EMI – TEST REPORT

- FCC Part 15.249, RSS 210 -

Type / Model Name	:	RR01
Product Description	:	Active Timing System
Applicant	:	race result AG
Address	:	Haid-und-Neu-Str. 7
		76131 Karlsruhe
		GERMANY
Manufacturer	:	race result AG
Address	:	Haid-und-Neu-Str. 7
		76131 Karlsruhe
		GERMANY

Test Result according to the standards listed in clause 1 test standards:	**POSITIVE**

Test Report No. : T39567-00-02JP	11. November 2015 Date of issue

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 (September, 2014)

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September, 2014)

Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.249	Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz, and 24.0 - 24.25 GHz
RSS-Gen Issue 4, Nov 2014	General Requirements and Information for the Certification of Radio Apparatus
RSS-210 Issue 8, Dec 2010	Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
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

2.2 Short description of the equipment under test (EUT)

The activce timing system is used for time measurements in sport events and consists out of the RR02 (base srarion) and the RR01 (transponder). The RR02s 125 kHz loop antenna is placed on the time measurement position. The RR01 is mounted on the participant of the event or its equipment. The 125 kHz signal triggers a 2.4GHz transmission between the RR02 and the RR01. This message contains the required information and is stored.
The functions of the RR01 are controlled by the 125 kHz signal of the RR02.

Number of tested samples: 1
Serial number: AETUN02 (modulated)
KCBKM95 (unmodulated)

2.3 Variants of the EUT

none

2.4 Operation frequency and channel plan

The operating frequency band is 2400 MHz to 2483.5 MHz.

Channel plan:

Channels	Frequency
0*	2480*
1*	2405*
2	2425
3	2475
4	2415
5	2460
6	2435
7*	2450*

* Frequencies tested.

2.5 EuT operation mode:

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

- 2.4GHz communication is active, 125kHz RFID reading is active

2.6 Antenna

Internal antenna, not accesable by the end user

2.7 Power supply system utilised

Power supply voltage tag : 3V DC (battery suplied)

2.8 Peripheral devices and interface cables

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

- none Model :

2.9 Determination of worst case conditions for final measurement

Measurement was made in all three orthogonal axes to locate the worst-case position. The results obtained in worst-case position are noted in this report.

3 TEST RESULT SUMMERY

FCC Rule Part	RSS Rule Part	Description	Result
15.207	RSS Gen, 8.8	AC power line conducted emissions	Not applicable[1]
15.209	RSS Gen, 8.9	General radiated emission limits	passed
15.215	-	Additional provisions (20dB BW)	passed
-	RSS-Gen, 6.6	Occupied bandwidth (99% BW)	passed
15.249	RSS-210, A2.9	Field strength of fundamental	passed

[1]EuT is battery supplied

This test report deals with the 2.4 GHz DTS function of the EuT.

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 : 08 April 2015

Testing concluded on : 26 October 2015

Checked by:

Klaus Gegenfurtner
I confirm the correctness and Integrity of this documents
2015.11.11 14:54:26 +01'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

Jürgen Pessinger
2015.11.11 14:45:51 +01'00'

Jürgen Pessinger

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 and IC

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.

The Open Area test site is listed under the Canadian Test-Sites File-No:

IC 3009A-1

In compliance with RSS 210 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.10 and applying the CISPR 22 limits.

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.

4.4.1.3 Details of test procedures

The test methods used comply with CISPR Publication 22, EN 55022 - " Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.4 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.10 and applying the CISPR 22 limits.

