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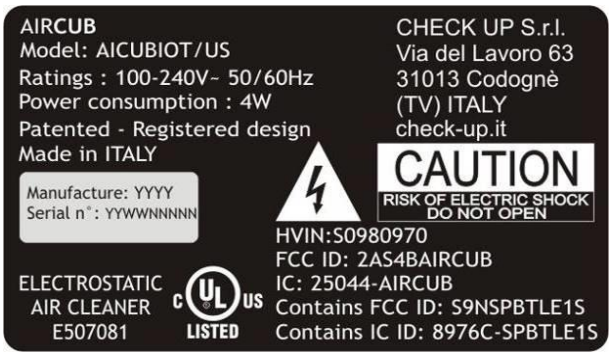
TEST REPORT
No. PE18-0032071-03

performed in accordance with

FCC Rules: Code of Federal Regulations (CFR) no. 47

Part 15 Subpart C Sections 15.207, 15.209, 15.215 and 15.225 for 13.56 MHz frequency transmitter

PRODUCT	AIRCUB - 13.56 MHz and Bluetooth Low Energy modules integrated
MODEL(s) TESTED	AICUBIOT/US
FCC ID	2AS4BAIRCUB
TRADE MARK(s)	

APPLICANT	CHECK UP S.r.l – Via del Lavoro 63 – 21013 Codognè (TV)

Tested by	Alessandro Macrì *[Laboratory technician]* Luigi Panzeri *[Laboratory technician*	
Approved by	Giovanni Di Turi *[Laboratory manager]*	

Revision Sheet

Release No.	Date	Revision Description
Rev. 0	2019-07-01	First edition Digital signed - PE18-0032071-03_TR_FCC_Part 15C_Check Up_AICUBIOT

1. GENERAL DATA

SAMPLE		
Samples received on	**2019-04-09**	**(Item(s) sampled and sent by applicant)**
IMQ reference samples	**BEM**	**95144**
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	
Date of acceptance of test item	2019-05-30	
TEST LOCATION		
Testing dates	2019-05-30	
Testing laboratory	IMQ S.p.A. - Via Quintiliano, 43 – I – 20138 Milano	
Testing site	Via Quintiliano, 43 – I – 20138 Milano	
ENVIRONMENTAL CONDITIONING		
Parameter	***Measured***	
Ambient Temperature	23.5 °C	
Relative Humidity	50.3 %	
Atmospheric Pressure	1004 mbar	
The laboratory is monitored by a continuous environmental conditions measurements system. Temperature, humidity and pressure data are recorded on a weekly basis and stored in local archive.		
REMARKS		
Throughout this report a point is used as the decimal separator. The ability or reliability of this product to perform its intended function in a particular application has not been investigated. IMQ declines any responsibility derived from missing or wrong information provided aside by the applicant.		

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2. REFERENCE DOCUMENT

DOCUMENT		DATE	TITLE
☒	47 CFR Part 15	2015	Radio Frequency Device
☒	ANSI C63.4	2014	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	2013	American National Standard for Testing Unlicensed Wireless Devices

3. UNIT UNDER TEST (EUT) DETAILS

GENERAL DATA

MODEL (basic)	Description
AICUBIOT	Air purifier and air freshener with ion and ozone technology with 13.56 MHz and Bluetooth Low Energy modules integrated
MODEL (derivated)	**Description**
/	/

FCC ID	2AS4BAIRCUB

Contains FCC ID module	S9NSPBTLE1S

Manufacturer	CHECK UP S.r.l – Via del Lavoro 63 – 21013 Codognè (TV)

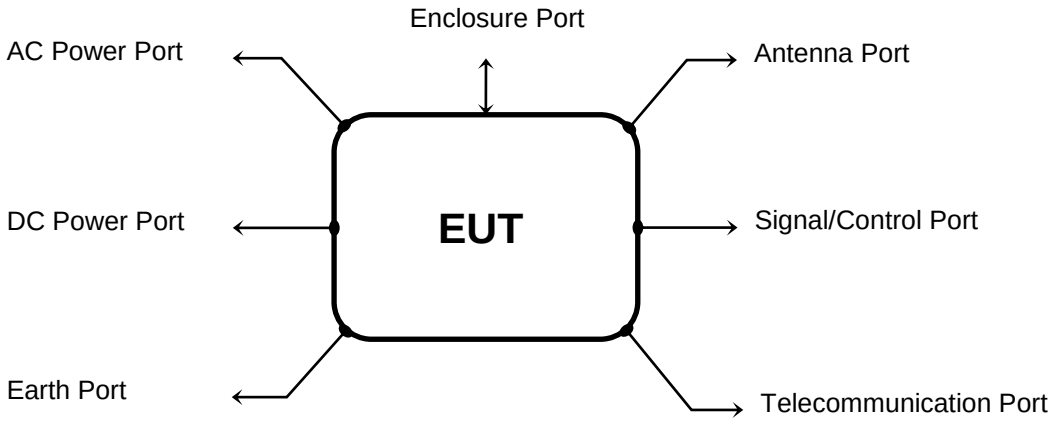
Type of equipment	RFID transmitter
Operating frequency	13.56 MHz
Max radiated power	/
Modulation	/
Channel Spacing	/
Channel bandwidth	/
Antenna	Integrated
Number of channels	1

Type of equipment	Radio module *IC-ID 8976C-SPBTLE1S*
Operating frequency	2402 ÷ 2480 MHz
Equipment Class	DTS
Max radiated power	101.09 dBµV/m (at 3m distance)
Modulation	GFSK
Channel Spacing	2MHz
Channel bandwidth	1MHz
Antenna	Ceramic antenna (Johanson Technology p/n 2450AT18A100E) peak gain: +0.5 dBi average gain: -0.5 dBi
Number of channels	40

