



Transmitter Tests For a  
PG2-X1 Wireless Microphone

For : Shure Inc.  
Niles, IL

P.O. No. : 4500118443  
Date Received : December 14, 2007  
Dates Tested : December 17 through February 4, 2007  
Test Personnel : Richard E. King, EMC Engineer  
Specification : FCC "Code of Federal Regulations" Title 47  
Part 74

Test Report By : *RICHARD E. KING*  
Richard E. King  
EMC Engineer

Witnessed By : Juan Castrejon  
Shure Inc.

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



**TABLE OF CONTENTS**

<u>PARAGRAPH</u>	<u>DESCRIPTION OF CONTENTS</u>	<u>PAGE NO.</u>
1.0	INTRODUCTION.....	4
1.1	DESCRIPTION OF TEST ITEM .....	4
1.2	PURPOSE .....	4
1.3	DEVIATIONS, ADDITIONS AND EXCLUSIONS.....	4
1.4	APPLICABLE DOCUMENTS .....	4
1.5	SUBCONTRACTOR IDENTIFICATION .....	4
1.6	LABORATORY CONDITIONS .....	5
2.0	TEST ITEM SET-UP AND OPERATION .....	5
2.1	POWER INPUT .....	5
2.2	GROUNDING .....	5
2.3	PERIPHERAL EQUIPMENT .....	5
3.0	TEST EQUIPMENT.....	5
3.1	TEST EQUIPMENT LIST .....	5
3.2	CALIBRATION TRACEABILITY .....	5
4.0	REQUIREMENTS, PROCEDURES AND RESULTS.....	5
4.1	RF POWER OUTPUT MEASUREMENTS .....	5
4.1.1	REQUIREMENTS.....	5
4.1.2	PROCEDURES .....	5
4.1.3	RESULTS.....	5
4.4	OCCUPIED BANDWIDTH MEASUREMENTS.....	5
4.4.1	REQUIREMENTS.....	5
4.4.2	PROCEDURES .....	6
4.4.3	RESULTS.....	6
4.5	SPURIOUS EMISSIONS AT ANTENNA TERMINAL .....	6
4.5.1	REQUIREMENTS.....	6
4.5.2	PROCEDURES .....	6
4.5.3	RESULTS.....	7
4.6	FIELD STRENGTH OF SPURIOUS EMISSIONS .....	7
4.6.1	PRELIMINARY RADIATED MEASUREMENTS.....	7
4.6.1.1	REQUIREMENTS .....	7
4.6.1.2	PROCEDURES .....	7
4.6.1.3	RESULTS.....	7
4.6.2	FINAL RADIATED EMISSIONS .....	8
4.6.2.1	REQUIREMENTS .....	8
4.6.2.2	PROCEDURES.....	8
4.6.2.3	RESULTS OF OPEN FIELD RADIATED TEST .....	8
5.0	CONCLUSION .....	8
6.0	CERTIFICATION.....	9
7.0	ENDORSEMENT DISCLAIMER.....	9
	TABLE I - EQUIPMENT LIST.....	10

<p><b>THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF ELITE ELECTRONIC ENGINEERING INCORPORATED.</b></p>
---



**REPORT REVISION HISTORY**

Revision	Date	Description
--	Feb. 5, 2008	Initial release



## Transmitter Tests for a Wireless Microphone

### 1.0 INTRODUCTION:

**1.1 DESCRIPTION OF TEST ITEM:** This report presents the results of a series of transmitter tests were performed on a Shure Inc. Wireless Microphone, (hereinafter referred to as the test item). Serial number none assigned was assigned to the test item. The tests were performed for Shure Inc. of Niles, IL.

The test item is a Wireless Microphone that operates in low power auxiliary station bands, 944 to 952MHz.

One transmitter with two power settings was submitted for testing.

Model No.	Serial Nos.	Rated Power (Watts)	Frequency (MHz)
PG2-X1	none assigned	.010	947.475

**1.2 PURPOSE:** The test series was performed to determine if the test item meets the technical requirements of FCC Part 74 for low power auxiliary station bands 944MHz to 952MHz.

**1.3 DEVIATIONS, ADDITIONS AND EXCLUSIONS:** There were no deviations, additions to, or exclusions from the test specification during this test series.

**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 74, dated 1 October 2007
- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 2, dated 1 October 2007
- ANSI C63.4-2003, "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"

**1.5 SUBCONTRACTOR IDENTIFICATION:** This series of tests was performed by Elite Electronic Engineering Incorporated, of Downers Grove, Illinois. The laboratory is accredited by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP Lab Code:

100278-0.

**1.6 LABORATORY CONDITIONS:** The temperature at the time of the test was 21.2°C and the relative humidity was 32%.

**2.0 TEST ITEM SET-UP AND OPERATION:**

**2.1 POWER INPUT:** The test item obtained 3.0 VDC from a battery.

**2.2 GROUNDING:** The test item was ungrounded during the tests.

**2.3 PERIPHERAL EQUIPMENT:** No peripheral equipment was submitted with the test item.

**3.0 TEST EQUIPMENT:**

**3.1 TEST EQUIPMENT LIST:** A list of the test equipment used can be found on Table I. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

**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).

**4.0 REQUIREMENTS, PROCEDURES AND RESULTS:**

**4.1 RF POWER OUTPUT MEASUREMENTS:**

**4.1.1 REQUIREMENTS:** In accordance with paragraph 74.861(d)(1), The maximum transmitter power which will be authorized is 1 watt.

**4.1.2 PROCEDURES:** The output from the antenna port of the test item was connected to spectrum analyzer through 40 dB of attenuation. The output of the each test item was then measured.

**4.1.3 RESULTS:** The output power measurements are presented on page 13. As can be seen from the data, the power output of each transmitter is within the 1 watt requirement of Part 74.861(d)(1).

