

**T-2765-KF RF Power Output:**

**Relevant FCC Chapter:**

2.1046 Measurements required: RF power output.

(a) For transmitters other than single side-band, independent side-band 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.

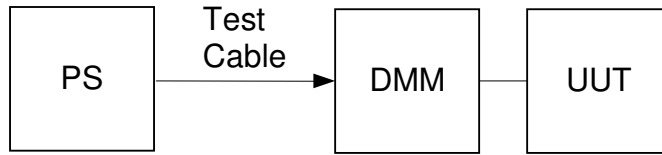
There are no RF output terminals on this unit. It has an integrated antenna, printed on the antenna circuit board. The electrical connection between the RF-generating PCB and the Antenna PCB is made by soldering. The entire 3-board circuit assembly, including the antenna, that comprises the design is wholly inaccessible by the user.

Hence it is not possible to perform conducted rf output power tests on the unit. For the reasons given above, it is requested that conducted rf output power testing be waived for this application. In its place are presented Fundamental Radiated Emissions test results, see Attachment TEST REPORT R-5428N, p.22. For the Fundamental Radiated Emission tests, the UUT was powered by a 1.5V AAA Lithium cell, the power source with which the unit is designed to operate (and specified in the User Manual).

For the purposes of satisfying 2.1033(c)(8), measurements were taken of supply current as a function of supply voltage, using a custom-built test cable that substitutes for the AAA battery supply and allows operation from a DC Power Supply.

**Test Setup:**

The setup for this test is shown below.



- PS - Power Supply - Kikusui PAB18-38
- Test Cable - Custom-made, for current measurements
- DMM - Digital Multi-Meter - HP 3478A - 2619A31605
- UUT - T-2765

UUT SUPPLY CURRENT AS FUNCTION OF SUPPLY VOLTAGE  
 Operation at Band Center Frequency (162MHz).

DC Supply Voltage V	Operating Current Transmit Mode mA
1.1	387
1.2	348
1.4	290
1.6	250

Note: 1.6V represents the voltage of a fresh battery. 1.2V-1.4V is typical of the battery under load throughout most of its operating duration. 1.1V is considered a battery on the point of exhaustion.

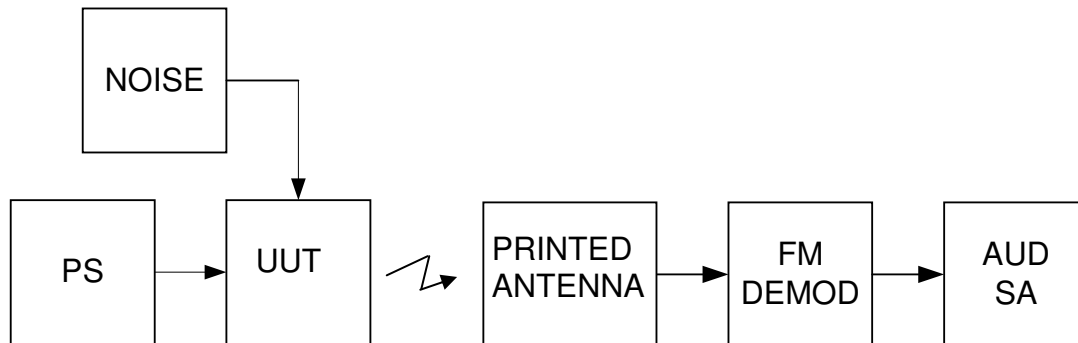
**T-2765-KF Modulation Characteristics - Deviation Frequency Response****Relevant FCC Chapter:**

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.



NOISE - Pink Noise Generator (trueAudio Inc. trueRTA)

PS - Power Supply - Kikusui PAB18-38

PRINTED ANTENNA - custom-built copper loop antenna on FR4

FM DEMOD - BOONTON 8210 SN 100910BA

UUT - T-2765-KF

AUD SA - Audio Spectrum Analyzer 1/24<sup>th</sup> Octave (trueAudio Inc. trueRTA)

**Test Method:**

A "pink-noise" (equal noise power per percent BW) generator was used instead of the Microphone as the input to the UUT. The noise spectrum was defined over the range of 10 Hz to 48 kHz. The noise level was initially adjusted to a level that produced a deviation of 1.25 kHz peak. The noise level was then increased by a factor of 16dB. The UUT RF carrier was then demodulated to audio base-band. The noise generator method of measurement overcomes the apparent frequency leveling action of the AGC and represents the true dynamic audio frequency response over the band of interest.

**Test Results:**

The results of the test are displayed in Figures 3 and 4, which clearly show the EIA 6 db / octave pre-emphasis characteristic along with the low pass cutoff above 3 kHz.

**Frequency Response (Pursuant to FCC requirement 2.1047a)**

**Figure 3, RAW Data**

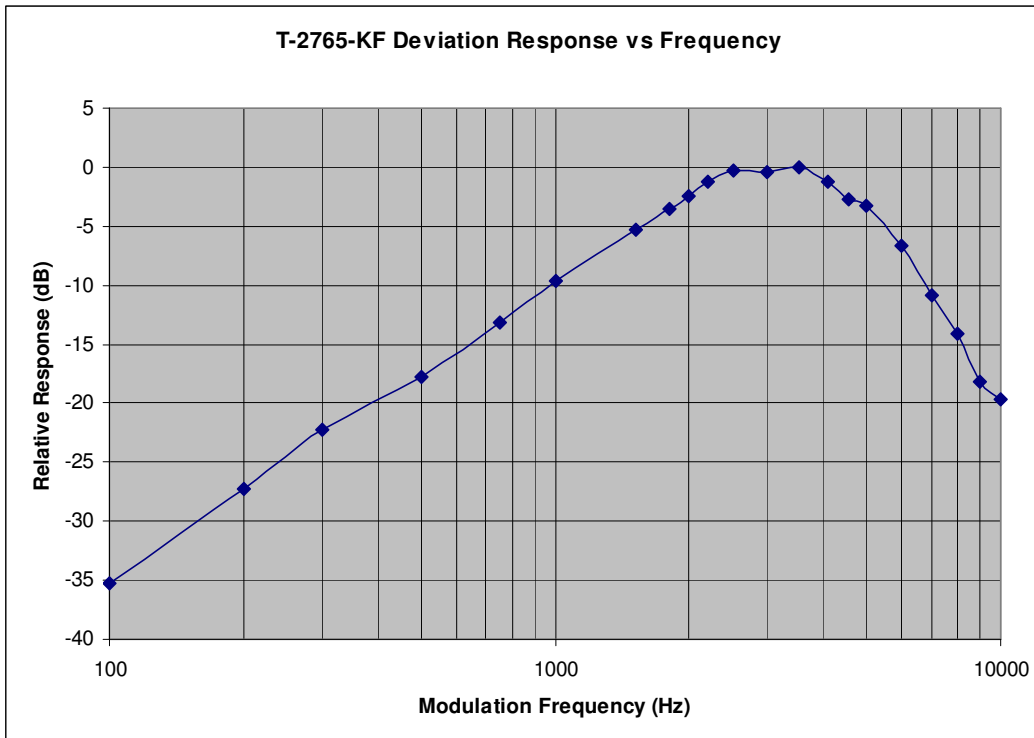
AGC = ON

Relative Level in dB

Frequency (Hz)	REL dBV	Normalized
100	-58	-35.2
200	-50	-27.2
300	-45	-22.2
500	-40.6	-17.8
750	-36	-13.2
1000	-32.5	-9.7
1520	-28.1	-5.3
1800	-26.4	-3.6
2000	-25.2	-2.4
2200	-24.1	-1.3
2520	-23.1	-0.3
3000	-23.2	-0.4
3520	-22.8	0
4080	-24.1	-1.3
4560	-25.5	-2.7
5000	-26.1	-3.3
6000	-29.5	-6.7
7000	-33.7	-10.9
8000	-36.9	-14.1
9000	-41	-18.2
10,000	-42.5	-19.7

