TABLE OF CONTENTS LIST

APPLICANT: AES CORPORATION

FCC ID: L9N-7085-UE

TEST REPORT:

EXHIBITS CONTAINING:

GENERAL INFORMATION REQUIRED FOR TYPE ACCEPTANCE

2.1033 (c)(1)(2) AES CORPORATION will sell the MODEL NO. L9N-7085-UE UHF transceiver in quantity, for use under FCC RULES 22 and 90.

2.1033 (c) TECHNICAL DESCRIPTION
2.1033 (3) User Manual See Exhibits 12A-12ZZ

2.1033 (4) Type of Emission: 11K0F2D

For 12.5 kHz channel bandwidths
Bn = 2M + 2DK
M = 3,000 Bits per second
D = 2.5 kHz (Peak Deviation)
K = 1
Bn = 2(3k) + 2(2.5k)(1) = 6.0K + 5.0K = 11.0k

Type of Emission: 11K0F3E

For 25 kHz & 12.5 kHz channel bandwidths
Bn = 2M + 2DK
M = 3,000 Hz
D = 2.5 kHz (Peak Deviation)
K = 1
Bn = 2(3k) + 2(2.5k)(1) = 6.0k + 5.0k = 11.0k

90.209(b)(5)
For 25 kHz channel BW
ALLOWED AUTHORIZED BANDWIDTH = 20.00 kHz.

For 12.5kHz channel BW
ALLOWED AUTHORIZED BANDWIDTH = 11.25 kHz.

2.1033 (5) Frequency Range: 410-512 MHz

(6) Power Range and Controls: There are NO user power controls. It is programmed at the factory.

(7) Maximum Output Power Rating:
HI POWER 6 WATTS
LOW POWER 1.5 WATTS

(8) DC Voltages and Current into Final Amplifier:

POWER INPUT
FINAL AMPLIFIER ONLY
Vce = 12 Volts
IC = HIGH 1.68 A
LOW .840 A

INPUT POWER - HIGH: (12V)(1.68A) = 20.16 Watts
INPUT POWER – LOW: (12V)(0.84A) = 10.08 Watts

(9) Tune-up procedure. The tune-up procedure is given in EXHIBIT 11.

2.1033 (10) Complete Circuit Diagrams: The circuit diagram is included as EXHIBITS 2A-2B. The block diagram is included as EXHIBITS 3A-3B.

(11) Function of each electron tube or semiconductor device or other active circuit device:
-SEE EXHIBITS 12 AND 13.

(8) Instruction book. The instruction manual is included as EXHIBIT 12.

(10) Description of all circuitry and devices provided for determining and stabilizing frequency is included in the circuit,
-SEE EXHIBITS 4A-4I.

2.1033(c)(11) A photograph or drawing of the equipment identification label is shown in Exhibit 1.

2.1033(c)(12) Photographs of the equipment of sufficient clarity to reveal equipment construction and layout and label location are shown in Exhibits 5-9.

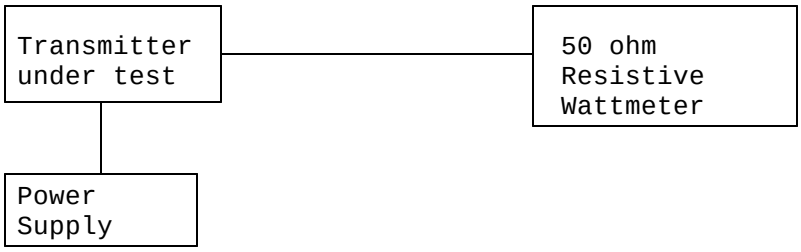
2.1033(c)(13) For equipment employing digital modulation, a detail description of the modulation technique. This UUT uses FSK to modulate the transmitter.

2.1033(c)(14) Data required for 2.1046 to 2.1057 See Below.

2.1046(a) RF power output.
RF power is measured by connecting a 50 ohm, resistive wattmeter to the RF output connector. With a nominal battery voltage of 12 VDC, and the transmitter properly adjusted the RF output measures:

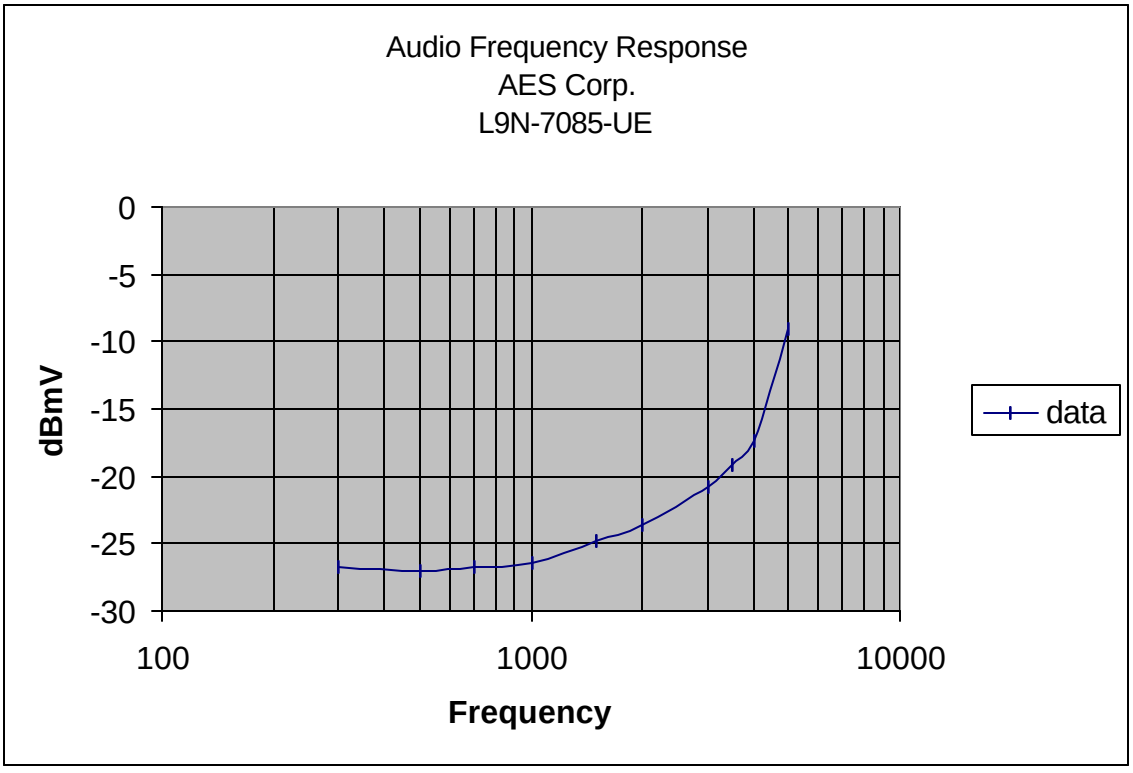
OUTPUT POWER: HIGH = 6 Watts
LOW = 1.5 Watts

