

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 LIMEBANK ROAD
RR#5 OTTAWA, ONTARIO
K1G 3N3**

APRIL 1994

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, 1994

APPROVED BY: David W. Drage DATE: April 29, 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 |

EQUIPMENT: UT-3/420-SN08 Transmitter

NAME OF TEST **PARA. NO.**
RF Power Output 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 RESULTS CONFORMS. 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

| Power Output (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.

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.

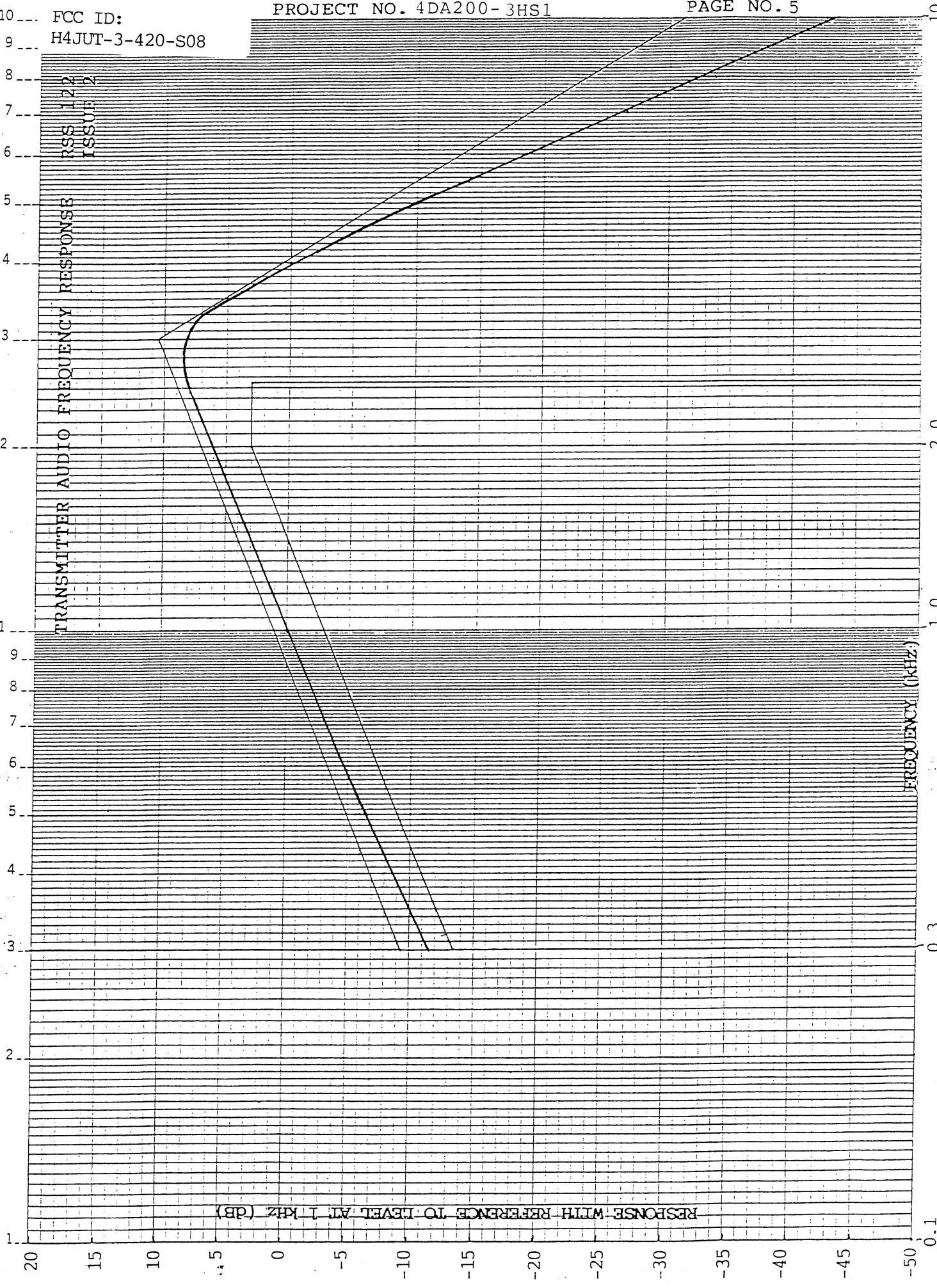
10... FCC ID:
9... H4JUT-3-420-S08

PROJECT NO. 4DA200-3HS1

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46 4973

K&E SEMI-LOGARITHMIC • 2 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.



EQUIPMENT: UT-3/420-SN08 Transmitter

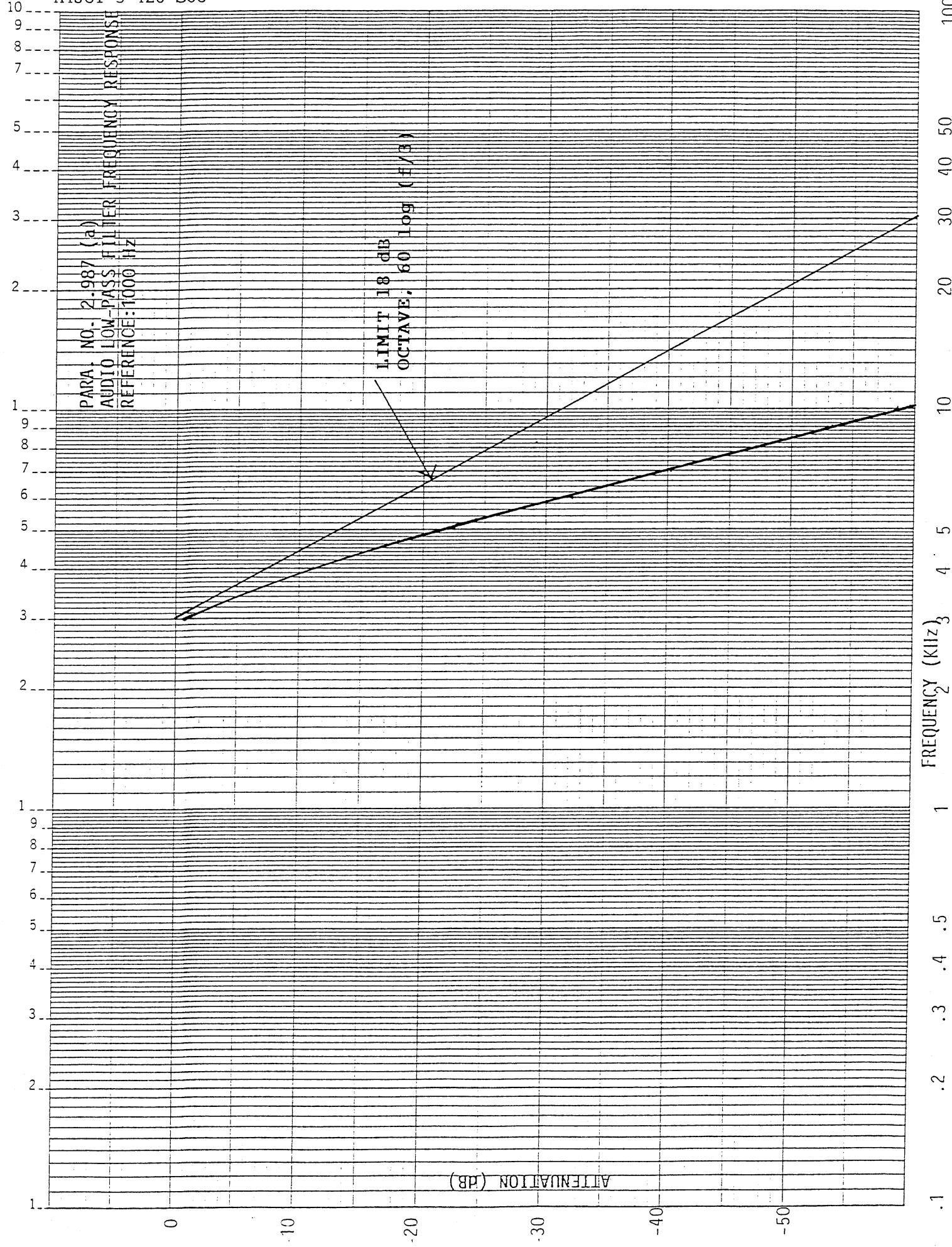
| <u>NAME OF TEST</u> | <u>PARA. NO.</u> |
|--|------------------|
| Audio Low-Pass Filter Frequency Response | 2.987(a) |