**Frequency Response (Pursuant to FCC requirement 2.1047a)**

**Figure 4**



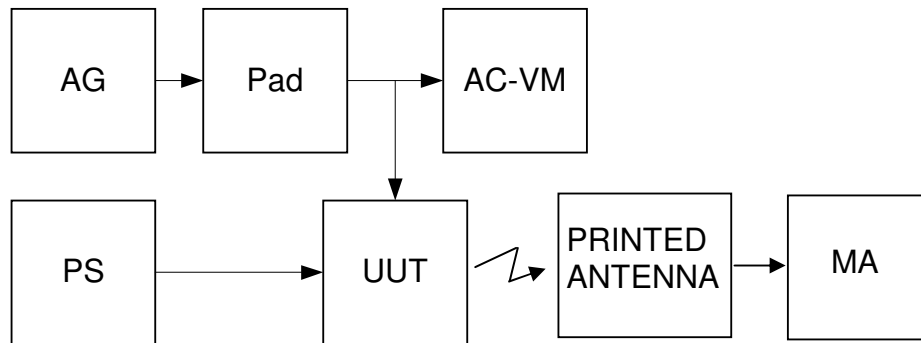
**T-2765-KF Modulation Characteristics - Modulation Sensitivity****Relevant FCC Chapter:**

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 - Kikusui PAB18-38

ACVM-AC Volt Meter-Leader LMV181A-3100941

UUT - T-2765-KF

PRINTED ANTENNA - custom-built copper loop antenna on FR4

MA - BOONTON 8210 SN 100910BA

**Test Method:**

The unit under test was calibrated to 100% modulation with a 1 kHz tone at a level of 10 mV RMS. This resulted in FM deviation of approximately 2.5 kHz. For the purposes of the test, the audio input to the unit was driven from 0.1 mV RMS to 100mV RMS for each of the audio tones of 500, 1000, and 3000 Hz. At each voltage interval and frequency, the deviation was recorded with AGC on and off.

