



# EMC Measurement/Technical Report

on

## Bluetooth Protocol Analyser DGABTPA101

Report Reference: 4\_Digi\_0300\_BT\_FCC\_e

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.

---

Registergericht - registered in:  
Ratingen, HRB 3264  
Aufsichtsratsvorsitzende -  
Chairman of the Supervisory Board:  
Dr. Sabine Grobecker

Vorstand - Board of Directors:  
Dr. Wolfgang Dahm  
Dr. Hans-Jürgen Meckelburg

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

---



## **Table of Contents**

<b>0. Summary</b>	<b>2</b>
0.1 Technical Report Summary	3
0.2 Measurement Summary	4
<b>1. Administrative Data</b>	<b>6</b>
1.1 Testing Laboratory	6
1.2 Project Data	6
1.3 Applicant Data	6
1.4 Manufacturer Data	6
<b>2. Product Labeling</b>	<b>7</b>
2.1 FCC ID Label	7
2.2 Location of Label on the EUT	7
<b>3. Testobject Data</b>	<b>8</b>
3.1 General EUT Description	9
3.2 EUT Main Components	9
3.3 Ancillary Equipment	9
3.4 EUT Setups	9
3.5 Operating Modes	10
<b>4. Measurement Results</b>	<b>11</b>
4.1 Conducted Emissions	11
4.2 Occupied Bandwidth	13
4.3 Output Power	16
4.4 Spurious Emissions Conducted	18
4.5 Spurious Emissions Radiated	20
4.6 Dwell Time	26
4.7 Power Density	28
4.8 Channel Separation	30
4.9 Processing Gain	31
<b>5. Testequipment</b>	<b>32</b>
<b>6. Foto Report</b>	<b>34</b>
<b>7. Setup Drawings</b>	<b>36</b>
<b>8. Annex</b>	<b>37</b>
Measurement plots	



## **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 0 to 19 (10-1-98 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification Sections

Part 15, Subpart C - Intentional Radiators

§ 15.201 Equipment authorization requirement

§ 15.203 Antenna requirements

§ 15.207 Conducted limits

§ 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 Results:**

**The EUT complied with all the applicable FCC rules as listed above.**

## 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 1992

<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>
op-mode 2	setup 2	AC mains of connected lap	passed

### **FCC Part 15, Subpart C § 15.247 (a) (1) (ii)**

#### **Occupied Bandwidth**

The measurement was performed according to ANSI C63.4 1992

<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>
op-mode 1	setup 1	temporary antenna port	passed
op-mode 2	setup 1	temporary antenna port	passed
op-mode 3	setup 1	temporary antenna port	passed
op-mode 4	setup 1	temporary antenna port	passed
op-mode 5	setup 1	temporary antenna port	passed

### **FCC Part 15, Subpart C § 15.247 (b) (1)**

#### **Peak Power Output**

The measurement was performed according to FCC §15.31 10-1-1998

<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>
op-mode 1	setup 1	temporary antenna port	passed
op-mode 2	setup 1	temporary antenna port	passed
op-mode 3	setup 1	temporary antenna port	passed

### **FCC Part 15, Subpart C § 15.247 (c)**

#### **Spurious RF Conducted Emissions**

The measurement was performed according to FCC §15.31 10-1-1998

<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>
op-mode 1	setup 1	enclosure	passed
op-mode 2	setup 1	enclosure	passed
op-mode 3	setup 1	enclosure	passed

### **FCC Part 15, Subpart C § 15.247 (c), §15.35 (b), § 15.209**

#### **Spurious Radiated Emissions**

The measurement was performed according to ANSI C63.4 1992

<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>
op-mode 1	setup 3	enclosure pcb antenna	passed
op-mode 1	setup 2	enclosure patch antenna	passed
op-mode 2	setup 2	enclosure patch antenna	passed
op-mode 2	setup 3	enclosure pcb antenna	passed
op-mode 3	setup 3	enclosure pcb antenna	passed
op-mode 3	setup 2	enclosure patch antenna	passed

### **FCC Part 15, Subpart C § 15.247(g)**

---

**Dwell Time**

The measurement was performed according to FCC §15.31 10-1-1998

OP-Mode	Setup	Port	Final Result
op-mode 4	setup 1	temporary antenna port	passed
op-mode 5	setup 1	temporary antenna port	passed

---

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

---

**Power Density**

The measurement was performed according to FCC §15.31 10-1-1998

OP-Mode	Setup	Port	Final Result
op-mode 4	setup 1	temporary antenna port	passed
op-mode 5	setup 1	temporary antenna port	passed

---

**FCC Part 15, Subpart C § 15.247 (a) (1)**

---

**Channel Separation**

The measurement was performed according to FCC §15.31 10-1-1998

OP-Mode	Setup	Port	Final Result
op-mode 4	setup 1	temporary antenna port	passed

---

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

---

**Processing Gain**

The measurement was performed according to FCC §15.31 10-1-1998

OP-Mode	Setup	Port	Final Result
see add. Report	see add. Report	see add. Report	

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 in a letter dated February 07, 2000 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 178/99-10
- Regulierungsbehörde für Telekommunikation und Post (Reg TP)

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

### **1.2 Project Data**

Project Leader: Arndt Stöcker  
Receipt of EUT: 31.10.00  
Date of Test(s): 31.10.00-21.11.00  
Date of Report: 21.11.00  
No. of Pages in Annex: 1

### **1.3 Applicant Data**

Company Name: Digianswer A/S  
Address: Skalhuse 5  
  
DK-9240 Nibe  
Denmark

Contact Person:

### **1.4 Manufacturer Data**

Company Name: see applicant  
Address:

Contact Person:



## **2.0 Product Labeling**

### **2.1 FCC ID Label:**

At the time of this report there was no ID label available. This will be added to the report whenever the report will be sent to the FCC.

### **2.2 Location of Label on the EUT:**

### **3. Testobject Data**

#### **3.1 General EUT Description**

<b>Equipment under Test:</b>	Bluetooth Protocol Analyser
<b>Type Designation:</b>	DGABTPA101
<b>Kind of Device: (optional)</b>	Bluetooth device
<b>Voltage Type:</b>	DC
<b>Voltage level:</b>	5 V DC

**General product description:**

**The EUT provides the following ports:**

##### **Ports**

AC mains of connected laptop  
temporary antenna port  
enclosure pcb antenna  
enclosure patch antenna

**The main components of 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	Protocol Analyser	DGABTPA101	0050CD01004F	DIG433-9	1.08	31.11.00

For all conducted measurements

EUT B	Protocol Analyser	DGABTPA101	0050CD010048	DIG433-9	1.08	31.11.00
-------	-------------------	------------	--------------	----------	------	----------

For all radiated measurements

**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 additional 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.

Short Description	Equipment under Test	Type Designation	HW Status	SW Status	Serial No.	FCC Id
AE 6	Laptop	IBM 2609-21G	-	-	BA-69672	409TA1-25871-M5-E
AE 5	Monitor	Samsung Sync Master 700p plus	-	-	SE17H3MK3052 94J	CSE 7839
AE 4	Keyboard	Compaq	-	-	123755-002	AQ6-23K15
AE 3	Printer	HP Desk Jet 895 Cxi	-	-	SG 97E1V0Y5	-
AE 1	Laptop	IBM 2626	-	-	55-3211P 99/09	-
AE 2	Laptop	HP Omnibook XE2	-	-	TW95004702	6CTTAI-34230-M5-E

### 3.4 EUT Setups

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

Setup No.	Combination of EUTs	Description
setup 1	EUT A + AE 1	For all conducted measurements
setup 2	EUT B + AE 1+ AE 3+ AE 4+ AE 5	For all radiated measurements and conducted emissions, use of patch antenna
setup 3	EUT B + AE 1+ AE 3+ AE 4+ AE 5	For all radiated measurements, use of pcb antenna

### 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	Transmitting DH1 packets at 2401 MHz (Channel B)	without hopping
op-mode 2	Transmitting DH1 packets at 2441 MHz (Channel M)	without hopping
op-mode 3	Transmitting DH1 packets at 2480 MHz (Channel T)	without hopping
op-mode 4	Inquiry	EUT in Inquiry mode
op-mode 5	Paging	EUT in Paging mode

## 4. Test Results

### 4.1 Conducted Emissions (AC Power Line)

**Standard** FCC Part 15, 10-1-98  
Subpart C

**The test was performed according to:** ANSI C63.4 1992

#### 4.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4-1992.

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 $\mu$ 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 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: 450 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 Limits

FCC Part 15, Subpart C, §15.207

Frequency Range (MHz):                      Class B Limit (dBμV)  
0.45 – 30    48

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

#### 4. 1 .3 Test Protocol

Temperature: 23 C

Air Pressure: 1010 hPa

Humidity: 35 %

Op. Mode	Setup	Port	Test Parameter
op-mode 2	setup 2	AC mains of connected laptop	

Powerline	Frequency MHz	Measured Value dBμV	Delta to Limit dBμV	Remarks
L1. N				please see Diagram 1.1

Remark: none

#### 4.1 .4 Test result: Conducted Emissions (AC Power Line)

FCC Part 15, Subpart C

Op. Mode	Setup	Port	Result
op-mode 2	setup 2	AC mains of connected laptop	<b>passed</b>

## 4.2 Occupied Bandwidth

**Standard** FCC Part 15, 10-1-98  
Subpart C

**The test was performed according to:** ANSI C63.4 1992

### 4.2.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4-1992.

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 10 kHz.

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

### 4.2.2 Test Limits

FCC Part 15, Subpart C, §15.247 (a) (1) (ii)

(1) Frequency hopping systems operating in the 2400 - 2483.5 MHz band should use at least 75 hopping frequencies.

(2) The average time of occupancy on any frequency should not be greater than 0.4 seconds within a 30 second period.

(3) The maximum 20 dB bandwidth of the hopping channel is 1MHz.

### 4.2.3 Test Protocol

Temperature: 23°C

Air Pressure: 1013 hPa

Humidity: 33%

Op. Mode	Setup	Port	Test Parameter
op-mode 1	setup 1	temporary antenna port	
20 dB Bandwidth MHz	Remarks		
0,708	please see annex		

Remark: none

Temperature: 23,5°C  
Air Pressure: 1013 hPa  
Humidity: 31%

Op. Mode	Setup	Port	Test Parameter
op-mode 2	setup 1	temporary antenna port	

20 dB Bandwidth MHz	Remarks
0,834	please see annex

Remark: none

Temperature: 23,5°C  
Air Pressure: 1013  
Humidity: 33%

Op. Mode	Setup	Port	Test Parameter
op-mode 3	setup 1	temporary antenna port	

20 dB Bandwidth MHz	Remarks
0,704	please see annex

Remark: none

Temperature: 23,5°C  
Air Pressure: 1013  
Humidity: 33%

Op. Mode	Setup	Port	Test Parameter
op-mode 4	setup 1	temporary antenna port	

20 dB Bandwidth MHz	Remarks
0,504	please see annex

Remark: none

Temperature: 23,5°C  
Air Pressure: 1013  
Humidity: 33%

Op. Mode	Setup	Port	Test Parameter
op-mode 5	setup 1	temporary antenna port	

20 dB Bandwidth MHz	Remarks
0,456	please see annex

Remark: none

#### 4.2 .4 Test result: Occupied Bandwidth

FCC Part 15, Subpart C		Op. Mode	Setup	Port	Result
		op-mode 1	setup 1	temporary antenna port	<b>passed</b>
		op-mode 2	setup 1	temporary antenna port	<b>passed</b>
		op-mode 3	setup 1	temporary antenna port	<b>passed</b>
		op-mode 4	setup 1	temporary antenna port	<b>passed</b>
		op-mode 5	setup 1	temporary antenna port	<b>passed</b>

### 4.3 Peak Power Output

**Standard** FCC Part 15, 10-1-98  
Subpart C

**The test was performed according to:** FCC §15.31 10-1-1998

#### 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 resolution bandwidth for measuring the output power was 1 MHz.