METHOD OF MEASURING RF POWER OUTPUT



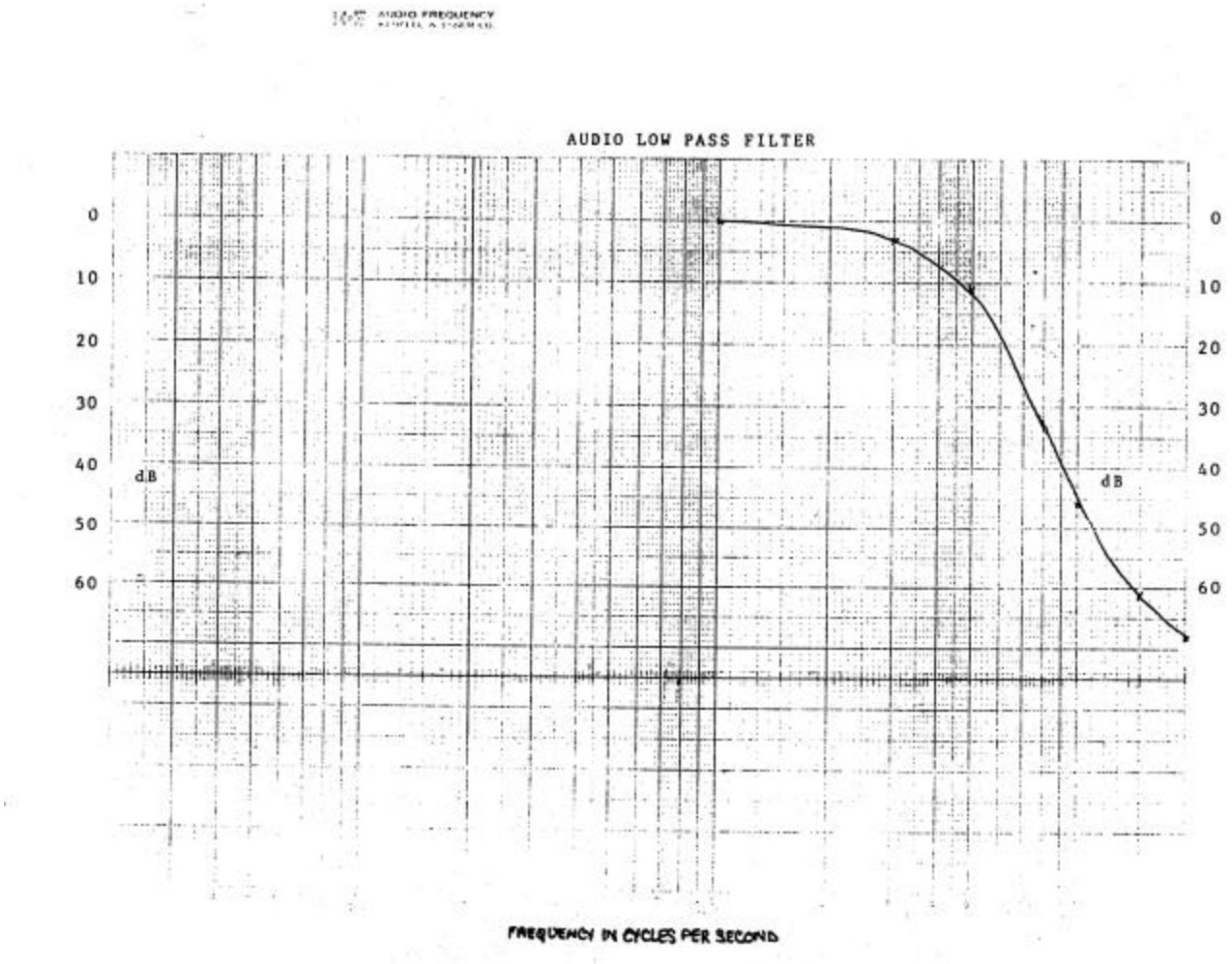
2.987(a) Modulation Characteristics:

AUDIO FREQUENCY REPSONSE
The audio frequency response was measure in accordance with EIA Specification RS-152B, Paragraph 7. The audio frequency response curve is shown below.



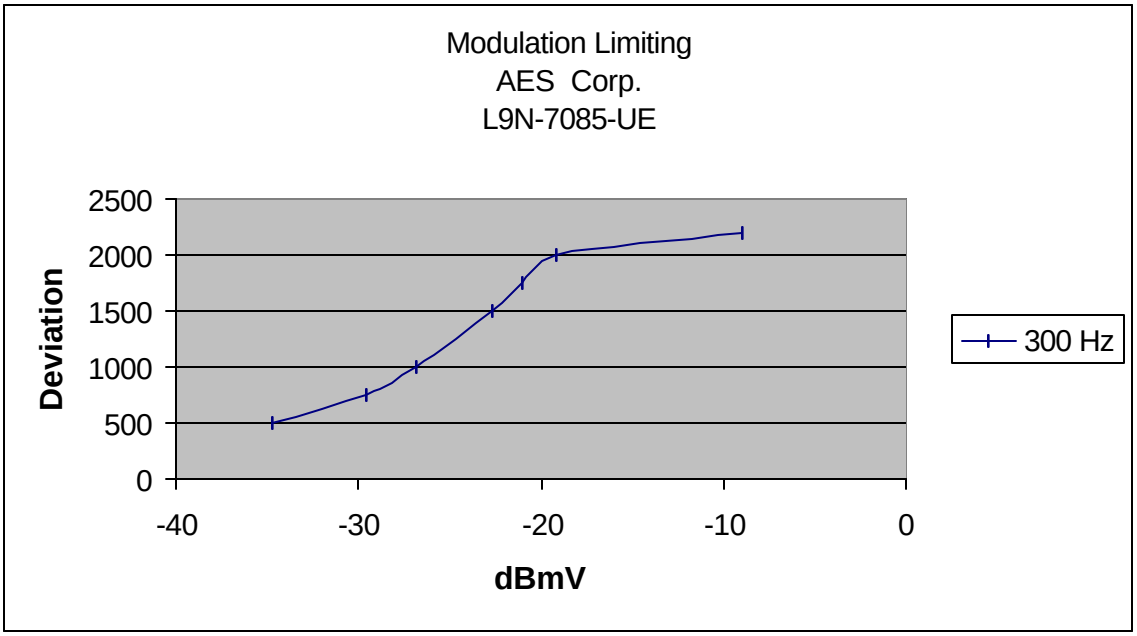
2.987 (b) AUDIO LOW PASS FILTER

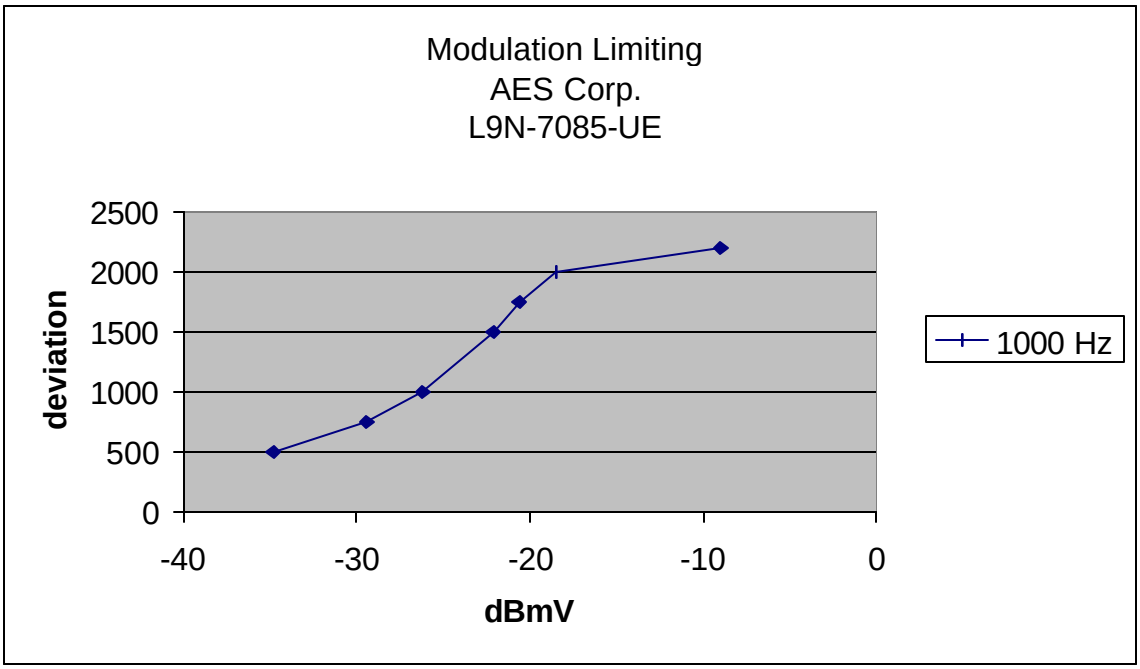
The audio low pass filter is required per FCC Rules 90.211 (c) & (d) for mobile stations with a power output of more than 2.0 watts. A plot of the audio low pass filter is shown below.

