TEST REPORT CONCERNING THE COMPLIANCE OF A BEACON FOR A COW POSITIONING SYSTEM, BRAND Nedap , MODEL VP4201

WITH 47 CFR PART 15 (10-1-12) AND THE REQUIREMENTS OF INDUSTRY CANADA: RSS-GEN (ISSUE 3, DECEMBER 2010) AND RSS-210 (ISSUE 8, DECEMBER 2010)

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December 17, 2013

FCC listed : 90828
Industry Canada : 2932G-2
R&TTE, LVD, EMC Notified Body : 1856

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MEASUREMENT/TECHNICAL REPORT

Brand: Nedap
Model: VP4201

FCC ID: CGDVP4201
IC: 1444A-VP4201

This report concerns:	Original grant/certification ~~Class 2 Permissive Change~~ ~~Verification~~
Equipment type:	DSC Remote Control Transmitter

Report prepared by:		
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The data taken for this test and report herein was done in accordance with 47 CFR Part 15 (10-1-12 edition) RSS-GEN (ISSUE 3, DECEMBER 2010), RSS-210 (ISSUE 8, DECEMBER 2010) and the measurement procedures of ANSI C63.4-2009. TÜV Rheinland EPS 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: December 17, 2013

Signature:

O. Hoekstra
Senior Engineer Telecom TÜV Rheinland EPS

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)	:	Beacon for a Cow Positioning System
Manufacturer	:	N.V. Nederlandsche Apparatenfabriek "Nedap"
Brand	:	Nedap
Model(s)	:	VP4201
Serial number(s)	:	--
Receipt date	:	November 07, 2013

Applicant information

Applicant's representative	:	Mr. J. Hulshof
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	:	November 07, 2013
Test(s) completed	:	December 09, 2013
Purpose of test(s)	:	Equipment Authorization (Original grant/certification)
Test specification(s)	:	47 CFR Part 15 (10-1-12 edition) and RSS-GEN (ISSUE 3, DECEMBER 2010) AND RSS-210 (ISSUE 8, DECEMBER 2010)
Test engineer(s)	:	R. van der Meer 
Report written by	:	R. van der Meer 
Report date	:	December 17, 2013

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Appendix-1 Calculated measurements results radiated field strength, H-Field

General information.

1.1 Product description.

1.1.1 Introduction.

The Beacon for a Cow Positioning System, brand Nedap, model VP4201 operates in the frequencyband 433.6 MHz – 434.2 MHz and on 52.8 – 57.36 kHz.

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: CGDVP4201 and IC: 1444A-VP4201.

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	:	Beacon for a Cow Positioning System
Manufacturer	:	N.V. Nederlandsche Apparatenfabriek "Nedap"
Brand	:	Nedap
Model	:	VP4201
Serial number	:	--
Voltage input rating	:	--
Voltage output rating	:	n.a.
Current input rating	:	--
Antenna	:	External
Operating frequency	:	TX1: 433.6 – 434.2 MHz TX2: 52.8 – 57.36 kHz Channel 1: 433.6 MHz Channel 2: 433.8 MHz Channel 3: 434.0 MHz Channel 4: 434.2 MHz
Modulation	:	FSK
Remarks	:	n.a.

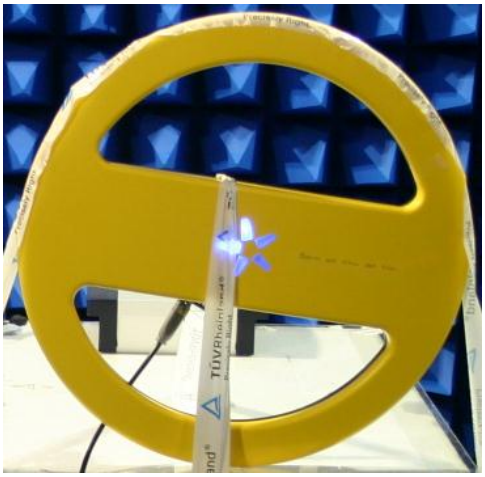


Photo 1. Photograph of the tested sample

1.3.1 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

1. AUX1
   - Product: Laptop Computer
   - Brand: HP
   - Model: Compaq nc6400
   - Serial Number: CND6412LVT
   - Remark: property applicant, host for testsoftware

2. AUX2
   - Product: Power supply for EUT
   - Manufacturer: Nedap
   - Brand: Nedap
   - Model: VP2002 and VP8001-2
   - Rated Voltage: --
   - Serial number: --
   - Remarks: --

3. AUX3
   - Product: Ethernet switch
   - Manufacturer: Netgear
   - Brand: Netgear
   - Model: FS105v2
   - Rated Voltage: --
   - Remarks: communication interface between EUT and AUX1

4. AUX4
   - Product: Antenna
   - Manufacturer: PROCOM
   - Brand: PROCOM
   - Model: CXL 70-1LW/h
   - Rated Voltage: --
   - Remarks: --

1.3.2 Description of input and output ports.

The EUT has input and output ports present for power supply connection, indicators and antenna.

No.	Port	From	To	Remarks
1.	Mains	Mains	AUX1	Unshielded cable <3m
2.	Mains	Mains	AUX3	Unshielded cable <3m
3.	Mains	Mains	AUX2	Unshielded cable <3m
4.	DC power	AUX2	EUT and AUX5	Shielded cable >30m
5.	Ethernet	AUX1	AUX3	Shielded cable <3m
6.	Ethernet	AUX3	AUX2	Shielded cable <3m
7.	Ethernet	AUX2	AUX5	Shielded cable <3m
8.	Antenna	AUX5	AUX4	Shielded cable <30m

