TEST REPORT
FROM
RADIO FREQUENCY
INVESTIGATION LTD.

Test Of: Nokia UK Ltd.
NHL-10 Model 3620

To: FCC Part 15.247

Test Report Serial No:
RFI/MPTB2/RP45157JD01B

Supersedes Test Report Serial No:
RFI/MPTB1/RP45157JD01B

This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director: 	**Checked By:** 
Tested By: 	**Release Version No:** **PDF01**
Issue Date: 03 October 2003	**Test Dates: 19 August 2003 to 11 September 2003**

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Test Of: Nokia UK Ltd.
NHL-10 Model 3620
To: FCC Part 15.247

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1. Client Information

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

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:	3620
Unique Type Identification:	NHM-10
FCC ID	QFXNHM-10X
IMEI Number	004400211684517
Country of Manufacture:	Finland
Date of Receipt:	21 July 2003

2.2. Description Of EUT

The equipment under test is a tri-band 850, 1900) camera mobile handset, which supports IR and Bluetooth.

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

Power Supply Requirement: (Internal, non-removable lithium ion battery)	Internal battery supply of 3.8 V		
Declared Battery End Point Voltage	4.2VDC (max), 3.45VDC (min)		
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:	Transceiver		
Weight:	130 g		
Dimensions:	130 x 55 x 23 mm		
Interface Ports:	Charger & Accessory Port		
Transmit Frequency Range	2402 MHz to 2481 MHz		
Transmit Channels Tested	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	1	2402
	Middle	40	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	40	2441
	Top	79	2480
Highest Fundamental Frequency	2480 MHz		
Maximum Power Output (EIRP)	5.6dBm		

2.5. Accessories

Description:	Li-ion Battery
Brand Name:	Nokia
Model Name or Number:	BL-5C
Serial Number:	231804
Cable Length And Type:	N/A
Connected to Port:	Battery

Description:	AC Power Supply
Brand Name:	Nokia
Model Name or Number:	ACP-12U
Serial Number:	06753033997911495A10001959
Cable Length And Type:	175 cm
Connected to Port:	Charger

Description:	Headset
Brand Name:	Nokia
Model Name or Number:	HDC-5
Serial Number:	0271467
Cable Length And Type:	108 cm
Connected to Port:	Accessory

Description:	Memory Card
Brand Name:	Nokia
Model Name or Number:	DTS-16
Serial Number:	HB288016MM1
Cable Length And Type:	N/A
Connected to Port:	Memory Card

2.6. Support Equipment

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

Description:	Bluetooth Test Set
Brand Name:	Anritsu
Model Name or Number:	MT8850A
Serial Number:	6K0000084
Connected to Port:	RF Link

3. Methods And Procedures

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.

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.

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 Nominal 3.8 V DC Battery and connected to a 115 V 60 Hz AC Mains charger.

5.2. Operating Modes

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

Transmit Mode

Preliminary radiated scans were performed on the DUT with the accessories stated in section 2.5 of this report connected and the disconnected. The combination that exhibited the worse case mode of operation was then used to perform final measurements.

The Bluetooth mode was active and set to transmit on Top, Middle, Bottom and Hopping on All channels.

Idle Mode

Idle mode was performed with the Bluetooth transmitter turned off.

5.3. Configuration And Peripherals

The EUT was tested in the following configuration:

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

The EUT was programmed to operate on specific channels using an Anritsu Bluetooth test set.

6. Summary Of Test Results

Part 15.247

Range Of Measurements	Specification Reference	Port Type	Compliancy Status
Idle Mode AC Conducted Emissions (150 kHz to 30 MHz)	C.F.R. 47 FCC Part 15: 2002 Section 15.107	AC Mains	Complied
Idle Mode Radiated Spurious Emissions	C.F.R. 47 FCC Part 15: 2002 Section 15.109	Antenna	Complied
Transmitter AC Conducted Emissions	C.F.R. 47 FCC Part 15: 2002 Section 15.207	AC Mains	Complied
Transmitter 20dB Bandwidth	C.F.R. 47 FCC Part 15: 2002 Section 15.247(a)(1)(iii)	Antenna	Complied
Transmitter Carrier Frequency Separation	C.F.R. 47 FCC Part 15: 2002 Section 15.247(a)(1)	Antenna	Complied
Transmitter Average Time of Occupancy	C.F.R. 47 FCC Part 15: 2002 Section 15.247(a)(1)(iii)	Antenna	Complied
Transmitter Maximum Peak Output Power	C.F.R. 47 FCC Part 15: 2002 Section 15.247(b)(1)	Antenna	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 Radiated Emissions	C.F.R. 47 FCC Part 15: 2002 Section 15.247(c) Section 15.209(a)	Antenna	Complied

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 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.

8. Test Results

8.1. Idle Mode 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.

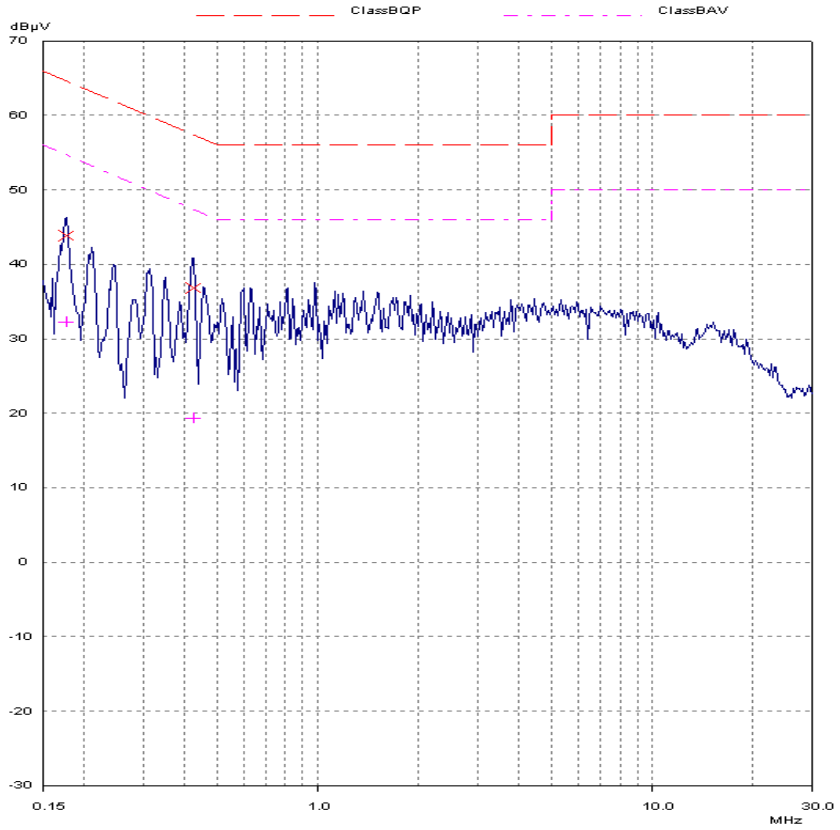
Quasi-Peak Detector Measurements on Live and Neutral Lines

Frequency (MHz)	Line	Q-P Level (dBμV)	Q-P Limit (dBμV)	Margin (dB)	Result
0.175850	Neutral	43.9	64.7	20.8	Complied
0.422620	Neutral	36.8	57.4	20.6	Complied

Average Detector Measurements on Live and Neutral Lines

Frequency (MHz)	Line	Avg Level (dBμV)	Avg Limit (dBμV)	Margin (dB)	Result
0.175850	Neutral	32.3	54.7	22.4	Complied
0.422620	Neutral	19.3	47.4	28.1	Complied

Idle Mode Conducted Emissions AC Mains: Section 15.107 (Continued)



Note: these plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

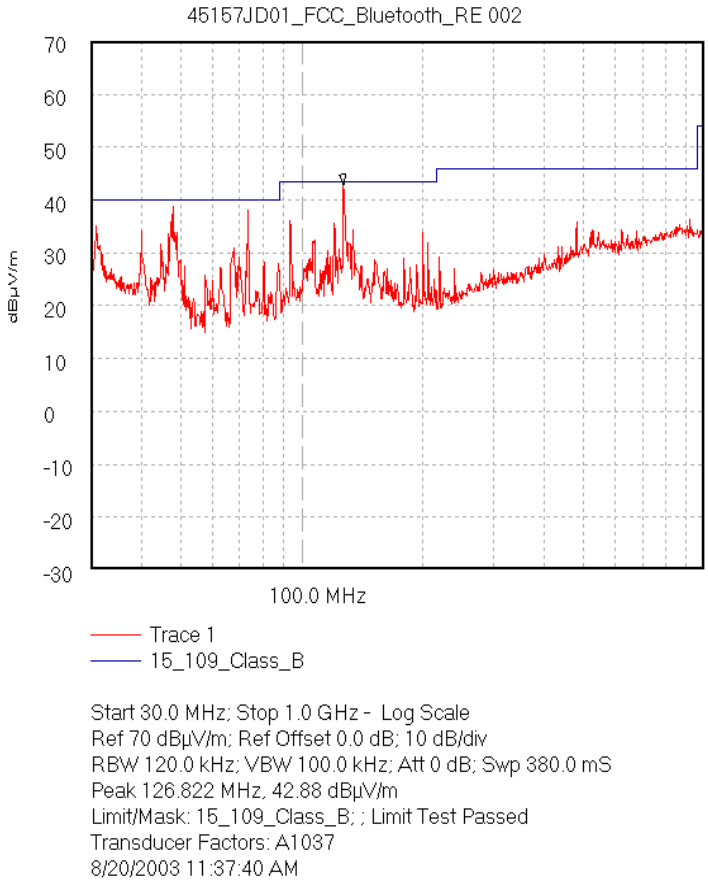
8.2. Idle Mode Radiated Emissions: Section 15.109

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 idle mode radiated emission level present in the band 30 MHz to 5 x the highest fundamental frequency.

