TEST REPORT
FROM
RFI GLOBAL SERVICES LTD

Test of: Zinwave DAS3000

To: FCC Part 90: 2007
Technology - ESMR

Test Report Serial No:
RFI-RPT3-RP74120JD01G

Supersedes Test Report Serial No:
RFI-RPT2-RP74120JD01G

This Test Report Is Issued Under The Authority Of Steve Flooks, Service Leader: 	
Checked By: Steve Flooks 	**Report Copy No: PDF01**
Issue Date: 24 October 2008	**Test Dates: 06 October 2008 to 17 October 2008**

This report is issued in Adobe Acrobat portable document format (PDF). It is only a valid copy of the report if it is being viewed in PDF format with the following security options not allowed: Changing the document, Selecting text and graphics, Adding or changing notes and form fields.
This report may be copied in full. The results in this report apply only to the sample(s) tested.

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

Registered in England and Wales. Company number:2117901

This page has been left intentionally blank.

Test of: Zinwave DAS3000
To: FCC Part 90: 2007
Technology - ESMR

Table of Contents

1. Customer Information

Company Name:	Zinwave Ltd
Address:	Harston Mill Harston Cambridge CB2 5GG
Contact Name:	Mr Andy Bell

2. Equipment Under Test (EUT)

The following information (with the exception of the Date of Receipt) has been supplied by the client:

2.1. Identification of Equipment Under Test (EUT)

Brand Name:	Zinwave Ltd
Model Name or Number:	PHUB (Primary Hub)
Serial Number:	Hub06
Revision Number:	HUB-302-0001-3.10
Country of Manufacture:	England
Date of Receipt:	06 October 2008

Brand Name:	Zinwave Ltd
Model Name or Number:	SHUB (Secondary Hub)
Serial Number:	Hub07
Revision Number:	HUB-302-0013-3.10
Country of Manufacture:	England
Date of Receipt:	06 October 2008

Brand Name:	Zinwave Ltd
Model Name or Number:	RU (Remote Unit)
Serial Number:	RU668
Revision Number:	302-006-1.20 + NCR 0037
FCC ID Number:	302-0007
Country of Manufacture:	England
Date of Receipt:	06 October 2008

2.2. Description of EUT

The 3000 Hub and wideband remote unit is a bi-directional wide-band repeater station with a pass band of 136 – 2700 MHz currently.

2.3. Modifications Incorporated in EUT

During the course of testing the EUT was not modified.

2.4. Additional Information Related to Testing

Power Supply Requirement:	120 V AC 60 Hz		
Intended Operating Environment:	Commercial / Light Industrial / Heavy Industrial		
Equipment Category:	Base Station		
Type of Unit:	DAS (Distributed Antenna System)		
Transmit Frequency Range:	935 MHz to 940 MHz		
Transmit Channels Tested:	**Modulation**	**Bandwidth**	**Channel Frequency (MHz)**
	16-QAM	25 kHz	939.975
Maximum Power Output (EIRP)	+28.0 dBm		

2.5. Port Identification

Port	Description	Type/Length	Applicable
1	Alarm Port	9 Pin D-Connector	N
2	RS232 Port	9 Pin D-Connector	N
3	Ethernet Port	CAT5	N
4	2 x USB Ports	USB	N
5	4 x Service Ports (I/O)	N-Type	N
6	8 x Optical Module Ports (I/O)	Fibre Optic Connectors	N

3.Test Specification, Methods and Procedures

Reference:	FCC Part 90: 2007 (Subpart B)
Title:	Code of Federal Regulations Part 90: Public Safety Radio Pool

3.1. Methods and Procedures

The methods and procedures used were as detailed in:

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

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

ANSI C63.4 (2003)
Title: American National Standard Methods of Measurement of Electromagnetic Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

ANSI C63.5 (1988)
Title: American National Standard for the Calibration of antennas used for Radiated Emission measurements in Electromagnetic Interference (EMI) control.

ANSI C63.7 (1988)
Title: American National Standard Guide for Construction of Open Area Test Sites for performing Radiated Emission Measurements.

CISPR 16-1: (1999)
Title: Specification For Radio Disturbance and Immunity Measuring Apparatus and Methods. Part 1: Radio Disturbance and Immunity Measuring Apparatus.

3.2. Definition of Measurement Equipment

The measurement equipment used complied with the requirements of the standards referenced in the methods & procedures section above. Appendix 1 contains a list of the test equipment used.

4. Deviations from the Test Specification

The testing has been performed in accordance with the following Project Plan:

Project Plan for DheaniSulis – End Customer Zinwave Ltd
American TCB Project Number: ATCB006596
Date of Issue: 01 October 2008

5. Operation of the EUT during Testing

5.1. Operating Modes

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

- Transmit mode, (maximum output power/gain)

5.2. Configuration and Peripherals

The EUT was tested in the following configuration unless otherwise stated:

The EUT comprises of 3 separate units. Primary Hub, Secondary Hub and the Remote Unit. The primary hub was connected to the secondary hub via fibre optic cables. The secondary hub was connected to the remote hub via fibre optic cables. An input signal was fed into the primary hub and was measured from the output of the remote unit. The remote unit was operating at maximum output power with the maximum gain settings allowed.

For radiated emissions testing, the EUT was connected to 4 input signals into the separate input ports. The levels were adjusted to give a composite signal output level of +20.0 dBm. The antenna port on the remote unit was terminated for this testing.

For conducted testing, the EUT was connected to between 1 – 4 input signals. Depending on the test case, either a CW or a modulated signal was fed into the unit with the antenna port on the remote unit used as the measurement point.

6. Summary of Test Results

Range of Measurements	Specification Reference	Port Type	Result
Transmitter AC Conducted Spurious Emissions (150 kHz to 30 MHz)	C.F.R. 47 FCC Part 15: Section 15.207	AC Mains Input	Complied
Transmitter Carrier Output Power	C.F.R. 47 FCC Part 90: Sections 90.205/90.267 TIA-603-B Section 2.2.1	Antenna Terminals	Complied
Transmitter Frequency Stability (Temperature Variation)	C.F.R. 47 FCC Part 90: Sections 90.213/2.1055 TIA-603-B Section 2.2.2	Antenna Terminals	Complied
Transmitter Frequency Stability (Voltage Variation)	C.F.R. 47 FCC Part 90: Sections 90.213/2.1055 TIA-603-B Section 2.2.2	Antenna Terminals	Complied
Transmitter Occupied Bandwidth	C.F.R. 47 FCC Part 90: Sections 90.209/90.267/2.1049	Antenna Terminals	Complied
Gain Flatness and Out of Band Rejection	Project Plan: ATCB006596	Antenna Terminals	Complied (note 1)
Inter-Modulation Attenuation	Project Plan: ATCB006596	Antenna Terminals	Complied (note 1)
Transmitter Out of Band Conducted Emissions	C.F.R. 47 FCC Part 90: Sections 90.210 TIA-603-B Section 2.2.13	Antenna Terminals	Complied
Transmitter Out of Band Radiated Emissions	C.F.R. 47 FCC Part 90: Sections 90.210 TIA-603-B Section 2.2.12	Antenna	Complied

Note 1: These tests are not required within the Part 90 regulations. These tests were defined within the referenced project plan.

6.1. Location of Tests

All the measurements described in this report were performed at the premises of RFI Global Services Ltd, Wade Road, Basingstoke, Hampshire, RG24 8AH.

6.2. Site Registration Number

FCC: 209735

7. Measurements, Examinations and Derived Results

7.1. General Comments

This section contains test results only.

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

7.2. Test Results

7.2.1. Transmitter AC Conducted Spurious Emissions: Section 15.207

The EUT was configured as for AC conducted emission measurements as described in section 9 of this report.

Tests were performed to identify the maximum emission levels present on the ac mains line of the EUT.

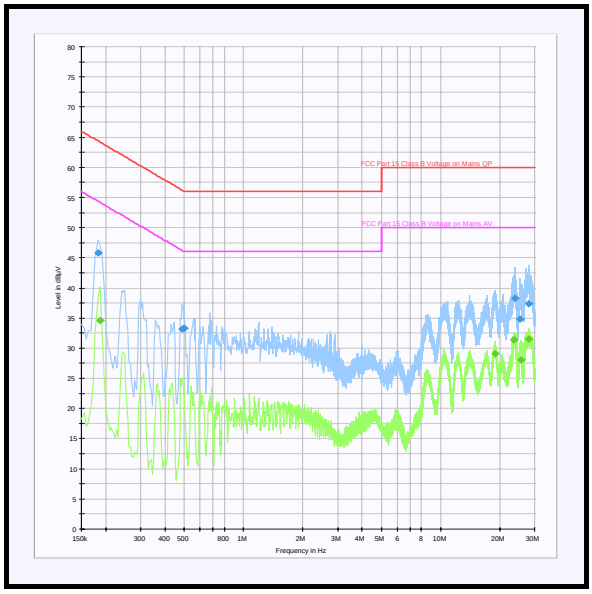
Quasi-Peak Detector Measurements on Live and Neutral Lines

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.181500	Live 1	45.8	64.4	18.6	Complied
0.487500	Neutral	33.2	56.2	23.0	Complied
0.501000	Neutral	33.3	56.0	22.7	Complied
23.739000	Live 1	38.2	60.0	21.8	Complied
25.242000	Neutral	34.9	60.0	25.1	Complied
27.915000	Neutral	37.4	60.0	22.6	Complied

Average Detector Measurements on Live and Neutral Lines

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.186000	Live 1	34.6	54.2	19.6	Complied
18.816000	Live 1	29.1	50.0	20.9	Complied
23.491500	Neutral	31.4	50.0	18.6	Complied
25.530000	Live 1	28.1	50.0	21.9	Complied
28.005000	Live 1	31.5	50.0	18.5	Complied

Transmitter Mode AC Conducted Spurious Emissions: Section 15.207 (Continued)



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

7.2.2. Transmitter Carrier Output Power: Section 2.1046(a)

The EUT was configured as for conducted RF output power as described in section 9 of this report.

Tests were performed to identify the EUT's maximum conducted transmit power.

Frequency (MHz)	Conducted RF O/P Power (dBm)	Declared Antenna Gain (dB)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
939.975	20.0	8.0	28.0	32.2	4.2	Complied

Note(s):

1. *Measurements were performed with a power sensor and meter.*

2. *The limit in FCC Part 90 is in reference to an ERP limit. Due to the nature of the equipment, the client has declared an EIRP and as such, the ERP limit has been converted to EIRP by adding 2.2 dB.*

7.2.3. Transmitter Frequency Stability (Temperature Variation): Section 90.213 / 2.1055

The EUT was configured as for frequency stability measurements as described in section 9 of this report.

