

EXHIBITS

- EXHIBIT 1. ID Label/Location Info
- EXHIBIT 2. Attestation Statements
- EXHIBIT 3. External Photos
- EXHIBIT 4. Block Diagrams
- EXHIBIT 5. Schematics
- EXHIBIT 6. Test Report
- EXHIBIT 7. Test Setup Photos
- EXHIBIT 8. User's Manual
- EXHIBIT 9. Internal Photos
- EXHIBIT 10. Parts List/Tune-up Info
- EXHIBIT 11. RF Exposure Info
- EXHIBIT 12. Operational Description
- EXHIBIT 13. Cover Letters

Wireless Inc.

FCC ID: EV9N2WLAX-5G7

EXHIBIT 6: Test Report

Product Overview

The N2-4XE1 is a point to point Wireless Extension operating in the 5.3/5.7 GHz UNII band as authorized in rule sections 15.401 through 15.407. The transmit section operates at 5.7 GHz, and the receive section operates at 5.3 GHz, at which the **companion** unit transmits. The FCC ID for the **companion transceiver** is EV9N2WLAX-5G3.

Each unit is enclosed in a weather proof outdoor enclosure and is intended to provide data links over distances up to 10 km. The radio in the unit operates full duplex, transmitting and receiving data at the rate of 8.448 Mbps. The radio is modulated using BPSK.

The product uses two separate 100 MHz bands within the U-NII frequency spectrum. Within these bands, the N2-4XE1 series operates in one of many independent channels providing for frequency reuse and network flexibility.

Synthesized RF channel selection is field configurable, as are the power output options for the selection of antenna sizes..

Frequency Band: Full-duplex operation in the UNII band

Transmit (TX) Frequency Range: 5,725 -5,825 MHz

Digital Interface ATM

<u>5.3 GHz RX(Low Band)</u>	<u>5.7 GHz TX (High Band)</u>
Frequency Range: 5,250 -5,350 MHz	5,725 -5,825 MHz
Output power: 0 dBm	0 dBm
	+4 dBm
	+8 dBm
	+12 dBm

The Wireless UNII radio will be professionally installed. Antenna cables are provided with the EUT, antennas are specified for the installer to purchase. At present, the following antennas are specified for use in the United States:

Gabriel	SSP2-52ARI	28.5 dBi dish
Gabriel	SSD2-52ARI	28.5 dBi dish (dual polarized)
Gabriel	DFPD-552	17.5 dBi flat panel antenna
Gabriel	DFPD1-52	23 dBi flat panel array
Radiowaves	SP1-5.2NL	23.3 dBi dish
Gabriel	DFPS2-52	27.5 dBi 2ft flat panel antenna
RadioWaves Inc.	model FP17.5-5.5	Integrated 9" x 9" flat panel, 18 dBi

The radio will be provided with a 6 ft or a 12 ft long coaxial cable.

6 ft cable cable loss: 1.0 dB

12 ft cable loss: 1.9 dB

Cable loss will decrease RF power level delivered to the antenna.

FCC CERTIFICATION INFORMATION

The following information is in accordance with FCC Rules, 47CFR Part 2.

2.1033(b)1 **Applicant:** Wireless Inc.
5452 Betsy Ross Drive
Santa Clara CA 95054-1101

2.1033(b)2 **FCC ID:** EV9N2WLAX-5G7

2.1033(b)3 **Installation instructions** are found in attached document.

2.1033(b)4 **A brief description of the circuit functions** is found in attached document

2.1033(b)5 **Block diagram** is found in attached document

2.1033(b)6 **Report of measurements** is found below.

2.1033(b)7 **Product photographs** are attached in JPEG format.

2.1033(b)8 The EUT is operated with **accessory devices** described below and in the attachments submitted.

2.1033(b) 9 NOT APPLICABLE

2.1033(b)10 - 12 NOT APPLICABLE

PART 15 REQUIREMENTS AND TEST RESULTS

15.15(b) Controls available to user

The Wireless AX UNII transceiver FCC ID EV9N2WLAX-5G7 and its companion transceiver FCC ID EV9N2WLAX-5G3, must be professionally installed. There is a DIP switch adjustment required to set power output and channel of operation. After settings are made, installer will seal the DIP switch access port with LOK-TITE adhesive to prevent setting changes that may cause operation to the device in violation of the regulations. Refer to **p 29 of the user manual**.

3. Labeling

Refer to separate attachment for label and label location.

15.21 Information to user

A statement cautioning user against making unauthorized modifications to the equipment is found on **page viii of the user manual**, submitted in separate attachment.

3. (b) Special Accessories

The Wireless UNII radio will be professionally installed. **Antenna cables are provided** with the EUT, **antennas are specified** for the installer to purchase. The following antennas were used for testing RF radiated emissions:

Gabriel	SSP2-52ARI	28.5 dBi dish
Gabriel	SSD2-52ARI	28.5 dBi dish (dual polarized)
Gabriel	DFPD-552	17.5 dBi flat panel antenna
Gabriel	DFPD1-52	23 dBi flat panel array
Radiowaves	SP1-5.2NL	23.3 dBi dish
Gabriel	DFPS2-52	27.5 dBi 2ft flat panel antenna
RadioWaves Inc.	model FP17.5-5.5	Integrated 9" x 9" flat panel, 18 dBi

The radio will be provided with a 6 ft or a 12 ft long coaxial cable.

6 ft cable cable loss: 1.0 dB

12 ft cable loss: 1.9 dB

Cable loss will decrease RF power level delivered to the antenna.

15.31 Measurement standards

Where applicable, ANSI C63.4 was followed. At the time of this writing there are no published official UNII test procedures. Test procedures for UNII parameters as

described below were derived after discussions with FCC Laboratory staff, and from general RF measurement practices employed throughout the industry.

15.33 (a)1 Frequency range of radiated measurements

Measurements were performed from the lowest frequency generated by device to 40 GHz.

15.109 Radiated emission limits (digital device)

Radiated emissions from digital portion of the EUT are attached below.

15.205 Restricted bands of operation

Radiated emissions data was performed up to 40 GHz. Emissions in the restricted bands were at least 20 dB below limit or were undetected above measurement system noise floor. Refer to separate attachment.

15.207 Conducted limits

The AX UNII product is designed to operate from DC only. AC line conducted data shown below was taken using an AC-DC converter employed for test purposes only.