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 | Para. 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. |

46 -)

Y. 46 SEMI-LOGARITHMIC CYCLIC 30 DIVISIONS
REDFERNS



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.

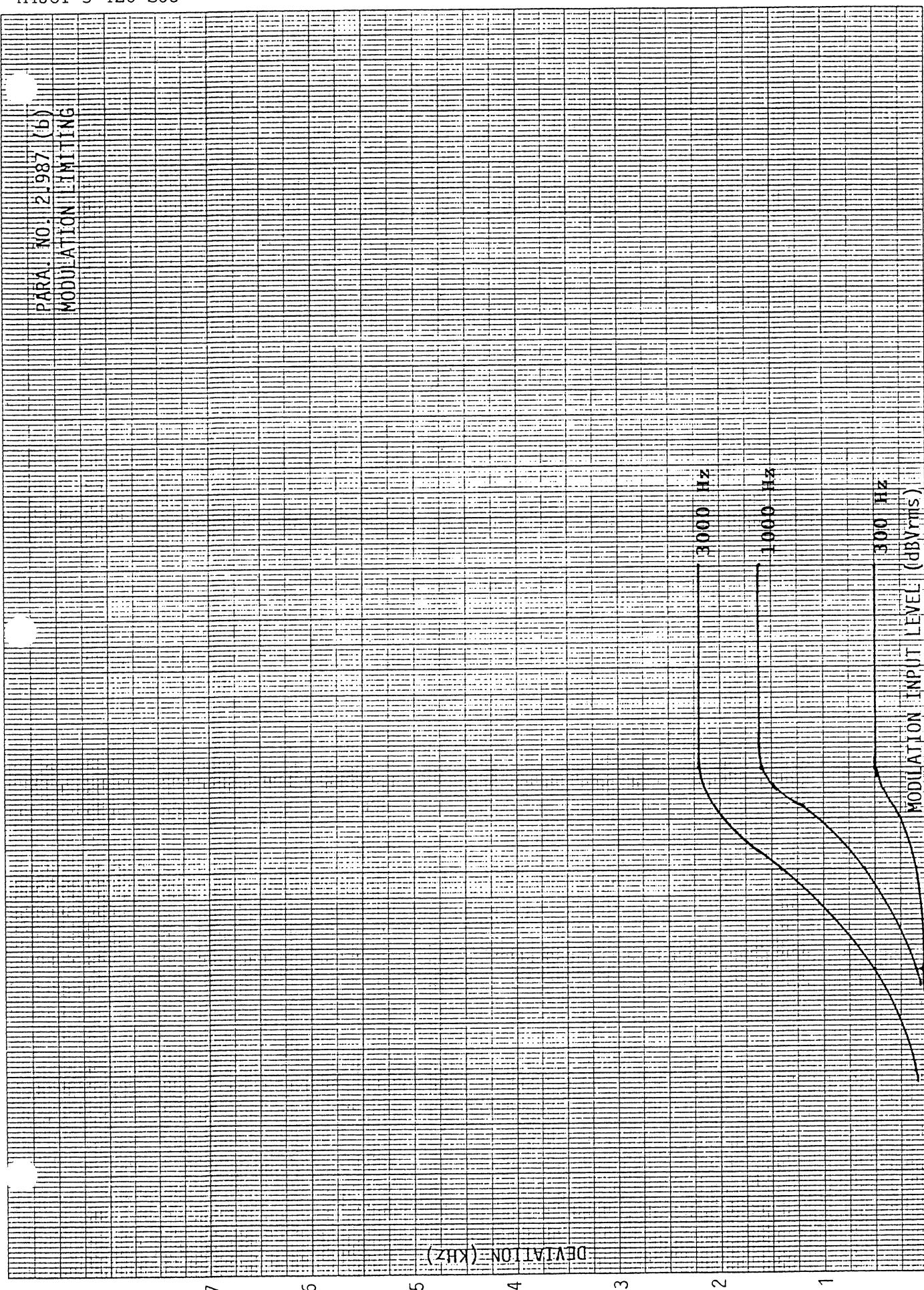
TEST RESULTS

CONFORMS. The maximum deviation is 2.2 kHz.

MEASUREMENT DATA

See attached graph.

PARA. NO. 12987 (B)
