

**TEST REPORT CONCERNING THE COMPLIANCE OF A
Part 15 Low Power Transmitter below 1705 kHz (DCD)**

**BRAND MEDTRONIC, MODEL TM90,
MODELNAME Communicator
OPERATING ON 175kHz.**

**WITH 47 CFR PART 15 (10-1-16 EDITION) AND THE
REQUIREMENTS OF INDUSTRY CANADA:
RSS-GEN (ISSUE 4, NOVEMBER 2014)**

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MEASUREMENT/TECHNICAL REPORT

Brand: Medtronic
Model: TM90
Modelname: Communicator

FCC ID: LF5TM90
IC: 3408D-TM90

This report concerns: Original grant/certification Class 2 Permissive Change Verification		
Equipment type: Part 15 Low Power Transmitter Below 1705 kHz (DCD)		
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 (10-1-16 Edition) RSS-GEN (ISSUE 4, NOVEMBER 2014) and the measurement procedures of ANSI C63.10-2013. TÜV Rheinland Nederland 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: November 16, 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

EUT	:	Low Power Communication Device Transmitter (DXX)
Manufacturer	:	Medtronic, Inc.
Brand	:	Medtronic
Model(s)	:	TM90
Modelname	:	Communicator
Serial Number	:	EUT1 N (Normal Operation- 20:5B:2A:47:09:8B) and EUT2(-)

Applicant information

Applicant's representative	:	Guillaume Girard
Company	:	Medtronic, Inc.
Address	:	710 Medtronic Parkway NE
Postal code	:	55432
City	:	Minneapolis MN
Country	:	USA
Telephone number	:	Office 763.526.0652 Mobile 612.991.3108
Telefax number	:	-
Email	:	g.guillaume@medtronic.com

Test(s) performed

Location	:	Leek
Test(s) started	:	May 19, 2017
Test(s) completed	:	July 07, 2017
Purpose of test(s)	:	Equipment Authorization (Original grant/certification)

Test specification(s)	:	47 CFR Part 15 (10-1-16 Edition) and RSS-GEN (ISSUE 4, NOVEMBER 2014)
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Test engineer(s)	:	R. van der Meer
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Report written by	:	R. van der Meer
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Report date	:	November 16, 2017
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The test results relate only to the item(s) tested.

Table of contents

1	General information.....	5
1.1	Product description.....	5
1.1.1	Introduction.	5
1.2	Related submittal(s) and/or Grant(s).....	5
1.2.1	General.	5
1.2.2	Tested system details.	5
1.2.3	Description of input and output ports.	8
1.3	Test summary.....	8
1.4	Test methodology.....	8
1.5	Test facility.	9
1.6	Test conditions.	9
1.7	Measurement Uncertainty	9
2	System test configuration.	10
2.1	Justification.....	10
2.2	EUT mode of operation.	10
2.3	Special accessories.....	10
2.4	Equipment modifications.	10
3	Radiated emission data.....	11
3.1	Radiated field strength measurements (30 MHz – 1 GHz, E-field).....	12
3.1.1	Plots of the radiated emissions of the EUT in the range 30 – 1000 MHz	13
3.2	Radiated field strength measurements (frequency range of 0.009-30 MHz, H-field).....	16
3.2.1	Test results radiated emissions in the range 0.009 – 30 MHz.....	17
3.2.2	Test equipment used (for reference see test equipment listing).....	17
3.2.3	Plot of the emissions in the range 0.009-30 MHz	18
4	Emission bandwidth.....	19
4.1	Bandwidth of the emission	19
5	AC Power-line Conducted emission data.....	20
5.1	AC Power Line Conducted Emission data of the EUT.....	20
5.1.1	Test results AC Power Line Conducted Emissions	21
5.1.2	Plots of the AC Power Line Conducted Emissions	22
6	List of utilized test equipment.	24

1 General information.

1.1 Product description.

1.1.1 Introduction.

The brand Medtronic, Model TM90, Modelname Communicator, hereafter referred to as EUT, is a Low Power Transmitter Below 1705 kHz (DCD). The EUT is factory configured for 175 kHz. The EUT also contains a transmitter operating on 2402-2480 MHz band (BLE), although the two transmitters never transmit at the same time. The 2402-2480 MHz band (BLE) transmitter is covered in a separate report

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 grant/certification in equipment authorization files under: FCC ID: LF5TM90 and IC: 3408D-TM90.

