

Test report

259622-1TRFWL

Date of issue: April 16, 2015

Applicant:

Sonatest AP Inc.

Product:

64 Elements – 5MHz

Model:

WP2

FCC ID:

2ACH4SONWP2

IC Registration number:

12048A-SONWP2

Specification:

- ◆ **FCC 47 CFR Part 15, Subpart C, Chapter 15.231**
Periodic operation in the band 40.66–40.70 MHz and above 70 MHz
- ◆ **RSS-210, Issue 8 Annex 1.1**
Momentarily operated devices



Nemko Canada Inc., a testing laboratory, is accredited by the Standards Council of Canada. The tests included in this report are within the scope of this accreditation

FCC and IC 433 MHz.docx; Date: June, 2013

Test location

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Date:	April 16, 2015
Signature:	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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Section 1 Report summary

1.1 Applicant

Company name:	Sonatest AP Inc.
Address:	2900 Chemin des Quatre-Bourgeois, Suite 305
City:	Quebec City
Province/State:	Quebec
Postal/Zip code:	G1V 1Y4
Country:	Canada

1.2 Manufacturer

Company name	Sonatest Ltd
Address	Dickens Road, Old Wolverton
City	Milton Keynes
Postal/Zip code	MK12 5QQ
Country	United Kingdom

1.3 Test specifications

FCC 47 CFR Part 15, Subpart C, Chapter 15.231	Periodic operation in the band 40.66–40.70 MHz and above 70 MHz
RSS-210, Issue 8 Annex 1.1	Momentarily Operated Devices

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See “Summary of test results” for full details.

1.5 Test report revision history

Table 1.5-1: Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued

Section 2 Summary of test results

2.1 FCC Part 15 Subpart C – Intentional Radiators, test results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not applicable
§15.231(a)	Conditions for intentional radiators to comply with periodic operation	Pass
§15.231(b)	Field strength of emissions	Pass
§15.231(c)	Emission bandwidth	Pass
§15.231(d)	Requirements for devices operating within 40.66–40.70 MHz band	Not applicable
§15.231(e)	Conditions for intentional radiators to comply with periodic operation	Pass

Notes: Battery operated device

2.2 RSS-210, Issue 8 Annex 1.1, test results

Part	Test description	Verdict
RSS-Gen 4.6.1	Occupied BW	Pass
RSS-Gen 6.1	Receiver spurious emissions limits (radiated)	Not applicable
RSS-Gen 6.2	Receiver spurious emissions limits (antenna conducted)	Not applicable
RSS-Gen 7.2.4	AC power lines conducted emission limits	Not applicable
RSS-210 A1.1.1	Types of momentary signals	Pass
RSS-210 A1.1.2	Field strength and frequency bands	Pass
RSS-210 A1.1.3	Bandwidth for momentary signals	Pass
RSS-210 A1.1.4	Frequency stability within 40.66–40.70 MHz band	Not applicable

Notes: 1 According to Notice 2012-DRS0126 (from January 2012) section 2.2 of RSS-Gen, Issue 3 has been revised. The EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

Section 3 Equipment under test (EUT) details

3.1 Sample information

Receipt date	May 28, 2014
Nemko sample ID number	1, 2

3.2 EUT information

Product name	64 Elements-5MHz
Model	WP2
Serial number	Prototype 1
Software version	Ve0 16:64
99% Bandwidth	59.45 kHz
Modulation	OOK
Power requirements	3 V _{DC} (Button Battery)
Product description and theory of operation	The EUT (WP or WheelProbe 2) was connected to a Jig providing the required power (5 V_{DC}) to the WheelProbe 2 and allowing verifying the functionality of the Wireless Remote. This Jig has a button allowing synchronizing the Jig to the Wireless Remote to be tested. It provides as well one LED for this sync button and three different LEDs that are linked to the pressing of the three Wireless Remote push-buttons. It also has a Lemo connector that allows connecting the JIG to a WheelProbe 2. In this configuration, the Jig provides power to the WheelProbe 2. Its sync button also allows syncing the WheelProbe 2 to any Wireless Remote. The WheelProbe 2 LEDs will then individually be controlled by the Wireless Remote.

