



# EMC Measurement/Technical Report

on

## Motorola Bluetooth PCMCIA Card BTPCM101

Report Reference: 4-F0003b/00

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.

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## 0 Summary

### 0.1 Technical Report Summary

#### Type of Authorization

Certification for an Unintentional Radiator (Class B digital device)

#### 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 B - Unintentional Radiators

§ 15.101 Equipment authorization requirement

§ 15.107 Conducted Limits

§ 15.109 Radiated emission limits

#### Summary Test Results:

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



## 0.2 Measurement Summary

### **FCC Part 15, Subpart B                    § 15.107**

#### **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 1	setup 1	enclosure	passed
op-mode 3	setup 1	enclosure	passed

### **FCC Part 15, Subpart B                    § 15.109**

#### **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 2	enclosure	passed
op-mode 2	setup 2	enclosure	passed
op-mode 3	setup 2	enclosure	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 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: Marco Kullik  
Receipt of EUT: 25.04.00  
Date of Test(s): 25.04. - 12.05.00  
Date of Report: 14.08.00  
No. of Pages in Annex: 10

### 1.3 Applicant Data

Company Name: Digianswer A/S  
Address: Skalhuse 5  
  
DK-9240 Nibe  
Denmark  
Contact Person: Tom Ringtved

### 1.4 Manufacturer Data

Company Name: Eloqtec Network Corporation  
Address: Lohja Plants - Gunnarlankatu  
P.O.Box 47  
FIN-08101 Lohja  
Finland  
Contact Person: Teemu Melin

## 2.0 Product Labeling

### 2.1 FCC ID Label:

All devices authorized under the certification procedures are required to display an identification label showing the FCC identifier (FCC ID) under which they are authorized.



### 2.2 Location of Label on the EUT:

The label shall be located in a conspicuous place on the device consistent with the requirements of section 15.19 of FCC CFR 47.

For this device it will be the topside.



### 3. Testobject Data

#### 2.1 General EUT Description

**Equipment under Test:** Motorola Bluetooth PCMCIA Card  
**Type Designation:** BTPCM101  
**Kind of Device:  
(optional)**  
**Voltage Type:** DC  
**Voltage level:** 5,0 V

#### General product description:

Bluetooth is a short-range radio link intended to be a cable replacement between portable and/or fixed electronic devices.

Bluetooth operates in the unlicensed ISM Band at 2.4 GHz. In the US a band of 83.5 MHz width is available. In this band, 79 RF channels spaced 1MHz apart are defined. The channel is represented by a pseudo-random hopping sequence through the 79 channels. The channel is divided into time slots, with a nominal slot length of 625µs, where each slot corresponds to different RF hop frequencies. The nominal hop rate is 1600 hops/s. All frequencies are equally used. The average time of occupancy is 0.3797 s within a 30 second period.

The symbol rate on the channel is 1 Ms/s.

The maximum output power, including antenna gain, is 18 dBm.

#### The EUT provides the following ports:

##### Ports

AC Mains Port (via Laptop)

Antenna Port

Enclosure

**The main components of EUT are listed and described in Chapter 2.2**



## 2.2 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	Bluetooth PCMCIA Card	BTPCM101	00003A	DIG8044240	PC Card Firmware - release 1.00	25.04.00
This EUT was equipped with a temporary antenna port.						
EUT B	Bluetooth PCMCIA Card	BTPCM101	00003E	DIG8044240	PC Card Firmware - release 1.00	25.04.00

This EUT is equipped with two integral antennas. One patch antenna and one PCB antenna. The PCB antenna has a maximum gain of 2.52 dBi and the patch antenna has a maximum gain of 2.17 dBi.  
Only one antenna can be active at the same time.  
The antennas are not detachable.

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

## 2.3 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 1	Laptop	IBM 2626	-	-	55-3211P 99/09	-
AE 2	Laptop	HP Omnibook XE2	-	-	TW95004702	-

## 2.4 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 2	For all conducted measurements
setup 2	EUT B + AE 1	For all radiated measurements

## 2.5 Operating Modes

This chapter describes the operating modes of the EUT's used for testing in this test report.

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

## 4. Test Results

### 4.1 Conducted Emissions (AC Power Line)

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

**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  $50\mu\text{H} \parallel 50 \text{ Ohm}$  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.