Tests were performed to identify the maximum frequency error of the EUT with variations in ambient temperature.

940 MHz - CW

Temperature (°C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
-30	940.000001	1	0.0	2.5	2.5	Complied
-20	940.000001	1	0.0	2.5	2.5	Complied
-10	940.000000	0	0.0	2.5	2.5	Complied
0	940.000000	0	0.0	2.5	2.5	Complied
10	940.000001	1	0.0	2.5	2.5	Complied
20	940.000001	1	0.0	2.5	2.5	Complied
30	940.000001	1	0.0	2.5	2.5	Complied
40	940.000000	0	0.0	2.5	2.5	Complied
50	940.000000	0	0.0	2.5	2.5	Complied

7.2.4. Transmitter Frequency Stability (Voltage Variation): Section 90.213 / 2.1055

The EUT was configured as for frequency stability measurements as described in section 9 of this report.

Tests were performed to identify the maximum frequency error of the EUT with variations in nominal operating voltage.

940 MHz - CW

Supply Voltage (V)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
102.0	940.000000	0	0.0	2.5	2.5	Complied
138.0	940.000000	0	0.0	2.5	2.5	Complied

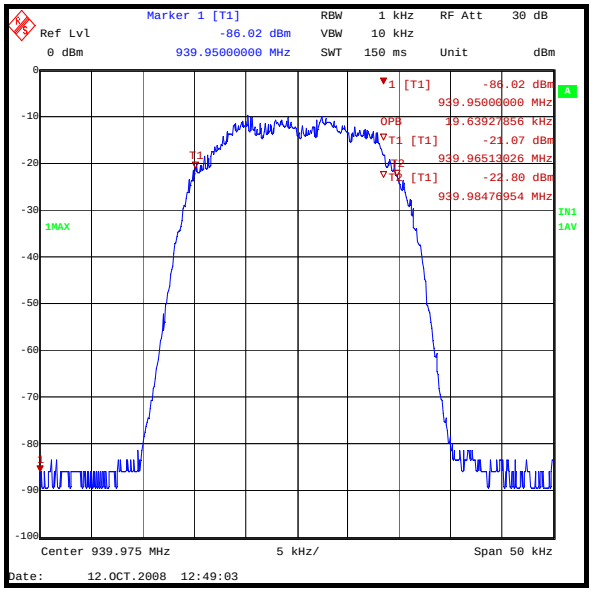
7.2.5. Transmitter Occupied Bandwidth: Section 90.209 / 90.267

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

Tests were performed to identify the maximum bandwidth occupied by the fundamental frequency of the EUT.

Input Signal

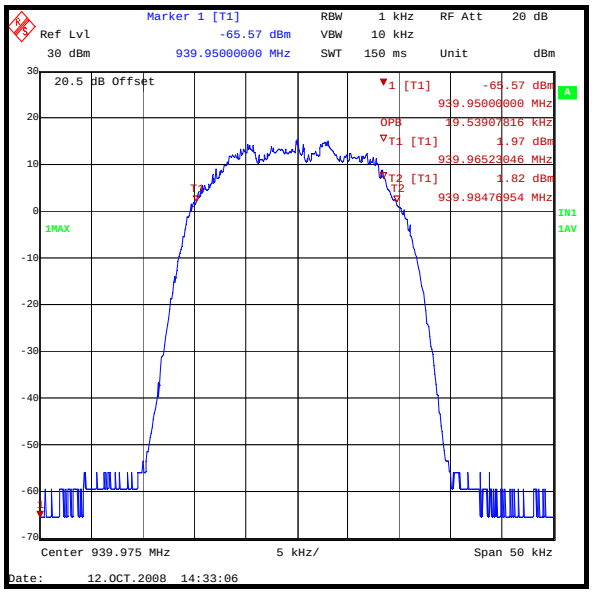
Frequency (MHz)	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (kHz)
939.975	1.0	10.0	19.639



Transmitter Occupied Bandwidth: Section 90.209 / 90.267 (Continued)

Output Signal

Frequency (MHz)	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (kHz)
939.975	1.0	10.0	19.539



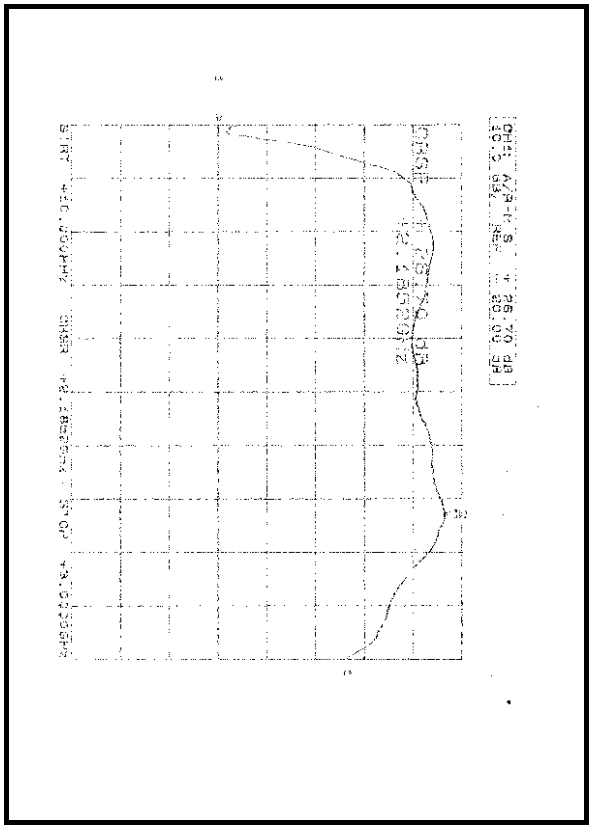
7.2.6. Gain Flatness and Out of Band Rejection

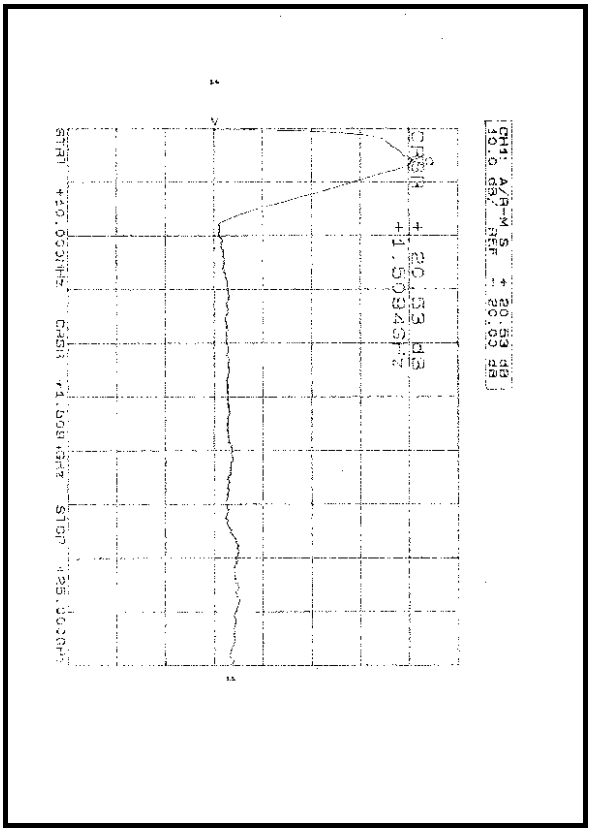
The EUT was configured as for transmitter conducted emission measurements as described in section 9 of this report.

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

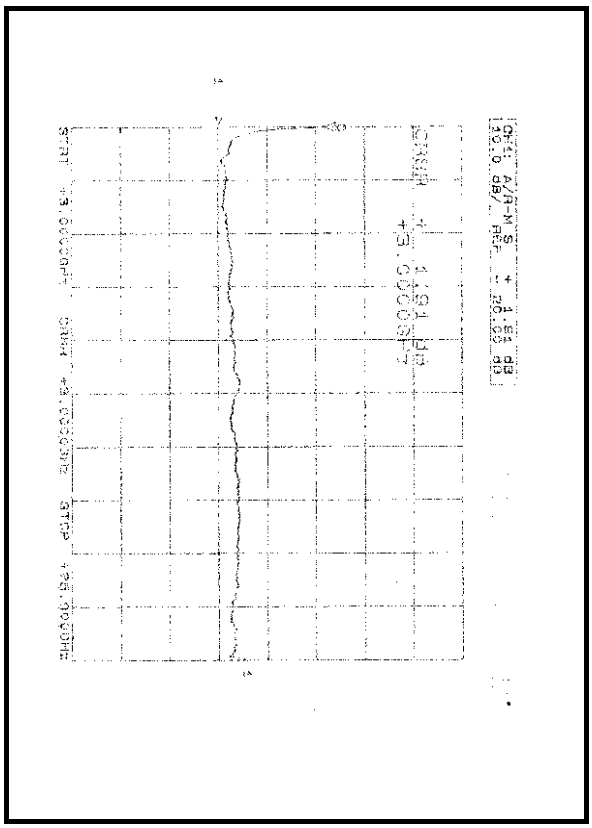
Maximum Gain Error (dB)	Limit (dB)	Margin (dB)	Result
7.2	10.0	2.8	Complied

Gain Flatness and Out of Band Rejection (Continued)





Test of: Zinwave DAS3000
To: FCC Part 90: 2007
Technology - ESMR



7.2.7. Inter-modulation Attenuation

The EUT was configured as for transmitter conducted emission measurements as described in section 9 of this report.