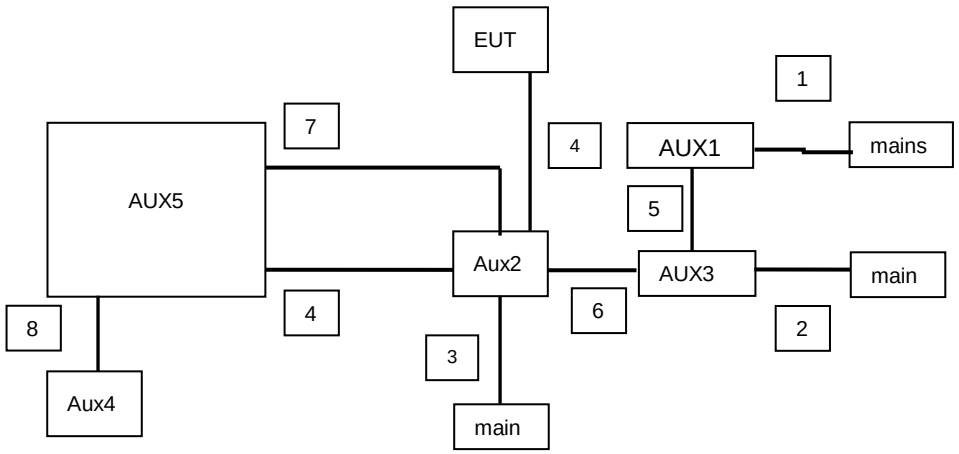
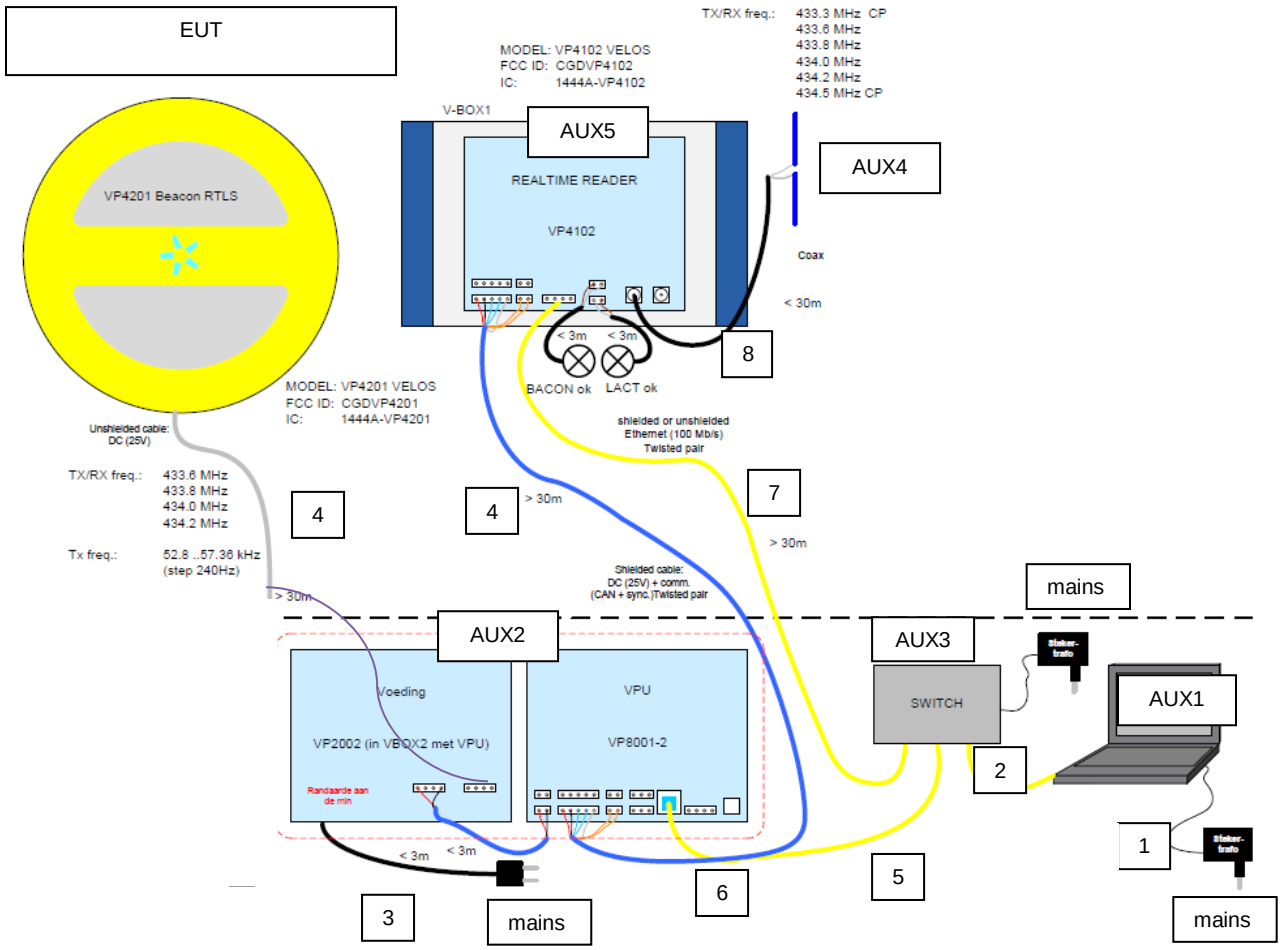


Figure 1. Basic set-up


EUT
MODEL: VP4102 VELOS
FCC ID: CGDVP4102
IC: 1444A-VP4102
TX/RX freq.: 433.3 MHz CP
433.6 MHz
433.8 MHz
434.0 MHz
434.2 MHz
434.5 MHz CP
V-BOX1
AUX5
REALTIME READER
VP4102
AUX4
Coax
< 30m
VP4201 Beacon RTLS
< 3m
< 3m
BACON ok
LACT ok
8
MODEL: VP4201 VELOS
FCC ID: CGDVP4201
IC: 1444A-VP4201
shielded or unshielded
Ethernet (100 Mb/s)
Twisted pair
Unshielded cable:
DC (25V)
TX/RX freq.: 433.6 MHz
433.8 MHz
434.0 MHz
434.2 MHz
Tx freq.: 52.8 ..57.36 kHz
(step 240Hz)
4
4
> 30m
7
> 30m
> 30m
Shielded cable:
DC (25V) + comm.
(CAN + sync.)Twisted pair
mains
AUX2
AUX3
Voeding
VP2002 (in VBOX2 met VPU)
VPU
VP8001-2
SWITCH
AUX1
2
1
< 3m
< 3m
3
mains
6
5
mains

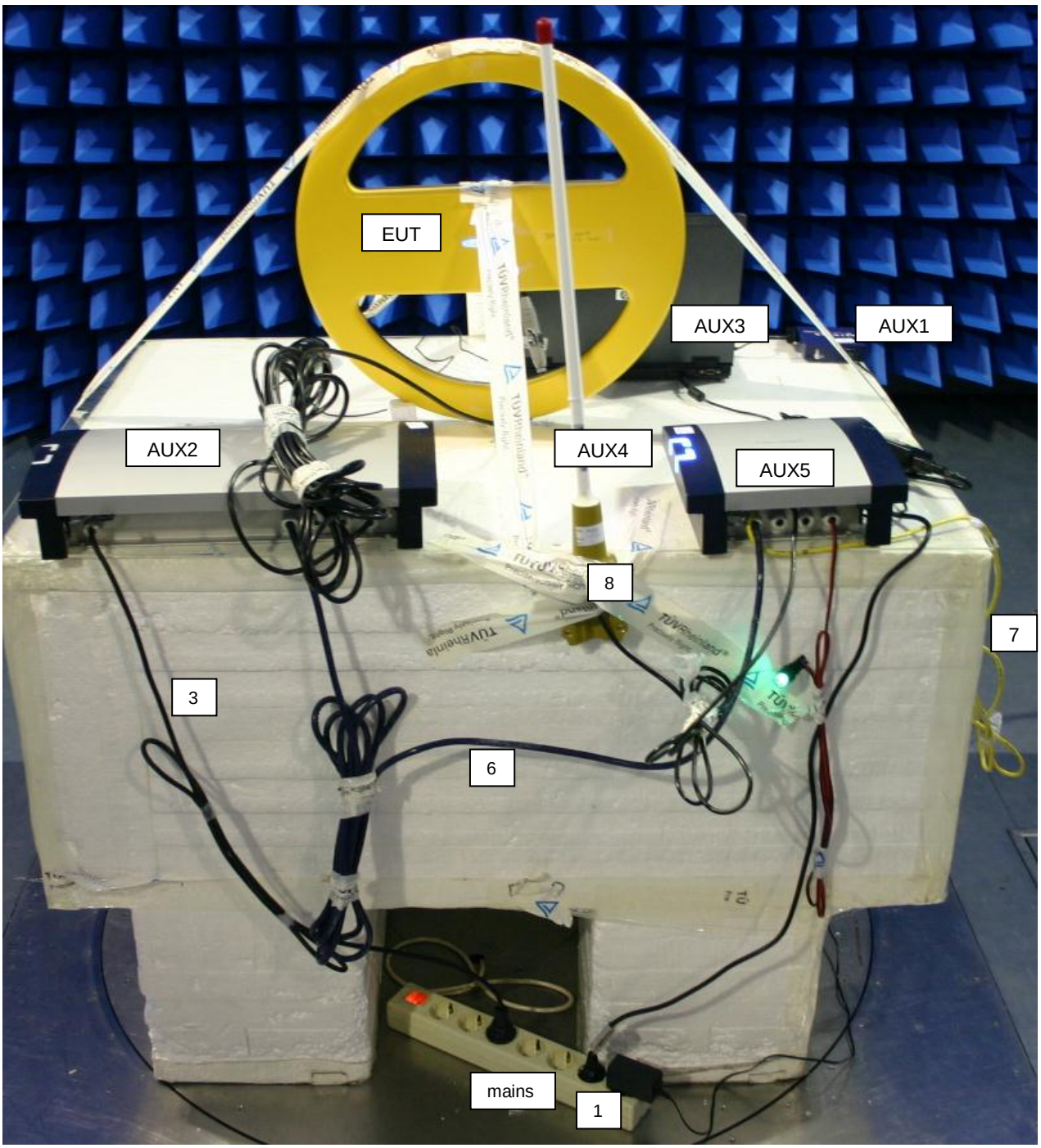


Figure 2. photograph of the basic set-up

1.4 Test summary

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

Test Standard		Description		Pass / Fail / Not Applicable
47 CFR Part 15 (10-1-12 Edition)	RSS-210 Issue 8, December 2010		Page	
15.207(a)	RSS-Gen(7.2.4)	Conducted emissions	18 – 19	Pass
15.209, 15.231(e)*	RSS-Gen(4.9 and 7.2.5) and RSS-210(2.5)	Radiated emissions	13 – 17	Pass
15.215(c)	RSS-Gen(4.6.1)	Bandwidth of the emission	20 – 26	Pass
15.231(e)*	RSS-210 (A.1.1.5)	RF on/off time	27 - 28	Pass

Table: Test specifications

Testmethods: ANSI C63.4:2009, RSS-Gen Issue 3, December 2010 and RSS-210 annex A section A1.1.5 and Table B limits.

