

**TEST REPORT CONCERNING THE COMPLIANCE OF AN
INDUCTIVE RFID CARD READER,
OPERATING ON 13.56 MHz.
BRAND Nedap, MODEL PG45i**

**WITH 47 CFR PART 15 (10-1-15) AND THE
REQUIREMENTS OF INDUSTRY CANADA:
RSS-Gen (Issue 4, November 2014) and
RSS-210 (Issue 9, August 2016)**

**16121902.fcc01
February 07, 2017**

FCC listed : 90828
Industry Canada : 2932G-2
:

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MEASUREMENT/TECHNICAL REPORT

Brand: Nedap
Model: PG45i

FCC ID: CGDPG45I135
IC: 1444A-PG45I135

This report concerns:	Original grant/certification	Class 2 Permissive Change	Verification
Equipment type:	Inductive RFID Card Reader		
Report prepared by:	Name	: Richard van der Meer	
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The data taken for this test and report herein was done in accordance with 47 CFR Part 15 (10-1-15 edition) RSS-GEN (Issue 4, November 2014), RSS-210 (ISSUE 9, AUGUST 2016) and the measurement procedures of ANSI C63.10-2013. TÜV Rheinland Nederland B.V. at Leek, The Netherlands, certifies that the data is accurate and contains a true representation of the emission profile of the Equipment Under Test (EUT) on the date of the test as noted in the test report. I have reviewed the test report and find it to be an accurate description of the test(s) performed and the EUT so tested.

Date: February 07, 2017

Signature:



E. van der Wal
Senior Engineer Telecom
TÜV Rheinland Nederland B.V.

Summary

The device under test does:

- fulfill the general approval requirements as identified in this test report
 not fulfill the general approval requirements as identified in this test report

Description of test item

Test item (EUT) : Inductive RFID Card Reader
Manufacturer : N.V. Nederlandsche Apparatenfabriek "Nedap"
Brand : Nedap
Model : PG45i
Serial number(s) : --
Receipt date : January 02, 2017

Applicant information

Applicant's representative : Mr. J. Hulshof / Mr. G. Heinen
Company : N.V. Nederlandsche Apparatenfabriek "Nedap"
Address : Parallelweg 2
Postal code : 7141 DC
City : Groenlo
Country : The Netherlands
Telephone number : +31 544 471 162
Telefax number : +31 544 463 475

Test(s) performed

Location : Leek
Test(s) started : January 24, 2017
Test(s) completed : February 06, 2017
Purpose of test(s) : Equipment Authorization (Original grant/certification)

Test specification(s) : 47 CFR Part 15 (10-1-15 edition) and
RSS-GEN (ISSUE 4, NOVEMBER 2014) AND
RSS-210 (ISSUE 9, AUGUST 2016)

Test engineer(s) : R. van der Meer 

Report written by : R. van der Meer 

Report date : February 07, 2017

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The test results relate only to the item(s) tested.

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1 General information.

1.1 Product description.

1.1.1 Introduction.

The brand Nedap model PG45i, hereafter referred to as EUT is an inductive RFID card reader intended to be used in library systems. The EUT can be connected to existing hardware (PC) and/or Library Management Systems. It is capable of reading 13.56 MHz inductive tags.

The content of this report and measurement results have not been changed other than the way of presenting the data.

1.2 Related submittal(s) and/or Grant(s).

1.2.1 General.

This test report supports the original certification in equipment authorization files under registration number.
FCC ID: CGDPG45I135 and IC: 1444A-PG45I135.

1.3 Tested system details.

Details and an overview of the system and all of its components, as it has been tested, may be found below.

EUT	:	RFID Card reader operating on 13.56 MHz
Manufacturer	:	N.V. Nederlandsche Apparatenfabriek "Nedap"
Brand	:	Nedap
Model	:	PG45i
Serial number	:	-
Voltage input rating	:	24 V _{DC}
Voltage output rating	:	n.a.
Current input rating	:	--
Antenna	:	External
Operating frequency	:	13.56 MHz
Modulation	:	Modulated carrier
Remarks	:	Firmware version 4.1.3.

AUX1	:	Power supply
Brand	:	POWER-WIN TECHNOLOGY CORP.
Model	:	PW-065A-1Y24F1
Serial number	:	--
Voltage input rating	:	100 – 240V 50-60Hz
Voltage output rating	:	24Vdc
Current output rating	:	2A
Remarks	:	n.a.

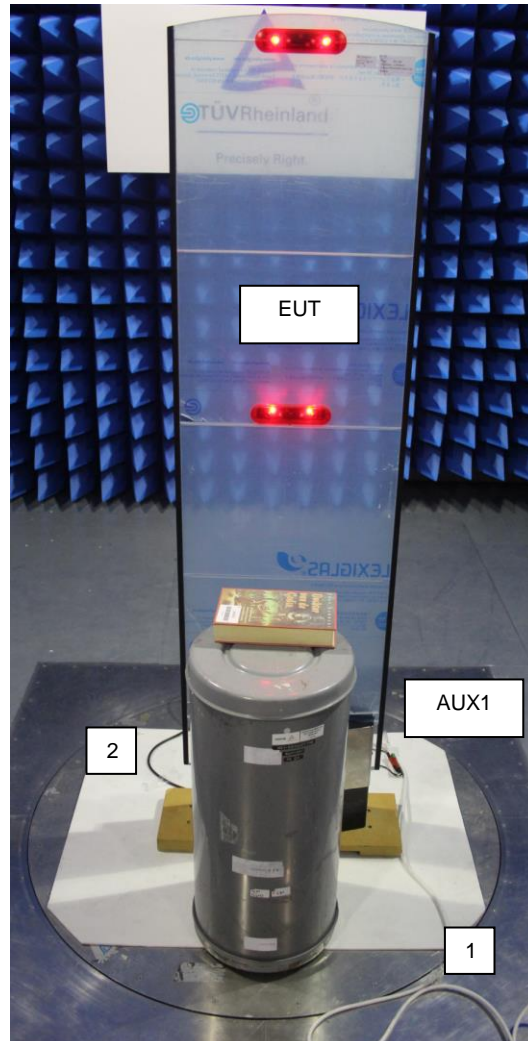


Photo 1a: EUT in a typical setup



Photo 1b: The tag (hub tag) as placed in a book

1.3.1 Description of input and output ports.

Number	Ports	From	To	Shielding	Remarks
1	AC mains	AC mains	AUX1	yes / no	None
2	24Vdc	AUX1	EUT	yes / no	None

Operation mode 1: System "Passive", not detecting a tag.