MODULATION LIMITING



10 X 10 IN. INCHIMETER
KUHNEL & LESSER CO. MADE IN U.S.A.

46 1513

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) |
|---------------------------------|----------------------------|
| fc ±10 to fc ±20 | 25 |
| fc ±20 to fc ±50 | 35 |
| <fc -50 to >fc +50 | 43 + 10Log P* |

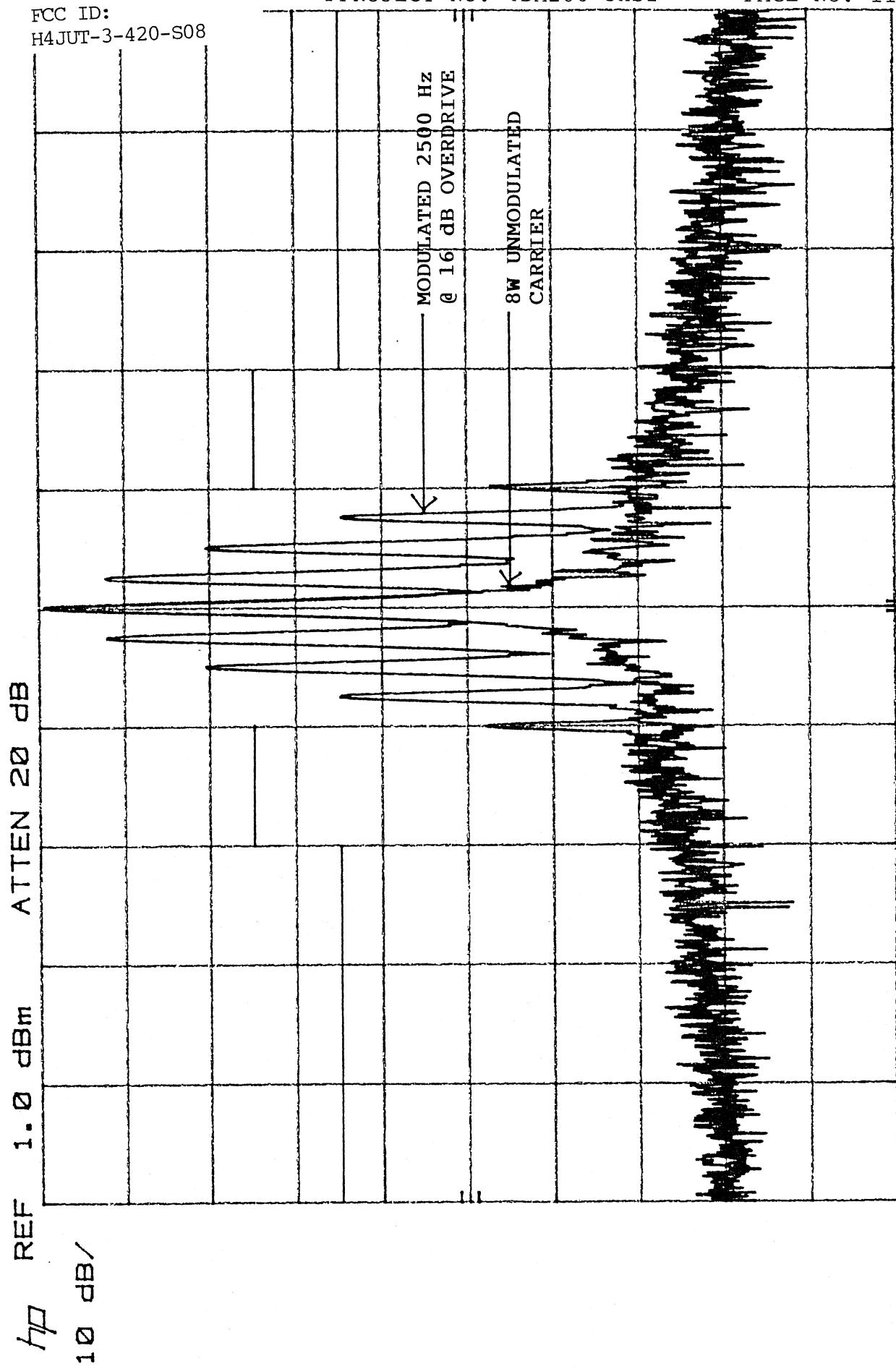
* P is the mean output power of the transmitter in watts.

