

RadioShack, A Division of Tandy Corporation

Application
For
FCC Part 90 Certification
(FCC ID: AAO3201222)

May 21, 1999

WO# 9810095
KWL/km
May 21, 1999

- The test results reported in this report shall refer only to the sample actually tested and shall not refer or be deemed a refer to bulk from which such a sample may be said to have been obtained
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FCC ID: AAO3201222

INTERTEK TESTING SERVICES

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INTERTEK TESTING SERVICES

MEASUREMENT/TECHNICAL REPORT

Application: RadioShack, A Division of Tandy Corporation
Trade Name: OPTIMUS
Model No.: 32-1222
Date: May 21, 1999

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

Equipment Type: Wireless FM Microphone

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.

Report prepared by:

K. W. Lam
Intertek Testing Services.
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STATEMENT OF CONFORMITY

This unit has been found to conform with the following parts of the 47 CFR as detailed below:

- 2.911 This report is certified by a qualified individual. This signature is located in the Measurement Section.
- 2.983 The name of the applicant and identification of the equipment is provided on Form 731. The product will be produced in mass quantities. The technical description information is included in Exhibit 1, Exhibit 8 to 11.
- 2.985 RF power data is located in Exhibit 3.1.
- 2.987 Modulation characteristics are detailed in Exhibit 4.0.
- 2.989 Occupied bandwidth measurements are detailed in Exhibit 5.0.
- 2.993 The field strength of spurious emissions was measured and the data is recorded in Exhibit 6.0.
- 2.995 The frequency stability of the unit, with respect to voltage and temperature variation, was measured and the results are recorded in Exhibit 7.0.
- 2.997 The frequency range investigated was from the lowest frequency present in the device to higher than the tenth harmonic of the carrier frequency.

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List of attached file

	Exhibit type	File Description	Filename
1	Cover Letter	Letter of Agency	letter.pdf
2	Operation Description	Technical Description	descri.pdf
3	Test Report	Bandwidth Plot	bw.pdf
4	Test Report	Modulation Frequency Response	mfr.pdf
5	Test Report	Modulation Limit Characteristic	mlc.pdf
6	Test Report	Unwanted Emission	emission.pdf
7	Block Diagram	Block Diagram	block.pdf
8	Schematics	Circuit Diagram	Circuit.pdf
9	ID Label/Location	Label Artwork and Location	label.pdf
10	User Manual	User Manual	manual.pdf
11	Test Report	Test Report	report.pdf
12	Test Setup Photo	Radiated Emission	radiated1.jpg
13	Test Setup Photo	Radiated Emission	radiated2.jpg
14	Internal Photo	Internal Photo	ipphoto.jpg
15	External Photo	External Photo	ophoto1.jpg
16	External Photo	External Photo	ophoto2.jpg
17	External Photo	External Photo	ophoto3.jpg
18	External Photo	External Photo	ophoto4.jpg

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EXHIBIT 1

GENERAL DESCRIPTION

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1.0 **General Description**

1.1 Product Description

The 32-1222 is a 6 Channel Wireless FM Microphone. The unit is powered from a single 9V battery.

Type of emission: F3E

Frequency Range: 169 MHz to 172 MHz

Rated Radiated Output Power: 0.025mW

Operating Frequency:

Frequency Channel	Carrier Frequency
A	169.445 MHz
E	171.045 MHz
D	170.305 MHz
G	171.845 MHz
C	170.245 MHz
H	171.905 MHz

The brief circuit description is saved with filename descri.pdf

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1.2 Related Submittal(s) Grants

This is an Application for Certification of the transmitter portion of a Wireless Microphone System. The receiver section of the receiver is subject to DOC verification process.

1.3 Test Methodology

Radiated emission measurements were performed according to the procedures in ANSI C63.4 (1992). All measurement were performed in Open Area Test Sites. Preliminary scans were performed in the Open Area Test Sites only to determine worst case modes. For each scan, the procedure of maximizing emissions in Appendices D and E were followed. All Radiated tests were performed at an antenna the EUT distance of 3 meters, unless stated otherwise in the **“Justification Section”** of this Application.

1.4 Test Facility

The open area test site and conducted measurement facility used to collect the emission data is located at Garment Centre, 576 Castle Peak Road, Kowloon, Hong Kong. The test facility and site measurement data have been fully placed on file with the FCC.

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EXHIBIT 2

SYSTEM TEST CONFIGURATION

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2.0 **System Test Configuration**

2.1 Justification

The device was configured for testing in a typical fashion (as a customer would normally use it). The device was mounted to a cardboard box, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes. When the radiated emissions are measured.

