

ENGINEERING TEST REPORT

UT-3/420-SN08 TRANSMITTER

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

PROJECT NO.: 4DA200-3HS1

TESTED FOR:

**DANIELS ELECTRONICS LTD.
43 ERIE STREET
VICTORIA, B.C.
V8V 1P8**

TESTED BY:

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

APRIL 1994

FCC ID: H4JUT-3-420-S08

EQUIPMENT: UT-3/420-SN08 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 bands 406-430 MHz and has provision for narrow band (12.5 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 EXCLUSION FROM THE TEST SPECIFICATION HAVE BEEN MADE. None**TESTED BY: Russell Grant DATE: April 29, 1994APPROVED BY: David W. Shige DATE: April 29, 1994

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

EQUIPMENT: UT-3/420-SN08 Transmitter**NAME OF TEST**

RF Power Output

PARA. NO.

2.985

TEST PERFORMED BY: Russell Grant**DATE:** March 30, 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 RESULTSCONFORMS. The maximum RF power output is 8.5 watts. This is within $\pm 6.25\%$ of the manufacturer's maximum rating of RF power output. The minimum RF power output is 2.0W. This is the manufacturer's minimum rating of RF power output.**MEASUREMENT DATA**

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

The manufacturer's rated of RF power output is 2 to 8W continuously variable. The RF power output control is not accessible to the user.

FCC ID: H4JUT-3-420-S08

EQUIPMENT: UT-3/420-SN08 Transmitter**NAME OF TEST**

Audio Frequency Response

PARA. NO.

2.987(a)

TEST PERFORMED BY: Russell Grant**DATE:** March 30, 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

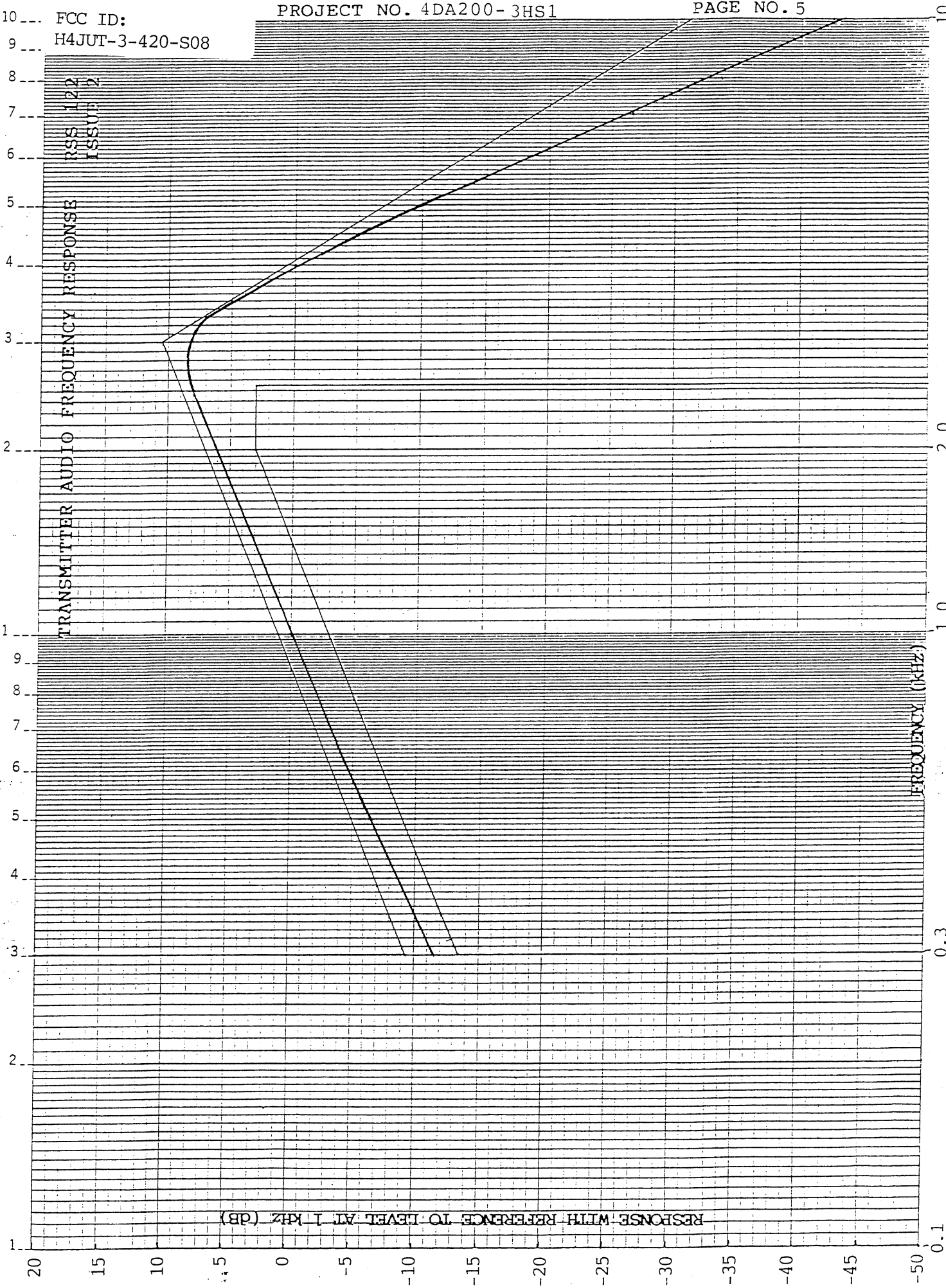
CONFORMS. See attached graph.