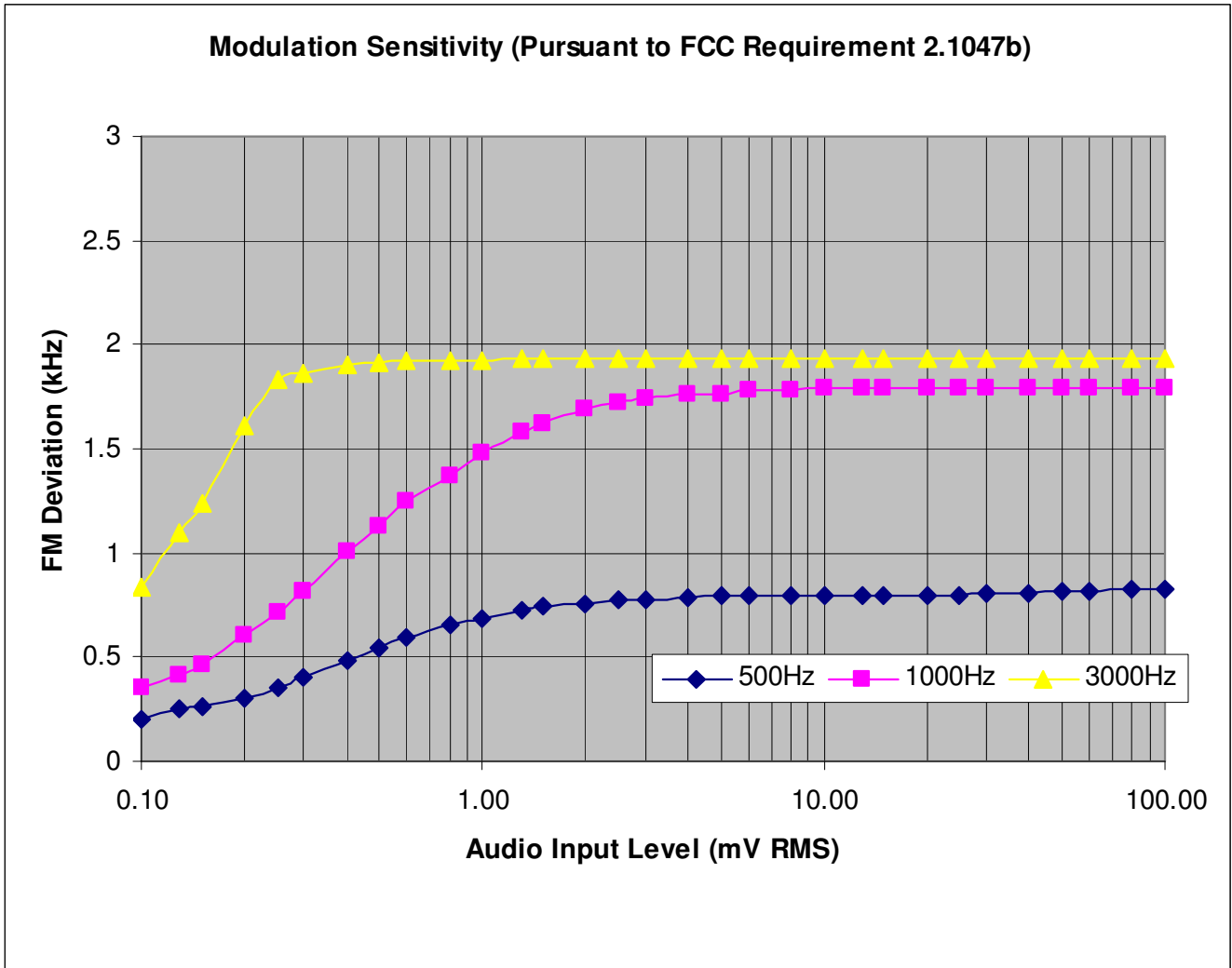
**Test Results:**

The results of the test are shown in Figures 5 and 6

**Modulation Sensitivity (Pursuant to FCC Requirement 2.1047b)  
Figure 5A, Raw Data**

Modulation Sensitivity (Pursuant to FCC Requirement 2.1047) Raw Data			
<b>AGC = ON</b>			
Audio Level	Mod Freq	Mod Freq	Mod Freq
(mV RMS)	500 Hz	1000 Hz	3000 Hz
	Dev (kHz)	Dev (kHz)	Dev (kHz)
0.10	0.202	0.35	0.84
0.13	0.248	0.41	1.1
0.15	0.26	0.46	1.24
0.20	0.3	0.6	1.61
0.25	0.35	0.71	1.83
0.30	0.4	0.82	1.86
0.40	0.48	1.01	1.9
0.50	0.54	1.13	1.91
0.60	0.59	1.25	1.92
0.80	0.65	1.37	1.92
1.00	0.68	1.48	1.92
1.30	0.72	1.58	1.93
1.50	0.74	1.62	1.93
2.00	0.76	1.69	1.93
2.50	0.78	1.72	1.93
3.00	0.78	1.74	1.93
4.00	0.79	1.76	1.93
5.00	0.8	1.76	1.93
6.00	0.8	1.78	1.93
8.00	0.8	1.78	1.93
10.00	0.8	1.79	1.93
13.00	0.8	1.79	1.93
15.00	0.8	1.79	1.93
20.00	0.8	1.79	1.93
25.00	0.8	1.79	1.93
30.00	0.81	1.79	1.93
40.00	0.81	1.79	1.93
50.00	0.82	1.79	1.93
60.00	0.82	1.79	1.93
80.00	0.83	1.79	1.93
100.00	0.83	1.79	1.93

Modulation Sensitivity (Pursuant to FCC Requirement 2.1047b)  
Figure 6A

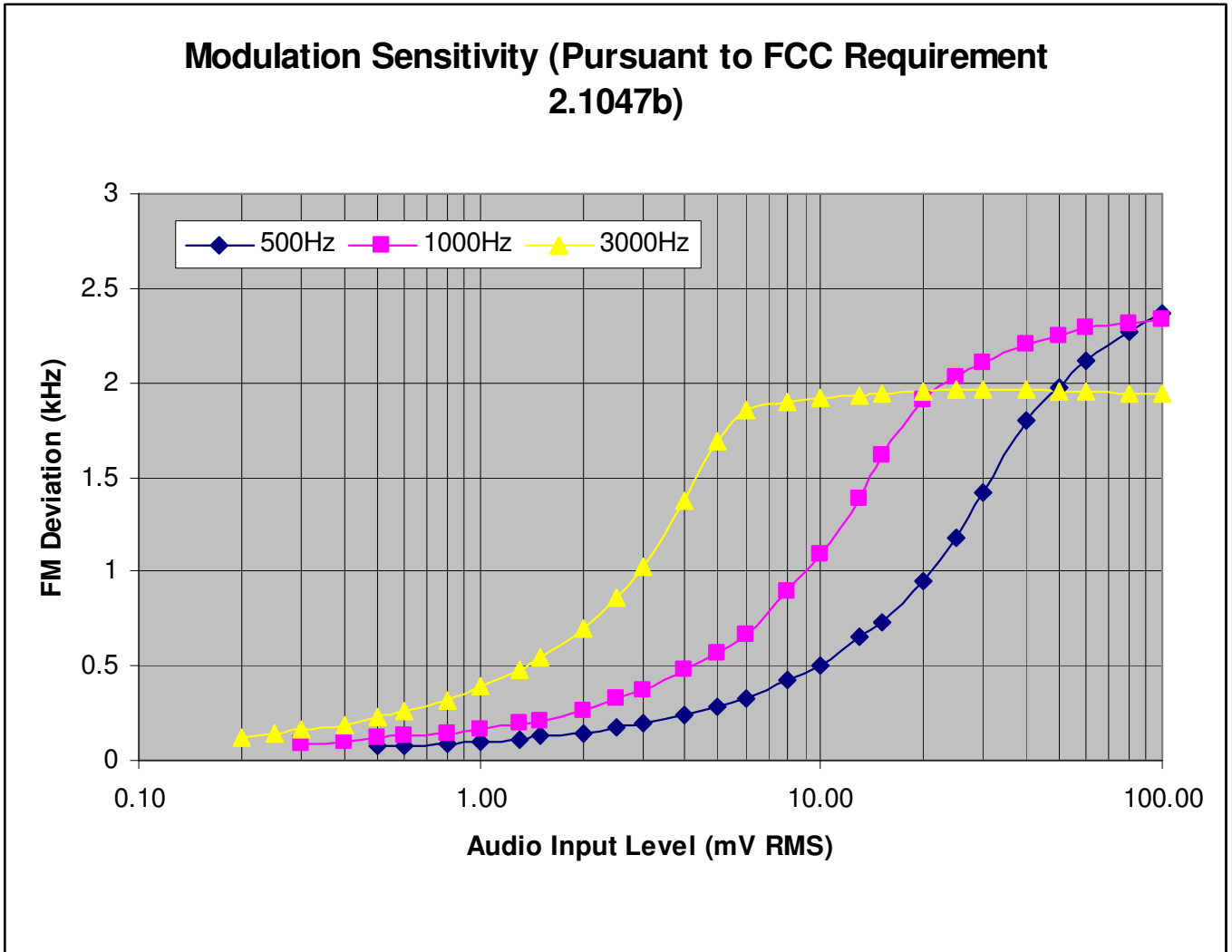


**Modulation Sensitivity (Pursuant to FCC Requirement 2.1047b)  
Figure 5B, Raw Data**

Modulation Sensitivity (Pursuant to FCC Requirement 2.1047) Raw Data			
<b>AGC = OFF</b>			
Audio Level (mV RMS)	Mod Freq 500 Hz	Mod Freq 1000 Hz	Mod Freq 3000 Hz
	Dev (kHz)	Dev (kHz)	Dev (kHz)
0.10			
0.13			
0.15			
0.20			0.12
0.25			0.14
0.30		0.09	0.16
0.40		0.102	0.19
0.50	0.08	0.117	0.23
0.60	0.08	0.129	0.26
0.80	0.09	0.147	0.32
1.00	0.1	0.169	0.39
1.30	0.114	0.191	0.48
1.50	0.126	0.209	0.54
2.00	0.147	0.26	0.7
2.50	0.173	0.328	0.86
3.00	0.195	0.37	1.03
4.00	0.238	0.48	1.37
5.00	0.289	0.57	1.69
6.00	0.331	0.67	1.85
8.00	0.421	0.89	1.9
10.00	0.503	1.09	1.92
13.00	0.654	1.39	1.93
15.00	0.735	1.61	1.94
20.00	0.952	1.91	1.95
25.00	1.18	2.03	1.96
30.00	1.42	2.1	1.96
40.00	1.8	2.2	1.96
50.00	1.98	2.25	1.95
60.00	2.12	2.29	1.95
80.00	2.27	2.31	1.94
100.00	2.37	2.34	1.94



Modulation Sensitivity (Pursuant to FCC Requirement 2.1047b)  
Figure 6B



**T-2765-KF 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 side-band or independent side-band 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 T-2765-KF is not specifically designed to operate with a 12.5 kHz bandwidth. It also does not incorporate an Audio Low Pass Filter. Under Section 90 part 210, the applicable mask would therefore be Emission Mask C:

(c) Emission Mask C. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:

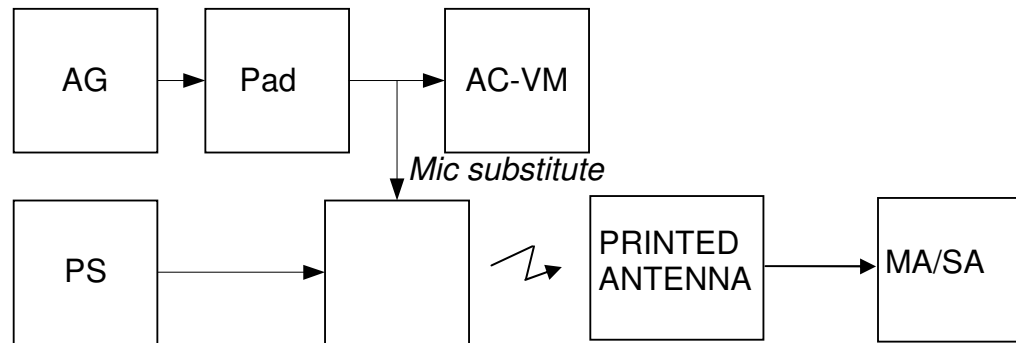
(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 5 kHz, but not more than 10 kHz: At least  $83 \log (f_d/5)$  dB;

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: At least  $29 \log (f_d^2/11)$  dB or 50dB, whichever is the lesser attenuation;

(3) On any frequency removed from the center of the authorized bandwidth by more than 250 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 LAB 120B - SN 7090853

PS - Power Supply - Kikusui PAB 18-3A

Pad - 10 dB Pad-Mini Circuits CAT10

ACVM - AC Volt Meter - Leader LMV181A - SN 3100941

UUT - T-2765-KF

MA - Modulation Analyzer- IFR 2975 - SN 598001503

PRINTED ANTENNA - custom-built copper loop antenna on FR4

SA-Spectrum Analyzer - Advantest R3131 -SN

**Test Method:**

With the Power Supply set to 1.5VDC, the unit under test was calibrated to 100% modulation with a 1 kHz tone at a level of 10 mV RMS. The Unit was then modulated with a 2500 Hz tone at a level of %50 - 1.25 kHz. The input level was then increased by 16 dB. The deviation was measured using the IFR 2975 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:

Un-modulated Carrier

AGC On

AGC Off

For the purpose of calculating mask segments, the power of the un-modulated carrier was 0.1 watt, therefore:

$$90.210 \text{ (c) } (3) 43 + \log(0.1) = 33\text{dB}$$

The mask calculations are shown in figure 8.

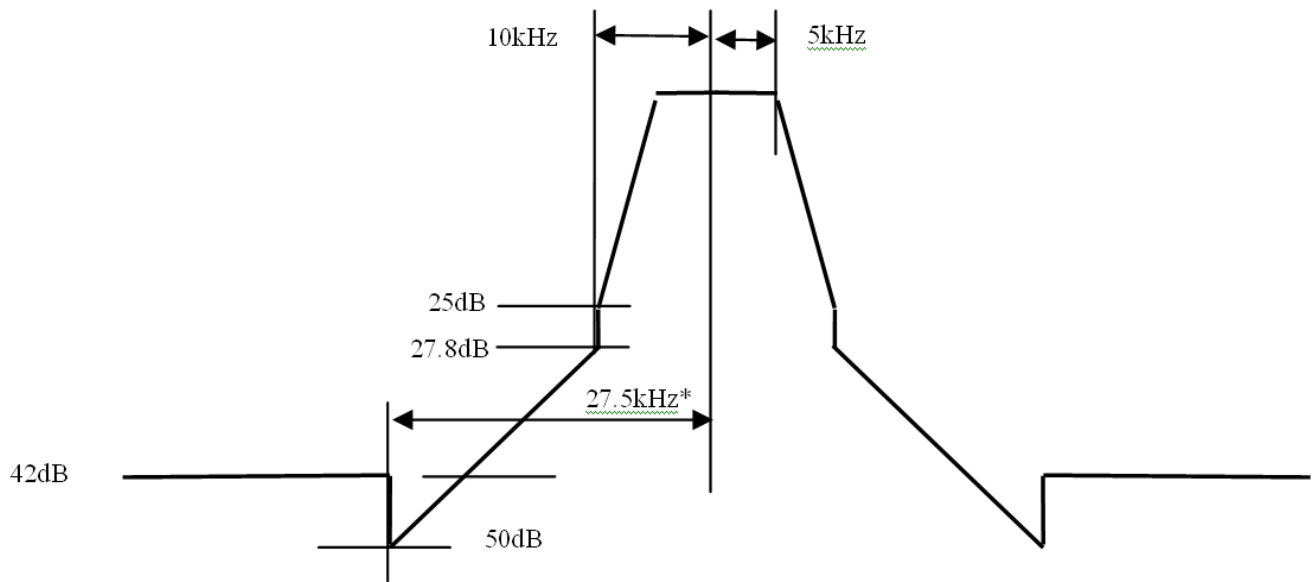
**Test Results:**

The results of the test are shown in Figures 9 thru 14.

The unit under test passes per the criteria established in 2.1049 and 90.210.

