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RTTE AND AUTOMOTIVE COMPONENTS LABORATORY

TEST REPORT
No. ARSN00025/3

performed in accordance with

FCC Rules: Code of Federal Regulations (CFR) no. 47
Part 15 Subpart C Section 15.249

PRODUCT	Vehicular remote control system
MODEL(s) TESTED	POWERDRIVE
FCC ID	O8IPOWERDRIVE
TRADE MARK(s)	SISTEMATICA
APPLICANT	SISTEMATICA S.p.A. – Via Sandro Pertini, 17 – I-12030 Manta

Tested by	Robertino Torri
	Francesco Lavanna
Approved by	Giorgio Belussi *[Laboratory head]*

Revision Sheet

Release No.	Date	Revision Description
Rev. 0	2013-04-24	First edition
Rev. 1	2013-05-10	§ 1 testing date; § 7.2 change duty cycle frequency measurement; § 7.5 test facility above 1 GHz;

1. GENERAL DATA

SAMPLE		
Samples received on	**2013-02-14**	**(item sent and sampling by applicant)**
IMQ reference samples	**BEM**	**67364**
Samples tested No.	1	
Object under analysis recognition	**Not carried out** Except where stated, characteristics of products were taken from client description and were not verified by the laboratory	
TEST LOCATION		
Testing dates	2013-02-20 ÷ 2013-04-24	
Testing laboratory.	IMQ S.p.A. - Via Quintiliano, 43 – I-20138 Milano	
Testing site	Viale Lombardia, 20 – I-20021 Bollate (MI) Via Quintiliano, 43 – I-20138 Milano	
ENVIRONMENTAL CONDITIONING		
Parameter	***Measured***	
Ambient Temperature	25 ÷ 35 °C	
Relative Humidity	50 ÷ 60 %	
Atmospheric Pressure	900 ÷ 1000 mbar	

2. REFERENCE DOCUMENT

DOCUMENT		DATE	TITLE
☒	47 CFR Part 15	2008	Radio Frequency Device
☒	ANSI C63.4	2009	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
☐	ANSI C63.10	2009	American National Standard for Testing Unlicensed Wireless Devices

3. UNIT UNDER TEST (EUT) DETAILS

GENERAL DATA

Model tested	POWERDRIVE
FCC ID	O8IPOWERDRIVE

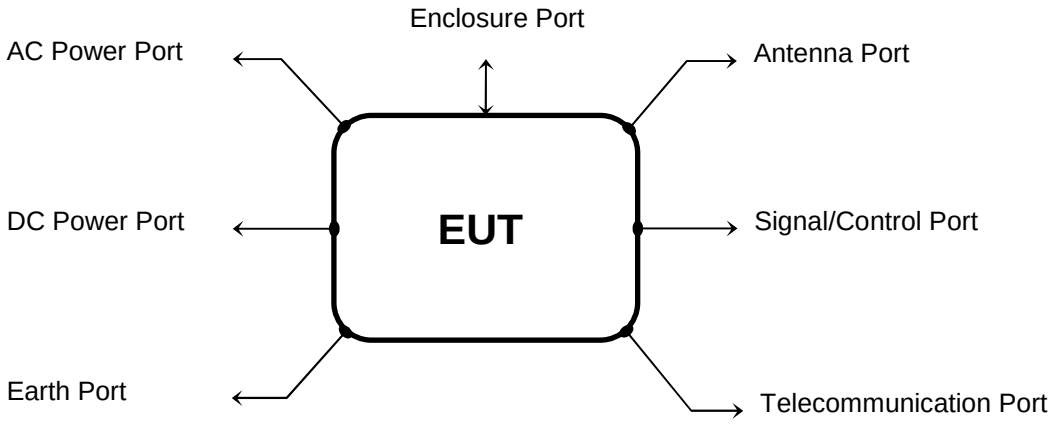
Manufacturer	SISTEMATICA S.p.A. – Via Sandro Pertini, 17 – I-12030 Manta

Equipment classification	According to the definition 15.3 (o) EUT is a **Intentional Radiator operating within the bands 902 ÷ 928 MHz** so it shall fulfill provisions of 47CFR Part 15 Subpart C – Intentional radiators – and Section 15.249

Type of equipment	Remote control for automotive control system
Power supply type	Vehicular battery supplied
Power specification	12 or 24 V DC
Operating frequency	915 to 918 MHz. Before working start there's the possibility to select the desired frequency (16 frequencies with 200 kHz step); only one frequency working it's possible
Maximum EIRP	82.35 dBµV/m
Modulation	FSK
Channel Spacing	200 kHz (During use you can select one of sixteen frequencies)
Antenna Type	Dedicated (soldered wire)
Peripherals included (for system application)	None
Interfaces	None
Integrated interfaces	None
AC adapter	/

4. TEST CONFIGURATION OF UNIT UNDER TEST

EUT PORTS



Port	Description	Max length
Enclosure	Non conductive case	/
AC power	Not present	/
DC power	12 or 24 V DC (from vehicular battery)	/
Earth	Not present	/
Telecommunication	Not present	/
Signal	Not present	/
Control	Not present	/
Antenna	Dedicated (soldered wire on PCB)	/

STATE OF THE EUT DURING TESTS

Ref.	Mode	Description
#1	Operating	Continuous modulated transmission with a duty cycle of 100%

SUPPORT EQUIPMENT

Defined as equipment needed for correct operation or loading of the EUT, but not considered as tested:

Equipment	Manufacturer	Model
None		

EUT TECHNICAL DOCUMENTATION

Document	Reference
None	/

5. METHODS OF MEASUREMENT

All compliance measurements have been carried out using the procedures described in the standard ANSI C63.4-2009 (excluding sub-par. 4.1.5.2, 5.7 9 and 14) and Section 15.31 of CFR47 Part 15 – Subpart A (General).

Additional test requirements have been adopted according to the reference Section indicated in the Test Table.

FREQUENCY RANGE INVESTIGATED

Radiated emission tests: from 9 kHz to tenth harmonic of fundamental.

6. SUMMARY OF TEST RESULTS

POSSIBLE TEST CASE VERDICTS:	
Test object does meet the requirement	PASS
Test object does not meet the requirement	FAIL
Test case does not apply to the test object	N.A.
Test not performed	N.P.

