

TEST REPORT

Title 47-Telecommunication

Chapter I - Federal Communications Commission

Subchapter A - General

Part 15 - Radio Frequency Devices

Subpart B - Unintentional Radiators

Report Reference No.: 293659TRFFCC

Tested by
(name, function and signature).....: G. Bazzi (project handler) *Bazzi*

Approved by
(name, function and signature).....: G. Curioni (verifier) *Curioni*

Date of issue: 2015-09-18

Testing Laboratory: **Nemko Spa**

Address.....: Via del Carroccio, 4 – 20853 Biassono (MB) – Italy

Testing location: Nemko Spa

Address.....: Via del Carroccio, 4 – 20853 Biassono (MB) – Italy

Registration number:: 481407

Applicant's name: SECO S.r.l.

Address.....: Via Calamandrei, 91 – Arezzo (AR) – Italy

Test specification:

Standard: FCC CFR 47 Part 15 Subpart B

§15.107 – Conducted limits

§15.109 – Radiated emission limits

Test procedure.....: Nemko WM L0077, WM L0177 and WM L1002

Test Report Form No.: FCCTRF

TRF Originator: Nemko Spa

Master TRF: 2014-03

Nemko Spa, 20853 Biassono (MB), Italy. All rights reserved.

This publication may be reproduced in whole for non-commercial purposes as long as Nemko Spa is acknowledged as copyright owner and source of the material. Nemko Spa takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.

Test item description : Mini PC

Trade Mark: --

Manufacturer.....: SECO S.r.l.

Address of manufacturer: Via Calamandrei, 91 – Arezzo (AR) – Italy

Model: UDOO Neo Full (Part N. SA69-0200-1100-C0)

Ratings.....: Input: 100-240V~ 50/60Hz 800mA

Output: 12Vdc 2000mA

This test report may not be partially reproduced, except with the prior written permission of Nemko Spa

The test report merely corresponds to the tested sample.

The phase of sampling / collection of equipment under test is carried out by the customer.

Test Report No. : 293659TRFFCC	2015-09-18 <hr/> Date of issue
--	--

Short description of the EuT	Copy of marking plate
The EuT is a mini PC	Not labelled
Number of tested samples:	1
Serial number:	1/1 (assigned by Nemko Spa)
Internal operating frequency:	1000 MHz
Class:	B
Device type:	Table Top/Rack Mounting
Accessories and detachable parts included:	The E.U.T. is composed by a single unit
Other options included:	--
Testing	
Date of receipt of test sample:	2015-09-18
Testing commenced on:	2015-09-18
Testing concluded on:	2015-09-18
Possible test case verdicts:	
test case does not apply to the test object:	N (Not applicable)
test object does meet the requirement:	P (Pass)
test object does not meet the requirement:	F (Fail)
Symbols used in this test report	
<input checked="" type="checkbox"/> The crossed square indicates that the listed condition or equipment is applicable for this report. <input type="checkbox"/> The empty square indicates that the listed condition or equipment is not applicable for this report.	
<p>The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.</p>	

Verdict according to the standards listed at page 5:	Pass
---	-------------

PROJECT HISTORY		
Report number	Modification to the report / comments	Date
293695TRFFCC	First release	2015-09-18
--	--	--
--	--	--
--	--	--
REMARKS		

PRODUCT VARIANTS		
Variant model	Difference against the main model	Additional test performed
--	--	--
--	--	--
--	--	--
--	--	--
REMARKS		

Contents

1	TEST STANDARDS	5
2	SUMMARY OF TEST RESULTS	5
3	EQUIPMENT UNDER TEST	6
3.1	POWER SUPPLY SYSTEM UTILISED	6
3.2	EUT OPERATION MODES	6
3.3	EUT CONFIGURATION MODES	6
3.4	INPUT/OUTPUT PORTS	7
3.5	EQUIPMENT USED DURING TEST	8
4	TEST ENVIRONMENT	9
4.1	ADDRESS OF THE TEST LABORATORY	9
4.2	ENVIRONMENTAL CONDITIONS	9
4.3	TEST EQUIPMENT USED FOR THE MONITORING OF THE ENVIRONMENTAL CONDITIONS	9
4.4	STATEMENT OF THE MEASUREMENT UNCERTAINTY	10
5	TEST CONDITIONS AND RESULTS	11
5.1	CLAUSE 15.107 – CONDUCTED LIMITS	11
5.2	CLAUSE 15.109 – RADIATED EMISSIONS LIMIT	15
6	EUT PHOTOS	22

1 TEST STANDARDS

The tests were performed according to following standards and procedures.

