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RADIO TEST REPORT

Report ID
REP003087

Project ID
PRJ0023933

Type of assessment:
Limited Assessment

Type of radio equipment:
Spread Spectrum/Digital Device (2400–2483.5 MHz)

Equipment class:
DTS

Applicant:
Honeywell International Inc

Description of product:
Triac Dimmer RF Lamp Controller

Model(s)/HVIN(s):
L510 Triac Lamp Controller

Product marketing name (PMN):
LAMP CONTROLLER

FCC identifier:
FCC ID: 2A8LT-L510TF0001

ISED certification number:
IC: 1225A-L510TF0001

Specifications:

- FCC 47 CFR Part 15 Subpart C, §15.247
- RSS-247, Issue 2, Feb 2017, Section 5

Date of issue: December 5, 2022

Tarek Elkholy, EMC/RF Specialist
Tested by

Tarek Elkholy
Signature

Kevin Rose, EMC/RF Specialist
Reviewed by

Signature

Lab locations

Company name	Nemko Canada Inc.			
Facilities	*Ottawa site:* 303 River Road Ottawa, Ontario Canada K1V 1H2 Tel: +1 613 737 9680 Fax: +1 613 737 9691	*Montréal site:* 292 Labrosse Avenue Pointe-Claire, Québec Canada H9R 5L8 Tel: +1 514 694 2684 Fax: +1 514 694 3528	*Cambridge site:* 1-130 Saltsman Drive Cambridge, Ontario Canada N3E 0B2 Tel: +1 519 650 4811	*Almonte site:* 1500 Peter Robinson Road West Carleton, Ontario Canada K0A 1L0 Tel: +1 613 256-9117

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.

Copyright notification

Table of Contents

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 2, Feb 2017, Section 5	Digital Transmission Systems (DTSs), 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.
RSS-Gen, Issue 5, April 2018	General Requirements for Compliance of Radio Apparatus
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

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
REP003087	December 5, 2022	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

As declared by the applicant, the EUT model L510 FET Lamp Controller has been chosen to be representative for both models in the model family. The model family, and the description of the variations, are as follows:
L510 Triac Lamp Controller uses the exact same radio module as the model L510 FET Lamp Controller therefore only spurious emissions were tested to verify compliance of the Triac model version.

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 ±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, ±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 / Manufacturer

Applicant name	Honeywell International Inc
Applicant address	12 Clintonville Road, Northford, CT 06472 USA
Manufacturer name	River Display LTD
Manufacture address	Block A 19F Prince IND BLDG, Hong Kong, China

5.3 EUT information

Product	Triac Dimmer RF Lamp Controller
Model (HVIN)	L510 Triac Lamp Controller
Part number	201-7051
Serial number	None
Power requirements	120 V_{AC}, 60 Hz
Description/theory of operation	Lamp Controller – Dimming of lighting management system, providing wireless plug and play automation
Operational frequencies	Crystal 8 MHz Crystal 16 MHz Crystal 16 MHz
Software details	M_L510F_100_255_35_3.srec (BL V1.0, FK V100.01, IRAS V1.34, AM V100_255_35_3, CBL32Ctrl V1.54)

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	2405 MHz
Frequency Max	2480 MHz
Type of modulation	IEEE 802.15.4/ZIGBEE® RF, O-QPSK
Emission classification	2K30GXW
Transmitter spurious, dBµV/m @ 3 m	Average at 4960.5 MHz, 47.0 dBµV/m
Antenna information	Type: Ceramic chip, Manufacturer: Johanson, Model: 2450AT43B100, Gain: 1.3 dBi

5.5 EUT setup details

5.5.1 Radio exercise details

Operating conditions	Using ST-Link utility interface and serial connection, the EUT was controlled to transmit at different frequency channels at power level of 5 dBm.
Transmitter state	Transmitter set into continuous mode.

5.5.2 EUT setup configuration

Table 5.5-1: EUT interface ports

Description	Qty.
AC power input port	1
AC power output port (load)	1
H4 RJ9 4-pin socket (Low Voltage Dry Contact Input)	1
H3 RJ12 6-pin socket (S5Bus communication + 12VDC 100mA output max)	1
8-pin programing interface	1

Table 5.5-2: Support equipment

Description	Brand name	Serial number, Part number, Model, Revision level
Laptop	Dell	MN: Latitude E6420, DPN: VVF52 A01, SN: 28MCCS1
System controller	INNCOM	SN: 92-0217, PN: 201-217, MN: Evora

