

ENGINEERING TEST REPORT

UT-3/420-SW08 TRANSMITTER

**IN ACCORDANCE WITH
FCC PART 90, SUBPART I
GENERAL TECHNICAL STANDARDS**

PROJECT NO.: 4DA200-3HS1

TESTED FOR:

**DANIELS ELECTRONICS LIMITED
43 ERIE STREET
VICTORIA, BC
V8V 1P8**

TESTED BY:

**CERTELECOM LABORATORIES INC.
3325 RIVER ROAD AT LIMBANK ROAD
RR#5 OTTAWA, ONTARIO
K1G 3N3**

MAY 1994

FCC ID: H4JUT-3-420-S08

EQUIPMENT: UT-3/420-SW08 Transmitter**GENERAL:**

These tests were conducted on a sample of the equipment for the purpose of compliance with FCC Part 90.

This equipment is designed for operation in the band 406-430 MHz and has provision for wide band (25 kHz channel spacing) voice modulation only. All measurements were made with the transmitter tuned to 418 MHz.

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.**THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO OR EXCLUSIONS FROM THE TEST SPECIFICATION HAVE BEEN MADE. None**TESTED BY: Russell Grant DATE: May 13, 1994APPROVED BY: D. W. Shag DATE: May 10, 1994

FCC ID: H4JUT-3-420-S08

ABSTRACT:

<u>TEST</u>	<u>PARA. NO.</u>	<u>RESULTS</u>
RF Power Output	2.985	CONFORMS
Audio Frequency Response	2.987(a)	CONFORMS
Audio Low-Pass Filter Frequency Response	2.987(a)	CONFORMS
Modulation Limiting	2.987(b)	CONFORMS
Occupied Bandwidth	2.989	CONFORMS
Spurious Emission at Antenna Terminals	2.991	CONFORMS
Field Strength of Spurious Radiation	2.993	CONFORMS
Frequency Stability	2.995	CONFORMS

FCC ID: H4JUT-3-420-S08

EQUIPMENT: UT-3/420-SW08 Transmitter**NAME OF TEST**

RF Power Output

PARA. NO.

2.985

TEST PERFORMED BY: Russell Grant**DATE:** April 28, 1994**TEST CONDITIONS**Standard Temperature & Humidity
Standard Test Voltage
Unmodulated**TEST EQUIPMENT**

As per block diagram and equipment list attached.

MINIMUM STANDARD

Para. No. 90.205(b). The transmitter power output shall not exceed 75 watts.

TESTS RESULTS

CONFORMS. The maximum RF power output is 8.0 watts.

MEASUREMENT DATA

<u>Power Output</u> (Watts)
8.0 Maximum
2.0 Minimum

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EQUIPMENT: UT-3/420-SW08 Transmitter**NAME OF TEST**

Audio Frequency Response

PARA. NO.

2.987(a)

TEST PERFORMED BY: Russell Grant**DATE:** April 27, 1994**TEST CONDITIONS**Standard Temperature & Humidity
Standard Test Voltage
Modulated**TEST EQUIPMENT**

As per block diagram and equipment list attached.

MINIMUM STANDARD

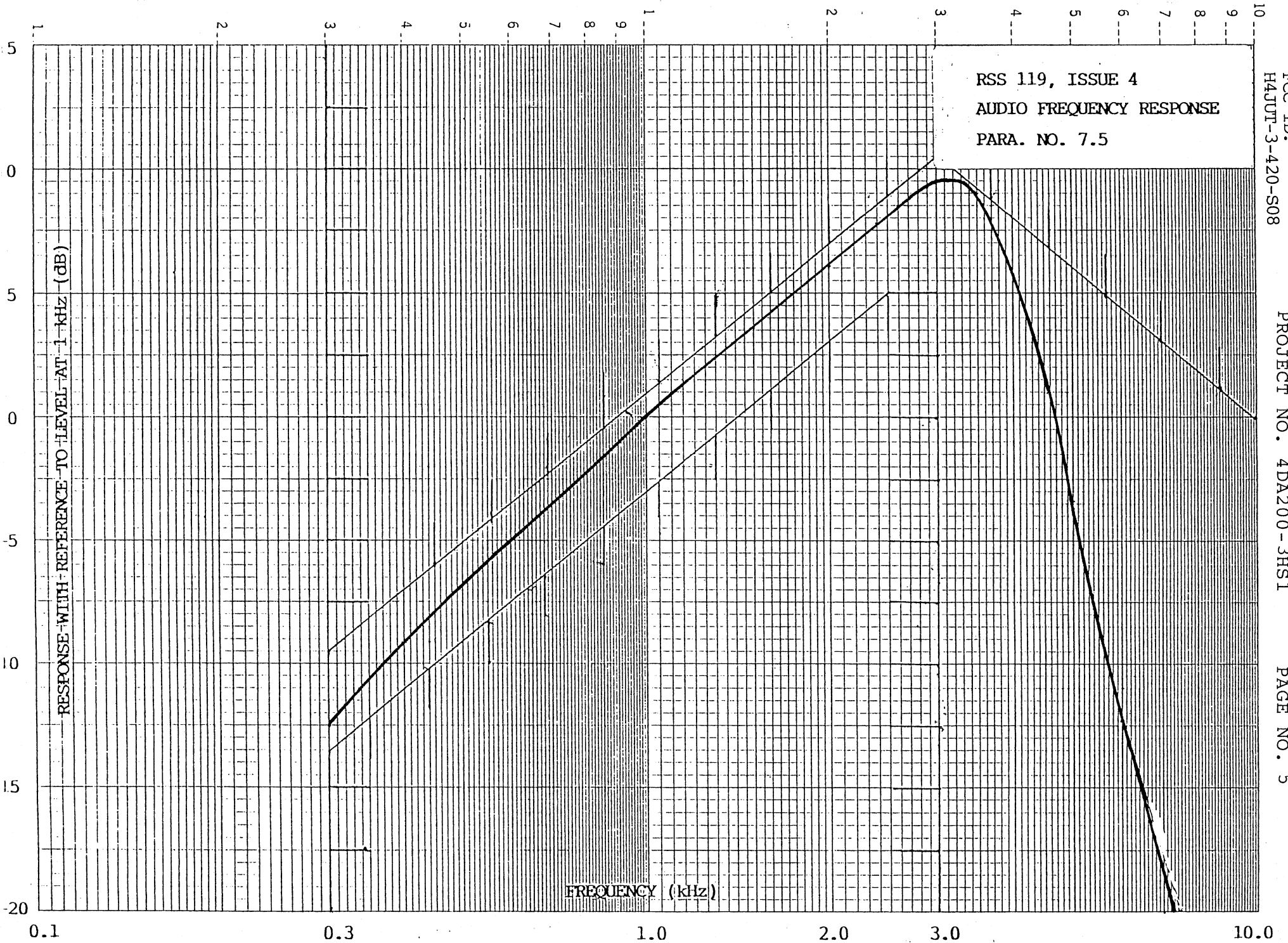
E1A RS-152-B, Para. No. 7.2(b) from 300 Hz to 3000 Hz. The transmitter audio frequency response shall have a nominal 6 dB per octave pre-emphasis characteristic.