NEMKO WM L0177: General routines for using instruments at Nemko

NEMKO WM L1002: Measurement Uncertainty - Policy and Statement

NEMKO WM L0077: General routines to perform EMC tests

FCC CFR 47 Part 15 Subpart B (10–1–13 Edition)

Code of Federal Regulations – Title 47 – Part 15 Radio Frequency Devices – Subpart B Unintentional radiation

The main standard above contains references to other standards, which are listed below.

ANSI C63.4 (2003)

‘Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz’

2 SUMMARY OF TEST RESULTS

FCC Part 15 Subpart B requirements			
Part	Test description	Frequency range	Verdict
§15.107	Conducted emission	150 kHz to 30 MHz	P
§15.109	Radiated emission	30 MHz to 8000 MHz	P
GENERAL REMARKS			

3 EQUIPMENT UNDER TEST

3.1 Power supply system utilised

Power supply voltage:	<input type="checkbox"/>	230V/50 Hz / 1 ϕ	<input type="checkbox"/>	115V/60Hz / 1 ϕ
	<input type="checkbox"/>	400V/50 Hz 3PE	<input type="checkbox"/>	400V/50 Hz 3NPE
	<input checked="" type="checkbox"/>	12 VDC	<input type="checkbox"/>	24 VDC

3.2 EuT operation modes


Mode	Description
1	EUT was tested connected to: power, HDMI cable loaded, keyboard, switch ethernet and MicroSD card

3.3 EuT configuration modes



The EuT was configured to measure its highest possible radiation level. The test modes selected are according to EuT instruction manual.

Mode	Description
1	The EuT was tested connected to the Mains.

3.4 Input/Output Ports

Port	Name	Type*	Cable Max. >3m	Cable Shielded	Description
0	Enclosure	N/E	—	—	—
1	Mains	AC/DC	<input type="checkbox"/>	<input type="checkbox"/>	
2	Switch Ethernet	I/O	<input type="checkbox"/>	<input type="checkbox"/>	—
3	Keyboard	I/O	<input type="checkbox"/>	<input type="checkbox"/>	—
4	HDMI	I/O	<input type="checkbox"/>	<input type="checkbox"/>	Loaded
<p>*Note:</p> <p>AC = AC Power Port DC = DC Power Port N/E = Non-Electrical</p> <p>I/O = Signal/Control Input or Output Port TP = Telecommunication Ports</p>					

3.5 Equipment Used During Test

Use*	Product Type	Manufacturer	Model	Comments
AE	Keyboard	Agilent Technologies	—	
AE	Ethernet switch	HP	—	
AE	SD card	Transcend	8 Gb	—
<p>Note: * Use EUT - Equipment Under Test AE - Auxiliary/Associated Equipment (Not Subjected to Test) SIM - Simulator (Not Subjected to Test)</p>				

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

Nemko Spa
Via del Carroccio, 4
20853 Biassono (MB) - Italy

Tests site/benches are in accordance with applicable standard/s, and have been utilized by Nemko Spa testing engineer(s).

4.2 Environmental conditions

Unless different values are declared in the test case, following ambient conditions apply for the tests:

Ambient temperature: 18÷33 °C

Relative Humidity: 30÷60 %

Atmospheric pressure: 980÷1020 hPa

4.3 Test equipment used for the monitoring of the environmental conditions

Equipment	Manufacturer	Model	Serial N°
Thermohygrometer data loggers	Testo	175-H2	20012380/305
Digital barometer	Haenni	ZED 150/111.121	900301402/0013