Table 5.5-3: Inter-connection cables

Cable description	From	To	Length (m)
AC power port	AC power supply	EUT	1

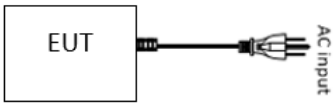


Figure 5.5-1: Radiated testing block diagram

Section 6 Summary of test results

6.1 Testing location

Test location (s)	Cambridge

6.2 Testing period

Test start date	November 22, 2022	Test end date	November 24, 2022

6.3 Sample information

Receipt date	November 17, 2022	Nemko sample ID number(s)	2

6.4 FCC test results

Table 6.4-1: FCC requirements results

Part	Test description	Verdict
Generic requirements		
§15.207(a)	Conducted limits	Not tested
§15.31(e)	Variation of power source	Not tested
§15.31(m)	Number of tested frequencies	Not tested
§15.203	Antenna requirement	Not tested
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	Not applicable
§15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	Not applicable
§15.247(d)	Spurious emissions	Pass
§15.247(f)	Time of occupancy for hybrid systems	Not applicable
DTS specific requirements		
§15.247(a)(2)	Minimum 6 dB bandwidth	Not tested
§15.247(b)(3)	Maximum peak output power	Not tested
§15.247(e)	Power spectral density	Not tested

Notes: EUT is an AC powered device.
As per applicant's test plan only spurious emissions were evaluated in this assessment.

6.5 ISED test results

Table 6.5-1: ISED requirements results

Part	Test description	Verdict
Generic requirements		
RSS-Gen, 7.3	Receiver radiated emission limits	Not applicable
RSS-Gen, 7.4	Receiver conducted emission limits	Not applicable
RSS-Gen, 6.9	Operating bands and selection of test frequencies	Not tested
RSS-Gen, 8.8	AC powerline conducted emissions limits	Not tested
RSS-247, 5.5	Unwanted emissions	Pass
RSS-247, 5.4	Transmitter output power and e.i.r.p. requirements	Not tested
DTS specific requirements		
RSS-247, 5.2 (a)	Minimum 6 dB bandwidth	Not tested
RSS-247, 5.2 (b)	Maximum power spectral density	Not tested
RSS-247, 5.4 (d)	Systems employing digital modulation techniques	Not tested
RSS-247, 5.4 (e)	Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band	Not applicable
RSS-247, 5.4 (f)	Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams	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 an AC powered device.
As per applicant's test plan only spurious emissions were evaluated in this assessment

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	FA003012	1 year	February 7, 2023
Flush mount turntable	SUNAR	FM2022	FA003006	—	NCR
Controller	SUNAR	SC110V	FA002976	—	NCR
Antenna mast	SUNAR	TLT2	FA003007	—	NCR
Bilog antenna (30–2000 MHz)	SUNAR	JB1	FA003010	1 year	June 21, 2023
Receiver/spectrum analyzer	Rohde & Schwarz	ESR26	FA002969	1 year	December 30, 2022
Horn antenna (1–18 GHz)	ETS Lindgren	3117	FA002911	1 year	May 11, 2023
Preamp (1–18 GHz)	ETS Lindgren	124334	FA002956	1 year	March 30, 2023
50 Ω coax cable	Huber + Suhner	None	FA003047	1 year	July 13, 2023
50 Ω coax cable	Huber + Suhner	None	FA003043	1 year	July 13, 2023
Horn antenna (18–40 GHz)	EMCO	3116B	FA002948	1 year	January 23, 2023
Preamp 18-40 GHz	None	None	FA003323	1 year	March 30, 2023
Notch filter (2.4-2.4835 GHz)	Microwave circuits	N0324413	FA003027	1 year	VOU
Vector signal generator	Rohde & Schwarz	SMW200A	FA002970	1 Year	December 31, 2022
Spectrum analyzer	Rohde & Schwarz	FSW43	FA002971	1 year	December 30, 2022

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

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.

RSS-Gen:

8.9 Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table below.

8.10 Restricted frequency bands are designated primarily for safety-of-life services (distress calling and certain aeronautical activities), certain satellite downlinks, radio astronomy and some government uses. The following conditions related to the restricted frequency bands apply:

a The transmit frequency, including fundamental components of modulation, of licence-exempt radio apparatus shall not fall within the restricted frequency bands.

b Unwanted emissions that fall into restricted frequency bands listed in table 7 shall comply with the limits specified in table below.

c Unwanted emissions that do not fall within the restricted frequency bands shall comply either with the limits specified in the applicable RSS or with those specified in table below.

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

	Field strength of emissions		
Frequency, MHz	**µV/m**	**dBµV/m**	**Measurement distance, 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		
Tested by	Tarek Elkholy	Test date	November 23, 2022

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.

