EMC Measurement/Technical Report

on

Motorola Bluetooth™ Development Kit BTDVK100

Report Reference: 4_DIGI_0502_ERF_FCCb

7 Layers AG
Borsigstr. 11
40880 Ratingen
Germany

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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 equipment under test fulfilled the requirements of the applied FCC rules.

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

OP Mode	Setup	Port	Final Result
op-mode 1	setup 1	AC port	passed

FCC Part 15, Subpart B §15.31, §15.109

Spurious Radiated Emissions

The measurement was performed according to ANSI C63.4 1992

OP Mode	Setup	Port	Final Result
op-mode 1	setup 1	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

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

1.2 Project Data

Responsible for Test Report:	Dipl. Ing. Thomas Hoell
Receipt of EUT:	11.06.2002
Date of Test(s):	25.06.-26.06.2002
Date of Report:	26.06.2002

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:	please see Applicant data
Address:	

Contact Person:

2.0 Product Labeling

2.1 FCC ID Label:

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

2.2 Location of Label on the EUT:

see above

3. Testobject Data

3.1 General EUT Description

Equipment under Test:	Motorola Bluetooth™ Development Kit
Type Designation:	BTDVK100
Kind of Device: (optional)	Bluetooth transceiver
Voltage Type:	DC
Voltage level:	5 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 devided 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 EUT provides the following ports:

Ports
AC port
Enclosure

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	Bluetooth Development Kit	BTDVK100	EUT code 34070a01	80000488000_R06	2.0	11.06.2002

EUT A is equipped with an internal antenna.

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 Tes	Type Designation	HW Status	SW Status	Serial No.	FCC Id
AE 5	Mouse	M-S34	-	-	F13490N5BH00D90	DZL211029
AE 4	Monitor	Samsung Sync Master 700p plus	-	-	SE17H3MK305316L	CSE7839
AE 3	Printer	HP Desk Jet 670C	-	-	ES7641B070	-
AE 2	Laptop	IBM 2626	-	-	55-3858H 99/10	-
AE 1	power supply	Sceptre PS-5024APL05	-	-	-	-

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 + AE 2 + AE 3 + AE 4 + AE 5	

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	Transmitter in standby mode, Receiver active	

4. Test Results

4. 1 Conducted Emissions (AC Power Line)

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

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 50µH || 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.
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4. 1 .2 Test Limits

FCC Part 15, Subpart B, §15.107

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: 28 °C
Air Pressure: 1020 hPa
Humidity: 32 %

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

Powerline	Frequency MHz	Measured Value dBµV	Delta to Limit dBµV	Remarks
L1	0,45	28,00	20,00	
L1	0,67	30,00	18,00	

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

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

FCC Part 15, Subpart I	Op. Mode	Setup	Port	Result
	op-mode 1	setup 1	AC port	**passed**

4. 2 Spurious Radiated Emissions

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

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 – 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 modfications 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, 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. 2 .3 Test Protocol

Temperature: 26 °C
Air Pressure: 1015 hPa
Humidity: 36 %

Op. Mode	Setup	Port	Test Parameter
op-mode 1	setup 1	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				
Vertical	48,00	36,30			40,00		3,70	
Vertical	63,90	32,60			40,00		7,40	
Horizontal	198,36	34,40			43,50		9,10	
Horizontal	199,68	34,80			43,50		8,70	
Horizontal	863,10	35,00			46,00		11,00	

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

4. 2 .4 Test result: Spurious Radiated Emissions

FCC Part 15, Subpart I	Op. Mode	Setup	Port	Result
	op-mode 1	setup 1	enclosure	**passed**

5. Testequipment

EUT Digital Signalling System

Equipment	Type	Serial No.	Manufacturer	Cal due
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz	17.06.02

EMI Test System

Equipment	Type	Serial No.	Manufacturer	Cal due
Signal Generator	SMR 20	846834/008	Rohde & Schwarz	26.07.02
EMI Analyzer	ESI 26	830482/004	Rohde & Schwarz	27.09.03
Comparison Noise Emitter	CNE III	99/016	York	

