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FCC Part 90 Certification Application

FCC Form 731

For The

**VIPER SC+ 200
VHF RADIO MODEM**

FCC ID: NP45028504

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1.0 Transmitter Rated Power Output

RULE PART NUMBER: FCC: 2.1046 (a) (c), 80.215, 90.729, 90.259(a), 95.855

Note:

Data taken at 12 watts is to be applied to Part 80.215 (216-220)

Data taken at 12 watts is to be applied Part 90.729 (220-222 MHz) only.

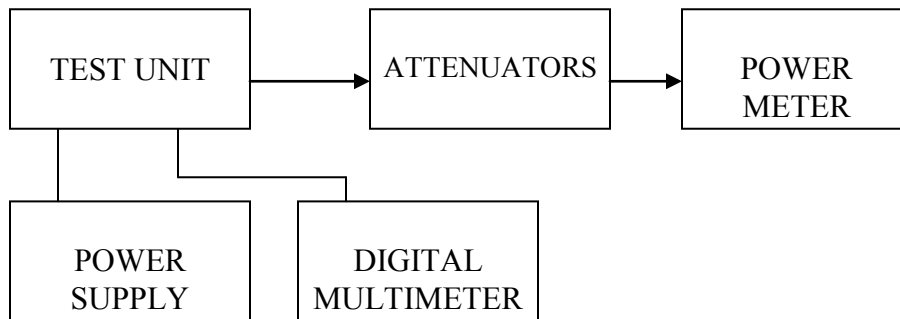
Data taken at 2 watts is to be applied to Part 90.259(a) (217-220 MHz).

TEST RESULTS: See results below

TEST CONDITIONS: Standard Test Conditions

TEST EQUIPMENT: 50-Ohm Atten, Bird Electronics Model 50-A-MFN-20 (20dB, 50W)
50-Ohm Atten, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
Power Supply, Hewlett Packard Model 6653A
Digital Multimeter, HP 3478A
Power Meter, Model HP437B

TEST SET-UP:



TEST RESULTS:

Frequency (MHz)	DC Voltage at Final (Vdc)	DC Current into Final (Adc)	DC Power into Final (W)	RF Power Output (W)
219.050	11.8	2.26	26.67	12.0
219.050	8.50	1.01	8.585	2.0
219.050	8.20	0.73	5.986	1.0

2.0 Transmitter Spurious and Harmonic Outputs

RULE PART NUMBER: FCC: 2.1051, 90.210 (b,3),(c,3)(d,3)(e,3)(f,3) 80.211 (f);
Note:
Data taken at 12 watts is to be applied to Part 80.215 (216-220)
Data taken at 12 watts is to be applied Part 90.729 (220-222 MHz) only.
Data taken at 2 watts is to be applied to Part 90.259(a) (217-220 MHz).

MINIMUM STANDARDS: The most restrictive specification is:
For 12 Watts: $55+10\text{Log}_{10}(12 \text{ Watts}) = -65.8 \text{ dBc}$
or -65dBc , whichever is the lesser attenuation.

For 2 Watts: $55+10\text{Log}_{10}(2 \text{ Watts}) = -58 \text{ dBc}$
or -65dBc , whichever is the lesser attenuation.

For 1 Watt: $55+10\text{Log}_{10}(1 \text{ Watt}) = -55 \text{ dBc}$
or -65 dBc , whichever is the lesser attenuation.

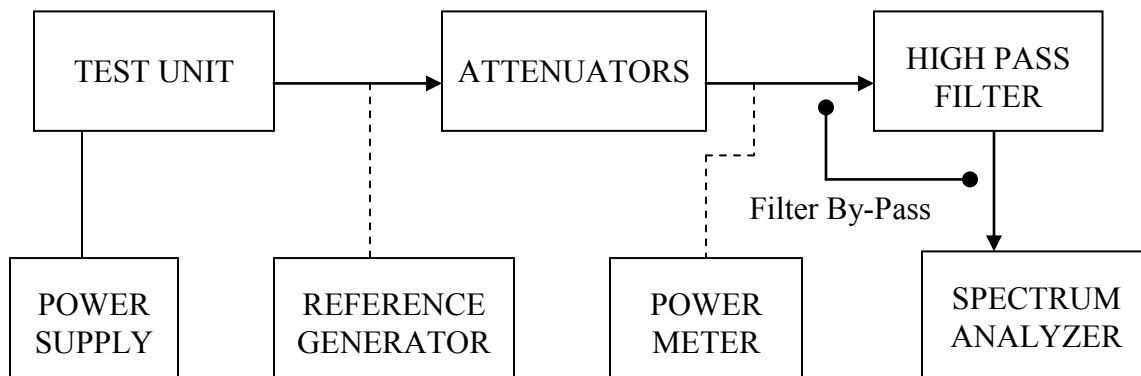
TEST RESULTS: Meets minimum standards (see data on following pages)

TEST CONDITIONS: Standard Test Conditions, 25 C
RF Voltage measured at antenna terminals

TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13

TEST EQUIPMENT: 50-Ohm Atten, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
50-Ohm Atten, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
Power Supply, Hewlett Packard Model 6653A
Spectrum Analyzer, HP 8563E
Power Meter, Model HP437B
Reference Generator, Agilent E8257D
High Pass Filter, Mini Circuits BHP-300

TEST SET-UP:



MEASUREMENT PROCEDURE:

1. The transmitter carrier output frequency is 216.050, 219.050 and 221.950 MHz. The reference oscillator frequency is 23.040 MHz. The power amplifier has voltage levels at 11.9 Volts, 8.4 Volts and 8.1 Volts for 12 watts, 2 watts, and 1 watt, respectively.
2. The carrier reference was established on the spectrum analyzer with the filter bypass in place. Then the spectrum was scanned from DC to 2 Fc. Finally, the high pass filter was inserted to null the carrier fundamental and extend the range of the spectrum analyzer for harmonic measurements above 2 Fc.
3. At each spurious frequency, generation substitution was used to establish the true spurious level.
4. The spectrum was scanned to the 10th harmonic of the highest internally generated frequency.

Tuned Frequency	216.050 MHz			Tuned Frequency	216.050 MHz	
Power (Watts)	12.0 Watts			Power (Watts)	1.00 Watt	
Power (dBm)	+40.8 dBm			Power (dBm)	+30 dBm	
Spec Limit	-65.8 dBc			Spec Limit	-55 dBc	
Worse Case				Worse Case		
Spurious	Relation to the Carrier	Relative to the Carrier		Spurious	Relation to the Carrier	Relative to the Carrier
Frequency (MHz)				Frequency (MHz)		
432.100	2Fo	-86.80		432.100	2Fo	-86.00
648.150	3Fo	-95.80		648.150	3Fo	-95.00
864.200	4Fo	-95.80		864.200	4Fo	-95.00
1080.250	5Fo	-95.80		1080.250	5Fo	-95.00
1296.300	6Fo	-95.80		1296.300	6Fo	-95.00
1512.350	7Fo	-95.80		1512.350	7Fo	-95.00
1728.400	8Fo	-95.80		1728.400	8Fo	-95.00
1944.450	9Fo	-95.80		1944.450	9Fo	-95.00
2160.500	10Fo	-95.80		2160.500	10Fo	-95.00

Tuned Frequency	219.050 MHz			Tuned Frequency	219.050 MHz	
Power (Watts)	1.00 Watt			Power (Watts)	2.00 Watt	
Power (dBm)	+30 dBm			Power (dBm)	+33 dBm	
Spec Limit	-55 dBc			Spec Limit	-58 dBc	
Worse Case				Worse Case		
Spurious	Relation to the Carrier	Relative to the Carrier		Spurious	Relation to the Carrier	Relative to the Carrier
Frequency (MHz)				Frequency (MHz)		
438.100	2Fo	-86.00		438.100	2Fo	-86.00
657.150	3Fo	-95.00		657.150	3Fo	-95.00
876.200	4Fo	-95.00		876.200	4Fo	-95.00
1095.250	5Fo	-95.00		1095.250	5Fo	-95.00
1314.300	6Fo	-95.00		1314.300	6Fo	-95.00
1533.350	7Fo	-95.00		1533.350	7Fo	-95.00
1752.400	8Fo	-95.00		1752.400	8Fo	-95.00
1971.450	9Fo	-95.00		1971.450	9Fo	-95.00
2190.500	10Fo	-95.00		2190.500	10Fo	-95.00

Tuned Frequency	219.050 MHz		
Power (Watts)	12.0 Watts		
Power (dBm)	+40.8 dBm		
Spec Limit	-65.8 dBc		
Worse Case			
Spurious	Relation to the Carrier	Relative to the Carrier	
Frequency (MHz)			
438.100	2Fo	-86.80	
657.150	3Fo	-95.80	
876.200	4Fo	-95.80	
1095.250	5Fo	-95.80	
1314.300	6Fo	-95.80	
1533.350	7Fo	-95.80	
1752.400	8Fo	-95.80	
1971.450	9Fo	-95.80	
2190.500	10Fo	-95.80	

Tuned Frequency	221.950 MHz			Tuned Frequency	221.950 MHz		
Power (Watts)	12.0 Watts			Power (Watts)	1.00 Watt		
Power (dBm)	+40.8 dBm			Power (dBm)	+30 dBm		
Spec Limit	-65.8 dBc			Spec Limit	-55 dBc		
Worse Case				Worse Case			
Spurious	Relation to the Carrier	Relative to the Carrier		Spurious	Relation to the Carrier	Relative to the Carrier	
Frequency (MHz)				Frequency (MHz)			
443.900	2Fo	-86.80		443.900	2Fo	-86.00	
665.850	3Fo	-95.80		665.850	3Fo	-95.00	
887.800	4Fo	-95.80		887.800	4Fo	-95.00	
1109.750	5Fo	-95.80		1109.750	5Fo	-95.00	
1331.700	6Fo	-95.80		1331.700	6Fo	-95.00	
1553.650	7Fo	-95.80		1553.650	7Fo	-95.00	
1775.600	8Fo	-95.80		1775.600	8Fo	-95.00	
1997.550	9Fo	-95.80		1997.550	9Fo	-95.00	
2219.500	10Fo	-95.80		2219.500	10Fo	-95.00	

3.0 Frequency Stability with Variation in Supply Voltage

RULE PART NUMBER: FCC: 2.1055 (d)(1), 90.213 (a) in conjunction with 90.733(c)(e), 80.209

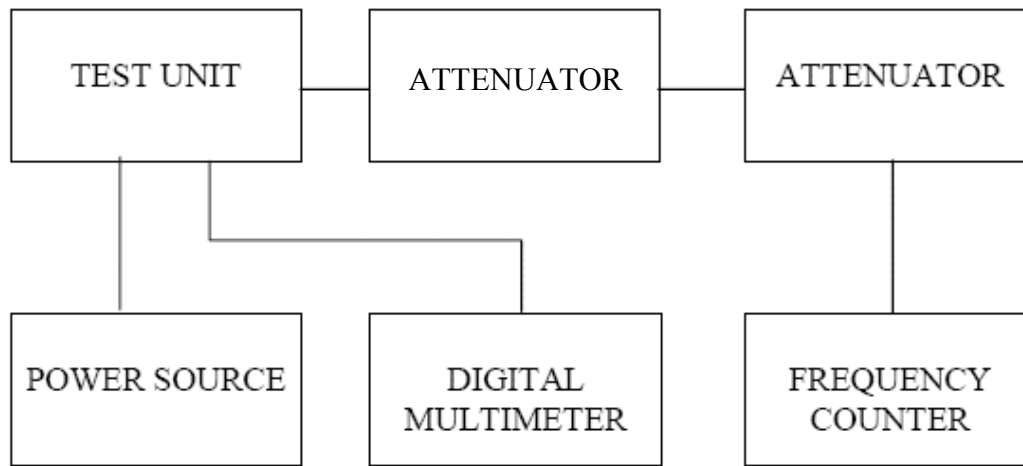
MINIMUM STANDARD: Shall not exceed 0.50 ppm.

TEST RESULTS: Meets minimum standard, see data on following page

TEST CONDITIONS: Standard Test Conditions, 25 C 13.6 Vdc Nominal

TEST EQUIPMENT: Frequency Counter, HP 8901A Modulation Analyzer
 DC Power Supply, Hewlett Packard Model 6653A
 Digital Voltmeter, HP 3478A DMM
 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
 50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)

TEST SET-UP:



TEST SET-UP

Channel Frequency: 219.0500 MHz
 Tolerance Requirements: ± 0.50 ppm
 Highest Variation: 0.00 ppm
 Power Output: 12 Watts

Input Voltage (Vdc)	Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)
10.0	219.050000	0.00	0.00
13.6 Nominal	219.050000	0.00	0.00
30.0	219.050000	0.00	0.00

4.0 Frequency Stability with Variation in Ambient Temperature

RULE PART NUMBER: FCC: 2.1055 (a) (b), 90.213 (a) in conjunction with 90.733(c)(e), 80.209
Note:

Data taken at 12 watts is to be applied to Part 80.215 (216-220)
Data taken at 12 watts is to be applied Part 90.729 (220-222 MHz) only.
Data taken at 2 watts is to be applied to Part 90.259(a) (217-220 MHz).

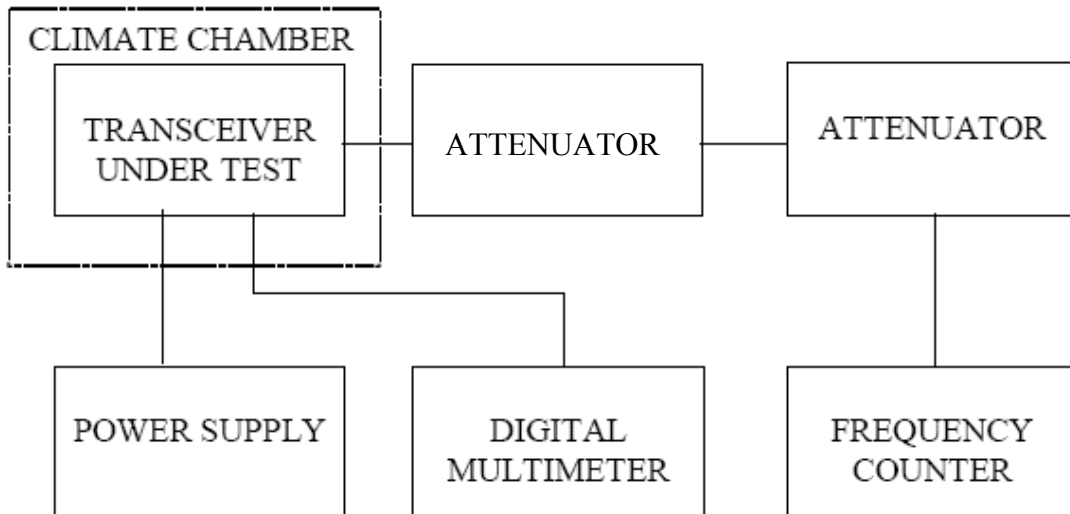
MINIMUM STANDARD: Shall not exceed 0.50 ppm from test frequency

TEST RESULTS: Meets minimum standard, see data on following page

TEST CONDITIONS: Standard Test Conditions

TEST EQUIPMENT: Frequency Counter, HP 8901B Modulation Analyzer
DC Power Supply, Hewlett Packard Model 6653A
Digital Voltmeter, HP 3478A DMM
50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
Climate Chamber, Tenney Jr.

TEST SET-UP:



Channel Frequency: 219.050000 MHz
 Voltage & Power Level: 13.6 Volts Nominal @ 12 Watts
 Highest Variation: -0.41 ppm

Temperature (Deg C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)
-30	219.049910	-90	-0.41
-20	219.049920	-80	-0.37
-10	219.049960	-40	-0.18
0	219.049960	-40	-0.18
10	219.049970	-30	-0.14
20	219.049990	-10	-0.05
25	219.050000	0	0.00
30	219.050000	0	0.00
40	219.050000	0	0.00
50	219.050000	0	0.00
60	219.050020	20	0.09

Channel Frequency: 219.050000 MHz
 Voltage & Power Level: 13.6 Volts Nominal @ 2 Watt
 Highest Variation: -0.41ppm

Temperature (Deg C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)
-30	219.049910	-90	-0.41
-20	219.049920	-80	-0.37
-10	219.049960	-40	-0.18
0	219.049960	-40	-0.18
10	219.049970	-30	-0.14
20	219.049990	-10	-0.05
25	219.050000	0	0.00
30	219.050000	0	0.00
40	219.050000	0	0.00
50	219.050000	0	0.00
60	219.050020	20	0.09

Channel Frequency: 219.050000 MHz
Voltage & Power Level: 13.6 Volts Nominal @ 1 Watt
Highest Variation: -0.41ppm

Temperature (Deg C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)
-30	219.049910	-90	-0.41
-20	219.049920	-80	-0.37
-10	219.049960	-40	-0.18
0	219.049960	-40	-0.18
10	219.049970	-30	-0.14
20	219.049990	-10	-0.05
25	219.050000	0	0.00
30	219.050000	0	0.00
40	219.050000	0	0.00
50	219.050000	0	0.00
60	219.050020	20	0.09

5.0 Transmitter Occupied Bandwidth Necessary Bandwidth

RULE PART NUMBER: FCC: 2.201, 2.202, 2.1033 (c)(14), 2.1049 (h), 2.1041;90.203(k); 80.211 (f), 95.857

Necessary Bandwidth Measurement

This radio modem uses digital modulation signals, passing through a Squared Root Raised Cosine $\alpha=0.2$ or $\alpha=0.5$ DSP implemented low-pass filter to an FM transceiver. The digital modulation is based on SRRC4FSK allows a SRRC2FSK subset to be used for lower bit rate with a better sensitivity reception. The necessary bandwidth calculation for this type of modulation is not covered by paragraphs (1), (2) or (3) from 2.202(c). Therefore, the approach outlined in (2.202(c)(4)) is applicable in this case.

The measurement explanations are provided below.

Necessary Bandwidth Measurement:

Channel Spacing	Emission Type	Data Rate	Baud Rate	Measured Peak Deviation	Measured 99% Occupied BW
6.25 kHz	3K30F1D	4 kbps	4000	1.15 kHz	3.30 kHz
6.25 kHz	3K55F1D	8 kbps	4000	1.09 kHz	3.55 kHz
6.25 kHz	3K20F1D	12 kbps	4000	1.15 kHz	3.20 kHz
12.5 kHz	8K20F1D	8 kbps	8000	3.05 kHz	8.20 kHz
12.5 kHz	8K30F1D	16 kbps	8000	3.70 kHz	8.30 kHz
12.5 kHz	8K50F1D	24 kbps	8000	3.725 kHz	8.50 kHz
12.5 kHz	8K08F1D	32 kbps	8000	3.728 kHz	8.08 kHz
25 kHz	16K5F1D	16 kbps	16000	6.3 kHz	16.5 kHz
25 kHz	16K8F1D	32 kbps	16000	6.3 kHz	16.8 kHz
25 kHz	17K8F1D	48 kbps	16000	7.590 kHz	17.8 kHz
25 kHz	17K0F1D	64 kbps	16000	7.520 kHz	17.0 kHz
50 kHz	33K3F1D	32 kbps	32000	12.31 kHz	33.3 kHz
50 kHz	34K0F1D	64 kbps	32000	14.45 kHz	34.0 kHz
50 kHz	36K0F1D	96 kbps	32000	15.33 kHz	36.0 kHz
50 kHz	33K0F1D	128 kbps	32000	11.66 kHz	33.0 kHz
100 kHz	55K0F1D	64 kbps	64000	12.32kHz	55.0 kHz
100 kHz	53K3F1D	128 kbps	64000	12.50kHz	53.3 kHz
100 kHz	51K7F1D	192 kbps	64000	13.17 kHz	51.7kHz
100 kHz	52K5F1D	256 kbps	64000	13.97 kHz	52.5 kHz

THEORY OF MEASUREMENT

The way to define the Occupied Bandwidth 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” (FCC 2.202), the mathematics are as follows:

$$0.005*TP=P_{(f1)}=\int_0^{f1} PSD_{(f)}df$$

$$0.995*TP=P_{(f2)}=\int_0^{f2} PSD_{(f)}df$$

$$OBW=f2-f1$$

where TP (total mean power) is

$$TP=\int_{-\infty}^{+\infty} PSD_{(f)}df=(1/t)\int_{-\infty}^{+\infty} |z_{(t)}|^2 dt$$

and PSD (power spectral distribution) is

$$PSD(f) = |Z(f)|^2 + |Z(-f)|^2 \quad 0 \leq f < \infty$$

and expresses the positive frequency representation of the transmitter output power for z(t) signal.

By applying these mathematics to the measurements, it is possible to measure the Occupied Bandwidth using a digital spectrum analyzer.

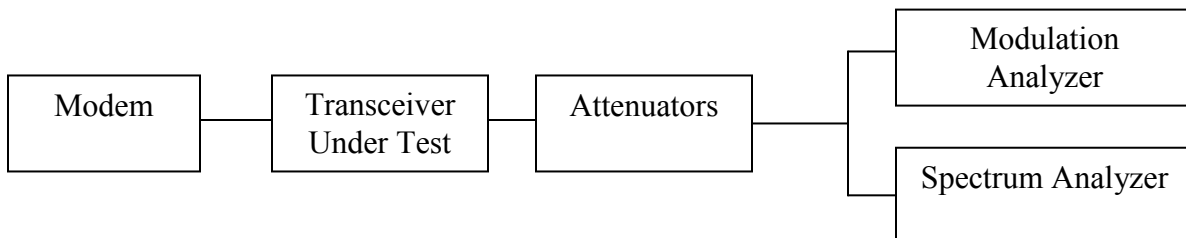
The Occupied Bandwidth measurement is in two parts relatively independent of each other. The first gives the RF spectrum profile, and the second calculates the frequency limits and they result in the Occupied bandwidth. While the first involves RF measurement instrumentation, the second is strictly a computational part related to measured trace.

TEST EQUIPMENT:

- 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
- 50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
- DC Power Supply, Hewlett Packard Model 6653A
- Spectrum Analyzer, Hewlett Packard Model HP8563E
- Modulation Analyzer, Hewlett Packard Model HP8901B

TEST SET-UP:

For the above requirements, the occupied bandwidth of a transmitter was measured using an HP8563E using the following settings:
 Occupied BW % Power: 99%
 Trace: Max Hold A
 RBW: 100 Hz (6.25 and 12.5 kHz channels)
 RBW: 300 Hz (25 kHz and 50 kHz channels)
 VBW: 3 kHz
 SPAN: 100 kHz (6.25 and 12.5 kHz channels)
 SPAN: 150 kHz (25 kHz channels)
 SPAN: 200 kHz (50 kHz channels)



MODULATION SOURCE DESCRIPTION:

The 4-level signaling transmits two information bits per symbol (baud), which yields a bit rate of twice the on-air baud rate. Hence the 64 kbps references in the Installation Guide correspond to a transmitter baud rate of 32000 baud. The 8-level signaling transmits three information bits per symbol (baud), which yields a bit rate of three times the on-air baud rate. Hence the 12, 24, 48, or 96 kbps references in the Installation Guide correspond to a transmitter baud rate of 4000, 8000, 16000 or 32000 baud. The 16-level signaling transmits four information bits per symbol (baud), which yields a bit rate of four times the on-air baud rate. Hence the 16, 32, 64, or 128 kbps references in the Installation Guide correspond to a transmitter baud rate of 4000, 8000, 16000 or 32000baud. That digital signal is digitally filtered (Square Root Raised Cosine pulse shaping with $\alpha=0.2$ or 0.5) by the DSP and converted to I&Q components, then fed to the digital to analog converter. This SRRC4FSK, SRRC8FSK, or SRRC16FSK wave shape applied to the FM modulator will then produce a compact RF spectrum, when using proper frequency deviation, to fit inside the restrictive masks inherent to the intended channel bandwidth.

TX Data Test Pattern:

The transmit "test data" pattern command produces a 107,3741,823 bit pseudo- random pattern. This pattern is generated by the DSP. The 107,3741,823 bit sequence is repeated thereafter as long is necessary to complete the test duration, this sequence lasts 67,109 seconds at 16 kbps. Commonly this is longer than the test duration. This pattern is applied to the DSP modulator for mapping to 4-FSK, 8-FSK and 16-FSK and pulse shaping with SRRC $\alpha=0.2$ or $\alpha=0.5$ depending on the channel selection. This data follows same modulation process as described in MODULATION SOURCE DESCRIPTION and the resulting base band signal feeds the modulator's input of the transceiver.

6.0 Part 80.211(f) - 6 kHz ABW

NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators
3K30F1D, 3K55F1D, and 3K20F1D

RULE PART NUMBER: FCC: 2.202, 80.211 (f): 80.215, 80.481
12 Watts and 1.0 Watt Part 80 216-220 MHz.

MINIMUM STANDARDS: **Part 80.211(f)**
Sidebands and Spurious [Rule 80.211 (f) P = 12 Watts and P=1 Watt]
Authorized Bandwidth = 6 kHz
On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;
On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and
On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10logP (mean power in watts) dB.

Attenuation = 0 dB at Fo to 3.00 kHz
Attenuation = 25 dB at 3.00 kHz
Attenuation = 35 dB at 6.00 kHz
Attenuation = 43 dB at 15.0 kHz
Attenuation = 43 dB > 15 kHz @ 1 Watt
Attenuation = 53.8 dB > 15 kHz @ 12 Watt

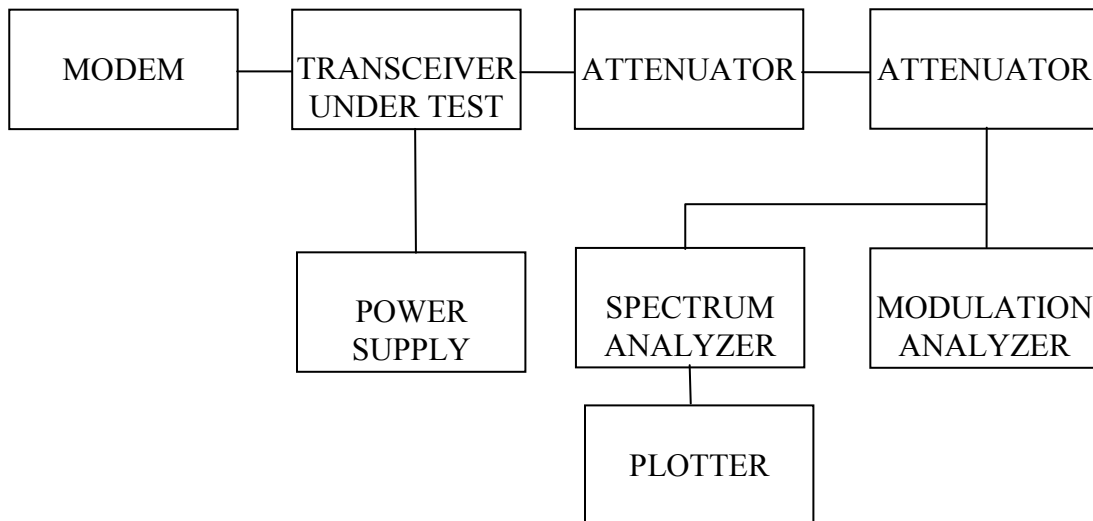
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C
RF Power Level = 1 Watt and 12 Watts
Voltage = 20VDC

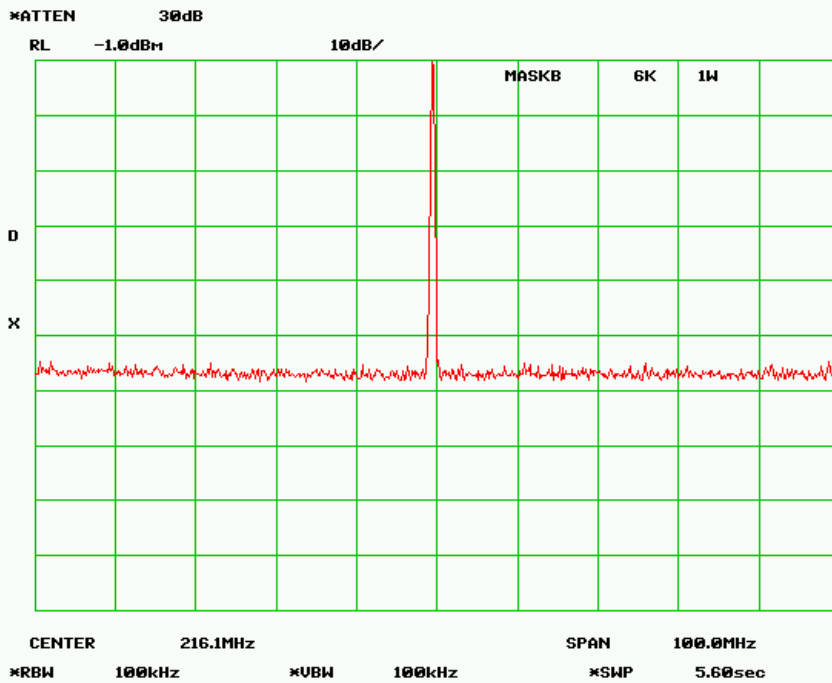
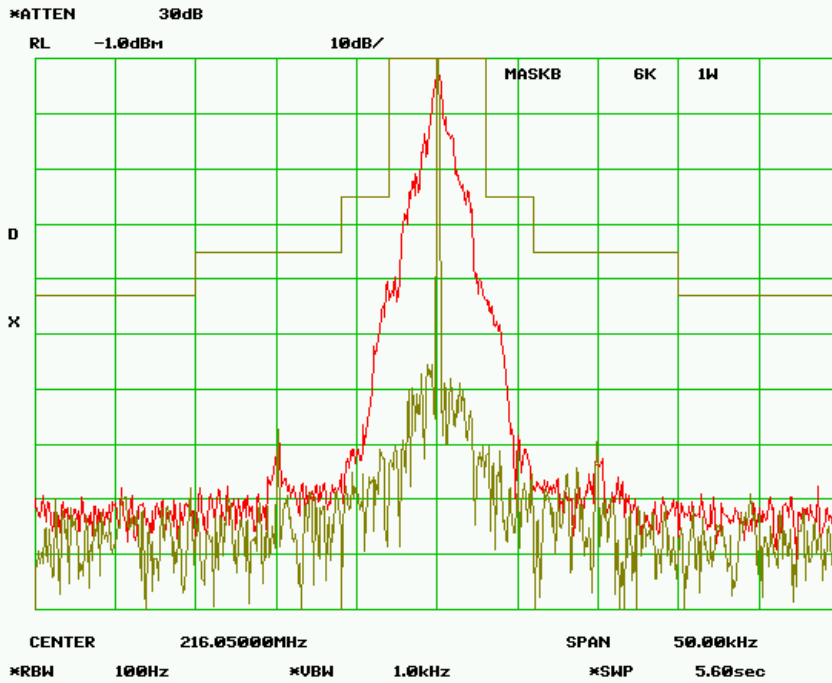
TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13, 3.2.11.2

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
50-Ohm Attenuator, Pasternack Model PE7002-10 (10dB)
DC Power Supply, Hewlett Packard Model 6653A
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901B

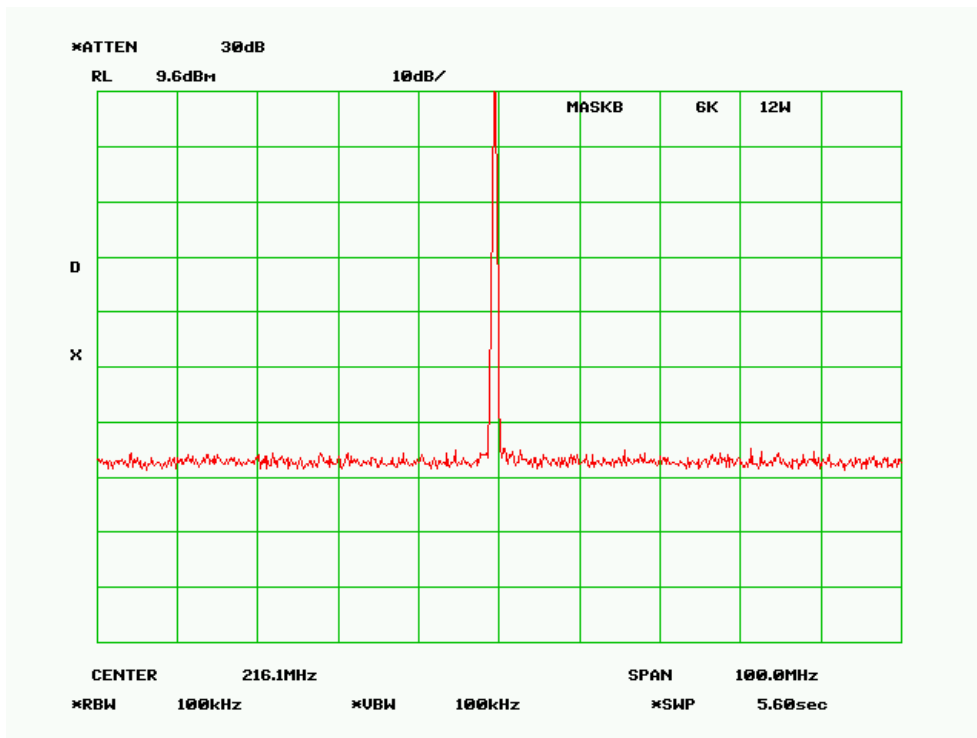
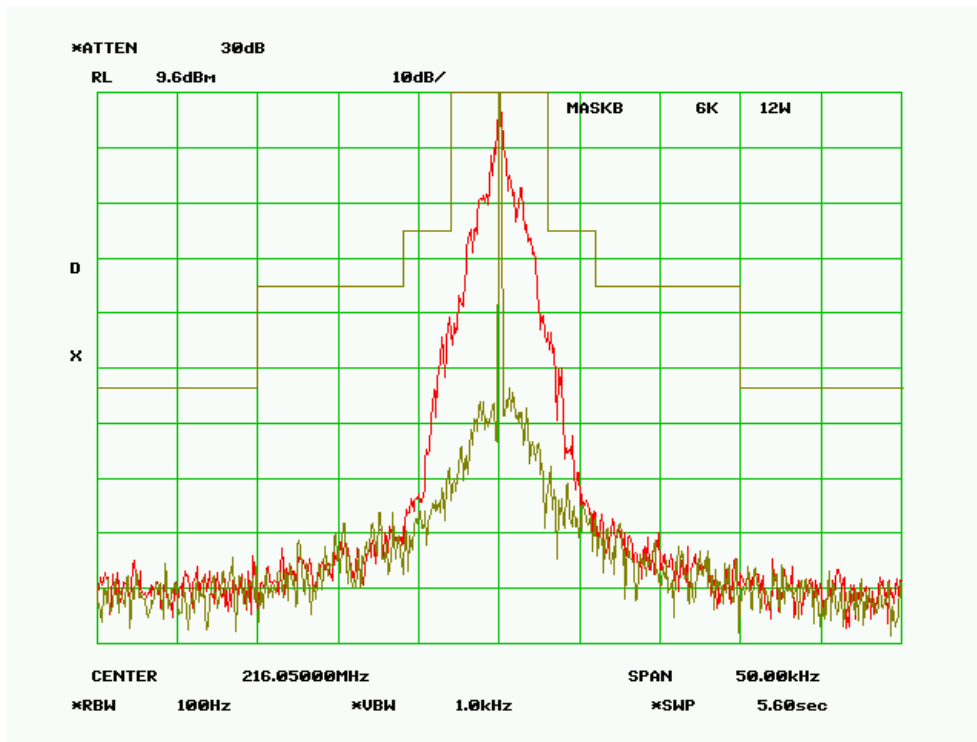
TEST SET-UP:



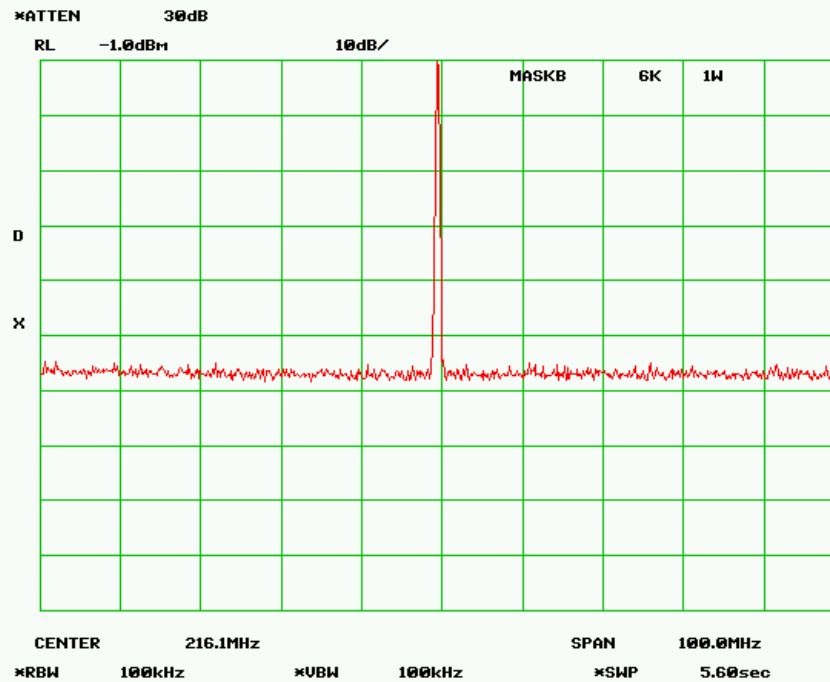
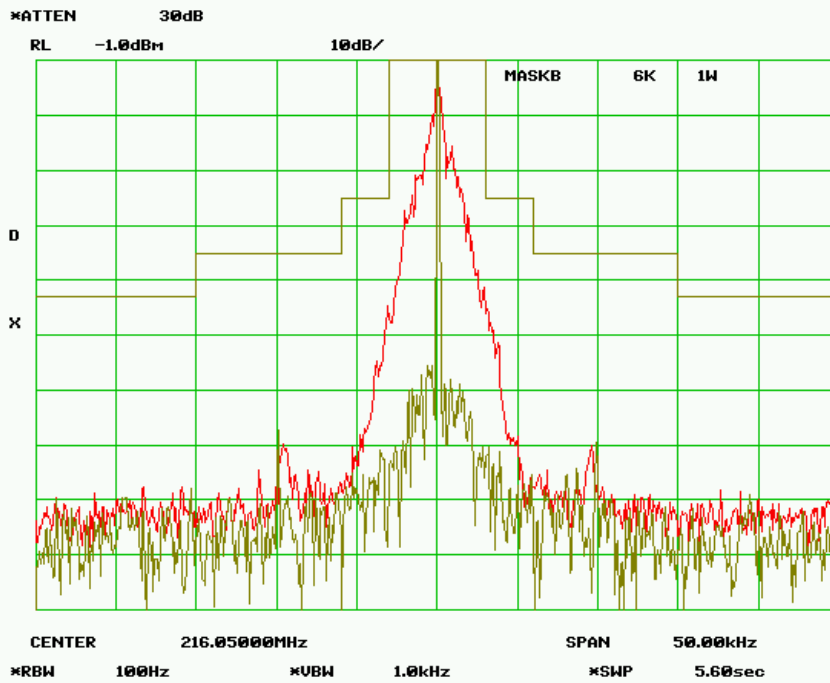
MASK B - 6 kHz - 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 3K30F1D
Data Rate = 4 kbps
PEAK DEVIATION = 1.15 kHz



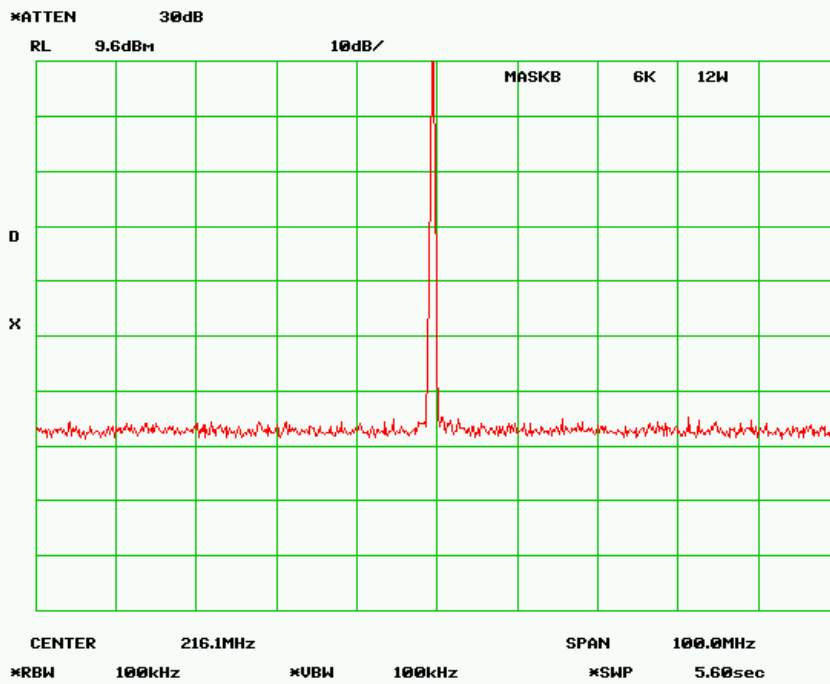
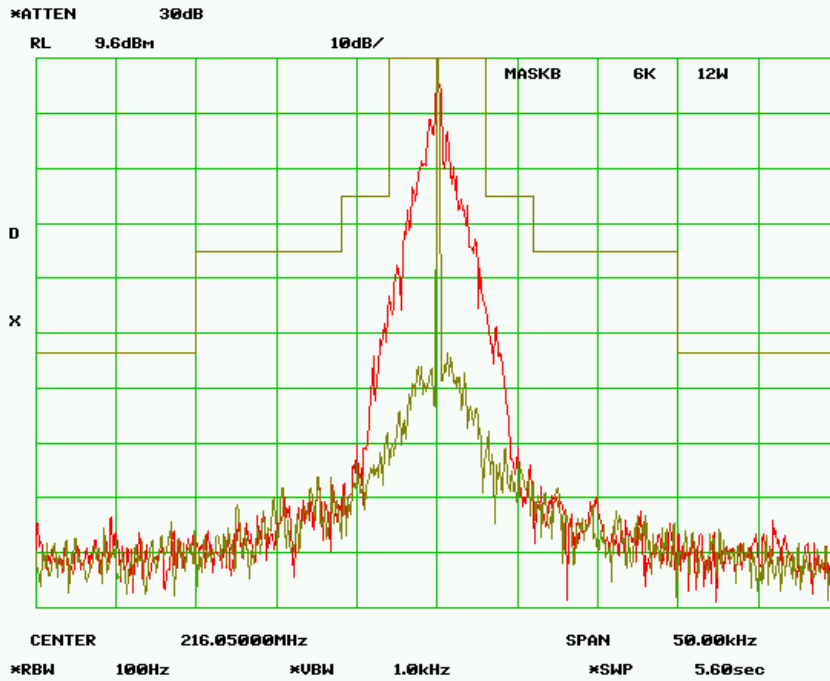
MASK B - 6 kHz – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 3K30F1D
Data Rate = 4 kbps
PEAK DEVIATION = 1.15 kHz



