



# EMI - TEST REPORT

- FCC 15.209 -

**Type / Model Name** : WC18CV

**Product Description** : Inductive battery charger system

**Applicant** : Robert Bosch GmbH

**Address** : Postfach 10 01 56

70745 Leinfelden-Echterdingen; GERMANY

**Manufacturer** : Robert Bosch GmbH

**Address** : Postfach 10 01 56

70745 Leinfelden-Echterdingen; GERMANY

**Licence holder** : Robert Bosch GmbH

**Address** : Postfach 10 01 56

70745 Leinfelden-Echterdingen; GERMANY

<b>Test Result</b> according to the standards listed in clause 1 test standards:	<b>POSITIVE</b>
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<b>Test Report No. :</b> <b>T39706-00-02KJ</b>	06. April 2016 Date of issue
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Deutsche  
Akkreditierungsstelle  
D-PL-12030-01-01  
D-PL-12030-01-02

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

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# **1 TEST STANDARDS**

The tests were performed according to following standards:

## **FCC Rules and Regulations Part 15, Subpart A - General (October, 2014)**

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths

## **FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (October, 2014)**

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.215	Additional provisions to the general radiated emission limitations

KDB 680106 D01 v02: 2013      RF Exposure considerations for low power consumer wireless power transfer applications

ANSI C63.4: 2014      Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

ANSI C63.10: 2013      Testing Unlicensed Wireless Devices

CISPR 16-4-2: 2013      Uncertainty in EMC measurement

## 2 EQUIPMENT UNDER TEST

### 2.1 Photo documentation of the EUT – Detailed photos see ATTACHMENT A



## 2.2 Short description of the equipment under test (EUT)

The product is an inductive charger for power tool battery packs. The product is intended to be used in vehicles. The power converter QQE090-14DD17 (13VDC to 290VDC) is part of the product.

Number of tested samples: 1  
 Serial number: 2607226070  
 Firmware version: -  
 Highest generated frequency: 64 MHz

## 2.3 Power supply system utilised

Power supply voltage,  $V_{nom}$  13 V to 16 V (tested with 13.2 V DC)

## 2.4 Operation frequency and channel plan

Operate at 141.6 kHz and 145.5 kHz.

## 2.5 Variants of the EUT

There are no other variants.

## 2.6 Transmit operating modes

The equipment under test was operated during the measurement under the following conditions:

- **Standby mode** - TX at 132.6 kHz - resonant frequency detection (without battery)

- **Charging mode** - TX at 141.6 kHz and 145.5 kHz - charging / transmitting frequency

- TX at 124.3 kHz - resonant frequency detection (with battery present)

- TX at 210.5 kHz - sync pulse transmission

- **Maintenance mode** - TX at 123.8 kHz - resonant frequency detection (with battery present)

- TX at 210.5 kHz - sync pulse transmission

	Duration (approx.)	Frequency (approx.)	Radiated Power (approx.)	Comments
Resonant Freq. Detection	24 ms	120kHz – 129kHz with Battery present  130kHz – 138kHz without battery (e.g. in standby)	Very Low	Driven from 2V DC supply
Sync Pulse Transmission	5ms	210kHz (fixed)	Low	Away from resonance, thus low power
Battery Communications	100ms	120kHz – 129kHz	Very low	Driven from 2V DC supply
Charging/ Transmitting	2.76sec	141.6kHz and 145.5kHz (frequency changes during charging)	< 21 dB $\mu$ V/m	Driven from rectified AC mains; measured@3m distance

## 2.7 Peripheral devices and interface cables

The following peripheral devices and interface cables are connected during the measurements:

- |                |                                   |
|----------------|-----------------------------------|
| - DC converter | Model : <u>QQE090-14DD17</u>      |
| - Accu pack    | Model : <u>WCBAT620 18V 4.0Ah</u> |
| - Accu pack    | Model : <u>GBA 18V 2.0Ah MW-B</u> |

## 2.8 Antenna

A permanently attached antenna which is direct soldered to the PCB is used.

## 2.9 Test Jig

No test jig is used.

## 2.10 Test software

No test software is used.

## 2.11 Determination of worst case conditions for final measurement

The inductive battery charger system "WC18CV" was tested in three operation modes (standby, charging and maintenance). The fundamental frequencies are measured in horizontal and vertical position with a 4 Ah accu and a 2 Ah accu to find out the worst case conditions.

For further measurements, the EUT is set in vertical position with a 4 Ah accu on top.

### 3 Test result summary

FCC Rule Part	Description	Result
15.209 (a)	Field strength of the fundamental wave	passed
15.209 (a)	Radiated emission limits	passed
15.215(c)	Emission bandwidth	No limit
15.35 (c)	Duty cycle	No limit
KDB 680106 D01 v02 Section 3, 3)	RF Exposure Requirements (H-Field)	passed
KDB 680106 D01 v02 Section 3, 3)	RF Exposure Requirements (E-Field)	passed

#### 3.1 FINAL ASSESSMENT:

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 8 July 2015

Testing concluded on : 06 April 2016

Checked by:

Tested by:



Klaus Gegenfurtner  
I confirm the correctness and  
Integrity of this document  
2016.04.06 15:31:32 +02'00'

Gegenfurtner Klaus  
Teamleader Radio



Josef Knab  
I'm the autor of this document  
2016.04.06 14:41:59 +02'00'

Josef Knab  
Radio Team

## 4 TEST ENVIRONMENT

### 4.1 Address of the test laboratory

**CSA Group Bayern GmbH  
Ohmstrasse 1-4  
94342 STRASSKIRCHEN  
GERMANY**

### 4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15-35 ° C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

### 4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor  $k = 2$ . The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. 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.

### 4.4 Measurement protocol for FCC

#### 4.4.1 GENERAL INFORMATION

##### 4.4.1.1 Test methodology

Conducted and radiated disturbance testing is performed according to the procedures set out by the International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under section 1 of this report.

##### 4.4.1.2 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.



## **5 TEST CONDITIONS AND RESULTS**

### **5.1 Conducted emissions**

For test instruments and accessories used see section 6 Part A 4.

#### **5.1.1 Description of the test location**

Test location: NONE

**Remarks:** Not applicable because the EuT is only DC powered.

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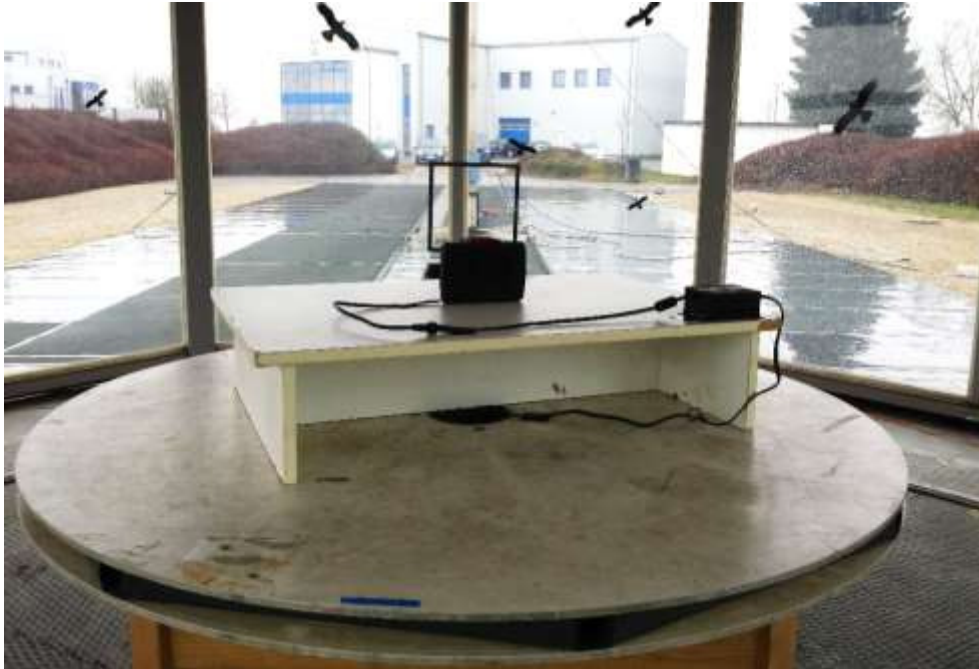
## 5.2 Field strength of the fundamental wave

For test instruments and accessories used see section 6 Part CPR 1.

### 5.2.1 Description of the test location

Test location: OATS 1  
Test distance: 3 m

### 5.2.2 Photo documentation of the test set-up



### 5.2.3 Applicable standard

According to FCC Part 15C, Section 15.209:

The emissions from intentional radiators shall not exceed the effective field strength limits.

### 5.2.4 Description of Measurement

The magnetic field strength from the EUT will be measured on an open area test site in the frequency range of 9 kHz to 30 MHz using a tuned receiver and a shielded loop antenna. The set up of the EUT will be in accordance to ANSI C63.4. Measurements have been made in horizontal and vertical axes and the shielded loop antenna was rotated to locate the maximum of the emissions. In the case where larger measuring distances are required the results will extrapolated based on the values measured on the closer distances according to Section 15.31(f)(2). The final measurement will be performed with an EMI receiver set to quasi peak detector except for the frequency bands 9 kHz to 90 kHz and 110 to 490 kHz where an average detector will be used according to Section 15.209(d).

The resolution bandwidth during the measurement is as follows:

9 kHz – 150 kHz: RBW: 200 Hz

150 kHz – 30 MHz: RBW: 9 kHz

### 5.2.5 Test result

The measurement value is calculated from a distance of 3 m to 300 m by subtracting the factor 40 dB/decade.

#### Standby mode (4 Ah accu):

f [kHz]	PK reading [dB $\mu$ V]	QP reading [dB $\mu$ V]	Duty cycle corr. [dB]	Ant. factor [dB]	Distance corr. [dB]	corr. AV level [dB $\mu$ V/m]	QP level [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]
132.588	75.6	65.2	-4.6	20.0	-80.0	11.0	5.2	25.2	-14.2

#### Charging mode (4 Ah accu):

f [kHz]	PK reading [dB $\mu$ V]	QP reading [dB $\mu$ V]	Duty cycle corr. [dB]	Ant. factor [dB]	Distance corr. [dB]	corr. AV level [dB $\mu$ V/m]	QP level [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]
124.277	68.6	59.2	-4.2	20.0	-80.0	4.4	-0.8	25.7	-21.3
141.594	84.1	84.0	0.0	20.0	-80.0	24.1	24.0	24.6	-0.5
145.458	83.8	83.7	0.0	20.0	-80.0	23.8	23.7	24.3	-0.5
210.523	78.5	67.6	-29.1	20.0	-80.0	-10.6	7.6	21.1	-31.7

#### Maintenance mode (4 Ah accu):

f [kHz]	PK reading [dB $\mu$ V]	QP reading [dB $\mu$ V]	Duty cycle corr. [dB]	Ant. factor [dB]	Distance corr. [dB]	corr. AV level [dB $\mu$ V/m]	QP level [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]
123.852	68.7	60.1	-2.9	20.0	-80.0	5.8	0.1	25.7	-19.9
210.523	78.8	67.9	-29.1	20.0	-80.0	-10.3	7.9	21.1	-31.4

**Standby mode (2 Ah accu):**

f [kHz]	PK reading [dBμV]	QP reading [dBμV]	Duty cycle corr. [dB]	Ant. factor [dB]	Distance corr. [dB]	corr. AV level [dBμV/m]	QP level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
132.588	75.5	64.9	-4.6	20.0	-80.0	10.9	4.9	25.2	-14.3

**Charging mode (2 Ah accu):**

f [kHz]	PK reading [dBμV]	QP reading [dBμV]	Duty cycle corr. [dB]	Ant. factor [dB]	Distance corr. [dB]	corr. AV level [dBμV/m]	QP level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
124.277	68.2	59.0	-4.2	20.0	-80.0	4.0	-1.0	25.7	-21.7
141.594	83.8	83.6	0.0	20.0	-80.0	23.8	23.6	24.6	-0.8
145.458	83.5	83.5	0.0	20.0	-80.0	23.5	23.5	24.3	-0.8
210.523	78.2	67.0	-29.1	20.0	-80.0	-10.9	7.0	21.1	-32.0

**Maintenance mode (2 Ah accu):**

f [kHz]	PK reading [dBμV]	QP reading [dBμV]	Duty cycle corr. [dB]	Ant. factor [dB]	Distance corr. [dB]	corr. AV level [dBμV/m]	QP level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
123.852	68.3	59.6	-2.9	20.0	-80.0	5.4	-0.4	25.7	-20.3
210.523	78.6	67.6	-29.1	20.0	-80.0	-10.5	7.6	21.1	-31.6

Limit according to FCC Part 15C, Section 15.209(a):

Frequency (MHz)	Field strength of fundamental wave		Measurement distance (metres)
	(μV/m)	dB(μV/m)	
0.009-0.490	2400/F(kHz)	--	300
0.490-1.705	24000/F (kHz)	--	30
1.705-30.0	30	29.5	30

The requirements are **FULFILLED**.

**Remarks:** All measurements were performed in horizontal and vertical position. Only the vertical results are shown in this test report because these are the worst case conditions.