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

F1 = 180 MHz
F2 = 2500 MHz

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
360.000	-17.1	-13.0	4.1	Complied
540.000	-28.6	-13.0	15.6	Complied
1960.000	-23.4	-13.0	10.4	Complied
2140.000	-17.8	-13.0	4.8	Complied
2680.000	-21.3	-13.0	8.3	Complied
2860.000	-25.7	-13.0	12.7	Complied

F1 = 406 MHz
F2 = 406.0125 MHz

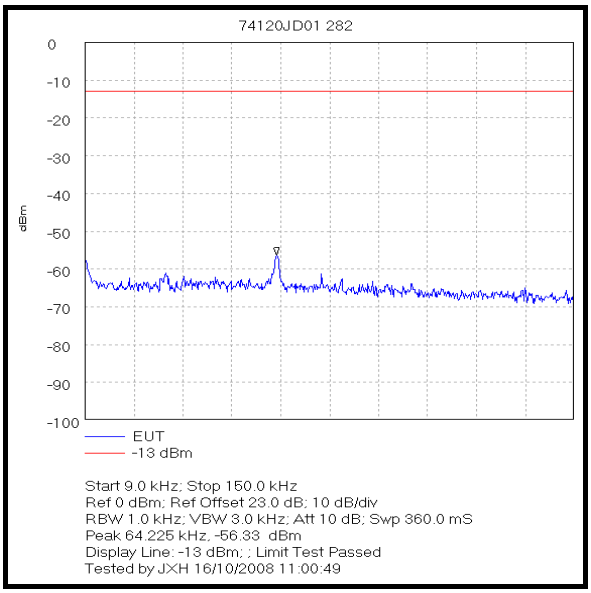
Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
812.0167	-18.3	-13.0	5.3	Complied
1218.000	-25.7	-13.0	12.7	Complied

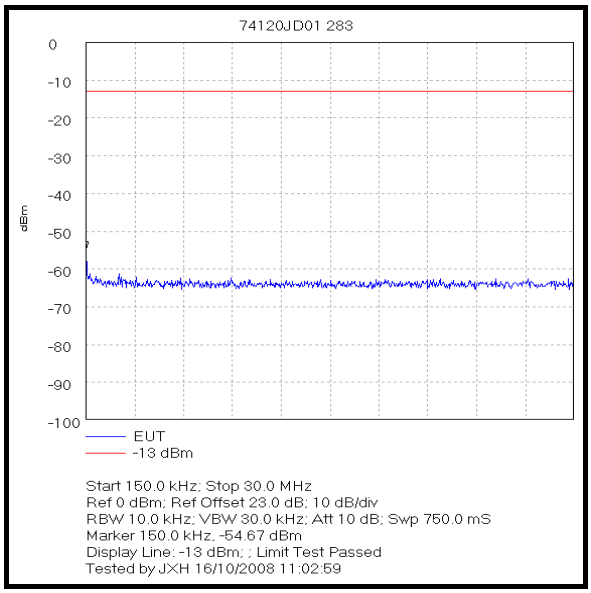
F1 = 2467 MHz
F2 = 2472 MHz

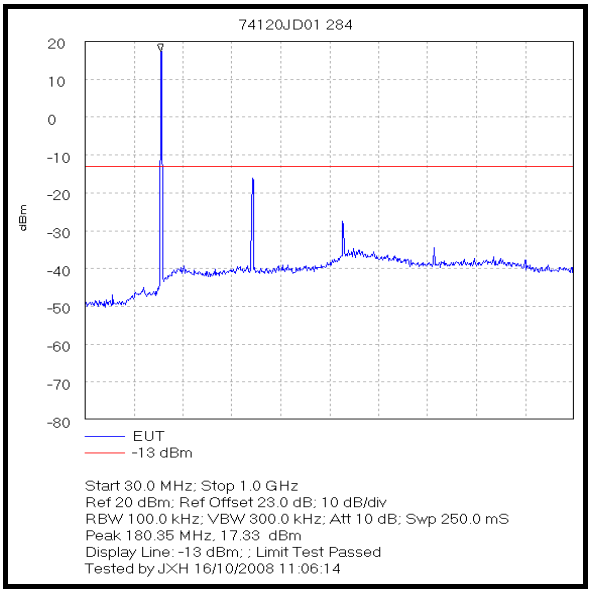
Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1777.930	-20.0	-13.0	7.0	Complied
2462.000	-28.1	-13.0	15.1	Complied
2472.000	-27.9	-13.0	14.9	Complied

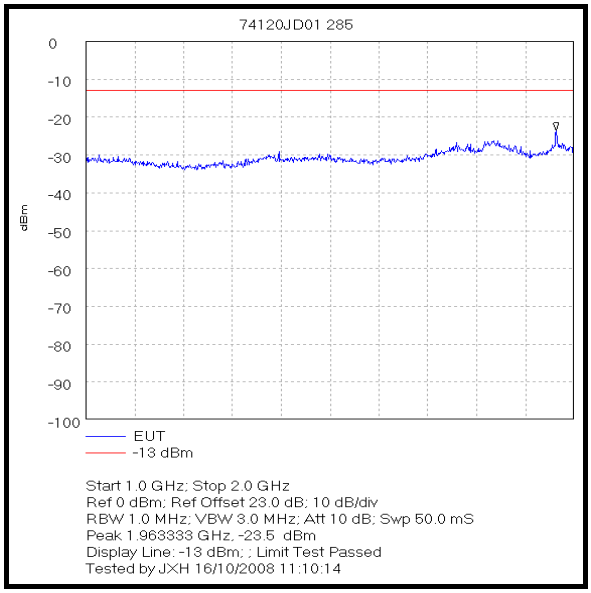
Inter-modulation Attenuation (Continued)

F1 = 180 MHz
F2 = 2500 MHz





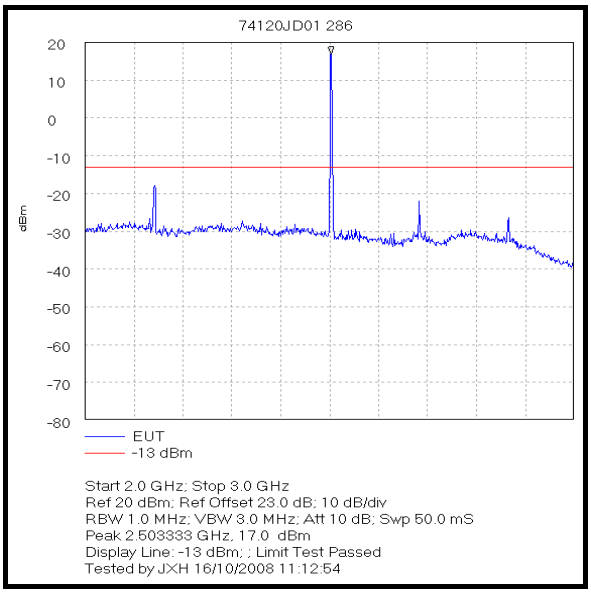


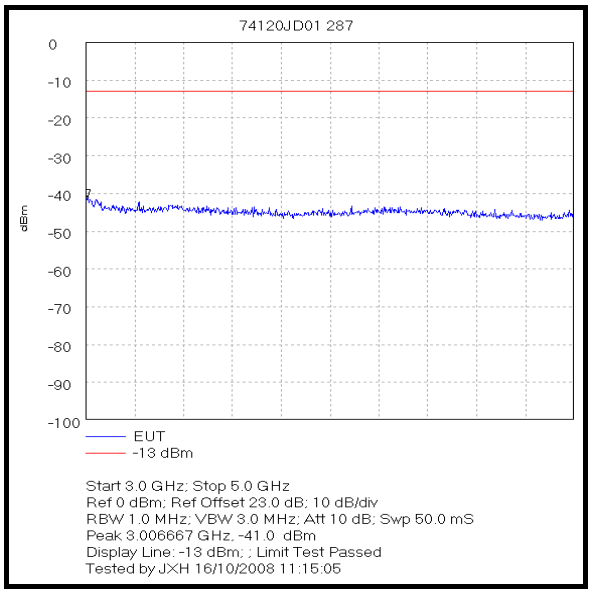


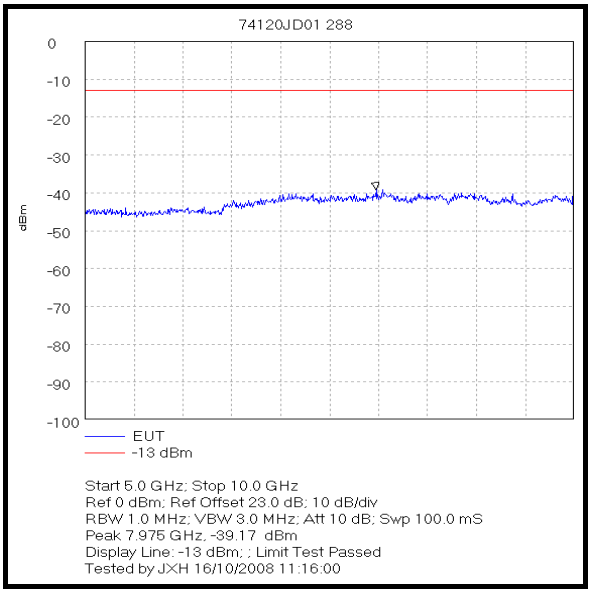
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

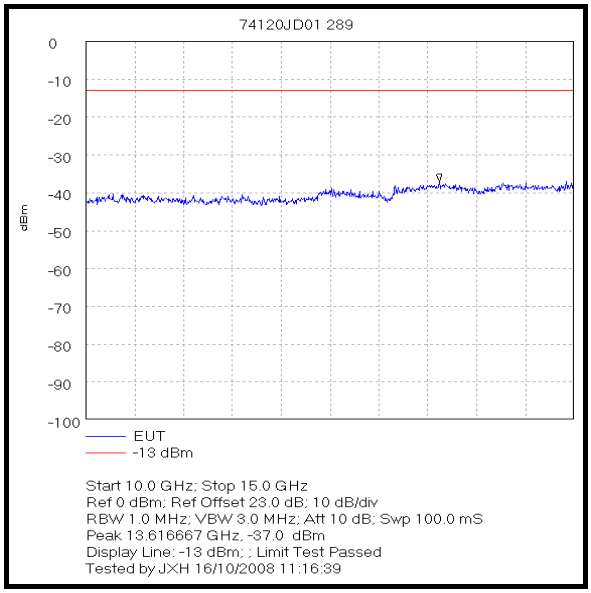
Inter-modulation Attenuation (Continued)

