



TEST REPORT FROM RADIO FREQUENCY INVESTIGATION LTD.

Test Of: Nokia UK Ltd.
NHL-8/3660 mobile handset

To: FCC Part 15.247

Test Report Serial No:
RFI/MPTB1/RP44964JD01B

This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director: 	Checked By: 
Tested By: 	Release Version No: PDF01
Issue Date: 29 August 2003	Test Dates: 21 July to 11 August 2003

This report is issued in Adobe Acrobat portable document format (PDF). It is only a valid copy of the report if it is being viewed in PDF format with the following security options not allowed: Changing the document, Selecting text and graphics, Adding or changing notes and form fields. Furthermore, the date of creation must match the issue date stated above.

This report may be copied in full. The results in this report apply only to the sample(s) tested.

Radio Frequency Investigation Ltd, Ewhurst Park, Ramsdell, Basingstoke, Hampshire, RG26 5RQ, ENGLAND. Tel: +44 (0) 1256 851193 Fax: +44 (0) 1256 851192	Registered in England, No. 211 7901. Registered Office: Ewhurst Park, Ramsdell, Basingstoke, Hampshire RG26 5RQ	
---	---	---

RADIO FREQUENCY INVESTIGATION LTD

Operations Department

Test Of: Nokia Mobile Phones
NHL-8/3660 mobile handset
To: FCC Part 15.247

TEST REPORT

S.No. RFI/MPTB1/RP44964JD01B

Page 2 of 68

Issue Date: 29 August 2003

This page has been left intentionally blank.

Table of Contents

1. Client Information.....	4
2. Equipment Under Test (EUT)	5
3. Methods And Procedures.....	8
4. Deviations From The Test Specification	9
5. Operation Of The EUT During Testing	10
6. Summary Of Test Results.....	11
7. Measurements, Examinations And Derived Results.....	12
8. Test Results.....	13
9. Measurement Methods	53
10. Measurement Uncertainty	62
Appendix 1. Test Equipment Used	63
Appendix 2. Test Configuration Drawings.....	65

Test Of: Nokia Mobile Phones
NHL-8/3660 mobile handset
To: FCC Part 15.247

1. Client Information

Company Name:	Nokia Mobile Phones
Address:	Nokia House Summit Avenue, Southwood, Farnborough, Hants GU14 0NG UK
Contact Name:	Mr Laszlo Gecseg

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

2. Equipment Under Test (EUT)

The following information (with the exception of the Date of Receipt) has been supplied by the client:

2.1. Identification Of Equipment Under Test (EUT)

Brand Name:	Nokia
Model Name or Number:	3660
FCC ID:	QFXNHL-8X
IMEI Number	004400291712576 *
Country of Manufacture:	Finland
Date of Receipt:	21 July 2003

** This sample was used for all radiated tests*

Brand Name:	Nokia
Model Name or Number:	Sylvester
FCC ID:	QFXNHL-8X
IMEI Number	004400291712774 **
Country of Manufacture:	Finland
Date of Receipt:	21 July 2003

*** This sample was used for all direct connection via supplied access port.*

2.2. Description Of EUT

The equipment under test is a tri-band (900, 1800 & 1900) camera mobile handset, which supports IR and Bluetooth.

2.3. Modifications Incorporated In EUT

None.

2.4. Additional Information Related To Testing

Power Supply Requirement: (Internal, non-removable lithium ion battery)	Internal battery supply of 3.7 V		
Declared Battery End Point Voltage	3.45 V DC		
Power Supply Requirement: (AC Battery Charger)	Nominal 115 V 60 Hz AC Mains supply		
Intended Operating Environment:	Within GSM Network Coverage		
Equipment Category:	Portable		
Type of Unit:	Mobile Phone		
Weight:	130 g		
Dimensions:	130 x 55 x 23 mm		
Interface Ports:	Charger Connection Headset Connection		
Transmit Frequency Range	2402 MHz to 2481 MHz		
Transmit Channels Tested	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	1	2402
	Middle	39	2441
	Top	79	2480
Receive Frequency Range	2402 MHz to 2481 MHz		
Receive Channels Tested	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	1	2402
	Middle	39	2441
	Top	79	2480
Highest Fundamental Frequency	2480 MHz		
Highest Oscillator Frequency	3980.0 MHz		
Maximum Power Output (EIRP)	5.83 dBm		

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

2.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

Description:	Universal Radio Communications Tester
Brand Name:	Rohde & Schwartz
Model Name or Number:	CMU200
Serial Number:	1100.0008.02
Connected to Port:	RF Link

Description:	Li-ion Battery
Brand Name:	Nokia
Model Name or Number:	BL-5C
Serial Number:	06704007034137111
Cable Length And Type:	N/A
Connected to Port:	Battery

Description:	AC Power Supply
Brand Name:	Nokia
Model Name or Number:	ACP-12X
Serial Number:	0675296394349J226210078763
Cable Length And Type:	175 cm
Connected to Port:	Charger

Description:	Headset
Brand Name:	Nokia
Model Name or Number:	Headset
Serial Number:	HDE-2
Cable Length And Type:	108 cm
Connected to Port:	Accessory

3. Methods And Procedures

The methods and procedures used were as detailed in:

ANSI C63.2 (1987)

Title: American National Standard for Instrumentation - Electromagnetic noise and field strength.

ANSI C63.4 (2001)

Title: American National Standard Methods of Measurement of Electromagnetic Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

ANSI C63.5 (1988)

Title: American National Standard for the Calibration of antennas used for Radiated Emission measurements in Electromagnetic Interference (EMI) control.

ANSI C63.7 (1988)

Title: American National Standard Guide for Construction of Open Area Test Sites for performing Radiated Emission Measurements.

CISPR 16-1: (1999)

Title: Specification For Radio Disturbance and Immunity Measuring Apparatus and Methods. Part 1: Radio Disturbance and Immunity Measuring Apparatus.

DA00-705 (2000)

Title: Filing and Frequency Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

3.1. Definition Of Measurement Equipment

The measurement equipment used complied with the requirements of the standards referenced in the Methods & Procedures section above. Appendix 1 contains a list of the test equipment used.

RADIO FREQUENCY INVESTIGATION LTD

Operations Department

Test Of: Nokia Mobile Phones
NHL-8/3660 mobile handset
To: FCC Part 15.247

TEST REPORT

S.No. RFI/MPTB1/RP44964JD01B

Page 9 of 68

Issue Date: 29 August 2003

4. Deviations From The Test Specification

None.

5. Operation Of The EUT During Testing

5.1. Operating Conditions

During testing, the EUT was powered by a 3.7volt lithium ion battery in conjunction with a 115 V 60 Hz AC Mains charger as required.

5.2. Operating Modes

The EUT was tested in the following operating modes, unless otherwise stated.

Preliminary radiated scans were performed on the DUT with the accessories stated in section 2.1 of this report connected and the disconnected. The combination that exhibited the worse case mode of operation was then used to perform final measurements.

Bluetooth mode, transmitting on Top, Middle, Bottom, Hopping in all channels or in Receive mode.

5.3. Configuration And Peripherals

The EUT was tested in the following configuration:

Configured with hands free kit, AC battery charger and internal battery.

The EUT was programmed to operate on specific channels using the Rohde and Schwarz Bluetooth test set.

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

6. Summary Of Test Results

Part 15.247

Range Of Measurements	Specification Reference	Port Type	Compliance Status
Receive Conducted Emissions (AC Mains)	C.F.R. 47 FCC Part 15: 2002 Section 15.107	AC Mains Terminals	Complied
Receive Radiated Emissions	C.F.R. 47 FCC Part 15: 2002 Section 15.109	Antenna	Complied
Transmitter Conducted Emissions (AC Mains)	C.F.R. 47 FCC Part 15: 2002 Section 15.207	AC Mains Terminals	Complied
Transmitter 20dB Bandwidth	C.F.R. 47 FCC Part 15: 2002 Section 15.247(a)(1)(iii)	*Antenna Terminals	Complied
Transmitter Carrier Frequency Separation	C.F.R. 47 FCC Part 15: 2002 Section 15.247(a)(1)	*Antenna Terminals	Complied
Transmitter Average Time of Occupancy	C.F.R. 47 FCC Part 15: 2002 Section 15.247(a)(1)(iii)	*Antenna Terminals	Complied
Transmitter Maximum Peak Output Power	C.F.R. 47 FCC Part 15: 2002 Section 15.247(b)(1)	*Antenna Terminals	Complied
Transmitter Conducted Emissions	C.F.R. 47 FCC Part 15: 2002 Section 15.247 (c)	*Antenna Terminals	Complied
Transmitter Radiated Emissions	C.F.R. 47 FCC Part 15: 2002 Section 15.247(c) Section 15.209(a)	Antenna	Complied
Transmitter Band Edge Conducted Emissions	C.F.R. 47 FCC Part 15: 2002 Section 15.247(c)	*Antenna Terminals	Complied
Transmitter Band Edge Radiated Emission	C.F.R. 47 FCC Part 15: 2002 Section 15.247(c) Section 15.209(a)	Antenna	Complied

**Note. This is an access point on the EUT provided by the manufacturer for the purpose of this test.*

6.1. Location Of Tests

All the measurements described in this report were performed at the premises of Radio Frequency Investigation Ltd, Ewhurst Park, Ramsdell, Basingstoke, Hampshire, RG26 5RQ, England.

7. Measurements, Examinations And Derived Results

7.1. General Comments

7.1.1. This section contains test results only. Details of the test methods and procedures can be found in Appendix 2 of this report.

7.1.2. Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to Section 8 for details of measurement uncertainties.

RADIO FREQUENCY INVESTIGATION LTD

Operations Department

Test Of: Nokia Mobile Phones
NHL-8/3660 mobile handset
To: FCC Part 15.247

TEST REPORT

S.No. RFI/MPTB1/RP44964JD01B

Page 13 of 68

Issue Date: 29 August 2003

8. Test Results

Reference:	FCC Part 15 Subpart C: 2002 (Section 15.247)
Title:	Code of Federal Regulations, Part 15 (47CFR15) Radio Frequency Devices
Comments:	A description of the test facility used for this test is on file with, and has been accepted by, the Federal Communications Commission as required by Section 2.948 of Federal Rules.
Purpose of Test:	To determine whether the equipment complied with the requirements of the specification for the purposes of certification.

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: FCC Part 15.247

8.1. Receive Conducted Emissions AC Mains: Section 15.107

8.1.1. The EUT was configured as for AC conducted emissions measurements as described in section 9 of this report.

8.1.2. Tests were performed to identify the maximum emissions levels on the AC mains line of the EUT.

Quasi-Peak Detector Measurements on Live and Neutral Lines

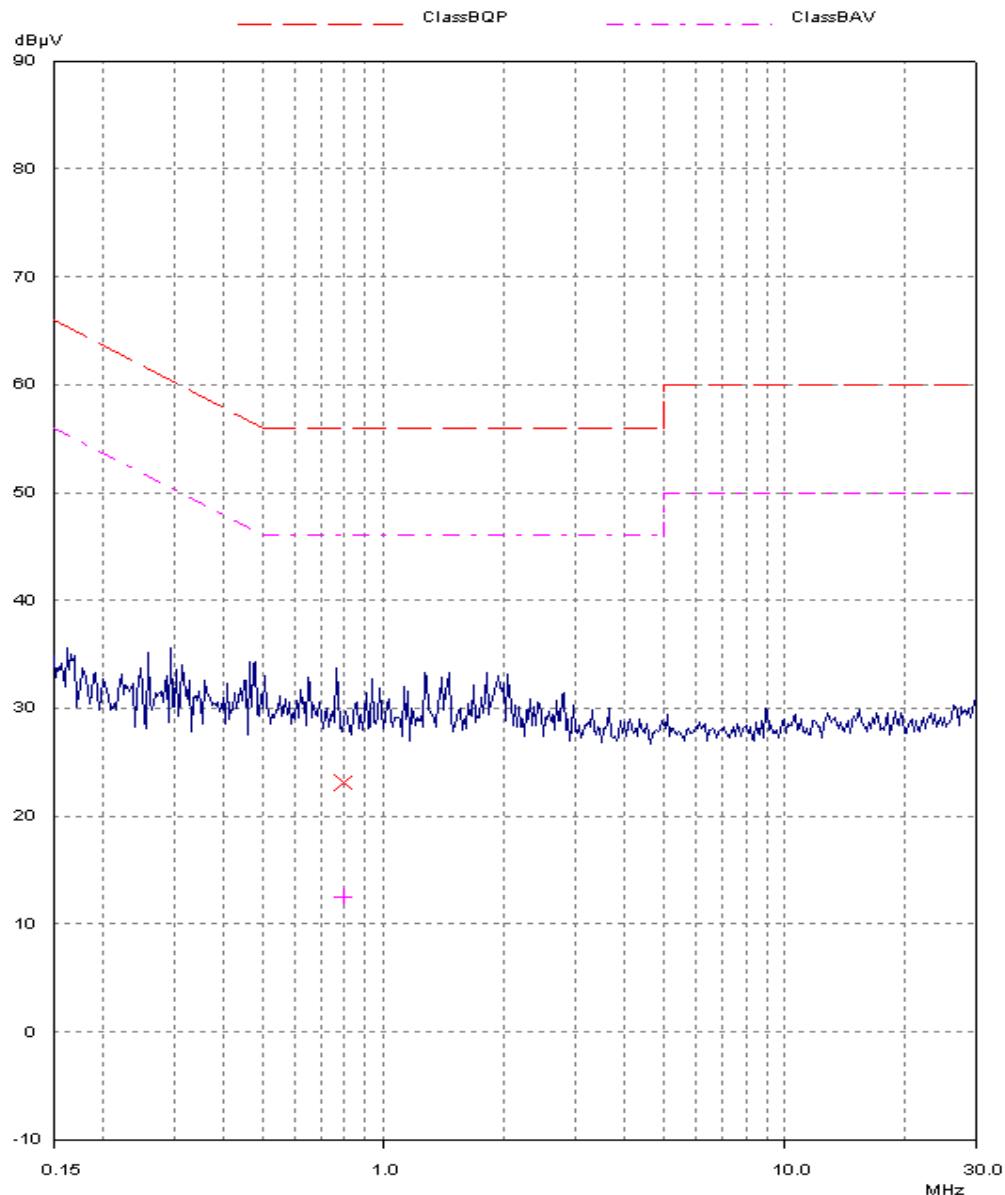
Frequency (MHz)	Line	Q-P Level (dB μ V)	Q-P Limit (dB μ V)	Margin (dB)	Result
0.79591	Live	23.14	56.00	32.86	Complied

Average Detector Measurements on Live and Neutral Lines

Frequency (MHz)	Line	Avg Level (dB μ V)	Avg Limit (dB μ V)	Margin (dB)	Result
0.79591	Live	12.5	46.00	33.5	Complied

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Receive Conducted Emissions AC Mains (Continued)



Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: FCC Part 15.247

8.2. Receive Radiated Emissions: Section 15.109

8.2.1. Electric Field Strength Measurements (Frequency Range: 30 to 1000 MHz)

8.2.1.1. The EUT was configured as for radiated field strength emissions testing as described in Section 9 of this report.

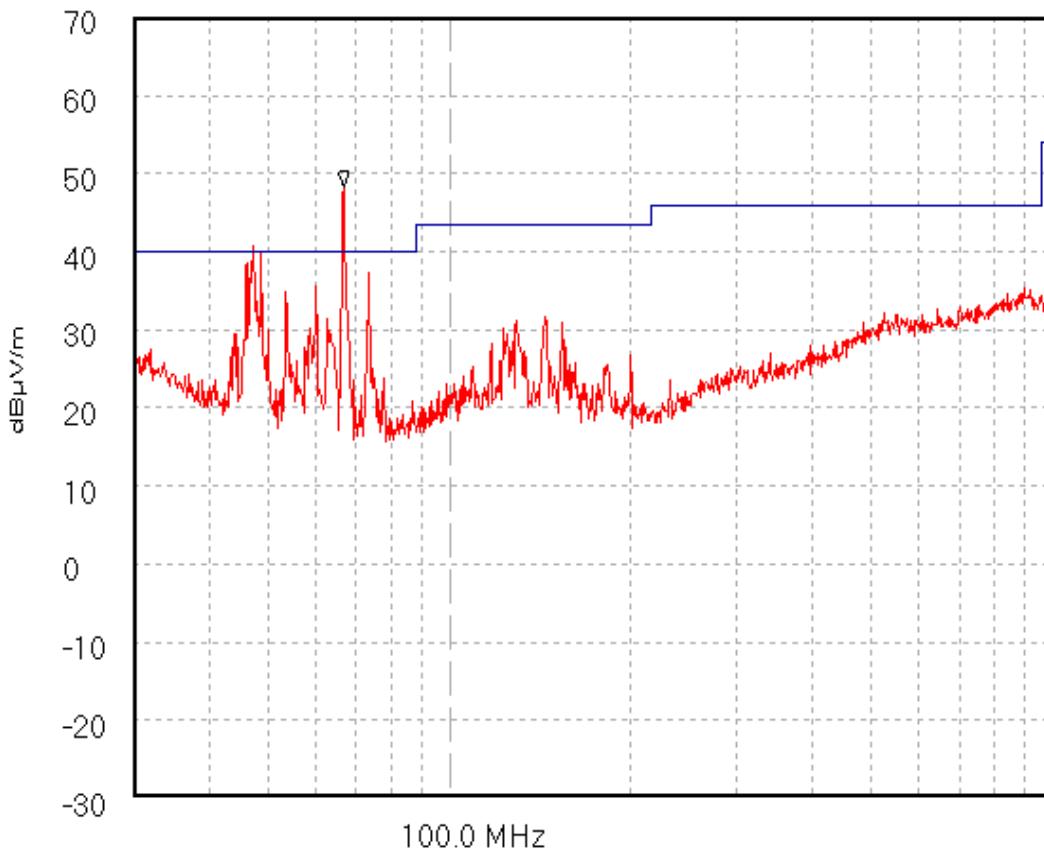
8.2.1.2. Tests were performed to identify the maximum radiated spurious emissions levels.

