TEST REPORT

Report Number: 3082387-003
Project Number: 3082387

Evaluation of the Radio Base Station (RBS) Model Number: HT500

FCC ID: ***EFCHT500***

IC ID: ***1308-HT500***

Tested to the Criteria in
FCC Part 15 Subpart C (15.247)
ICES-003 and RSS-210 Issue 6

For

Orion Electronics Ltd.

Test Performed by:	Test Authorized by:
Intertek	Orion Electronics Ltd.
731 Enterprise Drive	90 Sanford Drive Box 2728
Lexington, KY 40510	Windsor, Nova Scotia BON2TO

Prepared By:______________________ **Date:**____3/31/2006________

Jason Centers, Project Engineer

Approved By:______________________ **Date:**____3/31/2006________

Bryan C. Taylor, EMC Team Leader

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TABLE OF CONTENTS

1 JOB DESCRIPTION

1.1 Test Sample Information

Company Information	
Manufacturer:	Orion Electronics Ltd.
Address:	90 Sanford Drive Box 2728 Windsor Nova Scotia BON2TO
Contact Name:	David Roddis
Telephone Number:	(800)-665-4648
Fax Number:	(902)-798-8188
Email Address:	droddis@orion.ns.ca

Test sample	
Model Number:	HT500
Serial Number:	Not Labled
FCC ID:	EFCHT500
IC ID:	1308-HT500
Device Category:	Portable
RF Exposure Category:	Occupational / Controlled Exposure
Transmission Modes:	Frequency Hopping Spread Spectrum (FHSS) using Binary Frequency Shift-Keying (BFSK)
Frequency Range, MHz:	2401 – 2475 MHz
Maximum RF Output Power (Measured):	26dBm
Antenna Type:	Mobile Mark Model PSKN3-2400RS 90degree Swivel Antenna
Antenna Location:	Back Side of Radio Base Station (RBS)
Antenna Gain:	2.3dBi

Test Signal Mode	
Test Commands:	X
Base Station Simulator:	

1.2 System Support Equipment

Table 1 contains the details of the support equipment associated with the Equipment Under Test during the testing.

Description	Manufacturer	Model Number
Laptop Computer	Compaq	Armada
GPS Antenna	Unknown	SGM3

Table 1: System Support Equipment

1.3 Cables associated with EUT

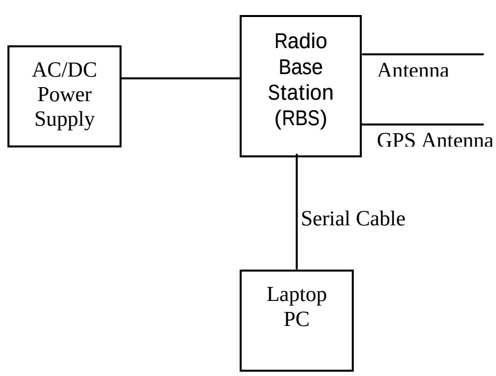
Table 2 contains the details of the cables associated with the EUT.

Cables					
Description	Length	Shielding	Ferrites	Connection	
				From	To
GPS Antenna Cable	8 ft	Yes	None	GPS Antenna Port	GPS Antenna
DC Power Cable	5 ft	None	None	AC/DC Power Supply	DC Input of the HT500
Serial Communications Cable	5 ft	Yes	None	Laptop Computer	Communications Port on the HT500

Table 2: Interconnecting cables between modules of EUT

1.4 System Block Diagram

The diagram shown below details the interconnection of the EUT and its accessories during the testing.



1.5 Justification

The EUT was operated in the stand-alone configuration with only the GPS and FHSS antennas, power supply, and serial cables connected. This represents the normal operating condition of this device.

1.6 Mode(s) of operation

The Radio Base Station (RBS) was powered by the AC to DC power supply provided with the sample. The sample had both internal and external antenna options. Both of these antennas were tested during the radiated tests.

1.7 Modifications required for compliance

No modifications were implemented by Intertek. All results in this report pertain to the un-modified sample provided to Intertek.

1.8 Related Submittal(s) Grants

None

2 EXECUTIVE SUMMARY

Testing performed for: Orion Electronics Ltd.

Equipment Under Test: HT500

Sample Receive Date: 7/21/2005

Test Start Date: 7/26/2005

Test Stop Date: 8/5/2005

DESCRIPTION OF TEST	RESULT	PAGE
Carrier Frequency Separation	**Compliant**	9
Number of Hopping Frequencies	**Compliant**	11
Time of Occupancy (Dwell Time)	**Compliant**	13
20dB Bandwidth	**Compliant**	17
Conducted Output Power	**Compliant**	19
Band Edge Measurements	**Compliant**	19
Conducted Spurious Emissions	**Compliant**	21
Field Strength of Spurious Radiation (Transmitting)	**Compliant**	27
Field Strength of Spurious Radiation (receiving)	**Compliant**	32
Power Line Conducted Emissions	**Compliant**	34

3 TEST FACILITY

The INTERTEK-Lexington is located at 731 Enterprise Drive, Lexington Kentucky, 40510. The radiated emission test site is a 10-meter semi-anechoic chamber. The chamber meets the characteristics of CISPR 16-1: 1993 and ANSI C63.4: 1992. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters.

This test site is listed with the FCC under registration number 485103 and with Industry Canada under number IC2055.

3.1 Test Equipment

Description	Manufacturer	Model Number	Serial Number	Calibration due date
Environmental Chamber	Thermotron	SM-8C	32692	1/19/2006
Signal Generator	HP	83620B	3614A00199	8/17/2005
Horn Antenna	Antenna Research	DRG-118/A	1086	7/6/2005
Horn Antenna	EMCO	3115	6556	7/27/2006
EMI Receiver	Rohde & Schwarz	ESI 26	1088.7490	8/16/2005
LISN	FCC	FCC-LISN-50-50-2M	1026	3/31/2006
Bilog Antenna	Chase	CBL6112A	2245	4/26/2006
Preamplifier	HP	8449B	3008A00775	12/1/2006

4 CARRIER FREQUENCY SEPARATION

4.1 Test Procedure

The antenna port of the HT500 was directly connected to the input of a spectrum analyzer through a specialized RF connector and an attenuator. The spectrum analyzer was offset by an appropriate amount to compensate for the attenuator and the associated cable loss. The hopping function of the HT500 was enabled. The following spectrum analyzer settings were used:

Span = wide enough to capture two adjacent channels

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep Time = Auto

Detector Function = Peak

Trace Type = Max Hold

The trace was allowed to stabilize and the marker-delta function was used to determine the separation between the peaks of the adjacent channels.

4.2 Test Results

The graph below illustrates that the carrier frequency separation is 1 MHz.

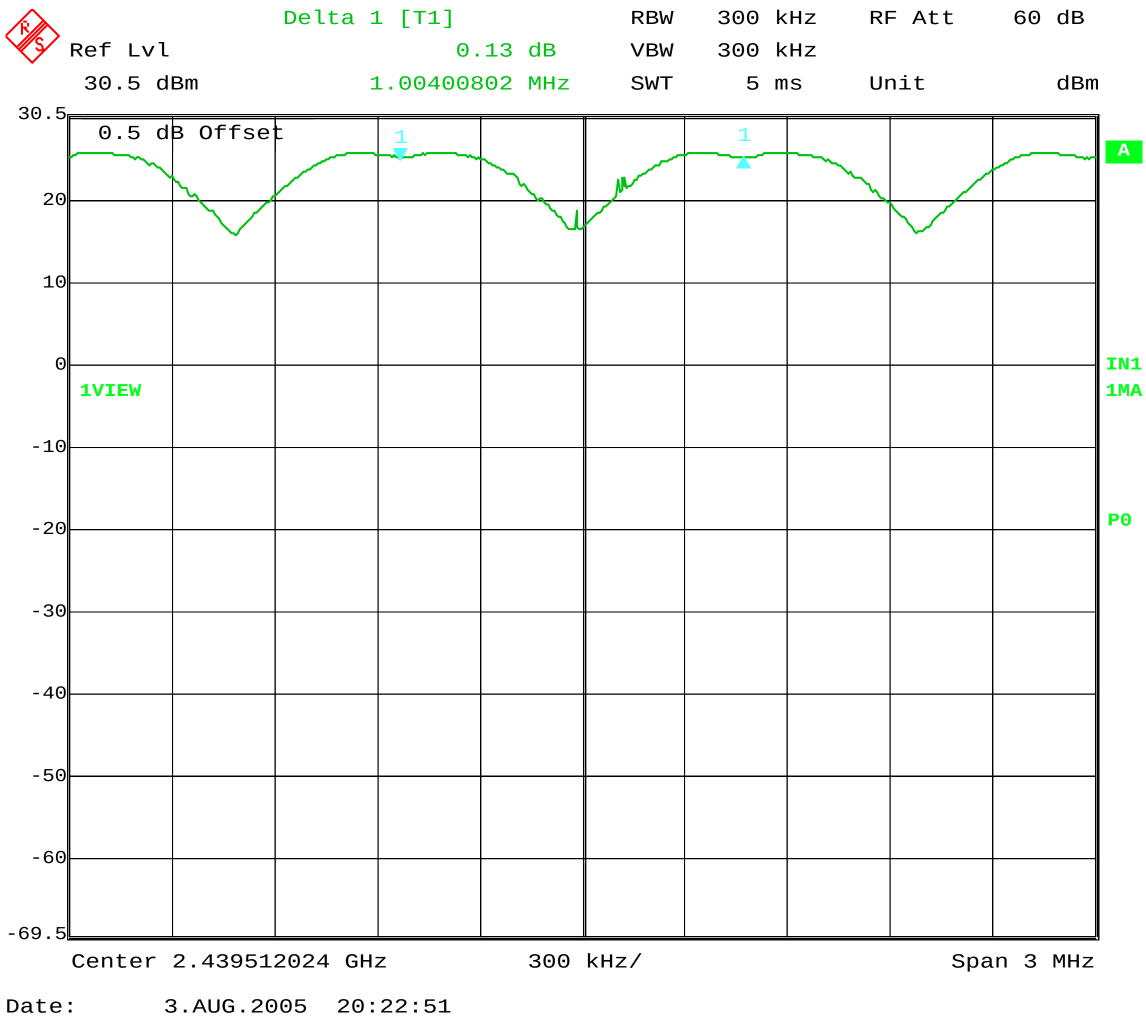


Figure 1: Carrier Frequency Separation

5 NUMBER OF HOPPING FREQUENCIES

5.1 Test Procedure

The antenna port of the HT500 was directly connected to the input of a spectrum analyzer through a specialized RF connector and an attenuator. The spectrum analyzer was offset by an appropriate amount to compensate for the attenuator and the associated cable loss. The hopping function of the HT500 was enabled. The following spectrum analyzer settings were used:

Span = wide enough to capture two adjacent channels

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep Time = Auto

Detector Function = Peak

Trace Type = Max Hold

The trace was allowed to stabilize and the number of hopping frequencies was counted.