1.2.2 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	:	Low Power Transmitter Below 1705 kHz (DCD)
Manufacturer	:	Medtronic, Inc.
Brand	:	Medtronic
Model	:	TM90
Modelname	:	Communicator
Serial Number	:	20:5B:2A:47:09:8B
Voltage input rating	:	5 Vdc
Voltage output rating	:	--
Current input rating	:	--
Antenna	:	Internal, integrated on the PCB
Antenna Gain	:	Not applicable, Inductive loop antenna
Operating frequency	:	175 kHz
Modulation	:	OOK burst
Remarks	:	1, single channel operation

Auxiliary (AUX 1) : Power supply adapter
Manufacturer : Samsung
Brand : Samsung
Model : ETA0U10EBE
Serial number : n.a.
Voltage output rating : 5.0 Vdc
Remark : Used to charge the EUT

Auxiliary (AUX 2) : Mobile phone
Manufacturer : Samsung
Brand : Samsung
Model : Galaxy J3
Serial number : -
Remark : Used to communicate with EUT in Normal mode

Auxiliary (AUX 3) : Implant
Manufacturer : Medtronic Inc
Brand : Medtronic
Model : Activa PC
Serial number : 16RC0425
Remark : Used to communicate with EUT in Normal mode



Photos of (Left to right) AUX1, AUX2 and AUX3



Photo 1a: EUT in a typical setup, Normal mode
(during testing the AUX2 was placed as far away as possible from EUT and measurement antenna)

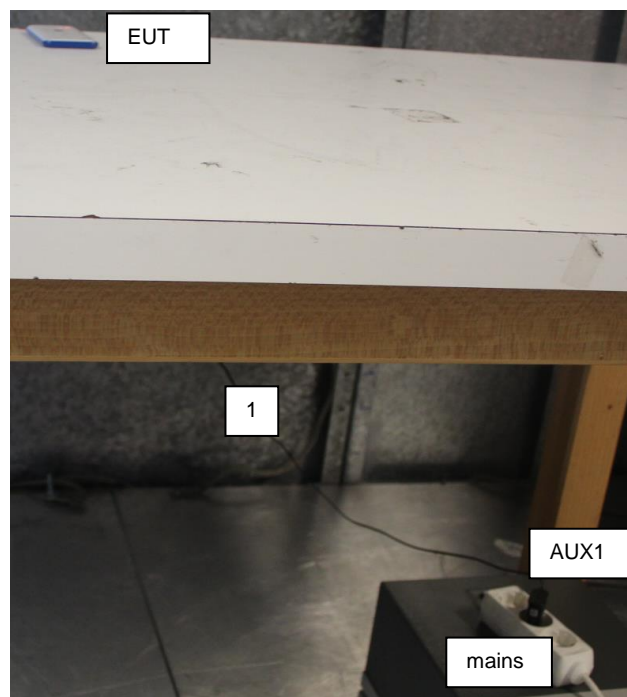


Photo 1b: EUT in Charging mode

1.2.3 Description of input and output ports.

Number	Ports	From	To	Shielding	Remarks
1	Power supply	AUX1	EUT	yes / no	None

1.3 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 (10-1-16 Edition)	RSS-Gen issue 4 and RSS-210 Issue 9			
15.207(a)	RSS-Gen(8.8)	AC Power line Conducted emissions	17 – 18	Pass
15.209	RSS-Gen(8.9)	Radiated emissions	12 - 16	Pass

Table 1: Test specifications

1.4 Test methodology.

The test methodology used is based on the requirements of 47 CFR Part 15 (10-1-16 Edition), sections 15.31, 15.35, 15.205, 15.209 and RSS-GEN (ISSUE 4, NOVEMBER 2014).

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.

1.5 Test facility.

The Federal Communications Commission and Industry Canada has reviewed the technical characteristics of the test facilities at TÜV Rheinland Nederland, 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 786213. 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.

1.6 Test conditions.

Normal test conditions:

Temperature (*) : +15°C to +35°C
Relative humidity(*) : 20 % to 75 %
Supply voltage : The EUT is battery operated and the battery was fully charged for the tests, for the charging mode a AC/DC Power Supply (AUX1) was used
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.

1.7 Measurement Uncertainty

Compliance of the product is based on the measured value. However, the measurement uncertainty is included for informational purposes.

The expanded uncertainty ($k = 2$) for radiated emissions below 1000 MHz has been determined to be: ± 5.22 dB at 3m.

The expanded uncertainty ($k = 2$) for mains conducted emissions from 150 kHz to 30 MHz has been determined to be: ± 3.5 dB.

2 System test configuration.

2.1 Justification.

The system was configured for testing in a typical situation as a customer would normally use it. The EUT was tested as called for in the test standard and was configured and operated in a manner consistent with its intended use. The EUT was powered by the internal battery and allowed to reach intended operating conditions. The placement of the EUT system components was guided by the test standard and selected to represent typical installation conditions. In the case of an EUT that can operate in more than one configuration, preliminary testing was performed to determine the configuration that produced maximum radiation. The final configuration was selected to produce the worst case radiation for emissions testing.

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 tests have been performed with a complete functioning EUT in Normal operation and in Charging mode. In Charging mode the 175 kHz signal is not active.

2.3 Special accessories.

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

2.4 Equipment modifications.

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

3 Radiated emission data.

RESULT: Pass

Date of testing: 2017-06-13

Frequency range: 30MHz - 1GHz

Requirements:

FCC 15.205, FCC 15.209 and IC RSS-Gen(8.8 and 8.9)

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).

Radiated emissions which fall outside the operation frequency band and outside restricted bands shall either meet the limit specified in FCC 15.209(a)/ RSS-Gen (8.10) or be attenuated at least 20dB below the power level in the 100kHz bandwidth within the band that contains the highest level of the desired power (the less severe limit applies).

