

**EXHIBIT E: REPORT OF MEASUREMENTS [2.1033(B6)]**

**Test Report for FCC ID: FBRLCK-EI**  
**FCC Part 2.1031, Part 15 Subpart C(15.247)**

**Report #0400678KF**  
**Issued 06/18/04**



**FREQUENCY HOPPING**  
**TRANSCEIVER MODEL LCK-EI**

Prepared for:

Mr. Harry Derks  
Fleetwood Group Inc.  
P.O. Box 1259  
Holland, MI 49422-1259

Test Date(s): May 12, June 1, 2, 11, 14, 2004

Report prepared by:

*Ted Chaffee*

Ted Chaffee, NCE

Report reviewed by

\_\_\_\_\_

Data recorded by:

*Ted Chaffee*

Gordon Helm, NCE  
Ted Chaffee, NCE

## TABLE OF CONTENTS

EXHIBIT E: Report of Measurements [2.1033(b6)].....	1
TABLE OF CONTENTS.....	2
Statements Concerning this Report.....	3
Manufacturer/Applicant [2.1033(b1)].....	4
Measurement/Test Site Facility & Equipment.....	4
Test Site [2.948, 2.1033(b6)].....	4
Measurement Equipment Used [2.947(d), 15.31(b)].....	4
Tested Configuration /Setup: [2.1033(b8)].....	5
Support Equipment & Cabling.....	5
Setup Diagram.....	5
Summary of Results:.....	6
Changes made to achieve compliance.....	6
Standards Applied to Test: [2.1033(b6)].....	7
Test Methodology: [2.1033(b6)].....	7
Radiated.....	8
FORMULAS AND SAMPLE CALCULATIONS:.....	9
Test Data [2.1033(b6)].....	10
Antenna Characteristics [15.203, 15.204].....	10
Modulation Characteristics.....	10
Frequency Hopping Characteristics.....	10
Band Edges [15.247(c)].....	13
Restricted Bands: [15.205].....	15
Radiated Field Strength / Output Power Measurements: [15.209, 15.247(b,c)].....	16

## Statements Concerning this Report

### **NVLAP Accreditation: NVLAP Lab Code 200129-0**

The scope of AHD accreditation is the conducted emissions, radiated emissions test methods of:

IEC/CISPR 22: Limits and methods measurement of radio disturbance characteristics of information technology equipment.

FCC Method – 47 CFT Part 15 – Digital Devices.

AS/NZS 3548: Electromagnetic Interference – Limits and Methods of Measurement of Information Technology Equipment.

IEC61000-4-2 and Amend.1: ElectroStatic Discharge Immunity

IEC61000-4-5: Surge Immunity

### **Test Data:**

This test report contains data included in the scope of the NVLAP accreditation.

### **Subcontracted Testing:**

This report contains data recorded at the University of Michigan Radiation Laboratory. The University of Michigan test facility is located at 8501 Beck Road, Belleville, Michigan 48111. This test facility has been fully described and accepted by the FCC and Industry Canada. This facility was utilized to measure emissions occurring at frequencies greater than 6GHz.

### **Test Traceability:**

The calibration of all measuring and test equipment and the measured data using this equipment are traceable to the National Institute for Standards and Technology (NIST).

### **Limitations on results:**

The test results contained in this report relate only to the Item(s) tested. Any electrical or mechanical modification made to the test item subsequent to the test date shall invalidate the data presented in this report. Any electrical or mechanical modification made to the test item subsequent to this test date shall require an evaluation to verify continued compliance.

### **Limitations on copying:**

This report shall not be reproduced, except in full, without the written approval of AHD.

### **Limitations of the report:**

This report shall not be used to claim product endorsement by NVLAP, FCC, or any agency of the US Government.

**Statement of Test Results Uncertainty:** Following the guidelines of NAMAS publication NIS81 and NIST Technical Note 1297, the Measurement Uncertainty at a 95% confidence level is determined to be:  $\pm 1.4$  dB

**Manufacturer/Applicant [2.1033(b1)]**

The manufacturer and applicant:

FLEETWOOD GROUP Inc.  
P.O. Box 1259  
Holland, Michigan 49422-1259

**Measurement/Test Site Facility & Equipment****Test Site [2.948, 2.1033(b6)]****SITE 1.**

The AHD test facility is centered on 9 acres of rural property near Sister Lakes, Michigan. The mailing address is 92723 M-152, Dowagiac, Michigan 49047. This test facility is NVLAP accredited (LabCode 200129-0). It has been fully described in a report filed with the FCC (No.90413) and Industry Canada (file:IC3161).

**SITE 2.**

The University of Michigan test facility is located at 8501 Beck Road, Belleville, Michigan 48111. This test facility has been fully described and accepted by the FCC and Industry Canada. This facility was utilized to measure emissions occurring at frequencies greater than 6GHz.

**Measurement Equipment Used [2.947(d), 15.31(b)]****SITE 1.**

Equipment Calibration	Model	S/N	Last Cal Date	Interval
HP EMI Receiver system	HP 8546A			
RF Filter Section	HP-85460A	3448A00283	27-Aug-03	12 months
RF Receiver Section	HP-85462A	3625A00342	27-Aug-03	12 months
Solar LISN	8012-50-R-24-BNC	962137	25-Aug-03	12 months
Solar LISN	8012-50-R-24-BNC	962138	25-Aug-03	12 months
(LCI) Double shielded 50ohm Coax	RG58/U	920809	04-Feb-04	12 months
(3-M) Type 129FF Ultra Flex LowLoss	RG58/U	9910-12	04-Feb-04	6 months
(3-M) LMR-400 Ultra Flex	LMR400	9812-11	04-Feb-04	6 months
(10-M) Amelco 50ohm Coax	RG213/U	9903-10ab	04-Feb-04	6 months
50ohm Coax	RG223/U	9802302	04-Feb-04	12 months
Double Ridged Horn	ONO91202-2	A00329	20-May-04*	physical
*inspection				

**SITE 2.**

Equipment Calibration	Model	S/N	Last Cal Date	Interval
C-Band Std. Gain Horn	UM NRL design		calibration by design	
XN-Band Std. Gain Horn	UM NRL design		calibration by design	
X-Band Std. Gain Horn	SA 12-8.2	730	calibration by design	
Avantek RF amplifier	AFT-12665		May 2004	12 months
3ft LowLoss coax	RG142	-	with Avantek amp	
Spectrum Analyzer	HP 8593E	3412A01131	May 2004	12 months

**Measurement Environment**

The tests were performed with the equipment under test, and measurement equipment inside the all-weather enclosure. Ambient temperature was 22deg.C., the relative humidity 40%.