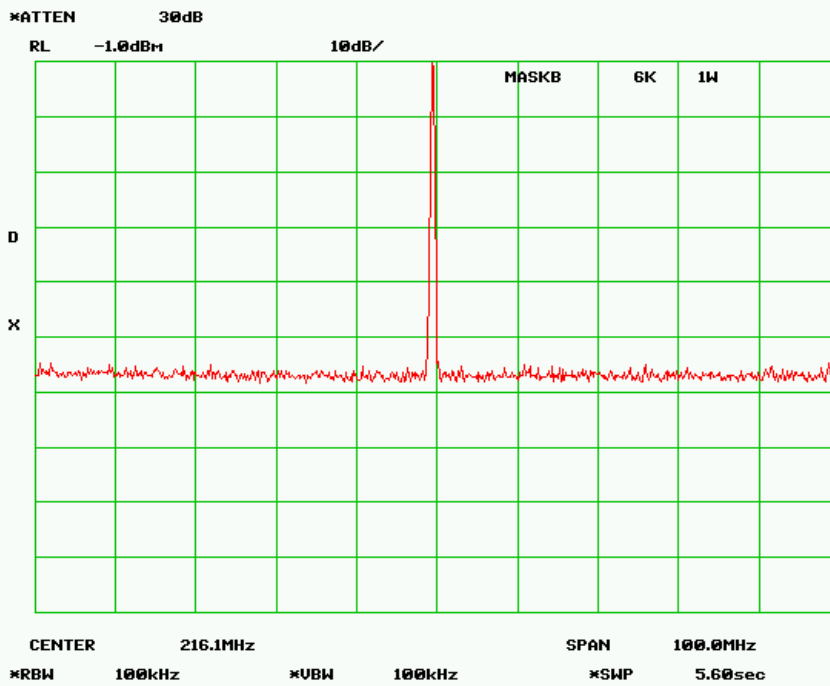
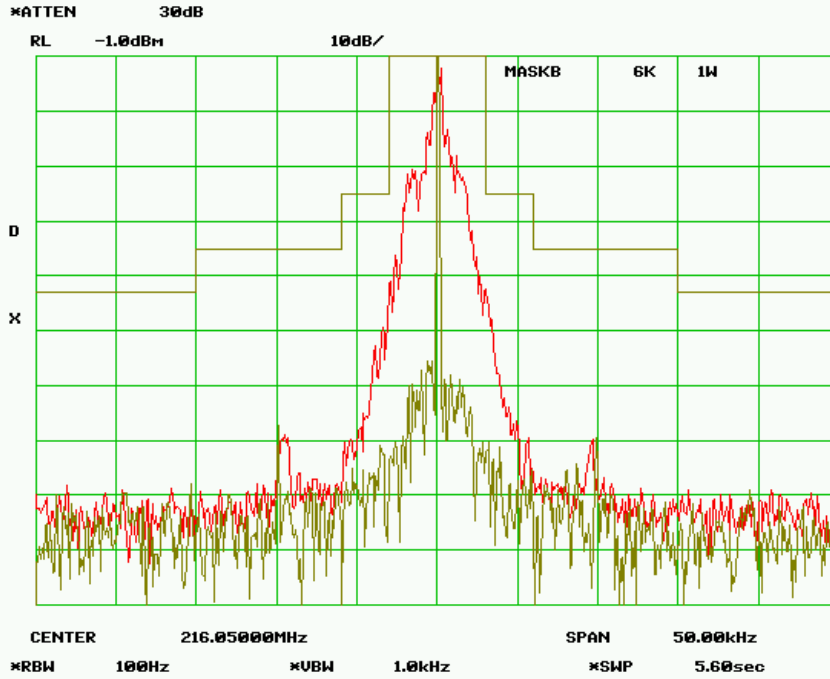
MASK B - 6 kHz - 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 3K55F1D
Data Rate = 8 kbps
PEAK DEVIATION = 1.09 kHz



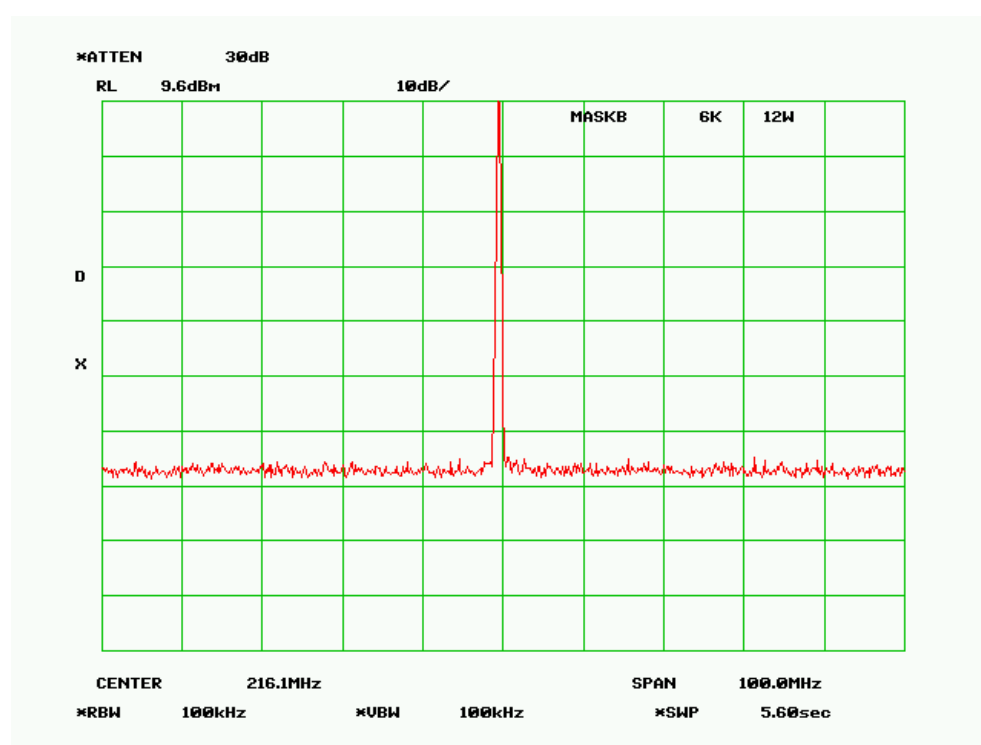
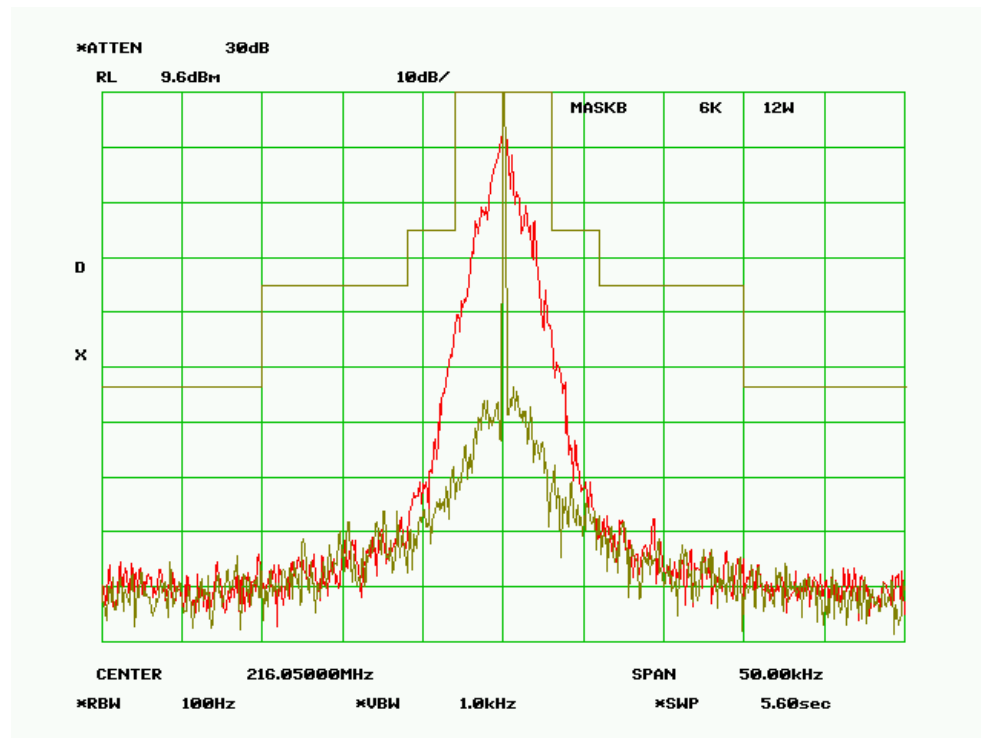
MASK B - 6 kHz – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 3K55F1D
Data Rate = 8 kbps
PEAK DEVIATION = 1.09 kHz



MASK B - 6 kHz – 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 3K20F1D
Data Rate = 12 kbps
PEAK DEVIATION = 1.15 kHz



MASK B - 6 kHz – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 3K20F1D
Data Rate = 12 kbps
PEAK DEVIATION = 1.15 kHz



7.0 Mask E Part 90.259(a) 6 kHz ABW

NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators
3K30F1D, 3K55F1D, and 3K20F1D

RULE PART NUMBER: FCC: 2.202, 90.209 (b)(5), 90.210(e), 2.1049 (c) (1)
Data taken at 2 watts is to be applied to Part 90.259(a) (217-220 MHz).

MINIMUM STANDARDS: **Mask E**
Sidebands and Spurious [Rule 90.210 (e), P =2 Watts and P=1 Watt
Authorized Bandwidth = 6 kHz [Rule 90.209(b) (5)
From Fo to 3 kHz, down 0 dB.
Greater than 3 kHz to not more than 4.6 kHz, down 30 +16.67(fd-3 kHz) dB
By more than 4.6 kHz, 55 +10 log(P) or 65 dB, whichever is the lesser attenuation.

Attenuation = 0 dB at Fo to 3 kHz
Attenuation = 30 dB at 3 kHz
Attenuation = 56.7 dB at ≤ 4.6 kHz @ 2 Watts
Attenuation = 55.0 dB at ≤ 4.6 kHz @ 1 Watt
Attenuation = 58 dB $55+10\log_{10}(P) > 4.6$ kHz @ 2 Watts
Attenuation = 55 dB $55+10\log_{10}(P) > 4.6$ kHz @ 1 Watt

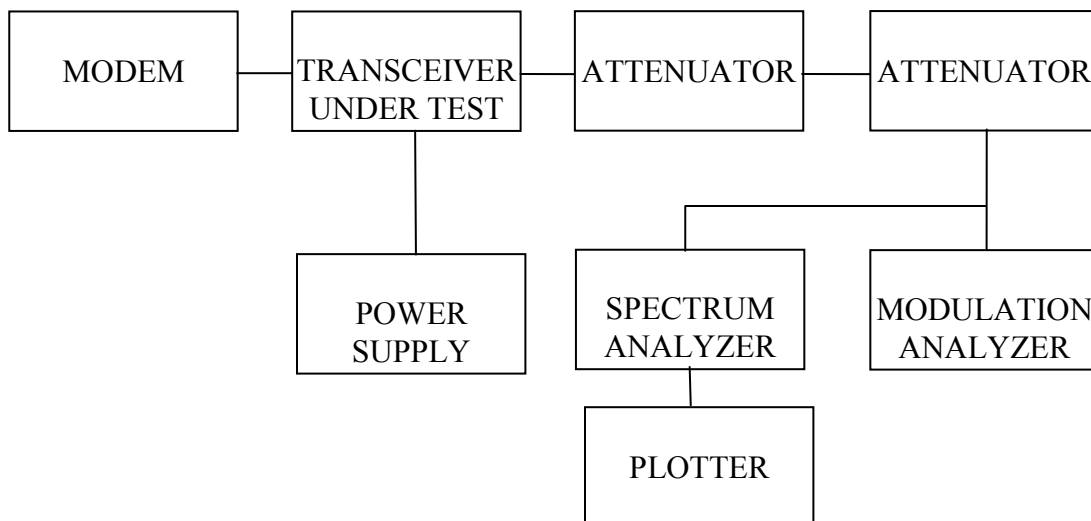
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C
RF Power Level = 1 Watt and 2 Watts
Voltage = 20VDC

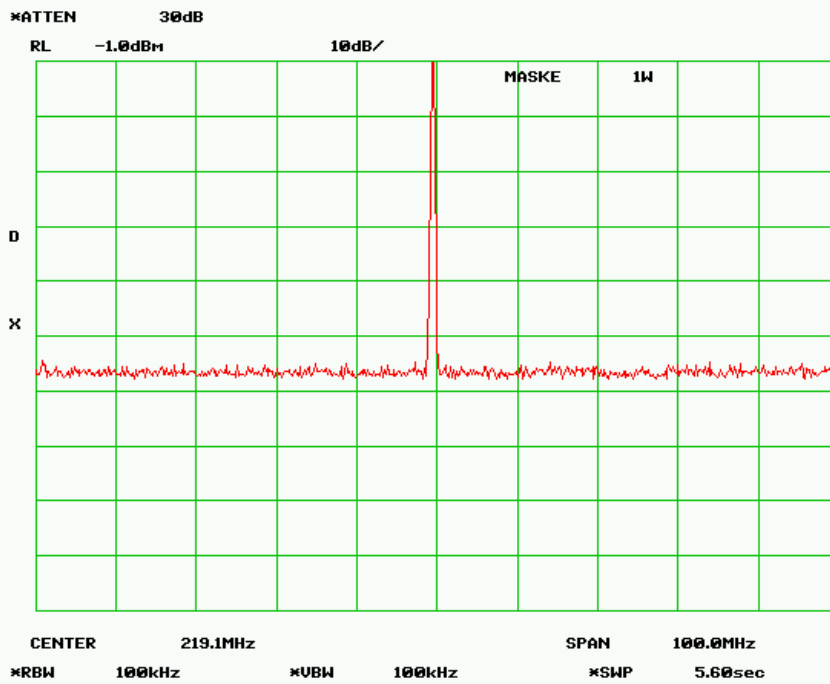
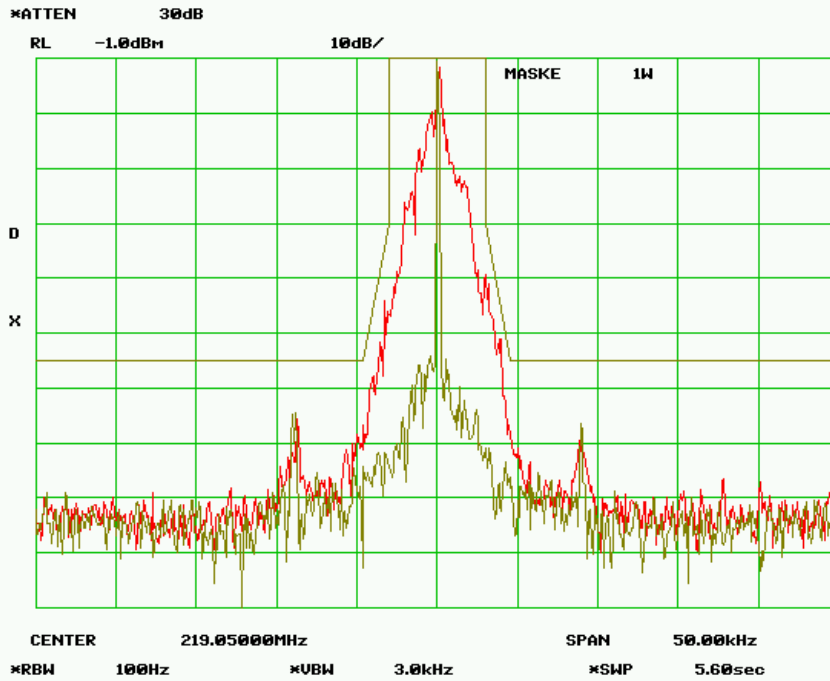
TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13, 3.2.11.2

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
50-Ohm Attenuator, Pasternack Model PE7002-10 (10dB)
DC Power Supply, Hewlett Packard Model 6653A
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901B

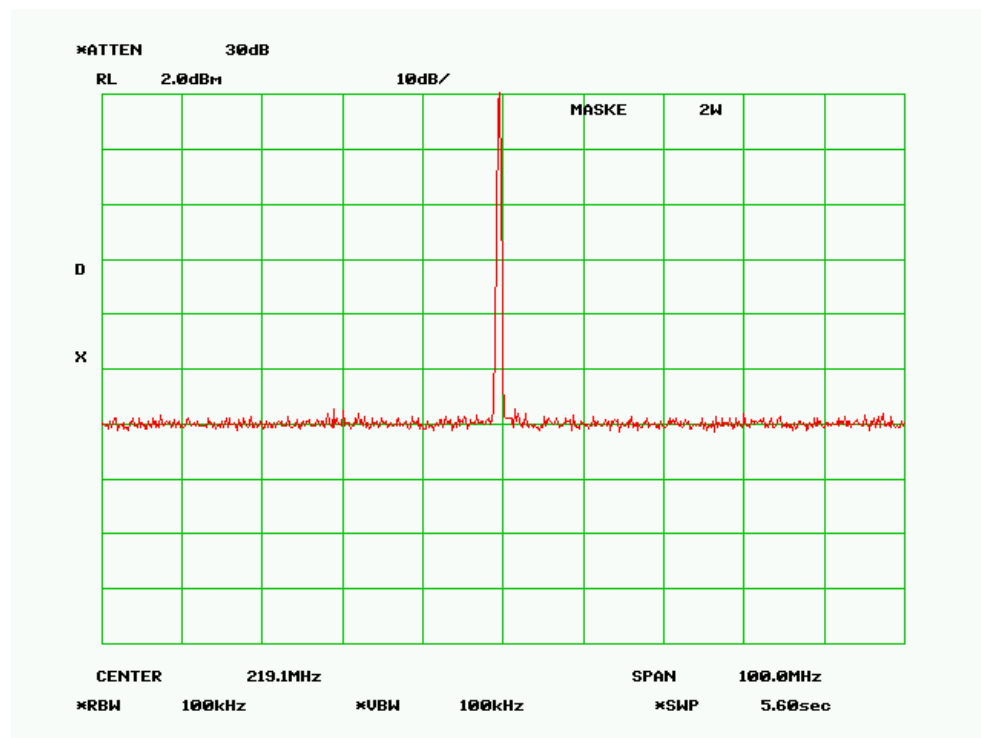
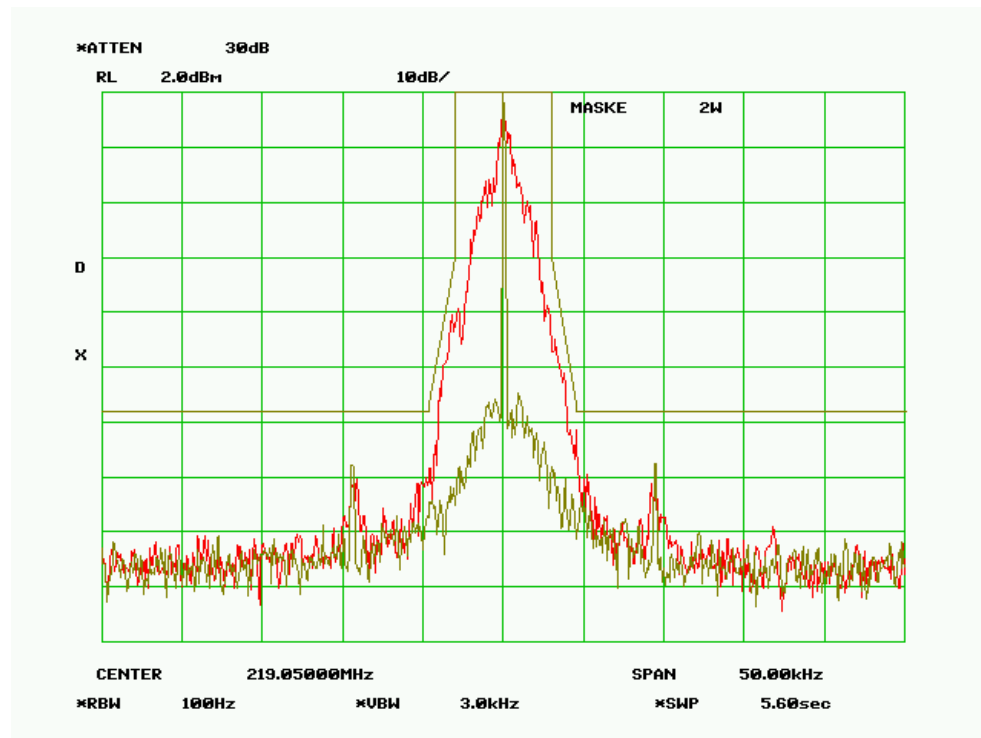
TEST SET-UP:



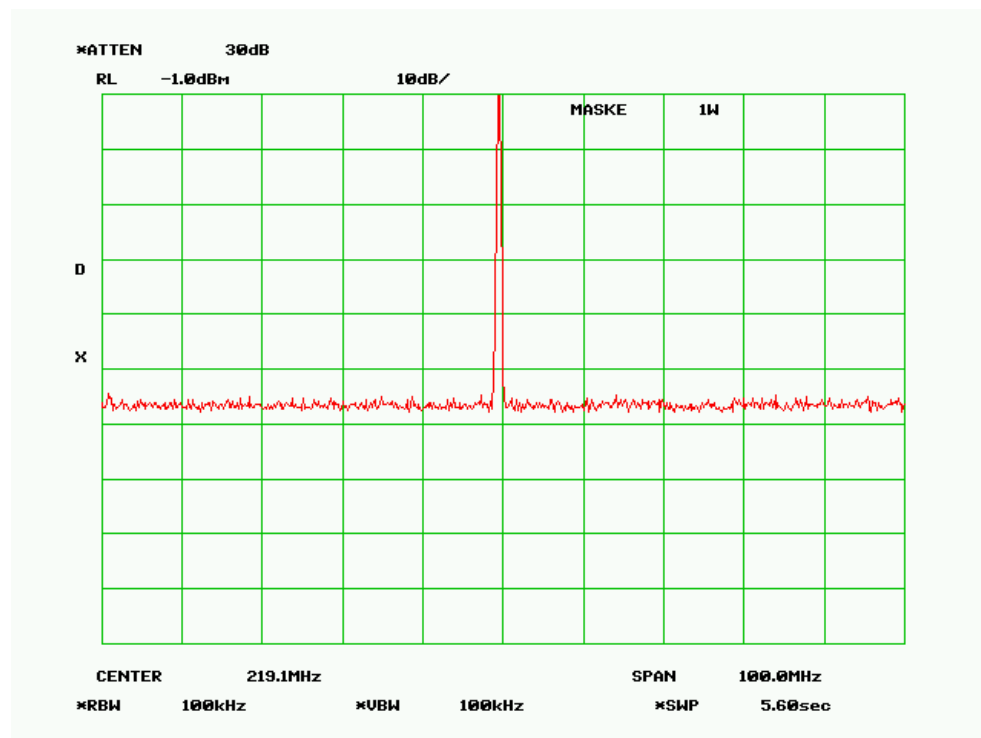
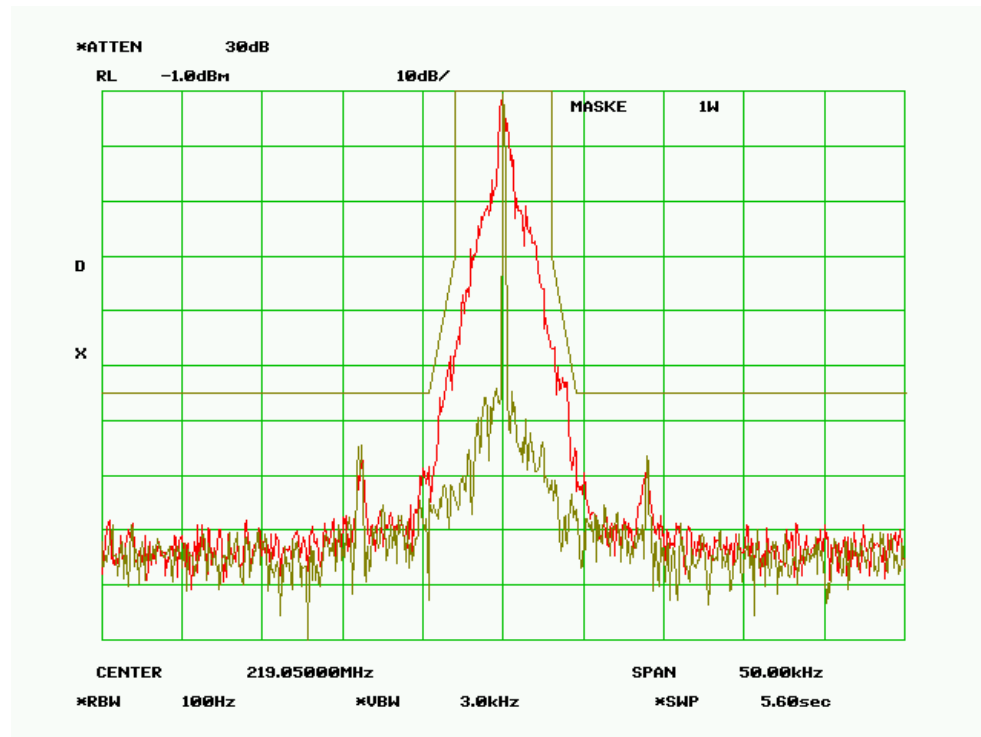
MASK E – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 3K30F1D
Data Rate = 4 kbps
PEAK DEVIATION = 1.15 kHz



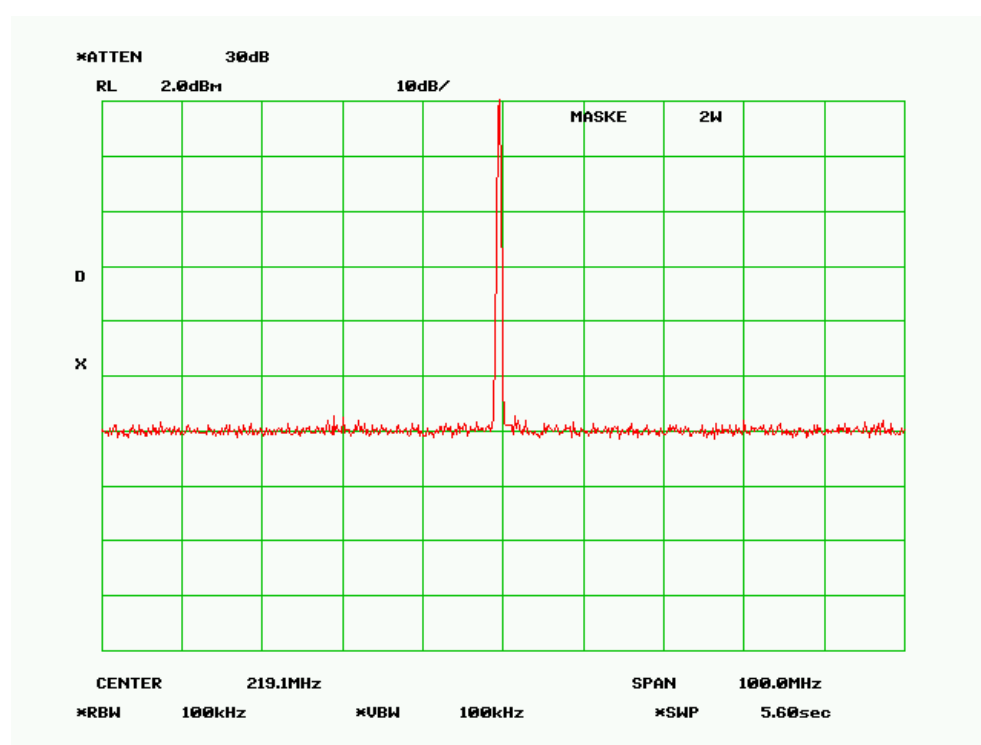
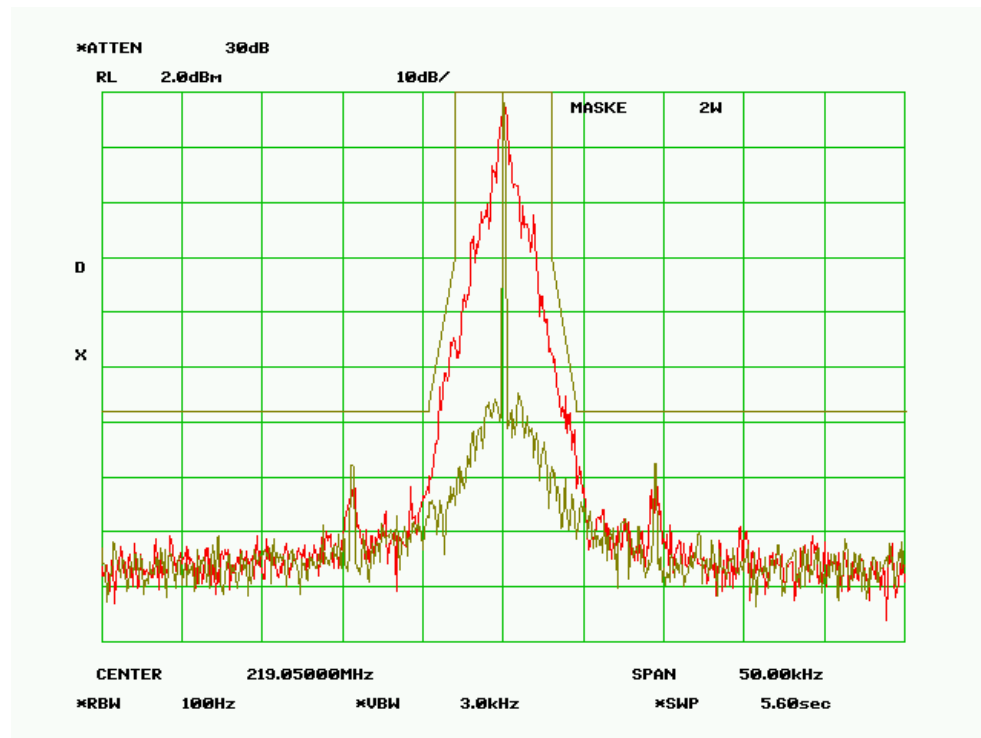
MASK E – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 3K30F1D
Data Rate = 4 kbps
PEAK DEVIATION = 1.15 kHz



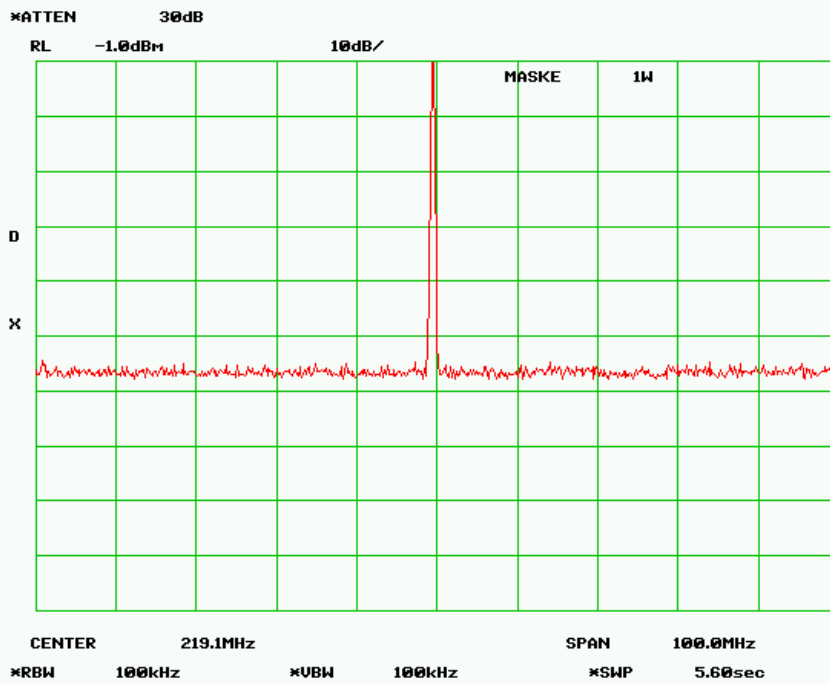
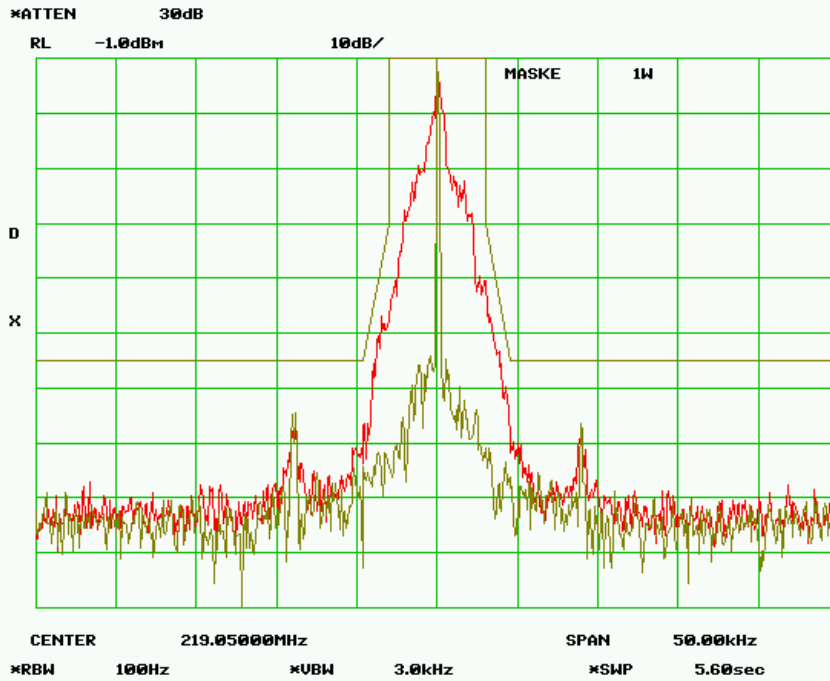
MASK E – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 3K55F1D
Data Rate = 8 kbps
PEAK DEVIATION = 1.09 kHz



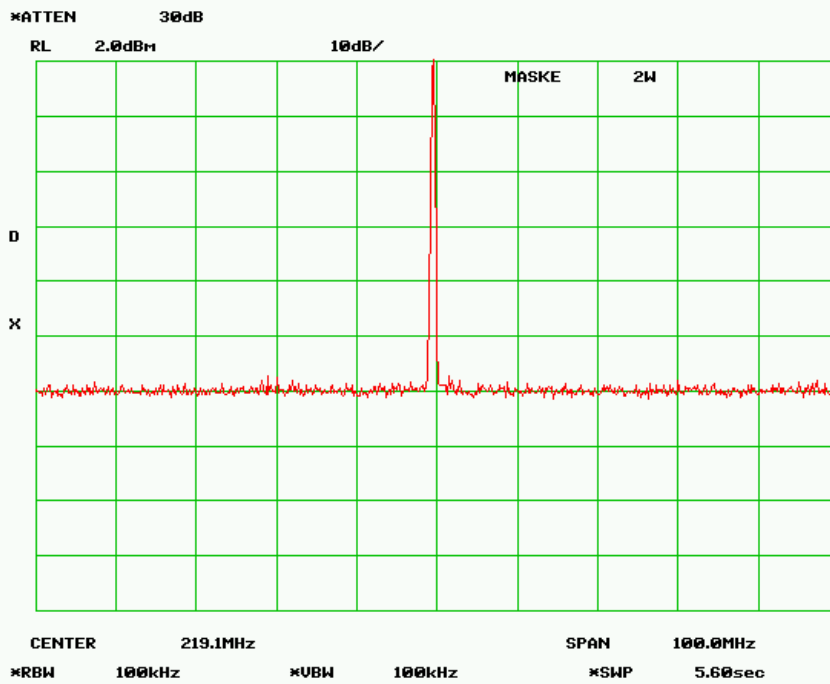
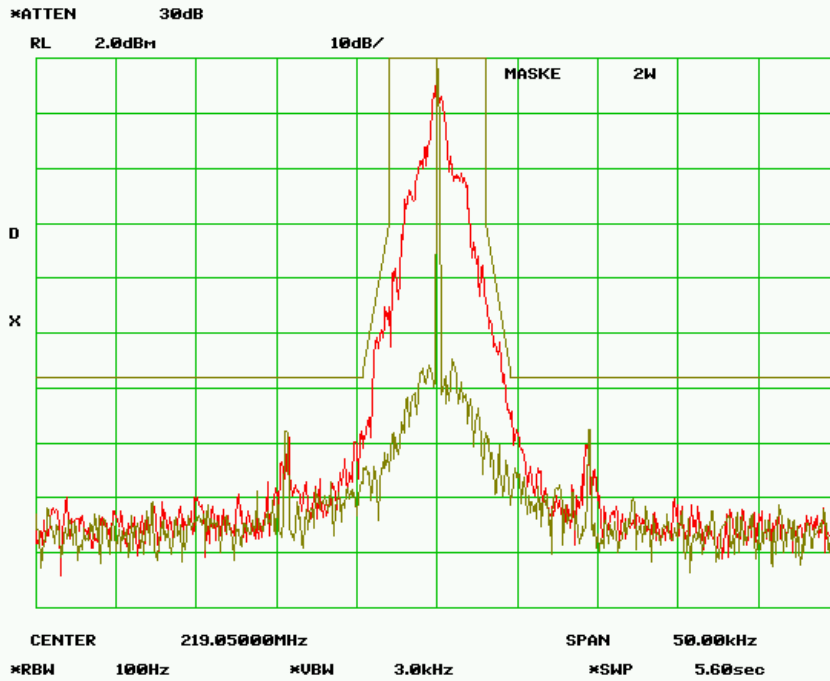
MASK E – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 3K55F1D
Data Rate = 8 kbps
PEAK DEVIATION = 1.09 kHz



MASK E – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 3K20F1D
Data Rate = 12 kbps
PEAK DEVIATION = 1.15 kHz



MASK E – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 3K20F1D
Data Rate = 12 kbps
PEAK DEVIATION = 1.15 kHz



8.0 Part 80.211(f) – 11.25 kHz ABW

NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators
8K20F1D, 8K30F1D, 8K50F1D and 8K08F1D

RULE PART NUMBER: FCC: 2.202, 80.211 (f): 80.215, 80.481
12 Watts and 1.0 Watt Part 80 216-220 MHz.

MINIMUM STANDARDS: **Part 80.211(f)**
Sidebands and Spurious [Rule 80.211 (f) P = 12 Watts and P=1 Watt]
Authorized Bandwidth = 11.25 kHz
On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;
On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and
On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10logP (mean power in watts) dB.

