



Inter**Lab**[®]

EMC Measurement/Technical Report on PCMCIA card Magnum

Report Reference: 4_Opti_0404_GSM_FCCc

Test Laboratory (Headquarter):

7 Layers AG
Borsigstr. 11
40880 Ratingen
Germany



Note:

The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the testing laboratory.

7 layers AG, Borsigstrasse 11
40880 Ratingen, Germany
Phone: +49 (0) 2102 749 0
Fax: +49 (0) 2102 749 350
<http://www.7Layers.com>

Aufsichtsratsvorsitzende
Chairman of the Supervisory Board:
Michael Abels
Vorstand - Board of Directors:
Dr. Hans-Jürgen Meckelburg

Registergericht - registered in:
Düsseldorf, HRB 44096
USt-IdNr. VAT Nr:
DE 203159652

Interlab is a registered trademark of 7 layers AG



Table of Contents

0	Summary	3
0.1	Technical Report Summary.....	3
0.2	Measurement Summary	4
1	Administrative Data.....	6
1.1	Testing Laboratory	6
1.2	Project Data.....	6
1.3	Applicant Data	6
1.4	Manufacturer Data.....	6
2	Product labeling	7
2.1	FCC ID label:	7
2.2	Location of the label on the EUT:	7
3	Testobject Data.....	8
3.1	General EUT Description	8
3.2	EUT Main components.....	9
3.3	Ancillary Equipment	9
3.4	EUT Setups.....	9
3.5	Operating Modes	10
4	Test Results	11
4.1	Conducted emissions (AC power line)	11
4.2	Occupied bandwidth	14
4.3	Peak power output	16
4.4	Spurious RF conducted emissions	18
4.5	Spurious radiated emissions	21
4.6	Band edge compliance	27
4.7	Power density	29
5	Test Equipment	31
6	Foto Report.....	34
7	Setup Drawings	36
8	Annex	37



0 Summary

0.1 Technical Report Summary

Type of Authorization

Certification for an Intentional Radiator (Frequency Hopping Spread Spectrum).

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 (2001-10-01 Edition) and 15 (2004-07-12 Edition). The following subparts are applicable to the results in this test report.

Part 2

Subpart J - Equipment Authorization Procedures, Certification

Part 15

§ 15.201 Equipment authorization requirement

§ 15.107 / 15.207 Conducted limits

§ 15.109 / 15.209 Radiated emission limits; general requirements

§ 15.247 Operation within the bands 902-928 MHz, 2400-2483,5 MHz and 5725-5850 MHz

Note:

The tests were selected and performed with reference to the FCC Public Notice DA 00-705, released March 30, 2000

Summary Test

The EUT complied with all performed tests as listed in chapter 0.2 Measurement Summary.



0.2 Measurement Summary

FCC Part 15, Subpart C		§ 15.207	
Conducted emissions (AC power line)			
The measurement was performed according to ANSI C63.4		2003	
OP-Mode	Setup	Port	Final Result
op-mode 2	37s20a02	AC port of laptop	passed
FCC Part 15, Subpart C		§ 15.247 (a) (2)	
Occupied bandwidth			
The measurement was performed according to ANSI C63.4		2003	
OP-Mode	Setup	Port	Final Result
op-mode 1	37020f01	temp. ant. conn.	passed
op-mode 2	37020f01	temp. ant. conn.	passed
op-mode 3	37020f01	temp. ant. conn.	passed
FCC Part 15, Subpart C		§ 15.247 (b) (3)	
Peak power output			
The measurement was performed according to FCC § 15.31		2004	
OP-Mode	Setup	Port	Final Result
op-mode 1	37020f01	temp. ant. conn.	passed
op-mode 2	37020f01	temp. ant. conn.	passed
op-mode 3	37020f01	temp. ant. conn.	passed
FCC Part 15, Subpart C		§ 15.247 (d)	
Spurious RF conducted emissions			
The measurement was performed according to FCC § 15.31		2004	
OP-Mode	Setup	Port	Final Result
op-mode 1	37020f01	temp. ant. conn.	passed
op-mode 2	37020f01	temp. ant. conn.	passed
op-mode 3	37020f01	temp. ant. conn.	passed
FCC Part 15, Subpart C		§ 15.247 (d), § 15.35 (b), § 15.209	
Spurious radiated emissions			
The measurement was performed according to ANSI C63.4		2003	
OP-Mode	Setup	Port	Final Result
op-mode 1	37020a01	enclosure	passed
op-mode 2	37020a01	enclosure	passed
op-mode 3	37020a01	enclosure	passed
FCC Part 15, Subpart C		§ 15.247 (d)	
Band edge compliance			
The measurement was performed according to ANSI C63.4		2003	
OP-Mode	Setup	Port	Final Result
op-mode 1	37020f01	temp. ant. conn.	passed
op-mode 3	37020a01	enclosure	passed

**FCC Part 15, Subpart C****§ 15.247 (e)**

Power density

The measurement was performed according to FCC § 15.31

2004

OP-Mode**Setup****Port****Final Result**

op-mode 2

37020f01

temp. ant. conn.

passed

Responsible for

Accreditation Scope: _____

Responsible

for Test Report: _____



1 Administrative Data

1.1 Testing Laboratory

Company Name: 7 Layers AG
Address Borsigstr. 11
40880 Ratingen
Germany

This facility has been fully described in a report submitted to the FCC and accepted under the registration number 96716 .

The test facility is also accredited by the following accreditation organisation:
- Deutscher Akkreditierungs Rat DAR-Registration no. TTI-P-G 178/99

Responsible for Accreditation Scope: Dipl.-Ing. Bernhard Retka
Dipl.-Ing. Arndt Stöcker
Dipl.-Ing. Thomas Hoell

1.2 Project Data

Responsible for testing and report: Dipl.-Ing. Thomas Hoell
Receipt of EUT: 2004-09-15
Date of Test(s): 2004-09-16 to 2004-09-28
Date of Report: 2004-12-07

1.3 Applicant Data

Company Name: Option International NV SA
Address: Kolonel Begaultlaan 45
3012 Leuven
Belgium
Contact Person: Mr. Stefan Lodeweyckx

1.4 Manufacturer Data

Company Name: please see applicant data
Address:
Contact Person:



2 Product labeling

2.1 FCC ID label:

At the time of the report there was no FCC label available.

2.2 Location of the label on the EUT:

see above



3 Testobject Data

3.1 General EUT Description

Equipment under Test:	PCMCIA card
Type Designation:	Magnum
Kind of Device: (optional)	WLAN Transceiver
Voltage Type:	DC
Voltage level:	3.5 V

General product description:

The WLAN (Wireless Local Area Network) Transceiver is operating in the 2,4 GHz ISM band in the range 2412.0 – 2462.0 MHz and uses the Direct Sequence Spread Spectrum (DSSS) Modulation.

The EUT provides the following ports:

Ports

temp. ant. conn.
enclosure
PCMCIA connection
AC port of laptop

The main components of the EUT are listed and described in Chapter 3.2



3.2 EUT Main components

Type, S/N, Short Descriptions etc. used in this Test Report

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status	Date of Receipt
EUT A (37020f01)	PCMCIA card	Magnum	none	v.1.0.0	v.1.0.0	2004-09-15
EUT A is equipped with an additional temporary antenna connector.						
EUT B (37020a01)	PCMCIA card	Magnum	none	v.1.0.0	v.1.0.0	2004-09-15

NOTE: The short description is used to simplify the identification of the EUT in this test report.

3.3 Ancillary Equipment

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	HW Status	SW Status	Serial no.	FCC ID
AE 1	Laptop	-	-	-	-	-
AE 2	Monitor	-	-	-	-	-
AE 3	Printer	-	-	-	-	-
AE 4	Mouse	-	-	-	-	-

3.4 EUT Setups

This chapter describes the combination of EUT's and ancillary equipment used for testing.

Setup No.	Combination of EUTs	Description
37020f01	EUT A + AE 2	PC Card + host adapter, used for conducted measurements
37020a01	EUT B + AE 1	PC Card + PC, used for radiated measurements
37s20a02	EUT B + AE 2+ AE 3+ AE 4	ITE setup



3.5 Operating Modes

This chapter describes the operating modes of the EUT's used for testing.