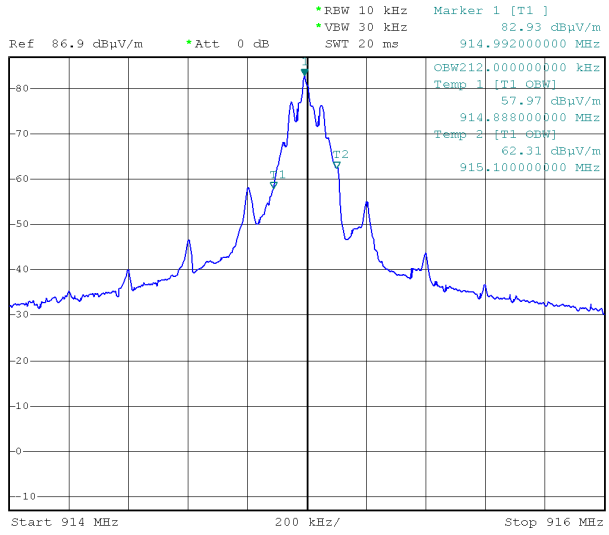
CFR47 Part 15	TITLE	RESULT
§ 2.202 (a)	Occupied bandwidth	Measured
§ 15.35 (c)	Pulse train measurement for pulsed operation	Measured
§ 15.203	Antenna Requirements	PASS
§ 15.205 (a)	Restricted band of operation	PASS
§ 15.205 (b) § 15.215 (b) § 15.249 (d)	Radiated Emission 9kHz to 30MHz 30MHz to 10GHz	PASS
§ 15.207 (a)	Conducted emission	N.A.
§ 15.215 (c)	Bandwidth of emission (20dB Bandwidth)	PASS
§ 15.249(a)	Maximum Peak Output Power	PASS
§ 15.249 (a)	Radiated emission measurement of harmonics	PASS
§ 1.1307(b)(1)	RF exposure evaluation	PASS

7. TEST RESULTS

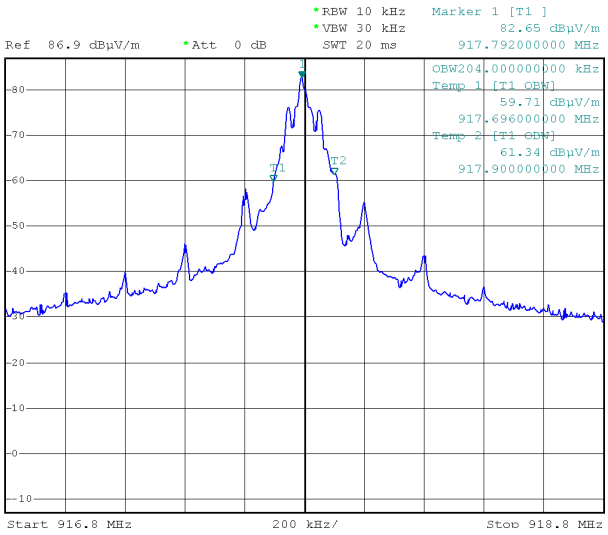
7.1 OCCUPIED BANDWIDTH

TEST REQUIREMENT
The frequency bandwidth according to CFR 47 Part 2, section 2.202(a) is measured as the 99% of emission bandwidth. The frequency bandwidth such that, below its lower and above its upper frequency limits, the mean power radiated are each equal to 0.5 percent of the total mean power radiated by a given emission. Guide ANSI C63.4 In order to measure the modulated signal properly, a resolution bandwidth that is small compared with the bandwidth required by the procuring or regulatory agency shall be used on the measuring instrument. However, the resolution bandwidth of the measuring instrument shall be set to a value within 1% to 5% of the signal bandwidth requirements.

Lowest frequency



Highest frequency



TEST RESULT	
Occupied bandwidth (99%)	218 kHz @915MHz and 210 kHz @918MHz

7.2 PULSE TRAIN MEASUREMENT FOR PULSED OPERATION

TEST REQUIREMENT

According to CFR 47 Part 15, section 15.35(c).

Guide ANSI C63.4

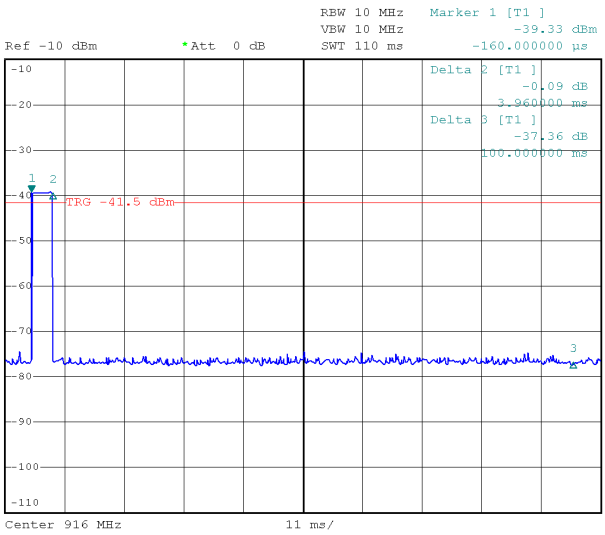
Devices transmitting pulsed emissions and subject to a limit requiring an average detector function for radiated emissions shall initially be measured with an instrument that uses a peak detector.

A radiated emission measured with a peak detector may then be corrected to a true average using the appropriate factor for emission duty cycle.

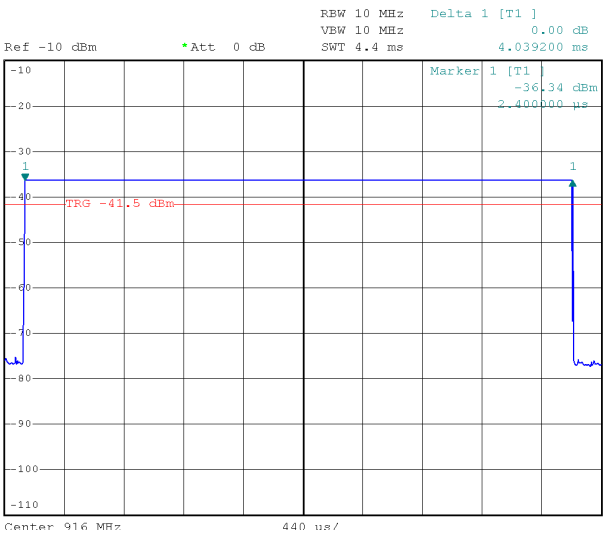
This correction factor relates the measured peak level to the average limit and is derived by averaging absolute field strength over one complete pulse train that is 0.1 s, or less, in length. If the pulse train is longer than 0.1 s, the average shall be determined from the average absolute field strength during the 0.1 s interval in which the field strength is at a maximum.

