EKTOS
Testing & Reliability Services

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REPORT

Accredited by DANAK under registration number 563 to testing.
TEST: Testing laboratory (DS/EN ISO/IEC 17025)
FCC designation. no.: DK0002
ISED CAB identifier.: DK0001

Date	Reference	Page
2019-12-19	P19-0189-2	1 (20)

Test Report

of

NFC reader
INT3520

according to

FCC 47 CFR, Part 15 Subpart B, Class B
ICES‑003, Issue 6:2016, Class B

Performed by

Søren Søltoft
Senior EMC Engineer

Examined by

David Busk
Lab. Manager, M. Sc. EE.

DANAK TEST Reg.No. 563 Member of EA MLA

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Report no.:	P19-0189-2	**Report date:**	2019-12-19
Test started:	2019-11-07	**Test ended:**	2019-11-12
Test laboratory:	EKTOS TRS A/S A. C. Meyers Vænge 15 2450 Copenhagen SV Denmark	**Client:**	Cryptera A/S Fabriksparken 20 2600 Glostrup Denmark
Contact person:	Søren Søltoft	**Contact person:**	Mark Bo Torstensen

Facility reg. no.	FCC designation number: DK0002 ISED CAB identifier: DK0001
Test specimens:	Model: INT3520, SN: 1542-93610303
Test specifications:	FCC 47 CFR Part 15 Subpart B ICES‑003, Issue 6:2016 The tests relevant for the test specimens are listed in *section 1.1*.
Documentation:	This test report shall not be reproduced except in full, without written approval of the laboratory. The complete test documentation is archived for 10 years at the testing laboratory.
Test results:	The test specimen complies with relevant parts of the test specifications. The test results relate only to the specimen tested.
Test personnel:	Søren Søltoft

CONTENTS

Appendices

None

1 SUMMARY

1.1 Test plan

Test method	Name of the test	Results
FCC 47 CFR Part 15 Subpart B, Class B ICES‑003, Issue 6:2016, Class B	Radiated emission	PASSED
FCC 47 CFR Part 15 Subpart B, Class B ICES‑003, Issue 6:2016, Class B	Conducted emission	PASSED

PASSED	The test was performed and the test specimen complies with the essential requirements in the standard.
FAILED	The test was performed and the test specimen does not comply with the essential requirements in the standard.
REF	The test is covered by a test in another report and/or on a similar test specimen.
NR	The test is not relevant for the test specimen or has been waived by the manufacturer.

1.2 Test Specimen

Manufacturer	Cryptera A/S
Product name	NFC reader
Model	INT3520
Serial no.	1542-93610303
Part no.	INT3520-2020
Software	-
Supply voltage	5 VDC from USB
Operational mode	Radio test modes

Photo 1. Test specimen. Front view.

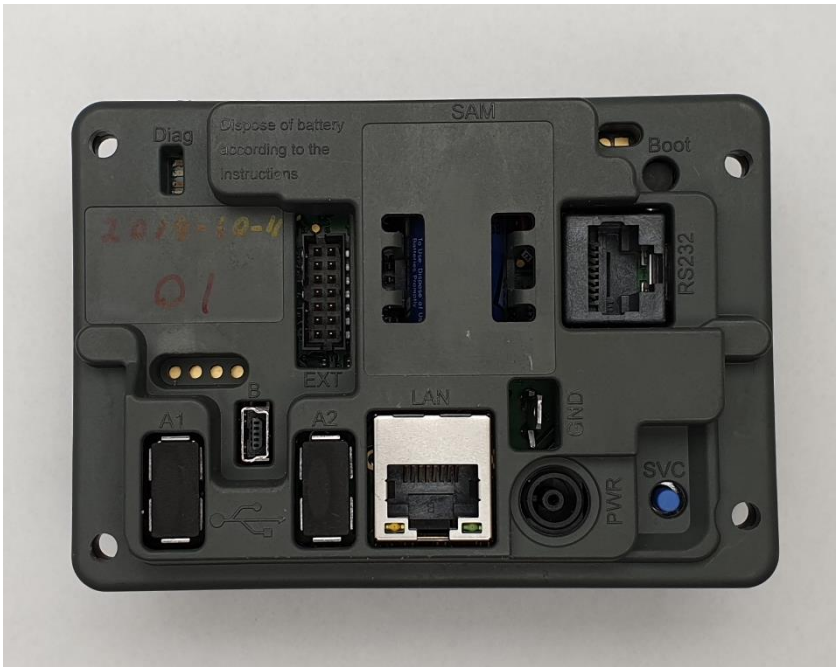

Photo 2. Test specimen. Back view.

1.3 Auxiliary Equipment

1.3.1 Laptop

Manufacturer	Dell
Model	Latitude E7250
Serial no.	34040064926
Software	“Tera Term” used for serial communication over USB
Details	None
Supply voltage	19.5 VDC from AC/DC power supply

1.3.2 AC/DC adaptor for Laptop

Manufacturer	Dell
Model	PA-1650-05D
Serial no.	CN - 05U092 - 71615 - 43F - 0F92 REV A02
Details	None
Supply voltage	AC 100 – 240 V 1.5A (120 VAC used during tests)
Output voltage	DC 19.5 V / 3.34 A

1.4 I/O port at test specimen

I/O Port	Type	Shielding	Cable length
Supply and communication[1]	Mini USB	Shielded	< 3m

Note 1: Conducted emission is performed on the AC power port of the AC/DC adapter for the laptop powering the test specimen through USB.

1.5 Test set-up

The NFC reader is powered and controlled by the laptop through an USB connection.
The laptop is installed by control software for the NFC reader.

