TEST REPORT
FROM
RFI GLOBAL SERVICES LTD

Test of: Multitone Electronics Plc
EkoTek - Repeater

To: FCC Part 15.247: 2006 (Subpart C)

Test Report Serial No:
RFI/RPTE2/RP48909JD013A

Supersedes Test Report Serial No:
RFI/RPTE1/RP48909JD013A

This Test Report Is Issued Under The Authority Of Michael Derby, Radio Performance Service Leader: 	
Tested By: Nirav Modi 	**Checked By: Michael Derby** 
Report Copy No: PDF01	
Issue Date: 12 July 2007	**Test Dates: 04 June 2007 to 19 June 2007**

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

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

RFI Global Services Ltd
Pavilion A, Ashwood Park, Ashwood Way, Basingstoke, Hampshire RG23 8BG
Telephone: +44 (0)1256 312000 Facsimile: +44 (0)1256 312001
Email: info@rfi-global.com Website: www.rfi-global.com

Registered in England and Wales. Company number:2117901

This page has been left intentionally blank.

Table of Contents

1. Client Information

Company Name:	Multitone Electronics Plc
Address:	Multitone House Shortwood Copse Lane Kempshott Basingstoke Hampshire RG23 7NL UK
Contact Name:	Mr B Merchant

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)

Description:	Radio Repeater
Brand Name:	Multitone
Model Name or Number:	EkoTek - Repeater
Unique Type Identification:	2WREP
Serial Number:	19
Hardware Version:	B
Software Version:	Issue 1 – modified for test coverage
FCC ID Number:	E862WREP
Country of Manufacture:	Malacca
Date of Receipt:	04 June 2007

2.2. Accessories

No accessories were supplied with the EUT.

2.3. Description of EUT

The equipment under test is a Radio repeater and Message Relay Device.

2.4. Modifications Incorporated in EUT

During the course of testing the EUT was not modified.

2.5. Additional Information Related to Testing

Power Supply Requirement:	Internal battery supply of 3 V		
Intended Operating Environment:	Residential Commercial Light Industry		
Equipment Category:	802.15.4		
Type of Unit:	Base Station (Fixed Use) Transceiver		
Transmit Frequency Range:	2.405 GHz to 2.480 GHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (GHz)**
	Bottom	1	2.405
	Middle	9	2.445
	Top	16	2.480
Maximum Peak Power Output (EIRP)	14.1 dBm		

3. Test Results

Reference:	FCC Part 15.247: 2006 Subpart C
Title:	Code of Federal Regulations, Part 15.247 (47CFR22) (Intentional Radiators operating within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz)

3.1. Methods and Procedures

The methods and procedures used were as detailed in:

ANSI/TIA-603-B-2003
Land Mobile Communications Equipment, Measurements and performance Standards

ANSI C63.2 (1987)
Title: American National Standard for Instrumentation - Electromagnetic noise and field strength.

ANSI C63.4 (2003)
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.

3.2. 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

There were no deviations from the test specification.

5. Operation of the EUT during Testing

5.1. Operating Modes

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

Transmit Mode only.

5.2. Configuration and Peripherals

The EUT was tested in the following configuration:

EUT was tested in a stand alone configuration, without support equipment.

6. Summary of Test Results

Range of Measurements	Specification Reference	Port Type	Compliancy Status
Transmitter Minimum 6 dB Bandwidth	C.F.R. 47 FCC Part 15: 2006 Section 15.247(a)(2)	Antenna	Complied
Transmitter 20 dB Bandwidth	C.F.R. 47 FCC Part 15: 2006 Section 2.1049	Antenna	Complied
Transmitter Peak Power Spectral Density	C.F.R. 47 FCC Part 15: 2006 Section 15.247(e)	Antenna	Complied
Transmitter Maximum Peak Output Power	C.F.R. 47 FCC Part 15: 2006 Section 15.247(b)(3)	Antenna	Complied
Transmitter Radiated Emissions	C.F.R. 47 FCC Part 15: 2006 Sections 15.247(d) & 15.209(a)	Antenna	Complied
Transmitter Band Edge Radiated Emissions	C.F.R. 47 FCC Part 15: 2006 Sections 15.247(d) & 15.209(a)	Antenna	Complied

6.1. Location of Tests

All the measurements described in this report were performed at the premises of
RFI Global Services Ltd, Ewhurst Park, Ramsdell, Basingstoke, Hampshire, RG26 5RQ, UK.

7. Measurements, Examinations and Derived Results

7.1. General Comments

This section contains test results only.

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

7.2. Test Results

7.2.1. Transmitter Minimum 6 dB Bandwidth: Section 15.247(a)(2)

The EUT was configured for 6 dB bandwidth measurements, as described in section 9 of this report.

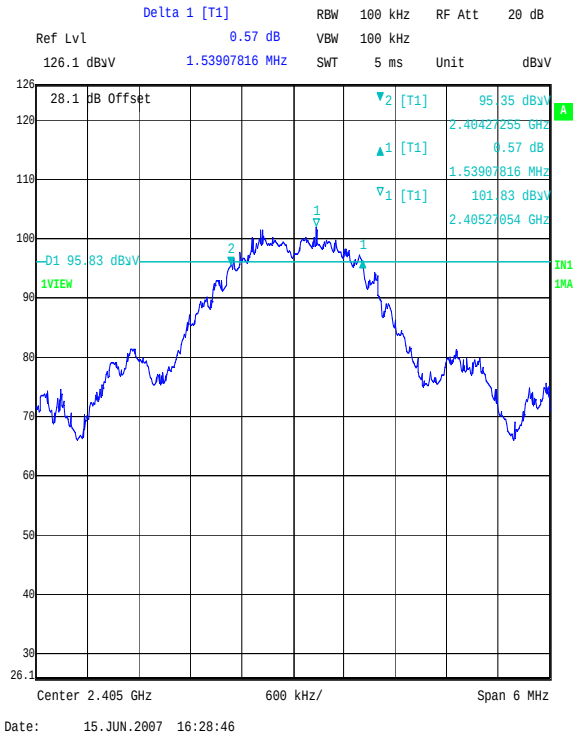
Tests were performed to identify the 6 dB bandwidth.

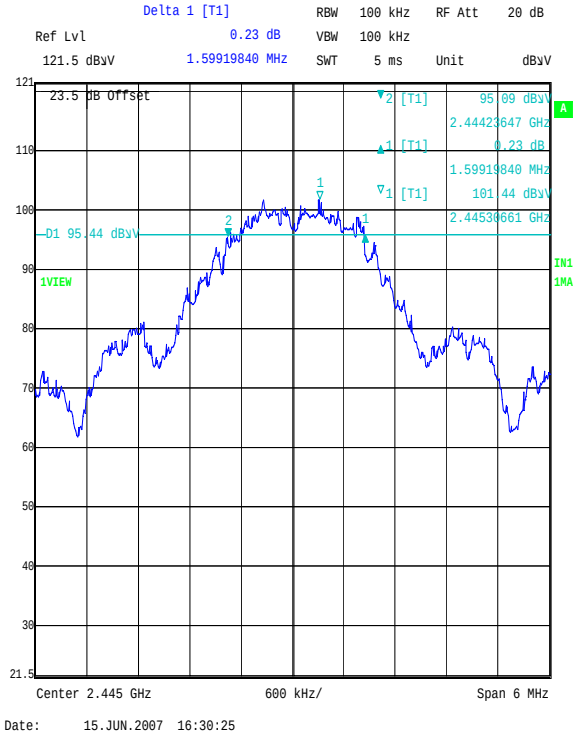
Results:

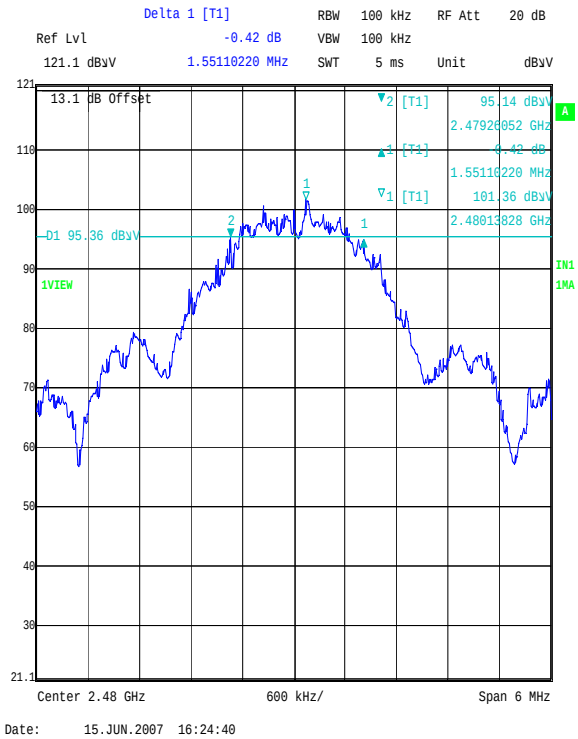
Channel	Transmitter 6 dB Bandwidth (MHz)	Limit (MHz)	Margin (MHz)	Result
Bottom	1.539078	≥ 0.5	1.039078	Complied
Middle	1.599198	≥ 0.5	1.099198	Complied
Top	1.551102	≥ 0.5	1.051102	Complied