**4.4 OCCUPIED BANDWIDTH MEASUREMENTS:**

**4.4.1 REQUIREMENTS:** In accordance with paragraph 74.861(d)(3), for low power auxiliary stations operating in the bands other than those allocated for TV broadcasting, the occupied bandwidth shall not be greater than that necessary for satisfactory transmission and, in any event, an emissions appearing on any discrete frequency outside the authorized band shall be attenuated, at least,  $43 + 10 \log(P)$  dB

below the mean output power of the transmitting unit.

#### **4.4.2 PROCEDURES:**

- (a) The test item was connected to a spectrum analyzer through 40 dB of attenuation. The unmodulated carrier signal level was measured and recorded.
- (b) The test item was modulated with a 15 kHz sine wave at an input level necessary to produce 85% of the rated system deviation.
- (c) Steps (a) and (b) were repeated separately for each of the remaining 3 transmitters. The bandwidth of the spectrum analyzer was set to 5kHz (1% of the span).

**4.4.3 RESULTS:** The plots of the occupied bandwidth measured are presented on pages 14 through 15.

As can be seen from the data, the test items met all occupied bandwidth requirements.

#### **4.5 SPURIOUS EMISSIONS AT ANTENNA TERMINAL:**

**4.5.1 REQUIREMENTS:** This test determines whether the test item produces excessive spurious emissions.

In accordance with paragraph 74.861(d)(3), for low power auxiliary stations operating in the bands other than those allocated for TV broadcasting, the occupied bandwidth shall not be greater than that necessary for satisfactory transmission and, in any event, an emissions appearing on any discrete frequency outside the authorized band shall be attenuated, at least,  $43 + 10 \log(P)$  dB below the mean output power of the transmitting unit.

**4.5.2 PROCEDURES:** In general, this test will measure spurious emissions at the antenna terminals.

- (a) A spectrum analyzer was connected to the output of the test item. The out of band emissions were measured.
- (b) The spectrum analyzer was adjusted accordingly.
  - (1) For the FCC measurements, the resolution bandwidth was set to 100kHz for spurious emissions below 1GHz and 1MHz for spurious emissions above 1GHz.
- (c) The test item was modulated with a 2500 Hz sine wave at an input level 16 dB greater than that necessary to produce 50% of the rated system

deviation.

- (d) The plots of the spectrum analyzer screens were recorded.

**4.5.3 RESULTS:** The plots of the antenna conducted output measurements are presented on pages 16 through 17. As can be seen from the data, the test item did not produce spurious emissions in excess of the limit.

#### **4.6 FIELD STRENGTH OF SPURIOUS EMISSIONS:**

##### **4.6.1 PRELIMINARY RADIATED MEASUREMENTS:**

**4.6.1.1 REQUIREMENTS:** Because emission levels in the open field may be masked by interference from sources other than the test item, preliminary radiated measurements are first performed in the low ambient environment of a shielded enclosure. The radiated emissions from the test item were first measured using peak detection. This data was then automatically plotted

**4.6.1.2 PROCEDURES:** All preliminary 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 2003 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All power lines and signal lines entering the enclosure pass through filters on the enclosure wall. The power line filters prevent extraneous signals from entering the enclosure on these leads.

The test was performed on each transmitter separately.

The preliminary measurements were performed with each test item operating with the input signal unmodulated. The broadband measuring antennas were positioned at a 3 meter distance from the test item. The frequency range from 30MHz to 10<sup>th</sup> harmonic was investigated. The readings were taken with a peak detector function and recorded.

**4.6.1.3 RESULTS:** The preliminary plots are presented on pages 18 through 21. Factors for the antennas and cables were added to the data before it was plotted.

This data is only presented for a reference, and is not used as official data. All significant radiated emissions were subsequently measured at an open field test site.

#### 4.6.2 FINAL RADIATED EMISSIONS:

**4.6.2.1 REQUIREMENTS:** The field strength of any emission on any frequency remove from the operating frequency by more than 250 percent of the authorized bandwidth: shall be attenuated by at least  $43 + 10 \log (P)$  dB.

**4.6.2.2 PROCEDURES:** Final open field measurements 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 2003 for site attenuation.

The final open field emission test procedure is as follows:

- a) The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.
- b) The antenna output of the test item was terminated in 50 ohms for the tests.
- c) A double ridged waveguide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.
- d) Detected emissions were maximized at each frequency by rotating the test item and adjusting the receive antenna height and polarization.
- e) The maximum meter reading was recorded.
- f) Measurements were performed with the input signal unmodulated.
- g) Measurements were performed separately at each frequency used during the preliminary measurements.

The equivalent power into a dipole antenna was determined from the field intensity levels measured at 3 meters using the substitution method. To determine the emission power another tuned dipole antenna or double ridged waveguide antenna was set in place of the test item and connected to a calibrated signal generator. The output of the signal generator was adjusted to match the received level at the spectrum analyzer. The signal level was recorded. The reading was corrected to compensate for cable loss, as required, and when the ridged waveguide antenna was used increased by the difference in gain between the dipole and the waveguide antenna.

**4.6.2.3 RESULTS:** The final open field radiated levels are presented on pages 22. The radiated emissions were measured through the 10th harmonic. All emissions measured from the test item were within the specification limits.

#### **5.0 CONCLUSION:**

It was found that the Shure Inc., model PG2-X1 Wireless Microphone, did comply





with the RF Power Output, the Occupied Bandwidth, the Spurious Emissions at Antenna Terminal, and the Field Strength of Spurious Emissions requirements of FCC Part 74 for low power auxiliary station bands 944MHz to 952MHz.

**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 as operated by Shure Incorporated personnel. Any electrical or mechanical modification made to the test item subsequent to the specified test date will serve to invalidate the data and void this certification.