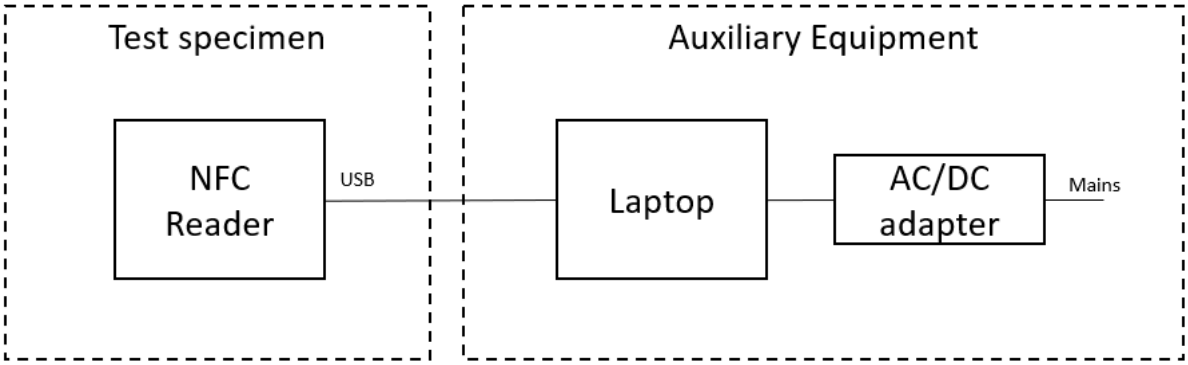

Figure 1. Test set-up.

2 TESTS

2.1 Radiated emission

Test specimen	NFC Reader
Test specification	FCC 47 CFR Part 15 Subpart B ICES-003, Issue 6:2016
Test method	ANSI C63.4:2014
Frequency range	30-3000 MHz
Limits	FCC 47 CRF §15.109 (a), Class B, Distance 3 m
Comments	Maximum internal frequency is 240 MHz
Temperature / Humidity	22 °C / 39 %RH
Date of measurements	2019-11-07
Test personnel	Søren Søltoft

2.1.1 Test setup

A measuring distance of 3 m was used during the tests.

The EUT was placed 80 cm above ground on a non-conductive table.

The auxiliary equipment was positioned on the floor.

Exploratory radiated emission measurements in the frequency range 30 – 1000 MHz with reflective floor were made by rotating the turntable between 0-360° and variating the antenna height between 1-4 m, in both horizontal and vertical antenna polarization.

Exploratory radiated emission measurements in the frequency range 1-3 GHz with absorbers on the floor were made by rotating the turntable between 0-360° and an antenna height of 1 m, in both horizontal and vertical antenna polarization.

Based on the preliminary measurements the frequencies with the highest emissions are selected for final radiated emission measurements. Final measurements were made by rotating the turntable and changing the height of the antenna to maximize the emission level.

The smallest beamwidth (θ_{3dB}) used between 1-6 GHz was 32.4° at 4 GHz. This resembles a beamwidth (w) of 1.74 m at a distance of 3 m.

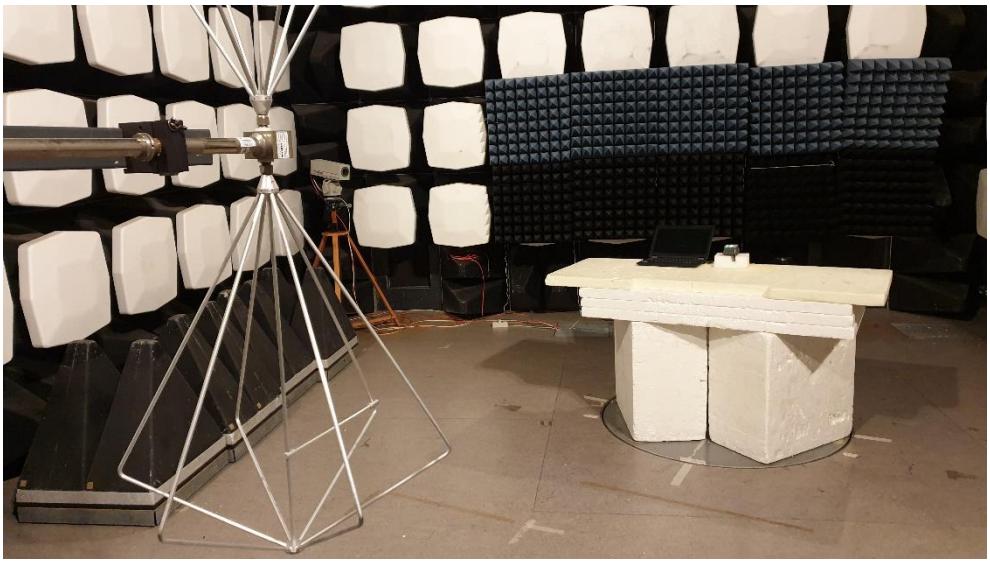

Photo 3. Radiated emission test setup for 30 - 200 MHz.

Photo 4. Radiated emission test setup for 200 - 1000 MHz.

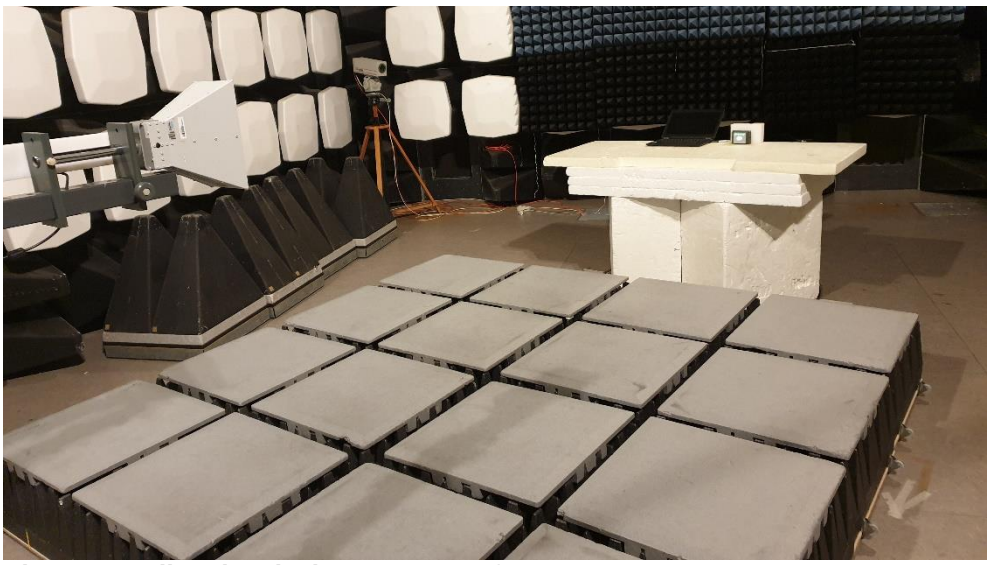

Photo 5. Radiated emission test setup for 1 – 3 GHz.

