EMI – TEST REPORT

- RSS 210 -

Type / Model Name : TSSRE3Ue

Product Description : TPMS sensors of G5.1 433

Applicant : Huf Hülsbeck & Fürst GmbH & Co. KG

Address : Steeger Str. 17

42551 Velbert, Germany

Manufacturer : Huf Electronics Bretten GmbH

Address : Gewerbestr. 40

75015 Bretten, Germany

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

Test Report No. :	**T44056-00-01HU**	26. July 2018 Date of issue

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12030-01-00

IC: 4008C-TSSRE3UE

Contents

1 TEST STANDARDS

The tests were performed according to following standards:

RSS-210 Issue 9, December 2016	Low Power Licence – Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment
RSS-Gen Issue 5, April 2018	General Requirements and Information for the Certification of Radiocommunication Equipment
RSS-102 Issue 5, March 2015	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
ANSI C63.10: 2013	Testing Unlicensed Wireless Devices
CISPR 16-4-2: 2013	Uncertainty in EMC measurement
CISPR 22: 2008 EN 55022: 2010	Information technology equipment

2 SUMMARY

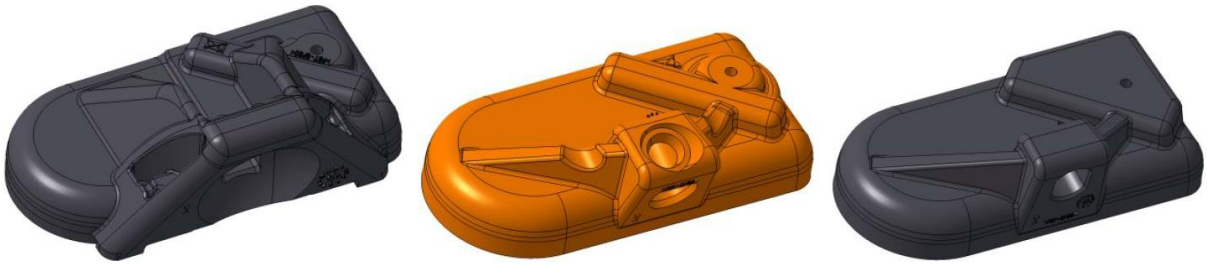
GENERAL REMARKS:

All radiated tests have been performed on samples which are in original state.

The EuT has an incorporated antenna and is powered by a primary battery.

All radiated measurements were made with the device positioned in three orientations.
Such as orientations X, Y and Z (Lying flat, lying on its end and lying on its side).
The values in the test report shows only the maximum measured value.

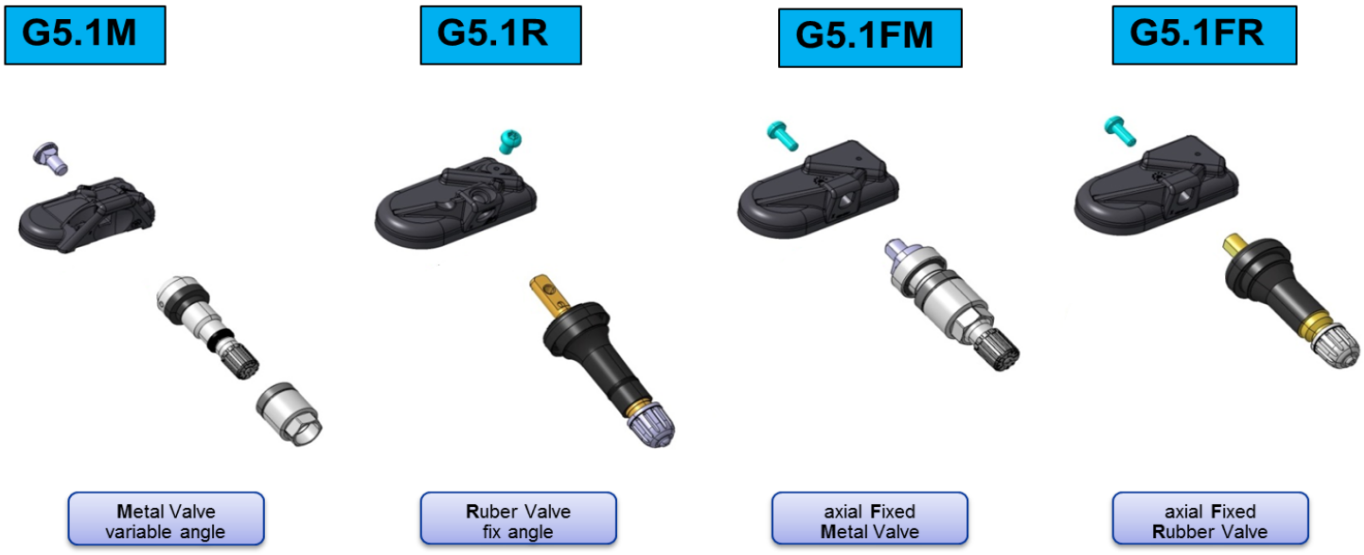
Declaration of the manufacturer:
The EuT, TSSRE3Ue, is a part of a tire monitoring system. The TPM electronic module and battery can be mounted in three different hosuings to provide the mounting option for four different types of valves.
=> The PCBA (Tx part) and the battery are always the same.



Housing G5.1M
Metal Valve

Housing G5.1R
Rubber Valve

Housing G5.1F
Metal or Rubber Valve



IC: 4008C-TSSRE3UE

This test report covers complete testing on version G5.1F of the TSSRE3Ue – family, which is as representative model defined by customer.
To active the different test modes from the wheel sensor the TPMS tool TransRaLF with test software GUI (TransRaLF.exe) was used. Both was supplied from the customer.

For testing the manufacturer declares following transmitting intervals:

The TPMS sensor includes already all possible application cases in its program memory and is configured once by a professional installer.
Upon manually activated LF request (through special configuration tool at a vehicle dealership), the EUT respond with a single RF transmission (sensor type information). In the second step the tool will send the configuration data on LF and the EUT will respond with a single confirmation transmission. Now the TPMS sensor is configured for the target vehicle application.
When the EUT is mounted in the vehicle tire in the worst case, periodically RF transmission where the duration of each transmission is always less than 1 second and the silent period is at least 30 times the duration of the transmission, and never less than 10 seconds.
In the case of an emergency condition (rapid pressure loss), the devise will transmit tire pressure and temperature information throughout the duration of the condition.

#	EUT test mode	repetition rate (sec)	number of frames	overall transmission time (sec)	max. frame length (msec)	min. frame period (msec)	frame encoding
1	CW lower	Single event exit after 4min or LF CMD					
2	CW upper	Single event exit after 4min or LF CMD					
3	ASK*	single	9	< 1	9.7	52.5	manchester encoded frames / ASK modulated / 9k6BPS / 8 bytes frame length
4	FSK*	15	4	< 1	9.7	100	manchester encoded frames / FSK modulated / 9k6BPS / 10 bytes frame length each FSK frame is 9.7msec in duration with no less than 100msec period
* Note: Device modes are bounded by these two worst case modulations. Devices are professional installed and configured by the vehicle dealership at the time of installation.							

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 : 11. June 2018

Testing concluded on : 21. June 2018

Checked by:

Klaus Gegenfurtner
I confirm the correctness and integrity of this document.
2018.07.26 13:25:16 +02'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

Markus Huber
I am the author of this document
2018.07.26 11:28:29 +02'00'

Markus Huber

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT – See attachment A

3.2 Power supply system utilised

Power supply voltage : 3.0 V / DC (Lithium battery)

3.3 Short description of the equipment under test (EUT)

The wheel unit sensor is a part of a TPMS system embedded on a vehicle.
The device takes places in the tire, fix on rim of a vehicles wheel.

Number of tested samples: 1
Variant: Housing G5.1F – JD 9
Serial number: Prototype

EUT operation mode:

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

- Unmodulated Tx mode at 315 MHz (Lower & Upper mode)

- Modulated Tx mode at 315 MHz (ASK & FSK mode)

- Standby

EUT configuration:

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

-	LapTop (supplied from CSA)	Model :	Toshiba
-	Software (supplied from manufacturer)	Model :	GUI (TransRALF.exe)
-	TPMS tool (supplied from manufacturer)	Model :	TransRaLF
-		Model :	
-		Model :	
-		Model :	

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY

4.2 Statement regarding the usage of logos in test reports

The accreditation and notification body logos displayed in this test report are only valid for standards listed in the accreditation or notification scope of CSA Group Bayern GmbH.

4.3 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

4.4 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.

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	± 3.29 dB
20 dB Bandwidth	Center frequency of EuT	95%	± 2.5 x 10^{-7}
99% Occupied Bandwidth	Center frequency of EuT	95%	± 2.5 x 10^{-7}
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	± 3.53 dB
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	± 3.71 dB
Radiated Spurious Emissions	1000 MHz to 10000 MHz	95%	± 2.34 dB
Radiated power of the fundamental wave	Center frequency of EuT	95%	± 3.71 dB
Peak conducted output power	902 MHz to 928 MHz	95%	± 0.35 dB
Conducted Spurious Emissions	9 kHz to 10000 MHz	95%	± 2.15 dB

4.5 Measurement protocol

4.5.1 GENERAL INFORMATION

4.5.1.1 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.

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

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

IC 3009A-1

The Anechoic chamber is a listed test site under the Canadian Test-Sites File-No:

IC 3009A-2

In compliance with RSS 210 Issue 9 testing for RSS compliance may be achieved by following the procedures set out in ANSI.

4.5.2 DETAILS OF TEST PROCEDURES

4.5.2.1 Conducted disturbance

Conducted disturbance on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi peak detection, and a Line Impedance Stabilization Network (LISN), with 50Ω/50 µH (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 cm above the floor and is positioned 40 cm from the vertical ground plane (wall) of the screen room. If the minimum passing margin appears to be less than 20 dB with a peak mode measurement, the emissions are remeasured using a tuned receiver with quasi peak and average detection and recorded on the data sheets.