5 TEST CONDITIONS AND RESULTS

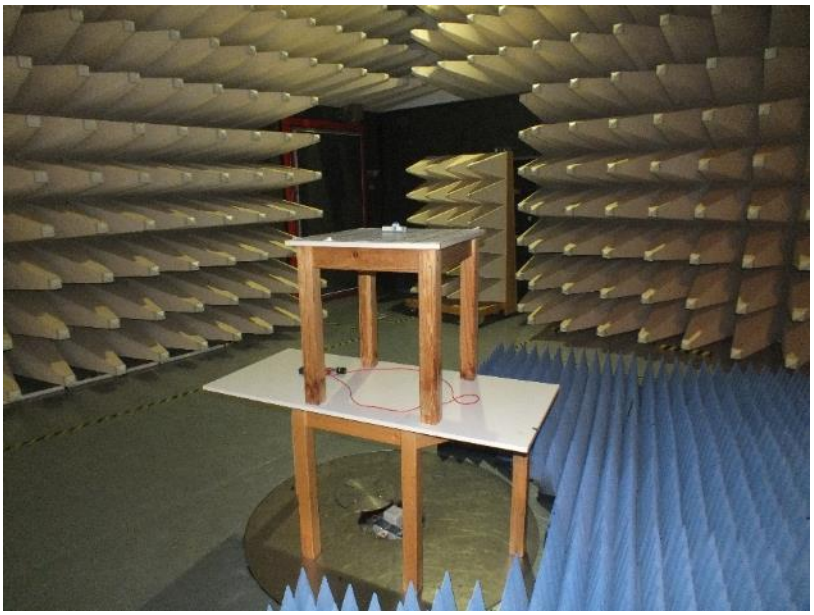
5.1 Field strength of fundamental

For test instruments and accessories used see section 6 Part **CPR 3**.

5.1.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 3 m

5.1.2 Photo documentation of the test set-up



5.1.1 Applicable standard

According to FCC Part 15C, Section 15.249 and RSS-210 A2.9:

5.1.2 Description of Measurement

The radiated emission of the fundamental wave from the EUT is measured using a spectrum analyser and appropriate linear polarized antennas. The set up of the EUT and the measurement procedure is in accordance to ANSI C63.10, Item 6.5. The EUT is measured in TX continuous mode unmodulated under normal conditions.

Analyser settings:
Peak measurement: RBW: 1 MHz VBW: 1 MHz Detector: Max peak

5.1.3 Test result

PK results

Channel	Frequency (MHz)	Reading level PK (dBµV)	Correction factor (dB)	Corrected level PK dB(µV/m)	Limit PK dB(µV/m)	Delta (dB)
0	2480	109.3	-14.3	94.9	114.0	-19.1
1	2405	107.5	-14.9	92.7	114.0	-21.3
7	2450	108.5	-14.7	93.8	114.0	-20.2

Note: The correction factor includes cable loss and antenna factor.

AV results

Channel	Frequency (MHz)	Level PK (dBµV)	Duty cycle correction (dB)	Level AV dB(µV/m)	Limit AV dB(µV/m)	Delta (dB)
0	2480	94.9	-29.3	65.6	94.0	-28.4
1	2405	92.7	-29.3	63.4	94.0	-30.6
7	2450	93.8	-29.3	64.5	94.0	-29.5

Note: The correction factor includes cable loss and antenna factor.

Average-Limit according to FCC Part 15C, Section 15.249 and RSS-210 A2.9:

Frequency	Field strength of fundamental	
(MHz)	(mV/m)	dB(µV/m)
902 - 928	50	94
2400 - 2483.5	**50**	**94**
5725-5875	50	94
24000 - 24250	250	108

The requirements are **FULFILLED.**

Remarks: Duty cycle correction factor is calculated under subclause 5.4 of this report.

5.2 Out-of-band emission, radiated

For test instruments and accessories used see section 6 Part **SER1, SER 2, SER 3**.

5.2.1 Description of the test location

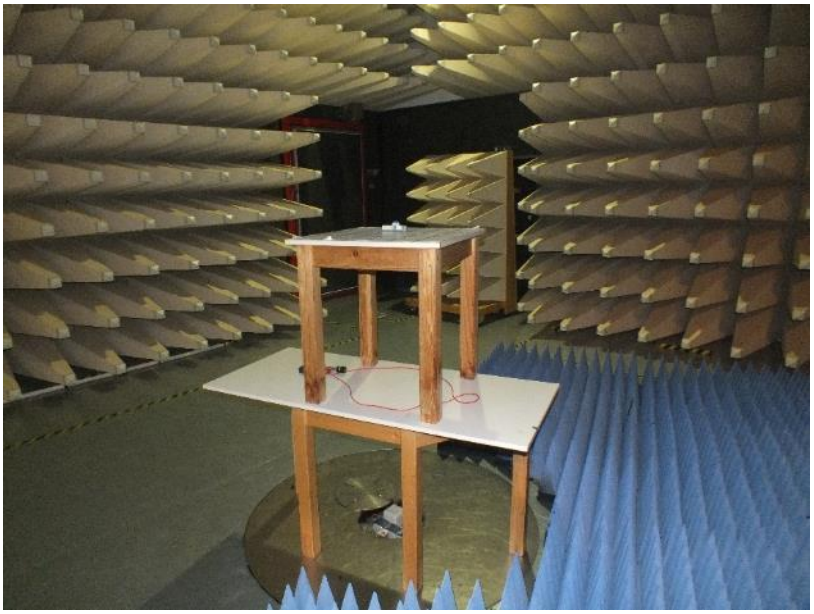
Test location: OATS 1
Test location: Anechoic chamber 1

