



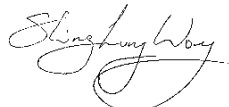


# TEST REPORT FROM RADIO FREQUENCY INVESTIGATION LTD.

Test Of: Nokia UK Ltd.  
NHL-10 mobile handset

To: FCC Part 15.247

**Test Report Serial No:**  
RFI/MPTB1/RP45084JD02A

<b>This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director:</b> 	<b>Checked By:</b> 
<b>Tested By:</b> 	<b>Release Version No:</b> PDF01
<b>Issue Date:</b> 01 September 2003	<b>Test Dates:</b> 01 August 2003 to 12 August 2003

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

**RADIO FREQUENCY INVESTIGATION LTD**

**Operations Department**

**Test Of:      Nokia UK Ltd.  
                 NHL-10  
To:              FCC Part 15.247**

**TEST REPORT**

**S.No. RFI/MPTB1/RP45084JD02A**

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**Issue Date: 01 September 2003**

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**1. Client Information**

<b>Company Name:</b>	Nokia Mobile Phones
<b>Address:</b>	Nokia House Summit Avenue Southwood Farnborough Hants GU14 0NG UK
<b>Contact Name:</b>	Mr A White

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## **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
Unique Type Identification:	NHL-10
IMEI Number:	004400261775348 *
FCC ID Number:	QVVNHL-10
Country of Manufacture:	Finland
Date of Receipt:	01 August 2003

*\* This sample was used for all radiated tests*

Brand Name:	Nokia
Unique Type Identification:	NHL-10
IMEI Number:	004400261775736 **
FCC ID Number:	QVVNHL-10
Country of Manufacture:	Finland
Date of Receipt:	01 August 2003

*\*\* This sample was used for all direct connection, i.e. conducted, tests*

### **2.2. Description Of EUT**

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

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### **2.3. Modifications Incorporated In EUT**

The EUT has not been modified from what is described by the Model Number and Unique Type Identification stated above.

### **2.4. Additional Information Related To Testing**

<b>Power Supply Requirement:</b> (Internal, non-removable lithium ion battery)	4.2 V DC		
<b>Declared Battery End Point Voltage</b>	3.45 V DC		
<b>Power Supply Requirement:</b> (AC Battery Charger)	Nominal 115 V 60 Hz AC Mains supply		
<b>Intended Operating Environment:</b>	Within GSM Network Coverage		
<b>Equipment Category:</b>	Portable		
<b>Type of Unit:</b>	Handset		
<b>Weight:</b>	122g		
<b>Dimensions:</b>	108.6mm x 58.2mm x 23.7mm		
<b>Interface Ports:</b>	Charger Connection Accessory Connection		
<b>Transmit Frequency Range</b>	2402 MHz to 2481 MHz		
<b>Transmit Channels Tested</b>	<b>Channel ID</b>	<b>Channel Number</b>	<b>Channel Frequency (MHz)</b>
	Bottom	1	2402
	Middle	40	2441
	Top	79	2480
<b>Receive Frequency Range</b>	2402 MHz to 2481 MHz		
<b>Receive Channels Tested</b>	<b>Channel ID</b>	<b>Channel Number</b>	<b>Channel Frequency (MHz)</b>
	Bottom	1	2402
	Middle	40	2441
	Top	79	2480
<b>Highest Fundamental Frequency</b>	1989.8 MHz		
<b>Highest Oscillator Frequency</b>	3980.0 MHz		
<b>Maximum Power Output (EIRP)</b>	1.8 dBm		

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## **2.5. Support Equipment**

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

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

<b>Description:</b>	AC Charger
<b>Brand Name:</b>	Nokia
<b>Model Name or Number:</b>	ACP-12U
<b>Serial Number:</b>	0675303399791K104L0070467
<b>Cable Length And Type:</b>	1 metre
<b>Connected to Port:</b>	Charger

<b>Description:</b>	Headset
<b>Brand Name:</b>	Nokia
<b>Model Name or Number:</b>	HDC-5
<b>Serial Number:</b>	02714676417182089923
<b>Cable Length And Type:</b>	175 cm
<b>Connected to Port:</b>	Accessory

<b>Description:</b>	Li-ion Battery
<b>Brand Name:</b>	Nokia
<b>Model Name or Number:</b>	BL-C5
<b>Serial Number:</b>	06704007034137111
<b>Cable Length And Type:</b>	N/A
<b>Connected to Port:</b>	Battery

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### **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.



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#### **4. Deviations From The Test Specification**

None.

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## **5. Operation Of The EUT During Testing**

### **5.1. Operating Conditions**

The EUT was tested in a normal laboratory environment.

During testing, the EUT was powered by a Nominal 115 V 60 Hz AC Mains supply

### **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 on 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 an Anritsu Bluetooth test set.

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## **6. Summary Of Test Results**

### **Part 15.247**

<b>Range Of Measurements</b>	<b>Specification Reference</b>	<b>Port Type</b>	<b>Compliance Status</b>
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	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 Emissions	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.

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## **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 Section 9 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 10 for details of measurement uncertainties.

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## **8. Test Results**

<b>Reference:</b>	FCC Part 15 Subpart C: 2002 (Section 15.247)
<b>Title:</b>	Code of Federal Regulations, Part 15 (47CFR15) Radio Frequency Devices
<b>Comments:</b>	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.
<b>Purpose of Test:</b>	To determine whether the equipment complied with the requirements of the specification for the purposes of certification.

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### **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.

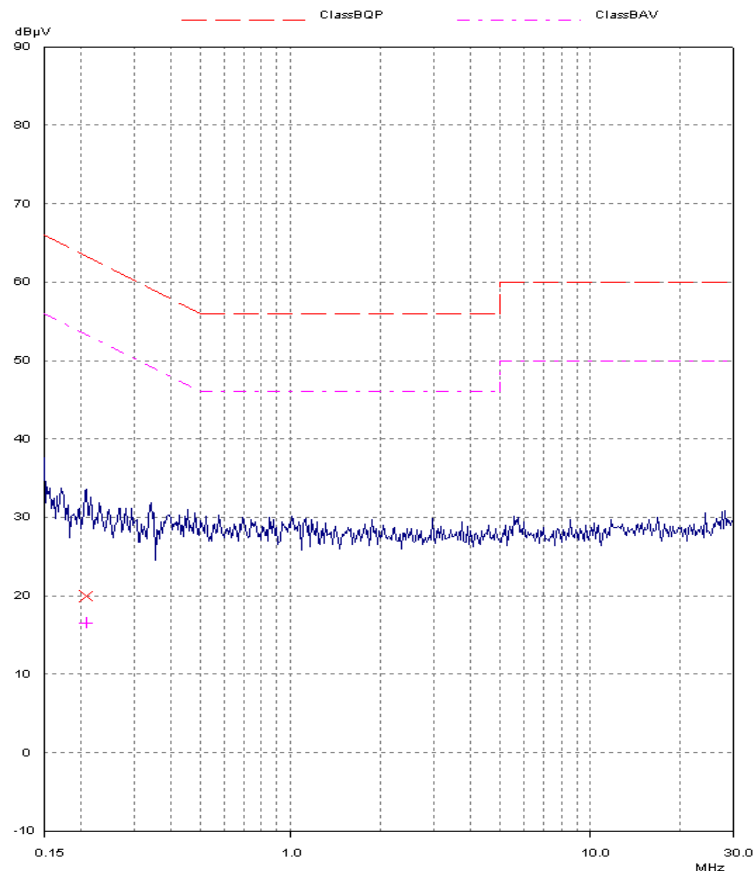
8.1.2. Tests were performed to identify the maximum emissions levels on the AC mains line of the EUT.

#### **Quasi-Peak Detector Measurements on Live and Neutral Lines**

Frequency (MHz)	Line	Q-P Level (dB $\mu$ V)	Q-P Limit (dB $\mu$ V)	Margin (dB)	Result
0.20739	Neutral	19.92	63.31	43.39	Complied

#### **Average Detector Measurements on Live and Neutral Lines**

Frequency (MHz)	Line	Avg Level (dB $\mu$ V)	Avg Limit (dB $\mu$ V)	Margin (dB)	Result
0.20739	Live	16.51	53.31	36.80	Complied



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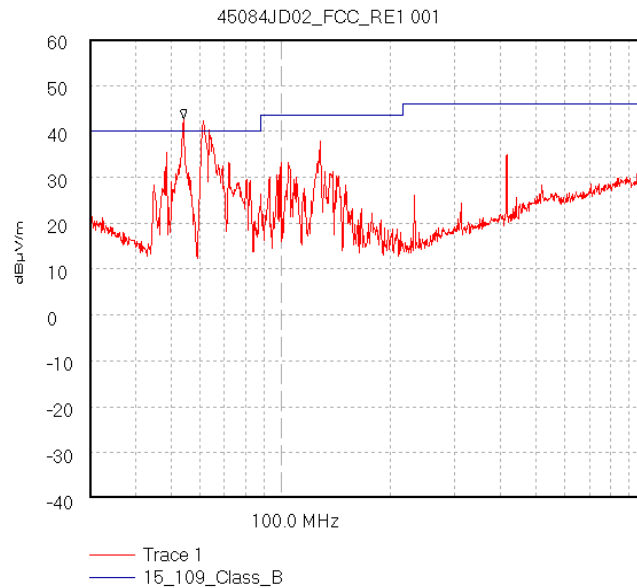
## 8.2. Receive Radiated Emissions: Section 15.109

### 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 $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
53.905	V	23.2	40.0	16.8	Complied
61.094	V	26.0	40.0	14.0	Complied
416.000	H	24.0	46.0	22.0	Complied



Start 30.0 MHz; Stop 1.0 GHz - Log Scale  
Ref 60 dB $\mu$ V/m; Ref Offset 0.0 dB; 10 dB/div  
RBW 120.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 80.0 mS  
Peak 54.24 MHz, 42.69 dB $\mu$ V/m  
Limit/Mask: 15\_109\_Class\_B; ; Limit Test Failed  
Transducer Factors: A1037  
8/1/2003 11:27:47 AM

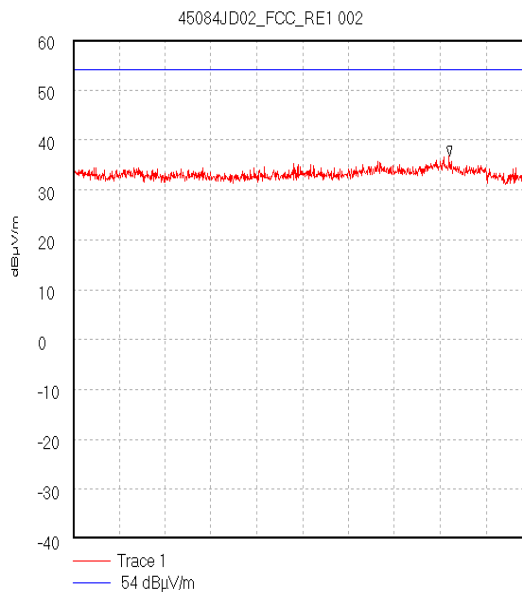
Test Of: Nokia UK Ltd.  
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**Receiver Radiated Emissions: Section 15.109 (Continued)****Electric Field Strength Measurements (Frequency Range: 1.0 to 12.5 GHz)****Highest Average Level:****Highest Average Level:**

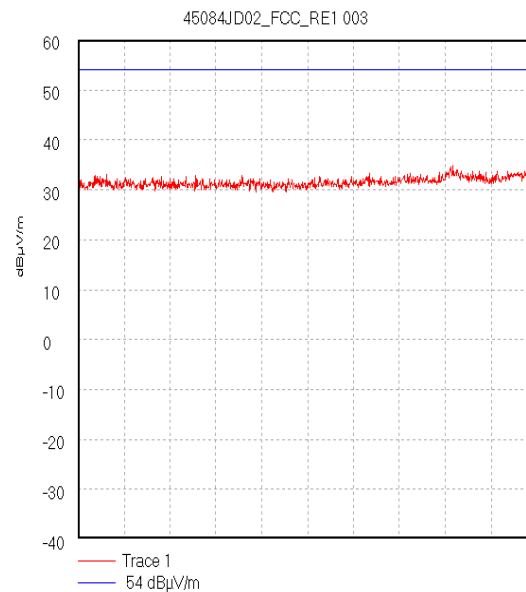
*\*Note: Not recorded, no spurious emissions were detected above the noise floor of the measuring receiver.*

**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 36.9 dB $\mu$ V/m at 1.820 GHz*



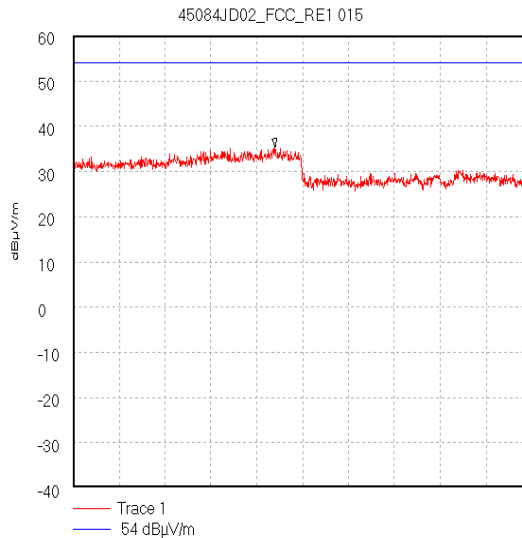
Start 1.0 GHz; Stop 2.0 GHz  
Ref 60 dB $\mu$ V/m; Ref Offset 5.0 dB; 10 dB/div  
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS  
Peak 1.82 GHz; 36.87 dB $\mu$ V/m  
Display Line: 54 dB $\mu$ V/m; ; Limit Test Passed  
8/1/2003 11:41:14 AM



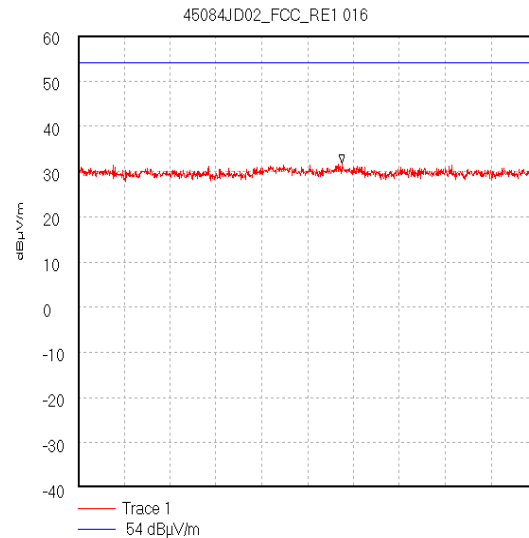
Start 2.0 GHz; Stop 4.0 GHz  
Ref 60 dB $\mu$ V/m; Ref Offset 5.0 dB; 10 dB/div  
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS  
Peak 3.98 GHz; 35.32 dB $\mu$ V/m  
Display Line: 54 dB $\mu$ V/m; ; Limit Test Passed  
8/1/2003 11:44:40 AM