15.407 General Technical Requirements

The UNII requirements for maximum power, peak power spectral density, minimum 26 dB emissions bandwidth, and maximum EIRP are interdependent variables. In addition, the level of transmitter spectral re-growth at the UNII band edges will limit the power output that may be transmitted into a particular antenna, since the emission limit is -17dBm/MHz and /or -27dBm/MHz EIRP, dependent on both antenna gain and power input.

The Wireless UNII radio has user programmable output power levels from 0 - 12 dBm.

The **26 dB channel bandwidth** is 11.4 MHz.

A number of antennas can be used with the point-to-point UNII radio, with gains that vary between 17.5 dBi and 28.1 dBi.

15.407(a)3 Power limits

$$17 \text{ dBm} + 10 \log (11.4) = 27.6 \text{ dBm max. for 5.725 - 5.825 GHZ band}$$

Peak power spectral density: = 17 dBm/MHz

Defacto EIRP limit: 27.7 dBm + 23 dBi = 50.6 dBm EIRP

Defacto EIRPsd limit: 23 dB + 17 dBm/MHz = 40 dBm/MHz EIRPsd

Maximum Power, dBm, into antenna

Antenna Type	Manufacturer P/N	Maximum Transmit Power Setting (dBm)		
		Ch1	Ch8	All others
6" External, Flat Panel, Plane Polarized., 17.5 dBi	Gabriel DFPD.5-52	+12	+12	+12
9" Integrated, Flat Panel ,P lane Polarized, 18 dBi	RadioWaves WFP.75-5.2	+12	+12	+12
12" External, Flat Panel , Plane Polarized, 23 dBi	Gabriel DFPD1-52	+12	+ 4*	+12
12" External, Parabolic, Plane Polarized, 23.3 dBi	RadioWaves SPI-5.2NL	+12	+ 4*	+12
24" External, Flat Panel, Plane Polarized, 27.5 dBi	Gabriel DFPD2-52	+ 8*	+ 0*	+12
24" External, Parabolic, Plane Polarized, 28.1 dBi	Gabriel SSP2-52AR1	+ 8*	+ 0*	+12
24" External, Parabolic, Plane Polarized, 28.1 dBi	Gabriel SSD2-52AR1	+ 8*	+ 0*	+12

*to meet bandedge EIRP limits in FCC Rule paragraph 15.407(b)3,

NOTE: The radio will be provided with a 6 ft or a 12 ft long coaxial cable.

6 ft cable cable loss: 1.0 dB

12 ft cable loss: 1.9 dB

Cable loss will decrease RF power level delivered to the antenna.

Refer to **page 17 of the user manual.**

RF Output Power Measurements
Ref: 15.407(a)2

Measurement equipment used:

HP 436B Power meter
HP 8381A power sensor
HP 8566 spectrum analyzer
30 dB attenuator

Test set-up:

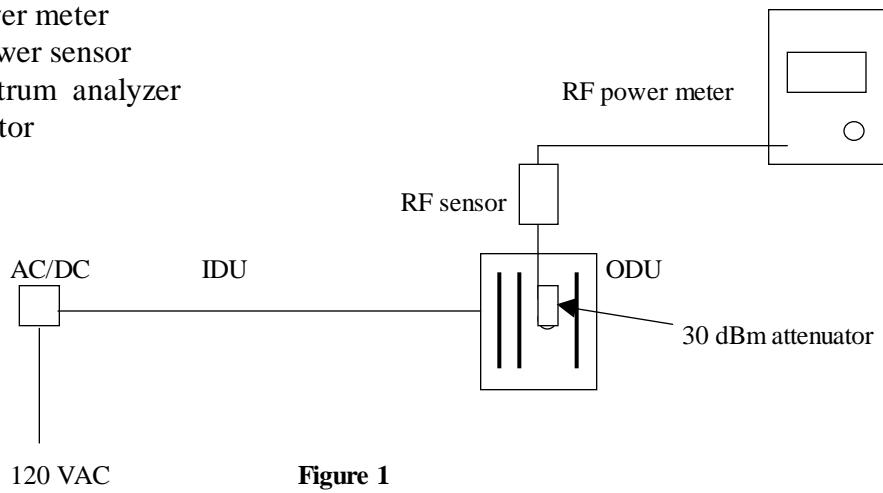


Figure 1

Test Procedures

- 1 Set the IDU to the desired channel and to maximum output power setting
- 2 RF Output = Meter reading dBm + 30 dB

Test Results: Power Output, Max

Chanel	Frequency, MHz	Pout, dBm	Cable loss, 6ft	dBm to antenna
1	5733.6	12.6	1.0	11.6
5	5776.6	13.2	1.0	12.2
8	5807.4	13.2	1.0	12.2

NOTE1: In actual use, maximum power levels chosen must meet the defacto EIRP limit and power spectral density requirements of 15.407, as well as band edge undesired emissions levels of -17 or -27 dBm/MHz EIRP.

NOTE2: The radio will be provided with a 6 ft or a 12 ft long coaxial cable.

6 ft cable cable loss: 1.0 dB

12 ft cable loss: 1.9 dB

Cable loss will decrease RF power level delivered to the antenna.

Peak Power Spectral Density
Ref: 15.407(a)5**Measurement equipment used:**

HP 8565E spectrum analyzer
3 dB attenuator

Test set-up: Refer to Figure 2 below

Test Procedures

1. Set EUT to lowest operating channel.
2. Set spectrum analyzer to TX output center frequency, RES BW = 1MHz,
VID BW = 1MHz.
3. Using MKR PEAK to find the peak power spectral density
4. Repeat for middle channel and highest channel

Test Results

Chanel	Frequency, MHz	PSD dBm/MHz	Limit, dBm/MHz
1	5733.6	11.5	17
5	5776.6	12.17	17
8	5807.4	12.17	17

NOTE: The radio will be provided with a 6 ft or a 12 ft long coaxial cable.

6 ft cable cable loss: 1.0 dB
12 ft cable loss: 1.9 dB

Cable loss will decrease PSD level delivered to the antenna.

Defacto EIRPsd limit: 23 dB + 17 dBm/MHz = 40 dBm/MHz EIRPsd

Worst case EIRPsd = Maximum antenna gain + maximum psd – minimum cable loss

= 28.1 dBi + 12.17 dBm/MHz – 1 dB = 39.27 dBm/MHz EIRPsd

Meets 40 dBm/MHz EIRPsd limit

Ratio: Peak Excursion Modulation Envelope to Peak Transmit Power**Ref: 15.407(a)6**

The emission from the Wireless Inc. radio has a distinct peak at channel center. As such, the ratio between peak transmit power and peak excursion in a 1 MHz bandwidth (i.e., psd) is small at the center. For the rest of the passband, refer to attached spectrum analyzer chart labeled "Peak Excursion Modulation Envelope".