Frequency (MHz)	Antenna. Polarity	Q-P Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
30.850	Vert.	19.5	40.0	20.5	Complied
47.575	Vert.	27.0	40.0	13.0	Complied



Note: these plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Idle Mode Radiated Emissions: Section 15.109 (Continued)

Electric Field Strength Measurements (Frequency Range: 1.0 to12.5 GHz)

Highest Peak Level:

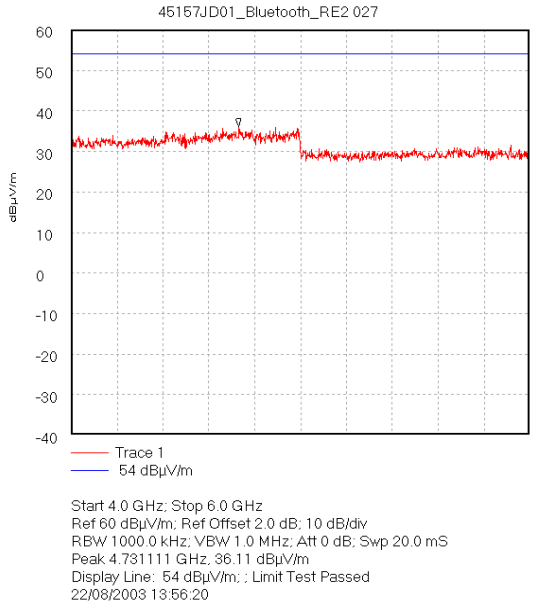
Frequency (GHz)	Antenna. Polarity (H/V)	Peak Detector Level (dBµV)	Antenna Factor	Cable Loss	Actual Peak Level (dBµV/m)	Peak Level (dBµV/m)	Peak Margin (dB)	Result
19.964444	Vert.	-0.9	37.1	5.0	41.2	74.0	32.8	Complied

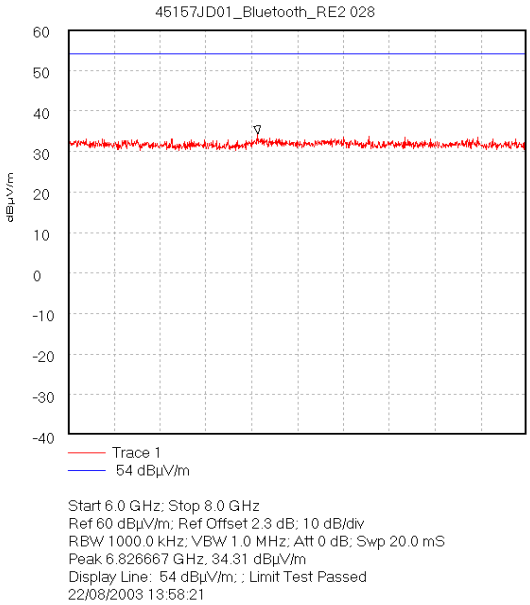
Note: There were no spurious emissions observed above the measurement analysers noise floor, as such the highest peak noise floor reading was recorded.

Highest Average Level:

Frequency (GHz)	Antenna. Polarity (H/V)	Average Detector Level (dBµV)	Antenna Factor	Cable Loss	Actual Average Level (dBµV/m)	Average Limit (dBµV/m)	Peak Margin (dB)	Result
19.964444	Vert.	-10.4	37.1	5.0	31.7	54.0	22.3	Complied

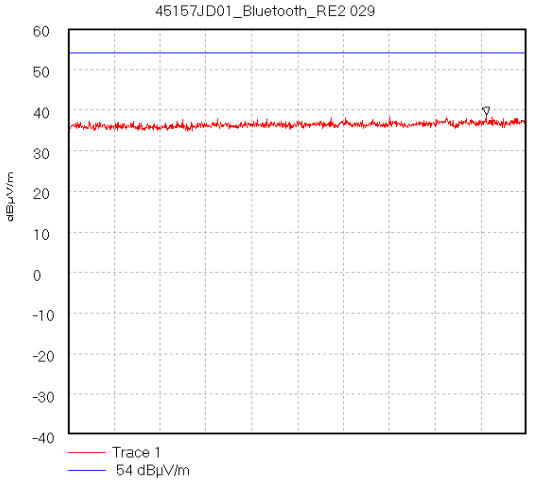
Note: There were no spurious emissions observed above the measurement analysers noise floor, as such the highest average noise floor reading was recorded.



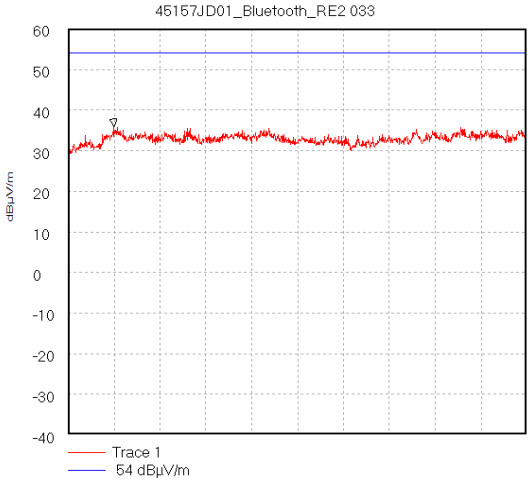


Note: these plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

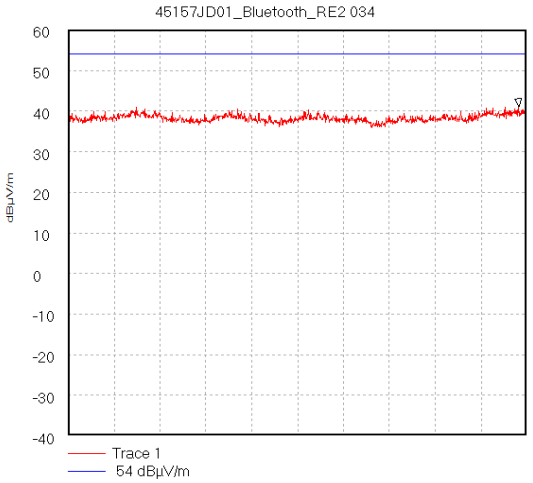
Receiver Radiated Emissions: Section 15.109 (Continued)



Start 8.0 GHz; Stop 12.5 GHz
Ref 60 dBµV/m; Ref Offset 2.9 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 40.0 mS
Peak 12.105 GHz, 38.8 dBµV/m
Display Line: 54 dBµV/m; ; Limit Test Passed
22/08/2003 14:00:17



Start 12.5 GHz; Stop 18.0 GHz
Ref 60 dBµV/m; Ref Offset 3.6 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 40.0 mS
Peak 13.05 GHz, 35.98 dBµV/m
Display Line: 54 dBµV/m;
22/08/2003 14:06:31



Start 18.0 GHz; Stop 20.0 GHz
Ref 60 dBµV/m; Ref Offset 5.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 19.964444 GHz, 41.06 dBµV/m
Display Line: 54 dBµV/m;
22/08/2003 14:09:05

Note: these plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

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 battery charger while connected to the EUT.

Middle Channel

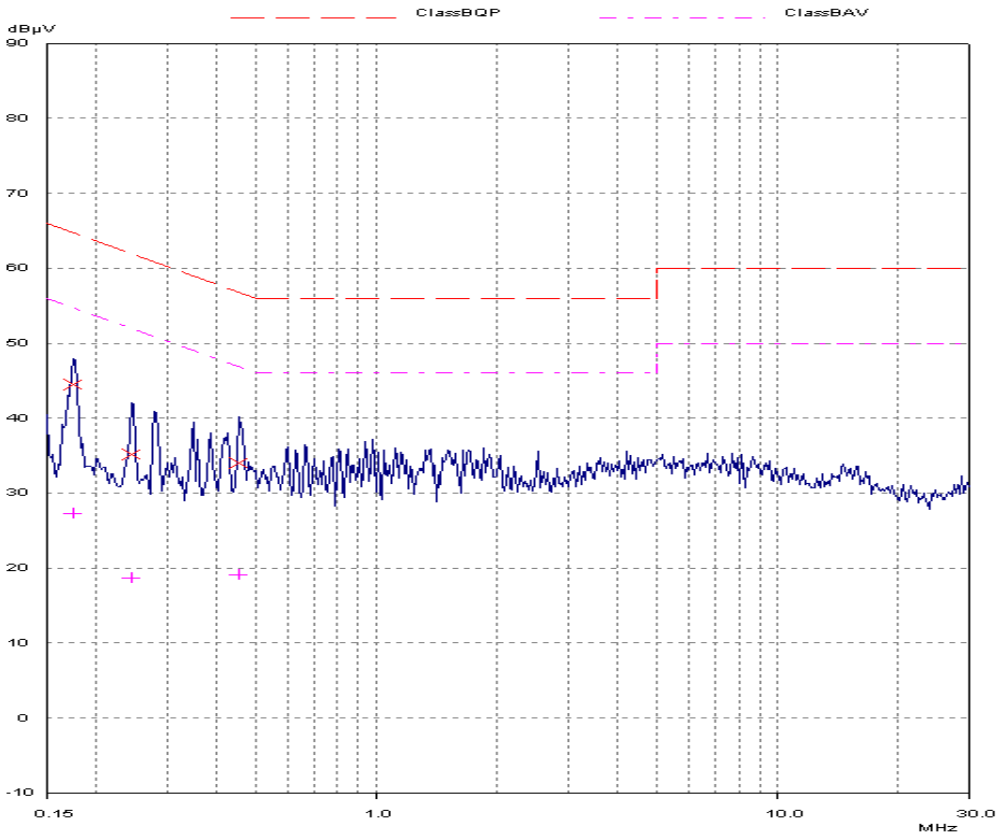
Frequency (MHz)	Line	Q-P Level (dBμV)	Q-P Limit (dBμV)	Margin (dB)	Result
0.174820	Neutral	44.6	64.7	20.1	Complied
0.244570	Neutral	35.1	61.9	26.8	Complied
0.451290	Neutral	34.0	56.9	22.9	Complied