Test of: Multitone Electronics Plc
EkoTek - Repeater
To: FCC Part 15.247: 2006 (Subpart C)

Transmitter Minimum 6 dB Bandwidth: Section 15.247(a)(2) (Continued)







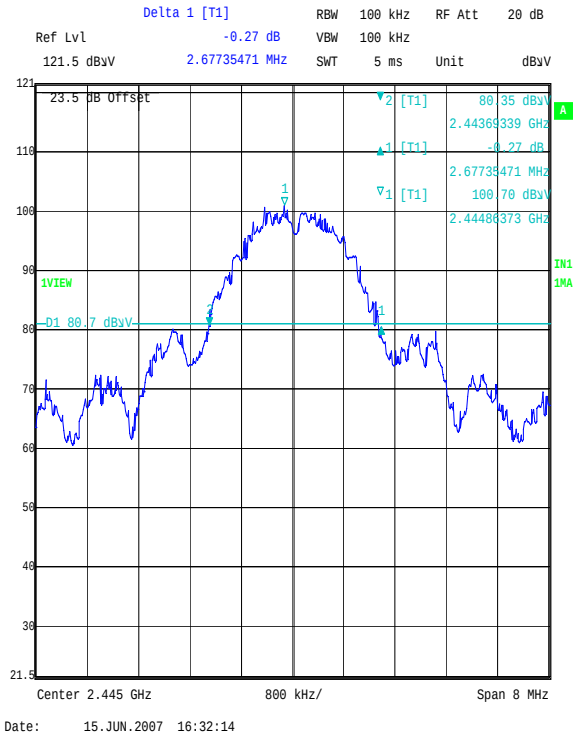
7.2.2. Transmitter 20 dB Bandwidth: Section 2.1049

The EUT was configured for 20 dB bandwidth measurements as described in section 9 of this report.

Tests were performed to identify the 20 dB bandwidth.

Results:

Transmitter 20 dB Bandwidth (MHz)
2.677355



7.2.3. Transmitter Peak Power Spectral Density: Section 15.247(e)

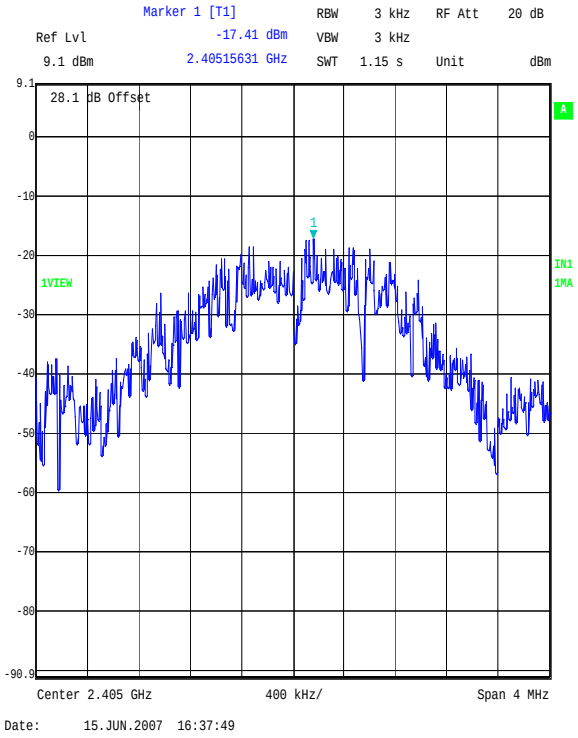
The EUT was configured for transmitter peak power spectral density measurements, as described in section 9 of this report.

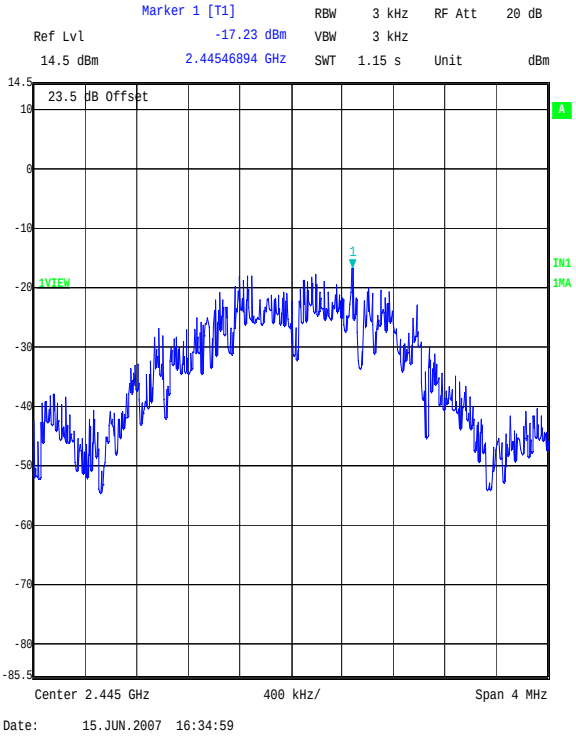
Tests were performed to identify the transmitter peak power spectral density.

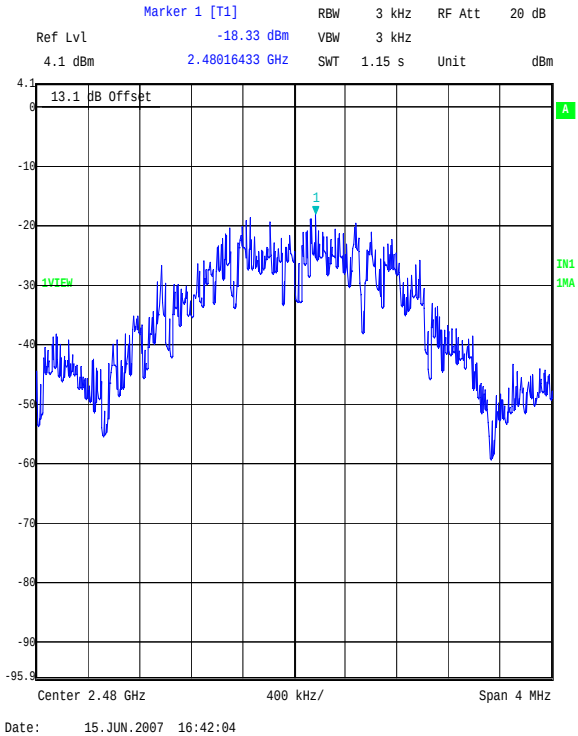
Results:

Channel	Output Power (dBm / 3 kHz)	Limit (dBm / 3 kHz)	Margin (dB)	Result
Bottom	-17.4	8.0	25.4	Complied
Middle	-17.2	8.0	25.2	Complied
Top	-18.3	8.0	26.3	Complied

Transmitter Peak Power Spectral Density: Section 15.247(e) (Continued)







7.2.4. Transmitter Maximum Peak Output Power: (EIRP) Section 15.247(b)(3)

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

Tests were performed to identify the transmitter maximum peak output power (EIRP) of the EUT.

