Recognized by the
Federal Communications Commission and Industry Canada
Anechoic chamber registration No.: 90462 (FCC)
Anechoic chamber registration No.: 3462C-1 (IC)
TCB ID: DE0001

Accredited by the
German Accreditation Council
DAR–Registration Number
DAT-P-176/94-D1

Test report No.: **5-6075-01-06/08-A**
Applicant : Robert Bosch GmbH
Type : Radarsensor (LRR3-SCU elliptical lens)
WVR (LRR3-SCU circular lens)
Test standard : FCC Part 15 (§15.253)
FCC ID : NF3-LRR3SCU
IC : 3887A-LRR3SCU

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1 General information

1.1 Notes

The test results of this test report relate exclusively to the test item specified in 1.5. CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item .

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Tester :

Date	Name	Signature
2009-03-23	Nicolas Stamber	

Technical responsibility for area of testing:

Date	Name	Signature
2009-03-23	Karsten Geraldy	

1.2 Testing laboratory

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Accredited testing laboratory
Accredited by : Deutscher AkkreditierungsRat DAR, DATech
Listed by : Federal Communications Commission (FCC)
Industry Canada (IC)

Authority	Identification/Registration No.
RegTP	DAT-P-174/94-D1
FCC	90462
IC	3462C-1

Testing location, if different from CETECOM ICT Services GmbH: Not applicable

1.3 Details of applicant

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1.4 Application details

Date of application : 2008-01-17
Date of receipt of EUT : 2008-07-21
Date of test : 2008-07-21, 2008-07-22, 2008-10-07, 2009-01-09, 2009-02-02, 2009-03-19

1.5 Test item (EUT)

Description of EUT	:	Millimeterwave Radar sensor; Vehicle mounted field disturbance sensor
System designation	:	Automatic cruise control system
Type designation	:	Radarsensor (LRR3-SCU with elliptical shaped lens) WVR (LRR3-SCU with circular shaped lens)
Manufacturer		
Name	:	Robert Bosch GmbH
Street	:	Daimlerstr.6
Town	:	D-71229 Leonberg
Country	:	Germany

1.6 Technical data

Frequency range	:	76.000 GHz ... 77.000 GHz
Operational frequency	:	76.105 GHz ... 76.909 GHz
Power Density (PEP)	:	1.16 µW/cm^2 (at 3m distance)
Type of modulation	:	808M0F0N (FMCW)
Antenna modules	:	TX / RX - Module with integrated fixed antenna
Normal DC power supply	:	13.8 V
Extreme DC power supply	:	10.0 ... 16.0 V

1.6.1 Operation conditions

Operation	:	As soon as the equipment is addressed via CAN / FlexRay-Bus, TX and RX start operation simultaneously. There is no receive-only mode applicable.
Purpose of operation	:	Adaptive distance measurement and cruise control for vehicular application
Operation modes	:	Vehicle in motion Vehicle not in motion
Additional test modes	:	CW center: Sweep stopped in the middle of band, CW transmission CW bottom: Sweep stopped on lower band edge, CW transmission CW top: Sweep stopped on upper band edge, CW transmission

1.6.2 Equipment under test

Radarsensor (LRR3-SCU with elliptical shaped lens) and WVR (LRR3-SCU with circular shaped lens). Two test samples (LRR3-SCU) were provided. One of them was equipped with a circular shaped lens (WVR), the other test sample (Radarsensor) had an elliptical shaped lens. Some tests (e.g. frequency stability, bandwidth) were performed on the WVR only. Comparison measurements was done showing possible differences between WVR and Radarsensor.

1.7 Test standards

	Code of Federal Regulations (CFR 47) Federal Communications Commission (FCC)
FCC Part 15	Radio Frequency Devices (2006-08) Section 15.253 Operation within the band 76.0 to 77.0 GHz.
	Section 15.209 Radiation emission limits, general requirements
	Section 15.205 Restricted bands of operation.
	Industry Canada Radio Standards Specification
RSS - 210	Low Power Licence-Exempt Radiocommunication Devices Section A13.1 76.0 - 77.0 GHz Vehicle -Mounted Field Disturbance Sensors Issue 7

2 Technical test

2.1 Summary of test results

[X] No deviations from the technical specification (s) were ascertained in the course of the performed tests.

[ ] The deviations as specified in 2.5 were ascertained in the course of the performed tests.

This test report :

[X] describes the first test

[ ] describes an additional test

[ ] is a verification of documents

[ ] is only valid with the test report no.

2.2 Test environment

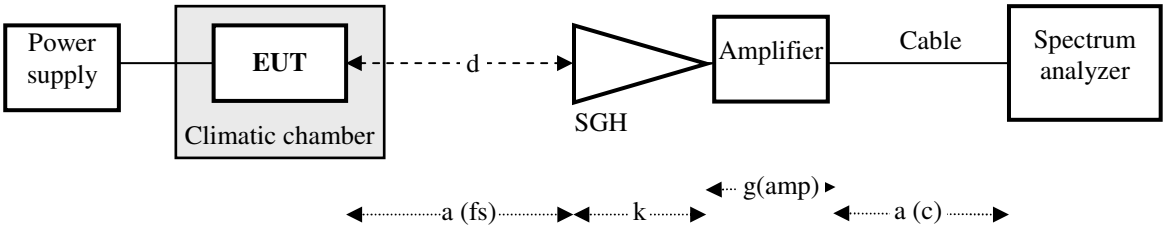
The environmental conditions are documented especially for each test.

2.3 Measurement and test set-up

The measurement and test set-up is defined in the technical specification.

2.4 Test equipment utilized and test set-up

Field strength of spurious radiation in the frequency range 12 GHz to 40 GHz
Frequency stability of wanted signals



Frequency f [GHz]	Distance d [m]	Standard gain Horn ant. (SGH)	Dist. correction. dc (3m/Xm) [dB]	Antenna factor k [dB 1/m]	Cable loss a [dB]	Amplifier gain g(amp)[dB]
12 ... 18	0.125	narda 639	-27.6	34.0	3.1	35.0
18 ... 26	0.125	narda 638	-27.6	40.2	3.3	33.0
26 ... 40	0.125	narda V637	-27.6	44.0	4.2	19.0

Calculation : Field strength = Analyser reading + Cable loss + Antenna factor + Distance correction – Amp. gain

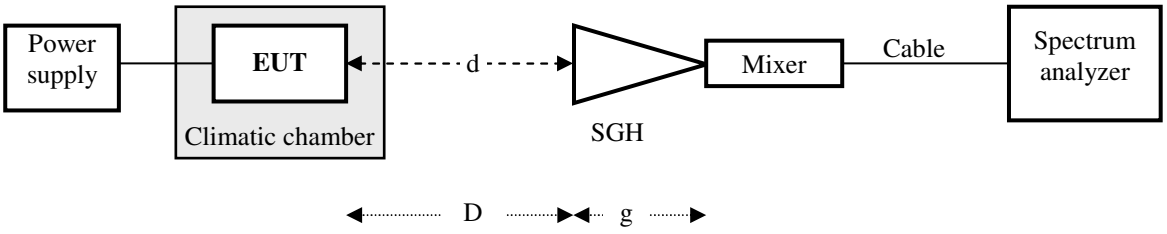
E = u + a + k + dc – g(amp)

Test equipment	Manufacturer	Type	CETECOM reference	cal. / verif. date
Spectrum Analyser	Rohde & Schwarz	FSU 50	300003443	05.06.2008
Spectrum Analyser	HP	HP 8565E	300001665	18.01.2008
SGH 12 ... 18 GHz	narda	639	300000787	visual inspection
SGH 18 ... 26 GHz	narda	638	300002442	visual inspection
SGH 26 ... 40 GHz	narda	V637	300000510	visual inspection
Power supply	HP	6032A	300002115	15.05.2007
Microwave amplifier	HP	83017A	300002268	verif. before test
Microwave amplifier	Farran Techn.	-/-	-/-	verif. before test
RF-cable	HP	5061-5359	300002033	verif. before test

Measurement uncertainties

Test parameter	Measurement uncertainty
Power supply	±0.1 VDC
Temperature	±0.2 °C
Frequency	±0.01 ppm
eirp	±1.7 dB

Frequency stability and power density of wanted signal and spurious radiation in the frequency range 40 to 240 GHz



Frequency f [GHz]	Distance d [m]	Free space attenuation D [dB]	Antenna gain g [dBi]	System Attenuation [dB]
40 ... 60	0.125	46.5 … 50.0	20.0 (50 GHz)	28.4
60 ... 90	0.125	50.0 … 53.5	25.7 (75 GHz)	26.3
76.5	2.0	76.1	25.7	50.4
90 ... 140	0.125	53.5 … 57.4	25.5 (115 GHz)	30.1
140 ... 170	0.125	57.4 … 59.0	22.0 (155 GHz)	36.2
170 ... 240	0.125	59.0 … 62.0	20.0 (205 GHz)	40.7

Test distance: 0.125 m was used for detecting of spurious radiations. 2.0 m was adjusted to measure wanted signal levels. A test distance of 2.0 m meets the far field condition. This was verified by repetition of radiated power measurement at different distances (1 m, 1.5 m, 2 m, 3 m, 4 m) and comparing the differences in level with the theoretical values (20 dB/decade). So, an inverse squared distance attenuation factor of 40 dB/decade has not to be considered for a test distance of 2.0 m.

Calculation : Power density = EIRP /($4\pi d^2$) = EIRP / 1130973.4 cm^2 (for 3 m evaluation distance)

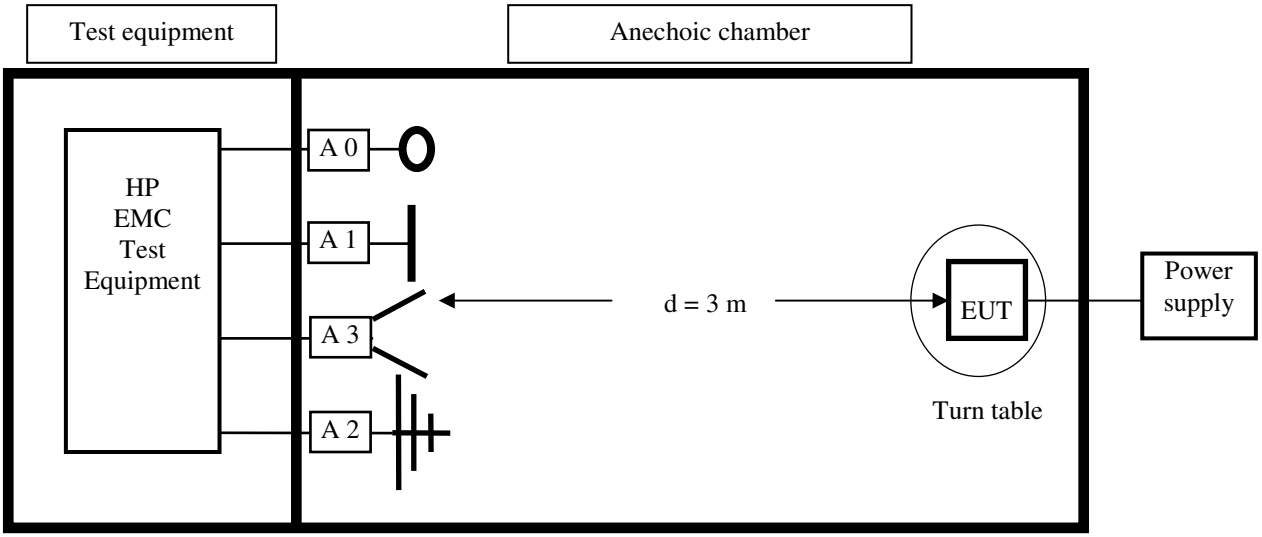
Test equipment	Manufacturer	Type	CETECOM reference	cal. / verif. date
Spectrum Analyser	HP	HP 8565E	300001665	18.01.2008
Spectrum Analyser	Tektronix	TEK 2782	300001401	28.08.2008
Spectrum Analyser	R&S	FSU 50	300003443	05.06.2008
Power supply	HP	6032A	300002115	15.05.2007
SGH 40 … 60 GHz	Flann	2424-20	300001200g	visual inspection
Mixer 40 … 60 GHz	Tektronix	WM490U	300000298b	2 year interval
SGH 60 … 90 GHz	Thomson	COR 60_90	300000814	visual inspection
Mixer 60 … 90 GHz	Tektronix	WM780E	300001685	2 year interval
SGH 90 … 140 GHz	Thomson	COR 90_140	300000799	visual inspection
Mixer 90 … 140 GHz	Tektronix	WM780F	300001685	n.a.
SGH 140 … 170 GHz	Flann	2924-20	300001999	visual inspection
Mixer 140 … 170 GHz	Tektronix	WM780D	300001685	n.a.
SGH 170 … 240 GHz	Flann	3224-20	300002000	visual inspection
Mixer 170 … 240 GHz	Tektronix	WM780J	300001685	n.a.

Measurement uncertainties

Test parameter	Measurement uncertainty
Power supply	±0.1 VDC
Temperature	±0.2 °C
Frequency	±0.01 ppm
eirp	±2.0 dB (up to 50 GHz)
eirp	±3.0 dB (above 50 GHz)

Field strength of spurious radiation in the frequency ranges 9 kHz to 30 MHz and 1 to 12 GHz (18 GHz pre-measurements)

Set-up for radiated measurements (FAC "Chamber C")



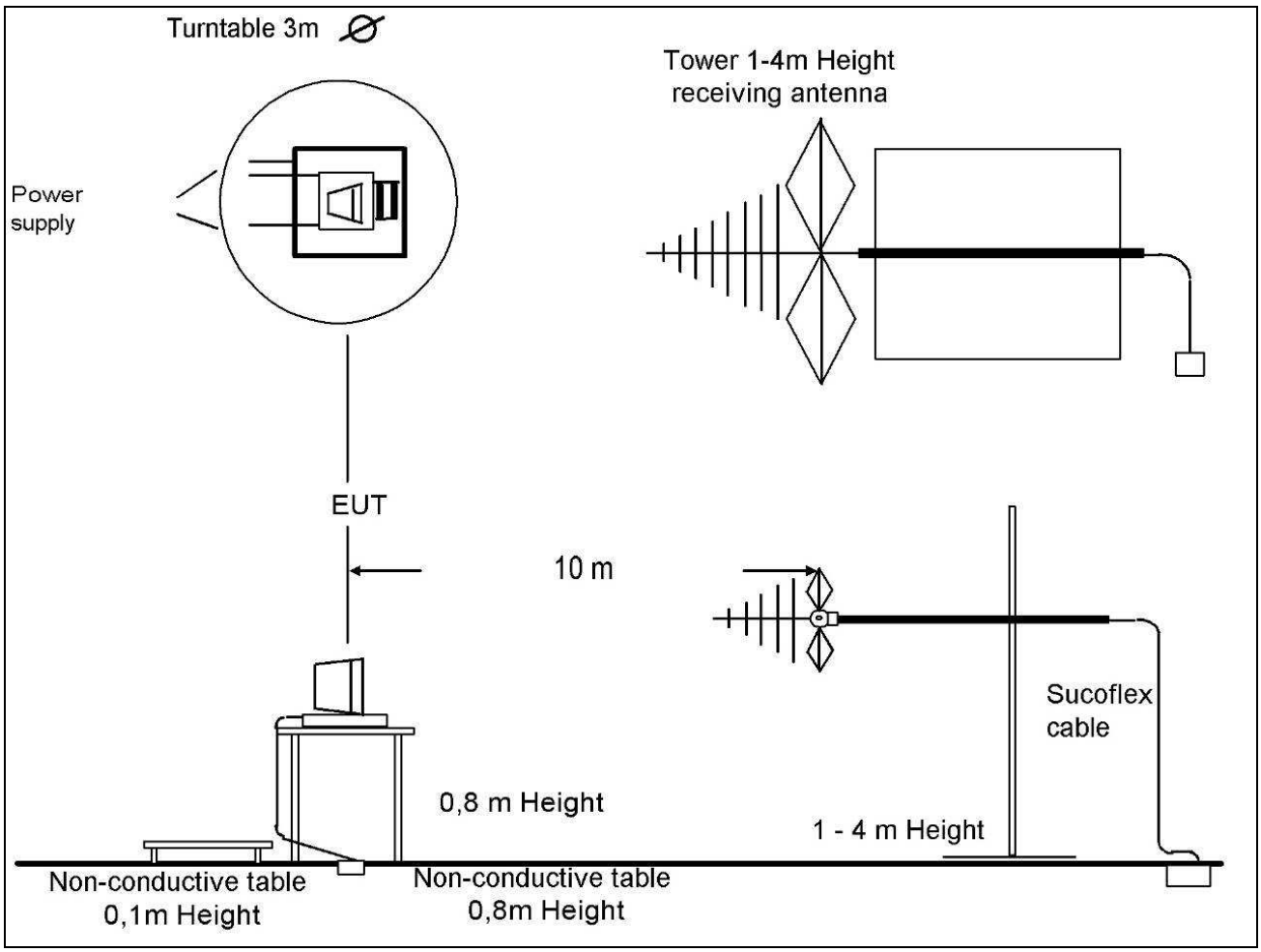
Test equipment	Manufacturer	Type	Serial No.	cal. / verif. date
Spectrum analyser	HP	HP 85660B	3138A07614	13.12.2007
Analyser display	HP	HP 85662A	2816A16541	13.12.2007
Quasi peak adapter	HP	HP 85650A	2811A01131	13.12.2007
RF-preselector	HP	HP 85685A	2833A00768	18.01.2008
Loop Antenna A 0	R&S	HFH 2–Z2	881 058/42	verif. before test
Biconical antenna A 1	Emco	3104	3758	verif. before test
Log.-per.-antenna A 2	Emco	3146	2304	verif. before test
Double ridge horn ant. A 3	Emco	3115	3007	verif. before test
Relay switch	R&S	RSU	375 339/002	verif. before test
High pass filter	FSY Microwave	HM 985955	(300001206)	verif. before test
Amplifier	Tron-Tech	P42-GA29	B2302	verif. before test
Power supply	HP	HP 6038A	2848A07027	15.05.2007
RF-cable	HP	5061-5359	P36303	verif. before test

Measurement uncertainties

Performance	Measurement uncertainty
Input power (DC)	±0.1 V
Temperature	±0.2 °C
Frequency	±0.01 ppm
RF-power	±2.0 dB

Field strength of spurious radiation in the frequency ranges 30 to 1000 MHz

Set-up for radiated measurements at test distances 3m and 10m (SAC "Chamber F")



Test equipment	Manufacturer	Type	Serial No.
Control Computer	F+W		FW0502032
Trilog-Antenna	Schwarzbeck	VULB 9163	9163-295
Amplifier	Veritech Microwave Inc.	0518C-138	-/-
Switch	HP	3488A	-/-
EMI Test receiver	R&S	ESCI	100083
Turntable Interface-Box	EMCO / ETS-LINDGREN	Model 105637	44583
Tower/Turntable Controller	EMCO / ETS-LINDGREN	Model 2090	64672
Tower	EMCO / ETS-LINDGREN	Model 2175	64762
Test Software	R&S	ESC 32	-/-

Measurement uncertainties:
The uncertainty of the measurement equipment meets CISPR 16 and the related European and international standards. The semi anechoic chamber fulfils the requirements of CISPR 16-1 (ANSI C63.4) for a test volume of 1.5m ∅.

2.5 Test results

2.5.1 Test results overview

This test was performed :

☐ in addition to the test report no.

Verification of EUT :

☒ EUT is in accordance with the technical description

☐ EUT is not in accordance with the technical description

☒ The equipment is compliant to FCC requirement

Remark: The results of the wanted signal measurements performed show a large margin to the limitations. So, the operation and test modes, on which the measurements were performed, are suitable and adequate to demonstrate compliance.

