COMPLIANCE TESTING REPORT
FCC TITLE 47 PART 15
SUBPART C

Client:	Locata Corporation Pty Ltd
Address:	111 Canberra Avenue Griffith ACT 2603, Australia
Report Number:	0514LOC_ASY-010007-1_fcc15c
Date of Testing:	6th December 2013 to 18th March 2014
File Number:	LOC121022
Equipment Name:	LocataLite G4
Equipment Model Number:	ASY-010007-1
Equipment Serial Number:	00219
Equipment FCC ID:	ARW-LOCLITEG4
Equipment Description:	Radio location transceiver (four transmitters operating on two 2.4GHz RF CH)
Result:	COMPLIES
Tested by:	Richard Turner
Approved by:	Colin Gan
Date of Issue:	14th May 2014

AUSTEST (NSW) FCC REGISTRATION NUMBER 90455

Results appearing herein relate only to the sample(s) tested.

This report is issued within the scope of A2LA accreditation #2765.02.

Accredited for compliance with ISO / IEC 17025.
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ACCREDITED
TEST LABORATORY
CERT #2765.02

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Report Revision History:

Date	Report Number	Changes
03rd June 2013	0603LOC_LocataLite_ASY_010007_1_fccab_c	Original Report.
22nd April 2014	0422LOC_ASY-010007-1_fcc15c	Retest report based on latest KDB 558074 version (i.e. v03r01) & with EUT outside transport case.
14th May 2014	0514LOC_ASY-010007-1_fcc15c	EUT description amendment on cover. Revisions to pp 6, 8 & 30.

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 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)
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

No modifications were required to achieve compliance.

3 REFERENCES

FCC Title47 Part 15 current as of March 2014
ANSI C63.10: 2009
KDB Publication 558074 D01 DTS Meas Guidance v03r01, 09/04/2013
KDB Publication 662911 D01 Multiple Transmitter Output v02r01, 31/10/2013

4 EQUIPMENT UNDER TEST (EUT) DESCRIPTION

EUT Name:	LocataLite G4
EUT Description:	Radio location transceiver, transmitting four signals simultaneously (two identical 2.4GHz RF channels on each antenna, using different CDMA codes)
EUT Model:	ASY-0010007-1
EUT Serial Number:	00219
EUT FCC ID:	ARW-LOCLITEG4
Manufacturer:	Locata Corporation Pty Ltd
Power Supply & Rating:	11-28V, max 40W
Highest Clock/Operating Frequency:	2.5GHz (PCI Bus)
Lowest Internal Frequency source	750kHz (switching regulator)
Transmit Frequency Range:	TX1 mode: 2411MHz and 2473MHz TX2 mode: 2411MHz and 2462MHz
Transmit Power:	TX1 mode: 7dBm TX2 mode: 24dBm
Modulation Technique:	BPSK
Number of Channels:	Transmission on 2 fixed channels
Antenna Specifications:	Two external transmit antennas and one external receiver antenna. AeroAntenna Technology Inc. AT2400-2W-TNCM-008-00-05-L, 5dBi gain.

The equipment under test (EUT) was a radio location transceiver unit, transmitting and receiving positional data signals from four transmitters on two RF channels in the 2.4GHz band.

The EUT is housed in a metal case, containing a main transmit PBA and a receive PBA. Two individual transmitter PBAs were located on the main transmit PBA, one for each antenna port. Each transmitter PBA has two transmitter circuits for transmission on the two fixed channels.
The client advised that the transmitter circuits transmit positional data simultaneously on two frequency channels from both antennas. Each antenna transmits the same two RF channel frequencies, but using different CDMA codes.

The EUT was operating under release version “v8r0” of the loclite code.

The EUT was labelled:
ASY-010007-1 R1.1
Locata LocataLite
SN 00219

The EUT was supplied with the two external transmitting antennas and one external receiving antenna. All antennas were identical, AeroAntenna Technology Inc. AT2400-2W-TNCM-008-00-05-L.

The EUT is usually powered by a solar panel, typically 13.8V regulated output. The EUT can also be powered from a vehicle battery supply or from an AC/DC adaptor. DC power supply range 11-28V.

5 EUT TEST SETUP & CONFIGURATION

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

In the test setup, shown in Appendix C, the following cables and auxiliary equipment were used.

EUT Port	External Connecting Cable	Source / Load
RX	Shielded 5m coaxial cable, bundled	Supplied antenna
A1	Unshielded 1.2m multicore cable	Supplied terminations
A2	Unshielded 1.2m multicore cable	Supplied terminations
TX1	Shielded 5m coaxial cable, bundled	Supplied antenna
TX2	Shielded 5m coaxial cable, bundled	Supplied antenna
Serial	Shielded 2m cable to two DB9 connections, bundled-	See below*
USB	Shielded 0.8m cable	Supplied Shintaro card reader
LAN	Shielded 2.8m CAT5 cable	Test PC
Power	1.9m cabling, bundled	Connected to the supplied AC adaptor
Mains Power (AC adaptor)	1.2m unshielded 3 core mains lead	115VAC 60Hz mains supply

* Both DB9 connections were terminated by connection to each other using a 1.8m shielded DB9 cable which was also bundled.

The supplied antennas were mounted vertically on a wooden support.

A network connection was established between the EUT and a test PC. Software supplied by the client allowed selection of either TX1 or TX2 modes.

For measurement of radiated emissions, the test PC was placed away from the test area.

The EUT was powered from the supplied AC adaptor. The AC adaptor was connected to the EUT by 1.9m long cabling, comprising a permanently fitted 1m long shielded DC output lead (with ferrite fitted at the load connection) and an additional 0.9m long unshielded two core power lead.

AC/DC adaptor details: MGP AC adaptor, model F10603-C, input 100-240VAC 1.8A 50-60Hz, output 12-14VDC 5.00-4.28A (12V 5A).

The AC/DC adaptor was connected to a 115VAC 60Hz mains power supply, provided by the AC source.

EUT Operating Modes

Mode No.	Operating Mode Description
TX1	Low power mode. Constant transmission with modulation on channel 02 and channel 62 from both antennas. Duty Cycle 100%.
TX2	High power mode. Constant transmission with modulation on channel 02 and channel 52 from both antennas. Duty cycle 100%.
RX	Receive only, no transmission

5.1 Transmitter Test Channels

The EUT is configured to only transmit on two channels simultaneously, a low channel and a high channel. Each of the two antennas transmit on both channels for a total of four transmissions. Each transmission is encoded with a different CDMA code. Following channels were used:

Operating mode	Channel	Transmitter Frequency (MHz)
TX1	CH02 (Low)	2411
	CH62 (High)	2473
TX2	CH02 (Low)	2411
	CH52 (High)	2462

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 C63.4-2009) 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	23 Jan 2015
Test Software	HP85969PC	-	Verified
Spectrum Analyser	HP 8593E	MEQ738	05 Jun 2014
Biconical Array Antenna	Emco EM6912	MEQ297	11 Jun 2014
Log-Periodic Array Antenna	Emco EM6950	MEQ298	10 Jun 2014
DRG Horn Antenna (1 – 18GHz)	AH Systems SAS-571	MEQ107	31 May 2016
DRG Horn Antenna (18 – 25GHz)	AH Systems SAS-200/574	MEQ600	13 Jan 2015
Loop Antenna	EM-6876	MEQ225	22 Jan 2015
Pre-Amplifier (30MHz-1GHz)	HP 8447E	MEQ74	17 Jan 2015
Pre-Amplifier (1GHz-25GHz)	RE 218A	MEQ651	15 Jan 2015
Pre-Amplifier (4.5GHz–25GHz)	RE 518A	MEQ650	15 Jan 2015
Attenuator	Omni Spectra 10dB	1022627	27 Sep 2014
AMN/LISN	Compower LI-200	MEQ80	29 Jan 2015
Coaxial Cables	Suhner	Various	Jan 2015
Multimeter	8060T	MEQ164	19 Sep 2014
Variable DC Power Supply	Austest	-	Verified
AC Source	Chroma 6512	MEQ320	Verified

All test equipment was checked and performance verified prior to testing.

6.5 Measurement Uncertainties

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

Test	Measurement Uncertainty
Mains Conducted Emissions	±2.6dB
Antenna Port Conducted Emissions	±2.6dB
Radiated Emissions	±4.7dB
Frequency	±5 part in 10^{10}

7 FCC Part 15C, Section 15.203 – ANTENNA REQUIREMENT

The EUT complies with the requirement of this Section since professional installation is required whereby “this device …, must be used in conjunction with a Locata-approved antenna as per Section 1.5.2 …”, as clearly stated in the user/installation manual (Locata-LocLite-UserManual v8r0), Clause 1.5 on page 11.

8 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 2411 to 2473MHz.

9 FCC Part 15C, Section 15.207 - CONDUCTED LIMITS

Test Date:	17/03/14	Temperature:	23°C
Test Officer:	Richard Turner	Humidity:	54%
Test Location:	Austest Laboratories (NSW)		

9.1 EUT Operating Mode

a. Mains power supply voltage – 115VAC 60Hz.
b. TX1 Mode. Duty cycle 100%.
c. TX2 Mode. Duty cycle 100%.

9.2 Test Method

a. Measurements are performed in accordance with ANSI C63.10-2009.
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. 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.
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 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.

9.3 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 dBµV for comparison to the limit.
V	=	EMI Receiver measured signal input voltage in dBµV.
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 (dBµV)	L_{cbl} (dB)	L_{LISN} (dB)	$L_{limiter}$ (dB)	Corrected Level, Vc (dBµV)
1.0	40.0	0.1	0.1	N.A.	40.2

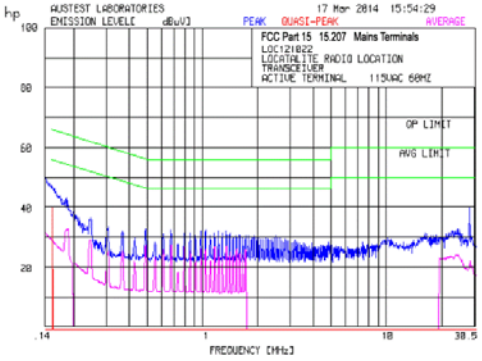
9.4 Test Results

Both TX modes were assessed to determine worse case. No significant difference in emission levels was noted between either TX mode. Final measurement was made using TX2 mode (high power).

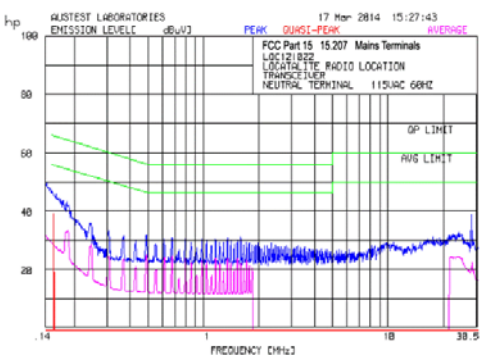
TX2 Mode

The highest measured average level was 18.6dB below the average limit at 0.68MHz.
All measured disturbances were greater than 20dB below the Class B quasi-peak limits.

Frequency MHz	Terminal	Av Level dBuV	Av Limit dBuV	Below Limit dB
0.68	Active	27.4	46.0	18.6
0.49	Active	27.3	46.1	18.8
1.35	Active	27.0	46.0	19.0
0.80	Active	26.7	46.0	19.3
1.16	Active	26.7	46.0	19.3
0.98	Active	26.1	46.0	19.9



Active Terminal



Neutral Terminal

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

Test Dates:	06/12/13, 13/02/14, 01/03/14, 17/03/14	Temperature:	23-32°C
Test Officer:	Richard Turner	Humidity:	54-68%
Test Location:	Austest Laboratories (NSW)		

10.1 EUT Operating Mode

a. Mains power supply voltage – 115VAC 60Hz.
b. TX1 Mode. Duty Cycle 100%.
c. TX2 Mode. Duty Cycle 100%.

10.2 Test Method

a. Measurements are performed in accordance with ANSI C63.10-2009 and KDB 558074 D01 DTS Meas Guidance v03r01.
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.
g. Check linearity of the measuring system, reducing gain when required.