TEST RESULTS

CONFORMS. See attached graph.

MEASUREMENT DATA See attached graph.

RSS 119, ISSUE 4
AUDIO FREQUENCY RESPONSE
PARA. NO. 7.5



FCC ID: H4JUT-3-420-S08

EQUIPMENT: UT-3/420-SW08 Transmitter**NAME OF TEST**

Audio Low-Pass Filter Frequency Response

PARA. NO.

2.987(a)

TEST PERFORMED BY: Russell Grant**DATE:** April 28, 1994**TEST CONDITIONS**Standard Temperature & Humidity
Standard Test Voltage
Modulated**TEST EQUIPMENT**

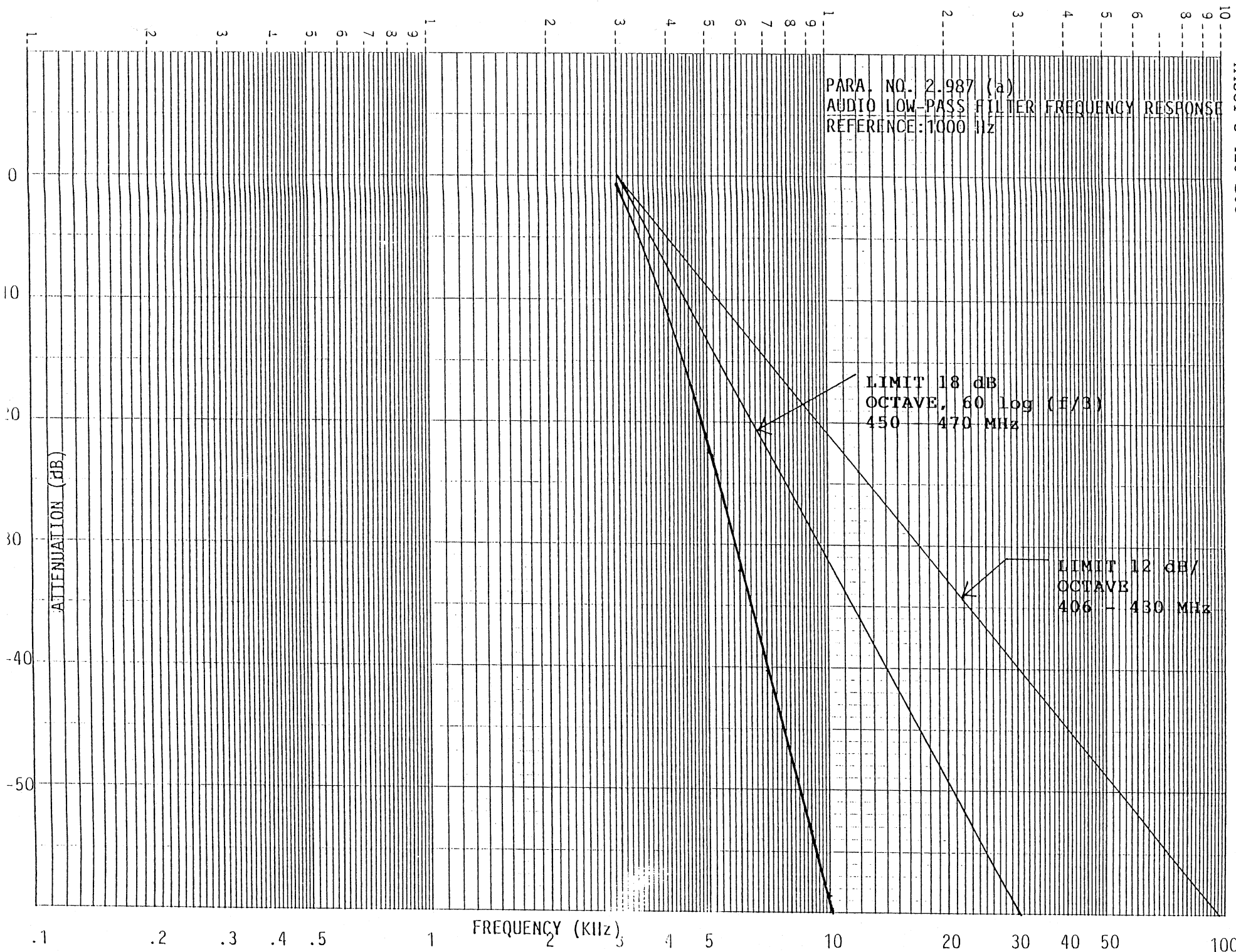
As per block diagram and equipment list attached.

