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Test report

335408-1TRFWL

Date of issue: February 27, 2018

Applicant:

Directed Electronics Canada Inc.

Product:

915MHz In Vehicule Transceiver Unit

Model:

6867T IVU

FCC ID: EZSDEI6867T

IC Registration number: 1513A-DEI6867T

Specifications:

- FCC 47 CFR Part 15 Subpart C, §15.247

  Operation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 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

  5) Standard specifications for frequency hopping systems and digital transmission systems operating in the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz

Test location

Company name	Nemko Canada Inc.
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City	Pointe-Claire
Province	QC
Postal code	H9R 5L8
Country	Canada
Telephone	+1 514 694 2684
Facsimile	+1 514 694 3528
Toll free	+1 800 563 6336
Website	www.nemko.com
Site number	FCC: CA2041; ISED: 2040G-5 (3 m semi anechoic chamber)

Tested by	Yong Huang, Wireless/EMC Specialist
Reviewed by	Andrey Adelberg, Senior Wireless/EMC Specialist
Review date	February 27, 2018
Reviewer 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.

Copyright notification

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Directed Electronics Canada Inc.
Address	2750 Rue Alphonse Gariepy H8T 3M2 Lachine Quebec Canada

1.2 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

1.3 Test methods

DA 00-705, Released March 30, 2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless 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 or as per detailed in the section 1.5 Exclusions below. 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 Exclusions

None

1.6 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, general requirements test results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not applicable
§15.31(e)	Variation of power source	Pass[1]
§15.203	Antenna requirement	Pass[2]

Notes: [1] For battery operated equipment, the equipment tests were performed while the EUT was powered by a DC power supply in place of the battery.
[2] The Antennas are located within the enclosure of EUT and not user accessible.

2.2 FCC Part 15 Subpart C, intentional radiators test results

Part	Test description	Verdict
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	Pass
§15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
§15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Not applicable
§15.247(b)(1)	Maximum peak output power of frequency hopping systems operating in the 2400–2483.5 MHz band and 5725–5850 MHz band	Not applicable
§15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band	Pass
§15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	Not applicable
§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(e)	Power spectral density for digitally modulated devices	Not applicable
§15.247(f)	Time of occupancy for hybrid systems	Not applicable

2.3 ISED RSS-GEN, Issue 4, test results

Part	Test description	Verdict
7.1.2	Receiver radiated emission limits	Not applicable
7.1.3	Receiver conducted emission limits	Not applicable
8.8	Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus	Not applicable

Notes: [1] According to sections 5.2 and 5.3 of RSS-Gen, Issue 4 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

2.4 ISED RSS-247, Issue 2, test results

Part	Test description	Verdict
5.1	Frequency Hopping Systems (FHSs)	
5.1 (a)	Bandwidth of a frequency hopping channel	Pass
5.1 (b)	Minimum channel spacing for frequency hopping systems	Pass
5.1 (c)	Frequency hopping systems operating in the 902–928 MHz band	Pass
5.1 (d)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
5.1 (e)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
5.2	Digital Transmission Systems (DTSs)	
5.2 (a)	Minimum 6 dB bandwidth	Not applicable
5.2 (b)	Maximum power spectral density	Not applicable
5.3	Hybrid Systems	
5.3 (a)	Digital modulation turned off	Not applicable
5.3 (b)	Frequency hopping turned off	Not applicable
5.4	Transmitter output power and e.i.r.p. requirements	
5.4 (a)	Frequency hopping systems operating in the 902–928 MHz band	Pass
5.4 (b)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
5.4 (c)	Frequency hopping systems operating in the 5725–5850 MHz	Not applicable
5.4 (d)	Systems employing digital modulation techniques	Not applicable
5.4 (e)	Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band	Not applicable
5.4 (f)	Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams	Not applicable
5.5	Unwanted emissions	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	July 11, 2017
Nemko sample ID number	Item #1

3.2 EUT information

Product name	915MHz In Vehicule Transceiver Unit
Model	6867T IVU
Serial number	M11, M16 (Rev 2.2) and B3 (Rev 2.5, identical to Rev 2.2 but with RF shielding)

3.3 Technical information

Applicant ISED company number	1513C
ISED UPN number	DEI6867T
All used IC test site(s) Reg. number	2040G-5
RSS number and Issue number	RSS-247 Issue 2, Feb 2017
Frequency band	902–928 MHz
Frequency Min (MHz)	907.095
Frequency Max (MHz)	923.835
RF power Min (W), Conducted/ERP/EIRP	N/A
RF power Max (W), Conducted	0.217 (23.37 dBm)
Field strength, Units @ distance	N/A
Measured BW (kHz) (20 dB)	294.9
Calculated BW (kHz), as per TRC-43	N/A
Type of modulation	GFSK
Emission classification (F1D, G1D, D1D)	F1D
Transmitter spurious, Units @ distance	50.0 dBµV/m, @ 3 m
Power requirements	12 V_{DC} Battery
Antenna information	The EUT uses a non-detachable antenna to the intentional radiator. As per customer, the antenna gain depends upon the car model and the installation, max peak gain is to 4.5 dBi.

3.4 Product description and theory of operation

The EUT is part of the DEI Car Remote Control DS4/DS4+ System. The EUT is a 915MHz transceiver installed on the windshield of the car. It serves as the Air Interface between user's remote key fob and the DS4/DS4+ Main Control Unit. The Air Interface uses FHSS scheme with 25 hopping channels. The pulse dwell time is 99.6ms. The EUT is paired to the user's remote key fob and will answer only to the command of the latter. In normal application, the user would use the key fob 2 to 10 times per day according to his/her need. In some circumstances, the EUT may want to communicate to the key fob (sending alarm to the user, or re-synchronizing the system time slots). In such communication, the average occupancy time would be 13.3ms to 16.5ms max per 10 seconds.

3.5 EUT exercise details

For measuring the radiated fundamental power and un-wanted emission & harmonic, the EUT is settled in continuous mode by mean of a controller box. Three operation frequencies (907.095, 916.395 and 923.835 MHz) had been tested.

For measuring the pulse dwell time and the average transmission time over 10 seconds, a complete DS4/DS4+ Remote system is used.
The EUT receives key fobs commands via a directional coupler. The EUT transmitted signals are directly measured by a spectrum analyzer in conducted mode (i.e. by mean of a 50 ohms coaxial cable, the EUT antenna is disconnected).
Note: the remote key fob is already a FCC / IC certified device.

3.6 EUT setup diagram

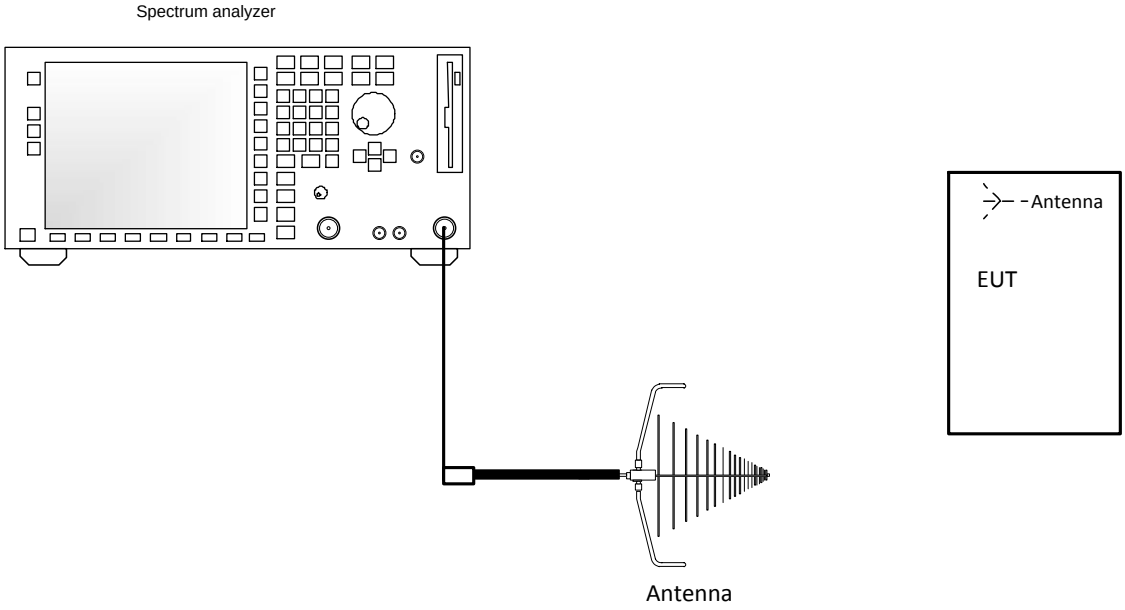
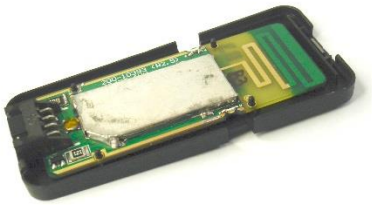