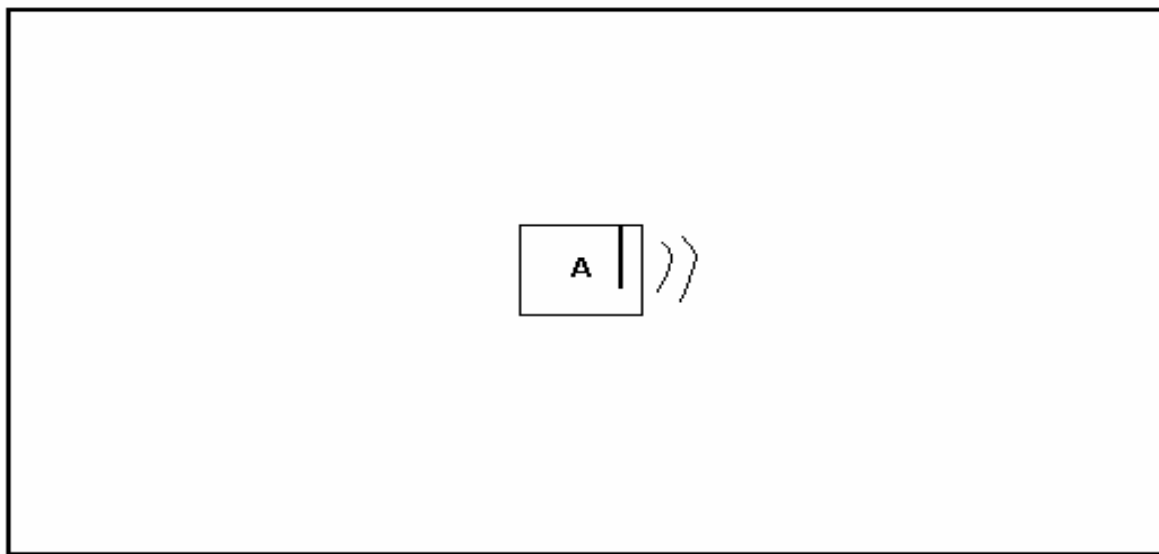
**Tested Configuration /Setup: [2.1033(b8)]**

**Support Equipment & Cabling**

Setup Diagram Legend	Description	Model	Serial No. / Part No.	EMC Consideration
A	[EUT] eInstruction Keypad Transceiver	[Fleetwood Group] LCK-EI	preproduction	FCC ID: FBRLCK-EI

**Setup Diagram**

Note: Setup photographs are located in Attached Electronic File, Exhibit E.



setup\_la 1 b

**BASIC EUT SETUP**  
 (Legend designation is above)

## Summary of Results:

1. This test series evaluated the Equipment Under Test to FCC Part 15, SubPart C.
2. The system tested is compliant to the requirement of CFR 47, FCC Part 15, SubPart C for Frequency Hopping operation in the 2400-2483.5MHz frequency band, ( Part 15.247 ).
3. The equipment under test was received on March 29, 2004 and this test series commenced on May 12, 2004.
4. The frequencies selected for final evaluation include 2401MHz, 2438MHz, and 2475MHz. This is in accordance with 47 CFR 15.31(m). The product is designed for 2401MHz to be the lowest frequency transmitted and 2475MHz to be the highest frequency transmitted.
5. The product is powered using two AA 1.5vdc batteries. There was no power line conducted evaluation.
6. The 20dB Bandwidth was greatest while observing 2401MHz. Using 10KHzRBW, the 20dB bandwidth measured 515KHz which is less than the limit of 1000KHz.
7. The Band Edge measurements: Below the lower band edge of 2400MHz a spurious was observed at approximately 2390MHz to be 27.5dB below inband transmitter level while hopping. Above the upper band edge of 2483.5MHz a spurious was observed at approximately 2498MHz to be 26.1B below the inband transmitter level while transmitting at a fixed frequency. The FCC limit (15.247c) is 20dB below the transmitter carrier level.
8. The output level of the fundamental was measured for 2401MHz, 2438MHz, and 2475MHz. The evaluation showed the emission nearest the limit occurred while operating at 2438MHz. The EUT was positioned on the 'end' and the receive antenna oriented in the horizontal polarization. This signal was measured with a Peak detection and the calculated EIRP was determined to be 24.3dB below the peak power limit of 1 Watt.
9. The evaluation of the field strength levels of the transmitter harmonics showed the emission nearest the limit occurred while operating at 2438MHz. The EUT was positioned on the 'end' and the receive antenna horizontally polarized. This emission was measured using Peak detection and corrected for the 'hopping' duty cycle. The emission at 4876MHz was calculated to be 1.6dB below the average limit of 54dBuV/m (500uV/m).
10. The field strength emission levels local oscillator and harmonics were below the background noise floor of the measurement system. No emissions were detected at a distance of 1 meter from the EUT.
12. The spurious emission level nearest the limit was measured while in transmitting mode. This emission, at 2390MHz, was determined to be 49.3dBuV/m Average which is 4.7dB below the limit of 54dBuV/m (500uV/m). The receive antenna was horizontally polarized.

### Changes made to achieve compliance

1. None

**Standards Applied to Test: [2.1033(b6)]**

ANSI C63.4 - 2001

CFR47 FCC Part 2, Part 15, SubPart C, 15.247 Intentional Radiator; SubPart B, Digital Device  
AHD test procedures TP0101-01, TP0102-01

**Test Methodology: [2.1033(b6)]**

The system was placed at the center of the table 80cm above the ground plane pursuant to ANSI C63.4 for stand-alone equipment. The setup pictures in this report indicate the configurations of testing for this product.

The product was evaluated for emissions in both transmit and a receive modes. The transmitted power output is set in firmware and the user does not have access to this location. The receiver uses a 300MHz IF with the local oscillator 300MHz above the transmit frequency.

This product contains a Nordic 2.4GHZ RF chip. The antenna is a foil trace on the circuit board. The antenna can not be adjusted by the user.

