

RADIO TEST REPORT – 446513-1TRFWL

Type of assessment:

Final product testing

Applicant:

ÉlanCité

Product:

Module Radar (field sensor) 24GHz band

Model:

ANTENNA MODULE REV1-3b

FCC ID:

2AF46DSPREV1-3b

IC Registration number:

20796-DSPREV13b

Specifications:

- ◆ FCC 47 CFR Part 15 Subpart C, §15.245
- ◆ RSS-210 Issue 10, December 2019, Annex F.2

Date of issue: October 7, 2021

Avul Nzenza, EMC/RF Specialist

Tested by



Signature

Andrey Adelberg, Senior EMC/RF Specialist

Reviewed by



Signature

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SCC File Number: 15064 (Ottawa/Almonte); 151100 (Montreal); 151097 (Cambridge)

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Test site identifier	Organization	Ottawa/Almonte	Montreal	Cambridge
	FCC:	CA2040	CA2041	CA0101
	ISED:	2040A-4	2040G-5	24676
Website	www.nemko.com			

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 contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 15, Subpart C, §15.245	Operation within the bands 902–928 MHz, 2435–2465 MHz, 5785–5815 MHz, 10500–10550 MHz, and 24075–24175 MHz.
RSS-210 Issue 10, December 2019, Annex F.2	Speed Radar Meters operating in the Bands 10.5–10.55 GHz, 24.075–24.175 GHz and 33.4–36 GHz.

1.2 Test methods

ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
RSS-Gen, Issue 5, March 2019	General Requirements for Compliance of Radio Apparatus

1.3 Exclusions

None

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.3 above. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

Determining compliance is based on the results of the compliance measurement, not taking into account measurement uncertainty, in accordance with section 1.3 of ANSI C63.10 v2013.

See “Summary of test results” for full details.

1.5 Test report revision history

Table 1.5-1: Test report revision history

Revision #	Date of issue	Details of changes made to test report
TRF	October 7, 2021	Original report issued

Section 2 Engineering considerations

2.1 Modifications incorporated in the EUT for compliance

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

2.2 Technical judgment

None

2.3 Model variant declaration

There were no model variants declared by the applicant.

2.4 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 3 Test conditions

3.1 Atmospheric conditions

Temperature	15 °C – 35 °C
Relative humidity	20 % – 75 %
Air pressure	86 kPa (860 mbar) – 106 kPa (1060 mbar)

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.

3.2 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 4 Measurement uncertainty

4.1 Uncertainty of measurement

UKAS Lab 34 and TIA-603-B have been used as guidance for measurement uncertainty reasonable estimations with regards to previous experience and validation of data. Nemko Canada, Inc. follows these test methods in order to satisfy ISO/IEC 17025 requirements for estimation of uncertainty of measurement for wireless products.

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

Table 4.1-1: Measurement uncertainty calculations

Test name	Measurement uncertainty, $\pm$ dB
All antenna port measurements	0.55
Occupied bandwidth	4.45
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 5 Information provided by the applicant

5.1 Disclaimer

This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results contained within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

5.2 Applicant/Manufacture

Applicant name	ÉlanCité
Applicant address	Zone industrielle de la Pentecôte, 12 Route de la Garenne 44700 Orvault France
Manufacture name	Same as applicant
Manufacture address	Same as applicant

5.3 EUT information

Product	Module Radar (field sensor) 24GHz band
Model	ANTENNA MODULE REV1-3b
Serial number	E357349b
Power supply requirements	11–15 VDC from car battery
Product description and theory of operation	24 GHz CW filed Sensor car speed detection for use on pedagogical products.

5.4 Radio technical information

Operating band	24075–24175 MHz
Operating frequency	24139 MHz
Modulation type	Continuous wave
Occupied bandwidth (99 %)	833.33 kHz
Emission designator	NON
Power requirements	11–15 V _{DC} from car battery
Antenna information	Manufacturer : INNOSSENT Type : CW Gain : 15 dBi Model : IPS-937_F The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

5.5 EUT setup details

EUT was energized and the transmission on the desired frequency was verified.

5.5.1 EUT setup configuration

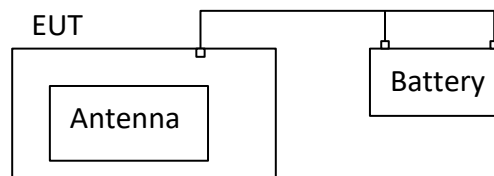


Figure 5.5-1: Setup diagram

Section 6 Summary of test results

6.1 Testing location

Test location (s)	Ottawa
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6.2 Testing period

Test start date	August 6, 2021	Test end date	August 9, 2021
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6.3 Sample information

Receipt date	August 6, 2021	Nemko sample ID number(s)	1
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6.4 FCC test results

Table 6.4-1: FCC requirements results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not applicable
§15.31(e)	Variation of power source	Pass
§15.31(m)	Number of tested frequencies	Pass
§15.203	Antenna requirement	Pass
§15.245(b)	Radiated emissions not in restricted bands	Pass
§15.245(b)(3)	Spurious emissions (except harmonics)	Pass
§15.215(c)	20 dB bandwidth	Pass

Notes: EUT is a battery-operated device, the testing was performed using fresh batteries.

6.5 ISED General test results

Table 6.5-1: ISED General requirements results

Part	Test description	Verdict
7.3	Receiver radiated emission limits	Not applicable
7.4	Receiver conducted emission limits	Not applicable
6.7	Occupied bandwidth (or 99% emission bandwidth) and x dB bandwidth	Pass
6.9	Operating bands and selection of test frequencies	Pass
8.8	AC power-line conducted emissions limits	Not applicable

Notes: ¹ According to sections 5.2 and 5.3 of RSS-Gen, Issue 5 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.
EUT is a battery-operated device, the testing was performed using fresh batteries.