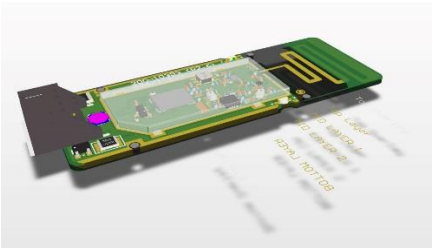
Figure 3.6-1: Setup diagram

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

The following modifications were performed by client: A shielding case has been installed on the RF chip. As shown in the photo and 3D view below:





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	860–1060 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.

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 ±5 %, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 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.

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.
Flush mount turntable	Sunol	FM2022	FA002550	—	NCR
Controller	Sunol	SC104V	FA002551	—	NCR
Antenna mast	Sunol	TLT2	FA002552	—	NCR
50 Ω coax cable	C.C.A.	None	FA002603	—	VOU
50 Ω coax cable	C.C.A.	None	FA002605	—	VOU
50 Ω coax cable	C.C.A.	None	FA002607	—	VOU
Bilog antenna (20–2000 MHz)	Sunol	JB1	FA002517	1 year	Oct. 5/17[2]
Horn antenna (1–18 GHz)	EMCO	RGA-60	FA002577	1 year	May 5/18
Pre-amplifier (0.5–18 GHz)	COM-POWER	PAM-118A	FA002561	1 year	May 8/18
High Pass Filter (> 1100 MHz)	Microwave Circuits	H1G212G1	FA002689	—	VOU
Power source	California Instruments	5001ix	FA001770	1 year	Feb 1/18
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	May 3/18

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

Tests using this equipment were performed before the cal due date.

Section 8. Testing data

8.1 FCC 15.247(a)(1) and RSS-247 5.1 Frequency Hopping Systems requirements

8.1.1 Definitions and limits

FCC:

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(i) For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

ISED:

a) The bandwidth of a frequency hopping channel is the −20 dB emission bandwidth, measured with the hopping stopped. The system's radio frequency (RF) bandwidth is equal to the channel bandwidth multiplied by the number of channels in the hopset. The hopset shall be such that the near-term distribution of frequencies appears random, with sequential hops randomly distributed in both direction and magnitude of change in the hopset, whereas the long-term distribution appears evenly distributed.

b) FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the −20 dB bandwidth of the hopping channel, whichever is greater. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

c) For FHSs in the band 902–928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

8.1.2 Test summary

Test date	July 11, 2017 to August 28, 2017	Temperature	25 °C
Test engineer	Yong	Air pressure	1005 mbar
Verdict	Pass	Relative humidity	48 %

8.1.3 Observations, settings and special notes

Spectrum analyzer settings for carrier frequency separation:

Resolution bandwidth	3 kHz
Video bandwidth	≥ RBW
Frequency span	wide enough to capture the peaks of two adjacent channels
Detector mode	Peak
Trace mode	Max Hold

Spectrum analyser settings for number of hopping frequencies:

Resolution bandwidth	3 kHz
Video bandwidth	≥ RBW
Frequency span	the frequency band of operation
Detector mode	Peak
Trace mode	Max Hold

Spectrum analyser settings for time of occupancy (dwell time):

Resolution bandwidth	≤ channel spacing
Video bandwidth	≥ RBW
Frequency span	Zero span
Detector mode	Peak
Trace mode	Max Hold

Spectrum analyser settings for 20 dB bandwidth:

Resolution bandwidth	1% to 5 % of the 20-dB bandwidth
Video bandwidth	≥ RBW
Frequency span	approximately 2 to 3 times the 20-dB bandwidth, centered on a hopping channel
Detector mode	Peak
Trace mode	Max Hold

8.1.4 Test data

Table 8.1-1: 20 dB bandwidth results

Frequency, MHz	20 dB bandwidth, kHz	Limit, kHz	Margin, kHz
907.095	290.9	500.0	209.1
916.395	294.9	500.0	205.1
923.835	294.9	500.0	205.1

Table 8.1-2: 99% bandwidth results

Frequency, MHz	99% bandwidth, kHz
907.095	291.7
916.395	314.9
923.835	315.7

Table 8.1-3: Carrier frequency separation results

Carrier frequency separation, kHz	Minimum limit, kHz	Margin, kHz
620.8	294.9	325.9

Table 8.1-4: Number of hopping frequencies results

Number of hopping frequencies	Minimum limit	Margin
25	25	0

Table 8.1-5: Average time of occupancy results

Dwell time of each pulse, ms	Number of pulses within period	Total dwell time within period, ms	Limit, ms	Margin, ms
100	1	100	400	300