Average Detector Measurements on Live and Neutral Lines

Middle Channel

Frequency (MHz)	Line	Avg Level (dBμV)	Avg Limit (dBμV)	Margin (dB)	Result
0.174820	Neutral	27.3	54.7	27.4	Complied
0.244570	Neutral	18.6	51.9	33.1	Complied
0.451290	Neutral	19.2	46.9	27.7	Complied

Transmitter Conducted Emissions AC Mains: Section 15.207 (Continued)



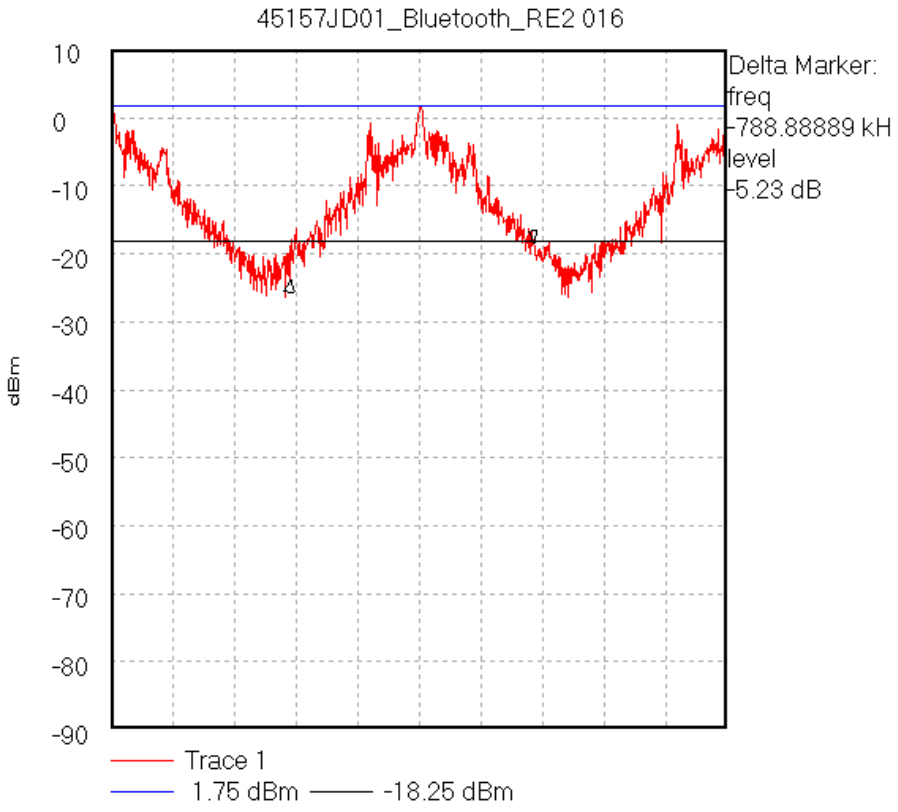
Note: these plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

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

8.4.1. The EUT was configured as for carrier frequency seperation/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)	Limit (kHz)
788.889	None specified



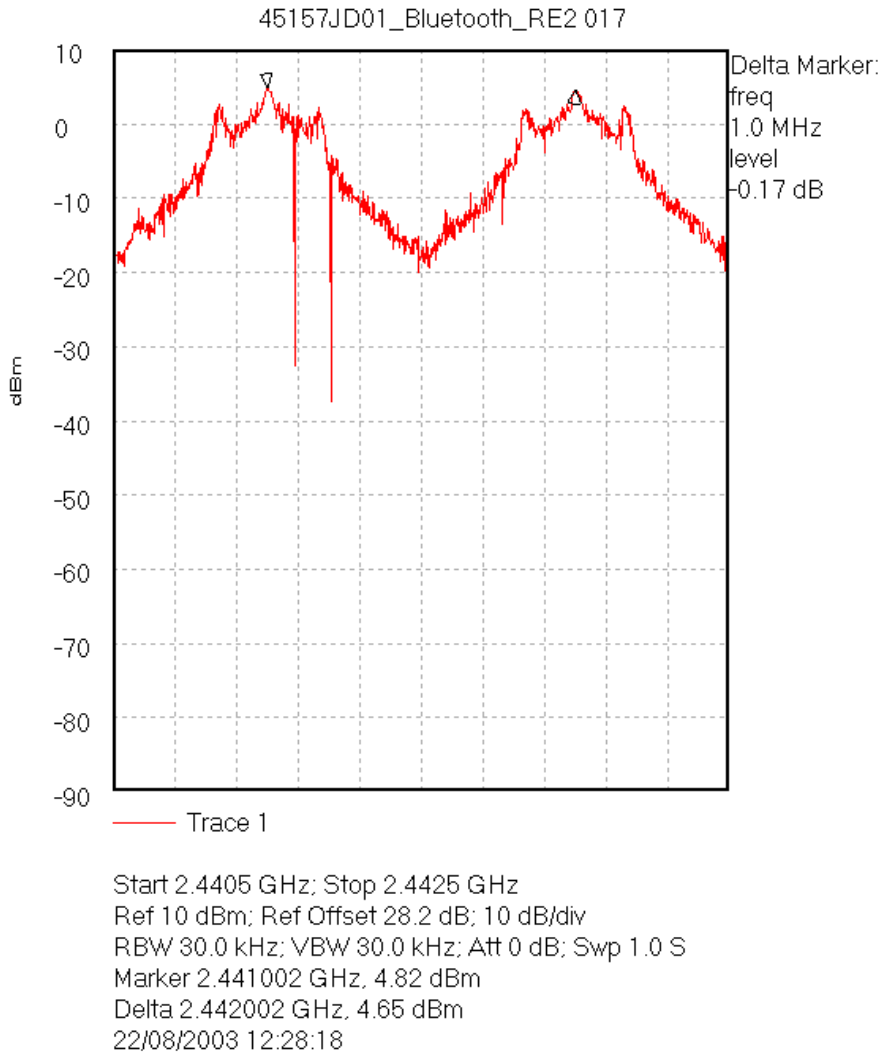
Start 2.44 GHz; Stop 2.442 GHz
Ref 10 dBm; Ref Offset 28.2 dB; 10 dB/div
RBW 10.0 kHz; VBW 10.0 kHz; Att 0 dB; Swp 1.0 S
Marker 2.441371 GHz, -18.49 dBm
Delta 2.440582 GHz, -23.72 dBm
Display Line: 1.75 dBm; -18.25 dBm;
22/08/2003 12:16:00

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 (> 20dB BW) (kHz)	Margin (kHz)	Result
1000.0	788.9	211.1	Complied



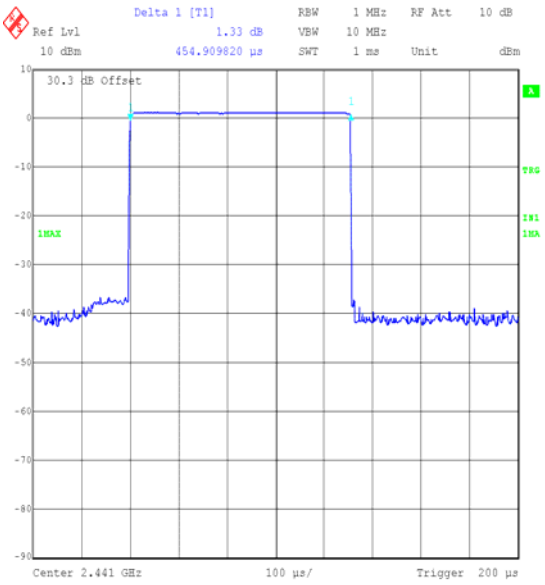
8.6. Transmitter Average Time of Occupancy: Section 15.247(a)(1)(iii)

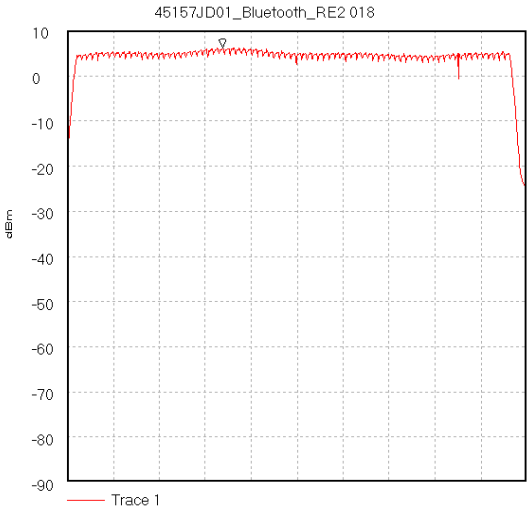
8.6.1. The EUT was configured as for average time of occupancy measurements as described in Section 9 of this report.