MINIMUM STANDARDPara. No. 90.211(d)(1)(ii). The attenuation of the audio low-pass filter between the frequencies 3 kHz and 20 kHz shall be greater than the attenuation at 1 kHz by at least: $60\log(f/3)$ decibels where f is the frequency in kHz. At frequencies above 20 kHz, attenuation shall be 50 dB greater than the attenuation at 1 kHz.**TEST RESULTS**

CONFORMS. See attached graph.

MEASUREMENT DATA

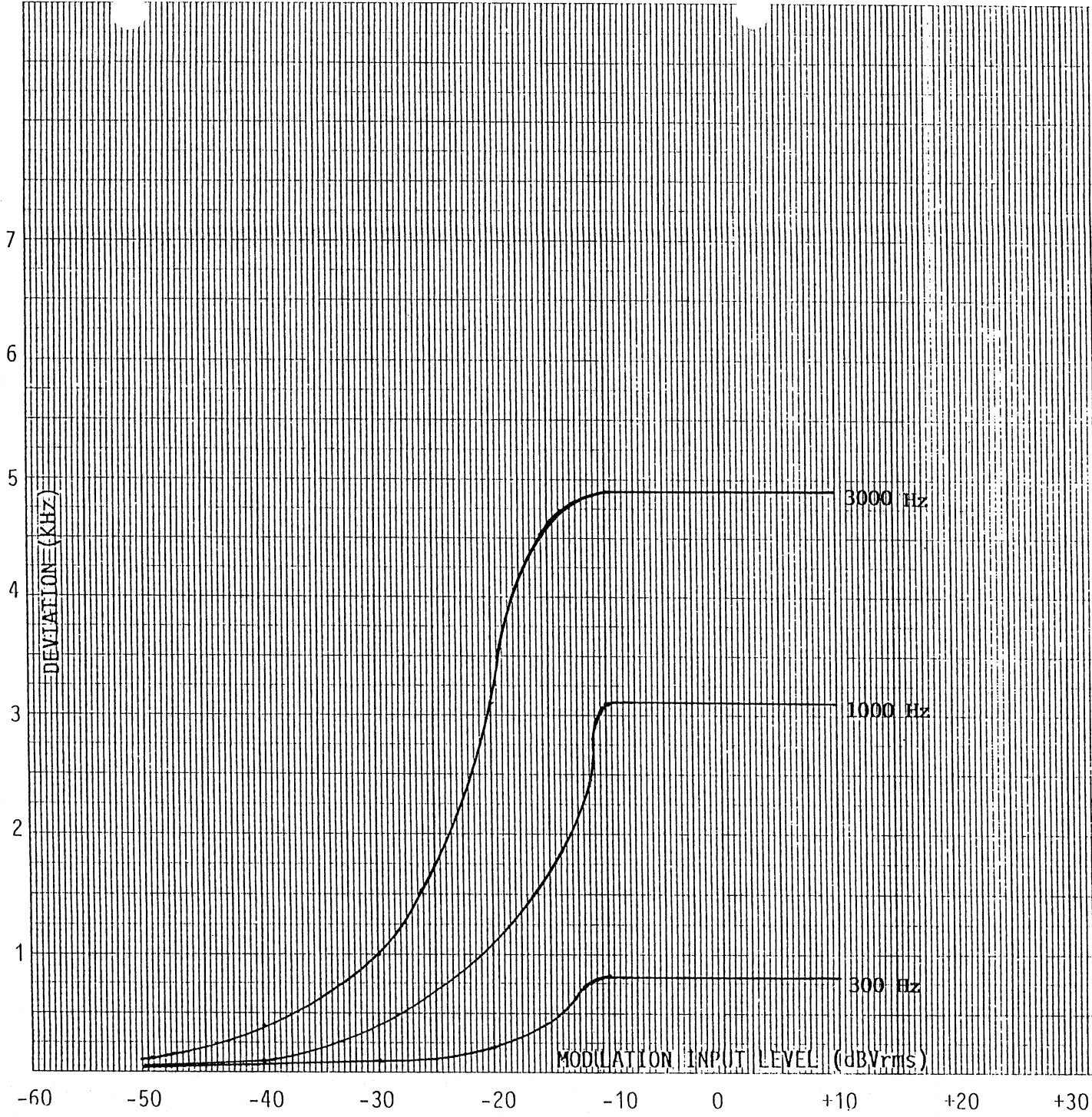
See attached graph.



FCC ID: H4JUT-3-420-S08

EQUIPMENT: UT-3/420-SW08 Transmitter**NAME OF TEST**
Modulation Limiting**PARA. NO.**
2.987(b)**TEST PERFORMED BY:** Russell Grant**DATE:** April 27, 1994**TEST CONDITIONS** Standard Temperature & Humidity
Standard Test Voltage**TEST EQUIPMENT** As per block diagram and equipment list attached.**MINIMUM STANDARD** Para. No. 90.209(b)(4). The maximum frequency deviation shall not exceed ± 5.0 kHz.**TEST RESULTS** CONFORMS. The maximum deviation is 4.9 kHz.**MEASUREMENT DATA** See attached graph.