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#### 4. 1 .2 Test Limits

FCC Part 15, Subpart B, §15.107  
Frequency Range (MHz): Class B Limit (dB $\mu$ V)  
0.45 – 30 48

Used conversion factor: Limit (dB $\mu$ V) = 20 log (Limit ( $\mu$ V)/1 $\mu$ V)

#### 4. 1 .3 Test Protocol

Temperature: 25, 5 °C

Air Pressure: 1017 hPa

Humidity: 44%

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

Remark: All QP values 20 dB below limit

Temperature: 25.4 °C

Air Pressure: 1017 hPa

Humidity: 44%

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

Remark: All QP values 20 dB below limit

#### 4.1 .3 Test result: Conducted Emissions (AC Power Line)

FCC Part 15, Subpart B	Op. Mode	Setup	Port	Result
	op-mode 1	setup 1	enclosure	<b>passed</b>
	op-mode 3	setup 1	enclosure	<b>passed</b>

## 4.2 Spurious Radiated Emissions

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

**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 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 µs
- 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 – 5m
- 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. 2 .2 Test Limits

FCC Part 15, Subpart B, §15.109

(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 (dB $\mu$ V/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 (dB $\mu$ V/m) = 20 log (Limit ( $\mu$ V/m)/1 $\mu$ V/m)

#### 4. 2 .3 Test Protocol

Temperature: 27,5 °C

Air Pressure: 1014 hPa

Humidity: 39 %

Op. Mode	Setup	Port	Test Parameter				
op-mode 1	setup 2	enclosure					
Polarisation	Frequency MHz	Corrected Value dB $\mu$ V/m			Limit QP/AV dB $\mu$ V/m	Limit Peak dB $\mu$ V/m	Delta to AV/QP Limit/dB
		QP	Peak	AV	46,00	74,00	0,80
Horizontal	608,00	45,20			46,00		0,80
Vertical	1146,50		43,70	35,20	54,00	74,00	18,80
Horizontal	1201,00		45,00	40,40	54,00	74,00	13,60
Horizontal	3870,50		53,00	44,50	54,00	74,00	9,50
Horizontal	4804,00		56,00	47,90	54,00	74,00	6,10
Remark: No other Spurious Emission found above noise level							



Temperature: 28,5 °C

Air Pressure: 1014 hPa

Humidity: 39 %

Op. Mode	Setup	Port	Test Parameter					
op-mode 2	setup 2	enclosure						
Polarisation	Frequency MHz	Corrected Value dB $\mu$ V/m			Limit QP/AV dB $\mu$ V/m	Limit Peak dB $\mu$ V/m	Delta to AV/QP Limit/dB	Delta to Peak Limit dB
		QP	Peak	AV				
Horizontal	204,00	38,00			46,00		8,00	
Horizontal	608,00	44,80			46,00		1,20	
Horizontal	1240,00		50,50	48,60	54,00	74,00	5,40	23,50
Horizontal	3270,00		53,50	49,20	54,00	74,00	4,80	20,50
Horizontal	3870,00		51,90	43,00	54,00	74,00	11,00	22,10

Remark: No other Spurious Emission found above noise level

Temperature: 28,5 °C

Air Pressure: 1014 hPa

Humidity: 39 %

Op. Mode	Setup	Port	Test Parameter					
op-mode 3	setup 2	enclosure						
Polarisation	Frequency MHz	Corrected Value dB $\mu$ V/m			Limit QP/AV dB $\mu$ V/m	Limit Peak dB $\mu$ V/m	Delta to AV/QP Limit/dB	Delta to Peak Limit dB
		QP	Peak	AV				
Horizontal	608,00	44,60			46,00		1,40	
Horizontal	1220,00		52,90	40,40	54,00	74,00	13,60	21,10
Vertical	3660,00		53,30	42,90	54,00	74,00	11,10	20,70
Horizontal	3870,00		53,00	44,90	54,00	74,00	9,10	21,00
Horizontal	4880,00		52,70	46,20	54,00	74,00	7,80	21,30
Horizontal	7320,00		50,10	42,70	54,00	74,00	11,30	23,90

Remark: No other Spurious Emission found above noise level

#### 4.2 .3 Test result: Spurious Radiated Emissions

FCC Part 15, Subpart B	Op. Mode	Setup	Port	Result
	op-mode 1	setup 2	enclosure	passed
	op-mode 2	setup 2	enclosure	passed
	op-mode 3	setup 2	enclosure	passed

## 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	4HC1600/12750-1.	9942011	Trilithic	02.11.2000
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz	16.06.2001
Cable "ESI to Horn Antenna"	RTK 081	W18.04+3599/001	Rosenberger	14.09.2000
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz	18.05.2001
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz	18.05.2001
Broadband Amplifier 45MHz-27GHz	JS4-00102600-42-5	619368	Miteq	
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz	04.10.2001
High Pass Filter	5HC2700/12750-1.	9942012	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	14.09.2000
Biconical dipole	VUBA 9117	9117108	Schwarzbeck	03.06.2001