**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

```

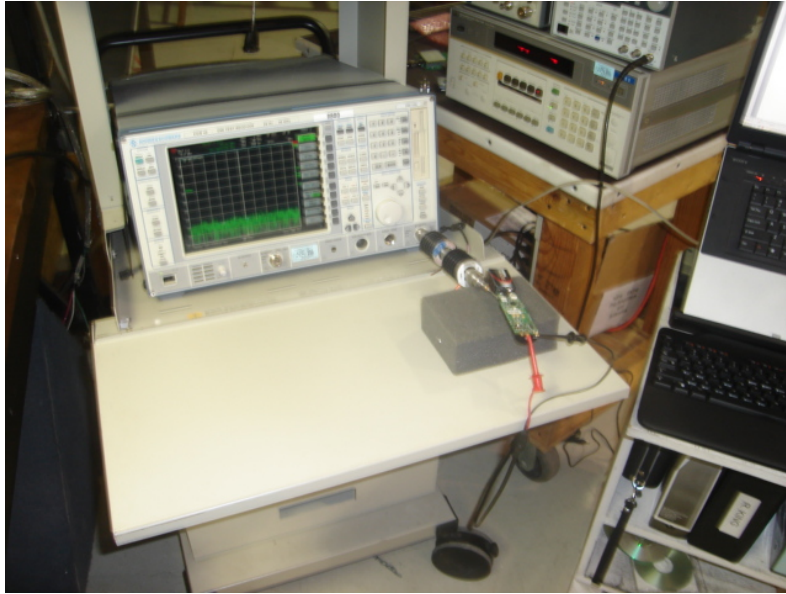
=====
Eq ID Equipment Description      Manufacturer  Model No.   Serial No.  Frequency Range  Cal Date  Cal Inv  Due
Date
-----
Equipment Type: ACCESSORIES, MISCELLANEOUS
-----
XLTX 5W, 50 OHM TERMINATION      JFW INDUSTRIES  50T-052     ---         DC-2GHZ         11/19/07  12
11/19/08
XZG0 ATTENUATOR/SWITCH DRIVER    HEWLETT PACKARD 11713A      3439A02724  ---            N/A
-----
Equipment Type: AMPLIFIERS
-----
APK0 PRE-AMPLIFIER              HEWLETT PACKARD 8449B       3008A00662  1-26.5GHZ      03/16/07  12
03/16/08
-----
Equipment Type: ANTENNAS
-----
NDQ1 TUNED DIPOLE ANTENNA       EMCO            3121C-DB4   313         400-1000MHZ    03/28/07  12
03/28/08
NTA0 BILOG ANTENNA              CHASE EMC LTD.  BILOG CBL611 2057      0.03-2GHZ     06/20/07  12
06/20/08
-----
Equipment Type: ATTENUATORS
-----
TIN3 10DB 20W ATTENUATOR        NARDA           766-10      ---         DC-4GHZ         09/04/07  12
09/04/08
T2D5 20DB, 25W ATTENUATOR       WEINSCHEL       46-20-43    AY9244      DC-18GHZ      02/22/07  12
02/22/08
T2DG 20DB 25W ATTENUATOR        WEINSCHEL       46-20-34    BN1038      DC-18GHZ      03/01/07  12
03/01/08
-----
Equipment Type: CONTROLLERS
-----
CMA0 MULTI-DEVICE CONTROLLER    EMCO            2090        9701-1213   ---            N/A
-----
Equipment Type: PROBES; CLAMP-ON & LISNS
-----
PLL2 50UH LISN 462D            ELITE           462D/70A    003         0.01-400MHZ    02/12/07  12
02/12/08
PLL5 50UH LISN 462D            ELITE           462D/70A    006         0.01-400MHZ    02/12/07  12
02/12/08
-----
Equipment Type: RECEIVERS
-----
RAC1 SPECTRUM ANALYZER         HEWLETT PACKARD 85660B      3407A08369  100HZ-22GHZ   02/21/07  12
02/21/08
RAF3 QUASIPPEAK ADAPTER        HEWLETT PACKARD 85650A      3303A01775  0.01-1000MHZ  02/21/07  12
02/21/08
RBB0 EMI TEST RECEIVER 20HZ TO  ROHDE & SCHWARZ ESIB40  100250      20 HZ TO 40GHZ 11/05/07  12
11/05/08
-----
Equipment Type: SIGNAL GENERATORS
-----
GBX1 SYNTHESIZED SWEEPER       HEWLETT PACKARD 83630A      3420A00857  10MHZ-26.5GHZ 02/23/07  12
02/23/08
=====

