



Compliance Testing Report

FCC Title 47 Part 15

Subparts A & B (Class B) & C

Client:	Emotiv Systems Pty Ltd
Address:	Suite 217/10, NIC Building, Australian Technology Park 4 Cornwallis Street, Eveleigh NSW 2015, Australia
Report Number:	0319EMOEPOC(Headset)_FCC15
Date of Testing:	11 th November to 3 rd December 2009
File Number:	EMOT091013
Equipment Name:	Emotiv EPOC
Equipment Model Number:	Not Supplied
Equipment Serial Number:	Not Supplied
Equipment FCC ID:	XUE-EPOC01
Equipment Description:	Wireless EEG Headset for Computer Interface and Gaming
Result:	COMPLIES (refer to page 5)
Tested by:	Richard Turner 
Approved by:	Colin Gan 
Date of Issue:	19 Mar 2010

AUSTEST (NSW) FCC REGISTRATION NUMBER 90455

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Report Revision History:

Date	Report Number	Changes
19 Mar 2010	0319EMOEPOC(Headset)_FCC15	Original Report.

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1 TEST SUMMARY

Austest makes no claim regarding the consistency of production versions of the EUT.

The results in this report apply only to the tested EUT described in Section 3 of this report.

FCC Section	Test	Result	Notes
FCC Part 15, Subpart B – Unintentional Radiators			
15.107	Conducted Limits	COMPLIES	
15.109	Radiated Emission Limits	COMPLIES	
FCC Part 15, Subpart C – Intentional Radiators			
15.203	Antenna Requirement	COMPLIES	
15.205	Restricted Bands of Operation	COMPLIES	
15.207	Conducted Limits	COMPLIES	
15.209	Radiated Emission Limits, General Requirements	COMPLIES	(i),(ii)
15.215	Additional Provisions to the General Radiated Limitations	COMPLIES	
15.249	Operation within the Bands 902-928MHz, 2400-2483.5MHz, 5725-5875MHz, and 24.0-24.25GHz	COMPLIES	

Notes (applicable only if referenced in “Notes” column of above summary table):

- (i) EUT complies (the measurement results were below the applicable limits), but some emissions were within the range of measurement uncertainty of the limits.
- (ii) EUT complies (when modified as described in Section 2 of this report).
- (iii) There were deviations from the applied standard as described in Section 5.2 of this report.

2 MODIFICATIONS

In order to ensure operation is maintained within the 2400 to 2483.5MHz band, channel selection was restricted from CH2 to CH80.

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3 EQUIPMENT UNDER TEST (EUT) DESCRIPTION

EUT Name:	Emotiv EPOC
EUT Description:	Wireless EEG Headset
EUT Model:	Not Supplied
EUT Serial Number:	Not Supplied
EUT FCC ID:	XUE-EPOC01
Manufacturer:	Emotiv Systems
Power Supply & Rating:	Internal 3.8V Lithium battery and supplied 100-240VAC AC adaptor for charging purposes.
Highest Clock/Operating Frequency:	40MHz
Transmit Frequency Range:	2402 to 2480MHz
Transmit Power:	0dBm
Modulation Technique:	GFSK
Number of Channels:	79
Antenna Specifications:	Integral Antenna

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4 EUT TEST SETUP & CONFIGURATION

Refer to the photographs in APPENDIX C – EUT TEST SETUP PHOTOGRAPHS for the EUT test setup and physical configuration.

Details of supporting equipment and cables used are listed as follows:

4.1 Supporting Equipment

Equipment	Brand & Model
AC adaptor	UNIFIVE UN305-0505
USB dongle	Emotiv EPOC
Desktop PC	DELL Inspiron 5455
LCD Monitor	Samsung 743N
Keyboard	DELL SK-8165
Mouse	DELL OXN967

The AC adaptor is only used to charge the headset internal battery. Whilst under charge the headset is unable to transmit.

The USB dongle is connected to the desktop PC. This ensures that transmission from the headset is maintained on the selected frequency.

4.2 Cables

Connection / Port	Connecting Cable	Source / Load
Headset Charger Port	1.8m unshielded fig.8 cable, bundled	Permanently fitted to the supplied AC adaptor
Mains supply connection	Powerboard with 1m unshielded 3 core mains lead	115VAC AMN

4.3 Transmitter Test Channels

The transmitter test channels per Section 15.31(m) were:

Channel	Transmitter Frequency (MHz)
Low	2402
Mid	2442
High	2480

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5 TEST SPECIFICATIONS

5.1 Accreditations & Listings

Austest Laboratories has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules and Test Site Criteria (ANSI C63.4-2003) by the FCC Laboratory Division for Certification testing under Parts 15 or 18 of the FCC Rules.

Austest Laboratories (NSW)'s Yarramalong test facilities are listed with the FCC under Registration Number 90455.

5.2 Deviations from Standards and/or Accreditations

None.

5.3 Test Facility

Testing was performed in New South Wales at Austest Laboratories (NSW)'s Yarramalong test facilities located at 46 Glenola Farm Lane in Yarramalong Valley, New South Wales, Australia.

Radiated emission testing is performed at an Open Area Test Site (OATS), where some ambient signals may exceed the continuous disturbance limit. The possibility of missing an emission during testing is removed by use of pre-scans, performed in a shielded enclosure, prior to the final OATS measurements.

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5.4 Test Equipment

Test Equipment	Brand & Model	Cal. Due Date
EMI Receiver	HP 8574B	23 Feb 2010
Spectrum Analyser	HP 8593E	09 Oct 2010
Biconical Array Antenna	EM6912	13 Jan 2010
Log-Periodic Array Antenna	EM6950	08 Jan 2010
DRG Horn Antenna	AH Systems SAS-571	29 Dec 2011
Loop Antenna	EM-6876	09 Sep 2010
Pre-Amplifier (25MHz-1GHz)	HP 8447E	24 Feb 2010
Pre-Amplifier (1GHz-25GHz)	RE 218A	12 Oct 2010
Pre-Amplifier (4GHz- 25GHz)	RE 518A	12 Oct 2010
LISN/AMN	Compower LI-200	25 Feb 2010
10dB attenuator	Microlab	10 Jan 2010
AC Source	Chroma	-

5.5 Measurement Uncertainties

The following uncertainties are for a 95% level of confidence, based on a coverage factor, k=2.

Test	Measurement Uncertainty
Conducted Emissions (Austest NSW)	±2.6dB
Radiated Emissions (Austest NSW)	±4.7dB

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6 FCC Part 15B, Section 15.107 - CONDUCTED LIMITS

Test Date:	11 Nov 2009	Temperature:	24°C
Test Officer:	RT	Humidity:	66%
Test Location:	Austest Laboratories (NSW)		

6.1 EUT Test Operating Mode

- a. Mains power supply voltage – 115VAC 60Hz.
- b. Headset under charge.

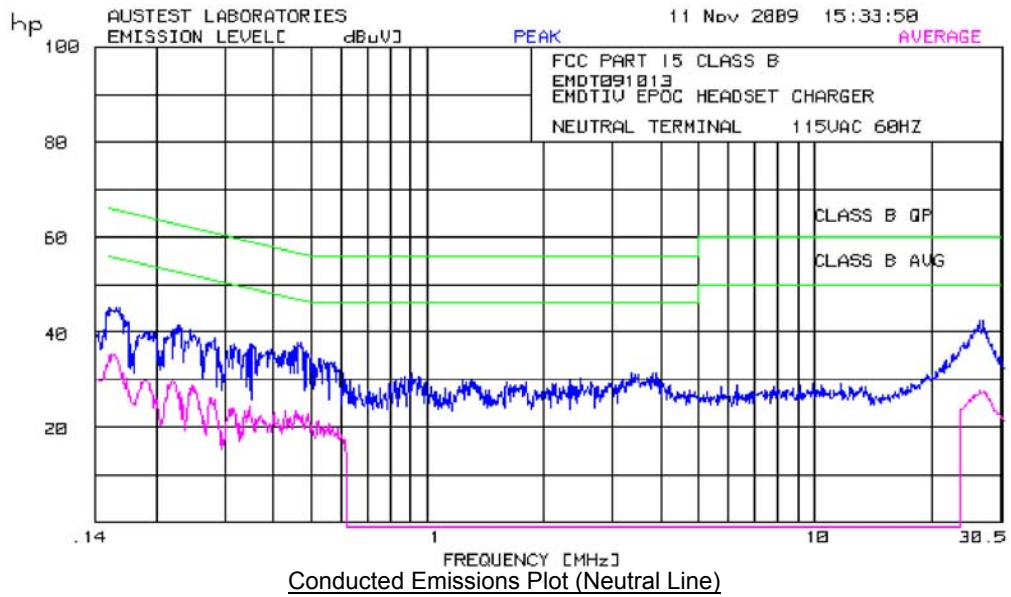
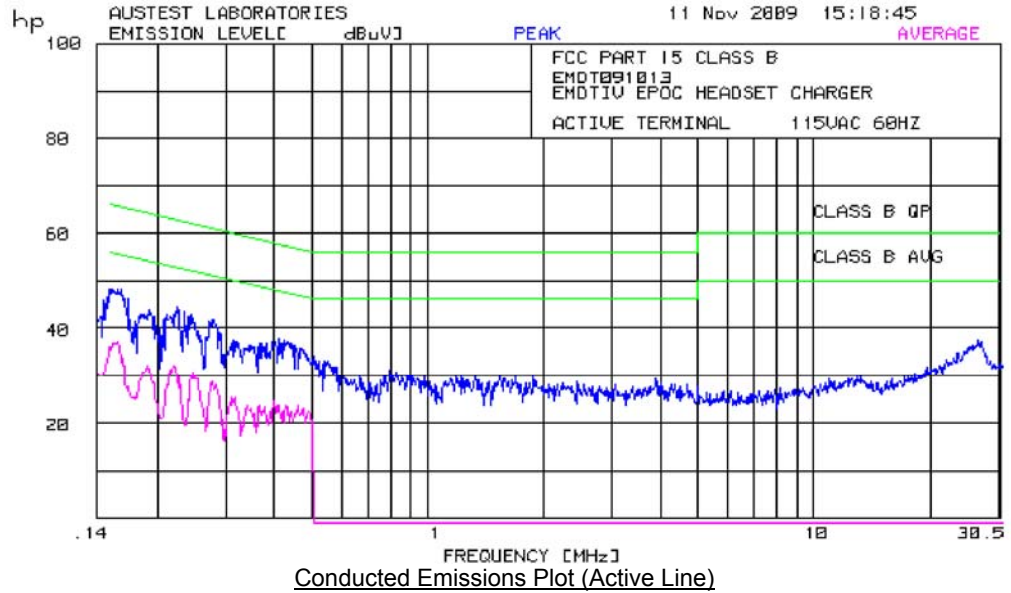
6.2 Test Method