10.3 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 dBµV/m at the specified distance.
V = EMI Receiver measured signal input voltage in dBµV.
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 (dBµV)	AF (dB/m)	Lcbl (dB)	Gpre (dB)	Corrected Level, E (dBµV/m)
100.0	40.0	12.0	2.9	22.5	32.4

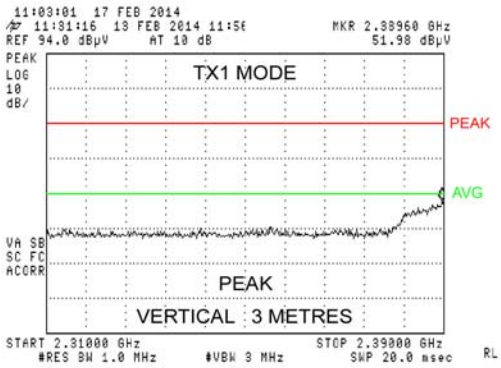
10.4 Test Results

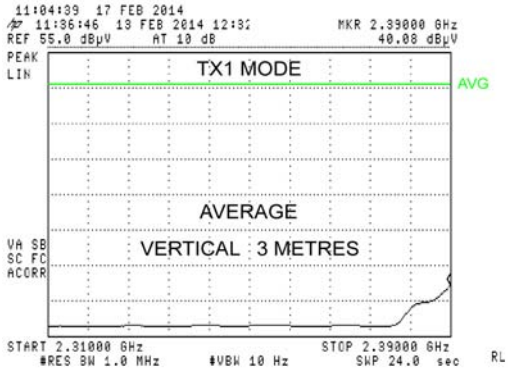
10.4.1 Band edge measurements at 3m distance

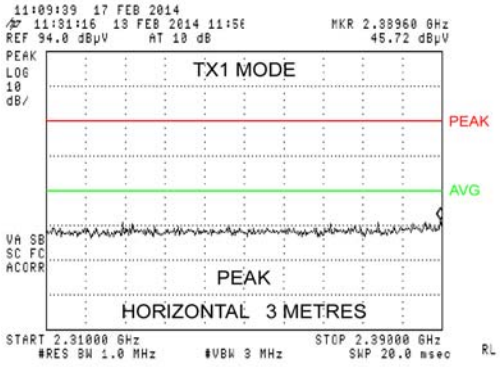
15.209 limit: 500µV/m using average detection. Peak limit set to 20dB above the average limit.

TX1 Mode - Restricted band 2310 to 2390MHz

Frequency MHz	Polarisation	Level dBuV/m		Limit dBuV/m		ΔPk Limit dB	Δ Avg Limit dB
		Peak	Average	Peak	Average		
2389.6	Vertical	52.0	-	74.0	-	-22.0	-
2390.0	Vertical	-	40.1	-	54.0	-	-13.9
2389.6	Horizontal	45.7	-	74.0	-	-28.3	-

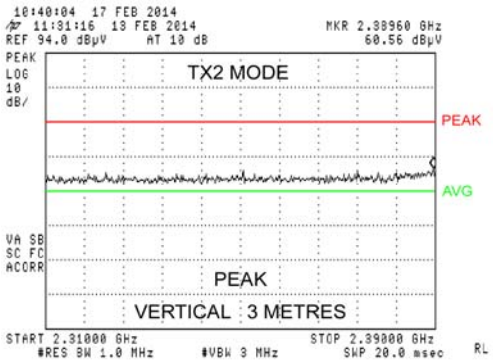


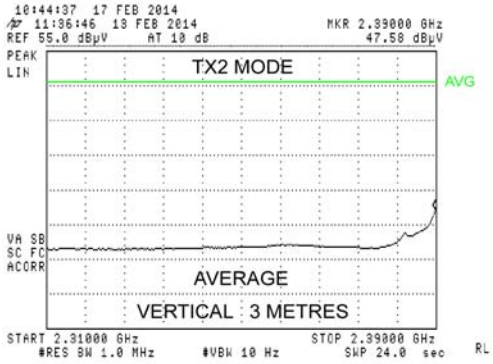


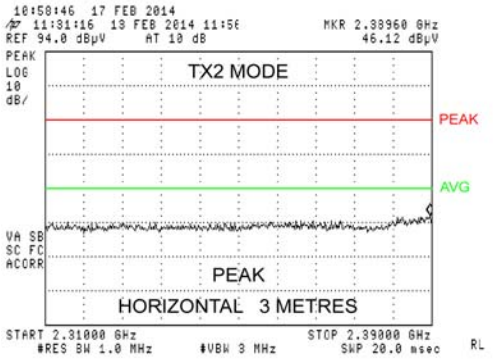


TX2 Mode - Restricted band 2310 to 2390MHz

Frequency MHz	Polarisation	Level dBuV/m		Limit dBuV/m		ΔPk Limit dB	Δ Avg Limit dB
		Peak	Average	Peak	Average		
2389.6	Vertical	60.6	-	74.0	-	-13.4	-
2390.0	Vertical	-	47.6	-	54.0	-	-6.4
2389.6	Horizontal	46.1	-	74.0	-	-27.9	-



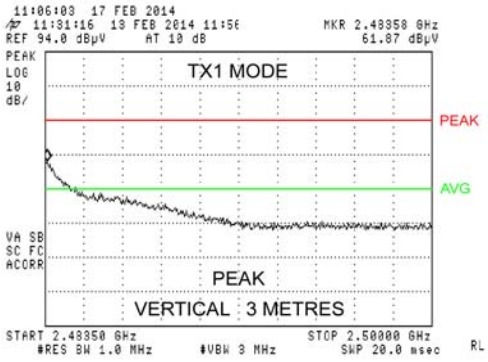


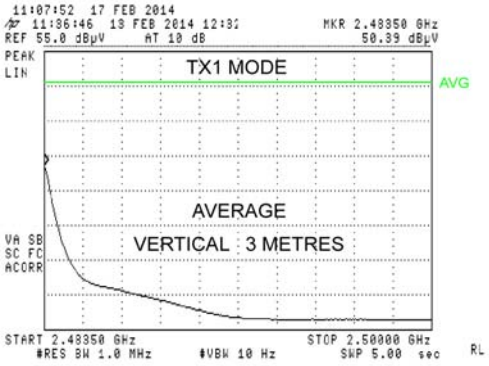


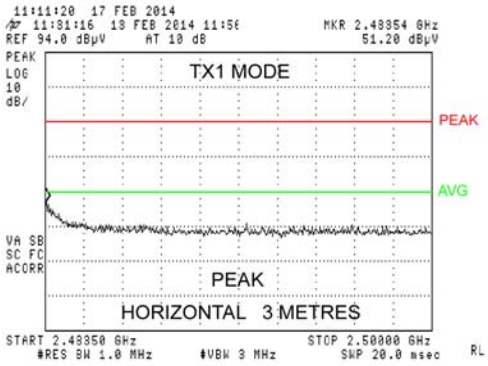
TX1 Mode - Restricted band 2483.5 to 2500MHz

Frequency MHz	Polarisation	Level dBuV/m		Limit dBuV/m		ΔPk Limit dB	Δ Avg Limit dB
		Peak	Average	Peak	Average		
2483.6	Vertical	61.9	-	74.0	-	-12.1	-
2483.5	Vertical	-	50.4	-	54.0	-	-3.6*
2483.5	Horizontal	51.2	-	74.0	-	-22.8	-

*Result was within the laboratory's measurement uncertainty.



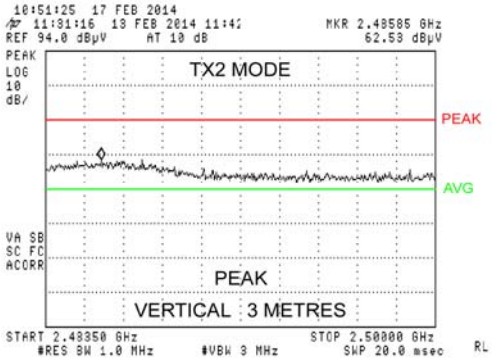


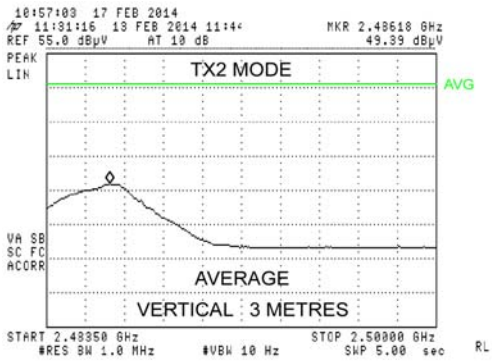


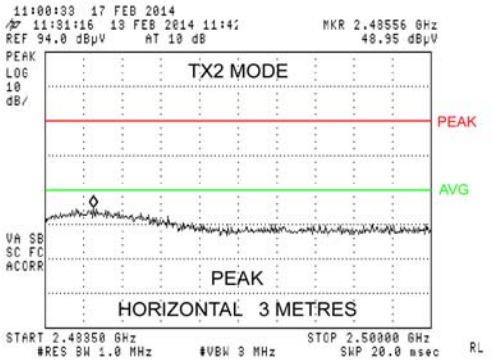
TX2 Mode - Restricted band 2483.5 to 2500MHz

Frequency MHz	Polarisation	Level dBuV/m		Limit dBuV/m		ΔPk Limit dB	Δ Avg Limit dB
		Peak	Average	Peak	Average		
2485.9	Vertical	62.5	-	74.0	-	-11.5	-
2486.2	Vertical	-	49.4	-	54.0	-	-4.6*
2485.6	Horizontal	49.0	-	74.0	-	-24.6	-

*Results were within the laboratory's measurement uncertainty.





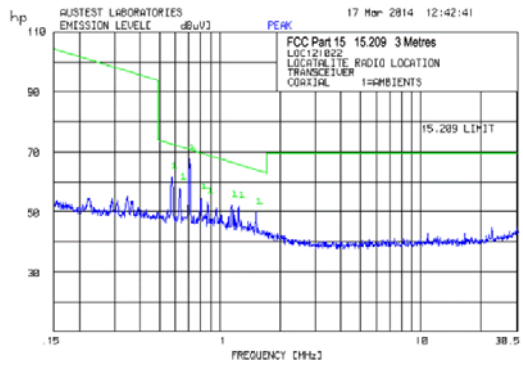


10.4.2 Radiated Disturbances: 150kHz to 30MHz at 3m distance

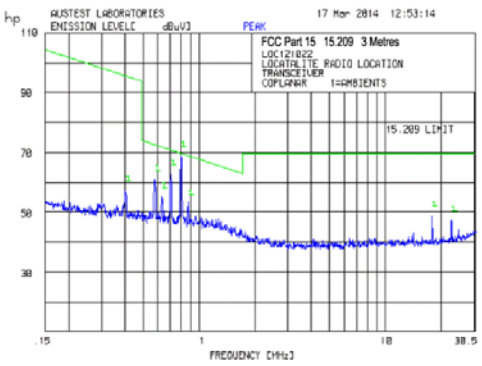
Both TX modes were assessed to determine worse case. No significant difference in emission levels was noted between either TX mode. Final measurement was made using TX2 mode (high power).

TX2 Mode

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



Coaxial Orientation



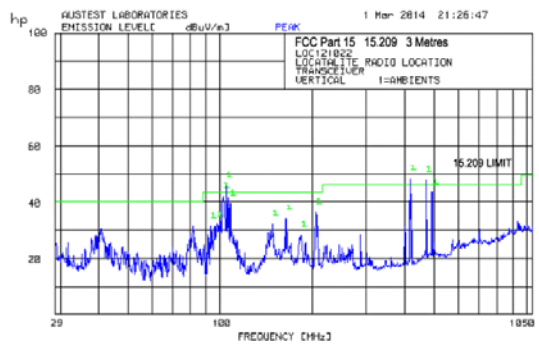
Coplanar Orientation

10.4.3 Radiated Disturbances: 30MHz to 1000MHz at 3m distance

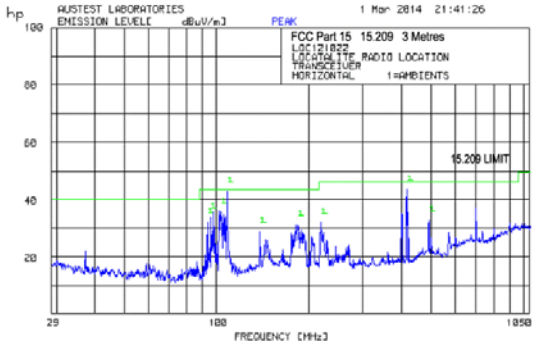
Both TX modes were assessed to determine worse case. No significant difference in emission levels was noted between either TX mode. Final measurement was made using TX2 mode (high power).

TX2 Mode

All measured intentional radiation was greater than 10dB below the limits specified in section 15.209. Radiation from other sources (unintentional) was assessed to the requirements specified in FCC part 15 subpart B.



Vertical Polarisation



Horizontal Polarisation

10.4.4 Radiated Disturbances: 1000MHz to 18000MHz at 3m distance

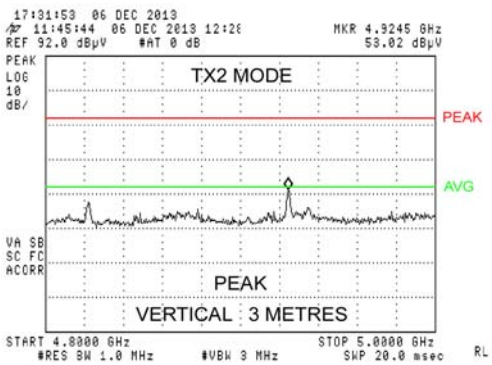
15.209 limit: 500µV/m using average detection. Peak limit set to 20dB above the average limit.

