

InterLab FCC Measurement/Technical Report on

WLAN transceiver PCMCIA card GT Fusion+ EMEA

Report Reference: 4_Opti_0605_UMTS_FCCe

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 (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 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
- § 15.201 Equipment authorization requirement
- § 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 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, Sub	opart C	§ 15.207				
Conducted emission	Conducted emissions (AC power line)					
The measurement was performed according to ANSI C63.4 2003						
OP-Mode	Setup	Port	Final Result			
op-mode 4	Setup_a01	AC Port (power line)	passed			
FCC Part 15, Sub	opart C	§ 15.247 (a) (1)				
Occupied bandwid	th					
The measurement	was performed acco	rding to FCC § 15.31	2004			
OP-Mode	Setup	Port	Final Result			
op-mode 1b	Setup_b01	Temp.ant.connector	passed			
op-mode 1g	Setup b01	Temp.ant.connector	passed			
op-mode 2b	Setup b01	Temp.ant.connector	, passed			
op-mode 2a	Setup b01	Temp.ant.connector	passed			
op-mode 3b	Setup b01	Temp.ant.connector	passed			
op-mode 3g	Setup_b01	Temp.ant.connector	passed			
FCC Part 15, Sub	opart C	§ 15.247 (b) (1)				
Peak power outpu	t ,					
The measurement	was performed acco	rding to FCC § 15.31	2004			
OP-Mode	Setup	Port	Final Result			
op-mode 1b	Setup_b01	Temp.ant.connector	passed			
op-mode 1g	Setup_b01	Temp.ant.connector	passed			
op-mode 2b	Setup_b01	Temp.ant.connector	passed			
op-mode 2g	Setup_b01	Temp.ant.connector	passed			
op-mode 3b	Setup_b01	Temp.ant.connector	passed			
op-mode 3g	Setup_b01	Temp.ant.connector	passed			
FCC Part 15, Sub	opart C	§ 15.247 (d)				
Spurious RF condu	icted emissions					
The measurement	was performed acco	rding to FCC § 15.31	2004			
OP-Mode	Setup	Port	Final Result			
op-mode 1b	Setup b01	Temp.ant.connector	passed			
op-mode 1g	Setup b01	Temp.ant.connector	, passed			
op-mode 2b	Setup b01	Temp.ant.connector	passed			
op-mode 2g	Setup b01	Temp.ant.connector	passed			
op-mode 3b	Setup b01	Temp.ant.connector	passed			
op-mode 3a	Setup b01	Temp.ant.connector	passed			
op mode by	occup_oor		pubbeu			
FCC Part 15, Sub	part C	§ 15.247 (d), § 15.3	85 (b), § 15.209			
Spurious radiated	emissions					
The measurement	was performed acco	rding to ANSI C63.4	2003			
OP-Mode	Setup	Port	Final Result			
op-mode 1b	Setup_a01	Enclosure	passed			
op-mode 2b	Setup_a01	Enclosure	passed			
op-mode 3b	Setup_a01	Enclosure	passed			



FCC Part 15, Subp	art C	§ 15.247 (d)	
Band edge complian	ce		
The measurement w	as performed accordi	ng to FCC § 15.31	2004 / 2003
(2004) / ANSI C63.4	4 (2003)		
OP-Mode	Setup	Port	Final Result
op-mode 1b	Setup_b01	Temp.ant.connector	passed
op-mode 1g	Setup_b01	Temp.ant.connector	passed
op-mode 2b	Setup_a01	Enclosure	passed
op-mode 2g	Setup_b01	Temp.ant.connector	passed
op-mode 3b	Setup_b01	Temp.ant.connector	passed
op-mode 3g	Setup_a01	Enclosure	passed

FCC Part 15, Subp	oart C	§ 15.247 (e)	
Power density			
The measurement w	was performed accord	ing to FCC § 15.31	2004
OP-Mode	Setup	Port	Final Result
op-mode 1b	Setup_b01	Temp.ant.connector	passed
op-mode 1g	Setup_b01	Temp.ant.connector	passed
op-mode 2b	Setup_b01	Temp.ant.connector	passed
op-mode 2g	Setup_b01	Temp.ant.connector	passed
op-mode 3b	Setup_b01	Temp.ant.connector	passed
op-mode 3g	Setup_b01	Temp.ant.connector	passed

This report replaces the report 4_Opti_0605_UMTS_FCCc.