Unless specified the device was powered by a new 9V alkaline battery.

The frequency range from 30 MHz to 10th harmonic was searched for spurious emissions from the device. Only those emissions reported were detected. All other emissions were at least 20 dB below the applicable limits.

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2.2 EUT Exercising Software

There was no special software to exercise the device. Once the unit is powered on, a signal is transmitted.

2.3 Special Accessories

There was no special accessory in the evaluation.

2.4 Equipment Modification

Any modification installed previous to testing by Radioshack, A Division of Tandy Corporation will be incorporated in each production model sold/leased in the United States.

No modification were installed by Intertek Testing Services.

Confirmed by:

*K. W. Lam
Technical Manager
Intertek Testing Services
Agent for Radioshack, A Division of Tandy Corporation*



_____ Signature

_____ Date

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EXHIBIT 3

RF POWER OUTPUT

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3.0 **RF Power Output [Section 90.265 (b)(2)]**

A. Equipment Used

Equipment	Brand Name	Model No.
Biconical Antenna	CDI	B300
Test receiver	Rohde & Schwarz	ESVS30
RF Filter	Tailithic	3VF
Tuned Dipole Antenna	CDI	Robert Antenna 4
Signal Generator	Maconi	2024

B. Testing Procedure

- 1) On a test site, the EUT shall be placed at 1.5m height on a turn table vertically.
- 2) The test antenna shall be oriented initially for vertical polarisation location 3m from EUT to correspond to the frequency of the transmitter.
- 3) The output of the test antenna shall be connected to the measuring receiver and the quasi-peak detector is used for the measurement.
- 4) The transmitter shall be switched on, if possible, without modulation and the measuring receiver shall be turned to the frequency of the transmitter under test.
- 5) The test antenna shall be raised and lowered through the specified range of height until a maximum signal level is detected by the measuring receiver.
- 6) The transmitter shall then be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver.
- 7) The test antenna shall be raised and lowered again through the specified range of height until a maximum signal level is detected by the measuring receiver.

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- 8) The maximum signal level detected by the measuring receiver shall be noted.
- 9) The transmitter shall be replaced by a tuned dipole (substitution antenna).
- 10) The substitution antenna shall be orientated for vertical polarisation and the length of the substitution antenna shall be adjusted to correspond to the frequency of the transmitter.
- 11) The substitution antenna shall be connected to a calibrated signal generator.
- 12) If necessary, the input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver.
- 13) The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received.
- 14) The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring receiver, that is equal to the level noted input attenuator setting of the measuring receiver.
- 15) The input level to the substitution antenna shall be recorded as power level in dBm, corrected for any change of input attenuator setting of the measuring receiver.
- 16) The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarisation.
- 17) The measure of the effective radiated power is the larger of the two levels recorded, at the input to the substitution antenna, corrected for gain of the substitution antenna if necessary.
- 18) Repeat above test procedure with the EUT placed horizontally.

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Table 1

**RadioShack, A Division of Tandy Corporation
OPTIMUS 32-1222**

Transmission Power

Channel	Frequency (M H z)	M easured Power (m W)	L i m i t (m W)	M a r g i n (m W)
A	169.445	0.0245	50	-49.9755
C	170.245	0.0158	50	-49.9842
D	170.305	0.0040	50	-49.9960
E	171.045	0.0079	50	-49.9921
G	171.845	0.0004	50	-49.9996
H	171.905	0.0005	50	-49.9995

Notes: Negative sign in the margin column shows the value below limits.

Test Engineer: Nick C. C. Leung

Date of Test: January 8, 1999

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EXHIBIT 4

MODULATION CHARACTERISTICS

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4.0 **Modulation Characteristics**

In order to satisfy the 2.987 requirement, Modulation Frequency Response, and Modulation Limit Characteristics are attached in Exhibit 4.1 & 4.2.

Plots for each tests are included in the following sections.