Op. Mode	Description of Operating Modes	Remarks
op-mode 1	TX-mode, the EUT transmits on the lowest channel (2412 MHz)	
op-mode 2	TX-mode, the EUT transmits on the mid channel (2437 MHz)	
op-mode 3	TX-mode, the EUT transmits on the highest channel (2462 MHz)	



4 Test Results

4.1 Conducted emissions (AC power line)

Standard FCC Part 15, 2004-07-12
Subpart C

The test was performed according to: ANSI C 63.4, 2003

4.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4-2003.

The Equipment Under Test (EUT) was setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was powered from 50 μ H || 50 Ohm Line Impedance Stabilization Network (LISN). The LISN's unused connections were terminated with 50 Ohm loads.

The measurement procedure consists of two steps. It is implemented into the EMI test software ES-K1 from R&S.

Step 1: Preliminary scan

Preliminary test to identify the highest amplitudes relative to the limit.

EMI receiver settings:

- Detector: Peak - Maxhold
- Frequency range: 150 kHz – 30 MHz
- Frequency steps: 5 kHz
- IF-Bandwidth: 10 kHz
- Measuring time / Frequency step: 1 ms
- Measurement on phase + neutral lines of the power cords

Intention of this step is, to determine the conducted EMI-profile of the EUT. With this data, the test system performs (to reduce the number of final measurements) a data reduction with the following parameters:

- Offset for acceptance analysis: Limit line – 6 dB
- Maximum number of final measurements: 6

Step 2: Final measurement

With the frequencies determined in step 1, the final measurement will be performed.

EMI receiver settings:

- Detector: Quasi-Peak
- IF - Bandwidth: 9 kHz
- Measuring time: 1s / frequency

At the final test the cable were and moved within the range of positions likely to find their maximum emission. After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the



frequencies and values of the results of the final measurement.

4.1.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.207

Frequency Range (MHz)	QP Limit (dBμV)	AV Limit (dBμV)
0.15 – 0.5	66 to 56	56 to 46
0.5 – 5	56	46
5 – 30	60	50

Used conversion factor: Limit (dBμV) = 20 log (Limit (μV)/1μV).

4.1.3 Test Protocol

Temperature: 22 °C
Air Pressure: 1010 hPa
Humidity: 38 %

Op. Mode	Setup	Port
op-mode 2	37s20a02	AC port of laptop

Powerline	Frequency MHz	Measured value dBμV	Delta to limit dBμV	Remarks
L1	0,36	47,7	11,3	QP value
N	0,365	46,2	12,8	QP value

Remark: No further emissions in the range 10 dB below the limit found.



4.1.4 Test result: Conducted emissions (AC power line)

FCC Part 15, Subpart C	Op. Mode	Setup	Port	Result
	op-mode 2	37s20a02	AC port of laptop	passed



4.2 Occupied bandwidth

Standard FCC Part 15, 2004-07-12
Subpart C

The test was performed according to: ANSI C 63.4, 2003

4.2.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4-2003.

The Equipment Under Test (EUT) was setup in a shielded room to perform the occupied bandwidth measurements.

The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.

The results recorded were measured with the modulation which produce the worst-case (widest) occupied bandwidth. The resolution bandwidth for measuring the reference level and the occupied bandwidth was 100 kHz.

The reference level of the spectrum analyzer was set equal to the reference level of the EUT.

4.2.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (2)

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483,5 MHz and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

4.2.3 Test Protocol

Temperature: 21 °C
Air Pressure: 1005 hPa
Humidity: 37 %

Op. Mode	Setup	Port
op-mode 1	37020f01	temp. ant. conn.

6 dB bandwidth MHz	Remarks
15,65	-

Remark: Please see annex for the measurement plot.



Temperature: 21 °C
Air Pressure: 1005 hPa
Humidity: 37 %

Op. Mode	Setup	Port
op-mode 2	37020f01	temp. ant. conn.

6 dB bandwidth MHz	Remarks
16,38	-

Remark: Please see annex for the measurement plot.

Temperature: 21 °C
Air Pressure: 1005 hPa
Humidity: 37 %

Op. Mode	Setup	Port
op-mode 3	37020f01	temp. ant. conn.

6 dB bandwidth MHz	Remarks
16,18	-

Remark: Please see annex for the measurement plot.

4.2.4 Test result: Occupied bandwidth

FCC Part 15, Subpart C	Op. Mode	Setup	Port	Result
	op-mode 1	37020f01	temp. ant. conn.	passed
	op-mode 2	37020f01	temp. ant. conn.	passed
	op-mode 3	37020f01	temp. ant. conn.	passed



4.3 Peak power output

Standard FCC Part 15, 2004-07-12
Subpart C

The test was performed according to: FCC §15.31, 2004-07-12

4.3.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room to perform the output power measurements.

The results recorded were measured with the modulation which produces the worst-case (highest) output power.

The EUT was connected to the power meter via a short coax cable with a known loss.

4.3.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (b) (3)

For systems using digital modulation techniques in the 902-928 MHz, 2400-2483,5 MHz and 5725-5850 MHz bands: 1 watt.

Used conversion factor: $\text{Limit (dBm)} = 10 \log (\text{Limit (W)}/1\text{mW})$
==> Maximum Output Power: 30 dBm

4.3.3 Test Protocol

Temperature: 21 °C
Air Pressure: 1005 hPa
Humidity: 37 %

Op. Mode	Setup	Port
op-mode 1	37020f01	temp. ant. conn.

Output power dBm	Remarks
12,2	The EIRP including antenna gain (-5 dBi) is 7,2 dBm

Remark: -



Temperature: 21 °C
Air Pressure: 1005 hPa
Humidity: 37 %

Op. Mode	Setup	Port
op-mode 2	37020f01	temp. ant. conn.

Output power dBm	Remarks
12,3	The EIRP including antenna gain (-5 dBi) is 7,3 dBm

Remark: -

Temperature: 21 °C
Air Pressure: 1005 hPa
Humidity: 37 %

Op. Mode	Setup	Port
op-mode 3	37020f01	temp. ant. conn.

Output power dBm	Remarks
12,1	The EIRP including antenna gain (-5 dBi) is 7,1 dBm

Remark: -

4.3.4 Test result: Peak power output

FCC Part 15, Subpart C	Op. Mode	Setup	Port	Result
	op-mode 1	37020f01	temp. ant. conn.	passed
	op-mode 2	37020f01	temp. ant. conn.	passed
	op-mode 3	37020f01	temp. ant. conn.	passed



4.4 Spurious RF conducted emissions

Standard FCC Part 15, 2004-07-12
 Subpart C

The test was performed according to: FCC §15.31, 2004-07-12

4.4.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room to perform the output power measurements.

The EUT was connected to spectrum analyzer via a short coax cable (Type: Rosenberger RTK 161, 1m, SMA connectors), with a known loss.

Analyzer settings:

- Detector: Peak-Maxhold
- Frequency range: 30 – 25000 MHz
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Sweep Time: Coupled

The reference level of the spectrum analyzer was set equal to the reference level of the EUT.

4.4.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. (...) Attenuation below the general limits specified in Section 15.209(a) is not required.



4.4.3 Test Protocol

Temperature: 21 °C
Air Pressure: 1005 hPa
Humidity: 37 %

Op. Mode	Setup	Port
op-mode 1	37020f01	temp. ant. conn.

Frequency MHz	Corrected measurement value dBm	Reference value dBm	Limit dBm	Delta to limit dB
-	-	-	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found. Please see annex for the measurement plot.

Temperature: 21 °C
Air Pressure: 1005 hPa
Humidity: 37 %

Op. Mode	Setup	Port
op-mode 2	37020f01	temp. ant. conn.

Frequency MHz	Corrected measurement value dBm	Reference value dBm	Limit dBm	Delta to limit dB
-	-	-	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found. Please see annex for the measurement plot.

Temperature: 21 °C
Air Pressure: 1005 hPa
Humidity: 37 %

Op. Mode	Setup	Port
op-mode 3	37020f01	temp. ant. conn.

Frequency MHz	Corrected measurement value dBm	Reference value dBm	Limit dBm	Delta to limit dB
-	-	-	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found. Please see annex for the measurement plot.