5.2 Test Results

The graph below illustrates that the number of hopping frequencies is 75.

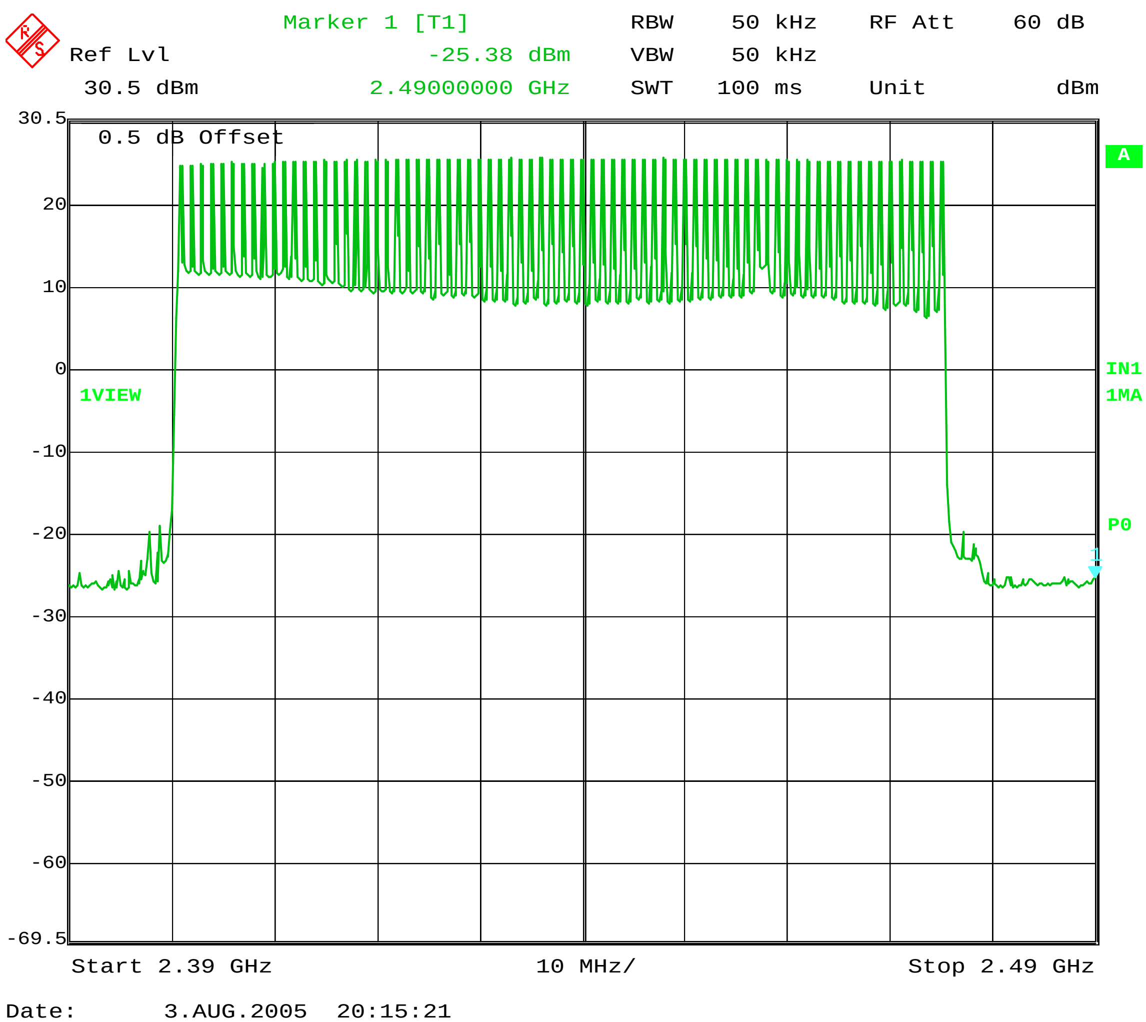


Figure 2: Number of Hopping Frequencies

6 TIME OF OCCUPANCY (DWELL TIME)

6.1 Test Procedure

The antenna port of the HT500 was directly connected to the input of a spectrum analyzer through a specialized RF connector and an attenuator. The spectrum analyzer was offset by an appropriate amount to compensate for the attenuator and the associated cable loss. The hopping function of the HT500 was enabled. The following spectrum analyzer settings were used:

Span = Zero span centered on a hopping channel

RBW =1MHz

VBW =1MHz

Detector Function = Peak

Trace Type = Max Hold

Sweep Time = Appropriate time to capture a complete dwell cycle

Detector Function = Peak

A complete dwell cycle was captured on the analyzer display. The marker delta function was used to determine the time of occupancy (dwell time).

6.2 Test Results

The graph below illustrates that the time of occupancy is 33.3ms. Also shown are plots of the activity on a single hopping channel over a 5 second and 30 second period.

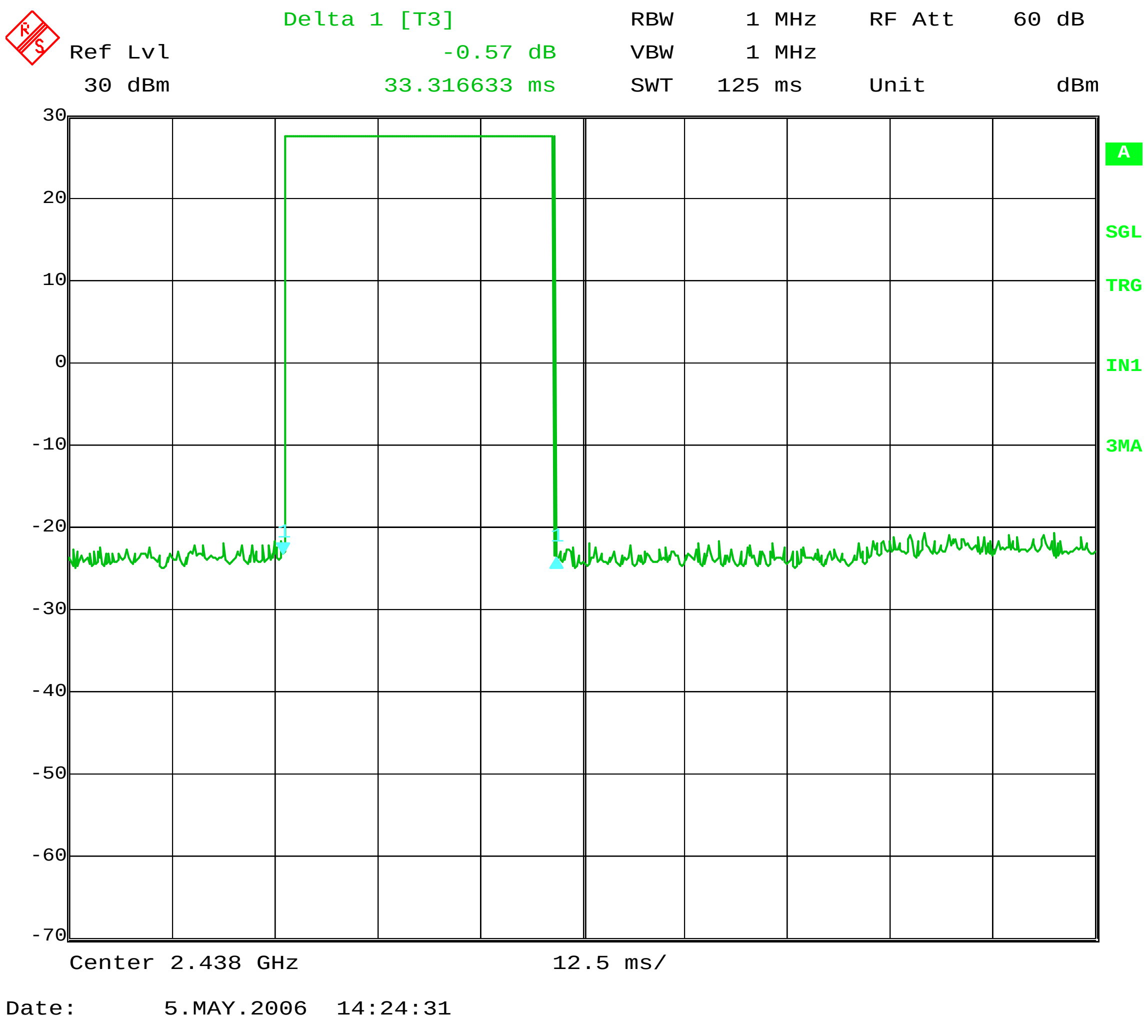


Figure 3: Time of Occupancy (Dwell Time) (normal sweep mode)