Attenuation = 0 dB at Fo to 5.625 kHz
Attenuation = 25 dB at 5.625 kHz
Attenuation = 35 dB at 11.25 kHz
Attenuation = 43 dB at 28.125 kHz
Attenuation = 43 dB > 28.125 kHz @ 1 Watt
Attenuation = 53.8 dB > 28.125 kHz @ 12 Watt

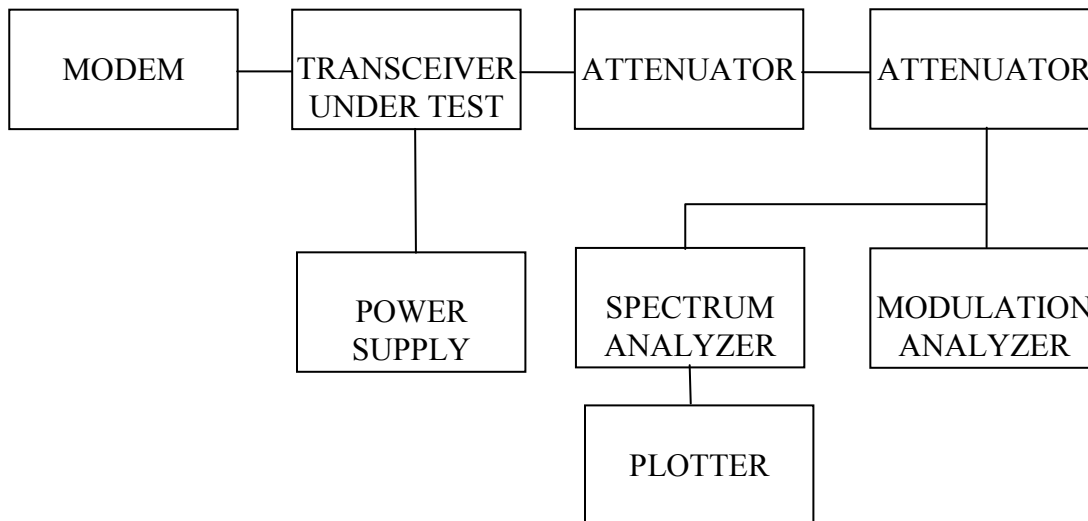
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C
RF Power Level = 1 Watt and 12 Watts
Voltage = 20VDC

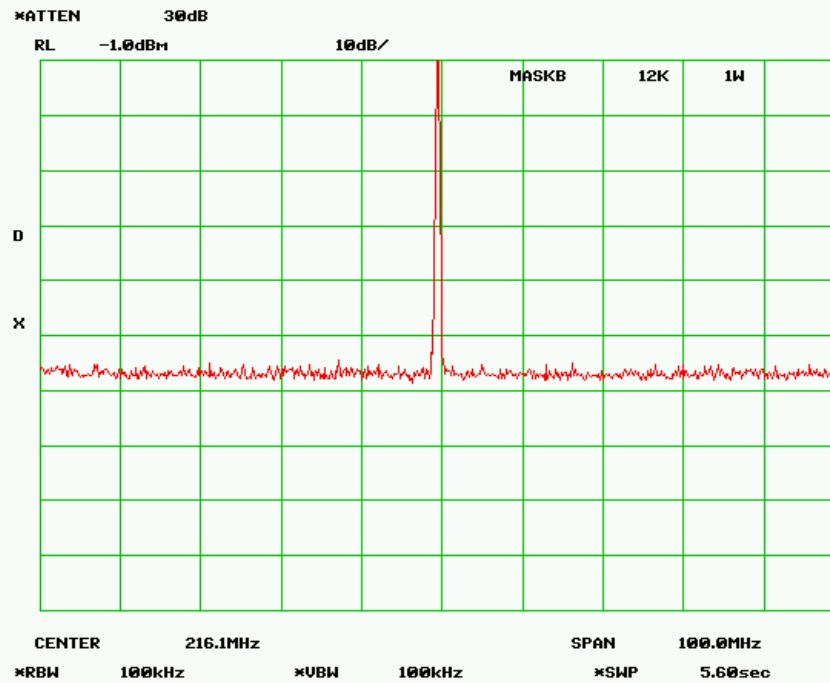
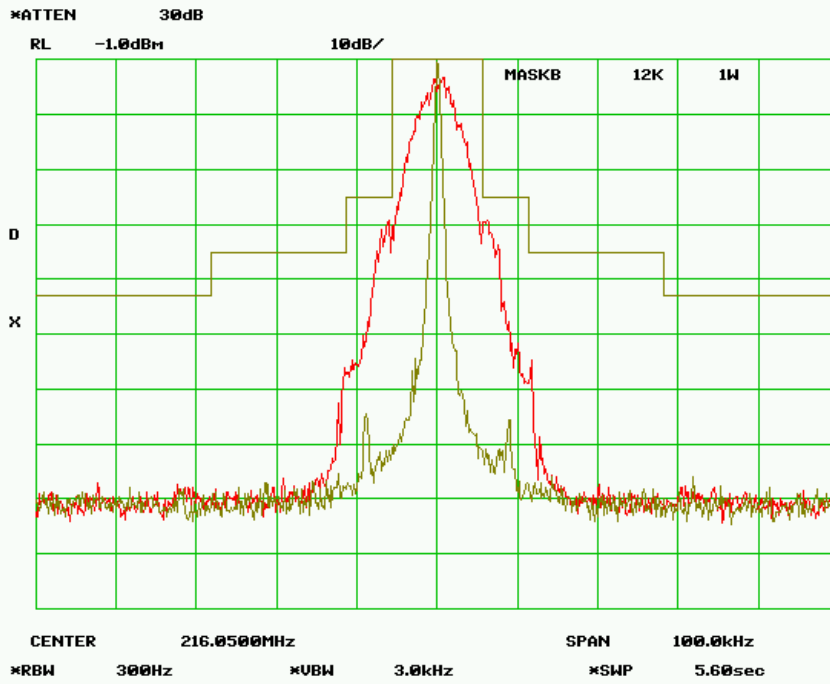
TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13, 3.2.11.2

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
50-Ohm Attenuator, Pasternack Model PE7002-10 (10dB)
DC Power Supply, Hewlett Packard Model 6653A
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901B

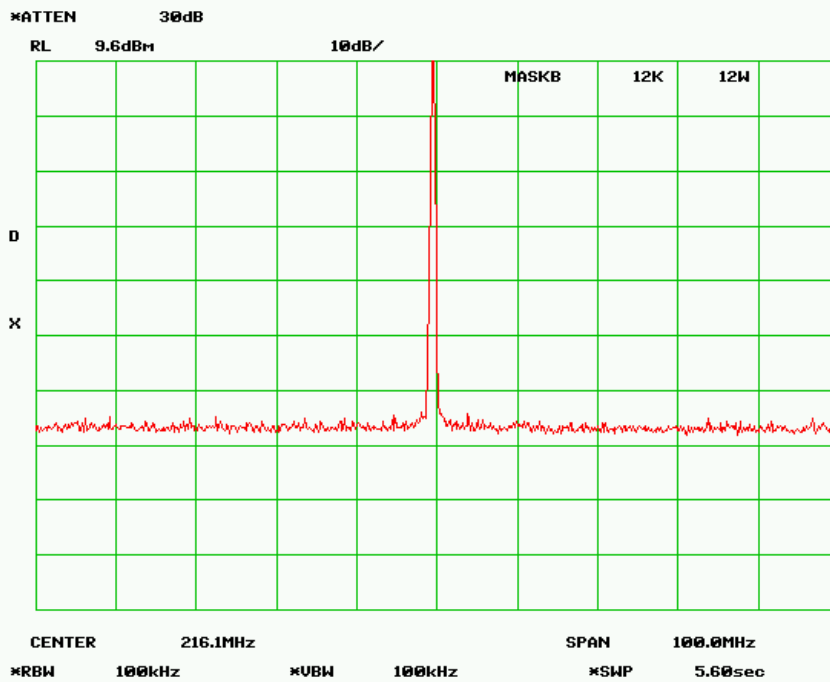
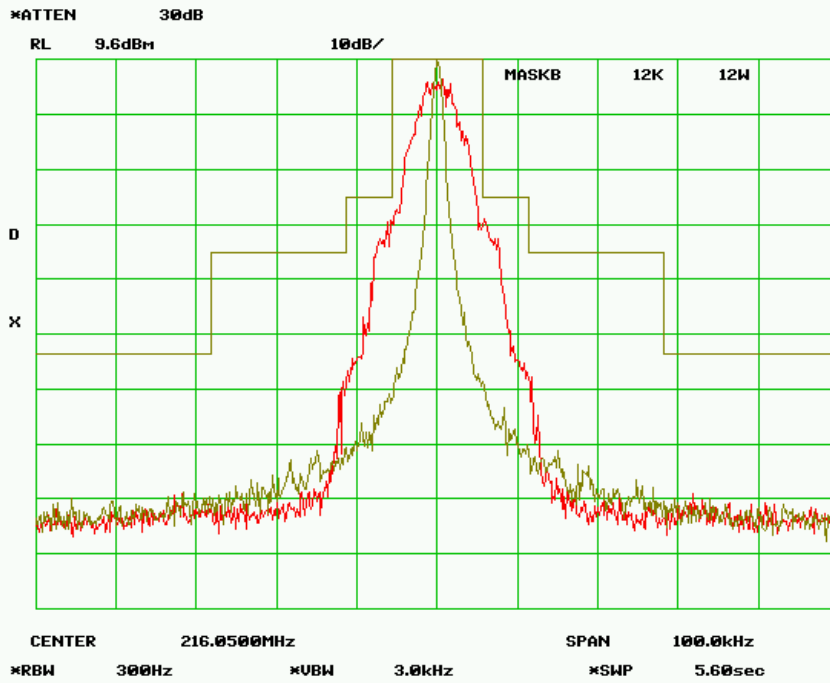
TEST SET-UP:



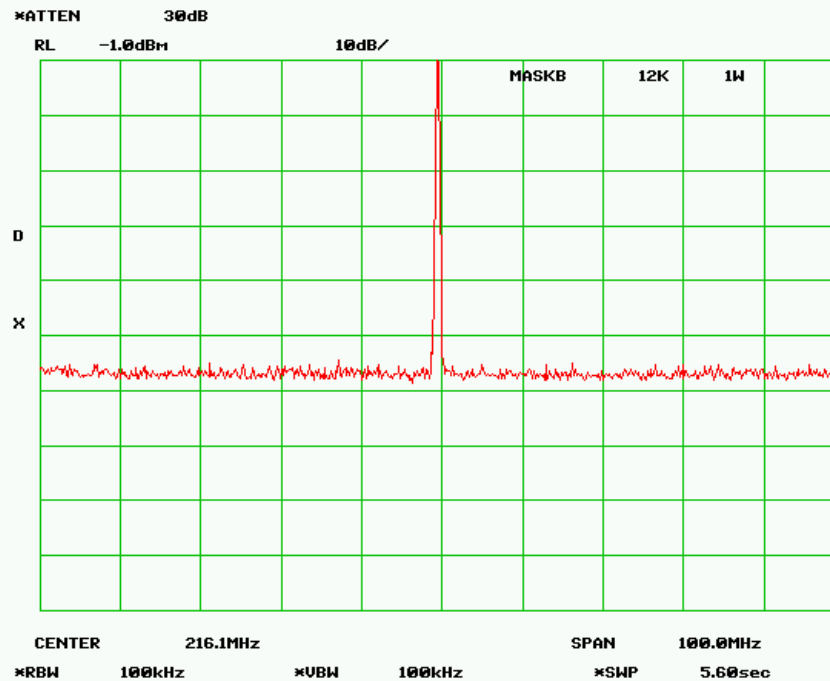
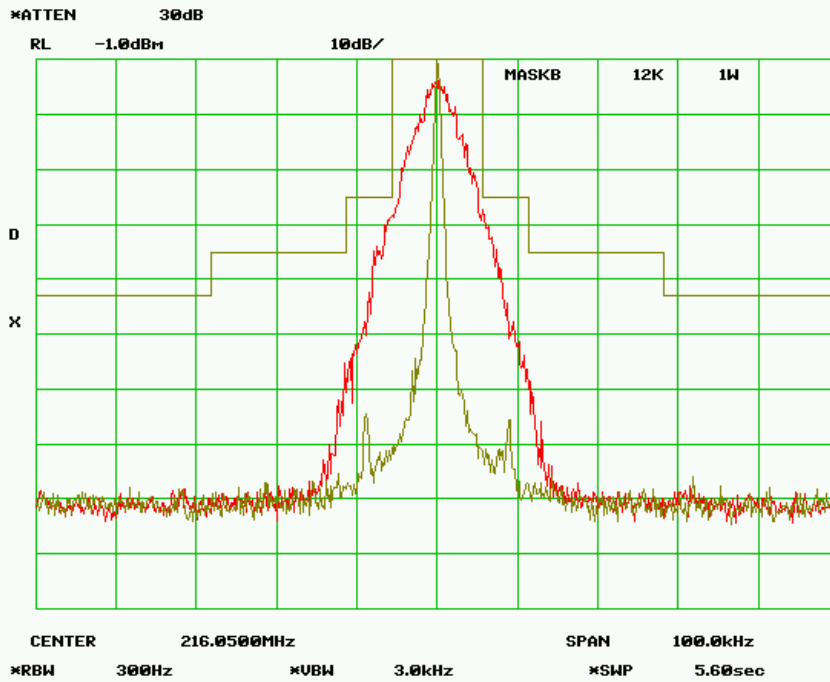
MASK B - 11.25 kHz – 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 8K20F1D
 Data Rate = 8 kbps
 PEAK DEVIATION = 3.05 kHz



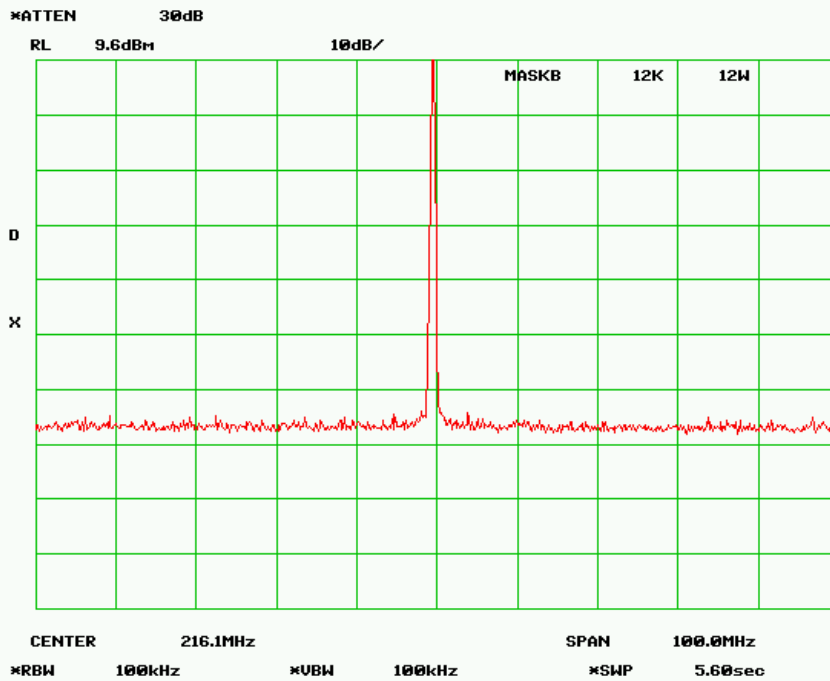
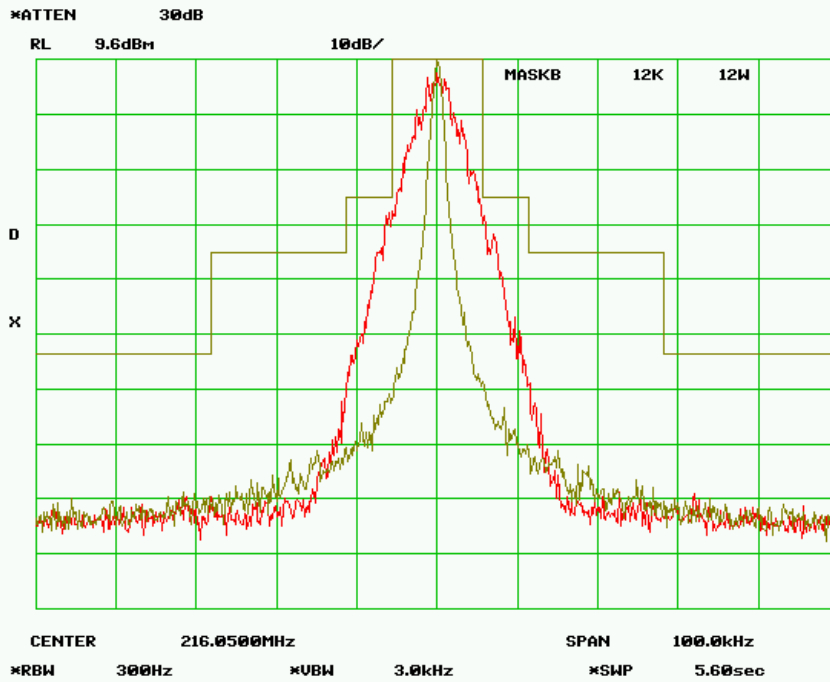
MASK B - 11.25 kHz – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 8K20F1D
 Data Rate = 8 kbps
 PEAK DEVIATION = 3.05 kHz



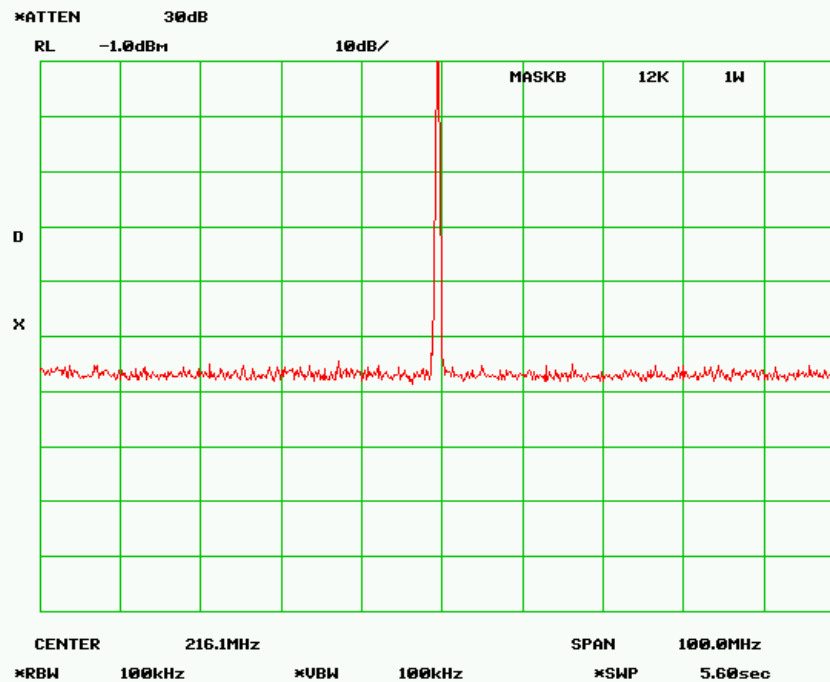
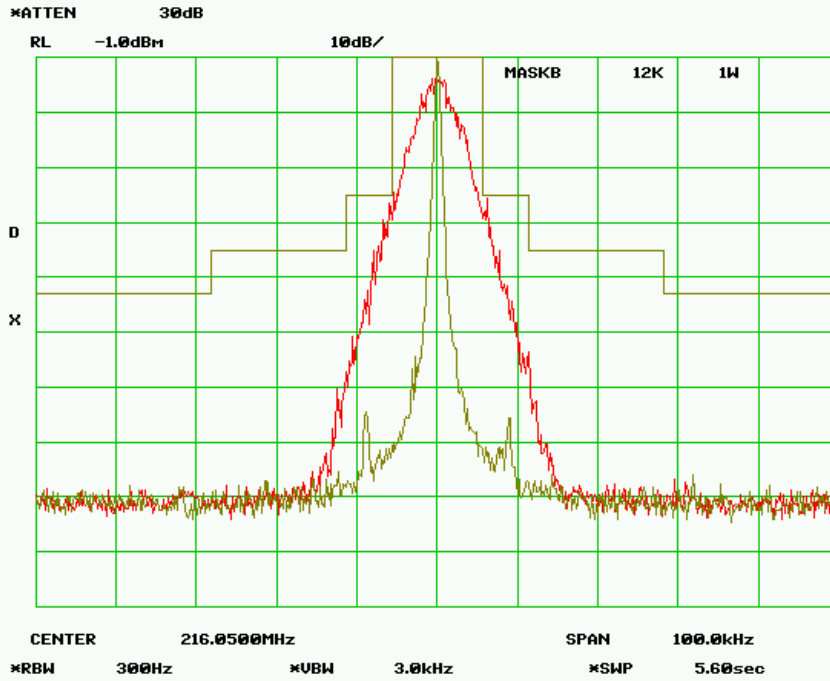
MASK B - 11.25 kHz – 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 8K30F1D
 Data Rate = 16 kbps
 PEAK DEVIATION = 3.70 kHz



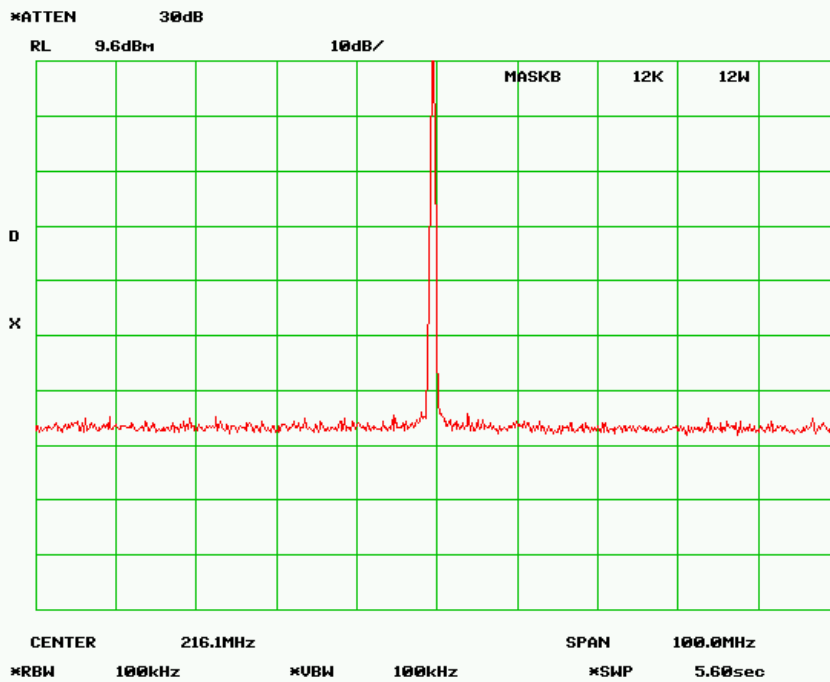
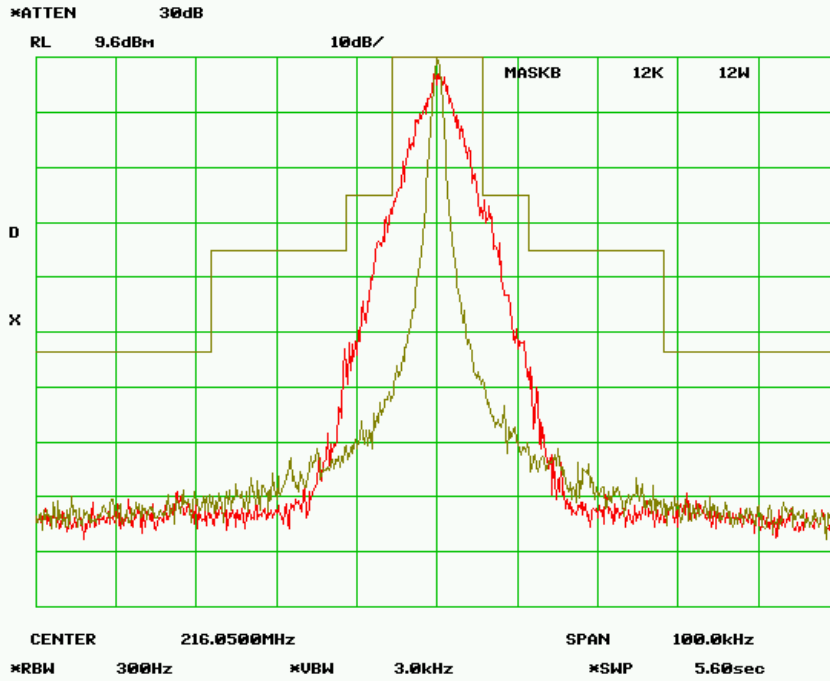
MASK B - 11.25 kHz – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 8K30F1D
 Data Rate = 16 kbps
 PEAK DEVIATION = 3.70 kHz



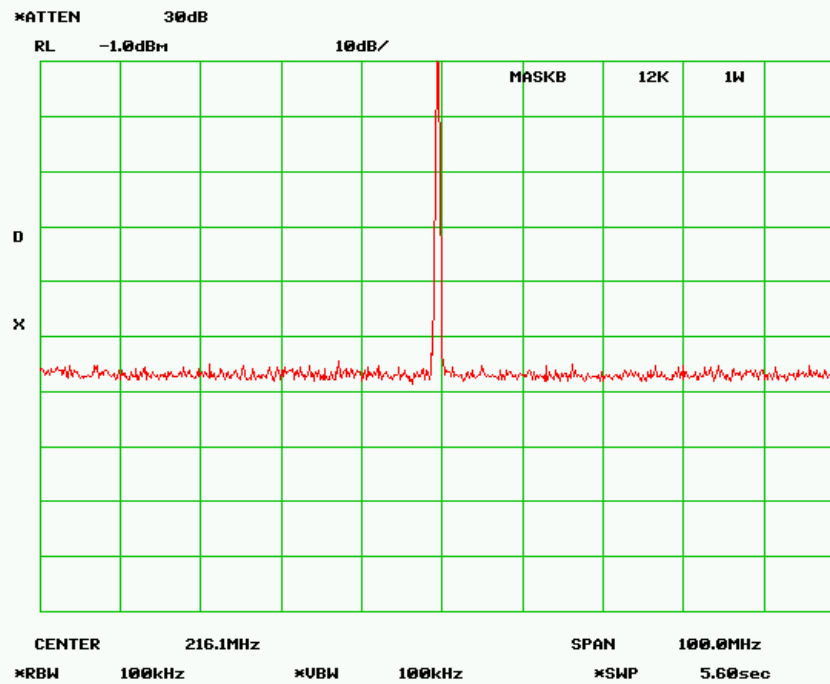
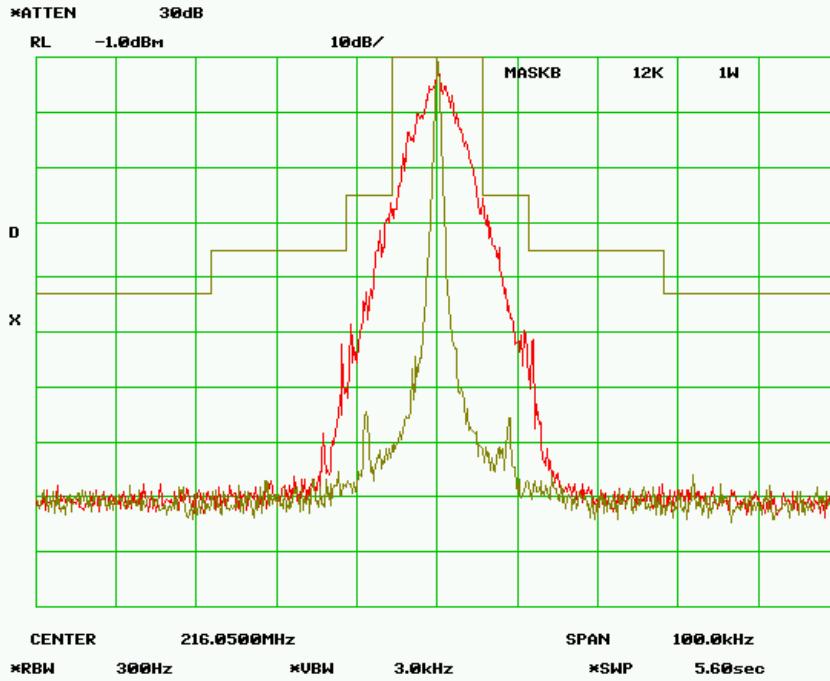
MASK B - 11.25 kHz – 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 8K50F1D
 Data Rate = 24 kbps
 PEAK DEVIATION = 3.725 kHz



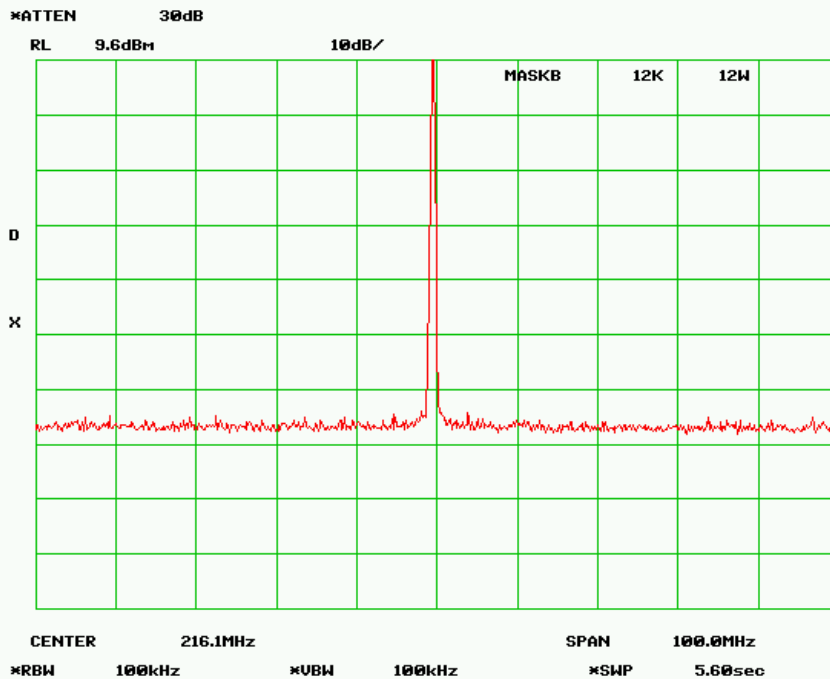
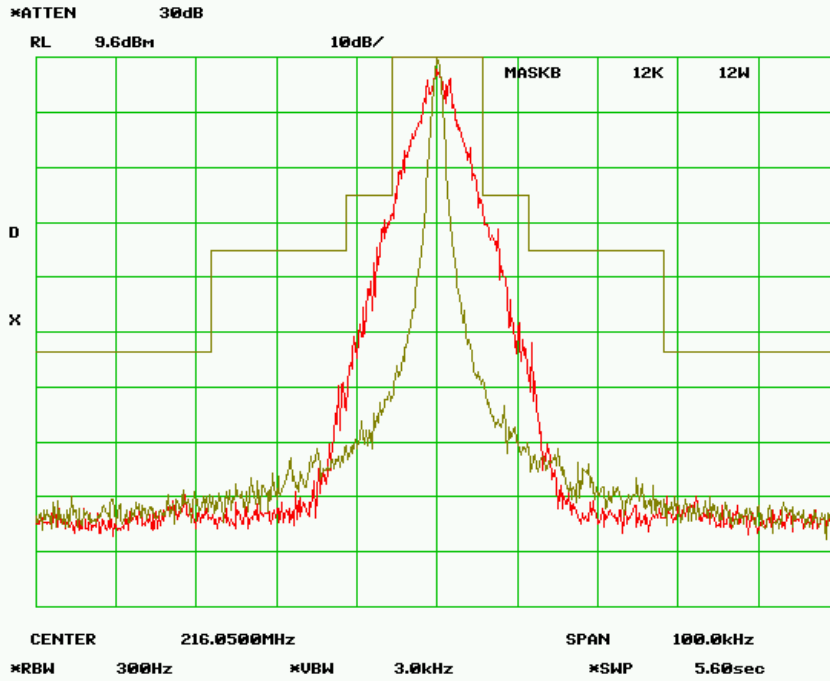
MASK B - 11.25 kHz – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 8K50F1D
 Data Rate = 24 kbps
 PEAK DEVIATION = 3.725 kHz



MASK B - 11.25 kHz – 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 8K08F1D
 Data Rate = 32 kbps
 PEAK DEVIATION = 3.728 kHz



MASK B - 11.25 kHz – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 8K08F1D
 Data Rate = 32 kbps
 PEAK DEVIATION = 3.728 kHz



9.0 Mask D Part 90.259(a) 11.25 kHz ABW

NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators **8K20F1D, 8K30F1D, 8K50F1D and 8K08F1D**

RULE PART NUMBER: FCC: 2.202, 90.209 (b)(5), 90.210(d), 2.1049 (c) (1)
Data taken at 2 watts is to be applied to Part 90.259(a) (217-220 MHz).

MINIMUM STANDARDS: **Mask D**
Sidebands and Spurious [Rule 90.210 (d), P =2 Watts and P=1 Watt
Authorized Bandwidth = 11.25 kHz [Rule 90.209(b) (5)]
From Fo to 5.625 kHz ,down 0 dB.
Greater than 5.625 kHz to 12.5 kHz, down 7.27($f_d-2.88\text{kHz}$) dB.
Greater than 12.5 kHz, at least 50+10log₁₀(P) or 70 dB, whichever is the lesser attenuation.

Attenuation = 0 dB at Fo to 5.625 kHz
Attenuation = 20 dB at 5.625 kHz and 70 dB at 12.5 kHz
Attenuation = 70 dB at 12.5 kHz
Attenuation = 53 dB at frequencies greater than 12.5 kHz @ 2 W
Attenuation = 50 dB at frequencies greater than 12.5 kHz @ 1 W

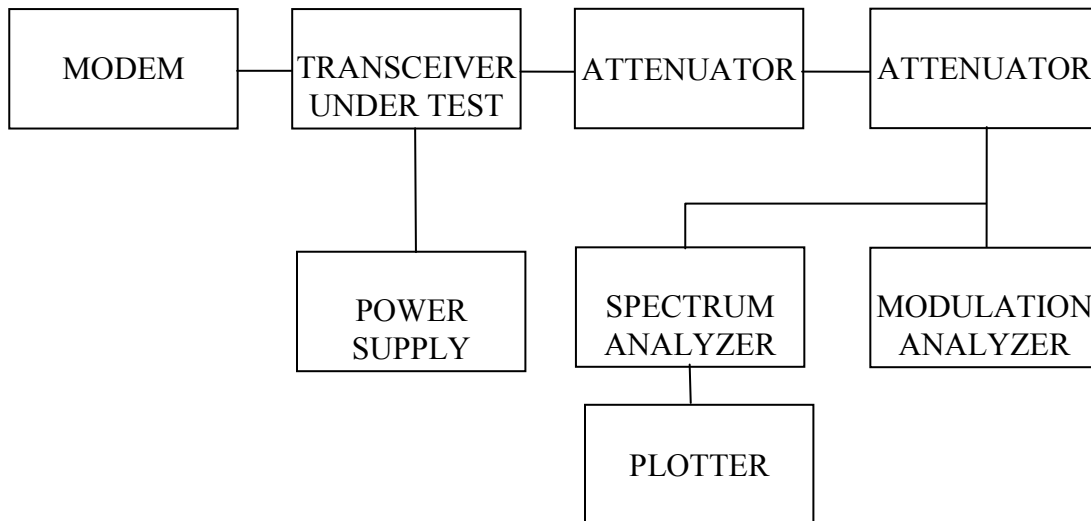
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C
RF Power Level = 1 Watt and 2 Watts
Voltage = 20VDC

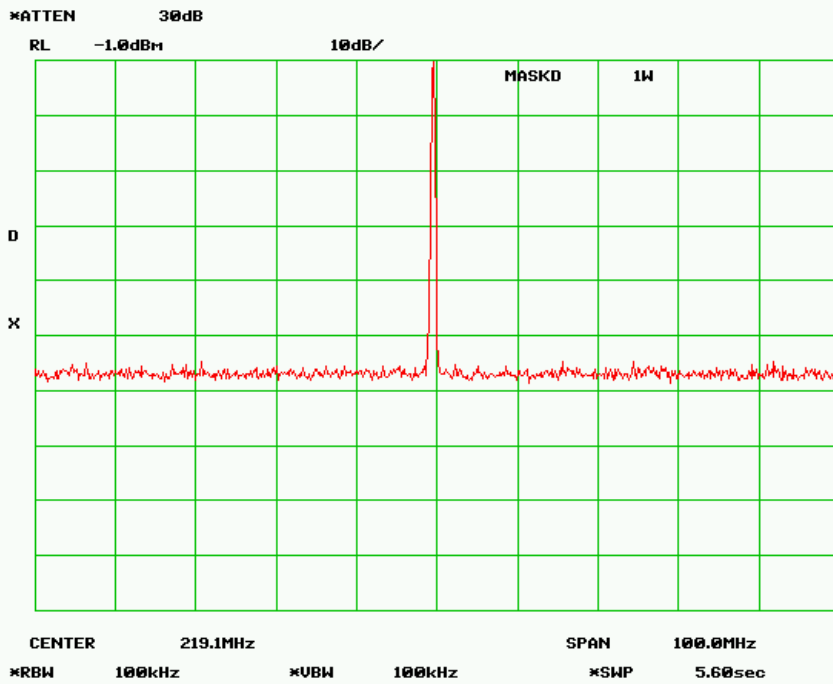
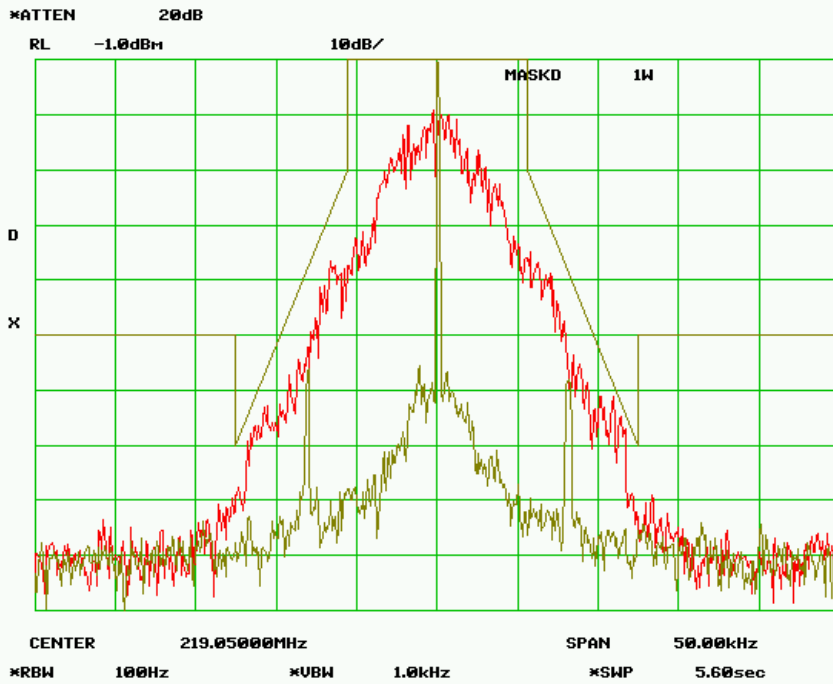
TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13, 3.2.11.2

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
50-Ohm Attenuator, Pasternack Model PE7002-10 (10dB)
DC Power Supply, Hewlett Packard Model 6653A
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901B

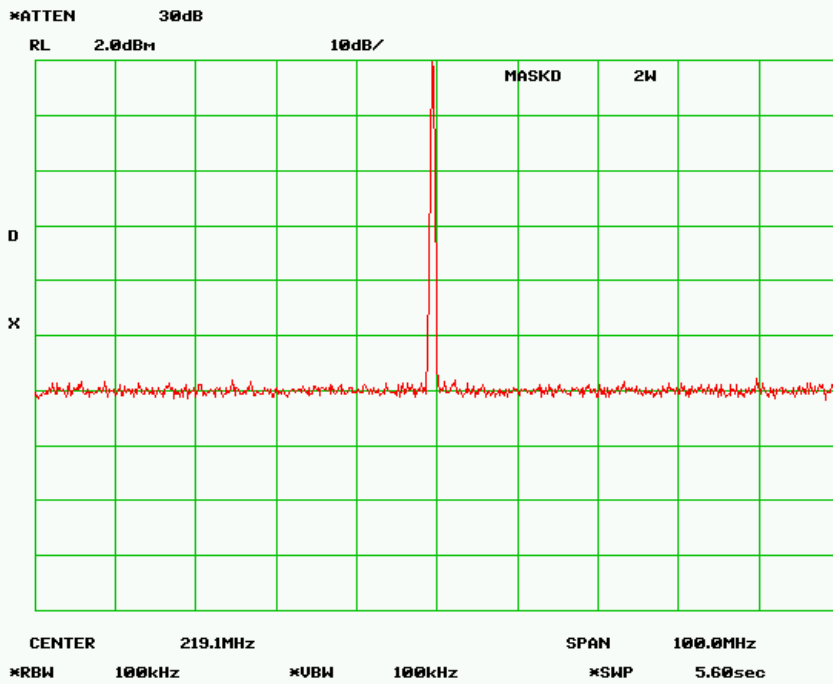
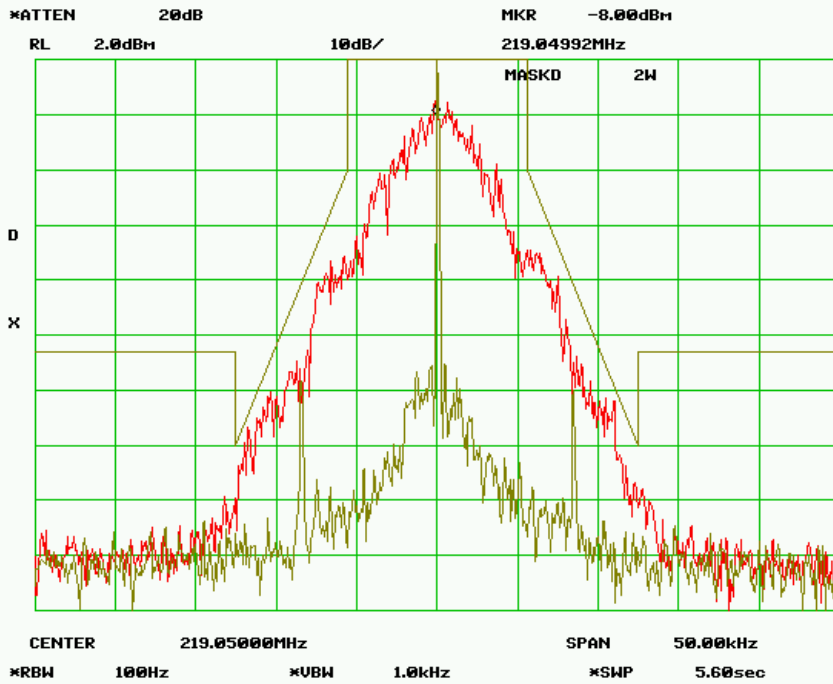
TEST SET-UP:



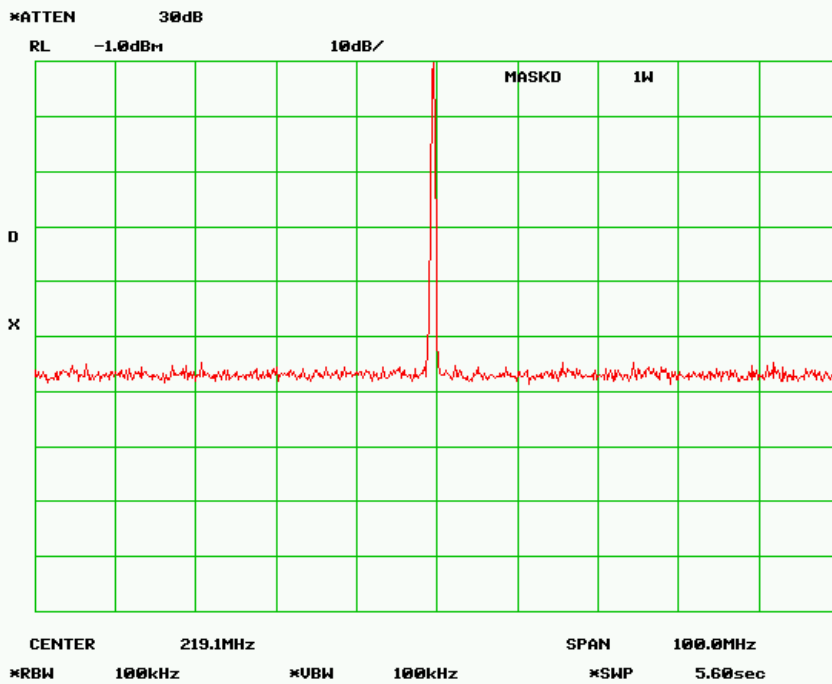
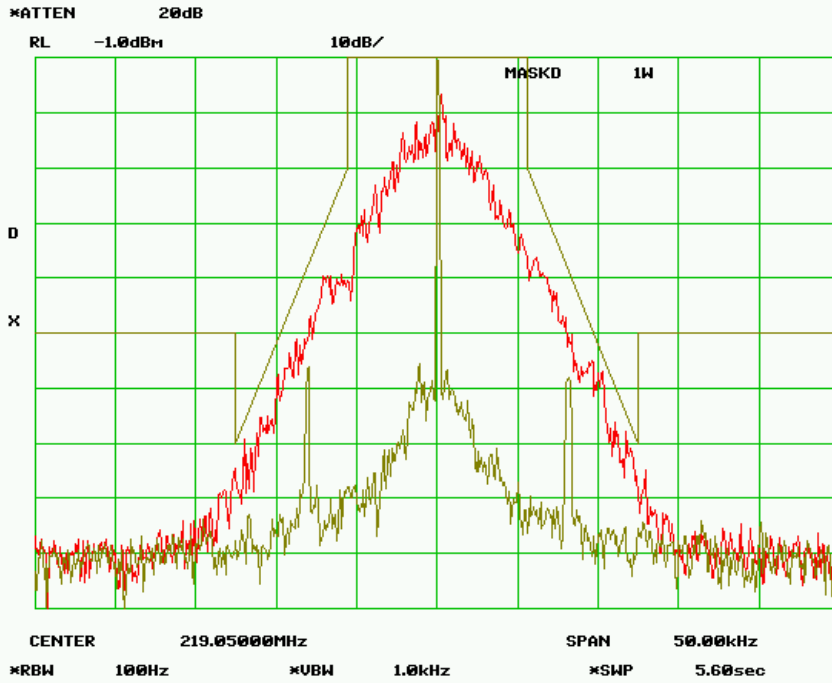
MASK D – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 8K20F1D
 Data Rate = 8 kbps
 PEAK DEVIATION = 3.05 kHz



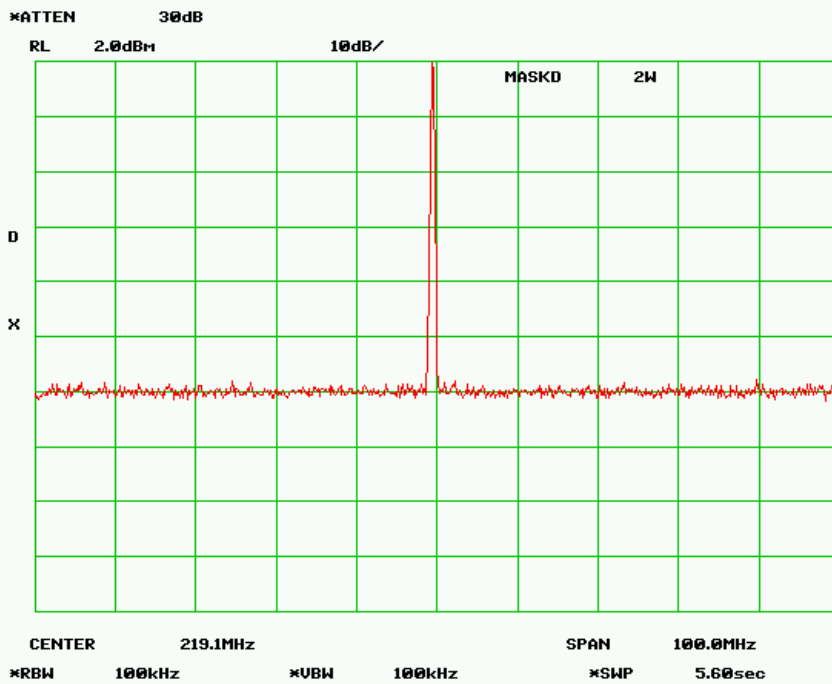
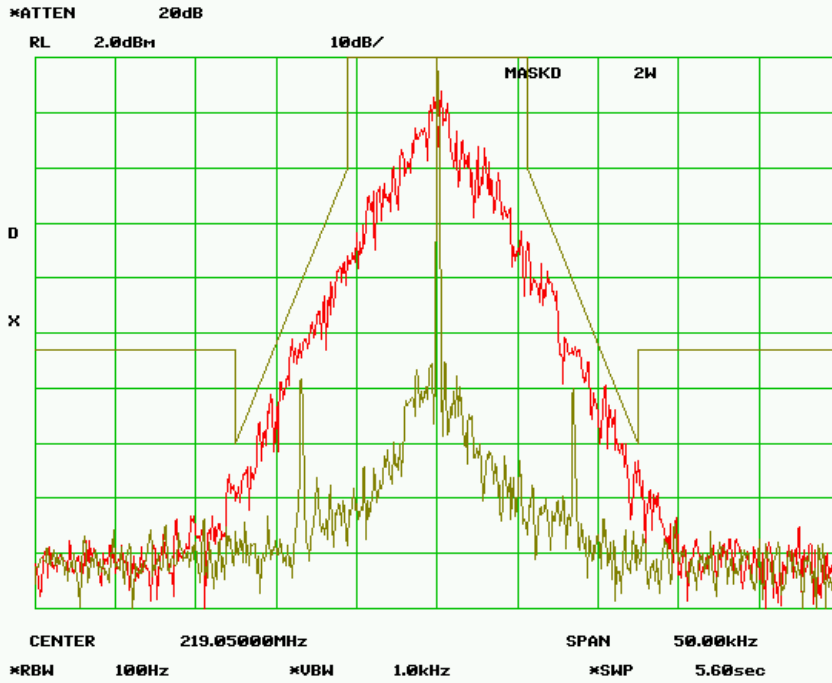
MASK D – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 8K20F1D
Data Rate = 8 kbps
PEAK DEVIATION = 3.05 kHz



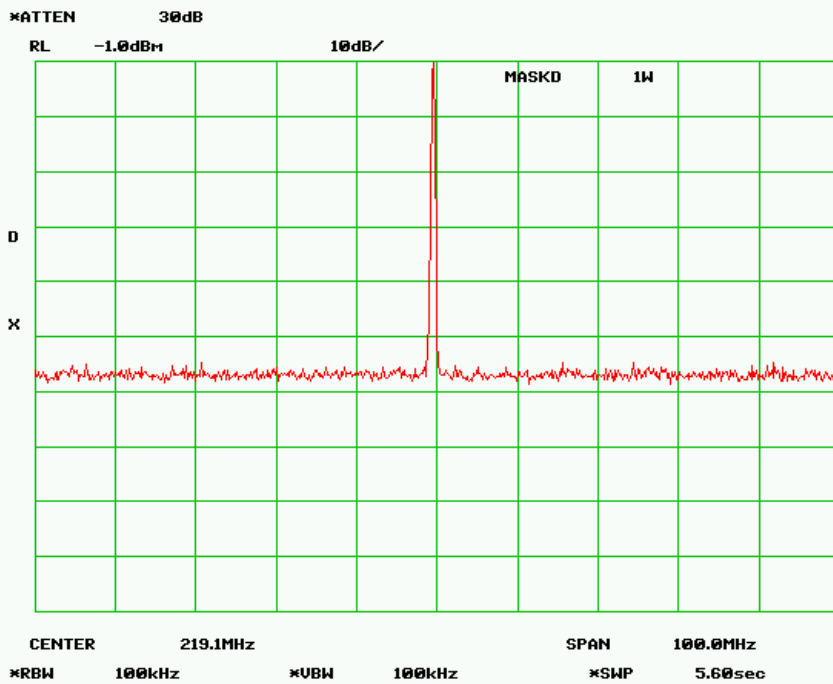
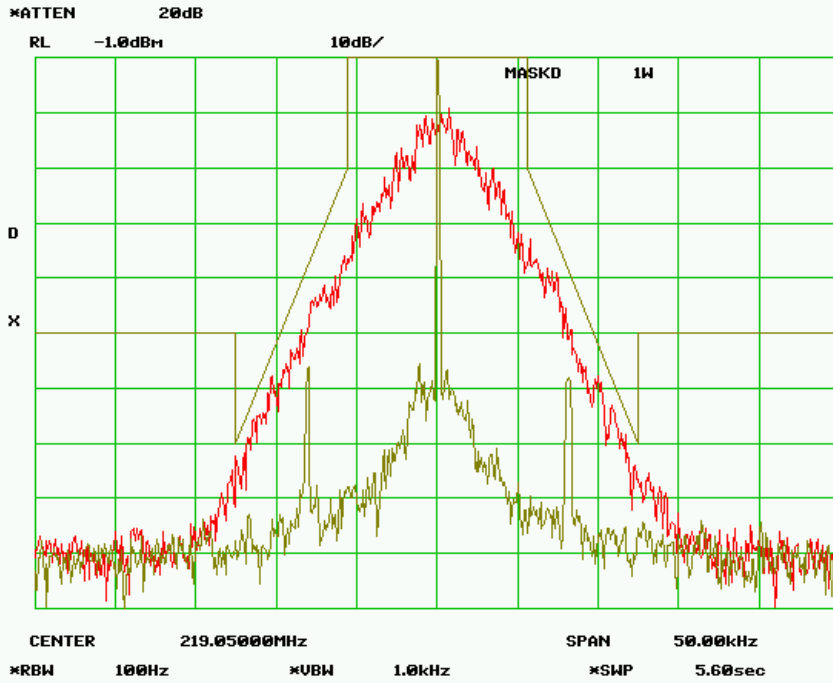
MASK D – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 8K30F1D
Data Rate = 16 kbps
PEAK DEVIATION = 3.70 kHz



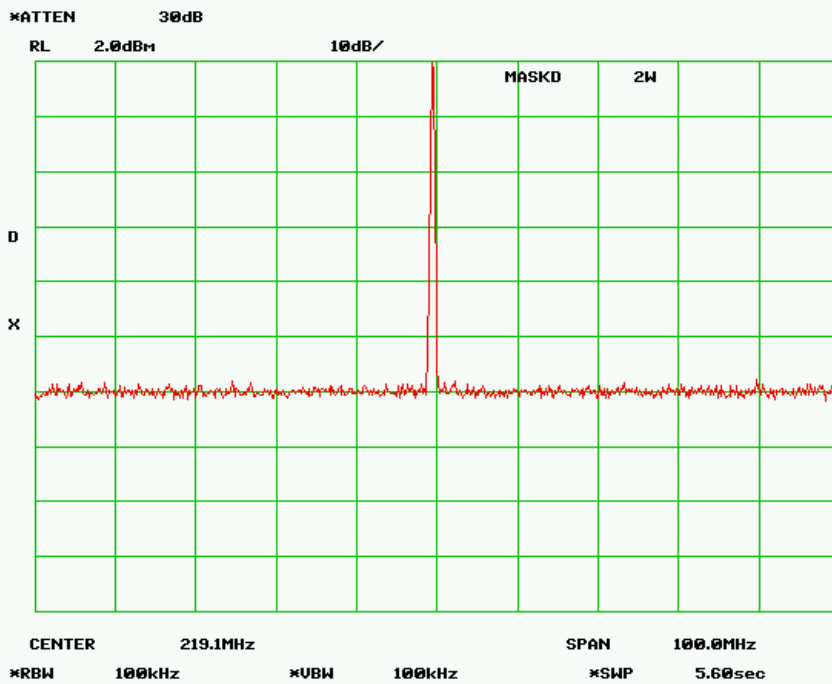
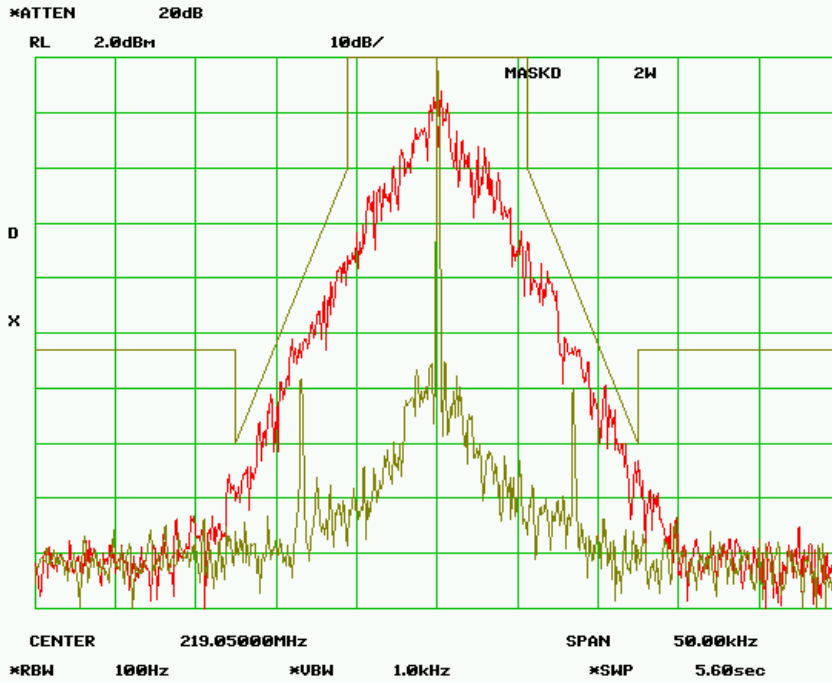
MASK D – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 8K30F1D
Data Rate = 16 kbps
PEAK DEVIATION = 3.70 kHz



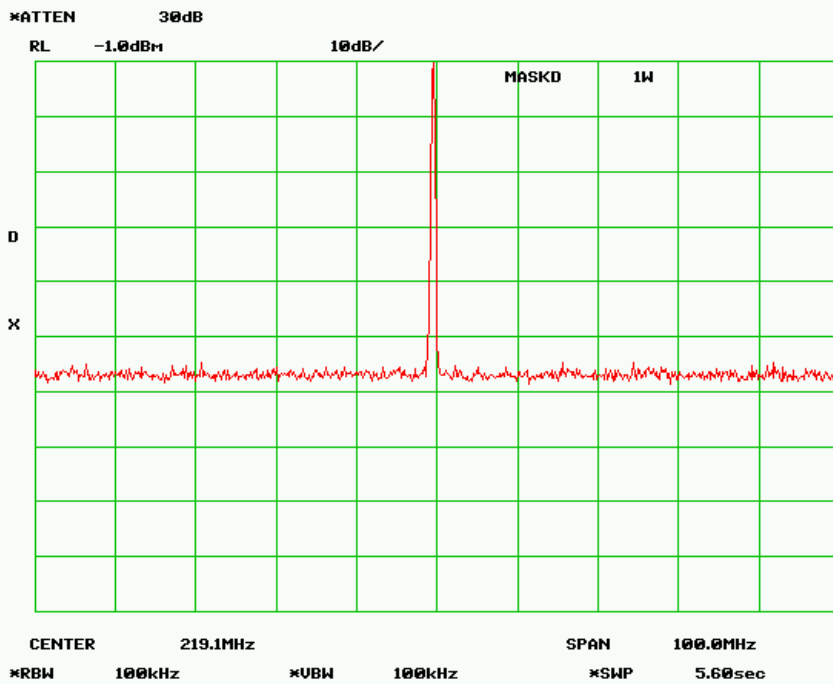
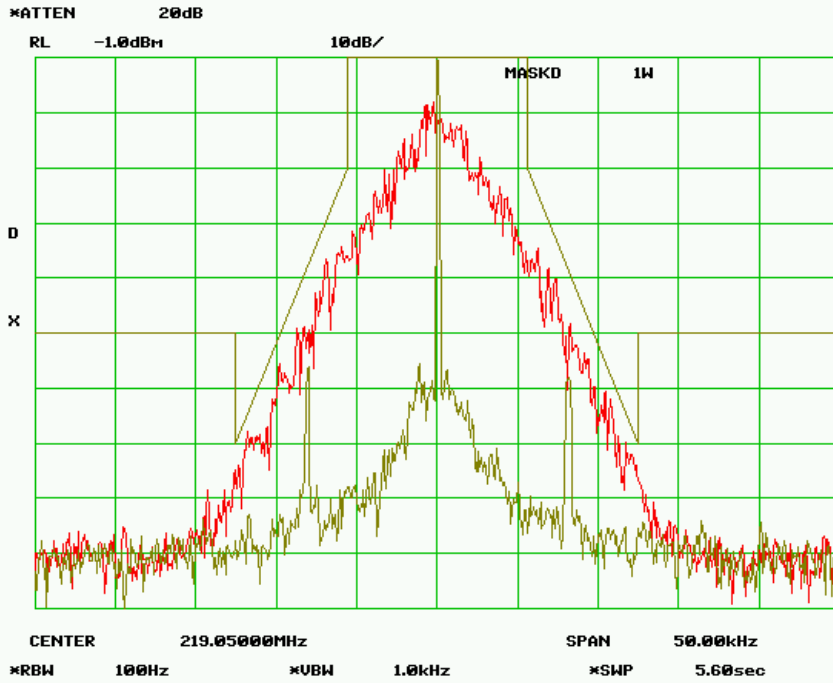
MASK D – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 8K50F1D
Data Rate = 24 kbps
PEAK DEVIATION = 3.725 kHz



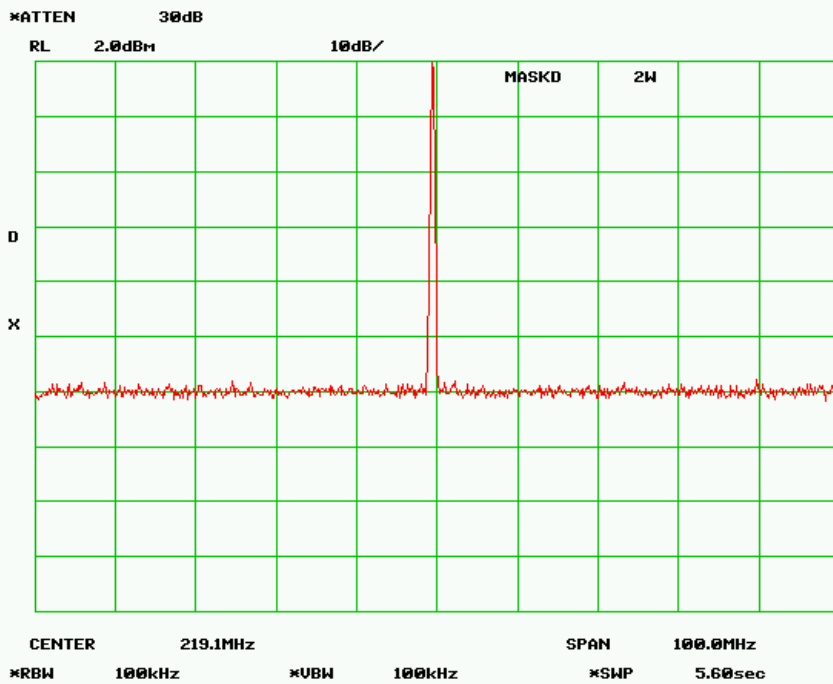
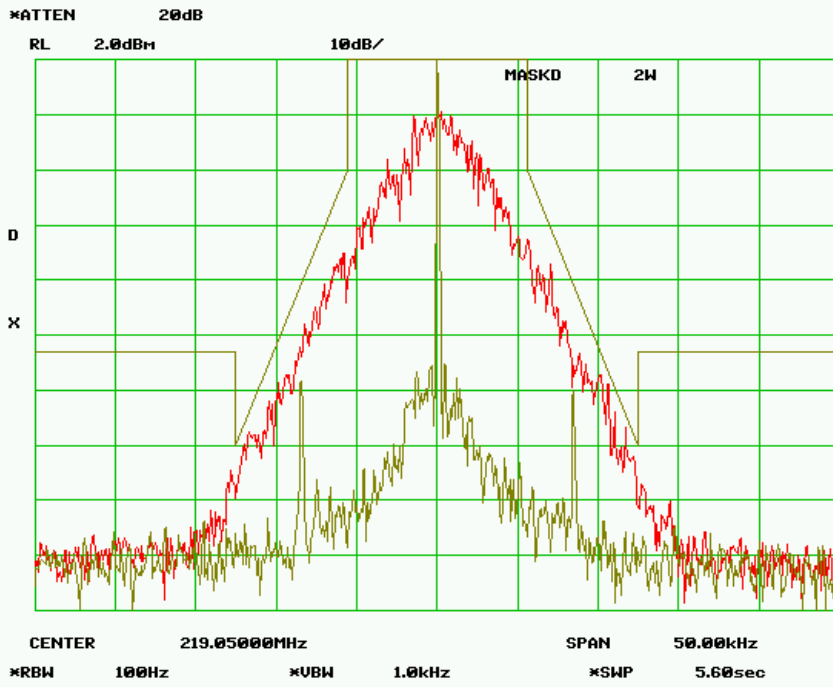
MASK D – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 8K50F1D
Data Rate = 24 kbps
PEAK DEVIATION = 3.725 kHz



MASK D – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 8K08F1D
Data Rate = 32 kbps
PEAK DEVIATION = 3.728 kHz



MASK D – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 8K08F1D
Data Rate = 32 kbps
PEAK DEVIATION = 3.728 kHz



10.0 Part 80.211(f) - 20 kHz ABW

NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designator
16K5F1D, 16K8F1D, 17K8F1D and 17K0F1D

RULE PART NUMBER: FCC: 2.202, 80.211 (f): 80.215, 80.481
12 Watts and 1.0 Watt Part 80 216-220 MHz.

MINIMUM STANDARDS: **Part 80.211(f)**
Sidebands and Spurious [Rule 80.211 (f) P = 12 Watts and P=1 Watt]
Authorized Bandwidth = 20 kHz
On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;
On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and
On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10logP (mean power in watts) dB.

Attenuation = 0 dB at Fo to 10.0 kHz
Attenuation = 25 dB at 10.0 kHz
Attenuation = 35 dB at 20.0 kHz
Attenuation = 43 dB at 50 kHz
Attenuation = 43 dB > 50 kHz @ 1 Watt
Attenuation = 53.8 dB > 50 kHz @ 12 Watt

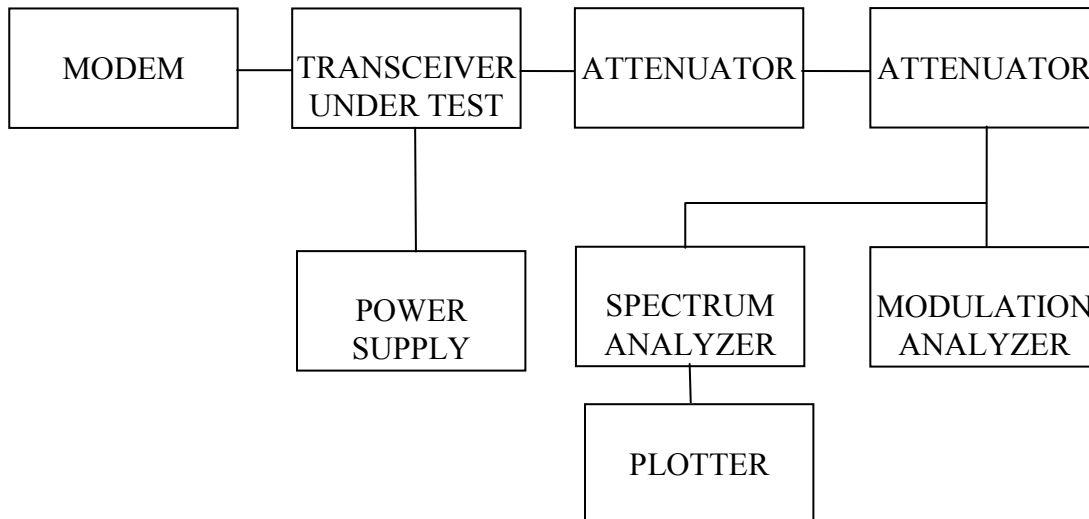
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C
RF Power Level = 1 Watt and 12 Watts
Voltage = 20VDC

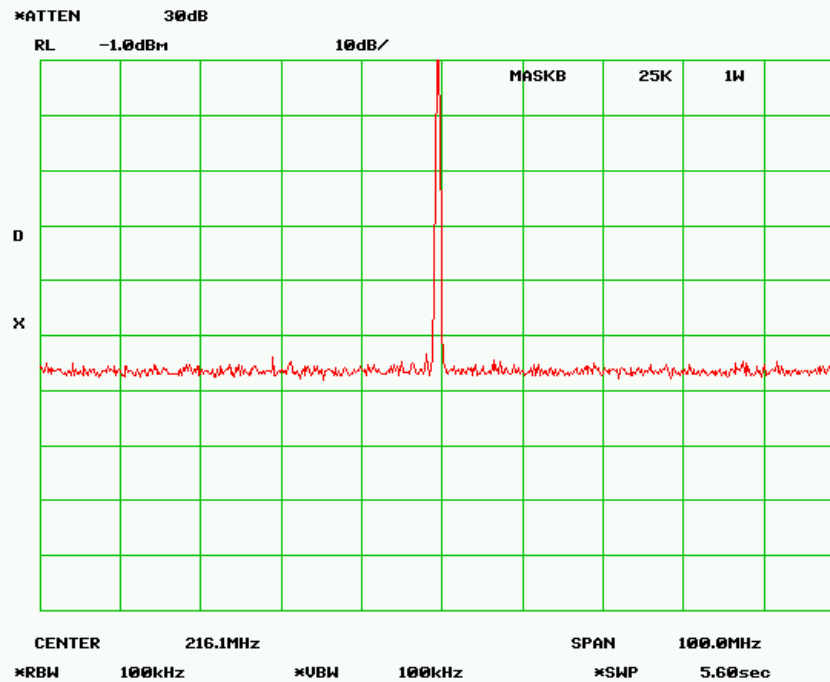
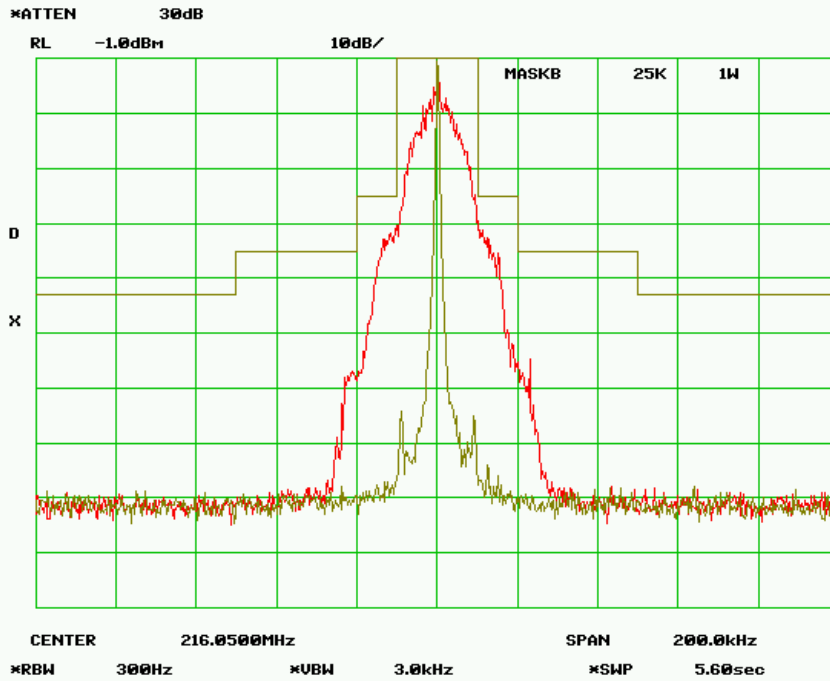
TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13, 3.2.11.2

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
50-Ohm Attenuator, Pasternack Model PE7002-10 (10dB)
DC Power Supply, Hewlett Packard Model 6653A
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901B

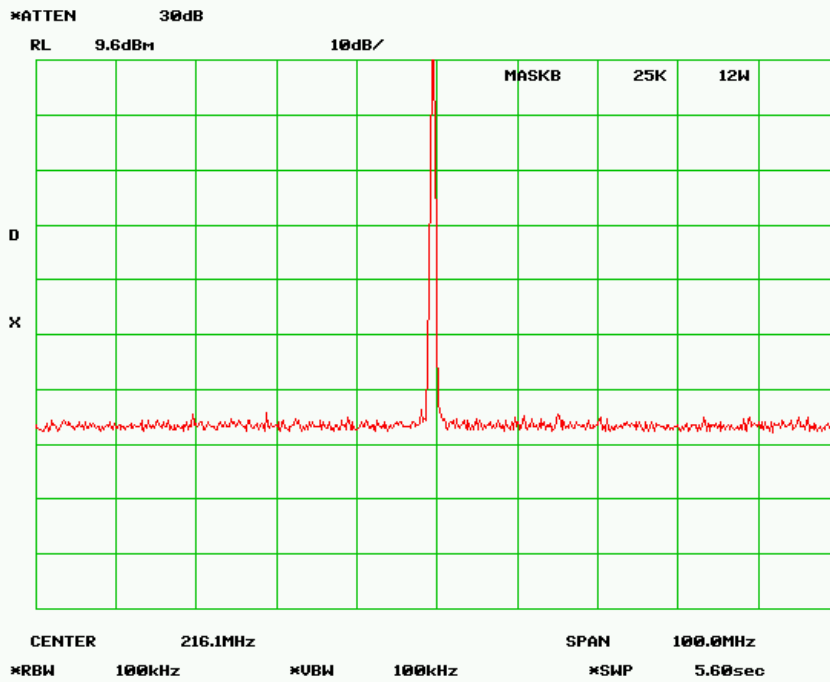
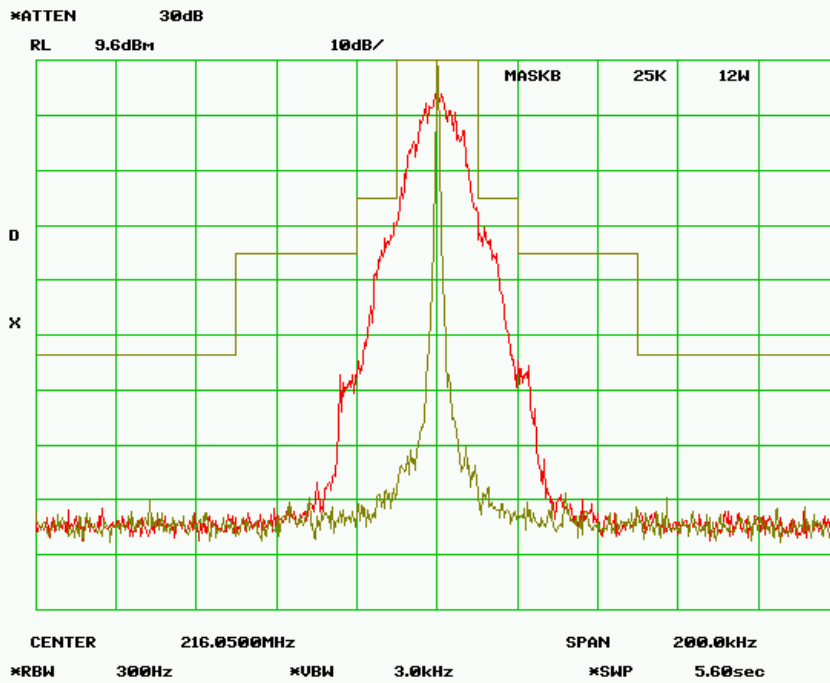
TEST SET-UP:



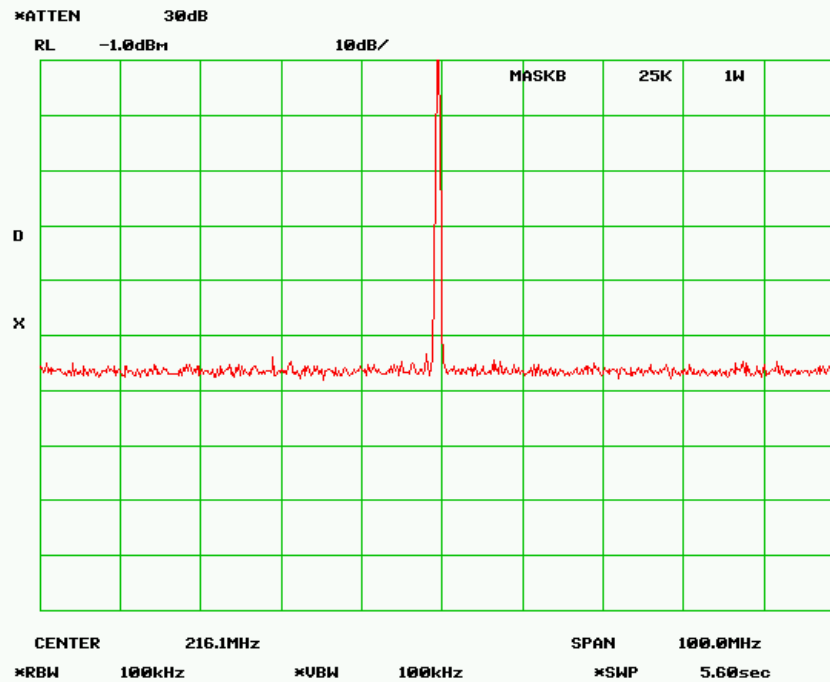
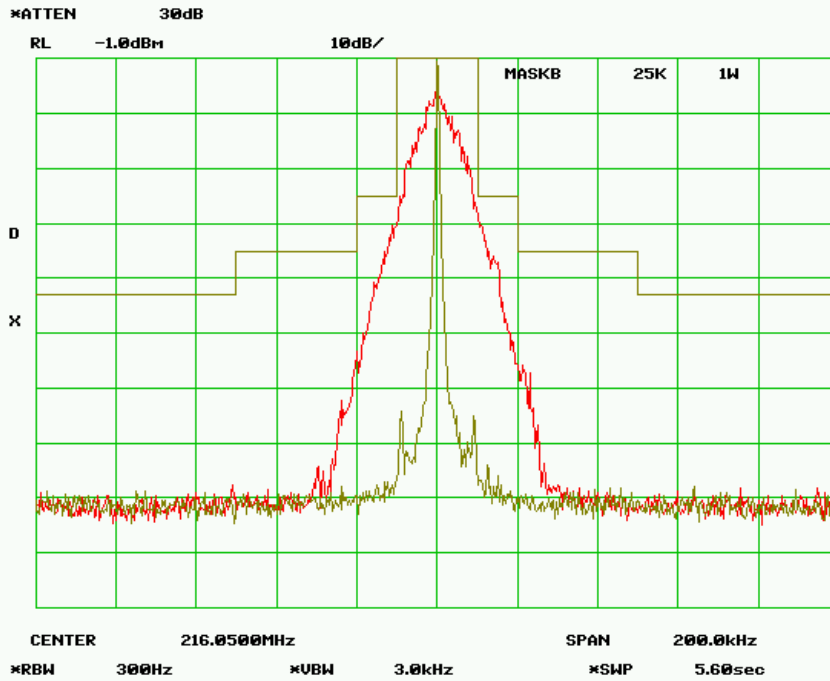
MASK B - 20 kHz – 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 16K5F1D
 Data Rate = 16 kbps
 PEAK DEVIATION = 6.30 kHz



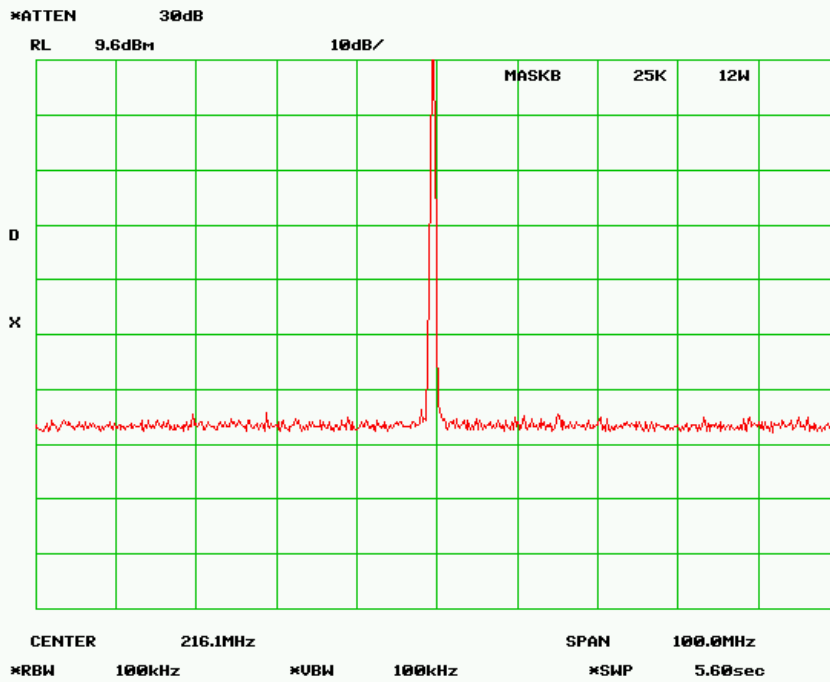
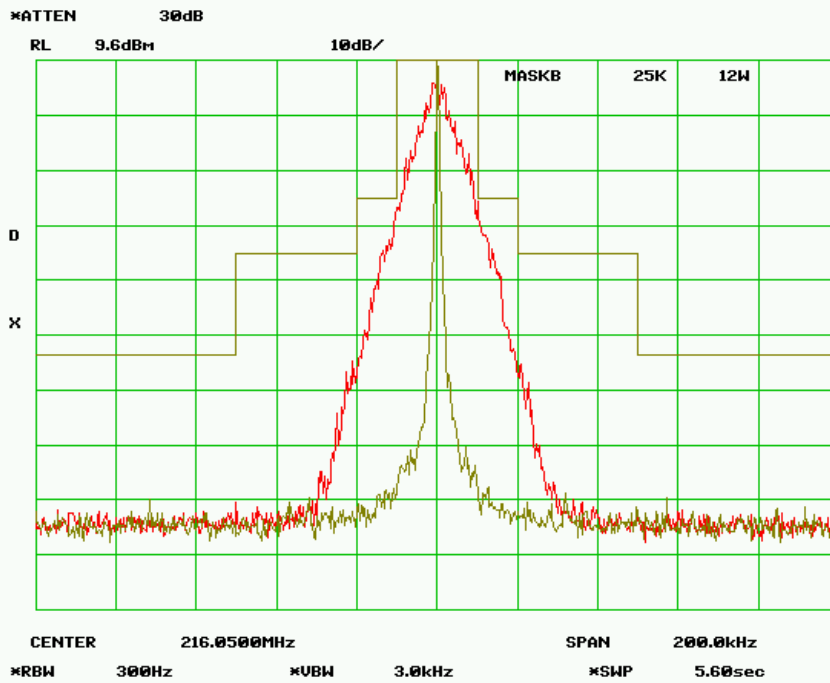
MASK B - 20 kHz – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 16K5F1D
 Data Rate = 16 kbps
 PEAK DEVIATION = 6.30 kHz