Frequency (MHz)	Field strength (microvolts/meter)	Field strength (dBmicrovolts/meter)	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

Test procedure:

ANSI C63.10-2013, RSS-Gen.

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 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 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)

Frequency (MHz)	EUT orientation	Antenna polarisation	Results @3m (dBµV/m)	Limits @3m (dBµV/m)	Pass/Fail
140.58	Vertical	Vertical	15.2	43.5	Pass
340.40	Vertical	Vertical	23.2	46.0	Pass
460.68	Vertical	Vertical	22.2	46.0	Pass
483.96	Horizontal	Vertical	24.9	46.0	Pass
584.84	Vertical	Horizontal	26.4	46.0	Pass
937.92 noise	Vertical	Vertical	33.0	46.0	Pass

Table 2a Radiated emissions of the EUT in the range 30 – 1000 MHz, EUT in Normal mode

Frequency (MHz)	EUT orientation	Antenna polarisation	Results @3m (dBµV/m)	Limits @3m (dBµV/m)	Pass/Fail
32.94	Vertical	Vertical	22.0	40.0	Pass
35.08	Vertical	Vertical	21.5	40.0	Pass
53.28	Vertical	Vertical	28.6	40.0	Pass
757.50	Vertical	Vertical	28.9	46.0	Pass
823.46* ⁶	Vertical	Vertical	30.7	46.0	Pass
970.9 noise* ⁶	Vertical	Vertical	33.2 Pk	74 Pk / 54 Av	Pass

Table 2b Radiated emissions of the EUT in the range 30 – 1000 MHz, EUT in Charging mode

The results of the radiated emission tests, carried out in accordance with 47 CFR Part 15 section 15.205, 15.209 and RSS-Gen, section 8.8 and 8.9 are depicted in Table 2a and 2b.

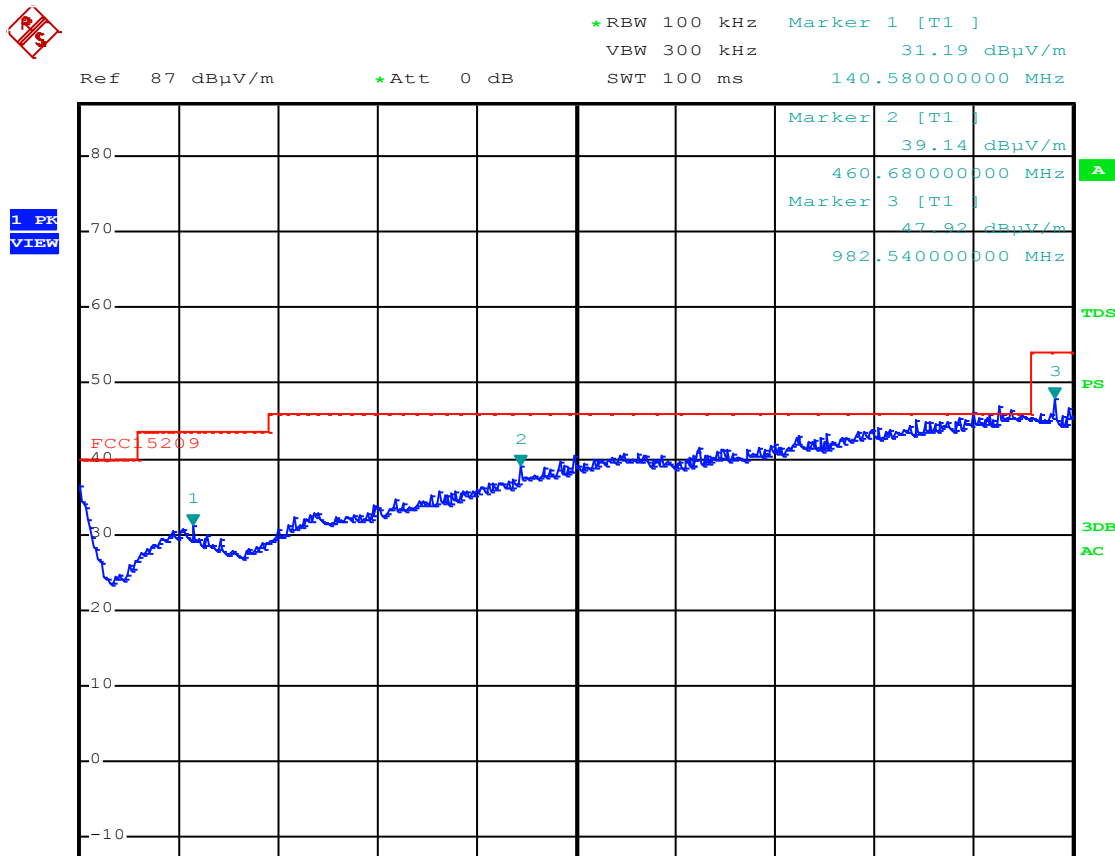
Notes:

- Field strength values of radiated emissions at frequencies not listed in the table above are more than 20 dB below the applicable limit.
- Measurement uncertainty is ± 5.22 dB.
- The EUT was varied in three positions, the measurement 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
- A Quasi-peak detector was used with a bandwidth of 120 kHz
- The six highest values relative to the applicable limits were noted
- A selection of plots are provided on the next page. Where in the range 800 – 1000 MHz Peak values exceeded Qp limit the Qp values were more than 10 dB below Qp limit- in fact only noise was measured.

