

RADIO TEST REPORT

Report ID

REP089192

Project ID

PRJ075234

Type of assessment:

Class II Permissive Change

Applicant:

GSI Electronics Inc.

Model (HVIN):

Raspberry Pi RM0

FCC ID:

2AFLZRPIRM0

ISED Certification number:

11880A-RPIRM0

Specifications:

- ◆ FCC 47 CFR Part 15 Subpart C, §15.247
- ◆ RSS-247, Issue 3, Aug 2023, Section 5

Date of issue: May 1, 2025

Kevin Rose, EMC/RF Specialist

Tested by

Andrey Adelberg, Senior RF/EMC Specialist

Reviewed by



Signature



Signature

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ANAB File Number: AT-3195 (Ottawa/Almonte); AT-3193 (Pointe-Claire); AT-3194 (Cambridge)



Lab locations

Company name	Nemko Canada Inc.			
Facilities	<i>Ottawa site:</i> 303 River Road Ottawa, Ontario Canada K1V 1H2 Tel: +1 613 737 9680 Fax: +1 613 737 9691	<i>Montréal site:</i> 292 Labrosse Avenue Pointe-Claire, Québec Canada H9R 5L8 Tel: +1 514 694 2684 Fax: +1 514 694 3528	<i>Cambridge site:</i> 1-130 Saltsman Drive Cambridge, Ontario Canada N3E 0B2 Tel: +1 519 650 4811	<i>Almonte site:</i> 1500 Peter Robinson Road West Carleton, Ontario Canada K0A 1L0 Tel: +1 613 256-9117
Test site identifier	Organization FCC: ISED:	Ottawa/Almonte CA2040 2040A-4	Montreal CA2041 2040G-5	Cambridge CA0101 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, Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–585 MHz
RSS-247, Issue 3, Aug 2023, Section 5	Digital Transmission Systems (DTSSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

1.2 Test methods

558074 D01 15.247 Meas Guidance v05r02 (April 2, 2019)	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules.
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
RSS-102, Issue 5, March 19, 2015	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

1.3 Exclusions

Partial testing was performed on the product with the transmitter operating to confirm that the module with the new antenna meets the FCC/ISED requirements. Client also declared that the 5 GHz operation will not be supported, as it will be deactivated in the firmware.

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.

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
REP089192	May 1, 2025	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

Only radiated spurious emissions test with the new antenna was performed.

2.3 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
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	GSI Electronics
Applicant address	5200 Armand-Frappier, St-Hubert, QC, J3Z 1G5, Canada
Manufacture name	Same as applicant
Manufacture address	Same as applicant

5.3 EUT information

WiFi radio Model (HVIN)	Raspberry Pi RM0
Power supply requirements	DC: 12 Vdc
Product description and theory of operation	RF WiFi module on vision connect host which provides WiFi connectivity of legacy GSI products.

5.4 Radio technical information

Category of Wideband Data Transmission equipment	☐ Frequency Hopping Spread Spectrum (FHSS) equipment
	☒ Other types of Wideband Data Transmission equipment (e.g. DSSS, OFDM, etc.).
Frequency band	2400–2483.5 MHz
Frequency Min (MHz)	2412
Frequency Max (MHz)	2462
Channel numbers	1–11
Antenna information	Molex Inc. 146153-0200 2.6 dBi Gain (for 2.4 GHz)

5.5 EUT setup details

5.5.1 Radio exercise details

Operating conditions	The EUT was powered with 12V DC supply through 100–240 V _{AC} 50/60 Hz PSU. It was then set to continuous transmission using RealTerm software.
Transmitter state	Transmitter set into continuous mode.

5.5.2 EUT setup configuration

Table 5.5-1: EUT sub assemblies

Description	Brand name	Model, Part number, Serial number, Revision level
AC/DC Adapter	GSI	NA

Table 5.5-2: EUT interface ports

Description	Qty.
3-Pin Supply connector	1

Table 5.5-3: Support equipment

Description	Brand name	Model, Part number, Serial number, Revision level
Laptop	Dell	SN: 6776506622, MN: Precision 7530
Router	D-link	TL-WR1043ND
Antenna	Molex Inc.	MN 1461530200

Table 5.5-4: Inter-connection cables

Cable description	From	To	Length (m)
DC Cable (2C 18-24 AWG Wire)	AC/DC PSU	DC input on EUT	5
AC Cord (3C 18 AWG Wire)	AC Mains	AC/DC PSU	2
Antenna Cable	EUT	Antenna	0.1

Section 6 Summary of test results

6.1 Testing location

Test location (s)	Montreal
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6.2 Testing period

Test start date	February 27, 2025	Test end date	March 18, 2025
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6.3 Sample information

Receipt date	February 27, 2025	Nemko sample ID number(s)	PRJ0752340001
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6.4 FCC Part §15.247 test results

Table 6.4-1: FCC requirements results

Part	Test description	Verdict
§15.247(d)	Spurious emissions	Pass

Notes: All other specification's requirements are not applicable for this type of assessment, therefore were removed from the table.

6.5 ISED RSS-247, Issue 3, test results

Table 6.5-1: ISED requirements results

Part	Test description	Verdict
5.5	Unwanted emissions	Pass

Notes: All other specification's requirements are not applicable for this type of assessment, therefore were removed from the table.

