

TEST REPORT

Report No.: HK09101135-1

RadioShack Corporation

Application
For
Certification
(Original Grant)
(FCC ID: AAO330283T)

Transceiver

Prepared and Checked by:



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Date: December 24, 2009

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GENERAL INFORMATION

RadioShack Corporation
BRAND NAME: AUVIO, MODEL: 33-283

FCC ID: AAO330283T

Grantee:	RadioShack Corporation
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Manufacturer:	N/A
Manufacturer Address:	N/A
Brand Name:	AUVIO
Model:	33-283
Type of EUT:	Transceiver
Description of EUT:	Portable Digital Wireless Stereo headphones (Transmitter)
Serial Number:	N/A
FCC ID:	AAO330283T
Date of Sample Submitted:	October 30, 2009
Date of Test:	November 19, 2009
Report No.:	HK09101135-1
Report Date:	December 24, 2009
Environmental Conidtions:	Temperature: +10 to 40°C Humidity: 10 to 90%

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SUMMARY OF TEST RESULT

RadioShack Corporation
BRAND NAME: AUVIO, MODEL: 33-283

FCC ID: AAO330283T

TEST SPECIFICATION	REFERENCE	RESULTS
Maximum Peak Output Power	15.247(b)	Pass
20 dB Bandwidth	15.247(a)	Pass
Number of Hopping Frequencies	15.247(a)	Pass
Channel Separation	15.247(a)	Pass
Average Channel Occupancy Time	15.247(a)	Pass
Out of Band Antenna Conducted Emission	15.247(d)	Pass
Radiated Emission in Restricted Bands	15.247(d)	Pass
Radiated Spurious Emissions	15.247(d)	Pass
Transmitter Power Line Conducted Emissions	15.207	Pass
Antenna Requirement	15.203	Pass (See Note 1)
Digital Device Radiated Emission	15.109	Pass
Digital Device Conducted Emission	15.107	Pass

- Note: 1. The EUT uses a permanently attached antenna which, in accordance to section 15.203, is considered sufficient to comply with the provisions of this section.
2. Pursuant to FCC part 15 Section 15.215(c), the 20 dB 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.

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1.0 General Description

1.1 Product Description

The Equipment Under Test (EUT) is a 2.4GHz Frequency Hopping Spread Spectrum wireless headphone system (Transmitter unit). It operates at frequency range of 2404.322MHz to 2476.350MHz with 18 physical hopping frequencies. The transmitter is powered by an internal rechargeable NiMH battery (Model: HKLP601730) which can be charged up by an AC/DC adaptor (Model: S003HU0500055, Input 100-240VAC, Output 5VDC 550mA). The transmitter unit consists of a on/off switch, it is used to transmit the audio signal to associated headphone unit. The audio signal will be transmitted continuously once the audio signal connected via a 3.5mm line in jack.

Antenna Type : Internal, Integral

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

1.2 Related Submittal(s) Grants

The Certification procedure of corresponding transceiver (headphone) for this transceiver (with FCC ID: AAO330283R) is being processed as the same time of this application. The receiver part of this transceiver is exempted from the Part 15 technical rules per 15.101(b).

1.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.4 (2003). All radiated measurements were performed in an Open Area Test Site. Preliminary scans were performed in the Open Area Test Site only to determine 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 open area test site and conducted measurement facility used to collect the radiated data is located at Garment Centre, 576 Castle Peak Road, Kowloon, Hong Kong. This test facility and site measurement data have been placed on file with the FCC.

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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 device was powered from an fully-charged internal rechargeable battery or an AC/DC adaptor (Model: S003HU0500055, Input: 100-240VAC 50/60Hz, Output 5VDC 550mA) for charging mode.

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.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was mounted to a plastic stand if necessary and placed on the wooden turntable, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes.

2.2 EUT Exercising Software

There was no special software to exercise the devices. Once the unit enters test mode, it transmits the RF Signal continuously.

2.3 Special Accessories

N/A

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 Hong Kong Ltd.

2.5 Measurement Uncertainty

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

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3.2 Radiated Emission Configuration Photograph

The worst case in radiated emission was found at 4952.700MHz

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

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.

Judgment: Passed by 10.8dB

3.4 Conducted Emission Configuration Photograph

For electronic filing, the worst case line-conducted configuration photographs are saved with filename: conducted photos.pdf.