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Responsible for Accreditation Scope:

J. Kel

Responsible for Test Report:

Madralec



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

2005-02-01

10.10.2005

3012 Leuven Belgium

Responsible for Accreditation Scope:	DiplIng. Bernhard Retka DiplIng. Arndt Stöcker DiplIng. Thomas Hoell

Report Template Version:

1.2 Project Data

Responsible for testing and report:

Date of Test(s): Date of Report:

1.3 Applicant Data

Company Name: Option International NV SA

Address:

Contact Person:

1.4 Manufacturer Data

Company Name:

please see applicant data

Kolonel Begaultlaan 45

Mr. Stefan Lodeweyckx

Dipl.-Ing. Robert Machulec

08.09.2005 - 22.09.2005

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 Testobject Data

3.1 General EUT Description

Equipment under Test
Type Designation:
Kind of Device:
(optional)
Voltage Type:
Voltage level:

PCMCIA card GT Fusion+ EMEA GSM-EDGE 850/900/1800/1900, FDDI-HSDPA WLAN DC 3.5 V

General product description:

The WLAN (Wireless Local Area Network) Transceiver is operating in the 2.4 GHz ISM band in the range 2412.0 – 2462.0 MHz and uses the Direct Sequence Spread Spectrum (DSSS) Modulation.

The EUT supports the modes 802.11b (11Mbps) and 802.11g (54Mbps) The Equipment Under Test (EUT) is a PCMCIA card which supports GSM/EDGE in the bands 850/900/1800/1900 MHz, UMTS/HSDPA in FDDI band and WLAN in 2400 MHz band.

The EUT provides the following ports:

Ports Temporary antenna connector Enclosure PCMCIA slot

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	PCMCIA	GT Fusion+	NB2B57S01K	2.0	3.1.0d	08.09.2005
(Code:	card	EMEA				
37070b01)						
Remark: EUT	A is equipped w	ith an integral a	ntenna (gain= -5	dBi).		
EUT B	PCMCIA	GT Fusion+	NB2B57S045	2.0	3.1.0d	08.09.2005
(Code:	card	EMEA				
37070a01)						
Remark: EUT	B is equipped w	ith a temporary	antenna connecte	or.		
NOTE: The short description is used to simplify the identification of the EUT in this test						

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	Laptop	Packerd Bell	-	-	S/N:281701 750122	-
AE 2	Laptop	Toshiba	-	-	S/N:484650 5E PCN0072	-

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 + AE 1	setup for radiated measurements
Setup_b01	EUT B + AE 2	setup for conducted measurements

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 1b	TX-mode, the EUT transmits on the lowest channel (2412 MHz)	Bit rate =11 Mbps	
op-mode 1g	TX-mode, the EUT transmits on the lowest channel (2412 MHz)	Bit rate =54 Mbps	
op-mode 2b	TX-mode, the EUT transmits on the mid channel (2437 MHz)	Bit rate =11 Mbps	
op-mode 2g	TX-mode, the EUT transmits on the mid channel (2437 MHz)	Bit rate =54 Mbps	
op-mode 3b	TX-mode, the EUT transmits on the highest channel (2462 MHz)	Bit rate =11 Mbps	
op-mode 3g	TX-mode, the EUT transmits on the highest channel (2462 MHz)	Bit rate =54 Mbps	
op-mode 4	PCMCIA card active, powered by a laptop		



4 Test Results

4.1 Conducted emissions (AC power line)

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

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 50μ 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, §15.207

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 (dB μ V) = 20 log (Limit (μ V)/1 μ V).

4.1.3 Test Protocol

Temperature:	25 °C
Air Pressure:	1020 hPa
Humidity:	40 %

Op. Mode	Setup	Port
op-mode 4	Setup_a01	Enclosure

Power line	Frequency MHz	Measured value dBµV	Delta to limit dBµV	Remarks
L1	0.49	37.60	8.5	AV values
N	4.33	34.00	12.0	AV values
N	4.81	32.80	13.2	AV values
N	4.88	33.10	12.9	AV values

Remark: none.

4.1.4 Test result: RF Power Output

FCC Part 15, Subpart C	Op. Mode	Result	
	op-mode 4	passed	



4.2 Occupied bandwidth

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 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 produce the worst-case (widest) occupied bandwidth.

