



COMPLIANCE TESTING REPORT

FCC TITLE 47 PART 15

SUBPARTS A & B (CLASS B) & C

Client:	Embed International		
Address:	2 Neil Street, Osborne Park WA 6107, Australia		
Report Number:	0405EMB_EI-WIR-180_FCC15tr-a		
Date of Testing:	7 th to 11 th February 2012		
File Number:	EMB111122		
Equipment Name:	Network Adapter 2.4GHz		
Equipment Model Number:	EI-WIR-180 or RAD-002 (refers to the same device)		
Equipment Serial Number:	00042545500051FA (Barcode)		
Equipment FCC ID:	CKORAD000		
Equipment Description:	Embed Network Adapter employing 802.15.4 (Zigbee) operation		
Result:	COMPLIES (Refer to Test Summary page for clarifications)		
Tested by:	Richard Turner		
Approved by:	Colin Gan		
Date of Issue:	20 Apr 2012		
<p>AUSTEST (NSW) FCC REGISTRATION NUMBER 90455</p> <p>Results appearing herein relate only to the sample(s) tested.</p> <p>This report is issued errors and omissions exempt and is subject to withdrawal at Austest Laboratories discretion.</p>			

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Report Revision History:

Date	Report Number	Changes
05 Apr 2012	0405EMB_EI-WIR-180_FCC15tr	Original Report.
20 Apr 2012	0405EMB_EI-WIR-180_FCC15tr-a	Report Revision due to error on cover page title.

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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 (Class B)	COMPLIES	
15.109	Radiated Emission Limits (Class B)	COMPLIES	(i)
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	
15.247	Operation within the Bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz	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 6.2 of this report.

2 MODIFICATIONS

To ensure the radiated emission levels were below the limits the following modifications were required:

1. The internal antenna trace, which was supplied disconnected from the 2.4GHz transceiver output, was connected to the PBA ground plane at positions C33 and C34. The client had previously advised that the internal antenna option would not be used.
2. Operation on CH26 (2480MHz) is to be inhibited. Tests were performed on channels CH11 to CH25 inclusive.

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3 REFERENCES

FCC Title47 Part 15 current as of February 2012
ANSI C63.4-2009
Measurement of Digital Transmission Systems (DTS) Operating under Section 15.247, March 23,2005

4 EQUIPMENT UNDER TEST (EUT) DESCRIPTION

EUT Name:	Network Adapter 2.4GHz
EUT Description:	Embed Network Adapter employing 802.15.4 (Zigbee) operation
EUT Model:	EI-WIR-180 or RAD-002 (refers to the same device)
EUT Serial Number:	00042545500051FA (barcode)
EUT FCC ID:	CKORAD000
Manufacturer:	Embed International
Power Supply & Rating:	12VDC 300mA
Highest Clock/Operating Frequency:	16.0MHz
Lowest Clock/Operating Frequency:	7.3728MHz
Transmit Frequency Range:	2405 to 2475MHz (802.15.4 specification)
Transmit Power:	Nominal 3dBm
Modulation Technique:	Offset-QPSK
Number of Channels:	15
Antenna Specifications:	External Antenna only with RP SMA connection 27cm stub antenna Gain: 7dBi

The EUT was housed in a plastic case.
 The client advised that the internal antenna would not be used.
 The EUT operates under the IEEE 802.15.4 specification.

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5 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:

Port	Connecting Cable	Source / Load
RS485 Port	2.0m unshielded CAT5 cable, bundled	120Ω termination
Power Port (#1)	1.5m unshielded fig.8 DC power lead	AC adaptor
Power Port (#2)	Supplied 15cm unshielded two core cable	
Antenna Port	Direct connection, no cable	Supplied 27cm stub antenna

The client advised that the second power port is used to power additional network adaptors and that the supplied cable is of a typical length. Emission levels from the EUT were not affected when this port was connected to a second unit.

Radiated and conducted emission levels were maximised with the EUT placed on the test table horizontally. The antenna was positioned vertically.

For intentional radiation measurements the client provided a PC with software that enabled channel selection prior to measurement. Connection to the PC was removed during measurement.

The EUT was housed in a plastic enclosure.

The EUT was tested within the allowed temperature and humidity range.

The EUT was powered by 12VDC provided by the Elementech International Co. Ltd ITE power supply. Input 100-240VAC 50/60Hz 0.5A, output 12VDC 1.5A. The power supply was connected to the 115VAC 60Hz mains supply.

The power supply is not part of the EUT and is designed to plug into the wall outlet. During measurement this was connected directly into the AC power source below the test table as per ANSI C63.4-2009 clause 6.3.1.2.

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EUT Operating Modes

Mode No.	Operating Mode Description
1	Normal operation.
2	Constant transmit condition with modulation on selected channels.

5.1 Transmitter Test Channels

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

Channel	Transmitter Frequency (MHz)
CH11 (Low)	2405
CH18 (Middle)	2440
CH25 (High)	2475

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6 TEST SPECIFICATIONS

6.1 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.

Austest Laboratories (NSW)'s Yarramalong test facilities are accredited by A2LA. The tests reported herein have been performed in accordance with its terms of accreditation.

6.2 Deviations from Standards and/or Accreditations

None.

6.3 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.

6.4 Test Equipment

Test Equipment	Brand & Model	Serial No./ID	Cal. Due Date
EMI Receiver	HP 8574B	MEQ72	09 Aug 2012
Test Software	HP85969PC	-	-
Spectrum Analyser	HP 8593E	MEQ738	14 Sep 2012
Test Software	Agilent E4444A	-	-

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	Benchlink		
Biconical Array Antenna	Emco EM6912	MEQ297	01 Aug 2012
Log-Periodic Array Antenna	Emco EM6950	MEQ298	02 Aug 2012
DRG Horn Antenna	AH Systems SAS-571	MEQ107	31 Mar 2012
Loop Antenna	EM-6876	MEQ225	29 Sep 2012
Pre-Amplifier (30MHz-1GHz)	HP 8447E	MEQ74	08 Aug 2012
Pre-Amplifier (1GHz-25GHz)	RE 218A	MEQ651	20 Jun 2012
Pre-Amplifier (4.5GHz-25GHz)	RE 518A	MEQ650	21 Jun 2012
Attenuator	Omni Spectra 10dB	1022627	27 Sep 2012
AMN/LISN	Compower LI-200	MEQ80	22 Nov 2012
Coaxial Cables	Suhner	Various	Sep 2012

6.5 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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7 FCC Part 15B, Section 15.107 - CONDUCTED LIMITS

Test Date:	07 Feb 2012	Temperature:	24°C
Test Officer:	Richard Turner	Humidity:	64%
Test Location:	Austest Laboratories (NSW)		

7.1 EUT Test Operating Mode

- EUT power supply voltage - 115Vac 60Hz.
- Mode 1 – Normal operation.

7.2 Test Method

- Measurements are performed in accordance with ANSI C63.4-2003.
- Set the EMI Receiver BW to 9kHz for the test.
- 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.
- The EUT power is supplied through the EUT LISN. Power for supporting equipment (if any) is supplied through the supporting equipment LISN. Both LISNs are grounded to the ground plane and kept 0.8m away from the EUT test setup.
- 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.
- Drape all interconnection cables 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.
- Conducted emission measurements are made on both Active and Neutral lines of the EUT.

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7.3 Sample Calculation Example

The final voltage levels were obtained from the measurement equipment software which automatically applied all the stored calibration factors. The calibration / correction factors were applied as follows:

$$V_c = V + L_{cbl} + L_{LISN} + L_{limiter}$$

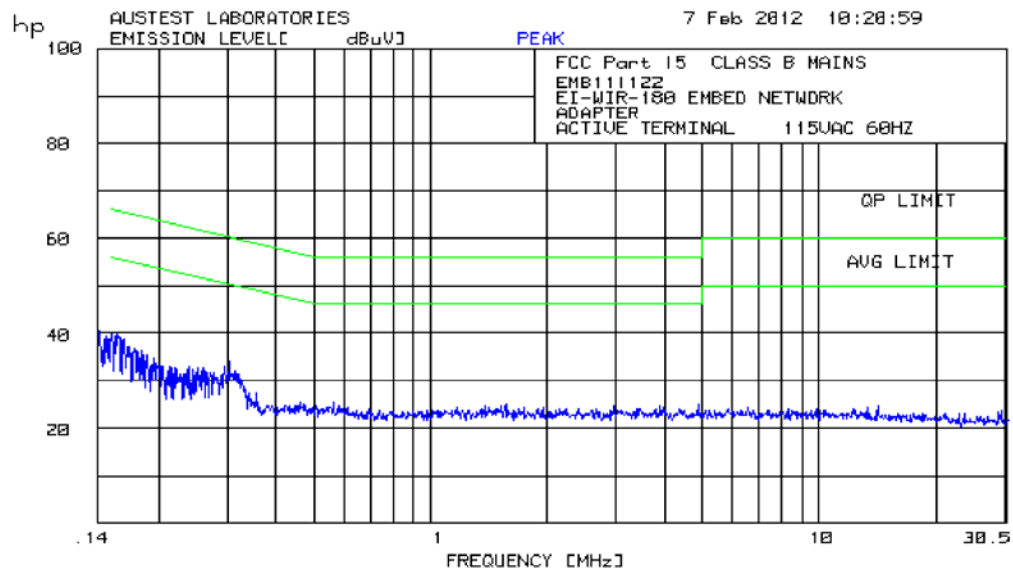
Where:

- V_c = Corrected voltage level in dB μ V for comparison to the limit.
- V = EMI Receiver measured signal input voltage in dB μ V.
- L_{cbl} = Total cable insertion loss in dB.
- L_{LISN} = Voltage division factor (insertion loss) of LISN in dB.
- $L_{limiter}$ = Insertion loss of voltage limiter, where applicable, in dB.

Frequency (MHz)	Receiver Level, V (dB μ V)	L_{cbl} (dB)	L_{LISN} (dB)	$L_{limiter}$ (dB)	Corrected Level, V_c (dB μ V)
1.0	40.0	0.1	0.1	N.A.	40.2

7.4 Test Results

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



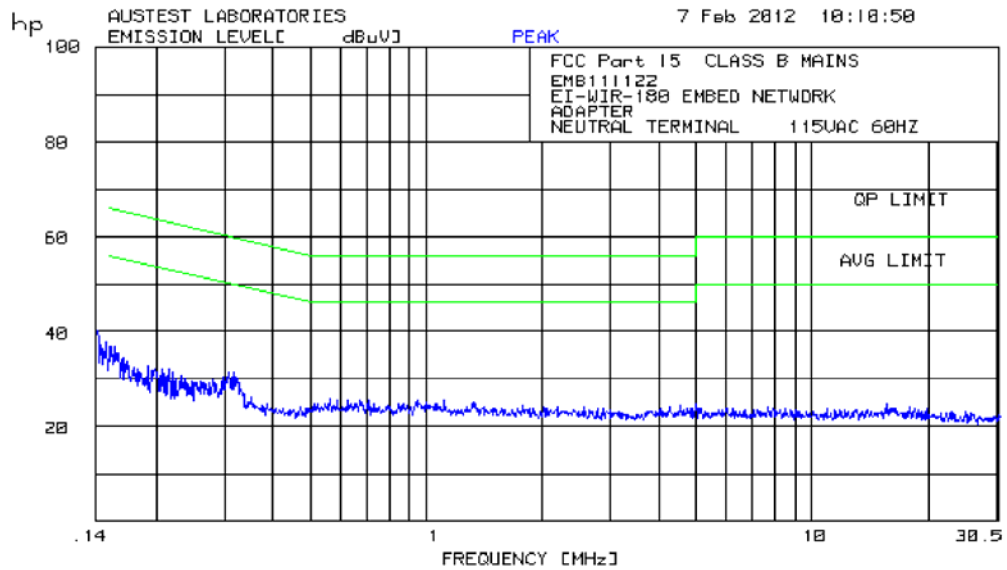
Conducted Emissions Plot (Active Line)

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Conducted Emissions Plot (Neutral Line)

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

Test Date:	07 Feb 2012	Temperature:	22°C
Test Officer:	Richard Turner	Humidity:	64%
Test Location:	Austest Laboratories (NSW)		

8.1 EUT Operating Mode

- a. EUT power supply voltage - 115Vac 60Hz.
- b. Mode 1 – Normal operation.

