EMC Measurement/Technical Report

on

BlueCore01
Bluetooth Chipset

Report Reference: 5BT_CSR_CCL_CON_FCCa

7 Layers AG
Borsigstr. 11
40880 Ratingen
Germany

Table of Contents

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:

Concerning the performed tests the EUT fulfilled the requirements of the applicable FCC rules.

0.2 Measurement Summary

FCC Part 15, Subpart C § 15.247 (c)

Spurious RF Conducted Emissions

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

OP-Mode	Setup	Port	Final Result
op-mode 1	setup 1	temporary antenna connec	passed
op-mode 2	setup 1	temporary antenna connec	passed
op-mode 3	setup 1	temporary antenna connec	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

OP-Mode	Setup	Port	Final Result
op-mode 1	setup 1	enclosure	passed
op-mode 2	setup 1	enclosure	passed
op-mode 3	setup 1	enclosure	passed

Responsible for Accreditation Scope: _____

Responsible for Test Report: _____

1. Administrative Data

1.1 Testing Laborato

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:	Carsten Kuhfuss
Receipt of EUT:	2000-09-25
Date of Test(s):	2000-10-16 until 2000-10-18
Date of Report:	2000-12-19
No. of Pages in Annex:	

1.3 Applicant Data

Company Name:	Cambridge Silicon Radio
Address:	Unit 300, Science Park, Milton R CB4 OXL Cambridge UK
Contact Person:	Peter Flittner

1.4 Manufacturer Data

Company Name:	Cambridge Silicon Radio
Address:	Unit 300, Science Park, Milton R CB4 OXL Cambridge UK
Contact Person:	Peter Flittner

2.0 Product Labeling

2.1 FCC ID Label:

At the time of generation of this report there was no ID label available.

2.2 Location of Label on the EUT:

see above

3. Testobject Data

3.1 General EUT Descriptio

Equipment under Test:	BlueCore01
Type Designation:	Bluetooth Chipset
Kind of Device: (optional)	Comp-HW
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 a 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
temporary antenna connector
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	Blue Core 01	Bluetooth Chipset	3047 31 07 00	BC01B	Radio 3, Power 25	2000-09-25

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
AE1	CASIRA	Development tool	none	none	none	

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 1 + AE 1	The Blue Core RF Module with the chipset BlueCore01 is pla inside the Casira Development Tool from CSR.

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 continuously DH1 packets at 2402 MHz	Radio = 3, Power = 25
op-mode 2	Transmitting continuously DH1 packets at 2441 MHz	Radio = 3, Power = 25
op-mode 3	Transmitting continuously DH1 packets at 2480 MHz	Radio = 3, Power = 25

4. Test Results

4.1 Spurious RF Conducted Emissions

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

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

4.1.1 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.

4.1.2 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.

4.1.3 Test Protocol

Temperature: 24 C
Air Pressure: 1115 hPa
Humidity: 37 %

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

Frequency MHz	Measured Value dBm	Correction Factor dB	Corrected Value	Reference Value dB	Limit dBm	Delta to Limit dB
6885,49	-38,30	0,00	-38,30	10,00	-16,90	21,40

Remark: No other spurious emission above noise level found.

Temperature: 24 %
Air Pressure: 1115 hPa
Humidity: 37 %

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

Frequency MHz	Measured Value dBm	Correction Factor dB	Corrected Value	Reference Value dB	Limit dBm	Delta to Limit dB
6885,40	-38,13	0,00	-38,13	0,00	-16,70	21,43

Remark: No other spurious emission above noise level found.

Temperature: 24 C
Air Pressure: 1115 hPa
Humidity: 37 %

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

Frequency MHz	Measured Value dBm	Correction Factor dB	Corrected Value	Reference Value dB	Limit dBm	Delta to Limit dB
6885,40	-38,26	0,00	-38,26	0,00	-16,40	21,86

Remark: No other spurious emission above noise level found.

4.1.4 Test result: Spurious RF Conducted Emissions

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

4.2 Spurious Radiated Emissions

Standard FCC Part 15, Subpart C 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: 23 C
Air Pressure: 1113 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				
Horizontal	2370,00	0,00	59,00	49,00	54,00	74,00	5,00	15,00

Remark: Measurements around 2.37 GHz has been done separately by setting t = 100 ms

Temperature: 23 C
Air Pressure: 1113 hPa
Humidity: 36 %

Op. Mode	Setup	Port	Test Parameter
op-mode 2	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				
Horizontal	4882,00	0,00	36,00	25,41	54,00	74,00	28,59	38,00

Remark: none

Temperature: 23 C
Air Pressure: 1113 hPa
Humidity: 36 %

Op. Mode	Setup	Port	Test Parameter
op-mode 3	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				
Horizontal	2496,00	0,00	59,00	44,75	54,00	74,00	9,25	15,00