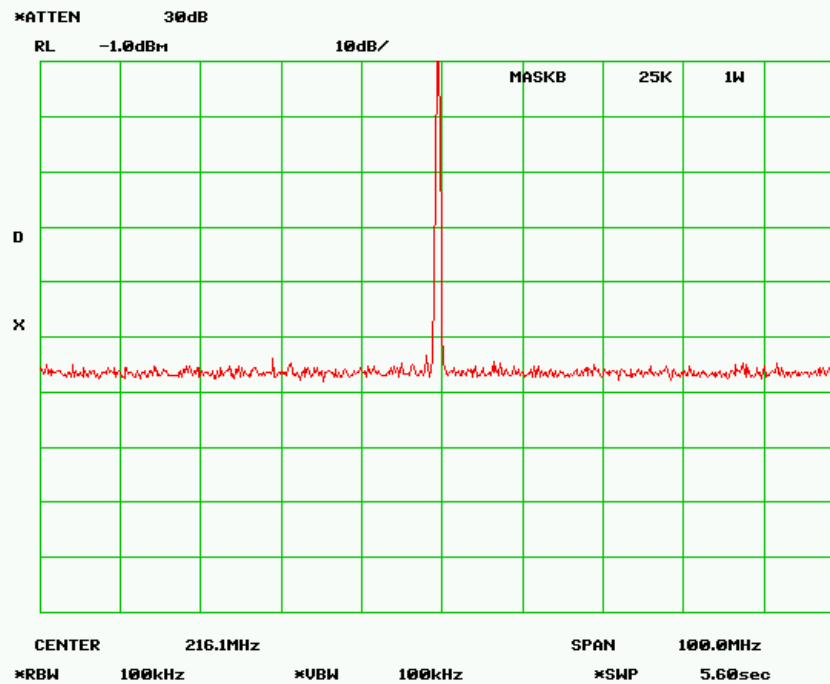
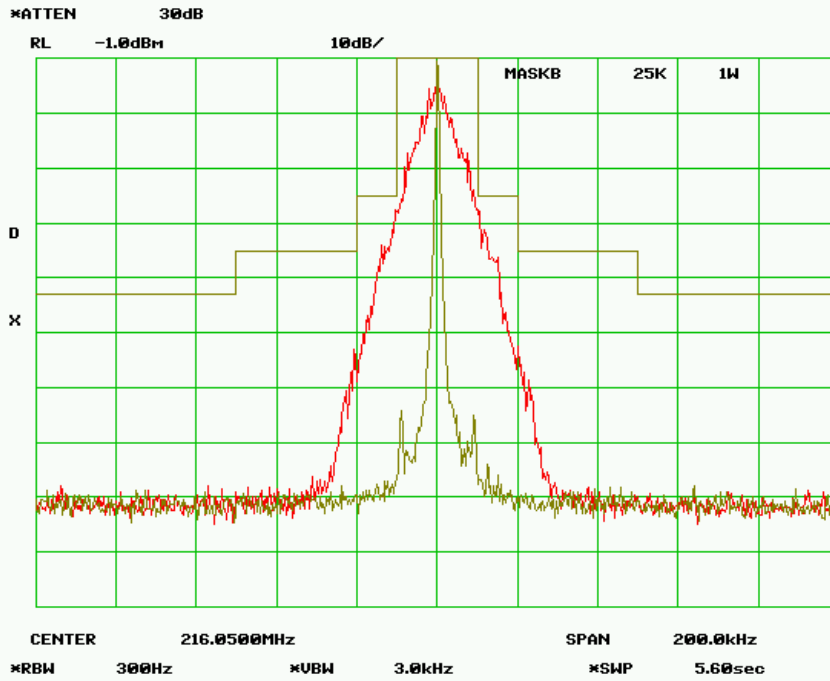
MASK B - 20 kHz – 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 16K8F1D
 Data Rate = 32 kbps
 PEAK DEVIATION = 6.30 kHz



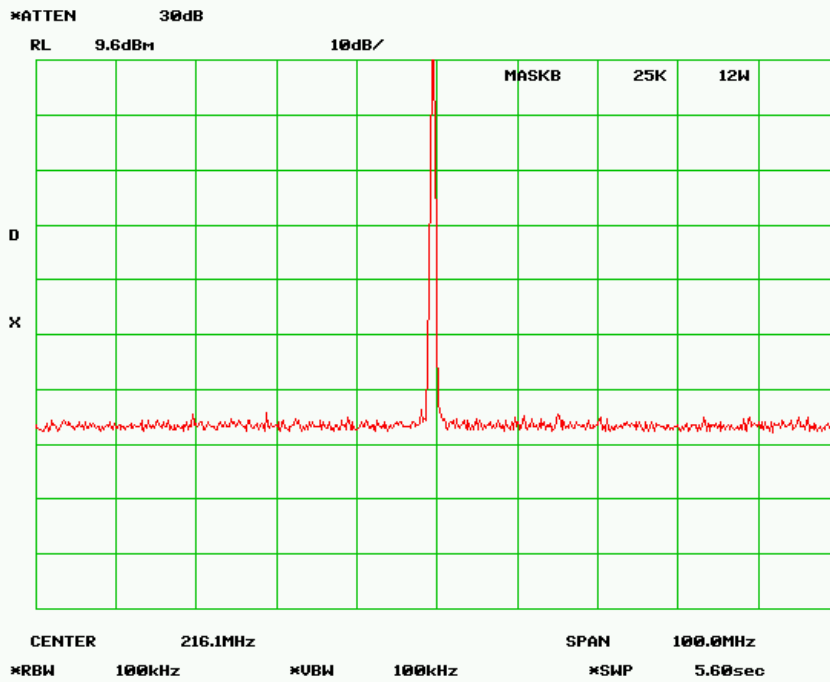
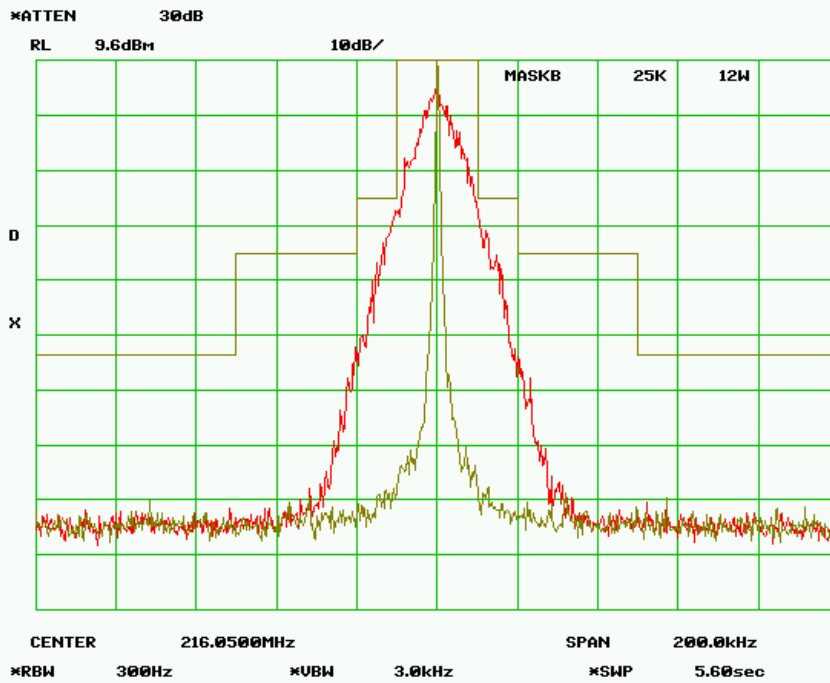
MASK B - 20 kHz – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 16K8F1D
Data Rate = 32 kbps
PEAK DEVIATION = 6.30 kHz



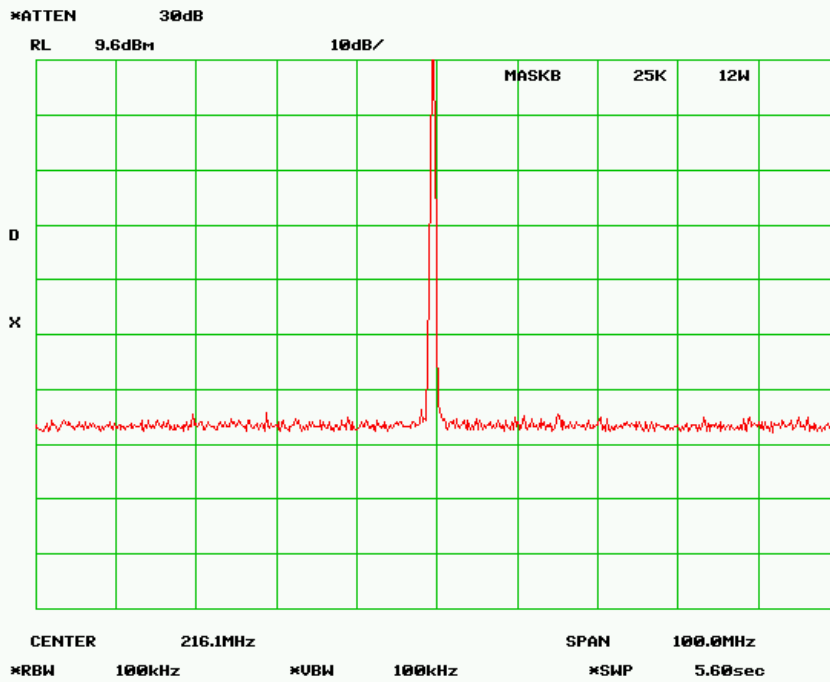
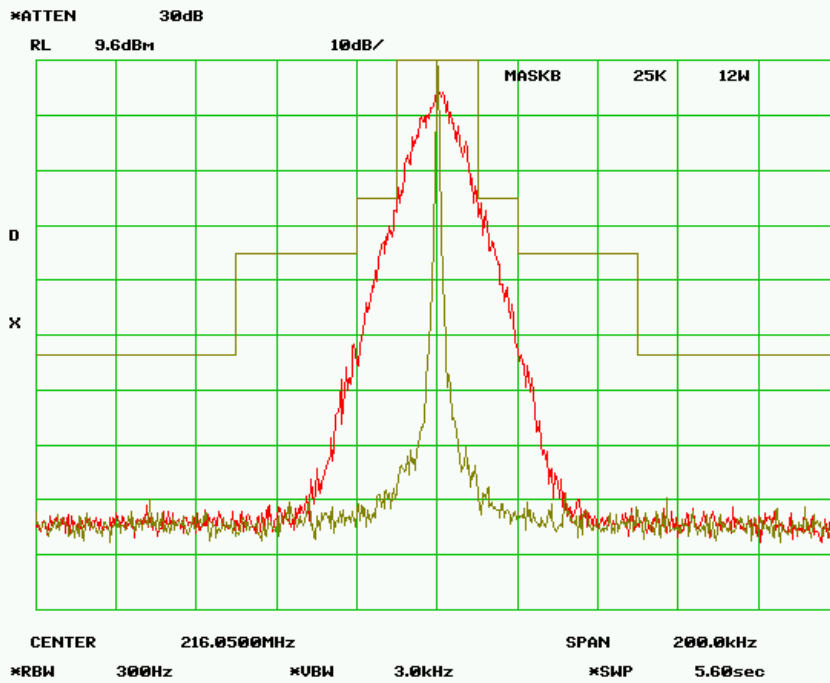
MASK B - 20 kHz – 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 17K8F1D
Data Rate = 48 kbps
PEAK DEVIATION = 7.59 kHz



MASK B - 20 kHz – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 17K8F1D
Data Rate = 48 kbps
PEAK DEVIATION = 7.59 kHz



MASK B - 20 kHz – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 17K0F1D
Data Rate = 64 kbps
PEAK DEVIATION = 7.52 kHz



11.0 Mask C Part 90.259(a) 20 kHz ABW

NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designator
16K5F1D, 16K8F1D, 17K8F1D and 17K0F1D

RULE PART NUMBER: FCC: 2.202, 90.209 (b)(5), 90.210(c), 2.1049 (c) (1)
Data taken at 2 watts is to be applied to Part 90.259(a) (217-220 MHz).

MINIMUM STANDARDS: **Mask C**
Sidebands and Spurious [Rule 90.210 (c), P = 2 Watts and P = 1 Watt]
Authorized Bandwidth = 20 kHz [Rule 90.209(b) (5), 90.259(a)]
From Fo to 5 kHz, down 0 dB.
Greater than 5 kHz to 10 kHz, down $83 * \log_{10}(f_d / 5)$ dB.
Greater than 10 kHz to 250% of authorized BW, at least
 $29 * \log_{10}(f_d^2 / 11)$ or 50 dB, whichever is the lesser attenuation
Greater than 250% of authorized BW, $43 + 10\log_{10}(P)$

Attenuation = 0 dB at Fo to 5.00 kHz
Attenuation = 25 dB at 10.0 kHz
Attenuation = 27.8 dB at >10.0 kHz
Attenuation = 35.4 dB at 13.5 kHz
Attenuation = 41.3 dB at 17.1 kHz
Attenuation = 46.0 dB at 20.6 kHz
Attenuation = 50 dB at 24.1 kHz
Attenuation = 50 dB at 50 kHz
Attenuation = 46 dB at frequencies greater than 50 kHz @ 2 W
Attenuation = 43 dB at frequencies greater than 50 kHz @ 1 W

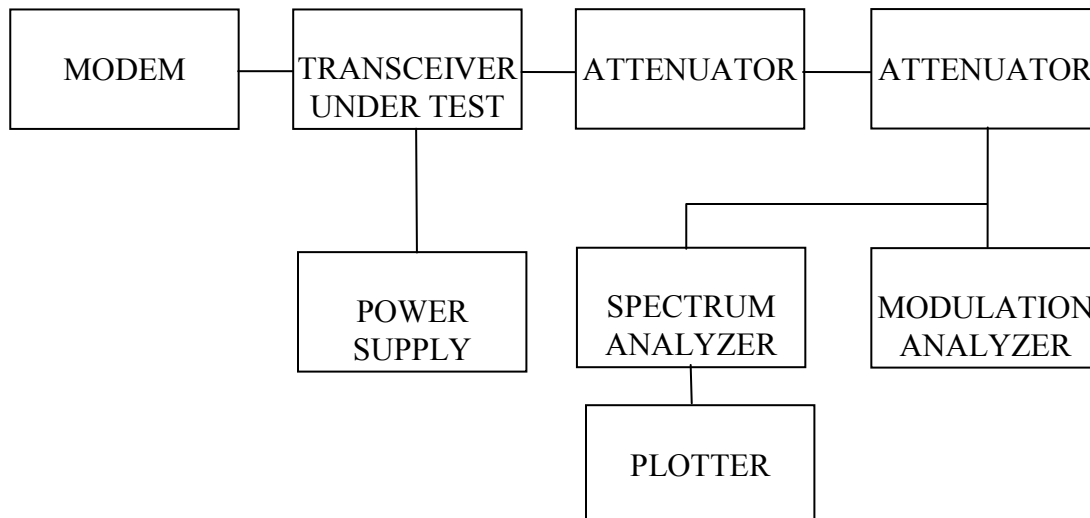
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C
RF Power Level = 1 Watt and 2 Watts
Voltage = 20VDC

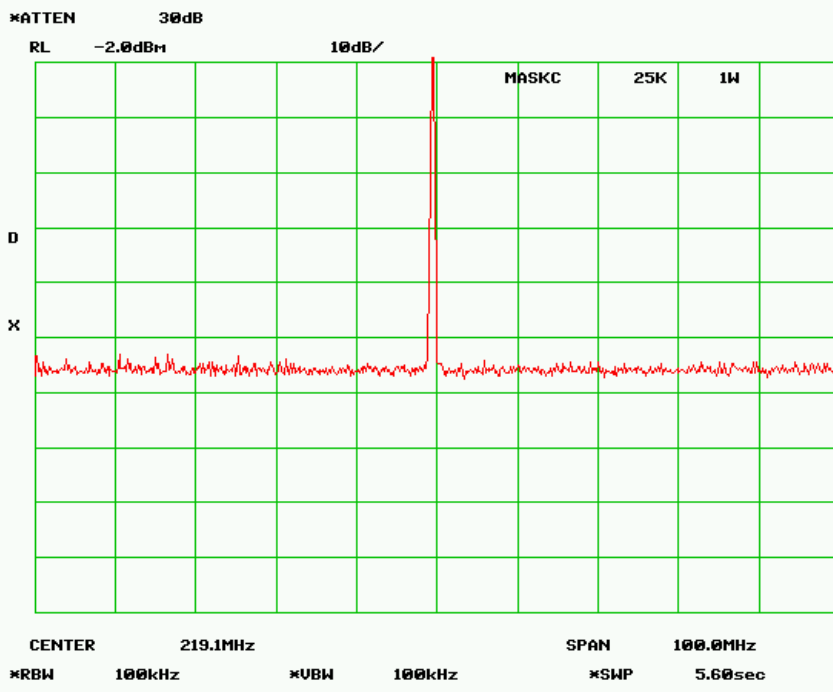
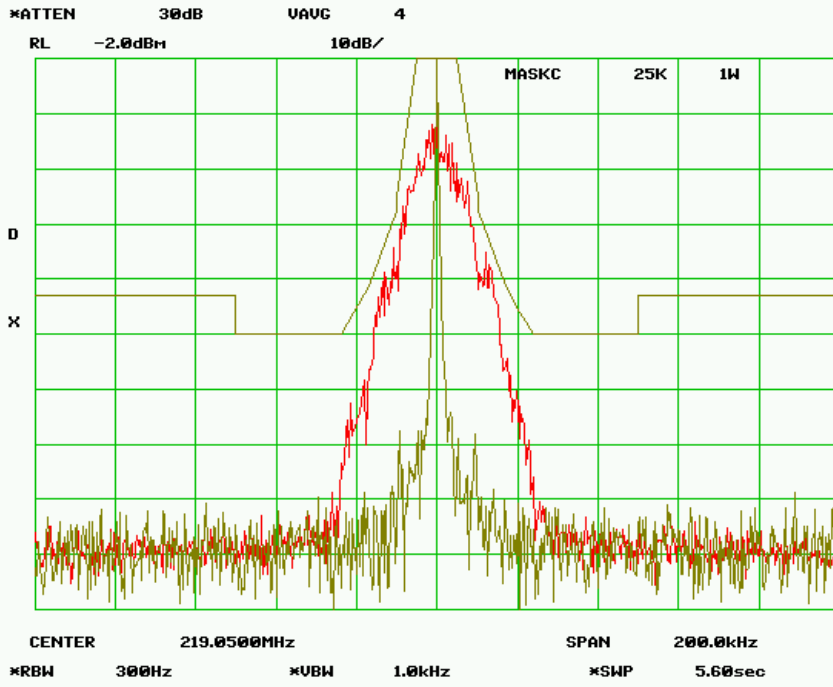
TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13, 3.2.11.2

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
50-Ohm Attenuator, Pasternack Model PE7002-10 (10dB)
DC Power Supply, Hewlett Packard Model 6653A
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901B

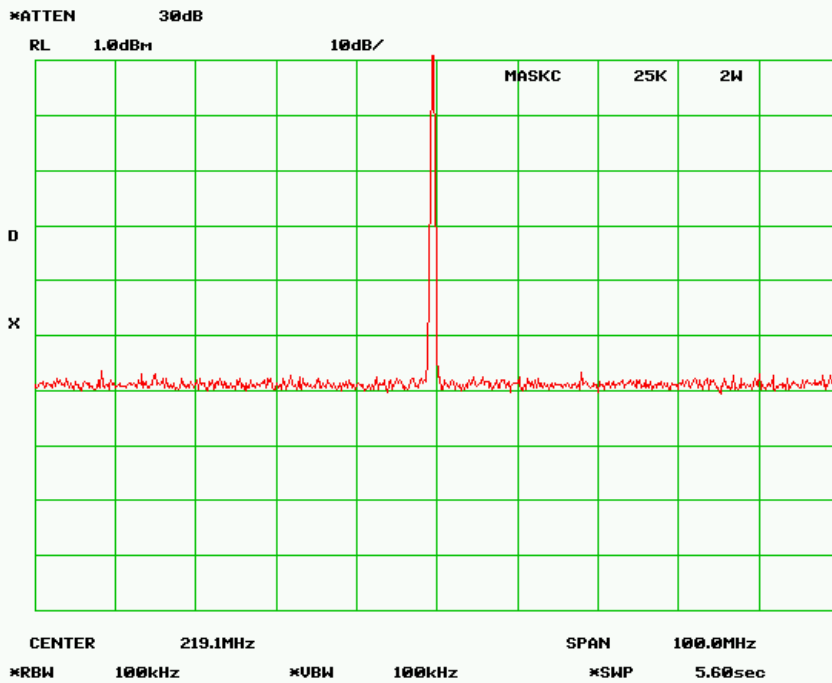
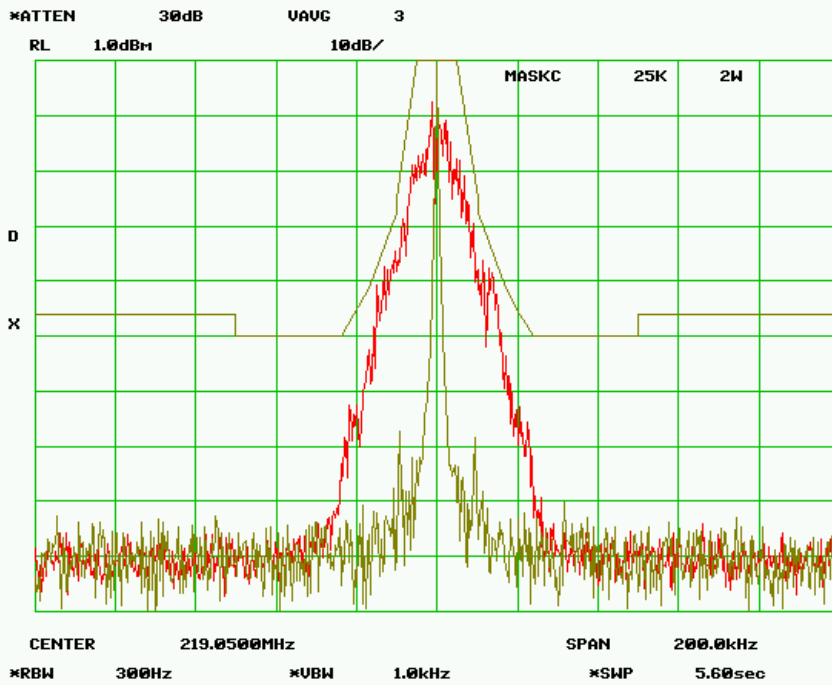
TEST SET-UP:



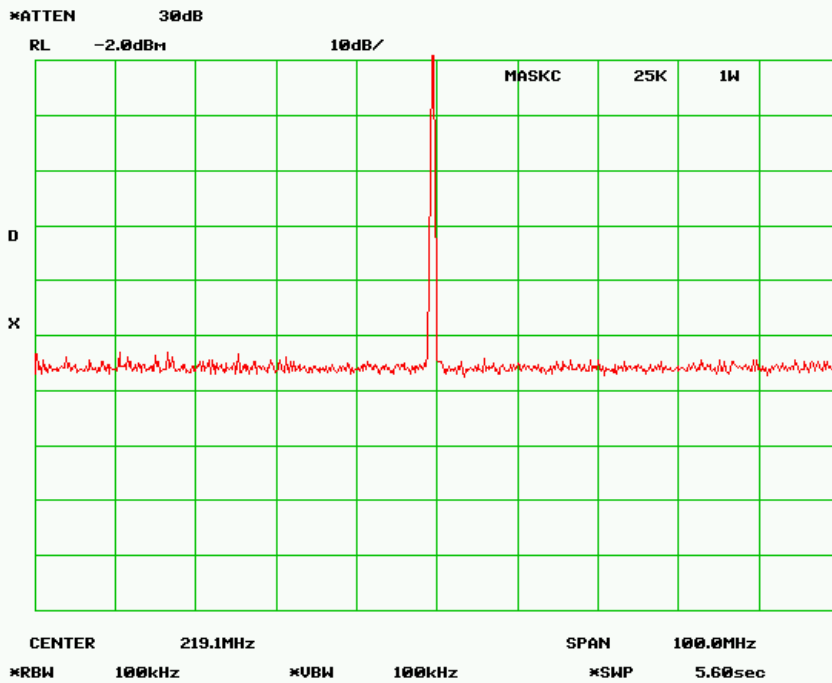
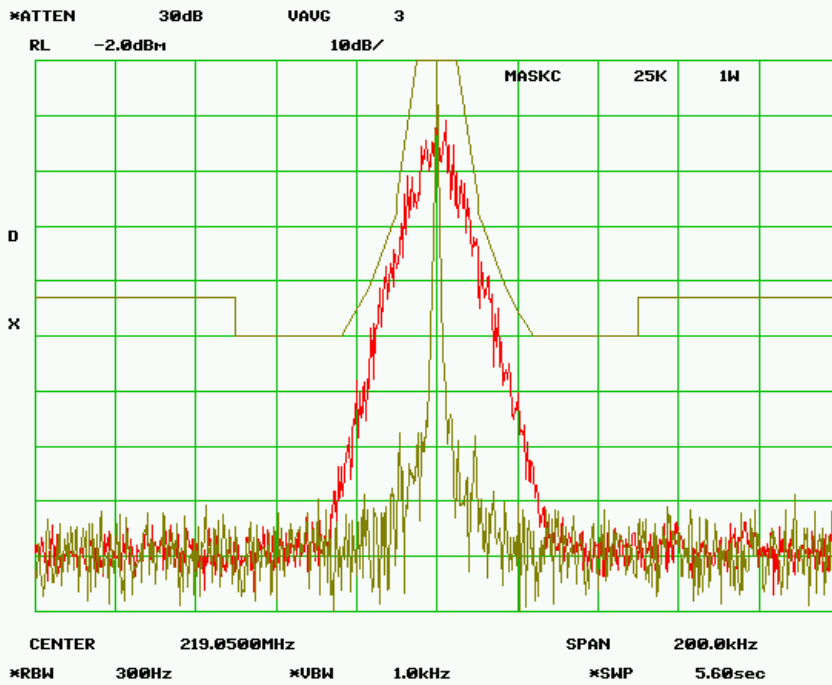
MASK C – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 16K5F1D
 Data Rate = 16 kbps
 PEAK DEVIATION = 6.30 kHz



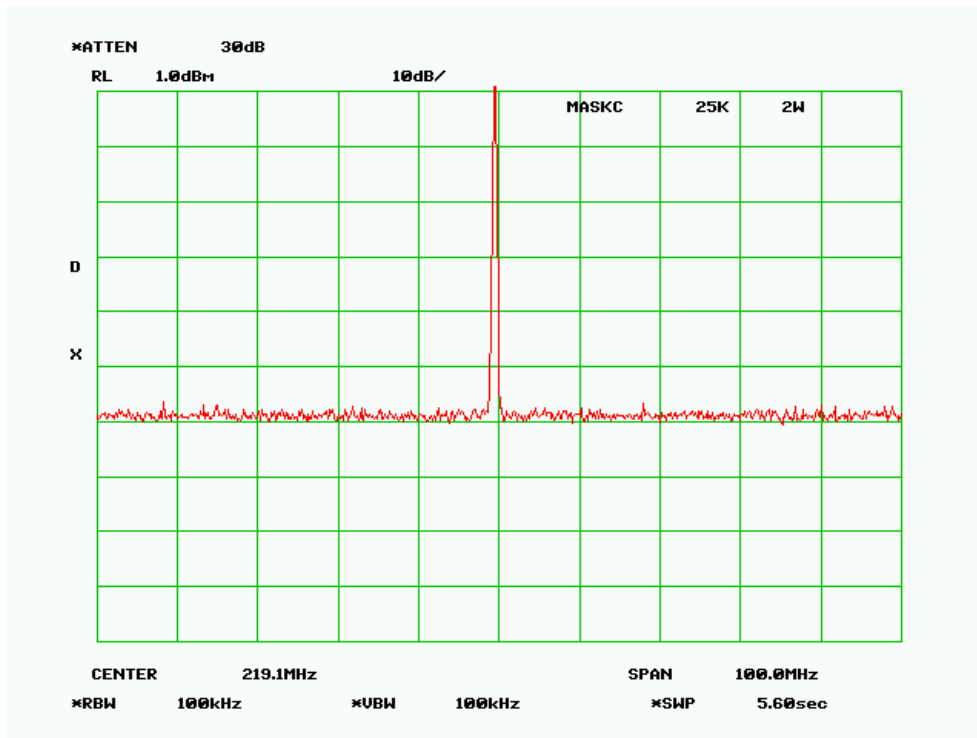
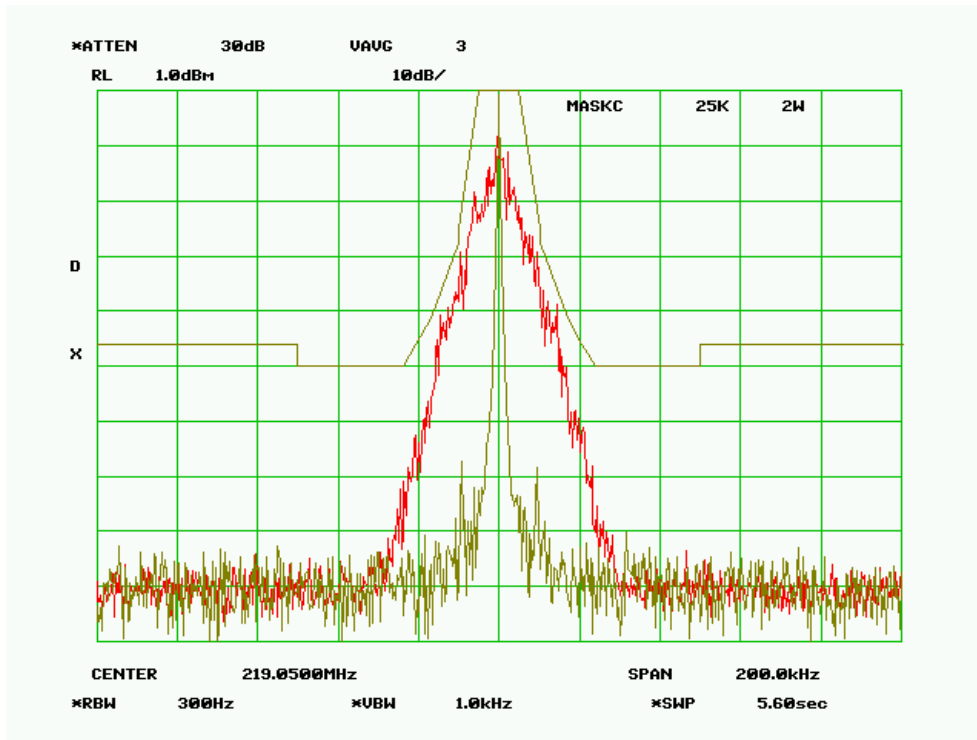
MASK C – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 16K5F1D
Data Rate = 16 kbps
PEAK DEVIATION = 6.30 kHz



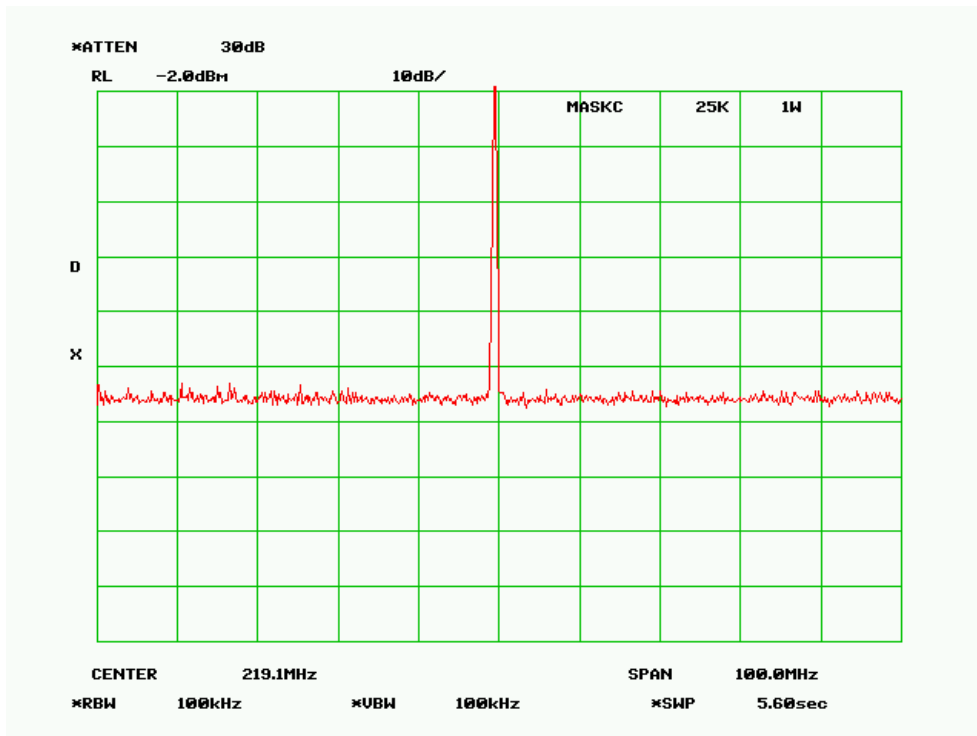
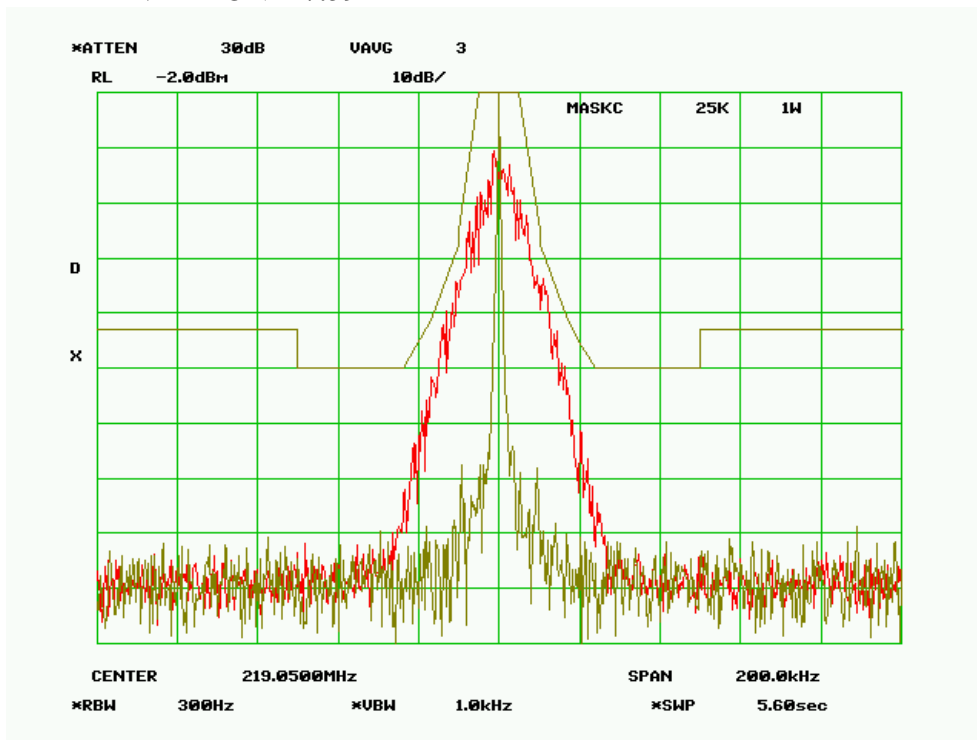
MASK C – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 16K8F1D
Data Rate = 32 kbps
PEAK DEVIATION = 6.30 kHz



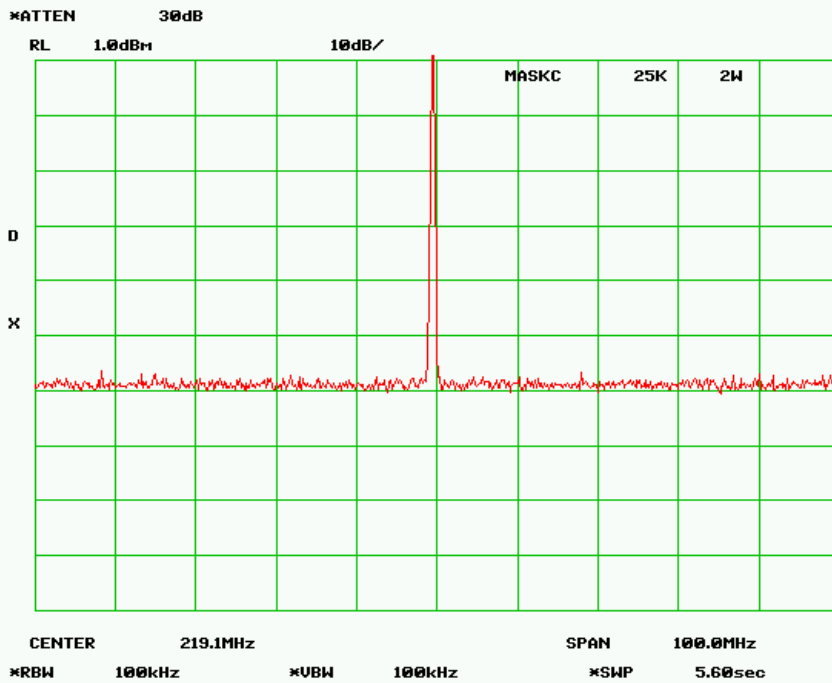
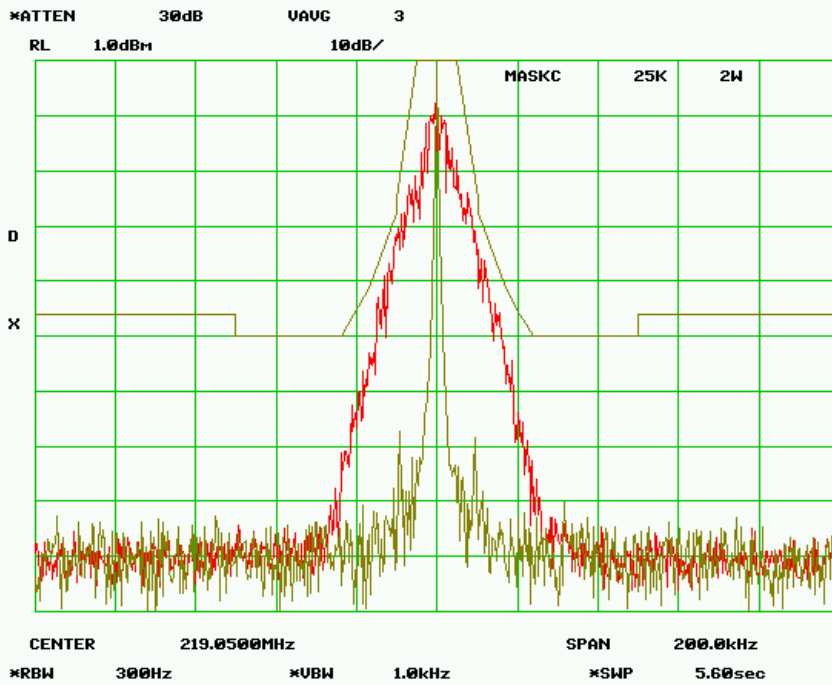
MASK C – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 16K8F1D
Data Rate = 32 kbps
PEAK DEVIATION = 6.30 kHz



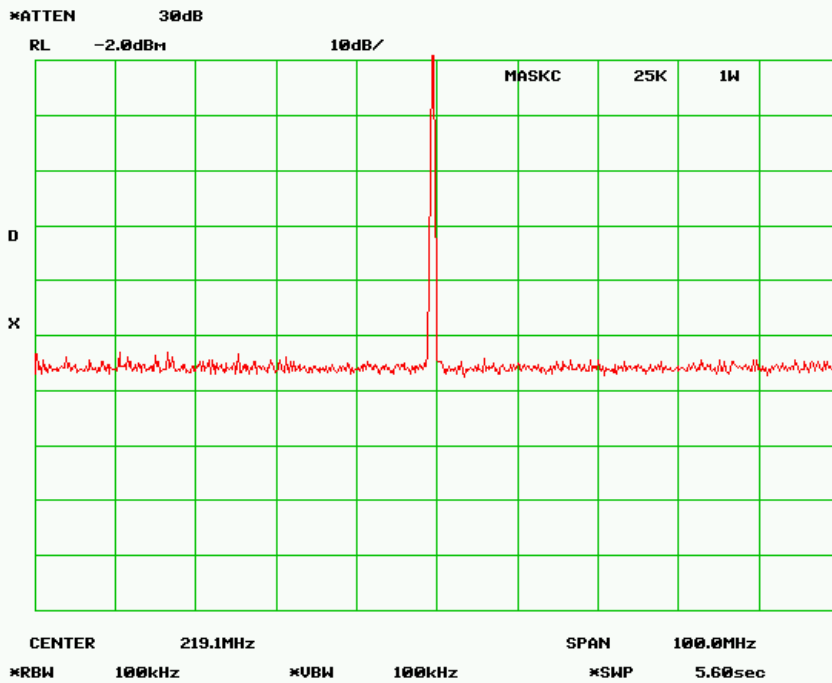
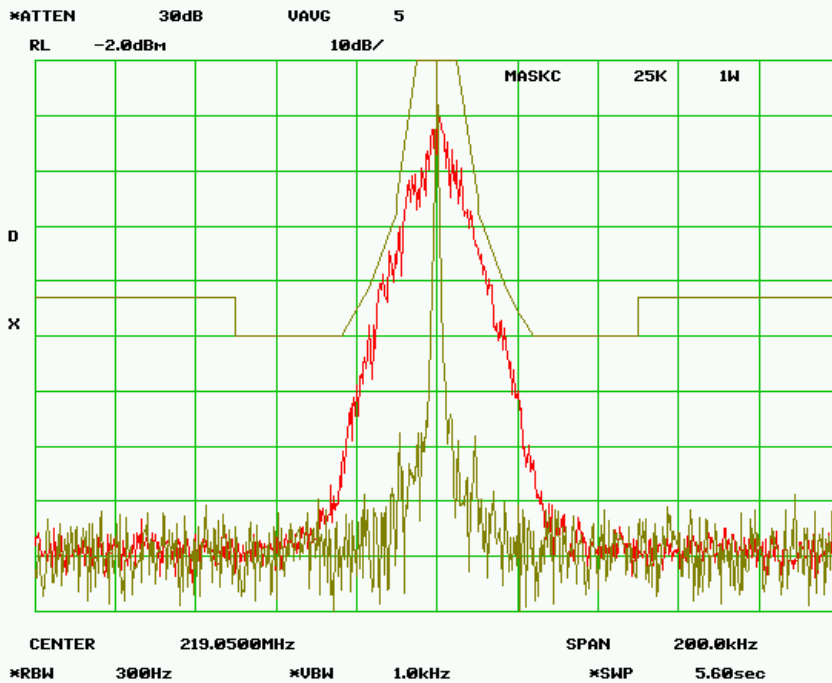
MASK C – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 17K8F1D
Data Rate = 48 kbps
PEAK DEVIATION = 7.59 kHz



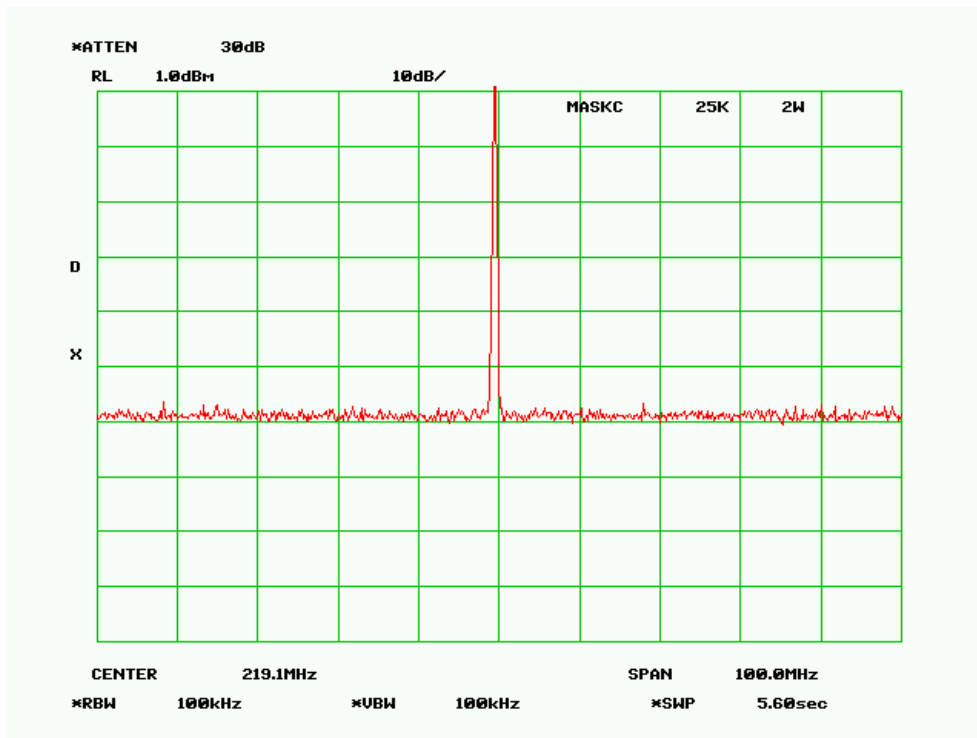
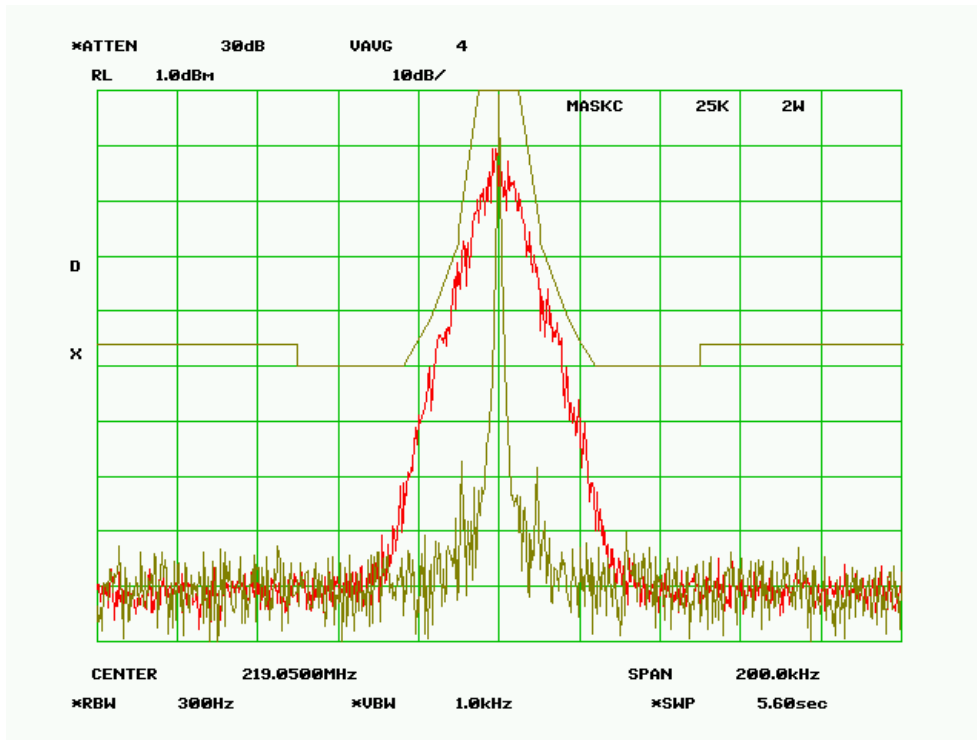
MASK C – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 17K8F1D
Data Rate = 48 kbps
PEAK DEVIATION = 7.59 kHz



MASK C – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 17K0F1D
Data Rate = 64 kbps
PEAK DEVIATION = 7.52 kHz



MASK C – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 17K0F1D
Data Rate = 64 kbps
PEAK DEVIATION = 7.52 kHz



12.0 Part 80.211(f) - 40 kHz ABW

NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators
33K3F1D, 34K0F1D, 36K0F1D, 33K0F1D

RULE PART NUMBER: FCC: 2.202, 80.211 (f): 80.215: 80.481
 12 Watts and 1.0 Watt Part 80 216-220 MHz.