Test distance: 3 m

5.2.2 Photo documentation of the test set-up

Test setup 30 MHz – 1000 MHz:

Test setup >1 GHz:



5.2.3 Applicable standard

According to FCC Part 15C, Section 15.209 and RSS-Gen 8.9:

5.2.4 Description of Measurement

The radiated emissions from the EUT are measured in the frequency range of 9 kHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. The setup of the EUT and the measurement procedure is in accordance to ANSI C63.10, Item 6.3. In the frequency range above 1 GHz a spectrum analyser is used with appropriate linear polarized antennas. If the emission level in peak mode complies with the average limit testing is stopped and peak values will be reported, otherwise, the emission is measured in average mode again and reported. The EUT is measured in TX continuous mode unmodulated under normal conditions.

Instrument settings:

9 kHz – 150 kHz	RBW:	200 Hz
150 kHz - 30 MHz	RBW:	9 kHz
30 MHz – 1000 MHz:	RBW:	120 kHz
1000 MHz – 25 GHz	RBW:	1 MHz

5.2.1 Test result f < 30 MHz

Note: In the frequency range 9 kHz to 30 MHz no emission could be detected. The frequencies mention the noise level. The measurement results from distance 3 m are extrapolated (D factor) to the specified distance.

Frequency (MHz)	Reading PK dB(µV)	D factor dB(µV/m)	Level PK dB(µV/m)	Limit AV dB(µV/m)	Delta (dB)
0.047	52.0	-80.0	-28.0	34.2	-62.2
1.5	51.0	-40.0	11.0	24.1	-13.1
18.2	39.0	-40.0	-1.0	29.5	-30.5

5.2.2 Test result f < 1 GHz

Channel 0

Frequency (MHz)	Reading level QP (dBµV)	Correction factor (dB/m)	Corrected level QP dB(µV/m)	Limit dB(µV/m)	Delta (dB)
127.26	11.5	13.6	25.1	43.5	-18.4
137.51	6.2	14.3	20.5	43.5	-23.0
211.36	16.5	12.3	28.8	43.5	-14.7
332.81	8.7	17.7	26.4	46.0	-19.6

Channel 1

Frequency (MHz)	Reading level QP (dBµV)	Correction factor (dB/m)	Corrected level QP dB(µV/m)	Limit dB(µV/m)	Delta (dB)
127.26	11.7	13.6	25.3	43.5	-18.2
137.51	6.0	14.3	20.3	43.5	-23.2
211.36	16.5	12.3	28.8	43.5	-14.7
332.81	8.9	17.7	26.6	46.0	-19.4

Channel 7

Frequency (MHz)	Reading level QP (dBµV)	Correction factor (dB/m)	Corrected level QP dB(µV/m)	Limit dB(µV/m)	Delta (dB)
127.26	11.0	13.6	24.6	43.5	-18.9
137.51	6.2	14.3	20.5	43.5	-23.0
211.36	16.4	12.3	28.7	43.5	-14.8
332.81	8.7	17.7	26.4	46.0	-19.6

Note: The correction factor includes cable loss and antenna factor.