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

8.1.4 Test data

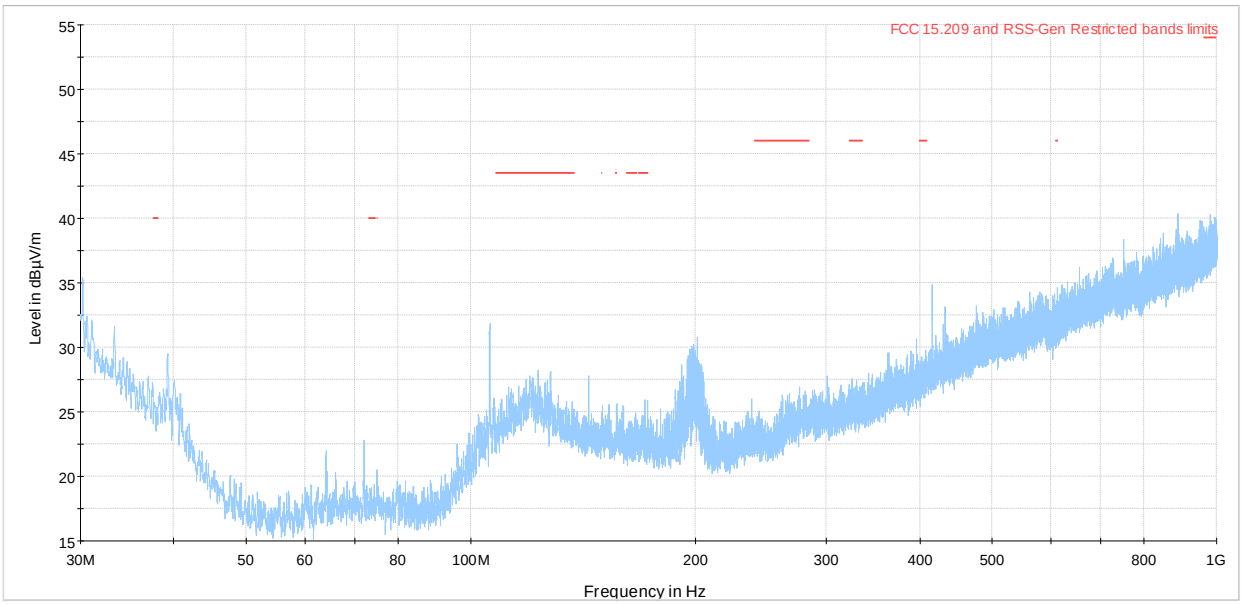


Figure 8.1-1: Radiated spurious emissions 30-1000 MHz low channel