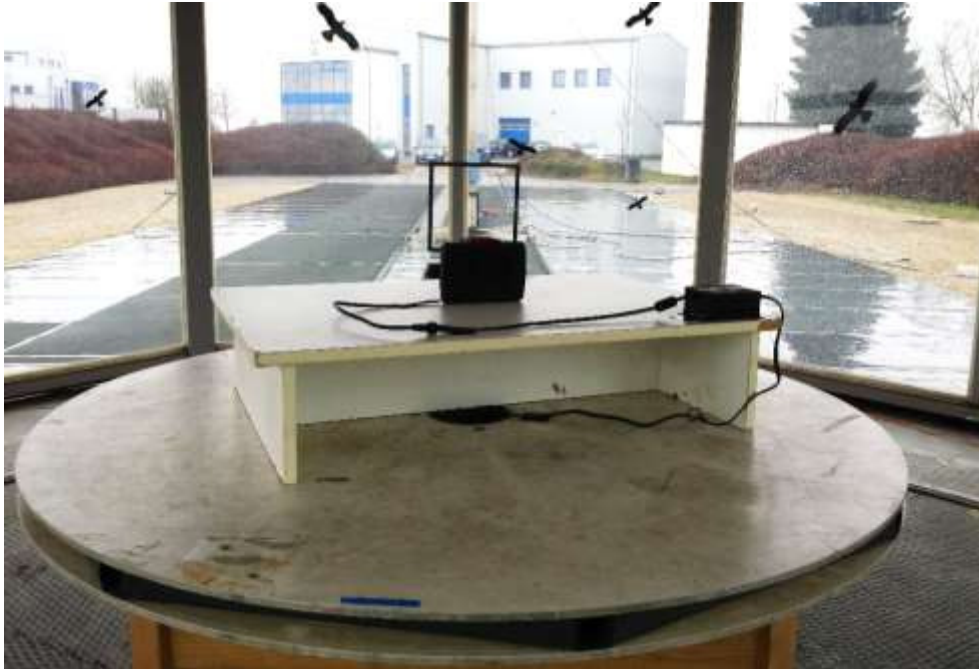
### 5.3 Spurious emissions

For test instruments and accessories used see section 6 Part SER 1.

#### 5.3.1 Description of the test location

Test location: OATS 1  
Test distance: 3 m

#### 5.3.2 Photo documentation of the test set-up



### 5.3.3 Applicable standard

According to FCC Part 15C, Section 15.209:

The emissions from intentional radiators shall not exceed the field strength limits for spurious emissions in the table.

### 5.3.4 Description of Measurement

The magnetic field strength of spurious emission from the EUT is measured in an open area test site in the frequency range of 9 kHz to 30 MHz using a tuned receiver and a shielded loop antenna. The setup of the EUT and the measurement procedure is in accordance to ANSI C63.4, Item 8.3. The EUT is measured in TX continuous mode, modulated, under normal conditions.

According to Section 15.31(f)(2): The measurement below 30 MHz is performed at a distance of 3 m. The results are extrapolated to the specified distance by using the square of an inverse linear distance extrapolation factor of 40 dB/decade.

The resolution bandwidth during the measurement is as follows:

9 kHz – 150 kHz: RBW: 200 Hz

150 kHz – 30 MHz: RBW: 9 kHz

### 5.3.5 Test result

#### Standby mode 132.6 kHz (4 Ah accu):

f [kHz]	PK reading [dBμV]	QP reading [dBμV]	Duty cycle corr. [dB]	Ant. factor [dB]	Distance corr. [dB]	corr. AV level [dBμV/m]	QP level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
383.953	43.3	27.3	-4.6	20.0	-80.0	-21.3	-32.7	15.9	-37.2

#### Charging mode 124.3 kHz (4 Ah accu):

f [kHz]	PK reading [dBμV]	QP reading [dBμV]	Duty cycle corr. [dB]	Ant. factor [dB]	Distance corr. [dB]	corr. AV level [dBμV/m]	QP level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
372.831	39.8	22.3	-4.2	20.0	-80.0	-24.4	-37.7	16.2	-40.6

**Charging mode 141.6 kHz (4 Ah accu):**

f [kHz]	PK reading [dBμV]	QP reading [dBμV]	Duty cycle corr. [dB]	Ant. factor [dB]	Distance corr. [dB]	corr. AV level [dBμV/m]	QP level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
283.188	53.0	45.0	0.0	20.0	-80.0	-7.0	-15.0	18.6	-25.6
424.783	50.2	49.2	0.0	20.0	-80.0	-9.8	-10.8	15.0	-24.8
566.377	38.8	35.7	0.0	20.0	-40.0	18.8	15.7	32.5	-16.8
707.971	53.0	50.1	0.0	20.0	-40.0	33.0	30.1	30.6	-0.5
849.565	35.5	33.2	0.0	20.0	-40.0	15.5	13.2	29.0	-15.8
991.159	45.7	45.5	0.0	20.0	-40.0	25.7	25.5	27.7	-2.2
1132.754	25.1	21.3	0.0	20.0	-40.0	5.1	1.3	26.5	-25.2
1274.348	35.1	33.6	0.0	20.0	-40.0	15.1	13.6	25.5	-11.9
1415.942	27.0	23.1	0.0	20.0	-40.0	7.0	3.1	24.6	-21.5
1557.536	37.1	32.8	0.0	20.0	-40.0	17.1	12.8	23.8	-11.0
1699.130	26.5	22.9	0.0	20.0	-40.0	6.5	2.9	23.0	-20.1
1840.725	35.3	32.6	0.0	20.0	-40.0	15.3	12.6	29.5	-16.9
1982.319	35.2	19.2	0.0	20.0	-40.0	15.2	-0.8	29.5	-30.3
2123.913	29.8	27.7	0.0	20.0	-40.0	9.8	7.7	29.5	-21.8
2265.507	19.1	16.5	0.0	20.0	-40.0	-0.9	-3.5	29.5	-33.0
2407.101	28.2	24.3	0.0	20.0	-40.0	8.2	4.3	29.5	-25.2
2548.696	21.6	14.5	0.0	20.0	-40.0	1.6	-5.5	29.5	-35.0
2690.290	24.9	22.0	0.0	20.0	-40.0	4.9	2.0	29.5	-27.5
2831.884	18.2	13.5	0.0	20.0	-40.0	-1.8	-6.5	29.5	-36.0
2973.478	23.7	21.0	0.0	20.0	-40.0	3.7	1.0	29.5	-28.5
3115.072	16.2	11.9	0.0	20.0	-40.0	-3.8	-8.1	29.5	-37.6
3256.667	23.9	21.6	0.0	20.0	-40.0	3.9	1.6	29.5	-27.9
3539.855	23.0	17.2	0.0	20.0	-40.0	3.0	-2.8	29.5	-32.3
3823.043	29.3	20.4	0.0	20.0	-40.0	9.3	0.4	29.5	-29.1
4106.232	25.1	19.9	0.0	20.0	-40.0	5.1	-0.1	29.5	-29.6
4389.420	18.9	13.0	0.0	20.0	-40.0	-1.1	-7.0	29.5	-36.5
4672.609	18.0	13.3	0.0	20.0	-40.0	-2.0	-6.7	29.5	-36.2

**FCC ID: TXTWC18CV**
**Charging mode 145.5kHz (4 Ah accu):**

f [kHz]	PK reading [dBµV]	QP reading [dBµV]	Duty cycle corr. [dB]	Ant. factor [dB]	Distance corr. [dB]	corr. AV level [dBµV/m]	QP level [dBµV/m]	Limit [dBµV/m]	Margin [dB]
290.916	54.2	43.7	0.0	20.0	-80.0	-5.8	-16.3	18.3	-24.1
436.375	54.4	53.0	0.0	20.0	-80.0	-5.6	-7.0	14.8	-20.4
581.833	35.7	31.5	0.0	20.0	-40.0	15.7	11.5	32.3	-20.8
727.291	52.2	47.1	0.0	20.0	-40.0	32.2	27.1	30.4	-3.3
872.749	33.8	32.0	0.0	20.0	-40.0	13.8	12.0	28.8	-16.8
1018.207	45.5	45.2	0.0	20.0	-40.0	25.5	25.2	27.4	-2.2
1163.666	28.8	26.5	0.0	20.0	-40.0	8.8	6.5	26.3	-19.8
1309.124	39.5	38.5	0.0	20.0	-40.0	19.5	18.5	25.3	-6.8
1454.582	21.3	15.4	0.0	20.0	-40.0	1.3	-4.6	24.3	-28.9
1600.040	35.1	28.6	0.0	20.0	-40.0	15.1	8.6	23.5	-14.9
1745.498	31.9	19.7	0.0	20.0	-40.0	11.9	-0.3	29.5	-29.8
1890.957	34.7	30.8	0.0	20.0	-40.0	14.7	10.8	29.5	-18.7
2036.415	30.4	19.4	0.0	20.0	-40.0	10.4	-0.6	29.5	-30.1
2181.873	32.8	30.3	0.0	20.0	-40.0	12.8	10.3	29.5	-19.2
2327.331	20.5	16.5	0.0	20.0	-40.0	0.5	-3.5	29.5	-33.0
2472.789	28.4	26.7	0.0	20.0	-40.0	8.4	6.7	29.5	-22.8
2618.248	18.4	12.9	0.0	20.0	-40.0	-1.6	-7.1	29.5	-36.6
2763.706	27.3	24.4	0.0	20.0	-40.0	7.3	4.4	29.5	-25.1
2909.164	16.1	10.3	0.0	20.0	-40.0	-3.9	-9.7	29.5	-39.2
3054.622	26.6	21.1	0.0	20.0	-40.0	6.6	1.1	29.5	-28.4
3200.080	13.8	7.0	0.0	20.0	-40.0	-6.2	-13.0	29.5	-42.5
3345.539	22.6	20.1	0.0	20.0	-40.0	2.6	0.1	29.5	-29.4
3636.455	29.9	24.6	0.0	20.0	-40.0	9.9	4.6	29.5	-24.9
3927.371	26.3	22.2	0.0	20.0	-40.0	6.3	2.2	29.5	-27.3
4218.288	20.8	13.6	0.0	20.0	-40.0	0.8	-6.4	29.5	-35.9
4509.204	20.7	16.5	0.0	20.0	-40.0	0.7	-3.5	29.5	-33.0
4800.121	21.4	13.9	0.0	20.0	-40.0	1.4	-6.1	29.5	-35.6

**Charging mode 210.5kHz (4 Ah accu):**

f [kHz]	PK reading [dBµV]	QP reading [dBµV]	Duty cycle corr. [dB]	Ant. factor [dB]	Distance corr. [dB]	corr. AV level [dBµV/m]	QP level [dBµV/m]	Limit [dBµV/m]	Margin [dB]
631.568	56.3	45.4	-29.1	20.0	-40.0	7.2	25.4	31.6	-6.2
1052.613	46.8	36.0	-29.1	20.0	-40.0	-2.3	16.0	27.2	-11.2
1473.658	38.4	27.3	-29.1	20.0	-40.0	-10.7	7.3	24.2	-16.9
1894.703	31.7	26.9	-29.1	20.0	-40.0	-17.4	6.9	29.5	-22.6
2315.748	22.8	12.6	-29.1	20.0	-40.0	-26.3	-7.4	29.5	-36.9
2736.793	24.4	14.4	-29.1	20.0	-40.0	-24.7	-5.6	29.5	-35.1
3157.838	20.1	6.8	-29.1	20.0	-40.0	-29.0	-13.2	29.5	-42.7



**Maintenance mode 123.8 kHz (4 Ah accu):**

f [kHz]	PK reading [dBμV]	QP reading [dBμV]	Duty cycle corr. [dB]	Ant. factor [dB]	Distance corr. [dB]	corr. AV level [dBμV/m]	QP level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
371.555	37.8	21.3	-2.9	20.0	-80.0	-25.1	-38.7	16.2	-54.9
866.961	33.2	16.7	-2.9	20.0	-40.0	10.3	-3.3	28.8	-32.1

**Maintenance mode 210.5 kHz (4 Ah accu):**

f [kHz]	PK reading [dBμV]	QP reading [dBμV]	Duty cycle corr. [dB]	Ant. factor [dB]	Distance corr. [dB]	corr. AV level [dBμV/m]	QP level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
631.568	57.1	46.1	-29.1	20.0	-40.0	8.0	26.1	31.6	-5.5
1052.613	47.4	37.1	-29.1	20.0	-40.0	-1.7	17.1	27.2	-10.1
1473.658	39.1	27.5	-29.1	20.0	-40.0	-10.0	7.5	24.2	-16.7
1894.703	33.9	19.1	-29.1	20.0	-40.0	-15.2	-0.9	29.5	-30.4
2315.748	28.7	13.6	-29.1	20.0	-40.0	-20.4	-6.4	29.5	-35.9
2736.793	23.8	13.2	-29.1	20.0	-40.0	-25.3	-6.8	29.5	-36.3
3157.838	21.8	9.7	-29.1	20.0	-40.0	-27.3	-10.3	29.5	-39.8

**Limit according to FCC Part 15C Section 15.209(a):**

Frequency (MHz)	Field strength of spurious emissions		Measurement distance (metres)
	(μV/m)	dB(μV/m)	
0.009-0.490	2400/F(kHz)	--	300
0.490-1.705	24000/F (kHz)	--	30
1.705-30.0	30	29.5	30

The requirements are **FULFILLED**.

**Remarks:** All measurements were performed in horizontal and vertical position. Only the vertical results are shown in this test report because this are the worst case conditions.

## 5.4 Spurious emissions radiated (electric field)

For test instruments and accessories used see section 6 Part SER 2.

### 5.4.1 Description of the test location

Test location: OATS 1  
Test distance: 3 m

### 5.4.2 Photo documentation of the test set-up



**5.4.3 Applicable standard**

According to FCC Part 15C, Section 15.209(a):

The emissions from intentional radiators shall not exceed the effective field strength limits.