Spectrum analyzer RES BW setting is limited to 3 MHz, not sufficient for measuring peak power of 11.4 MHz wide signal. Measurements were taken at intermediate bandwidths and results were extrapolated to 11 MHz emission bandwidth:

15.407(a)6 Maximum allowed excursion: 13 dB

Measured excursion, 100 kHz v 1 MHz BW: 5.3 dB

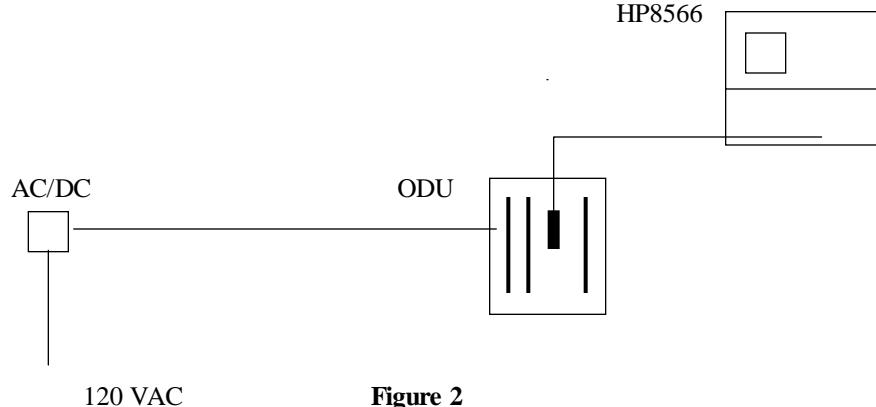
Theoretical excursion: $10 \log (1/0.1) = 10$ dB

Extrapolated excursion, 1 MHz v 10.8 MHz: $10 \log(11.4/10) + 5.3 = 5.9$ dB

Theoretical excursion: $10 \log (11.4/1) = 10.6$ dB

Antenna Conducted Output (For determining bandedge EIRP)**Ref: 15.407(b)3****Measurement equipment used:**

HP 8565E spectrum analyzer
3 dB attenuator

Test set-up:**Figure 2****Test Procedures**

1. Set EUT to lowest operating channel.
2. Set spectrum analyzer center frequency to TX output, RES BW = 1MHz, VID BW = 1 MHz
3. Use analyzer MKR function to measure output at bandedge and 10 MHz from bandedge
4. Add antenna gain and compare to -17dBm/MHz and /or -27dBm/MHz EIRP
5. Plot spectrum analyzer data
6. Repeat steps 1-6 for highest channel

Test Results

Refer to attached spectrum analyzer graphs A' and B'.

Unwanted Emissions below 1 GHz

Ref: 15.407(b)6

15.207 AC Line Conducted Emissions

Refer to attached spectrum analyzer chart

15.109, 15.209 Radiated Emissions Below 1 GHz

Refer to radiated data below taken for model N24X, with digital board and DC to DC converter power circuitry virtually identical to the AX radio. Data is applicable to and representative of emissions below 1 GHz for the AX radios.

Field Strength of Spurious and Harmonic Radiation**Ref: 15.407(b)6****Measurement Equipment Used:**

HP 8566 Spectrum Analyzer

HP 11975A Preamplifier, 2 - 8 GHz (used with HP11970 external mixers)

Antenna Research Associates MWH 1826/B, 18 - 26.5 GHz

HP 11970K Harmonic mixer, 18 - 26.5 GHz

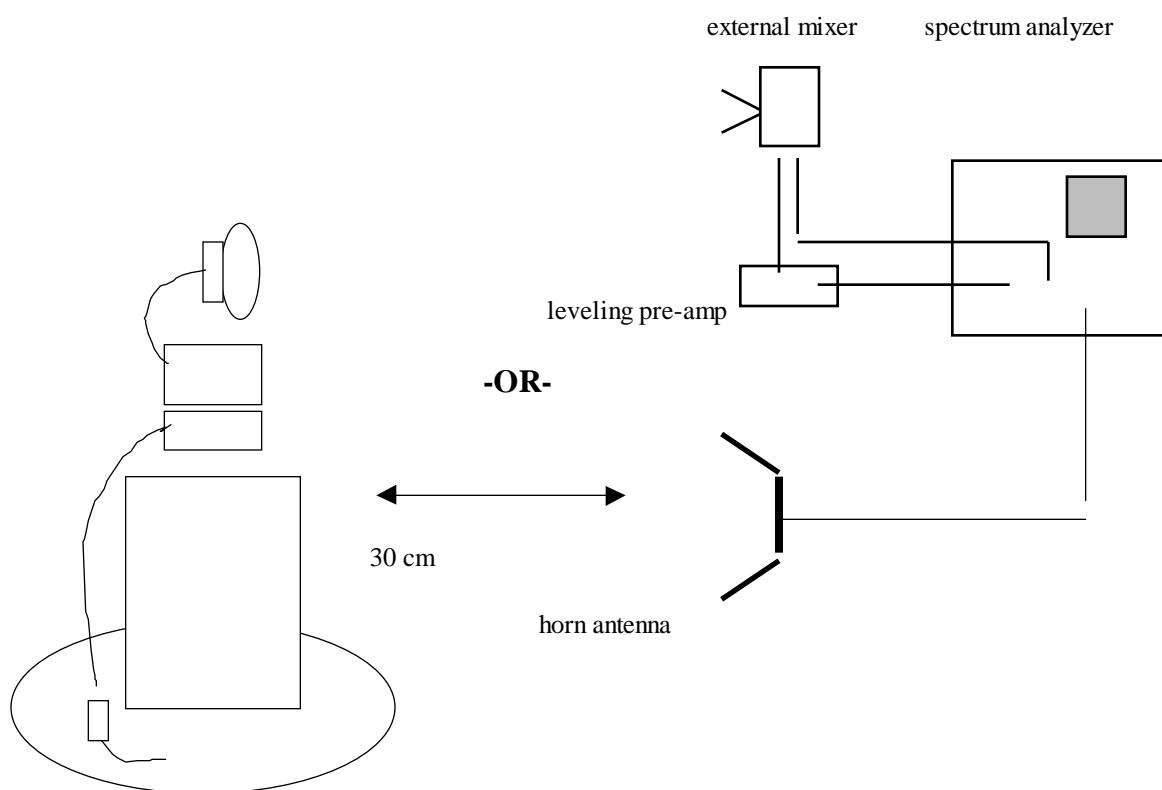
HP 11970A Harmonic mixer, 26.5 - 40 GHz

HP 11970Q Harmonic mixer, 33 - 50 GHz

HP 11970V Harmonic mixer, 50 - 75 GHz

HP 11970W Harmonic mixer, 75 - 110 GHz

Low loss antenna cable (0.7 dB/ft @ 24 GHz)