3.5 Conducted Emission Data

For electronic filing, the graph and data table of conducted emission is saved with filename: conducted.pdf.

Judgment: Passed by more than 20 dB

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4.0 Measurement Results

4.1 Maximum Conducted Output Power at Antenna Terminals, FCC Rules 15.247(b)(1):

The antenna power of the EUT was connected to the input of a power meter. Power was read directly and cable loss correction was added to the reading to obtain power at the EUT antenna terminals.

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 0.125 watt (+21 dBm). Maximum antenna gain for this transmitter is 0 dBi.

Frequency (MHz)	Output in dBm	Output in mWatt
Low Channel: 2404.322	1.78	1.51
Middle Channel: 2440.310	1.25	1.33
High Channel: 2476.350	2.39	1.73

EUT dBm max. output level = 2.39 dBm (Limit: ≤ 21dBm)

For RF Safety, the information is saved with filename: RF exposure.pdf.

4.2 Hopping Channel 20dB RF Bandwidth, FCC Rule 15.247(a)(1)(i):

Setting:

- Hopping function turned off
- Span = ~ 2 to 3 times the 20dB bandwidth, centred on a hopping channel
- RBW ≥ 1% of 20dB bandwidth, VBW ≥ RBW
- Repeat the test with different mode of operation (e.g. maximum data rate, modulation formats etc)

Frequency (MHz)	20 dB Bandwidth (KHz)
Lowest Channel: 2404.322	2118
Middle Channel: 2440.310	2220
Highest Channel: 2476.350	2112

Limit: N/A

Refer to the following plots for 20 dB bandwidth sharp:

Plot B2A: Low Channel 20dB RF Bandwidth

Plot B2B: Middle Channel 20dB RF Bandwidth

Plot B2C: High Channel 20dB RF Bandwidth

For electronic filing, the above plots are saved with filename: 20dB.pdf

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4.3 Minimum Number of Hopping Frequencies, FCC Rule 15.247(a)(1)(i):

Setting:

- Hopping function enabled
- Span = frequency band of operation
- RBW \geq 1% of the span, VBW \geq RBW
- It may be necessary to break the span into sections, in order to show all of the hopping frequencies:

Mode of operation	No. of hopping channels
Normal operation mode	18

Limit: Number of hopping channels \geq 15

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

4.4 Minimum Hopping Channel Carrier Frequency Separation, FCC Rule 15.247(a)(1):

Setting:

- Hopping function enabled
- Span = wide enough to capture the peaks of two adjacent channels
- RBW \geq 1% of the span, VBW \geq RBW

Channel Separation (KHz)
4000

Limit: \geq 2/3 20dB bandwidth of hopping channel = 1480KHz

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

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4.5 Average Channel Occupancy Time, FCC Ref.: 15.247(a)(1)(iii):

The spectrum analyzer center frequency was set to one of the known hopping channels. The SWEEP was set to 2ms for transmitter unit, the SPAN was set to ZERO SPAN, and the TRIGGER was set to VIDEO. The time duration of the transmission so captured was measured with the MARKER DELTA function.

The SWEEP was then set to the time required by the regulation (0.4 seconds × Number of hopping channels employed” seconds for 2400-2483.5MHz). The analyzer was set to SINGLE SWEEP, the total ON time was added and compared against the limit (0.4 seconds).

Transmitter Unit (Worst-case: Operation)
Average occupancy time in the period of 7.2s = 1.32 ms x 138 = 182.16 ms

Limit: ≤ 0.4 seconds

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

4.6 Out of Band Conducted Emissions, FCC Rule 15.247(d)

In any 100 kHz bandwidth outside the EUT passband, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20dB below that of the maximum in-band 100 kHz emission, or else shall meet the general limits for radiated emissions at frequencies outside the passband, whichever results in lower attenuation.

All other types of emissions from the EUT shall meet the general limits for radiated frequencies outside the passband.

Refer to the following plots for out of band conducted emissions data:

- Plot B6A.1 – B6A.2: Lowest Channel Emissions
- Plot B6B.1 – B6B.2: Middle Channel Emissions
- Plot B6C.1 – B6C.2: Highest Channel Emissions
- Plot B6D.1 – B6D.2: Modulation Products Emission at bandedges

The plots showed all spurious emission and up to the tenth harmonic was measured and they were found to be at least 20 dB below the highest level of the desired power in the passband.