8.1.4 Test data, continued

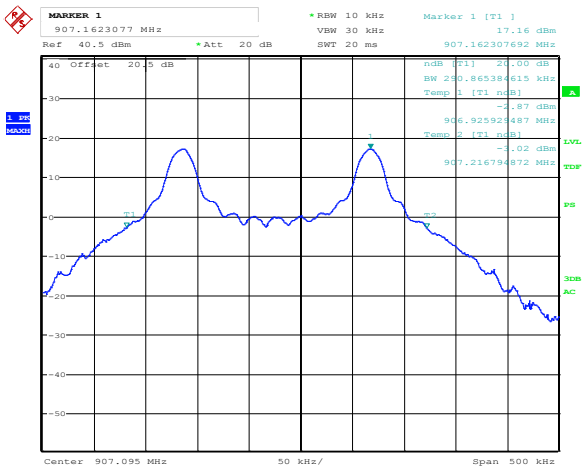


Figure 8.1-1: 20 dB bandwidth on low channel

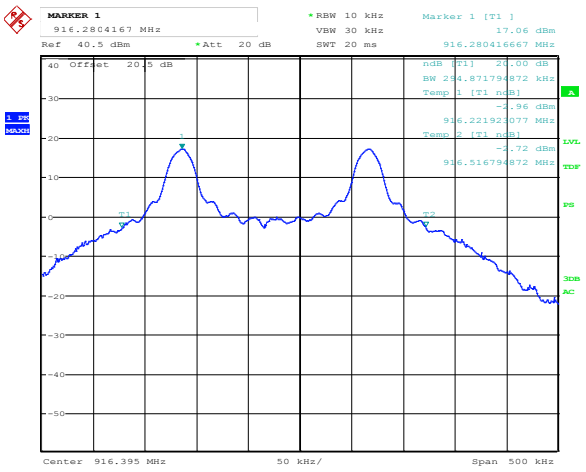


Figure 8.1-2: 20 dB bandwidth on mid channel

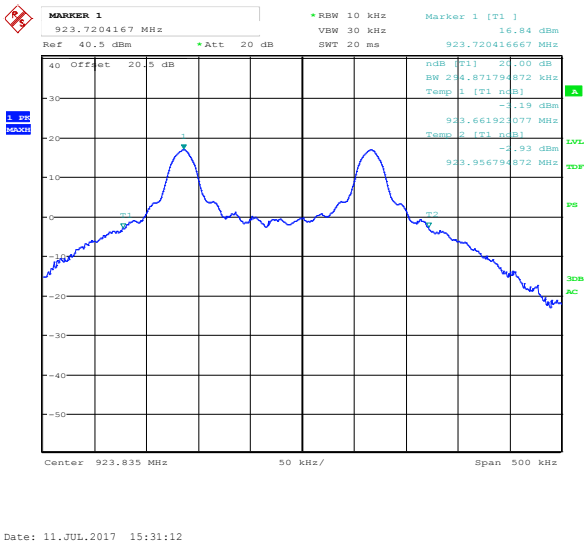


Figure 8.1-3: 20 dB bandwidth on hi channel

8.1.4 Test data, continued

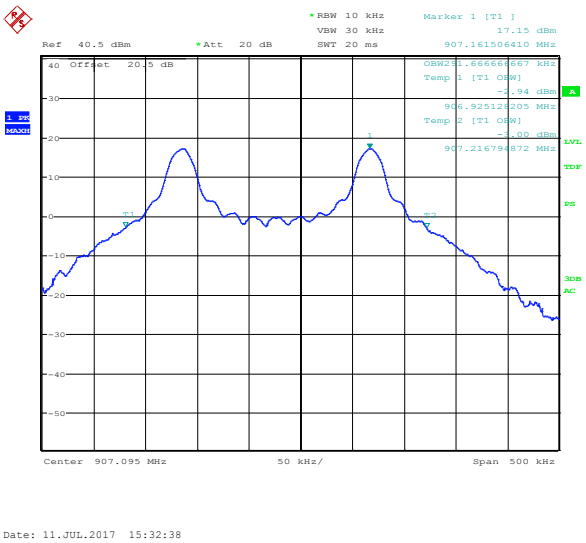


Figure 8.1-4: 99% bandwidth on low channel

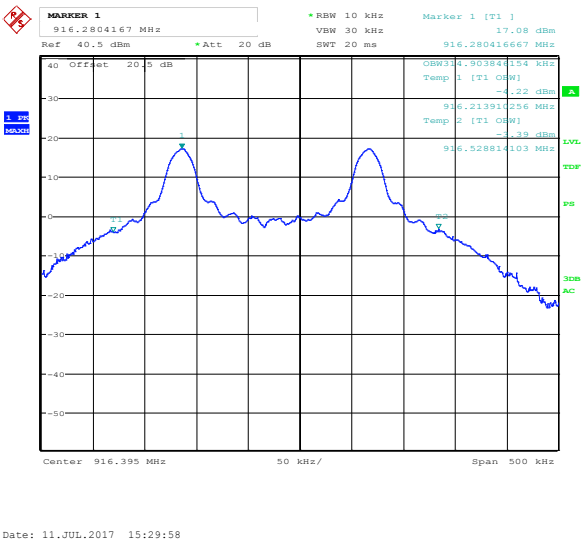


Figure 8.1-5: 99% bandwidth on mid channel

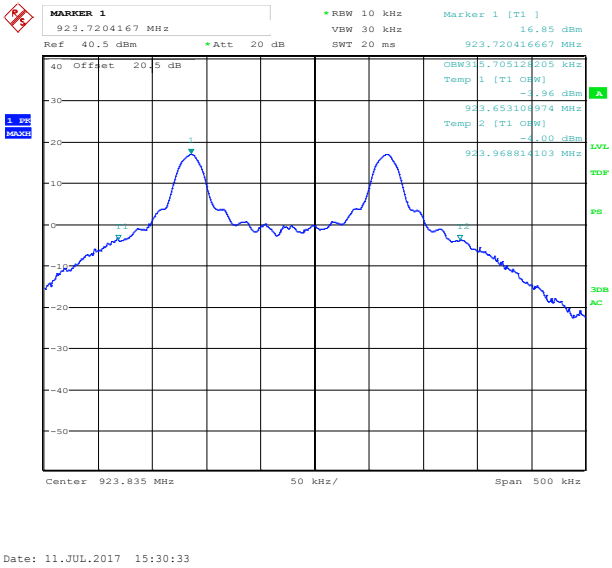


Figure 8.1-6: 99% bandwidth on hi channel

8.1.4 Test data, continued

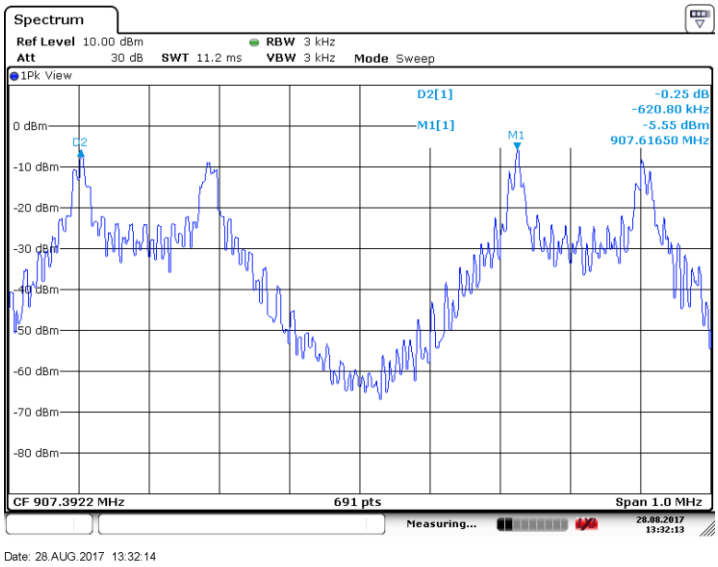


Figure 8.1-7: Carrier frequency separation

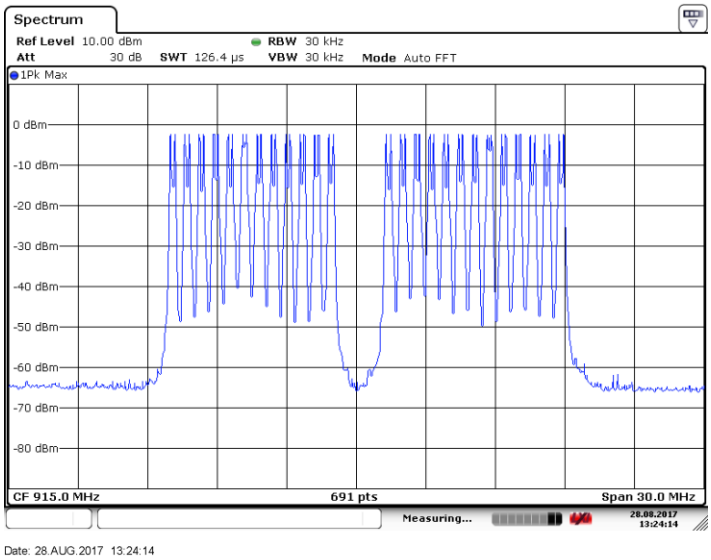


Figure 8.1-8: Number of hopping channels, 25 channels

8.1.4 Test data, continued

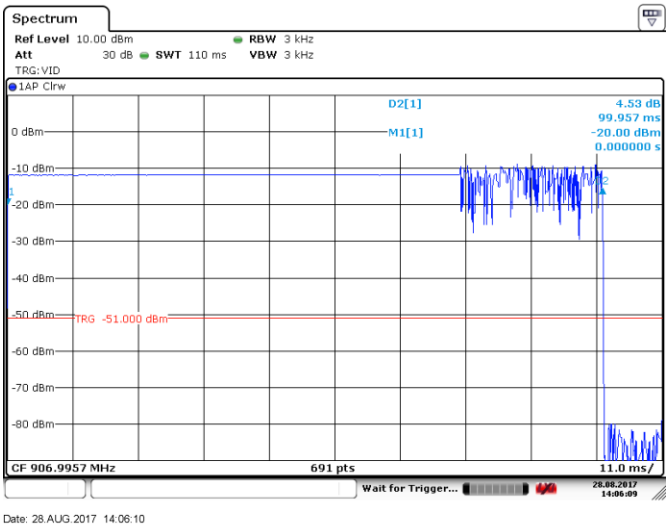


Figure 8.1-9: Dwell time, 100 ms

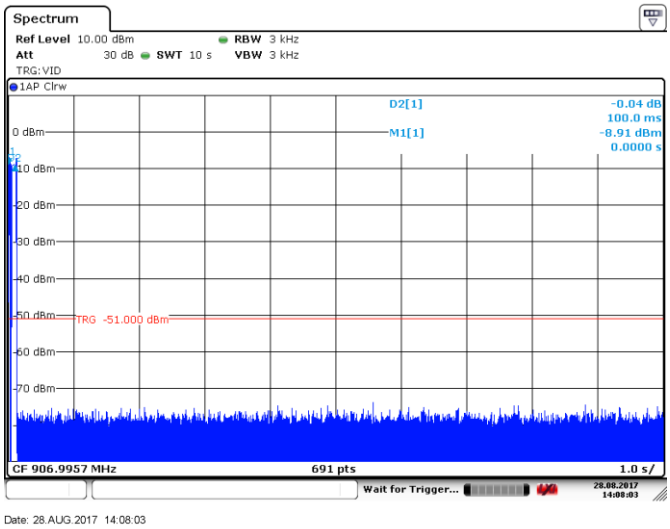


Figure 8.1-10: Dwell time, 10 s period

As the worst-case scenario of channel occupancy time provided by client, the transmission in the plot above occurs no more than once within a 10 s period in the same channel. The analyzation is as following:
The EUT's communications can be done via two modes:

1) The IVU answers to a (paired only) HHU command:
Typically, the HHU and IVU just need two pulses (on different channels) for establishing a communication. Each pulse dwell time is 99.6 ms, the rest time between each pulse is 100.4 ms.
In a worst case, the HHU will send at max 6 pulses on 6 different channels (1.2 s total) and then wait 5 s for receiving the answer from the IVU. The later can answer via 6 pulses at max (using the same channels).
For 2 cycles of HHU-IVU communication = 12.4 s (6.2 s × 2), the system may use at max 12 channels among the 25 channels available. Even if the user forces the system by activating continuously the HHU (possibly 4 times during 10 s), a total of 24 channels will be used. Therefore, a channel will not be used more than 1 time (99.6 ms) during 10 s.

2) The IVU does not answer to its paired HHUs, but may warn the HHU (signaling an alarm, for example) according to a scheduled time slot: in such a communication, the average occupancy would be 13.3 ms to 16.5 ms per 10 s.