Frequency (MHz)	Ant. Pol.	Q-P Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
46.973	V	13.7	40.0	26.3	Complied
53.396	H	14.8	40.0	25.2	Complied
59.970	H	12.2	40.0	27.8	Complied
66.640	H	25.5	40.0	14.5	Complied
73.300	H	15.5	40.0	24.5	Complied

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Receive Radiated Emissions (Continued)

44964JD01_FCC_Bluetooth_RE1 001



Start 30.0 MHz; Stop 1.0 GHz - Log Scale
Ref 70 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 120.0 kHz; VBW 100.0 kHz; Att 0 dB; Spw 380.0 mS
Peak 66.941 MHz, 48.27 dB μ V/m
Limit/Mask: 15_109_Class_B; ; Limit Test Failed
Transducer Factors: A1037
7/21/2003 2:49:02 PM

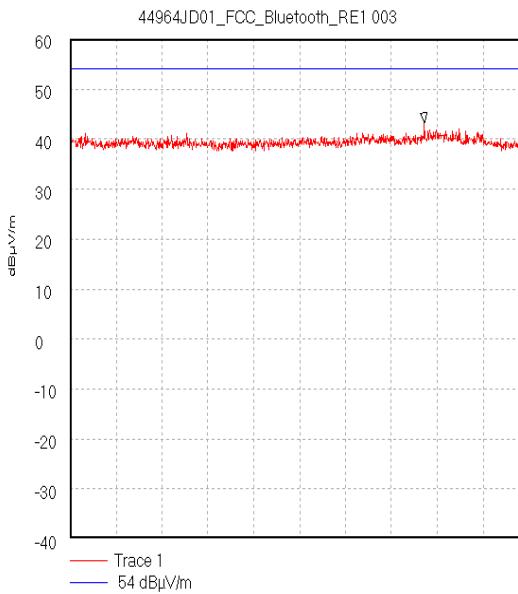
Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Receive Radiated Emissions (Continued)**Electric Field Strength Measurements (Frequency Range: 1.0 to 12.5 GHz)****Highest Average Level:**

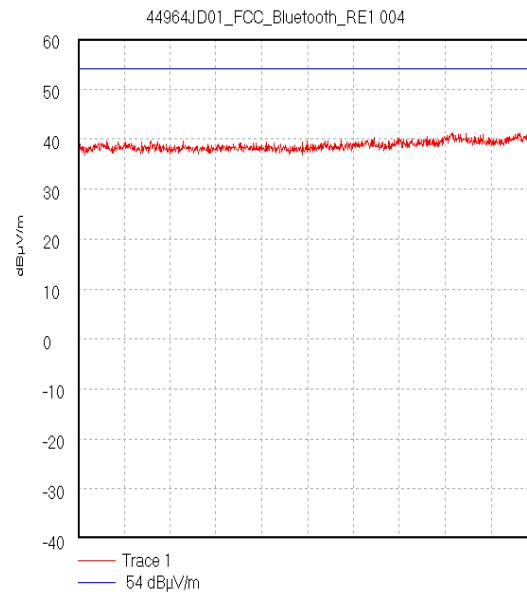
**Note: Not recorded, no spurious emissions were detected above the noise floor of the measuring receiver.*

Highest Peak Level:

**Note: No spurious emissions were detected above the noise floor of the measuring receiver; the highest peak noise floor reading of the measuring receiver recorded was 43.3 dB μ V/m at 1.772 GHz*

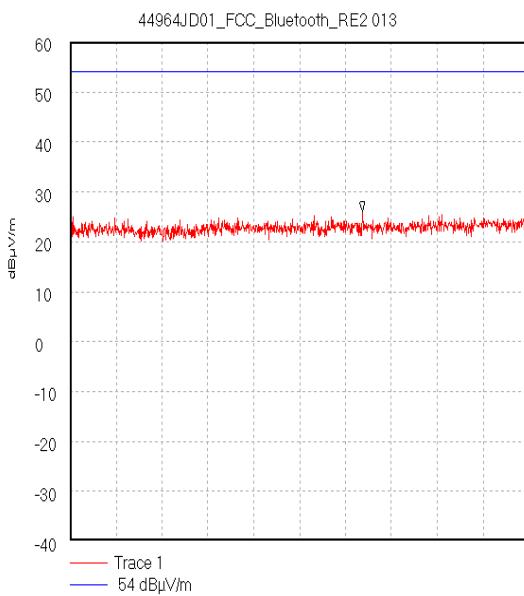
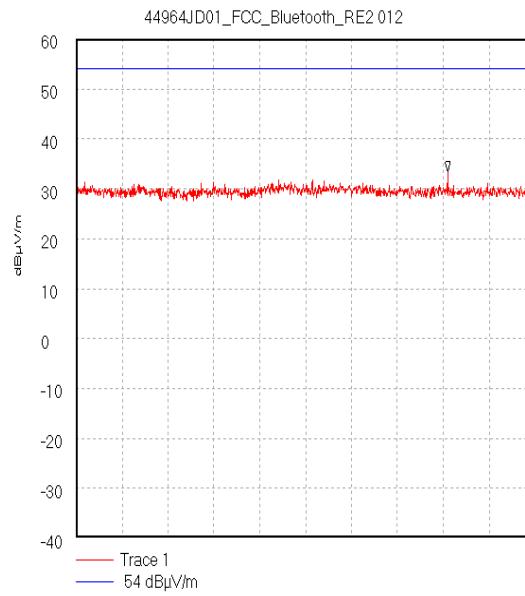
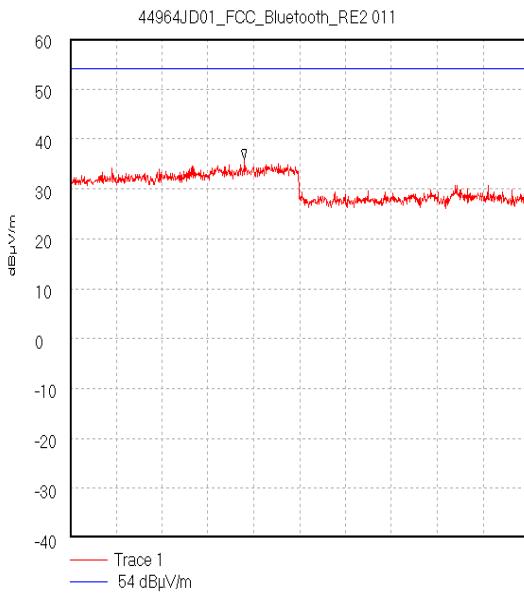


Start 1.0 GHz; Stop 2.0 GHz
Ref 60 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 1.772 GHz, 43.27 dB μ V/m
Display Line: 54 dB μ V/m; Limit Test Passed
7/21/2003 3:04:42 PM



Start 2.0 GHz; Stop 4.0 GHz
Ref 60 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 3.987 GHz, 42.51 dB μ V/m
Display Line: 54 dB μ V/m; Limit Test Passed
7/21/2003 3:17:57 PM

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Receive Radiated Emissions (Continued)

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

8.3. Transmitter Conducted Emissions AC Mains: Section 15.207

Quasi-Peak Detector Measurements on Live and Neutral Lines

8.3.1. The EUT was configured as for AC conducted emissions measurements as described in Section 9 of this report.

8.3.2. Tests were performed to identify the maximum emissions levels on the AC mains line of the EUT.

Quasi-Peak Detector Measurements on Live and Neutral Lines

Middle Channel

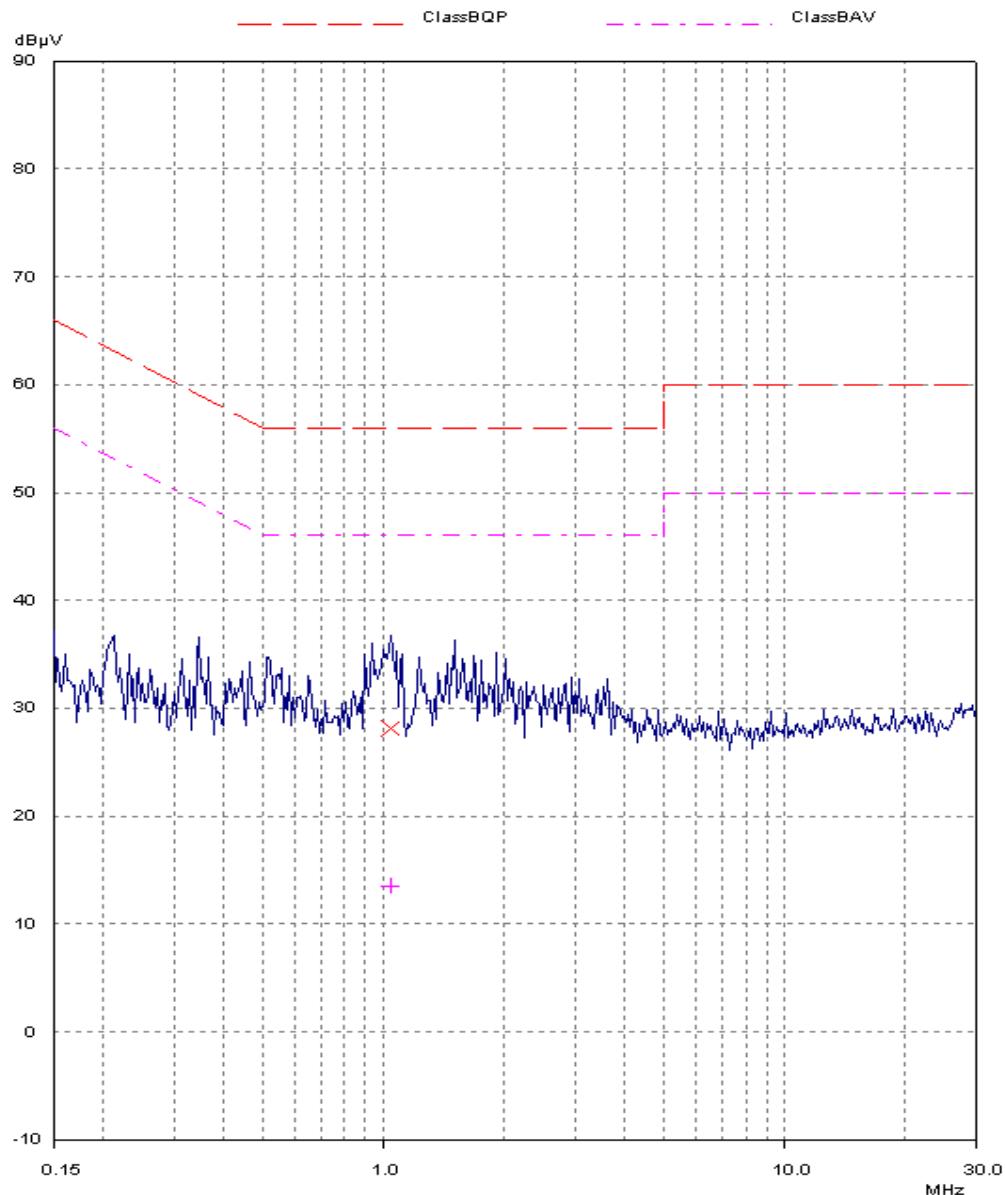
Frequency (MHz)	Line	Q-P Level (dB μ V)	Q-P Limit (dB μ V)	Margin (dB)	Result
1.0355	Live	28.12	56.00	27.88	Complied

Average Detector Measurements on Live and Neutral Lines

Middle Channel

Frequency (MHz)	Line	Avg Level (dB μ V)	Avg Limit (dB μ V)	Margin (dB)	Result
1.0355	Live	13.52	46.00	32.48	Complied

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Transmitter Conducted Emissions AC Mains

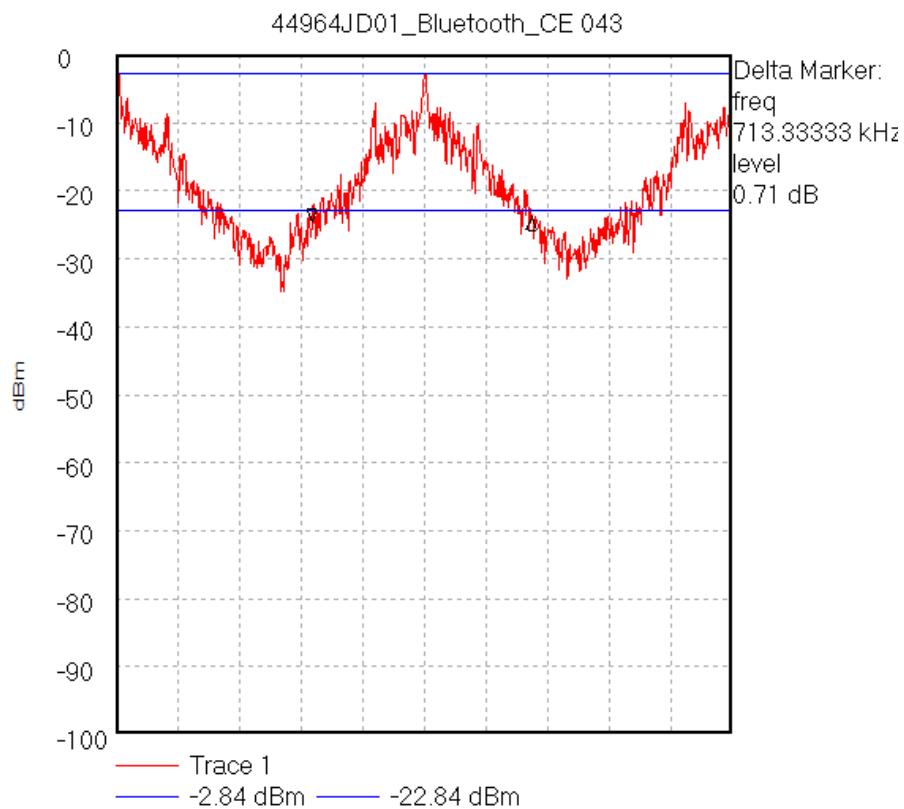
Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

8.4. Transmitter 20dB Bandwidth: Section 15.247(a)(1)(iii)

8.4.1. The EUT was configured as for carrier frequency separation/20dB bandwidth measurements as described in Section 9 of this report.

8.4.2. Tests were performed to identify the 20dB bandwidth.

Transmitter 20dB Bandwidth (kHz)
713.33



Start 2.44 GHz; Stop 2.442 GHz
Ref 0 dBm; Ref Offset 22.5 dB; 10 dB/div
RBW 10.0 kHz; VBW 10.0 kHz; Att 0 dB; Swp 60.0 mS
Marker 2.440636 GHz, -24.65 dBm
Delta 2.441349 GHz, -23.94 dBm
Display Line: -2.84 dBm; -22.84 dBm;
06/08/2003 12:19:27

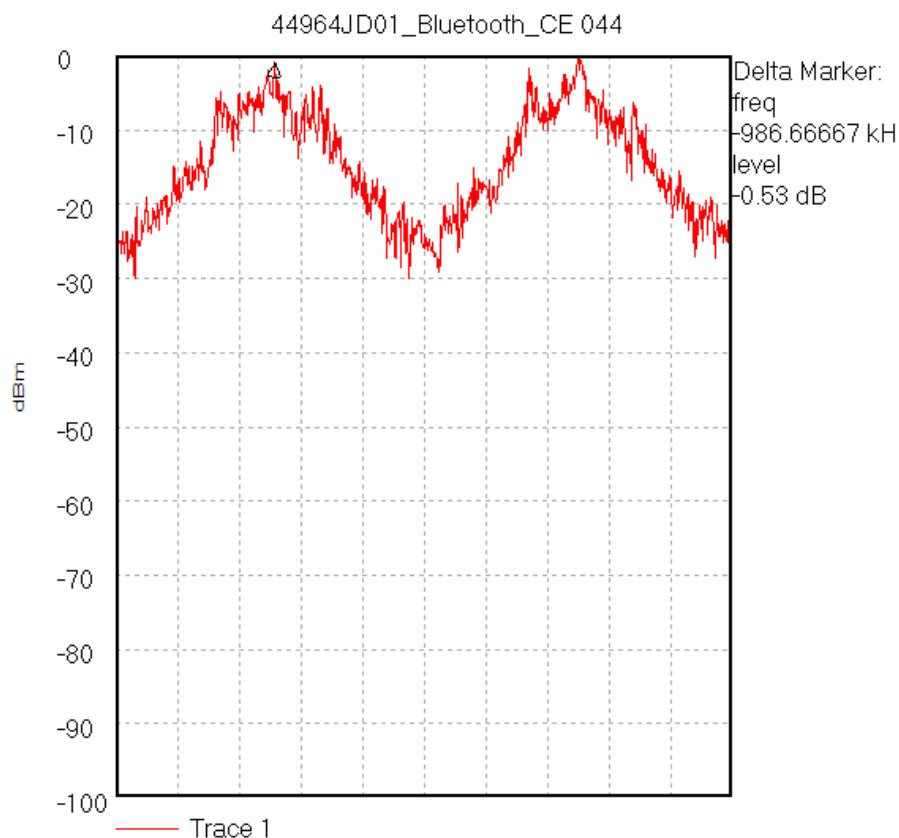
Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

8.5. Transmitter Carrier Frequency Separation: Section 15.247(a)(1)

8.5.1. The EUT was configured as for carrier frequency separation measurements as described in Section 9 of this report.

8.5.2. Tests were performed to identify the carrier frequency separation.

Transmitter Carrier Frequency Separation (kHz)	Limit (25kHz or 20dB BW which ever is greater) (kHz)	Margin (kHz)	Result
986.67	713.33	273.34	Complied



Start 2.4405 GHz; Stop 2.4425 GHz
Ref 0 dBm; Ref Offset 22.5 dB; 10 dB/div
RBW 30.0 kHz; VBW 30.0 kHz; Att 0 dB; Swp 20.0 mS
Marker 2.442 GHz, -0.4 dBm
Delta 2.441013 GHz, -0.93 dBm
06/08/2003 12:27:06

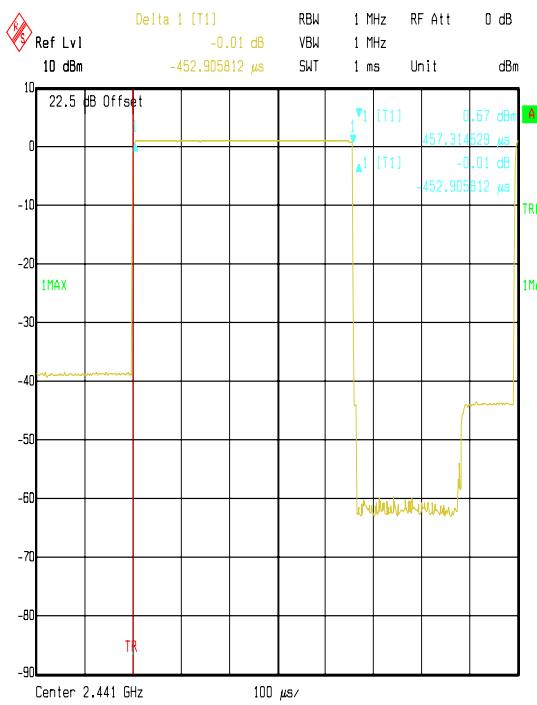
Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

8.6. Transmitter Average Time of Occupancy: Section 15.247(a)(1)(iii)

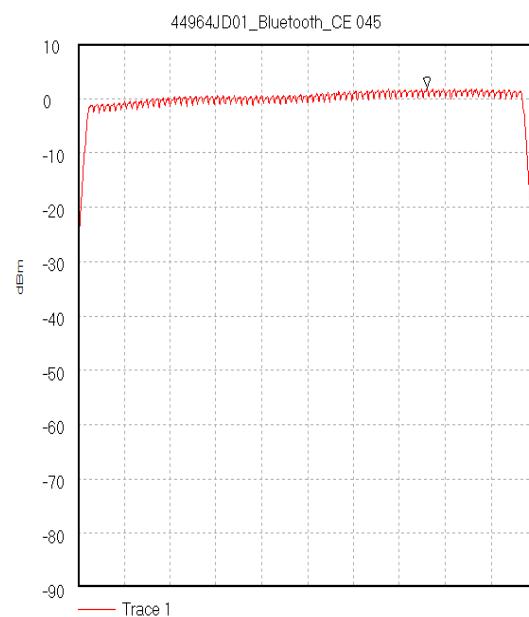
8.6.1. The EUT was configured as for average time of occupancy measurements as described in Section 9 of this report.

