

InterLab[®]

EMC Measurement/Technical Report on Bluetooth (R) transceiver with integrated antenna RX-1M

Report Reference: 4_NOKIA_0804_BTT_FCCa

Test Laboratory (Headquarter):

7 Layers AG
Borsigstr. 11
40880 Ratingen
Germany



TTI-P-G 178/99

Note:

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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 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

§ 15.207 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:

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

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

1.2 Project Data

Responsible for testing and report: Dipl.-Ing. Robert Machulec
Receipt of EUT: 06.04.2004
Date of Test(s): 06.04.2004 - 16.04.2004
Date of Report: 19.04.2004

1.3 Applicant Data

Company Name: Nokia GmbH
Address: Meesmannstr 103
P.O. Box 101823
44718 Bochum
Germany
Contact Person: Mr. Heiko Dorschel

1.4 Manufacturer Data

Company Name: please see Applicant data
Address:

Contact Person:



2.0 Product Labeling

2.1 FCC ID Label:

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

2.2 Location of Label on the EUT:

see above

3. Testobject Data

3.1 General EUT Description

Equipment under Test:	Bluetooth (R) transceiver with integrated antenna
Type Designation:	RX-1M
Kind of Device: (optional)	Mobile phone Accessory
Voltage Type:	DC
Voltage level:	12 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 are defined. The channel is represented by a pseudo-random hopping sequence through the 79 channels. The channel is divided 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

CAN bus
Temp.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	Mobile phone Accessory	RX-1M	Test sample 1	0700	3.040	06.04.2004
EUT B	Mobile phone Accessory	RX-1M	Test sample 2	0700	3.040	06.04.2004

sample with temporary antenna connector

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
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3.4 EUT Setups

This chapter describes the combination of EUT's and ancillary equipment used for testing.

Setup No.	Combination of EUTs	Description
04t000b01	EUT A	used for radiated measurements
04t00a01	EUT B	used 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 1	The EUT transmits continuously on 2402 MHz	TX mode / loopback mode / local TX mode
op-mode 2	The EUT transmits continuously on 2441 MHz	TX mode / loopback mode / local TX mode
op-mode 3	The EUT transmits continuously on 2480 MHz	TX mode / loopback mode / local TX mode
op-mode 4	10 neighbouring channels	The EUT is set to transmit on ten neighbouring channels one after the other to see the channel separation.

4. Test Results

4.1 Occupied Bandwidth

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

The test was performed according to: ANSI C63.4 1992

4.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4-1992.

The Equipment Under Test (EUT) was setup in a shielded room to perform the 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 resolution bandwidth for measuring the reference level and the occupied bandwidth was 10 kHz.

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 (a) (1) (ii)

(1) Frequency hopping systems operating in the 2400 - 2483.5 MHz band should use at least 75 hopping frequencies.

(2) The average time of occupancy on any frequency should not be greater than 0.4 seconds within a 30 second period.

(3) The maximum 20 dB bandwidth of the hopping channel is 1MHz.

4.1.3 Test Protocol

Temperature: 24 °C

Air Pressure: 1018 hPa

Humidity: 32 %

Op. Mode	Setup	Port	Test Parameter
op-mode 1	04t00a01	antenna connector	

20 dB Bandwidth MHz	Remarks
0,9784	none

Remark: Please see annex for the measurement plot.

Temperature: 24 °C
Air Pressure: 1018 hPa
Humidity: 32 %

Op. Mode	Setup	Port	Test Parameter
op-mode 2	04t00a01	antenna connector	

20 dB Bandwidth MHz	Remarks
0,9784	none

Remark: Please see annex for the measurement plot.

Temperature: 24 °C
Air Pressure: 1018 hPa
Humidity: 32 %

Op. Mode	Setup	Port	Test Parameter
op-mode 3	04t00a01	antenna connector	

20 dB Bandwidth MHz	Remarks
0,9824	none

Remark: Please see annex for the measurement plot.

4.1.3 Test result: Occupied Bandwidth

FCC Part 15, Subpart C	Op. Mode	Setup	Port	Result
	op-mode 1	04t00a 01	antenna connector	passed
	op-mode 2	04t00a 01	antenna connector	passed
	op-mode 3	04t00a 01	antenna connector	passed

4.2 Peak Power Output

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

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

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 analyser was set equal to the output power of the EUT.

The EUT was connected to the spectrum analyzer via a short coax cable (Type: Rosenberger RTK 161, 1m, SMA connectors), with a known loss.

4.2.2 Test Limits

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

(1) For frequency hopping systems operating in the band 2400 - 2483,5 MHz or 5725 - 5850 MHz and for all direct sequence systems: 1 Watt

Used conversion factor: Limit (dBm) = 10 log (Limit (W))/1mW)

==> Maximum Output Power: 30 dBm

4.2.3 Test Protocol

Temperature: 24 °C

Air Pressure: 1018 hPa

Humidity: 32 %

Op. Mode	Setup	Port	Test Parameter
op-mode 1	04t00a01	antenna connector	

Output Power dBm	Remarks
2,51	The EIRP including antenna gain (0 dBi) is 2,51 dBm

Remark: Please see annex for the measurement plot.

Temperature: 24 °C
Air Pressure: 1018 hPa
Humidity: 32 %

Op. Mode	Setup	Port	Test Parameter
op-mode 2	04t00a01	antenna connector	

Output Power dBm	Remarks
2,63	The EIRP including antenna gain (0 dBi) is 2,63 dBm

Remark: Please see annex for the measurement plot.

Temperature: 24 °C
Air Pressure: 1018 hPa
Humidity: 32 %

Op. Mode	Setup	Port	Test Parameter
op-mode 3	04t00a01	antenna connector	

Output Power dBm	Remarks
2,33	The EIRP including antenna gain (0 dBi) is 2,33 dBm

Remark: Please see annex for the measurement plot.

4.2.3 Test result: Peak Power Output

FCC Part 15, Subpart C	Op. Mode	Setup	Port	Result
	op-mode 1	04t00a01	antenna connector	passed
	op-mode 2	04t00a01	antenna connector	passed
	op-mode 3	04t00a01	antenna connector	passed

4.3 Spurious RF Conducted Emissions

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

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

4.3.1 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.

4.3.2 Test 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.

4.3.3 Test Protocol

Temperature: 24 °C
Air Pressure: 1018 hPa
Humidity: 32 %

Op. Mode	Setup	Port	Test Parameter			
op-mode 1	04t00a01	antenna connector				

Frequency MHz	Measured Value dBm	Correction Factor dB	Corrected Value	Reference Value dBm	Limit dBm	Delta to Limit dB
30,00			-43,38	2,54	-17,46	25,92

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

Temperature: 24 °C
Air Pressure: 1018 hPa
Humidity: 32 %

Op. Mode	Setup	Port	Test Parameter
op-mode 2	04t00a01	antenna connector	

Frequency MHz	Measured Value dBm	Correction Factor dB	Corrected Value	Reference Value dBm	Limit dBm	Delta to Limit dB
30,00			-48,08	2,65	-17,35	30,73

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

Temperature: 24 °C
Air Pressure: 1018 hPa
Humidity: 32 %

Op. Mode	Setup	Port	Test Parameter
op-mode 3	04t00a01	antenna connector	

Frequency MHz	Measured Value dBm	Correction Factor dB	Corrected Value	Reference Value dBm	Limit dBm	Delta to Limit dB
30,00			-50,07	2,34	-17,66	32,41

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

4.3.3 Test result: Spurious RF Conducted Emissions

FCC Part 15, Subpart C

Op. Mode	Setup	Port	Result
op-mode 1	04t00a01	antenna connector	passed
op-mode 2	04t00a01	antenna connector	passed
op-mode 3	04t00a01	antenna connector	passed

4.4 Spurious Radiated Emissions

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

The test was performed according to: ANSI C63.4 1992

4.4.1 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 were 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 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 (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.

4.4.2 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)

4.4.3 Test Protocol

Temperature: 23 °C

Air Pressure: 1023 hPa

Humidity: 36 %

Op. Mode	Setup	Port	Test Parameter					
op-mode 1	04t000b01	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				
Vertical	2390,00		63,43	37,69	54,00	74,00	16,31	10,57
Vertical	4804,00		34,67	22,96	54,00	74,00	31,04	39,33

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

Temperature: 23 °C

Air Pressure: 1023 hPa

Humidity: 36 %

Op. Mode	Setup	Port	Test Parameter					
op-mode 2	04t000b01	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				
Vertical	4882,00		34,90	23,08	54,00	74,00	30,92	39,10

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

Temperature: 23 °C
Air Pressure: 1023 hPa
Humidity: 36 %

Op. Mode	Setup	Port	Test Parameter
op-mode 3	04t000b01	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				
Vertical	2483,50		71,43	36,84	54,00	74,00	17,16	2,57
Vertical	4960,00		35,28	24,24	54,00	74,00	29,76	38,72

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

4.4.3 Test result: Spurious Radiated Emissions

FCC Part 15, Subpart C		Op. Mode	Setup	Port	Result
		op-mode 1	04t000b01	Enclosure	passed
		op-mode 2	04t000b01	Enclosure	passed
		op-mode 3	04t000b01	Enclosure	passed

4.5 Channel Separation

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

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

4.5.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room to perform the channel separation 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
- Span: 10 MHz
- Resolution Bandwidth (RBW): 300 kHz
- Video Bandwidth (VBW): 300 kHz
- Sweep Time: Coupled

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

4.5.2 Test 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.

4.5.3 Test Protocol

Temperature: 24 °C
Air Pressure: 1020 hPa
Humidity: 33 %

Op. Mode	Setup	Port	Test Parameter
op-mode 4	04t00a01	antenna connector	

Channel Separation MHz	Remarks
1,002	none

Remark: Please see annex for the measurement plot.