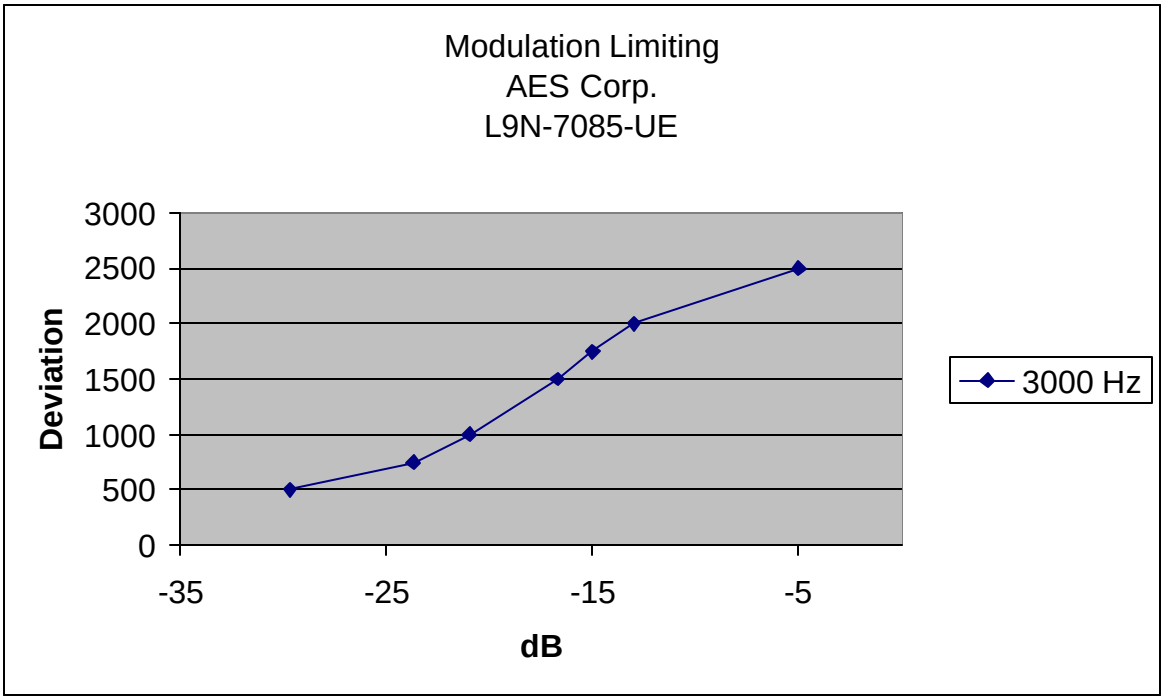


2.987 (b) AUDIO INPUT VERSES MODULATION

A plot of the audio input versus deviation is shown below.






Modulation Limiting
AES Corp.
L9N-7085-UE
Deviation
3000
2500
2000
1500
1000
500
0
-35
-25
-15
-5
dB
3000 Hz

2.10 Measurement Procedures for Type Acceptance:

Measurement techniques have been in accordance with TIA/EIA STD 603-1992.

2.1049 Occupied bandwidth:

90.210(c,)

For transmitters that are not equipped with an audio low pass filter pursuant to S90.211(b), the power of any emission must be attenuated below the unmodulated carrier output power as follows; (1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency(fd in kHz) of more than 5kHz but not more than10 kHz: At least 83 log(fd/5)dB; (2)ON any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10kHz, but not more than 250% of the authorized bandwidth: At least 29 log(fd2/11)dB or 50dB, whichever is the lesser attenuation; (3) On any frequency removed from the center of the authorized bandwidth by more than 250% of the authorized bandwidth: At least 43+10 log(Po)dB.

90.210(d) Emission Mask D - 12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.

(2) On any frequency from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27 (fd - 2.88 kHz) dB.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

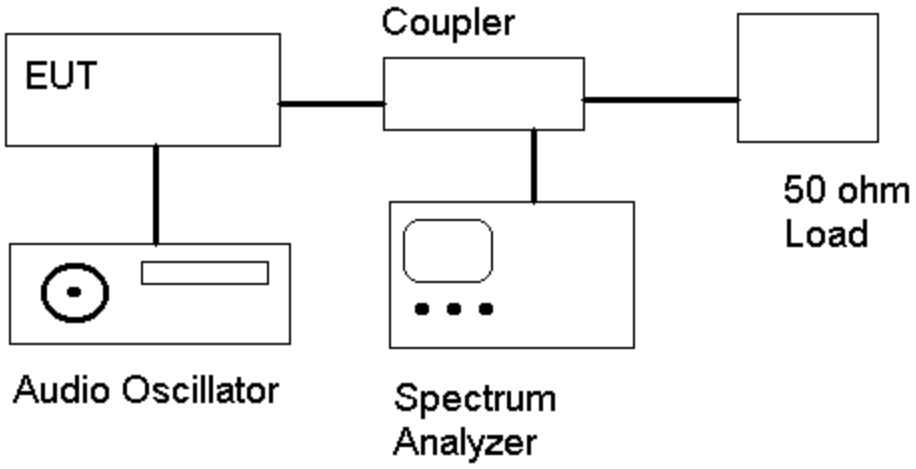
Data in the plots shows that on any frequency removed from the assigned frequency by more than 50%, but not more than 100%: At least 25dB. On any frequency removed from the assigned frequency by more than 100%, but not more than 250%: At least 35dB. On any frequency removed from the assigned frequency by more than 250%, of the authorized bandwidth: At least 43+log(P)dB.

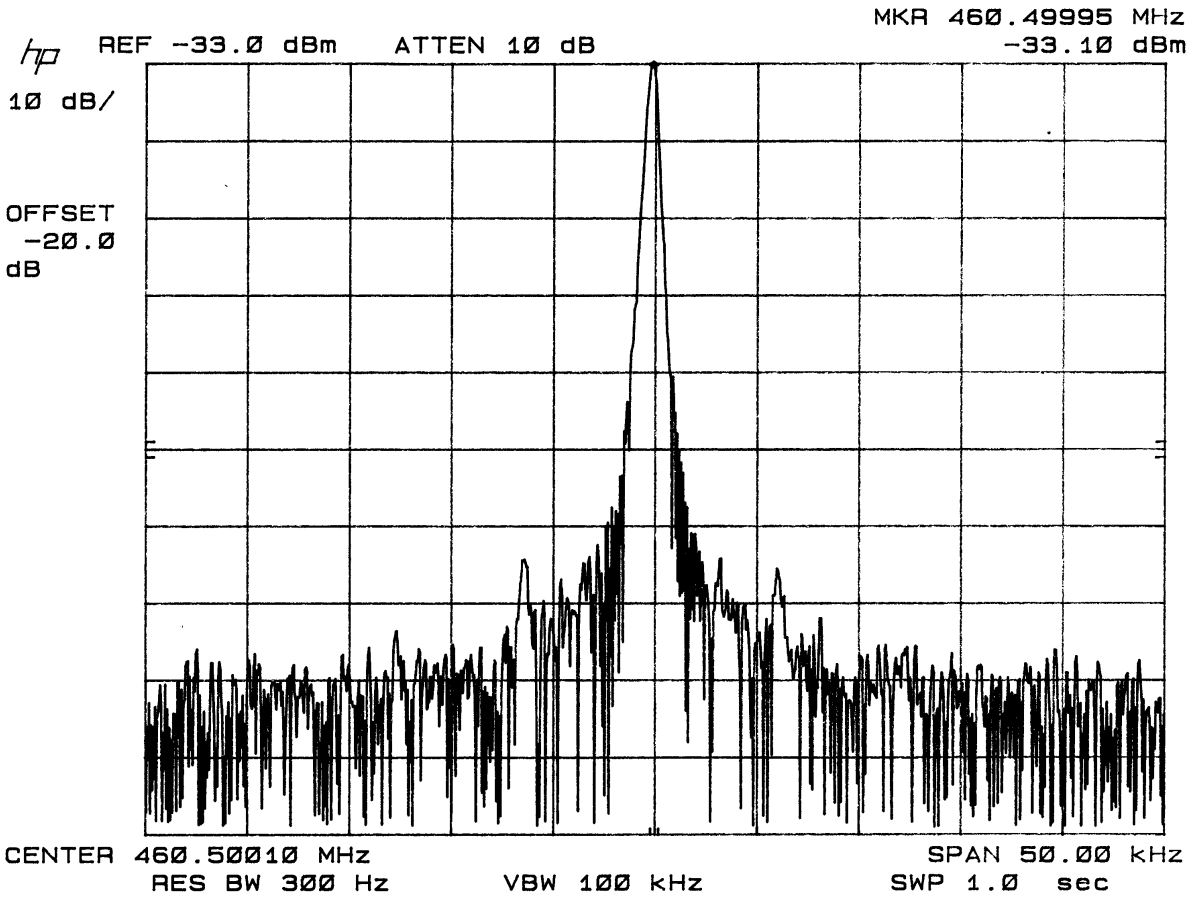
Radiotelephone transmitter with modulation limiter.

Test procedure: TIA/EIA-603 para 2.2.11 , with the exception that various tones were used.