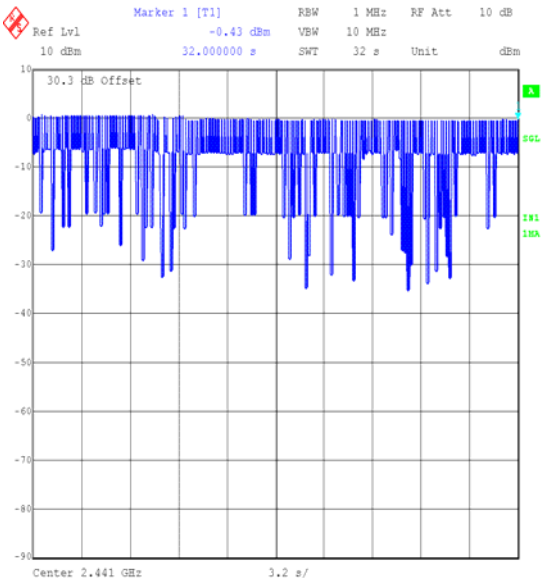
8.6.2. Tests were performed to identify the average time of occupancy in number of channels (79) x 0.4 seconds. The calculated period is 31.6 seconds.

Emission Width (μs)	Number of Hops in 31.6 seconds	Average Time of Occupancy (s)	Limit (s)	Margin (s)	Result
454.909820	232	0.105539	0.4	0.294461	Complied

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







8.7. Transmitter Effective Isotropic Radiated Power (EIRP): Section 15.247(b)(1)

8.7.1. The EUT was configured as for Transmitter Effective Isotropic Radiated Power measurements as described in Section 9 of this report.

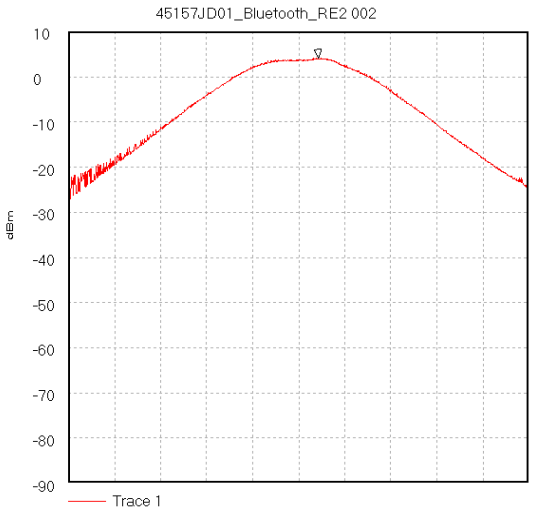
8.7.1. Tests were performed to identify the transmitter maximum EIRP of the EUT.

Channel	Input Voltage (AC)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	93.50	4.2	30.0	25.8	Complied
Bottom	110.00	4.1	30.0	25.9	Complied
Bottom	126.50	4.3	30.0	25.7	Complied

Note: These tests were performed radiated; as such the EUT antenna gain is encompassed in the final result and not measurable.

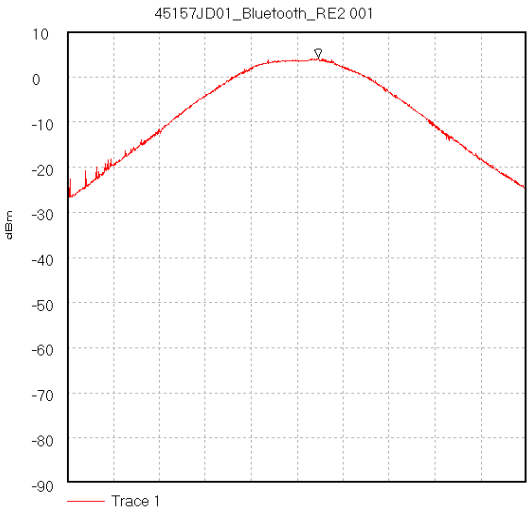
Transmitter Effective Isotropic Radiated Power (EIRP):Section 15.247(b)(1) (Continued)

Input Voltage (AC) 93.50 V



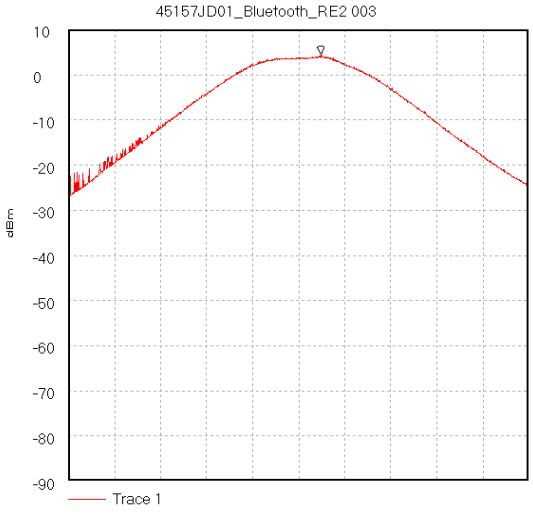
Start 2.3995 GHz; Stop 2.4045 GHz
Ref 10 dBm; Ref Offset 27.8 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 20 dB; Swp 20.0 mS
Marker 2.402217 GHz, 4.24 dBm
22/08/2003 10:43:02

Input Voltage (AC) 110.00 V



Start 2.3995 GHz; Stop 2.4045 GHz
Ref 10 dBm; Ref Offset 27.8 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 20 dB; Swp 20.0 mS
Marker 2.402233 GHz, 4.11 dBm
22/08/2003 10:39:51

Input Voltage (AC) 126.50 V



Start 2.3995 GHz; Stop 2.4045 GHz
Ref 10 dBm; Ref Offset 27.8 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 20 dB; Swp 20.0 mS
Marker 2.402244 GHz, 4.29 dBm
22/08/2003 10:44:50

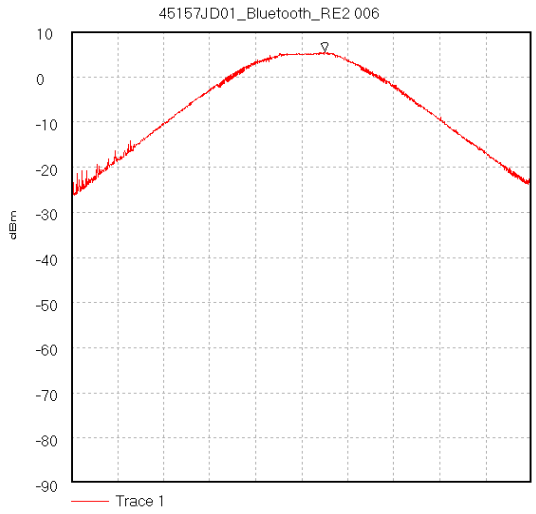
Transmitter Effective Isotropic Radiated Power (EIRP): Section 15.247(b)(1) (Continued)

Channel	Input Voltage (AC)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Middle	93.50	5.6	30.0	24.4	Complied
Middle	110.00	5.6	30.0	24.4	Complied
Middle	126.50	5.6	30.0	24.4	Complied

Note: These tests were performed radiated; as such the EUT antenna gain is encompassed in the final result and not measurable.

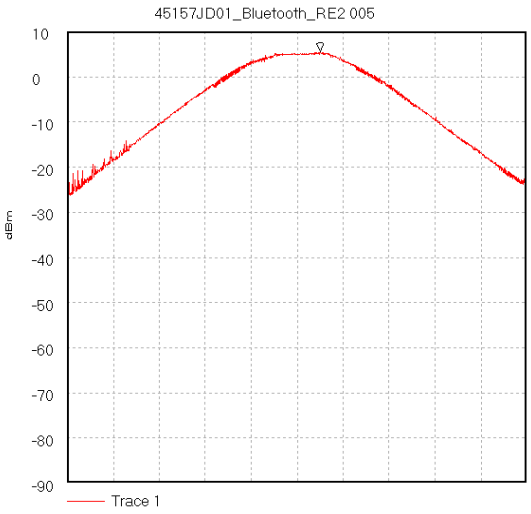
Transmitter Effective Isotropic Radiated Power (EIRP): Section 15.247(b)(1) (Continued)

Input Voltage (AC) 93.50 V



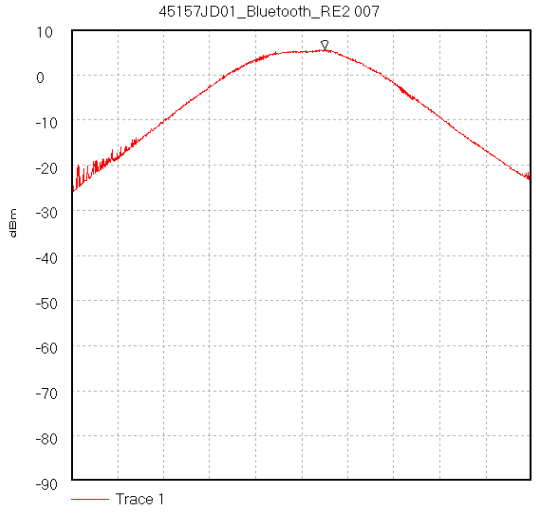
Start 2.4385 GHz; Stop 2.4435 GHz
Ref 10 dBm; Ref Offset 28.2 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 20 dB; Swp 20.0 mS
Peak 2.441256 GHz, 5.64 dBm
22/08/2003 10:51:21

Input Voltage (AC) 110.00 V



Start 2.4385 GHz; Stop 2.4435 GHz
Ref 10 dBm; Ref Offset 28.2 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 20 dB; Swp 20.0 mS
Peak 2.441256 GHz, 5.64 dBm
22/08/2003 10:50:36