3.3 EUT technical specifications

Operating frequency range	433.92 MHz
Number of channels	Not applicable
Channel spacing	Not applicable
Antenna data	Integral

3.4 Operation of the EUT during testing

The EUT (WheelProbe) was connected to a Veo 16:64 with two different cables. The Encoder-GPIO cable provided power (5 V_{DC}) to the WheelProbe as well as several digital signals for the Position Encoder, push-buttons input (coming from Wireless Remote) and LED outputs. The I-PEX cable was used to pulse up to 64 ultrasound phased-array elements at 5 MHz.

A Veo 16.64 was used as support equipment for monitoring and controlling the WheelProbe. Here are the details:

- Powers the WheelProbe;
- Pulses and listens the 64 WheelProbe phased-array ultrasound elements;
- Reads the WheelProbe Position Encoder;
- Reads the WheelProbe buttons' status (coming from the Wireless Remote);
- Controls the WheelProbe status LEDs.

Apart from the Encoder-GPIO cable and I-PEX cable going from the Veo to the EUT, three Veo USB ports are used to connect a USB memory key containing the software application and configuration file, a keyboard and a mouse.

The Veo can either be powered by its external 15 V power supply connected to the MAINS or by its own internal batteries.

The Veo main application (Embedded G3) was used in play mode and monitored to see if the various tests have any impact on performance of the product. A configuration file for the 5MHz WheelProbe is available to configure easily and rapidly the Veo for WheelProbe application.

A JIG was also provided. Here are its features and how to operate it. The Jig has a button allowing synchronizing the Jig to the Wireless Remote to be tested. It provides as well one LED for this sync button and three LEDs that are linked to the pressing of the three Wireless Remote push-buttons. It also has a Lemo connector that allows connecting the JIG to a WheelProbe. In this configuration, the Jig sync button allows syncing the WheelProbe to a Wireless Remote. The WheelProbe LEDs will then individually be controlled by the Wireless Remote.

Two different Wireless Remotes were available. A normal Wireless Remote providing the usual features and a modified Wireless Remote which had one of its push-button shorted to simulate the continuous pressing of one of its push-buttons.