```

```

=====
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
=====

```



Output Power Test Set-up



Occupied Bandwidth Test Set-up



Antenna Conducted Emissions Test Set-up



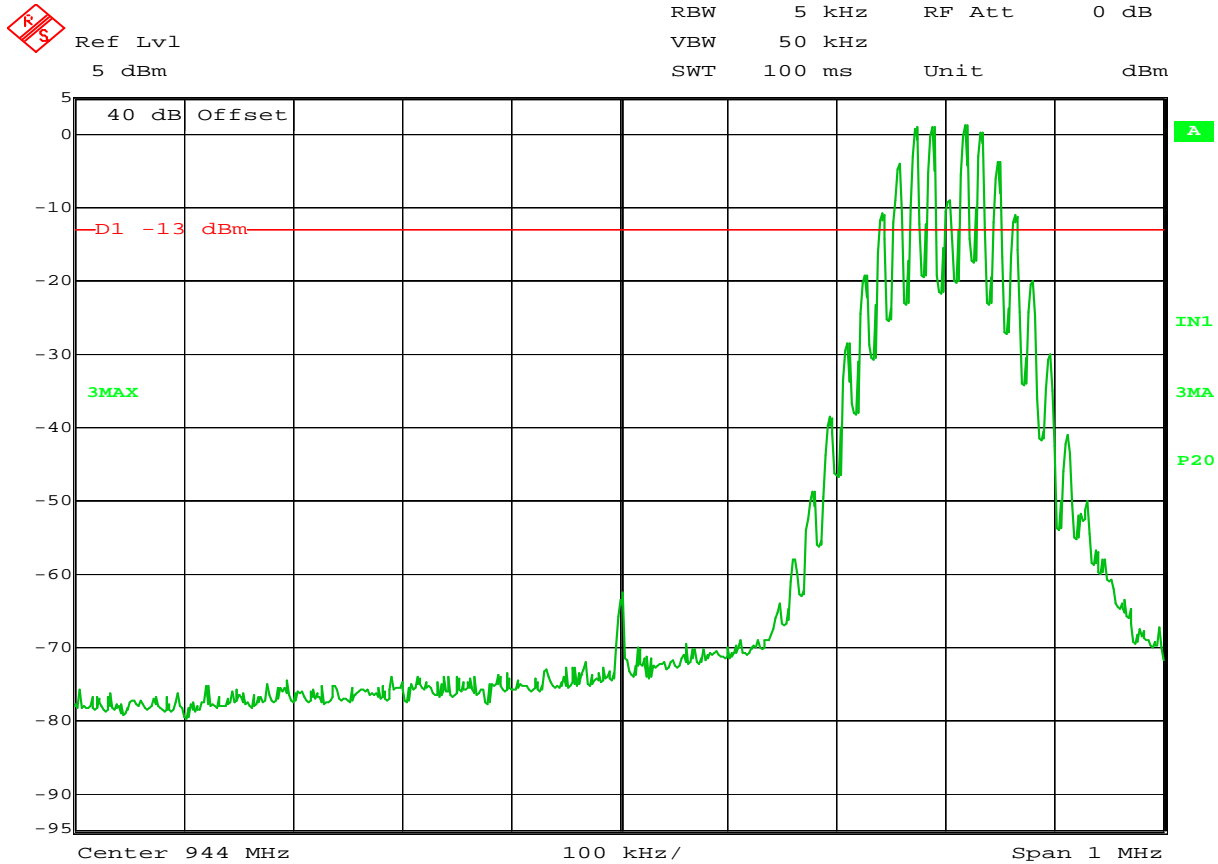
Data Page

MANUFACTURER : Shure Inc.  
MODEL NO. : All Transmitters  
SERIAL NO. : None assigned  
SPECIFICATION : FCC-74  
TEST PERFORMED : RF Output Power  
DATE : December 18, 2007  
NOTES :

UNIT	Rated Power (Watts)	Frequency (MHz)	Meter Reading (dBm)	Attenuation (dB)	Total (dBm)	Limit (dBm)	Total (Watts)	Limit (Watts)
PG2-X1	.010	947.475	-30.77	40.0	9.23	30.0	0.009	1.000