MEASUREMENT DATA

See attached graph.

RSS 122
ISSUE 2

TRANSMITTER AUDIO FREQUENCY RESPONSE



FCC ID: H4JUT-3-420-S08

EQUIPMENT: UT-3/420-SN08 Transmitter**NAME OF TEST**

Audio Low-Pass Filter Frequency Response

PARA. NO.

2.987(a)

TEST PERFORMED BY: Russell Grant**DATE:** March 30, 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: $60\text{Log}(f/3)$ 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.

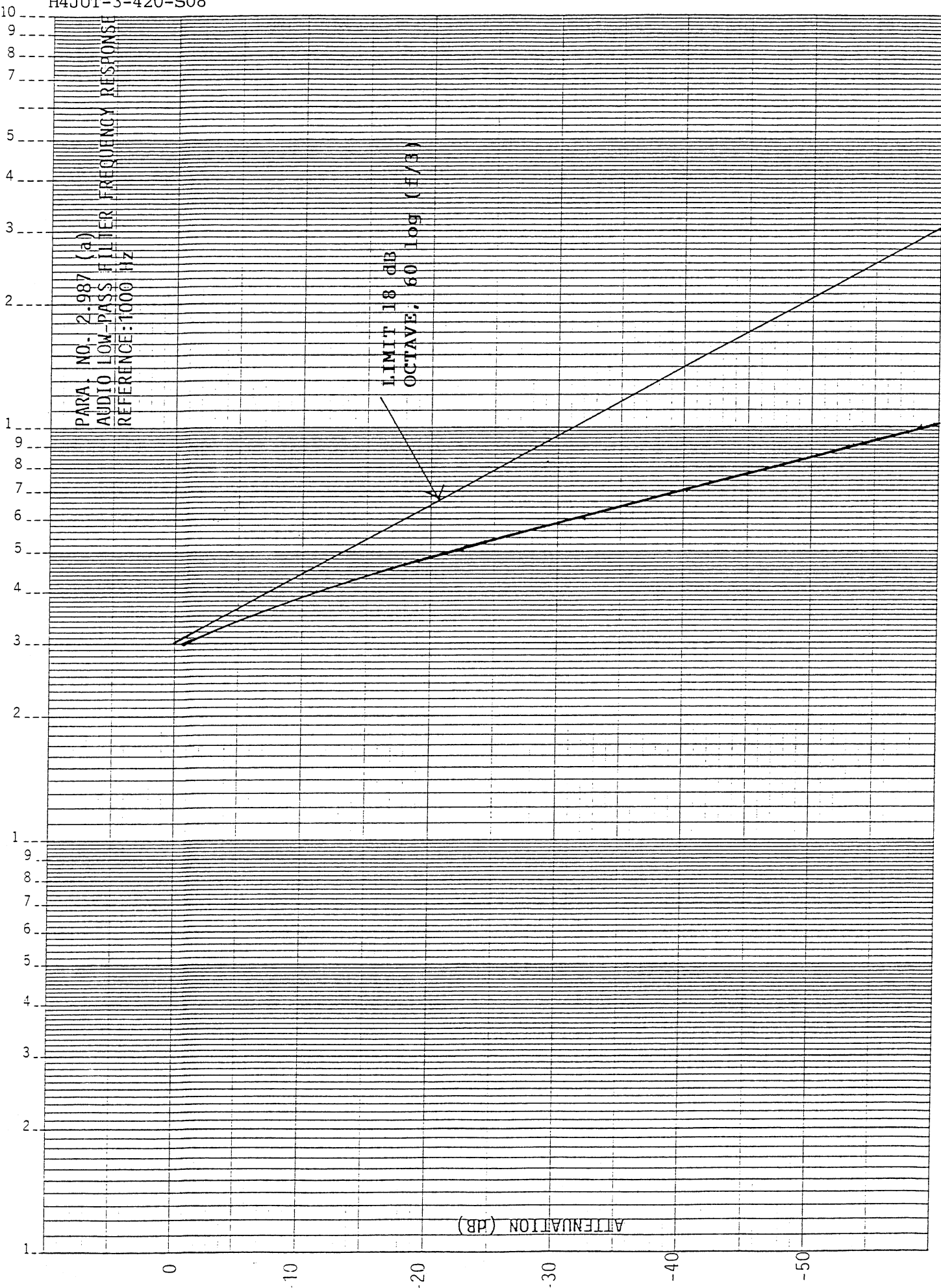
PARA. NO. 2.987 (a)
AUDIO LOW-PASS FILTER FREQUENCY RESPONSE
REFERENCE: 1000 HZ

LIMIT 18 dB
OCTAVE, 60 log (f/3)

ATTENUATION (dB)

FREQUENCY (KHz)

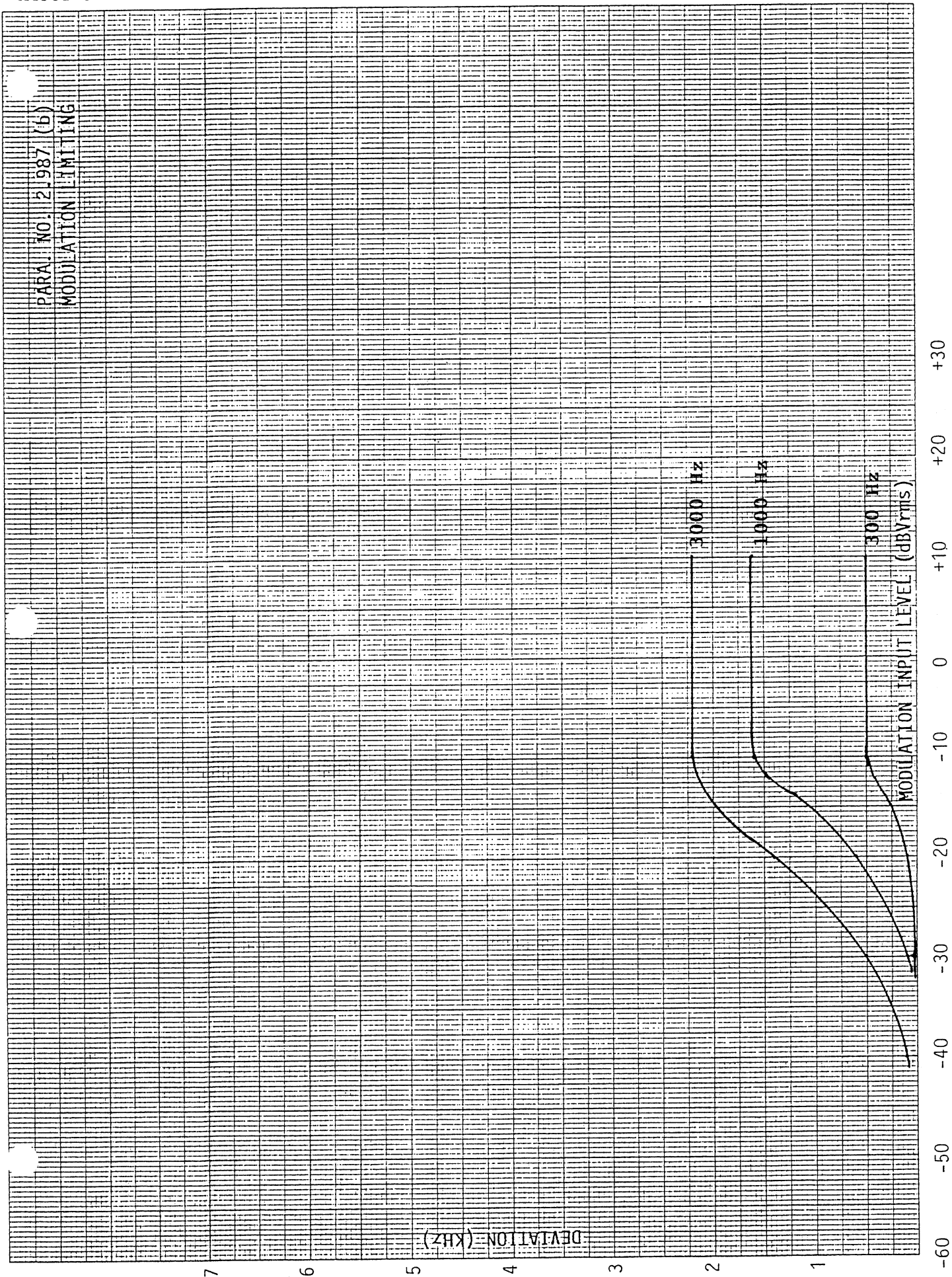
100
50
40
30
20
10
4
5
1
1
0.5
0.4
0.3
0.2
0.1



