

March 04, 2009

Lenovo (United States) Incorporated  
1009 Think Place-Building One  
Dept ZGSA / B2-5J8  
Morrisville, NC 27650  
United States

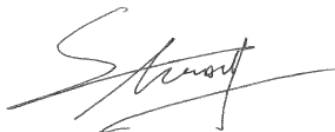
Dear James B Pate :

Enclosed you will find your file copy of a Part 15 Certification (FCC ID: S2L332110U).

For your reference, TCB will normally take another 20 days for reviewing the report.  
Approval will then be granted when no query is sorted.

Please contact me if you have any questions regarding the enclosed material.

Sincerely,

A handwritten signature in black ink, appearing to read "Shawn Xing", with a stylized flourish extending from the end.

Shawn Xing  
Assistant Manager

Enclosure

**Intertek Testing Services Shenzhen Ltd. Kejiyuan Branch**

6F, D Block, Huahan Building, Langshan Road, Nanshan District, Shenzhen, P. R. China  
Tel: (86 755) 8601 6288 Fax: (86 755) 8601 6751 Website: [www.china.intertek-etlsemko.com](http://www.china.intertek-etlsemko.com)



## Lenovo (United States) Incorporated

Application  
For  
Certification  
**(FCC ID: S2L332110U)**

Lenovo ConstantConnect Express Card

**332110U**

2.4GHz Transceiver

SZ08120223-2

Louisa Lu

March 04, 2009

- The test results reported in this test report shall refer only to the sample actually tested and shall not refer or be deemed to refer to bulk from which such a sample may be said to have been obtained.
- This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to copy or distribute this report. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results referenced from this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.
- For Terms And Conditions of the services, it can be provided upon request.
- The evaluation data of the report will be kept for 3 years from the date of issuance.

TRF no.: FCC 15C\_TXa

FCC ID: S2L332110U

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## INTERTEK TESTING SERVICES

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### LIST OF EXHIBITS

#### *INTRODUCTION*

<i>EXHIBIT 1:</i>	General Description
<i>EXHIBIT 2:</i>	System Test Configuration
<i>EXHIBIT 3:</i>	Emission Results
<i>EXHIBIT 4:</i>	Equipment Photographs
<i>EXHIBIT 5:</i>	Product Labelling
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<i>EXHIBIT 8:</i>	Miscellaneous Information

## INTERTEK TESTING SERVICES

### MEASUREMENT/TECHNICAL REPORT

**Lenovo (United States) Incorporated - MODEL: 332110U**  
**ADDITIONAL MODEL: 45K1687 / 332110F**

**FCC ID: S2L332110U**

**March 04, 2009**

This report concerns (check one)      Original Grant   X   Class II Change       

Equipment Type: DXX - Part 15 Low Power Communication Device Transmitter

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)?      Yes             No   X  

If yes, defer until:                                   
date

Company Name agrees to notify the Commission by:                                   
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Transition Rules Request per 15.37?      Yes             No   X  

If no, assumed Part 15, Subpart C for intentional radiator – the new 47 CFR [09-20-07 Edition] provision.

Report prepared by:

Shawn Xing  
Intertek Testing Services Shenzhen Ltd.  
Kejiyuan Branch  
6F, Block D, Huahan Building, Langshan Road,  
Nanshan District, Shenzhen, P. R. China  
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# INTERTEK TESTING SERVICES

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## INTERTEK TESTING SERVICES

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### List of attached file

Exhibit type	File Description	Filename
Test Report	Test Report	report.pdf
Test Setup Photo	Radiated Emission	radiated photos.pdf
Test Setup Photo	Conducted Emission	conducted photos.pdf
Test Report	Bandedge Plot	be.pdf
Test Report	20dB BW Plot	bw.pdf
External Photo	External Photo	external photos.pdf
Internal Photo	Internal Photo	internal photos.pdf
Block Diagram	Block Diagram	block.pdf
Schematics	Circuit Diagram	circuit.pdf
Operation Description	Technical Description	descri.pdf
ID Label/Location	Label Artwork and Location	label.pdf
User Manual	User Manual	manual.pdf
Cover Letter	Confidentiality Letter	request.pdf