4.5.3 Test result: Channel Separation

FCC Part 15, Subpart C	Op. Mode	Setup	Port	Result
	op-mode 4	04t00a01	antenna connector	passed

5. Testequipment

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	JS4-18002600-32-5P	849785	Miteq
Broadband Amplifier 30MHz-18GHz	JS4-00101800-35-5P	896037	Miteq
Broadband Amplifier 45MHz-27GHz	JS4-00102600-42-5A	619368	Miteq
Cable "ESI to EMI Antenna"	RTK081+Aircell7	W18.01+W38.01a	Huber+Suhner
Cable "ESI to Horn Antenna"	RTK 081	W18.04+3599/001	Rosenberger
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic
High Pass Filter	5HC3500/12750-1.2-KK	200035008	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	WRCA800/960-6EEK	24	Wainwright
Spectrum Analyzer 9KHz To 3GHz	FSP3	838164/004	Rohde & Schwarz
Temperature Chamber	VT 4002	58566002150010	Vötsch
Temperature Chamber	KWP 120/70	59226012190010	Weiss
ThermoHygro_01	430202		Fischer

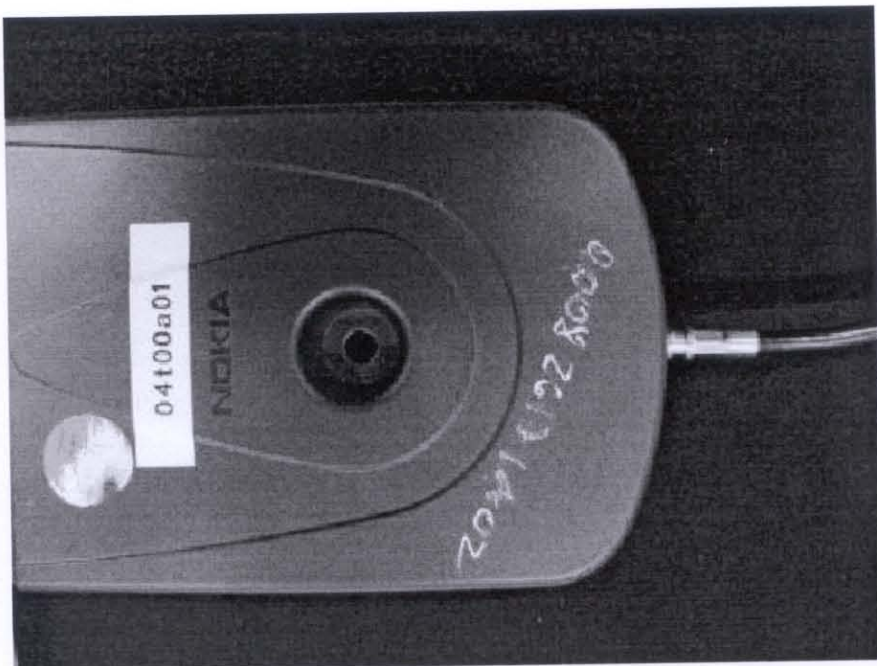
Anechoic Chamber

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
10MHz 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 Analyser FSIQ26 832695/007	FSIQ26	832695/007	Rohde & Schwarz
Signal Analyser FSP30 100051	FSP30	100051	Rohde & Schwarz
Signal Generator 101175	SMIQ03B	101175	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

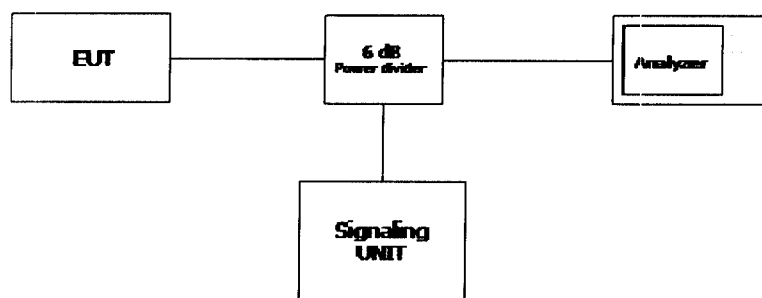


Picture 1 : EUT for conducted tests

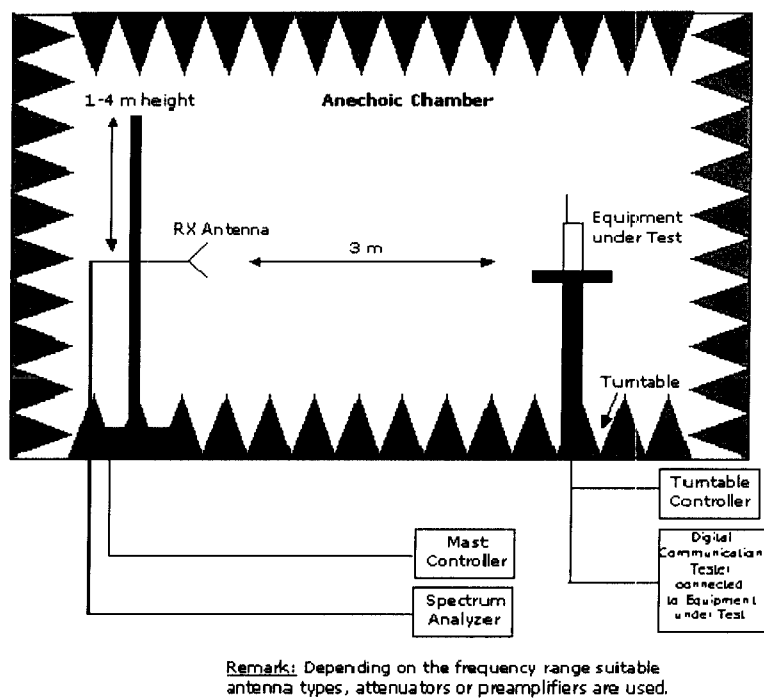


Picture 2 : Setup for the test "radiated emission"

7. Setup Drawings



Drawing 1 : Setup for conducted emission measurement (in principle)



Drawing 2 : Setup for radiated emission measurement (fully anechoic, in principle)

8. Annex

measurement plots

Occupied Bandwidth

Op. Mode

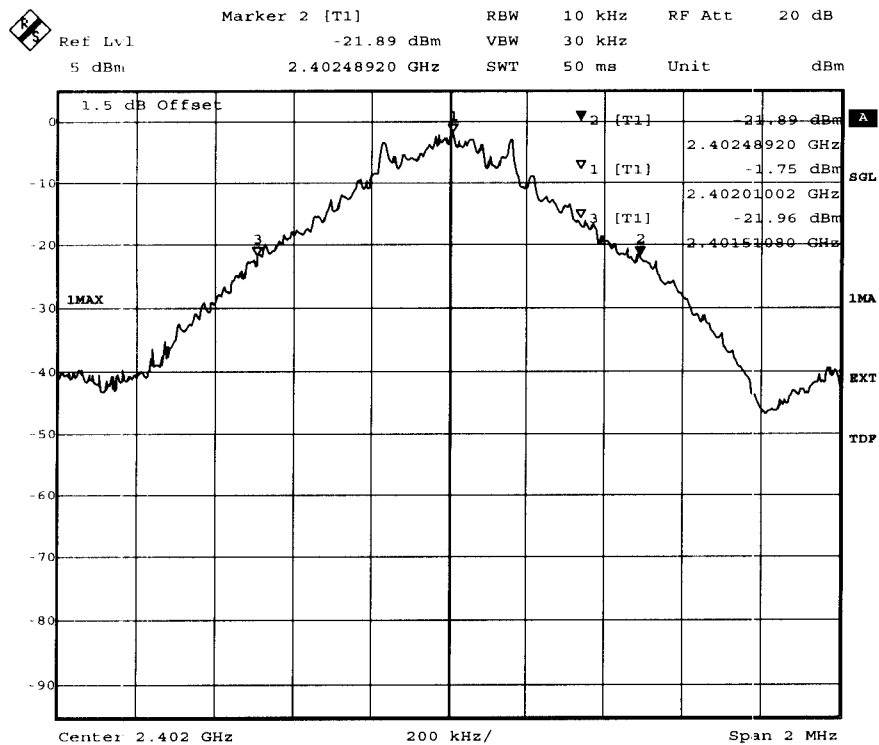
op-mode 1 The EUT transmits continuously on 2402 MHz

Setup

04t00a01

Port

antenna connector



Title: 20dB Bandwidth
 Comment A: CH B: 2402 MHz; 20dB bandwidth (kHz):978.4
 Date: 13.APR.2004 16:24:30

20 dB bandwidth

Occupied Bandwidth

Op. Mode

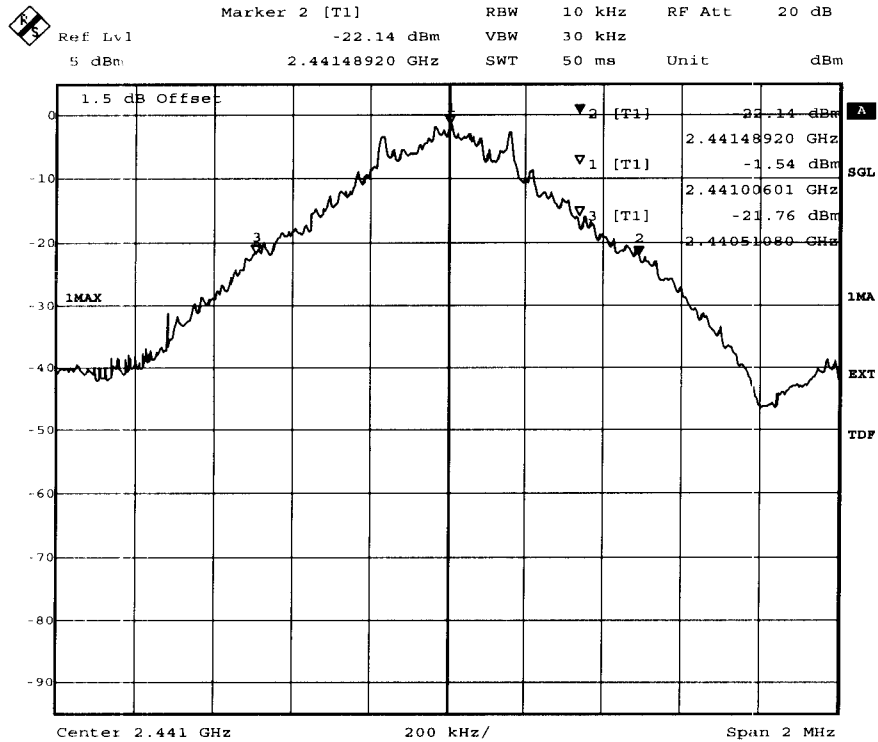
op-mode 2 The EUT transmits continuously on 2441 MHz