FCC ID: H4JUT-3-420-S08

EQUIPMENT: UT-3/420-SN08 Transmitter**NAME OF TEST**
Modulation Limiting**PARA. NO.**
2.987(b)**TEST PERFORMED BY:** Russell Grant**DATE:** March 30, 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 2.2 kHz.**MEASUREMENT DATA** See attached graph.

PARA. NO. 21987 (6)
MODULATION LIMITING



FCC ID: H4JUT-3-420-S08

EQUIPMENT: UT-3/420-SN08 Transmitter**NAME OF TEST**

Occupied Bandwidth

PARA. NO.

2.989

TEST PERFORMED BY: Russell Grant**DATE:** March 30, 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.

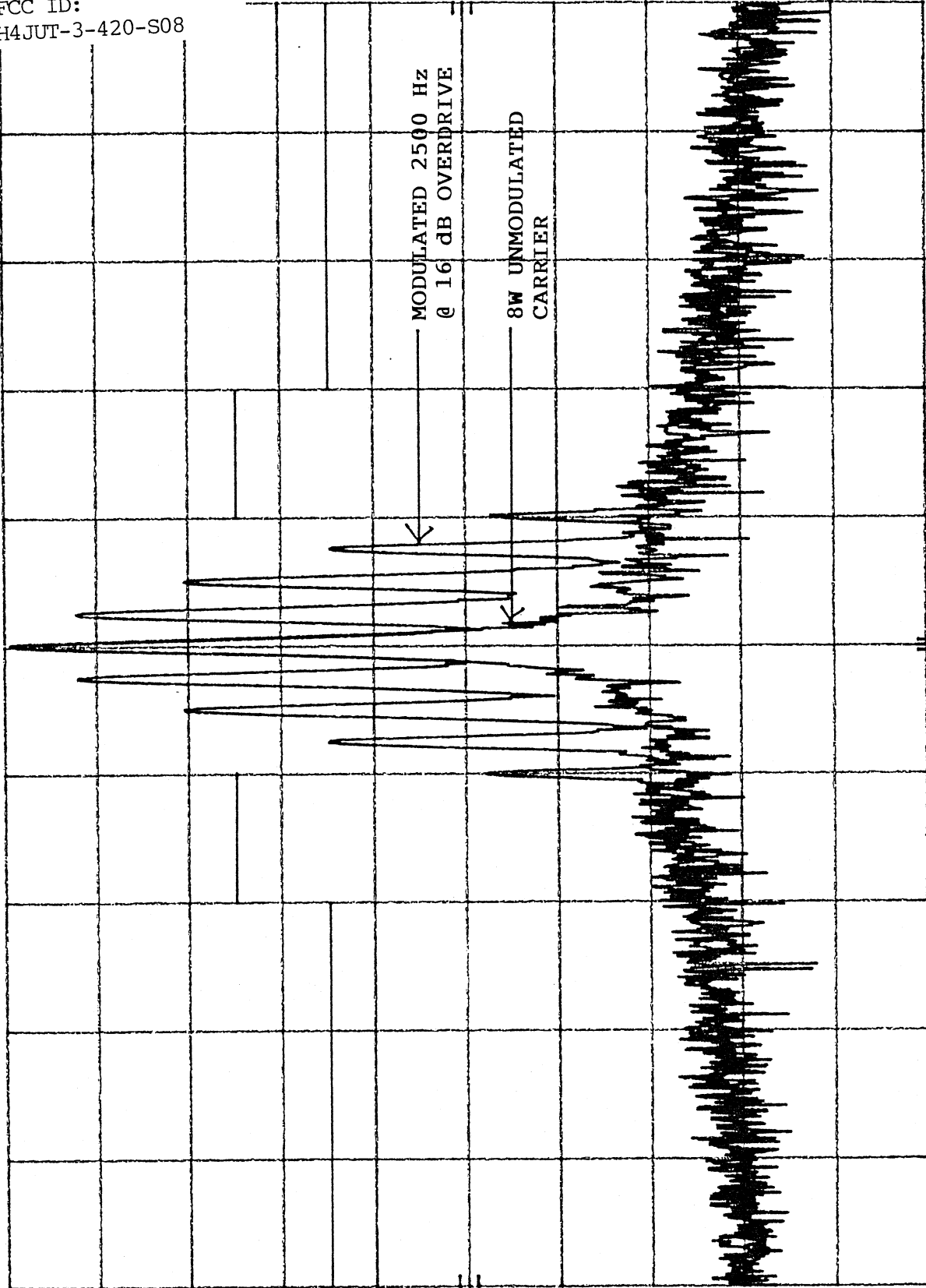
MEASUREMENT DATA

See attached graphs.