F1 = 180 MHz
F2 = 2500 MHz





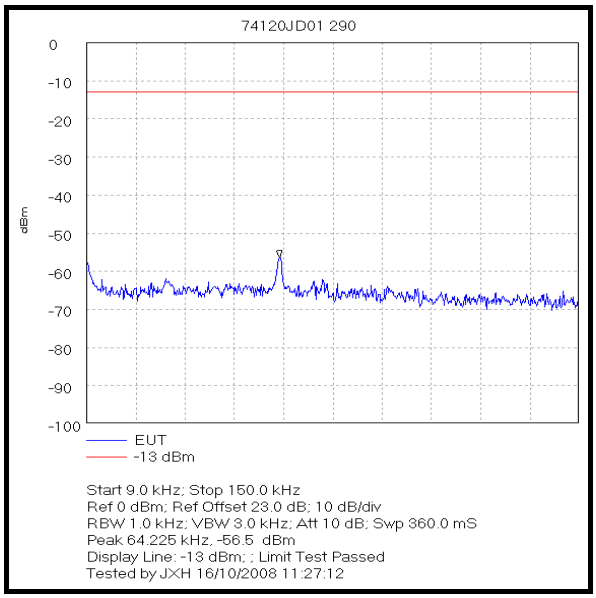


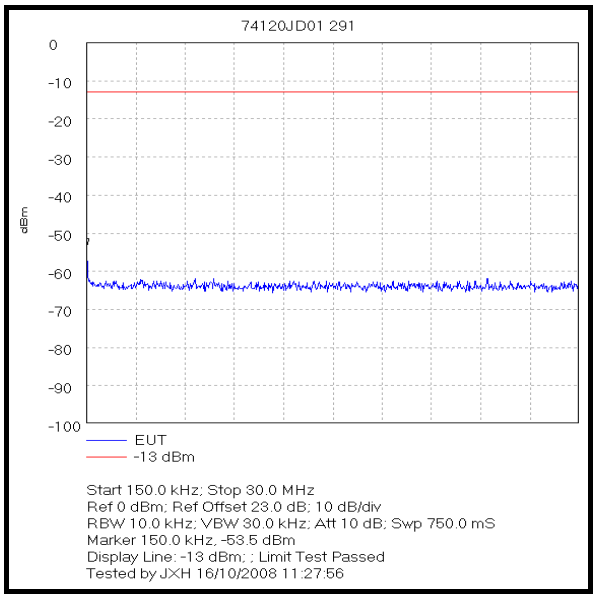


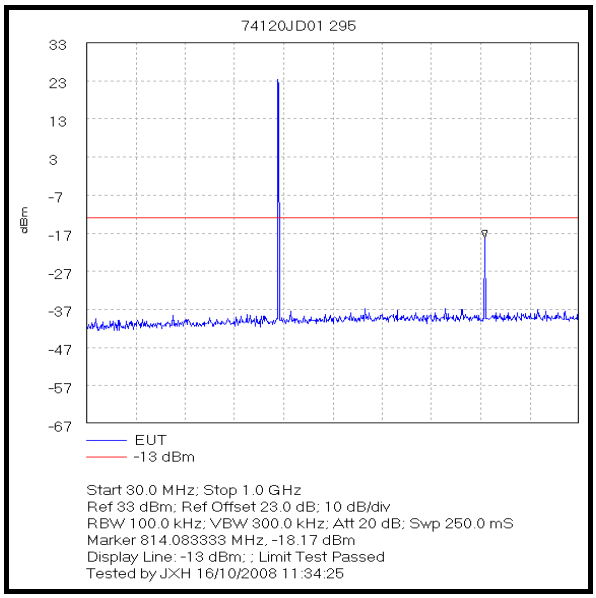
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

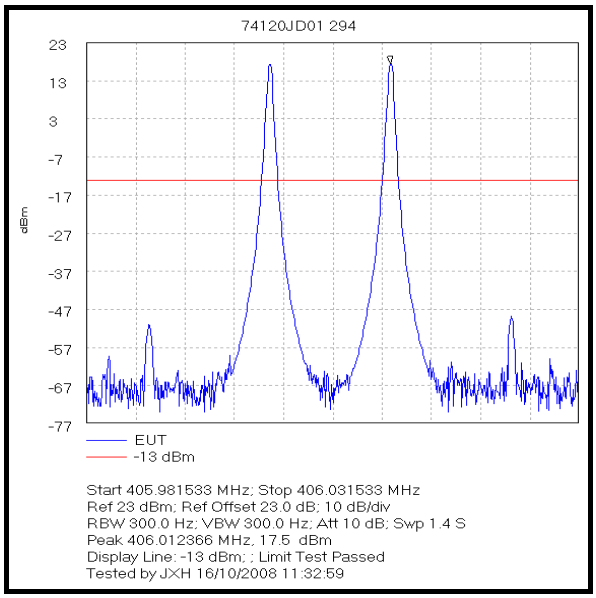
Inter-modulation Attenuation (Continued)

F1 = 406 MHz
F2 = 406.0125 MHz





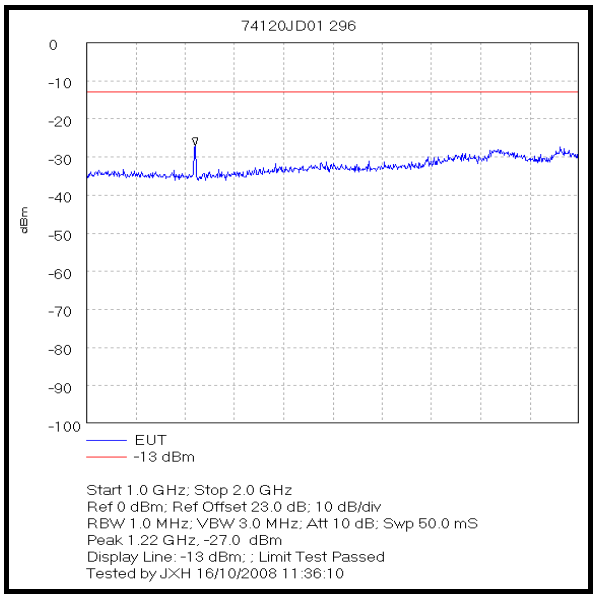


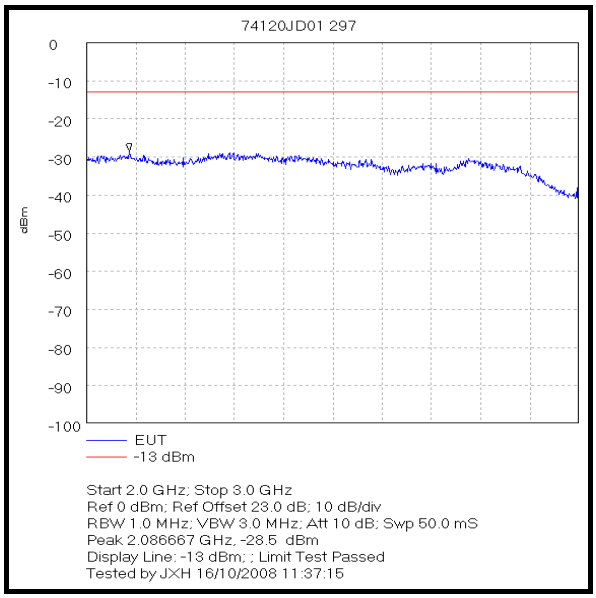


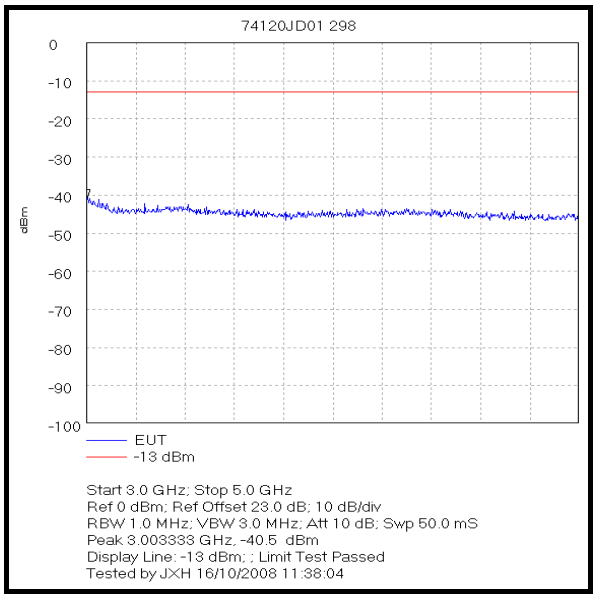
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Inter-modulation Attenuation (Continued)

F1 = 406 MHz
F2 = 406.0125 MHz



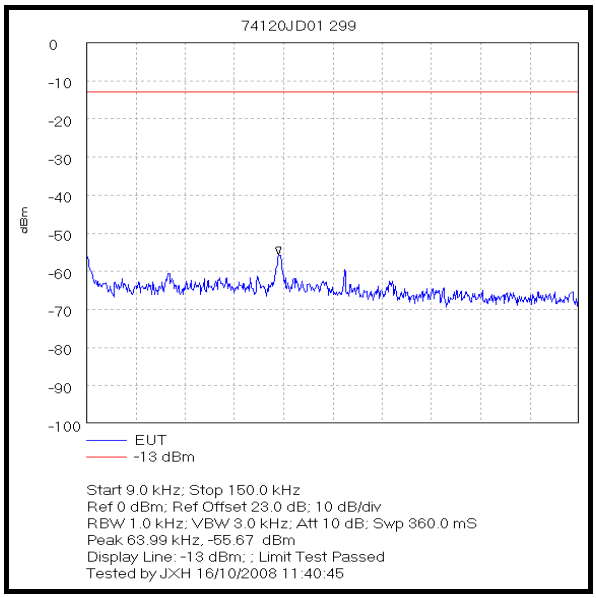


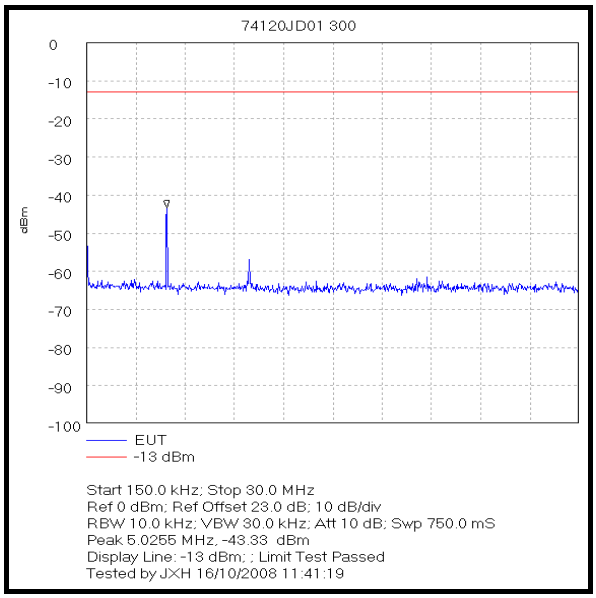


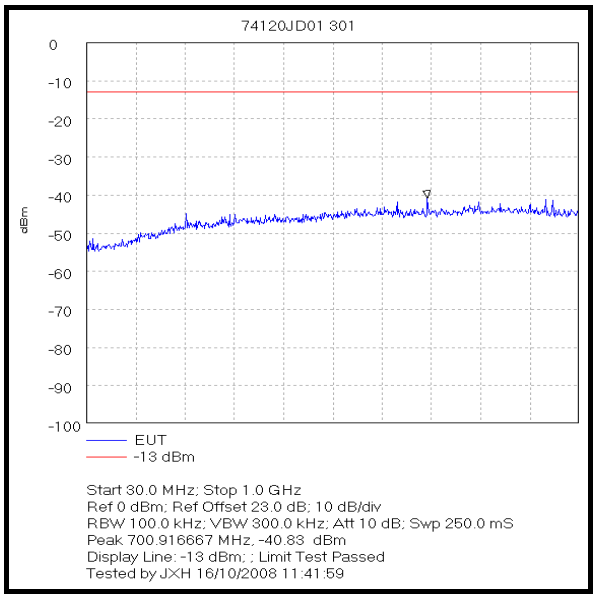
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