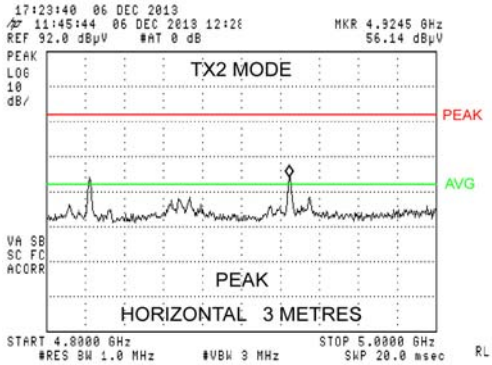
TX1 Mode
All measured intentional radiation was greater than 10dB below the limits specified in section 15.209.

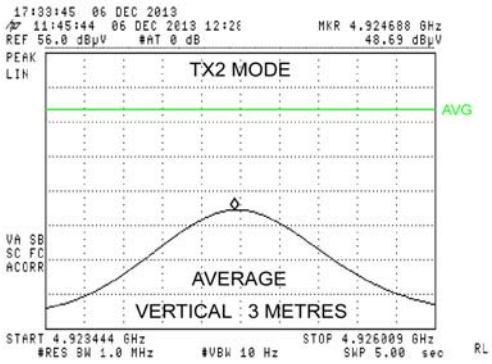
TX2 Mode
The highest measured peak level was at 4924.7MHz. Peak level 56.6dBµV/m, 17.4dB under the limit. Average level 53.5dBµV/m, 0.5dB under the limit.

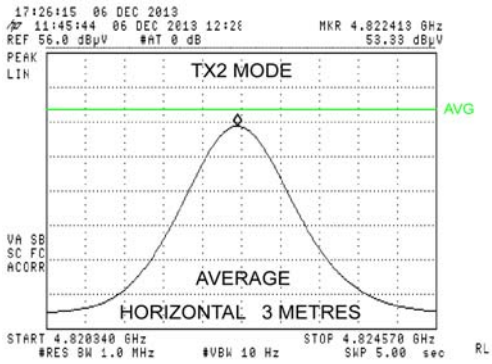
Frequency MHz	Polarisation	Level dBuV/m		Limit dBuV/m		ΔPk Limit dB	Δ Av Limit dB
		Peak	Average	Peak	Average		
4924.7	Horizontal	56.6	53.5	74.0	54.0	-17.4	-0.5*
4822.4	Horizontal	56.1	53.3	74.0	54.0	-17.9	-0.7*
4924.7	Vertical	53.0	48.7	74.0	54.0	-21.0	-5.3
4935.0	Horizontal	51.1	-	74.0	-	-22.9	-
4822.4	Vertical	50.5	-	74.0	-	-23.5	-
4868.5	Horizontal	50.4	-	74.0	-	-23.6	-

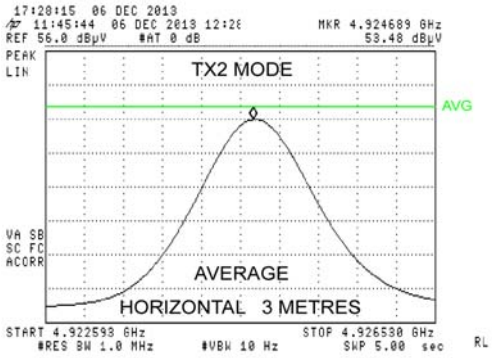
* Result was within the laboratory's measurement uncertainty.











10.4.5 Radiated Disturbances: 18000MHz to 25000MHz

Preliminary measurements indicated no significant radiation between 18000MHz and 25000MHz in either TX mode.

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

11.1 6dB Bandwidth - Section 15.247(a)(2)

Test Date:	18/03/14	Temperature:	26°C
Test Officer:	Richard Turner	Humidity:	67%
Test Location:	Austest Laboratories (NSW)		

11.1.1 EUT Operating Mode

a. Mains power supply voltage – 115VAC 60Hz.
b. TX1 Mode. Duty cycle 100%.
c. TX2 Mode. Duty cycle 100%.

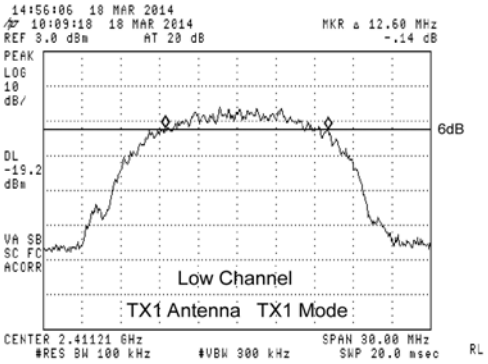
11.1.2 Test Method

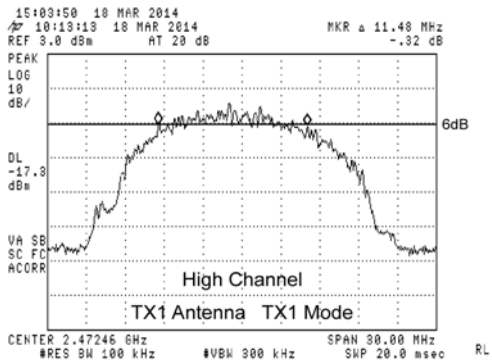
a. Measurements are performed in accordance with ANSI C63.10-2009 and KDB 558074 D01 DTS Meas Guidance v03r01.
b. Connect the EUT antenna port directly to a spectrum analyser via a low loss RF cable, and attenuator (as necessary).
c. Set the spectrum analyser RBW to 100kHz RBW, and the VBW to 300kHz.
d. Mark the peak frequency level and note the -6dB (lower and upper) frequencies.
e. Repeat the above for both low and high channels and at the second antenna port.

11.1.3 Test Results

TX1 Antenna – TX1 Mode

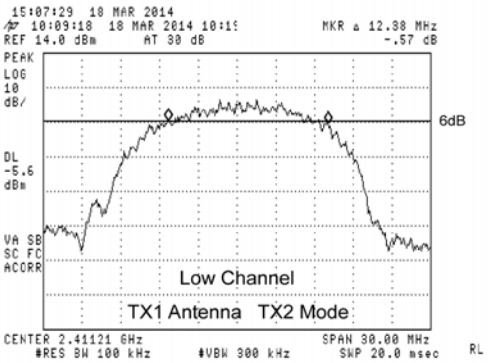
Channel	6dB Bandwidth (MHz)	6dB BW Limit (kHz)	Result
Low	12.60	>500	COMPLIES
High	11.48	>500	COMPLIES

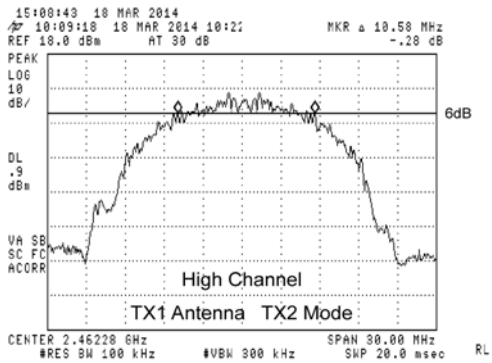




TX1 Antenna – TX2 Mode

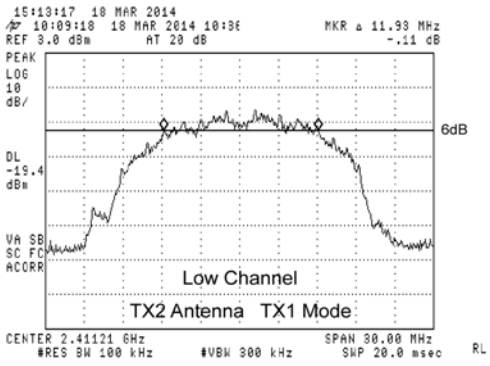
Channel	6dB Bandwidth (MHz)	6dB BW Limit (kHz)	Result
Low	12.38	>500	COMPLIES
High	10.58	>500	COMPLIES

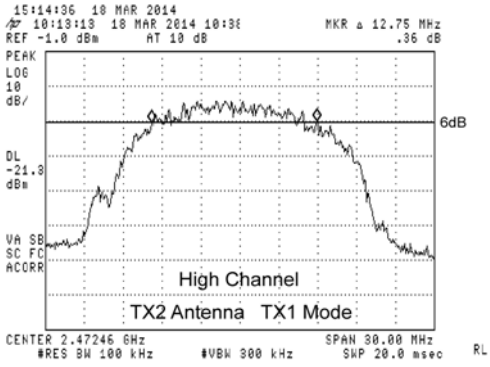




TX2 Antenna – TX1 Mode

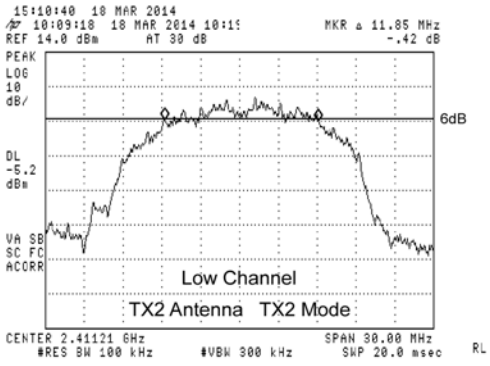
Channel	6dB Bandwidth (MHz)	6dB BW Limit (kHz)	Result
Low	11.93	>500	COMPLIES
High	12.75	>500	COMPLIES

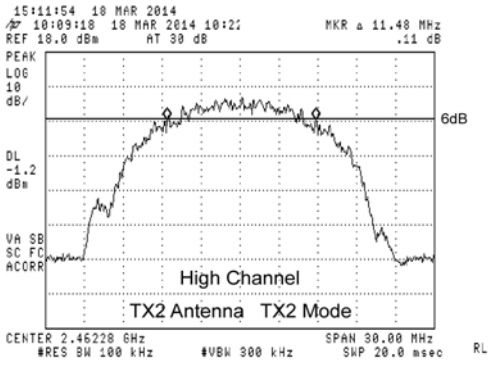




TX2 Antenna – TX2 Mode

Channel	6dB Bandwidth (MHz)	6dB BW Limit (kHz)	Result
Low	11.85	>500	COMPLIES
High	11.48	>500	COMPLIES





11.2 Peak Conducted Output Power – Section 15.247(b)

Test Date:	18/03/14	Temperature:	26°C
Test Officer:	Richard Turner	Humidity:	58%
Test Location:	Austest Laboratories (NSW)		

11.2.1 EUT Operating Mode

a. Mains power supply voltage – 115VAC 60Hz.
b. TX1 Mode. Duty cycle 100%.
c. TX2 Mode. Duty cycle 100%.

11.2.2 Test Method – Peak Conducted Output Power

a. Measurements are performed in accordance with ANSI C63.10-2009 and KDB 558074 D01 DTS Meas Guidance v03r01 section 9.1.2.
b. Since two transmit antennas are used, reference was made to KDB 662911 D01 Multiple Transmitter output v02r01
c. Connect the EUT antenna port directly to a spectrum analyser via a low loss RF cable, and attenuator (as necessary).
d. Set the spectrum analyser RBW to 1MHz, and the VBW to 3MHz.
e. Use the spectrum analyser channel power measurement function with the band limits set equal to the 6dB bandwidth. (DTS Bandwidth)
f. Power is integrated over the bandwidth
g. Record the maximum reading.
h. Repeat the above for all channels and the second antenna port.

11.2.3 Directional antenna gain

The EUT was supplied with two identical transmitter antennas (N_{ANT}) each having a maximum antenna gain of 5dBi (G_{ANT}). The client advised that transmissions from both antennas are simultaneous and therefore transmitted signals should be determined as correlated.

In accordance with KDB 662911 directional antenna gain is calculates as:

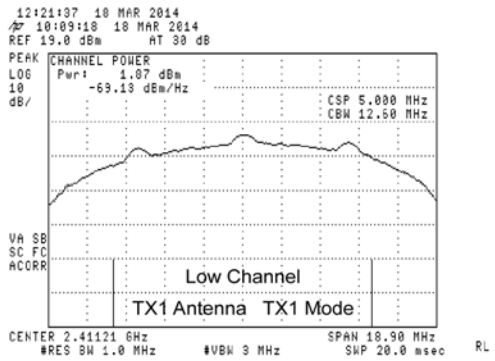
Directional gain = G_{ANT} + 10 log(N_{ANT}) dBi
Directional gain = 5.0 +10 log 2 = 8.0dBi

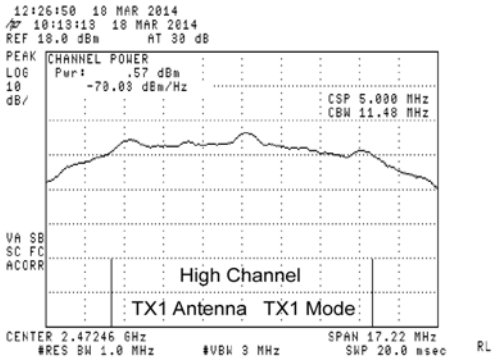
Section 15.247 (b) (4) indicates that for antennas whose directional gain exceeds 6dBi, the specified limit of 1W should be reduced by the amount in dB above 6dBi, in this case 2dB.