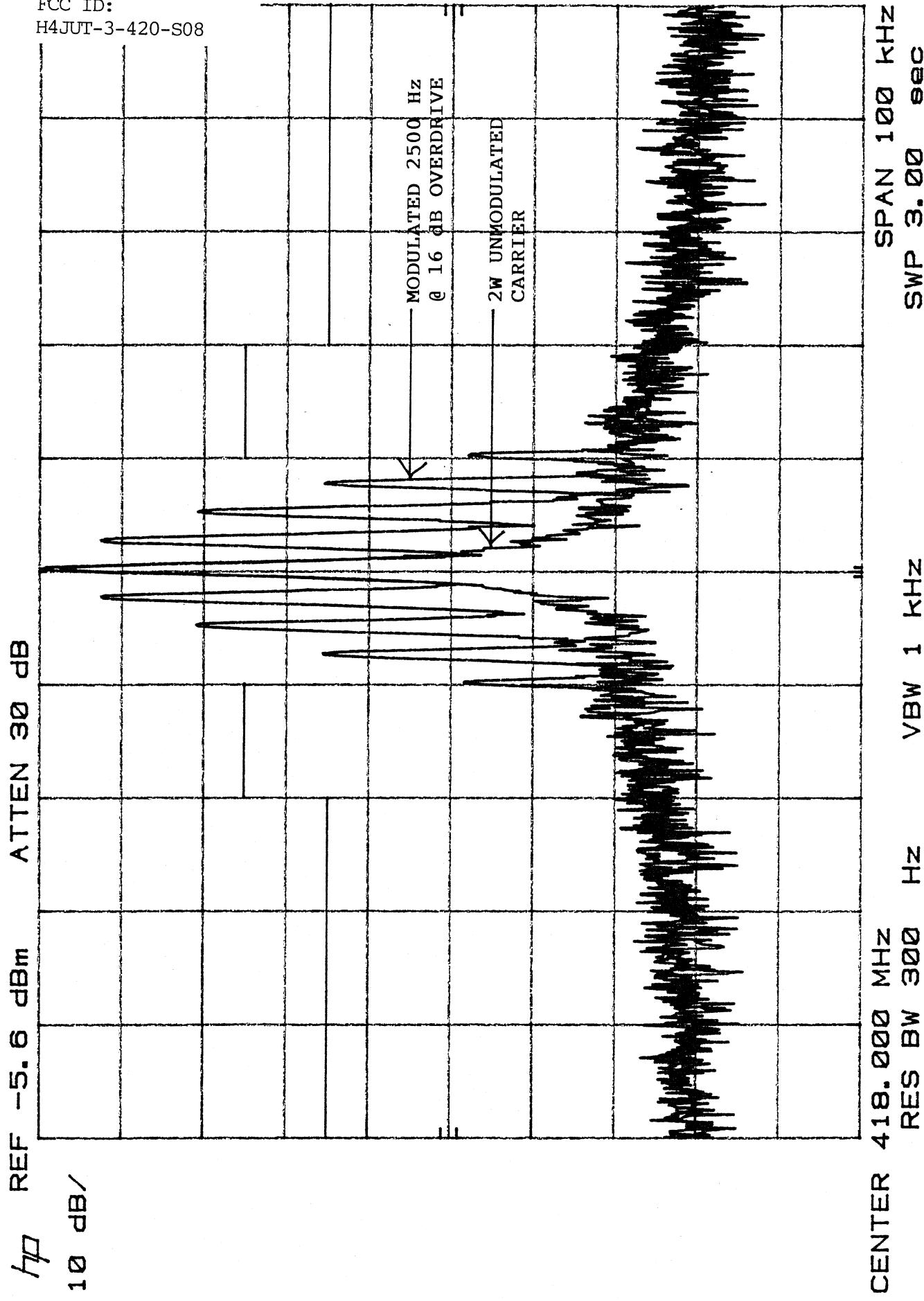
TEST RESULTS

CONFORMS. See attached graphs.

MEASUREMENT DATA

See attached graphs.

FCC ID:
H4JUT-3-420-S08

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 STANDARD

Para. 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

| Frequency of Emission (MHz) | Polarization | | Received Signal (dB μ V) | Antenna Factor* | Field Strength (dB μ V@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 | | | 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 $43 + 10\log 3 = 47.8$ 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 $\text{dB}\mu\text{V/m}$ @ 3m.

