

RadioShack Corporation

Application
For
Certification
(FCC ID: AAO1200255)

Transmitter

WO# 0101413
WL/Sandy
March 29, 2001

INTERTEK TESTING SERVICES

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
<i>EXHIBIT 6:</i>	Technical Specifications
<i>EXHIBIT 7:</i>	Instruction Manual
<i>EXHIBIT 8:</i>	Miscellaneous Information

INTERTEK TESTING SERVICES

Table of Contents

1.0 General Description	2
1.1 Product Description	2
1.2 Related Submittal(s) Grants	2
1.3 Test Methodology	3
1.4 Test Facility.....	3
2.0 System Test Configuration	5
2.1 Justification	5
2.2 EUT Exercising Software	5
2.3 Special Accessories	5
2.4 Equipment Modification	6
2.5 Support Equipment List and Description	6
3.0 Emission Results	8
3.1 Field Strength Calculation.....	9
3.2 Radiated Emission Configuration Photograph.....	11
3.3 Radiated Emission Data	12
4.0 Equipment Photographs	15
5.0 Product Labelling	17
6.0 Technical Specifications	19
7.0 Instruction Manual	21
8.0 Miscellaneous Information	23
8.1 Measured Bandwidth	24
8.2 Discussion of Pulse Desensitization	25
8.3 Calculation of Average Factor	26
8.4 Emissions Test Procedures.....	27

INTERTEK TESTING SERVICES

List of attached file

Exhibit type	File Description	filename
Test Report	Test Report	report.doc
Operation Description	Technical Description	descri.pdf
Test Setup Photo	Radiated Emission	radiated1.jpg, radiated2.jpg
Test Report	Bandwidth Plot	bw.pdf
External Photo	External Photo	ophoto1.jpg to ophoto2.jpg
Internal Photo	Internal Photo	iphoto1.jpg to iphoto2.jpg
Block Diagram	Block Diagram	block.pdf
Schematics	Circuit Diagram	circuit.pdf
ID Label/Location	Label Artwork and Location	label.pdf
User Manual	User Manual	manual.pdf

INTERTEK TESTING SERVICES

EXHIBIT 1

GENERAL DESCRIPTION

INTERTEK TESTING SERVICES

1.0 **General Description**

1.1 Product Description

The Equipment Under Test (EUT) is a remote sensor transmitter operating at 433.92MHz. The EUT is powered by 4.5V d.c. (3 x 1.5V “AA” battery). There is a switch (3 channels selector) inside the battery compartment. The remote sensor has a low battery indicator. When the voltage is low, the indicator will repeatedly flashes twice in 30 seconds. During normal use, the duration of each transmission is 0.47s and the silent period between transmissions is 29.625 seconds. It complies with the silent period between transmissions requirement at least 30 times the duration of transmission but in no case less than 10 seconds.

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

1.2 Related Submittal(s) Grants

This is a single application for certification of a transmitter.

INTERTEK TESTING SERVICES

1.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.4 (1992). All measurements 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 for maximizing emissions in Appendices D and E were followed. 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 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. This test facility and site measurement data have been fully placed on file with the FCC.

INTERTEK TESTING SERVICES

EXHIBIT 2

SYSTEM TEST CONFIGURATION

INTERTEK TESTING SERVICES

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 C63.4 (1992.)

The EUT was powered from 3 x fully charged 1.5V "AA" battery.

For maximizing emissions, 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 reported in Exhibit 3.0.

The unit was operated standalone and placed in the center of the turntable.2.1
Justification

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 turntable, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes. The worst case bit sequence was applied during test.

For simplicity of testing, the unit was wired to transmit continuously.

2.2 EUT Exercising Software

There was no special software to exercise the device. Once the button is depressed, the unit transmits the typical signal. For simplicity of testing, the unit was wired to transmit continuously.

2.3 Special Accessories

There are no special accessories necessary for compliance of this product.

INTERTEK TESTING SERVICES

2.4 Equipment Modification

Any modifications installed previous to testing by RadioShack Corporation will be incorporated in each production model sold/leased in the United States.

No modifications were installed by Intertek Testing Services.

2.5 Support Equipment List and Description

This product was tested in a standalone configuration.

All the items listed under section 2.0 of this report are

Confirmed by:

*Wilson Loke
Manager
Intertek Testing Services Hong Kong Ltd.
Agent for RadioShack Corporation*



Signature

March 29, 2001

Date

INTERTEK TESTING SERVICES

EXHIBIT 3

EMISSION RESULTS

INTERTEK TESTING SERVICES

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.

INTERTEK TESTING SERVICES

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 μ V/m

RA = Receiver Amplitude (including preamplifier) in dB μ 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:

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

INTERTEK TESTING SERVICES

3.1 Field Strength Calculation (cont'd)

Example

Assume a receiver reading of 62.0 dB μ 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 μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

$$RA = 62.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$PD = 0 \text{ dB}$$

$$AV = -10 \text{ dB}$$

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

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

INTERTEK TESTING SERVICES

3.2 Radiated Emission Configuration Photograph

Worst Case Radiated Emission
at
433.920 MHz

For electronic filing, the front view and back view of test configuration photograph is saved with filename: radiated1.jpg and radiated2.jpg respectively.

