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Report Reference ID:	381308-2TRFWL

Test specification:	Title 47 - Telecommunication Chapter I - Federal Communications Commission Subchapter A - General Part 15 - Radio Frequency Devices Subpart C - Intentional Radiators **§15.247** - Operation within the bands 2400–2483.5 MHz

Applicant:	Advanced Microwave Engineering s.r.l. Via Lucca, 50 Firenze, 50142 Italy
Apparatus:	Sensor for EGOProSafe System
Model:	PLXSAFEMOVESENS4 PLXSAFEMOVESEN4M
FCC ID:	UKOMOVESENS4

Testing laboratory:	**Nemko Spa** Via del Carroccio, 4 I 20853 Biassono (Italy) Telephone: +039 039 2201201 Facsimile: +39 039 220 1221

	Name and title	**Date**
Tested by:	Daniele Guarnone, Wireless/EMC Specialist	2019-10-17
Reviewed by:	Paolo Barbieri Wireless/EMC Specialist	2019-10-17

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Section 1: Report summary

1.1 Test specification

Specifications	**FCC Part 15 Subpart C, 15.247** Operation within the bands 2400–2483.5 MHz

1.2 Statement of compliance

Compliance	In the configuration tested the EUT was found compliant Yes ☒ No ☐ This report contains an assessment of apparatus against specifications based upon tests carried out on samples submitted at Nemko Canada Inc. These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15; Subpart C. Radiated tests were conducted in accordance with ANSI C63.10-2013.

1.3 Exclusions

Exclusions	None

1.4 Registration number

Test site FCC ID number	682159

1.5 Test report revision history

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

1.6 Limits of responsibility

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.

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Section 2: Summary of test results

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

General requirements for FCC Part 15

Part	Test description	Verdict
§15.31(e)	Variation of power source	Pass
§15.31(m)	Number of operating frequencies	Pass
§15.203	Antenna requirement	Pass
§15.207(a)	Conducted limits	Pass

Specific requirements for FCC Part 15 Subpart C, 15.247

Part	Test description	Verdict
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	N/A
§15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	N/A
§15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	N/A
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Pass
§15.247(b)(1)	Maximum peak output power of frequency hopping systems operating in the 2400–2483.5 MHz band	N/A
§15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band	N/A
§15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 2400–2483.5 MHz	Pass
§15.247(b)(4)	Maximum peak output power	Pass
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	N/A
§15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	N/A
§15.247(d)	Spurious emissions	Pass
§15.247(e)	Power spectral density for digitally modulated devices	Pass
§15.247(f)	Time of occupancy for hybrid systems	N/A

Notes: None

Section 3: Equipment under test (EUT) and application details

3.1 Applicant details

Applicant complete business name	Name:	Advanced Microwave Engineering s.r.l.
	Federal Registration Number (FRN):	FRN0015463417
	Grantee code	UKO
Mailing address	Address: City: Province/State: Post code: Country:	Via Lucca, 50 Firenze Firenze 50142 Italy

3.2 Modular equipment

a) Single modular approval	Single modular approval Yes ☐ No ☒
b) Limited single modular approval	Limited single modular approval Yes ☐ No ☒

3.3 Product details

FCC ID	Grantee code:	**UKO**
	Product code:	**MOVESENS4**
Equipment class	DTS – Digital Transmission system 15C	
Description of product as it is marketed	Sensor for EGOProSafe System	
	Model name/number:	PLXSAFEMOVESENS4 PLXSAFEMOVESEN4M
	Serial number:	--

3.4 Application purpose

Type of application	☒ Original certification ☐ Change in identification of presently authorized equipment Original FCC ID: Grant date: ☐ Class II permissive change or modification of presently authorized equipment

3.5 Composite/related equipment

a) Composite equipment	The EUT is a composite device subject to an additional equipment authorization Yes ☒ No ☐
b) Related equipment	The EUT is part of a system that operates with, or is marketed with, another device that requires an equipment authorization Yes ☒ No ☐
c) Related FCC ID	If either of the above is "yes": ☐ has been granted under the FCC ID(s) listed below: ☒ is in the process of being filled under the FCC ID(s) listed below: ☐ is pending with the FCC ID(s) listed below: ☐ has a mix of pending and granted statues under the FCC ID(s) listed below: i. FCC ID: UKOMOVESENS4

	ii. FCC ID: UKOTAG3T iii. FCC ID: UKOTAG3TH

3.6 Sample information

Receipt date:	2019-09-30
Nemko sample ID number:	---

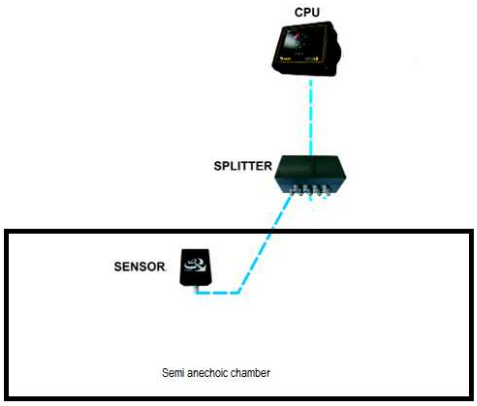
3.7 EUT technical specifications

Operating band:	2400 MHz ÷ 2483.5 MHz
Operating frequency:	2452 MHz
Modulation type:	OOK on a random MSK modulated carrier
Occupied bandwidth:	2 MHz
Channel spacing:	5 MHz
Emission designator:	1M96WXD
Antenna type:	Patch antenna 6dBi gain @2.45GHz
Power source:	External 12-24Vdc

3.8 Operation of the EUT during testing

Details:	Transmitting to maximum power at 2452 MHz, with the following modulation: OOK on a random MSK modulated carrier

3.9 EUT setup diagram



Section 4: Engineering considerations

4.1 Modifications incorporated in the EUT

Modifications	Modifications performed to the EUT during this assessment None ☒ Yes ☐, performed by Client ☐ or Nemko ☐ Details:

4.2 Deviations from laboratory tests procedures

Deviations	Deviations from laboratory test procedures None ☒ Yes ☐ - details are listed below:

4.3 Technical judgment

Judgment	None

Section 5: Test conditions

5.1 Power source and ambient temperatures

Normal temperature, humidity and air pressure test conditions	Temperature: 15–30 °C Relative humidity: 20–75 % Air pressure: 86–106 kPa When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.
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

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report according to CISPR 16-4-2 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the Nemko Spa Technical Procedure WML1002. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2 which has been derived from the assumed normal probability distribution with infinite degrees of freedom and for a coverage probability of 95 %;.

EUT	Type	Test	Range and Setup features	Measurement Uncertainty	Notes
Transmitter	Conducted	Frequency error	0.001MHz ÷ 18 GHz	0.08 ppm	(1)
		Carrier power RF Output Power	1MHz ÷ 18 GHz With power meter	1.6 dB	(1)
			1MHz ÷ 18 GHz With spectrum/receiver	3.0 dB	(1)
		Adjacent channel power	1MHz ÷ 18 GHz	1.6 dB	(1)
		Conducted spurious emissions	1MHz ÷ 18 GHz	4.2 dB	(1)
		Intermodulation attenuation	1MHz ÷ 18 GHz	2.2 dB	(1)
		Attack time – frequency behaviour	1MHz ÷ 18 GHz	2.0 ms	(1)
		Attack time – power behaviour	1MHz ÷ 18 GHz	2.5 ms	(1)
		Release time – frequency behaviour	1MHz ÷ 18 GHz	2.0 ms	(1)
		Release time – power behaviour	1MHz ÷ 18 GHz	2.5 ms	(1)
		Transient behaviour of the transmitter– Transient frequency behaviour	1MHz ÷ 18 GHz	0.2 kHz	(1)
		Transient behaviour of the transmitter – Power level slope	1MHz ÷ 18 GHz	9%	(1)
		Frequency deviation - Maximum permissible frequency deviation	0.001MHz ÷ 18 GHz	1.3%	(1)
		Frequency deviation - Response of the transmitter to modulation frequencies above 3 kHz	0.001MHz ÷ 18 GHz	0.5 dB	(1)
		Dwell time	-	3%	(1)
		Hopping Frequency Separation	0.01MHz ÷ 18 GHz	1%	(1)
		Occupied Channel Bandwidth	0.01MHz ÷ 18 GHz	2%	(1)
		Modulation Bandwidth	0.01MHz ÷ 18 GHz	2%	(1)
	Radiated	Radiated spurious emissions	30MHz ÷ 18 GHz	6.0 dB	(1)
		Effective radiated power transmitter	30MHz ÷ 18 GHz	6.0 dB	(1)
Receiver	Radiated	Radiated spurious emissions	30MHz ÷ 18 GHz	6.0 dB	(1)
		Sensitivity measurement	1MHz ÷ 18 GHz	6.0 dB	(1)
	Conducted	Conducted spurious emissions	1MHz ÷ 18 GHz	4.2 dB	(1)