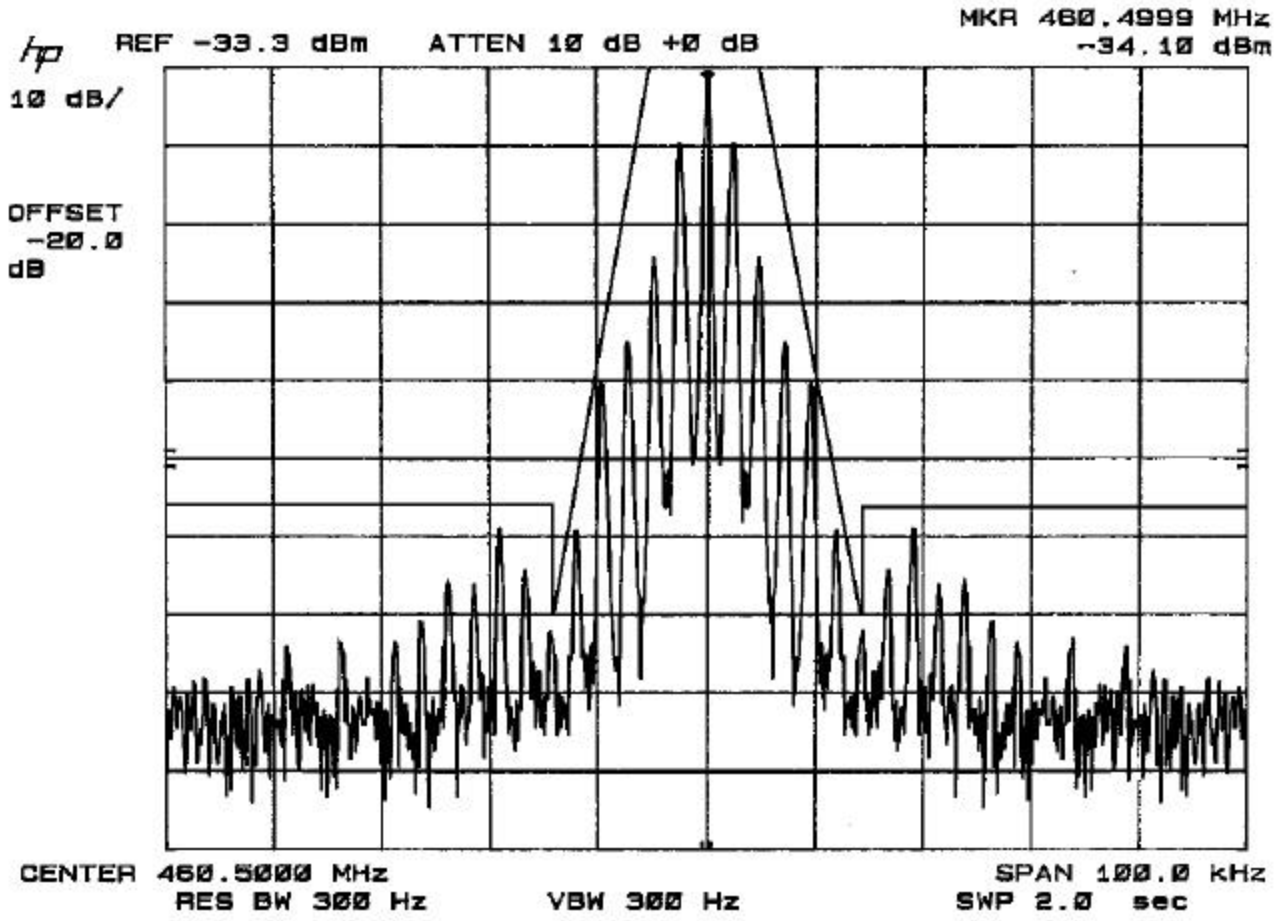
Test procedure diagram

OCCUPIED BANDWIDTH MEASUREMENT

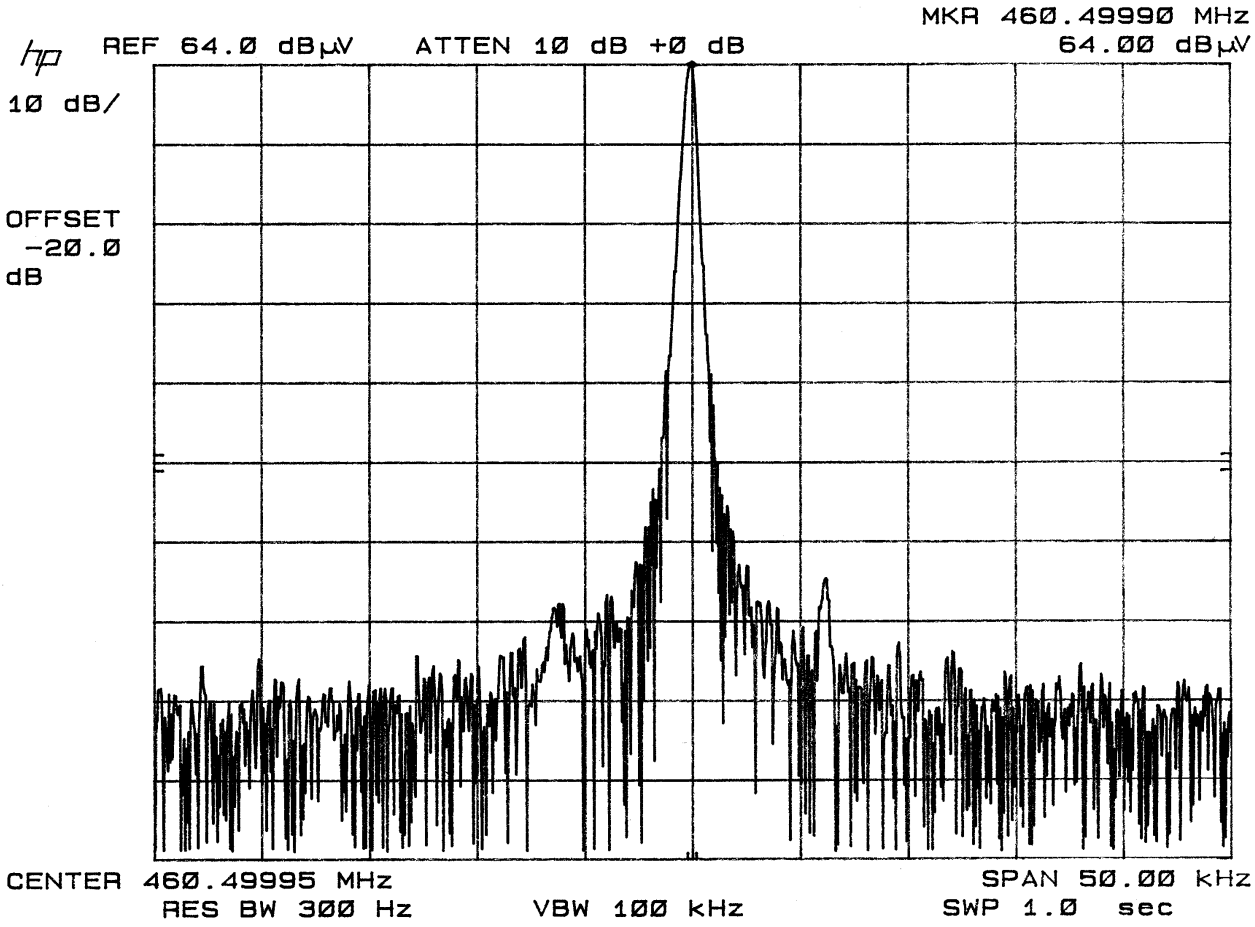




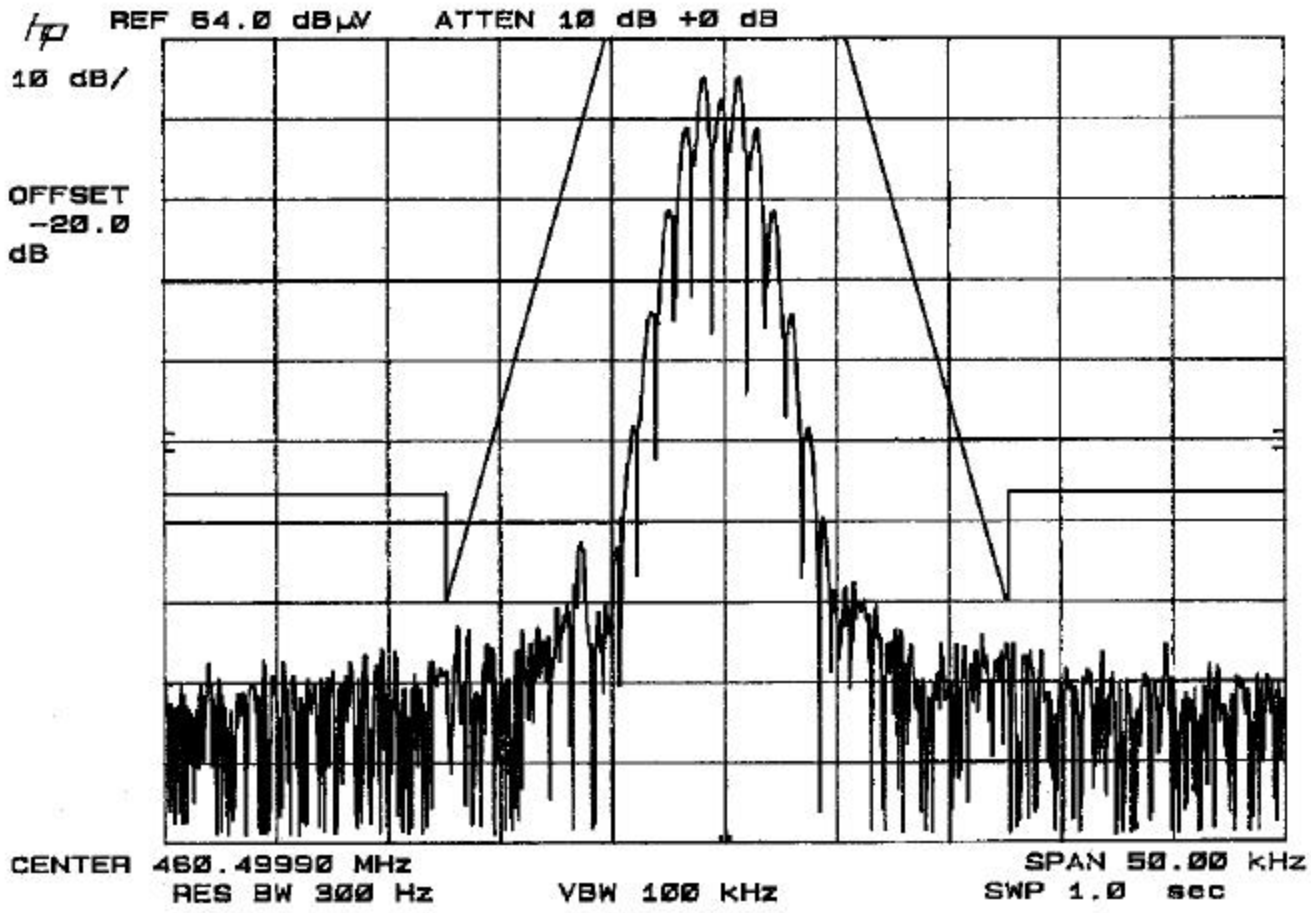
Occupied Bandwidth Plot CW



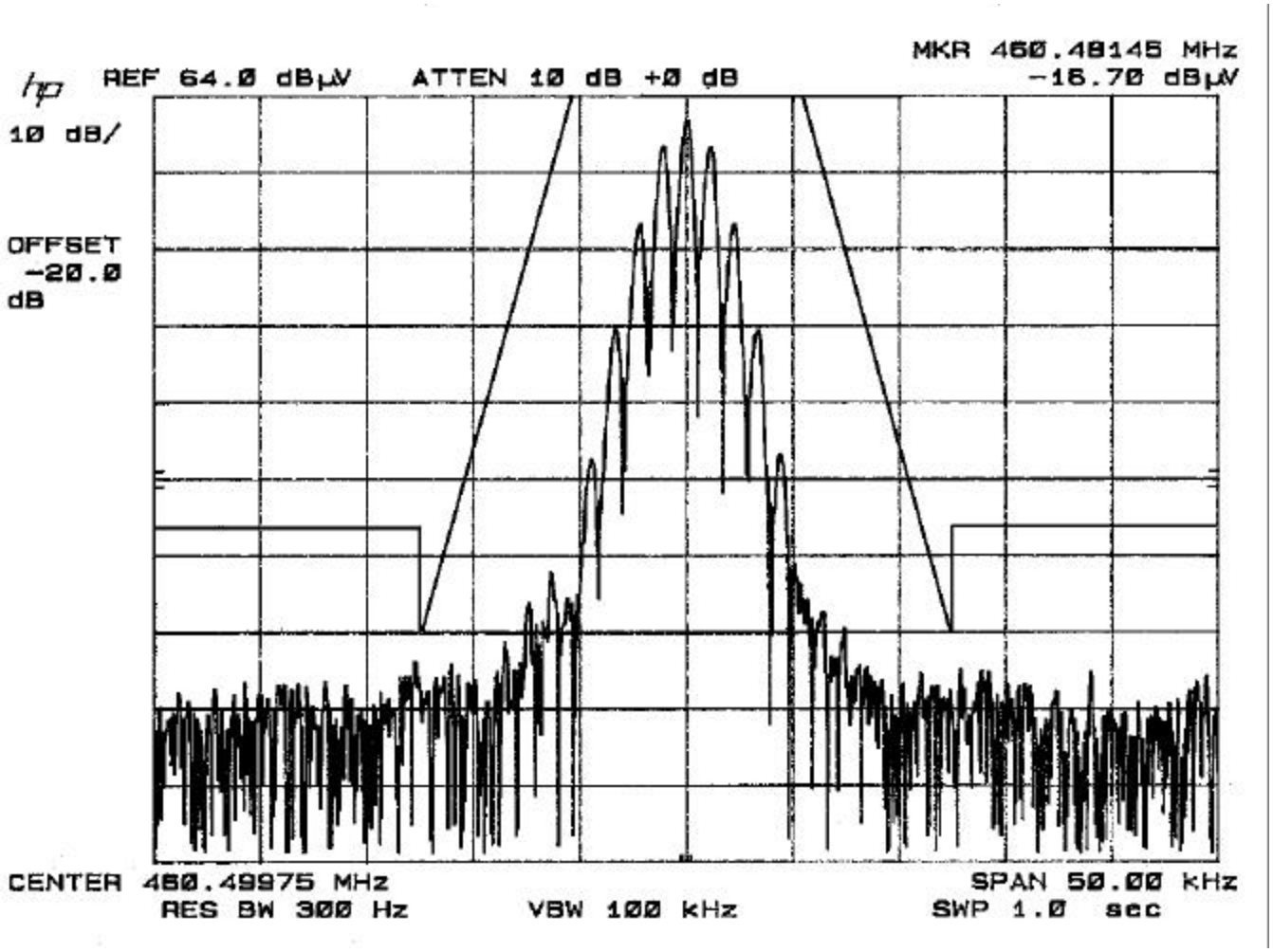
Occupied Bandwidth Plot Modulated
2.5 kHz tone modulated 16 dB over 50%



CW plot for F2D



Occupied BW plot: continuous ‘mark’ tone for F2D



Occupied BW plot: continuous ‘space’ tone for F2D

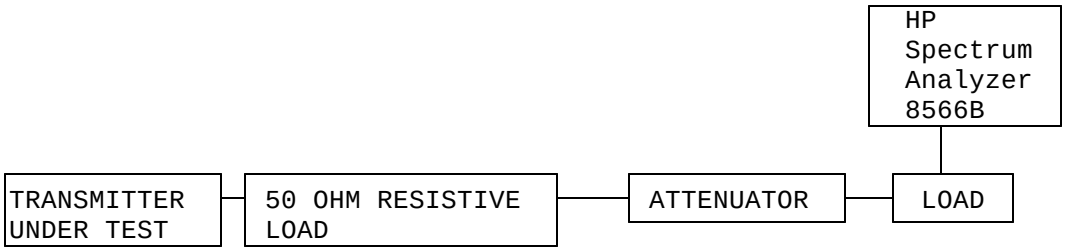
2.1051 Spurious emissions at antenna terminals(conducted):
2.1052 Data on the following page shows the level of conducted spurious responses. The carrier was modulated 100% using a 2500Hz tone. The spectrum was scanned from 0.4 to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard TIA/EIA-603.

REQUIREMENTS: Emissions must be 43 +10log(Po) dB below the mean power output of the transmitter.

	High Power	Low Power
For 25kHz	43 + 10log(6.0) = 50.78 dB	43 + 10log(1.5) = 44.76 dB
For 12.5kHz	50 + 10log(6.0) = 57.78 dB	50 + 10log(1.5) = 51.76 dB

EMISSION FREQUENCY MHz	dB BELOW CARRIER HIGH POWER	dB BELOW CARRIER LOW POWER
410.50	0.00	00.0