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	2402	2	2404	3	2406	4	2408
5	2410	6	2412	7	2414	8	2416
9	2418	10	2416	11	2422	12	2424
13	2426	14	2420	15	2430	16	2432
17	2434	18	2424	19	2438	20	2440
21	2442	22	2428	23	2446	24	2448
25	2450	26	2432	27	2454	28	2456
29	2458	30	2436	31	2462	32	2464
33	2466	34	2440	35	2470	36	2472
37	2474	38	2444	39	2478	40	2480

4. TEST CONFGURATION OF UNIT UNDER TEST

EUT PORTS



Port	Description	Max length
Enclosure	Plastic	/
AC power	100-240V 50/60 Hz	/
DC power	/	/
Signal/ Control	/	/
Antenna	Integrated	/

STATE OF THE EUT DURING TESTS

Ref.	Mode	Description
#1	Operating	Continuous transmission on NFC module and BTLE module activated and in normal condition

SUPPORT EQUIPMENT

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

Equipment	Manufacturer	Model
/	/	/

ELECTROMAGNETICALLY RELEVANT COMPONENTS

Component	No.	Manufacturer	Model
Mainboard	1	CHECK UP	CS980970.6
NFC reader	1	ST	ST25R3911B
Ionizer module	1	MURATA	MHM305
Bluetooth Low Energy 4.2	1	ST	SPBTLE-1S
Switching power supply 12Vdc Output 5 Vdc Output	2	MEAN WELL	IRM-02
Fan	1	SUNON	MF50151V1-B00U-A99

Firmware version: F131701_B12

RFI SUPPRESSION DEVICES

Component	No.	Manufacturer	Model
Capacitor	2	KEMET	R46KF310000P1M
Varistor	1	EPCOS	S10K275G5

EMI PROTECTION DEVICES

Component	No.	Manufacturer	Model
/	/	/	/

EUT TECHNICAL DOCUMENTATION

Document	Reference
/	/

5. METHODS OF MEASUREMENT

All compliance measurements have been carried out using the procedures described in the standard ANSI C63.4:2014, ANSI C63.10:2013 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 § 6 of this test report.
FREQUENCY RANGE INVESTIGATED
Conducted emission tests: from 150 kHz to 30 MHz. Radiated emission tests: from 9 kHz to tenth harmonic of fundamental (or 1GHz)

6. SUMMARY OF TEST RESULTS

POSSIBLE TEST CASE VERDICTS:	
Test object meets 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
§ 15.203	Antenna Requirements	PASS
§ 15.207 (a)	Conducted Emission	PASS
§ 15.209	Radiated Disturbance and Field Strength	PASS
§ 15.215 (c)	Occupied Bandwidth (20 dB)	PASS
§ 15.225 (a)	Field Strength emissions within the band 13.553–13.567 MHz	PASS
§ 15.225 (c)	Field Strength emissions outside of the band 13.110–14.010 MHz	PASS
§ 15.225 (e)	Frequency Tolerance	PASS

7. TEST RESULTS

7.1 ANTENNA REQUIREMENTS

TEST 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 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.

Testing dates	2019-05-30

Antenna specifications	
N° of authorized antenna types	1 for 13.56 MHz
Antenna type	Integrated on PCB
Antenna size	---
Maximum total gain	---
External power amplifiers	Not present

TEST RESULT
The EUT meets the requirements of section 15.203 and 15.204

7.2 CONDUCTED DISTURBANCES

TEST REQUIREMENT	
Test setup	ANSI C63.4
Frequency range	150 kHz ÷ 30 MHz
IF bandwidth	9 kHz
EMC class	B
Limits	sections 15.207 (a)
EUT operating condition	#1
Remark	None
Testing dates	2019-05-30
Tested by	Luigi Panzeri

TEST RESULT
The EUT meets the requirements of sections 15.207.

TEST PROCEDURE
1) The EUT was placed on a wooden table of size, 80 cm by 80 cm, raised 80 cm in which is located 40 cm away from the vertical wall the shielded room.
2) Each EUT power cord input cord was individually connected through a 50Ω/50µH LISN to the input power source.
3) Exploratory measurements (on both phase and neutral conductor) were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
4) The final test on all current-carrying conductors (L1 and N) of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
5) The measurements were made with the detector set to PEAK and AVERAGE amplitude within a bandwidth of 10 kHz during the measurements.
6) The measurements with Quasi-Peak detector are performed only for frequencies for which the Peak values are ≥ (Q.P. limit - 6 dB).

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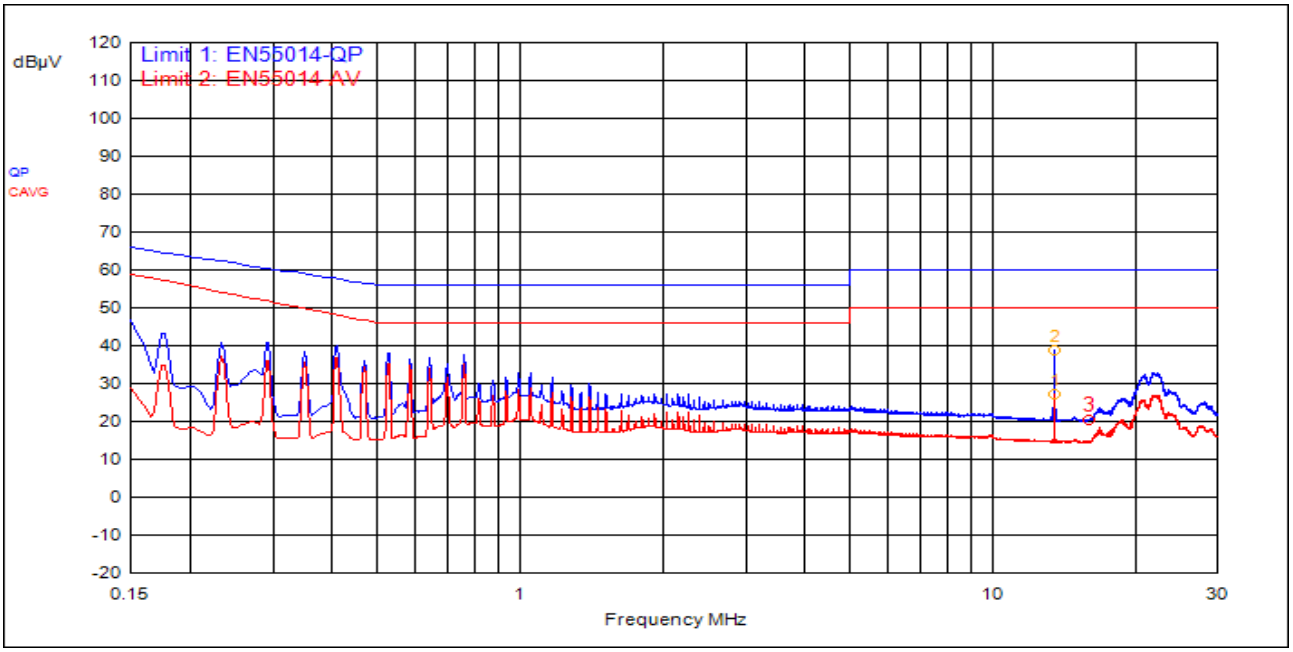
MEASUREMENTS RESULTS