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 (Emissions)	TDK	SAC-3	FA002532e	1 year	May 8, 2025
Flush mount turntable	Sunol	FM2022	FA002550	—	NCR
Controller	Sunol	SC104V	FA002551	—	NCR
Antenna mast	Sunol	TLT2	FA002552	—	NCR
Bilog antenna (20–2000 MHz)	Sunol	JB1	FA002517	1 year	June 6, 2025
Horn antenna (1–18 GHz)	EMCO	3115	FA001451	1 year	June 6, 2025
50 Ω coax cable	Huber + Suhner	None	FA003438	1 year	May 11, 2025
RF Cable Assembly	Huber + Suhner	2M-750-195A-750	FA002554	1 year	May 11, 2025
LNA (1–18 GHz)	Miteq	N/A	FA003391	1 year	January 20, 2026
2.4 GHz band Notch Filter	Microwave Circuits	N0324413	FA002693	—	NCR
Horn antenna (18–40 GHz)	EMCO	3116	FA002487	1 year	April 9, 2025

Notes: NCR - no calibration required

Section 8 Testing data

8.1 Spurious (out-of-band) unwanted emissions

8.1.1 References, definitions and limits

FCC §15.247:

- (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

RSS-247, Clause 5.5:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Table 8.1-1: FCC §15.209 and RSS-Gen – Radiated emission limits

Frequency, MHz	Field strength of emissions		Measurement distance, m
	µV/m	dBµV/m	
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	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

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.

References, definitions and limits, continued

Table 8.1-2: 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	Above 38.6
12.29–12.293	240–285	4500–5150	
12.51975–12.52025	322–335.4	5350–5460	

Note: Certain frequency bands listed in Table 8.1-2 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 8.1-3: 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			

8.1.2 Test summary

Verdict	Pass		
Test date	March 19, 2025	Temperature	21 °C
Tested by	Kevin Rose	Air pressure	1008 mbar
Test location	Montreal	Relative humidity	36 %

8.1.3 Observations, settings and special notes

- As part of the current assessment, the test range of 9 kHz to 10th harmonic has been fully considered and compared to the actual frequencies utilized within the EUT. Since the EUT contains a transmitter in the GHz range, the EUT has been deemed compliant without formal testing in the 9 kHz to 30 MHz test range, therefore formal test results (tabular data and/or plots) are not provided within this test report.
- EUT was set to transmit with 100 % duty cycle
- Radiated measurements were performed at a distance of 3 m.
- DTS emissions in restricted frequency bands test was performed as per KDB 558074, section 8.6 with reference to ANSI C63.10 subclause 11.12.
- DTS band-edge emission measurements test was performed as per KDB 558074, section 8.7 with reference to ANSI C63.10 subclause 11.13.

Spectrum analyser settings for radiated measurements within restricted bands below 1 GHz:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for peak radiated measurements within restricted bands above 1 GHz:

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

Spectrum analyser settings for average radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	10 Hz
Detector mode:	Peak
Trace mode:	Max Hold

8.1.4 Test data

Table 8.1-4: Output power results with the new antenna (worst case modulation results)

Channel	Frequency, MHz	Output power, dBm		Margin, dB	Antenna gain, dBi	EIRP, dBm		Margin, dB
		Measured	Limit			Measured	Limit	
Low	2412	9.05	30	20.95	2.6	11.65	36	24.35
Mid	2437	9.30	30	20.70	2.6	11.90	36	24.10
High	2462	9.16	30	20.84	2.6	11.76	36	24.24

Notes: The modulation that resulted in the highest output power was 802.11g with 6 Mbps, so it was the basis for the EIRP calculation.

Table 8.1-5: Radiated field strength measurement results

Channel	Frequency, MHz	Peak Field strength, dBμV/m		Margin, dB	Average Field strength, dBμV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390.0*	50.2	74.0	32.0	41.6	54.0	12.0
High	2483.5*	50.7	74.0	28.1	41.8	54.0	8.1

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

* - peak levels were below the average limit, therefore those frequencies weren't tested with average detector.