8.2 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.
 - ii. 1MHz (above 1GHz) RBW, 1MHz or more VBW, using a Spectrum Analyser for Peak measurements.
 - iii. 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. Biconical and Log-Periodic antennas (30MHz to 1GHz) - Both vertical and horizontal polarizations.
 - ii. Horn antenna (above 1GHz) - Both vertical and horizontal polarizations.
- e. Measure the maximised emission and repeat the above for all measurement frequencies.

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8.3 Sample Calculation Example

The final field strength levels were obtained from the measurement equipment software which automatically applied all the stored calibration factors. The calibration / correction factors were applied as follows:

$$E = V + AF + L_{cbl} - G_{pre}$$

Where:

- E = Radiated Electric Field Strength in dB μ V/m at the specified distance.
- V = EMI Receiver measured signal input voltage in dB μ V.
- AF = Antenna Factor of the measuring antenna in dB/m.
- L_{cbl} = Total cable insertion loss in dB.
- G_{pre} = Preamplifier gain in dB.

Frequency (MHz)	Receiver Level, V (dB μ V)	AF (dB/m)	Lcbl (dB)	Gpre (dB)	Corrected Level, E (dB μ V/m)
100.0	40.0	12.0	2.9	22.5	32.4

8.4 Test Results

8.4.1 RADIATED DISTURBANCES: 30MHz to 1000MHz, 3m Distance

The highest measured quasi-peak level was 0.7dB below the Class B quasi-peak limit at 199.1MHz

Frequency MHz	Polarisation	Quasi-Peak Level		Limit		Below Limit dB*
		μ V/m	dB μ V/m	μ V/m	dB μ V/m	
199.1	Horizontal	138	42.8	150	43.5	0.7
199.1	Vertical	129	42.2	150	43.5	1.3
206.4	Vertical	129	42.2	150	43.5	1.3
213.8	Vertical	126	42.0	150	43.5	1.5
287.5	Horizontal	155	43.8	200	46.0	2.2
206.4	Horizontal	99	39.9	150	43.5	3.6

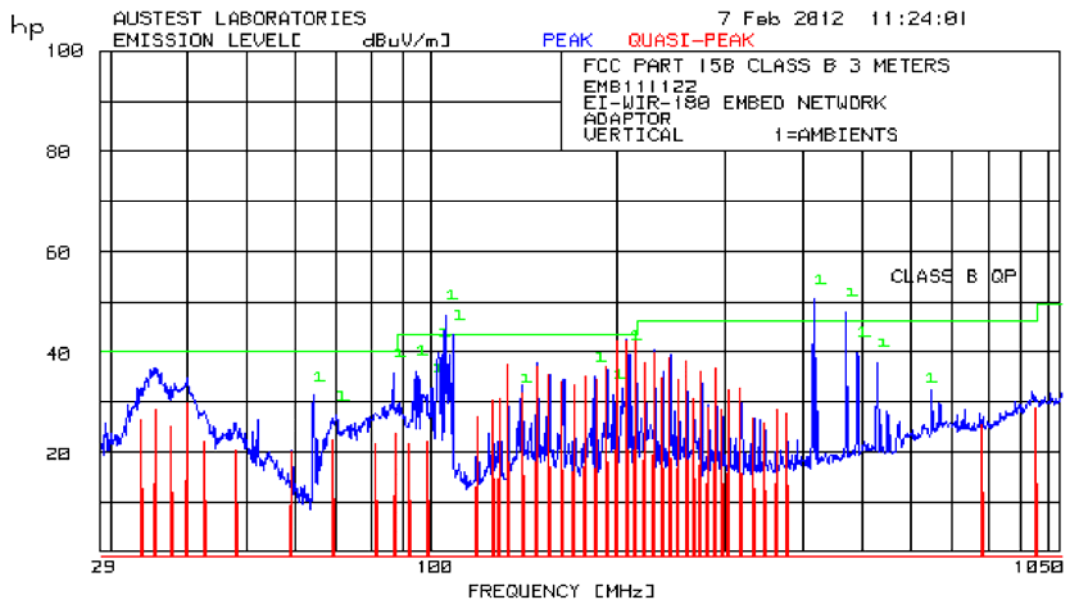
*Results were within the laboratory's measurement uncertainty.

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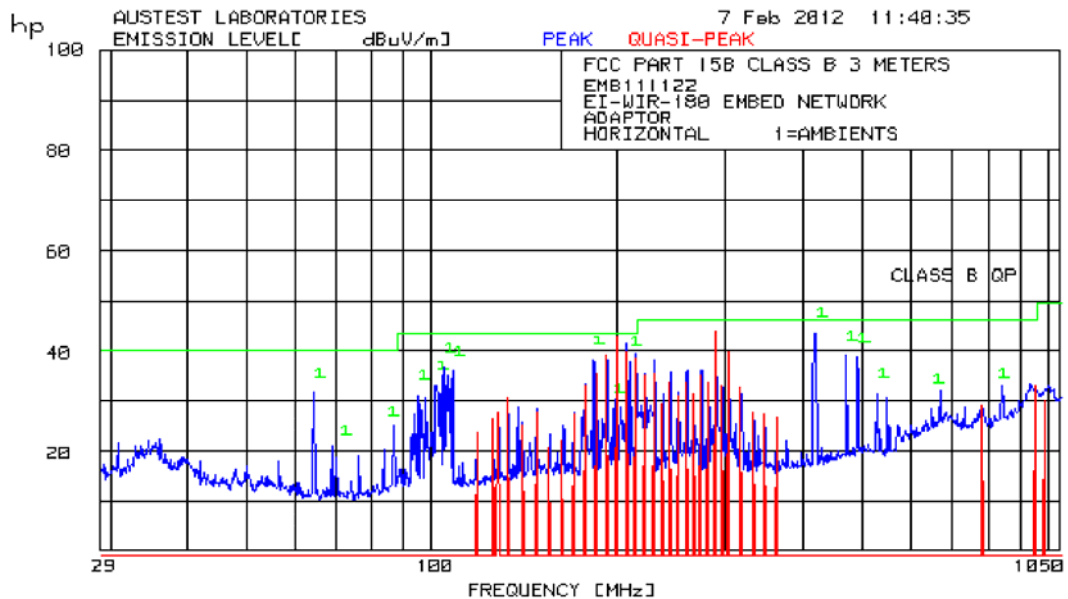
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Radiated Emissions Plot (Vertical Polarisation, 30MHz to 1GHz)



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

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8.4.2 RADIATED DISTURBANCES: Above 1000MHz

NOT APPLICABLE to the EUT as the highest internal operating frequency used was 16MHz and in accordance with section 15.33 of FCC Part 15 the upper measurement frequency for unintentional emissions is defined as 1000MHz.

9 **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 uses a unique coupling to the intentional radiator – i.e. RP SMA connector.

10 **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 2475MHz.

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11 FCC Part 15C, Section 15.207 - CONDUCTED LIMITS

Test Date:	07 Feb 2012	Temperature:	24°C
Test Officer:	Richard Turner	Humidity:	64%
Test Location:	Austest Laboratories (NSW)		

11.1 EUT Operating Mode

- EUT power supply voltage - 115Vac 60Hz.
- Mode 2 – Constant transmit with modulation on selected channels.

11.2 Test Method

- Measurements are performed in accordance with ANSI C63.4-2003.
- Set the EMI Receiver BW to 9kHz for the test.
- 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.
- The EUT power is supplied through the EUT LISN. Power for supporting equipment (if any) is supplied through the supporting equipment LISN. Both LISNs are grounded to the ground plane and kept 0.8m away from the EUT test setup.
- 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.
- Drape all interconnection cables 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.
- Conducted emission measurements are made on both Active and Neutral lines of the EUT.

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11.3 Sample Calculation Example

The final voltage levels were obtained from the measurement equipment software which automatically applied all the stored calibration factors. The calibration / correction factors were applied as follows:

$$V_c = V + L_{cbl} + L_{LISN} + L_{limiter}$$

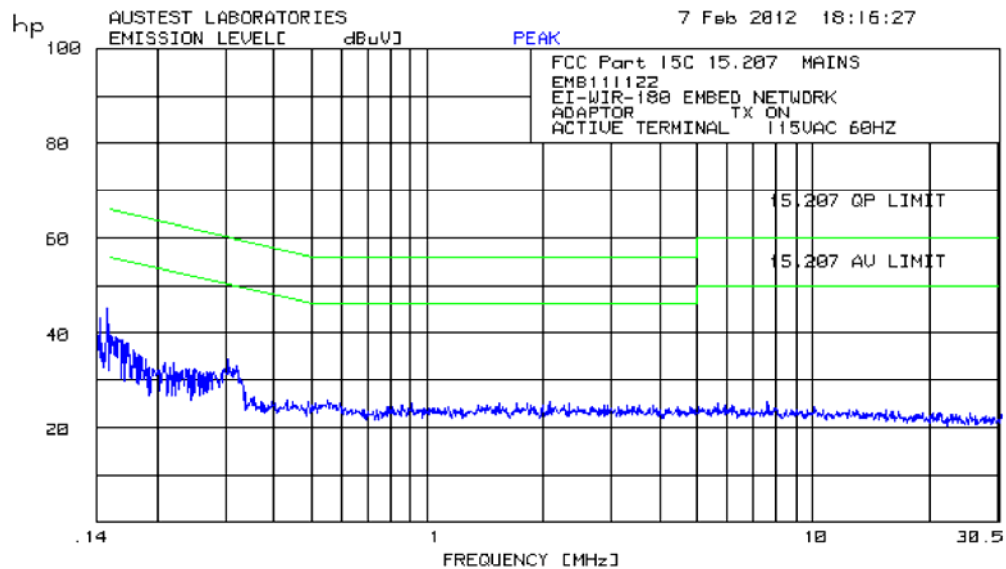
Where:

- V_c = Corrected voltage level in dB μ V for comparison to the limit.
- V = EMI Receiver measured signal input voltage in dB μ V.
- L_{cbl} = Total cable insertion loss in dB.
- L_{LISN} = Voltage division factor (insertion loss) of LISN in dB.
- $L_{limiter}$ = Insertion loss of voltage limiter, where applicable, in dB.

Frequency (MHz)	Receiver Level, V (dB μ V)	L_{cbl} (dB)	L_{LISN} (dB)	$L_{limiter}$ (dB)	Corrected Level, V_c (dB μ V)
1.0	40.0	0.1	0.1	N.A.	40.2

11.4 Test Results

All measured disturbances were greater than 10dB below the average and quasi-peak limits specified in section 15.207.