3.5 EUT setup details

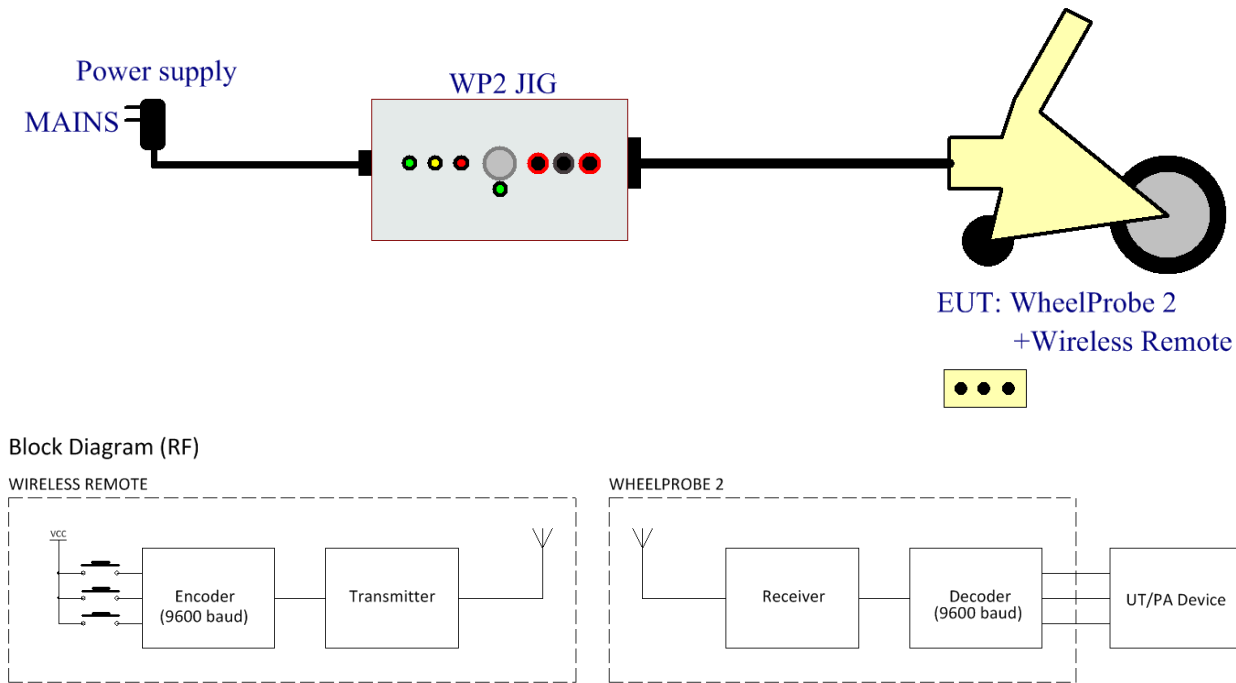


Figure 3.5-1: Setup diagram

Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5 Test conditions

5.1 Atmospheric conditions

Temperature: 15–30 °C
Relative humidity: 20–75 %
Air pressure: 86–106 kPa

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$, for which the equipment was designed.

Section 6 Measurement uncertainty

6.1 Uncertainty of measurement

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of $K = 2$ with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 7 Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Mar. 18/15
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	Oct. 24/14
Spectrum analyzer	Rohde & Schwarz	FSU	FA001877	1 year	Jan. 27/15
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	Mar. 12/15
Horn antenna (1–18 GHz)	EMCO	3115	FA000825	1 year	Mar. 10/15
Pre-amplifier (1–18 GHz)	JCA	JCA118-503	FA002091	1 year	June 21/14
50 Ω coax cable	Huber + Suhner	NONE	FA002392	1 year	July. 17/14
50 Ω coax cable	C.C.A.	None	FA002555	1 year	Oct. 07/14

Notes: NCR - no calibration required

Table 7.1-2: Test software details

Test description	Manufacturer of Software	Details
Radiated emissions	Rhode & Schwarz	EMC32, Software for EMC Measurements, Version 8.53.0

Section 8 Testing data

8.1 Clause 15.231(e) RSS-210 A1.1 Conditions for intentional radiators to comply with periodic operation

8.1.1 Definitions and limits

Clause 15.231(e)

In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

RSS-210: A1.1.5 Reduced Field Strengths

The following conditions shall be met to comply with the provisions for momentary operation:

- 1 Devices may be employed for any type of operation, including operation prohibited in Section A1.1.1, provided that the device complies with the requirements of sections A1.1.2 through A1.1.4 and that the field strength meets the limits in Table B of this annex.
- 2 In addition, devices operated under the provisions of this section (A1.1.5) shall be capable of automatically limiting their operation so that the duration of each transmission shall not be greater than 1 second and the silent period between transmissions shall be at least 30 times the duration of the transmission, but in no case less than 10 seconds. However, devices that are designed for limited use for the purpose of initial programming, reprogramming or installation, and not for regular operations, may operate up to 5 seconds provided that such devices are used only occasionally in connection with each unit being programmed or installed.

8.1.2 Test summary

Test date:	June 2, 2014	Temperature:	23 °C
Test engineer:	Kevin Rose	Air pressure:	1001 mbar
Verdict:	Pass	Relative humidity:	37 %

