

FCC ID: KR537978000
IC ID: 7812D-37978000

EMI - TEST REPORT

- FCC Part 15.249, RSS210 -

**Test Report No. :** T36248-01-01HU

20. February 2013

Date of issue

Type / Model Name : A2C37978000**Product Description** : Transceiver for remote vehicle access**Applicant** : Continental Automotive GmbH

Address : Siemensstr. 12

93055 Regensburg, Germany

Manufacturer : Continental Guadalajara México, S.A. de C.V.

Address : Camino a la Tijera No.3

45640 Tlajomulco de Zúñiga, Jalisco, Mexico

Licence holder : Continental Automotive GmbH

Address : Siemensstr. 12

93055 Regensburg, Germany

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

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, 2012)

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, 2012)

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 15.207	Conducted limits
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

ANSI C63.4: 2009	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
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CISPR 16-4-2: 2003	Uncertainty in EMC measurement
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CISPR 22: 2005 EN 55022: 2006	Information technology equipment
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2 SUMMARY

2.1 Test result summary

The A2C37978000 is a transceiver for remote vehicle access:

Operating in the 902 MHz – 928 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS Gen, 7.2.4	AC power line conducted emissions	not applicable
15.215(c)	RSS Gen, 4.6.3	-20 dBc EBW	not applicable
15.249(a)	RSS-210, A8.4(4)	Field strength of fundamental	passed
15.249(d)	RSS-210, A8.5	Out-of-band emission, radiated	passed
15.205(a)	RSS-Gen, 7.2.2	Emissions in restricted bands	passed
15.35(c)	RSS-Gen, 4.5	Pulsed operation	not applicable
15.107	RSS Gen, 7.2.4.	AC power line conducted emissions	not applicable
	RSS-Gen, 7.2.6	Transmitter frequency stability	not applicable
	RSS-Gen, 4.6.1	99 % Bandwidth	passed
OET Bulletin 65	RSS102, 3.2	Co-location, Co-transmission	not applicable

The mentioned RSS Rule Parts in the above table are related to:

RSS Gen, Issue 3, December 2010

RSS 210, Issue 8, December 2010

RSS 102, Issue 4, March 2010

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2.2 GENERAL REMARKS:

All radiated tests have been performed on samples which are in original state in a test mode function with two different car roof antennas.

- No. 1: 39150 – TZ6A – A013 – M1
- No. 2: 39150 – TZ5A – A012 – M1

For technical differences between the two antennas please refer to the manufacturer documents.

The EuT has an external antenna and is powered by a vehicle battery.

2.3 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 : 31. January 2013

Testing concluded on : 31. January 2013

Checked by:

Tested by:

Klaus Gegenfurtner
Dipl.-Ing.(FH)
Manager Radio Group

Markus Huber

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3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT – Please see attachment A

3.2 Power supply system utilised

Power supply voltage : 12.0 V / DC (Vehicle regulated)

3.3 Short description of the equipment under test (EUT)

The EUT is a transceiver module for remote vehicle access.

Number of tested samples: 1

Serial number: Prototype

EUT operation mode:

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

- Tx mode at SR1 926.225 MHz, SR2 925.925 MHz, LR1 925.775 MHz, LR2 926.375 MHz

- Rx mode at SR1 926.225 MHz, SR2 925.925 MHz, LR1 925.775 MHz, LR2 926.375 MHz

-

EUT configuration:

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

- | | |
|--|--|
| - Car roof antenna, 39150-TZ5A-A012-M1 | Model : Supplied by customer Continental |
| - Car roof antenna, 39150-TZ6A-A013-M1 | Model : Supplied by customer Continental |
| - Car battery 12 V / DC | Model : Supplied by mikes-testingpartners gmbh |
| - | Model : |
| - | Model : |
| - | Model : |
| - Customer specific cables | |
| - Unscreened power cables | |

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4 TEST ENVIRONMENT

4.1 Address of the test laboratory

mikes-testingpartners gmbh
Ohmstrasse 2-4
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. The reader may notice that tolerances within the calibration of the equipment and facilities may cause additional uncertainty. The measurement uncertainty is calculated for all measurements listed in this test report acc. to CISPR 16-4-2 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurement“ and documented in the mikes-testingpartners gmbh quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, mikes-testingpartners 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 diversity and modifications in production processes may result in additional deviation. If necessary, refer to the test lab for the actual measurement uncertainty for specific tests. The manufacturer has the sole responsibility of continued compliance of the EUT.

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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 a listed Open Site 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 C63.4 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 C63.4 and applying the CISPR 22 limits.

4.4.1.4 Conducted emission

The final level, expressed in dB μ V, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC limit or to the CISPR limit.

To convert between dB μ V and μ V, the following conversion formula apply:

$$\begin{aligned} \text{dB}\mu\text{V} &= 20 \cdot \log(\mu\text{V}) \\ \mu\text{V} &= 10^{(\text{dB}\mu\text{V}/20)} \end{aligned}$$

Conducted emissions 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 50 Ω / 50 μ H (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin of a peak mode measurement appears to be less than 20 dB, the emissions are remeasured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

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4.4.1.5 Radiated emission (electrical field 30 MHz - 1 GHz)

Spurious emission from the EUT is measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is established in accordance with ANSI C63.4. The interface cables that are closer than 40 cm to the ground plane are bundled in the center in a serpentine fashion so that 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 screened room located outside the test area. The antenna is positioned 3, 10 or 30 m horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 m and the EUT is rotated 360 degrees.

The final level in dB μ V/m is calculated by add on the reading value from the EMI receiver (level dB μ V) the correction factor. The FCC or CISPR limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The resolution bandwidth setting:

30 MHz – 1000 MHz: RBW: 120 kHz

Example:

Frequency (MHz)	Reading level (dB μ V)	+	Correction Factor (dB/m)	=	Level (dB μ V/m)	-	CISPR Limit (dB μ V/m)	=	Delta (dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

4.4.2 Radiated emission (electrical field 1 GHz - 40 GHz)

Description of measurement

Radiated emissions from the EUT are measured in the frequency range 1 GHz up to the maximum frequency as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 metre non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is following set out in ANSI C63.4. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyser set to max peak detector function and a resolution 1 MHz and video bandwidth 3 MHz for peak and 10 Hz for average measurement. The conditions determined as worst case will then be used for the final measurements. When the EUT is larger than the beam width of the measuring antenna it will be moved over the surface for the four sides of the equipment. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty and are calculated at the specified test distance.

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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 FCC Part 15, Section 15.207(a):

Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the given limits.

5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.4 described under item 4.4.3. 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

Limit according to FCC Part 15, Section 15.207(a):

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

Remarks: The measurement is not applicable.

The EuT has no AC mains connections.

The EuT is separated powered by a 12.0 V / DC vehicle battery.

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5.2 Radiated emission of the fundamental wave

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

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



5.2.1 Applicable standard

According to FCC Part 15C, Section 15.249(a):

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the effective limits.

5.2.2 Description of Measurement

The radiated power of the fundamental wave from the EUT is 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. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003.

The Interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres 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 meters horizontally from the EuT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarization's and the EuT are rotated 360 degrees.

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The final level, expressed in dB μ V/m, is arrived by taking the reading from the EMI receiver (Level dB μ V) and adding the correction factors and cable loss factor (Factor dB) to it. This is done automatically in the EMI receiver, where the correction factors are stored. This result then has the FCC or CISPR limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets at page.

The resolution bandwidth during the measurement is as follows:

30 MHz – 1000 MHz:

ResBW: 120 kHz

5.2.3 Test result

- Car roof antenna 39150-TZ6A-A013-M1

Frequency [MHz]	L: QP [dB μ V]	L: AV [dB μ V]	Bandwidth [kHz]	Correct. [dB]	L: QP [dB μ V/m]	L: AV [dB μ V/m]	Limit [dB μ V/m]	Delta [dB]
926.225	58.3		120	29.5	87.8		94.0	-6.2
925.925	59.3		120	29.5	88.8		94.0	-5.2
925.775	58.5		120	29.5	88.0		94.0	-6.0
926.375	59.5		120	29.5	89.0		94.0	-5.0

- Car roof antenna 39150-TZ5A-A012-M1

Frequency [MHz]	L: QP [dB μ V]	L: AV [dB μ V]	Bandwidth [kHz]	Correct. [dB]	L: QP [dB μ V/m]	L: AV [dB μ V/m]	Limit [dB μ V/m]	Delta [dB]
926.225	59.1		120	29.5	88.6		94.0	-5.4
925.925	59.2		120	29.5	88.7		94.0	-5.3
925.775	59.2		120	29.5	88.7		94.0	-5.3
926.375	59.3		120	29.5	88.8		94.0	-5.2

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

Average-Limit according to FCC Part 15C, Section 15.249(a):

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

Peak-Limit according to FCC Part 15C, Section 15.249(e):

However the peak fieldstrength shall not exceed the maximum permitted average limit by more than 20 dB.

The requirements are **FULFILLED**.

Remarks:

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5.3 Spurious emissions radiated

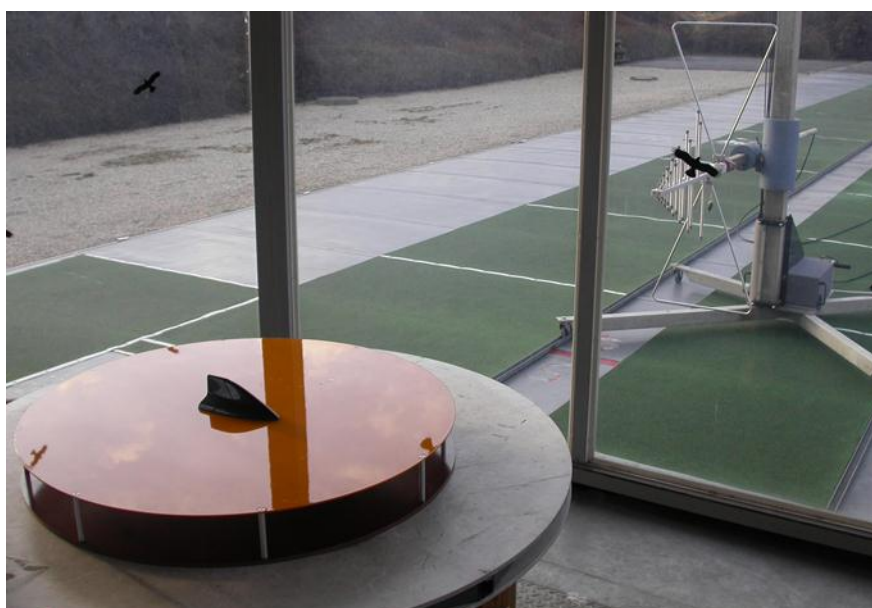
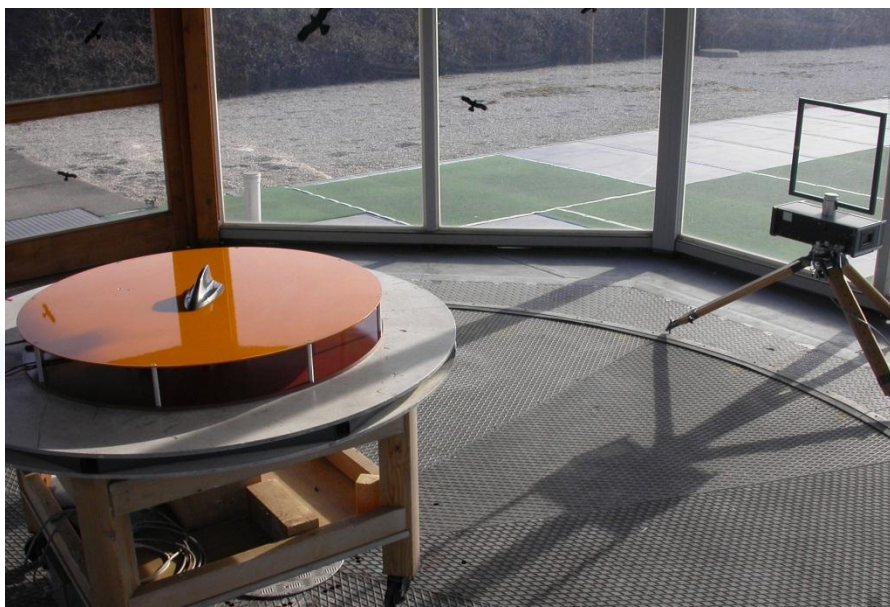
For test instruments and accessories used see section 6 Part **SER1**, **SER 2**, **SER 3**.