The reference level of the spectrum analyser was set equal to the output power of the EUT.

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

#### 4.3.2 Test Limits

FCC Part 15, Subpart C, §15.247 (b) (1)

(1) For frequency hopping systems operating in the band 2400 - 2483,5 MHz or 5725 - 5850 MHz and for all direct sequence systems: 1 Watt

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

==> Maximum Output Power: 30 dBm

#### 4.3.3 Test Protocol

Temperature: 23°

Air Pressure: 1013

Humidity: 33%

Op. Mode	Setup	Port	Test Parameter
op-mode 1	setup 1	temporary antenna port	

Output Power dBm	Remarks
15,8	The EIRP including antenna gain (2.52 dBi) is 18.32 dBm; please see annex

Remark: none

Temperature: 23,5°C  
Air Pressure: 1013  
Humidity: 33%

Op. Mode	Setup	Port	Test Parameter
op-mode 2	setup 1	temporary antenna port	

Output Power dBm	Remarks
15,57	The EIRP including antenna gain (2.52 dBi) is 18.09 dBm; please see annex

Remark: none

Temperature: 23,5°C  
Air Pressure: 1013 hPa  
Humidity: 33%

Op. Mode	Setup	Port	Test Parameter
op-mode 3	setup 1	temporary antenna port	

Output Power dBm	Remarks
15,72	The EIRP including antenna gain (2.52 dBi) is 18.24 dBm; please see annex

Remark: none

#### 4.3 .4 Test result: Peak Power Output

FCC Part 15, Subpart C				Op. Mode	Setup	Port	Result
				op-mode 1	setup 1	temporary antenna port	passed
				op-mode 2	setup 1	temporary antenna port	passed
				op-mode 3	setup 1	temporary antenna port	passed

#### 4.4 Spurious RF Conducted Emissions

**Standard** FCC Part 15, 10-1-98  
Subpart C

**The test was performed according to:** FCC §15.31 10-1-1998

##### 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.

Analyser settings:

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

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

##### 4.4.2 Test Limits

FCC Part 15, Subpart C, §15.247(c)

(1) All harmonics/spurs must be at least 20dB below the highest emission level within the authorized band as measured with a 100kHz RBW, based on either RF conducted or radiated measurement.

##### 4.4.3 Test Protocol

Temperature: 23,5

Air Pressure: 1013

Humidity: 33%

Op. Mode	Setup	Port	Test Parameter			
op-mode 1	setup 1	enclosure				
Frequency MHz	Measured Value dBm	Correction Factor dB	Corrected Value	Reference Value dB	Limit dBm	Delta to Limit dB
17844,26	0,00	0,00	-39,42	0,00	-5,41	34,01

Remark: please see annex

Temperature: 23,5°C  
Air Pressure: 1013 hPa  
Humidity: 33%

Op. Mode	Setup	Port	Test Parameter
op-mode 2	setup 1	enclosure	

Frequency MHz	Measured Value dBm	Correction Factor dB	Corrected Value	Reference Value dB	Limit dBm	Delta to Limit dB
17744,18	0,00	0,00	-39,19	0,00	-5,02	34,17

Remark: please see annex

Temperature: 23,5°C  
Air Pressure: 1013  
Humidity: 33%

Op. Mode	Setup	Port	Test Parameter
op-mode 3	setup 1	enclosure	

Frequency MHz	Measured Value dBm	Correction Factor dB	Corrected Value	Reference Value dB	Limit dBm	Delta to Limit dB
17744,18	0,00	0,00	-39,11	0,00	-5,05	34,06

Remark: please see annex

#### 4.4 .4 Test result: Spurious RF Conducted Emissions

FCC Part 15, Subpart C

Op. Mode	Setup	Port	Result
op-mode 1	setup 1	enclosure	<b>passed</b>
op-mode 2	setup 1	enclosure	<b>passed</b>
op-mode 3	setup 1	enclosure	<b>passed</b>

## 4.5 Spurious Radiated Emissions

**Standard** FCC Part 15, 10-1-98  
Subpart C

**The test was performed according to:** ANSI C63.4 1992

### 4.5.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4-1992.

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 was made in a typical installation configuration.

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

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  $\mu$ s
- Turntable angle range: –180 to 180 °
- Turntable stepsize: 90°
- Height variation range: 1 – 3m
- Height variation stepsize: 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 stepsize: 45°
- Height variation range: 1 – 4m
- Height variation stepsize: 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 +/- 22,5° 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° to + 22,5 ° around the value determined in step 2
- Height variation range: -0,25m to + 0,25m 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

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 (invers linear-distance for field strength measurements, invers 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.

Detector: Peak, Average

RBW = VBW = 1 MHz, above 7 GHz 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 Limits

FCC Part 15, Subpart C, §15.247(c)

(2) A radiated emission test applies to harmonic/spurs that fall in the restricted bands as listed in § 15.205(a). The maximum permitted QP (< 1GHz) and average (> 1GHz) field strength is listed in § 15.209(a).

(3)

FCC Part 15, Subpart C, §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: 1000 hPa

Humidity: 40 %

Op. Mode	Setup	Port	Test Parameter
op-mode 1	setup 2	enclosure patch antenna	

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				
Horizontal	408,00	45,90	0,00	0,00	46,00	0,00	0,10	0,00
Vertical	608,00	41,60	0,00	0,00	46,00	0,00	4,40	0,00
Horizontal	3602,50	0,00	49,52	37,87	54,00	74,00	16,13	24,48
Horizontal	4584,50	0,00	50,82	34,19	54,00	74,00	19,81	23,18
Horizontal	4804,00	0,00	49,94	36,58	54,00	74,00	17,42	24,06
Horizontal	8407,00	0,00	45,78	33,66	54,00	74,00	20,34	28,22

Remark: none

Temperature: 22 °C  
Air Pressure: 1000 hPa  
Humidity: 40 %

Op. Mode	Setup	Port	Test Parameter
----------	-------	------	----------------

op-mode 1	setup 3	enclosure pcb antenna	
-----------	---------	-----------------------	--

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				
Horizontal	408,00	45,80	0,00	0,00	46,00	0,00	0,20	0,00
Vertical	608,00	42,70	0,00	0,00	46,00	0,00	3,30	0,00
Horizontal	1201,00	0,00	45,58	36,02	54,00	74,00	17,98	28,42
Horizontal	3603,00	0,00	53,30	41,68	54,00	74,00	12,32	20,70
Horizontal	4584,00	0,00	52,01	44,99	54,00	74,00	9,01	21,99
Horizontal	4804,00	0,00	51,61	40,62	54,00	74,00	13,38	22,39

Remark: none

Temperature: 22 °C  
Air Pressure: 1000 hPa  
Humidity: 40 %

Op. Mode	Setup	Port	Test Parameter
----------	-------	------	----------------

op-mode 2	setup 2	enclosure patch antenna	
-----------	---------	-------------------------	--

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				
Horizontal	408,00	45,30	0,00	0,00	46,00	0,00	0,70	0,00
Vertical	608,00	41,50	0,00	0,00	46,00	0,00	4,50	0,00
Horizontal	3661,50	0,00	50,33	38,23	54,00	74,00	15,77	23,67
Horizontal	4584,00	0,00	51,08	37,01	54,00	74,00	16,99	22,92
Horizontal	4882,00	0,00	55,87	43,59	54,00	74,00	10,41	18,13
Horizontal	7323,00	0,00	53,09	33,85	54,00	74,00	20,15	20,91

Remark: none

Temperature: 22 °C  
Air Pressure: 1000 hPa  
Humidity: 40 %

Op. Mode	Setup	Port	Test Parameter
----------	-------	------	----------------

op-mode 2	setup 3	enclosure pcb antenna
-----------	---------	-----------------------

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				
Vertical	240,00	38,00	0,00	0,00	46,00	0,00	8,00	0,00
Horizontal	400,00	37,70	0,00	0,00	46,00	0,00	8,30	0,00
Horizontal	408,00	45,50	0,00	0,00	46,00	0,00	0,50	0,00
Vertical	608,00	42,20	0,00	0,00	46,00	0,00	3,80	0,00
Horizontal	1220,50	0,00	47,87	38,43	54,00	74,00	15,57	26,13
Horizontal	3662,00	0,00	49,40	37,12	54,00	74,00	16,88	24,60
Horizontal	4585,00	0,00	51,36	37,69	54,00	74,00	16,31	22,64
Horizontal	4882,00	0,00	49,13	35,57	54,00	74,00	18,43	24,87

Remark: none

Temperature: 22 °C  
Air Pressure: 1000 hPa  
Humidity: 40 %

Op. Mode	Setup	Port	Test Parameter
----------	-------	------	----------------

op-mode 3	setup 2	enclosure patch antenna
-----------	---------	-------------------------

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				
Vertical	240,00	38,20	0,00	0,00	46,00	0,00	7,80	0,00
Horizontal	400,00	39,20	0,00	0,00	46,00	0,00	6,80	0,00
Horizontal	408,00	45,50	0,00	0,00	46,00	0,00	0,50	0,00
Vertical	608,00	41,90	0,00	0,00	46,00	0,00	4,10	0,00
Horizontal	3720,00	0,00	51,19	38,18	54,00	74,00	15,82	22,81
Horizontal	4584,00	0,00	51,22	37,01	54,00	74,00	16,99	22,78
Horizontal	4959,50	0,00	51,11	37,51	54,00	74,00	16,49	22,89

Remark: none

Temperature: 22 °C  
Air Pressure: 1000 hPa  
Humidity: 40 %

Op. Mode	Setup	Port	Test Parameter
op-mode 3	setup 3	enclosure pcb antenna	

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				
Vertical	240,00	38,20	0,00	0,00	46,00	0,00	7,80	0,00
Horizontal	400,00	36,40	0,00	0,00	46,00	0,00	9,60	0,00
Horizontal	408,00	45,30	0,00	0,00	46,00	0,00	0,70	0,00
Vertical	608,00	42,30	0,00	0,00	46,00	0,00	3,70	0,00
Horizontal	1240,00	0,00	49,12	39,60	54,00	74,00	14,40	24,88
Horizontal	3720,00	0,00	48,19	36,57	54,00	74,00	17,43	25,81
Horizontal	4584,50	0,00	51,49	33,18	54,00	74,00	20,82	22,51
Horizontal	4960,00	0,00	47,42	35,48	54,00	74,00	18,52	26,58

Remark: none

#### 4.5 .4 Test result: Spurious Radiated Emissions

FCC Part 15, Subpart C

Op. Mode	Setup	Port	Result
op-mode 1	setup 2	enclosure patch antenna	<b>passed</b>
op-mode 1	setup 3	enclosure pcb antenna	<b>passed</b>
op-mode 2	setup 2	enclosure patch antenna	<b>passed</b>
op-mode 2	setup 3	enclosure pcb antenna	<b>passed</b>
op-mode 3	setup 2	enclosure patch antenna	<b>passed</b>
op-mode 3	setup 3	enclosure pcb antenna	<b>passed</b>

## 4.6 Dwell Time

**Standard** FCC Part 15, 10-1-98  
Subpart C

**The test was performed according to:** FCC §15.31 10-1-1998

### 4.6.1 Test Description

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

The reference level of the spectrum analyser was set equal to the output power of the EUT.