2.5.2 Remarks on methods of measurements

1. General

The radar under test is positioned on a non-conductive fixture and can be rotated and tilted in all angles.
The measurements of radiated emissions in the frequency range from 30 MHz to 1 GHz are performed in vertical and horizontal plane in a semi-anechoic chamber, compliant to CISPR 16-1 for test distances of 3m and 10m. The EUT is positioned on a non-conductive support at a height of 0.80 m above the conductive ground plane covering the whole chamber. The measuring antennas can be moved over a height range from 1.0 m to 4.0 m in order to detect the maximum field strength emitted from the EUT. These antennas are compliant with specifications ANSI C63.2-1996 clause 15 and ANSI C63.4-2003 clause 4.1.5.

Radiated emissions measurements in the frequency ranges from 9 kHz to 30 MHz and 1 GHz to 12 GHz (18 GHz for per-measurements) are carried out in a fully-anechoic chamber, compliant to CISPR 16-1, providing test distances up to 5 m. EUT and receiving antennas are positioned 1.5 m above the tips of the absorbers.
Measurements between 12 (18) GHz and 240 GHz are performed in certain test laboratory environments, where analyzers up to 50 GHz, without using mixers, and harmonic mixer modules and standard gain horns are available up to 320 GHz.

The measurement distances between EUT and receiving antennas are indicated in the test set–ups for the various frequency ranges. For each measurement, the EUT is three-dimensional rotated until the maximum field strength is received for both polarisations of the measuring antennas.

The wanted and unwanted emissions are received by spectrum analysers where the detector modes and resolution bandwidths (RBW) over various frequency ranges are set according to requirement ANSI C63-4-2003 clause 4.2.

2. Measurements of the EIRP and power density (PD) at fundamental frequency

The measurements are conducted according to FCC guideline "Millimeter Wave Test Procedure" with a spectrum analyser (SA), harmonic mixer covering appropriate frequency range and a rectangular standard gain horn antenna (SGH) with matching wave guide dimensions. The conversion loss of the external mixer is taken into account in the SA power level reading automatically.

The radiated power measurements are performed with resolution bandwidth filter (RBW) of 1.0 MHz and a video filter of 1 MHz. Tests are repeated with RBW 2.0 MHz and Video bandwidth filter (VBW) 3.0 MHz. The received EIRP does not change when RBW and VBW are set to higher values.

The evaluation distance for fundamental power measurement is 3.0 m. If the far field condition is met, a test distance of 2 m is usually used and compliance with the 3 m requirement is proved by corresponding calculation. The SA level scale is set to the dimension dBm. With the appropriate antenna aperture area the power density can be calculated from the equation:

Power Density	=	EIRP	/	Antenna aperture area [mW/cm ^{2}]
pd	=	eirp	–	a [dB(mW/cm ^{2})]

3. Measurements of frequency stability

The frequency stability of the EUT under normal and extreme test conditions is measured in CW-mode.

Frequency measurements are performed under normal test conditions (normal power supply voltage and normal temperature).

Then the test is repeated with extreme test conditions. For extreme test conditions the EUT is placed in a climatic chamber where the front door is made of stable polystyrene. The EUT can radiate through the front door without any additional path losses. The climatic chamber together with the EUT is cooled down to -20 ºC for 1 hour. Then frequency and power density measurements are carried out with power supply set to minimum and maximum values.

The climatic chamber together with the EUT is warmed up at a rate of + 1ºC/minute. During warming-up time the frequency stability and the eirp is monitored constantly. After 2 hours the temperature stability at 50 ºC is reached. Then frequency and power density measurements are carried out with minimum and maximum power supply.

4. Measurements of field strength and power density at spurious frequencies

Spurious frequencies are produced by transmitter and receiver when the EUT is active. The radar unit under test provides following operation modes:
- in motion mode
- not in motion mode

In order to avoid measuring errors in power levels caused by very short sweep times, the sweep of the EUT is stopped as certain frequencies.
According to FCC requirements 15.209 and 15.253, spurious emissions have to be investigated as maximum field strength values in the frequency range from 9 kHz to 40 GHz, and as maximum power density in the frequency range above 40 GHz up to 240 GHz. Where possible, the measurement distance shall be 3 m.

In the low frequency range (9 kHz to 30 MHz), the receiving antenna is an active loop antenna which is positioned at 3 m distance in a shielded, anechoic chamber. In case of required measuring distances greater than 3 m, a distance correction factor is used to calculate the received field strength.

Spurious field strength measurements in the frequency range 1 to 12 GHz (18 GHz for pre-measurements) are carried out in shielded fully-anechoic test chambers. The measurement distance is 3 m.

In the frequency range 12 (18) to 240 GHz, spurious field strength measurements are performed in a certain test laboratory environments with rectangular SGH´s. The test distance is 3 m for tests up to 40 GHz.

In the frequency range 40 to 240 GHz, spurious frequencies are measured as power densities. The EUT is operating with FMCW-modulation. The RBW and VBW are set to such a value that spurious power levels are clearly readable above the fundamental noise level of spectrum analyzer. The measurement distance is chosen to 0.125 m for detecting spurious emission signals.

5. Measurements of maximum safe level for radiated power density

According to FCC § 1.1307, § 1.1310, § 2.1091 and § 2.1093 measurements are carried out in order to evaluate the impact of human exposure to RF radiation. For this test the EUT is in normal operation mode: FMCW. The measurement is performed at 6 different distances: 4 m, 2 m, 1 m, 0.5 m, 0.25 m, and 0.125 m.
The measurements are applicable only for far field conditions. The near field area extends to a distance of R (meters) and can be calculated from the following equation:

$$R < 2 * L^2 / \lambda$$

with R = distance in meters, L = largest dimension of either measuring horn or transmitting EUT antenna (L ≈ 0.07 m), and λ = wavelength in meters. In case of 76.5 GHz (λ = 0.0039 m), the far field theoretically starts at R = 2.5 m. However, it was shown by variation the test distance that measurements in a distance of 2.0 m provide accurate results.

The maximum peak power density PD in r = 3 m distance is determined as 1.16 µW/cm^2.

Peak Power (EIRP) $EIRP = PD * 4\pi * r^2 = PD * 1130973.4\ cm^2$
$EIRP = 1.32$ W (see plot 1)

Limit of maximum ERP (EIRP) for frequencies above 1.5 GHz is 3 W (4.9W). See FCC § 2.1091 (eirp = erp + 2.15 dB, EIRP = ERP x 1.64).

RF Exposure for mobile conditions at r = 20 cm distance from EUT

$PD = EIRP / (4\pi * r^2)$
$PD = 0.26$ mW/cm² = 2.6 W/m²

Limit of maximum permissible exposure (MPE) for uncontrolled environment:1.0 mW/cm². See FCC § 1.1310.

2.5.3 Test results in details

Equipment under test (EUT) : **WVR and Radasensor**
Ambient temperature : 20 °C - 24 °C
Relative humidity : 45 % - 75 %

TRANSMITTER PARAMETERS **SECTION 15.253**

FUNDAMENTAL FREQUENCY **Section 15.253 b (2)**
76.000 GHz to 77.000 GHz

Operation : - Frequency sweep stopped
- In Motion mode, WVR and Radarsensor
- Not in motion mode, WVR and Radarsensor
Antenna assembly : Fixed integral antenna

TEST CONDITIONS T = 23.0 ° C	TRANSMITTER POWER DENSITY			
EUT operating: TX on and RX on	Frequency f [GHz]	EIRP [dBm]	Power Density PD [µW/cm ^{2}]	See plot
Low channel stopped	76.000	31.2	1.16	1
Mid channel stopped	76.500	30.5	0.99	2
High channel stopped	77.000	31.2	1.16	3
In motion mode (WVR)	76.500	27.2	0.46	19a
In motion mode (Radarsensor)	76.400	27.7	0.52	19b
Not in motion mode - WVR (average detector)	76.500	17.8	0.05	20a
Not in motion mode – Radarsensor (average detector)	76.500	17.9	0.05	20b

Remark: In case of FMCW signal, a correction regarding the ratio between the RBW used and the operating frequency range would cause a rough overestimate of signal power, because there is no even distribution of the emitted power over the frequency range. Due to this fact, the bandwidth correction is not allowed.
Plots 19a and 19b respectively 20a and 20b are made to show that the differences in EIRP caused by the different shapes of the EUT lens are negligible.

REFERENCE OF TEST EQUIPMENT USED : see test set-up on page 9

LIMITS: **Section 15.253 b (2)**

Frequency range [GHz] 76.0 to 77.0	Measurement distance [m]	Power density pd [dBm/cm^2]	Power Density PD [µW/cm ^{2}]
vehicle in motion	3.0	-12.2	60
vehicle not in motion	3.0	-37.0	0.2

Verdict :	Power Density limit is kept

Equipment under test (EUT) : **WVR**
Ambient temperature : -20 °C / 23 °C / 55 °C
Relative humidity : 55 % at 23°C

TRANSMITTER PARAMETERS **SECTION 15.253**

FREQUENCY STABILITY **Section 15.253 e**
76.000 GHz to 77.000 GHz

Operation : Frequency sweep stopped (center frequency)
Antenna assembly : Fixed integral antenna

TEST CONDITIONS T = 23°C	FREQUENCY STABILITY OVER VOLTAGE
EUT operating: Tx on	Frequency f [GHz]
U DC = 10.0 V	76.496 474
U DC = 11.0 V	76.496 314
U DC = 12.0 V	76.496 314
U DC = 13.0 V	76.496 154
U DC = 14.0 V	76.496 154
U DC = 15.0 V	76.496 154
U DC = 16.0 V	76.495 993

Remark: Test was performed on WVR in CW center test mode. Due to same microwave unit used in WVR and Radarsensor, it is not necessary to repeat the test for the Radarsensor.

REFERENCE OF TEST EQUIPMENT USED : see test set-up on page 9

LIMITS: **Section 15.253 e**

Frequency range [GHz]
76.0 to 77.0

Verdict :	Frequency Stability over voltage limit is kept

Equipment under test (EUT) : **WVR**
Ambient temperature : -20 °C / 23 °C / 55 °C
Relative humidity : 55 % at 23°C

TRANSMITTER PARAMETERS **SECTION 15.253**

FREQUENCY STABILITY **Section 15.253 e**
76.000 GHz to 77.000 GHz

Operation : Frequency sweep stopped (center frequency)
Antenna assembly : Fixed integral antenna

TEST CONDITIONS U = 13.8 V	FREQUENCY STABILITY OVER TEMPERATURE
EUT operating: Tx on	Frequency f [GHz]
T = -20 °C	76.504 326
T = -10 °C	76.504 006
T = 0 °C	76.502 885
T = 10 °C	76.501 122
T = 20 °C	76.499 679
T = 30 °C	76.498 397
T = 40 °C	76.497 276
T = 50 °C	76.495 353

Remark: Test was performed on WVR in CW center test mode. Due to same microwave unit used in WVR and Radarsensor, it is not necessary to repeat the test for the Radarsensor.

REFERENCE OF TEST EQUIPMENT USED : see test set-up on page 9

LIMITS: **Section 15.253 e**

Frequency range [GHz]
76.0 to 77.0

Verdict :	Frequency Stability limit over temperature is kept

Equipment under test (EUT) : **WVR**
Ambient temperature : -20 °C / 23 °C / 55 °C
Relative humidity : 55 % at 23°C

TRANSMITTER PARAMETERS **SECTION 15.253**

OCCUPIED BANDWIDTH **Section 15.253 e**

76.000 GHz to 77.000 GHz

Operation : Not in motion mode (wider frequency spectrum)
Antenna assembly : Fixed integral antenna

EUT operating: MR+LR TX on and RX on	Low Frequency f [GHz]	High Frequency f [GHz]	Bandwidth B [MHz]	See plot
T = -20°C / U = 10.0 V DC	76.109	76.915	806	4
T = -20°C / U = 13.8 V DC	76.109	76.915	806	4
T = -20°C / U = 16.0 V DC	76.109	76.915	806	4
T = 23°C / U = 10.0 V DC	76.105	76.909	804	5
T = 23°C / U = 13.8 V DC	76.105	76.909	804	5
T = 23°C / U = 16.0 V DC	76.105	76.909	804	5
T = 50°C / U = 10.0 V DC	76.101	76.909	808	6
T = 50°C / U = 13.8 V DC	76.101	76.909	808	6
T = 50°C / U = 16.0 V DC	76.101	76.909	808	6

Remark: Test was performed on WVR in CW center test mode. Due to same microwave unit used in WVR and Radarsensor, it is not necessary to repeat the test for the Radarsensor.

REFERENCE OF TEST EQUIPMENT USED : see test set-up on page 9

LIMITS: **Section 15.253 e**

Frequency range [GHz]
76.0 to 77.0

Verdict :	Occupied bandwidth over voltage and temperature limit is kept

EUT : **WVR and Radarsensor**
Ambient temperature : 20 °C - 24 °C
Relative humidity : 45 % - 75 %

TRANSMITTER PARAMETERS **SECTION 15.253**

SPURIOUS FREQUENCIES **Section 15.253 c (1)**
In the frequency range 9 kHz to 12 GHz

Operation : Frequency sweep stopped (bottom, middle, top – middle frequency reported)
Antenna assembly : Fixed integral antenna

TEST CONDITIONS	TRANSMITTER SPURIOUS FIELD STRENGTH			
WVR				
Frequency range [MHz]	Spurious frequencies [MHz]	S A e [dBµV/m]	E [µV/m]	See plot
0.009 – 30.000 (h + v) horizontal and vertical plane	Noise	< limit	< limit	7a
30.000 – 1.0 GHz (h + v)	Noise	< limit	< limit	8a
1.0 – 4.0 GHz (h + v)	Noise	< limit	< limit	9a
4.0 – 12.0 GHz (h + v)	Noise	< limit	< limit	10a

TEST CONDITIONS	TRANSMITTER SPURIOUS FIELD STRENGTH			
Radarsensor				
Frequency range [MHz]	Spurious frequencies [MHz]	S A e [dBµV/m]	E [µV/m]	See plot
0.009 – 30.000 (h + v) horizontal and vertical plane	Noise	< limit	< limit	7b
30.000 – 1.0 GHz (h + v)	Noise	< limit	< limit	8b
1.0 – 3.0 GHz (h + v)	Noise	< limit	< limit	9b
3.0 – 12.0 GHz (h + v)	3528, 4704, 9544, 9583	< limit	< limit	10b

REFERENCE OF TEST EQUIPMENT USED : see test set-up on page 10 + 11

LIMITS: **SECTION 15.253 / 15.205 / 15.209**

Frequency range (MHz)	Measurement distance [m]	Field strength e [dBµV/m] @ 3 m	Field strength E [µV/m]
0.009 – 0.490	300	88.5 ... 53.8	2400/F(kHz)
0.490 – 1.705	30	53.8 ... 43.0	24000/F(kHz)
1.705 – 30.0	30	49.5	30
30.0 – 88.0	3	40.0	100
88.0 – 216.0	3	43.5	150
216.0 – 960.0	3	46.0	200
960.0 MHz – 40.0 GHz	3	54.0	500

Verdict : Field strength limits are kept

EUT : **WVR and Radarsensor**
Ambient temperature : 20 °C - 24 °C
Relative humidity : 45 % - 75 %

TRANSMITTER PARAMETERS **SECTION 15.253**

SPURIOUS FREQUENCIES **Section 15.253 c (1)**
In the frequency range 12 GHz to 40 GHz

Operation : Frequency sweep stopped (bottom, middle, top – middle frequency reported)
Antenna assembly: Fixed integral antenna

TEST CONDITIONS		TRANSMITTER SPURIOUS FIELD STRENGTH			
Frequency range [GHz]		Spurious frequencies [GHz]	S A e [dBµV/m]	E [µV/m]	See plot
WVR					
12.0 – 18.0	(h + v)	Noise	< limit	< limit	11a
18.0 – 26.0	(h + v)	18.57	44.34	164.8	12a
26.0 – 40.0	(h + v)	37.15	50.54	336.5	13a

TEST CONDITIONS		TRANSMITTER SPURIOUS FIELD STRENGTH			
Frequency range [GHz]		Spurious frequencies [GHz]	S A e [dBµV/m]	E [µV/m]	See plot
Radarsensor					
12.0 – 18.0	(h + v)	Noise	< limit	< limit	11b
18.0 – 26.0	(h + v)	18.57	43.58	151.0	12b
26.0 – 40.0	(h + v)	37.15	49.70	305.5	13b

REFERENCE OF TEST EQUIPMENT USED : see test set-up on page 8

LIMITS: **SECTION 15.253 / 15.205 / 15.209**

Frequency range (MHz)	Measurement distance [m]	Field strength e [dBµV/m] @ 3 m	Field strength E [µV/m]
0.009 – 0.490	300	88.5 ... 53.8	2400/F(kHz)
0.490 – 1.705	30	53.8 ... 43.0	24000/F(kHz)
1.705 – 30.0	30	49.5	30
30.0 – 88.0	3	40.0	100
88.0 – 216.0	3	43.5	150
216.0 – 960.0	3	46.0	200
960.0 MHz – 40.0 GHz	3	54.0	500

Verdict :	Field strength limits are kept

EUT : **WVR and Radarsensor**
Ambient temperature : 20 °C - 24 °C
Relative humidity : 45 % - 75 %

TRANSMITTER PARAMETERS **SECTION 15.253**

SPURIOUS FREQUENCIES **Section 15.253 c (2) + (3)**
In the frequency range 40 GHz to 240 GHz

Operation : Frequency sweep stopped (bottom, middle, top – middle frequency reported)
Antenna assembly: Fixed integral antenna

TEST CONDITIONS	TRANSMITTER SPURIOUS POWER DENSITY			
Frequency range [GHz]	Spurious frequencies [GHz]	S A [dBm]	PD [pW/cm^2]	See plot
WVR				
40.0 – 60.0 (h + v)	48.62	-27.74	1.49	14a
60.0 – 90.0 (h + v)	Noise	< limit	< limit	15a
90.0 – 140.0 (h + v)	139.12	-12.04	55.2	16a
140.0 – 170.0 (h + v)	Noise	< limit	< limit	17a
170.0 – 240.0 (h + v)	Noise	< limit	< limit	18a

TEST CONDITIONS	TRANSMITTER SPURIOUS POWER DENSITY			
Frequency range [GHz]	Spurious frequencies [GHz]	S A [dBm]	PD [pW/cm^2]	See plot
Radarsensor				
40.0 – 60.0 (h + v)	48.62	-26.24	2.10	14b
60.0 – 90.0 (h + v)	Noise	-26.95	1.78	15b
90.0 – 140.0 (h + v)	139.12	-12.49	49.84	16b
140.0 – 170.0 (h + v)	Noise	< limit	< limit	17b
170.0 – 240.0 (h + v)	Noise	< limit	< limit	18b

