TAC/COM 2005 RF Power Output:

Relevant FCC Chapter:

"§ 2.1046 Measurements required: RF power output.

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

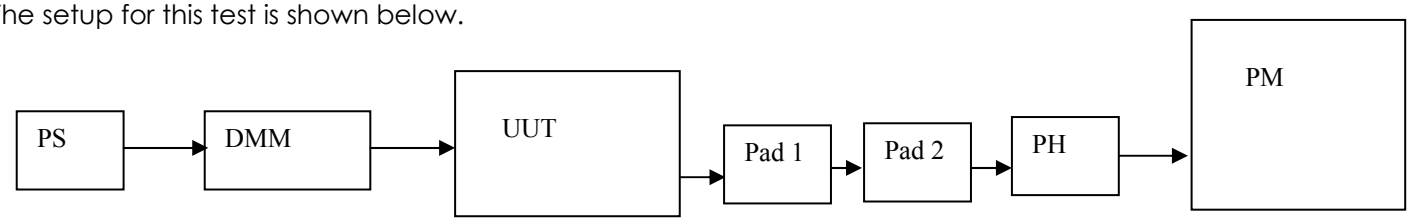
§ 2.1033 Application for certification.

(c) Applications for equipment other than that operating under parts 15 and 18 of the rules shall be accompanied by a technical report containing the following information:

(8) The dc voltages applied to and dc currents into the several elements of the final radio frequency amplifying device for normal operation over the power range."

Test Setup:

The setup for this test is shown below.



PS – Power Supply – Elpac FW3015
DMM – Digital Multi-Meter – HP 3478A – 2619A31605
UUT – TAC/COM 2005
Pad 1 – 10 dB Pad – Mini Circuits CAT10
Pad 2 – 20 dB Pad – Mini Circuits CAT20
PH – Power Head – HP 8481A – SN 2702A53289
PM – Power Meter - HP 435B - SN 2342A06959

Test Method:

The Power amplifier in the unit under test was calibrated to 4 watts at the lowest output frequency at a supply voltage of 15.0 VDC before installation in the UUT, per the factory test procedure. For the data collection, the RF output of the UUT was measured at three frequencies across the operating band. The power was measured with the 30 dB of padding (50 ohms, pure resistive) connected directly to the input of the Power Head.

Test Results:

The results of the test are shown in Table 1 and Figure 1.

Frequency (MHz)	9.0 VDC	
	Pout (mW)	I (mA)
150	2250	840
162.5	2600	1250
174	3400	1110

Table 1 - Power Output (Pursuant to FCC Requirement 2.1046a) – Raw Data

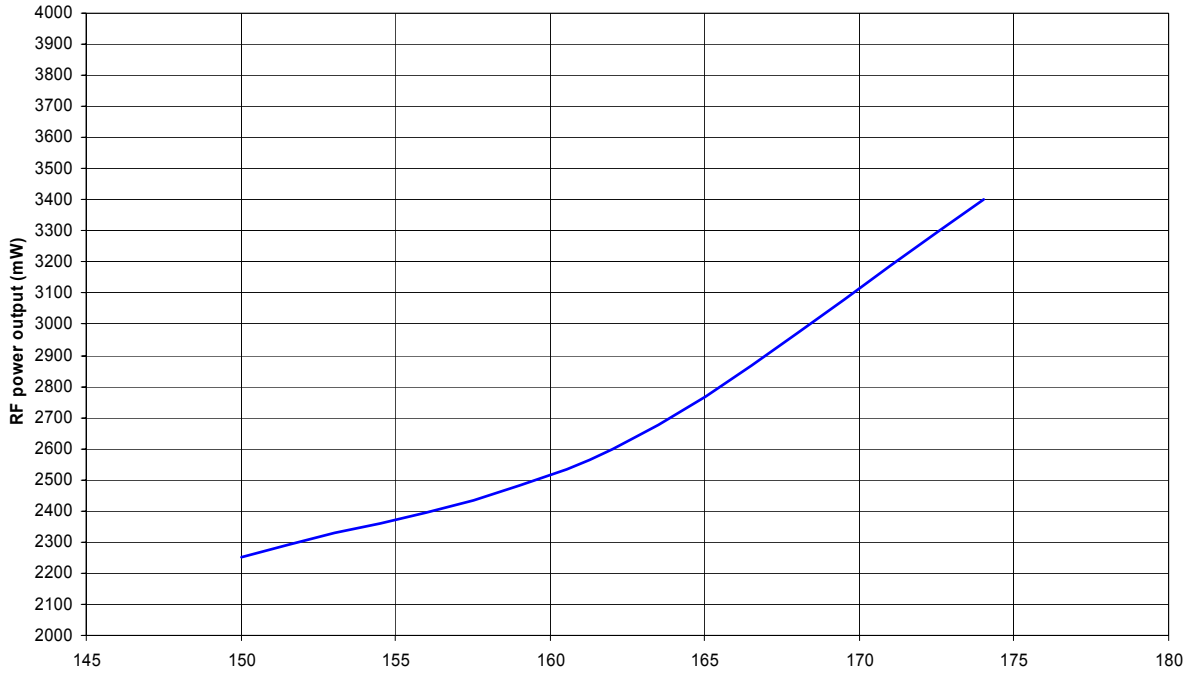


Figure 1 - RF Power Output As A Function of Frequency (Pursuant to FCC Requirement 2.1046a)