Test data, Continued

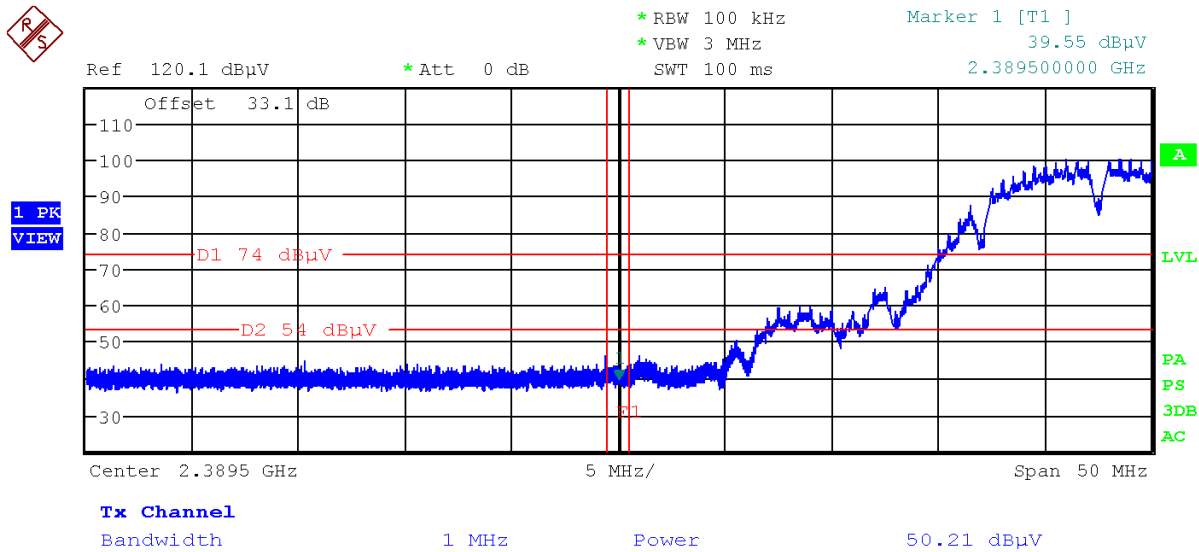


Figure 8.2 1: Band edge spurious emissions at 2390 MHz Peak

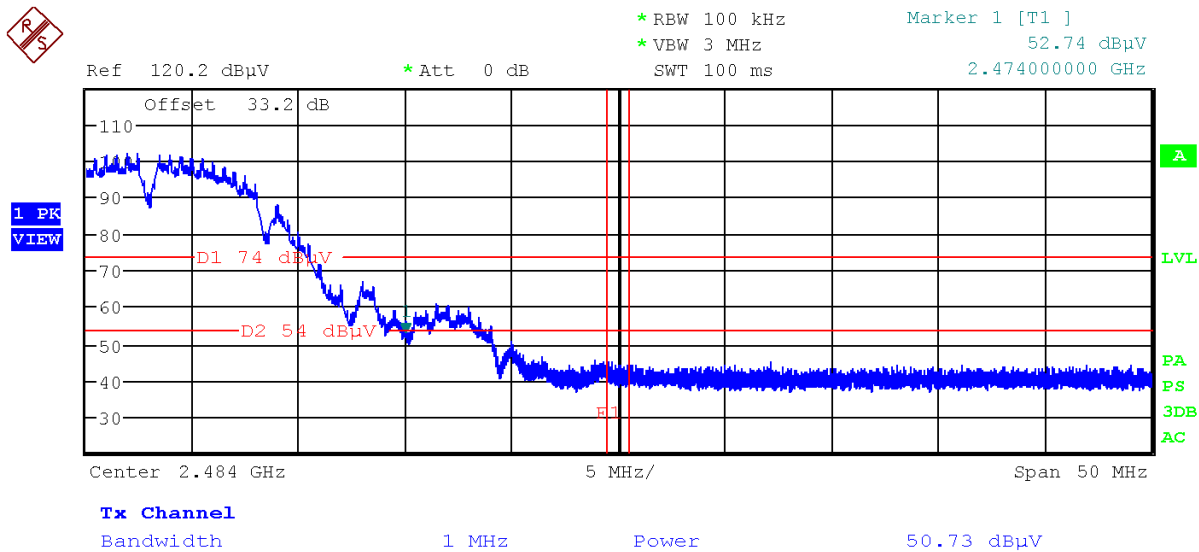


Figure 8.2 2: Band edge spurious emissions at 2483.5 MHz Peak