Setup

04t00a01

Port

antenna connector



Title: 20dB Bandwidth
 Comment A: CH M: 2441 MHz; 20dB bandwidth (kHz):978.4
 Date: 13.APR.2004 16:38:18

20 dB bandwidth

Occupied Bandwidth

Op. Mode

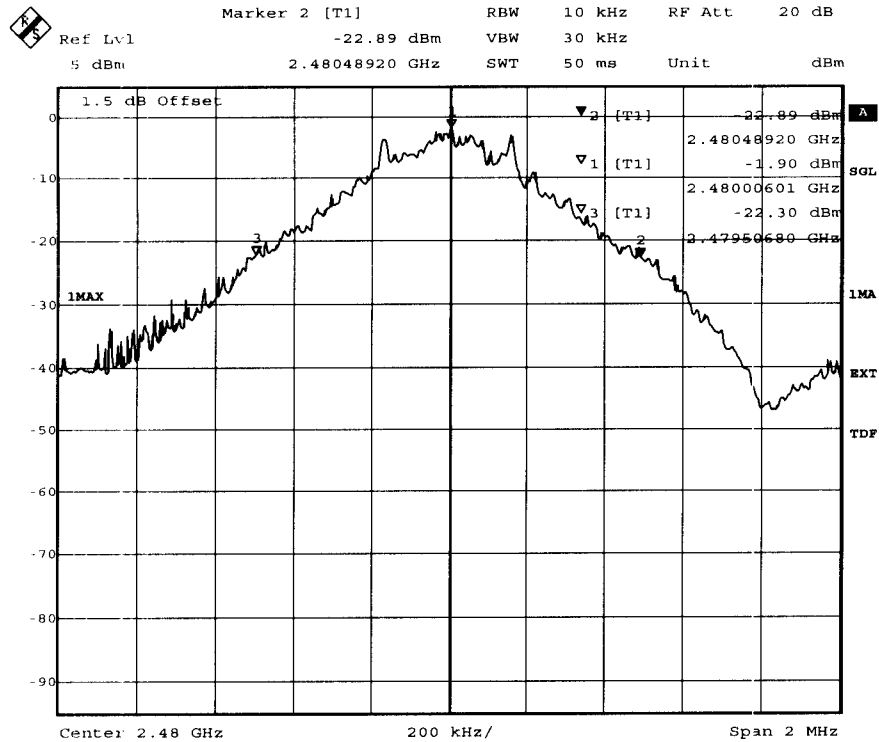
op-mode 3 The EUT transmits continuously on 2480 MHz

Setup

04t00a01

Port

antenna connector



Title: 20dB Bandwidth
 Comment A: CH T: 2480 MHz; 20dB bandwidth (kHz):982.4
 Date: 13.APR.2004 16:51:18

20 dB bandwidth

Peak Power Output

Op. Mode

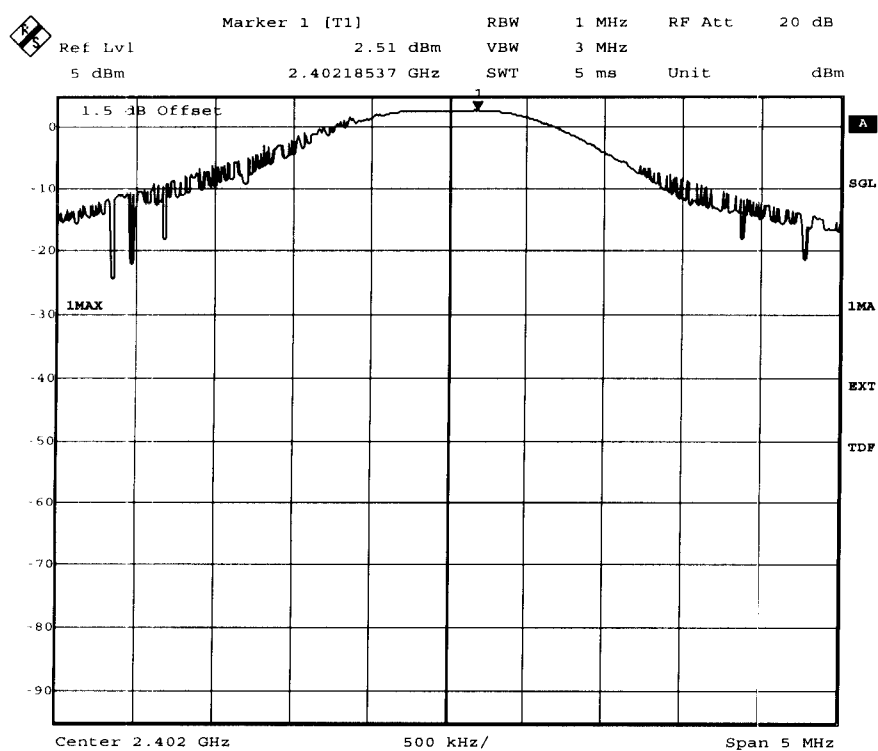
op-mode 1 The EUT transmits continuously on 2402 MHz

Setup

04t00a01

Port

antenna connector



Title: Peak outputpower Power
 Comment A: CH B: 2402 MHz
 Date: 13.APR.2004 16:24:57

peak output power



Peak Power Output

Op. Mode

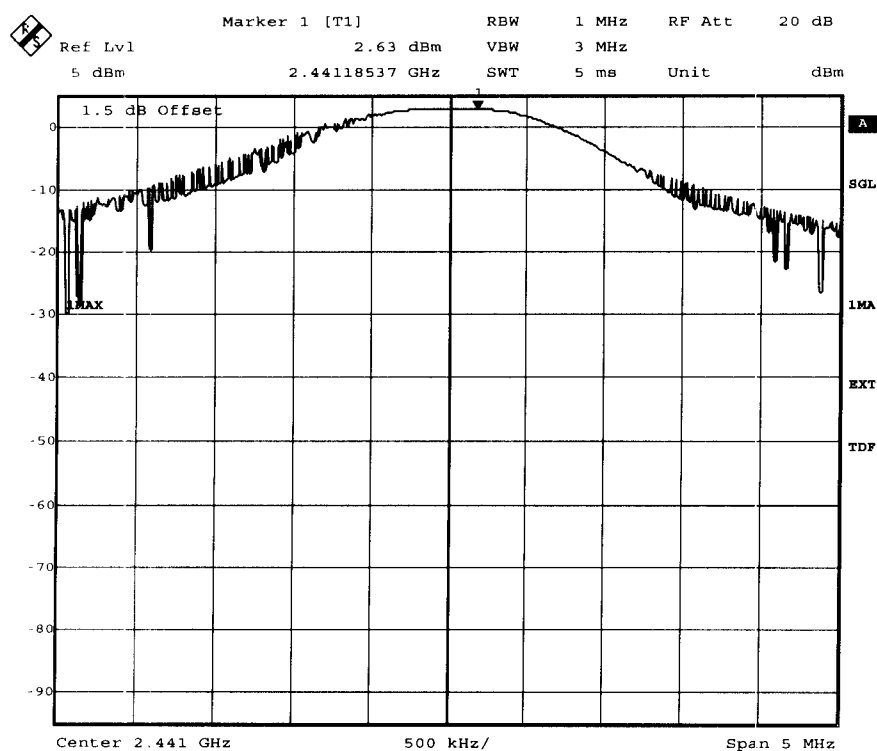
op-mode 2 The EUT transmits continuously on 2441 MHz

Setup

04t00a01

Port

antenna connector



Title: Peak outputpower Power
Comment A: CH M: 2441 MHz
Date: 13.APR.2004 16:38:44

peak output power

Peak Power Output

Op. Mode

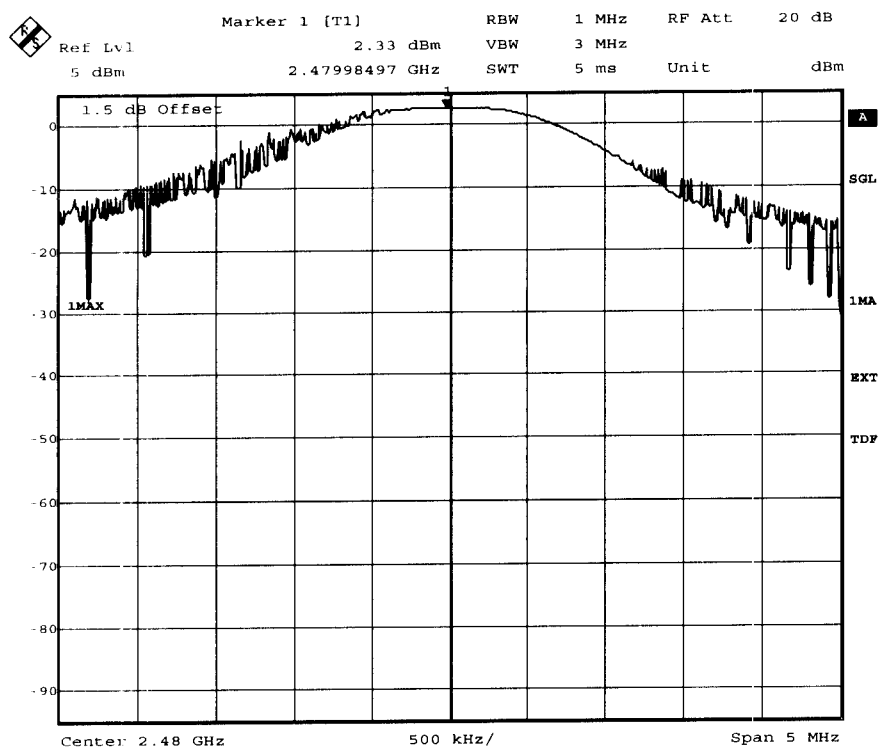
op-mode 3 The EUT transmits continuously on 2480 MHz