Note:
IVU - In Vehicle Transceiver Unit (i.e. the EUT)
HHU - Hand Held Unit (i.e. user's remote key fob)

8.2 FCC 15.247(b) and RSS-247 5.4 Transmitter output power and e.i.r.p. requirements

8.2.1 Definitions and limits

FCC:

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(2) For frequency hopping systems operating in the 902–928 MHz band: 1 watt (30 dBm) for systems employing at least 50 hopping channels; and, 0.25 watts (24 dBm) for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

(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.

ISED:

For FHSs operating in the band 902–928 MHz, the maximum peak conducted output power shall not exceed 1.0 W (30 dBm), and the e.i.r.p. shall not exceed 4 W (36 dBm) if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W (24 dBm) and the e.i.r.p. shall not exceed 1 W (30 dBm) if the hopset uses less than 50 hopping channels.

8.2.2 Test summary

Test date	October 23, 2017	Temperature	23 °C
Test engineer	Yong	Air pressure	1005 mbar
Verdict	Pass	Relative humidity	36 %

8.2.3 Observations, settings and special notes

Spectrum analyser settings for output power:

Resolution bandwidth	> the 20 dB bandwidth of the emission being measured
Video bandwidth	≥ RBW
Frequency span	5 MHz
Detector mode	Peak
Trace mode	Max Hold

8.2.4 Test data

Table 8.2-1: Output power and EIRP results

Frequency, MHz	Field Strength at 3 m, dBµV/m	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB	Antenna gain, dBi	Output power, dBm	Output power limit, dBm	Margin, dB
907.095	120.5	25.27	30	4.73	4.5	20.77	24	3.23
916.395	121.1	25.87	30	4.13	4.5	21.37	24	2.63
923.835	121.6	26.37	30	3.63	4.5	21.87	24	2.13

Note: EIRP = Field Strength at 3 m – 95.23
Output power = EIRP - Antenna gain

8.2.4 Test data, continued

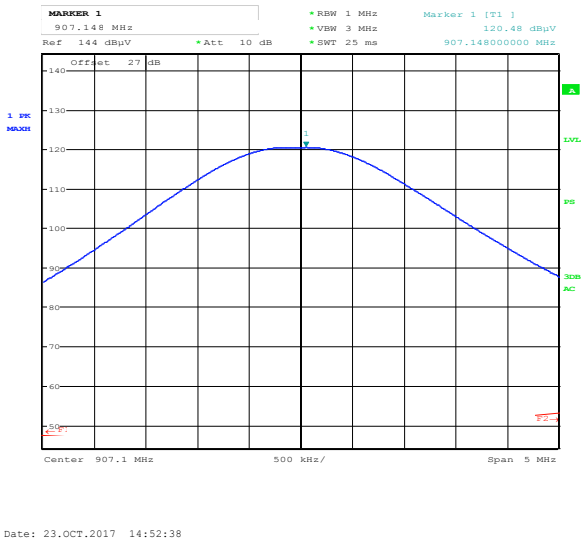


Figure 8.2-1: Output power on low channel

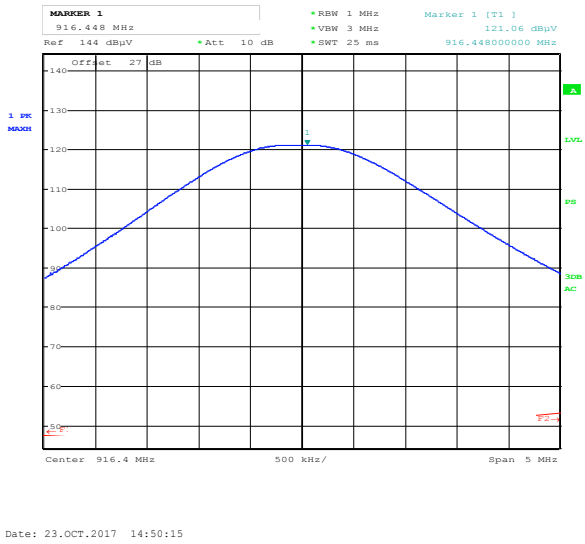


Figure 8.2-2: Output power on mid channel

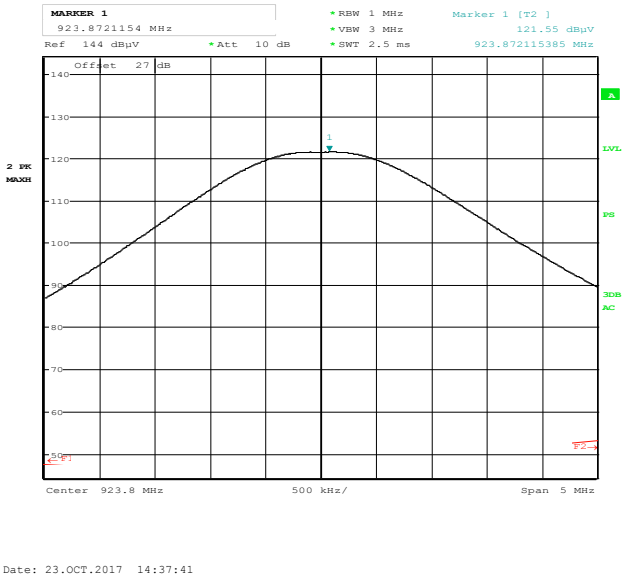


Figure 8.2-3: Output power on high channel

8.3 FCC 15.247(d) and RSS-247 Section 5.5 Spurious (out-of-band) emissions

8.3.1 Definitions and limits

FCC:
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. 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)).