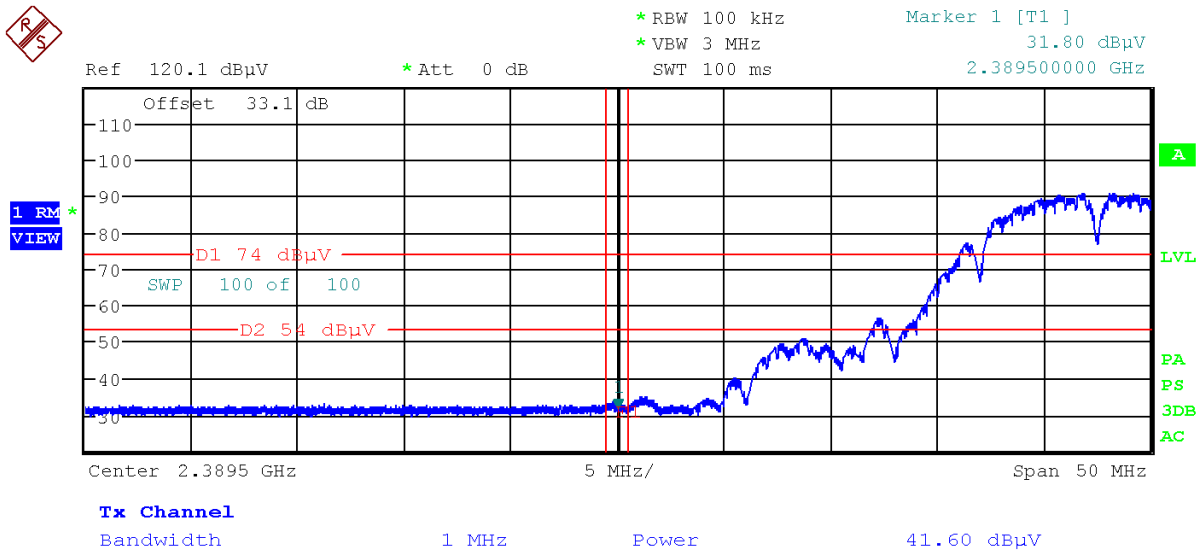


Figure 8.2.1: Band edge spurious emissions at 2390 MHz AVG

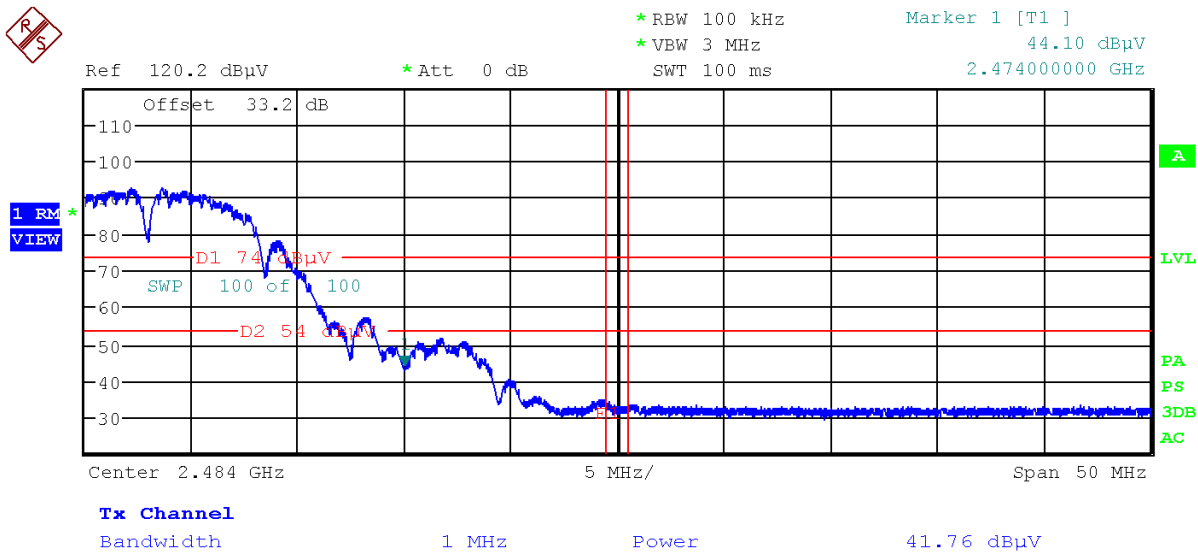
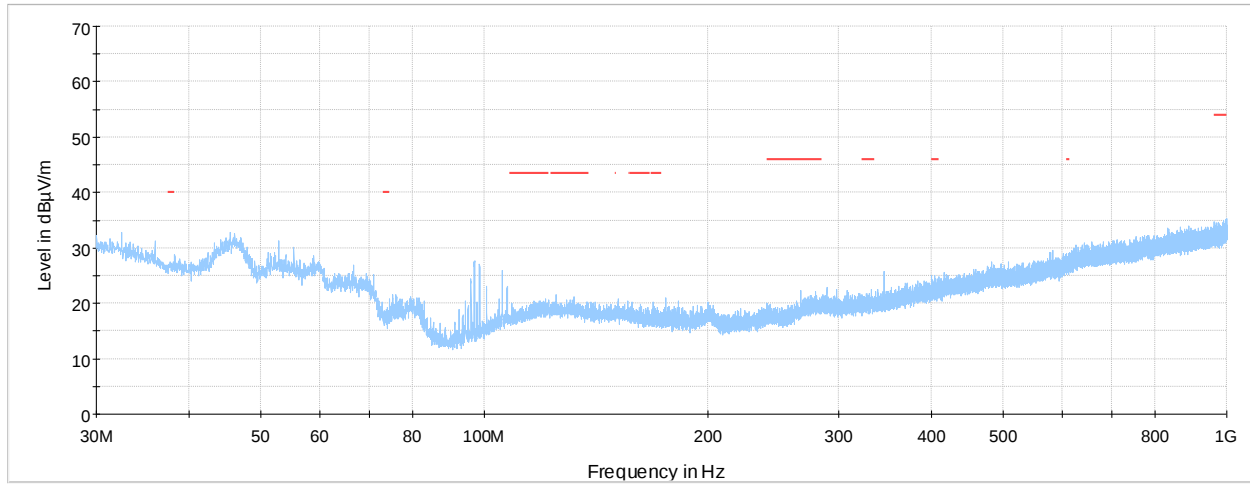