Test Set-Up

Test Method

With the transmitter operating at full power, the EUT was rotated 360° and the search antenna was raised and lowered in both polarities, all in an attempt to maximize the levels of the received emission for each harmonic and spurious emission up to 40 GHz.

Test Results

Refer to worst-case radiated data sheet submitted as a separate attachment.

No emissions above instrumentation noise floor were detected. Tests were performed for each of the 4 antennas at a LOW, MID, and HIGH channel.

Antenna conducted measurements confirmed there are no harmonic emissions generated by this transmitter above the noise floor of the spectrum analyzer (-51 dBm or lower). Using the relationship between field strength, output power and distance

$$EV/m = (\bullet(30*PW*G))/d \text{ meters} \quad (E \text{ volts/m}, P \text{ watts}, G \text{ numeric gain over isotropic})$$

Assuming G=1, converting volts to microvolts and watts to milliwatts, simplifying and combining terms, and using a distance of d = 3m

$$E@3m, dBuV/m = (95.24 + PdBm) dBuV/m = 95.24 - 51dBm = \mathbf{44.24 \ dBuV/m}$$

15.205, 15.209 limit: 54 dBuV/m @ 3m

15.407(c) Automatic Transmitter Shut-off when No Data Present

If the RF transmitter synthesizer loses lock (frequency error) or the output transmitter cannot level power (Pout control error), logic signals are sent to the digital board to shut down the unit. This also happens if the negative power supply isn't present.

15.407(d) Integral Antenna Requirement 5.15 – 5.25 GHz

NOT APPLICABLE

15.407(e) Indoor Operation Limitation 5.15 – 5.25 GHz

NOT APPLICABLE

15.407(f) RF Exposure Information

RF Hazard Distance Calculation

mW/cm2 from Table1: **1.00**

Max RF Power P, dBm	TX Antenna G, dBi	MPE Safe Distance, cm
12.0	18.0	8.9
12.0	23.0	15.9
12.0	26.0	22.4
8.0	28.5	18.9

RF Hazard Distance Calculation

Basis of Calculations:

$$E^2/3770 = S, \text{ mW/cm}^2$$

$$E, \text{ V/m} = (P_{\text{watts}} \cdot G_{\text{gain}} \cdot 30)^{0.5} / d, \text{ meters}$$

$$d = ((P_{\text{watts}} \cdot G \cdot 30) / (3770 \cdot S))^{0.5}$$

$$P_{\text{watts}} \cdot G_{\text{gain}} = 10^{(P_{\text{dBm}} - 30 + G_{\text{dBi}}) / 10}$$

The Wireless UNII radio will be professionally installed. Antenna cables are provided with the EUT, antennas are specified for the installer to purchase. At present, there are four antennas specified for use with the radio:

Gabriel	SSP2-52ARI	28.5 dBi dish
MTI Technology	MT 30102	23 dBi flat panel array
Radiowaves	SP1-5.2NL	26 dBi dish
Gabriel	DFPD.5-52	18 dBi flat panel array

The radio will be provided with a 6 ft or a 12 ft long coaxial cable.

6 ft cable cable loss: 1.0 dB

12 ft cable loss: 1.9 dB

Cable loss will decrease RF power level delivered to the antenna.

Antennas will be fixed mounted in outdoor locations such as pole tops, building roofs, and similar structures. Professional installation is required for these antennas. Installer will

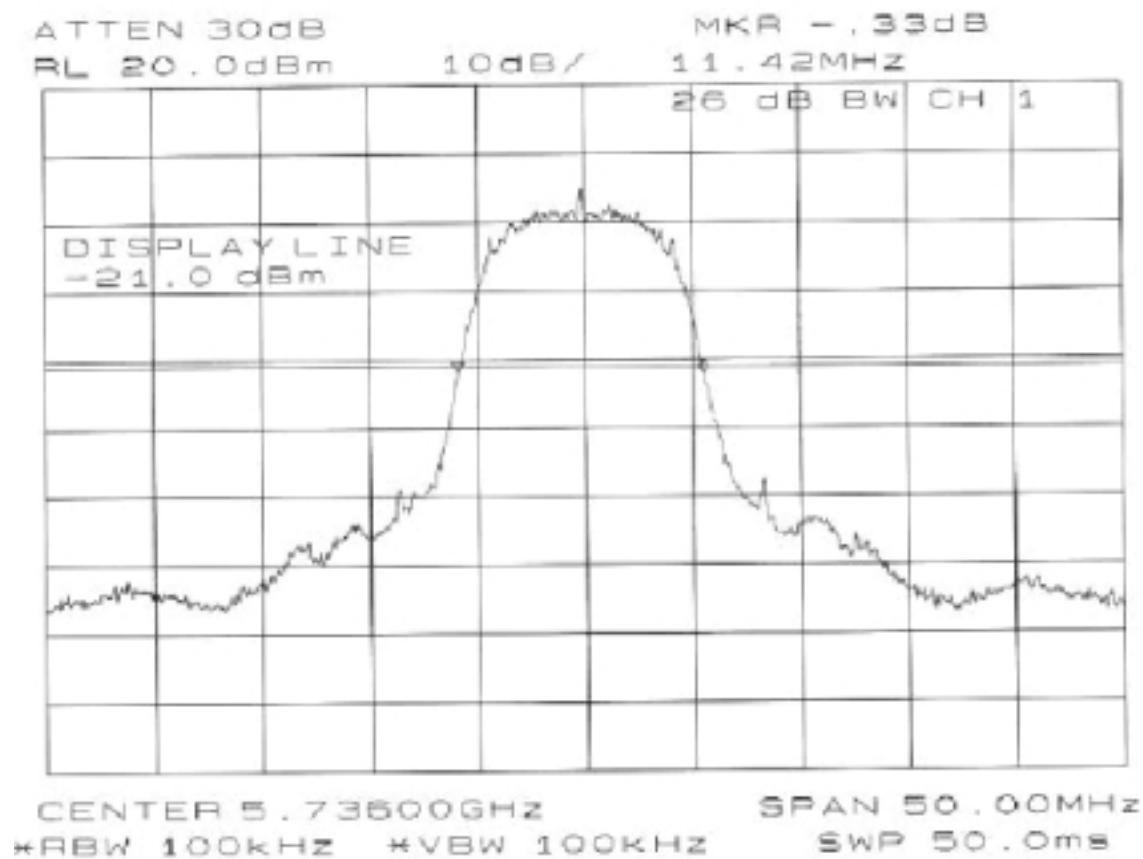
be instructed to mount antennas so that a minimum distance of **1.5 meters** is maintained between all persons and the antenna. Refer to **page vii of the user manual**.