The EUT was connected to spectrum analyzer via a short coax cable with a known loss. Analyzer settings:

- Resolution Bandwidth (RBW): 10 kHz

- Video Bandwidth (VBW): 30 kHz
- Span: 30 MHz

4.2.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

4.2.3 Test Protocol

Temperature:25 °CAir Pressure:1018 hPaHumidity:38 %

Op. Mode	Setup	Port
op-mode 1b	Setup_b01	Temp.ant.connector
		Demostra

MHz		Remarks	
9.80		-	
Remark: Please see	annex for the measu	rement plot.	
Op. Mode	Setup	Port	
op-mode 1g	Setup_b01	Temp.ant.connector	
6 dB bandwidth MHz		Remarks	
16.54			

Remark: Please see annex for the measurement plot.



Op. Mode	Setup	Port	
op-mode 2b	Setup_b01	Temp.ant.connector	
6 dB bandwidth MHz		Remarks	
10.10		-	
Remark: Please see	annex for the meas	surement plot.	
Op. Mode	Setup	Port	
op-mode 2g	Setup_b01	Temp.ant.connector	
6 dB bandwidth		Remarks	
MHz			
16.54		-	

Remark: Please see annex for the measurement plot.

Op. Mode	Setup	Port
op-mode 3b	Setup_b01	Temp.ant.connector
6 dB bandwidth MHz		Remarks
9.80		-
Remark: Please see	annex for the measureme	nt plot.
Op. Mode	Setup	Port
op-mode 3g	Setup_b01	Temp.ant.connector
6 dB bandwidth MHz		Remarks

16.54

Remark: Please see annex for the measurement plot.

4.2.4 Test result: Occupied bandwidth

nassed
pussed
passed

-



4.3 Peak power output

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

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

4.3.1 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 EUT was connected to the power meter via a short coax cable with a known loss.

4.3.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (b) (3) For systems using digital modulation techniques in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands: 1 watt.

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

4.3.3 Test Protocol

Temperature:	21 °C
Air Pressure:	1015 hPa
Humidity:	37 %

Op. Mode

Setup Port op-mode 1b Temp.ant.connector Setup_b01

Output power		Remarks	
dBm			
5.9		EIRP including antenna gain (-5 dBi)	
Remark: -			
Op. Mode	Setup	Port	
op-mode 1g	Setup_b01	Temp.ant.connector	

Output power dBm	Remarks
6.2	EIRP including antenna gain (-5 dBi)
Pomark:	

Remark:



Op. Mode	Setup	Port	
op-mode 2b	Setup_b01	Temp.ant.connector	
Output power dBm		Remarks	
6.0		EIRP including antenna gain (-5 dBi)	
Remark: -			
Op. Mode	Setup	Port	
Op. Mode op-mode 2g	Setup Setup_b01	Port Temp.ant.connector	
Op. Mode op-mode 2g Output power dBm	Setup_b01	Port Temp.ant.connector Remarks	
Op. Mode op-mode 2g Output power dBm 5.9	Setup_b01	Port Temp.ant.connector Remarks EIRP including antenna gain (-5 dBi)	

Op. Mode	Setup	Port	
op-mode 3b	Setup_b01	Temp.ant.connector	
Output power dBm		Remarks	
5.7		EIRP including antenna gain (-5 dBi)	
Remark: -			
Op. Mode	Setup	Port	
Op. Mode op-mode 3g	Setup_b01	Port Temp.ant.connector	
Op. Mode op-mode 3g Output power dBm	Setup_b01	Port Temp.ant.connector Remarks	
Op. Mode op-mode 3g Output power dBm 5.8	Setup_b01	Port Temp.ant.connector Remarks EIRP including antenna gain (-5 dBi)	

4.3.4 Test result: Peak power output

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



4.4 Spurious RF conducted emissions

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

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

4.4.1 Test Description

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

The EUT was connected to spectrum analyzer via a short coax cable with a known loss. Analyzer settings:

- Detector: Peak-Maxhold
- Frequency range: 30 25000 MHz
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Sweep Time: 330 s

4.4.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (c)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

4.4.3 Test Protocol

Temperature:	25 °C
Air Pressure:	1018 hPa
Humidity:	38 %

Op. Mode	Setup	Port
op-mode 1b	Setup_b01	Temp.ant.connector

Frequency MHz	Corrected measurement value dBm	Reference value dBm	Limit dBm	Delta to limit dB
4784	-50.20	2.23	-17.77	32.43

Remark: No (further) spurious emissions in the range 20 dB below the limit found. Please see annex for the measurement plot.