REFERENCE OF TEST EQUIPMENT USED: see test set-up on page 9

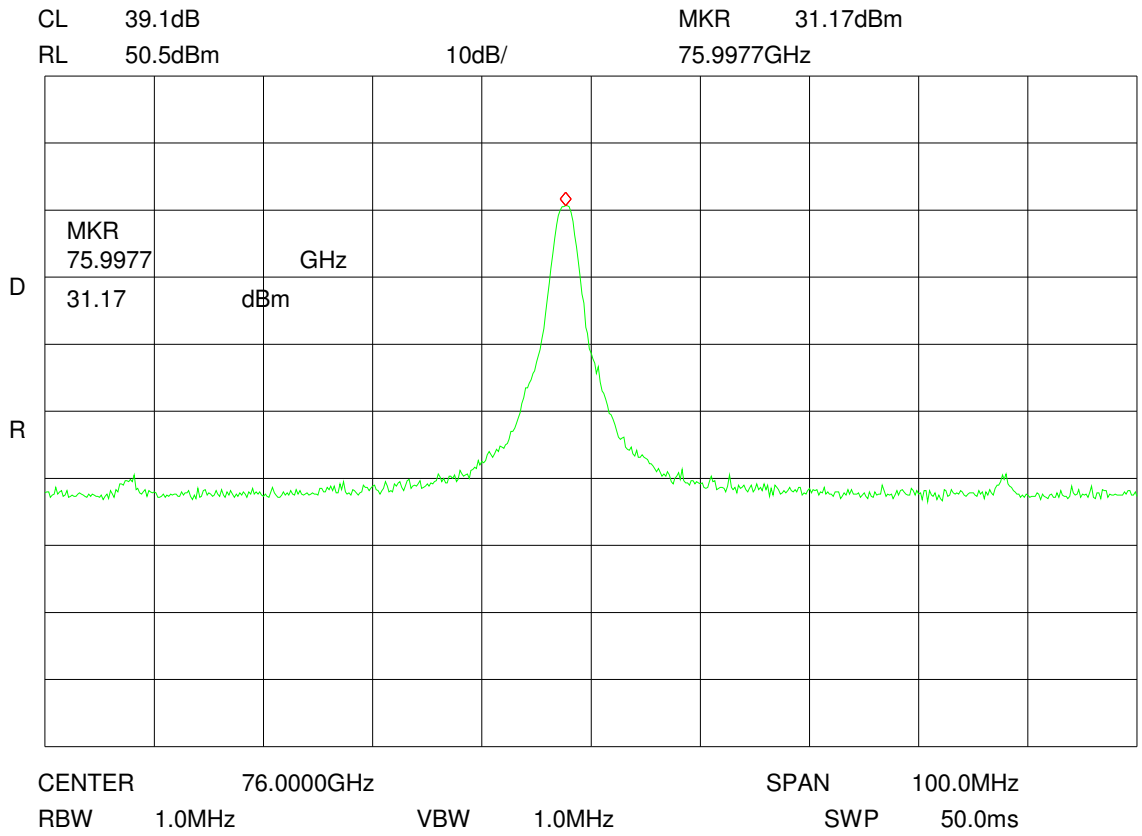
LIMITS: **SECTION 15.253 / 15.205 / 15.209**

Frequency range (MHz)	Measurement distance [m]	power [dBm]	Power density PD [pW/cm^2]
40.0 GHz - 200 GHz	3.0	-1.7	600
200 GHz - 231 GHz	3.0	0.5	1000

Verdict :	Power density limits are kept

3 Plots, graphs and data sheets

Plot 1



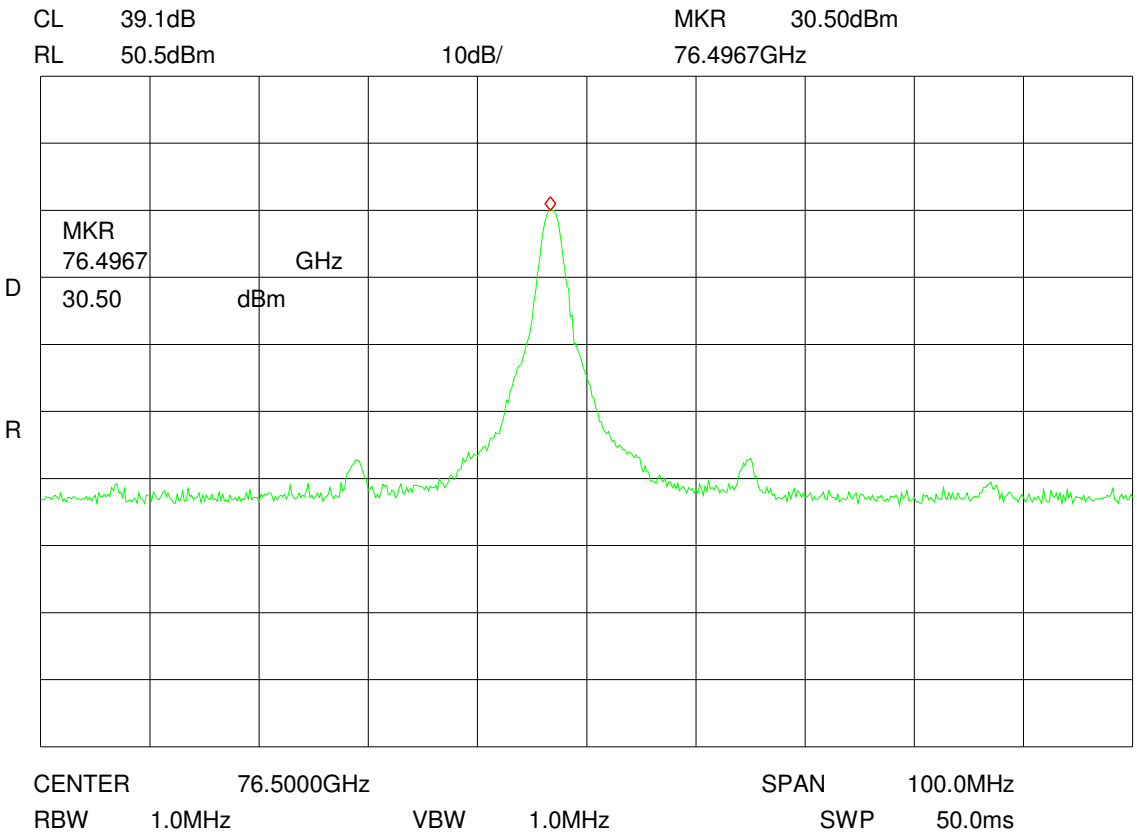
The mark "R" in the measurement plot indicates a reference level offset adjusted. This offset equates to the system attenuation at a measurement distance of 2.0 m and is considered in the test.

System attenuation a = 50.4 dB

Measurement distance d = 2.0 m
Evaluation distance R = 3.0 m

Calculation **: Power density** PD = EIRP / ($4\pi * R^2$) = EIRP / 1130973.4 cm^2
= 1.31 W (31.17 dBm) / 1130973.4 cm^2
= 1.16 µW/cm^2

Plot 2



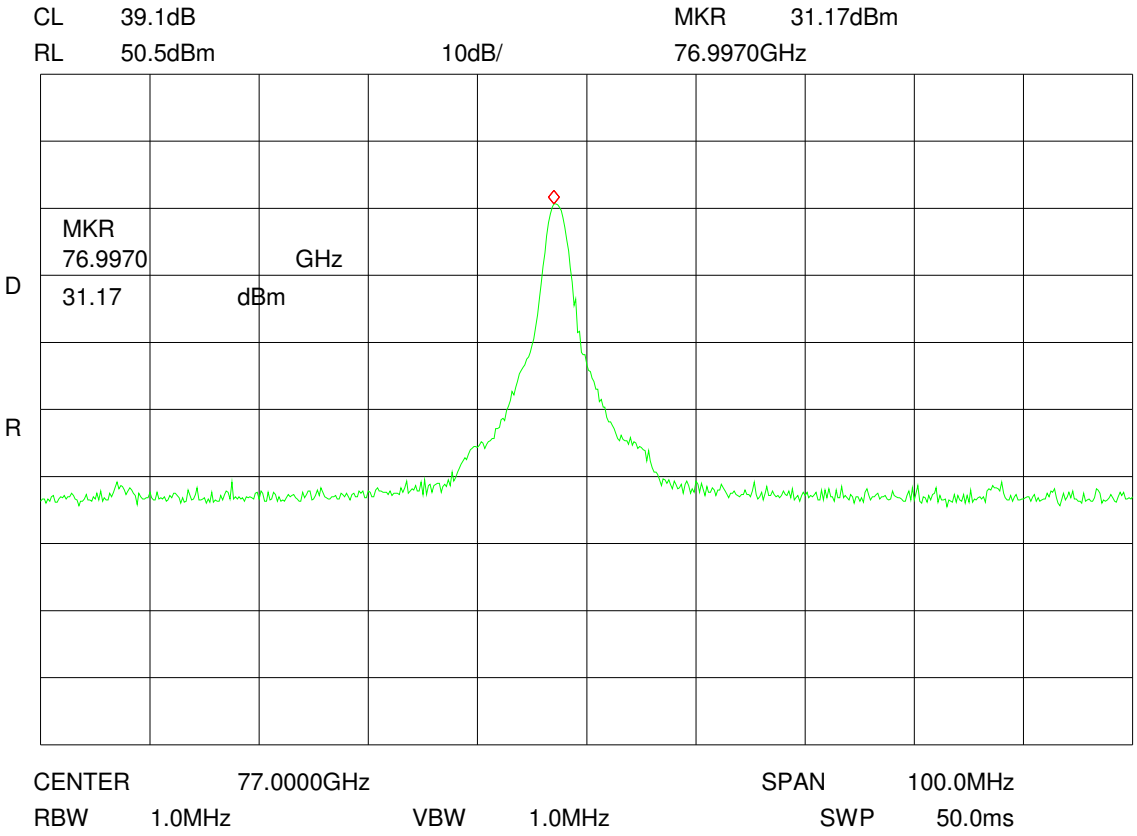
The mark “R” in the measurement plot indicates a reference level offset adjusted. This offset equates to the system attenuation at a measurement distance of 2.0 m and is considered in the test.

System attenuation a = 50.4 dB

Measurement distance d = 2.0 m
Evaluation distance R = 3.0 m

Calculation **: Power density** PD = EIRP / ($4\pi * R^2$) = EIRP / 1130973.4 cm^2
= 1.12 W (30.50 dBm) / 1130973.4 cm^2
= .99 $\mu W/cm^2$

Plot 3



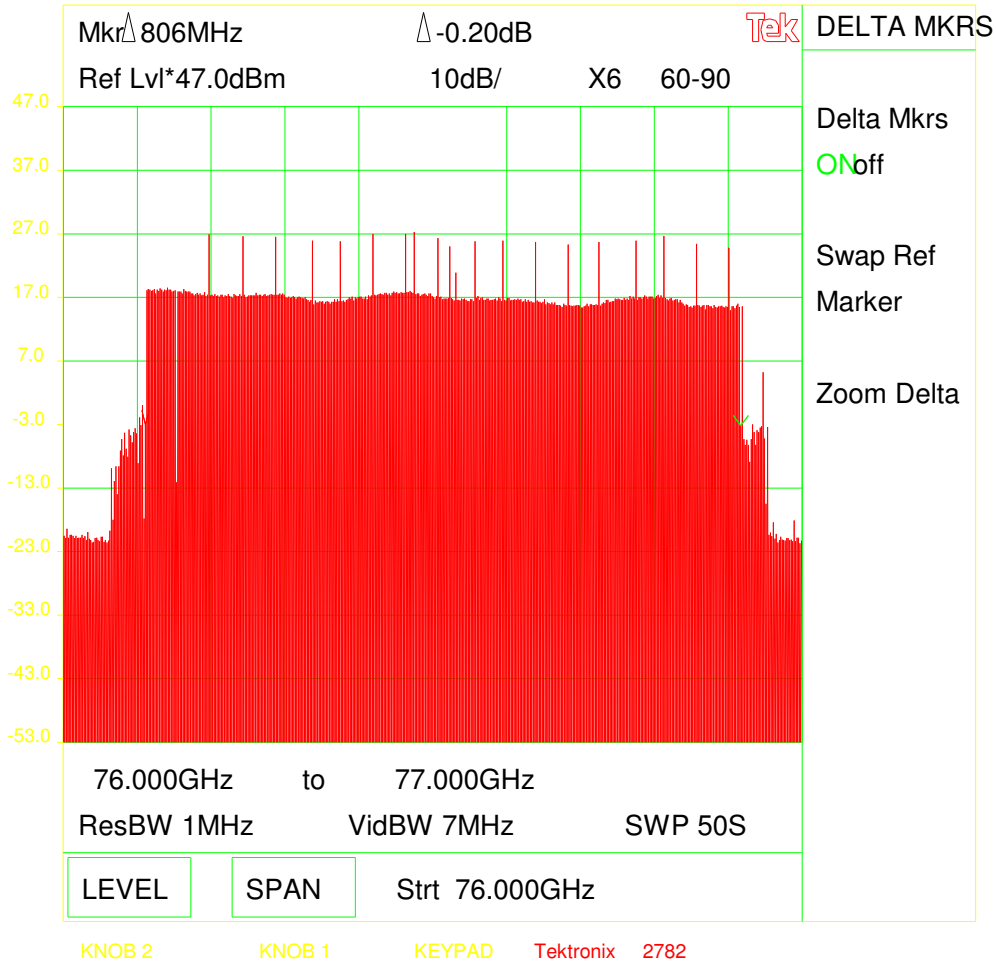
The mark "R" in the measurement plot indicates a reference level offset adjusted. This offset equates to the system attenuation at a measurement distance of 2.0 m and is considered in the test.

System attenuation a = 50.4 dB

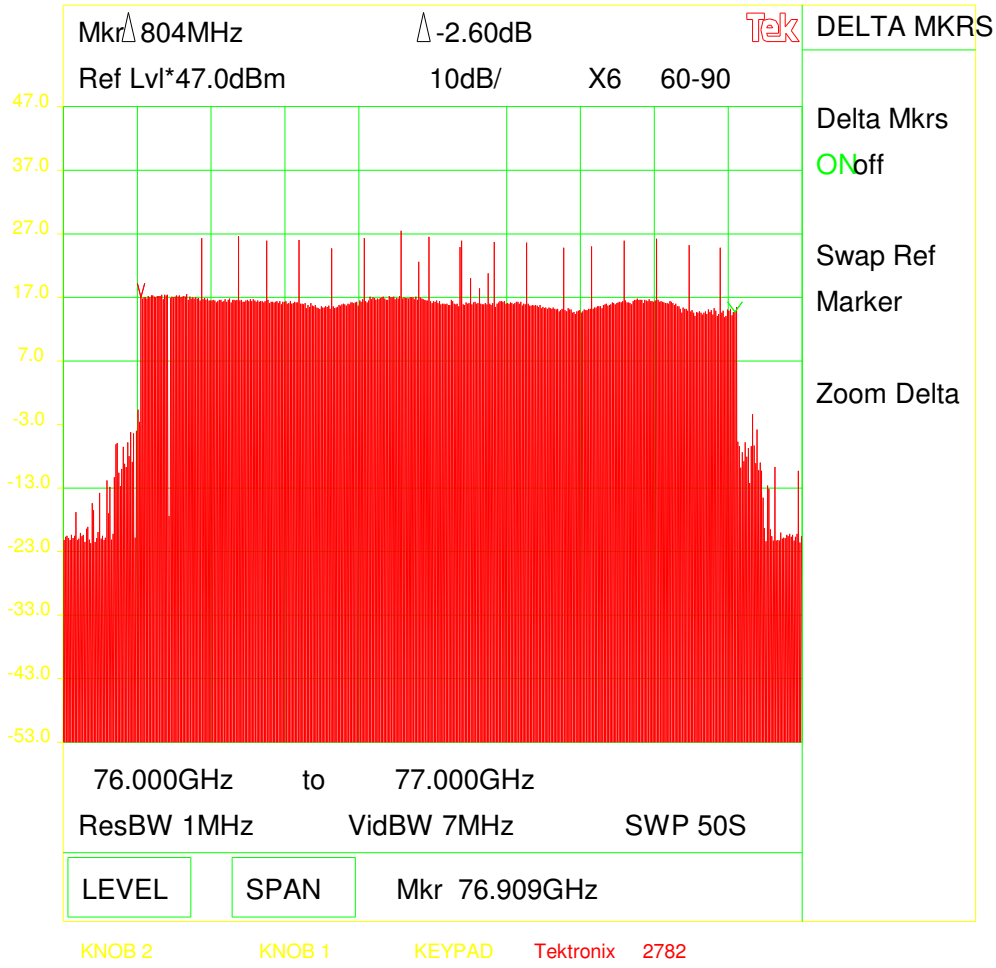
Measurement distance d = 2.0 m
Evaluation distance R = 3.0 m

Calculation **: Power density** PD = EIRP / ($4\pi * R^2$) = EIRP / 1130973.4 cm^2
= 1.31 W (31.17 dBm) / 1130973.4 cm^2
= 1.16 µW/cm^2

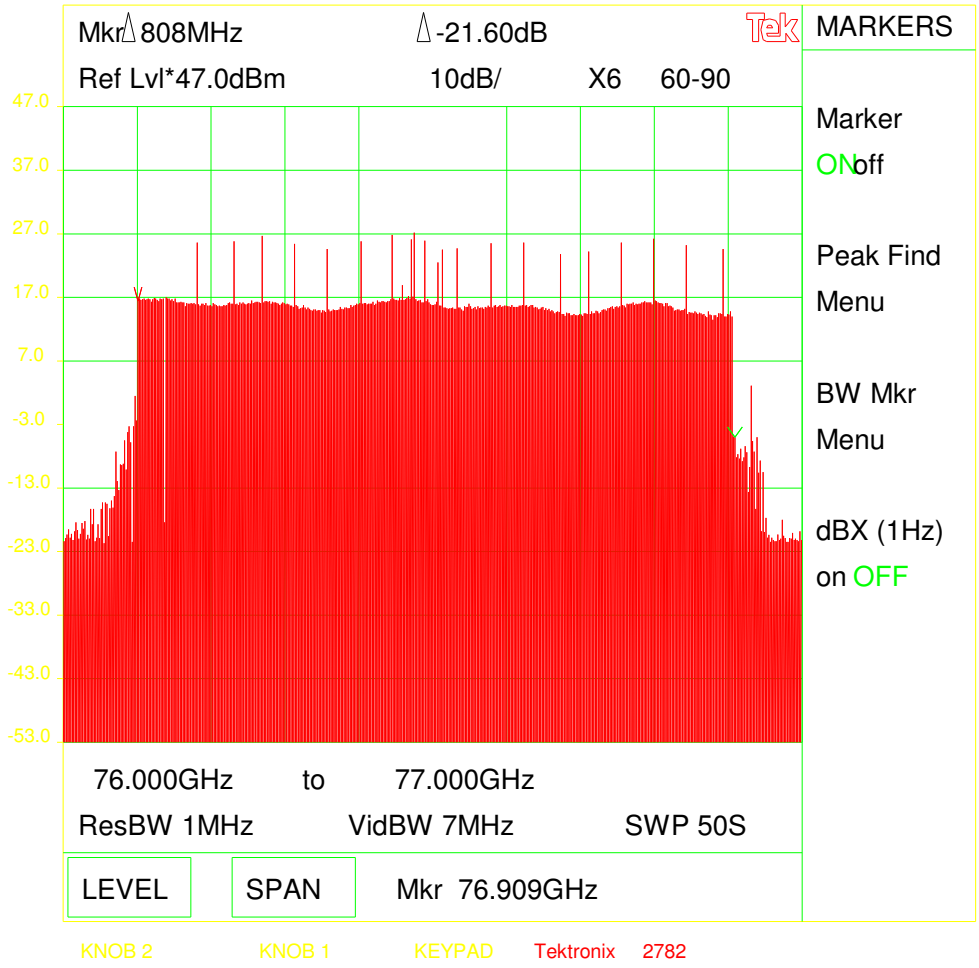
Plot 4


Mkr 806MHz
-0.20dB
Tek
DELTA MKRS
Ref Lvl*47.0dBm
10dB/
X6
60-90
47.0
37.0
27.0
17.0
7.0
-3.0
-13.0
-23.0
-33.0
-43.0
-53.0
Delta Mkrs
ONoff
Swap Ref
Marker
Zoom Delta
76.000GHz
to
77.000GHz
ResBW 1MHz
VidBW 7MHz
SWP 50S
LEVEL
SPAN
Strt 76.000GHz
KNOB 2
KNOB 1
KEYPAD
Tektronix
2782