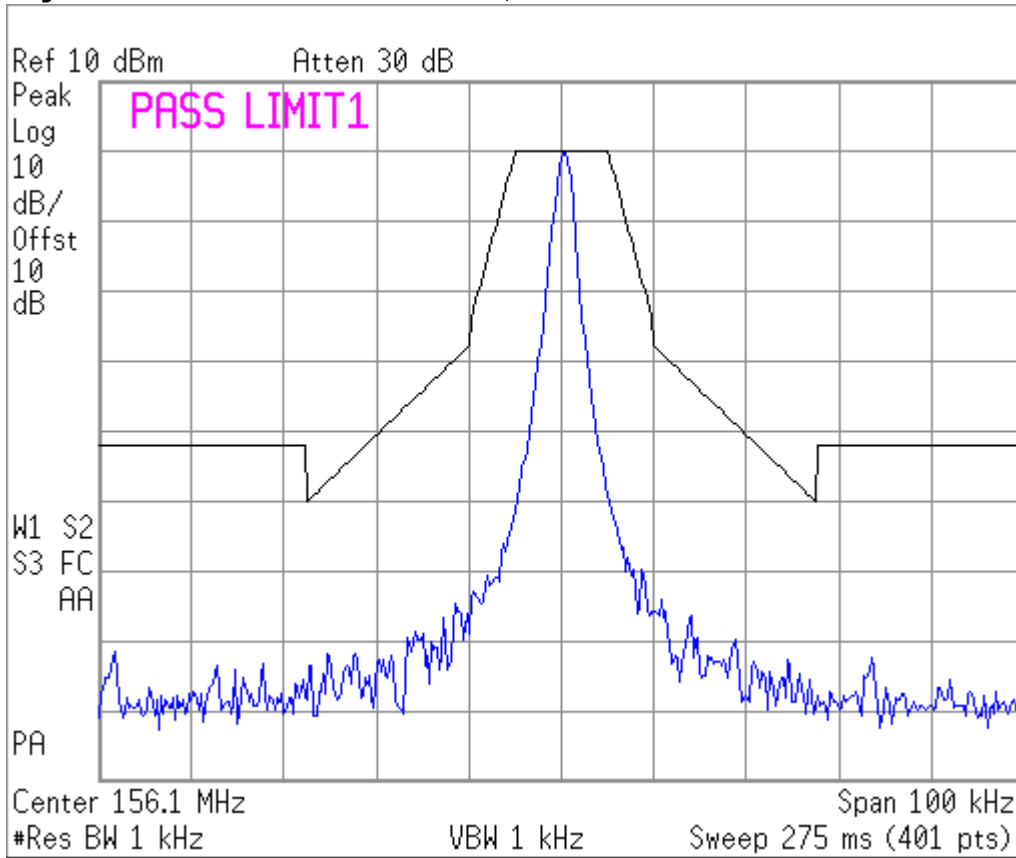
**Emission Masks**

**Figure 8 - Mask 90.210 C**

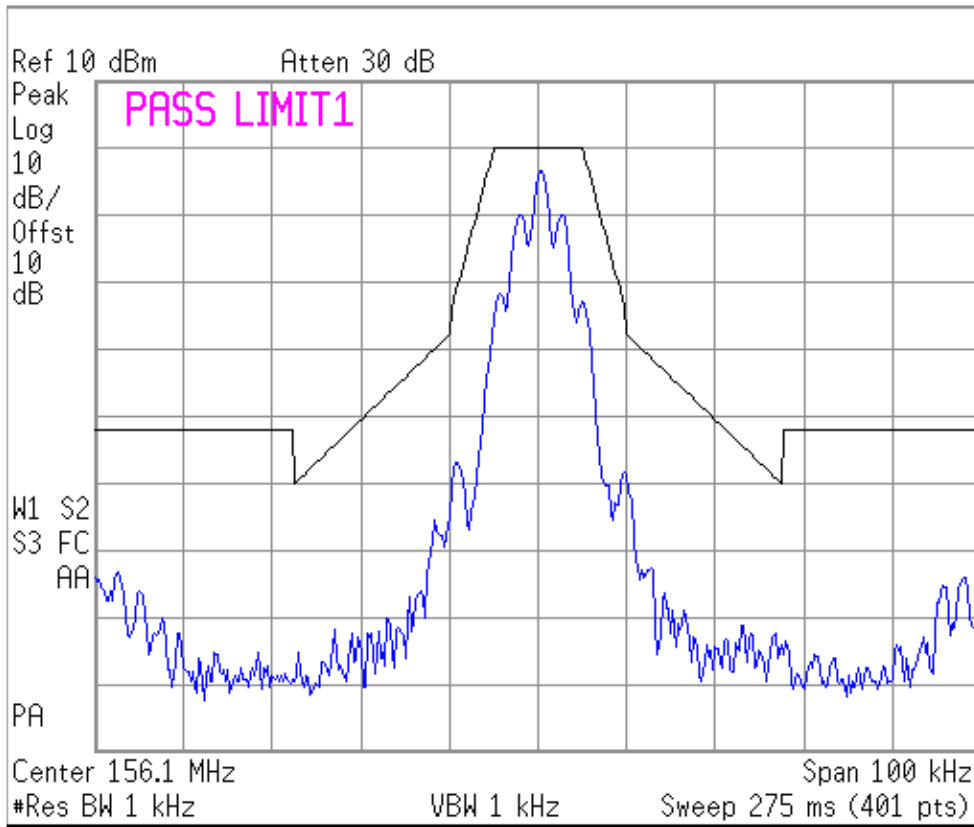


\*27.5kHz = 250% x 11kHz (= Authorized Bandwidth)