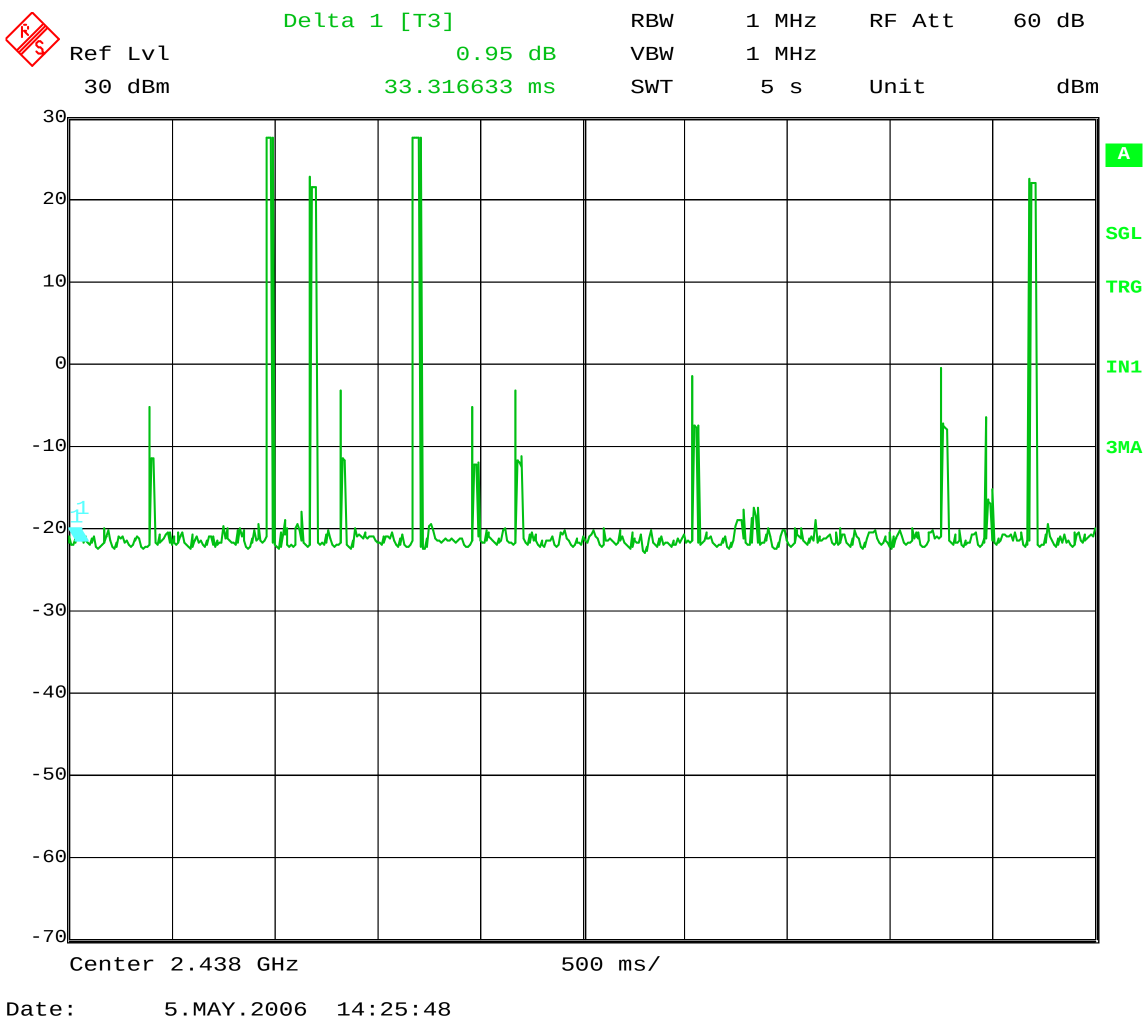


Figure 4: Time of Occupancy (Dwell Time) (over a 5 second period)

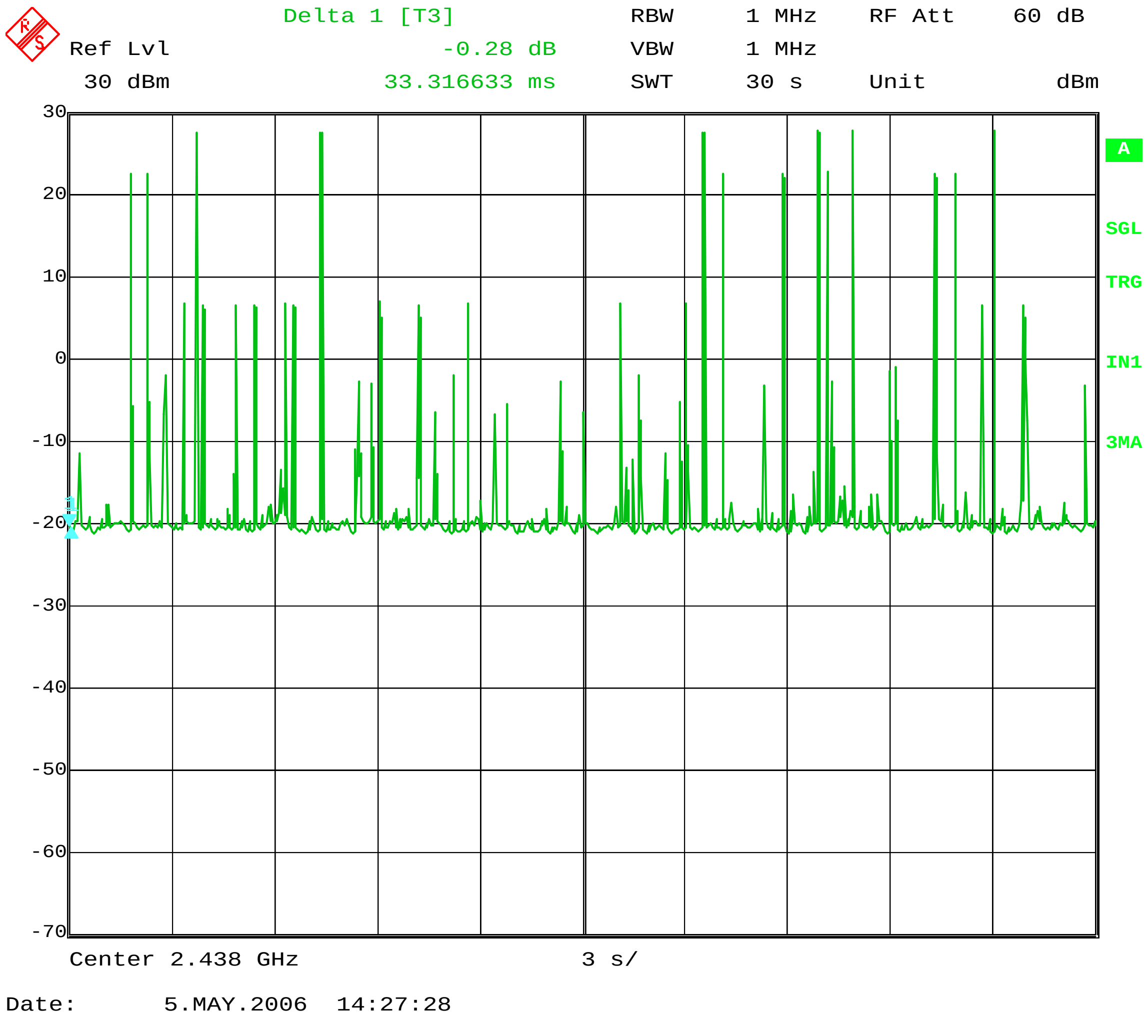


Figure 5: Time of Occupancy (Dwell Time) (over a 30 second period)

7 20DB BANDWIDTH

7.1 Test Procedure

The antenna port of the HT500 was directly connected to the input of a spectrum analyzer through a specialized RF connector and an attenuator. The spectrum analyzer was offset by an appropriate amount to compensate for the attenuator and the associated cable loss. The hopping function of the HT500 was enabled. The following spectrum analyzer settings were used:

Span = 2 to 3 times the 20dB bandwidth, centered on a hopping channel

RBW ≥ 1% of the 20dB span

VBW ≥ RBW

Sweep Time = Auto

Detector Function = Peak

Trace Type = Max Hold

The EUT was made to transmit at its maximum data rate. The analyzer trace was allowed to stabilize and the marker to peak function was used to set the marker to the peak of the emission. The marker delta function was used to measure 20dB down one side of the emission. The marker delta function was reset and marker 2 was moved to the other side of the emission until it was even with the reference marker. The marker delta reading at this point was recorded as the 20dB bandwidth.

7.2 Test Results

The graph below illustrates that the maximum 20dB bandwidth is 877.7kHz.

