



Inter**Lab**[®]

FCC Measurement/Technical Report on

Bluetooth[®] transceiver

ActiveBoard Module LMX9820A

Report Reference: 4_Natsc_IRV_0304_ERF_FCCa

Test Laboratory:

7 layers AG
Borsigstrasse 11
40880 Ratingen
Germany
email: info@7Layers.de



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.

7 layers AG, Borsigstrasse 11
40880 Ratingen, Germany
Phone: +49 (0) 2102 749 0
Fax: +49 (0) 2102 749 350
<http://www.7Layers.com>

Aufsichtsratsvorsitzende
Chairman of the Supervisory Board:
Michael Abels
Vorstand - Board of Directors:
Dr. Hans-Jürgen Meckelburg

Registergericht - registered in:
Düsseldorf, HRB 44096
USt-IdNr. VAT Nr:
DE 203159652

InterLab[®] is a registered trademark of 7 layers AG



Table of Contents

0	Summary.....	3
0.1	Technical Report Summary.....	3
0.2	Measurement Summary.....	4
1	Administrative Data.....	5
1.1	Testing Laboratory.....	5
1.2	Project Data.....	5
1.3	Applicant Data.....	5
1.4	Manufacturer Data.....	5
2	Product labeling.....	6
2.1	FCC ID label.....	6
2.2	Location of the label on the EUT.....	6
3	Test object Data.....	7
3.1	General EUT Description.....	7
3.2	EUT Main components.....	8
3.3	Ancillary Equipment.....	8
3.4	EUT Setups.....	8
3.5	Operating Modes.....	8
4	Test Results.....	9
4.1	Occupied bandwidth.....	9
4.2	Peak power output.....	11
5	Test Equipment.....	13
6	Photo Report.....	16
7	Setup Drawings.....	19
8	Annex.....	20



0 Summary

0.1 Technical Report Summary

Type of Authorization

Certification for an Intentional Radiator (Frequency Hopping Spread Spectrum).

Covered FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 (2001-10-01 Edition) and 15 (2004-07-12 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 15, Subpart C – Intentional Radiators

§ 15.247 Operation within the bands 902-928 MHz, 2400-2483,5 MHz and 5725-5850 MHz

Note:

The tests were selected by the customer and performed with reference to the FCC Public Notice DA 00-705, released March 30, 2000

Instead of applying ANSI C63.4-1992 which is referenced in the FCC Public Note, the newer ANSI C63.4-2003 is applied.

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 C

§ 15.247 (a) (1) (ii)

Occupied bandwidth

The measurement was performed according to FCC § 15.31

2004

OP-Mode	Setup	Port	Final Result
op-mode 1	1K020a01	temp. ant. conn.	passed
op-mode 2	1K020a01	temp. ant. conn.	passed
op-mode 3	1K020a01	temp. ant. conn.	passed

FCC Part 15, Subpart C

§ 15.247 (b) (1)

Peak power output

The measurement was performed according to FCC § 15.31

2004

OP-Mode	Setup	Port	Final Result
op-mode 1	1K020a01	temp. ant. conn.	passed
op-mode 2	1K020a01	temp. ant. conn.	passed
op-mode 3	1K020a01	temp. ant. conn.	passed

Responsible for
Accreditation Scope:

B. Pethen

Responsible
for Test Report:

M. Dulce



7 layers AG, Borsigstr. 11.
40880 Ratingen, Germany
Phone +49 (0)2102 749 0



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. TTI-P-G 178/99

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

Report Template Version: 2004-12-09

1.2 Project Data

Responsible for testing and report: Dipl.-Ing. Thomas Hoell

Date of Test(s): 2004-11-29

Date of Report: 2004-12-20

1.3 Applicant Data

Company Name: National Semiconductor
Address: 1st Floor, Apple II, Apple Walk,
Kembrey Park
Swindon, Wiltshire, SN2 8BL
UK

Contact Person: Mr. Martin Lee

1.4 Manufacturer Data

Company Name: TDS House
Address: Lower Philips Road
Blackburn, Lancashire, BB1 5TH
UK