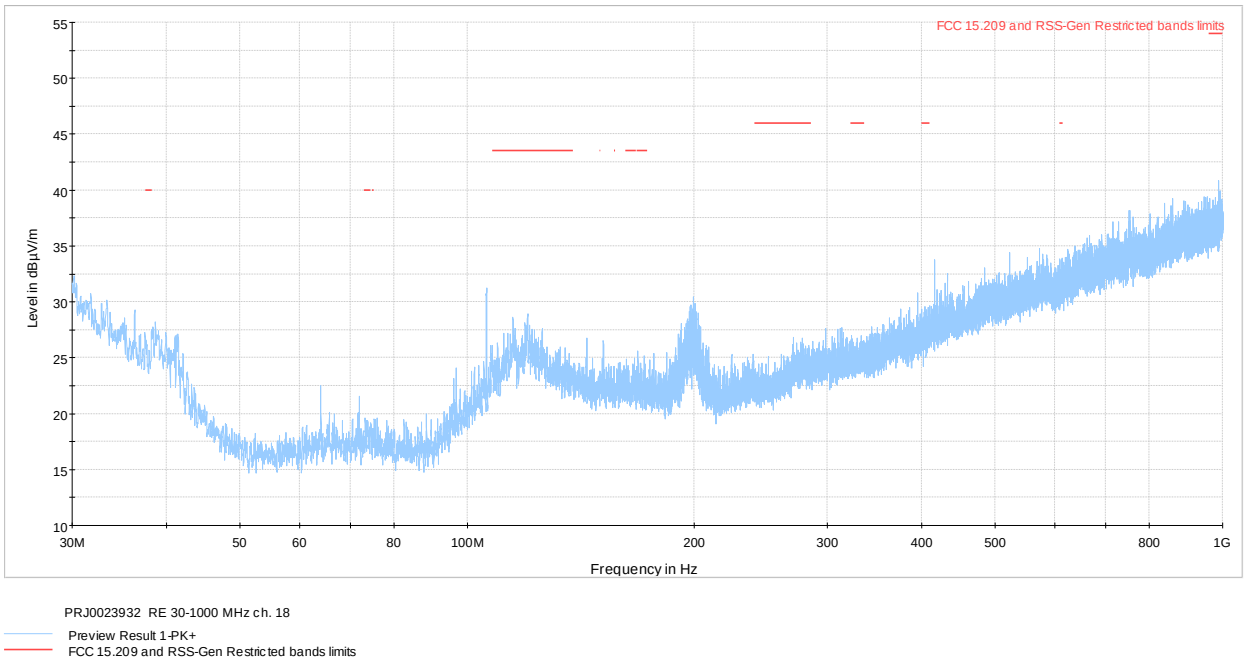
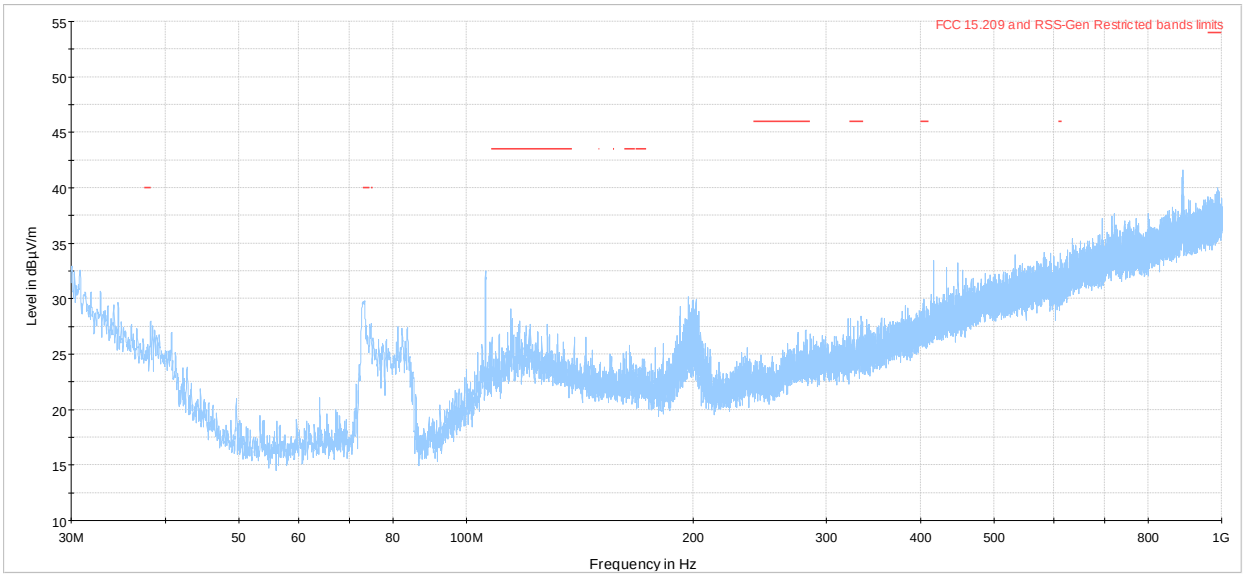


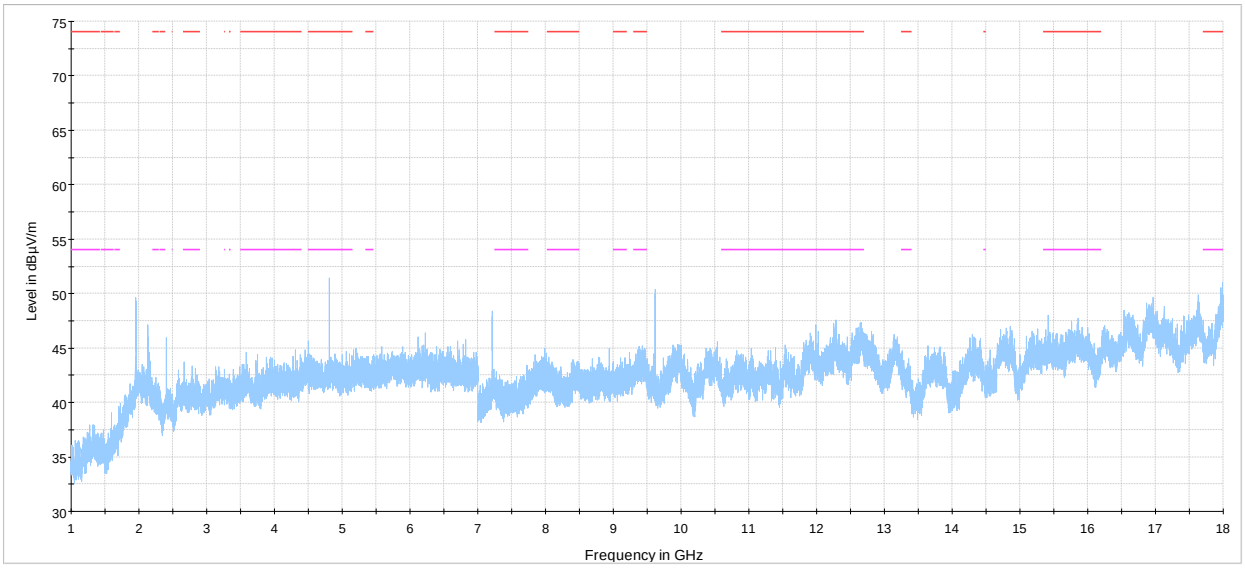
Figure 8.1-2: Radiated spurious emissions 30-1000 MHz mid channel