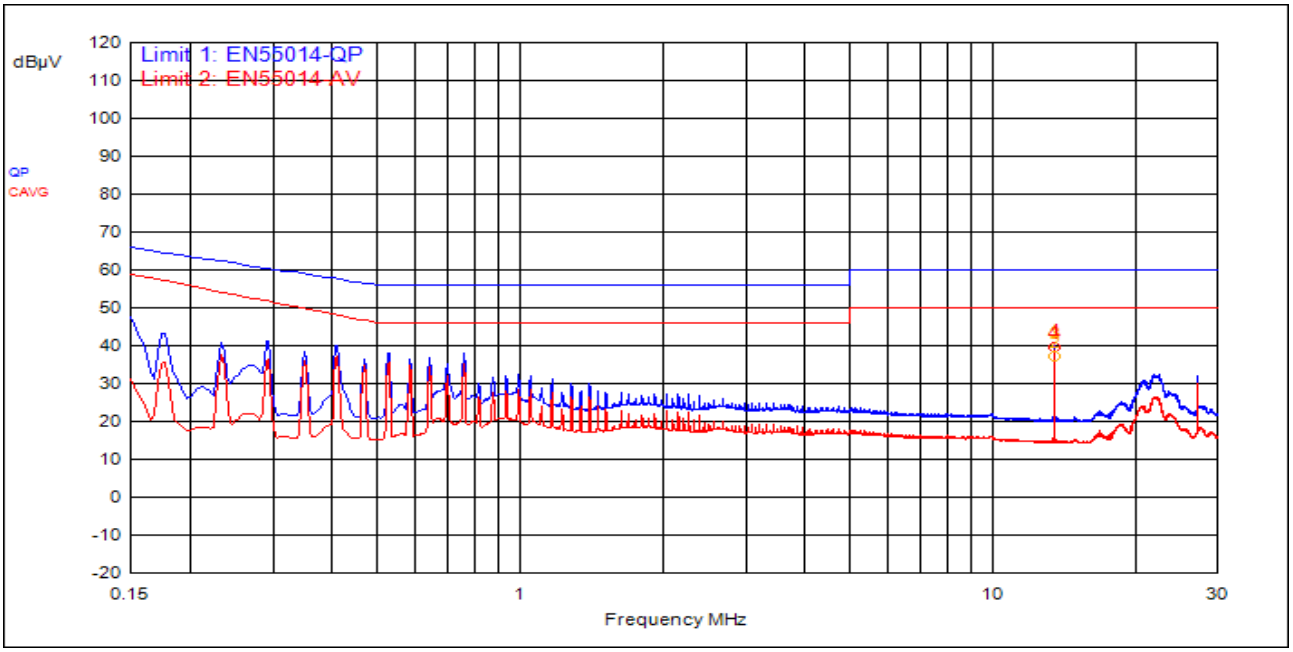
MAINS SUPPLY POWER PORT OF AC/DC ADAPTER (N and L1 conductor)
Line: 120V 60 Hz

AC 120V, 60 Hz – without TAG



ID	Frequency	Cable	Atten.	Detector	Meter Read	Meas Level	Limit	Limit Dist.
2	13.560MHz	0.1	10.0	QPeak	28.8	38.9	60.0	-21.1
1	13.560MHz	0.1	10.0	C_AVG	17.2	27.2	50.0	-22.8
3	16.014MHz	0.1	10.0	QPeak	10.2	20.3	60.0	-39.7

AC 120V, 60 Hz – with TAG



ID	Frequency	Cable	Atten.	Detector	Meter Read	Meas Level	Limit	Limit Dist.
4	13.560MHz	0.1	10.0	QPeak	29.8	39.8	60.0	-20.2
2	13.563MHz	0.1	10.0	QPeak	26.9	37.0	60.0	-23.0

7.3 RADIATED DISTURBANCES

TEST REQUIREMENT	
Test setup	ANSI C63.4
Test facility	Semi-anechoic chamber
Test distance	3 meters
Frequency range	9 kHz to tenth harmonic of fundamental (or 1 GHz)
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
Limits	sections 15.209 (a)
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
Testing dates	2019-05-30
Tested by	Luigi Panzeri

TEST RESULT
The EUT meets the requirements of sections 15.209 (a)

LIMITS FOR SPURIOUS		
Band of operations	**Peak (dBµV/m)**	**Average Limit (dBµV/m)**
Restricted bands (par. 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)