INTERTEK TESTING SERVICES

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 15.4 dB

TEST PERSONNEL:



Signature

Ben W. K. Ho, Compliance Engineer
Typed/Printed Name

March 7, 2001
Date

INTERTEK TESTING SERVICES

Company: RadioShack Corporation
Model: 12-255

Date of Test: February 26, 2001

Table 1

Radiated Emissions

Polarity	Frequency (M H z)	Reading (dB μ V)	Antenna Factor (dB)	Pre- Amp Gain (dB)	Average Factor (-dB)	Net at 3m (dB μ V /m)	L i m i t at 3m (dB μ V /m)	M a r g i n (dB)
H	433.961	63.1	16.3	16	6.0	57.4	72.8	-15.4
V	867.922	26.8	22.2	16	6.0	27.0	52.8	-25.8
V	1301.882	41.0	24.2	34	6.0	25.2	52.8	-27.6
V	1735.836	47.7	26.5	34	6.0	34.2	52.8	-18.6
V	2169.797	39.5	29.1	34	6.0	28.6	52.8	-24.2
V	2603.752	42.1	29.1	34	6.0	31.2	52.8	-21.6
H	3037.700	44.9	31.4	34	6.0	36.3	52.8	-16.5
V	3471.663	42.5	31.4	34	6.0	33.9	52.8	-18.9
V	3905.624	39.2	32.8	34	6.0	32.0	52.8	-20.8

- 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 and average detector are used for the emission over 1000MHz.

Test Engineer: Ben W. K. Ho

INTERTEK TESTING SERVICES

EXHIBIT 4

EQUIPMENT PHOTOGRAPHS

INTERTEK TESTING SERVICES

4.0 **Equipment Photographs**

For electronic filing, the photographs of the tested EUT are saved with filename: ophoto1.jpg to ophoto2.jpg for external photo and iphoto1.jpg to iphoto2.jpg for internal photo.

INTERTEK TESTING SERVICES

EXHIBIT 5

PRODUCT LABELLING

INTERTEK TESTING SERVICES

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

EXHIBIT 6

TECHNICAL SPECIFICATIONS

INTERTEK TESTING SERVICES

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

EXHIBIT 7

INSTRUCTION MANUAL

INTERTEK TESTING SERVICES

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

EXHIBIT 8

MISCELLANEOUS INFORMATION

INTERTEK TESTING SERVICES

8.0 Miscellaneous Information

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

INTERTEK TESTING SERVICES

8.1 Measured Bandwidth

For electronic filing, the plot shows the fundamental emission when modulated is saved with filename: bw.pdf. From the plot, the bandwidth is observed to be 11.5 kHz, at 20 dBc where the bandwidth limit is 108.5 kHz.

Therefore, the unit meets the requirement of section 15.231(c).

Figure 8.1 Bandwidth

INTERTEK TESTING SERVICES

8.2 Discussion of Pulse Desensitization

The determination of pulse desensitivity was made in accordance with Hewlett Packard Application Note 150-2, *Spectrum Analysis ... Pulsed RF*.

Pulse desensitivity was not applicable for this device. The effective period (T_{eff}) was approximately 235 ms for a digital "1" bit, as shown in the plots of Exhibit 8.3. With a resolution bandwidth (3 dB) of 100 kHz, the pulse desensitivity factor was 0 dB.

INTERTEK TESTING SERVICES

8.3 Calculation of Average Factor

Averaging factor in dB = $20 \log(\text{duty cycle})$

The specification for output field strengths in accordance with the FCC rules specify measurements with an average detector. During testing, a spectrum analyzer incorporating a peak detector was used. Therefore, a reduction factor can be applied to the resultant peak signal level and compared to the limit for measurement instrumentation incorporating an average detector.

The time period over which the duty cycle is measured is 100 milliseconds, or the repetition cycle, whichever is a shorter time frame. The worst case (highest percentage on) duty cycle is used for the calculation. The duty cycle is measured by placing the spectrum analyzer in zero scan (receiver mode) and linear mode at maximum bandwidth (3 MHz at 3 dB down) and viewing the resulting time domain signal output from the analyzer on a Tektronix oscilloscope. The oscilloscope is used because of its superior time base and triggering facilities.

The duty cycle is simply the on-time divided by the period:

The duration of one cycle = 100 ms

Effective period of the cycle = 50 ms

DC = $100 \text{ ms} / 50 \text{ ms} = 0.5$

Therefore, the averaging factor is found by $20 \log_{10} 0.5 = -6.0 \text{ dB}$

INTERTEK TESTING SERVICES

8.4 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 - 1992.

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. The height of the antenna is varied from one to four meters.

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. A detailed description for the calculation of the average factor can be found in Exhibit 8.3.

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 450 kHz to 30 MHz.

INTERTEK TESTING SERVICES

8.4 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 - 1992.

The IF bandwidth used for measurement of radiated signal strength was 100 kHz or greater when frequency is below 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. A discussion of whether pulse desensitivity is applicable to this unit is included in this report (See Exhibit 8.2). 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 forbidden 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, unless otherwise reported. Measurements taken at a closer distance are so marked.