Test data, continued



PRJ0023932 RE 30-1000 MHz ch. 26
Preview Result 1-PK+
FCC 15.209 and RSS-Gen Restricted bands limits

Figure 8.1-3: Radiated spurious emissions 30-1000 MHz high channel



PRJ0023932 RE 1-18 GHz ch. 11
Preview Result 1-PK+
FCC 15.209 and RSS-Gen Restricted bands peak limits
FCC 15.209 and RSS-Gen Restricted bands average limits

Figure 8.1-4: Radiated spurious emissions 1-18 GHz low channel

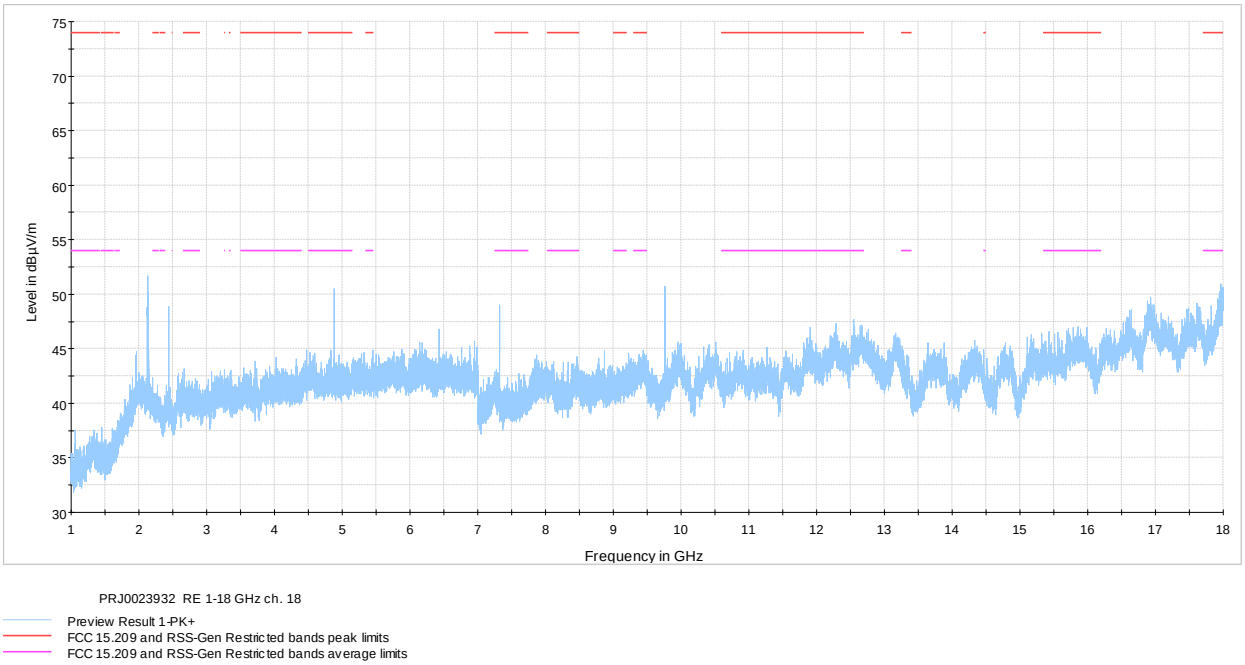


Figure 8.1-5: Radiated spurious emissions 1-18 GHz mid channel

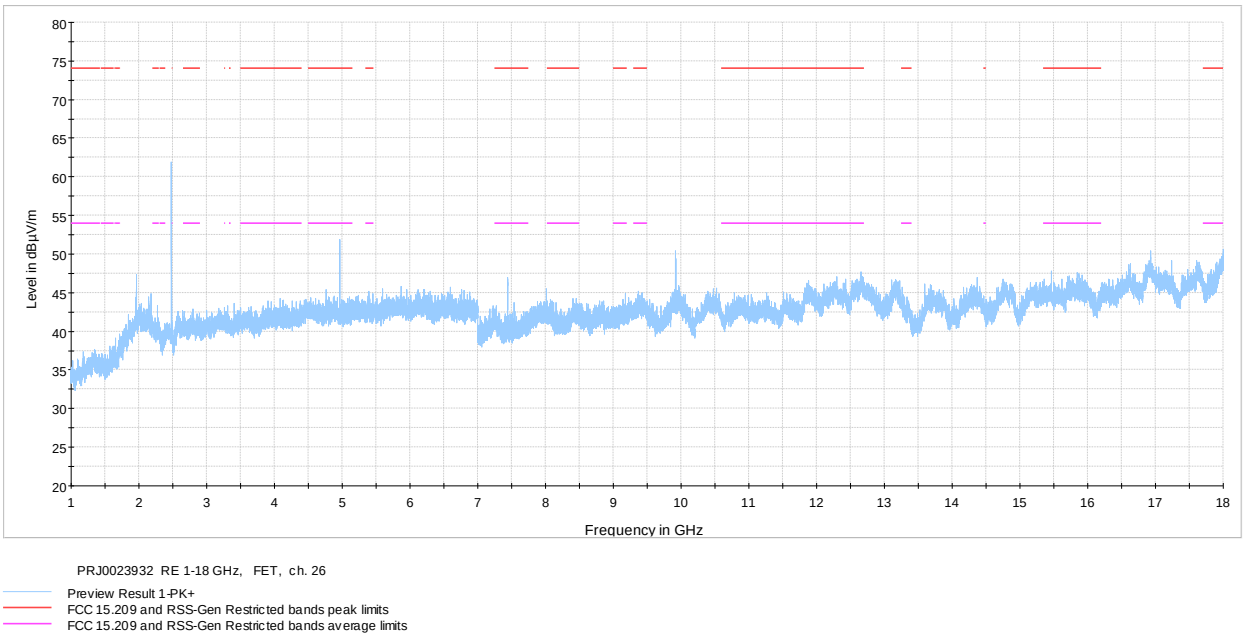