4.5.2.2 Radiated disturbance

Radiated disturbance from the EUT are measured in the frequency range of 30 to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi peak detection and measurements above 1000 MHz are made with a 1 MHz/6 dB bandwidth and average detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 cm above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Interface cables that are closer than 40 cm to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 cm from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna was positioned 3, 10 or 30 m horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 m, measurement scans are made with both horizontal and vertical antenna polarizations and the EUT are rotated 360 degrees.

4.5.2.3 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.

4.6 Deviations or Exclusions from the Requirements and Standards

This test report covers complete testing on version G5.1F of the TSSRE3Ue – family, which is as representative model defined by customer.
To active the different test modes from the wheel sensor the TPMS tool TransRaLF with test software GUI (TransRaLF.exe) was used. Both was supplied from the customer.

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

5.1.2 Photo documentation of the test set-up

5.1.3 Applicable standard

According to RSS-Gen, Section 7.2.2:
The purpose of this test is to measure unwanted radio frequency currents induced in any AC conductor external to the equipment which could conduct interference to other equipment via the AC electrical network. Except when the requirements applicable to a given device state otherwise, for any licence-exempt radiocommunication 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 150 kHz to 30 MHz shall not exceed the defined limits. The tighter limit applies at the frequency range boundaries.

5.1.4 Description of Measurement

The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a line impedance stabilization network (LISN) with 50Ω/50 µH (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 cm above the floor and is positioned 40 cm from the vertical ground plane (wall) of the screen room. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are remeasured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

5.1.5 Test result

Frequency range:

Min. limit margin

Limit according to RSS-Gen, Section 7.2.2 Table 2:

Frequency of Emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56 *	56 to 46 *
0.5 - 5	56	46
5 - 30	60	50

* Decreases with the logarithm of the frequency

The requirements are**.**

Remarks: The measurement is not applicable.

The EuT has no AC mains connections. The EuT is separated powered by a 3.0 V battery.

5.2 Field strength of the fundamental

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

5.2.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

5.2.2 Photo documentation of the test set-up

5.2.1 Applicable standard

According to RSS 210, A1.1.2:
The field strength of emissions from intentional radiators shall not exceed the effective field strength limits.

5.2.2 Description of Measurement

The radiated field strength of the fundamental wave from the EUT is measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver with 120 kHz/6 dB bandwidth, quasi-peak detection and appropriate broadband linear polarized antenna as described under item 4.4. The set up of the EUT will be in accordance to ANSI C63.10.
The resolution bandwidth during the measurement is as follows:
30 MHz – 1000 MHz: RBW: 120 kHz

The resolution bandwidth during the measurement is as follows:
30 MHz – 1000 MHz: RBW: 120 kHz

Example:

Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level dB(µV/m)	-	Limit dB(µV/m)	=	Delta (dB)
170.5	5	+	20	=	25	-	30	=	-5

5.2.3 Test result

Lower Mode:

Frequency (MHz)	Level Pk (dBµV)	Level QP (dBµV)	Bandwidth (kHz)	Correct. factor (dB)	Duty Cycle Correct. factor (dB)	Level Pk dB(µV/m)	Calculated Level Av dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
315.0	55.9	55.1	120	15.9	-16.48	71.8	55.32	67.66	-12.34

Upper Mode:

Frequency (MHz)	Level Pk (dBµV)	Level QP (dBµV)	Bandwidth (kHz)	Correct. factor (dB)	Duty Cycle Correct. factor (dB)	Level Pk dB(µV/m)	Calculated Level Av dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
315.0	56.3	56.0	120	15.9	-16.48	72.2	55.72	67.66	-11.94

For calculating the AV Level the Duty Cycle Correction Factor from the ASK mode was used, because this correction factor is stronger as the ASK mode.

Limit for momentarily operated devices according to RSS 210, Table A2:

Frequency (MHz)	Field strength of fundamental @ 3m		Effective limit for 315 MHz	
	(µV/m)	dB(µV/m)	(µV/m)	dB(µV/m)
70 - 130	500	54		
130 - 174	500 to 1500*	54 to 63.5		
174 - 260	1500	63.5		
260 - 470	**1500 to 5000***	**63.5 to 74***	**2416.67**	**67.66**
Above 470	5000	74		

*Linear interpolation

The requirements are **FULFILLED.**

Remarks: The level of Field Strength are identically in all Tx operation modes.

The test was performed in “CW Mode” of the EuT.

5.3 Spurious emissions (magnetic field) 9 kHz – 30 MHz

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

5.3.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

5.3.2 Photo documentation of the test set-up

5.3.3 Applicable standard

Limit according to RSS 210:
The emissions from intentional radiators shall not exceed the effective field strength limits outside of this band.

5.3.4 Description of Measurement

The spurious emissions 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 antenna was positioned 30 metres horizontally from the EUT. Measurements have been made in all three orthogonal axes and the shielded loop antenna was rotated to locate the maximum of the emissions. 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 RSS 210, Table 3.

The resolution bandwidth during the measurement is as follows:
9 kHz – 150 kHz: RBW: 200 Hz
150 kHz – 30 MHz: RBW: 9 kHz

Example:

Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level dB(µV/m)	-	Limit dB(µV/m)	=	Delta (dB)
1.705	5	+	20	=	25	-	30	=	-5

5.3.5 Test result

Measurement distance: 3 m

Frequency [kHz]	L: QP [dBµV]	L: AV [dBµV]	Bandwidth [kHz]	Correct. [dB]	L: QP [dBµV/m]	L: AV [dBµV/m]	Limit [dBµV/m]	Delta [dB]
536.8	24.1	19.7	9.0	20	44.1	39.7	73.0	-33.3
1073.6	23.4	18.0	9.0	20	43.4	38.0	67.0	-29.0
1342.0	21.6	15.9	9.0	20	41.6	35.9	65.0	-29.1

⇨ No unwanted emissions from the EuT could be measured in the relevant frequency ranges.
⇨ Only ambient noises could be detected.

Limit according to RSS-Gen, Table 6:

Frequency (MHz)	Magnetic field strength (H-Field) (µA/m)	Limit (µV/m)	Limit dB(µV/m)	Measurement distance (metres)
9 - 490 kHz[Note 1]	6.37/F (F in kHz)	2400/F (kHz)	--	300
0.490 – 1.705	63.7/F (F in kHz)	24000/F (kHz)	--	30
1.705 – 30.0	0.08	30	29.5	30

Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

The requirements are **FULFILLED.**

Remarks: All unwanted emissions in the frequency range from 9 kHz to 30 MHz are below 10 dBµV/m at a test distance of 3 metres.

The level of Field Strength are identically in all Tx operation modes.

The test was performed in “CW Mode” of the EuT.

5.4 Field strength of Unwanted Emissions

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

5.4.1 Description of the test location

Test location: OATS 1
Test location: Anechoic Chamber A2

Test distance: 3 metres

5.4.2 Photo documentation of the test set-up

5.4.3 Description of Measurement

Radiated spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linear polarized antennas. The measurements are made with 120 kHz bandwidth and quasi-peak detection. The EUT is placed on a 1.0 X 1.5 m non-conducting table 80 cm above the ground plane. The set up of the equipment under test will be in accordance to ANSI C63.10. To locate maximum emissions from the EUT the antenna is shifted in height from 1 to 4 m, after the EUT is turned vertically 360 degrees. The measurement scan is made in horizontal and vertical polarization of the antenna. For the radiated measurement up from 1 GHz to maximum frequency as specified in RSS-Gen Issue 3, section 4.9, a spectrum analyzer and appropriate linear polarized antennas are used. The EUT is placed on a 1.0 X 1.5 m non-conducting table 80 cm above the ground plane. The set up of the EUT will be in accordance to ANSI C63.10. To locate maximum emissions the EUT was rotated 360 degrees in the fully anechoic chamber. The measurement scan is made in horizontal and vertical polarization of the antenna. For testing above 1 GHz, if the emission level of the EUT in peak mode complies with the average limit is 20 dB lower, then testing will be stopped and peak values of the EUT will be reported, otherwise, the emission will be measured in average mode again and reported.

The resolution bandwidth during the measurement is as follows:
30 MHz – 1000 MHz: RBW: 120 kHz
1000 MHz – 18000 MHz RBW: 1 MHz

5.4.4 Test result

f < 1 GHz

Lower Mode

Frequency (MHz)	Level Pk (dBµV)	Level QP (dBµV)	Bandwidth (kHz)	Correct. factor (dB)	Duty Cycle Correct. factor (dB)	Level Pk dB(µV/m)	Calculated Level Av dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
630.0	5.3	5.1	120	24.4	-16.48	29.7	13.22	47.7	-34.48

Lower Mode

Frequency (MHz)	Level Pk (dBµV)	Level QP (dBµV)	Bandwidth (kHz)	Correct. factor (dB)	Duty Cycle Correct. factor (dB)	Level Pk dB(µV/m)	Calculated Level Av dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
630.0	6.0	5.8	120	24.4	-16.48	30.4	13.92	47.7	-33.78

f > 1 GHz

Lower mode:

Frequency (MHz)	L: PK (dBµV)	L: AV (dBµV)	Bandwidth (kHz)	Correct. (dB)	Duty Cycle Correct. factor (dB)	PK level dB(µV/m)	Calculated AV level dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
1260.0	54.2	--	1000	-18.0	-16.48	36.2	19.72	54.0	-34.28
1575.0	62.7	--	1000	-19.8	-16.48	42.9	26.42	54.0	-27.58
1890.0	57.5	--	1000	-15.0	-16.48	42.5	26.02	54.0	-27.98
2205.0	73.8	--	1000	-14.9	-16.48	58.9	42.42	54.0	-11.58
2520.0	71.7	--	1000	-12.8	-16.48	58.9	42.42	54.0	-11.58
2835.0	69.9	--	1000	-12.5	-16.48	57.4	40.92	54.0	-13.08
3150.0	68.0	--	1000	-11.7	-16.48	56.3	39.82	54.0	-14.18

Upper mode:

Frequency (MHz)	L: PK (dBµV)	L: AV (dBµV)	Bandwidth (kHz)	Correct. (dB)	Duty Cycle Correct. factor (dB)	PK level dB(µV/m)	Calculated AV level dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
1260.0	52.3	--	1000	-18.0	-16.48	34.3	17.82	54.0	-36.18
1575.0	61.4	--	1000	-19.8	-16.48	41.6	25.12	54.0	-28.88
1890.0	58.9	--	1000	-15.0	-16.48	43.9	27.42	54.0	-26.58
2205.0	74.1	--	1000	-14.9	-16.48	59.2	42.72	54.0	-11.28
2520.0	71.4	--	1000	-12.8	-16.48	58.6	42.12	54.0	-11.88
2835.0	69.6	--	1000	-12.5	-16.48	57.1	40.62	54.0	-13.38
3150.0	67.9	--	1000	-11.7	-16.48	56.2	39.72	54.0	-14.28

For calculating the AV Level the Duty Cycle Correction Factor from the ASK mode was used, because this correction factor is stronger as the ASK mode.