TAC/COM 2005 Modulation Characteristics - Deviation Frequency Response

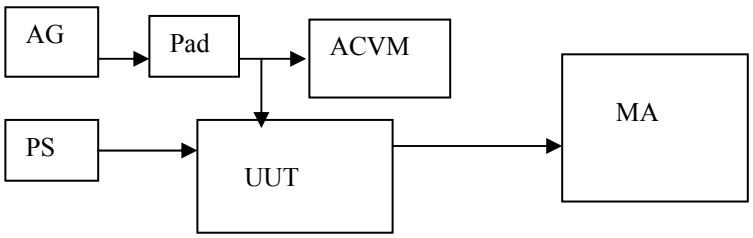
Relevant FCC Chapter:

"§ 2.1047 Measurements required: Modulation characteristics.

(a) *Voice modulated communication equipment.* A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted."

Test Setup:

The setup for this test is shown below.



AG – Audio Generator – Leader LAG120B – SN 7090853
PS – Power Supply – Elpac FW3015
Pad – 10 dB Pad – Mini Circuits CAT10
Pad – 20 dB Pad – Mini Circuits CAT20
ACVM – AC Volt Meter – Leader LMV181A – 3100941
UUT – TAC/COM 2005
MA – Modulation Analyzer – HP8901B – SN 2806A01820

Test Method:

The unit under test is left with the OEM calibration: 100% modulation with a 1 kHz tone results in FM deviation of 2 kHz at the Narrow Band setting and 4 kHz at the Wide Band setting. For the purposes of the test, the audio input of the unit was driven with a level adequate to modulate the carrier at 50% (for both the Narrow and Wide Band settings) from 100 Hz to 5000 Hz with measurements being taken at every 100 Hz.

Test Results:

The results of the test are shown in Table 2 and Figure 2. At 5 KHz in the narrow band settingIt was not possible to drive the input level high enough to elicit a 50% modulation level.

AC mV RMS Required to Maintain Deviation (1000 Hz for Narrow, 2 kHz for Wide)		
Hz x 100	Narrow Band Modulation	Wide Band Modulation
1	56	57
2	67	66
3	70	72
4	68	70
5	66	69
6	66	68
7	66	68
8	66	68
9	67	68
10	68	68
11	68	68
12	68	68
13	68	68
14	70	69
15	70	70
16	71	70
17	71	70
18	72	70
19	73	71
20	75	71
21	75	72
22	77	72
23	77	73
24	78	74
25	80	74
26	82	75
27	84	76
28	84	76
29	85	77
30	86	78
31	89	78
32	91	80
33	93	80
34	95	82
35	98	83
36	100	84
37	102	86
38	106	88
39	110	90
40	112	92
41	118	95
42	122	98
43	129	105
44	133	110
45	145	115
46	150	120
47	160	126
48	204	134
49	490	143
50	* unable to achieve 20% deviation	151

Table 2 - Deviation Frequency Response (Pursuant to FCC Requirement 2.1047a) – Raw Data