Section 7: Test equipment

Equipment	Manufacturer	Model	Serial N°	Due date
EMI receiver 2Hz ÷ 44 GHz	R&S	ESW44	101620	08/2020
EMI receiver 20 Hz ÷ 8 GHz	R&S	ESU8	100202	01/2020
Trilog Broad Band Antenna 25 MHz÷2 GHz	Schwarzbeck	VULB 9162	9162-025	07/2021
Bilog antenna 1 ÷18 GHz	Schwarzbeck	STLP 9148	9148-123	07/2021
Broadband preamplifier 1 ÷18 GHz	Schwarzbeck	BBV 9718	9718-137	09/2020
Loop antenna	TESEQ	HLA 6121	45749	07/2020
Semi-anechoic chamber	Nemko	10m semi-anechoic chamber	530	09/2021
Shielded room	Siemens	10m control room	1947	NCR
Trilog Broad Band Antenna 25 MHz÷2 GHz	Schwarzbeck	VULB 9162	9162-025	07/2021
Bilog antenna 1 ÷18 GHz	Schwarzbeck	STLP 9148	9148-123	07/2021
Semi-anechoic chamber	Nemko	10m semi-anechoic chamber	530	09/2021
Shielded room	Siemens	10m control room	1947	NCR
Note: N/A = Not Applicable, NCR = No Cal Required, COU = CAL On Use				

Section 8: Testing data

8.1 Clause 15.31(e) Variation of power source

§ 15.31 Measurement standards.

(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.

Special notes

None

Test data

No variation of radiated level emission observed varying power supply

8.2 Clause 15.31(m) Number of operating frequencies

§ 15.31 Measurement standards.

(m) Measurements on intentional radiators or receivers, other than TV broadcast 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:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz and less	1	Middle
1 to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

Special notes
The frequency range over which the device operates is greater than 10 MHz. The tests were performed on three operating channels (low, mid, high)

Test data	
Mid frequency / channel 7	2452 MHz

8.3 Clause 15.203 Antenna requirement

§ 15.203 Antenna requirement.

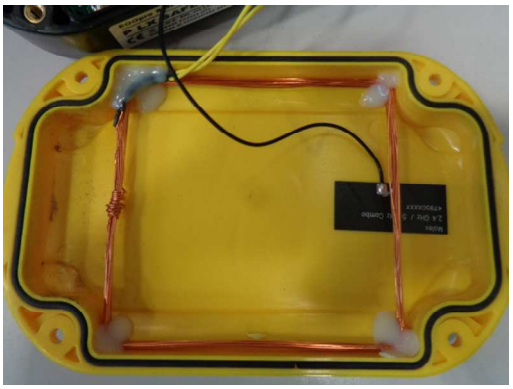
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply 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 carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, 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.

Special notes

None

Test data

- Detailed photo of RF connector:
-



8.4 Clause 15.247(a)(2) Minimum 6 dB bandwidth for systems using digital modulation techniques

§ 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz.

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

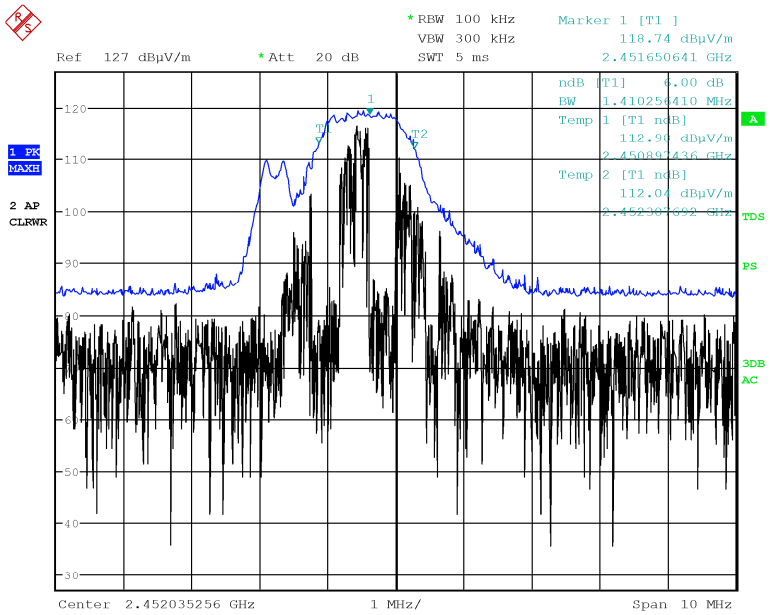
(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Special notes
None

Test data

Radiated measurement 558074 D01 DTS Meas Guidance v03r03

Middle channel 6 dB bandwidth



Frequency (MHz)	6 dB bandwidth (MHz)	Limit (MHz)	Margin (MHz)
2452	1.41	> 0.5	0.91

–

8.5 Clause 15.247(b) Maximum peak conducted output power

§ 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz.

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

(1) For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

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

(3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

(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.

(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(ii) Systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

(iii) Fixed, point-to-point operation, as used in paragraphs (b)(3)(i) and (b)(3)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

Special notes

None

Test data

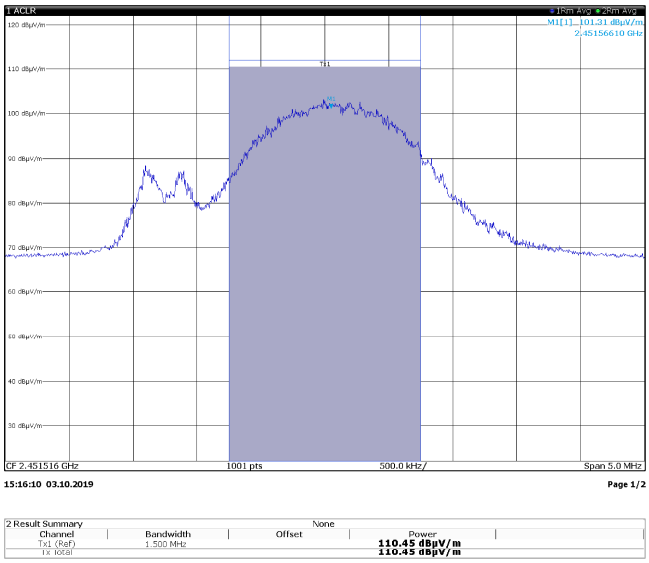
Section (3) Results

Radiated measurements: 558074 D01 DTS Meas Guidance v03r03

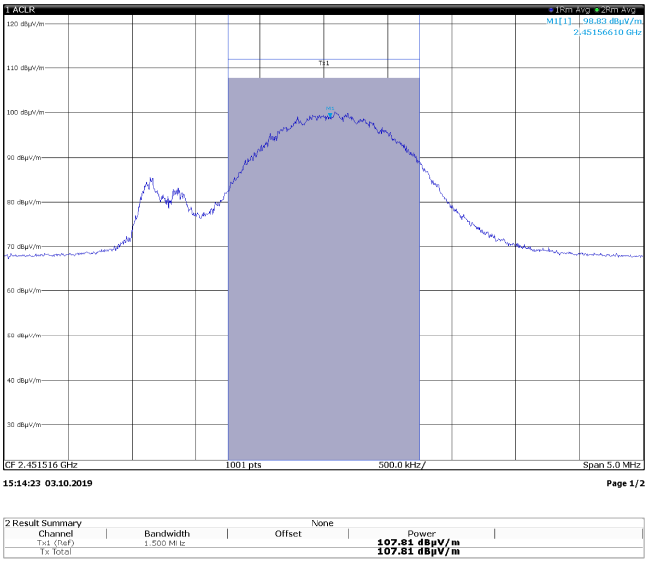
Radiated measurements were performed:

- The EUT was measured on three orthogonal axis.
- All measurements were performed at a distance of 3 m.
- All measurements were performed:

Horizontal polarization middle channel



Middle channel, vertical polarization



Test data, continued

Section (3) Results, continued

Radiated measurements, horizontal polarization

Radiated measurements were performed:
- The EUT was measured on three orthogonal axis.
- All measurements were performed at a distance of 3 m.
- All measurements were performed:

Calculate the EIRP from the radiated field strength in the far field using Equation (22):
EIRP = E + 20log d –104.7 (22)
where
EIRP is the equivalent isotropically radiated power, in dBm
EMeas is the field strength of the emission at the measurement distance, in dBµV/m
dMeas is the measurement distance, in m (3m)

Frequency (MHz)	Field strength (dBµV/m)	EIRP (dBm)	Limit (dBm)	Margin (dBm)
2452	110.5	15.3	36.0	-20.7

Note:.