8.1.3 Observations/special notes

None

Section 8

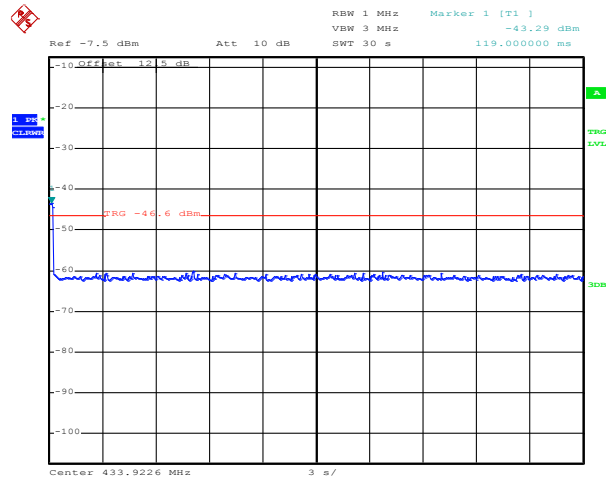
Test name

Specification

Testing data
Clause 15.231(a) RSS-210 A1.1 Conditions for intentional radiators to comply with periodic operation
FCC Part 15 Subpart C, RSS-210 A1.1



8.1.4 Test data



Date: 3 JUN 2014 19:46:37

Figure 8.1-1: 30 second off time

Table 8.1-1: Test summary 15.231(e)

FCC / IC	1 / a
FCC	Comply Figure 8.1-2
IC	Comply Figure 8.1-2

8.2 Clause 15.231(e) RSS-210 A1.1.2 Field strength of emissions

8.2.1 Definitions and limits

In addition to the provisions of §15.205 the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Table 8.2-1: Field strength limits

Fundamental Frequency (MHz), excluding restricted band frequencies of RSS-Gen	Field Strength of the Fundamental (microvolts/m at 3 m) (Note 1)	Field Strength of Unwanted Emissions (microvolts/m at 3 m)
260–470	1,500 to 5,000	150 to 500

Note 1: Limits on the field strength of emissions, as shown in this table, are based on the average value of the measured emissions. As an alternative, compliance with the limits in this table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector.* Linear interpolation with frequency

$$260\text{--}470 \text{ MHz: FS (microvolts/m)} = (16.67 \times F) - 2833.33$$

- 1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.
- 2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.
- 3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

8.2.2 Test summary

Test date:	June 2, 2014	Temperature:	23 °C
Test engineer:	Kevin Rose	Air pressure:	1001 mbar
Verdict:	Pass	Relative humidity:	37 %

8.2.3 Observations/special notes

Table 8.2-2: §15.209 and RSS 210 A1.1 – Radiated emission limits

Frequency (MHz)	Field strength (μV/m)	Measurement distance (dBμV/m)	(m)
0.009–0.490	2400/F	67.6–20log(F)	300
0.490–1.705	24000/F	87.6–20log(F)	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

- F = fundamental frequency in kHz
- In the emission table above, the tighter limit applies at the band edges.
- For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

8.2.3 Observations/special notes, continued

Table 8.2-3: §15.205 – Restricted bands of operation

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
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	Above 38.6
13.36–13.41			

Table 8.2-4: RSS-Gen– Restricted bands of operation

MHz	MHz	MHz	GHz
0.090–0.110	12.51975–12.52025	399.9–410	5.35–5.46
2.1735–2.1905	12.57675–12.57725	608–614	7.25–7.75
3.020–3.026	13.36–13.41	960–1427	8.025–8.5
4.125–4.128	16.42–16.423	1435–1626.5	9.0–9.2
4.17725–4.17775	16.69475–16.69525	1645.5–1646.5	9.3–9.5
4.20725–4.20775	16.80425–16.80475	1660–1710	10.6–12.7
5.677–5.683	25.5–25.67	1718.8–1722.2	13.25–13.4
6.215–6.218	37.5–38.25	2200–2300	14.47–14.5
6.26775–6.26825	73–74.6	2310–2390	15.35–16.2
6.31175–6.31225	74.8–75.2	2655–2900	17.7–21.4
8.291–8.294	108–138	3260–3267	22.01–23.12
8.362–8.366	156.52475–156.52525	3332–3339	23.6–24.0
8.37625–8.38675	156.7–156.9	3345.8–3358	31.2–31.8
8.41425–8.41475	240–285	3500–4400	36.43–36.5
12.29–12.293	322–335.4	4500–5150	Above 38.6

- The spectrum was searched from 30 MHz to the 10th harmonic at a distance of 3 m.
- The EUT was measured on three orthogonal axis.
- All measurements within 30–1000 MHz range: using a peak detector with 100 kHz/300 kHz RBW/VBW,
- above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
- and using a duty cycle/average factor for average results calculations.
- Transmit output power was measured while supply voltage was varied from 2.5 VDC to 3 VDC. No change in transmit output power was observed.

