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Test report

381308-3TRFWL

Date of issue: 2019-10-10

Applicant: Advanced Microwave Engineering s.r.l. Via Lucca, 50 Firenze, 5142 Italy

Product: Sensor for EGOProSafe System

Model: PLXSAFEMOVESENS4; PLXSAFEMOVESEN4M

FCC ID: UKOMOVESENS4

Specifications:

- FCC 47 CFR Part 15 Subpart C
  Intentional radiators

Test location

Company name:	Nemko Spa
Address:	Via del Carroccio, 4
City:	Biassono
Province:	MB
Postal code:	20853
Country:	Italy
Site number:	FCC test site registration number: 682159

Tested by:	Daniele Guarnone
Reviewed by:	Paolo Barbieri
Date:	2019-10-10
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

Table of contents

Section 1. Report summary

1.1 Applicant and manufacturer

Company name:	Advanced Microwave Engineering s.r.l.
Address:	Via Lucca, 50
City:	Firenze
Province/State:	FI
Postal/Zip code:	50142
Country:	Italy

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C	Intentional radiators

1.3 Test methods

ANSI C63.10 2013	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. 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	Pass
§15.31(e)	Variation of power source	Pass[1]
§15.203	Antenna requirement	Pass[2]
§15.209	Radiated emission limits; general requirements.	Pass

Notes: [1] Measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, was performed with the supply voltage varied between 85 % and 115 % of the nominal rated supply voltage. No noticeable output power variation was observed

[2] The Antennas are located within the enclosure of EUT and not user accessible.

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	September 30 2019
Nemko sample ID number	381308-3

3.2 EUT information

Product name	Sensor for EGOProSafe System
Model	PLXSAFEMOVESENS4; PLXSAFEMOVESEN4M
Model variant	--
Serial number	--

3.3 Technical information

Operating band	125 KHz
Operating frequency	125 kHz
Modulation type	FSK
Occupied bandwidth (99 %)	240 Hz
Emission designator	240HD1D
Power requirements	12/24 VDC
Antenna information	The EUT uses a unique antenna coupling.

3.4 Product description and theory of operation

The EUT is a sensor for people and object detection in particular area items and persons may be equipped with a Tag

3.5 EUT exercise detils

E.UT. has been tested supplied and connected as indicate in the following picture

3.6 EUT setup diagram

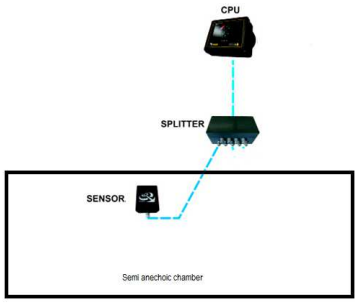


Figure 3.6-1: Setup diagram

3.7 EUT sub assemblies

Table 3.7-1: EUT sub assemblies

Use*	Product Type	Manufacturer	Model	Comments
AE	CPU	Advanced Microwave Engineering	PLX Safemove CPU	—
AE	Disply	Advanced Microwave Engineering	PLX Safemove DIS	
AE	TAG	Advanced Microwave Engineering	PLX TAG Safety 3T/H	
AE	Board	Advanced Microwave Engineering	PLX Safemove HUB4	

Note: * Use: EUT - Equipment Under Test
AE - Auxiliary/Associated Equipment (Not Subjected to Test) / SIM - Simulator (Not Subjected to Test)

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

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

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	18–33 °C
Relative humidity	30–60 %
Air pressure	980–1060 hPa

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

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

7.1 Test equipment list

Table 7.1-1: Equipment list

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 FCC 15.207(a) AC power line conducted emissions limits

8.1.1 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.

IC:
The purpose of this test is to measure unwanted radio frequency currents induced in any AC conductor external to the equipment which could conduct interference to other equipment via the AC electrical network.

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 8.1-1: 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.

8.1.2 Test summary

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

8.1.3 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.