Checked BY : *RICHARD E. KING*

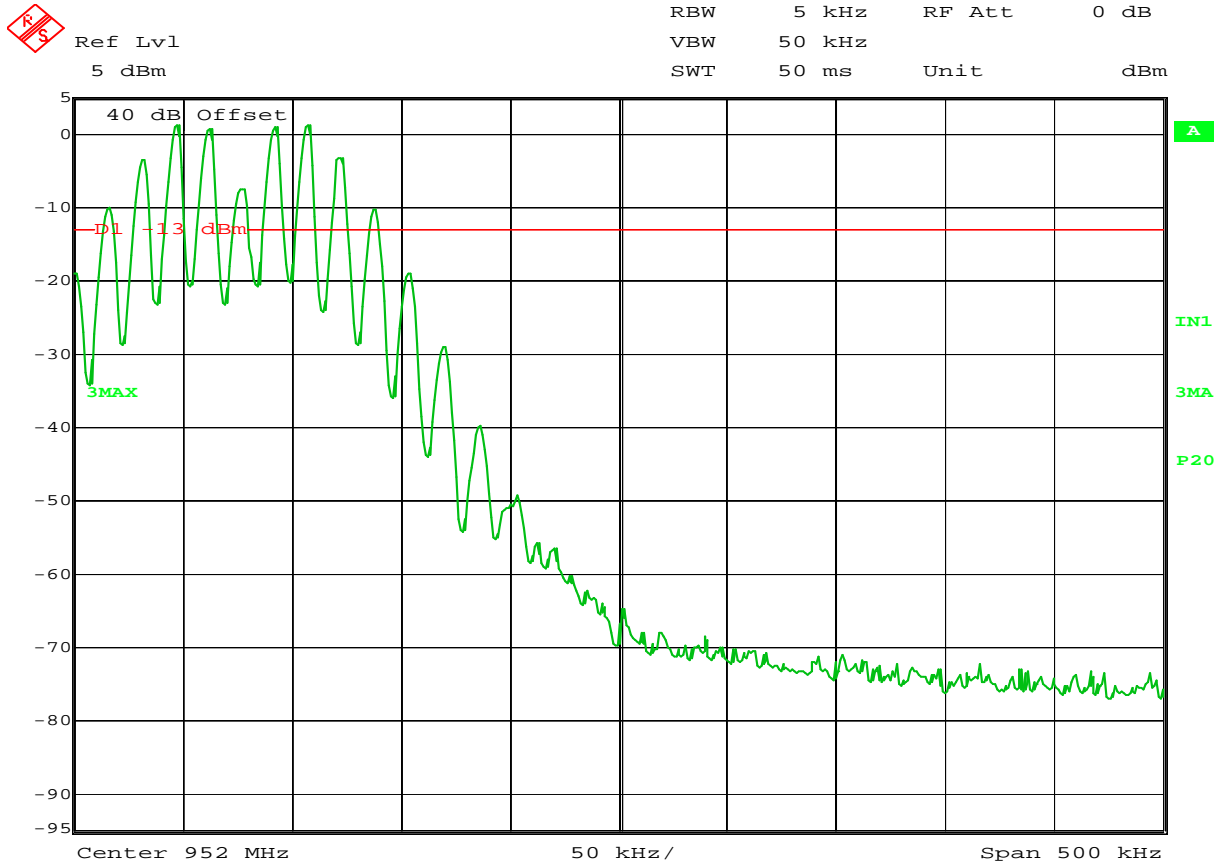
Richard E. King



Date: 4.FEB.2008 21:23:24

### CFR 47 Part 74

MANUFACTURER : Shure Inc.  
MODEL NUMBER : PG2-X1  
SERIAL NUMBER : none assigned  
TEST MODE : Tx 10mW @ 944.300 MHz  
TEST PARAMETERS : 15kHz @ 85% modulation



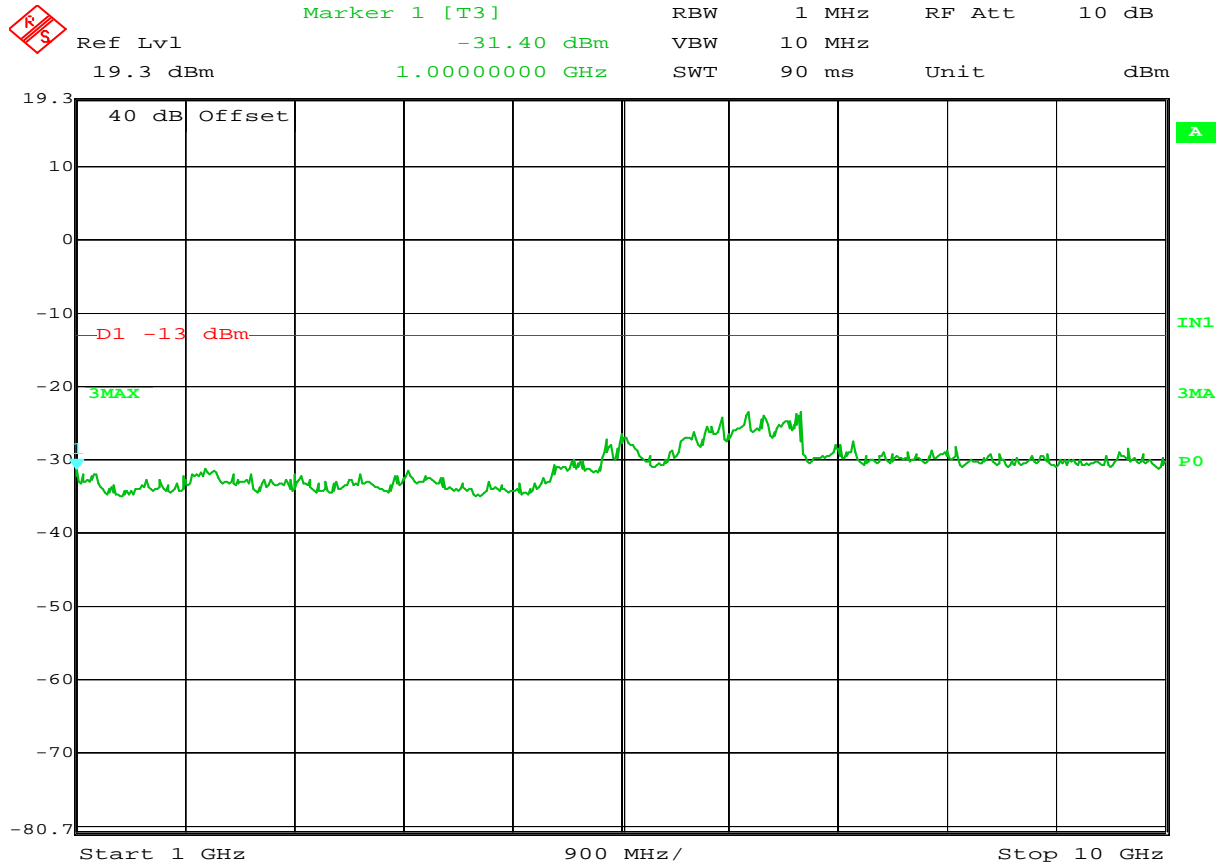
Date: 4.FEB.2008 21:21:29

### CFR 47 Part 74

MANUFACTURER : Shure Inc.  
MODEL NUMBER : PG2-X1  
SERIAL NUMBER : none assigned  
TEST MODE : Tx 10mW @ 951.825 MHz  
TEST PARAMETERS : 15kHz @ 85% modulation