8.6.2. Tests were performed to identify the average time of occupancy.

Emission Width (μs)	Number of Hopping Channels Employed	Average Time of Occupancy (S)	Limit (S)	Margin (S)	Result
452.9	79	0.035779	0.4	0.364221	Complied



Title: Nokia Sylvester FCC P15.247 Time Occupancy. 004400291712774
Comment A: 44964JD01_FCC_Bluetooth_001
Date: 6.AUG.2003 12:30:30



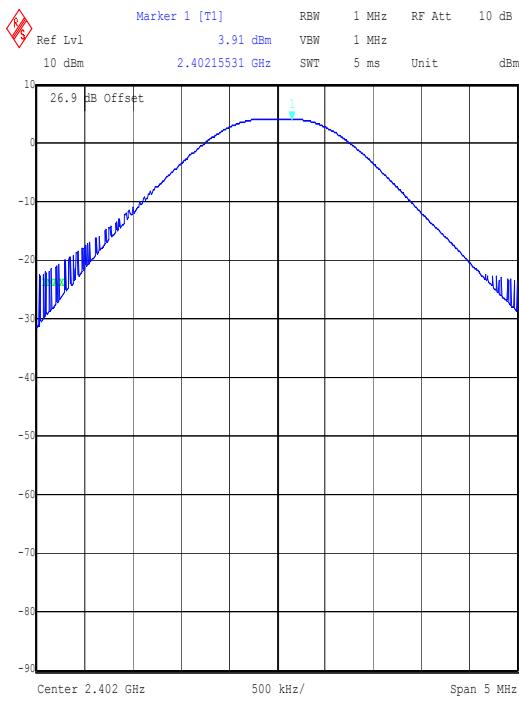
Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

8.7. Transmitter Peak Output Power: Section 15.247(b)(1)

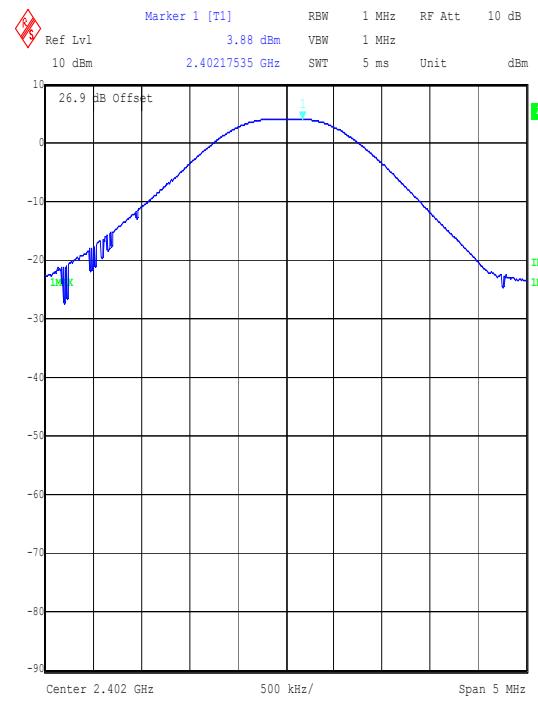
8.7.1. The EUT was configured as for peak output power measurements as described in Section 9 of this report.

8.7.2. Tests were performed to identify the transmitter output power of the EUT.

Channel	Input Voltage (AC)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	93.5	3.9	30.0	26.1	Complied
Bottom	110.0	3.9	30.0	26.1	Complied
Bottom	126.5	3.9	30.0	26.1	Complied

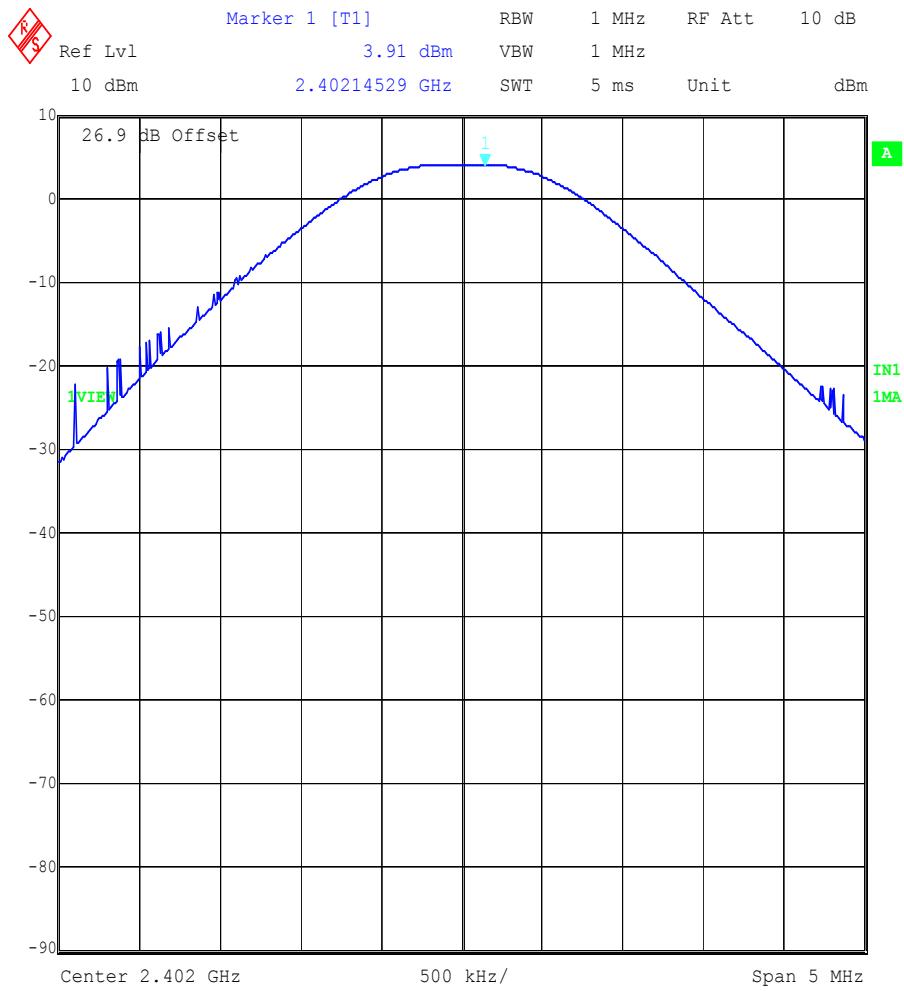


Title: Nokia EUT: Sylvester NHL-8. FCC P15.247 Peak Output Power.
Comment A: 44964JD01_FCC_Bot_LV_002
Date: 19.AUG.2003 11:05:39



Title: Nokia EUT: Sylvester NHL-8. FCC P15.247 Peak Output Power.
Comment A: 44964JD01_FCC_Bot_NV_001
Date: 19.AUG.2003 11:05:19

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Transmitter Peak Output Power (Continued)

Title: Nokia EUT: Sylvester NHL-8. FCC P15.247 Peak Output Power.

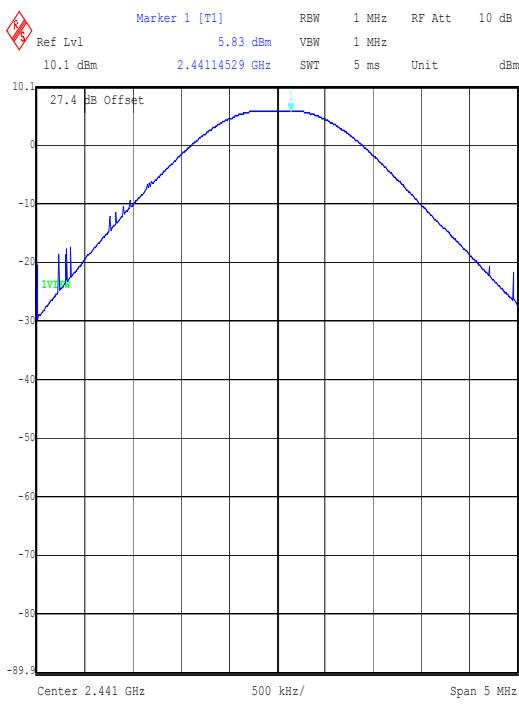
Comment A: 44964JD01_FCC_Bot_HV_003

Date: 19.AUG.2003 11:05:56

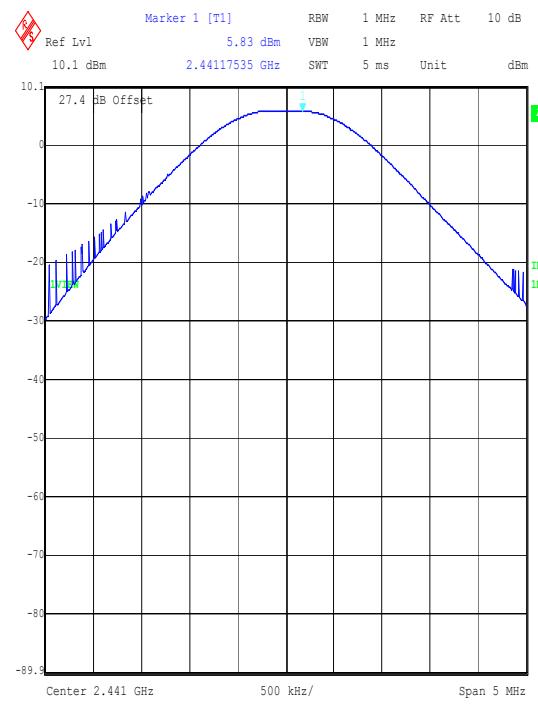
Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Transmitter Peak Output Power (Continued)

Channel	Input Voltage (AC)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Middle	93.5	5.8	30.0	24.2	Complied
Middle	110.0	5.8	30.0	24.2	Complied
Middle	126.5	5.8	30.0	24.2	Complied

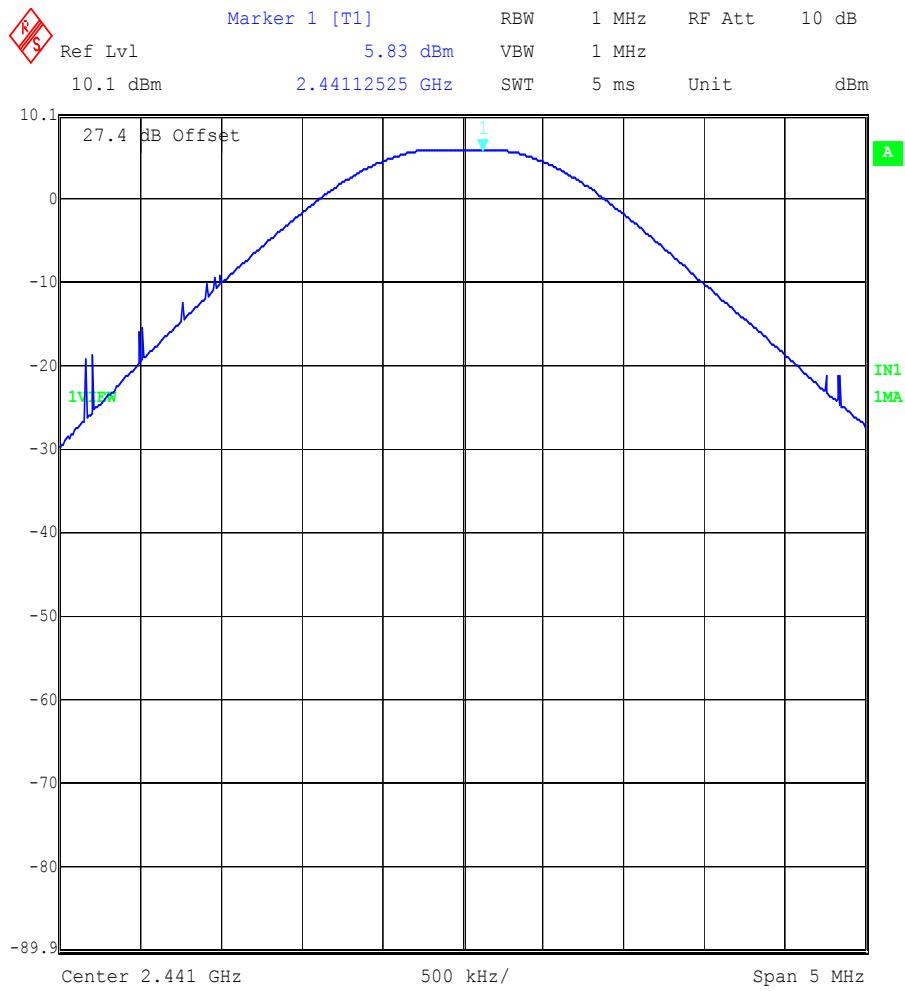


Title: Nokia EUT: Sylvester NHL-8. FCC P15.247 Peak Output Power.
Comment A: 44964JD01_FCC_Mid_LV_005
Date: 19.AUG.2003 11:10:20



Title: Nokia EUT: Sylvester NHL-8. FCC P15.247 Peak Output Power.
Comment A: 44964JD01_FCC_Mid_NV_004
Date: 19.AUG.2003 11:09:56

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Transmitter Peak Output Power (Continued)

Title: Nokia EUT: Sylvester NHL-8. FCC P15.247 Peak Output Power.

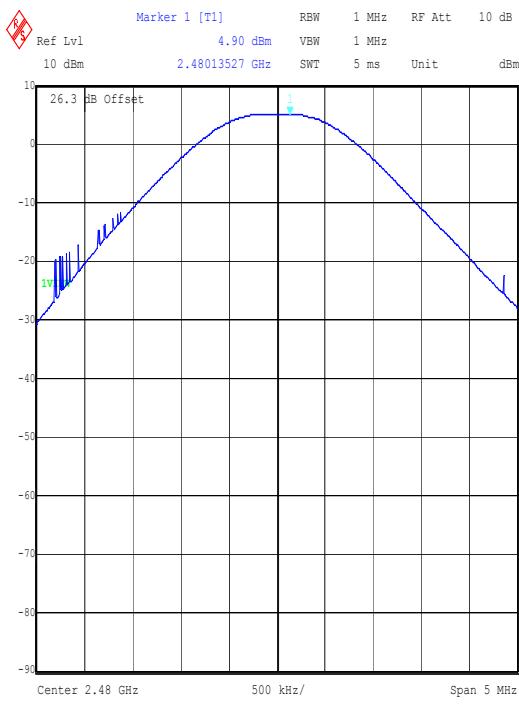
Comment A: 44964JD01_FCC_Mid_HV_006

Date: 19.AUG.2003 11:10:37

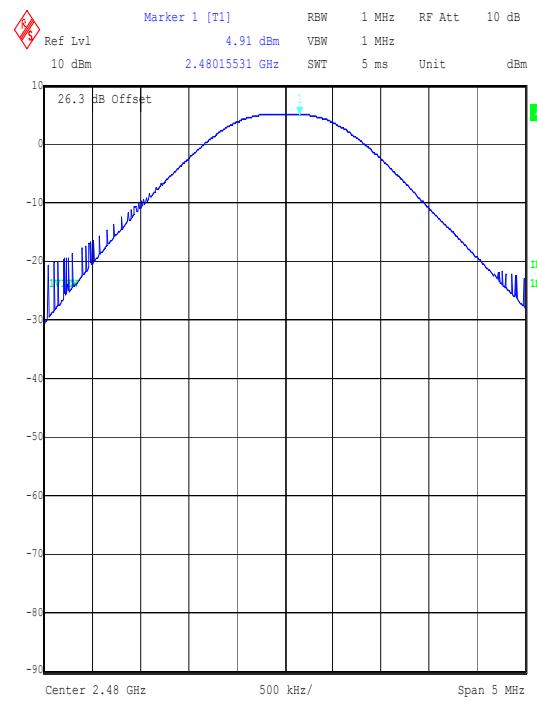
Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Transmitter Peak Output Power (Continued)

Channel	Input Voltage (AC)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Top	93.5	4.9	30.0	25.1	Complied
Top	110.0	4.9	30.0	25.1	Complied
Top	126.5	4.9	30.0	25.1	Complied

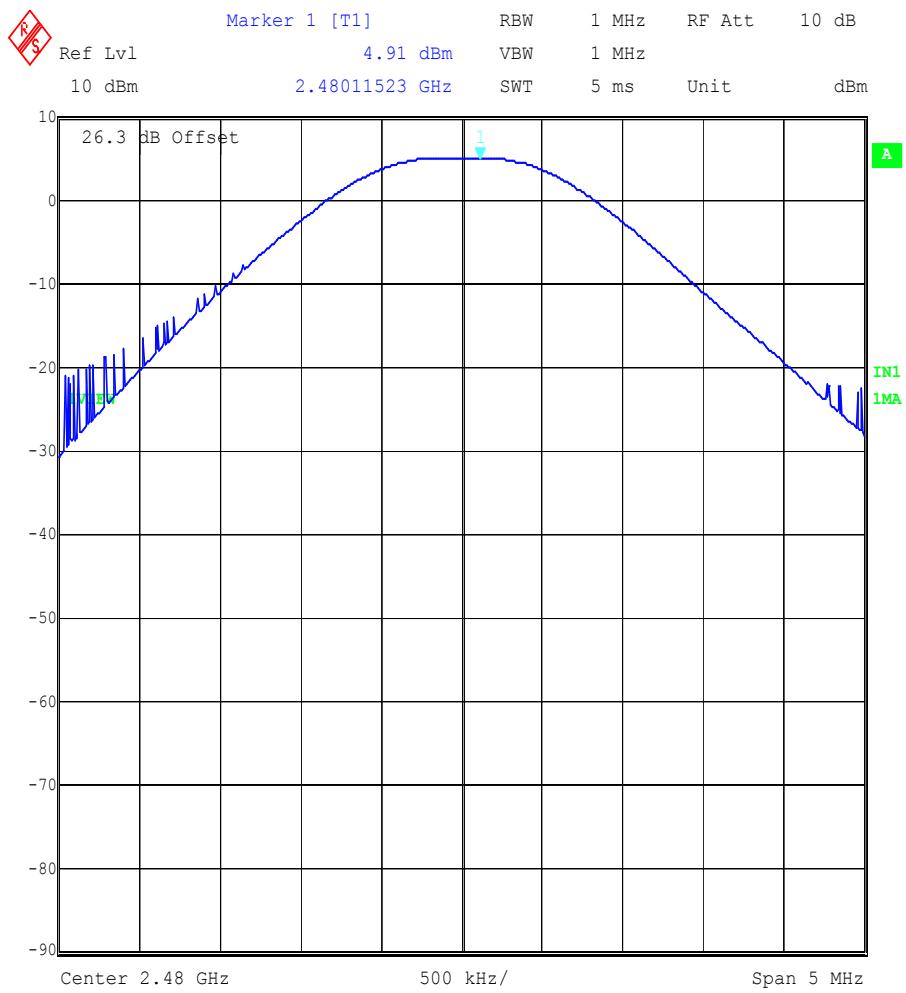


Title: Nokia EUT: Sylvester NHL-8. FCC P15.247 Peak Output Power.
Comment A: 44964JD01_FCC_Top_LV_008
Date: 19.AUG.2003 11:12:17



Title: Nokia EUT: Sylvester NHL-8. FCC P15.247 Peak Output Power.
Comment A: 44964JD01_FCC_Top_NV_007
Date: 19.AUG.2003 11:12:00

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Transmitter Peak Output Power (Continued)

Title: Nokia EUT: Sylvester NHL-8. FCC P15.247 Peak Output Power.