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

To determine the dwell time, 3 single measurements are necessary. The first plot shows the activity for a complete inquiry/paging on one channel. The second plot shows the repetition rate on one channel, and the third plot shows the duration of the burst used in inquiry/paging.

With this 3 single values the dwell time of the channel can be calculated.

### 4.6.2 Test Limits

FCC Part 15, Subpart C, §15.247 (g)

The dwell time of the channel shall be less than 400 ms in a XX s period

### 4.6.3 Test Protocol

Temperature: 23°C  
Air Pressure: 1013 hPa  
Humidity: 33%

Op. Mode	Setup	Port	Test Parameter
op-mode 4	setup 1	temporary antenna port	

Dwell time ms	Remarks
56,8	please see annex

Remark: none



Temperature: 23°C  
Air Pressure: 1013 hPa  
Humidity: 33%

Op. Mode	Setup	Port	Test Parameter
op-mode 5	setup 1	temporary antenna port	

Dwell time ms	Remarks
28,8	please see annex

Remark: none

#### 4.6 .4 Test result: Dwell Time

FCC Part 15, Subpart C

Op. Mode	Setup	Port	Result
op-mode 4	setup 1	temporary antenna port	<b>passed</b>
op-mode 5	setup 1	temporary antenna port	<b>passed</b>

## 4.7 Power Density

**Standard** FCC Part 15, 10-1-98  
Subpart C

**The test was performed according to:** FCC §15.31 10-1-1998

### 4.7.1 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.

The Analyser settings are according 15.247 (d):

- Detector: Peak-Maxhold
- Span: 2 MHz
- Resolution Bandwidth (RBW): 3 kHz
- Video Bandwidth (VBW): 3 kHz
- Sweep Time: Coupled

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

### 4.7.2 Test Limits

FCC Part 15, Subpart C, §15.247 (g)

The power density shall be below 8 dBm measured with a resolution bandwidth of 3 kHz.

### 4.7.3 Test Protocol

Temperature: 23°C

Air Pressure: 1013 hPa

Humidity: 33%

Op. Mode	Setup	Port	Test Parameter
op-mode 4	setup 1	temporary antenna port	
<b>Power Density dBm</b>	<b>Remarks</b>		
3,47	please see annex		

Remark: none

Temperature: 23°C  
Air Pressure: 1013 hPa  
Humidity: 33%

Op. Mode	Setup	Port	Test Parameter
op-mode 5	setup 1	temporary antenna port	

Power Density dBm	Remarks
-3,4	please see annex

Remark: none

#### 4.7 .4 Test result: Power Density

FCC Part 15, Subpart C	Op. Mode	Setup	Port	Result
	op-mode 4	setup 1	temporary antenna port	<b>passed</b>
	op-mode 5	setup 1	temporary antenna port	<b>passed</b>

## 4.8 Channel Separation

**Standard** FCC Part 15, 10-1-98  
Subpart C

**The test was performed according to:** FCC §15.31 10-1-1998

### 4.8.1 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.

Analyser settings:

- Detector: Peak-Maxhold
- Span: 10 MHz
- Resolution Bandwidth (RBW): 300 kHz
- Video Bandwidth (VBW): 300 kHz
- Sweep Time: Coupled

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

### 4.8.2 Test Limits

### 4.8.3 Test Protocol

Temperature: 24°C  
Air Pressure: 1015 hPa  
Humidity: 34%

Op. Mode	Setup	Port	Test Parameter
op-mode 4	setup 1	temporary antenna port	

Channel Separation MHz	Remarks
1	please see annex

Remark: none

### 4.8.4 Test result: Channel Separation

FCC Part 15, Subpart C	Op. Mode	Setup	Port	Result
	op-mode 4	setup 1	temporary antenna port	<b>passed</b>

## 4.9 Processing Gain

**Standard** FCC Part 15, 10-1-98  
Subpart C

**The test was performed according to:** FCC §15.31 10-1-1998

### 4.9.1 Test Description

See additional test report.

### 4.9.2 Test Limits

FCC Part 15, Subpart C, §15.247 (g)

The processing gain shall be greater than 17 dB.

### 4.9.3 Test Protocol

Temperature:

Air Pressure:

Humidity:

Op. Mode	Setup	Port	Test Parameter
e add. Rep	ee add. Rep	ee add. Report	

Remark:

### 4.9.4 Test result: Processing Gain

FCC Part 15, Subpart C	Op. Mode	Setup	Port	Result
	see add. Report	see add. Report	see add. Report	

## 5. Testequipment

### *EUT Digital Signaling System*

Equipment	Type	Serial No.	Manufacturer	Cal due
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz	17.06.2001

### *EMI Test System*

Equipment	Type	Serial No.	Manufacturer	Cal due
EMI Analyzer	ESI 26	830482/004	Rohde & Schwarz	29.06.2001
Signal Generator	SMR 20	846834/008	Rohde & Schwarz	26.07.2002
Comparison Noise Emitter	CNE III	99/016	York	04.05.2001

### *EMI Radiated Auxiliary Equipment*

Equipment	Type	Serial No.	Manufacturer	Cal due
High Pass Filter	5HC2700/12750-1.	9942012	Trilithic	02.11.2000
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz	04.10.2001
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz	16.06.2001
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz	18.05.2001
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz	18.05.2001
Biconical dipole	VUBA 9117	9117108	Schwarzbeck	03.06.2001
High Pass Filter	4HC1600/12750-1.	9942011	Trilithic	02.11.2000
Pyramidal Horn Antenna 26,5 GHz	Model 3160-09	9910-1184	EMCO	22.08.2001
Cable "ESI to EMI Antenna"	RTK081+Aircell7	W18.01+W38.01a	Huber+Suhner	09.12.2000
Cable "ESI to Horn Antenna"	RTK 081	W18.04+3599/001	Rosenberger	09.12.2000
Broadband Amplifier 45MHz-27GHz	JS4-00102600-42-5	619368	Miteq	

### *EMI Conducted Auxiliary Equipment*

Equipment	Type	Serial No.	Manufacturer	Cal due
Two-Line V-Network	ESH 3-Z5	829996/002	Rohde & Schwarz	22.06.2001
Cable "LISN to ESI"	RG214	W18.03+W48.03	Huber+Suhner	14.09.2000
Two-Line V-Network	ESH 3-Z5	828304/029	Rohde & Schwarz	22.06.2001

## Auxiliary Test Equipment

Equipment	Type	Serial No.	Manufacturer	Cal due
Notch Filter ultra stable	WRCA800/960-6EE	24	Wainwright	03.02.2003
Digital Multimeter 02	Voltcraft M-3860M	IJ095955	Conrad	03.06.2001
Digital Multimeter 01	Voltcraft M-3860M	IJ096055	Conrad	03.06.2001
Digital Oscilloscope	TDS 784C	B021311	Tektronix	26.05.2001
Fibre optic link Transceiver	FO RS232 Link	182-018	Pontis	
ThermoHygro_01	430202		Fischer	10.11.2001
Broadband Resist. Power Divider SMA	1515 / 93459	LN673	Weinschel	
Broadband Resist. Power Divider N	1506A / 93459	LM390	Weinschel	
Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz	09.11.2000
I/Q Modulation Generator	AMIQ-B1	832085/018	Rohde & Schwarz	27.10.2000
Temperature Chamber	VT 4002	58566002150010	Vötsch	
Temperature Chamber	S-1.2C-B	393/25-1389-27RF	Thermotron	23.05.2003
Fibre optic link Satellite	FO RS232 Link	181-018	Pontis	

