



FCC ID: V9X-LMD400R

## EMI -- TEST REPORT

- FCC Part 90.217 -

<b>Test Report No. :</b>	<b>T33730-00-00AA</b>	19. October 2009
		Date of issue

**Type / Model Name** : LMD-400-R

**Product Description** : UHF Narrow Band Multi Channel Transceiver

**Applicant** : Circuit Design Inc.

**Address** : 7557-1, Hotaka Azumino-city  
Nagano 399-8303, Japan

**Manufacturer** : Circuit Design Inc.

**Address** : 7557-1, Hotaka Azumino-city  
Nagano 399-8303, Japan

**Licence holder** : Circuit Design Inc.

**Address** : 7557-1, Hotaka Azumino-city  
Nagano 399-8303, Japan

<b>Test Result</b> according to the standards listed in clause 1 test standards:	<b>POSITIVE</b>
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DAT-P-207/05-00

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 90, Subpart A - General Information (10-1-07 Edition)**

### **FCC Rules and Regulations Part 90, Subpart I – General Technical Standards (10-1-07 Edition)**

Part 90, Subpart I, Section 90.213 Frequency stability

Part 90, Subpart I, Section 90.217 Exemption from technical standards

**ANSI/TIA/EIA-603-C-2004** **Test Requirements acc. to 47 CFR Parts 2.1046 – 2.1055**

### **FCC Rules and Regulations Part 1, Subpart I - Procedures Implementing the National Environmental Policy Act of 1969**

Part 1, Subpart I, Section 1.1310 Radiofrequency radiation exposure limits

Part 1, Subpart 2, Section 2.1093 Radiofrequency radiation exposure evaluation: portable device

### **OET Bulletin 65, 65A, 65B, 65C Edition 97-01, August 1997 – Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.**

ANSI C63.4: 2003 Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

ANSI C95.1:1992 IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

CISPR 16-4-2: 2003 Uncertainty in EMC measurement

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## **2 SUMMARY**

### **GENERAL REMARKS:**

The EuT is working in the frequency range from 458.0 to 462.5 MHz.

The maximum output power is less than 10 mW.

Channel space 12.5 kHz.

The allowed channels (Frequencies) can be selected external by DIP switches.

**DoC statement:** The EuT can be switched into receive mode. Therefore class B of DoC has to be followed. This EuT has been verified according to 47 CFR part 15 B and fulfills all requirements.

### **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 : 03. September 2009

Testing concluded on : 29. September 2009

Checked by:

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Thomas Weise  
Dipl.-Ing.(FH)  
Laboratory Manager

Tested by:

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Anton Altmann  
Dipl.-Ing.(FH)

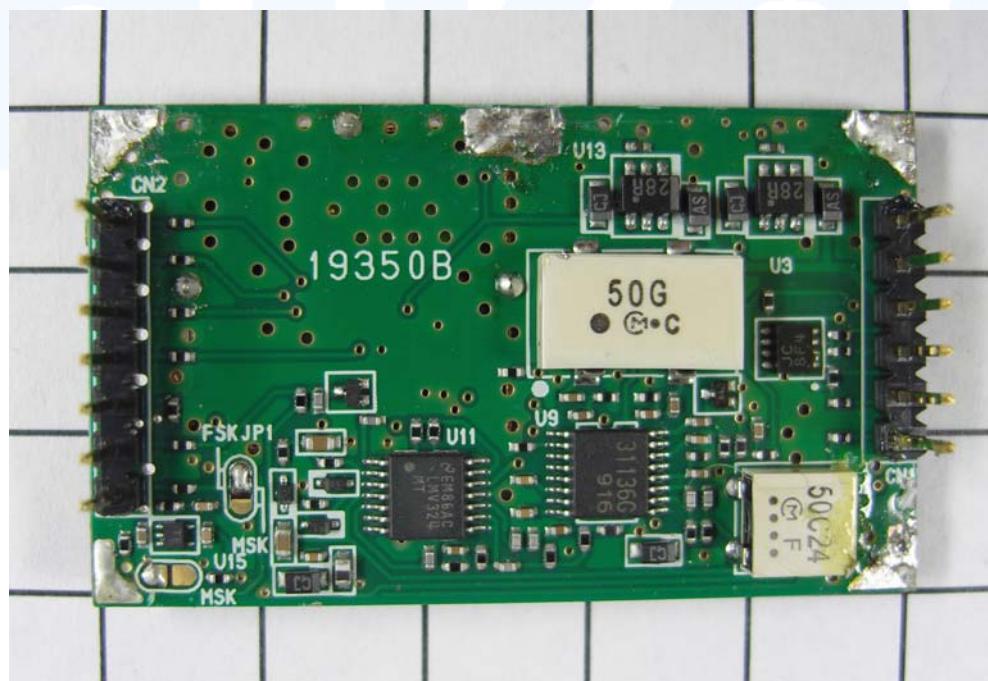
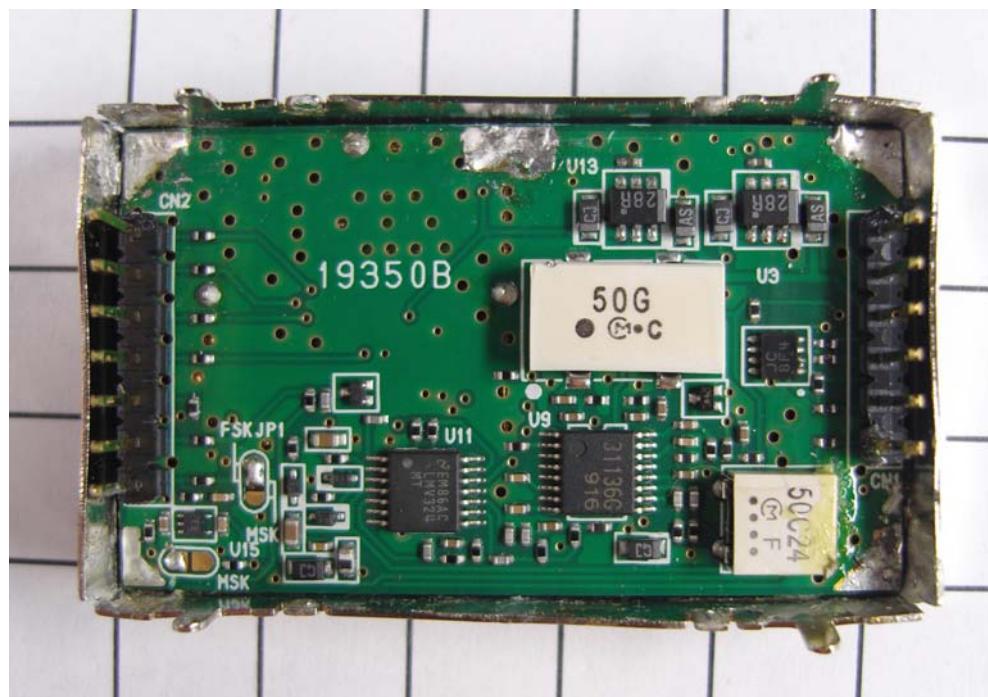
FCC ID: V9X-LMD400R