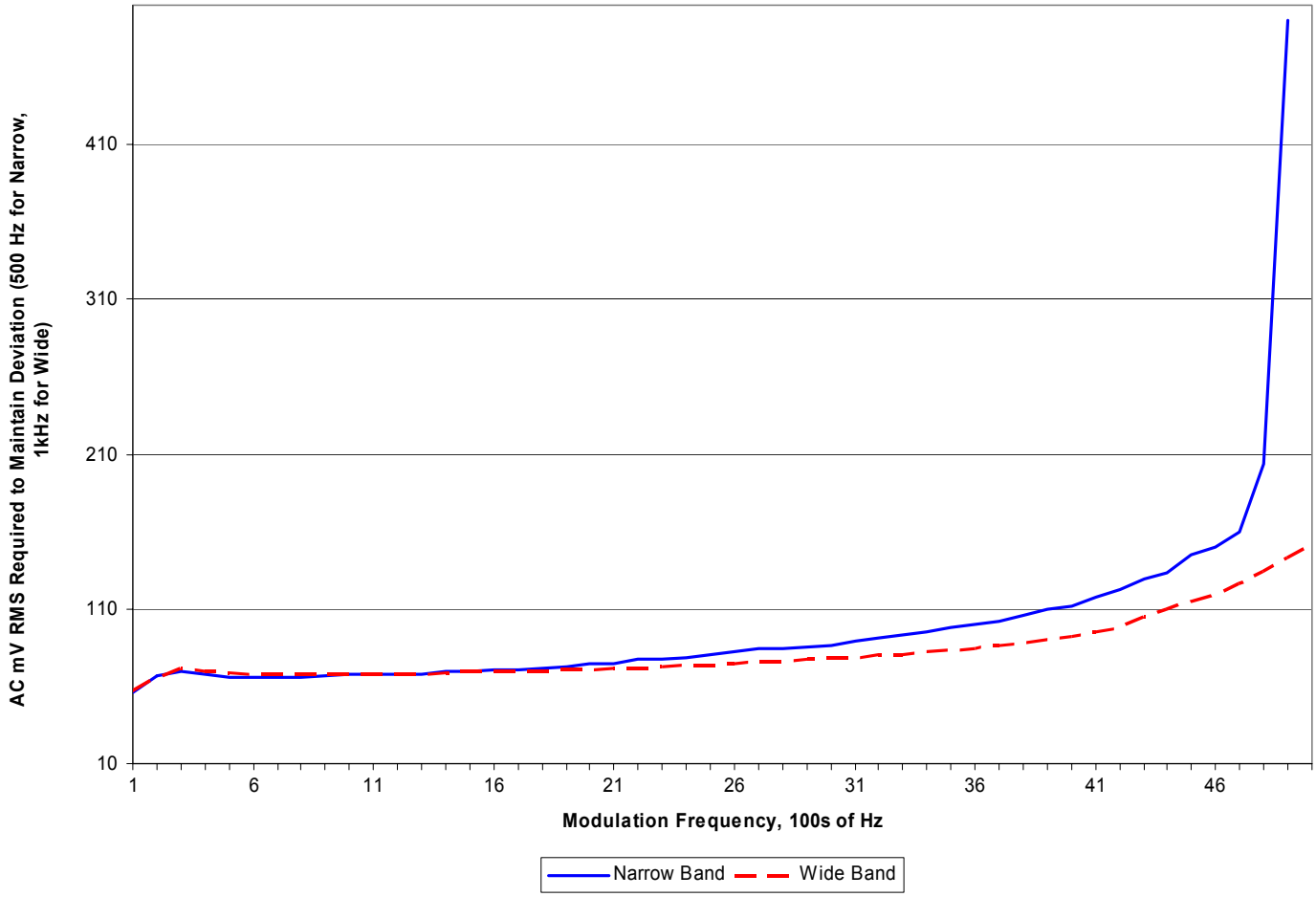


Figure 2 – Audio Sensitivity as a Function of Input Frequency (Pursuant to FCC Requirement 2.1047a)

TAC/COM 2005 Modulation Characteristics – Modulation Sensitivity

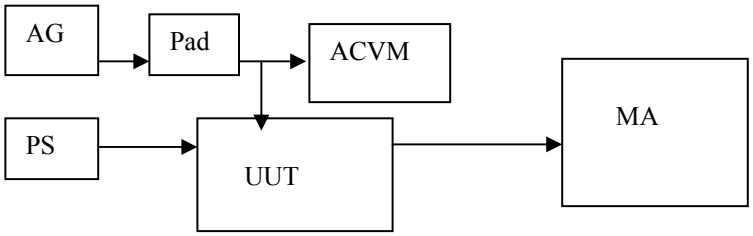
Relevant FCC Chapter:

"§ 2.1047 Measurements required: Modulation characteristics.

(b) *Equipment which employs modulation limiting*. A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed. "

Test Setup:

The setup for this test is shown below.



AG – Audio Generator – Leader LAG120B – SN 7090853
PS – Power Supply – Elpac FW3015
Pad – 10 dB Pad – Mini Circuits CAT10
Pad – 20 dB Pad – Mini Circuits CAT20
ACVM – AC Volt Meter – Leader LMV181A – 3100941
UUT – TAC/COM 2005
MA – Modulation Analyzer – HP8901B – SN 2806A01820

Test Method:

Based on supplier calibration, the Maxon Amplifier reaches 100% modulation with a 1 kHz tone at a level of 140 mV RMS in Narrow band mode and 150 mV RMS in Wide Band mode. This resulted in FM deviation of 2 kHz at the Narrow Band setting and 4 kHz at the Wide Band setting. For the purposes of the test, the audio input of the unit was driven at 1mv intervals from 1 to 10 mv RMS, then 10 mV intervals from 10 mV RMS until 100% deviation was reached , for each of the audio tones of 500, 1000, and 3000 Hz. At each voltage interval and frequency, the deviation was recorded with the unit in Narrow Band mode and Wide Band mode.

Test Results:

The results of the test are shown in Table 3 and Figure 3. At 3 kHz in Narrow Band mode and 500 Hz in Wide Band mode, the audio demodulated from the Modulation Analyzer showed extreme distortion when observed in the time domain before 100% deviation was reached.

Kilohertz of deviation as a function of audio input level at various frequencies

Audio Input ACmvRMS	500 Hz		1000 Hz		3000 Hz	
	Wide	Narrow	Wide	Narrow	Wide	Narrow
1	50	35	50	40	40	30
2	75	50	80	51	70	40
3	110	65	100	70	90	60
4	140	85	140	80	120	70
5	165	100	170	100	150	80
6	190	110	200	110	175	90
7	220	125	225	125	200	100
8	250	140	255	140	230	110
9	280	155	285	160	260	130
10	310	170	315	170	280	140
20	580	310	590	310	520	245
30	870	460	890	450	770	360
40	1150	600	1180	595	1030	460
50	1430	750	1480	740	1290	590
60	1710	900	1750	900	1540	700
70	2000	1060	2065	1035	1820	810
80	2280	1210	2360	1190	2060	930
90	2560	1351	2660	1335	2325	1040
100	2840	1510	2870	1486	2580	1150
110	3050	1615	3195	1600	2780	1250
120	3320	1760	3485	1750	3040	1340
130	3580	1900	3745	1903	3290	1480
140	3700	1960	3890	1963	3550	1580
150	3760	2000	3959	1990	3740	1660
160	3820	2025	3990	2005	3845	1720
170	3866	2040	4020	2015	3920	1750
180	(distortion)	*	*	*	3980	1780
190					4030	1800
200					*	1820
210						1835
220						1840