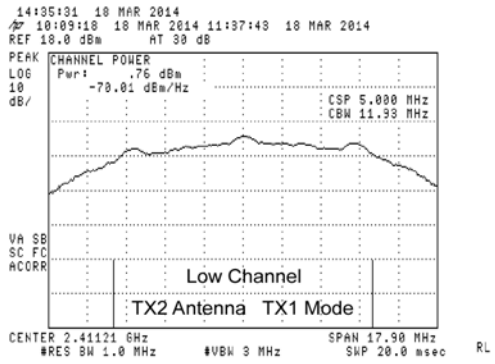
11.2.4 Test Results – Peak Conducted Output Power – TX1 Mode

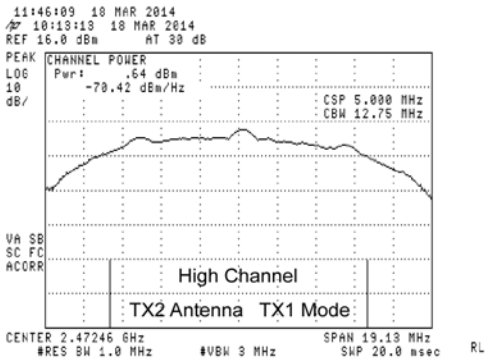
Antenna	Channel	Output Power dBm	Output Power mW	Power at each antenna mW	Total Power mW
ANT TX1	Low	1.87	1.5	2.6	5.0
ANT TX1	High	0.57	1.1		
ANT TX2	Low	0.76	1.2	2.4	
ANT TX2	High	0.64	1.2		

Total peak transmit power under TX1 mode was calculated as 5mW or 7.0dBm, 21dB below the adjusted limit.





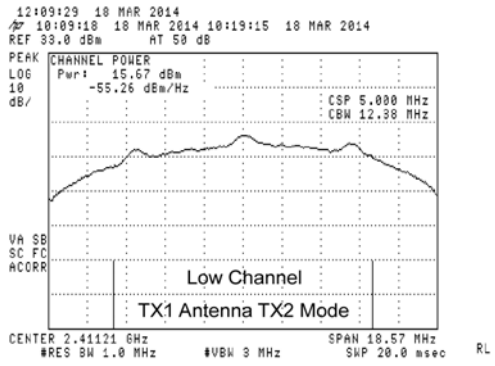


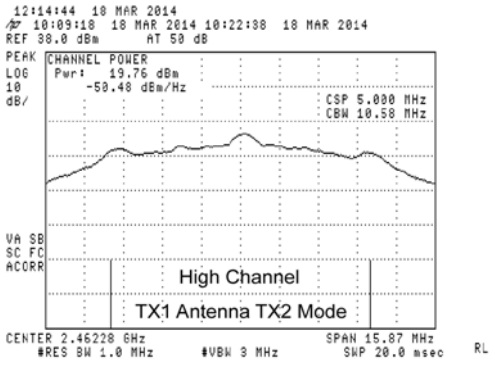


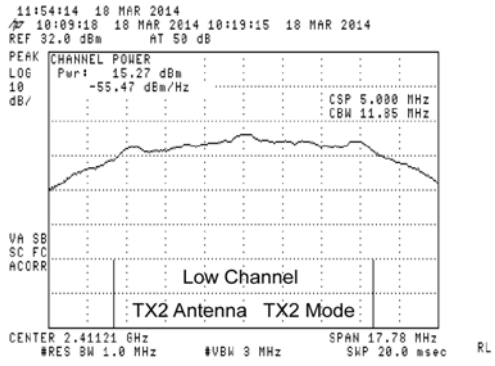
11.2.5 Test Results – Peak Conducted Output Power – TX2 Mode

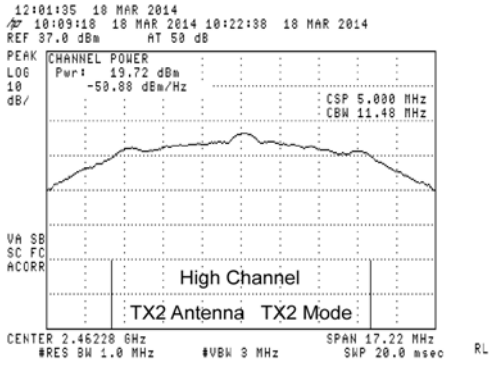
Antenna	Channel	Output Power dBm	Output Power mW	Power at each antenna mW	Total Power mW
ANT TX1	Low	15.67	36.9	131.5	259
ANT TX1	High	19.76	94.6		
ANT TX2	Low	15.27	33.7	127.5	
ANT TX2	High	19.72	93.8		

Total peak transmit power under TX2 mode was calculated as 259mW or 24.1dBm, 3.9dB below the adjusted limit.









11.2.6 Test Results – Transmit Power – Supply Voltage Variation

The EUT can be powered from a DC supply. Client specified voltage range 11-28VDC.

Section15.31 (e) requires transmitted power at the fundamental to be measured with the supply voltage varied between 85% and 115% of the nominal voltage range.

No change in transmit power at the fundamental was observed with the DC supply to the EUT varied between 11.2VDC* and 32.2VDC, measured at both the low and high channels, at both transmit antenna ports and under each operating mode.

* Below 11.2VDC the EUT ceased transmitting.

11.3 Out-of-band emissions – Section 15.247(d)

Test Date:	18/13/14	Temperature:	26°C
Test Officer:	Richard Turner	Humidity:	58%
Test Location:	Austest Laboratories (NSW)		

11.3.1 EUT Operating Mode

a. Mains power supply voltage – 115VAC 60Hz.
b. TX1 Mode. Duty cycle 100%.
c. TX2 Mode. Duty cycle 100%.

11.3.2 Test Method

a. Measurements are performed in accordance with ANSI C63.10-2009 and KDB 558074 D01 DTS Meas Guidance v03r01
b. Connect the EUT antenna port directly to a spectrum analyser via a low loss RF cable, and attenuator (as necessary).
c. Set the spectrum analyser RBW to 100kHz, and the VBW to 100kHz or more.
d. Record the highest in-band level.
e. Sweep through the frequency range to locate the highest out-of-band emissions.
f. For TX1 mode, ensure that any out-of-band emissions are greater than 20dB below the recorded in-band level.
g. For TX2 mode, ensure that any out-of-band emissions are greater than 30dB below the recorded in-band level.
h. 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.
i. Repeat the above for all measurement frequencies.

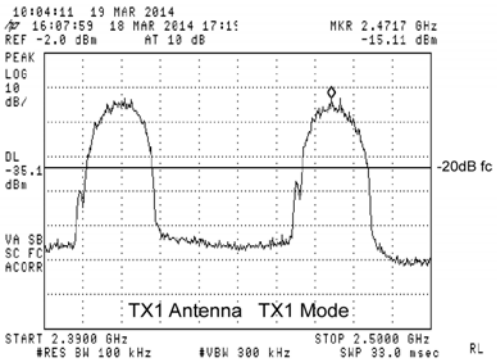
11.3.3 Test Results – Out-of-band emissions – TX1 Mode

TX1 Antenna
Frequency range: 150kHz to 25000MHz.
Highest in-band level at 2471.7MHz, -15.1dBm.

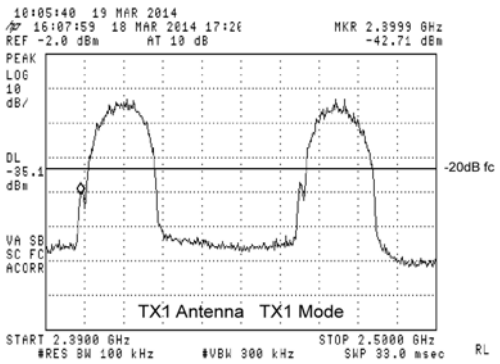
Under TX1 mode, measurement of peak conducted output power was used to determine compliance with section 15.247 (b) (3). Therefore the out-of-band emission limit is 20dB below the in-band level, -35.1dBm.

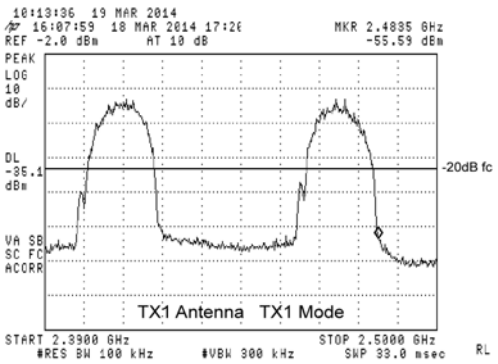
Highest measured out-of-band emission level was at 2399.9MHz which was 27.6dB below the in-band level.

Frequency (MHz)	Peak Level (dBm)	In-Band Peak Level (dBm)	Out-of-Band Limit (dBm)	Δ Limit (dB)
2399.9	-42.7	-15.1	-35.1	-7.6
2483.5	-55.6	-15.1	-35.1	-20.5

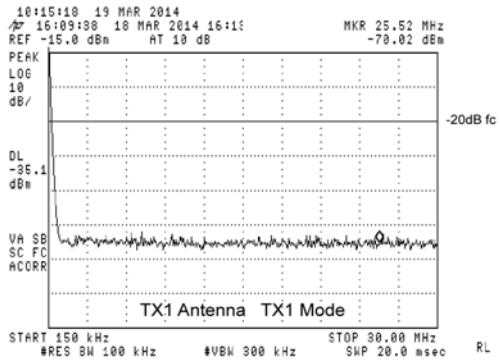


In-band

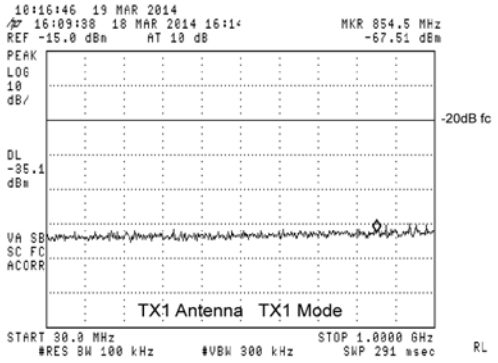




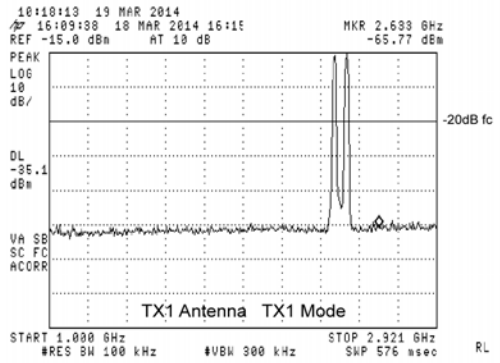
Band-edges



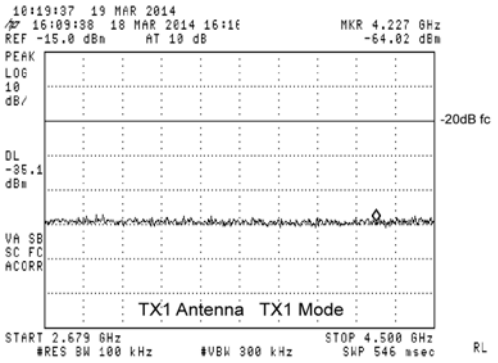
150kHz to 30MHz



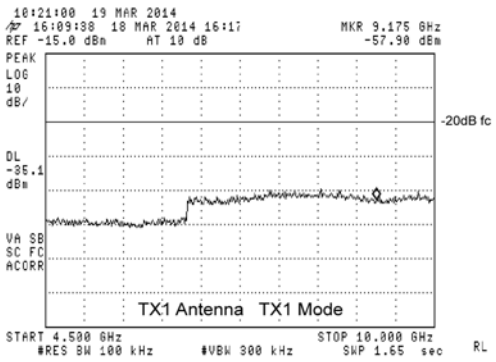
30MHz to 1000MHz



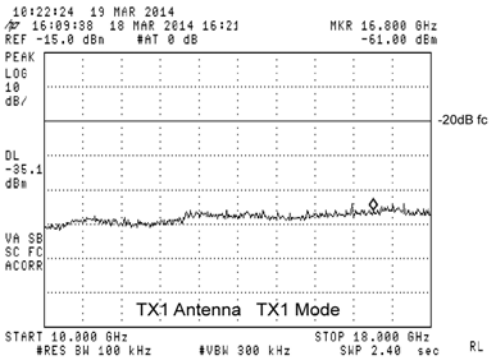
1000MHz to 2900MHz



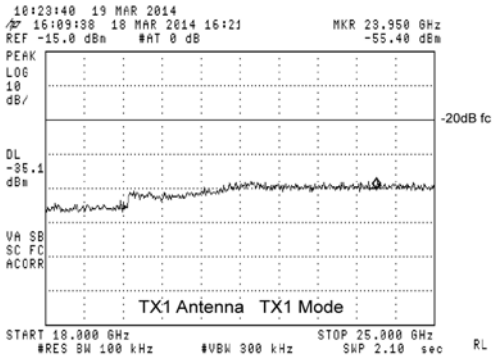
2600MHz to 4500MHz



4500MHz to 10000MHz



10000MHz to 18000MHz



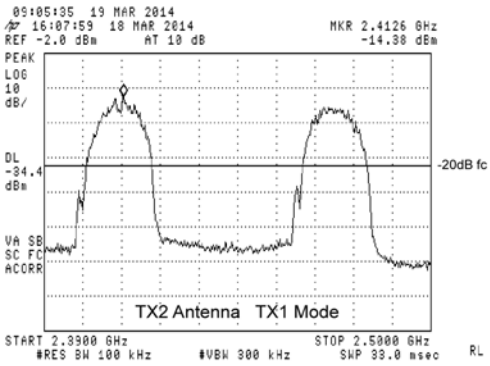
18000MHz to 25000MHz

TX2 Antenna
Frequency range: 150kHz to 25000MHz.
Highest in-band level at 2412.6MHz, -14.4dBm.