Comment A: 44964JD01_FCC_Top_HV_009

Date: 19.AUG.2003 11:12:55

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

8.8. Transmitter Conducted Emissions: Section 15.247(c)

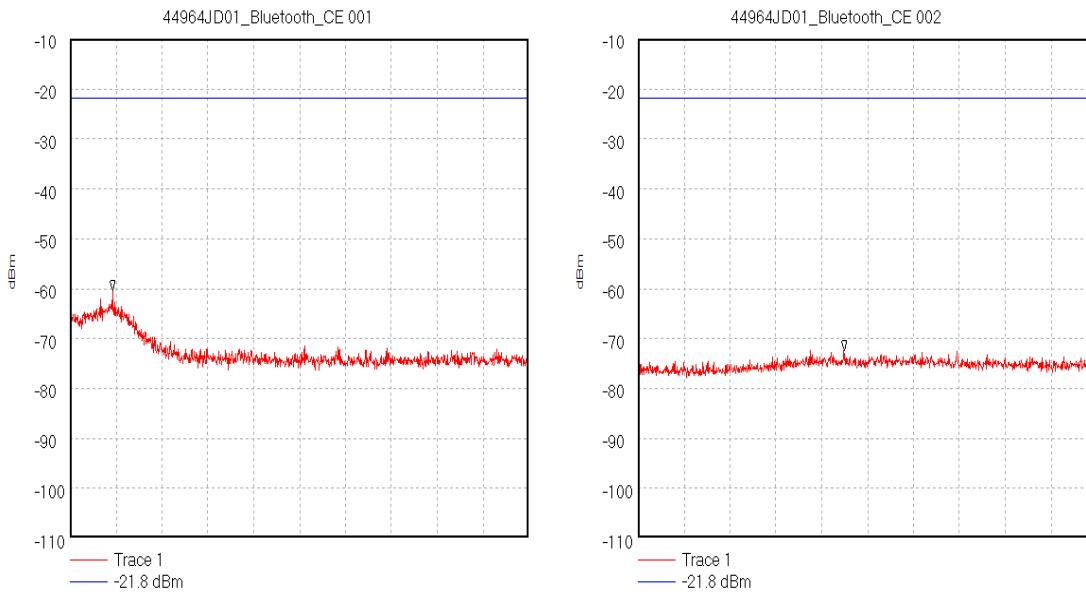
8.8.1. The EUT was configured as for conducted measurements as described in Section 9 of this report.

8.8.2. Tests were performed to identify the maximum conducted emissions levels on the antenna port.

Results:

Highest Peak Level: Bottom Channel

Frequency (GHz)	Peak Detector level (dBm)	Peak Limit (dBm)	Peak Margin (dB)	Result
2.400	-48.0	-21.8	26.2	Complied



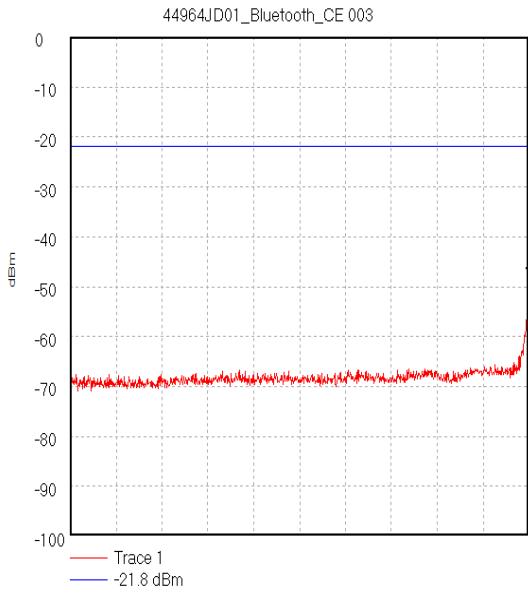
Start 1.0 MHz; Stop 30.0 MHz
Ref -10 dBm; Ref Offset 24.4 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 20.0 mS
Peak 3.674444 MHz, -60.38 dBm
Display Line: -21.8 dBm;
06/08/2003 10:30:42

Start 30.0 MHz; Stop 1.0 GHz
Ref -10 dBm; Ref Offset 21.4 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 300.0 mS
Peak 465.422222 MHz, -72.39 dBm
Display Line: -21.8 dBm;
06/08/2003 10:31:57

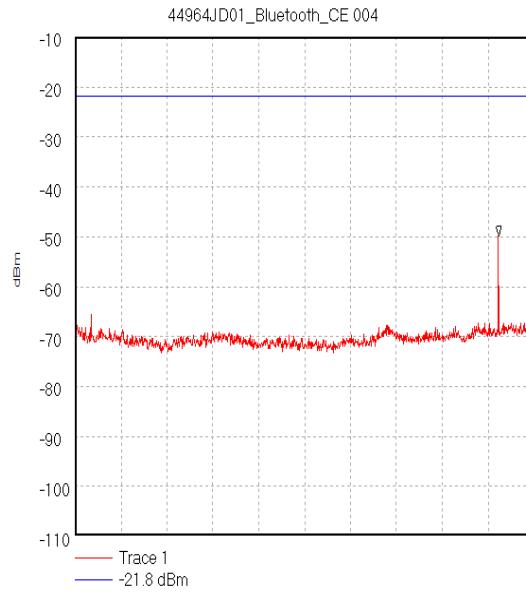
Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

TEST REPORT
S.No. RFI/MPTB1/RP44964JD01B
Page 32 of 68
Issue Date: 29 August 2003

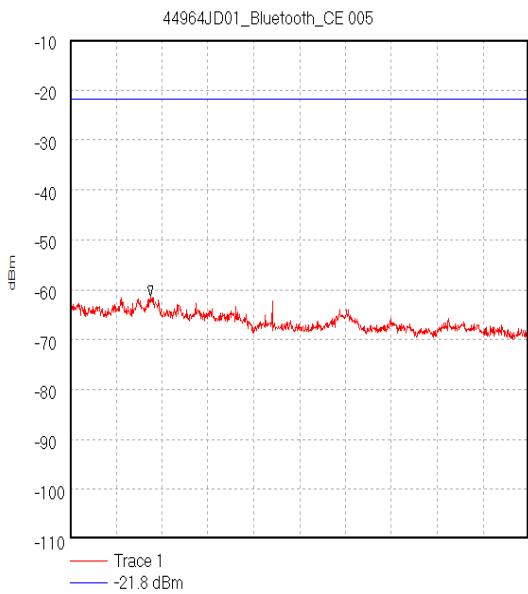
Transmitter Conducted Emissions Bottom Channel (Continued)



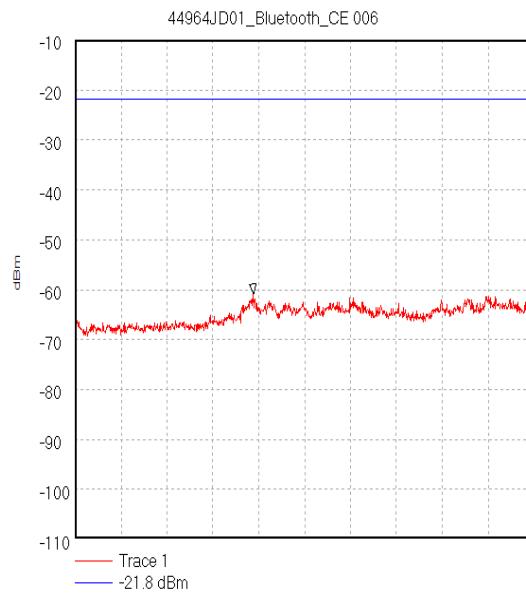
Start 1.0 GHz; Stop 2.4 GHz
Ref 0 dBm; Ref Offset 25.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 420.0 mS
Peak 2.4 GHz, -48.04 dBm
Display Line: -21.8 dBm;
06/08/2003 10:33:49



Start 2.4835 GHz; Stop 5.0 GHz
Ref -10 dBm; Ref Offset 23.4 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 760.0 mS
Peak 4.807068 GHz, -49.89 dBm
Display Line: -21.8 dBm;
06/08/2003 10:36:11

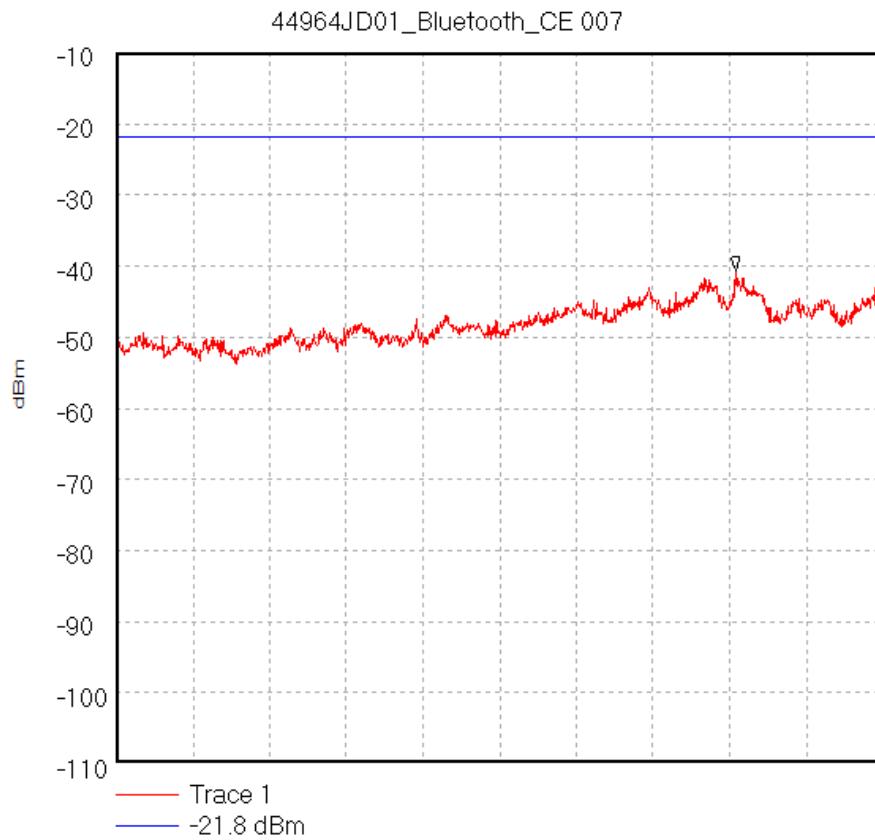


Start 5.0 GHz; Stop 10.0 GHz
Ref -10 dBm; Ref Offset 26.9 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 1.5 S
Peak 5.877778 GHz, -61.29 dBm
Display Line: -21.8 dBm;
06/08/2003 10:38:36



Start 10.0 GHz; Stop 18.0 GHz
Ref -10 dBm; Ref Offset 27.7 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 2.4 S
Peak 13.111111 GHz, -60.86 dBm
Display Line: -21.8 dBm;
06/08/2003 10:43:58

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

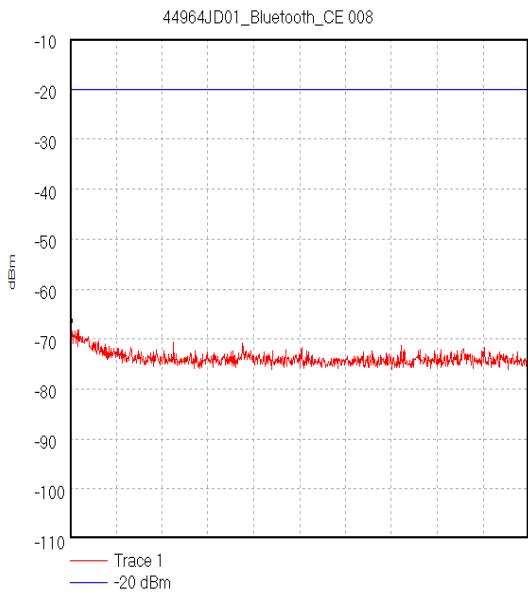
Transmitter Conducted Emissions Bottom Channel (Continued)

Start 18.0 GHz; Stop 26.5 GHz
Ref -10 dBm; Ref Offset 39.3 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 2.6 S
Peak 24.875556 GHz, -40.65 dBm
Display Line: -21.8 dBm;
06/08/2003 10:46:13

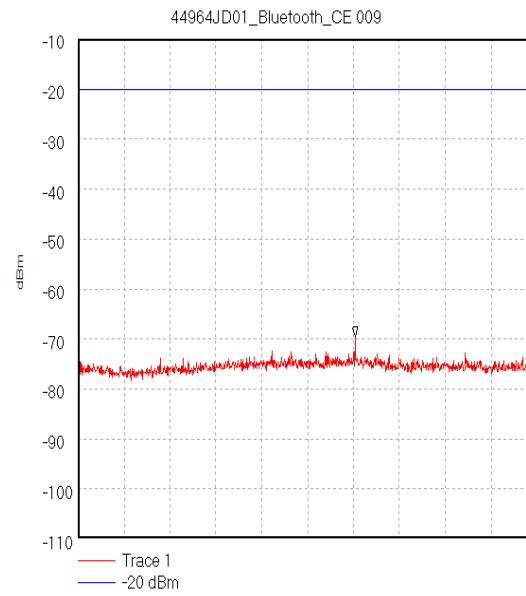
Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Transmitter Conducted Emissions: Section 15.247(c) (Continued)**Highest Peak Level: Middle Channel**

Frequency (GHz)	Peak Detector level (dBm)	Peak Limit (dBm)	Peak Margin (dB)	Result
4.885	-53.0	-20.0	-33.0	Complied



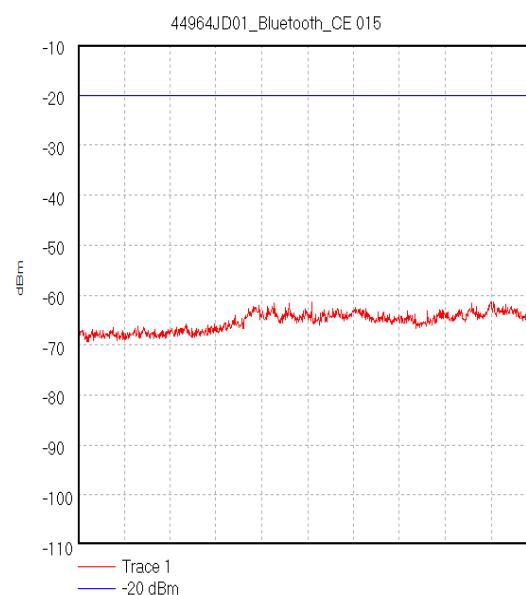
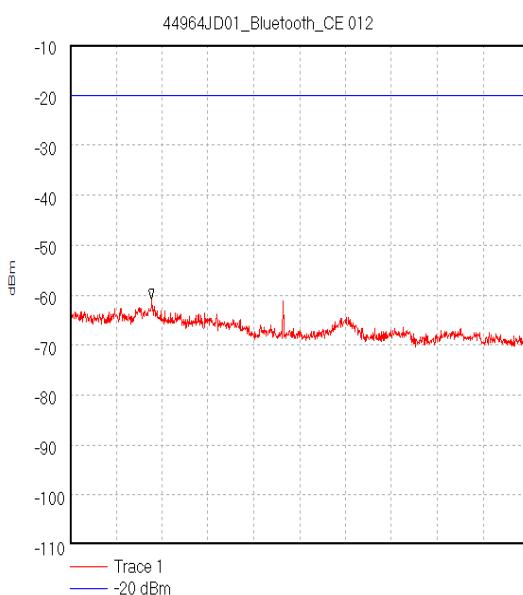
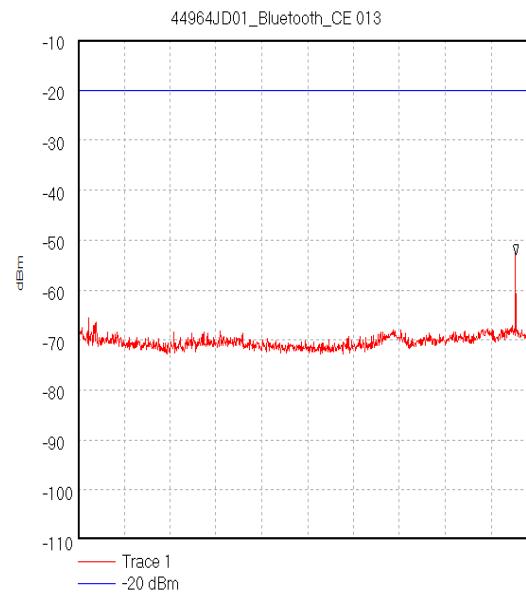
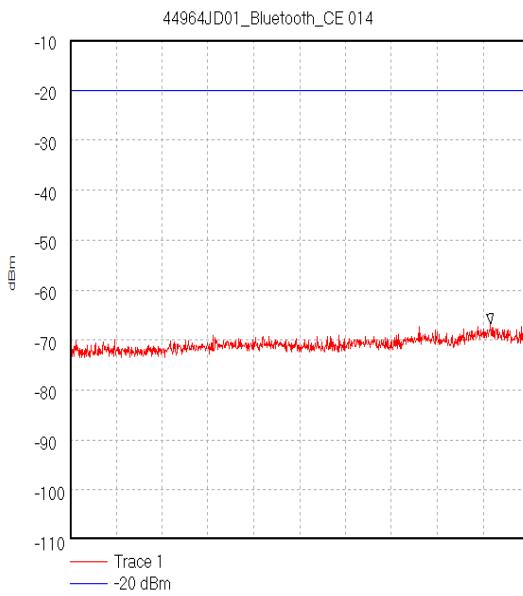
Start 1.0 MHz; Stop 30.0 MHz
Ref -10 dBm; Ref Offset 24.4 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 20.0 mS
Peak 1.0 MHz, -67.97 dBm
Display Line: -20 dBm;
06/08/2003 10:51:59