ISED:
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. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Table 8.3-1: 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

Table 8.3-2: ISED restricted frequency bands

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

Note: Certain frequency bands listed in Table 8.3-2 and above 38.6 GHz are designated for low-power licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

Table 8.3-3: 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			

8.3.2 Test summary

Test date	July 11, 2017 to October 23, 2017	Temperature	25 °C
Test engineer	Yong	Air pressure	1010 mbar
Verdict	Pass	Relative humidity	49 %

8.3.3 Observations, settings and special notes

Radiated measurement were performed for spurious emission from 30 MHz to the 10th harmonic. Due to configuration limitation of EUT provided by client, band edge measurement on hopping mode was tested on temperately antenna port.
EUT was set to transmit continuously.

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:	3 MHz
Detector mode:	Average
Trace mode:	Max Hold

8.3.4 Test data

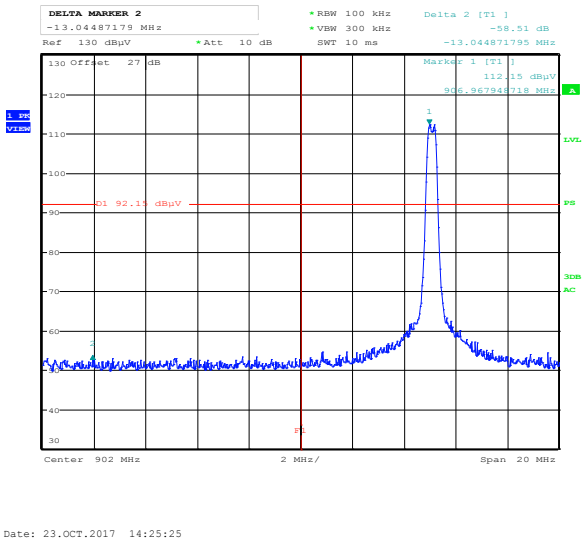


Figure 8.3-1: Lower band edge emission, tx on low channel

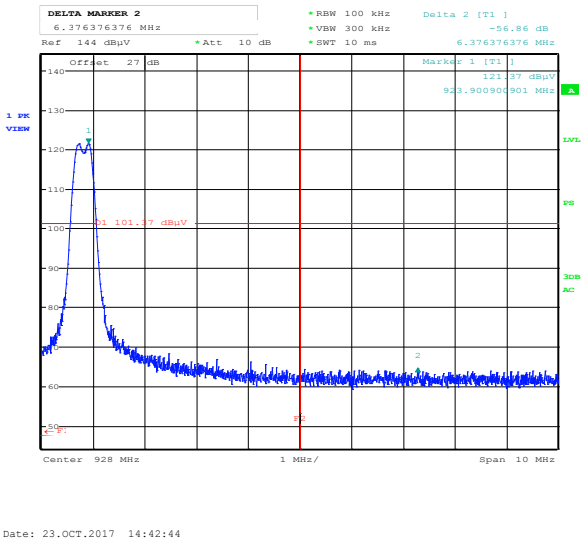


Figure 8.3-2: Upper band edge emission, tx on high channel

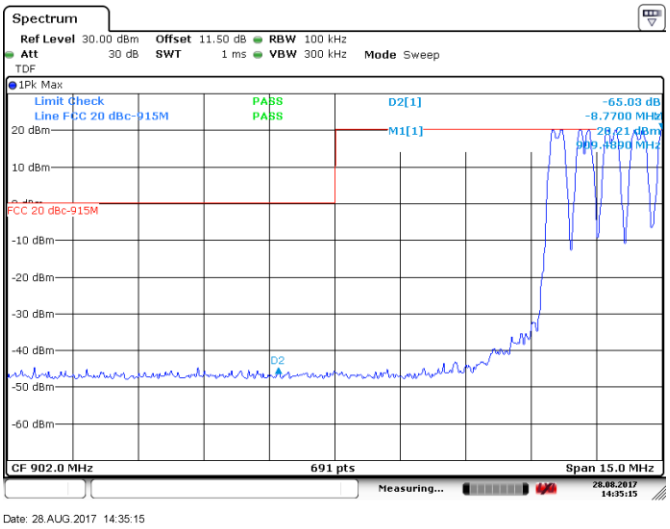


Figure 8.3-3: Lower band edge emission, tx hopping on

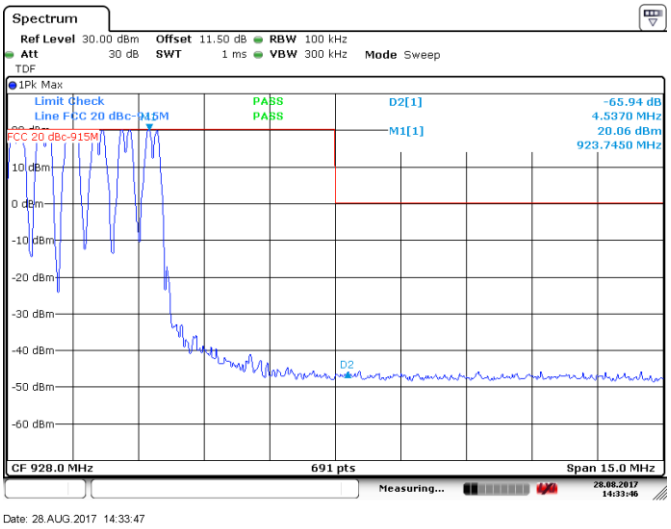


Figure 8.3-4: Upper band edge emission, tx hopping on

8.3.4 Test data, continued

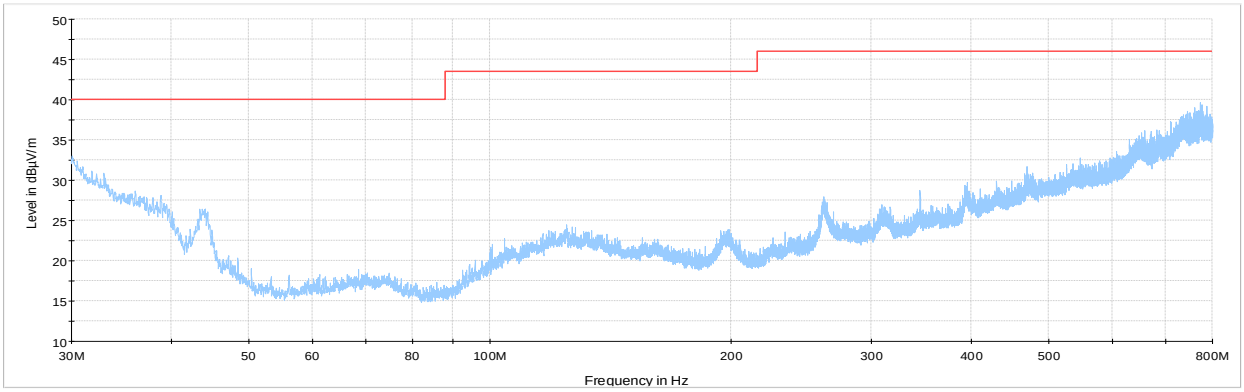


Figure 8.3-5: Radiated spurious emissions for low channel 30 MHz to 800 MHz for restricted band emissions

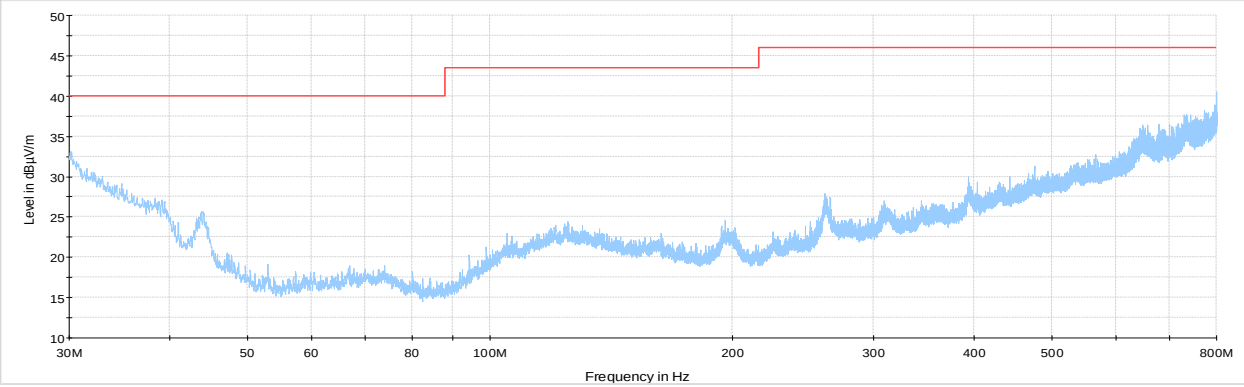


Figure 8.3-6: Radiated spurious emissions for mid channel 30 MHz to 800 MHz for restricted band emissions

