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ENGINEERING STATEMENT

For Type Acceptance of

MAXON AMERICA, INC.

Model No. RT-800
FCC ID: F3JRT800

I am an Electronic Engineer, a principal in the firm of Hyak Laboratories, Inc., Springfield, Virginia. My education and experience are a matter of record with the Federal Communication Commission.

Hyak Laboratories, Inc. has been authorized by Maxon Electronics Co. Ltd. to make type acceptance measurements on the RT-800 transceiver. These tests were made by me or under my supervision in our Springfield laboratory.

Test data required by the FCC for type acceptance are included in this report. It is submitted that the above mentioned transceiver meets FCC requirements and type acceptance is requested.

Rowland S. Johnson

Dated: April 29, 1998

A. INTRODUCTION

The following data are submitted in connection with this request for type acceptance of the RT-800 transceiver in accordance with Part 2, Subpart J of the FCC Rules.

The RT-800 is a 0.6 watt, UHF, hand-held portable, frequency modulated transmitter/receiver combination intended for cellular land mobile applications in the 824-849 MHz and 869-894 MHz bands. It is configured for portable applications.

NOTE: SAR data is included as Appendix 9.

B. GENERAL INFORMATION REQUIRED FOR TYPE ACCEPTANCE (Paragraph 2.983 of the Rules)

1. Name of applicant: Maxon Electronics Co. Ltd.

2. Identification of equipment: FCC ID: F3JRT800.

   a. The equipment identification label is shown in Appendix 1.
   b. Photographs of the equipment are included in Appendix 2.

3. Quantity production is planned.
4. Technical description:

   a. 40K0F8W and 40K0F1D emissions
   b. Frequency range: 869-894 MHz (Receiver)
824-849 MHz (Transmitter)
   c. Operating power of the transmitter is dynamically set to one of six power levels via cellular base station command. The power levels range from 6 mW to 0.6 W in approximate 4 dB steps.

   d. Maximum power permitted under Part 22.904 of the FCC rules is 7 watts effective radiated power and the RT-800 fully complied with the power limitation.
   e. The dc voltage and dc currents at final amplifier: 4.3 V @ 369 mA (MAC 010).
   f. Function of each active semiconductor device: See Appendix 3.
   g. Complete circuit diagram is included in Appendix 4
   h. A draft instruction book is submitted as Appendix 5.
   i. The transmitter tune-up procedure is included in Appendix 6.
   j. A description of circuits for stabilizing frequency is included in Appendix 7.
   k. A description of circuits and devices employed for suppression of spurious radiation and for limiting modulation is included in Appendix 8.

5. Data for 2.985 through 2.997 follow this section B.

C. RF POWER OUTPUT (Paragraph 2.985(a) of the Rules)

RF power output at the antenna port* was measured with a HP 432/478A power meter/sensor and Narda 765-20 attenuator as a 50 ohm dummy load. (The transmitter was tuned by the factory according to the procedure in Appendix 4.) Maximum power of 0.603 watts was measured with a supply voltage 5.0 Vdc. The available power levels, listed by Mobile Attenuation Code, were measured per 2.985 and found to comply with the Mobile Station Power Class III schedule of OST 53 (July 83):

Table 1
RF Power Output
Supply Voltage 5.0 VDC

MAC	Conducted RF Power Output watts	Conducted RF Power Output dBW	OST 53 Limit Class III dBW (ERP)	Measured ERP dBW
000	N/A			
001	N/A			
010	0.603	- 2.2	- 2	-2.8
011	0.250	- 6.0	- 6	-6.6
100	0.126	- 9.0	-10	-9.6
101	0.040	-14.0	-14	-14.6
110	0.016	-18.1	-18	-18.7
111	0.007	-21.8	-22	-22.4

Radiated power was calculated after measurement of radiated carrier level as 0.53 watts or -2.8 dBW which is within the +2, -4 dB specification of OST 53 Para. 2.1.2.2

D. MODULATION CHARACTERISTICS (Paragraph 2.987 of the Rules)

1. A curve showing frequency response of the transmitter is shown in Figure 1. Reference level was a 1 kHz audio signal from a Boonton 8220 modulation meter with two kHz deviation. Audio output was measured with an Audio Precision System One integrated test system.

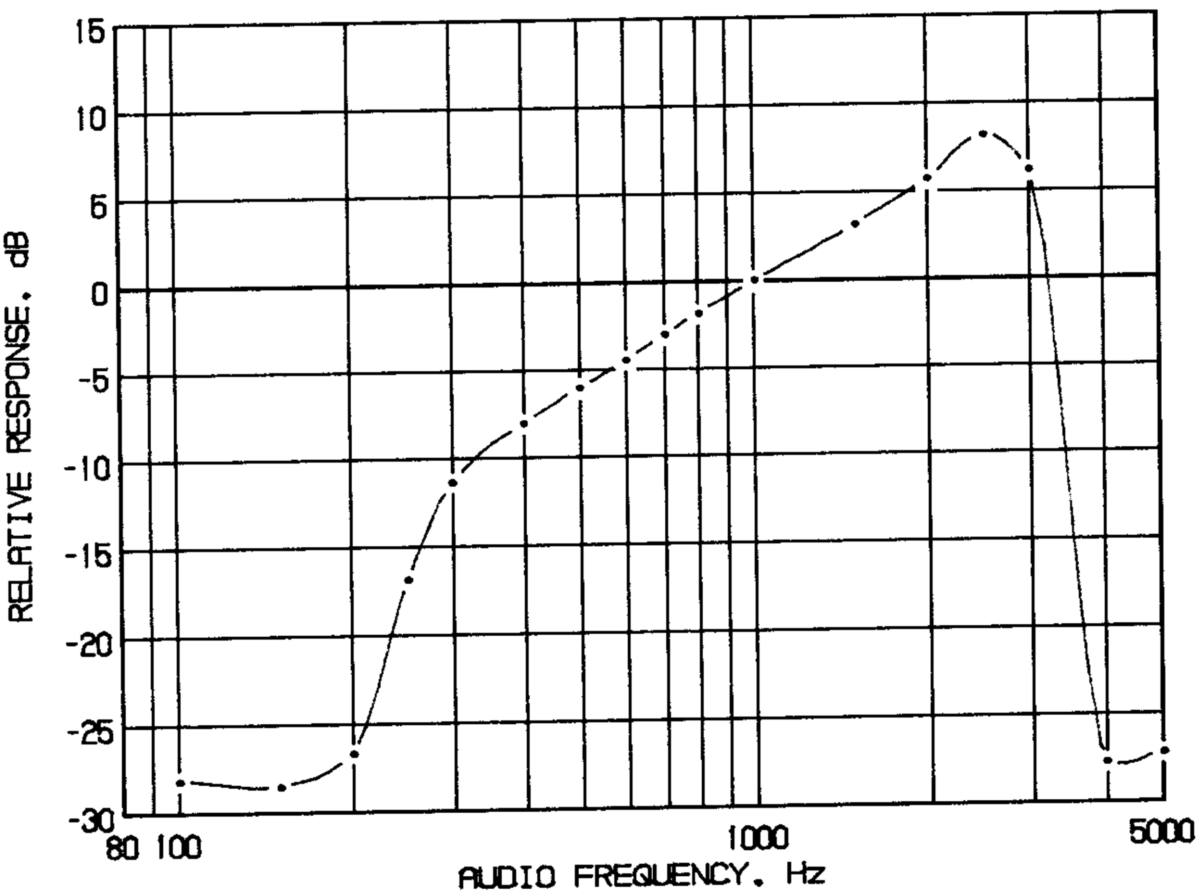
2. Modulation limiting curves are shown in Figure 2, using a Boonton 8220 modulation meter. Signal level was established with an Audio Precision System One integrated test system. The curves show compliance with paragraphs 2.987(b) and 22.906(a).