Input Voltage (AC) 126.50 V



Start 2.4385 GHz; Stop 2.4435 GHz
Ref 10 dBm; Ref Offset 28.2 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 20 dB; Swp 20.0 mS
Marker 2.44125 GHz, 5.59 dBm
22/08/2003 10:52:34

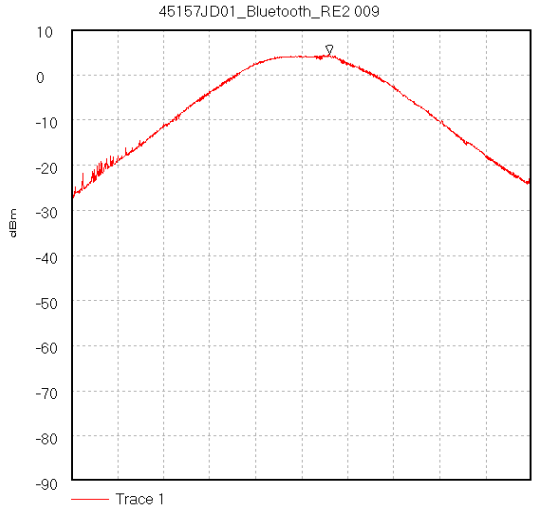
Transmitter Effective Isotropic Radiated Power (EIRP): Section 15.247(b)(1) (Continued)

Channel	Input Voltage (AC)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Top	93.50	4.6	30.0	25.4	Complied
Top	110.00	4.7	30.0	25.3	Complied
Top	126.50	4.5	30.0	25.5	Complied

Note: These tests were performed radiated; as such the EUT antenna gain is encompassed in the final result and not measurable.

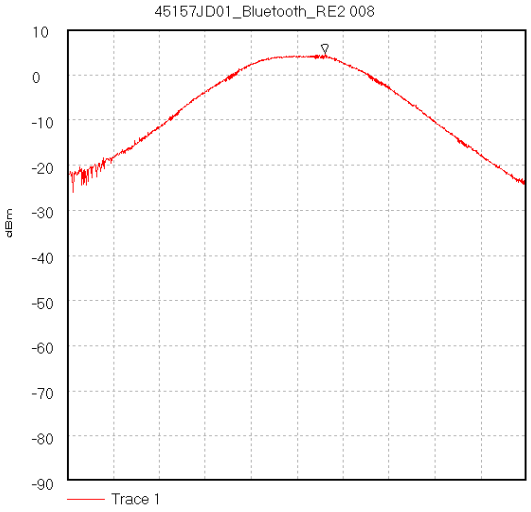
Transmitter Peak Output Power: Section 15.247(b)(1) (Continued)

Input Voltage (AC) 93.50 V



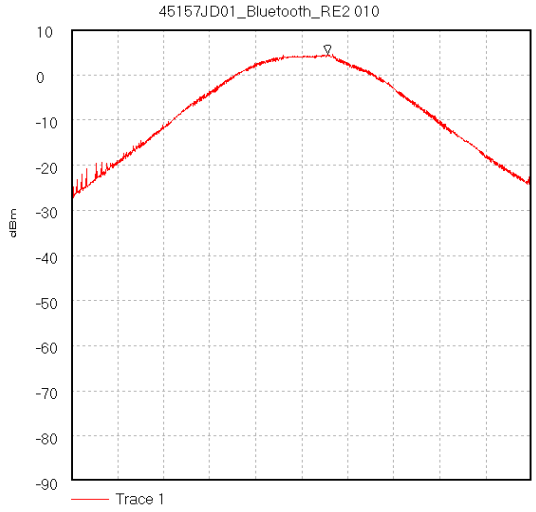
Start 2.4775 GHz; Stop 2.4825 GHz
Ref 10 dBm; Ref Offset 27.3 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 20 dB; Swp 20.0 mS
Peak 2.4803 GHz, 4.55 dBm
22/08/2003 10:59:35

Input Voltage (AC) 110.00 V



Start 2.4775 GHz; Stop 2.4825 GHz
Ref 10 dBm; Ref Offset 27.3 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 20 dB; Swp 20.0 mS
Peak 2.480306 GHz, 4.72 dBm
22/08/2003 10:58:00

Input Voltage (AC) 126.50 V



Start 2.4775 GHz; Stop 2.4825 GHz
Ref 10 dBm; Ref Offset 27.3 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 20 dB; Swp 20.0 mS
Marker 2.480283 GHz, 4.49 dBm
22/08/2003 11:00:52

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

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

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

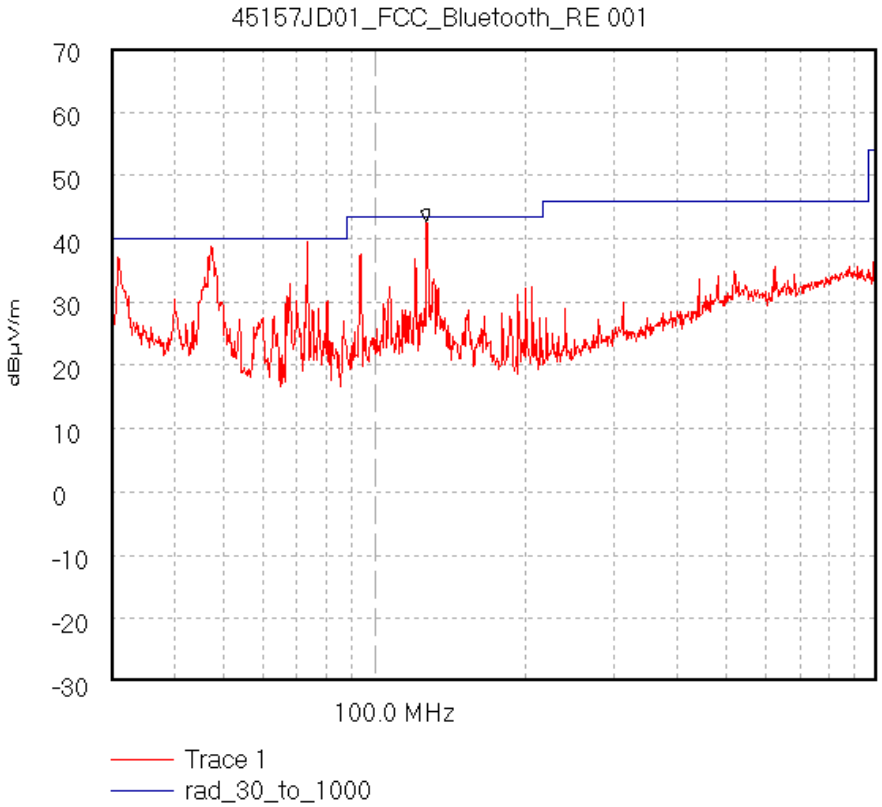
8.8.1.2. Tests were performed to identify the maximum out of band transmitter radiated spurious emission level present in the band 30 MHz to 10 x the highest fundamental frequency.

Middle Channel

Frequency (MHz)	Antenna. Polarity (H/V)	Q-P Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
30.956	Vert.	20.3	40.0	19.7	Complied
47.569	Vert.	27.1	40.0	12.9	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.

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



Start 30.0 MHz; Stop 1.0 GHz - Log Scale
Ref 70 dBµV/m; Ref Offset 0.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 540.0 mS
Peak 126.822 MHz, 42.81 dBµV/m
Limit/Mask: rad_30_to_1000; ; Limit Test Passed
Transducer Factors: A1037
8/20/2003 11:04:25 AM

Note: these plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

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

Electric Field Strength Measurements: 1.0 to 26.0 GHz

Highest Peak Level: Bottom Channel

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dBμV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)	Result
4.803903	Horiz	23.3	24.4	2.0	47.9	74.0	26.1	Complied

Highest Average Level: Bottom Channel

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dBμV)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dBμV/m)	Average Limit (dBμV/m)	Average Margin (dB)	Result
4.803903	Horiz.	9.7	24.4	2.0	34.3	54.0	19.7	Complied

Highest Peak Level: Middle Channel

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dBμV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)	Result
4.882092	Horiz.	21.3	24.4	2.0	45.9	74.0	28.1	Complied

Highest Average Level: Middle Channel

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dBμV)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dBμV/m)	Average Limit (dBμV/m)	Average Margin (dB)	Result
4.882092	Horiz.	8.9	24.4	2.0	33.5	54.0	20.5	Complied

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

Highest Peak Level: Top Channel

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dBμV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)	Result
4.960153	Horiz.	16.1	24.4	2.0	40.7	74.0	33.3	Complied

Highest Average Level: Top Channel

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dBμV)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dBμV/m)	Average Limit (dBμV/m)	Average Margin (dB)	Result
4.960153	Horiz.	3.3	24.4	2.0	27.9	54.0	26.1	Complied

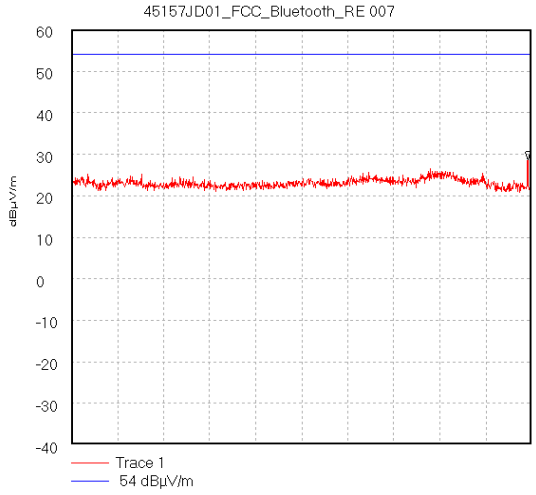
Highest Peak Level: Hopping Channel

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dBμV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)	Result
4.816019	Horiz.	22.4	24.4	2.0	47.0	74.0	27.0	Complied