**5.4.4 Description of Measurement**

The radiated power of the spurious emission from the EUT is measured in a test setup following the procedures set out in ANSI C63.4, Item 8.3.

Instrument settings:

30 MHz – 1000 MHz:                      RBW: 120 kHz

**5.4.5 Test result 30 MHz to 1 GHz**

f [MHz]	PK reading [dB $\mu$ V]	QP reading [dB $\mu$ V]	Corr. factor [dB]	PK level [dB $\mu$ V/m]	QP level [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]
30.40	21.8	17.6	13.9	35.7	31.5	40.0	-8.5
33.50	18.6	12.6	13.6	32.2	26.2	40.0	-13.8
43.10	23.1	19.4	14.7	37.8	34.1	40.0	-5.9
44.70	24.7	19.3	14.9	39.6	34.2	40.0	-5.8
46.20	25.0	21.7	15.0	40.0	36.7	40.0	-3.3
47.20	24.8	20.7	15.0	39.8	35.7	40.0	-4.3
48.20	24.4	19.9	15.0	39.4	34.9	40.0	-5.1
52.60	24.0	19.0	14.8	38.8	33.8	40.0	-6.2
54.40	24.1	18.3	14.7	38.8	33.0	40.0	-7.0
54.80	24.5	18.6	14.7	39.2	33.3	40.0	-6.7
58.30	21.3	18.3	14.5	35.8	32.8	40.0	-7.2
60.80	22.0	16.7	14.3	36.3	31.0	40.0	-9.0
68.20	19.2	17.5	13.4	32.6	30.9	40.0	-9.1
71.80	19.7	15.9	12.8	32.5	28.7	40.0	-11.3
74.60	23.6	16.3	12.2	35.8	28.5	40.0	-11.5
77.20	20.1	14.3	11.7	31.8	26.0	40.0	-14.0
78.60	19.6	15.1	11.4	31.0	26.5	40.0	-13.5
83.00	17.9	12.9	10.5	28.4	23.4	40.0	-16.6
83.50	18.1	12.3	10.4	28.5	22.7	40.0	-17.3
152.00	18.0	11.9	15.3	33.3	27.2	43.5	-16.3
153.50	17.5	11.1	15.4	32.9	26.5	43.5	-17.0
156.70	16.9	10.0	15.6	32.5	25.6	43.5	-17.9
160.00	17.3	10.8	15.8	33.1	26.6	43.5	-16.9
162.70	17.0	10.9	15.6	32.6	26.5	43.5	-17.0
176.70	18.2	11.9	14.6	32.8	26.5	43.5	-17.0
182.50	17.4	13.0	14.0	31.4	27.0	43.5	-16.5
187.60	22.1	17.3	13.2	35.3	30.5	43.5	-13.0
194.20	19.8	15.0	12.2	32.0	27.2	43.5	-16.3

**FCC ID: TXTWC18CV**

Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in the table above or to the general limits shown in the table below according to § 15.209, whichever limit permits a higher field strength.

Frequency (MHz)	15.209 Limits ( $\mu\text{V}/\text{m}$ )	15.209 Limits $\text{dB}(\mu\text{V}/\text{m})$
30 - 88	100	40
88 - 216	150	43,5
216 - 960	200	46
Above 960	500	54

Additionally there is a limit according to §15.35(b) on the radio frequency emissions, as measured with a peak detector, corresponding to 20 dB above the maximum permitted average limits.

The requirements are **FULFILLED**.

**Remarks:** The measurement was performed up to the 10<sup>th</sup> harmonic.

The highest generated frequency is 64 MHz.

All measurements were performed in horizontal and vertical position. The radiated emission test was carried out in charging mode. Only the vertical results are shown in this test report because these are the worst case conditions.

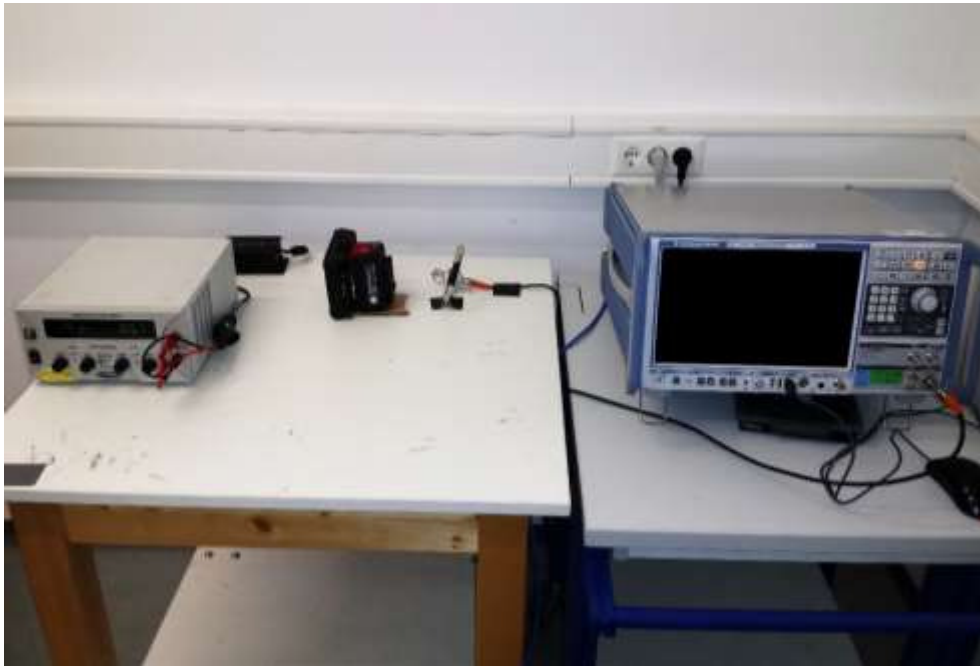
## 5.5 Emission bandwidth

For test instruments and accessories used see section 6 Part MB.

### 5.5.1 Description of the test location

Test location:                 Shielded Room S6

### 5.5.2 Photo documentation of the test set-up



**5.5.3 Applicable standard**

According to FCC Part 15C, Section 15.215(c):

**5.5.4 Description of Measurement**

The measurement is performed radiated using a spectrum analyser. The analyser span is set wide enough to capture the most of the power envelope of the signal.

Analyser settings:

Span: see plots,                      RBW: 100 Hz                      VBW: 300 Hz                      Detector: peak;

**5.5.5 Test result**
**Standby mode 132.6 kHz**

20dB Bandwidth M2 [kHz]	20dB Bandwidth M3 [kHz]	Measured Bandwidth [kHz]
131.8534	133.4666	1.6132

**Charging mode 124.3 kHz**

20dB Bandwidth M2 [kHz]	20dB Bandwidth M3 [kHz]	Measured Bandwidth [kHz]
124.8258	126.3670	1.5412

**Charging mode 141.6 kHz**

20dB Bandwidth M2 [kHz]	20dB Bandwidth M3 [kHz]	Measured Bandwidth [kHz]
141.2002	141.9973	0.7971

**Charging mode 145.5 kHz**

20dB Bandwidth M2 [kHz]	20dB Bandwidth M3 [kHz]	Measured Bandwidth [kHz]
145.0652	145.8273	0.7621

**Charging mode 210.5 kHz**

20dB Bandwidth M2 [kHz]	20dB Bandwidth M3 [kHz]	Measured Bandwidth [kHz]
209.7804	211.2796	1.4992

**FCC ID: TXTWC18CV**

**Maintenance mode 123.8 kHz**

20dB Bandwidth M2 [kHz]	20dB Bandwidth M3 [kHz]	Measured Bandwidth [kHz]
123.7525	125.2597	1.5072

**Maintenance mode 210.5 kHz**

20dB Bandwidth M2 [kHz]	20dB Bandwidth M3 [kHz]	Measured Bandwidth [kHz]
209.7804	211.2796	1.4992

**Remarks:**

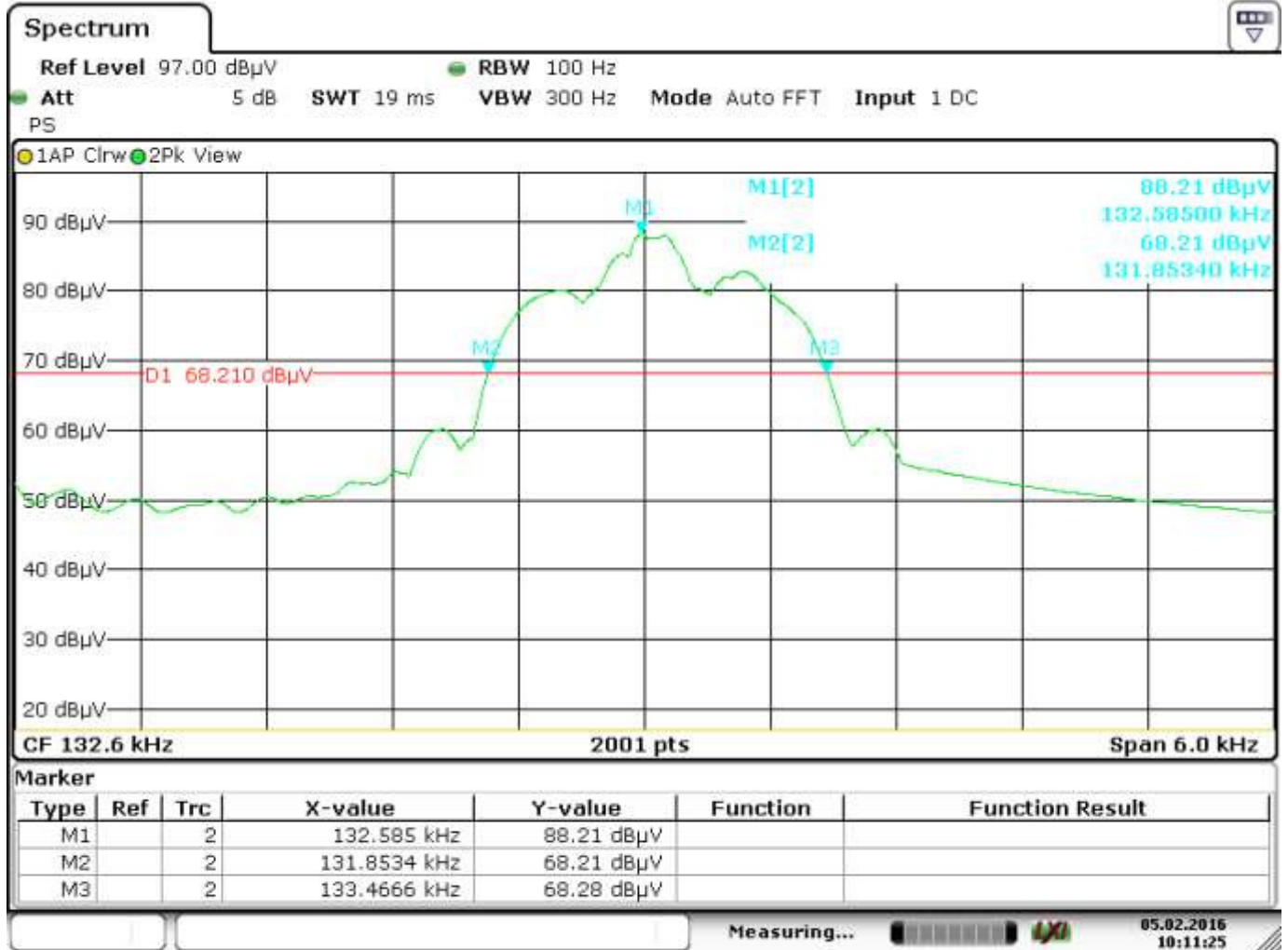
There is no emission bandwidth limit for FCC Part 15.209.

This measurement is only to give an overview of the emission bandwidth spectrum.