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

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

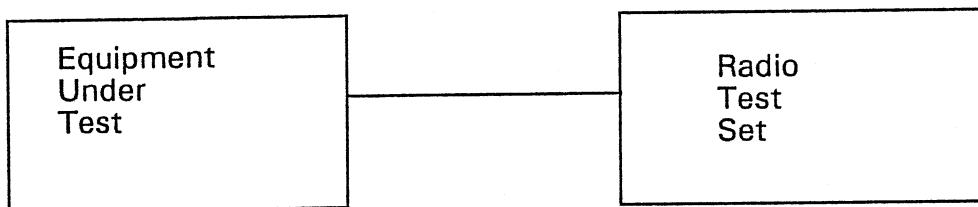
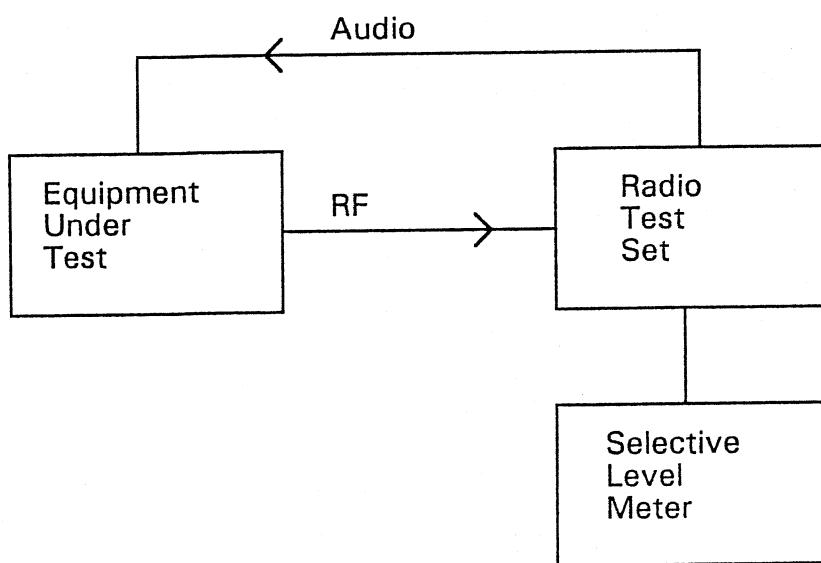
| TIME (Min) | Frequency (MHz) | | | |
|---------------|-----------------|--------------|--------------|-------------|
| | <u>-30°C</u> | <u>-20°C</u> | <u>-10°C</u> | <u>0°C</u> |
| 0 | 418.000 047 | 418.000 166 | 418.000 282 | 418.000 219 |
| 0.5 | 418.000 048 | 418.000 166 | 418.000 283 | 418.000 218 |
| 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 |