Most of the evaluations in transmit mode were performed with the frequency hopping function disabled. In this mode the EUT was setup up to transmit continuously, with modulation, at the three test frequencies. The measurements of the fundamental were recorded with Peak detection. The measurements of the fundamental frequencies were compared to the Peak power limit of section 15.247. The measurements of the fundamental harmonics, greater than 1GHz, were recorded with peak detection and adjusted using the duty cycle averaging. This final result was compared to the Average limits of Section 15.35(b).

Line conducted emission testing was not performed on this product. The product is powered from two AA 1.5Volt batteries only. The batteries were replaced during the course of testing to maintain battery 'freshness'.





**FORMULAS AND SAMPLE CALCULATIONS:**

THE HP8546A EMI Receiver has stored in memory the antenna and coax correction factors used in this test. The resultant Field Strength (FS) in dBuV/m presented by the HP8546A is the summation in decibels (dB) of the Received Level (RF), the Antenna Correction Factor (AF), and the Cable Loss Factor (CF).

Formula 1: Field Strength                       $FS(\text{dBuV/m}) = RF(\text{dBuV}) + AF(\text{dB/m}) + CF(\text{dB})$

With the EUT transmitting the resultant Field Strength measurement is recorded using the peak hold detector of the HP8546A.

Formula 2: Equivalent Isotropic Radiated Power                       $PG = \frac{(E*d)^2}{30}$

$$E = 10^{(FS(\text{dBuV/m})/20)} / 1000000$$

$$d = 3 \text{ meter}$$

Where applicable, the recorded level is further corrected, by calculation, using a duty cycle correction factor. The duty cycle factor is determined by:

Formula 3: Duty Cycle factor                       $DC \text{ factor (dB)} = 20 * \text{LOG}(\text{dwell time} / 100\text{mSec}).$

When the dwell time is determined to be less than 10mSec, the duty cycle factor to apply is determined to be 20dB. [ duty cycle factor(dB) =  $20 * \text{Log}(0.1) = -20.0 \text{ dB}$  ]

Where it was necessary to move the EUT to 1 meter distance to take measurements a 'dB' factor which adjusts for this distance variance is used before comparing the emission level to the FCC limits. This factor is determined by the following formula.

Formula 4:                       $\text{Distance factor(dB)} = 20 * \text{Log}(3\text{meter}/1\text{meter}) = 20 * \text{Log}(3) = 9.54\text{dB}.$

## Test Data [2.1033(b6)]

### Antenna Characteristics [15.203, 15.204]

The antenna is 'J' section of foil trace on the printed circuit board. The user can not adjust nor replace the trace antenna.

### Modulation Characteristics

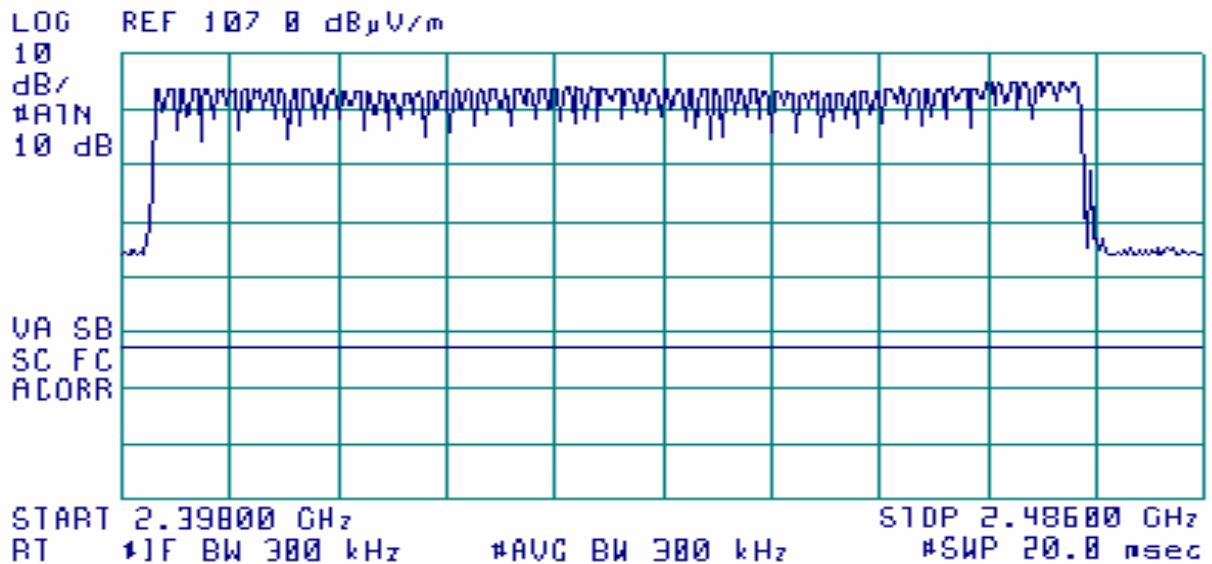
The transmitter is FSK modulated.

Modulation. F1 represents the bit "1", F2 represents the bit "0". F1 and F2 are separated by approximately 300KHz. Data rate is 256KB/sec

### Frequency Hopping Characteristics

#### Number of Hopping Frequencies [15.247a1i]

Seventy Five (75) frequencies from 2401MHz through 2475MHz are available for the keypad transceiver to utilize. The base initiates the communications to the associated keypad units. Refer to Exhibit B for a detailed operational description.