Operation mode 2: System "Active", detecting a tag.

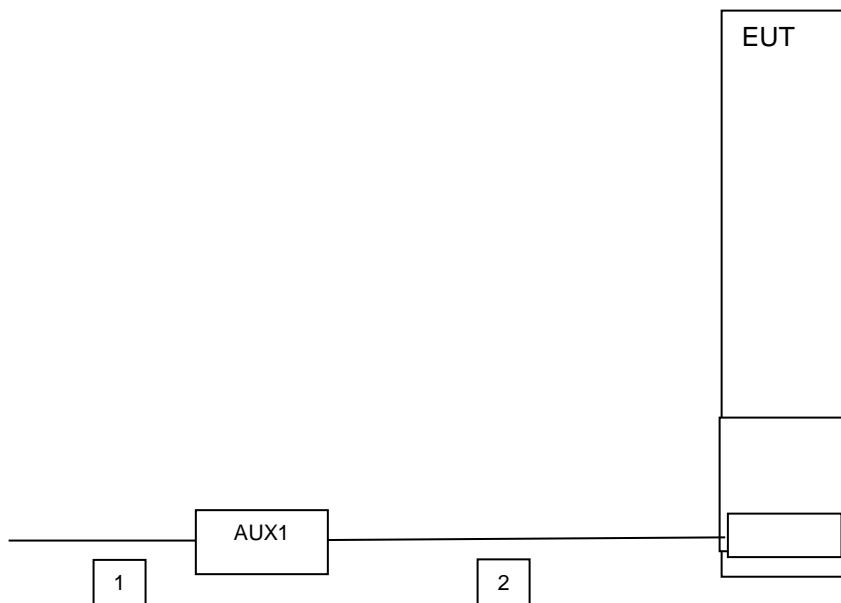


Figure 1: Basic test setup and connections

1.4 Test summary

The EUT was tested in accordance with the specifications given in the table below.

Test Standard		Description	Page	Pass / Fail / Not Applicable
47 CFR Part 15 (10-1-15 Edition)	RSS-Gen Issue 4, November 2014 and RSS-210 Issue 9, August 2016			
15.207(a)	RSS-Gen(8.8)	AC Power Line Conducted emissions	16 - 19	Pass
15.209, 15.225(a)	RSS-210(B.6) and RSS-Gen (8.9)	Radiated emissions	11 - 15	Pass
15.215(c)	RSS-Gen(6.6)	Bandwidth of the emission	21 - 22	Pass
15.225(e)	RSS-210(B.6)	Frequency stability	20 - 20	Pass

Table 1. : Test specifications

Test methods: ANSI C63.10-2013 and RSS-Gen.

1.5 Test methodology.

The test methodology used is based on the requirements of 47 CFR Part 15 (10-1-15), sections 15.31, 15.35, 15.205, 15.209, 15.231, RSS-GEN (ISSUE 4, NOVEMBER 2014) and RSS-210 (ISSUE 9, August 2016).

The test methods, which have been used, are based on ANSI C63.10-2013.

Radiated emission tests above 30 MHz were performed at a measurement distance of 3 meters.

Radiated emission tests below 30 MHz were performed at a measurement distance of 3 meters.

To calculate the field strength level from these results to the appropriate distance at which the limit is specified, the appropriate extrapolation factor is used.

The receivers are switching automatically to the right bandwidth in accordance with CISPR 16. This is implemented in the receiver. The antenna factors are programmed in the test receiver. The receiver automatically calculates the appropriate correction factor for the utilized antenna and also the appropriate antenna factor for the cable loss. The total correction is automatically added to the measured value.

1.6 Test facility.

The Federal Communications Commission and Industry Canada has reviewed the technical characteristics of the test facilities at TÜV Rheinland Nederland B.V., located in Leek, 9351VT Eiberkamp 10, The Netherlands, and has found these test facilities to be in compliance with the requirements of 47 CFR Part 15, section 2.948.

The description of the test facilities has been filed at the Office of the Federal Communications Commission under registration number 90828. The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

The description of the test facilities has been filed to Industry Canada under registration number 2932G-2. The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

1.7 Test conditions.

Normal test conditions:

Temperature (*) : +15°C to +35°C
Relative humidity(*) : 20 % to 75 %
Supply voltage : 120 V_{ac} 60 Hz applied to the ac/dc adapter AUX1 which is connected to the EUT.

When it was impracticable to carry out the tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests are stated separately.

2 System test configuration.

2.1 Justification.

The system was configured for testing in a typical situation as a customer would normally use it. Only for AC Power Line conducted emissions a 24 Vdc power supply was used instead of the AUX1 power supply.

The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.10-2013.

2.2 EUT mode of operation.

The EUT has been tested in modulated transmit mode, i.e. the EUT is transmitting while continuously transmitting data. All test set ups have been documented in pictures in the documentation package which will be submitted to the Commission.