### **3 EQUIPMENT UNDER TEST**

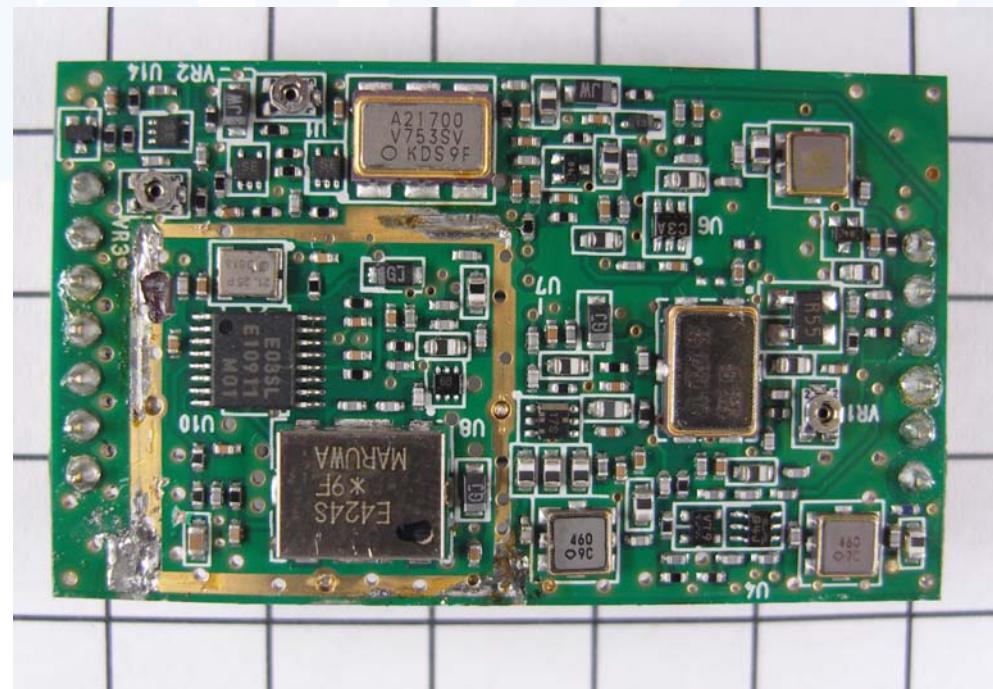
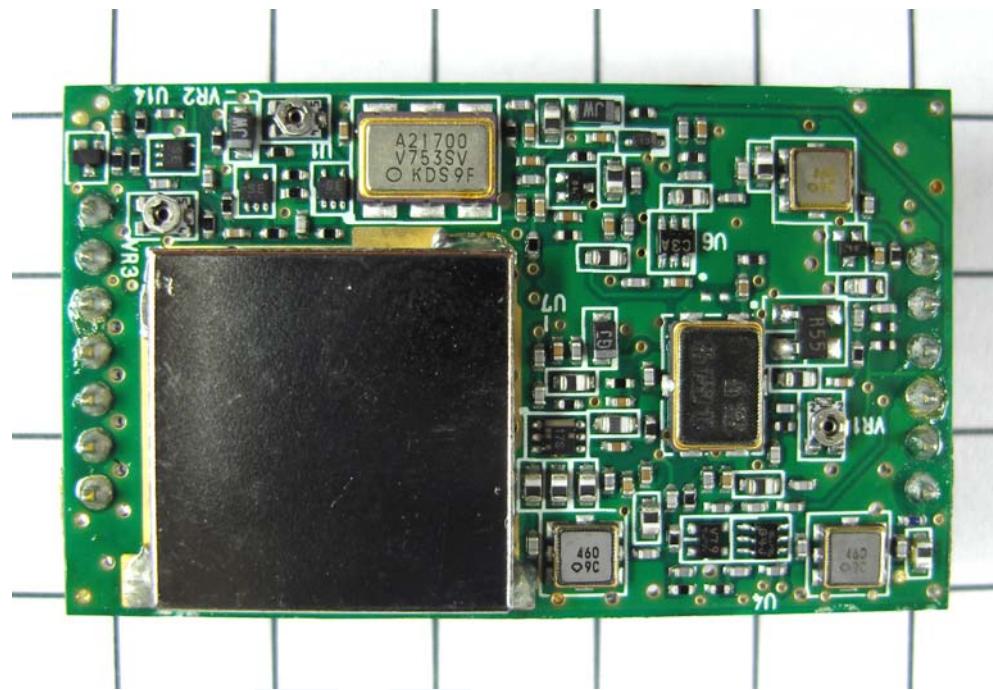
#### **3.1 Photo documentation of the EUT – See attachment A**



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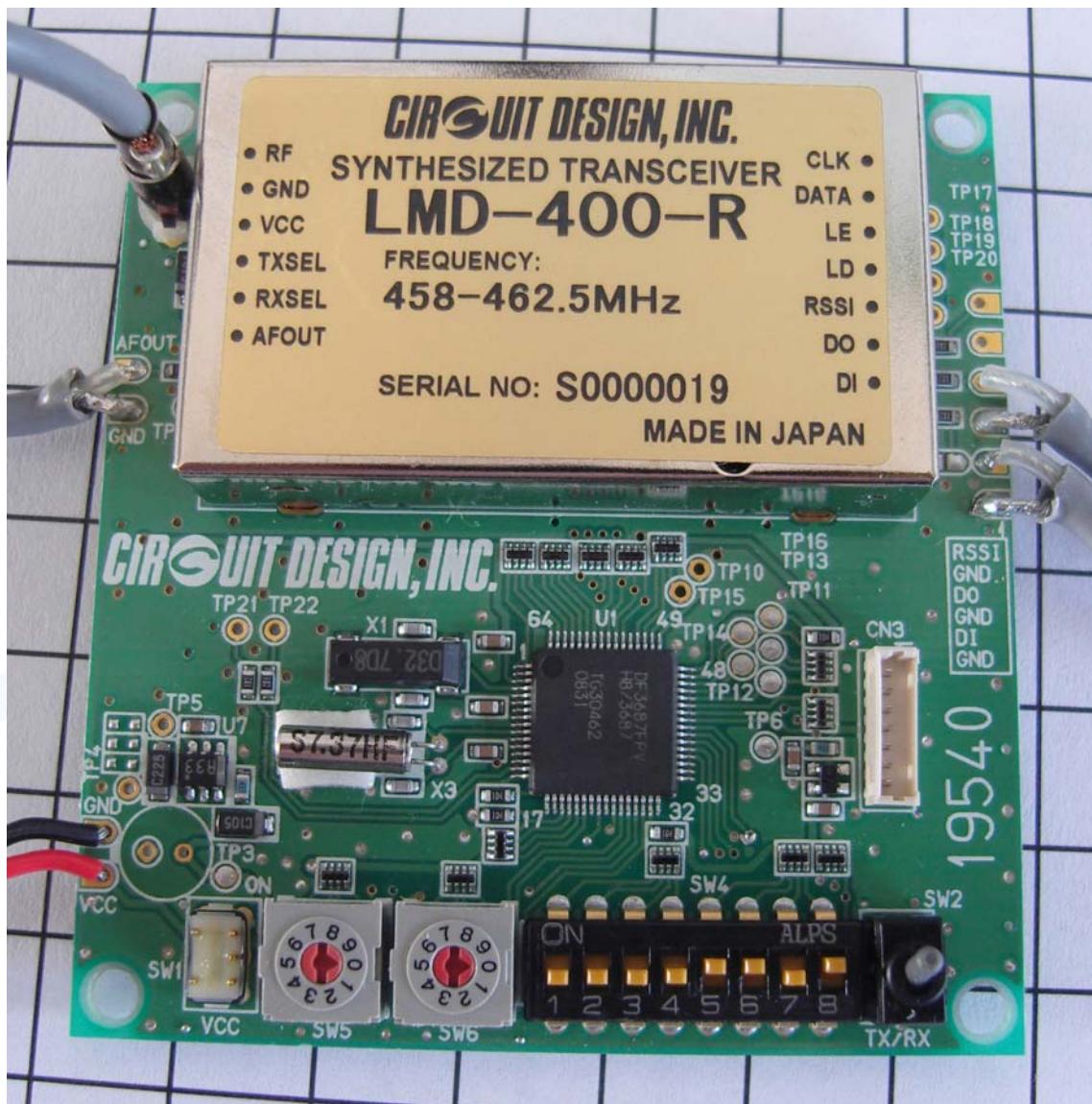


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Test PCB



Reference Antenna



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### 3.2 Power supply system utilised

Power supply voltage : 3 to 5.5 VDC

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

The EuT LMD-400-R is a synthesized multi channel transceiver module. The small, highly integrated and fully shielded module is designed for embedding in user equipment. The module is suitable for various low power industriel telecontrol and telemetry applications.

Number of tested samples: 1  
Serial number: S0000019

#### EUT operation mode:

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

- TX CW (unmodulated)
- TX modulated
- Receive mode

#### EUT configuration:

(The CDF filled by the applicant can be viewed at the test laboratory.)

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

- Test PCB Model : 19540 supplied by Circuit Design
- Reference Antenna Model : 1/4 lambda coaxial antenna
- \_\_\_\_\_ Model : \_\_\_\_\_

## 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.

### 4.1 Measurement Protocol for FCC, VCCI and AUSTEL

#### 4.1.1 GENERAL INFORMATION

##### 4.1.1.1 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 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.