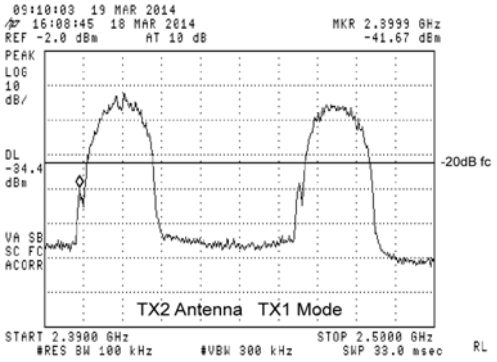
Under TX1 mode, measurement of peak conducted output power was used to determine compliance with section 15.247 (b) (3). Therefore the out-of-band emission limit is 20dB below the in-band level, -34.4dBm.

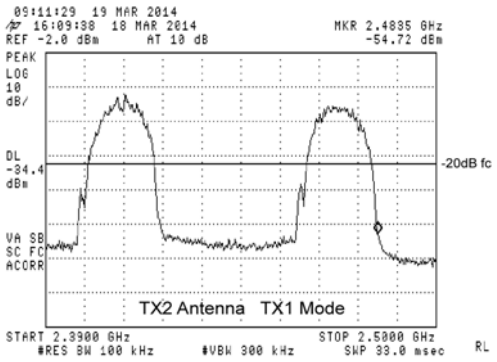
Highest measured out-of-band emission level was at 2399.9MHz which was 27.3dB below the in-band level.

Frequency (MHz)	Peak Level (dBm)	In-Band Peak Level (dBm)	Out-of-Band Limit (dBm)	Δ Limit (dB)
2399.9	-41.7	-14.4	-34.4	-7.3
2483.5	-54.7	-14.4	-34.4	-20.3

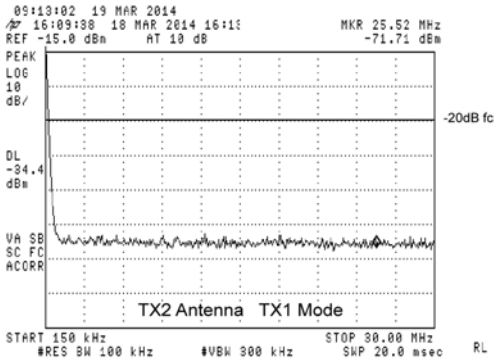


In-band

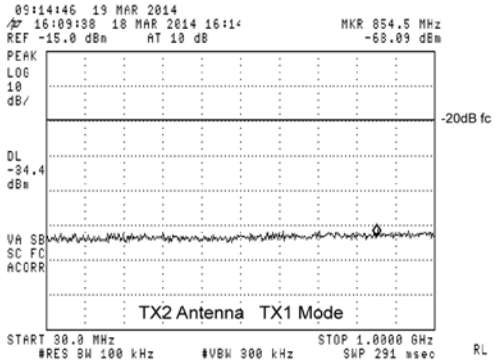




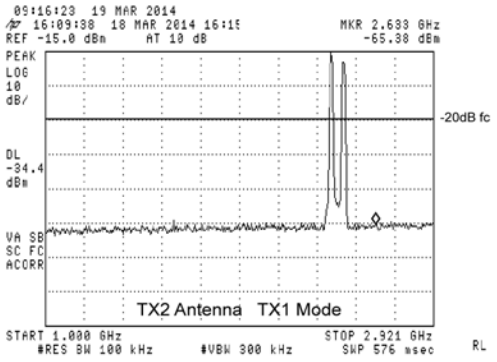
Band-edges



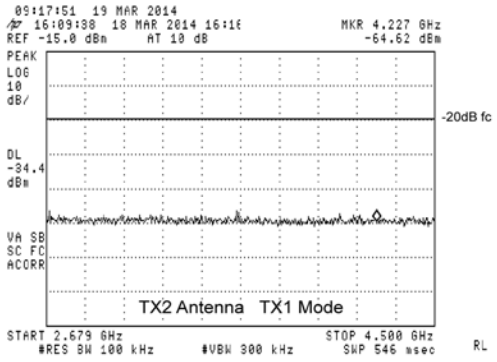
150kHz to 30MHz



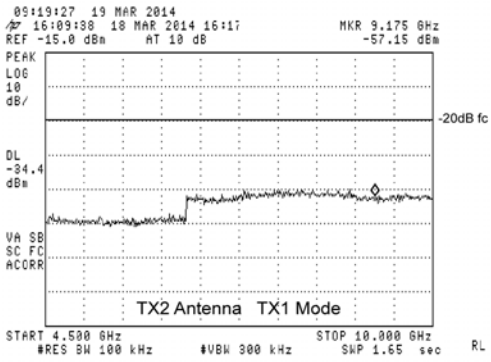
30MHz to 1000MHz



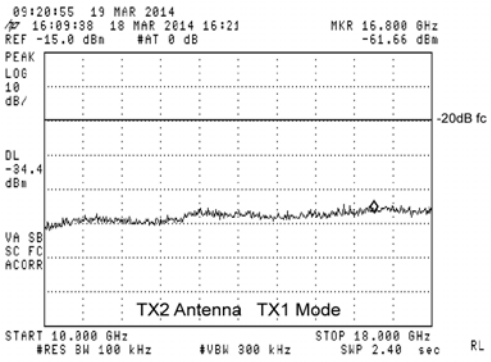
1000MHz to 2900MHz



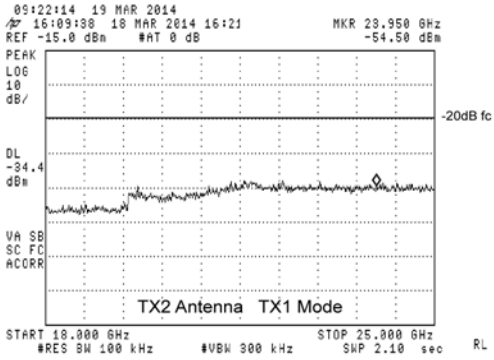
2600MHz to 4500MHz



4500MHz to 10000MHz



10000MHz to 18000MHz



18000MHz to 25000MHz

11.3.4 Test Results – Out-of-band emissions – TX2 Mode

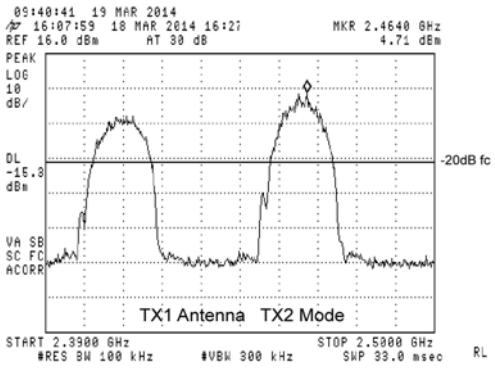
TX1 Antenna
Frequency range: 150kHz to 25000MHz.
Highest in-band level at 2464.0MHz, 4.7dBm.

Under TX2 mode, measurement of peak conducted output power was used to determine compliance with section 15.247 (b) (3). Therefore the out-of-band emission limit is 20dB below the in-band level, -15.3dBm.

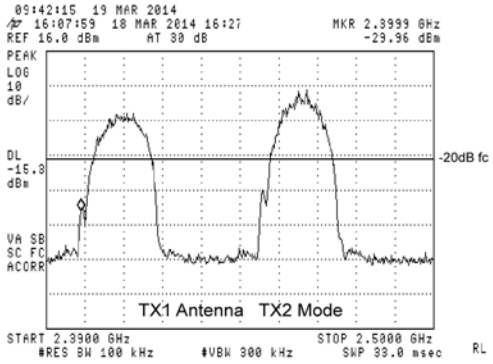
Highest measured out-of-band emission level was at 2399.9MHz which was 34.7dB below the in-band level.

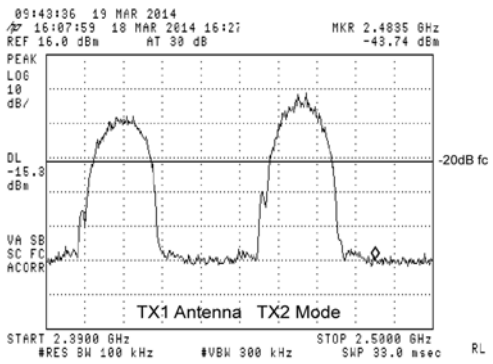
Frequency (MHz)	Peak Level (dBm)	In-Band Peak Level (dBm)	Out-of-Band Limit (dBm)	Δ Limit (dB)
2399.9	-30.0	4.7	-15.3	-14.7
2483.5	-43.7*	4.7	-15.3	-28.4
4924.7	-46.4	4.7	-15.3	-31.1
4822.4	-49.8	4.7	-15.3	-34.5