* - 100% modulation reached

Table 3 - Modulation Sensitivity (Pursuant to FCC Requirement 2.1047b) – Raw Data

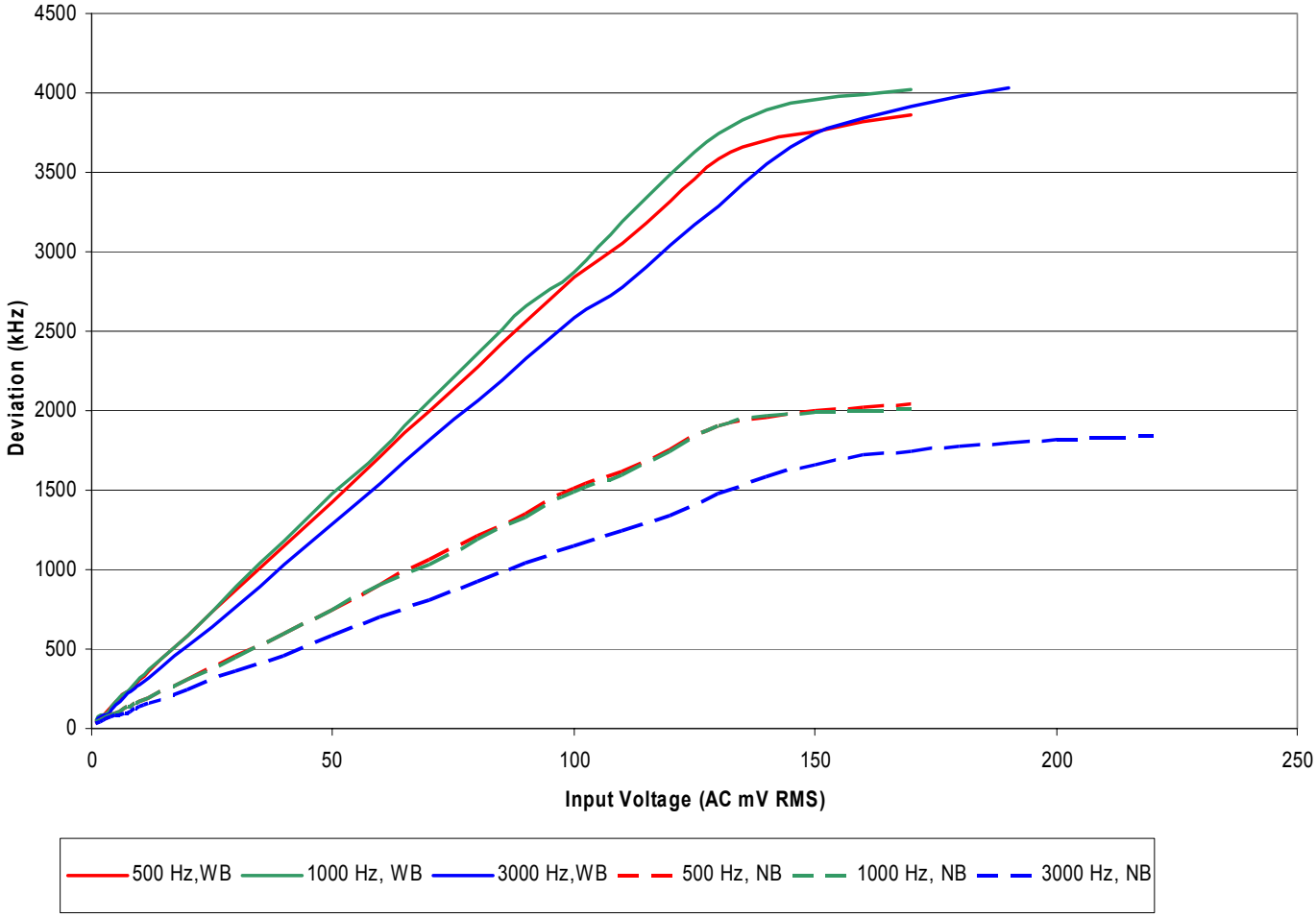


Figure 3 – Wide and Narrow Band Modulation Sensitivity
(Pursuant to FCC Requirement 2.1047b)

TAC/COM 2005 Occupied Bandwidth

Relevant FCC Chapters:

§ 2.1049 Measurements required: Occupied bandwidth.

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

(c) Radiotelephone transmitters equipped with a device to limit modulation or peak envelope power shall be modulated as follows.

(1) Other than single sideband or independent sideband transmitters—when modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation. The input level shall be established at the frequency of maximum response of the audio modulating circuit.

§ 90.210 Emission masks.

(The TAC/COM 2005 is designed to operate at either 12.5 kHz bandwidth (aka Narrow), 25 kHz bandwidth (Wide), or off. Under Section 90 part 210, the masks for equipment designated to operate in the 150 to 174 MHz band are specified in the Applicable Emission Masks Chart, footnote 2.)