MINIMUM STANDARDS: **Part 80.211(f)**
 Sidebands and Spurious [Rule 80.211 (f) P = 12 Watts and P=1 Watt]
 Authorized Bandwidth = 40 kHz
 On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;
 On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and
 On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10logP (mean power in watts) dB.

Attenuation = 0 dB at Fo to 20.0 kHz
 Attenuation = 25 dB at 20.0kHz
 Attenuation = 35 dB at 40.0 kHz
 Attenuation = 43 dB at 100 kHz
 Attenuation = 43 dB > 100 kHz @ 1 Watt
 Attenuation = 53.8 dB > 100 kHz @ 12 Watt

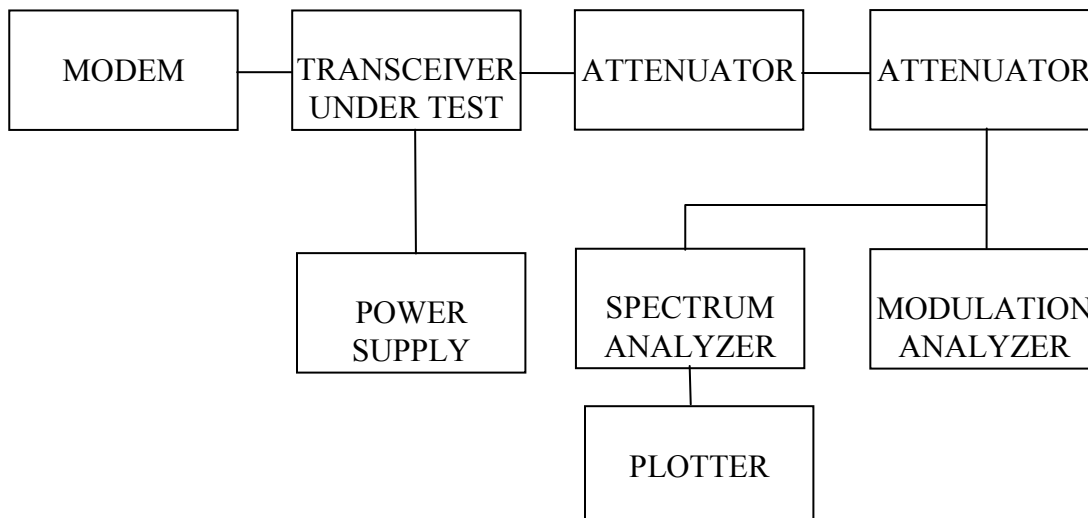
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C
 RF Power Level = 1 Watt and 12 Watts
 Voltage = 20VDC

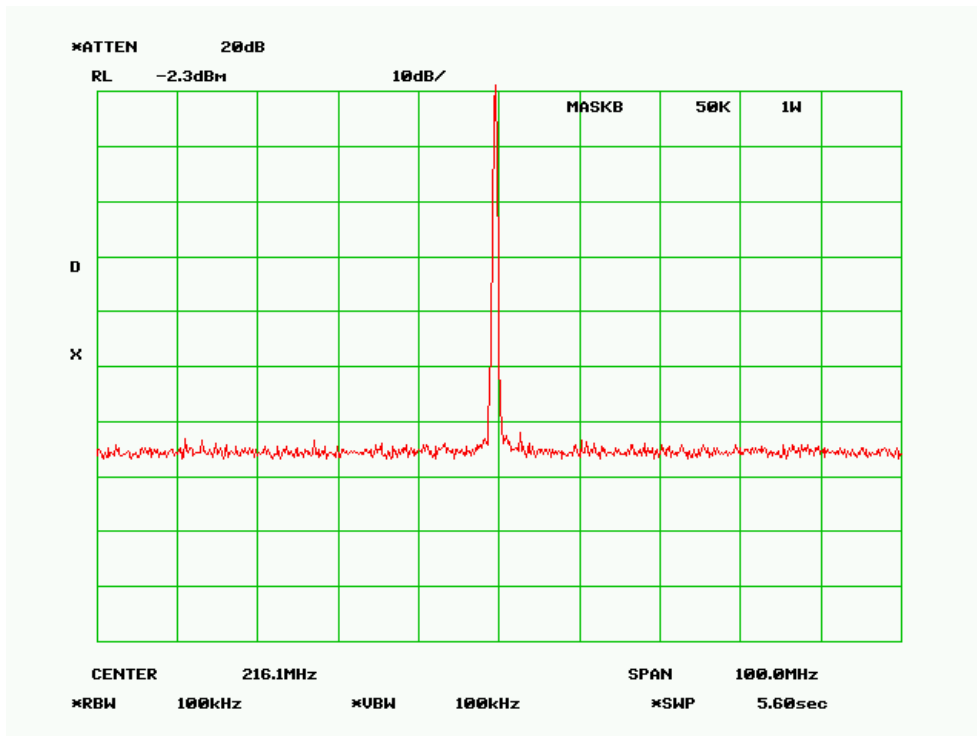
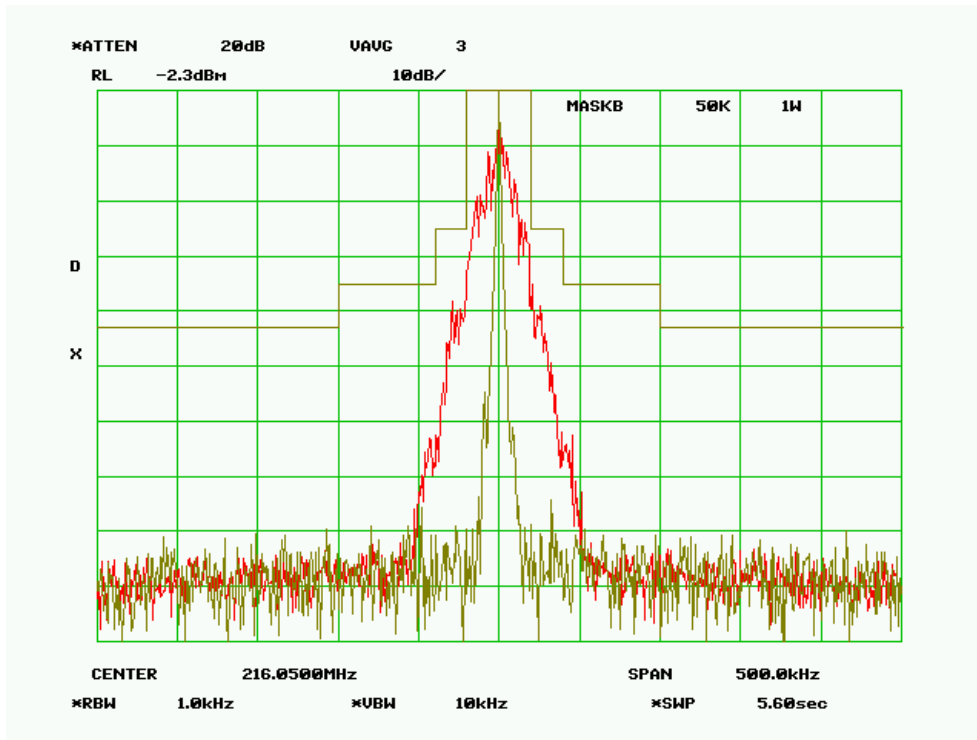
TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13, 3.2.11.2

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
 50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
 50-Ohm Attenuator, Pasternack Model PE7002-10 (10dB)
 DC Power Supply, Hewlett Packard Model 6653A
 Spectrum Analyzer, Hewlett Packard Model HP8563E
 Modulation Analyzer, Hewlett Packard Model HP8901B

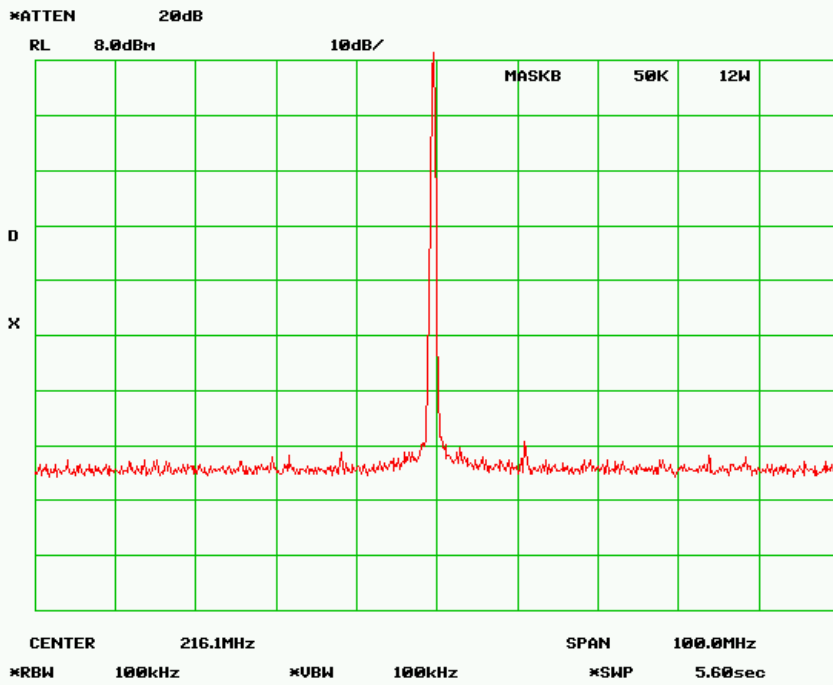
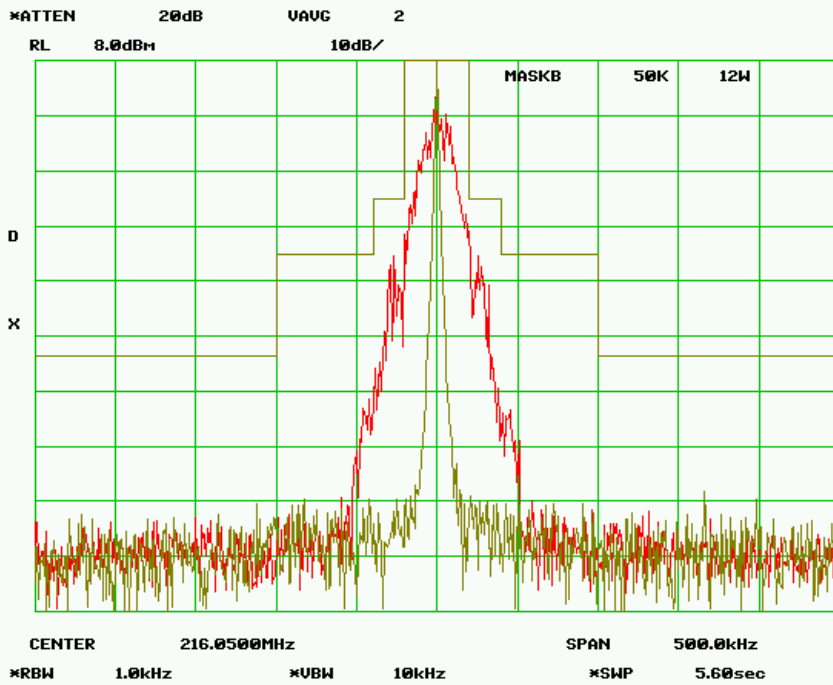
TEST SET-UP:



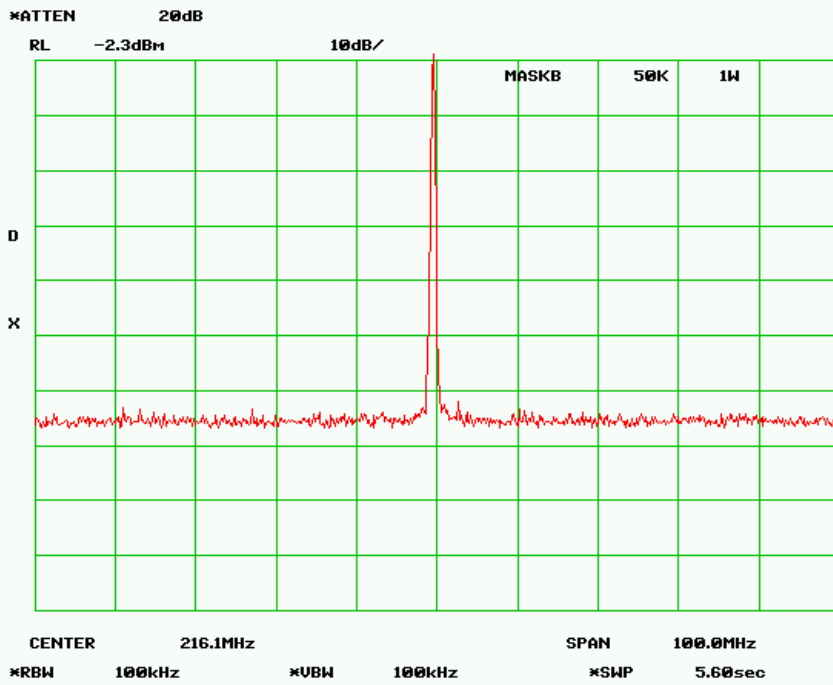
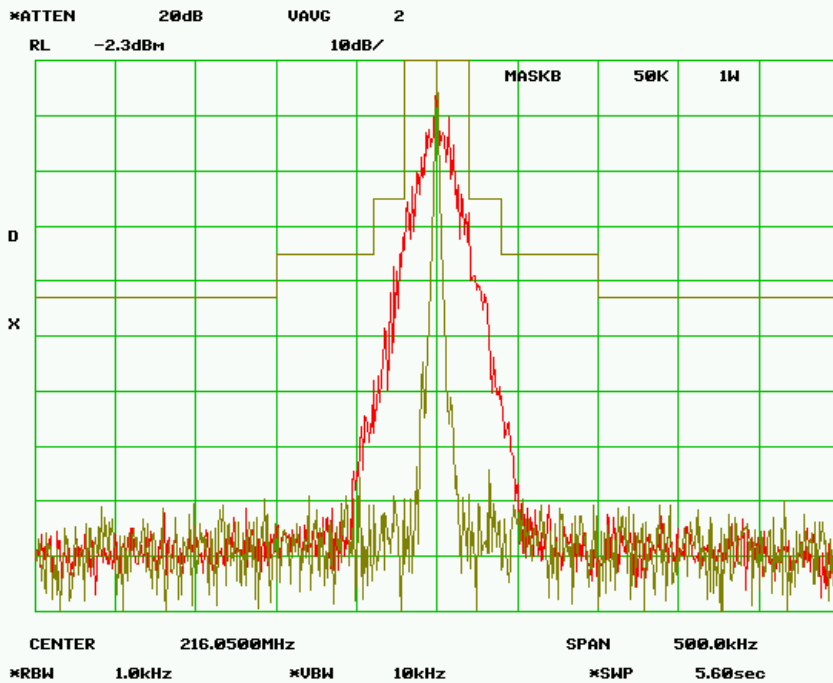
MASK B – 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 33K3F1D
Data Rate = 32 kbps
PEAK DEVIATION = 12.31 kHz



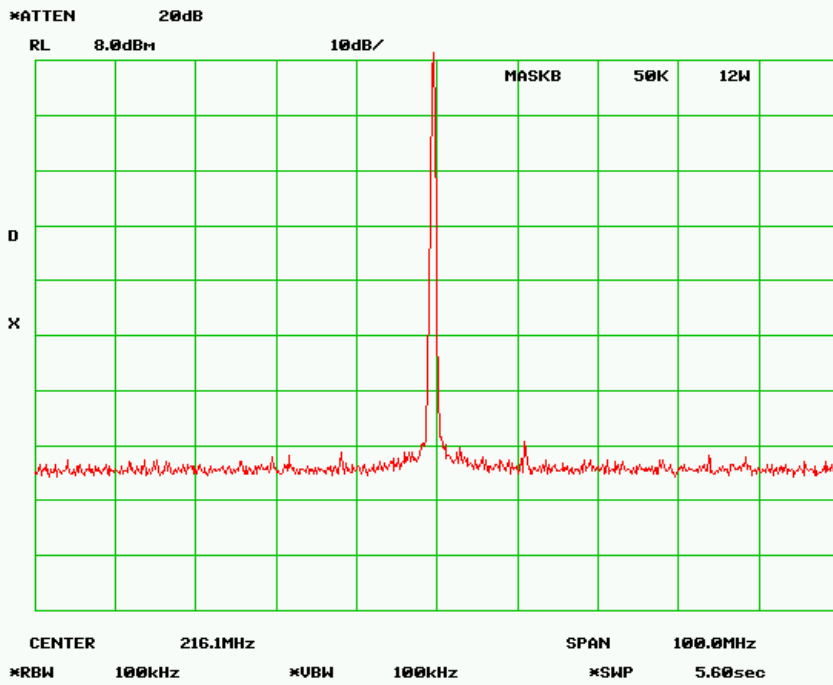
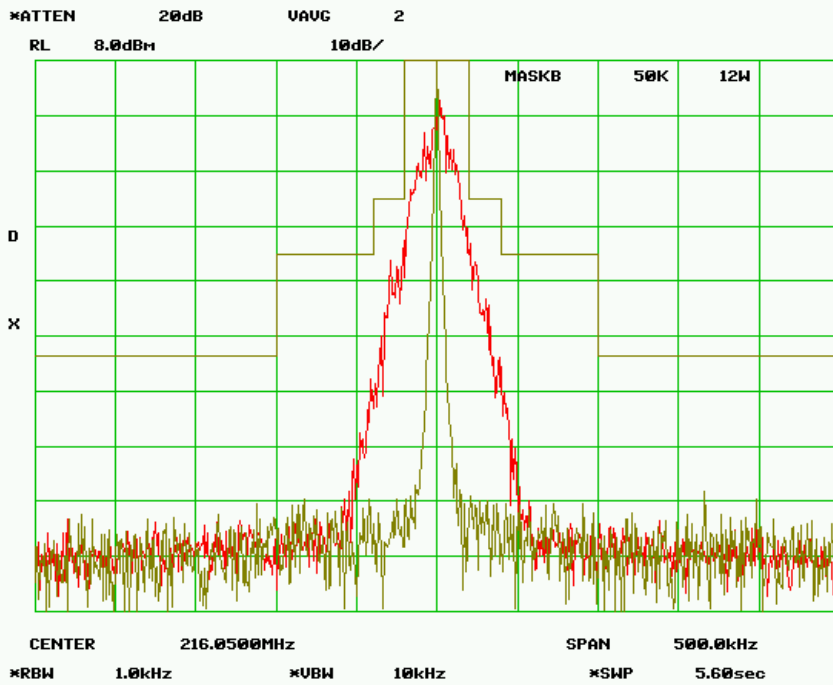
MASK B – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 33K3F1D
Data Rate = 32 kbps
PEAK DEVIATION = 12.31 kHz



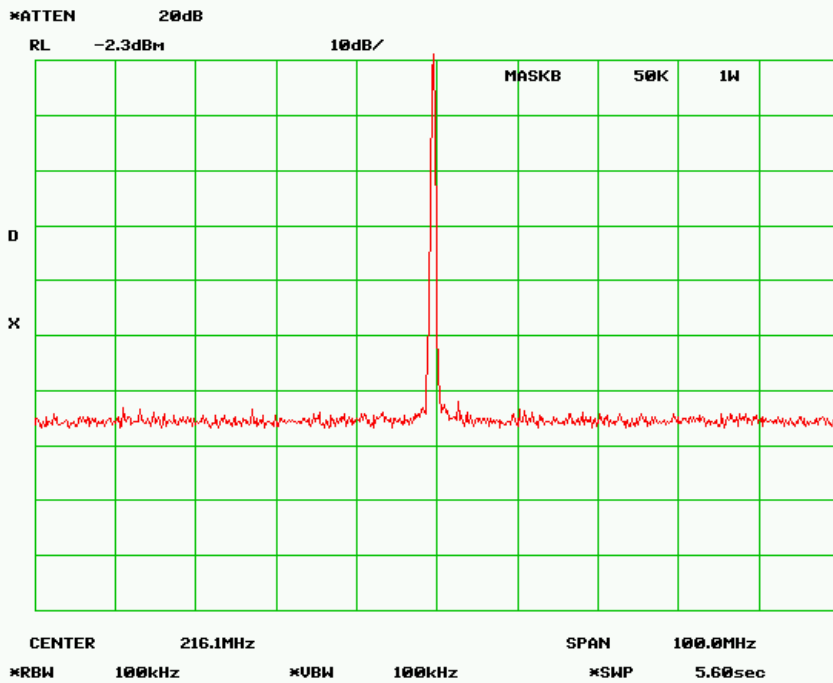
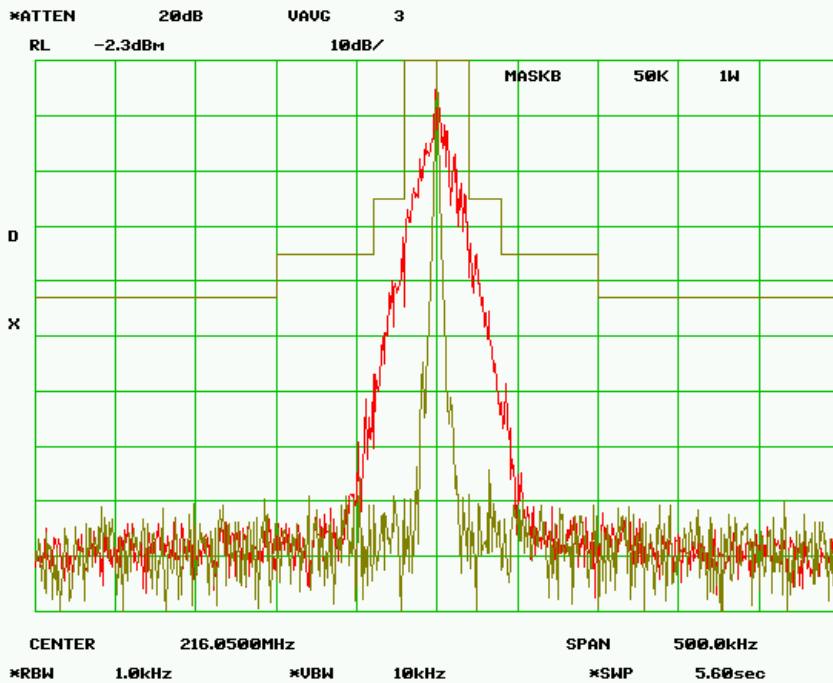
MASK B – 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 34K0F1D
Data Rate = 64 kbps
PEAK DEVIATION = 14.45 kHz



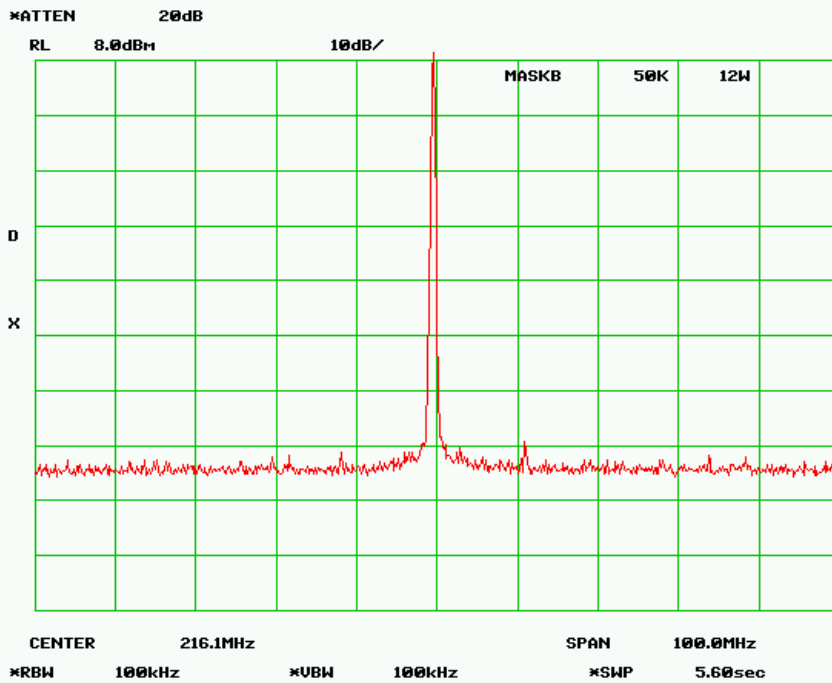
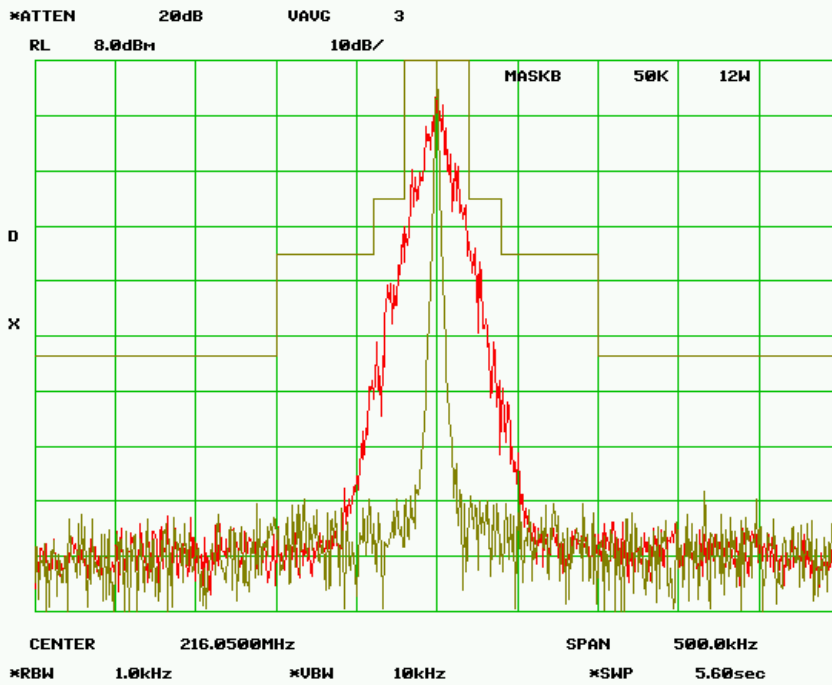
MASK B – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 34K0F1D
Data Rate = 64 kbps
PEAK DEVIATION = 14.45 kHz



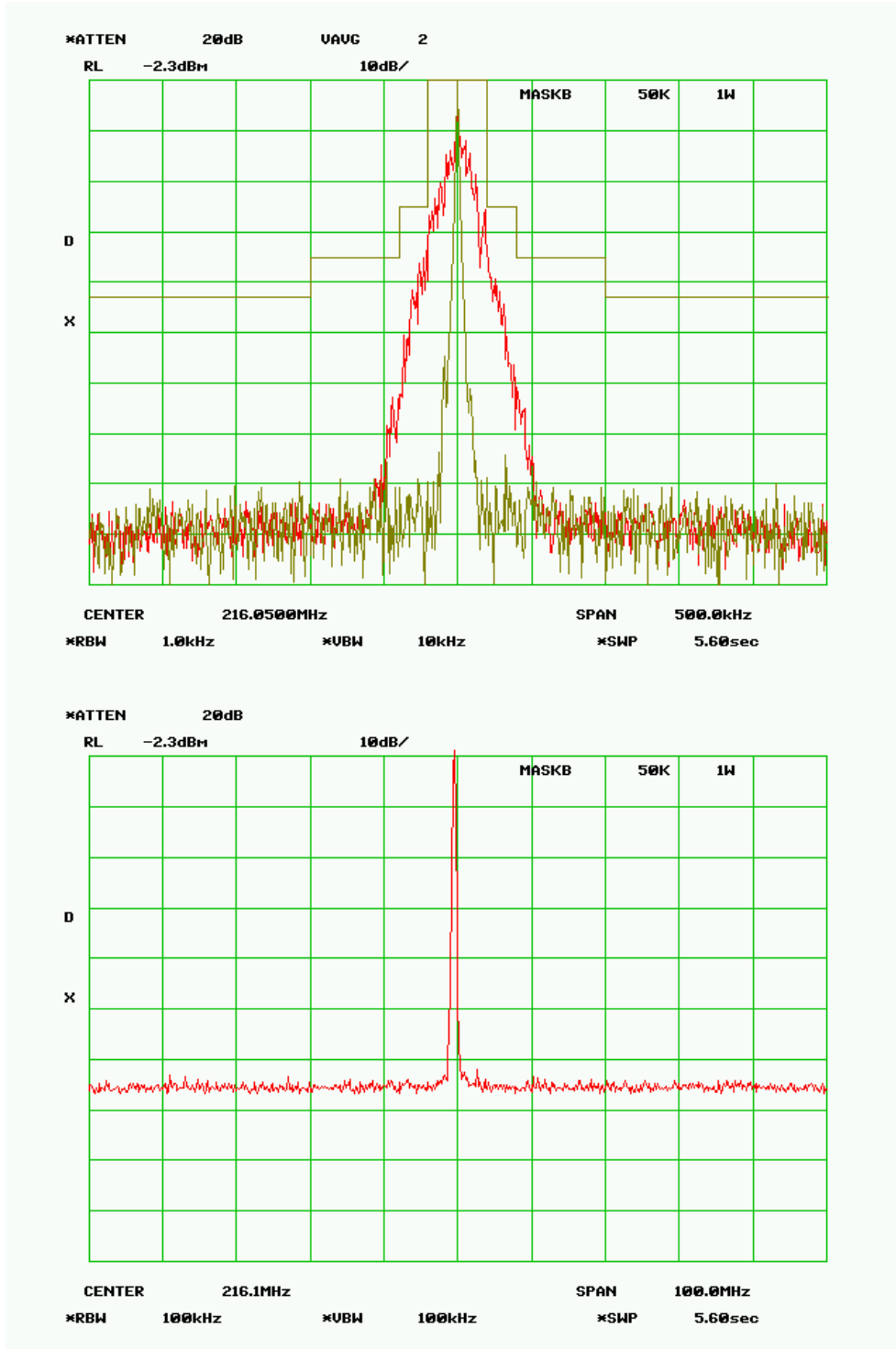
MASK B – 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 36K0F1D
Data Rate = 96 kbps
PEAK DEVIATION = 15.33 kHz



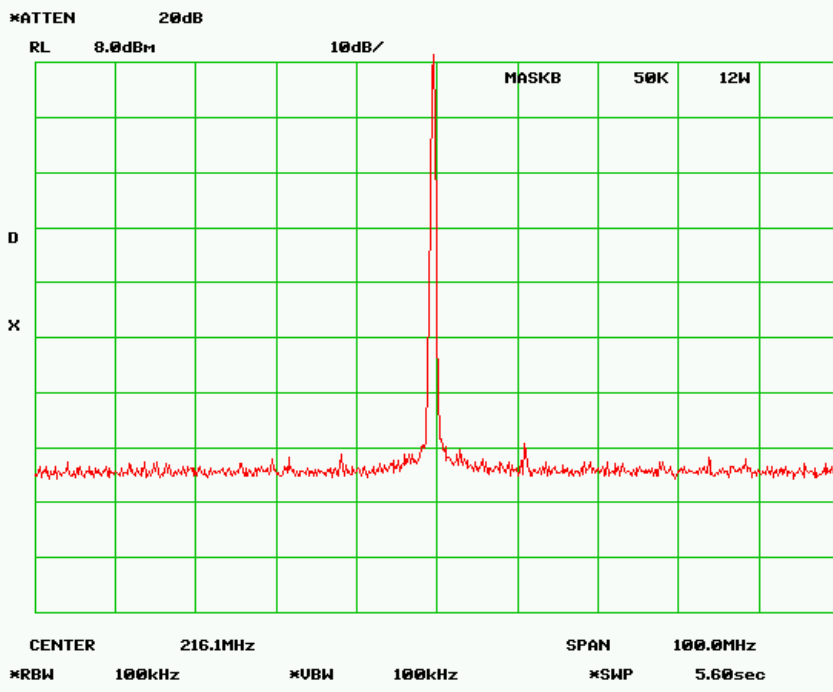
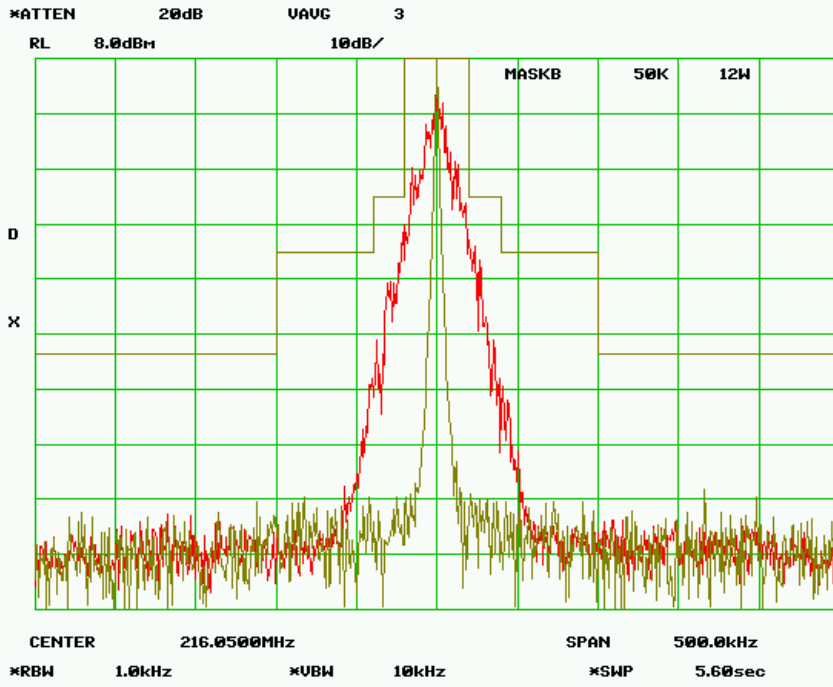
MASK B – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 36K0F1D
Data Rate = 96 kbps
PEAK DEVIATION = 15.33 kHz



MASK B – 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 33K0F1D
Data Rate = 128 kbps
PEAK DEVIATION = 11.66 kHz



MASK B – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 33K0F1D
Data Rate = 128 kbps
PEAK DEVIATION = 11.66 kHz



13.0 Mask C – Part 90.259(a) 40 kHz ABW

NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators **33K3F1D, 34K0F1D, 36K0F1D and 33K0F1D**

RULE PART NUMBER: FCC: 2.202, 90.209 (b)(5), 90.210(c), 2.1049 (c) (1)
Data taken at 2 watts is to be applied to Part 90.259(a) (217-220 MHz).