Limit according to RSS-210:

Frequency	Field strength of spurious emissions @ 3m		Effective limit for 315 MHz	
(MHz)	(µV/m)	dB(µV/m)	(µV/m)	dB(µV/m)
70 - 130	50	34		
130 - 174	50 to 150*	34 to 43.5*		
174 - 260	150	43.5		
260 - 470	**150 to 500***	**51.4 to 54**	**241.67**	**47.66**
Above 470	500	54		

*Linear interpolation.

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 RSS Gen, whichever limit permits a higher field strength.

Table 5

Frequency (MHz)	Limit (µV/m)	Limit dB(µV/m)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

Besides is a limit on the radio frequency emissions, as measured with a peak detector, corresponding to 20 dB above the maximum permitted average limits in pulsed operation according RSS-Gen.

Restricted bands of operation:

Table 7

MHz	MHz	MHz	GHz
0.090 – 0.110	12.51975 – 12.52025	399.9 – 410	5.350 – 5.460
2.1735 – 2.1905	12.57675 – 12.57725	608 – 614	7.250 – 7.750
3.020 – 3.026	13.36 – 13.41	960 – 1427	8.025 – 8.500
4.125 – 4.128	16.42 – 16.423	1435 – 1626.5	9.0 – 9.2
4.17725 – 4.17775	16.69475 – 16.69525	1645.5 – 1646.5	9.3 – 9.5
4.20725 – 4.20775	16.80425 – 16.80475	1660 – 1710	10.6 – 12.7
5.677 – 5.683	25.5 – 25.67	1718.8 – 1722.2	13.25 – 13.4
6.215 – 6.218	37.5 – 38.25	2200 – 2300	14.47 – 14.5
6.26775 – 6.26825	73 – 74.6	2310 – 2390	15.35 – 16.2
6.31175 – 6.31225	74.8 – 75.2	2655 – 2900	17.7 – 21.4
8.291 – 8.294	108 – 138	3260 – 3267	22.01 – 23.12
8.362 – 8.366	156.52475 – 156.52525	3332 – 3339	23.6 – 24.0
8.37625 – 8.38675	156.7 – 156.9	3345.8 – 3358	31.2 – 31.8
8.41425 – 8.41475	240 – 285	3500 – 4400	36.43 – 36.5
12.29 – 12.293	322 – 335.4	4500 – 5150	Above 38.6

The requirements are **FULFILLED.**

Remarks: The level of Field Strength are identically in all Tx operation modes.

The test was performed in “Lower Mode” of the EuT.

The test was performed in “Upper Mode” of the EuT.

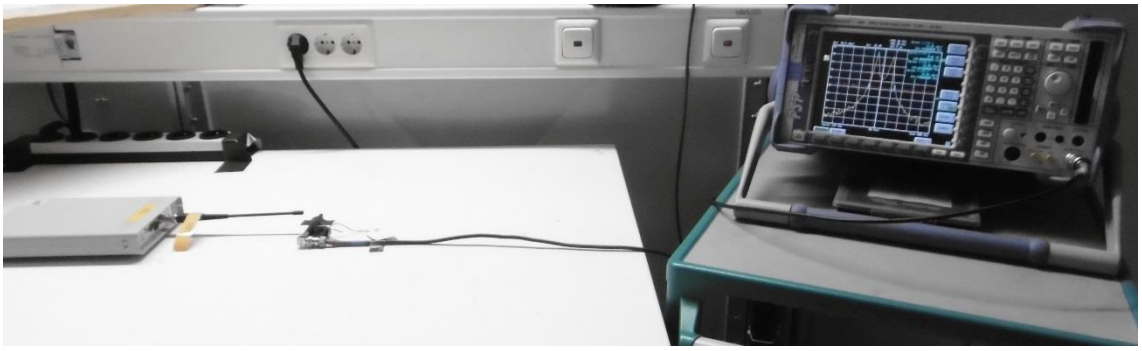
5.5 Pulsed operation

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

5.5.1 Description of the test location

Test location: Shielded room S4

5.5.2 Photo documentation of the test set-up



5.5.3 Applicable standard

According to RSS-Gen:
When the field strength (or envelope power) is not constant or when it is in pulses, and average detector is specified to be used, the value of field strength or power shall be determined by averaging over one complete pulse train, including blanking intervals within the pulse train, as long as the puls train not exceed 0.1 s. In case where the pulse train exceeds 0.1 s, the average value shall be determined during 0.1 s interval during which the field strength is at its max value.

5.5.4 Test result

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

$$K_E = 20 \log ((t_{iB})/100)$$

K_E:	pulse operation correction factor	(dB)
t_{iB}	pulse duration for one pulse	(ms)

ASK: Maximum transmitting duration in every 100ms period:
$K_E = 20 \log ((15.0)/100) = -16.48$ dB

FSK: Maximum transmitting duration in every 100ms period:
$K_E = 20 \log ((10.0)/100) = -20.00$ dB

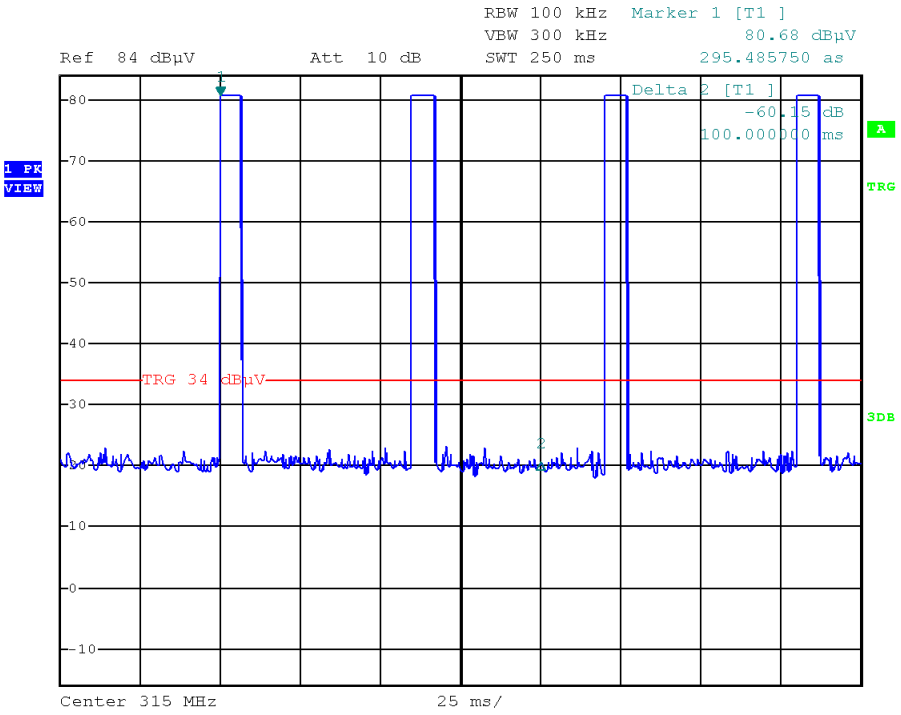
Remarks: The pulse train (*Tw*) exceeds 100 ms, therefore the duty cycle have been calculated by averaging the sum of the pulse widths over the 100 ms width with the highest average value.

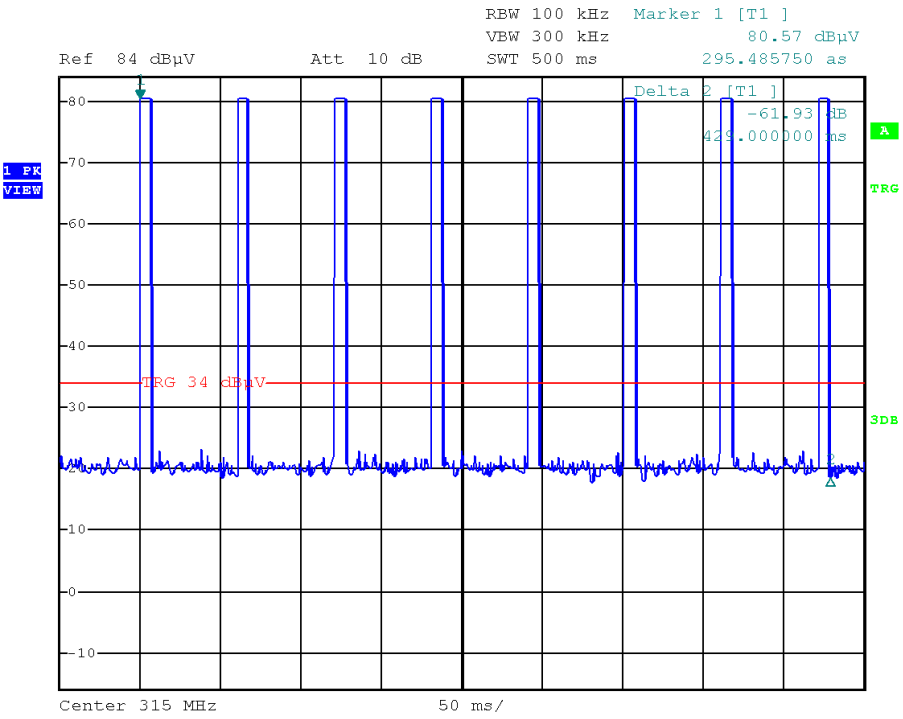
For detailed results, please see the test protocol below.