2.1.2 Test limits

Frequency range [MHz]	Field strength limit [µV/m]	Field strength limit [dBµV/m]
30 – 88	100	40.0
88 – 216	150	43.5
216 – 960	200	46.0
Above 960	500	54.0

Table 1. Radiated emission limits. FCC 47 CRF §15.109 (a), Class B.

The field strength limit in µV/m is converted to limit in dBµV/m.

2.1.3 Test results

The measured test results were below the limits.

The measurement time during final measurements were 15 s.

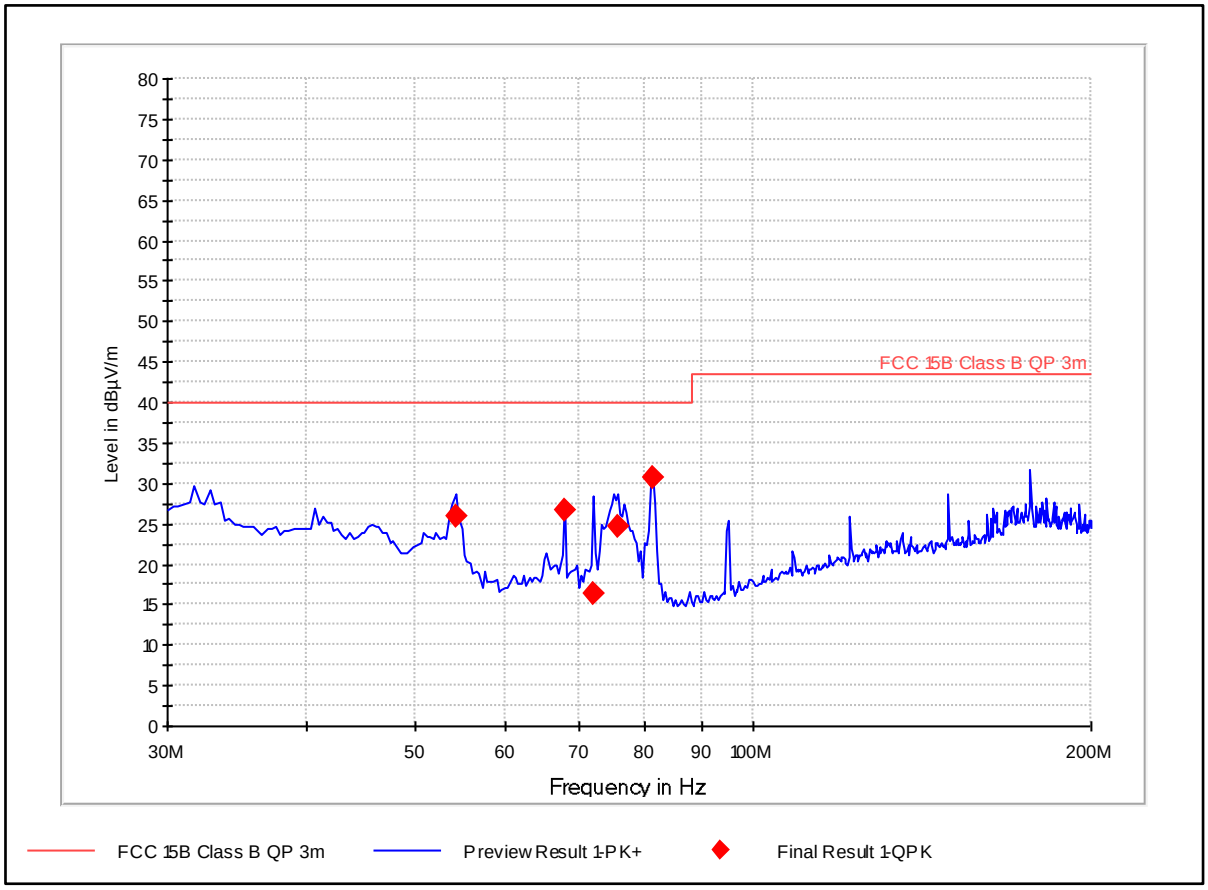

Figure 2. Radiated emission test results. 30 - 200 MHz. EUT Vertical.

Frequency [MHz]	QP [dBµV/m]	BW [kHz]	Height [cm]	Pol.	Azimuth [deg]	Margin [dB]	Limit [dBµV/m]	Result
54.208377	26.0	120.0	100.0	V	278.0	14.0	40.0	PASSED
67.805631	26.6	120.0	188.0	V	74.0	13.4	40.0	PASSED
71.963808	16.3	120.0	100.0	V	255.0	23.7	40.0	PASSED
75.619940	24.7	120.0	100.0	V	270.0	15.3	40.0	PASSED
81.352886	30.6	120.0	224.0	H	185.0	9.4	40.0	PASSED

Table 2. Radiated emission test results. 30 - 200 MHz. EUT Vertical.