4.4 Statement of the 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. Hereafter the best measurement capability for Nemko Spa laboratory is reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Disturbance 3m, 10m Chamber	Antenna distance 1m, 3m, 10m (30÷200) MHz	5.0 dB	(1)
	Antenna distance 1m, 3m, 10m (0.2÷6) GHz	5.2 dB	(1)
	Antenna distance 1m, 3m (6÷18) GHz	5.8 dB	(1)
	Antenna distance 1m, 3m (18÷40) GHz	7.2 dB	(1)
Conducted Disturbance	9 kHz ÷ 150 kHz with AMN	3.8 dB	(1)
	150 kHz ÷ 30 MHz with AMN	3.4 dB	(1)
	150 kHz ÷ 30 MHz with AAN	4.6 dB	(1)
	9 kHz ÷ 30 MHz with voltage probe	2.9 dB	(1)
	9 kHz ÷ 30 MHz with current probe	2.9 dB	(1)

NOTES:

(1) 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 %;

5 TEST CONDITIONS AND RESULTS

5.1 Clause 15.107 – Conducted limits

5.1.1 Photo documentation of the test set-up



5.1.2 Test method

Measurements were made on a ground plane that extends 1-meter minimum beyond all sides of the system under test. All power was connected to the system through Line Impedance Stabilization Networks (LISN). Conducted voltage measurements on mains lines were made at the output of the LISN.

5.1.3 Limits for AC mains port

Except for Class A digital devices, for equipment 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 μ H/50ohms 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 band edges.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-Peak	Average
0.15 to 0.50	66 to 56*	59 to 46*
0.50 to 5	56	46
5 to 30	60	50

*The limits decrease linearly with the logarithm of the frequency

For a Class A digital device 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 μ H/50 ohms 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.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-Peak	Average
0.15 to 0.50	79	66
0.50 to 30	73	60

5.1.4 Test result

Verdict:	<input checked="" type="checkbox"/> P <input type="checkbox"/> F <input type="checkbox"/> N
Frequency range:	0.15MHz - 30MHz
Kind of test site:	Shielded room
Remarks:	-

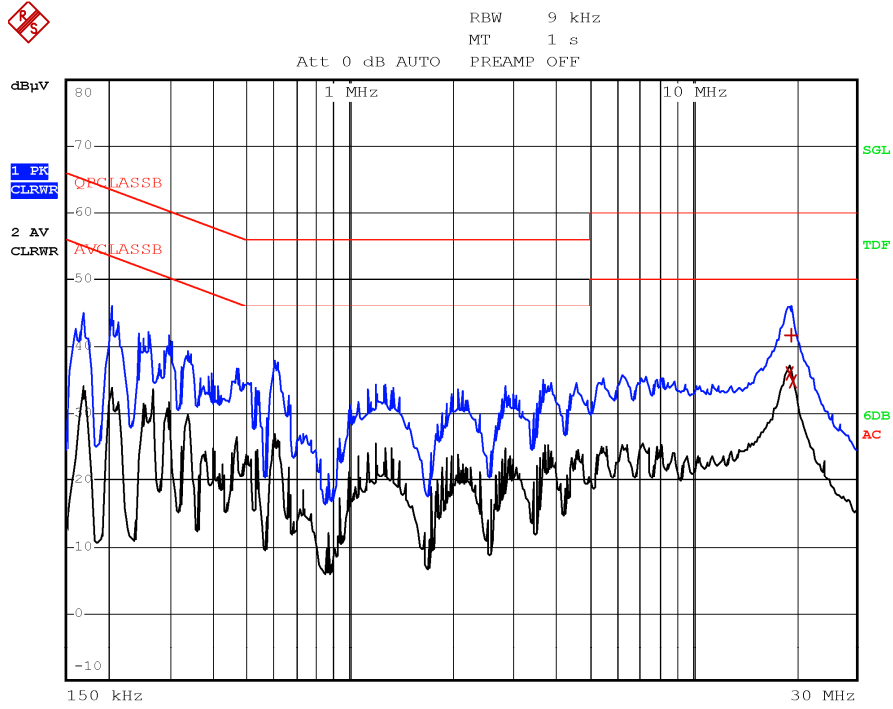
5.1.5 Test equipment used

Equipment	Manufacturer	Model	Serial N°
EMI receiver 9 kHz ÷ 3 GHz	R&S	ESCI	100888
LISN 9 kHz ÷ 30 MHz	R&S	ESH2-Z5	872 460/041
Shielded room	Siemens	Conducted emission test room	1862