3. Figure 3 is a graph of the post-limiter low pass filter which meets the requirements of paragraph 22.907(a) in providing a roll-off of 40Logf/3 dB where f is audio frequency in kHz. Measurements were made following EIA RS-152B with an Audio Precision System One integrated test system on the Boonton 8220 modulation meter output.

***The device has a RF output coaxial connector.**

FIGURE 1

MODULATION FREQUENCY RESPONSE

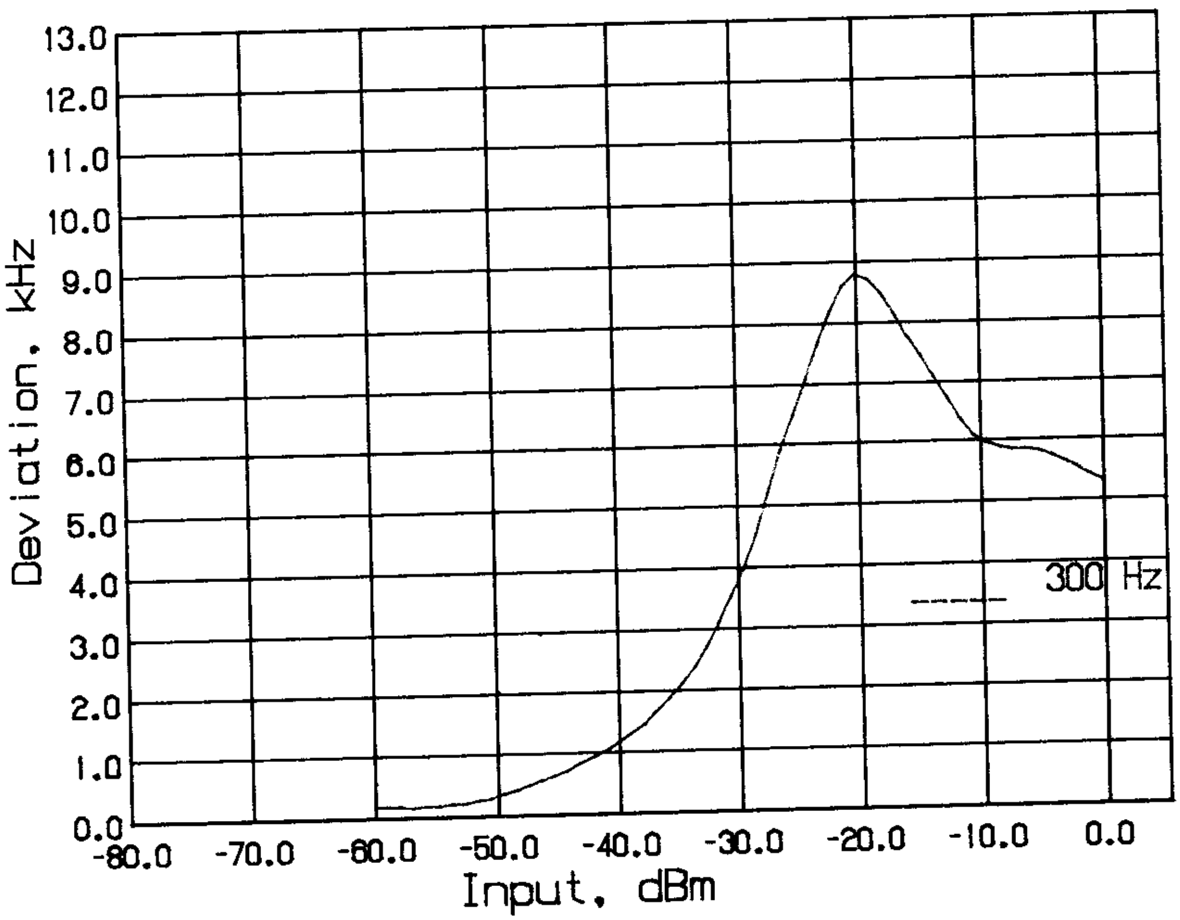


MODULATION FREQUENCY RESPONSE
FCC ID: F3JRT800

FIGURE 1

FIGURE 2

AUDIO LIMITER CHARACTERISTICS

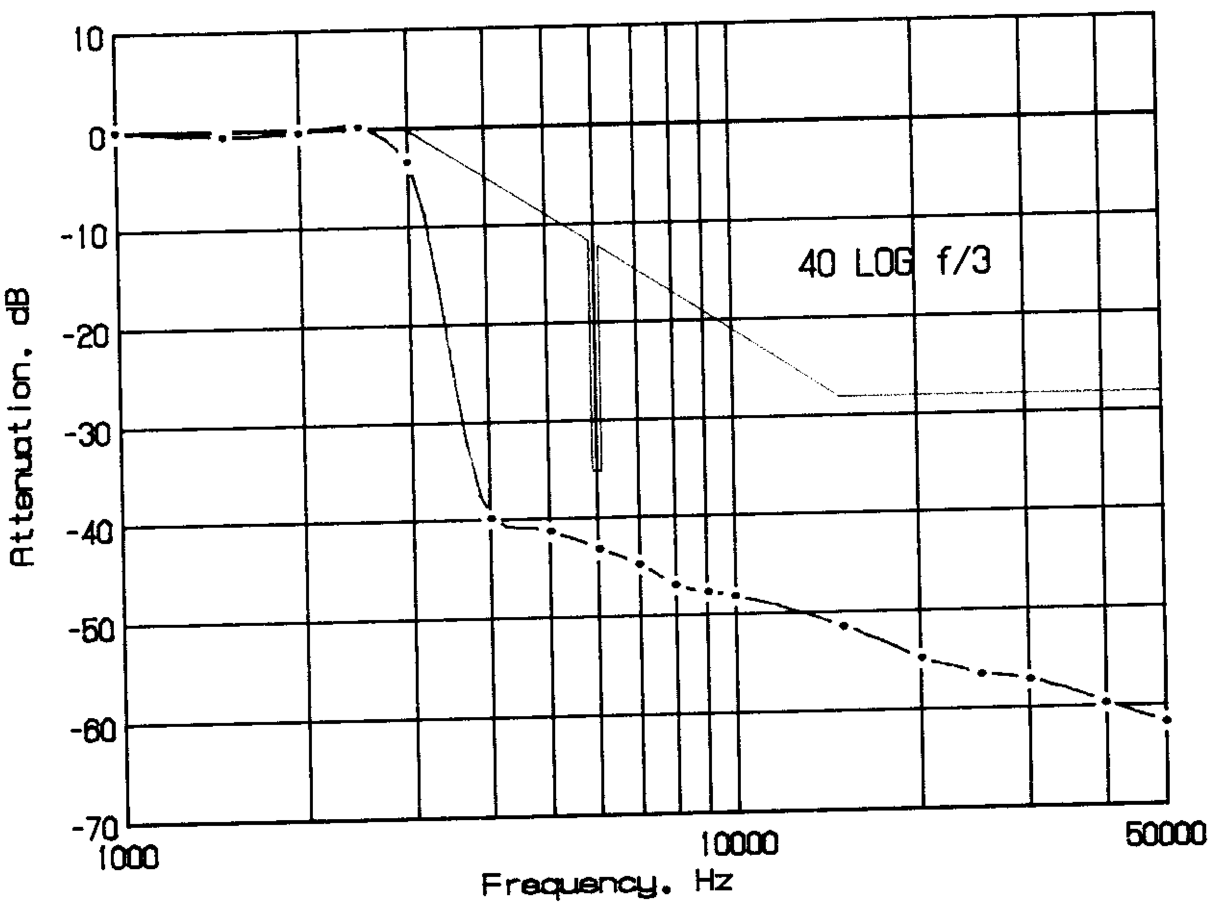


AUDIO LIMITER CHARACTERISTICS
FCC ID: F3JRT800

FIGURE 2

FIGURE 3

AUDIO LOW PASS FILTER RESPONSE



AUDIO LOW PASS FILTER RESPONSE
FCC ID: F3JRT800

FIGURE 3

E. OCCUPIED BANDWIDTH (Paragraph 2.989 of the Rules)

The reference level of each following plot was the unmodulated transmitter carrier.