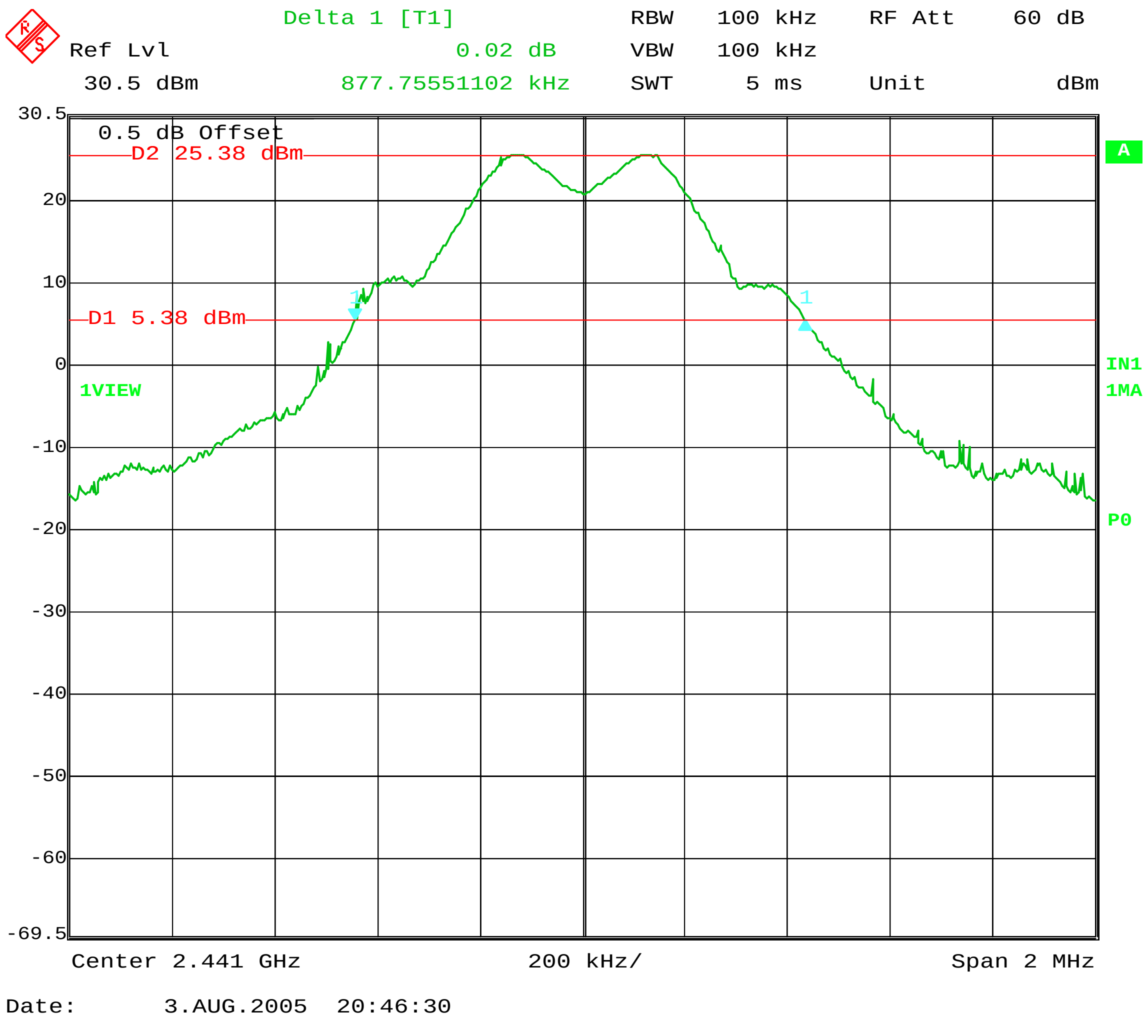


Figure 6: 20dB Bandwidth

8 CONDUCTED OUTPUT POWER

8.1 Test Procedure

The antenna port of the HT500 was directly connected to the input of a peak RF power meter through a specialized RF connector and an attenuator. The power meter was offset by an appropriate amount to compensate for the attenuator and the associated cable loss. The hopping function of the HT500 was enabled. The EUT was made to transmit at its maximum data rate. The output power was recorded from the display on the peak power meter. This test was repeated at 85% and 115% of the nominal input voltage.

8.2 Test Results

The data below illustrates that the maximum conducted RF output is 26dBm.

Frequency (MHz)	Modulation	Conducted Power (dBm)
2401	On	25.8
	Off	25.3
2440	On	26.0
	Off	25.6
2480	On	25.6
	Off	25.2

Figure 7: Conducted Output Power – 100% Nominal Input Voltage

Frequency (MHz)	Modulation	Conducted Power (dBm)
2401	On	25.36
	Off	24.93
2440	On	25.77
	Off	25.3
2480	On	25.37
	Off	25.17

Figure 8: Conducted Output Power – 85% Nominal Input Voltage

Frequency (MHz)	Modulation	Conducted Power (dBm)
2401	On	25.36
	Off	24.89
2440	On	25.57
	Off	25.15
2480	On	25.17
	Off	24.8

Figure 9: Conducted Output Power – 115% Nominal Input Voltage

9 BAND EDGE MEASUREMENTS

9.1 Test Procedure

The antenna port of the HT500 was directly connected to the input of a spectrum analyzer through a specialized RF connector and an attenuator. The spectrum analyzer was offset by an appropriate amount to compensate for the attenuator and the associated cable loss. The hopping function of the HT500 was enabled. The following spectrum analyzer settings were used:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep Time = Auto

Detector Function = Peak

Trace Type = Max Hold

The trace was allowed to stabilize and the marker was set on the emission at the band edge or highest modulation product outside of the band (if this level was higher than that at the band edge). The marker delta function was enabled and the marker to peak function was used to move the marker to the peak of the in band emission. The marker delta value displayed was compared to the limit. This process was repeated with the hopping function enabled and disabled.

9.2 Test Results

The graphs below illustrate that the band edge requirements are met.