- a. Measurements are performed in accordance with ANSI C63.4-2003.
- b. Set the EMI Receiver BW to 9kHz for the test.
- c. Set up the EUT on a non-conductive table, 0.8m above a conductive ground plane, with the rear of the whole EUT setup 0.4m away from a conductive vertical reference plane (in electrical contact with the ground plane), and 0.8m away from any other conductive surface.
- d. The EUT power is supplied through the EUT LISN. The LISN is grounded to the ground plane and kept 0.8m away from the EUT test setup.
- e. Maintain the power cable length between the EUT and the EUT LISN between 0.8m to 1m. Bundle any excess power cable lengths together in the centre of the cable to form a bundle 30cm to 40cm long.
- f. Drape all interconnection cables over the table edge and keep them at least 40cm above the ground plane. Bundle any excess cables in the centre of the cable to form a bundle 30cm to 40cm long.
- g. Conducted emission measurements are made on both Active and Neutral lines of the EUT.

6.3 Test Results

All measured disturbances were greater than 10dB below the average and quasi-peak limits.

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7 FCC Part 15B, Section 15.109 - RADIATED EMISSION LIMITS

Test Date:	17 Nov 2009	Temperature:	23°C
Test Officer:	RT	Humidity:	54%
Test Location:	Austest Laboratories (NSW)		

7.1 EUT Operating Mode

- a. Mains power supply voltage – 115VAC 60Hz.
- b. Headset under charge.

7.2 Test Method

- a. Measurements are performed in accordance with ANSI C63.4-2003.
- b. Set the measuring receiver BW settings to:
 - i. 120kHz (30MHz to 1GHz) EMI Receiver BW.
- c. Set up the EUT on a non-conductive turntable, 0.8m above the OATS conductive ground plane, and at the indicated test distance away from the measuring antenna.
- d. To maximise emissions, rotate the EUT through 360° and adjust the measuring antenna height between 1m to 4m in the following antenna orientations:
 - i. Biconical and Log-Periodic antennas (30MHz to 1GHz) - Both vertical and horizontal polarizations.
- e. Measure the maximised emission and repeat the above for all measurement frequencies.
- f. Highest frequency used in the device, disregarding the intentional 2.4GHz transmission, was 40MHz. In accordance with section 15.33 (b) (1) the upper frequency of measurement is 1GHz.
- g. Disturbances from the headset were assessed whilst under charge, this being the worse case. Under normal operation, with communication established with the USB dongle, unintentional disturbances were significantly lower in level.
- h. Unintentional radiated disturbances were measured with both the headset and Emotiv USB dongle on the test table. The USB dongle was connected to the desktop PC. To minimise disturbances after test setup the LCD monitor was switched off.

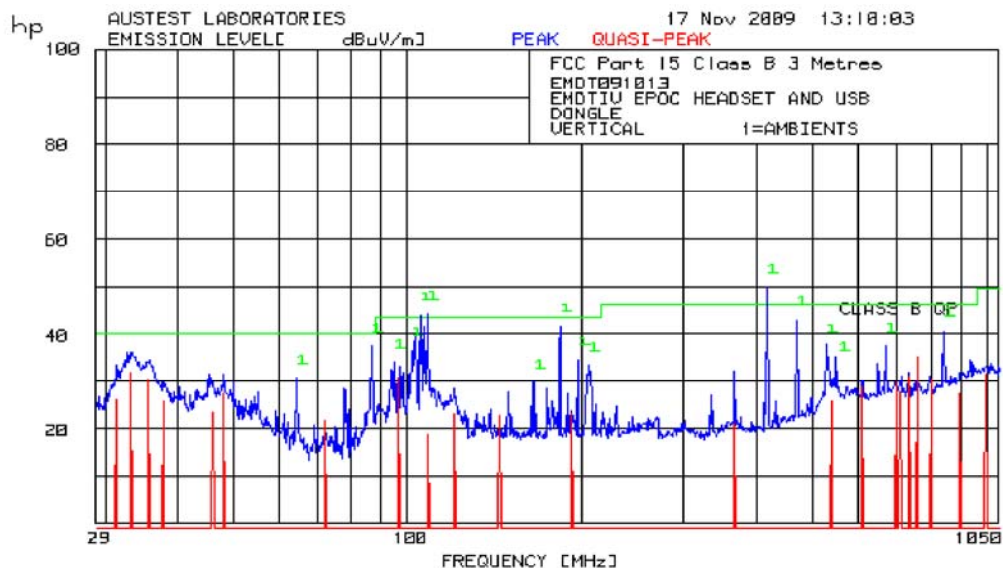
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7.3 Test Results

7.3.1 30MHz to 1000MHz

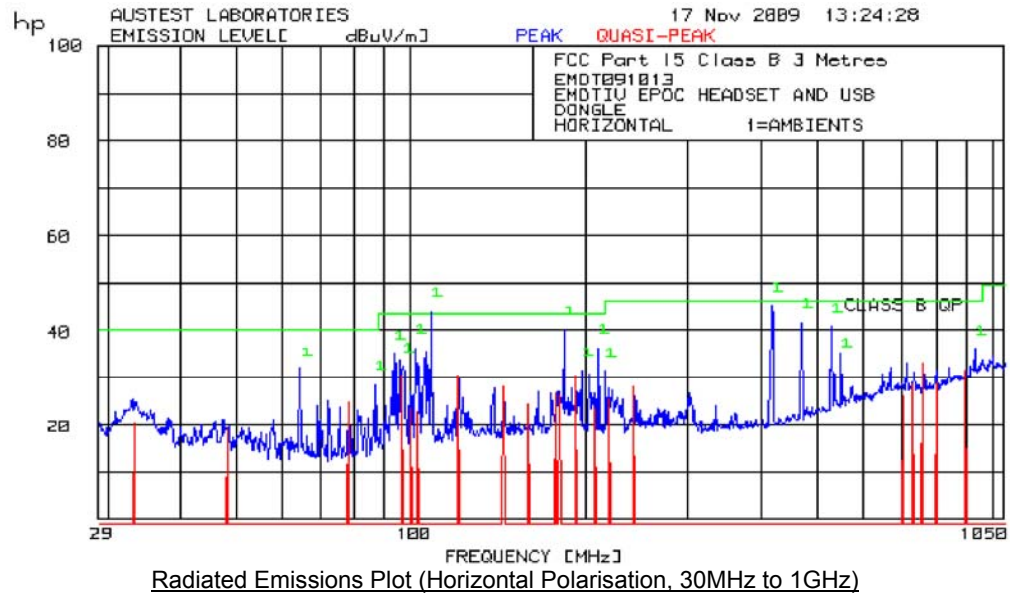
- a. The highest measured disturbance level was 38µV/m (31.7dBµV/m) at 33.2MHz.
- b. Disturbance was broadband and occurred when the headset was under charge.
- c. The 6 worst-case results are:

Frequency (MHz)	QP Level @ 3m (dBµV/m)	Antenna Pol	QP Limit @ 3m (dBµV/m)	QP Pass Margin (dB)
33.2	31.7	Vertical	40.0	-8.3
35.7	30.2	Vertical	40.0	-9.8
758.9	35.2	Vertical	46.0	-10.8
96.2	30.8	Vertical	43.5	-12.7
48.1	27.2	Vertical	40.0	-12.8
758.9	33.1	Horizontal	46.0	-12.9



Radiated Emissions Plot (Vertical Polarisation, 30MHz to 1GHz)

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8 FCC Part 15C, Section 15.203 – ANTENNA REQUIREMENT

The EUT complies with the requirement of this Section since it is “designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device”, as the antenna is an integral antenna.

9 FCC Part 15C, Section 15.205 – RESTRICTED BANDS OF OPERATION

The EUT complies with the requirements of this Section since it does not operate within the listed Restricted Bands of Operation. The EUT operates in the frequency range 2402 to 2480MHz

10 FCC Part 15C, Section 15.207 - CONDUCTED LIMITS

NOT APPLICABLE

The headset is designed so that when it is connected to the mains supply using the AC adaptor, the intentional 2.4GHz transmission is inhibited. Transmission does not occur when the headset is under charge.

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11 FCC Part 15C, Section 15.209 - RADIATED EMISSION LIMITS, GENERAL REQUIREMENTS

Test Date:	1 to 3 Dec 2009	Temperature:	28°C
Test Officer:	RT	Humidity:	48%
Test Location:	Austest Laboratories (NSW)		

11.1 EUT Operating Mode

- a. EUT power supply voltage – 3.8V internal battery.
- b. The EUT was set in transmitting mode.