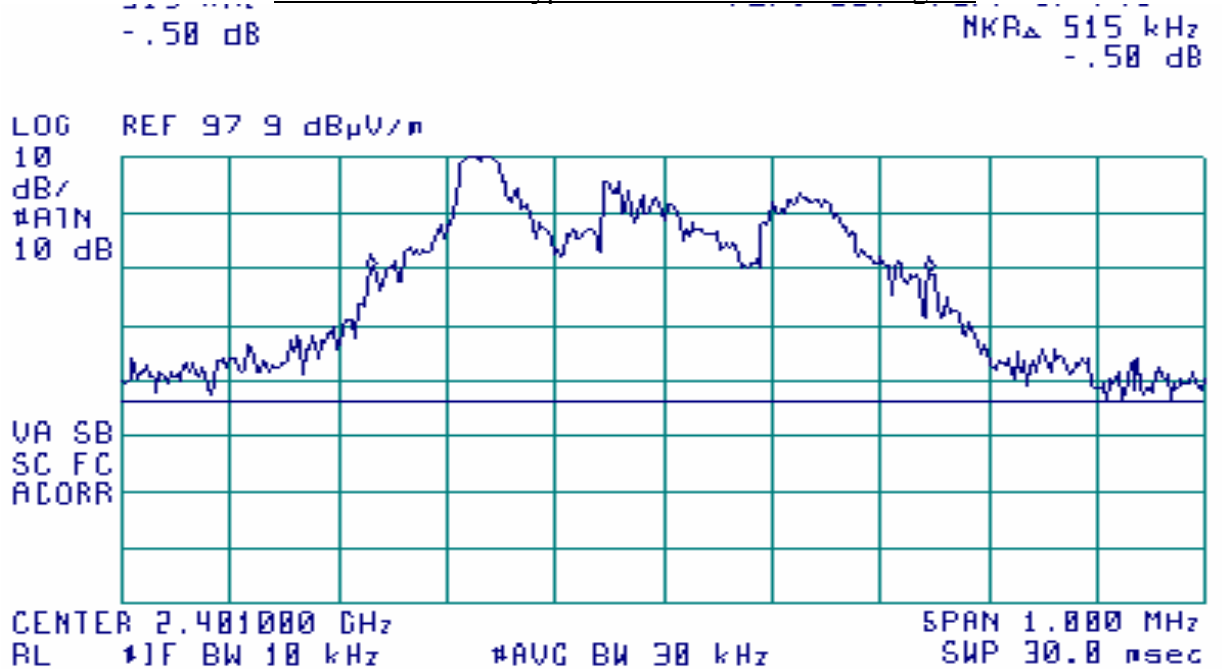
Plot scan of the FHSS profile. Seventy five transmitted frequencies can be discerned.

**Carrier Frequency 20dB bandwidth [15.247a1i]**

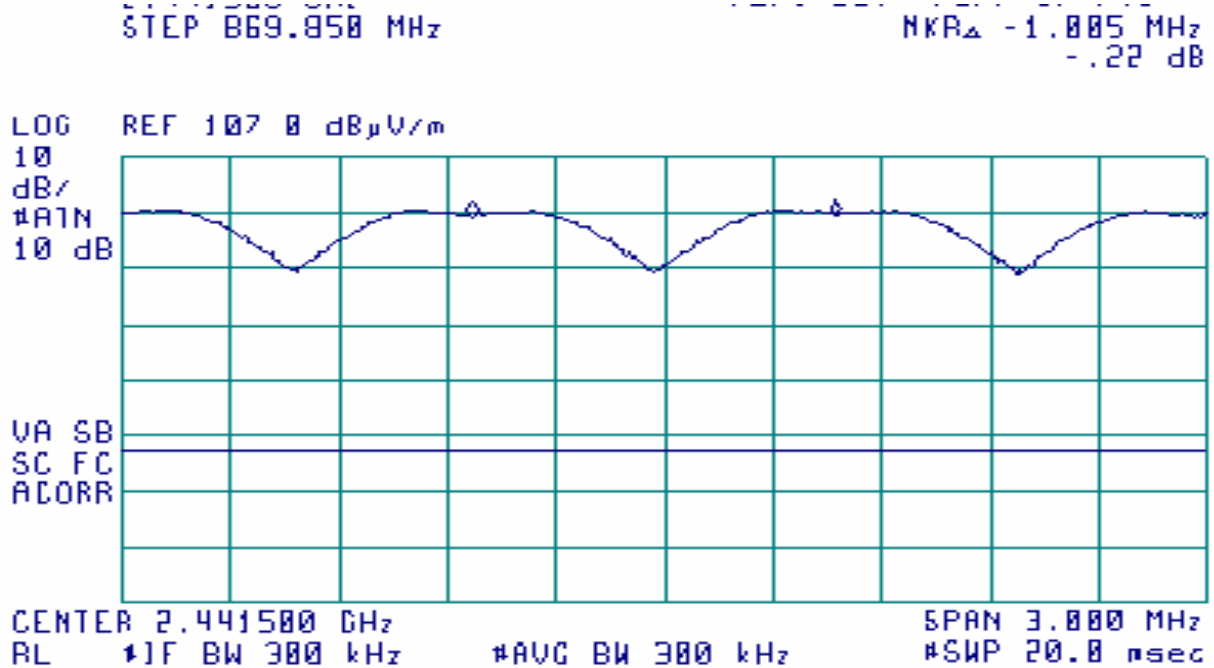
The 20dB bandwidth was measured with the unit hopping function disabled and the transmission modulated.

Fundamental (MHz)	Measured 20dB Bandwidth 10KHzRBW	LIMIT RSS-210(a3)
2401	515 KHz	1000 KHz
2438	485 KHz	1000 KHz
2475	470 KHz	1000 KHz

This chart shows a typical measured bandwidth signal.