Used test equipment and ancillaries:

A00446	A00235	A00447	A00726	A00466	A00258			

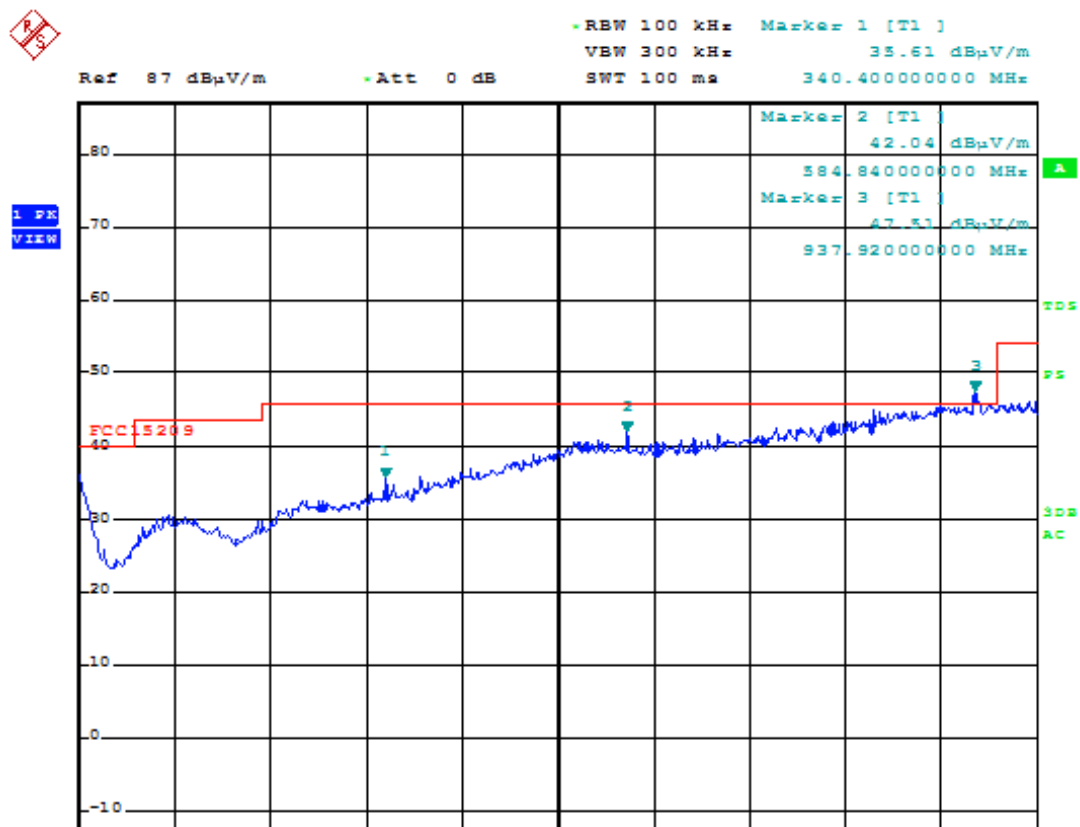
3.1.1 Plots of the radiated emissions of the EUT in the range 30 – 1000 MHz



ORI

Date: 13.JUN.2017 14:56:41

Plot 1a radiated emissions of the EUT in Normal mode, EUT Vertical, Antenna vertical, Peak values shown