821.00	88.1	82.8
1231.50	88.4	83.4
1642.00	93.4	89.7
2052.50	85.3	89.6
2463.00	94.2	93.8
2873.50	82.8	78.4
3284.00	91.1	93.5
3694.50	99.2	91.5
4105.00	97.2	100.8
460.50	00.0	00.0
921.00	85.4	76.5
1381.50	68.1	74.4
1842.00	74.4	65.1
2302.50	75.7	74.0
2763.00	86.4	76.7
3223.50	90.5	74.4
3684.00	89.5	77.5
4144.50	87.2	82.1
4605.00	92.0	91.0
490.50	0.00	0.00
981.00	87.7	84.9
1471.5	78.6	77.5
1962.00	77.7	69.2
2452.50	81.3	72.3
2943.00	89.0	71.8
3433.50	91.6	75.6
3924.00	89.1	92.1
4414.50	106.9	92.6
4905.00	92.5	88.1

Method of Measuring Conducted Spurious Emissions



METHOD OF MEASUREMENT: The procedure used was TIA/EIA-603 STANDARD without any exceptions. An audio generator was connected to the UUT through a dummy microphone circuit and the output of the transmitter connected to a standard load and from the standard load through a pre-selector filter of the spectrum analyzer. The spectrum was scanned from 400kHz to at least the tenth harmonic of the fundamental using a HP model 8566B spectrum analyzer. The measurements were made using the shielded room located at TIMCO ENGINEERING INC. 849 N.W. State Road 45 Newberry, Florida 32669.

