



TEST SPECIFICATION:

FCC "Rules and Regulations", Part 74,
Experimental Radio, Auxiliary, Special Broadcast and Other Program
Distribution Services for Operation in the

692.125 - 715.875 MHz Band

Subpart H, Low Power Auxiliary Stations
Sections 74.801 to 74.882

THE FOLLOWING **MEETS** THE ABOVE TEST SPECIFICATION

Formal Name: U1B UHF-FM Body Pack Transmitter

Kind of Equipment: UHF-FM Transmitter

Test Configuration: NA

Emission Designator: 120KF3B

Transmitter FCC ID: DD4U1B

Model Number: U1B

Serial Number: 0710980089

Dates of Test: November 17, 1998

Test Conducted For: Shure Brothers, Inc

222 Hartrey Avenue

Evanston, Illinois 60202

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SIGNATURE PAGE

Report Written By:

A handwritten signature in black ink that reads "Arnom C. Rowe".

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EMC-001375-NE

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Report Reviewed by:

Jack Prawica

Lab Manager

A handwritten signature in black ink that reads "Brian J. Mattson".

Report Approved by:

Brian J. Mattson
General Manager

Company Official:

Shure Brothers, Inc

United States Department of Commerce
National Institute of Standards and Technology

NVLAP[®]



ISO 9002:1987
ANSI Z39-18:1990

Certificate of Accreditation

D.L.S. ELECTRONIC SYSTEMS, INC.
WHEELING, IL

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**ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS
FCC**

September 30, 1999

Effective through

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For the National Institute of Standards and Technology

NVLAP Lab Code: 100276-0

National Institute
of Standards and Technology



National Voluntary
Laboratory Accreditation Program

ISO/IEC GUIDE 25:1990
ISO 9002:1987

Scope of Accreditation



Page: 1 of 1

**ELECTROMAGNETIC COMPATIBILITY
AND TELECOMMUNICATIONS**

NVLAP LAB CODE 100276-0

D.L.S. ELECTRONIC SYSTEMS, INC.

1250 Peterson Drive

Wheeling, IL 60090-6454

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NVLAP Code Designation / Description

International Special Committee on Radio Interference (CISPR) Methods

12/CIS22 IEC/CISPR 22:1993: Limits and methods of measurement of radio disturbance characteristics of information technology equipment

Federal Communications Commission (FCC) Methods

12/F01 FCC Method - 47 CFR Part 15 - Digital Devices

12/F01a Conducted Emissions, Power Lines, 450 KHz to 30 MHz

12/F01b Radiated Emissions

Australian Standards referred to by clauses in AUSTEL Technical Standards

12/T51 AS/NZS 3548: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment

September 30, 1999

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A handwritten signature in black ink, appearing to read "John L. Galt".

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1.0 SUMMARY OF TEST REPORT

It was found that the U1B UHF-FM Body Pack Transmitter S/N 0710980089 **meets** the radio interference emission requirements of the FCC "Rules and Regulations", Part 74, Subpart H, Sections 74.801 to 74.882 for Low Power Auxiliary Stations operating in the 692 - 716 MHz Frequency Band.

2.0 INTRODUCTION

On November 17, 1998, a series of radio frequency interference measurements were performed on UHF-FM Transmitter, S/N 0710980089. The tests were performed according to the procedures of FCC as stated in Part 2 Subpart J, Equipment Authorization Procedures of the Code of Federal Regulations 47, by personnel of D.L.S. Electronic Systems, Inc. who are responsible to Donald L. Sweeney, Senior EMC Engineer.

3.0 OBJECT

The purpose of this series of tests was to determine if the test sample could meet the radio frequency emission requirements of the FCC "Rules and Regulations", Part 74, Subpart H, Sections 74.801 to 74.882 for Low Power Auxiliary Stations operating in the 692 - 716 MHz Frequency Band.

4.0 TEST SET-UP

All radiated emission tests were performed at D.L.S. Electronic Systems, Inc. The radiated tests were made with the test item placed on a wooden turntable located in the Test Room with the receive antenna placed one meter from the device under test.



5.0 TEST EQUIPMENT (Bandwidths and Detector Function)

All data was automatically plotted using peak detector function. This information was then used to determine the frequencies of maximum emissions. Manual measurements were performed on these frequencies using a peak detector function of the Analyzer with the bandwidths specified by the FCC. From 200 MHz to 1000 MHz a bandwidth of 100 kHz was used (except for Occupied Bandwidth), and above 1000 MHz, wide enough bandwidths were used, depending upon the test being made, to ensure proper measurement of the narrowband signal. A list of the equipment used can be found in Table 1. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

6.0 RF POWER OUTPUT - PART 2.985

As stated in PART 74.861 (e-1), the output power should not exceed 250 milliwatts (24 dBm). The U1B UHF-FM Body Pack Transmitter was tuned according to the tune-up procedures specified in Part 2.983 (d-5), and adjusted for its maximum output power. The RF output power was measured in the open field, using the following test method:

The radiated signal from the EUT was measured. The EUT was then substituted with a signal generator and a tuned dipole antenna. The output of the signal generator was increased until the level received by the tuned dipole equaled that of the previous measured from the EUT.

Actual Measurements Taken:

10.6	dBuV Measured output of the transmitter
+0	<u>dBuV Total system losses (Antenna, Pads & Cable)</u>
10.60	dBuV which equals 0.01 watts

LIMIT:

Manufacturer's rated output power = 0.01 watts
Tolerance = 100 ppm

MARGIN:

0.25 watts - 0.01 watts = 0.24 watts

NOTE:

See the following pages for the graphs of the actual measurements made:



GRAPHS TAKEN OF THE RF POWER

OUTPUT MEASUREMENTS

PART 2.985

NOTE:

The RF Power Output graphs taken during testing can be found under the exhibits label "RF Power Output".