1.5 Test methodology.

The test methodology used is based on the requirements of 47 CFR Part 15 (10-1-12)), sections 15.31, 15.35, 15.205, 15.209, 15.231 and RSS-GEN (ISSUE 3, DECEMBER 2010) RSS-210 (ISSUE 8, DECEMBER 2010).

The test methods, which have been used, are based on ANSI C63.4: 2009.

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 and 30 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 EPS, 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	: 120Vac – 60Hz
Air pressure	: 950 – 1050 hPa

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 EUT was not modified for testing purposes.

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 C63.4- 2009.

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 Test frequencies

Measurements are made with the EUT set to 3 frequencies in it's operating range, 1 near the bottom (433.6 MHz), 1 near the center (433.8 MHz) and 1 near the top (434,2 MHz). The other transmitter was tested in it's operating frequencyband of 52.8 – 57.36 kHz at one frequency only.

2.4 Testsoftware

Testsoftware was provided by the applicant to enable settings required for testing.

Testsoftware: VP4102 Commander
Version: 11-9-2013
Special note on settings: TX Power= 8

2.5 Special accessories.

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

2.6 Equipment modifications.

No modifications have been made to the equipment in order to achieve compliance.

2.7 Product Labeling

The product labeling information is available in the technical documentation package.

2.8 Block diagram of the EUT.

The block diagram is available in the technical documentation package.

2.9 Schematics of the EUT.

The schematics are available in the technical documentation package.

2.10 Part list of the EUT.

The part list is available in the technical documentation package.

3 Radiated emission data.

RESULT: PASS

Date of testing: 2013-11-18

Frequency range: 30MHz - 4.35GHz

Requirements:

FCC 15.205, FCC 15.209, FCC 15.231(e) and IC RSS-Gen(4.9, 7.2.2 and 7.2.5) and RSS-210(2.5)

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).

Test procedure:

ANSI C63.4-2009.

The EUT was placed on a nonconductive turntable 0.8m above the ground plane. 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 the 10th harmonic of the highest fundamental transmitter frequency. 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 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.

Correction factors are incorporated in the spectrum analyzers as an automated function.
Correction factors includes: antenna factor, cable loss and pre-amplifier gain.

3.1 Radiated field strength measurements (30 MHz – 4.35 GHz, E-field)

Frequency (MHz)	Detector	Polarization	Results @3m (dBµV/m)	Limits @3m (dBµV/m)	Pass/ Fail
50.80	Qp	Vertical	24.5	40.0	Pass
400.40	Qp	Vertical	31.0	46.0	Pass
412.40	Qp	Vertical	31.4	46.0	Pass
425.20	Qp	Vertical	31.9	46.0	Pass
755.80	Qp	Vertical	39.0	46.0	Pass
952.70	Qp	Horizontal	43.2	46.0	Pass
Fundamentals:					
433.60	Pk	Vertical	88.0	92.86	Pass
433.80	Pk	Vertical	88.1	92.87	Pass
434.20	Pk	Vertical	87.6	92.88	Pass
Harmonics:					
867.20	Qp	Vertical	33.8	46.0	Pass
867.60	Qp	Vertical	34.6	46.0	Pass
868.40	Qp	Vertical	33.8	46.0	Pass
Frequency (MHz)	**Detector**	**Polarization**	**Results Pk @3m (dBm eirp)**	**Limits @3m (dBm eirp)***	**Pass/ Fail**
1056	Pk	Vertical	-57.9	-21.2 Pk/ -41.2 Av	Pass
1329	Pk	Vertical	-56.7	-21.2 Pk/ -41.2 Av	Pass
1595	Pk	Vertical	-58.4	-21.2 Pk/ -41.2 Av	Pass
1861	Pk	Vertical	-55.5	-21.2 Pk/ -41.2 Av	Pass

*Derived from the expression dBm eirp= E (dBµV/m) – 95.2 dB

Table 1 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, 15.231(e), RSS-210 (Annex 1) and RSS-Gen (4.9, 7.2.2 and 7.2.5) are depicted in Table 1.
See notes on page 15.

Notes:

1. Field strength values of radiated emissions at frequencies not listed in the Table 1 above are more than 20 dB below the applicable limit.
2. The frequency of 1329 MHz falls within a restricted band as specified in section 15.205. Therefore the limit specified in section 15.209 has been applied.
3. Measurements were performed up to the 10th harmonic of the transmit frequency of 434.5 MHz.
4. A resolution bandwidth of 120 kHz was used below 1000 MHz.
5. Above 1000 MHz a Peak detector was used with a bandwidth of 1 MHz.
6. Where measured Peak values were below the Average limit by at least 3dB measurement with Average detector was not performed.
7. Measurement uncertainty is ±5.0dB.

Used test equipment and ancillaries:

99580/99847	99855	99877	12483	99608	99609	99699		

3.2 Radiated field strength measurements (30 MHz – 4.35 GHz, E-field), Average values

Frequency (MHz)	Measurement results @3m (dBµV)	Polarization	Detector	Duty Cycle Correction factor (dB)	Results after correction (dBµV/m)	Limits @3m (dBµV/m)	Pass/ Fail
Fundamentals:							
433.60	88.0	Vertical	Av	-20.00	68.0	72.86	Pass
433.80	88.1	Vertical	Av	-20.00	68.1	72.87	Pass
434.20	87.6	Vertical	Av	-20.00	67.6	72.88	Pass

Table 2 Radiated emissions of the EUT, Average values.

The results of the radiated emission tests, carried out in accordance with 47 CFR Part 15 section 15.35, 15.205, 15.209,15.231, RSS-210 and RSS-Gen are depicted in Table 2.

Notes:

1. Table 2 show calculated average values from the pulsed emissions measurement data from section 3.1 Peak values, corrected with the worst case duty cycle factor over 100 msec (see Note 2 on this page).
2. The values noted in Table 1 are after application of a duty cycle correction, according to part 15.35c of – 20.00 dB. Duty cycle calculated from: Duty cycle correction (dB) = 20 log (10.0 msec / 100 msec) = -20.00 dB. See page 27 of this document for the RF On-time of 10.0 msec.

3.3 Radiated field strength measurements of the TX2 (52.8 – 57.36 kHz) transmitter (frequency range of 0.009-30 MHz, H-field).

Frequency (MHz)	Detector / Resolution Bandwidth (kHz)	Polarization	Results @3m (dBµV/m)	Correction factor / distance factor (dB)	Results @300m (dBµV/m)	Limits @300m (dBµV/m)	Pass/ Fail
0.04447	Pk / 0.2	Vertical	35.2	21.2 / 80	-25.9	34.6	Pass
0.05544 fundamental	Pk / 0.2	Vertical	143.50	note[3]	24.3[3]	52.4	Pass
0.05544 fundamental	Pk / 0.2	Vertical	112.3 @10m	note[3]	24.3[3]	52.4	Pass
0.05544 fundamental	Av / 0.2	Vertical	143.30	note[3]	24.0[3]	32.4	Pass
0.05544 fundamental	Av / 0.2	Vertical	112.1 @10m	note[3]	24.0[3]	32.4	Pass
0.05729	Pk / 0.2	Vertical	30.8	21.2 / 80	-28.0	32.4	Pass
0.08890	Pk / 0.2	Vertical	29.2	21.1 / 80	-30.3	28.6	Pass
0.11088	Pk / 0.2	Vertical	-1.1	72.4 / 80	-8.7	26.7	Pass
0.16770	Pk / 0.2	Vertical	12.4	71.3 /80	3.7	23.1	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. Field strength values of radiated emissions at frequencies not listed in the Table 3 above are more than 20 dB below the applicable limit.
2. Calculated measurement results are obtained by using the 40dB/decade factor (antenna factor and cable loss is included). i.e at 0.11088 MHz: -1.1 dBµV + 71.4 dB + 1dB - 80dB= -8.7 dBµV/m.
3. See Appendix 1 for the calculation of the fundamental value at 300 meters (Pk value given as example).
4. The fundamental was measured on 3m with a passive loop antenna and on 30m with an active loop antenna.
5. Where measured Peak values were below the Average limit by at least 3dB measurement with Average detector was not performed.
6. The EUT was varied in three positions, the loop antenna was varied in horizontal and vertical orientations and also around it's axis. The reported value is the worst case found at the reported frequency.
7. Correction factor = Antenna factor +1dB cable loss.
8. Measurement uncertainty is ±5.0dB.