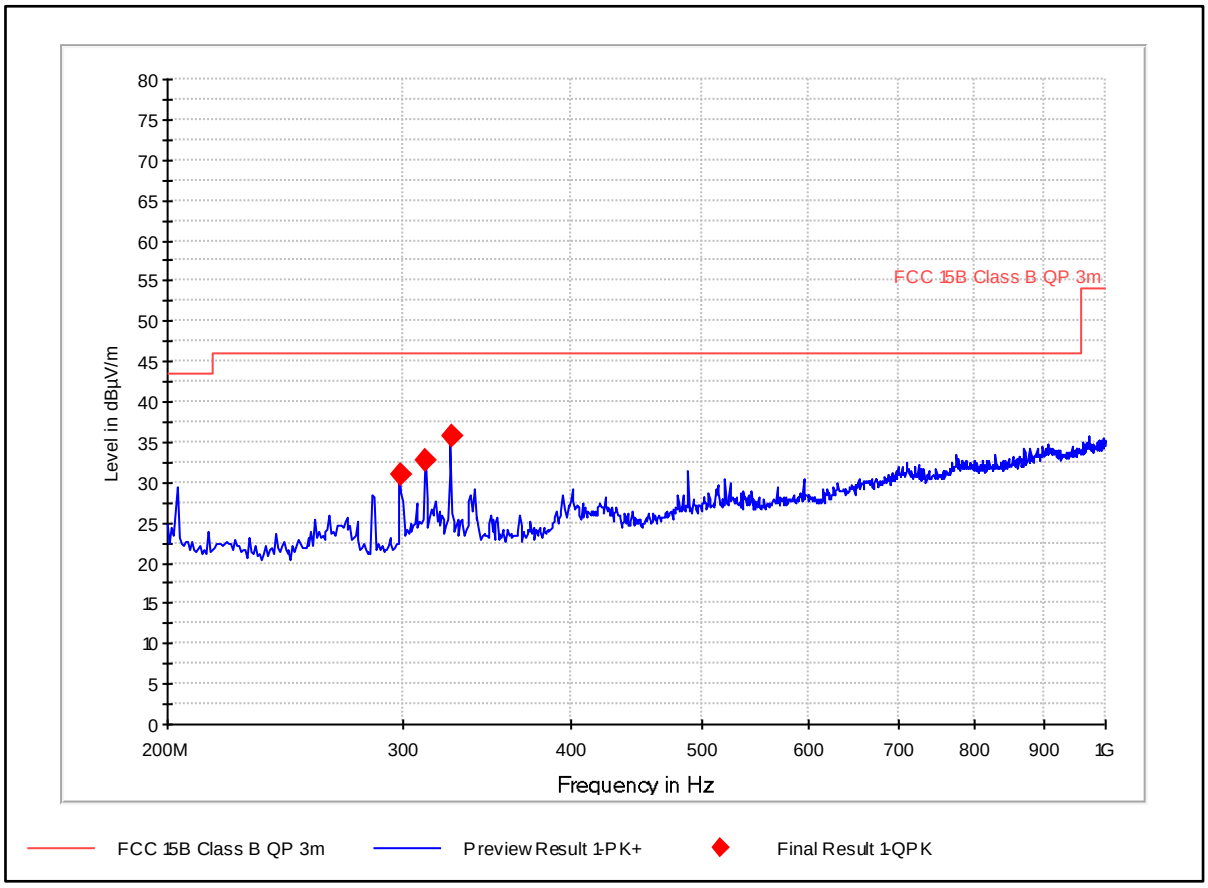

Figure 3. Radiated emission test results. 200 - 1000 MHz. EUT Vertical.

Frequency [MHz]	QP [dBµV/m]	BW [kHz]	Height [cm]	Pol.	Azimuth [deg]	Margin [dB]	Limit [dBµV/m]	Result
298.345591	31.0	120.0	100.0	H	169.0	15.0	46.0	PASSED
311.912846	32.7	120.0	100.0	H	171.0	13.3	46.0	PASSED
325.430100	35.7	120.0	100.0	H	179.0	10.3	46.0	PASSED

Table 3. Radiated emission test results. 200 - 1000 MHz. EUT Vertical.