11.2 Test Method

- a. Measurements are performed in accordance with ANSI C63.4-2003.
- b. Set the measuring receiver BW settings to:
 - i. 9kHz (150kHz to 30MHz) EMI Receiver BW.
 - ii. 120kHz (30MHz to 1GHz) EMI Receiver BW.
 - iii. 1MHz (above 1GHz) RBW, 3MHz VBW, using a Spectrum Analyser for Peak measurements.
 - iv. 1MHz (above 1GHz) RBW, 10Hz VBW, using a Spectrum Analyser for Average measurements.
- c. Set up the EUT on a non-conductive turntable, 0.8m above the OATS conductive ground plane, and at the indicated test distance away from the measuring antenna.
- d. To maximise emissions, rotate the EUT through 360° and adjust the measuring antenna height between 1m to 4m in the following antenna orientations:
 - i. Loop antenna (150kHz to 30MHz) – Coaxial and coplanar orientations.
 - ii. Biconical and Log-Periodic antennas (30MHz to 1GHz) - Both vertical and horizontal polarizations.
 - iii. Horn antenna (above 1GHz) - Both vertical and horizontal polarizations.
- e. Measure the maximised emission and repeat the above for all measurement frequencies.
- f. The client advised that the lowest frequency utilised by the intentional radiator was 16MHz. Measurement was made from 150kHz to 25GHz (10th harmonic)
- g. Communication was established with an Emotiv USB dongle. The USB dongle was connected to the desktop PC and placed away from the test area.

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11.3 Test Results

11.3.1 150kHz to 30MHz

All measured disturbances were greater than 10dB below the limits.

11.3.2 30MHz to 1000MHz

All measured disturbances were greater than 10dB below the limits.

11.3.3 1GHz to 25GHz

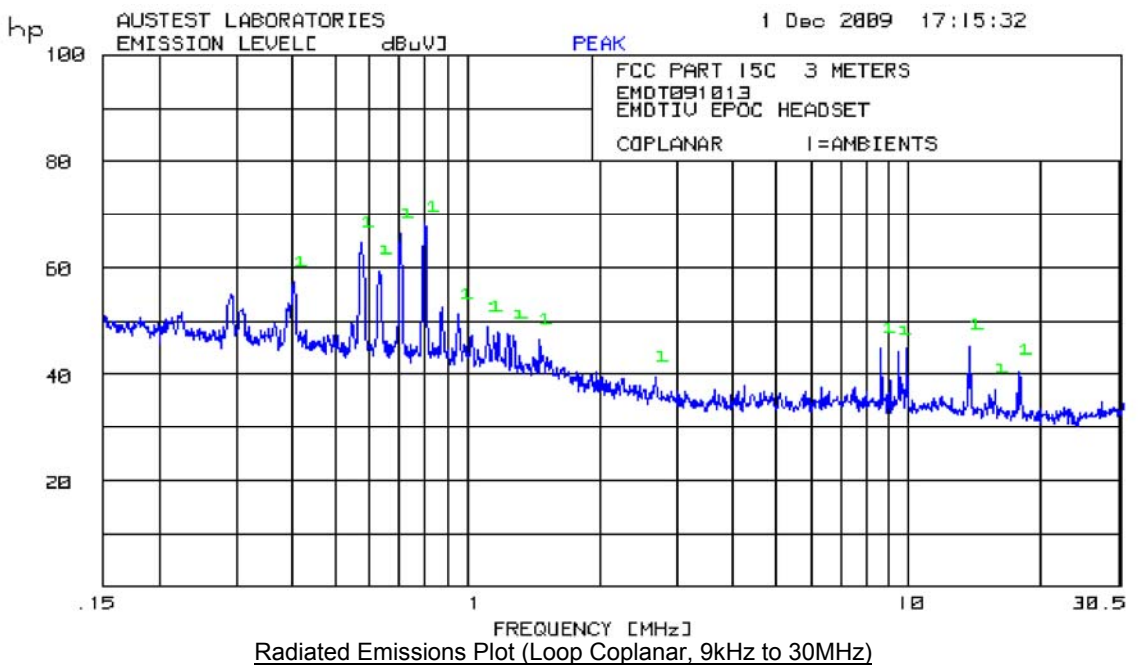
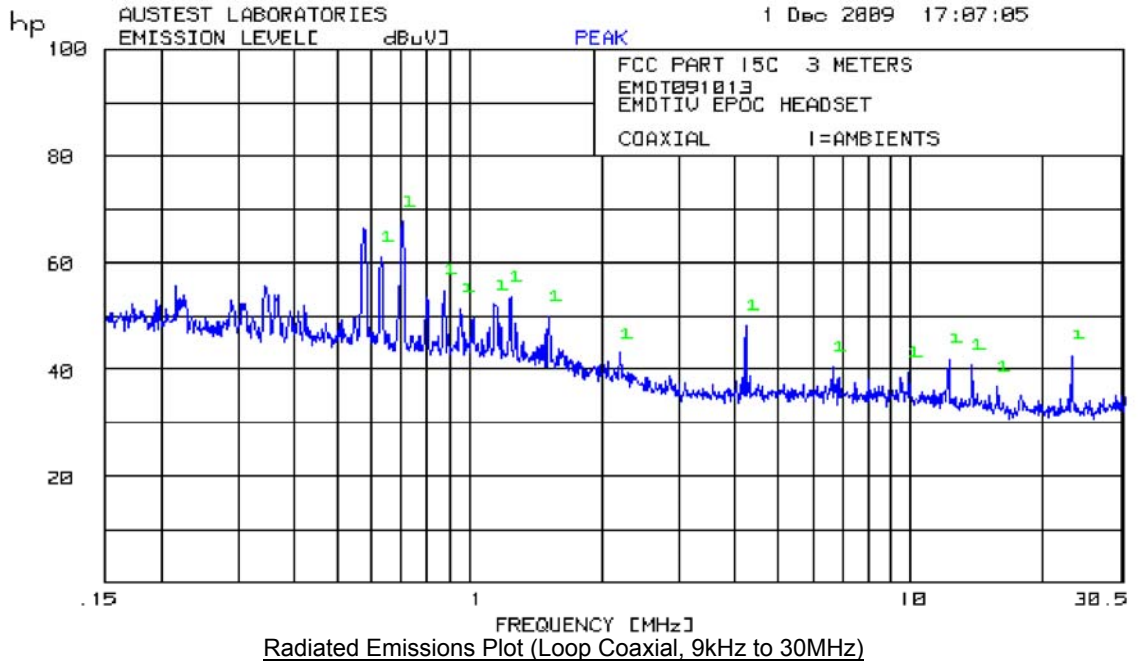
- a. The highest measured peak level was 3.3mV/m (70.3dBµV/m) at 2483.5MHz using CH80.
- b. The highest measured average level was 75µV/m (37.5dBµV/m) at 2400.0MHz using CH2.
- c. Field strength measurements were made at a 1 meter or 3 meter distance. Measurements made at a 1 meter distance were extrapolated to a 3 meter distance using an extrapolation factor of 20dB/decade as specified in section 15.31 (f) (1).
- d. Average measurements were only made when peak levels exceeded the average limit of 500µV/m.
- e. The worse case results are

Frequency (MHz)	Peak Level @ 3m (dBµV/m)	Antenna Pol	Peak Limit @ 3m (dBµV/m)	Pk Pass Margin (dB)
2483.5 (CH80)	70.3	Vertical	74.0	-3.7*
2400.0 (CH2)	70.2	Vertical	74.0	-3.8*
2400.0 (CH2)	69.1	Horizontal	74.0	-4.9
2483.5 (CH80)	64.8	Horizontal	74.0	-9.2
7439.0 (CH80)	58.0	Vertical	74.0	-16.0
7439.0 (CH80)	57.2	Horizontal	74.0	-16.8
7325.0 (CH42)	54.5	Vertical	74.0	-19.5
7325.0 (CH42)	53.9	Horizontal	74.0	-20.1

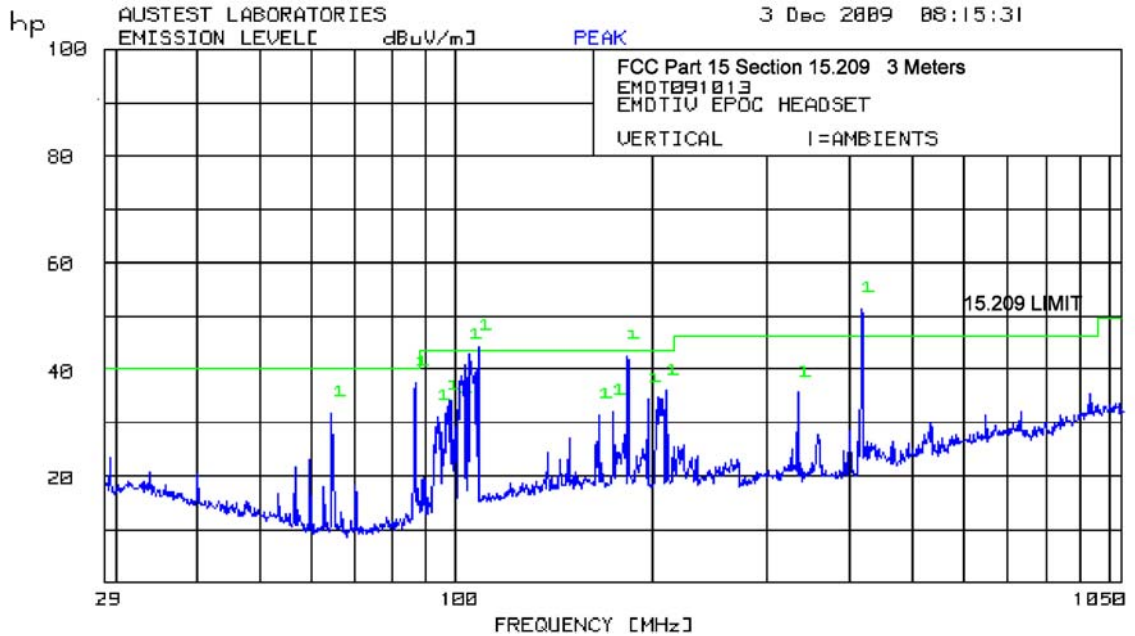
Frequency (GHz)	AV Level @ 3m (dBµV/m)	Antenna Pol	AV Limit @ 3m (dBµV/m)	AV Pass Margin (dB)
2400.0 (CH2)	37.5	Vertical	54.0	-16.5
2400.0 (CH2)	37.4	Horizontal	54.0	-16.6
2483.5 (CH80)	37.2	Vertical	54.0	-16.8
2483.5 (CH80)	37.1	Horizontal	54.0	-16.9
7439 (CH80)	31.5	Vertical	54.0	-22.5
7439 (CH80)	31.3	Horizontal	54.0	-22.7
7325 (CH42)	30.8	Vertical	54.0	-23.2

*Results were within the laboratory's measurement uncertainty.