FCC ID:
H4JUT-3-420-S08

h₀ REF 1.0 dBm ATTN 20 dB

10 dB/

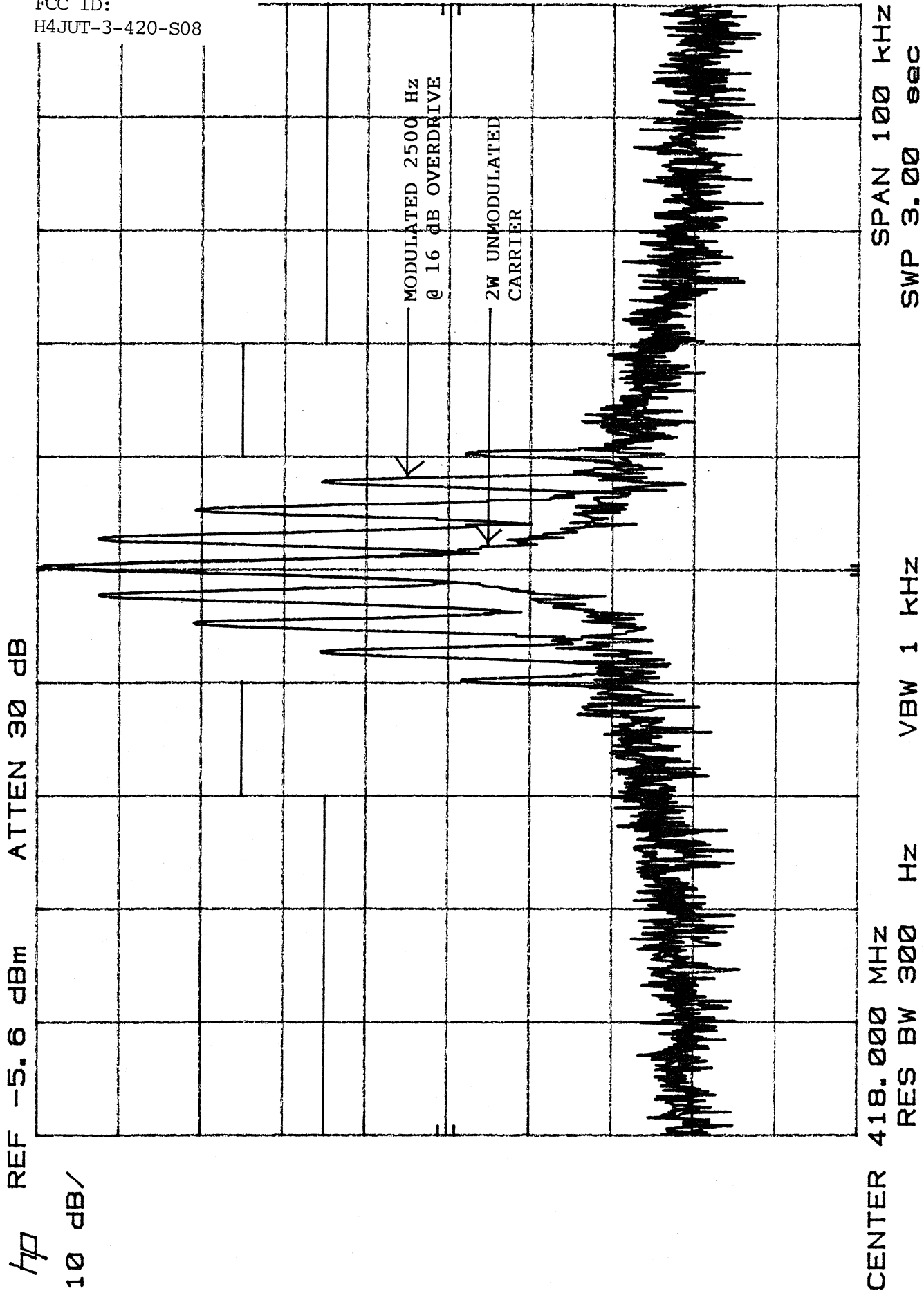


SPAN 100 KHz
SWP 3.00 sec

VBW 1 KHz

CENTER 418.000 MHz
RES BW 300 Hz

FCC ID:
H4JUT-3-420-S08



FCC ID: H4JUT-3-420-S08

EQUIPMENT: UT-3/420-SN08 Transmitter**NAME OF TEST**

Spurious Emission at Antenna Terminals

PARA. NO.

2.991

TEST PERFORMED BY: Russell Grant**DATE:** March 30, 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 -21.5 dBm @ 836 MHz. This is 8.5 dB below the specification limit.

MEASUREMENT DATA Mean Output Power of Transmitter 39.3 dBm.

<u>Frequency</u> (MHz)	<u>Emission Level</u> (dBm)	<u>Attenuation</u> (dB)
836	-21.5	60.8
1254	-22.1	61.4
2926	-31.2	70.5

EQUIPMENT: UT-3/420-SN08 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: Unmodulated Carrier Level: 39.3 dBm

<u>Frequency of Emission</u> (MHz)	<u>Polarization</u> H V		<u>Received Signal</u> (dBμV)	<u>Antenna Factor*</u> (dB)	<u>Field Strength</u> (dBμV@3m)	<u>Radiated Power</u> (dBm)	<u>Attenuation</u> (dBc)
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		See attached sample calculation.				
		x					
	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-SN08 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 STANDARD** Para. 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	+53
-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

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

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	418.000 219
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