MEASUREMENTS RESULTS

Worst case 0.1 second interval



Total pulse train



TEST RESULT

T_{on}: 4.039 ms

Total period: 100 ms

Pulse train correction: 20*log (T_{on}/Total period) = –27.874 dB

Pulse train correction used = –20 dB

REMARKS

None

7.3 ANTENNA REQUIREMENTS

TEST REQUIREMENT
According to CFR 47 Part 15, section 15.203 / 15.204. 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 Sections 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 Section 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.

Antenna specifications	
N° of authorized antenna types	Not Applicable
Antenna type	Integral antenna
Maximum total gain	---
External power amplifiers	Not present

TEST RESULT
The EUT meets the requirements of sections 15.203 and 15.204.

7.4 RESTRICTED BAND OF OPERATION

TEST REQUIREMENT	
Test setup	ANSI C63.4
Test facility	Semi-anechoic chamber
Test distance	3 m
Frequency range	960 ÷ 1240
RBW bandwidth	100 kHz
VBW bandwidth	300 kHz
Detector	Peak
EUT operating condition	#1

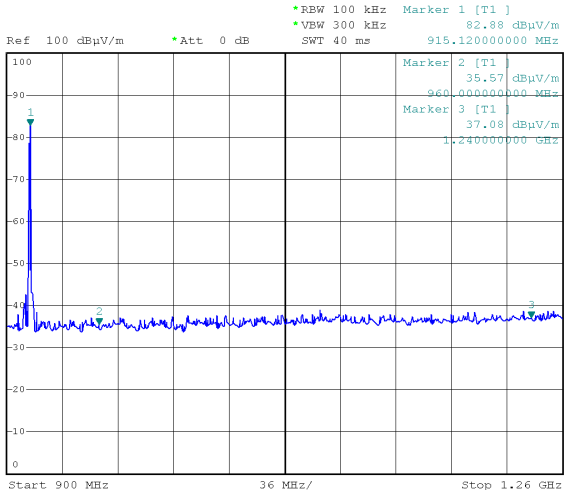
LIMITS

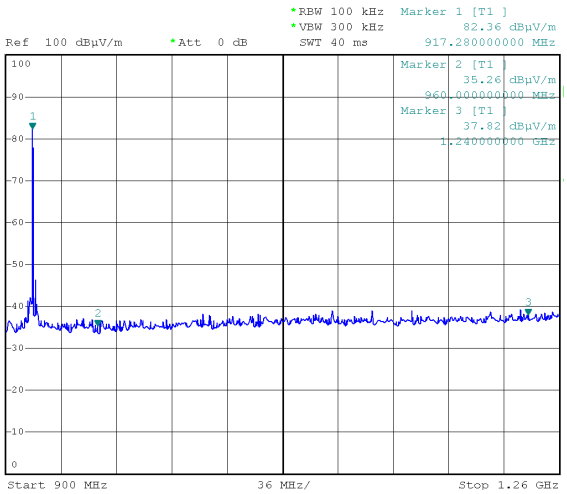
Band of operations	Peak (dBµV/m)	Average Limit (dBµV/m)
Restricted bands (§ 15.205)	74	54
Other bands	According to § 15.209 or fundamental –20dB (which is greater)	According to § 15.209 or fundamental –20dB (which is greater)

TEST PROCEDURE

1) The EUT was placed on turntable which is 0.8 m above the ground plane
2) The turntable shall rotate from 0° to 360°degrees to determine the position of maxim um emission level.
3) The EUT is positioned 3 m away from the receiving antenna which varied from 1 to 4 m to find the highest emission.
4) The measurements were made with EUT set to operate at 100% of duty cycle and maximum power with normal modulation
5) The receiving antenna was positioned in both horizontal and vertical polarization.

MEASUREMENTS RESULTS AT LOWEST AND HIGHEST FREQUENCY TRANSMISSION





TEST RESULT

The EUT meets the requirements of sections 15.205 (a)

7.5 RADIATED EMISSIONS

TEST REQUIREMENT	
Test setup	ANSI C63.4
Test facility	Semi-anechoic chamber below 1 GHz; for measurement above 1 GHz are used 2.4 m by 2.4 m RF absorbing material covering the ground plane between the antenna and the EUT
Test distance	3 meters
Frequency range	9 kHz to tenth harmonic of fundamental
IF bandwidth (below 30 MHz)	9 kHz
IF bandwidth (below 1,000 MHz)	120 kHz
IF bandwidth (above 1,000 MHz)	1 MHz
Deviation to test procedure	None
EUT operating condition	#1
Remark	(*) In accordance with part 15.31 (f) (2), where the measurement distance was specified to be 30 or 300 meters, a correction factor was applied in order to permit measurement to be performed at a separation distance. The applied formula for limits at 3 meter is: Extrapolation (dB) = 40log (300meter / 3meter) = +80dB Extrapolation (dB) = 40log (30meter / 3meter) = +40dB

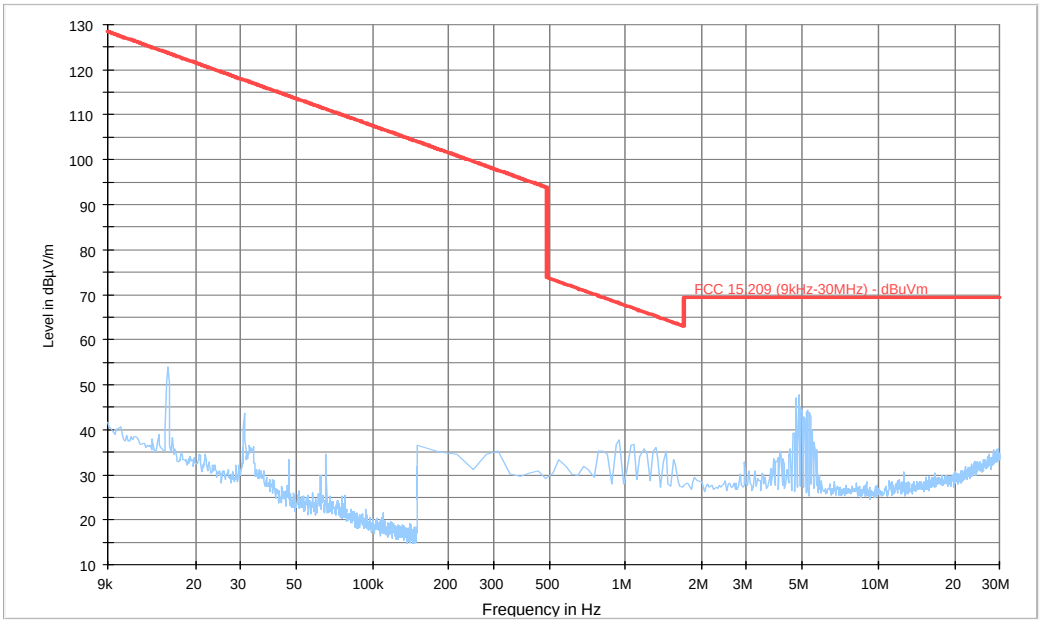
LIMITS		
Band of operations	**Peak Limit (dBµV/m)**	**Average Limit (dBµV/m)**
Restricted bands (§ 15.205)	74	54
Other bands	According to § 15.209 or fundamental –20dB (which is greater)	According to § 15.209 or fundamental –20dB (which is greater)