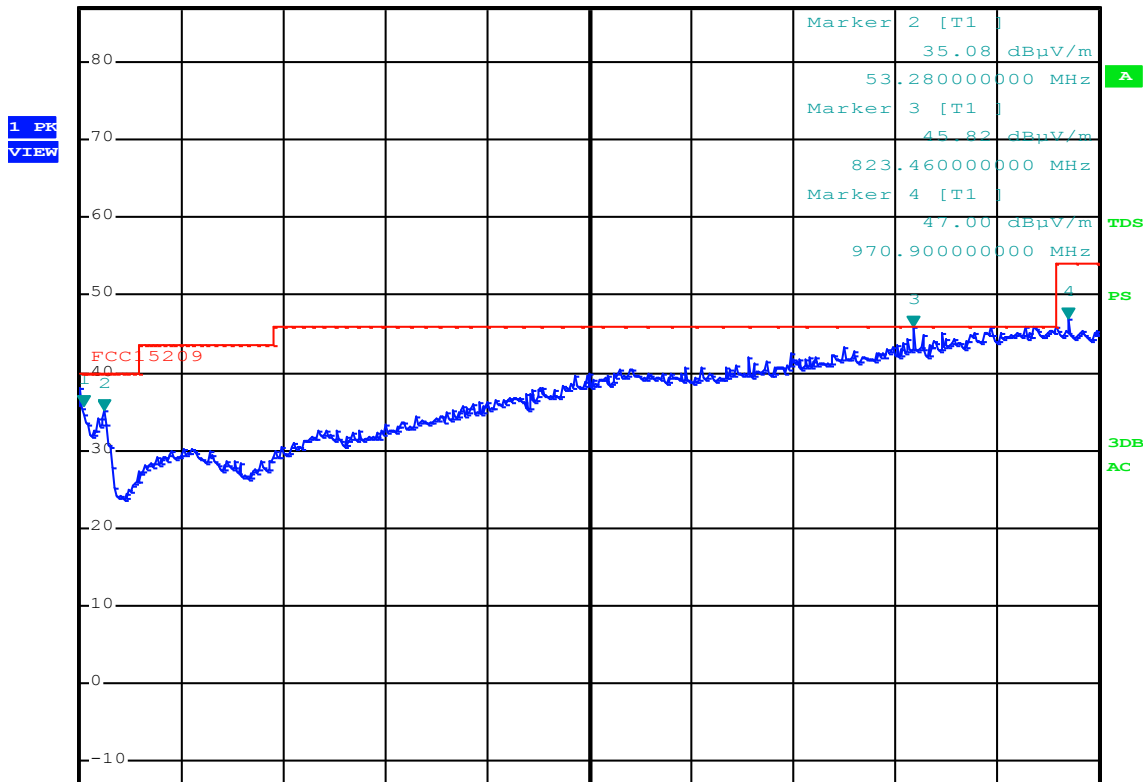
ORI

Date: 13.JUN.2017 14:57:55

Plot 1b radiated emissions of the EUT in Normal mode, EUT Horizontal, Antenna vertical, Peak values shown



Ref 87 dBµV/m *Att 0 dB *RBW 100 kHz Marker 1 [T1] 35.57 dBµV/m
VBW 300 kHz 32.940000000 MHz
SWT 100 ms



ORI

Date: 13.JUN.2017 15:13:11

Plot 1c radiated emissions of the EUT in Charging mode, EUT Vertical, Antenna vertical, Peak values shown

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

RESULT: Pass.

Date of testing: 2017-06-13

Requirements:

Radiated emissions tests were performed using the procedures of ANSI C63.10-2013 including methods for signal maximizations and EUT configuration. The test setup photos report shows the EUT in its maximized configuration. Radiated emission testing was performed at a distance of 3 meters in a 5 meter semi-anechoic chamber. The measured values were corrected to the 30m distance using the extrapolation factor of 40dB/decade as per FCC Part 15.31(f)(2).

The field strength of emissions shall not exceed the general radiated emission limits in § 15.209 and RSS-Gen section 8.8 Table 5.

Test procedure: ANSI C63.10-2013.

3.2.1 Test results radiated emissions in the range 0.009 – 30 MHz

Measured Frequency	Measurement results	Detector	Antenna factor	Cable loss	Extrapolation factor	Measurement results (calculated)	Limits	Pass/Fail
MHz	dBµV @3m		dB	dB	dB	dBµV/m@30m	dBµV/m@30m	
0.175 fundamental	77.8	Pk	20.0	1	80	18.8 Pk @300m	42.7 Pk / 22.7 Av @300m	Pass
0.350 ^H	26.7	Pk	20.0	1	80	-32.3 Pk@300m	36.7 Pk / 16.7 Av @300m	Pass
0.525 ^H	43.0	Qp	20.0	1	40	24.0	33.2	Pass
0.700 ^H	7.2	Qp	20.0	1	40	-11.8	30.7	Pass
1.28526	6.5	Qp	19.7	1	40	-12.8	25.4	Pass
17.165	5.1	Qp	19.7	1	40	-14.2	29.5	Pass

Table 4 Radiated emissions of the EUT 0.009 – 30 MHz.

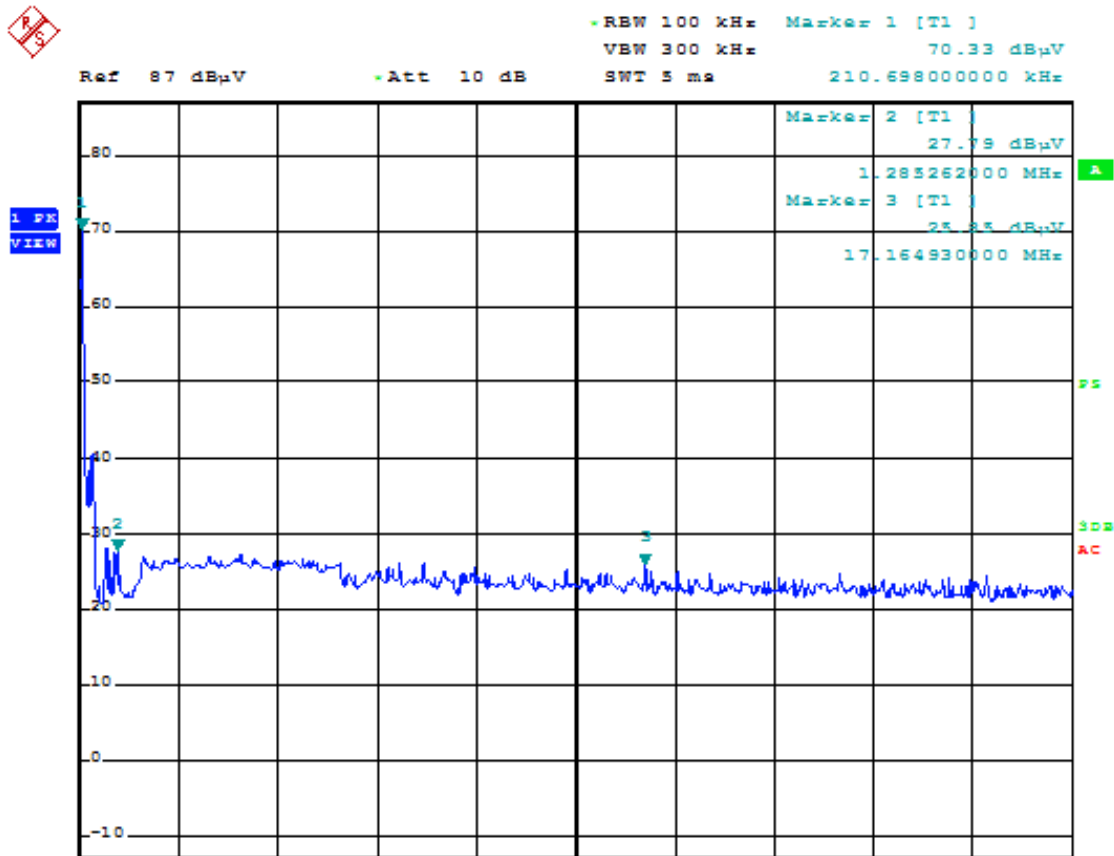
Notes:

1. Calculated measurement results are obtained by using the 40dB/decade factor (antenna factor and cable loss is included). i.e at 0.175 MHz: 77.8 dBµv + 20.0 dB + 1dB - 80dB= 18.8 dBµV/m.
2. A resolution bandwidth of 9kHz was used during testing
3. The six highest values-relative to the applicable limits- were noted.
4. 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.
5. Measurement uncertainty is ±5.22 dB
6. Peak values were already within Av limits, therefore Av not tested.
7. A plot of the emissions is provided on the next page.

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

A00141	A01491	A00450	A00446	A00235	A00447	A00726
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3.2.3 Plot of the emissions in the range 0.009-30 MHz



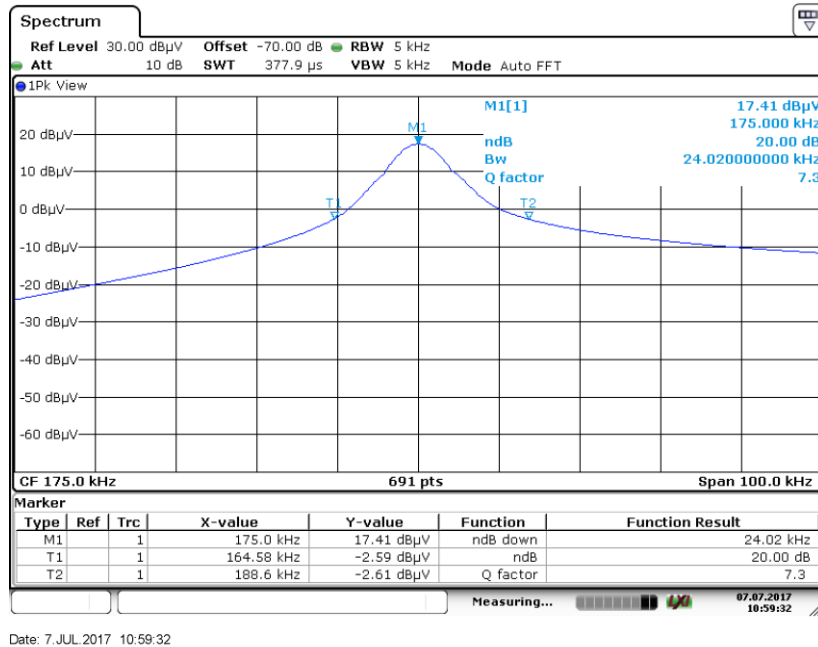
ORI

Date: 13.JUN.2017 13:43:13

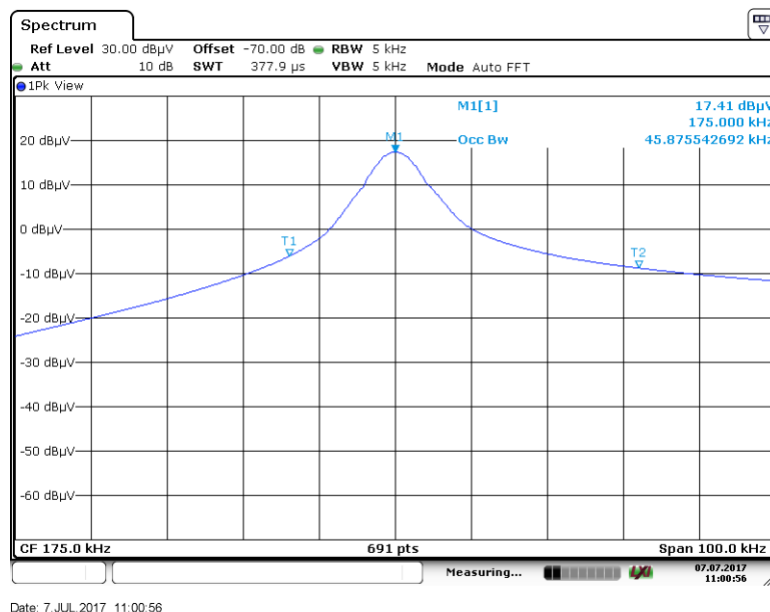
Plot 1c radiated emissions of the EUT in Normal mode, EUT Vertical, Antenna vertical, Peak values shown