5.5.6 Test protocol

Emission bandwidth  
FCC Part 15C, Section 15.215(c)

Standby mode 132.6 kHz

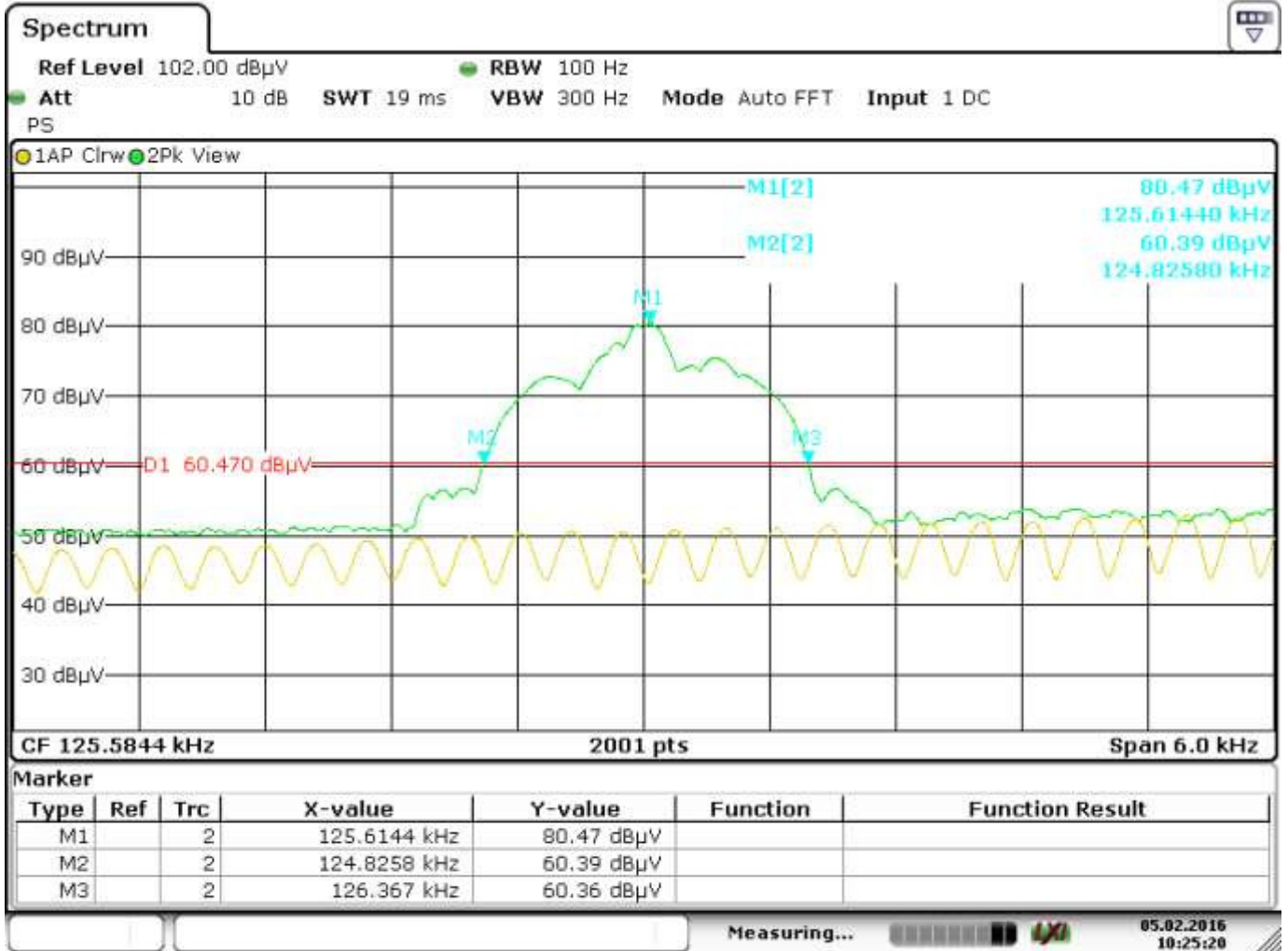


Date: 5.FEB.2016 10:11:25



**Emission bandwidth**  
FCC Part 15C, Section 15.215(c)

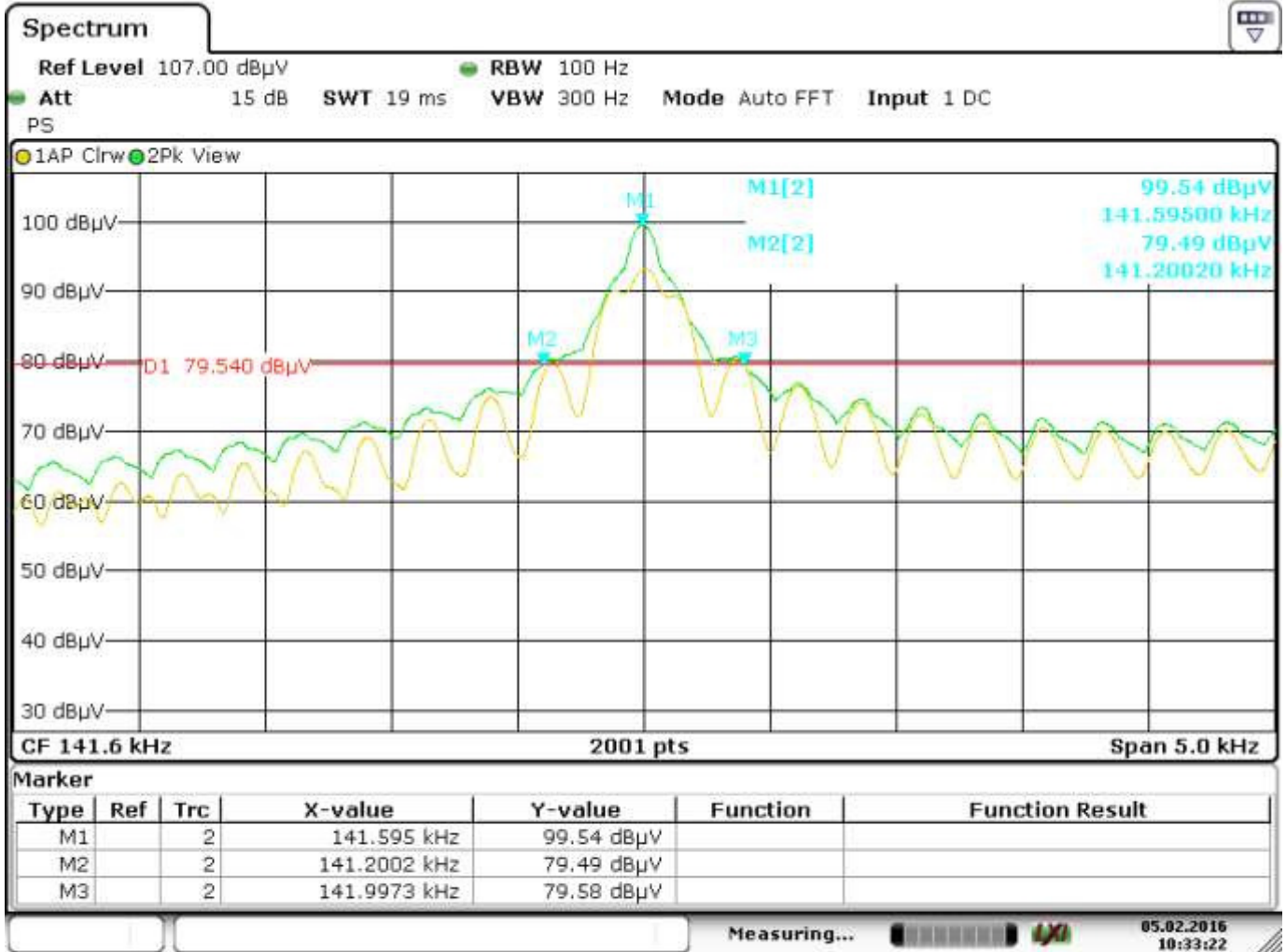
Charging mode 124.3 kHz



Date: 5.FEB.2016 10:25:20

**Emission bandwidth**  
FCC Part 15C, Section 15.215(c)

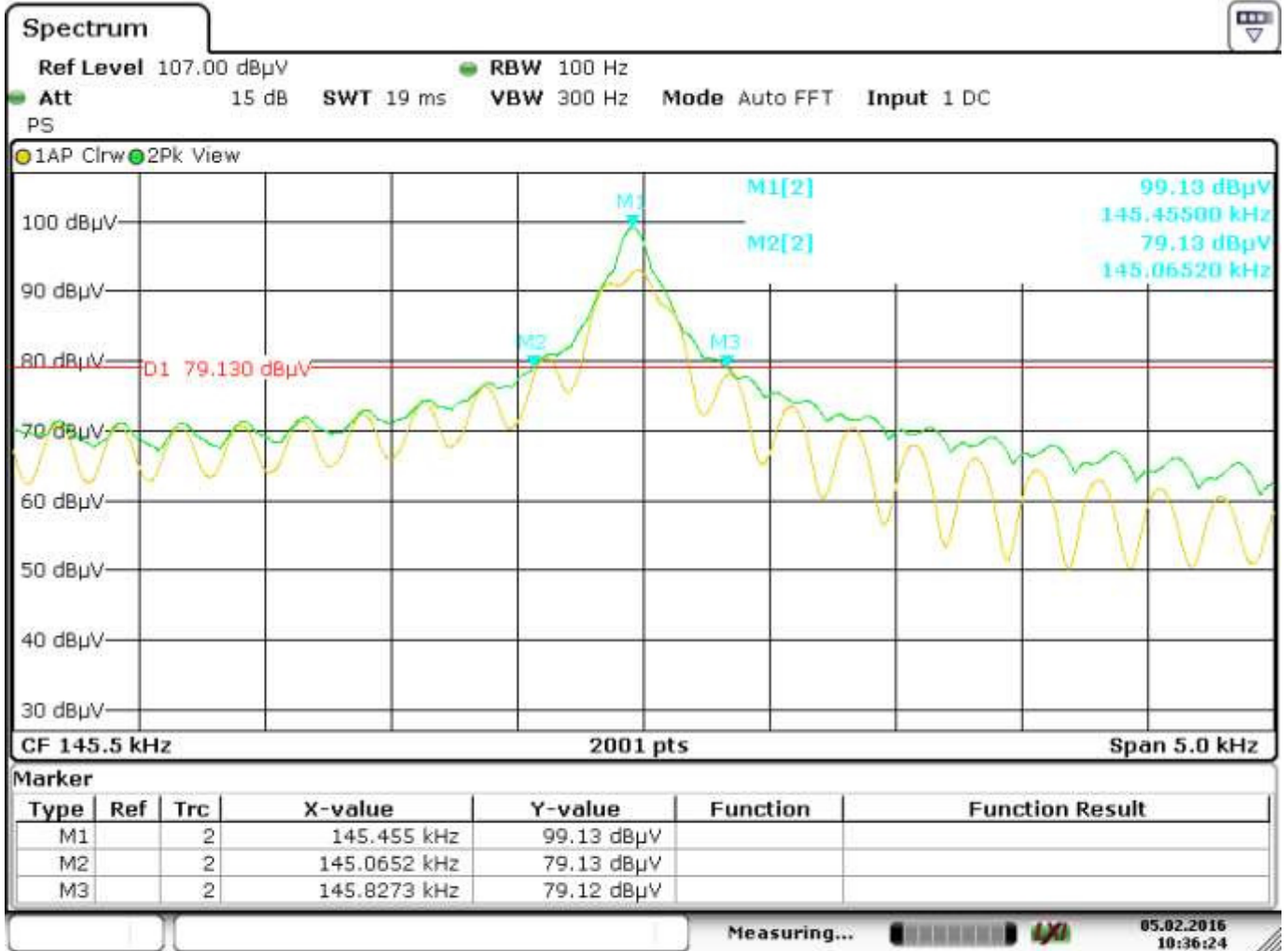
Charging mode 141.6 kHz



Date: 5.FEB.2016 10:33:22

**Emission bandwidth**  
FCC Part 15C, Section 15.215(c)

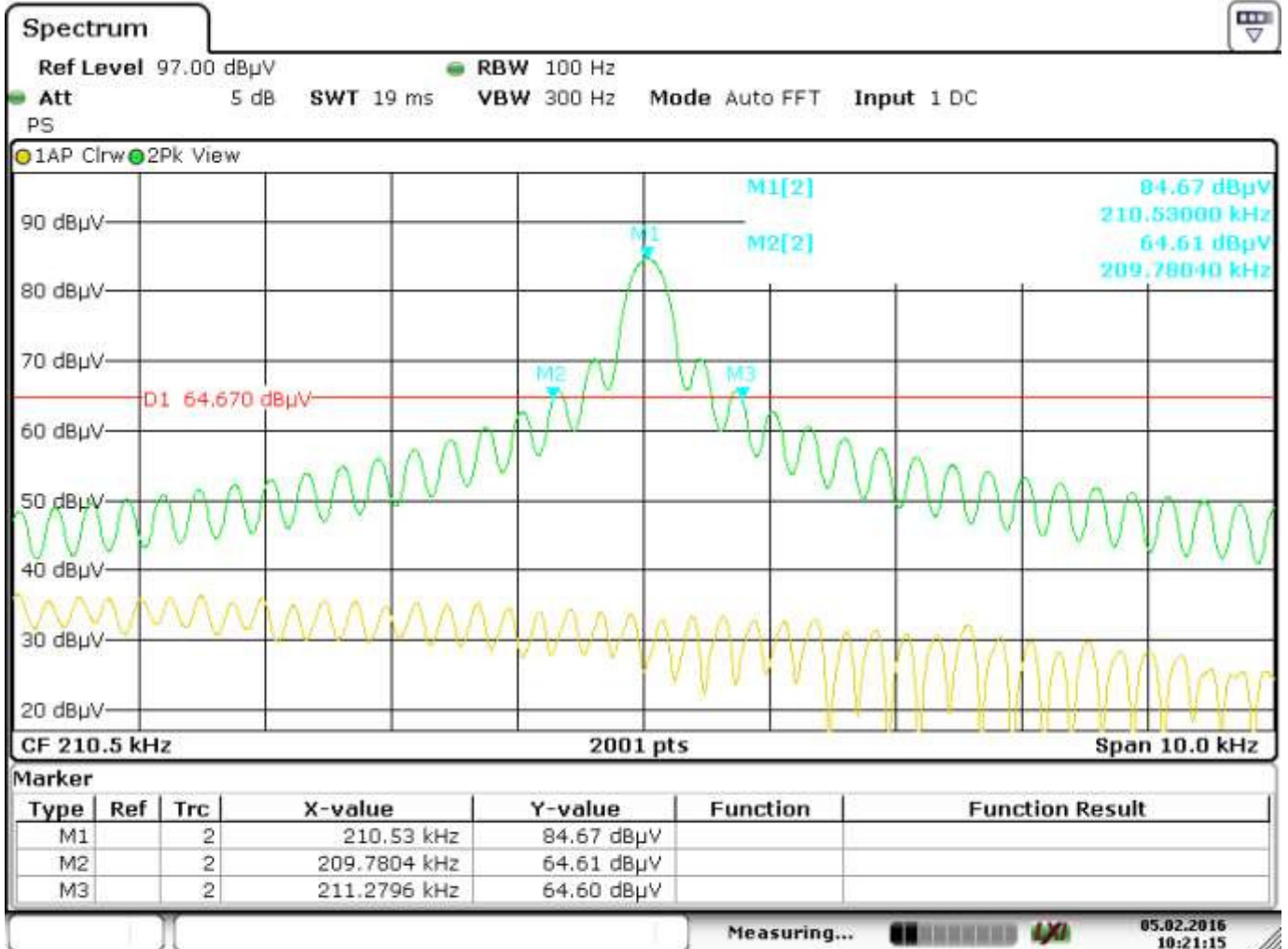
Charging mode 145.5 kHz



Date: 5.FEB.2016 10:36:24

