Project Number: 02079-10

Prepared for:

SPECTRUM MANAGEMENT
2545 Tarpley Road.
Carrollton, Texas 75006

By

Professional Testing (EMI), Inc.
1601 FM 1460, Suite B
Round Rock, Texas 78664

September, 2001

CERTIFICATION
Electromagnetic Interference
Test Report

SPECTRUM MANAGEMENT
9kHz Transmitter

Table of Contents

Figures

Appendices

Certificate of Compliance

Applicant:	Spectrum Management
Applicant's Address:	2545 Tarpley Road Carrollton, Texas 75006
Model:	9kHz Transmitter
Serial Number:	0022 & 0107
Project Number:	02079-10

I, Dale L. Reynolds, for Professional Testing (EMI), Inc., being familiar with the FCC rules and test procedures have reviewed the test setup, measured data and this report. I believe them to be true and accurate.

The **Spectrum Management 9kHz Transmitter** was tested to and found to be in compliance with FCC Part 15 Subpart C for an Intentional Radiator.

The highest emissions generated by the above equipment are listed below:

	Frequency (kHz)	Level (µV/m)	Limit (µV/m)	Margin (µV)
Fundamental	9.0	56.9	266.7	-209.8
Spurious	63.0	1.5	38.1	-36.6

Dale L. Reynolds

_____

Dale L. Reynolds
Laboratory Manager

This report has been reviewed and accepted by Spectrum Management. The undersigned is responsible for ensuring that the **9kHz Transmitter** will continue to comply with the FCC rules.

_____

1.0 EUT Description

The Equipment Under Test (EUT) is the **Spectrum Management 9kHz Transmitter**. The **9kHz Transmitter** is a dye-pack actuation transmitter. It operates on AC power and also contains a rechargeable battery for protection during power outages. It transmits FSK codes to trigger dye-packs used for security purposes. The EUT operates at 9kHz and is designed for compliance with 47 CFR Part 15 of the FCC rules. Specific test requirements for this device include the following:

47 CFR 15.203	Antenna Requirement
47 CFR 15.207	Conducted Emissions
47 CFR 15.209	Radiated Emissions

The system tested was comprised of the following components:

Manufacturer & Model	**Serial #**	**FCC ID #**	**Description**
Spectrum Management, 9kHz Transmitter	0022 & 0107	None	9 kHz Transmitter

1.1 EUT Operation

The **Transmitter** communicates with a receiver by producing a time varying magnetic field. Information is transferred by frequency-shift being the carrier. The mark frequencies are 9131kHz and 8949kHz respectively. Setup and operational modes represent worst-case configuration and operating modes for the device.

2.0 Electromagnetic Emissions Testing

Professional Testing (EMI), Inc. (PTI) follows the guidelines of NIST for uncertainty calculations, estimates, and expressions thereof for EMC testing.

Fundamental and spurious radiated emissions levels for the 9 kHz transmitter were measured. Power line conducted emissions levels were also evaluated.

The radiated emissions measurements were made at the Professional Testing "Open Field" Site 3, located in Round Rock, Texas. A "Description of Measurement Facilities" has been submitted to the FCC, and approval has been received pursuant to Section 2.948 of CFR 47 of the FCC rules. Conducted emissions measurements were made in a shielded room also located at the Round Rock, Texas facility.

ANSI C63.4-1992 specifies that 9 kHz to 30 MHz magnetic field measurements be made using a calibrated loop antenna. Electric field emissions below 30 MHz must be made with a calibrated monopole antenna. Measurements were made using both a

loop and a monopole antenna to determine whether the field produced by the product is primarily magnetic or electric. At the frequencies and distances at which the product is designed to be used, the field should be primarily magnetic.

2.1 Test Procedure

In the radiated emissions tests, the EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a motorized turntable that allows 360-degree rotation. Rod and loop antennas were positioned three meters from the nearest part of the EUT. Radiated electric emissions were maximized by rotating the EUT, raising and lowering the antenna one to four meters, and by configuring the antenna for horizontal and vertical polarization. Magnetic emissions were maximized by rotating the loop antenna on its vertical axis.

A spectrum analyzer with peak and quasi-peak detection capability was used to find the maximum emissions levels during testing. Figures 1 and 2 contain drawings of the test equipment configurations.

The conducted emissions tests were performed to determine compliance with Part 15.107. The measurements were performed in a shielded room, using equipment and procedures specified in ANSI C63.4-1992, Section 7.

A spectrum analyzer with peak and quasi-peak detection capability was used to find the maximum emissions levels during testing. Figure 2 contains a drawing of the test setup.