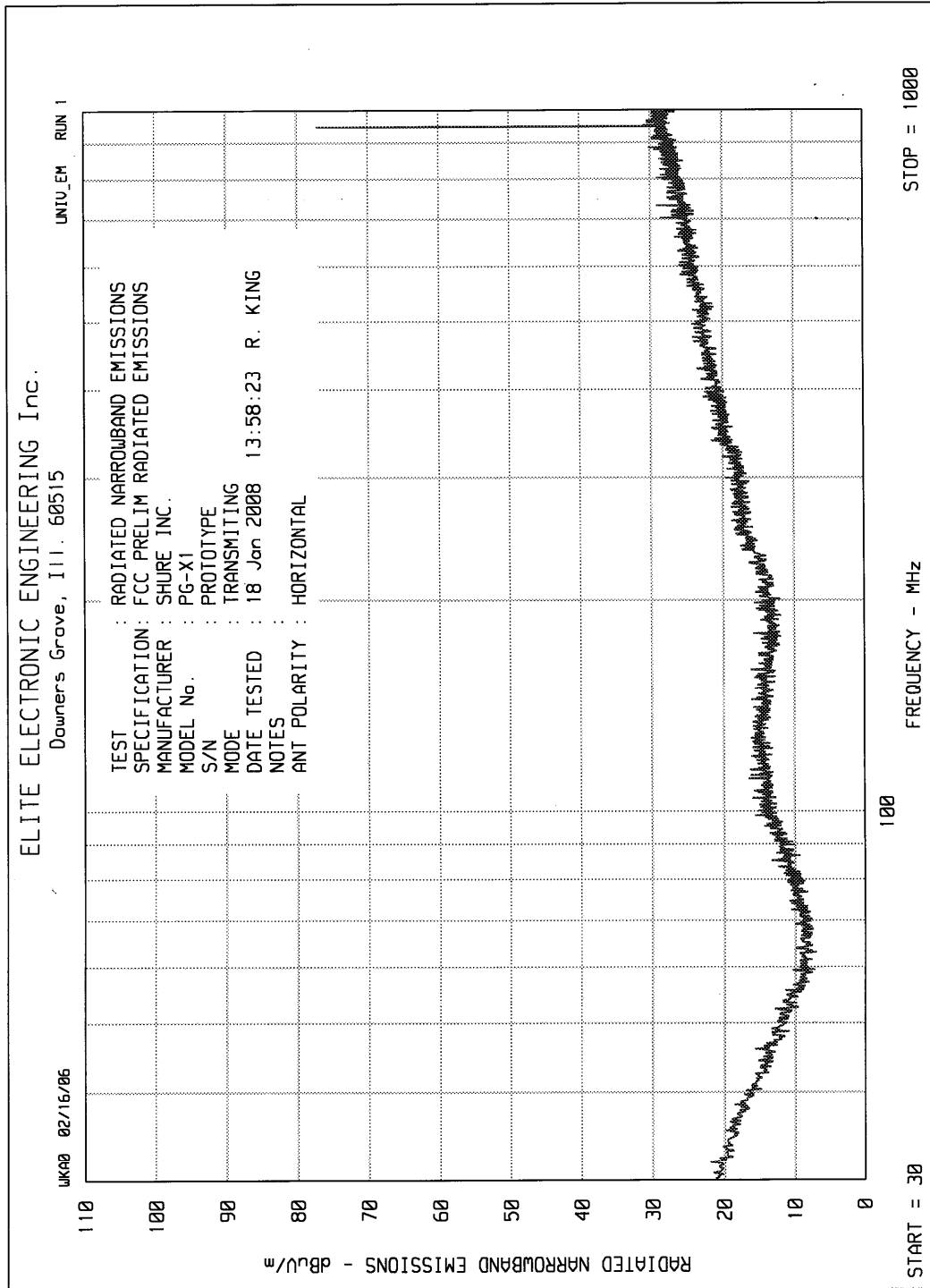


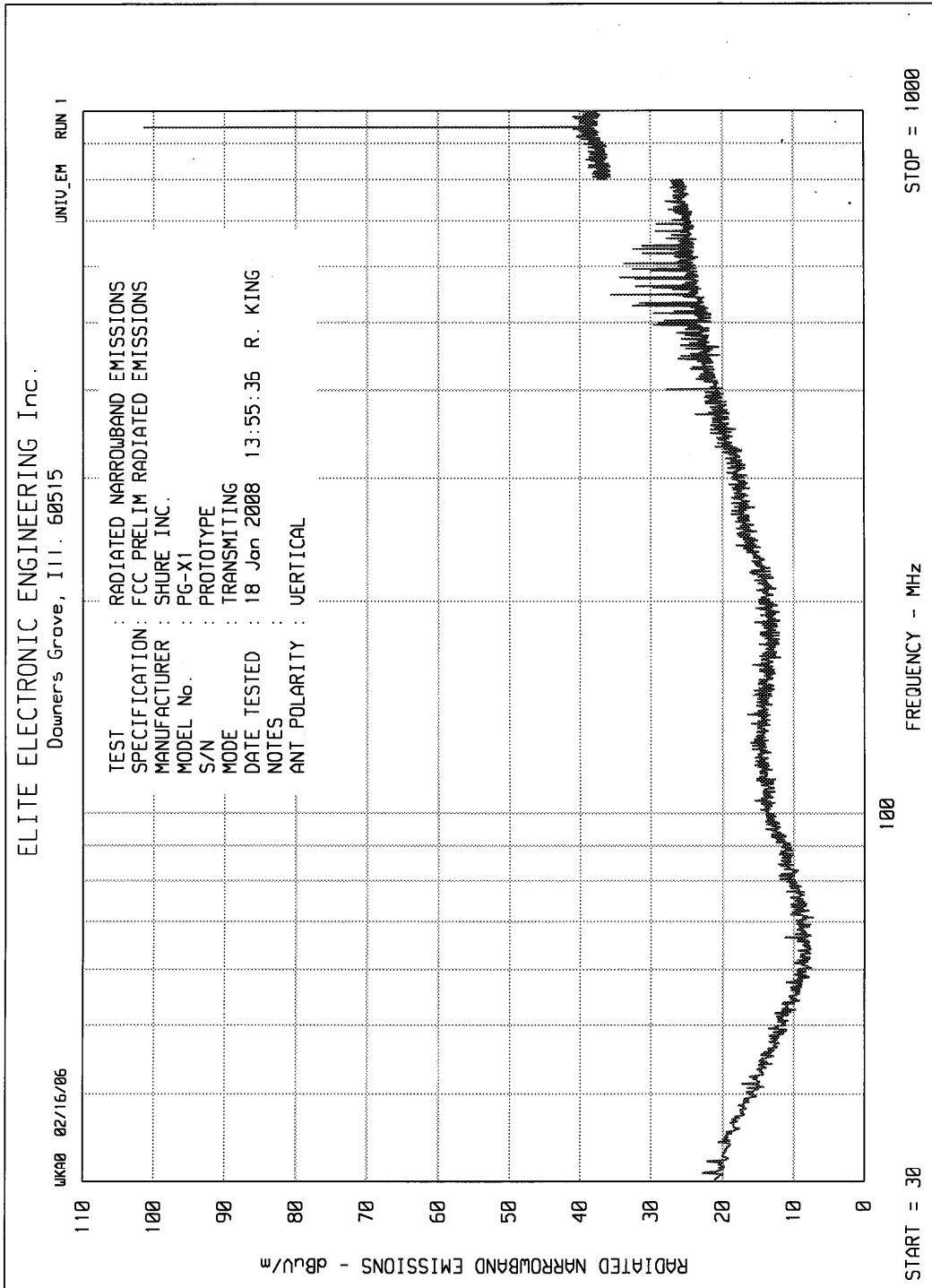


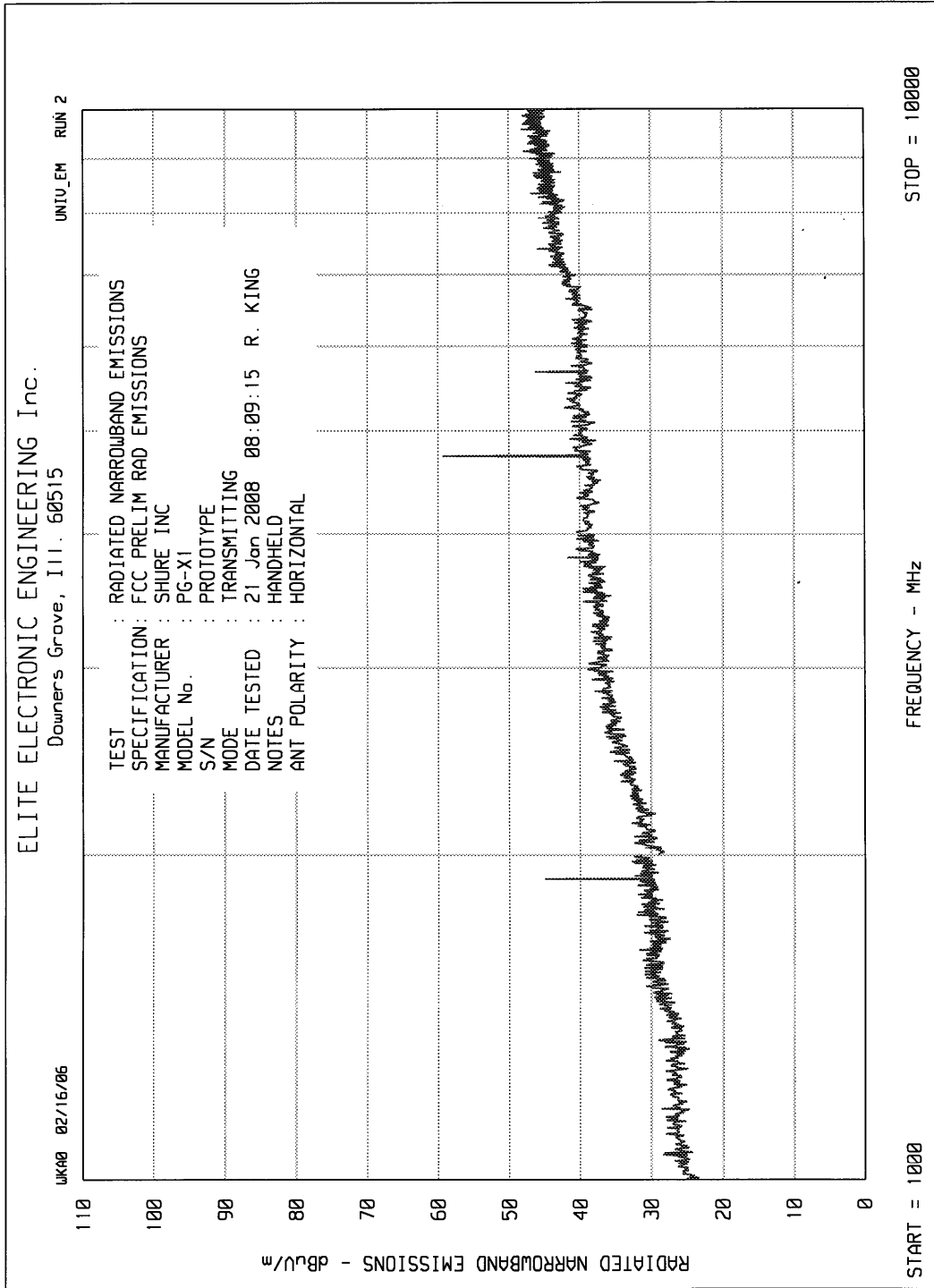
Date: 16.JAN.2008 15:39:31

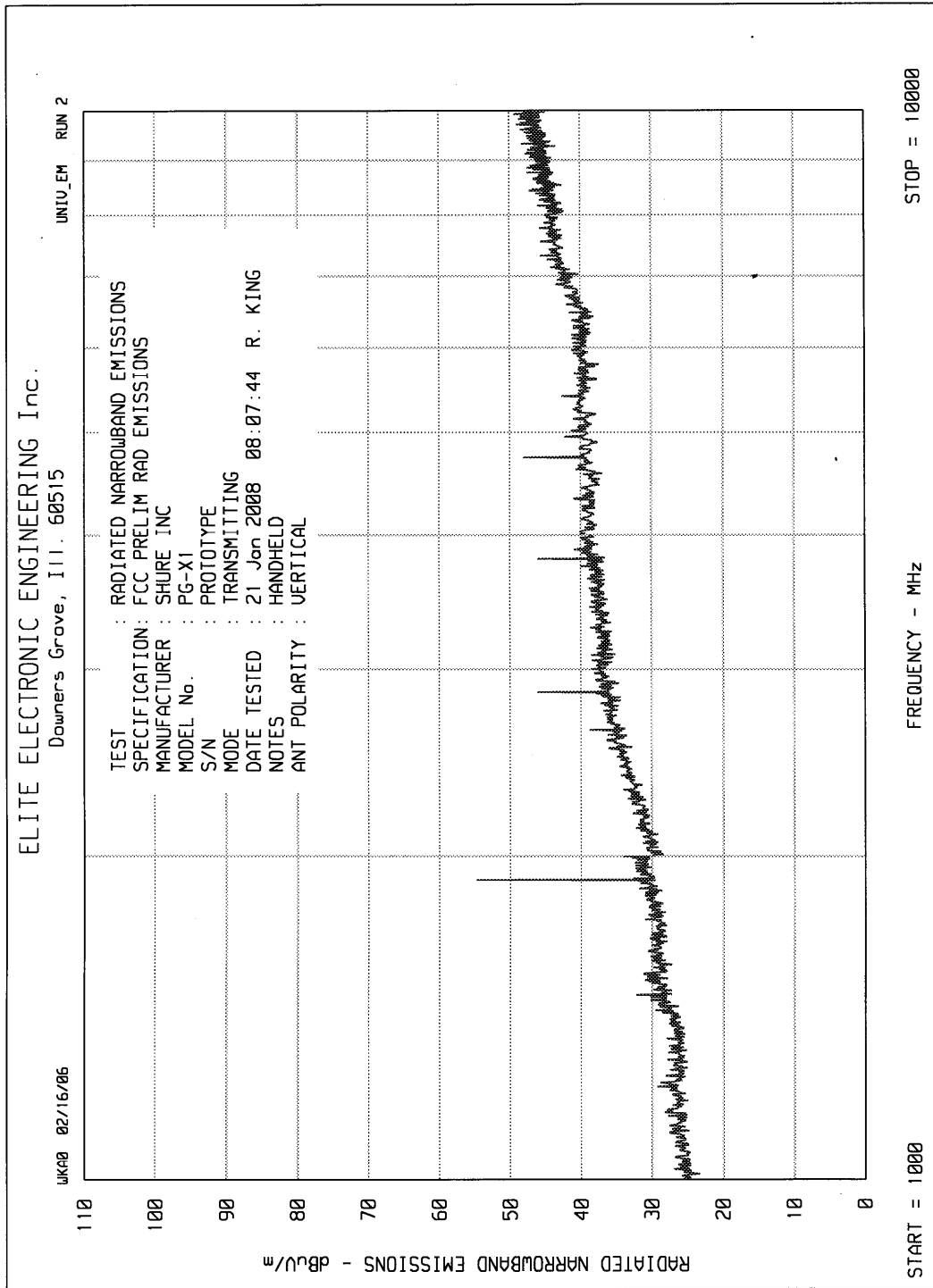
### CFR 47 Part 74 Antenna Conducted Emissions

MANUFACTURER : Shure Inc.  
MODEL NUMBER : PG2-X1  
SERIAL NUMBER : None Assigned  
TEST MODE : Tx 10mW @ 947.475  
NOTES :











Data Page

**MANUFACTURER** : Shure Inc.  
**MODEL NO.** : PG2-X1  
**SERIAL NO.