Remark: none

4.2.4 Test result: Spurious Radiated Emissions

FCC Part 15, Subpart C	Op. Mode	Setup	Port	Result
	op-mode 1	setup 1	enclosure	**passed**
	op-mode 2	setup 1	enclosure	**passed**
	op-mode 3	setup 1	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	17.06.01

EMI Test System

Equipment	Type	Serial No.	Manufacturer	Cal due
EMI Analyzer	ESI 26	830482/004	Rohde & Schwarz	29.06.01
Signal Generator	SMR 20	846834/008	Rohde & Schwarz	26.07.02
Comparison Noise Emitter	CNE III	99/016	York	04.05.01

EMI Radiated Auxiliary Equipment

Equipment	Type	Serial No.	Manufacturer	Cal due
Biconical dipole	VUBA 9117	9117108	Schwarzbeck	03.06.01
High Pass Filter	5HC2700/12750-1.	9942012	Trilithic	03.05.01
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz	16.06.01
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz	18.05.01
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz	18.05.01
Pyramidal Horn Antenna 26,5 GHz	Model 3160-09	9910-1184	EMCO	22.08.01
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz	04.10.01
Cable "ESI to EMI Antenna"	RTK081+Aircell7	W18.01+W38.01a	Huber+Suhner	10.03.01
Cable "ESI to Horn Antenna"	RTK 081	W18.04+3599/001	Rosenberger	10.03.01
High Pass Filter	4HC1600/12750-1.	9942011	Trilithic	03.05.01
Broadband Amplifier 45MHz-27GHz	JS4-00102600-42-5	619368	Miteq	

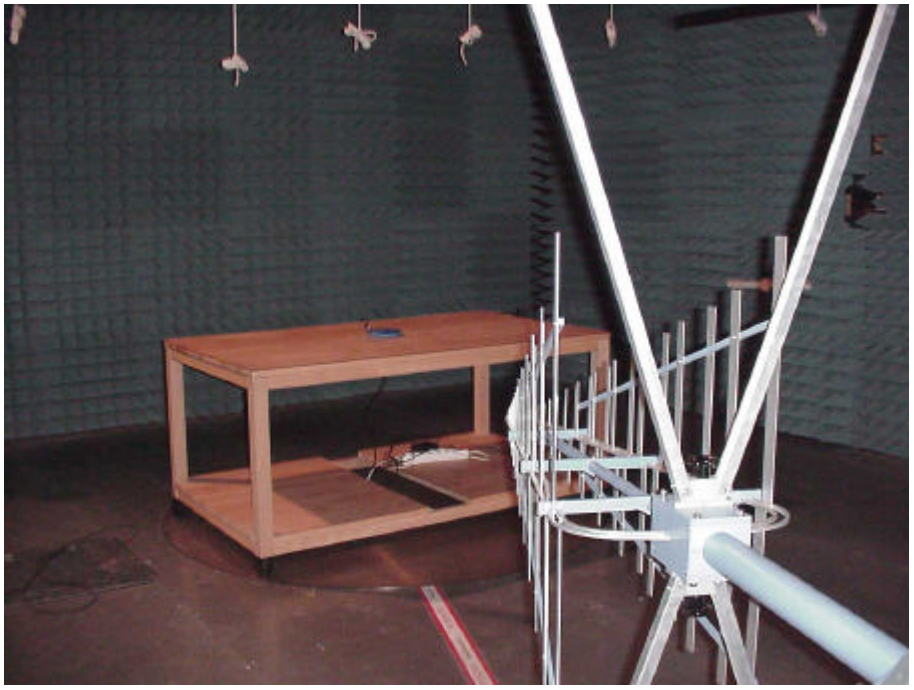
EMI Conducted Auxiliary Equipment

Equipment	Type	Serial No.	Manufacturer	Cal due
Two-Line V-Network	ESH 3-Z5	828304/029	Rohde & Schwarz	22.06.01
Two-Line V-Network	ESH 3-Z5	829996/002	Rohde & Schwarz	22.06.01