Figure 4A is a plot of the sideband envelope of the transmitter taken with a Advantest R3361A spectrum analyzer. Modulation corresponded to conditions of 2.989(c)(1) and consisted of 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50% modulation at 2608 Hz, the frequency of maximum response. **Measured deviation under these conditions was 10.9 kHz.** The plot shows the emissions within the limits imposed by Paragraph 22.907 for voice F3 modulation. The horizontal scale, frequency, is 10kHz per division and the vertical scale, amplitude, is a logarithmic presentation equal to 10dB per division.

Figure 4B is a plot of the sideband envelope of the transmitter internally modulated with a DTMF tone pair, digit "9", the worst case. **Deviation under this condition was 12.8 kHz.** The photograph shows the emissions within the limits imposed by Paragraph 22.907 for DTMF F3 modulation. The horizontal scale, frequency, is 10 kHz per division and the vertical scale, amplitude, is a logarithmic presentation equal to 10dB per division.

Figure 4C is a plot of the sideband envelope of the transmitter internally modulated with the signaling tone, ST. **Deviation under this condition was 8.2 kHz.** The plot shows the emissions within the limits imposed by Paragraph 22.907 for ST modulation. The horizontal scale, frequency, is 20 kHz per division and the vertical scale, amplitude, is a logarithmic presentation equal to 10dB per division.

Figure 4D is a plot of the sideband envelope of the transmitter internally modulated with the supervisory audio tone, SAT. **Deviation under this condition was 2.0 kHz.** The plot shows the emissions within the limits imposed by Paragraph 22.907 for SAT modulation. The horizontal scale, frequency, is 10 kHz per division and the vertical scale, amplitude, is a logarithmic presentation equal to 10dB per division.

Figure 4E is a plot of the sideband envelope of the transmitter internally modulated with wideband data. **Measured deviation under this condition was 8.4 kHz.** The modulation for the test was a pseudo-random sequence. The plot shows the emissions within the limits imposed by Paragraph 22.907 for wideband data modulation. The horizontal scale, frequency, is 10 kHz per division and the vertical scale, amplitude, is a logarithmic presentation equal to 10dB per division.

E. OCCUPIED BANDWIDTH (Continued)

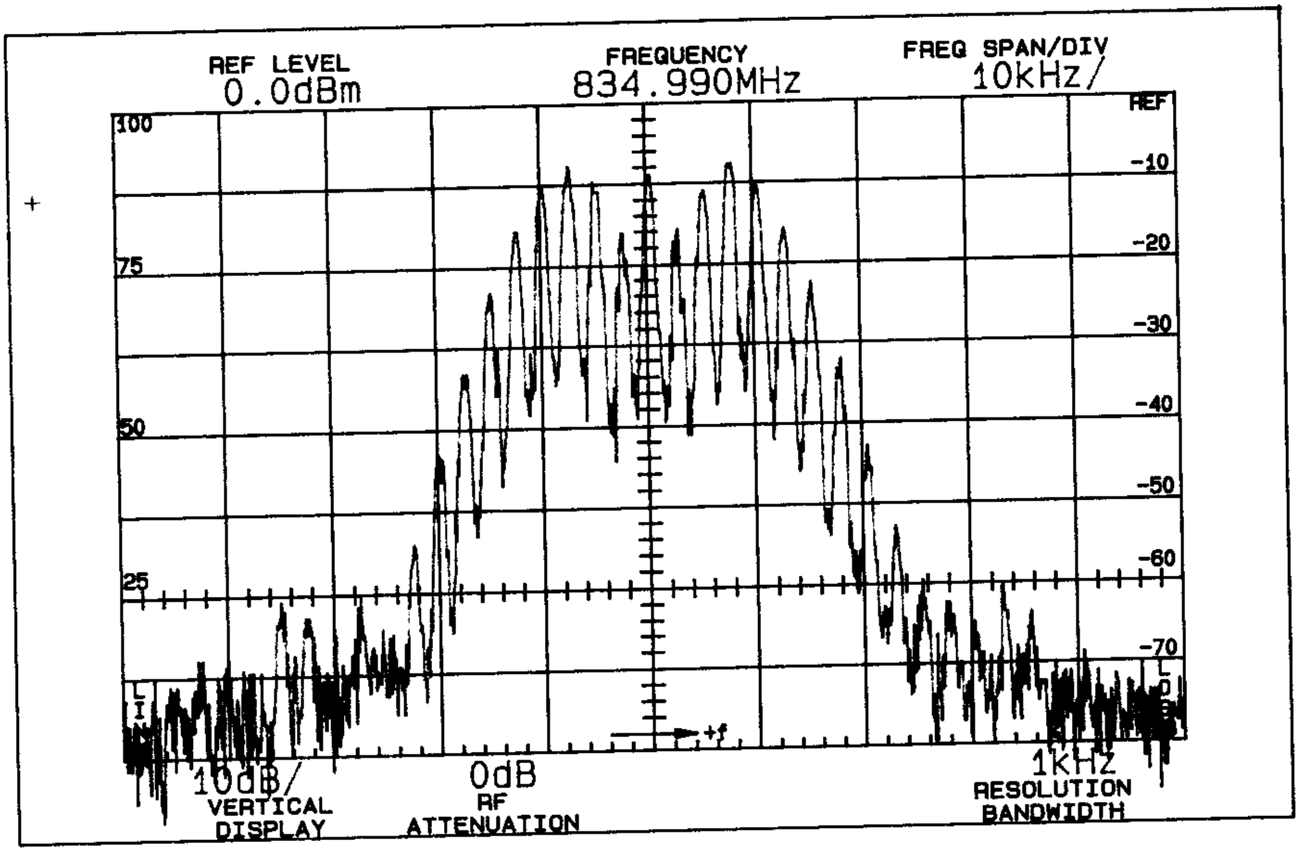
Figure 4F is a plot of the sideband envelope of the transmitter modulated with composite 2500 Hz and internally modulated SAT. (The applied external modulation consisted of a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50% modulation at 2608 Hz, the frequency of maximum response.) **Measured deviation under this condition was 12.4 kHz.** The plot shows the emissions within the limits imposed by Paragraph 22.907 for SAT modulation. The horizontal scale, frequency, is 10kHz per division and the vertical scale, amplitude, is a logarithmic presentation equal to 10dB per division.

Figure 4G is a plot of the sideband envelope of the transmitter with internal modulation with composite DTMF (digit "1") and SAT. **Measured deviation under this condition was 14.3 kHz.** The plot shows the emissions within the limits imposed by Paragraph 22.907 for SAT. The horizontal scale, frequency, is 10 kHz per division and the vertical scale, amplitude, is a logarithmic presentation equal to 10 dB per division.