# **INTERTEK TESTING SERVICES**

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## **EXHIBIT 1**

### **GENERAL DESCRIPTION**

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## INTERTEK TESTING SERVICES

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### 1.0 **General Description**

#### 1.1 Product Description

The Equipment Under Test (EUT) is a Lenovo ConstantConnect Express Card, model: 332110U. It operates at frequency range of 2402MHz to 2480MHz with 79 hopping frequencies. This Card is designed to support specified ThinkPad® computer models that have been customized to support the ConstantConnect application. The ConstantConnect application is a software and hardware solution that uses the Bluetooth technology to synchronize data between your ThinkPad mail client (Microsoft® Outlook® 2007) and your BlackBerry Smartphone. The Express Card provides the communication support to send and receive complete e-mails and attachments while the PC system is lipped off in suspend, hibernation or power-off state, the Bluetooth module in the express card will turn off automatically and Bluetooth module integrated in the PC will work when the PC system is powered on. The two LEDs (light-emitting diode) on the Express Card indicate the current state of your Express Card and the Inbox of your mail client.

This Express Card uses the Freescale i.MX27L processor, which is a high-performance, low-power processor up to 400MHz based on the ARM926EJ-S microprocessor core. The transceiver part (i.e. Bluetooth) operating at 2402 to 2480MHz. Also, this Express Card takes the Windows® CE 6.0 operating system as the software platform to provide exciting user experiences. And this device is powered by notebook PC.

The Model: 45K1687 / 332110F are the same as the tested Model: 332110U in hardware and software aspect. The only differences are the packing accessories and model no. for trading purpose.

Antenna Type: PCB antenna

For electronic filing, the brief circuit description is saved with filename: descri.pdf.

#### 1.2 Related Submittal(s) Grants

This is an application for certification of a transmitter.

The receiver portion associated with this transmitter is exempted from technical requirement of this part.



## INTERTEK TESTING SERVICES

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### 1.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.4 (2003). Radiated emission measurement was performed in semi-anechoic chamber and conducted emission measurement was performed in shield room. For radiated emission measurement, preliminary scans were performed in the semi-anechoic chamber only to determine the worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application.

### 1.4 Test Facility

The Semi-Anechoic chamber and shield room used to collect the radiated data and conducted data is **Interterk Testing Services Shenzhen Ltd. Kejiyuan Branch** and located at 6F, Block D, Huahan Building, Langshan Road, Nanshan District, Shenzhen, P. R. China. This test facility and site measurement data have been fully placed on file with the FCC.

# **INTERTEK TESTING SERVICES**

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## **EXHIBIT 2**

### **SYSTEM TEST CONFIGURATION**

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## INTERTEK TESTING SERVICES

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### 2.0 **System Test Configuration**

#### 2.1 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.4 (2003).

The EUT was powered by notebook PC during test.

For maximizing emissions below 30 MHz, the EUT was rotated through 360°, the centre of the loop antenna was placed 1 meter above the ground, and the antenna polarization was changed. For maximizing emission at and above 30 MHz, the EUT was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data report in Exhibit 3.0.

The rear of unit shall be flushed with the rear of the table.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was placed on a turn table, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes.

#### 2.2 EUT Exercising Software

The EUT exercise program (provided by client) used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use.

The parameters of test software setting:

During the test, Channel and power controlling software provided by the applicant was used to control the operating channel as well as the output power level.

#### 2.3 Special Accessories

No special accessories used.

#### 2.4 Equipment Modification

## INTERTEK TESTING SERVICES

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Any modifications installed previous to testing by Lenovo (United States) Incorporated will be incorporated in each production model sold / leased in the United States.

No modifications were installed by Intertek Testing Services.

### 2.5 Measurement Uncertainty

When determining the test conclusion, the Measurement Uncertainty of test has been considered.