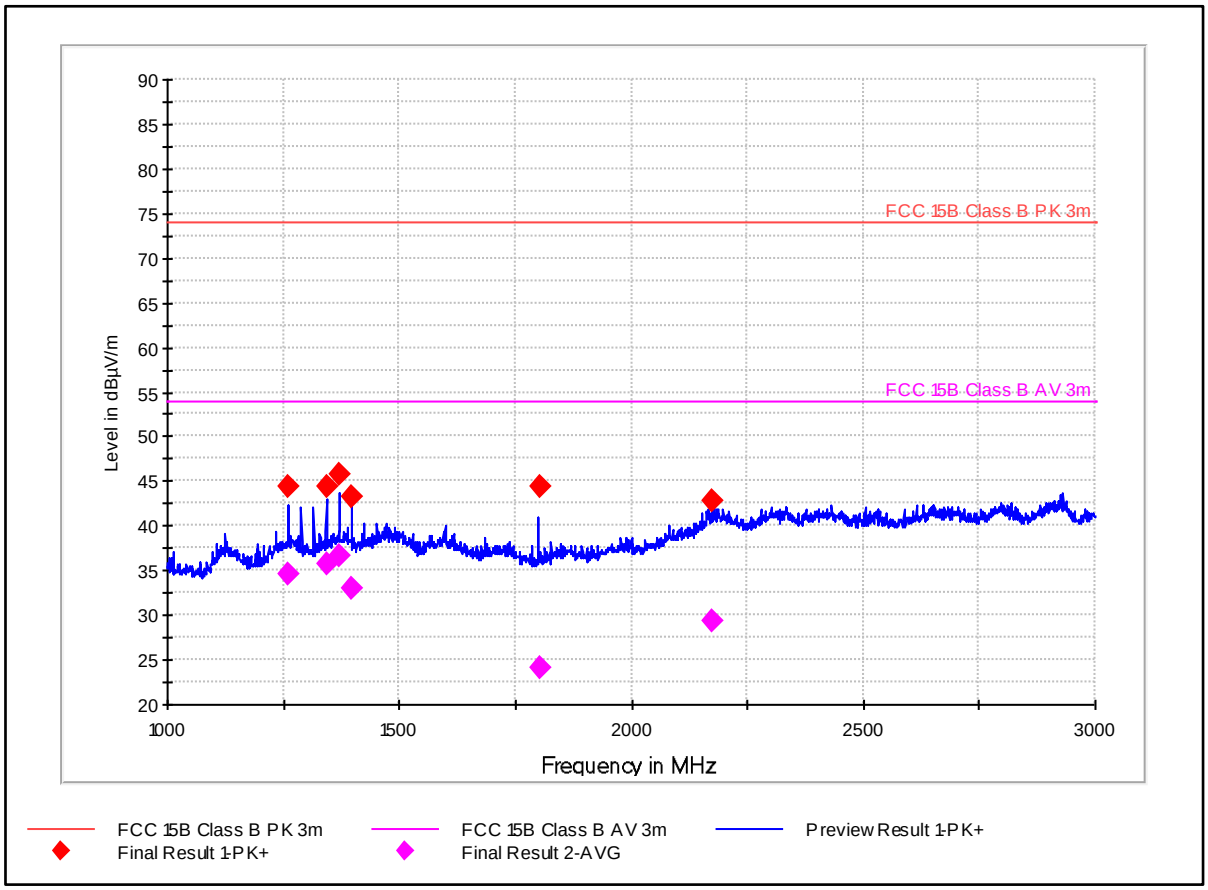

Figure 4. Radiated emission test results 1 - 3 GHz. EUT Vertical.

Frequency [MHz]	Peak [dBµV/m]	BW [kHz]	Height [cm]	Pol.	Azimuth [deg]	Margin [dB]	Limit [dBµV/m]	Result
1261.223046	44.5	1000	100.0	V	170.0	29.50	74.00	PASSED
1342.585371	44.4	1000	100.0	H	141.0	29.60	74.00	PASSED
1369.639479	45.7	1000	100.0	V	182.0	28.30	74.00	PASSED
1396.893587	43.3	1000	100.0	H	301.0	30.70	74.00	PASSED
1802.199198	44.5	1000	100.0	V	189.0	29.50	74.00	PASSED
2174.454709	42.8	1000	207.0	H	16.0	31.20	74.00	PASSED

Table 4. Radiated emission test results 1 - 3 GHz. Peak detector. EUT Vertical.

Frequency [MHz]	Average [dBµV/m]	BW [kHz]	Height [cm]	Pol.	Azimuth [deg]	Margin [dB]	Limit [dBµV/m]	Result
1261.223046	34.7	1000	100.0	V	170.0	19.30	54.00	PASSED
1342.585371	35.7	1000	100.0	H	141.0	18.30	54.00	PASSED
1369.639479	36.7	1000	100.0	V	182.0	17.30	54.00	PASSED
1396.893587	32.9	1000	100.0	H	301.0	21.10	54.00	PASSED
1802.199198	24.0	1000	100.0	V	189.0	30.00	54.00	PASSED
2174.454709	29.2	1000	207.0	H	16.0	24.80	54.00	PASSED

Table 5. Radiated emission test results- 1 - 3 GHz. Average detector. EUT Vertical.

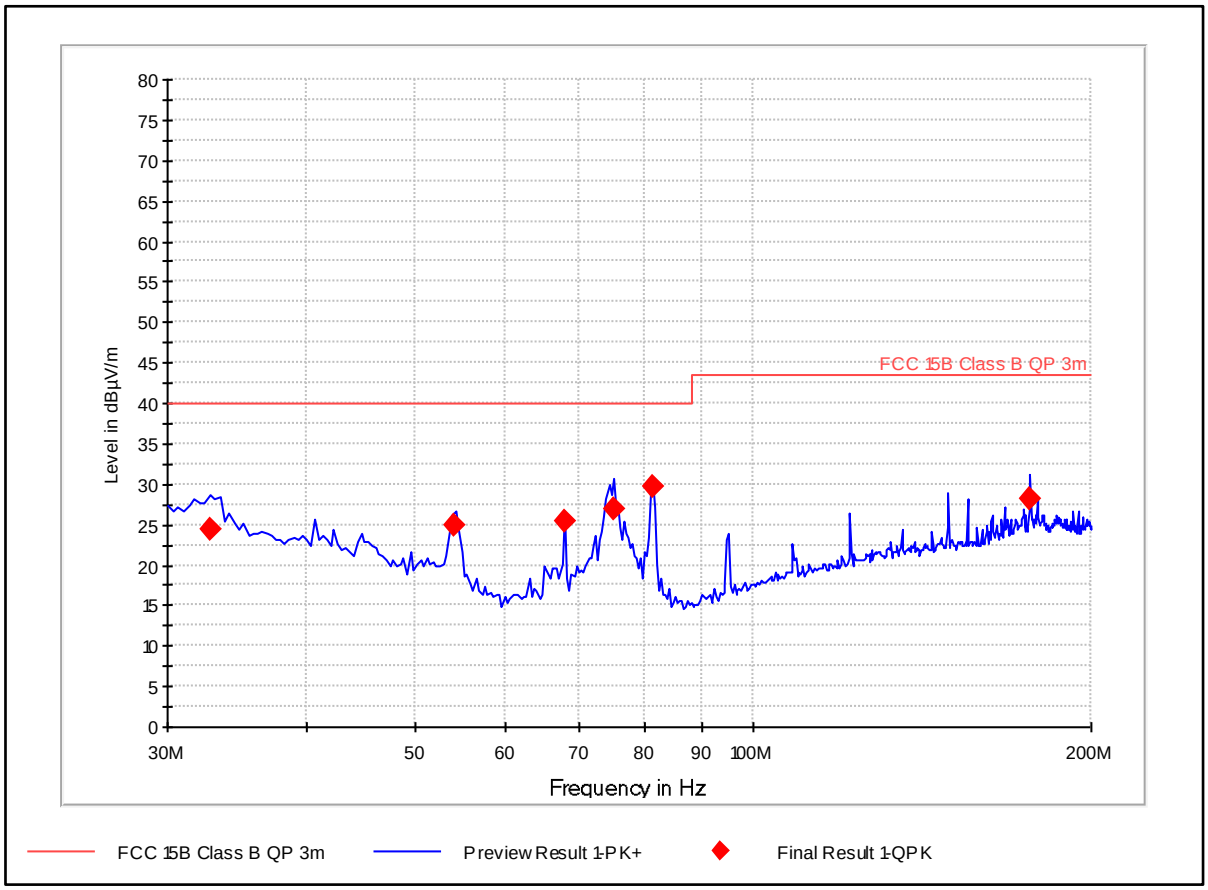

Figure 5. Radiated emission test results. 30 - 200 MHz. EUT Horizontal.