For electronic filing, the above plots are saved with filenames: obantcon.pdf.

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4.7 Out of Band Radiated Emissions, FCC Rule 15.247(d):

For out of band emissions that are close to or that exceed the 20dB attenuation requirement described in the specification, radiated measurements were performed at a 3m separation distance to determine whether these emissions complied with the general radiated emission requirement.

Not required, since all emissions are more than 20 dB below fundamental.

4.8 General radiated emission limit for spurious emissions at bandedge and within restricted band, FCC Rule 15.257(d):

Data is included of the 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. All measurements were performed with peak detection unless otherwise specified.

The following data list the significant emission frequencies, the limit and the margin of compliance.

Frequency (MHz)	OATS radiated field strength at carrier frequency measured at 3m (dB μ V/m)		Attenuation (dBc)	Calculated radiated field strength at the bandage (dB μ V/m)	
	Peak	Average		Peak	Average
2483.5	98	66.4	-48.88	49.12	17.52

Limit:

The average radiated field strength at bandedge should be smaller than 54 dB μ V/m and the peak radiated field strength at bandedge should be smaller than 74 dB μ V/m.

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4.9 Radiated Spurious Emissions

Applicant: RadioShack Corporation

Date of Test: November 19, 2009

Model: 33-283

Worst-Case Operating Mode: Transmitting (Lower Channel)

Table 1

Radiated Emissions

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Average Factor (dB)	Calculated at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
V	4808.000	25.1	33	34.9	58.6	31.6	27.0	54.0	-27.0
V	7212.000	16.8	33	37.9	53.3	31.6	21.7	54.0	-32.3

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Average Factor (dB)	Calculated at 3m (dB μ V/m)	Peak Limit at 3m (dB μ V/m)	Margin (dB)
V	4808.000	56.7	33	34.9	58.6	0	58.6	74.0	-15.4
V	7212.000	48.4	33	37.9	53.3	0	53.3	74.0	-20.7

NOTES: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances 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 sign in the column shows value below limit.

4. Horn antenna is used for the emission over 1000MHz.

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Applicant: RadioShack Corporation

Date of Test: November 19, 2009

Model: 33-283

Worst-Case Operating Mode: Transmitting (Middle Channel)

Table 2

Radiated Emissions

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Average Factor (dB)	Calculated at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
V	4880.000	24.1	33	34.9	57.6	31.6	26.0	54.0	-28.0
V	7320.000	16.5	33	37.9	53.0	31.6	21.4	54.0	-32.6
V	12200.000	11.3	33	40.5	50.4	31.6	18.8	54.0	-35.2

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Average Factor (dB)	Calculated at 3m (dB μ V/m)	Peak Limit at 3m (dB μ V/m)	Margin (dB)
V	4880.000	55.7	33	34.9	57.6	0	57.6	74.0	-16.4
V	7320.000	48.1	33	37.9	53.0	0	53.0	74.0	-21.0
V	12200.000	42.9	33	40.5	50.4	0	50.4	74.0	-23.6

NOTES: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances 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 sign in the column shows value below limit.
4. Horn antenna is used for the emission over 1000MHz.

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Applicant: RadioShack Corporation

Date of Test: November 19, 2009

Model: 33-283

Worst-Case Operating Mode: Transmitting (Upper Channel)

Table 3

Radiated Emissions

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Average Factor (dB)	Calculated at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
V	4952.700	29.7	33	34.9	63.2	31.6	31.6	54.0	-22.4
V	7429.050	18.3	33	37.9	54.8	31.6	23.2	54.0	-30.8
V	12381.750	13.0	33	40.5	52.1	31.6	20.5	54.0	-33.5

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Average Factor (dB)	Calculated at 3m (dB μ V/m)	Peak Limit at 3m (dB μ V/m)	Margin (dB)
V	4952.700	61.3	33	34.9	63.2	0	63.2	74.0	-10.8
V	7429.050	49.9	33	37.9	54.8	0	54.8	74.0	-19.2
V	12381.750	44.6	33	40.5	52.1	0	52.1	74.0	-21.9

NOTES: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances 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 sign in the column shows value below limit.
4. Horn antenna is used for the emission over 1000MHz.