6.6 ISED RSS-210, Issue 10, test results

Table 6.6-1: RSS-210 requirements results

Section	Test description	Verdict
F.2.a	Radiated Emissions of fundamental and harmonics	Pass
F.2.a	Radiated Emissions except for harmonic	Pass
F.2.e	Frequency stability	Pass

Notes: None

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	March 26, 2022
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	November 6, 2021
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	February 2, 2022
Horn (1–18 GHz)	ETS Lindgren	3117	FA002840	1 year	February 2, 2022
Preamp (1–18 GHz)	ETS Lindgren	124334	FA002873	1 year	October 13, 2021
Horn antenna (18–40 GHz)	EMCO	3116	FA001847	1 year	May 11, 2022
Pre-amplifier (18–26 GHz)	Narda	BBS-1826N612	FA001550	—	VOU
Pre-amplifier (26–40 GHz)	Narda	DBL-2640N610	FA001556	—	VOU
Temperature chamber	Espec	EPX-4H	FA002735	1 year	October 8, 2021
Signal and Spectrum Analyzer	Rhode&Schwarz	FSW50	FA003267	1 year	December 7, 2021
Temperature chamber	Espec	EPX-4H	FA002735	1 year	October 8, 2021
Standard gain horn (33-50 GHz)	Mi-Wave	261B-25/383	FA003274	NCR	NCR
Standard gain horn (50-75 GHz)	Mi-Wave	261V-25/385	FA003270	NCR	NCR
Standard gain horn (75-110 GHz)	Mi-Wave	261W-25/387	FA003271	NCR	NCR
Hamonic mixer (50-75 GHz)	Rohde & Schwarz	FS-Z75	FA003263	2 years	September 24, 2022
Hamonic mixer (75-110 GHz)	Rohde & Schwarz	FS-Z110	FA003262	2 years	March 2, 2022
Signal and Spectrum Analyzer	Rhode&Schwarz	FSW50	FA003267	1 year	December 7, 2021

Notes: NCR - no calibration required, VOU - verify on use

Section 8 Testing data

8.1 Variation of power source

8.1.1 References, definitions and limits

FCC §15.31 (e):

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

8.1.2 Test summary

Verdict	Pass		
Tested by	Avul Nzenza	Test date	August 7, 2021

8.1.3 Observations, settings and special notes

The testing was performed as per ANSI C63.10 Section 5.13.

- Where the device is intended to be powered from an external power adapter, the voltage variations shall be applied to the input of the adapter provided with the device at the time of sale. If the device is not marketed or sold with a specific adapter, then a typical power adapter shall be used.
- For devices, where operating at a supply voltage deviating $\pm 15\%$ from the nominal rated value may cause damages or loss of intended function, test to minimum and maximum allowable voltage per manufacturer's specification and document in the report.
- For devices with wide range of rated supply voltage, test at 15% below the lowest and 15% above the highest declared nominal rated supply voltage.
- For devices obtaining power from an input/output (I/O) port (USB, firewire, etc.), a test jig is necessary to apply voltage variation to the device from a support power supply, while maintaining the functionalities of the device.

For battery-operated equipment, the equipment tests shall be performed using a variable power supply.

8.1.4 Test data

EUT Power requirements:	☐ AC	☐ DC	☒ Battery
If EUT is an AC or a DC powered, was the noticeable output power variation observed?	☐ YES	☐ NO	☒ N/A
If EUT is battery operated, was the testing performed using fresh batteries?	☐ YES	☐ NO	☒ N/A
If EUT is rechargeable battery operated, was the testing performed using fully charged batteries?	☒ YES	☐ NO	☐ N/A

8.2 Number of frequencies

8.2.1 References, definitions and limits

FCC §15.31:

- (m) Measurements on intentional radiators or receivers shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table.

RSS-Gen, Clause 6.9:

Except where otherwise specified, measurements shall be performed for each frequency band of operation for which the radio apparatus is to be certified, with the device operating at the frequencies in each band of operation shown in table below. The frequencies selected for measurements shall be reported in the test report.

Table 8.2-1: Frequency Range of Operation

Frequency range over which the device operates (in each band)	Number of test frequencies required	Location of measurement frequency inside the operating frequency range
1 MHz or less	1	Center (middle of the band)
1–10 MHz	2	1 near high end, 1 near low end
Greater than 10 MHz	3	1 near high end, 1 near center and 1 near low end

Notes: “near” means as close as possible to or at the centre / low end / high end of the frequency range over which the device operates.

8.2.2 Test summary

Verdict	Pass		
Tested by	Avul Nzenza	Test date	August 7, 2021

8.2.3 Observations, settings and special notes

ANSI C63.10, Clause 5.6.2.1:

The number of channels tested can be reduced by measuring the center channel bandwidth first and then applying the following relaxations as appropriate:

- For each operating mode, if the measured channel bandwidth on the middle channel is at least 150% of the minimum permitted bandwidth, then it is not necessary to measure the bandwidth on the high and low channels.
- For multiple-input multiple-output (MIMO) systems, if the measured channel bandwidth on testing the middle channel exceeds the minimum permitted bandwidth by more than 50% on one transmit chain, then it is not necessary to repeat testing on the other chains.
- If the measured channel bandwidth on the middle channel is less than 50% of the maximum permitted bandwidth, then it is not necessary to measure the bandwidth on the high and low channels.