### 2.6 Support Equipment List and Description

This product was tested in the following configuration:

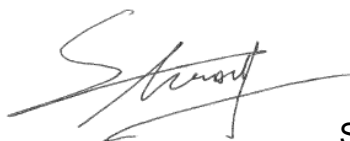
Refer List:

Description	Manufacturer	Model No.
Test PC	Lenovo	276811C
Adaptor	Shenzhen Ya Da	92P1103
Hard Disk	Smart.drive	HD3-SU2FW
USB Cable	Smart.drive	Length 155cm
1394 Cable	Smart.drive	Length 180cm

All the items listed under section 2.0 of this report are

*Confirmed by:*

*Shawn Xing*  
*Assistant Manager*  
*Intertek Testing Services Shenzhen Ltd. Kejiyuan Branch*  
*Agent for Lenovo (United States) Incorporated*



Signature

March 04, 2009

Date

## **INTERTEK TESTING SERVICES**

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### **EXHIBIT 3**

### **EMISSION RESULTS**

## INTERTEK TESTING SERVICES

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### 3.0 **Emission Results**

Data is included worst-case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

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## INTERTEK TESTING SERVICES

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### 3.1 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

$$FS = RA + AF + CF - AG + PD + AV$$

Where      FS = Field Strength in dB $\mu$ V/m  
             RA = Receiver Amplitude (including preamplifier) in dB $\mu$ V  
             CF = Cable Attenuation Factor in dB  
             AF = Antenna Factor in dB  
             AG = Amplifier Gain in dB  
             PD = Pulse Desensitization in dB  
             AV = Average Factor in -dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

$$FS = RA + AF + CF - AG + PD + AV$$

Assume a receiver reading of 62.0 dB $\mu$ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted. The pulse desensitization factor of the spectrum analyzer was 0 dB, and the resultant average factor was -10 dB. The net field strength for comparison to the appropriate emission limit is 32 dB $\mu$ V/m. This value in dB $\mu$ V/m was converted to its corresponding level in  $\mu$ V/m.

RA = 62.0 dB $\mu$ V  
AF = 7.4 dB  
CF = 1.6 dB  
AG = 29.0 dB  
PD = 0 dB

AV = -10 dB

$$FS = 62 + 7.4 + 1.6 - 29 + 0 + (-10) = 32 \text{ dB}\mu\text{V/m}$$

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(32 \text{ dB}\mu\text{V/m})/20] = 39.8 \mu\text{V/m}$$

## **INTERTEK TESTING SERVICES**

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### **3.2 Radiated Emission Configuration Photograph**

Worst Case Radiated Emission  
at  
2441.000 MHz

For electronic filing, the worst case radiated emission configuration photograph is saved with filename: radiated photos. pdf.



## INTERTEK TESTING SERVICES

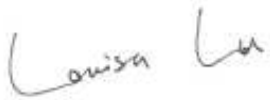
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### 3.3 Radiated Emission Data

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Judgement: Passed by 10.0 dB

#### **TEST PERSONNEL:**



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*Signature*

Louisa Lu, Engineer

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*Typed/Printed Name*

March 04, 2009

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*Date*

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## INTERTEK TESTING SERVICES

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Applicant: Lenovo (United States) Incorporated

Date of Test: January 7, 2009

Model: 332110U

Worst Case Operating Mode: Transmit

Table 1

### Radiated Emissions

(2402MHz)

Polarization	Frequency (MHz)	Reading (dB $\mu$ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dB $\mu$ V/m)	Limit at 3m (dB $\mu$ V/m)	Margin (dB)
Vertical	2402.000	91.2	36.7	28.5	83.0	94.0	-11.0
Horizontal	2402.000	88.8	36.7	28.5	80.6	94.0	-13.4
Vertical	4804.000	46.3	36.1	33.1	43.3	54.0	-10.7
Vertical	7206.000	41.1	36.2	37.8	42.7	54.0	-11.3
Vertical	9608.000	38.2	36.3	38.6	40.5	54.0	-13.5
Vertical	12010.000	35.8	35.6	39.5	39.7	54.0	-14.3

(2441MHz)

Polarization	Frequency (MHz)	Reading (dB $\mu$ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dB $\mu$ V/m)	Limit at 3m (dB $\mu$ V/m)	Margin (dB)
Vertical	2441.000	91.3	36.7	28.5	83.1	94.0	-10.9
Horizontal	2441.000	92.2	36.7	28.5	84.0	94.0	-10.0
Vertical	4882.000	46.0	36.1	33.3	43.2	54.0	-10.8
Vertical	7323.000	40.8	36.3	37.9	42.4	54.0	-11.6
Vertical	9764.000	38.9	36.3	38.7	41.3	54.0	-12.7
Vertical	12205.000	36.6	35.3	39.5	40.8	54.0	-13.2