5.2.3 Test result f > 1 GHz

Channel 0

PK results

Frequency (MHz)	Reading level PK (dBµV)	Correction factor (dB)	Corrected level PK dB(µV/m)	Limit PK dB(µV/m)	Delta (dB)
1438.00	58.7	-20.6	38.0	74.0	-36.0
4960.00	53.1	3.2	56.3	74.0	-17.7
7440.00	49.2	7.1	56.2	74.0	-17.8

Note: The correction factor includes cable loss and antenna factor.
Note: For frequencies were the PK value is below the average limit, no duty cycle correction was performed

AV results

Frequency (MHz)	Level PK (dBµV)	Duty cycle correction (dB)	Level AV dB(µV/m)	Limit AV dB(µV/m)	Delta (dB)
4960.00	56.3	-29.3	27.0	54.0	-27.0
7440.00	56.2	-29.3	26.9	54.0	-27.1

Note: The correction factor includes cable loss and antenna factor.
Note: For frequencies were the PK value is below the average limit, no duty cycle correction was performed

Channel 1

PK results

Frequency (MHz)	Reading level PK (dBµV)	Correction factor (dB)	Corrected level PK dB(µV/m)	Limit PK dB(µV/m)	Delta (dB)
1330.00	58.1	-19.8	38.3	74	-35.7
1848.00	59.8	-17.2	42.6	74	-31.4
4810.00	54.7	2.7	57.4	74	-16.6
7215.00	46.7	7.2	53.9	74	-20.1

Note: The correction factor includes cable loss and antenna factor.
Note: For frequencies were the PK value is below the average limit, no duty cycle correction was performed

AV results

Frequency (MHz)	Level PK (dBµV)	Duty cycle correction (dB)	Level AV dB(µV/m)	Limit AV dB(µV/m)	Delta (dB)
4810.00	57.4	-29.3	28.1	54	-25.9

Note: The correction factor includes cable loss and antenna factor.
Note: For frequencies were the PK value is below the average limit, no duty cycle correction was performed

Channel 7

PK results

Frequency (MHz)	Reading level PK (dBµV)	Correction factor (dB)	Corrected level PK dB(µV/m)	Limit PK dB(µV/m)	Delta (dB)
1327.60	57.3	-19.8	37.5	74	-36.5
1444.00	58.5	-20.7	37.8	74	-36.2
1864.00	57.7	-17.0	40.7	74	-33.3
4900.00	54.9	2.9	57.7	74	-16.3
7350.00	47.0	7.0	54.0	74	-20.0

Note: The correction factor includes cable loss and antenna factor.
Note: For frequencies were the PK value is below the average limit no duty cycle correction was performed

AV results

Frequency (MHz)	Level PK (dBµV)	Duty cycle correction (dB)	Level AV dB(µV/m)	Limit AV dB(µV/m)	Delta (dB)
4900.00	57.7	-29.3	28.4	54	-25.6
7350.00	54.0	-29.3	24.7	54	-29.3

Note: The correction factor includes cable loss and antenna factor.
Note: For frequencies were the PK value is below the average limit, no duty cycle correction was performed

Limit according to FCC Part 15C, Section 15.209 and RSS-Gen 8.9:

Frequency (MHz)	Limit (µV/m)	Measurement distance (m)
0.009 - -0.49	2400/f(kHz)	300
0.49 – 1.705	24000/f(kHz)	30
1.705 – 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

The requirements are **FULFILLED.**

Remarks: The measurement was performed up to the 10th harmonic (25000 MHz).

Duty cycle correction factor is calculated under subclause 5.4 of this report.

The limit according to FCC subpart 15.209 and RSS-Gen 8.9 are met.

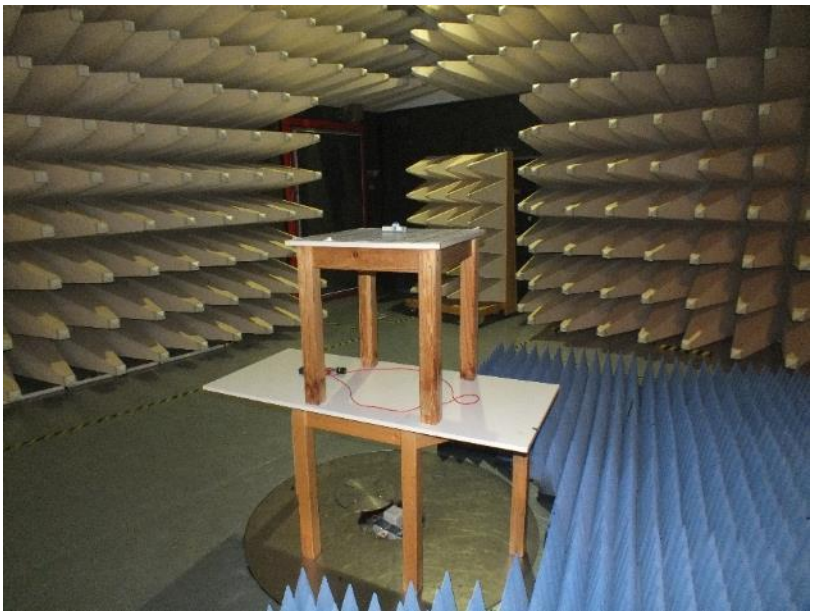
5.3 EBW

For test instruments and accessories used see section 6 Part **SER 3**.