2.3 Special accessories.

No special accessories are used and/or needed to achieve compliance.

2.4 Equipment modifications.

Only for the Conducted Emissions testing (section 4) test, the test unit was modified to add a resistive termination in lieu of the antenna as per FCC KDB 174176. Pictures are available to show the modifications. For all other tests no modifications have been made to the equipment.

3 Radiated emission data.

RESULT: PASS

Date of testing: 2017-01-24
 Frequency range: 30MHz - 1GHz

Requirements:

FCC 15.205, FCC 15.209, FCC 15.225(a) and IC RSS-Gen(4.9, 8.9) and RSS-210(B.6)

Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a), must comply with the radiated emission limits specified in FCC 15.209(a). FCC 15.225(a) and RSS-210 (B.6) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 84 dBµV/m at 30 meters.

Frequency (MHz)	Field strength (µV/meter)	Field strength (dBµV/m)	Measurement distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Table of applicable limits

Measuring instrument and setting

Radiated emissions test settings	
Frequency range	30 MHz – 1000 MHz
Test distance	3 m
Receive antenna scan height	1 m - 4 m
Receive antenna polarization	Vertical / Horizontal
Test instrument detector and bandwidth	<1GHz Quasi-peak (Qp) 120 kHz *unless otherwise noted

Test procedure:

ANSI C63.10-2013, RSS-Gen Issue 4, November 2014.

The EUT is considered as **floor-standing equipment** not typically installed with its base in direct electrical contact with, or connected to, a metal floor or grid. The EUT was placed on the floor with insulation material in-between of 4mm thickness to prevent electric contact.

Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained.

The spectrum was examined from 30MHz to 1 GHz. Final radiated emission measurements were made at 3m distance. At each frequency where a spurious emission was found, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

The six highest emission amplitudes relative to the appropriate limit were recorded in this report. Field strength values of radiated emissions at frequencies not listed in the tables are more than 20 dB below the applicable limit.

3.1 Radiated field strength measurements (30 MHz – 1 GHz, E-field)

3.1.1 Radiated field strength measurements (30 MHz- 1 GHz, E-field)

Frequency [MHz]	Antenna Orientation	Level QP [dB μ V/m]	Limit QP [dB μ V/m]	Result Pass/Fail
30.00	Vertical	30.9	40.0	Pass
40.68 ^{*H}	Vertical	32.0	40.0	Pass
55.22	Vertical	25.4	40.0	Pass
134.76 ^{*R}	Vertical	19.5	43.5	Pass
256.98 ^{*R}	Vertical	21.1	46.0	Pass
827.34 (noise)	Vertical	33.3	46.0	Pass

Table 2. Radiated emissions of the EUT

The results of the radiated emission tests, carried out in accordance with 47 CFR Part 15 section 15.205, 15.209 and 15.225 and RSS-210 and RSS-Gen, section 2.2 and 2.6 are depicted in Table 2.

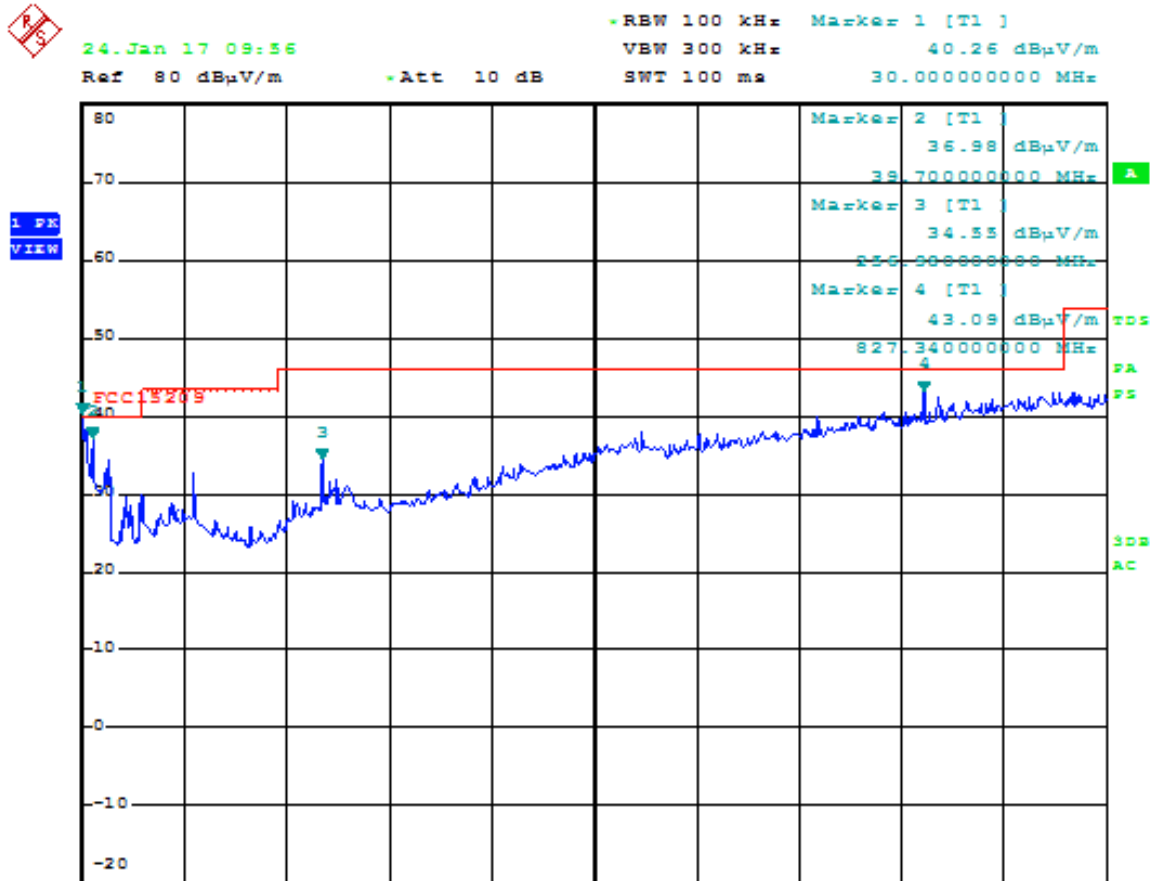
Notes:

1. Measurement uncertainty is ± 5.22 dB.
2. The EUT was tested in both normal mode (i.e. without a tag in its proximity) and in activated mode (i.e. with a tag in its proximity). Worst case values noted, which was with tag in proximity of the eut, See plot on the next page.
3. ^{*R} refers to an emission in a restricted frequency band, ^{*H} refers to an emission that's a harmonic of the fundamental frequency.

3.1.2 Used test equipment and ancillaries:

A00314	A00447	A00450	A00257	A00235	A00258	A00444	A00466	

3.1.3 Plots of the emissions



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Plot 2: radiated emissions in the frequency range 30-1000 MHz, EUT scanning tag-antenna vertical, Peak values shown.

3.2 Radiated field strength measurements (frequency range of 0.009-30 MHz, H-field).

3.2.1 Radiated field strength measurements (frequency range of 0.009-30 MHz, H-field)

Frequency (MHz)	Measurement results	Detector	Antenna factor	Cable loss	Extrapolation factor	Measurement results (calculated)	Limits	Pass/Fail
	dBµV @3m					dB		
1.9878	24.4	Qp	19.7	1	40	5.1	29.5	Pass
13.110-13.410 (13.4085)	39.8	Qp	19.7	1	40	20.5	40.5	Pass
13.410-13.553 (13.485)	49.6	Qp	19.7	1	40	30.3	50.5	Pass
13.560 fundamental	78.4	Qp	19.7	1	40	59.1	84.0	Pass
13.567-13.710 (13.5671)	62.2	Qp	20.0	1	40	43.2	50.5	Pass
13.710-14.010 (13.718)	35.0	Qp	20.0	1	40	16.0	40.5	Pass
27.120*h	6.9	Qp	19.7	1	40	-12.4	29.5	Pass

Table 3. Radiated emissions of the EUT, in the frequency range 0.009 – 30 MHz

The results of the radiated emission tests in the frequency range 0.009 – 30 MHz, carried out in accordance with 47 CFR Part 15 section 15.209 and RSS-210 and RSS-Gen are depicted in Table 3.

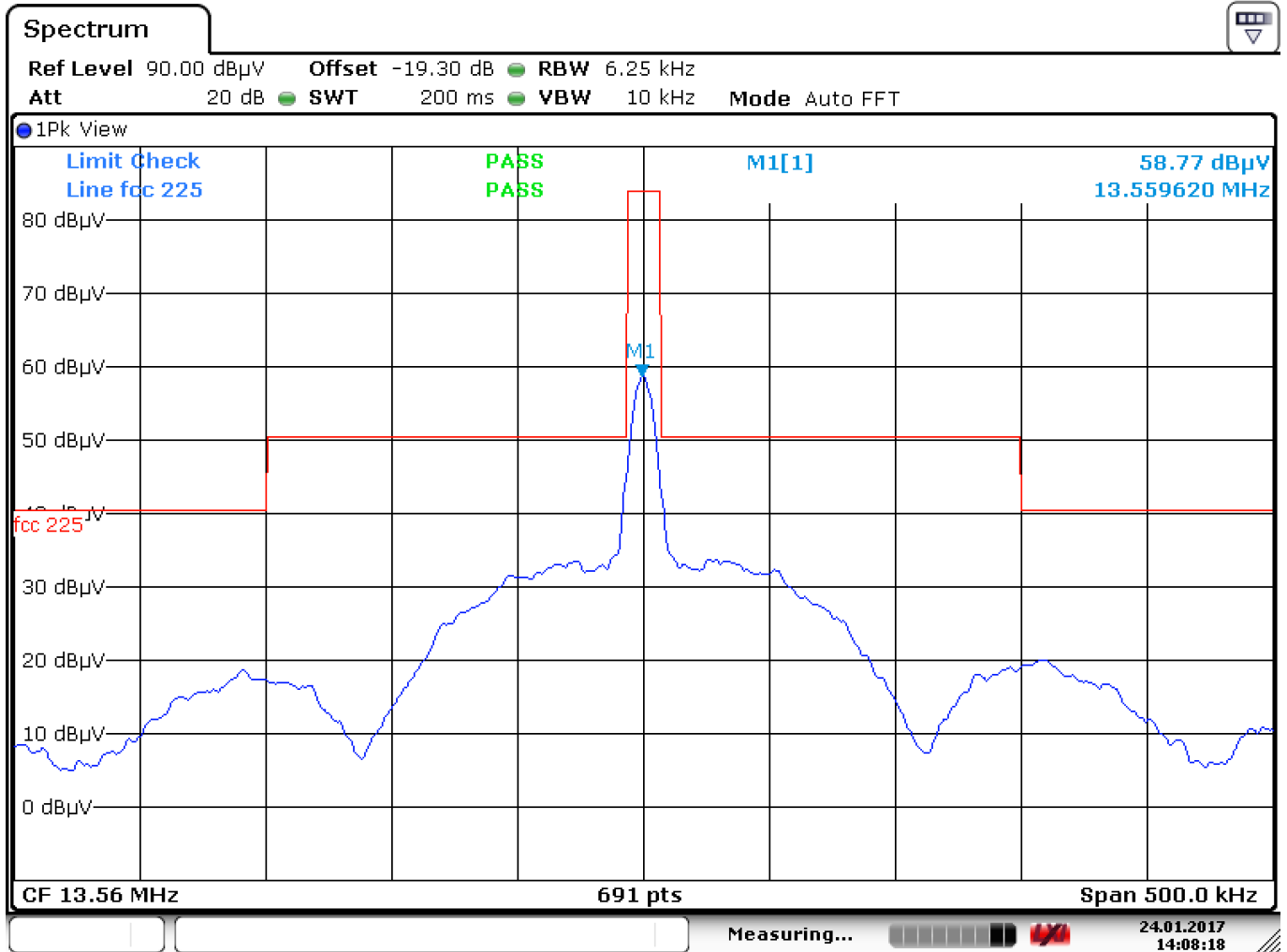
Notes:

1. Calculated measurement results are obtained by using the 40dB/decade factor (antenna factor and cable loss is included). i.e at 13.56 MHz: 78.4 dBµV/m + 19.7 dB + 1dB - 40dB= 59.1 dBµV/m.
2. A resolution bandwidth of 9kHz was used during testing
3. Field strength values of radiated emissions at frequencies not listed in Table 3 are more than 20 dB below the applicable limit, some noise levels are noted.
4. *h denotes to an emission that's a harmonic of the fundamental frequency.
5. The loop antenna was varied in horizontal and vertical orientations and also around its axis. The reported value is the worst case found at the reported frequency.
6. Measurement uncertainty is ±5.0dB
7. Tested without LAN connection, this was tested as part of the unintentional radiator Part 15B tests.
8. The EUT was tested in both normal mode (i.e. without a tag in its proximity) and in activated mode (i.e. with a tag in its proximity). Worst case values noted.

3.2.2 Test equipment used (for reference see test equipment listing).

A01491	A00726	A00444	A00450	A00447		
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3.2.3 Plot of the emission mask



Date: 24.JAN.2017 14:08:18

Plot 1: plot of the emission mask (Peak detector value shown)

4 AC Power Line Conducted emission data.

4.1 AC Power Line Conducted Emission data of the EUT.

RESULT: Pass.

Date of testing: 2017-02-06

Requirements: Except when the requirements applicable to a given device state otherwise, for any license-exempt radio communication 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 the following table. The tighter limit applies at the frequency range boundaries.

Frequency of Emission (MHz)	Conducted Limit (dB μ V) Quasi-Peak	Conducted Limit (dB μ V) Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 - 30	46	50

*Decreases with the logarithm of the frequency.

Test procedure:

ANSI C63.10-2013.

Each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a 50 μ H / 50 Ω LISN. The frequency range from 150kHz to 30MHz was searched. The six highest EUT emissions relative to the limit were noted for three supply voltages.

The EUT is considered as floor-standing equipment not typically installed with its base in direct electrical contact with, or connected to, a metal floor or grid. The EUT was placed on the floor with insulation material in-between of 4mm thickness to prevent electric contact. The EUT was positioned at least 80cm from the LISN. The power cable was routed over the non-conductive plate to the LISN.

4.1.1 AC Power Line Conducted Emissions

Frequency (MHz)	Measurement results dB μ V Neutral		Measurement results dB μ V Line 1		Limits dB μ V		Pass/Fail
	QP	AV	QP	AV	QP	AV	
0.68500	45.9	19.3	38.5	10.0	56.0	46.0	PASS
0.71641	46.3	20.1	40.9	20.0	56.0	46.0	PASS
0.81406	45.6	18.3	43.0	12.0	56.0	46.0	PASS
0.84531	44.2	19.3	33.3	12.0	56.0	46.0	PASS
0.88047	42.1	18.9	37.4	12.0	56.0	46.0	PASS
13.56016	44.7	43.4	39.8	35.0	60.0	50.0	PASS

Table 4. Conducted emission measurements

The results of the conducted emission tests, carried out in accordance with 47 CFR Part 15 section 15.207 & RSS-Gen, section 7.2.4, at the 120 Volts AC mains connection terminals of the 24 Vdc power supply which was connected to the EUT, are depicted in Table 4.