Contact Person: Mr. Brian Lofthouse



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

Equipment under Test	Bluetooth® transceiver module
Type Designation:	ActiveBoard Module LMX9820A
Kind of Device:	Bluetooth® Module
(optional)	
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, 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. A channel is occupied for a defined amount of time slots, with a nominal slot length of 625 μ s. The maximum dwell time on one channel is defined by the packet type and is 0.625 ms for DH1 packets, 1.875 ms for DH3 and 3.125 ms for DH5. The nominal hop rate is 1600 hops/s for DH1, 1600/3 for DH3 and 1600/5 for DH5. All frequencies are equally used. The maximum nominal average time of occupancy is 0.4 s within a period of 79*0.4 seconds.

The EUT provides the following ports:

Ports

Temporary antenna connector
control jacks

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: 1K020a01) Remark: none	Bluetooth® transceiver module	ActiveBoard Module LMX 9820A	none	3.1	6.13	2004-11-24

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
AE 1	ActiveBoard electronics	-	-	-	-	-

3.4 EUT Setups

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

Setup No.	Combination of EUT's	Description
1K020a01	EUT A + AE 1	-

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	The EUT transmits on 2402 MHz	Loopback mode / TX-mode / local TX mode
op-mode 2	The EUT transmits on 2441 MHz	Loopback mode / TX-mode / local TX mode
op-mode 3	The EUT transmits on 2480 MHz	Loopback mode / TX-mode / local TX mode



4 Test Results

4.1 Occupied bandwidth

Standard FCC Part 15, 2004-07-12
Subpart C

The test was performed according to: FCC §15.31, 2004-07-12

4.1.1 Test Description

The Equipment Under Test (EUT) was setup in a shielded room to perform the occupied bandwidth measurements.

The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.

The results recorded were measured with the modulation which produces the worst-case (widest) occupied bandwidth. The resolution bandwidth for measuring the reference level and the occupied bandwidth was 10 kHz.

4.1.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

4.1.3 Test Protocol

Temperature: 22 °C
Air Pressure: 1010 hPa
Humidity: 38 %

Op. Mode	Setup	Port
op-mode 1	1K020a01	temp. ant. conn.

20 dB bandwidth MHz	Remarks
0,964	none

Remark: Please see annex for the measurement plot.



Temperature: 22 °C
 Air Pressure: 1010 hPa
 Humidity: 38 %

Op. Mode	Setup	Port
op-mode 2	1K020a01	temp. ant. conn.

20 dB bandwidth MHz	Remarks
0,944	none

Remark: Please see annex for the measurement plot.

Temperature: 22 °C
 Air Pressure: 1010 hPa
 Humidity: 38 %

Op. Mode	Setup	Port
op-mode 3	1K020a01	temp. ant. conn.

20 dB bandwidth MHz	Remarks
0,948	none

Remark: Please see annex for the measurement plot.

4.1.4 Test result: Occupied bandwidth

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed
	op-mode 2	passed
	op-mode 3	passed



4.2 Peak power output

Standard FCC Part 15, 2004-07-12
 Subpart C

The test was performed according to: FCC §15.31, 2004-07-12

4.2.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room to perform the output power measurements.

The results recorded were measured with the modulation which produces the worst-case (highest) output power.

The resolution bandwidth for measuring the output power was 1 MHz.

The reference level of the spectrum analyzer was set higher than the output power of the EUT.

4.2.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (b) (1)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt.

Used conversion factor: Limit (dBm) = 10 log (Limit (W)/1mW)
==> Maximum Output Power: 30 dBm

4.2.3 Test Protocol

Temperature: 22 °C
Air Pressure: 1010 hPa
Humidity: 38 %

Op. Mode	Setup	Port
op-mode 1	1K020a01	temp.ant.conn.

Output power dBm	Remarks
2,86	The EIRP including antenna gain (0 dBi) is 2,86 dBm

Remark: Please see annex for the measurement plot.