Figure 4H is a plot of the sideband envelope of the transmitter internally modulated with the signaling tone, ST, and the supervisory audio tone, SAT. **Deviation measured under this condition was 9.9 kHz.** The plot shows the emissions within the limits imposed by Paragraph 22.907 for ST and SAT modulation. The horizontal scale, frequency, is 20 kHz per division and the vertical scale, amplitude, is a logarithmic presentation equal to 10dB per division.

A: \MAX800A.OBW

FIGURE 4A



	Attenuation in dB Below Mean Output Power Required
On any frequency removed from the carrier frequency by greater than 20 kHz up to and including 45 kHz	26
On any frequency removed from the carrier frequency by greater than 45 kHz	43+10LogP=41 (P=0.603W)

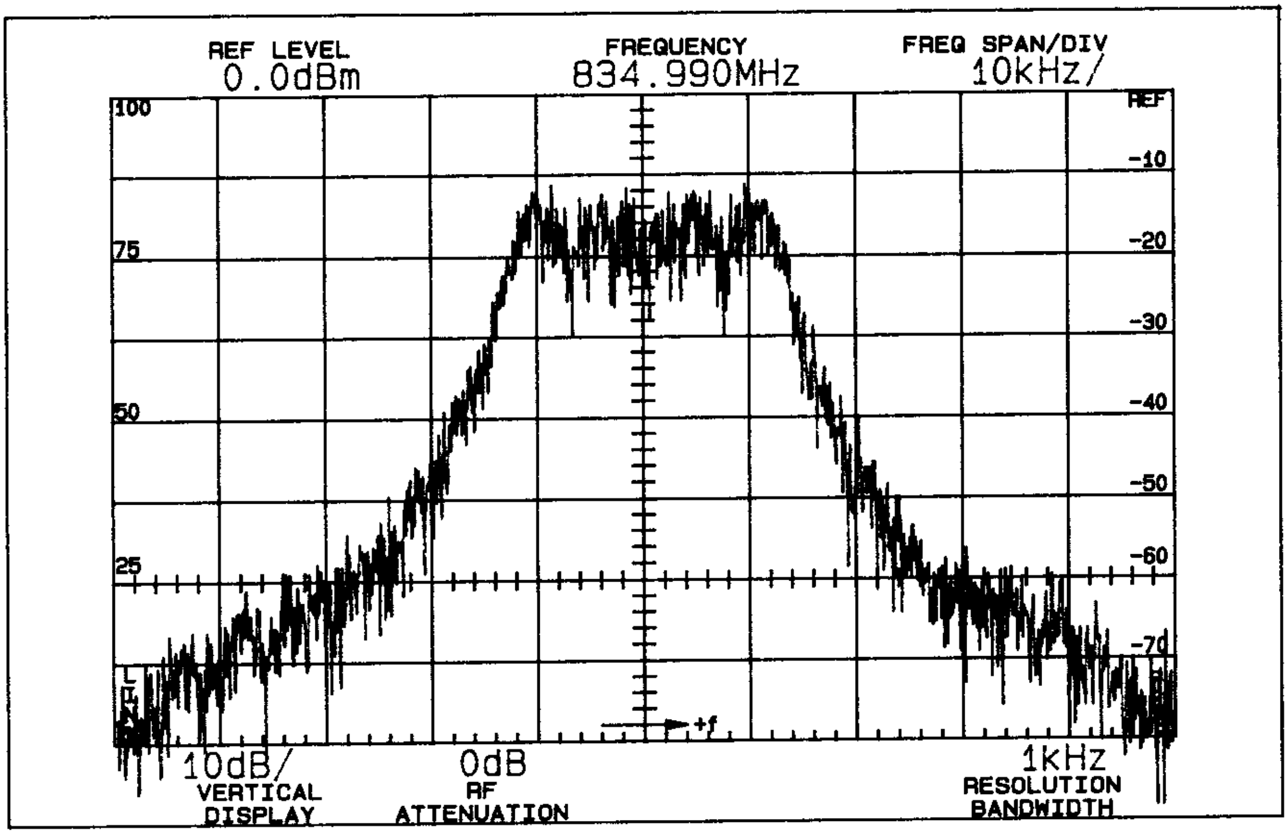
OCCUPIED BANDWIDTH - 2500 Hz

FCC ID: F3JRT800

FIGURE 4A

A:\MAX800B.OBW

FIGURE 4B



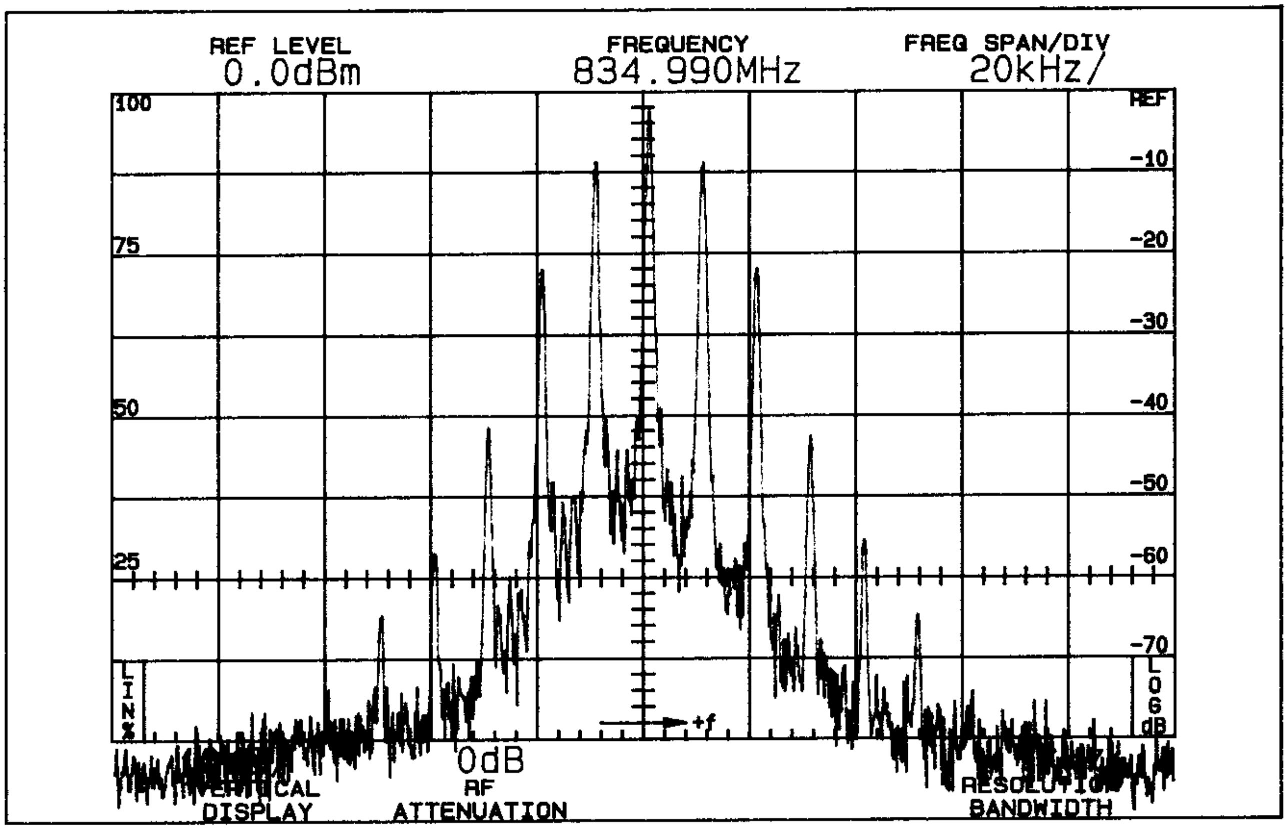
	Attenuation in dB Below Mean Output Power Required
On any frequency removed from the carrier frequency by greater than 20 kHz up to and including 45 kHz	26
On any frequency removed from the carrier frequency by greater than 45 kHz	43+10LogP=41 (P=0.603W)