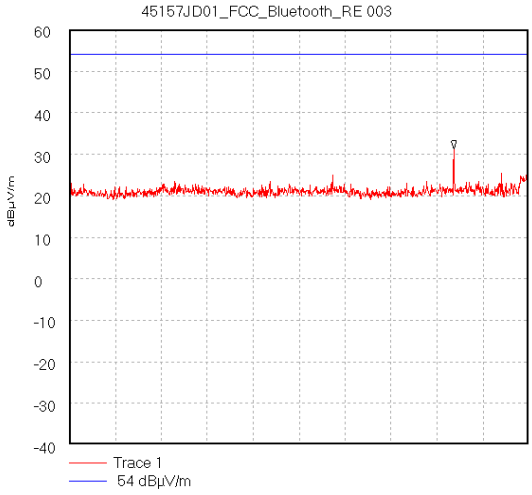
Highest Average Level: Hopping Channel

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dBμV)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dBμV/m)	Average Limit (dBμV/m)	Average Margin (dB)	Result
4.816019	Horiz.	7.5	24.4	2.0	33.9	54.0	20.1	Complied

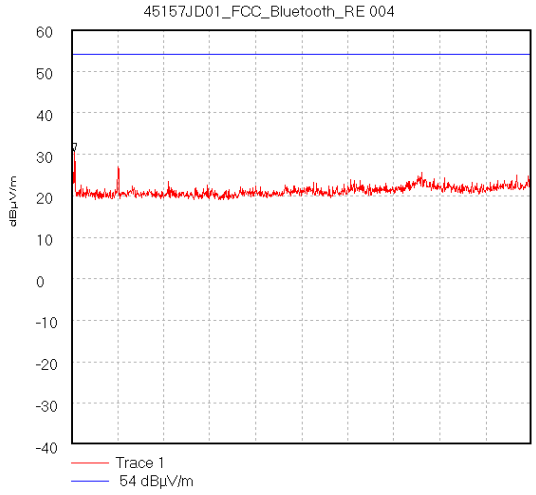
Transmitter Radiated Emissions: Section 15.247(c) and 15.209(a) (continued)



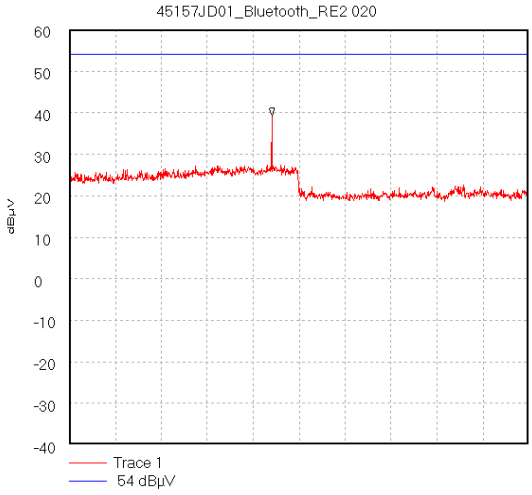
Start 1.0 GHz; Stop 2.0 GHz
Ref 60 dBµV/m; Ref Offset 5.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 640.0 mS
Peak 1.992 GHz, 28.62 dBµV/m
Display Line: 54 dBµV/m; ; Limit Test Passed
8/20/2003 12:13:34 PM



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 2.335 GHz, 31.23 dBµV/m
Display Line: 54 dBµV/m; ; Limit Test Passed
8/20/2003 11:57:08 AM



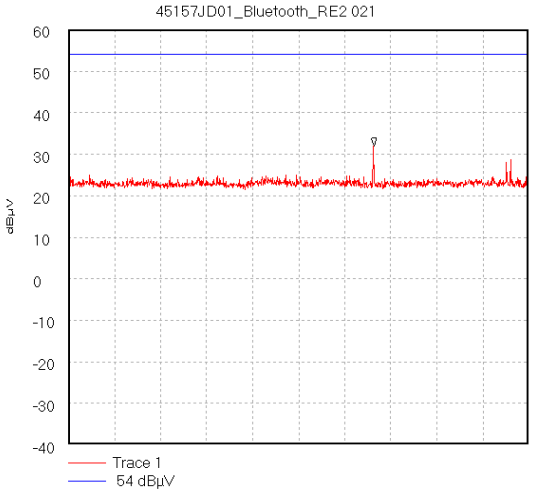
Start 2.483 GHz; Stop 4.0 GHz
Ref 60 dBµV/m; Ref Offset 5.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 960.0 mS
Peak 2.493 GHz, 30.57 dBµV/m
Display Line: 54 dBµV/m; ; Limit Test Passed
8/20/2003 12:00:44 PM



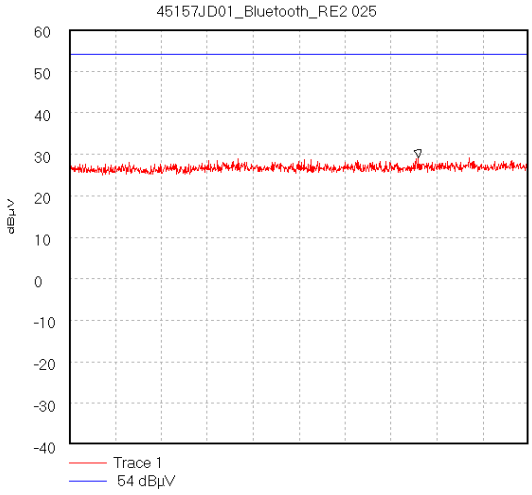
Start 4.0 GHz; Stop 6.0 GHz
Ref 60 dBµV; Ref Offset 2.0 dB; 10 dB/div
RBW 145.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 1.28 S
Peak 4.882222 GHz, 39.18 dBµV
Display Line: 54 dBµV;
22/08/2003 12:48:56

Note: these plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

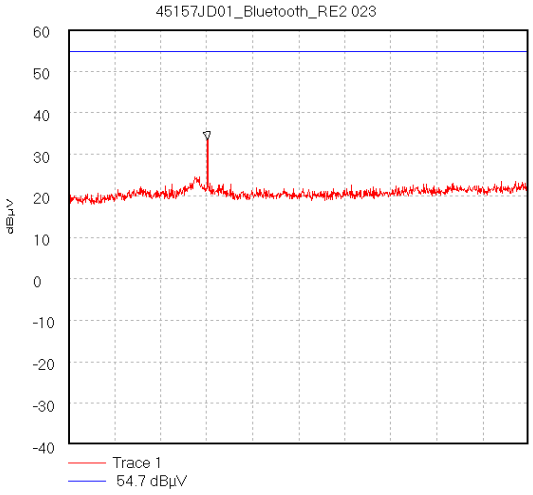
Transmitter Radiated Emissions: Section 15.247(c) and 15.209(a) (continued)



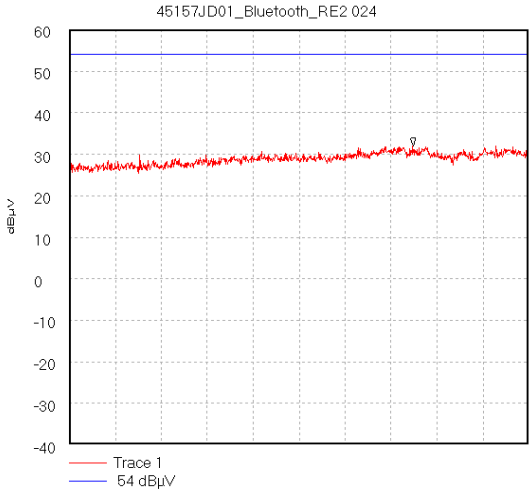
Start 6.0 GHz; Stop 8.0 GHz
Ref 60 dBµV; Ref Offset 2.3 dB; 10 dB/div
RBW 145.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 1.28 S
Peak 7.326667 GHz, 32.05 dBµV
Display Line: 54 dBµV;
22/08/2003 13:15:10



Start 8.0 GHz; Stop 12.5 GHz
Ref 60 dBµV; Ref Offset 2.9 dB; 10 dB/div
RBW 145.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 3.0 S
Peak 11.42 GHz, 29.1 dBµV
Display Line: 54 dBµV;
22/08/2003 13:45:32



Start 12.5 GHz; Stop 18.0 GHz
Ref 60 dBµV; Ref Offset 3.6 dB; 10 dB/div
RBW 145.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 3.6 S
Peak 14.162222 GHz, 33.6 dBµV
Display Line: 54.7 dBµV;
22/08/2003 13:28:15



Start 18.0 GHz; Stop 26.5 GHz
Ref 60 dBµV; Ref Offset 5.0 dB; 10 dB/div
RBW 145.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 5.4 S
Peak 24.356111 GHz, 32.0 dBµV
Display Line: 54 dBµV;
22/08/2003 13:31:12

Note: these plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

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

8.9.1. Electric Field Strength Measurements

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

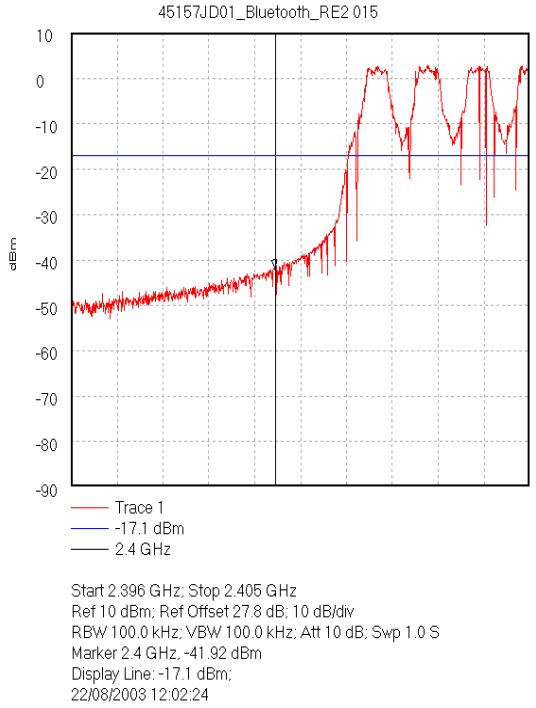
8.9.1.2. Tests were performed to identify the maximum radiated band edge emissions.