TEST PROCEDURE

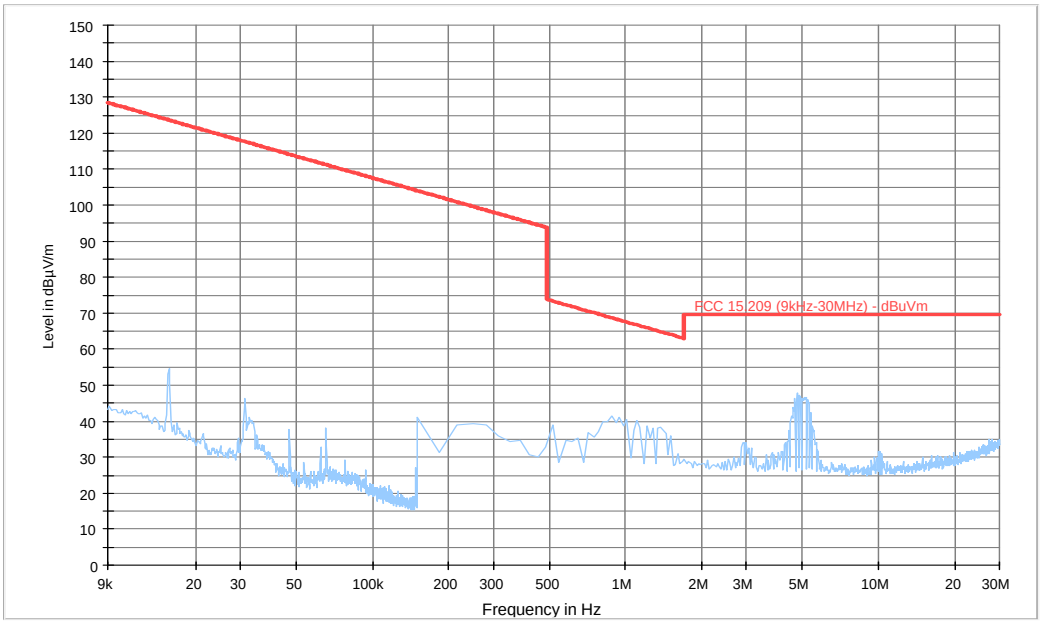
1) The EUT was placed on turntable which is 0.8 m above the ground plane
2) The turntable shall rotate from 0° to 360°degrees to determine the position of maxim um emission level.
3) The EUT is positioned 3 m away from the receiving antenna which varied from 1 to 4 m to find the highest emission.
4) The measurements were made with the detector set to **PEAK** amplitude within a bandwidth of 120 kHz below 1000 MHz and 1 MHz above 1000 MHz.
5) The receiving antenna was positioned in both horizontal and vertical polarization.
6) The measurements with Quasi-Peak detector, below 1000 MHz are performed only for frequencies for which the Peak values are ≥ Q.P. limit – 6 dB (♦ mark symbol).

MEASUREMENTS RESULTS

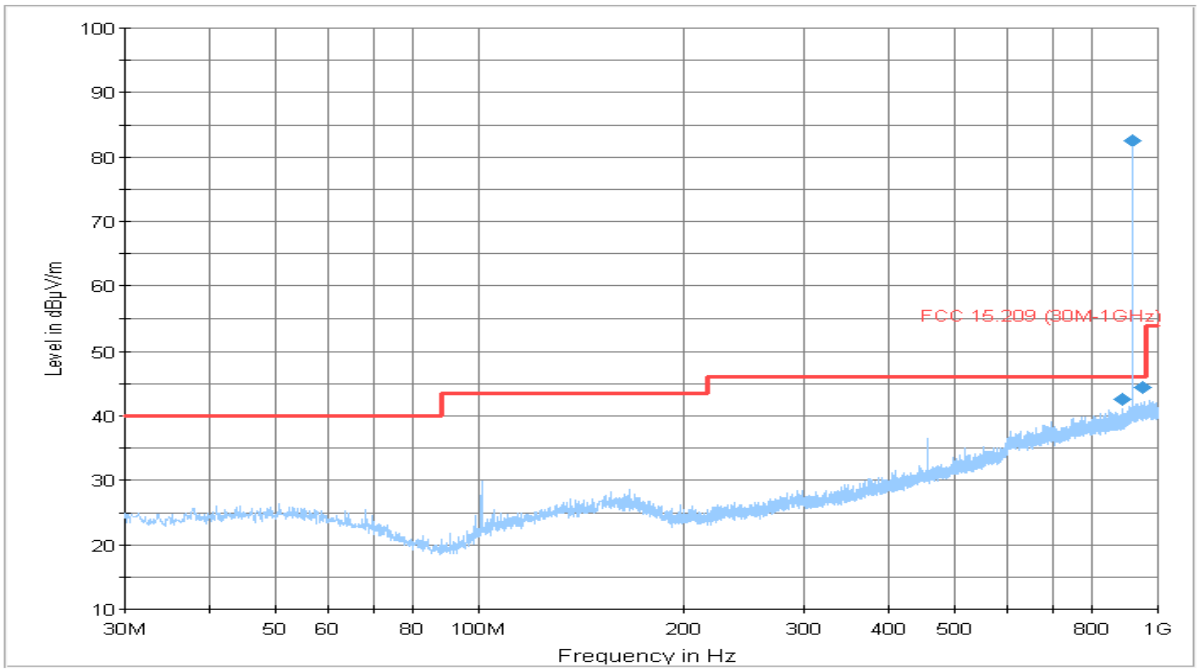
Range: 9kHz ÷ 30 MHz a lowest transmission frequency