Output power [dBm] = EIRP – Antenna gain [dBi] (6 dBi)

Frequency (MHz)	EIRP (dBm)	Output power (dBm)	Limit (dBm)	Margin (dBm)
2452	15.3	9.3	30	-20.7

Note:.

8.6 Clause 15.247(d) Spurious emissions

§ 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz.

(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)).

Special notes

§15.209 – Radiated emission limits

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

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

§15.205 – Restricted bands of operation

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

- The spectrum was searched from 30 MHz to the 10th harmonic.
- The EUT was measured on three orthogonal axis.
- All measurements were performed at a distance of 3 m.
- All measurements were performed:
  - within 30–1000 MHz range: using a quasi-peak detector with 120 kHz/300 kHz RBW/VBW,
  - above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results

Test data

Duty cycle/average factor calculations

§15.35(c) When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.

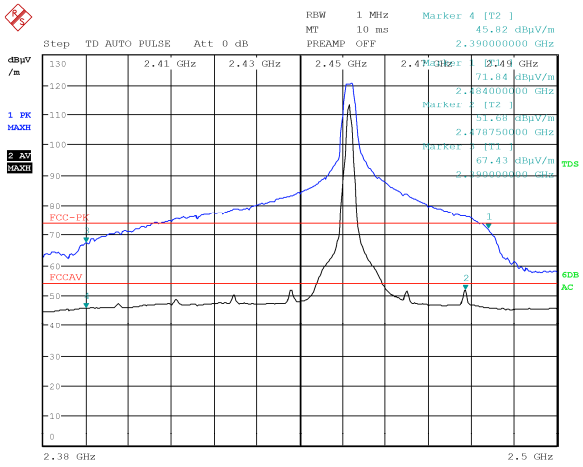
Duty cycle/average factor calculations: duty cycle =100%

$$Duty\,cycle\,/\,average\,factor = 20\times\log_{10}\left(\frac{Tx_{100\,ms}}{100\,ms}\right)$$ = not applicable

Test data, continued

Test method: see 558074 D01 DTS Meas Guidance v03r03

Horizontal polarization



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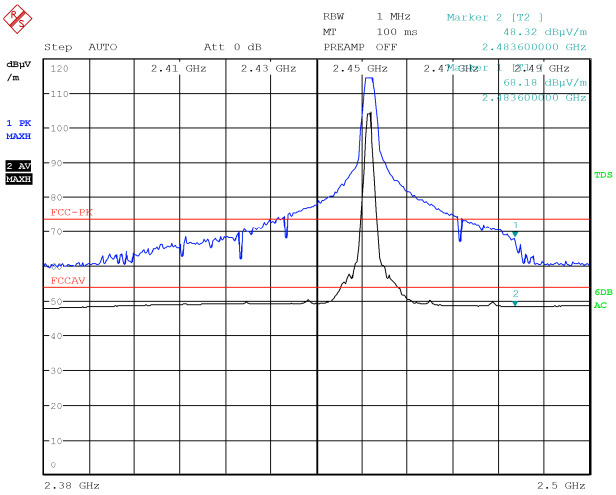
Vertical polarization



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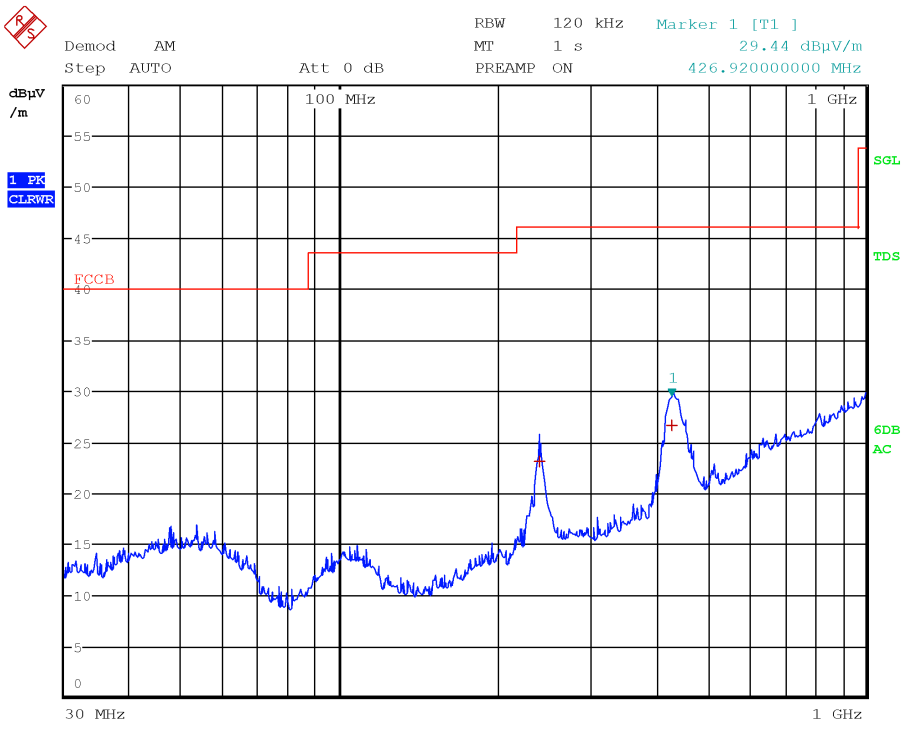
Test data, continued

Horizontal polarization:



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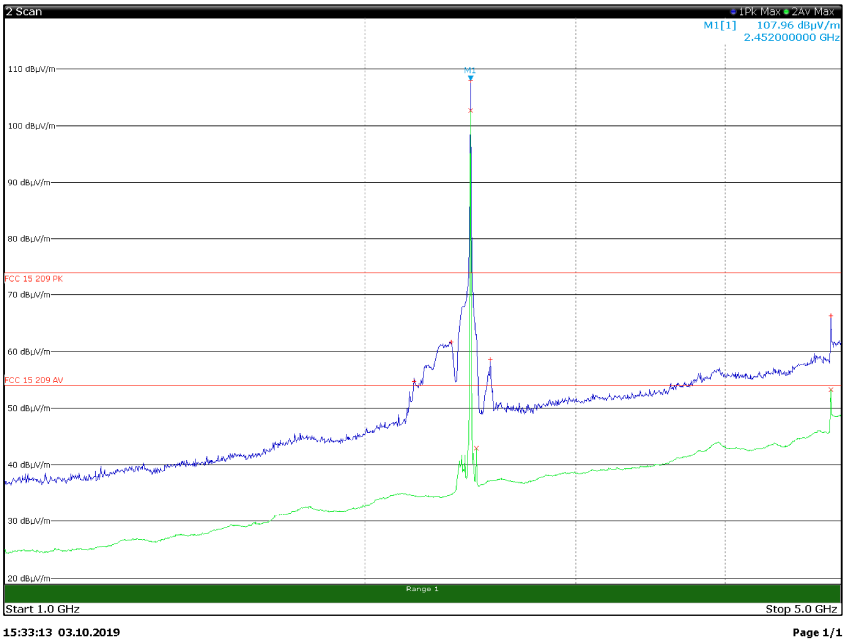
Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remarks
239.8800	23.2	46.0	-22.8	QP
426.9200	26.7	46.0	-19.3	QP