**Emission bandwidth**  
FCC Part 15C, Section 15.215(c)

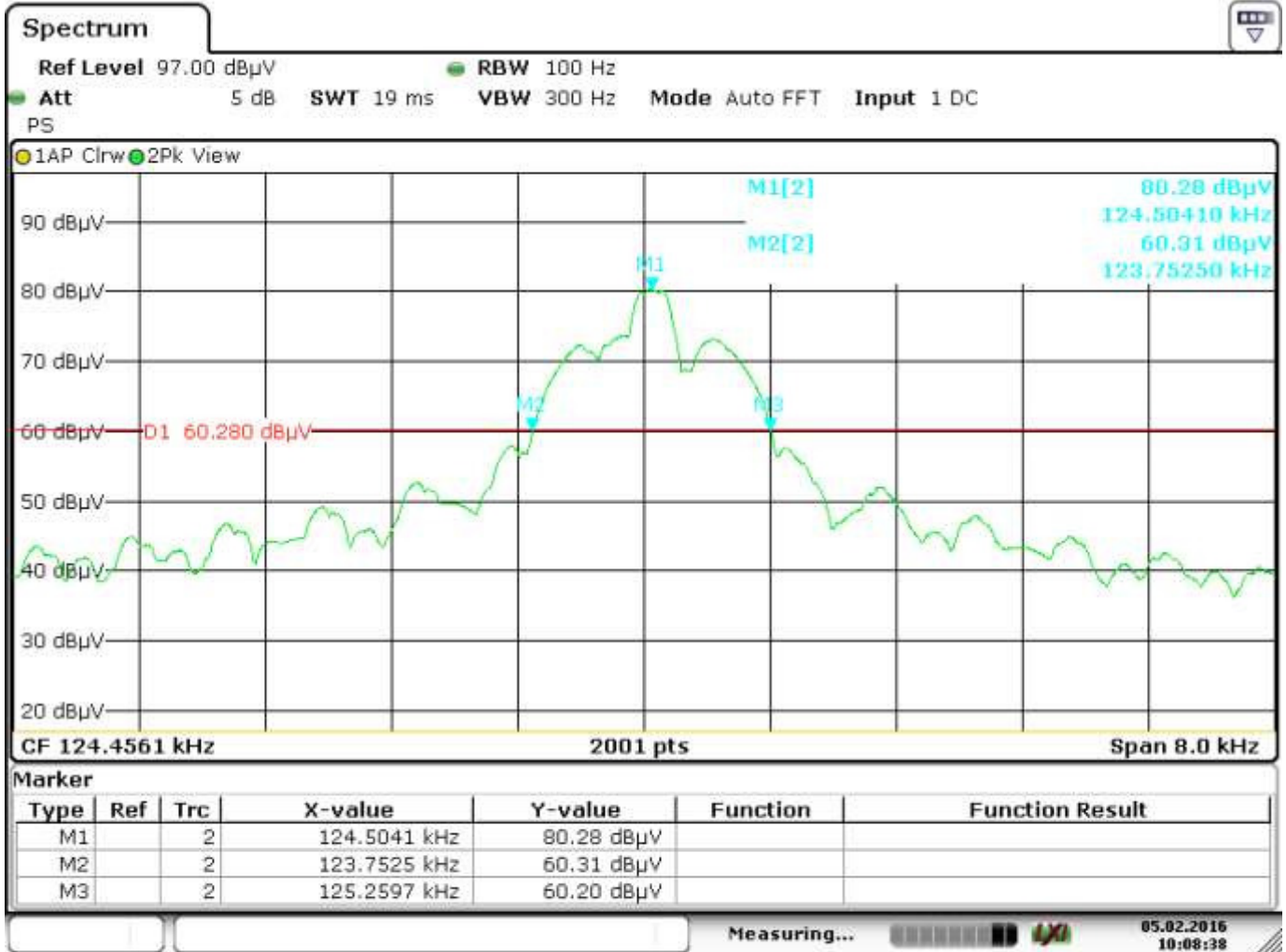
Charging mode 210.5 kHz



Date: 5.FEB.2016 10:21:15

**Emission bandwidth**  
FCC Part 15C, Section 15.215(c)

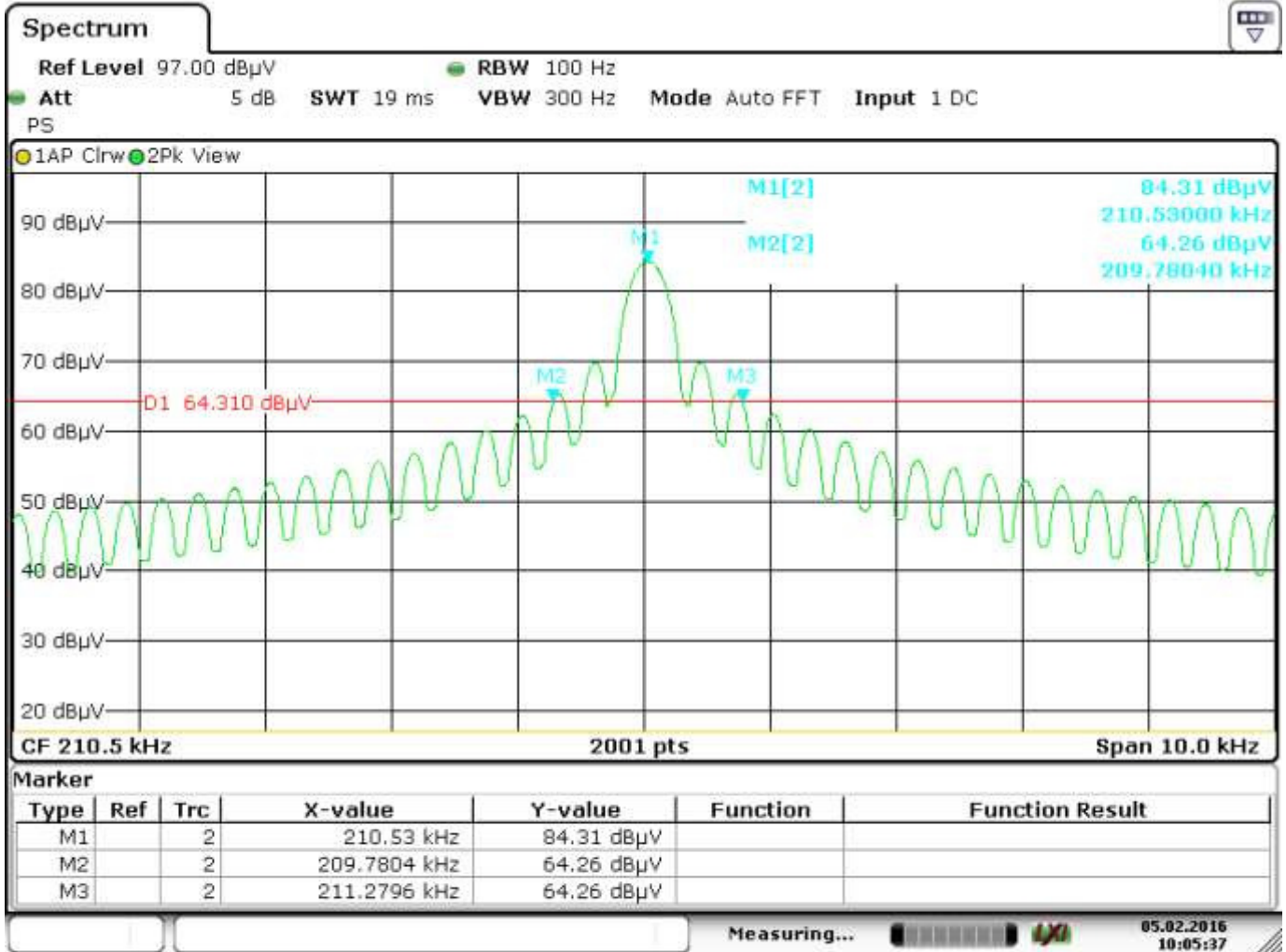
Maintenance mode 123.8 kHz



Date: 5.FEB.2016 10:08:38

**Emission bandwidth**  
FCC Part 15C, Section 15.215(c)

Maintenance mode 210.5 kHz



Date: 5.FEB.2016 10:05:37

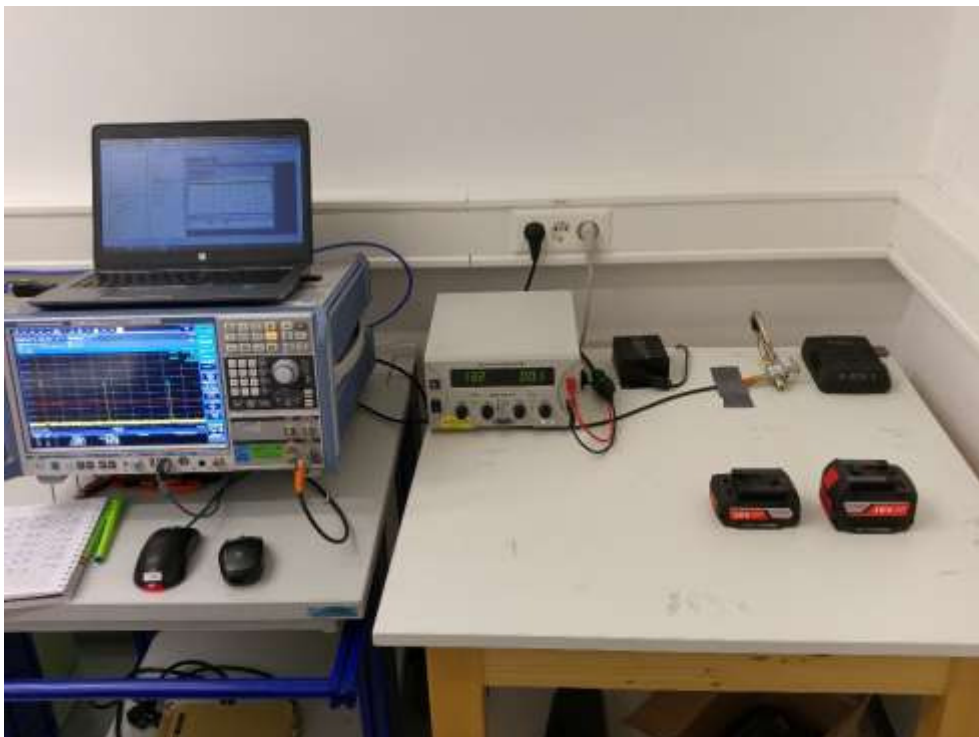
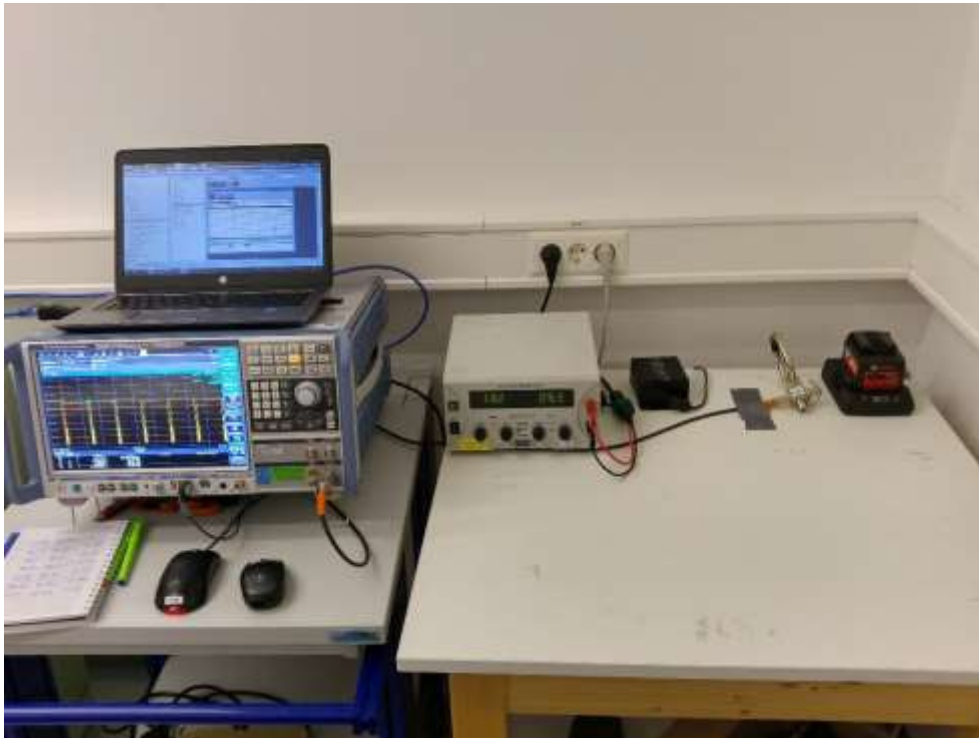
## 5.6 Correction for pulse operation (duty cycle)

For test instruments and accessories used see section 6 Part DC.