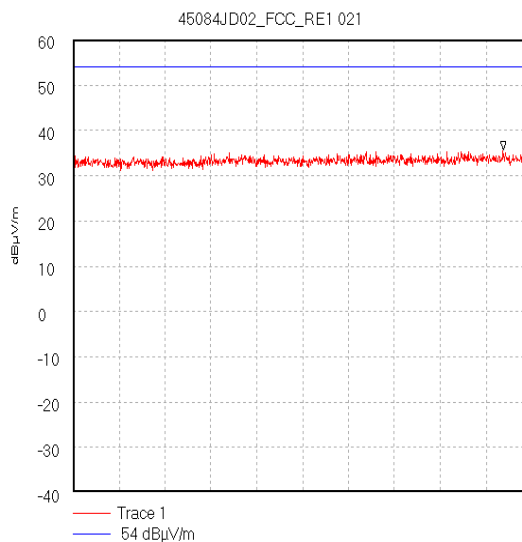
Test Of: Nokia UK Ltd.  
NHL-10  
To: FCC Part 15.247

**Receive Radiated Emissions (Continued)**

Start 4.0 GHz; Stop 6.0 GHz  
Ref 60 dBµV/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 4.88 GHz, 35.35 dBµV/m  
Display Line: 54 dBµV/m; : Limit Test Passed  
Transducer Factors: 4to6g\_Horn  
06/08/2003 15:06:14



Start 6.0 GHz; Stop 8.0 GHz  
Ref 60 dBµV/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 7.151111 GHz, 31.69 dBµV/m  
Display Line: 54 dBµV/m; : Limit Test Passed  
Transducer Factors: 6to8g\_Horn  
06/08/2003 15:09:52



Start 8.0 GHz; Stop 12.5 GHz  
Ref 60 dBµV/m; Ref Offset 0.0 dB; 10 dB/div  
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 40.0 mS  
Peak 12.22 GHz, 35.58 dBµV/m  
Display Line: 54 dBµV/m; : Limit Test Passed  
Transducer Factors: 8to12G\_Horn  
06/08/2003 15:26:35

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**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.

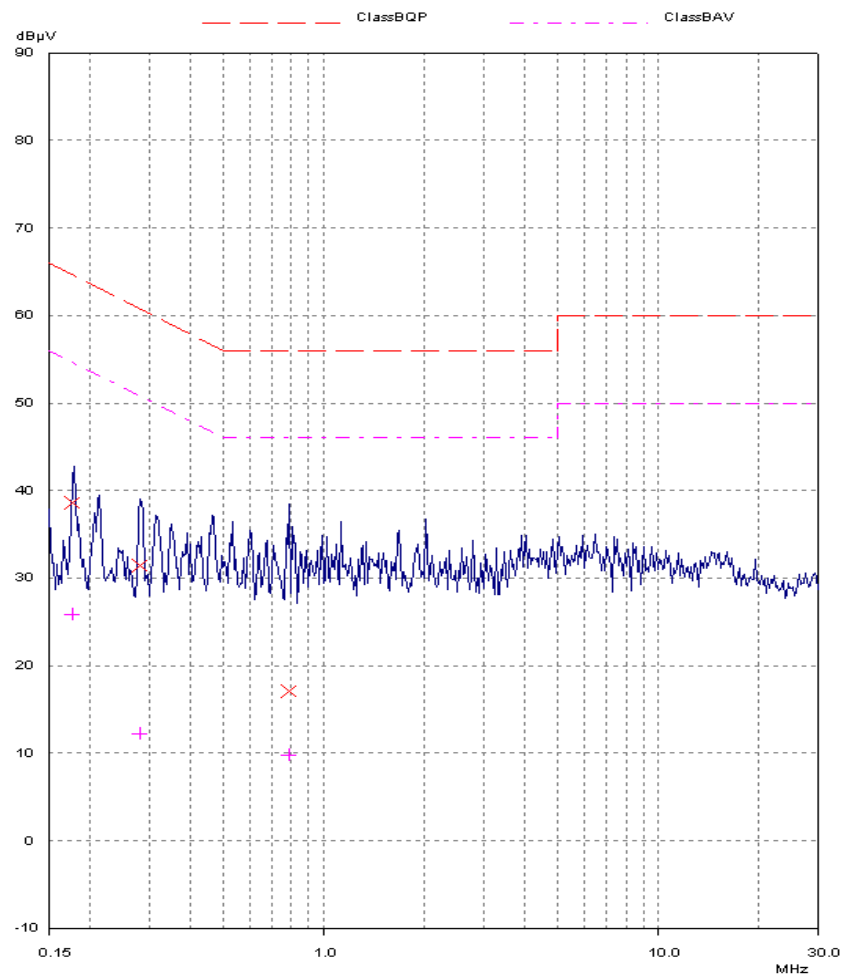
**Middle Channel**

Frequency (MHz)	Line	Q-P Level (dB $\mu$ V)	Q-P Limit (dB $\mu$ V)	Margin (dB)	Result
0.17694	Live	38.66	64.63	25.97	Complied
0.28011	Neutral	31.50	60.81	29.31	Complied
0.78048	Live	17.13	56.00	38.87	Complied

**Average Detector Measurements on Live and Neutral Lines****Middle Channel**

Frequency (MHz)	Line	Avg Level (dB $\mu$ V)	Avg Limit (dB $\mu$ V)	Margin (dB)	Result
0.17694	Live	25.81	54.63	28.82	Complied
0.28011	Live	12.23	50.81	38.58	Complied
0.78048	Live	9.79	46.00	36.21	Complied

Test Of: Nokia UK Ltd.  
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**Transmitter Conducted Emissions AC Mains (Continued)**

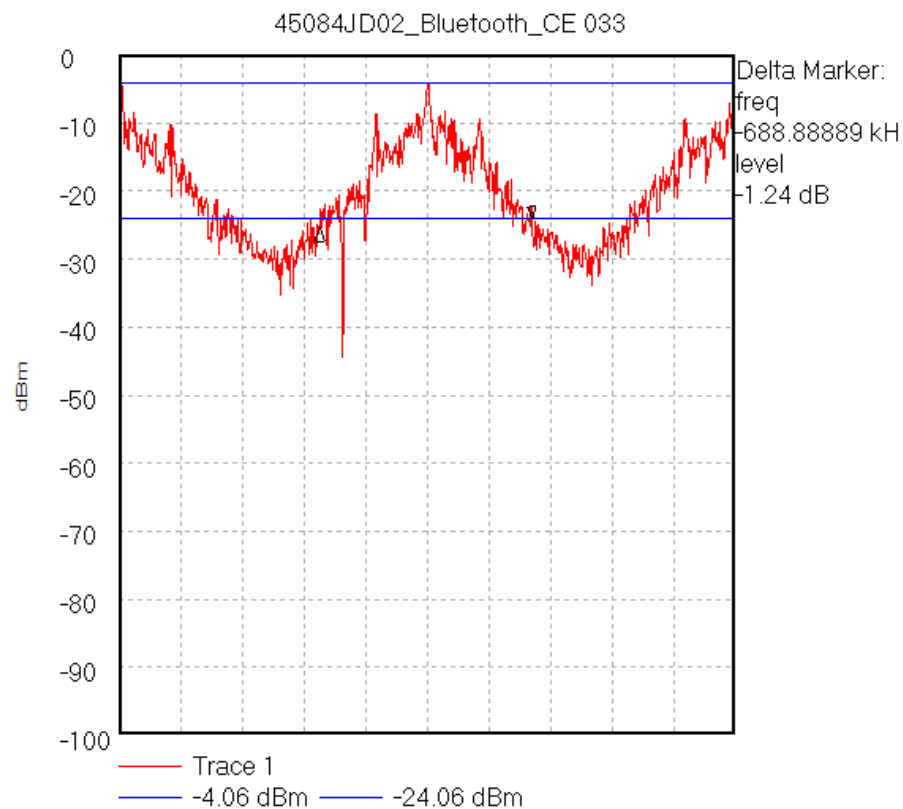
Test Of: Nokia UK Ltd.  
NHL-10  
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#### **8.4.Transmitter 20dB Bandwidth: Section 15.247(a)(1)(iii)**

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)
688.89



Start 2.44 GHz; Stop 2.442 GHz  
Ref 0 dBm; Ref Offset 22.8 dB; 10 dB/div  
RBW 10.0 kHz; VBW 10.0 kHz; Att 0 dB; Swp 60.0 mS  
Marker 2.44134 GHz, -24.12 dBm  
Delta 2.440651 GHz, -25.36 dBm  
Display Line: -4.06 dBm; -24.06 dBm;  
08/08/2003 12:36:01

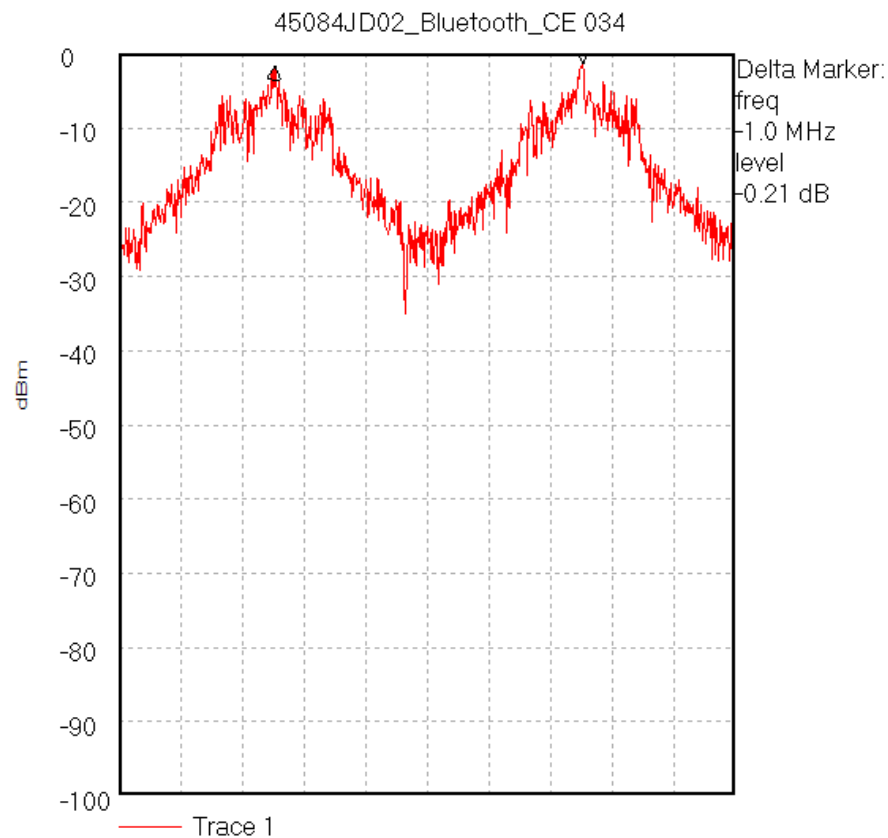
Test Of: Nokia UK Ltd.  
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### **8.5. Transmitter Carrier Frequency Separation: Section 15.247(a)(1)**

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
1000.00	688.89	311.11	Complied



Start 2.4405 GHz; Stop 2.4425 GHz  
Ref 0 dBm; Ref Offset 22.8 dB; 10 dB/div  
RBW 30.0 kHz; VBW 30.0 kHz; Att 0 dB; Swp 20.0 mS  
Marker 2.442004 GHz, -1.44 dBm  
Delta 2.441004 GHz, -1.65 dBm  
08/08/2003 12:42:10

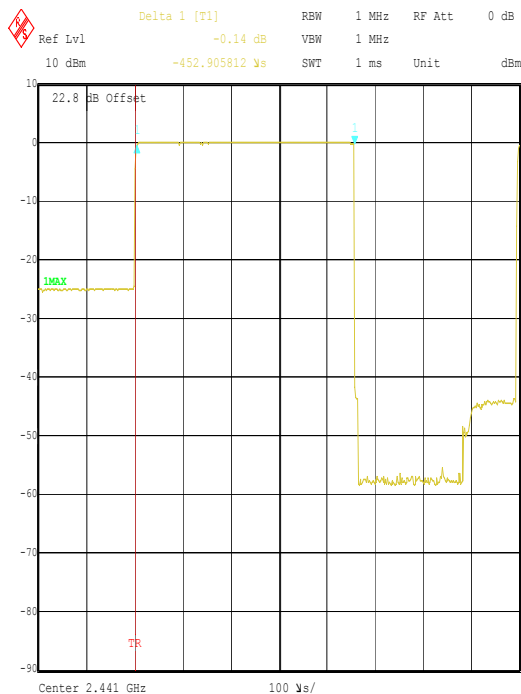
Test Of: Nokia UK Ltd.  
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### 8.6. Transmitter Average Time of Occupancy: Section 15.247(a)(1)(iii)

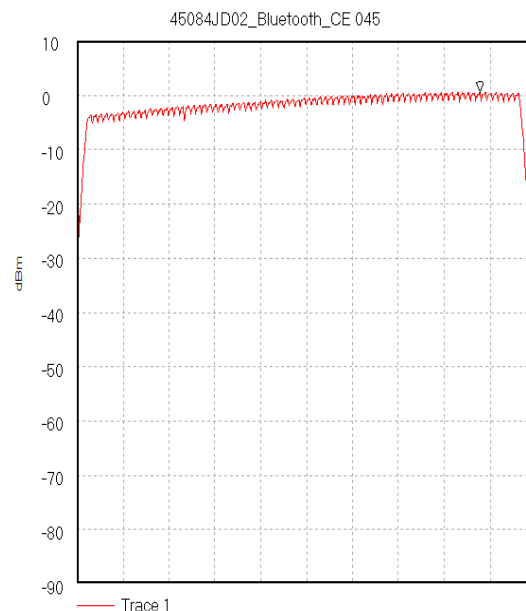
8.6.1. The EUT was configured as for average time of occupancy measurements as described in Section 9 of this report.