EMI Radiated Auxiliary Equipment

Equipment	Type	Serial No.	Manufacturer	Cal due
Cable "ESI to Horn Antenna"	RTK 081	W18.04+3599/001	Rosenberger	25.07.02
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz	16.06.02
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz	04.10.02
Biconical dipole	VUBA 9117	9117108	Schwarzbeck	03.07.02
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz	18.07.02
Cable "ESI to EMI Antenna"	RTK081+Aircell7	W18.01+W38.01a	Huber+Suhner	25.07.02
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz	18.07.02

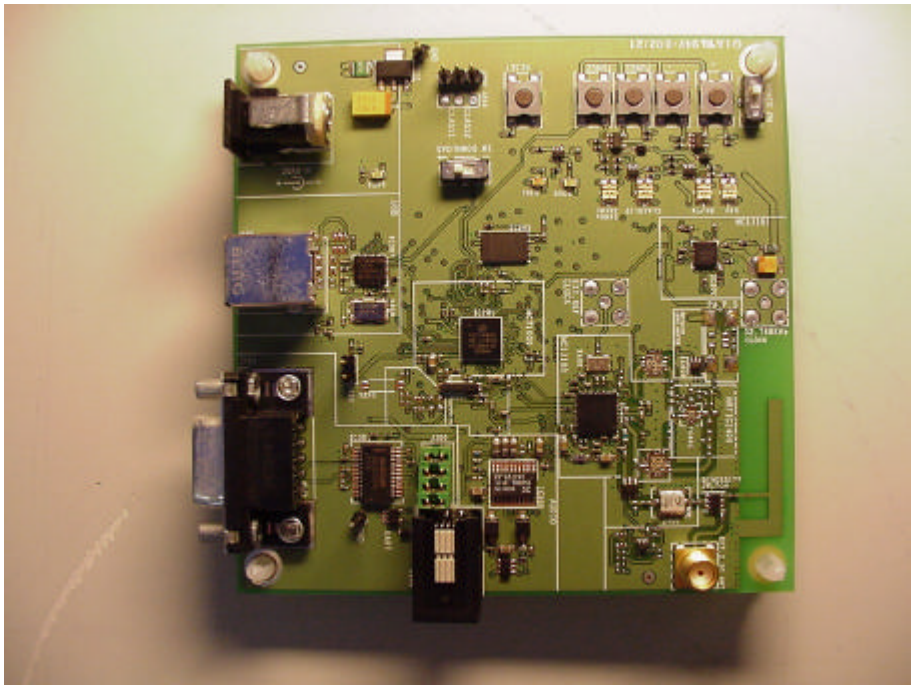
EMI Conducted Auxiliary Equipment

Equipment	Type	Serial No.	Manufacturer	Cal due
Two-Line V-Network	ESH 3-Z5	829996/002	Rohde & Schwarz	22.06.02