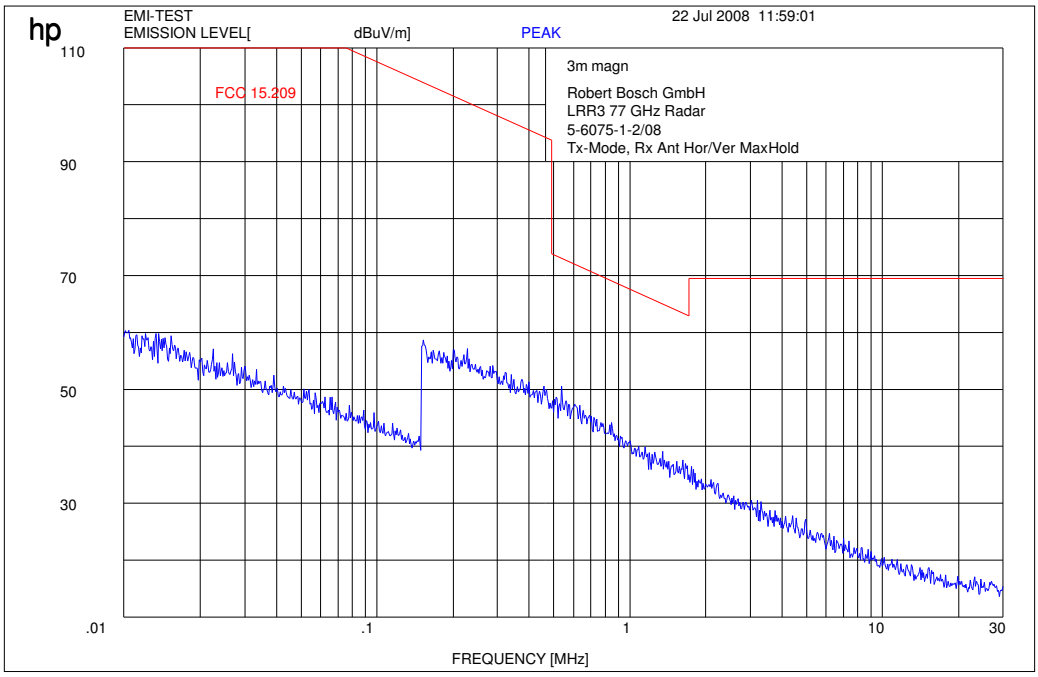
Plot 5


Mkr 804MHz
-2.60dB
Tek
DELTA MKRS
Ref Lvl*47.0dBm
10dB/
X6
60-90
47.0
37.0
27.0
17.0
7.0
-3.0
-13.0
-23.0
-33.0
-43.0
-53.0
Delta Mkrs
ONoff
Swap Ref
Marker
Zoom Delta
76.000GHz
to
77.000GHz
ResBW 1MHz
VidBW 7MHz
SWP 50S
LEVEL
SPAN
Mkr 76.909GHz
KNOB 2
KNOB 1
KEYPAD
Tektronix
2782

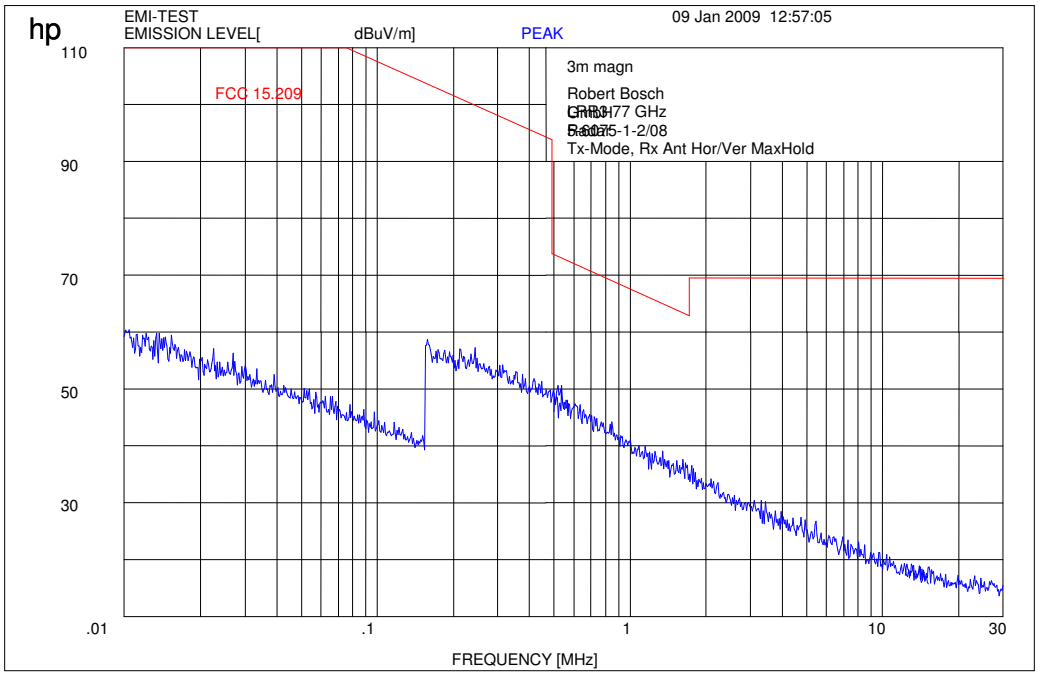
Plot 6


Mkr 808MHz
-21.60dB
Tek
MARKERS
Ref Lvl*47.0dBm
10dB/
X6
60-90
47.0
37.0
27.0
17.0
7.0
-3.0
-13.0
-23.0
-33.0
-43.0
-53.0
Marker
ONoff
Peak Find
Menu
BW Mkr
Menu
dBX (1Hz)
on OFF
76.000GHz
to
77.000GHz
ResBW 1MHz
VidBW 7MHz
SWP 50S
LEVEL
SPAN
Mkr 76.909GHz
KNOB 2
KNOB 1
KEYPAD
Tektronix
2782