(2480MHz)

Polarization	Frequency (MHz)	Reading (dB $\mu$ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dB $\mu$ V/m)	Limit at 3m (dB $\mu$ V/m)	Margin (dB)
Vertical	2480.000	91.3	36.7	28.6	83.2	94.0	-10.8
Horizontal	2480.000	90.4	36.7	28.6	82.3	94.0	-11.7
Vertical	4960.000	46.4	36.1	33.4	43.7	54.0	-10.3
Vertical	7440.000	40.1	36.3	38.2	42.0	54.0	-12.0
Vertical	9920.000	38.4	36.3	38.8	40.9	54.0	-13.1
Vertical	12400.000	35.8	35.3	39.6	40.1	54.0	-13.9

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TRF no.: FCC 15C\_TXa

FCC ID: S2L332110U

## **INTERTEK TESTING SERVICES**

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- Notes:
1. Peak Detector Data unless otherwise stated.
  2. All measurements were made at 3 meter. Harmonic emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
  3. Negative value in the margin column shows emission below limit.
  4. Horn antenna is used for the emission over 1000MHz.

Test Engineer: Louisa Lu

## **INTERTEK TESTING SERVICES**

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### 3.4 Conducted Emission Configuration Photograph

Worst Case Line-Conducted Configuration  
at  
1.534 MHz

For electronic filing, the worst case conducted emission configuration photograph is saved with filename: conducted photos.pdf.

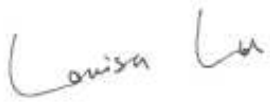
## INTERTEK TESTING SERVICES

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### 3.5 Conducted Emission Data

Judgement: Passed by 26.4 dB margin

#### **TEST PERSONNEL:**



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*Signature*

Louisa Lu, Engineer  
*Typed/Printed Name*

March 04, 2009  
*Date*

## INTERTEK TESTING SERVICES

Company: Lenovo (United States) Incorporated

Date of Test: March 4, 2009

Model: 332110U

Worst Case Operating Mode: Transmit (PC power off)

**Table 2**

### Conducted Emissions

#### Live Line Data

Frequency (MHz)	Quasi-Peak		Average	
	Disturbance level dB( $\mu$ V)	Permitted limit dB( $\mu$ V)	Disturbance level dB( $\mu$ V)	Permitted limit dB( $\mu$ V)
0.202	30.7	63.5	25.0	53.5
0.302	29.9	60.2	22.1	50.2
0.510	25.0	56.0	15.7	46.0
1.534	29.6	56.0	16.7	46.0
8.286	25.5	60.0	17.1	50.0
20.526	25.0	60.0	19.1	50.0

#### Neutral Line Data

Frequency (MHz)	Quasi-Peak		Average	
	Disturbance level dB( $\mu$ V)	Permitted limit dB( $\mu$ V)	Disturbance level dB( $\mu$ V)	Permitted limit dB( $\mu$ V)
0.202	31.1	63.5	24.1	53.5
0.302	29.3	60.2	21.2	50.2
0.410	29.5	57.6	19.8	47.6
0.510	28.6	56.0	18.6	46.0
7.410	26.9	60.0	19.2	50.0
20.494	26.8	60.0	20.7	50.0

Test Engineer: Louisa Lu

TRF no.: FCC 15C\_TXa

FCC ID: S2L332110U

## **INTERTEK TESTING SERVICES**

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### **EXHIBIT 4**

### **EQUIPMENT PHOTOGRAPHS**

## INTERTEK TESTING SERVICES

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### 4.0 Equipment Photographs

For electronic filing, the photographs of the tested EUT are saved with filename: external photos.pdf & internal photos.pdf.



## **INTERTEK TESTING SERVICES**

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### **EXHIBIT 5**

### **PRODUCT LABELLING**

## INTERTEK TESTING SERVICES

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### 5.0 **Product Labelling**

For electronic filing, the FCC ID label artwork and the label location are saved with filename: label.pdf.