Used test equipment and ancillaries:

99580/99847	99858	15453	99699	99857	12479			

4 Conducted emission data.

4.1 AC Power Line Conducted Emission data of the EUT.

RESULT: Pass.

Date of testing: December 04, 2013

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 (dBµV) Quasi-Peak	Conducted Limit (dBµV) 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.

Frequency (MHz)	Measurement results dB(µV) Line 1		Measurement results dB(µV) Line 2 (N)		Limits dB(µV)		Pass/Fail
	QP	AV	QP	AV	QP	AV	
0.15364	43.1	*4	40.0	*4	66.0	56.0	Pass
0.16420	40.0	*4	44.4	*4	65.5	55.5	Pass
0.17181	45.0	*4	44.2	*4	65.0	55.0	Pass
0.25104	38.0	*4	38.5	*4	61.8	51.8	Pass
4.77772	33.9	*4	23.5	*4	56.0	46.0	Pass
11.45258	45.4	*4	45.1	*4	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 AUX2 which connected to the EUT, are depicted in Table 4.

Notes:

1. The test data shown is the worst case. The six highest values are recorded.
2. Tested on 120 Vac.
3. Measurement uncertainty is ±3.5dB.
4. Qp values already within Av limits, therefore not tested on Av.
5. See plots on pages 27-28

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

12512	99161	99852	15667	13313	99848	99220

5 Plots of measurement data

5.1 Bandwidth of the emission

RESULT: PASS

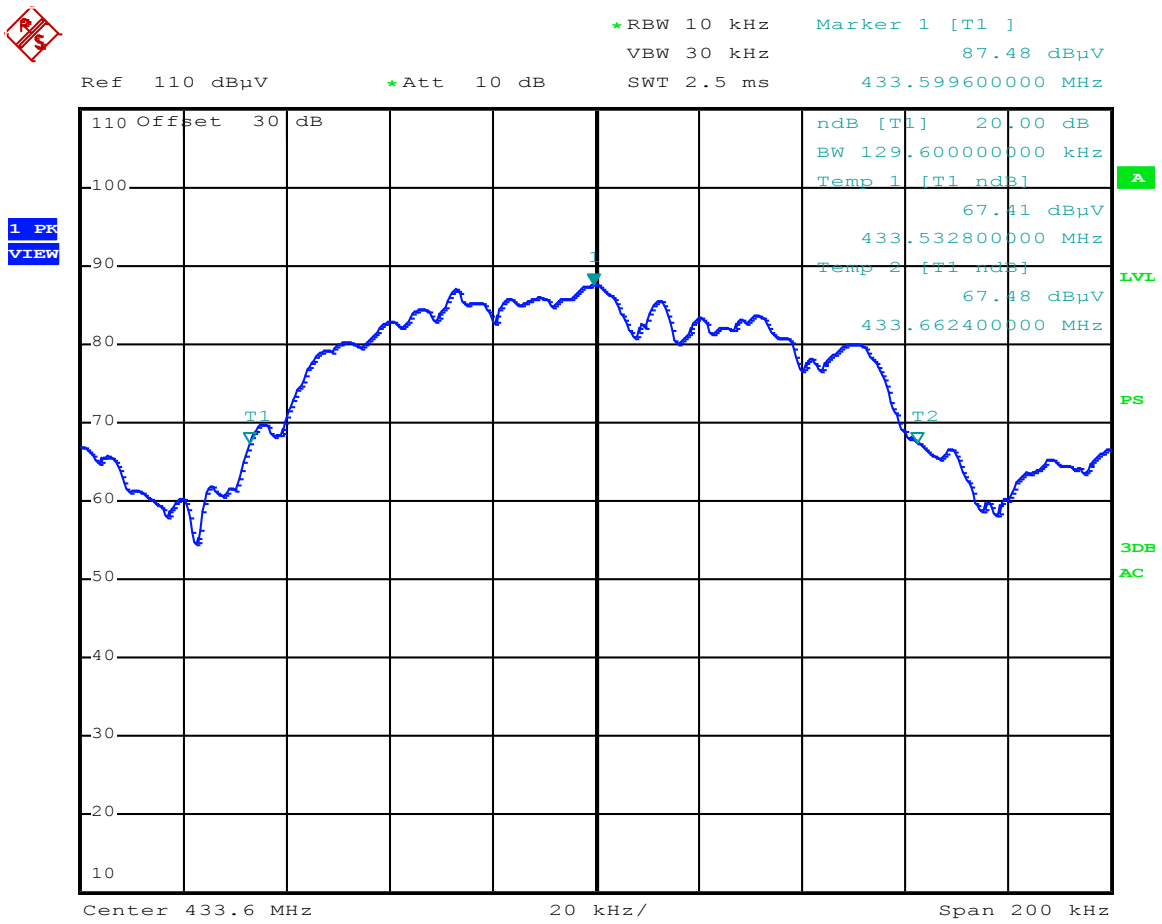
Date of testing: 2013-12-04

Requirement:

The bandwidth of emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.
For this EUT operating at the lowest operating frequency of 433.60 MHz (Channel 1) the allowable bandwidth of emissions would be:
0.25% * 433.60 MHz = 1084.0 kHz.

Testresult:

The measured bandwidth of the emissions as measured with a spectrum analyzer was: **129.60 kHz** (see Plot1a on the next page).
The test was performed on a modified EUT, where constant transmission was enabled.



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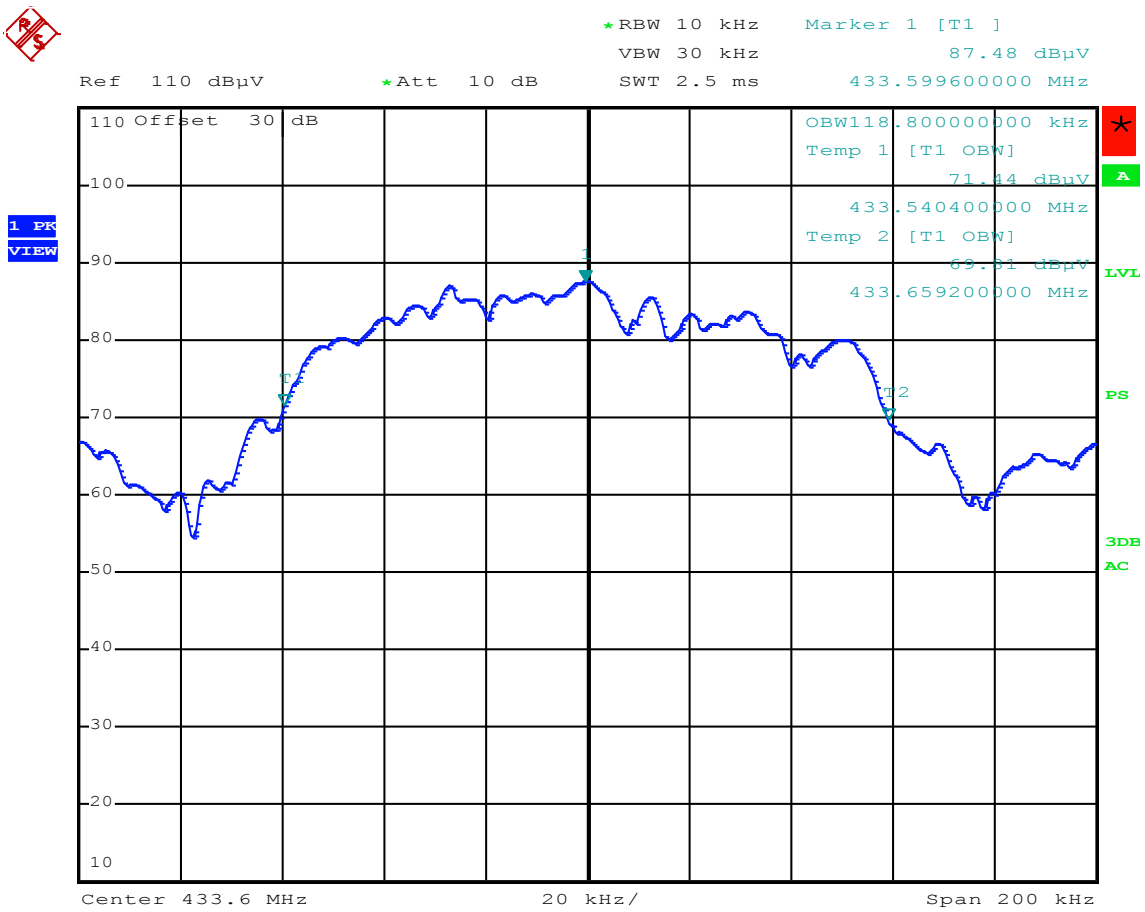
Plot1a: plot of the emission at Channel 1. Measured value is 129.60 kHz as measured on a spectrum analyzer.