5.3.1 Description of the test location

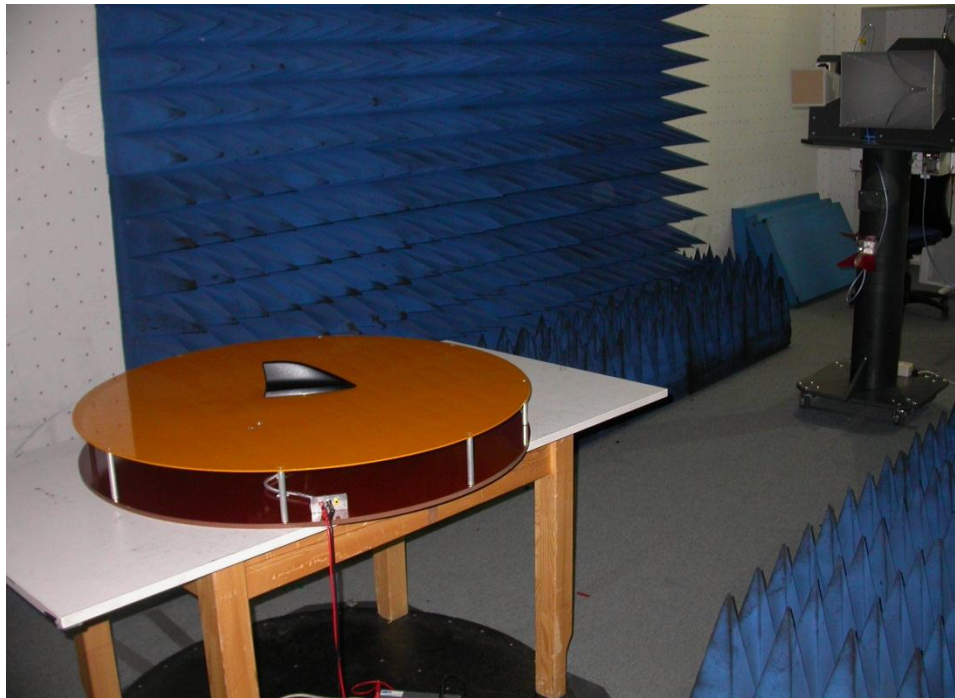
Test location: OATS 1
Test location: Anechoic chamber 2

Test distance: 3 m

5.3.2 Photo documentation of the test set-up



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5.3.3 Applicable standard

According to FCC Part 15C, Section 15.249 (d):

Emission radiated outside of the specified frequency bands, except harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated limit in FCC Part 15C, Section 15.209, whichever is the lesser attenuation.

5.3.4 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 set up of the EUT will be in accordance to ANSI C63.4. 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 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. During the test, the EUT was set into continuous transmitting mode modulated.

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 – 40 GHz	RBW:	1 MHz

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5.3.5 Test result $f < 1$ GHz

Frequency [MHz]	L: PK [dB μ V]	L: AV [dB μ V]	L: QP [dB μ V]	Correct. [dB]	L: PK [dB μ V/m]	L: AV [dB μ V/m]	L: QP [dB μ V/m]	Limit [dB μ V/m]	Delta [dB]
0.009 – 0.15							< 30		>20
0.15 – 30.0							< 30		>20

Frequency [MHz]	L: QP [dB μ V]	L: AV [dB μ V]	Bandwidth [kHz]	Correct. [dB]	L: QP [dB μ V/m]	L: AV [dB μ V/m]	Limit [dB μ V/m]	Delta [dB]
30-1000			120		<30			>20

5.3.6 Test result $f > 1$ GHz

Car roof antenna 39150-TZ6A-A013-M1

Frequency SR1, 926.225 MHz:

Frequency (MHz)	L: PK (dB μ V)	L: AV (dB μ V)	Bandwidth (kHz)	Correct. (dB)	Duty Cycle Correct. factor (dB)	Corrected PK level dB(μ V/m)	Effective limit dB(μ V/m)	Delta (dB)
1852.45	54.8	--	1000	-11.6	--	43.2	54.0	-10.8
2778.68	56.7	--	1000	-10.0	--	46.7	54.0	-7.3
		--						

Frequency SR2, 925.925 MHz:

Frequency (MHz)	L: PK (dB μ V)	L: AV (dB μ V)	Bandwidth (kHz)	Correct. (dB)	Duty Cycle Correct. factor (dB)	Corrected PK level dB(μ V/m)	Effective limit dB(μ V/m)	Delta (dB)
1851.85	54.4	--	1000	-11.6	--	42.8	54.0	-11.2
2777.78	56.2	--	1000	-10.0	--	46.2	54.0	-7.8

Frequency LR1, 925.775 MHz:

Frequency (MHz)	L: PK (dB μ V)	L: AV (dB μ V)	Bandwidth (kHz)	Correct. (dB)	Duty Cycle Correct. factor (dB)	Corrected PK level dB(μ V/m)	Effective limit dB(μ V/m)	Delta (dB)
1851.55	57.4	--	1000	-11.2	--	46.2	54.0	-7.8
2777.33	56.5	--	1000	-10.0	--	46.5	54.0	-7.5

Frequency LR2, 926.375 MHz:

Frequency (MHz)	L: PK (dB μ V)	L: AV (dB μ V)	Bandwidth (kHz)	Correct. (dB)	Duty Cycle Correct. factor (dB)	Corrected PK level dB(μ V/m)	Effective limit dB(μ V/m)	Delta (dB)
1852.75	56.5	--	1000	-11.2	--	45.3	54.0	-8.7
2779.13	57.9	--	1000	-10.0	--	47.9	54.0	-6.1

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Car roof antenna 39150-TZ5A-A012-M1

Frequency SR1, 926.225 MHz:

Frequency (MHz)	L: PK (dBμV)	L: AV (dBμV)	Bandwidth (kHz)	Correct. (dB)	Duty Cycle Correct. factor (dB)	Corrected PK level dB(μV/m)	Effective limit dB(μV/m)	Delta (dB)
1852.45	53.3	--	1000	-11.6	--	41.7	54.0	-12.3
2778.68	55.8	--	1000	-10.0	--	45.8	54.0	-8.2
		--						

Frequency SR2, 925.925 MHz:

Frequency (MHz)	L: PK (dBμV)	L: AV (dBμV)	Bandwidth (kHz)	Correct. (dB)	Duty Cycle Correct. factor (dB)	Corrected PK level dB(μV/m)	Effective limit dB(μV/m)	Delta (dB)
1851.85	56.3	--	1000	-11.6	--	44.7	54.0	-9.3
2777.78	58.2	--	1000	-10.0	--	48.2	54.0	-5.8

Frequency LR1, 925.775 MHz:

Frequency (MHz)	L: PK (dBμV)	L: AV (dBμV)	Bandwidth (kHz)	Correct. (dB)	Duty Cycle Correct. factor (dB)	Corrected PK level dB(μV/m)	Effective limit dB(μV/m)	Delta (dB)
1851.55	56.6	--	1000	-11.2	--	45.4	54.0	-8.6
2777.33	56.5	--	1000	-10.0	--	46.5	54.0	-7.5

Frequency LR2, 926.375 MHz:

Frequency (MHz)	L: PK (dBμV)	L: AV (dBμV)	Bandwidth (kHz)	Correct. (dB)	Duty Cycle Correct. factor (dB)	Corrected PK level dB(μV/m)	Effective limit dB(μV/m)	Delta (dB)
1852.75	56.4	--	1000	-11.2	--	45.2	54.0	-8.8
2779.13	57.0	--	1000	-10.0	--	47.0	54.0	-7.0

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Limit according to FCC Part 15C, Section 15.209:

Frequency (MHz)	15.209 Limits dB(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	40	3
88-216	43.5	3
216-960	46	3
Above 960	54	3

Average limit according to FCC Part 15C, Section 15.249(a):

Fundamental frequency (MHz)	Field strength of harmonics	
	(μV/m)	dB(μV/m)
902 - 928	500	54
2400 - 2483.5	500	54
5725-5875	500	54
24000 - 24250	2500	68

Peak-Limit according to FCC Subpart 15.249(a), Subpart 15.249(e)

Frequency (MHz)	Fieldstrength of harmonics	
	(μV/m)	dB (μV/m)
902-928	5000	74
2400-2483.5	5000	74
5725-5875	5000	74

Average-Limit according to FCC Subpart 15.249(d) for spurious emissions outside of the specified frequency band:

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

Frequency [MHz]	50dB below of the fundamental [dBμV/m]	15.209 Limits [dBμV/m]	General Radiated Limits [dBμV/m]
30-88	44	40	44
88-216	44	43.5	44
216-960	44	46	46
Above 960	44	54	54

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Restricted bands of operation:

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209

MHz	MHz	GHz
25.5 – 25.67	960 – 1240	4.5 – 5.15
37.5 – 38.25	1300 – 1427	5.35 – 5.46
73 – 74.6	1435 – 1626.5	7.25 – 7.75
74.8 – 75.2	1645.5 – 1646.5	8.025 – 8.5
108 – 121.94	1660 – 1710	9.0 – 9.2
123 – 138	1718.8 – 1722.2	9.3 – 9.5
149.9 – 150.05	2200 – 2300	10.6 – 12.7
156.52475 – 156.52525	2310 – 2390	13.25 – 13.4
156.7 – 156.9	2483.5 – 2500	14.47 – 14.5
162.0125 – 167.17	2655 – 2900	15.35 – 16.2
167.72 – 173.2	3260 – 3267	17.7 – 21.4
240 – 285	3332 – 3339	22.01 – 23.12
322 – 335.4	3345.8 – 3358	23.6 – 24.0
399.9 – 410	3600 – 4400	31.2 – 31.8
608 – 614		36.43 – 36.5

The requirements are **FULFILLED**.

Remarks: The measurement was performed up to the 10th harmonic (10.0 GHz).

FCC ID: KR537978000
IC ID: 7812D-37978000

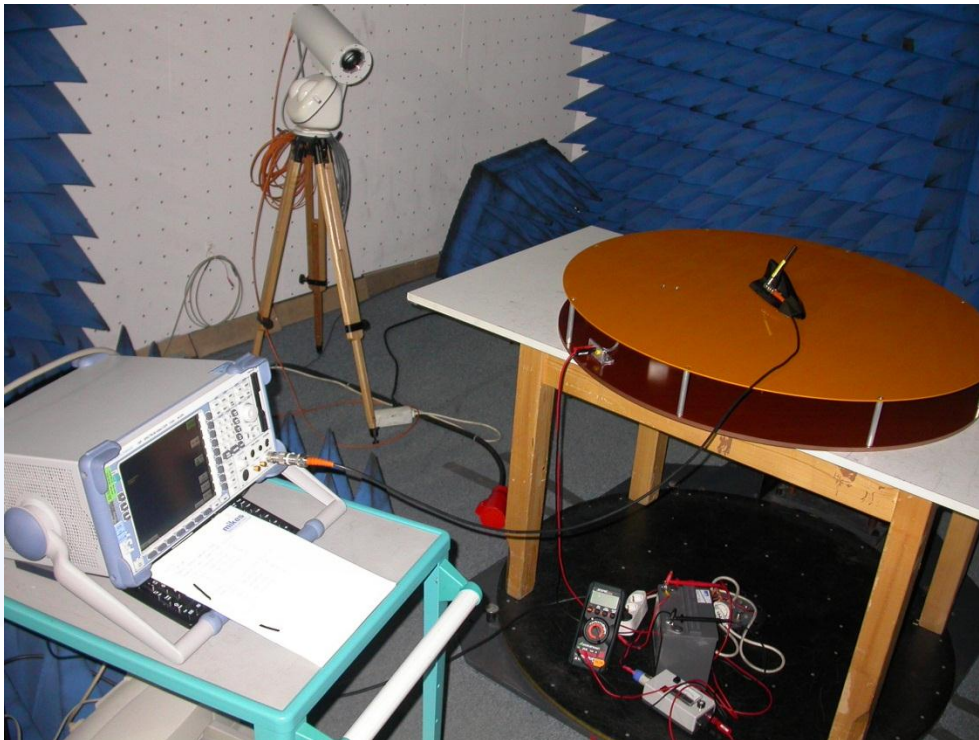
5.4 20 dB bandwidth

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

5.4.1 Description of the test location

Test location: Anechoic chamber 2

5.4.2 Photo documentation of the test set-up



5.4.3 Applicable standard

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

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in Section 15.217 through Section 15.257, must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section under which the equipment is operated.