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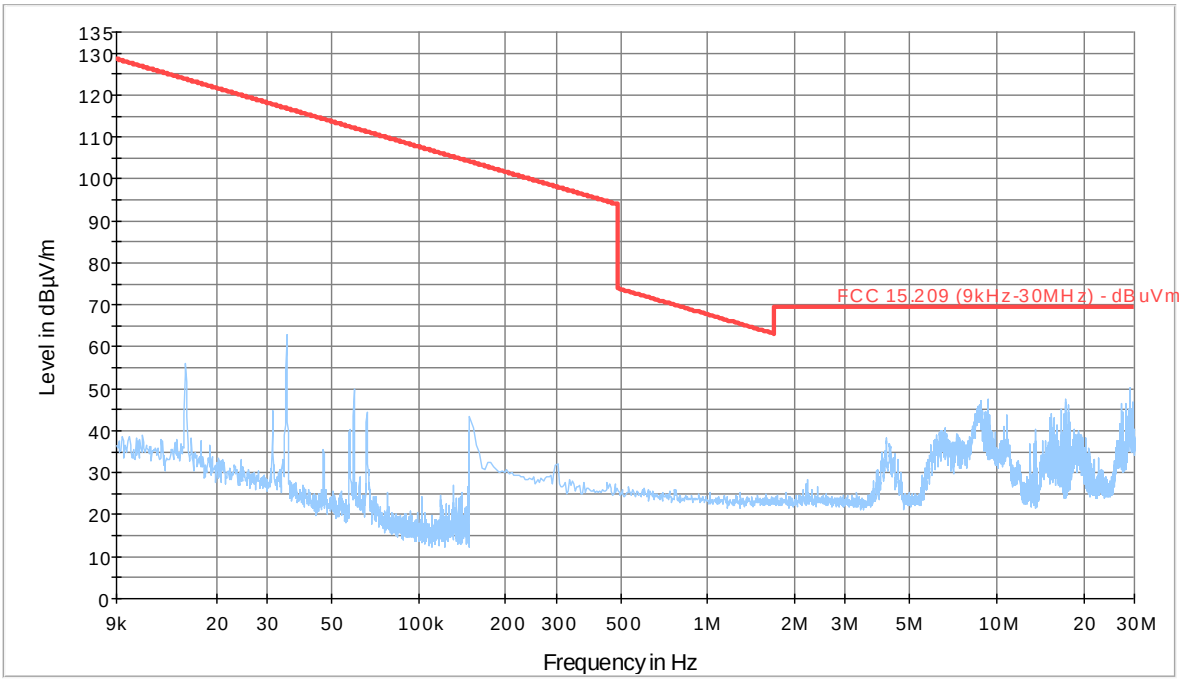
TEST PROCEDURE

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 maximum 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 and AVERAGE amplitude within a bandwidth of 100 kHz below 1000 MHz and 1 MHz above 1000 MHz.
5) The receiving antenna was positioned in both horizontal and vertical polarization. For radiated measurements below 30MHz the receiver loop antenna was rotated about all 3 axis (X,Y & Z).
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).