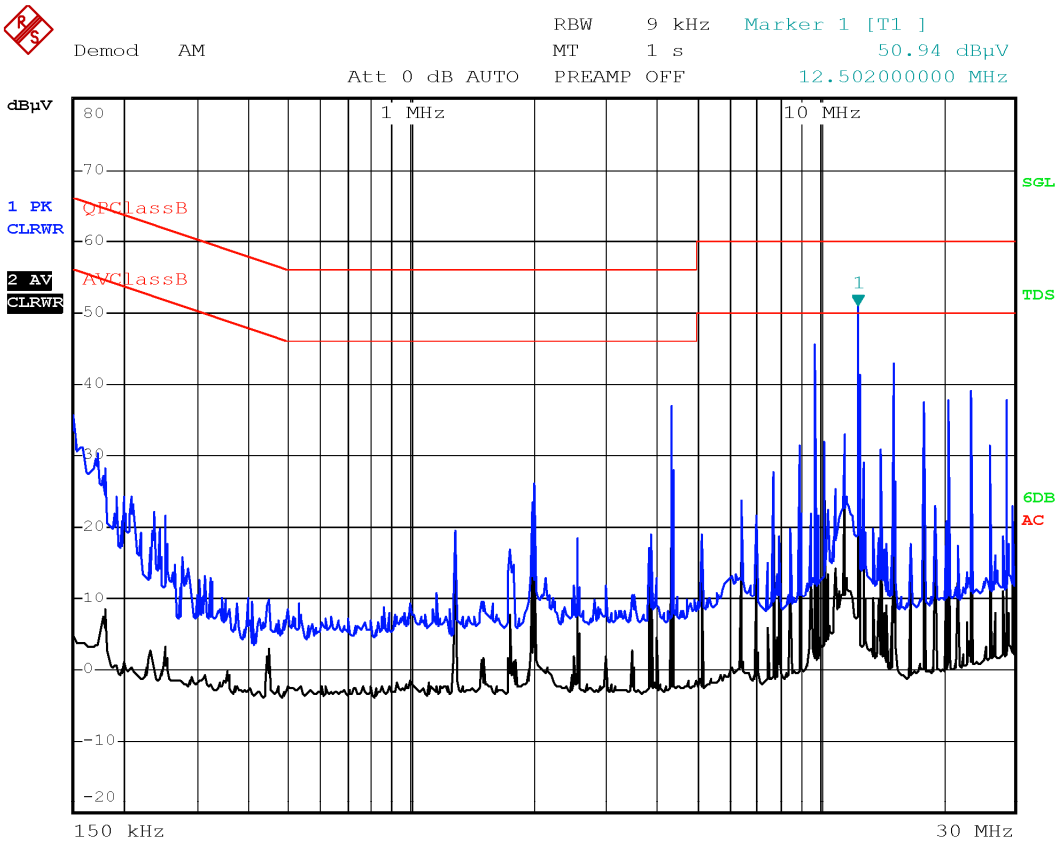
Receiver settings for preview measurements:

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 8.1-1: Conducted emissions on phase line