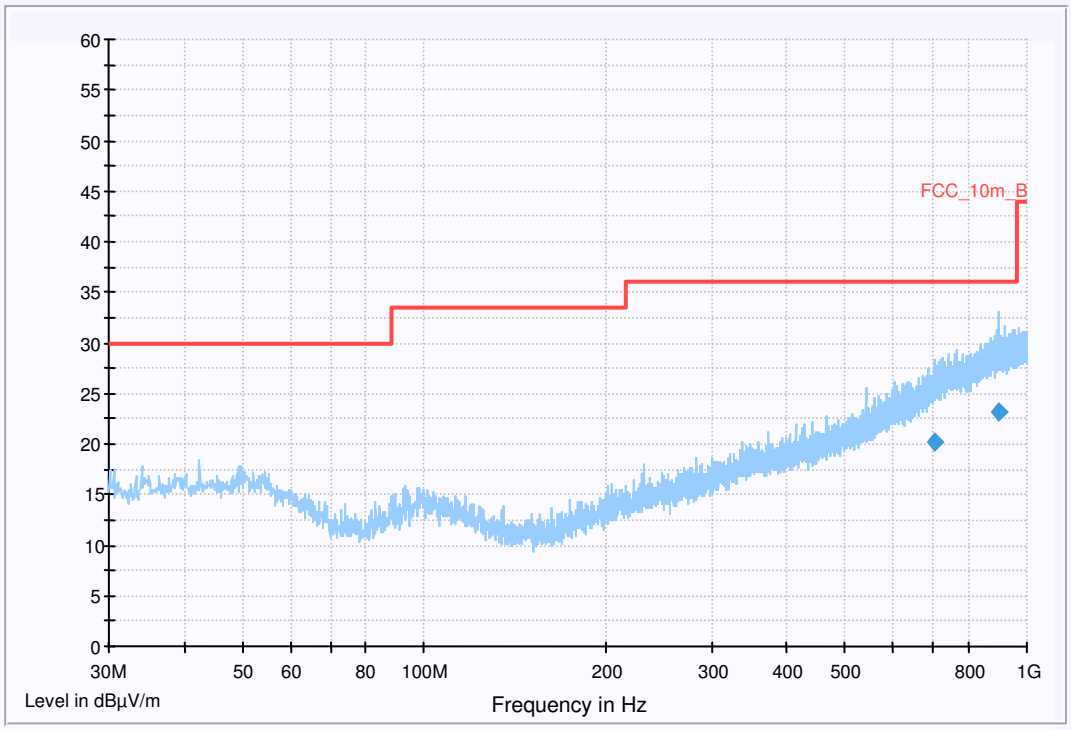
Plot 7a



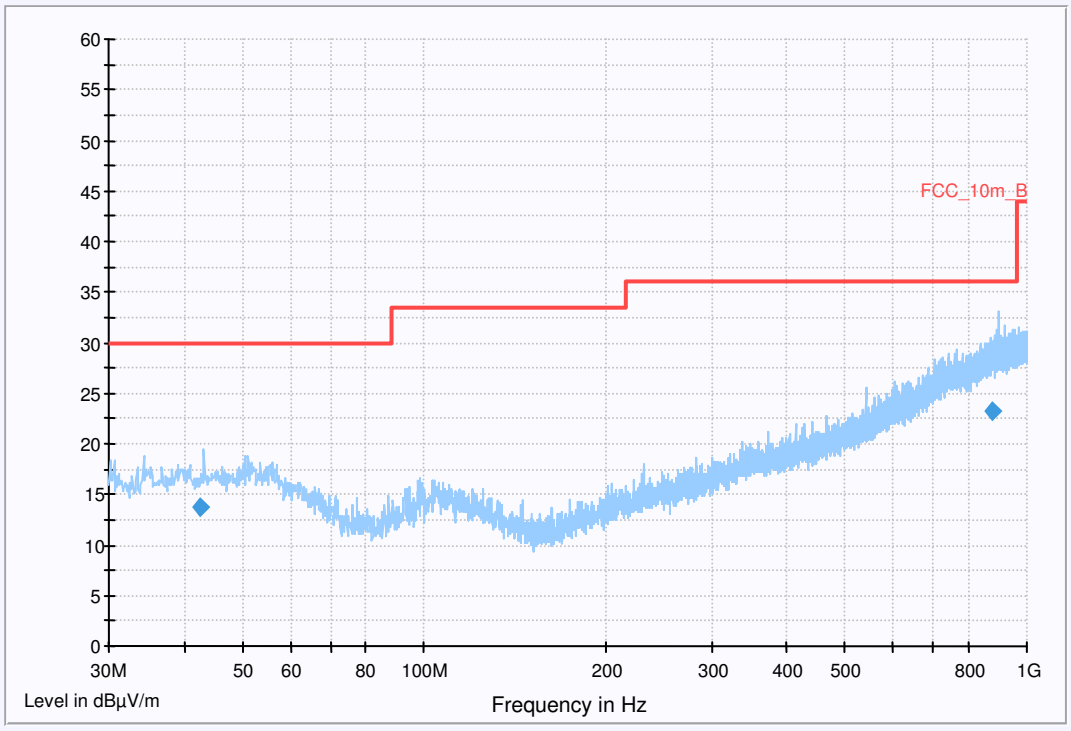
Plot 7b



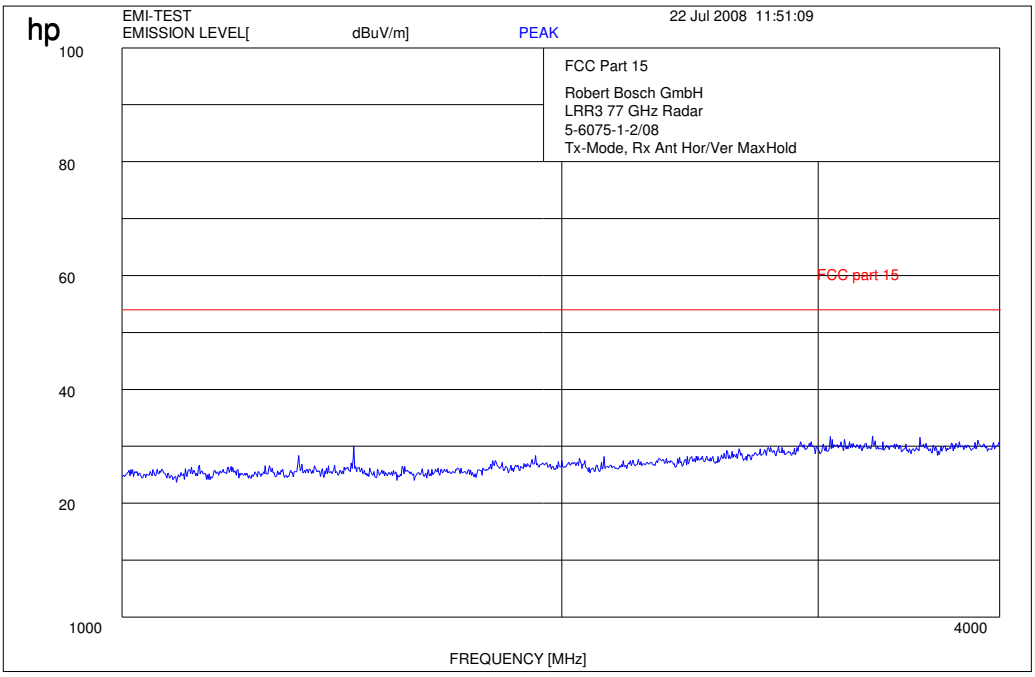
Plot 8a



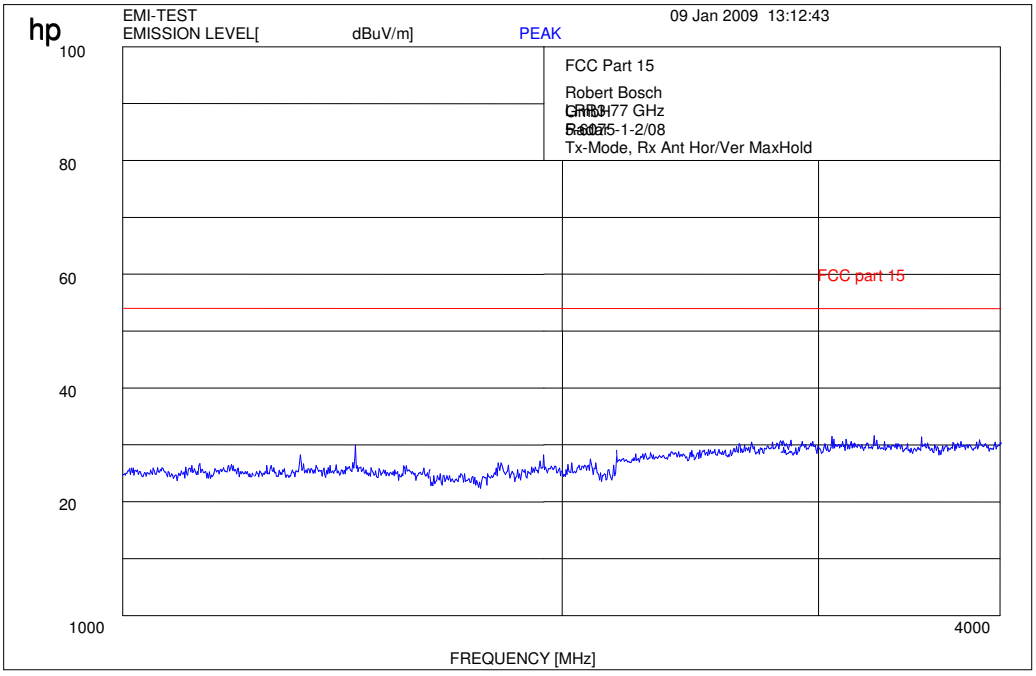
Plot 8b



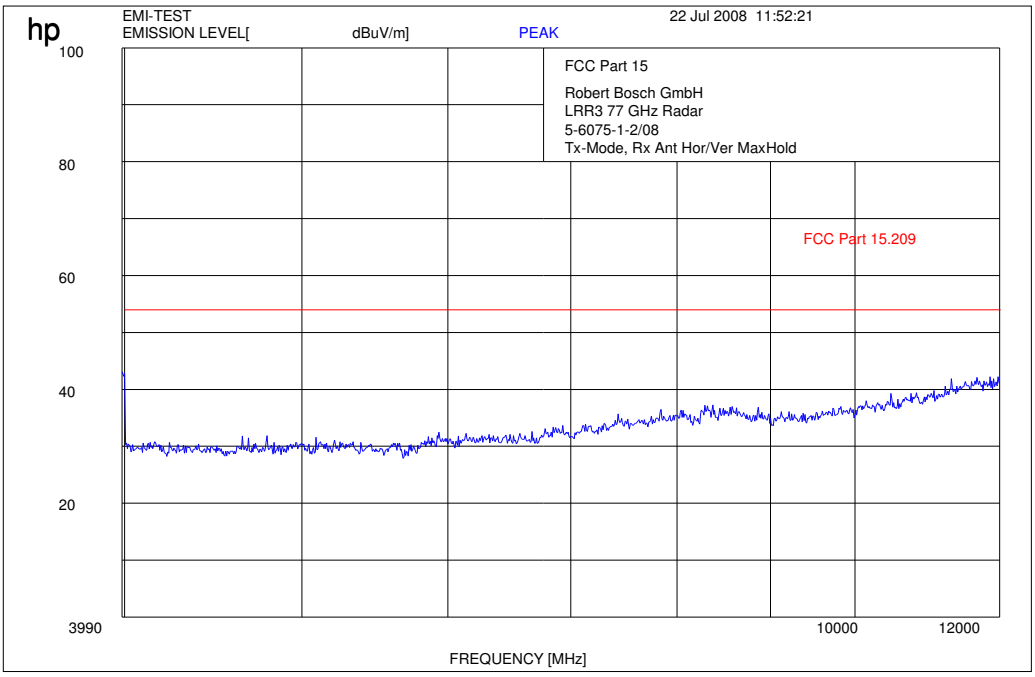
Plot 9a



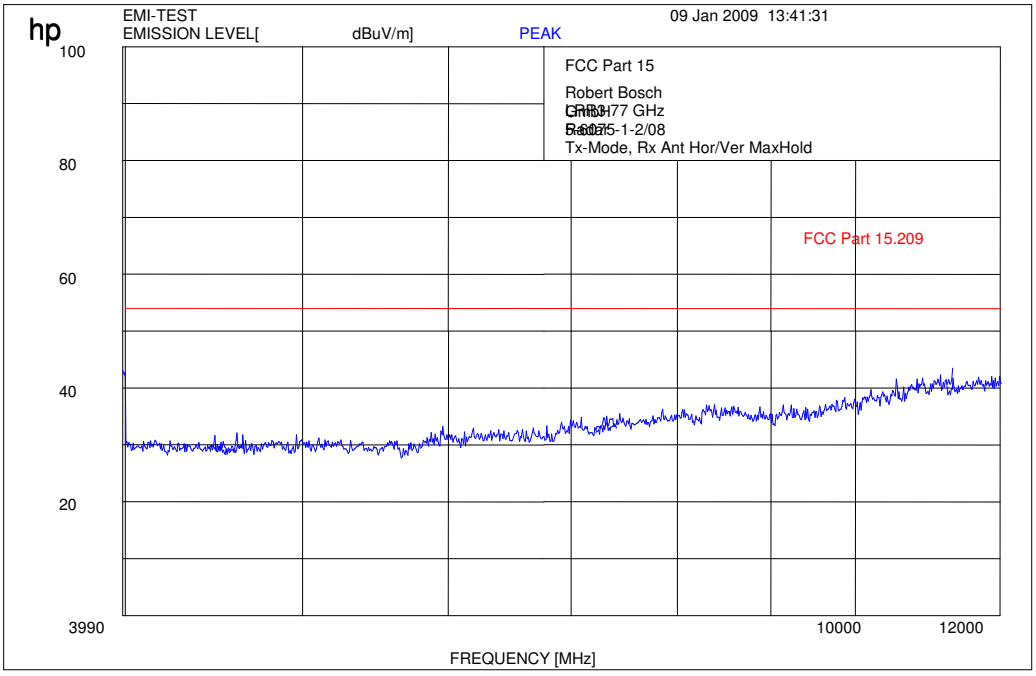
Plot 9b



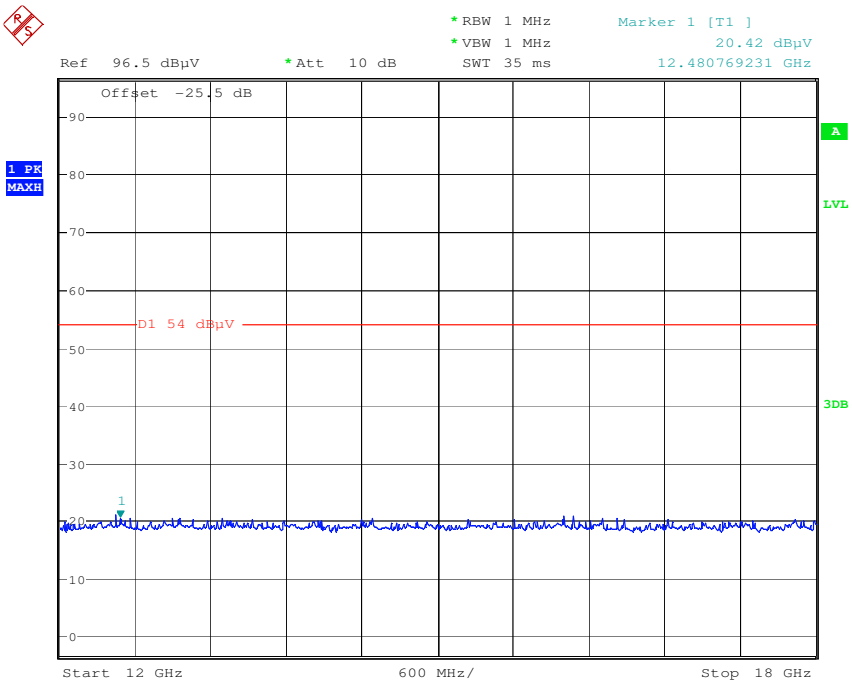
Plot 10a



Plot 10b

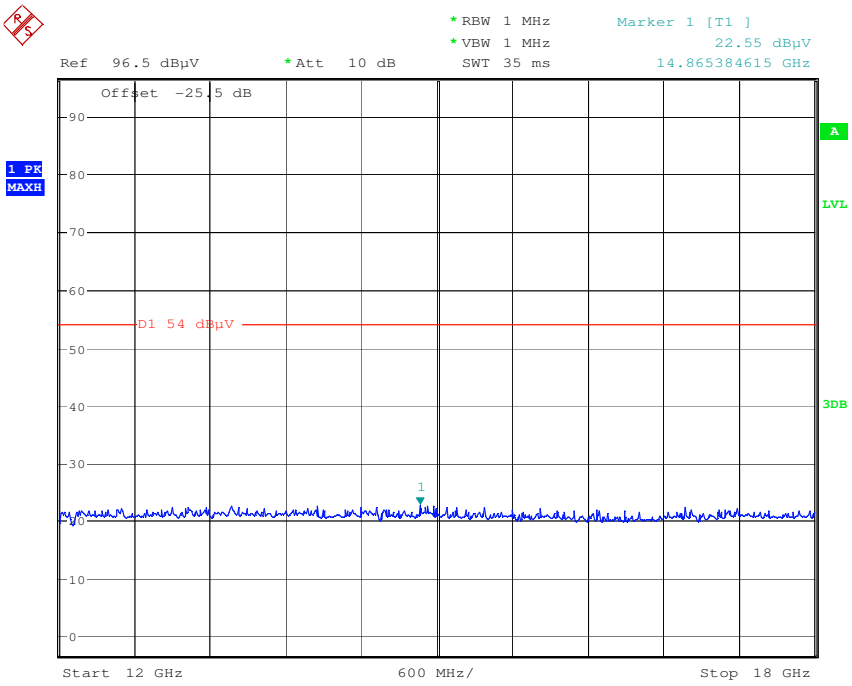


Plot 11a



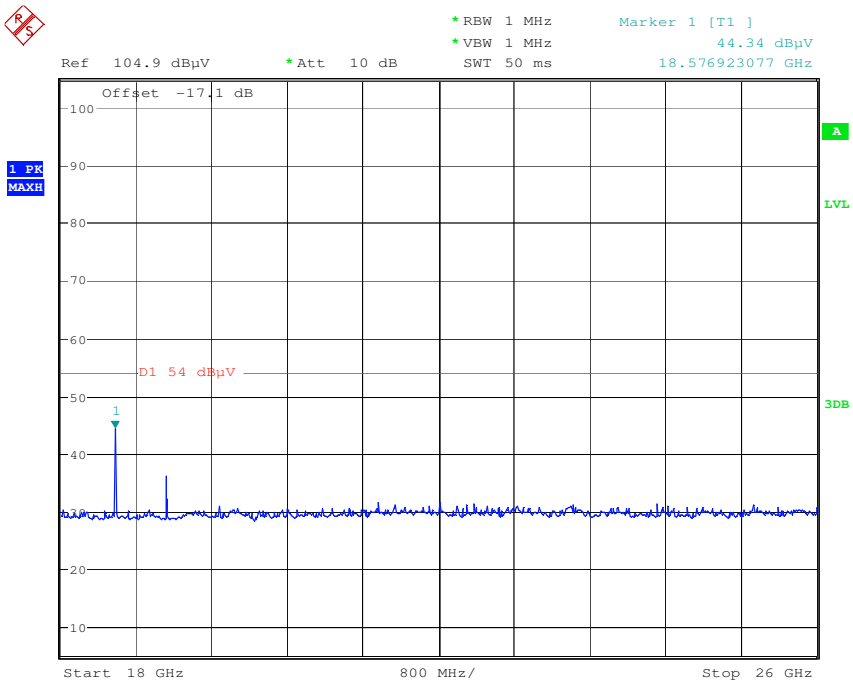
Date: 22.JUL.2008 10:04:37

Plot 11b



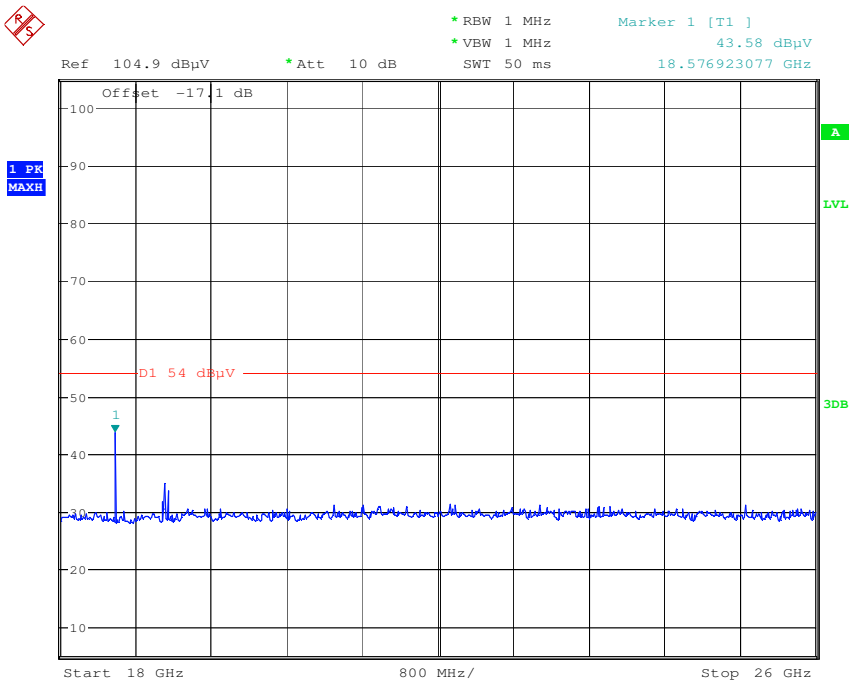
Date: 2.FEB.2009 11:33:14

Plot 12a



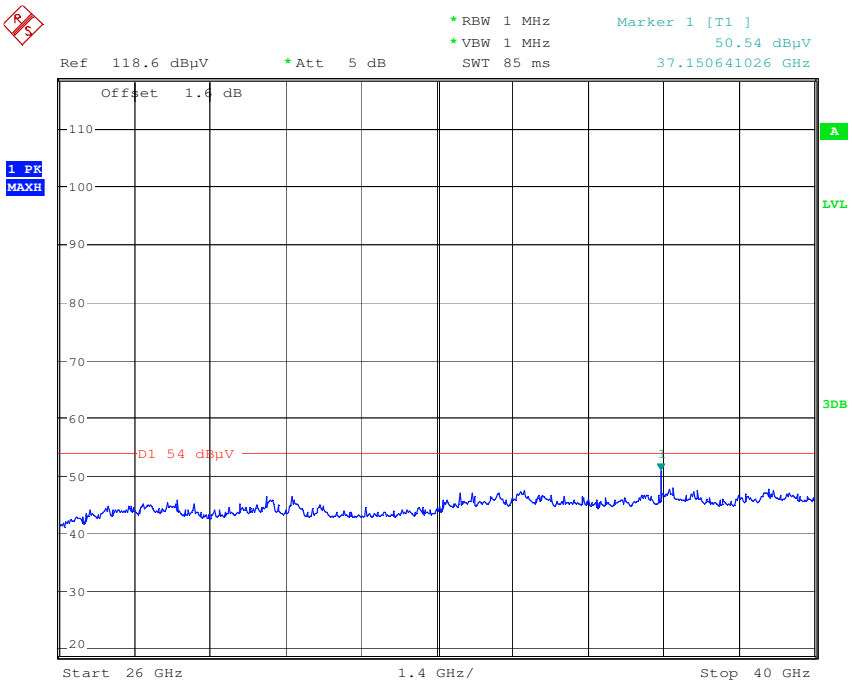
Date: 22.JUL.2008 10:12:23

Plot 12b



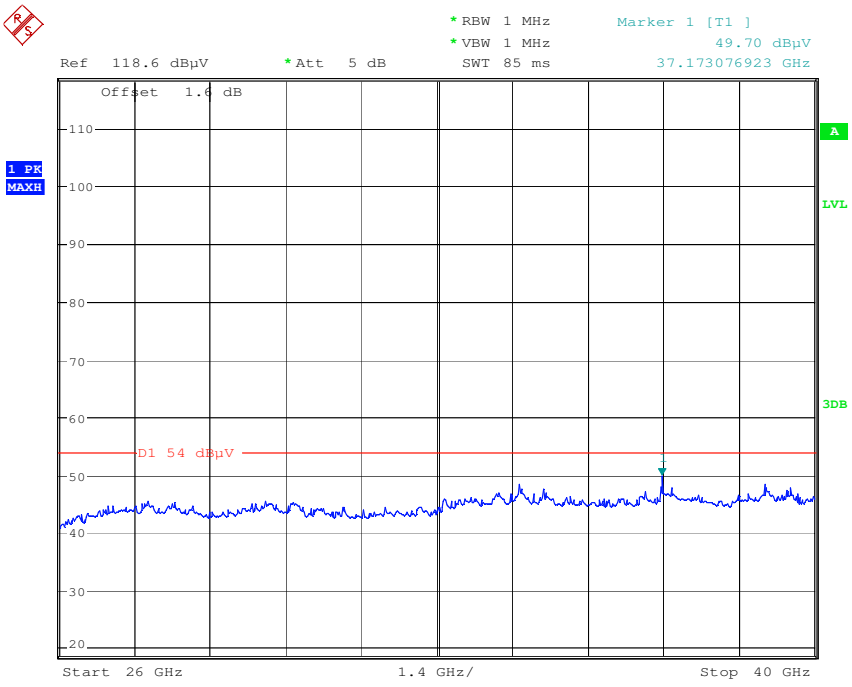
Date: 2.FEB.2009 11:39:59

Plot 13a



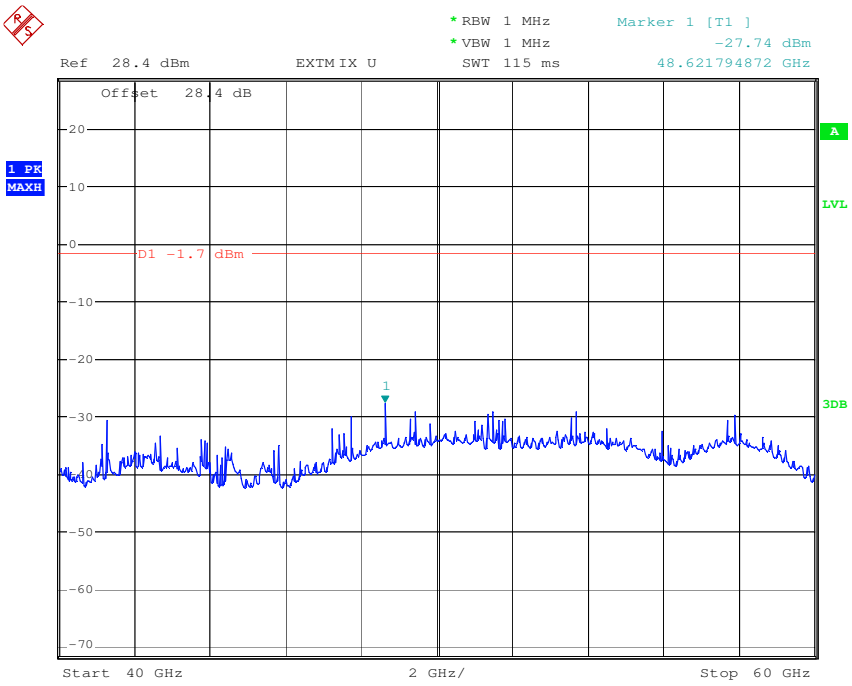
Date: 22.JUL.2008 10:36:58

Plot 13b



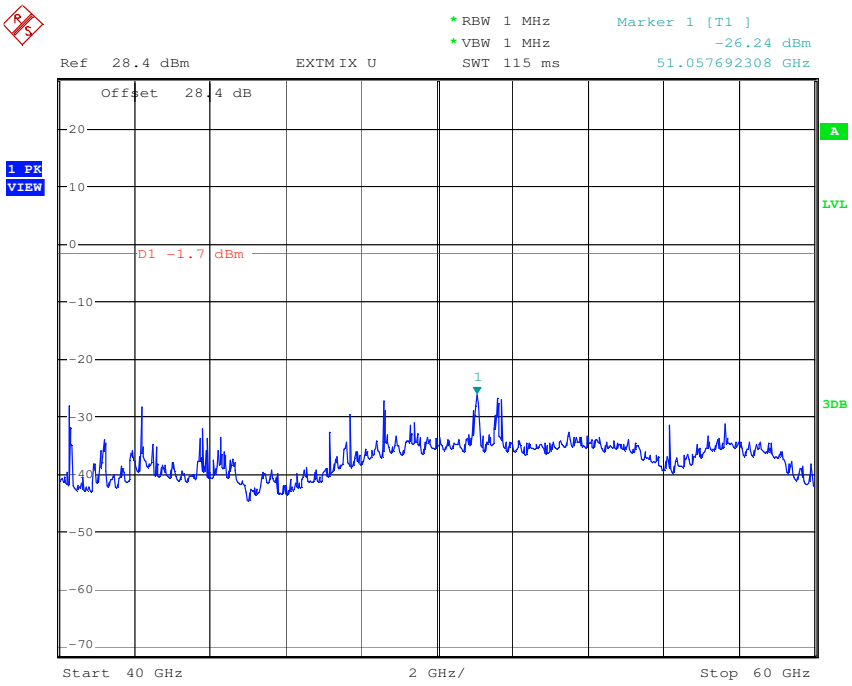
Date: 2.FEB.2009 11:47:05

Plot 14a



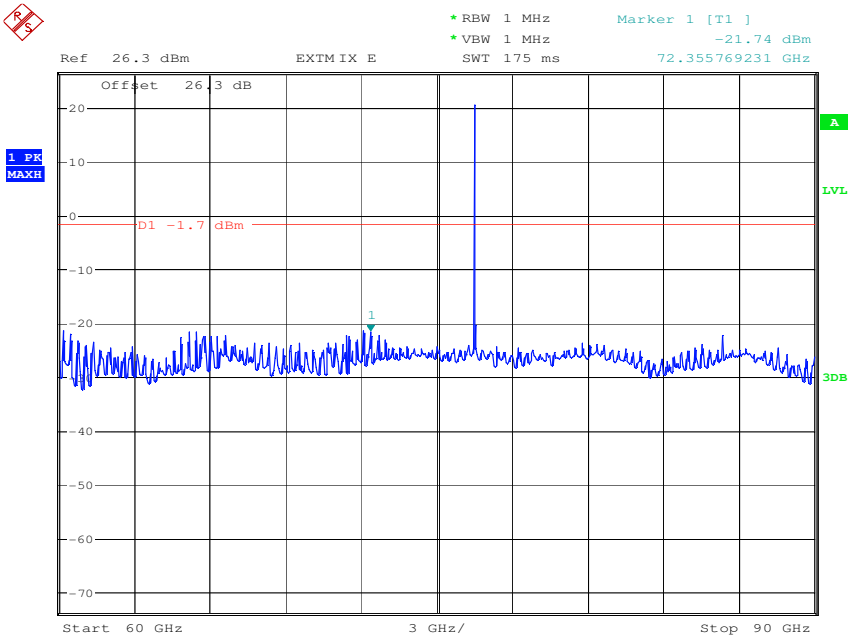
Date: 22.JUL.2008 09:17:02

Plot 14b



Date: 2.FEB.2009 10:42:24

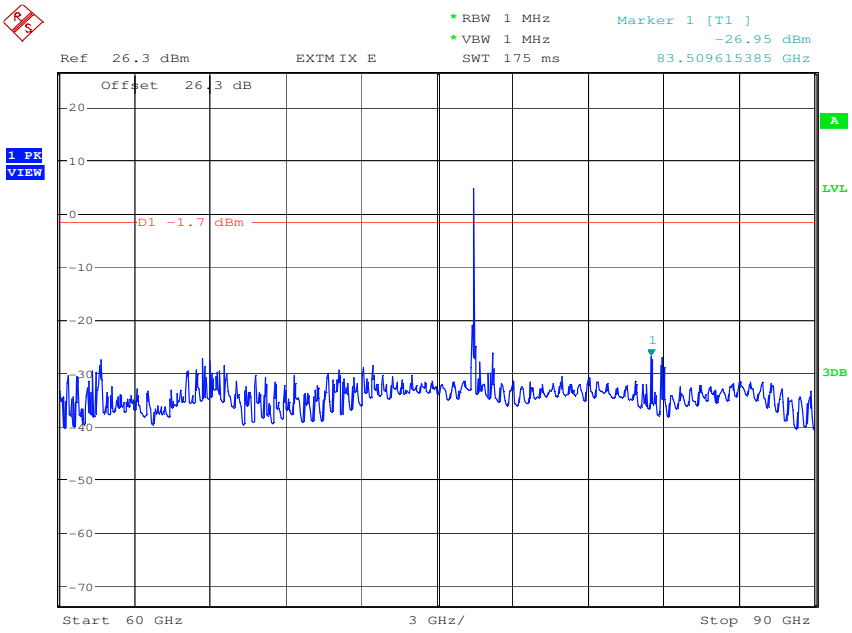
Plot 15a



Date: 22.JUL.2008 09:22:03

The peak at 77 GHz shows the wanted signal.