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**4.1.1.2 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.

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## **5 TEST CONDITIONS AND RESULTS**

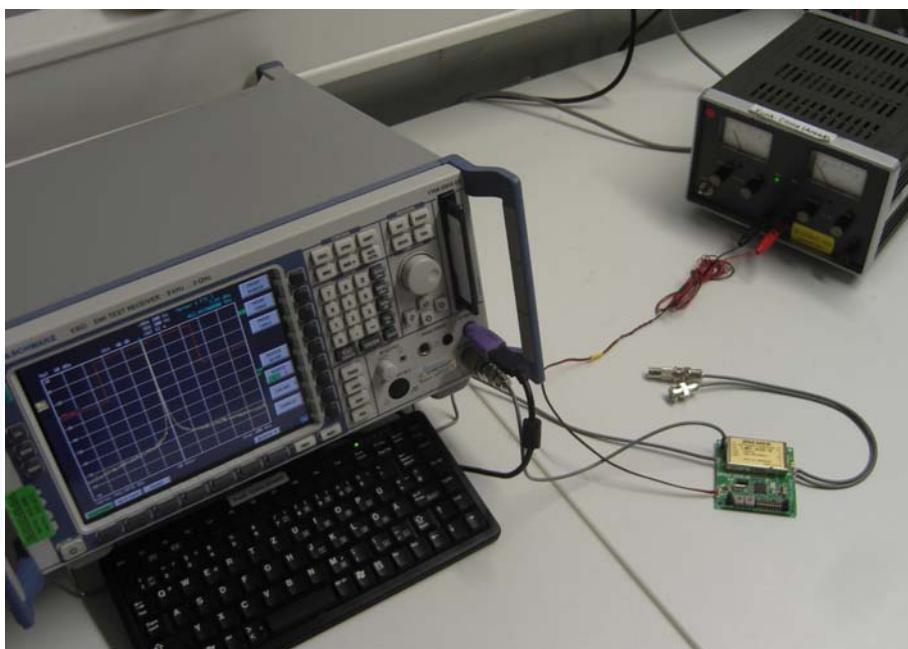
### **5.1 Maximum output power**

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

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

Test location: AREA4

#### **5.1.2 Photo documentation of the test set-up**



#### **5.1.3 Applicable standard**

According to FCC Part 90, Section 90.217 and Part 2, Section 2.1046:

Except as noted herein, transmitters used at stations licensed below 800 MHz on any frequency listed in subparts B and C of this part or licensed on a business category channel above 800 MHz which have an output power not exceeding 120 mW are exempt from the technical requirements set out in this subpart.

#### **5.1.4 Description of Measurement**

The transmitter output was connected to the spectrum analyzer through an attenuator. The center frequency of the spectrum analyzer is set to the fundamental frequency. The span of the spectrum analyzer should be larger than the emission bandwidth (EBW). The cable loss or other external attenuation was taken into account and expressed in a correction factor. The absolute maximum peak output power is calculated by adding the reading of the analyzer plus correction and compared with the limit.

Spectrum analyzer settings:

RBW 120 kHz

Detector Peak

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## 5.1.5 Test result

Channel	Frequency (MHz)	Measured power (mW)	Power limit (mW)	Delta (mW)
1	458.0	8.5	120	-111.5
360	462.5	7.4	120	-112.6

Power Limit according to FCC Part 90, Section 90.217:

Frequency (MHz)	Power Limit
	(mW)
<800	120

The requirements are **FULFILLED**.

Remarks: \_\_\_\_\_

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## 5.2 Maximum permissible exposure (MPE)

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

### 5.2.1 Description of the test location

Test location: AREA4

### 5.2.2 Applicable standard

The test methods used comply with ANSI/IEEE C95.1, "IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz".

This test report shows the compliance with the limits for Maximum Permissible Exposure (MPE) specified in FCC Part 1, Section 1.1310 and the criteria to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in FCC Part 1, Section 1.1307(b).

### 5.2.3 Description of Measurement

The maximum total power input to the antenna has been measured conducted as described in clause 5.1 of this document. Through the Friis transmission formula, the known maximum gain of the antenna, the maximum power and the limit of MPE, we can calculate the distance, away from the product, where the limit of MPE is reached.

$$\text{Friis transmission formula: } P_d = \frac{P_{out} * G}{4 * \pi * r^2}$$

where

$P_d$  = power density ( $\text{mW/cm}^2$ )

$P_{out}$  = output power to antenna ( $\text{mW}$ )

$G$  = gain of antenna (linear scale)

$r$  = distance between antenna and observation point (cm)

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#### 5.2.4 Test result

For the calculation of the MPE, a reference antenna with a gain of 2.14 dBi has been assumed.

Channel No.	Frequency (MHz)	Max power output to antenna (dBm) (mW)		Antenna gain (dBi)	Power density at 20 cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )
1	458.0	9.3	8.5	2.14	0.003	0.305
360	462.5	8.7	7.4	2.14	0.002	0.305

#### Prediction

The maximum allowable MPE value of 0.305 mW/cm<sup>2</sup> will be reached in a distance of 20 cm in case that an antenna gain less than 22 dBi will be used.

Limits for maximum permissible exposure (MPE) according to FCC 1.1307(b):

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
<b>(B) Limits for General Population / Uncontrolled Exposure</b>				
0.3 – 3.0	614	1.63	100	30
3.0 – 30	824/f	2.19/f	180/f <sup>2</sup>	30
30 - 300	27.5	0.073	0.2	30
<b>300-1500</b>	---	---	<b>f/1500</b>	<b>30</b>
1500-100000	---	---	1.0	30

f = Frequency in MHz

The requirements are **FULFILLED**.

Remarks:

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### 5.3 Frequency stability

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

#### 5.3.1 Description of the test location

Test location: AREA4

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



#### 5.3.3 Applicable standard

According to FCC Part 90, Section 90.213 and Part 2, Section 2.1055:

The frequency tolerance of the carrier signal shall be maintained within  $\pm 1.5$  ppm for mobile equipment over a temperature range of  $-20$  °C to  $+60$  °C while the supply voltage is varied from 3.0 to 5.5 Volt.

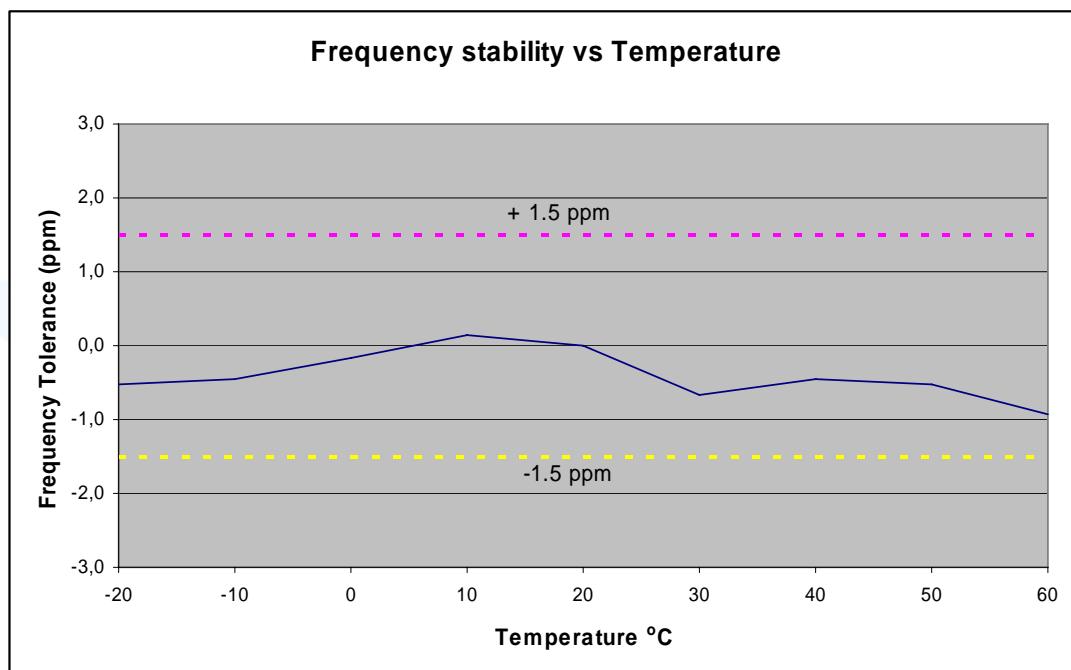
#### 5.3.4 Description of Measurement

The frequency tolerance is measured using a spectrum analyzer. The test signal is unmodulated. The RBW is set small enough to get a suitable frequency resolution. The measurement was performed conducted. The frequency was measured at normal condition and at combinations of extreme temperature and voltage conditions in 10 °C increments.