15.407 (g) Frequency Stability Data

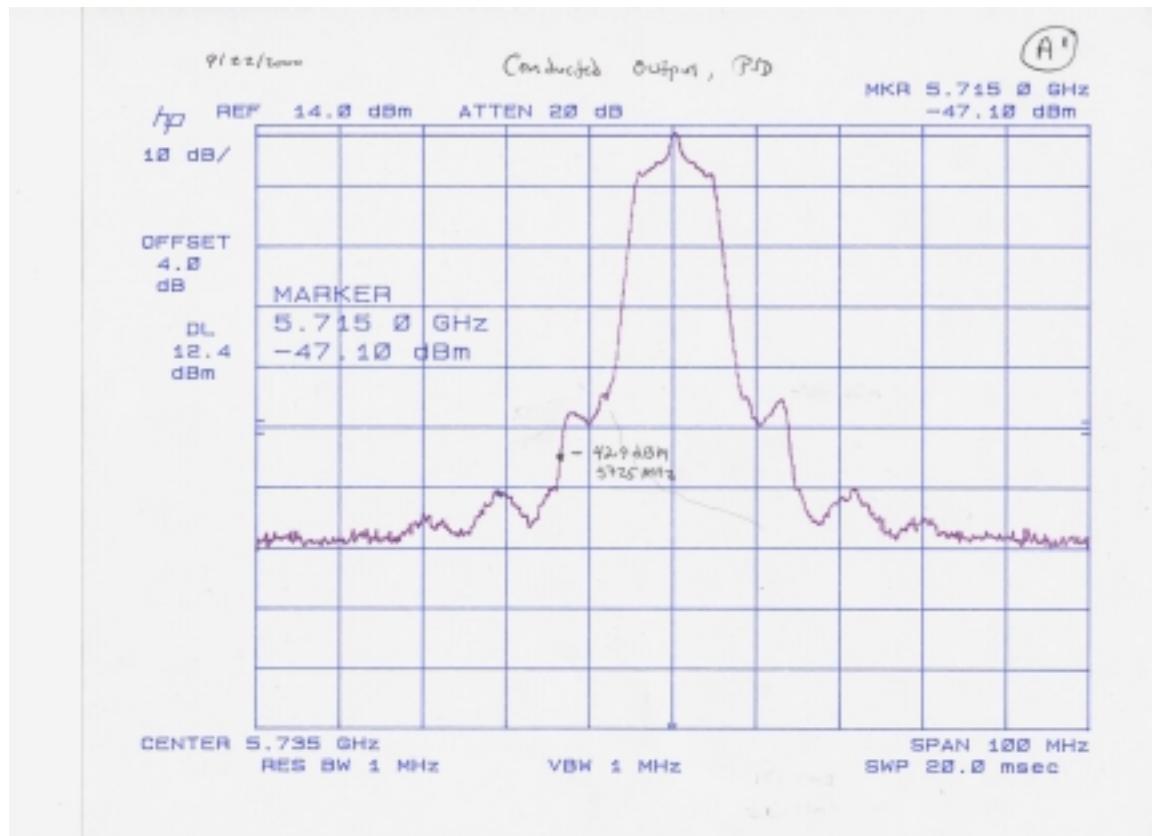
The EUT was placed in the temperature chamber. The EUT was set to one of the operating channels and the output mask was monitored on the spectrum analyzer. The chamber temperature was increased to +65C (highest temperature specified by mfr), and then was brought down to -35C (the lowest operating temperature specified by the mfr). The mask center frequency was compared to the center frequency at +25 C.

Data indicates that the EUT stays within its operating frequency range across the manufacturer specified operating frequency range.

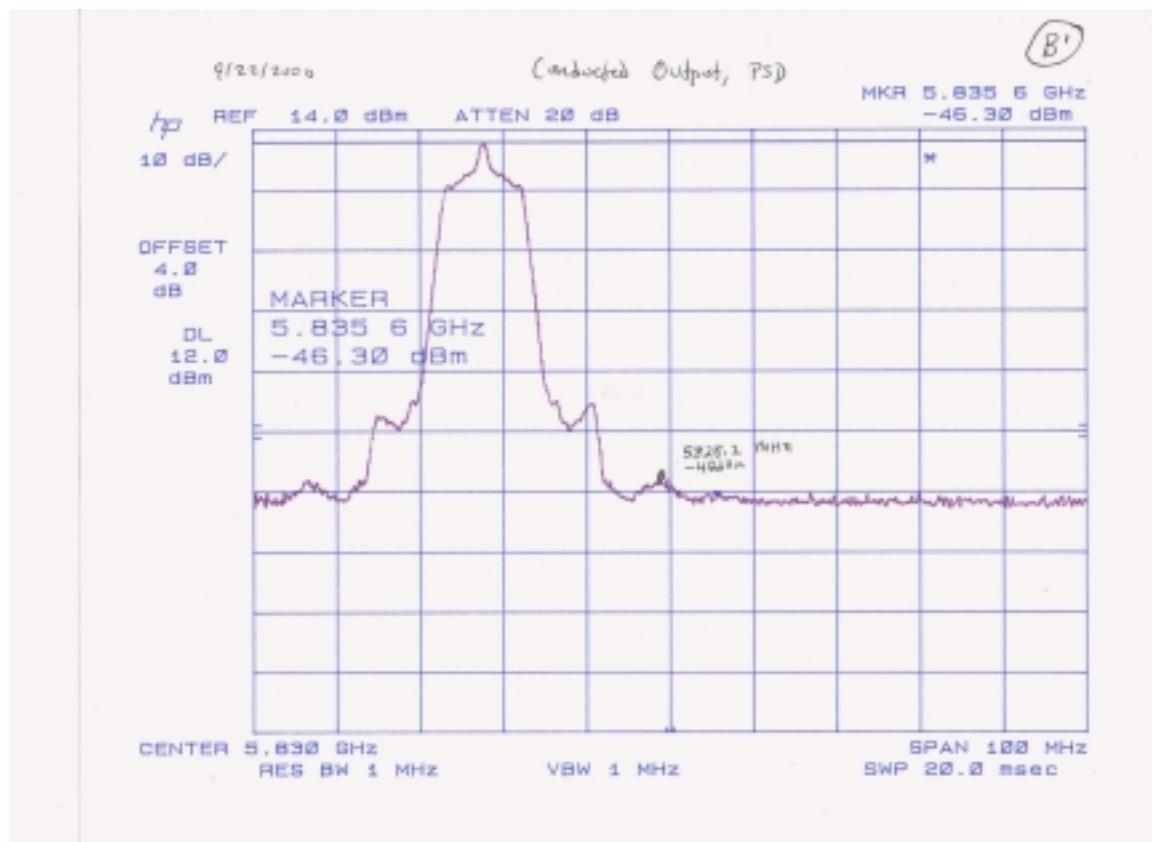
Data is presented in spectrum analyzer graphs shown below.

