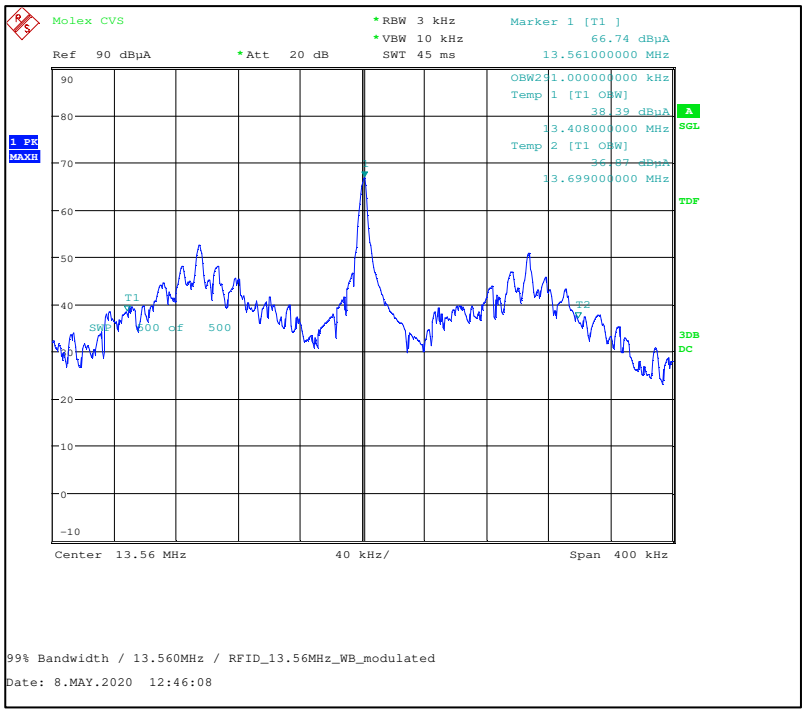
8.3. Test results (ISED)

OP3:



Frequency [MHz]	99 % Bandwidth [kHz]	Result
13.56	285.67	PASSED

OP4:



Frequency [MHz]	99 % Bandwidth [kHz]	Result
13.56	291.0	PASSED

9. Test Equipment

9.1. Radiated Emission

Equipment	Manufacturer	Type	Serial No.	Actual Calibration	Next Calibration
Antenna	Schwarzbeck Mess-Elektronik	FMZB_1519	1519-056	14.07.2017	14.07.2020
EMI Test Receiver	ROHDE & SCHWARZ	ESIB26	827769/010	23.05.2019	23.05.2020
Signal Generator	ROHDE & SCHWARZ	SMP02	828269/008	09.08.2017	09.08.2020
Signal Generator	ROHDE & SCHWARZ	SML01	100652	06.04.2018	06.04.2021
Power Supply	Hewlett Packard - Agilent	E3632A	KR75303301	17.05.2018	17.05.2020
Radio Communication Tester	ROHDE & SCHWARZ	CMU 200	101138	22.05.2018	22.05.2020
Field Analyzer	Wandel & Goltermann	EMR20	P-0030	23.11.2017	23.11.2020
Antenna	ROHDE & SCHWARZ	HL025	359012/006	-	-
EMI Test Receiver	ROHDE & SCHWARZ	ESU26	100077	20.05.2019	20.05.2020
Temp. / Humidity Logger	Lufft	Opus 10	13262	21.01.2020	21.01.2023
Antenna	ROHDE & SCHWARZ	HL562	100191	26.10.2018	26.10.2021
Antenna	ROHDE & SCHWARZ	HK-116: 20-300MHz	825177/0017	21.07.2017	21.07.2020
Antenna	ROHDE & SCHWARZ	HK-116: 20-300MHz	100401	21.07.2017	21.07.2020
Antenna	ROHDE & SCHWARZ	HL223	832369/006	26.04.2019	26.04.2022
Antenna	Schwarzbeck	UBA 9116	9116-396	28.07.2017	28.07.2020
Antenna	Emco	3115	9810-5588	24.04.2018	24.04.2021
Antenna	Schwarzbeck	BBHA-9120-D	01617	09.04.2019	09.04.2022
Antenna	ROHDE & SCHWARZ	HL223	100731	07.12.2018	07.12.2021
H-Field Probe 100 cm²	Narda Safety Test Solutions GmbH	Probe	M-0823	07.12.2017	07.12.2020
H-field Probe 3cm2	Narda Safety Test Solutions GmbH	2300/90.20	C-0150	23.04.2018	23.04.2021
Antenna	Schwarzbeck Mess-Elektronik	VAMP 9243	9243-486	23.05.2018	23.05.2021
Exposure Level Tester	Narda Safety Test Solutions GmbH	ELT-400	N-0385	07.12.2017	07.12.2020
Antenna	Emco	3160-09	1232	07.08.2017	07.08.2020
Isotropic Electric Field Probe	Wandel & Goltermann	Type 8	M-0082	23.11.2017	23.11.2020
Signal Generator	ROHDE & SCHWARZ	SMB100A	181275	08.07.2019	08.07.2020
EMI Test Receiver	ROHDE & SCHWARZ	ESW44	101733	19.08.2019	19.08.2020
Vector Signal Generator	ROHDE & SCHWARZ	SMBV100A	263158	16.05.2019	16.05.2020
Wideband Radio Comm.Tester	ROHDE & SCHWARZ	CMW500	101674	22.05.2019	22.05.2020

9.2. Conducted Radio

Equipment	Manufacturer	Type	Serial No.	Actual Calibration	Next Calibration
Signal Generator	ROHDE & SCHWARZ	SMP02	828269/008	09.08.2017	09.08.2020
Signal Generator	ROHDE & SCHWARZ	SMB100A	181275	08.07.2019	08.07.2020
Vector Signal Generator	ROHDE & SCHWARZ	SMBV100A	263158	16.05.2019	16.05.2020
EMI Test Receiver	ROHDE & SCHWARZ	ESU26	100077	20.05.2019	20.05.2020
Vector Signal Generator	ROHDE & SCHWARZ	SMJ100A	100845	16.05.2018	16.05.2020
EMI Test Receiver	ROHDE & SCHWARZ	ESW44	101733	19.08.2019	19.08.2020
Power Supply	Hewlett Packard - Agilent	E3632A	MY40011318	23.05.2018	23.05.2020
Powermeter	ETS	EMPower 7002-006	7202040	18.01.2019	18.01.2022
Climatic Chamber	Vötsch	VT4002	521/85094	23.11.2018	23.11.2020
Network Analyzer	Hewlett Packard - Agilent	8722ES	US39175320	03.11.2017	03.08.2020
BT-/W-Lan-Testsetup	Hewlett Packard - Agilent	N4010A	MY46320388	17.08.2017	17.08.2020
Radio Communication Tester	ROHDE & SCHWARZ	CMU 200	101138	22.05.2018	22.05.2020
Wideband Radio Comm.Tester	ROHDE & SCHWARZ	CMW500	101674	22.05.2019	22.05.2020

End of Report