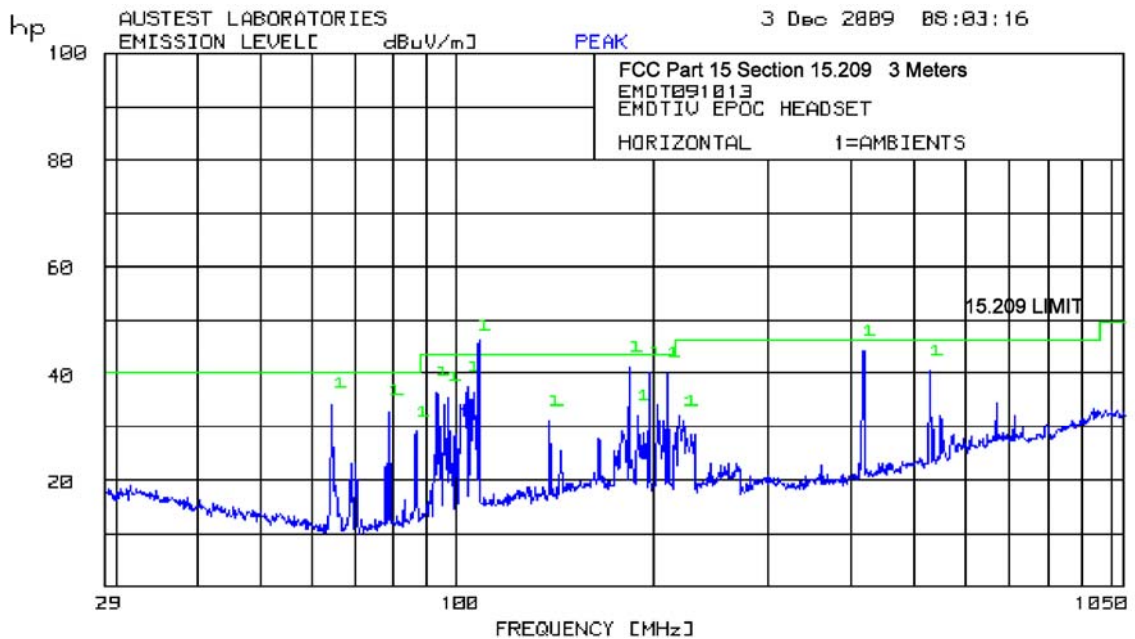
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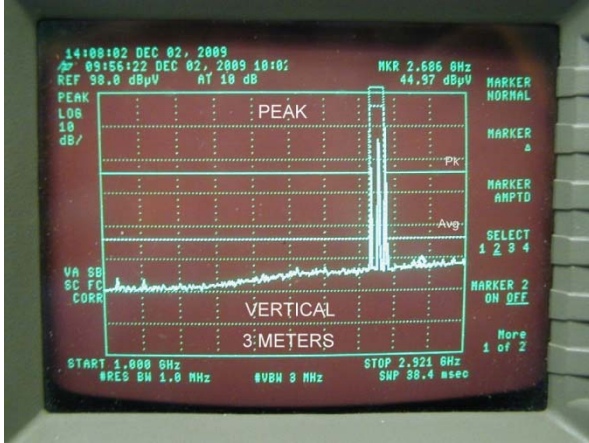


Radiated Emissions Plot (Vertical Polarisation, 30MHz to 1GHz)

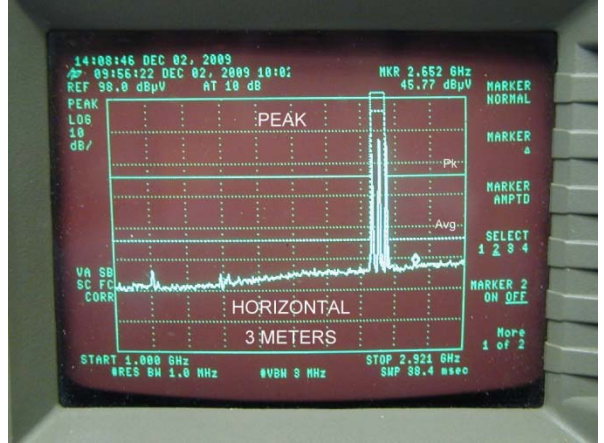


Radiated Emissions Plot (Horizontal Polarisation, 30MHz to 1GHz)

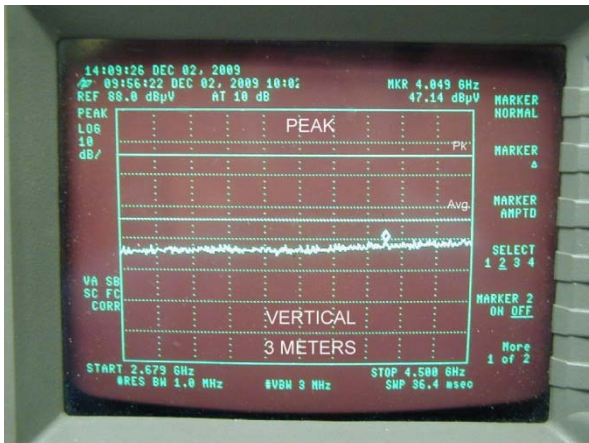
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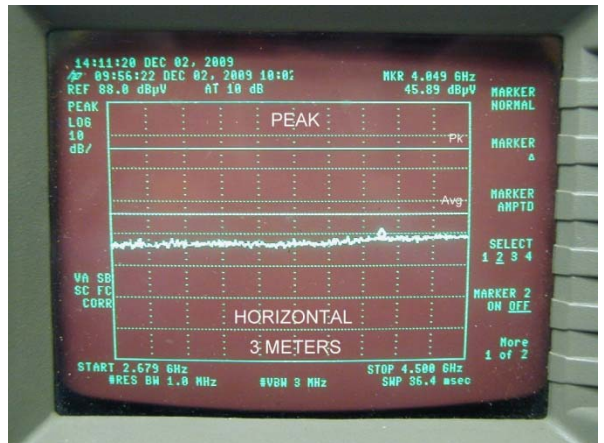
Radiated Emissions Plot (V-Pol, 1GHz-2.92GHz)



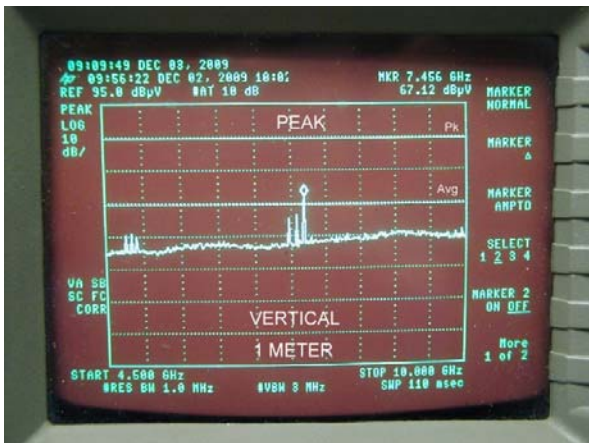
Radiated Emissions Plot (H-Pol, 1GHz-2.92GHz)



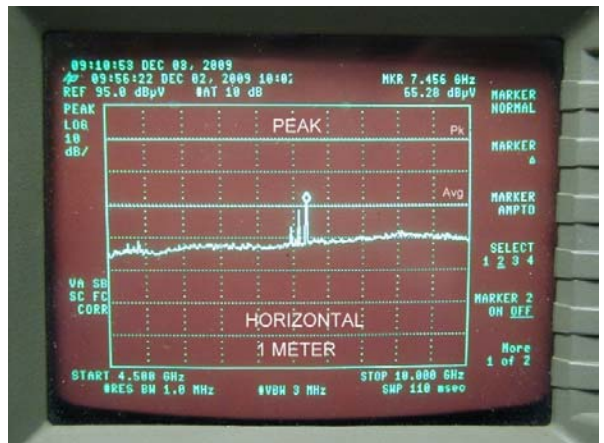
Radiated Emissions Plot (V-Pol, 2.68GHz-4.5GHz)



Radiated Emissions Plot (H-Pol, 2.68GHz-4.5GHz)

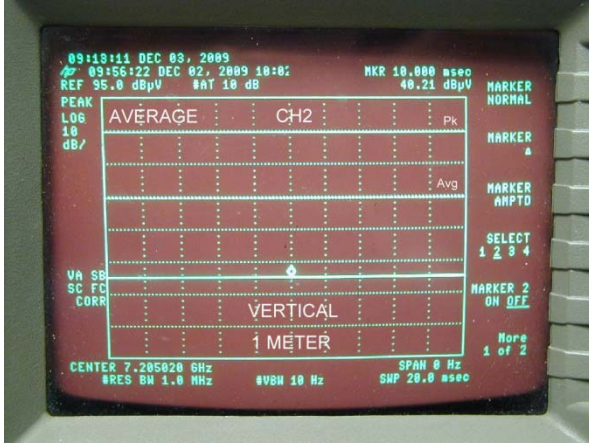


Radiated Emissions Plot (V-Pol, 4.5GHz-10GHz)