26 dB Bandwidth (11.4 MHz)

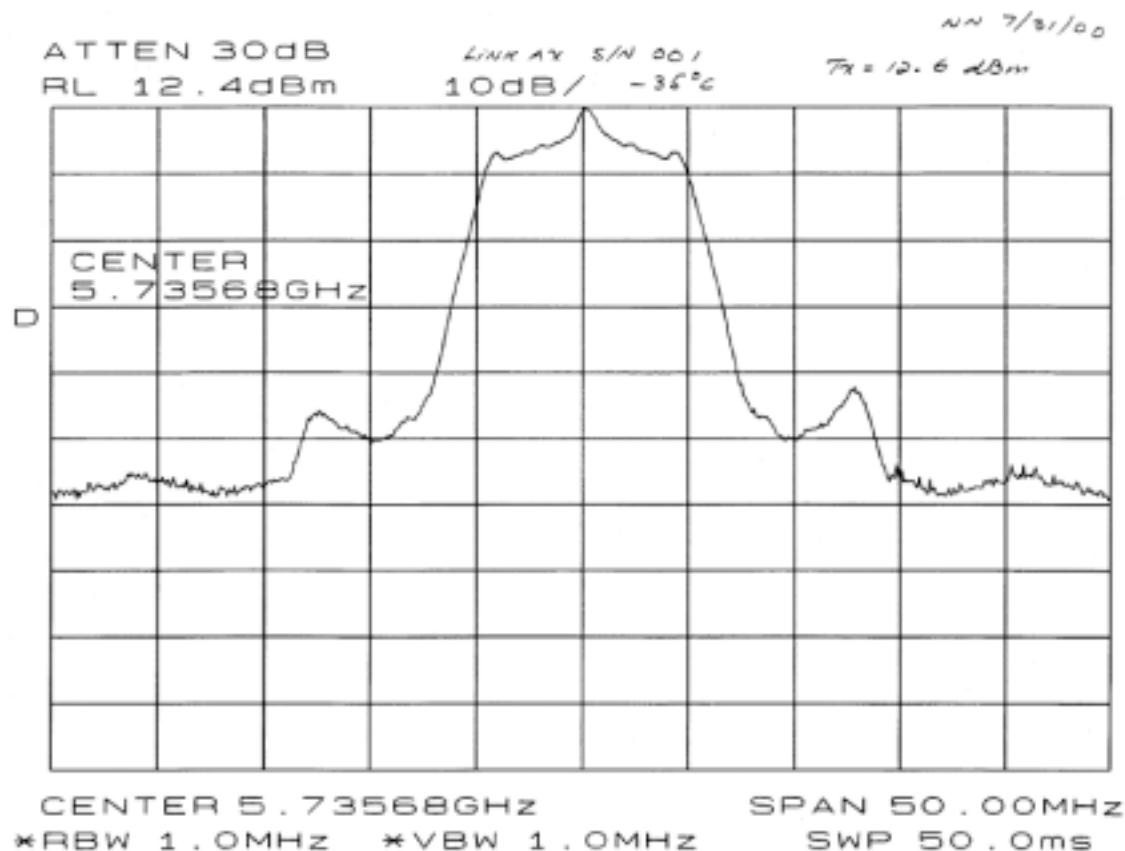
Spectrum Analyzer Graphs – Bandedge



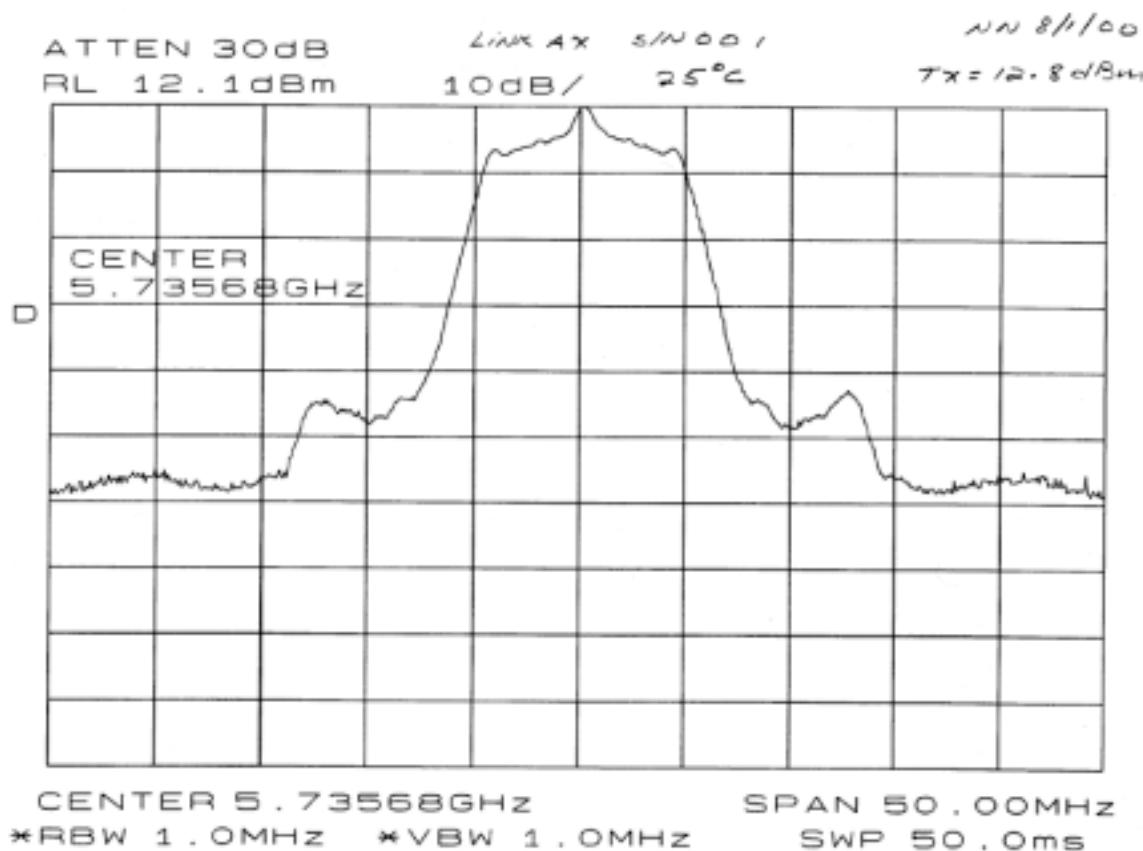
Spectrum Analyzer Graphs – Bandedge