OCCUPIED BANDWIDTH - DTMF
FCC ID: F3JRT800

FIGURE 4B

A:\MAX800C.CBW

FIGURE 4C



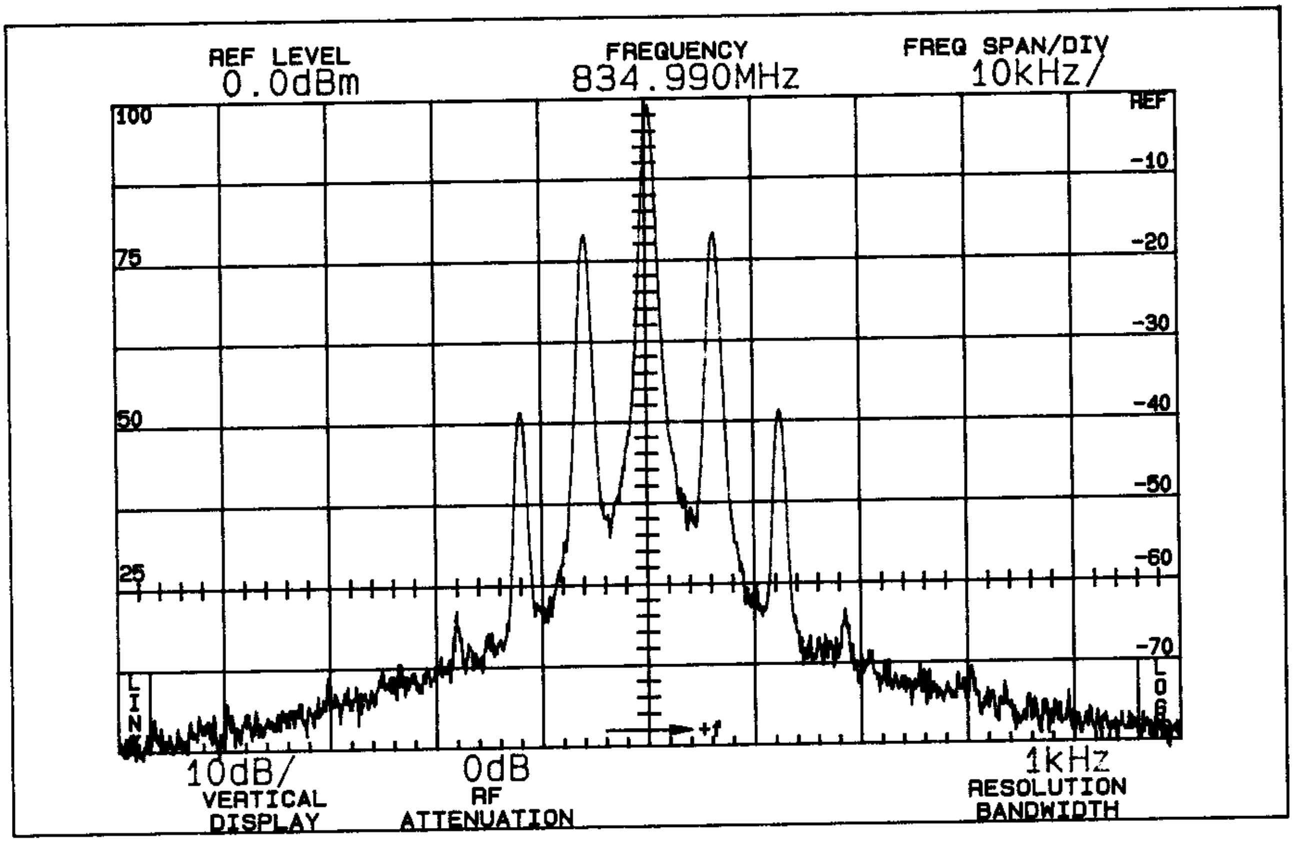
	Attenuation in dB Below Mean Output Power Required
On any frequency removed from the carrier frequency by greater than 20 kHz up to and including 45 kHz	26
On any frequency removed from the carrier frequency by greater than 45 kHz up to and including 90 kHz	45
On any frequency removed from the carrier frequency by more than 90 kHz up to $2f_C$	43+10LogP=41 (P=0.603W)

OCCUPIED BANDWIDTH - ST
FCC ID: F3JRT800

FIGURE 4C

A:\MAX800D.OBW

FIGURE 4D

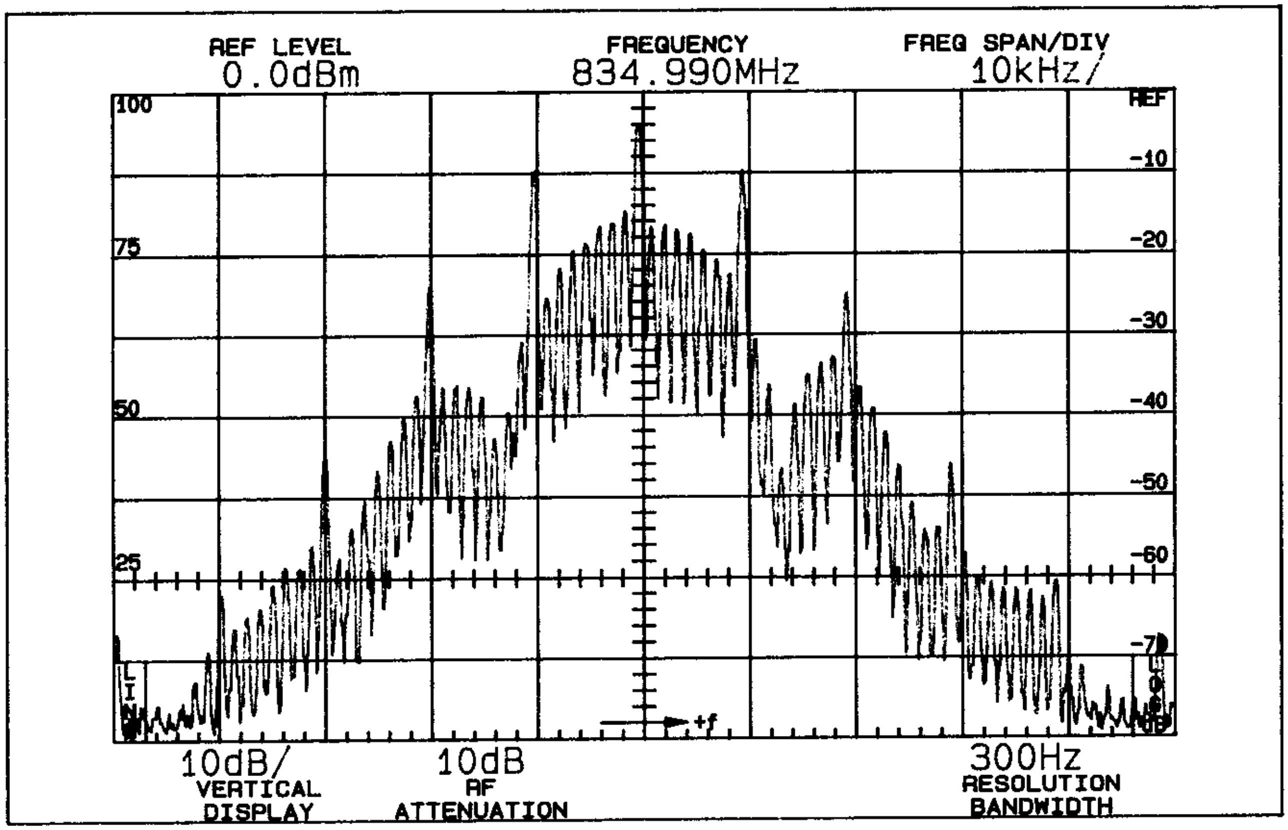


	Attenuation in dB Below Mean Output Power Required
On any frequency removed from the carrier frequency by greater than 20 kHz up to and including 45 kHz	26
On any frequency removed from the carrier frequency by greater than 45 kHz up to and including $2f_C$	43+10LogP=41 (P=0.603W)