5.5.5 Test protocol

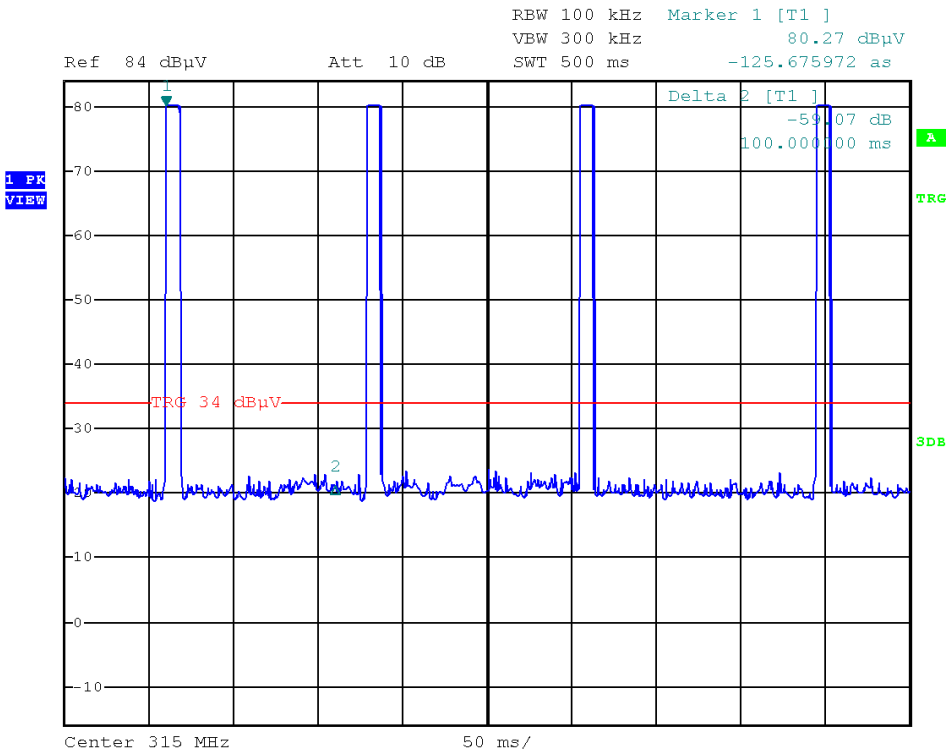
Correction for pulse operation (duty cycle)
RSS-GEN, section 8.2
Pulse duration for one pulse (Identically in all Tx operation modes)
Pulse duration for one pulse

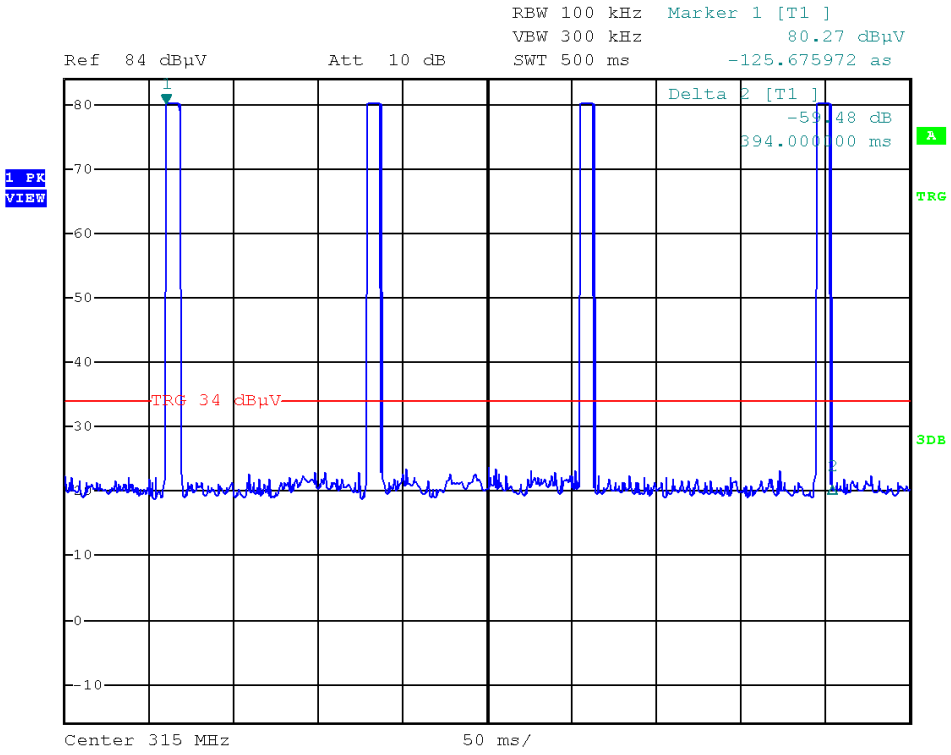
Worst Tx on time – ASK mode: 2 times a 7.5 ms within 100ms





Worst Tx on time – FSK mode: 10.0 ms within 100ms





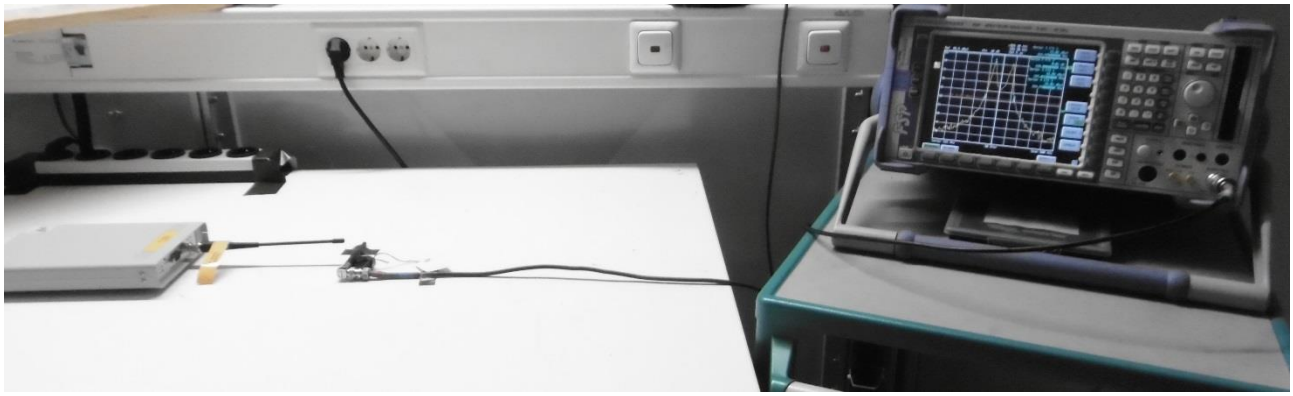
5.6 Bandwidth of momentary signals

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

5.6.1 Description of the test location

Test location: Shielded room S4

5.6.2 Photo documentation of the test set-up



5.6.3 Test result

G3.8 - ASK mode:

Fundamental frequency (MHz)	99% bandwidth *f1* (MHz)	99% bandwidth *f2* (MHz)	Measured bandwidth (MHz)	Limit (MHz)
315.0	314.9530	315.0580	0.105	0.7875

G3.8 - FSK mode:

Fundamental frequency (MHz)	99% bandwidth *f1* (MHz)	99% bandwidth *f2* (MHz)	Measured bandwidth (MHz)	Limit (MHz)
315.0	314.9430	315.0670	0.124	0.7875

Limit according to RSS 210, Annex 1, section A1.3:

The 99% bandwidth shall be no wider than 0.25% of the center frequency for devices operating between 70 MHz - 900 MHz.

The requirements are **FULFILLED.**

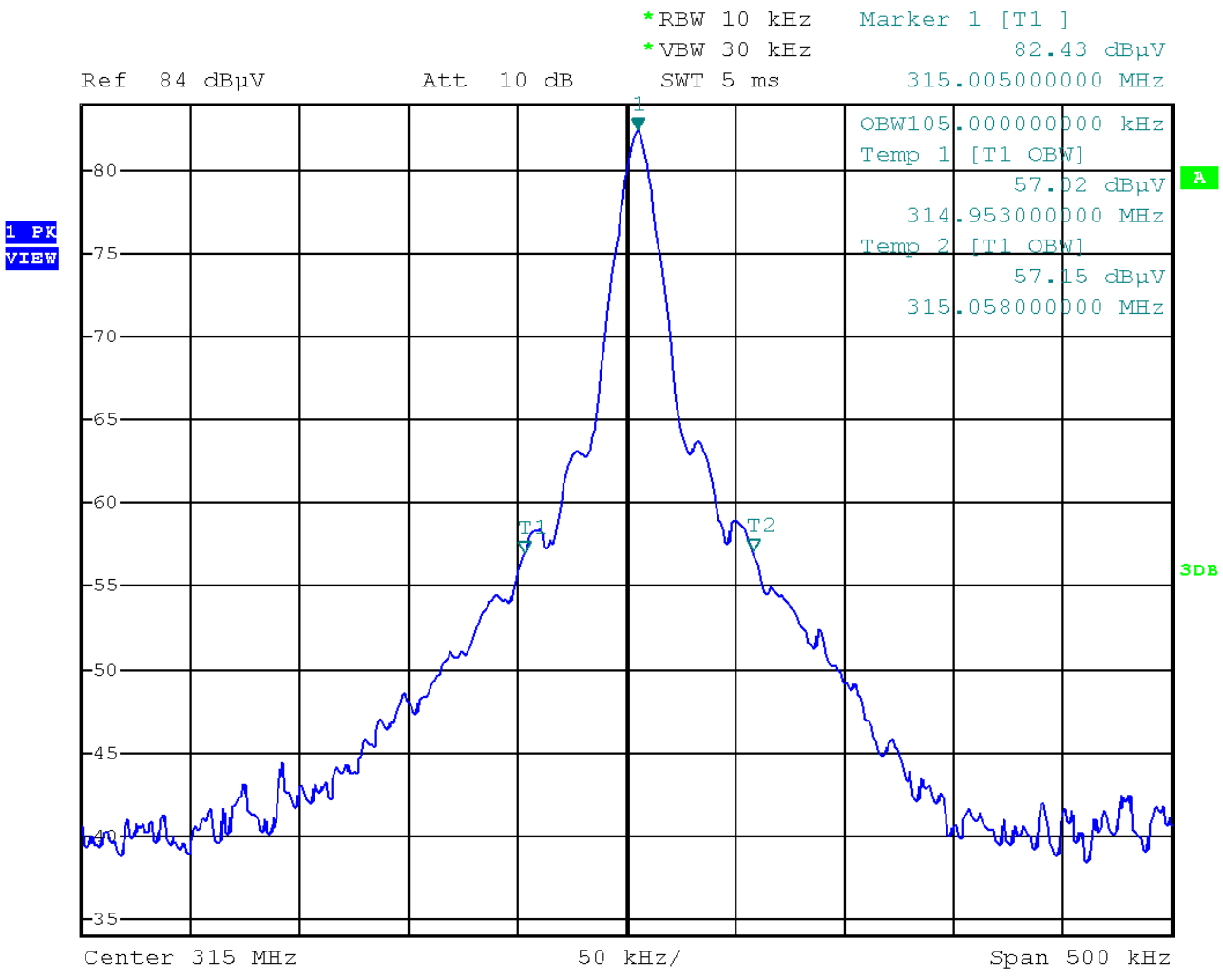
Remarks: For detailed results, please see the test protocol below.