Results:

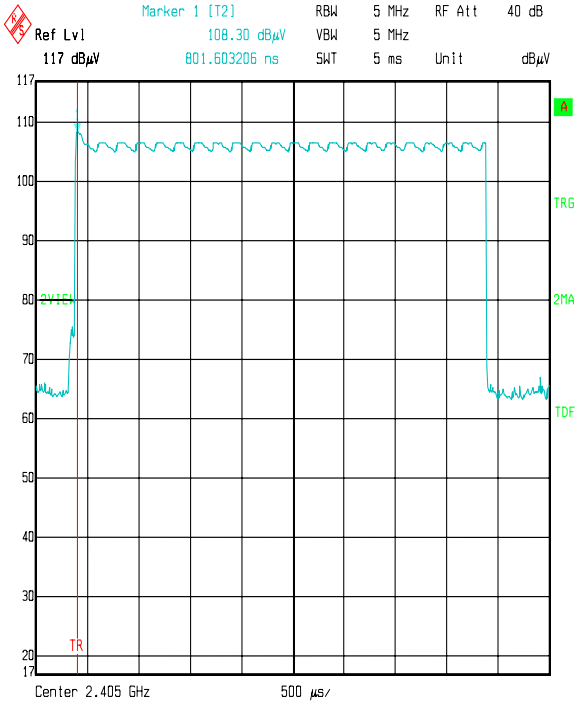
Battery Powered Devices

Channel	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	13.1	30.0	16.9	Complied
Middle	14.1	30.0	15.9	Complied
Top	13.4	30.0	16.6	Complied

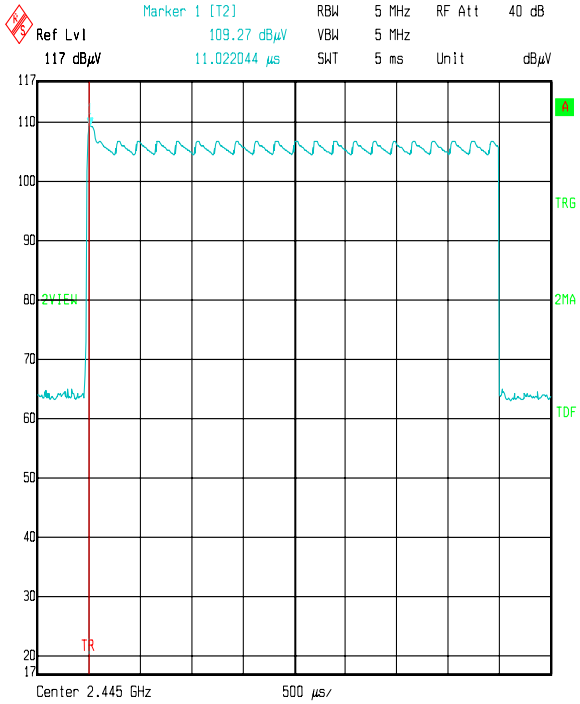
Note(s):

1. *These tests were performed radiated; therefore the EUT antenna gain is encompassed in the final result and not measurable.*

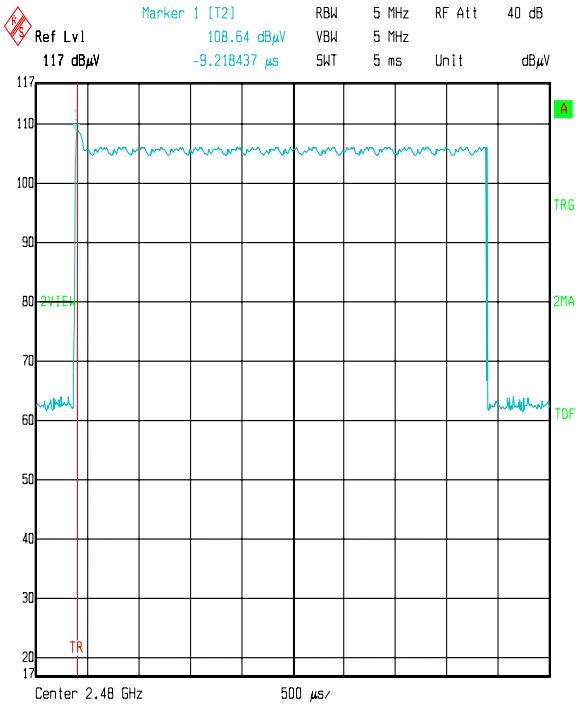
Transmitter Maximum Peak Output Power: (EIRP) Section 15.247(b)(3) (Continued)



Date: 06.JUN.2007 11:02:08



Date: 06.JUN.2007 10:37:23



Date: 06.JUN.2007 11:07:05

Note: Due to the pulsing nature of the transmit signal, the EIRP was measured in a zero-Hz span, to allow an accurate maximisation of the EUT position to be performed and to allow measurement of the pulse at the start of the burst.

7.2.5. Transmitter Radiated Emissions: Section 15.247(d) and 15.209(a)

The EUT was configured for radiated emission testing as described in section 9 of this report.

Tests were performed to identify the maximum transmitter radiated emission levels.

Results:

Electric Field Strength Measurements: 30 MHz to 1000 MHz (emissions occurring in the restricted bands)

Top Channel

Frequency (MHz)	Antenna Polarity	Q-P Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
614.000	Horizontal	33.0	46.0	13.0	Complied

Note(s):

1. *No emissions were observed above the system noise floor, therefore the highest level of noise was measured with a peak detector and compared to the quasi-peak limit.*

7.2.6. Transmitter Radiated Emissions: Section 15.247(d) and 15.209(a)

The EUT was configured for radiated emission testing, as described in section 9 of this report.

Tests were performed to identify the maximum transmitter radiated emission levels.

Results:

Electric Field Strength Measurements: 30 MHz to 1000 MHz (emissions outside the restricted bands)

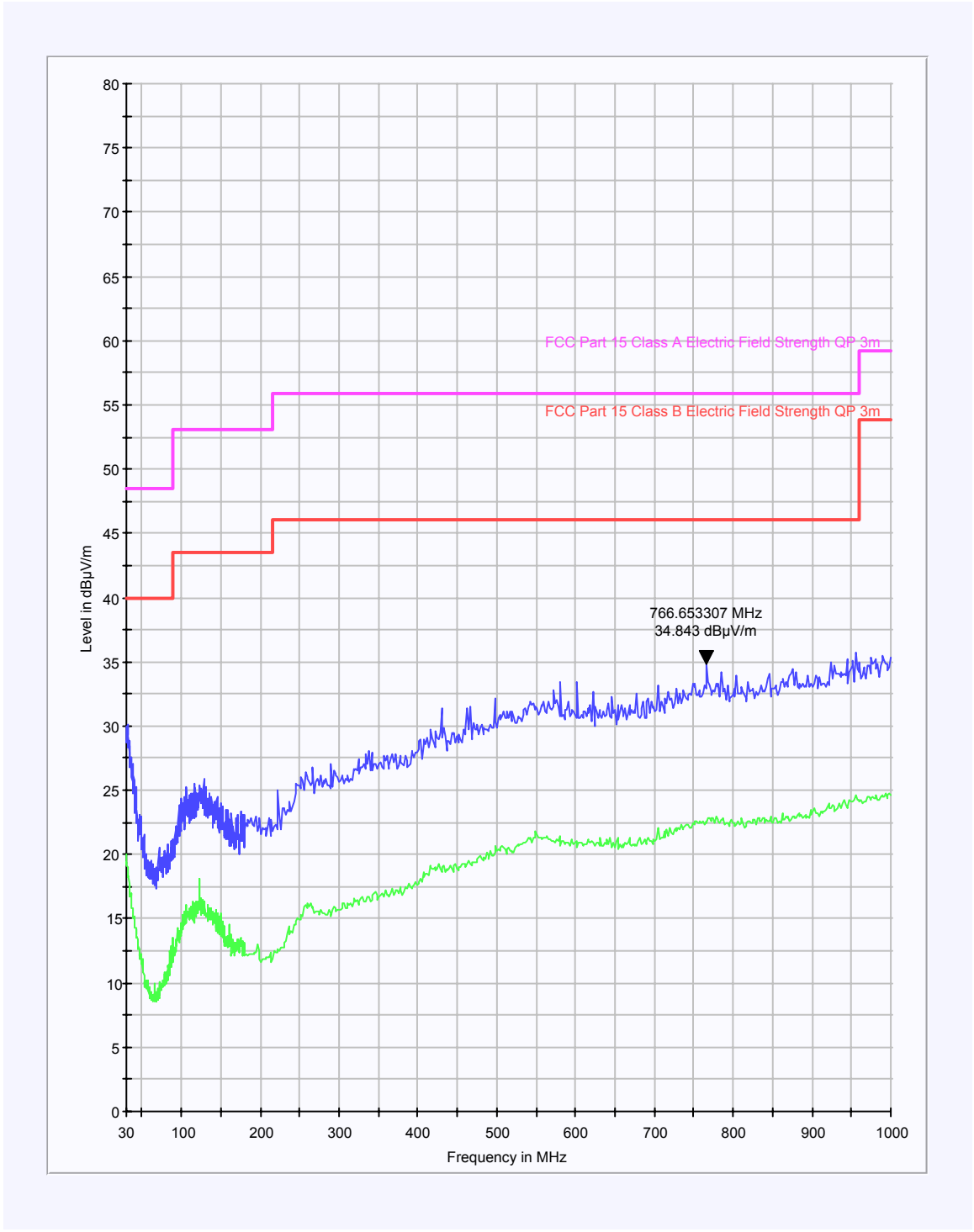
Top Channel

Frequency (MHz)	Antenna Polarity	Peak Level (dBμV/m)	-20 dBc Limit (dBμV/m)	Margin (dB)	Result
766.653	Horizontal	34.8	79.6	44.8	Complied

Note(s):

1. *No emissions were observed above the system noise floor, therefore the highest level of noise was measured with a peak detector and compared to the peak limit.*

Transmitter Radiated Emissions: Section 15.247(d) and 15.209(a) (Continued)



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.