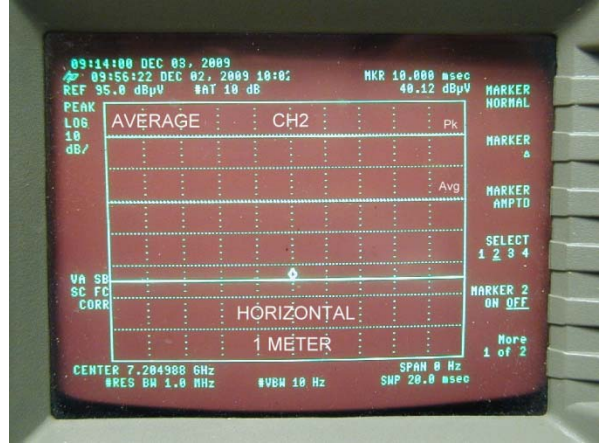


Radiated Emissions Plot (H-Pol, 4.5GHz-10GHz)

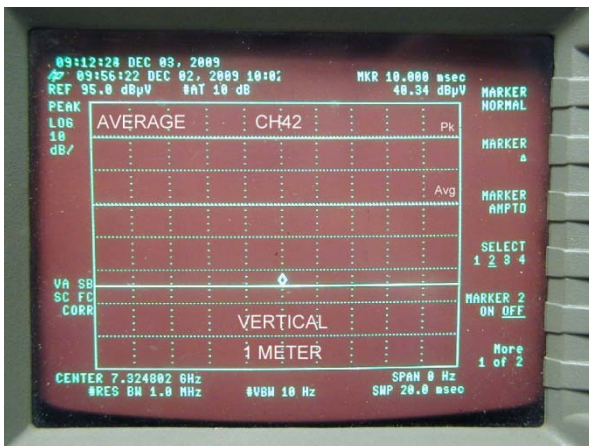
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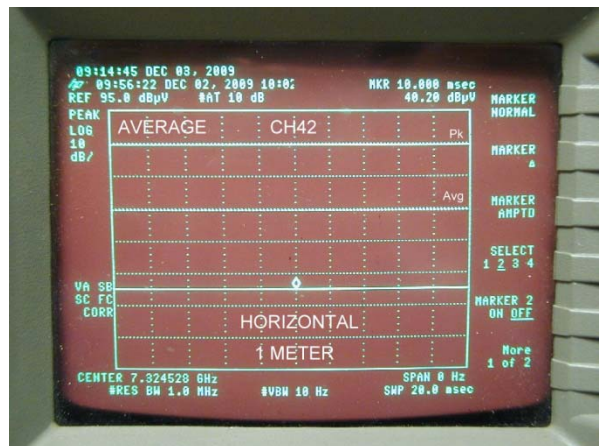
Radiated Emissions Plot (CH2 3rd Har, V-Pol, Average)



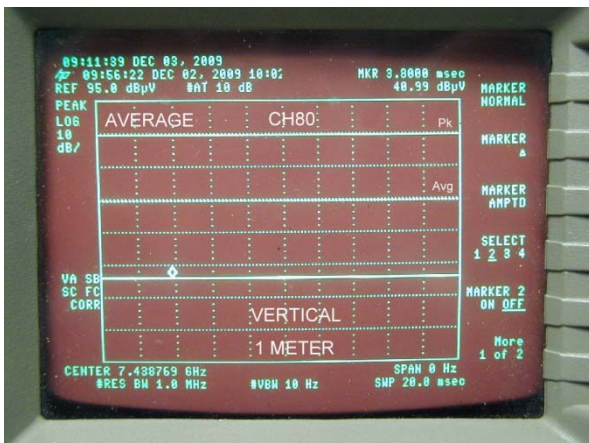
Radiated Emissions Plot (CH2 3rd Har, H-Pol, Average)



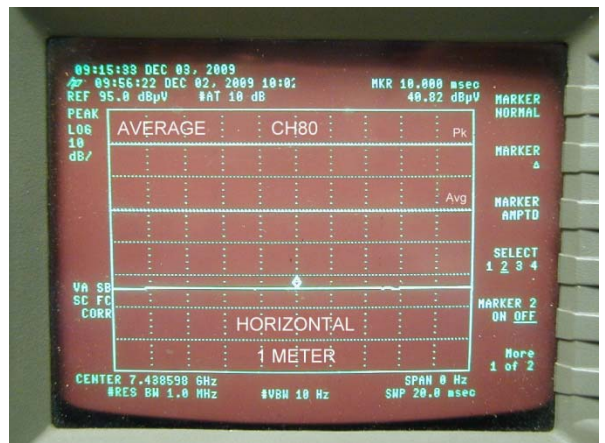
Radiated Emissions Plot (CH42 3rd Har, V-Pol, Average)



Radiated Emissions Plot (CH42 3rd Har, H-Pol, Average)

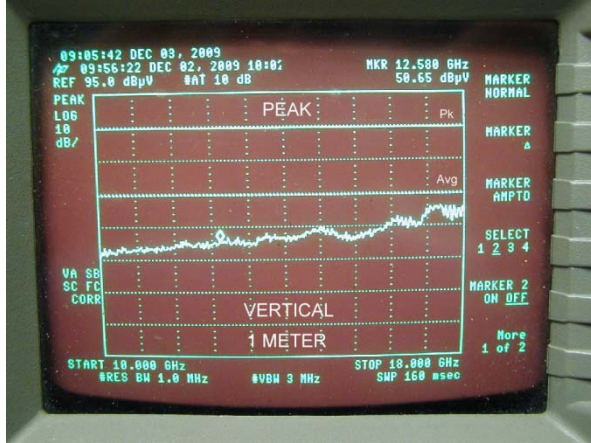


Radiated Emissions Plot (CH80 3rd Har, V-Pol, Average)



Radiated Emissions Plot (CH80 3rd Har, H-Pol, Average)

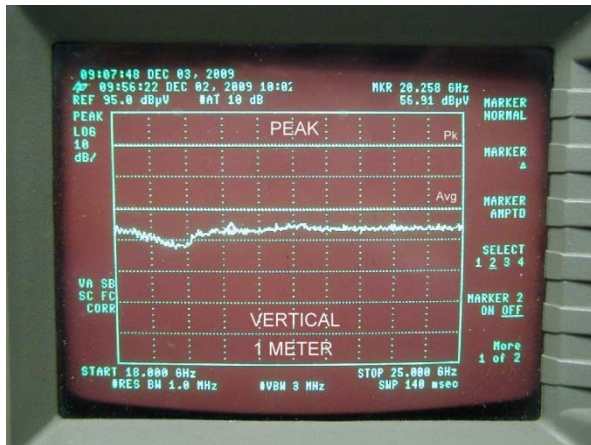
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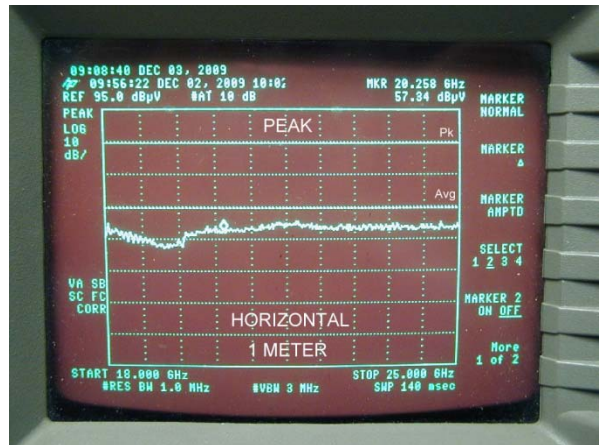
Radiated Emissions Plot (V-Pol, 10GHz-18GHz)



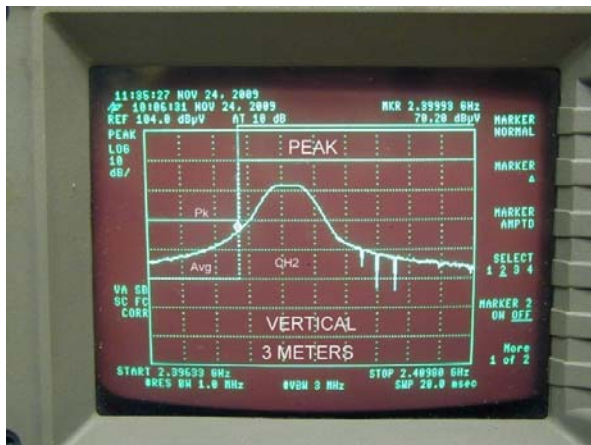
Radiated Emissions Plot (H-Pol, 10GHz-18GHz)



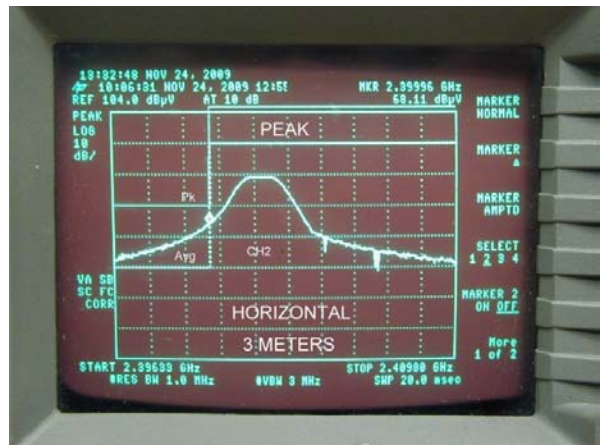
Radiated Emissions Plot (V-Pol, 18GHz-25GHz)