Test data, continued

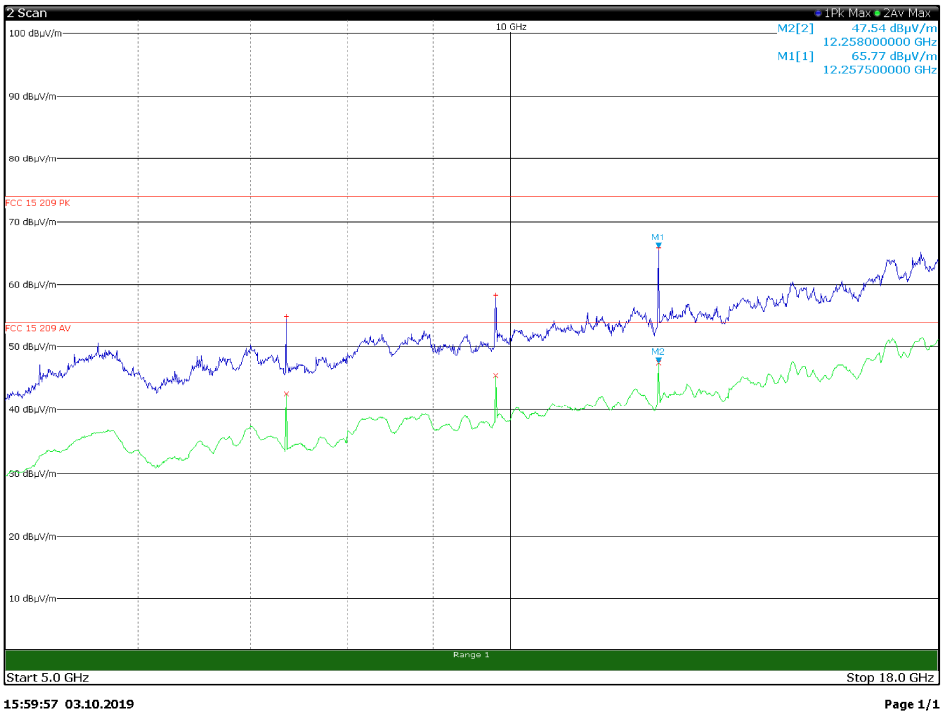
Horizontal polarization:



Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remarks
2199	54.8	74.0	-19.2	Pk
2362.25	61.8	74.0	-12.2	Pk
2451.5	102.8	--	--	Av
2452	108.0	--	--	Pk
2478.5	42.9	54.0	-11.1	Av
2545.25	58.8	74.0	-15.2	Pk
4902.5	66.3	74.0	-7.7	Pk
4903.25	53.3	54.0	-0.7	Av

Test data, continued

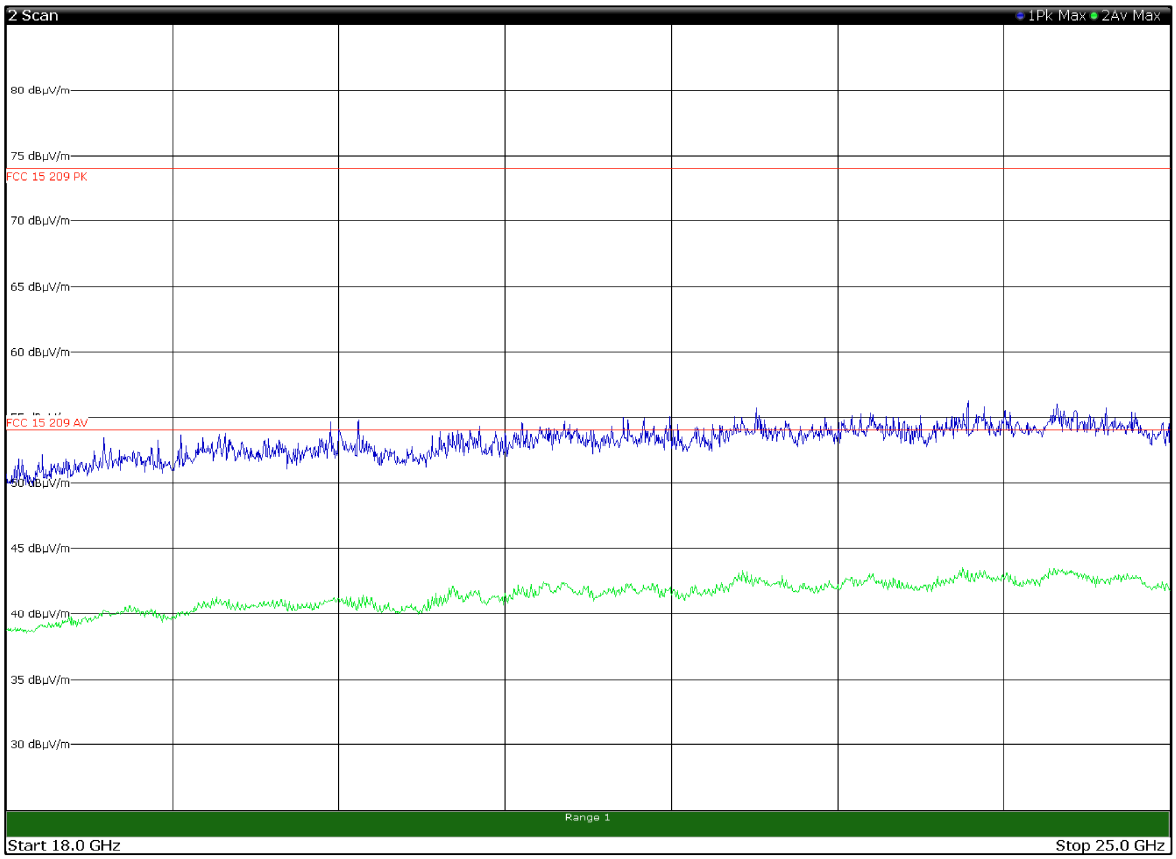
Horizontal polarization:



Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remarks
7354.7500	42.6	54.0	-11.4	Av
7356.0000	55.0	74.0	-19.0	Pk
9804.2500	58.3	74.0	-15.7	Pk
9806.5000	45.5	54.0	-8.5	Av
12257.5000	65.8	74.0	-8.2	Pk
12258.0000	47.6	54.0	-6.4	Av

Test data, continued

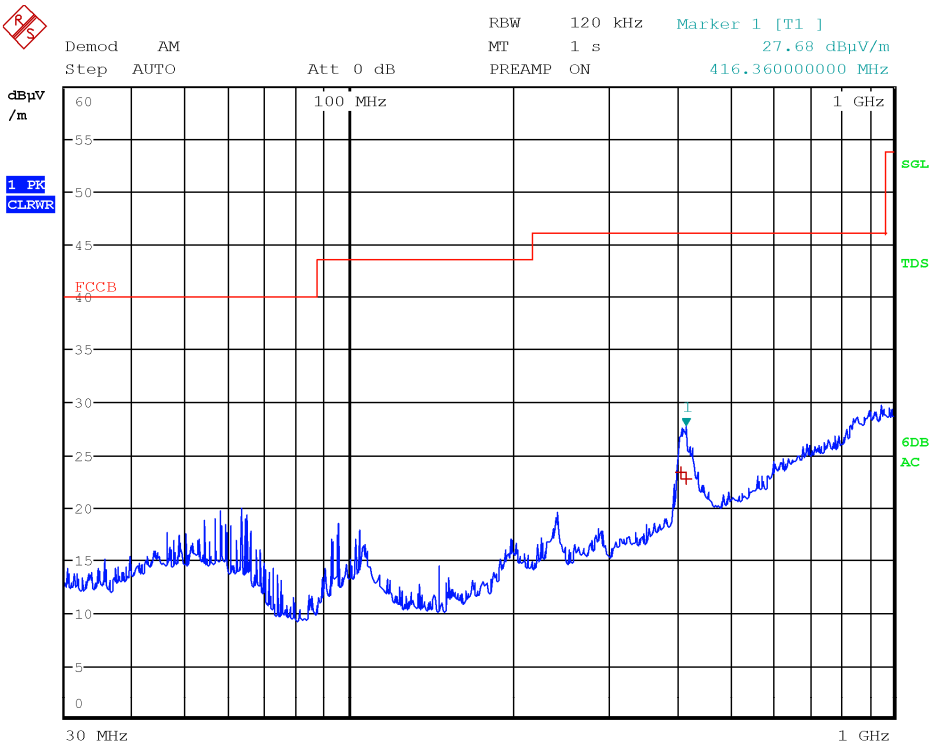
Horizontal polarization:



Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remarks
--	--	--	--	--

Test data, continued

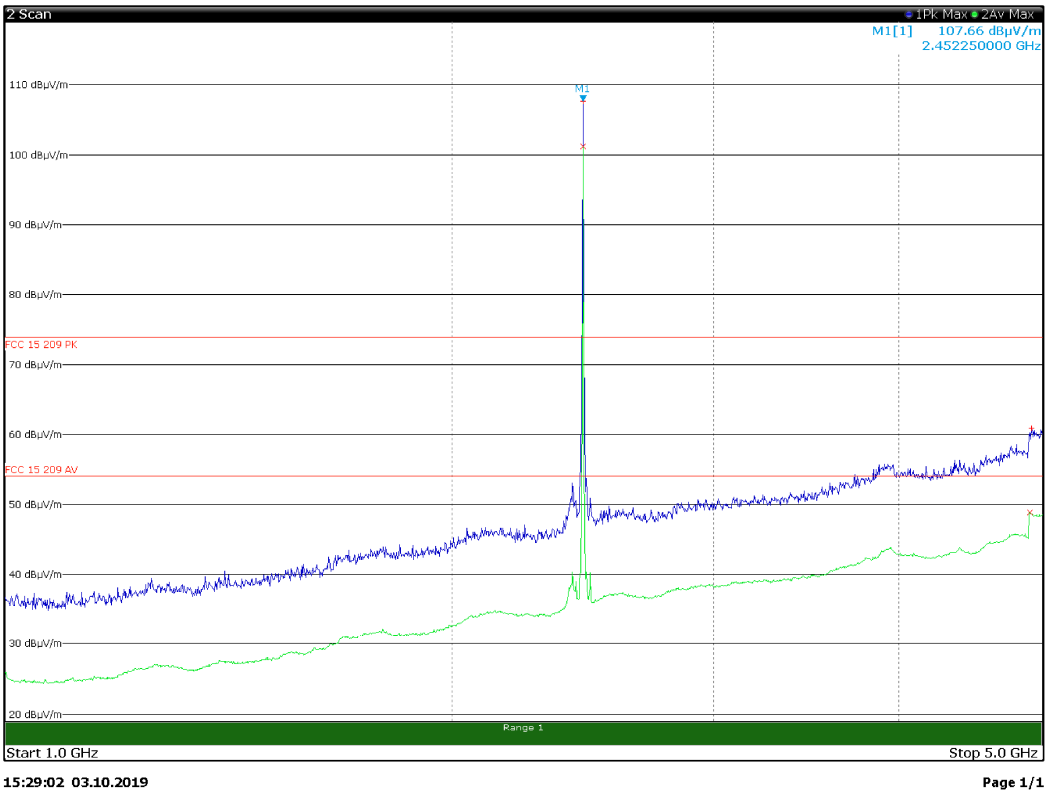
Vertical polarization:



Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remarks
406.9200	23.5	46.0	-22.5	QP
416.3600	22.8	46.0	-23.2	QP

Test data, continued

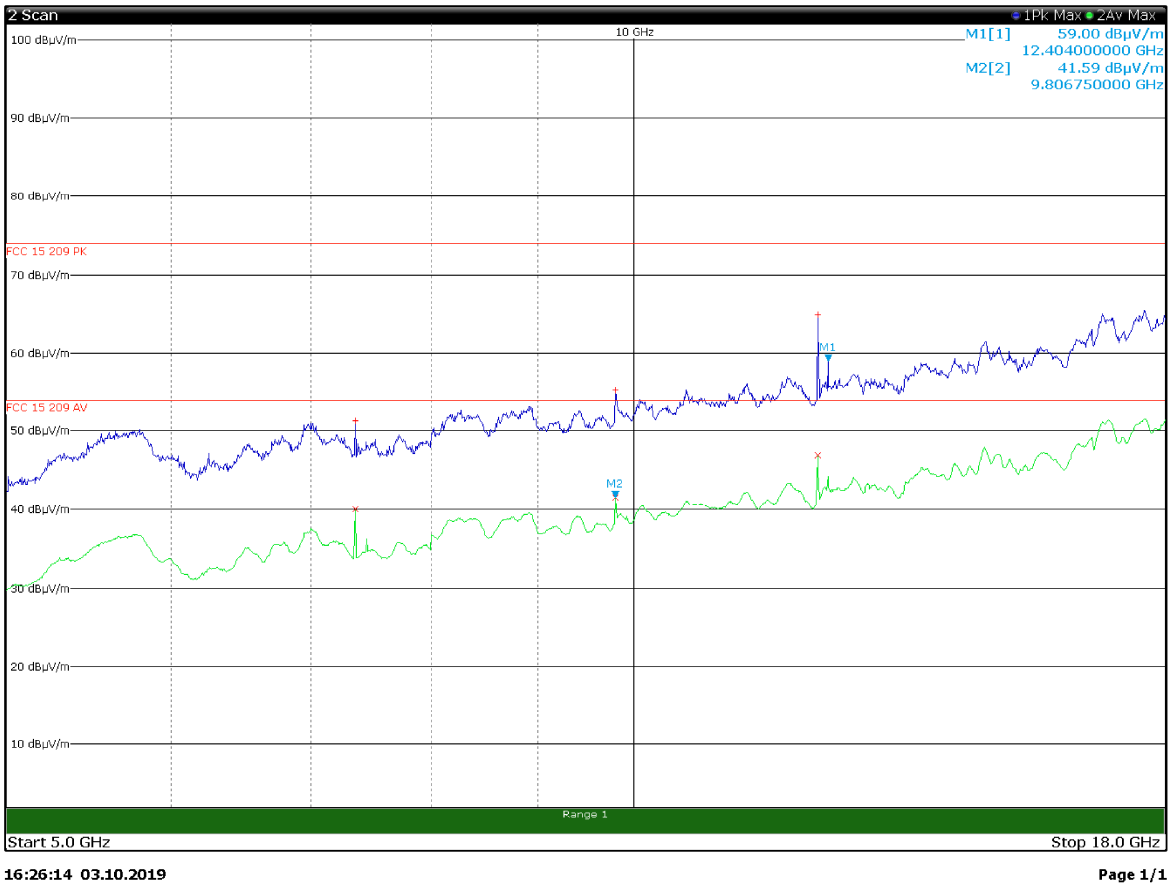
Vertical polarization:



Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remarks
2451.5	101.3	--	--	Av
2452.25	107.7	--	-	Pk
4901.5	48.9	54	-5.1	Av
4915	61	74	-13	Pk

Test data, continued

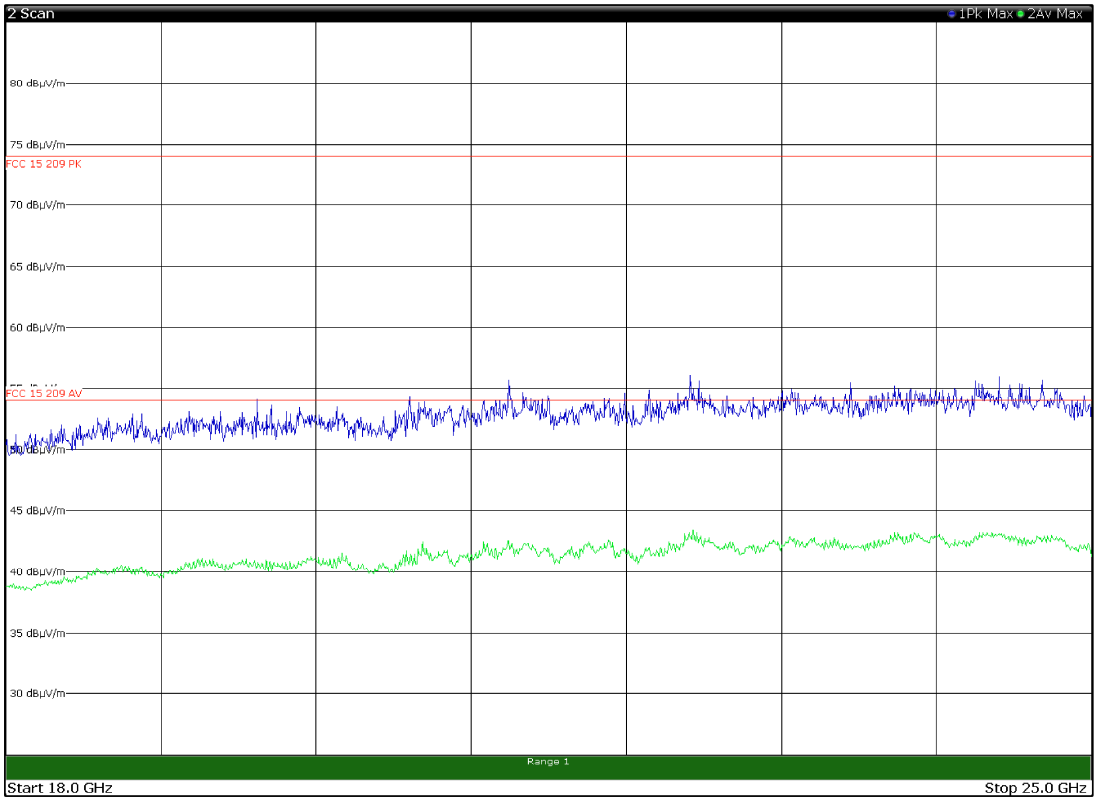
Vertical polarization:



Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remarks
7354.5	51.3	74.0	-22.7	Pk
7354.75	40	54.0	-14.0	Av
9804.75	55.3	74.0	-18.7	Pk
9806.75	41.6	54.0	-12.4	Av
12257.75	64.9	74.0	-9.1	Pk
12258	47	54.0	-7.0	Av