Figure 8.1-6: Radiated spurious emissions 1-18 GHz high channel

Test data, continued

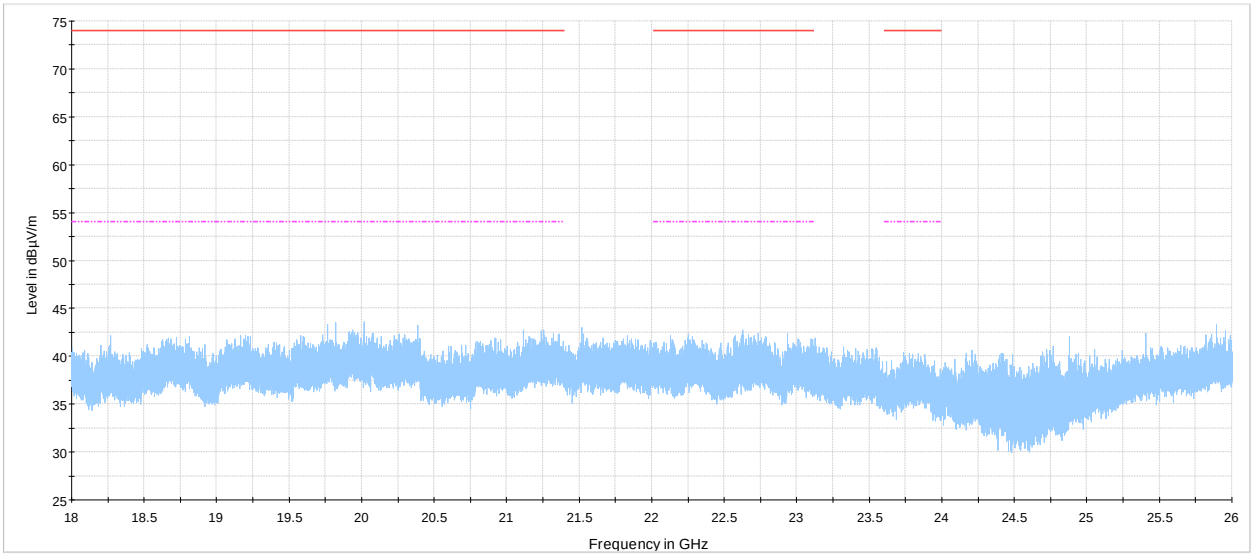


Figure 8.1-7: Radiated spurious emissions 18-26 GHz low channel

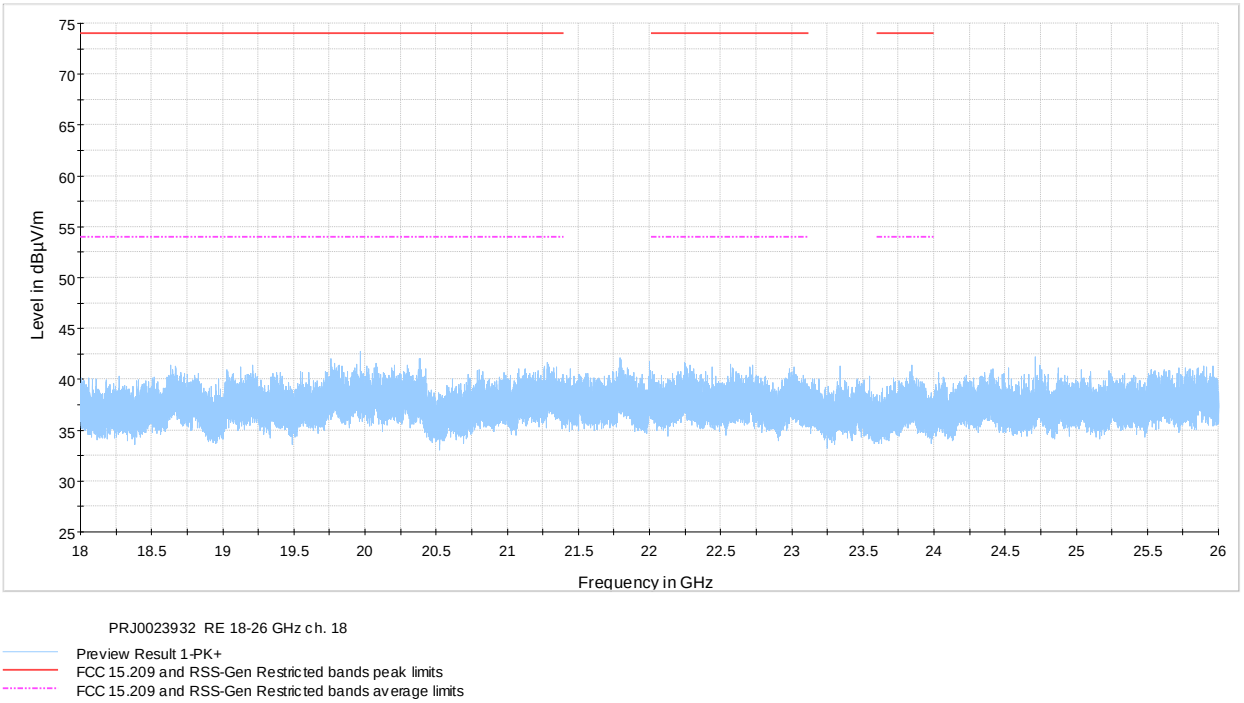


Figure 8.1-8: Radiated spurious emissions 18-26 GHz mid channel