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

Emission Width ( $\mu$ s)	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 Calimero 004400261775736 FCC P15.247 Time Occupancy  
Comment A: 45084JD02\_FCC\_001  
Date: 8.AUG.2003 16:39:31



Start 2.4 GHz; Stop 2.4835 GHz  
Ref 10 dBm; Ref Offset 22.8 dB; 10 dB/div  
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS  
Peak 2.473294 GHz, 0.63 dBm  
08/08/2003 13:45:17

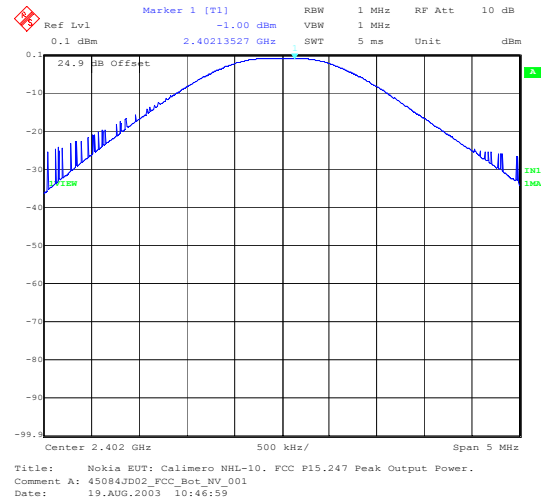
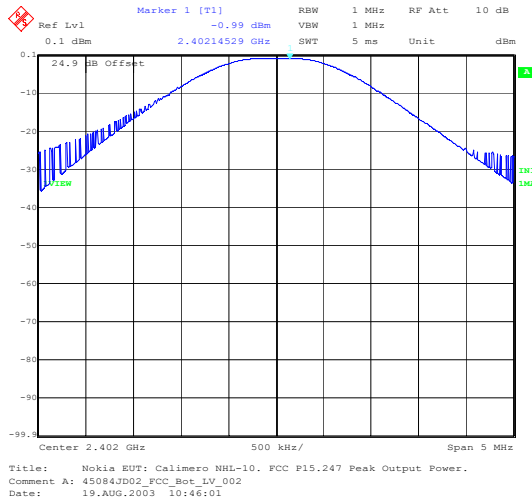
Test Of: Nokia UK Ltd.  
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### 8.7. Transmitter Peak Output Power: Section 15.247(b)(1)

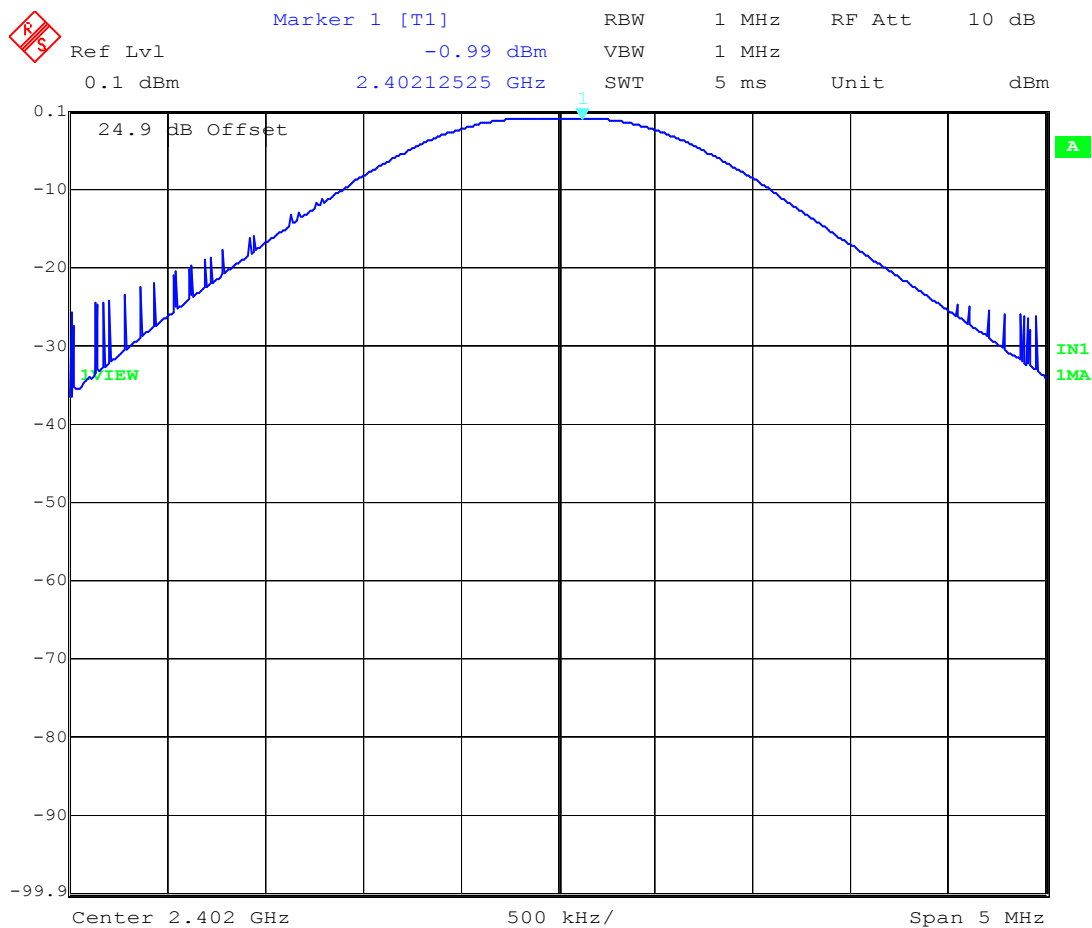
8.7.1. The EUT was configured as for peak output power measurements as described in Section 9 of this report.

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	-1.0	30.0	21.0	Complied
Bottom	110.0	-1.0	30.0	21.0	Complied
Bottom	126.5	-1.0	30.0	21.0	Complied



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**Transmitter Peak Output Power (Continued)**

Title: Nokia EUT: Calimero NHL-10. FCC P15.247 Peak Output Power.

Comment A: 45084JD02\_FCC\_Bot\_HV\_003

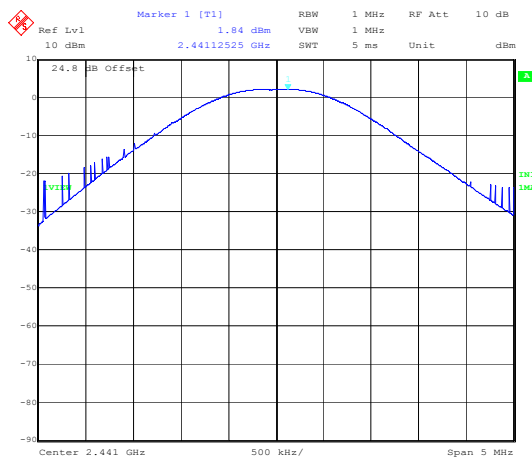
Date: 19.AUG.2003 10:47:20



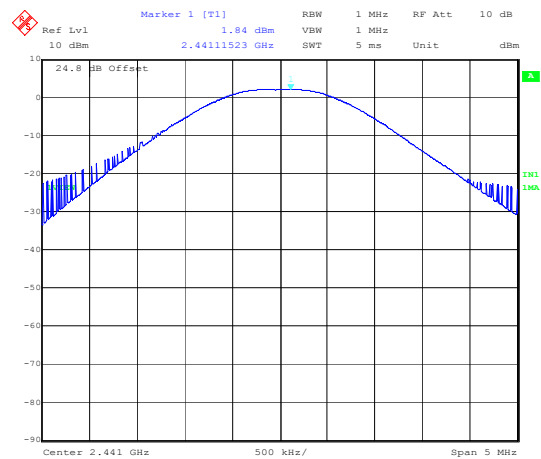
Test Of: Nokia UK Ltd.  
NHL-10  
To: FCC Part 15.247

**Transmitter Peak Output Power (Continued)**

Channel	Input Voltage (AC)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Middle	93.5	1.8	30.0	18.2	Complied
Middle	110.0	1.8	30.0	18.2	Complied
Middle	126.5	1.8	30.0	18.2	Complied

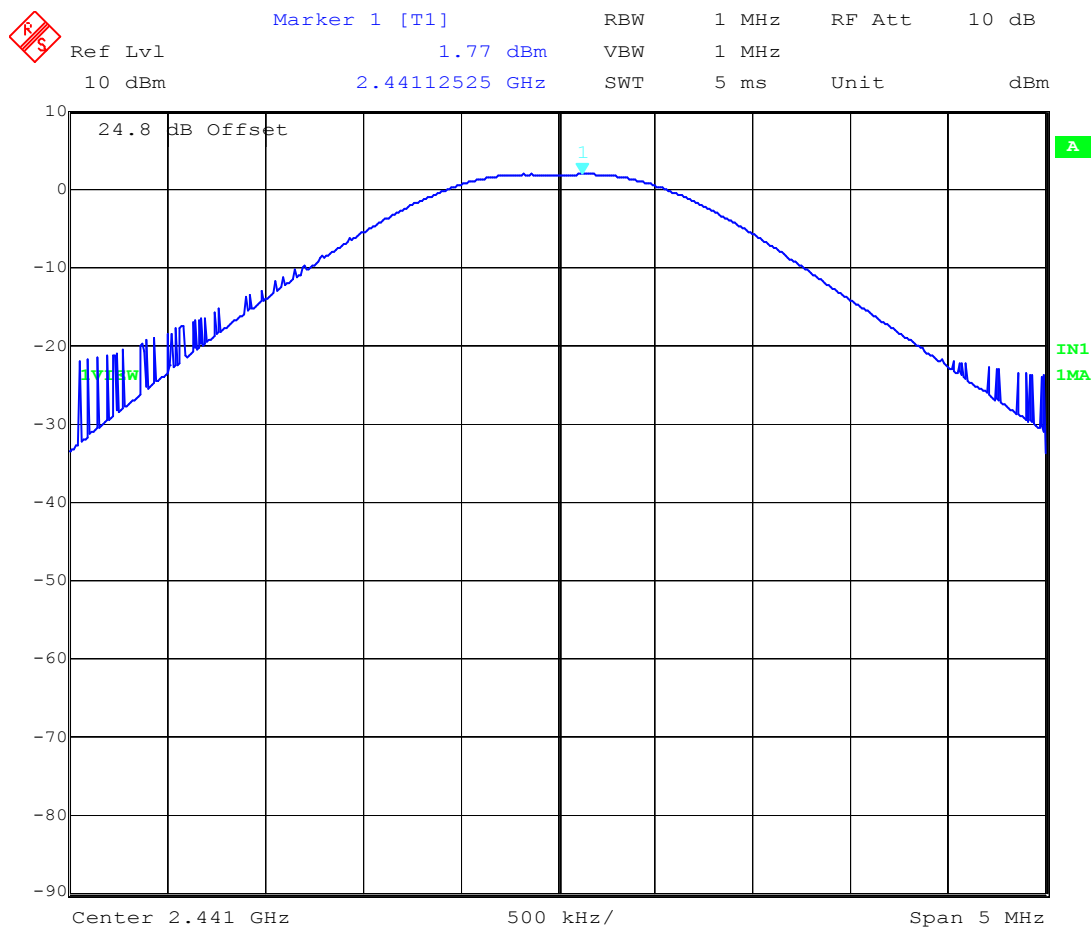


Title: Nokia EUT: Calimero NHL-10. FCC P15.247 Peak Output Power.  
Comment A: 45084JD02\_FCC\_Mid\_LV\_005  
Date: 19.AUG.2003 10:49:36



Title: Nokia EUT: Calimero NHL-10. FCC P15.247 Peak Output Power.  
Comment A: 45084JD02\_FCC\_Mid\_NV\_004  
Date: 19.AUG.2003 10:49:01

Test Of: Nokia UK Ltd.  
NHL-10  
To: FCC Part 15.247

**Transmitter Peak Output Power (Continued)**

Title: Nokia EUT: Calimero NHL-10. FCC P15.247 Peak Output Power.

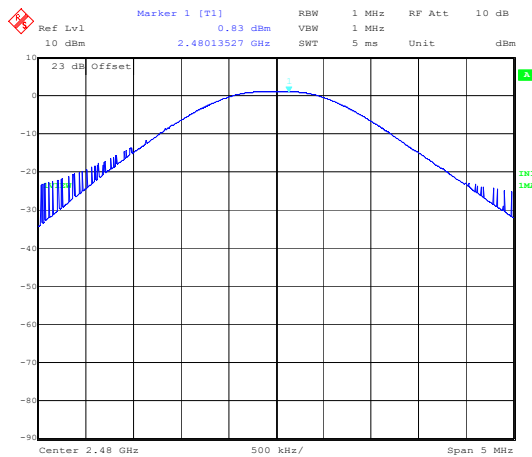
Comment A: 45084JD02\_FCC\_Mid\_HV\_006

Date: 19.AUG.2003 10:51:22

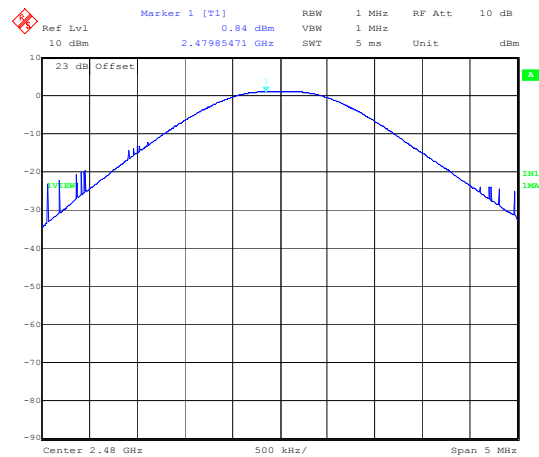
Test Of: Nokia UK Ltd.  
NHL-10  
To: FCC Part 15.247

**Transmitter Peak Output Power (Continued)**

Channel	Input Voltage (AC)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Top	93.5	0.8	30.0	19.2	Complied
Top	110.0	0.8	30.0	19.2	Complied
Top	126.5	0.8	30.0	19.2	Complied