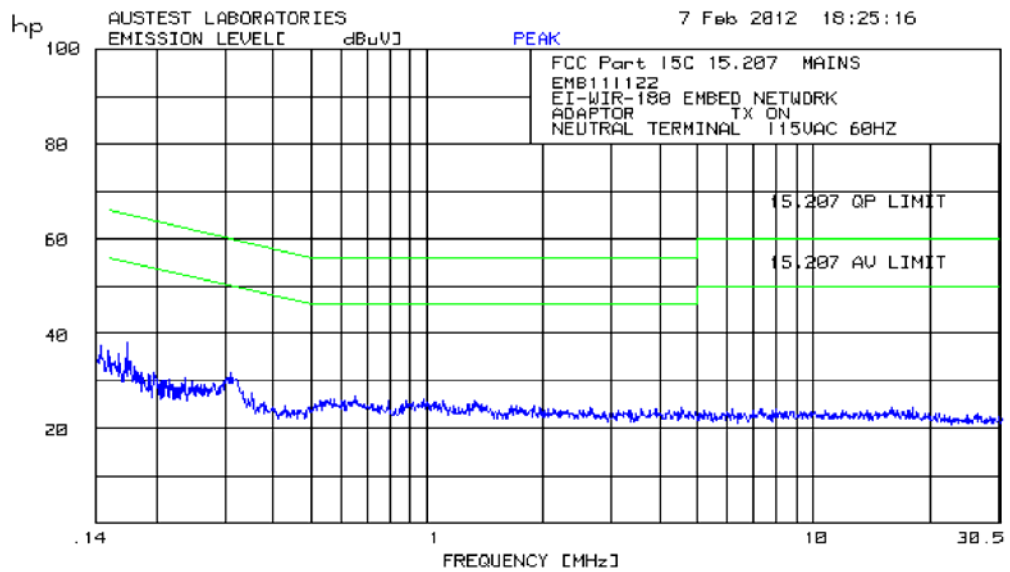
Conducted Emissions Plot (Active Line)

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Conducted Emissions Plot (Neutral Line)

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

Test Date:	09 to 11 Feb 2012	Temperature:	24°C
Test Officer:	Richard Turner	Humidity:	68%
Test Location:	Austest Laboratories (NSW)		

12.1 EUT Operating Mode

- a. EUT power supply voltage - 115Vac 60Hz.
- b. Mode 2 – Constant transmit with modulation on selected channels.

12.2 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, 1MHz or more 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. Average level measurements were not made where the peak level did not exceed the average limit.

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12.3 Sample Calculation Example

The final radiated emission levels were obtained from the measurement equipment software which automatically applied all the stored calibration factors. The calibration / correction factors were applied as follows:

$$E = V + AF + L_{cbl} - G_{pre}$$

Where:

- E = Radiated Electric Field Strength in dB μ V/m at the specified distance.
- V = EMI Receiver measured signal input voltage in dB μ V.
- AF = Antenna Factor of the measuring antenna in dB/m.
- L_{cbl} = Total cable insertion loss in dB.
- G_{pre} = Preamplifier gain in dB.

Frequency (MHz)	Receiver Level, V (dB μ V)	AF (dB/m)	Lcbl (dB)	Gpre (dB)	Corrected Level, E (dB μ V/m)
100.0	40.0	12.0	2.9	22.5	32.4

12.4 Test Results

12.4.1 BANDEDGE MEASUREMENTS: 3m Distance

15.209 limit: 500 μ V/m using average detection. Peak limit set to 20dB above the average limit.

CH11 (2405MHz)

Restricted Band: 2310 to 2390MHz

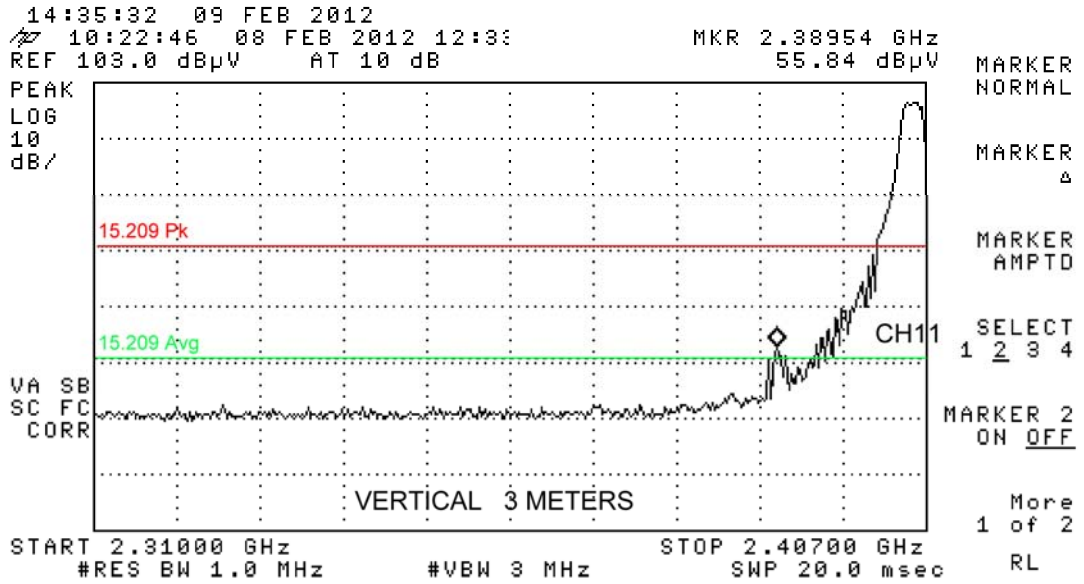
Frequency MHz	Polarisation	Level dBuV/m		Limit dBuV/m		Δ Pk Limit dB	Δ Avg Limit dB
		Peak	Average	Peak	Average		
2389.5	Vertical	55.8	34.5	74.0	54.0	-18.2	-19.5
2389.8	Horizontal	47.6	-	74.0	54.0	-26.4	-

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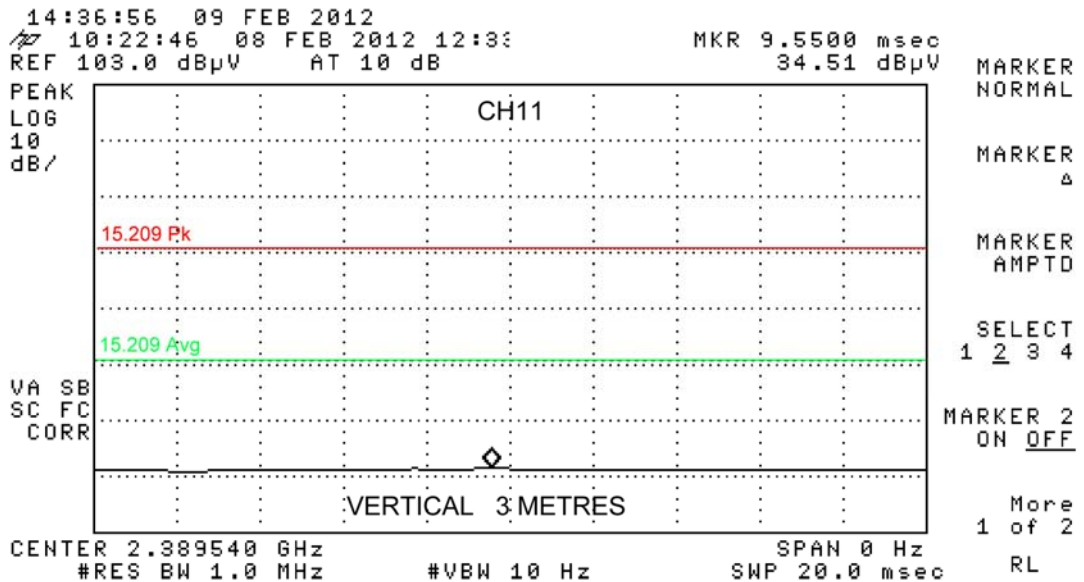
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Bandedge CH11 2389MHz (Peak – Vertical)



Bandedge CH11 2389MHz (Average – Vertical)

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Bandedge CH11 2389MHz (Peak – Horizontal)

CH25 (2475MHz)

Restricted Band: 2483.5 to 2500MHz

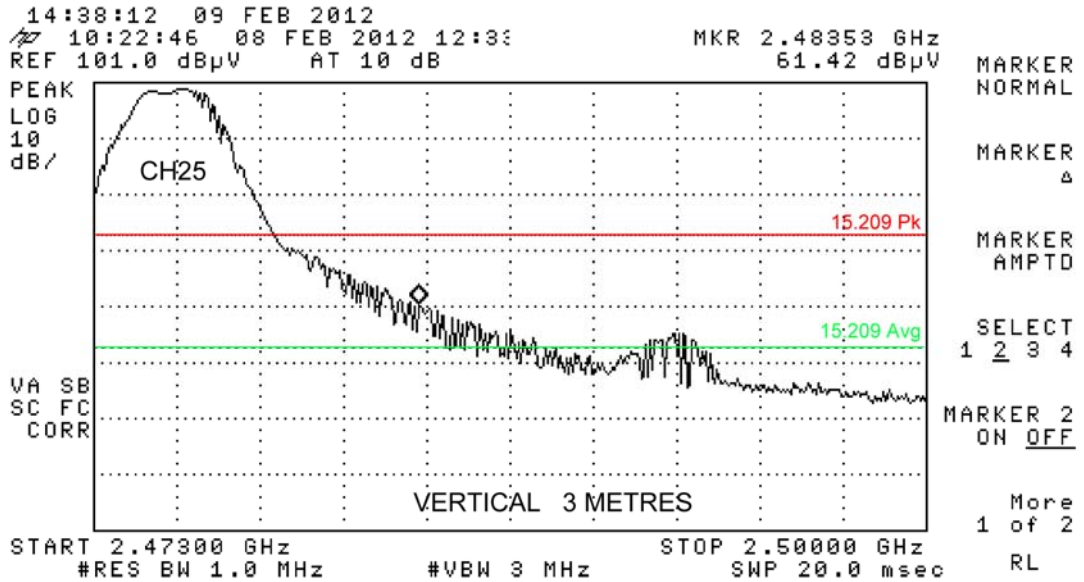
Frequency MHz	Polarisation	Level dBuV/m		Limit dBuV/m		ΔPk Limit dB	Δ Avg Limit dB
		Peak	Average	Peak	Average		
2483.5	Vertical	61.4	36.9	74.0	54.0	-12.6	-17.1
2491.8	Vertical	56.4	33.6	74.0	54.0	-17.6	-20.4
2483.7	Horizontal	51.9	-	74.0	54.0	-22.1	-

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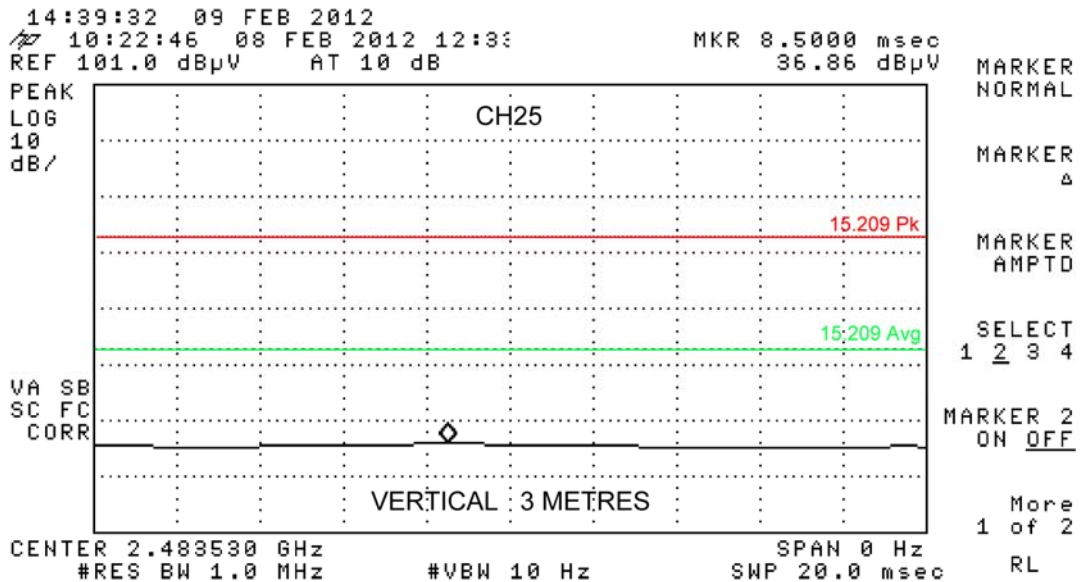
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Bandedge CH25 2483MHz (Peak – Vertical)