* System noise floor

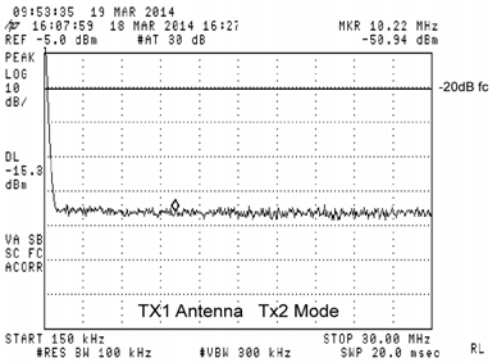


In-band

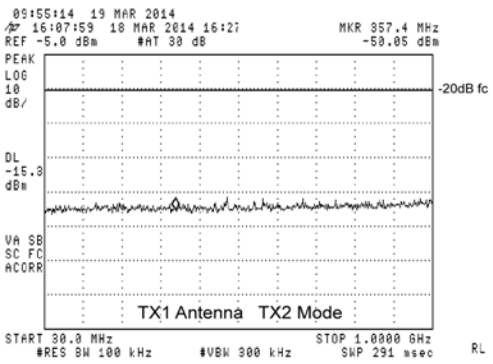




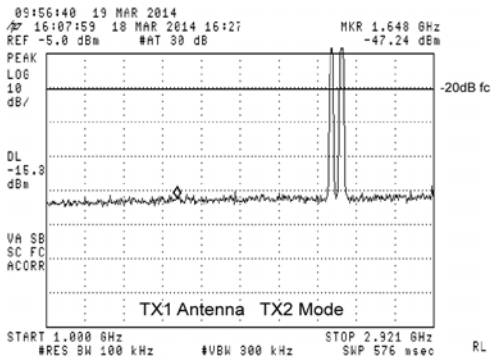
Band-edges



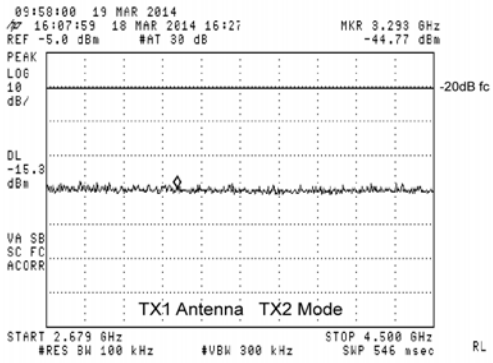
150kHz to 30MHz



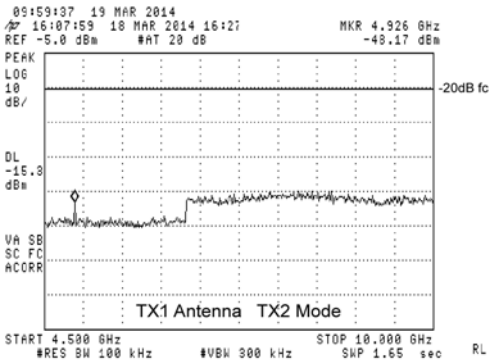
30MHz to 1000MHz



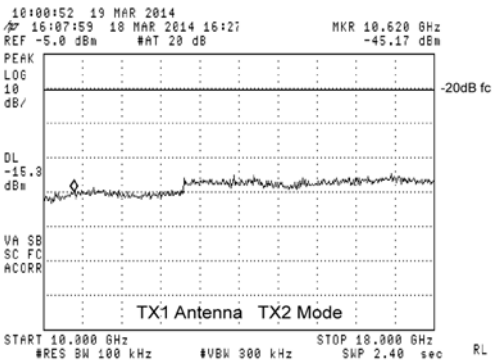
1000MHz to 2900MHz



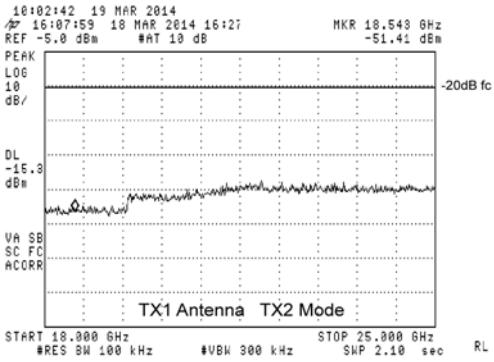
2600MHz to 4500MHz



4500MHz to 10000MHz



10000MHz to 18000MHz



18000MHz to 25000MHz

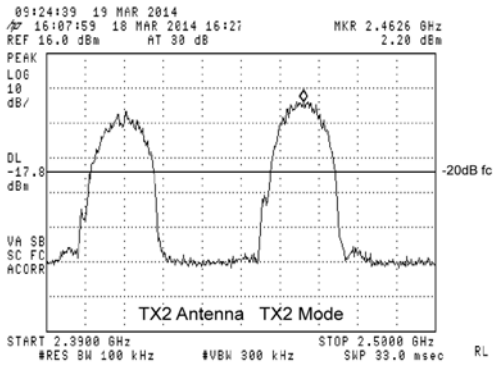
TX2 Antenna
Frequency range: 150kHz to 25000MHz.
Highest in-band level at 2462.6MHz, 2.2dBm.

Under TX2 mode, measurement of peak conducted output power was used to determine compliance with section 15.247 (b) (3). Therefore the out-of-band emission limit is 20dB below the in-band level, -17.8dBm.

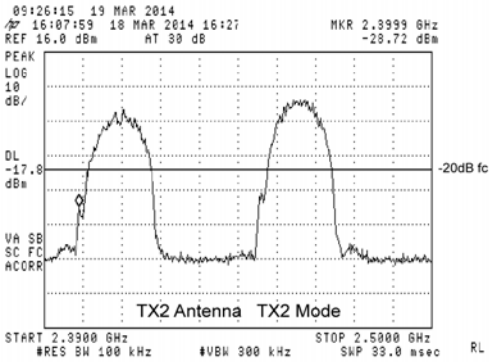
Highest measured out-of-band emission level was at 2399.9MHz which was 30.9dB below the in-band level.

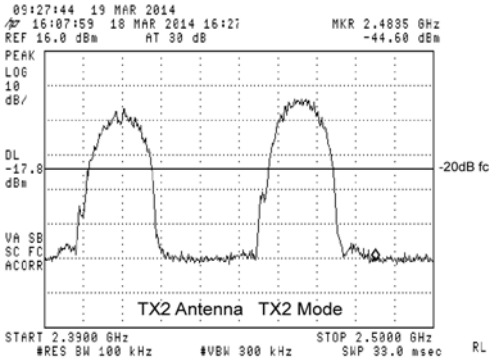
Frequency (MHz)	Peak Level (dBm)	In-Band Peak Level (dBm)	Out-of-Band Limit (dBm)	Δ Limit (dB)
2399.9	-28.7	2.2	-17.8	-10.9
2483.5*	-44.6	2.2	-17.8	-26.8
4924.7	-45.5	2.2	-17.8	-27.7
4822.4	-50.4	2.2	-17.8	-32.6

* System noise floor

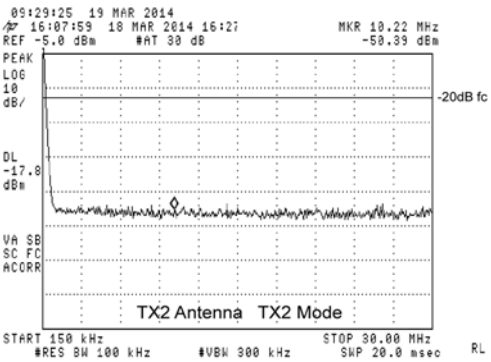


In-band

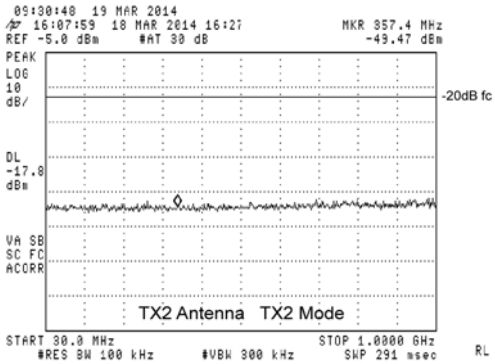




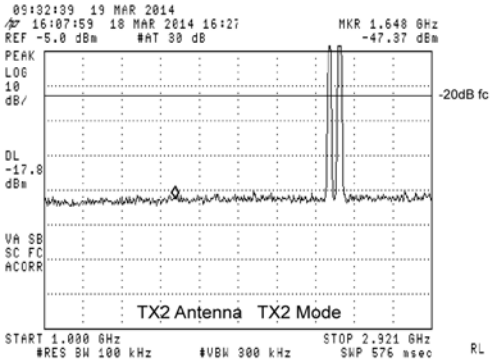
Band-edges



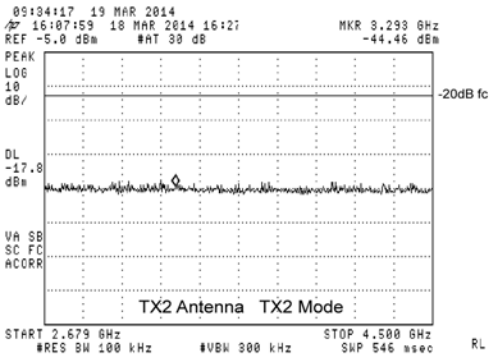
150kHz to 30MHz



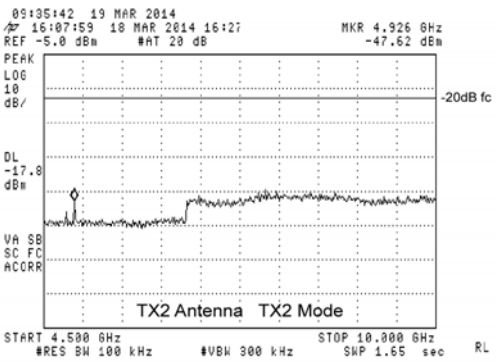
30MHz to 1000MHz



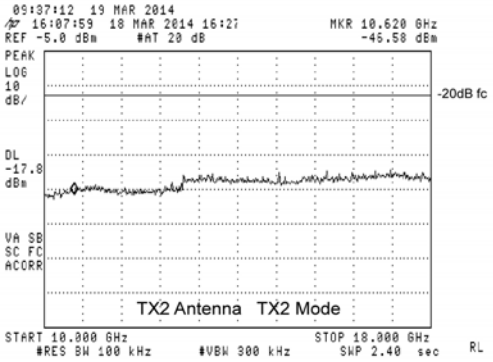
1000MHz to 2900MHz



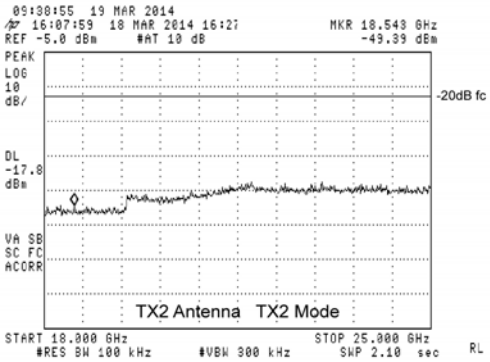
2900MHz to 4500MHz



4500MHz to 10000MHz



10000MHz to 18000MHz



18000MHz to 25000MHz

11.4 Peak Power Spectral Density – Section 15.247(e)

Test Date:	18/03/14	Temperature:	26°C
Test Officer:	Richard Turner	Humidity:	67%
Test Location:	Austest Laboratories (NSW)		

11.4.1 EUT Operating Mode

a. Mains power supply voltage – 115VAC 60Hz.
b. TX1 Mode. Duty cycle 100%.
c. TX2 Mode. Duty cycle 100%.

11.4.2 Test Method

a. Measurements are performed in accordance with ANSI C63.10-2009 and KDB 558074 D01 DTS Meas Guidance v03r01 section 10.2
b. Since two transmit antennas are used, reference was made to KDB 662911 D01 Multiple Transmitter output v02r01
c. Connect the EUT antenna port directly to a spectrum analyser via a low loss RF cable, and attenuator (as necessary).
d. Set the spectrum analyser RBW to 3kHz, VBW to 10kHz, span 1.5 x 6dB bandwidth.
e. Record the maximum reading.
f. Repeat the above for both RF channels, TX modes and antennas.

11.4.3 Directional antenna gain

The EUT was supplied with two identical transmitter antennas (N_{ANT}) each having a maximum antenna gain of 5dBi (G_{ANT}). The client advised that transmissions from both antennas are simultaneous and therefore transmitted signals should be determined as correlated.

In accordance with KDB 662911 directional antenna gain is calculates as:

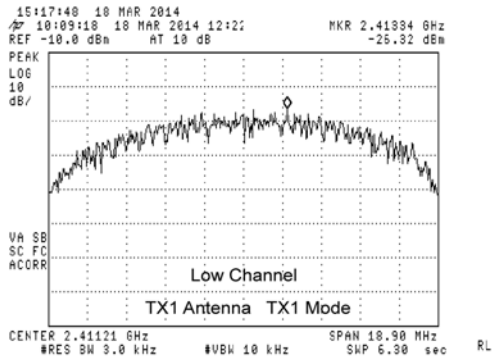
Directional gain = G_{ANT} + 10 log(N_{ANT}) dBi
Directional gain = 5.0 +10 log 2 = 8.0dBi

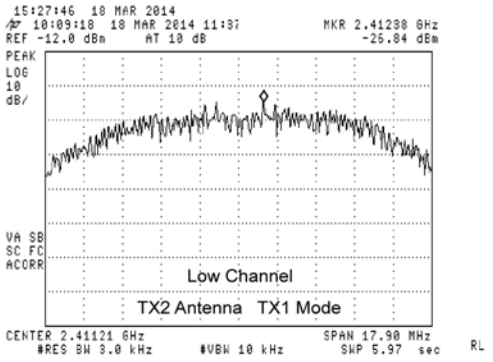
Section 15.247 (b) (4) indicates that for antennas whose directional gain exceeds 6dBi, the specified limit of 8dBm per 3kHz should be reduced by the amount in dB above 6dBi, in this case 2dB.

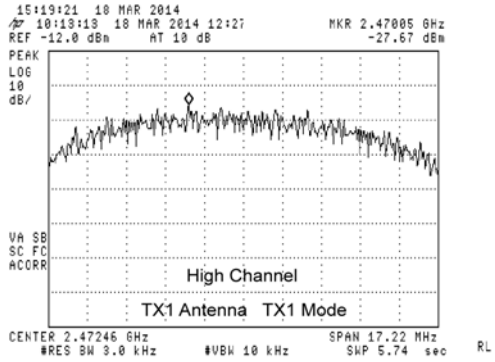
11.4.4 Test Results – Spectral Density – TX1 Mode

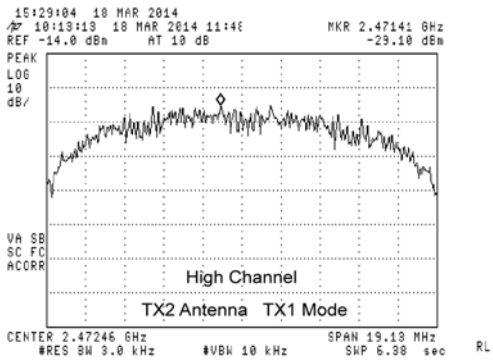
Antenna	Channel	Frequency MHz	Spectral Density dBm	Spectral Density µW	Spectral Density for each channel µW
ANT TX1	Low	2413.3	-26.3	2	4
ANT TX2	Low	2412.4	-26.8	2	
ANT TX1	High	2470.1	-27.7	2	3
ANT TX2	High	2471.4	-29.1	1	

Maximum spectral density was calculated as 4µW at 2413MHz, or -24.0dBm, 30dB below the adjusted limit.