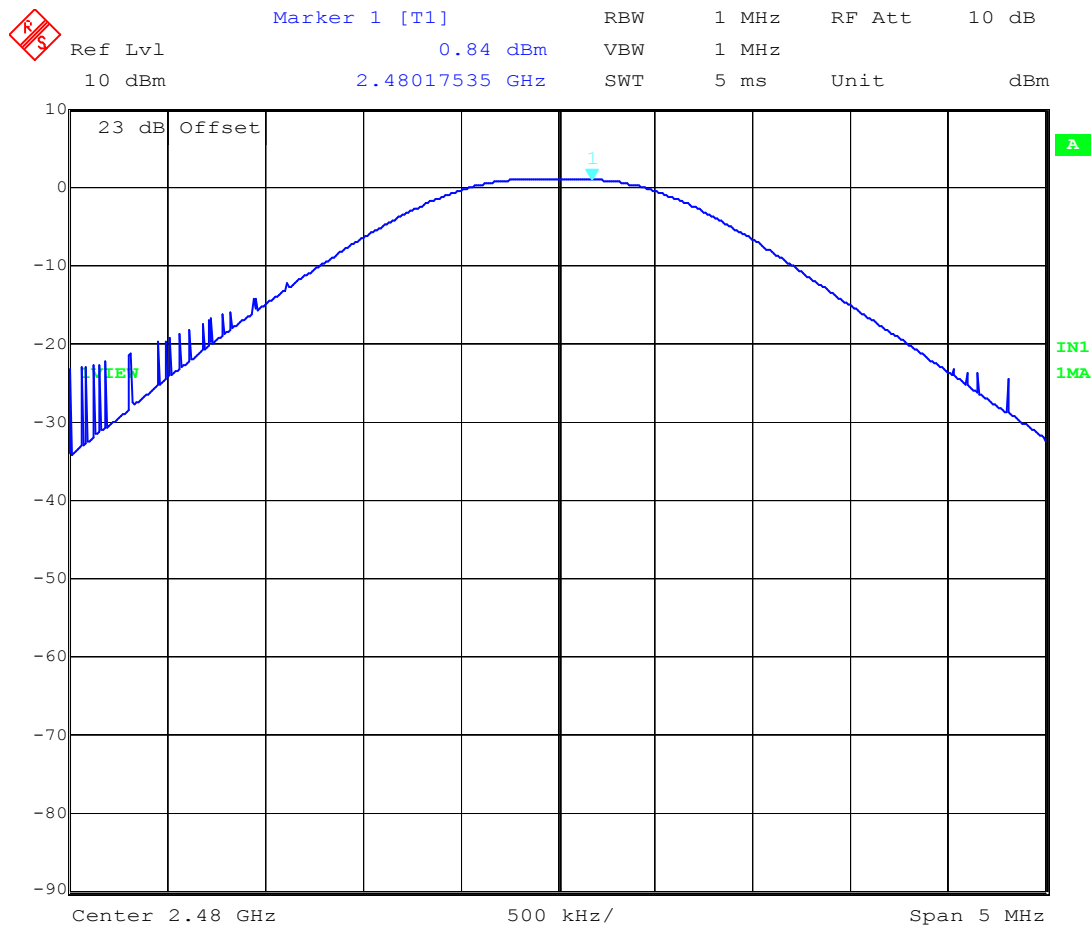


Title: Nokia EUT: Calimero NHL-10. FCC P15.247 Peak Output Power.  
Comment A: 45084JD02\_FCC\_Top\_LV\_008  
Date: 19.AUG.2003 10:54:25



Title: Nokia EUT: Calimero NHL-10. FCC P15.247 Peak Output Power.  
Comment A: 45084JD02\_FCC\_Top\_NV\_007  
Date: 19.AUG.2003 10:53:57

Test Of: Nokia UK Ltd.  
NHL-10  
To: FCC Part 15.247

**Transmitter Peak Output Power (Continued)**

Title: Nokia EUT: Calimero NHL-10. FCC P15.247 Peak Output Power.

Comment A: 45084JD02\_FCC\_Top\_HV\_009

Date: 19.AUG.2003 10:54:53

Test Of: Nokia UK Ltd.  
NHL-10  
To: FCC Part 15.247

## 8.8. Transmitter Conducted Emissions: Section 15.247(c)

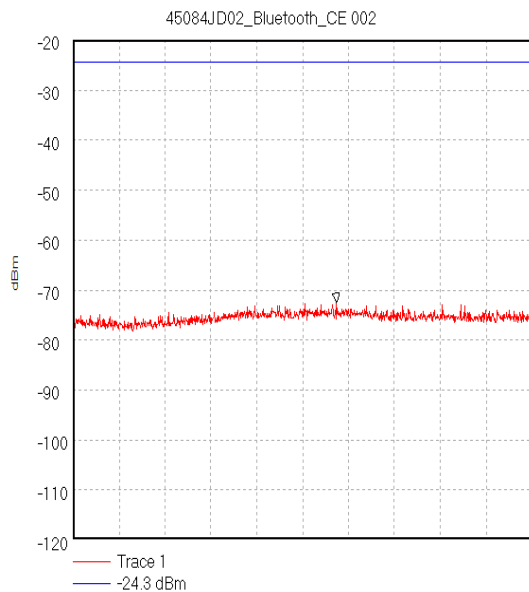
8.8.1. The EUT was configured as for conducted antenna port emissions measurements as described in Section 9 of this report.

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

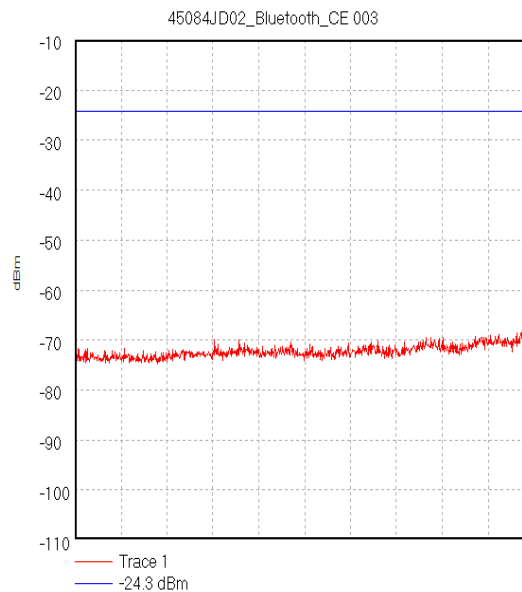
### Results:

#### Highest Peak Level: Bottom Channel

Frequency (GHz)	Peak Detector level (dBm)	Peak Limit (dBm)	Peak Margin (dB)	Result
2.400	-48.8	-24.3	24.5	Complied

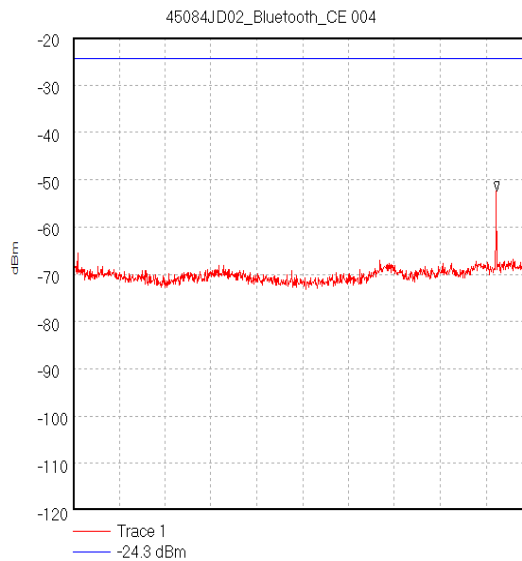


Start 30.0 MHz; Stop 1.0 GHz  
Ref -20 dBm; Ref Offset 21.9 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 300.0 mS  
Peak 587.211111 MHz, -72.46 dBm  
Display Line: -24.3 dBm;  
08/08/2003 11:28:39

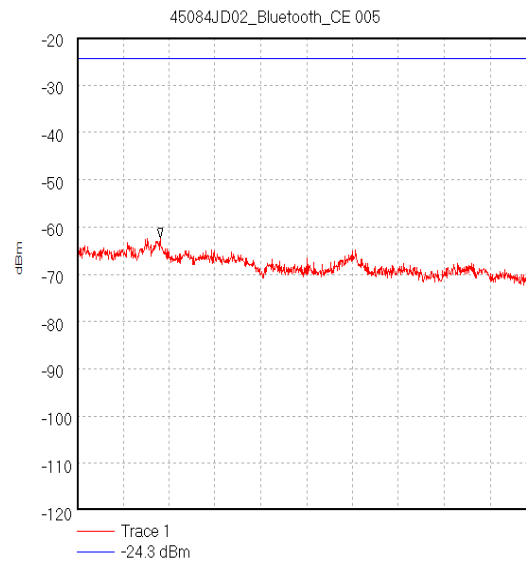


Start 1.0 GHz; Stop 2.4 GHz  
Ref -10 dBm; Ref Offset 22.8 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 420.0 mS  
Peak 2.4 GHz, -48.77 dBm  
Display Line: -24.3 dBm;  
08/08/2003 11:31:06

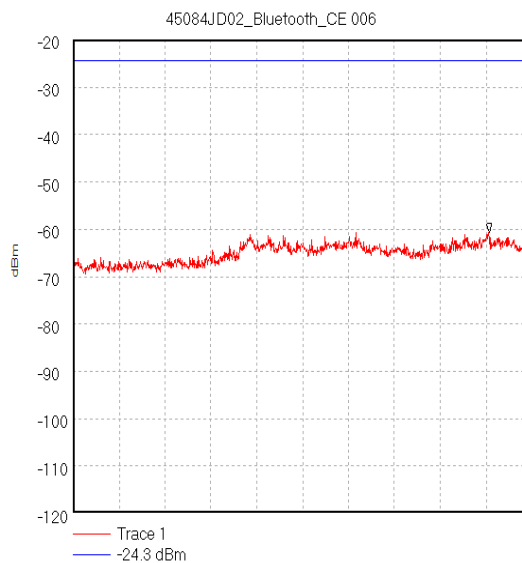
Test Of: **Nokia UK Ltd.  
NHL-10**  
To: **FCC Part 15.247**

**Transmitter Conducted Emissions Bottom Channel (Continued)**

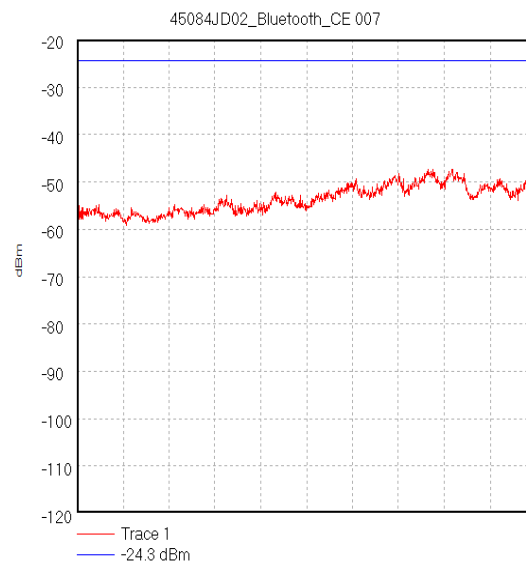
Start 2.4835 GHz; Stop 5.0 GHz  
Ref -20 dBm; Ref Offset 23.9 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 760.0 mS  
Peak 4.807068 GHz, -52.37 dBm  
Display Line: -24.3 dBm;  
08/08/2003 11:32:09



Start 5.0 GHz; Stop 10.0 GHz  
Ref -20 dBm; Ref Offset 25.5 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 1.5 S  
Peak 5.905556 GHz, -62.35 dBm  
Display Line: -24.3 dBm;  
08/08/2003 11:33:40



Start 10.0 GHz; Stop 18.0 GHz  
Ref -20 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 17.253333 GHz, -60.62 dBm  
Display Line: -24.3 dBm;  
08/08/2003 11:34:29

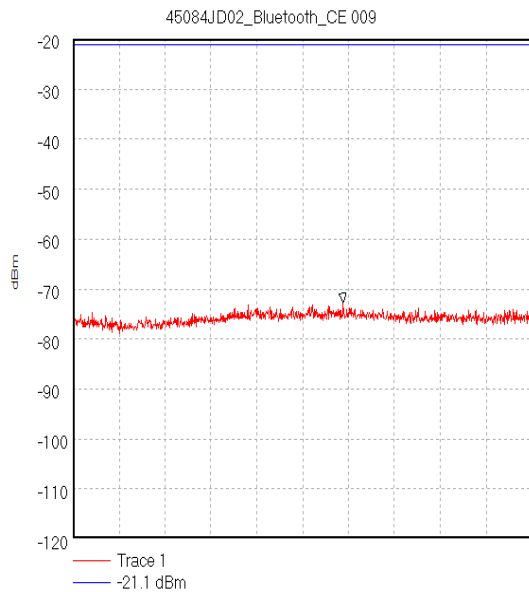


Start 18.0 GHz; Stop 26.5 GHz  
Ref -20 dBm; Ref Offset 34.1 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 2.6 S  
Peak 26.5 GHz, -46.99 dBm  
Display Line: -24.3 dBm;  
08/08/2003 11:36:31

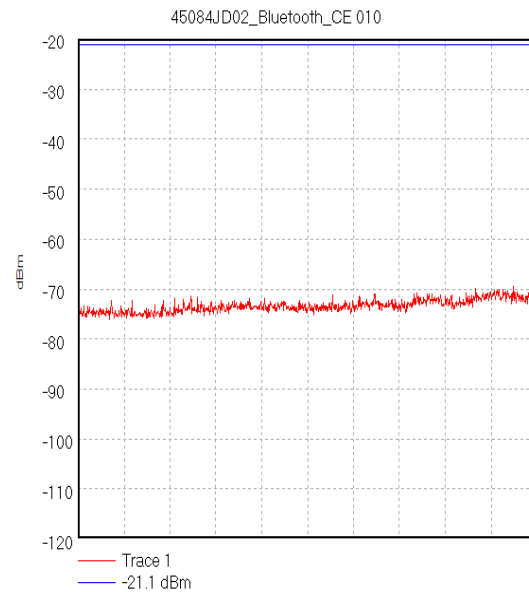
Test Of: Nokia UK Ltd.  
NHL-10  
To: FCC Part 15.247

**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
4.882	-52.9	-21.1	31.8	Complied

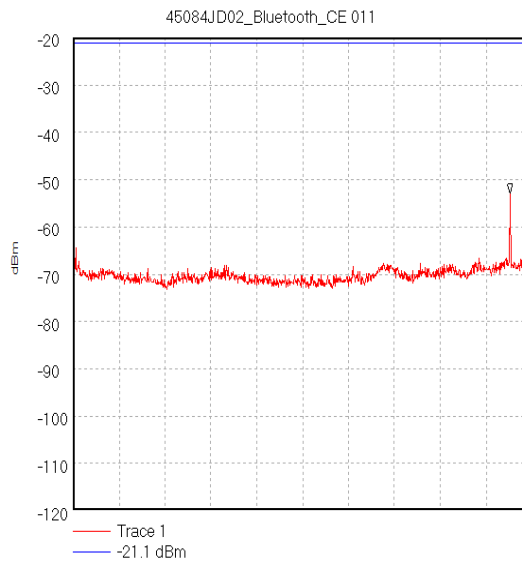


Start 30.0 MHz; Stop 1.0 GHz  
Ref -20 dBm; Ref Offset 21.9 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 300.0 mS  
Peak 601.222222 MHz, -72.81 dBm  
Display Line: -21.1 dBm;  
08/08/2003 11:39:11