Frequency [MHz]	QP [dBµV/m]	BW [kHz]	Height [cm]	Pol.	Azimuth [deg]	Margin [dB]	Limit [dBµV/m]	Result
32.785451	24.5	120.0	100.0	V	257.0	15.5	40.0	PASSED
54.138377	25.0	120.0	100.0	V	253.0	15.0	40.0	PASSED
67.795631	25.4	120.0	100.0	V	224.0	14.6	40.0	PASSED
74.999940	26.9	120.0	100.0	V	261.0	13.1	40.0	PASSED
81.362886	29.6	120.0	209.0	H	181.0	10.4	40.0	PASSED
176.252986	28.1	120.0	100.0	V	126.0	15.4	43.5	PASSED

Table 6. Radiated emission test results. 30 - 200 MHz. EUT Horizontal.

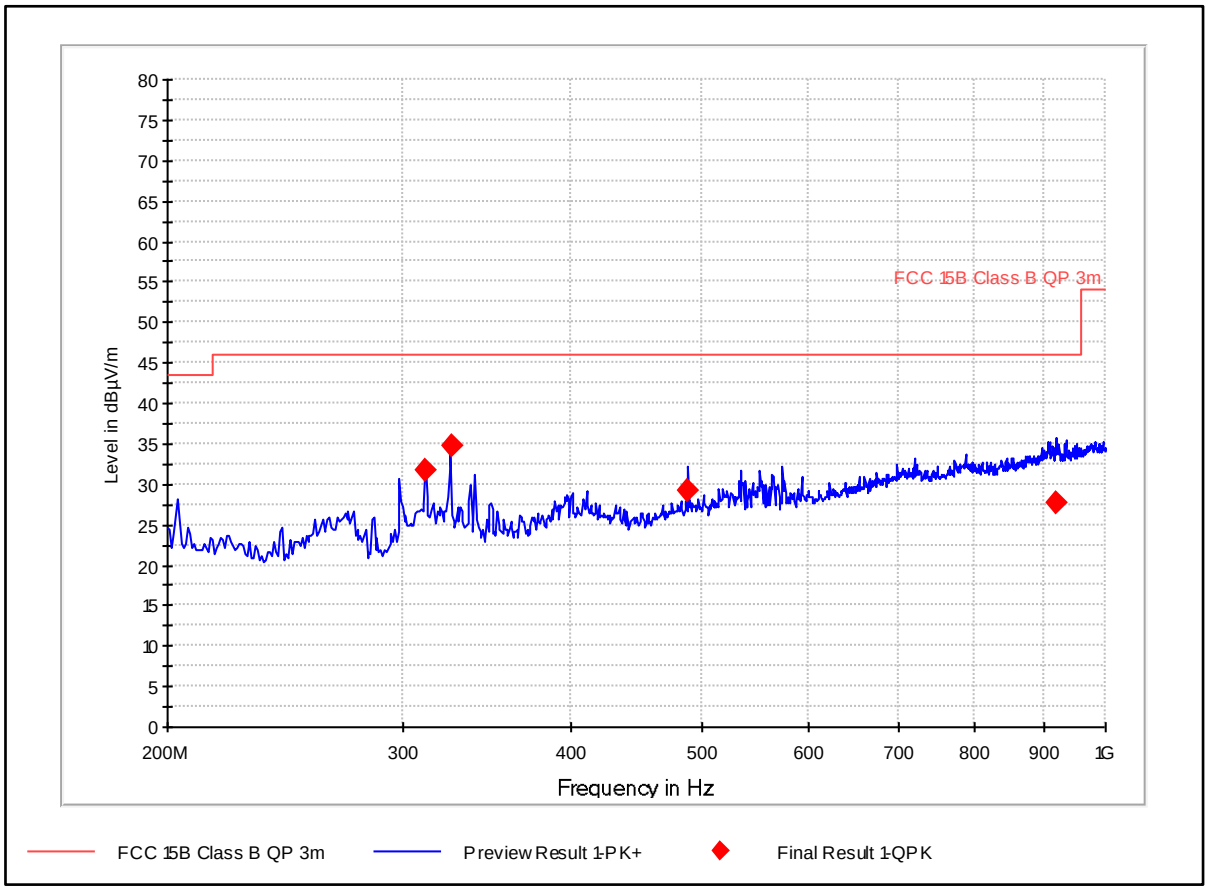

Figure 6. Radiated emission test results. 200 - 1000 MHz. EUT Horizontal.

Frequency [MHz]	QP [dBµV/m]	BW [kHz]	Height [cm]	Pol.	Azimuth [deg]	Margin [dB]	Limit [dBµV/m]	Result
311.912846	31.8	120.0	100.0	H	61.0	14.2	46.0	PASSED
325.460100	34.8	120.0	100.0	H	155.0	11.2	46.0	PASSED
488.197154	29.3	120.0	119.0	V	8.0	16.7	46.0	PASSED
918.068076	27.6	120.0	337.0	V	122.0	18.4	46.0	PASSED

Table 7. Radiated emission test results. 200 - 1000 MHz. EUT Horizontal.