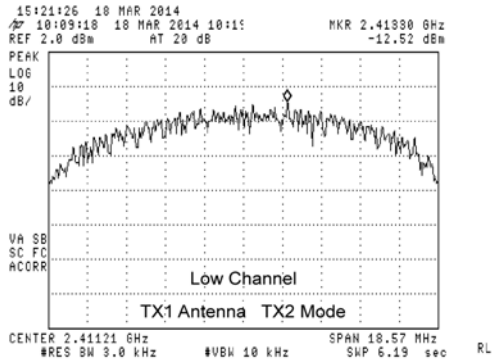


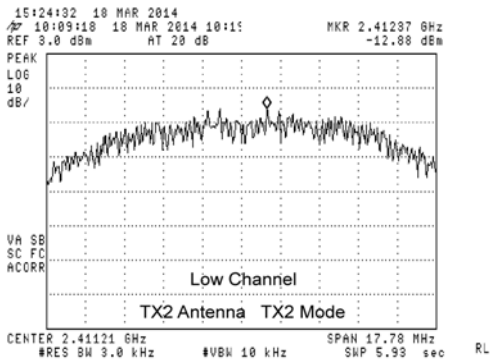


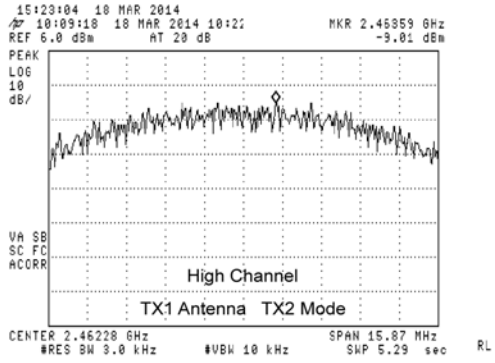
11.4.5 Test Results – Spectral Density – TX2 Mode

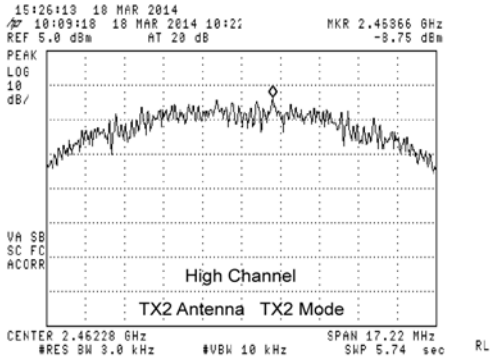
Antenna	Channel	Frequency MHz	Spectral Density dBm	Spectral Density µW	Spectral Density for each channel µW
ANT TX1	Low	2413.3	-12.5	56	107
ANT TX2	Low	2412.4	-12.9	51	
ANT TX1	High	2463.6	-9.0	126	258
ANT TX2	High	2463.7	-8.8	132	

Maximum spectral density was calculated as 258µW at 2464MHz, or -5.9dBm, 11.9dB below the adjusted limit.

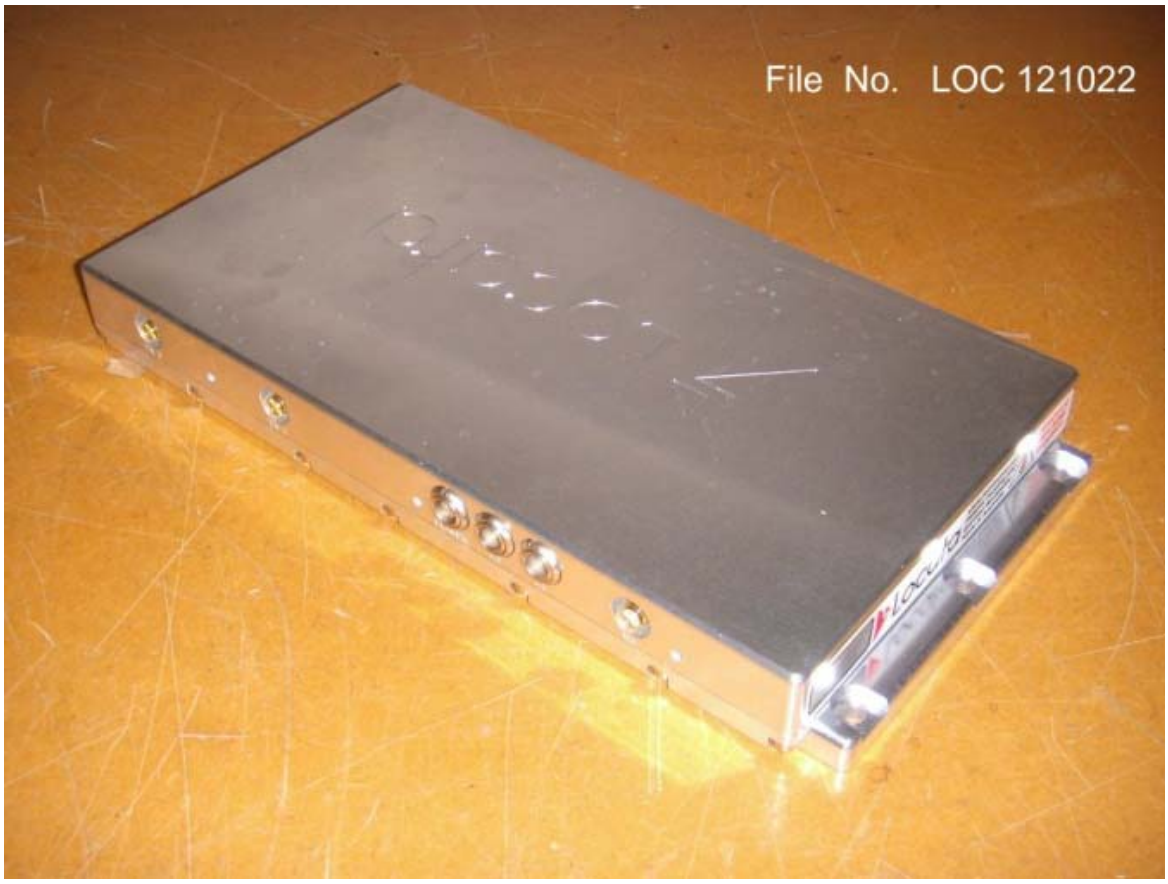








APPENDIX A – PHOTOGRAPHIC RECORD OF EUT



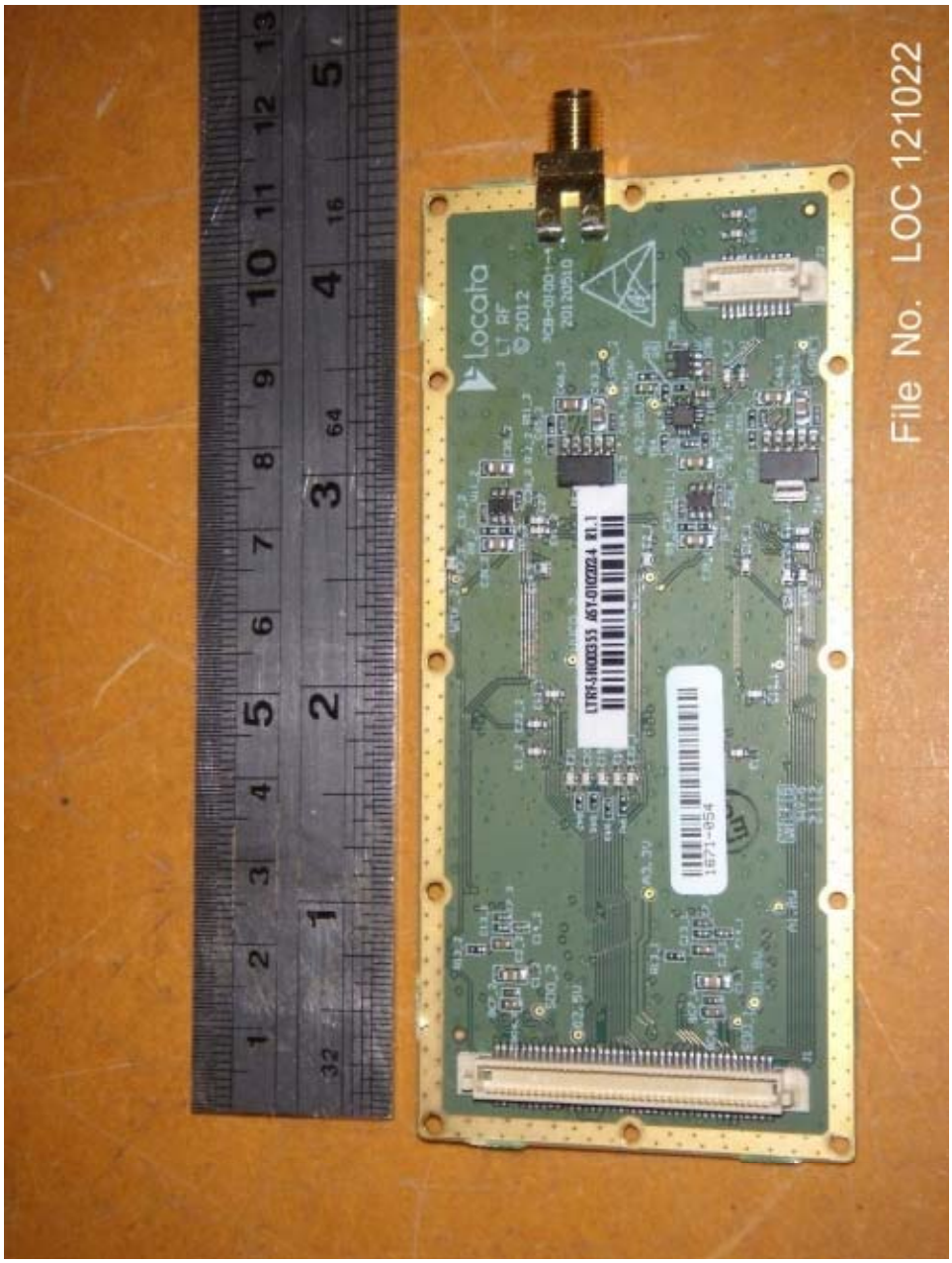
EUT External View

EUT Internal View

EUT Main PCB (Trace Side)

EUT Main PCB (Trace Side)