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Detector
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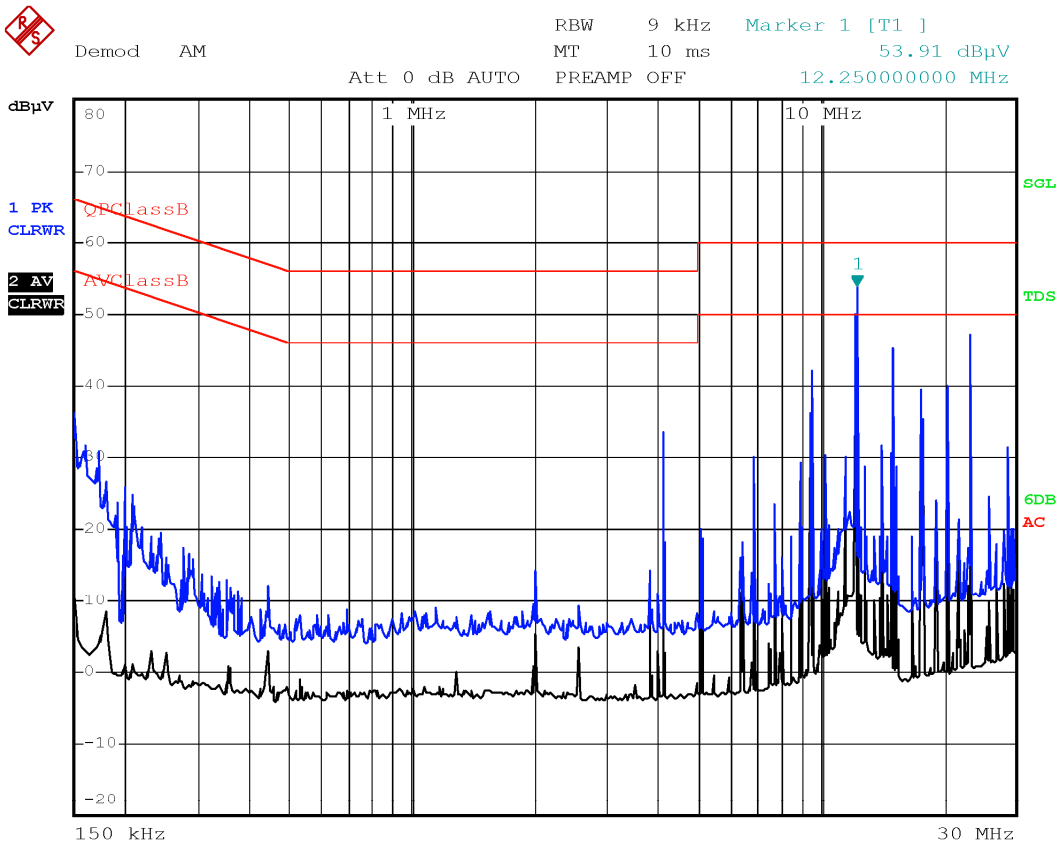
Table 8.1-2: Quasi-Peak conducted emissions results on phase line

- Test data, continued



Plot 8.1-2: Conducted emissions on neutral line

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Detector
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Table 8.1-3: **Quasi-Peak conducted emissions results on neutral line**

8.2 Occupied bandwidth

8.2.1 Definitions and limits

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99 percent emission bandwidth, as calculated or measured.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1 percent of the selected span as is possible without being below 1 percent. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold, may produce a wider bandwidth than actual.

The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 percent of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded.

The span between the two recorded frequencies is the occupied bandwidth.

8.2.2 Test summary

Test date:	May 27, 2019	Temperature:	21 °C
Test engineer:	Daniele Guarnone	Air pressure:	1005 mbar
Verdict:	Pass	Relative humidity:	35 %

8.2.3 Observations, settings and special notes

Spectrum analyser settings:

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

8.2.4 Test data

Table 8.2-1: 99 % bandwidth results

Modulation	99 % bandwidth, Hz
FSK	**17400**

8.2.4 Test data, continued

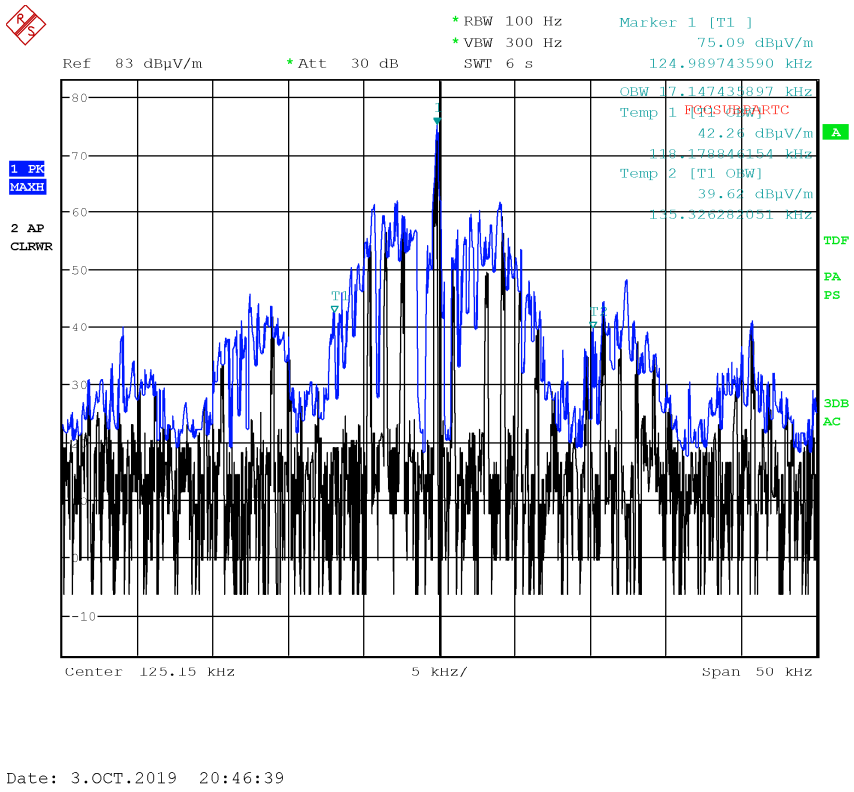

Figure 8.2-1: 99 % bandwidth 17.4 kHz

8.2.5 Test data, continued

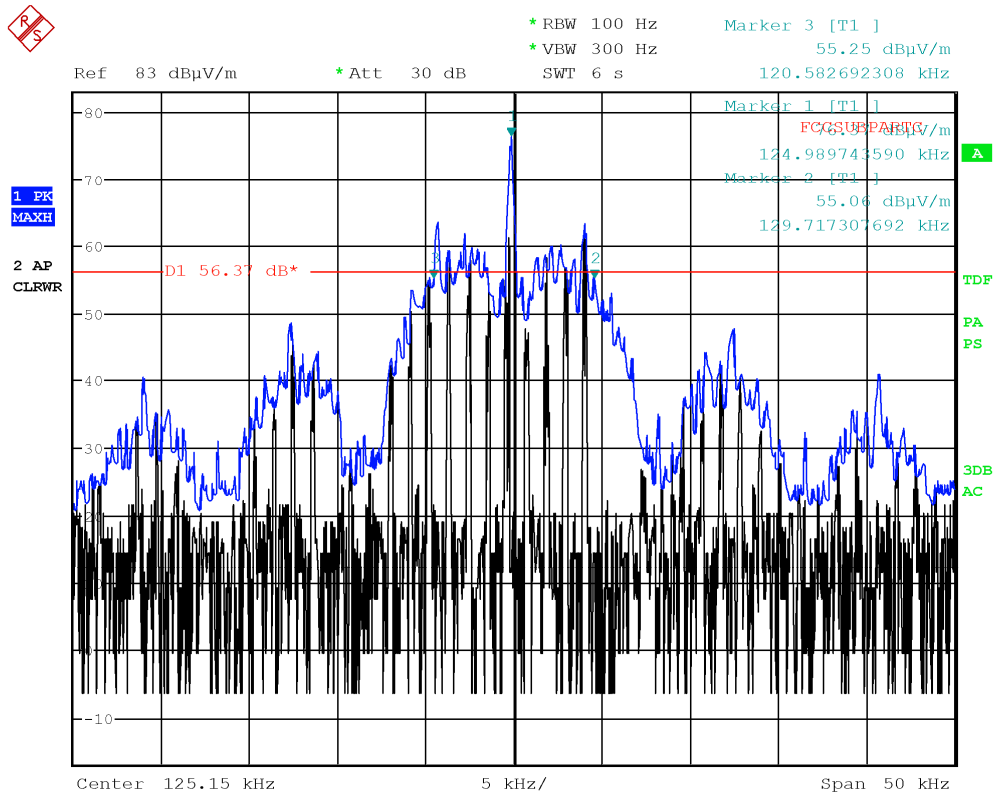

Figure 8.2-2: 20 dB bandwidth : 9.13 kHz

8.3 FCC 15.209(a) Radiated emissions limits

8.3.1 Definitions and limits

FCC:

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the Table 8.3-1 below.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

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Table 8.3-1: FCC §15.209– 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.