ANSI C63.10, Clause 5.6.2.2:

For devices with multiple operating modes, measurements on the middle channel can be used to determine the worst-case mode(s). The worst-case modes are as follows:

- Band edge requirements—Measurements on the mode with the widest bandwidth can be used to cover the same channel (center frequency) on modes with narrower bandwidth that have the same or lower output power for each modulation family (e.g., OFDM and direct sequence spread spectrum).
- Spurious emissions—Measure the mode with the highest output power and the mode with the highest output power spectral density for each modulation family (e.g., OFDM and direct sequence spread spectrum).
- In-band PSD—Measurements on the mode with the narrowest bandwidth can be used to cover all modes within the same modulation family of an equal or lower output power provided the result is less than 50% of the limit.

8.2.4 Test data

Table 8.2-2: *Test channels selection*

Start of Frequency range, MHz	End of Frequency range, MHz	Frequency range bandwidth, MHz	Single frequency, MHz
24075	24175	100	24139

Note: EUT doesn't use channels, only one frequency

8.3 Antenna requirement

8.3.1 References, definitions and limits

FCC §15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

FCC §15.247:

- (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
- (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS-Gen, Clause 6.8:

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report.

8.3.2 Test summary

Verdict	Pass		
Tested by	Avul Nzenza	Test date	August 7, 2021

8.3.3 Observations, settings and special notes

None

8.3.4 Test data

Must the EUT be professionally installed? ☐ YES ☒ NO

Does the EUT have detachable antenna(s)? ☐ YES ☒ NO

If detachable, is the antenna connector(s) non-standard? ☐ YES ☐ NO ☒ N/A

8.4 Occupied (Emission) bandwidth

8.4.1 References, definitions and limits

FCC.215(c)

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80 % of the permitted band in order to minimize the possibility of out-of-band operation.

RSS-GEN, 6.7

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

RSS-210 F.2.2

The frequency stability shall be sufficient to ensure that the 40 dB bandwidth stays within the operating frequency band when tested at the temperature and supply voltage variations specified the frequency stability measurement in RSS-Gen.

8.4.1 Test summary

Verdict	Pass		
Tested by	Avul Nzenza	Test date	August 7, 2021

8.4.1 Observations, settings and special notes

Spectrum analyser settings:

Detector mode	Peak
Resolution bandwidth	≥1 % of OBW
Video bandwidth	RBW × 3
Trace mode	Max Hold

8.4.2 Test data

Table 8.4-1: Lower 20 dBc frequency cross result

Lower 20 dBc frequency cross, GHz	Lower limit, GHz	Margin, MHz
24.139441	24.075	64.4

Table 8.4-2: Upper 20 dBc frequency cross result

Upper 20 dBc frequency cross, GHz	Upper limit, GHz	Margin, MHz
24.140141	24.175	34.8

Table 8.4-3: Lower 40 dBc frequency cross result

Lower 40 dBc frequency cross, GHz	Lower limit, GHz	Margin, MHz
24.138922	24.075	63.9

Table 8.4-4: Upper 40 dBc frequency cross result

Upper 40 dBc frequency cross, GHz	Upper limit, GHz	Margin, MHz
24.1407	24.175	34.3

Table 8.4-5: 99% occupied bandwidth results

Frequency, MHz	99% occupied bandwidth, MHz
24.139	0.5723

Note: there is no 99% occupied bandwidth limit in the standard's requirements, the measurement results provided for information purposes only.