" [2] Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D"

(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 removed 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 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.

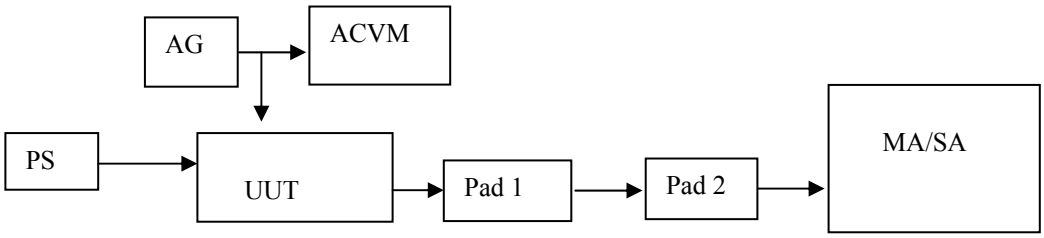
(b) *Emission Mask B - 25 kHz channel bandwidth equipment.* For transmitters that are equipped with an audio lowpass filter pursuant to § 90.211(a), the power of any emission must be below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

Test Setup:
The setup for this test is shown below.



AG – Audio Generator – Leader LAG120B – SN 7090853
PS – Power Supply – Elpac FW3015
Pad 1 – 10 dB Pad – Mini Circuits CAT10
Pad 2 – 20 dB Pad – Mini Circuits CAT20
ACVM – AC Volt Meter – Leader LMV181A – 3100941
UUT – TAC/COM 2005
MA – Modulation Analyzer – HP8901B – SN 2806A01820
SA – Spectrum Analyzer – Advantest R3131 – SN 120401992

Test Method:
The Unit Under Test was modulated with a 2500 Hz tone at a level of %50 – 1.25 kHz. The Audio input level was then increased by 16 dB. The deviation was measured using the HP8901B Modulation analyzer, then the output was switched to the spectrum analyzer for the purpose of measuring the occupied bandwidth. The spectrum was measured with the unit set to each of the following modes:

Unmodulated Carrier
Narrow Band,
Wide Band

For the purpose of calculating mask segments, the power of the unmodulated carrier was 1 watt, therefore:

90.210 (b) (3) 43 + 10log(2.0) = 46 dB
90.210 (d) (3) 50 + 10log(2.0) = 53 dB

Test Results:
The results of the test are shown in Figures 4 - 6.
The unit under test passes per the criteria established in 2.1049 and 90.210.

