ELITE ELECTRONIC ENGINEERING COMPANY
1516 CENTRE CIRCLE
DOWNERS GROVE, ILLINOIS 60515-1082

ELITE PROJECT: 27698 DATES TESTED: May 3 and 17, 1999

TEST PERSONNEL: D.E. Crowder

TEST SPECIFICATION: FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.239 for Intentional Radiators Operating in the band 88-108MHz

AMMENDMENT TO

ENGINEERING TEST REPORT NO. 20753

MEASUREMENT OF RADIATED EMISSIONS FROM

SKY-1 AND SKY-7 ANTENNA

FOR: Skywave Electronics, Inc.
Rockford, Illinois

Report By: Neil Hurley

Approved By: Raymond J. Klouda
Registered Professional
Engineer of Illinois - 44894

ENGINEERING TEST REPORT NO. 20753 AMENDMENT

ADMINISTRATIVE DATA AND SUMMARY OF TESTS

DESCRIPTION OF TEST ITEM(S)	:	Auxiliary antennas for the SKY2000 transmitter
MODEL	:	SKY-1 Fixed base antenna SKY-7 Magnet base antenna
SERIAL NUMBER	:	None
FCC ID NUMBER	:	NX3SKY2000
MANUFACTURER	:	Skywave Electronics, Inc. 1205 N. Horace Avenue Rockford, IL 61101
APPLICABLE SPECIFICATION	:	FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C for Intentional Radiators, Section 15.239
QUANTITY OF ITEMS TESTED	:	One (1)
TEST PERFORMED BY:		ELITE ELECTRONIC ENGINEERING INC Downers Grove, Illinois 60515-1082
DATES TESTED	:	May 17, 1999
TEST PERSONNEL	:	Dan Crowder
ELITE JOB NO.	:	27698

ABSTRACT: The Skywave Electronics, Inc. , SKY-1 fixed base antenna with 100 ft of RG-58 cable and the SKY-7 magnetic base antenna with 12 ft of RG-58 cable when used with the SKY-2000 FM transmitter **DO MEET** the radiated emissions requirements of the FCC "Code of Federal Regulations", Title 47, Part 15, Subpart C for intentional radiators operating in the 88-108MHz frequency band.

The radiated emissions level closest to the limit occurred at 99.3MHz. The emissions level at this frequency was 1.0 dB within the limit. Refer to the individual test results and Data Pages for details.

ENGINEERING TEST REPORT NO. 20753 AMENDMENT

TABLE OF CONTENTS

MEASUREMENT OF RADIATED EMISSIONS FROM THE SKY-1 AND SKY-7 ANTENNAS

1.0 INTRODUCTION:

This report presents the results of the radiated emissions measurements performed for the SKY-1 and SKY-7 auxiliary antennas when connected to the SKY-2000 Low Powered FM Broadcast Band Transmitter. No serial number was assigned to the antennas. The test item was manufactured by Procom for Skywave Electronics, Inc., located in Rockford, Illinois.

1.1 DESCRIPTION OF THE TEST ITEM: The test items are external antennas that can be used with the SKY-2000 FM Transmitter. The antennas are 34" whip antennas.

The SKY-1 is a fixed base antenna. It was supplied with 100 ft length of RG-58 cable. The SKY-7 has a magnetic base. It was supplied with a 12 ft length of RG-58 cable.

In order to attach the antenna the transmitter its normal telescoping rod antenna was removed. In its place a special coupling attachment was installed the antennas are then connected to the transmitter through this special adapter.

1.2 PURPOSE: The test series was performed to determine if the test items meet the radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C for Intentional Radiators operated in the FM Broadcast Band. Testing was performed in accordance with ANSI C63.4-1992.

1.3 DEVIATIONS, ADDITIONS AND EXCLUSIONS: There were no deviations, additions, or exclusions from the test specification.

1.4 APPLICABLE DOCUMENTS: The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission, "Code of Federal Regulations", Title 47, Part 15, Subpart C, dated 1 October 1998.
- American National Standards Institute (ANSI) C63.4-1992 entitled "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz".
- American National Standards Institute (ANSI/NCSL) Z540-1 "Calibration Laboratories and Measuring and Test Equipment - General Requirements", dated 10 August 1994.

1.5 SUBCONTRACTOR IDENTIFICATION: This series of tests was performed by the Elite Electronic Engineering Inc. of Downers Grove, Illinois.

2.0 TEST ITEM SETUP AND OPERATION:

For all tests, each test item was placed on a 0.8m high non-conductive turntable. The test item was connected to transmitter through the cable that was supplied with the antenna. Excess cable was draped down and laid out in a serpentine fashion.