8.3.1 Definitions and limits, continued

8.3.2 Definitions and limits, continued

Table 8.3-2: 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			

8.3.3 Test summary

Test date:	2019-05-20	Temperature:	21 °C
Test engineer:	Daniele Guarnone	Air pressure:	1005 mbar
Verdict:	pass	Relative humidity:	35 %

Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.
EUT was set to transmit with 100 % duty cycle.
Radiated measurements were performed at a distance of 3 m, the EUT was transmitting on both MIMO chains simultaneously.
Since fundamental power was tested using average method, the spurious emissions limit is −30 dBc/100 kHz

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

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

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

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

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

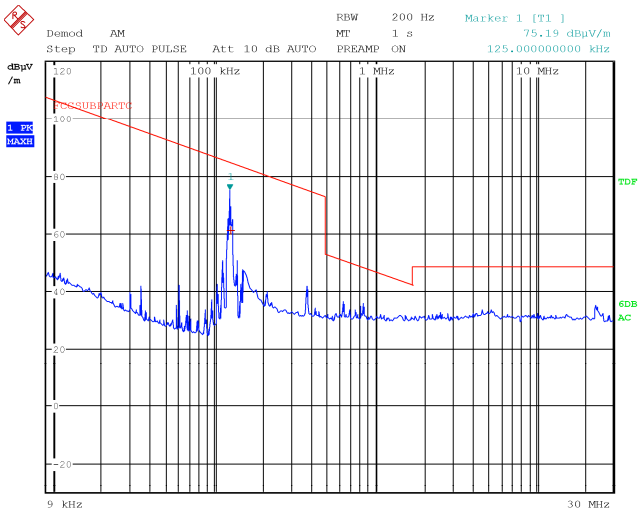
Resolution bandwidth:	1 MHz
Video bandwidth:	10 Hz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for conducted spurious emissions measurements:

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

8.3.4 Test data

8.3.4 Test data, continued



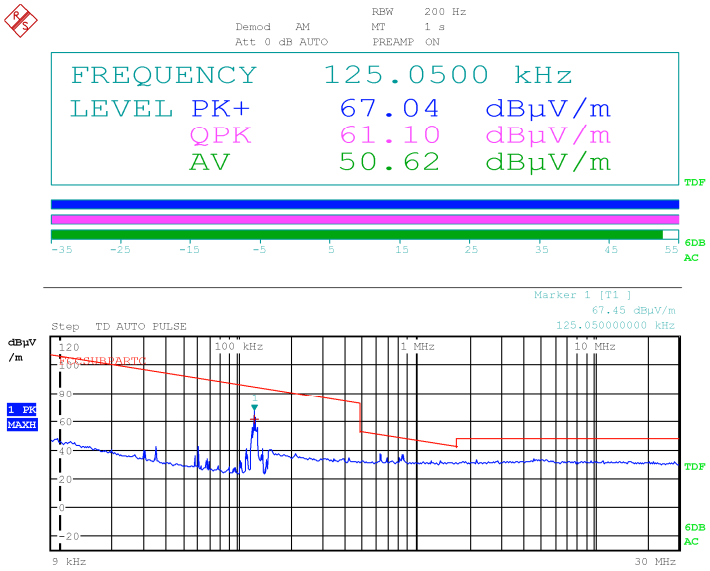
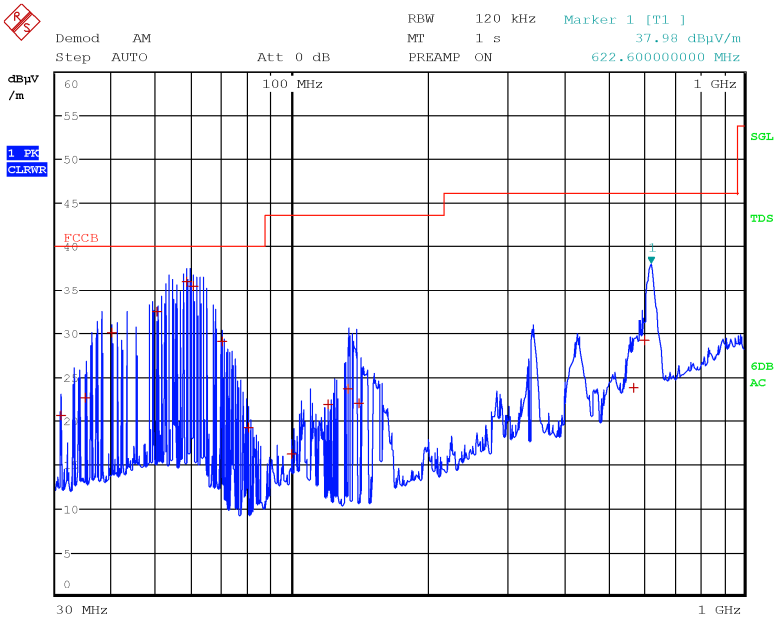