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5.3.5 Test result

Test conditions		Frequency $f_e$ (MHz)	
Temperature	Voltage	Ch1 (458.0 MHz)	Ch 360(462.5MHz)
20 °C	$V_{\text{nom}}$ (3.3 V)	457.99783	462.49776
60 °C	$V_{\text{min}}$ (3.0 V)	457.99743	462.49743
	$V_{\text{max}}$ (5.5 V)	457.99741	462.49741
-20 °C	$V_{\text{min}}$ (3.0 V)	457.99761	462.49755
	$V_{\text{max}}$ (5.5 V)	457.99759	462.49754
Measurement uncertainty		$\pm 100$ Hz	



Maximum frequency drift:  $f - f_e = 457.99783 \text{ MHz} - 457.99741 \text{ MHz} = -420 \text{ Hz} = -0.9 \text{ ppm}$   
 Calculated limit at 458.0 MHz  $\pm 1.5 \text{ ppm} = \pm 687 \text{ Hz}$

The requirements are **FULFILLED**.

Remarks:

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FCC ID: V9X-LMD400R

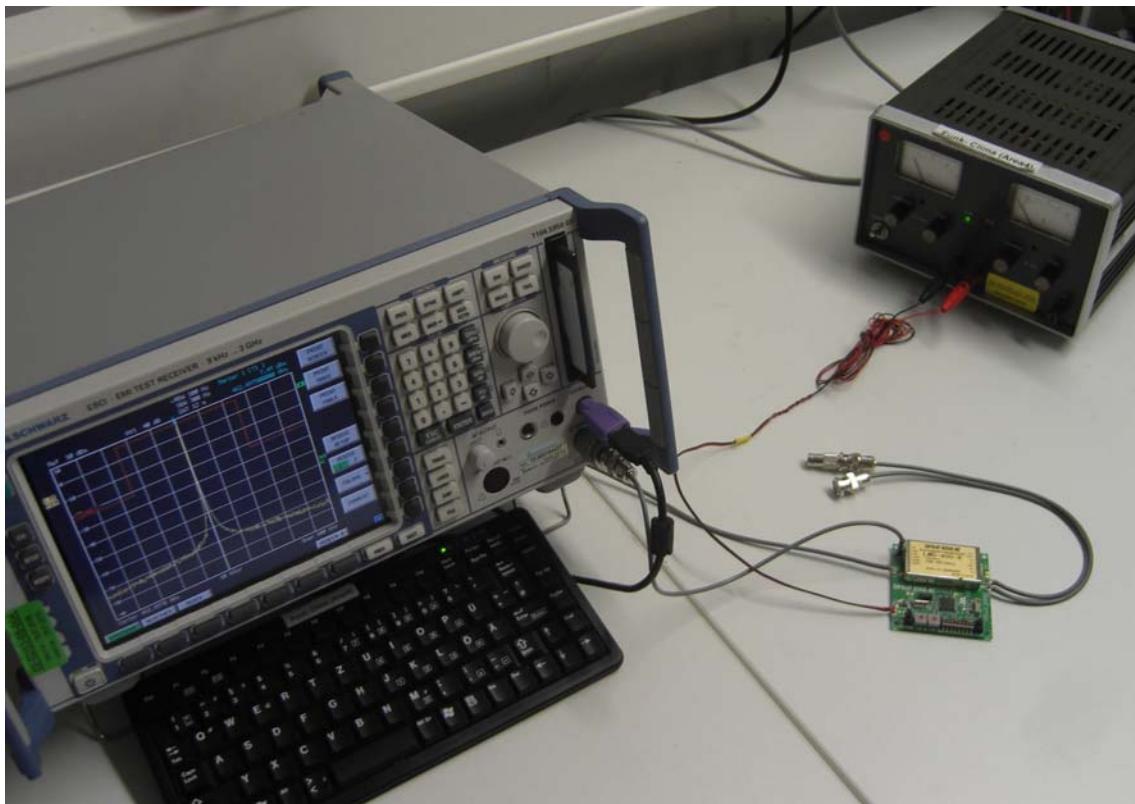
## 5.4 Transmitter sideband spectrum

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

### 5.4.1 Description of the test location

Test location: AREA4

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



### 5.4.3 Applicable standard

According to FCC Part 90, Section 90.217(b) and Part 2, Section 2.1049:

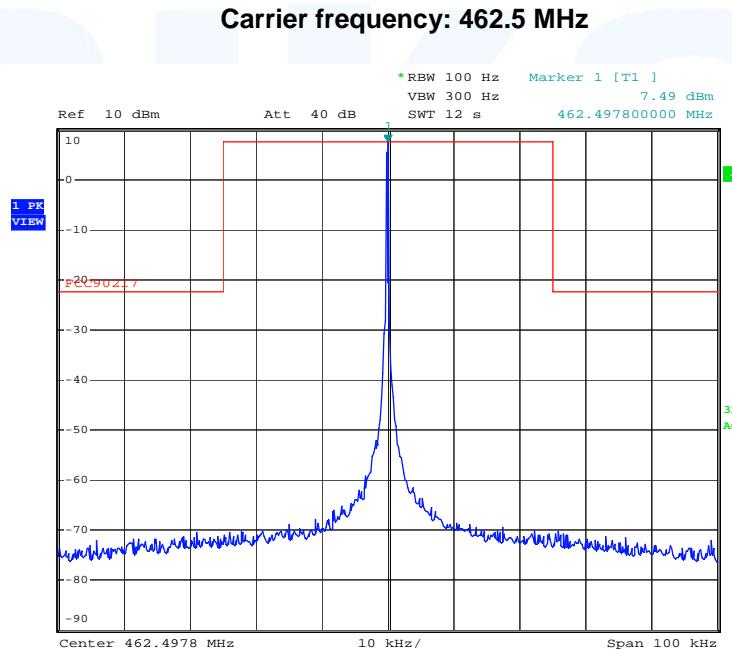
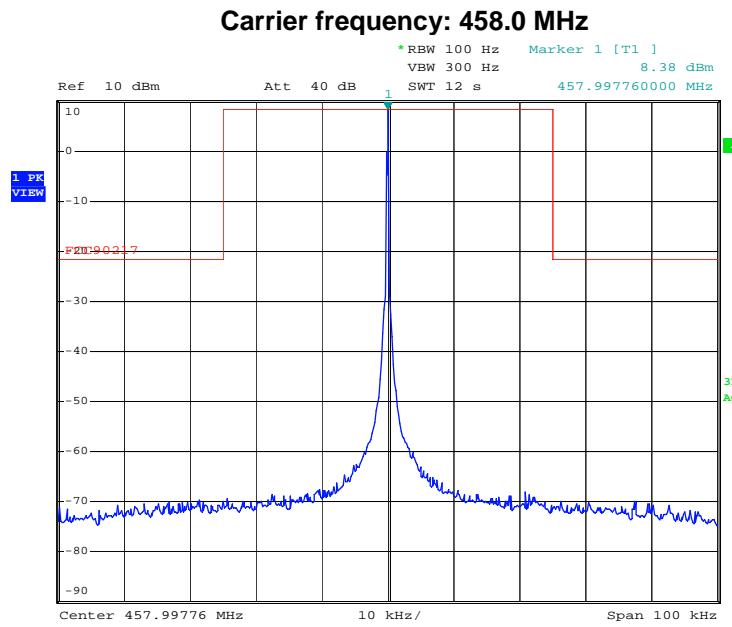
For equipment designed to operate with a 12.5 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 25 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

### 5.4.4 Description of Measurement

The transmitter outside spectrum is measured using a spectrum analyser. The RBW is set small enough to capture all associated emissions. The measurement was performed conducted. The test signal is unmodulated as intended. The limit line is adjusted to the maximum output power.

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#### 5.4.5 Test result



The requirements are **FULFILLED**.