MINIMUM STANDARDS: **Mask C. 50 kHz – 90.259(a)**
Sidebands and Spurious [Rule 90.210 (c), P = 2 Watts and P = 1 Watt]
Authorized Bandwidth = 40 kHz [Rule 90.209(b) (5), 90.259(a)]
From Fo to 5 kHz, down 0 dB.
Greater than 5 kHz to 10 kHz, down $83 * \log_{10}(f_d / 5)$ dB.
Greater than 10 kHz to 250% of authorized BW, at least $29 * \log_{10}(f_d^2 / 11)$ or 50 dB, whichever is the lesser attenuation
Greater than 250% of authorized BW, $43 + 10\log_{10}(P)$

- Attenuation = 0 dB at Fo to 17.5 kHz
- Attenuation = 25 dB at 22.500 kHz
- Attenuation = 27.8 dB at 22.500 kHz
- Attenuation = 35.4 dB at 26.0 kHz
- Attenuation = 41.3 dB at 29.6 kHz
- Attenuation = 46.0 dB at 33.1 kHz
- Attenuation = 50 dB at 36.6 kHz
- Attenuation = 50 dB at 100 kHz
- Attenuation = 46 dB at frequencies greater than 100 kHz @ 2 W
- Attenuation = 43 dB at frequencies greater than 100 kHz @ 1 W

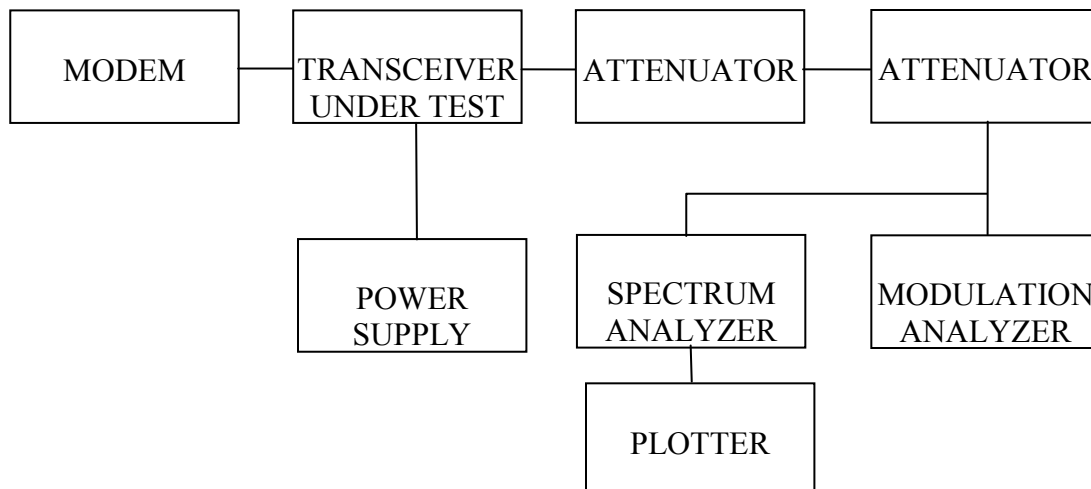
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C
RF Power Level = 1 Watt and 2 Watts
Voltage = 20VDC

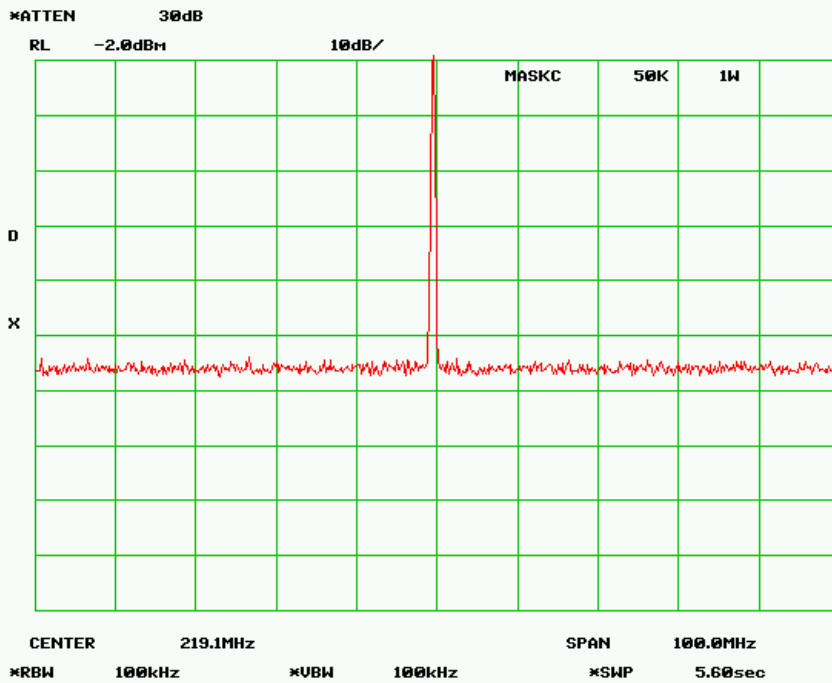
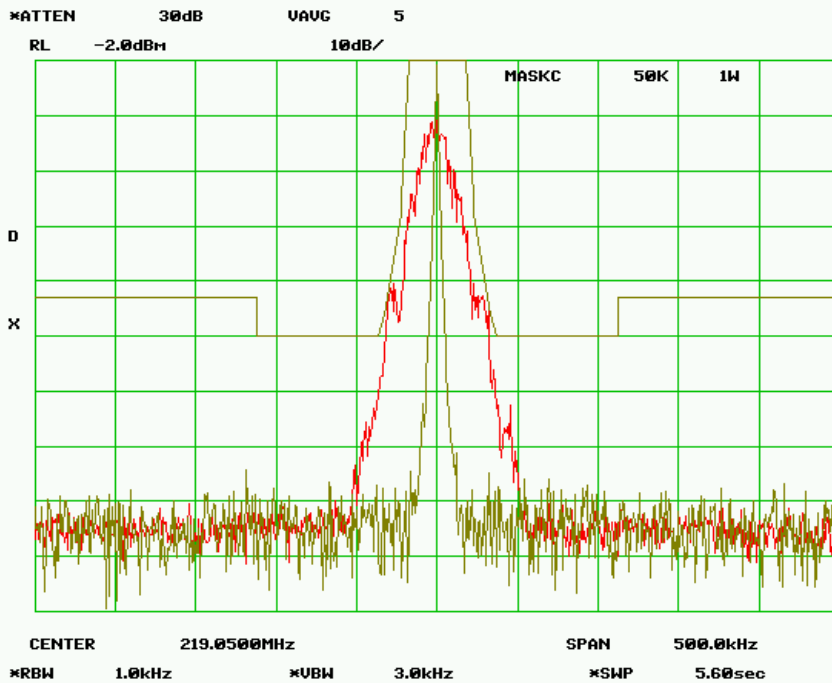
TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13, 3.2.11.2

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
50-Ohm Attenuator, Pasternack Model PE7002-10 (10dB)
DC Power Supply, Hewlett Packard Model 6653A
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901B

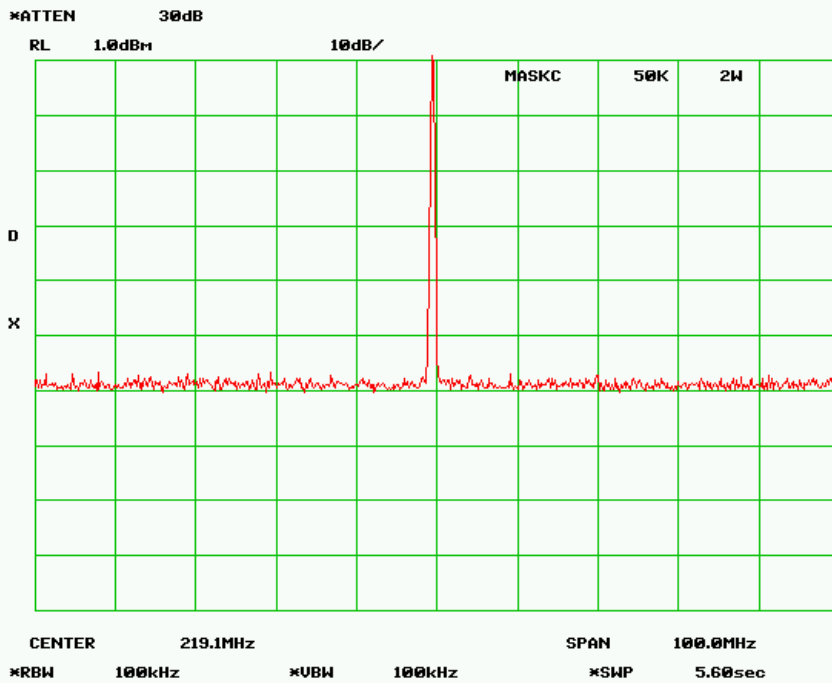
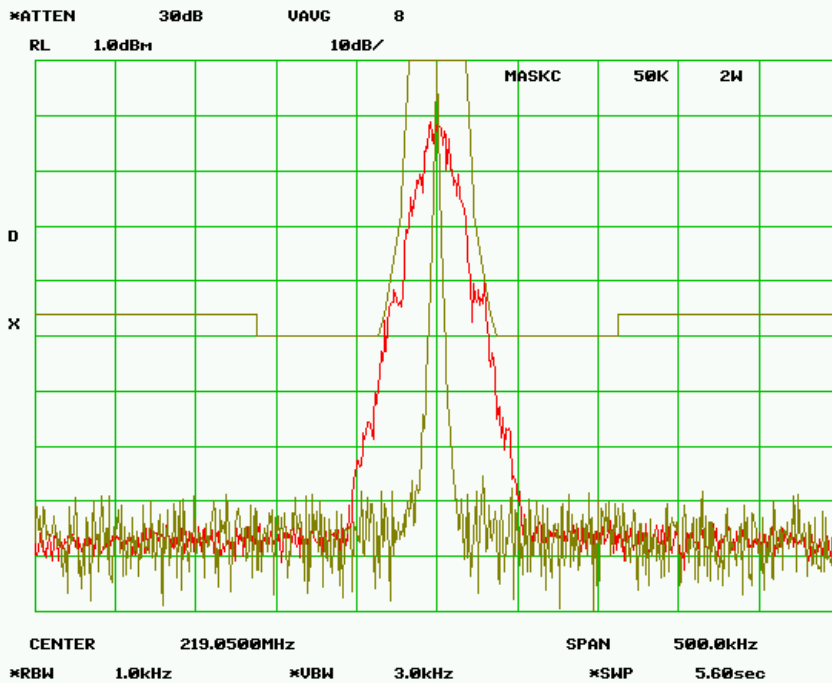
TEST SET-UP:



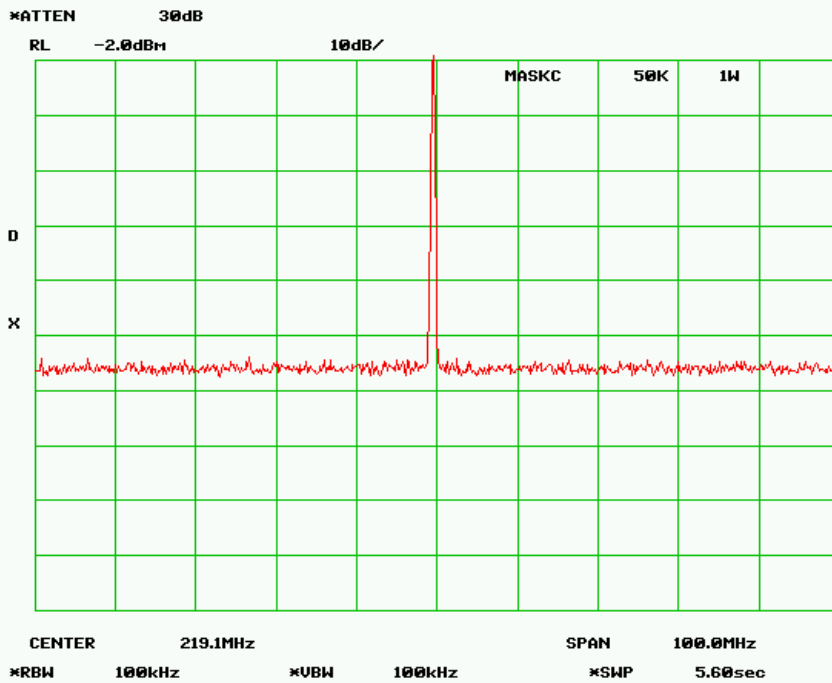
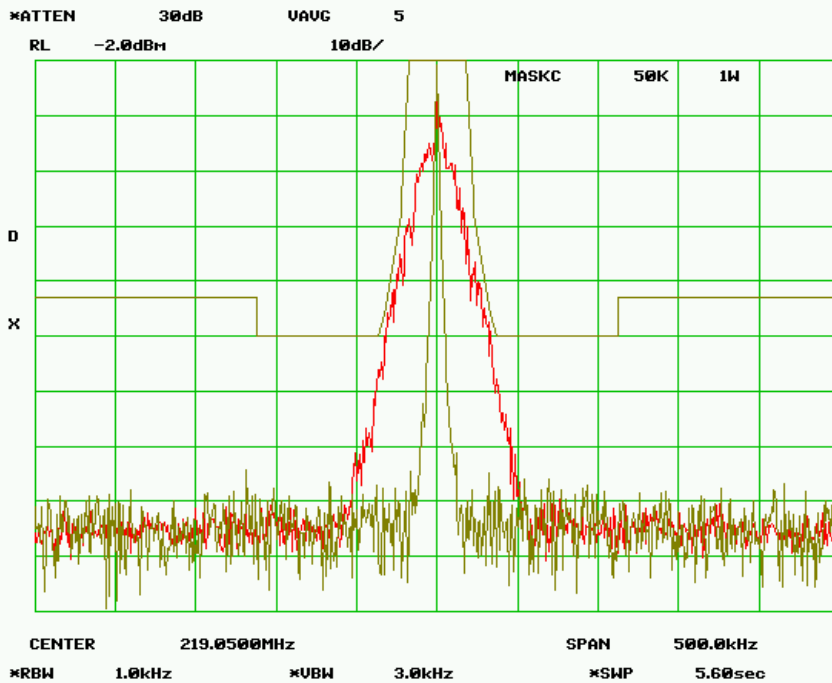
MASK C 50 kHz – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 33K3F1D
Data Rate = 32 kbps
PEAK DEVIATION = 12.31 kHz



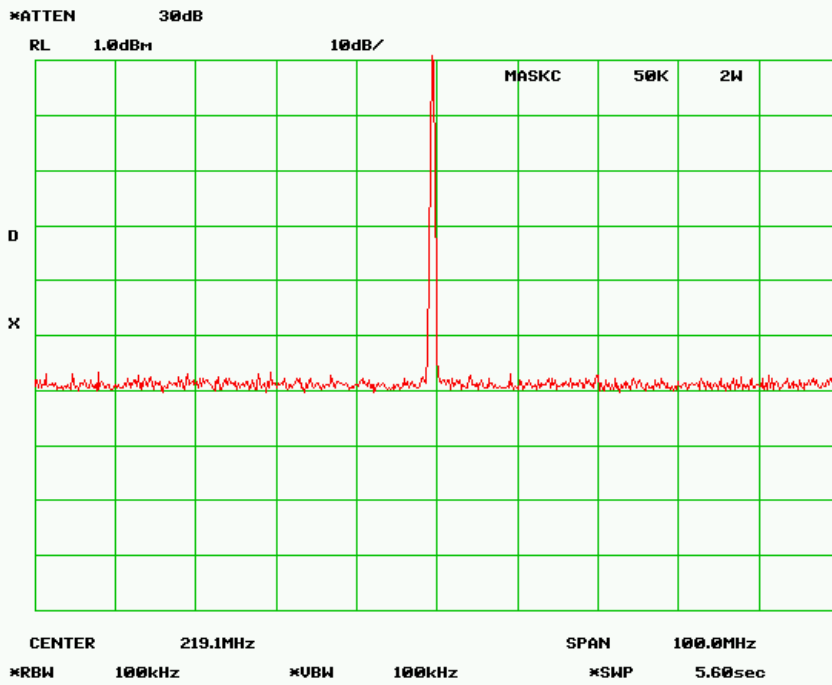
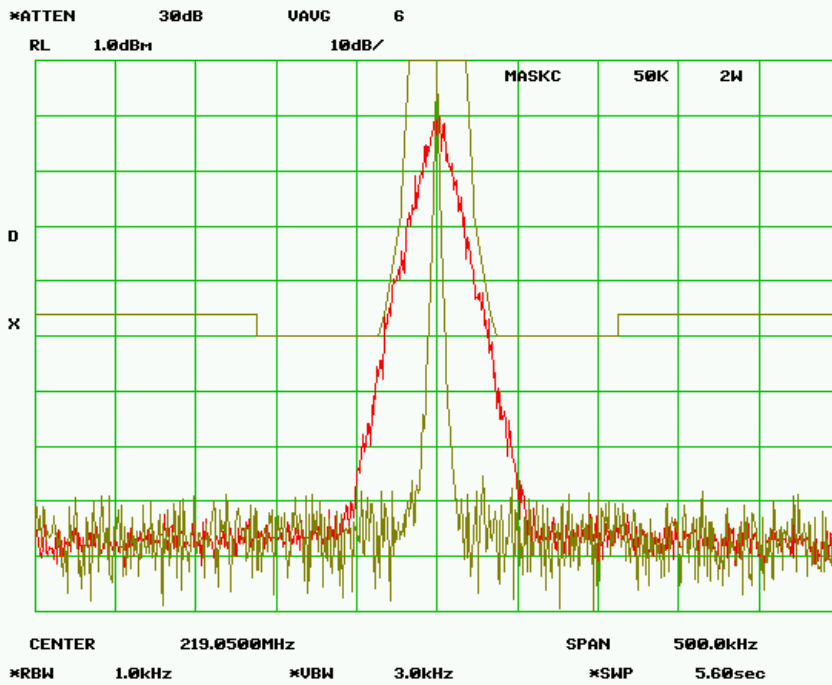
MASK C 50 kHz – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 33K3F1D
Data Rate = 32 kbps
PEAK DEVIATION = 12.31 kHz



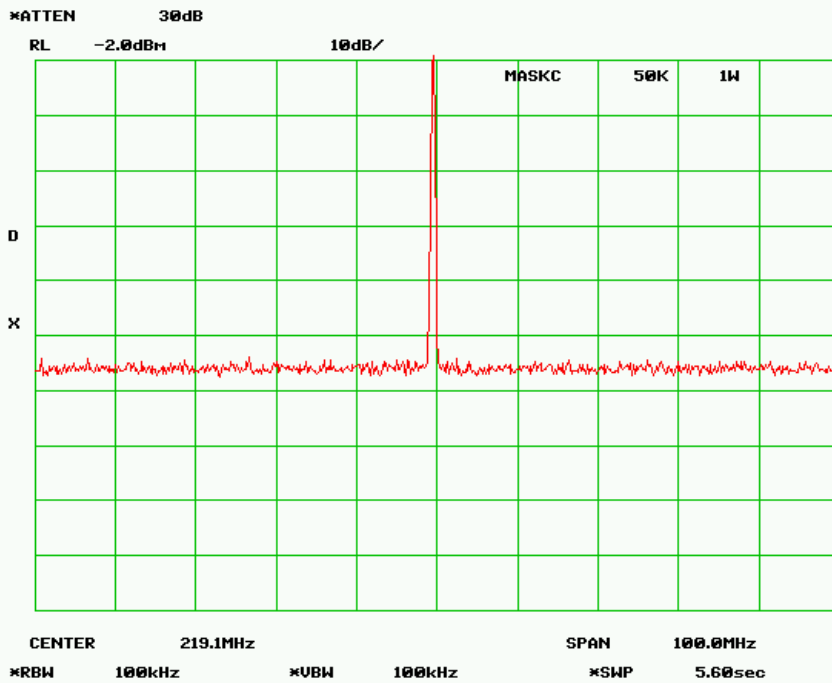
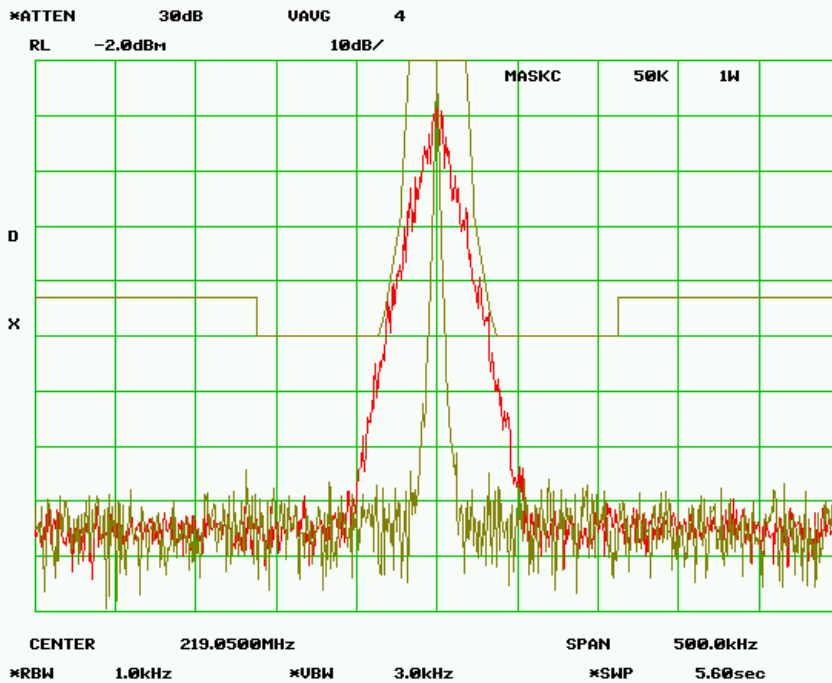
MASK C 50 kHz – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 34K0F1D
Data Rate = 64 kbps
PEAK DEVIATION = 14.45 kHz



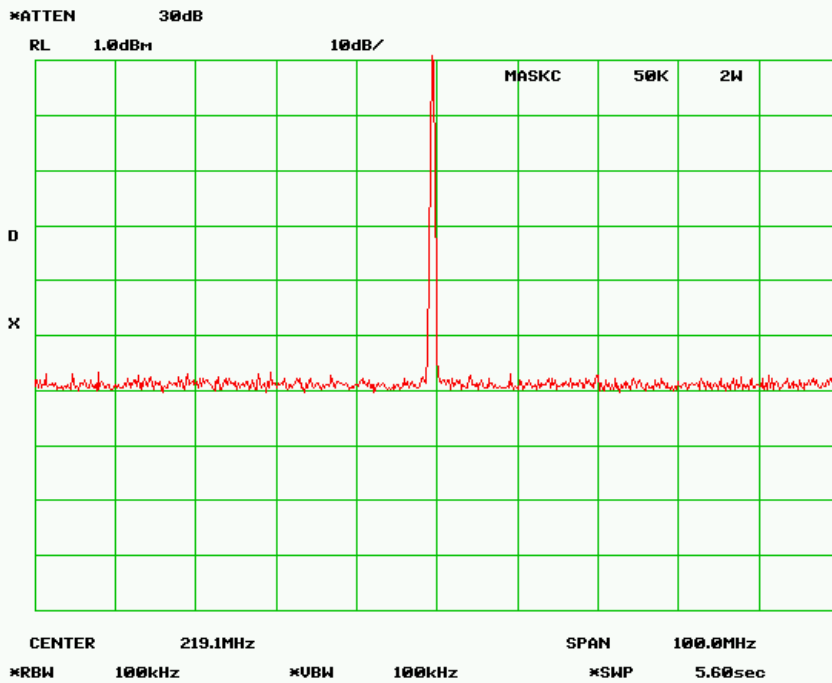
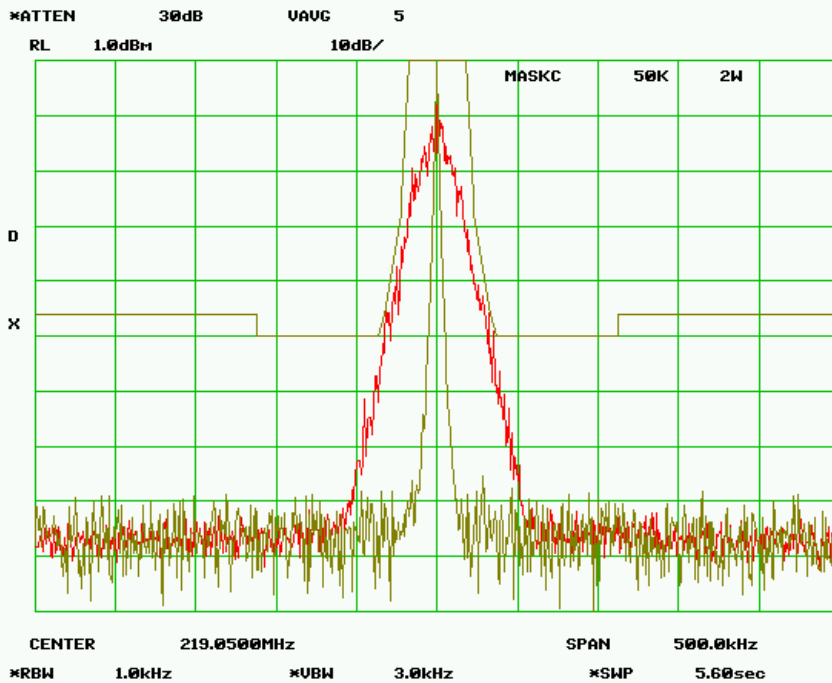
MASK C 50 kHz – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 34K0F1D
Data Rate = 64 kbps
PEAK DEVIATION = 14.45 kHz



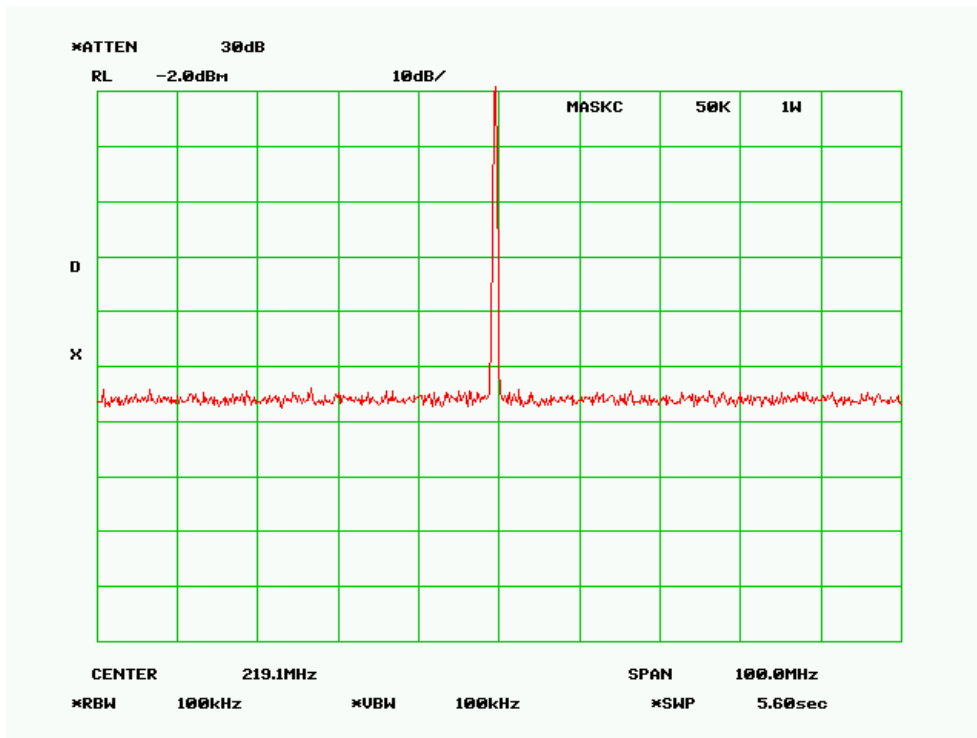
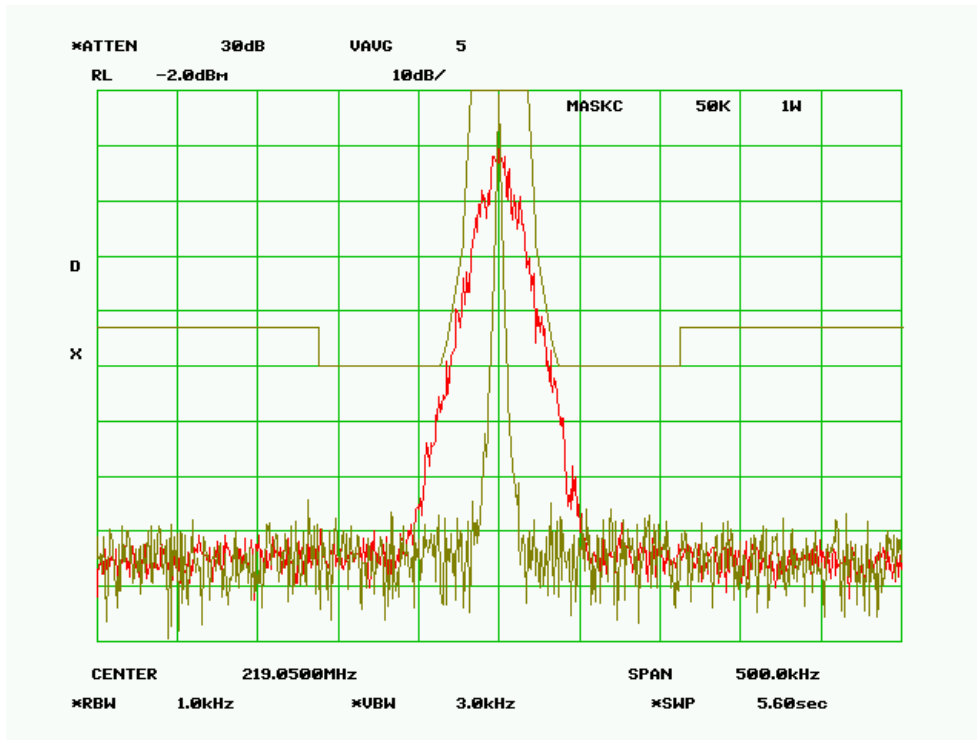
MASK C 50 kHz – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 36K0F1D
Data Rate = 96 kbps
PEAK DEVIATION = 15.33 kHz



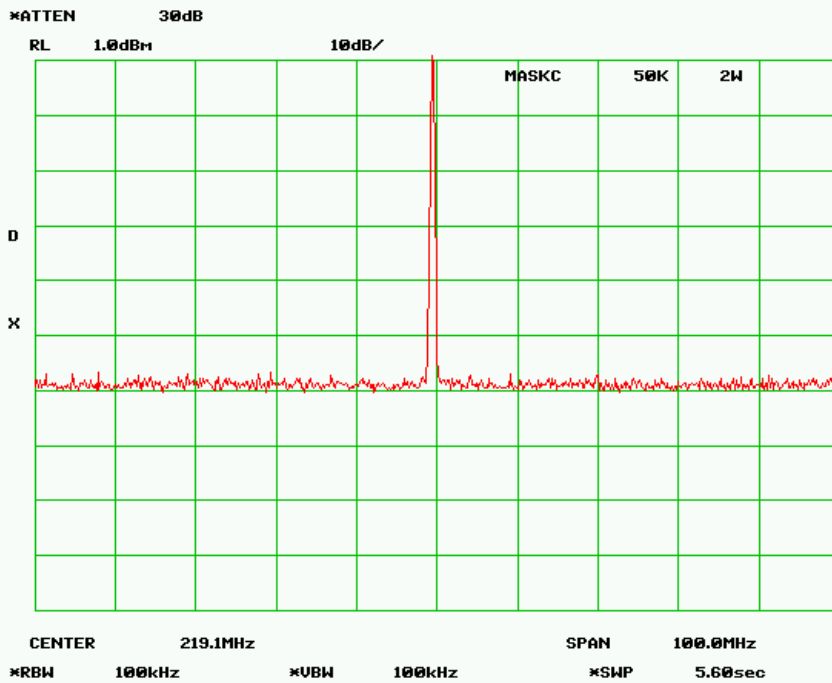
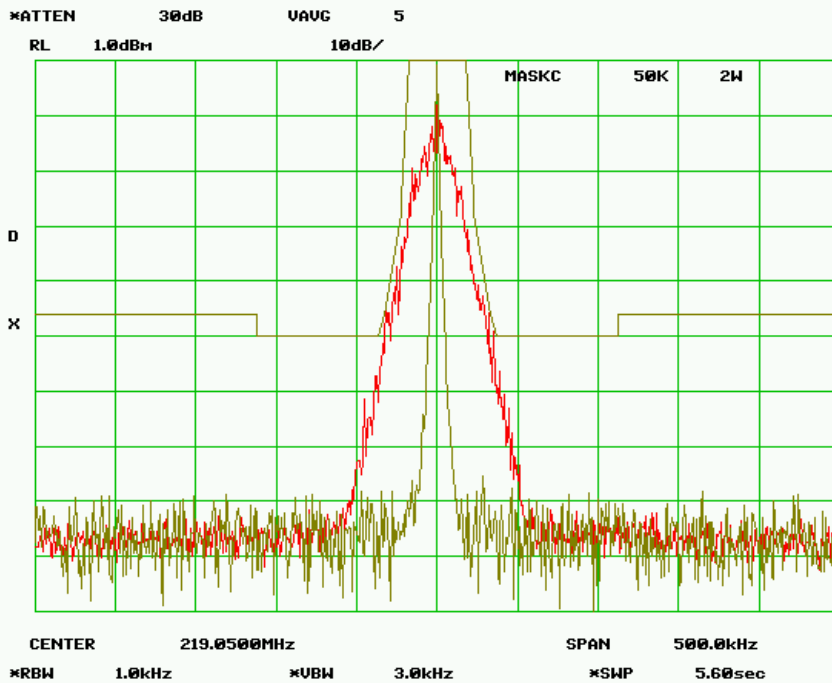
MASK C 50 kHz – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 36K0F1D
Data Rate = 96 kbps
PEAK DEVIATION = 15.33 kHz



MASK C 50 kHz – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 33K0F1D
Data Rate = 128 kbps
PEAK DEVIATION = 11.66 kHz



MASK C 50 kHz – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 33K0F1D
Data Rate = 128 kbps
PEAK DEVIATION = 11.66 kHz



14.0 Part 80.211(f) - 80 kHz ABW

NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators **55K0F1D, 53K3F1D, 51K7F1D and 52K5F1D**

RULE PART NUMBER: FCC: 2.202, 80.211 (f): 80.215: 80.481
12 Watts and 1.0 Watt Part 80 216-220 MHz.

MINIMUM STANDARDS: **Part 80.211(f)**
Sidebands and Spurious [Rule 80.211 (f) P = 12 Watts and P=1 Watt]
Authorized Bandwidth = 80 kHz
On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;
On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and
On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10logP (mean power in watts) dB.

Attenuation = 0 dB at Fo to 40.0 kHz
Attenuation = 25 dB at 40.0 kHz
Attenuation = 35 dB at 80.0 kHz
Attenuation = 43 dB at 200 kHz
Attenuation = 43 dB > 200 kHz @ 1 Watt
Attenuation = 53.8 dB > 200 kHz @ 12 Watt

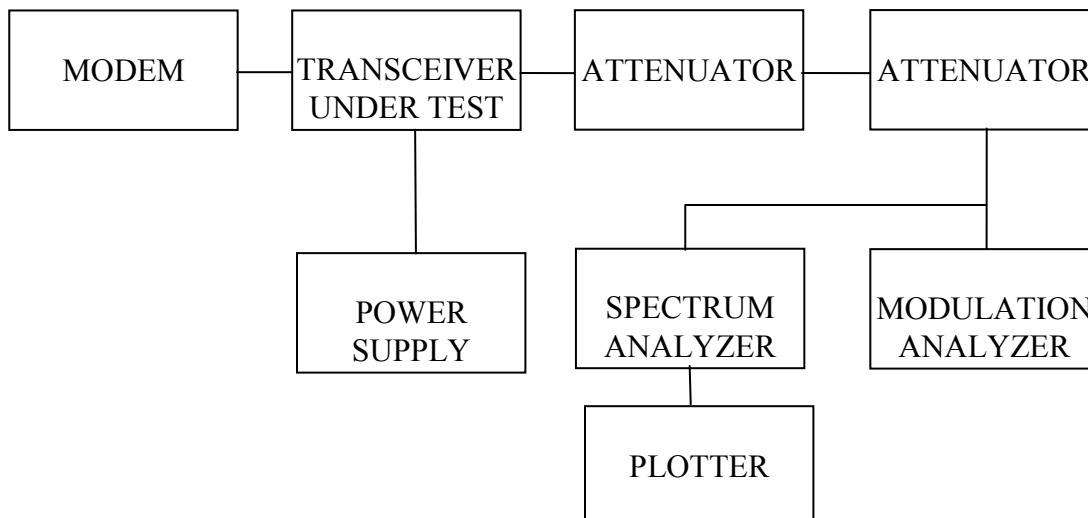
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C
RF Power Level = 1 Watt and 12 Watts
Voltage = 20VDC

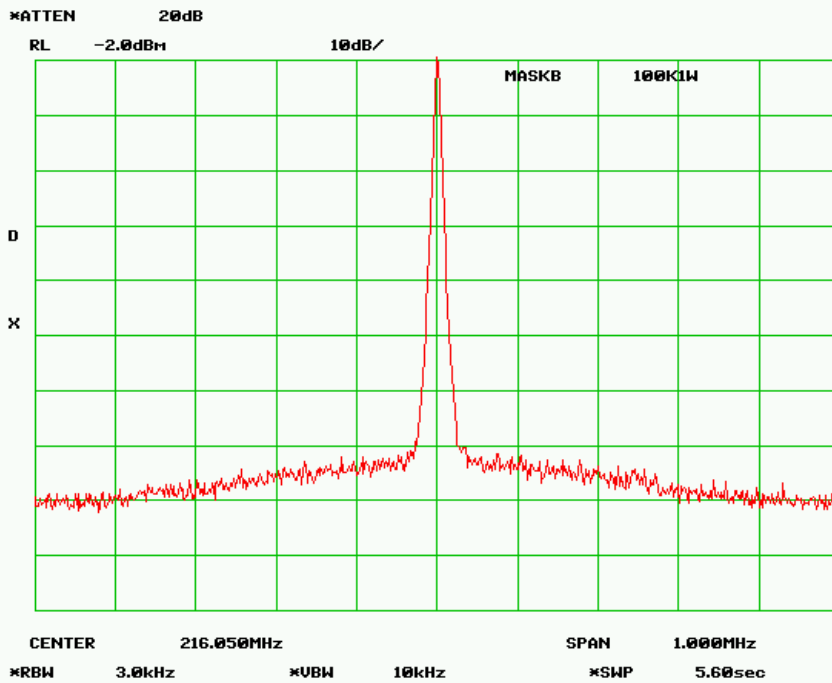
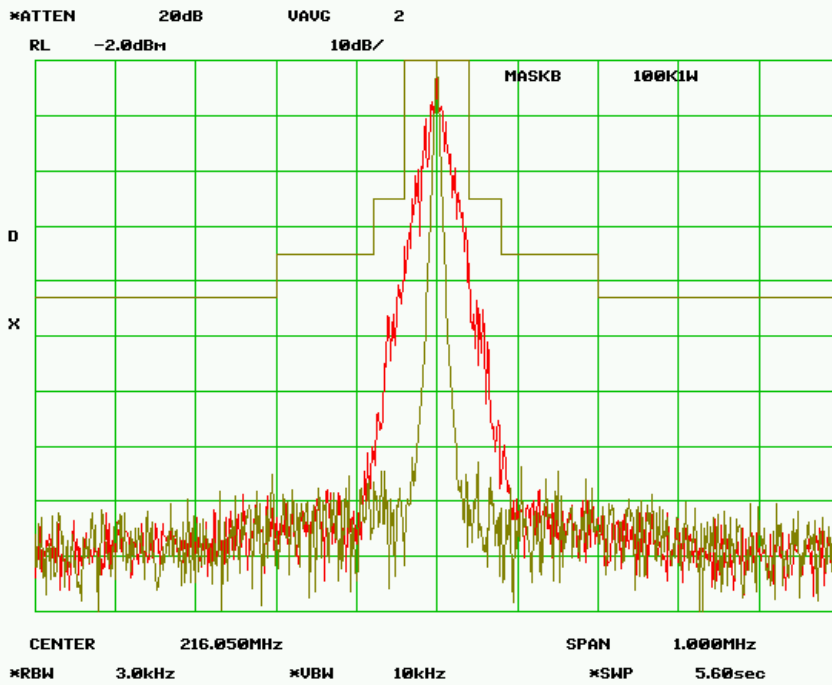
TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13, 3.2.11.2

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
50-Ohm Attenuator, Pasternack Model PE7002-10 (10dB)
DC Power Supply, Hewlett Packard Model 6653A
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901B