7.0 Modulation Characteristics - Part 2.987

a. Voice modulated communication equipment

A curve showing the frequency response of the audio modulating circuit over a range of 20 Hz to 20000 Hz is submitted with this report.

b. Equipment which employs modulation limiting

A family of curves showing the percentage of modulation versus the modulation input voltage with sufficient information showing the modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

NOTE:

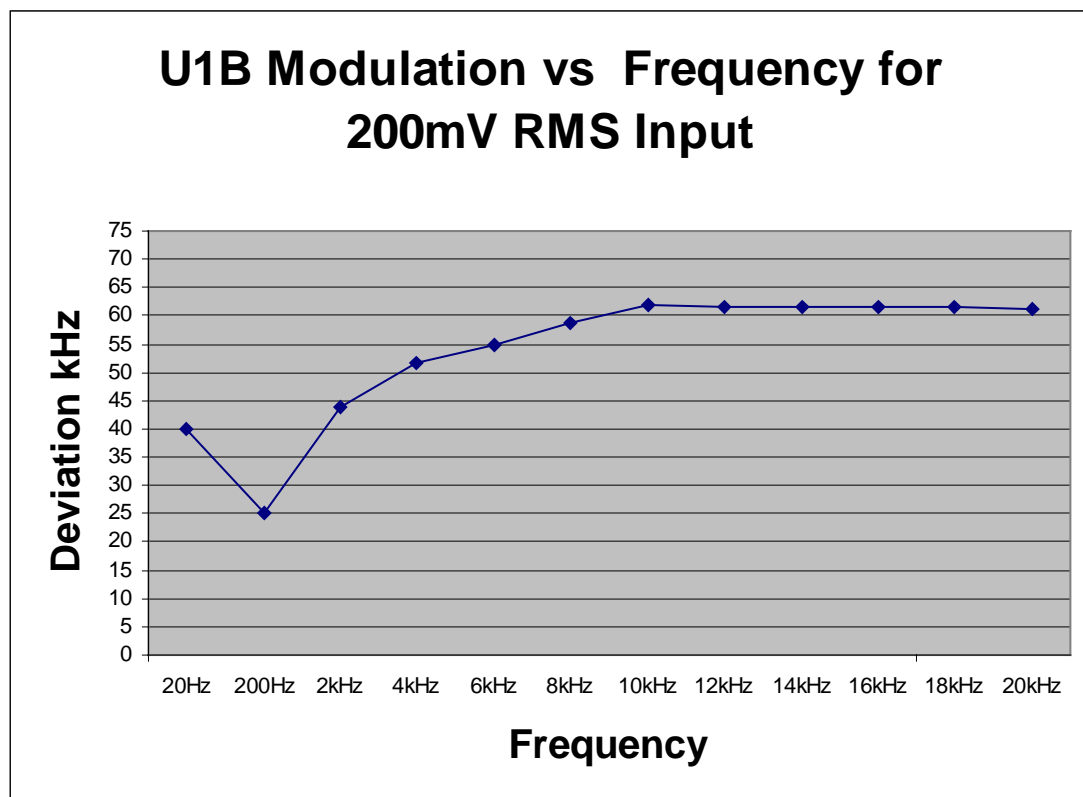
See the following pages for the graphs of the actual measurements made:

GRAPHS TAKEN SHOWING THE FREQUENCY

RESPONSE OF THE

AUDIO MODULATING CIRCUIT

PART 2.987





8.0 OCCUPIED BANDWIDTH – PART 2.989

The frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to .5% of the total mean power radiated by a given emission.

As stated in Part 2.989 c-1 the U1B UHF-FM Body Pack Transmitter was modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation. This input level was established at the frequency of maximum response of the audio modulating circuit.

The U1B UHF-FM Body Pack Transmitter uses the same frequency range as television broadcast monaural transmitters so the test was also run using a 15 kHz input signal modulated by 85% as stated in Part 2.989 e-6.

Paragraph e-5 states that the maximum authorized bandwidth shall be 200 kHz for all emissions inside these frequency bands.

Carson's Rule:

Section 2.202 (g)

$B_n = 2M_{2DK}, K=1$ $B_n =$ Bandwidth

$M = 15 \text{ kHz},$ $M =$ Maximum Modulating Frequency

$D = 45 \text{ kHz},$ $D =$ Peak Deviation

$B_n = 2(15) + 2(45)(1) = 120 \text{ kHz}$

NOTE: See the following pages for the graphs of the actual measurements made:

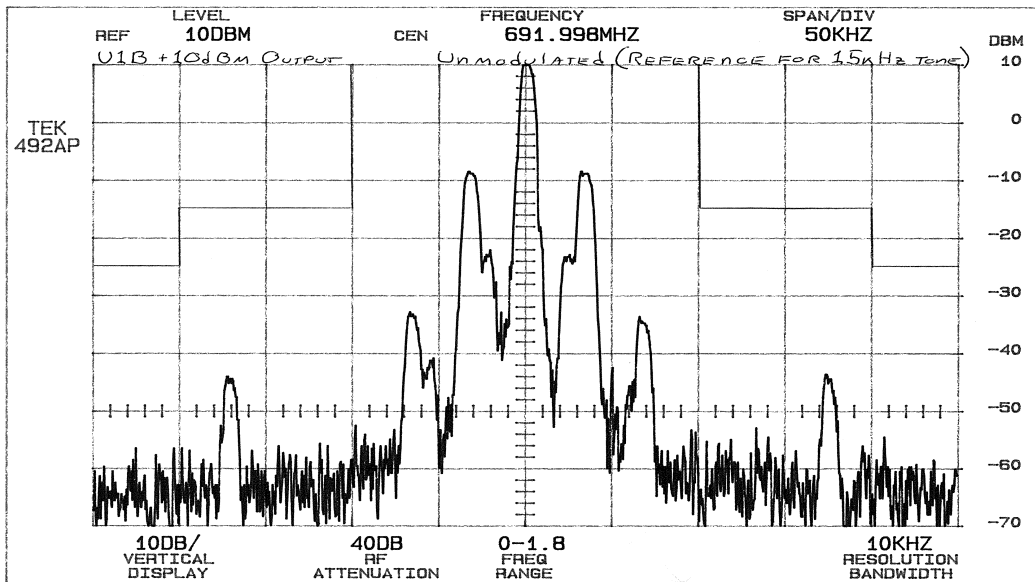


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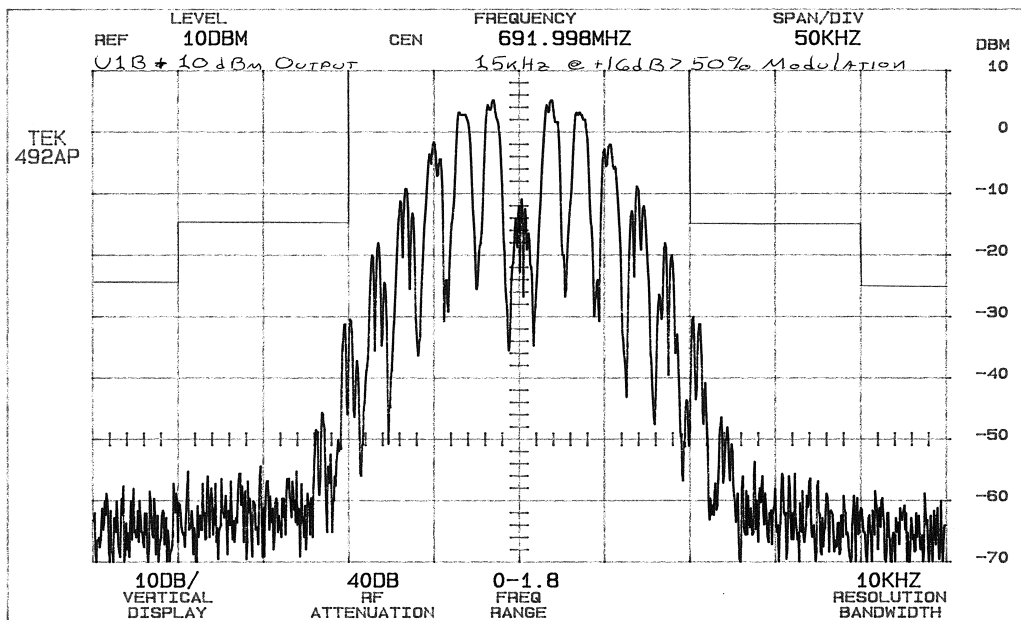
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GRAPHS TAKEN OF THE OCCUPIED BANDWIDTH