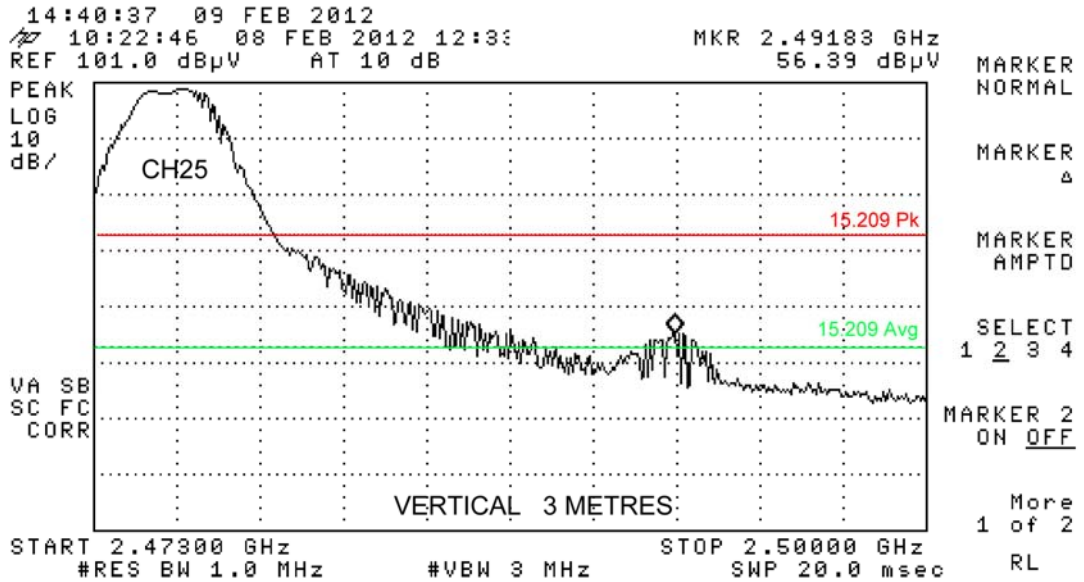
Bandedge CH25 2483MHz (Average – Vertical)

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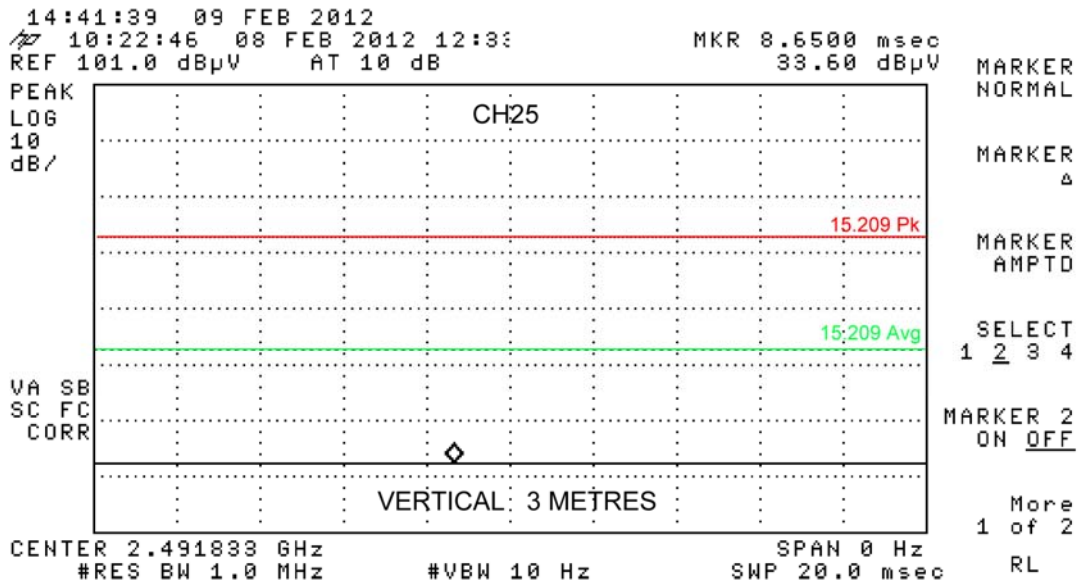
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Bandedge CH25 2492MHz (Peak – Vertical)



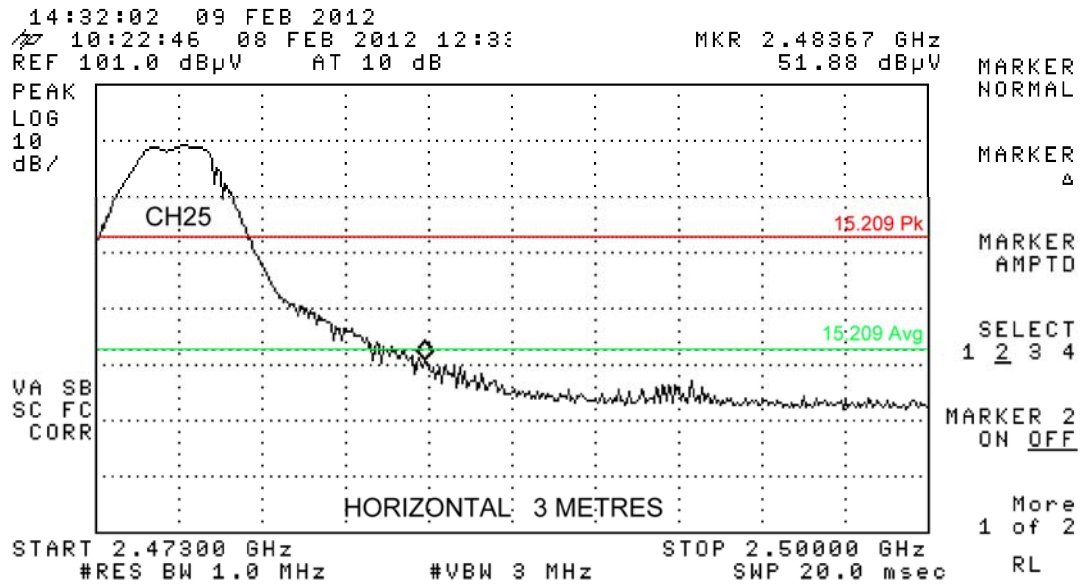
Bandedge CH25 2492MHz (Average – Vertical)

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Bandedge CH25 2483MHz (Peak – Horizontal)

12.4.2 RADIATED DISTURBANCES: 150kHz to 30MHz, 3m Distance

All measured intentional radiation was greater than 10dB below the limits specified in section 15.209.

12.4.3 RADIATED DISTURBANCES: 30MHz to 1000MHz, 3m Distance

All measured intentional radiation was greater than 10dB below the limits specified in section 15.209.

12.4.4 RADIATED DISTURBANCES: 1000MHz to 25000MHz, 3m Distance

15.209 limit: 500µV/m using average detection. Peak limit set to 20dB above the average limit.

The highest measured spurious level was at 4811.7MHz with CH11 selected. Peak level 71.5dBµ/m, 2.5dB under the limit. Average level 45.5dBµ/m, 8.5dB under the limit.

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CH11(2405MHz)

Frequency MHz	Polarisation	Level dBuV/m		Limit dBuV/m		ΔPk Limit dB	Δ Avg Limit dB
		Peak	Average	Peak	Average		
4811.7	Vertical	71.5	45.5	74.0	54.0	-2.5 ¹	-8.5
4809.8	Horizontal	69.5	44.6	74.0	54.0	-4.5 ¹	-9.4
7217.6	Horizontal	61.4	41.5	74.0	54.0	-12.6	-12.5
7217.8	Vertical	56.6	39.9	74.0	54.0	-17.4	-14.1
9623.9	Horizontal	53.7	-	74.0	54.0	-20.3	-
9623.9 ²	Vertical	-	-	74.0	54.0	>26.0	-
12024.6	Horizontal	52.1 ³	-	74.0	54.0	-21.9	-
12029.4	Vertical	49.2 ³	-	74.0	54.0	-24.8	-

1. Results were within the laboratory's measurement uncertainty.
2. Emission below the measuring system noise floor.
3. Measured at 1m test distance. Results were then extrapolated to 3m distance using an extrapolation factor of 20dB/decade in accordance with Section 15.31(f)(1).

CH18 (2440MHz)

Frequency MHz	Polarisation	Level dBuV/m		Limit dBuV/m		ΔPk Limit dB	Δ Avg Limit dB
		Peak	Average	Peak	Average		
4881.8	Vertical	69.8	44.6	74.0	54.0	-4.2 ¹	-9.4
4881.9	Horizontal	67.0	43.5	74.0	54.0	-7.0	-10.5
7319.7	Horizontal	60.3	41.4	74.0	54.0	-13.7	-12.6
7322.8	Vertical	56.1	39.8	74.0	54.0	-17.9	-14.2
9759.3	Horizontal	52.7	-	74.0	54.0	-21.3	-
9759.3 ²	Vertical	-	-	74.0	54.0	>26.0	-
12024.5	Vertical	48.6 ³	-	74.0	54.0	-25.4	-
12199.5	Horizontal	47.9 ³	-	74.0	54.0	-26.1	-

1. Results were within the laboratory's measurement uncertainty.
2. Emission below the measuring system noise floor.
3. Measured at 1m test distance. Results were then extrapolated to 3m distance using an extrapolation factor of 20dB/decade in accordance with Section 15.31(f)(1).

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CH18 (2475MHz)

Frequency MHz	Polarisation	Level dBuV/m		Limit dBuV/m		Δ Pk Limit dB	Δ Avg Limit dB
		Peak	Average	Peak	Average		
4951.8	Vertical	69.8	44.7	74.0	54.0	-4.2 ¹	-9.3
4951.8	Horizontal	66.1	43.3	74.0	54.0	-7.9	-10.7
7424.6	Horizontal	59.7	41.4	74.0	54.0	-14.3	-12.6
7427.4	Vertical	56.4	40.3	74.0	54.0	-17.6	-13.7
9899.7	Horizontal	49.7	-	74.0	54.0	-24.3	-
9899.7 ²	Vertical	-	-	74.0	54.0	>26.0	-
12374.7	Horizontal	48.8 ³	-	74.0	54.0	-25.2	-
12379.6	Vertical	48.0 ³	-	74.0	54.0	-26.0	-

1. Results were within the laboratory's measurement uncertainty.
2. Emission below the measuring system noise floor.
3. Measured at 1m test distance. Results were then extrapolated to 3m distance using an extrapolation factor of 20dB/decade in accordance with Section 15.31(f)(1).