Test data, continued

Vertical polarization:

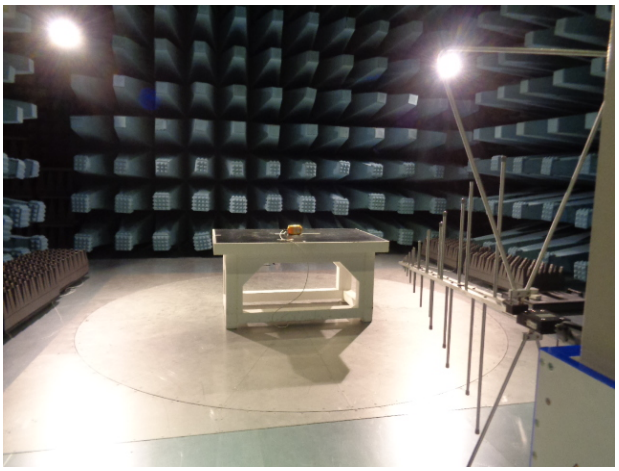
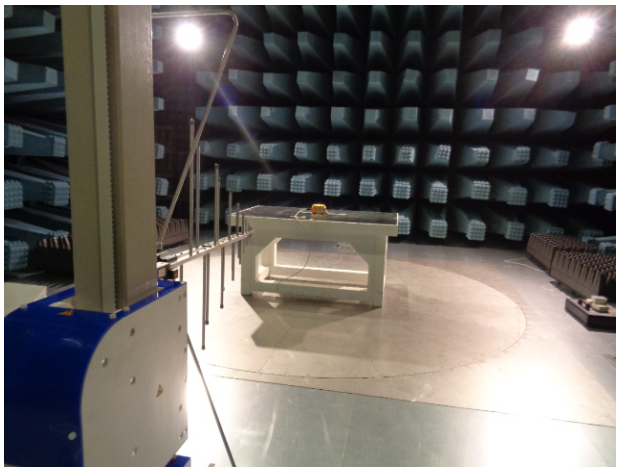
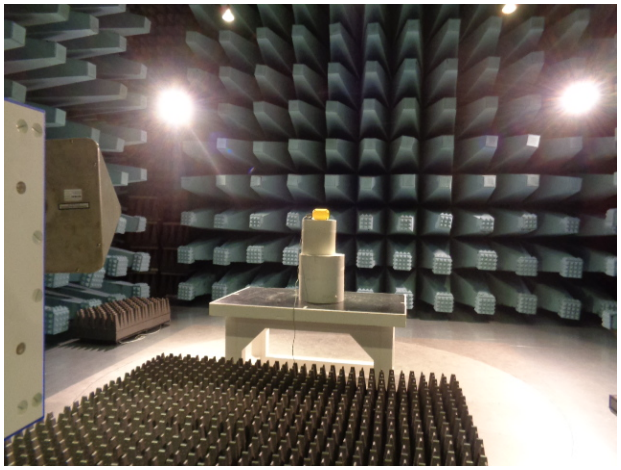
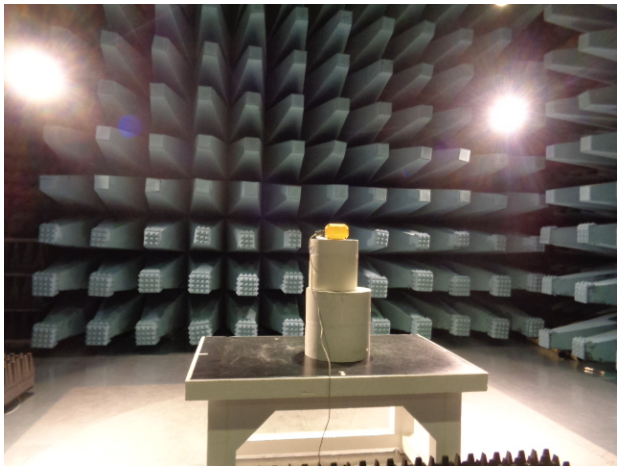
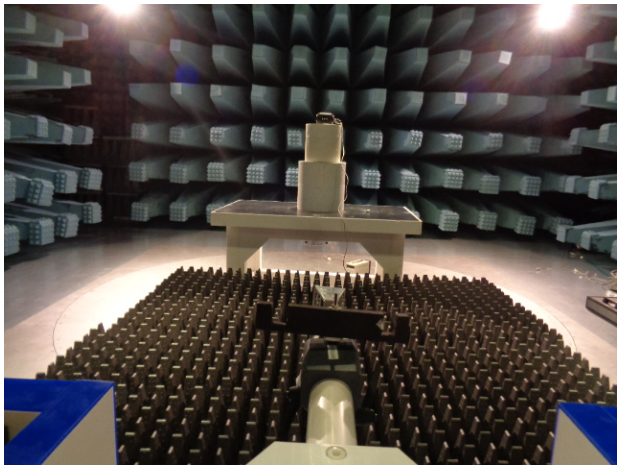
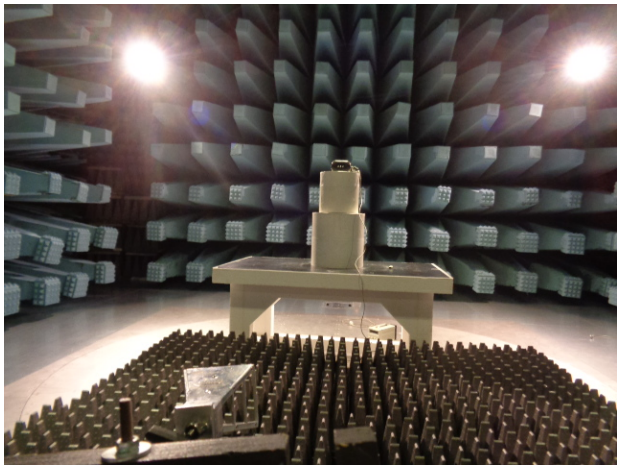


Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remarks
--	--	--	--	--

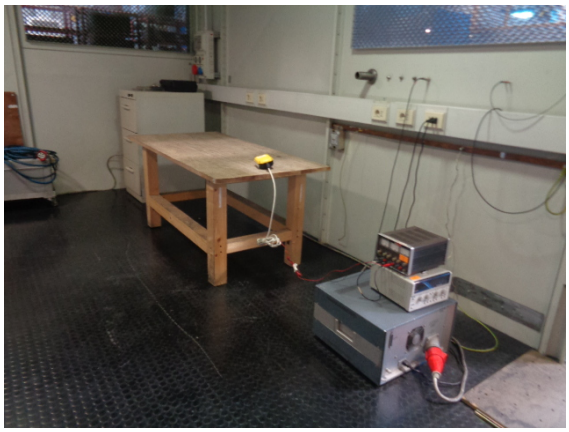
Test data, continued
Radiated measurement
Radiated Measurements

– All measurements were performed at a distance of 3 m.
– All measurements performed:
  – within 30–1000 MHz range: using a quasi-peak detector with 120 kHz/300 kHz RBW/VBW,
  – above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
  – and using average detector with 1 MHz/3 MHz RBW/VBW for average results

Setup photos

Setup photos



8.7 Clause 15.247(e) Power spectral density for digitally modulated devices

§ 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz.

(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Special notes

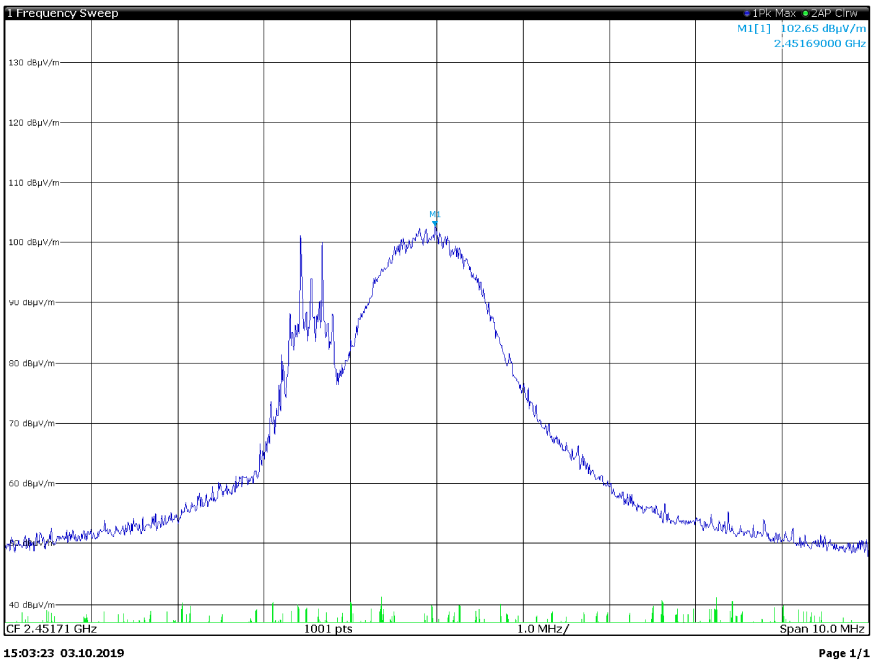
– The test was performed using guidelines of ANSI C63.10-2013,

– PSD option 1 was used since output power option 1 was used.
– Emission peak was located and zoomed in. RBW was set to 3 kHz, VBW was set > RBW. Sweep time was set to Span/3 kHz. Peak level was measured.