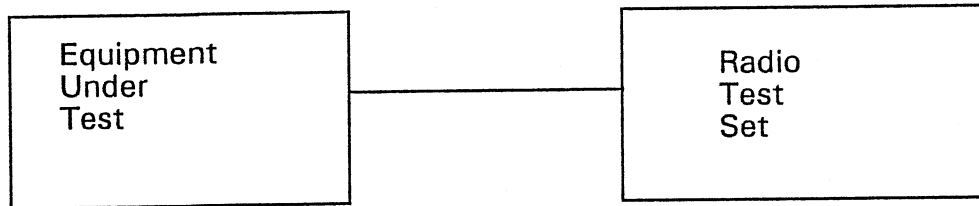
FCC ID: H4JUT-3-420-S08

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

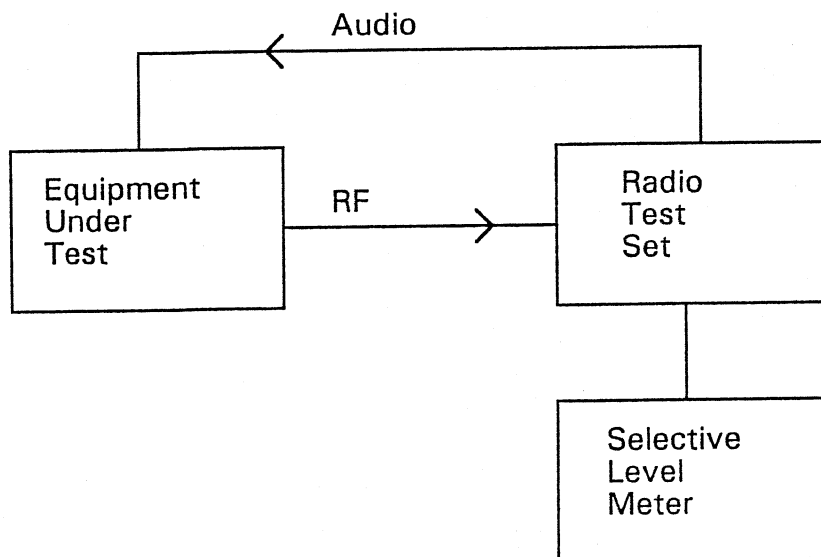
MEASUREMENT PROCEDURE PARA. NO. 2.985

RF POWER OUTPUT



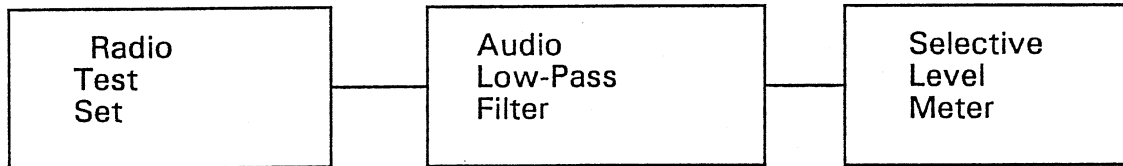
MEASUREMENT PROCEDURE PARA. NO. 2.987(a)

AUDIO FREQUENCY RESPONSE



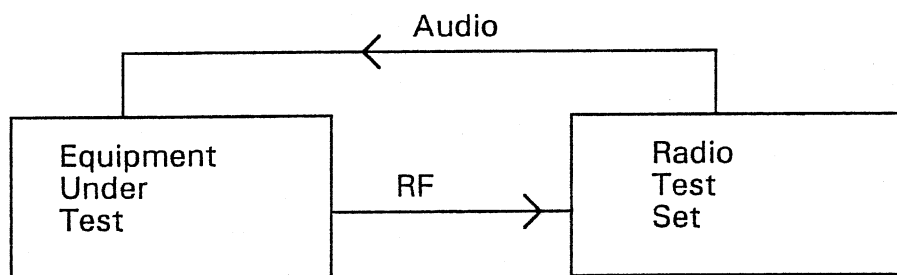
FCC ID: H4JUT-3-420-S08

MEASUREMENT DATA PARA. NO. 2.987(a)