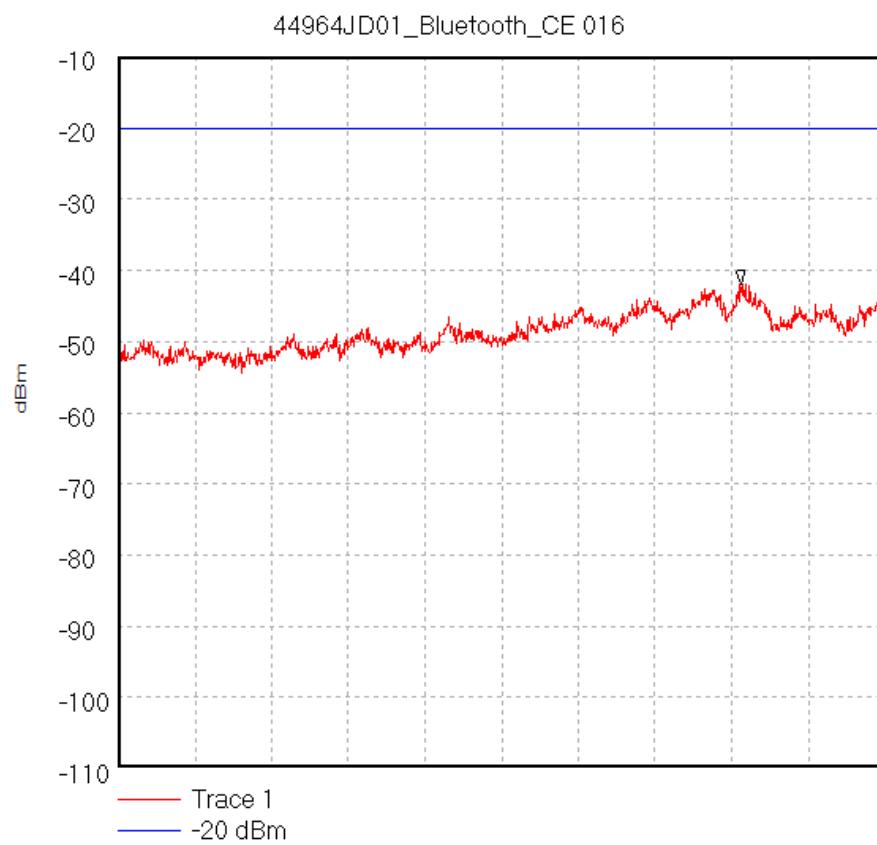
Start 30.0 MHz; Stop 1.0 GHz
Ref -10 dBm; Ref Offset 21.4 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 300.0 mS
Peak 616.311111 MHz, -69.44 dBm
Display Line: -20 dBm;
06/08/2003 10:52:33

Test Of: Nokia Mobile Phones
NHL-8/3660 mobile handset
To: FCC Part 15.247

Transmitter Conducted Emissions Middle Channel (Continued)



Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

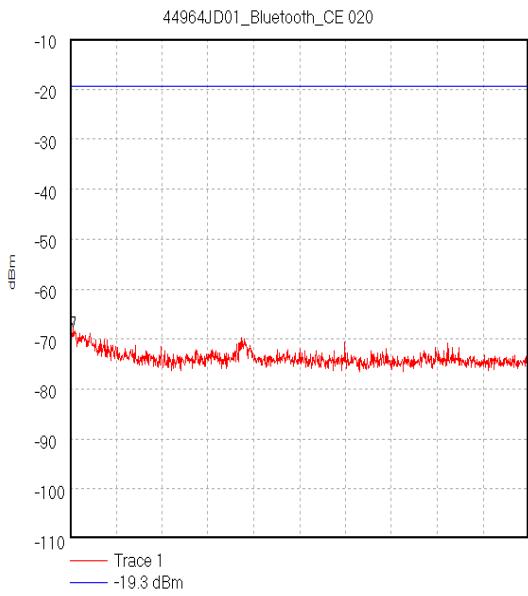
Transmitter Conducted Emissions Middle Channel (Continued)

Start 18.0 GHz; Stop 26.5 GHz
Ref -10 dBm; Ref Offset 39.3 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 2.6 S
Peak 24.903889 GHz, -41.91 dBm
Display Line: -20 dBm;
06/08/2003 11:00:51

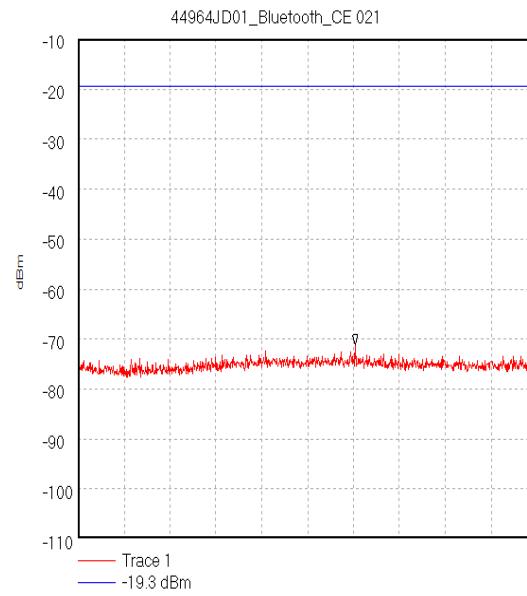
Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Transmitter Conducted Emissions: Section 15.247(c) (Continued)**Highest Peak Level: Top Channel**

Frequency (GHz)	Peak Detector level (dBm)	Peak Limit (dBm)	Peak Margin (dB)	Result
2.4835	-48.5	-19.3	29.2	Complied



Start 1.0 MHz; Stop 30.0 MHz
Ref -10 dBm; Ref Offset 24.4 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 20.0 mS
Peak 1.193333 MHz, -67.51 dBm
Display Line: -19.3 dBm;
06/08/2003 11:04:22

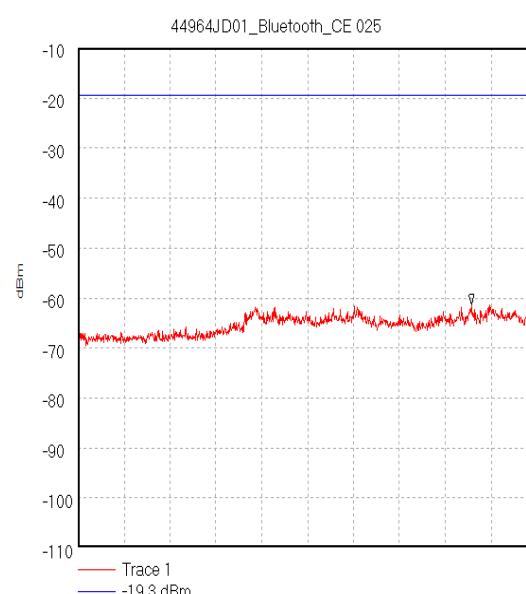
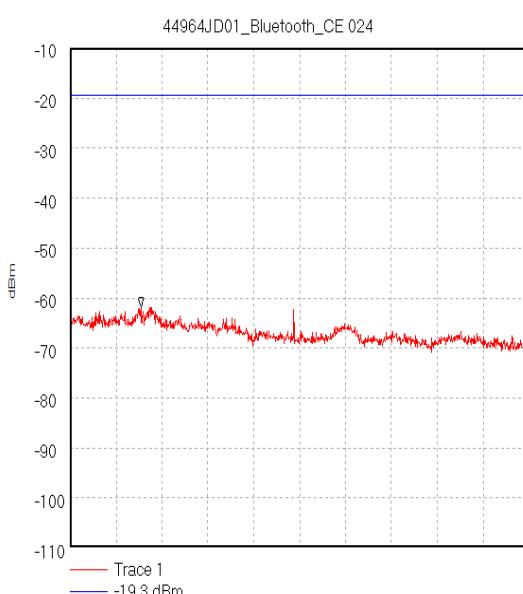
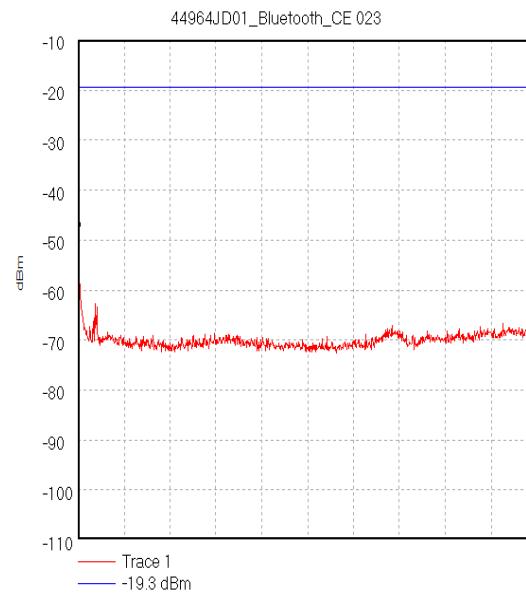
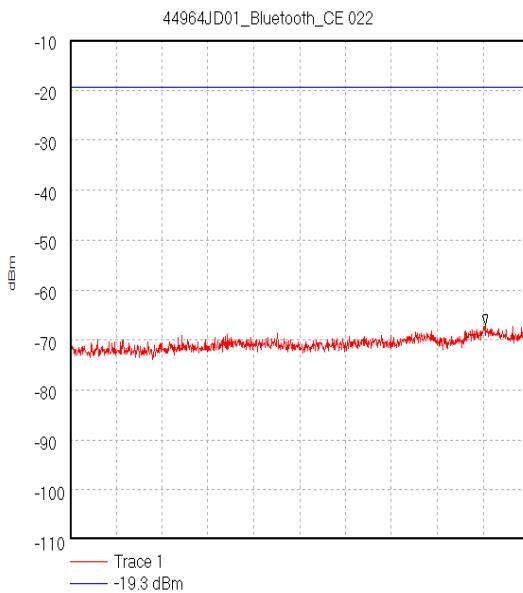


Start 30.0 MHz; Stop 1.0 GHz
Ref -10 dBm; Ref Offset 21.4 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 300.0 mS
Peak 616.311111 MHz, -71.17 dBm
Display Line: -19.3 dBm;
06/08/2003 11:04:58

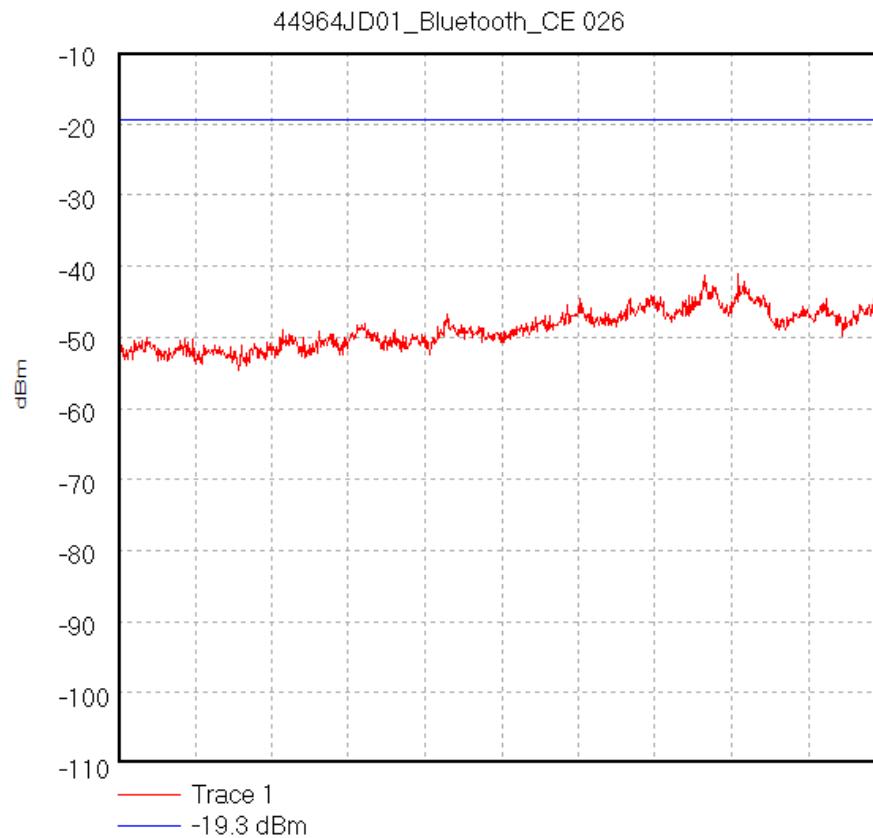
Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

TEST REPORT
S.No. RFI/MPTB1/RP44964JD01B
Page 38 of 68
Issue Date: 29 August 2003

Transmitter Conducted Emissions Top Channel (Continued)



Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

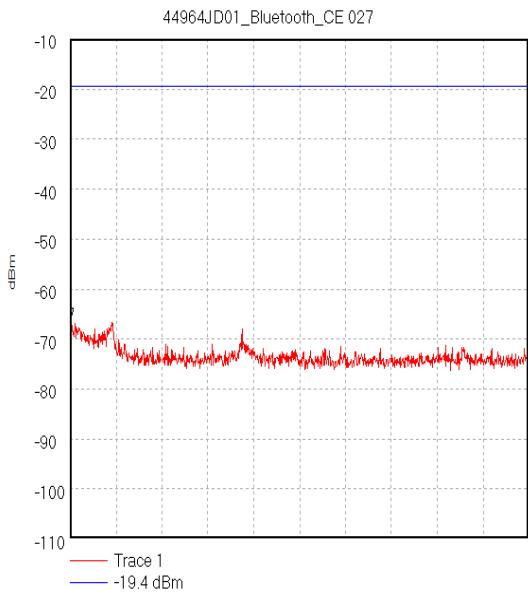
Transmitter Conducted Emissions Top Channel (Continued)

Start 18.0 GHz; Stop 26.5 GHz
Ref -10 dBm; Ref Offset 39.3 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 2.6 S
Peak 26.5 GHz, -40.65 dBm
Display Line: -19.3 dBm;
06/08/2003 11:11:34

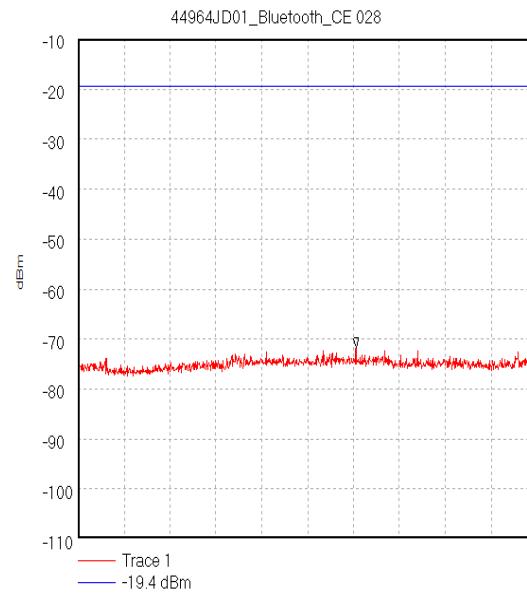
Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Transmitter Conducted Emissions: Section 15.247(c) (Continued)**Highest Peak Level: Hopping All Channels**

Frequency (GHz)	Peak Detector level (dBm)	Peak Limit (dBm)	Peak Margin (dB)	Result
4.899	-47.0	-19.4	27.6	Complied



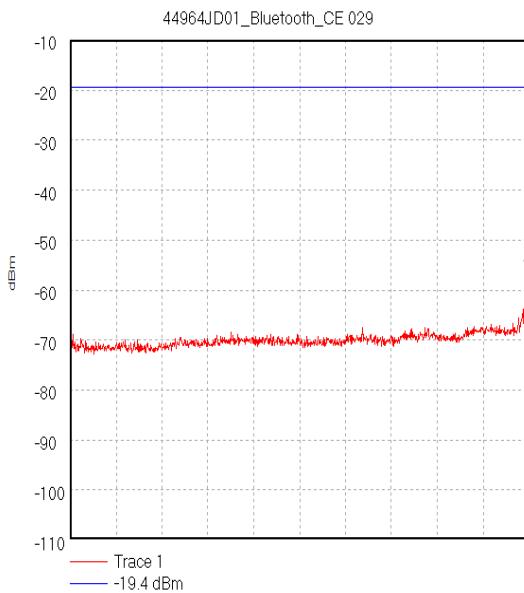
Start 1.0 MHz; Stop 30.0 MHz
Ref -10 dBm; Ref Offset 24.4 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 20.0 mS
Peak 1.032222 MHz, -65.86 dBm
Display Line: -19.4 dBm;
06/08/2003 11:13:30



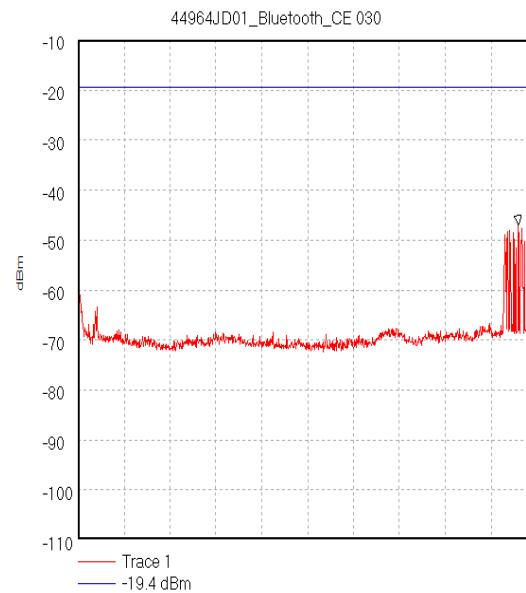
Start 30.0 MHz; Stop 1.0 GHz
Ref -10 dBm; Ref Offset 21.4 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 300.0 mS
Peak 618.466667 MHz, -71.78 dBm
Display Line: -19.4 dBm;
06/08/2003 11:14:20

Test Of: Nokia Mobile Phones
NHL-8/3660 mobile handset
To: FCC Part 15.247

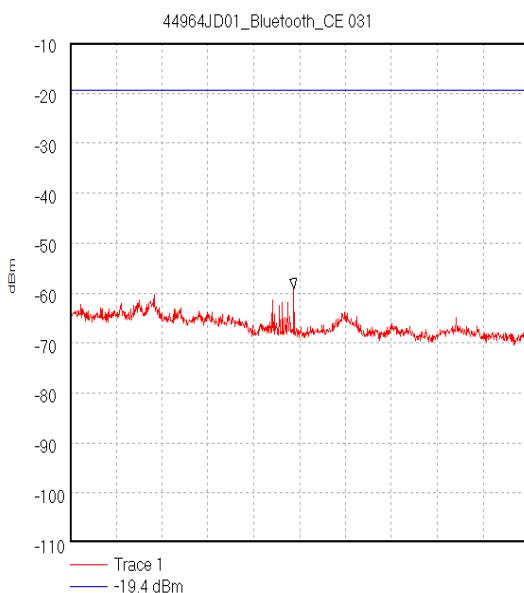
Transmitter Conducted Emissions Hopping All Channels (Continued)



