EMC Measurement/Technical Report

on

Bluetooth Protocol Analyser
DGABTPA101

Report Reference: 4_Digi_0300_BT_FCC_f

7 Layers AG
Borsigstr. 11
40880 Ratingen
Germany

Table of Contents

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

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 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 2	setup 2	AC mains of connected lap	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 2	setup 3	enclosure pcb antenna	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:	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

Equipment under Test:	Bluetooth Protocol Analyser
Type Designation:	DGABTPA101
Kind of Device: (optional)	Bluetooth device
Voltage Type:	DC
Voltage level:	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	-	-	SE17H3MK305294J	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, 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 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 B	Op. Mode	Setup	Port	Result
	op-mode 2	setup 2	AC mains of connected laptop	**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 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. 2 .3 Test Protocol

Temperature: 20%
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

4.2 .4 Test result: Spurious Radiated Emissions

FCC Part 15, Subpart B	Op. Mode	Setup	Port	Result
	op-mode 2	setup 3	enclosure pcb antenna	**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	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

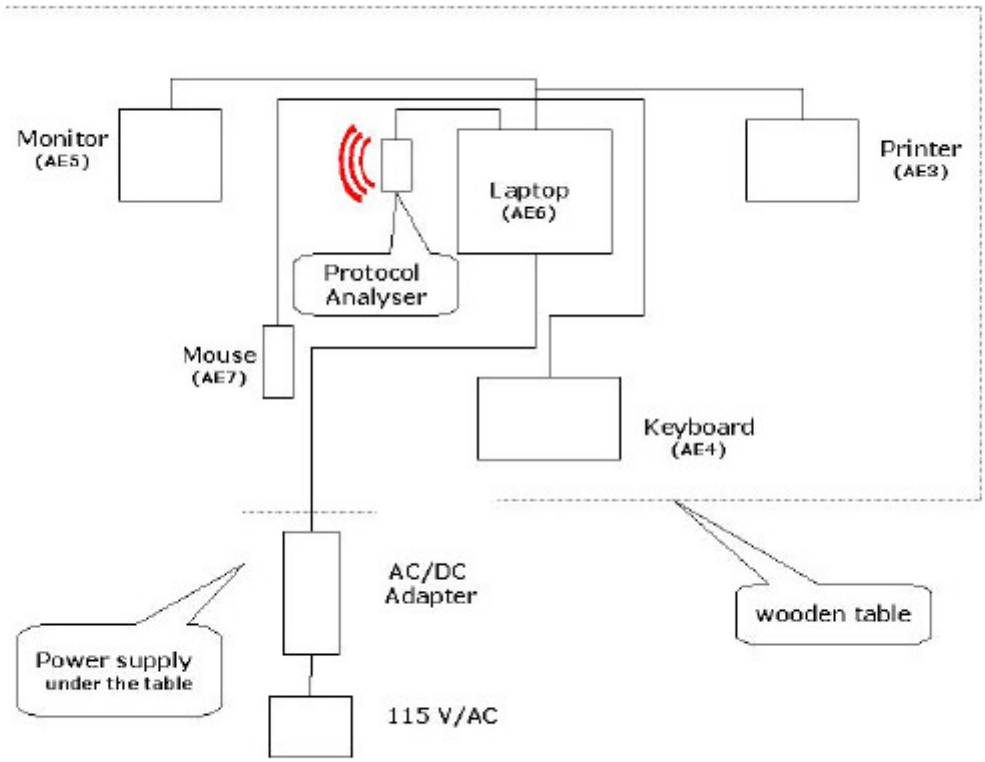
Equipment	Type	Serial No.	Manufacturer	Cal due
Notch Filter ultra stable	WRCA800/960-6EE	24	Wainwright	03.02.2003
Digital Multimeter 02	Voltcraft M-3860M	IJ095955	Conrad	03.06.2001
Digital Multimeter 01	Voltcraft M-3860M	IJ096055	Conrad	03.06.2001
Digital Oscilloscope	TDS 784C	B021311	Tektronix	26.05.2001
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 : Test set-up for conducted emissions on AC power line

Picture 2 : Test set-up for radiated emissions

7. Setup Drawings



Drawing 1 : Test setup for radiated tests

8. Annex

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 Frequency	Stop Frequency	Step Width	Detector	Meas. Time	IF Bandw.	Transducer
150.0 kHz	30.0 MHz	5.0 kHz	MaxPeak Average	20.0 ms	9 kHz	ESH3-Z5