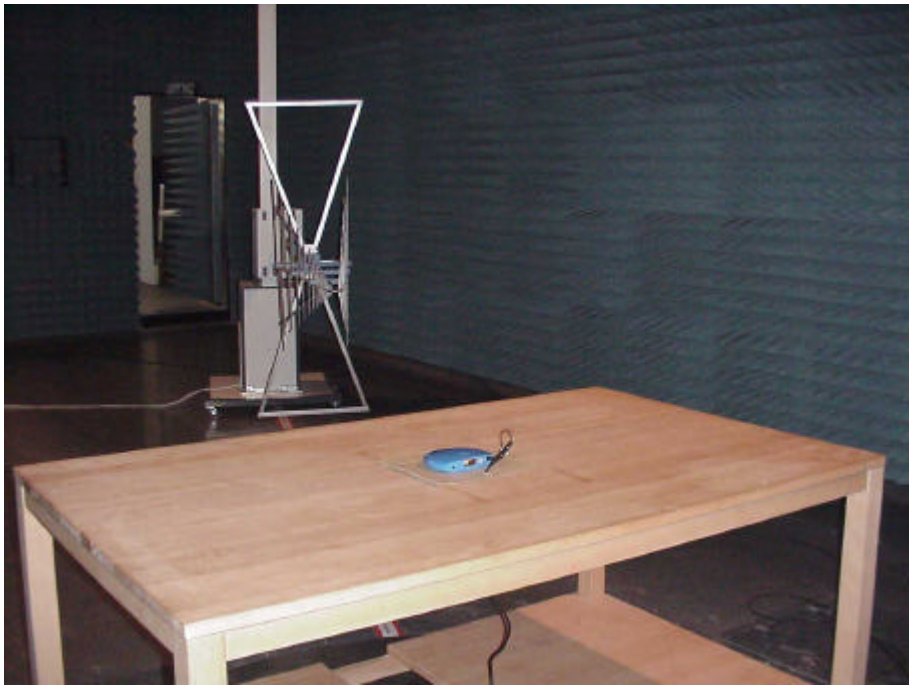
Auxiliary Test Equipment

Equipment	Type	Serial No.	Manufacturer	Cal due
Digital Multimeter 02	Voltcraft M-3860M	IJ095955	Conrad	03.06.01
Digital Multimeter 01	Voltcraft M-3860M	IJ096055	Conrad	03.06.01
Digital Oscilloscope	TDS 784C	B021311	Tektronix	26.05.01
Fibre optic link Transceiver	FO RS232 Link	182-018	Pontis	
Notch Filter ultra stable	WRCA800/960-6EE	24	Wainwright	03.02.03
Broadband Resist. Power Divider SMA	1515 / 93459	LN673	Weinschel	
Broadband Resist. Power Divider N	1506A / 93459	LM390	Weinschel	
Temperature Chamber	VT 4002	58566002150010	Vötsch	
Temperature Chamber	S-1.2C-B	393/25-1389-27RF	Thermotron	23.05.03
ThermoHygro_01	430202		Fischer	10.11.01
Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz	10.05.01
I/Q Modulation Generator	AMIQ-B1	832085/018	Rohde & Schwarz	28.04.01
Fibre optic link Satellite	FO RS232 Link	181-018	Pontis	