4.4.4 Test result: Spurious RF conducted emissions

FCC Part 15, Subpart C	Op. Mode	Setup	Port	Result
	op-mode 1	37020f01	temp. ant. conn.	passed
	op-mode 2	37020f01	temp. ant. conn.	passed
	op-mode 3	37020f01	temp. ant. conn.	passed



4.5 Spurious radiated emissions

Standard FCC Part 15, 2004-07-12
Subpart C

The test was performed according to: ANSI C 63.4, 2003

4.5.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4-2003.

The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m in the semi-anechoic chamber. The test was performed at an EUT to receiving antenna distance of 3m.

The radiated emissions measurements were made in a typical installation configuration.

The measurement procedure is implemented into the EMI test software ES-K1 from R&S.

Measurement up to 1GHz

Step 1: Preliminary scan

Preliminary test to identify the highest amplitudes relative to the limit.

Settings for step 1:

- Detector: Peak-Maxhold
- Frequency range: 30 – 1000 MHz
- Frequency steps: 60 kHz
- IF-Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 μ s
- Turntable angle range: -180 to 180°
- Turntable step size: 90°
- Height variation range: 1 – 3m
- Height variation step size: 2m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. With this data, the test system performs (to reduce the number of final measurements) a data reduction with the following parameters:

- Offset for acceptance analysis: Limit line – 10 dB
- Maximum number of final measurements: 12

Step 2:

With the frequencies determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is, to find out the approximate turntable angle and antenna height for each frequency.

Settings for step 2:

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies



- IF – Bandwidth: 120 kHz
- Measuring time: 100ms
- Turntable angle range: -180 to 180 °
- Turntable step size: 45°
- Height variation range: 1 – 4m
- Height variation step size: 0,5m
- Polarisation: horizontal + vertical

After this step the EMI test system has determined the following values for each frequency (of step 1):

- Frequency
- Azimuth value (of turntable)
- Antenna height

The last two values have now the following accuracy:

- Azimuth value (of turntable): 45°
- Antenna height: 0,5m

Step 3:

In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.

For each frequency the turntable azimuth and antenna height, which was determined in step 3, will be adjusted. The turntable azimuth will be slowly varied by $\pm 22,5^\circ$ around this value. During this action the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position the antenna height is also slowly varied by ± 25 cm around the antenna height determined in step 3. During this action the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

Settings for step 3:

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100ms
- Turntable angle range: $-22,5^\circ$ to $+ 22,5^\circ$ around the value determined in step 2
- Height variation range: -0,25m to $+ 0,25$ m around the value determined in step 2

Step 4:

With the settings determined in step 3, the final measurement will be performed:

EMI receiver settings for step 4:

- Detector: Quasi-Peak(< 1GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1s

Measurement above 1GHz

The following modifications apply to the measurement procedure for the frequency range above 1 GHz:

The measurement distance was reduced to 1m. The results were extrapolated by



the extrapolation factor of 20 dB/decade (inverse linear distance for field strength measurements, inverse linear-distance squared for the power reference level measurements). Due to the fact that in this frequency range a double ridged wave guided horn antenna (up to 18 GHz) and a horn antenna (18-25 GHz) are used, the steps 2-4 are omitted. Step 1 was performed with one height of the receiving antenna only.

EMI receiver settings:

- Detector: Peak, Average
- RBW = VBW = 100 kHz

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

4.5.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (d)

... In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

FCC Part 15, §15.109 / 15.209, Radiated Emission Limits

Frequency Range (MHz)	Class B Limit (dBµV/m)
30 – 88	40,0
88 – 216	43,5
216 – 960	46,0
above 960	54,0

§15.35(b)

..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

Used conversion factor: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)



4.5.3 Test Protocol

Temperature: 22 °C
Air Pressure: 1008 hPa
Humidity: 40 %

Op. Mode	Setup	Port
op-mode 1	37020a01	enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit QP/AV dBµV/m	Limit Peak dBµV/m	Delta to AV/QP limit/dB	Delta to Peak limit dB
		QP	Peak	AV				
Ver	0,073180	20,90			40,00		19,10	
Ver	0,075160	26,90			40,00		13,10	
Ver	0,120000	27,00			43,50		16,50	
Ver	0,133320	33,00			43,50		10,50	
Ver	0,166633	35,70			43,50		7,80	
Hor	0,167960	36,10			43,50		7,40	
Hor	0,266580	32,10			46,00		13,90	
Hor	0,283260	31,20			46,00		14,80	
Ver	0,333220	43,60			46,00		2,40	
Hor	0,399900	40,00			46,00		6,00	
Ver+Hor	1,0665		45,86	34,62	54	74	19,3800	28,14
Ver+Hor	1,1000		34,77	34,06	54	74	19,9400	39,23
Ver+Hor	1,1330		48,45	36,16	54	74	17,8400	25,55
Ver+Hor	1,1665		46,96	40,83	54	74	13,1700	27,04
Ver+Hor	1,2000		45,25	35,29	54	74	18,7100	28,75

Remark: No further spurious emissions in the range 20 dB below the limit found.

Temperature: 22 °C
Air Pressure: 1008 hPa
Humidity: 40 %

Op. Mode	Setup	Port
op-mode 2	37020a01	enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit QP/AV dBµV/m	Limit Peak dBµV/m	Delta to AV/QP limit/dB	Delta to Peak limit dB
		QP	Peak	AV				
Ver	0,073180	36,30			40,00		3,70	
Ver	0,074920	36,10			40,00		3,90	
Ver	0,120000	37,70			43,50		5,80	
Ver	0,133320	37,50			43,50		6,00	
Ver	0,166633	39,40			43,50		4,10	
Hor	0,168020	35,80			43,50		7,70	
Ver	0,332800	44,50			46,00		1,50	
Hor	0,399900	39,10			46,00		6,90	
Ver+Hor	1,0665		44,00	32,05	54	74	21,9500	30,00
Ver+Hor	1,0995		43,49	34,01	54	74	19,9900	30,51
Ver+Hor	1,1330		46,34	34,76	54	74	19,2400	27,66
Ver+Hor	1,1665		44,22	36,27	54	74	17,7300	29,78
Ver+Hor	1,2000		43,17	32,35	54	74	21,6500	30,83
Ver+Hor	1,2330		42,55	31,84	54	74	22,1600	31,45

Remark: No further spurious emissions in the range 20 dB below the limit found.



Temperature: 22 °C
Air Pressure: 1008 hPa
Humidity: 40 %

Op. Mode	Setup	Port
op-mode 3	37020a01	enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit QP/AV dBµV/m	Limit Peak dBµV/m	Delta to AV/QP limit/dB	Delta to Peak limit dB
		QP	Peak	AV				
Ver	0,073180	36,50			40,00		3,50	
Ver	0,074920	36,40			40,00		3,60	
Ver	0,120000	37,00			43,50		6,50	
Ver	0,133320	38,60			43,50		4,90	
Hor	0,166573	33,50			43,50		10,00	
Hor	0,168020	37,80			43,50		5,70	
Hor	0,240000	40,50			46,00		5,50	
Ver	0,333220	44,20			46,00		1,80	
Hor	0,399900	36,70			46,00		9,30	
Ver+Hor	1,133		46,21	35,96	54	74	18,0400	27,79
Ver+Hor	1,1665		44,98	38,13	54	74	15,8700	29,02

Remark: No further spurious emissions in the range 20 dB below the limit found.



4.5.4 Test result: Spurious radiated emissions

FCC Part 15, Subpart C	Op. Mode	Setup	Port	Result
	op-mode 1	37020a01	enclosure	passed
	op-mode 2	37020a01	enclosure	passed
	op-mode 3	37020a01	enclosure	passed



4.6 Band edge compliance

Standard FCC Part 15, 2004-07-12
Subpart C

The test was performed according to: ANSI C 63.4, 2003
FCC §15.31, 2004-07-12

4.6.1 Test Description

The procedure to show compliance with the band edge requirement is divided into two measurements: 1. Show compliance of the lower band edge by a conducted measurement and 2. show compliance of the higher band edge by a radiated measurement.

For the first measurement the EUT is set to transmit on the lowest channel (2412 MHz). The lower band edge is 2400 MHz.