Setup

04t00a01

Port

antenna connector



Title: Peak outputpower Power
 Comment A: CH T: 2480 MHz
 Date: 13.APR.2004 16:51:44

peak output power

Spurious RF Conducted Emissions

Op. Mode

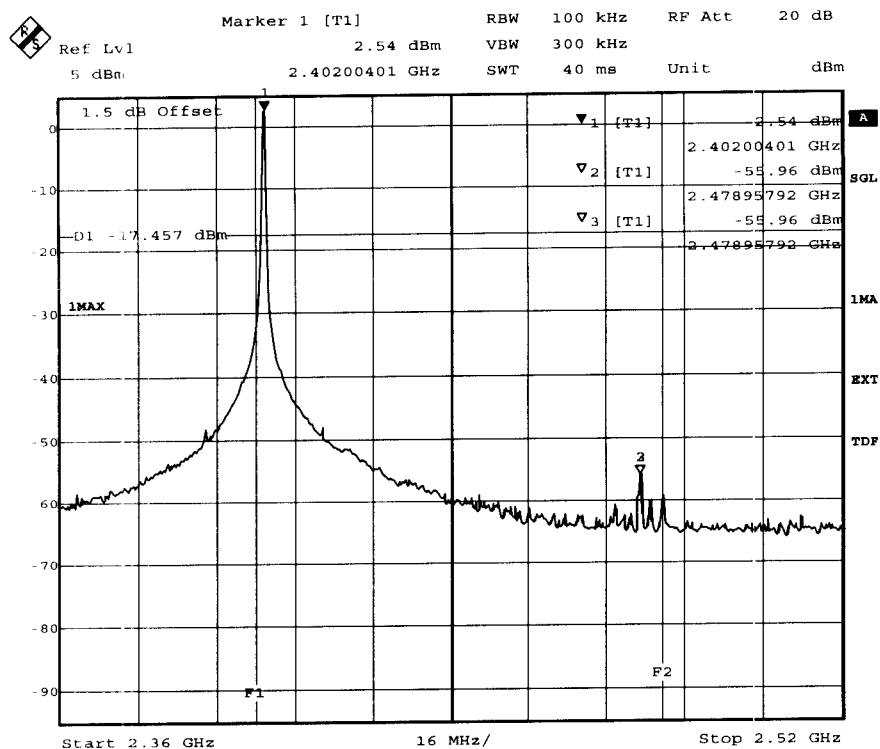
op-mode 1 The EUT transmits continuously on 2402 MHz

Setup

04t00a01

Port

antenna connector



Title: Band Edge Compliance
 Comment A: CH B: 2402 MHz
 Date: 13.APR.2004 16:14:46

band edge compliance

Spurious RF Conducted Emissions

Op. Mode

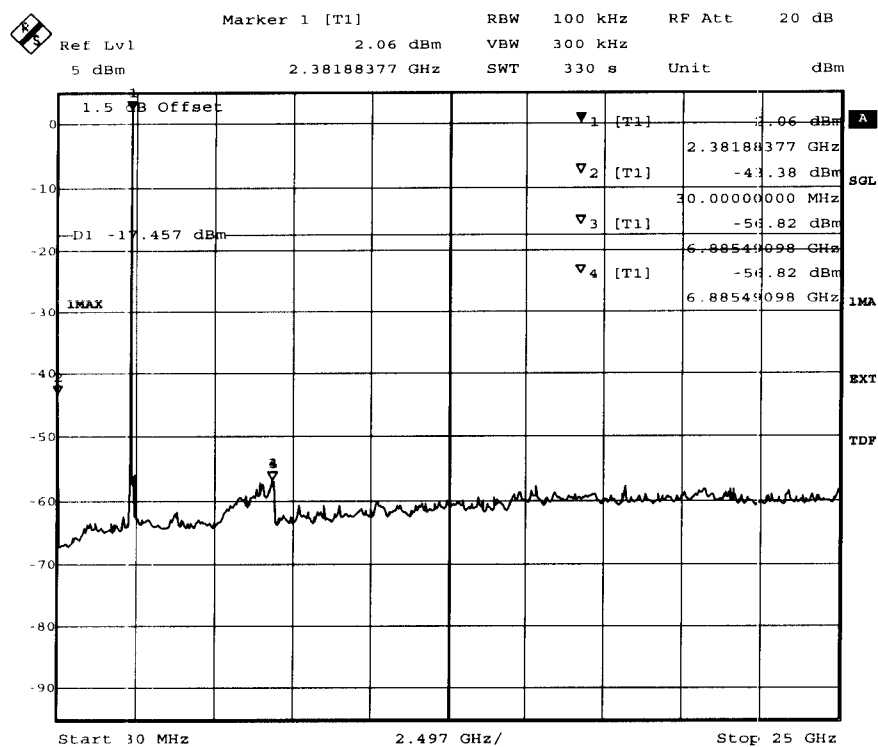
op-mode 1 The EUT transmits continuously on 2402 MHz

Setup

04t00a01

Port

antenna connector



Title: spurious emissions
 Comment A: CH B: 2402 MHz
 Date: 13.APR.2004 16:20:53

spurious emissions conducted

Spurious RF Conducted Emissions

Op. Mode

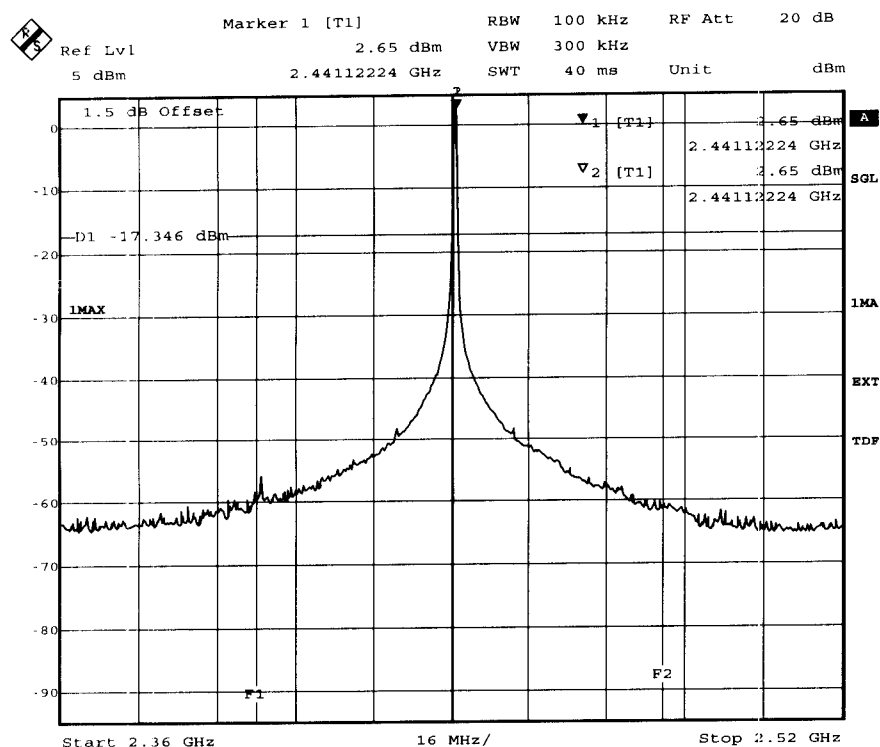
op-mode 2 The EUT transmits continuously on 2441 MHz

Setup

04t00a01

Port

antenna
connector



Title: Band Edge Compliance
Comment A: CH M: 2441 MHz
Date: 13.APR.2004 16:28:49

band edge compliance

Spurious RF Conducted Emissions

Op. Mode

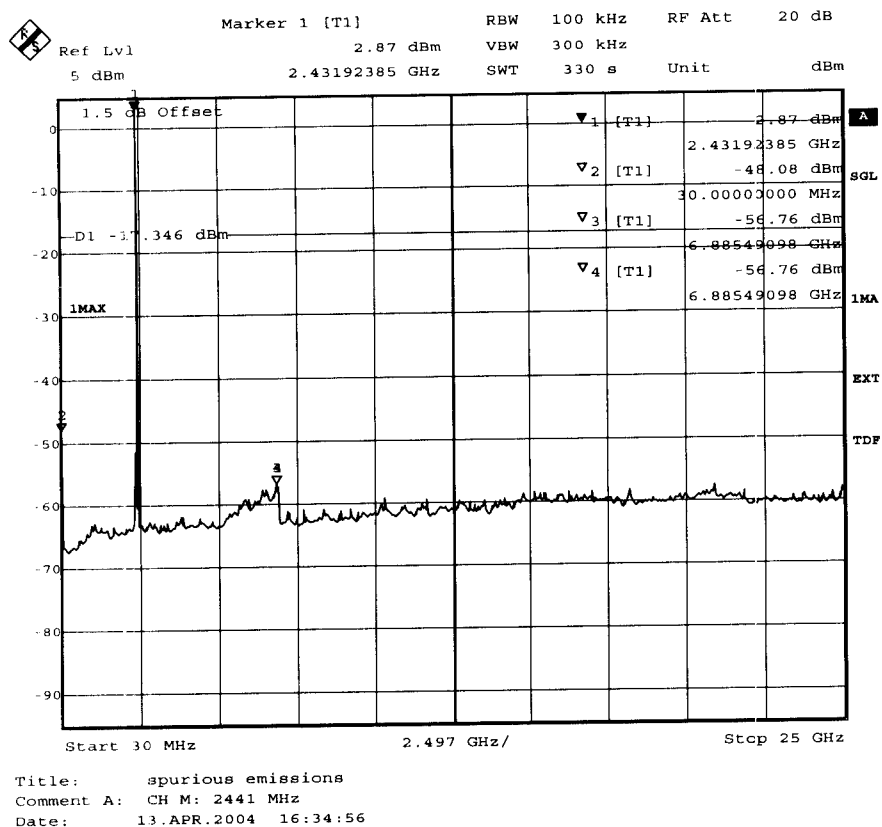
op-mode 2 The EUT transmits continuously on 2441 MHz