2.1053 Field strength of spurious emissions:

NAME OF TEST: RADIATED SPURIOUS EMISSIONS

REQUIREMENTS: Emissions must be:

HIGH POWER
for 12.5 kHz channel spacing - 50 + 10log (6)= 57.78 dB
for 25 kHz channel spacing – 43 + 10log (6)= 50.78 dB

LOW POWER
for 12.5 kHz channel spacing – 50 + 10log(1.5)= 51.76 dB
for 25 kHz channel spacing – 43 + 10log (1.5)= 44.76 dB

dB below the mean output of the transmitter

TEST DATA:

HIGH POWER

Emission Frequency MHz	dB Below Carrier
460.50	00.00
921.00	71.12
1381.50	66.65
1842.00	77.33
2302.50	79.35
2763.00	88.86
3223.50	83.10
3684.00	92.29
4605.00	90.43

LOW POWER

Emission Frequency MHz	dB Below Carrier
460.50	00.00
921.00	67.42
1381.50	72.35
1842.00	68.53
2302.50	69.53
2763.00	70.36
3223.50	75.60
3684.00	73.39
4144.50	84.38
4605.00	86.13

All emissions were scanned to the 10^{th} harmonic.

Test procedure used is TIA/EIA 603, 2.2.12 substitution method.

2.1055 Frequency stability:
90.213(a)(1)

Temperature and voltage tests were performed to verify that the frequency remains within the .00015%, 1.5 ppm specification limit, for 25kHz spacing & 0.00025% for 12.5kHz spacing and 0.0001% for 6.25kHz spacing. The test was conducted as follows: The transmitter was placed in the temperature chamber at 25 degrees C and allowed to stabilize for one hour. The transmitter was keyed ON for one minute during which four frequency readings were recorded at 15 second intervals. The worse case number was taken for temperature plotting. The assigned channel frequency was considered to be the reference frequency. The temperature was then reduced to -30 degrees C after which the transmitter was again allowed to stabilize for one hour. The transmitter was keyed ON for one minute, and again frequency readings were noted at 15 second intervals. The worst case number was recorded for temperature plotting. This procedure was repeated in 10 degree increments up to + 50 degrees C.

Readings were also taken at minus 15% of the battery voltage of 12VDC, which we estimate to be the battery endpoint.

MEASUREMENT DATA:

Assigned Frequency (Ref. Frequency): 460.500 000 MHz

TEMPERATURE_°C	FREQUENCY_MHz	PPM
REFERENCE	460.500 000	0.00
-30	460.499 435	-1.23
-20	460.499 900	-0.22
-10	460.500 029	0.06
0	460.500 057	0.12
+10	460.500 097	0.21
+20	460.500 005	0.01
+30	460.499 837	-0.35
+40	460.499 360	-1.39
+50	460.499 303	-1.52
BATT. End-Point 10.2V/dc	462.500 312	0.68
BATT. End-Point 13.8V/dc	460.500 324	0.70

RESULTS OF MEASUREMENTS: The maximum frequency variation over the temperature range was +.21 to –1.52 ppm.

2.1055(a)(1) Frequency stability:
90.214 Transient Frequency Behavior

REQUIREMENTS: In the 421-512 MHz frequency band, transient frequencies must be within the maximum frequency difference limits during the time interval indicated below.
The values shown in the table are the same for all 3 channel BWs 25, 12.5, and 6.25 kHz.

Time Interval	Maximum Frequency	Portable Radios 421-512 MHz
t1	+6.25 kHz	10.0 ms
t2	+6.25 kHz	25.0 ms
t3	+6.25 kHz	10.0 ms

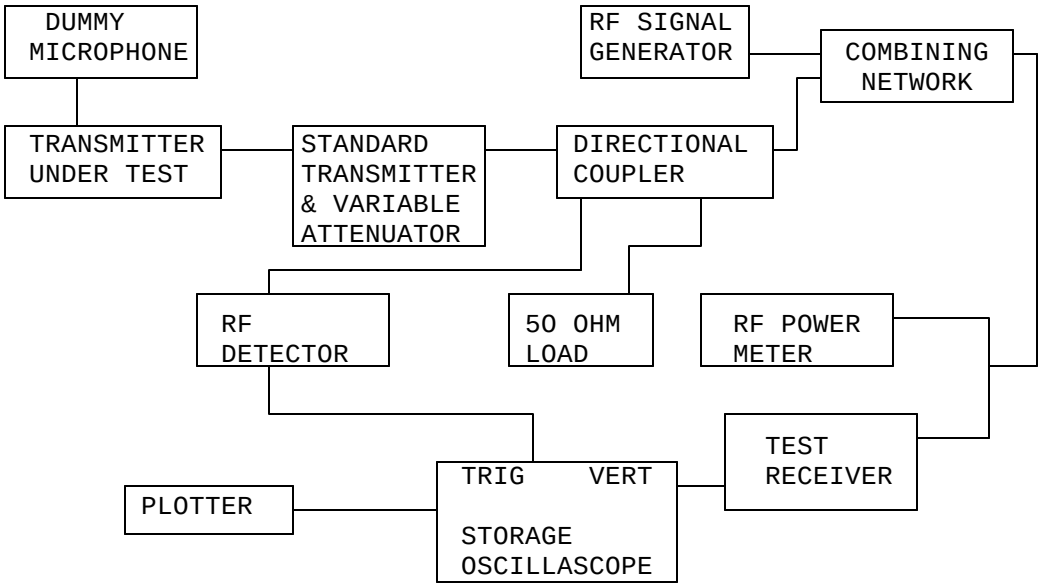
note 4: If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

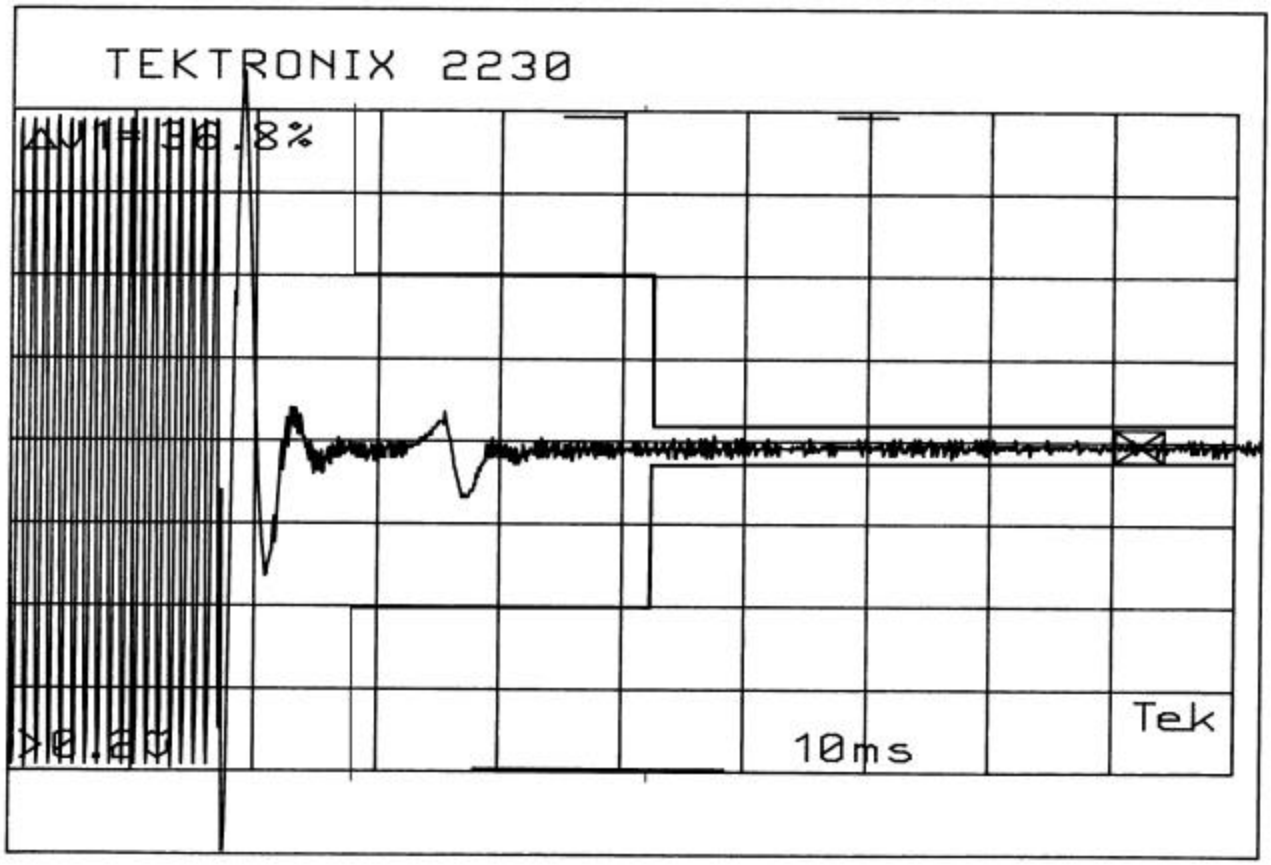
TEST PROCEDURE: TIA/EIA TS603 PARA 2.2.19, the levels were set as follows;