Figure 8.2.2: Band edge spurious emissions at 2483.5 MHz AVG

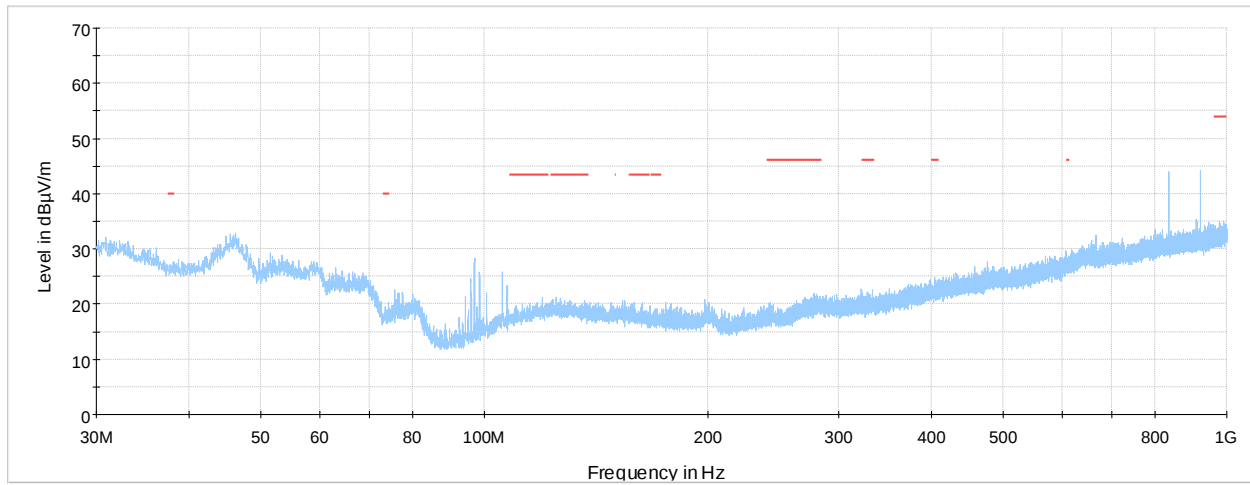
Test data, Continued



PRJ0075234 Low channel tx 30 MHz-1 GHz

- Preview Result 1-PK+
- Critical_Freqs PK+
- FCC 15.209 and RSS-210 limit line RstrB
- ◆ Final_Result QPK

Figure 8.2.3: Radiated spurious emissions on 30 MHz to 1 GHz (low channel)

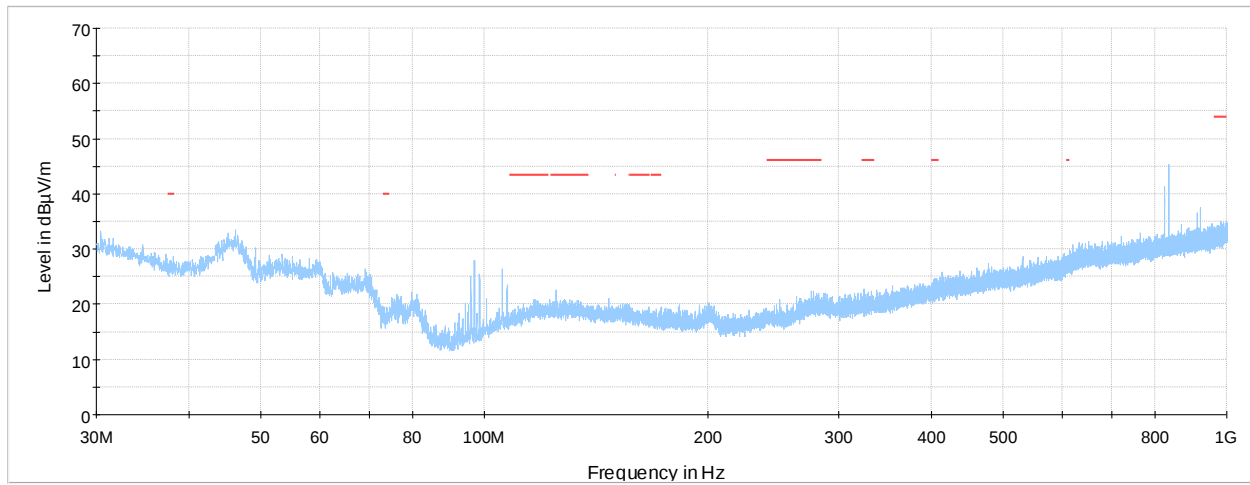


PRJ0075234 Mid channel tx 30 MHz-1 GHz

- Preview Result 1-PK+
- Critical_Freqs PK+
- FCC 15.209 and RSS-210 limit line RstrB
- ◆ Final_Result QPK

Figure 8.2.4: Radiated spurious emissions on 30 MHz to 1 GHz (mid channel)

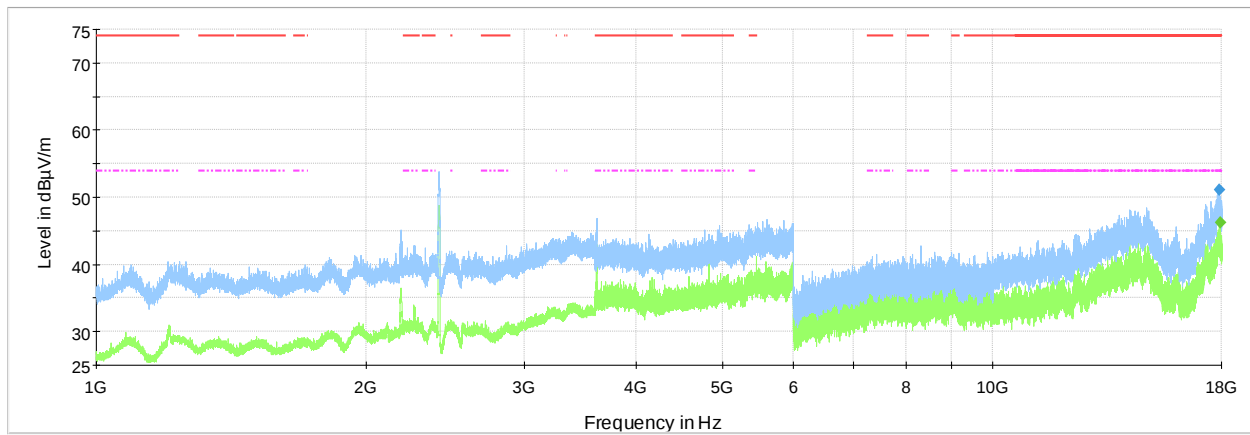
Test data, Continued



PRJ0075234 High channel tx 30 MHz-1 GHz

- Preview Result 1-PK+
- Critical_Freqs PK+
- FCC 15.209 and RSS-210 limit line RstrB
- ◆ Final_Result QPK