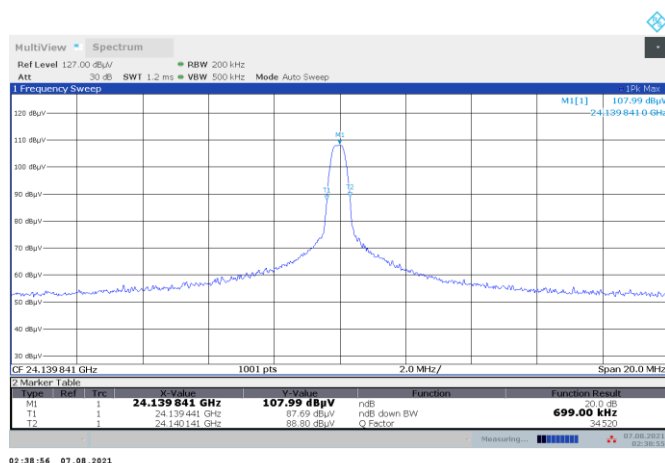


Figure 8.4-1: 20 dB bandwidth

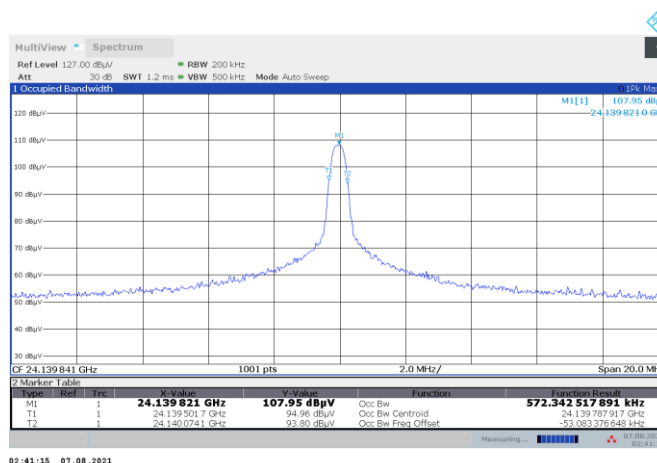


Figure 8.4-2: 99% bandwidth

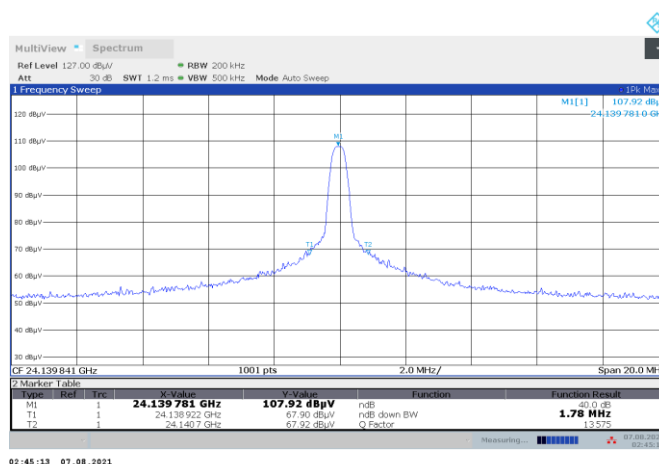


Figure 8.4-3: 40 dB bandwidth

8.5 Field strength of fundamental and harmonics outside restricted bands

8.5.1 Definitions and limits

FCC 15.245(b)

The field strength of emissions from intentional radiators shall comply with the following FCC table.

ISED RSS-210 Annex F.2.a

The field strength of fundamental and harmonic emissions shall not exceed the following ISED table.

Table 8.5-1: FCC field strength limits at a distance of 3 meters

Fundamental frequencies, MHz	Field strength of fundamental		Field strength of harmonics	
	mV/m	dBμV/m	mV/m	dBμV/m
902–928	500	114	1.6	64
2435–2465	500	114	1.6	64
5785–5815	500	114	1.6	64
10500–10550	2500	128	25.0	88
24075–24175	2500	128	25.0	88

Note: The emission limits shown above are based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

Regardless of the limits shown in the above table, harmonic emissions in the restricted bands below 17.7 GHz, as specified in §15.205, shall not exceed the field strength limits shown in §15.209. Harmonic emissions in the restricted bands at and above 17.7 GHz shall not exceed the following field strength limits:

- (i) For the second and third harmonics of field disturbance sensors operating in the 24075–24175 MHz band and for other field disturbance sensors designed for use only within a building or to open building doors, 25.0 mV/m.
- (ii) For all other field disturbance sensors, 7.5 mV/m.

Table 8.5-2: ISED field strength limits at a distance of 3 meters

Fundamental frequencies, MHz	Average field strength of fundamental		Average field strength of harmonics	
	mV/m	dBμV/m	mV/m	dBμV/m
10500–10550	2500	128	25	88
24075–24175	2500	128	25	88
33400–36000	2500	128	80	98

Harmonic emissions falling into restricted bands listed in RSS-Gen and which are below 17.7 GHz shall meet the general field strength limits specified in RSS-Gen.

Harmonic emissions falling into restricted bands listed in RSS-Gen and which are at and above 17.7 GHz shall not exceed the following strength limits measured at a distance of 3 m

25 mV/m for the second and third harmonic emissions of devices operating in the band 24.075–24.175 GHz and for the second harmonic emission of devices operating in the band 33.4–36.0 GHz;

7.5 mV/m for all other devices.

8.5.2 Test summary

Verdict	Pass		
Tested by	Avul Nzenza	Test date	August 10, 2021

8.5.3 Observations, settings and special notes

As per FCC §15.33 (2) If the intentional radiator operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower. Therefore the spectrum was searched from 30 MHz to 100 GHz

Radiated measurements were performed at a distance of 3 m for frequencies up to 18 GHz, 1 m within 18–40 GHz, and 0.1 m above 40 GHz. All distance corrections were included in the correction factors settings.

Spectrum analyser settings fundamental:

Detector mode	Peak
Resolution bandwidth	1 MHz
Video bandwidth	1 MHz
Trace mode	Max Hold

Spectrum analyser settings harmonics:

Detector mode	Peak
Resolution bandwidth	1 MHz
Video bandwidth	1 MHz
Trace mode	Max Hold

8.5.4 Test data

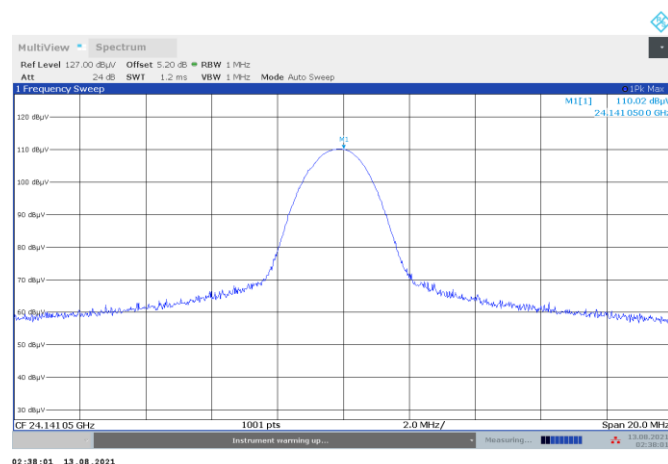


Figure 8.5-1: Field strength of fundamental

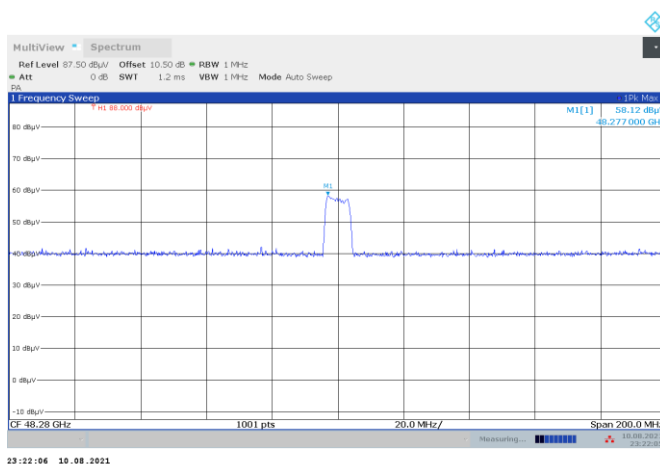


Figure 8.5-2: Field strength spurious emission at 2nd harmonic

Table 8.5-3: Field strength measurement results

Frequency, GHz	Field strength (peak), dBμV/m	Average limit, dBμV/m	Margin, dB
24.141	110.02	128.00	17.98
48.277	58.12	88.00	29.88