1. Using the variable attenuator the transmitter level was set to 40 dB below the test receivers maximum input level, then the transmitter was turned off.
2. With the Transmitter off the signal generator was set 20dB below the level of the transmitter in the above step, this level will be maintained with the signal generator through-out the test.
3. Reduce the attenuation between the transmitter and the RF detector by 30 dB.
4. With the levels set as above the transient frequency behavior was observed & recorded.

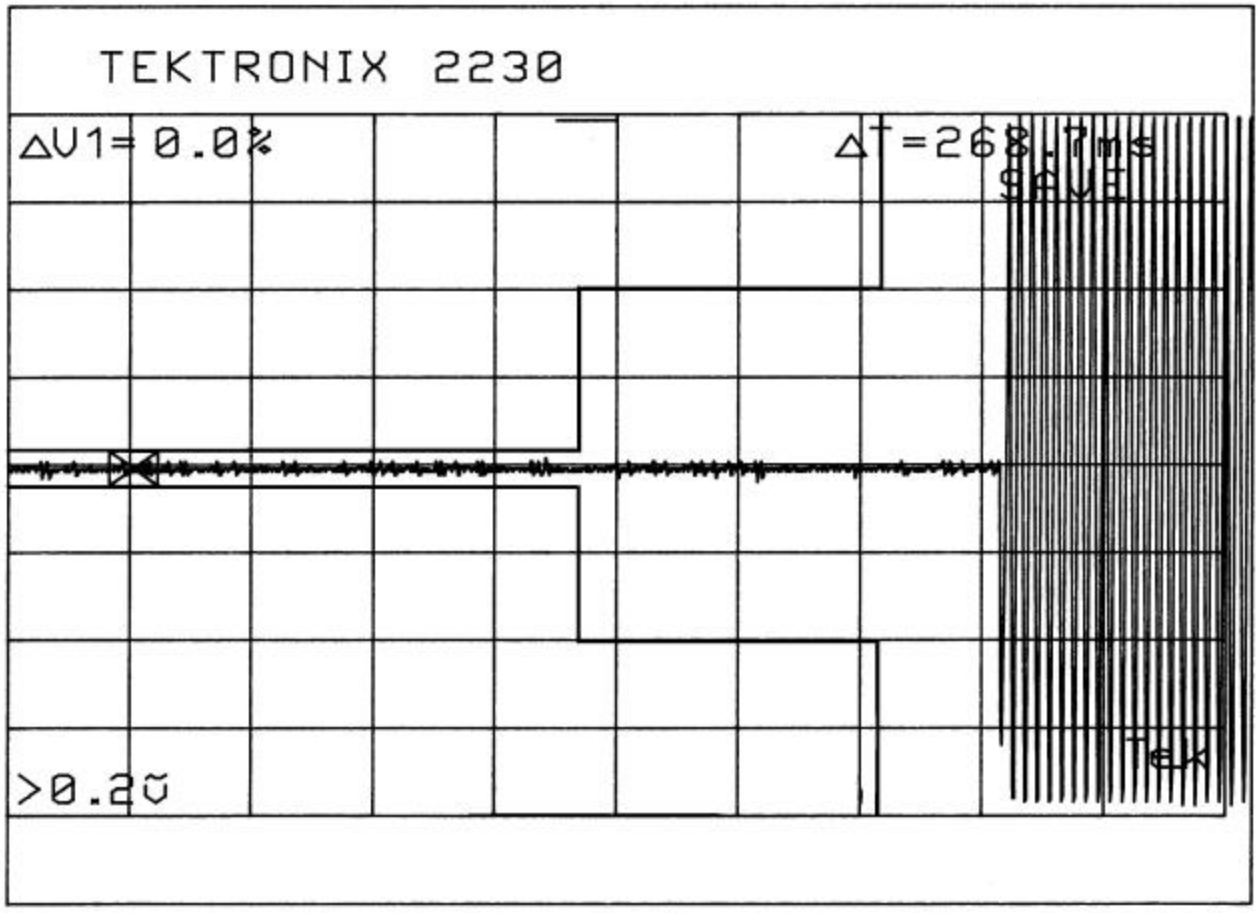
Plots were taken for 25 and 12.5 kHz channel bandwidths at high and low power settings and the worst case data presented on the following pages.