### 5.6.1 Description of the test location

Test location:               Shielded Room S6

### 5.6.2 Photo documentation of the test set-up



**5.6.3 Applicable standard**

According to FCC Part 15A, Section 15.35(c):

When the radiated emission limits are expressed in terms of average value and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete puls train, including blanking intervals, as long as the pulse train does not exceed 0.1s. In cases where the puls train exceeds 0.1s, the measured field strength shall be determined from the average absolute voltage during a 0.1s interval during which the field strength is at its maximum. The exact method of calculating the average field strength shall be submitted.

**5.6.4 Description of Measurement**

The duty cycle factor (dB) is calculated applying the following formula:

$$K_E = 20 \log \frac{T_{ON}}{T_{PT}}$$

$$-4.6 \text{ dB} = 20 \log \frac{58.9 \text{ ms}}{100 \text{ ms}}$$

$K_E$ : pulse operation correction factor (dB)

$T_{ON}$  complete on time (ms)

$T_{PT}$  complete pulse train (ms)

*Spectrum analyser settings:*

RBW: 10 kHz

VBW: 30 kHz

Span: zero span

Sweep time: manual

Detector: Max. peak

Trace Mode: single sweep

**5.6.5 Test result**
**Standby mode 132.6 kHz**

$T_{ON}$ (ms)	$T_{PT}$ (ms)	$K_E$ (dB)
58.9	>100 (2706.4)	-4.6

**Charging mode 124.3 kHz**

$T_{ON}$ (ms)	$T_{PT}$ (ms)	$K_E$ (dB)
61.4	>100 (2998.9)	-4.2

**Charging mode 141.6 kHz**

$T_{ON}$ (ms)	$T_{PT}$ (ms)	$K_E$ (dB)
>100 (2761.4)	>100 (2990.0)	0

**Charging mode 145.5 kHz**

$T_{ON}$ (ms)	$T_{PT}$ (ms)	$K_E$ (dB)
>100 (2761.4)	>100 (2998.8)	0



**FCC ID: TXTWC18CV**
**Charging mode 210.5 kHz**

$T_{ON}$ (ms)	$T_{PT}$ (ms)	$KE$ (dB)
3.5	>100 (2998.9)	-29.1

**Maintenance mode 123.8 kHz**

$T_{ON}$ (ms)	$T_{PT}$ (ms)	$KE$ (dB)
71.9	>100 (7163.5)	-2.9

**Maintenance mode 210.5 kHz**

$T_{ON}$ (ms)	$T_{PT}$ (ms)	$KE$ (dB)
3.5	>100 (7158.5)	-29.1

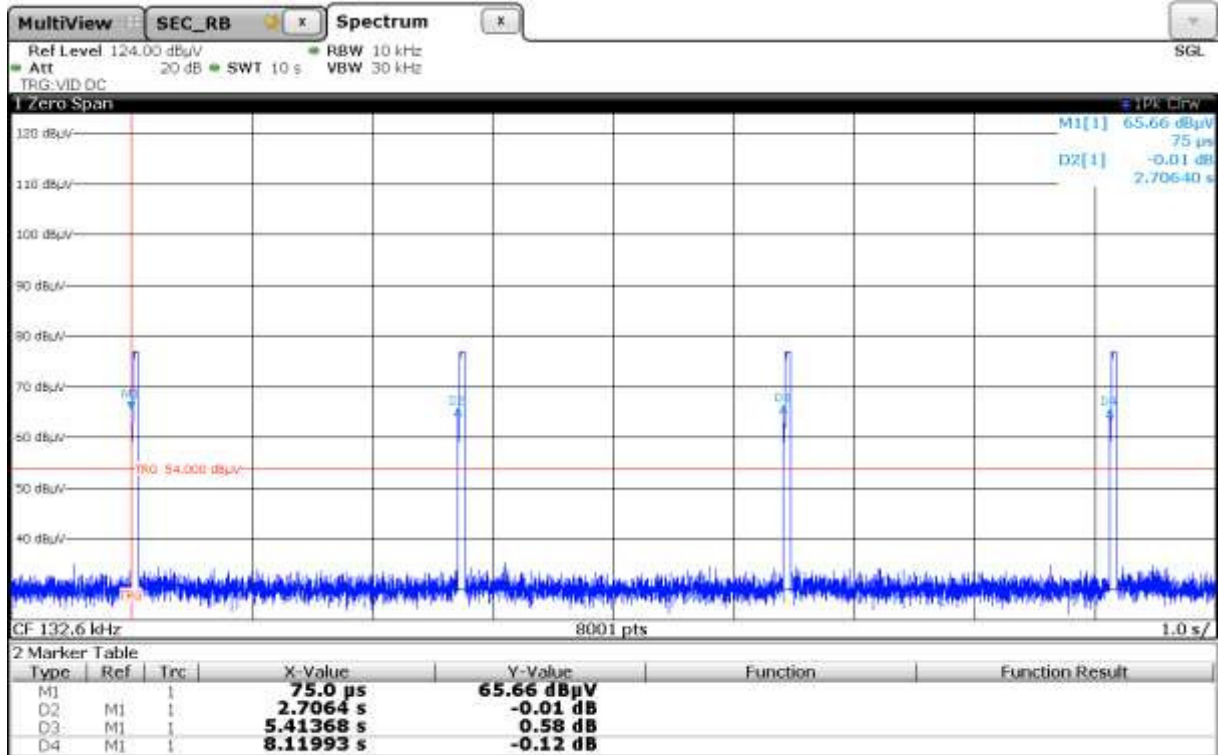
**Remarks:** The pulse train ( $T_w$ ) exceeds 100 ms, therefore the duty cycle have been calculated by averaging the sum of the pulse widths over the 100 ms width with the highest average value.

For detailed results, please see the test protocol below.

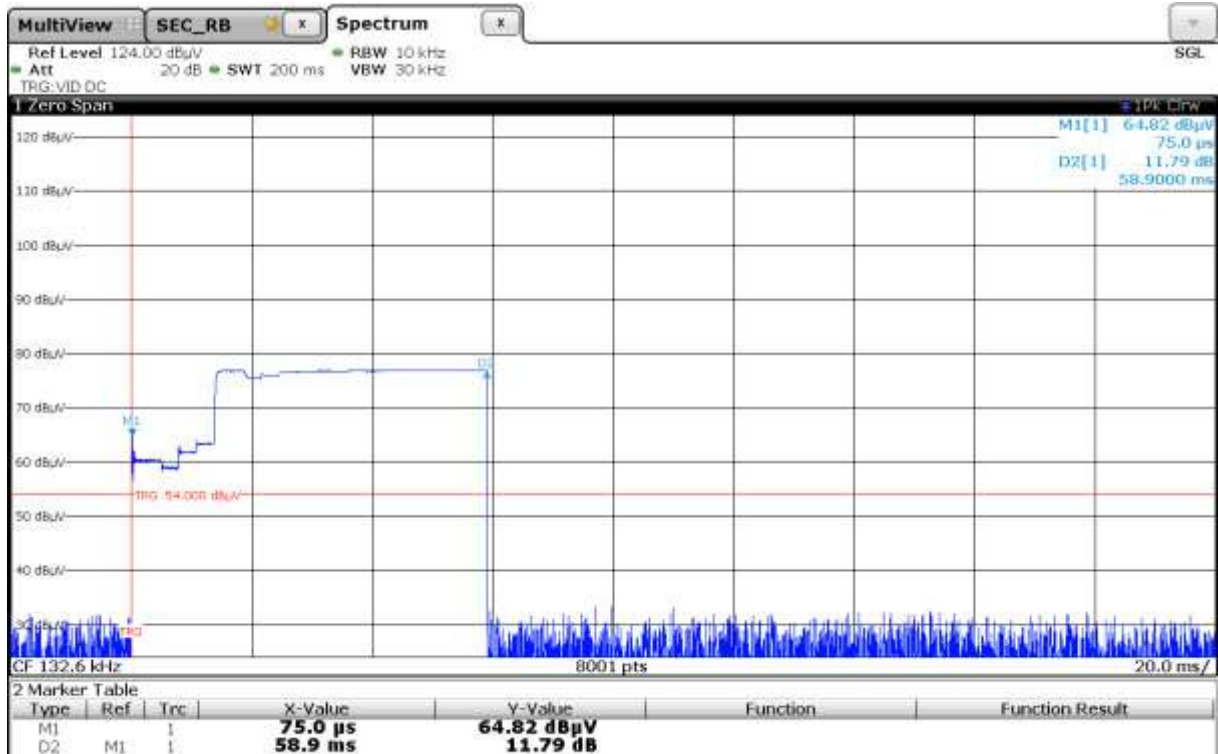
5.6.6 Test protocol

Correction for Pulse Operation (Duty Cycle)  
FCC Part 15A, Section 15.35(c)

Standby mode 132.6 kHz



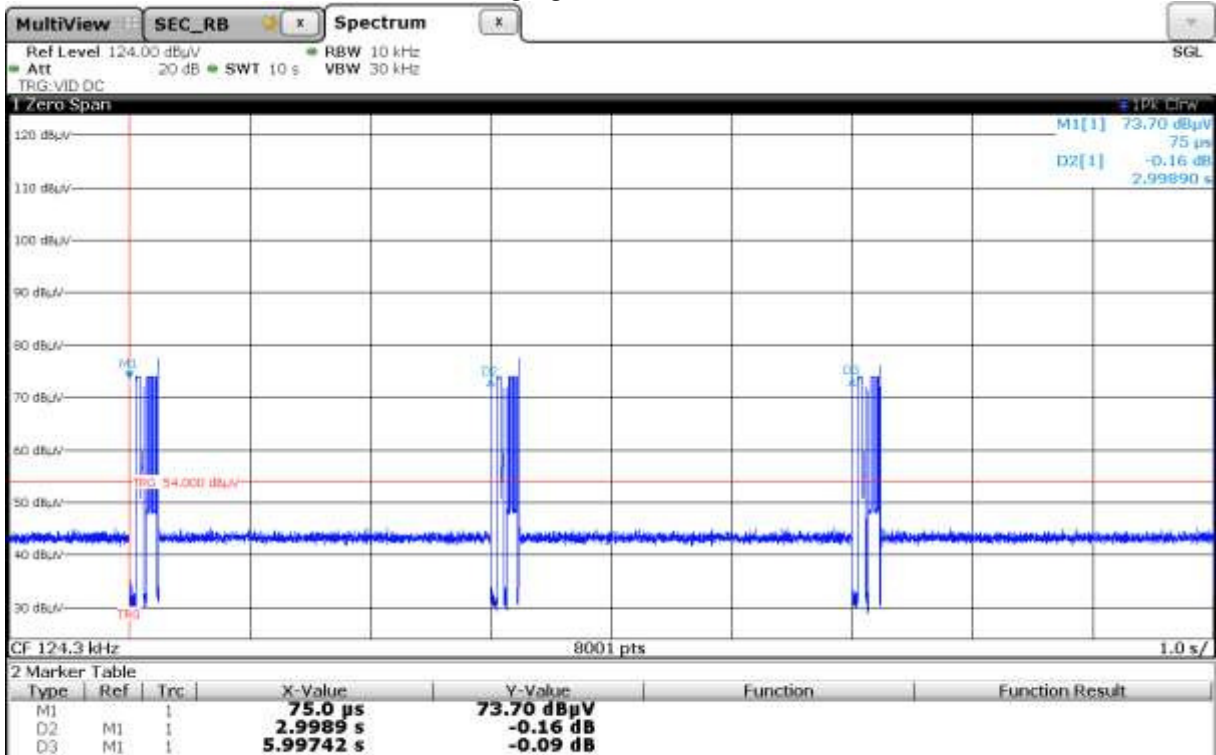
Date: 6 APR 2016 09:43:24



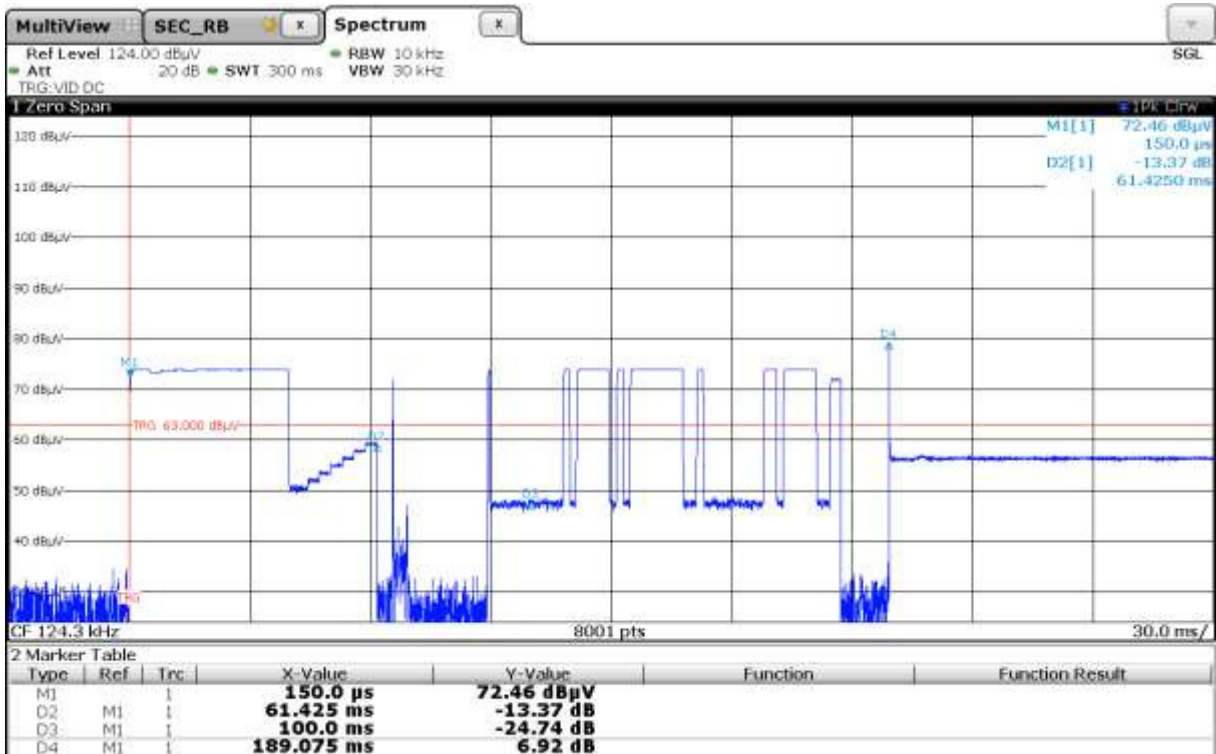
Date: 6 APR 2016 09:45:26

Correction for Pulse Operation (Duty Cycle)  
FCC Part 15A, Section 15.35(c)