Figure 8.2.5: Radiated spurious emissions on 30 MHz to 1 GHz (high channel)

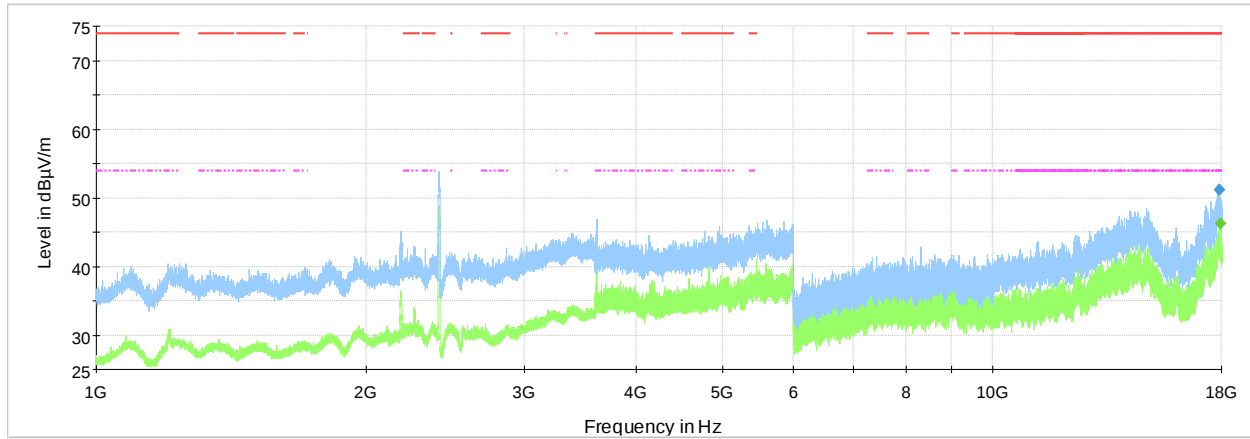


PRJ0075234 Low channel tx 1-18 GHz

- Preview Result 2-AVG
- Preview Result 1-PK+
- FCC 15.209 and RSS-210 limit line RstrB pk
- FCC 15.209 and RSS-210 limit line RstrB
- ◆ Final_Result PK+
- ◆ Final_Result AVG

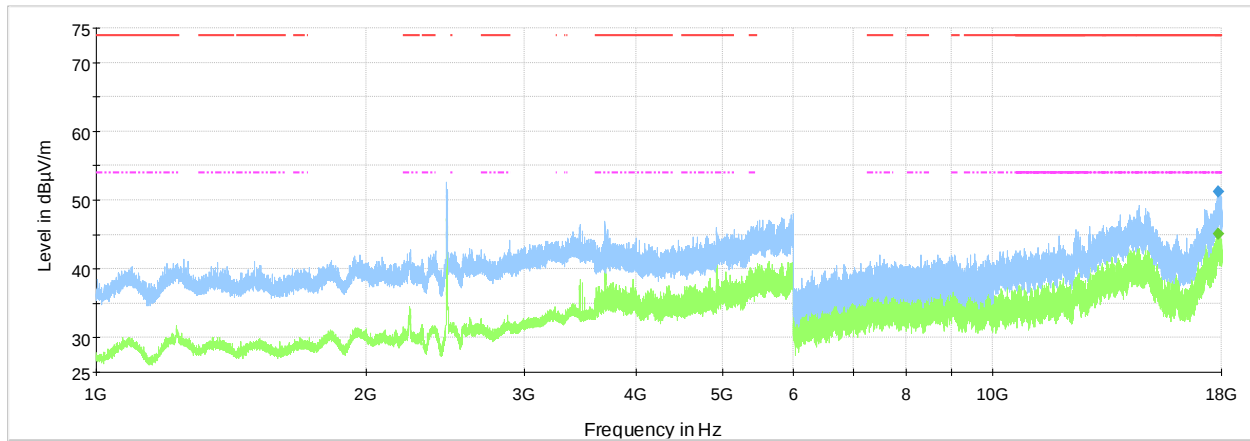
Figure 8.2.6: Radiated spurious emissions on 1-18 GHz (low channel)

Test data, Continued



PRJ0075234 Mid channel tx 1-18 GHz
 Preview Result 2-AVG
 Preview Result 1-PK+
 FCC 15.209 and RSS-210 limit line RstrB pk
 FCC 15.209 and RSS-210 limit line RstrB
 Final_Result PK+
 Final_Result AVG

Figure 8.2 7: Radiated spurious emissions on 1–18 GHz (mid channel)



high channel tx 1-18 GHz
 Preview Result 2-AVG
 Preview Result 1-PK+
 FCC 15.209 and RSS-210 limit line RstrB pk
 FCC 15.209 and RSS-210 limit line RstrB
 Final_Result PK+
 Final_Result AVG

Figure 8.2 8: Radiated spurious emissions on 1–18 GHz (high channel)