Range: 9kHz ÷ 30 MHz a highest transmission frequency

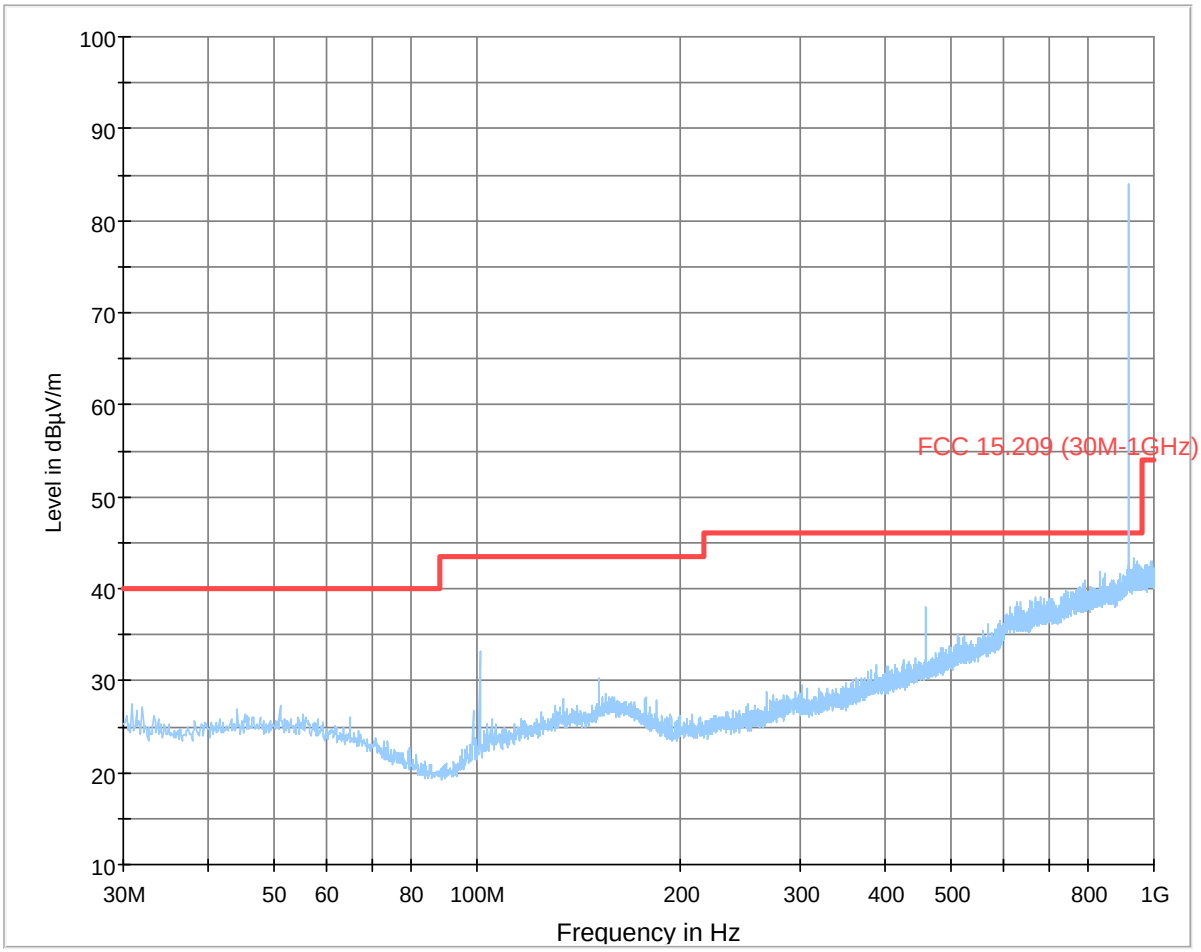


Range: 30 ÷ 1000 MHz a lowest transmission frequency



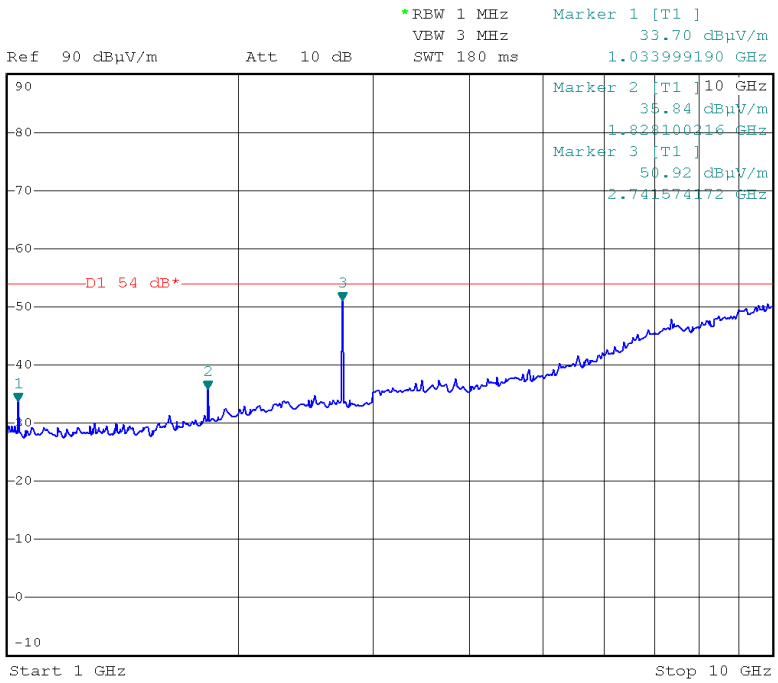
Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
886,103750	42,6	1000,0	120,000	99,9	V	95,0	26,5	3,40
915,003750	81,4	1000,0	120,000	99,9	V	-26,0	FUNDAMENTAL	
951,352500	44,4	1000,0	120,000	99,9	H	80,0	27,8	1,60