Analyzer settings:

- Detector: Peak
- RBW=VBW=100 kHz

For the second measurement the EUT is set to transmit on the highest channel (2462 MHz). The higher band edge is 2483,5 MHz.

Analyzer settings:

- Detector: Peak, Average
- RBW = VBW = 100 kHz

4.6.2 Test Requirements / Limits

FCC Part 15.247 (d)

"In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

...

Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c))."

For the measurement of the **lower bandedge** the RF power at the bandedge shall be "at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power..."



For the measurement of the **higher bandedge** the limit is "specified in Section 15.209(a)".

4.6.3 Test Protocol

4.6.3.1 Lower bandedge

Temperature: 21 °C
Air Pressure: 1005 hPa
Humidity: 37 %

Op. Mode	Setup	Port
op-mode 1	37020f01	temp. ant. conn.

Frequency MHz	Corrected value dBm	Reference value dBm	Limit dBm	Delta to limit dB
2400	-39	1,27	-18,73	20,27

Remark: none

4.6.3.2 Higher bandedge

Temperature: 22 °C
Air Pressure: 1008 hPa
Humidity: 40 %

Op. Mode	Setup	Port
op-mode 3	37020a01	enclosure

Frequency MHz	Polarisation	Corrected value dBµV/m			Limit QP/AV dBµV/m	Limit Peak dBµV/m	Delta to AV/QP limit/dB	Delta to Peak limit dB
		QP	Peak	AV				
2483,50			49,00	36,00	54,00	74,00	18	25

Remark: none

4.6.4 Test result: Band edge compliance

FCC Part 15, Subpart C		Op. Mode	Setup	Port	Result
		op-mode 1	37020f01	temp. ant. conn.	passed
		op-mode 3	37020a01	enclosure	passed



4.7 Power density

Standard FCC Part 15, 2004-07-12
Subpart C

The test was performed according to: FCC §15.31, 2004-07-12

4.7.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room to perform the power density measurements.

The EUT was connected to spectrum analyzer via a short coax cable with a known loss.

In a pre-measurement the maximum value was determined. This value was finally measured with a spectrum analyzer with the following settings:

- Detector: Peak-Maxhold
- Span: 300 kHz
- Resolution Bandwidth (RBW): 3 kHz
- Video Bandwidth (VBW): 30 kHz
- Sweep Time: Coupled

The reference level of the spectrum analyzer was set equal to the reference level of the EUT.

4.7.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (e)

For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

4.7.3 Test Protocol

Temperature: 21 °C
Air Pressure: 1005 hPa
Humidity: 37 %

Op. Mode	Setup	Port
op-mode 2	37020f01	temp. ant. conn.

Power density dBm/3 kHz	Remarks
-12,4	-

Remark: Please see annex for the measurement plot.



4.7.4 Test result: Power density

FCC Part 15, Subpart C	Op. Mode	Setup	Port	Result
	op-mode 2	37020f01	temp. ant. conn.	passed

5 Test Equipment

EUT Digital Signalling System

Equipment	Type	Serial No.	Manufacturer
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz
Signalling Unit for Bluetooth Spurious Emissions	PTW60	100004	Rohde & Schwarz
Universal Radio Communication Tester	CMU 200	102366	Rohde & Schwarz

EMI Test System

Equipment	Type	Serial No.	Manufacturer
Comparison Noise Emitter	CNE III	99/016	York
EMI Analyzer	ESI 26	830482/004	Rohde & Schwarz
Signal Generator	SMR 20	846834/008	Rohde & Schwarz

EMI Radiated Auxiliary Equipment

Equipment	Type	Serial No.	Manufacturer
Antenna mast 4m	MA 240	240/492	HD GmbH H. Deisel
Biconical dipole	VUBA 9117	9117108	Schwarzbeck
Broadband Amplifier 18MHz -26GHz	JS4-18002600-32	849785	Miteq
Broadband Amplifier 30MHz -18GHz	JS4-00101800-35	896037	Miteq
Broadband Amplifier 45MHz -27GHz	JS4-00102600-42	619368	Miteq
Cable "ESI to EMI Antenna"	RTK081+Aircell7	W18.01+W38.01a	Huber + Suhner
Cable "ESI to Horn Antenna"	RTK 081	W18.04+3599/001	Rosenberger
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz
High Pass Filter	5HC3500/12750-1.2-KK	200035008	Trilithic
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic
KUEP pre amplifier	Kuep 00304000	001	7layers
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz
Pyramidal Horn Antenna 26,5 GHz	Model 3160-09	9910-1184	EMCO



EMI Conducted Auxiliary Equipment

Equipment	Type	Serial No.	Manufacturer
Cable "LISN to ESI"	RG214	W18.03+W48.03	Huber+Suhner
Two-Line V-Network	ESH 3-Z5	828304/029	Rohde & Schwarz
Two-Line V-Network	ESH 3-Z5	829996/002	Rohde & Schwarz
Power Meter	URV 5	828999/025	Rohde & Schwarz
Power Sensor	NRV-Z1	836219/005	Rohde & Schwarz

Auxiliary Test Equipment

Equipment	Type	Serial No.	Manufacturer
Broadband Resist. Power Divider N	1506A / 93459	LM390	Weinschel
Broadband Resist. Power Divider SMA	1515 / 93459	LN673	Weinschel
Digital Multimeter 01	Voltcraft M-3860M	IJ096055	Conrad
Digital Multimeter 02	Voltcraft M-3860M	IJ095955	Conrad
Digital Oscilloscope	TDS 784C	B021311	Tektronix
Fibre optic link Satellite	FO RS232 Link	181-018	Pontis
Fibre optic link Transceiver	FO RS232 Link	182-018	Pontis
I/Q Modulation Generator	AMIQ-B1	832085/018	Rohde & Schwarz
Notch Filter ultra stable	WRCA800/960-6E	24	Wainwright
Spectrum Analyzer 9 kHz to 3 GHz	FSP3	838164/004	Rohde & Schwarz
Temperature Chamber	VT 4002	58566002150010	Vötsch
Temperature Chamber	KWP 120/70	59226012190010	Weiss
ThermoHygro_01	430202		Fischer

Anechoic Chamber

Equipment	Type	Serial No.	Manufacturer
Air Compressor (pneumatic)			Atlas Copco
Controller	HD 100	100/603	HD GmbH H. Deisel
EMC Camera	CE-CAM/1		CE-SYS
EMC Camera for observation of EUT	CCD-400E	0005033	Mitsubishi
Filter ISDN	B84312-C110-E1		Siemens&Matsushita
Filter telephone systems / modem	B84312-C40-B1		Siemens&Matsushita
Filter Universal 1A	B84312-C30-H3		Siemens&Matsushita
Fully/Semi AE Chamber	10.58x6.38x6		Frankonia
Turntable	DS 420S	420/573/99	HD GmbH, H. Deisel
Valve Control Unit (pneum.)	VE 615P	615/348/99	HD GmbH, H. Deisel



*7 layers Bluetooth™ Full RF Test
Solution*

*Bluetooth RF Conformance
Test System TS8960*

Equipment	Type	Serial No.	Manufacturer
10 MHz Reference	MFS	5489/001	Efratom
Power Meter 832025/059	NRVD	832025/059	Rohde & Schwarz
Power Sensor A 832279/013	NRV-Z1	832279/013	Rohde & Schwarz
Power Sensor B 832279/015	NRV-Z1	832279/015	Rohde & Schwarz
Power Supply	E3632A	MY40003776	Agilent
Power Supply	PS-2403D	-	Conrad
RF Step Attenuator 833695/001	RSP	833695/001	Rohde & Schwarz
Rubidium Frequency Normal	MFS	002	Efratom
Signal Analyzer FSQ26 832695/007	FSQ26	832695/007	Rohde & Schwarz
Signal Analyzer FSP30	FSP30	100051	Rohde & Schwarz
Signal Generator 101175	SMIQ03B	101175	Rohde & Schwarz
Signal Generator 833680/003	SMP 03	833680/003	Rohde & Schwarz
Signal Generator A 834344/002	SMIQ03B	834344/002	Rohde & Schwarz
Signal Generator B 832870/017	SMIQ03B	832870/017	Rohde & Schwarz
Signal Switching and Conditioning Unit	SSCU	338826/005	Rohde & Schwarz
Signalling Unit PTW60 838312/014	PTW60 for TS8960	838312/014	Rohde & Schwarz
System Controller 829323/008	PSM12	829323/008	Rohde & Schwarz