5.3.1 Description of the test location

Test location: Anechoic chamber 1

5.3.2 Photo documentation of the test set-up



5.3.3 Applicable standard

According to FCC Part 15, Section 15.215 and RSS-Gen 6.6:

5.3.4 Description of Measurement

Spectrum analyser settings:
See attached plots

5.3.5 Test result

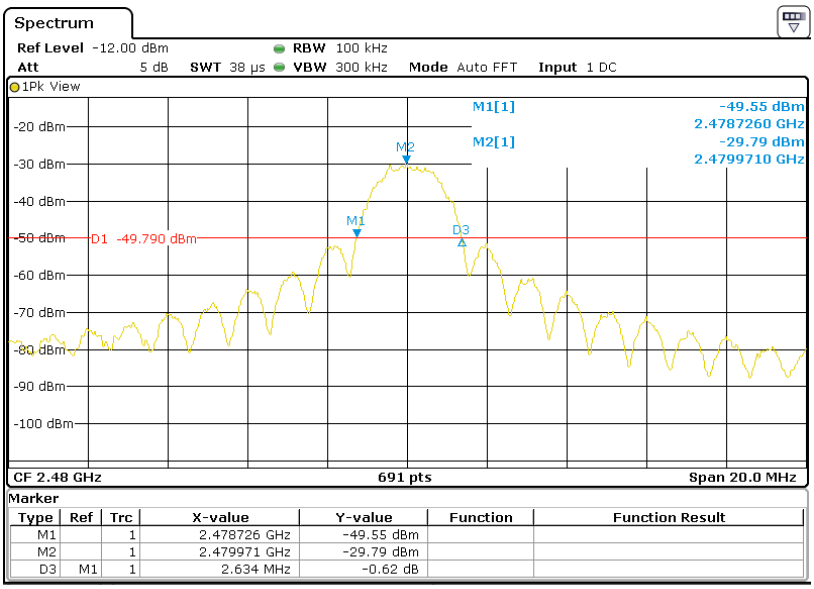
Channel	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)
0 (2480 MHz)	2.634	2.518
1 (2405 MHz)	2.634	2.373
7 (2450 MHz)	2.605	2.460