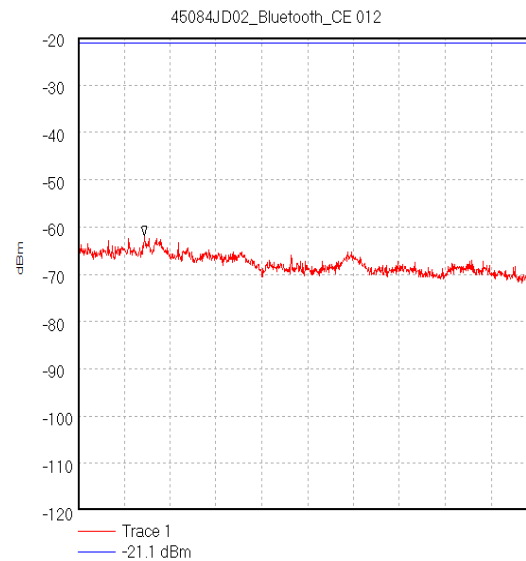


Start 1.0 GHz; Stop 2.4 GHz  
Ref -20 dBm; Ref Offset 22.8 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 420.0 mS  
Peak 2.395333 GHz, -69.08 dBm  
Display Line: -21.1 dBm;  
08/08/2003 11:39:54

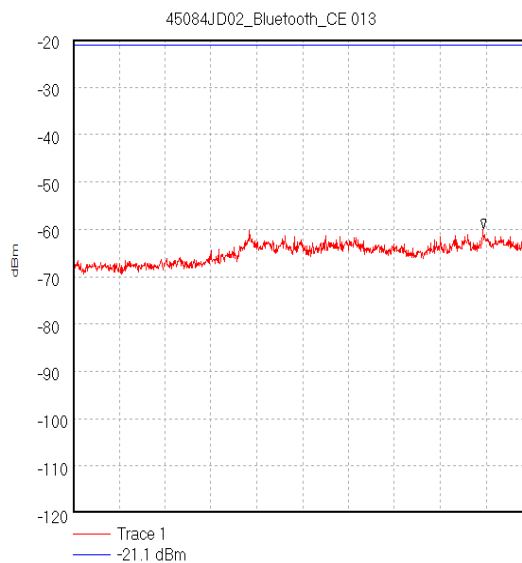
Test Of: **Nokia UK Ltd.**  
**NHL-10**  
To: **FCC Part 15.247**

**Transmitter Conducted Emissions Middle Channel (Continued)**

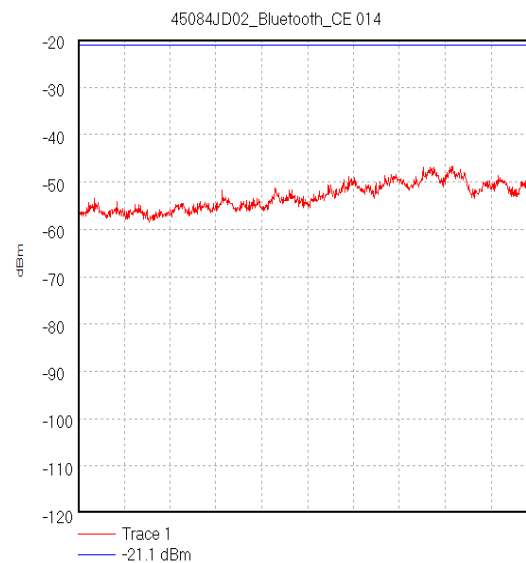
Start 2.4835 GHz; Stop 5.0 GHz  
Ref -20 dBm; Ref Offset 23.9 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 760.0 mS  
Peak 4.882563 GHz, -52.91 dBm  
Display Line: -21.1 dBm;  
08/08/2003 11:40:36



Start 5.0 GHz; Stop 10.0 GHz  
Ref -20 dBm; Ref Offset 25.5 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 1.5 S  
Peak 5.722222 GHz, -61.92 dBm  
Display Line: -21.1 dBm;  
08/08/2003 11:41:52



Start 10.0 GHz; Stop 18.0 GHz  
Ref -20 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 17.155556 GHz, -59.94 dBm  
Display Line: -21.1 dBm;  
08/08/2003 11:42:50



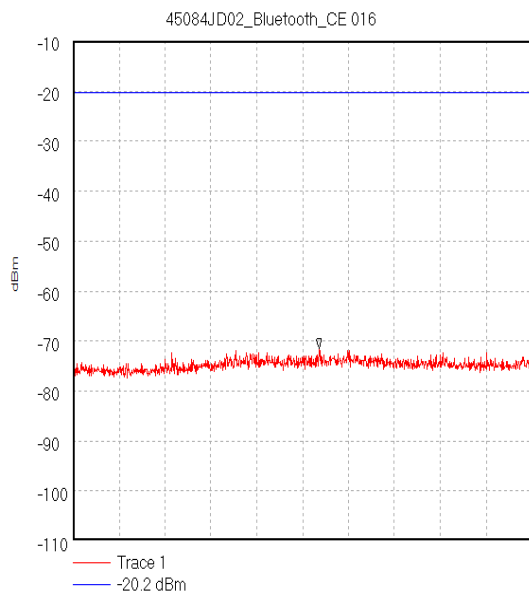
Start 18.0 GHz; Stop 26.5 GHz  
Ref -20 dBm; Ref Offset 34.1 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 2.6 S  
Peak 26.481111 GHz, -46.58 dBm  
Display Line: -21.1 dBm;  
08/08/2003 11:44:07



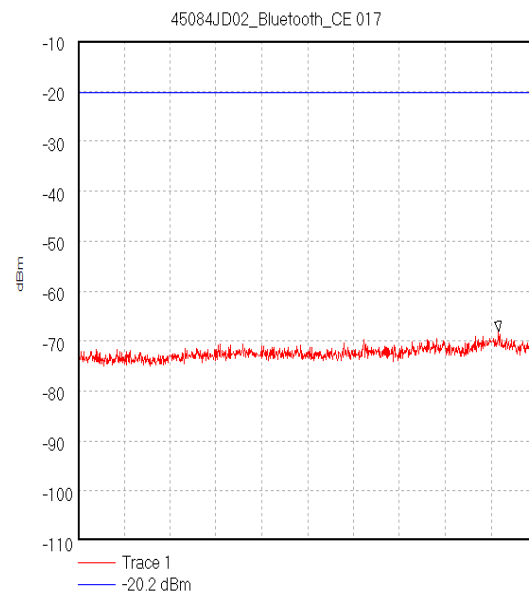
Test Of: Nokia UK Ltd.  
NHL-10  
To: FCC Part 15.247

**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	-48.2	-20.2	28.0	Complied

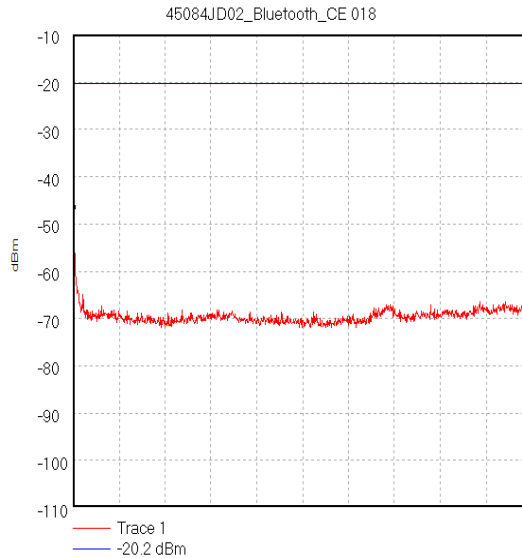


Start 30.0 MHz; Stop 1.0 GHz  
Ref -10 dBm; Ref Offset 21.9 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 300.0 mS  
Peak 560.566667 MHz, -71.45 dBm  
Display Line: -20.2 dBm;  
08/08/2003 11:46:49

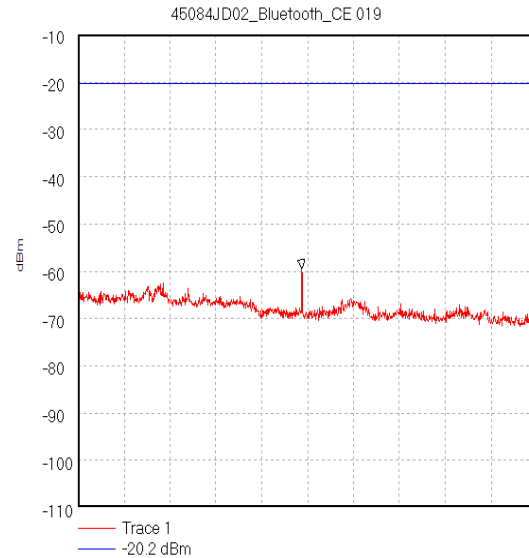


Start 1.0 GHz; Stop 2.4 GHz  
Ref -10 dBm; Ref Offset 22.8 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 420.0 mS  
Peak 2.283333 GHz, -68.07 dBm  
Display Line: -20.2 dBm;  
08/08/2003 11:47:29

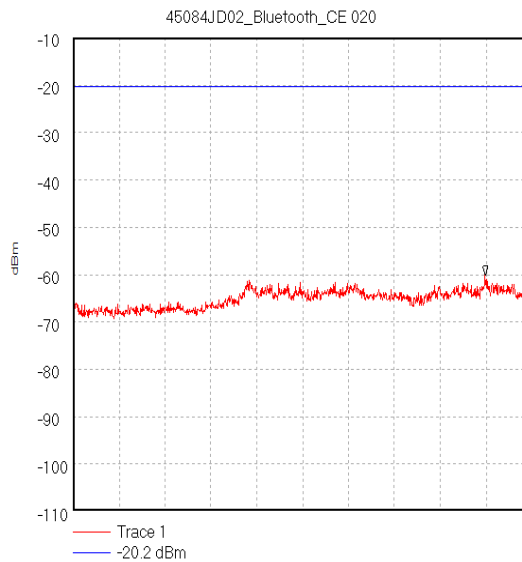
Test Of: Nokia UK Ltd.  
NHL-10  
To: FCC Part 15.247

**Transmitter Conducted Emissions Top Channel (Continued)**

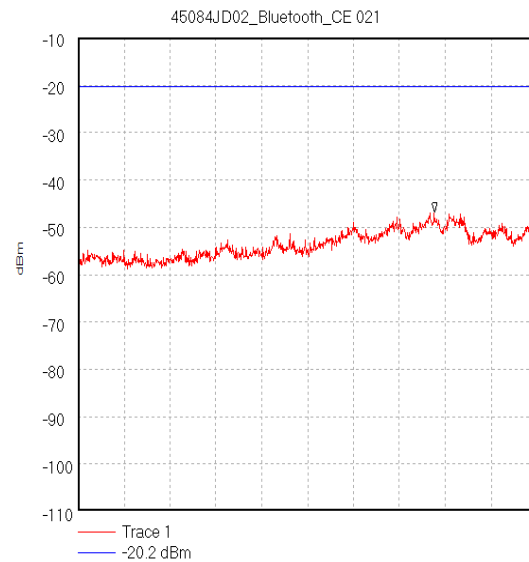
Start 2.4835 GHz; Stop 5.0 GHz  
Ref -10 dBm; Ref Offset 23.9 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 760.0 mS  
Peak 2.4835 GHz, -48.19 dBm  
Display Line: -20.2 dBm;  
08/08/2003 11:48:13



Start 5.0 GHz; Stop 10.0 GHz  
Ref -10 dBm; Ref Offset 25.5 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 1.5 S  
Peak 7.438889 GHz, -59.44 dBm  
Display Line: -20.2 dBm;  
08/08/2003 11:49:00



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 17.191111 GHz, -60.2 dBm  
Display Line: -20.2 dBm;  
08/08/2003 11:49:46

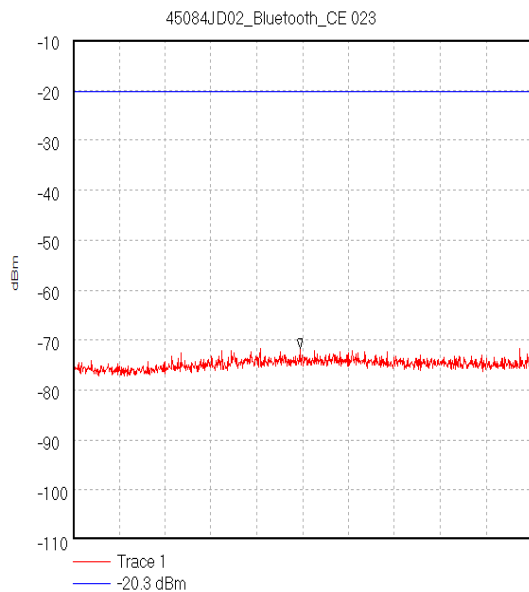


Start 18.0 GHz; Stop 26.5 GHz  
Ref -10 dBm; Ref Offset 34.1 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 2.6 S  
Peak 24.601667 GHz, -46.89 dBm  
Display Line: -20.2 dBm;  
08/08/2003 11:50:25

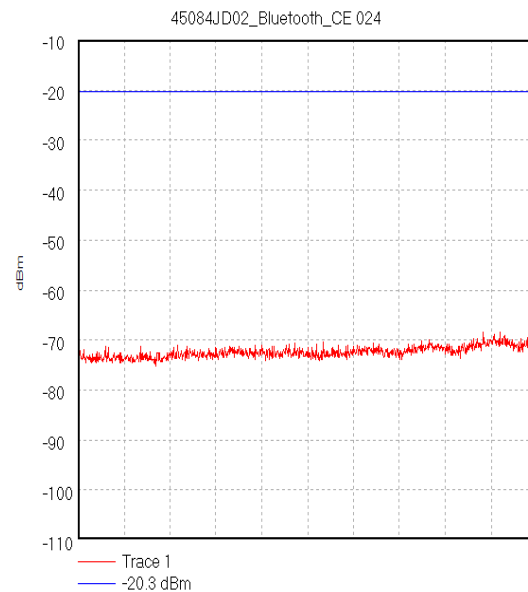
Test Of: Nokia UK Ltd.  
NHL-10  
To: FCC Part 15.247