2.2 Test Criteria

The table below shows FCC Part 15.209 radiated limits for an intentional radiator operating at 9kHz band. In addition to these requirements, the EUT must meet the restricted emission band requirements of §15.205. For this frequency range, the unintentional radiated emission limits of §15.109 for 9kHz radiator is higher than the restricted band limits of §15.205. The limit of §15.205 was used for the spurious emission test. The spurious measurements of the harmonic were performed to the 10th harmonic of the fundamental. The reference distance for each limit is also shown in this table.

Frequency	Test Distance	Field Strength	
MHz	(Meters)	(µV/m)	(dBµV/m)
0.009-0.490	300	2400/F (kHz)	
0.490-1.705	30	24000/F (kHz)	
1.705 to 30.0	30	30	29.5
30 to 88	3	100	40.0
88 to 216	3	150	43.5
216 to 960	3	200	46.0
Above 960	3	500	54.0

2.3 Radiated Emissions Test Results

The fundamental emissions test data for electric field measurements using a calibrated rod antenna are presented in Appendices A and B. The levels shown were taken in Quasi-peak mode. Harmonic emissions data are presented in Appendix B.

Electric field radiated emissions from the 9 kHz transmitter comply with the requirements of FCC Part 15.205 and FCC Part 15.209.

Magnetic field emissions data are presented in Appendix C. The levels shown were taken in average mode. Magnetic field emissions from the 9 kHz transmitter comply with the requirements of FCC Part 15.205 and FCC Part 15.209.
.

2.4 Conducted Emissions Test Results

Appendix D contains the conducted emissions test results. The levels shown were taken with the spectrum analyzer in peak mode.

Conducted emissions on both the Phase and Neutral lines comply with the requirements of FCC Part 15.107, Paragraph b.

3.0 Antenna Requirement

An analysis of the **9kHz Transmitter** was performed to determine compliance with Section 15.203 of the Rules. This section requires specific handling and control of antennas used for devices subject to regulations under the Intentional Radiator portions of Part 15.

3.1 Evaluation Procedure

The structure and application of the **9kHz Transmitter** were analyzed with respect to the rules. The antenna for this unit is an internal antenna, which is soldered onto the main board and is not accessible by the user. An auxiliary antenna port is not present.

3.2 Evaluation Criteria

Section 15.203 of the rules states that the subject device must meet at least one of the following criteria:

(a) Antenna be permanently attached to the unit.

(b) Antenna must use a unique type of connector to attach to the EUT.

(c) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

3.3 Evaluation Results

The **9kHz Transmitter** meets the criteria of this rule by virtue of having an internal antenna permanently attached to the unit. The EUT is therefore compliant with §15.203.

4.0 Modifications to Equipment

There were no modifications made on the **9kHz Transmitter** during the performance of the test program in order to meet the FCC criteria.

5.0 List of Test Equipment

A list of the test equipment utilized to perform the testing is given below. The date of calibration is given for each.

Electromagnetic Emissions Test Equipment

Device	Description	Calibration Due
Advantest R3265	Spectrum Analyzer	February 2002
Compliance Design B-100	Biconical Antenna	November 2001
EMCO 3301B	Active Rod Antenna	March 2002
Tektronix 2706	RF Preselector	November 2001
HP 8447D	Preamp	May 2002
EMCO 3146	Log Antenna	November 2001
Schwartzbeck 8127	LISN	August 2002