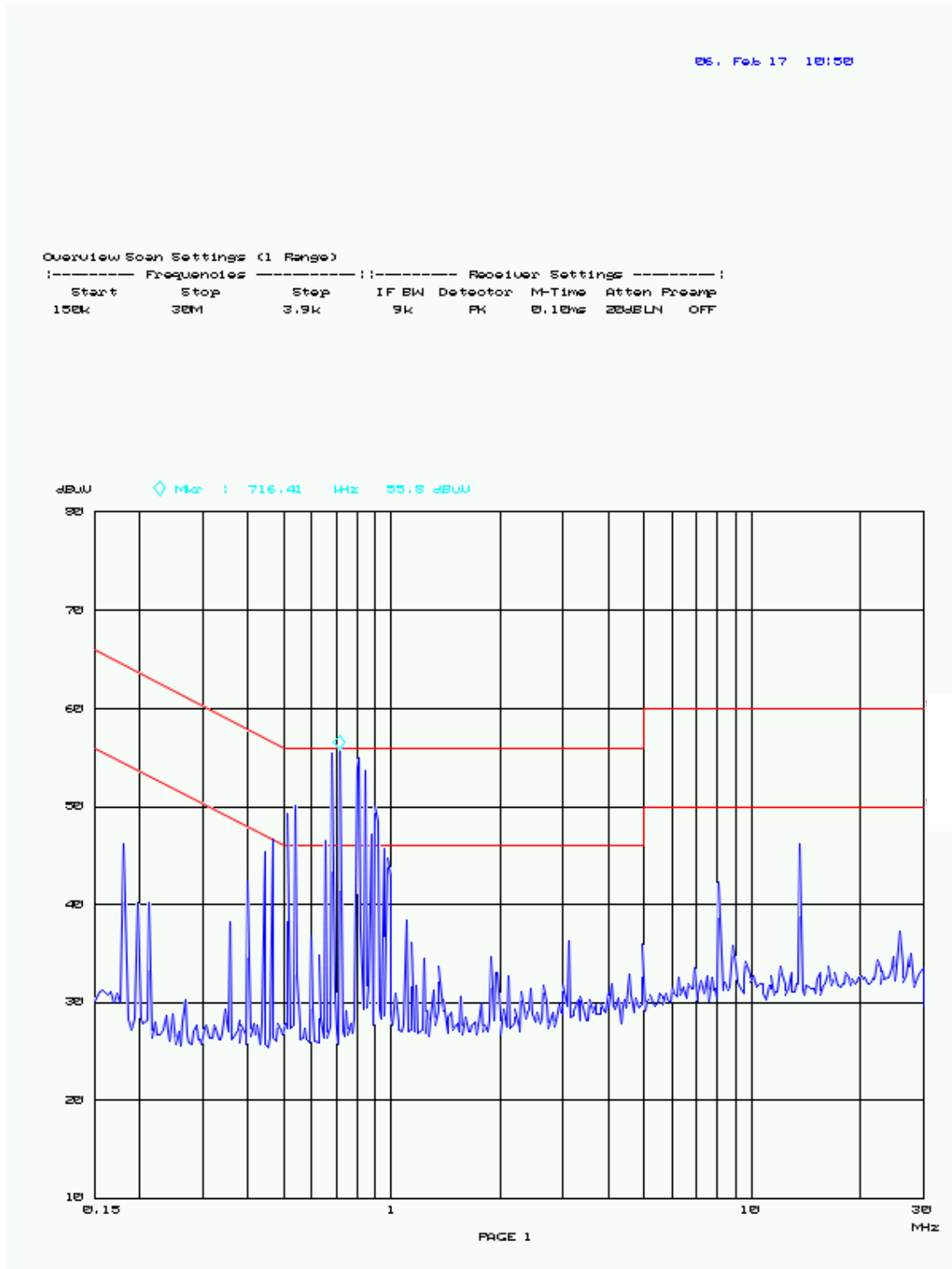
Notes:

1. The test data shown above is of the EUT as shown in the test setup photographs document. The six highest values relative to the applicable limits were noted.
2. The values of conducted emissions at frequencies not listed in the table above are more than 20 dB below the applicable limit.
3. Measurement uncertainty is ± 3.5 dB
4. Tested without LAN connection, which was tested as part of the unintentional radiator Part 15B tests.
5. The EUT was tested in while continuously transmitting.
6. The test unit was modified to add resistive terminations in lieu of the antenna as per KDB 174176. At the side where the terminations were placed the EUT's cover could not be placed. For this measurement it was not of influence on the test results.
7. A power supply is not delivered with the EUT when brought on to the market, a test lab power supply (inventory number A00124) was used on 24 Vdc.
8. Plots are provided on the next pages.

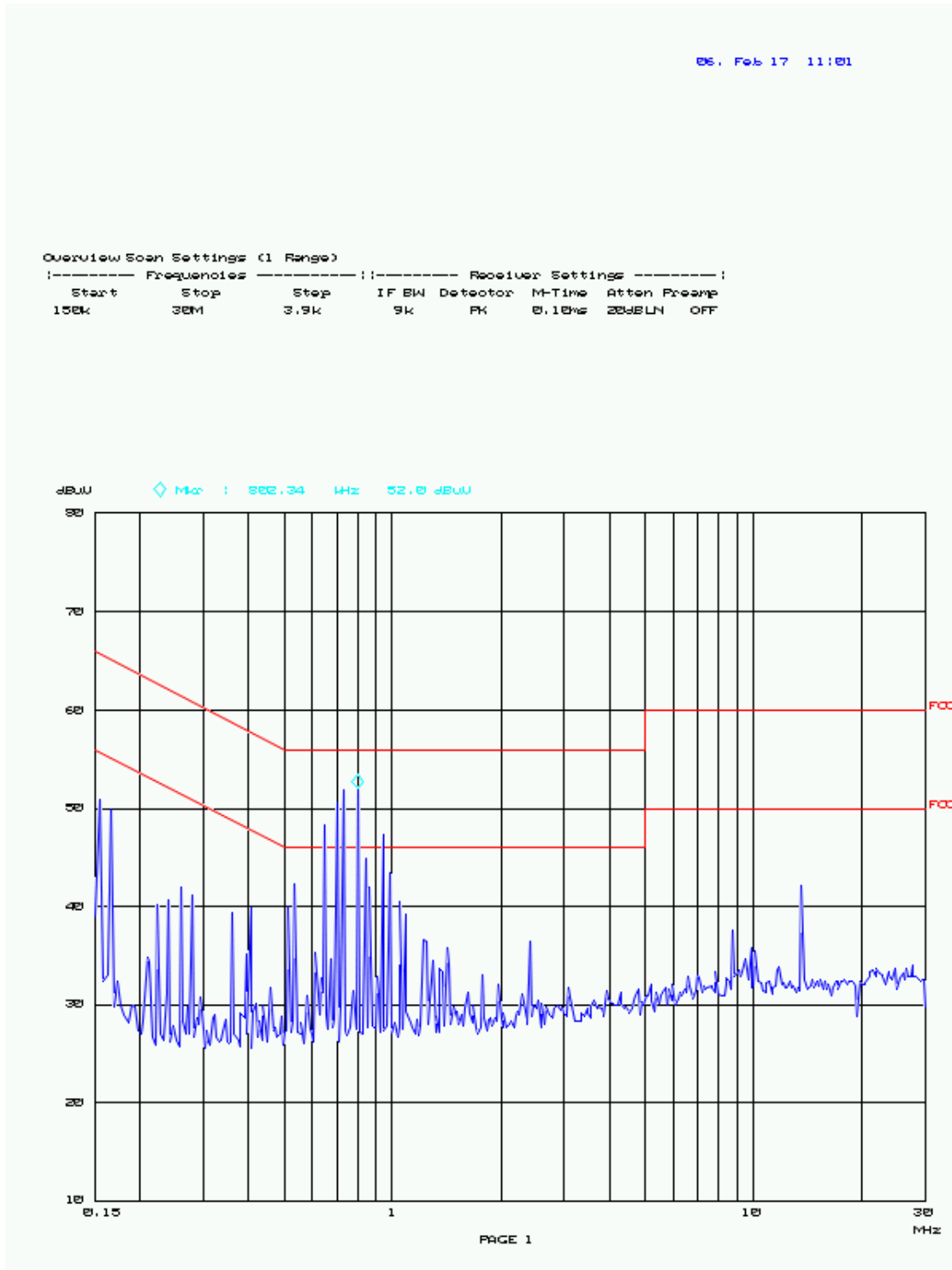
4.1.2 Test equipment used (for reference see test equipment listing).