MEASUREMENTS RESULTS

Range: 9kHz ÷ 30 MHz 120V 60 Hz



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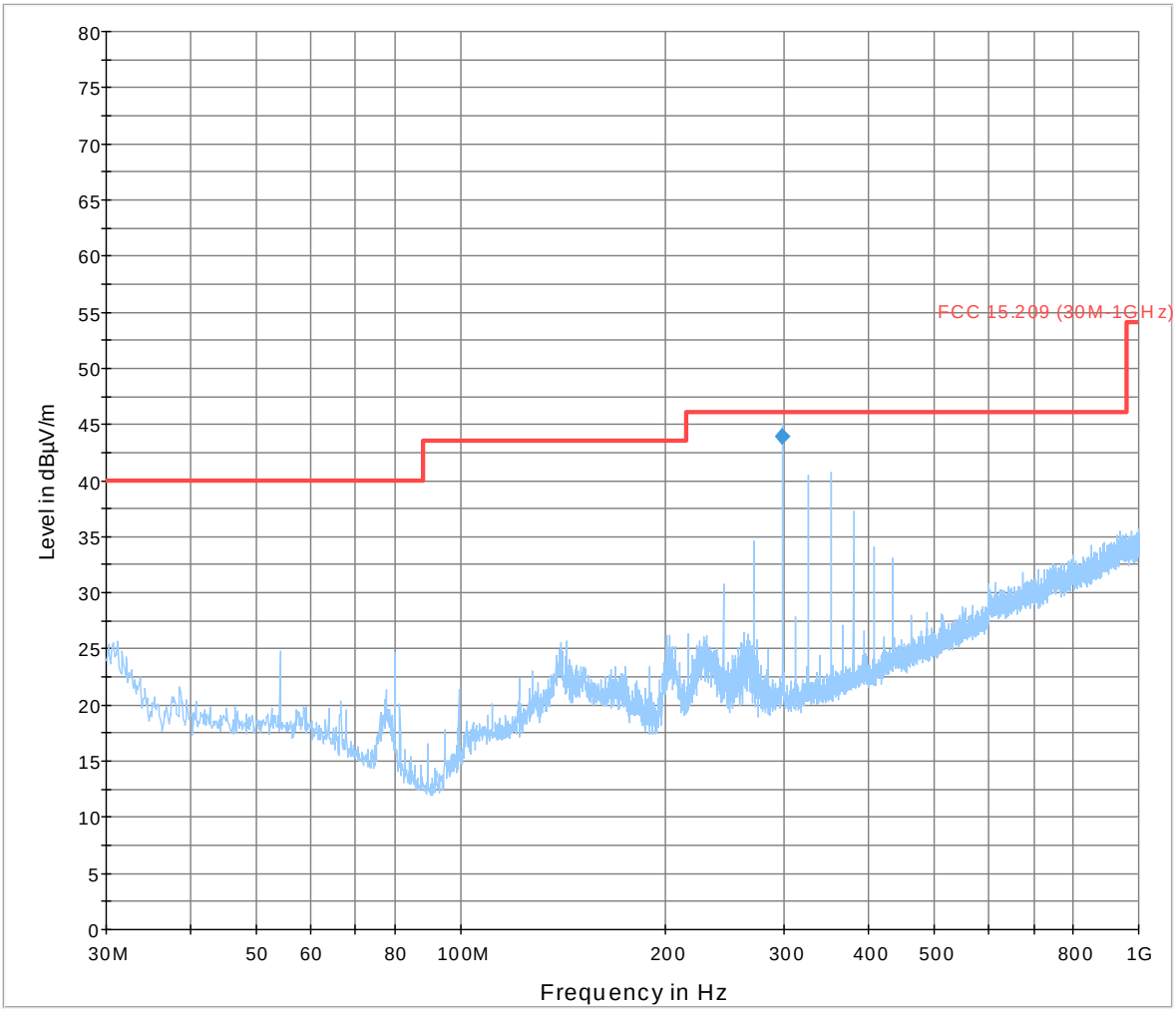
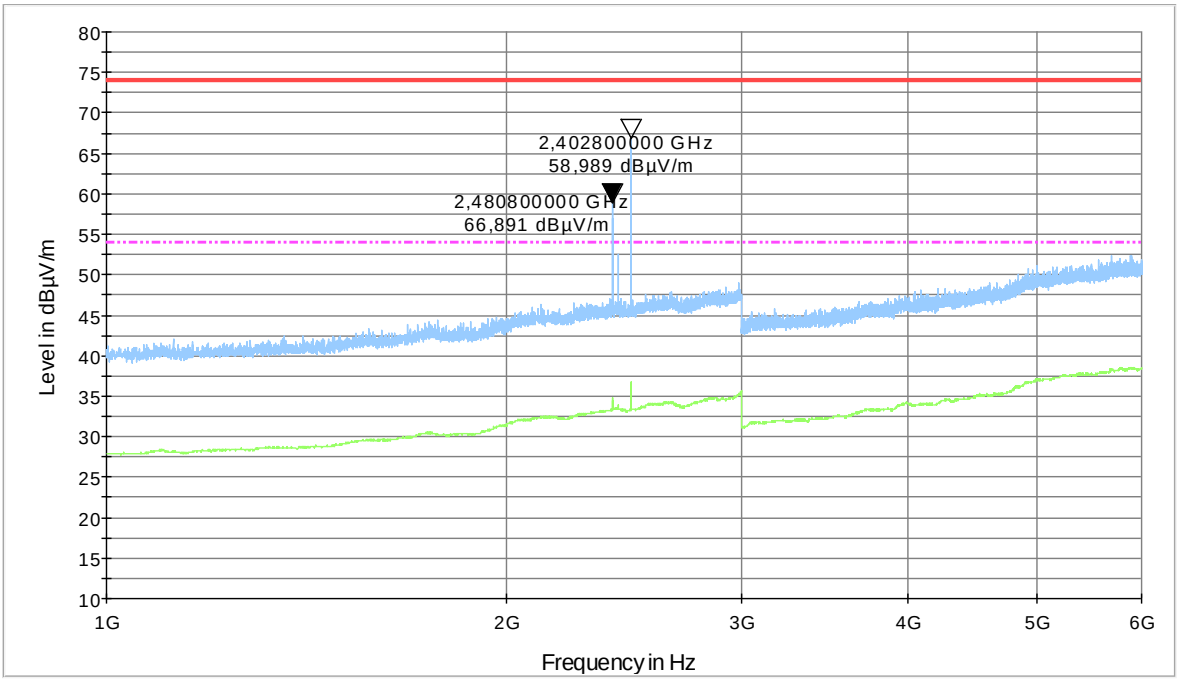
Range: 30 ÷ 1000 MHz 120V 60 Hz



Frequency	QuasiPeak	Meas. Time	Bandwidth	Height	Polarization	Azimuth	Corr.	Margin	Limit
MHz	dBµV/m	ms	kHz	cm		deg	dB	dB	dBµV/m
298.342750	43.9	1000.0	120.000	99.9	H	0.0	15.9	3.10	47.00

Range: 1 ÷ 6 GHz 120V 60 Hz



Frequency MHz	MaxPeak dBµV/m	Meas. Time ms	Bandwidth kHz	Polarization	Azimuth deg	Corr. dB	Margin dB	Limit dBµV/m
2402.400000	45.3	20.0	1000.000	V	90.0	31.6	28.7	74.0
2480.000000	45.0	20.0	1000.000	V	90.0	31.9	29.0	74.0

No significant values found for frequencies above 6 GHz.

Test performed up to 25GHz which is above to the tenth harmonic of the highest fundamental frequency (24.8 GHz)

NOTE: In search of max noise (EUT rotation: from 0° to 360°; receiving antenna height: from 1 m to 4 m; receiving antenna polarization: horizontal and vertical). The measurements with Quasi-Peak detector are performed only for frequencies for which the Peak values are ≥ (Q.P. limit - 6 dB).

7.4 OCCUPATED BANDWIDTH

TEST REQUIREMENT	
Test setup	ANSI C63.4
Test facility	Semi-Anechoic chamber
Frequency range	Over 70MHz
Resolution BW	See next table
Deviation to test procedure	None
EUT operating condition	#1
Remark	None
Testing dates	2019-05-30
Tested by	Alessandro Macrì

TEST RESULT
The EUT meets the requirements of sections 15.215 (c)