Figure 8.3-1: Radiated emissions

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
0.1252	61.1	84.7	-23.6	QP

8.3.4 Test data, continued



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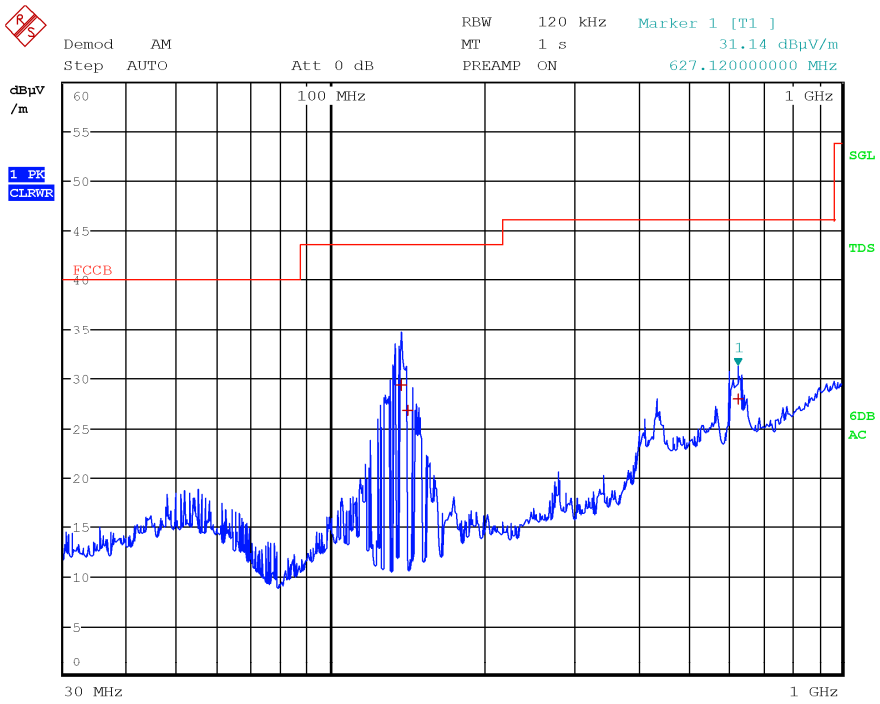
Antenna in vertical polarization @ 3 m

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
30.7600	20.7	40.0	-19.3	QP
34.9600	22.7	40.0	-17.3	QP
40.0000	30.1	40.0	-9.9	QP
50.2400	32.5	40.0	-7.5	QP
58.6000	36.1	40.0	-3.9	QP
60.6400	35.6	40.0	-4.4	QP
69.8800	29.1	40.0	-10.9	QP
80.1200	19.2	40.0	-20.8	QP
99.7200	16.2	43.5	-27.3	QP
120.2400	21.9	43.5	-21.6	QP
132.6800	23.7	43.5	-19.8	QP
140.8400	22.0	43.5	-21.5	QP
570.1200	23.8	46.0	-22.2	QP
604.8800	29.2	46.0	-16.8	QP