**Remarks:** \_\_\_\_\_

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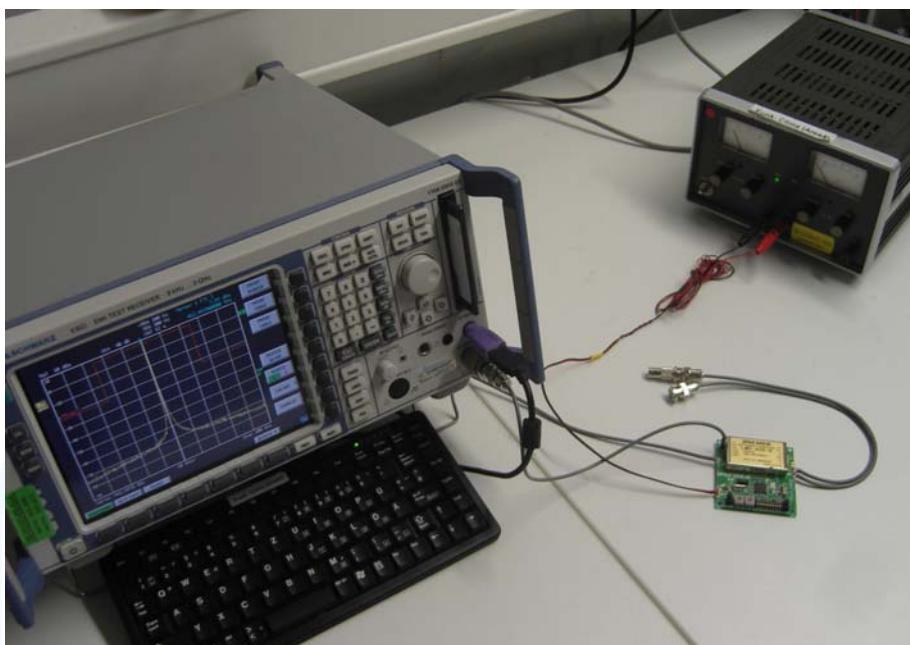
## 5.5 Transmitter spurious emissions conducted

For test instruments and accessories used see section 6 Part **SEC 1**, **SEC 2** and **SEC 3**.

### 5.5.1 Description of the test location

Test location: AREA4

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



### 5.5.3 Applicable standard

According to FCC Part 90, Section 90.217(b) and Part 2, Section 2.1051:

For equipment designed to operate with a 12.5 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 25 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

### 5.5.4 Description of measurement

The spurious emissions have been measured conducted using a spectrum analyser. The measurement has been made while the transmitter was set to the lowest operating frequency (Ch1) and to the highest operating frequency (Ch 360). In the frequency above 1 GHz a highpass filter has been used. The measurement has been performed at normal test conditions in unmodulated TX continuous mode.

The resolution bandwidth was set as follows:

9 kHz – 150 kHz:	RBW=200 Hz
150 kHz – 30 MHz:	RBW=9 kHz
30 MHz – 1 GHz:	RBW=120 kHz
Above 1 GHz:	RBW=1 MHz

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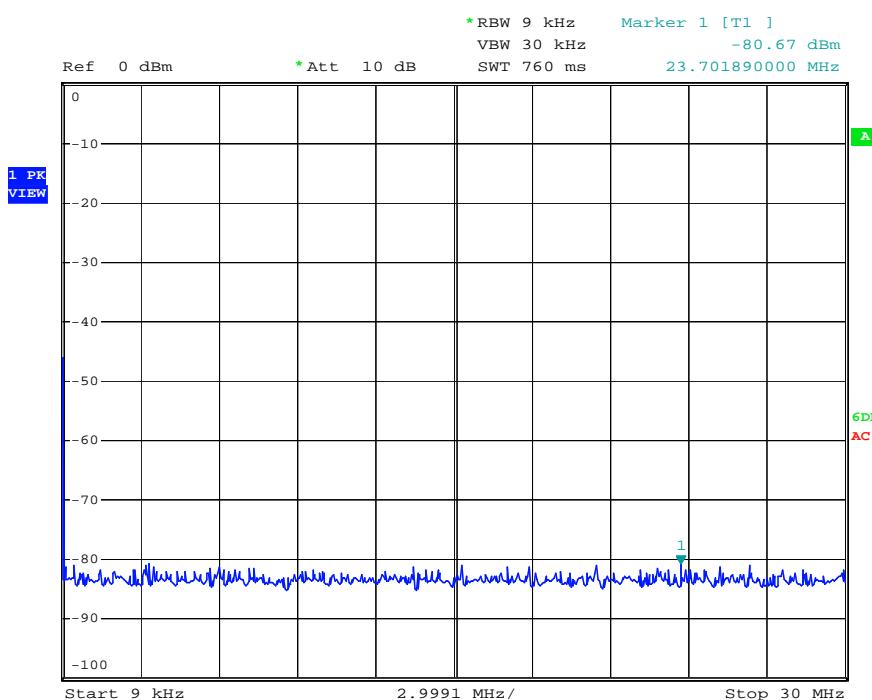
5.5.5 Test result

Ch 1 (458.0 MHz)			Ch 360 (462.5 MHz)		
f (MHz)	Level PK (dBm)	Limit (dBm)	f (MHz)	Level PK (dBm)	Limit (dBm)
0.009-30	<-65	-20.0	0.009-30	<-65	-20.0
916.6	-47.3	-20.0	30-1000	<-65	-20.0
1364	-58.2	-20.0	1000-8000	<-60	-20.0
2750	-55.5	-20.0			
3212	-57.5	-20.0			
3674	-56.4	-20.0			
Measurement uncertainty			± 3 dB		

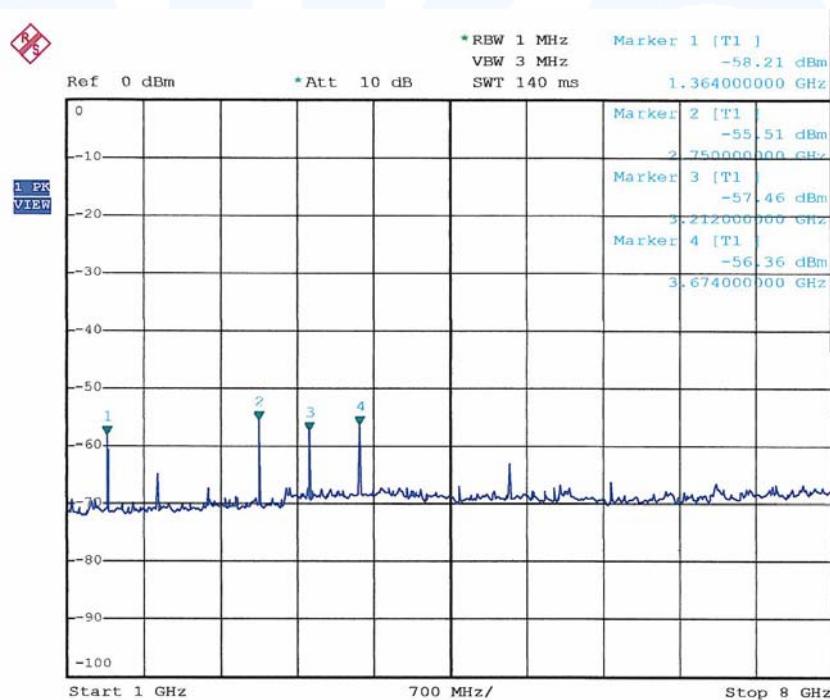
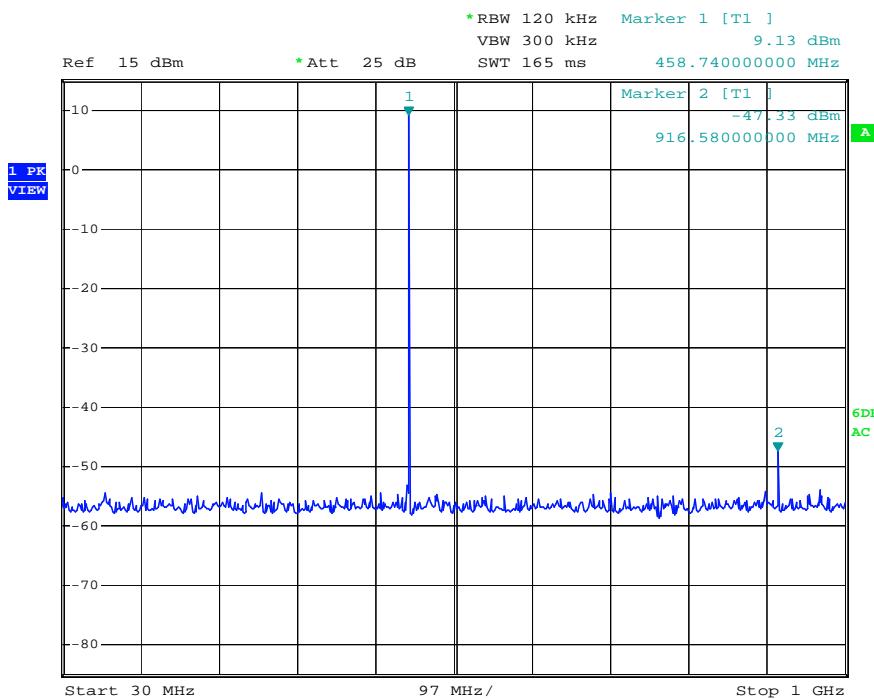
The requirements are **FULFILLED**.