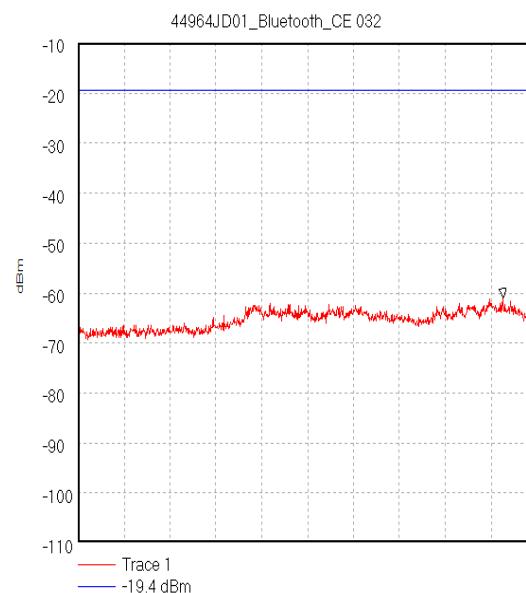
Start 1.0 GHz; Stop 2.4 GHz
 Ref -10 dBm; Ref Offset 25.0 dB; 10 dB/div
 RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 420.0 mS
 Peak 2.398444 GHz, -55.81 dBm
 Display Line: -19.4 dBm;
 06/08/2003 11:15:26



Start 2.4835 GHz; Stop 5.0 GHz
 Ref -10 dBm; Ref Offset 23.4 dB; 10 dB/div
 RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 760.0 mS
 Peak 4.89934 GHz, -46.97 dBm
 Display Line: -19.4 dBm;
 06/08/2003 11:16:30



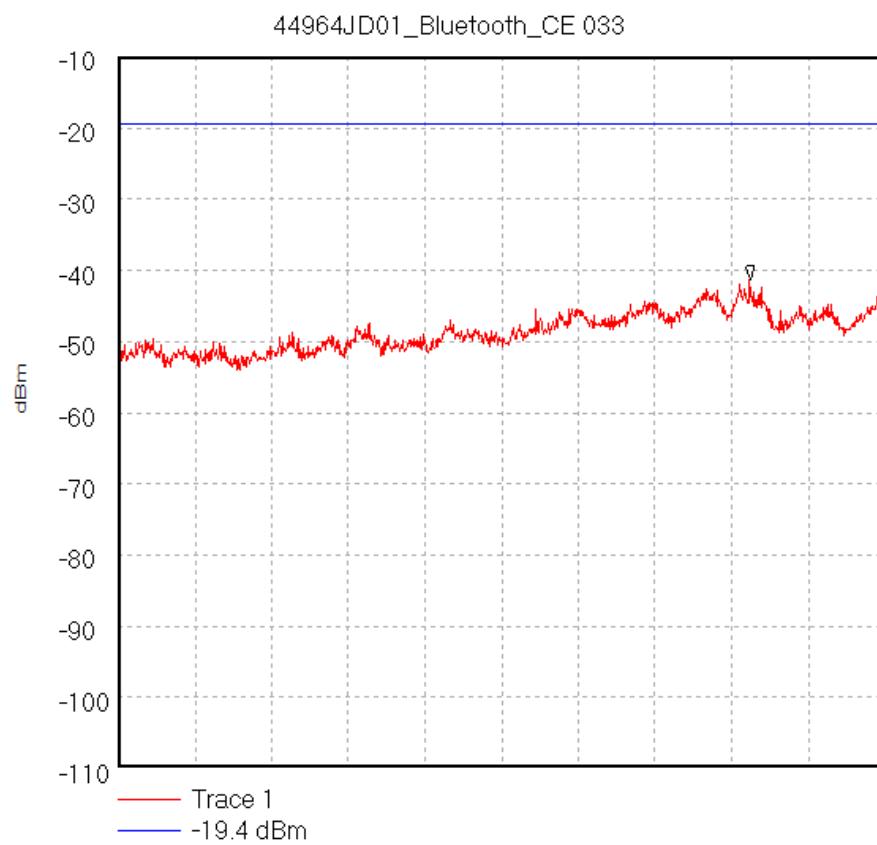
Start 5.0 GHz; Stop 10.0 GHz
 Ref -10 dBm; Ref Offset 26.9 dB; 10 dB/div
 RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 1.5 S
 Peak 7.438889 GHz, -59.13 dBm
 Display Line: -19.4 dBm;
 06/08/2003 11:21:48



Start 10.0 GHz; Stop 18.0 GHz
 Ref -10 dBm; Ref Offset 27.7 dB; 10 dB/div
 RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 2.4 S
 Peak 17.413333 GHz, -60.99 dBm
 Display Line: -19.4 dBm;
 06/08/2003 11:22:38

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Transmitter Conducted Emissions Hopping All Channels (Continued)



Start 18.0 GHz; Stop 26.5 GHz
Ref -10 dBm; Ref Offset 39.3 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 2.6 S
Peak 25.007778 GHz, -41.28 dBm
Display Line: -19.4 dBm;
06/08/2003 11:23:20

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

8.9. Transmitter Radiated Emissions: Section 15.247(c) and 15.209(a)

8.9.1. Electric Field Strength Measurements: 30 to 1000 MHz.

8.9.1.1. The EUT was configured as for radiated field strength measurements as described in Section 9 of this report.

8.9.1.2. Tests were performed to identify the maximum radiated emissions levels.

Middle Channel

Frequency (MHz)	Ant. Pol.	Q-P Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
47.296	V	18.1	40.0	21.9	Complied
53.31	H	23.1	40.0	16.9	Complied
66.646	H	26.0	40.0	14.0	Complied
73.316	H	25.9	40.0	14.1	Complied

Note 1: The preliminary scans showed similar emission levels for each mode below 1 GHz, therefore final radiated emissions measurements were performed with the EUT set to the Middle channel only.

Note 2: The following table are pre-scans performed within a screen room and used for indication purposes only and do not reflect the final measured level of an emission. Final measurements are noted in the table above.

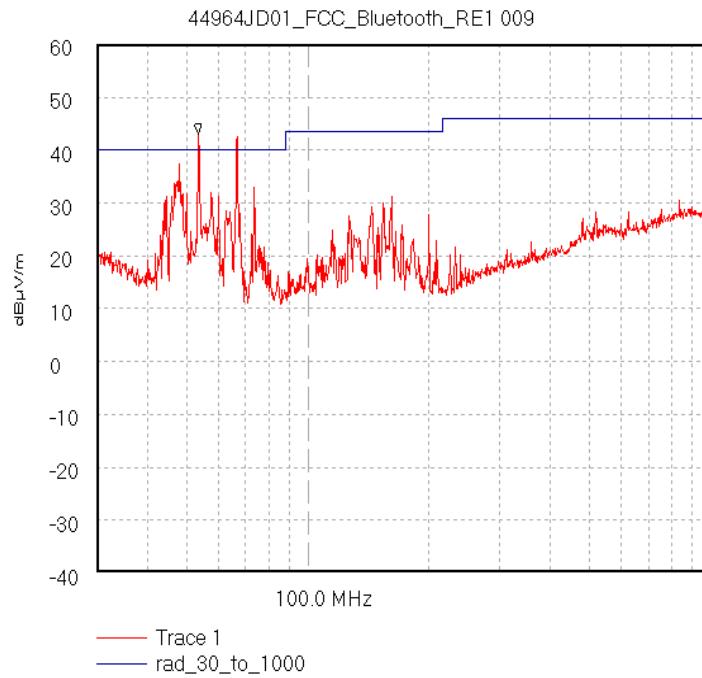
RADIO FREQUENCY INVESTIGATION LTD**Operations Department****TEST REPORT**

S.No. RFI/MPTB1/RP44964JD01B

Page 44 of 68

Issue Date: 29 August 2003

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**



Start 30.0 MHz; Stop 1.0 GHz - Log Scale
Ref 60 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 100.0 mS
Peak 53.61 MHz, 43.02 dB μ V/m
Limit/Mask: rad_30_to_1000; ; Limit Test Failed
Transducer Factors: A1037
7/21/2003 5:21:59 PM

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Transmitter Radiated Emissions: Section 15.247(c) and 15.209(a) (continued)**8.9.2. Electric Field Strength Measurements: 1.0 to 26.0 GHz****Highest Average Level: Middle Channel**

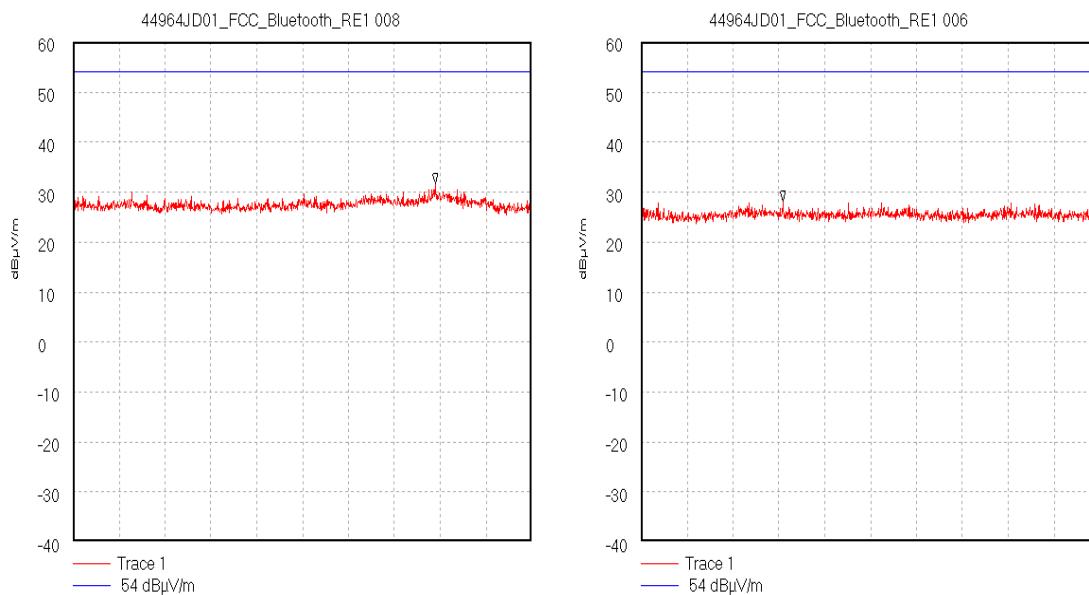
Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dB μ V)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dB μ V/m)	Average Limit (dB μ V/m)	Average Margin (dB)	Result
4.88212	V	1.0	24.2	1.8	27.0	54.0	27.0	Complied

Highest Peak Level: Middle Channel

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dB μ V)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Peak Margin (dB)	Result
4.88212	V	5.6	24.2	1.8	31.6	74.0	42.4	Complied

Note: No spurious emissions were detected within 20 dB of the average limit of 54.0 dB μ V/m; therefore the highest spurious emission level detectable above the noise floor was recorded. Final measurements were not performed on the bottom and top channels because all emissions on the middle channel were greater than 20 dB below the limit.

Note: Final measurements were performed exactly in line with the measurement guidelines stated in Public Notice DA 00-705 for Section 15.247 (c) Spurious Radiated Emissions.

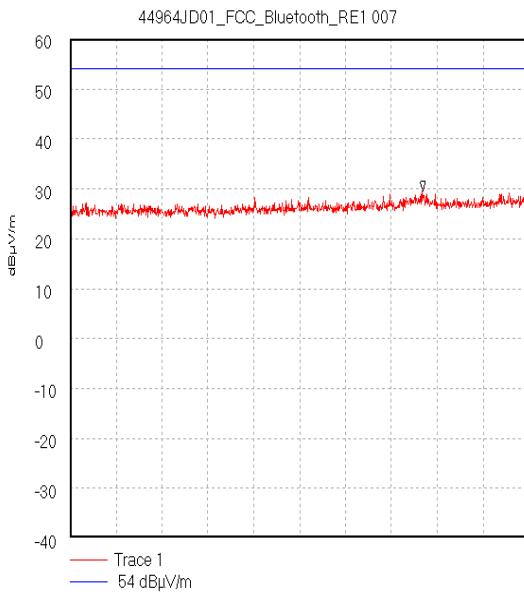


Start 1.0 GHz; Stop 2.0 GHz
Ref 60 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 640.0 mS
Peak 1.79 GHz, 31.72 dB μ V/m
Display Line: 54 dB μ V/m; ; Limit Test Passed
7/21/2003 5:16:31 PM

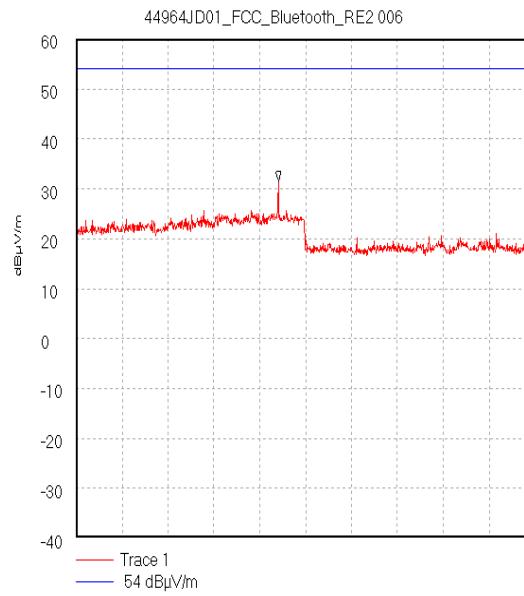
Start 2.0 GHz; Stop 2.4 GHz
Ref 60 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 260.0 mS
Peak 2.124 GHz, 28.16 dB μ V/m
Display Line: 54 dB μ V/m; ; Limit Test Passed
7/21/2003 5:11:33 PM

Test Of: Nokia Mobile Phones
NHL-8/3660 mobile handset
To: FCC Part 15.247

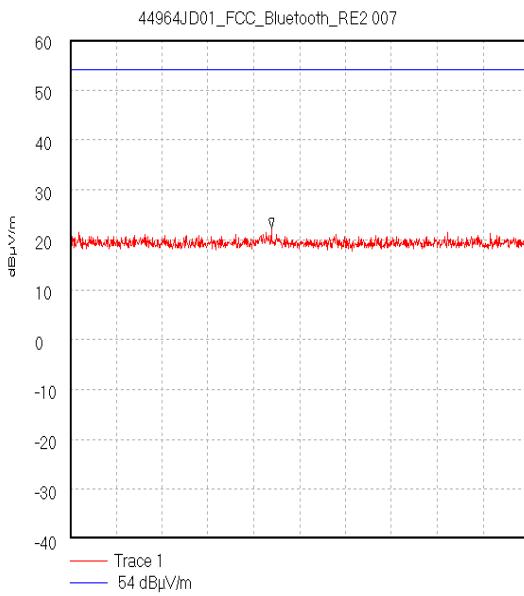
Transmitter Radiated Emissions (Continued)



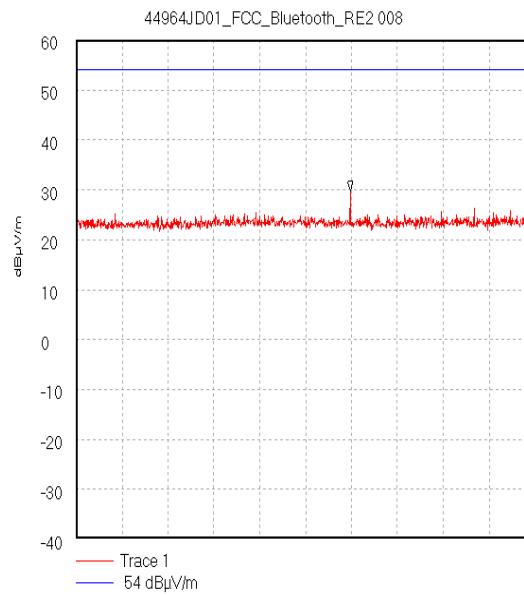
Start 2.484 GHz; Stop 4.0 GHz
Ref 60 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 960.0 mS
Peak 3.65 GHz, 29.56 dB μ V/m
Display Line: 54 dB μ V/m; ; Limit Test Passed
7/21/2003 5:13:15 PM



Start 4.0 GHz; Stop 6.0 GHz
Ref 60 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 1.28 S
Peak 4.882 GHz, 31.59 dB μ V/m
Display Line: 54 dB μ V/m; ; Limit Test Passed
23/07/2003 11:26:52



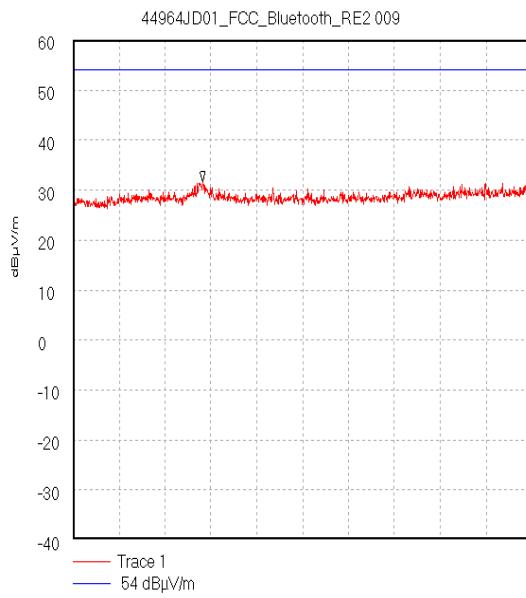
Start 6.0 GHz; Stop 8.0 GHz
Ref 60 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 1.28 S
Peak 6.878 GHz, 22.3 dB μ V/m
Display Line: 54 dB μ V/m; ; Limit Test Passed
23/07/2003 11:34:10



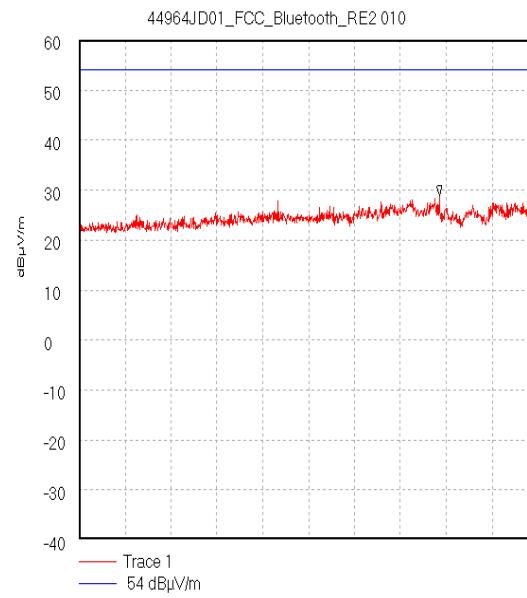
Start 8.0 GHz; Stop 12.5 GHz
Ref 60 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 3.0 S
Peak 10.69 GHz, 29.84 dB μ V/m
Display Line: 54 dB μ V/m; ; Limit Test Passed
23/07/2003 11:38:12

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Transmitter Radiated Emissions (Continued)



Start 12.5 GHz; Stop 18.0 GHz
Ref 60 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 3.6 S
Peak 14.052 GHz, 31.64 dB μ V/m
Display Line: 54 dB μ V/m; Limit Test Passed
23/07/2003 11:40:23