### *EMI Conducted Auxiliary Equipment*

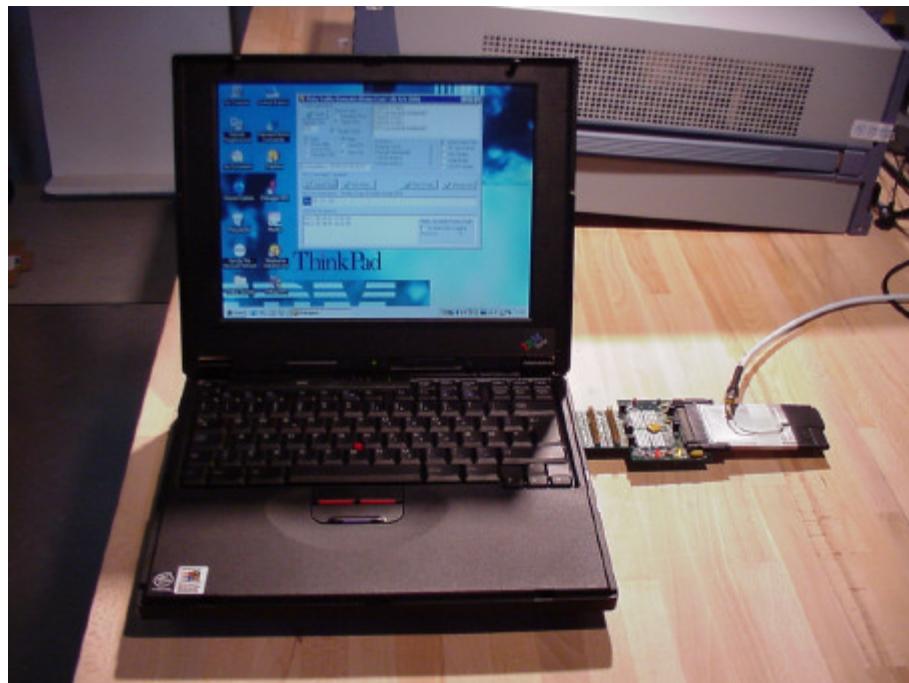
Equipment	Type	Serial No.	Manufacturer	Cal due
Two-Line V-Network	ESH 3-Z5	829996/002	Rohde & Schwarz	22.06.2001
Cable "LISN to ESI"	RG214	W18.03+W48.03	Huber+Suhner	14.09.2000
Two-Line V-Network	ESH 3-Z5	828304/029	Rohde & Schwarz	22.06.2001



## *Auxiliary Test Equipment*

<b>Equipment</b>	<b>Type</b>	<b>Serial No.</b>	<b>Manufacturer</b>	<b>Cal due</b>
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	
Notch Filter ultra stable	WRCA800/960-6EE	24	Wainwright	
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 : Conducted Test set-up**