## 6. Foto Report



**Picture 1 : Test set-up for conducted emissions on AC power line**



**Picture 2 : Test set-up for radiated emissions**

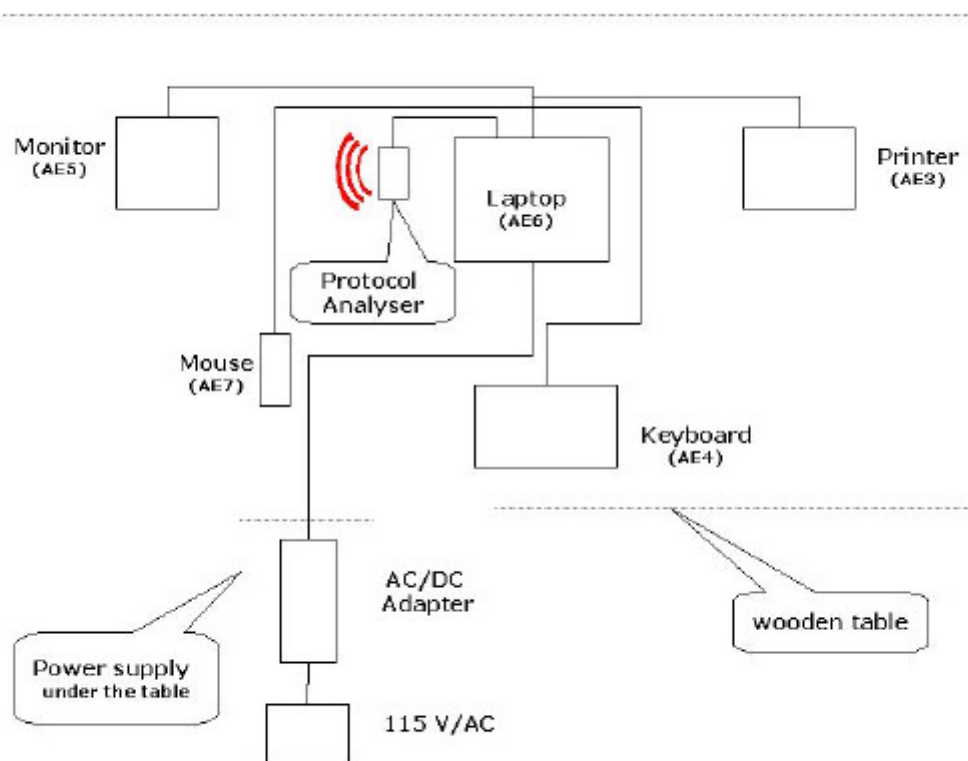


Picture 3 : testsetup rear view



Picture 4 : Protokol Analyser DGABTPA101

## 7. Setup Drawings

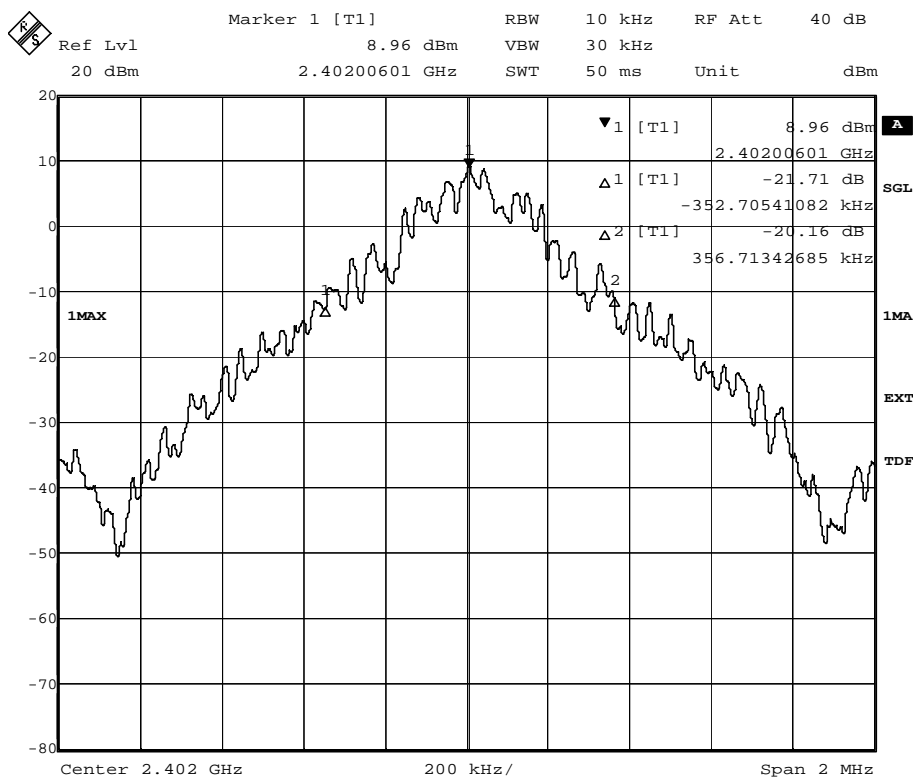


**Drawing 1 : Test setup for radiated tests**

## 8. Annex

### Occupied Bandwidth

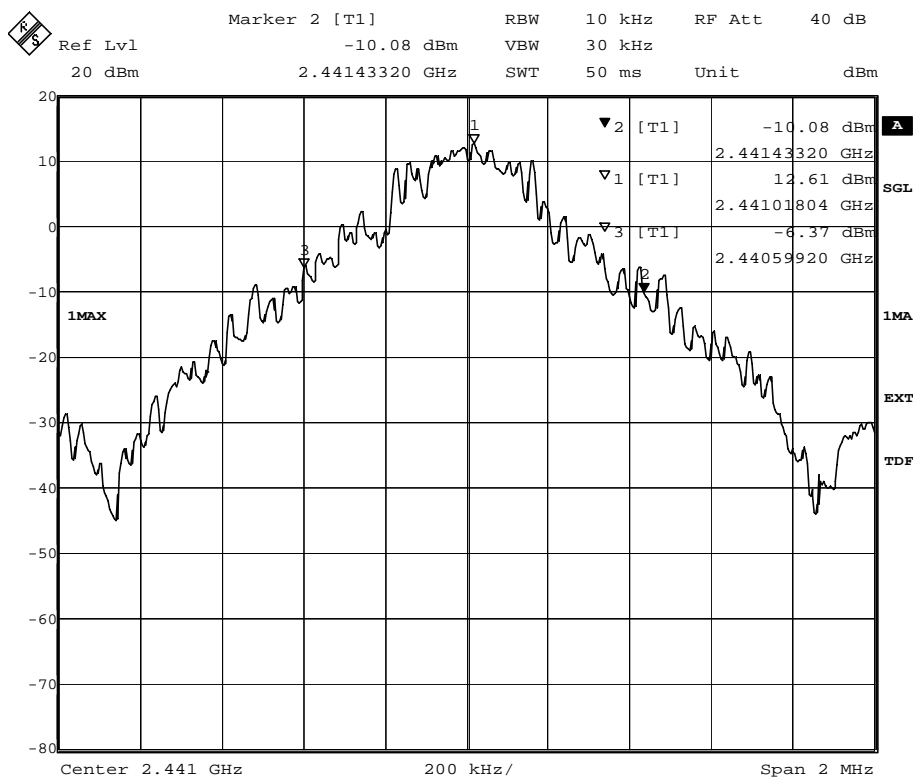
**Op. Mode**    **Setup**    **Port**  
op-mode 1    setup 1    temporary  
                                 antenna port



Title: spurious emissions  
Comment A: 2402 MHz  
Date: 9.NOV.2000 19:25:15

### Occupied Bandwidth

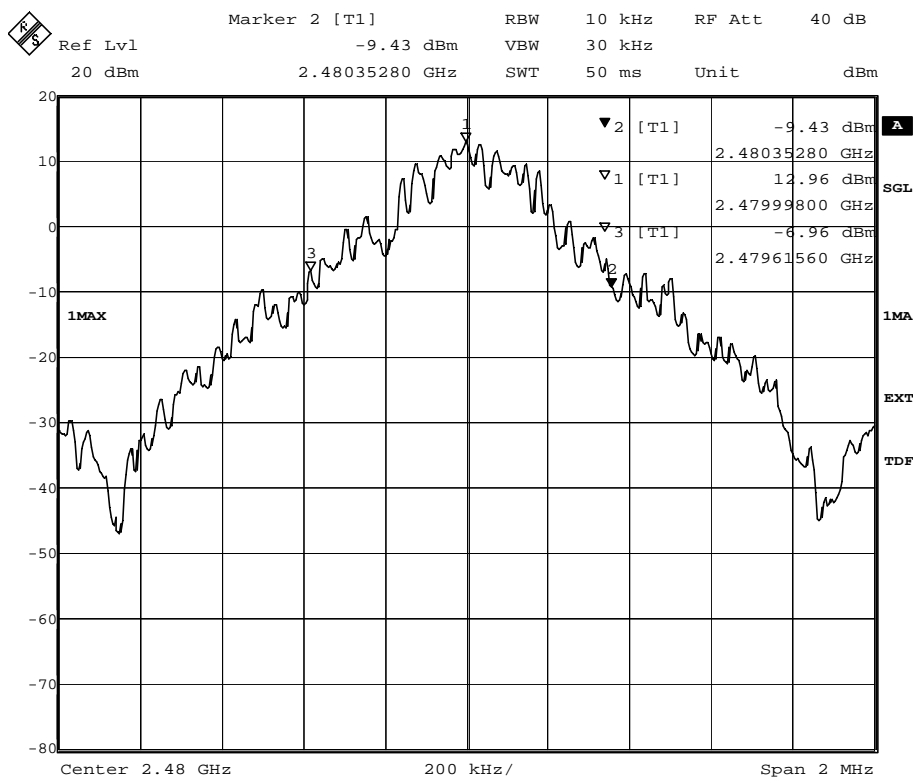
**Op. Mode**    **Setup**    **Port**  
op-mode 2    setup 1    temporary  
antenna port



Title: Peak outputpower Power  
Comment A: 2441 MHz  
Date: 10.NOV.2000 15:38:50

#### Occupied Bandwidth

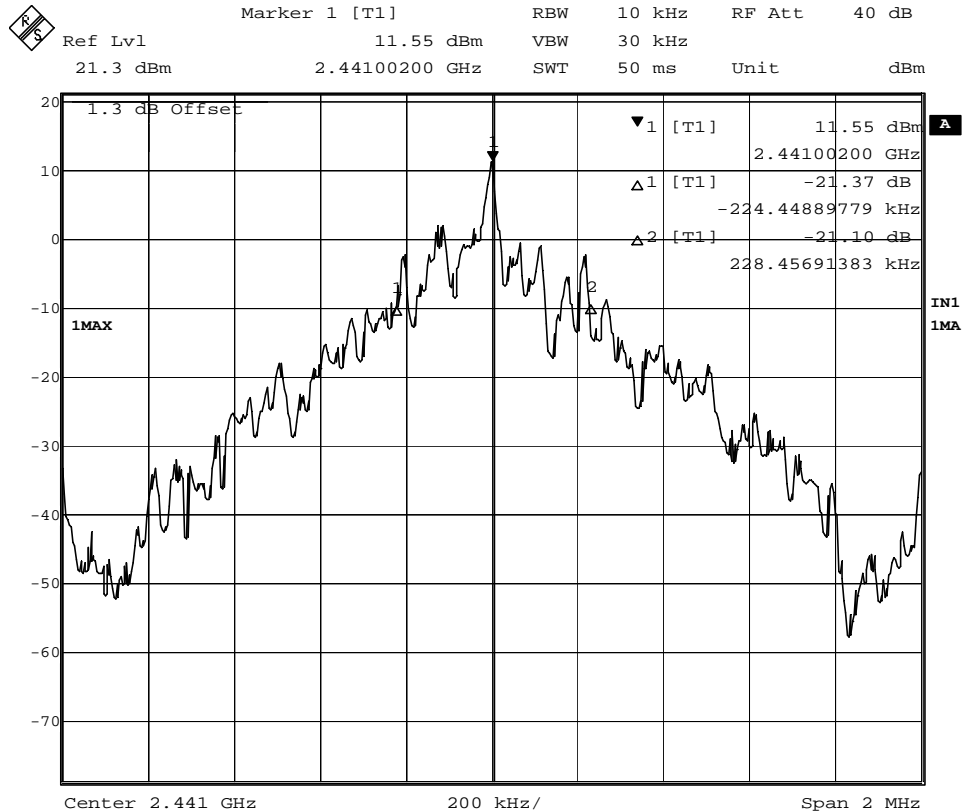
**Op. Mode**    **Setup**    **Port**  
op-mode 3    setup 1    temporary  
antenna port



Title: Peak outputpower Power  
Comment A: 2480 MHz  
Date: 10.NOV.2000 15:58:52

#### Occupied Bandwidth

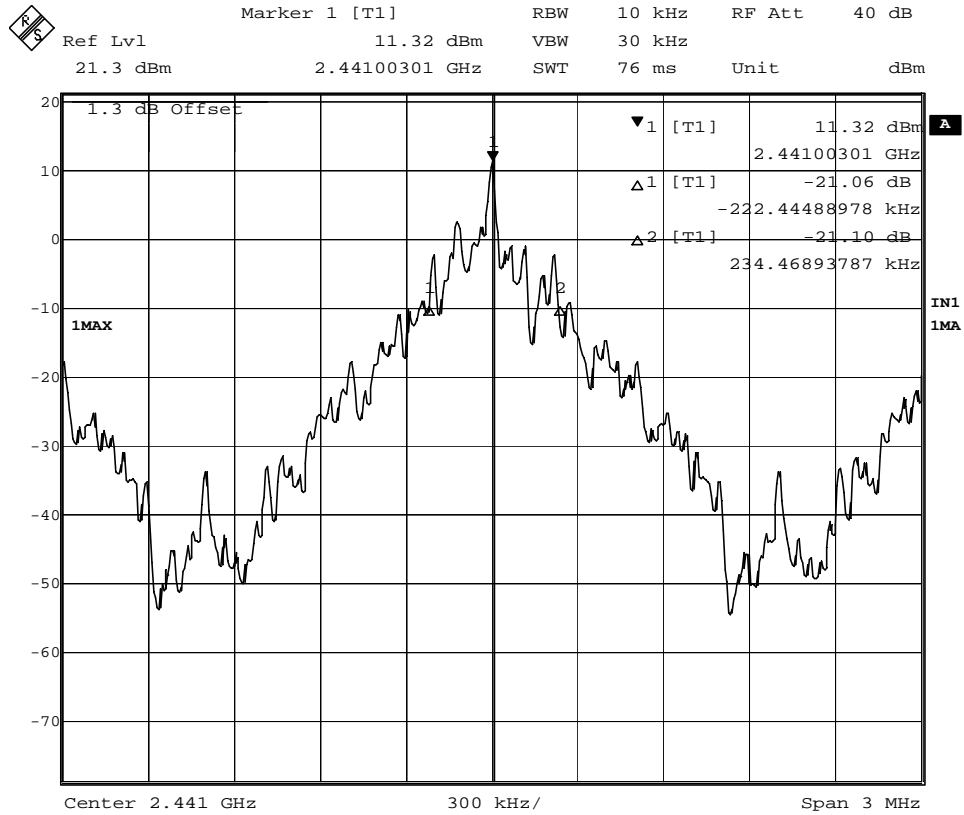
**Op. Mode**    **Setup**    **Port**  
op-mode 4    setup 1    temporary  
antenna port