Transmitter PBA



Transmitter PBA

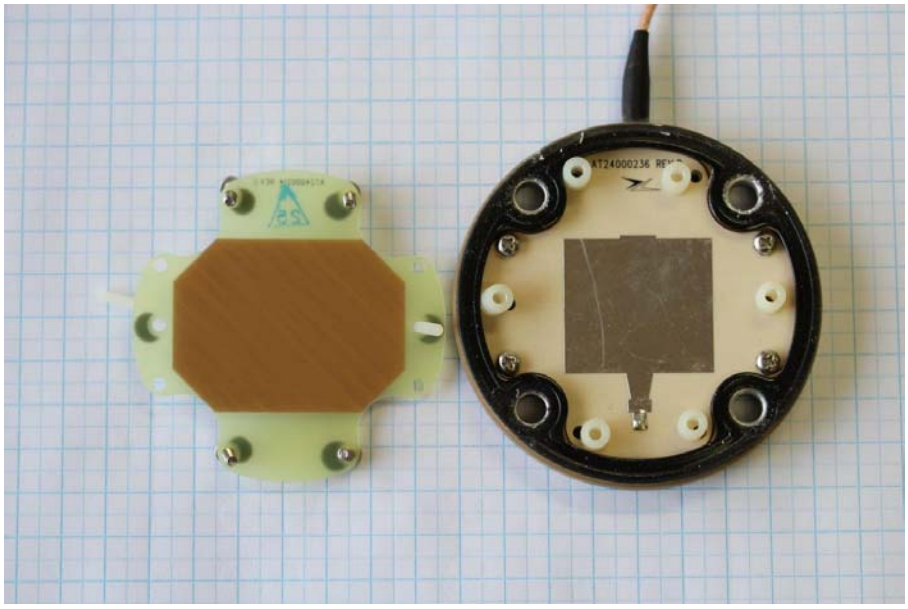
AT2400-2 Antenna

EUT Label

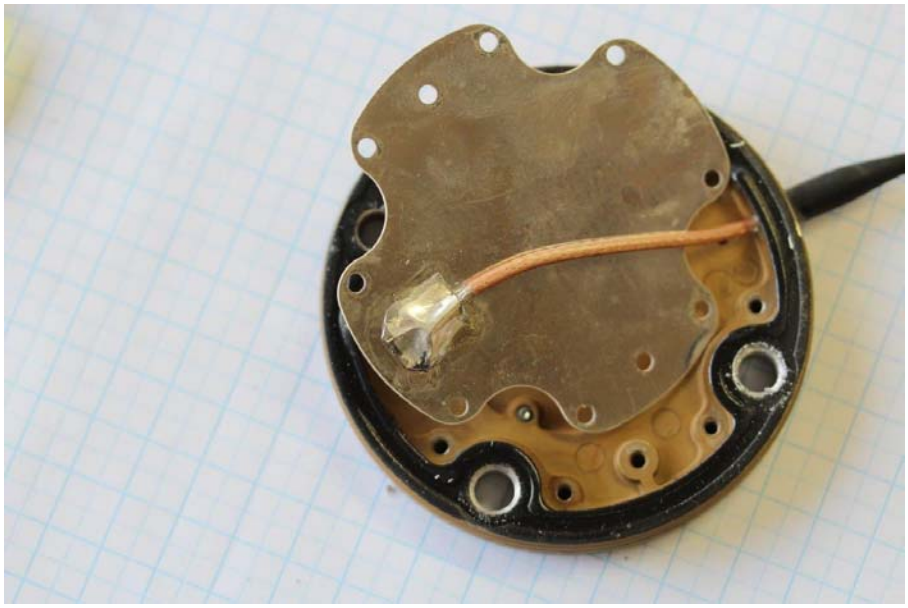
AC Adaptor Label

AT2400-2W-TNCM-008-00-05-L front

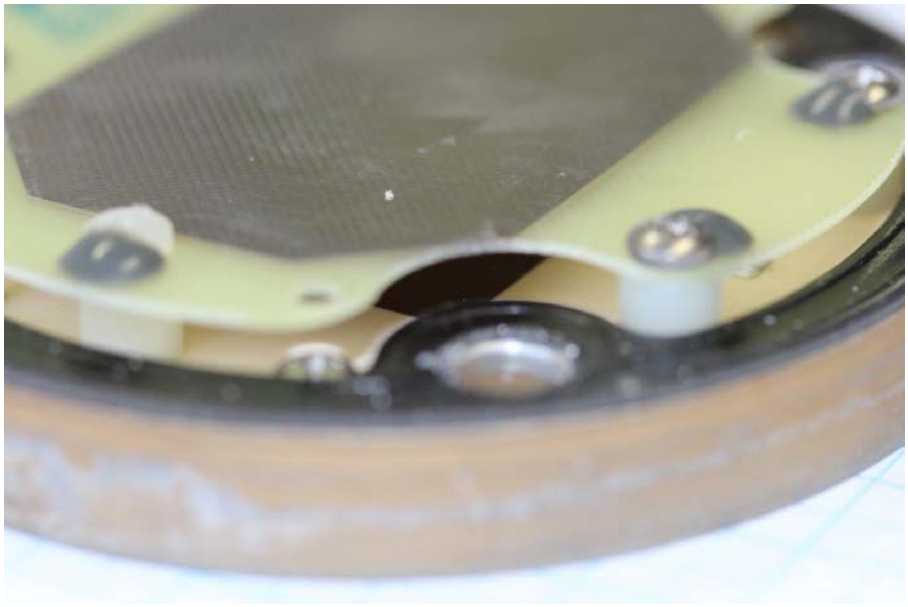
AT2400-2W-TNCM-008-00-05-L inside (front)



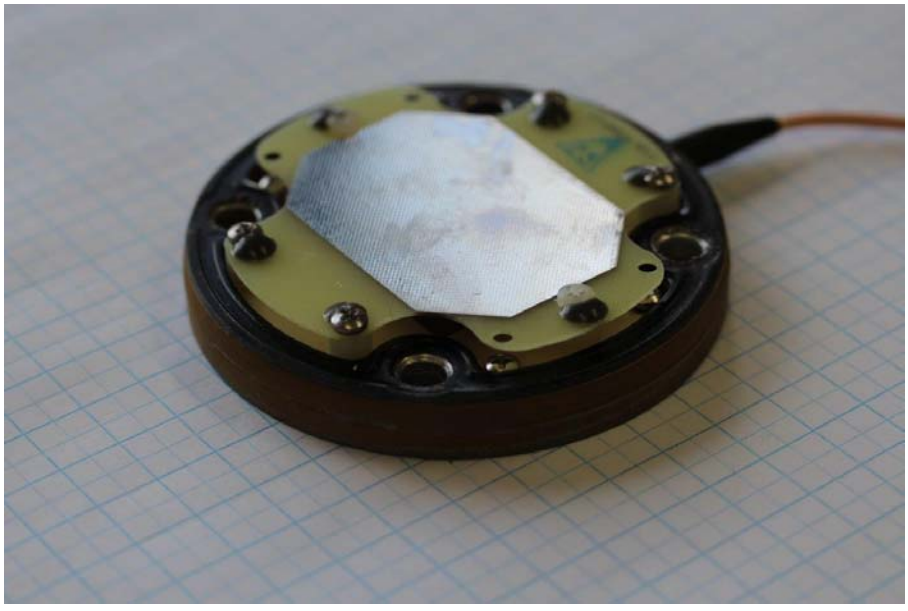
AT2400-2W-TNCM-008-00-05-L inside (front) - stacked patch assembly separated



AT2400-2W-TNCM-008-00-05-L inside (rear) - feedline



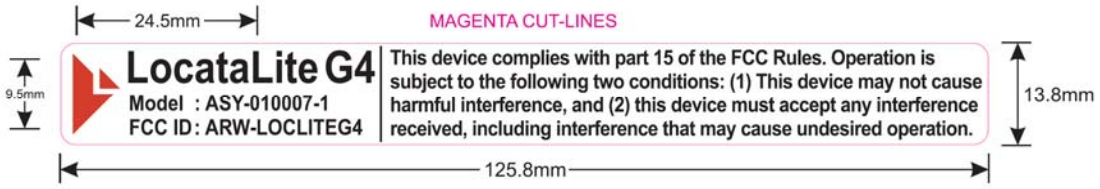
AT2400-2W-TNCM-008-00-05-L inside (side detail)



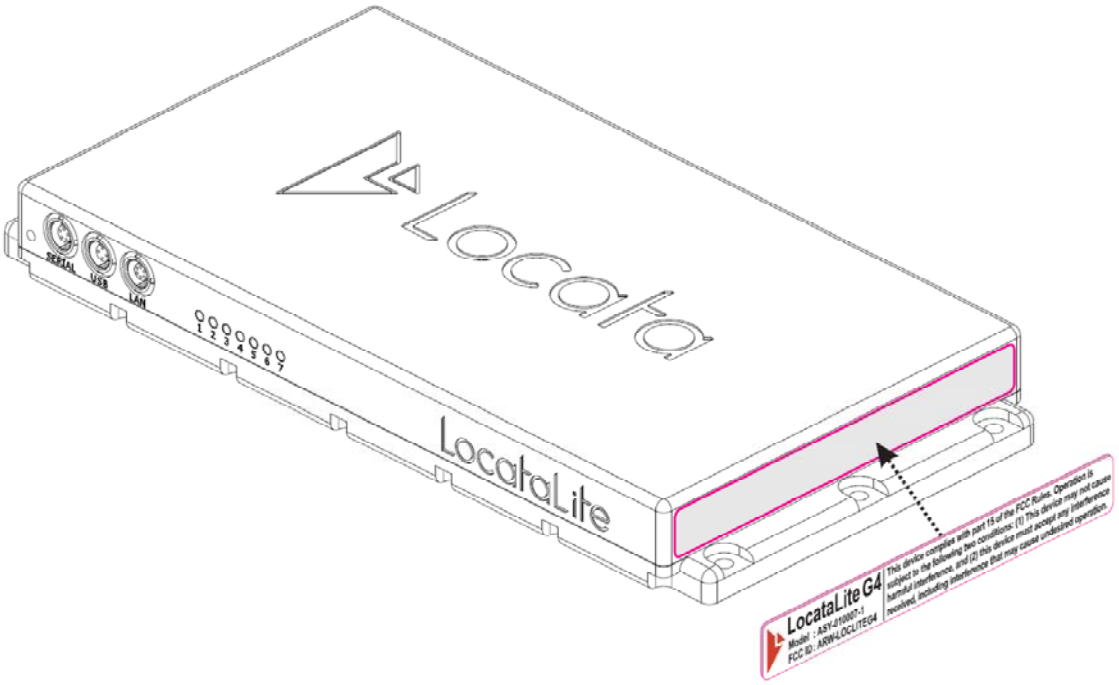
AT2400-2W-TNCM-008-00-05-L inside (side)

AT2400-2W-TNCM-008-00-05-L rear

APPENDIX B – FCC LABEL & LOCATION



FCC Label

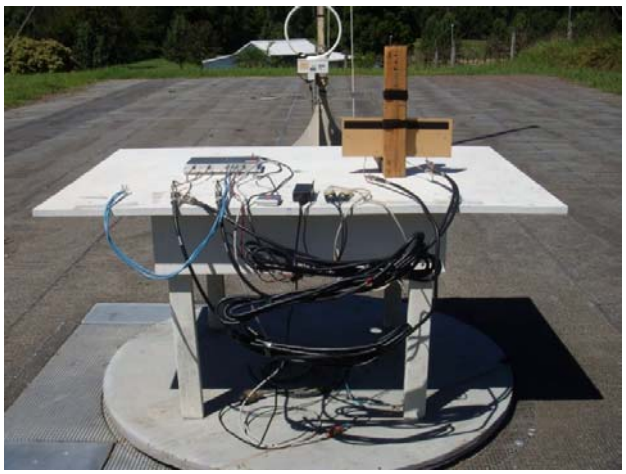


FCC Label Location on EUT

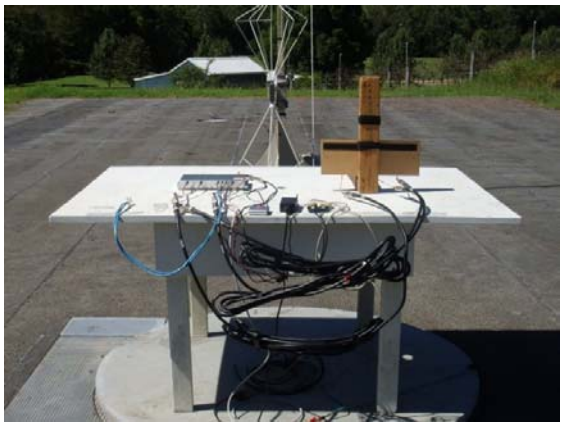
APPENDIX C – EUT TEST SETUP PHOTOGRAPHS

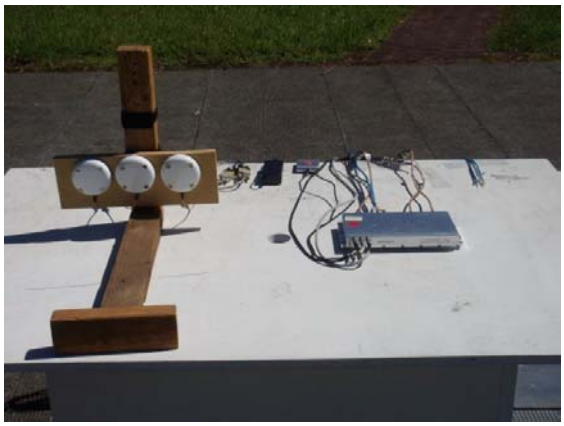
15.207 Mains Conducted

15.247 Antenna Port Conducted Measurement

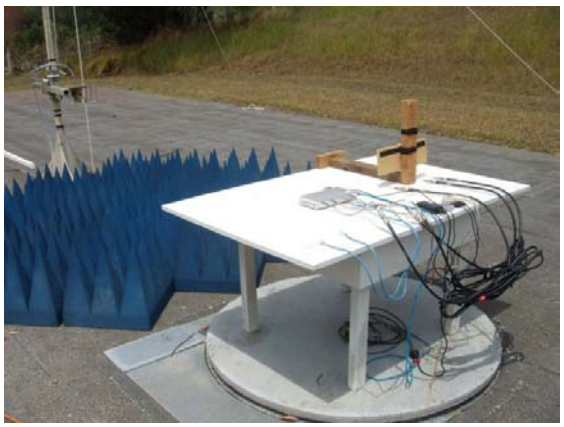


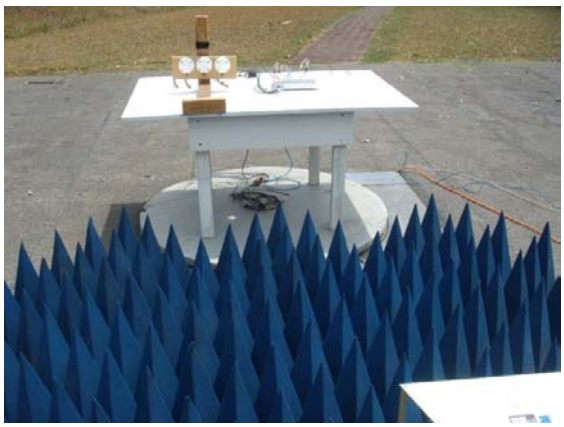
15.209 Radiated Emissions Below 30MHz





15.209 Radiated Emissions below 1GHz





15.209 Radiated Emissions above 1GHz