LIMIT
Operational bandwidth: 13.110-14.010 MHz

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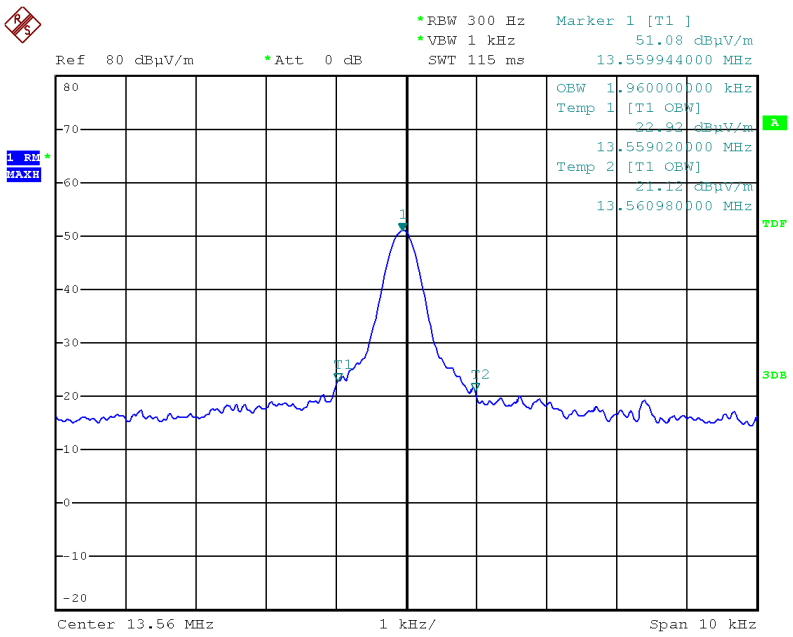
MEASUREMENTS RESULTS

BANDWIDTH OF EMISSION (AT -20dB POINTS)

Plot 1



7.5 FIELD STRENGTHS

TEST REQUIREMENT	
Spectrum analyzer settings	
Span	Wide enough to capture the peak level of the emission
Resolution bandwidth (RBW)	100 kHz
Video bandwidth (VBW)	300 kHz
Sweep time (SWT)	2.5 ms
Detector function	Peak
Trace	Max hold
Attenuator	/
Deviation to test procedure	None
EUT operating condition	#1
Remark	None
Testing dates	2019-05-30
Tested by	Alessandro Macrì

TEST PROCEDURE
Radiated measurements:
As the EUT is supplied with a dedicated antenna, the effective radiated power is measured in a 3 m anechoic chamber with the substitution antenna method

LIMITS
The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15.848 µV/m at 30 meters (124 dBµV/m at 3 meter). The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in § 15.209 [1.705–30.0 MHz 30 µV/m at 30 meters (70 dBµV/m at 3 meter) or fundamental –20dB (which is greater)].

TEST RESULT
The EUT meets the requirements of § 15.225 (a) and (c)

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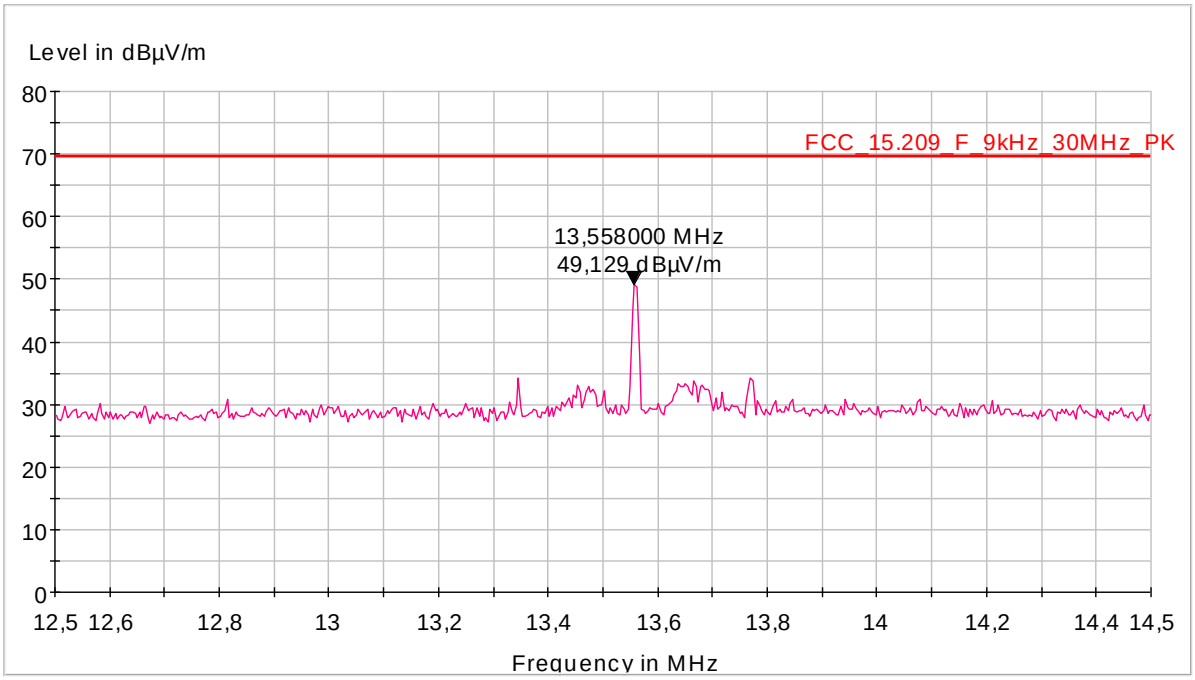
FIELDS STRENGTHS RESULTS (RADIATED)

Channel (No.)	Frequency (MHz)	Detector	Radiated Output Power (at 3m. distance) (dBµV/m)	Limit (dBµV/m)
1	13.56	PK	49.943	70

Plot 1



7.6 FREQUENCY TOLERANCE

TEST REQUIREMENT	
Requirement	The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of -20 degrees to + 50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.
Testing dates	2019-05-30
Tested by	Alessandro Macrì

TEST PROCEDURE
Radiated measurements:
As the EUT is supplied with a dedicated antenna, the effective radiated power is measured in a 3 m anechoic chamber with the substitution antenna method

LIMITS
±0.01% of fundamental (13.56 MHz → ±0.001356 MHz)

TEST RESULT
The EUT meets the requirements of § 15.225 (e)

Test conditions		Max. Frequency error (MHz)	Drift (MHz)
Temperature	**Voltage**		
T_{nom} +25°C	V_{nom} 120 V	13.559944	
T_{min} -20 °C	V_{nom} 120 V	13.559916	-0.000028
T_{max} +50 °C	V_{nom} 120 V	13.559952	+0.000008
Limit			**±0.001315**