Radiated Emissions Plot (H-Pol, 18GHz-25GHz)

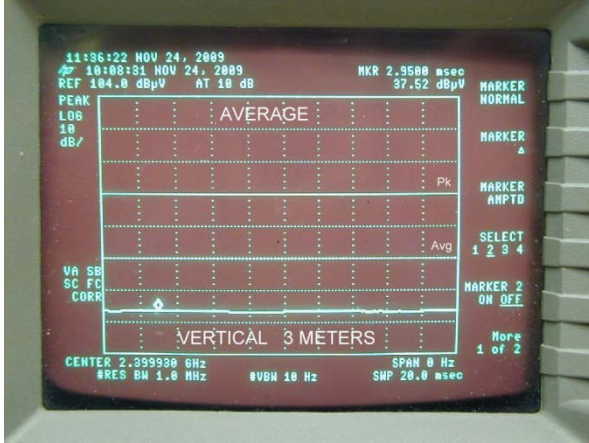


Radiated Emissions Plot (CH2, V-Pol, Peak)

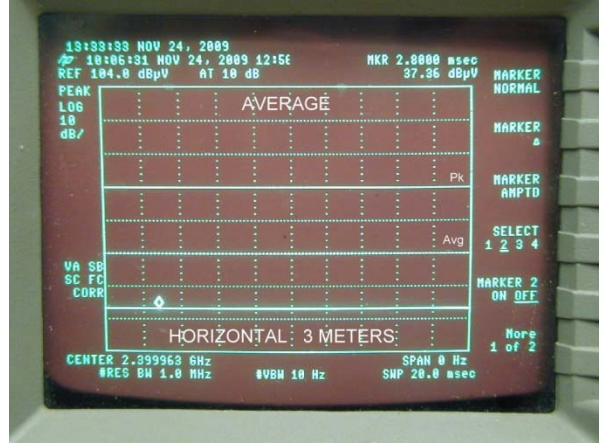


Radiated Emissions Plot (CH2, H-Pol, Peak)

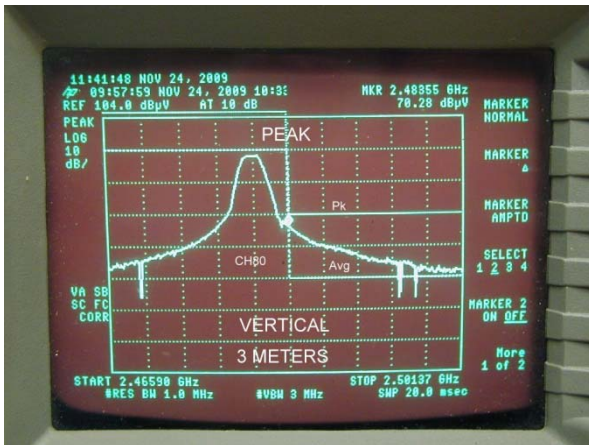
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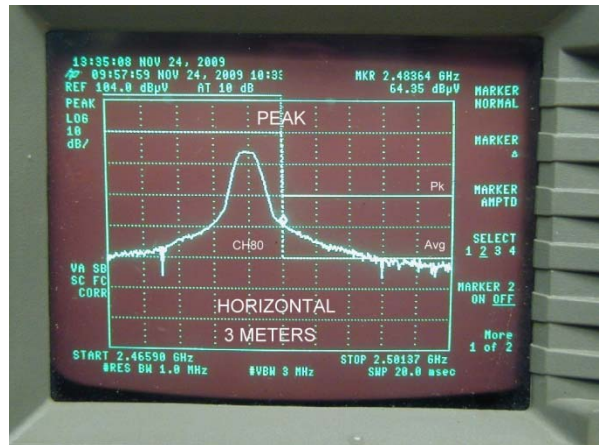
Radiated Emissions Plot (CH2, V-Pol, Average)



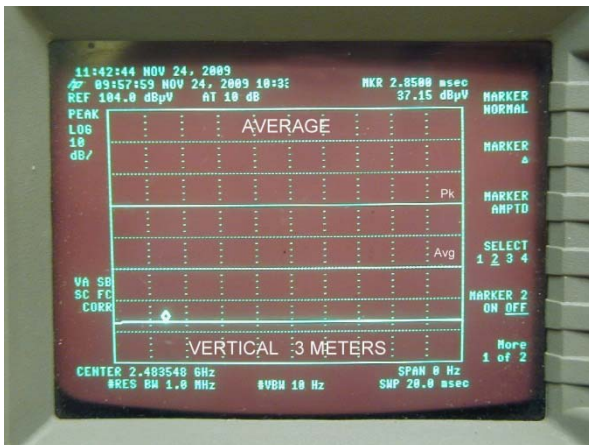
Radiated Emissions Plot (CH2, H-Pol, Average)



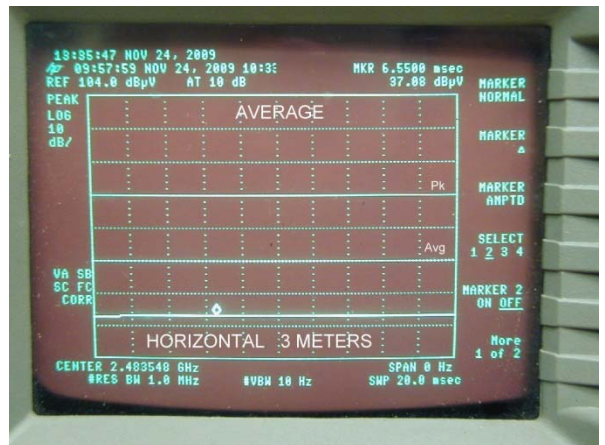
Radiated Emissions Plot (CH80, V-Pol, Peak)



Radiated Emissions Plot (CH80, H-Pol, Peak)



Radiated Emissions Plot (CH80, V-Pol, Average)



Radiated Emissions Plot (CH80, H-Pol, Average)

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12 FCC Part 15C, Section 15.215 – ADDITIONAL PROVISIONS TO THE GENERAL RADIATED LIMITATIONS

The EUT complies with the requirements of this Section as shown by the test results of this report.

Test Date:	24 Nov 2009	Temperature:	23°C
Test Officer:	RT	Humidity:	72%
Test Location:	Austest Laboratories (NSW)		

12.1 EUT Operating Mode

- a. EUT power supply voltage – 3.8V internal battery.
- b. The EUT was set in transmitting mode.

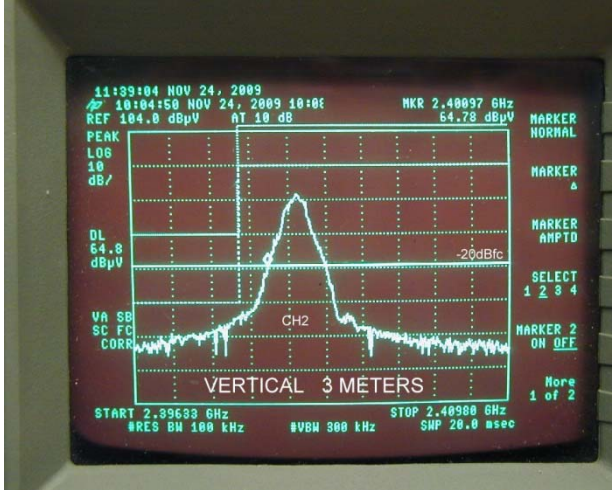
12.2 Test Method

- a. Set the spectrum analyser to capture Peak power, which in this case was achieved using a RBW of 100kHz RBW, and a VBW of 300kHz.
- b. Set up the EUT on a non-conductive turntable, 0.8m above the OATS conductive ground plane, and at the indicated test distance away from the measuring antenna.
- c. To maximise the emission, rotate the EUT through 360° and adjust the measuring antenna height between 1m to 4m in both vertical and horizontal antenna polarizations.
- d. Mark the peak frequency level and note the -20dB lower frequency of the Low Channel and the upper frequency of the High Channel to ensure that they are within the permitted operating frequency band.
- e. Communication was established with an Emotiv USB dongle. The USB dongle was connected to the desktop PC and placed away from the test area.

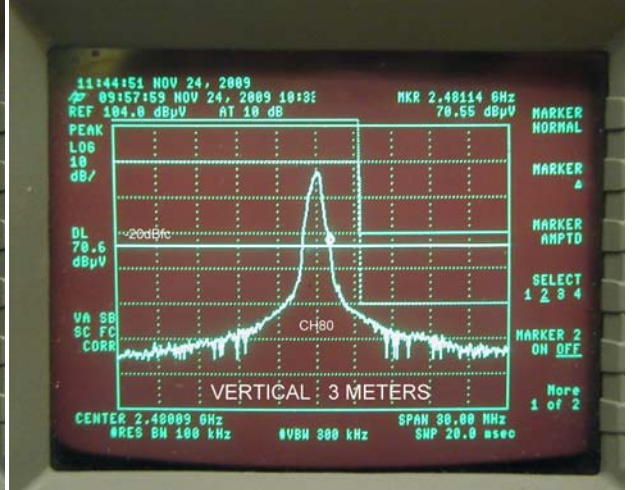
12.3 Test Results

Channel 2 Lower Frequency (MHz)	Channel 80 Upper Frequency (MHz)	Permitted Frequency Range (MHz)	Result
2401.0	2481.1	2400 to 2483.5	COMPLIES

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20dB Bandwidth Low Channel Plot (Lower Frequency)



20dB Bandwidth High Channel Plot (Upper Frequency)

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13 FCC Part 15C, Section 15.249 – OPERATION WITHIN THE BANDS 902-928MHz, 2400-2483.5MHz, 5725-5850MHz, AND 24.0-24.25GHz

13.1 Field Strength at 3m (Fundamental & Harmonics) – Section 15.249(a), (c) & (e)

Test Date:	24 Nov 2009	Temperature:	23°C
Test Officer:	RT	Humidity:	72%
Test Location:	Austest Laboratories (NSW)		

13.1.1 EUT Operating Mode

- a. EUT power supply voltage – 3.8V internal battery.
- b. The EUT was set in transmitting mode.