**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
4.885359	-51.1	-20.3	30.8	Complied



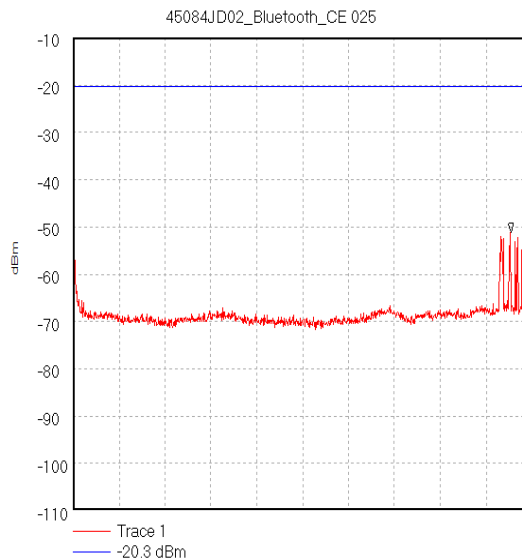
Start 30.0 MHz; Stop 1.0 GHz  
Ref -10 dBm; Ref Offset 21.9 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 300.0 mS  
Peak 509.611111 MHz; -71.68 dBm  
Display Line: -20.3 dBm;  
08/08/2003 11:52:04



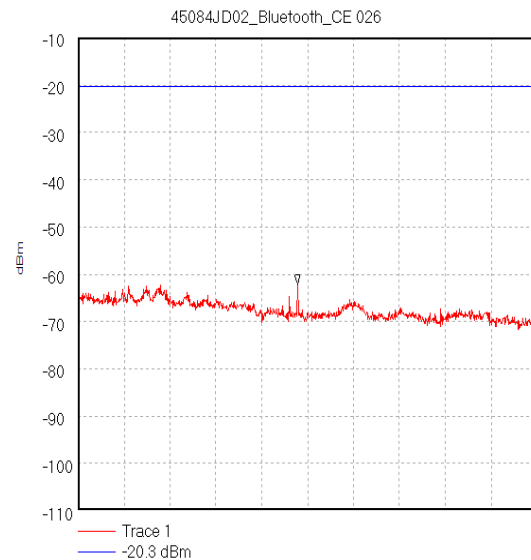
Start 1.0 GHz; Stop 2.4 GHz  
Ref -10 dBm; Ref Offset 22.8 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 420.0 mS  
Peak 2.4 GHz; -60.96 dBm  
Display Line: -20.3 dBm;  
08/08/2003 11:54:12

Test Of: **Nokia UK Ltd.**  
**NHL-10**  
 To: **FCC Part 15.247**

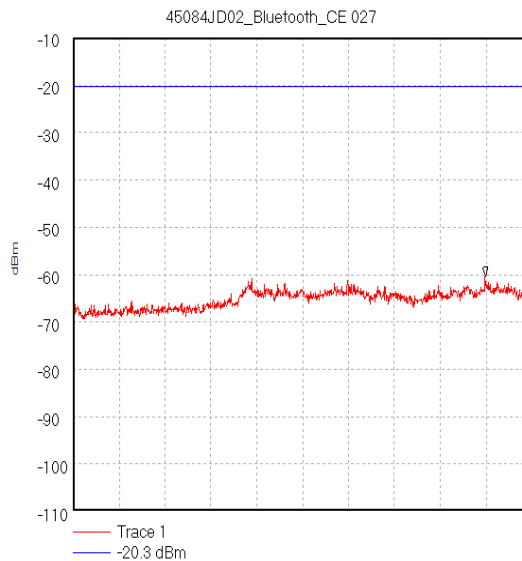
### Transmitter Conducted Emissions Hopping All Channels (Continued)



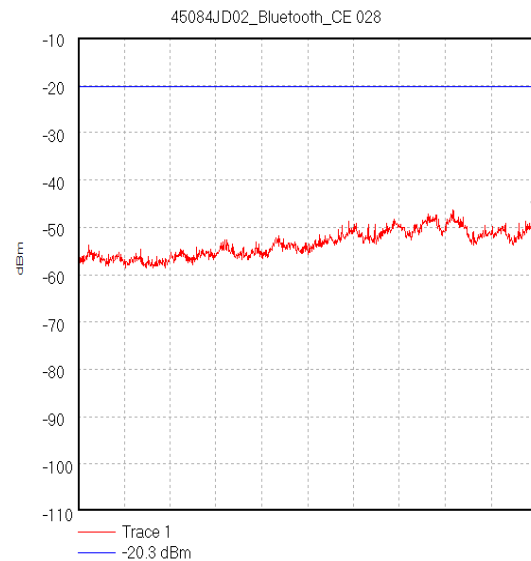
Start 2.4835 GHz; Stop 5.0 GHz  
 Ref -10 dBm; Ref Offset 23.9 dB; 10 dB/div  
 RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 760.0 mS  
 Peak 4.885359 GHz, -51.13 dBm  
 Display Line: -20.3 dBm;  
 08/08/2003 11:55:13



Start 5.0 GHz; Stop 10.0 GHz  
 Ref -10 dBm; Ref Offset 25.5 dB; 10 dB/div  
 RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 1.5 S  
 Peak 7.394444 GHz, -62.13 dBm  
 Display Line: -20.3 dBm;  
 08/08/2003 11:56:02



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 17.191111 GHz, -60.38 dBm  
 Display Line: -20.3 dBm;  
 08/08/2003 11:56:41



Start 18.0 GHz; Stop 26.5 GHz  
 Ref -10 dBm; Ref Offset 34.1 dB; 10 dB/div  
 RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 2.6 S  
 Peak 26.471667 GHz, -46.31 dBm  
 Display Line: -20.3 dBm;  
 08/08/2003 11:57:29

Test Of: Nokia UK Ltd.  
NHL-10  
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.**

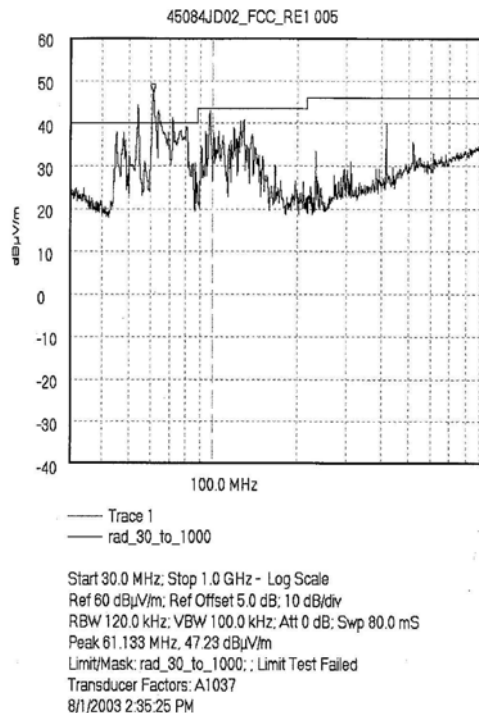
8.9.1.1. The EUT was configured as for radiated field strength measurements as described in Section 9 of this report.

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

#### **Middle Channel**

Frequency (MHz)	Ant. Pol.	Q-P Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
53.63	V	23.4	40.0	16.6	Complied
61.00	V	26.0	40.0	14.0	Complied
71.68	V	15.0	40.0	25.0	Complied
97.68	H	30.0	43.5	13.5	Complied
416.00	H	26.0	46.0	20.0	Complied

**Note:** 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.



Test Of: Nokia UK Ltd.  
NHL-10  
To: FCC Part 15.247

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

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dB $\mu$ V)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dB $\mu$ V/m)	Average Limit (dB $\mu$ V/m)	Average Margin (dB)	Result
4.804238	V	15.5	12.8	1.9	30.2	54.0	23.8	Complied

**Highest Peak Level: Bottom Channel**

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dB $\mu$ V)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dB $\mu$ V/m)	Peak Limit (dB $\mu$ V/m)	Peak Margin (dB)	Result
4.804238	V	33.2	12.8	1.9	47.9	74.0	26.1	Complied

**Highest Average Level: Middle Channel**

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dB $\mu$ V)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dB $\mu$ V/m)	Average Limit (dB $\mu$ V/m)	Average Margin (dB)	Result
4.882177	V	16.7	12.8	1.9	31.4	54.0	22.6	Complied

**Highest Peak Level: Middle Channel**

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dB $\mu$ V)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dB $\mu$ V/m)	Peak Limit (dB $\mu$ V/m)	Peak Margin (dB)	Result
4.882177	V	34.8	12.8	1.9	49.5	74.0	24.5	Complied

Test Of: Nokia UK Ltd.  
NHL-10  
To: FCC Part 15.247

**Transmitter Radiated Emissions: Section 15.247(c) and 15.209(a) (continued)****Highest Average Level: Top Channel**

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dB $\mu$ V)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dB $\mu$ V/m)	Average Limit (dB $\mu$ V/m)	Average Margin (dB)	Result
4.960083	V	20.2	12.8	1.9	34.9	54.0	19.1	Complied

**Highest Peak Level: Top Channel**

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dB $\mu$ V)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dB $\mu$ V/m)	Peak Limit (dB $\mu$ V/m)	Peak Margin (dB)	Result
4.960083	V	31.6	12.8	1.9	46.3	74.0	27.7	Complied

**Highest Average Level: Hopping Channel**

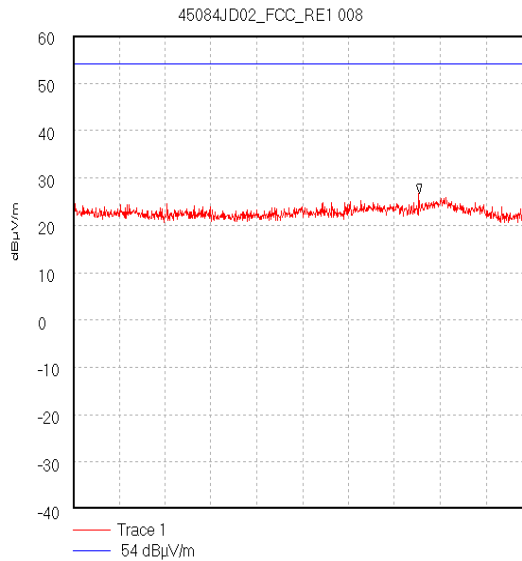
Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dB $\mu$ V)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dB $\mu$ V/m)	Average Limit (dB $\mu$ V/m)	Average Margin (dB)	Result
4.87586	V	7.6	12.8	1.9	22.3	54.0	31.7	Complied

**Highest Peak Level: Hopping Channel**

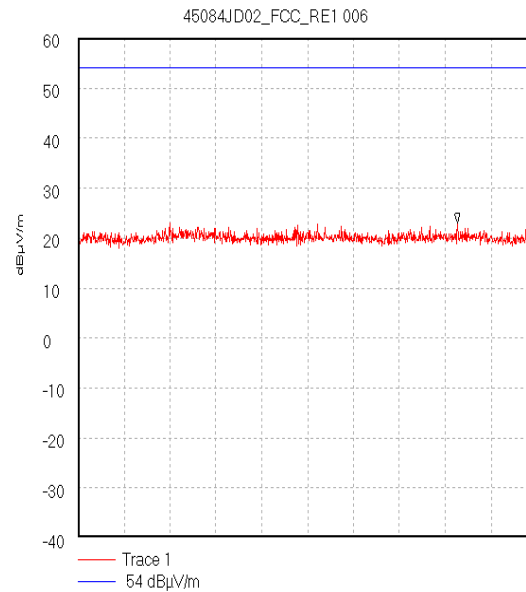
Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dB $\mu$ V)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dB $\mu$ V/m)	Peak Limit (dB $\mu$ V/m)	Peak Margin (dB)	Result
4.87586	V	33.9	12.8	1.9	48.6	74.0	25.4	Complied

Test Of: Nokia UK Ltd.  
NHL-10  
To: FCC Part 15.247

**Transmitter Radiated Emissions (continued)**



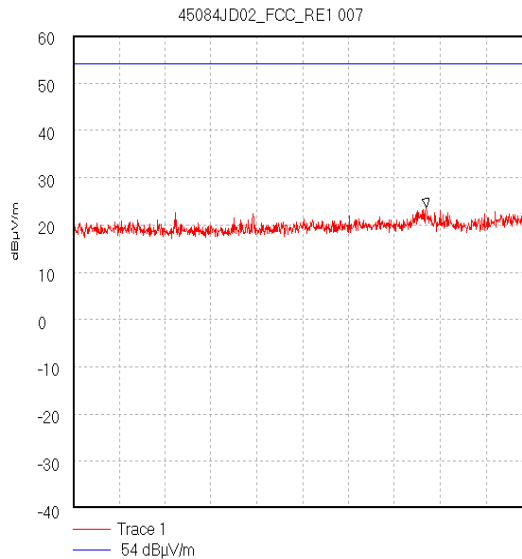
Start 1.0 GHz; Stop 2.0 GHz  
Ref 60 dBµV/m; Ref Offset 5.0 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 640.0 mS  
Peak 1.754 GHz, 26.71 dBµV/m  
Display Line: 54 dBµV/m; ; Limit Test Passed  
8/1/2003 3:18:54 PM



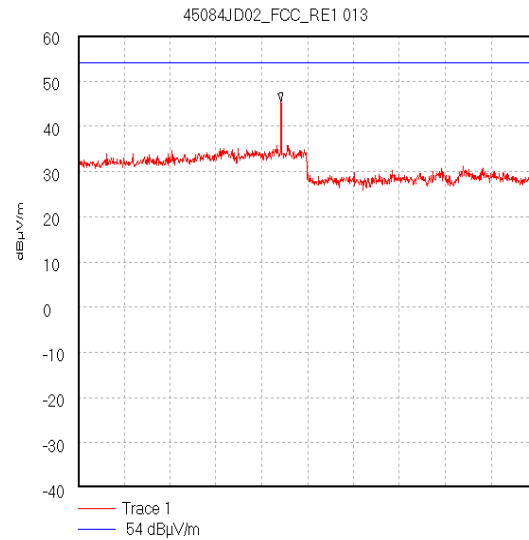
Start 2.0 GHz; Stop 2.4 GHz  
Ref 60 dBµV/m; Ref Offset 5.0 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 260.0 mS  
Peak 2.331 GHz, 23.06 dBµV/m  
Display Line: 54 dBµV/m; ; Limit Test Passed  
8/1/2003 2:57:26 PM