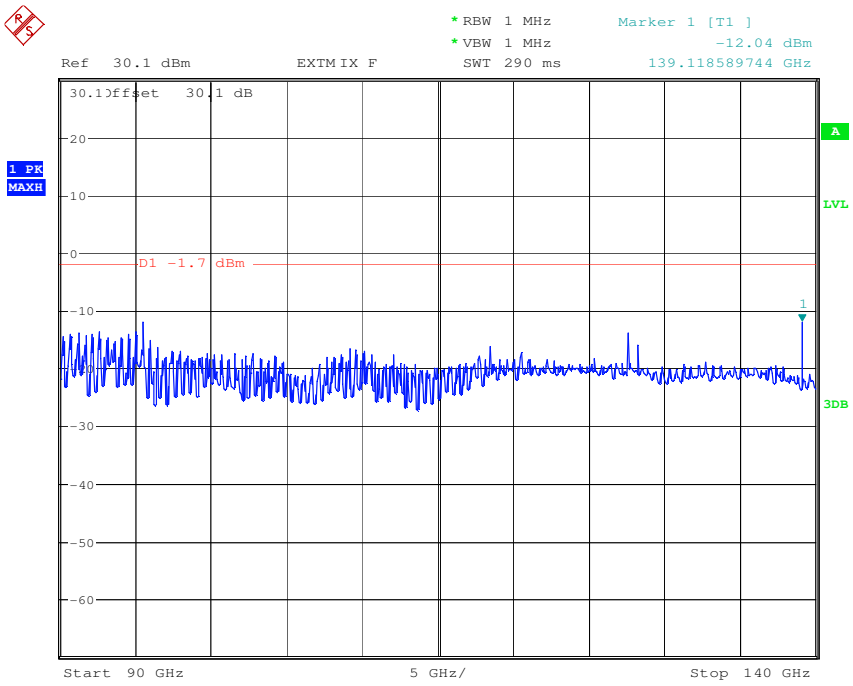
Plot 15b



Date: 2.FEB.2009 10:50:49

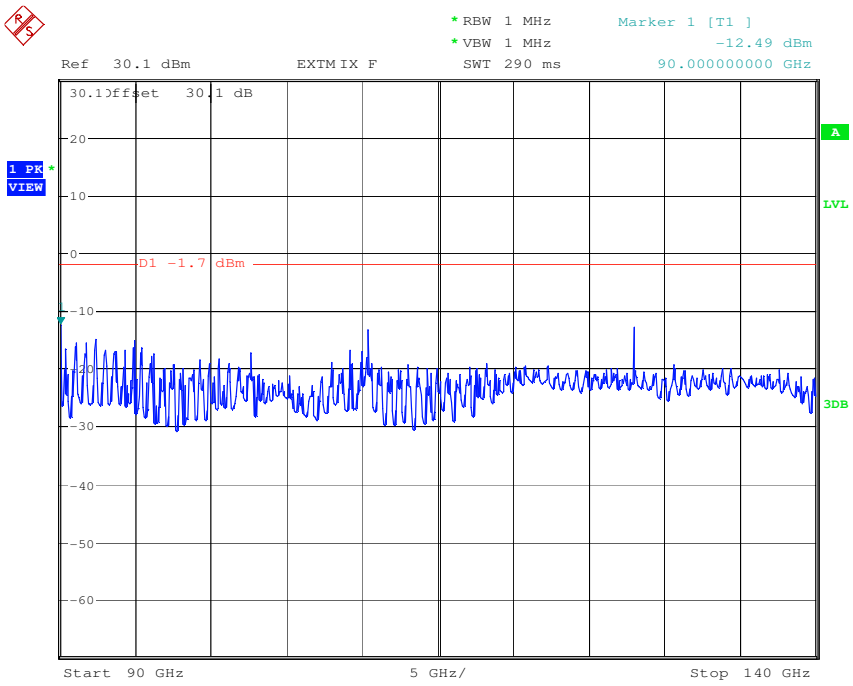
The peak at 77 GHz shows the wanted signal carrier.

Plot 16a



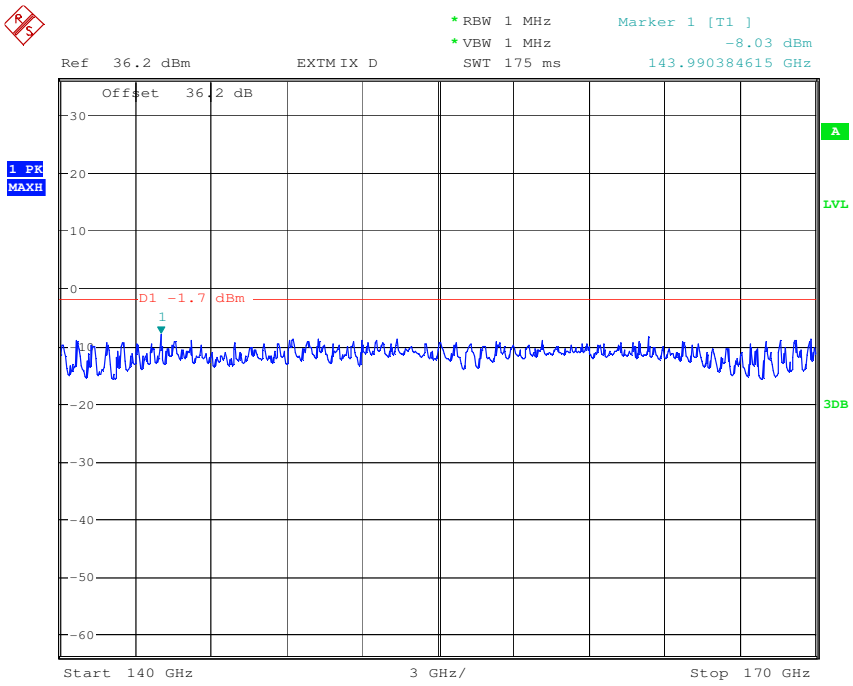
Date: 22.JUL.2008 09:31:52

Plot 16b



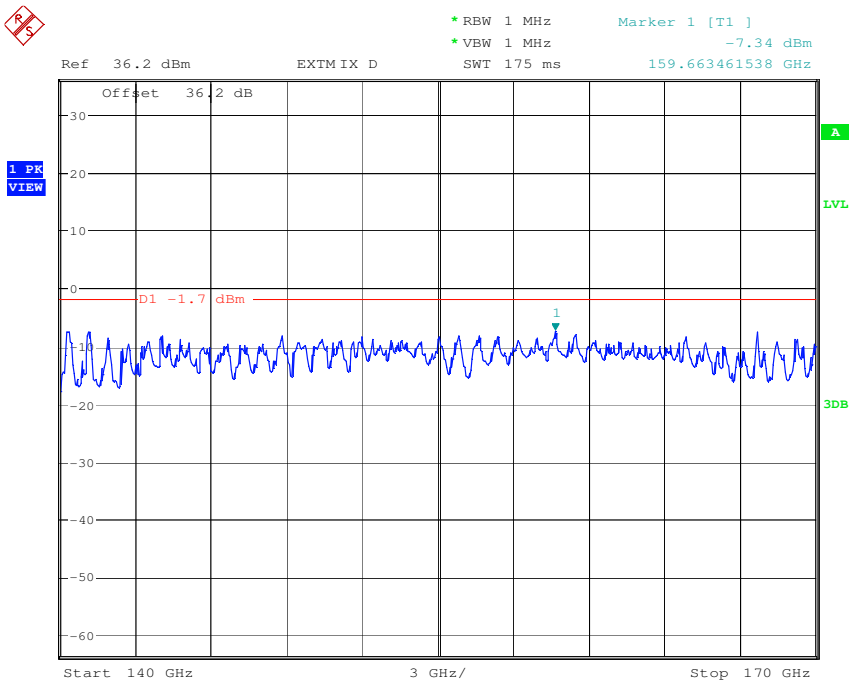
Date: 2.FEB.2009 10:54:07

Plot 17a



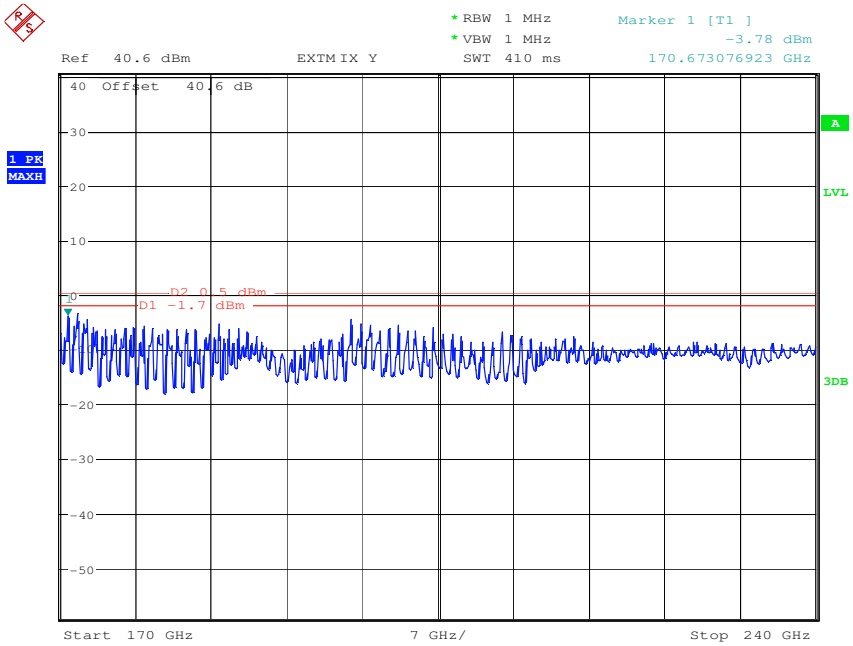
Date: 22.JUL.2008 09:38:34

Plot 17b



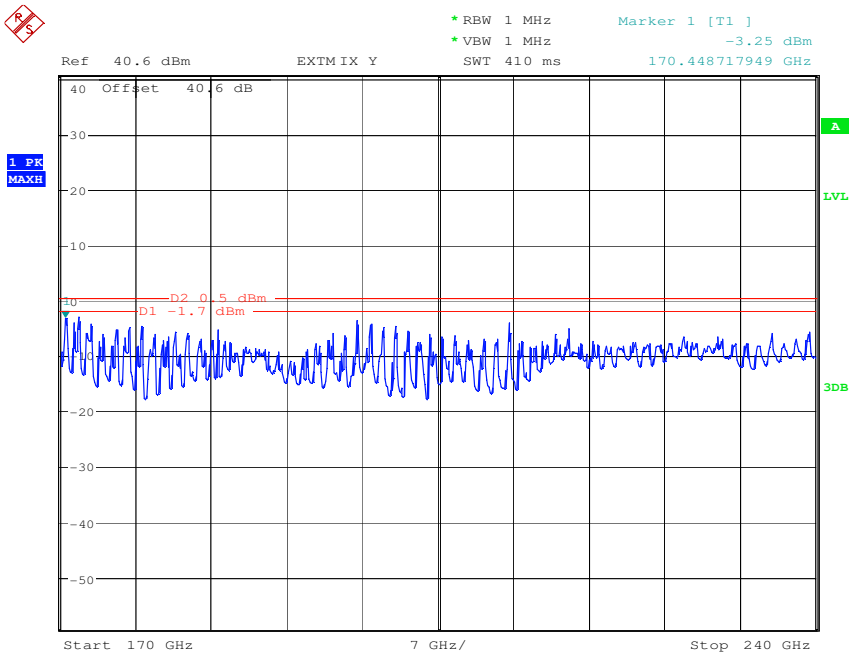
Date: 2.FEB.2009 10:57:01

Plot 18a



Date: 22.JUL.2008 09:47:12

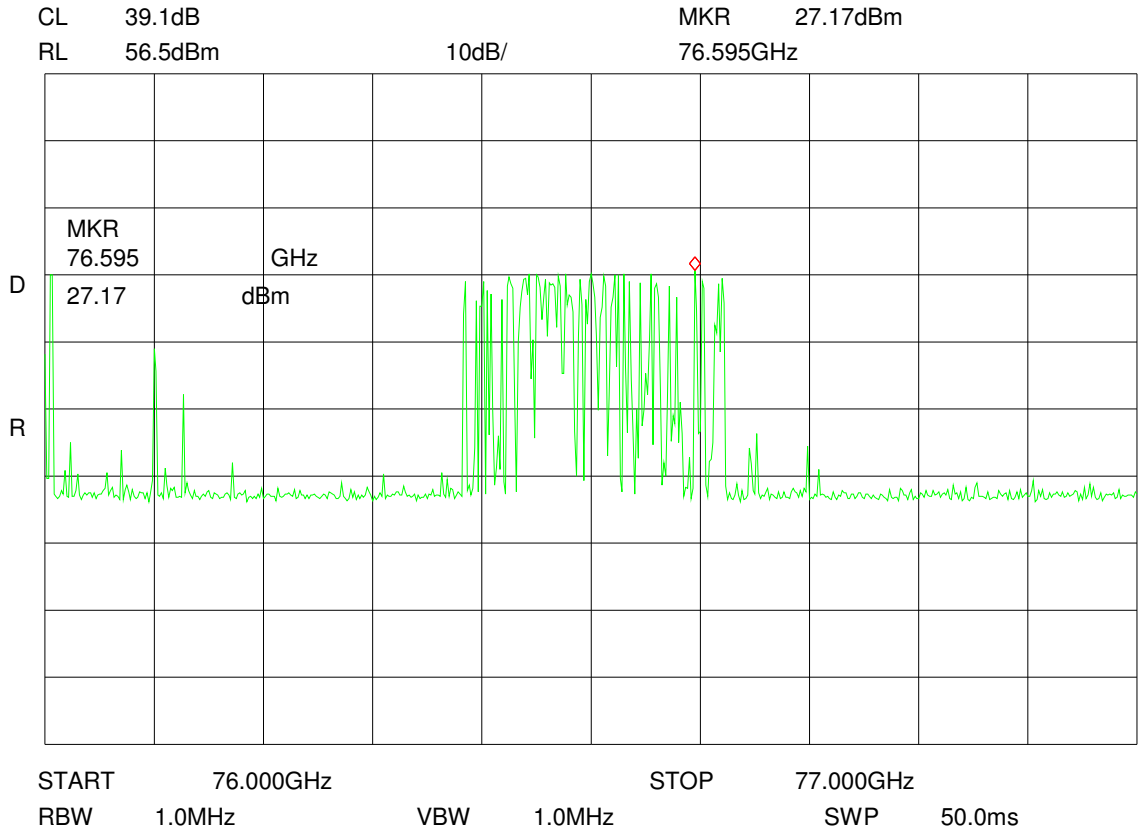
Plot 18b



Date: 2.FEB.2009 11:24:54

The lower limit line is valid for frequencies up to 200 GHz.
The upper limit line of 0.5 dBm is valid for the frequency range 200 GHz to 240 GHz.

Plot 19a



Remark: There is a false image generating by the external harmonic mixer used in the frequency range 76.0 to 76.2 GHz.

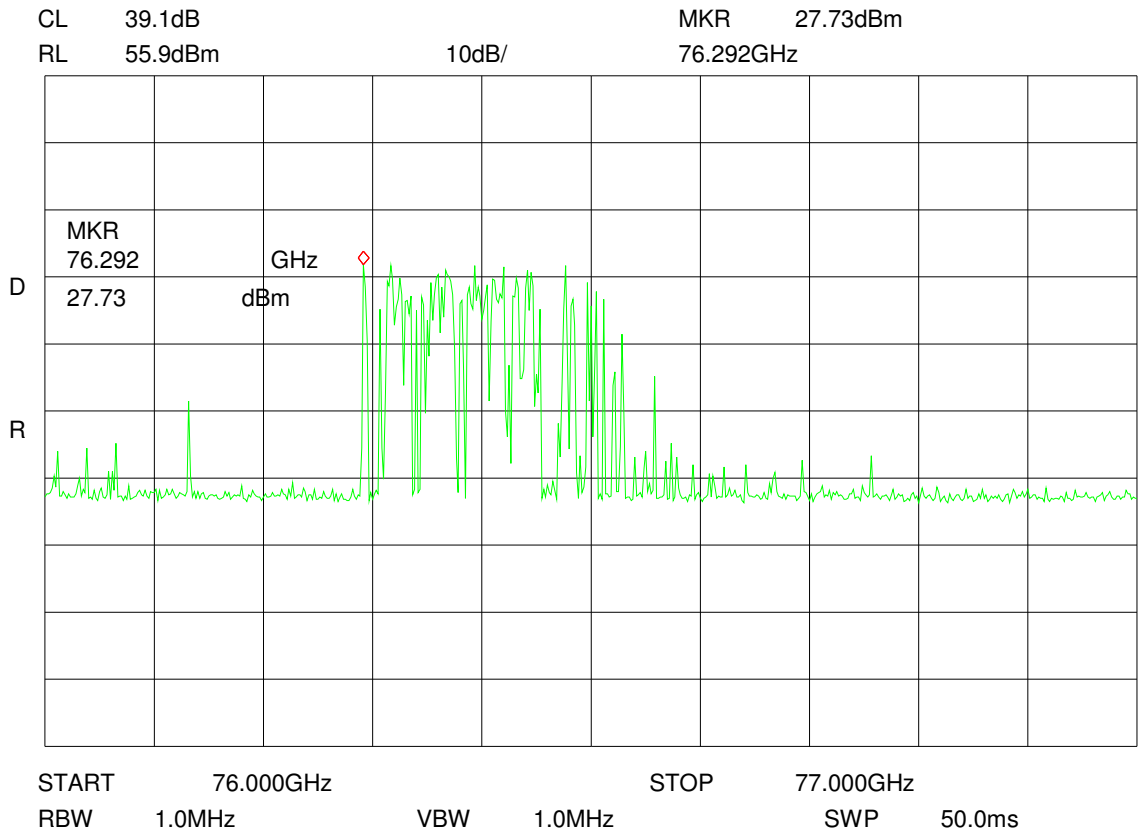
The mark “R” in the measurement plot indicates a reference level offset adjusted. This offset equates to the system attenuation at a measurement distance of 2.0 m and is considered in the test.

System attenuation a = 50.4 dB

Measurement distance d = 2.0 m
Evaluation distance R = 3.0 m

Calculation **: Power density** PD = EIRP / ($4\pi * R^2$) = EIRP / 1130973.4 cm^2
= 521.2 mW (27.17 dBm) / 1130973.4 cm^2
= 0.46 µW/cm^2

Plot 19b



Remark: There is a false image generating by the external harmonic mixer used in the frequency range 76.0 to 76.2 GHz.