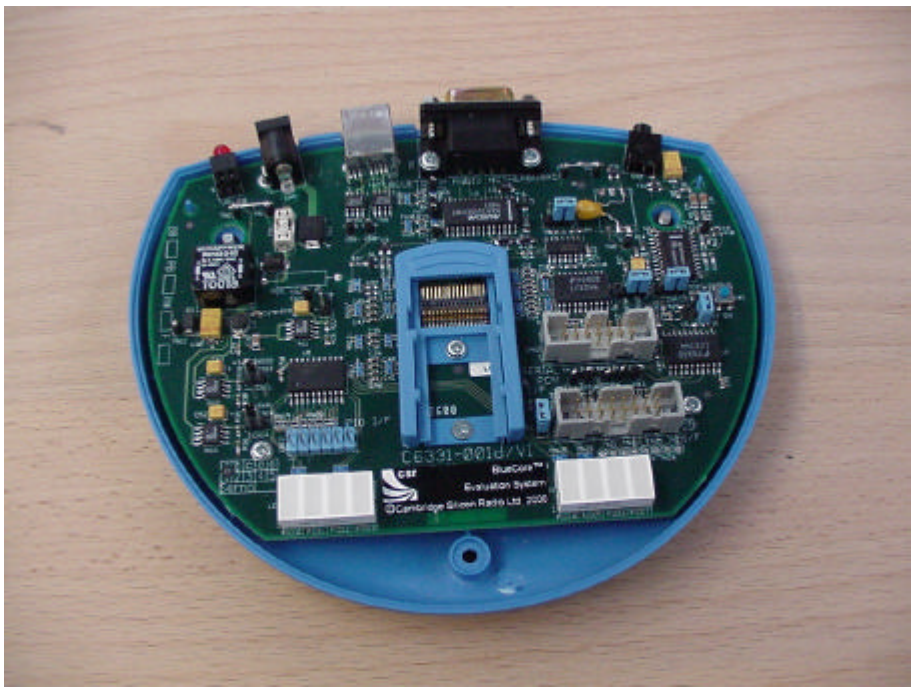
6. Foto Report



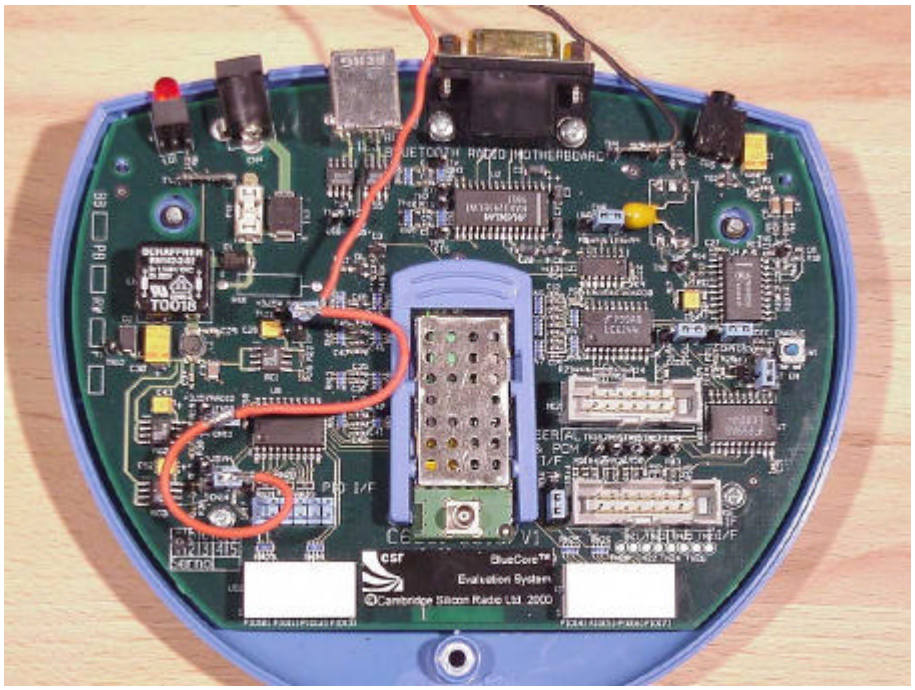
Picture 1 : Setup for radiated emission test, front view



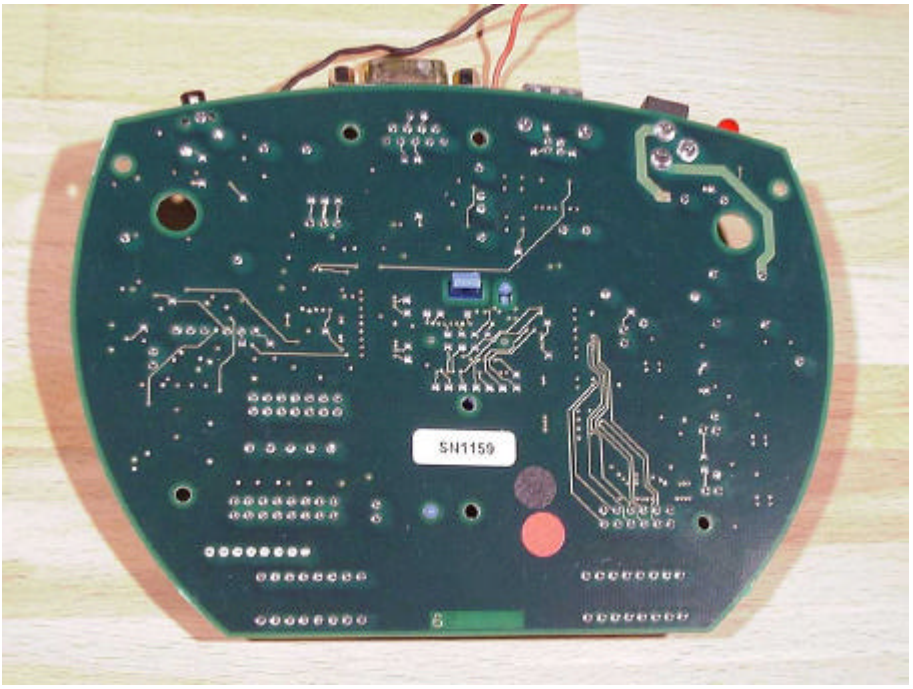
Picture 2 : Setup for radiated emission test, rear view



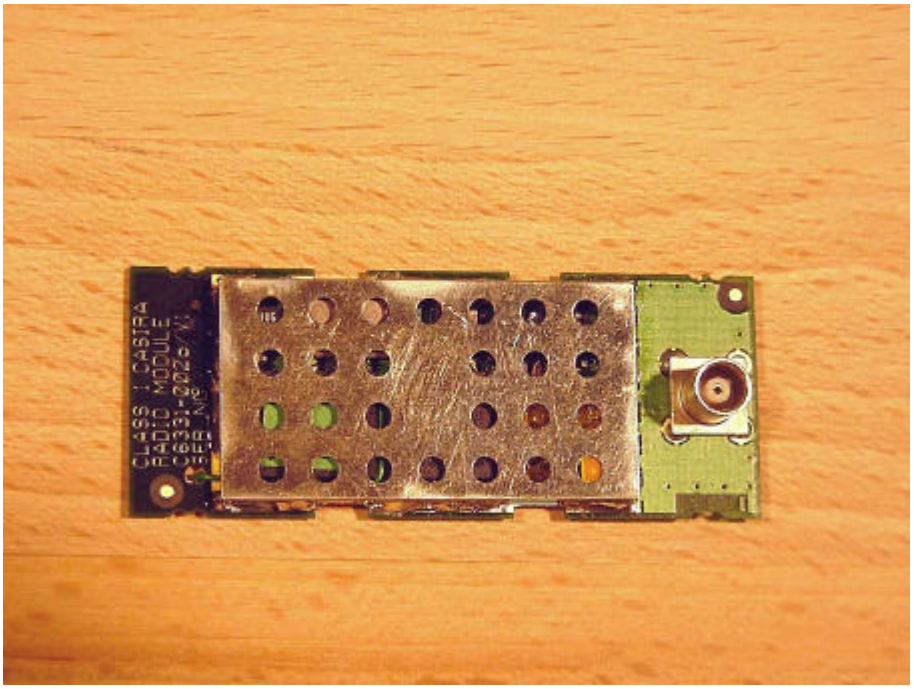
Picture 3 : PCB top view without RF part