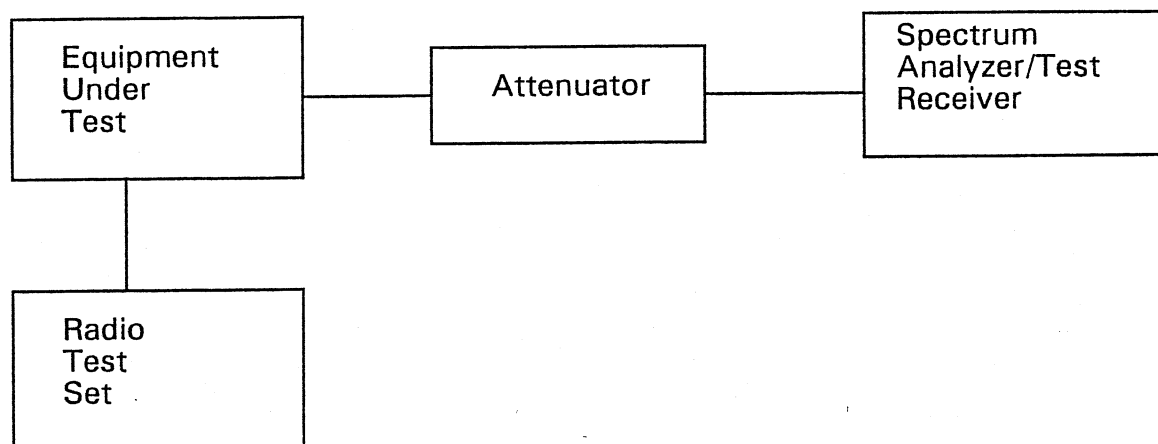
AUDIO LOW-PASS
FILTER FREQUENCY
RESPONSE

MEASUREMENT DATA PARA. NO. 2.987(b)

MODULATION LIMITING

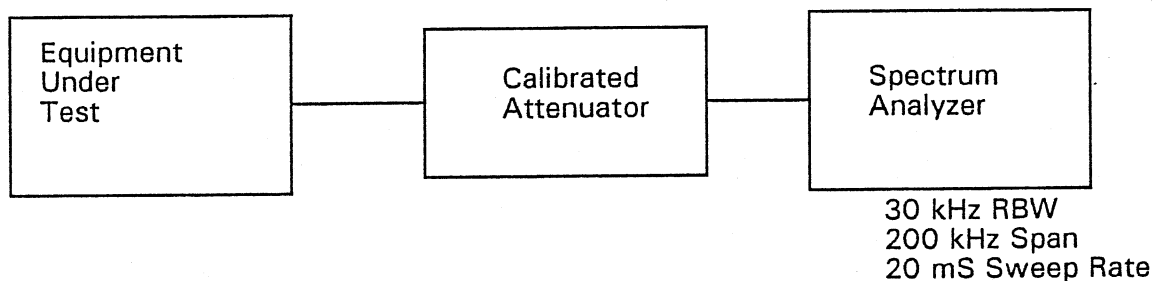


FCC ID: H4JUT-3-420-S08

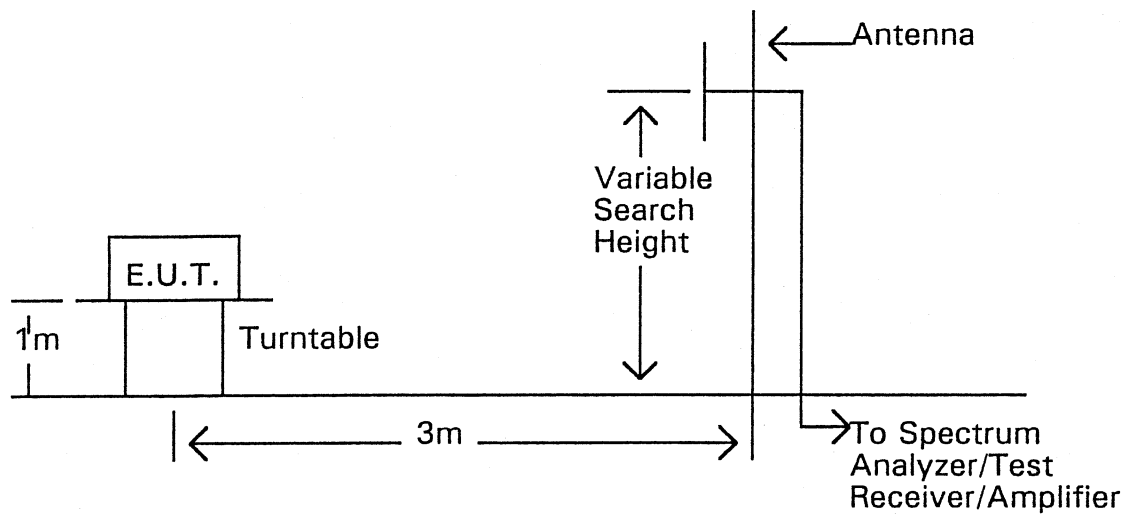
MEASUREMENT PROCEDURE PARA. NO. 2.989**OCCUPIED BANDWIDTH**

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