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Applicant: RadioShack Corporation
Model: 33-283
Worst-Case Operating Mode: Charging mode

Date of Test: November 19, 2009

Data Table
Radiated Scan
Pursuant to FCC 15.109: Emissions Requirement

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-amp (dB)	Antenna Factor (dB)	Net at 3m (dB μ V/m)	Limit at 3m (dB μ V/m)	Margin (dB)
V	38.485	29.4	16	10	23.4	40	-16.6
V	45.586	29.6	16	10	23.6	40	-16.4
V	54.629	30.4	16	10	24.4	40	-15.6
V	59.706	31.6	16	10	25.6	40	-14.4
V	62.384	31.2	16	11	26.2	40	-13.8
V	72.596	30.0	16	11	25.0	40	-15.0

Notes: 1. Peak Detector Data.

2. Negative sign (-) in the margin column signify levels below the limit.

3. Only emissions significantly above equipment noise floor are reported.

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4.10 Transmitter Duty Cycle Calculation and Measurements, FCC Rule 15.35(b), (c)

The EUT antenna output port was connected to the input of the spectrum analyzer. The analyzer center frequency was set to EUT RF channel carrier. The SWEP function on the analyzer was set to ZERO SPAN. The transmitter ON time was determined from the resultant time-amplitude display:

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

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5.0 **Equipment Photographs**

For electronic filing, the photographs are saved with filename: external photos.pdf and internal photos.pdf.

6.0 **Product Labelling**

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

7.0 **Technical Specifications**

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

8.0 **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.

9.0 **Miscellaneous Information**

The miscellaneous information includes details of the test procedure and calculation of factor such as averaging factor (calculation and timing diagram).

9.1 **Calculation of Average Factor**

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

The duration of one cycle = 100 ms

Effective period of the cycle = (1.32 x 2)ms

DC = 2.64/ 100 = 0.0264

Therefore, the averaging factor is found by $20\log(0.0264) = -31.6\text{dB}$.

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9.2 Emissions Test Procedures

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

The test set-up and procedures described below are designed to meet the requirements of ANSI C63.4 - 2003. A typical or an unmodulated CW signal at the operating frequency of the EUT has been supplied to the EUT for all measurements. Such a signal is supplied by a signal generator and an antenna in close proximity to the EUT. The signal level is sufficient to stabilize the local oscillator of the EUT.

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 axis to obtain maximum emission levels. The antenna height and polarization are also 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 150 kHz to 30 MHz.

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 were made as described in ANSI C63.4 - 2003.

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 8.1). Above 1000 MHz, a resolution bandwidth of 1 MHz is used.

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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.

10.0 Confidentiality Request

For electronic filing, a preliminary copy of the confidentiality request is saved with filename: request.pdf.

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11.0 Equipment List

1) Radiated Emissions Test

Equipment	EMI Test Receiver	Spectrum Analyzer	Biconical Antenna
Registration No.	EW-0014	EW-2188	EW-0954
Manufacturer	R&S	AGILENTTECH	EMCO
Model No.	ESVS30	E4407B	3104C
Calibration Date	Jun. 01, 2009	Dec. 18, 2008	Sep. 30, 2008
Calibration Due Date	Jun. 01, 2010	Dec. 18, 2009	Mar. 30, 2010

Equipment	Log Periodic Antenna	RF Amplifiers (100MHz to 12GHz) 2 Pieces	Double Ridged Guide Antenna
Registration No.	EW-0446	EW-1779	EW-1015
Manufacturer	EMCO	MITEQ	EMCO
Model No.	3146	AMF-4D-001120-34-13P	3115
Calibration Date	Oct. 02, 2008	Jul. 27, 2009	Jul. 28, 2008
Calibration Due Date	Apr. 02, 2010	Aug. 01, 2010	Jan. 28, 2010

2) Conducted Emissions Test

Equipment	EMI Test Receiver	Pulse Limiter	LISN
Registration No.	EW-2251	EW-0698	EW-0090
Manufacturer	R&S	R&S	R&S
Model No.	ESCI	ESH3-Z2	ESH3-Z5
Calibration Date	Oct. 28, 2008	Feb. 03, 2009	Jan. 20, 2009
Calibration Due Date	Oct. 28, 2009	Feb. 03, 2010	Jan. 20, 2010

3) 15.247 Test

Equipment	Spectrum Analyzer
Registration No.	EW-2249
Manufacturer	ROHDESCHWARZ
Model No.	FSP30
Calibration Date	Jun. 25, 2009
Calibration Due Date	Jun. 25, 2010