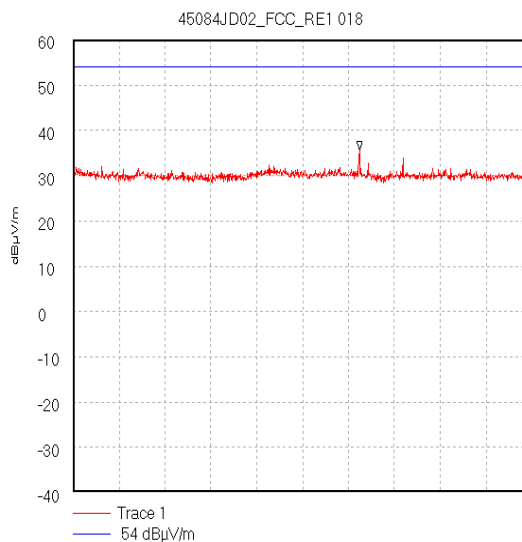
Test Of: **Nokia UK Ltd.**  
**NHL-10**  
 To: **FCC Part 15.247**

**Transmitter Radiated Emissions (continued)**

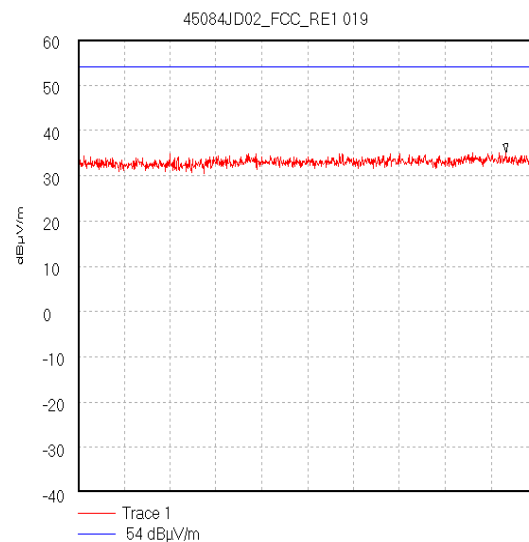
Start 2.484 GHz; Stop 4.0 GHz  
 Ref 60 dBμV/m; Ref Offset 5.0 dB; 10 dB/div  
 RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 960.0 mS  
 Peak 3.651 GHz; 23.69 dBμV/m  
 Display Line: 54 dBμV/m; Limit Test Passed  
 8/1/2003 3:15:33 PM



Start 4.0 GHz; Stop 6.0 GHz  
 Ref 60 dBμV/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 4.884444 GHz; 45.43 dBμV/m  
 Display Line: 54 dBμV/m; Limit Test Passed  
 Transducer Factors: 4to6g\_Horn  
 06/08/2003 14:25:29



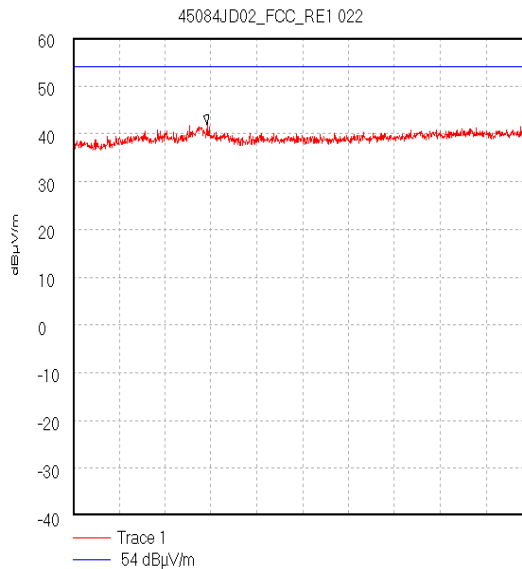
Start 6.0 GHz; Stop 8.0 GHz  
 Ref 60 dBμV/m; Ref Offset 0.0 dB; 10 dB/div  
 RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS  
 Peak 7.248889 GHz; 35.65 dBμV/m  
 Display Line: 54 dBμV/m; Limit Test Passed  
 Transducer Factors: 6to8g\_Horn  
 06/08/2003 15:17:49



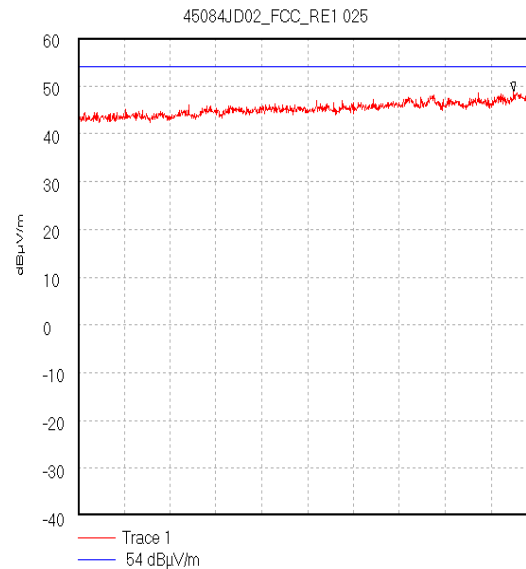
Start 8.0 GHz; Stop 12.5 GHz  
 Ref 60 dBμV/m; Ref Offset 0.0 dB; 10 dB/div  
 RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 40.0 mS  
 Peak 12.2 GHz; 35.14 dBμV/m  
 Display Line: 54 dBμV/m; Limit Test Passed  
 Transducer Factors: 8to12G\_Horn  
 06/08/2003 15:22:59

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**Transmitter Radiated Emissions (continued)**



Start 12.5 GHz; Stop 18.0 GHz  
Ref 60 dBμV/m; Ref Offset 0.0 dB; 10 dB/div  
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 40.0 mS  
Peak 14.107222 GHz, 41.87 dBμV/m  
Display Line: 54 dBμV/m; ; Limit Test Passed  
Transducer Factors: 12to18G\_Horn  
06/08/2003 15:29:35



Start 18.0 GHz; Stop 26.5 GHz  
Ref 60 dBμV/m; Ref Offset 0.0 dB; 10 dB/div  
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 60.0 mS  
Peak 26.075 GHz, 48.96 dBμV/m  
Display Line: 54 dBμV/m; ; Limit Test Passed  
Transducer Factors: 18to26  
06/08/2003 15:40:02

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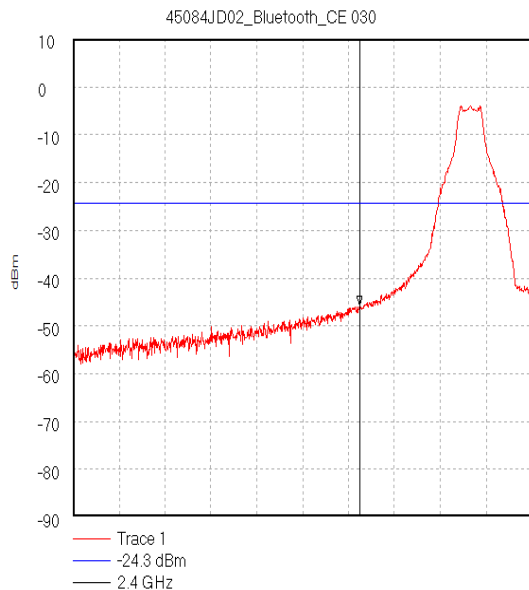
### 8.10. Transmitter Band Edge Conducted Emissions: Section 15.247(c)

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

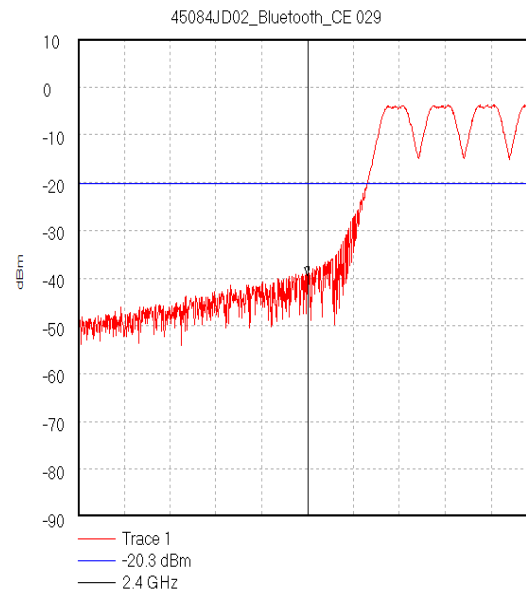
8.10.2. Tests were performed to identify the maximum conducted band edge emissions.

#### Highest Peak Level Lower Band Edge

Frequency (GHz)	Mode	Peak Detector level (dBμV)	Peak Limit (dBμV)	Peak Margin (dB)	Result
2.400	Static	-45.7	-24.3	21.4	Complied
2.400	Hopping	-39.6	-20.3	19.3	Complied



Start 2.395 GHz; Stop 2.403 GHz  
Ref 10 dBm; Ref Offset 22.8 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 20.0 mS  
Marker 2.4 GHz; -45.73 dBm  
Display Line: -24.3 dBm;  
08/08/2003 12:14:32

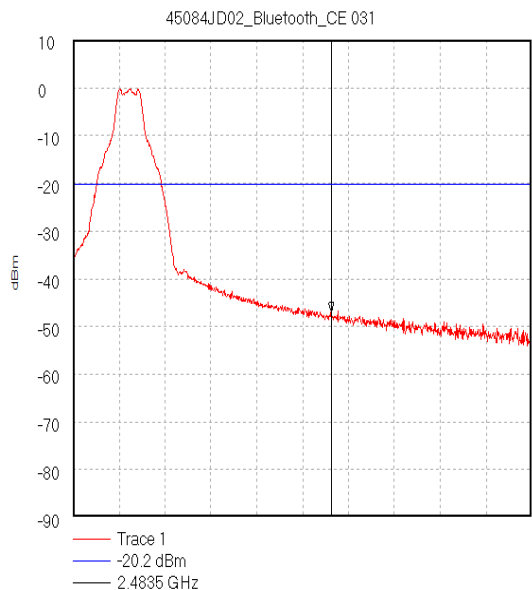


Start 2.395 GHz; Stop 2.405 GHz  
Ref 10 dBm; Ref Offset 22.8 dB; 10 dB/div  
RBW 300.0 kHz; VBW 300.0 kHz; Att 0 dB; Swp 20.0 mS  
Marker 2.4 GHz; -39.59 dBm  
Display Line: -20.3 dBm;  
08/08/2003 12:12:48

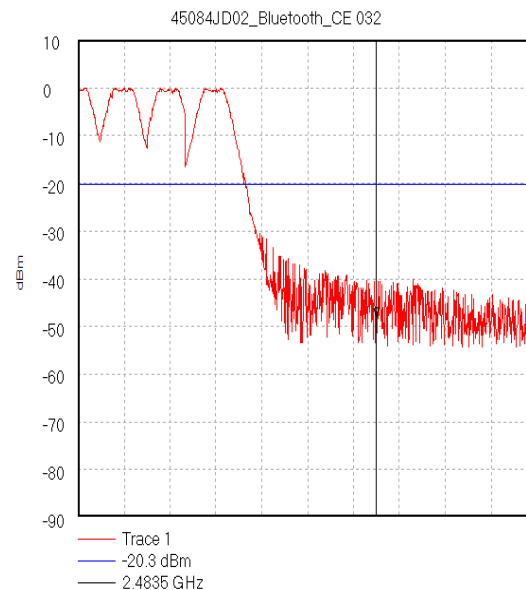
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**Transmitter Band Edge Conducted Emissions (Continued)****Highest Peak Level Upper Band Edge**

Frequency (GHz)	Mode	Peak Detector level (dBμV)	Peak Limit (dBμV)	Peak Margin (dB)	Result
2.4835	Static	-47.0	-20.2	26.8	Complied
2.4835	Hopping	-48.1	-20.3	27.8	Complied



Start 2.479 GHz; Stop 2.487 GHz  
Ref 10 dBm; Ref Offset 22.8 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 20.0 mS  
Marker 2.4835 GHz, -46.95 dBm  
Display Line: -20.2 dBm;  
08/08/2003 12:18:39



Start 2.477 GHz; Stop 2.487 GHz  
Ref 10 dBm; Ref Offset 22.8 dB; 10 dB/div  
RBW 300.0 kHz; VBW 300.0 kHz; Att 0 dB; Swp 20.0 mS  
Marker 2.4835 GHz, -48.07 dBm  
Display Line: -20.3 dBm;  
08/08/2003 12:23:39

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### **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:**

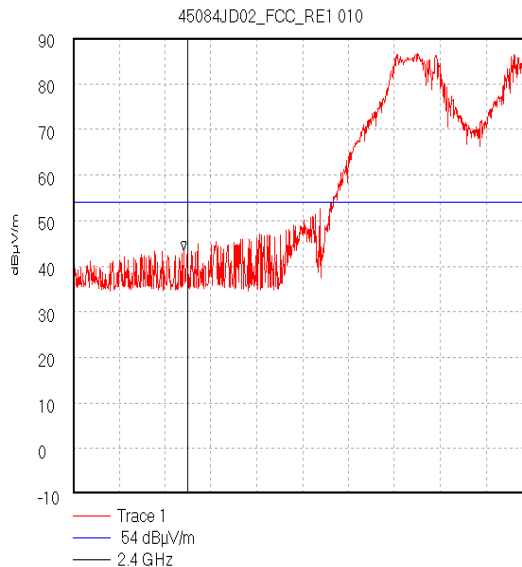
Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dB $\mu$ V)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dB $\mu$ V/m)	Peak Limit (dB $\mu$ V/m)	Peak Margin (dB)	Result
2.400	V	31.0	11.1	1.3	43.4	74.0	30.6	Complied
2.4835	V	42.2	11.1	1.3	54.6	74.0	19.4	Complied

#### **Average Power Level Hopping Mode:**

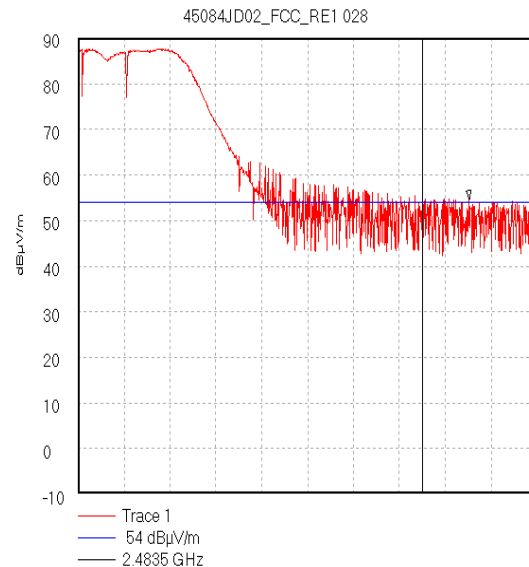
Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dB $\mu$ V)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dB $\mu$ V/m)	Average Limit (dB $\mu$ V/m)	Average Margin (dB)	Result
2.4835	V	18.5	11.1	1.3	30.9	54.0	23.1	Complied