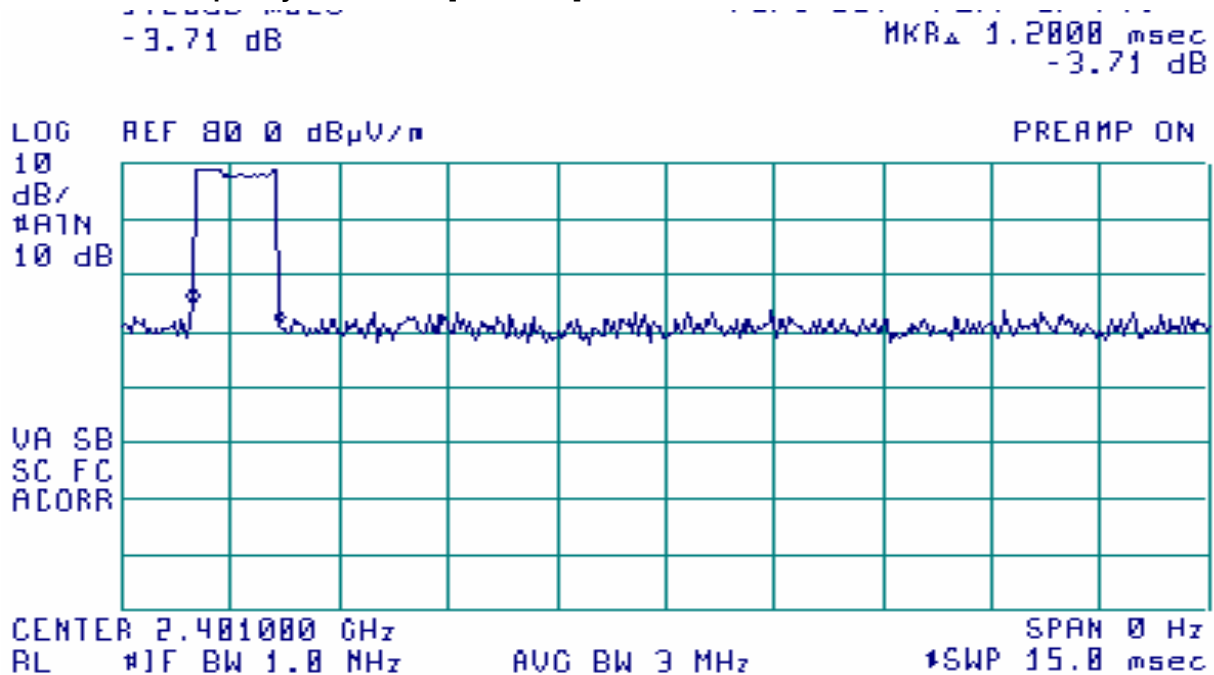


### Carrier Frequency Separation [15.247a1]



Each Hopping channel is separated by 1000KHz. This is greater than the minimum requirement of 25KHz or 20dB bandwidth (568KHz). Refer to Exhibit B ‘operational description’ for the list of frequencies used.

### Carrier Frequency Dwell Time [15.247a1i]



The Dwell Time of each hopping frequency is 1.2mSec. Refer to Exhibit B ‘operational description’ for a table showing dwell times of the system operations.

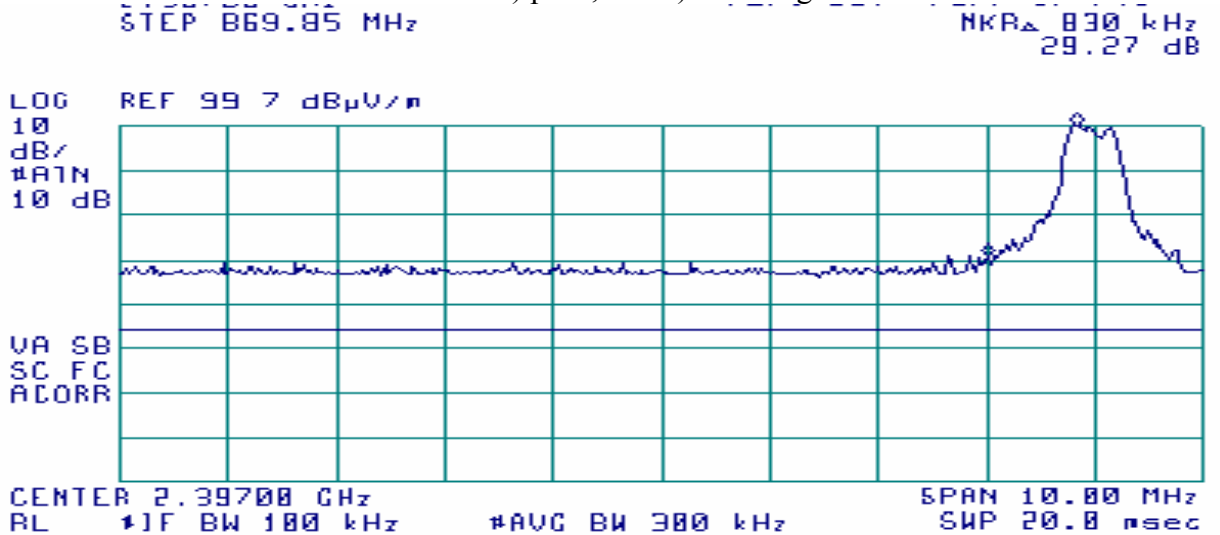
**Band Edges [15.247(c)]**

The emissions outside the 2400-2483.5MHz band are to be either 20dB below the level of the fundamental or the limits of section 15.209.

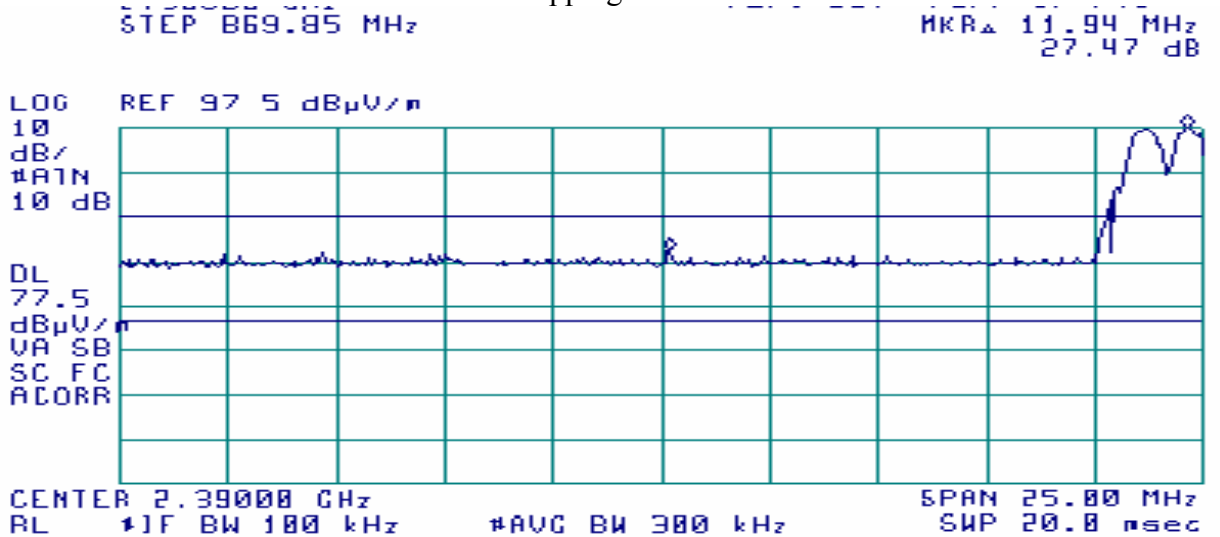
2400MHz Band Edge. EUT transmitting at lowest frequency of 2401MHz.