Range: 30 ÷ 1000 MHz a highest transmission frequency

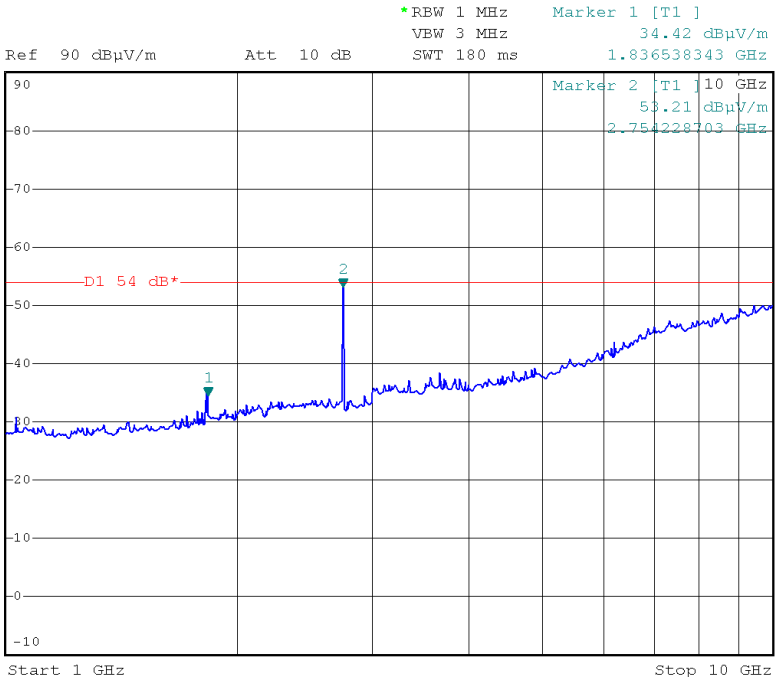


Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
918.04375	83.0	1000.0	120.000	141.0	V	24.4	FUNDAMENTAL	

Range: 1000 + 10000 MHz a lowest transmission frequency



Range: 1000 + 10000 MHz a highest transmission frequency



TEST RESULT

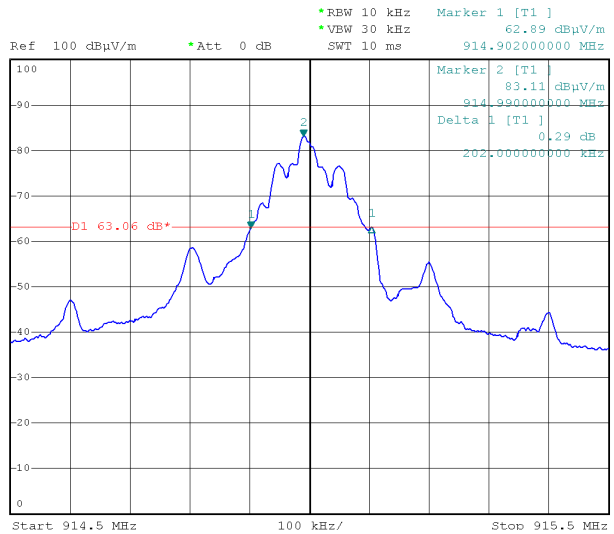
The EUT has been tested in 3 orthogonal axes and the results presented are worst case
The EUT meets the requirements of sections 15.205 (b), 15.215 (b) and 15.249 (d).

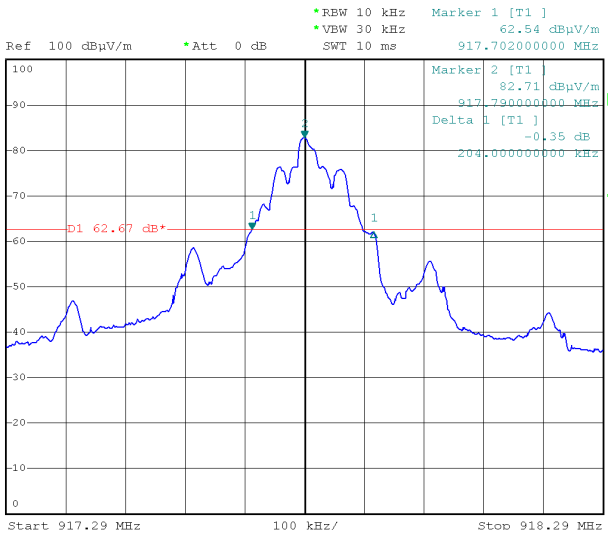
7.6 BANDWIDTH OF EMISSIONS

TEST REQUIREMENT	
Spectrum analyzer settings	
Span	Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
Resolution bandwidth (RBW)	10 kHz
Video bandwidth (VBW)	30 kHz
Sweep time (SWT)	Auto
Detector function	Peak
Trace	Max hold
Attenuator	/
Deviation to test procedure	None
EUT operating condition	#1
Remark	None

LIMITS
20 dB below peak output power

MEASUREMENTS RESULTS AT LOWEST AND HIGHEST FREQUENCY TRANSMISSION





TEST RESULT
All out of band spurious emissions are more 20 dB below the in band power of the fundamental in accordance to section 15.215 (c).

7.7 FIELD STRENGTH OF FUNDAMENTAL (DE FACTO EIRP)

TEST REQUIREMENT	
Spectrum analyzer settings	
Span	Wide enough to capture the peak level of the emission
Resolution bandwidth (RBW)	100 kHz
Video bandwidth (VBW)	Auto
Sweep time (SWT)	Auto
Detector function	Peak
Trace	Max hold
Attenuator	/
Deviation to test procedure	None
EUT operating condition	#1
Remark	None