Figure 9 - Un-modulated Carrier, 156.1MHz



**Figure 10 -AGC On, 156.1MHz**



**Figure 11 -AGC Off, 156.1MHz**

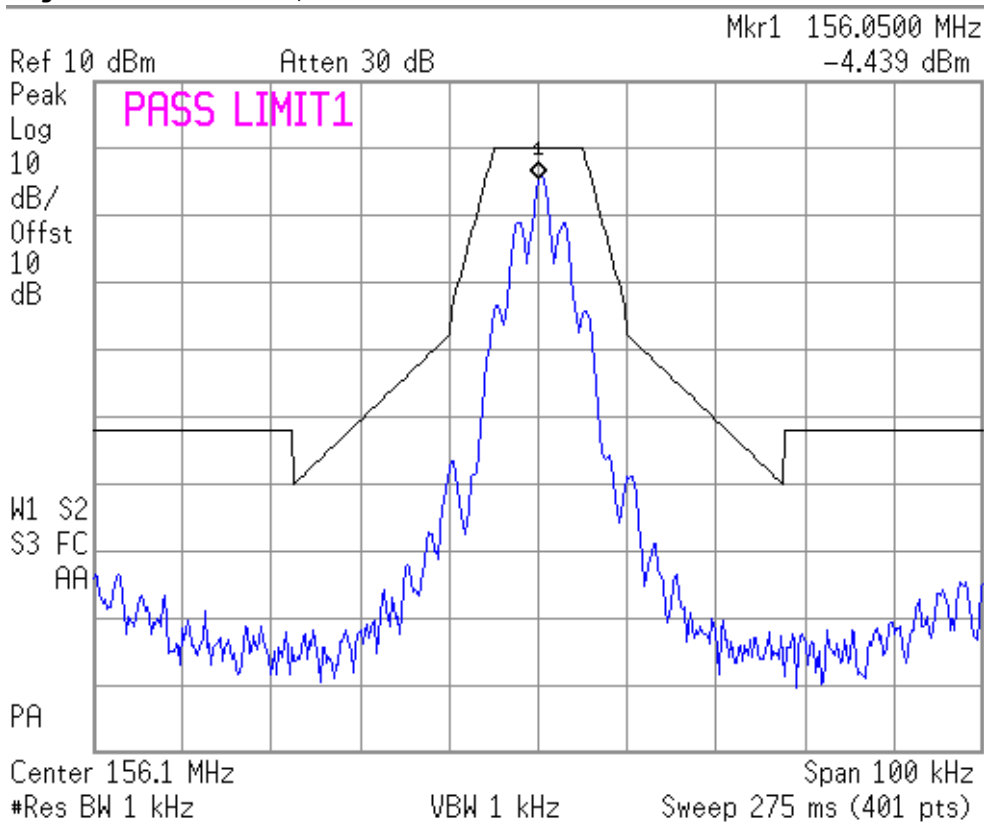


Figure 12 - Un-modulated Carrier, 167.1MHz

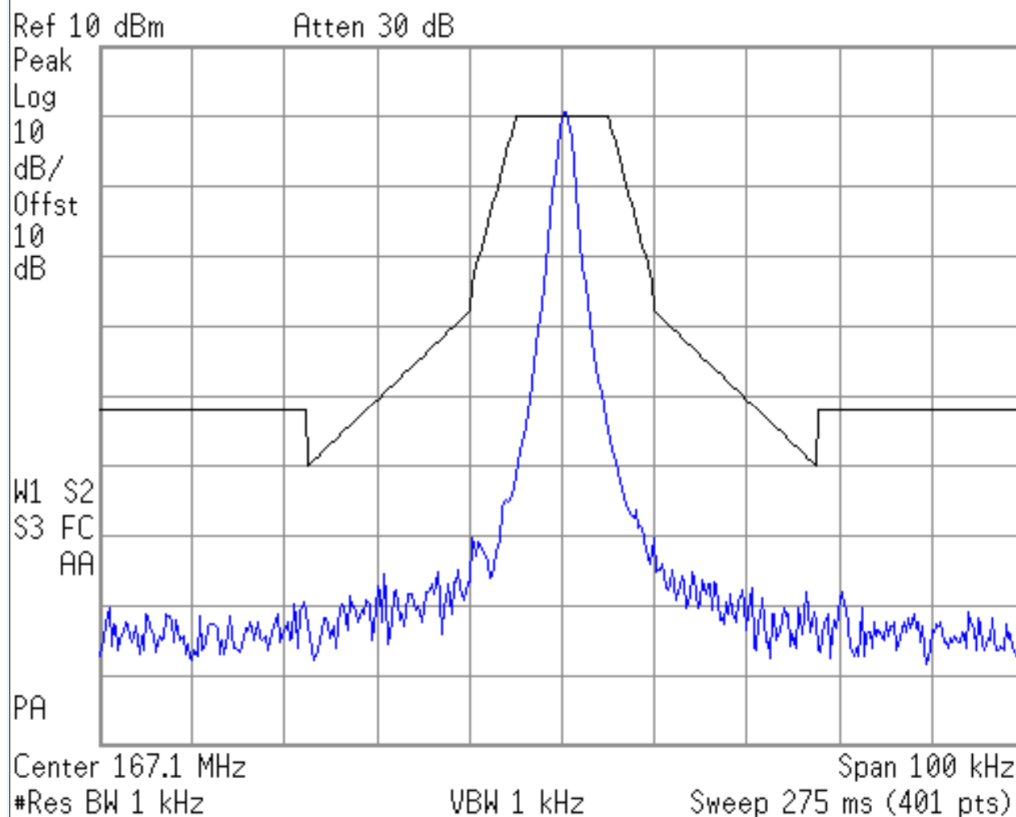


Figure 13 -AGC On 167.1MHz

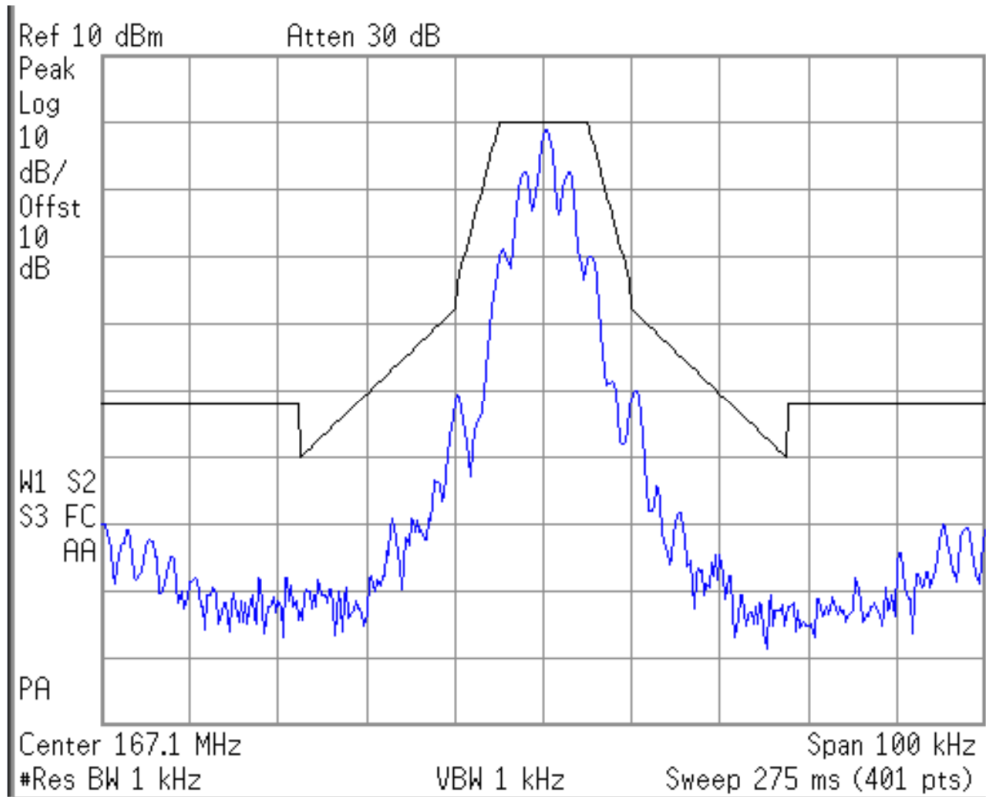
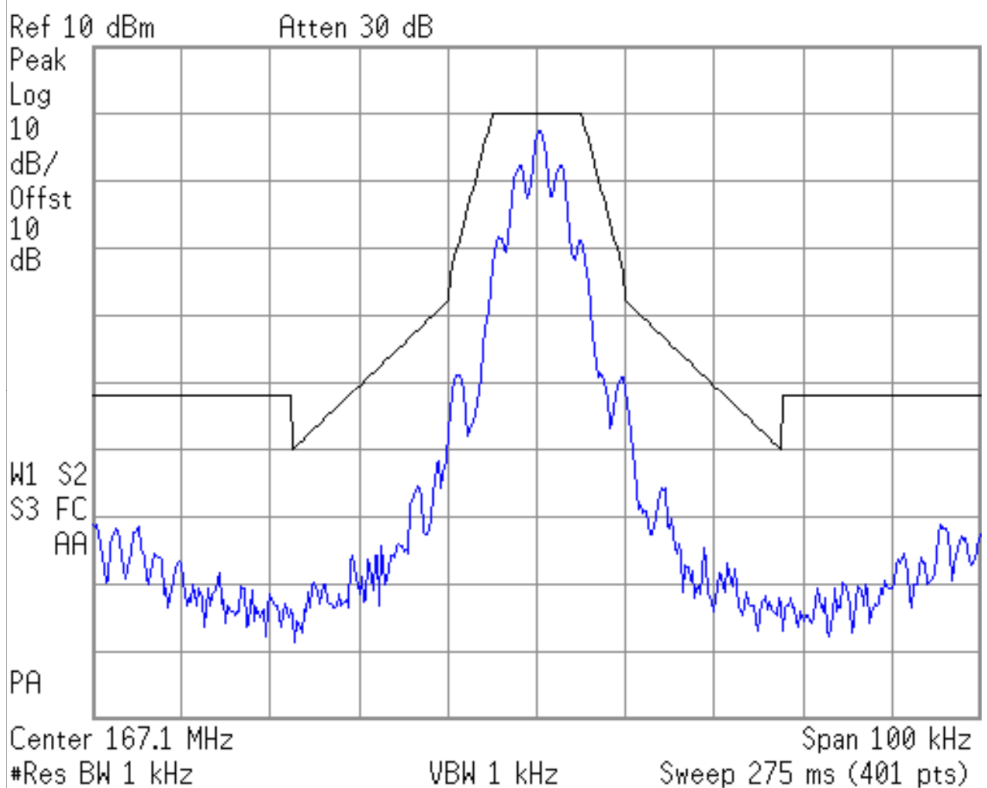


Figure 14 -AGC Off 167.1MHz





**T-2765-KF 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)

There are no antenna terminals on this unit. The unit has an integrated antenna, printed on the antenna circuit board. The electrical connection to the RF circuit board is made by soldering. The entire 3-board circuit assembly, including the antenna, that comprises the design is wholly inaccessible by the user.