Test conditions		Max. Frequency error (MHz)	Drift (MHz)
Temperature	**Voltage**		
T_{nom} +20°C	V_{nom} 120 V	13.559952	
	V_{min}85 V	13.559940	0.000012
	V_{max} 264.5 V	13.559952	0
Limit			**±0.001315**

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8. MEASUREMENTS AND TESTS UNCERTAINTY

Unless otherwise stated the uncertainties for the tests and measurements are evaluated in according to IMQ Operational Instruction IO-LAB-001 and IO-LAB-004. and requirement of NIST Technical Note 1297 and NIS 81: 1994 "The Treatment of Uncertainty in EMC Measurements"
The expanded uncertainty was calculated for all measurements and tests listed in this test report according to CISPR 16-4-2 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainty in EMC Measurements", with UKAS document LAB 34 and is documented in the quality system accordance to ISO/IEC 17025.
Internal Procedure PG-037 ensures that the requirements for traceability of calibrations, of all test equipment requiring calibration, and calibration intervals are met.

Methods/Standard	Parameter	Expanded Uncertainty	Unit	Confidence level
Continuous disturbance	QP detector 9 – 150 kHz	2,47	dB	95%
	QP detector 150 k – 30 MHz	2,61	dB	95%
Radiated disturbance	QP detector (30 MHz - 100 MHz) H polarization	4,33	dB	95%
	QP detector (30 MHz - 100 MHz) V polarization	4,22	dB	95%
	QP detector (100 MHz - 200 MHz) H polarization	3,40	dB	95%
	QP detector (100 MHz - 200 MHz) V polarization	4,76	dB	95%
	QP detector (200 MHz - 1000 MHz) H polarization	3,91	dB	95%
	QP detector (200 MHz - 1000 MHz) V polarization	3,82	dB	95%
	P detector 1-6 GHz	4,77	dB	95%

9. LIST OF MEASURING EQUIPMENT AND CALIBRATION INFORMATION

Test Equipment Used					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal. Date**	**Cal. Due**
Artificial Mains V-network	ROHDE & SCHWARZ	ESH2-Z5	S00554	2018-07-10	2019-07-31
Pulse limiter	ROHDE & SCHWARZ	ESH3-Z2	S02153	2018-07-13	2019-07-31
EMI receiver	ROHDE & SCHWARZ	ESCI 3	S04355	2018-09-14	2019-09-30
coaxial cable	/	/	S05489	2018-05-06	2019-05-31
Supplementary information: None					

Test Equipment Used					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal. Date**	**Cal. Due**
EMI receiver	ROHDE & SCHWARZ	ESCI 7	S05563	2018-07-03	2019-07-31
Loop Antenna	R&S	HFH2-Z2	S02508	2018-07-30	2019-07-31
Bilog antenna	SCHWARZBECK	VULB9160	S06463	2016–04-15	2019-05-31
Shielded semianechoic chamber	SIDT EUROPE	—	P01709	2018-10-01	2019-10-31
Position controller	Frankonia	FCTAM01	P02486/02488	—	—
Software	R&S	EMC32 v8.53	—	—	—
Supplementary information: None					

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10. PHOTOGRAPHIC DOCUMENTATION