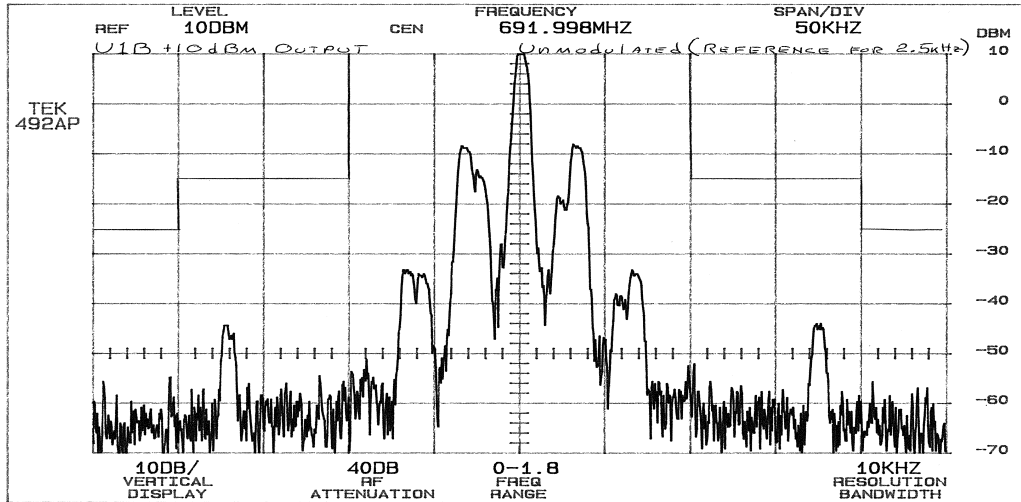
PART 2.989



U1B 15kHz Reference

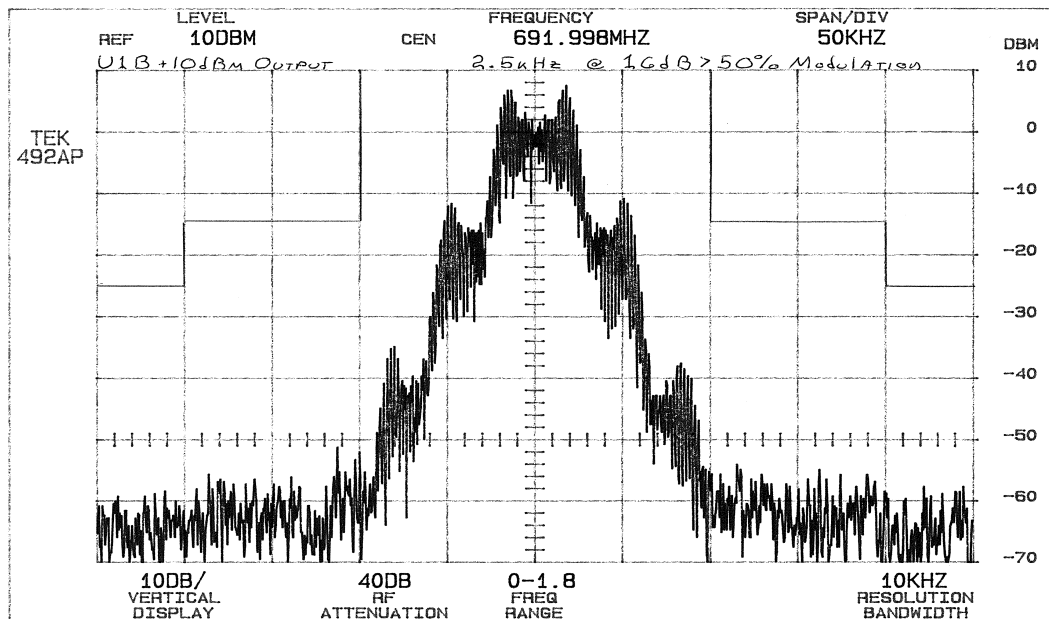


U1B 15kHz @ +16dB > 50% Modulation

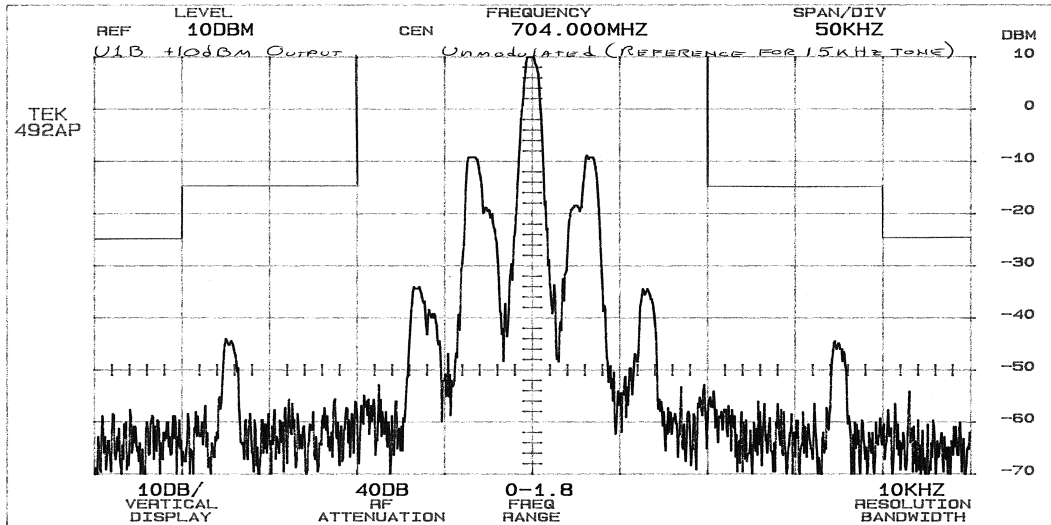


U1B 2.5kHz Reference

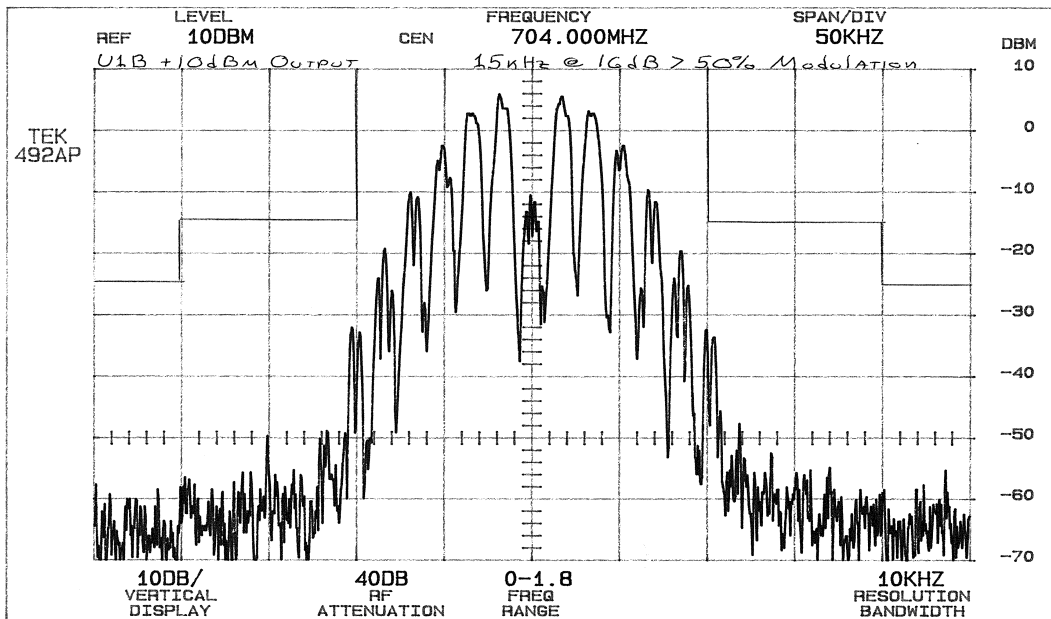
Note: The input level for +16dB >50% Modulation was -25.5dBV for all U1B Occupied Bandwidth tests.