Charging mode 124.3 kHz



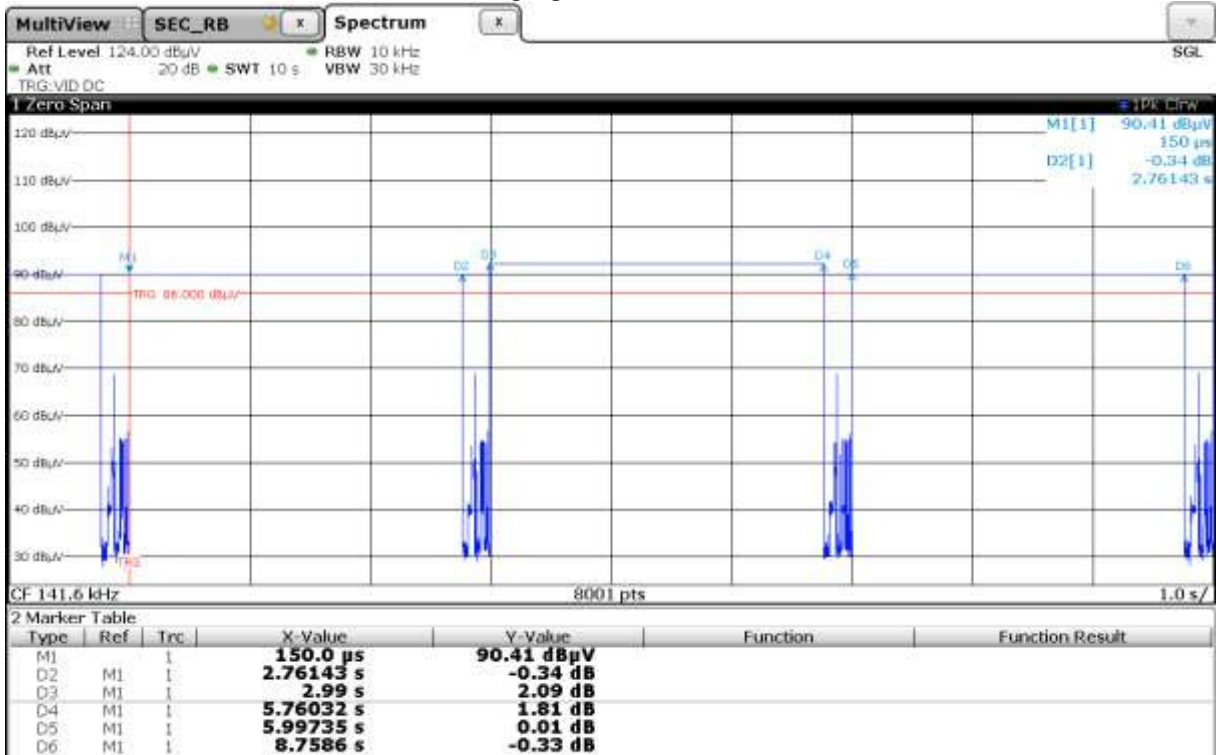
Date: 6 APR 2016 09:52:25



Date: 6 APR 2016 10:04:06

Correction for Pulse Operation (Duty Cycle)  
FCC Part 15A, Section 15.35(c)

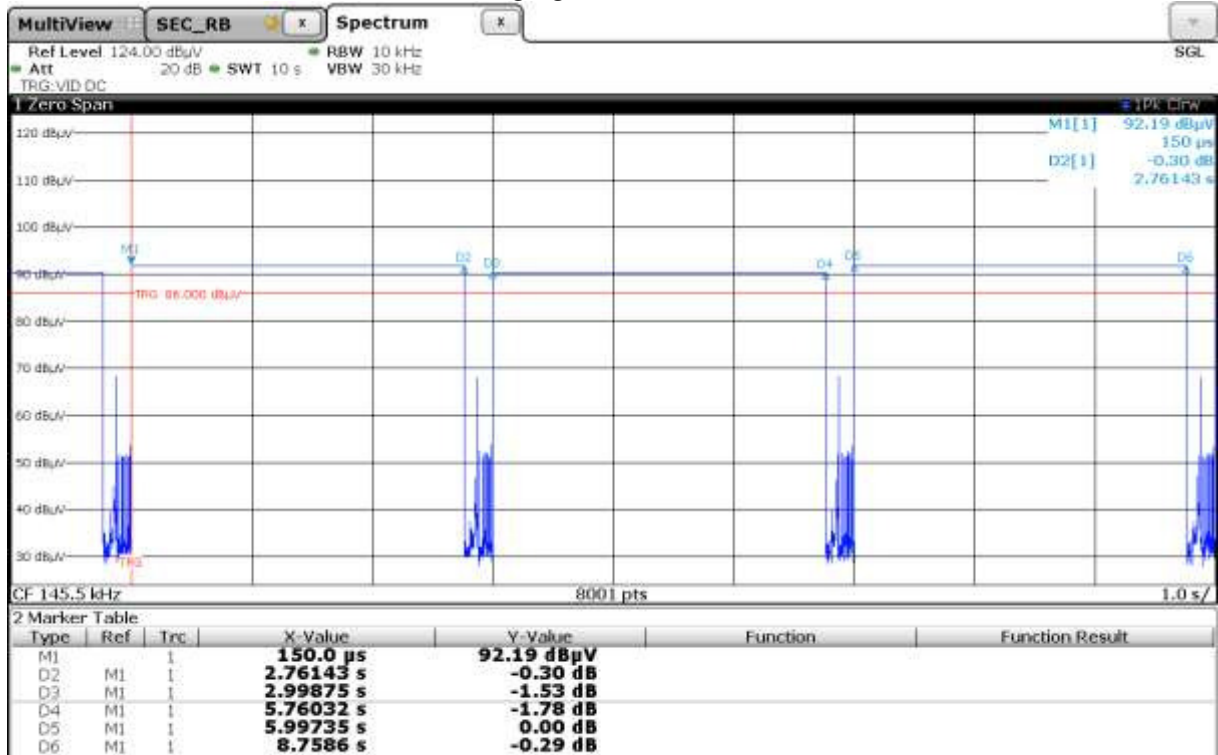
Charging mode 141.6 kHz



Date: 5 APR 2016 10:10:16

Correction for Pulse Operation (Duty Cycle)  
FCC Part 15A, Section 15.35(c)

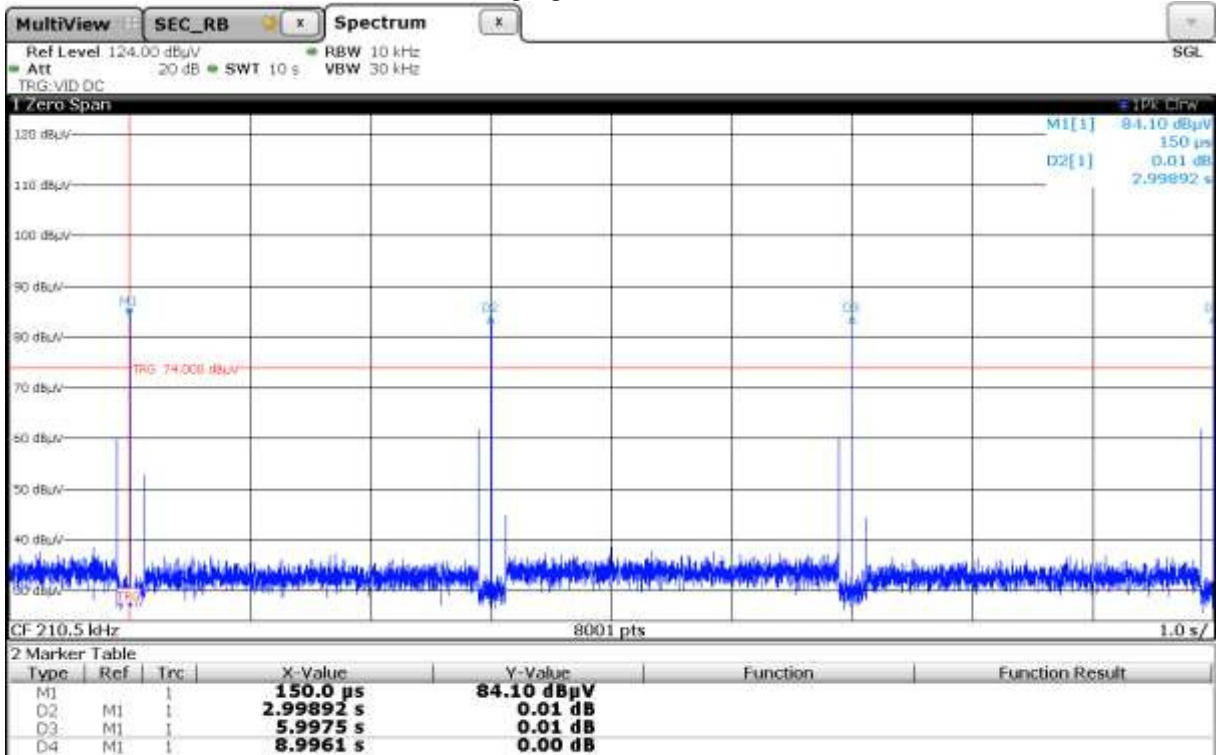
Charging mode 145.5 kHz



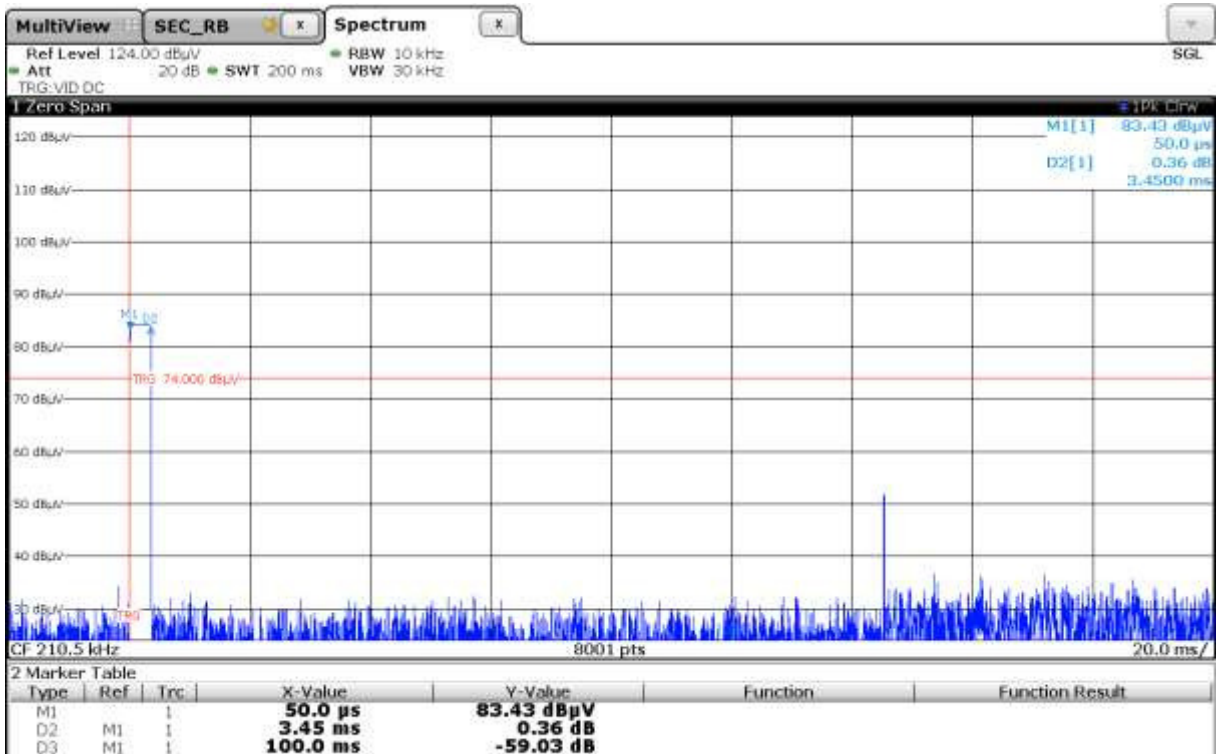
Date: 6 APR 2016 10:13:40

Correction for Pulse Operation (Duty Cycle)  
FCC Part 15A, Section 15.35(c)