8.6 Spurious emissions (except for harmonics)

8.6.1 Definitions and limits

FCC 15.245(b)(3)

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

ISED RSS-210 Annex F.2.d

Emissions radiated outside of this specified operating frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits specified in RSS-Gen, whichever is less stringent.

Table 8.6-1: 15.209 and RSS-Gen emissions field strength limits

Frequency, MHz	Field strength of emissions		Measurement distance, m
	µV/m	dBµV/m	
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: 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

Table 8.6-2: ISED restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	12.57675–12.57725	399.9–410	7.25–7.75
0.495–0.505	13.36–13.41	608–614	8.025–8.5
2.1735–2.1905	16.42–16.423	960–1427	9.0–9.2
3.020–3.026	16.69475–16.69525	1435–1626.5	9.3–9.5
4.125–4.128	16.80425–16.80475	1645.5–1646.5	10.6–12.7
4.17725–4.17775	25.5–25.67	1660–1710	13.25–13.4
4.20725–4.20775	37.5–38.25	1718.8–1722.2	14.47–14.5
5.677–5.683	73–74.6	2200–2300	15.35–16.2
6.215–6.218	74.8–75.2	2310–2390	17.7–21.4
6.26775–6.26825	108–138	2483.5–2500	22.01–23.12
6.31175–6.31225	149.9–150.05	2655–2900	23.6–24.0
8.291–8.294	156.52475–156.52525	3260–3267	31.2–31.8
8.362–8.366	156.7–156.9	3332–3339	36.43–36.5
8.37625–8.38675	162.0125–167.17	3345.8–3358	
8.41425–8.41475	167.72–173.2	3500–4400	
12.29–12.293	240–285	4500–5150	Above 38.6
12.51975–12.52025	322–335.4	5350–5460	

Note: Certain frequency bands listed in this table and above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

Table 8.6-3: FCC restricted frequency bands

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			

8.6.2 Test summary

Verdict	Pass		
Tested by	Avul Nzenza	Test date	August 8, 2021

8.6.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to 100 GHz. No spurious emissions were detected above 40 GHz, except for the second harmonic, which is covered in the previous section.

Radiated measurements up to 18 GHz were performed at a distance of 3 m, from 18 GHz and up to 40 GHz at 1 m, and from 40 GHz and up to 100 GHz at 0.1 m. All distance correction factors were included in the offsets of the plots. Correction factors were calculated using following formula: $20 \times \log_{10} (3 \text{ m} / \text{measurement distance})$.

Spectrum analyzer settings for peak measurements at the frequencies above 1000 MHz:

Spectrum analyzer settings for frequencies below 1000 MHz:

Detector mode	Peak or Quasi-Peak
Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Trace mode	Max Hold

Spectrum analyzer settings for peak measurements at the frequencies above 1000 MHz:

Detector mode	Peak
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Trace mode	Max Hold

8.6.4 Test data

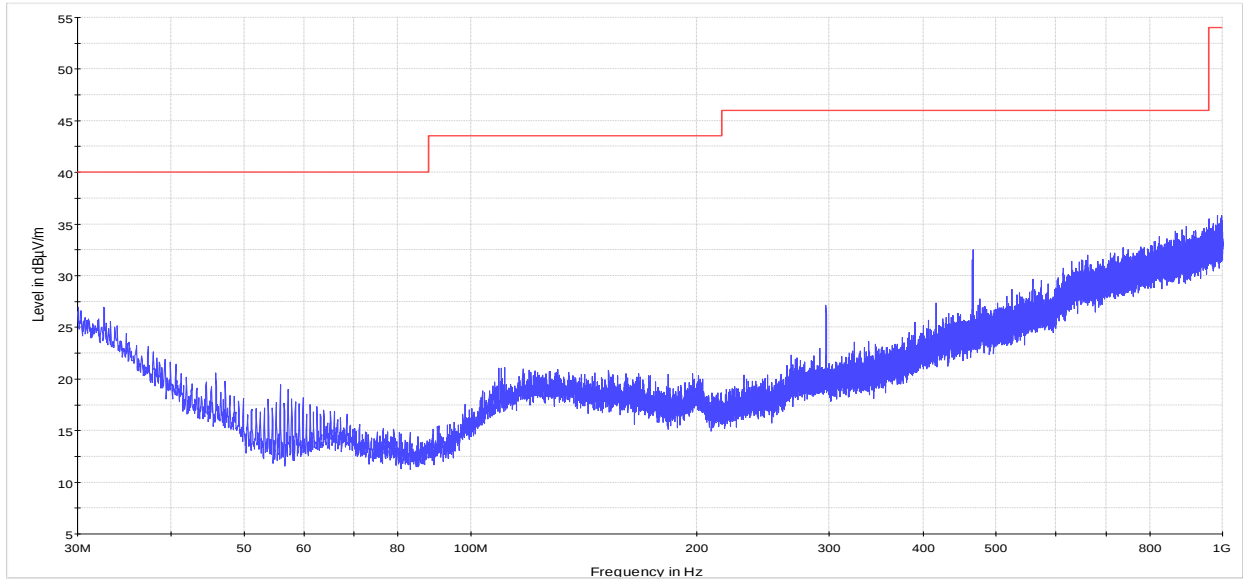


Figure 8.6-1: Field strength of spurious emissions below 1000 MHz

Note: all measurement results indicated in the plot were taken with a peak detector, which is more stringent measurement, and still comply with quasi-peak limit.