13.1.2 Test Method

- a. Measurements are performed in accordance with ANSI C63.4-2003.
- b. Set the measuring receiver to Peak detection and the BW settings to:
 - i. 1MHz (above 1GHz) RBW, 1MHz or more VBW, using a Spectrum Analyser for Peak measurements.
 - ii. 1MHz (above 1GHz) RBW, 10Hz VBW, using a Spectrum Analyser for Average measurements.
- c. Set up the EUT on a non-conductive turntable, 0.8m above the OATS conductive ground plane, and at the indicated test distance away from the measuring antenna.
- d. To maximise emissions, rotate the EUT through 360° and adjust the measuring antenna height between 1m to 4m in the following antenna orientations:
 - i. Horn antenna (above 1GHz) - Both vertical and horizontal polarizations.
- e. Measure the maximised emission and repeat the above for all measurement frequencies.
- f. Communication was established with an Emotiv USB dongle. The USB dongle was connected to the desktop PC and placed away from the test area.

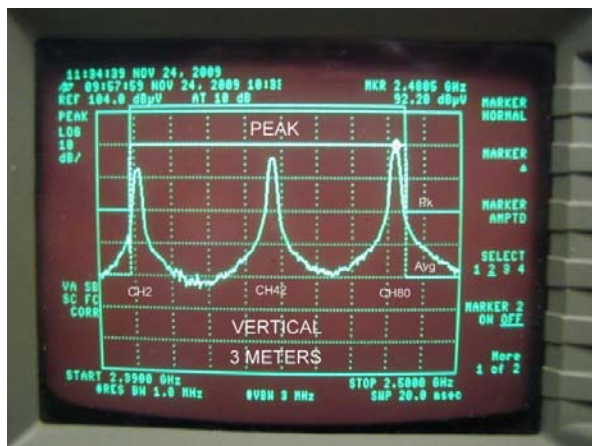
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13.1.3 Test Results

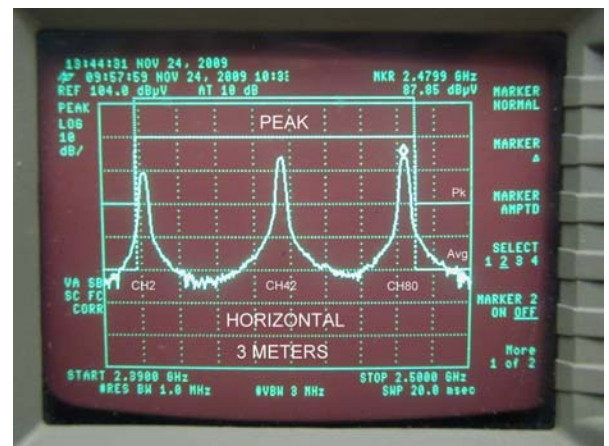
13.1.3.1 Fundamental Frequencies

- a. The highest measured peak level was 41mV/m (92.2dBµV/m) at 2480MHz using CH80.
- b. The measured field strength of the fundamental frequencies at a 3 meter distance is shown below.
- c. Average measurements were only made when peak levels exceeded the average limit of 50mV/m.

Frequency (MHz)	Ant. Pol.	Measured Peak Field Strength @ 3m		Peak Field Strength Limit @ 3m		Pass Margin (dB)
		(dBµV/m)	(mV/m)	(dBµV/m)	(mV/m)	
2480.0 (CH80)	Vertical	92.2	41	114.0	500	-21.8
2442.0 (CH42)	Vertical	89.6	30	114.0	500	-24.4
2480.0 (CH80)	Horizontal	88.0	25	114.0	500	-26.0
2442.0 (CH42)	Horizontal	87.8	25	114.0	500	-26.2
2402.0 (CH2)	Vertical	86.3	21	114.0	500	-27.7
2402.0 (CH2)	Horizontal	83.4	15	114.0	500	-30.6



Field Strength Plot (Vertical Polarization)



Field Strength Plot (Horizontal Polarization)

13.1.3.2 Harmonics

All measured harmonic levels were below the limits specified in FCC Part 15, Sections 15.209 and 15.249. For details, please refer to Clause 11 of this report.

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13.2 Emissions Radiated Outside the Specified Frequency Bands – Section 15.249(d)

All emissions outside the specified frequency bands were below the radiated emission limits specified in FCC Part 15, Section 15.209.

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APPENDIX A – PHOTOGRAPHIC RECORD OF EUT



EUT (View 1)



EUT (View 2)

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EUT Left Side (Internal Battery View)



EUT Internal Battery

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EUT Power Switch & Power Port

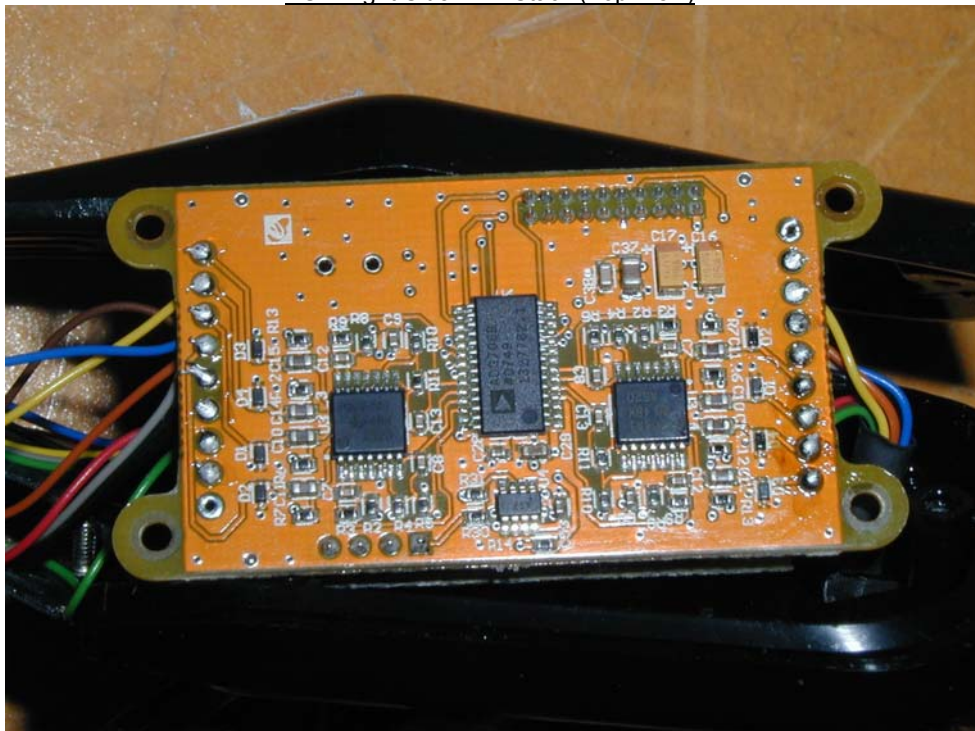


EUT Right Side (Internal View)

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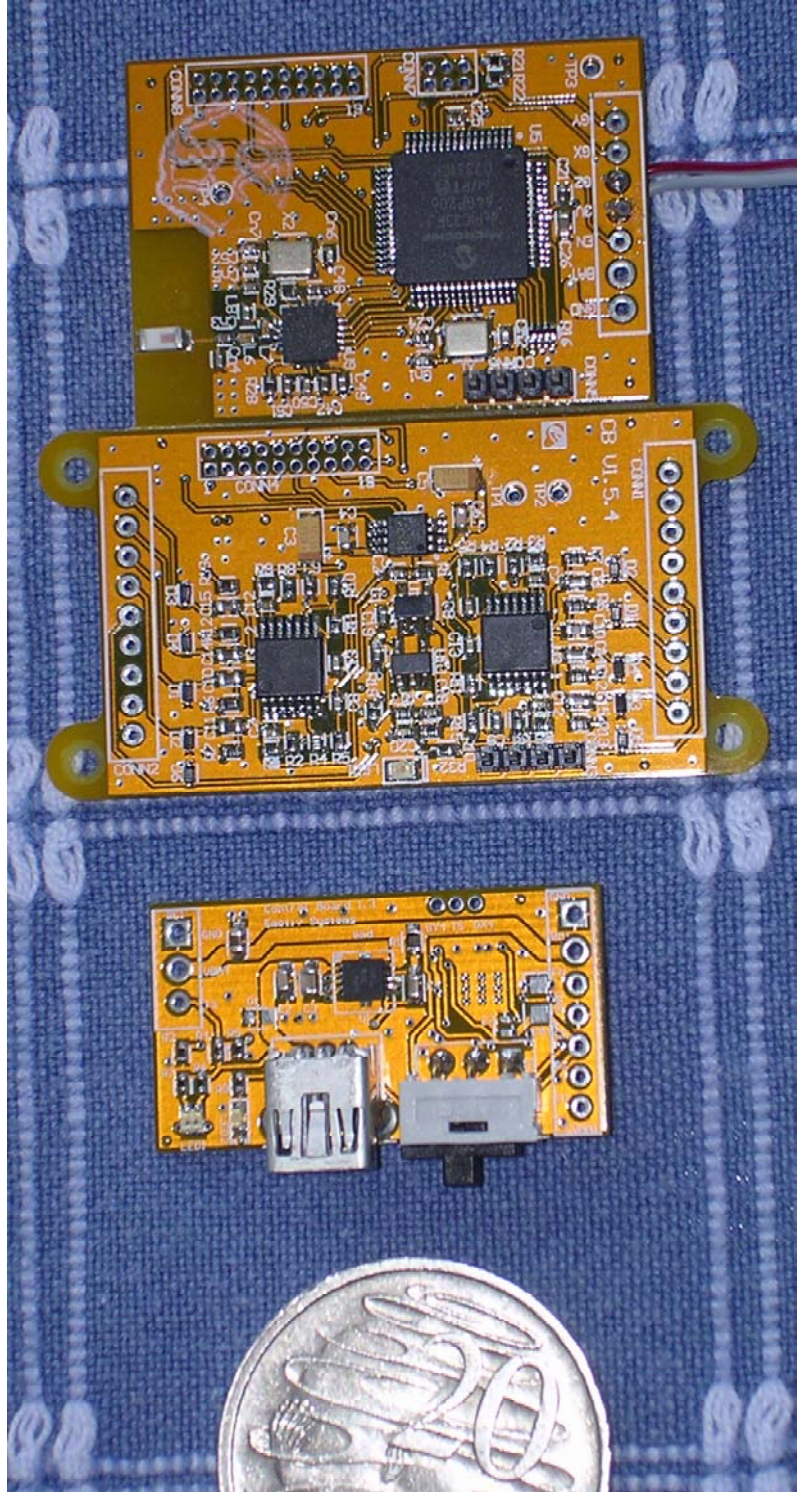