PARA. NO. 21987 (b)
MODULATION LIMITING



FCC ID: H4JUT-3-420-S08

EQUIPMENT: UT-3/420-SW08 Transmitter**NAME OF TEST**
Occupied Bandwidth**PARA. NO.**
2.989**TEST PERFORMED BY:** Russell Grant**DATE:** April 27, 1994**TEST CONDITIONS** Standard Temperature & Humidity
Standard Test Voltage**TEST EQUIPMENT** As per block diagram and equipment list attached.**MINIMUM STANDARD** Para. No. 90.209(c). Emissions shall be attenuated as follows:

<u>Frequency Range</u> (kHz)	<u>Attenuation</u> (dB)
$f_c \pm 10$ to $f_c \pm 20$	25
$f_c \pm 20$ to $f_c \pm 50$	35
$<f_c - 50$ to $>f_c + 50$	$43 + 10\log P^*$

* P is the mean output power of the transmitter in watts.

TEST RESULTS CONFORMS. See attached graphs.**MEASUREMENT DATA** See attached graphs.

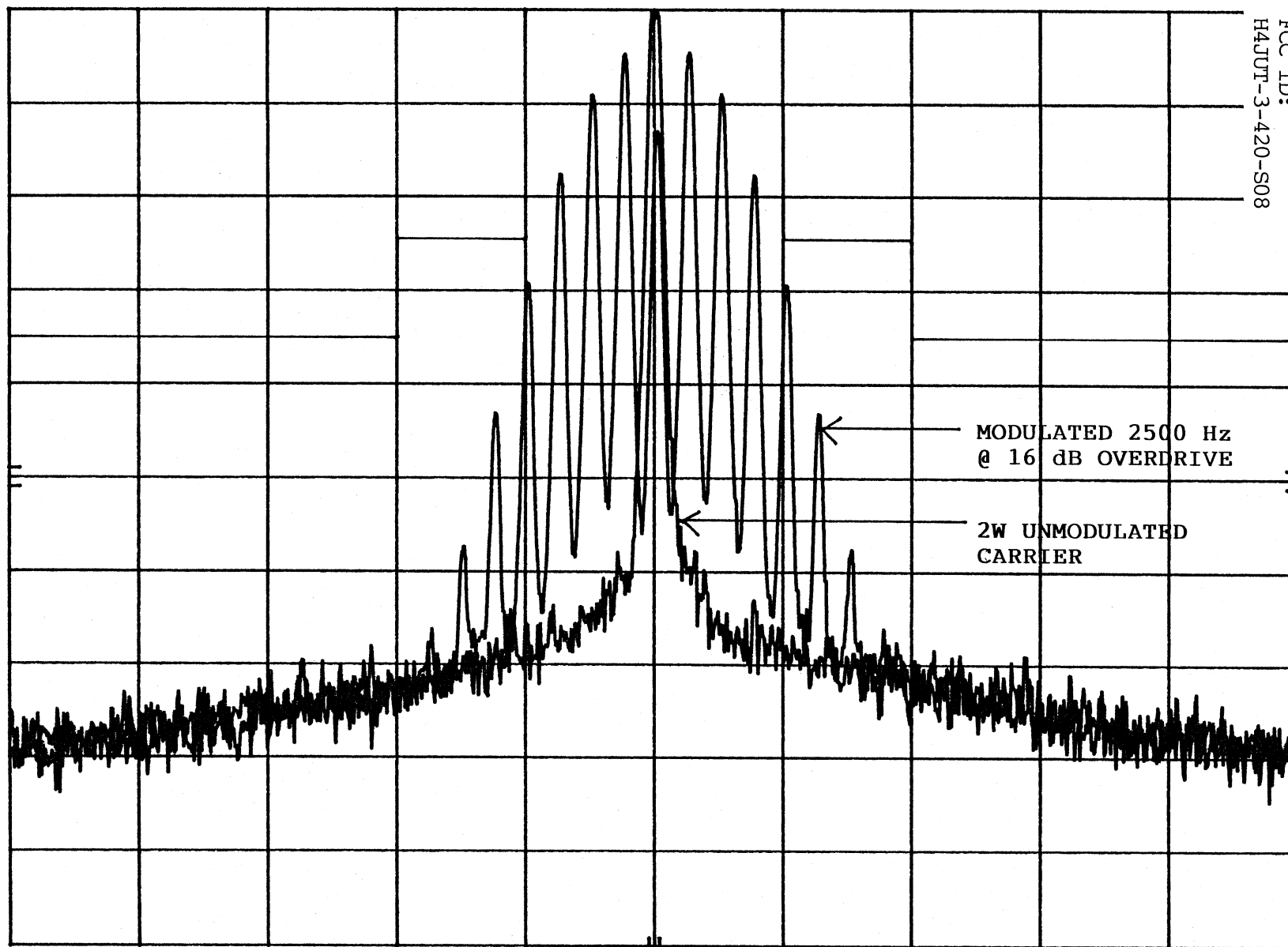
hp
10 dB/

ATTEN 30 dB

FCC ID:
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CENTER 418.000 MHz

RES BW 300 Hz

VBW 1 kHz

SPAN 100 kHz

SWP 3.00 sec

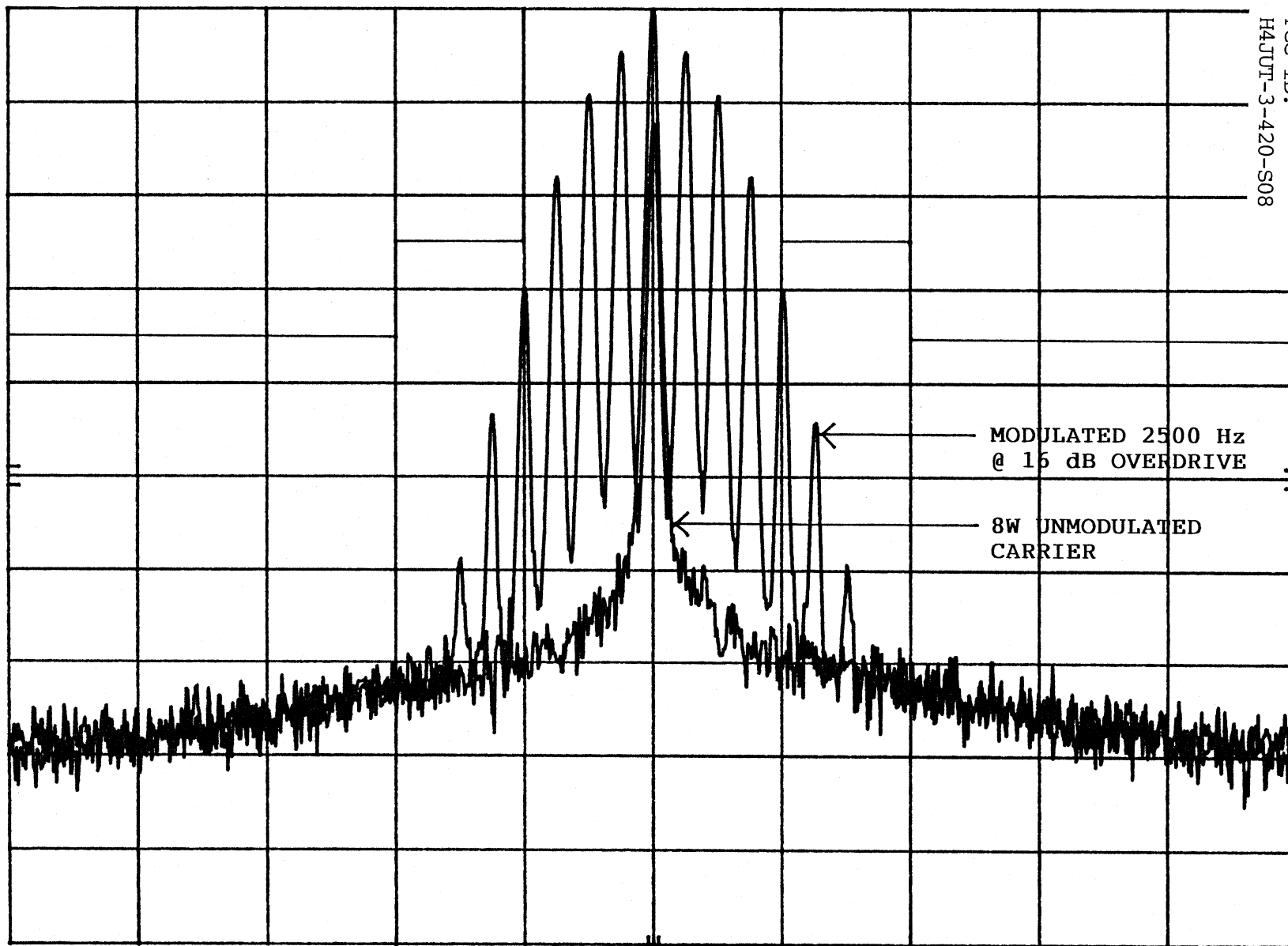
hp
10 dB/

ATTEN 30 dB

FCC ID:
H4JUT-3-420-S08

PROJECT NO. 4DA200-3HS1

PAGE NO. 12



CENTER 418.000 MHz

RES BW 300 Hz

VBW 1 kHz

SPAN 100 kHz

SWP 3.00 sec

FCC ID: H4JUT-3-420-S08

EQUIPMENT: UT-3/420-SW08 Transmitter**NAME OF TEST**

Spurious Emission at Antenna Terminals

PARA. NO.

2.991