Test data

Radiated measurement protocol, horizontal polarization

High channel



Calculate the EIRP from the radiated field strength in the far field using Equation (22):
EIRP = E + 20log d –104.7 (22)
where
EIRP is the equivalent isotropically radiated power, in dBm
EMeas is the field strength of the emission at the measurement distance, in dBµV/m
dMeas is the measurement distance, in m (3m)

Frequency (MHz)	Field strength (dBµV/m)	EIRP (dBm)
2452	102.6	7.4

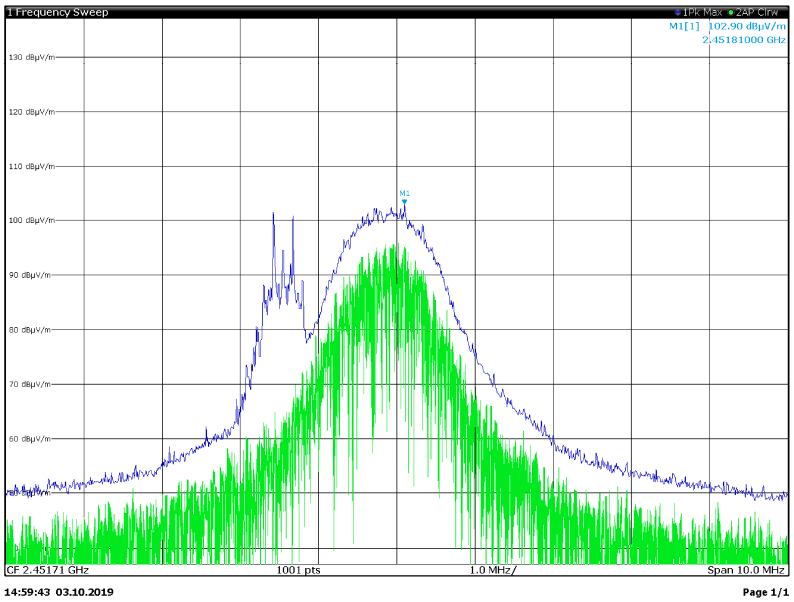
Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)
2452	1.4	8	-6.6

Theoretical conversion from Field Strength measured at 3 m to power conducted from the intentional radiator to the PSD [dBm/3 kHz] = EIRP – Antenna gain [dBi] (6 dBi)

Test data

Radiated measurement protocol, vertical polarization

High channel



Calculate the EIRP from the radiated field strength in the far field using Equation (22):
EIRP = E + 20log d −104.7 (22)
where
EIRP is the equivalent isotropically radiated power, in dBm
EMeas is the field strength of the emission at the measurement distance, in dBµV/m
dMeas is the measurement distance, in m (3m)

Frequency (MHz)	Field strength (dBµV/m)	EIRP (dBm)
2452	102.9	7.7

Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)
2452	1.7	8	-6.3

Theoretical conversion from Field Strength measured at 3 m to power conducted from the intentional radiator to the PSD [dBm/3 kHz] = EIRP – Antenna gain [dBi] (6 dBi)

FCC 15.207(a) AC power line conducted emissions limits

Definitions and limits

FCC:
Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

. Except when the requirements applicable to a given device state otherwise, for any licence-exempt radiocommunication device equipped to operate from the public utility AC power supply, either directly or indirectly, the radio frequency voltage that is conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in Table 2. The tighter limit applies at the frequency range boundaries.

The conducted emissions shall be measured with a 50 Ω/50 µH line impedance stabilization network (LISN).

Table 1-1: Conducted emissions limit

Frequency of emission, MHz	**Conducted limit, dBµV**	
	Quasi-peak	**Average**
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

Note: * - Decreases with the logarithm of the frequency.

Test summary

Test date:	October 03, 2019	Temperature:	21 °C
Test engineer:	Daniele Guarnone	Air pressure:	1005 mbar
Verdict:	Pass	Relative humidity:	35 %

Observations, settings and special notes

The EUT was set up as tabletop configuration.

The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

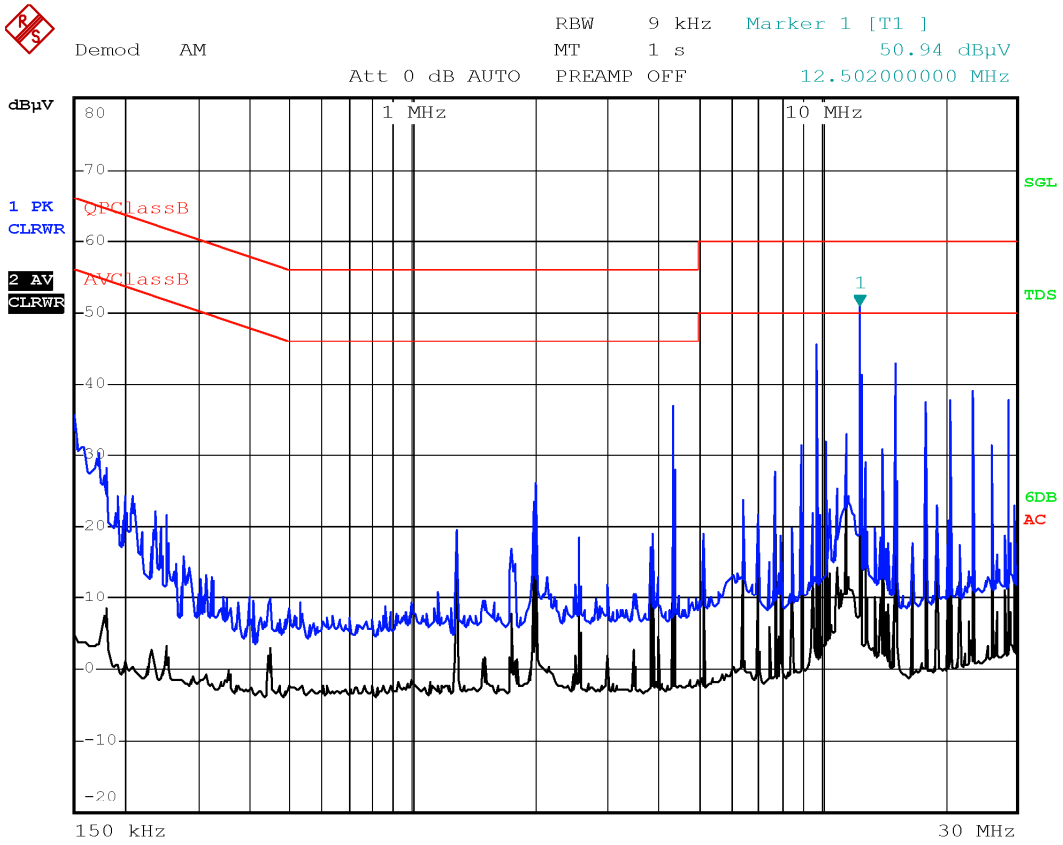
Receiver settings for preview measurements:

Resolution bandwidth:	9 kHz
Video bandwidth:	30 kHz
Detector mode:	Peak and Average
Trace mode:	Max Hold
Measurement time:	1000 ms

Receiver settings for final measurements:

Resolution bandwidth:	9 kHz
Video bandwidth:	30 kHz
Detector mode:	Quasi-Peak and Average
Trace mode:	Max Hold
Measurement time:	1000 ms