7.2.7. Transmitter Radiated Emissions: Section 15.247(d) and 15.209(a)

The EUT was configured for radiated emission testing, as described in section 9 of this report.

Tests were performed to identify the maximum transmitter radiated emission levels.

Results:

Electric Field Strength Measurements (Frequency Range: 1 GHz to 25 GHz)
(emissions occurring in the restricted bands)

Highest Peak Level: Bottom Channel

Frequency (GHz)	Antenna Polarity	Detector Level (dBμV)	Transducer Factor (dB)	Actual Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2.328089	Vertical	53.8	-6.5	47.3	74.0	26.7	Complied
2.352795	Vertical	62.2	-6.5	55.7	74.0	18.3	Complied
4.809619	Vertical	68.1	-5.3	62.8	74.0	11.2	Complied
4.889779	Vertical	70.7	-5.0	65.7	74.0	8.3	Complied
4.961923	Vertical	68.9	-4.7	64.2	74.0	9.8	Complied
7.333426	Vertical	61.6	-0.2	61.4	74.0	12.6	Complied
7.438676	Vertical	59.1	-0.6	58.5	74.0	15.5	Complied
12.22695	Vertical	53.5	5.1	58.6	74.0	15.4	Complied
12.40330	Vertical	56.2	5.3	61.5	74.0	12.5	Complied

Highest Average Level: Bottom Channel

Frequency (GHz)	Antenna Polarity	Detector Level (dBμV)	Transducer Factor (dB)	Actual Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2.328089	Vertical	35.4	-6.5	28.9	54.0	25.1	Complied
2.352795	Vertical	30.5	-6.5	24.0	54.0	30.0	Complied
4.809619	Vertical	42.9	-5.3	37.6	54.0	16.4	Complied
4.889779	Vertical	45.5	-5.0	40.5	54.0	13.5	Complied
4.961923	Vertical	43.6	-4.7	38.9	54.0	15.1	Complied
7.333426	Vertical	36.2	-0.2	36.0	54.0	18.0	Complied
7.438676	Vertical	35.2	-0.6	34.6	54.0	19.4	Complied
12.22695	Vertical	31.4	5.1	36.5	54.0	17.5	Complied
12.40330	Vertical	32.7	5.3	38.0	54.0	16.0	Complied

Transmitter Radiated Emissions: Section 15.247(d) and 15.209(a) (Continued)

Highest Peak Level: Middle Channel

Frequency (GHz)	Antenna Polarity	Detector Level (dBμV)	Transducer Factor (dB)	Actual Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2.328089	Vertical	53.8	-6.5	47.3	74.0	26.7	Complied
2.352795	Vertical	62.2	-6.5	55.7	74.0	18.3	Complied
4.809619	Vertical	68.1	-5.3	62.8	74.0	11.2	Complied
4.889779	Vertical	70.7	-5.0	65.7	74.0	8.3	Complied
4.961923	Vertical	68.9	-4.7	64.2	74.0	9.8	Complied
7.333426	Vertical	61.6	-0.2	61.4	74.0	12.6	Complied
7.438676	Vertical	59.1	-0.6	58.5	74.0	15.5	Complied
12.22695	Vertical	53.5	5.1	58.6	74.0	15.4	Complied
12.40330	Vertical	56.2	5.3	61.5	74.0	12.5	Complied

Highest Average Level: Middle Channel

Frequency (GHz)	Antenna Polarity	Detector Level (dBμV)	Transducer Factor (dB)	Actual Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2.328089	Vertical	35.4	-6.5	28.9	54.0	25.1	Complied
2.352795	Vertical	30.5	-6.5	24.0	54.0	30.0	Complied
4.809619	Vertical	42.9	-5.3	37.6	54.0	16.4	Complied
4.889779	Vertical	45.5	-5.0	40.5	54.0	13.5	Complied
4.961923	Vertical	43.6	-4.7	38.9	54.0	15.1	Complied
7.333426	Vertical	36.2	-0.2	36.0	54.0	18.0	Complied
7.438676	Vertical	35.2	-0.6	34.6	54.0	19.4	Complied
12.22695	Vertical	31.4	5.1	36.5	54.0	17.5	Complied
12.40330	Vertical	32.7	5.3	38.0	54.0	16.0	Complied

Transmitter Radiated Emissions: Section 15.247(d) and 15.209(a) (Continued)

Highest Peak Level: Top Channel

Frequency (GHz)	Antenna Polarity	Detector Level (dBμV)	Transducer Factor (dB)	Actual Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2.328089	Vertical	53.8	-6.5	47.3	74.0	26.7	Complied
2.352795	Vertical	62.2	-6.5	55.7	74.0	18.3	Complied
4.809619	Vertical	68.1	-5.3	62.8	74.0	11.2	Complied
4.889779	Vertical	70.7	-5.0	65.7	74.0	8.3	Complied
4.961923	Vertical	68.9	-4.7	64.2	74.0	9.8	Complied
7.333426	Vertical	61.6	-0.2	61.4	74.0	12.6	Complied
7.438676	Vertical	59.1	-0.6	58.5	74.0	15.5	Complied
12.22695	Vertical	53.5	5.1	58.6	74.0	15.4	Complied
12.40330	Vertical	56.2	5.3	61.5	74.0	12.5	Complied

Highest Average Level: Top Channel

Frequency (GHz)	Antenna Polarity	Detector Level (dBμV)	Transducer Factor (dB)	Actual Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2.328089	Vertical	35.4	-6.5	28.9	54.0	25.1	Complied
2.352795	Vertical	30.5	-6.5	24.0	54.0	30.0	Complied
4.809619	Vertical	42.9	-5.3	37.6	54.0	16.4	Complied
4.889779	Vertical	45.5	-5.0	40.5	54.0	13.5	Complied
4.961923	Vertical	43.6	-4.7	38.9	54.0	15.1	Complied
7.333426	Vertical	36.2	-0.2	36.0	54.0	18.0	Complied
7.438676	Vertical	35.2	-0.6	34.6	54.0	19.4	Complied
12.22695	Vertical	31.4	5.1	36.5	54.0	17.5	Complied
12.40330	Vertical	32.7	5.3	38.0	54.0	16.0	Complied

7.2.8. Transmitter Radiated Emissions: Section 15.247(d) and 15.209(a)(Continued)

The EUT was configured for radiated emission testing, as described in section 9 of this report.

Tests were performed to identify the maximum transmitter radiated emission levels.