EUT IDENTIFICATION – External views

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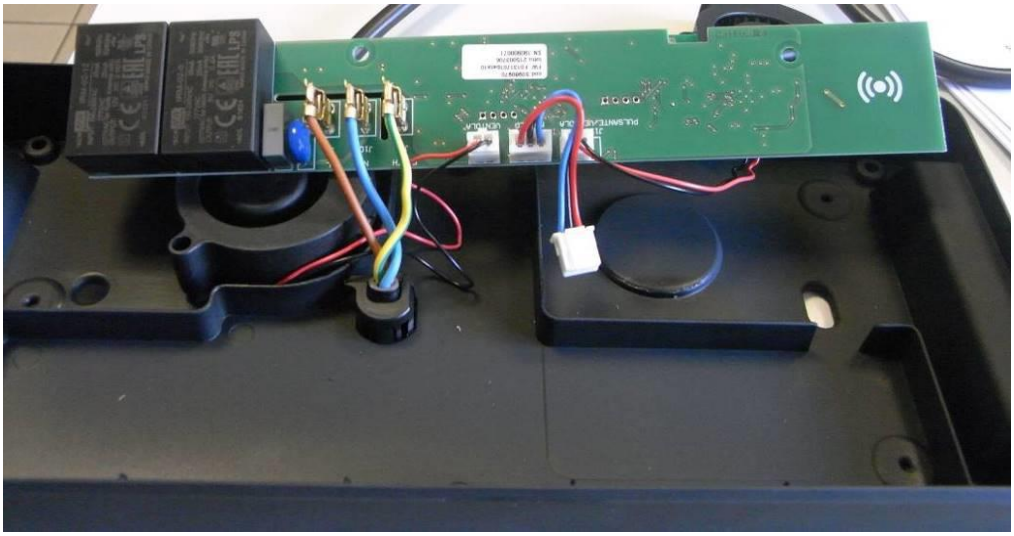
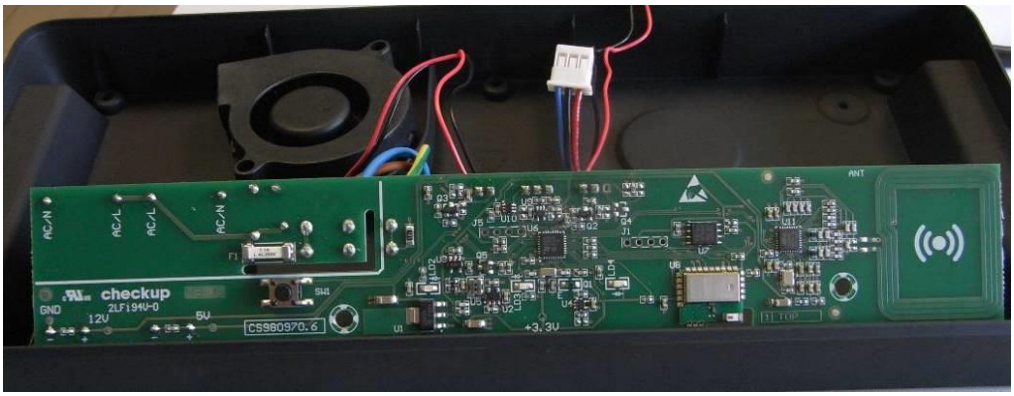
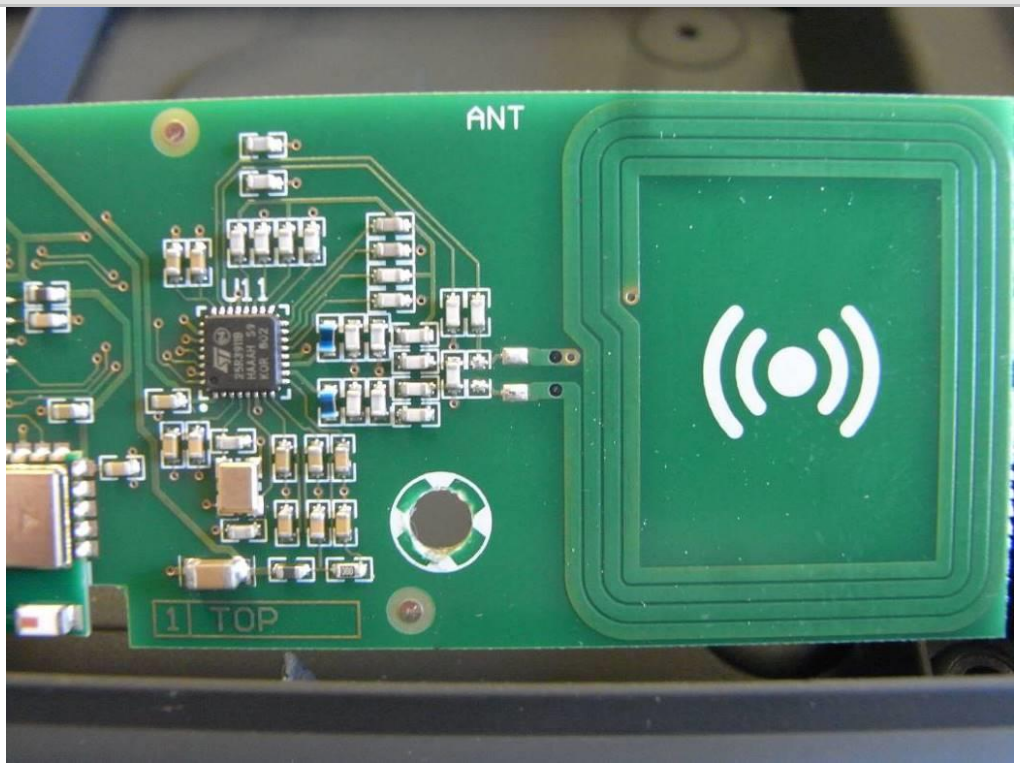
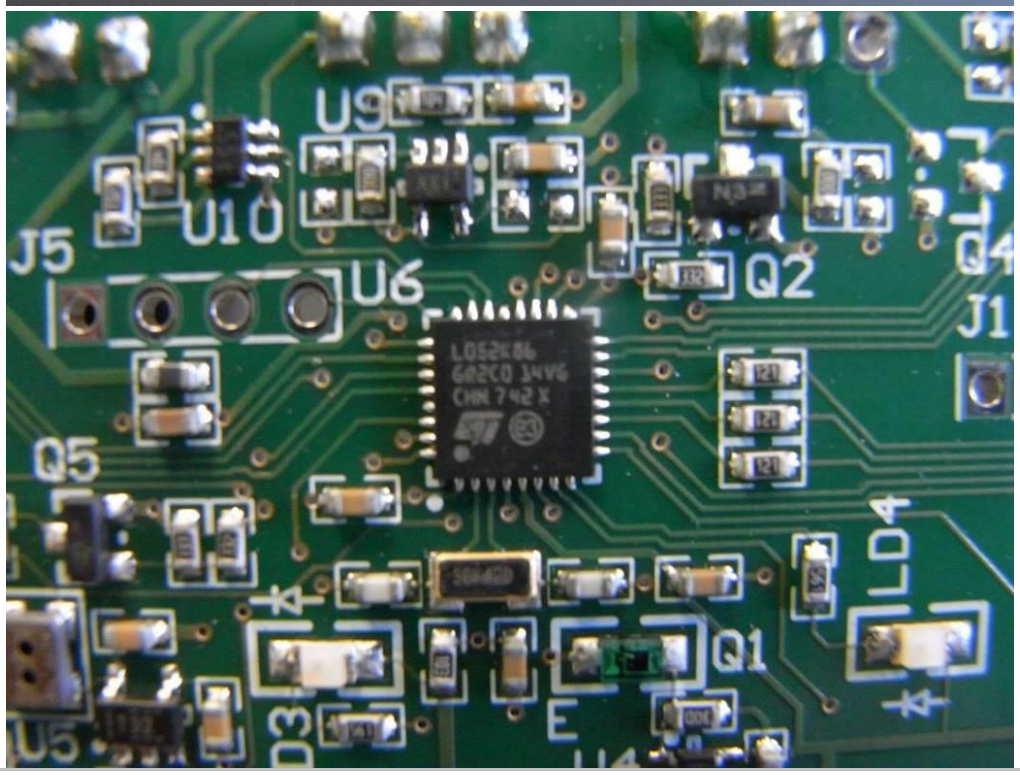
EUT IDENTIFICATION – Internal views





EUT IDENTIFICATION – Internal views radio module





Set-up
Test set-up conducted emission test

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Set-up

Test set-up radiated emission test

END OF TEST REPORT