The requirements are **FULFILLED.**

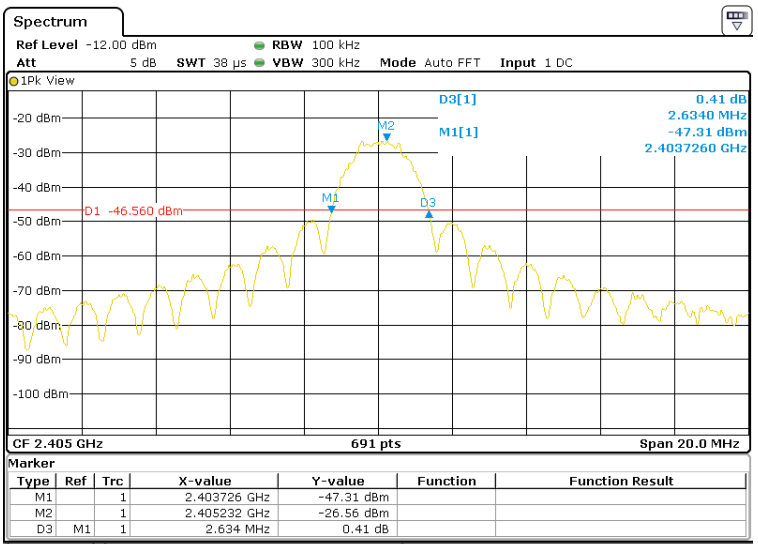
Remarks: none

5.3.6 Test protocols

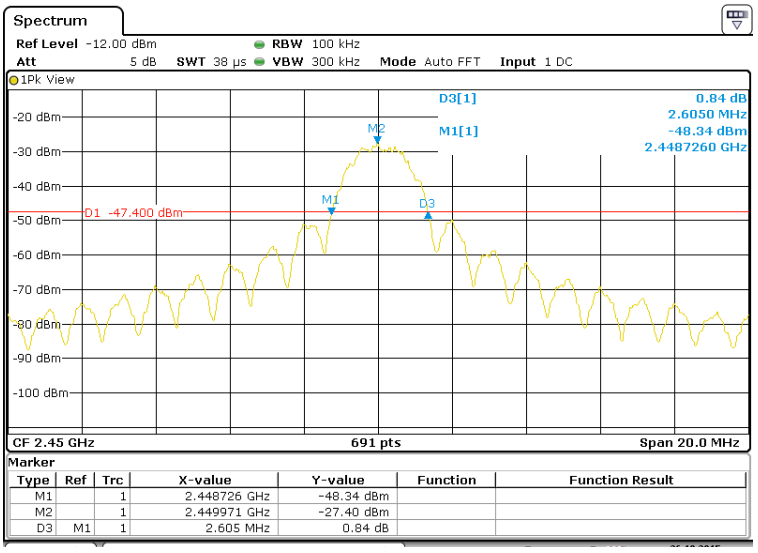
20dB Bandwidth, Channel 0



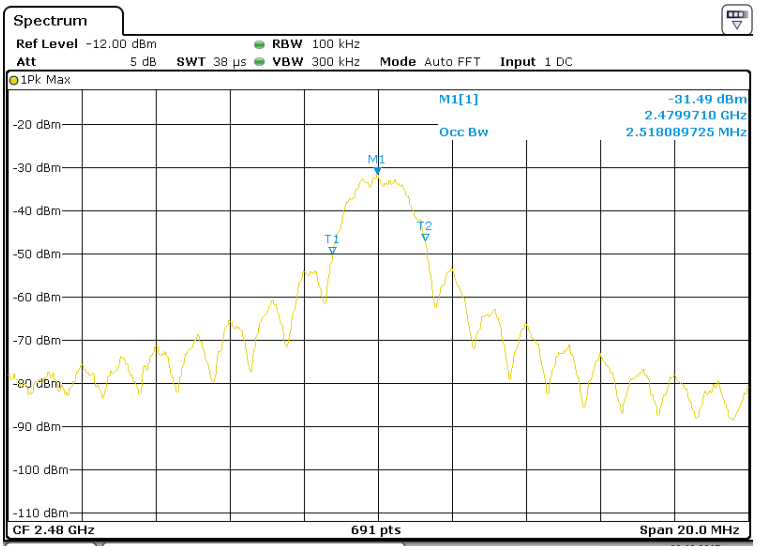
20dB Bandwidth, Channel 1



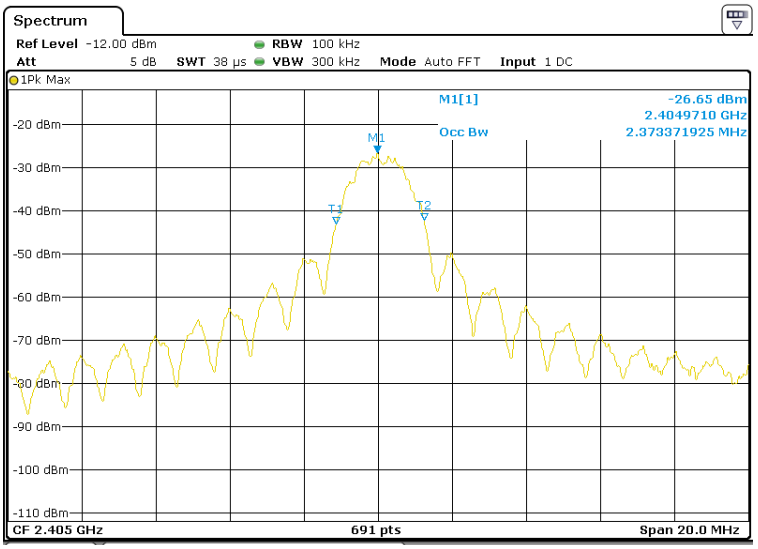
20dB Bandwidth, Channel 7



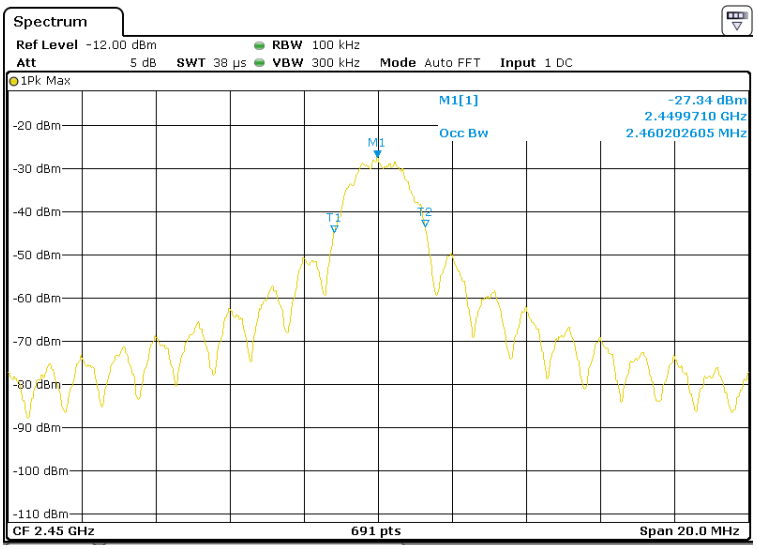
99% Bandwidth, Channel 0



99% Bandwidth, Channel 1