TEST PERFORMED BY: Russell Grant**DATE:** April 27, 1994**TEST CONDITIONS**Standard Temperature & Humidity
Standard Test Voltage**TEST EQUIPMENT**

As per block diagram and equipment list attached.

MINIMUM STANDARDPara. No. 90.209(c). Spurious Emissions at the antenna terminals shall be attenuated below the mean output power of the transmitter by at least $43 + 10\log$ (mean power output in watts) dB.**TEST RESULTS**

CONFORMS. The strongest emission is -20.2 dBm @ 836 MHz. This is 7.2 dB below the specification limit.

MEASUREMENT DATA Mean Output Power of Transmitter 39.0 dBm.

<u>Frequency</u> (MHz)	<u>Emission Level</u> (dBm)	<u>Attenuation</u> (dB)
836	-20.2	59.2
1254	-20.3	59.3
2926	-28.4	67.4

FCC ID: H4JUT-3-420-S08

EQUIPMENT: UT-3/420-SW08 Transmitter**NAME OF TEST**

Field Strength of Spurious Radiation

PARA. NO.

2.993

TEST PERFORMED BY: Russell Grant**DATE:** March 31, 1994**TEST CONDITIONS**Outdoor Range
Standard Test Voltage**TEST EQUIPMENT**

As per block diagram and equipment list attached.

MINIMUM STANDARDPara. No. 90.209(c). The field strength of spurious radiation shall be attenuated below the mean output power of the transmitter by at least $43 + 10\log$ (mean output power in watts) dB.**TEST RESULTS**

CONFORMS. The strongest emission is -50.7 dBm @ 1254 MHz. This is 90.0 dB below the unmodulated carrier.

MEASUREMENT DATA

See attached.