A00051	A00171	A00022	A00726	A00441	A00437	A00124
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4.1.3 Plots of the AC Power Line Conducted Emissions



Plot of the AC Power Line Conducted Emissions on L1



Plot of the AC Power Line Conducted Emissions on L2

5 Carrier stability under special conditions.

5.1 Frequency stability (on 13.56 MHz) in accordance with 47 CFR Part 15, section 15.225 (e) & RSS-Gen section 6.11 and 8.11 and RSS-210 section B.6:

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency (13.560 MHz ±1.356 kHz) over a temperature variation of -20 °C to +50 °C at normal supply voltage (see Table 5).

Stability under special conditions Temperature (°C)	Supply Voltage (Vdc)	Measured frequency (MHz)	Frequency deviation (limit ±0.01%) (%)	PASS/FAIL
20.0	24	13.5597875 (reference)	N.A.	N.A.
-20.0	24	13.5598259	< 0.01	PASS
50.0	24	13.5598104	< 0.01	PASS

Table 5. The frequency tolerance of the carrier signal

5.1.1 At 85% and 115% of rated voltage supply level

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency (13.560 MHz ±1.356 kHz) at 85% and at 115% of the rated power supply voltage at 20 °C environmental temperature. The reference is taken at 24 Vdc which is the recommended supply voltage. The results are stated in Table 6.

Stability under special conditions % variation U	Measured Frequency (MHz)	Frequency deviation (limit ±0.01%) (%)	PASS/FAIL
100.0 (24.0 Vdc)	13.5597875 (reference)	N.A.	N.A.
85.0 (20.4 Vdc)	13.5596992	< 0.01	PASS
115.0 (27.6 Vdc)	13.5596985	< 0.01	PASS

Table 6. The frequency tolerance of the carrier signal

5.1.2 Test equipment used (for reference see test equipment listing).

A00049	A01634	A00337	A00472+ A00328	A00446	A00346	A00266
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Test engineer

Signature : 

Name : R. van der Meer

Date : December 21, 2016

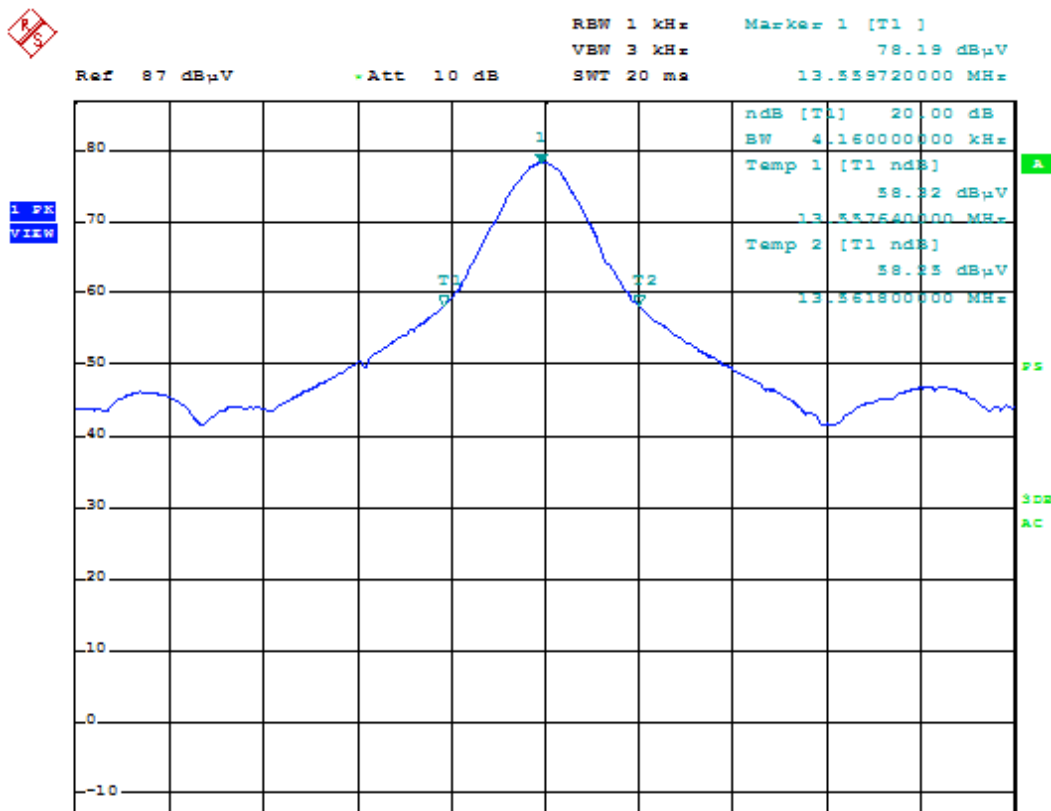
6 Plots of Emission bandwidth

6.1 Bandwidth of the emission

RESULT: Pass

Date of testing: 2017-01-24

Test result:



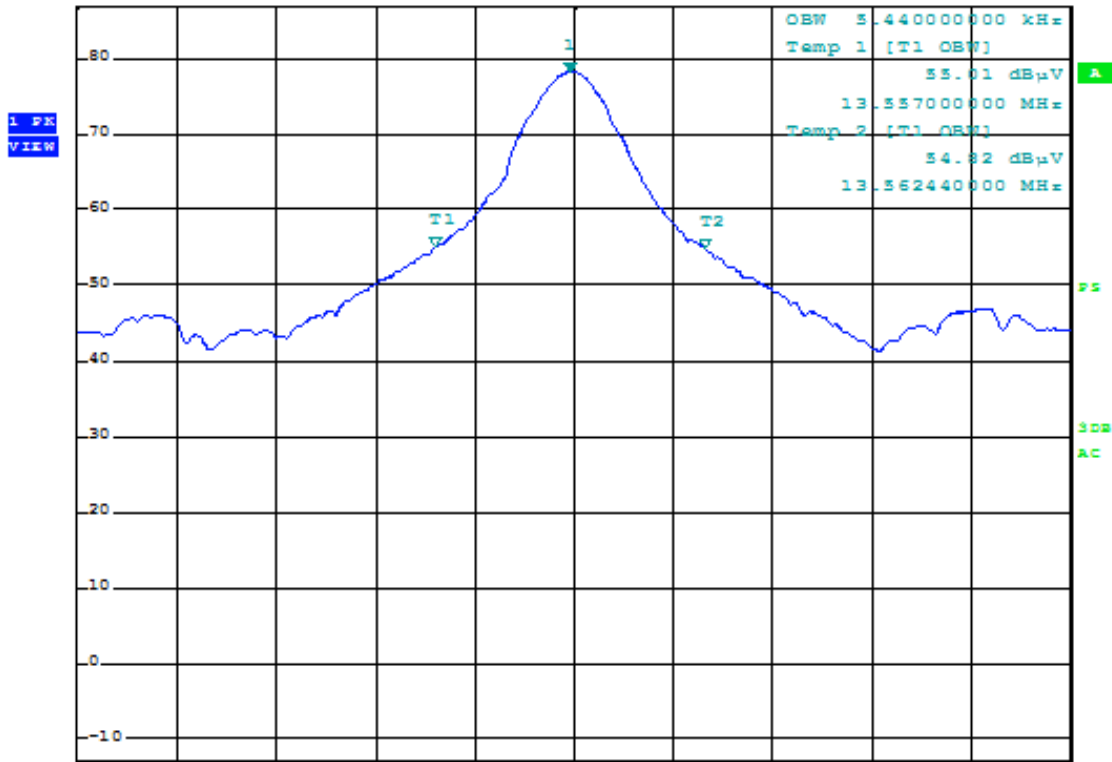
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Date: 24.JAN.2017 11:27:01

Plot1a: plot of the 20dB emission bandwidth. Measured value is 4.16 kHz as measured on a spectrum analyzer.



RBW 1 kHz Marker 1 [T1]
 VBW 3 kHz 78.21 dBμV
 Ref 87 dBμV Att 10 dB SWT 20 ms 13.539720000 MHz



ORI

Date: 24.JAN.2017 11:28:16

Plot1b: plot of the 99% emission bandwidth. Measured value is 5.44 kHz as measured on a spectrum analyzer.

7 List of utilized test equipment.

Inventory number	Description	Brand	Model	Last cal.	Next cal.
A00022	LISN	EMCO	3625/2	01/2016	01/2018
A00051	Pulse Limiter	R&S	ESH3-Z2	02/2016	02/2017
A00466	Biconilog Testantenna	Teseq	CBL 6111D	08/2015	08/2016
A00726	Measuring receiver	R&S	ESCS30	10/2016	10/2017
A00257	Controller	EMCS	DOC202	NA	NA
A00171	Variac	RFT	LSS020	NA	NA
A00441/ A00444/ A00446	Temperature- Humiditymeter	Extech	SD500	04/2016	04/2017
A00235/ A00436	Anechoic Room	Siepel	FCC listed: 90828 IC: 2932G-2	07/2014	07/2017
A00437	Shielded room (AC power line cond. Em.)	Euroshield	RFD-100 359	NA	NA
A00450	Controller	Maturo	SCU/088/8090811	NA	NA
A00258	Antenna mast	EMCS	AP-4702C	NA	NA
A00314	Measuring receiver	R&S	ESCI	03/2016	03/2017
A00447	RF Cable S-AR	Gigalink	APG0500	02/2016	02/2017
A00337	Spectrum analyzer	R&S	FSV	06/2016	06/2017
A00049	Temperature chamber	Heraeus	VEM03/500	NA	NA
A01491	Active loopant. 60 cm	Chase	HLA6120	05/2016	05/2017
A00266	Variac 120Vac	RFT	LTS001	NA	NA
A01634	Digital Voltmeter	Keysight Technologies	34461A	02/2017	02/2018
A00124	24 Vdc power supply	Delta Elektronika	E030-3	04/2016	04/2017
A00427+ A00328	Temperature meter + thermocouple	Yokogawa	YC-727	02/2016	02/2017

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025:2005 has been confirmed before testing. NA= Not Applicable

<< End of report >>