| TIME (Min) | Frequency (MHz) | | | | |
|---------------|-----------------|--------------|--------------|--------------|--------------|
| | <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 |

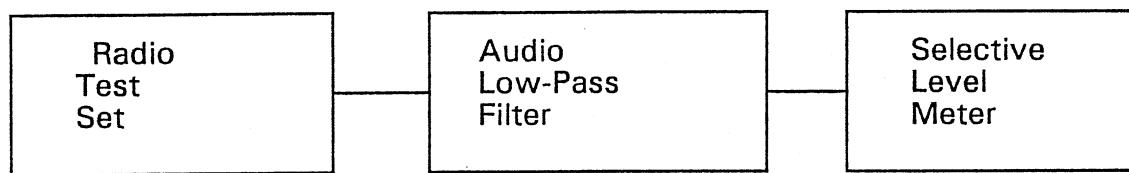
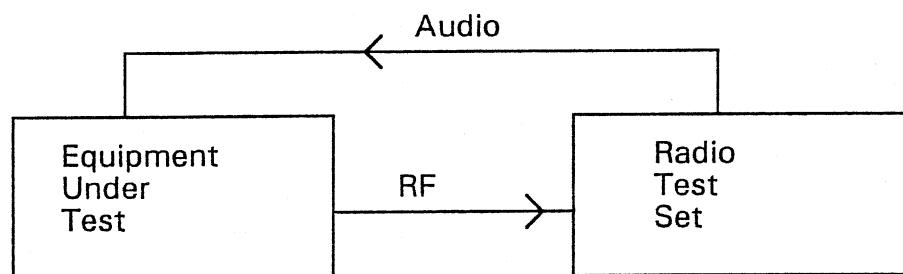
FCC ID: H4JUT-3-420-S08