Test data, Continued

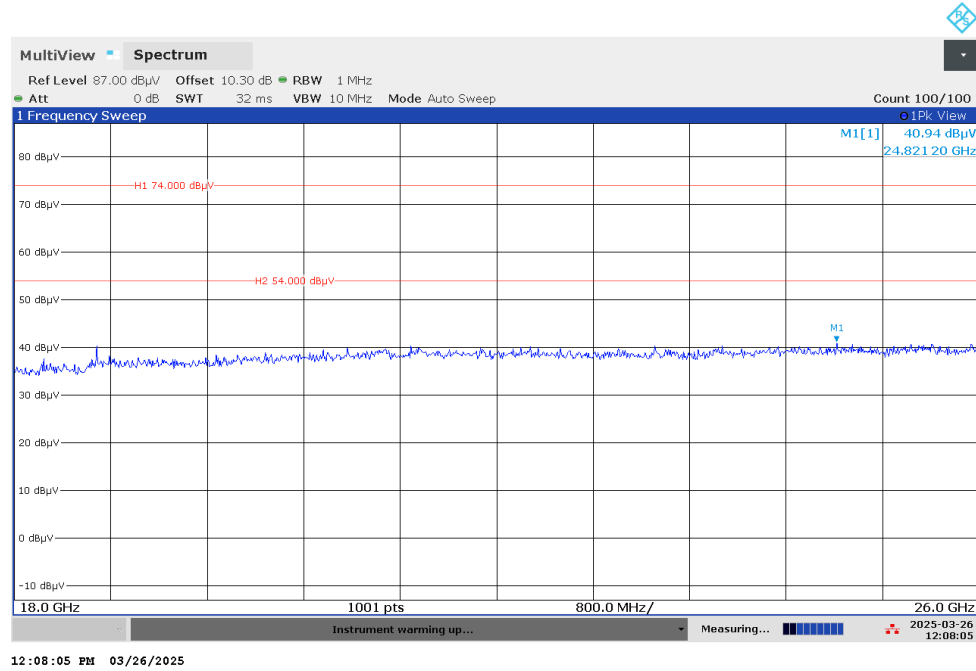


Figure 8.2 9: Radiated spurious emissions on 18–26 GHz (low channel)

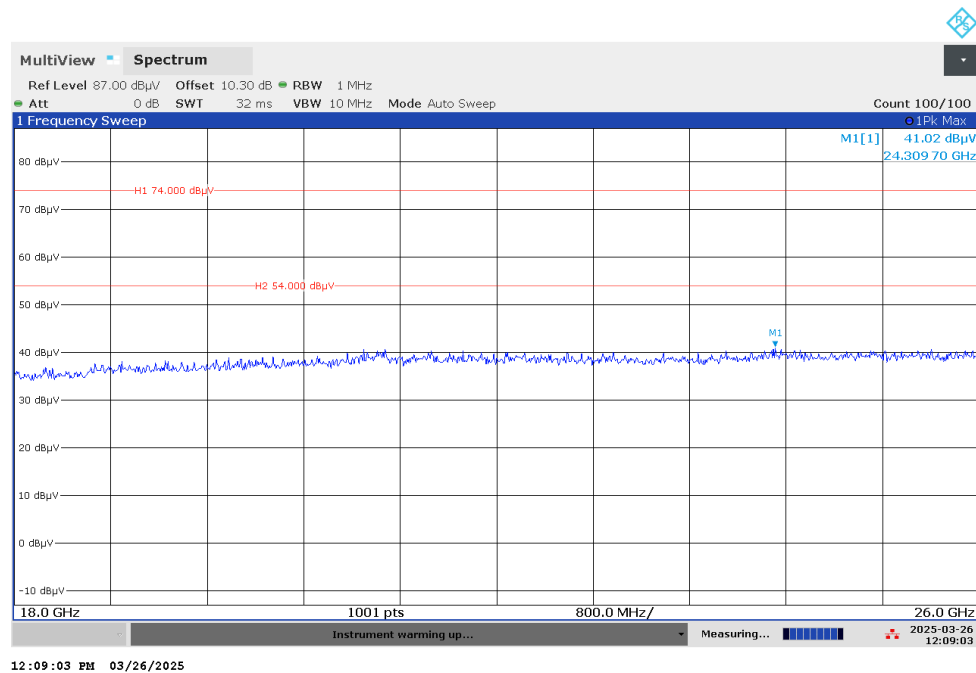


Figure 8.2 10: Radiated spurious emissions on 18–26 GHz (mid channel)