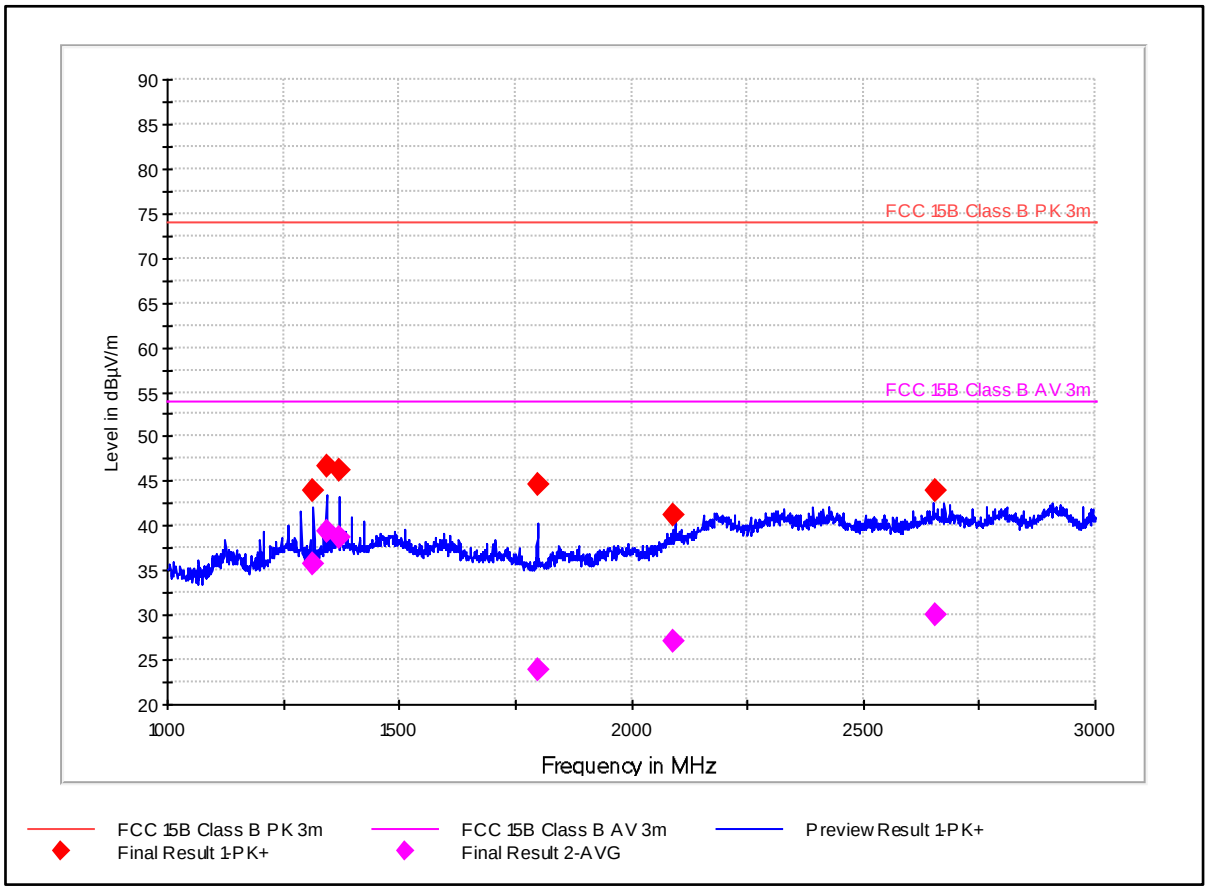

Figure 7. Radiated emission test results 1 - 3 GHz. EUT Horizontal.

Frequency [MHz]	Peak [dBµV/m]	BW [kHz]	Height [cm]	Pol.	Azimuth [deg]	Margin [dB]	Limit [dBµV/m]	Result
1315.331263	43.9	1000	100.0	V	177.0	30.10	74.00	PASSED
1342.585371	46.6	1000	213.0	V	301.0	27.40	74.00	PASSED
1369.639479	46.3	1000	191.0	V	295.0	27.70	74.00	PASSED
1799.497194	44.7	1000	100.0	V	197.0	29.30	74.00	PASSED
2091.488377	41.1	1000	243.0	V	190.0	32.90	74.00	PASSED
2655.804609	43.8	1000	255.0	H	350.0	30.20	74.00	PASSED

Table 8. Radiated emission test results 1 - 3 GHz. Peak detector. EUT Horizontal.

Frequency [MHz]	Average [dBµV/m]	BW [kHz]	Height [cm]	Pol.	Azimuth [deg]	Margin [dB]	Limit [dBµV/m]	Result
1315.331263	35.8	1000	100.0	V	177.0	18.20	54.00	PASSED
1342.585371	39.4	1000	213.0	V	301.0	14.60	54.00	PASSED
1369.639479	38.6	1000	191.0	V	295.0	15.40	54.00	PASSED
1799.497194	23.9	1000	100.0	V	197.0	30.10	54.00	PASSED
2091.488377	27.2	1000	243.0	V	190.0	26.80	54.00	PASSED
2655.804609	30.0	1000	255.0	H	350.0	24.00	54.00	PASSED

Table 9. Radiated emission test results- 1 - 3 GHz. Average detector. EUT Horizontal.

2.1.4 Test equipment

Description	Supplier	Model	Tag no.	Cal. due date
Antenna Biconical 25-300MHz	Schwarzbeck	VHA9103 + BBA9106	13835	2022-02-28
Antenna Log Per 0.2 - 1 GHz	ETS-LINDGREN	3148	50023	2022-05-02
Amplifier 30 MHz – 3 GHz	Miteq	AFS3-00100400-18-ULN	50084	-
Antenna Horn	Schwarzbeck	BBHA 9120 D	20031	2022-04-15
LNA amplifier (3-18 GHz)	Miteq	AMF60-020180-29-20P	50080	-
LNA amplifier (1-26 GHz)	Miteq	JS4-01002600-36-5P	50081	-
Filter high pass	Wainwright	WHKS 1000-10SS	13917	-
Analyzer 20 Hz-26.5 GHz	Rohde&Schwarz	ESI26	20763	2019-12-10
Analyzer 20 Hz-26.5 GHz	Rohde&Schwarz	ESIB	18880	2020-10-15

Table 10. Radiated emission test equipment.

