



Inter**Lab**<sup>®</sup>

# FCC Measurement/Technical Report on Bluetooth Transceiver Module BTCoMB

**Report Reference:** MDE\_Siem\_0617\_FCCb

**Test Laboratory:**

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**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 Intentional Radiator (Periodic operation in the band above 70 MHz)

#### **Applicable FCC Rules**

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 (10-1-06 Edition) and 15 (10-1-06 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 15, Subpart A – General

§ 15.33 Frequency range of radiated measurements

Part 15, Subpart B – Unintentional Radiators

§ 15.101 Equipment authorization of unintentional radiators

§ 15.107 Conducted limits

§ 15.109 Radiated emission limits

Note:  
none

#### **Summary Test Results:**

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

## 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

2003

**OP-Mode**

**Setup**

**Port**

**Final Result**

op-mode 1

Setup\_a01

AC Port (power line)

passed

### FCC Part 15, Subpart B

### § 15.109

Spurious Radiated Emissions

The measurement was performed according to ANSI C63.4

2003

**OP-Mode**

**Setup**

**Port**

**Final Result**

op-mode 2

Setup\_a02

enclosure

passed



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Responsible for  
Accreditation Scope:

B. Petha

Responsible  
for Test Report:

A. Peth



## 1 Administrative Data

### 1.1 Testing Laboratory

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

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

The test facility is also accredited by the following accreditation organisation:  
- Deutscher Akkreditierungs Rat DAR-Registration no. DAT-P-192/99-01

Responsible for Accreditation Scope: Dipl.-Ing. Bernhard Retka  
Dipl.-Ing. Robert Machulec  
Dipl.-Ing. Thomas Hoell

Report Template Version: 2006-12-18

### 1.2 Project Data

Responsible for testing and report: Dipl.-Ing. Andreas Petz  
Date of Test(s): 2007-05-25 to 2007-06-04  
Date of Report: 2007-06-06

### 1.3 Applicant Data

Company Name: Siemens AG  
Address: Siemensallee 84  
76187 Karlsruhe  
Germany  
Contact Person: Markus Rödle

### 1.4 Manufacturer Data

Company Name: please see applicant data

Address:

Contact Person:



## **2 Product labeling**

### **2.1 FCC ID label**

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

### **2.2 Location of the label on the EUT**

see above



### 3 Test object Data

#### 3.1 General EUT Description

<b>Equipment under Test</b>	Bluetooth Transceiver Module
<b>Type Designation:</b>	BTCoMB
<b>Kind of Device:</b>	Module
<b>(optional)</b>	
<b>Voltage Type:</b>	AC / DC
<b>Voltage level:</b>	115 V / 3.3 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, the Bluetooth technology defines 79 RF channels spaced 1 MHz (2402 - 2480 MHz). The actual RF channel is chosen from a pseudo-random hopping sequence through the 79 channels.

#### The EUT provides the following ports:

##### Ports

AC Port (power line)  
enclosure

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



### 3.2 EUT Main components

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

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status	Date of Receipt
EUT A (Code: 01120e01) Remark: none	Bluetooth Transceiver Module	BTCoMB	-	1.0	1.0	2007-05-07

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

### 3.3 Ancillary Equipment

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

Short Description	Equipment under Test	Type Designation	HW Status	SW Status	Serial no.	FCC ID
AE1	Printer	Epson Stylus C84	-	-	FBPT048906	-
AE2	Monitor	LG Flatron L1740BQ	-	-	509WANF1 W607	BEJL17NU
AE3	Keyboard	Logitech UltraX Media Y-BL49A	-	-	867618-0102	-
AE4	Mouse	Logitech M-BB48	-	-	LZC90505478	-
AE5	Laptop	IBM 9461-54G	-	-	L3-AA47106/10	-
AE6	AC Adapter	Lenovo	-	-	11S92P1103 Z1ZBEF716 1JH REV 05	-
AE7	external antenna (built-in into TFT frame)	IMS Connector Systems F117180	2.1	-	A5E00875506	-

### 3.4 EUT Setups

This chapter describes the combination of EUTs and ancillary equipment used for testing.

Setup No.	Combination of EUT's	Description
Setup_a01	EUT A +AE2+AE3+AE4 +AE5+AE6+AE7	for conducted tests
Setup_a02	EUT A +AE1+AE2+AE4 +AE5+AE6+AE7	for radiated tests





### 3.5 Operating Modes

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

<b>Op. Mode</b>	<b>Description of Operating Modes</b>	<b>Remarks</b>
op-mode 1	BT TX on 2402 MHz, loopback mode, powered by laptop via USB	BT test mode
op-mode 2	BT off, powered by laptop via USB	BT scan mode



## 4 Test Results

### 4.1 Conducted emissions (AC power line)

**Standard** FCC Part 15, 10-1-06  
Subpart B

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

#### 4.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4-2003. The Equipment Under Test (EUT) was setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was powered from 50 $\mu$ 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 the EMI test software ES-K1 from R&S.