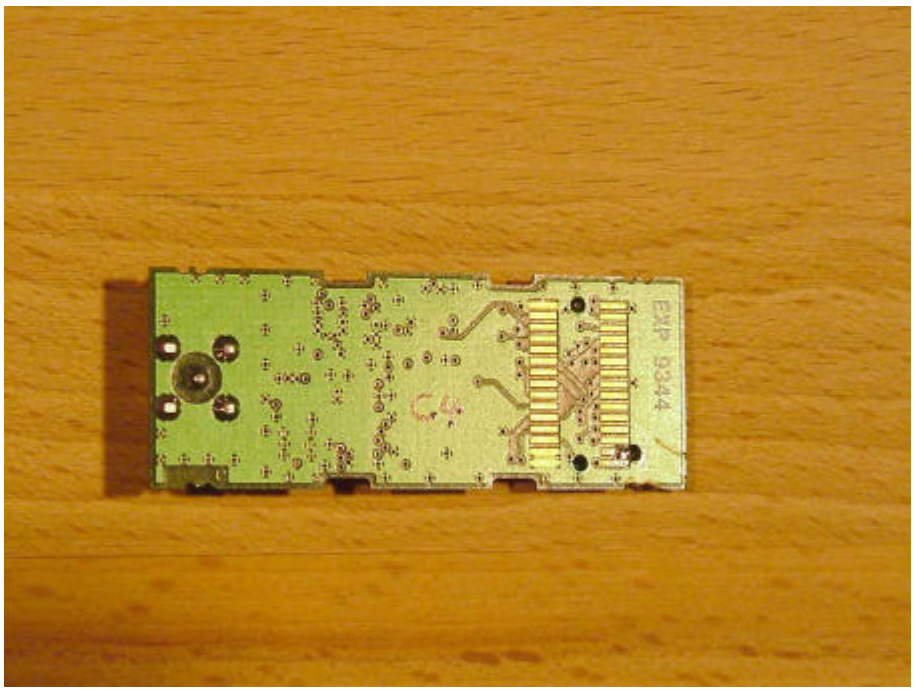
Picture 4 : PCB top view with RF part



Picture 5 : PCB bottom



Picture 6 : RF Module top view



Picture 7 : RF Module bottom view

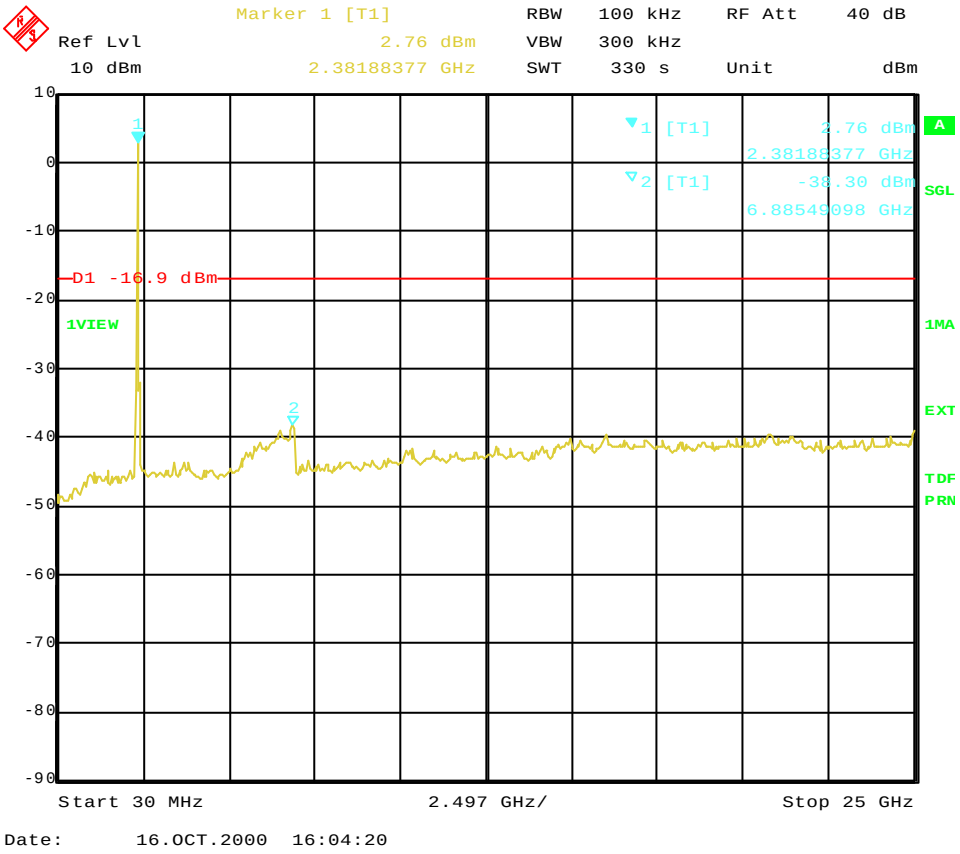