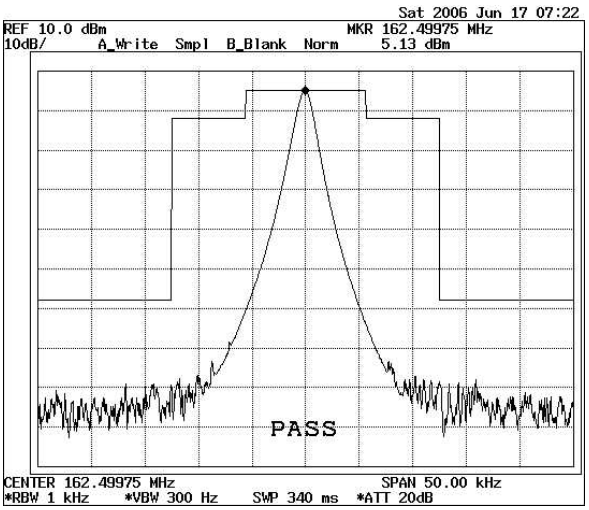


Figure 4 – Unmodulated Carrier

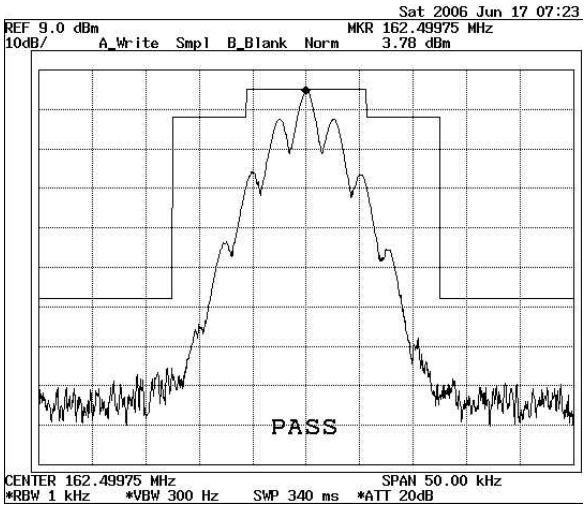


Figure 5 – Narrow Band

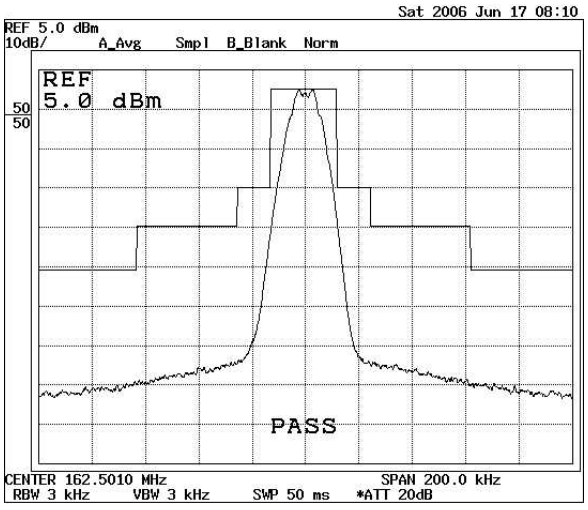


Figure 6 – Wide Band

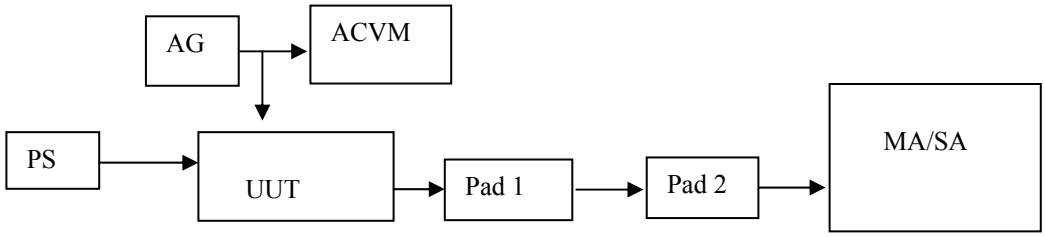
TAC/COM 2005 Spurious Emissions at Antenna Terminals

Relevant FCC Chapters:
§ 2.1051 Measurements required: Spurious emissions at antenna terminals.
The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§ 2.1049 Measurements required: Occupied bandwidth. (c) (1)

§ 90.210 Emission masks. (b) (d)

Test Setup:
The setup for this test is shown below.



AG – Audio Generator – Leader LAG120B – SN 7090853
PS – Power Supply – Elpac FW3015
Pad 1 – 10 dB Pad – Mini Circuits CAT10
Pad 2 – 20 dB Pad – Mini Circuits CAT20
ACVM – AC Volt Meter – Leader LMV181A – 3100941
UUT – TAC/COM 2005
MA – Modulation Analyzer – HP8901B – SN 2806A01820
SA – Spectrum Analyzer – Advantest R3131 – SN 120401992

Test Method:
The method used for testing Spurious Emissions is identical to the method used for testing the Occupied Bandwidth. The spectrum was measured with the unit set to each of the following modes:

Narrow Band, AGC On
Wide Band, AGC On

For the purpose of calculating mask segment (b)(3), the power of the unmodulated carrier was 2 watt, therefore:

$$43 + 10\log(2) = 46 \text{ dBc}$$

Test Results:
The results of the test are shown in Table 4 and Figures 7 and 8.
The unit under test passes per the criteria established in 2.1051, 2.1049, and 90.210.

Harmonic	Frequency (MHz)	Narrow and Level (dBc)	Wide band level (dBc)
F2	324	-62	-60
F3	486	>-70	>-70
F4	648	>-70	>-70
F5	810	>-70	>-70
F6	972	>-70	>-70
F7	1134	>-70	>-70
F8	1296	>-70	>-70
F9	1458	>-70	>-70
F10	1620	>-70	>-70
F11	1782	>-70	>-70
F12	1944	>-70	>-70

Table 4 – Spurious Emissions (Pursuant to FCC Requirement 2.1051) – Raw Data F0 162.500000MHz – 0dB ref.