Hence it is a) not possible to perform Conducted Spurious Emissions tests on the unit, nor b) does it make sense to do so. In addition, the internal antenna forms an integral part of the harmonic and spurious filtering. The Radiated Spurious Emissions test results given in this report show that the unit passes the required specifications, for that test, with high margin.

For the reasons given above, it is requested that the Conducted Spurious Emissions test requirement be waived for this application.

**T-2765-KF 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.

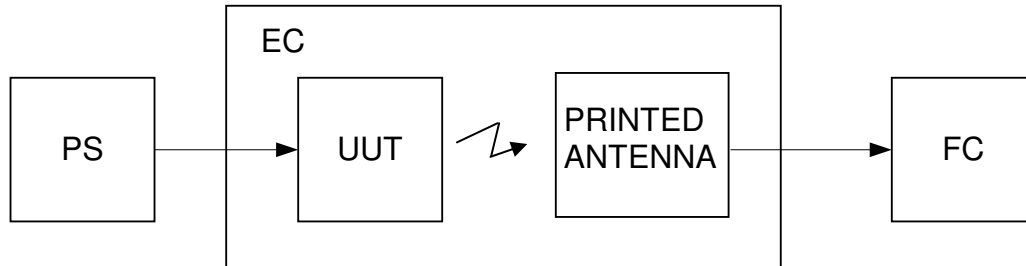
The T-2765-KF does not qualify under part 47, chapter 2.1055 (a) (2) or (a) (3) (c) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10deg centigrade through the range. A period of time sufficient to stabilize all of the components 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.

90.213

(Paraphrased) - For stations operating at less than 2 watts, with a 12.5 kHz channel spacing, and in the frequency band between 150 and 174 MHz, the frequency stability shall be less than 5 PPM

**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 - T-2765-KF

PRINTED ANTENNA - custom-built copper loop antenna on FR4

FC - Frequency Counter - HP 5351B - SN 3049A01169

**Test Method:**

The unit under test was powered at 1.5VDC and tested at two carrier frequencies 156,050,000 Hz and 167,050,000 Hz, at an ambient temperature of 22.3° C. The Environmental Chamber was set to -30° C and swept to +70° C in 10° steps. Due to the small size of the chamber and the UUT, the unit was left at each temperature for 30 minutes before the measurement was made. Since there is no method of keying the transmitter or any form of heating element in the UUT, those results are not required.

**Test Results:**

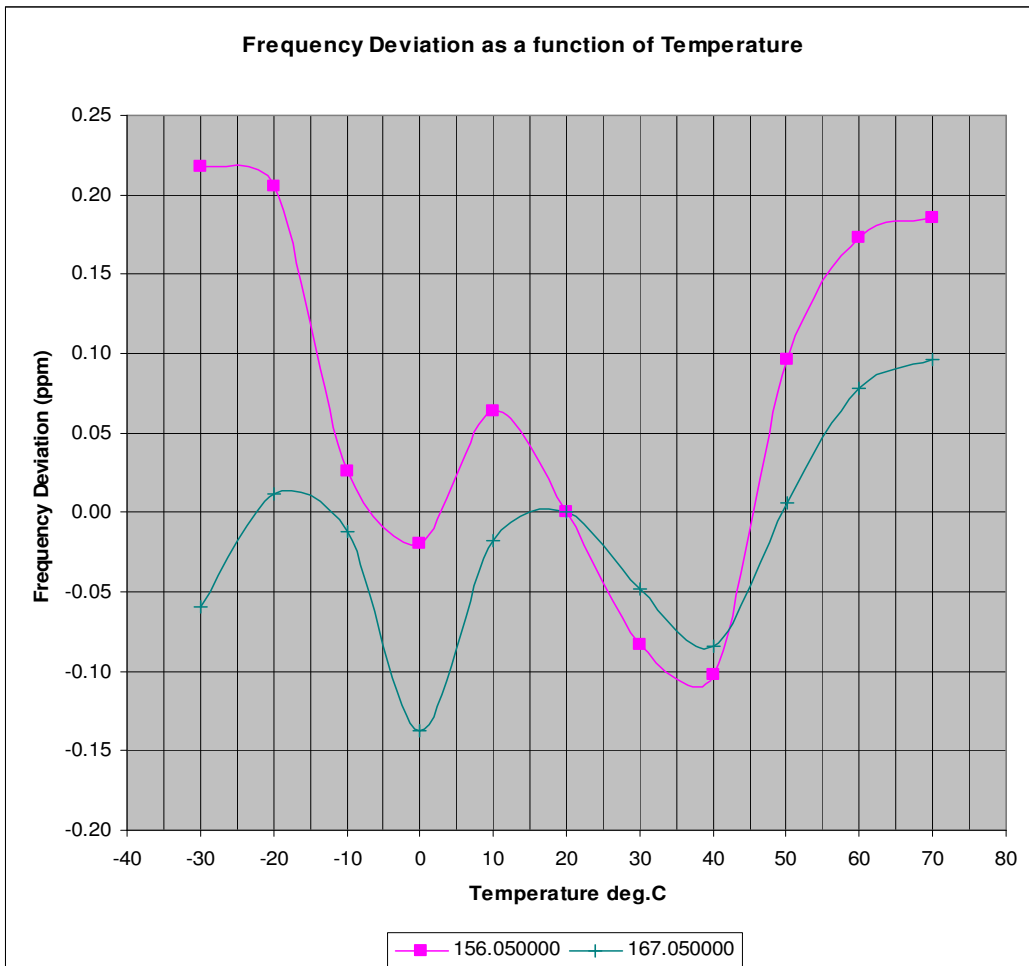
The results of the test are shown in Figures 15 and 16

**Frequency Stability (Pursuant to FCC Requirement 2.1055a)**  
**Figure 15, Raw Data**

(Pursuant to FCC Requirement 2.1055a)		
Temp	TX Frequency	Freq Deviation
(deg C.)	(MHz)	(PPM)
-30	156.050099	0.22
-20	156.050097	0.21
-10	156.050069	0.03
0	156.050062	-0.02
10	156.050060	0.06
20	156.050065	0.00
30	156.050052	-0.08
40	156.050049	-0.10
50	156.050080	0.10
60	156.050092	0.17
70	156.050094	0.19

(Pursuant to FCC Requirement 2.1055a)		
Temp	TX Frequency	Freq Deviation
(deg C.)	(MHz)	(PPM)
-30	167.049996	-0.06
-20	167.050008	0.01
-10	167.050004	-0.01
0	167.049983	-0.14
10	167.050003	-0.02
20	167.050006	0.00
30	167.049998	-0.05
40	167.049992	-0.08
50	167.050007	0.01
60	167.050019	0.08
70	167.050022	0.10

**Frequency Stability (Pursuant to FCC Requirement 2.1055a)**  
**Figure 16**



**T-2765-KF Frequency Stability: Power Supply Stability**

**Relevant FCC Chapter:**

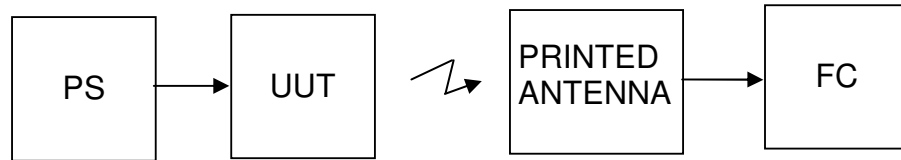
2.1055 Measurements required: Frequency Stability.