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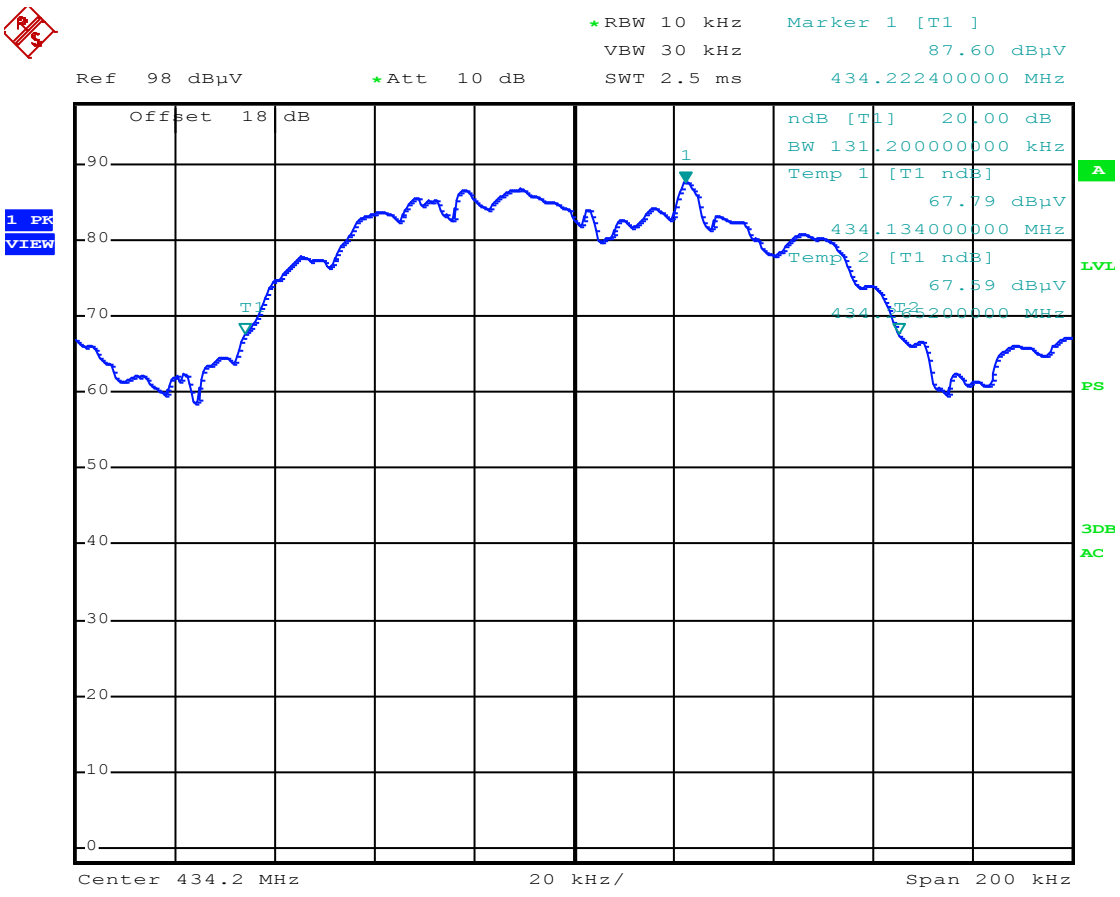
Plot1b: plot of the 99% emission bandwidth Channel 1. Measured value is 118.09 kHz as measured on a spectrum analyzer.

Requirement:

For this EUT operating at the highest operating frequency of 434.2 MHz (Channel 4) the allowable bandwidth of emissions would be:
0.25% * 434.20 MHz = 1085.50 kHz.

Testresult:

The measured bandwidth of the emissions as measured with a spectrum analyzer was: **131.20 kHz** (see Plot2a).
The test was performed on a modified EUT, where constant transmission was enabled.