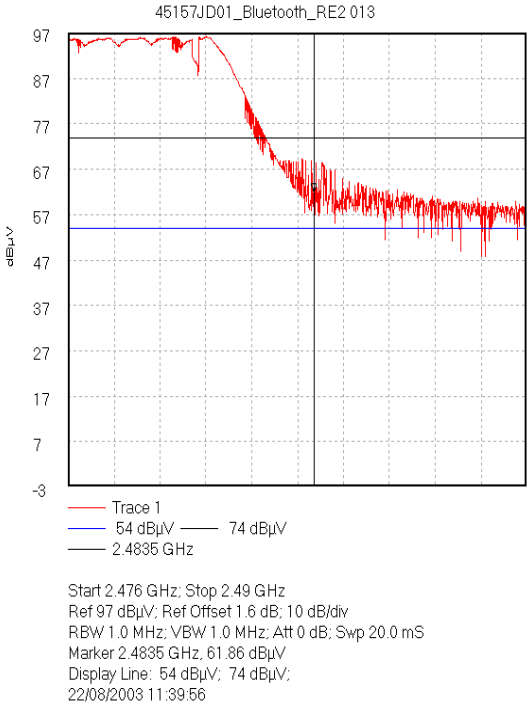
Peak Power Level Hopping Mode:

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dBµV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	Result
2.4000	Horiz.	42.4	21.1	1.6	65.1	89.9	24.8	Complied
2.4835	Horiz.	39.2	21.1	1.6	61.9	74.0	12.1	Complied

Average Power Level Hopping Mode:

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dBµV)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dBµV/m)	Average Limit (dBµV/m)	Average Margin (dB)	Result
2.4835	Horiz.	18.12	21.2	1.6	40.82	54.0	13.2	Complied





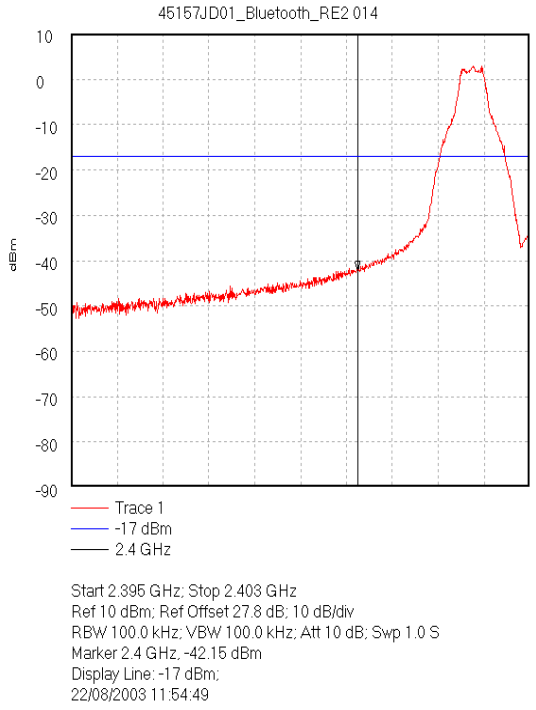
Transmitter Band Edge Radiated Emissions: Section 15.247(c) & 15.209(a) (Continued)

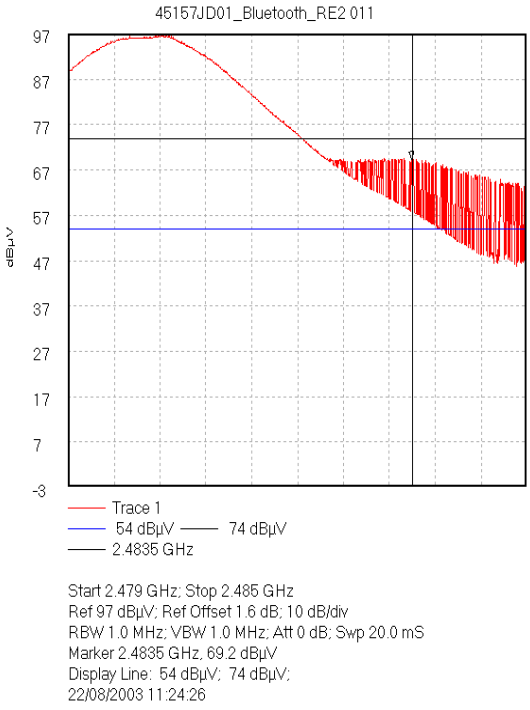
Peak Power Level Static Mode:

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dBµV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	Result
2.4000	Horiz.	42.1	21.1	1.6	64.8	90.0	25.2	Complied
2.4835	Horiz.	46.5	21.1	1.6	69.2	74.0	74.0	Complied

Average Power Level Static Mode:

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dBµV)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dBµV/m)	Average Limit (dBµV/m)	Average Margin (dB)	Result
2.4835	Horiz.	22.2	21.1	1.6	44.9	54.0	9.1	Complied





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 pre-scans covering the entire measurement band from the lowest generated frequency declared up to 'n' times the highest fundamental frequency stated in section 2.5 of this report where 'n' is either 5 or 10 dependant upon whether the emission was produced via a transmitter/receiver or idle mode.

The pre-scans were performed within a screened chamber in order to identify frequencies on which the EUT was generating spurious.

This procedure identified the frequencies from the EUT, which required further examination.

The initial scans were performed using an antenna height of 1.5 m and at a measurement distance of 3 m.

A limit line was set to the specification limit by characterising the screen room using a known signal source set at exactly the same location as the EUT.

The signal source was derived from either a horn antenna or a dipole dependant on the frequency band under investigation.

Any levels within 20dB of this limit were measured where possible, on occasion; the receiver noise floor came within the 20dB boundary. On these occasions, the system noise floor may have been recorded.

An open area test site was then used with the EUT being set to the appropriate test distance.

Where an emission fell inside a restricted band, measurements were made at the appropriate test 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. A peak detector was used for all other measurements.

The levels were maximised by initially rotating the turntable through 360° and then varying the antenna height between 1 m and 4 m in the vertical polarisation.

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.

The above procedure was repeated for the horizontal polarisation.

The final result was calculated as:-

E dBuV/m = LvL + AF + CL

Radiated Field Strength Emissions (Continued)

Where:

E dBuV/m = Final field strength recorded.
LvL = Raw level indicate on measuring receiver.
AF = Antenna factor of test antenna.
CL = Cable loss.

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 for radiated 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 measurement analyser was configured to measure two adjacent channels whilst the EUT was in hopping mode.

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 line intercepted the power envelope of the emission.

9.4. Average Time of Occupancy

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

First the maximum packet length was determined on the centre channel.

The measurement analyser was configured to the time domain mode by setting the span to 0 with a sweep time sufficiently wide enough to measure one pulse.

The EUT was configured to operate in normal mode of operation.

The pulse width of one transmission was then recorded.

The measurement analyser was then configured in 0 span with the time domain and a 31.6 second sweep time. This period was determined by multiplying the number of channels the device operates over (79) by 0.4 seconds.

The number of transmissions within this period was noted and multiplied by the pulse width recorded earlier. This gives the maximum occupancy over 31.6 seconds.

9.5. Effective Isotropic Radiated Power (EIRP)

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

The EIRP 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 EIRP 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 level 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 maximum amplitude had been obtained, the EUT was substituted with a horn antenna.

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 6dB or greater PAD.

The signal generator was tuned to the EUT's frequency under test.

Effective Isotropic Radiated Power (EIRP) (Continued)

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 EIRP was calculated as:-

EIRP = Signal Generator Level - Cable Loss + Antenna Gain

Circumstances where the signal generator could not produce the desired power level, 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 EIRP of the signal generator was calculated using the above formulae. The recorded delta was added to the calculated EIRP to obtain the substituted EUT EIRP.

Delta (dB) = EUT – SG

Where :

EUT = spectrum analyser indicated EUT raw level

SG = spectrum analyser indicated signal generator raw level

The signal generator actual EIRP is calculated as:

EIRP SG= Signal Generator Level - Cable Loss + Antenna Gain

The EUT EIRP is calculated as:

EIRP EUT = EIRP SG + Delta.

9.6. 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 >= 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.

It 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

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
Effective Isotropic Radiated Power (EIRP)	Not applicable	95%	+/- 1.78 dB
Transmitter Maximum Peak Output Power	Not applicable	95%	+/- 0.46 dB
Transmitter Carrier Frequency Separation	Not applicable	95%	+/- 0.01 ppm
20dB Bandwidth	1850 to 1910 MHz	95%	+/- 0.12 %
Transmitter Average Time of Occupancy	Not applicable	95%	+/- 10.00 %
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

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.