The Rhode & Schwarz analyzer which we used for this measurement calculates automatically the 99 % emission bandwidth.

5.6.4 Test protocol

Emission bandwidth
RSS 210 Annex 1, section A1.3

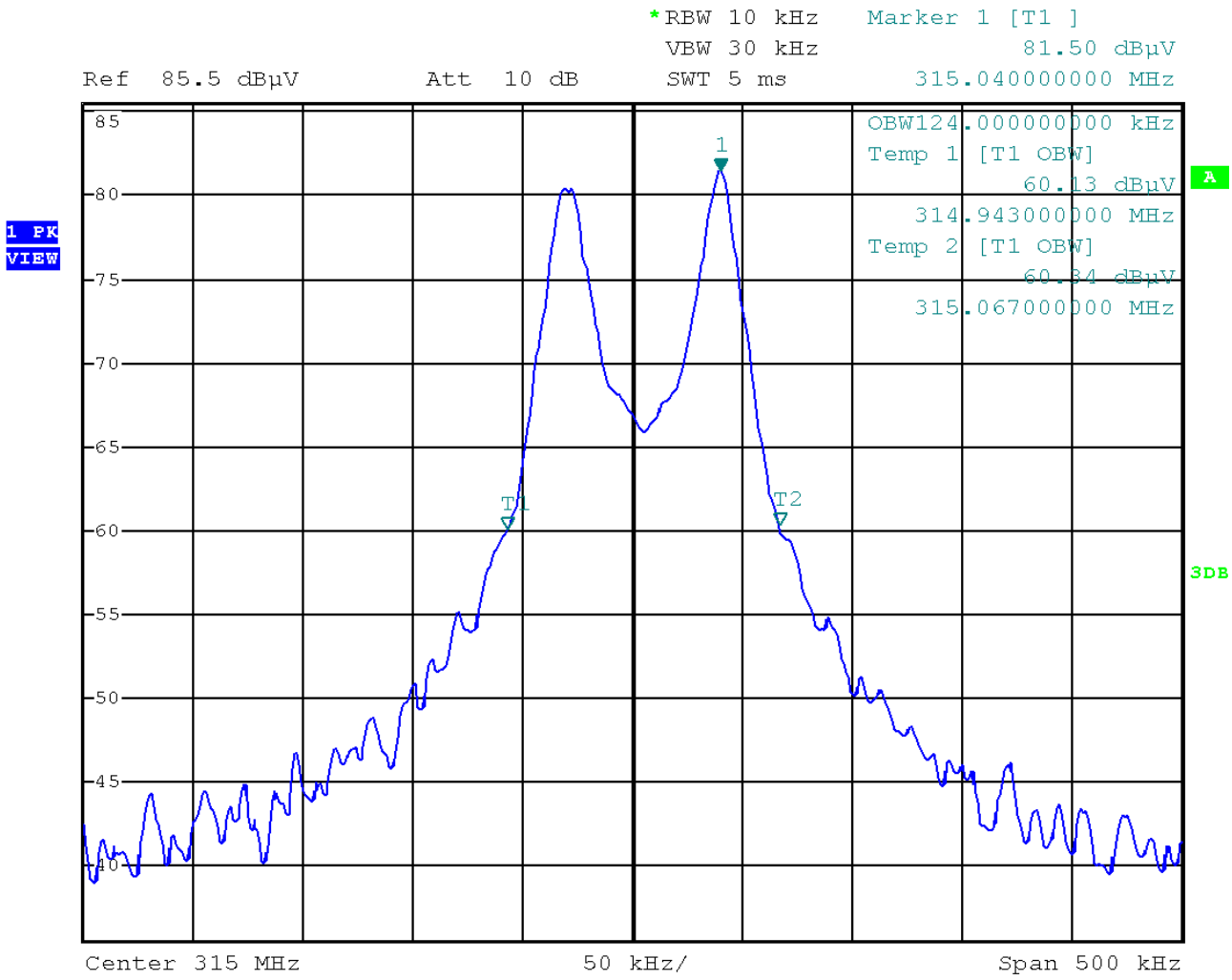
ASK mode:



The 99 % emission bandwidth was automatically calculated by the used Rhode & Schwarz analyzer.

Emission bandwidth
RSS 210 Annex 1, section A1.3

FSK mode:



The 99 % emission bandwidth was automatically calculated by the used Rhode & Schwarz analyzer.

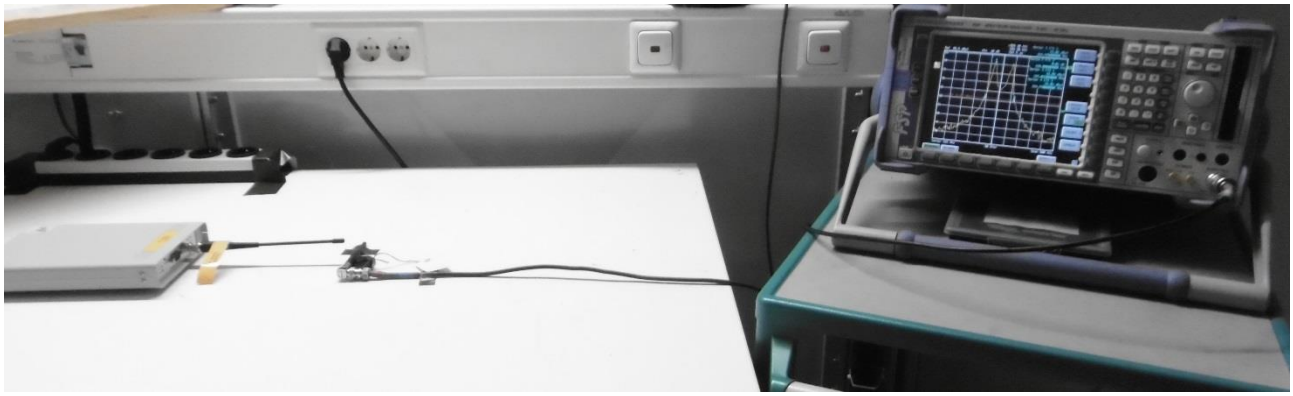
5.7 On / Off Period

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

5.7.1 Description of the test location

Test location: Shielded room S4

5.7.2 Photo documentation of the test set-up



5.7.3 Applicable standard

According to RSS 210, Annex 1, section A1.1.3:

5.7.4 Description of Measurement

The duration of transmission is measured with the spectrum analyzer. The sweep points were set to maximum for higher the time resolution. The signal is modulated; the marker of the analyzer is set to maximum amplitude at normal temperature and zero span. The analyser was set to single sweep and triggered on the button, the marker was set to the edges in order to measure the duration time and than recorded.

5.7.5 Test result

The manufacturer declares following transmitting intervals:
When the EUT is mounted in the vehicle tire in the worst case, periodically RF transmission where the duration of each transmission is always less than 1 second and the silent period is at least 30 times the duration of the transmission, and never less than 10 seconds.
In the case of an emergency condition (rapid pressure loss), the devise will transmit tire pressure and temperature information throughout the duration of the condition.

-ASK mode:

Duration of transmission (ms)	Limit (s)
429.0	1.0

Silent period (s)	Limit (s)
14.04	> 10.0

-FSK mode:

Duration of transmission (ms)	Limit (s)
394.0	1.0

Silent period (s)	Limit (s)
14.84	> 10.0

Limit according to RSS 210, Annex A, section A1.4:

(a) Devices may not meet the requirements in Section A.1.1 and may be employed for any type of operation, provided the device complies with the requirements of Section A.1.3 and the field strength corresponds with the limits specified in Table A2.

(b) In addition, devices operated under the provisions of this section shall be capable of automatically limiting their operation so that the duration of each transmission is not greater than 1 second and the silent period between transmissions is at least 30 times the duration of the transmission, but not less than 10 seconds under any circumstances. However, devices that are designed for limited use for the purpose of initial programming, reprogramming or installing, and not for regular operations, may operate for up to 5 seconds, provided such devices are used only occasionally in connection
with each unit being programmed or installed.

(c) The field strength limits shown in Table A2 are based on the average value of the measured emissions. As an alternative, compliance with the limits in this table may be
based on the use of measurement instruments with an International Special Committee on Radio Interference (CISPR) quasi-peak detector.

(d) Unwanted emissions shall comply with the general field strength limits specified in RSS-Gen or 10 times below the fundamental emissions field strength limit in Table A2, whichever is less stringent.