FCC ID: H4JUT-3-420-S08

MEASUREMENT DATA:

Frequency of Emission (MHz)	Polarization		Received Signal (dBμV)	Antenna Factor* (dB)	Field Strength (dBμV@3m)	Radiated Power (dBm)	Attenuation (dBc)
	H	V					
836		x	-4.7	33.0	28.3	-69.1	108.4
836	x		-1.6	33.0	31.4	-66.0	105.3
1254		x	12.2	25.2	37.4	-57.8	97.1
1254	x		19.3	25.2	44.5	-50.7	90.0
2090		x	44.1	28.3 -40.6	31.8	-63.4	102.7
2090	x		46.8	28.3 -40.6	34.5	-60.7	100.0
2508		x	39.0	29.3 -38.0	30.3	-64.9	104.2
2508	x		43.9	29.3 -38.0	35.2	-60.0	99.3
2926		x	36.0	30.1 -35.6	30.5	-64.7	104.0
2926	x		39.3	30.1 -35.6	33.8	-61.4	100.7
3344		x	27.9	31.1 -33.0	26.0	-69.2	108.5
3344	x		25.7	31.1 -33.0	23.8	-71.4	110.7
3762		x	39.9	32.0 -31.2	40.7	-54.5	93.8
3762	x		37.1	32.0 -31.2	37.9	-57.3	96.6
4180		x	29.9	32.7 -29.5	33.1	-62.1	101.4
4180	x		NOT DETECTED				
		x					
	x						
		x	See attached sample calculation				
	x						

* Includes cable loss and amplifier gain.

CALCULATION OF RADIATED POWER

All emissions below 1000 MHz are expressed in terms of the equivalent power that would have to be fed into a dipole antenna in order to produce the same electric field strength. All emissions above 1000 MHz are expressed in terms of equivalent isotropic power. The equivalent power was determined by using the following formula: $P_t = E^2 R^2 / 30G$

Example: Electric field strength is $E = 41.1 \text{ dB}\mu\text{V/m}$
 Measured at a distance of $R = 3\text{m}$
 The gain of a dipole antenna is 1.64

$$P_t = [10^{(41.1/20)} \times 10^{-6}]^2 \times 3^2 / 30 \times 1.64 = 2.36 \times 10^{-9} \text{ watts} = -56.3 \text{ dBm}$$

When calculating equivalent isotropic radiated power for emissions above 1000 MHz the gain is $G=1$.

Example: If the mean output power of the transmitter is 3 watts.

The minimum attenuation is $43 + 10\text{Log } 3 = 47.8$ so the maximum power must not exceed $3 \times 10^{-4.78} = 4.98 \times 10^{-5}\text{W}$.

Using the above relation we have $E = (30GP_t)^{0.5} / R$

For emissions which are less than or equal to 1000 MHz

$$G = 1.64 \text{ and } E = (30 \times 1.64 \times 4.98 \times 10^{-5})^{0.5} / 3 = 0.0165 \text{ v/m} \\ = 84.3 \text{ dB}\mu\text{V}$$

Therefore the electric field strength of emissions must not exceed $84.3 \text{ dB}\mu\text{V/m @ } 3\text{m}$.

Similarly for emissions which are greater than 1000 MHz $G=1$ and the field strength must not exceed $82.2 \text{ dB}\mu\text{V/m @ } 3\text{m}$.

EQUIPMENT: UT-3/420-SW08 Transmitter**NAME OF TEST**

Frequency Stability

PARA. NO.

2.995

TEST PERFORMED BY: Russell Grant**DATE:** April 4, 1994**TEST CONDITIONS**

As per measurement data.

TEST EQUIPMENT

As per block diagram and equipment list attached.

MINIMUM STANDARDPara. No. 90.213. The transmitter carrier frequency shall remain within ± 0.0005 percent of the assigned frequency.**TEST RESULTS**

CONFORMS. The maximum frequency drift is 284 Hz, 0.0000679% of the standard test frequency.

MEASUREMENT DATA

Assigned Frequency: 418.000 MHz

Standard Test Voltage: 13.8 VDC

<u>Temperature</u> (°C)	<u>Frequency Drift</u> (Hz)
-30	+3
-20	+183
-10	+284
0	+219
+10	-114
+20	-100
+30	+109
+40	+12
+50	+148
<u>Voltage</u> (VDC)	<u>Frequency Drift</u> (Hz)
11.7	-108
13.8	-100
15.9	-118

FCC ID: H4JUT-3-420-S08

MEASUREMENT DATA:

Standard Test Frequency: 418.000 MHz

Standard Test Voltage: 13.8 VDC

FREQUENCY VERSUS SUPPLY VOLTAGE

TIME (Min)	11.7 VDC	13.8 VDC	15.9 VDC
0	417.999 896	417.999 905	417.999 887
0.5	417.999 895	417.999 904	417.999 886
1.0	417.999 894	417.999 903	417.999 886
1.5	417.999 894	417.999 902	417.999 886
2.0	417.999 894	417.999 902	417.999 885
2.5	417.999 892	417.999 901	417.999 884
3.0	417.999 892	417.999 900	417.999 882