4 Emission bandwidth

4.1 Bandwidth of the emission



Emission Bandwidth (-20 dB down points) of the emission at 175 kHz (Fundamental Carrier), as measured on a spectrum analyzer



Occupied Bandwidth (99% points) of the emission at 175 kHz (Fundamental Carrier), by using the spectrum analyzer function for 99% Occ BW.

5 AC Power-line Conducted emission data.

5.1 AC Power Line Conducted Emission data of the EUT.

RESULT: Pass

Date of testing: 2017-06-27

Requirements: 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/50 ohms 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	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. The EUT was positioned at least 80cm from the LISN. The power cable was routed over the non-conductive plate to the LISN.

5.1.1 Test results AC Power Line Conducted Emissions

Frequency (MHz)	Measurement results (dBµV) L1		Measurement results (dBµV) L2/Neutral		Limits (dBµV)		Verdict (Pass/Fail)
	QP	AV	QP	AV	QP	AV	
0.16172	38.9	*2	30.6	*2	65.5	55.5	Pass
0.19297	28.8	*2	20.3	*2	63.6	53.6	Pass
6.48594	27.9	*2	24.2	*2	60.0	50.0	Pass
9.45469	27.3	*2	26.2	*2	60.0	50.0	Pass
21.97422	27.7	*2	25.0	*2	60.0	50.0	Pass
22.41172	24.0	*2	24.7	*2	60.0	50.0	Pass

Table 5 AC Power Line Conducted Emissions results

The results of the conducted emission tests, carried out in accordance with 47 CFR Part 15 section 15.207(a) and RSS-Gen section 8.8, at the AC mains connection terminals of the AUX3 that connects to the EUT, are depicted in the table above.

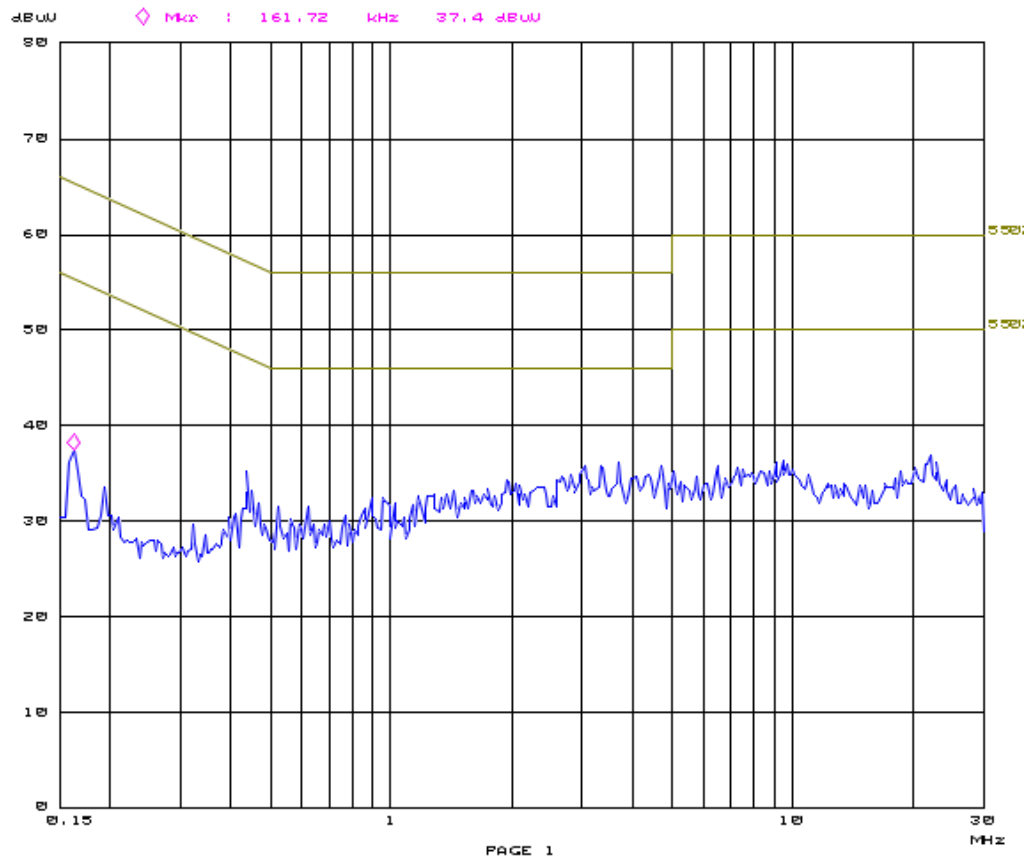
Notes:

1. The resolution bandwidth used was 9 kHz.
2. Qp values were already within Av limits, therefor Av not tested.
3. Plots are provided on the next pages.