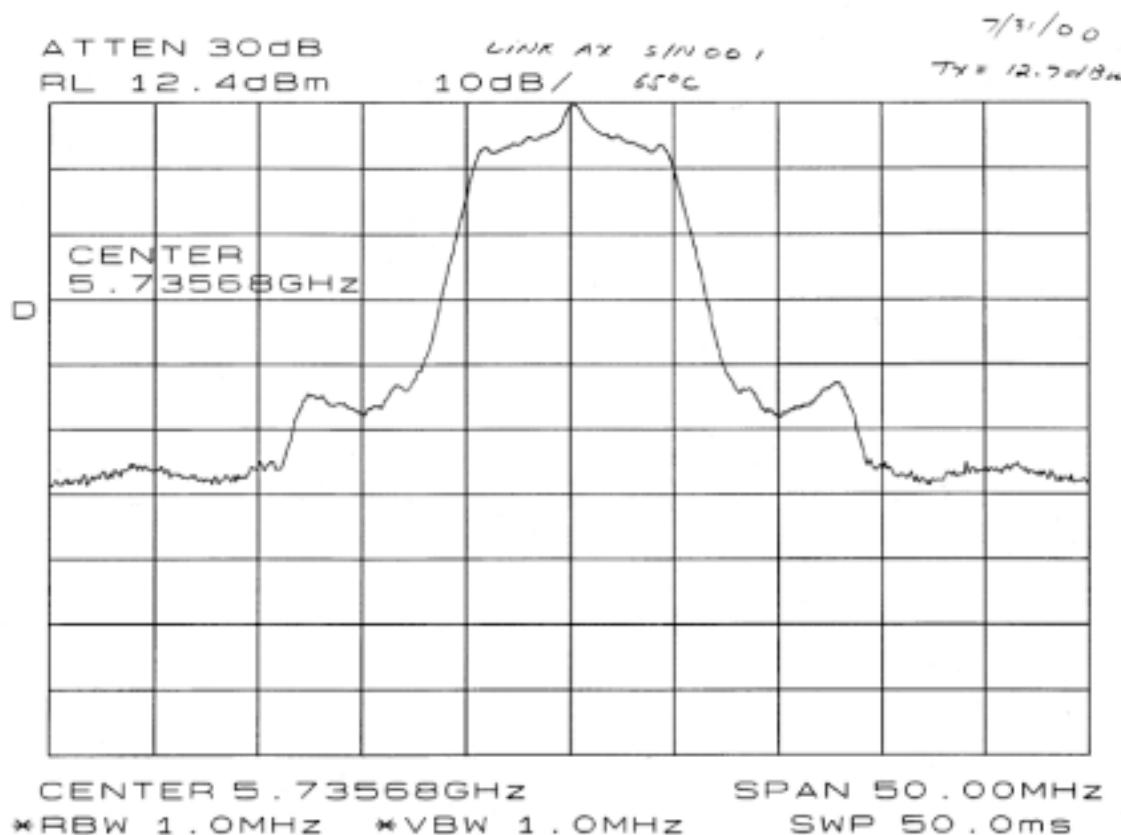
15.407 (g) Temperature Stability Data: T = -35C



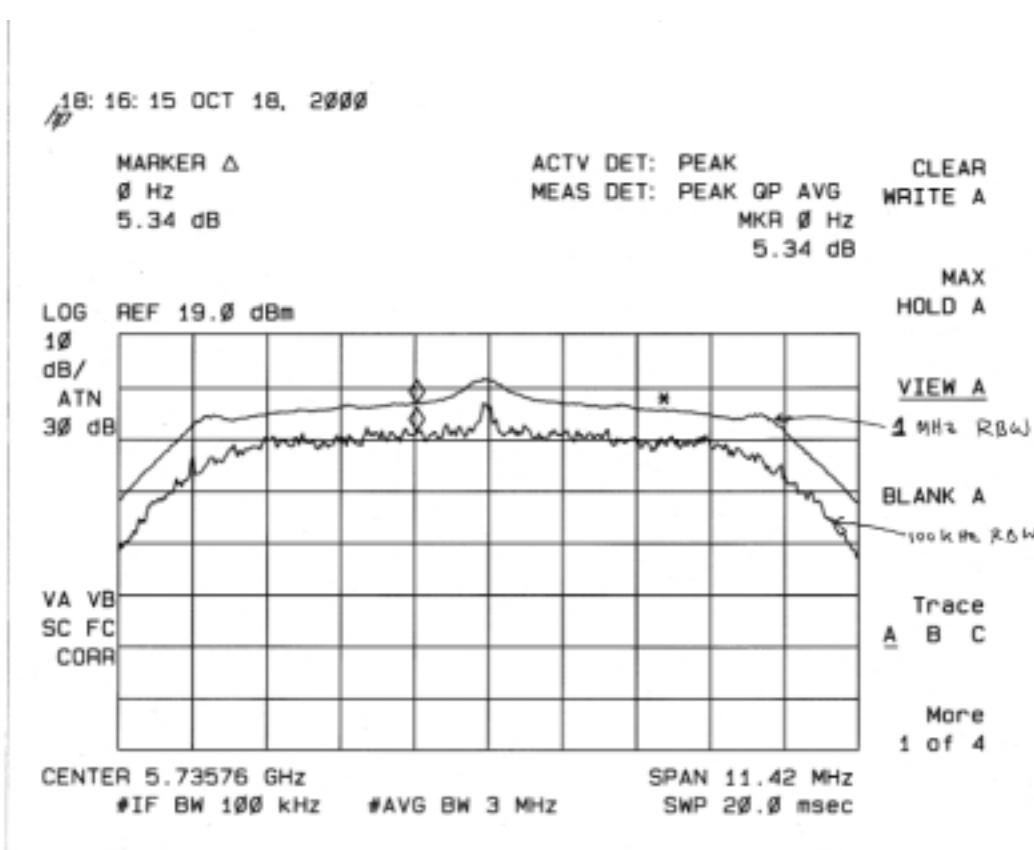
15.407 (g) Temperature Stability Data: T = +25C