2.2 Conducted emission

Test specimen	NFC Reader
Test specification	FCC 47 CFR Part 15 Subpart B ICES‑003, Issue 6:2016
Test method	ANSI C63.4:2014
Frequency range	0.15 - 30 MHz
Limits	FCC 47 CRF §15.107 (a), Class B
Comments	None
Temperature / Humidity	22°C / 44%RH
Date of measurements	2019-11-12
Test personnel	Søren Søltoft

2.2.1 Test setup

Measurements were performed with the test specimen powered from a USB port on a laptop.
Tests were done on the AC Power port of the AC/DC adapter to the laptop.

The test specimen was sending continuous with 100% AM.
The mains supply was 120 VAC.

Photo 6 - Conducted emission test setup.

2.2.2 Test results

The measured test results were below the limits.

The measurement time during final measurements were 15 s.

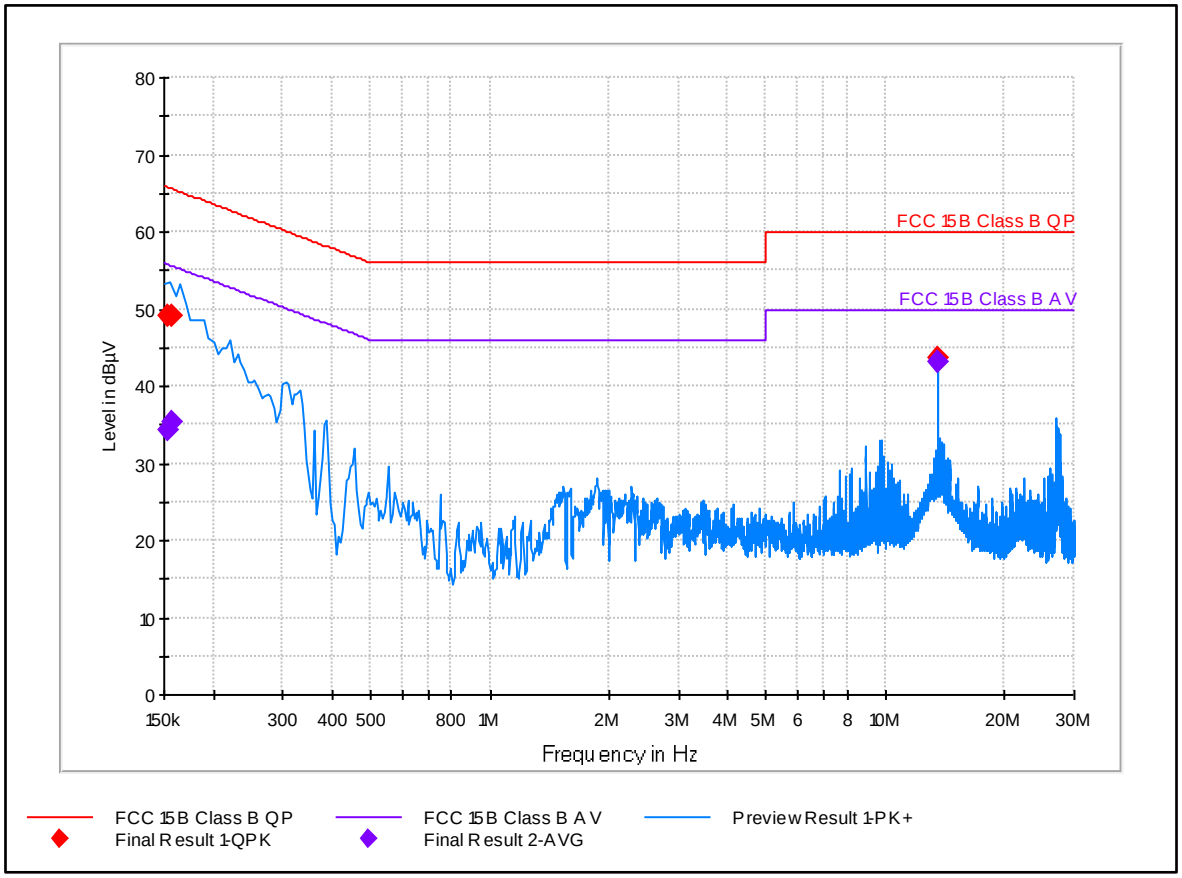

Figure 8. AC Conducted emission.

Frequency [MHz]	QuasiPeak [dBµV]	BW [kHz]	Line	Margin [dB]	Limit [dBµV]	Result
0.1530	49.0	9.0	L1	16.9	65.8	PASSED
0.1566	49.2	9.0	N	16.5	65.6	PASSED
13.5609	43.5	9.0	N	16.5	60.0	PASSED

Table 11. AC Conducted emission. QuasiPeak detector.

Frequency [MHz]	Average [dBµV]	BW [kHz]	Line	Margin [dB]	Limit [dBµV]	Result
0.1530	34.3	9.0	L1	21.5	55.8	PASSED
0.1566	35.4	9.0	N	20.2	55.6	PASSED
13.5609	43.0	9.0	N	7.0	50.0	PASSED

Table 12. AC Conducted emission. Average detector.

2.2.3 Test equipment

Description	Supplier	Model	Tag no.	Cal. due date
V-network Two Line	R&S	ESH3-Z5	20682	2020-02-25
Receiver EMI Test 20Hz-26.5GHz	Rohde & Schwarz	ESIB 26	18880	2020-10-15

Table 13. Conducted emission test equipment.

3 MEASURING UNCERTAINTIES

Compliancy evaluation is based on a shared risk principle with respect to the measurement uncertainty.

EMC tests	Frequency [MHz]	Polarization	Expanded Uncertainty [dB] (k=2)
Radiated emission	30 - 200	Vertical	**4.59**
	200 - 1000	Vertical	**4.77**
	1000-6000	Vertical	**3.76**
	30 - 200	Horizontal	**4.57**
	200 - 1000	Horizontal	**4.86**
	1000-6000	Horizontal	**3.77**
Conducted emission	0.01 - 30		**3.44**