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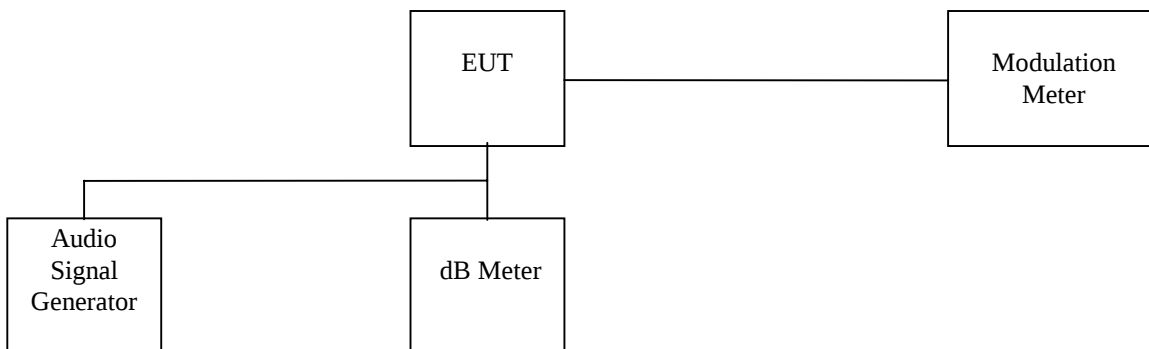
4.1 Modulation Frequency Response

A. Test Equipment

Equipment	Brand Name	Model No.
Audio Signal Generator	Leader	LFG-1300S
dB meter	Leader	LMV-182A
Modulation Meter	Marconi Instrument	2945

B. Testing Procedure

- 1) Set-up the test equipment in the following configuration:



- 2) Set the audio signal generator frequency to the sound pressure level 97.0dB SPL at the microphone of the EUT.
- 3) The frequency of the audio signal generator is changed from 100Hz to 5kHz.
- 4) Record the frequency deviation.

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C. Test Result

Table 2

**RadioShack, A Division of Tandy Corporation
OPTIMUS 32-1222**

Modulation Frequency Response (Section 2.987(a))

Test Channel : H

Input Level : 97.0dB SPL

Modulation Frequency (Hz)	Frequency deviation (kHz)	Modulation index
100	6.30	63.00
200	10.04	50.20
300	6.81	22.70
400	6.06	15.15
500	5.69	11.38
600	5.42	9.03
700	5.23	7.47
800	5.08	6.35
900	4.91	5.46
1000	5.13	5.13
1250	4.96	3.97
1500	4.84	3.23
1750	4.71	2.69
2000	4.86	2.43
2250	5.32	2.36
2500	5.91	2.36
2750	6.20	2.25
3000	6.37	2.12
3125	6.11	1.96
3250	5.91	1.82
3500	5.79	1.65
4000	5.72	1.43
5000	6.37	1.27

Test Engineer: Nick C. C. Leung

Date of Test: December 28, 1998

For electronic filing, the Modulation Frequency Response plots are saved with filename: mfr.dpf

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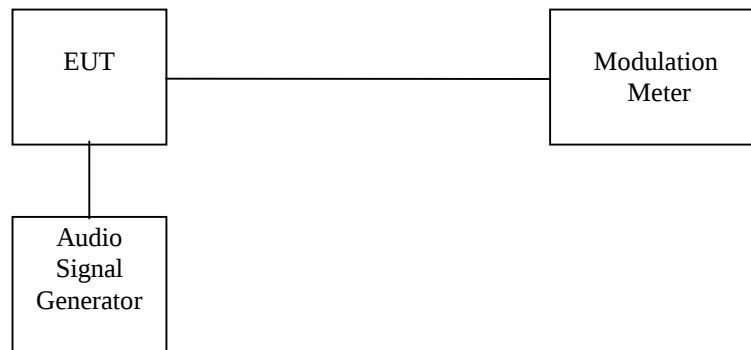
4.2 Modulation Limiting Characteristics (Section 2.987(b))

A. Test Equipment

Equipment	Brand Name	Model No.
Audio Signal Generator	Leader	LFG-1300S
Modulation Meter	Marconi	2950

B. Testing Procedure

- 1) Set-up the test equipment in the following configuration:



- 2) Set the frequency of the audio signal generator to 500Hz and adjust the level from 67dBSPL to 127dBSPL. Record the output modulation index.
- 3) Record the maximum value of plus or minus peak frequency deviation.
- 4) Repeat the above procedure with frequency 500Hz, 1000Hz, 2500Hz & 5000Hz.