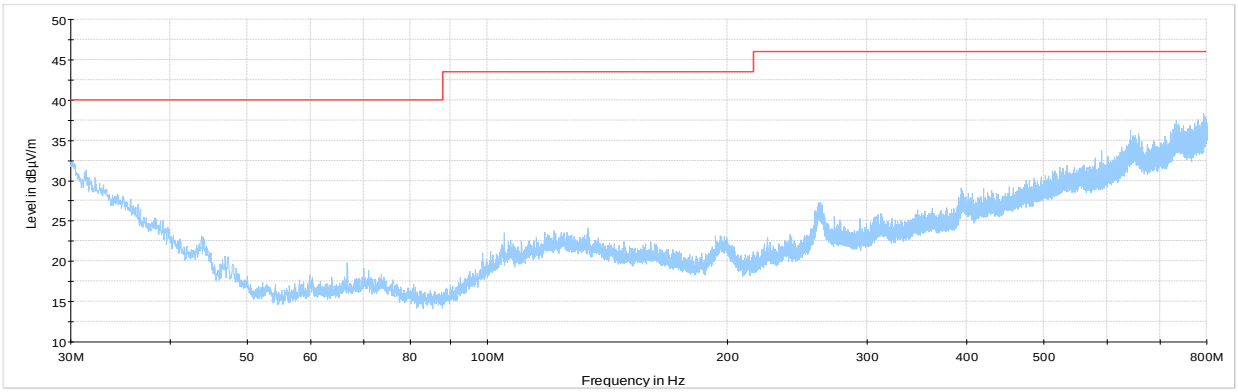


Figure 8.3-7: Radiated spurious emissions for high channel 30 MHz to 800 MHz for restricted band emissions

8.3.4 Test data, continued

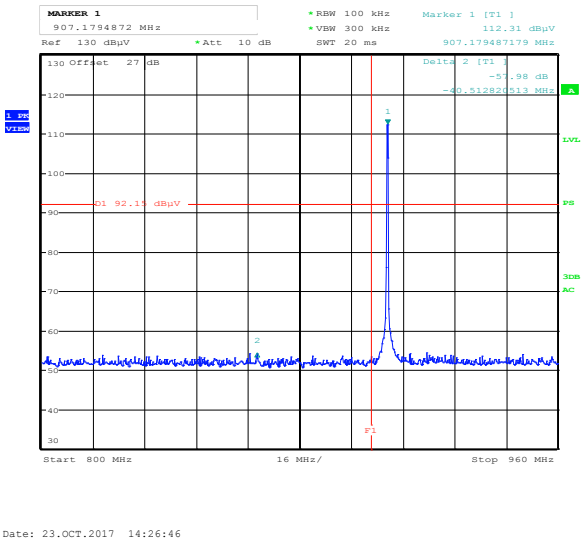


Figure 8.3-8: Radiated spurious emissions for low channel, 800 MHz to 960 MHz outside restricted band emissions

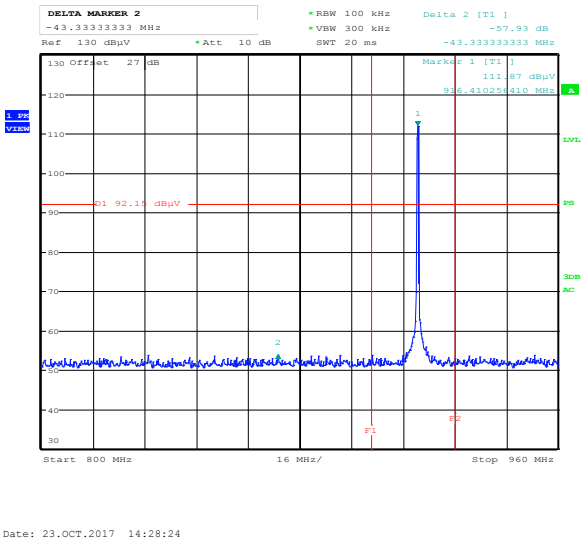


Figure 8.3-9: Radiated spurious emissions for mid channel, 800 MHz to 960 MHz outside restricted band emissions

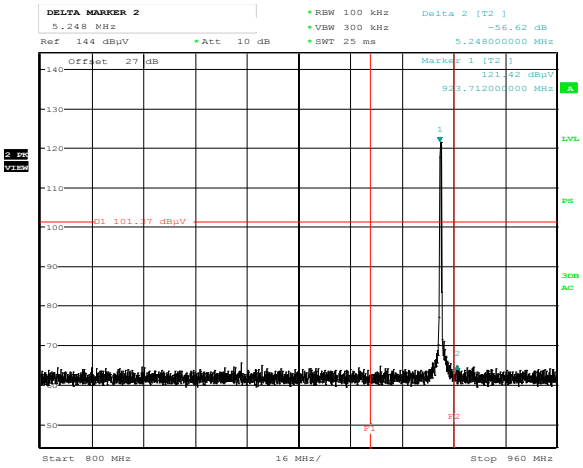


Figure 8.3-10: Radiated spurious emissions for high channel, 800 MHz to 960 MHz outside restricted band emissions

8.3.4 Test data, continued

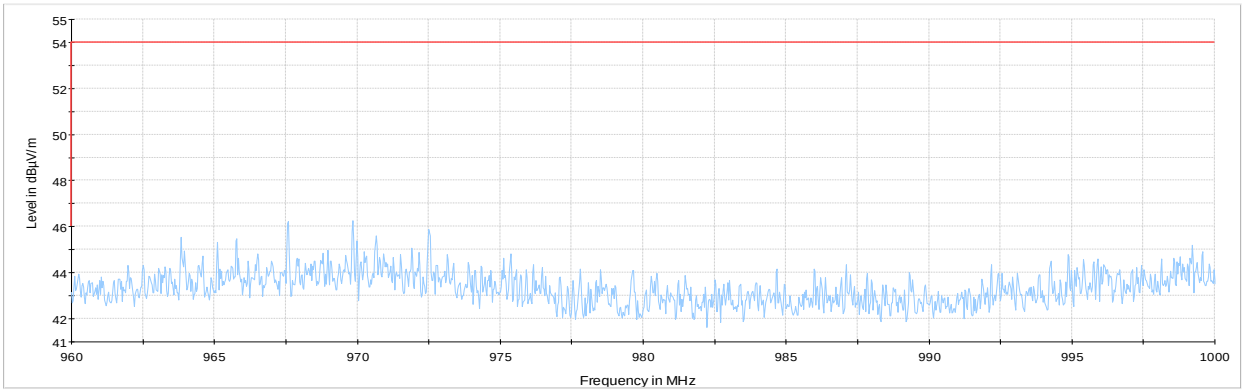


Figure 8.3-11: Radiated spurious emissions for low channel, 960 MHz to 1 GHz for restricted band emissions