Setup

04t00a01

Port

antenna connector



spurious emissions conducted

Spurious RF Conducted Emissions

Op. Mode

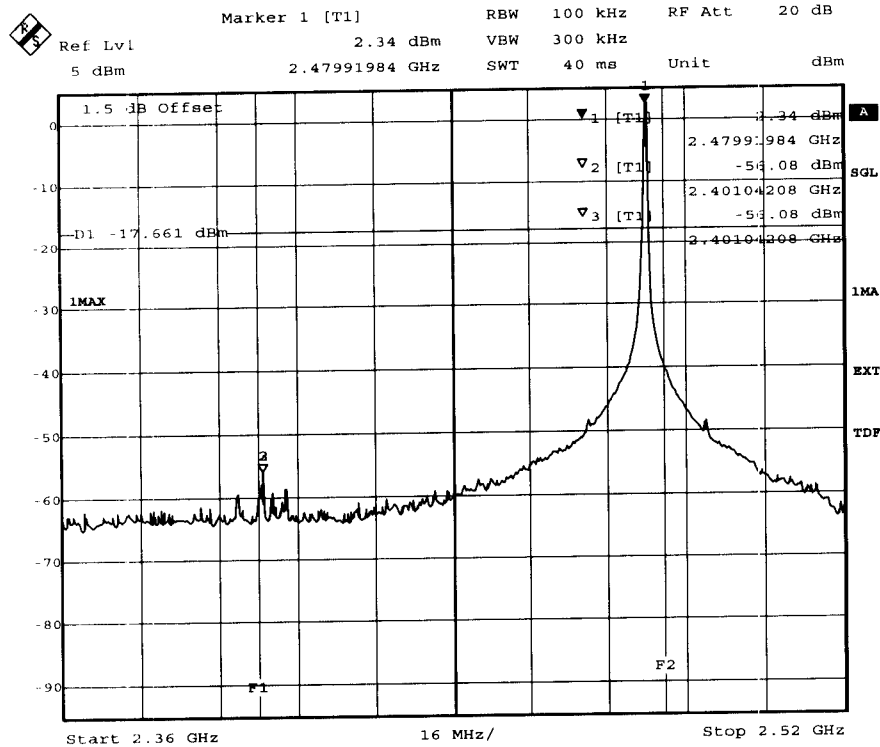
op-mode 3 The EUT transmits continuously on 2480 MHz

Setup

04t00a01

Port

antenna connector



Title: Band Edge Compliance
 Comment A: CH T: 2480 MHz
 Date: 13.APR.2004 16:41:39

band edge compliance

Spurious RF Conducted Emissions

Op. Mode

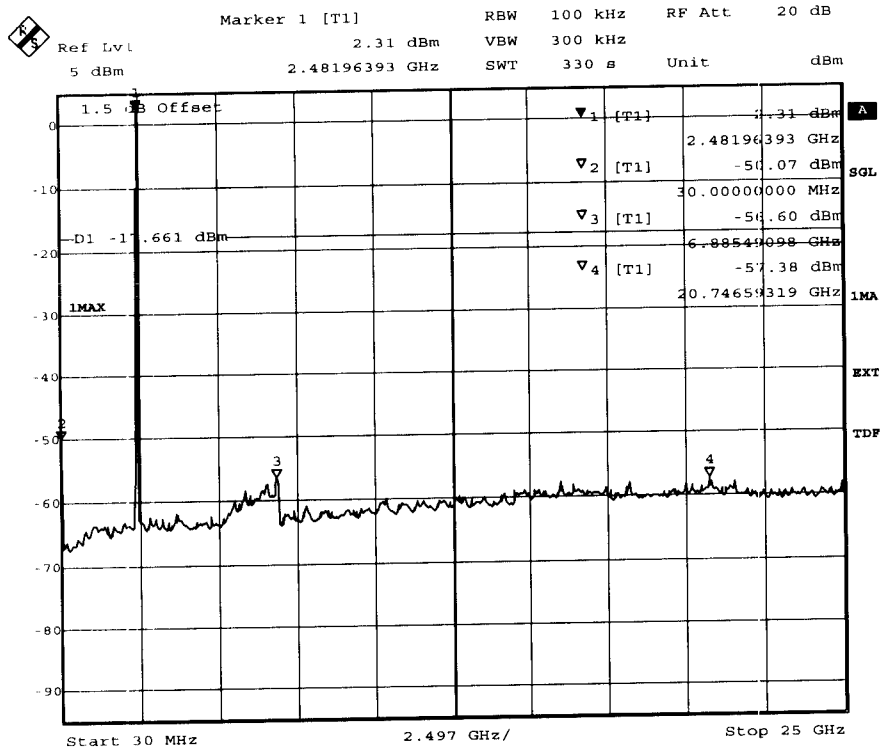
op-mode 3 The EUT transmits continuously on 2480 MHz