8.3.4 Test data, continued



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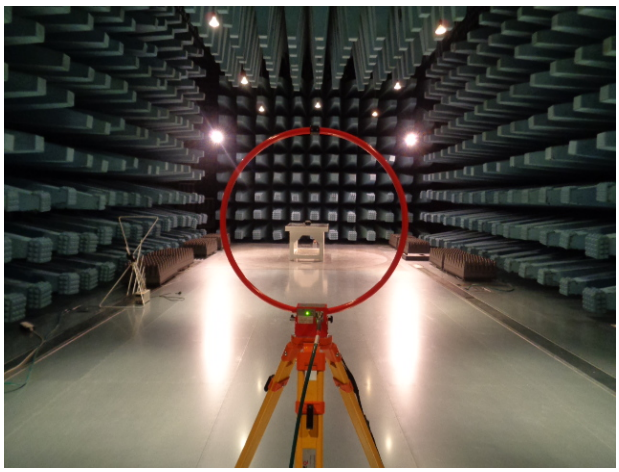
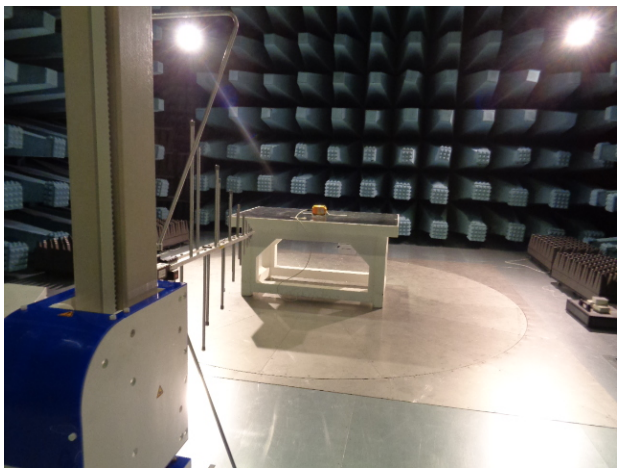
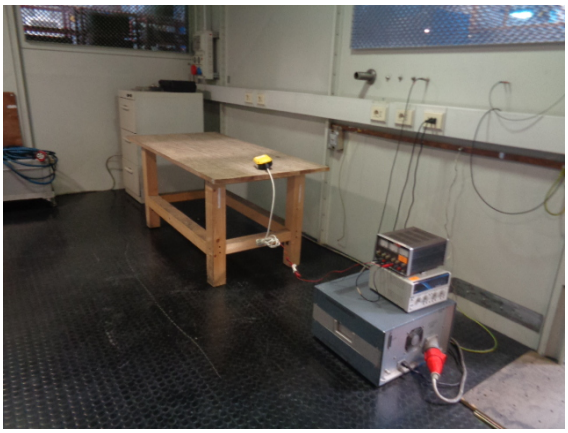
Antenna in horizontal polarization @ 3 m

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
137.1600	29.3	43.5	-14.2	QP
141.2800	26.8	43.5	-16.7	QP
627.1200	27.9	46.0	-18.1	QP