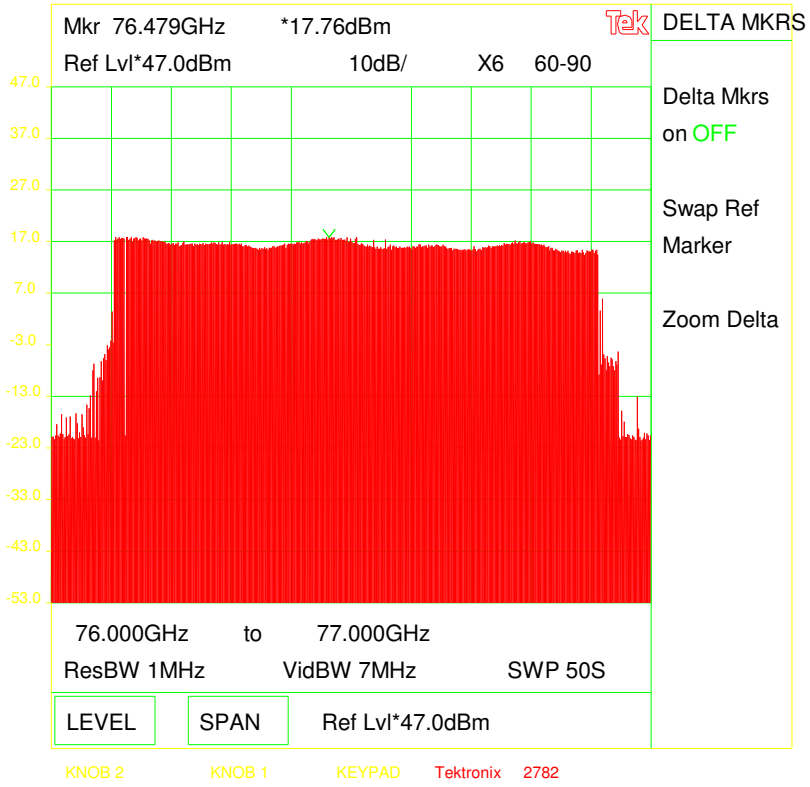
The mark “R” in the measurement plot indicates a reference level offset adjusted. This offset equates to the system attenuation at a measurement distance of 2.0 m and is considered in the test.

System attenuation a = 50.4 dB

Measurement distance d = 2.0 m
Evaluation distance R = 3.0 m

Calculation **: Power density** PD = EIRP / ($4\pi * R^2$) = EIRP / 1130973.4 cm^2
= 593 mW (27.73 dBm) / 1130973.4 cm^2
= 0.52 µW/cm^2

Plot 20a



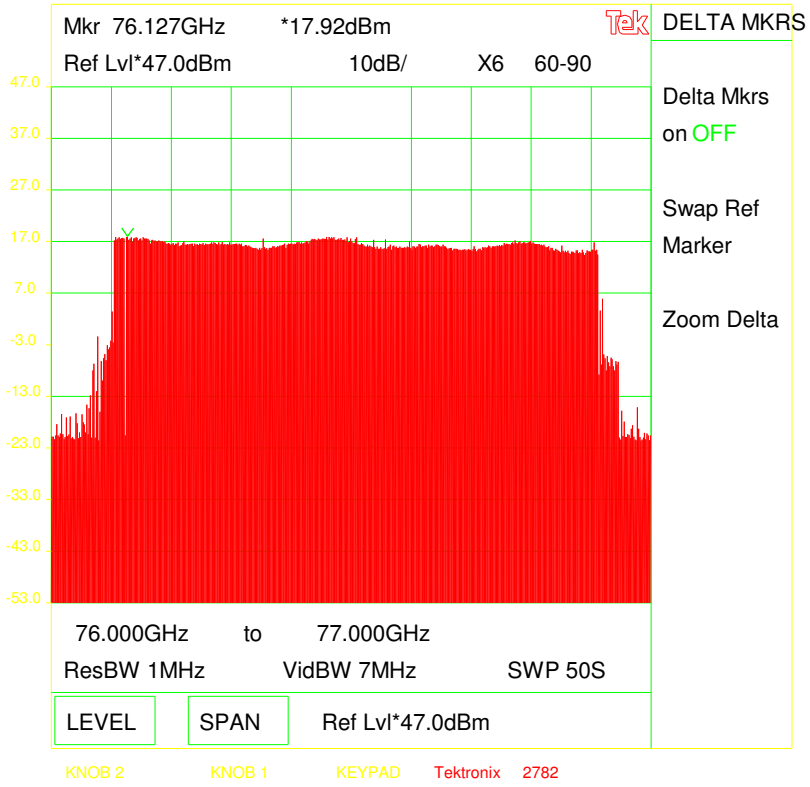
The mark "*" in the measurement plot indicates a reference level offset adjusted. This offset equates to the system attenuation at a measurement distance of 2.0 m and is considered in the test.

System attenuation a = 50.4 dB

Measurement distance d = 2.0 m
Evaluation distance R = 3.0 m

Calculation **: Power density** PD = EIRP / ($4\pi * R^2$) = EIRP / 1130973.4 cm^2
= 60 mW (17.76 dBm) / 1130973.4 cm^2
= 0.05 µW/cm^2

Plot 22a



The mark "*" in the measurement plot indicates a reference level offset adjusted. This offset equates to the system attenuation at a measurement distance of 2.0 m and is considered in the test.

System attenuation a = 50.4 dB

Measurement distance d = 2.0 m
Evaluation distance R = 3.0 m

Calculation **: Power density** PD = EIRP / ($4\pi * R^2$) = EIRP / 1130973.4 cm^2
= 62 mW (17.92 dBm) / 1130973.4 cm^2
= 0.05 µW/cm^2

4 Photographs of the EUT, exterior view

Photo 1

Front view of EUT with circular shaped lens (WVR)

Photo 2

Front view of EUT with elliptical shaped lens (Radarsensor)