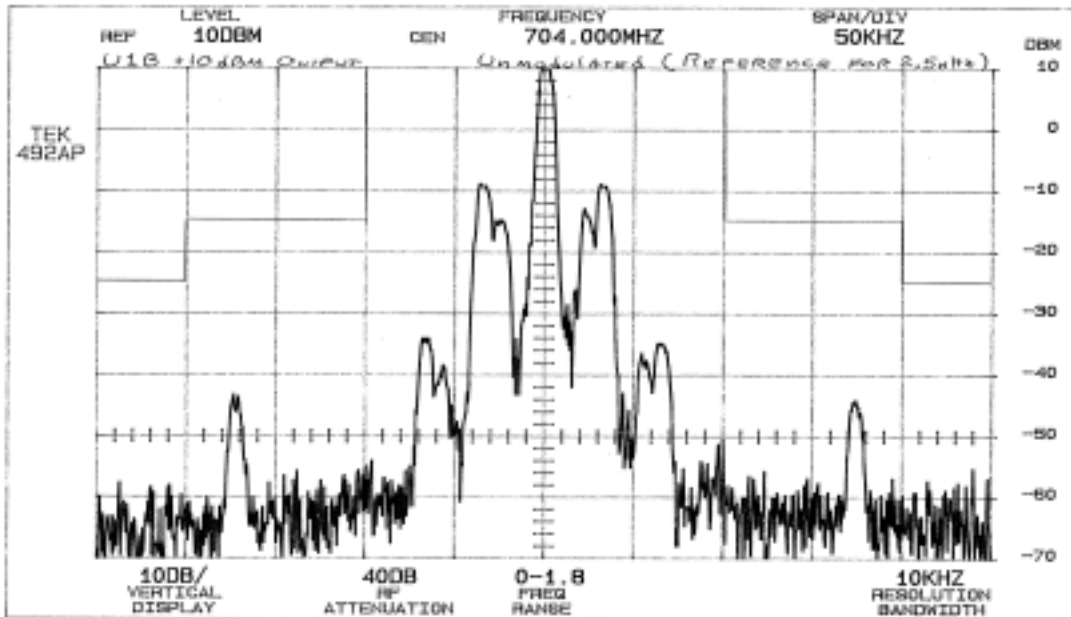
U1B 2.5kHz @16 dB > 50% Modulation



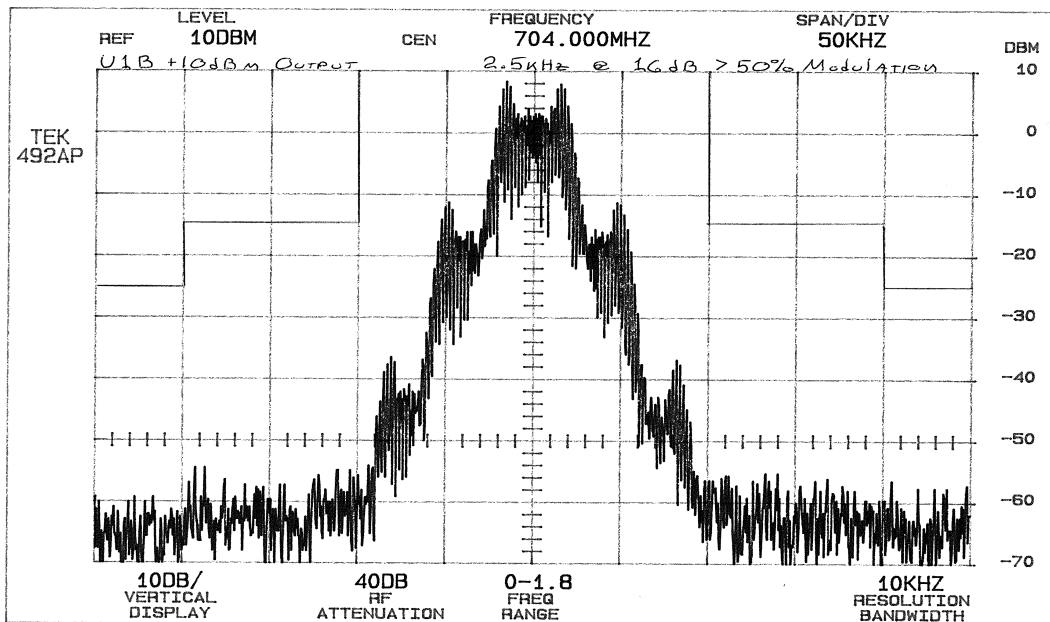
UIB 704 15kHz Reference



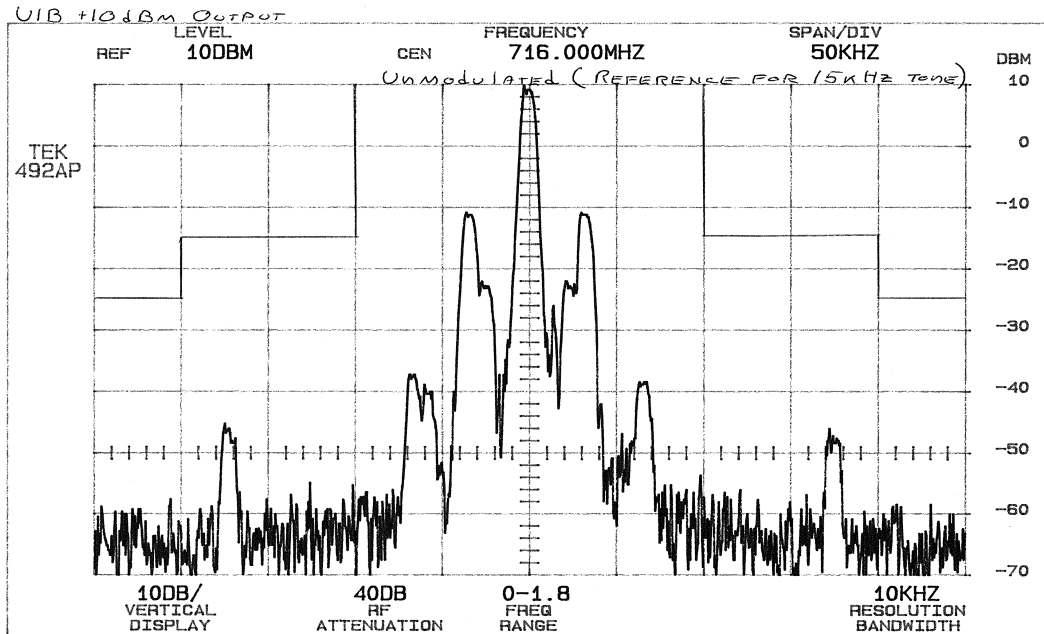
UIB 704 15kHz@+16dB >50% Modulation



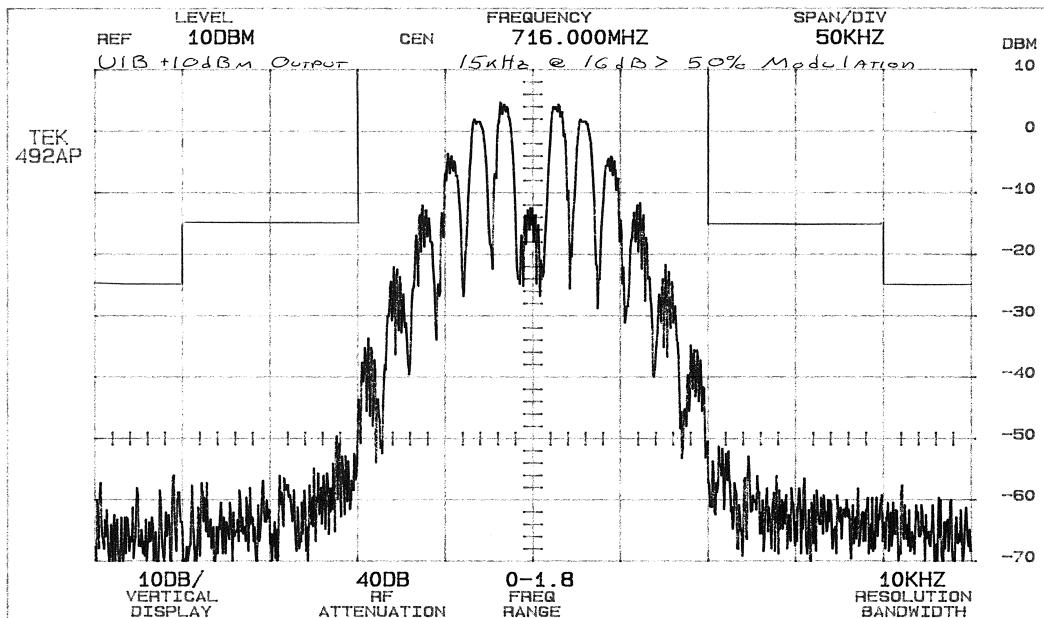
U1B(704) Reference 2.5kHz



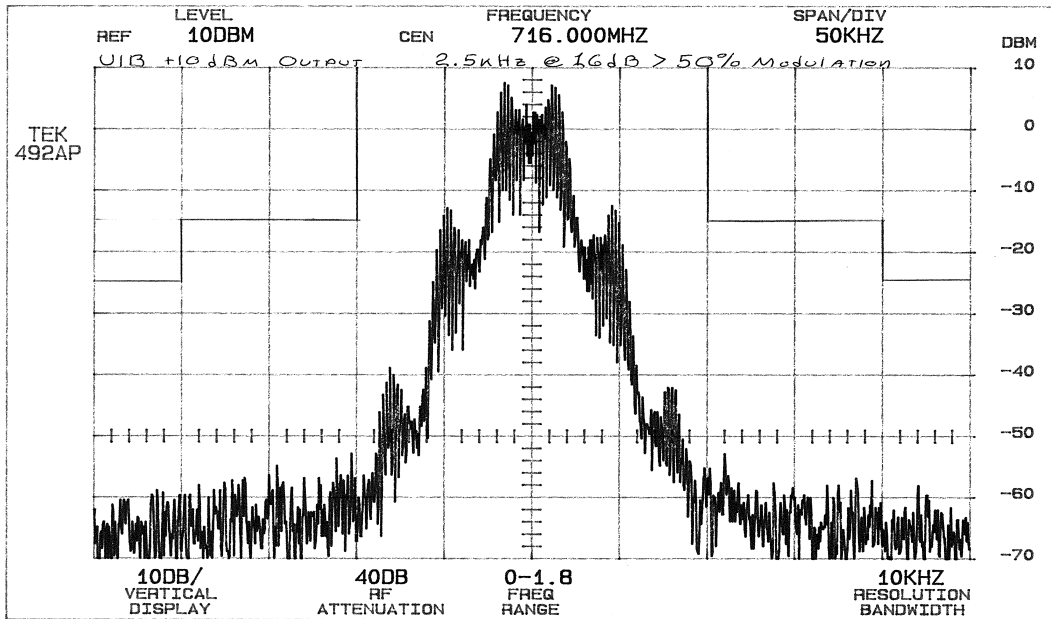
U1B (704) 2.5kHz @ +16dB >50% Modulation



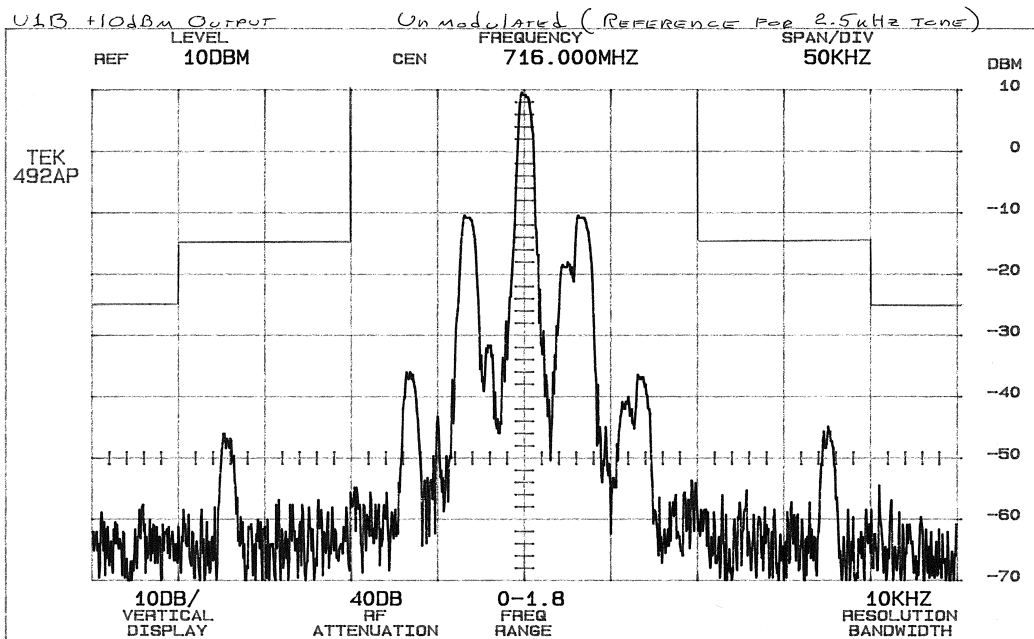
UIB 716 15kHz Reference



UIB 716 15kHz @ +16dB >50% Modulation