*Note: The position of marker on plots 45084JD02\_FCC\_RE1 010 and 45084JD02\_FCC\_RE1 028 are 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 marker frequencies are incorrectly shown at 2.399964 GHz and 2.484113 GHz and not at 2.400 GHz and 2.4835 GHz respectively as they should be. This was, once again, due to the same software glitch detailed above. It is confirmed that the measurements were made at the actual band edge frequencies of 2.400 GHz and 2.4835 GHz and the results given in the table above are valid for those frequencies.*

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**Transmitter Band Edge Radiated Emissions (Continued)**

Start 2.399 GHz; Stop 2.403 GHz  
Ref 90 dBμV/m; Ref Offset 0.0 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 20.0 mS  
Marker 2.399964 GHz, 43.43 dBμV/m  
Display Line: 54 dBμV/m;  
Transducer Factors: 2to4GHz\_Horn  
06/08/2003 12:43:46



Start 2.479 GHz; Stop 2.485 GHz  
Ref 90 dBμV/m; Ref Offset 0.0 dB; 10 dB/div  
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS  
Marker 2.484113 GHz, 54.58 dBμV/m  
Display Line: 54 dBμV/m; ; Limit Test Failed  
Transducer Factors: 2to4GHz\_Horn  
06/08/2003 16:34:51

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### Transmitter Band Edge Radiated Emissions: Section 15.247(c) & 15.209(a) (Continued)

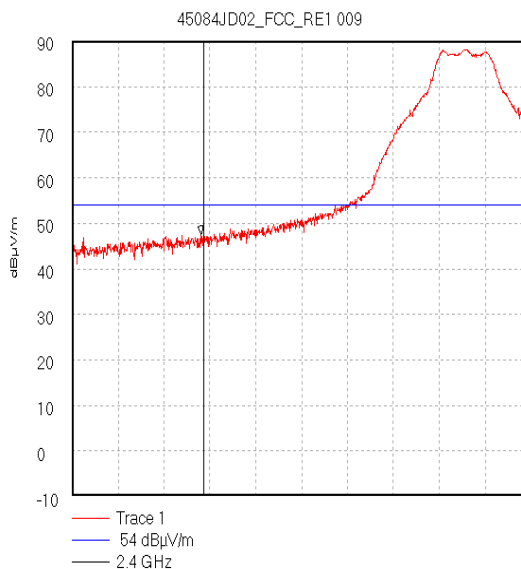
#### Peak Power Level Static Mode:

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dB $\mu$ V)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dB $\mu$ V/m)	Peak Limit (dB $\mu$ V/m)	Peak Margin (dB)	Result
2.400	V	35.1	11.1	1.3	47.5	74.0	26.5	Complied
2.4835	V	43.4	11.1	1.3	55.8	74.0	18.2	Complied

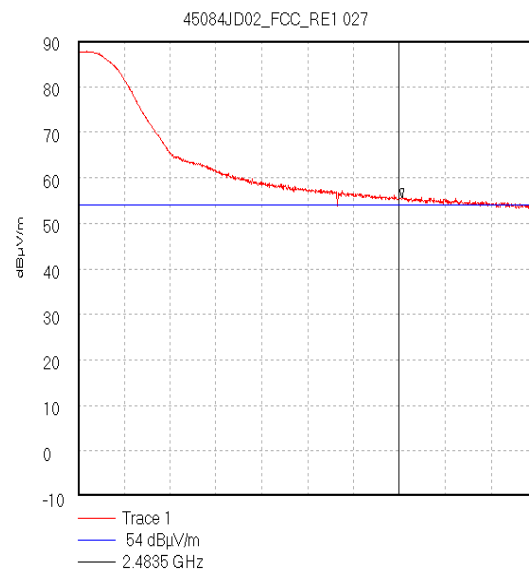
#### Average Power Level Static Mode:

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dB $\mu$ V)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dB $\mu$ V/m)	Average Limit (dB $\mu$ V/m)	Average Margin (dB)	Result
2.4835	V	18.5	11.1	1.3	30.9	74.0	43.1	Complied

*Note: The position of marker on plots 45084JD02\_FCC\_RE1 009 and 45084JD02\_FCC\_RE1 027 are 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 marker frequencies are incorrectly shown at 2.399984 GHz and 2.483529 GHz and not at 2.400 GHz and 2.4835 GHz respectively as they should be. This was, once again, due to the same software glitch detailed above. It is confirmed that the measurements were made at the actual band edge frequencies of 2.400 GHz and 2.4835 GHz and the results given in the table above are valid for those frequencies.*



Start 2.399 GHz; Stop 2.4025 GHz  
Ref 90 dB $\mu$ V/m; Ref Offset 0.0 dB; 10 dB/div  
RBW 100.0 kHz; VBW 100.0 kHz; Att 15 dB; Swp 20.0 mS  
Marker 2.399984 GHz, 47.52 dB $\mu$ V/m  
Display Line: 54 dB $\mu$ V/m;  
Transducer Factors: 2to4GHz\_Horn  
06/08/2003 12:24:32



Start 2.48 GHz; Stop 2.485 GHz  
Ref 90 dB $\mu$ 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  
Marker 2.483529 GHz, 55.57 dB $\mu$ V/m  
Display Line: 54 dB $\mu$ V/m; Limit Test Failed  
Transducer Factors: 2to4GHz\_Horn  
06/08/2003 16:30:09

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## **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.



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## **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 dBs of the limit were then measured on the open area test site, except in cases where the noise floor was within 20dBs 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).

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**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

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### **9.3. Carrier Frequency Separation/20dB Bandwidth**

The EUT and spectrum analyser was configured as for conducted antenna port measurements, And 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 20dB below the peak level. The bandwidth was determined at the points where the 20dB reference crossed the profile of the emission.

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#### **9.4. Average Time of Occupancy**

The EUT and spectrum analyser was configured as for conducted antenna port measurements

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.

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### **9.5. Conducted Antenna Port Emissions**

Conducted Antenna Port 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.

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### **9.6. Peak Output Power**

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.

Prior to testing being performed a suitable RF attenuator and cable were calibrated for the required frequencies. For each frequency to be measured, the calibrated level of the attenuator and cable were entered as an offset into a wideband power meter to compensate for the measurement set up.

To determine the transmitter output power, the EUT was operated at maximum power and a result was obtained from the wideband power meter.

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

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### **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

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## **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”.

<b>Measurement Type</b>	<b>Range</b>	<b>Confidence Level (%)</b>	<b>Calculated Uncertainty</b>
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 kHz to 26 GHz	95%	+/- 1.2 dB
Conducted Emissions Antenna Port	30.0 MHz to 40.0 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.



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### **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

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**Test Equipment Used (Continued)**

RFI No.	Instrument	Manufacturer	Type No.	Serial No.
C457	Cable	Rosenberger	RG142XX-002-RFIB	C457-10081998
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/ Humidity 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.

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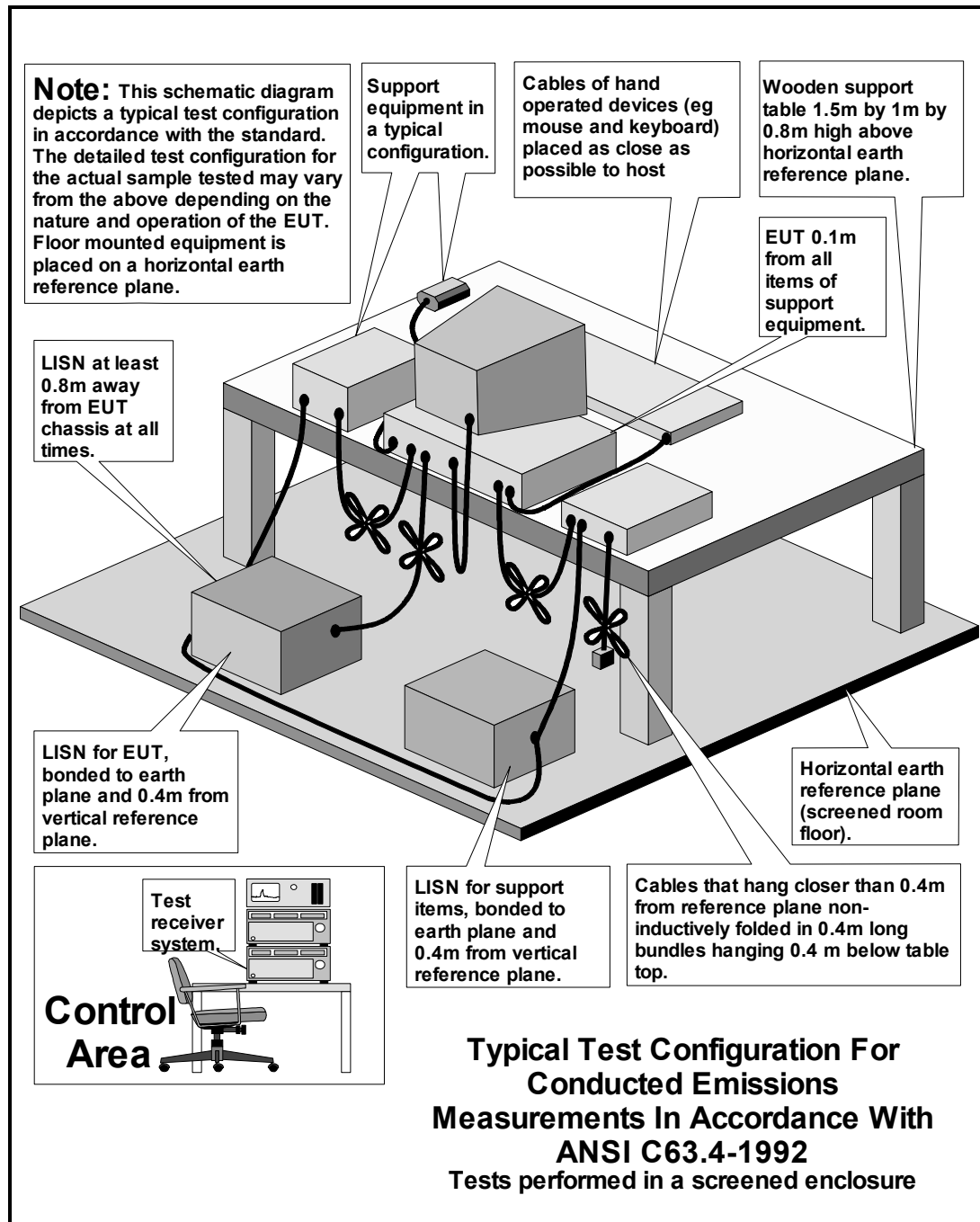
## **Appendix 2. Test Configuration Drawings**

This appendix contains the following drawings:

<b>Drawing Reference Number</b>	<b>Title</b>
DRG\45084JD01\EMICON	Test configuration for measurement of conducted emissions
DRG\45084JD01\EMIRAD	Test configuration for measurement of radiated emissions

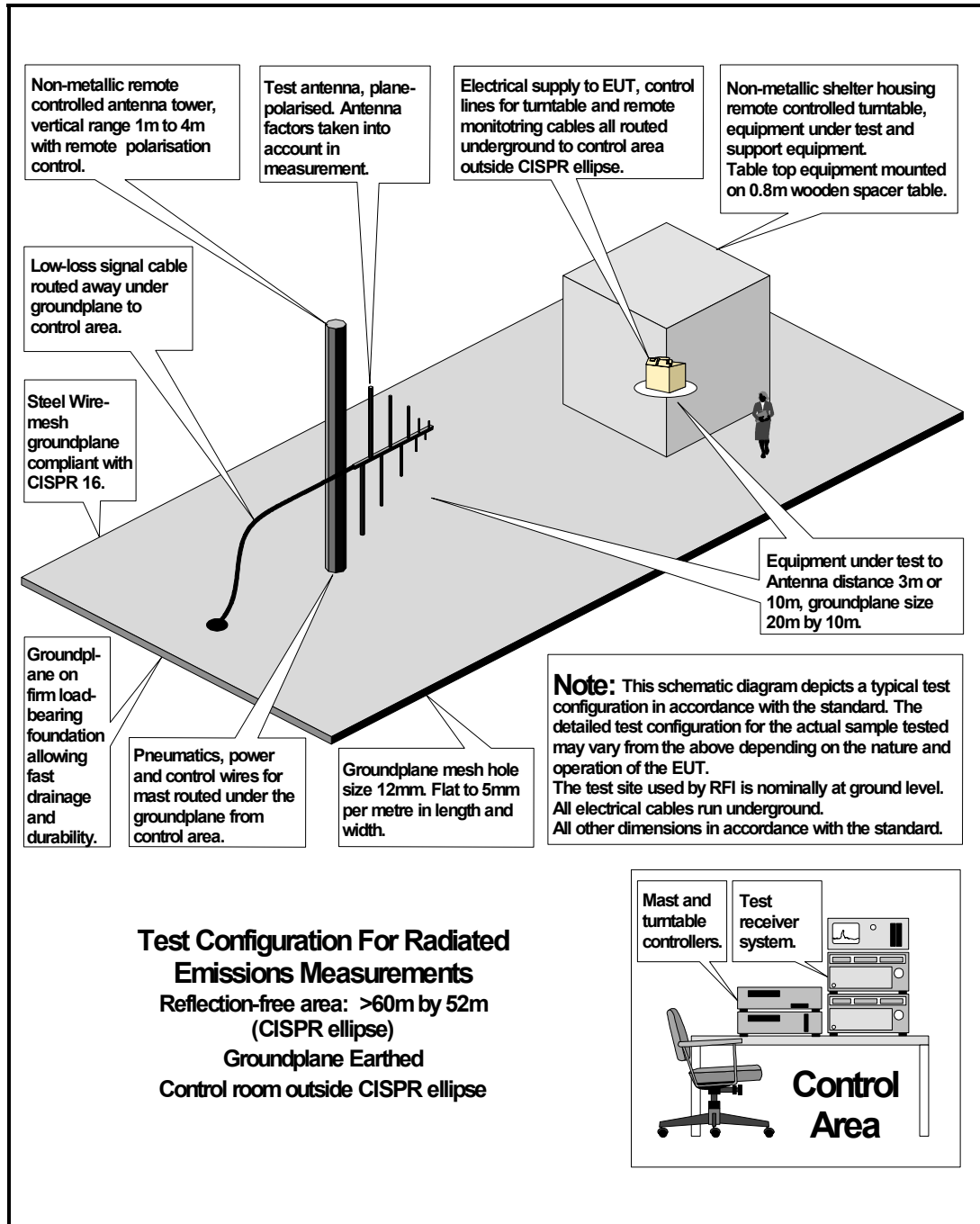
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DRG\45084JD01\EMIRAD



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**Operations Department**

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