2.1055 Frequency stability:
90.214 Transient Frequency Behavior
(Continued)

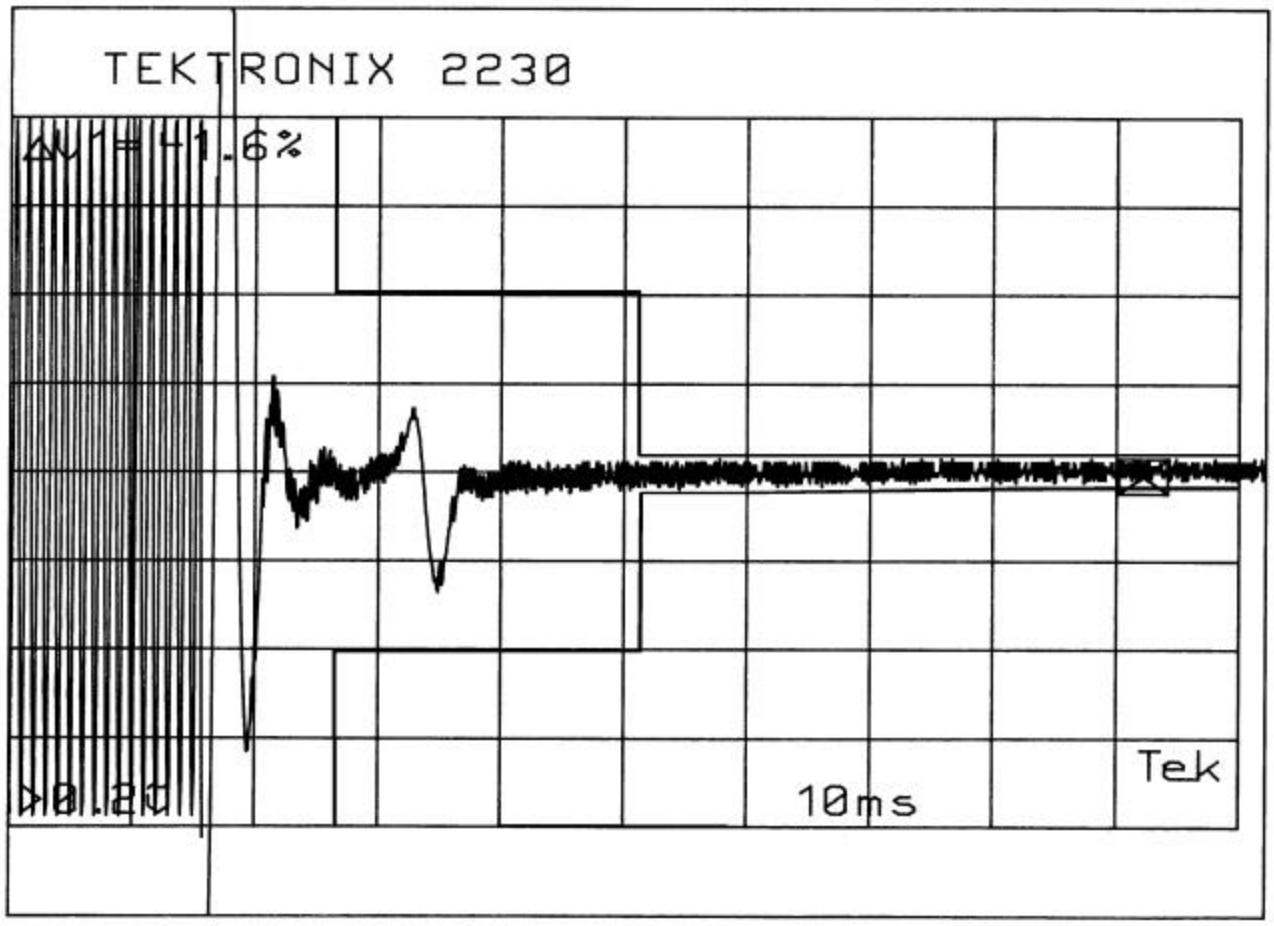




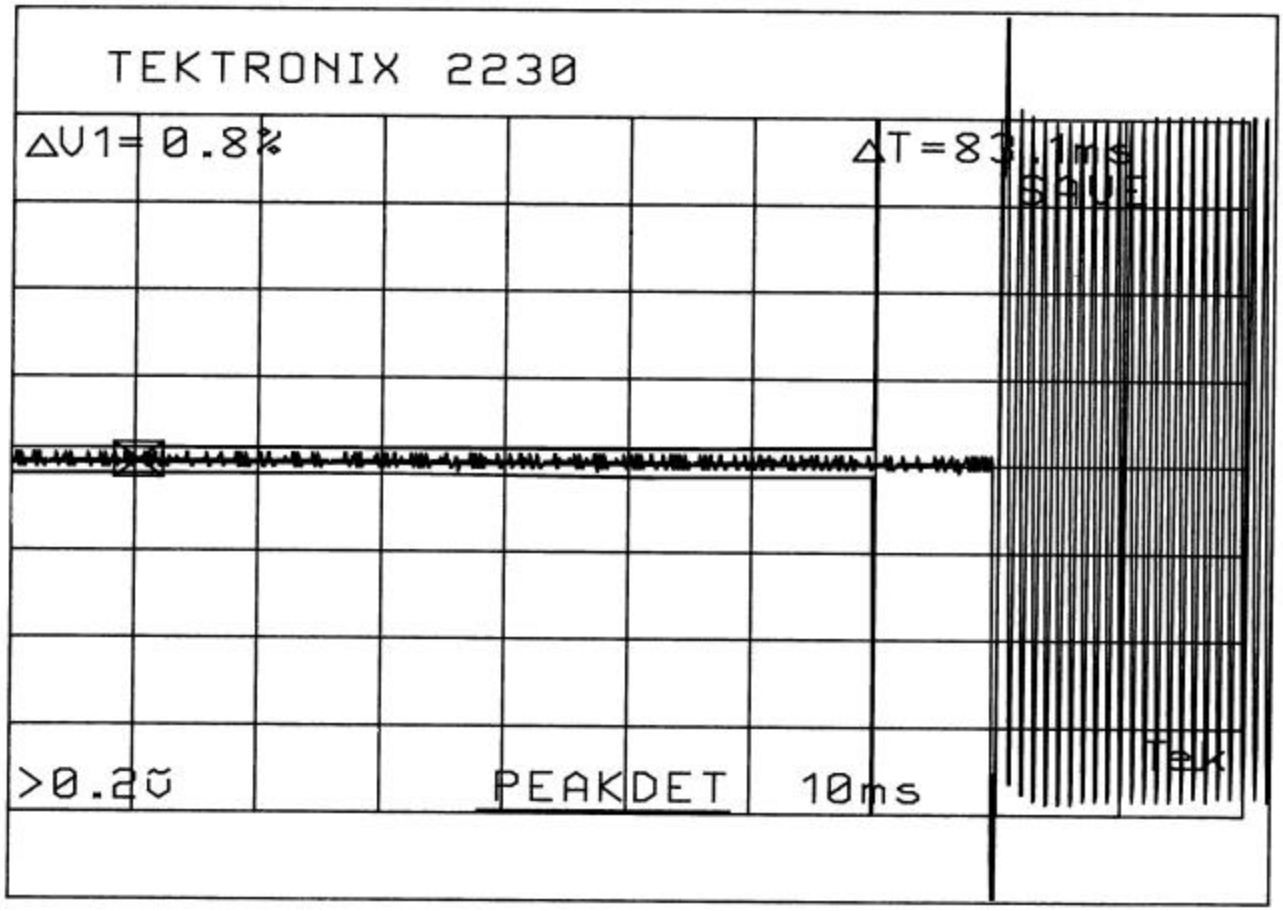
Turn on transient 25 kHz high power (6 watts)



Turn off transient 25 kHz high power (6 watts)



Turn on transient 12.5 kHz high power (6 watts)



Turn off transient 12.5 kHz high power (6 watts)

TEST EQUIPMENT LIST

1._X_Spectrum Analyzer: HP 8566B-Opt 462, S/N 3138A07786, w/ preselector HP 85685A, S/N 3221A01400, Quasi-Peak Adapter HP 8565OA, S/N 3303A01690 & Preamplifier HP 8449B-OPT H02, S/N 3008A00372 Cal. 8/31/01 Due 8/31/02
2.__ Biconnical Antenna: Eaton Model 94455-1, S/N 1057, Cal. 10/1/01 Due 10/1/02
3.__ Biconnical Antenna: Electro-Metrics Model BIA-25, S/N 1171 Cal. 4/26/01 Due 4/26/03
4._X_Log-Periodic Antenna: Electro-Metrics Model EM-6950, S/N 632 Char. 10/15/01 Due 10/15/02
5.__ Log-Periodic Antenna: Electro-Metrics Model LPA-30, S/N 409 Char. 10/16/01 Due 10/16/02
6.__ Log-Periodic Antenna: Electro-Metrics Model LPA-25, S/N 1122 Char. 2/10/01 Due 3/10/02
7.__ Double-Ridged Horn Antenna: Electro-Metrics Model RGA-180, 1-18 GHz, S/N 2319 Cal. 12/19/01 Due 12/19/02
8.__ 18-26.3GHz Systron Donner Standard Gain Horn #DBE-520-20 No Cal Required
9.__ Horn 40-60GHz: ATM Part #19-443-6R No Cal Required
10.__ Line Impedance Stabilization Network: Electro-Metrics Model EM-7820, w/NEMA Adapter S/N 2682 Cal. 3/16/01 Due 3/16/02
11._X_Temperature Chamber: Tenney Engineering Model TTRC, S/N 11717-7 Char. 1/22/02 Due 1/22/03
12._X_Frequency Counter: HP Model 5385A, S/N 3242A07460 Char. 12/11/01 Due 12/11/02
13.__ Peak Power Meter: HP Model 8900C, S/N 2131A00545 Char. 1/26/01 Due 1/26/02
14._X_Open Area Test Site #1-3meters Cal. 12/22/99
15.__ Signal Generator: HP 8640B, S/N 2308A21464 Cal. 11/15/01 Due 11/15/02
16.__ Passive Loop Antenna: EMCO Model 6512, 9KHz to 30MHz, S/N 9706-1211 Char. 7/10/01 Due 7/10/02
17.__ Dipole Antenna Kit: Electro-Metrics Model TDA-30/1-4, S/N 152 Cal. 3/21/01 Due 3/21/02
18.__ AC Voltmeter: HP Model 400FL, S/N 2213A14499 Cal. 10/9/01 Due 10/09/02
19._X_Digital Multimeter: Fluke Model 77, S/N 35053830 Char. 1/8/02 Due 1/8/03
20.__ Oscilloscope: Tektronix Model 2230, S/N 300572 Char. 2/1/01 Due 2/1/02

$W := 6.0$ power in Watts $D := 1$ Duty Factor in decimal % (1=100%)

$E := 1.5$ exposure time in minutes $U := 30$ (use 6 for controlled and 30 for uncontrolled)

$$Wexp := W \cdot D \cdot \left\{ \frac{E}{U} \right\} \qquad PC := \frac{E}{U}$$

$PC = 0.05$ percent on time

$Wexp = 0.3$ Watts

Correction for ON Time in 1.5 Minutes

$Po := 300$ mWatts $dBd := 3$ antenna gain $f := 460$ Frequency in MHz

$G := dBd + 2.15$ gain in dBi

$Gn := 10^{\frac{G}{10}}$ gain numeric $S := \frac{f}{1500}$ 1500 use for uncontrolled exposure

use 300 for controlled

$Gn = 3.273$ $S = 0.307$

$$R := \sqrt{\frac{(Po \cdot Gn)}{(4 \cdot \pi \cdot S)}}$$

$$inches := \frac{R}{2.54}$$

$R = 15.963$ distance in centimeters

required for compliance $inches = 6.285$

RF Exposure Assessment

The preceding calculations are based on a worst case installation.

1.) An antenna gain of 3 dBd was used. A typical installation would have a unity or lesser gain antenna.

2.) A 5 % on time for the transmitter was used. In a typical installation the on time is under 1%.