Test data, continued

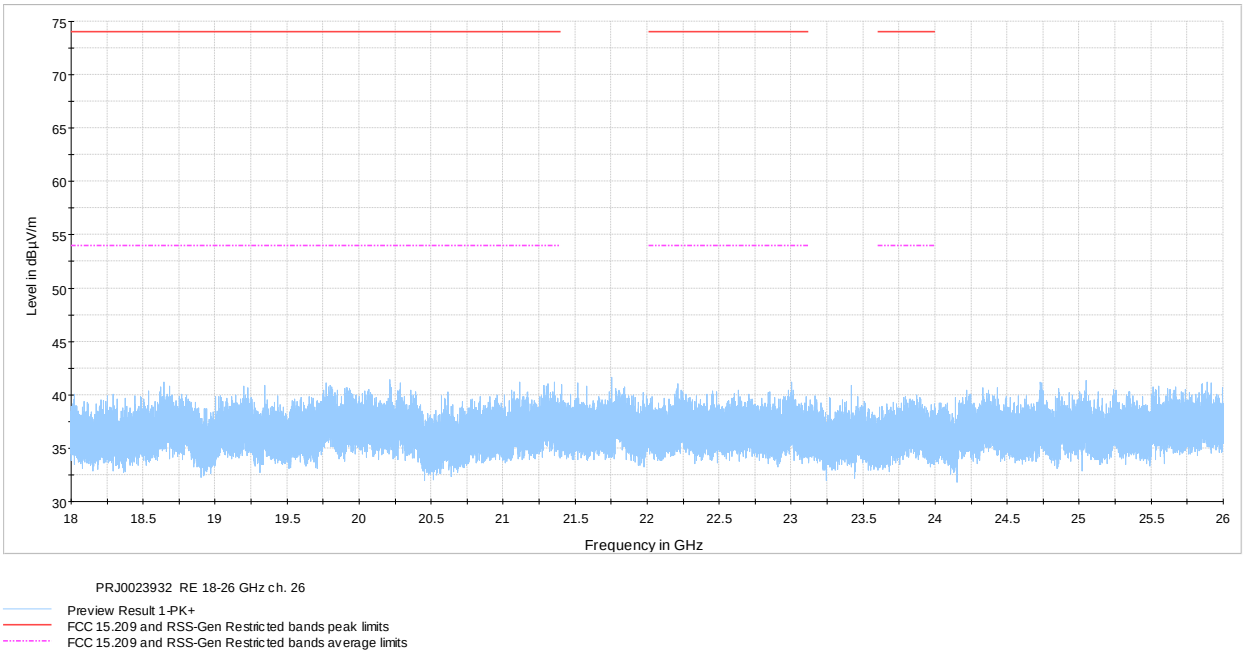
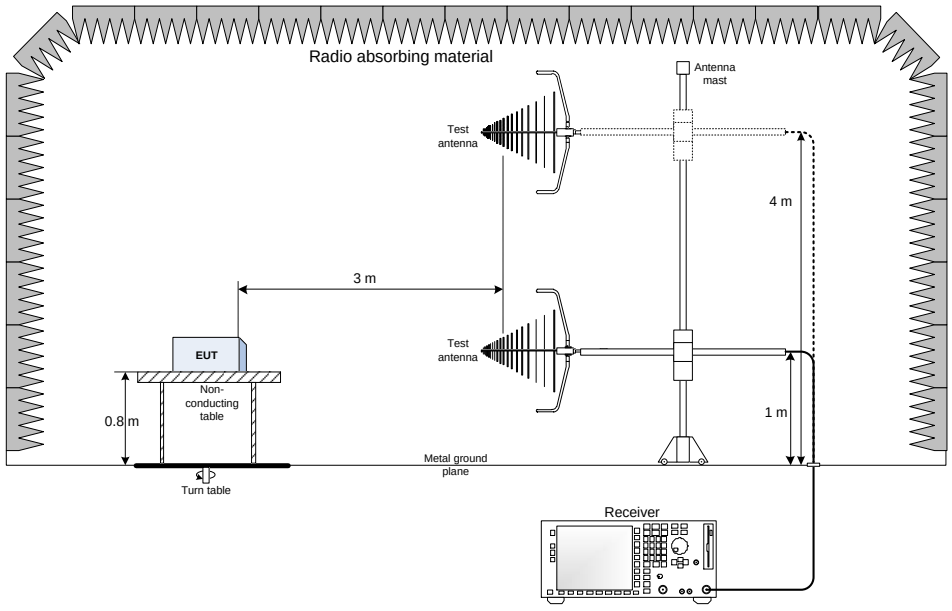


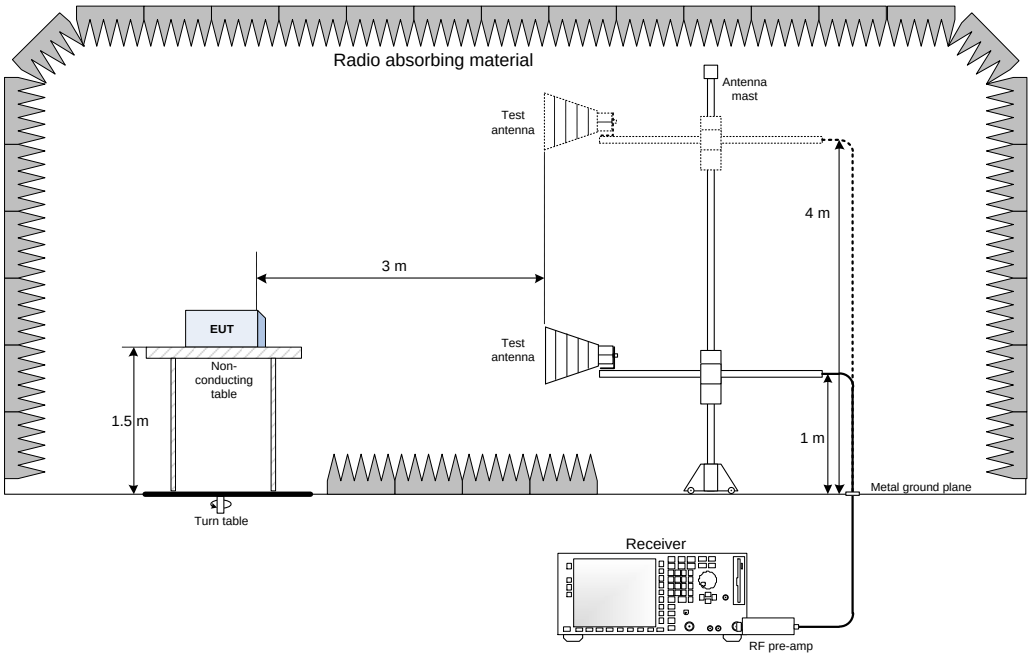
Figure 8.1-9: Radiated spurious emissions 18-26 GHz high channel

Section 9 Test 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