5.1.6 Test protocol

Test point: Phase line
 Operation mode: 1
 Configuration mode: 1
 Remarks: -

Verdict: Pass

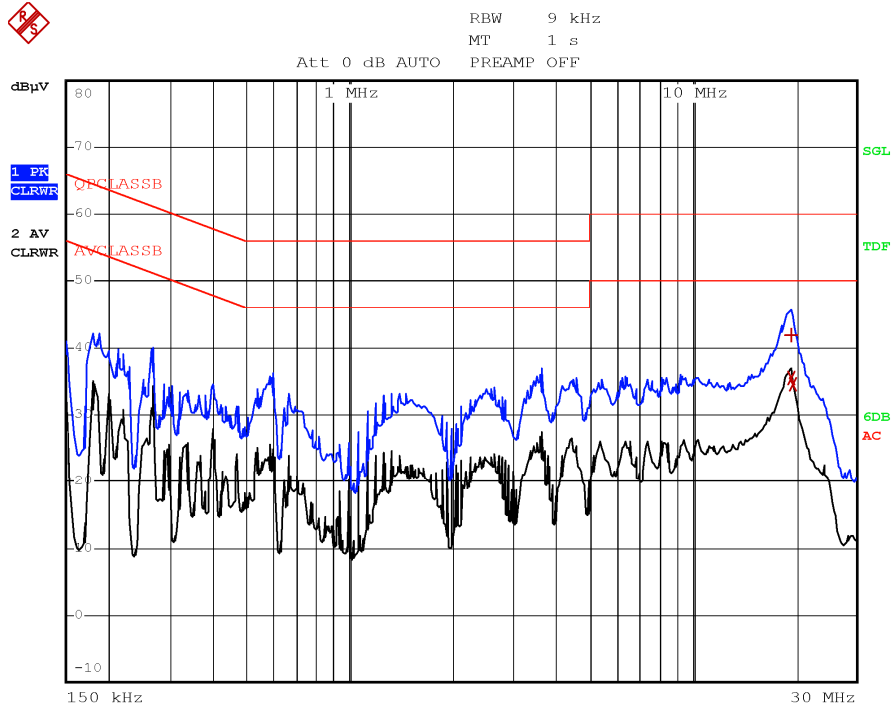


Date: 18.SEP.2015 17:05:05

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Detector
19.2300	36.1	50.0	-13.9	AV
19.3820	41.6	60.0	-18.4	QP
19.6820	34.8	50.0	-15.2	AV

Test point: Neutral line
 Operation mode: 1
 Configuration mode: 1
 Remarks: -

Verdict: Pass

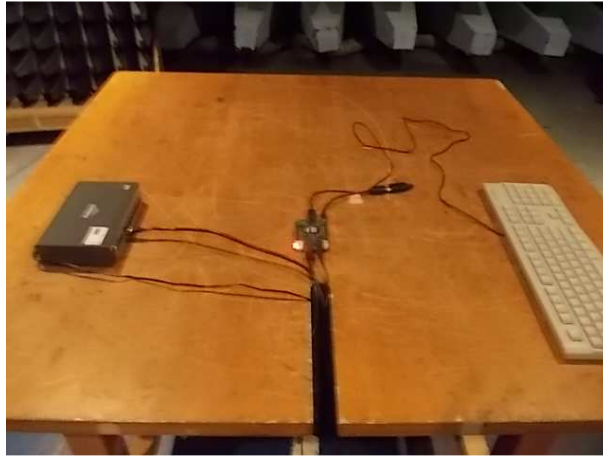


Date: 18.SEP.2015 17:02:18

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Detector
19.3460	41.8	60.0	-18.2	QP
19.5260	35.4	50.0	-14.6	AV
19.6700	34.5	50.0	-15.5	AV

5.2 Clause 15.109 – Radiated emissions limit

5.2.1 Photo documentation of the test set-up



5.2.2 Test method

Measurements were made on a semi anechoic chamber. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 3 or 10 meters with the receive antenna located at a fixed height (from 1 to 4 meter) in both horizontal and vertical polarities. Final measurements (quasi-peak) were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4 meters. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable.