##### **Step 1: Preliminary scan**

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

EMI receiver settings:

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

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

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

##### **Step 2: Final measurement**

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

EMI receiver settings:

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

#### 4.1.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.107

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

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

#### 4.1.3 Test Protocol

Temperature: 27 °C  
 Air Pressure: 1020 hPa  
 Humidity: 42 %

Op. Mode	Setup	Port
op-mode 1	Setup_a01	AC Port (power line)

Power line	Frequency MHz	Measured value dBµV	Delta to limit dBµV	Remarks
N	0.395	43.90	14.1	QP
L1	11.870	40.30	9.7	AV
L1	11.970	40.20	9.8	AV
N	12.065	41.30	8.7	AV
N	14.030	40.40	9.6	AV
L1	14.425	41.30	8.7	AV
N	14.525	42.00	8.0	AV
N	14.620	42.70	7.3	AV
N	14.720	42.80	7.2	AV
L1	14.820	40.90	9.1	AV
N	15.410	40.70	9.3	AV

Remark: Please see annex for the measurement plot.

#### 4.1.4 Test result: Conducted emissions (AC power line)

FCC Part 15, Subpart B	Op. Mode	Result
	op-mode 1	passed

## 4.2 Spurious radiated emissions

**Standard** FCC Part 15, 10-1-06  
Subpart B

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

### 4.2.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4-2003. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m in the semi-anechoic chamber. The test was performed at the distance of 3 m between the EUT and the receiving antenna.

The radiated emissions measurements were made in a typical installation configuration. The measurement procedure is implemented into the EMI test software ES-K1 from R&S.

#### Measurement between 30 MHz and 1 GHz

##### 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 step size:  $90$ °
- Height variation range: 1 – 3m
- Height variation step size: 2m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

##### Step 2: second measurement

For the relevant emissions 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.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100ms
- Turntable angle range:  $-180$  to  $180$  °
- Turntable step size:  $45$ °
- Height variation range: 1 – 4m
- Height variation step size: 0.5m
- Polarisation: horizontal + vertical

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

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

The last two values have now the following accuracy:

- Azimuth value (of turntable):  $45$ °
- Antenna height: 0.5m

##### Step 3: final measurement



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.

- 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:** final measurement with QP detector

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

#### 4.2.2 Test Requirements / 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



### 4.2.3 Test Protocol

Temperature: 26 °C  
 Air Pressure: 1008 hPa  
 Humidity: 48 %

Op. Mode	Setup	Port
op-mode 2	Setup_a02	Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
Vertical	30.12	34.60			40.0			5.4	
Vertical	32.64	32.30			40.0			7.7	
Vertical	33.66	33.00			40.0			7.0	
Vertical	38.28	32.50			40.0			7.5	
Vertical	39.36	31.10			40.0			8.9	
Vertical	45.48	33.00			40.0			7.0	
Vertical	50.76	31.80			40.0			8.2	
Horizontal	60.06	39.10			40.0			0.9	
Horizontal	62.64	34.20			40.0			5.8	
Horizontal	165.96	32.90			43.5			10.6	

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

### 4.2.4 Test result: Spurious radiated emissions

FCC Part 15, Subpart B	Op. Mode	Result
	op-mode 2	passed

## 5 Test Equipment

### *EUT Digital Signalling System*

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

### *EMI Test System*

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

### *EMI Radiated Auxiliary Equipment*

<b>Equipment</b>	<b>Type</b>	<b>Serial No.</b>	<b>Manufacturer</b>
Antenna mast 4m	MA 240	240/492	HD GmbH H. Deisel
Biconical dipole	VUBA 9117	9117108	Schwarzbeck
Broadband Amplifier 18MHz-26GHz	JS4-18002600-32	849785	Miteq
Broadband Amplifier 30MHz-18GHz	JS4-00101800-35	896037	Miteq
Broadband Amplifier 45MHz-27GHz	JS4-00102600-42	619368	Miteq
Cable "ESI to EMI Antenna"	EcoFlex10	W18.01-2 + W38.01-2	Kabel Kusch
Cable "ESI to Horn Antenna"	UFB311A + UFB293C	W18.02-2 + W38.02-2	Rosenberger-Microcoax
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz
High Pass Filter	5HC3500/12750-1.2-KK	200035008	Trilithic
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic
KUEP pre amplifier	Kuep 00304000	001	7layers
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz
Pyramidal Horn Antenna 26.5 GHz	Model 3160-09	9910-1184	EMCO