Op. Mode	Setup	Port		
op-mode 1g	Setup_b01	Temp.ant.conne	ector	
Frequency MHz	Corrected measurement value dBm	Reference value dBm	Limit dBm	Delta to limit dB
4834	-58.31	0.31	-19.69	38.62

Remark: No (further) spurious emissions in the range 20 dB below the limit found. Please see annex for the measurement plot.



4834

Op. Mode	Setup	Port		
op-mode 2b	Setup_b01	Temp.ant.conne	ector	
Frequency MHz	Corrected measurement value dBm	Reference value dBm	Limit dBm	Delta to limit dB

-49.12

Remark: No (further) spurious emissions in the range 20 dB below the limit found. Please see annex for the measurement plot.

3.09

-16.91

32.21

Op. Mode	Setup	Port	
op-mode 2g	Setup_b01	Temp.ant.connector	

Frequency MHz	Corrected measurement value dBm	Reference value dBm	Limit dBm	Delta to limit dB
4834	-56.54	0.53	-19.47	37.07

Remark: No (further) spurious emissions in the range 20 dB below the limit found. Please see annex for the measurement plot.

Op. Mode	Setup	Port
op-mode 3b	Setup_b01	Temp.ant.connector

Frequency MHz	Corrected measurement value dBm	Reference value dBm	Limit dBm	Delta to limit dB
4.884	-47.57	2.31	-17.69	29.88

Remark: No (further) spurious emissions in the range 20 dB below the limit found. Please see annex for the measurement plot.

Op. Mode	Setup	Port		
op-mode 3g	Setup_b01	Temp.ant.conne	ctor	
Frequency MHz	Corrected measurement value dBm	Reference value dBm	Limit dBm	Delta to limit dB
4884	-54.53	0.49	-19.51	35.02

Remark: No (further) spurious emissions in the range 20 dB below the limit found. Please see annex for the measurement plot.

4.4.4 Test result: Spurious RF conducted emissions

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



4.5 Spurious radiated emissions

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

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

4.5.1 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 1.0×2.0 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 up to 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 µs
- 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. 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 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:

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 $+22.5^{\circ}$ 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

Measurement above 1GHz

The following modifications 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 (inverse linear distance for field strength measurements, inverse 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.

EMI receiver settings:

- Detector: Peak, Average
- RBW = VBW = 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.



4.5.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (d)

... In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

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 $(dB\mu V/m) = 20 \log (Limit (\mu V/m)/1\mu V/m)$

4.5.3 Test Protocol

Temperature:	25 °C
Air Pressure:	1018 hPa
Humidity:	38 %

Op. Mode	Setup	Port	
op-mode 1b	Setup_a01	Enclosure	

Polari- sation	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	1328		52.8	35.86		74	54	21.2	18.14
vertical	1593		50.2	34.06		74	54	23.8	19.94
vertical	3859		39.8	36.57		74	54	34.2	17.43
vertical	4824		54.38	42.27		74	54	19.62	11.73

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



Op. Mode	e Seti	лb	Poi		rt				
op-mode 2b Setup_a01 E			Enc	closure					
Polari- sation	Frequency MHz	Co	rrected va dBµV/m	alue	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	1326		52.41	35.69		74	54	21.59	18.31
vertical	1596		48.51	32.87		74	54	25.49	21.13
vertical	3899		39.9	37.25		74	54	34.1	16.75
vertical	4874		52.68	39.77		74	54	21.32	14.23

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

Op. Mode	Setup	Port
op-mode 3b	Setup_a01	Enclosure

Polari- sation	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	1329		51.81	36.04		74	54	22.19	17.96
vertical	3393		40.53	37.69		74	54	33.47	16.31
vertical	4924		50.86	23.14		74	54	23.14	14.94

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

4.5.4 Test result: Spurious radiated emissions

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



4.6 Band edge compliance

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

The test was performed according to: ANSI C 63.4, 2003 FCC §15.31, 2004-07-12

4.6.1 Test Description

The procedure to show compliance with the band edge requirement is divided into two measurements: 1. Show compliance of the lower band edge by a conducted measurement and 2. show compliance of the higher band edge by a radiated measurement.