**Remarks:** All emissions not reported are more than 30 dB below the specified limit.

For detailed results please refer to following plots.



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## 5.6 Radiated spurious emissions (transmit and receive mode)

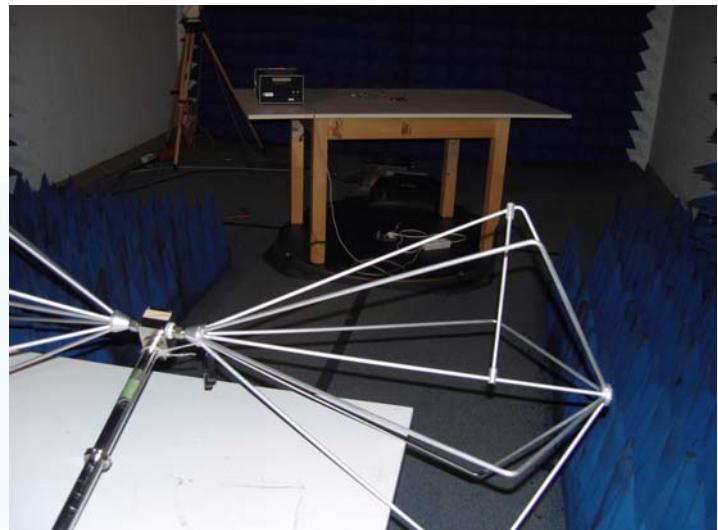
For test instruments and accessories used see section 6 Part **SER1, SER 2, SER 3**.

### 5.6.1 Description of the test location

Test location: Anechoic Chamber A2

Test distance: 3 metres

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



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### 5.6.3 Applicable standard

According to FCC Part 90, Section 90.217(b) and Part 2, Section 2.1053:

For equipment designed to operate with a 12.5 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 25 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

### 5.6.4 Description of Measurement

The spurious emissions of the EUT have been measured in the frequency range from 9 kHz to 8 GHz using a Spectrum Analyzer. In the frequency range from 9 kHz to 30 MHz a magnetic coil antenna have been 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 equipment under test will be in accordance to ANSI C63.4. To locate maximum emissions the EUT was rotated 360 degrees. The measurement scan is made in horizontal and vertical polarization of the antenna.

The resolution bandwidth was set as follows:

9 kHz – 150 kHz:	RBW=200 Hz
150 kHz – 30 MHz:	RBW=9 kHz
30 MHz – 1 GHz:	RBW=120 kHz
Above 1 GHz:	RBW=1 MHz

### 5.6.5 Test result

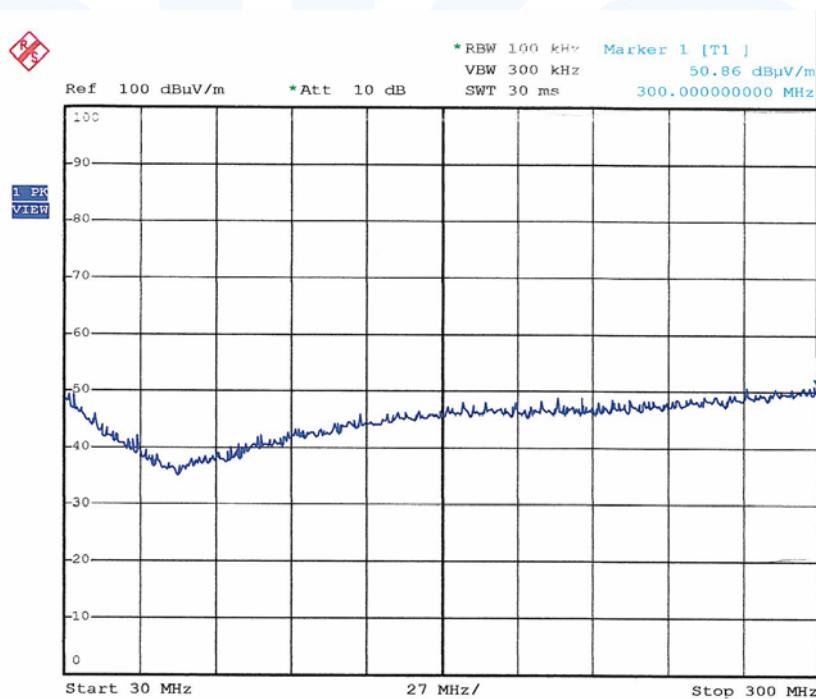
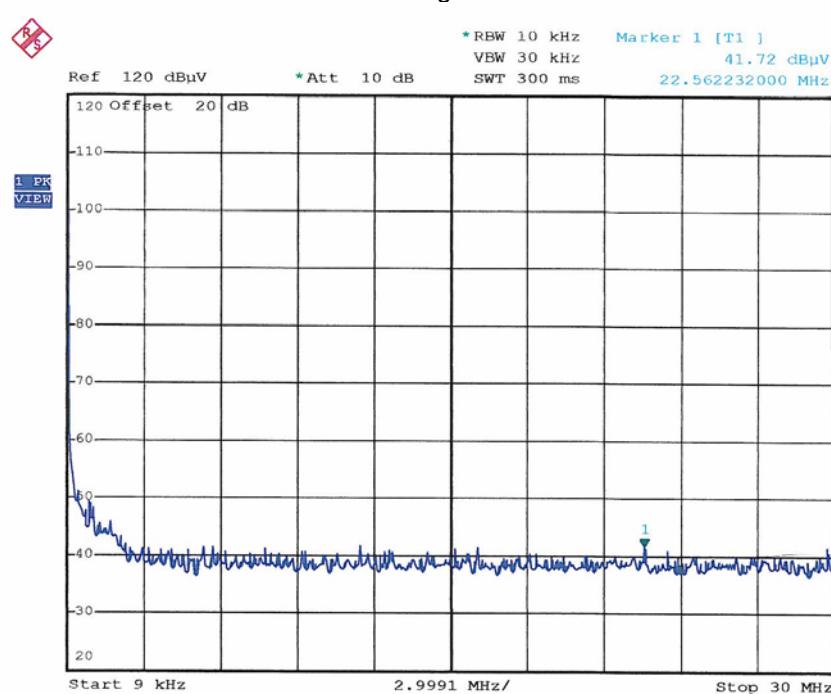
Ch 1 (458.0 MHz)			Ch 360 (462.5 MHz)		
f (MHz)	Level PK (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	f (MHz)	Level PK (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)
0.009-30	<40	70	0.009-30	<40	70
30-1000	<40	70	30-1000	<40	70
1888	44.4	70	2776	45.2	70
2746	46.5	70	3238	43.3	70
Measurement uncertainty			$\pm 6$ dB		

The requirements are **FULFILLED**.

**Remarks:** The measurement was performed up to 8 GHz. All emissions not reported in this test report are more than 30 dB below the specified limit. For detailed test results please refer to following test protocols.