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C. Test Result

Table 3

**RadioShack, A Division of Tandy Corporation
OPTIMUS 32-1222**

Modulation Limiting Characteristics

Test Channel : H

Modulation Input (dBSPL)	Peak Frequency deviation (kHz) at 500Hz	Peak Frequency deviation (kHz) at 1000Hz	Peak Frequency deviation (kHz) at 2500Hz	Peak Frequency deviation (kHz) at 5000Hz
67	0.78	0.84	0.98	1.48
77	1.45	1.39	1.65	2.51
87	2.64	2.42	2.86	4.11
97	4.80	4.32	5.09	7.05
107	8.62	7.74	9.06	12.07
117	15.36	13.95	15.72	17.94
127	20.67	21.96	16.80	19.20

Test Engineer: Nick C. C. Leung

Date of Test: December 28, 1998

For electronic filing, the Modulation Limiting Characteristics plot is saved with filename:
mlc.pdf

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EXHIBIT 5

OCCUPIED BANDWIDTH

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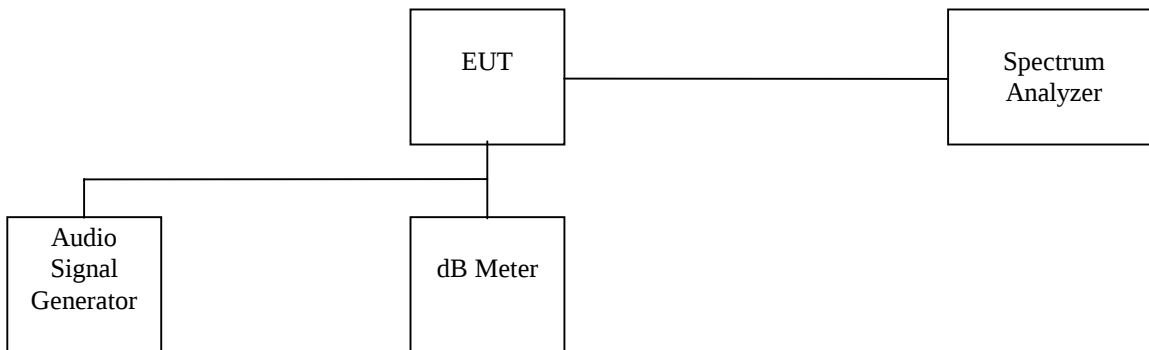
5.0 Occupied Bandwidth [Section 2.989 & Section 90.265 (b)(1)]

A. Test Equipment

Equipment	Brand Name	Model No.
Audio Signal Generator	Leader	LFG-1300S
dB meter	Leader	LMV-182A
Spectrum Analyzer	Hewlett Packard	8951EM

B. Testing Procedure

- 1) Set-up the test equipment in the following configuration:



- 2) Set the level of audio signal generator to obtain 85% modulation.
- 3) The occupied bandwidth is measured with the spectrum analyzer set at 5kHz/div scan and 10dB/div.

C. Test Result

The occupied Bandwidth is measured to be 18.00kHz and 17.88kHz for carrier frequencies of 169.445MHz and 171.905MHz respectively.

Test Engineer: Nick C. C. Leung

Date of Test: January 12, 1999

For electronic filing, the Bandwidth Plots are saved with filename: bw.pdf

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EXHIBIT 6

SPURIOUS EMISSION

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6.0 **Spurious Emission [Section 90.210 (c)]**

In order to satisfy the 90.210(c) requirement, the spurious emission from the EUT are measured and shown in the Exhibit 6.1.

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6.1 Field Strength of Spurious Radiation

A. Test Equipment

Equipment	Brand Name	Model No.
Antenna	CDI	B100,B200,B300, Horn
Test receiver	Rohde & Schwarz	ESVS30
RF Filter	Tailithic	3VF

B. Testing Procedure

Radiated emission measurements were performed according to the procedures in ANSI C63.4(1992). All measurements were performed in Open Area Test Sites located at Roof Top of Garment Centre, 576 Castle Peak Road, Kowloon, Hong Kong.

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C. Radiated Emission Configuration Photograph

For electronic filing, photographs of the Worst Case Radiated Emission are saved with filename: radiated1.jpg and radiated2.jpg for front view and back view respectively.