7. Setup Drawings

8. Annex

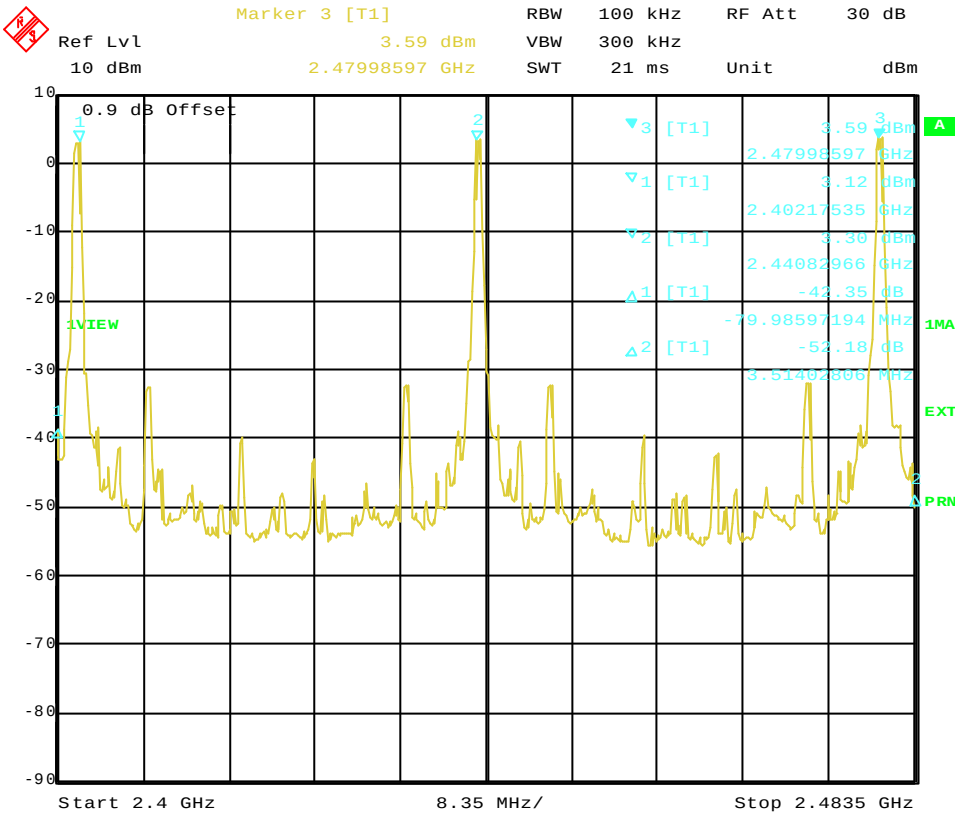
measurement plots

Spurious RF Conducted Emissions

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

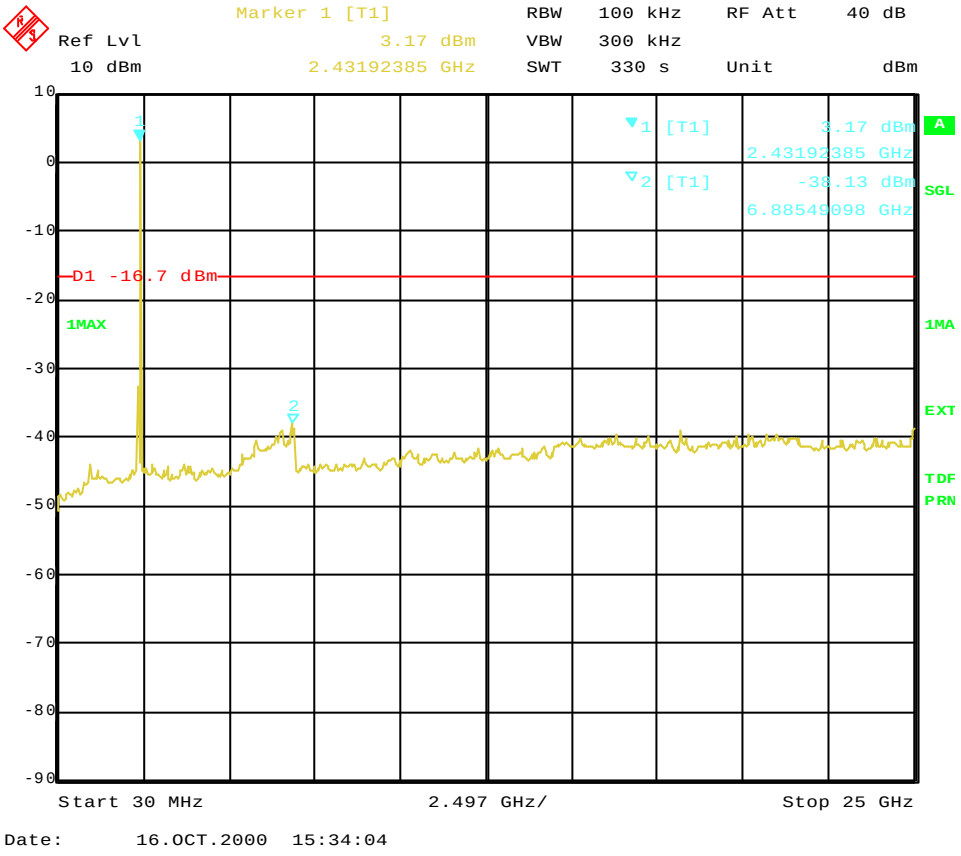