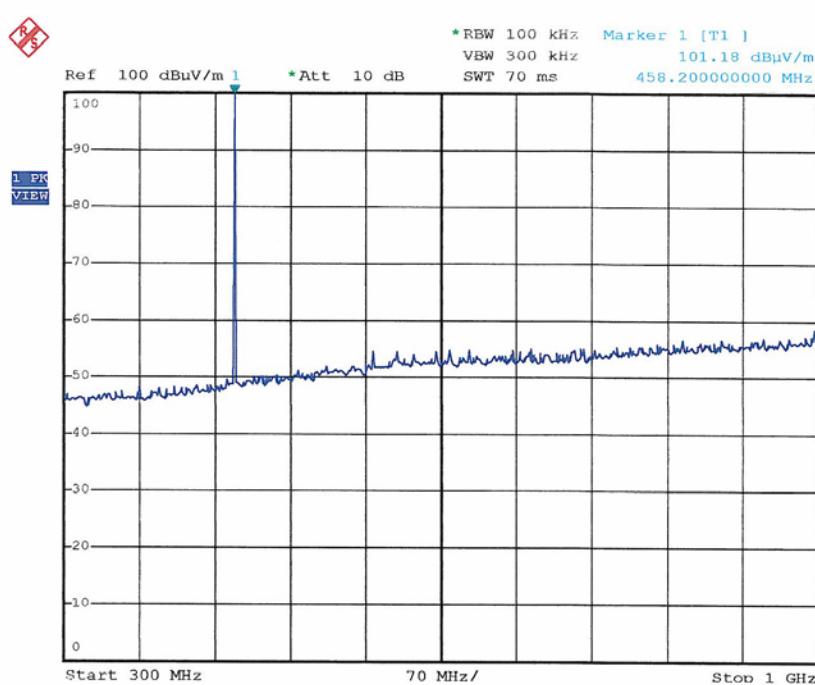
FCC ID: V9X-LMD400R

Transmitting Mode

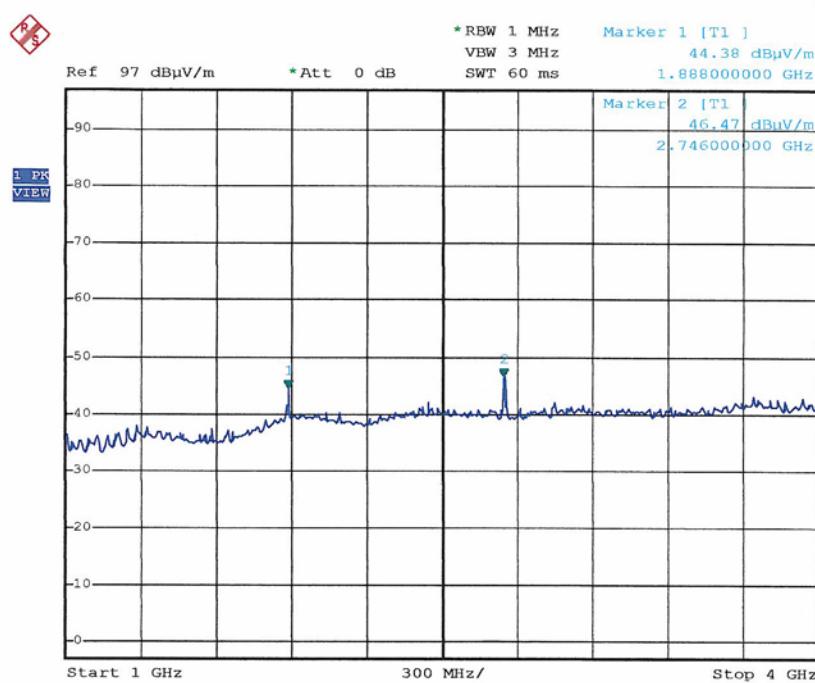


FCC ID: V9X-LMD400R

Transmitting Mode

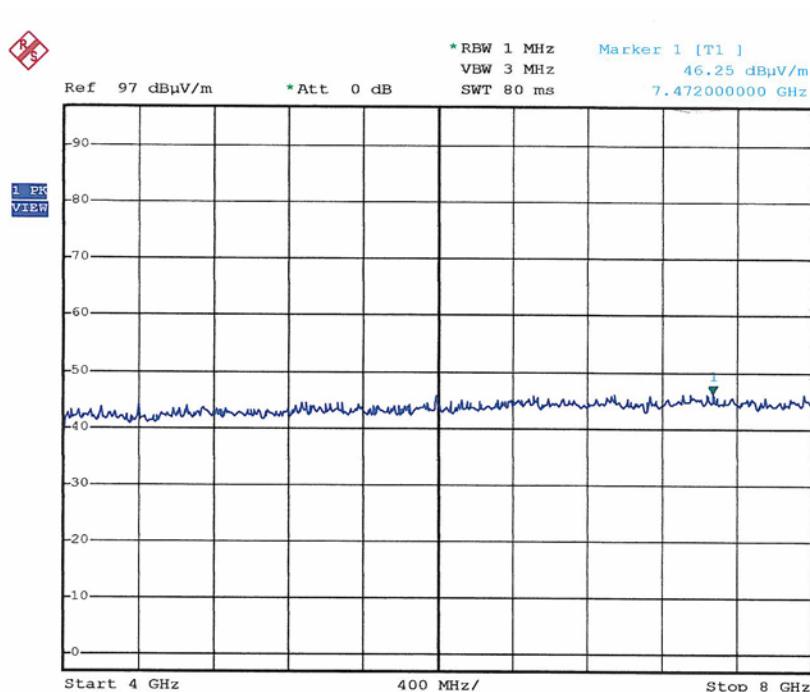


Note: Carrier frequency at marker 1



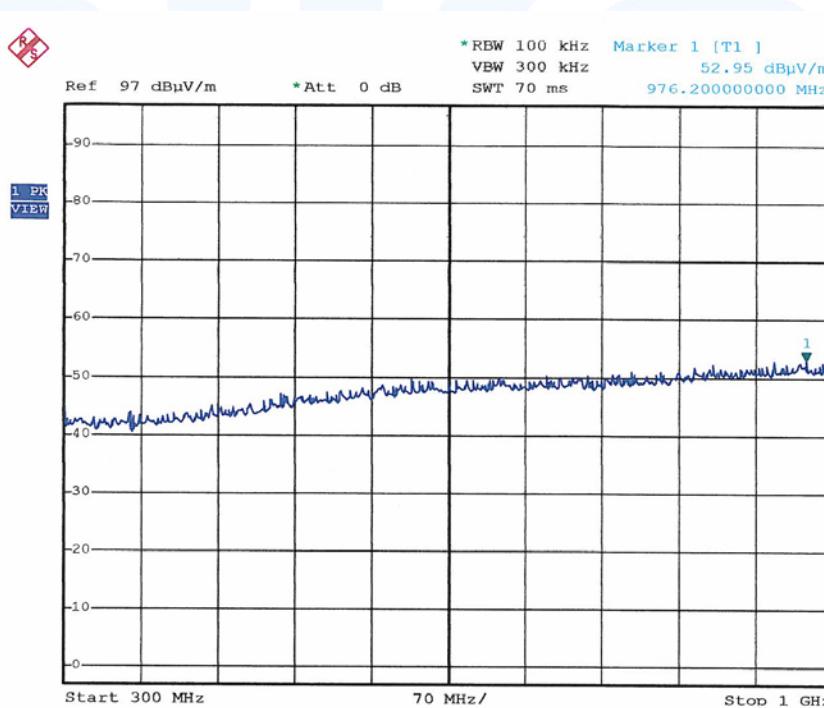
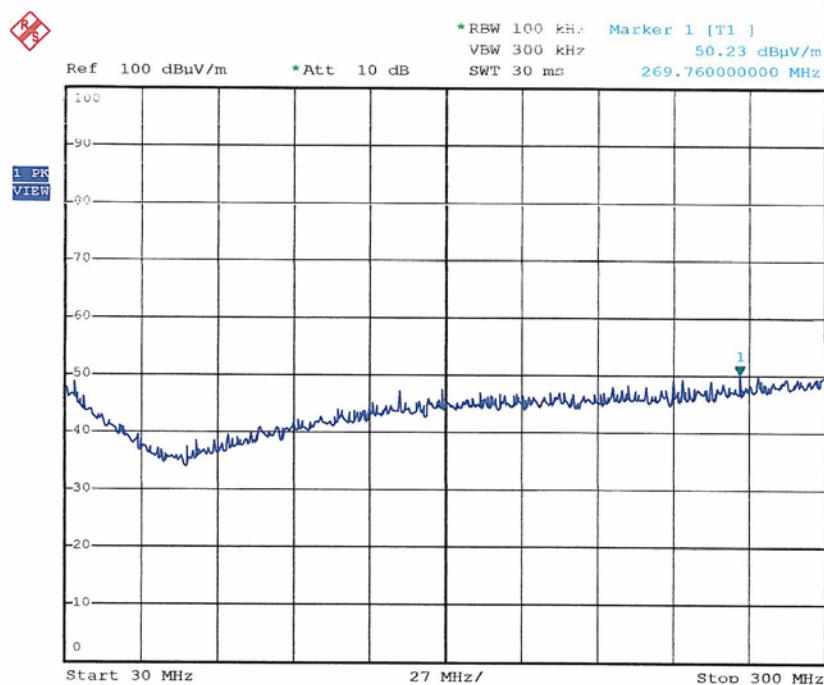
FCC ID: V9X-LMD400R