Temperature: 22 °C
 Air Pressure: 1010 hPa
 Humidity: 38 %

Op. Mode	Setup	Port
op-mode 2	1K020a01	temp.ant.conn.

Output power dBm	Remarks
2,75	The EIRP including antenna gain (0 dBi) is 2,75 dBm

Remark: Please see annex for the measurement plot.

Temperature: 22 °C
 Air Pressure: 1010 hPa
 Humidity: 38 %

Op. Mode	Setup	Port
op-mode 3	1K020a01	temp.ant.conn.

Output power dBm	Remarks
2,67	The EIRP including antenna gain (0 dBi) is 2,67 dBm

Remark: Please see annex for the measurement plot.

4.2.4 Test result: Peak power output

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed
	op-mode 2	passed
	op-mode 3	passed

5 Test Equipment

EUT Digital Signalling System

Equipment	Type	Serial No.	Manufacturer
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

Equipment	Type	Serial No.	Manufacturer
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

Equipment	Type	Serial No.	Manufacturer
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	HD 100	100/603	HD GmbH H. Deisel
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

Equipment	Type	Serial No.	Manufacturer
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

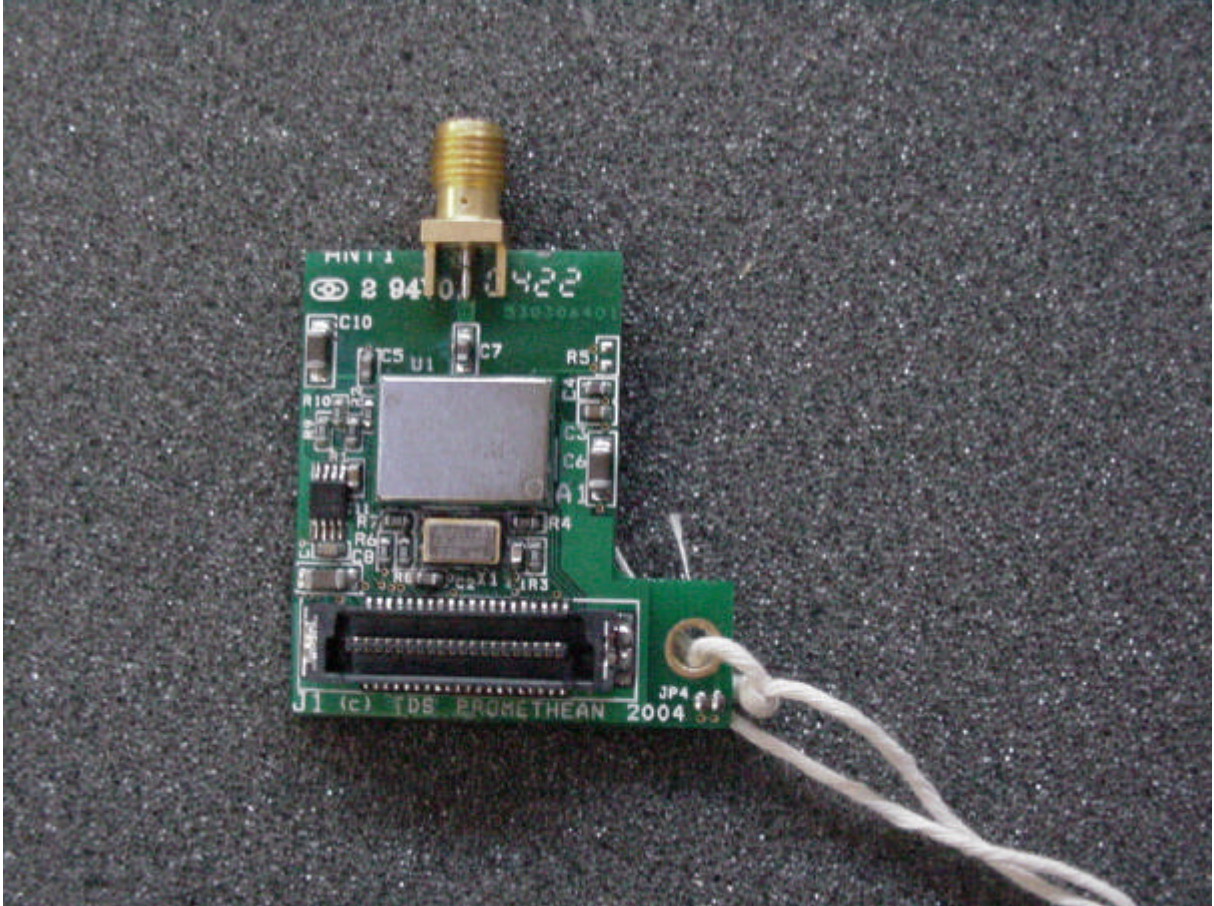


Photo 1: Bluetooth module LMX9820A

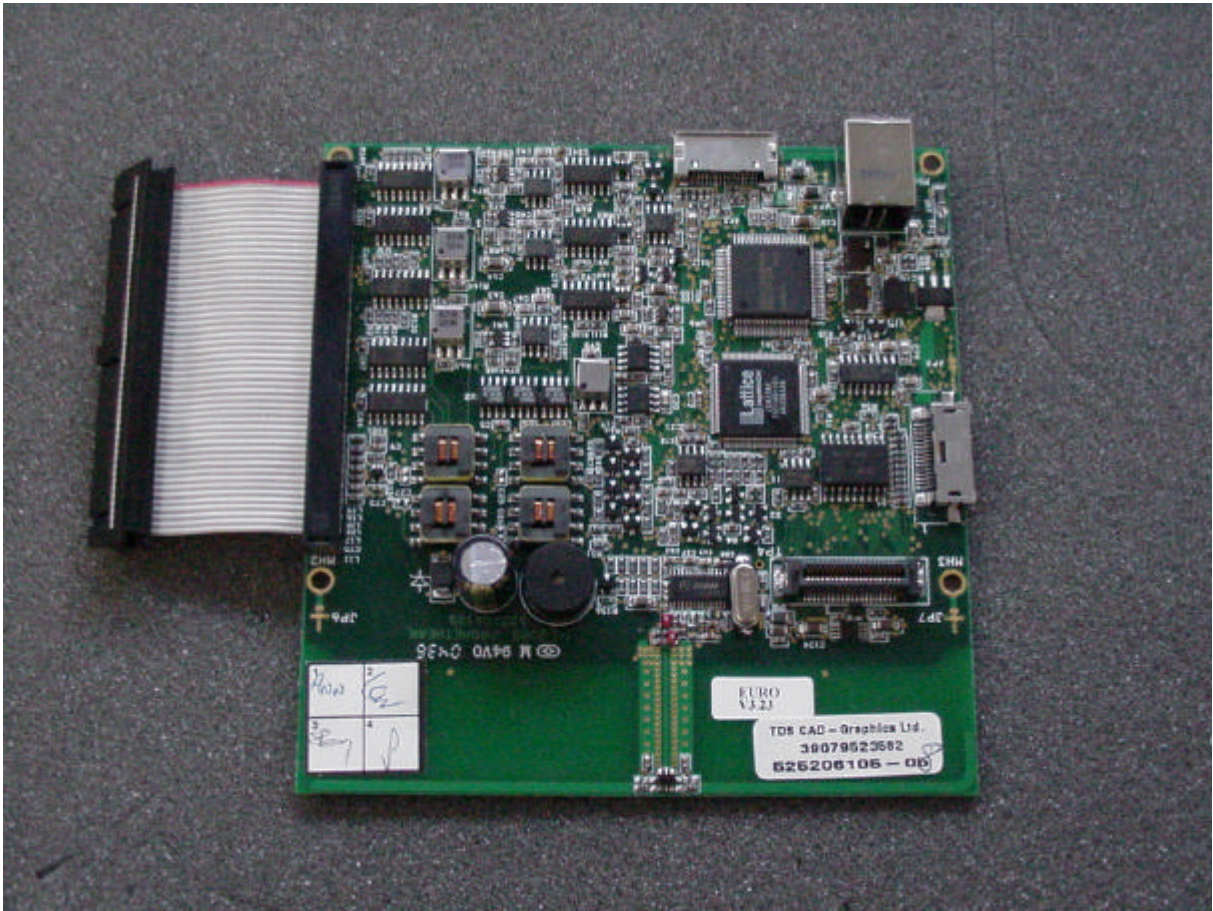


Photo 2: ActivBoard electronics

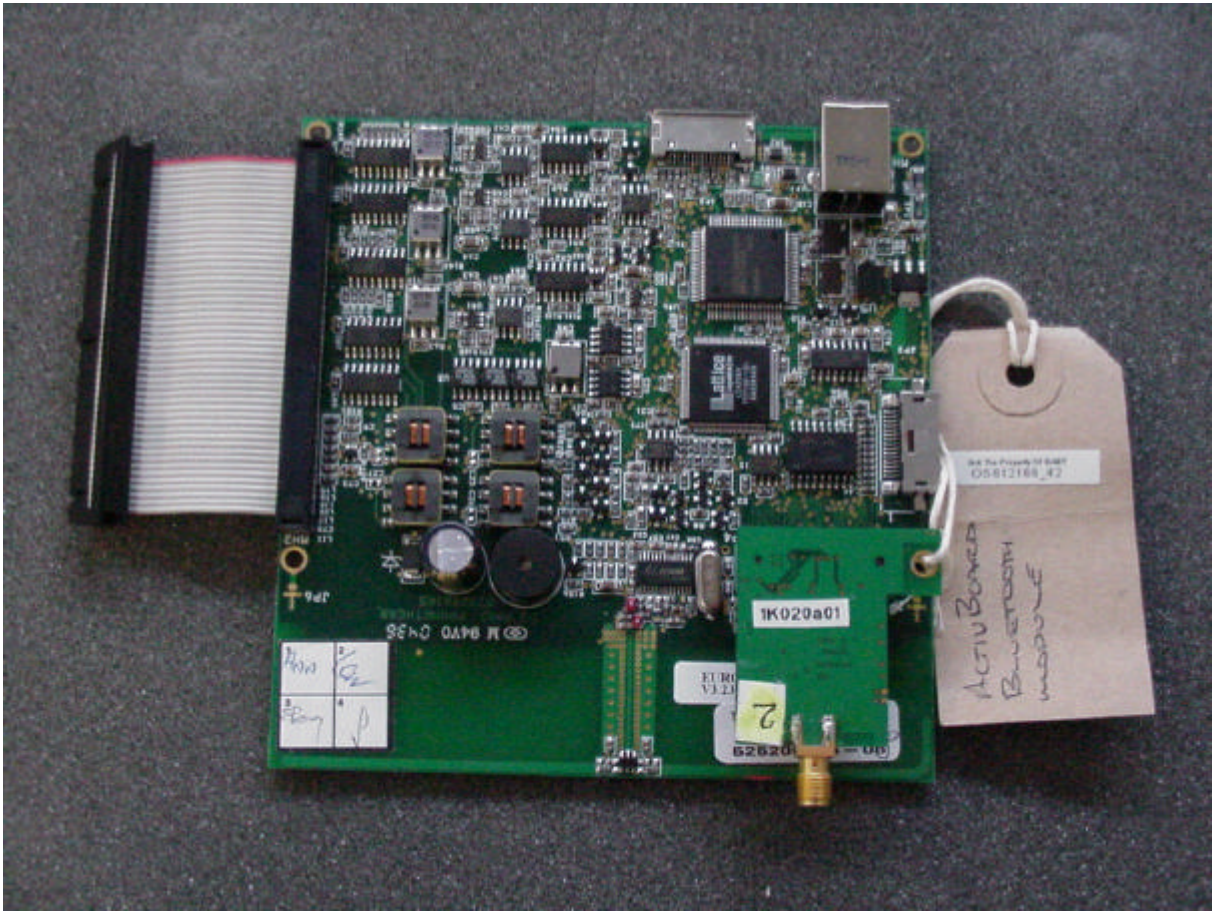
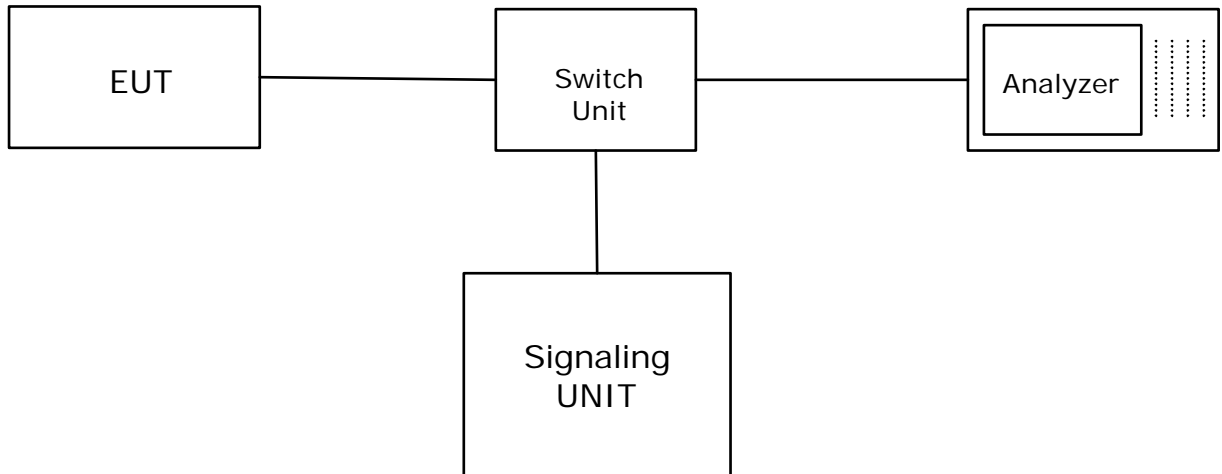