5.2.3 Limits for enclosure

Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission (MHz)	Field strength ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)
30–88	100	40.0
88–216	150	43.5
216–960	200	46.0
Above 960	500	54.0

The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the following:

Frequency of emission (MHz)	Field strength ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)
30–88	90	39.0
88–216	150	43.5
216–960	210	46.4
Above 960	300	49.5

5.2.4 Test result

Verdict:	<input checked="" type="checkbox"/> P <input type="checkbox"/> F <input type="checkbox"/> N
Frequency range:	30MHz - 8000MHz
Kind of test site:	Semi anechoic chamber
Measurement distance:	3 m
<p>Remarks: for an unintentional radiator, including a digital device, the spectrum shall be investigated from the lowest radio frequency signal generated or used in the device, without going below the lowest frequency for which a radiated emission limit is specified, up to the frequency shown as follow:</p> <p>If the intentional radiator operates at frequency upper than 1.705 MHz and lowers than 108 MHz the upper frequency of measurement range is 1000 MHz.</p> <p>If the intentional radiator operates at frequency upper than 108 MHz and lowers than 500 MHz the upper frequency of measurement range is 2000 MHz.</p> <p>If the intentional radiator operates at frequency upper than 500 MHz and lowers than 1000 MHz the upper frequency of measurement range is 5000 MHz.</p> <p>If the intentional radiator operates at frequency above 1000 MHz the upper frequency of measurement range is 5th harmonic of the highest frequency or 40 GHz, whichever is lower.</p> <p>If the intentional radiator operates at or above 10 GHz and below 30 GHz to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.</p> <p>If the intentional radiator operates at or above 30 GHz to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.</p>	

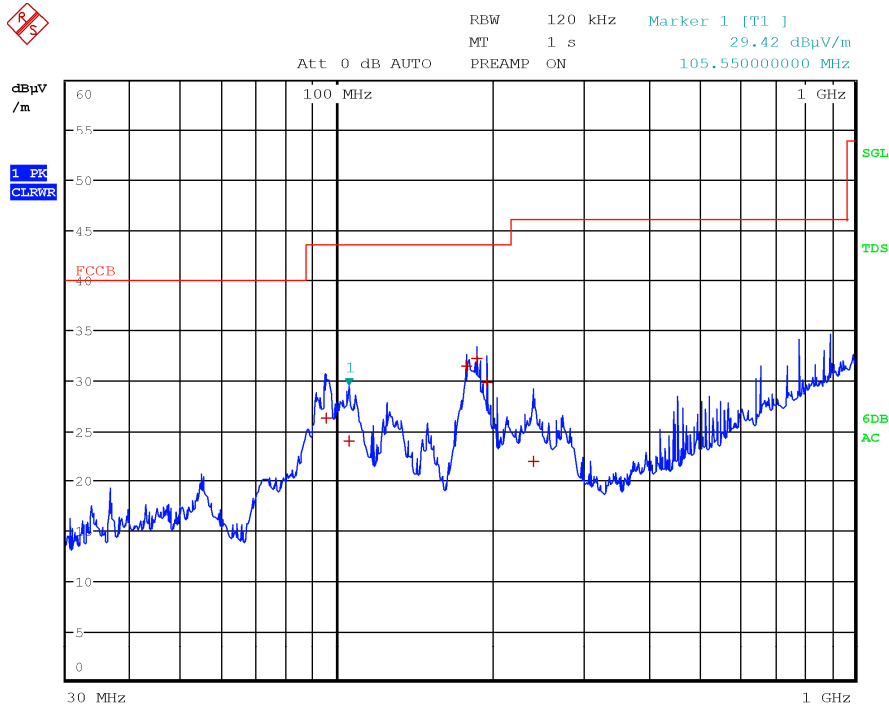
5.2.5 Test equipment used

Equipment	Manufacturer	Model	Serial N°
Trilog Broadband Antenna 25 ÷ 8000 MHz	Schwarzbeck	VULB 9162	9162-025
Bilog antenna 1 ÷ 18 GHz	Schwarzbeck	STLP 9148-123	123
Broadband preamplifier	Schwarzbeck	BBV 9718	9718-137
Spectrum Analyzer 9kHz-40GHz	R&S	FSEK	848255/005
EMI receiver 20 Hz ÷ 8 GHz	R&S	ESU8	100202
Turn-table	R&S	HCT	835 803/03
Antenna mast	R&S	HCM	836 529/05
Controller	R&S	HCC	836 620/7
Semi-anechoic chamber	Nemko	10m semi-anechoic chamber	530
Shielded room	Siemens	10m control room	1947