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13 FCC Part 15C, Section 15.247 – OPERATION WITHIN THE BANDS 902-928MHz, 2400-2483.5MHz, AND 5725-5850MHz

13.1 6dB Bandwidth - Section 15.247(a)(2)

Test Date:	10 Feb 2012	Temperature:	26°C
Test Officer:	Richard Turner	Humidity:	67%
Test Location:	Austest Laboratories (NSW)		

13.1.1 EUT Operating Mode

- a. EUT power supply voltage - 115Vac 60Hz.
- b. Mode 2 – Constant transmit with modulation on selected channels

13.1.2 Test Method

- a. Connect the EUT antenna port directly to a spectrum analyser via a low loss RF cable, and attenuator (as necessary).
- b. Set the spectrum analyser RBW to 100kHz RBW, and the VBW to 100kHz or more.
- c. Mark the peak frequency level and note the -6dB (lower and upper) frequencies.
- d. Repeat the above for all measurement frequencies.

13.1.3 Test Results

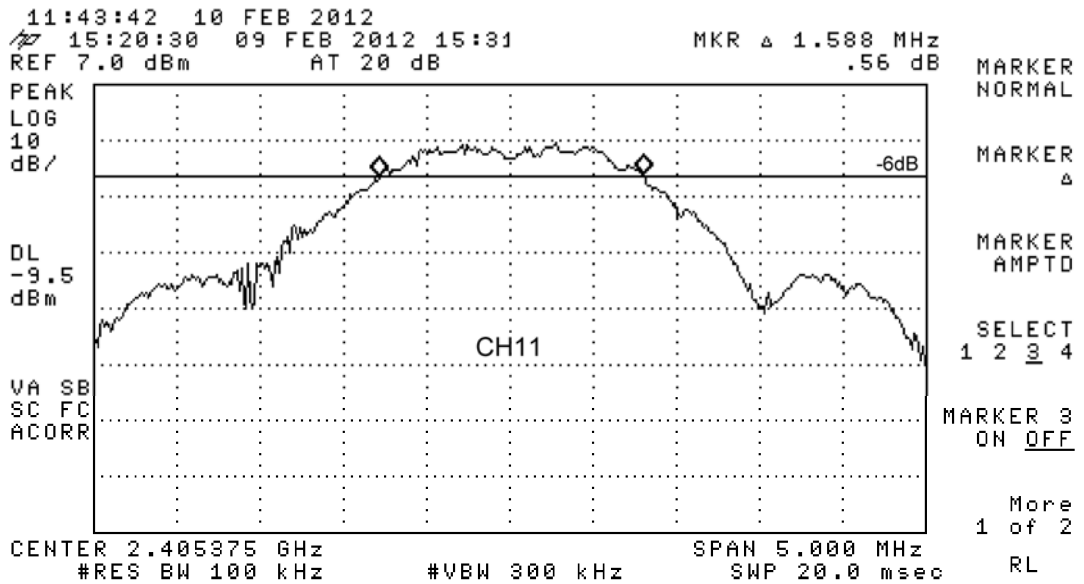
Channel	6dB Bandwidth (kHz)	6dB BW Limit (kHz)	Result
CH11 (Low)	1588	500	COMPLIES
CH18 (Mid)	1613	500	COMPLIES
CH 25 (High)	1663	500	COMPLIES

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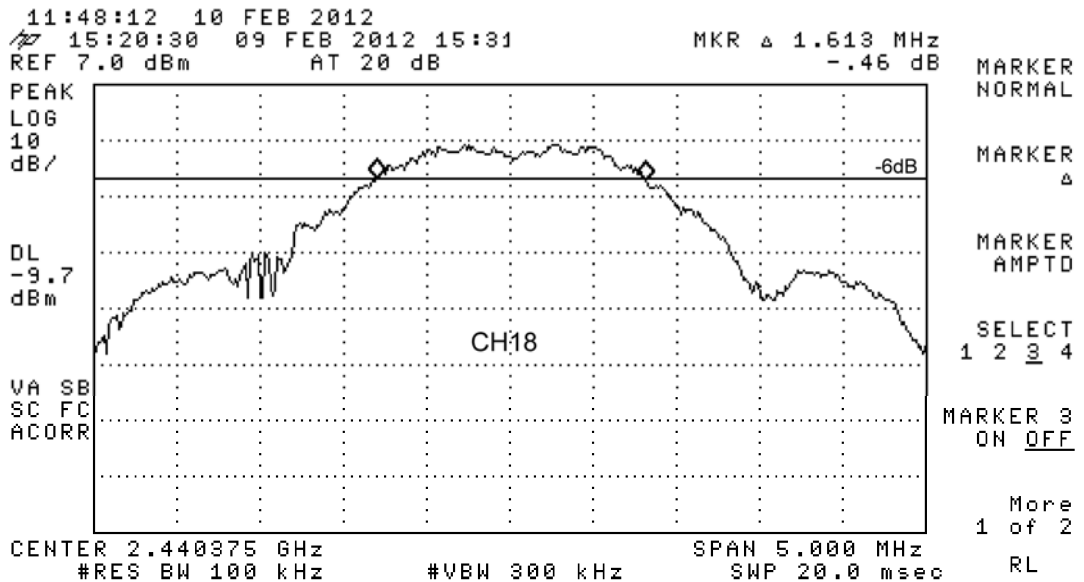
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6dB Bandwidth (Low Channel)



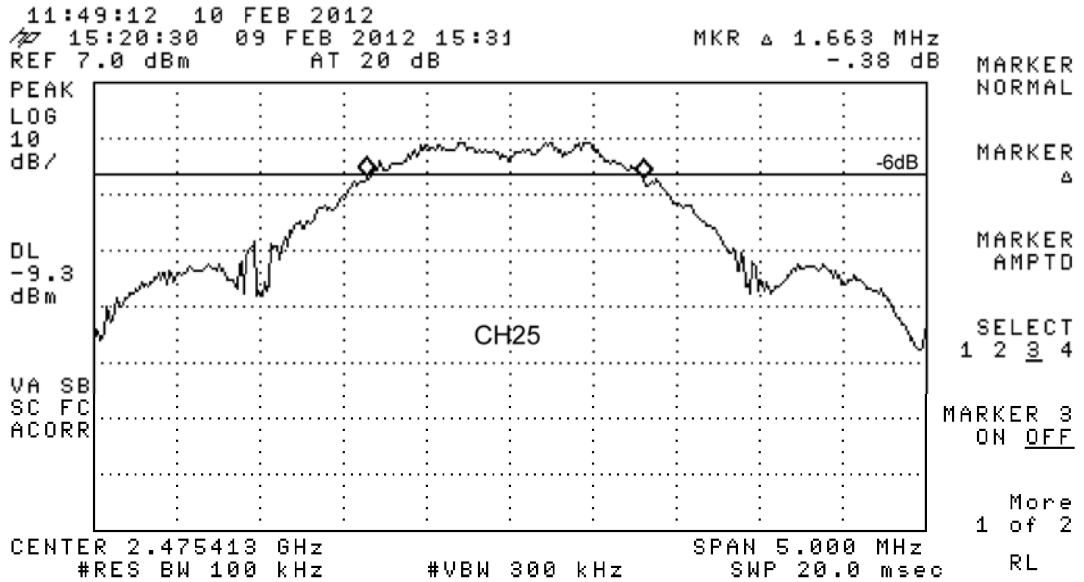
6dB Bandwidth (Mid Channel)

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6dB Bandwidth (High Channel)

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13.2 Peak Conducted Output Power – Section 15.247(b)

Test Date:	10 Feb 2012	Temperature:	26°C
Test Officer:	Richard Turner	Humidity:	67%
Test Location:	Austest Laboratories (NSW)		

13.2.1 EUT Operating Mode

- a. EUT power supply voltage - 115Vac 60Hz.
- b. Mode 2 – Constant transmit with modulation on selected channels.

13.2.2 Test Method

- a. Connect the EUT antenna port directly to a spectrum analyser via a low loss RF cable, and attenuator (as necessary).
- b. Set the spectrum analyser RBW to 1MHz, and the VBW to 1MHz or more.
- c. Use the spectrum analyser Occupied Bandwidth function set for 99% power.
- d. Power is integrated over the bandwidth.
- e. Record the maximum reading.
- f. Repeat the above for all measurement frequencies.

13.2.3 Test Results

The EUT was supplied with an external antenna having a gain of 7dBi. Section 15.247 (b) (4) indicates that for antennas whose gain exceeds 6dBi, the specified limit of 1W should be reduced by the amount in dB above 6dBi, in this case 1dB.

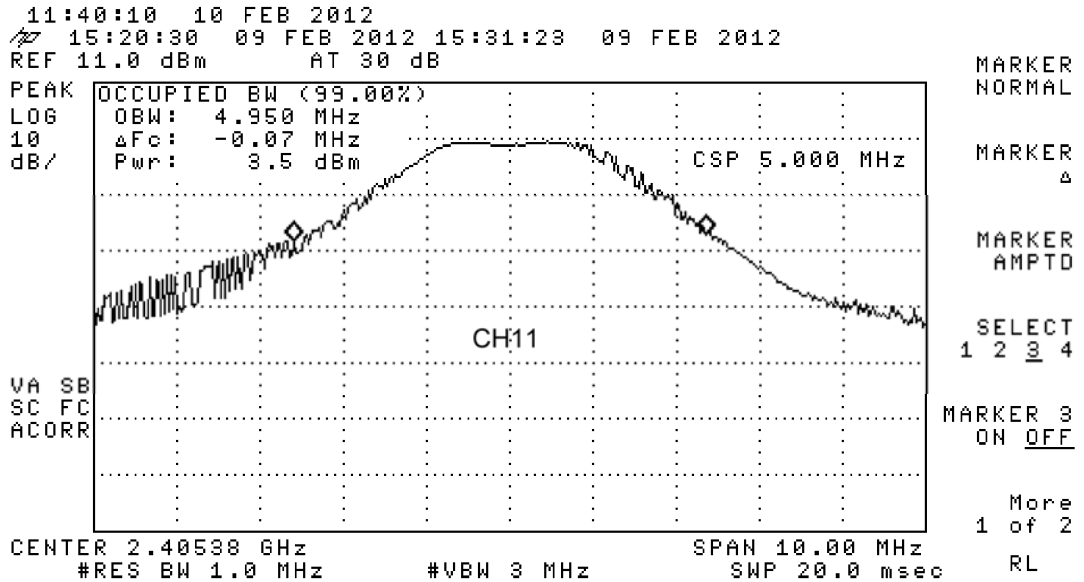
Channel	Output Power		Power Limit		Below Limit (dB)
	(dBm)	(mW)	(dBm)	(mW)	
CH11 (Low)	3.5	2.2	29.0	794	25.5
CH18 (Mid)	3.5	2.2	29.0	794	25.5
CH25 (High)	3.8	2.4	29.0	794	25.2