Spurious RF Conducted Emissions TX = 2402

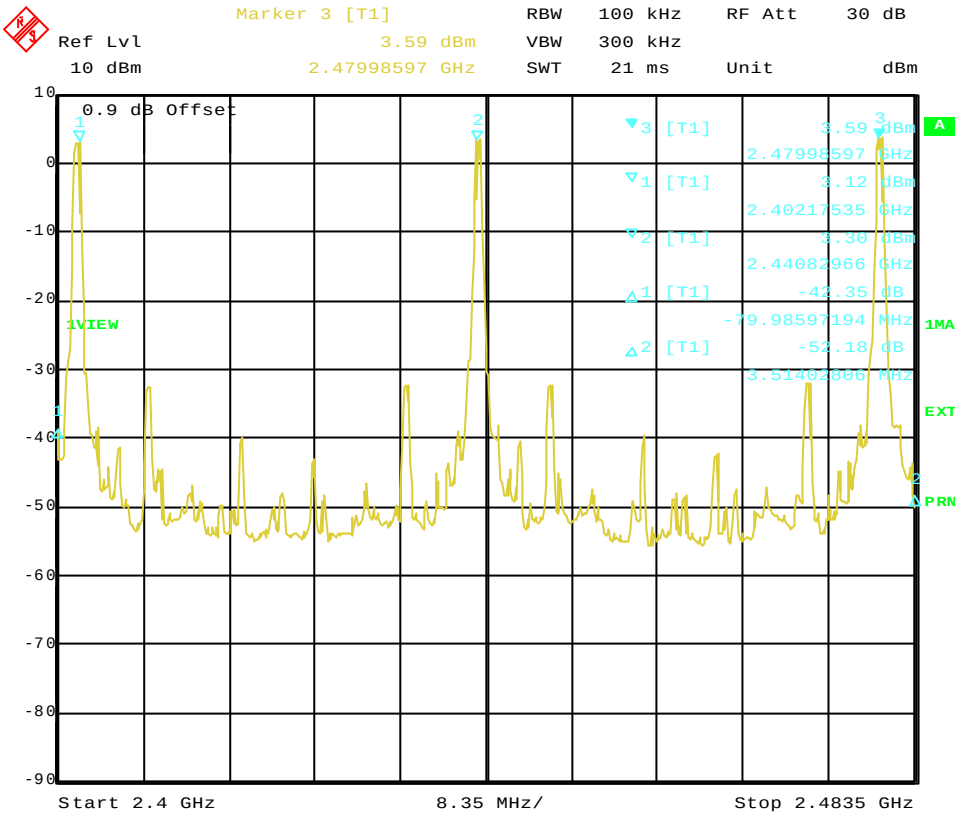


Band Edge Compliance

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

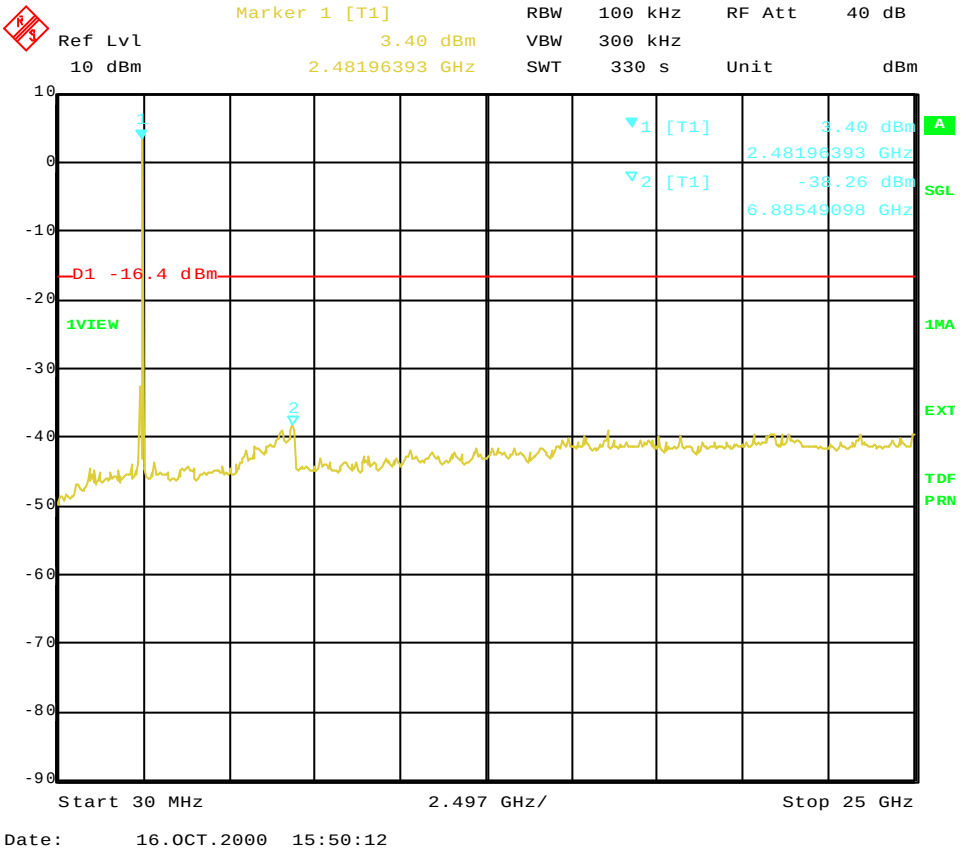