Results:

Electric Field Strength Measurements (Frequency Range: 1 GHz to 25 GHz)
(emissions outside the restricted bands)

Highest Peak Level: Bottom Channel

Frequency (GHz)	Antenna Polarity	Detector Level (dBμV)	Transducer Factor (dB)	Actual Level (dBμV/m)	-20 dBc Limit (dBμV/m)	Margin (dB)	Result
2.548941	Vertical	54.7	-8.6	46.1	79.6	33.5	Complied
2.553556	Vertical	53.9	-8.6	45.3	79.6	34.3	Complied
2.627749	Vertical	49.3	-9.1	40.2	79.6	39.4	Complied
7.214428	Vertical	59.1	0.2	59.3	79.6	20.3	Complied
9.778055	Vertical	49.9	3.5	53.4	79.6	26.2	Complied
9.922344	Vertical	54.4	3.4	57.8	79.6	21.8	Complied
14.66683	Vertical	44.6	6.4	51.0	79.6	28.6	Complied
14.88326	Vertical	47.0	5.9	52.9	79.6	26.7	Complied

Highest Peak Level: Middle Channel

Frequency (GHz)	Antenna Polarity	Detector Level (dBμV)	Transducer Factor (dB)	Actual Level (dBμV/m)	-20 dBc Limit (dBμV/m)	Margin (dB)	Result
2.548941	Vertical	54.7	-8.6	46.1	80.3	34.2	Complied
2.553556	Vertical	53.9	-8.6	45.3	80.3	35.0	Complied
2.627749	Vertical	49.3	-9.1	40.2	80.3	40.1	Complied
7.214428	Vertical	59.1	0.2	59.3	80.3	21.0	Complied
9.778055	Vertical	49.9	3.5	53.4	80.3	26.9	Complied
9.922344	Vertical	54.4	3.4	57.8	80.3	22.5	Complied
14.66683	Vertical	44.6	6.4	51.0	80.3	29.3	Complied
14.88326	Vertical	47.0	5.9	52.9	80.3	27.4	Complied

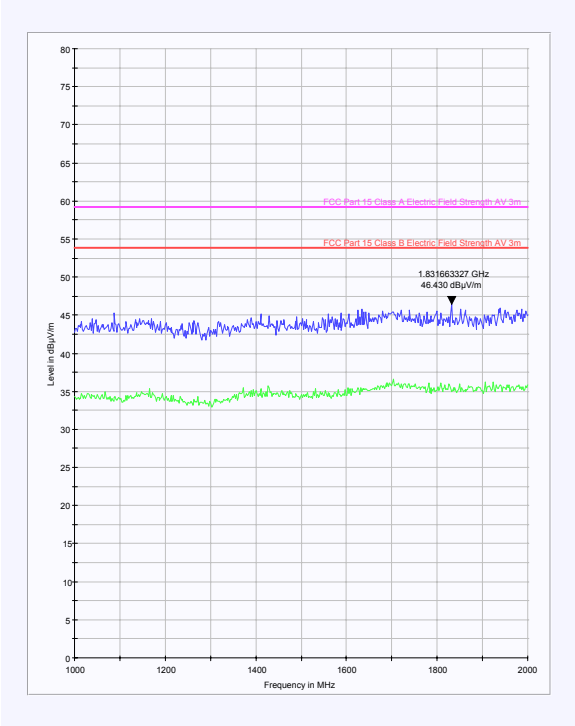
Transmitter Radiated Emissions: Section 15.247(d) and 15.209(a)(Continued)

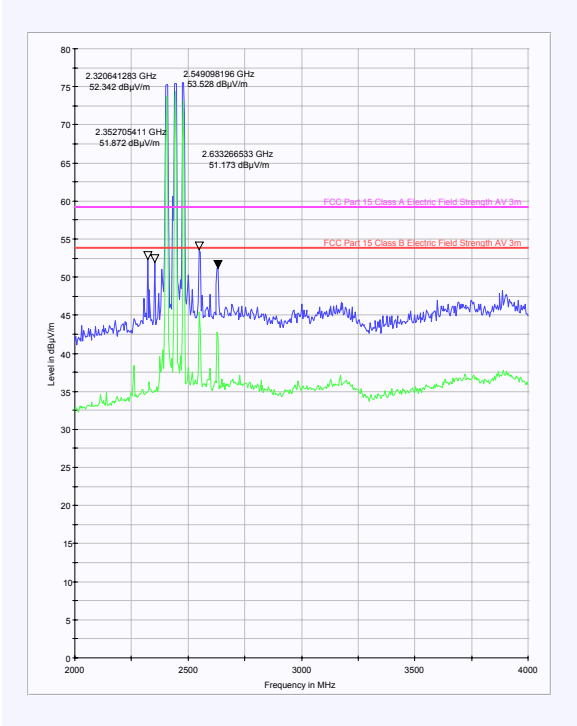
Highest Peak Level: Top Channel

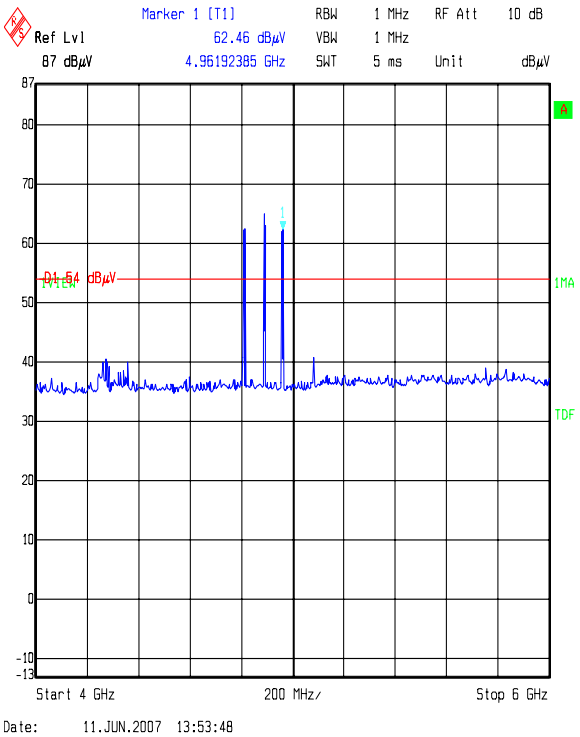
Frequency (GHz)	Antenna Polarity	Detector Level (dBμV)	Transducer Factor (dB)	Actual Level (dBμV/m)	-20 dBc Limit (dBμV/m)	Margin (dB)	Result
2.548941	Vertical	54.7	-8.6	46.1	79.8	33.7	Complied
2.553556	Vertical	53.9	-8.6	45.3	79.8	34.5	Complied
2.627749	Vertical	49.3	-9.1	40.2	79.8	39.6	Complied
7.214428	Vertical	59.1	0.2	59.3	79.8	20.5	Complied
9.778055	Vertical	49.9	3.5	53.4	79.8	26.4	Complied
9.922344	Vertical	54.4	3.4	57.8	79.8	22.0	Complied
14.66683	Vertical	44.6	6.4	51.0	79.8	28.8	Complied
14.88326	Vertical	47.0	5.9	52.9	79.8	26.9	Complied

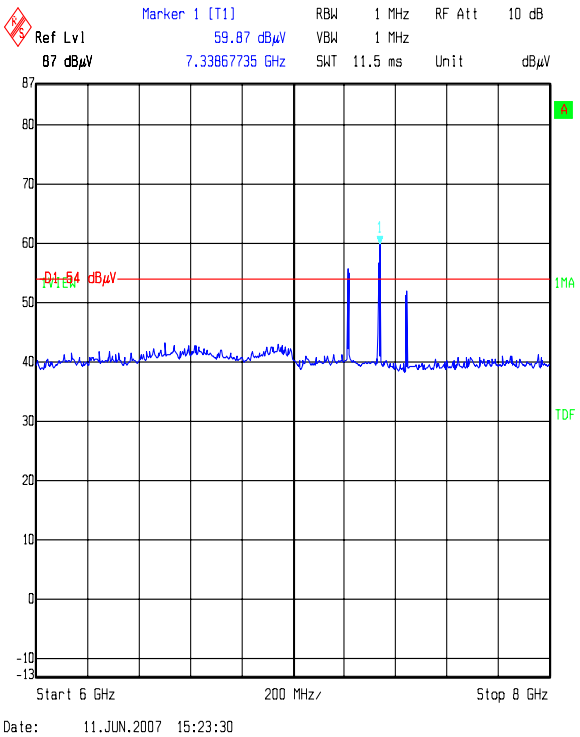
Test of: Multitone Electronics Plc
EkoTek - Repeater
To: FCC Part 15.247: 2006 (Subpart C)

Transmitter Radiated Emissions: Section 15.247(d) and 15.209(a) (Continued)