5.2.6 Test protocol

Antenna polarization: Horizontal
 Operation mode: 1
 Configuration mode: 1
 Remarks: Up to 1 GHz

Verdict: Pass

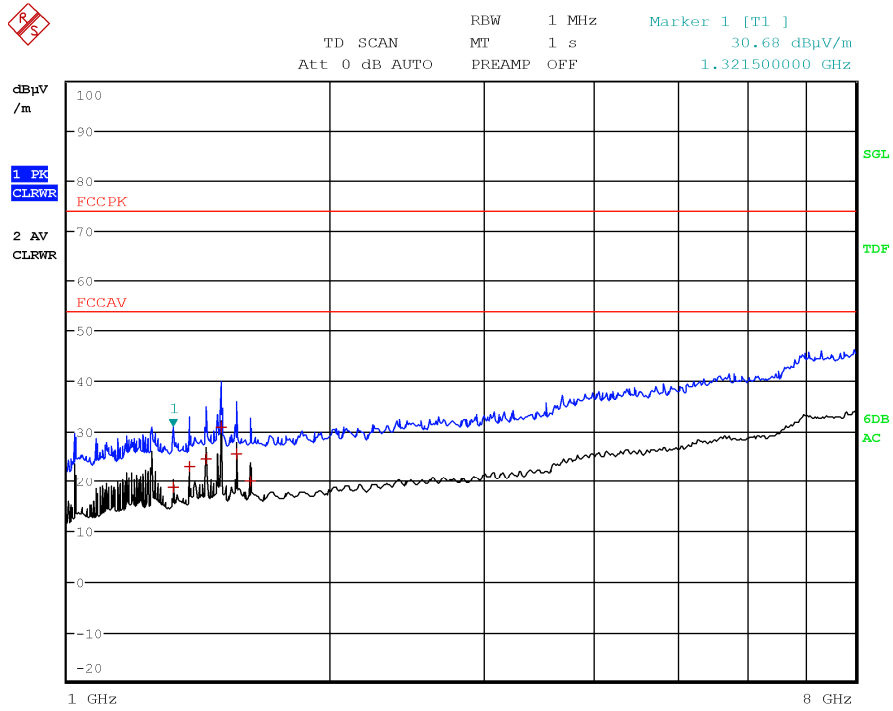


Date: 18.SEP.2015 16:13:33

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
95.4250	26.3	43.5	-17.2	QP
105.5500	24.0	43.5	-19.5	QP
177.9500	31.4	43.5	-12.1	QP
186.6250	32.2	43.5	-11.4	QP
195.3000	29.8	43.5	-13.7	QP
240.3500	21.9	46.0	-24.1	QP

Antenna polarization: Horizontal
 Operation mode: 1
 Configuration mode: 1
 Remarks: 1 GHz to 8 GHz