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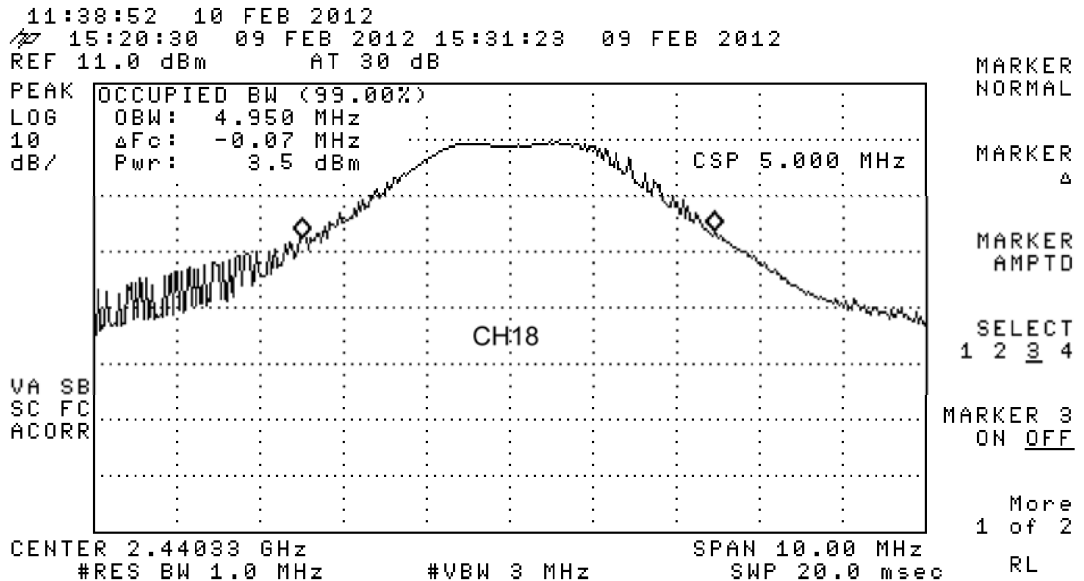
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Peak Power (Low Channel)



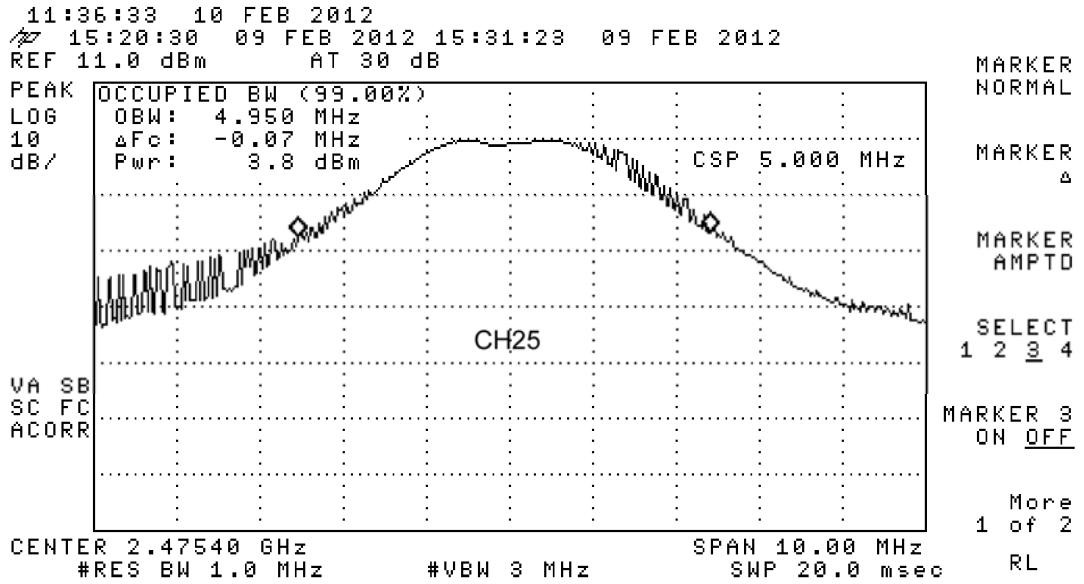
Peak Power (Mid Channel)

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Peak Power (High Channel)

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13.3 Out-of-Band Emissions – Section 15.247(d)

Test Date:	10 Feb 2012	Temperature:	26°C
Test Officer:	Richard Turner	Humidity:	67%
Test Location:	Austest Laboratories (NSW)		

13.3.1 EUT Operating Mode

- a. EUT power supply voltage - 115Vac 60Hz.
- b. Mode 2 – Constant transmit with modulation on selected channels.

13.3.2 Test Method

- a. Connect the EUT antenna port directly to a spectrum analyser via a low loss RF cable, and attenuator (as necessary).
- b. Set the spectrum analyser RBW to 100kHz, and the VBW to 100kHz or more.
- c. Record the highest in band level.
- d. Sweep through the frequency range to locate the highest out of band emissions.
- e. Ensure that any out of band emissions are greater than 20dB below the recorded in band level.
- f. Ensure that any emissions that fall within the restricted bands specified in section 15.205 also meet the radiated emission limits specified in section 15.209.
- g. Repeat the above for all measurement frequencies.

13.3.3 Test Results

Frequency range: 7 to 25000MHz
 Highest measured out of band emission level was at 4809.8MHz which was 37dB below the in band level, with CH11 selected

Frequency (MHz)	Channel	Peak Level (dBm)	In-Band Peak Level (dBm)	Out of Band Limit (dBm)	Limit (dB)
4809.8	CH11	-41.0	-4.0	-24.0	-17.0
4879.8	CH18	-41.3	-4.0	-24.0	-17.3
4949.8	CH25	-43.2	-4.0	-24.0	-19.2
2399.6*	CH11	-47.2	-4.0	-24.0	-23.2
2483.8*	CH25	-50.4	-4.0	-24.0	-26.4

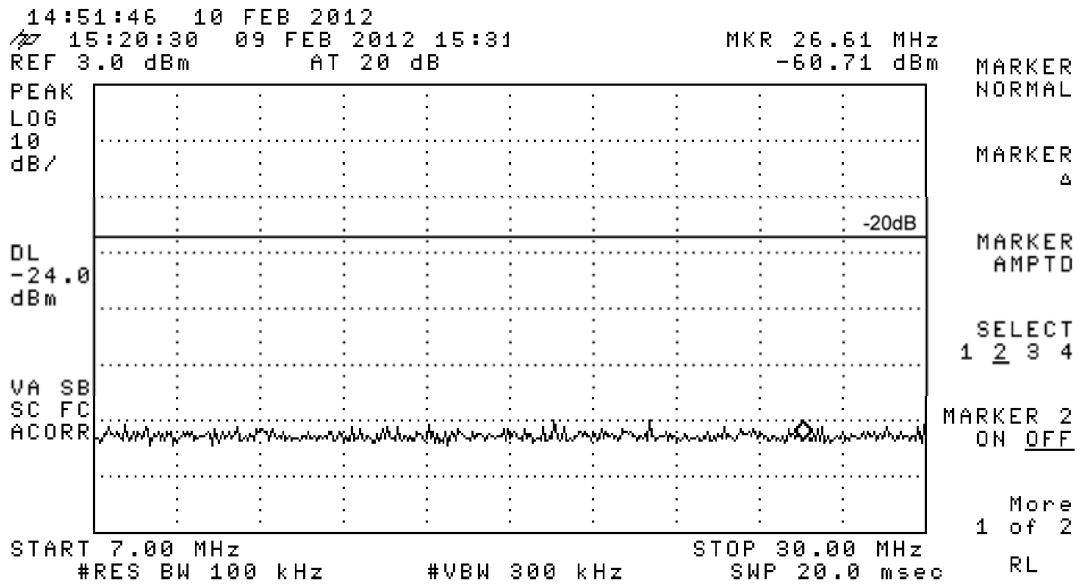
*Measurement at the band edge.

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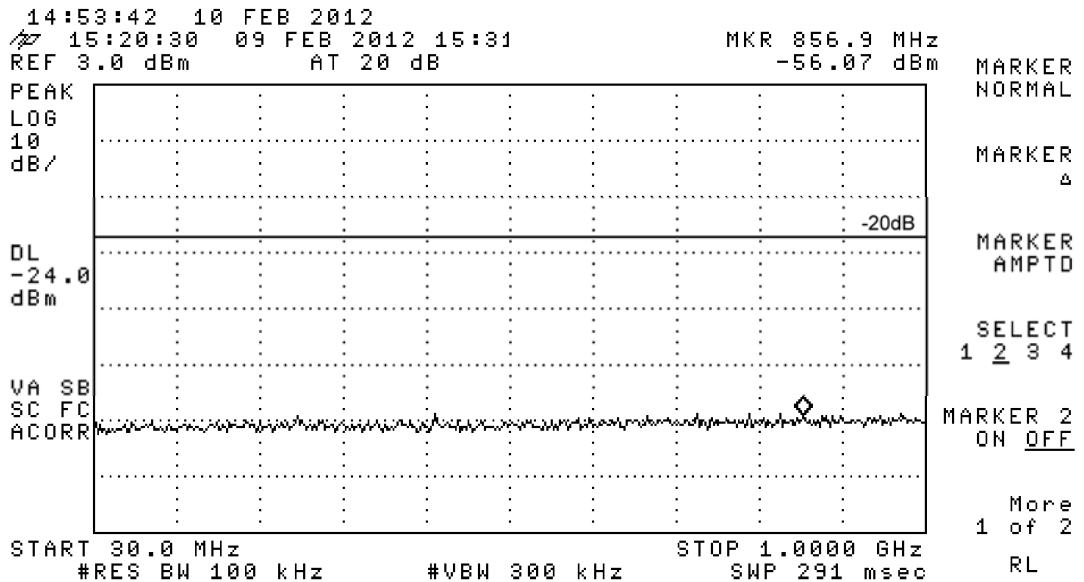
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Out-of-Band Emissions (7MHz to 30MHz)



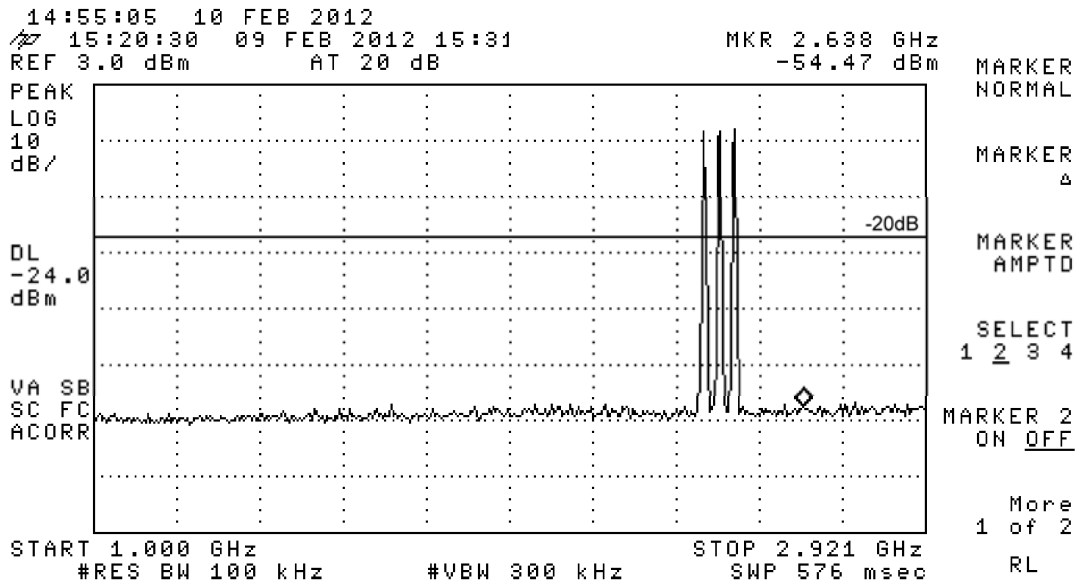
Out-of-Band Emissions (30MHz to 1000MHz)