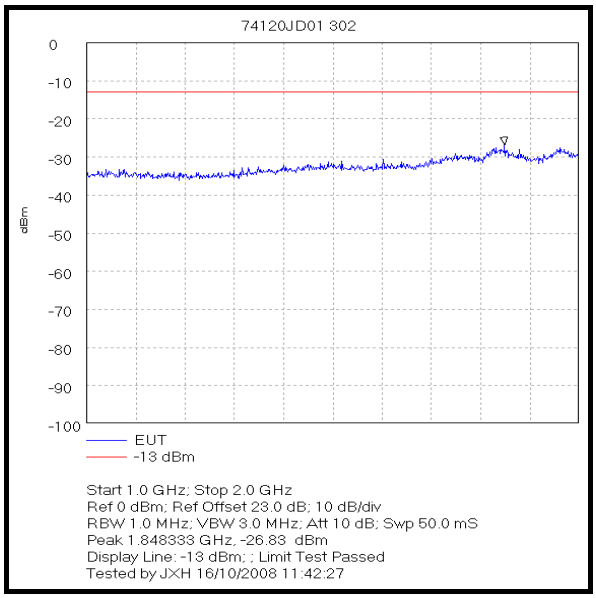
Inter-modulation Attenuation (Continued)

F1 = 2467 MHz
F2 = 2472 MHz





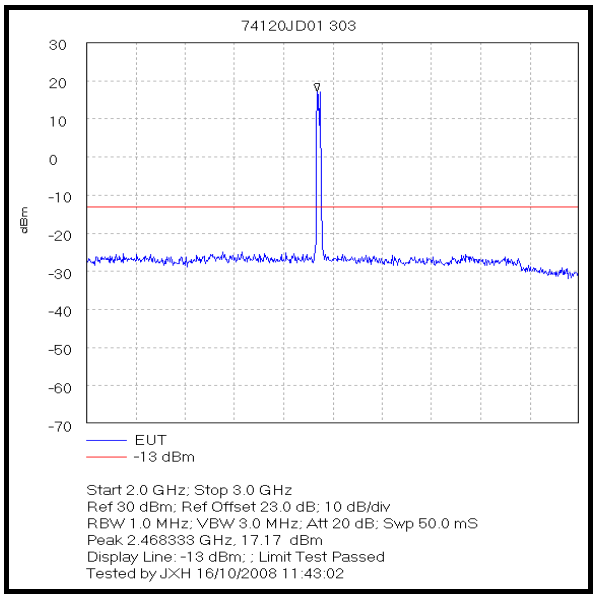


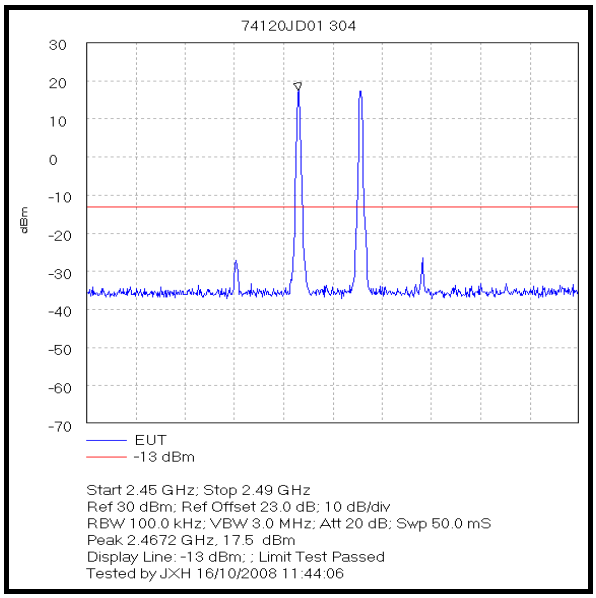


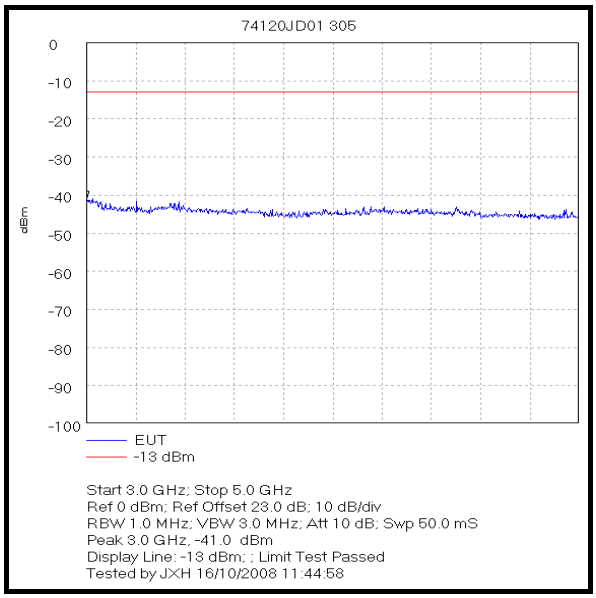
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

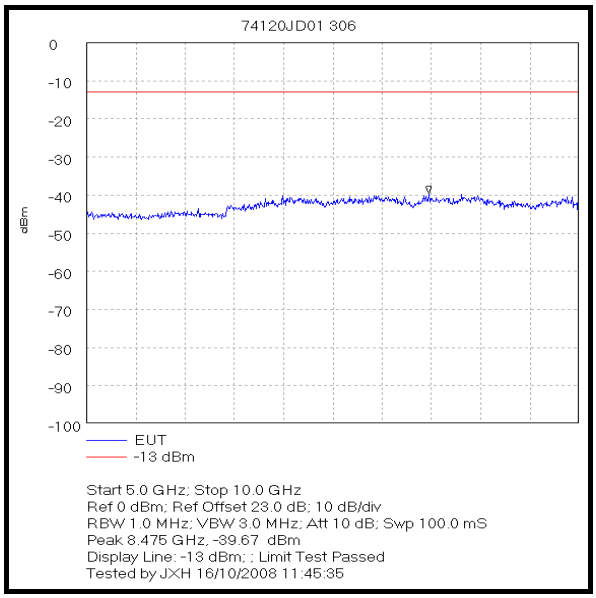
Inter-modulation Attenuation (Continued)

F1 = 2467 MHz
F2 = 2472 MHz





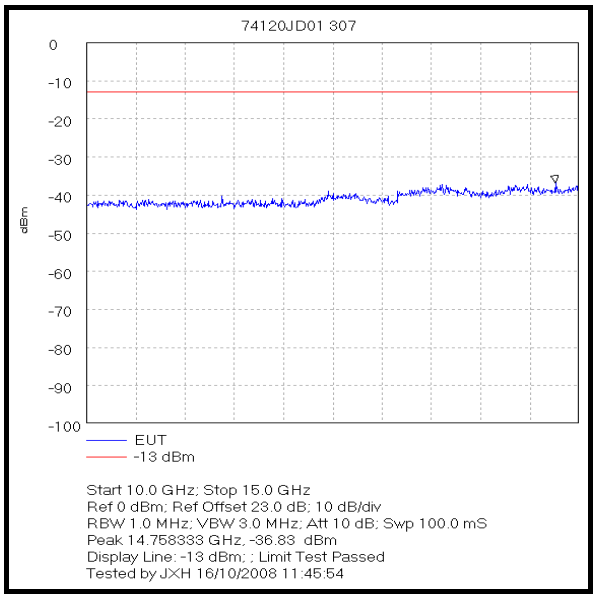




Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Inter-modulation Attenuation (Continued)

F1 = 2467 MHz
F2 = 2472 MHz



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

7.2.8. Transmitter Out of Band Conducted Emissions: Section 90.210

The EUT was configured as for transmitter conducted emission measurements as described in section 9 of this report.

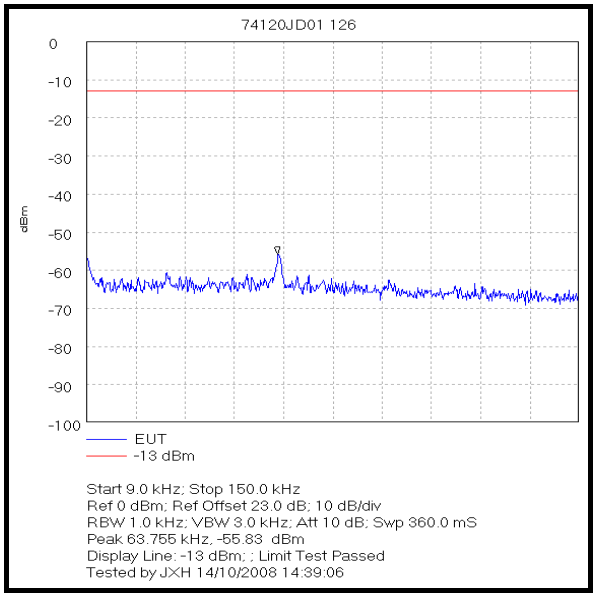
Tests were performed to identify the maximum transmitter conducted emission levels.