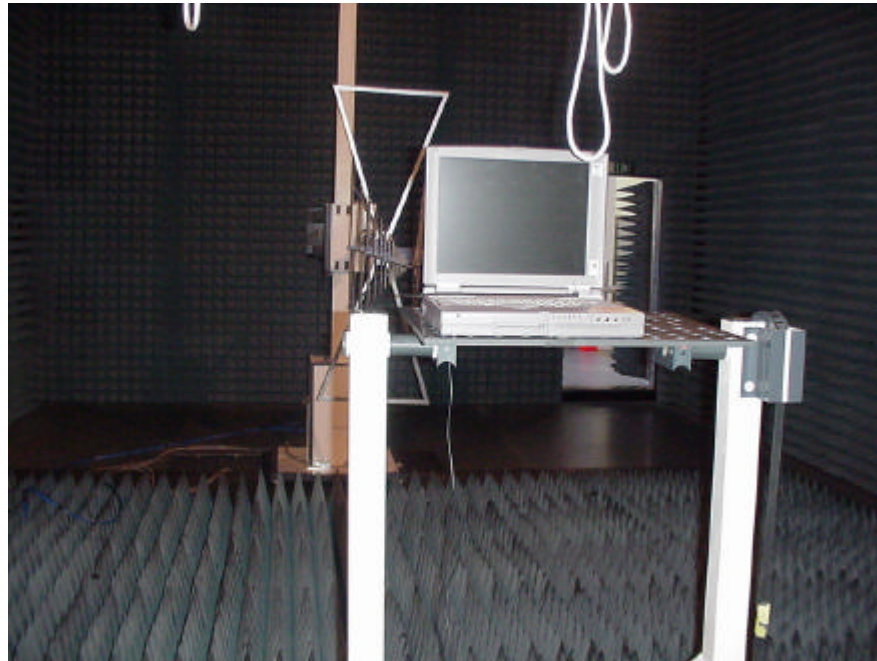
6 Foto Report



Picture 1: Setup for conducted emissions measurement on AC mains

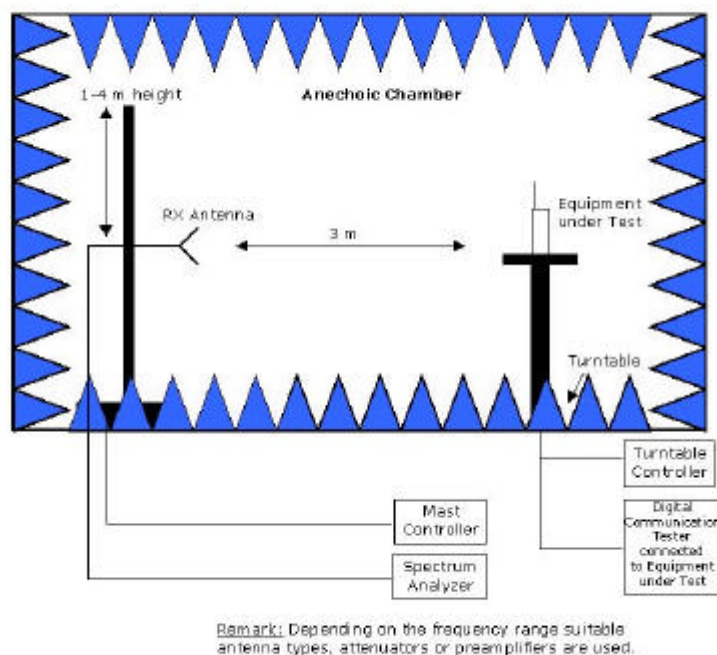


Picture 2: Setup for radiated measurements below 1 GHz



Picture 3: Setup for radiated measurements above 1 GHz

7 Setup Drawings

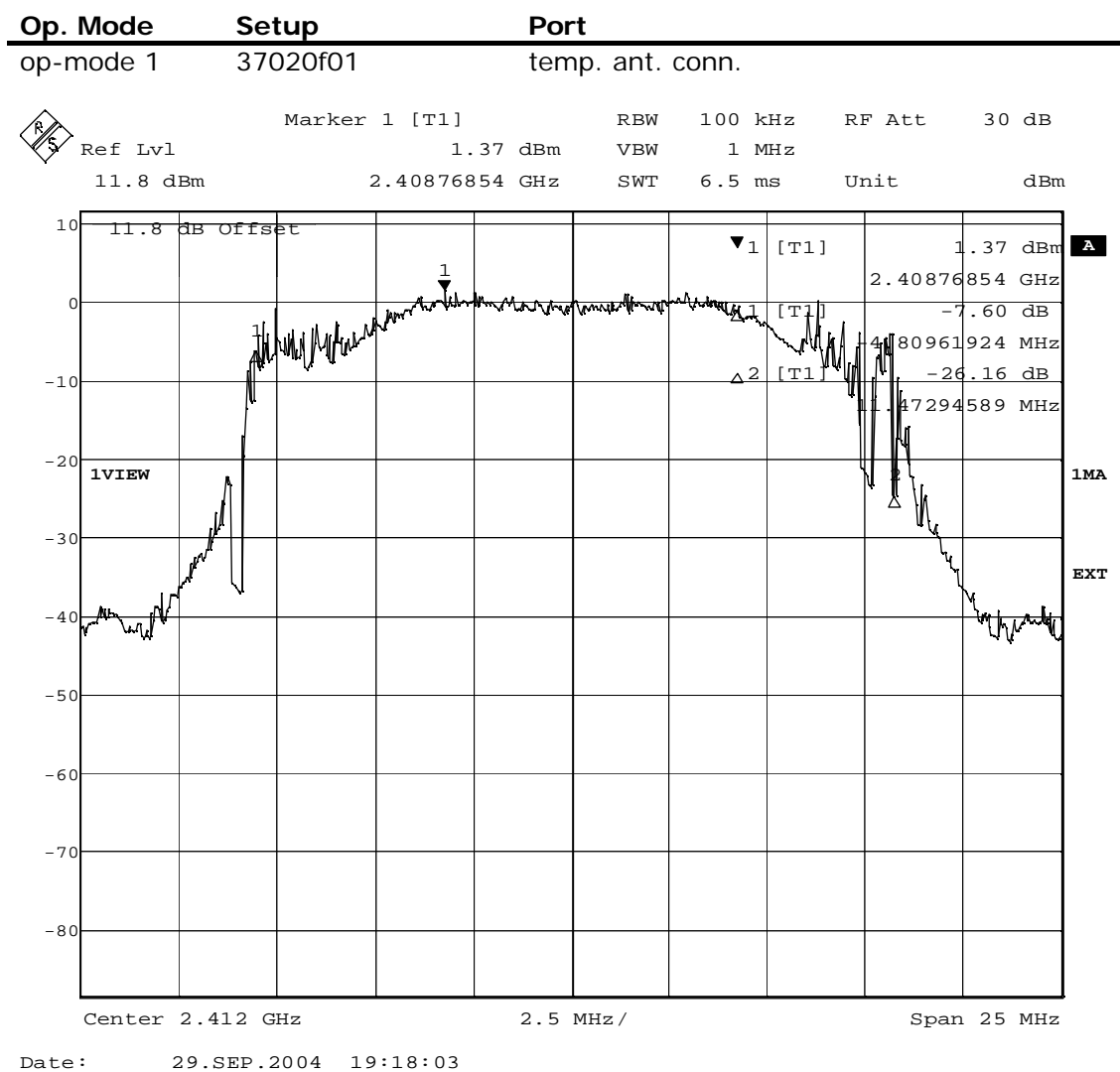


Drawing 1: Setup in the Anechoic chamber. For measurements below 1 GHz the ground was replaced by a conducting groundplane.