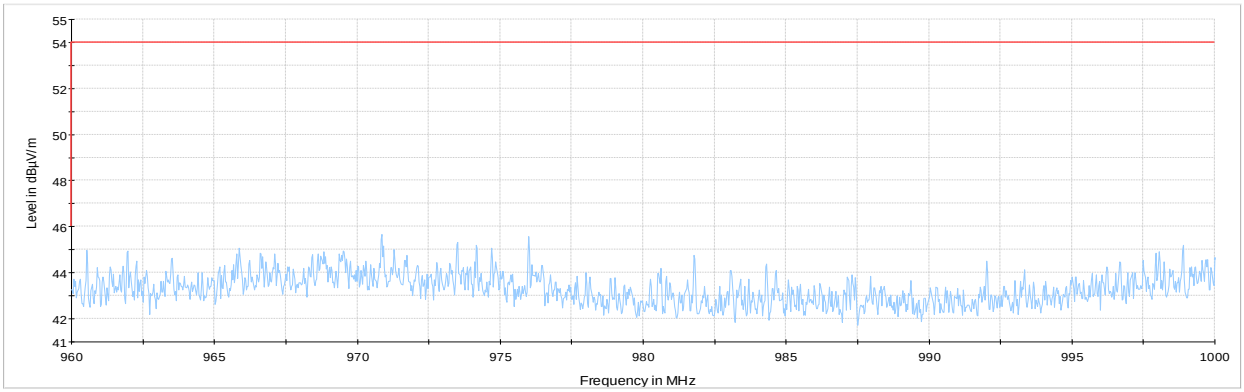


Figure 8.3-12: Radiated spurious emissions for mid channel, 960 MHz to 1 GHz for restricted band emissions

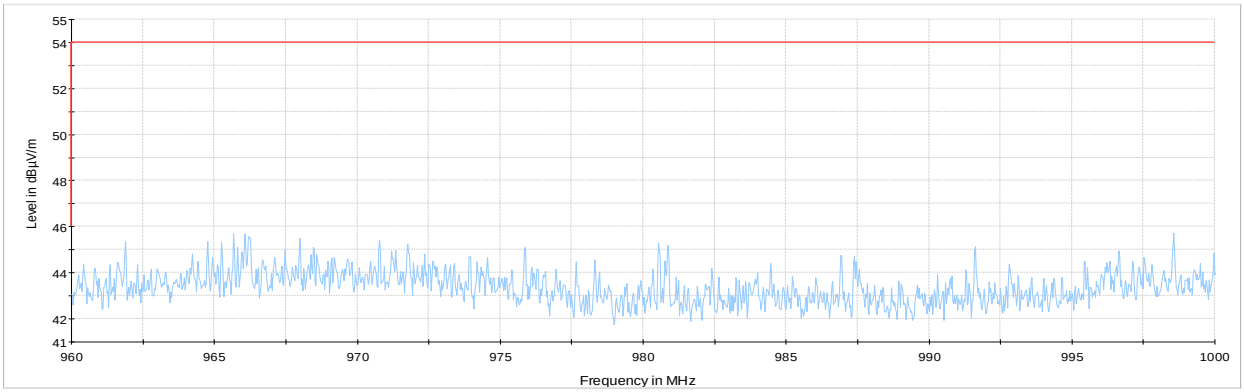


Figure 8.3-13: Radiated spurious emissions for high channel, 960 MHz to 1 GHz for restricted band emissions

8.3.5 Test data, continued

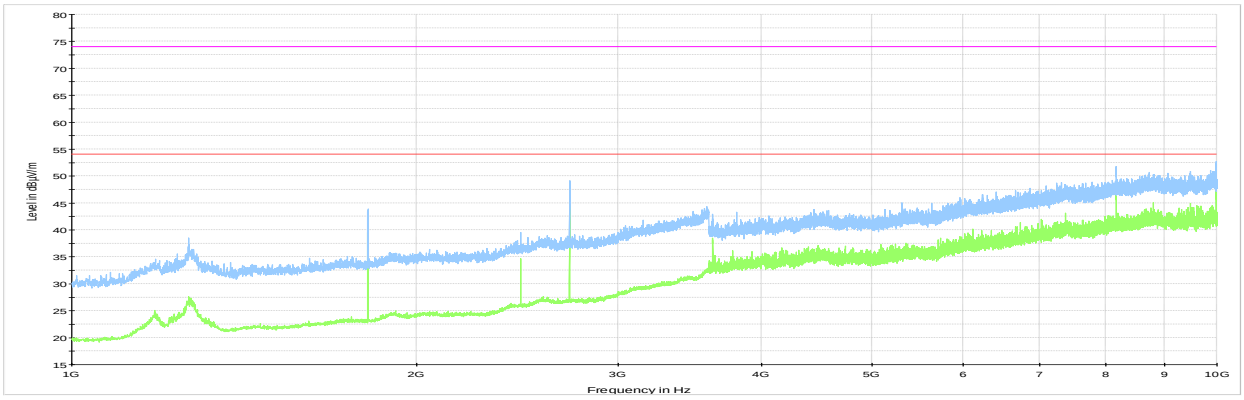


Figure 8.3-14: Radiated spurious emissions for low channel, above 1 GHz for restricted band emissions

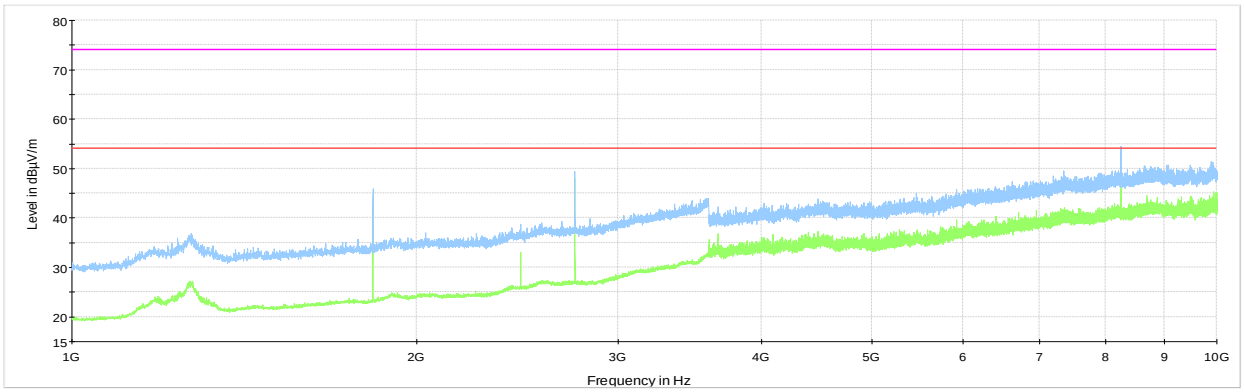


Figure 8.3-15: Radiated spurious emissions for mid channel, above 1 GHz for restricted band emissions

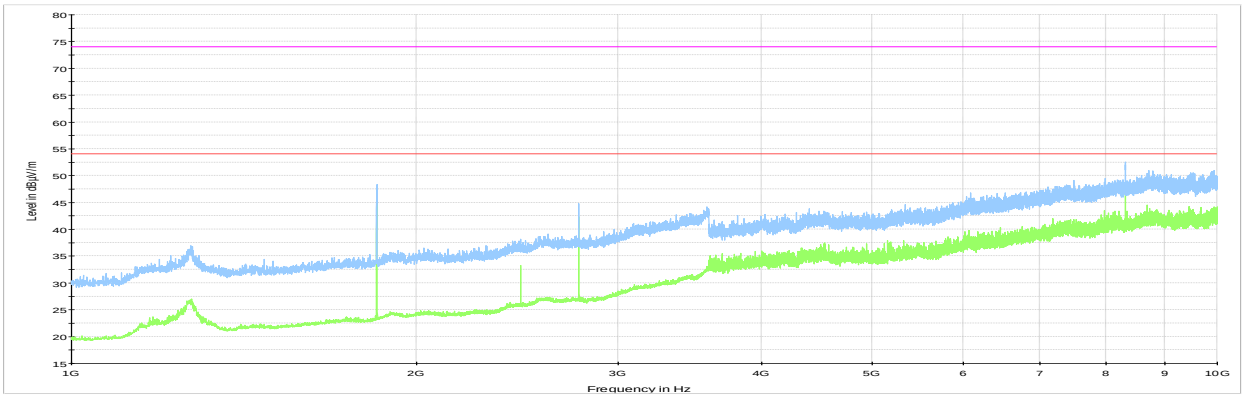


Figure 8.3-16: Radiated spurious emissions for high channel, above 1 GHz for restricted band emissions

Note: 1.8 GHz emission is a second harmonic that falls outside restricted bands.