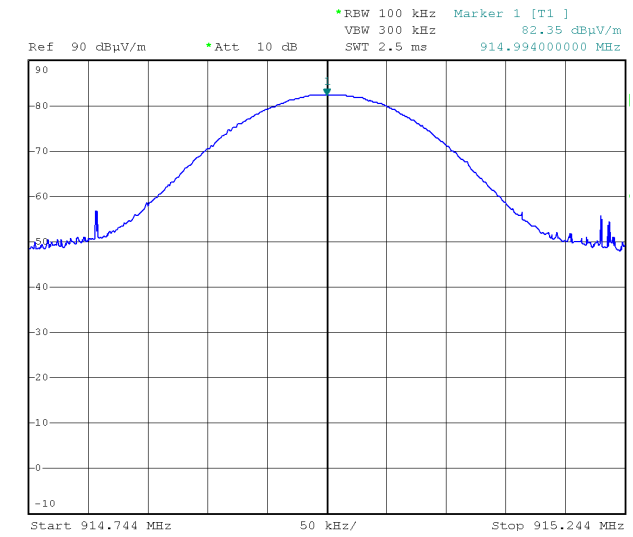
TEST PROCEDURE

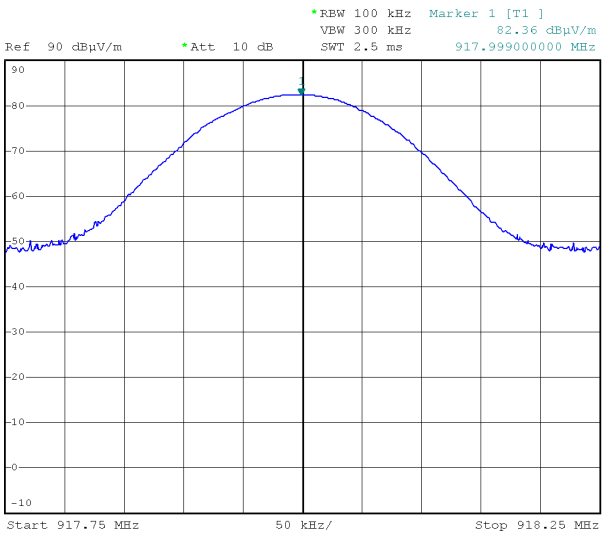
1) The EUT was placed on turntable which is 0.8 m above the ground plan
2) The turntable shall rotate from 0° to 360° degrees to determine the position of maxim um emission level.
3) The EUT is positioned 3 m away from the receiving antenna which varied from 1 to 4 m to find the highest emission.
4) The measurements were made with the detector set to PEAK amplitude within a bandwidth of 100 kHz.
5) The receiving antenna was positioned in both horizontal and vertical polarization.

LIMITS

94 dBµV/m

MEASUREMENTS RESULTS AT LOWEST AND HIGHEST FREQUENCY TRANSMISSION





TEST RESULT

The EUT meets the requirements of sections 15.249 (a).

7.8 FIELD STRENGTH OF HARMONICS

TEST REQUIREMENT	
Spectrum analyzer settings	
Resolution bandwidth (RBW)	1 MHz
Detector function	Peak
Trace	Max hold
Attenuator	/
Deviation to test procedure	None
EUT operating condition	#1
Remark	None

TEST PROCEDURE

1) The EUT was placed on turntable which is 0.8 m above the ground plan
2) The turntable shall rotate from 0° to 360° degrees to determine the position of maxim um emission level.
3) The EUT is positioned 3 m away from the receiving antenna which varied from 1 to 4 m to find the highest emission.
4) The measurements were made with the detector set to PEAK amplitude within a bandwidth of 100 kHz.
5) The receiving antenna was positioned in both horizontal and vertical polarization.

MEASUREMENTS RESULTS AT LOWEST FREQUENCY TRANSMISSION

Frequency MHz	Antenna polarization	Detector	Receiver reading dBµV	Correction factor dB	Final value dBµV/m	Limit dBµV/m	Margin dB
1830	V	Peak	52.15	–10.55	41.60	74	32.40
2745	V	Peak	67.83	–7.09	60.74	74	13.26

MEASUREMENTS RESULTS AT HIGHEST FREQUENCY TRANSMISSION

Frequency MHz	Antenna polarization	Detector	Receiver reading dBµV	Correction factor dB	Final value dBµV/m	Limit dBµV/m	Margin dB
1830	V	Peak	50.82	–10.55	40.28	74	33.72
2754	V	Peak	66.90	–7.09	59.81	74	14.19

TEST RESULT

All out of band spurious emissions are more 20 dB below the in band power of the fundamental.
The EUT meets the requirements of sections 15.249 (a).

7.9 RF EXPOSURE EVALUATION

TEST REQUIREMENT	
Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines § 1.1307(b)(1).	
EUT classification (fixed, mobile or portable devices)	Fixed on board vehicle
Deviation to test procedure	None
EUT operating condition	#1
Remark	None

Limit for maximum permissible Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Avarage Time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3÷3.0	614	1.63	(100)*	6
3.0÷30	1842/f	4.89/f	($900/f^2$)*	6
30÷300	61.4	0.163	1.0	6
300÷1500	--	--	f/300	6
1500÷100,000	--	--	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3÷3.0	614	1.63	(100)*	30
3.0÷30	824/f	2.19/f	($180/f^2$)*	30
30÷300	27.5	0.073	0.2	30
300÷1500	--	--	f/1500	30
1500÷100,000	--	--	1.0	30
F = Frequency in MHz *Plane-wave equivalent power density				

The distance from the device's transmitting antenna where the exposure level reaches the maximum permitted limit is calculated using the general equation:

$S = P*G/ 4\pi R^2$

Where:
S = Power Density (mW/cm^2)
P = Conducted power (mW)
G = Linear power gain relative to isotropic radiator (numeric gain)
R = Distance (cm)

RF Exposure evaluation

Low threshold limit			
Exposure category	**Frequency range *f*MHz**	**Limit**	**Limit value (mW/cm^2)**
General population	918	f_{MHz}/ 1500	0.612

Both conducted and radiated (EIRP) output power values must be compared to the threshold limit.

MEASUREMENTS RESULTS

T_{on} (ms)	Total Period (ms)	Time average factor (dB)	Source-based time averaged output (dBm)	Source-based time averaged output (mW)
4.039	100	-20.00	-32.88	0.00052

The time average factor is calculated as follows:

10 * log (T_{on} / *Total Period*) dB

T_{on} and *Total Period* are expressed in ms; measured values are:

T_{on} = 4.039 ms

Total Period = 100 ms

The resulting time average factor used is –20.00 dB

The highest output power (radiated) is -12.88 dBm (82.35 dBµV/m). Therefore the averaged output power is calculated as follows:

-12.88 -20.00 = -32.88 dBm (0.00052 mW)

TEST RESULT

This value is less than the low threshold limit corresponding to the general population exposure category and therefore no SAR test is required.

The value is calculated used the Total period similar then the associated wireless equipment.