Test data

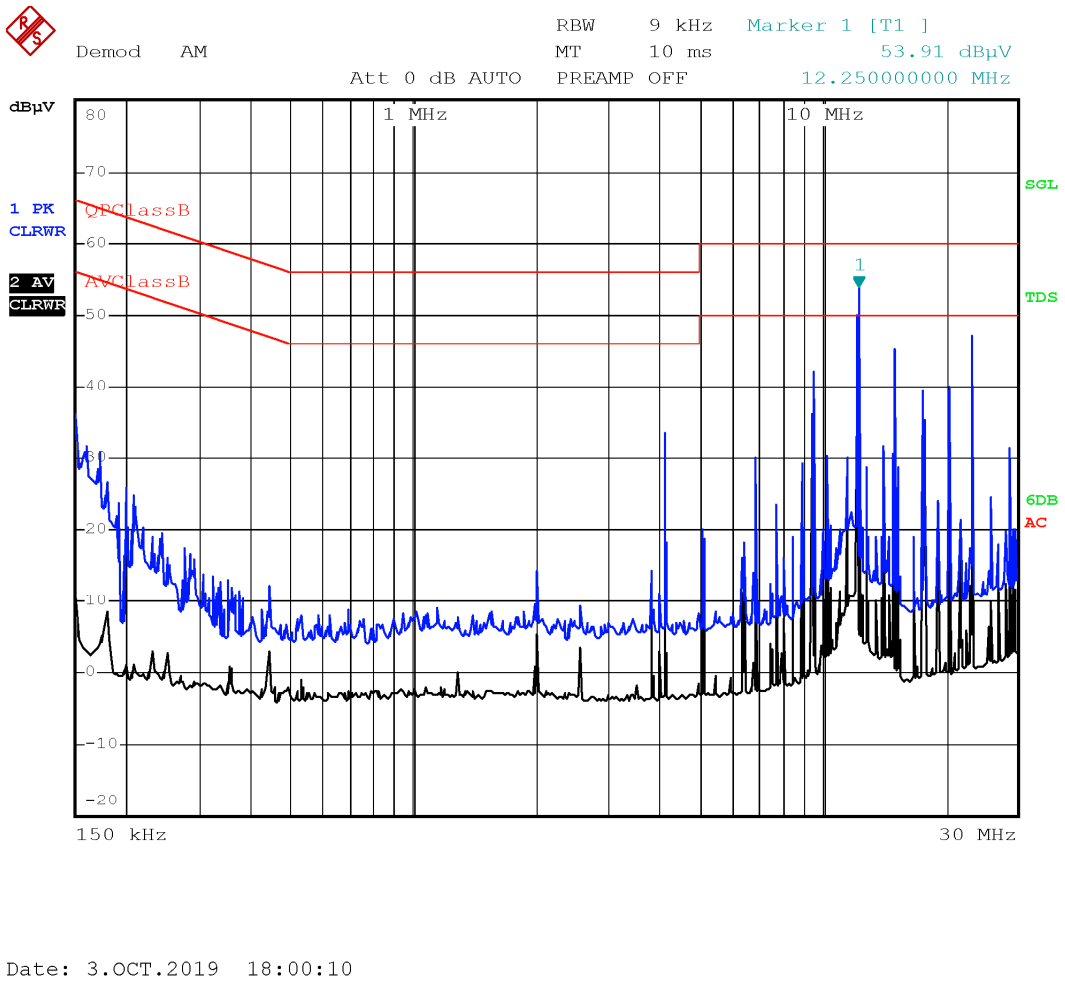


Plot 1-1: Conducted emissions on phase line

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Detector
--	--	--	-	-

Table 1-2: Quasi-Peak conducted emissions results on phase line

Test data, continued



Plot 1-2: Conducted emissions on neutral line

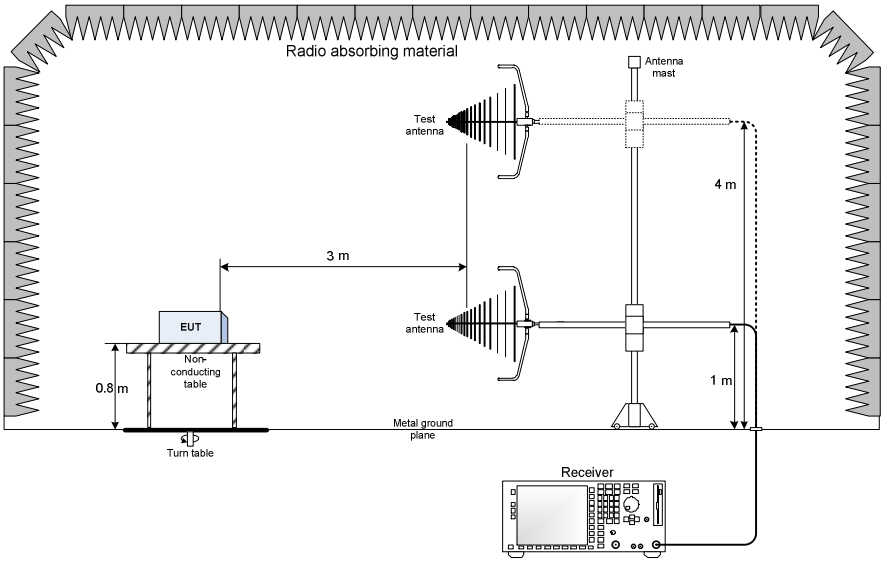
Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Detector
--	--	--	--	--

Table 1-3: **Quasi-Peak conducted emissions results on neutral line**

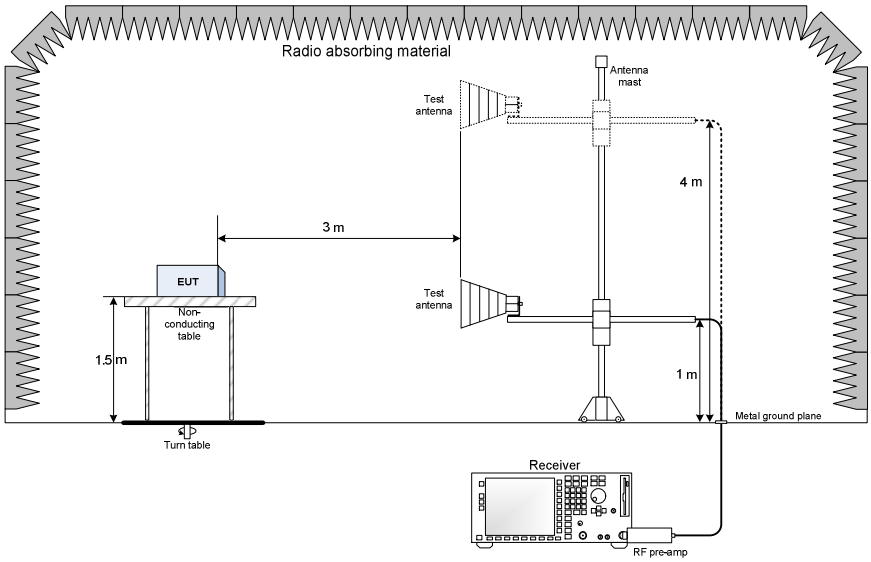
Section 9: Block diagrams of test set-ups

Radiated emissions set-up

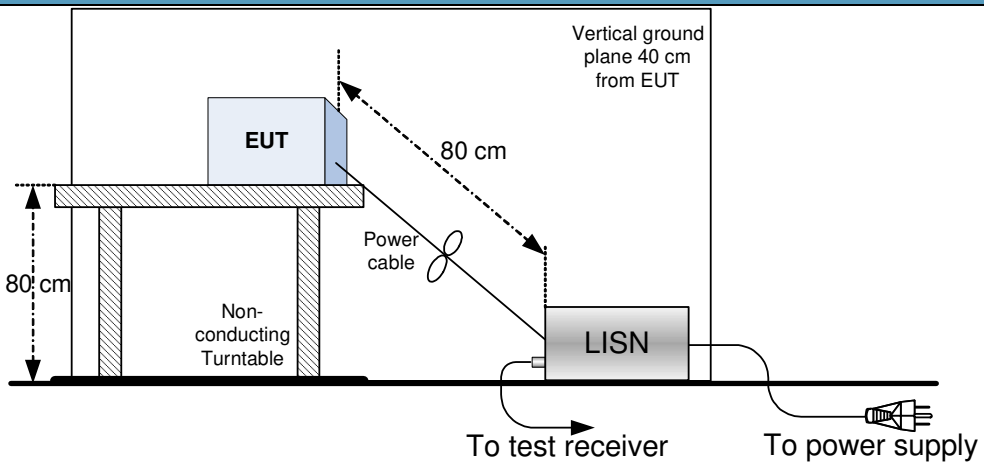
Radiated emissions set-up for frequencies below 1 GHz



Radiated emissions set-up for frequencies above 1 GHz



Conducted emissions set-up



Section 10: EUT photos

EUT