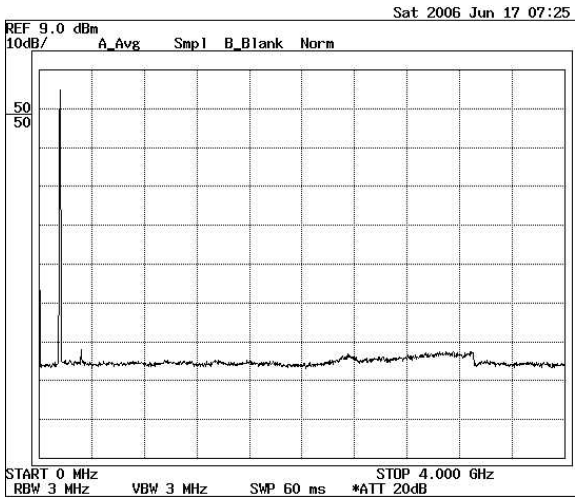


Fig 7 – Narrow Band Spurious Emissions – Spectral Display

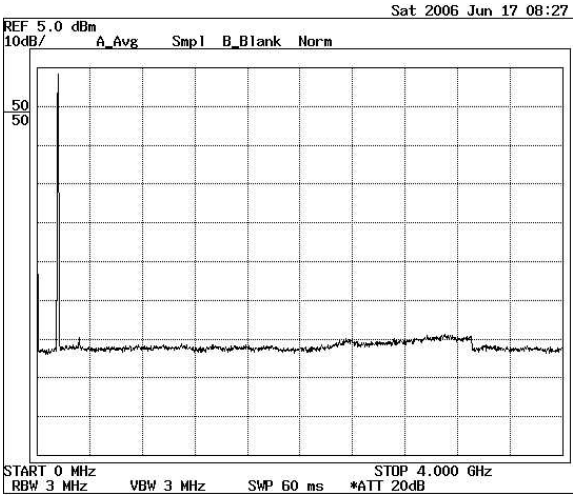


Fig 8 – Wide Band Spurious Emissions – Spectral Display

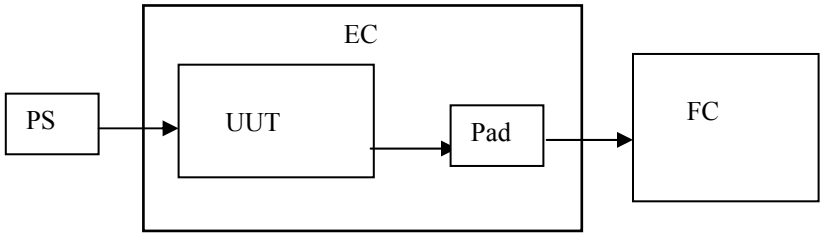
TAC/COM 2005 (Digital Body Wire) Frequency Stability: Temperature Stability

Relevant FCC Chapter:
"§ 2.1055 Measurements required: Frequency Stability.
(a) The frequency stability shall be measured with variation of ambient temperature as follows:
(1) From -30° to +50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

[The TAC/COM 2005 does not qualify under part 47, chapter 2.1055 (a)(2) or (a)(3)]

(c) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

Test Setup:
The setup for this test is shown below.



PS – Power Supply – BK 1743 – SN 273 0200 0483
EC – Environmental Chamber – Applied Systems BK-1101 – SN 8665
UUT – TAC/COM 2005 Digital Body Wire
Pad – 10 dB Pad – Mini-Circuits CAT 10
FC – Frequency Counter – HP 5351B – SN 3049A01169

Test Method:
The unit under test was powered at 15.0 VDC and set to a carrier frequency of 162.5 MHz. At an ambient temperature of 23.7^{O} C the frequency was 162,499,525 Hz. The Environmental Chamber was set to –30^{O} C and swept to +70^{O} C in 10^{O} steps. Due to the small size of the chamber and the UUT, the unit was left at each temperature for 600 minutes before the measurement was made.

Test Results:
The results of the test are shown in Table 5 and Figure 9.

Frequency Deviation (PPM) as a function of temperature

Temp (°C)	Frequency Deviation (PPM)
-30	.18
-20	.12
-10	.07
0	0
10	0
20	0
30	0
40	-.11
50	-.13
60	-.44
70	1.2

Table 5 – Frequency Stability (Pursuant to FCC Requirement 2.1055a) – Raw Data

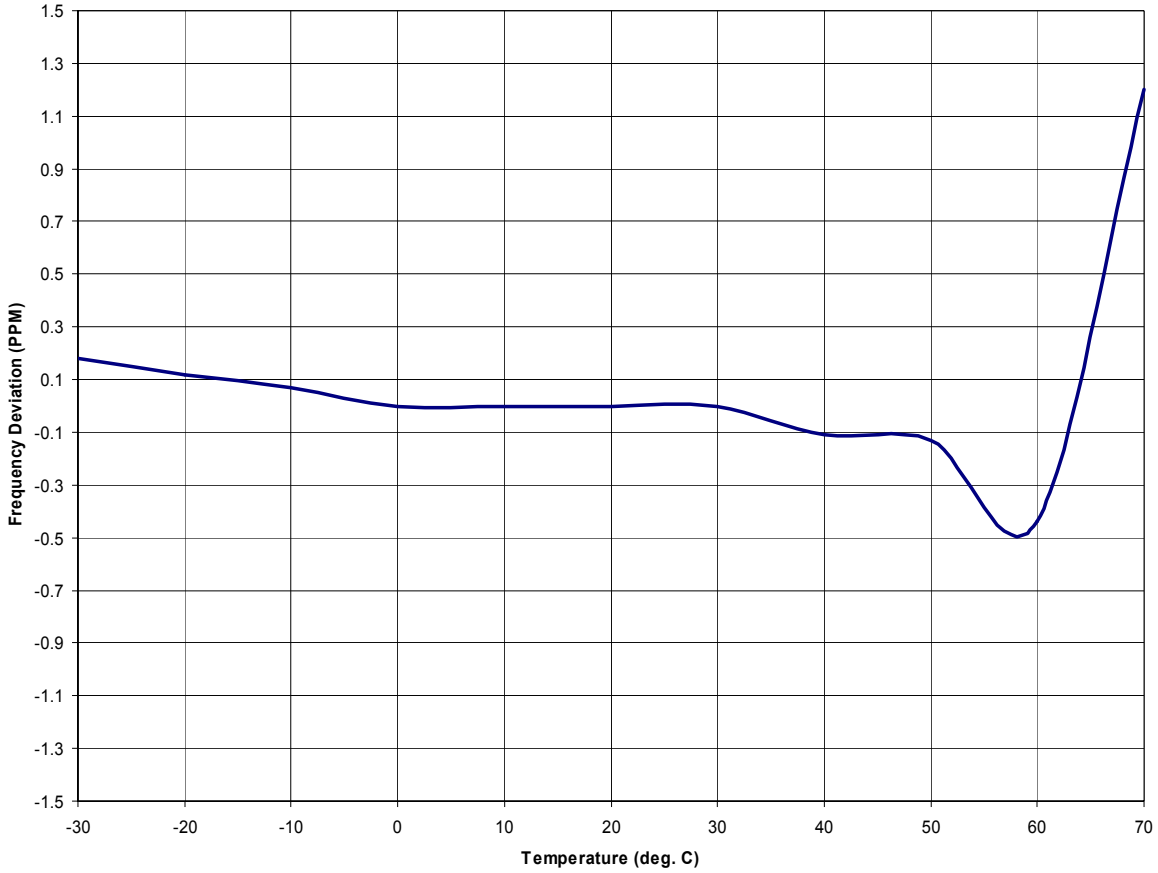
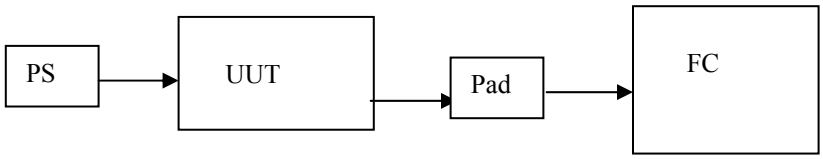