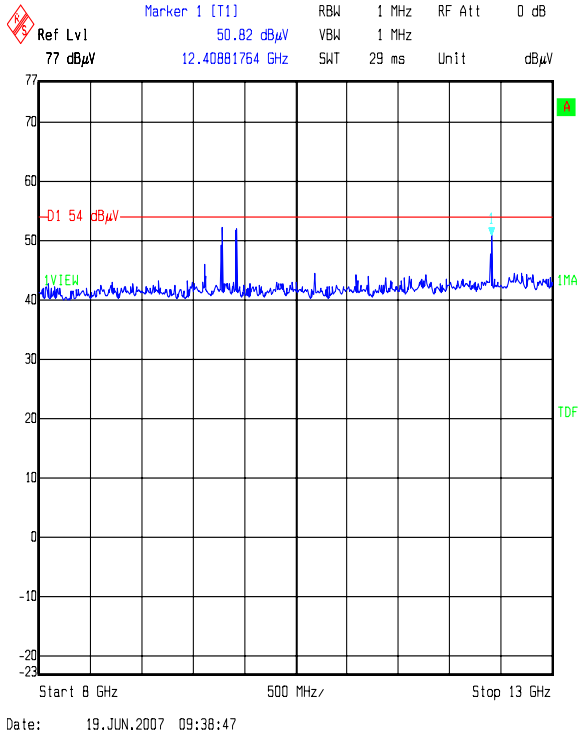


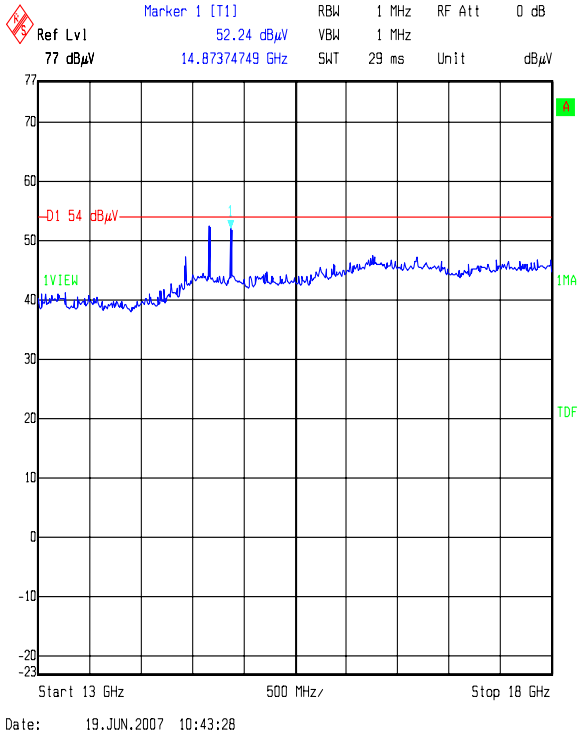


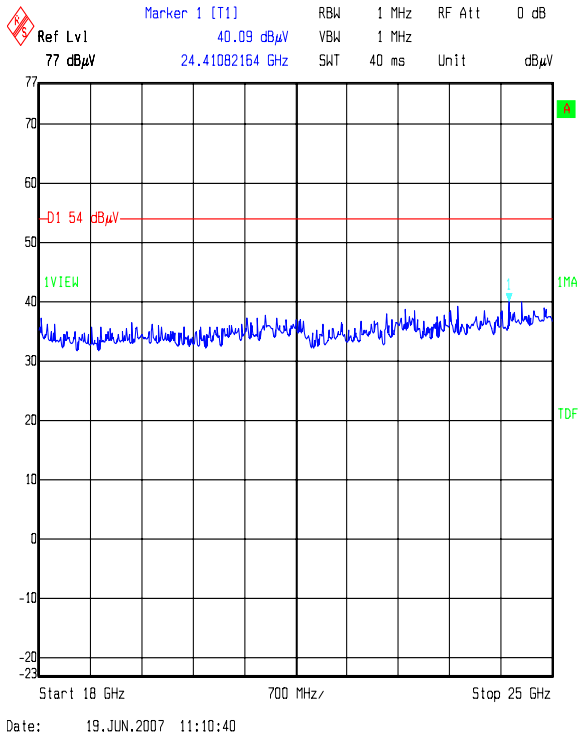
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Test of: **Multitone Electronics Plc**
EkoTek - Repeater
To: **FCC Part 15.247: 2006 (Subpart C)**

Transmitter Radiated Emissions: Section 15.247(d) and 15.209(a) (Continued)







Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.

7.2.9. Transmitter Band Edge Radiated Emissions: Section 15.247(d) & 15.209(a)

The EUT was configured for band edge compliance of radiated emission measurements, as described in section 9 of this report.

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

Results:

Electric Field Strength Measurements

Peak Power Level:

Frequency (GHz)	Antenna Polarity	Detector Level (dBμV)	Transducer Factor (dB)	Actual Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2.4000	Vertical	62.1	-6.5	55.6	78.6	23.0	Complied
2.4835	Vertical	57.5	-8.0	49.5	74.0	24.5	Complied

Note(s):

1. *The limit at 2.400 GHz is -20 dBc because it is not within a restricted band.*
2. *The limit at 2.4835 GHz is the FCC part 15.209 limit because it is within a restricted band.*

7.2.10. Transmitter Band Edge Radiated Emissions: Section 15.247(d) & 15.209(a)

The EUT was configured for band edge compliance of radiated emission measurements, as described in section 9 of this report.

Tests were performed to identify the average radiated band edge emissions.

Results:

Average Power Level:

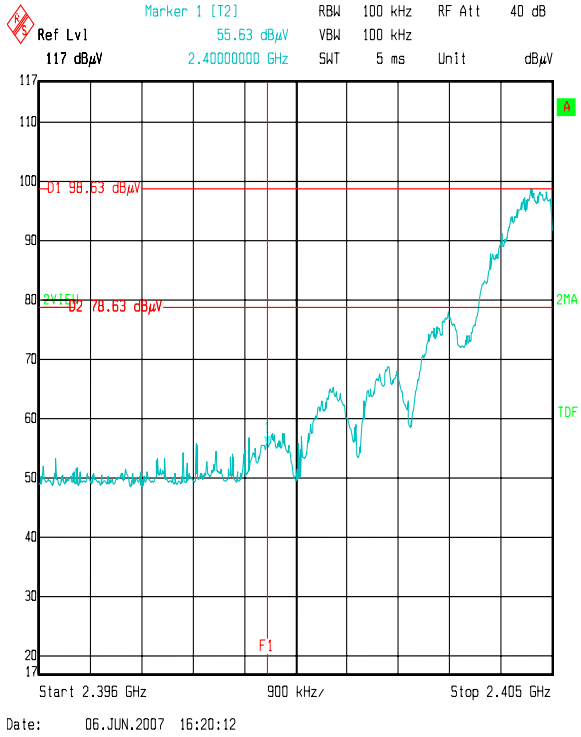
Frequency (GHz)	Antenna Polarity	Detector Level (dBμV)	Transducer Factor (dB)	Actual Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2.4835	Vertical	45.7	-8.0	37.7	54.0	16.3	Complied

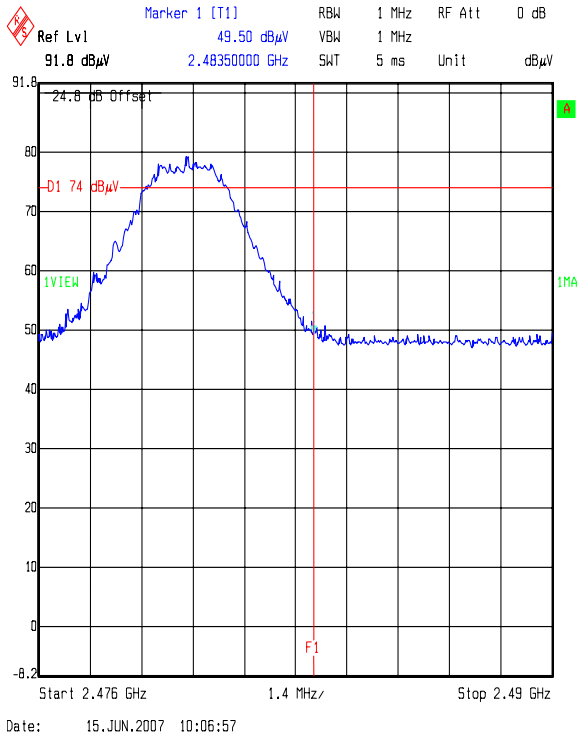
Note(s):

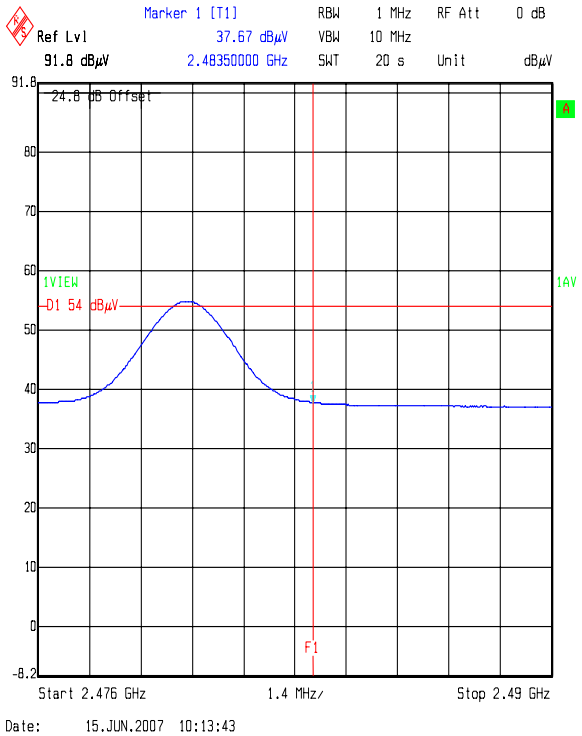
1. *The limit at 2.4835 GHz is the FCC part 15.209 limit because it is within a restricted band.*

Test of: Multitone Electronics Plc
EkoTek - Repeater
To: FCC Part 15.247: 2006 (Subpart C)

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







8. Measurement Uncertainty

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.