FIGURE 1 Radiated Emissions Test Setup

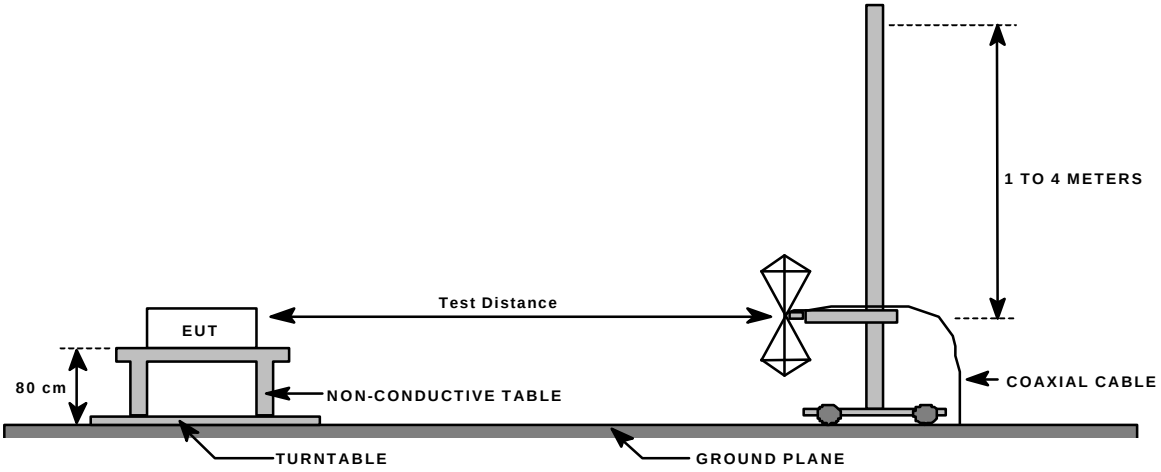
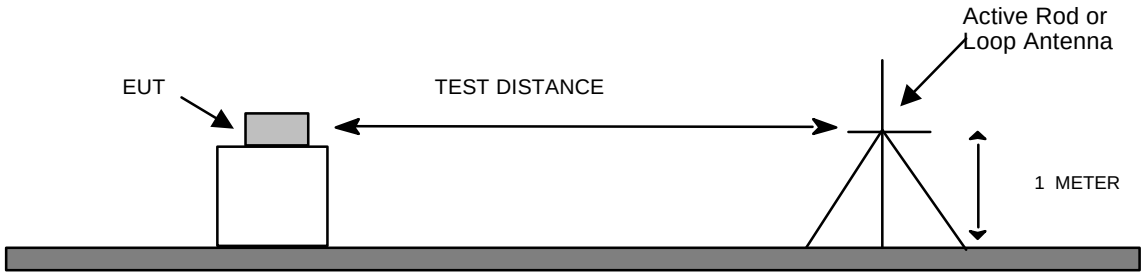


FIGURE 2 Radiated Emissions Test Setup



Intentional Emitter Test set-up.

Appendix A

Fundamental Emissions Data Sheets

Fundamental and Harmonics Radiated Data Sheet
Spectrum Management
9kHz Transmitter

SERIAL #: 0022 & 0107
DATE: August 27, 2001
PROJECT #: 02079-10

MEASUREMENT DISTANCE (m): 3
DETECTOR FUNCTION: Quasi-Peak
Antenna Polarization: Active Rod

Corrected Level = Recorded Level + Antenna Factor + Cable Loss

.

Freq. (kHz)	Antenna Height Meters	Rec. Level (dBuV/m)	Antenna Factor (dB)	Cable Loss (dB)	Corr. @3m (dBuV/m)	Corr. @300m (uV/m)	Limit @300m (uV/m)	Margin (uV)	Not
9.02	1.0	53.8	61.1	0.2	115.1	56.9	266.7	-209.8	1.(
18.00	1.0	32.5	61.6	0.2	94.3	5.2	133.0	-127.8	1.(
27.00	1.0	29.6	62.6	0.2	92.4	4.2	88.9	-84.7	1.(
36.00	1.0	28.4	62.6	0.2	91.2	3.6	66.7	-63.1	1.(
45.00	1.0	25.1	61.9	0.2	87.2	2.2	53.3	-51.1	1.(
54.00	1.0	22.6	61.8	0.2	84.6	1.7	44.4	-42.7	1.(
63.00	1.0	21.4	61.8	0.2	83.4	1.5	38.1	-36.6	1.(

COMMENT: Original measurements taken in dBuV at 3m. Results extrapolated to 300m as per CFR47, Pt 15.31 (f) (2) using the square of an inverse linear distance extrapolation factor (40dB per decade). Over the two decades from 3m to 300m, this amounts to an 80dB reduction. These results were then converted to microvolts and compared to the 300m limit.

TEST ENGINEER: John Baker

Appendix B Sheets

Spurious Radiated Emissions Data

1601 FM 1460, Suite B Round Rock, Texas 78664 512/244-3371 Fax 512/244-1846

Spurious Radiated Data Sheet
Spectrum Management
9kHz Transmitter

SERIAL #: 0022 & 0107
DATE: August 27, 2001
PROJECT #: 02079-10

MEASUREMENT DISTANCE (m): 3
DETECTOR FUNCTION: Quasi-Peak
Antenna Polarization: Vertical

Corrected Level = Recorded Level-Amplifier Gain + Antenna Factor + Cable Loss

Freq. (MHz)	EUT Dir (Deg.)	Antenna Elevation (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Marg (dB
39.40	1.0	1.0	30.8	26.5	12.1	1.4	17.8	40.0	-22.
150.00	0.0	1.0	21.5	26.6	12.7	2.9	10.5	43.5	-33.
300.00	0.0	1.0	20.8	26.9	14.2	4.3	12.4	46.0	-33.
505.00	0.0	1.0	21.3	27.2	18.0	5.7	17.9	46.0	-28.
750.00	0.0	1.0	20.0	26.2	21.2	7.2	22.2	46.0	-23.
990.00	0.0	1.0	20.5	26.7	23.9	9.3	27.0	54.0	-27.