8.2.4 Test data

Table 8.2-5: Field strength measurement results

Frequency (MHz)	Polarization V/H	Peak Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
433.92	H	61.3	72.8	11.5
2169.57	H	46.4	52.8	6.4
2590.30	V	31	52.8	21.8

Note: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

8.3 Clause 15.231(c) RSS-Gen 4.6.1 Emission bandwidth

8.3.1 Definitions and limits

FCC:

The bandwidth of the emission shall be no wider than 0.25 % of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5 % of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

IC:

For the purpose of Section A1.1, the 99 % bandwidth shall be no wider than 0.25 % of the centre frequency for devices operating between 70 MHz and 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5 % of the centre frequency.

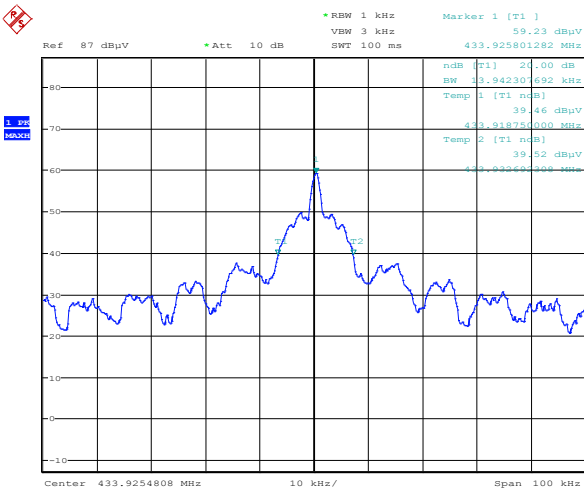
8.3.2 Test summary

Test date:	June 2, 2014	Temperature:	23 °C
Test engineer:	Kevin Rose	Air pressure:	1001 mbar
Verdict:	Pass	Relative humidity:	37 %

8.3.3 Observations/special notes

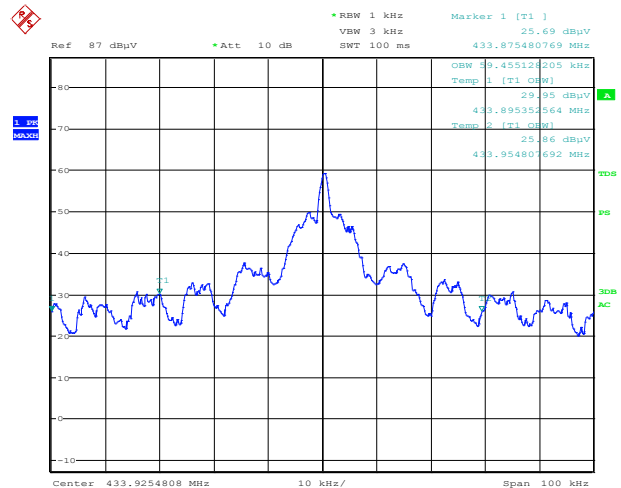
The test was performed using peak detector of the spectrum analyzer with RBW no narrower than 1 % of the emission bandwidth.