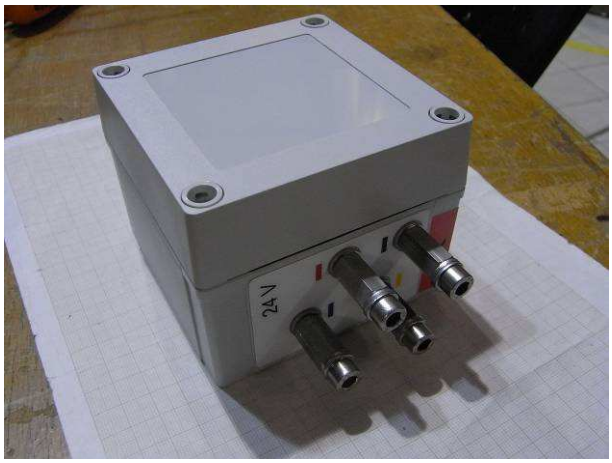
8. LIST OF MEASURING EQUIPMENT AND CALIBRATION INFORMATION

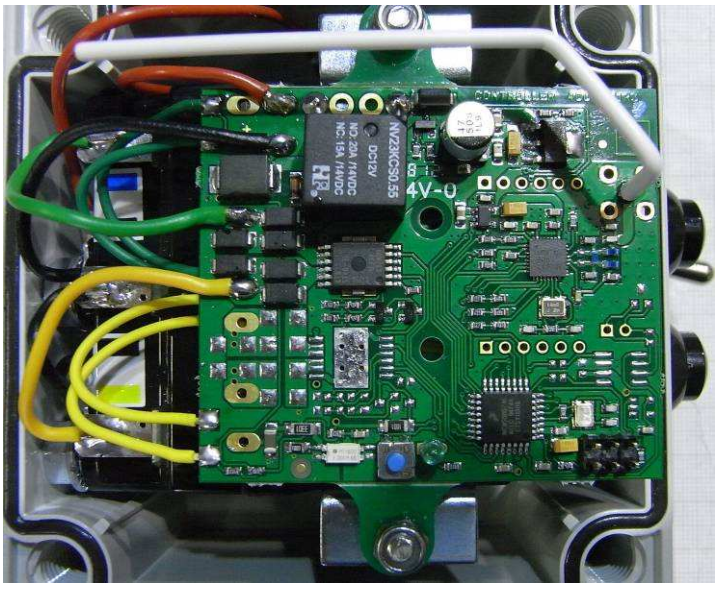
IMQ Serial Number	Instrument	Manufacturer	Type	Last Cal.	Cal. Period.	Calibration Company
P01709	Shielded semi-anechoic chamber	SIDT	/	03/2013	12	IMQ
S05562	EMI Receiver	Rohde & Schwarz	ESU 8	08/2012	12	ROHDE & SCHWARZ
S03629	Spectrum Analyzer	Rohde & Schwarz	FSP40	10/2012	12	I.N.RI.M.
S02349+S02350	Receiver	Rohde & Schwarz	ESMI + ESMI-RF	06/2012	12	I.N.RI.M.
S02508	Loop Antenna	Rohde & Schwarz	HFH2-Z2	01/2012	24	SEIBERSDORF
S06463	Bilog Antenna	Schwarzbeck	VULB9160	03/2013	36	NPL
S03464	Horn Antenna	Schwarzbeck	BBHA 9120D	08/2011	36	NPL
S03542	Preamplifier	Hewlett Packard	HP 8449B	02/2011	24	IMQ
S04193	Preamplifier	Bonn Elektronik	BLNA 0110-15C35	02/2011	24	IMQ
S03745	Oscilloscope	Yokogawa	DL 7200	07/2012	12	AVIATRONIK
S04308	Band Reject Filter 2400÷2483 MHz	Wainwright	WRCG2400/ 2483	09/2012	12	IMQ
S04309	Highpass Filter 3.4÷18 GHz	Wainwright	WHK3.4/18	09/2012	12	IMQ
S04467	Crystal Detector	Agilent	8472B	/	/	/
S04159	Multimeter	Fluke	45	04/2013	12	IMQ
S01340	Meter-graph	Salmoiraghi	1656/2B	03/2013	12	IMQ
W-00124-ME+	Software for test automation	Rohde & Schwarz	EMC 32 Vers. 8.30	/	/	/

Note: The IMQ instruments are tested and calibrated according to UNI EN 45001, the IMQ procedure IP-037 "Calibration test equipment and measurement" and according to plans set on IMQ operating instruction IO-FT-034 “Criteria for the calibration of test equipment and measurement” which are an integral part of the Quality Manual of IMQ.

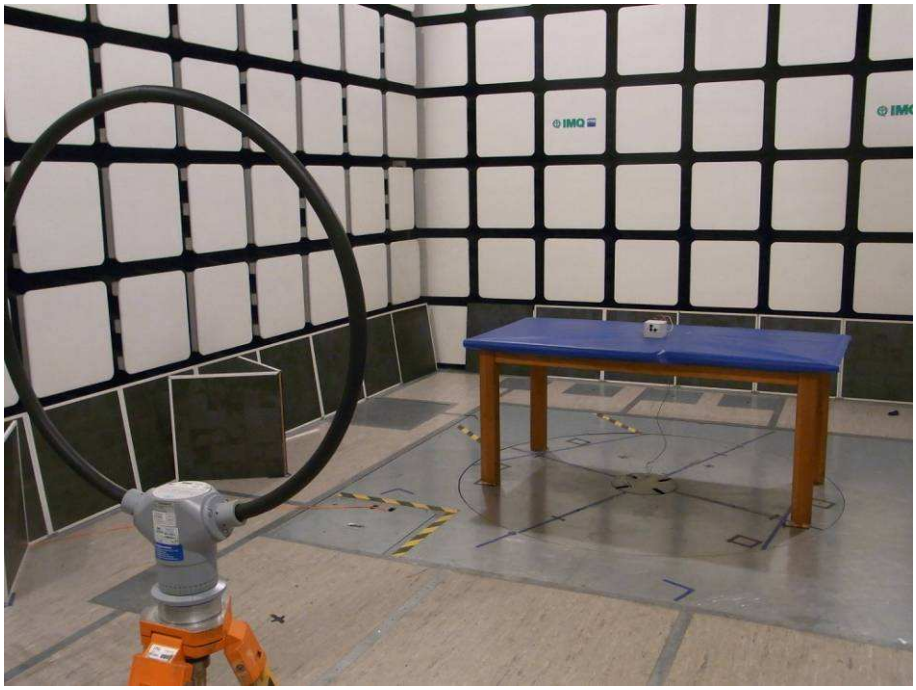
10. PHOTOGRAPHIC DOCUMENTATION

EUT IDENTIFICATION





SET-UP



END OF REPORT