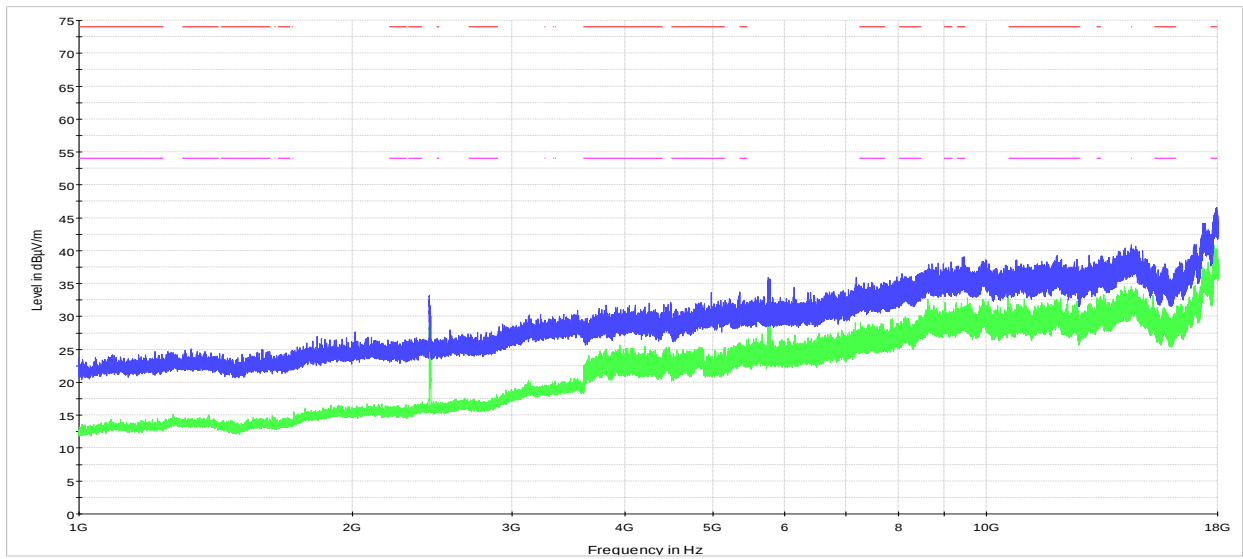


Figure 8.6-2: Field strength of spurious emissions within 1–18 GHz

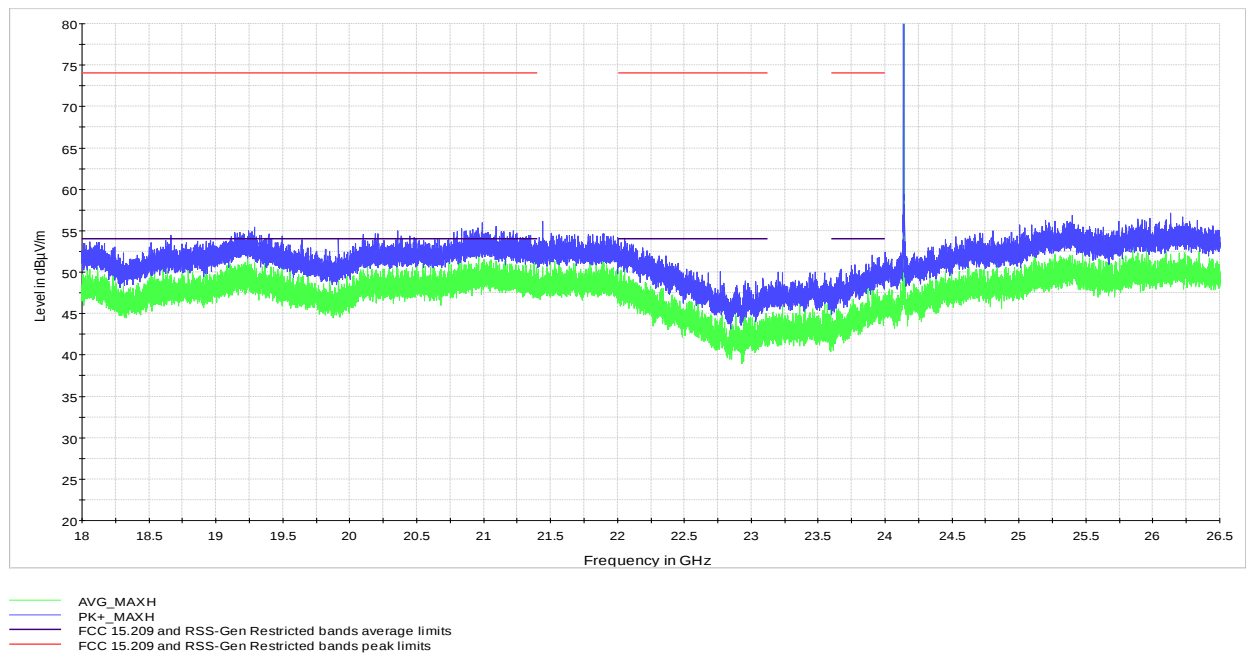


Figure 8.6-3: Field strength of spurious emissions within 18–26.5 GHz

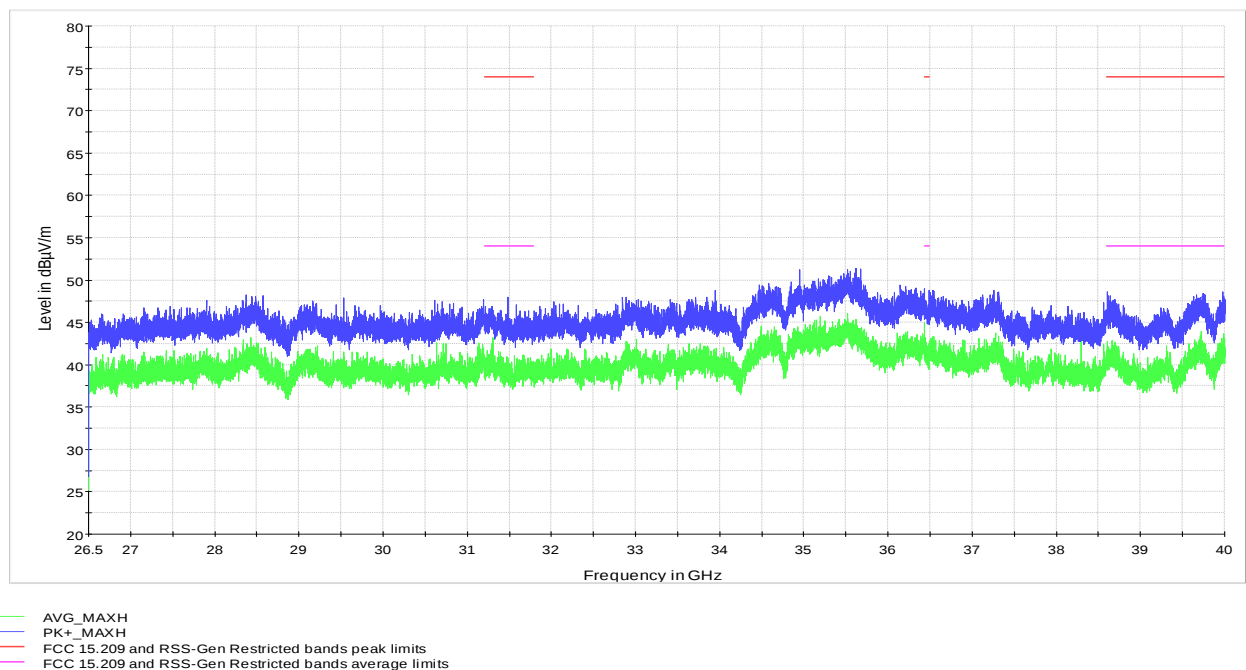


Figure 8.6-4: Field strength of spurious emissions within 26.5–40 GHz

The spectrum was scanned up to 110 GHz. No spurious emissions were detected above 40 GHz, except for the second harmonic, which is covered in the previous section.

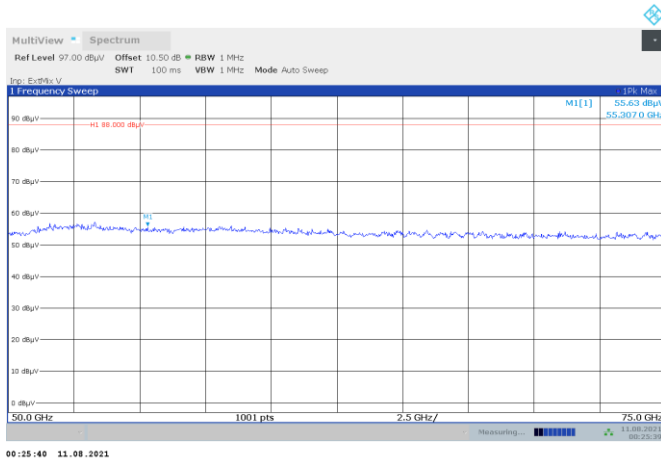


Figure 8.6-5: Field strength spurious 50 -75 GHz