EUT Right Side PBA Stack (Top View)



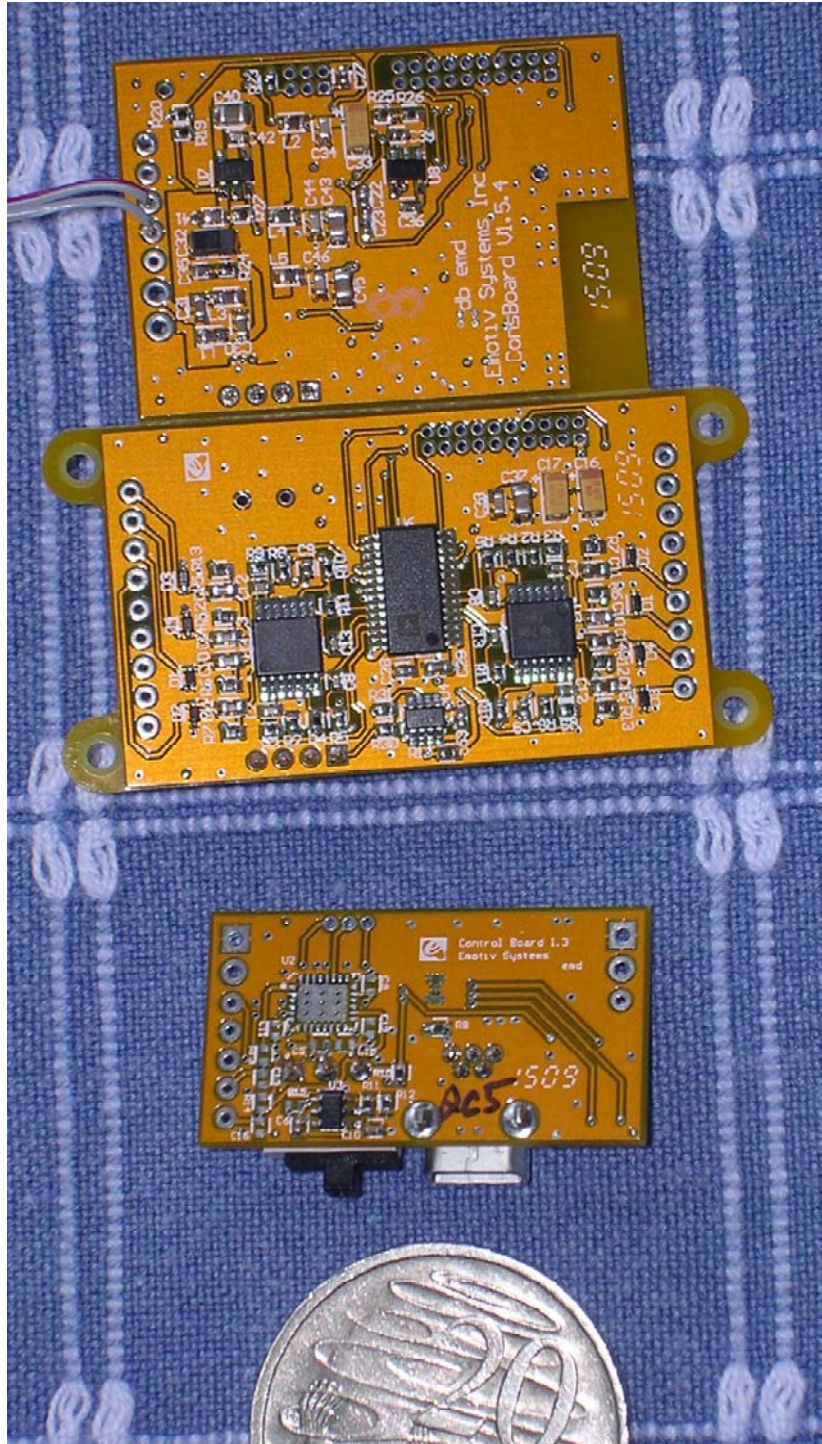
EUT Right Side PBA Stack (Bottom View)

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EUT PBAs (Side 1)

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EUT PBAs (Side 2)

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EUT 100-240VAC AC Adaptor



EUT 100-240VAC AC Adaptor (Label Details)

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APPENDIX B – FCC LABEL & LOCATION



FCC Label



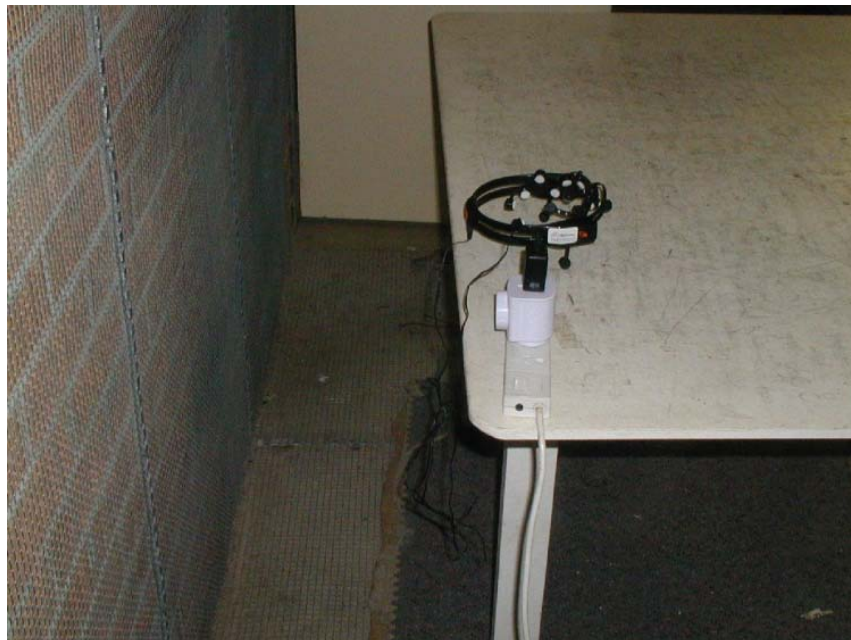
FCC Label Location on EUT

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APPENDIX C – EUT TEST SETUP PHOTOGRAPHS



Conducted Disturbance Test Setup (Front View)



Conducted Disturbance Test Setup (Side View)

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FCC Part 15B Radiated Disturbance Test Setup (Front View – EUT Charging Mode)

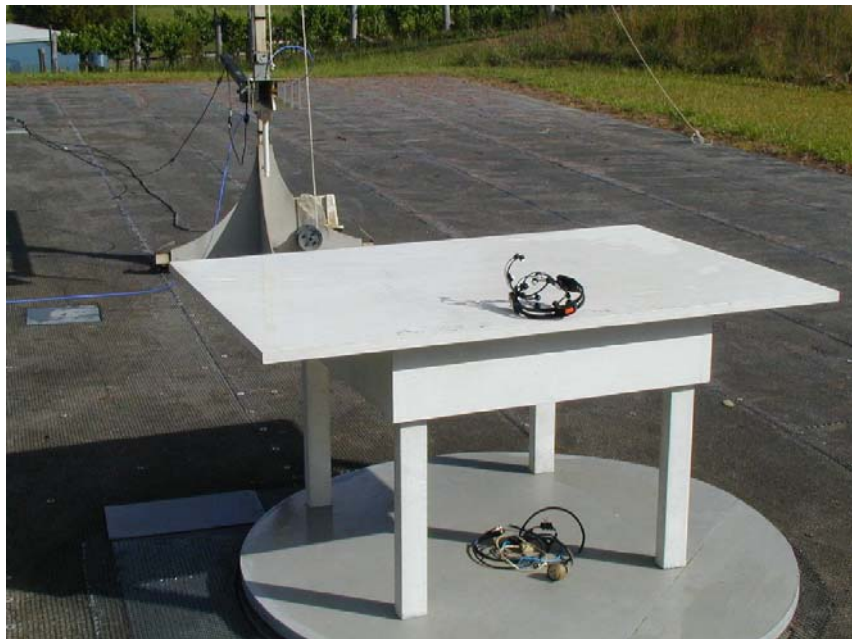


FCC Part 15B Radiated Disturbance Test Setup (Rear View – EUT Charging Mode)

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FCC Part 15C Radiated Disturbance Test Setup (Front View – EUT Transmit Mode)



FCC Part 15C Radiated Disturbance Test Setup (Rear View – EUT Transmit Mode)

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