5.4.4 Description of Measurement

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio of -20 dB. The reference level is the level of the highest signal amplitude observed from the transmitter at the fundamental frequency. Alternative is the x-dB-down function of the analyser used. The EBW is then directly shown in the marker display. The measurement is performed with normal modulation and a transfer rate means the worst case.

FCC ID: KR537978000
IC ID: 7812D-37978000

5.4.5 Test result

- Car roof antenna 39150-TZ6A-A013-M1:

Fundamental [MHz]	20dB Bandwidth F1 [MHz]	20dB Bandwidth F2 [MHz]	Measured Bandwidth [MHz]	LIMIT Fundamental $f \cdot 0,0050$ [MHz]
926.225	926.1854	926.2694	0.84	4.63
925.925	925.8854	925.9694	0.84	4.63
925.775	925.7598	925.7944	0.35	4.63
926.375	926.3596	926.3942	0.35	4.63

- Car roof antenna 39150-TZ5A-A012-M1:

Fundamental [MHz]	20dB Bandwidth F1 [MHz]	20dB Bandwidth F2 [MHz]	Measured Bandwidth [MHz]	LIMIT Fundamental $f \cdot 0,0050$ [MHz]
926.225	926.1842	926.2688	0.85	4.63
925.925	925.8842	925.9688	0.85	4.63
925.775	925.7592	925.7940	0.35	4.63
926.375	926.3592	926.3938	0.35	4.63

Limit according to FCC Part 15C Section 15.231(c):

Frequency (MHz)	20 dB BW limit dependent of the carrier (%)
70 – 900	0.25
above 900	0.50

The bandwidth of the emission shall be no wider than 0.50% of the centre frequency for devices operating above 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

The requirements are **FULFILLED**.

Remarks: For detailed test result please refer to following test protocols.

FCC ID: KR537978000
IC ID: 7812D-37978000

5.4.6 Test protocols

20 dB bandwidth with car roof antenna 39150-TZ6A-A013-M1

SR1, 926.225 MHz:



★ RBW 10 kHz Marker 1 [T1]
VBW 30 kHz 62.02 dBμV
SWT 5 ms 926.185400000 MHz

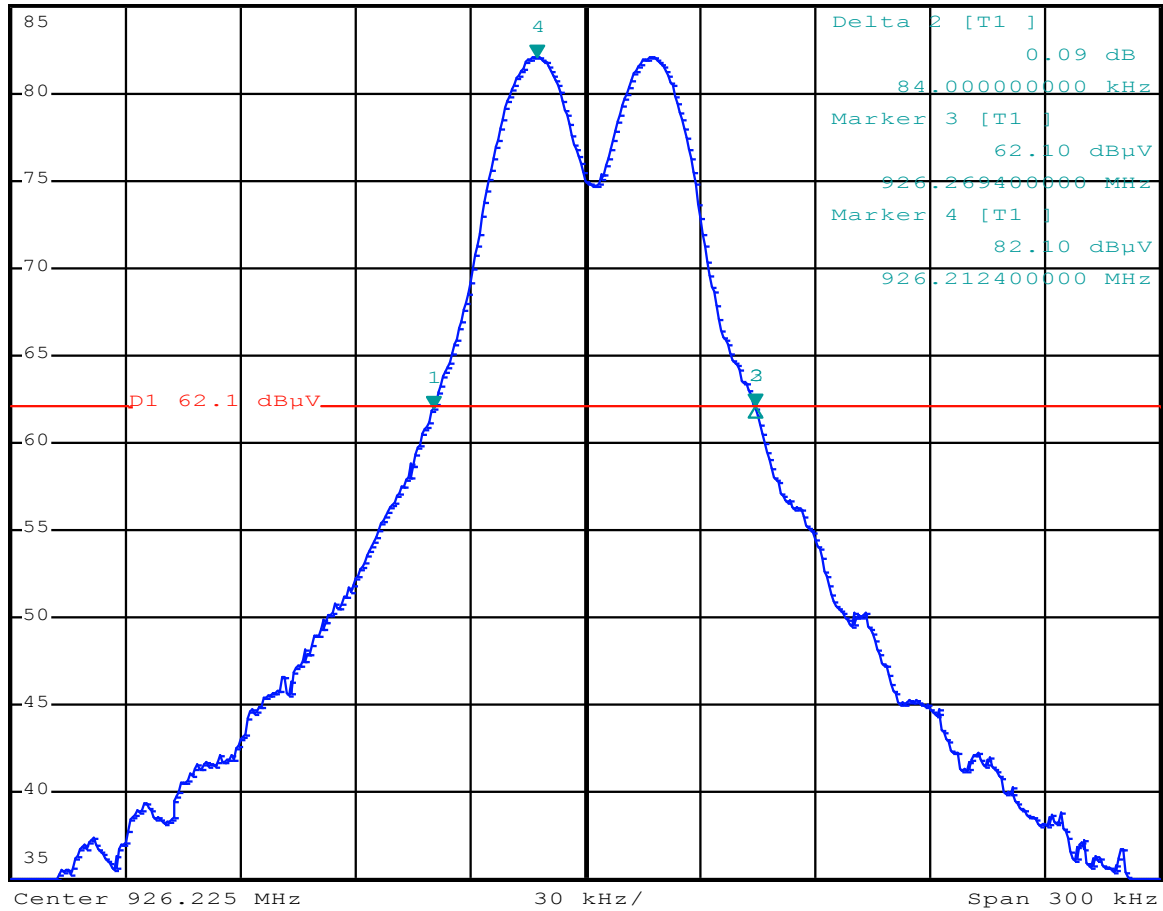
Ref 85 dBμV

Att 10 dB

SWT 5 ms

926.185400000 MHz

1 PK
VIEW



FCC ID: KR537978000
IC ID: 7812D-37978000

SR2, 925.925 MHz:



*RBW 10 kHz Marker 1 [T1]
VBW 30 kHz 62.11 dBμV
SWT 5 ms 925.885400000 MHz

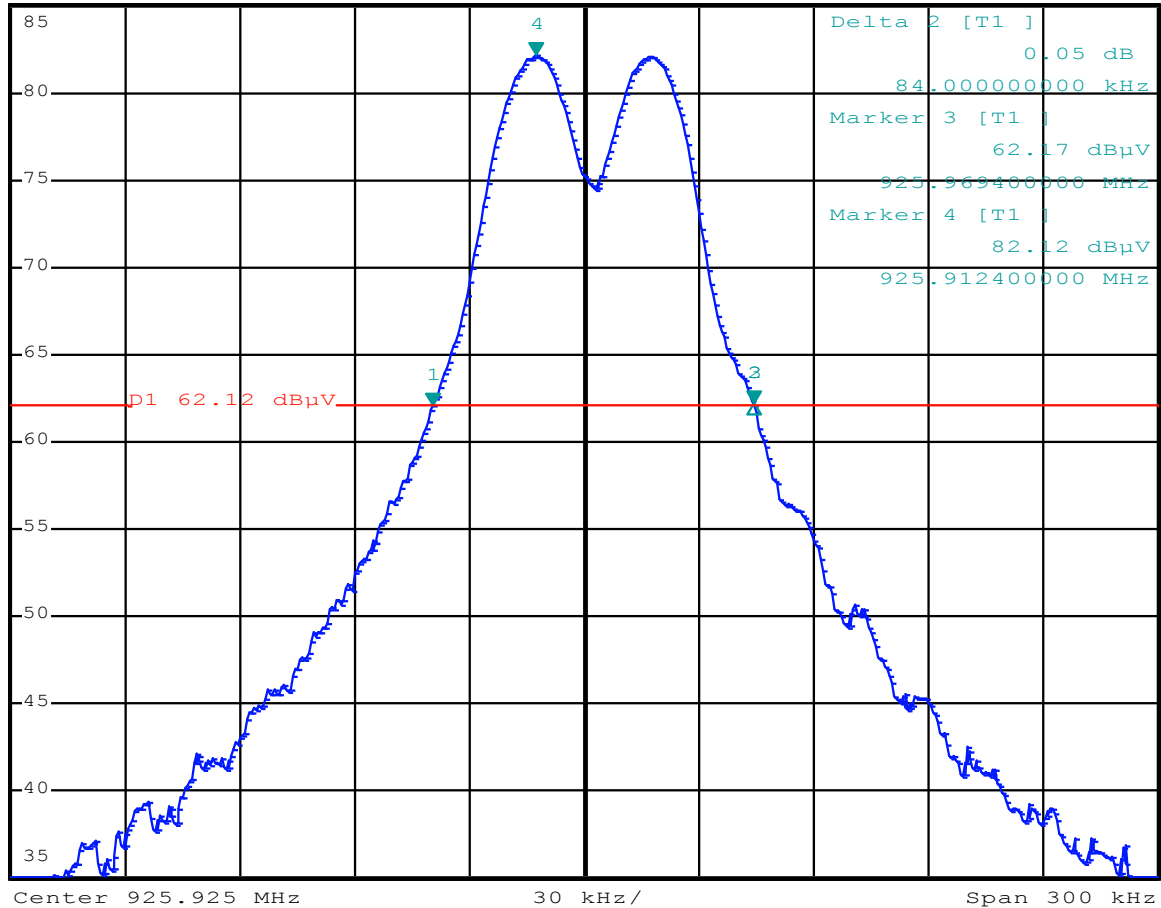
Ref 85 dBμV

Att 10 dB

SWT 5 ms

925.885400000 MHz

1 PK
VIEW



FCC ID: KR537978000
IC ID: 7812D-37978000

LR1, 925.775 MHz:



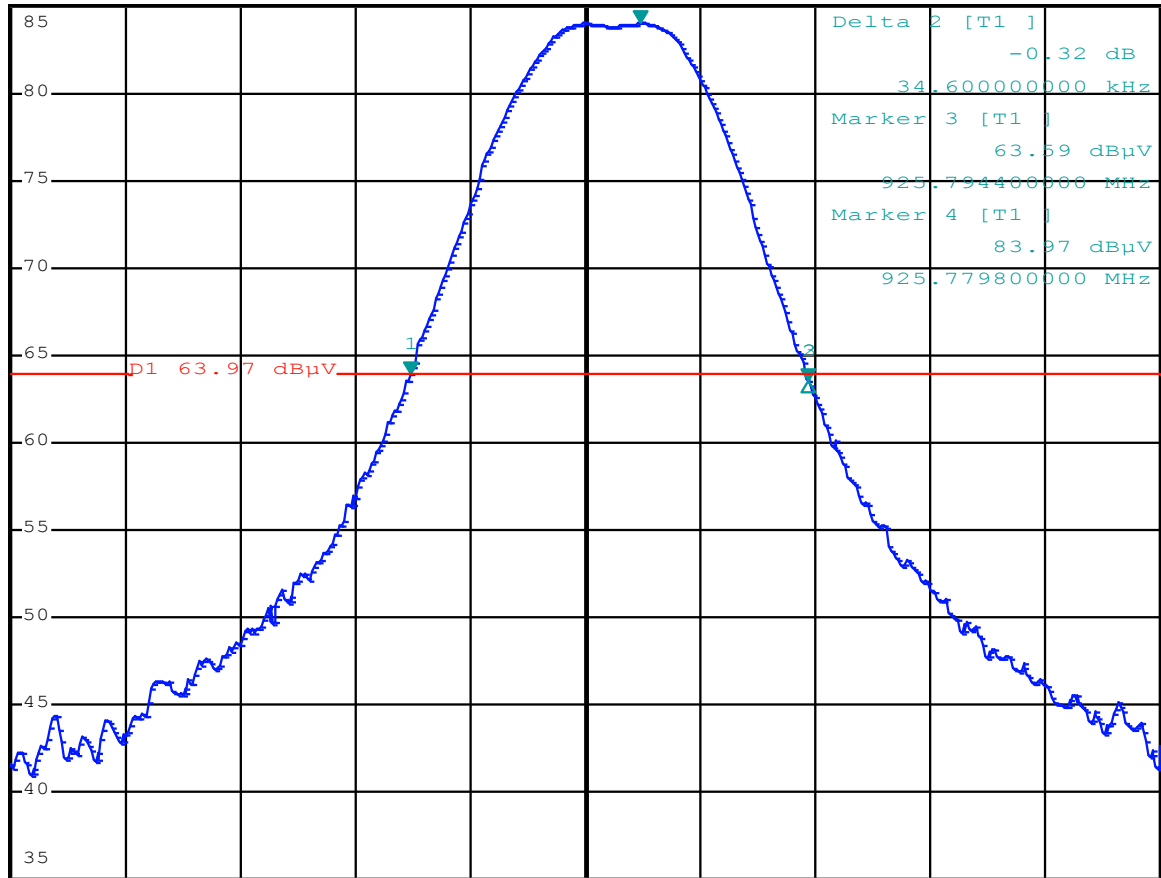
*RBW 10 kHz Marker 1 [T1]
VBW 30 kHz 63.91 dBμV
SWT 2.5 ms 925.759800000 MHz