Spurious RF Conducted Emissions (TX = 2441 MHz)

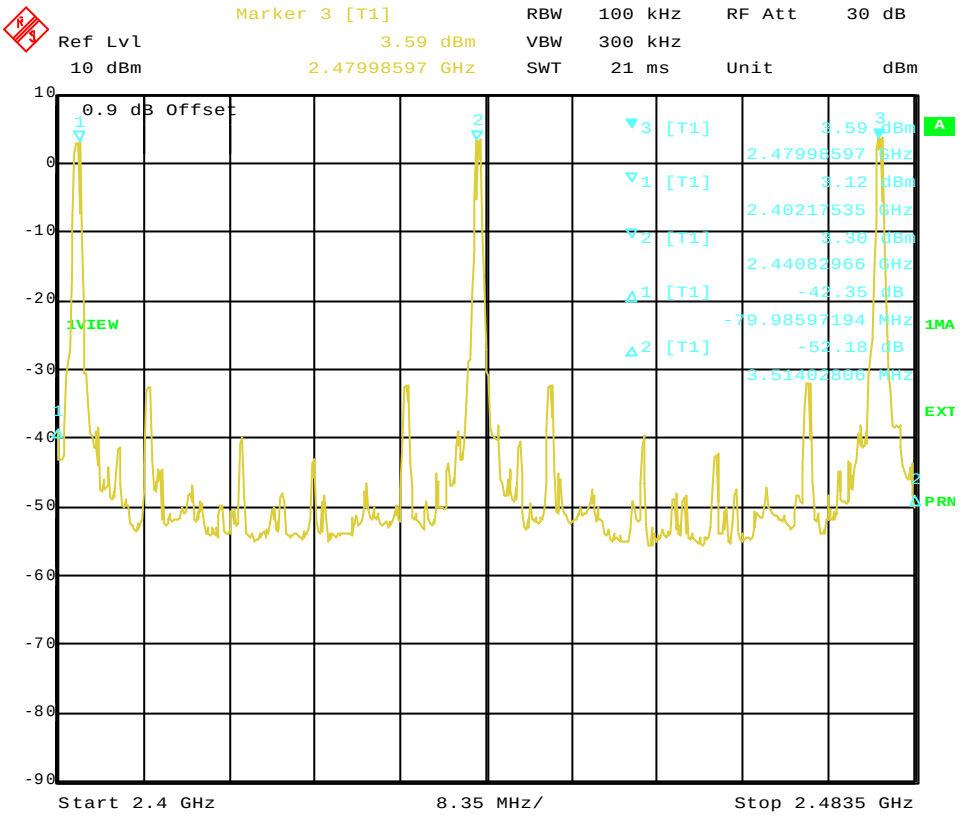


Band Edge Compliance

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



Spurious RF Conducted Emissions (TX = 2448 MHz)



Band Edge Compliance