TEST ENGINEER: John Baker

Spurious Radiated Data Sheet
Spectrum Management
9kHz Transmitter

SERIAL #: 0022 & 0107
DATE: August 27, 2001
PROJECT #: 02079-10

MEASUREMENT DISTANCE (m): 3
DETECTOR FUNCTION: Quasi-Peak
Antenna Polarization: Horizontal

Corrected Level = Recorded Level-Amplifier Gain + Antenna Factor + Cable Loss

Freq. (MHz)	EUT Dir (Deg.)	Antenna Elevation (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Marg (dB
35.00	0.0	4.0	27.3	26.5	12.0	1.3	14.0	40.0	-26.
150.00	0.0	4.0	21.0	26.6	12.7	2.9	10.0	43.5	-33.
300.00	0.0	4.0	21.3	26.9	14.2	4.3	12.9	46.0	-33.
505.00	0.0	4.0	20.8	27.2	18.0	5.7	17.4	46.0	-28.
750.00	0.0	4.0	20.3	26.2	21.2	7.2	22.5	46.0	-23.
990.00	0.0	4.0	20.8	26.7	23.9	9.3	27.3	54.0	-26.

TEST ENGINEER: John Baker

Appendix C Magnetic Emissions Data Sheets

Magnetic Emissions Data Sheet
Spectrum Management
9kHz Transmitter

SERIAL #: 0022 & 0107
DATE: November 19, 2001
PROJECT #: 02079-10

MEASUREMENT DISTANCE (m): 3
DETECTOR FUNCTION: Quasi-Peak
Antenna Polarization: Loop

Corrected Level = Recorded Level-Amplifier Gain + Antenna Factor + Cable Loss

Freq. (MHz)	EUT Dir (Deg.)	Antenna Elevation (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Marg (dB
9.02	1.0	23.5	34.0	0.2	57.7	29.0	266.7	-237.7	1.0
18.00	1.0	N/A							2.0
27.00	1.0	N/A							2.0
36.00	1.0	N/A							2.0
45.00	1.0	N/A							2.0
54.	1.0	N/A							2.0
63.00	1.0	N/A							2.0

COMMENT: Original measurements taken in dBuV at 3m. Results extrapolated to 300m as per CFR47, Pt 15.31 (f) (2) using the square of an inverse linear distance extrapolation factor (40dB per decade). Over the two decades from 3m to 300m, this amounts to an 80dB reduction. These results were then converted to microvolts and compared to the 300m limit.

COMMENTS: Signals were not reliably detectable at these frequencies.

TEST ENGINEER: Brad Rehm

Conducted Emissions

Appendix D Data Sheets

Conducted Emissions Data Sheet
Spectrum Management
9kHz Transmitter

SERIAL #: 0022 & 0107
DATE: August 27, 2001
PROJECT #: 02079-10

MEASUREMENT DISTANCE (m): 3
DETECTOR FUNCTION: Quasi-Peak
LINE MEASURED: Neutral

FREQ	READING	CORR	CORR	Limit	Margin	Detector
INPUT	INPUT	FACTOR	READING			
MHz	dBuV	dB	dBuV	dBuV	dB	Function
0.627	18.6	0.1	18.7	48	-29.3	Peak
0.636	18.6	0.1	18.7	48	-29.3	Peak
0.645	18.5	0.1	18.6	48	-29.4	Peak
7.164	11.7	1.2	12.9	48	-35.1	Peak
10.745	18.4	1.7	20.1	48	-27.9	Peak
17.910	13.7	2.7	16.4	48	-31.6	Peak

COMMENT: 110VAC/ 60Hz

TEST ENGINEER: John Baker

Conducted Emissions Data Sheet
Spectrum Management
9kHz Transmitter

SERIAL #: 0022 & 0107
DATE: August 27, 2001
PROJECT #: 02079-10

MEASUREMENT DISTANCE (m): 3
DETECTOR FUNCTION: Quasi-Peak
LINE MEASURED: Phase

FREQ	READING	CORR	CORR	Limit	Margin	Detector
INPUT	INPUT	FACTOR	READING			
MHz	dBuV	dB	dBuV	dBuV	dB	Function
0.62	10	0.2	10.2	48	-37.8	Peak
0.629	9.9	0.2	10.1	48	-37.9	Peak
0.639	9.9	0.2	10.1	48	-37.9	Peak
7.163	11.2	1.4	12.6	48	-35.4	Peak
10.746	18.3	2.0	20.3	48	-27.7	Peak
17.910	13.9	3.1	17.0	48	-31.0	Peak

COMMENT: 110VAC/ 60Hz

TEST ENGINEER: John Baker