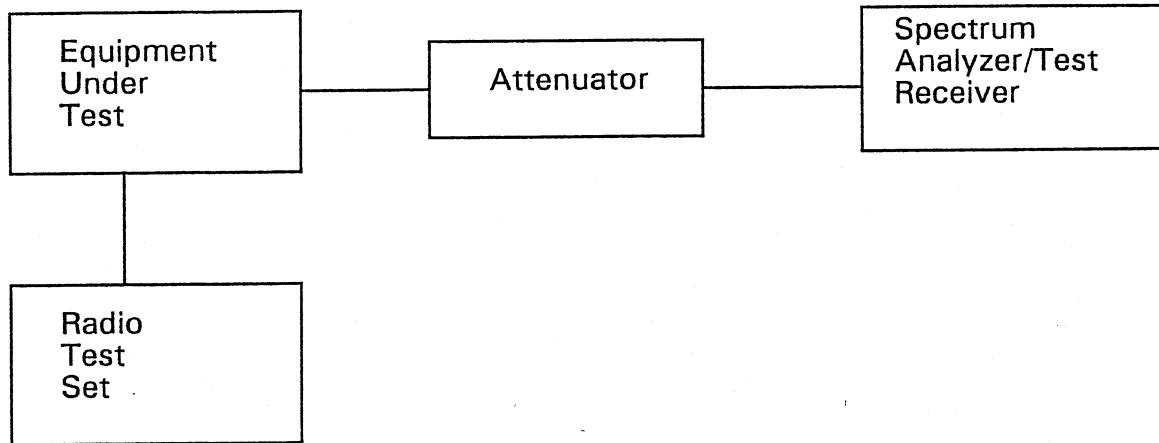
EQUIPMENT LIST

| <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**

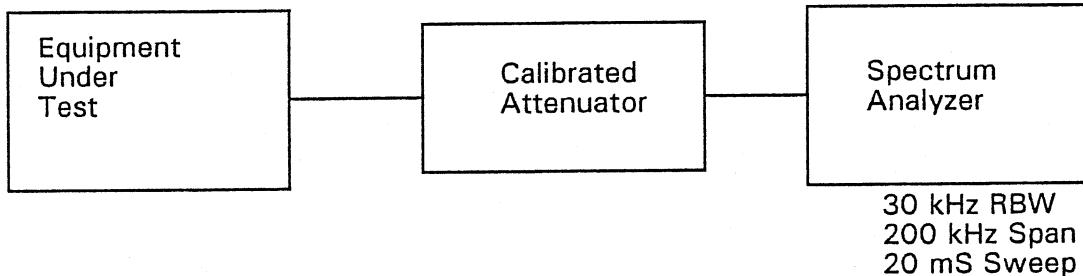
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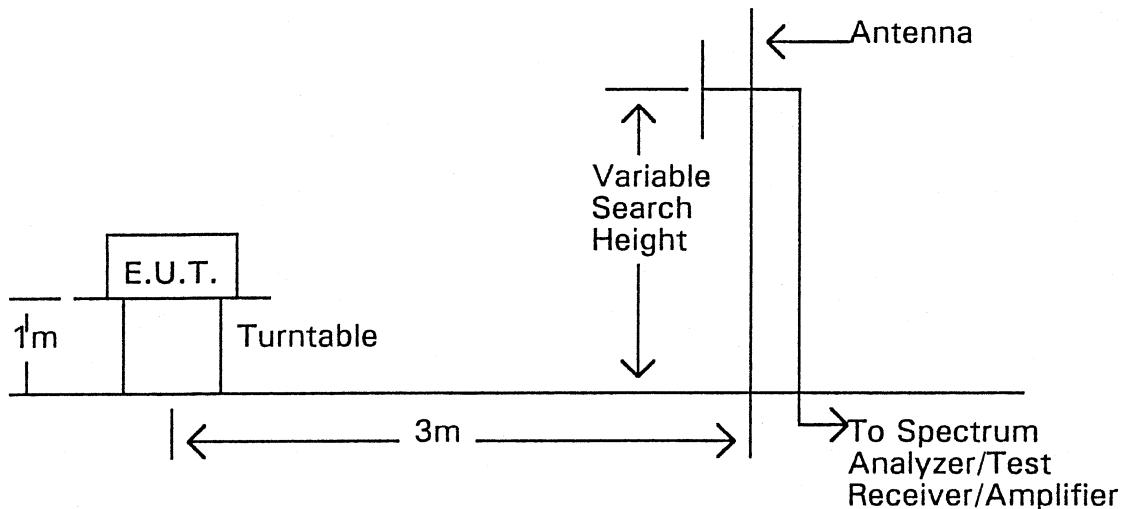
MEASUREMENT DATA PARA. NO. 2.987(a)**AUDIO LOW-PASS FILTER FREQUENCY RESPONSE****MEASUREMENT DATA PARA. NO. 2.987(b)****MODULATION LIMITING**

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**

**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**