8 Annex

Measurement plots

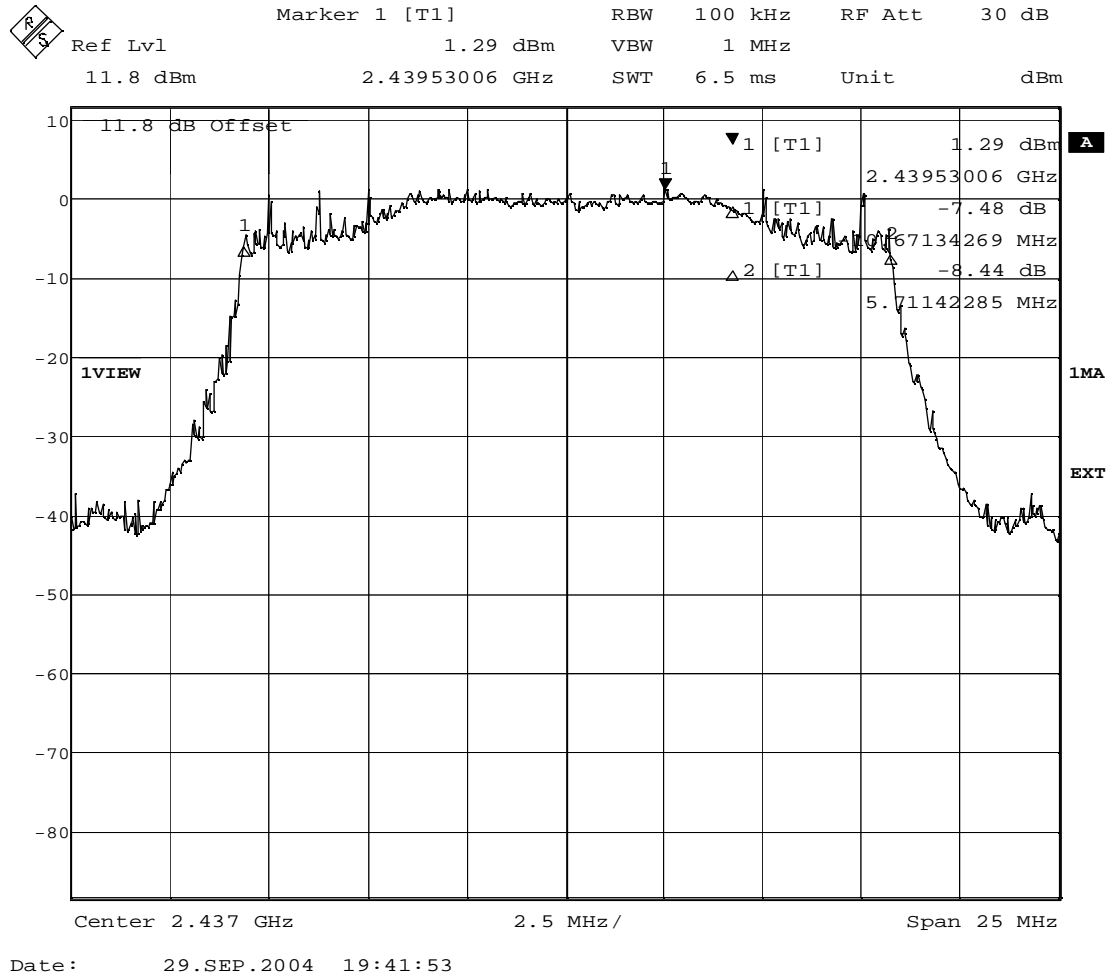
Occupied bandwidth





Occupied bandwidth

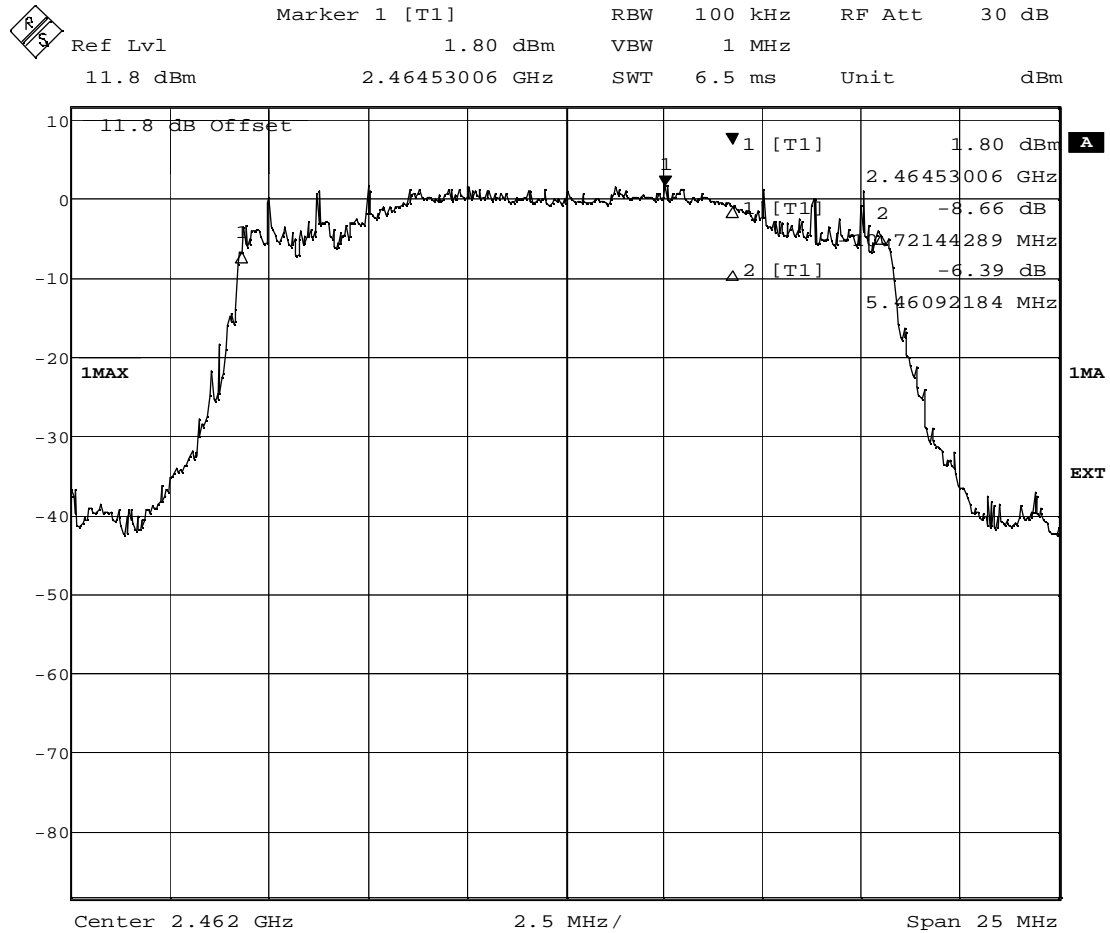
Op. Mode	Setup	Port
op-mode 2	37020f01	temp. ant. conn.





Occupied bandwidth

Op. Mode	Setup	Port
op-mode 3	37020f01	temp. ant. conn.