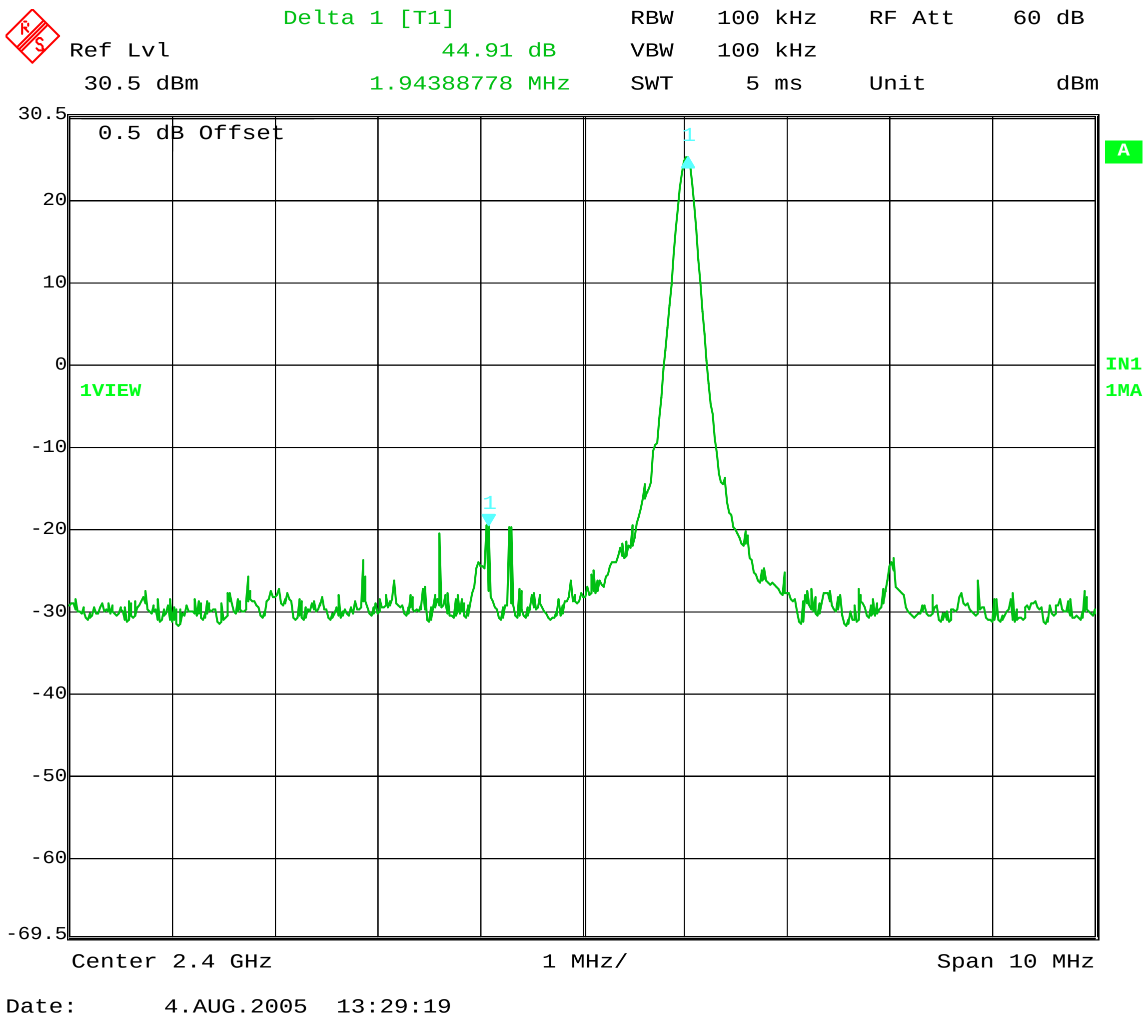


Figure 10: Low Band Edge – Unmodulated

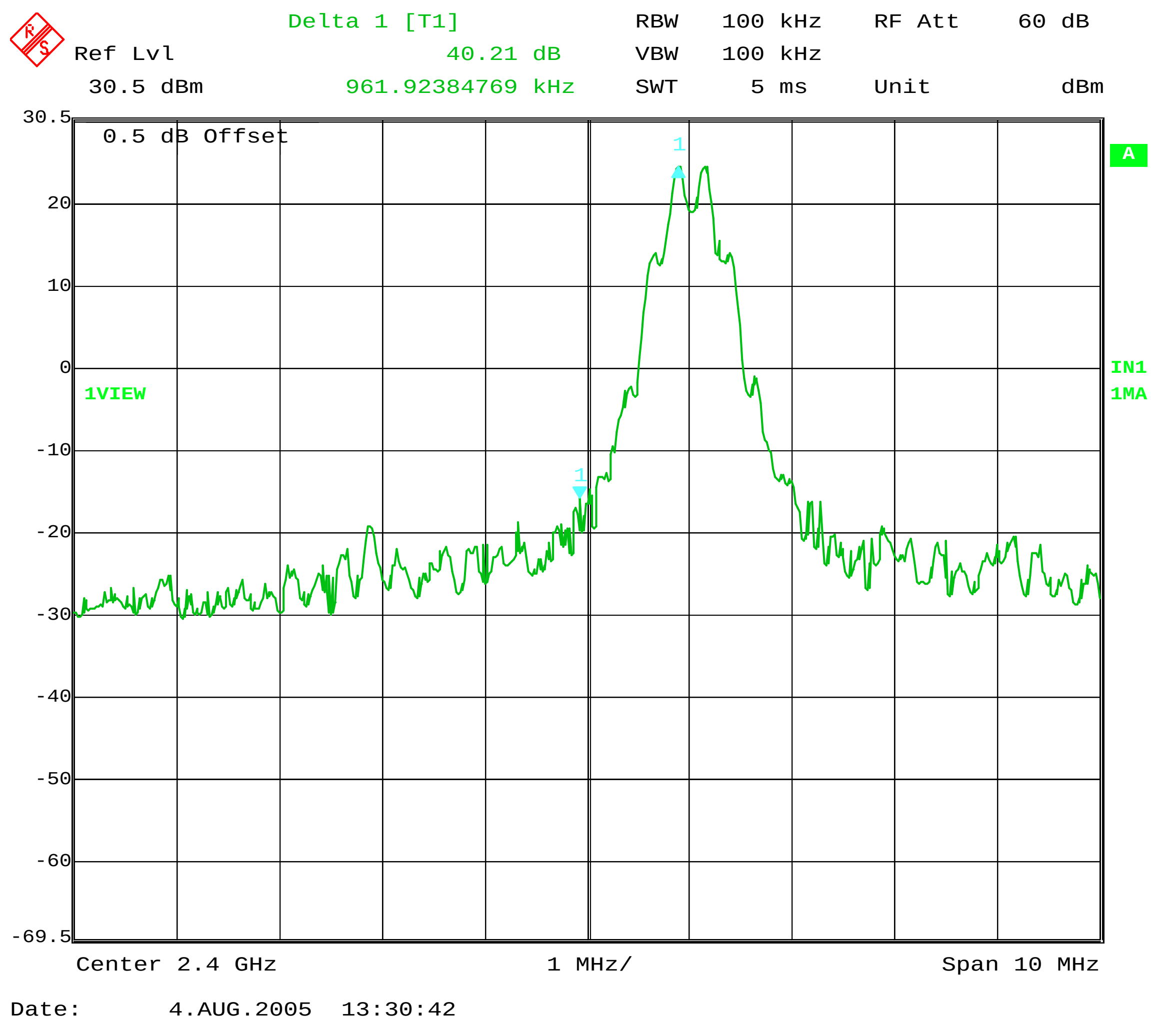


Figure 11: Low Band Edge – Modulated

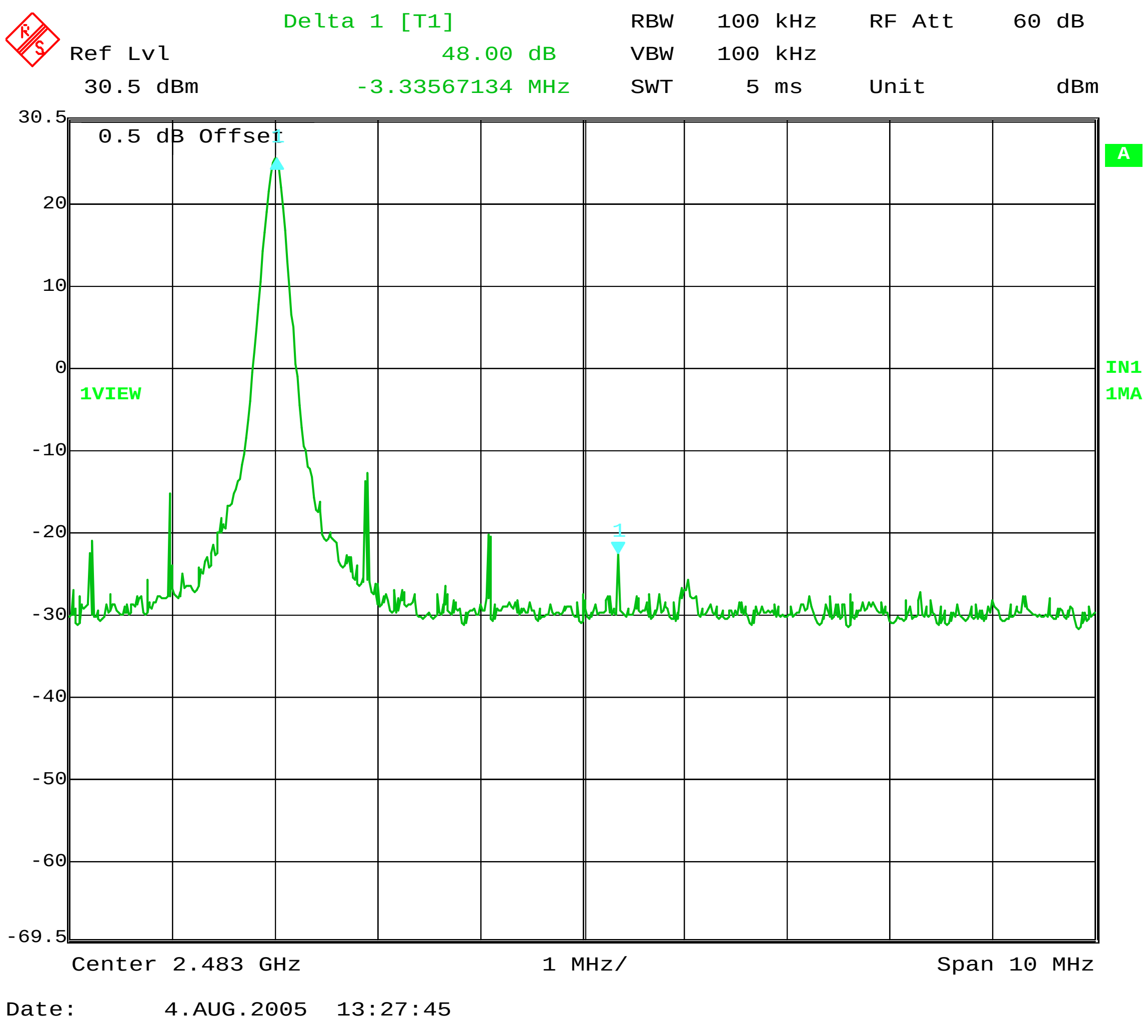


Figure 12: High Band Edge – Unmodulated

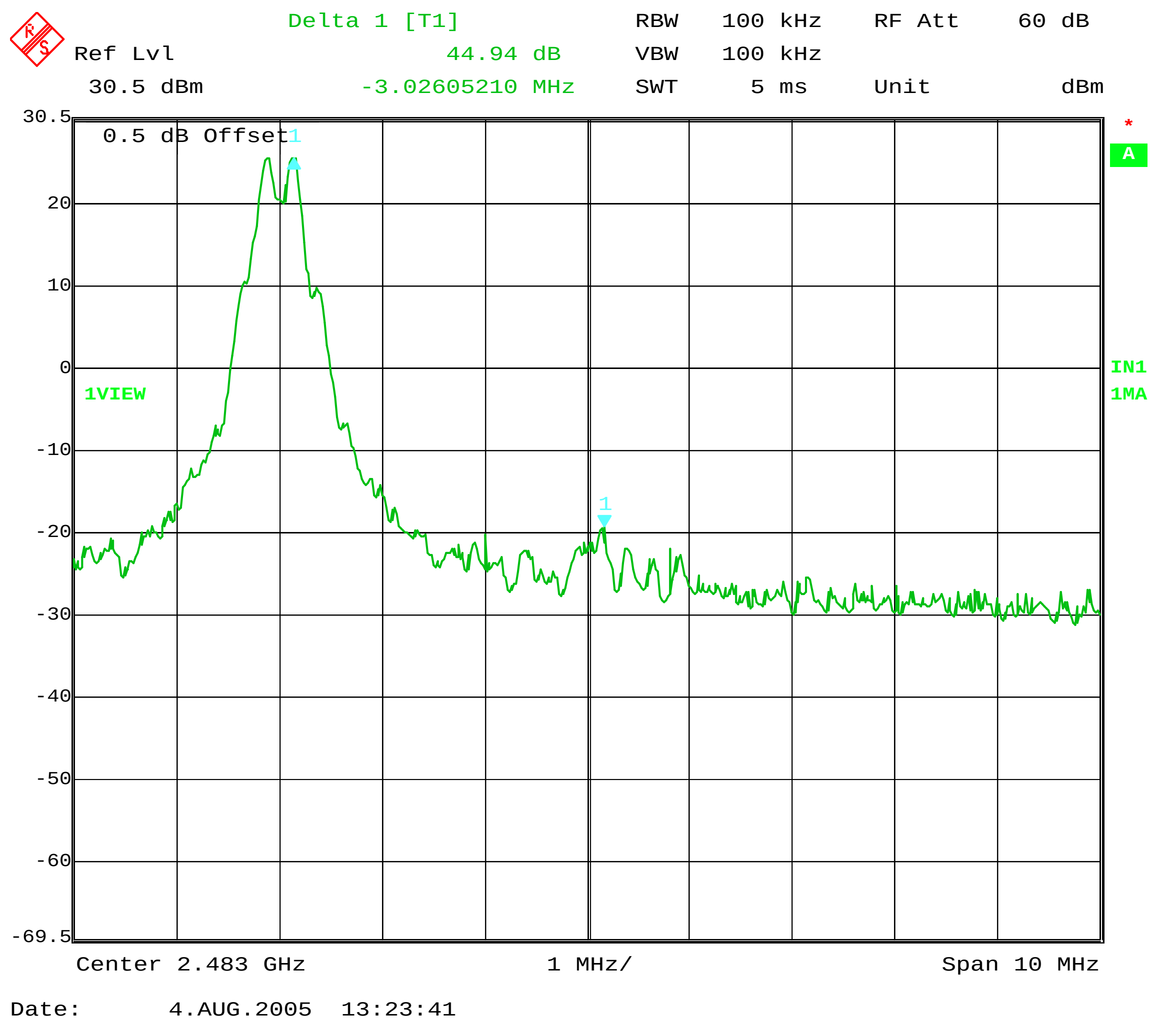


Figure 13: High Band Edge – Modulated

10 CONDUCTED SPURIOUS EMISSIONS

10.1 Test Procedure

The antenna port of the HT500 was directly connected to the input of a spectrum analyzer through a specialized RF connector and an attenuator. The spectrum analyzer was offset by an appropriate amount to compensate for the attenuator and the associated cable loss. The hopping function of the HT500 was enabled. The following spectrum analyzer settings were used:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (harmonics) from the lowest frequency generated in the EUT through the 10^{th} harmonic. This was accomplished using software to perform multiple scans and then plot all of the scans on the same graph.