8.3.4 Test data, continued

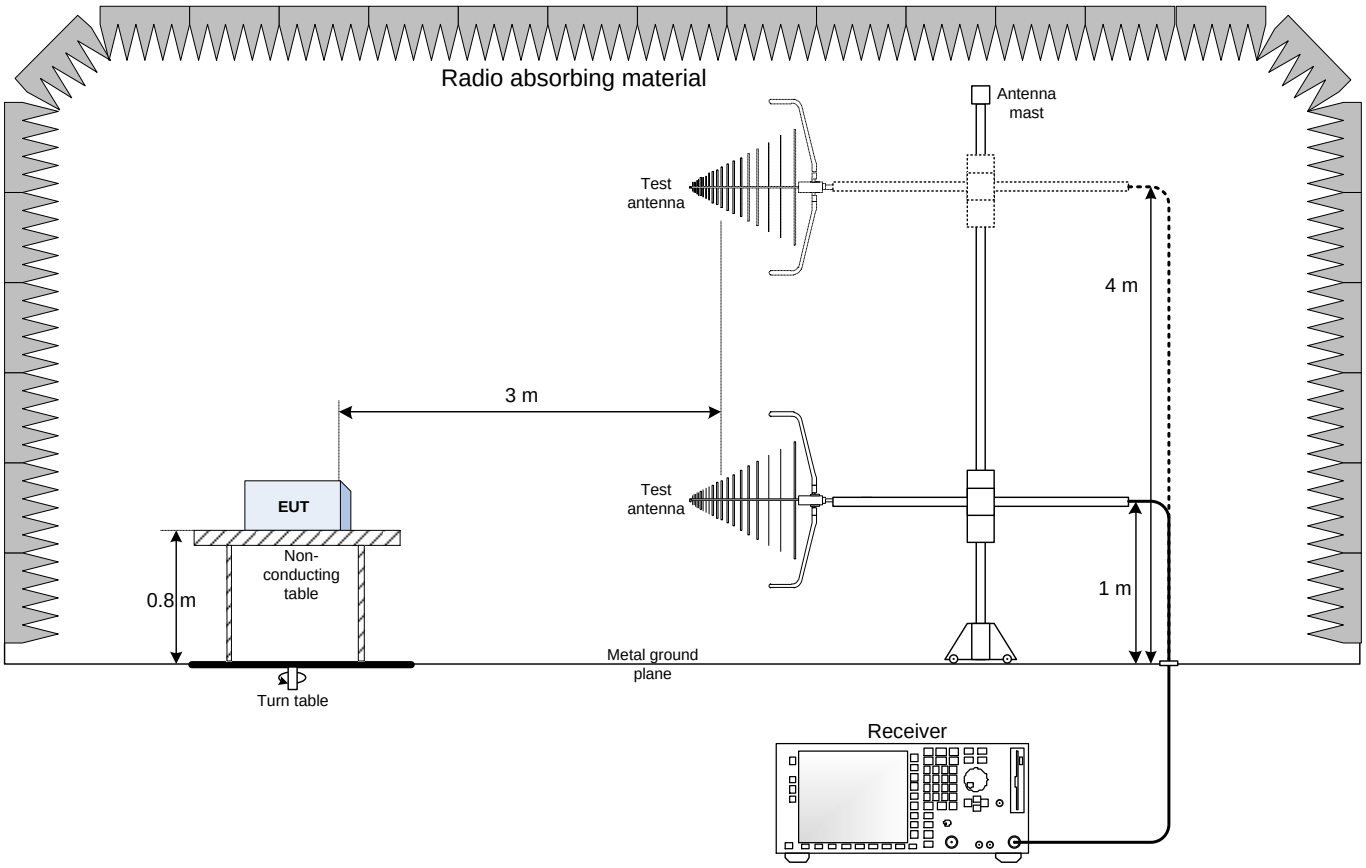
Table 8.3-4: Radiated field strength measurement results

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2721	49.2	74	24.8	45.1	54	8.9
Mid	2749	50.2	74	23.8	45.0	54	9.0
Mid	8246	55.2	74	18.8	50.0	54	4.0
High	2771	44.8	74	29.2	42.4	54	11.6
High	8315	52.7	74	21.3	48.8	54	5.2

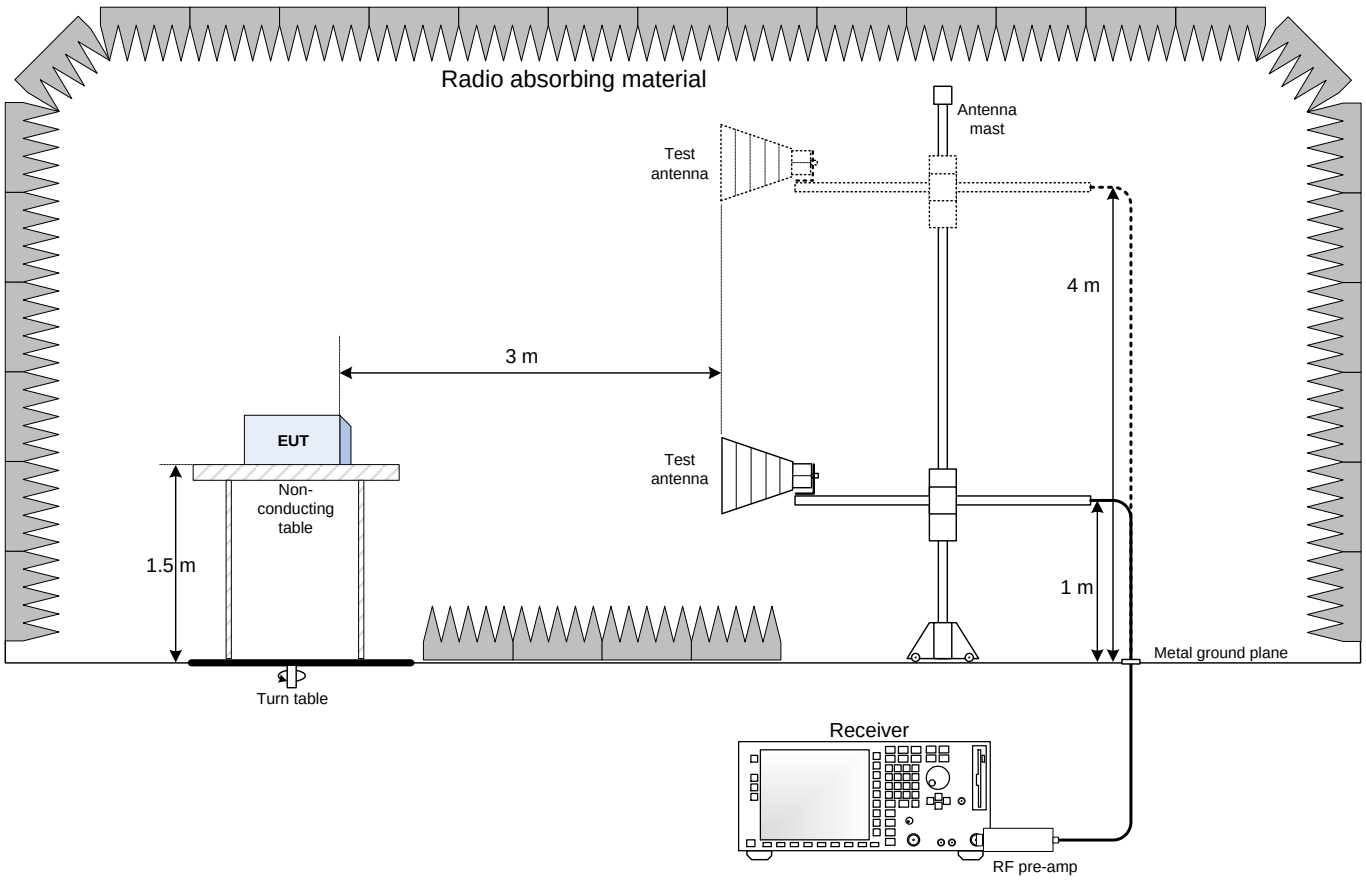
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

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



9.3 Conducted antenna port set-up