8.3.4 Test data



Date: 2.JUN.2014 19:02:05

Figure 8.3-1: 20 dB bandwidth



Date: 2.JUN.2014 19:01:27

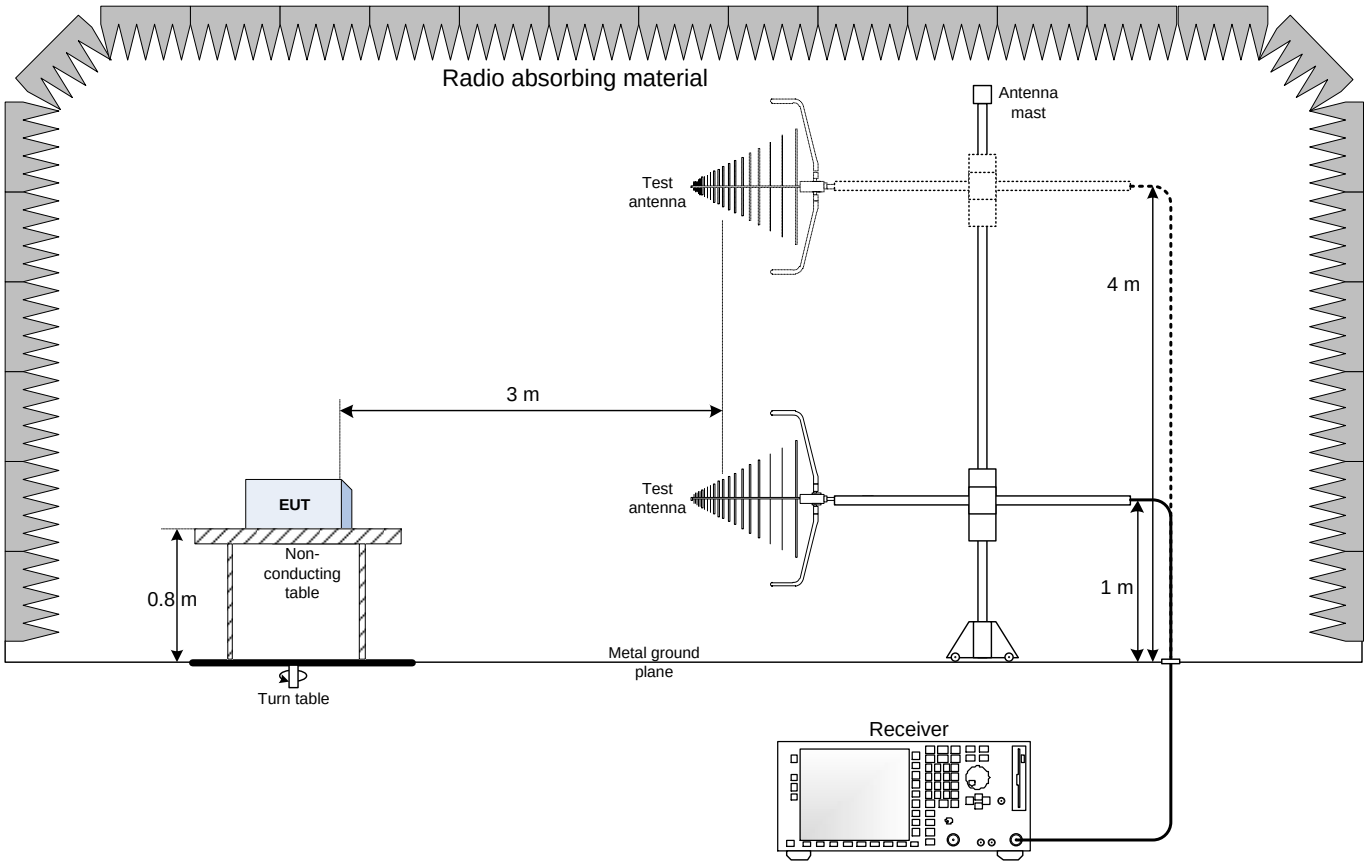
Figure 8.3-2: 99% bandwidth (59.45 kHz)

Table 8.3-1: 20 dB bandwidth

20 dB bandwidth (kHz)	Limit (MHz)	Margin (kHz)
13.94	1.0848	1070.86

Section 9 Block diagrams of test set-ups

9.1 Radiated emissions set-up



Section 10 EUT photos

10.1 External photos

10.1.1 EUT front view



Figure 10.1-1: Top view



Figure 10.1-2: Bottom view