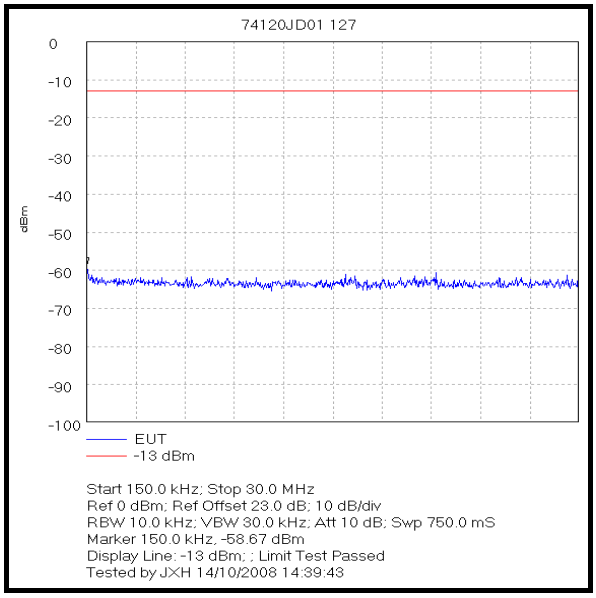
Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1880.025	-19.0	-13.0	6.0	Complied

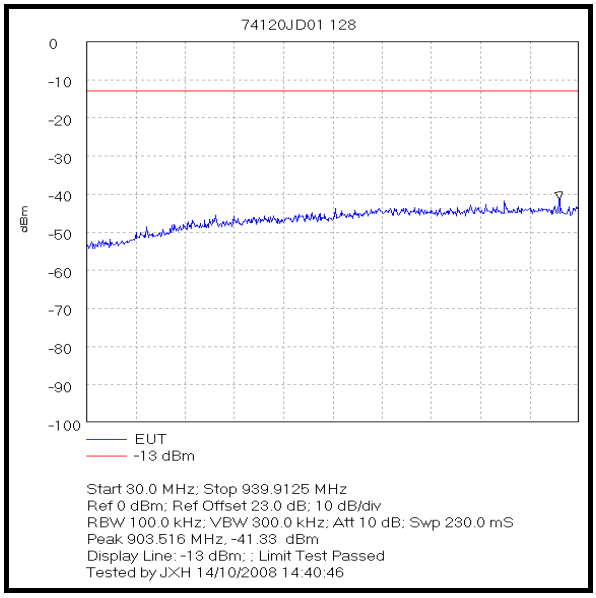
Note(s):

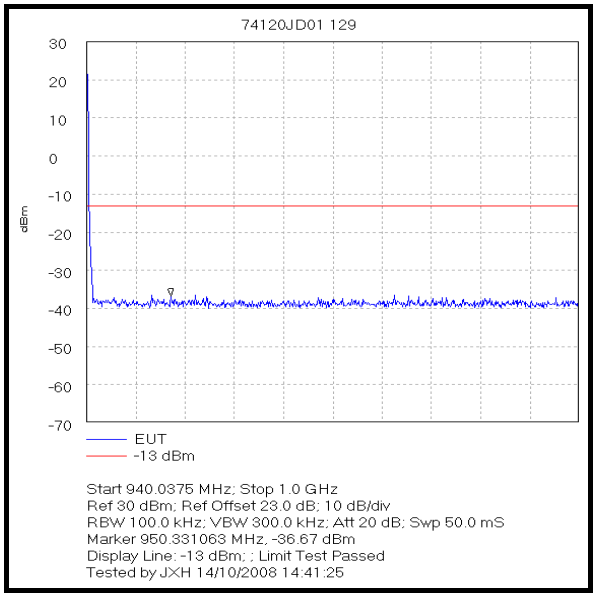
1. All other emissions were at least 20 dB below the limit.

Transmitter Out of Band Conducted Emissions: Section 90.210 (Continued)



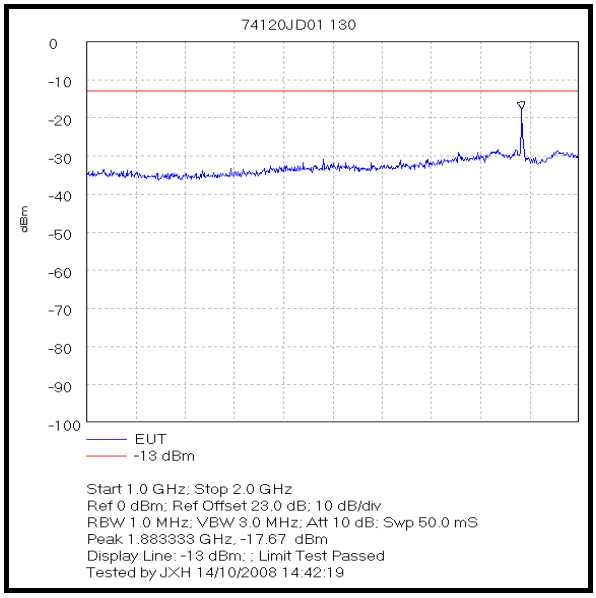


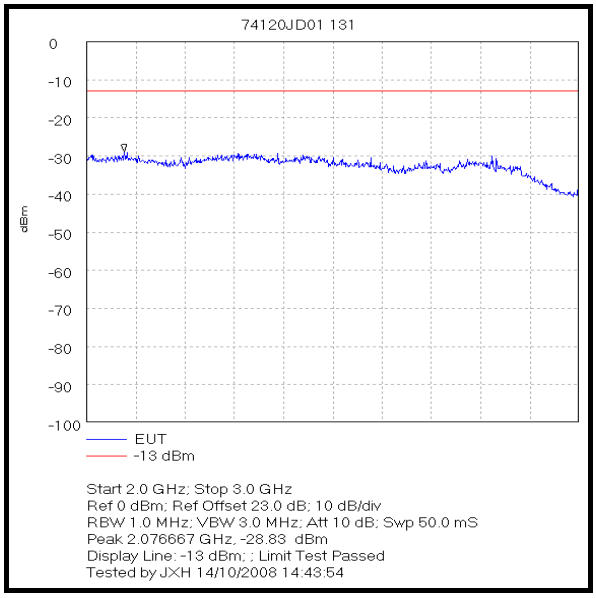


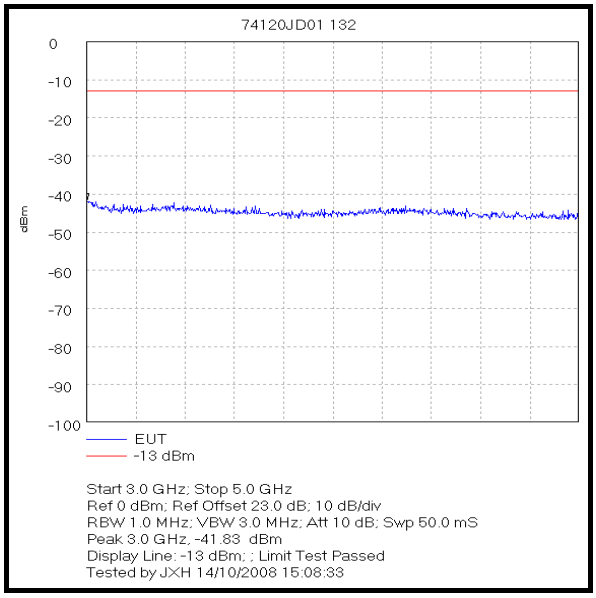


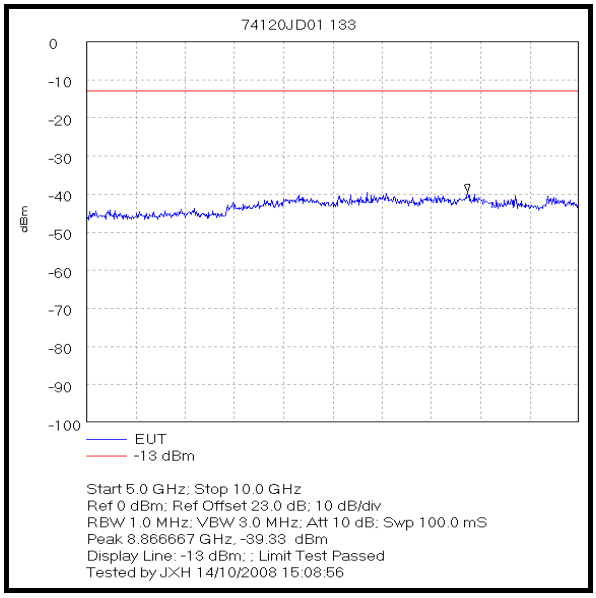
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Transmitter Out of Band Conducted Emissions: Section 90.210 (Continued)