OCCUPIED BANDWIDTH - SAT
FCC ID: F3JRT800

FIGURE 4D

FIGURE 4E



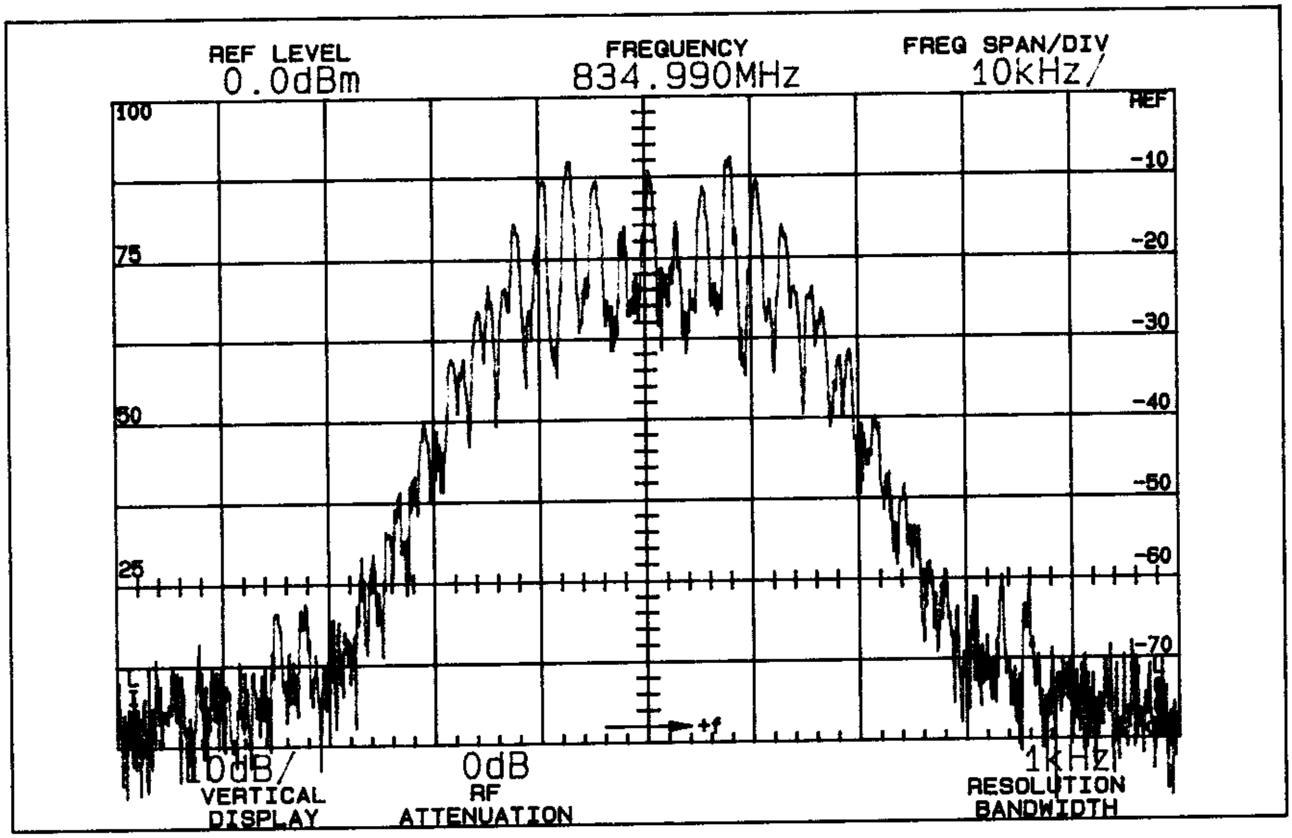
	Attenuation in dB Below Mean Output Power Required
On any frequency removed from the carrier by greater than 20 kHz up to and including 45 kHz	26
On any frequency removed from the carrier frequency by greater than 45 kHz up to and including 90 kHz	45
On any frequency removed from the carrier frequency by greater than 90 kHz up to $2f_c$	43+10LogP=41 (P=0.603W)

OCCUPIED BANDWIDTH - WIDEBAND DATA
FCC ID: F3JRT800

FIGURE 4E

A:\MAX800F.DBW

FIGURE 4F



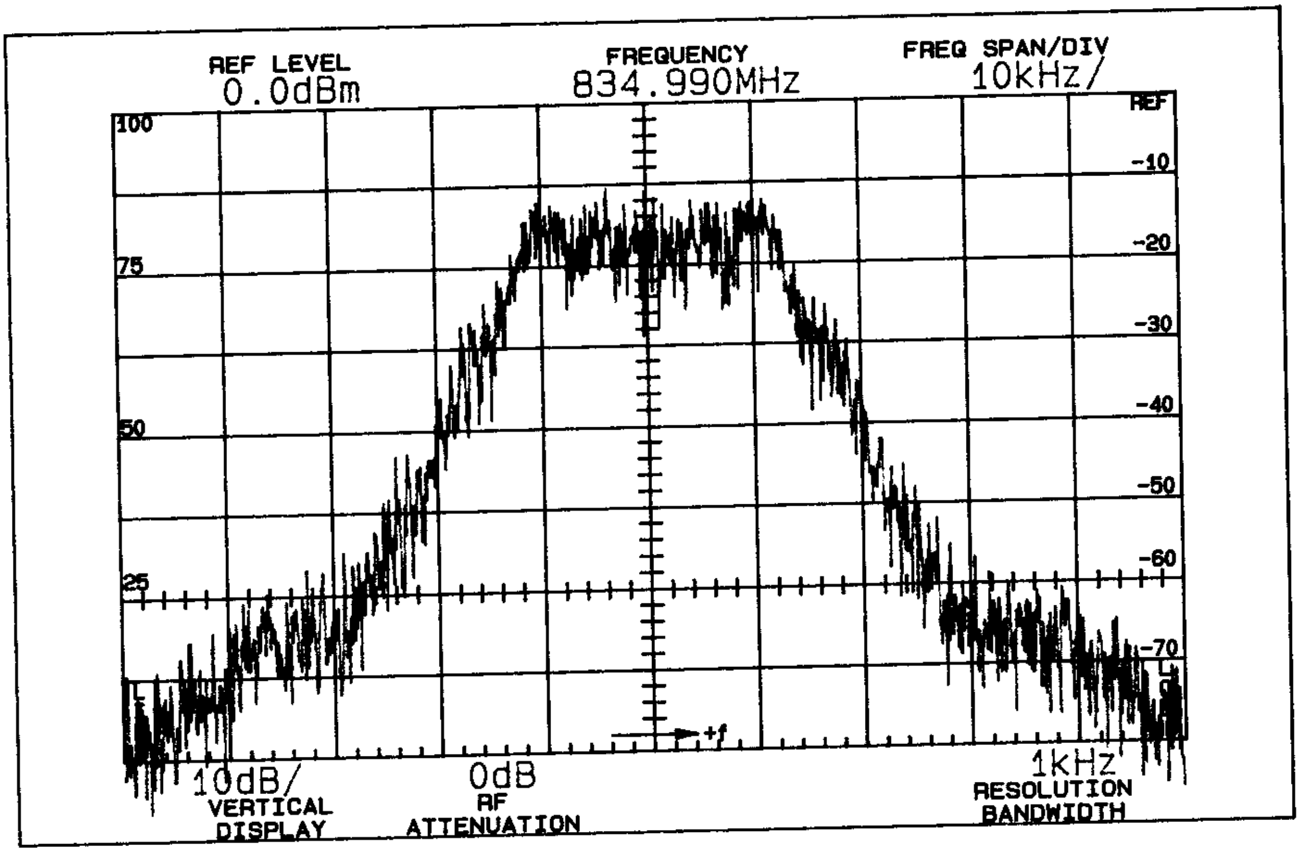
	Attenuation in dB Below Mean Output Power Required
On any frequency removed from the carrier frequency by greater than 20 kHz up to and including 45 kHz	26
On any frequency removed from the carrier frequency by greater than 45 kHz up to and including $2f_c$	43+10LogP=41 (P=0.603W)