Photo 3

Side view of EUT with circular shaped lens (WVR

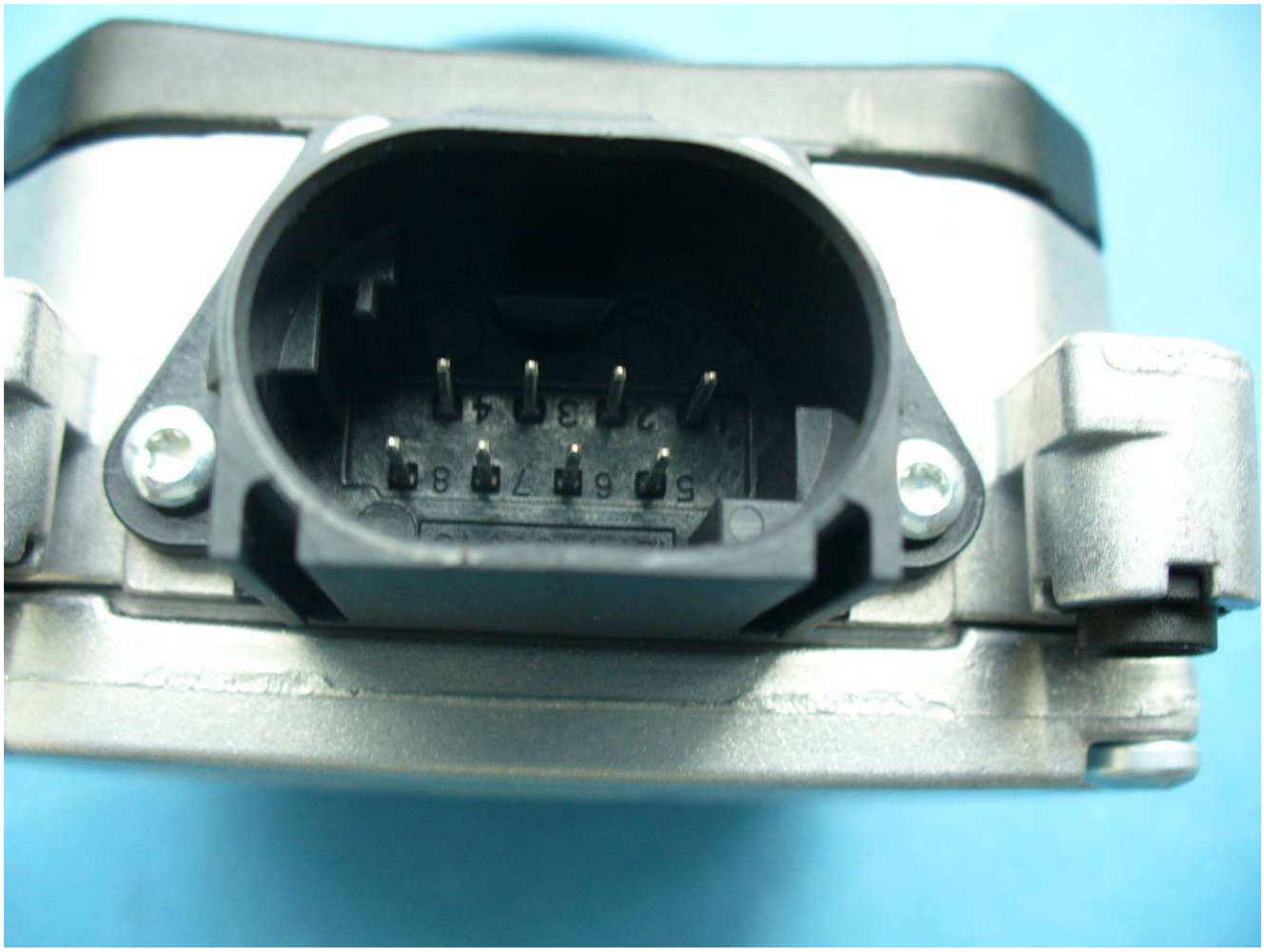
Photo 4

Back view of EUT

Photo 5

EUT label

Photo 6



Connector

5 Photographs of the EUT, interior view

Photo 7

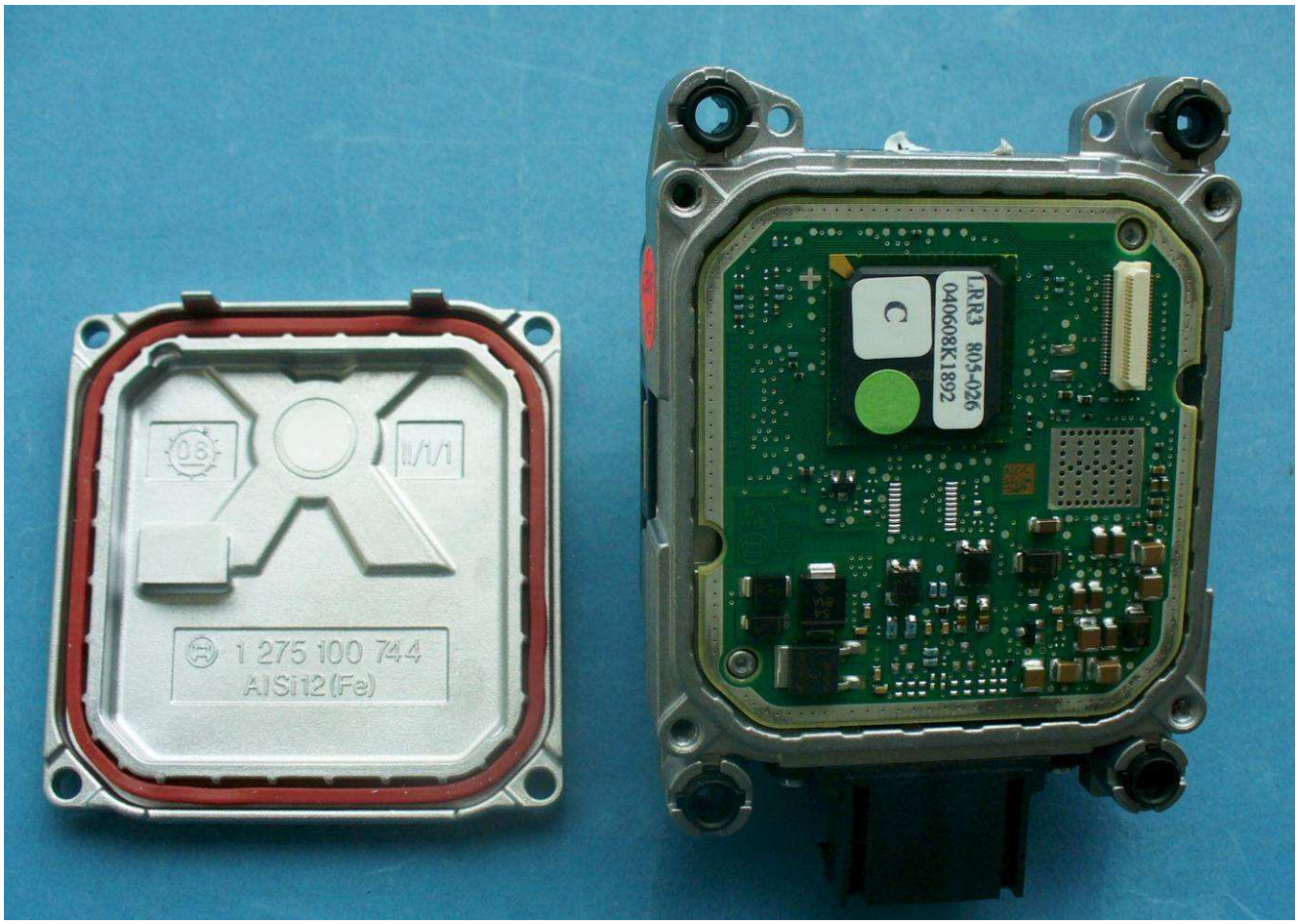


Photo 8

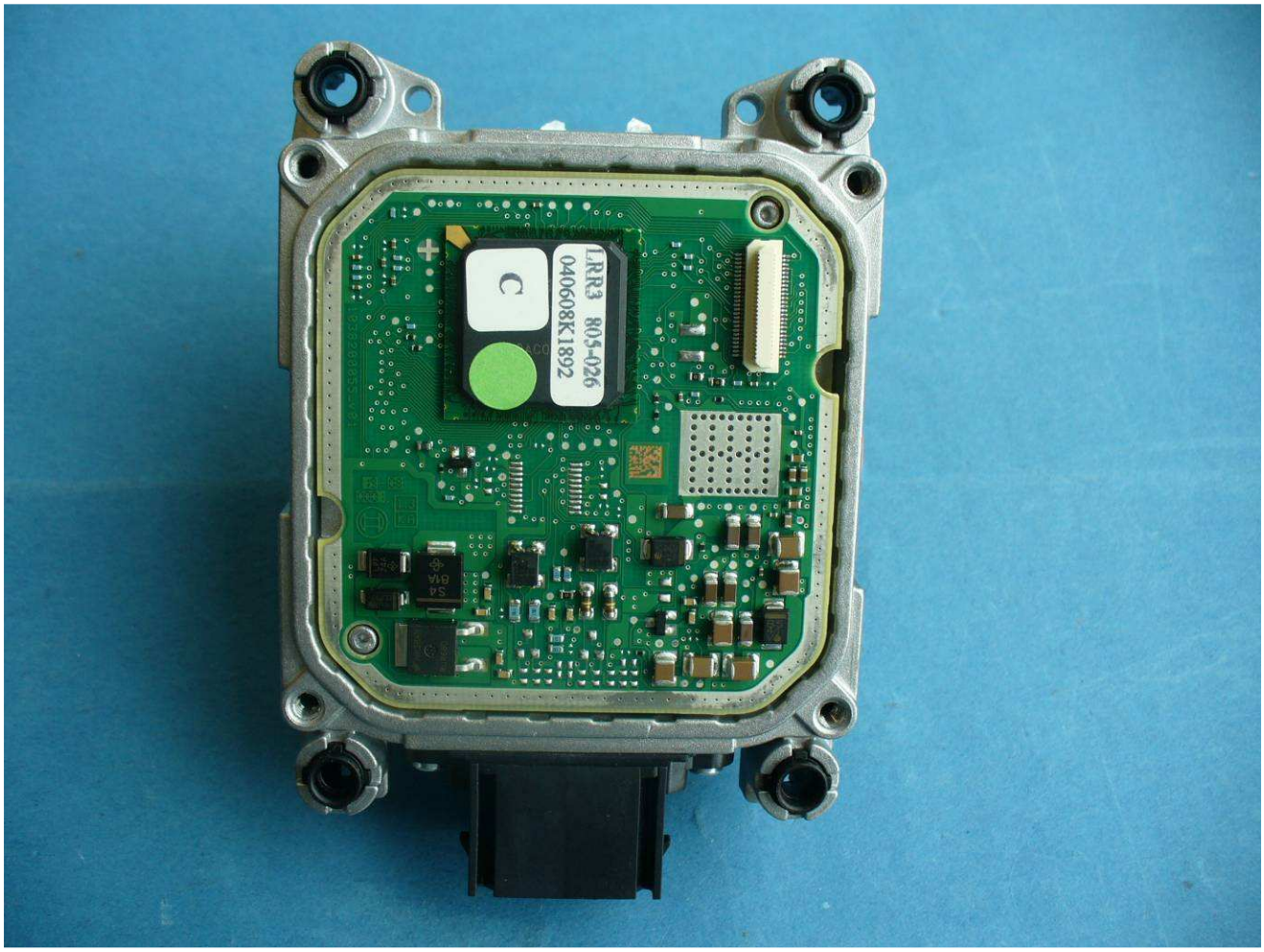


Photo 9

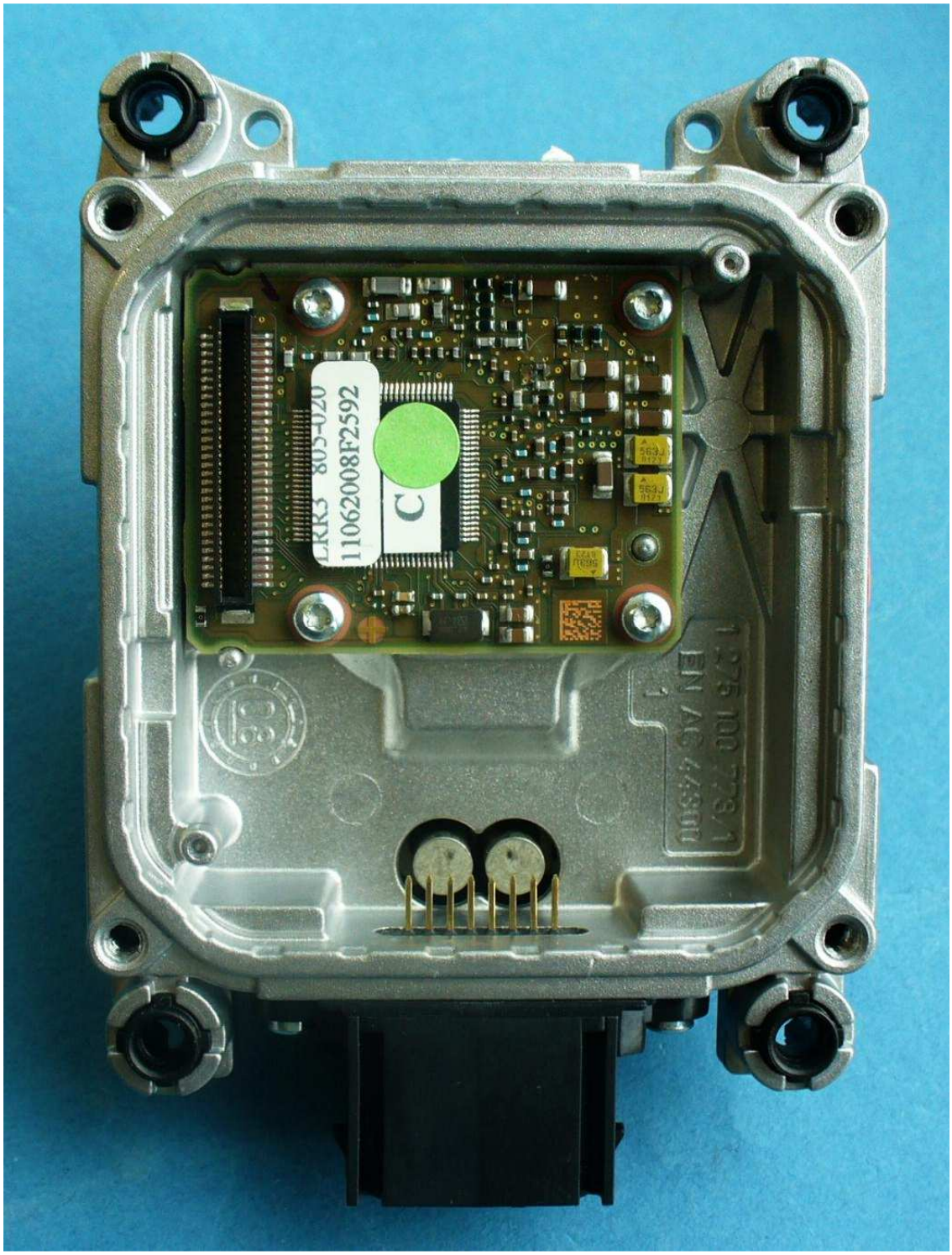


Photo 10

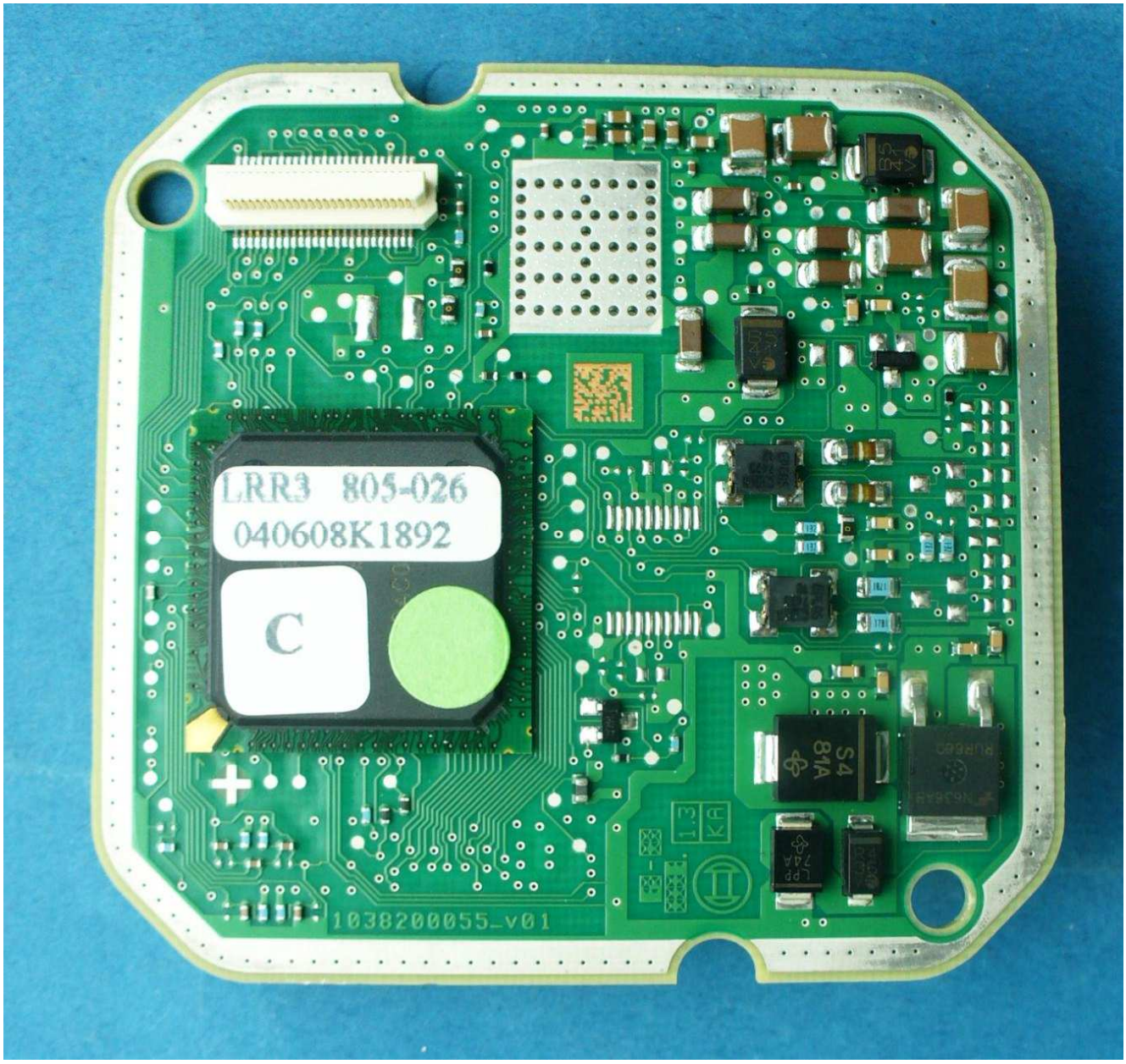


Photo 11

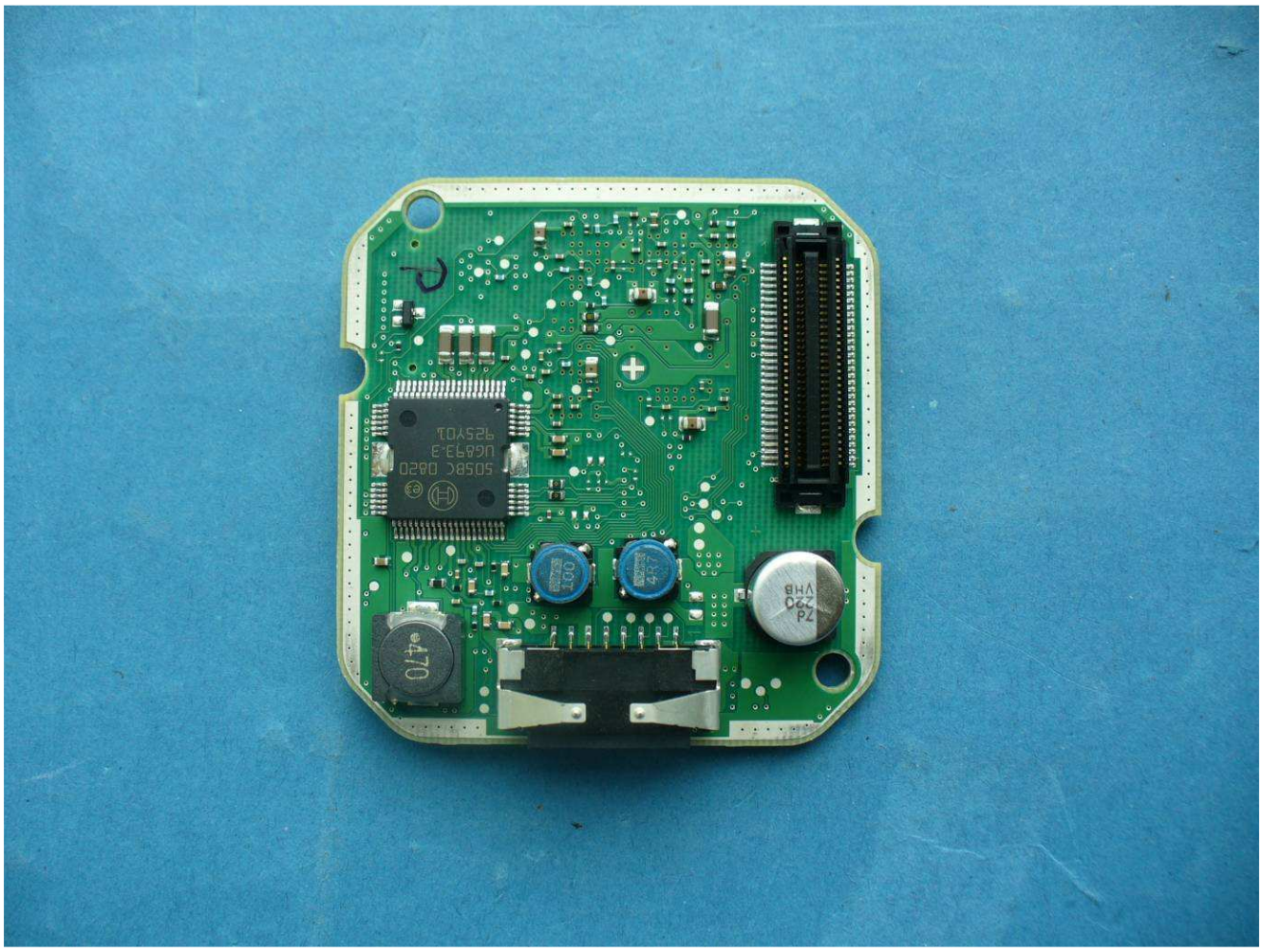


Photo 12

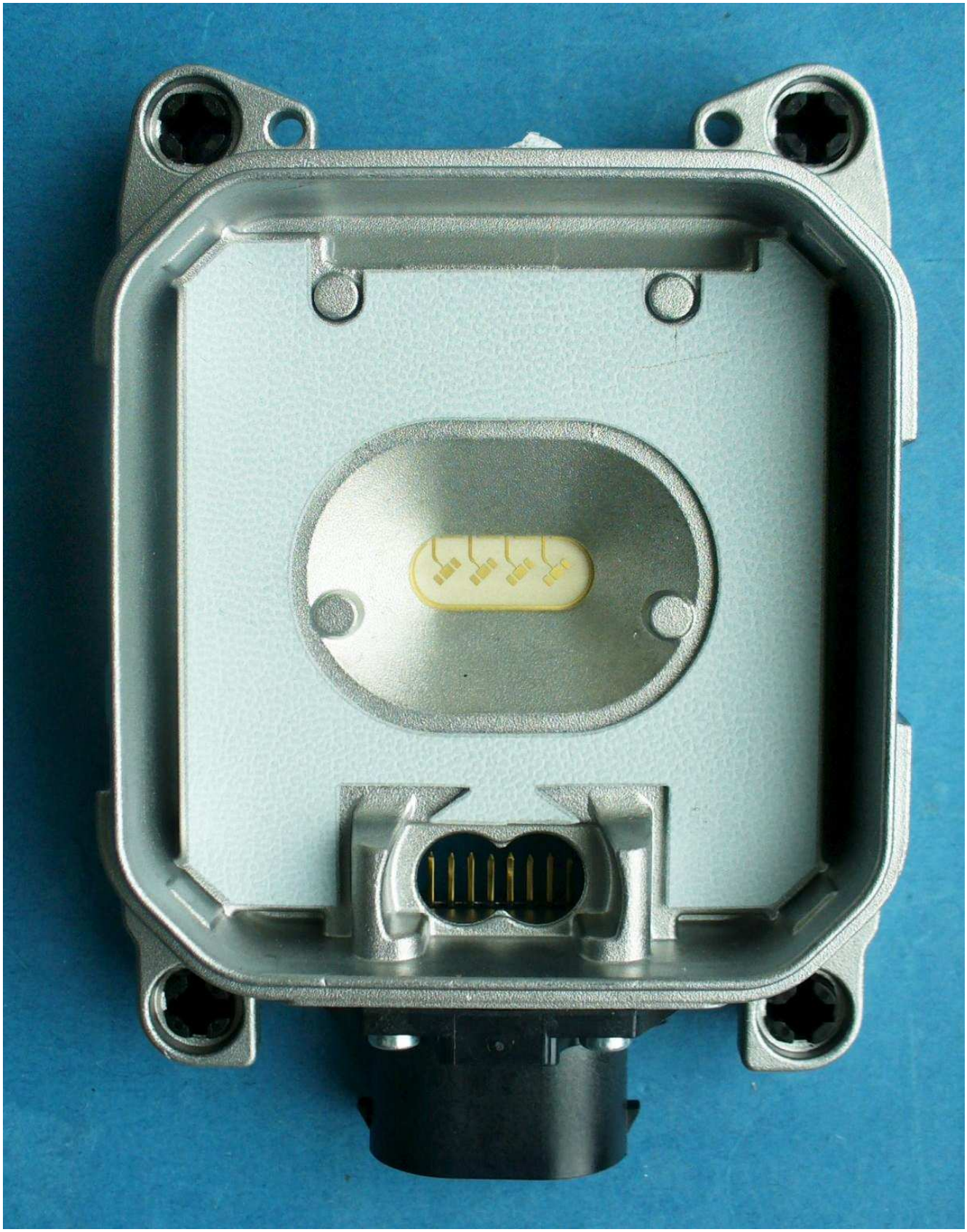
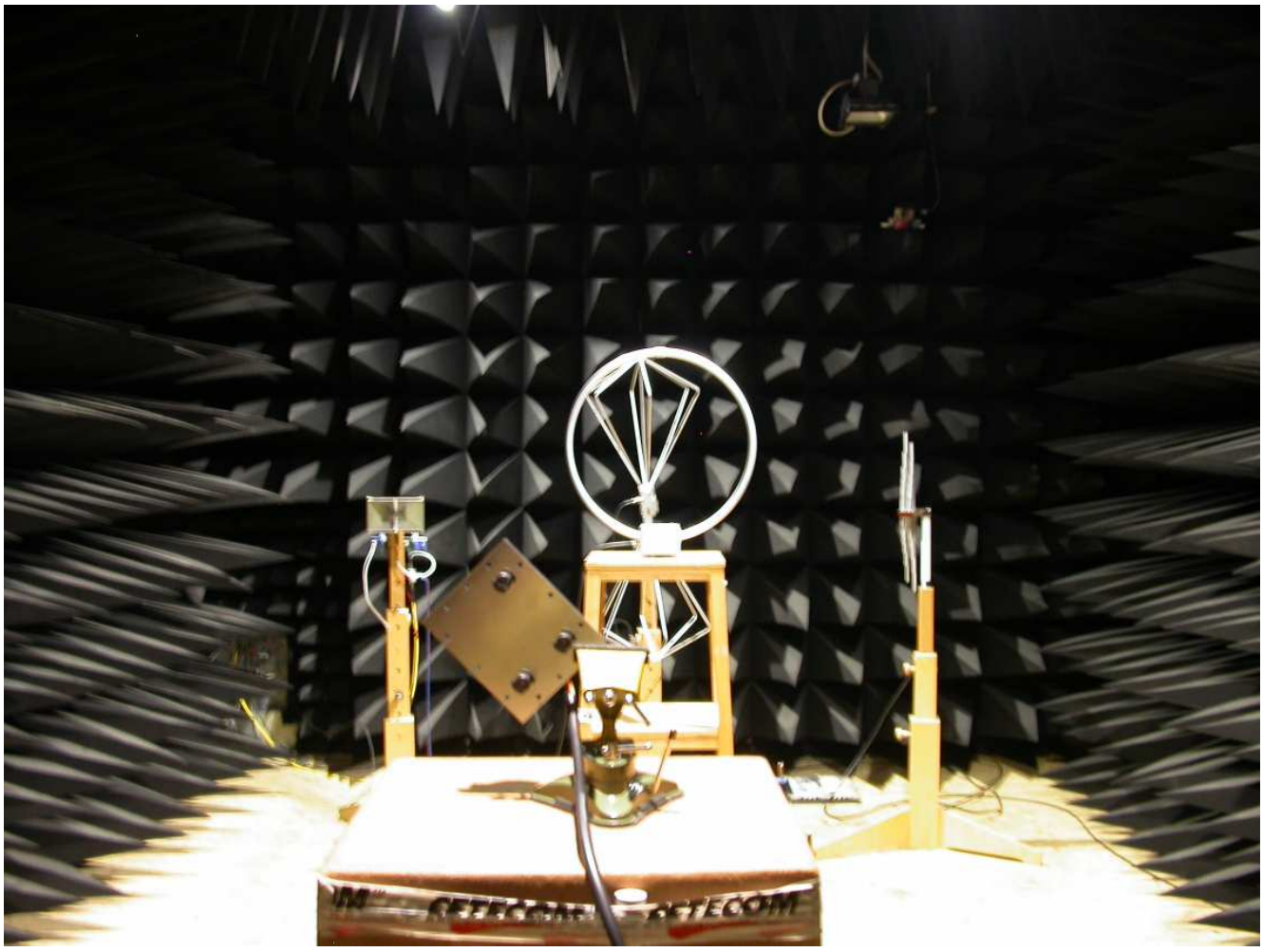


Photo 13

6 Photographs of the Test Set-ups

Photo 13



Spurious emission measurement 9 kHz – 30 MHz

Photo 14

Spurious emission measurement 30 MHz – 1 GHz

Photo 15

Spurious emission measurement 30 MHz – 1 GHz

Photo 16

Spurious emission measurement 1 GHz – 12 (18) GHz

Photo 17

Spurious emission measurement 1 GHz – 12 (18) GHz

Annex A: Test Report Cover Sheet

Type of equipment	:	Field disturbance sensor
Model name	:	Radarsensor (LRR3-SCU with elliptical shaped lens) WVR (LRR3-SCU with circular shaped lens)
Manufacturer	:	Robert Bosch GmbH
Address	:	Daimlerstr.6
City	:	D-71229 Leonberg
Country	:	Germany
Tested to Radio Standards Specification (RSS) No.	:	210 Issue 7
Open Area Test Site Industry Canada Number	:	IC 3463C-1
Frequency Range (or fixed frequency)	:	76.000 – 77.000 GHz
RF: Power in Watts RF: Power density @ 3m in dBµW/cm^2	: :	1.32 1.16
Field Strength (at what distance)	:	-/-
Occupied Bandwidth (99% BW)	:	808 MHz
Type of Modulation	:	F0N
Emission Designator	:	808M0F0N (FMCW)
Antenna Information	:	Integrated antenna
Transmitter Spurious (worst case)	:	50.5 dBµV/m (37.15 GHz)
Receiver Spurious (worst case)	:	receive-only not applicable (TX+RX operate simultaneously)
IC no.	:	3887A-LRR3SCU
FCC ID	:	NF3-LRR3SCU

ATTESTATION:
DECLARATION OF COMPLIANCE:

I declare that the testing was performed or supervised by me; that the test measurements were made in accordance with the above-mentioned Industry Canada standard(s); and that the equipment identified in this application has been subjected to all the applicable test conditions specified in the Industry Canada standards and all of the requirements of the standard have been met.

Laboratory Manager :

2009-03-23	RSC	Nicolas Stamber	N. Stamber
Date	Section	Name	Signature

Annex B: RF Technical Brief Cover Sheet acc. to RSS-102

All Fields must be completed with the requested information or the following codes:
N/A for Not Applicable, N/P for Not Performed or N/V for Not Available.
Where applicable, check appropriate box.

1. COMPANY NUMBER: 3887A

2. MODEL NUMBER: Radarsensor (LRR3-SCU with elliptical shaped lens)
WVR (LRR3-SCU with circular shaped lens)

3. MANUFACTURER: Robert Bosch GmbH
Daimlerstrasse 6
Germany, 71229 Leonberg

4. TYPE OF EVALUATION: (c) RF Evaluation

- **Evaluated against exposure limits: General Public Use** ☒ **Controlled Use** ☐
- **Duty cycle used in evaluation:** 100 %
- **Standard used for evaluation:**
- **Measurement distance:** 0.2 m
- **RF value:** 2.6 W/m^2
  Measured ☐ **Computed** ☐ **Calculated** ☒

ATTESTATION:
DECLARATION OF RF EXPOSURE COMPLIANCE:

I attest that the information provided in this test report are correct; that a Technical Brief was prepared and the information it contains is correct; that the device evaluation was performed or supervised by me; that applicable measurement methods and evaluation methodologies have been followed and that the device meets the SAR and/or RF exposure limits of RSS-102.

Laboratory Manager :

2009-03-23	RSC	Nicolas Stamber	N. Stamber
Date	Section	Name	Signature