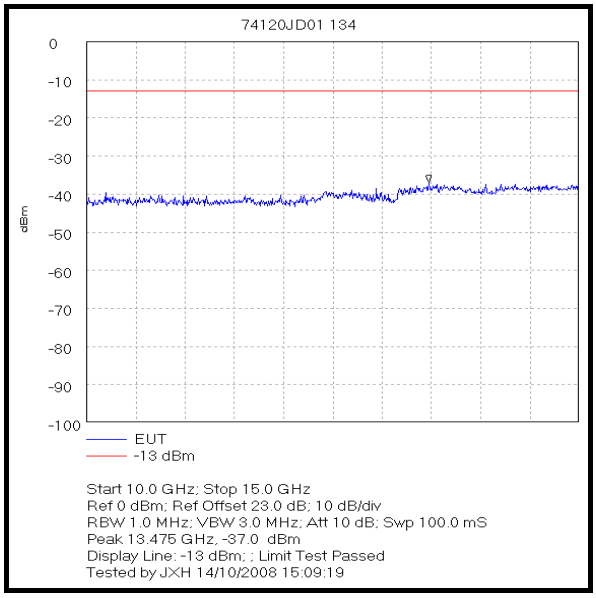


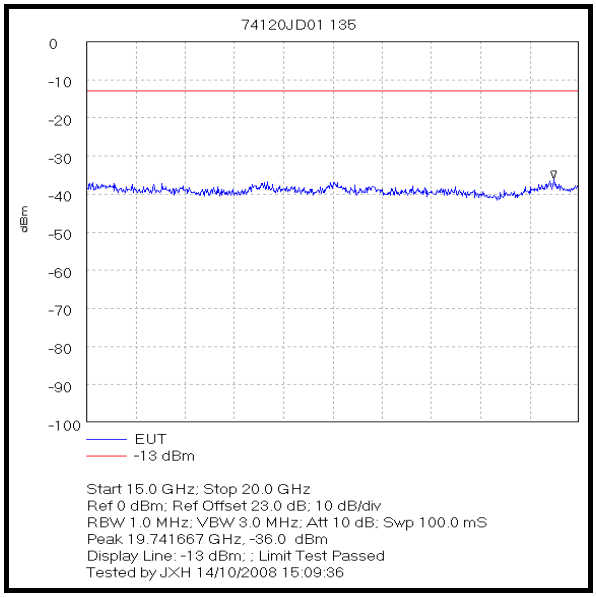


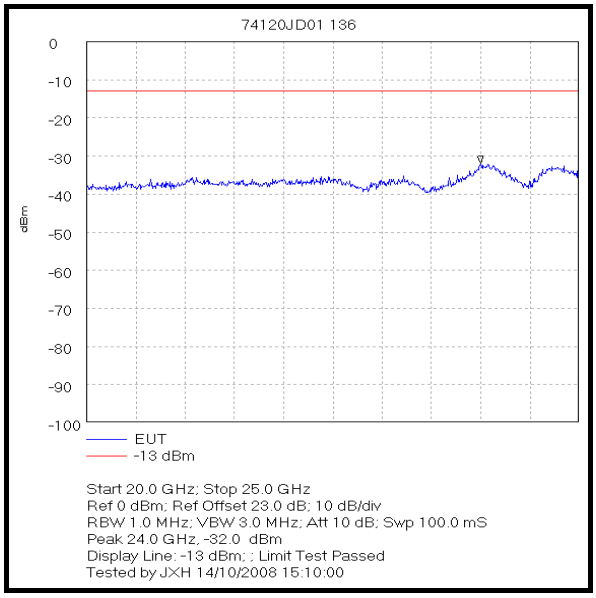


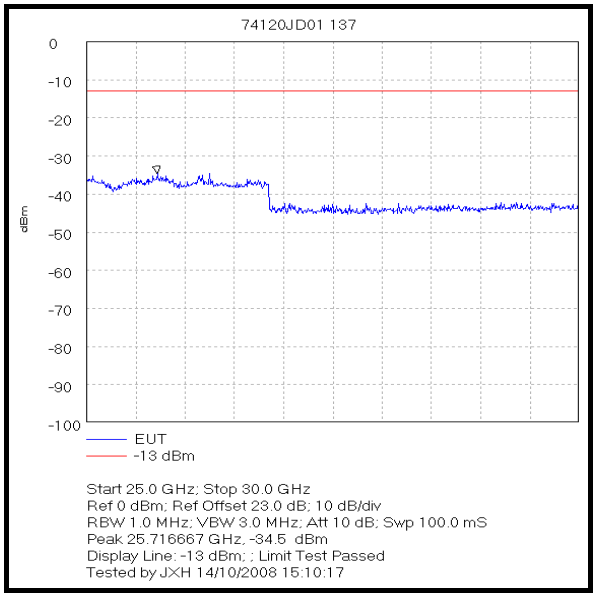
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Transmitter Out of Band Conducted Emissions: Section 90.210 (Continued)









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

7.2.9. Transmitter Out of Band Radiated Emissions: Section 90.210

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

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

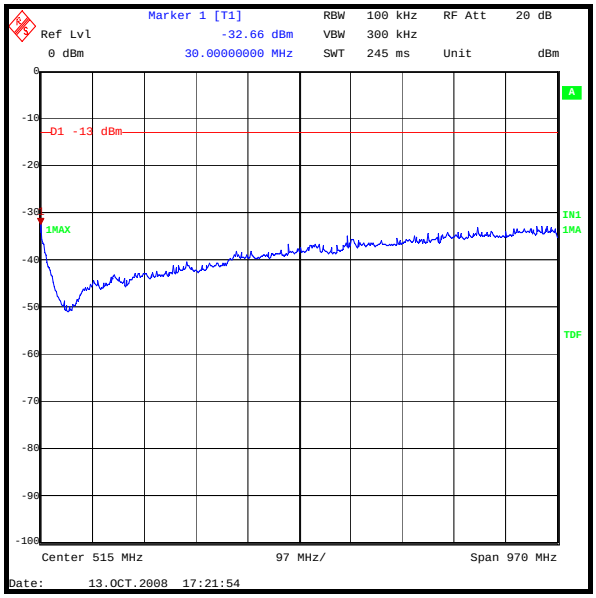
Frequency (GHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
25.546	-35.9	-13.0	22.9	Complied

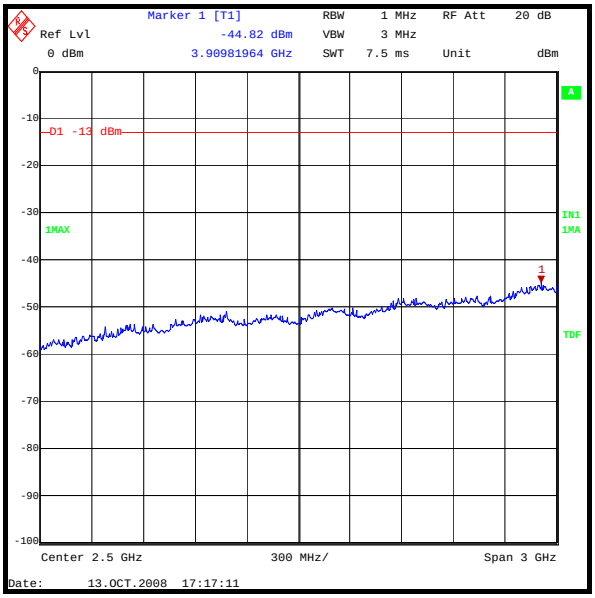
Note(s):

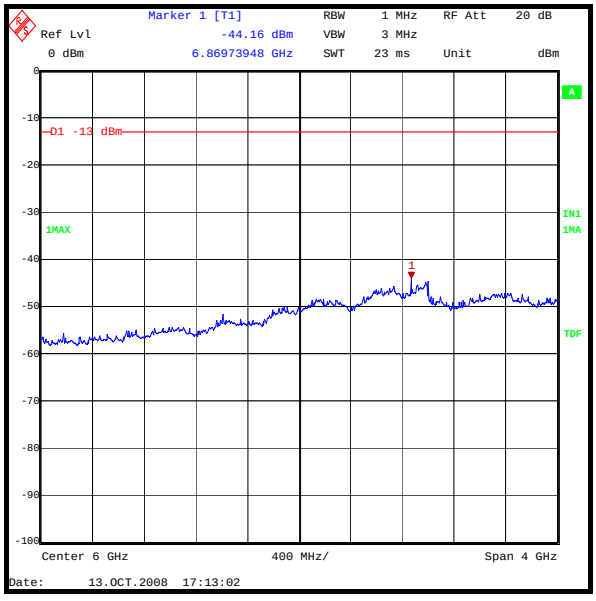
1. *Measurements were performed with the CW signals in the following bands:*
   UHF 406.1 to 454 MHz
   UHF 456 to 512 MHz
   Public Safe 698 to 824 MHz
   Public Safe / SMR / ESMR 851 to 869 MHz

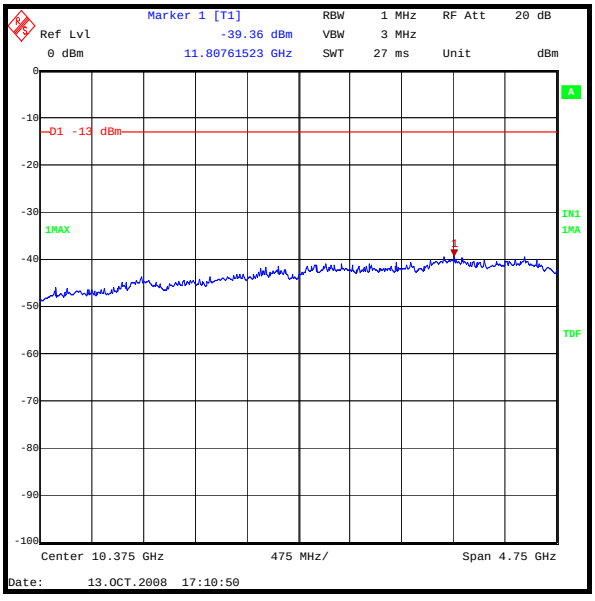
Test of: Zinwave DAS3000
To: FCC Part 90: 2007
Technology - ESMR

Transmitter Out of Band Radiated Emissions: Section 90.210 (Continued)



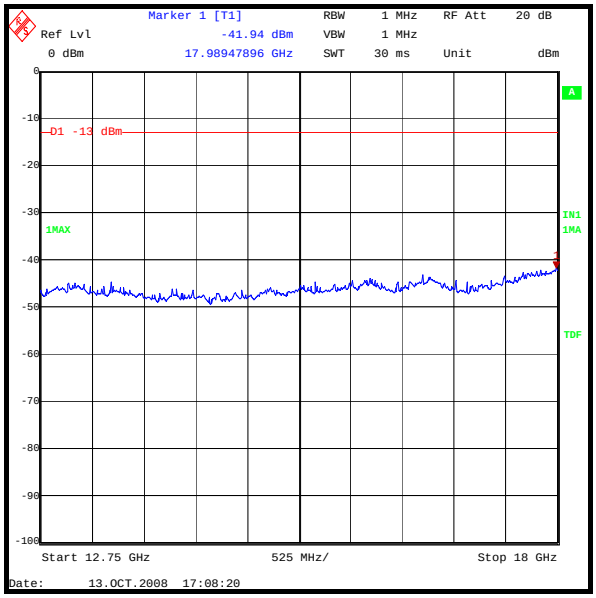






Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Transmitter Out of Band Radiated Emissions: Section 90.210 (Continued)



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

8. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

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

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

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor, such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±3.72 dB
Carrier Output Power	Not applicable	95%	±0.28 dB
Conducted Emissions	9 kHz to 26 GHz	95%	±0.46 dB
Conducted Emissions Antenna Port	30 MHz to 40 GHz	95%	±0.28 dB
Frequency Stability	Not applicable	95%	±11.4 ppm
Occupied Bandwidth	824 to 849 MHz	95%	±11.4 ppm
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	±4.64 dB
Radiated Spurious Emissions	1 GHz to 26 GHz	95%	±2.94 dB

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

9. Measurement Methods

9.1. Conducted Output Power

The EUT was connected to a spectrum analyser and to a test set via suitable cables, RF attenuators and combiners.

The connection was made to the EUT either via an antenna port or by antenna terminals made available by the client.

The total loss of the cables, attenuators and combiner were measured and entered as a reference level offset into the measuring receiver to correct for the losses.

The EUT was set to the required channel and the transmitter set to operate at full power.

A marker was set to the maximum indicated peak and the conducted power was recorded.

This test was performed on the bottom, middle and top channels.

The test equipment settings for conducted antenna port measurements were as follows:

Receiver Function	Setting
Detector Type:	Peak
Mode:	Max Hold
Bandwidth:	≥ Emission Bandwidth
Amplitude Range:	100 dB
Step Size:	Continuous sweep
Sweep Time:	Coupled

9.2. Effective Radiated Power (ERP)

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

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

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

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

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

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

ERP = Signal Generator Level - Cable Loss + Antenna Gain

Effective Radiated Power (ERP) (Continued)

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

Delta (dB) = EUT – SG

Where :

EUT = spectrum analyser indicated EUT raw level

SG = spectrum analyser indicated signal generator raw level

The signal generator actual ERP is calculated as:

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

The EUT ERP is calculated as:

ERP EUT = ERP SG + Delta.

The test equipment settings for ERP measurements were as follows:

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

9.3. Frequency Stability

The EUT was situated within an environmental test chamber and connected directly to the test set via an access port.

Measurements were performed with the EUT operating under extremes of temperature in 10 degree increments within the range -30 to 50 ºC.