Date: 10.NOV.2000 16:36:44

**Occupied Bandwidth**

**Op. Mode**    **Setup**    **Port**  
op-mode 5    setup 1    temporary  
antenna port



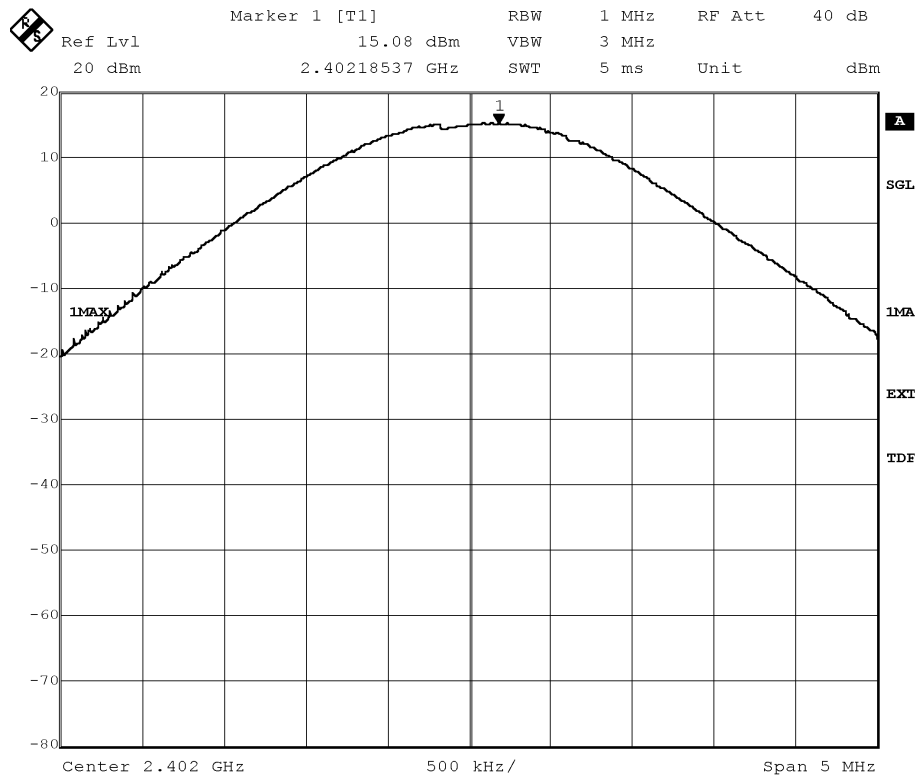
Date: 13.NOV.2000 11:10:18

**Occupied Bandwidth**



## Peak Power Output

**Op. Mode**    **Setup**    **Port**  
op-mode 1    setup 1    temporary  
                                 antenna port

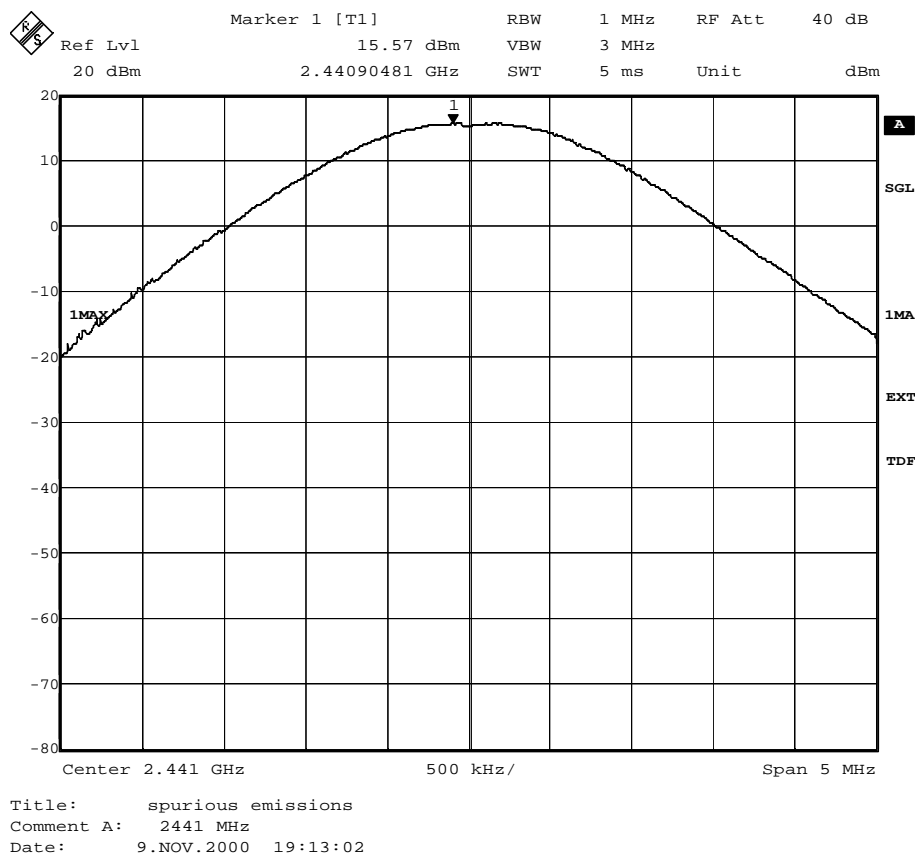


Title:    spurious emissions  
Comment A:    2402 MHz  
Date:    9.NOV.2000    19:13:56

## Peak Power Output

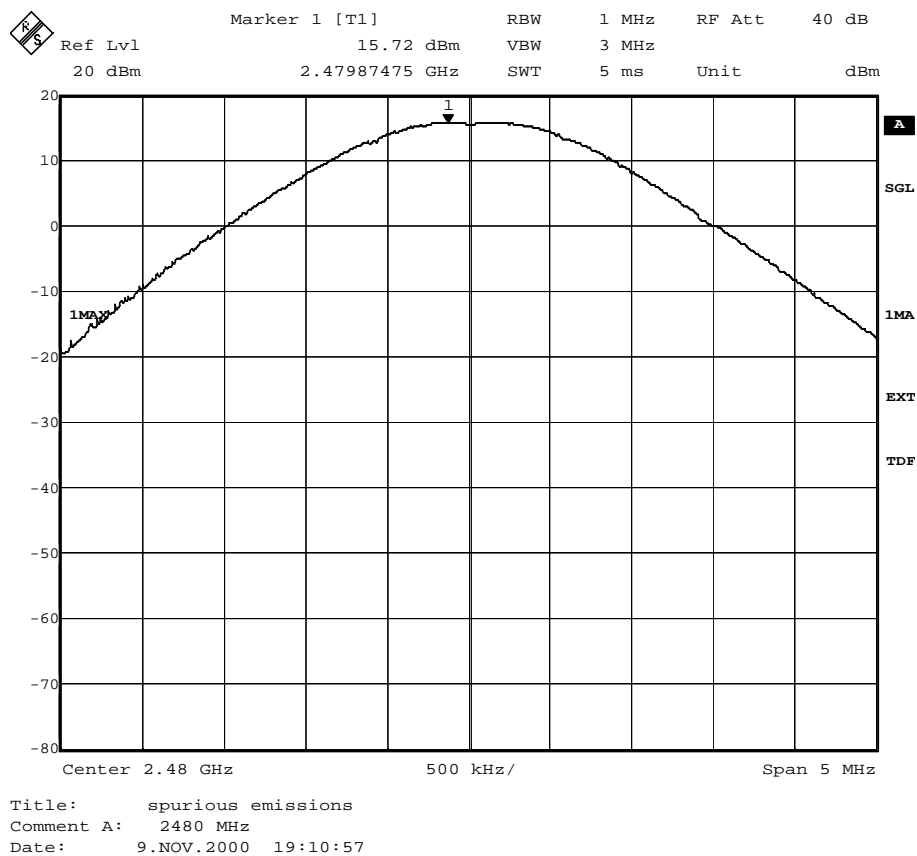


**Op. Mode**    **Setup**    **Port**  
op-mode 2    setup 1    temporary  
                         antenna port



**Peak Power Output**

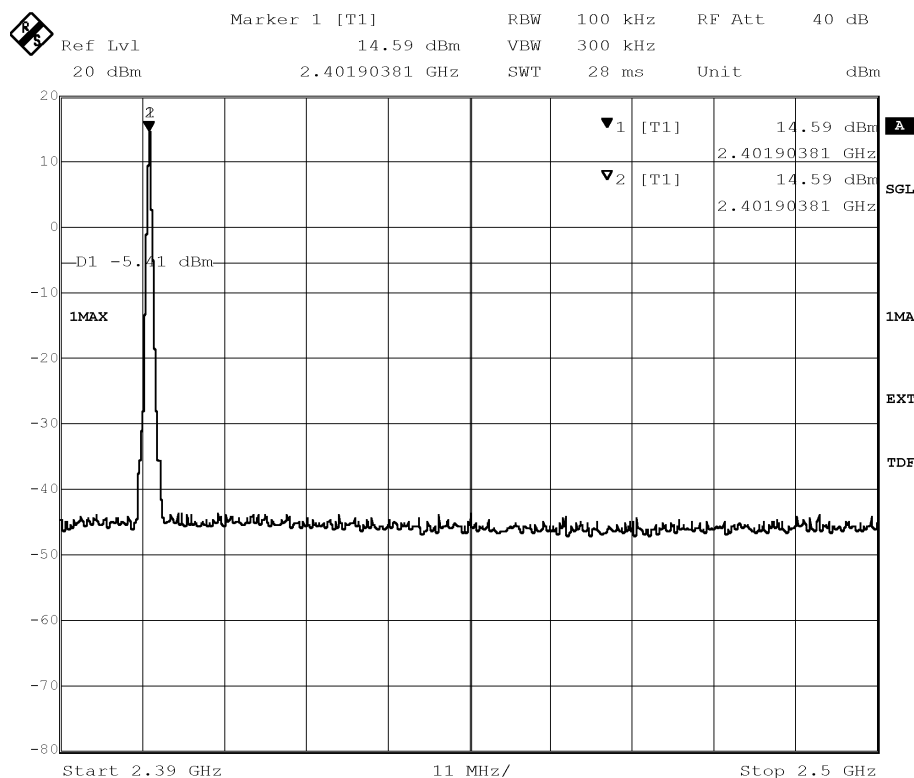
**Op. Mode**    **Setup**    **Port**  
op-mode 3    setup 1    temporary  
antenna port