Transmitting Mode



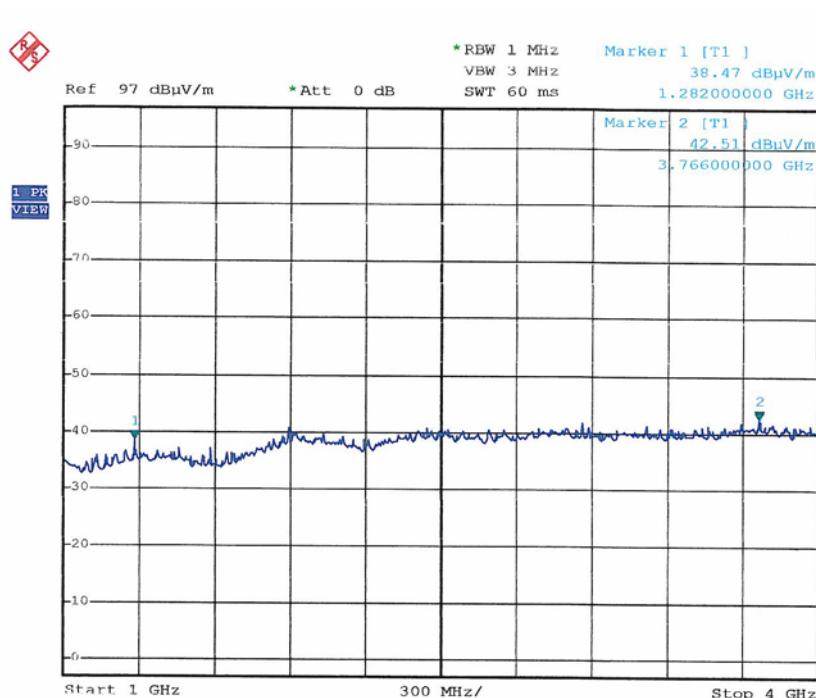
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Receive Mode



FCC ID: V9X-LMD400R

Receive Mode



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**FCC ID: V9X-LMD400R**

## **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	Kind of Equipment	Manufacturer	Equipment No.
CPC 2	ESCI SMBV100A PE1540	EMI Test Receiver Vector Signal Generator Power Supply	Rohde & Schwarz München Rohde & Schwarz Phillips Fluke GmbH	02-02/03-05-004 02-02/05-09-001 02-02/50-07-032
FE	ESCI WK-340/40 PE1540	EMI Test Receiver Climatic Chamber Power Supply	Rohde & Schwarz München Weiss Umwelttechnik GmbH Phillips Fluke GmbH	02-02/03-05-004 02-02/45-05-001 02-02/50-07-032
HE	FSP 30 PE1540	Spectrum Analyzer Power Supply	Rohde & Schwarz München Phillips Fluke GmbH	02-02/11-05-001 02-02/50-07-032
MB	FSP 30 PE1540	Spectrum Analyzer Power Supply	Rohde & Schwarz München Phillips Fluke GmbH	02-02/11-05-001 02-02/50-07-032
SEC 1-3	FSP 30 PE1540	Spectrum Analyzer Power Supply	Rohde & Schwarz München Phillips Fluke GmbH	02-02/11-05-001 02-02/50-07-032
SER 1	FMZB 1516 ESCI FSP 30 PE1540	Magnetic Field Antenna EMI Test Receiver Spectrum Analyzer Power Supply	Schwarzbeck Mess-Elektronik Rohde & Schwarz München Rohde & Schwarz München Phillips Fluke GmbH	01-02/24-01-018 02-02/03-05-004 02-02/11-05-001 02-02/50-07-032
SER 2	FSP 30 BBA 9106 / VHA 9103 UHALP 9108 A PE1540	Spectrum Analyzer Biconical Antenna Log. Per. Antenna Power Supply	Rohde & Schwarz München Schwarzbeck Mess-Elektronik Schwarzbeck Mess-Elektronik Phillips Fluke GmbH	02-02/11-05-001 02-02/24-05-002 02-02/24-05-003 02-02/50-07-032
SER 3	FSP 30 AFS4-01000400-10-10P-4 AMF-4F-04001200-15-10P BBHA 9120 E 251 WBH218H N Sucoflex N-2000-SMA PE1540 Multiflex 141-SMA-N-1500 Multiflex 141-SMA-N-1500	Spectrum Analyzer RF Amplifier 1-4 GHz RF Amplifier 4-12 GHz Broadband Horn Antenna Horn Antenna 2-18 GHz RF Cable Power Supply Coaxicable Coaxicable	Rohde & Schwarz München PARZICH GMBH PARZICH GMBH Schwarzbeck Mess-Elektronik Q-par Angus Ltd novotronik Signalverarbeitung Phillips Fluke GmbH novotronik Signalverarbeitung novotronik Signalverarbeitung	02-02/11-05-001 02-02/17-05-003 02-02/17-05-004 02-02/24-05-006 02-02/24-05-007 02-02/50-05-075 02-02/50-07-032 02-02/50-09-015 02-02/50-09-016

**FCC ID: V9X-LMD400R**

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
CPC 2	ESCI	02-02/03-05-004	01/19/2010	01/19/2009		
	SMBV100A	02-02/05-09-001	03/12/2012	03/12/2009	03/12/2010	03/12/2009
	PE1540	02-02/50-07-032				
FE	ESCI	02-02/03-05-004	01/19/2010	01/19/2009		
	WK-340/40	02-02/45-05-001	06/17/2014	06/17/2009	12/17/2009	06/17/2009
	PE1540	02-02/50-07-032				
HE	FSP 30	02-02/11-05-001	04/20/2010	04/20/2009		
	PE1540	02-02/50-07-032				
MB	FSP 30	02-02/11-05-001	04/20/2010	04/20/2009		
	PE1540	02-02/50-07-032				
SEC 1-3	FSP 30	02-02/11-05-001	04/20/2010	04/20/2009		
	PE1540	02-02/50-07-032				
SER 1	FMZB 1516	01-02/24-01-018			02/23/2010	02/23/2009
	ESCI	02-02/03-05-004	01/19/2010	01/19/2009		
	FSP 30	02-02/11-05-001	04/20/2010	04/20/2009		
	PE1540	02-02/50-07-032				
SER 2	FSP 30	02-02/11-05-001	04/20/2010	04/20/2009		
	BBA 9106 / VHA 9103	02-02/24-05-002			01/03/2010	07/03/2009
	UHALP 9108 A	02-02/24-05-003			01/03/2010	07/03/2009
	PE1540	02-02/50-07-032				
SER 3	FSP 30	02-02/11-05-001	04/20/2010	04/20/2009		
	AFS4-01000400-10-10P-4	02-02/17-05-003				
	AMF-4F-04001200-15-10P	02-02/17-05-004				
	BBHA 9120 E 251	02-02/24-05-006			11/08/2009	05/08/2009
	WBH218H N	02-02/24-05-007				
	Sucoflex N-2000-SMA	02-02/50-05-075				
	PE1540	02-02/50-07-032				
	Multiflex 141-SMA-N-1500	02-02/50-09-015				
		02-02/50-09-016				