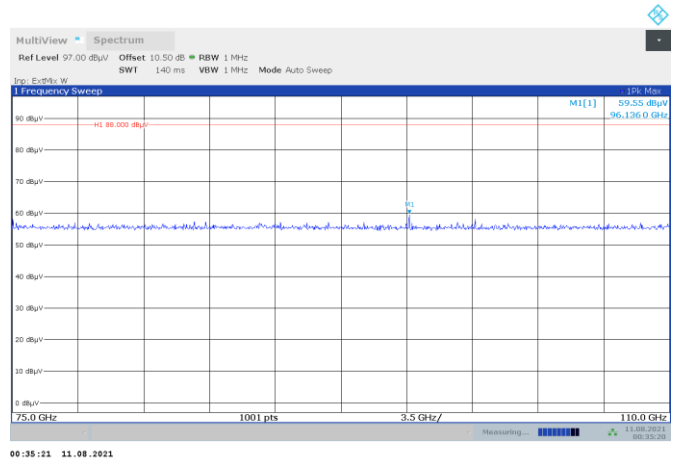


Figure 8.6-6: Field strength spurious emission 75-110 GHz

Note: all measurement results indicated in the plots above were taken with a peak detector, which is more stringent measurement, and still comply with average limit.

8.7 Frequency stability

8.7.1 Definitions and limits

RSS 210 Annex F.2.e

The frequency stability shall be sufficient to ensure that the 40 dB bandwidth stays within the operating frequency band when tested at the temperature and supply voltage variations specified the frequency stability measurement in RSS-Gen.