RBW = 100kHz

VBW $\geq$ RBW

Sweep Time = Auto

Detector Function = Peak

Trace Type = Max Hold

The level of each spurious emission was compared with the appropriate limit.

10.2 Test Results

The graphs below illustrate that the conducted spurious emissions were all at least 20dB below the in-band conducted power. The limit shown on the graph is 20dB down from the lowest conducted output power measured in the conducted output power section of this report. The emissions over the limit are the wanted in-band emissions.

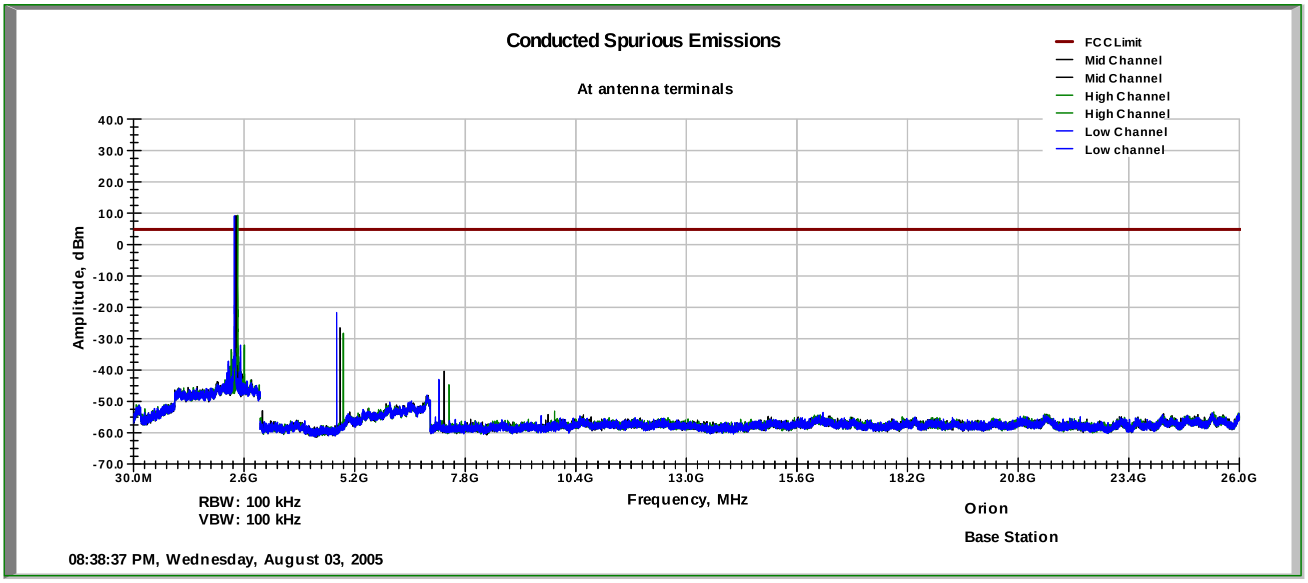


Figure 14: Out of band emissions at antenna terminals

11 FIELD STRENGTH OF SPURIOUS RADIATION (TRANSMITTING)

11.1 Test Procedure

The measurement guidelines from ANSI C63.4-2003 were followed. The Radio Base Station (RBS) was placed on a non-conductive turntable. It was then set to transmit at its highest output power level and with the modulation scheme that produced the highest conducted output power level. The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The measurement was then performed with an average detector and corrected for antenna factor and cable loss. Since the dwell time per hopping channel was less than 100ms, the corrected reading was then adjusted by applying a "duty cycle correction factor", derived from 20log(dwell time/100ms) as allowed by the rules.

11.2 Test Results

The Radio Base Station (RBS) met the field strength of spurious radiation requirements of FCC §15.209 and §15.247(c). See Figure 15 through Figure 17 for the graphical peak scans. The maximized final measurements are shown in Table 3 below. Peak and average measurements in the restricted band from 2483.5MHz – 2500MHz are shown in Figure 18 and Figure 19.

Tx Frequency (MHz)	Spurious Frequency (MHz)	Polarity (H/V)	Peak Reading (dBuV/m)	Avg. Reading. (dBuV/m)	Duty Cycle Factor	Corr. Peak Reading (dBuV/m)	Peak Limit (dBuV/m)	Corr. Avg. Reading. (dBuV/m)	Avg. Limit (dBuV/m)
Low	2.2571 GHz	H	55.4	46.99	-9.56	45.84	74	37.43	53.98
Low	2.2571 GHz	V	61.9	53.59	-9.56	52.34	74	44.03	53.98
Low	2.551 GHz	H	51.2	24.2	-9.56	41.64	74	14.64	53.98
Low	2.551 GHz	V	62.5	54.3	-9.56	52.94	74	44.74	53.98
Low	4.8 GHz	H	56.9	51.62	-9.56	47.34	74	42.06	53.98
Low	4.8 GHz	V	71.07	61.2	-9.56	61.51	74	51.64	53.98
Low	7.2 GHz	H	44.8	33.1	-9.56	35.24	74	23.54	53.98
Low	7.2 GHz	V	59.2	49.7	-9.56	49.64	74	40.14	53.98
Low	9.6 GHz	H	50.8	39.65	-9.56	41.24	74	30.09	53.98
Low	9.60 GHz	V	55.9	46.21	-9.56	46.34	74	36.65	53.98
Mid	2.265 GHz	V	55.6	52.68	-9.56	46.04	74	43.12	53.98
Mid	2.2969 GHz	V	59.02	56.4	-9.56	49.46	74	46.84	53.98
Mid	4.88 GHz	H	57.8	49.5	-9.56	48.24	74	39.94	53.98
Mid	4.8823 GHz	V	71.2	61.53	-9.56	61.64	74	51.97	53.98
Mid	7.3227 GHz	H	54.1	48.14	-9.56	44.54	74	38.58	53.98
Mid	7.3227 GHz	V	55.4	51.47	-9.56	45.84	74	41.91	53.98
Mid	9.762 GHz	V	46.5	40.25	-9.56	36.94	74	30.69	53.98
Mid	9.762 GHz	H	52.2	43.67	-9.56	42.64	74	34.11	53.98
High	2.3266 GHz	V	57.42	56.61	-9.56	47.86	74	47.05	53.98
High	2.6355 GHz	V	56.92	55.86	-9.56	47.36	74	46.3	53.98
High	4.9591 GHz	H	59.67	54.13	-9.56	50.11	74	44.57	53.98
High	4.961 GHz	V	72.42	63.4	-9.56	62.86	74	53.84	53.98
High	7.4399 GHz	H	60.53	55.77	-9.56	50.97	74	46.21	53.98
High	7.4401 GHz	V	63.56	60.63	-9.56	54	74	51.07	53.98