99% Bandwidth, Channel 7



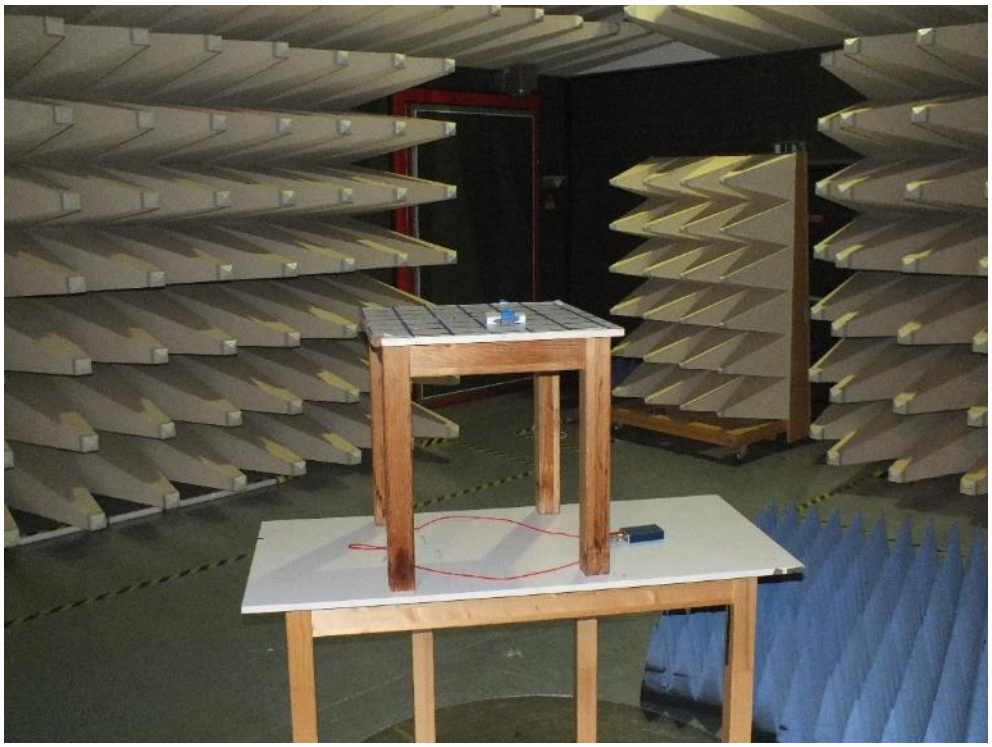
5.4 Correction for pulse operation (duty cycle)

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

5.4.1 Description of the test location

Test location: Anechoic chamber 1

5.4.2 Photo documentation of the test set-up



5.4.3 Applicable standard

According to FCC Part 15A, Section 15.35 and RSS-Gen 6.10:
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.