8.7.2 Test summary

Verdict	Pass		
Tested by	Avul Nzenza	Test date	April 20, 2021

8.7.3 Observations, settings and special notes

Spectrum analyzer settings for peak measurements at the frequencies above 1000 MHz:

8.7.4 Test data

Table 8.7-1: Frequency drift results

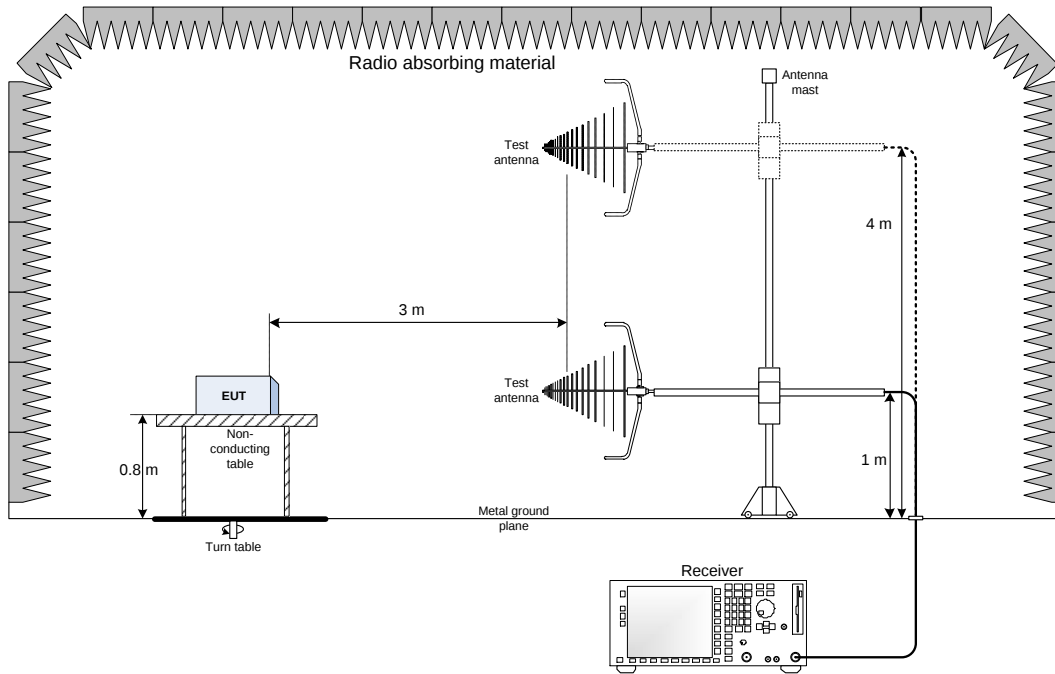
Conditions	Frequency, GHz	Frequency drift, MHz
Temperature: +70 °C Voltage: Nominal	24.10650070	-34.5493
Temperature: +20 °C Voltage: Nominal + 15%	24.12097622	-20.07378
Temperature: +20 °C Voltage: Nominal	24.14105000	Reference
Temperature: +20 °C Voltage: Nominal - 15%	24.12095308	-20.09692
Temperature: -30 °C Voltage: Nominal	24.13334647	-7.70353

Table 8.7-2: Frequency stability results

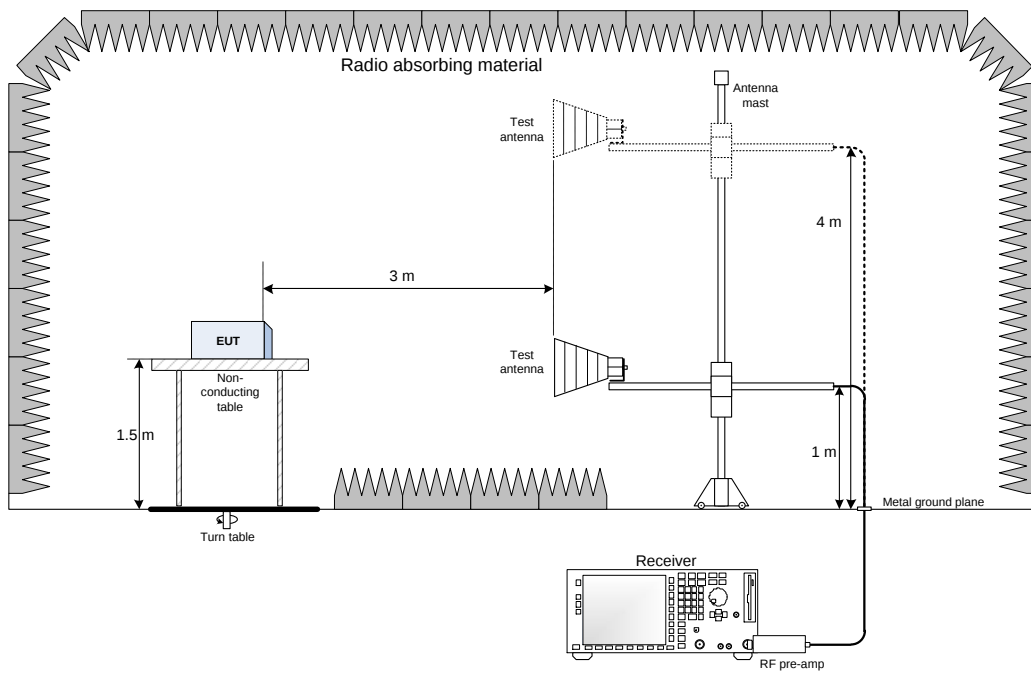
-40 dBc, GHz	Max drift, MHz	Drifted frequency, GHz	Limit, GHz	Margin, MHz
24.1389	-34.5493	24.1044	24.0750	29.3727
24.1407	0	24.1407	24.1750	34.3000

Section 9 Block diagrams of test set-ups

9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz



End of the test report