### Peak Power Output

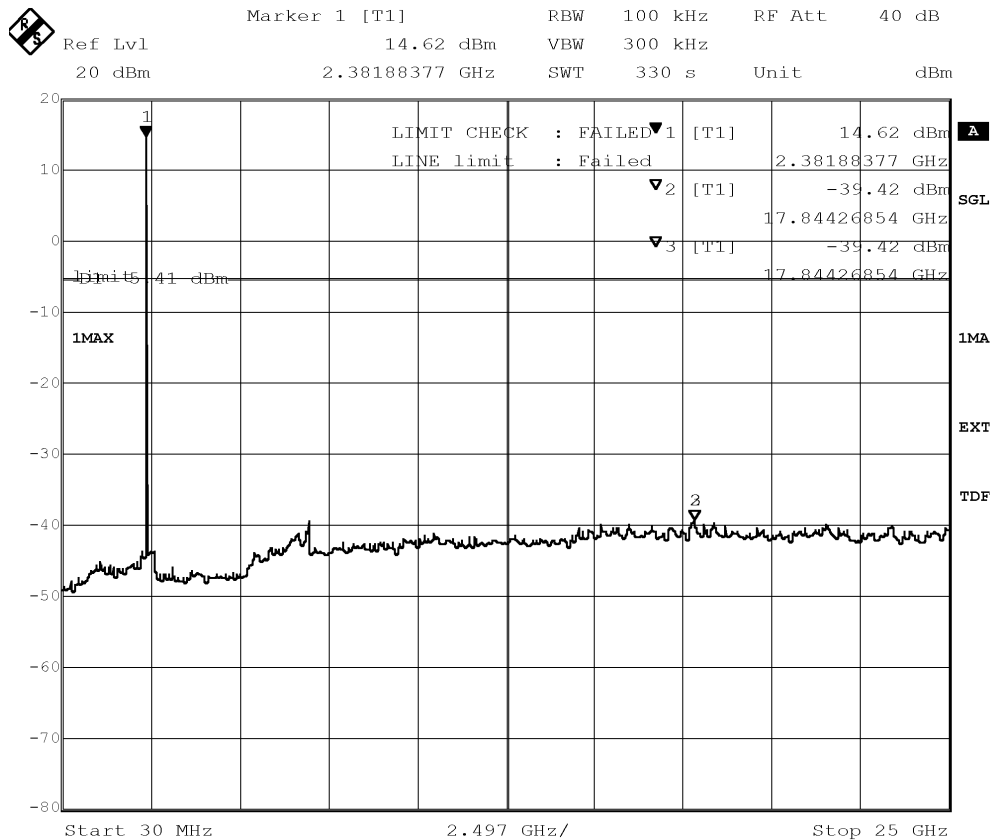
## Spurious RF Conducted Emissions

**Op. Mode**    **Setup**    **Port**  
op-mode 1    setup 1    enclosure



Title: Band Edge Compliance  
Comment A:  
Date: 9.NOV.2000 17:38:52

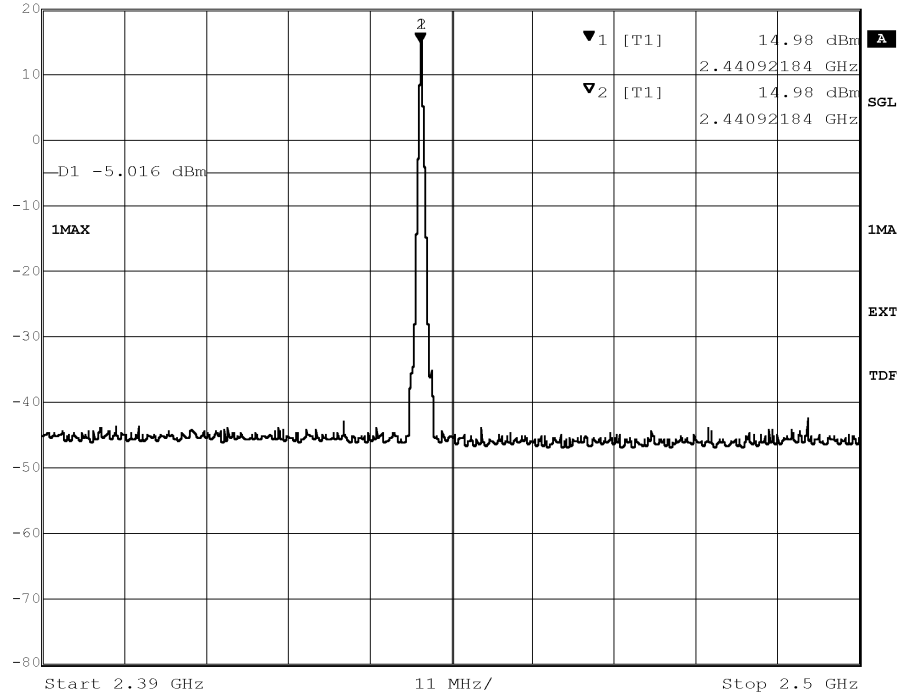
**Band edge compliance**



# Spurious RF Conducted Emissions

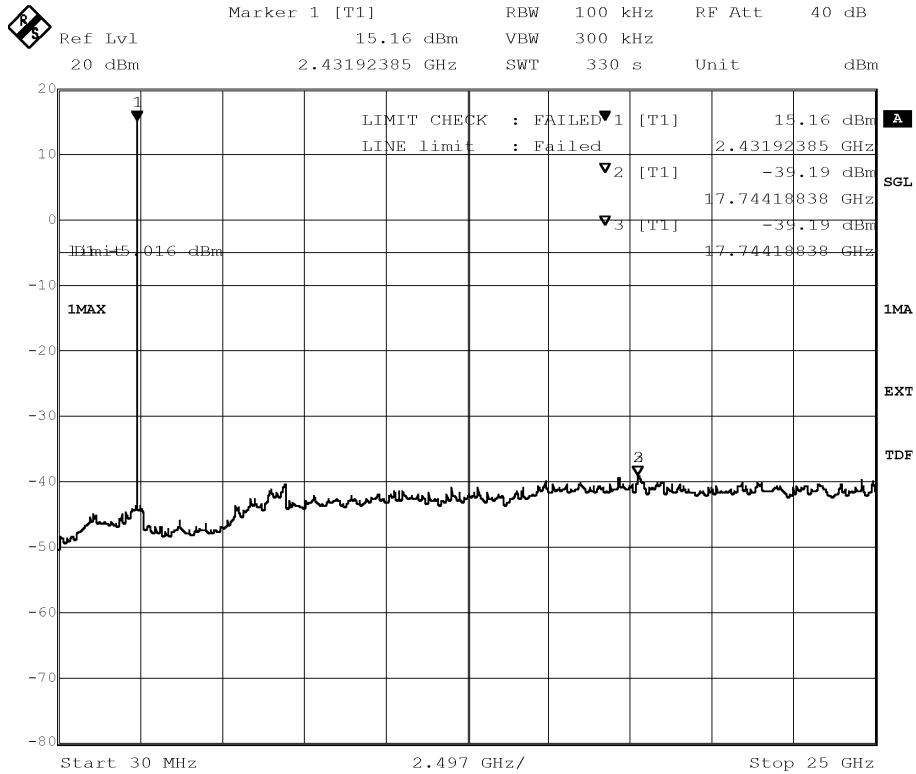
**Op. Mode**    **Setup**    **Port**  
op-mode 2    setup 1    enclosure

Marker 1 [T1]    RBW 100 kHz    RF Att 40 dB  
Ref Lvl 14.98 dBm    VBW 300 kHz  
20 dBm    2.44092184 GHz    SWT 28 ms    Unit dBm



Title: Band Edge Compliance  
Comment A:  
Date: 9.NOV.2000 17:59:31

#### Band edge compliance



Title: spurious emissions  
 Comment A:  
 Date: 9.NOV.2000 18:05:26

#### Spurious RF Conducted Emissions



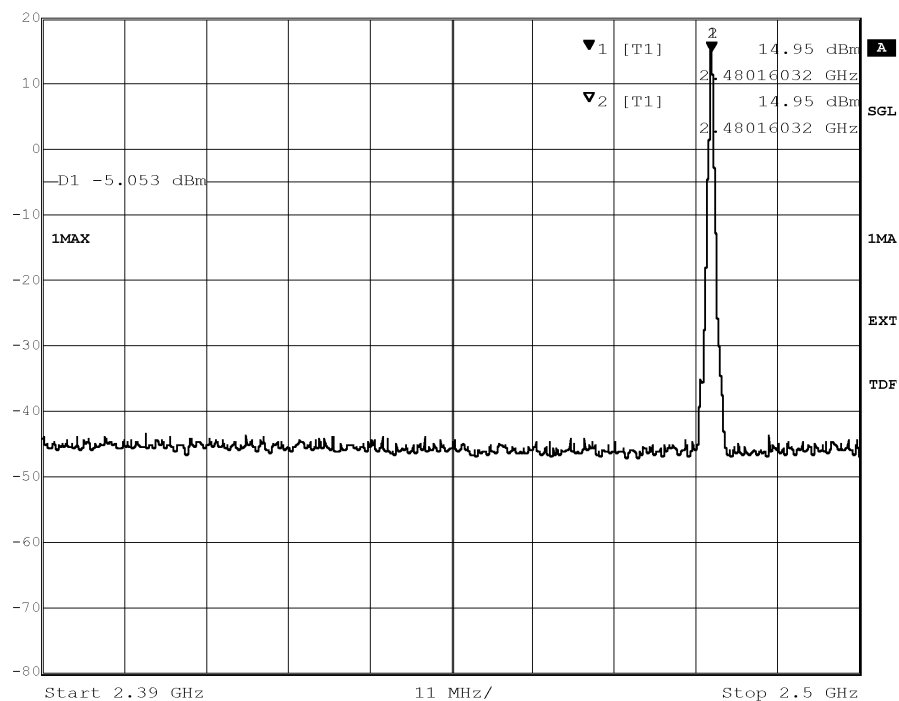
**Op. Mode**  
op-mode 3

**Setup**  
setup 1

**Port**  
enclosure

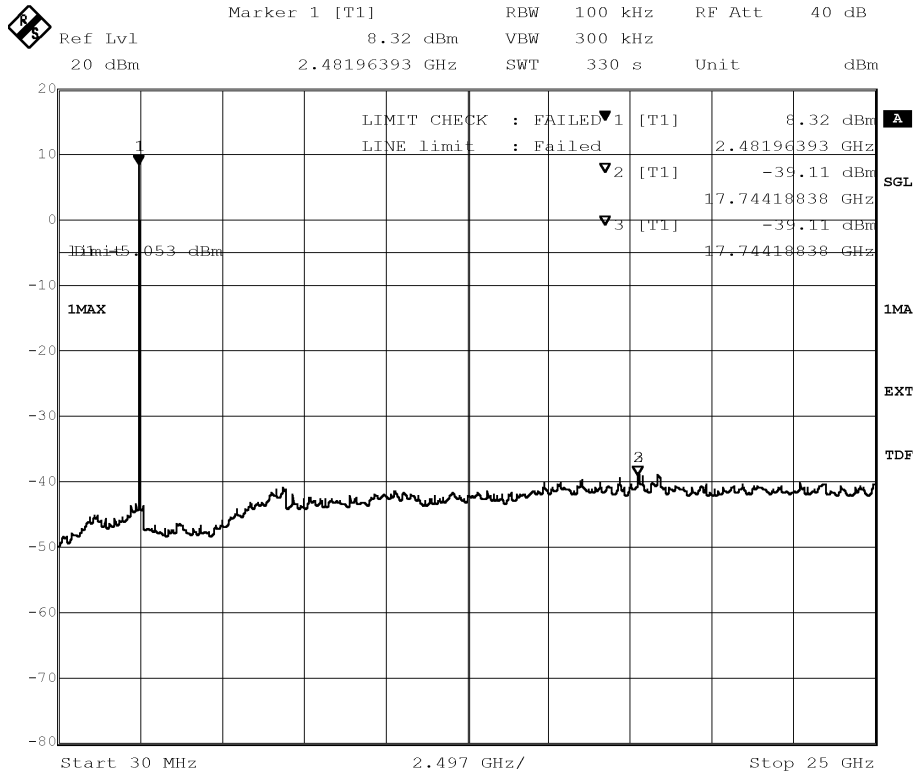


Marker 1 [T1] RBW 100 kHz RF Att 40 dB  
Ref Lvl 14.95 dBm VBW 300 kHz  
20 dBm 2.48016032 GHz SWT 28 ms Unit dBm