Figure 9 - Frequency Deviation (PPM) as a Function of Temperature (Pursuant to FCC Requirement 2.1055a)

TAC/COM 2005 (Digital Body Wire) Frequency Stability: Power Supply Stability

Relevant FCC Chapter:
"§ 2.1055 Measurements required: Frequency Stability.
(d) The frequency stability shall be measured with variation of primary supply voltage as follows:
(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

Test Setup:
The setup for this test is shown below.



PS – Power Supply – Hewlett-Packard HP6207B – SN 1149A01889
UUT – TAC/COM 2005 Digital Body Wire
Pad – 10 dB Pad – Mini-Circuits 10
FC – Frequency Counter – HP 5351B – SN 3049A01169

Test Method:
The Frequency was measured at a nominal 12 VDC, then measured at supply voltages from 11 VDC to 16 VDC in 1 VDC increments.

Test Results: The results of the test are shown in Table 6 and Figure 10.

Frequency Deviation (Hz) as a function of supply voltage

Voltage (VDC)	Fr Dev. (Hz)
11	0
12	0
13	0
14	0
15	0
16	0

Table 6 – Frequency Stability (Pursuant to FCC Requirement 2.1055d) – Raw Data

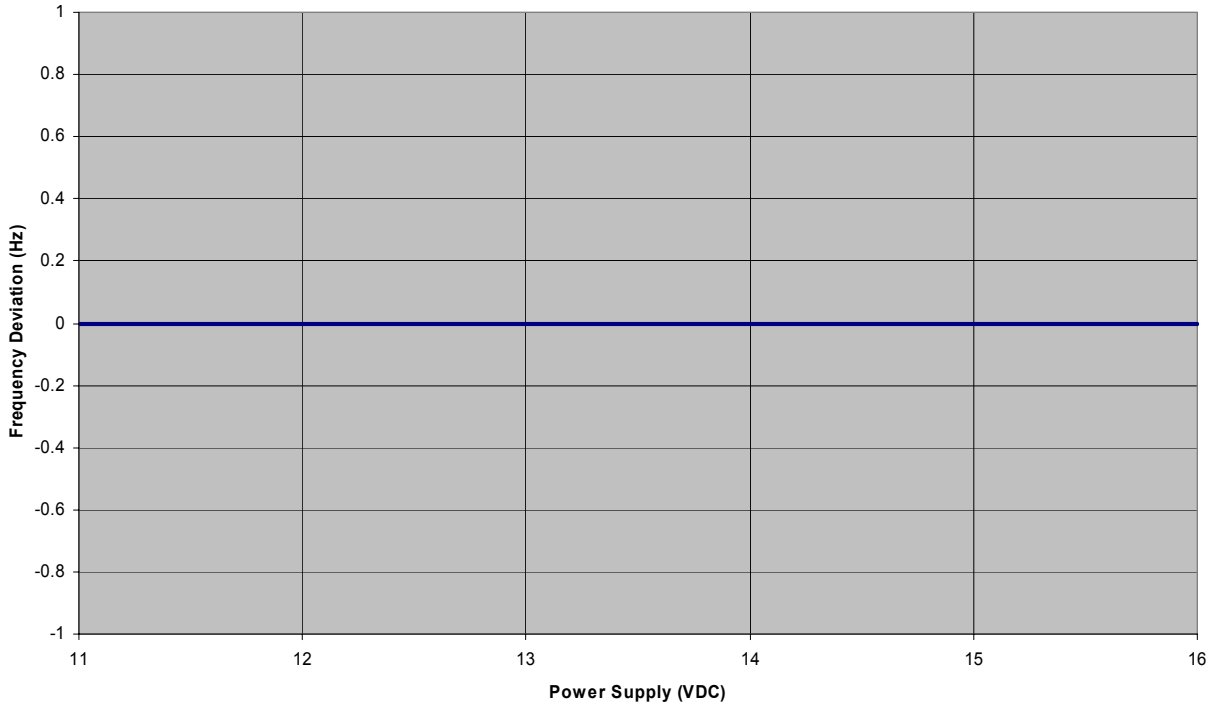


Figure 10 - Frequency Deviation (Hz) as a Function of Supply Voltage (Pursuant to FCC Requirement 2.1055d)