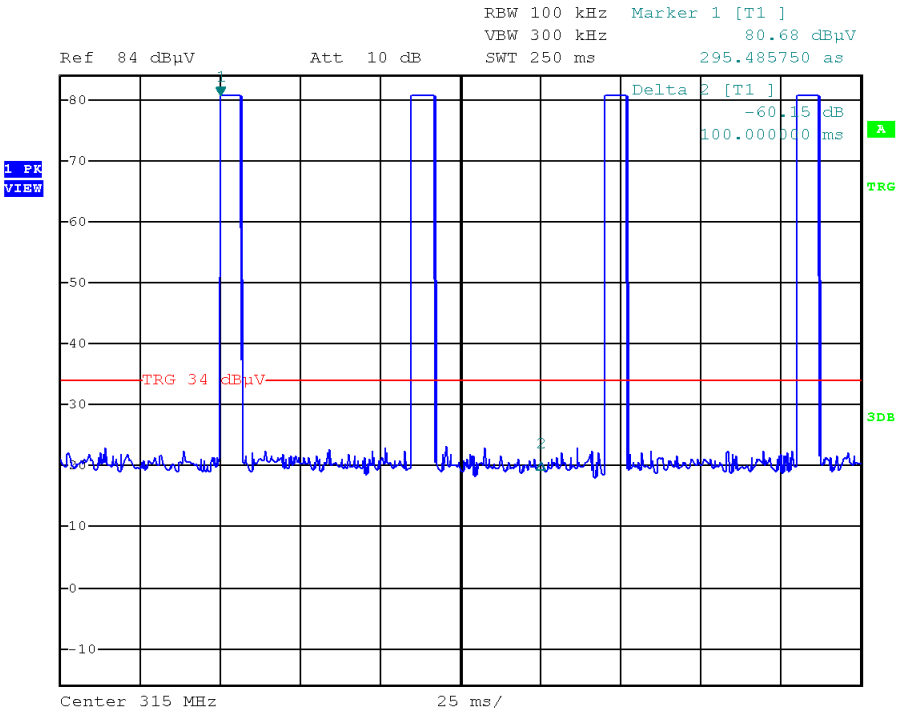
The requirements are **FULFILLED.**

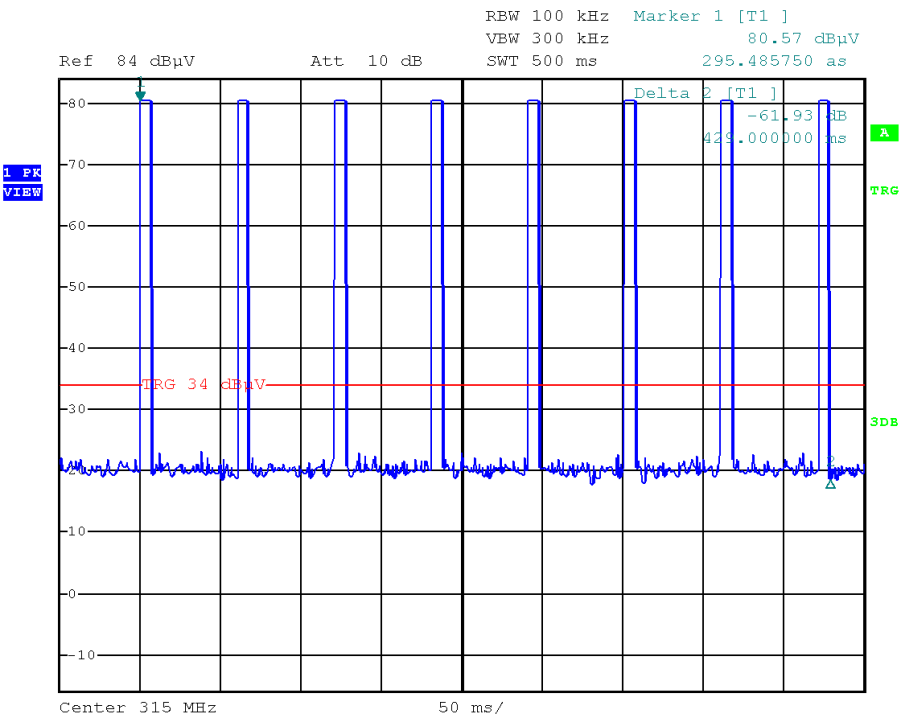
Remarks: For detailed test results, please see the test protocol below.