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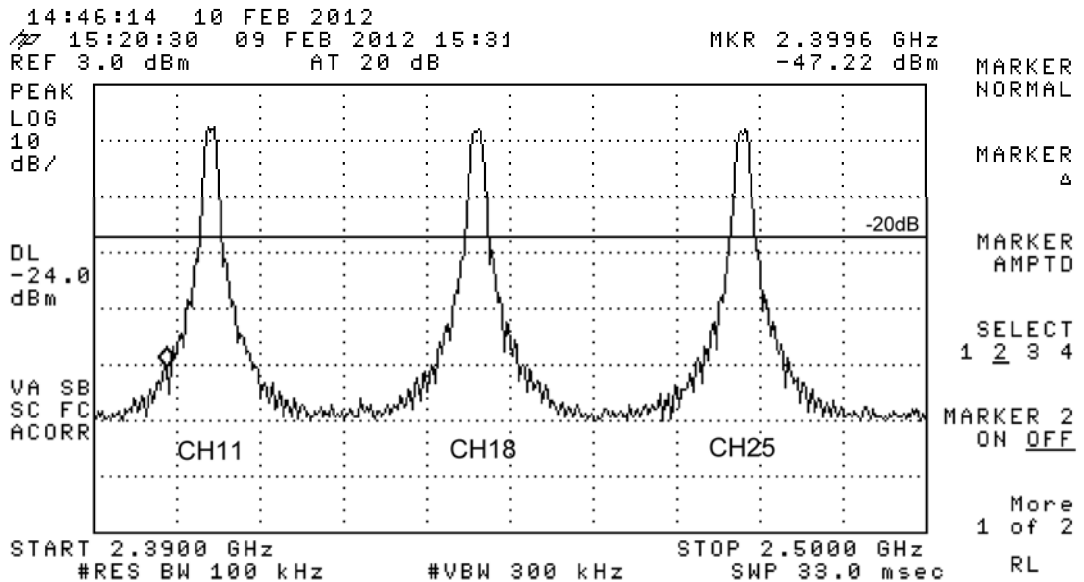
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Out-of-Band Emissions (1000MHz to 2900MHz)



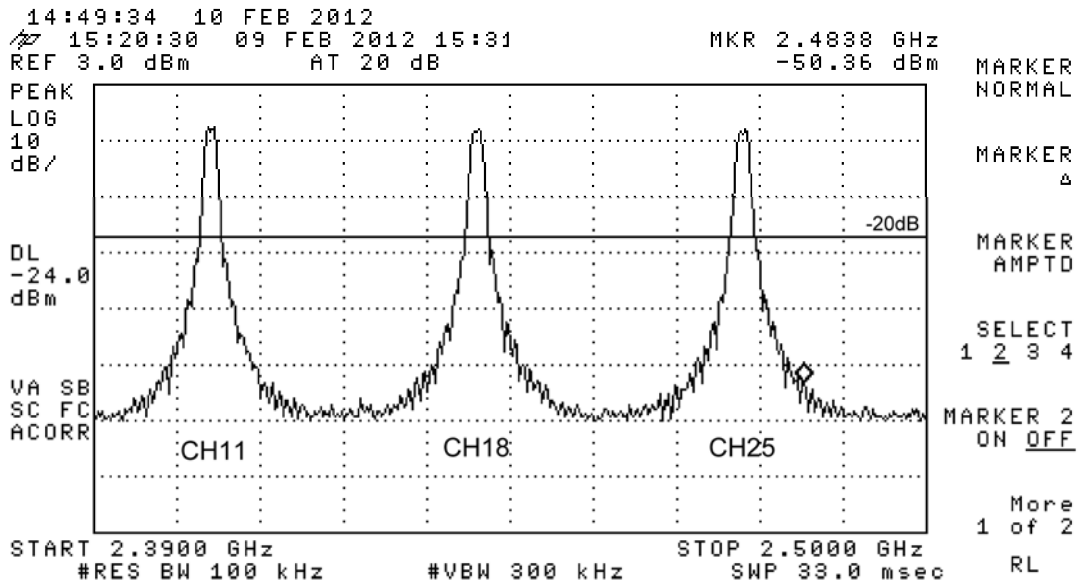
Out-of-Band Emissions (2400MHz)

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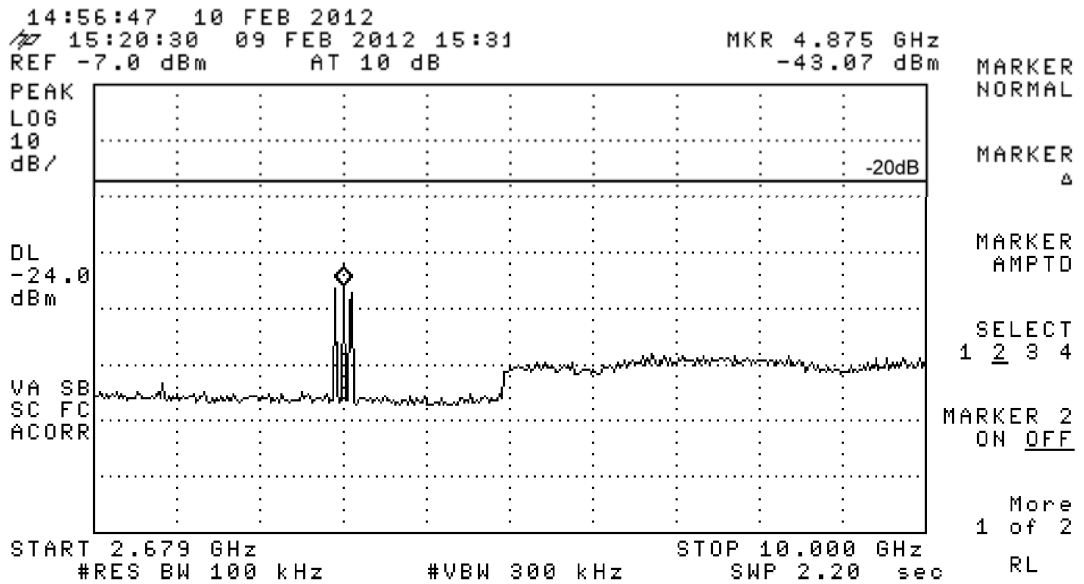
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Out-of-Band Emissions (2483MHz)



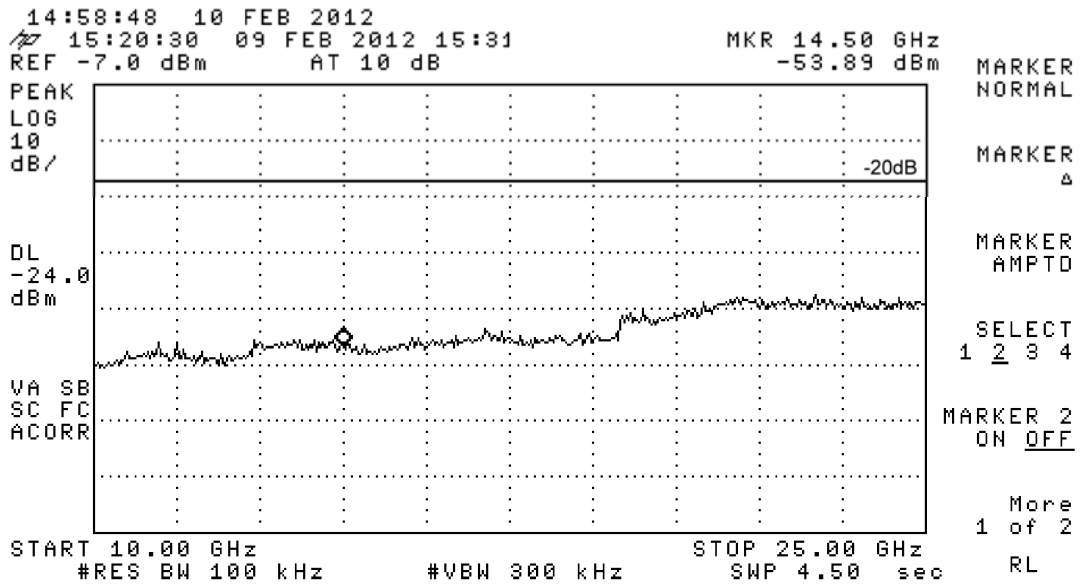
Out-of-Band Emissions (2600MHz to 10000MHz)

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Out-of-Band Emissions (10000MHz to 25000MHz)

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13.4 Peak Power Spectral Density – Section 15.247(e)

Test Date:	10 Feb 2011	Temperature:	26°C
Test Officer:	Richard Turner	Humidity:	67%
Test Location:	Austest Laboratories (NSW)		

13.4.1 EUT Operating Mode

- a. EUT power supply voltage - 115Vac 60Hz.
- b. Mode 2 – Constant transmit with modulation on selected channels.

13.4.2 Test Method

- a. Connect the EUT antenna port directly to a spectrum analyser via a low loss RF cable, and attenuator (as necessary).
- b. Set the spectrum analyser RBW to 3kHz, VBW to 10kHz, span 300kHz and sweep to 100secs.
- c. Record the maximum reading.
- d. Repeat the above for all measurement frequencies.

13.4.3 Test Results

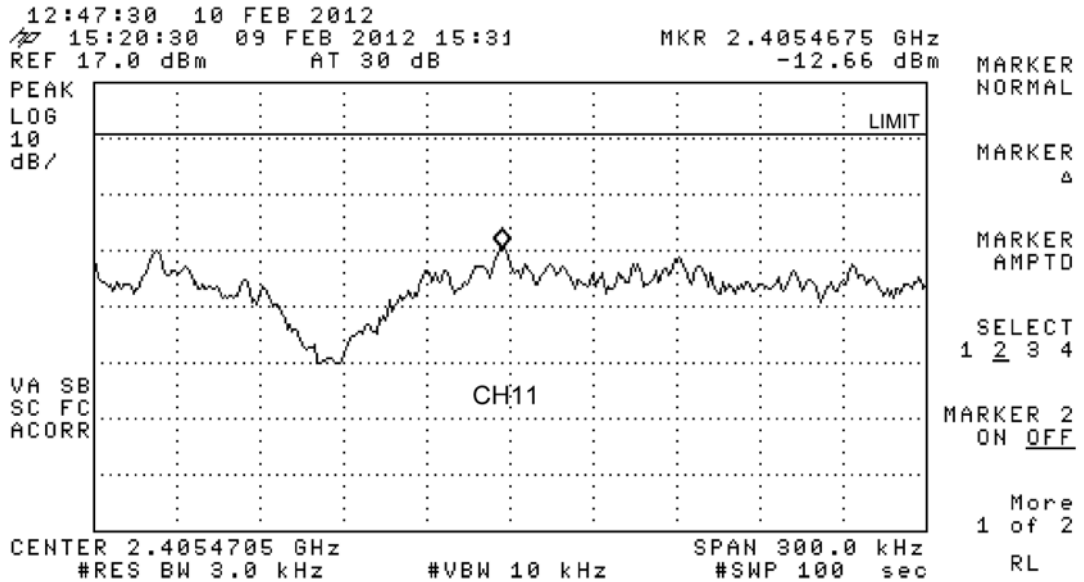
Channel	Frequency (MHz)	Power Density Level per 3kHz (dBm)	Power Density Limit (dBm)	Below Limit (dB)
CH11 (Low)	2405.47	-12.7	8.0	20.7
CH18 (Mid)	2440.85	-11.8	8.0	19.8
CH25 (High)	2475.85	-12.3	8.0	20.3