Table 3: Radiated Spurious Emission Measurements

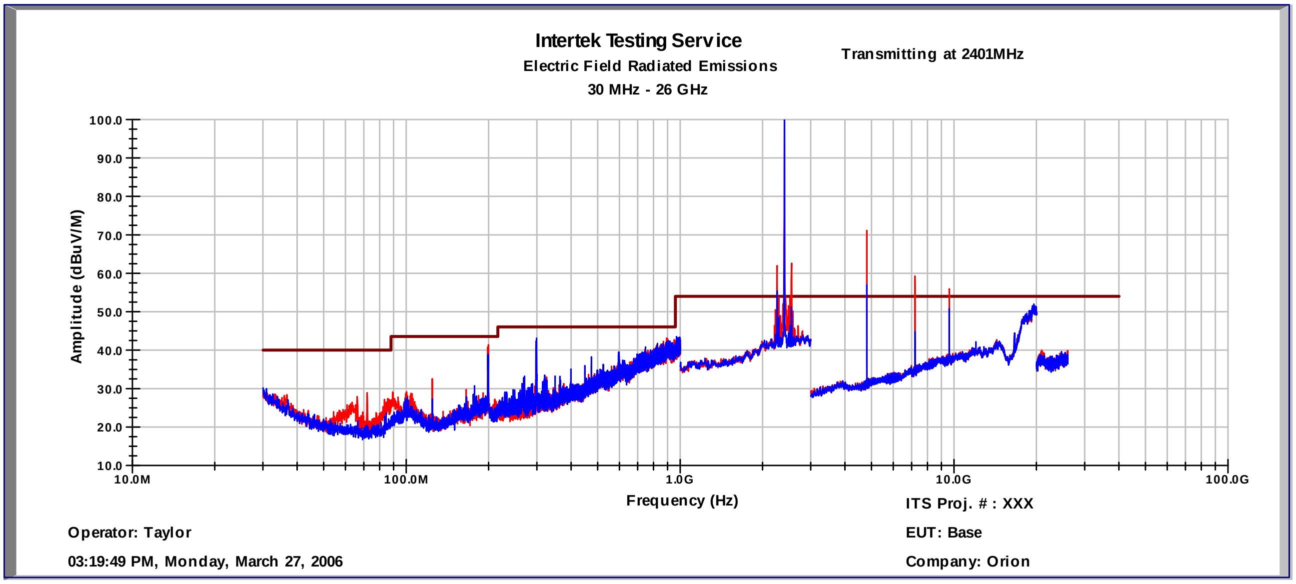


Figure 15: Field Strength of Spurious Radiation

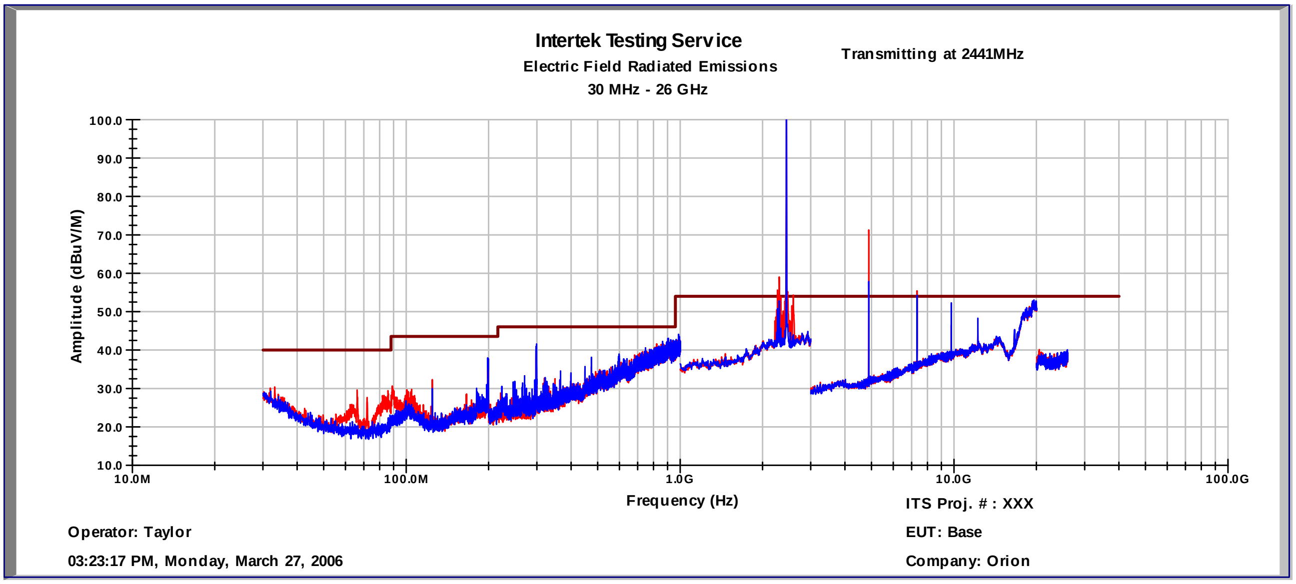


Figure 16: Field Strength of Spurious Radiation

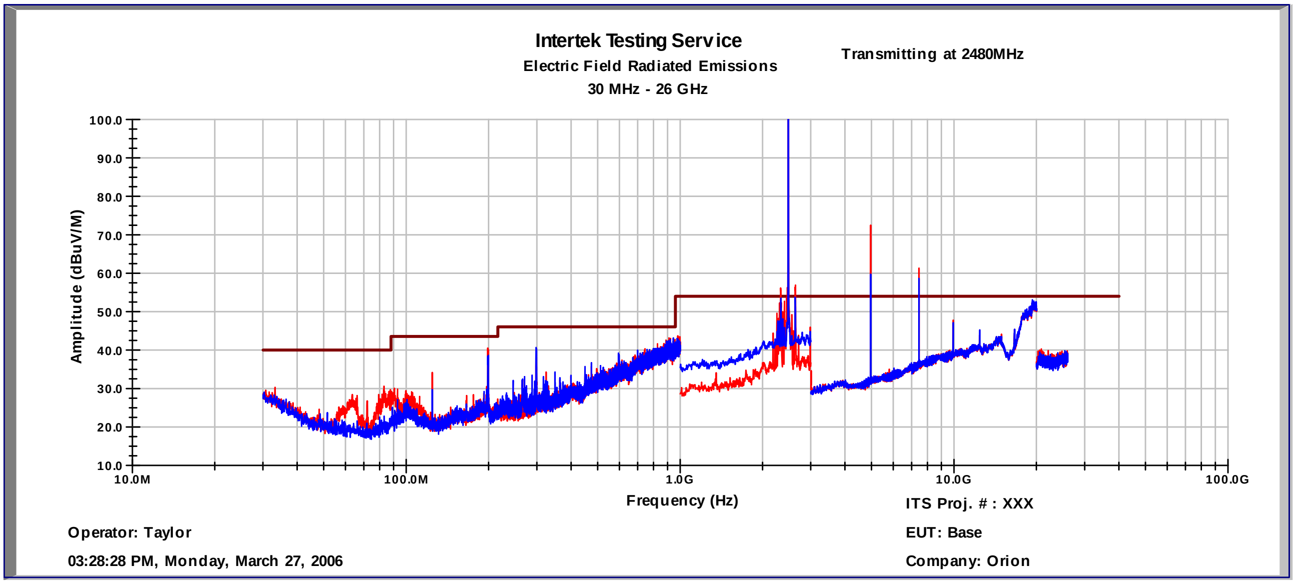


Figure 17: Field Strength of Spurious Radiation

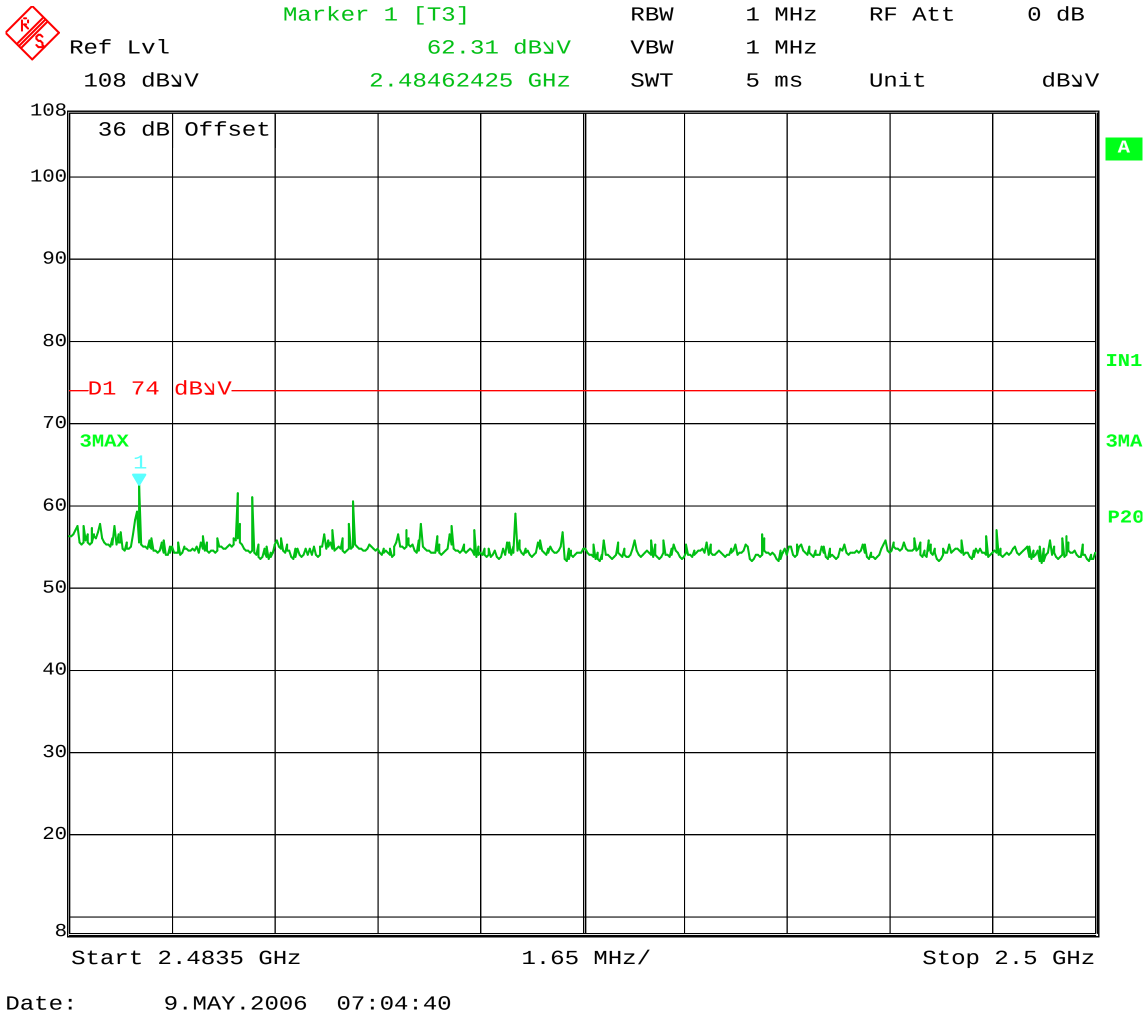


Figure 18: Peak Band Edge Measurement

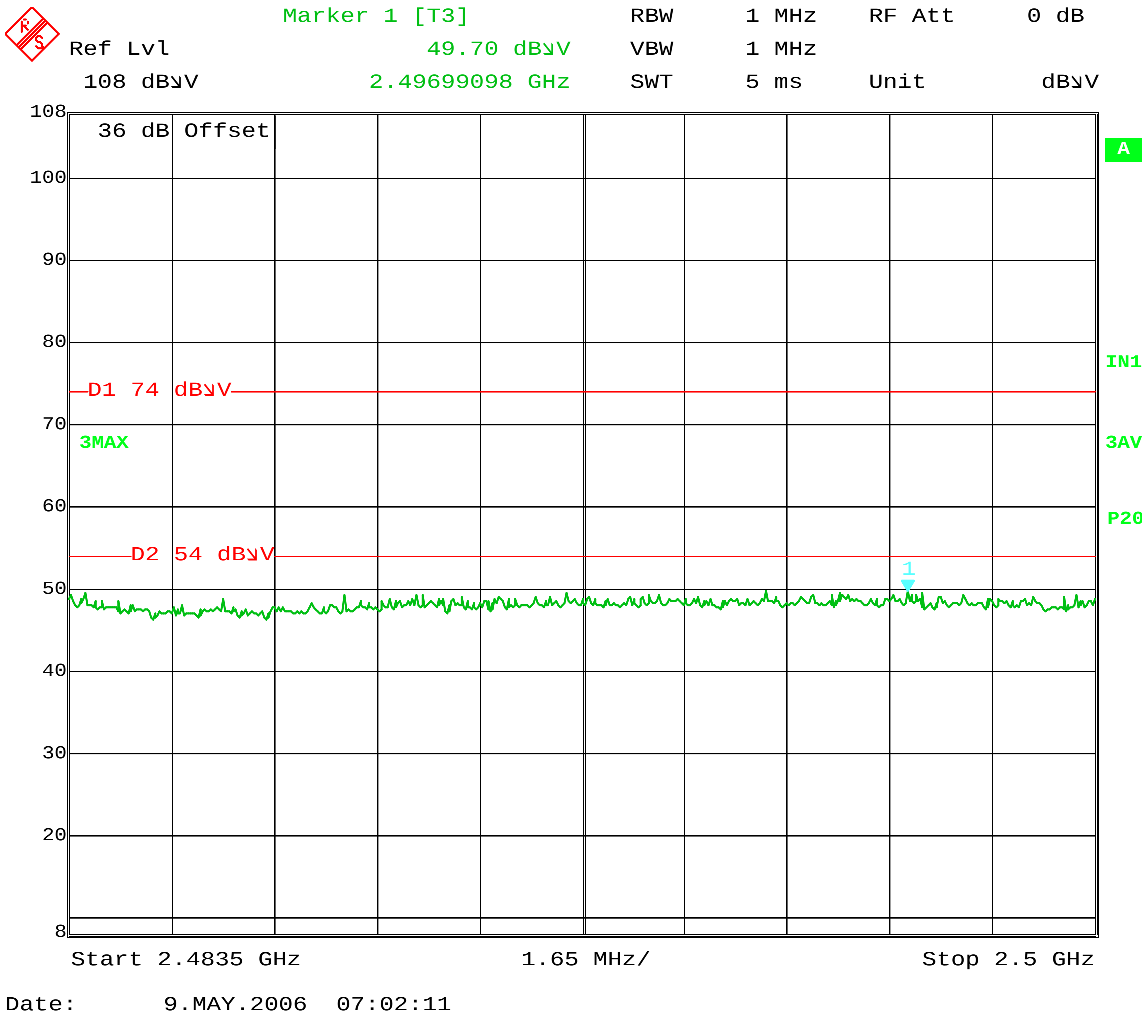


Figure 19: Average Band Edge Measurement

12 FIELD STRENGTH OF SPURIOUS RADIATION (RECEIVING)

12.1 Test Procedure

Measurements are made over the frequency range of 30 MHz to five times the highest frequency operating within the device. The measuring receiver meets the requirements of Section One of CISPR 16 and the measuring antenna correlates to a balanced dipole. From 30 to 1000 MHz, a quasi-peak detector was used for measurement. Above 1000 MHz, average measurements were performed.

Measurements of the radiated field are made with the antenna located at a distance of 3 meters from the EUT. If the field-strength measurements at 3m cannot be made because of high ambient noise level or for other reasons, measurements may be made at a closer distance, for example 1m. An inverse proportionality factor of 20 dB per decade should be used to normalize the measured data to the specified distance for determining compliance.

The antenna is adjusted between 1m and 4m in height above the ground plane for maximum meter reading at each test frequency.

The antenna-to-EUT azimuth is varied during the measurement to find the maximum field-strength readings.

The antenna-to-EUT polarization (horizontal and vertical) is varied during the measurements to find the maximum field-strength readings.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Equipment setup for radiated disturbance tests followed the guidelines of ANSI C63.4-2003.

12.2 Test Results