### EMI Conducted Auxiliary Equipment

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

### Auxiliary Test Equipment

Equipment	Type	Serial No.	Manufacturer
Broadband Resist. Power Divider N	1506A / 93459	LM390	Weinschel
Broadband Resist. Power Divider SMA	1515 / 93459	LN673	Weinschel
Digital Multimeter 01	Voltcraft M-3860M	IJ096055	Conrad
Digital Multimeter 02	Voltcraft M-3860M	IJ095955	Conrad
Digital Oscilloscope	TDS 784C	B021311	Tektronix
Fibre optic link Satellite	FO RS232 Link	181-018	Pontis
Fibre optic link Transceiver	FO RS232 Link	182-018	Pontis
I/Q Modulation Generator	AMIQ-B1	832085/018	Rohde & Schwarz
Notch Filter ultra stable	WRCA800/960-6E	24	Wainwright
Spectrum Analyzer 9 kHz to 3 GHz	FSP3	838164/004	Rohde & Schwarz
Temperature Chamber	VT 4002	58566002150010	Vötsch
Temperature Chamber	KWP 120/70	59226012190010	Weiss
ThermoHygro Datalogger 03	Opus10 THI (8152.00)	7482	Lufft Mess- und Regeltechnik GmbH

### Anechoic Chamber

Equipment	Type	Serial No.	Manufacturer
Air Compressor (pneumatic)			Atlas Copco
Controller	CO 2000	CO2000/328/12470406 /L	Innco innovative constructions GmbH
EMC Camera	CE-CAM/1		CE-SYS
EMC Camera for observation of EUT	CCD-400E	0005033	Mitsubishi
Filter ISDN	B84312-C110-E1		Siemens&Matsushita
Filter telephone systems / modem	B84312-C40-B1		Siemens&Matsushita
Filter Universal 1A	B84312-C30-H3		Siemens&Matsushita
Fully/Semi AE Chamber	10.58x6.38x6		Frankonia
Turntable	DS 420S	420/573/99	HD GmbH, H. Deisel
Valve Control Unit (pneum.)	VE 615P	615/348/99	HD GmbH, H. Deisel





*7 layers Bluetooth Full RF Test Solution*

*Bluetooth RF Conformance Test System TS8960*

<b>Equipment</b>	<b>Type</b>	<b>Serial No.</b>	<b>Manufacturer</b>
10 MHz Reference	MFS	5489/001	Efratom
Power Meter 832025/059	NRVD	832025/059	Rohde & Schwarz
Power Sensor A 832279/013	NRV-Z1	832279/013	Rohde & Schwarz
Power Sensor B 832279/015	NRV-Z1	832279/015	Rohde & Schwarz
Power Supply	E3632A	MY40003776	Agilent
Power Supply	PS-2403D	-	Conrad
RF Step Attenuator 833695/001	RSP	833695/001	Rohde & Schwarz
Rubidium Frequency Normal	MFS	002	Efratom
Signal Analyzer FS1Q26 832695/007	FS1Q26	832695/007	Rohde & Schwarz
Signal Generator 833680/003	SMP 03	833680/003	Rohde & Schwarz
Signal Generator A 834344/002	SMIQ03B	834344/002	Rohde & Schwarz
Signal Generator B 832870/017	SMIQ03B	832870/017	Rohde & Schwarz
Signal Switching and Conditioning Unit	SSCU	338826/005	Rohde & Schwarz
Signalling Unit PTW60 838312/014	PTW60 for TS8960	838312/014	Rohde & Schwarz
System Controller 829323/008	PSM12	829323/008	Rohde & Schwarz

## 6 Photo Report

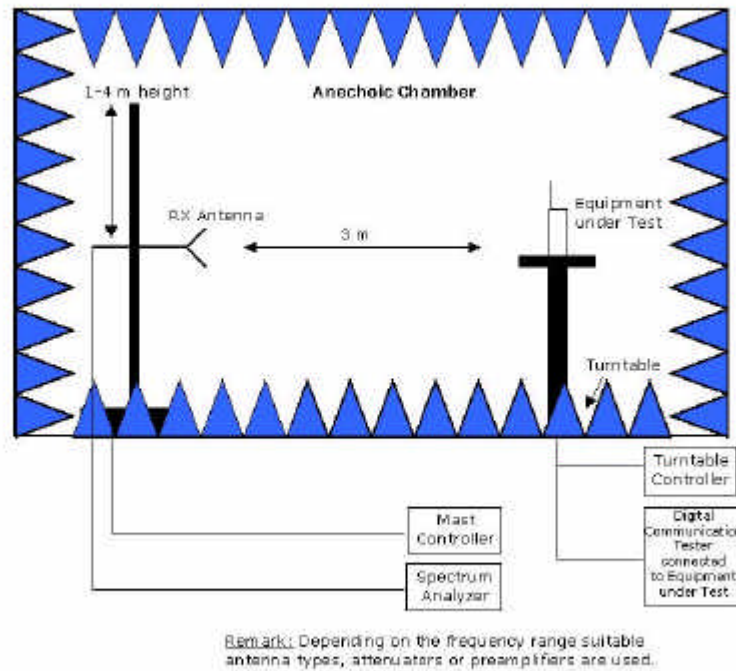


**Photo 1:** Test setup for radiated measurements



**Photo 2:** Test setup for conducted measurements

## 7 Setup Drawings



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

## 8 Annex measurement plots

### 8.1 AC Mains conducted

#### Op. Mode

op-mode 1

Short Description: FCC 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