Photo 3: Module connected to the ActiveBoard electronics

7 Setup Drawings



Drawing 1: Setup for conducted measurements.

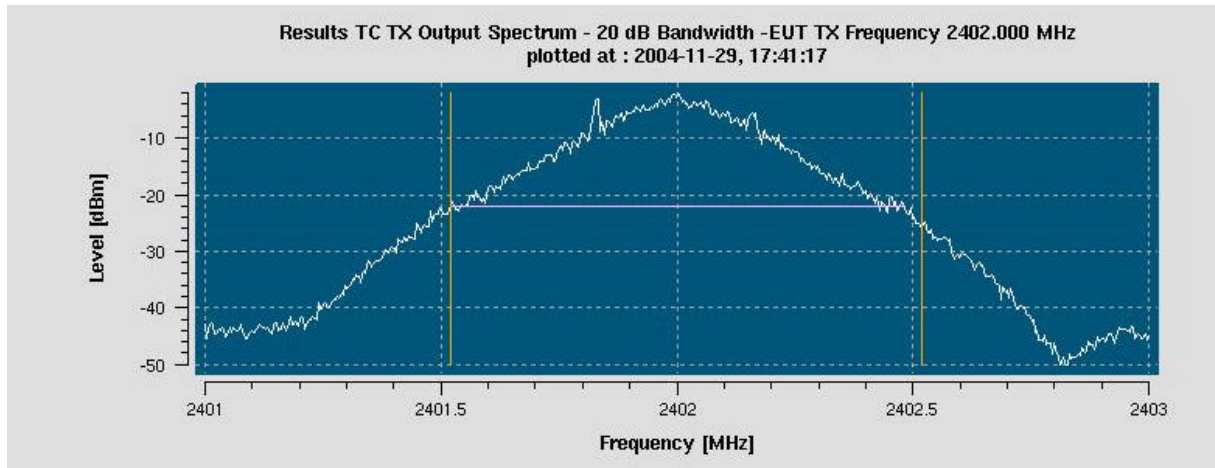
8 Annex

Measurement plots

Occupied bandwidth

Op. Mode

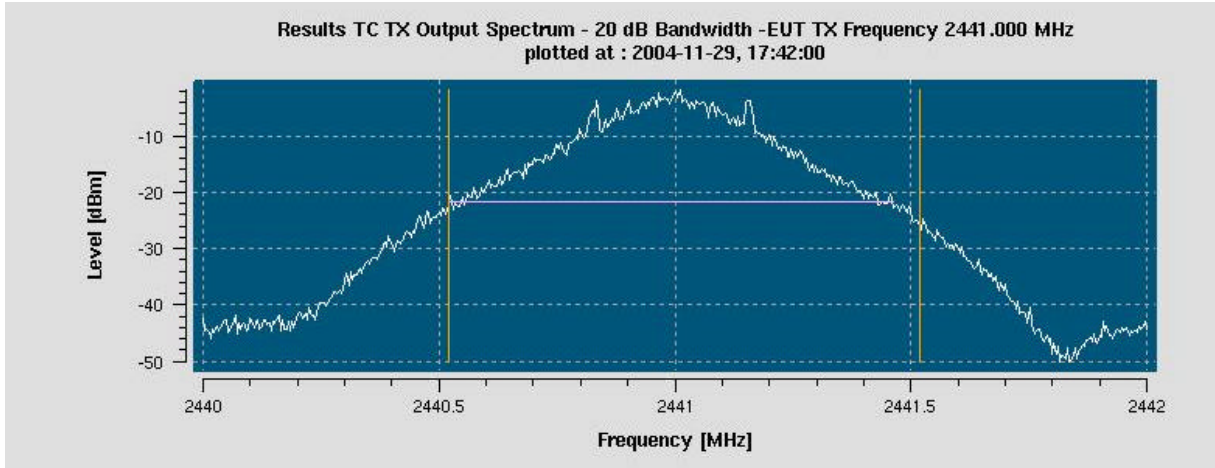
op-mode 1



Occupied bandwidth

Op. Mode