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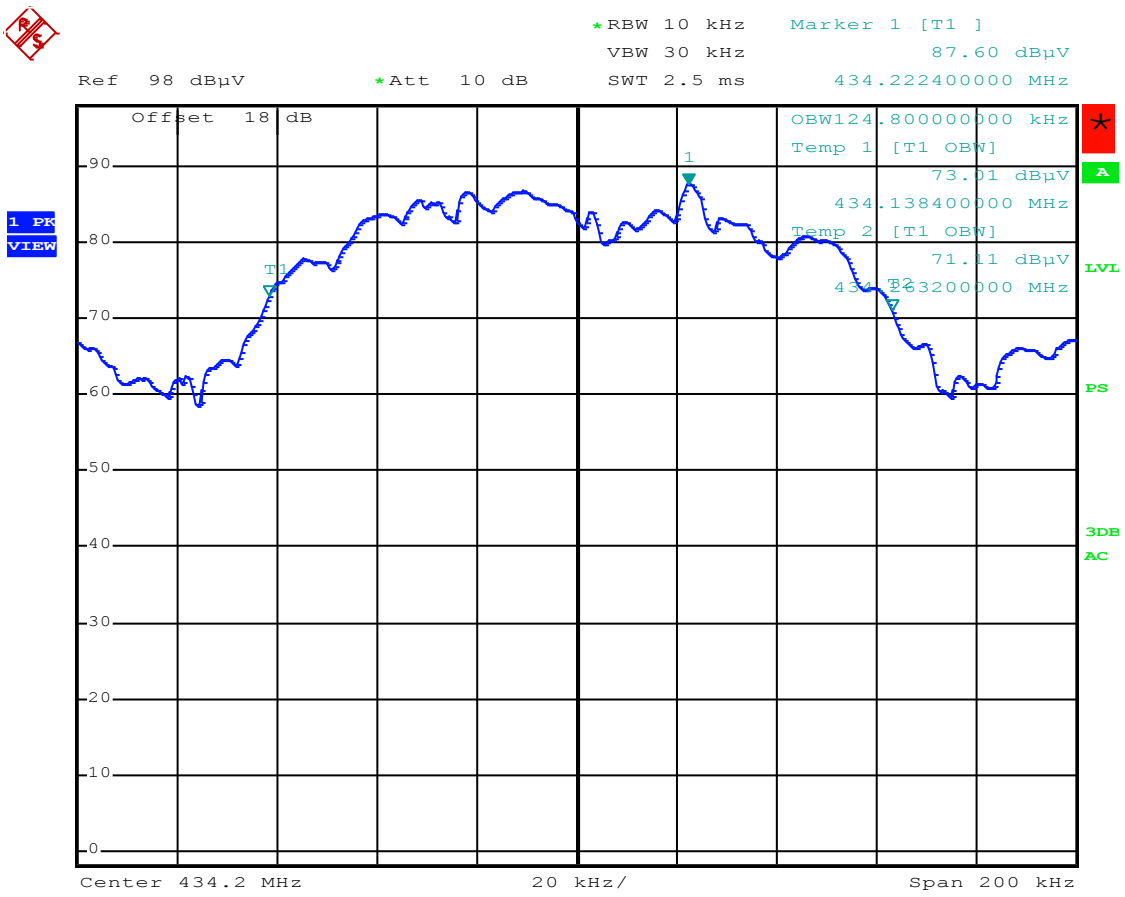
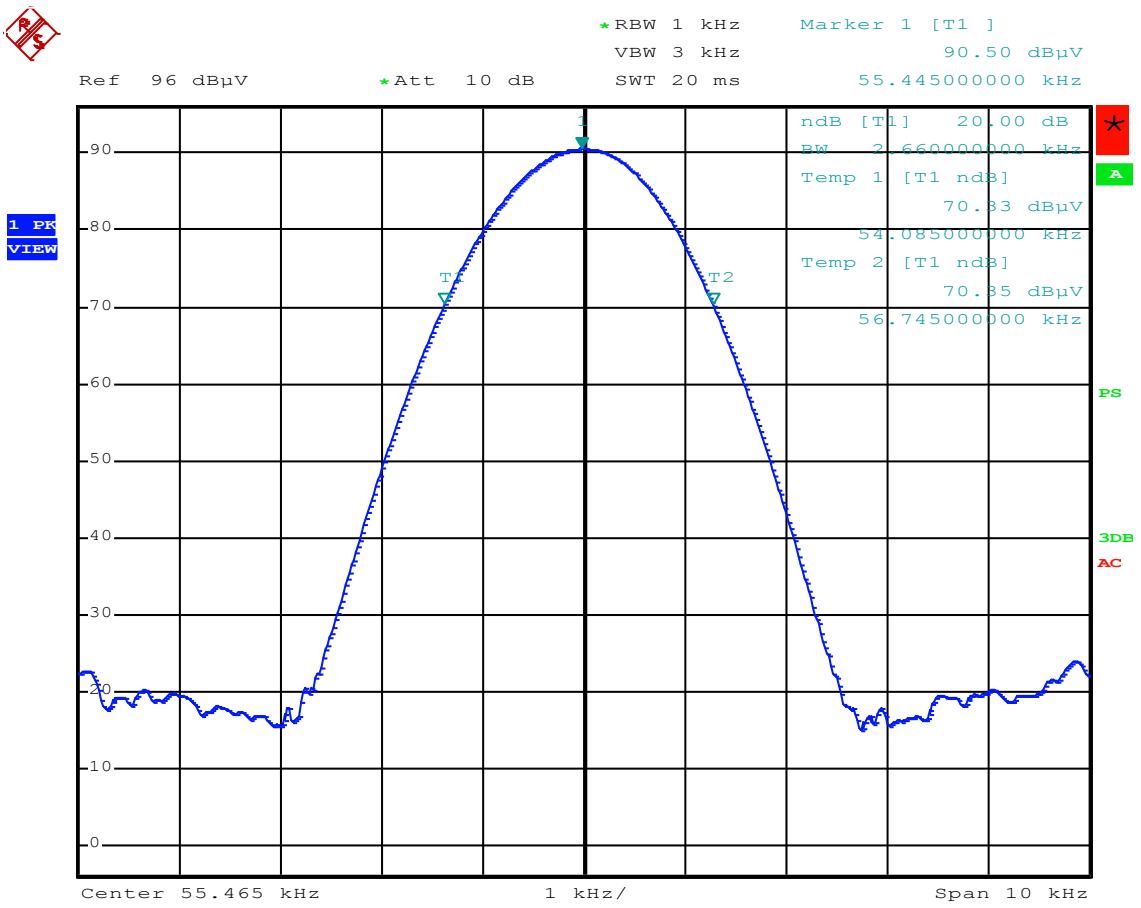
Plot2a: plot of the emission at Channel 4. Measured value is 131.20 kHz as measured on a spectrum analyzer.



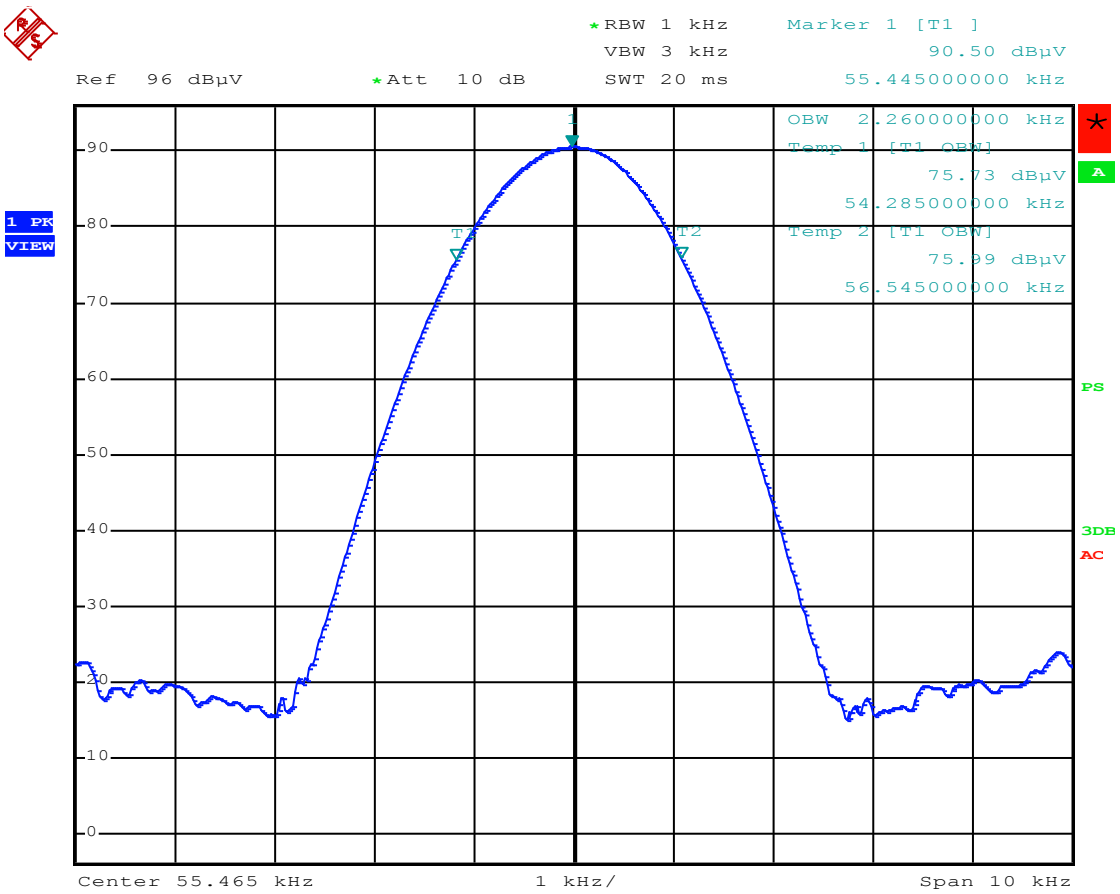
Date: 4.DEC.2013 11:33:49

Plot 2b: plot of the 99% emission bandwidth Channel 4. Measured value is 124.80 kHz as measured on a spectrum analyzer.



Date: 4.DEC.2013 12:52:04

Plot3a: plot of the Low frequency emission of 52.8 – 57.36 kHz. Measured value is 2.66 kHz as measured on a spectrum analyzer.



Date: 4.DEC.2013 12:51:37

Plot3b: plot of the 99% emission bandwidth of the Low frequency emission of 52.8 – 57.36 kHz. Measured value is 2.26 kHz as measured on a spectrum analyzer.