For the first measurement the EUT is set to transmit on the lowest channel (2402 MHz). The lower band edge is 2400 MHz.

Analyzer settings:

- Detector: Peak
- RBW= 100 kHz
- VBW= 300 kHz

For the second measurement the EUT is set to transmit on the highest channel (2462 MHz). The higher band edge is 2483.5 MHz.

Analyzer settings:

- Detector: Peak, Average

- RBW = VBW = 100 kHz

4.6.2 Test Requirements / Limits

FCC Part 15.247 (d)

"In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c))."

For the measurement of the **lower band edge** the RF power at the band edge shall be "at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power..."

For the measurement of the **higher band edge** the limit is "specified in Section 15.209(a)".



4.6.3 Test Protocol

4.6.3.1 Lower band edge

Temperature:	25 °C
Air Pressure:	1018 hPa
Humidity:	38 %

Op. Mode	Setup	Port
op-mode 1b	Setup_b01	Temp.ant.connector

Frequency	Measured value	Reference value	Limit	Delta to limit
MHz	dBm	dBm	dBm	dB
2400.00	-51.04	2.23	-17.77	33.27

Remark: Please see annex for the measurement plot.

Op. Mode	Setup	Port		
op-mode 1g	Setup_b01	Temp.ant.connector		
Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Delta to limit dB
2400.00	-33.67	0.31	-19.69	13.98

Remark: Please see annex for the measurement plot.



4.6.3.2 Higher band edge Conducted measurement

Temperature:	25 °C
Air Pressure:	1018 hPa
Humidity:	38 %

Op. Mode	Setup	Port
op-mode 3b	Setup_b01	Temp.ant.connector

Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Delta to limit dB
2483.50	-55.89	2.31	-17.69	38.20
Op. Mode	Setup	Port		

op-mode 3g Setup_b01

Temp.ant.connector

Frequency	Measured value	Reference value	Limit	Delta to limit
MHz	dBm	dBm	dBm	dB
2483.50	-46.14	0.49	-19.51	26.63

Radiated measurement

Temperature:	25 °C
Air Pressure:	1018 hPa
Humidity:	38 %

Op. Mode	Setup	Port
op-mode 3b	Setup_a01	Enclosure

Frequency MHz	Polarisation	Correcto dBµ	ed value V/m	Limit Peak	Limit AV	Delta to Peak	Delta to AV limit
		Peak	AV	dBµV/m	dBµV/m	limit/dB	dB
2483.50	Vertical + horizontal	48.89	35.79	74.00	54.00	25.11	18.21

Remark: Please see annex for the measurement plot.

4.6.4 Test result: Band edge compliance

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



4.7 Power density

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

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

4.7.1 Test Description

The EUT was connected to spectrum analyzer via a short coax cable with a known loss. Analyzer settings:

- Detector: Peak-Maxhold
- Span: 300 kHz
- Resolution Bandwidth (RBW): 3 kHz
- Video Bandwidth (VBW): 30 kHz
- Sweep Time: Coupled

The reference level of the spectrum analyzer was set equal to the reference level of the EUT.

4.7.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (e)

For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

4.7.3 Test Protocol

Temperature:	25 °C
Air Pressure:	1018 hPa
Humidity:	38 %

dBm/3 kHz

Op. Mode	Setup	Port	
op-mode 1b	Setup_b01	Temp.ant.connector	
Power density		Remarks	
dBm/3 kHz			
-10.99		-	
Remark: Please see	annex for the measu	urement plot.	
Op. Mode	Setup	Port	
op-mode 1g	Setup_b01	Temp.ant.connector	
Power density		Remarks	

-13.63 Remark: Please see annex for the measurement plot.



Op. Mode	Setup	Port
op-mode 2b	Setup_b01	Temp.ant.connector
Power density dBm/3 kHz		Remarks
-11.46		-
Remark: Please see	annex for the measureme	nt plot.
Op. Mode	Setup	Port
op-mode 2g	Setup_b01	Temp.ant.connector
Power density		Remarks
dBm/3 kHz		
-12.36		-

Remark: Please see annex for the measurement plot.

Op. Mode	Setup	Port	
op-mode 3b	Setup_b01	Temp.ant.connector	
Power density dBm/3 kHz		Remarks	
-11.23		-	
Remark: Please see	annex for the measu	urement plot.	
Op. Mode	Setup	Port	
op-mode 3g	Setup_b01	Temp.ant.connector	
Power density dBm/3 kHz		Remarks	
-13.68		-	

Remark: Please see annex for the measurement plot.