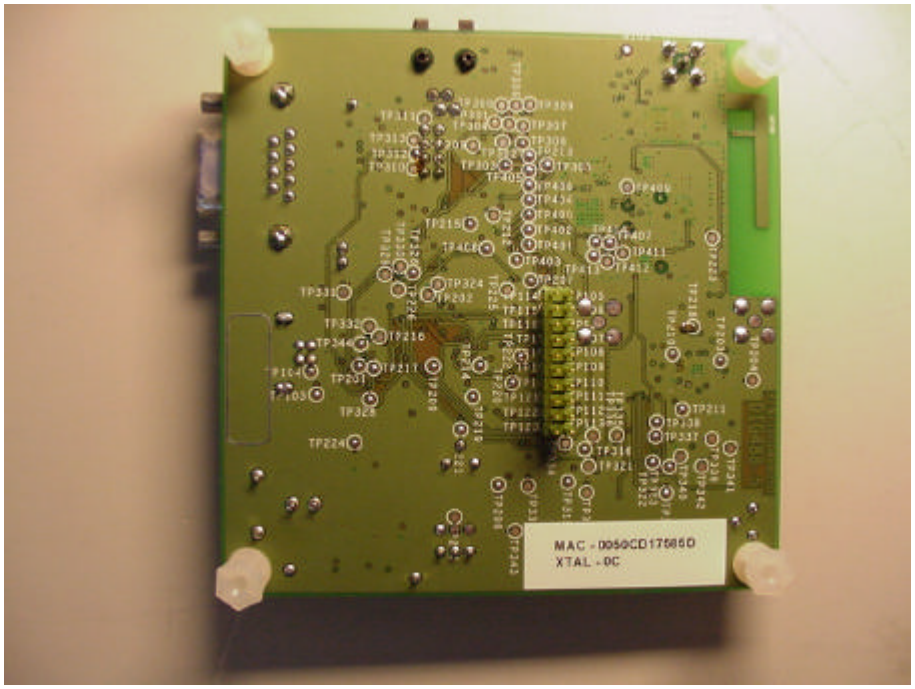
Auxiliary Test Equipment

Equipment	Type	Serial No.	Manufacturer	Cal due
Broadband Resist. Power Divider SMA	1515 / 93459	LN673	Weinschel	
Digital Multimeter 02	Voltcraft M-3860M	IJ095955	Conrad	18.07.02
Digital Multimeter 01	Voltcraft M-3860M	IJ096055	Conrad	18.07.02
Digital Oscilloscope	TDS 784C	B021311	Tektronix	26.07.02
Fibre optic link Satellite	FO RS232 Link	181-018	Pontis	
Notch Filter ultra stable	WRCA800/960-6EE	24	Wainwright	03.02.03
Broadband Resist. Power Divider N	1506A / 93459	LM390	Weinschel	
I/Q Modulation Generator	AMIQ-B1	832085/018	Rohde & Schwarz	27.10.02
Temperature Chamber	VT 4002	58566002150010	Vötsch	
Temperature Chamber	S-1.2C-B	393/25-1389-27RF	Thermotron	
ThermoHygro_01	430202		Fischer	15.12.02
Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz	09.11.02
Temperature Chamber	KWP 120/70	59226012190010	Weiss	
Fibre optic link Transceiver	FO RS232 Link	182-018	Pontis	