FCC ID: H4JUT-3-420-S08

MEASUREMENT DATA

Standard Test Frequency: 418.000 MHz

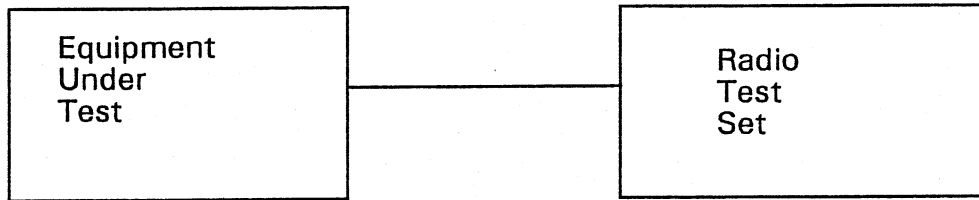
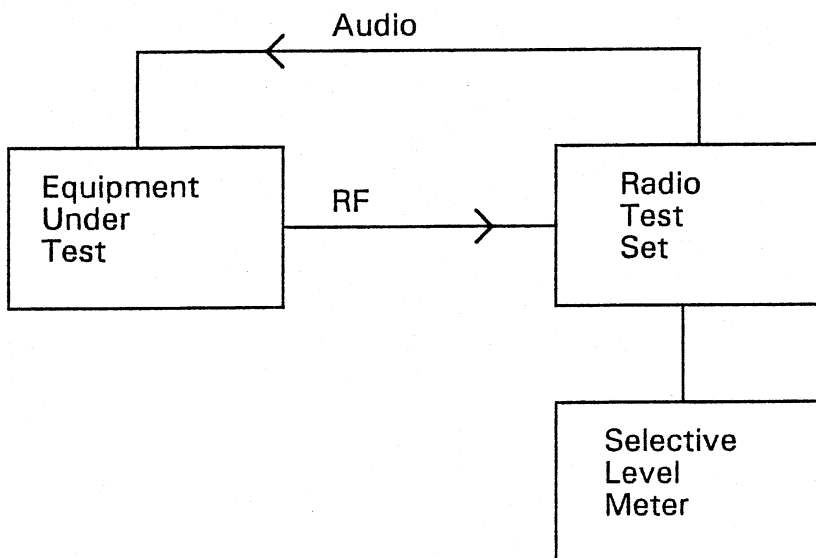
Standard Test Voltage: 13.8 VDC

<u>TIME</u>	<u>Frequency (MHz)</u>			
(Min)	<u>-30°C</u>	<u>-20°C</u>	<u>-10°C</u>	<u>0°C</u>
0	418.000 047	418.000 166	418.000 282	418.000 218
0.5	418.000 048	418.000 166	418.000 283	418.000 218
1.0	418.000 050	418.000 171	418.000 284	418.000 217
1.5	418.000 052	418.000 176	418.000 284	418.000 218
2.0	418.000 052	418.000 176	418.000 284	418.000 217
2.5	418.000 051	418.000 181	418.000 284	418.000 216
3.0	418.000 053	418.000 183	418.000 284	418.000 216

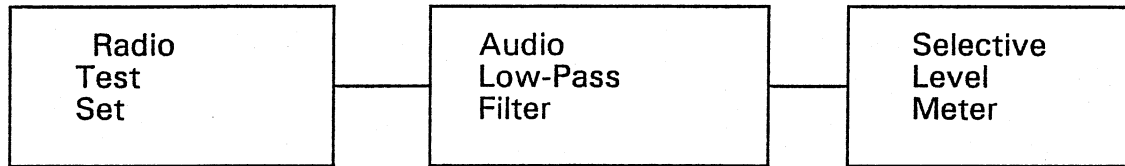
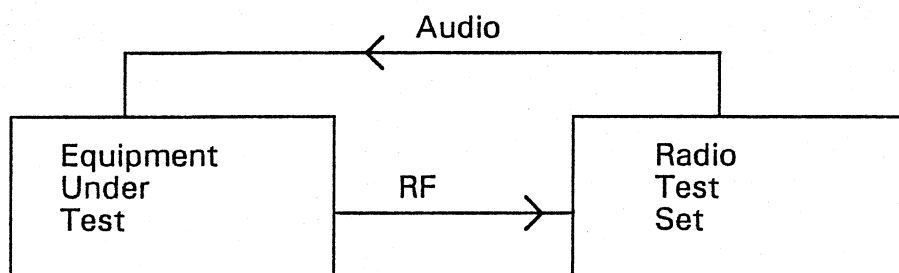
<u>TIME</u>	<u>Frequency (MHz)</u>				
(Min)	<u>+10°C</u>	<u>+20°C</u>	<u>+30°C</u>	<u>+40°C</u>	<u>+50°C</u>
0	417.999 891	417.999 905	418.000 109	418.000 012	418.000 148
0.5	417.999 890	417.999 904	418.000 106	418.000 012	418.000 147
1.0	417.999 890	417.999 903	418.000 106	418.000 012	418.000 147
1.5	417.999 888	417.999 902	418.000 107	418.000 010	418.000 145
2.0	417.999 887	417.999 902	418.000 105	418.000 010	418.000 144
2.5	417.999 886	417.999 901	418.000 105	418.000 009	418.000 143
3.0	417.999 887	417.999 900	418.000 104	418.000 008	418.000 142

EQUIPMENT LIST

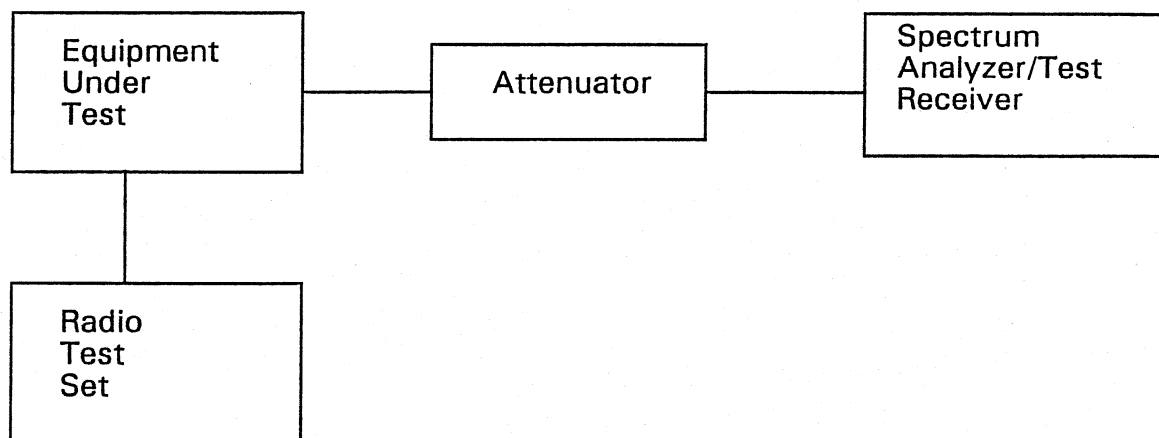
<u>Equipment</u>	<u>Manufacturer</u>	<u>Model</u>
Attenuator	Sage	9990-20
Test Receiver	Rohde & Schwarz	ESVP
Antenna	Electrometrics	RGA-180
Antenna	Roberts	Dipoles
Power Supply	Astron	VS-50M
Radio Test Set	Rohde & Schwarz	CMS 52
Selective Level Meter	Hewlett Packard	3586B
Spectrum Analyzer	Hewlett Packard	8566B
Climate Chamber	Conrad	FH-27-3-3
Amplifier	Avantek	AWT8035