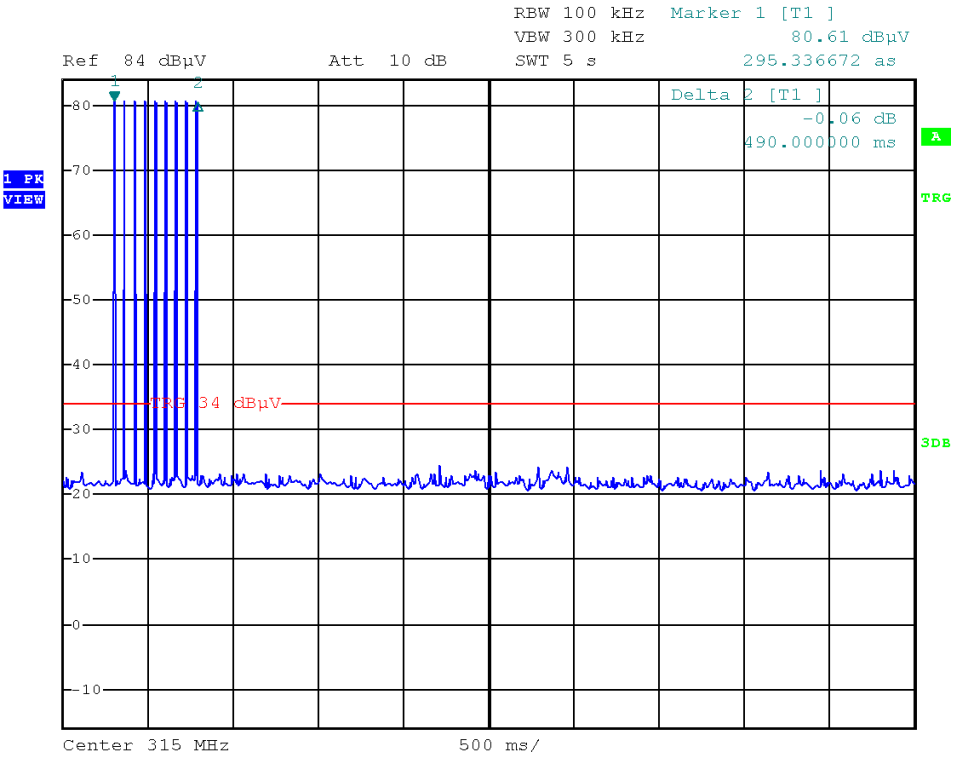
5.7.6 Test protocol

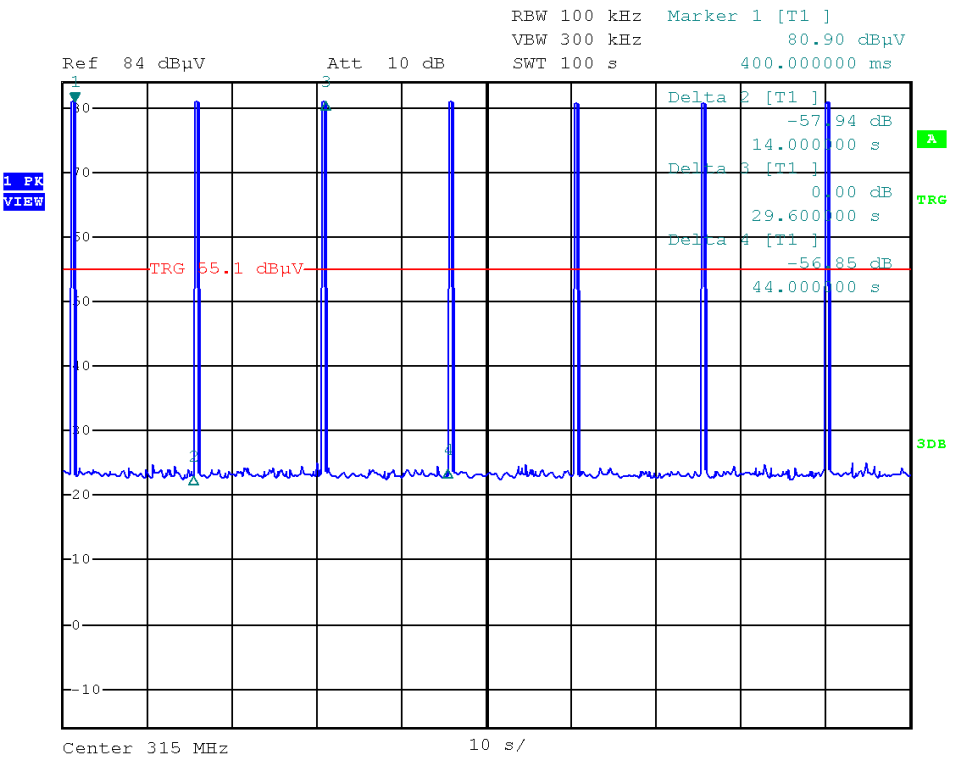
Signal deactivation

Worst Tx on time – ASK mode: 15.0 ms within 100ms

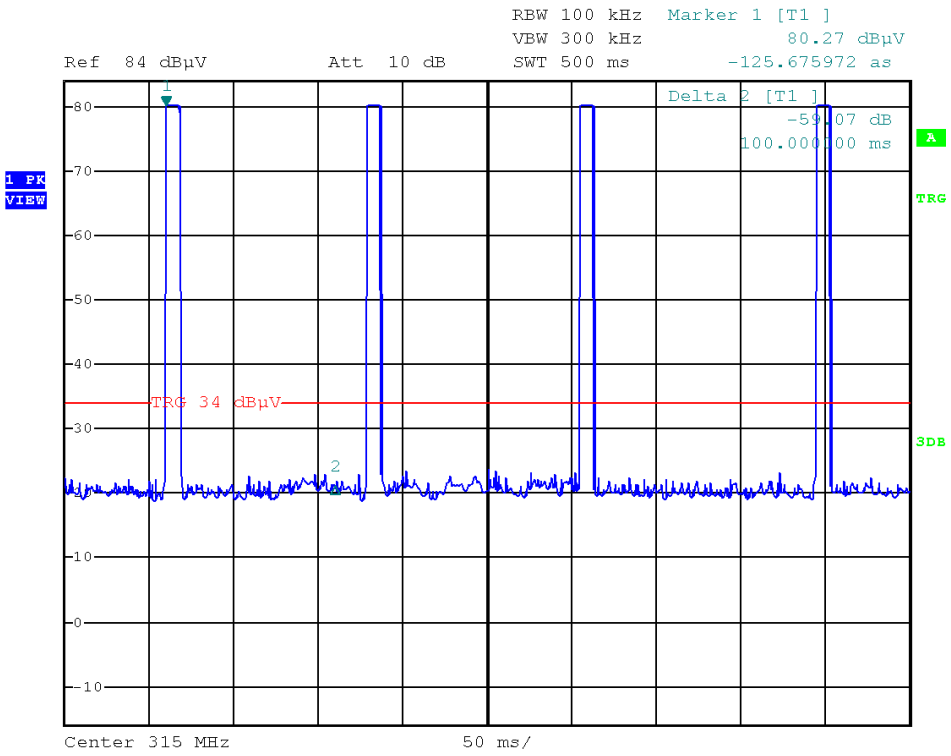


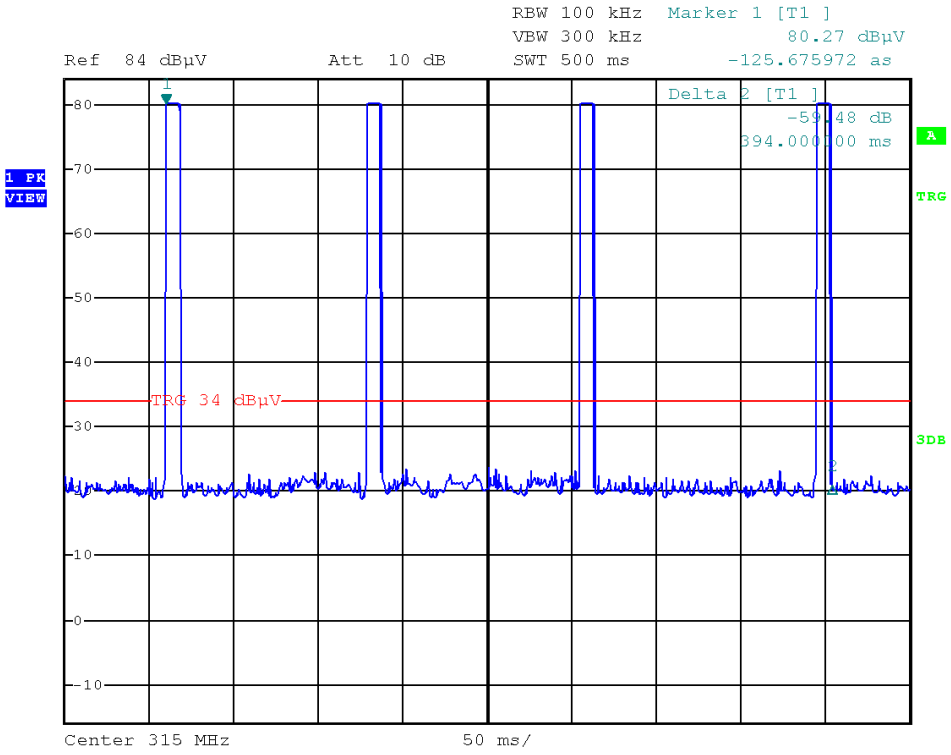


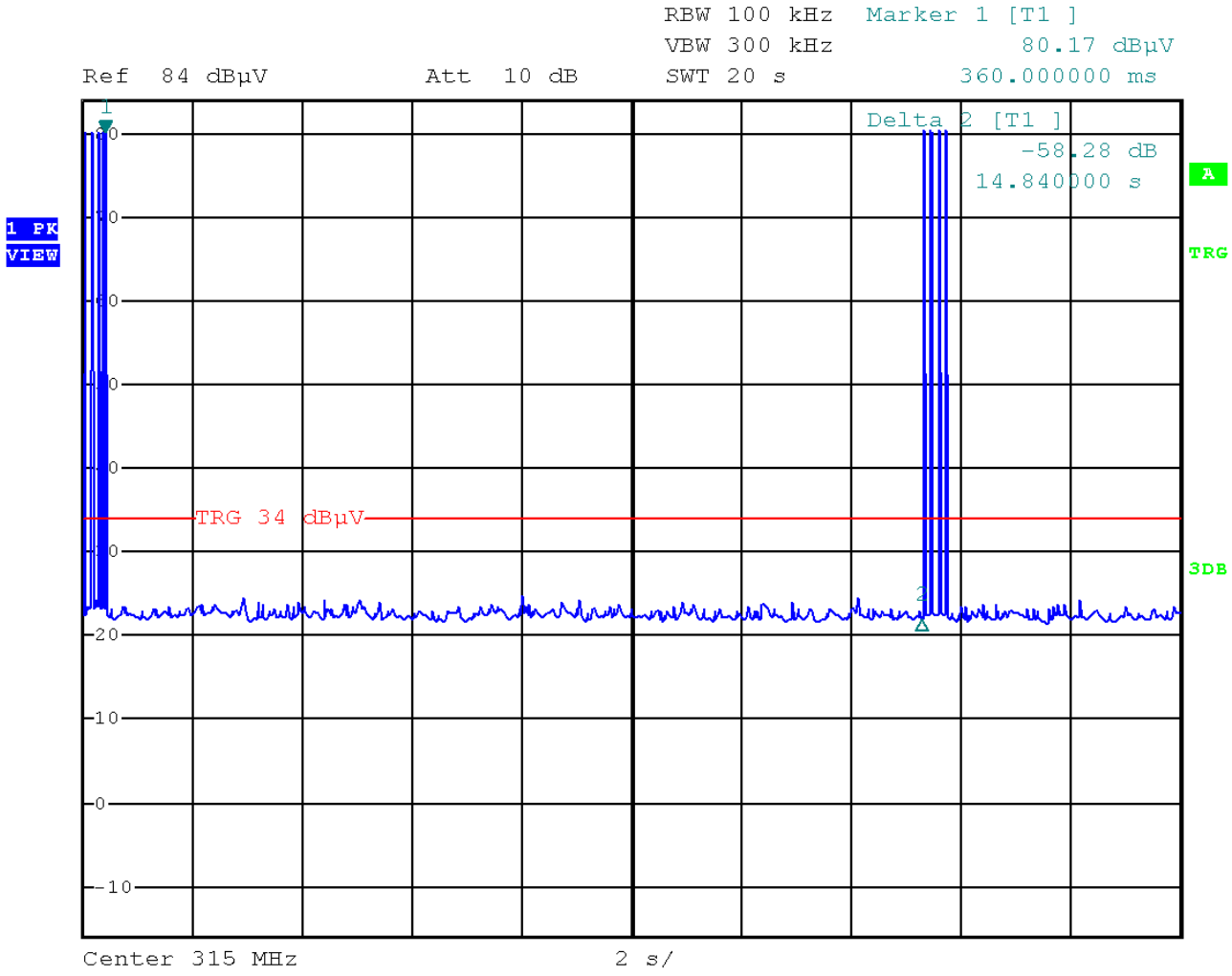

RBW 100 kHz
VBW 300 kHz
SWT 5 s
Marker 1 [T1]
80.61 dBµV
295.336672 as
Ref 84 dBµV
Att 10 dB
Delta 2 [T1]
-0.06 dB
490.000000 ms
1 PK
VIEW
A
TRG
3DB
TRG 34 dBµV
Center 315 MHz
500 ms/


RBW 100 kHz
VBW 300 kHz
SWT 100 s
Marker 1 [T1]
80.90 dBµV
400.000000 ms
Ref 84 dBµV
Att 10 dB
Delta 2 [T1]
-57.94 dB
14.000000 s
Delta 3 [T1]
0.00 dB
29.600000 s
Delta 4 [T1]
-56.85 dB
44.000000 s
1 PK
VIEW
A
TRG
3DB
TRG 55.1 dBµV
Center 315 MHz
10 s/

Worst Tx on time – FSK mode: 10.0 ms within 100ms






RBW 100 kHz
VBW 300 kHz
SWT 20 s
Marker 1 [T1]
80.17 dBµV
360.000000 ms
Ref 84 dBµV
Att 10 dB
Delta 2 [T1]
-58.28 dB
14.840000 s
1 PK
VIEW
A
TRG
3DB
TRG 34 dBµV
Center 315 MHz
2 s/

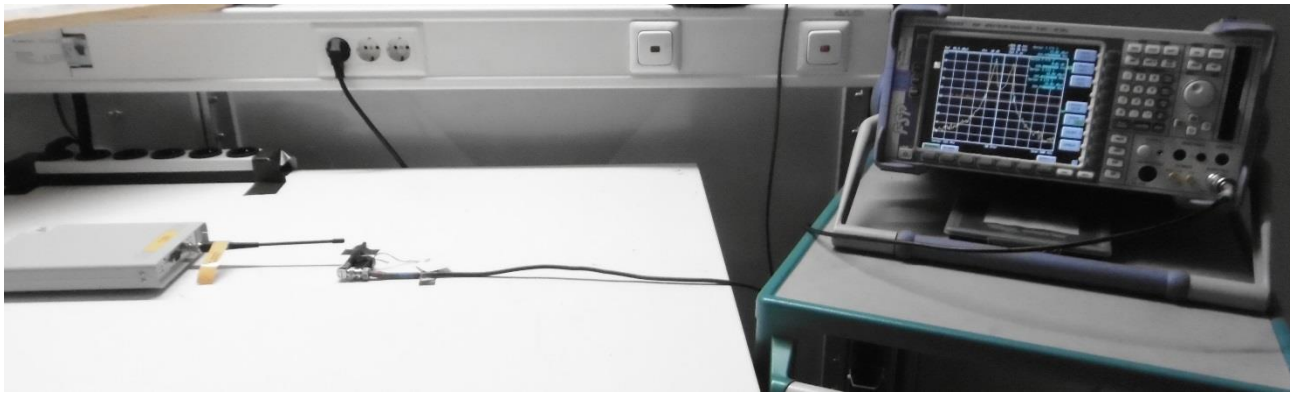
5.8 Signal deactivation

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

5.8.1 Description of the test location

Test location: AREA 4

5.8.2 Photo documentation of the test set-up



5.8.3 Test result

The manufacturer declares following transmitting intervals:

ASK mode:

Duration of transmission (ms)
15.0

FSK mode:

Duration of transmission (ms)
10.0

IC: 4008C-TSSRE3UE

Limit according to RSS 210, Annex A, section A1.1.1(d):

(a) A manually operated transmitter shall employ a push-to-operate switch and be under manual control at all transmission times. When released, the transmitter shall cease transmission (holdover time of up to 5 seconds is permitted).