Title: Band Edge Compliance  
Comment A:  
Date: 9.NOV.2000 18:09:19

#### Band edge compliance

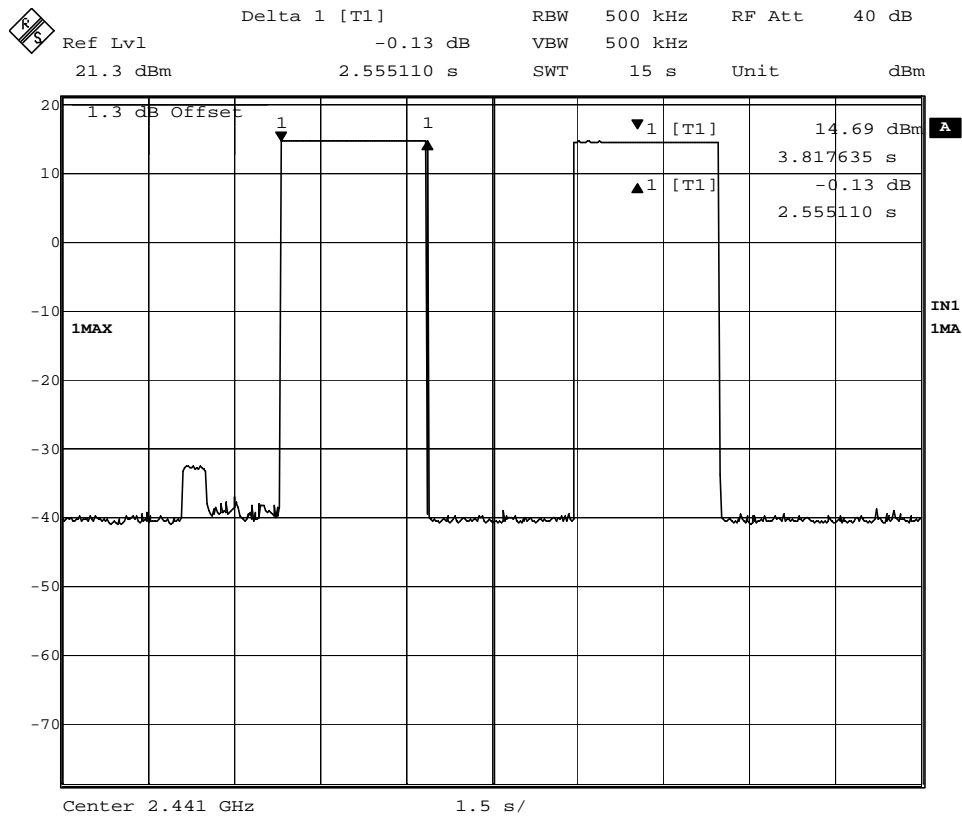


Title: spurious emissions  
 Comment A:  
 Date: 9.NOV.2000 18:15:15

#### Spurious RF Conducted Emissions

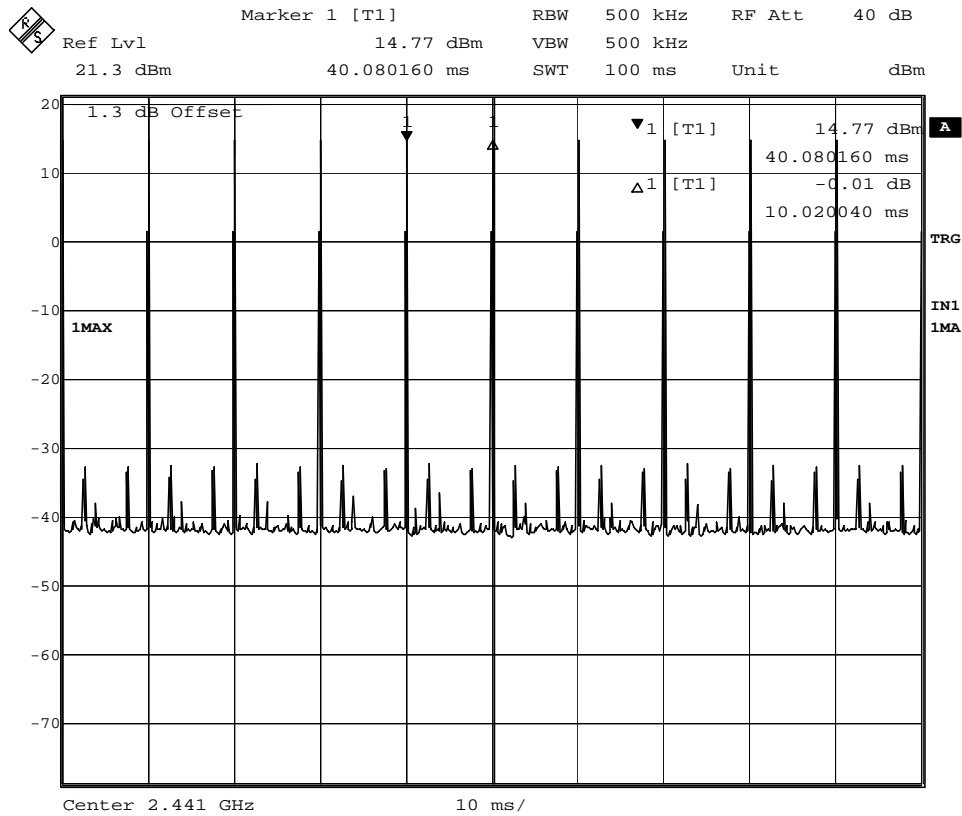
## Dwell Time

**Op. Mode**    **Setup**    **Port**  
op-mode 4    setup 1    temporary  
antenna port



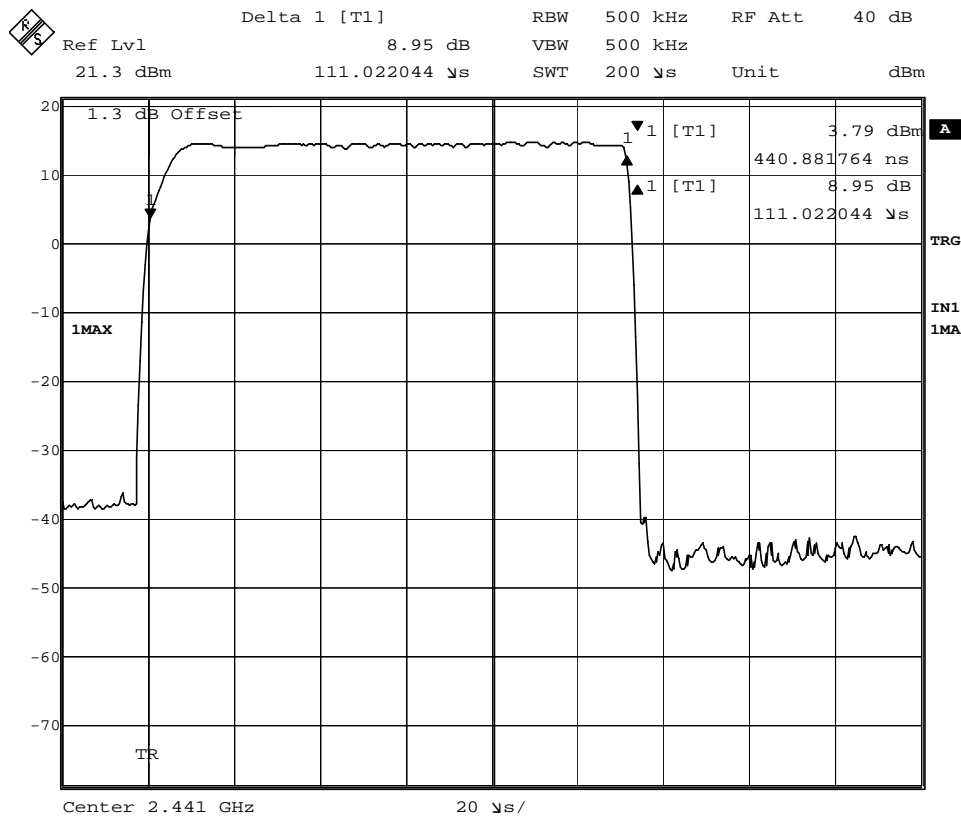
Date:    10.NOV.2000    15:36:05

**Dwell Time plot 1**



Date: 10.NOV.2000 15:38:46

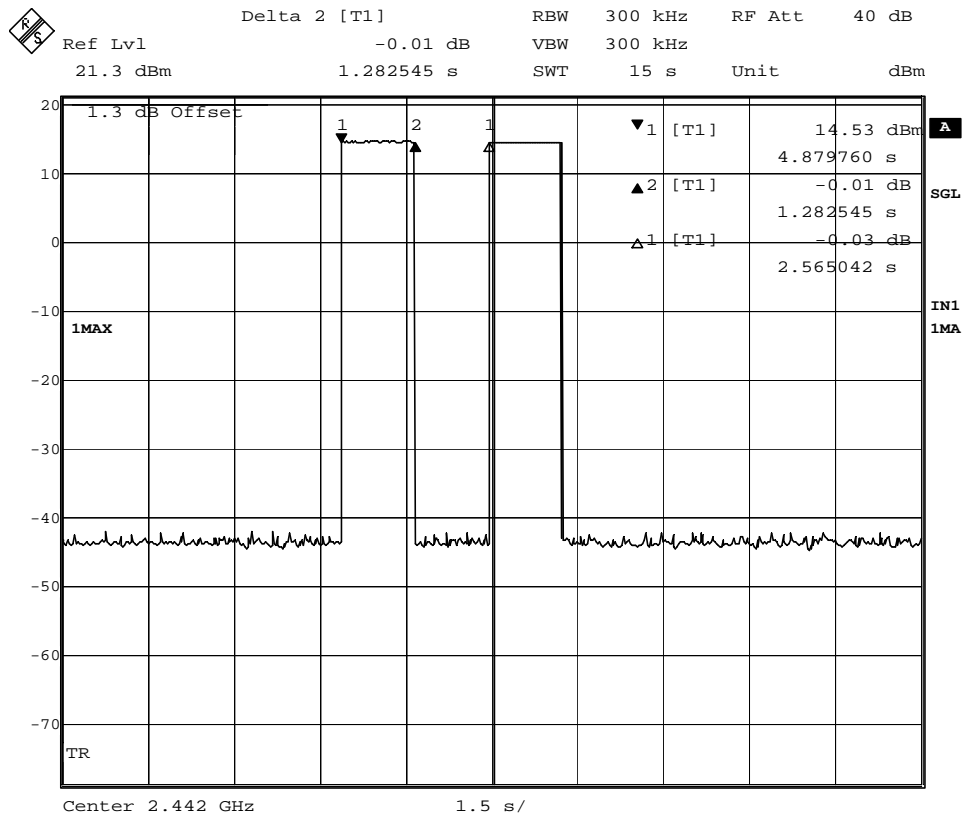
#### Dwell Time plot 2



Date: 10.NOV.2000 15:40:54

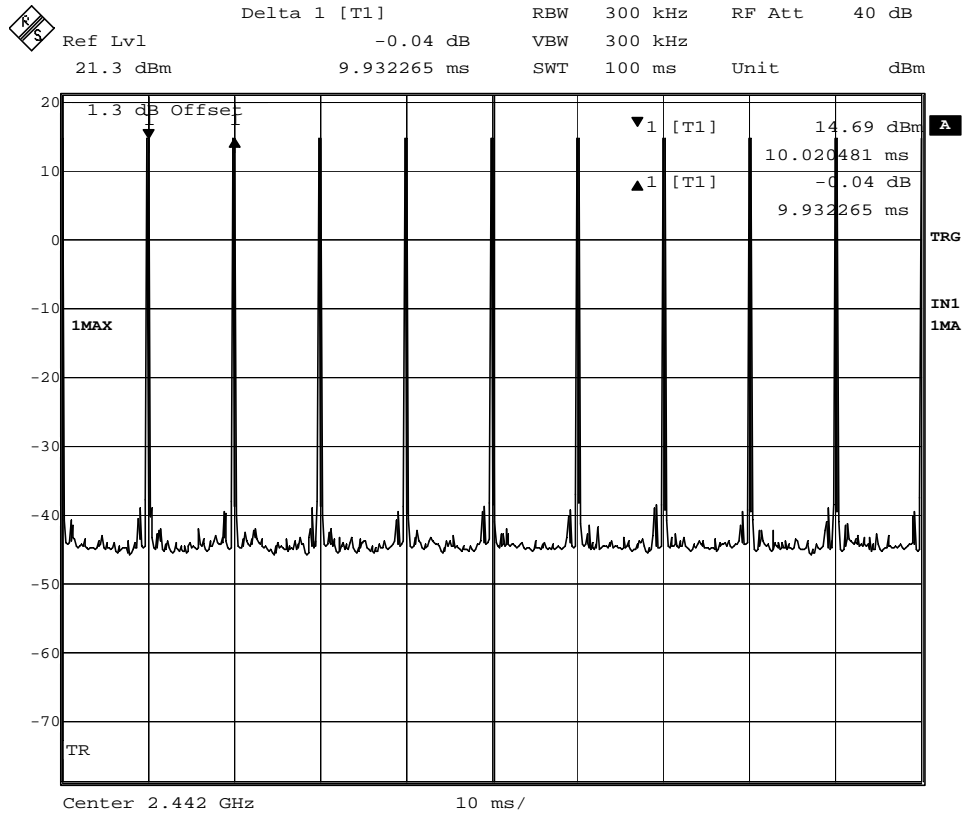
**Dwell Time plot 3**

**Op. Mode**    **Setup**    **Port**  
 op-mode 5    setup 1    temporary  
                                  antenna port



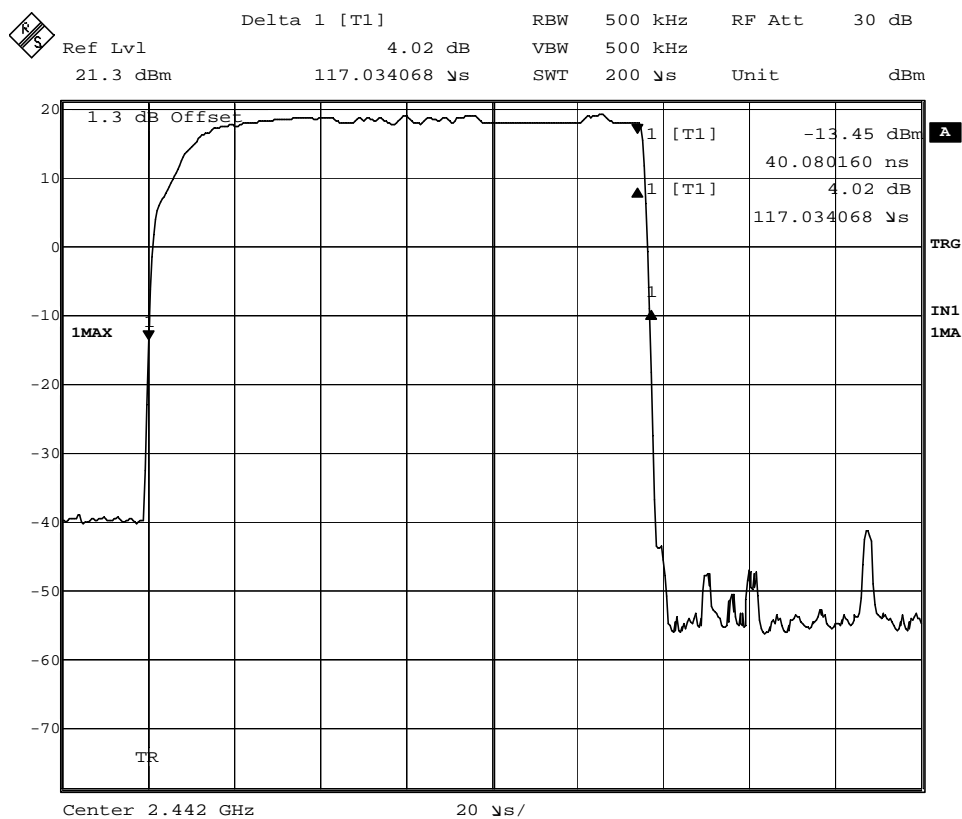
Date: 10.NOV.2000 15:49:06

**Dwell Time plot 1**



Date: 10.NOV.2000 15:46:12

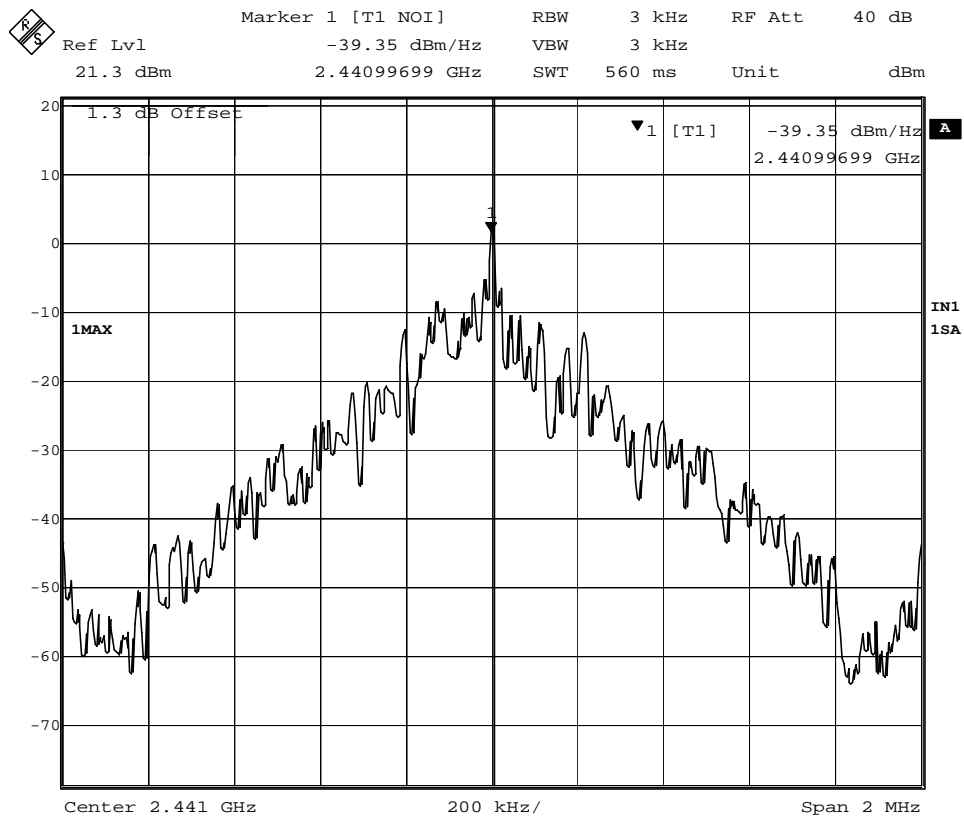