6. Foto Report

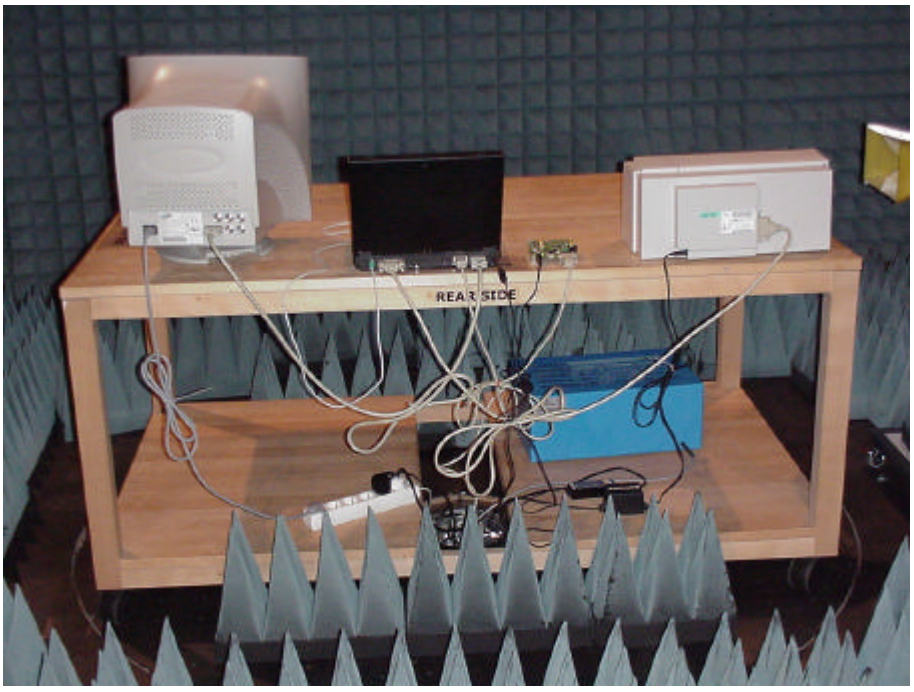


Picture 1 : Top side of the EUT



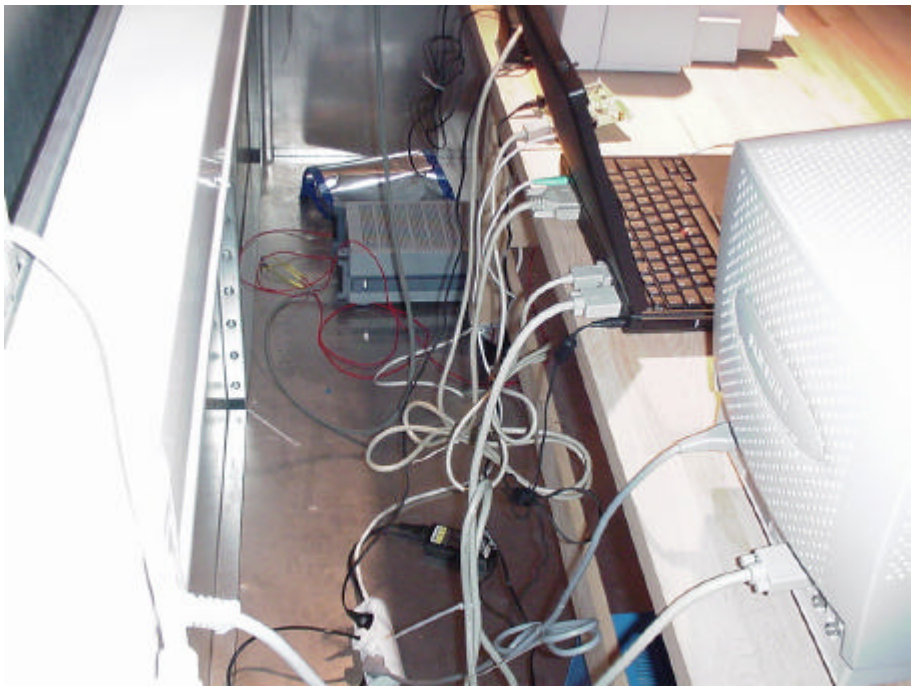
Picture 2 : Bottom side of the EUT

Picture 3 : Setup for radiated emission measurements above 1 GHz



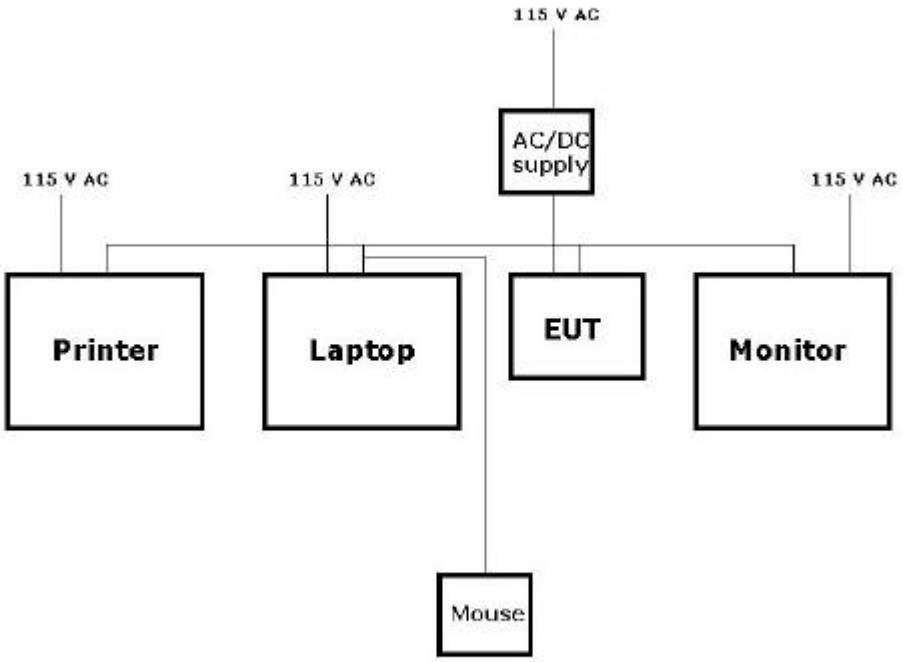
Picture 4 : Setup for radiated emission measurements above 1 GHz (rear side)

Picture 5 : Setup for conducted emission test on the AC mains



Picture 6 : Setup for conducted emission test on the AC mains (rear side)

7. Setup Drawings



Drawing 1 : General test setup