SKY-1 antenna was tested with its 34" whip and four 24" radials connected at the base.

SKY-7 antenna was tested with its 34" whip antenna attached to the base.

The antennas were oriented vertically.

The transmitter operates on discrete frequencies inside the 88.1MHz to 107.9MHz frequency band. Measurements were performed at 88.3, 99.3 and 107.3 MHz to meet the requirements of FCC 15.31(m).

3.0 TEST EQUIPMENT:

3.1 TEST EQUIPMENT LIST: A list of the test equipment used can be found on Table I.

Radiated emissions were performed with an HP 85462A spectrum analyzer.

3.2 CALIBRATION TRACEABILITY: Test equipment is maintained and calibrated on a regular basis. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

3.3 MEASUREMENT UNCERTAINTY: All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

The measurement uncertainty budgets were based on guidelines in "ISO Guide to the Expression of Uncertainty in Measurements" and NAMAS NIS81 "The Treatment of Uncertainty in EMC Measurements".

The measurement uncertainty for these tests is presented below:

Radiated Emission Measurements:		
Combined Standard Uncertainty	2.26	-2.18
Expanded Uncertainty (95% confidence)	4.5	-4.4

4.0 REQUIREMENTS, PROCEDURES AND RESULTS:

4.1 RADIATED MEASUREMENTS:

4.1.1 REQUIREMENTS: FCC Section 15.239(b) states that the field strength of any emissions within the band of 88MHz to 108MHz shall not exceed 250uV/m at 3m. The emission limit is based on measurements instrumentation employing an average detector. All other emissions must comply with the limits detailed in Section 15.209(a) as shown on Table A (below):

TABLE A - RADIATION LIMITS PER SECTION 15.209(a)

Frequency MHz	Field Strength* microvolt/meter	Measurement Distance meters
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

* The tighter limit applies at the band edges. Emissions limits are based on using a quasi-peak detector except for the bands 9-90kHz, 110-490kHz and above 1000MHz where an average detector is to be used.

4.1.2 PROCEDURES: The tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4 1992 for site attenuation.

The broadband measuring antenna was positioned at a 3 meter distance from the test item. The frequency range from 30MHz to 1000MHz was investigated.

The measurements were performed for all significant emissions using the following methods:

1) Measurements were made using a peak detector and a broadband bi-log antenna or tuned dipole antenna.

2) To ensure that maximum, or worst case, emission levels were measured, the following steps were taken:

   (a) The test item was rotated so that all of its sides were exposed to the receiving antenna.

   (b) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.

(c) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.

4.1.3 RESULTS: The radiated emission levels are presented on data page 22. As can be seen from the data, all emissions measured from the test item were within the specification limits. The emissions level closet to the limit (worst case) occurred at 99.3 MHz. The emissions level at this frequency was 1.0 dB within the limit. See data page 22 for details.

5.0 CONCLUSION:

It was found that the Skywave Electronics, Inc. SKY-1 and SKY-7 Antennas with the SKY-2000 FM Transmitter, **DO MEET** the radiated emissions requirements for Section 15.239 of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C for intentional radiators operating within the 88MHz-108MHz band.

6.0 CERTIFICATION:

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specification.

The data presented in this test report pertains only to the test item at the test date

7.0 ENDORSEMENT DISCLAIMER:

This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.

TABLE I: TEST EQUIPMENT LIST

ELITE ELECTRONIC ENG. INC. Page: 1

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Cal Inv	Due Date
Equipment Type: ANTENNAS								
NDN0	TUNED DIPOLE ANTENNA	EMCO	3121C-DB2	311	60-140MHZ	10/07/98	12	10/07/99
NTA1	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2054	.03-2GHZ	05/12/98	13	06/12/99
Equipment Type: CONTROLLERS								
CMA0	MULTI-DEVICE CONTROLLER	EMCO	2090	9701-1213	---		N/A	
Equipment Type: RECEIVERS								
RAKG	RF SECTION	HEWLETT PACKARD	85462A	3549A00284	9KHZ-6.5GHZ	02/02/99	12	02/02/00
RAKH	RF FILTER SECTION	HEWLETT PACKARD	85460A	3448A00324	---	02/02/99	12	02/02/00

Cal. Interval: Listed in Months I/O: Initial Only N/A: Not Applicable

Note 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

TEST SETUP BLOCK DIAGRAM FOR 20/25A

Elite Electronic Engineering INC.