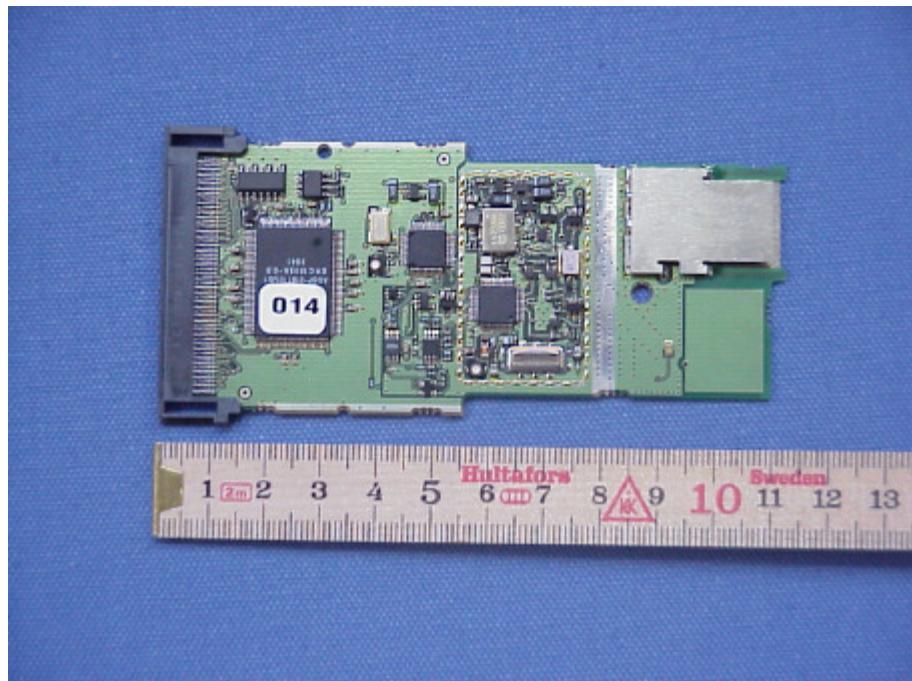
**Picture 2 : RF Radiated Test set-up**



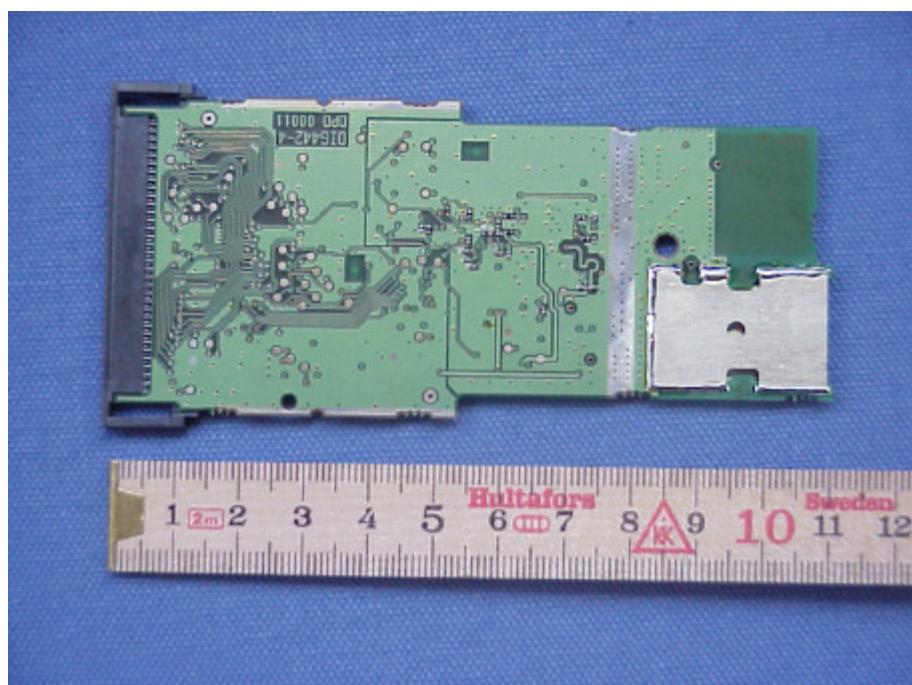
**Picture 3 : RF Radiated Test set-up (Detail view)**



**Picture 4 : PCMCIA Card Frontside**

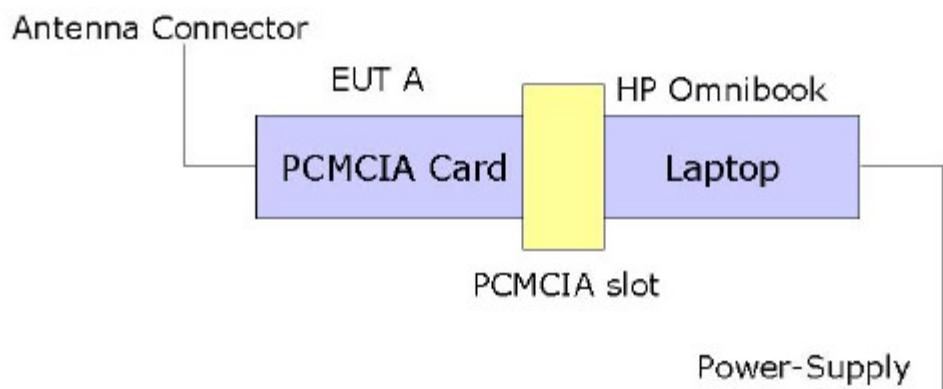


**Picture 5 : PCMCIA Card Enclosure removed (PCB Frontside)**

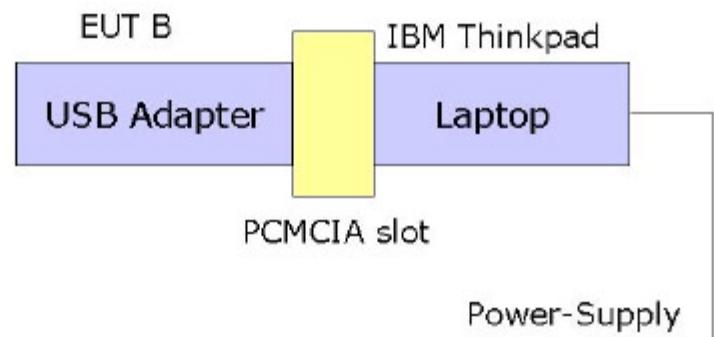


**Picture 6 : PCMCIA Card Enclosure removed (PCB Rearside)**

## 7. Setup Drawings



**Drawing 1 : Setup 1 (Conducted Measurements)**



**Drawing 2 : Setup 2 (Radiated Measurements)**