op-mode 2

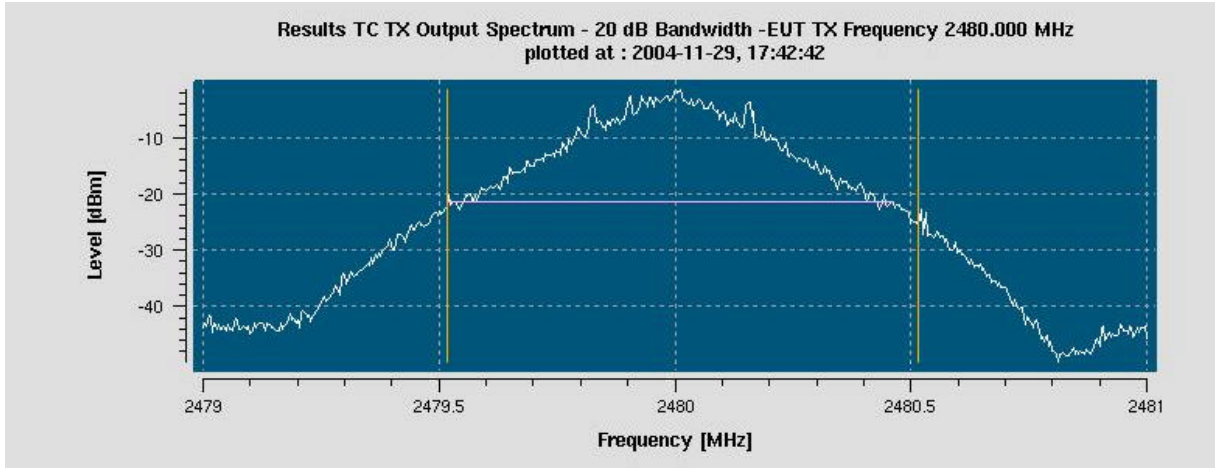




Occupied bandwidth

Op. Mode

op-mode 3

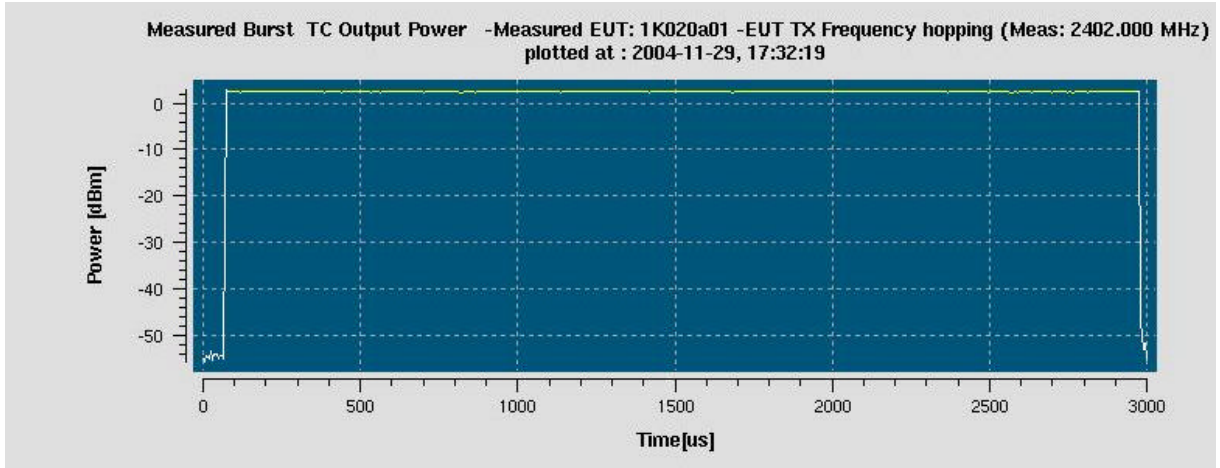




Peak power output

Op. Mode

op-mode 1

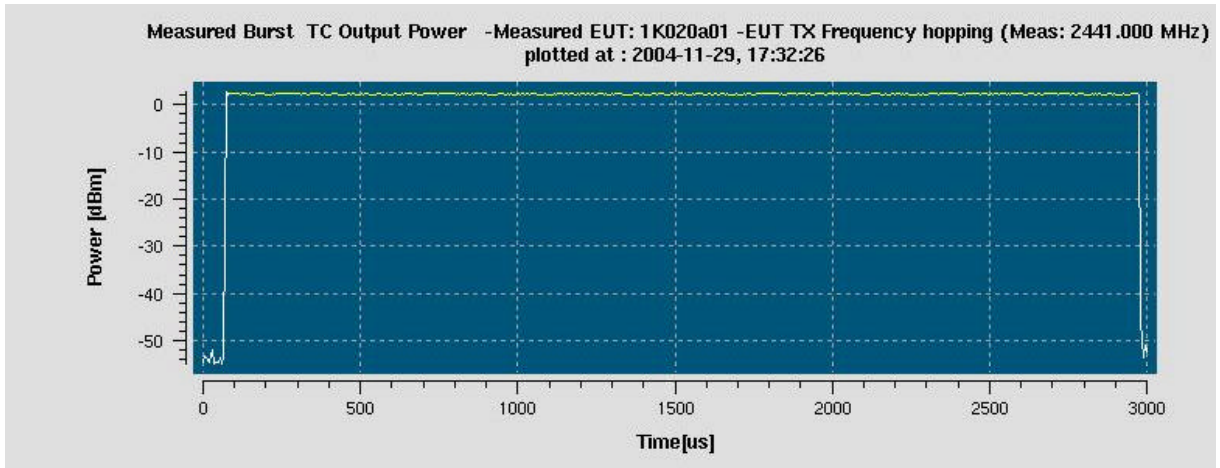




Peak power output

Op. Mode

op-mode 2





Peak power output

Op. Mode

op-mode 3