Charging mode 210.5 kHz



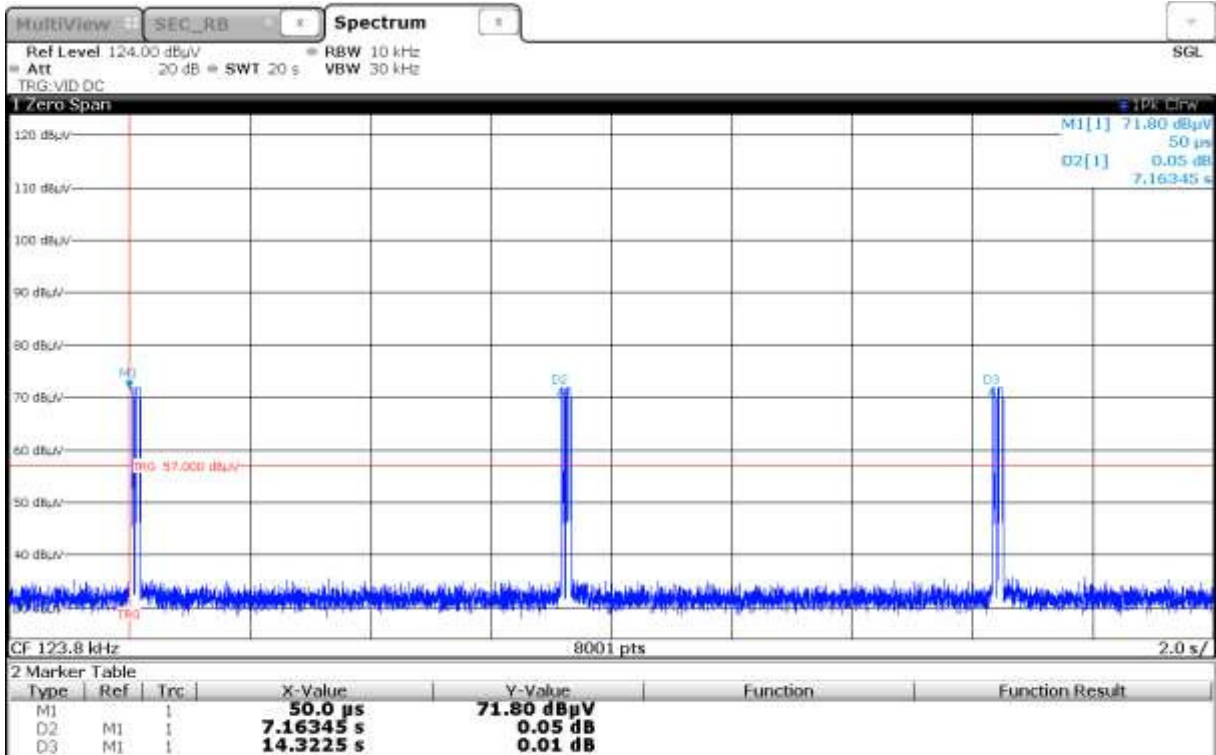
Date: 6 APR 2016 10:17:43



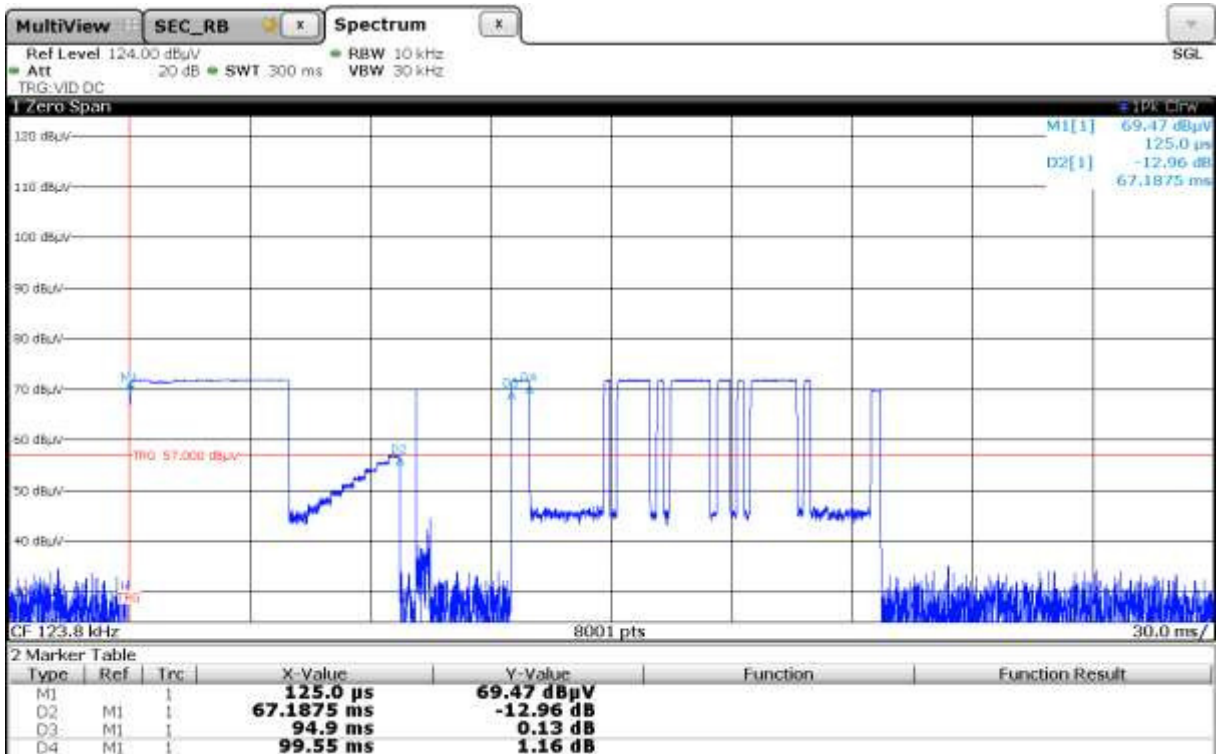
Date: 6 APR 2016 10:19:48

Correction for Pulse Operation (Duty Cycle)  
FCC Part 15A, Section 15.35(c)

Maintenance mode 123.8 kHz



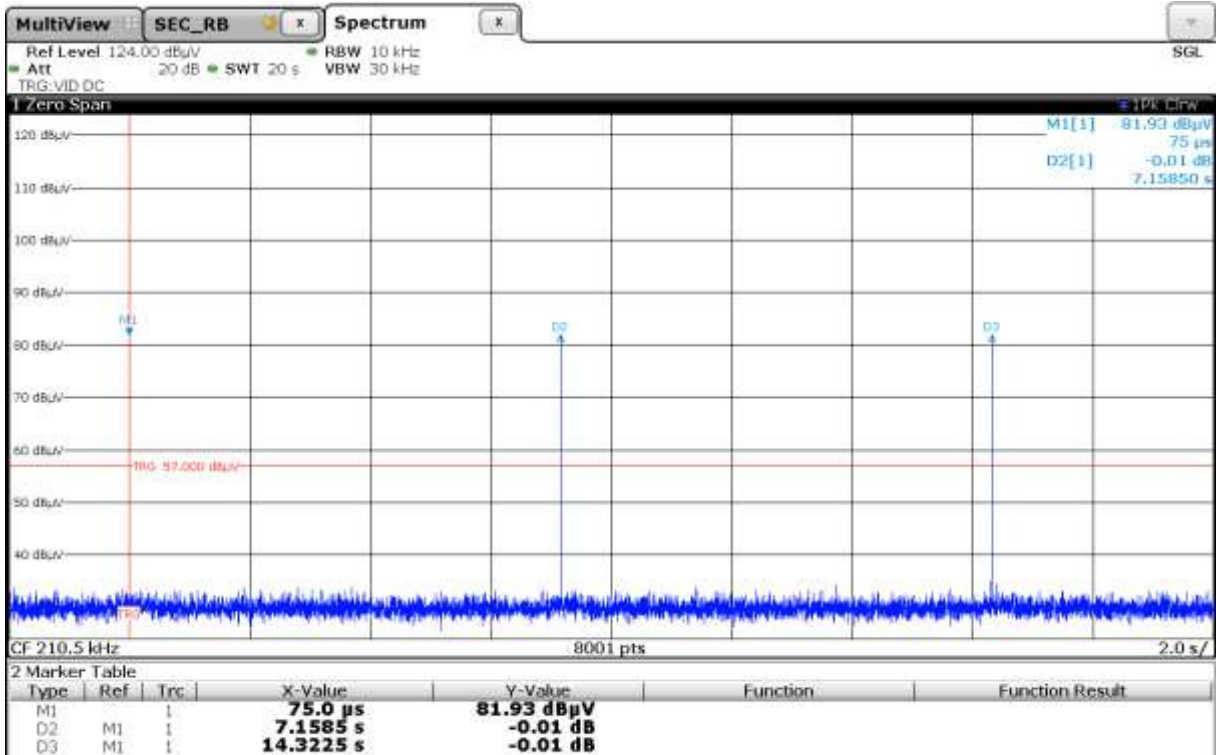
Date: 6 APR 2016 12:49:57



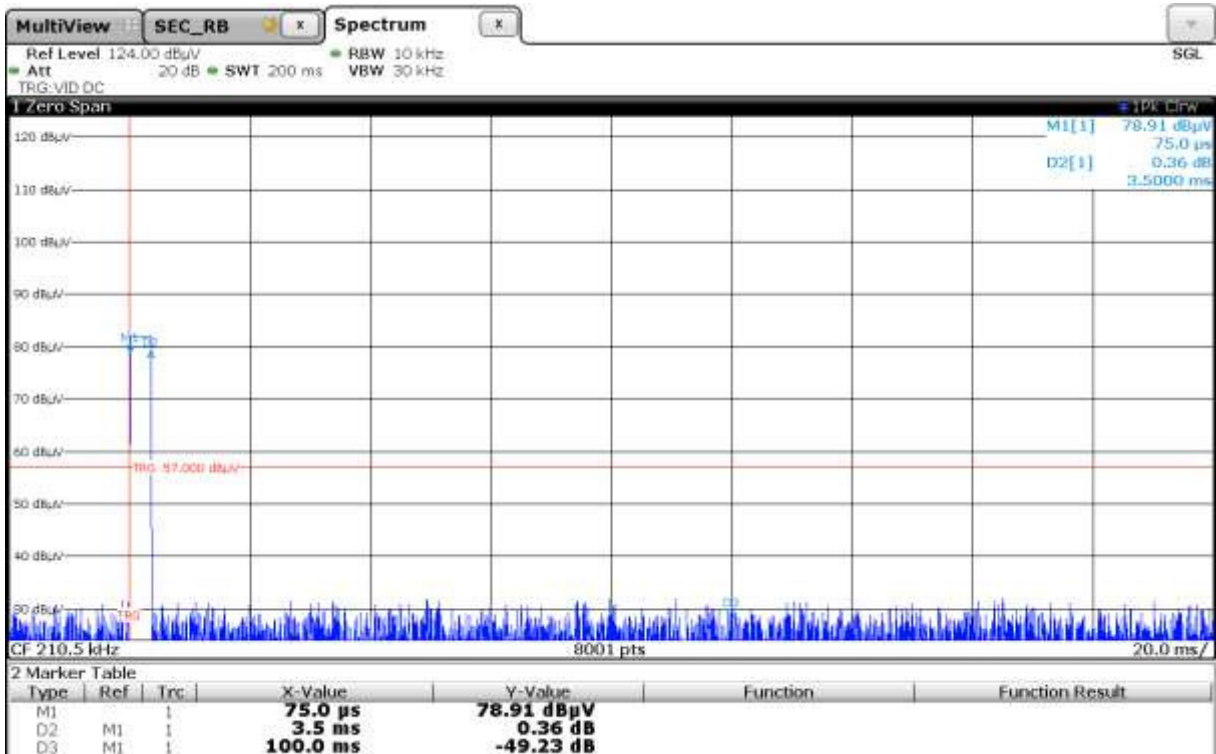
Date: 6 APR 2016 12:51:48

Correction for Pulse Operation (Duty Cycle)  
FCC Part 15A, Section 15.35(c)

Maintenance mode 210.5 kHz



Date: 6 APR 2016 13:00:43



Date: 6 APR 2016 12:59:21



## **6 USED TEST EQUIPMENT AND ACCESSORIES**

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

<b>Test ID</b>	<b>Model Type</b>	<b>Equipment No.</b>	<b>Next Calib.</b>	<b>Last Calib.</b>	<b>Next Verif.</b>	<b>Last Verif.</b>
CPR 1	FMZB 1516	01-02/24-01-018			19/01/2016	19/01/2015
	ESR 7	02-02/03-13-001	29/05/2016	29/05/2015		
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
DC	FSW43	02-02/11-15-001	05/08/2016	05/08/2015		
	HFRAE 5161 _ 50 kHz-120	02-02/24-11-004				
	EA-PS 3032-20B	02-02/50-11-013				
MB	FSW43	02-02/11-15-001	05/08/2016	05/08/2015		
	HFRAE 5161 _ 50 kHz-120	02-02/24-11-004				
	EA-PS 3032-20B	02-02/50-11-013				
SER 1	FMZB 1516	01-02/24-01-018			19/01/2016	19/01/2015
	ESR 7	02-02/03-13-001	29/05/2016	29/05/2015		
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 2	ESVS 30	02-02/03-05-006	26/06/2016	26/06/2015		
	VULB 9168	02-02/24-05-005	17/04/2016	17/04/2015	20/11/2015	20/05/2015
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				