** : none assigned  
**SPECIFICATION** : FCC-74 Spurious Radiated Emissions  
**DATE** : December 18, 2007  
**NOTES** : Test Distance is 3 Meters

Freq. (MHz)	Ant Pol	Meter Reading (dBUV)	Amb.	Matched Sig Gen (dBm)	Antenna Gain (dB)	Cable Factor (dB)	ERP Total (dBm)	Part 74 Atten. (dB)	Part 74 Min. Atten. (dB)
1895.0	H	18.4		-51.6	5.2	2.3	-48.7	58.7	23
1895.0	V	29.7		-33.1	5.2	2.3	-30.2	40.2	23
2842.4	H	23.6		-43.5	5.3	3.1	-41.3	51.3	23
2842.4	V	22.0		-46.0	5.3	3.1	-43.8	53.8	23
3789.9	H	21.3		-36.9	6.9	3.6	-33.6	43.6	23
3789.9	V	20.3		-47.0	6.9	3.6	-43.7	53.7	23
4737.4	H	22.6		-41.0	8.1	3.9	-36.8	46.8	23
4737.4	V	20.5		-42.7	8.1	3.9	-38.5	48.5	23
5684.9	H	19.1		-42.9	7.5	4.3	-39.7	49.7	23
5684.9	V	17.8		-45.3	7.5	4.3	-42.1	52.1	23
6632.3	H	18.5	*	-46.0	8.0	4.9	-42.9	52.9	23
6632.3	V	18.8	*	-45.1	8.0	4.9	-42.0	52.0	23
7579.8	H	46.3	*	-51.2	7.6	5.4	-49.1	59.1	23
7579.8	V	47.8	*	-52.7	7.6	5.4	-50.6	60.6	23
8527.3	H	50.0		-48.6	8.8	5.8	-45.7	55.7	23
8527.3	V	48.8	*	-51.2	8.8	5.8	-48.3	58.3	23
9474.8	H	47.3	*	-48.5	9.2	6.0	-45.3	55.3	23
9474.8	V	47.1	*	-47.9	9.2	6.0	-44.7	54.7	23

Checked BY : RICHARD E. KING

Richard E. King