Hopping Disabled

Markers are at 1) peak, and 2) band edge or lower



Hopping Enabled

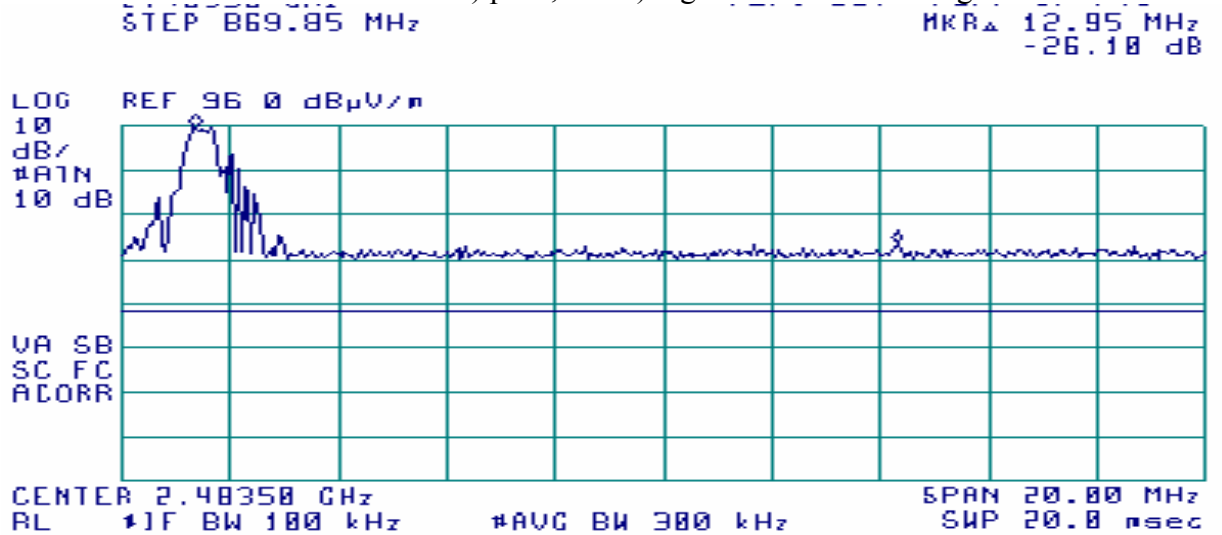


Fund. (MHz)	Delta dBc without hopping	Delta dBc with hopping	dBc LIMIT 15.247c	Marker Outside Bandedge (MHz)	Avg. Level dBuV/m	LIMIT dBuV/m	
2401	-29.2B	-27.5	-20 dB	2390	49.3	54	Pass

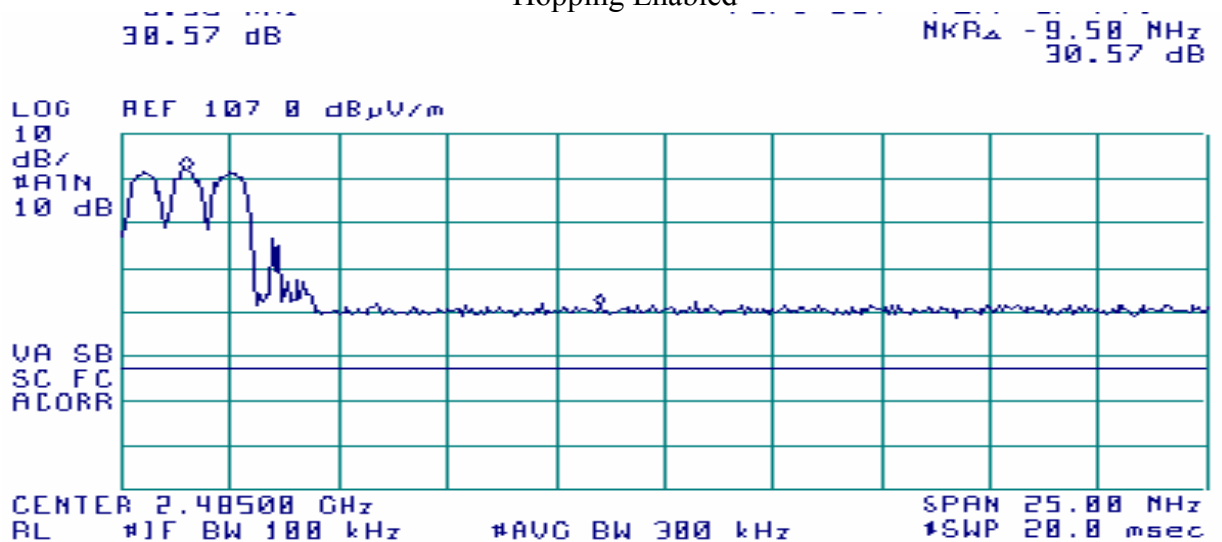
2483.5MHz Band Edge. EUT transmitting at highest frequency of 2475MHz.

Hopping Disabled

Markers are at 1) peak, and 2) highest outside band edge



Hopping Enabled



Fund. (MHz)	Delta dBc without hopping	Delta dBc with hopping	dBc LIMIT 15.247c	Marker Outside Bandedge (MHz)	Avg. Level dBuV/m	LIMIT dBuV/m	
2475	-26.1B	-30.6	-20 dB	2489	37.9	54	Pass

**Restricted Bands: [15.205]**

The following frequency bands are restricted. Only spurious emissions are permitted at levels limited by 15.209:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.25
0.490-0.510	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

**LIMIT @ 3meter: [15.209(a)]**

30-88MHz	100uV/m	40dBuV/m
88-216MHz	150uV/m	43.5dBuV/m
216-960MHz	200uV/m	46dBuV/m
above 960MHz	500uV/m	54dBuV/m

The spurious emissions observed in the restricted bands did not exceed the allowed limits for the restricted bands.

**Radiated Field Strength / Output Power Measurements: [15.209, 15.247(b,c)]****Field Strength Measurements of Fundamental & LO: [15.247(a), 15.209]**

Direct Connect Measurements were not conducted on the keypad. Measurements were made only at the 3meter OATS and the measured peak field strength was used to calculate EIRP of the unit. Formulas are listed on page 9.