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

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

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 MHz	95%	+/- 3.25 dB
Transmitter Maximum Peak Output Power	Not applicable	95%	+/- 0.46 dB
Conducted Emissions Antenna Port	30 MHz to 40 GHz	95%	+/- 1.2 dB
Spectral Power Density	Not applicable	95%	+/- 1.2 dB
6 dB/20 dB Bandwidth	Not applicable	95%	+/- 0.12 %
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	+/- 5.26 dB
Radiated Spurious Emissions	1 GHz to 40 GHz	95%	+/- 1.78 dB

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.

9. Measurement Methods

9.1. Radiated 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 on which the EUT should be re-measured in full on the open area test site. In order to minimise the time taken for the swept measurements, a peak detector was used in conjunction with the appropriate detector IF measuring bandwidth (see table below). Repetitive scans were performed to allow for emissions with low repetition rates.

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

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.

For the final measurements the EUT was arranged on a non-conducting turn table on a standard test site compliant with ANSI C63.4 – 2003 Clause 5.4.

All measurements on the open area test site were performed using broadband antennas in both vertical and horizontal polarisations.

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.

Radiated Emissions (Continued)

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 limits as stated in section 15.33

The final field strength was determined as the indicated level in dBμV plus cable loss and antenna factor.

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

Receiver Function	Initial Scan	Final Measurements <1 GHz	Final Measurements ≥1 GHz
Detector Type:	Peak	Quasi-Peak (CISPR)	Peak / Average
Mode:	Max Hold	Not applicable	Max Hold
Bandwidth:	(120 kHz <1 GHz) (1 MHz ≥1 GHz)	120 kHz	1 MHz
Amplitude Range:	100 dB	100 dB	100 dB
Step Size:	Continuous sweep	Not applicable	Not applicable
Sweep Time:	Coupled	Not applicable	Not applicable

9.2. Minimum 6 dB Bandwidth

The EUT and spectrum analyser were configured as for radiated measurements.

To determine the 6 dB bandwidth, a resolution bandwidth of 100 kHz was used, which is approximates to 1% of the 6 dB bandwidth. A video bandwidth of 100 kHz was used. The analyser was set to a span of 6 MHz which is greater than twice the 6 dB bandwidth and for a maximum hold scan to capture the profile of the signal. The peak level was then determined, and a reference established 6 dB below the peak level. The bandwidth was determined at the points where the 6 dB reference crossed the profile of the emission.

9.3. Transmitter 20 dB Bandwidth

The EUT and spectrum analyser was configured as for transmitter radiated measurements.

To determine the occupied bandwidth, a resolution bandwidth of 100 kHz was used, which is greater than 1% of the 20 dB bandwidth. A video bandwidth of a least the same value was used. The analyser was set for a maximum hold scan to capture the profile of the signal. The peak level was then determined, and a reference line was drawn 20 dB below the peak level. The bandwidth was determined at the points where the 20 dB reference crossed the profile of the emission.

9.4. Spectral Power Density

The EUT and spectrum analyser were configured as for conducted antenna port emissions measurements.

Prior to testing being performed a suitable RF attenuator and cables were calibrated for the required frequencies. For each frequency 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.

Prior to the measurement being taken the spectrum analyser was tuned to the fundamental frequency of the EUT.

A resolution bandwidth of 3 kHz was selected and the analyser was set to a span greater than twice the 6 dB bandwidth. The trace was max held and a reading was taken at the peak point of the trace.

9.5. Peak Output Power

The EUT and spectrum analyser were configured as for conducted antenna port emissions measurements.

Prior to testing being performed a suitable RF attenuator and cables 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 spectrum analyser 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 spectrum analyser, using a suitable resolution bandwidth.

9.6. Band Edge Compliance of RF Radiated Emissions

The EUT and spectrum analyser were configured as for radiated measurements.

To determine band edge compliance, the analyser resolution bandwidth was set to >= 1% of the analyser span. The video bandwidth was set to be ≥ to 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 lower band edge of the allocated frequency band was produced. A marker was set to the level of the highest in band emission with a limit line set to 20 dB below this. The 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 upper band edge except that, as the upper band edge fell on a restricted band edge (as defined in section 15.205(a)), the limit for the restricted band was applied instead of the 20 dBc limit i.e. the general limits defined in section 15.209(a).

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

9.7. Effective Radiated Power (ERP)

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

The ERP was measured with the EUT arranged on a non-conducting turn table on a standard test site compliant with ANSI C63.4 – 2003 Clause 5.4. The transmitter was fitted with an integral antenna; as such all radiated tests were performed with the unit operating into the integral antenna.

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

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

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

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

ERP = Signal Generator Level - Cable Loss + Antenna Gain

Effective Radiated Power (ERP) (Continued)

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

Delta (dB) = EUT – SG

Where :

EUT = spectrum analyser indicated EUT raw level

SG = spectrum analyser indicated signal generator raw level

The signal generator actual ERP is calculated as:

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

The EUT ERP is calculated as:

ERP EUT = ERP SG + Delta.

The test equipment settings for ERP measurements were as follows:

Receiver Function	Setting
Detector Type:	Peak
Mode:	Not applicable
Bandwidth:	≥ Emission Bandwidth
Amplitude Range:	100 dB
Sweep Time:	Coupled

Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
A028	Horn Antenna	Eaton	91888-2	304	08 Jun 2006	36
A031	Horn Antenna	Eaton	91889-2	557	08 Jun 2006	36
A1362	Horn Antenna	Stoddart Aircraft Radio Co., Inc.	91889-1	N/A	08 Jun 2006	12
A1534	Preamplifier	Hewlett Packard	8449B OPT H02	3008A00405	Cal before use	-
A253	Horn Antenna	Flann Microwave	12240-20	128	17 Nov 2006	36
A254	Horn Antenna	Flann Microwave	14240-20	139	17 Nov 2006	36
A255	Horn Antenna	Flann Microwave	16240-20	519	17 Nov 2006	36
A256	Horn Antenna	Flann Microwave	18240-20	400	17 Nov 2006	36
A436	Horn Antenna	Flann	20240-20	330	24 Apr 2006	36
A553	Bi-log Antenna	Chase	CBL6111A	1593	01 Nov 2006	12
C055	Cable	RFI	None	None	05 Jun 2007	12
C1065	Cable	Rosenberger	UFA210-1-7872	0985	06 Jun 2007	12
C1165	Cable	Rosenberger Micro-Coax	FA210A102000 7070	43189-1	05 Jun 2007	12
C1167	Cable	Rosenberger Micro-Coax	FA210A103000 7070	43190-01	05 Jun 2007	12
C1191	Cable	Rosenburg	FA210A1015M 3030	27141-06	Cal before use	-
C1193	Cable	Utiflex	FA147A1015M 2020A	BUA02C 0154	Cal before use	-
C151	Cable	Rosenberger	UFA210A-1-1181-70x70	None	Cal before use	-

Test Equipment Used (Continued)

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
C160	Cable	Rosenberger	UFA210A-1-1181-70x70	None	Cal before use	-
C348	Cable	Rosenberger	UFA210A-1-1181-70x70	2993	Cal before use	-
M1124	Spectrum Analyser	Rohde & Schwarz	ESIB26	100046K	08 Sep 2006	12
M1242	Spectrum Analyser	Rohde & Schwarz	FSEM30	845986_022	08 Sep 2006	12
M1263	EMI Test Receiver	Rohde & Schwarz	ESIB7	100265	25 Jan 2007	12
S202	3m OATS	RFI	2	S202-15011990	17 Nov 2006	12
S207	PMR Bench Site	RFI	7	None	No calibration	-
S212	Emissions Screened Room	RFI	12	None	No calibration	-