ETR No. 20753A
DATA SHEET

RADIATED QP/AVG EMISSION MEASUREMENTS IN A 3m ANECHOIC ROOM

SPECIFICATION : FCC-15B
MANUFACTURER : SKYWAVE
MODEL NO. : SKY 2000
SERIAL NO. : NONE ASSIGNED
NOTES : SKY 1 ANTENNA
TEST DATE : 17 May 1999
TEST DISTANCE : 3m

FREQUENCY (MHz)	ANT POL	MTR RDG dBuV	ANT FAC dB	CBL FAC dB	DIST FAC dB	TOTAL dBuV/m	TOTAL uV/m	LIMIT uV/m
TRANSMITTING AT 89.3MHz								
89.3	H	26.3 #	7.2	0.9	---	34.4	52.5	250
	V	38.9 #	7.2	0.9	---	47.0	223.9	250
178.6	H	17.1	10.0	1.3	---	28.4	26.3	150
	V	13.6	10.0	1.3	---	24.9	17.6	150
267.9	H	14.1	13.4	1.7	---	29.2	28.8	200
	V	14.1	13.4	1.7	---	29.2	28.8	200
TRANSMITTING AT 99.3MHz								
99.3	H	21.1 #	8.2	0.9	---	30.2	32.4	250
	V	37.7 #	8.2	0.9	---	46.8	218.8	250
198.6	H	14.9	10.0	1.3	---	26.2	20.4	150
	V	15.2	10.0	1.3	---	26.5	21.1	150
297.9	H	14.7	14.0	1.7	---	30.4	33.1	200
	V	14.1	14.0	1.7	---	29.8	30.9	200
TRANSMITTING AT 107.3MHz								
107.3	H	15.1 #	8.3	0.9	---	24.3	16.4	250
	V	35.5 #	8.3	0.9	---	44.7	171.8	250
214.6	H	12.1	10.9	1.3	---	24.3	16.4	150
	V	10.6	10.9	1.3	---	22.8	13.8	150
321.9	H	15.9	14.5	1.7	---	32.1	40.3	200
	V	15.8	14.5	1.7	---	32.0	39.8	200

- A DIPOLE ANTENNA WAS USED AS THE PICK-UP DEVICE
* - AMBIENT

CHECKED BY: RJK

Elite Electronic Engineering INC.

ETR No. 20753A
DATA SHEET

RADIATED QP/AVG EMISSION MEASUREMENTS IN A 3m ANECHOIC ROOM

SPECIFICATION : FCC-15B
MANUFACTURER : SKYWAVE
MODEL NO. : SKY 2000
SERIAL NO. : NONE ASSIGNED
NOTES : SKY 7 ANTENNA
TEST DATE : 17 May 1999
TEST DISTANCE : 3m

FREQUENCY (MHz)	ANT POL	MTR RDG dBuV	ANT FAC dB	CBL FAC dB	DIST FAC dB	TOTAL dBuV/m	TOTAL uV/m	LIMIT uV/m
TRANSMITTING AT 89.3MHz								
89.3	H	28.6	7.2	0.9	---	36.7	68.4	250
	V	29.5	7.2	0.9	---	37.6	75.9	250
178.6	H	12.8	10.0	1.3	---	24.1	16.0	150
	V	14.4	10.0	1.3	---	25.7	19.3	150
267.9	H	10.4 *	13.4	1.7	---	25.5	18.8	200
	V	10.9 *	13.4	1.7	---	26.0	20.0	200
TRANSMITTING AT 99.3MHz								
99.3	H	27.1	8.2	0.9	---	36.2	64.6	250
	V	36.2	8.2	0.9	---	45.3	184.1	250
198.6	H	15.3	10.0	1.3	---	26.6	21.4	150
	V	14.2	10.0	1.3	---	25.5	18.8	150
297.9	H	15.6	14.0	1.7	---	31.3	36.7	200
	V	11.4	14.0	1.7	---	27.1	22.6	200
TRANSMITTING AT 107.3MHz								
107.3	H	28.9 #	8.3	0.9	---	38.1	80.4	250
	V	37.6 #	8.3	0.9	---	46.8	218.8	250
214.6	H	16.2	10.9	1.3	---	28.4	26.3	150
	V	12.9	10.9	1.3	---	25.1	18.0	150
321.9	H	16.0	14.5	1.7	---	32.2	40.7	200
	V	15.9	14.5	1.7	---	32.1	40.3	200

- A DIPOLE ANTENNA WAS USED AS THE PICK-UP DEVICE
* - AMBIENT

CHECKED BY: RJK