Setup

04t00a01

Port

antenna connector



Title: spurious emissions
 Comment A: CH T: 2480 MHz
 Date: 13.APR.2004 16:47:46

spurious emissions conducted

Channel Separation

Op. Mode

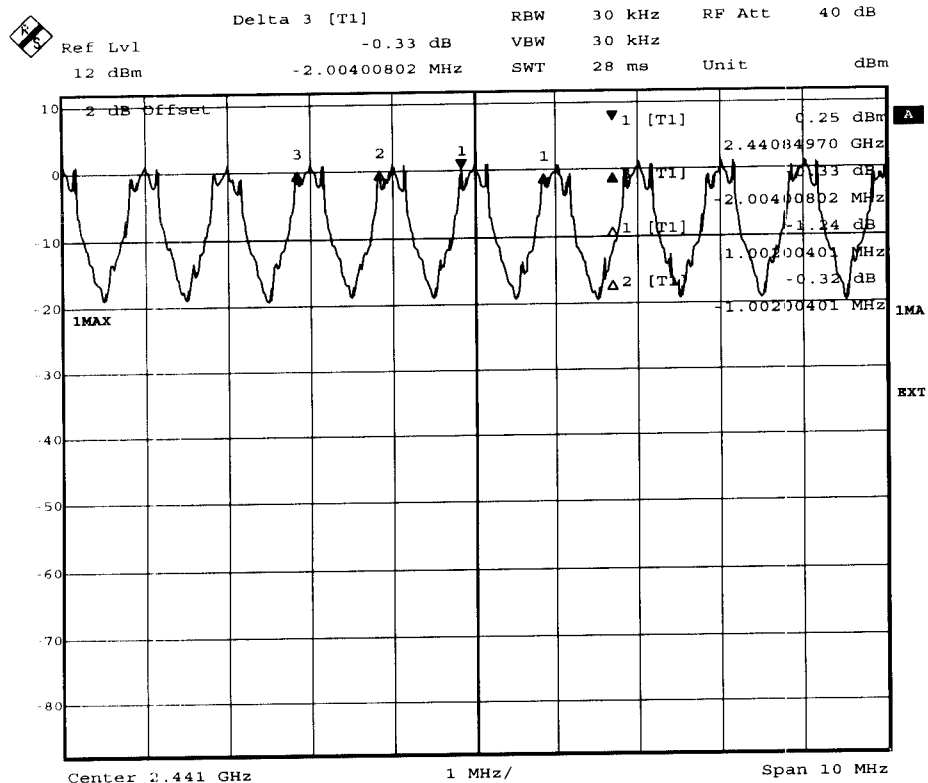
op-mode 4 10 neighbouring channels

Setup

04t00a01

Port

antenna
connector



Date: 16.APR.2004 08:03:31

channel separation

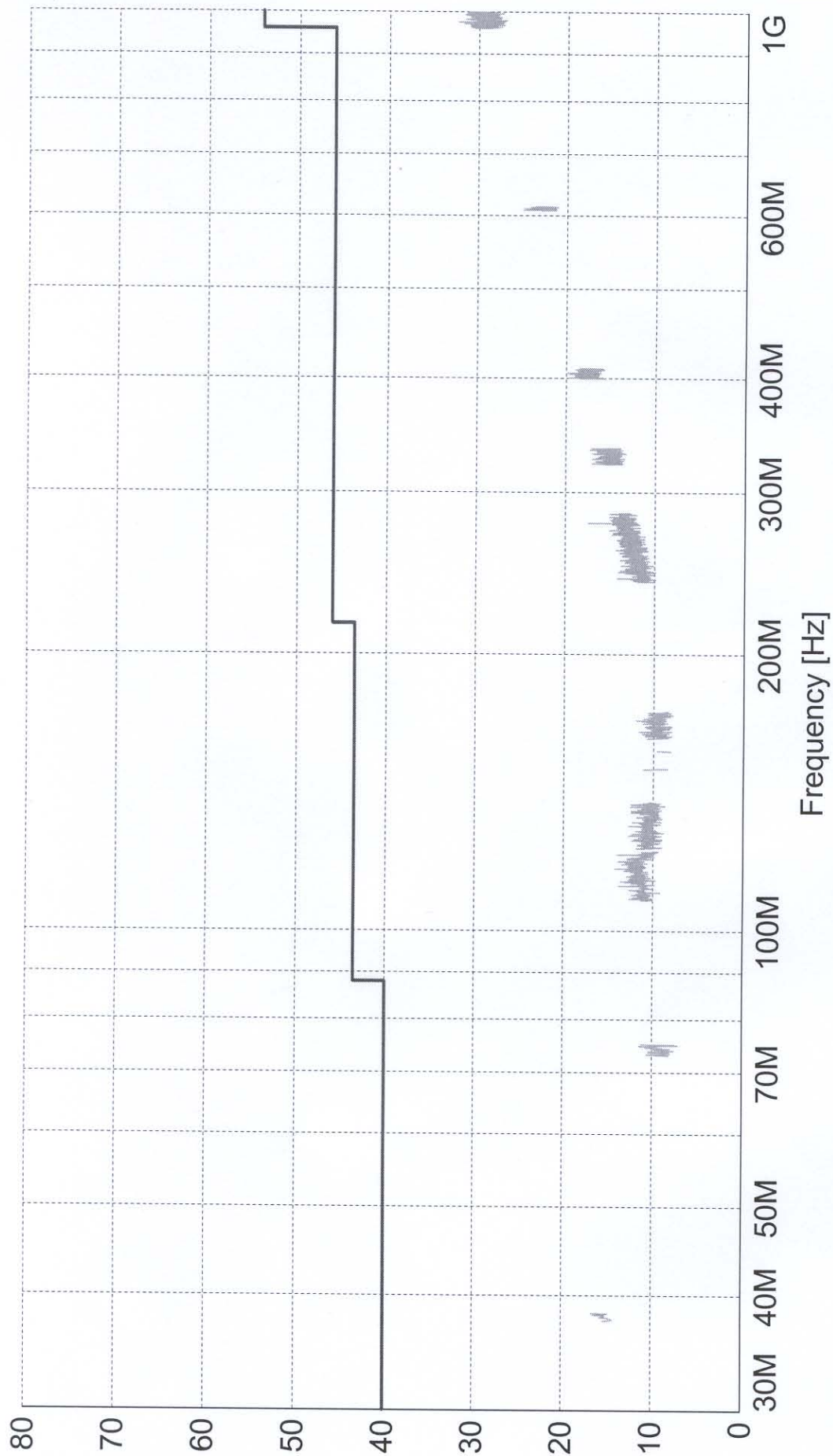
SPURIOUS EMISSION RADIATED

EUT: Proto (04T000b01) / 15.04.04
 Manufacturer: Nokia
 Operating Condition: TX on 2402 MHz
 Test Site: 7 layers, Ratingen
 Operator: GAL
 Test Specification: FCC 15.247 (15.35b, 15.209)
 Comment: vertical + horizontal polarisation
 Start of Test: 15.04.04 / 20:27:17

SCAN TABLE: "FCC 15.209 Field <1G"

Short Description:		EN 55022 Field Strength				Transducer	
Start	Stop	Step	Detector	Meas.	IF		
Frequency	Frequency	Width		Time	Bandw.		
37.5 MHz	38.3 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562	
73.0 MHz	74.6 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562	
74.8 MHz	75.2 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562	
108.0 MHz	121.9 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562	
123.0 MHz	138.0 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562	
149.9 MHz	150.1 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562	
156.5 MHz	156.5 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562	
156.7 MHz	156.9 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562	
162.0 MHz	167.2 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562	
167.7 MHz	173.2 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562	
240.0 MHz	285.0 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562	
322.0 MHz	335.4 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562	
399.9 MHz	410.0 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562	
608.0 MHz	614.0 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562	
960.0 MHz	1.0 GHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562	

Level [dBμV/m]



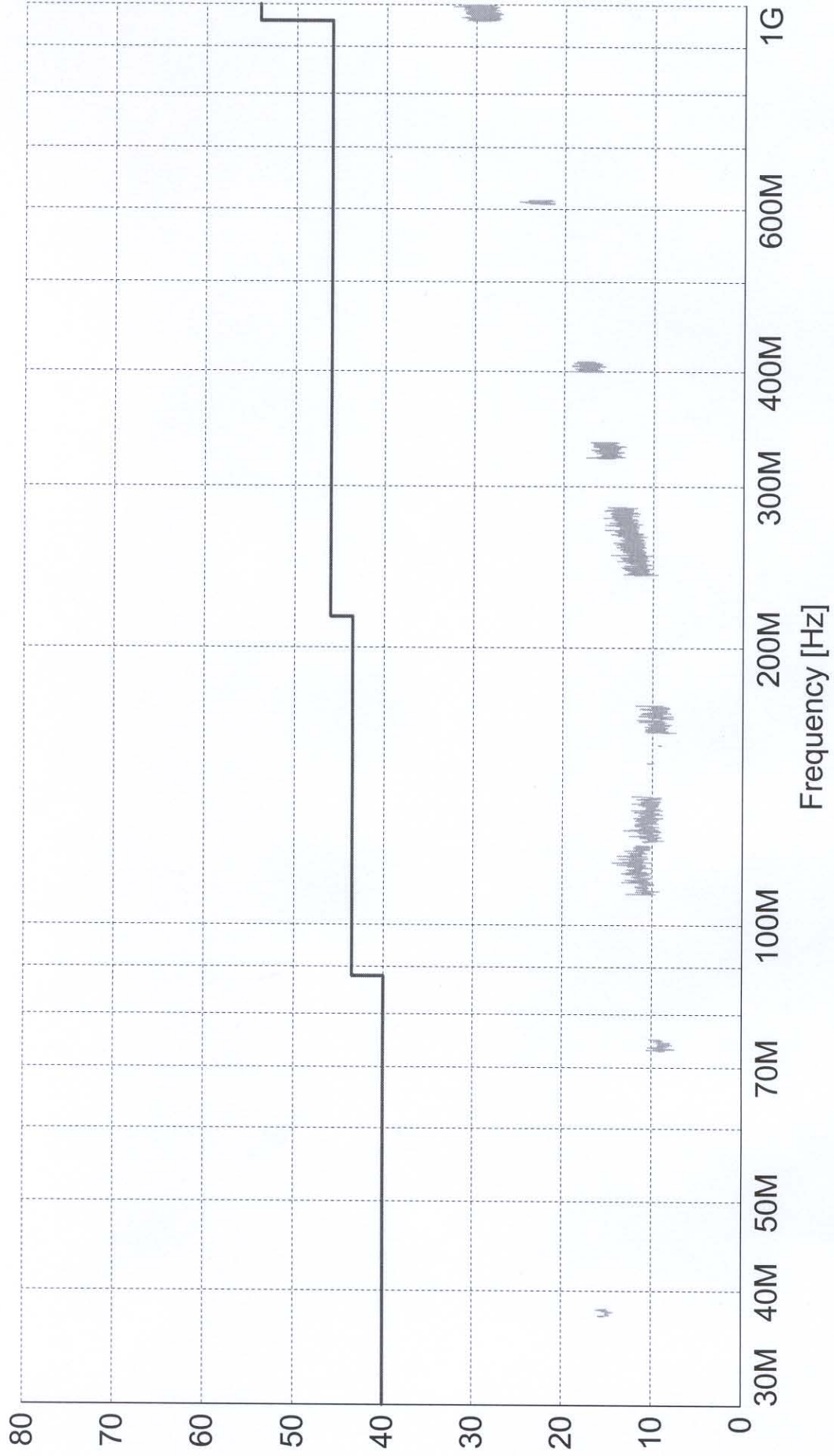
SPURIOUS EMISSION RADIATED

EUT: Proto (04T000b01) / 15.04.04
 Manufacturer: Nokia
 Operating Condition: TX on 2480 MHz
 Test Site: 7 layers, Ratingen
 Operator: GAL
 Test Specification: FCC 15.247 (15.35b, 15.209)
 Comment: vertical + horizontal polarisation
 Start of Test: 15.04.04 / 20:55:48

SCAN TABLE: "FCC 15.209 Field <1G"

Short Description:		EN 55022 Field Strength		IF		Transducer
Start	Stop	Step	Detector	Meas.	Bandw.	
Frequency	Frequency	Width	Time	Time	Bandw.	
37.5 MHz	38.3 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
73.0 MHz	74.6 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
74.8 MHz	75.2 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
108.0 MHz	121.9 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
123.0 MHz	138.0 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
149.9 MHz	150.1 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
156.5 MHz	156.5 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
156.7 MHz	156.9 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
162.0 MHz	167.2 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
167.7 MHz	173.2 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
240.0 MHz	285.0 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
322.0 MHz	335.4 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
399.9 MHz	410.0 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
608.0 MHz	614.0 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
960.0 MHz	1.0 GHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562

Level [dBμV/m]