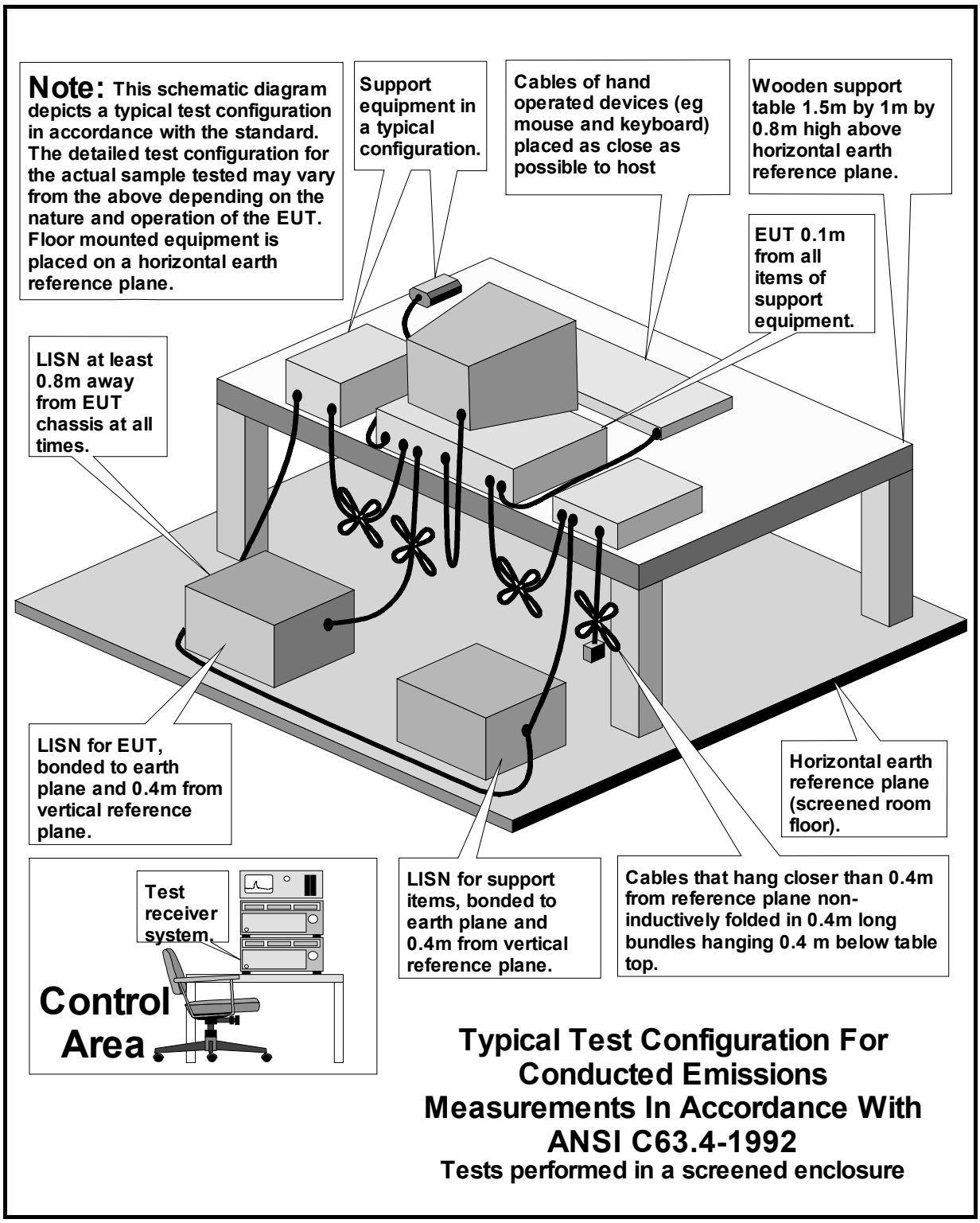
NB In accordance with UKAS requirements, all the measurement equipment is on a calibration schedule. All equipment was within calibration at the time of the test.

Appendix 2. Test Configuration Drawings

This appendix contains the following drawings:

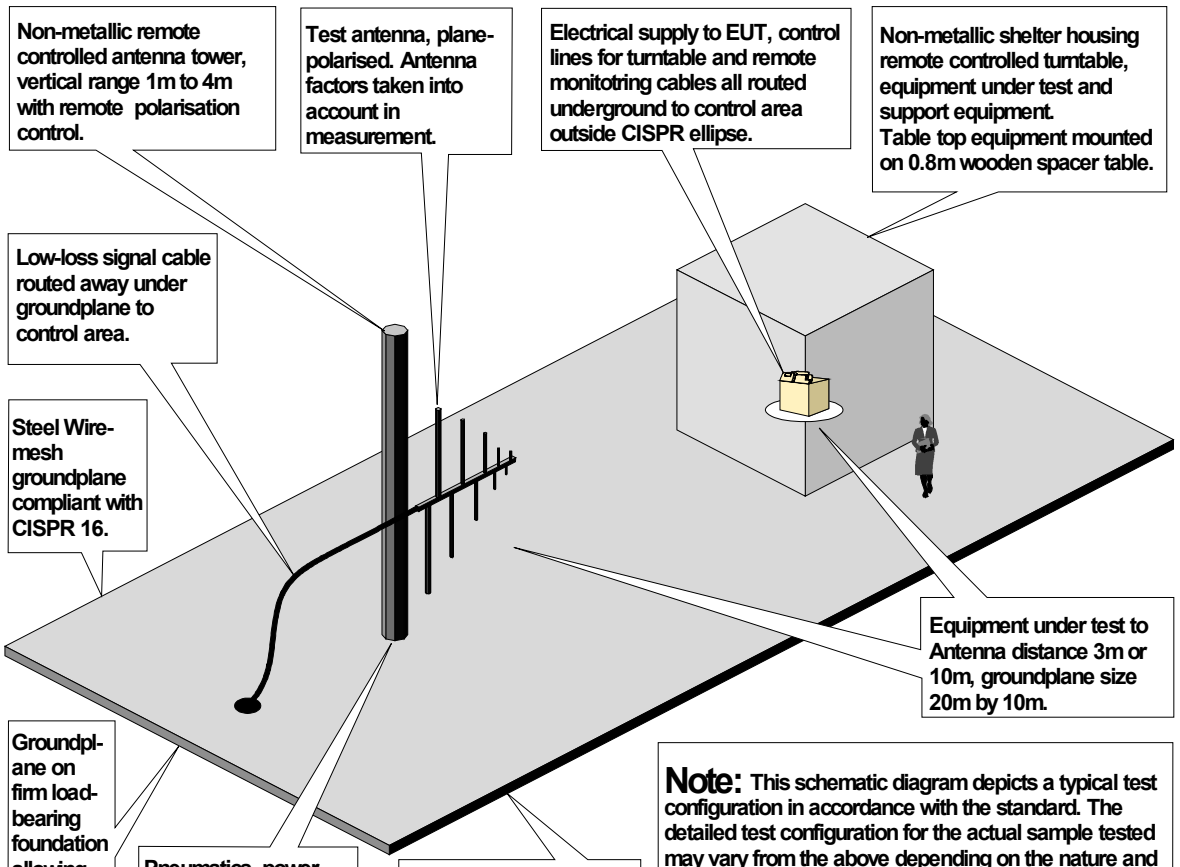
Drawing Reference Number	Title
DRG\48909JD013A\EMICON	Test configuration for measurement of conducted emissions.
DRG\48909JD013A\EMIRAD	Test configuration for measurement of radiated emissions.

DRG\48909JD013A\EMICON

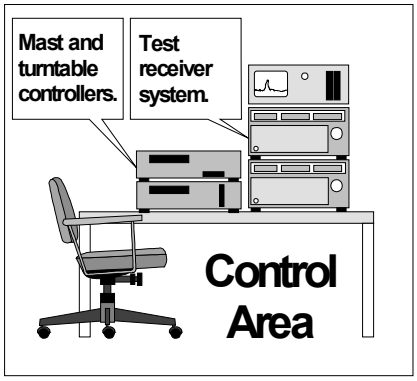


Note: This diagram is also valid for the latest version of ANSI C63.4-2003

DRG\48909JD013A\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