4.7.4 Test result: Power density

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



5 Test Equipment

EUT Digital Signalling System

Equipment	Туре	Serial No.	Manufacturer
Digital Radio	CMD 55	831050/020	Rohde & Schwarz
Communication Tester			
Signalling Unit for	PTW60	100004	Rohde & Schwarz
Bluetooth Spurious			
Emissions			
Universal Radio	CMU 200	102366	Rohde & Schwarz
Communication Tester		102300	KUNUE & SCHWARZ

EMI Test System

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

EMI Radiated Auxiliary Equipment

Equipment	Туре	Serial No.	Manufacturer
Antenna mast 4m	MA 240	240/492	HD GmbH H. Deisel
Biconical dipole	VUBA 9117	9117108	Schwarzbeck
Broadband Amplifier	JS4-18002600-32	849785	Miteq
18MHz-26GHz			
Broadband Amplifier	JS4-00101800-35	896037	Miteq
30MHz-18GHz			
Broadband Amplifier	JS4-00102600-42	619368	Miteq
45MHz-27GHz			
Cable "ESI to EMI	EcoFlex10	W18.01-2 + W38.01-2	Kabel Kusch
Antenna"			
Cable "ESI to Horn	UFB311A + UFB293C	W18.02-2 + W38.02-2	Rosenberger-Microcoax
Antenna"			
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
Logper. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz
Pyramidal Horn Antenna	Model 3160-09	9910-1184	EMCO
26.5 GHz			



EMI Conducted Auxiliary Equipment

Equipment	Туре	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

Туре	Serial No.	Manufacturer
1506A / 93459	LM390	Weinschel
1515 / 93459	LN673	Weinschel
Voltcraft M-3860M	IJ096055	Conrad
Voltcraft M-3860M	IJ095955	Conrad
TDS 784C	B021311	Tektronix
FO RS232 Link	181-018	Pontis
FO RS232 Link	182-018	Pontis
AMIQ-B1	832085/018	Rohde & Schwarz
WRCA800/960-6E	24	Wainwright
FSP3	838164/004	Rohde & Schwarz
VT 4002	58566002150010	Vötsch
KWP 120/70	59226012190010	Weiss
Opus10 THI (8152.00)	7482	Lufft Mess- und
		Regeltechnik GmbH
	Type 1506A / 93459 1515 / 93459 Voltcraft M-3860M Voltcraft M-3860M TDS 784C FO RS232 Link FO RS232 Link AMIQ-B1 WRCA800/960-6E FSP3 VT 4002 KWP 120/70 Opus10 THI (8152.00)	TypeSerial No.1506A / 93459LM3901515 / 93459LN6731515 / 93459LN673Voltcraft M-3860MIJ096055Voltcraft M-3860MIJ095955TDS 784CB021311FO RS232 Link181-018FO RS232 Link182-018AMIQ-B1832085/018WRCA800/960-6E24FSP3838164/004VT 400258566002150010KWP 120/7059226012190010Opus10 THI (8152.00)7482

Anechoic Chamber

Equipment	Туре	Serial No.	Manufacturer
Air Compressor			Atlas Copco
(prieumatic)			
Controller	HD 100	100/603	HD GmbH H. Deisel
EMC Camera	CE-CAM/1		CE-SYS
EMC Camera for	CCD-400E	0005033	Mitsubishi
observation of EUT			
Filter ISDN	B84312-C110-E1		Siemens&Matsushita
Filter telephone systems	B84312-C40-B1		Siemens&Matsushita
/ modem			
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	VE 615P	615/348/99	HD GmbH, H. Deisel
(pneum.)			