716 2.5kHz UIB @ +16 > 50% Modulation



UIB 716 2.5kHz Reference



9.0 Frequency Deviation and Tolerance - PART 74.861

Paragraph e-3 states that the maximum authorized deviation shall be 75 kHz for all frequency modulation emissions in the frequency bands 692 - 716 MHz.

Frequency Deviation used: **15 kHz, 153.33% modulation**

Paragraph e-4 states that the frequency tolerance of the transmitter shall be .005 percent.

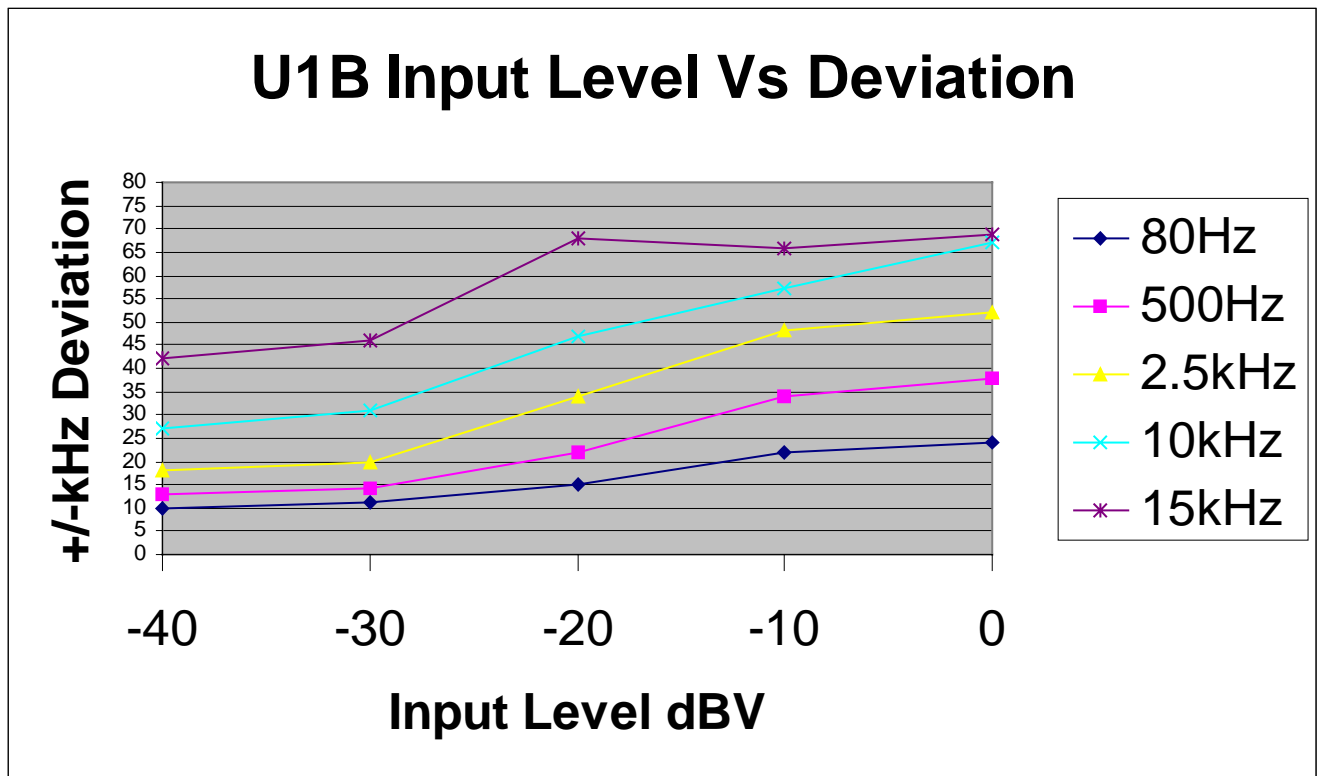
NOTE:

See the following pages for the graphs of the actual measurements made:

GRAPHS TAKEN OF THE FREQUENCY DEVIATION

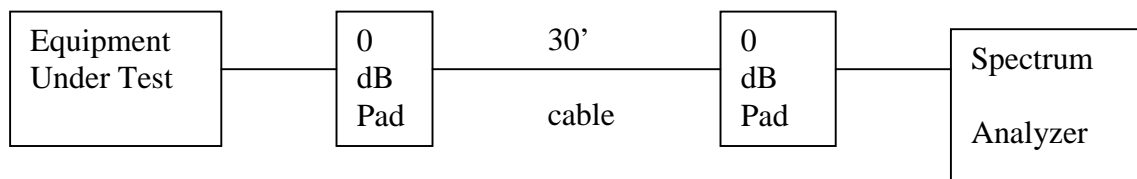
WITH MODULATION

PART 2.989



10.0 SPURIOUS CONDUCTED EMISSION MEASUREMENTS AT ANTENNA TERMINALS PART 2.991

Spurious conducted emissions were measured at the antenna terminals using an artificial load. Plots were made showing the amplitude of each harmonic emissions with the equipment operated as specified in 2.989. As shown by the radiated charts there was no reason to believe that there were any spurious emissions other than the harmonics which were than individually investigated when doing the conducted test at the antenna terminals. Measurements were made up to the 10 Harmonic of the fundamental. The following setup was used showing placement of the attenuators:



The allowed emissions for transmitters operating in the 692 - 716 MHz bands for U1B UHF-FM Body Pack Transmitter equipment are found under Part 74, Section 74.861, Paragraph e-6 for Low Power Auxiliary Stations. This paragraph states the mean power of the emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

- (1) On any frequency removed from the operating frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: at least 25 dB.
- (2) On any frequency removed from the operating frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: at least 35 dB.
- (3) On any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth: at least $43+10\text{Log}_{10}$ (mean output power in watts) dB.

NOTE: See the following pages for the data and graphs of the actual measurements made:

NOTE: This test was not run because there is no antenna port.



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**CONDUCTED EMISSION DATA TAKEN FOR
SPURIOUS EMISSION MEASUREMENTS MADE
AT THE ANTENNA TERMINALS**

PART 2.991

NOTE: This test was not run because there is no antenna port.



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**CONDUCTED EMISSION GRAPHS TAKEN FOR
SPURIOUS EMISSION MEASUREMENTS MADE
AT THE ANTENNA TERMINALS**

PART 2.991

NOTE: This test was not run because there is no antenna port.



11.0 FIELD STRENGTH OF SPURIOUS EMISSION MEASUREMENTS PART 2.993

Radiated measurements were performed at a 1 or 3 meter test distance automatically scanning the frequency range from 200 MHz to 10000 MHz, depending upon the fundamental frequency.

For the U1B UHF-FM Body Pack Transmitter, the highest fundamental frequency is 716 MHz so the scans were made up to 10000 MHz, to cover the tenth harmonic.

All signals in the frequency range of 30 MHz to 200 MHz were measured with a Biconical Antenna and from 200 MHz to 1000 MHz a Log Periodic Antenna was used as the pickup devices. From 1000 MHz to 10000 MHz, a Double Ridge Horn Antenna was used. The cables and equipment were placed and moved within the range of positions likely to find their maximum emissions. Tests were made in both the horizontal and vertical planes of polarization.

The allowed emissions for transmitters operating in the 692 - 716 MHz bands for U1B UHF-FM Body Pack Transmitter equipment are found under Part 74, Section 74.861, Paragraph e-6 for Low Power Auxiliary Stations. This paragraph states the mean power of the emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

- (1) On any frequency removed from the operating frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: at least 25 dB.
- (2) On any frequency removed from the operating frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: at least 35 dB.
- (3) On any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth: at least $43 + 10 \log_{10}$ (mean output power in watts) dB.



11.0 FIELD STRENGTH OF SPURIOUS EMISSION MEASUREMENTS (CON'T) PART 2.993

To determine the limit for all spurious & harmonic emissions, the following method was used:

LIMIT for Spurious Emissions:

As stated in Part 74, Section 74.861 (e-1 ii) the limit is 250 mW in the frequency range 692.125 - 715.875 MHz.

$$43 + 10 * \text{LOG}_{10}(0.25 \text{ watts}) = 36.98 \text{ dB}$$

23.03dBm extrapolated level for 0.01 watts

-36.98 dB required reduction below the unmodulated fundamental

-13.95 dBm or 93.05 dBuV/m at 1 meter maximum spurious emissions allowed

Extrapolating the level to 3 meters:

$$93.05 \text{ dBuV/m} - 9.54 \text{ dB} = \mathbf{83.51 \text{ dBuV/m at 3 meters}}$$

NOTE:

The data and graphs taken during testing can be found under the exhibits label "Radiated Data and Radiated Graphs".



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RADIATED DATA TAKEN FOR FIELD STRENGTH

SPURIOUS EMISSION MEASUREMENTS

PART 2.993

NOTE:

The data taken during testing can be found under the exhibit label “Radiated Data”.



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RADIATED GRAPHS TAKEN FOR FIELD STRENGTH

SPURIOUS EMISSION MEASUREMENTS

PART 2.993

NOTE:

The graphs taken during testing can be found under the exhibit label “Radiated Graphs”.