OCCUPIED BANDWIDTH - 2500 Hz/SAT
FCC ID: F3JRT800

FIGURE 4F

A: \MAX800G.OBM

FIGURE 4G



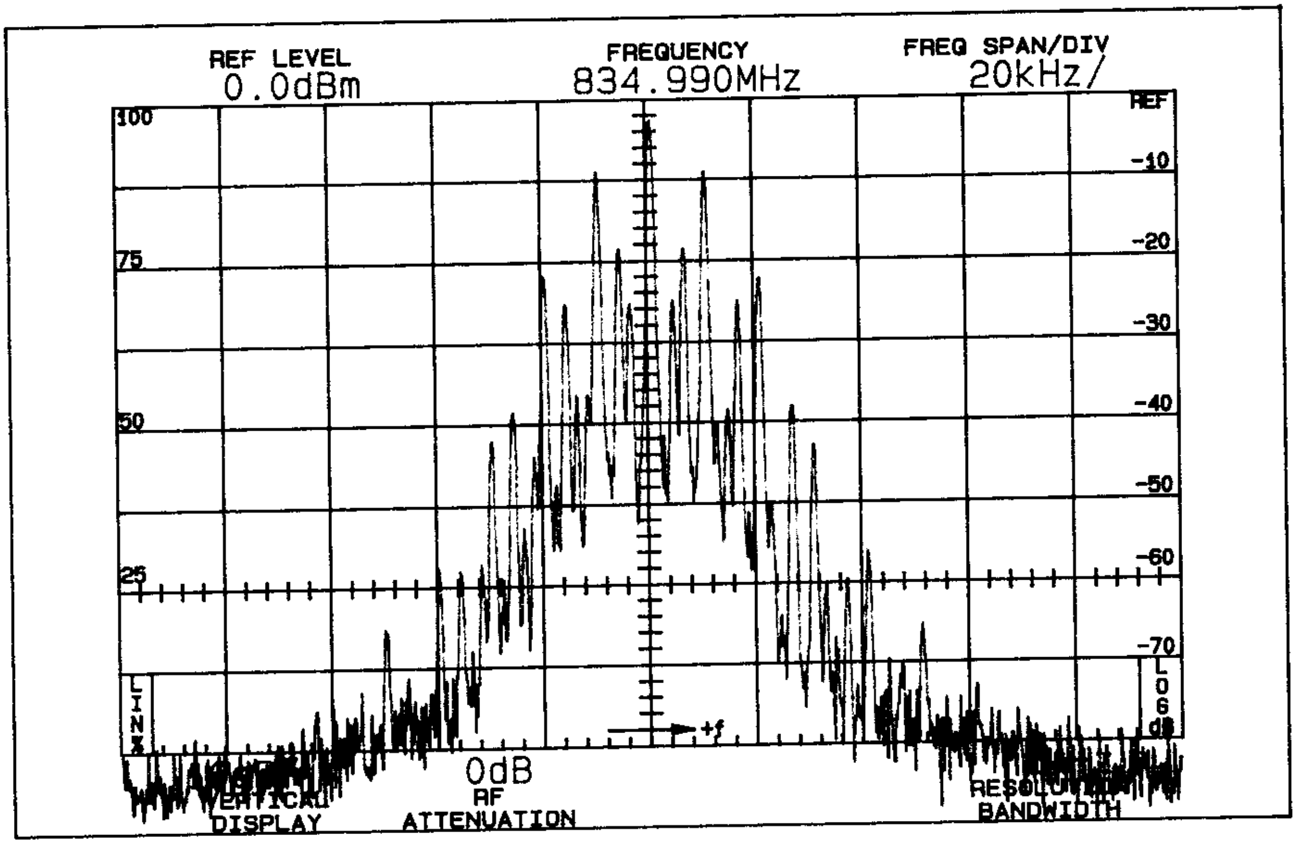
	Attenuation in dB Below Mean Output Power Required
On any frequency removed from the carrier frequency by greater than 20 kHz up to and including 45 kHz	26
On any frequency removed from the carrier frequency by greater than 45 kHz up to and including $2f_C$	43+10LogP=41 (P=0.603W)

OCCUPIED BANDWIDTH-DTMF/SAT
FCC ID: F3JRT800

FIGURE 4G

A:\MAXBOOH.OBM

FIGURE 4H



	Attenuation in dB Below Mean Output Power Required
On any frequency removed from the carrier by greater than 20 kHz up to and including 45 kHz	26
On any frequency removed from the carrier frequency by greater than 45 kHz up to and including 90 kHz	45
On any frequency removed from the carrier frequency by greater than 90 kHz up to $2f_C$	43+10LogP=41 (P=0.603W)

OCCUPIED BANDWIDTH ST/SAT
FCC ID: F3JRT800

FIGURE 4H

F. SPURIOUS EMISSIONS AT THE ANTENNA TERMINALS
(Paragraph 2.991 of the Rules)

1. Spurious Emissions Other Than 870 - 890 MHz.

The RT-800 transmitter was tested for spurious emissions at the antenna terminals while the equipment was internally modulated with wideband data, the worst case modulation mode.

Measurements were made with a Tektronix 494P spectrum analyzer coupled to the transmitter output terminals through a Narda 765-20 50 ohm power attenuator. A wave trap was used at the junction of the attenuator output and spectrum analyzer input to provide a 35 dB attenuation of the carrier test frequency, 834.99 MHz. (The wave trap was used to improve the dynamic range of the spectrum analyzer.) During the tests, the transmitter was terminated in the Narda attenuator. Supply was 6 Vdc throughout the tests.

Spurious emissions were measured throughout the RF spectrum from 14.4 MHz (lowest frequency generated in the transmitter) to 8.5 GHz. Any emissions that were between the required attenuation and the noise floor of the spectrum analyzer were recorded. Each spurious emission was measured with 2500 Hz (2.989(c)(1)) modulation, with wideband data modulation and with no modulation. Each reported emission level was the worst case modulation condition. Data are shown in Table 2 and are corrected for the effect of the wavetrap.