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D. Test Result

RadioShack, A Division of Tandy Corporation
OPTIMUS 32-1222
Radiated Spurious Emissions

- 1) Unwanted emission from CARRIER $\pm$ 5kHz to Carrier $\pm$ 135kHz

Table 6(a)

Region	Attenuation from unmodulated carrier emissions			
	Channel A	Limit	Channel H	Limit
CARRIER + 5kHz	10dB	--	10dB	--
CARRIER - 5kHz	9dB	--	9dB	--
CARRIER + 7.5kHz	17dB	>14.6	18dB	>14.6
CARRIER - 7.5kHz	16dB	>14.6	16dB	>14.6
CARRIER + 10kHz	29dB	>24.5	30dB	>24.5
CARRIER - 10kHz	27dB	>24.5	27dB	>24.5
CARRIER + 12.5kHz	42dB	>33.4	44dB	>33.4
CARRIER - 12.5kHz	38dB	>33.4	40dB	>33.4
CARRIER + 15kHz	57dB	>38.0	59dB	>38.0
CARRIER - 15kHz	52dB	>38.0	54dB	>38.0

For electronic filing, the emission plots are saved with filename: emission.pdf

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2) Unwanted emission

Table 6(b): Channel A

Polarization	Frequency (MHz)	Net at 3m (dBμV/m)	Limit at 3m (dBμV/m)	Margin (dB)
H	155.336	48.5	82.2	- 33.7
H	183.574	43.5	82.2	- 38.7
H	211.815	61.1	82.2	- 21.1
H	254.185	44.6	82.2	- 37.6

Table 6(c): Channel H

Polarization	Frequency (MHz)	Net at 3m (dBμV/m)	Limit at 3m (dBμV/m)	Margin (dB)
H	157.587	44.6	82.2	- 37.6
H	186.241	41.2	82.2	- 41.0
H	214.892	31.0	82.2	- 51.2
H	257.870	41.2	82.2	- 41.0

- Remark:
1. Quasi-peak data for emission below 1000MHz.
 2. ' - ' sign in margin column shows the value below the limits.
 3. Any emissions and any other harmonics which are attenuated more than 20dB below the permissible value need not be recorded.
 4. Horn Antenna and average detector is used for emission over 1000MHz.

$$\begin{aligned} \text{* Calculated limit} &= 10 \log_{10} (\text{TP(W)}) - 43 - 10 \log_{10} (\text{TP}) \\ &= -43\text{dBW} \\ &= 82.2\text{dB}\mu\text{V/m at 3m} \end{aligned}$$

Test Engineer: Nick C. C Leung

Date of Test: January 12, 1999

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EXHIBIT 7

FREQUENCY STABILITY

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7.0 **Frequency Stability**

The frequency tolerance was tested in normal condition & over extreme ambient conditions with respect to voltage and temperature variation.

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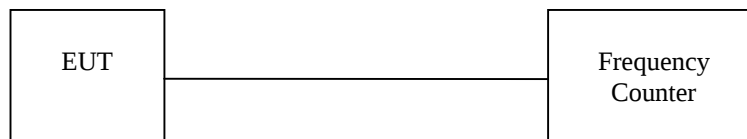
7.1 Frequency Tolerance

A. Test Equipment

Equipment	Brand Name	Model No.
Frequency Counter	Phillips	PM6668

B. Testing Procedure

- 1) Set-up the test equipment in the following configuration:



- 2) Measure all transmit channel frequencies in MHz.

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C. Test Result

Table 9

**RadioShack, A Division of Tandy Corporation
OPTIMUS 32-1222
Frequency Tolerance**

Channel	Frequency (MHz)	Measured Frequency (MHz)	Tolerance (kHz)
A	169.44500	169.44743	2.43
C	170.24500	170.24865	3.65
D	170.30500	170.30841	3.41
E	171.04500	171.04980	4.80
G	171.84500	171.84827	3.27
H	171.90500	171.90879	3.79

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7.2 Frequency Stability - Temperature

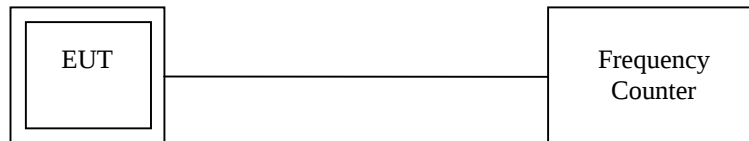
A. Test Equipment

Equipment	Brand Name	Model No.
Frequency Counter	Phillips	PM6668

B. Testing Procedure

- 1) Set-up the test equipment in the following configuration:

Temperature Chamber



- 2) Set the Temperature Chamber to -30°C and stabilize the EUT temperature for one hour. Turn the transmitter ON for two minutes.
- 3) Measure the channel frequency of channel A, H in MHz.
- 4) Turn the EUT OFF
- 5) Repeat the above procedure with 10°C intervals from -30°C to 50°C