5.1.2 Plots of the AC Power Line Conducted Emissions

27. Jun 17 13:08

Overview Scan Settings (1 Range)
:----- Frequencies -----: Receiver Settings :
Start Stop Step IF BW Detector M-Time Atten Preamp
150k 30M 3.9k 9k PK 0.10ms 20dB LN OFF



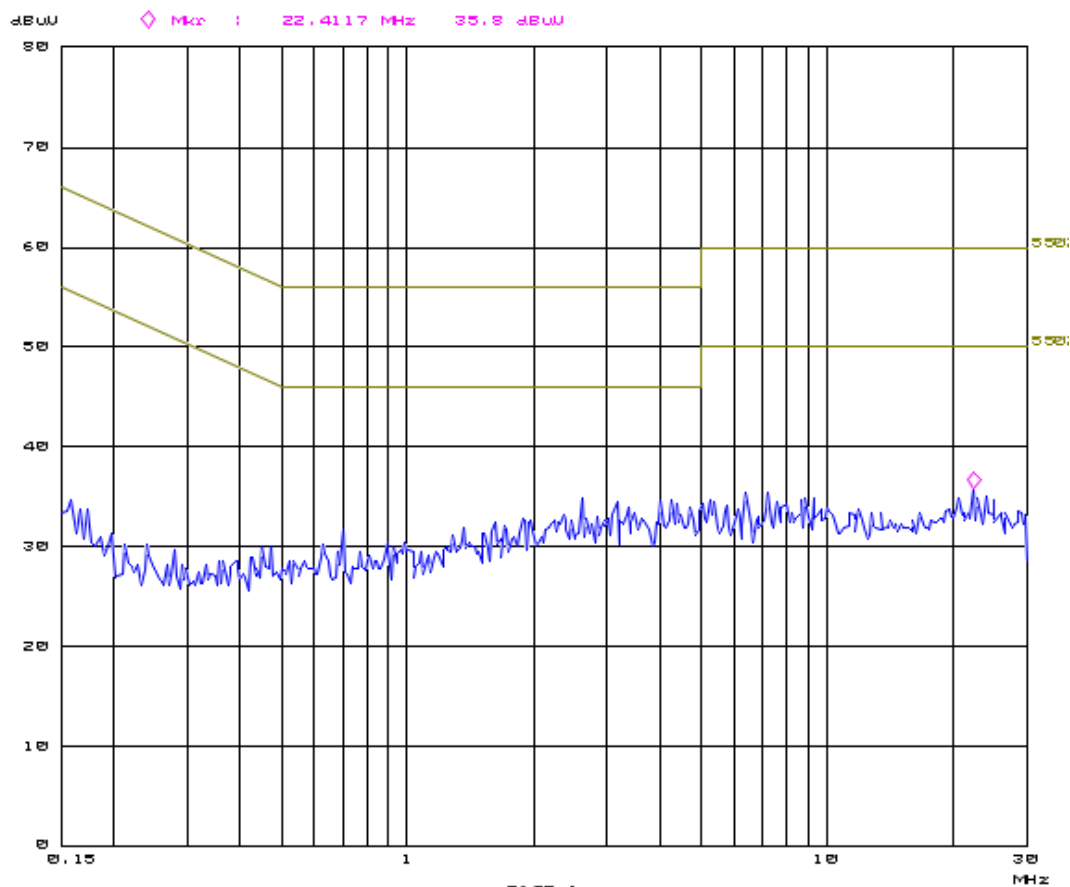
Plot 7a of the AC Power Line Conducted Emissions on L1



27. Jun 17 13:16

Overview Scan Settings (1 Range)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp
150k	30M	3.9k	9k	PK	0.10ms	20dB LN	OFF



Plot 7b of the AC Power Line Conducted Emissions on L2

6 List of utilized test equipment.

To facilitate inclusion of the test equipment, used for performing the tests, on each page of this test report, each item of test equipment and ancillaries, such as cables, must be identified (numbered) by the test laboratory.

Inventory number	Description	Brand	Model	Serial number	Last cal.	Next cal.
A00141	Tripod for A01491	Chase	--	--	NA	NA
A01491	Loop antenna	Chase	HLA6120	1107	05/2017	05/2018
A00466	Biconilog Testantenna	Teseq	CBL 6111D	35555	10/2016	10/2017
A00450	Controller	Maturo	SCU/088/80908 11	--	NA	NA
A00444/ A00446/	Temperature-Humiditymeter	Extech	SD500	--	04/2017	04/2018
A00235	Test site	Comtest	FCC listed: 7836213	--	08/2014	08/2017
A00258	Antenna mast	EMCS	AP-4702C	--	NA	NA
A00447	Cable S-AR	Gigalink	APG0500	--	01/2017	01/2018
A00309	Loop antenna, 6cm	NA	7405-901	--	05/2017	05/2018
A00726	Measurement receiver	R&S	ESCS30	100313	10/2016	10/2017

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

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