Test data, Continued

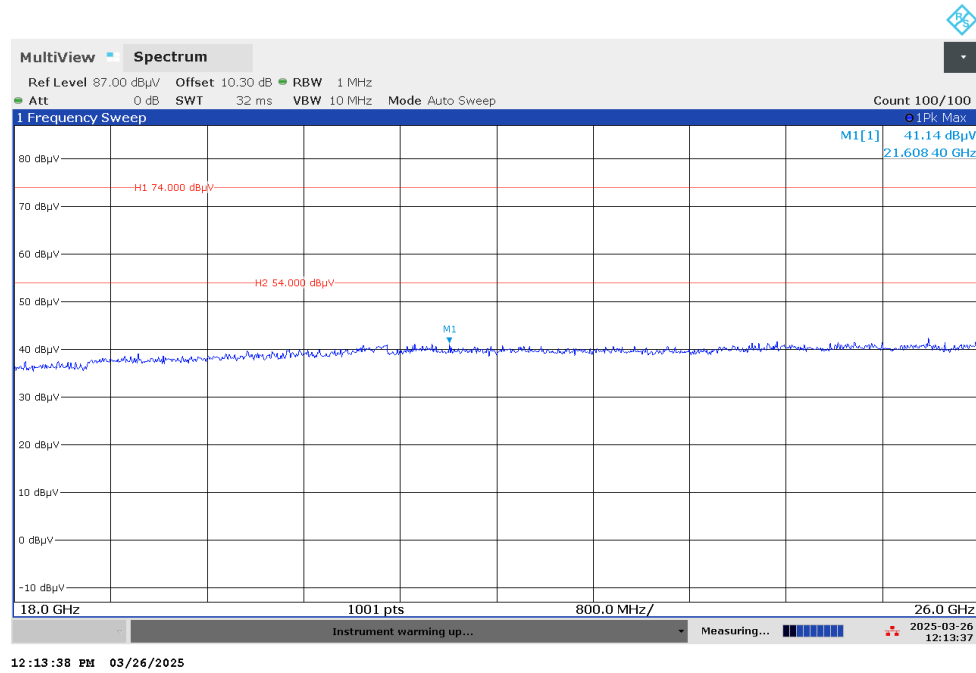
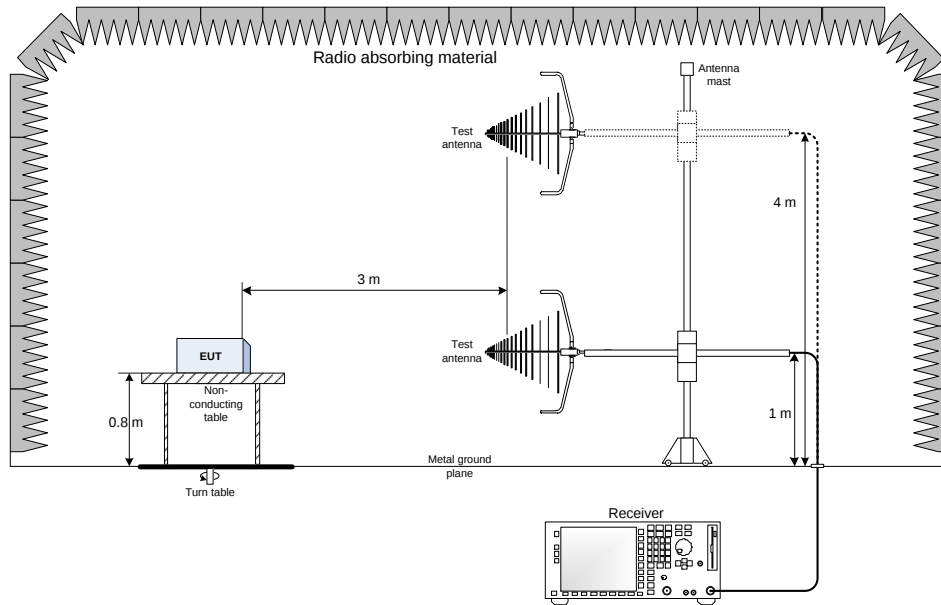


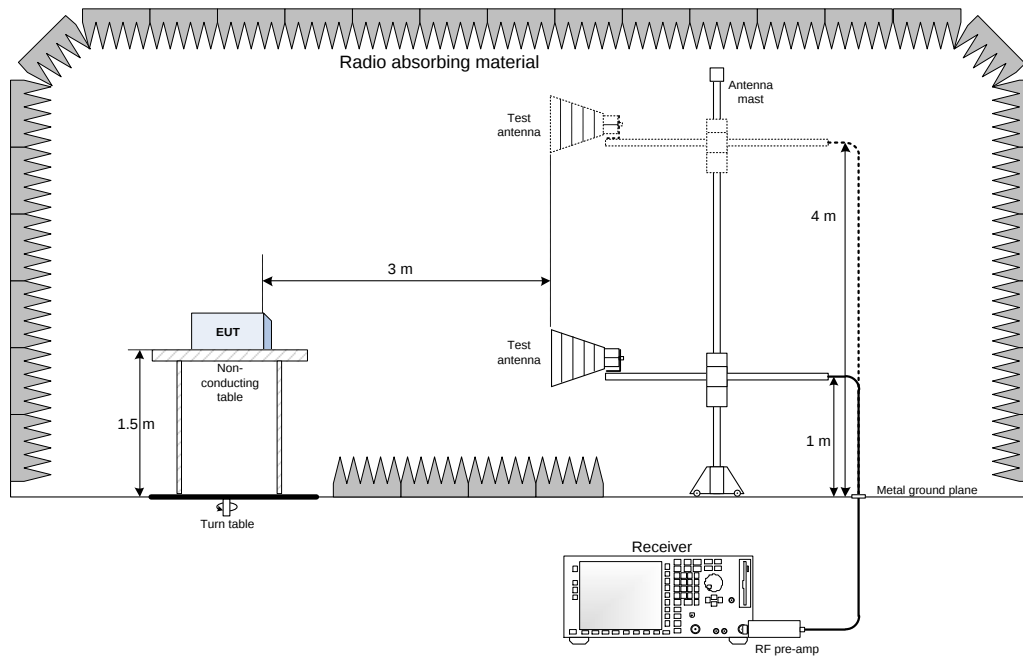
Figure 8.2 11: Radiated spurious emissions on 18–26 GHz (high channel)

Section 9 EUT setup diagrams

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