## **INTERTEK TESTING SERVICES**

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### **EXHIBIT 6**

### **TECHNICAL SPECIFICATIONS**

## INTERTEK TESTING SERVICES

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### 6.0 **Technical Specifications**

For electronic filing, the block diagram and schematics of the tested EUT are saved with filename: block.pdf and circuit.pdf respectively.

# **INTERTEK TESTING SERVICES**

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## **EXHIBIT 7**

### **INSTRUCTION MANUAL**

## INTERTEK TESTING SERVICES

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### 7.0 **Instruction Manual**

For electronic filing, a preliminary copy of the Instruction Manual is saved with filename: manual.pdf.

This manual will be provided to the end-user with each unit sold/leased in the United States.

## **INTERTEK TESTING SERVICES**

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### **EXHIBIT 8**

### **MISCELLANEOUS INFORMATION**

## INTERTEK TESTING SERVICES

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### 8.0 **Miscellaneous Information**

This miscellaneous information includes details of the measured bandedge, the test procedure and calculation of factor such as pulse desensitization.



## INTERTEK TESTING SERVICES

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### 8.1 Bandedge Plot

For electronic filing, the plot shows the fundamental emission when modulated is saved with filename: be.pdf. From the plot, the field strength of any emissions outside of the specified frequency band are attenuated to the general radiated emission limits in section 15.209. It fulfil the requirement of 15.249(d).

#### Peak Measurement

Bandedge compliance is determined by applying marker-delta method, i.e ( Bandedge Plot).

Resultant field strength = Fundamental emissions (peak value) – delta from the bandedge plot

$$\begin{aligned} &= 83.0\text{dB}\mu\text{v/m}-45.7\text{dB} \\ &= 37.3\text{dB}\mu\text{v/m} \end{aligned}$$

Resultant field strength = Fundamental emissions (peak value) – delta from the bandedge plot

$$\begin{aligned} &= 83.2\text{dB}\mu\text{v/m}-46.23\text{dB} \\ &= 36.97\text{dB}\mu\text{v/m} \end{aligned}$$

The resultant field strength meets the general radiated emission limit in section 15.209, which does not exceed 74 dB $\mu$ v/m (Peak Limit) and 54dB $\mu$ v/m (Average Limit).

## INTERTEK TESTING SERVICES

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### 8.1 Bandedge Plot (cont'd)

Pursuant to FCC part 15 Section 15.215(c), the 20dB bandwidth of the emission was contained within the frequency band designated (mentioned as above) which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over excepted variations in temperature and supply voltage were considered.

Figure 8.1 Bandwidth

## INTERTEK TESTING SERVICES

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### 8.2 Discussion of Pulse Desensitization

Pulse desensitivity is not applicable for this device. The effective period ( $T_{eff}$ ) is approximately 210 $\mu$ s for a digital “1” bit which illustrated on technical specification, with a resolution bandwidth (3dB) of 1MHz, so the pulse desensitivity factor is 0dB.

## INTERTEK TESTING SERVICES

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### 8.3 Emissions Test Procedures

The following is a description of the test procedure used by Intertek Testing Services in the measurements of transmitters operating under Part 15, Subpart C rules.

The test set-up and procedures described below are designed to meet the requirements of ANSI C63.4 - 2003.

The transmitting equipment under test (EUT) is placed on a wooden turntable which is four feet in diameter and approximately one meter in height above the ground plane. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The EUT is adjusted through all three orthogonal axes to obtain maximum emission levels. The antenna height and polarization are varied during the testing to search for maximum signal levels.

Detector function for radiated emissions is in peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings.

The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower. For line conducted emissions, the range scanned is 150 kHz to 30 MHz.

## INTERTEK TESTING SERVICES

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### 8.3 Emissions Test Procedures (cont'd)

The EUT is warmed up for 15 minutes prior to the test.

AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new, fully charged battery is used.

Conducted measurements are made as described in ANSI C63.4 - 2003.

The IF bandwidth used for measurement of radiated signal strength was 10 kHz for emission below 30 MHz and 120 kHz for emission from 30 MHz to 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. Above 1000 MHz, a resolution bandwidth of 1 MHz is used.

Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the restricted bands and above 1 GHz, signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, but those measurements taken at a closer distance are so marked.