MEASUREMENT PROCEDURE PARA. NO. 2.985**RF POWER OUTPUT****MEASUREMENT PROCEDURE PARA. NO. 2.987(a)****AUDIO FREQUENCY RESPONSE**

FCC ID: H4JUT-3-420-S08

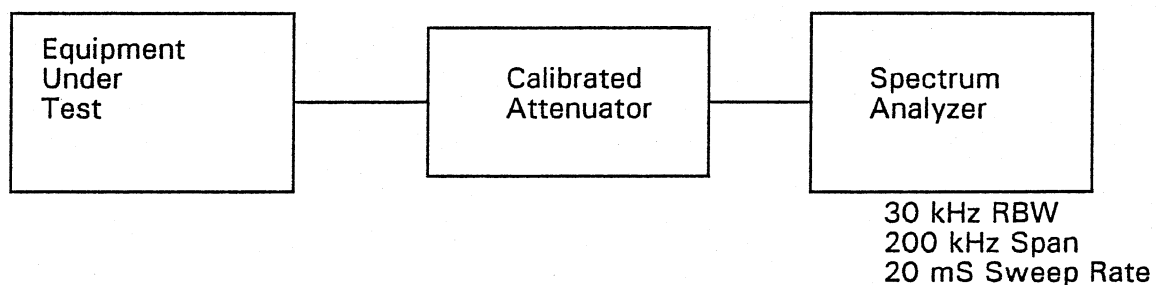
MEASUREMENT DATA PARA. NO. 2.987(a)**AUDIO LOW-PASS
FILTER FREQUENCY
RESPONSE****MEASUREMENT DATA PARA. NO. 2.987(b)****MODULATION LIMITING**

FCC ID: H4JUT-3-420-S08

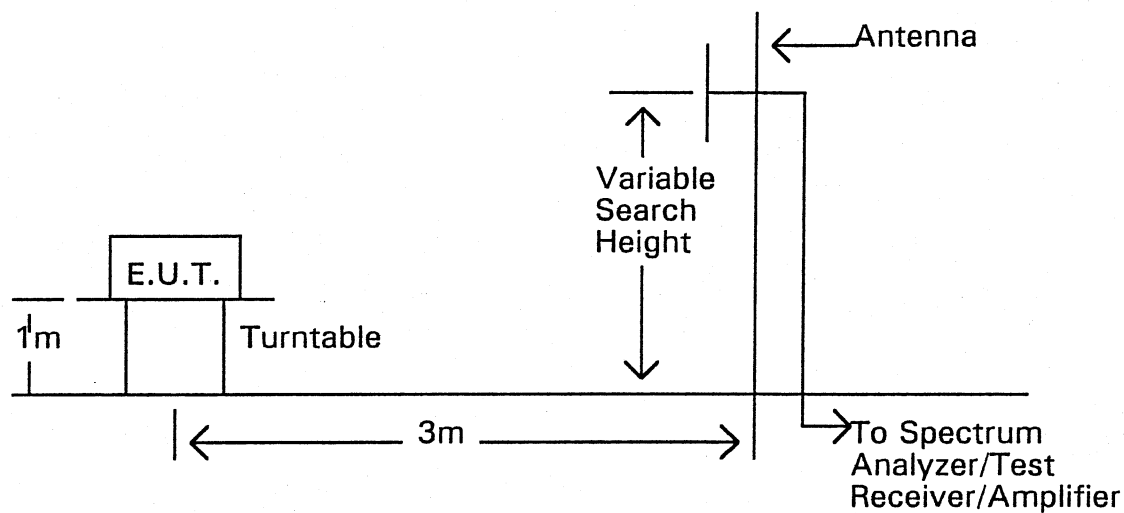
MEASUREMENT PROCEDURE PARA. NO. 2.989**OCCUPIED BANDWIDTH**

The transmitter was modulated with a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50% modulation.

Spectrum Analyzer settings as per measurement data.

MEASUREMENT DATA PARA. NO. 2.991**SPURIOUS EMISSIONS AT ANTENNA TERMINALS**

FCC ID: H4JUT-3-420-S08

**MEASUREMENT DATA PARA. NO. 2.993
SPURIOUS****FIELD STRENGTH OF
RADIATION**Frequency Range

<1300 MHz

Test Receiver Settings

12 kHz BW

Average Detector

>1300 MHz

Spectrum Analyzer Settings

30 kHz RBW

200 kHz Span

20 mS Sweep Rate

FCC ID: H4JUT-3-420-S08

MEASUREMENT PROCEDURE PARA. NO. 2.995

FREQUENCY STABILITY