TABLE 2
TRANSMITTER CONDUCTED SPURIOUS
Other than 869 - 894 MHz
834.99 MHz, 5.0 Vdc

Spurious Frequency, MHz	dB below carrier reference for highest and lowest power 0.603W	0.007W
1669.982	97	95
2504.973	>101	>100
3339.964	>102	>101
4174.955	>101	>104
5009.946	>101	>103
5844.937	>102	>101
6679.928	>102	>101
7514.919	>90	>89
8349.910	>88	>90
Required: 43+10Log(P)	41	21

F. SPURIOUS EMISSIONS AT THE ANTENNA TERMINALS (Cont'd)

All other emissions were more than 95 dB below the carrier reference.

2. Spurious Emissions 870-890 MHz

Measurements were made with a Tektronix 494P spectrum analyzer. Between the RT-800 antenna terminal and the spectrum analyzer was a Narda 765-20 50-ohm power attenuator, a wave trap, a General Radio 1602-P1 stub wave trap and an HP-8447D amplifier. The transmitter was terminated in the Narda attenuator. The 834.99 MHz carrier was notched out 82dB with the stub wave traps to achieve a -100 dBm measurement on the spectrum analyzer without front end saturation.

(The amplifier was necessary to make up the loss of the attenuator to achieve a -100 dBm measurement at the antenna terminal. The 869 - 894 MHz effect of the attenuator/traps/amplifier network between the transmitter antenna terminal and the spectrum analyzer.)

The network was calibrated using a Boonton 102F signal generator swept from 870 MHz to 890 MHz while set for -30 dBm input to the network. The network exhibited -5dB loss at 870 MHz to +2dB at 890 MHz.

No spurious emissions were detected above the -102 dBm noise floor at any of the applicable MAC power levels from 870 MHz to 890 MHz thereby complying with the -80 dBm limit of 22.907(f).

G. FIELD STRENGTH MEASUREMENTS OF SPURIOUS RADIATION (Paragraph 2.993(a),(b)(2) of the Rules)

Field intensity measurements of radiated spurious emissions from the RT-800 were made with a Tektronix 494P spectrum analyzer using Singer DM-105A calibrated test antennas below 1 GHz, Polarad CA-L from 1 - 2.4 GHz, Polarad CA-S from 2 - 4.6 GHz, Polarad CA-M from 4.3 - 7.8 GHz and Polarad CA-X from 7 - 10 GHz, or EMCO 3115 horn, 1 - 10 GHz. The transmitter and dummy load were located in an open field 3 meters from the test antenna. Supply voltage was a power supply with a terminal voltage under load of 5.0 Vdc. Output power to the antenna was 0.603 watts at the 834.99 MHz operating frequency. The transmitter and test antennas were arranged to maximize pickup. Both vertical and horizontal test antenna polarization were employed.

Reference level for the spurious radiation was taken as the measured field intensity in uV/m @ 3m (See Table 3).

Effective radiated power was calculated from:

$$ERP = \frac{(FsxD)^2}{30xG}$$

Where Fs is Field Intensity in uV/m.

D is Distance in Meters.

G is Antenna Gain*.

$$ERP = \frac{(1{,}106{,}900 \times 10^{-6} x3)^2}{30x0.69}$$

$$= 0.53 \text{ watts}$$

*Antenna Gain was measured by Centurian International Inc. in a anechoic chamber at 0.6

Measurements were made from the lowest frequency generated within the unit, or 14.4 MHz, to 10 times operating frequency, 8.5 GHz. Data after application of antenna factors and line loss corrections are shown in Table 3.

G. FIELD STRENGTH MEASUREMENTS...(Continued)

TABLE 3

TRANSMITTER RADIATED SPURIOUS
834.99 MHz; 5.0 Vdc; 0.603 watts

Spurious Frequency, MHz	F.I. @ 3m uV/m	dB Below Carrier Reference
834.990	1,106,900	0
1669.980		77V*
2504.970		69H*
3339.960		71V*
4174.950		66V*
5009.940		65H*
5844.930		70V*
6679.920		62V*
7514.910		>74**
8349.900		>76**

Required: 43+10Log(0.603) = 41

1. Worst-case polarization, H-horizontal, V-vertical.

2. Includes transmission line losses. Horn antenna factors from FCC Project 3235-18.

* Reference data; more than 20 dB below FCC limit.
** Reference data; noise floor

All other spurious from 14.4 - 8500 MHz were 20 dB or more below FCC limit.

H. FREQUENCY STABILITY
(Paragraph 2.995(a)(1) and 22.101 of the Rules)

Measurement of frequency stability versus temperature was made at temperatures from $-30^{o}C$ to $+50^{o}C$. At each temperature, the unit was exposed to test chamber ambient a minimum of 60 minutes after indicated chamber temperature ambient had stabilized to within $\pm 2^{o}$ of the desired test temperature. Following the 1 hour soak at each temperature, the unit was turned on, keyed and frequency measured within 2 minutes. Test temperature was sequenced in the order shown in Table 4, starting with $-30^{o}C$.

H. FREQUENCY STABILITY .....(Continued)

A Thermotron S1.2 temperature chamber was used. Temperature was monitored with a Keithley 871 digital temperature probe. The transmitter output stage was terminated in a Narda 765-20 power attenuator. Primary supply was 5.0 volts. Frequency was measured with a HP 5385A (0.1 ppm) digital frequency counter connected to the transmitter through a power attenuator. Measurements were made at 835.50 MHz. No transient keying effects were observed.

TABLE 4
FREQUENCY STABILITY vs. TEMPERATURE
835.50 MHz, 5.0 Vdc, 0.603 watts

Temperature, ^{o}C	Output Frequency, MHz	p.p.m.
-29.1	835.499813	-0.2
-19.9	835.499828	-0.2
- 9.9	835.499717	-0.3
- 0.1	835.499669	-0.4
10.4	835.499711	-0.3
20.0	835.499443	-0.7
30.5	835.499438	-0.7
39.9	835.499369	-0.8
50.4	835.499347	-0.8

Maximum frequency error: 835.500000
835.499347

\- .000653 MHz

Rule 22.101(a) specifies .00025% a maximum of ±.002089 MHz, which corresponds to:

High Limit	835.502089 MHz
Low Limit	835.497911 MHz

G. FREQUENCY STABILITY AS A FUNCTION OF SUPPLY VOLTAGE
(Paragraph 2.995(d)(2) of the Rules)

Oscillator frequency as a function of power supply voltage was measured with a HP 5385A digital frequency counter as supply voltage provided by a HP 6264B variable dc power supply was varied ±15% from the nominal 5.0 volt rating. A Keithley 197 digital voltmeter was used to measure supply voltage at transmitter primary input terminals. Measurements were made at 20^{o}C ambient.

G. FREQUENCY STABILITY...(Continued)

TABLE 5

FREQUENCY STABILITY vs. SUPPLY VOLTAGE
835.50 MHz, 5.0 Vdc, 0.603 watts

Supply Voltage	Output Frequency, MHz	p.p.m.
5.75 (115%)	835.499444	-0.7
5.50 (110%)	835.499452	-0.7
5.25 (105%)	835.499441	-0.7
5.00 (RATED)	835.499443	-0.7
4.75 (95%)	835.499426	-0.7
4.50 (90%)	835.499420	-0.7
4.25 (85%)	**	
4.00 (*)	**	

Maximum frequency error: 835.500000
835.499420

\- .000580 MHz

FCC Rule 22.101(a) specifies .00025% or a maximum of ±.002089 MHz, corresponding to:

High Limit	835.502089 MHz
Low Limit	835.497911 MHz

*Rated battery end-point.

** Processor shut-down, no RF output.