Start 18.0 GHz; Stop 26.5 GHz
Ref 60 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 5.4 S
Peak 24.677 GHz, 28.97 dB μ V/m
Display Line: 54 dB μ V/m; Limit Test Passed
23/07/2003 11:43:44

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

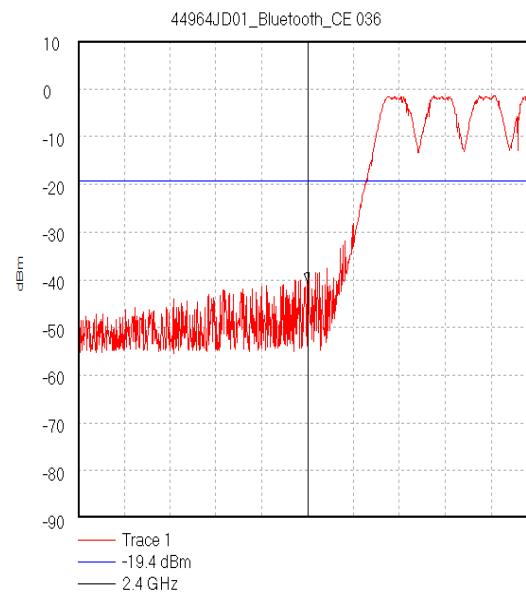
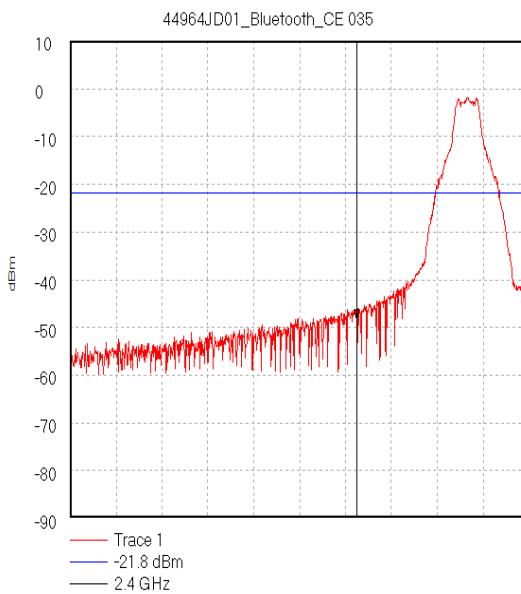
8.10. Transmitter Band Edge Conducted Emissions: Section 15.247(c)

8.10.1. The EUT was configured as for conducted emissions measurements as described in Section 9 of this report.

8.10.2. Tests were performed to identify the maximum conducted band edge emissions.

Highest Peak Level Lower Band Edge

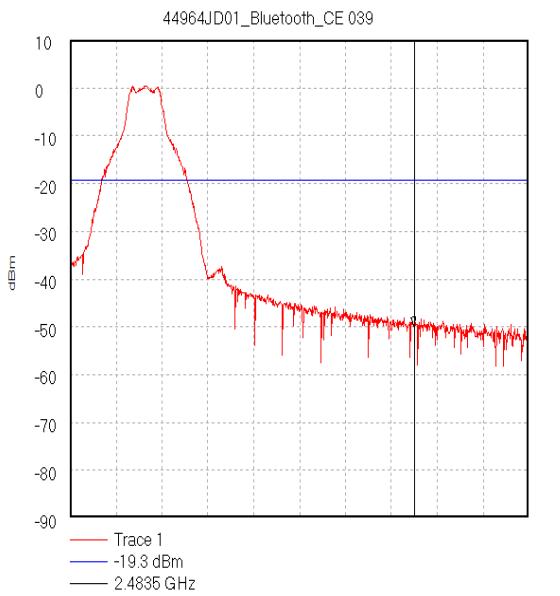
Frequency (GHz)	Mode	Peak Detector level (dB μ V)	Peak Limit (dB μ V)	Peak Margin (dB)	Result
2.400	Static	-48.2	-21.8	26.4	Complied
2.400	Hopping	-40.6	-19.4	21.2	Complied



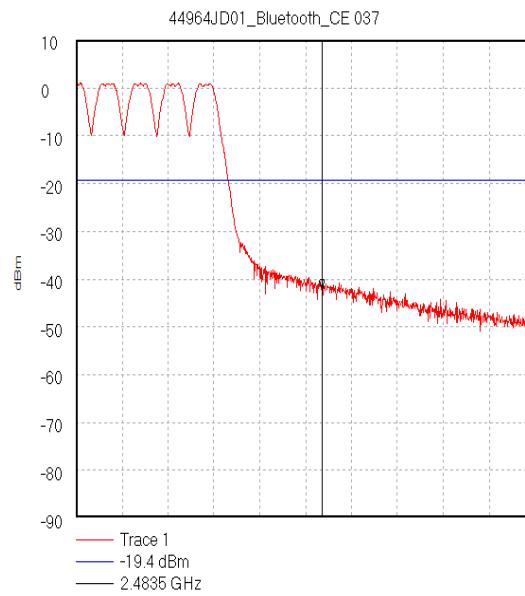
Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Transmitter Band Edge Conducted Emissions: Section 15.247(c) (Continued)**Highest Peak Level Upper Band Edge**

Frequency (GHz)	Mode	Peak Detector level (dB μ V)	Peak Limit (dB μ V)	Peak Margin (dB)	Result
2.4835	Static	-49.8	-19.3	30.5	Complied
2.4835	Hopping	-42.2	-19.4	22.8	Complied



Start 2.479 GHz; Stop 2.485 GHz
Ref 10 dBm; Ref Offset 22.5 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 20.0 mS
Marker 2.4835 GHz, -49.82 dBm
Display Line: -19.3 dBm;
06/08/2003 12:05:23



Start 2.476 GHz; Stop 2.49 GHz
Ref 10 dBm; Ref Offset 22.5 dB; 10 dB/div
RBW 300.0 kHz; VBW 300.0 kHz; Att 0 dB; Swp 20.0 mS
Marker 2.4835 GHz, -42.2 dBm
Display Line: -19.4 dBm;
06/08/2003 12:02:11

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

8.11. Transmitter Band Edge Radiated Emissions: Section 15.247(c) & 15.209(a)

8.11.1. Electric Field Strength Measurements

8.11.1.1. The EUT was configured as for band edge compliance of radiated emissions measurements as described in Section 9 of this report.

8.11.1.2. Tests were performed to identify the maximum radiated band edge emissions.

Peak Power Level Hopping Mode:

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dB μ V)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Peak Margin (dB)	Result
2.400	Horiz.	22.3	21.5	0.8	44.6	71.6	27.0	Complied
2.4835	Horiz.	15.7	21.5	0.8	38.0	74.0	36.0	Complied

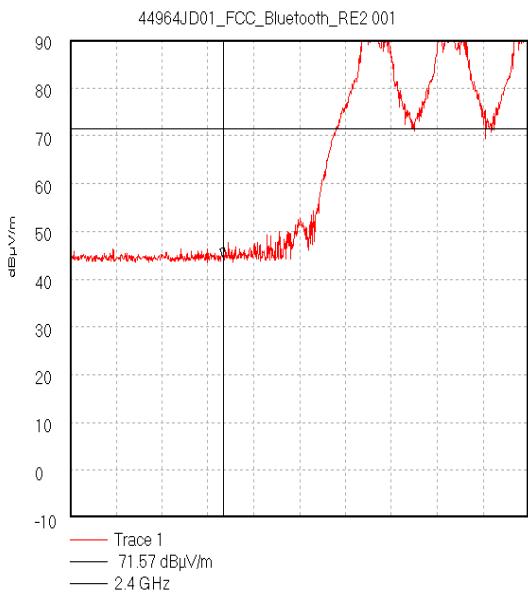
Average Power Level Hopping Mode:

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dB μ V)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dB μ V/m)	Average Limit (dB μ V/m)	Average Margin (dB)	Result
2.4835	Horiz.	13.9	21.5	0.8	36.2	54.0	17.8	Complied

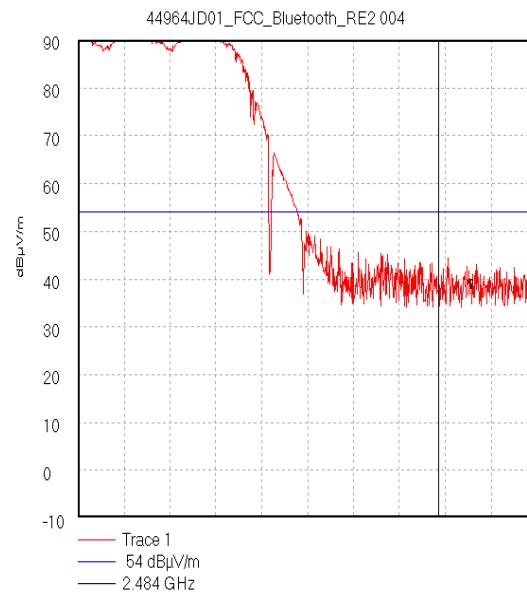
Note: The position of marker on plot 44964JD01_FCC_Bluetooth_RE 004 is incorrectly shown due to a glitch in the software used to transpose the on-screen image on the spectrum analyser to the PC holding the soft copy of the plot. Additionally the band edge frequency line and marker frequency are incorrectly shown as 2.484 GHz and not 2.4835 GHz as they should be. This was, once again, due to the same software glitch detailed above. It is confirmed that the measurement was made at the actual band edge frequency of 2.4835 GHz and the result given in the table above is valid for that frequency.

RADIO FREQUENCY INVESTIGATION LTD**Operations Department**

Test Of: Nokia Mobile Phones
NHL-8/3660 mobile handset
To: FCC Part 15.247

TEST REPORT**S.No. RFI/MPTB1/RP44964JD01B****Page 51 of 68****Issue Date: 29 August 2003**

Start 2.398 GHz; Stop 2.404 GHz
Ref 90 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 5 dB; Swp 20.0 mS
Marker 2.4 GHz, 44.63 dB μ V/m
Display Line: 71.57 dB μ V/m; Limit Test Failed
23/07/2003 10:51:24



Start 2.478 GHz; Stop 2.485 GHz
Ref 90 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 1000.0 kHz; VBW 100.0 kHz; Att 5 dB; Swp 20.0 mS
Marker 2.484 GHz, 37.97 dB μ V/m
Display Line: 54 dB μ V/m; Limit Test Failed
23/07/2003 11:19:14

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

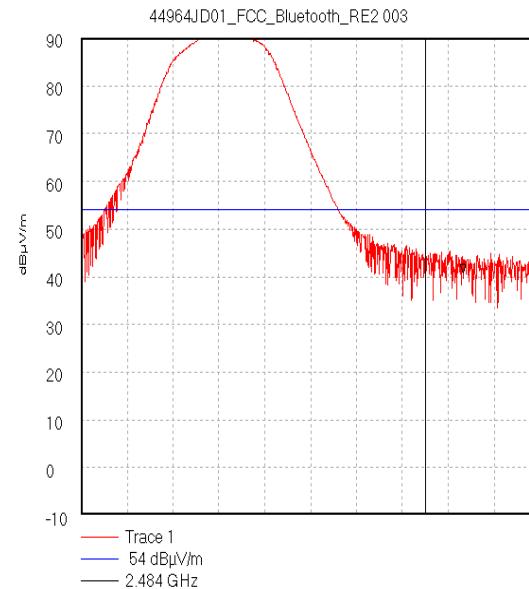
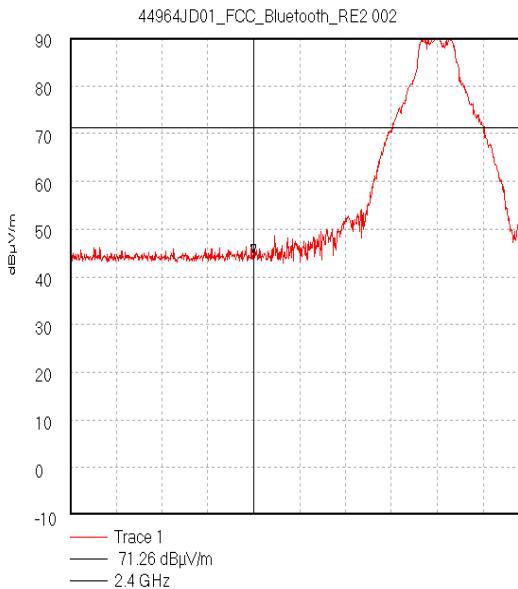
Transmitter Band Edge Radiated Emissions: Section 15.247(c) & 15.209(a) (Continued)**Peak Power Level Static Mode:**

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dB μ V)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Peak Margin (dB)	Result
2.400	Horiz.	22.6	21.5	0.8	44.9	71.3	26.4	Complied
2.4835	Horiz.	18.4	21.5	0.8	40.7	74.0	33.3	Complied

Average Power Level Static Mode:

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dB μ V)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dB μ V/m)	Average Limit (dB μ V/m)	Average Margin (dB)	Result
2.4835	Horiz.	14.7	21.5	0.8	37.0	54.0	17.0	Complied

Note: The position of marker on plot 44964JD01_FCC_Bluetooth_RE 003 is incorrectly shown due to a glitch in the software used to transpose the on-screen image on the spectrum analyser to the PC holding the soft copy of the plot. Additionally the band edge frequency line and marker frequency are incorrectly shown as 2.484 GHz and not 2.4835 GHz as they should be. This was, once again, due to the same software glitch detailed above. It is confirmed that the measurement was made at the actual band edge frequency of 2.4835 GHz and the result given in the table above is valid for that frequency.



Start 2.398 GHz; Stop 2.403 GHz
Ref 90 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 5 dB; Swp 20.0 mS
Marker 2.4 GHz, 44.86 dB μ V/m
Display Line: 71.26 dB μ V/m; Limit Test Failed
23/07/2003 11:01:47

Start 2.479 GHz; Stop 2.485 GHz
Ref 90 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 1000.0 kHz; VBW 100.0 kHz; Att 5 dB; Swp 20.0 mS
Marker 2.484 GHz, 40.74 dB μ V/m
Display Line: 54 dB μ V/m; Limit Test Failed
23/07/2003 11:16:01

9. Measurement Methods

9.1. AC Mains Conducted Emissions

AC mains conducted emissions measurements were performed in accordance with the standard, against appropriate limits for each detector function.

The test was performed in a shielded enclosure with the equipment arranged as detailed in the standard on a wooden bench using the floor of the screened enclosure as the ground reference plane. The EUT powered with 115V 60 Hz AC mains supplied via a Line Impedance Stabilisation Network (LISN)

Initial measurements in the form of swept scans covering the entire measurement band were performed in order to identify frequencies on which the EUT was generating interference. In order to minimise the time taken for these swept measurements, a Peak detector was used in conjunction with the appropriate detector IF measuring bandwidths (see table below). Repetitive scans were performed to allow for emissions with low repetition rates, and the duty cycle of the EUT. The test configuration was the same for the initial scans as for the final measurements.

Following the initial scans, a graph was produced giving an overview of the emissions from the EUT plotted against the appropriate specification limit. A tolerance line was set 6 dB below the specification limit and levels above the tolerance line were re-tested (at individual frequencies) using the appropriate detector function.

The EUT was configured in accordance with section 5.2 of this report.

The test equipment settings for conducted emissions measurements were as follows:

Receiver Function	Initial Scan	Final Measurements
Detector Type:	Peak	Quasi-Peak (CISPR)*
Mode:	Max Hold	Not applicable
Bandwidth:	9 kHz	9 kHz
Amplitude Range:	100 dB	20 dB
Measurement Time:	Not applicable	> 1 s
Observation Time:	Not applicable	> 15 s
Step Size:	Continuous sweep	Not applicable
Sweep Time:	Coupled	Not applicable

* In some instances an Average detector function may also have been used, where this was the case it would have been documented in the relevant section.

9.2. Radiated Field Strength Emissions

Radiated emissions measurements were performed in accordance with the standard, against appropriate limits for each detector function.

Initial measurements covering the entire measurement band in the form of swept scans in a shielded enclosure were performed in order to identify frequencies on which the EUT was generating interference. This determined the frequencies from the EUT that should be re-measured in full on the open area test site. In order to minimise the time taken for the swept measurements, a Peak detector was used in conjunction with the appropriate detector IF measuring bandwidth (see table below). Repetitive scans were performed to allow for emissions with low repetition rates.

The initial scans were performed using an antenna height of 1.5 m and a measurement distance of 3 m. Following the initial scans, graphs were produced giving an overview of the emissions from the EUT plotted against the appropriate specification limit. Any emission within 20 dB of the limit were then measured on the open area test site, except in cases where the noise floor was within 20 dB of the limit, in these cases the emission between the noise floor and the limit line or the highest point of the noise floor was measured.

In either case the measurement was made at the appropriate distance using a measuring receiver with a Quasi-Peak detector for measurements below 1000 MHz and an Average and Peak detector for measurements above 1000 MHz.

All measurements on the open area test site were performed using broadband antennas.

On the open area test site, at each frequency where a signal was to be measured, the trace was maximised by rotating a turntable through 360°. The angle at which the maximum signal was observed was locked out. For frequencies below 1000 MHz the test antenna was varied in height between 1 m and 4 m in order to further maximise the target emission.

For frequencies above 1000 MHz where a horn antenna was used, height searching was performed to locate the optimal height of the horn with respect to the EUT. At this point the horn was locked off and the turntable was again rotated through 360° to maximise the target signal. It should be noted that the received signal from the EUT would diminish very quickly after it exits the beam width of the horn antenna, for this reason it may not be necessary to fully height search with the horns.

At this point, any signals found to be between the limit and a level 6 dB below it were further maximised by changing the configuration of the EUT, e.g. re-routing cables to peripherals and moving peripherals with respect to the EUT.

Scans were performed to the upper frequency limit as stated in 15.33(a)(1)

Final measurements were performed on the worst-case configuration as described in Part 15.31(i).

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Radiated Field Strength Emissions (Continued)

The EUT was configured in accordance with section 5.2 of this report for radiated emissions testing.

The test equipment settings for radiated emissions measurements were as follows:

Receiver Function	Initial Scan Below 1000 MHz	Final Measurements Below 1000 MHz
Detector Type:	Peak	Quasi-Peak (CISPR)
Mode:	Max Hold	Not applicable
Bandwidth:	100 kHz	120 kHz
Amplitude Range:	100 dB	100 dB
Measurement Time:	Not applicable	> 1 s
Observation Time:	Not applicable	> 15 s
Step Size:	Continuous sweep	Not applicable
Sweep Time:	Coupled	Not applicable

Receiver Function	Initial Scan Above 1000 MHz	Final Measurements Above 1000 MHz
Detector Type:	Peak	Peak/Average
Mode:	Max Hold	Max Hold where applicable
Bandwidth:	100 kHz	1 MHz
Amplitude Range:	100 dB	100 dB
Measurement Time:	Not applicable	> 1 s
Observation Time:	Not applicable	> 15 s
Step Size:	Continuous sweep	Not applicable
Sweep Time:	Coupled	Not applicable

9.3. Carrier Frequency Separation/20dB Bandwidth

The EUT and spectrum analyser was configured as per FCC Public Notice DA 00-705, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

To determine the bandwidth and separation of each transmission channel the analyser was configured to measure two adjacent channels.