Ref 85 dBμV

Att 10 dB

4

1 PK
VIEW



Center 925.775 MHz

10 kHz/

Span 100 kHz

FCC ID: KR537978000
IC ID: 7812D-37978000

LR2, 926.375 MHz:

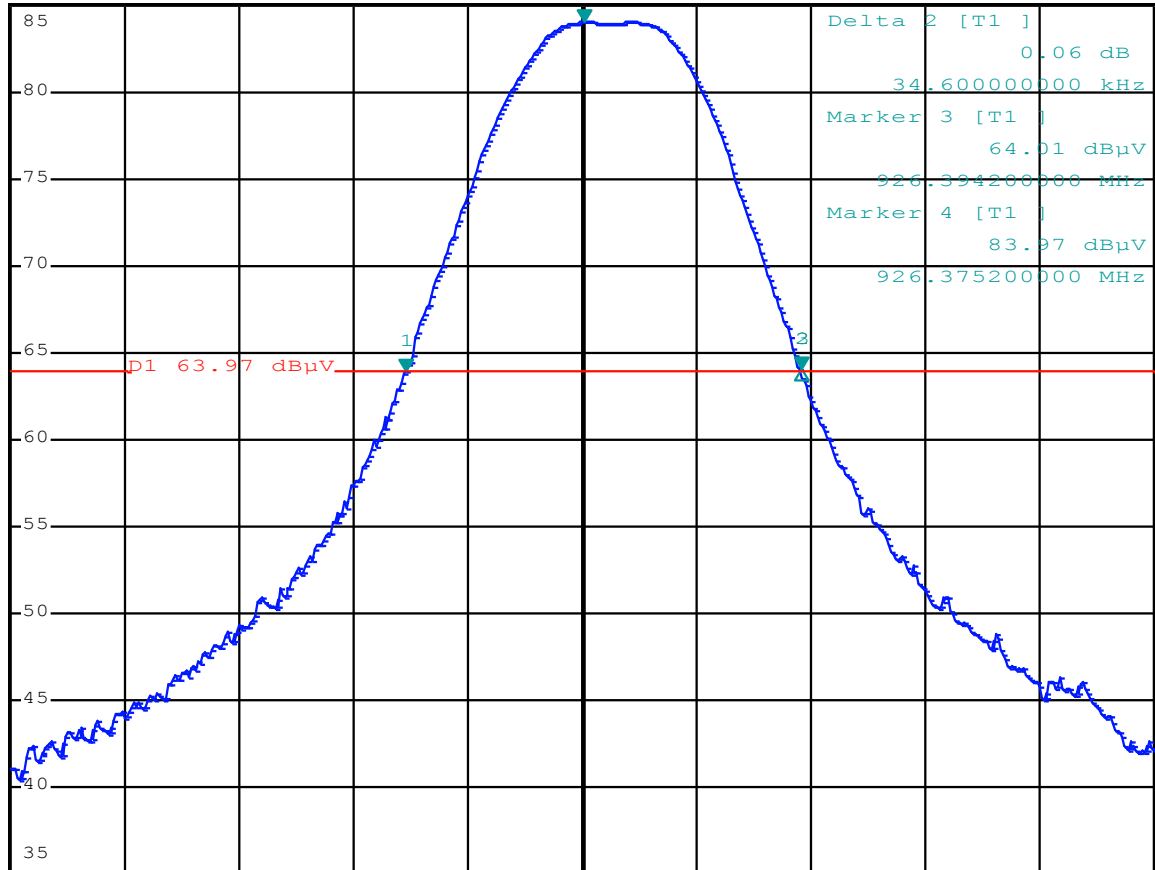


*RBW 10 kHz Marker 1 [T1]
VBW 30 kHz 63.94 dBμV
SWT 2.5 ms 926.359600000 MHz

Ref 85 dBμV

Att 10 dB

1 PK
VIEW



Center 926.375 MHz

10 kHz/

Span 100 kHz

FCC ID: KR537978000
IC ID: 7812D-37978000

20 dB bandwidth with car roof antenna 39150-TZ5A-A012-M1

SR1, 926.225 MHz:

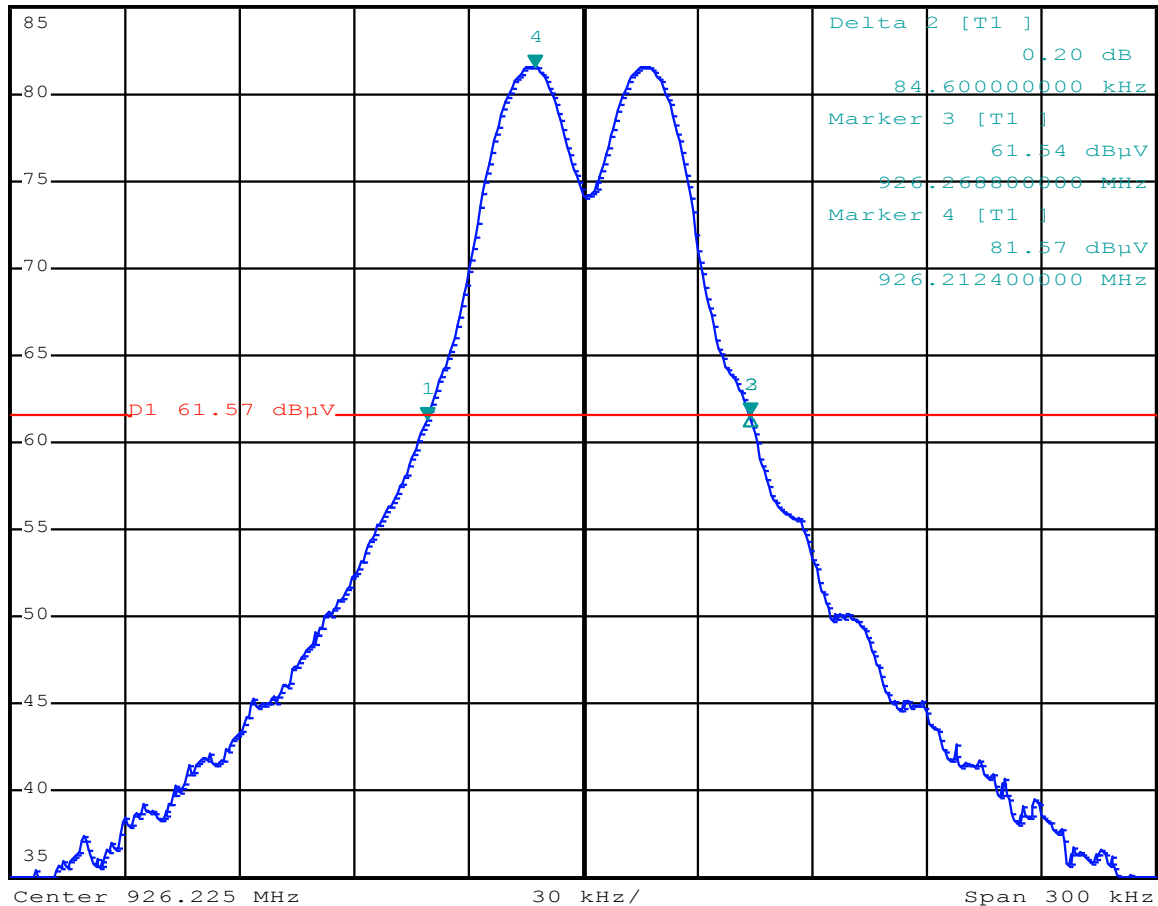


*RBW 10 kHz Marker 1 [T1]
VBW 30 kHz 61.34 dBμV
SWT 5 ms 926.184200000 MHz

Ref 85 dBμV

Att 10 dB

1 PK
VIEW



FCC ID: KR537978000
IC ID: 7812D-37978000

SR2, 925.925 MHz:



*RBW 10 kHz Marker 1 [T1]
VBW 30 kHz 61.43 dBμV
SWT 5 ms 925.884200000 MHz

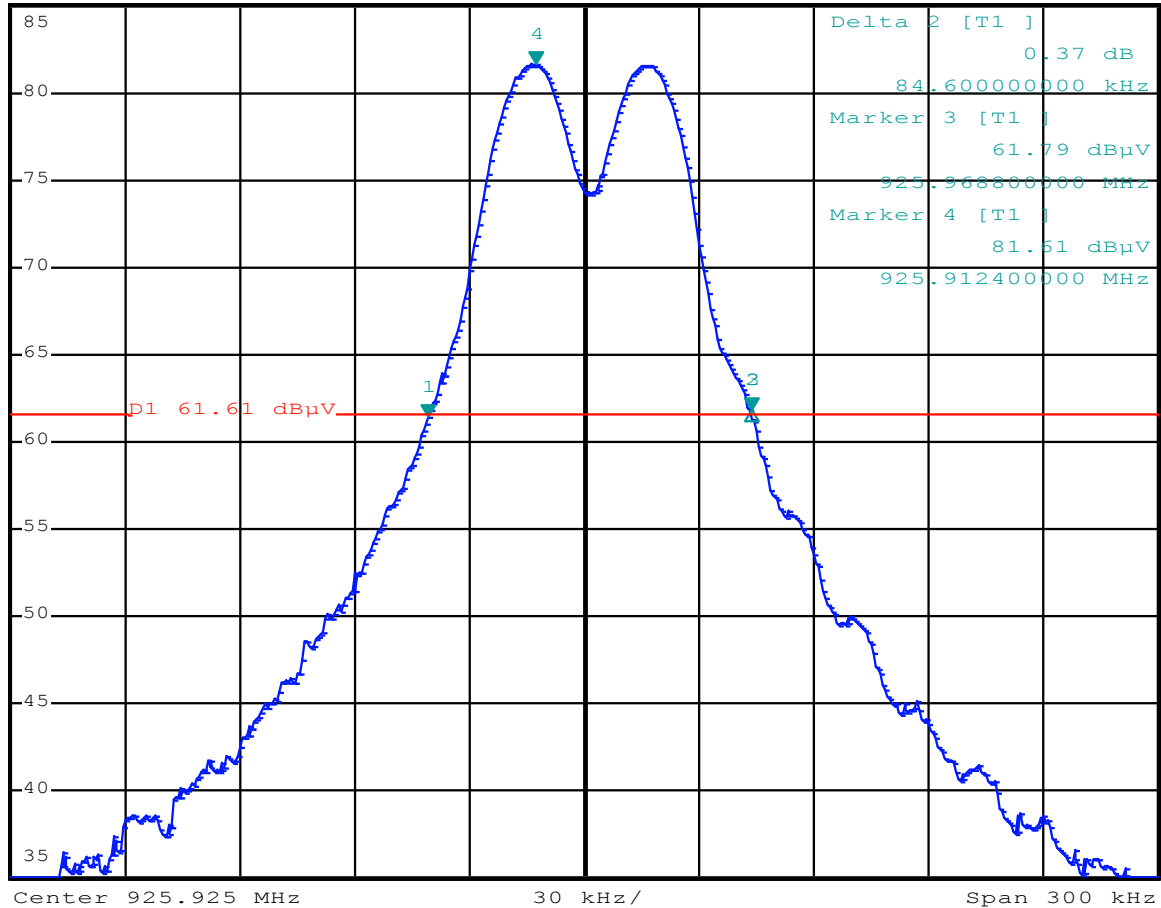
Ref 85 dBμV

Att 10 dB

SWT 5 ms

925.884200000 MHz

1 PK
VIEW



FCC ID: KR537978000
IC ID: 7812D-37978000

LR1, 925.775 MHz:



*RBW 10 kHz
VBW 30 kHz
SWT 2.5 ms

Marker 1 [T1]
63.34 dBμV
925.759200000 MHz

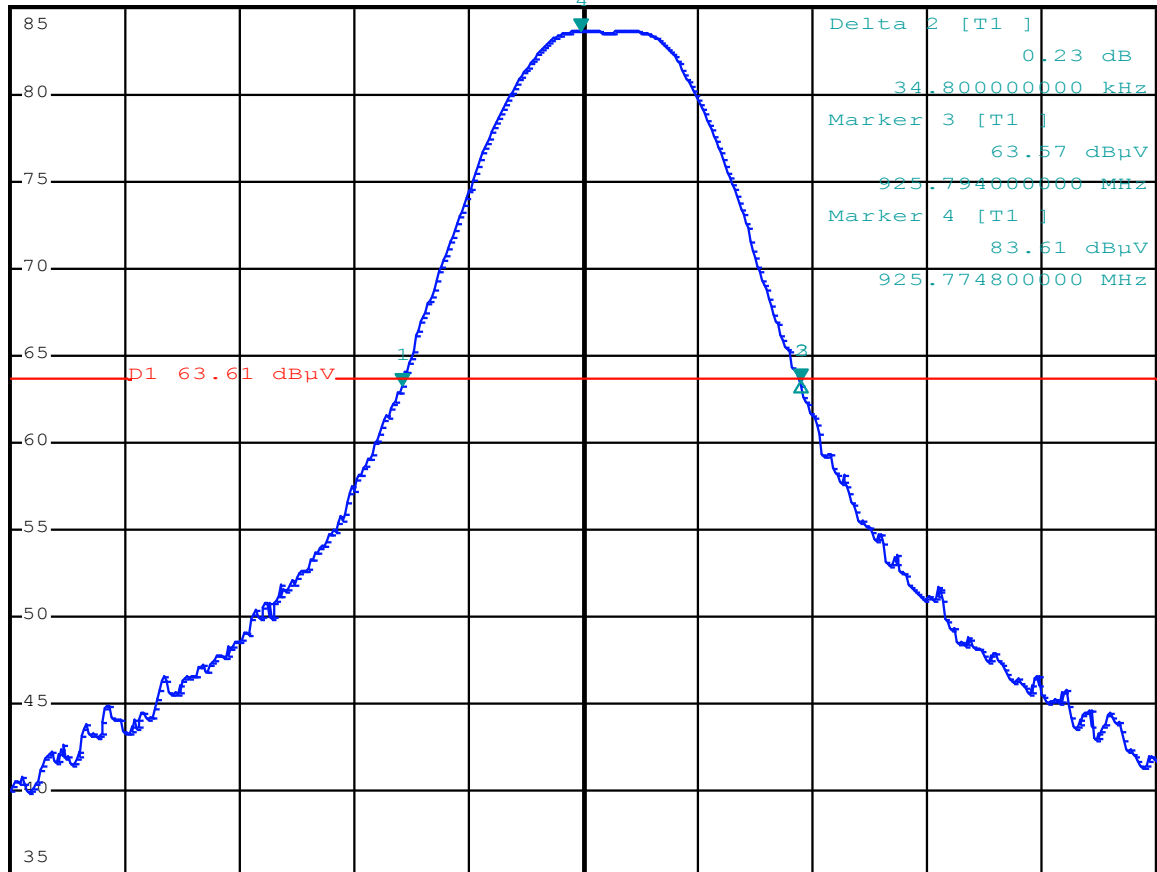
Ref 85 dBμV

Att 10 dB

SWT 2.5 ms

925.759200000 MHz

1 PK
VIEW



Center 925.775 MHz

10 kHz/

Span 100 kHz

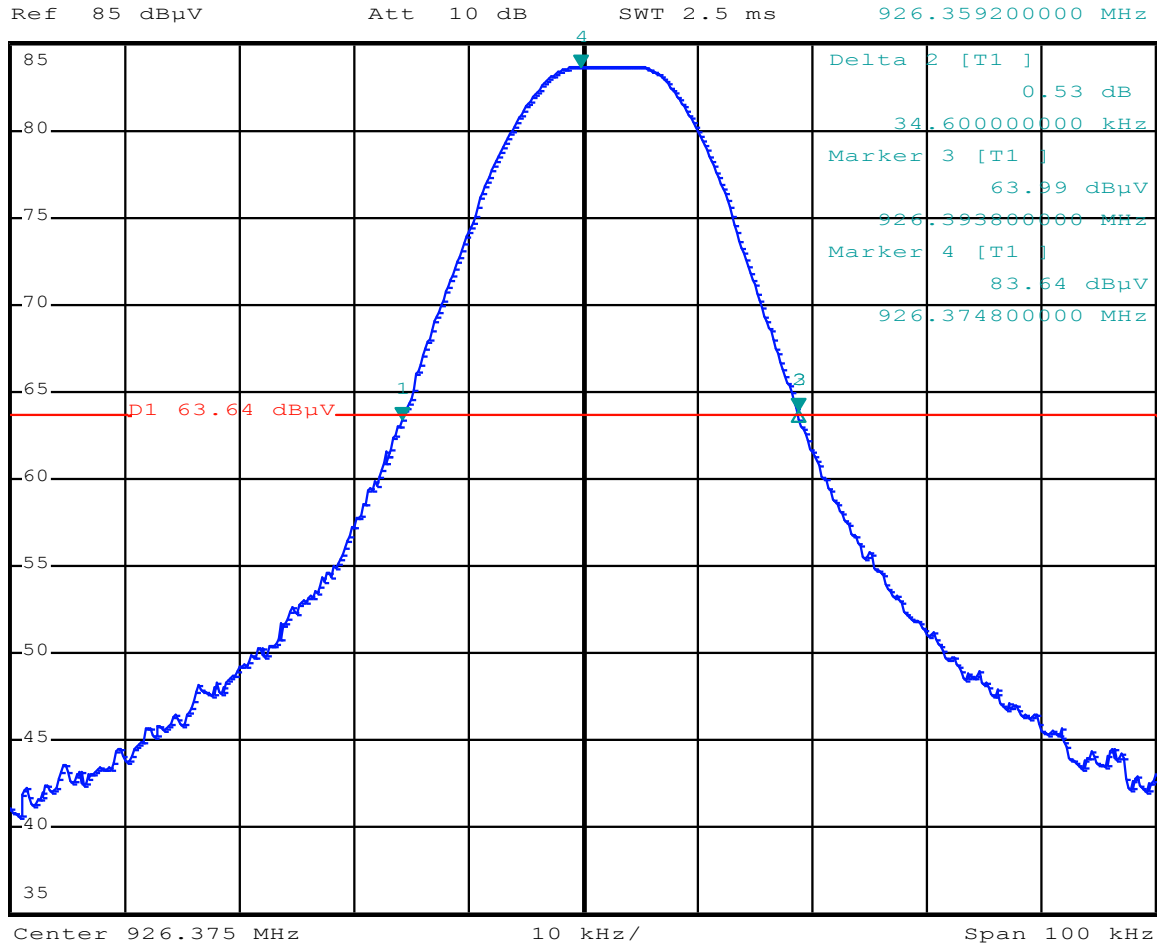
3DB

FCC ID: KR537978000
IC ID: 7812D-37978000

LR2, 926.375 MHz:



*RBW 10 kHz Marker 1 [T1]
VBW 30 kHz 63.45 dBμV
SWT 2.5 ms 926.359200000 MHz



FCC ID: KR537978000
IC ID: 7812D-37978000

5.5 Bandwidth of momentary signals

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

5.5.1 Description of the test location

Test location: Anechoic chamber 2

5.5.2 Photo documentation of the test set-up



5.5.3 Test result

- Car roof antenna 39150-TZ6A-A013-M1

Fundamental frequency (MHz)	99% bandwidth f_1 (MHz)	99% bandwidth f_2 (MHz)	Measured bandwidth (MHz)	Limit (MHz)
926.225	926.1908	926.2640	0.73	4.63
925.925	925.8908	925.9640	0.73	4.63
925.775	925.7622	925.7918	0.30	4.63
926.375	926.3622	926.3918	0.30	4.63

- Car roof antenna 39150-TZ5A-A012-M1

Fundamental frequency (MHz)	99% bandwidth f_1 (MHz)	99% bandwidth f_2 (MHz)	Measured bandwidth (MHz)	Limit (MHz)
926.225	926.1896	926.2628	0.73	4.63
925.925	925.8896	925.9628	0.73	4.63
925.775	925.7618	925.7912	0.30	4.63
926.375	926.3618	926.3912	0.30	4.63

FCC ID: KR537978000
IC ID: 7812D-37978000

Limit according to RSS 210, Annex 1, section A1.1.3:

The 99% bandwidth shall be no wider than 0.50% of the center frequency for devices operating above 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.

mikes

FCC ID: KR537978000
IC ID: 7812D-37978000

5.5.4 Test protocol

Emission bandwidth

RSS 210 Annex 1, section A1.1.3

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

With car roof antenna 39150-TZ6A-A013-M1

SR1, 926.225 MHz:



★ RBW 10 kHz Marker 1 [T1]
VBW 30 kHz 82.26 dBμV
SWT 5 ms 926.212400000 MHz

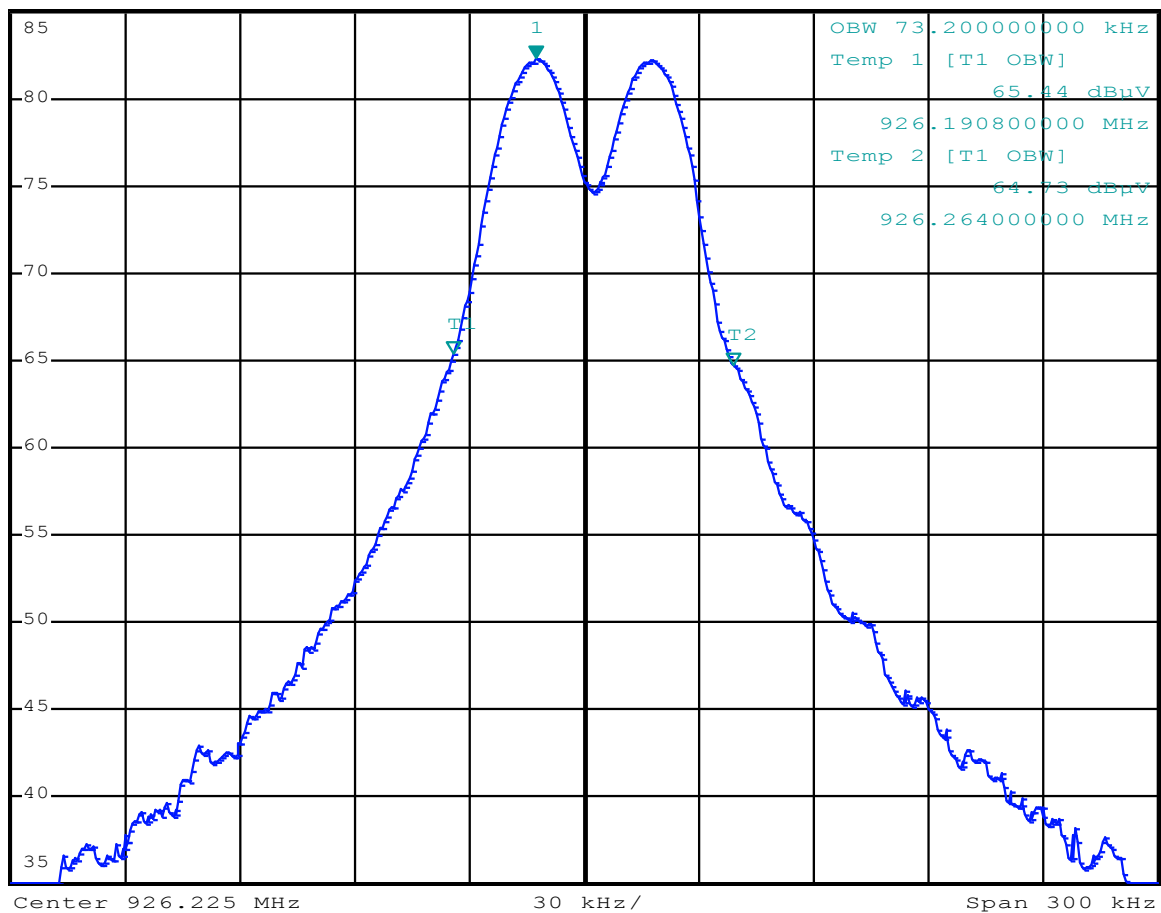
Ref 85 dBμV

Att 10 dB

SWT 5 ms

926.212400000 MHz

1 PK
VIEW



FCC ID: KR537978000
IC ID: 7812D-37978000

SR2, 925.925 MHz:



*RBW 10 kHz Marker 1 [T1]
VBW 30 kHz 82.21 dBμV
SWT 5 ms 925.912400000 MHz

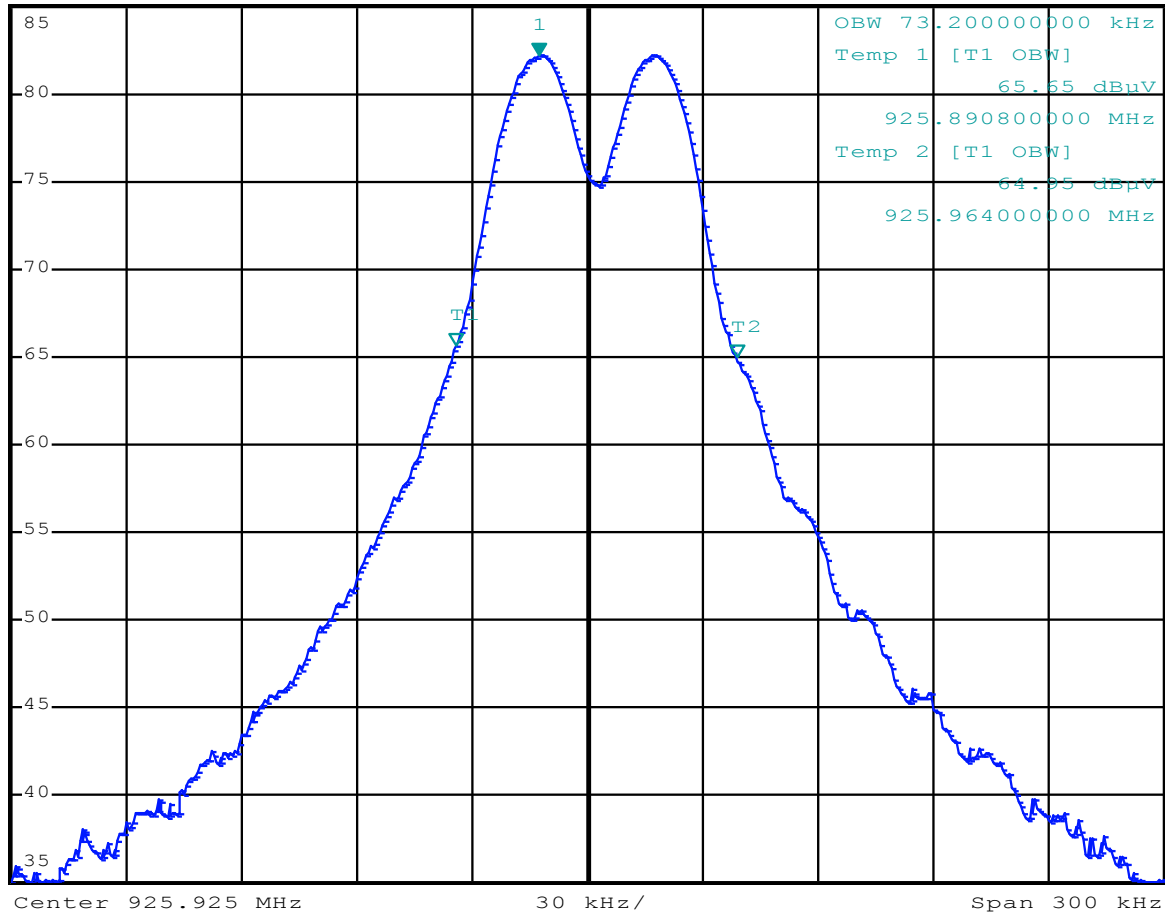
Ref 85 dBμV

Att 10 dB

SWT 5 ms

925.912400000 MHz

1 PK
VIEW



FCC ID: KR537978000
IC ID: 7812D-37978000

LR1, 925.775 MHz:



*RBW 10 kHz Marker 1 [T1]
VBW 30 kHz 84.11 dBμV
SWT 2.5 ms 925.779800000 MHz

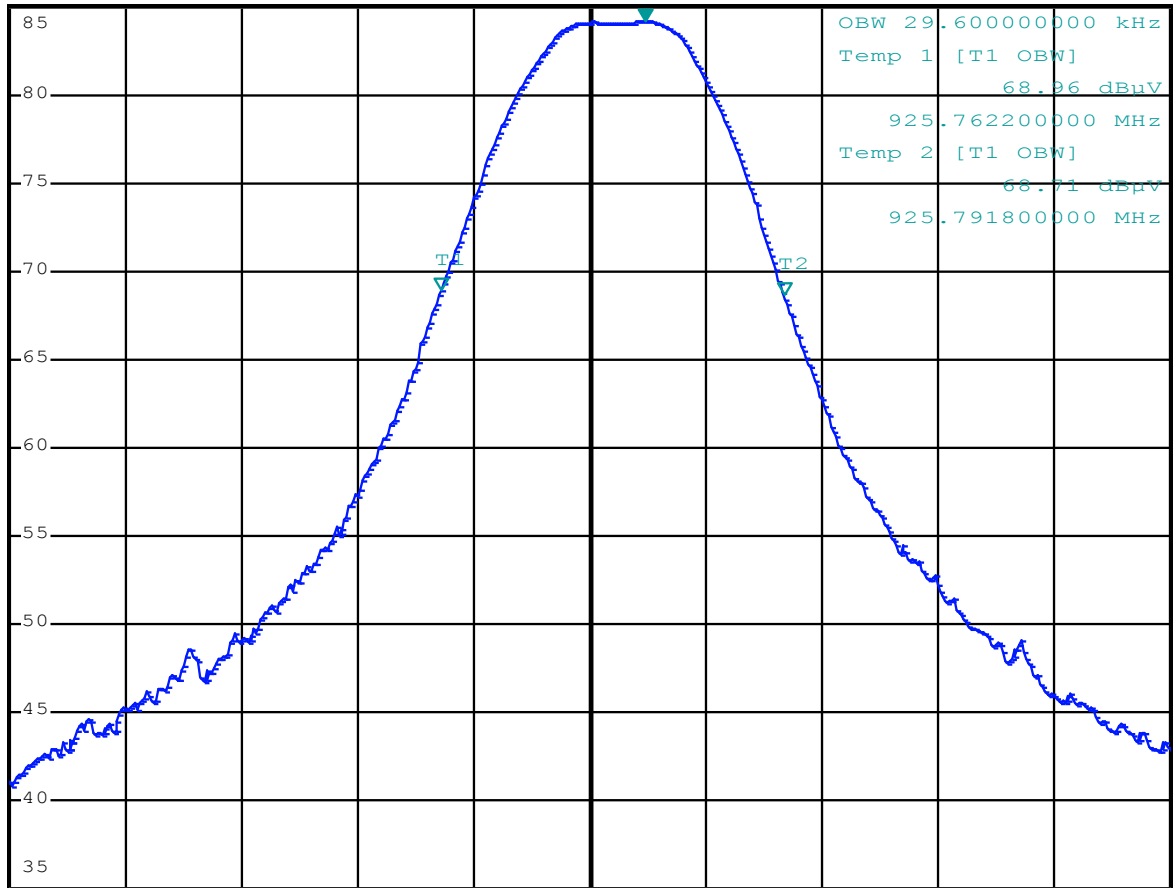
Ref 85 dBμV

Att 10 dB

SWT 2.5 ms

925.779800000 MHz

1 PK
VIEW



Center 925.775 MHz

10 kHz/

Span 100 kHz

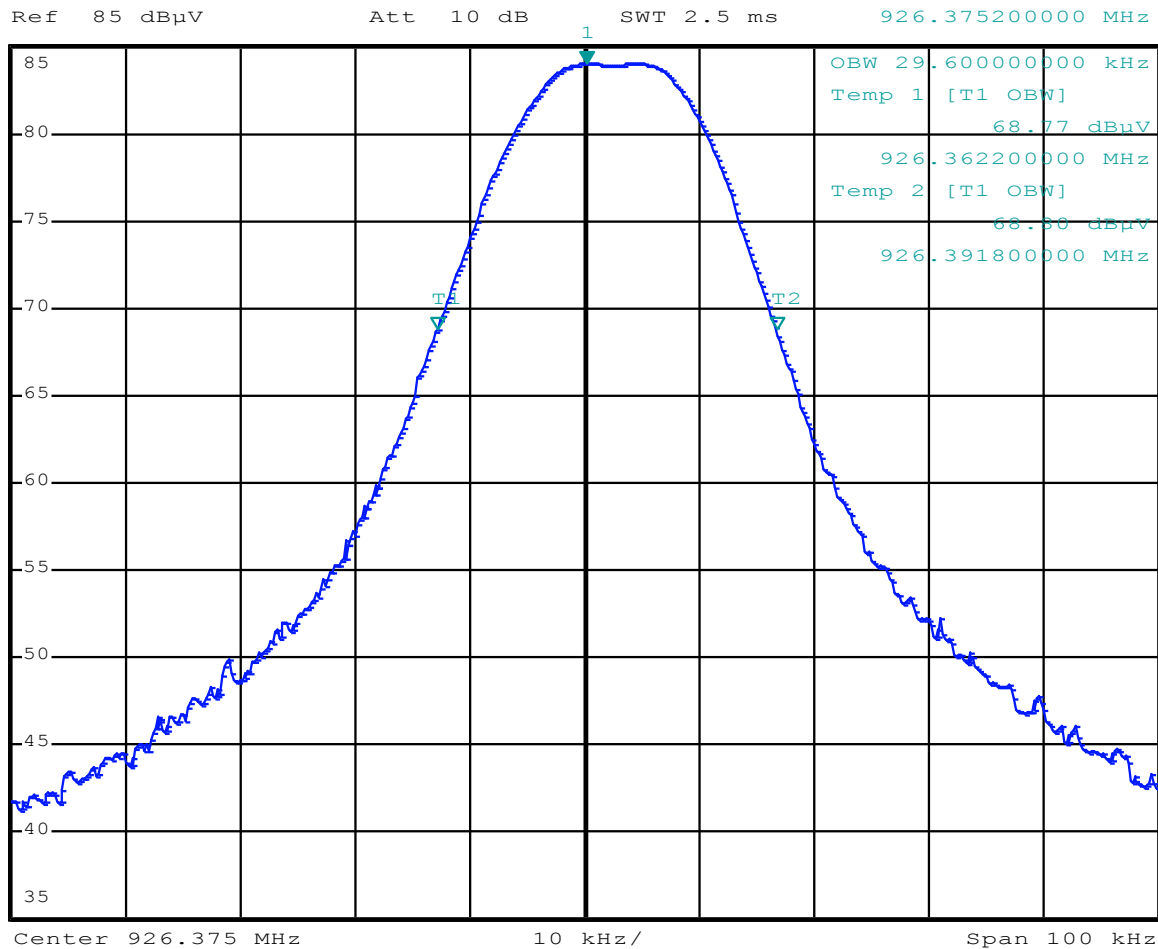
FCC ID: KR537978000
IC ID: 7812D-37978000

LR2, 926.375 MHz:



*RBW 10 kHz Marker 1 [T1]
VBW 30 kHz 83.98 dBμV
SWT 2.5 ms 926.375200000 MHz

1 PK
VIEW



3

FCC ID: KR537978000
IC ID: 7812D-37978000

With car roof antenna 39150-TZ5A-A012-M1

SR1, 926.225 MHz:

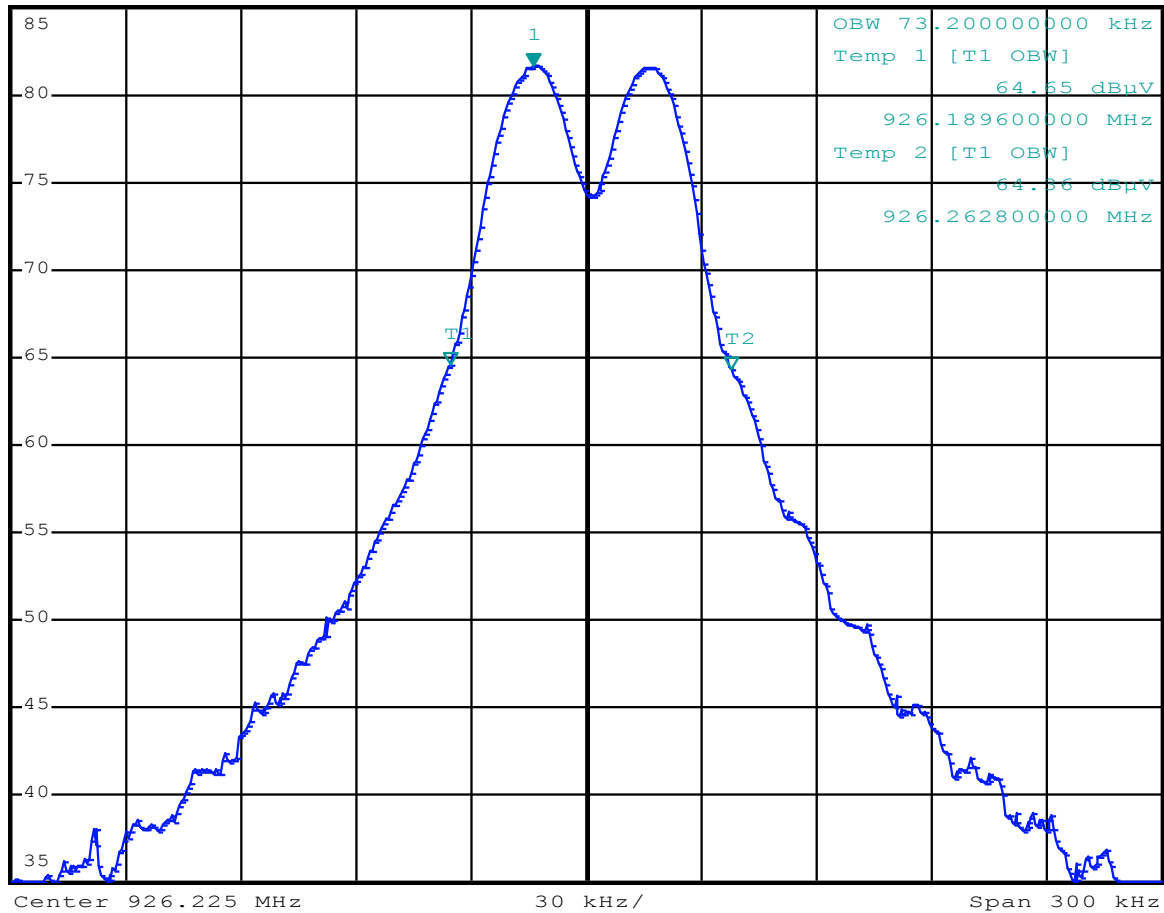


*RBW 10 kHz Marker 1 [T1]
VBW 30 kHz 81.68 dBμV
SWT 5 ms 926.211200000 MHz

Ref 85 dBμV

Att 10 dB

1 PK
VIEW



FCC ID: KR537978000
IC ID: 7812D-37978000

SR2, 925.925 MHz:



*RBW 10 kHz Marker 1 [T1]
VBW 30 kHz 81.59 dBμV
SWT 5 ms 925.911200000 MHz

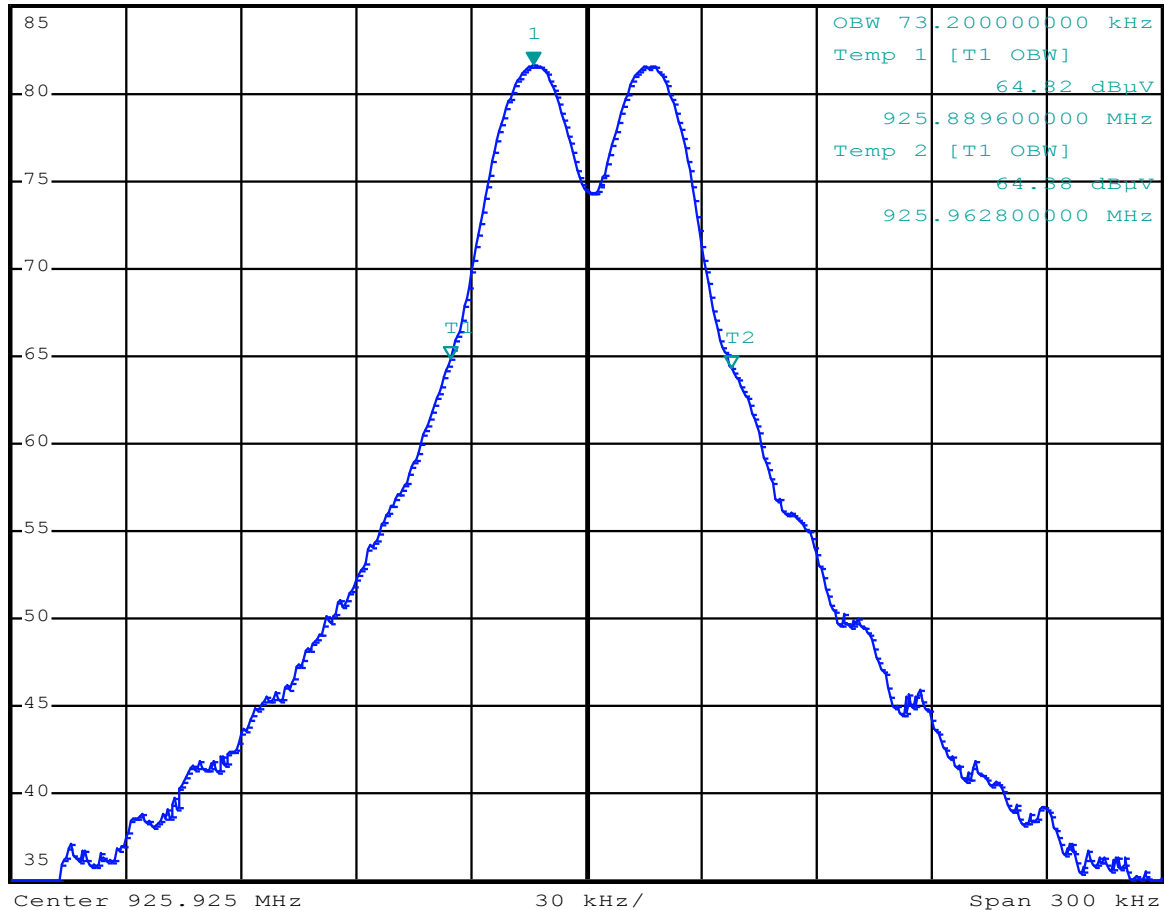
Ref 85 dBμV

Att 10 dB

SWT 5 ms

925.911200000 MHz

1 PK
VIEW



FCC ID: KR537978000
IC ID: 7812D-37978000

LR1, 925.775 MHz:

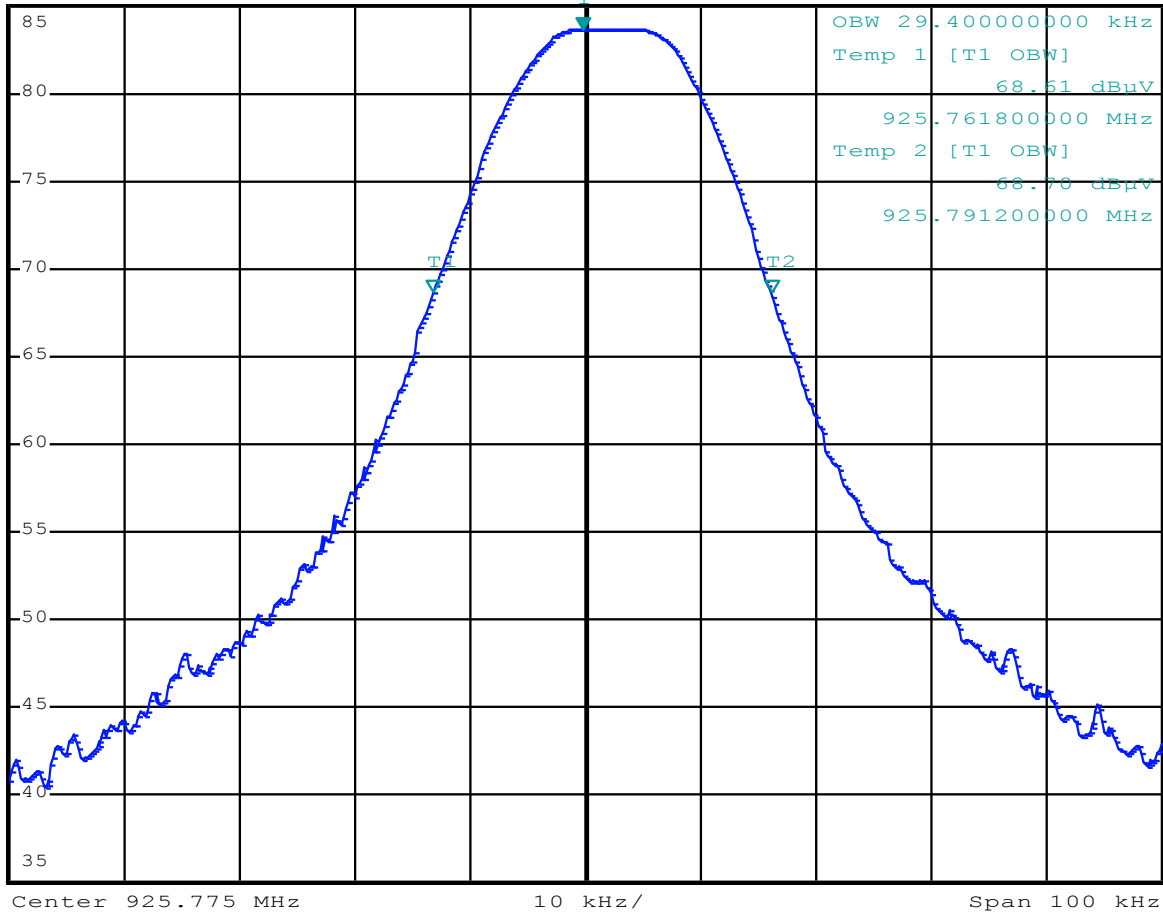


*RBW 10 kHz Marker 1 [T1]
VBW 30 kHz 83.68 dBμV
SWT 2.5 ms 925.774800000 MHz

Ref 85 dBμV

Att 10 dB

1 PK
VIEW



FCC ID: KR537978000
IC ID: 7812D-37978000

LR2, 926.375 MHz:

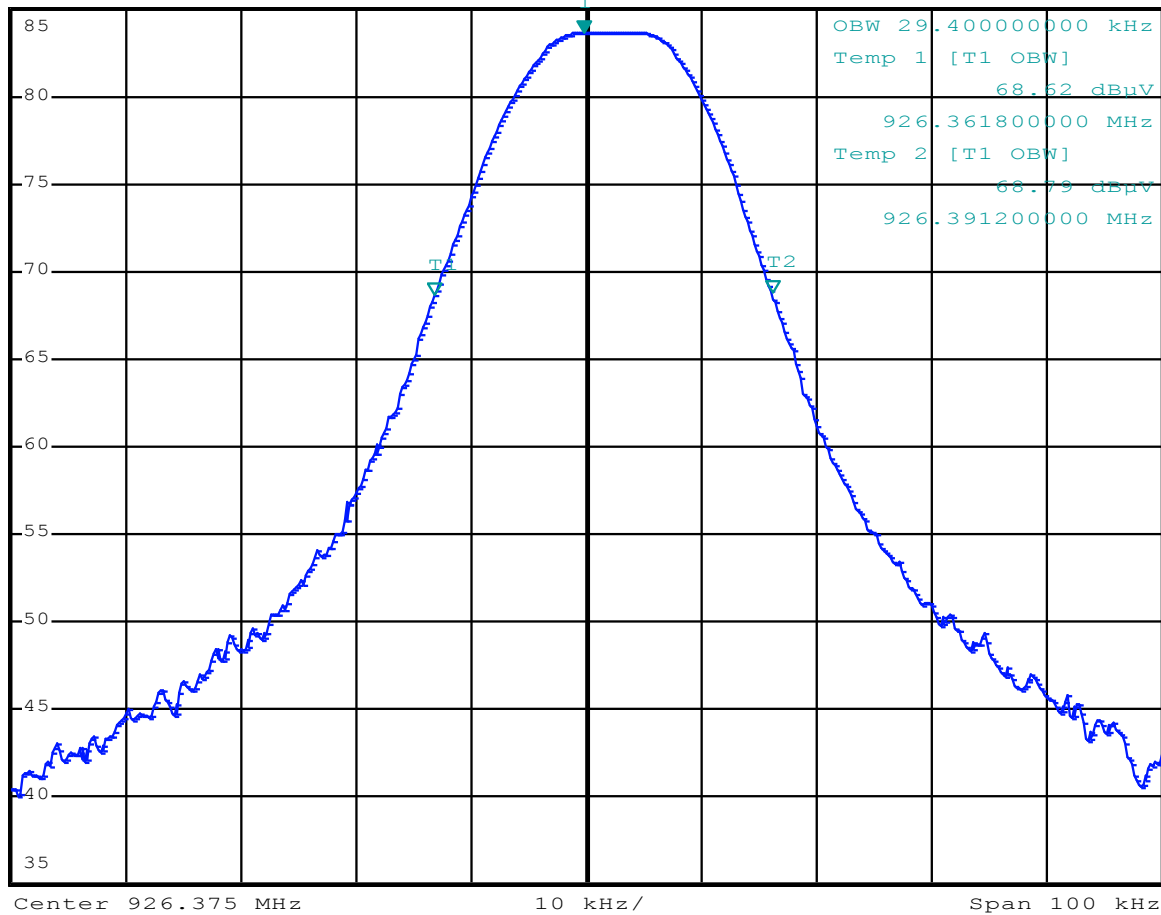


*RBW 10 kHz Marker 1 [T1]
VBW 30 kHz 83.64 dBμV
SWT 2.5 ms 926.374800000 MHz

Ref 85 dBμV

Att 10 dB

1 PK
VIEW



FCC ID: KR537978000
IC ID: 7812D-37978000

5.6 Antenna application

5.6.1 Applicable standard

According to FCC Part 15C, Section 15.203(a):

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section.