MES Nok_0804_09_pre PK
LIM FCC 15.209 3m
Field Strength QP/AV Limit

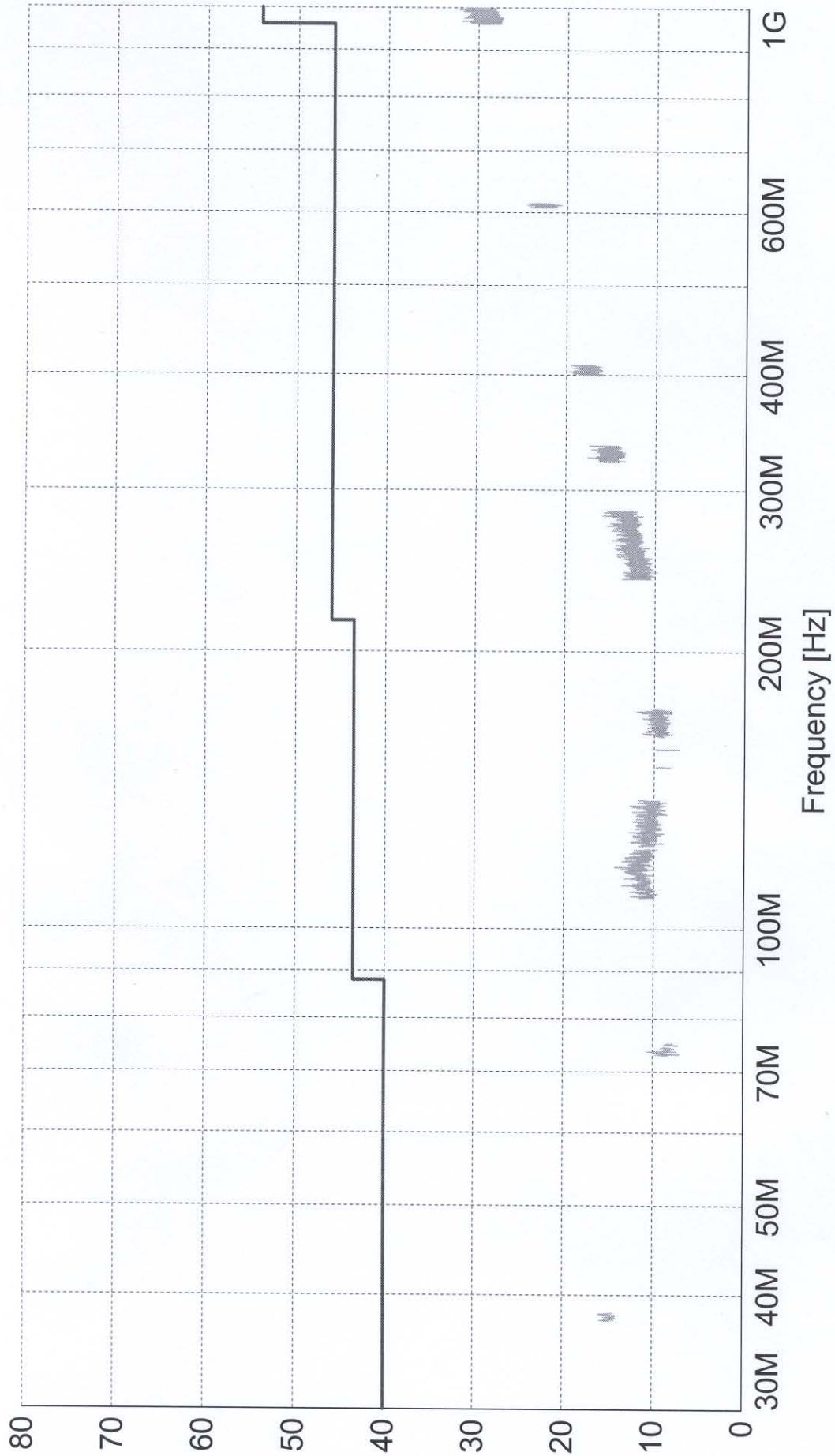
SPURIOUS EMISSION RADIATED

EUT: Proto (04T000b01) / 15.04.04
 Manufacturer: Nokia
 Operating Condition: TX on 2441 MHz
 Test Site: 7 layers, Ratingen
 Operator: GAL
 Test Specification: FCC 15.247 (15.35b, 15.209)
 Comment: vertical + horizontal polarisation
 Start of Test: 15.04.04 / 20:43:02

SCAN TABLE: "FCC 15.209 Field <1G"

Short Description:		EN 55022 Field Strength		IF		Transducer
Start	Stop	Step	Detector	Meas. Time	Bandw.	
Frequency	Frequency	Width				
37.5 MHz	38.3 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
73.0 MHz	74.6 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
74.8 MHz	75.2 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
108.0 MHz	121.9 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
123.0 MHz	138.0 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
149.9 MHz	150.1 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
156.5 MHz	156.5 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
156.7 MHz	156.9 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
162.0 MHz	167.2 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
167.7 MHz	173.2 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
240.0 MHz	285.0 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
322.0 MHz	335.4 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
399.9 MHz	410.0 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
608.0 MHz	614.0 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
960.0 MHz	1.0 GHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562

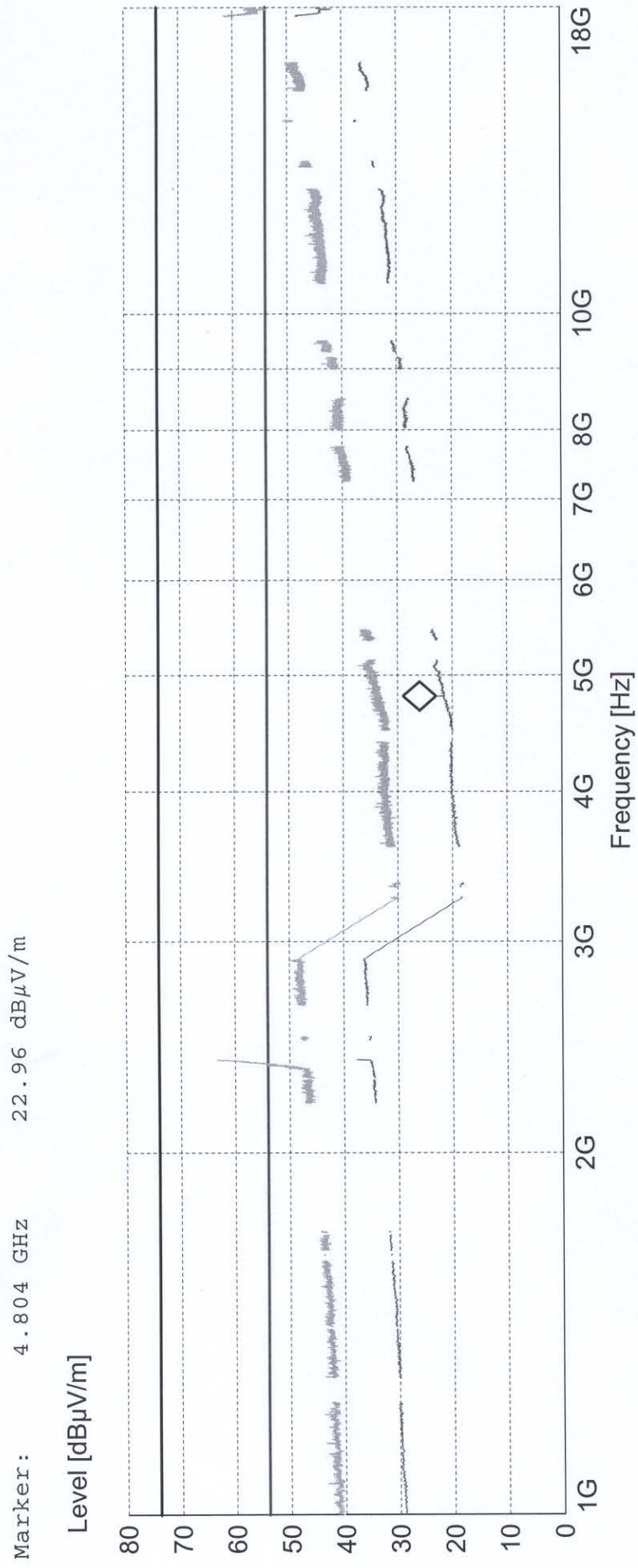
Level [dBμV/m]



MES Nok_0804_08_pre PK
LIM FCC 15.209 3m Field Strength QP/AV Limit

SPURIOUS EMISSION RADIATED

EUT: Proto (04T000b01) / 13.04.04
 Manufacturer: Nokia
 Operating Condition: TX on 2402 MHz
 Test Site: 7 layers Ratingen
 Operator: Groe
 Test Specification: FCC 15.247 (15.35b, 15.209)
 Comment: vertical + horizontal antenna polarisation
 vertical EUT position



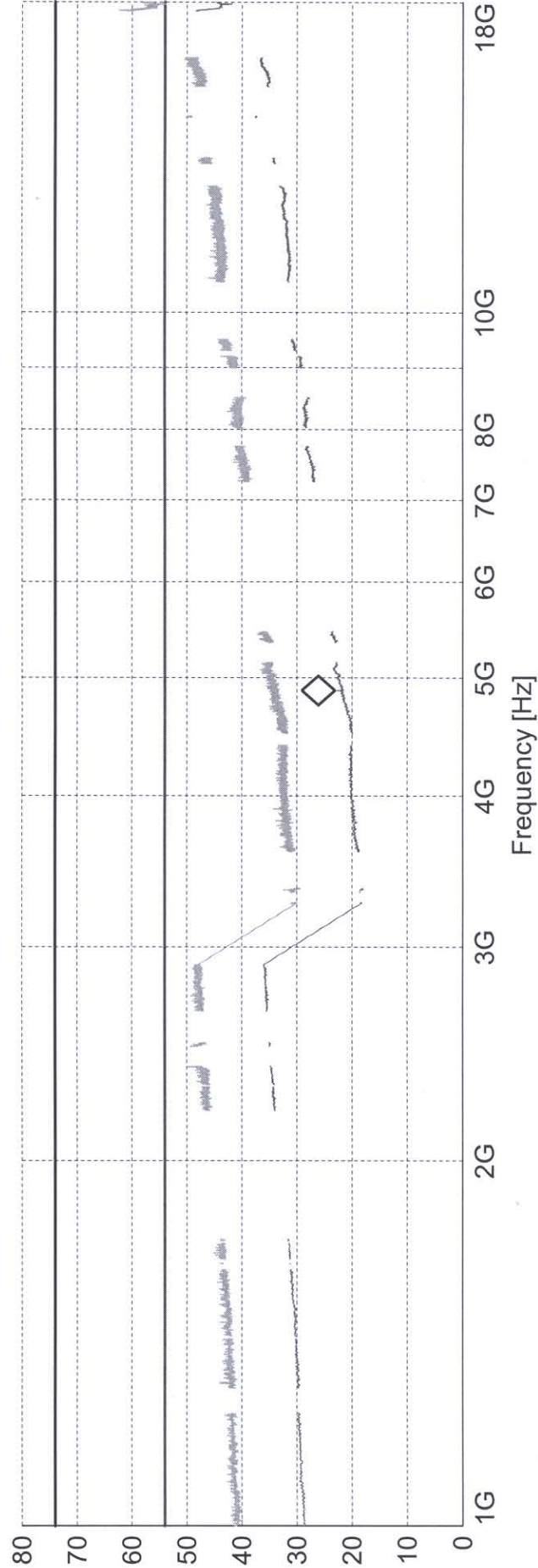
MES	Nok_0804_01_pre PK	
MES	Nok_0804_01_pre AV	
LIM	FCC 15.209 3m	Field Strength QP/AV Limit
LIM	FCC 15.209 3m Peak	Field Strength Peak Limit