7 layers Bluetooth Full RF Test Solution

Bluetooth RF Conformance Test System TS8960

Equipment	Туре	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 FSIQ26 832695/007	FSIQ26	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 Foto Report



Photo 1: EUT (front side)





Photo 2: EUT (rear side)





Picture 1: Setup for conducted emissions measurement on AC mains





Picture 2: Setup for radiated measurements below 1 GHz





Picture 3: Setup for radiated measurements above 1 GHz



7 Setup Drawings



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



8 Annex measurement plots

8.1 AC Mains conducted

Op. Mode

op-mode 4

Short Description: FCC Voltage Start IF Stop Step Detector Meas. Transducer Frequency Frequency 150.0 kHz 30.0 MHz Width Time Bandw. 5.0 kHz MaxPeak 20.0 ms 9 kHz ESH3-Z5 Average Level [dBµV] 70 60 50 40 30 W 20 10 0 30M 150 300 500 2N 3M 1M Frequency [Hz] MES Opti 0605 70 fin AV MES Opti 0605 70 pre PK MES Opti 0605 70 pre AV LIM FCC ClassB V QP new FCC ClassB, voltage LIM FCC ClassB V AV new FCC ClassB, voltage



8.2 Occupied bandwidth

8.2.1 Occupied bandwidth operating mode 1







op-mode 1g



Date: 13.SEP.2005 15:05:29



8.2.2 Occupied bandwidth operating mode 2

Op. Mode op-mode 2b Marker 2 [T1] RBW 10 kHz RF Att 20 dB Ref Lvl 30 kHz -12.14 dBm VBW 5 dBm 2.44205200 GHz SWT 760 ms Unit dBm **▼**2 A [T1] dBr 1 2.44205200 GHz will. ∇_1 -5.69 dBm [T1] SGL -10 2.43913427 GHz .y -17 **⊽** 3 -12.41 dBm (T1] 4800 GHz -20 4319 1MAX 1MA -30 -40 -50 TDF show -60 -70 -80 -90 Center 2.437 GHz 3 MHz/ Span 30 MHz Title: 6dB Bandwidth

Comment A: CH M: 2437 MHz; 6dB bandwidth (kHz):10104 Date: 13.SEP.2005 17:09:30











8.2.3 Occupied bandwidth operating mode 3









Comment A: CH T: 2462 MHz; 6dB bandwidth (kHz):16536 Date: 13.SEP.2005 15:48:39



8.3 Band edge compliance conducted and Spurious RF conducted emission

8.3.1 Band edge compliance conducted operating mode 1





op-mode 1g





8.3.2 Spurious RF conducted emission operating mode 1



Date: 14.SEP.2005 07:42:52







Date: 13.SEP.2005 23:50:15



8.3.3 Spurious RF conducted emission operating mode 2









op-mode 2g



Date: 13.SEP.2005 23:52:58





Date: 14.SEP.2005 00:04:35



8.3.4 Band edge compliance conducted operating mode 3









Date: 14.SEP.2005 00:06:43



8.3.5 Spurious RF conducted emission operating mode 3

mode 3b									
	Marker	1 [T1]		RBW	100 k	Hz	RF Att	20	dB
Ref Lvl		2.	.57 dBm	VBW	300 k	Hz			
5 dBm		2.431923	885 GHz	SWT	330	s	Unit		dBn
					V ₁	-[<u>T1</u>]		2.57	dBm
							2.43192	2385	GHz
					∇_2	[T1]	- 4	7.57	dBn
10							4.8838	3778	GHz
51 17 60	1 15				v ₃	[T1]	-5	6.24	dBn
20 DI -1 .69	l dBm-						6.8854	8606	GHz
					$\mathbf{\nabla}_4$	[T1]	-5	6.24	dBn
1MAX							6.8854	9098	GHz
40 50	2				. 14				
70 mm min	wall	h mar	hunn	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	/W_J W~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		hhan	.
80									
90									
Start 30 M	Hz		2.497	GHz/			Stor	> 2.5	GHz

Comment A: CH T: 2462 MHz Date: 14.SEP.2005 07:12:35







Date: 14.SEP.2005 00:18:21



8.3.6 Band edge compliance radiated operating mode 3

Op. Mode	higher band edge	
op-mode 3	TX on 2462 MHz	

Radiated measurement

Mai Del	rker: ta Mk:	2.4835 GHz 0 Hz	3	35.79 dBμV/m 13.1 dB		
Level [dBµV/m]						
80						
70						
60						
50						
40		\diamond				
30						
20						
10						
0	2.48G	2.485G	2.49G Frequency [Hz]	2.495G	2.5G	
	MES Opti_0605_35_pre PK MES Opti_0605_35_pre AV LIM FCC 15.209 3m Field Strength QP/AV Limit LIM FCC 15.209 3m Peak Field Strength Peak Limit					



8.4 Power density









Date: 14.SEP.2005 08:48:32













Date: 14.SEP.2005 09:31:17