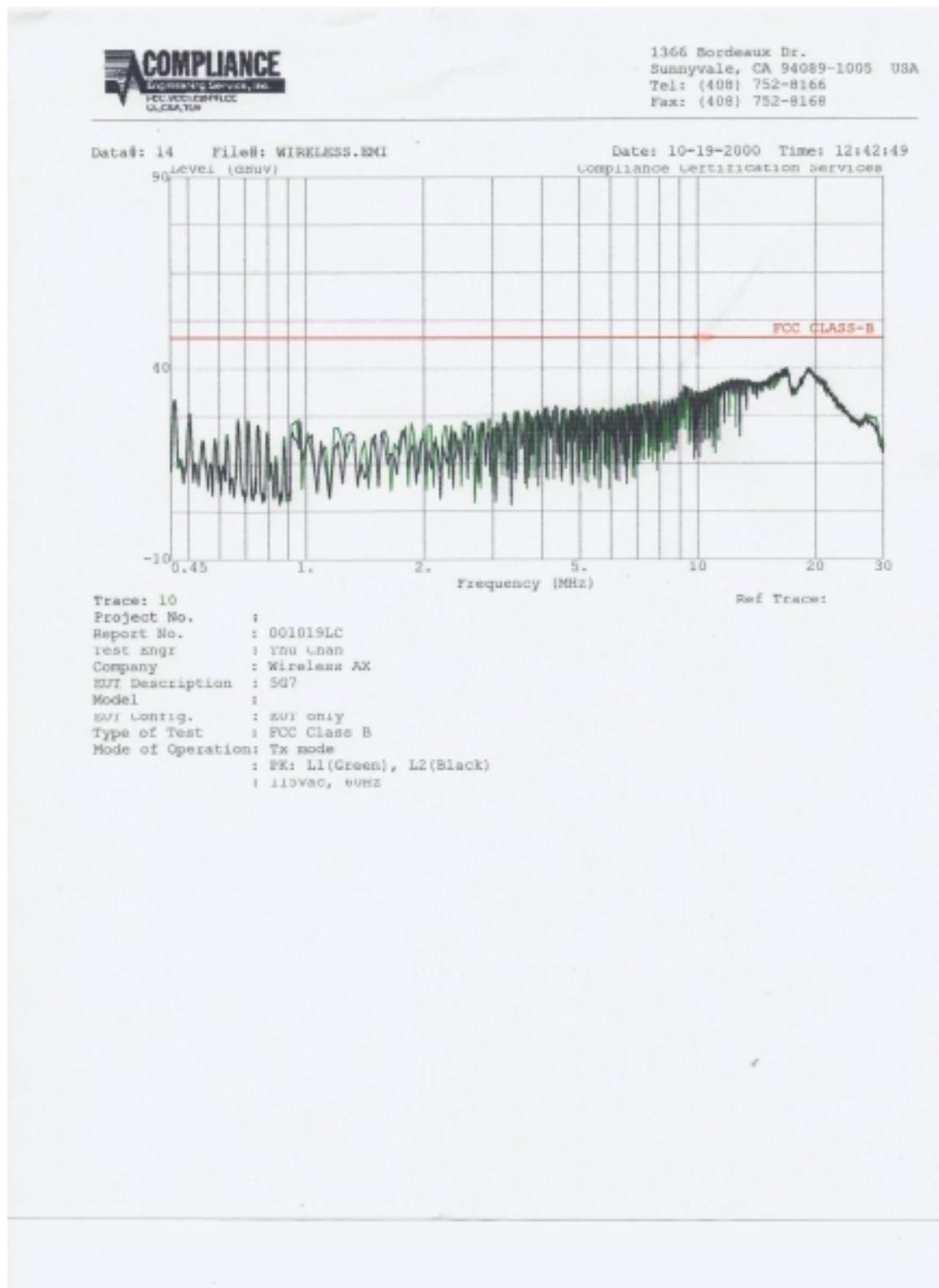
15.407 (g) Temperature Stability Data: T = +65C



Peak Excursion Modulation Envelope



15.207 AC Line Conducted



15.109, 15.209 Radiated Emissions

Project No. : 0002281
Report No. : 000228B2
Date : 02/28/2000
Time : 13:14
Compliance Engineering Services Inc. >> 3 M RADIATED EMISSION DATA << Test Engr : RONNY CASTILLO

Company : WIRELESS INC
Equipment Under Test : INDOOR UNIT FOR WIRELESS DATA SYSTEM MN N24X
IDU
Test Configuration : EUT/ODU
Type of Test : FCC CLASS B
Mode of Operation : NORMAL

Freq.	dBuV	PreAmp	Ant	Cable	dBuV/m	Limit	Margin	Pol	Hgt(m)	Az
Bilog 2586 ; Pre-pamp = 8447D-P8 2944A06589:										
520.00	46.50	-27.62	18.31	5.40	42.59	46.00	-3.41	H	2.0	180
309.98	44.30	-26.47	14.17	3.98	35.97	46.00	-10.03	H	2.0	270

Total # of data 2
v. 112999b

(refer to separate attachment for emissions above 1 GHz)