5.4.4 Description of Measurement

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

$$\delta(dB) = 20 \log ((t_1 + t_2 + \ldots + t_n) / T)$$

δ(dB) duty cycle correction factor expressed in dB
t_1 duration of pulse 1 in the defined time period T
t_n duration of pulse n in the defined time period T
T period of one complete puls train or 100ms if the complete puls train is longer 100ms

5.4.5 Test result

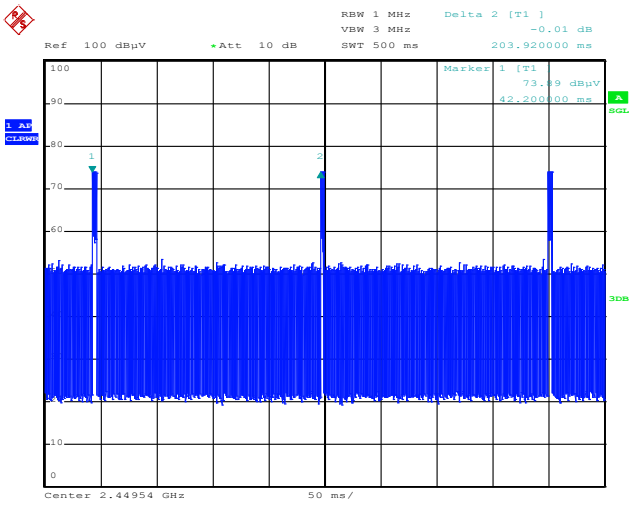
t_1 [ms]	t_2 [ms]	t_3 [ms]	t_4 [ms]	T [ms]
3.40	--	--	--	100

RESULT δ(dB) = -29.3

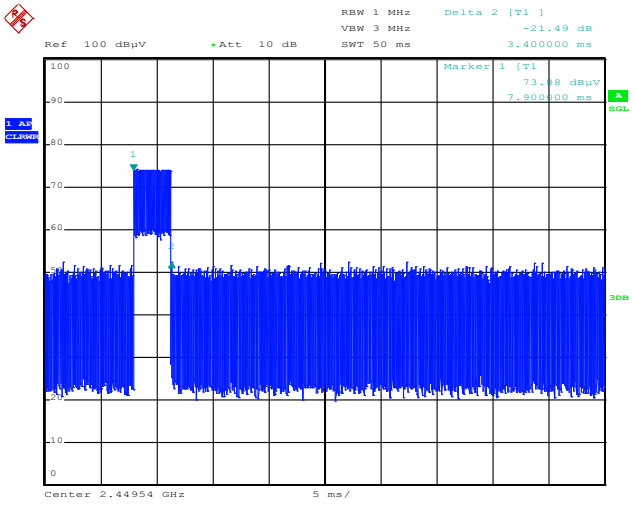
Remarks: Maximum possible duty cycle used for calculation.

5.4.6 Test protocol

Determination of T = 203.92ms (due to 100ms maximum 100ms are used)



Determination of t_1 = 3.40ms



6 USED TEST EQUIPMENT AND ACCESSORIES

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

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
CPR 3	FSP 40	02-02/11-11-001	02/10/2015	02/10/2014		
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	3117	02-02/24-05-009	12/05/2016	12/05/2015		
	Sucoflex N-2000-SMA	02-02/50-05-075				
	SF104/11N/11N/1500MM	02-02/50-13-015				
DC	FSP 40	02-02/11-11-001	02/10/2015	02/10/2014		
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	3117	02-02/24-05-009	12/05/2016	12/05/2015		
	Sucoflex N-2000-SMA	02-02/50-05-075				
	SF104/11N/11N/1500MM	02-02/50-13-015				
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		
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 2	ESVS 30	02-02/03-05-003	09/07/2016	09/07/2015		
	VULB 9168	02-02/24-05-005	17/04/2016	17/04/2015	29/02/2016	31/08/2015
	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 3	FSP 40	02-02/11-11-001	02/10/2015	02/10/2014		
	JS4-18004000-30-5A	02-02/17-05-017				
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	AMF-4F-04001200-15-10P	02-02/17-13-003				
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