The Radio Base Station (RBS) is **compliant** with the radiated disturbance requirements of FCC §15.109 for a class B device. The graphical peak scans can be found in Figure 20. Maximized quasi-peak measurements are shown in Table 4 below.

Frequency (MHz)	Polarity (H/V)	Cab. (dB)	Ant. (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Azimuth (deg)	Tower (cm)	Results
48.002 MHz	V	0.56	9.59	38.98	40	-1.02	-2	101	**Compliant**
83.101 MHz	V	0.71	7.29	34.35	40	-5.65	339	123	**Compliant**
124.49 MHz	V	0.92	13.2	42.39	43.52	-1.13	104	101	**Compliant**

Table 4: Maximized Quasi-Peak Measurements

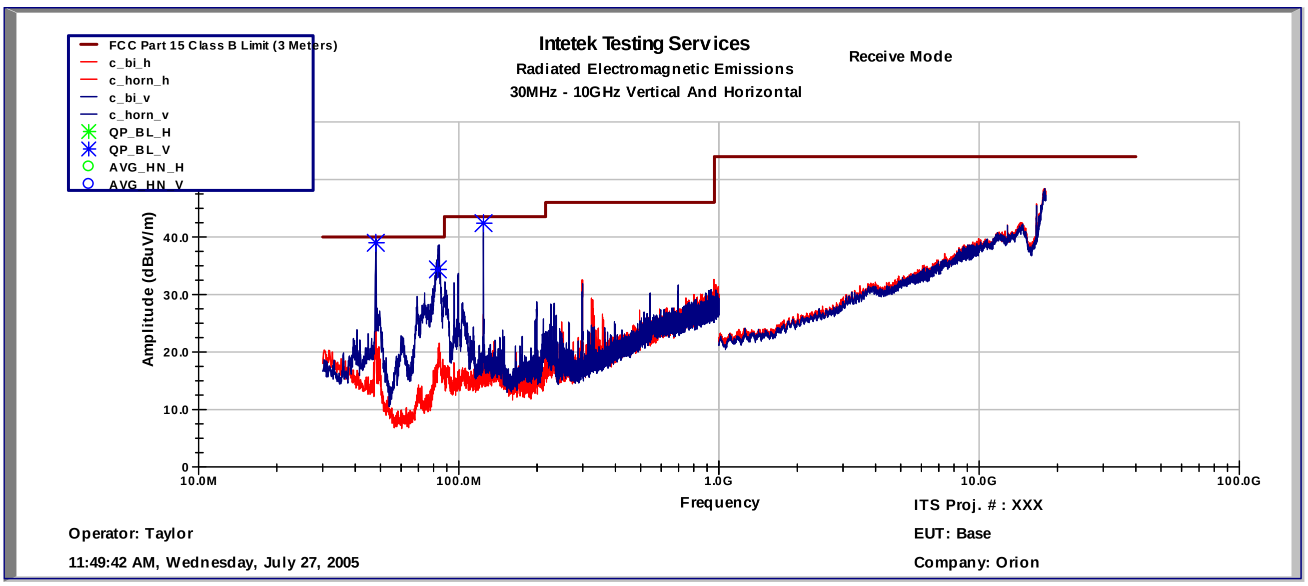


Figure 20: Receive Mode Spurious Emissions

13 POWER LINE CONDUCTED EMISSIONS

13.1 Test Procedure

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Floor standing EUTs are placed on a horizontal metal ground plane and isolated from the ground plane by 3 to 12 mm of insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.4: 1992.

13.2 Test Results

The Radio Base Station (RBS) met the power line conducted emission requirements of FCC §15.107 and §15.207. The test results are located in Table 5and Figure 21 below.

Line	Frequency (MHz)	Quasi-Peak-L1 (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Delta (dB)	Average -L1 (dBuV)	Average Limit (dBuV)	Average Delta (dB)	Results
Line 1	152.0 KHz	45.49	65.89	-20.4	32.82	55.94	-23.12	**Compliant**
Line 1	258.0 KHz	40.84	61.5	-20.66	31.41	52.91	-21.5	**Compliant**
Line 1	461.0 KHz	38.42	56.67	-18.26	30.09	47.11	-17.03	**Compliant**
Line 2	152.0 KHz	42.53	65.89	-23.36	32.5	55.94	-23.44	**Compliant**
Line 2	258.0 KHz	38.39	61.5	-23.11	31.18	52.91	-21.73	**Compliant**
Line 2	461.0 KHz	35.38	56.67	-21.3	29.89	47.11	-17.23	**Compliant**

Table 5: Power Line Conducted Emissions (Quasi-Peak and Average Measurements)

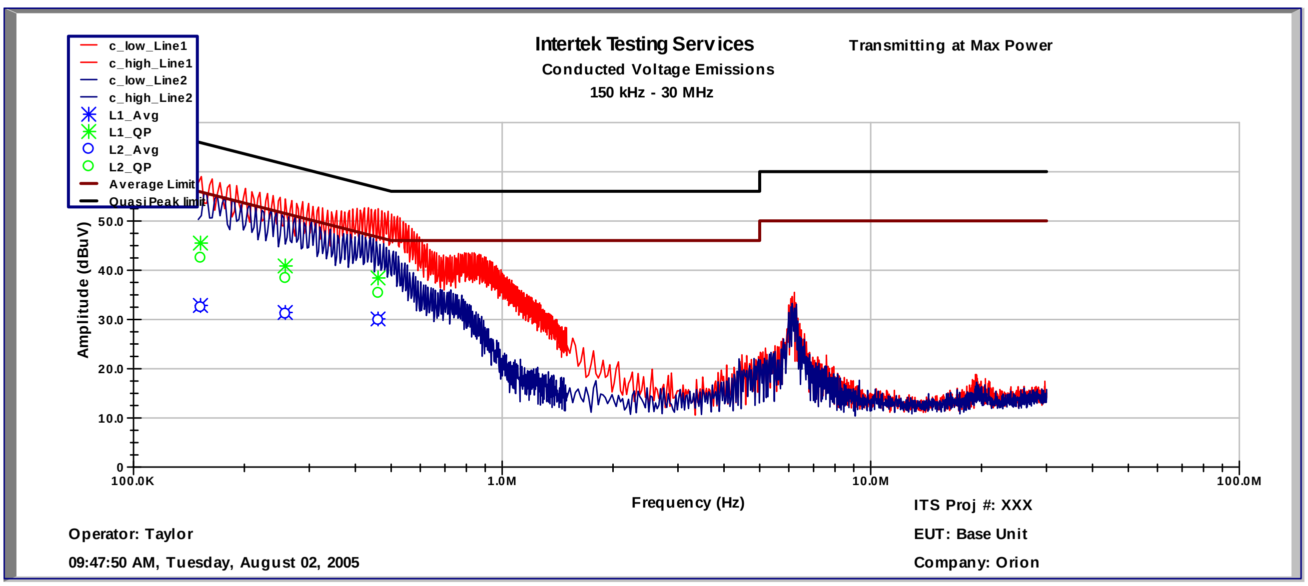


Figure 21: Power Line Conducted Emissions