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
A197	Site 2 Controller SC144	Unknown	SC144	150720
A253	WG 12 Microwave Horn	Flann Microwave	12240-20	128
A254	WG 14 Microwave Horn	Flann Microwave	14240-20	139
A255	WG 16 Microwave Horn	Flann Microwave	16240-20	519
A256	WG 18 Microwave Horn	Flann Microwave	18240-20	400
A258	Zenith Variable Power Supply	Zenith Electric	SVA 10	None
A259	Bilog Antenna	Chase	CBL6111	1513
A276	OATS Positioning Controller	Rohde & Schwarz	HCC	
A392	3 dB attenuator (9)	Suhner	6803.17.B	None
A427	WG 14 horn Microwave Horn	Flann	14240-20	150
A428	WG 12 horn Microwave Horn	Flann	12240-20	134
A429	WG 16 horn Microwave Horn	Flann	16240-20	561
A430	WG 18 horn Microwave Horn	Flann	18240-20	425
A435	WG 22 horn Microwave Horn	Flann	22240-20	400
C1080	Cable	Rosenberger	FA210A1030M5050	28464-1
C1081	Cable	Rosenberger	FA210A1020M5050	28463-2
C453	Cable	Rosenberger	RG142XX-001-RFIB	C453-10081998

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
M003	Spectrum Monitor	Rohde & Schwarz	EZM	883 580/008
M005	LAS-Z11 Floppy Disc Station	Rohde & Schwarz	LAS-Z11	879 330/004
M023	ESVP Receiver	Rohde & Schwarz	ESVP	872 991/027
M069	ESMI Spectrum Analyser / Receiver	Rohde & Schwarz	ESMI	829 808/007 (DU) / 827 063/008 (RU)
M072	FSM Spectrum Analyser	Rohde & Schwarz	FSM	862 967/010 (RF) & 863 912/048 (Display)
M088	Receiver / Spectrum Analyser System	Rohde & Schwarz	ESBI	DU:835862/018 RU:835387/006
M1093	Will tek	Will tek	4202S	0513018
M114	Temperature/Humidity Meter	RS Components	212-146	None
M173	Turntable Controller	R.H.Electrical Services	RH351	3510020
S201	Site 1	RFI	1	-
S202	Site 2	RFI	2	-
S207	Site 7	RFI	7	-

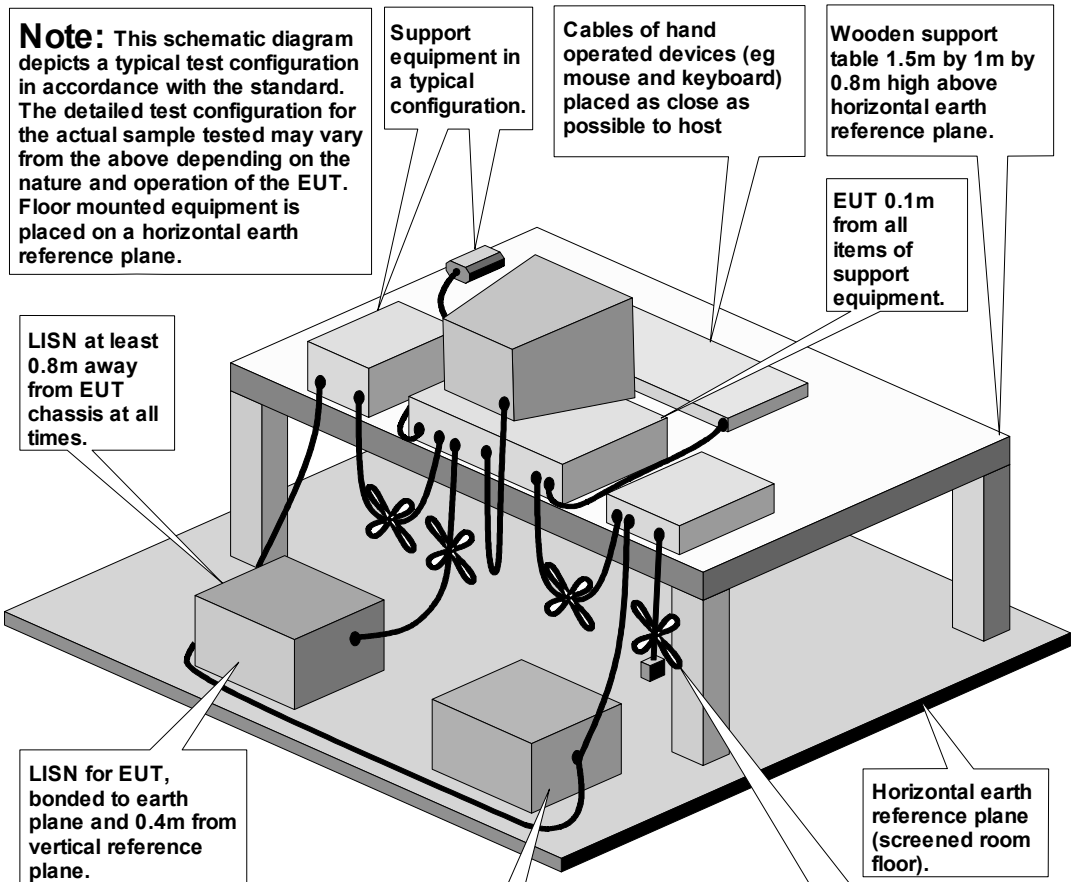
NB In accordance with UKAS requirements, all the measurement equipment is on a calibration schedule.

Appendix 2. Test Configuration Drawings

This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\45157JD01\EMICON	Test configuration for measurement of conducted emissions
DRG\45157JD01\EMIRAD	Test configuration for measurement of radiated emissions

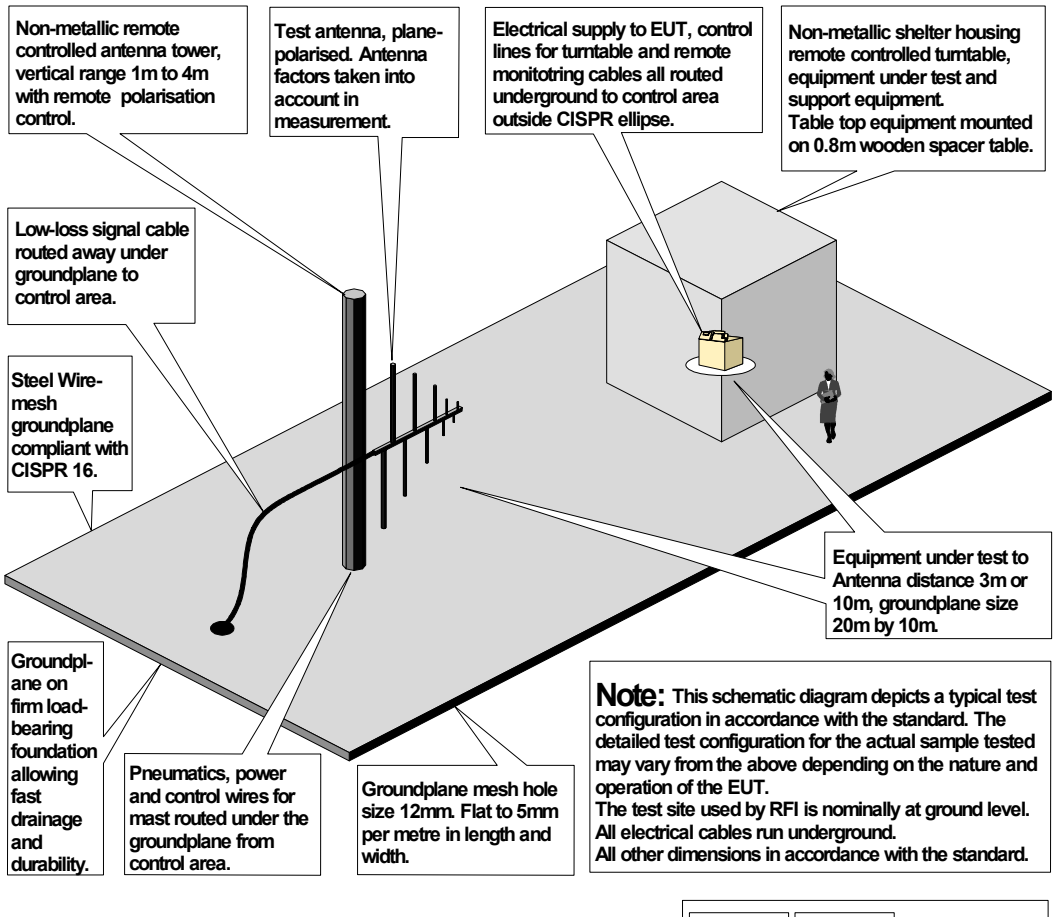
DRG\45157JD01\EMICON



Typical Test Configuration For Conducted Emissions Measurements In Accordance With ANSI C63.4-1992

Tests performed in a screened enclosure

DRG\45157JD01\EMIRAD



Note: This schematic diagram depicts a typical test configuration in accordance with the standard. The detailed test configuration for the actual sample tested may vary from the above depending on the nature and operation of the EUT.
The test site used by RFI is nominally at ground level.
All electrical cables run underground.
All other dimensions in accordance with the standard.

Test Configuration For Radiated Emissions Measurements

Reflection-free area: >60m by 52m
(CISPR ellipse)
Groundplane Earthed
Control room outside CISPR ellipse