SPURIOUS EMISSION RADIATED

EUT: Proto (04T000b01) / 13.04.04
 Manufacturer: Nokia
 Operating Condition: TX on 2441 MHz
 Test Site: 7 layers Ratingen
 Operator: Groe
 Test Specification: FCC 15.247 (15.35b, 15.209)
 Comment: vertical + horizontal antenna polarisation
 vertical EUT position

Marker: 4.882 GHz 23.08 dB μ V/m

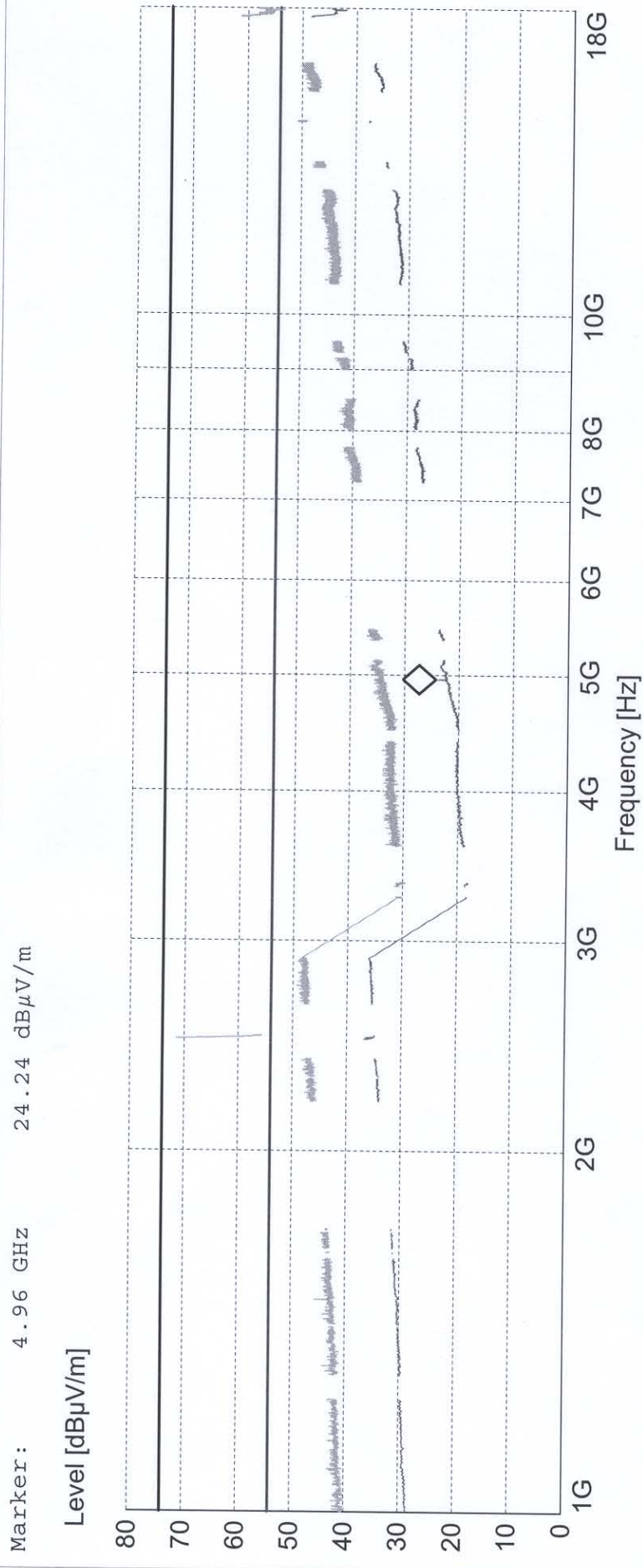
Level [dB μ V/m]



MES Nok_0804_02_pre PK
 MES Nok_0804_02_pre AV
 LIM FCC 15.209 3m Field Strength QP/AV Limit
 LIM FCC 15.209 3m Peak Field Strength Peak Limit

SPURIOUS EMISSION RADIATED

EUT: Proto (04T000b01) / 13.04.04
 Manufacturer: Nokia
 Operating Condition: TX on 2480 MHz
 Test Site: 7 layers Ratingen
 Operator: Groe
 Test Specification: FCC 15.247 (15.35b, 15.209)
 Comment: vertical + horizontal antenna polarisation
 vertical EUT position



— MES	Nok_0804_03_pre PK	
— MES	Nok_0804_03_pre AV	
— LIM	FCC 15.209 3m	Field Strength QP/AV Limit
— LIM	FCC 15.209 3m Peak	Field Strength Peak Limit

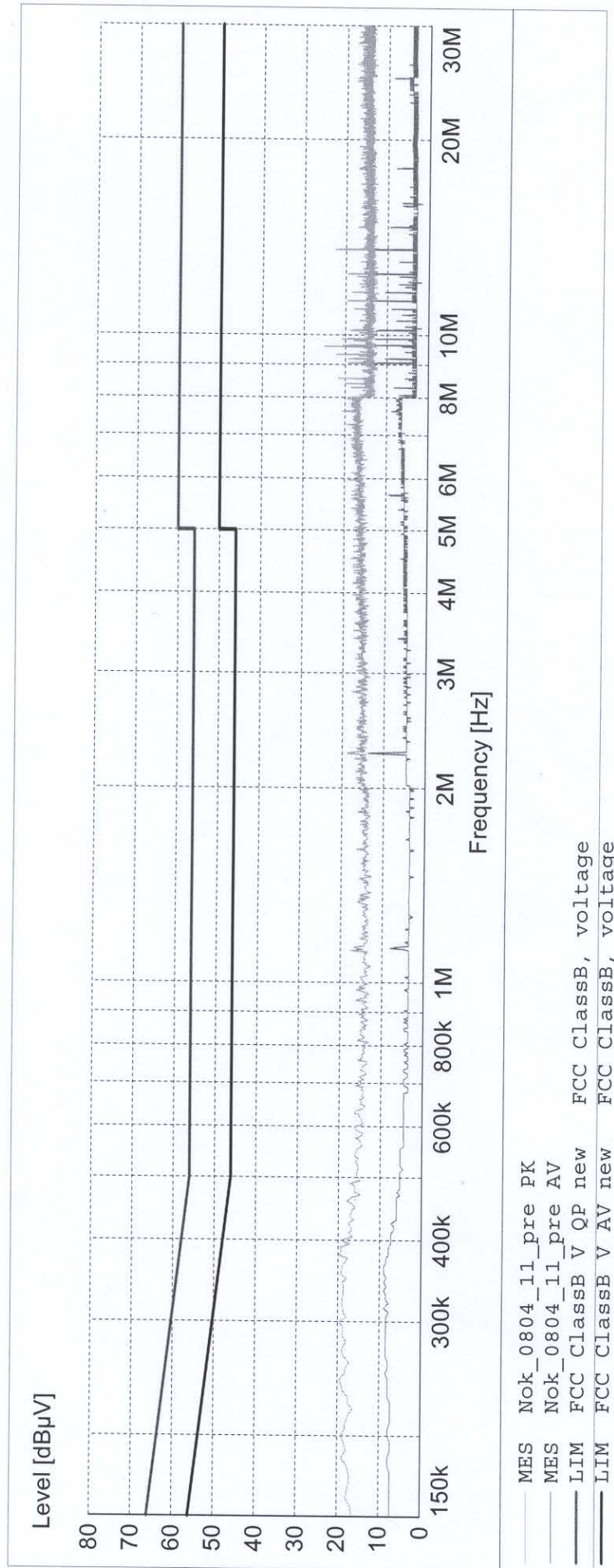
AC MAINS CONDUCTED

Diagram No.: 1.01

EUT: Proto (04T000b01) / 15.04.04
Manufacturer: Nokia
Operating Condition: Tx on 2441 MHz
Test Site: 7 layers Ratingen
Operator: GAL
Test Specification: ANSI C63.4; FCC 15.107 / 15.207
Comment:
Start of Test: 15.04.04 / 22:27:15

SCAN TABLE: "EN 55022 Voltage"

Short Description: EN 55022 Voltage				Transducer	
Start	Stop	Step	Detector	Meas. Time	IF Bandw.
150.0 kHz	30.0 MHz	5.0 kHz	MaxPeak	20.0 ms	9 kHz
				Average	ESH3-Z5



EMI RADIATED TEST

Diagram No.: 2.01

EUT: Proto (04T000b01) / 15.04.04
Manufacturer: Nokia
Operating Condition: TX on 2441 MHz
Test Site: 7 layers, Ratingen
Operator: GAL
Test Specification: FCC part 15 b
Comment: Horizontal EUT position
Start of Test: 15.04.04 / 21:11:16

SCAN TABLE: "FCC part 15 b"

Short Description:		FCC part 15 b		IF	Transducer
Start	Stop	Step	Detector	Meas. Time	
Frequency	Frequency	Width			Bandw.
30.0 MHz	1.0 GHz	60.0 kHz	MaxPeak	1.0 ms	120 kHz HL562