5.6.2 Result

The EUT use an antenna which will be mounted on a roof of a vehicle. There are two different antenna types. No other antenna than that furnished by the responsible party or external power amplifier can be applied by a customer.

The antenna of the EUT meets the requirement of FCC Part 15C, Section 15.203 and 15.204.

- Antenna data:

Table. 6 BIDIR, Directionality (ϕ 1m GND Plane)

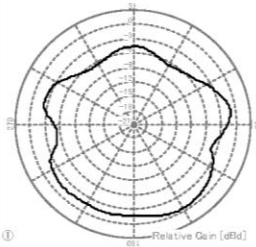
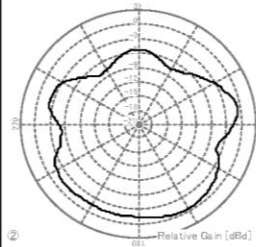
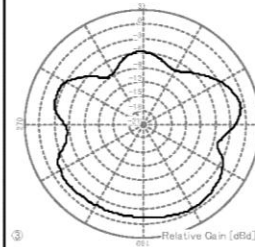
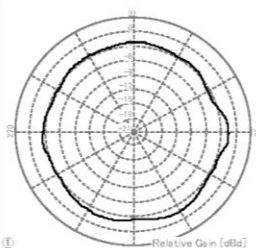
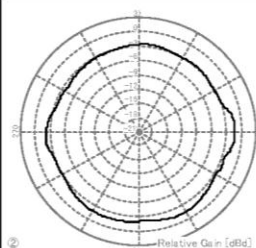
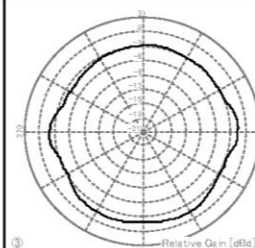
Sample No.	Part#	Frequency [MHz]		
		920	925	930
1	39150-TZ6A-A013-M1			
		①	②	③
		Relative Gain [dBd]	Relative Gain [dBd]	Relative Gain [dBd]
2	39150-TZ5A-A012-M1			
		①	②	③
		Relative Gain [dBd]	Relative Gain [dBd]	Relative Gain [dBd]

Table.3 BIDIR, Avg. Gain [dBd]

		Avg. Gain [dBd]		
Frequency		920MHz	925MHz	930MHz
SPEC.		≥ -4.0		
Sample No.	1	-3.07	-3.04	-3.08
	2	-2.63	-2.61	-2.65

1. Sample information

Sample No.	Part#	Media		
		XM	TEL	BIDIR
1	39150-TZ6A-A013-M1	○	○	○
2	39150-TZ5A-A012-M1	○	-	○

Table.4 BIDIR, Min. Gain [dBd]

		Min. Gain [dBd]		
Frequency		920MHz	925MHz	930MHz
SPEC.		≥ -10.0		
Sample No.	1	-6.63	-8.02	-8.84
	2	-3.83	-3.76	-4.10

2. Measurement Result

Table.2 BIDIR, VSWR

		VSWR		
Frequency		920MHz	925MHz	930MHz
SPEC.		≤ 2.0		
Sample No.	1	1.81	1.74	1.69
	2	1.80	1.76	1.69

Table.5 BIDIR, Antenna DC Resistance

		Resistance Value (k Ω)
Frequency		
SPEC.		9~11
Sample No.	1	9.96
	2	10.08

FCC ID: KR537978000
IC ID: 7812D-37978000

5.7 Receiver radiated emissions

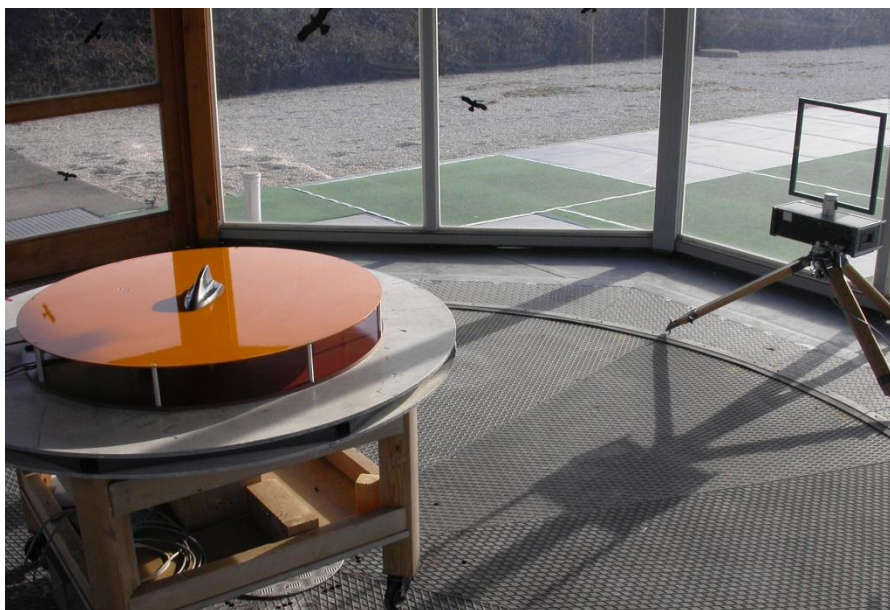
For test instruments and accessories used see section 6 Part **SER1**, **SER2** and **SER3**.

5.7.1 Description of the test location

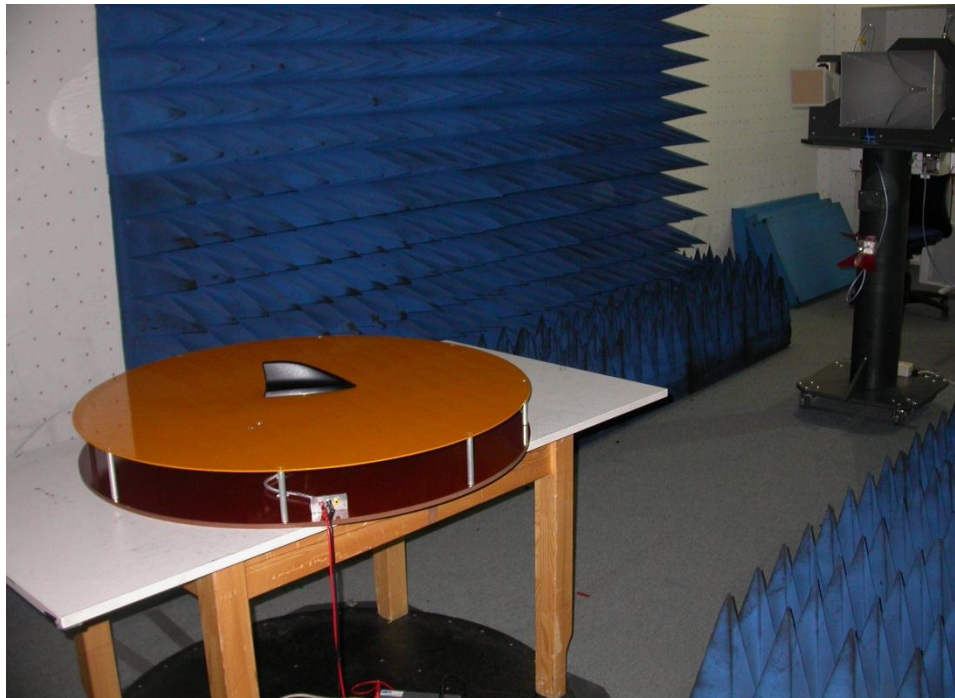
Test location: OATS 1
Test location: Anechoic chamber 2

Test distance: 3 m

5.7.2 Photo documentation of the test set-up



FCC ID: KR537978000
IC ID: 7812D-37978000



5.7.3 Applicable standard

According to FCC Part 15C, Section 15.109(a):

Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 m shall not exceed the given limit.

5.7.4 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. In the frequency range above 1 GHz a spectrum analyser is used with appropriate linear polarized antennas. The set up of the EUT will be in accordance to ANSI C63.4. If the emission level in peak mode complies with the average limit 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. During the test, the EUT was set into continuous transmitting mode, modulated.

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 – 40 GHz	RBW = VBW:	1 MHz

FCC ID: KR537978000
IC ID: 7812D-37978000

5.7.5 Test result $f < 1$ GHz

Frequency [MHz]	L: QP [dB μ V]	L: AV [dB μ V]	Bandwidth [kHz]	Correct. [dB]	L: QP [dB μ V/m]	L: AV [dB μ V/m]	Limit [dB μ V/m]	Delta [dB]
0.009-0.150			0.2	20				>20
0.150-30.0			9.0	20				>20

Frequency [MHz]	L: PK [dB μ V]	L: AV [dB μ V]	L: QP [dB μ V]	Correct. [dB]	L: PK [dB μ V/m]	L: AV [dB μ V/m]	L: QP [dB μ V/m]	Limit [dB μ V/m]	Delta [dB]
30-88							<20	40	>20
88-216							<20	43,5	>23,5
216-960							<20	46	>26

5.7.6 Test result $f > 1$ GHz

Frequency (MHz)	L: PK (dB μ V)	L: AV (dB μ V)	Bandwidth (kHz)	Correct. (dB)	L: PK dB(μ V/m)	L: AV dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
Above 960	---	---	1000				54	>20

Limit according to FCC Part 15 Subpart 15.209(a)

Frequency (MHz)	Field strength of spurious emissions		Measurement distance (meters)
	(μ V/m)	dB (μ V/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

Limit according to FCC part , Section 15.109(a):

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

The requirements are **FULFILLED**.

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

FCC ID: KR537978000
IC ID: 7812D-37978000

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	26/06/2013	26/06/2012		
	VULB 9168	02-02/24-05-005	16/03/2013	16/03/2012	08/04/2013	08/10/2012
	MetraHIT World	02-02/32-10-001	09/08/2013	09/08/2012		
	S10162-B	02-02/50-05-031				
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N_20m	02-02/50-12-018				
MB	FSP 40	02-02/11-11-001	18/09/2013	18/09/2012		
	RF Antenna	02-02/24-05-032				
	MetraHIT World	02-02/32-10-001	09/08/2013	09/08/2012		
SER 1	FMZB 1516	01-02/24-01-018			16/02/2013	16/02/2012
	ESCI	02-02/03-05-005	03/12/2013	03/12/2012		
	MetraHIT World	02-02/32-10-001	09/08/2013	09/08/2012		
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
SER 2	ESVS 30	02-02/03-05-006	26/06/2013	26/06/2012		
	VULB 9168	02-02/24-05-005	16/03/2013	16/03/2012	08/04/2013	08/10/2012
	MetraHIT World	02-02/32-10-001	09/08/2013	09/08/2012		
	S10162-B	02-02/50-05-031				
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N_20m	02-02/50-12-018				
SER 3	FSP 40	02-02/11-11-001	18/09/2013	18/09/2012		
	AFS4-01000400-10-10P-4	02-02/17-05-003				
	AMF-4F-04001200-15-10P	02-02/17-05-004				
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	3117	02-02/24-05-009	18/12/2013	18/12/2012		
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