5.2 RF On time

RESULT: PASS

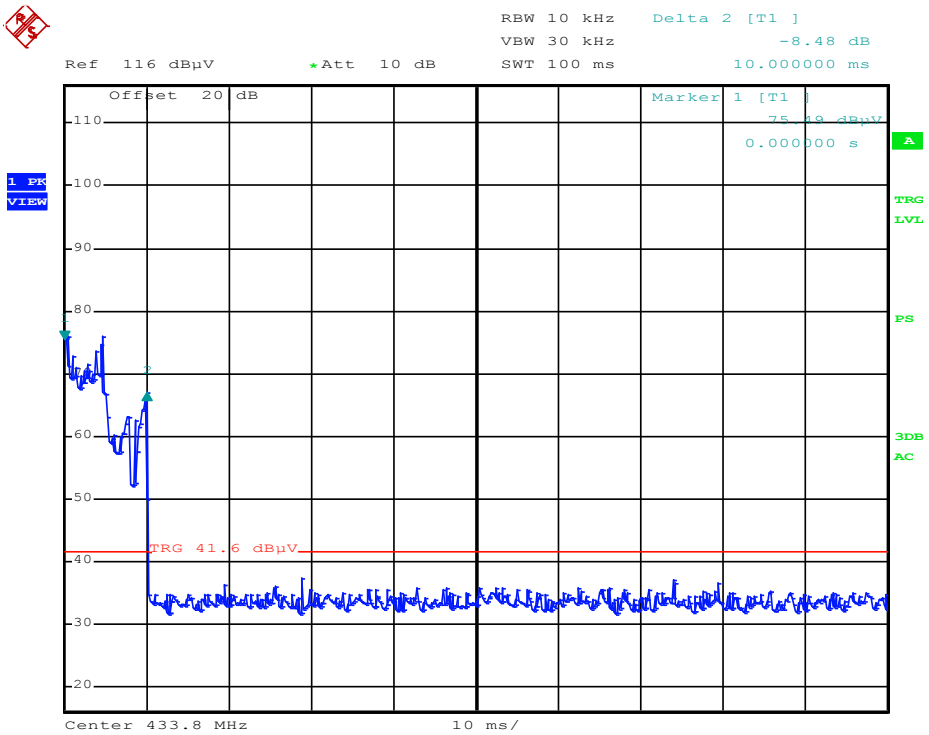
Date of testing: 2013-12-04 and 2013-12-09

Requirement:

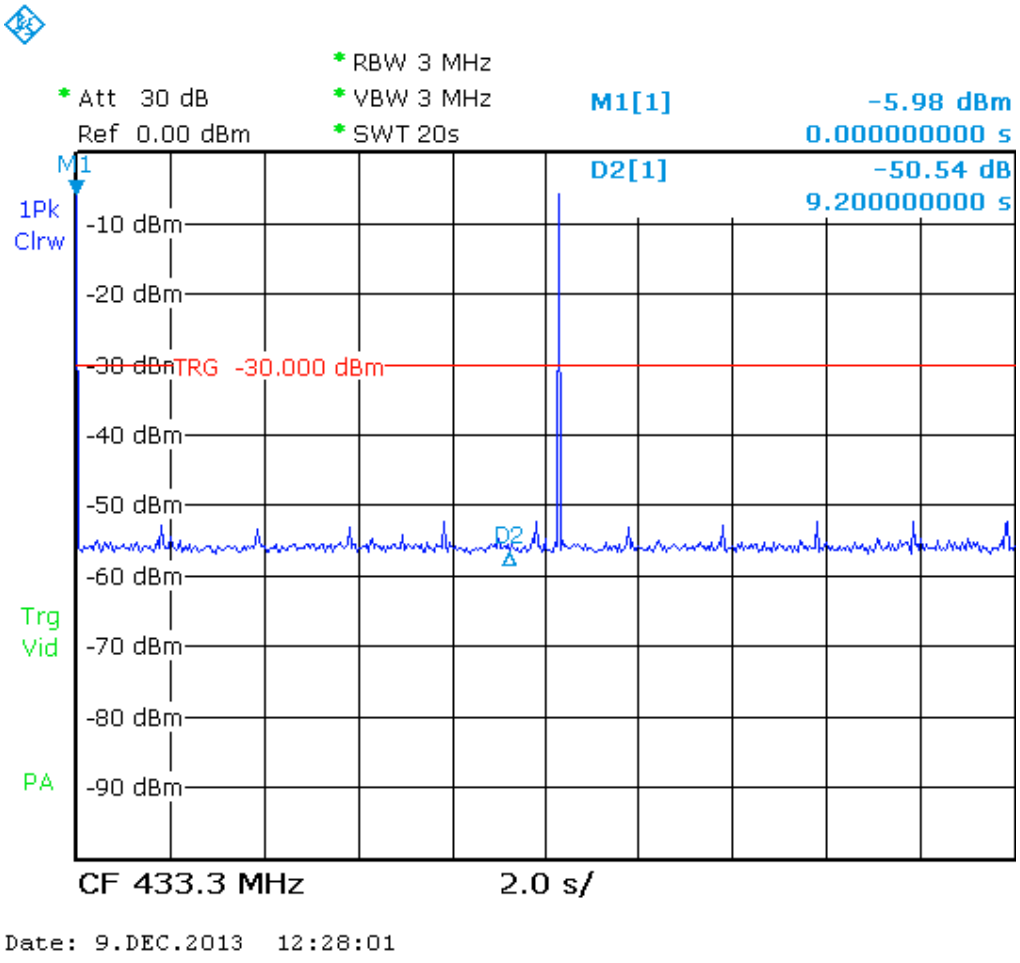
The duration of each transmission is confined within 1 second, and the required silent period is at least 10 seconds or 30 times the duration of transmissions according to 15.231(e) and RSS-210 (Annex A1.1.5).

Testresult:

Plot 4 below shows the EUT’s RF On Time. Plot 5 on page 28 shows that the time between transmissions is more than 30 times the RF On time and far more than 10 seconds.
The RF On time in 100 ms is: 10.00 ms.



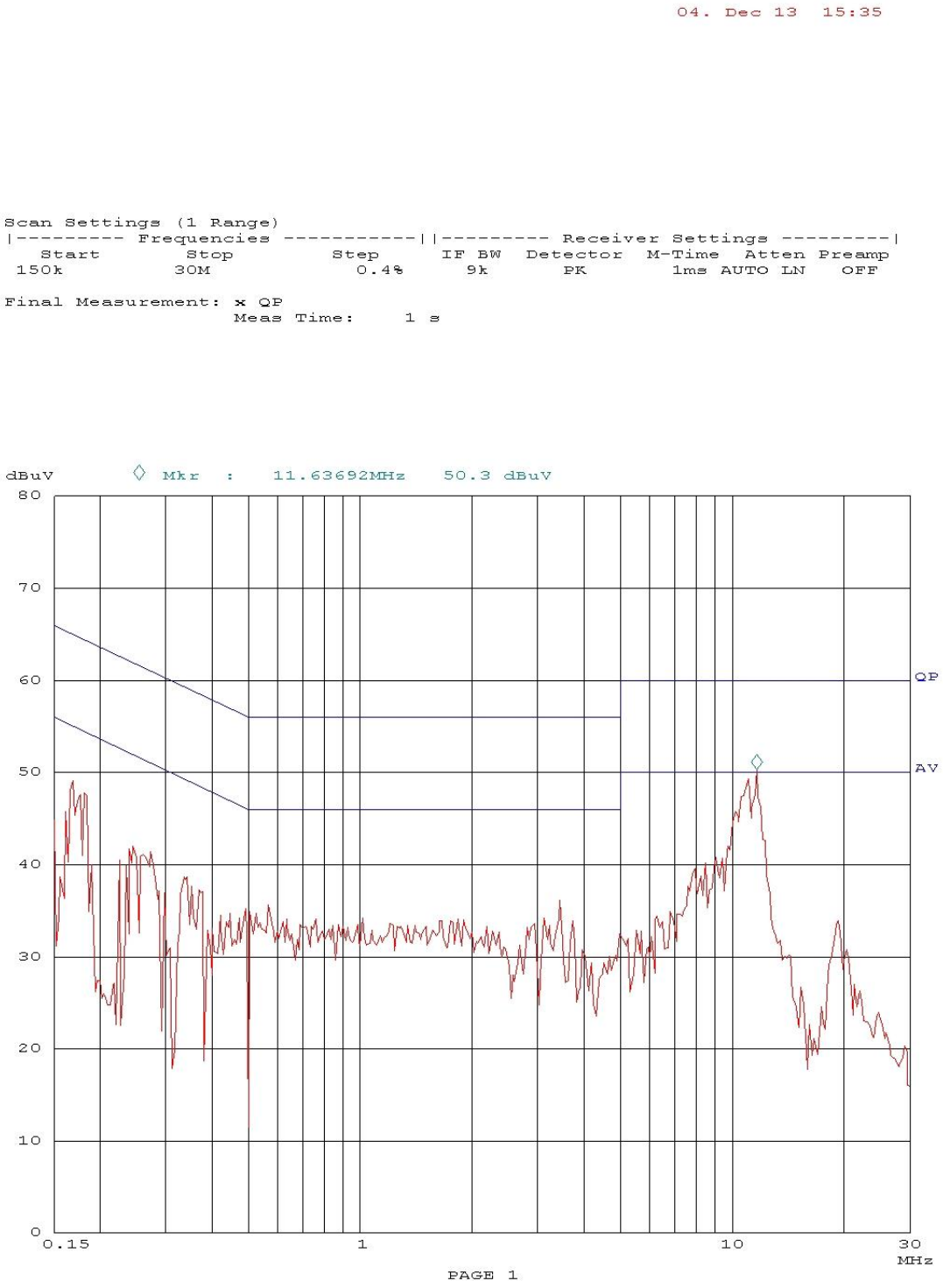
Plot 4: RF On Time of the transmitter as measured on a spectrum analyzer.