**MEASUREMENT PROCEDURE:**

1. The EUT was trained to one of the three test frequencies.
2. The EUT was setup to one of the three orthogonal positions.
3. The receiving antenna was placed in vertical or horizontal orientation.
4. Steps 1-3 were repeated to cover all polarities, and frequencies.

**Transmit Mode. Fundamental**

Frequency MHz	Corrected PEAK Measurement dBuV/m	Included Cable+Antenna Factors dB+dB/m	Turntable Azimuth deg	Antenna Height Mtr	Calculated EIRP mWatt	FCC Limit 15.247b mWatt	Margin dB	EUT positio n	Ant Pol.
2401	100.3	35.2	90	1.4	3.21	1000	<b>-24.9</b>	end	H
2438	100.9	35.39	270	1.7	3.69	1000	<b>-24.3</b>	end	H
2475	97.4	35.58	0	2	1.65	1000	<b>-27.8</b>	end	H

**Receive Mode. Local Oscillator**

The levels of the RF emissions of the local oscillator and harmonics were below the background noise floor of the measurement system. No emissions were detected at a distance of 1 meter from the EUT.



**Field Strength Measurements of Fundamental & LO Harmonics: [15.247(b,c)]****MEASUREMENT PROCEDURE:**

1. The EUT was tuned to one of the three test frequencies.
2. The receive antenna was set to vertical and horizontal positions.
3. Steps 1-2 were repeated to cover all positions, and frequencies.

**DUTY CYCLE:** The on time is a maximum of 2.4mSec in a 100mSec period.

The duty cycle, for the 100mSec period, is  $\lceil 20\text{Log}(2.4/100) \rceil > 20\text{dB}$ .

The 20dB factor is used for the averaging calculations of emission levels above 1000MHz.

Transmit Mode. Fundamental harmonics

Freq MHz	Corrected PEAK Measurement dBuV/m	Duty Cycle averaging factor dB	Calculated Level w. Duty Cycle dBuV/m	Turntable Azimuth deg	Antenna Height Mtr	FCC Avg Limit 15.209 or -20dBc dBuV/m	Margin dB	EUT Pos.	Ant Pol.	Included Cable+Antenna Factors dB+dB/m
<b>2401</b>										
4802	72.2	20	52.2	100	1.1	54	-1.8	End	H	40.65
<b>2438</b>										
4876	72.4	20	52.4	90	1.3	54	-1.6	End	H	40.87
<b>2475</b>										
4950	72.3	20	52.3	0	1.7	54	-1.7	end	H	41.1

The measurement of the 3rd through 10th transmitter harmonic was taken at the UM Radiation Lab facility. For this test the distance between the EUT and Horn antenna is 1 meter.

The raw data is located in a separate pdf file "EInstruction\_RFk.pdf"

The explanation of the Table 5.1 data in file "EInstruction\_RFk.pdf" is as follows:

In the column headings for the EInstruction\_RFk.pdf are:

"Peak dBm"=Peak analyzer measurement; "Ka dBm" = Antenna/cable correction factor;

"Kg dB" = Amplifier gain; "E3" is the calculated "Peak" + "Ka" - "Kg";

"E3lim" = FCC average limit plus 20dB for Peak limit.

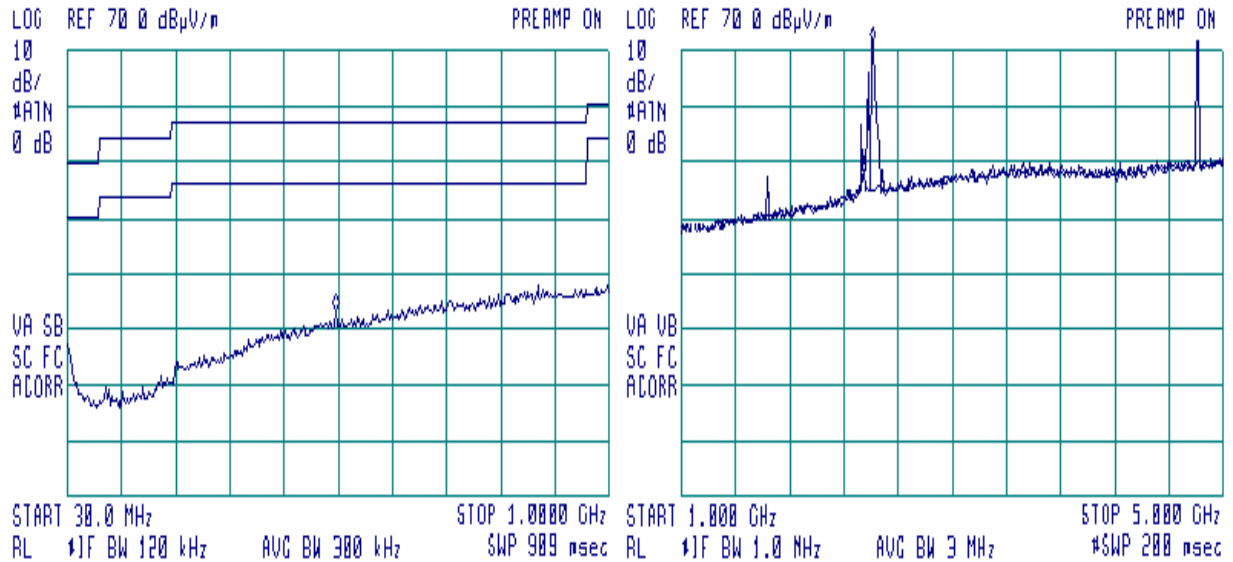
The first page of the "EInstruction\_RFk.pdf" file is the transmit data, the second page is the data while in receive only mode, and the third page is data with the receiver at a low output level.

The measurement of the higher order harmonics indicated that 7314MHz (2438 x 3) measured nearest the limit. It was calculated to be 67.8dBuV/m peak (67.8dBuV/m - 20dB = 47.8dBuV/m average) which is 6.2dB below the FCC limit.