12.0 FREQUENCY STABILITY - PART 2.995a (Temperature)

The frequency stability was measured from -30° to +50° centigrade at intervals of 10° centigrade throughout the range. Prior to each frequency measurement, the equipment was left alone for a sufficient period of time (approximately 30 minutes or more) to allow the components of the U1B UHF-FM Body Pack Transmitter oscillator circuitry to stabilize. The following information was taken:

FREQUENCY STABILITY FOR TEMPERATURE VARIATION IN MHZ:

-30°	703.990260
-20°	703.998040
-10°	703.998950
0°	703.998950
+10°	703.997080
+20°	703.997080
+30°	703.997430
+40°	703.996820
+50°	703.996400

Worst Case Variance:

8690 Hz

As stated in Part 74, Section 74.861 e-4 the Frequency Tolerance and Margin for this range are as follows:

$$\begin{aligned} \text{Frequency Tolerance:} &= \underline{\mathbf{0.005\%}} \\ 703.990260 * 0.005\% &= \underline{\mathbf{35199.5 Hz}} \\ 35199.5 - 8690 &= \underline{\mathbf{26509.5 Hz}} \end{aligned}$$

This is well in the specified limits.

NOTE:

The Frequency Stability for Temperature Variation Graphs taken during testing can be found under the exhibit label “Temperature Variation Graphs”.



**GRAPHS TAKEN FOR FREQUENCY
STABILITY WHEN VARYING THE TEMPERATURE**

PART 2.995A

NOTE:

The Frequency Stability for Temperature Variation Graphs taken during testing can be found under the exhibit label “Temperature Variation Graphs”.



13.0 FREQUENCY STABILITY - PART 2.995d (**Voltage**)

The frequency stability of U1B UHF-FM Body Pack Transmitter was measured by varying the primary supply voltage from 85% to 115% of nominal value for all equipment other than hand carried battery equipment.

FREQUENCY STABILITY FOR VOLTAGE VARIATION:

85%	0
100%	0
115%	0

FREQUENCY STABILITY FOR HAND HELD DEVICES:

For hand carried, battery powered equipment, the supply voltage was reduced to the battery operating end point specified by the manufacturer. Readings were taken at the reduced end point and with a fresh battery:

Fresh Battery verses Battery end point:

- Frequency #1 **704.37364 Hz**
- Frequency #2 **704.37357Hz**
- Frequency #3 **704.37355 Hz**
- Frequency #4 **704.37353 Hz**
- Frequency #5 **704.37357Hz**
- Frequency #6 **704.37360 Hz**

As stated in Part 74, Section 74.861 e-4 the Frequency Tolerance and Margin for this range are as follows:

Frequency Tolerance: 0.005%

Limit: 35199.5 Hz

This is well in the specified limits.

NOTE:

The Frequency Stability for Voltage Variation Graphs taken during testing can be found under the exhibit label “Voltage Variation Graphs”.



**GRAPHS TAKEN FOR FREQUENCY
STABILITY WHEN VARYING THE
PRIMARY SUPPLY VOLTAGE**

PART 2.995d

NOTE:

The Frequency Stability for Voltage Variation Graphs taken during testing can be found under the exhibit label “Voltage Variation Graphs”



14.0 PHOTO INFORMATION AND TEST SET-UP

The test set-up can be seen on the accompanying photo page.

Item 0 U1B UHF-FM Body Pack Transmitter
FCC ID#: DD4U1B SN: 0710980089
U1 UHF-FM Body Pack Transmitter SN: 0710980089

Item 1 Shielded Microphone Cable.

Item 2

Item 3

Item 4

Item 5

Item 6

Item 7

Item 8

Item 9

Item 10



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15.0 RADIATED PHOTOS TAKEN DURING TESTING.

For photos taken during testing see exhibit label “Test Setup Photos”.



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15.0 CONDUCTED PHOTOS TAKEN DURING TESTING

For photos taken during testing see exhibit label “Test Setup Photos”.



16.0 CHANGE INFORMATION

The following changes were implemented during the testing and must be incorporated into the production units to ensure compliance.

Change 1. There were no changes made at D.L.S. Electronic Systems, Inc.

Change 2.

Change 3.

Change 4.

Change 5.



16.0 CHANGE INFORMATION (CON'T)

Change 6.

Change 7.

Change 8.

Change 9.

Change 10.

The responsibility of implementing the changes listed in this report is accepted or I certify that no changes were made.

by _____
Signature Title

for _____
Company Name Date



17.0 RESULTS OF TESTS

The emission test results can be seen on pages at the end of this report. Data sheets indicating the open field radiated measurements can also be found with this report. Those points on the radiated charts shown with a yellow mark are background frequencies which were verified during the test.

18.0 CONCLUSION

It was found that the UHF-FM Transmitter, S/N 0710980089 the radio interference emission requirements of the FCC "Rules and Regulations", Part 74, Subpart H, Sections 74.801 to 74.882 for Low Power Auxiliary Stations operating in the 692.125 - 715.875 MHz Frequency Band. This test report relates only to the items tested.

This report contains the following number of pages.

Text: 39 pages

Data Summary: 0 pages

Charts: 18 pages



TABLE 1 – EQUIPMENT LIST

Test Equipment	Manufacturer/Description	Model Number	Serial Number	Frequency Range	Cal Due Date
*Spectrum Analyzer	Hewlett/Packard	8566B	2240A 02041	5 Hz - 22GHz	4/99
Quasi-Peak Adapter	Hewlett/Packard	85650A	2043A 00121	10 kHz - 1GHz	4/99
Spectrum Analyzer	Tektronix	492AP	B010123	50kHz-21GHz	5/99
Modulation Analyzer	Boonton	8200	24602bh	100kHz-2000MHz	6/99
Receiver	Electrometrics	EMC-25 Mark-III	772	.01-1000 MHz	10/99
Meter Module	Electrometrics	CRM-25	162	.01-1000 MHz	10/99
Receiver	Electrometrics	EMC-25 Mark-III	804	.01-1000 MHz	10/99
Meter Module	Electrometrics	CRM-25	138	.01-1000 MHz	10/99
Antenna	Electrometrics	BIA-25	2453	20-200 MHz	10/99
Antenna	Electrometrics	LPA-25	1114	200-1000 MHz	10/99
Antenna	Electrometrics	BIA-25	2614	20-200 MHz	10/99
Antenna	Electrometrics	LPA-25	1205	200-1000 MHz	10/99
Antenna	D.L.S.	Dipoles		20-1000 MHz	I/O
Antenna	Electro-Mechanics Co	3115	2479	1 – 18 GHz	I/O

*Firmware Version	29.9.86	Software Version	85864C Rev A
**Firmware Version	14.1.85	Software Version	85864C Rev A
***Firmware Version	5.1.3	Software Version	82301-12029 Rev C

I/O Initial Calibration Only