To determine the occupied bandwidth, A resolution bandwidth of 10 kHz was used, which is greater than 1% of the 20 dB bandwidth. A video bandwidth of a least the same value was used. The analyser was set for a maximum hold scan to capture the profile of the signal. The peak level was then determined, and a reference line was drawn 20 dB below the peak level. The bandwidth was determined at the points where the 20 dB reference crossed the profile of the emission.

9.4. Average Time of Occupancy

The EUT and spectrum analyser was configured then connected to an access point on the EUT provided by the manufacturer for the purpose of this test.

To determine the maximum packet length on any given channel, the analyser was configured in the time domain mode and the EUT was configured to operate as intended.

To determine the average occupancy time on any given channel the analyser was configured in the time domain and a 30 second sweep carried out. The number of times the channel was occupied in any 30 second period multiplied by the maximum packet length will give the total time on the given channel.

9.5. Conducted Emissions Measurment

Conducted Emissions measurements were performed in accordance with the standard, against appropriate limits for each detector function.

Prior to testing being performed a suitable RF attenuator and cable were calibrated for the required frequency range. For each measurement range the calibrated level of the attenuator and cable were entered as an offset into the spectrum analyser to compensate for the losses in the measurement set up.

A limit line was set to 20 dB below the maximum in band emission as stated in 15.247(c).

Initial measurements covering the entire frequency band in the form of swept scans were performed in order to identify frequencies on which the EUT was generating interference. This determined the frequencies on which final measurements were necessary. To make the final measurements a peak detector was used in conjunction with the appropriate detector IF measuring bandwidth.

Repetitive scans were performed to allow for emissions with low repetition rates.

Scans were performed to the upper frequency limit as stated in 15.33(a)(1)

Final measurements were performed on the worst-case configuration as described in Part 15.31(i) for conducted emissions.

The EUT was configured in accordance with section 5.2 of this report.

9.6. Peak Output Power

The EUT and spectrum analyser were configured as ERP measurements in accordance with the standard, and as per FCC Public Notice DA 00-705, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. The EUT was configured in accordance with section 5.2 of this report.

ERP measurements were performed in accordance with the standard, against appropriate limits.

The ERP was measured with the EUT arranged on a non-conducting turn table on a standard test site compliant with ANSI C63.4 – 2001 Clause 5.4. The transmitter was fitted with an integral antenna; as such all radiated tests were performed with the unit operating into the integral antenna.

The level of the ERP was measured using a spectrum analyser.

The test antenna was positioned in the horizontal plane. The EUT was oriented in the X plane. The test antenna was then raised and lowered until a maximum peak was observed. The turntable was then rotated through 360 degrees and the maximum peak reading obtained. The height search was then repeated to take into consideration the new angular position of the turntable. The maximum reading observed was then recorded. This procedure was then repeated with the EUT oriented in the Y and Z planes. The highest reading taken in all 3 planes was recorded. The entire procedure was then repeated with the test antenna set in the Vertical polarity.

Once the final amplitude (maximised) had been obtained, the EUT was substituted with a substitution antenna. For ERP measurements a dipole antenna was used. The centre of the substitution antenna was set to approximately the same centre location as the EUT. The substitution antenna was set to the horizontal polarity. The substitution antenna was matched into a signal generator using a 6 dB or greater PAD. The signal generator was tuned to the EUT's frequency under test.

The test antenna was then raised and lowered to obtain a maximum reading on the spectrum analyser. The level of the signal generator output was then adjusted until the maximum recorded EUT level was observed. The signal generator level was noted. This procedure was repeated with both test antenna and substitution antenna vertically polarised. The ERP was calculated as:-

$$\text{ERP} = \text{Signal Generator Level} - \text{Cable Loss} + \text{Antenna Gain}$$

Note that an ideal dipole has 0 dBd of gain, however, realistically this isn't the case and any gain/or loss present is taken into consideration.

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Effective Radiated Power (ERP) (Continued)

Circumstances where the signal generator could not produce the desired power substitution was performed with the signal generator set to 0 dBm. The radiated signal was maximised as previously described. The level indicated on the measuring receiver was noted. The delta between this level and the maximum level for the EUT was calculated and also noted. The ERP of the signal generator was calculated using the above formulae. The recorded delta was added to the calculated ERP to obtain the substituted EUT ERP.

The test equipment settings for ERP measurements were as follows:

Receiver Function	Setting
Detector Type:	Peak
Mode:	Not applicable
Bandwidth:	As stated in Public Notice DA 00-705
Amplitude Range:	100 dB
Sweep Time:	Coupled

9.7. Band Edge Compliance of RF Radiated Emissions

The EUT and spectrum analyser were configured as for Radiated measurements, And as per FCC Public Notice DA 00-705, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

To determine band-edge compliance, the analyser resolution bandwidth was set to $\geq 1\%$ of the analyser span. The video bandwidth was set to be no less than the resolution bandwidth. The sweep was set to auto and the detector to peak. The trace was set to max hold and a trace was produced.

A plot of the upper band edge of the allocated frequency band was produced. A limit line was set to the level of the highest in-band emission with a further limit line set to 20 dB below this. A marker was then placed on the highest out of band emission (The specification states that either the band edge level must be measured or the highest out of band emission, whichever is the greater). The plots show that the highest out of band emission complies with the 20 dBc Limit. The above procedure was then repeated for the lower band edge.

If the upper or lower band edges fell on a restricted band edge then the limit set for the restricted band would be applied instead of the 20 dBc limit.

(Final measurements were performed on the worst-case configuration as described in Part 15.31(i).)

The EUT was configured in accordance with section 5.2 of this report

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

10. Measurement Uncertainty

10.1. No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

10.2. The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

10.3. The uncertainty of the result may need to be taken into account when interpreting the measurement results.

10.4. The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor, such that a confidence level of approximately 95% is maintained. For the purposes of this document "approximately" is interpreted as meaning "effectively" or "for most practical purposes".

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	0.15 MHz to 30.0 MHz	95%	+/- 3.25 dB
Carrier Output Power	Not applicable	95%	+/- 0.46 dB
Conducted Emissions	0.009 MHz to 26 GHz	95%	+/- 1.2 dB
Effective Isotropic Radiated Power (EIRP)	Not applicable	95%	+/- 1.78 dB
Frequency Stability	Not applicable	95%	+/- 20 Hz
Minimum Bandwidth	Not applicable	95%	+/- 0.12 %
Occupied Bandwidth	1850 to 1910 MHz	95%	+/- 0.12 %
Radiated Spurious Emissions	30.0 MHz to 1000.0 MHz	95%	+/- 5.26 dB
Radiated Spurious Emissions	1.0 GHz to 26.0 GHz	95%	+/- 1.78 dB
Spectral Power Density	Not applicable	95%	+/- 1.2 dB

10.5. The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

RADIO FREQUENCY INVESTIGATION LTD**Operations Department**

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

TEST REPORT**S.No. RFI/MPTB1/RP44964JD01B****Page 63 of 68****Issue Date: 29 August 2003****Appendix 1. Test Equipment Used**

RFI No.	Instrument	Manufacturer	Type No.	Serial No.
A003	ESH3-Z2 Pulse Limiter	Rohde & Schwarz	ESH3-Z2	357 881/052
A027	Horn Antenna	Eaton	9188-2	301
A031	2 to 4 GHz Eaton Horn Antenna	Eaton	91889-2	557
A067	LISN	Rohde & Schwarz	ESH3-Z5	890603/002
A090	Narda Step Attenuator 0-60dB	Narda	743-60	01057
A1037	Chase Bilog Antenna	Chase EMC Ltd	CBL6112B	2413
A1141	HP 11691D	Hewlett Packerd	11691D	1212A02494
A197	Site 2 Controller SC144	Unknown	SC144	150720
A248	60 dB Variable Attenuator	Narda	743-60	01411
A254	WG 14 Microwave Horn	Flann Microwave	14240-20	139
A255	WG 16 Microwave Horn	Flann Microwave	16240-20	519
A259	Bilog Antenna	Chase	CBL6111	1513
A276	OATS Positioning Controller	Rohde & Schwarz	HCC	
A392	3 dB attenuator (9)	Suhner	6803.17.B	None
A428	WG 12 horn	Flann	12240-20	134
A430	WG 18 horn	Flann	18240-20	425
A433	WG 27 Straight	Flann	27441	None
C1001	Cable	Rosenberger	FA210A1020M30309	003
C1071	3m Rosenberger Cable	Rosenberger	FA21A1030M5050	Not Stated
C1077	1m Rosenberger Cable	Rosenberger	FA210A1010M5050	28462-2
C1079	Rosenberger 1m Cable	Rosenberger	FA210A1010M5050	28462-1
C1082	Rosenberger Cable 2m	Rosenberger	FA210A1020M5050	28463-1
C202	Rosenberger cable	Rosenberger	UFA 210A-1-1180-70X70	1543
C453	Cable	Rosenberger	RG142XX-001-RFIB	C453-10081998
C457	Cable	Rosenberger	RG142XX-002-RFIB	C457-10081998

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

Test Equipment Used (Continued)

RFI No.	Instrument	Manufacturer	Type No.	Serial No.
C461	Cable	Rosenberger	UFA210A-1-1182-704704	98H0305
C499	Cable	Rosenberger	FA210A1020M30309	001
C564	C564-N-2	Rosenberger	UFA 210A-1-0787-70x70	96L0226
G085	Generator	Hewlett Packard	83650L	3614A00104
M003	Spectrum Monitor	Rohde & Schwarz	EZM	883 580/008
M023	ESVP Receiver	Rohde & Schwarz	ESVP	872 991/027
M072	FSM Spectrum Analyser	Rohde & Schwarz	FSM	862 967/010 (RF) & 863 912/048 (Display)
M080	TestLab DMM	METEX	M8181B	AA163868
M115	Temperature/Humidit y Meter	RS Components	212-146	None
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016
M139	Digital Multimeter	Fluke	11	65830028
M141	Power Meter	Boonton	4220	33402BE
M150	Power Sensor	Boonton	51072	28473
M173	Turntable Controller	R.H.Electrical Services	RH351	3510020
S009	D.C. PSU	Farnell	PDD3502A	174
S201	Site 1	RFI	1	
S202	Site 2	RFI	2	S202-15011990
S207	Site 7	RFI	7	S202-15011990
S212	Site 12	RFI	12	

NB In accordance with UKAS requirements, all the measurement equipment is on a calibration schedule.

RADIO FREQUENCY INVESTIGATION LTD

Operations Department

TEST REPORT

S.No. RFI/MPTB1/RP44964JD01B

Page 65 of 68

Issue Date: 29 August 2003

Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

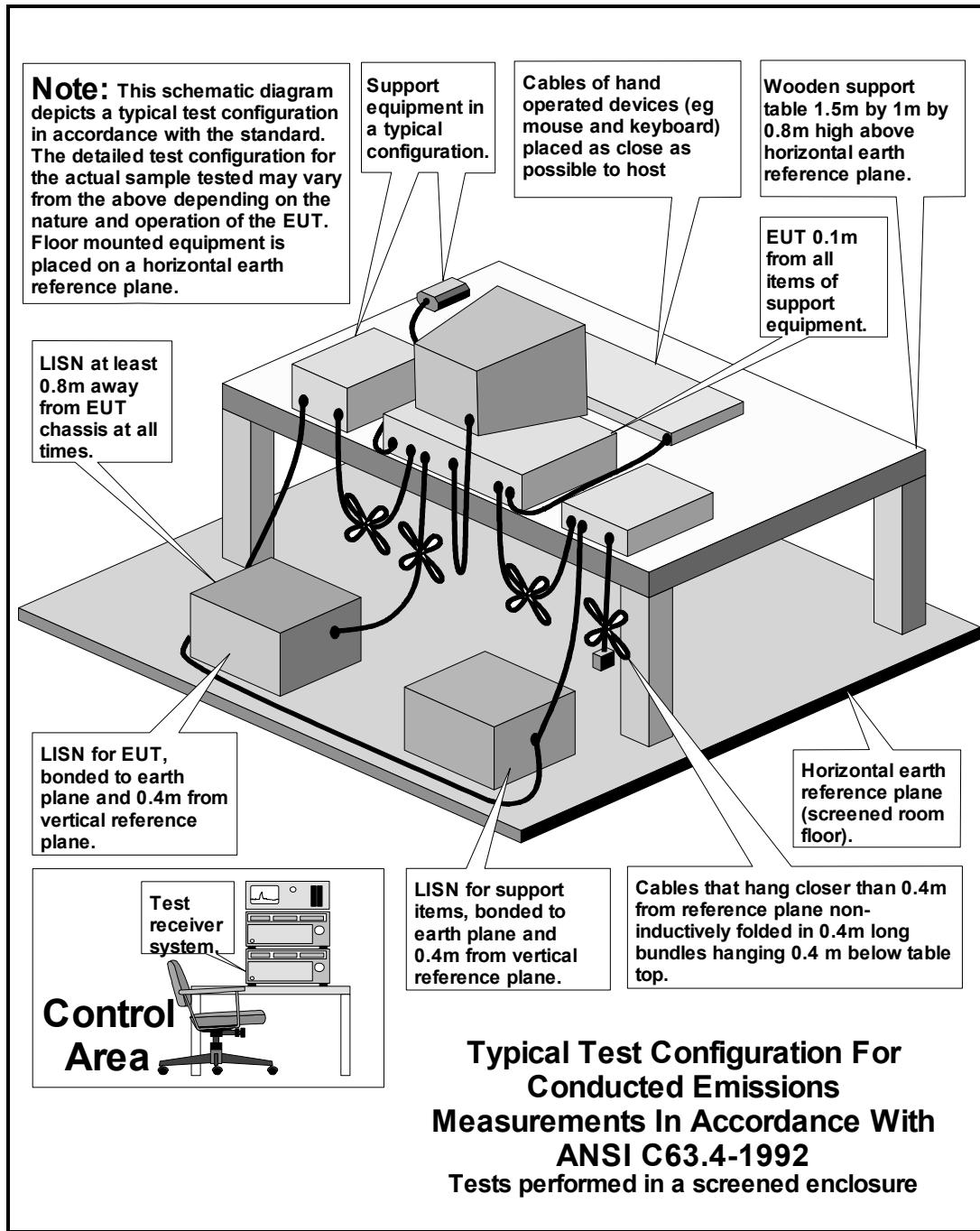
Appendix 2. Test Configuration Drawings

This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\44964JD01\EMICON	Test configuration for measurement of conducted emissions
DRG\44964JD01\EMIRAD	Test configuration for measurement of radiated emissions

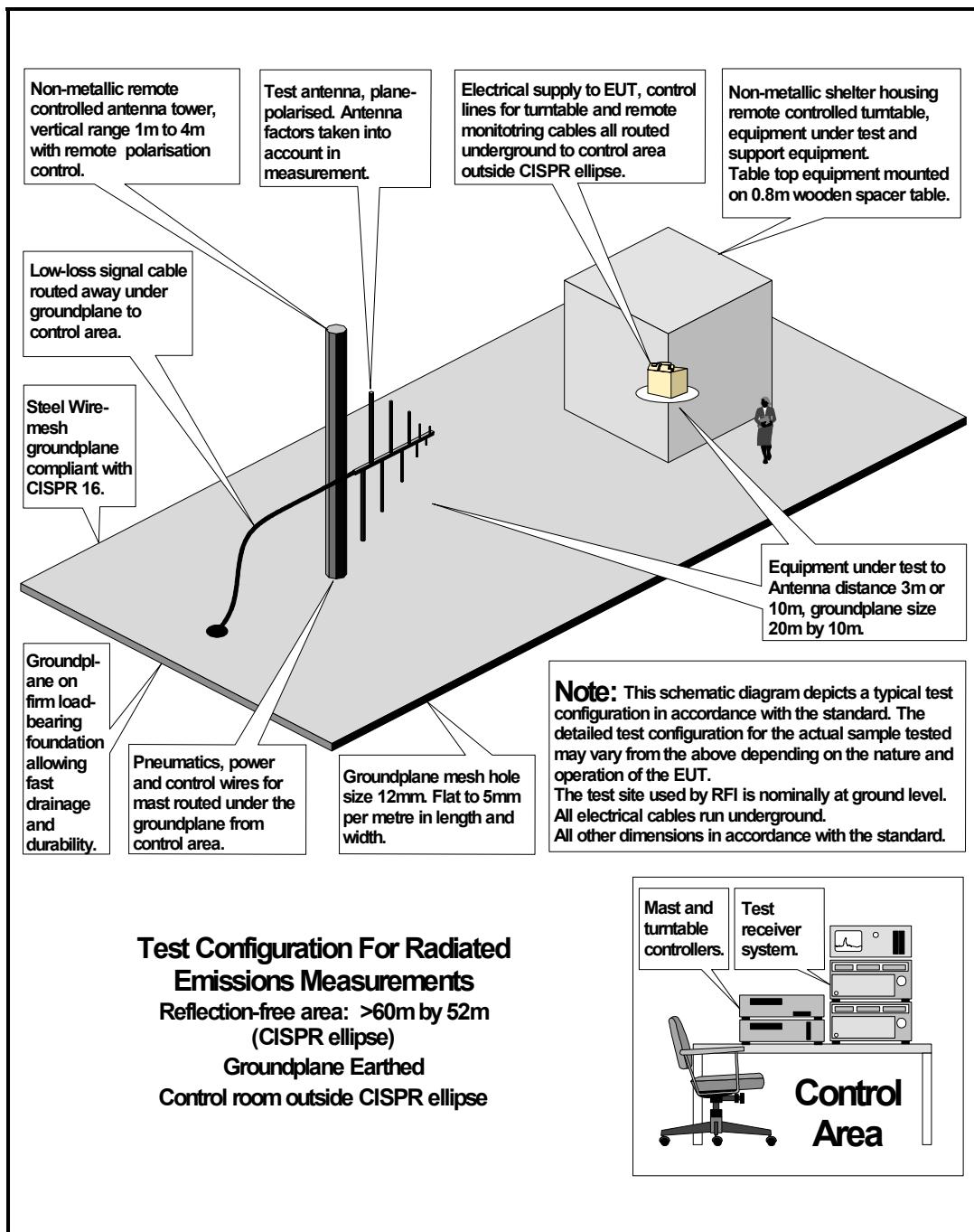
Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

DRG\44964JD01\EMICON



Test Of: **Nokia Mobile Phones**
NHL-8/3660 mobile handset
To: **FCC Part 15.247**

DRG\44964JD01\EMIRAD



RADIO FREQUENCY INVESTIGATION LTD

Operations Department

Test Of: Nokia Mobile Phones
NHL-8/3660 mobile handset
To: FCC Part 15.247

TEST REPORT

S.No. RFI/MPTB1/RP44964JD01B

Page 68 of 68

Issue Date: 29 August 2003

This page has been left intentionally blank.