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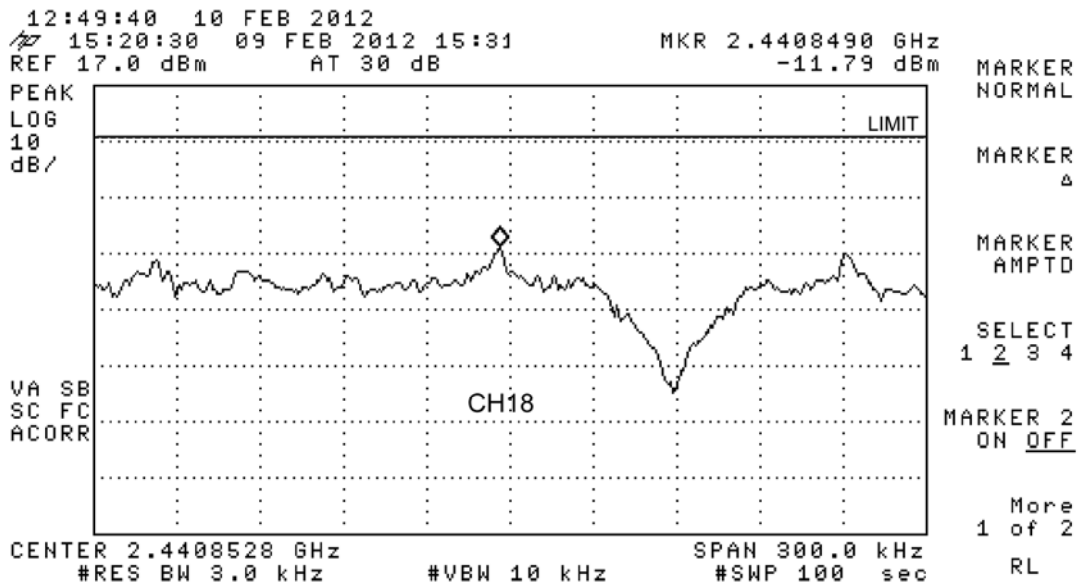
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Power Spectral Density (Low Channel)



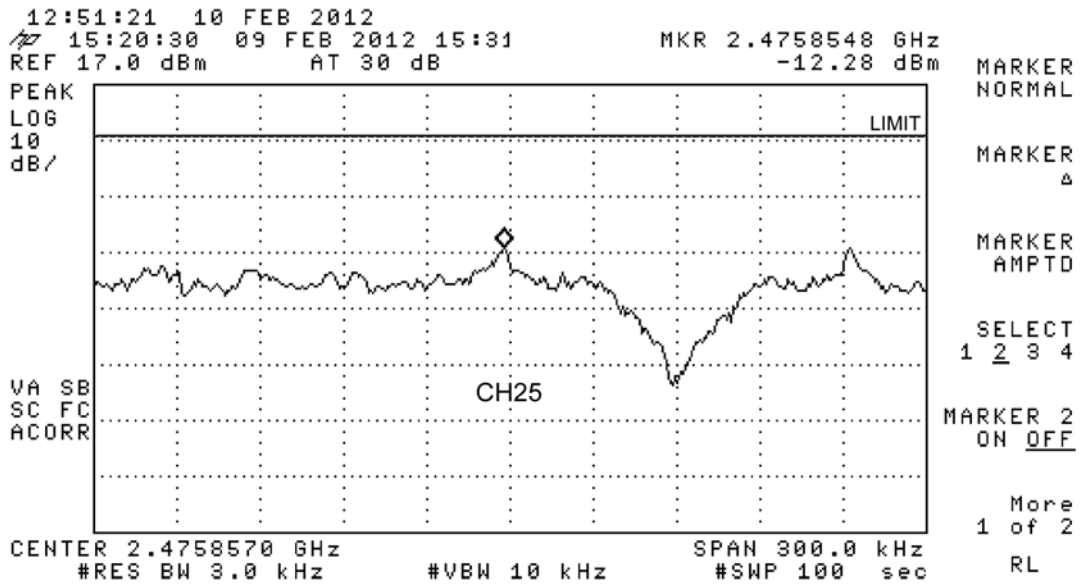
Power Spectral Density (Mid Channel)

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Power Spectral Density (High Channel)

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APPENDIX A – PHOTOGRAPHIC RECORD OF EUT



EUT Overview



EUT Bottom Ports

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EUT Top Ports



EUT Internal View & PCB (Component Side)

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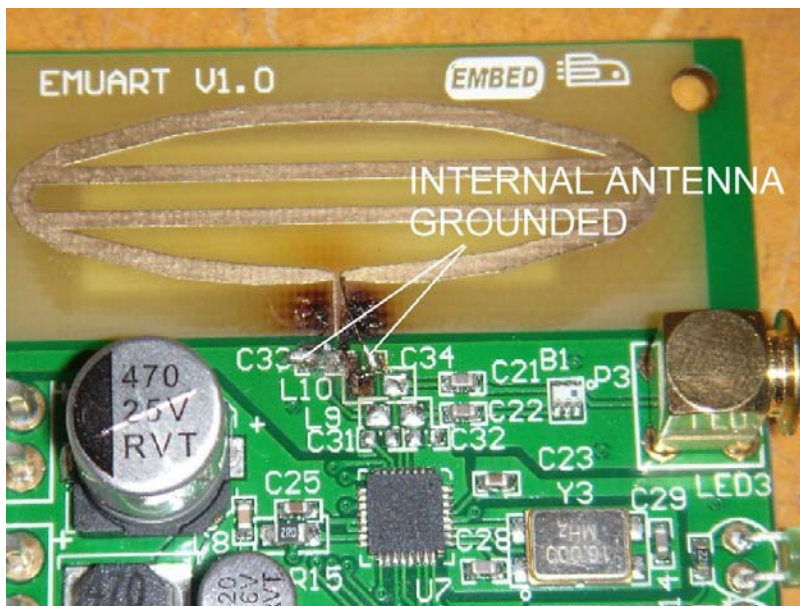
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EUT PCB (Trace Side)



EUT PCB (RF Circuit with Internal Antenna Grounded (not used))

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EUT External Antenna

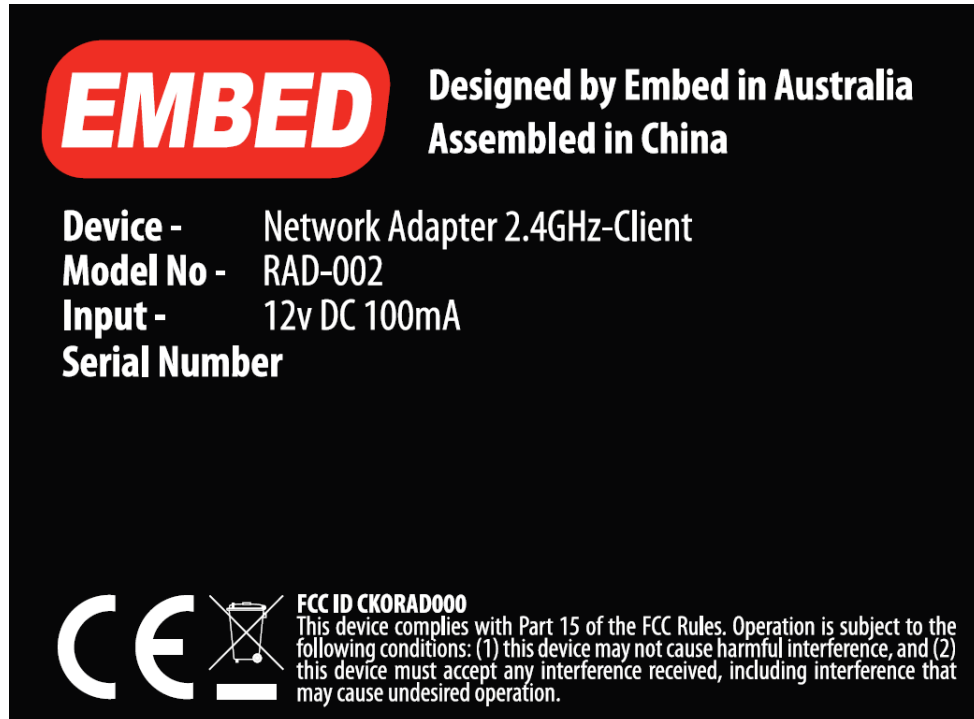
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APPENDIX B – FCC LABEL & LOCATION



FCC Label



FCC Label Location on EUT

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APPENDIX C – EUT TEST SETUP PHOTOGRAPHS



Conducted Disturbance Test Setup



Conducted Disturbance Test Setup

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Radiated Disturbance Test Setup



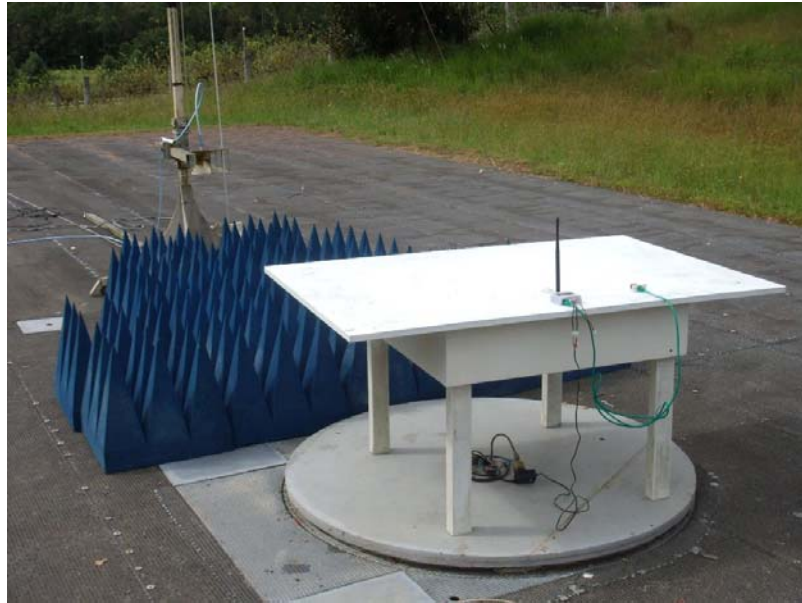
Radiated Disturbance Test Setup

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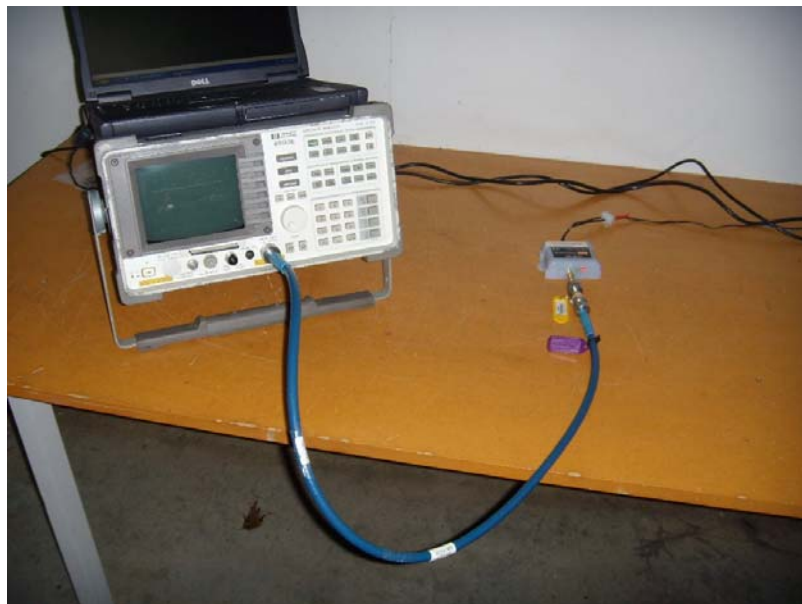
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Radiated Disturbance Test Setup



RF Conducted Test Setup

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