INTERTEK TESTING SERVICES

C. Test Result

Table 10

**RadioShack, A Division of Tandy Corporation
OPTIMUS 32-1222**

Frequency Deviation with Temperature Variation

Channel : A

Temperature (°C)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Deviation (kHz)
-30	169.44500	169.45076	5.76
-20	169.44500	169.45065	5.65
-10	169.44500	169.45059	5.59
0	169.44500	169.44980	4.80
10	169.44500	169.44971	4.71
20	169.44500	169.44880	3.80
30	169.44500	169.44737	2.37
40	169.44500	169.44619	1.19
50	169.44500	169.44281	2.19

Test Engineer: Nick C. C. Leung

Date of Test: January 14, 1999

INTERTEK TESTING SERVICES

C. Test Result

Table 11

**RadioShack, A Division of Tandy Corporation
OPTIMUS 32-1222**

Frequency Deviation with Temperature Variation

Channel : H

Temperature (°C)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Deviation (kHz)
-30	171.90500	171.91474	9.74
-20	171.90500	171.91417	9.17
-10	171.90500	171.91324	8.24
0	171.90500	171.91222	7.22
10	171.90500	171.91132	6.32
20	171.90500	171.90986	4.86
30	171.90500	171.90625	1.25
40	171.90500	171.90537	0.37
50	171.90500	171.89020	-14.80

Test Engineer: Nick C. C. Leung

Date of Test: January 14, 1999

INTERTEK TESTING SERVICES

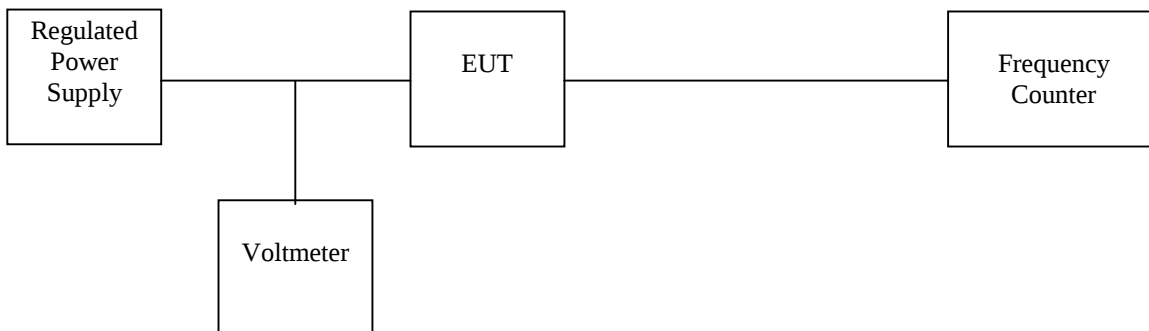
7.3 Frequency Stability - Voltage

A. Test Equipment

Equipment	Brand Name	Model No.
Regulated Power Supply	PAD	30-35L
Voltage meter	Fluke	87
Frequency Counter	Phillips	PM6668

B. Testing Procedure

- 1) Set-up the test equipment in the following configuration:



- 2) Vary the level of regulated power supply from to manufacturer specified battery end point of the EUT.
- 3) Measure the channel frequency of channel A & H in MHz at each input power level.

INTERTEK TESTING SERVICES

C. Test Result

Table 7

**RadioShack, A Division of Tandy Corporation
OPTIMUS 32-1222**

Frequency Deviation with Voltage Variation

The manufacturer specified battery end point 6.3V

Channel : A

Voltage (V)	Assigned Frequency (MHz)	Measured Frequency (MHz)	% Deviation (MHz)
6.3	169.445	169.446	0.001

Channel : 19

Voltage (V)	Assigned Frequency (MHz)	Measured Frequency (MHz)	% Deviation (MHz)
6.3	171.905	171.905	0.000

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EXHIBIT 8

TECHNICAL SPECIFICATIONS

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8.0 **Technical Specifications**

For electronic filing, the block diagram and the schematic diagram of the Wireless Microphone transmitter are saved with filename: block.pdf and circuit.pdf

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EXHIBIT 9

PRODUCT LABELLING

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9.0 **Product Labelling**

For electronic filing, the label and label location is saved with filename: label.pdf

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EXHIBIT 10

PHOTOGRAPHS

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10.0 **Equipment Photographs**

For electronic filing, photographs of the tested EUT are saved with filename: ophoto1.jpg and iphoto1.jpg to iphoto4.jpg for external and internal photo respectively.

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EXHIBIT 11

INSTRUCTION MANUAL

INTERTEK TESTING SERVICES

11.0 **Instruction Manual**

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

Please note that the required FCC Information to the User can be found at the front of this manual.

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