Measurements were also performed at voltage extremes between the declared nominal supply voltage and at the declared endpoint voltage (for hand carried battery operated equipment) or by varying the primary supply voltage from 85% to 115% of the nominal value for all other equipment types.

The requirement was to determine the frequency stability of the device under specified environmental operating conditions.

Measurements were made on the top and bottom channels.

The EUT was switched off for a minimum of 30 minutes between each stage of testing while the environmental chamber stabilised at the next temperature within the stated temperature range.

The frequency error measured was converted to an error in ppm using the following formula as defined by TIA_EIA_603A :-

$$\text{ppm error} =$$

where MCF_{MHz} is the measured carrier frequency in MHz
ACF_{MHz} is the assigned carrier frequency in MHz

The measured ppm had to be less then the relevant limits in order to comply.

9.4. Occupied Bandwidth

The EUT was connected to a spectrum analyser enabled with an occupied bandwidth function and a test set via a bi-directional coupler to its antenna port.

Measurements were performed to determine the occupied bandwidth in accordance with FCC Part 2.1049. The occupied bandwidth was measured from the fundamental emission at the bottom, middle and top channels.

The occupied bandwidth was measured using the built in occupied bandwidth function of the Rohde and Schwarz FSEB or ESIB spectrum analyser. It was set to measure the bandwidth where 99% of the signal power was contained. The analyser settings were set as per those outlined in the spectrum analyser user manual for this measurement, i.e., RBW $\geq$ 1% of occupied bandwidth. A value of 3 kHz was used.

9.5. Transmitter Conducted Emissions Measurements

Spurious emission measurements at the antenna port were performed from the lowest declared frequency to 10 times the highest EUT fundamental frequency.

A measuring receiver was connected to the antenna port of the EUT via a suitable cable and RF attenuator. The total loss of both the cable and the attenuator were measured and entered as a reference level offset into the measuring receiver to correct for the losses.

The limit in the standard states that emissions shall be attenuated by at least 43+10 log (P) dB below the transmitter power (P), where (P) is the maximum measured fundamental power for the channel under test. This limit always reduces to -13 dBm therefore, the limit line presented on the accompanying plots is set to -13 dBm.

The frequency band described above was investigated with the transmitter operating at full power on the top, bottom and middle channels. Any spurious observed were then recorded and compared to the -13 dBm limit. The requirement is for the emission to be less than -13 dBm. The margin between emission and limit is recorded and should always be positive to indicate compliance.

It should be noted that FCC Part 22.917 states that the 1st MHz band immediately adjacent to the applicants declared frequency block may be measured using a resolution bandwidth of at least 1% of the emission bandwidth. This bandwidth was found to be 3 kHz

The test equipment settings for conducted antenna port measurements were as follows:

Receiver Function	Settings
Detector Type:	Peak
Mode:	Max Hold
Bandwidth:	100 kHz >1 GHz
Bandwidth:	10 kHz <1 GHz
Amplitude Range:	100 dB
Step Size:	Continuous sweep
Sweep Time:	Coupled

The resolution bandwidth used for measurements in the 1 MHz blocks either side of the declared operating frequency block were set as described in the procedure above.

9.6. AC Mains Conducted Emissions

AC mains conducted emission measurements were performed in accordance with the standard, against appropriate limits for each detector function.

The test was performed in a shielded enclosure with the equipment arranged as detailed in the standard on a wooden bench using the floor of the screened enclosure as the ground reference plane. The EUT was powered with 115V 60 Hz AC mains supplied via a line impedance stabilisation network (LISN).

Initial measurements in the form of swept scans covering the entire measurement band were performed in order to identify frequencies on which the EUT was generating interference. In order to minimise the time taken for these swept measurements, a peak detector was used in conjunction with the appropriate detector IF measuring bandwidths (see table below). Repetitive scans were performed to allow for emissions with low repetition rates, and the duty cycle of the EUT. The test configuration was the same for the initial scans as for the final measurements.

Following the initial scans, a graph was produced giving an overview of the emissions from the EUT plotted against the appropriate specification limit. A tolerance line was set 6 dB below the specification limit and levels above the tolerance line were re-tested (at individual frequencies) using the appropriate detector function.

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

Receiver Function	Initial Scan	Final Measurements
Detector Type:	Peak	Quasi-Peak (CISPR)/Average
Mode:	Max Hold	Not applicable
Bandwidth:	10 kHz	9 kHz
Amplitude Range:	60 dB	20 dB
Measurement Time:	Not applicable	> 1 s
Observation Time:	Not applicable	> 15 s
Step Size:	Continuous sweep	Not applicable
Sweep Time:	Coupled	Not applicable

9.7. Transmitter Radiated Emissions

Radiated emission measurements were performed in accordance with the standard, against appropriate limits for each detector function.

Initial pre-scans covering the entire measurement band from the lowest generated frequency declared up to 10 times the highest fundamental frequency. The scans were performed within a screened chamber in order to identify frequencies on which the EUT was generating spurious. This procedure identified the frequencies from the EUT, which required further examination. Repetitive scans were performed to allow for emissions with low repetition rates, and for the duty cycle of the EUT.

The initial scans were performed using an antenna height of 1.5 m and a measurement distance of 3 m. A limit line was set to the specification limit by characterising the screen room using a known signal source set at exactly the same location as the EUT. The signal source was derived from either a horn antenna or a dipole dependant on the frequency band under investigation. Any levels within 20 dB of this limit were measured where possible, on occasion; the receiver noise floor came within the 20 dB boundary. On these occasions, the system noise floor may have been recorded.

An open area test site using the appropriate test distance and measuring receiver with a peak detector was used for final measurements at each frequency recorded in the screen room.

The levels were maximised by initially rotating the turntable through 360° and then varying the antenna height between 1 m and 4 m in the vertical polarisation. At this point, any signals found to be between the limit and a level 6 dB below it were further maximised by changing the configuration of the EUT, e.g. re-routing cables to peripherals and moving peripherals with respect to the EUT. The procedure was repeated for the horizontal polarisation.

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

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

EIRP/ERP = Signal Generator Level - Cable Loss + Antenna Gain

Transmitter Radiated Emissions (Continued)

The limit in the standard states that emissions shall be attenuated by at least 43+10 log (P) dB below the transmitter power (P), where (P) is the maximum measured fundamental power for the channel under test. This limit always reduces to -13dBm therefore, the limit line presented on the accompanying plots is set to -13dBm.

Any spurious measured were then compared to the -13dBm limit. The requirement is for the emission to be less than -13dBm. The margin between emission and limit is recorded and should always be positive to indicate compliance.

It should be noted that FCC Part 22.917 states that the 1st MHz band immediately adjacent to the applicants declared frequency block may be measured using a resolution bandwidth of at least 1% of the emission bandwidth. This bandwidth was found by calculating 1% of the bandwidth measured in the transmitter occupied bandwidth section of this report. The next largest available bandwidth above this calculated figure was, therefore, used i.e. 3 kHz.

Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
A004	Line Impedance Stabilization Network	Rohde & Schwarz	ESH3-Z5	890 604/027	19 May 2008	12
A1299	Antenna	Schaffner	CBL6143	5094	28 Jul 2008	12
A1738	Attenuator	Atlantic Microwave	BBS40-10	R1379	Calibrated before use	-
A1793	Pre Amplifier	A.H.Systems Inc.	PAM-0118	183	03 Jul 2008	12
A1818	Antenna	EMCO	3115	00075692	30 Aug 2008	12
A1830	Pulse Limiter	Rhode & Schwarz	ESH3-Z2	100668	16 Jan 2008	12
A259	Antenna	Chase	CBL6111	1513	25 Jul 2008	12
A435	Antenna	Flann	22240-20	400	21 Jul 2006	36
A436	Antenna	Flann	20240-20	330	24 Apr 2006	36
C1111	Cable	Semflex Inc.	X116BFSX10080	0337	Calibrated before use	-
C1142	Cable	HP	65474	1187396	Calibrated before use	-
C1164	Cable	Rosenberger Micro-Coax	FA210A1015007070	43188-1	20 Apr 2008	12
C1169	Cable	Microcoax	n/a	n/a	Calibrated before use	-
C1296	3m Cable	Rosenberger	FA210A0030005050	58940-02	10 Jul 2008	12
C1297	10m Cable	Rosenberger	FA210A0100005050	58941-01	10 Jul 2008	12
C1298	10m Cable	Rosenberger	FA210A0100005050	58941-02	10 Jul 2008	12
C1302	3m Cable	Rosenberger	FA210A1030005050	59153-01	04 Aug 2008	12
C1306	15m Cable	Rosenberger	FA210A0015005050	59152-01	01 Aug 2008	12
C363	Cable	Rosenberger	RG142	None	20 Apr 2008	12
E0518	Environmental Chamber	TAS	LTCL 1200	24000107	Calibration not required	-
G085	Continuous Wave Generator	Hewlett Packard	83650L	3614A00104	03 Nov 2006	24
M1124	Spectrum Analyser	Rohde & Schwarz	ESIB26	100046K	19 Feb 2008	12

Test of: **Zinwave DAS3000**
To: **FCC Part 90: 2007**
Technology - ESMR

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
M1242	Spectrum Analyser	Rohde & Schwarz, Inc.	FSEM30	845986/022	29 Nov 2007	12
M1249	Thermometer	Fluke	52II	88800049	09 Jul 2008	12
M1251	Digital Multimeter	Fluke	175	89170179	21 Dec 2007	12
M1263	Test Receiver	Rohde & Schwarz	ESIB7	100265	06 Feb 2008	12
M1273	Test Receiver	Rhode & Schwarz	ESIB 26	100275	26 Feb 2008	12
M1348	Network Analyser Display	Agilent	8757E	3025A00346	26 Jun 2008	12
M1349	Network Analyser Detector	Agilent	85025D	01447	06 Jun 2008	12
M1391	Thermometer/ Hygrometer	Oergon Scientific	BAR629HGU	N/A	18 Jun 2008	12
M1449	SMIQ03B	Rohde and Schwarz	SMIQ03B	100176	23 Jan 2008	12
M1501	Network Analyser 50GHz Sensor	Hewlett Packard	85025D	US38012297	28 Jun 2008	12
M166	Thermometer/ Barometer/ Hygrometer	EuroCom	None	None	18 Jun 2008	12
M259	SME03 Signal Generator	Rohde & Schwarz	1038.6002.03	827758/021	Calibrated before use	-
M260	SMP02 Signal Generator	Rohde & Schwarz	1035.5005.02	829076/008	N/A	12
M295	Spectrum Analyser	Hewlett Packard	8564E	3846A01561	13 Nov 2007	12

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