(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 - T-2765-KF

PRINTED ANTENNA - custom-built copper loop antenna on FR4

FC - Frequency Counter - HP 5342A - SN 2840A12777

**Test Method:**

The unit was tested at two carrier frequencies 156,050,000 Hz and 167,050,000 Hz. In each case, the unit was calibrated to the test frequency at supply voltage of 1.5 VDC. The Frequency output of the unit under test was then measured at supply voltages from 0.8VDC to 2.0VDC.

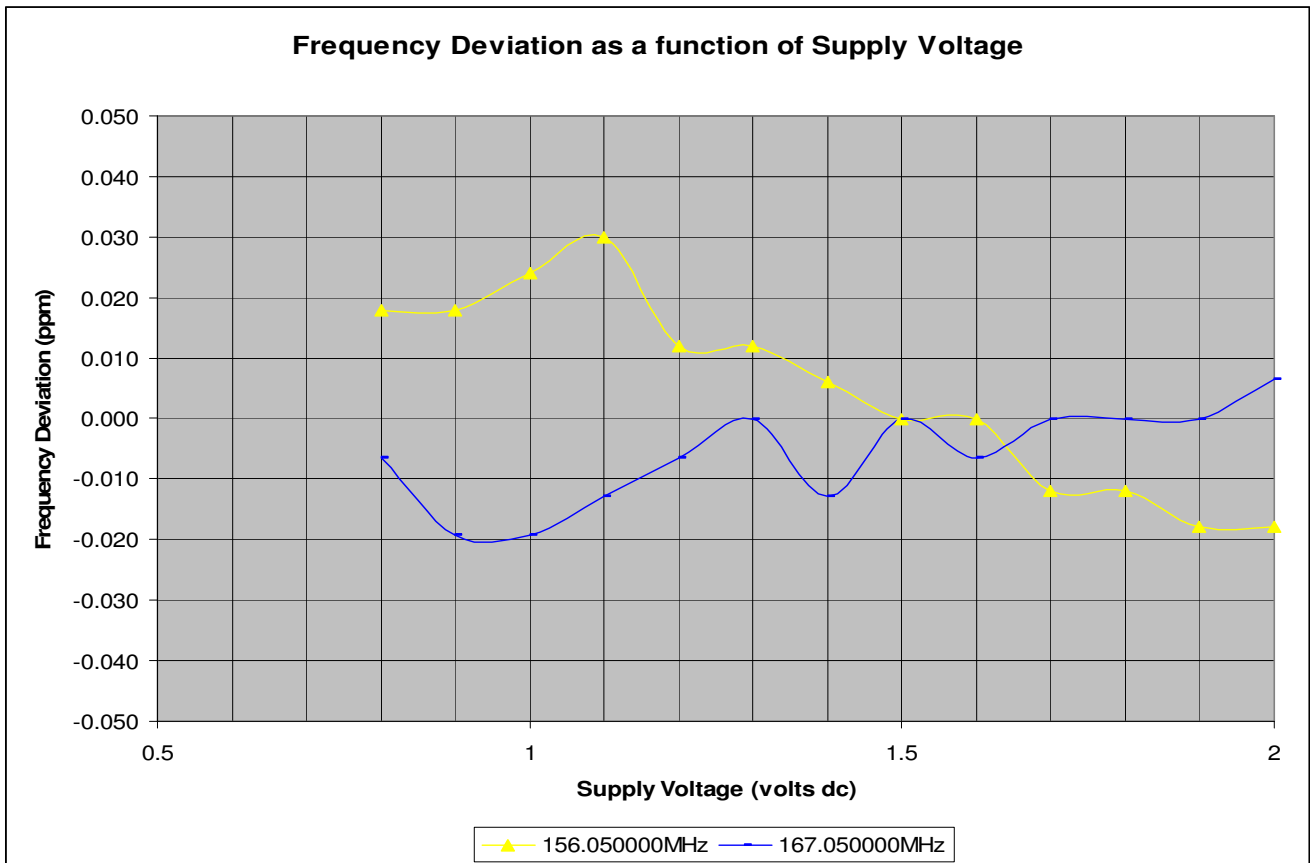
Test Results: The results of the test are shown in Figures 17 and 18.

**Frequency Stability (Pursuant to FCC Requirement 2.1055d)**  
**Figure 17, Raw Data**

Frequency Stability (2.1055d)		
Vsupply (VDC)	Freq Dev (Hz)	Freq Dev (PPM)
0.8	156.050025	-0.006
0.9	156.050027	-0.019
1	156.050027	-0.019
1.1	156.050026	-0.013
1.2	156.050025	-0.006
1.30	156.050024	0.000
1.4	156.050026	-0.013
1.5	156.050024	0.000
1.6	156.050025	-0.006
1.7	156.050024	0.000
1.8	156.050024	0.000
1.9	156.050024	0.000
2	156.050023	0.006

Frequency Stability (2.1055d)		
Vsupply (VDC)	Freq Dev (Hz)	Freq Dev (PPM)
0.8	167.050015	0.018
0.9	167.050015	0.018
1	167.050014	0.024
1.1	167.050013	0.030
1.2	167.050016	0.012
1.30	167.050016	0.012
1.4	167.050017	0.006
1.5	167.050018	0.000
1.6	167.050018	0.000
1.7	167.05002	-0.012
1.8	167.05002	-0.012
1.9	167.050021	-0.018
2	167.050021	-0.018

**Frequency Stability as a Function of Supply Voltage**  
(Pursuant to FCC Requirement 2.1055d)  
**Figure 18**



**T-2765-KF SAR Testing**

**Relevant FCC Chapter:**

2.1093 Radiofrequency radiation exposure evaluation: portable devices.

2.1093

(c) Portable devices that operate in the Cellular Radiotelephone Service, the Personal Communications Service (PCS), the Satellite Communications Services, the General Wireless Communications Service, the Wireless Communications Service, the Maritime Services, the Specialized Mobile Radio Service, the 4.9 GHz Band Service, the Wireless Medical Telemetry Service (WMTS) and the Medical Implant Communications Service (MICS), authorized under subpart H of part 22 of this chapter, parts 24, 25, 26, 27, 80 and 90 of this chapter, subparts H and I of part 95 of this chapter, and unlicensed personal communication service, unlicensed NII devices and millimeter wave devices authorized under subparts D and E, §§15.253, 15.255 and 15.257 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use. All other portable transmitting devices are categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in §§1.1307(c) and 1.1307(d) of this chapter.

The T-2765-KF does not operate in the services delineated by 2.1093 (c) and therefore is categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use.