Plot 5: RF Off Time as measured on a spectrum analyzer.

The RF Off time is more than 10 seconds as required by section 15.231(e) as shown in plot 5 above where the RF On is indicated with marker 1. Ignore Marker D2, the next peak is passed the 5th vertical division which indicates the 10 seconds period, while the whole plot covers 20 seconds.

5.3 Plots of the conducted emissions



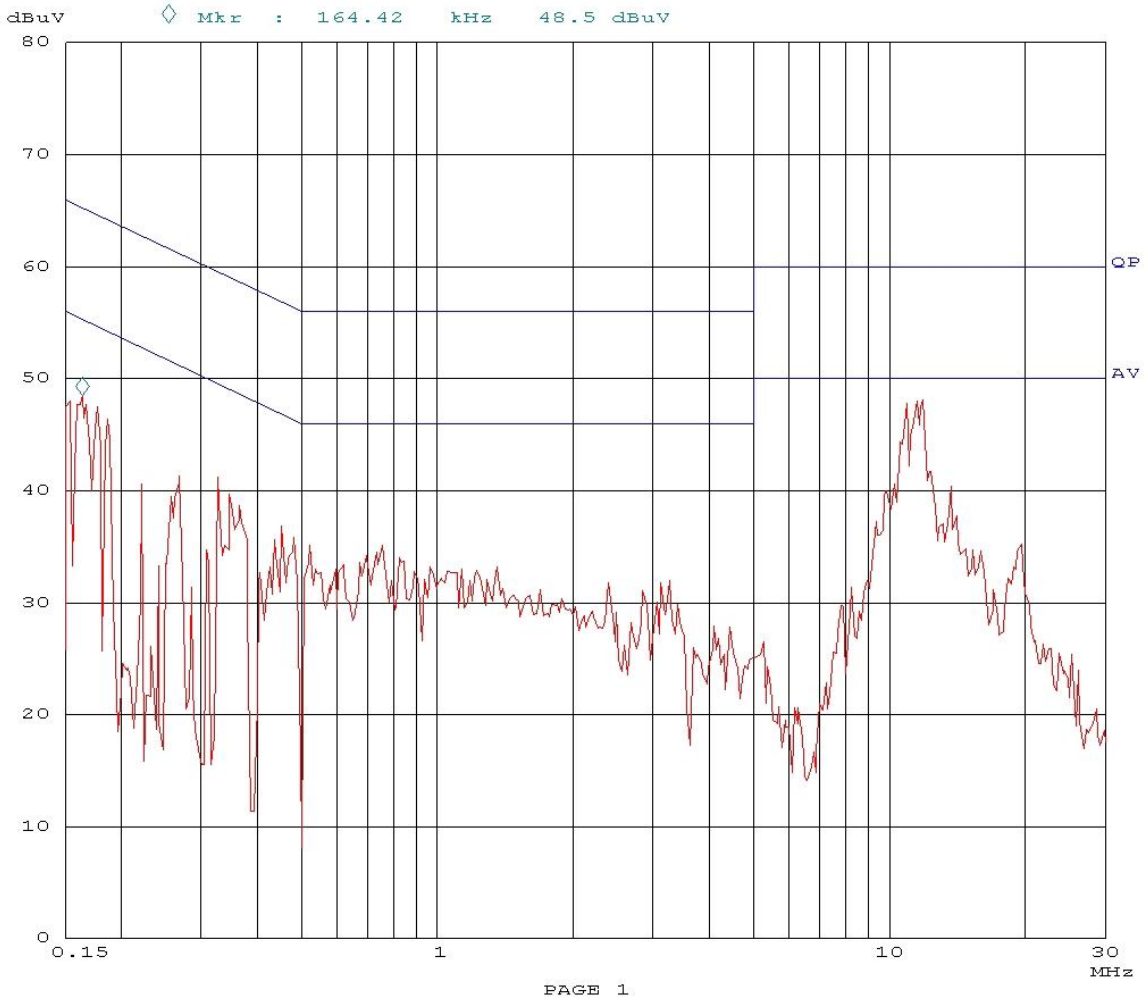
Plot 6a: Conducted emissions on L1

04. Dec 13 15:40

Scan Settings (1 Range)

Frequencies			Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp
150k	30M	0.4%	9k	PK	1ms	AUTO	LN OFF

Final Measurement: x QP
Meas Time: 1 s



Plot 6b: Conducted emissions on L2(Neutral)

6 List of utilized test equipment.

Inventory number	Description	Brand	Model	Last cal.	Next cal.
12479	Passive Loop Antenna	Emco	6509	05/2013	05/2014
12483	Guide horn antenna	Emco	3115	04/2013	04/2014
12512	LISN FCC 50 uH / 50 ohm	Emco	3725/2	01/2012	01/2014
13313	Pulse limiter	R&S	ESH3-Z2	01/2013	01/2014
15453	Active loop antenna 60 cm	Chase	HLA6120	04-2013	04-2014
15667	Measuring receiver	R&S	ESCS30	09-2013	09-2014
99161	Variac 250V 6A	RFT	LTS006	NA	NA
99220	Variac	RFT	LSS020	NA	NA
99848	Shielded room for Conducted emissions	--	--	NA	NA
99877	Biconilog Testantenna	Teseq	CBL 6111D	06/2013	06/2014
99861	Turntable controller	Maturo	SCU/088/8090811	NA	NA
99733	Spectrum analyzer	R&S	FSV	05/2013	05/2014
99852/ 99855/ 99857	Temperature-Humiditymeter	EXtech	SD500	02/2013	02/2014
99580/ 99847	Test facility	Comtest	FCC listed: 90828 IC listed: 2932G-2	12/2011	12/2014
99608	Antenna mast Controller	EMCS	DOC202	NA	NA
99609	Antenna mast	EMCS	AP-4702C	NA	NA
99699	Measuring receiver	R&S	ESCI	03/2013	03/2014
99858	RF Cable S-AR	Gigalink	APG0500	01/2013	01/2014

NA= Not Applicable

Appendix 1

Calculated measurements results radiated field strength, H-Field

The rules of Part 15 section 15.31 allow scaling of the measured values or limits when measurements are made at distances other than those specified. The extrapolation factor for frequencies below 30 MHz are 40 dB/decade which means that for a distance change of 10 to 1 (a decade), the limit, or measured value, may be recalculated by adding(moving closer) or subtracting (moving away) 40 dB, respectively.

It is also possible to make radiated-emission measurements at two different distances and extrapolate to a third distance. The calculation method described below, should then be followed.

General Formula:

d_1 = short distance

d_2 = long distance

So:
$(d_1/d_2)^n = H_{d2}/H_{d1}$

$n \log(d_1/d_2) = \log(H_{d2}/H_{d1})$

Calculation of n:

$n = \log(H_{d2}/H_{d1}) / \log(d_1/d_2)$

Calculation of field strength at other distance (10m --> 300m):

$H_{d2} = H_{d1} (d_1/d_2)^n$

Example

For the fundamental frequency of 55.44 kHz the level at a distance of 300m would be calculated as follows:

d1= 3m Hd1= 143.5 dBµV/m = 14962356
d2= 10m Hd2= 112.3 dBµV/m = 412097
Calculation for n: $n= \log(H_{d2}/H_{d1}) / \log(d_1/d_2)$ --> n=log(412097/14962356)/ log(3m/10m) --> n=2.98
$H_{d2} = H_{d1} (d_1/d_2)^n$ --> $H_{d2} = 14962356 (3/300)^{2.98}$ = 24.3 dBµV/m.