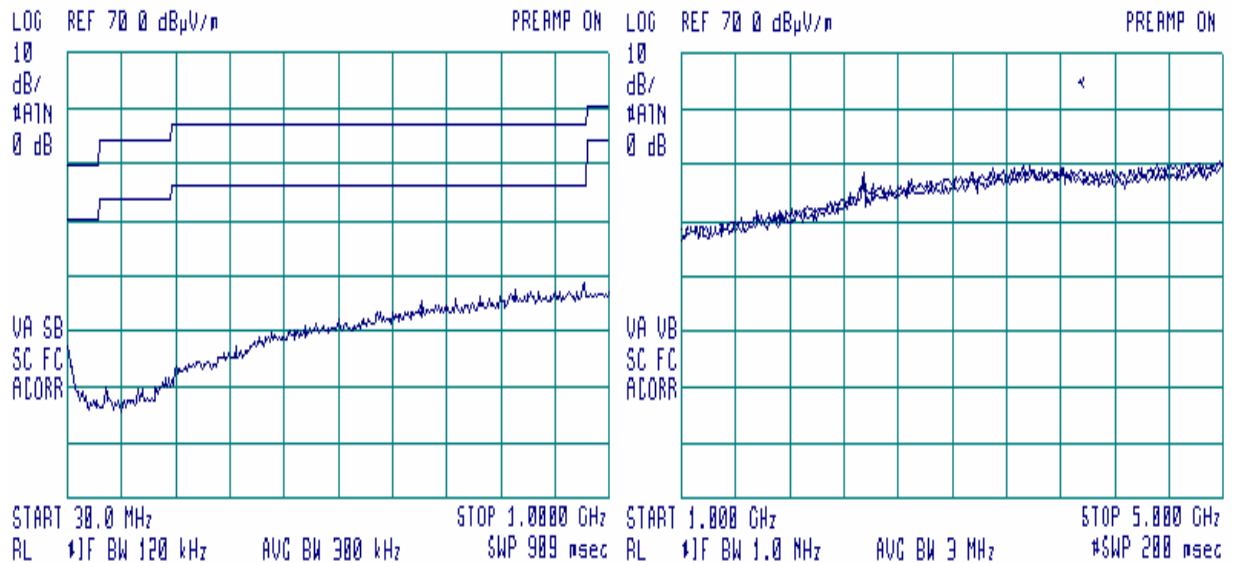
### Spurious Emissions: [15.247c]

A scan of the LCK-EI was made in a shielded room to study the emission profile of the EUT. These scans indicate spurious emissions from the unit other than the fundamental and its associated harmonics. These suspect signals were measured at the 3-meter open area test site.

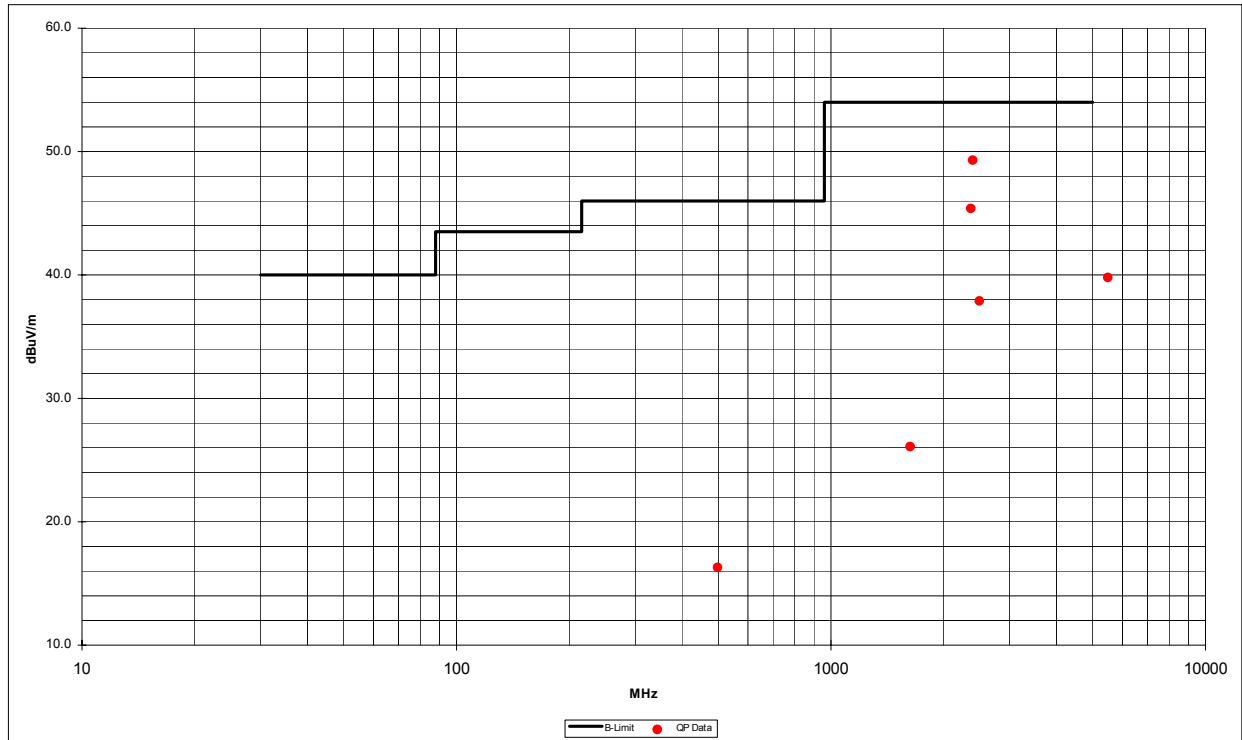
#### Transmitting



#### Receiving



Other Spurious emissions



Tabulated Quasi-Peak Measurements.

Frequency MHz	Corrected Measurement dBuV/m	Duty Cycle factor dB	Included Cable+Antenna Factors dB+dB/m	Turntabl e Azimuth deg	Antenna Height Mtr	Polarity	FCC Class B Limit dBuV/m	Margin dB
498.1	**16.3QP	--	20.4	--	--	H	46.0	-29.7
1626	**26.1Avg	--	31.0	--	--	H	54.0	-27.9
#2362	65.4peak	20	35.0	0	2	H	54.00	-8.6
#2390	69.3peak	20	35.1	0	2	H	54.00	-4.7
#2483.5	59.8peak	20	35.6	180	1.7	H	54.00	-14.2
#2489	57.9peak	20	35.6	180	1.7	H	54.00	-16.1

The frequencies for measurements were determined by the suspect list generated from the shielded room prescan of 30MHz through 6GHz.

\*\*The measured levels represent the background floor noise of the measurement system.

#These emissions have a pulse width of 0.15mSec and a repetition rate of 20.5mSec, the 20dB factor applies.