**Dwell Time plot 2**



**Dwell Time plot 3**

## Power Density

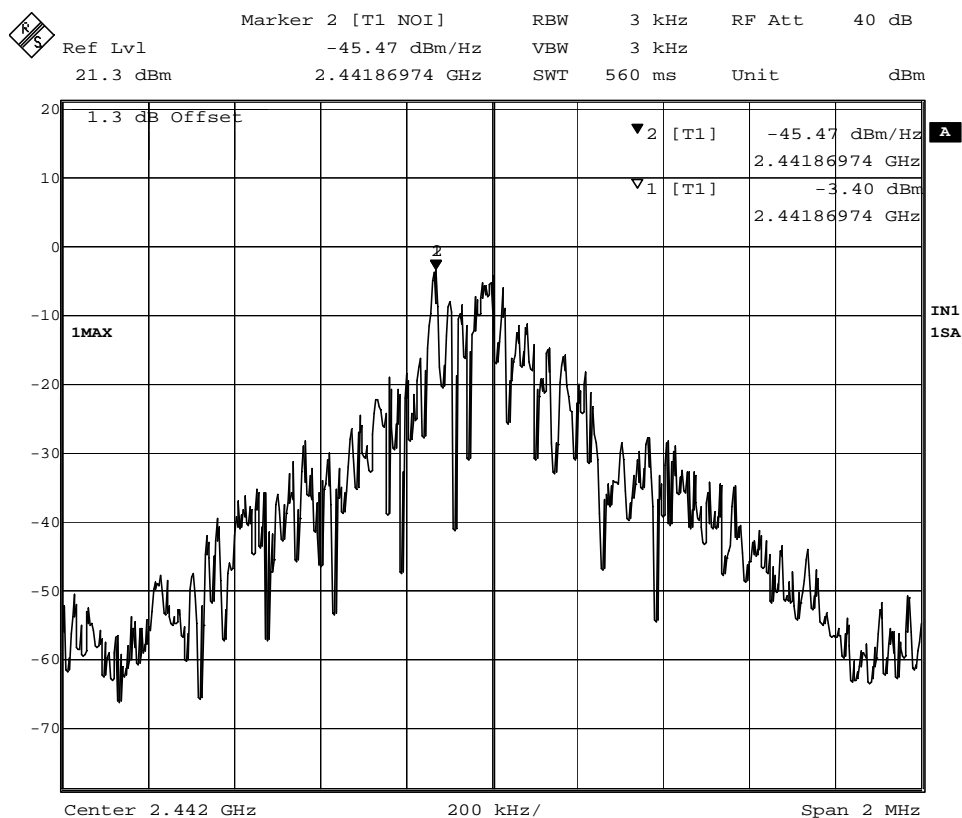
**Op. Mode**    **Setup**    **Port**  
 op-mode 4    setup 1    temporary  
                                  antenna port



Date: 10.NOV.2000 16:10:22

**Power Density**

**Op. Mode**    **Setup**    **Port**  
 op-mode 5    setup 1    temporary  
                                  antenna port



Date: 10.NOV.2000 16:20:20

**Power Density**



## EMI CONDUCTED TEST: Diagram 1.1

EUT: Protocol Analyser  
Manufacturer: Digianswer  
Operating Condition: 115V  
Test Site: 7 layers Ratingen  
Operator: Peu/Sto/Ber  
Test Specification: FCC part 15  
Comment:  
Start of Test: 07.11.00 / 16:43:28

### SCAN TABLE: "EN 55022 Voltage"

Short Description:		EN 55022 Voltage					
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer	
Frequency	Frequency	Width					
150.0 kHz	30.0 MHz	5.0 kHz	MaxPeak Average	20.0 ms	9 kHz	ESH3-Z5	