Verdict: Pass

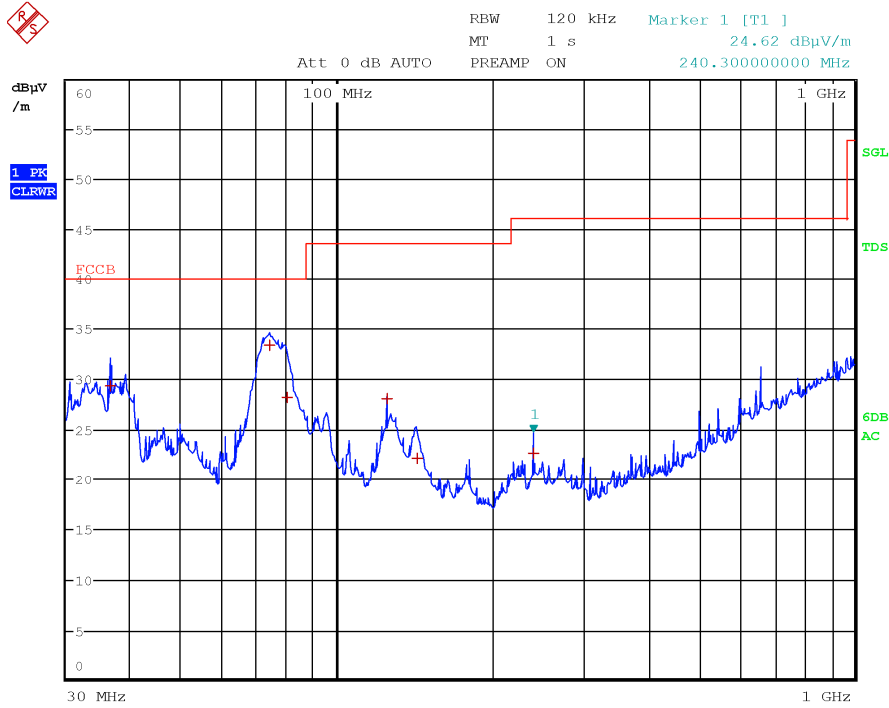


Date: 18.SEP.2015 16:35:02

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1321.5000	18.7	54.0	-35.3	QP
1381.7500	23.1	54.0	-30.9	QP
1442.2500	24.5	54.0	-29.5	QP
1502.2500	30.8	54.0	-23.2	QP
1562.5000	25.5	54.0	-28.5	QP
1621.2500	19.9	54.0	-34.0	QP

Antenna polarization: Vertical
 Operation mode: 1
 Configuration mode: 1
 Remarks: Up to 1 GHz

Verdict: Pass

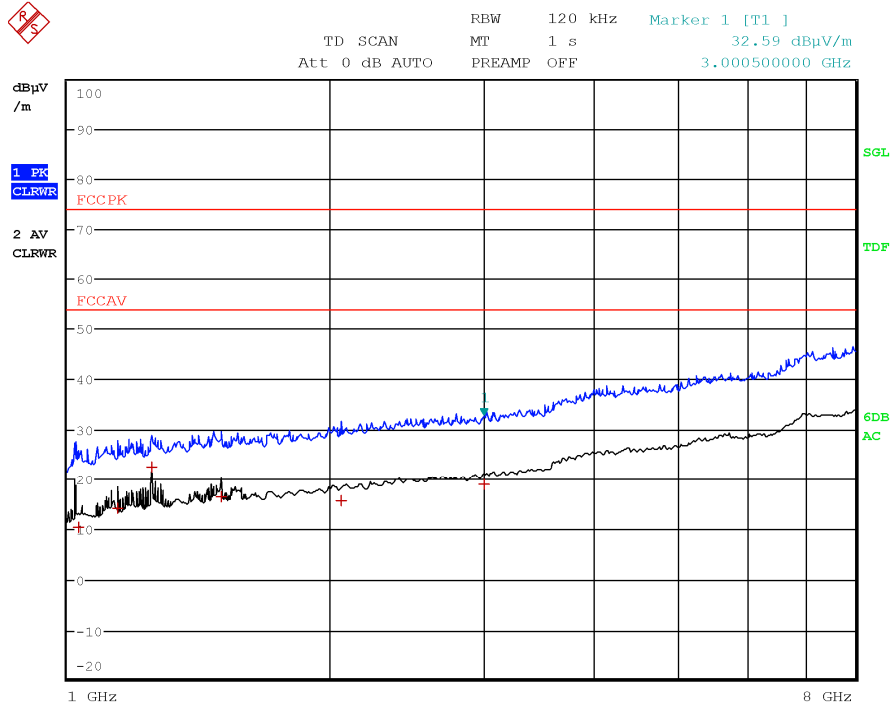


Date: 18.SEP.2015 16:05:03

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
36.5500	29.3	40.0	-10.7	QP
74.2750	33.4	40.0	-6.6	QP
80.1250	28.2	40.0	-11.8	QP
125.0250	28.1	43.5	-15.4	QP
143.1750	22.1	43.5	-21.4	QP
240.3000	22.7	46.0	-23.4	QP

Antenna polarization: Vertical
 Operation mode: 1
 Configuration mode: 1
 Remarks: 1 GHz to 8 GHz

Verdict: Pass



Date: 18.SEP.2015 16:39:42

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1029.7500	10.4	54.0	-43.6	QP
1141.2500	14.1	54.0	-39.9	QP
1250.0000	22.5	54.0	-31.5	QP
1502.7500	16.3	54.0	-37.6	QP
2059.7500	15.7	54.0	-38.2	QP
3000.5000	19.0	54.0	-35.0	QP

6 EUT PHOTOS



End of report