(b) A transmitter activated automatically shall cease transmission within 5 seconds after activation (i.e. maximum 5 seconds of operation).

(c) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmission dies not exceed 2 seconds per hour for each transmitter.

(d)Intentional radiators employed for radio control purposes during emergencies involving fire, security of goods (e.g. burglar alarms), and safety-of-life, when activated to signal an alarm, may operate during the interval of the alarm condition.

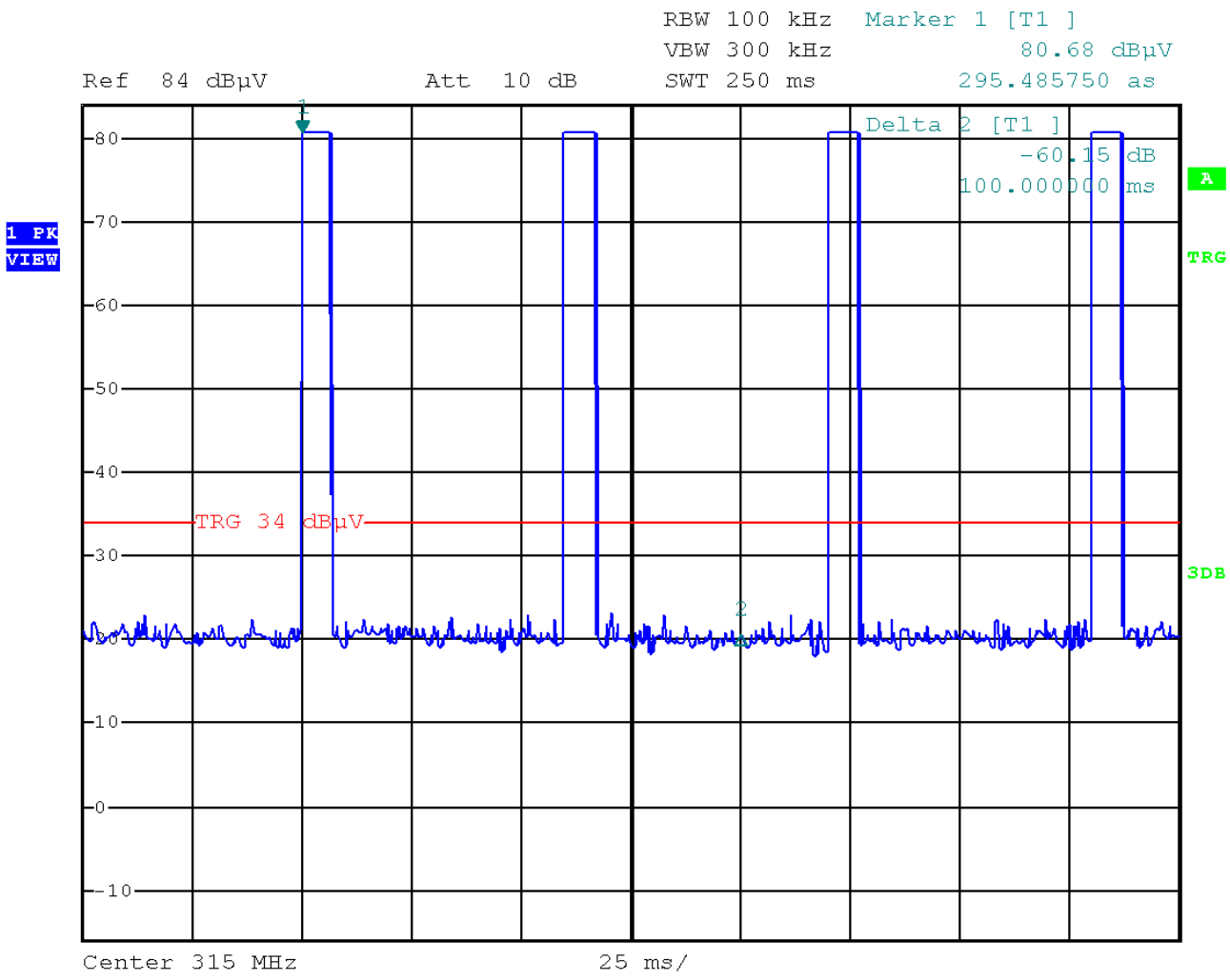
The requirements are **FULFILLED.**

Remarks: For detailed test results, please see the test protocol below.

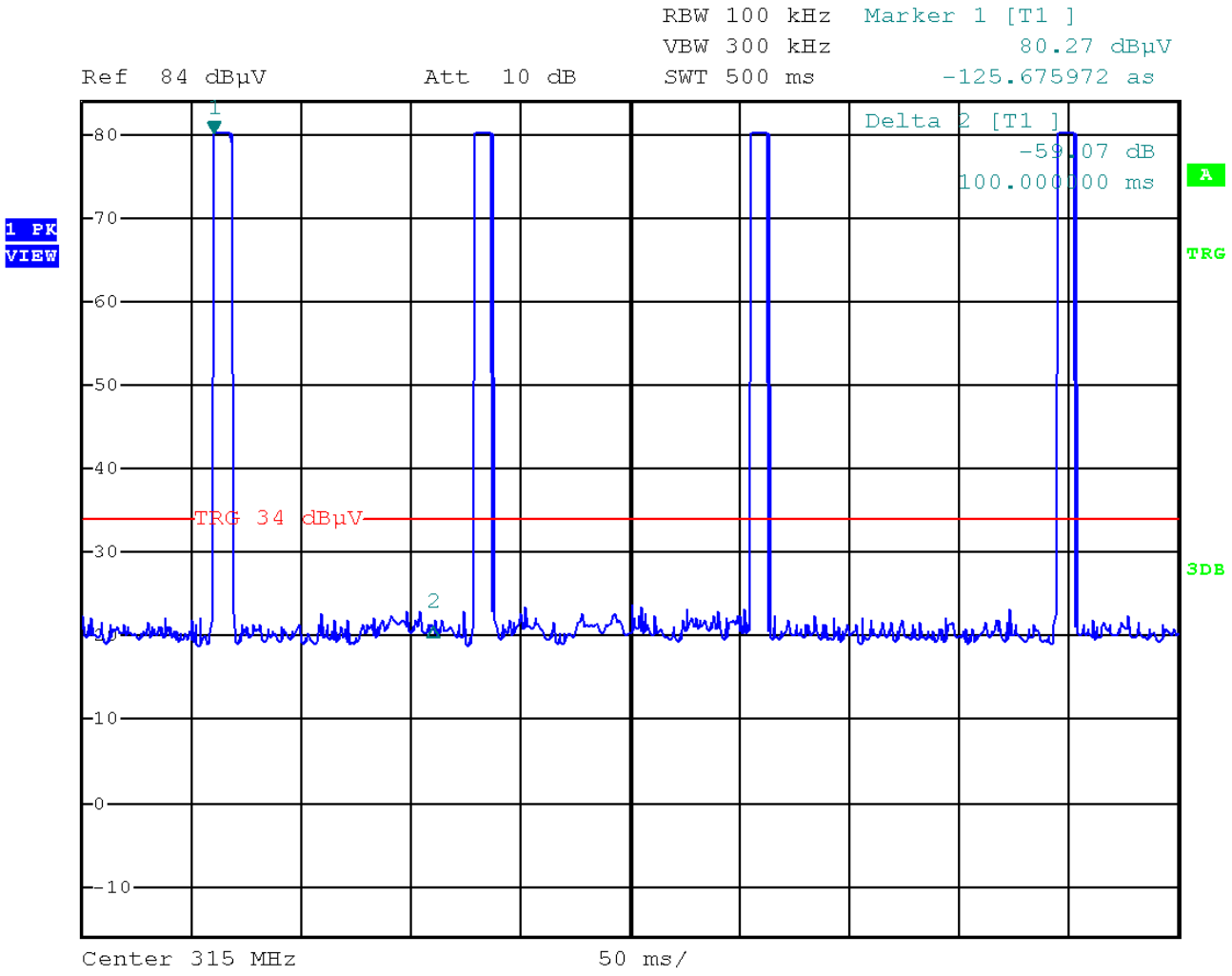
5.8.4 Test protocol

Signal deactivation
RSS 210 Annex A.1.1.1

Worst Tx on time – ASK mode: 15.0 ms within 100ms



Worst Tx on time – FSK mode: 10.0 ms within 100ms



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 2	ESVS 30	02-02/03-05-006	06/06/2019	06/06/2018		
	VULB 9168	02-02/24-05-005	18/04/2019	18/04/2018	21/09/2018	21/03/2018
	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				
MB	FSP 40	02-02/11-11-001	09/10/2018	09/10/2017		
	RF Antenna	02-02/24-05-032				
SER 1	ESCI	02-02/03-05-005	14/12/2018	14/12/2017		
	HFH 2 - Z 2	02-02/24-15-001	22/03/2019	22/03/2018		
	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	06/06/2019	06/06/2018		
	VULB 9168	02-02/24-05-005	18/04/2019	18/04/2018	21/09/2018	21/03/2018
	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	09/10/2018	09/10/2017		
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	08/05/2019	08/05/2018		
	18N-20	02-02/50-17-003				
	NMS111-GL200SC01-NMS11	02-02/50-17-012				
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				