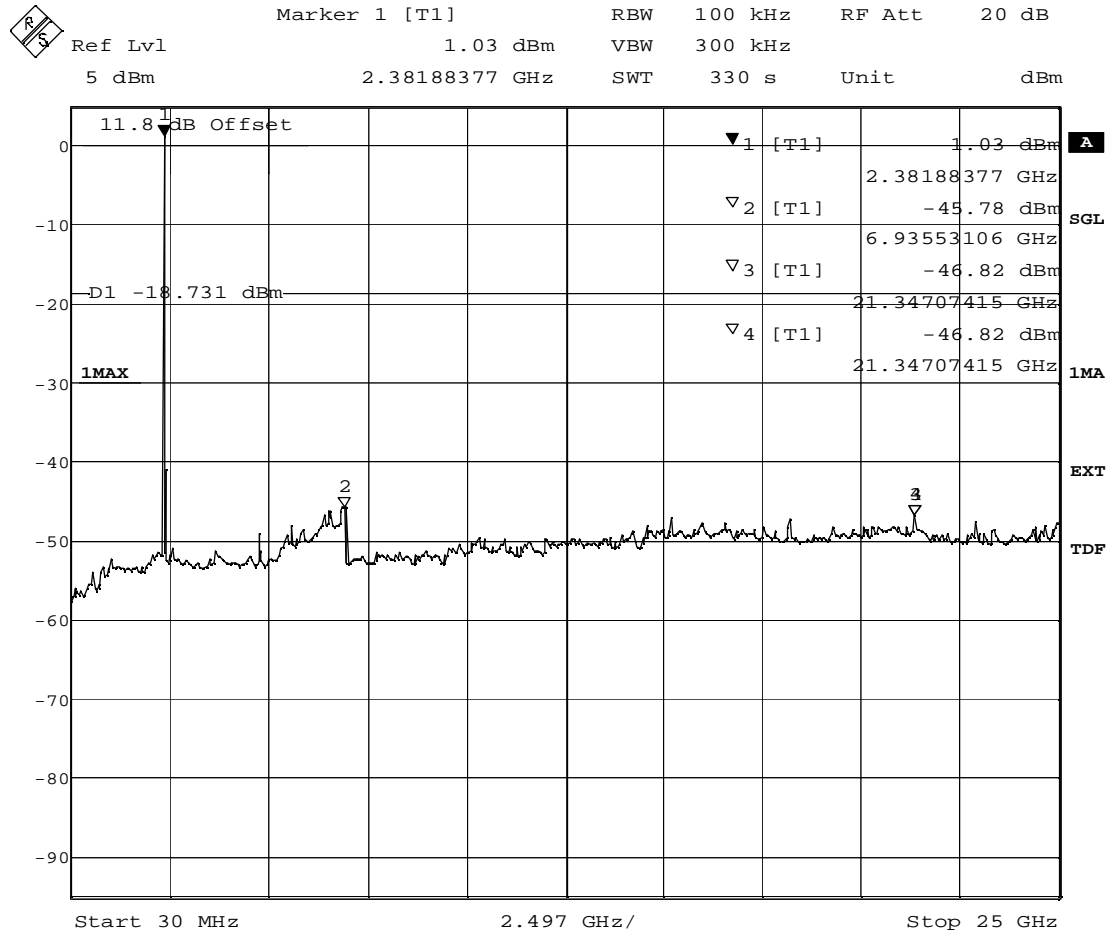


Date: 29.SEP.2004 20:22:53



Spurious RF conducted emission

Op. Mode	Setup	Port
op-mode 1	37020f01	temp. ant. conn.

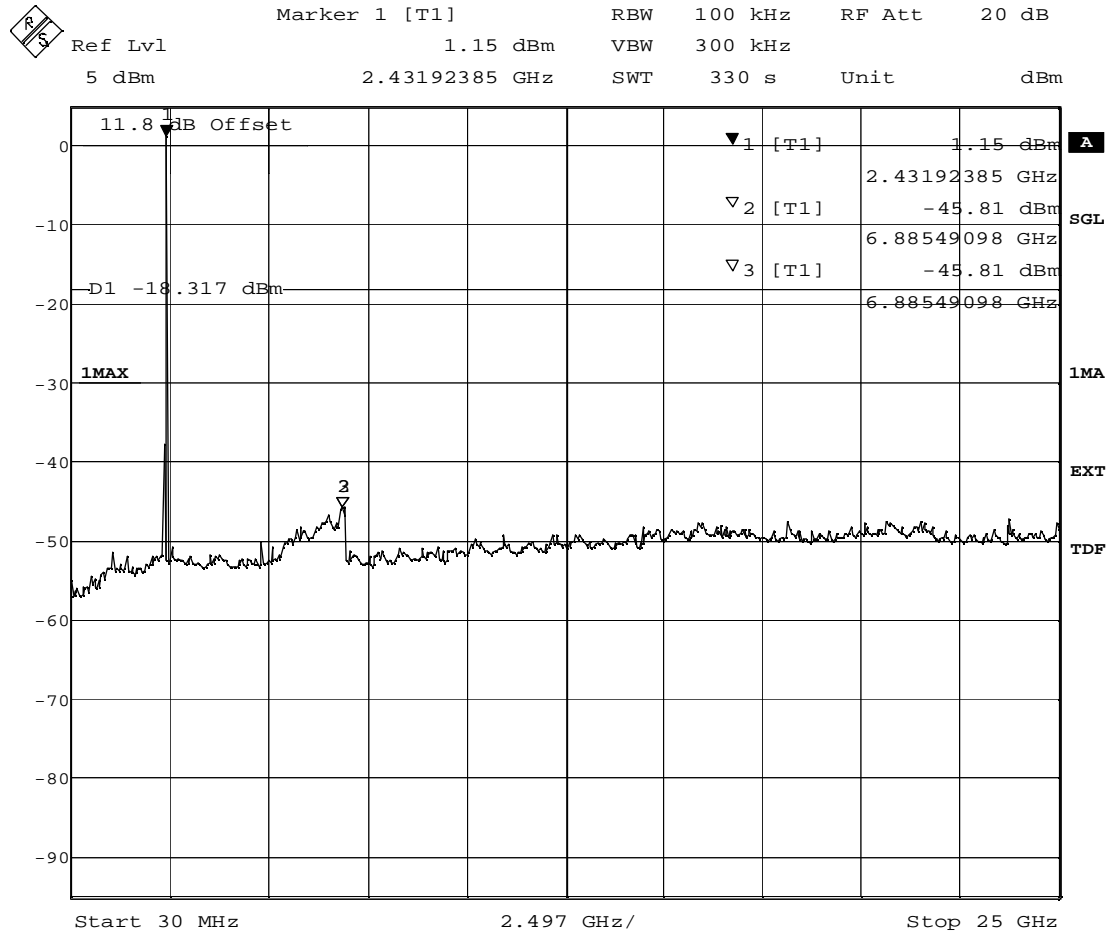


Title: spurious emissions
Comment A: CH B: 2402 MHz
Date: 29.SEP.2004 18:55:52



Spurious RF conducted emission

Op. Mode	Setup	Port
op-mode 2	37020f01	temp. ant. conn.