Setup photos

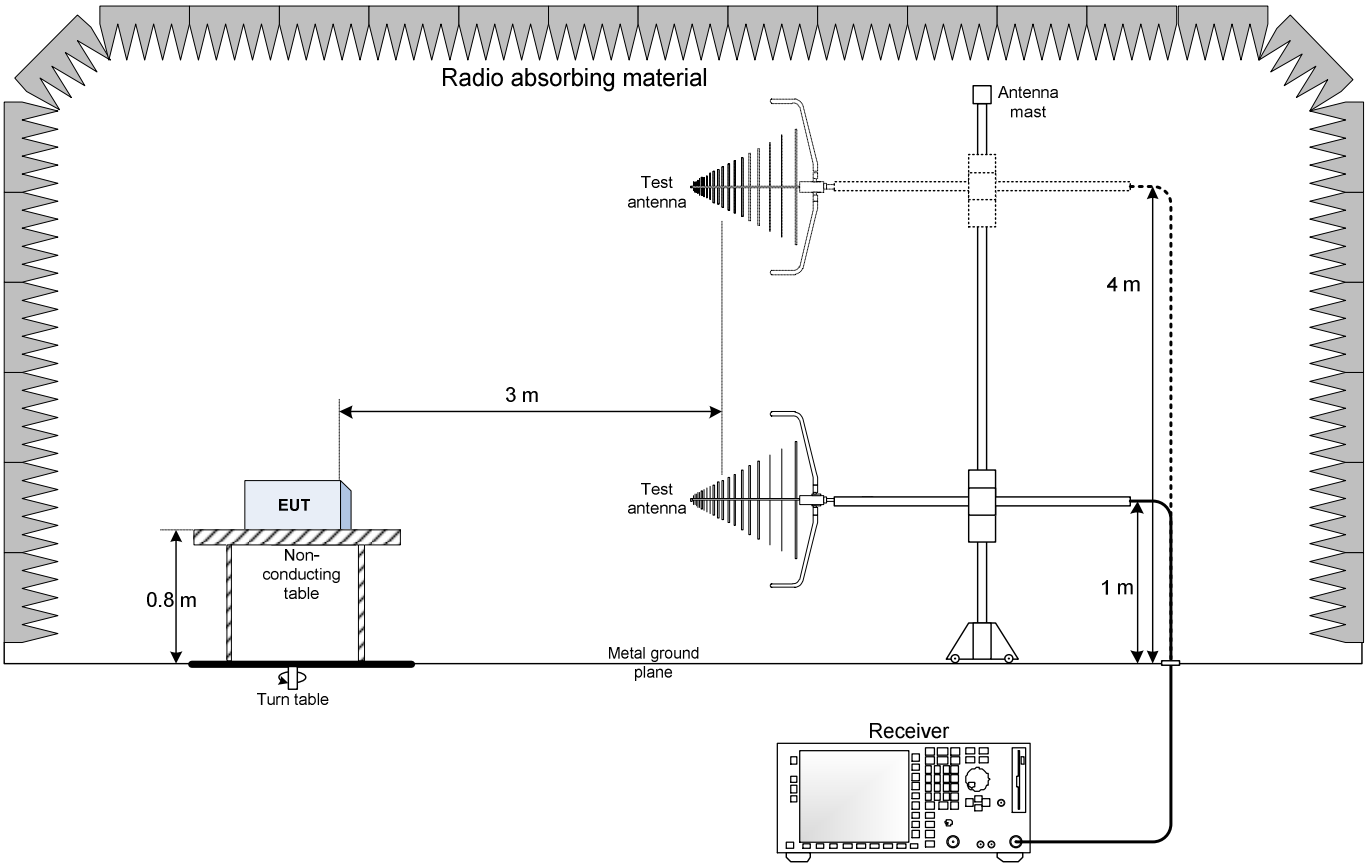


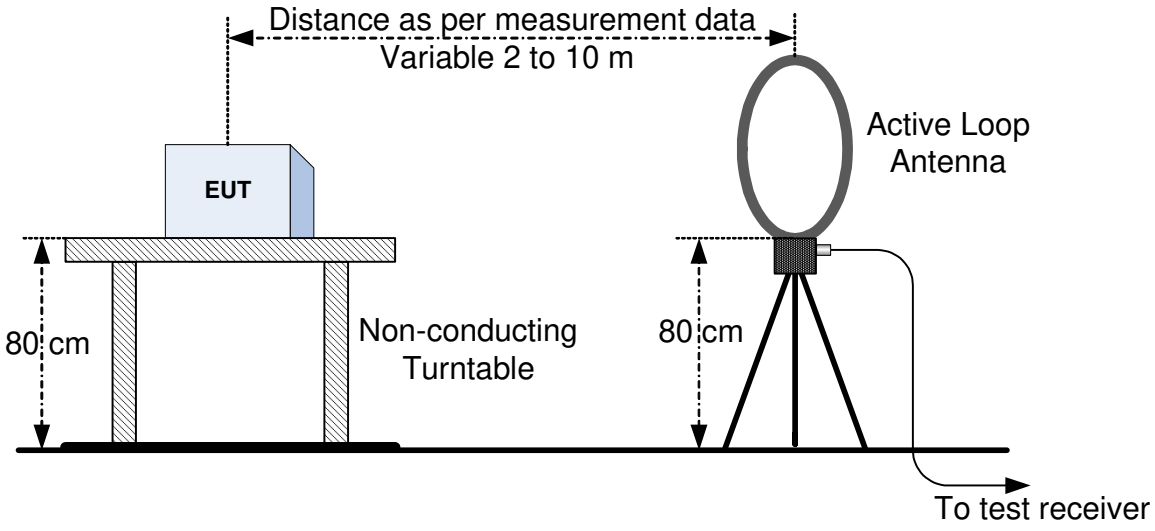




Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up





9.2 Conducted emissions set-up