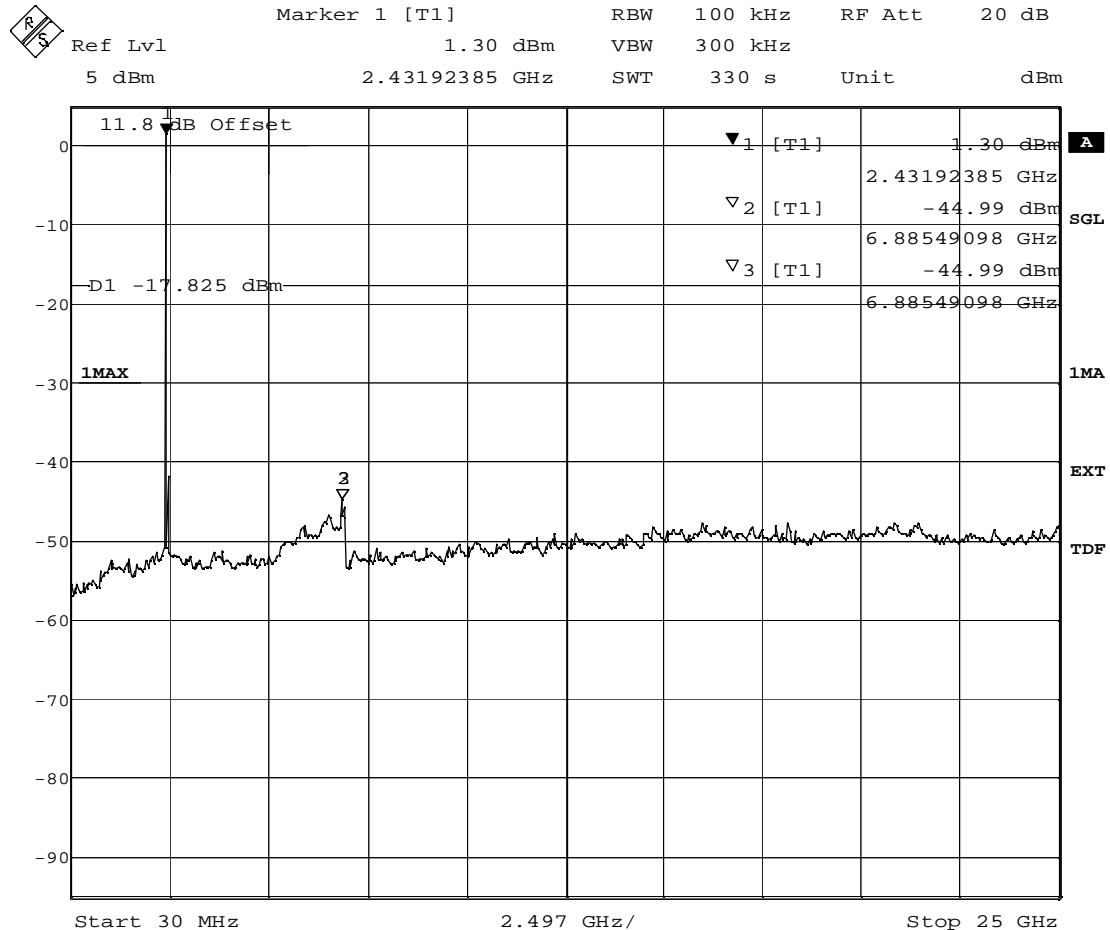


Title: spurious emissions
Comment A: CH M: 2441 MHz
Date: 29.SEP.2004 20:00:34



Spurious RF conducted emission

Op. Mode	Setup	Port
op-mode 3	37020f01	temp. ant. conn.




Title: spurious emissions
Comment A: CH T: 2480 MHz
Date: 29.SEP.2004 20:15:14

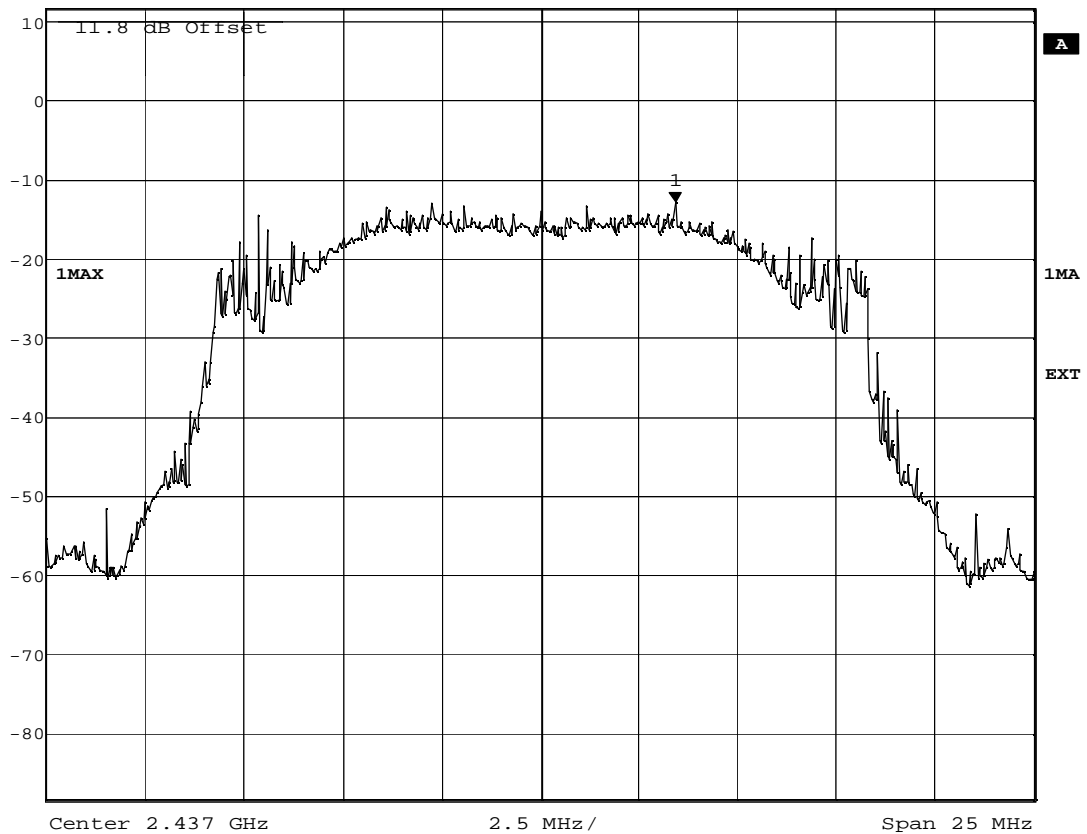


Power density

first measurement (to find the maximum power value)

Op. Mode	Setup	Port
op-mode 2	37020f01	temp. ant. conn.

	Marker 1 [T1]	RBW	3 kHz	RF Att	30 dB
Ref Lvl	-12.89 dBm	VBW	30 kHz		
11.8 dBm	2.44043186 GHz	SWT	7 s	Unit	dBm




Date: 29.SEP.2004 19:47:51

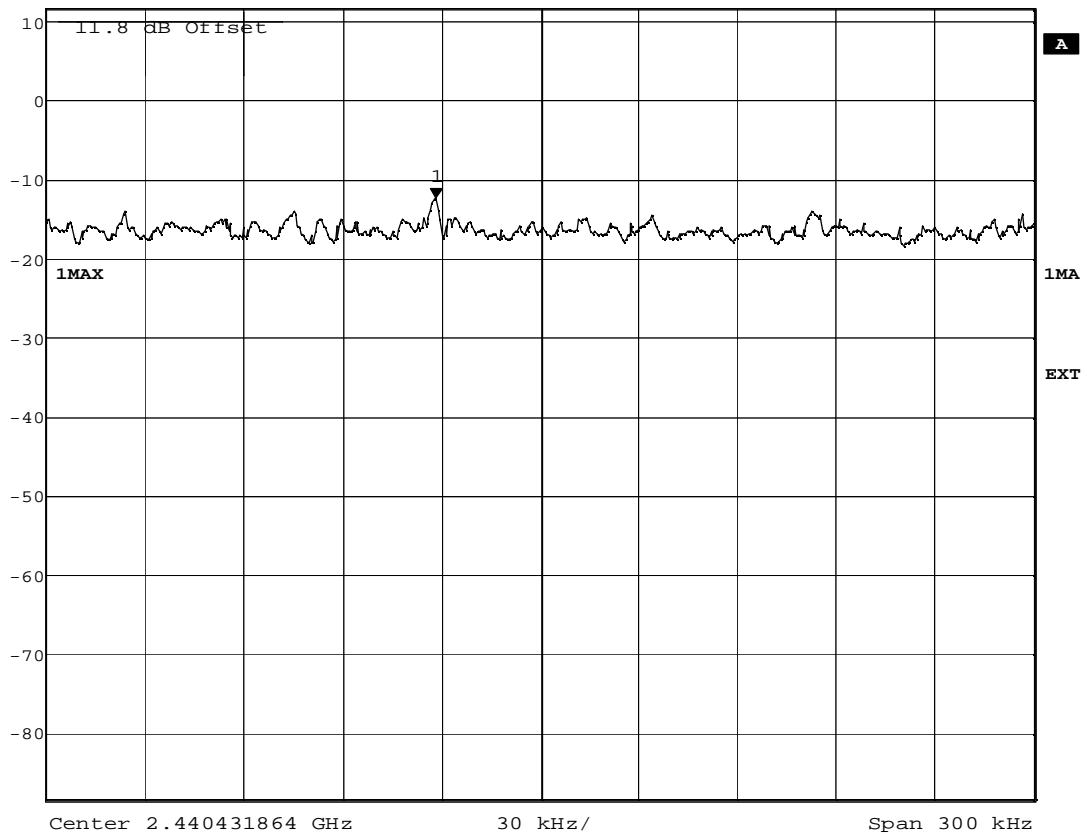


Power density

second measurement (to determine the power density)

Op. Mode	Setup	Port
op-mode 2	37020f01	temp. ant. conn.

	Marker 1 [T1]	RBW	3 kHz	RF Att	30 dB
Ref Lvl	-12.40 dBm	VBW	30 kHz		
11.8 dBm	2.44040030 GHz	SWT	84 ms	Unit	dBm



Date: 29.SEP.2004 19:52:22