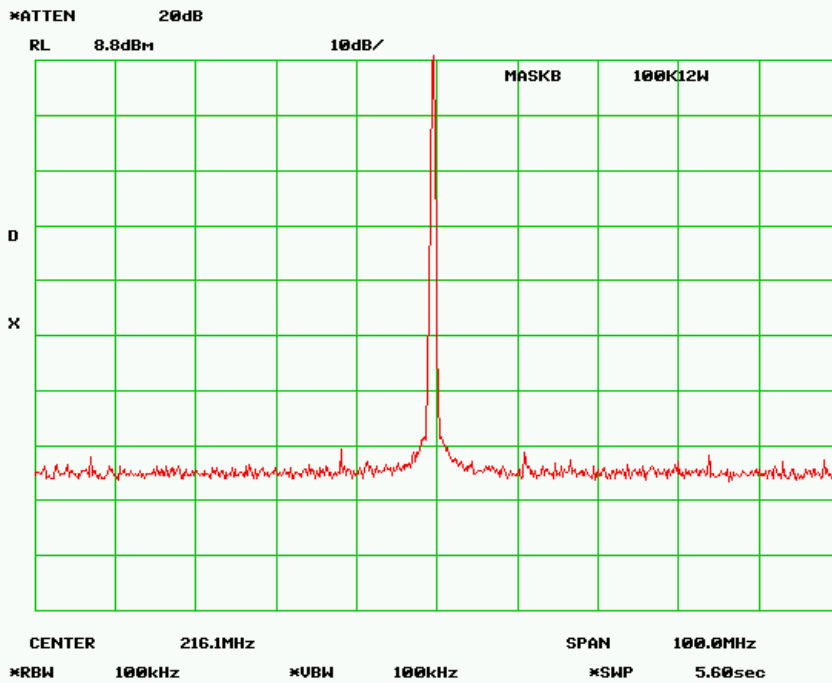
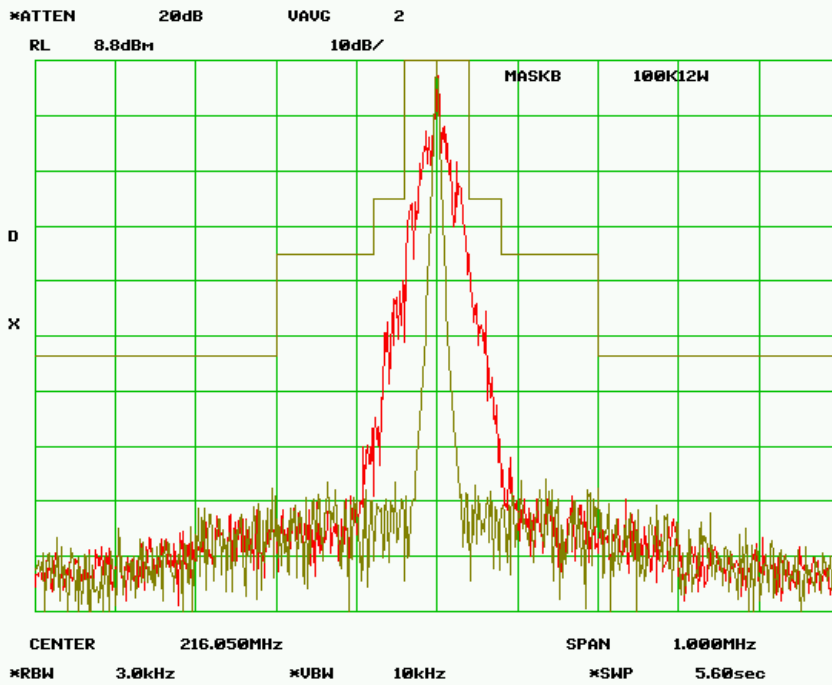
TEST SET-UP:



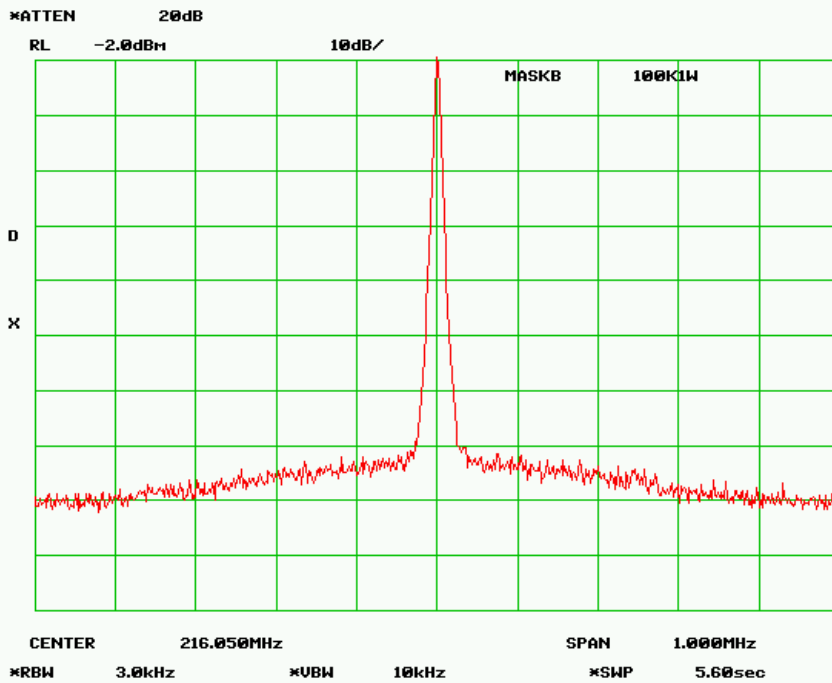
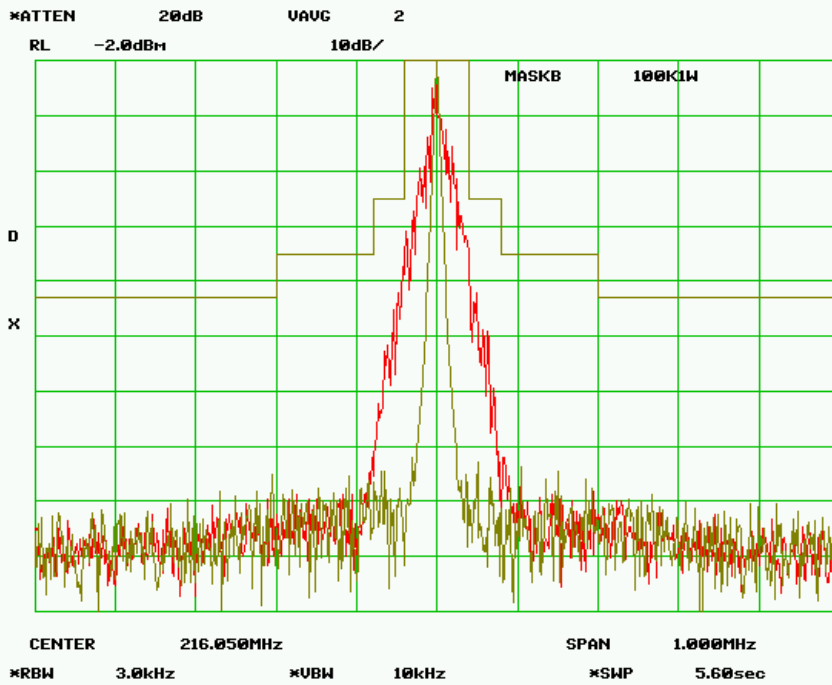
MASK B – 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 55K0F1D
Data Rate = 64 kbps
PEAK DEVIATION = 12.32 kHz



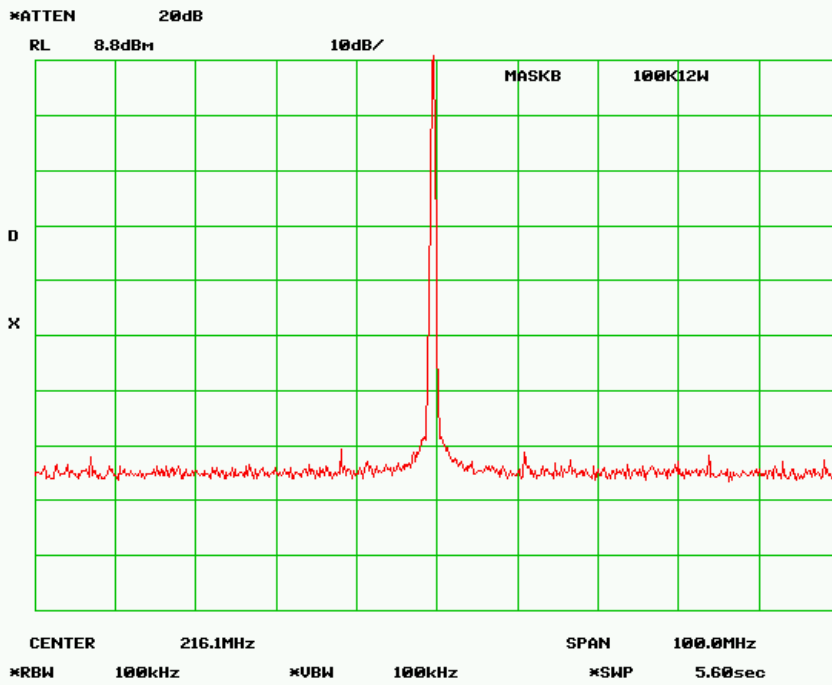
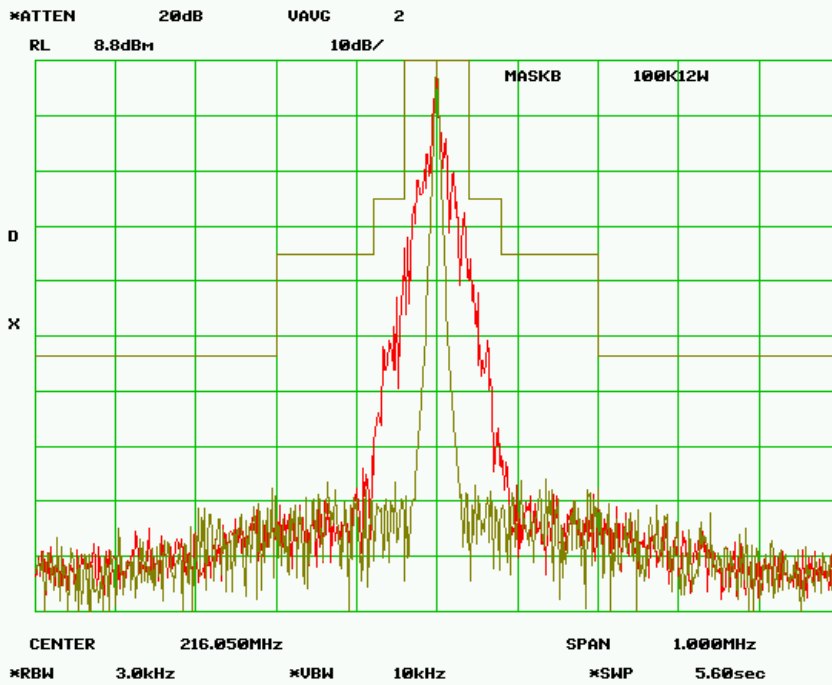
MASK B – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 55K0F1D
Data Rate = 64 kbps
PEAK DEVIATION = 12.32 kHz



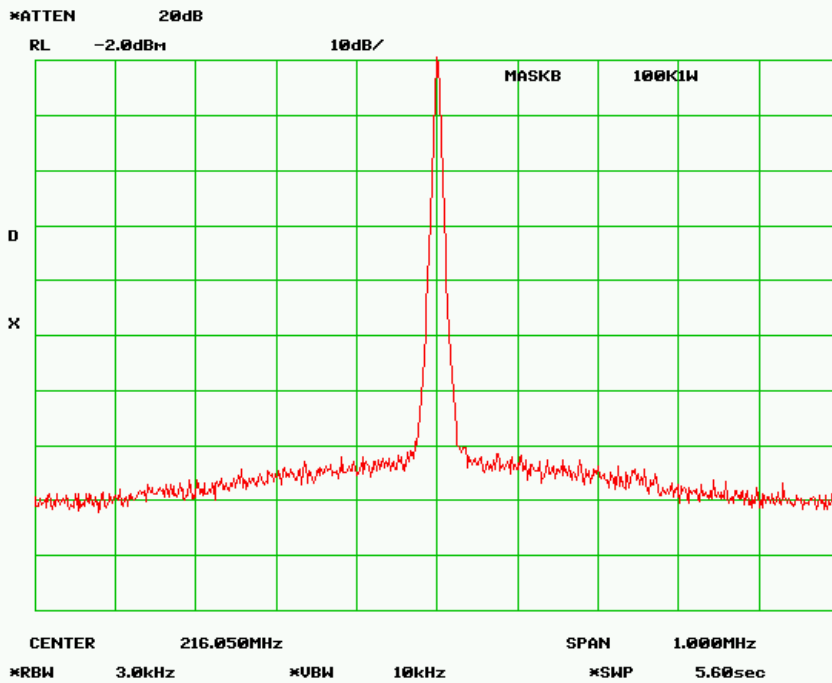
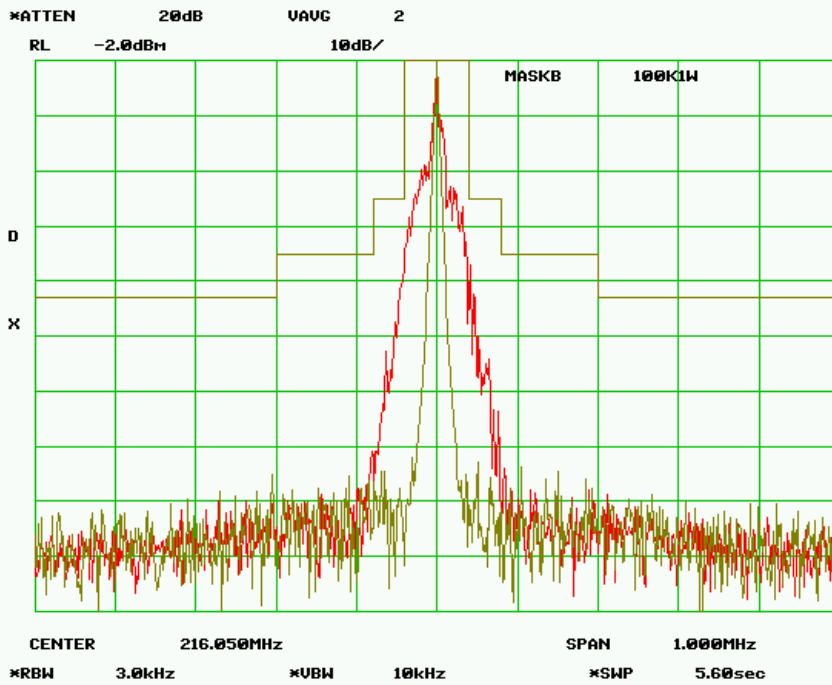
MASK B – 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 53K3F1D
Data Rate = 128 kbps
PEAK DEVIATION = 12.50 kHz



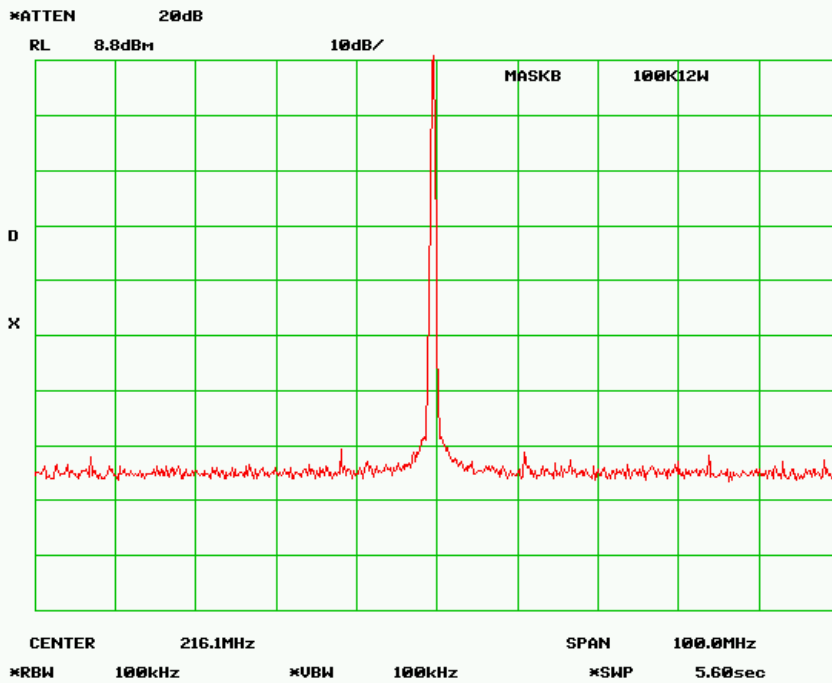
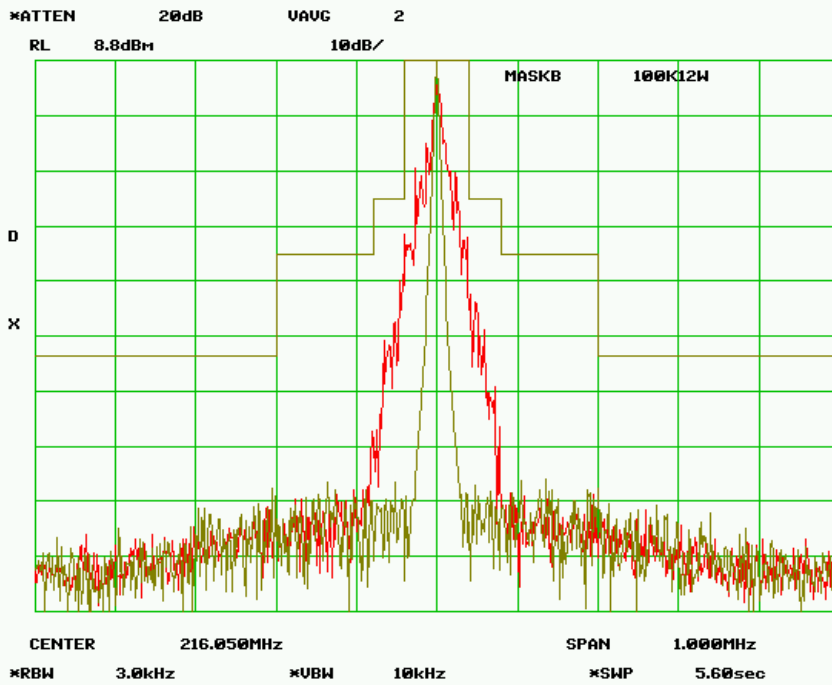
MASK B – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 53K3F1D
Data Rate = 128 kbps
PEAK DEVIATION = 12.50 kHz



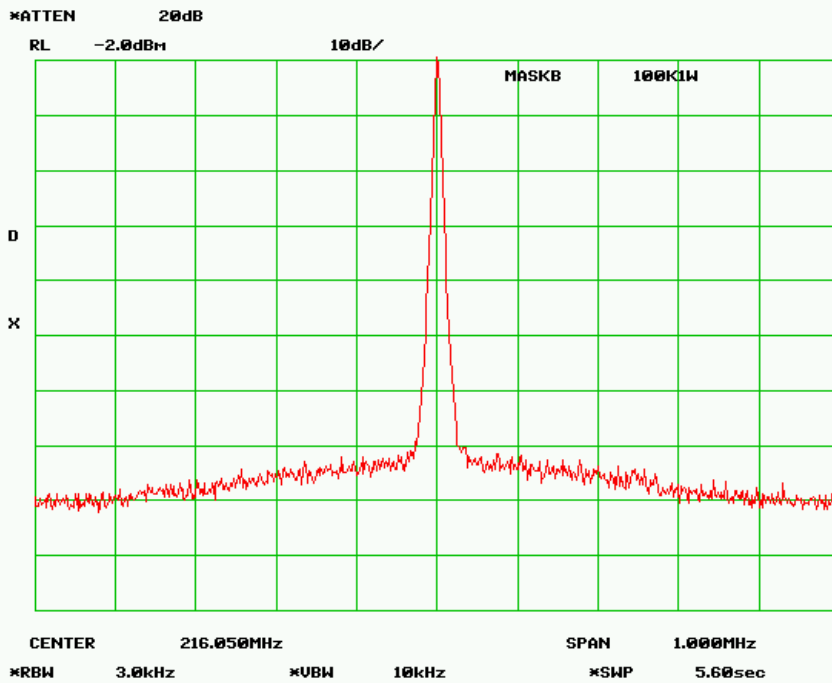
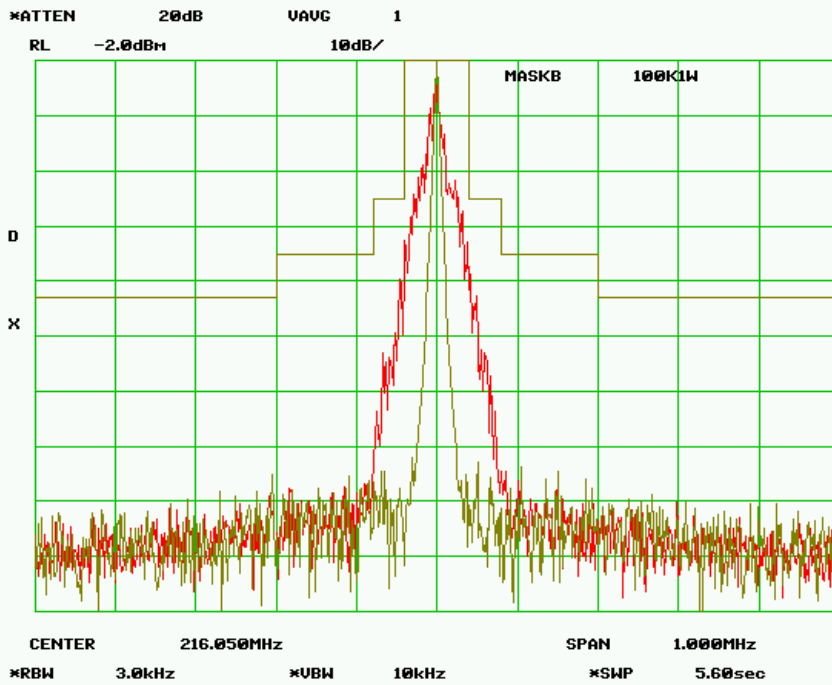
MASK B – 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 51K7F1D
Data Rate = 192 kbps
PEAK DEVIATION = 13.17 kHz



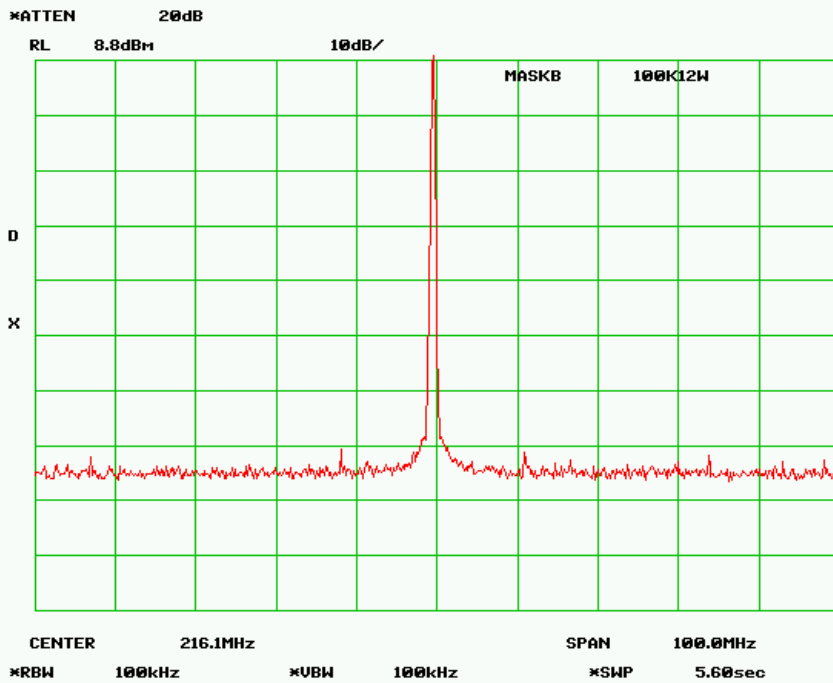
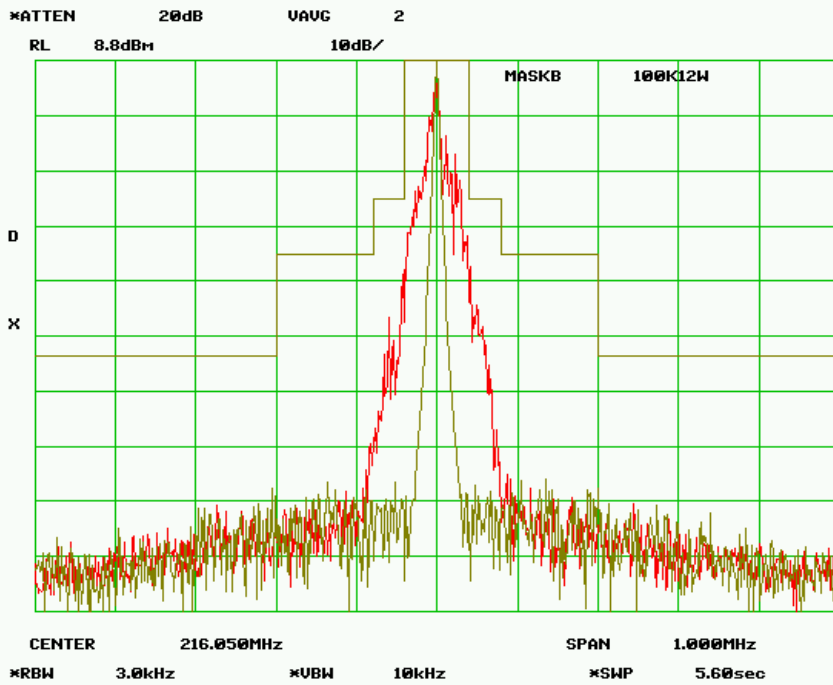
MASK B – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 51K7F1D
Data Rate = 192 kbps
PEAK DEVIATION = 13.17 kHz



MASK B – 1.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 52K5F1D
Data Rate = 256 kbps
PEAK DEVIATION = 13.97 kHz



MASK B – 12.0 Watts
RF Frequency 216.050 MHz
SPECTRUM FOR EMISSION - 52K5F1D
Data Rate = 256 kbps
PEAK DEVIATION = 13.97 kHz



15.0 Mask C – Part 90.259(a) – 80 kHz ABW

NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators **55K0F1D, 53K3F1D, 51K7F1D and 52K5F1D**

RULE PART NUMBER: FCC: 2.202, 90.209 (b)(5), 90.210(c), 2.1049 (c) (1)
Data taken at 2 watts is to be applied to Part 90.259(a) (217-220 MHz).

MINIMUM STANDARDS: **Mask C 100 kHz – 90.259(a)**
Sidebands and Spurious [Rule 90.210 (c), P = 2 Watts and P = 1 Watt]
Authorized Bandwidth = 80 kHz [Rule 90.209(b) (5), 90.259(a)]
From Fo to 5 kHz, down 0 dB.
Greater than 5 kHz to 10 kHz, down $83 * \log_{10}(f_d / 5)$ dB.
Greater than 10 kHz to 250% of authorized BW, at least $29 * \log_{10}(f_d^2 / 11)$ or 50 dB, whichever is the lesser attenuation
Greater than 250% of authorized BW, $43 + 10\log_{10}(P)$

- Attenuation = 0 dB at Fo to 42.5 kHz
- Attenuation = 25 dB at 47.500 kHz
- Attenuation = 27.8 dB at 47.500 kHz
- Attenuation = 35.4 dB at 51.0 kHz
- Attenuation = 41.3 dB at 54.6 kHz
- Attenuation = 46.0 dB at 58.1 kHz
- Attenuation = 50 dB at 61.6 kHz
- Attenuation = 50 dB at 237.5 kHz
- Attenuation = 46 dB at frequencies greater than 237.5 kHz @ 2 W
- Attenuation = 43 dB at frequencies greater than 237.5 kHz @ 1 W

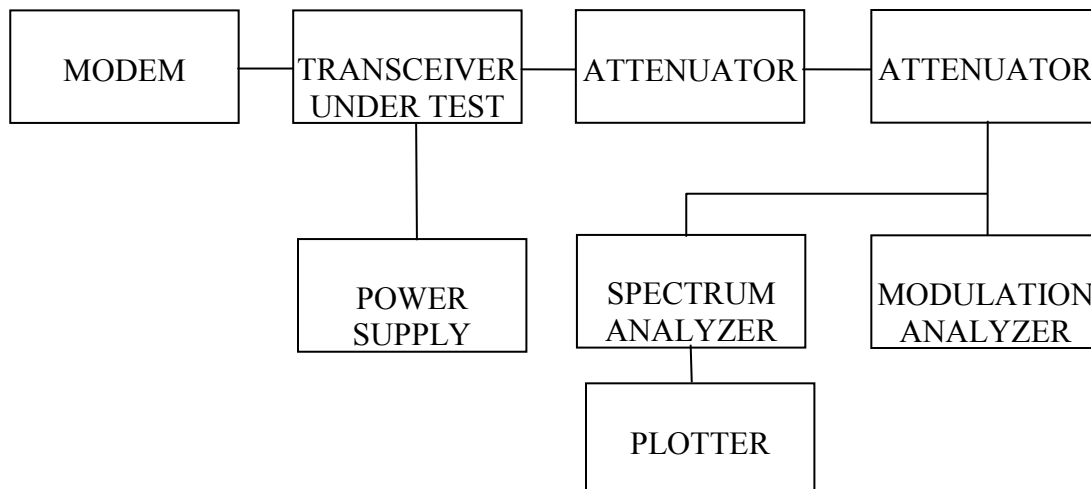
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C
RF Power Level = 1 Watt and 2 Watts
Voltage = 20VDC

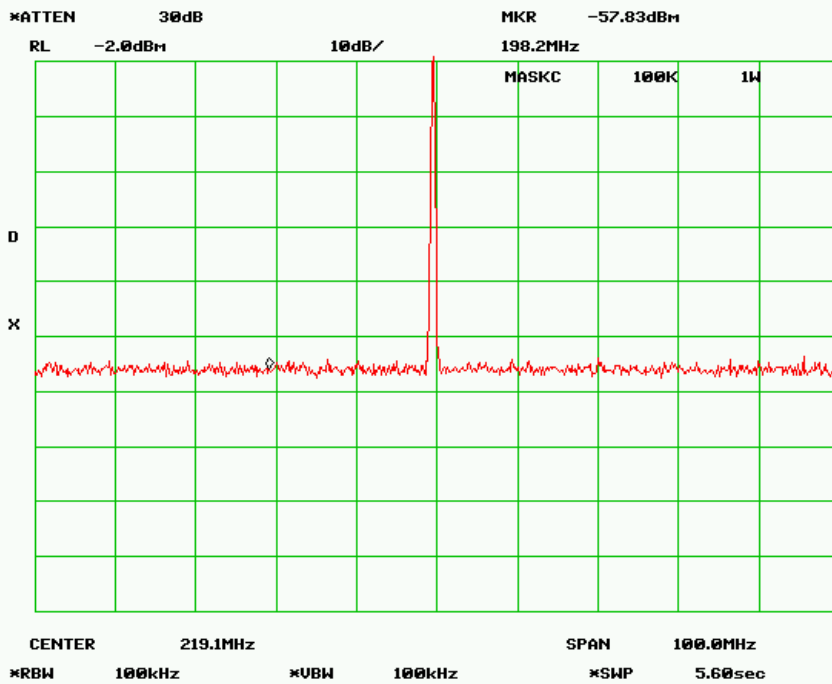
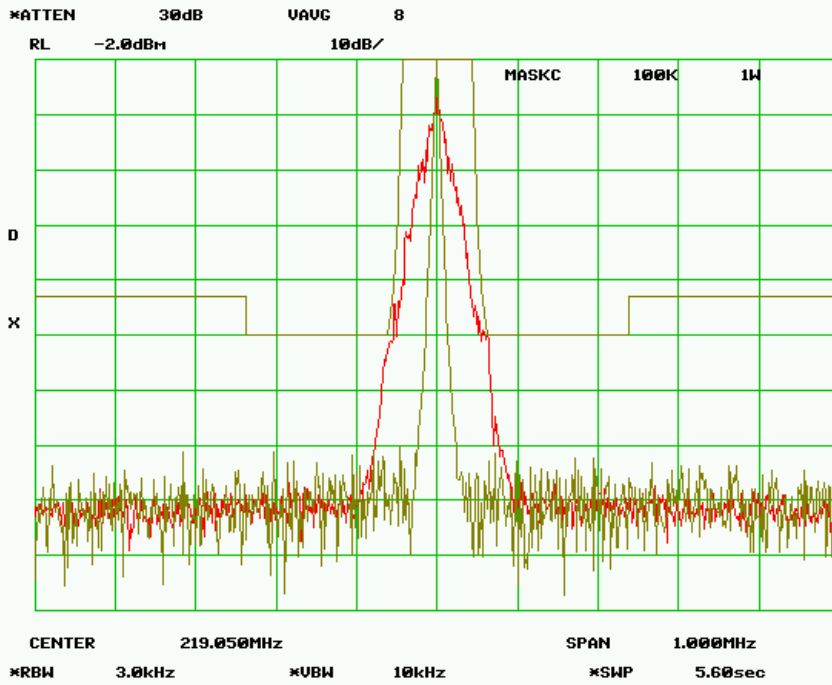
TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13, 3.2.11.2

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
50-Ohm Attenuator, Pasternack Model PE7002-10 (10dB)
DC Power Supply, Hewlett Packard Model 6653A
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901B

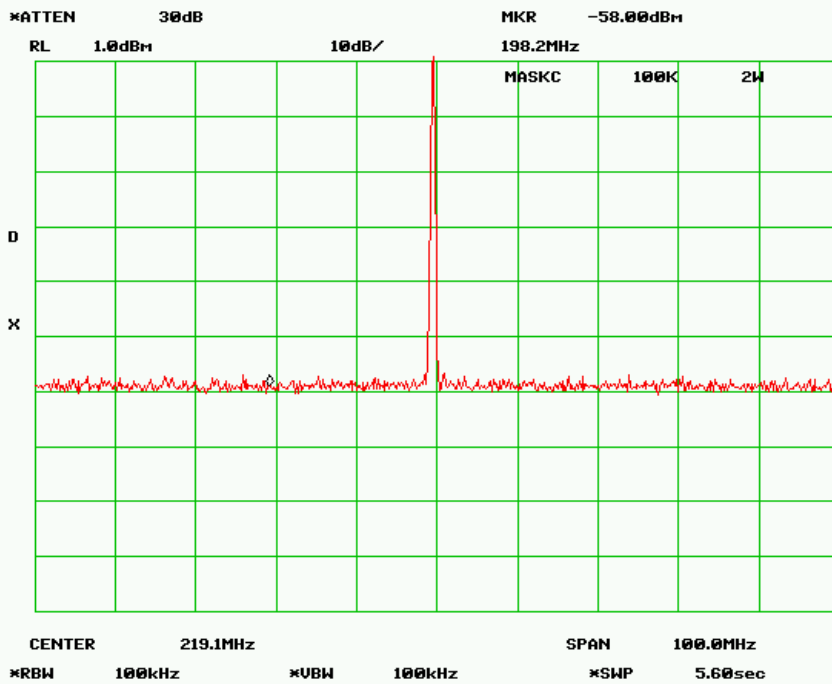
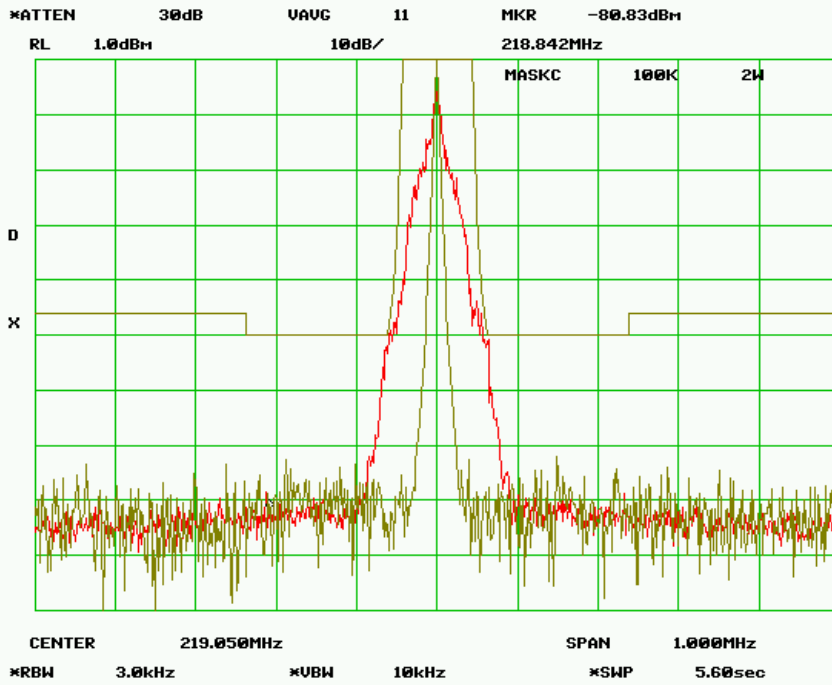
TEST SET-UP:



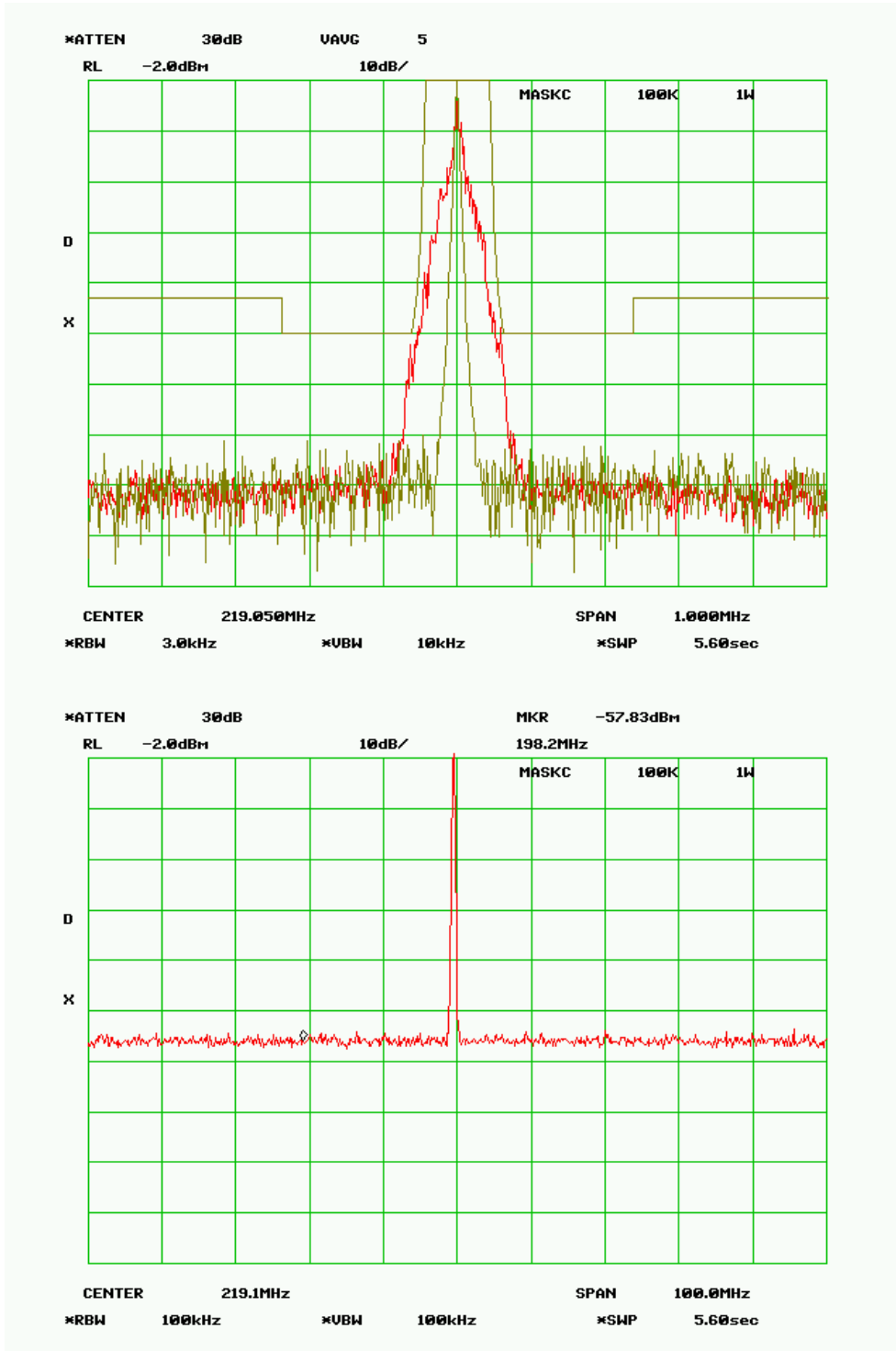
MASK C 100 kHz – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 55K0F1D
Data Rate = 64 kbps
PEAK DEVIATION = 12.32 kHz



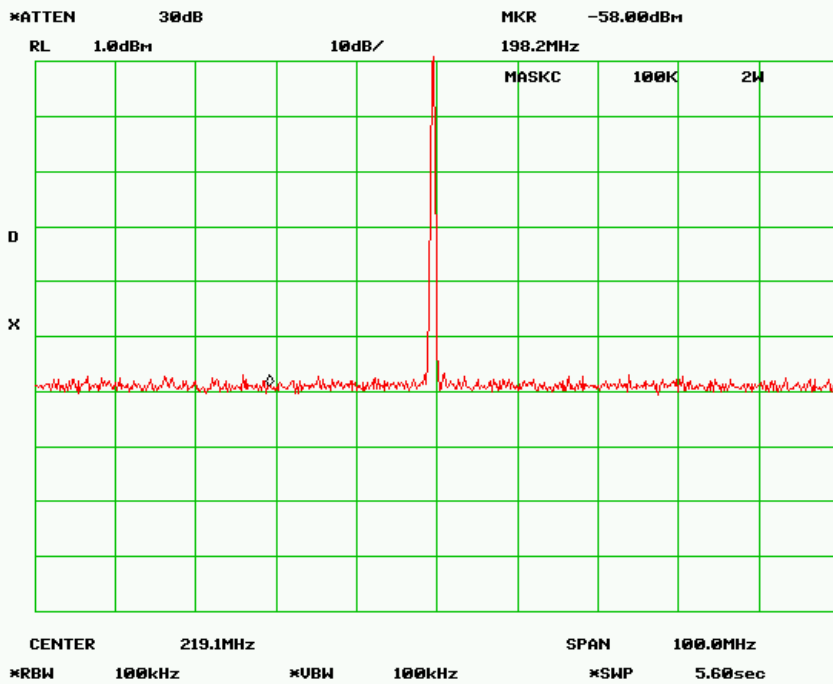
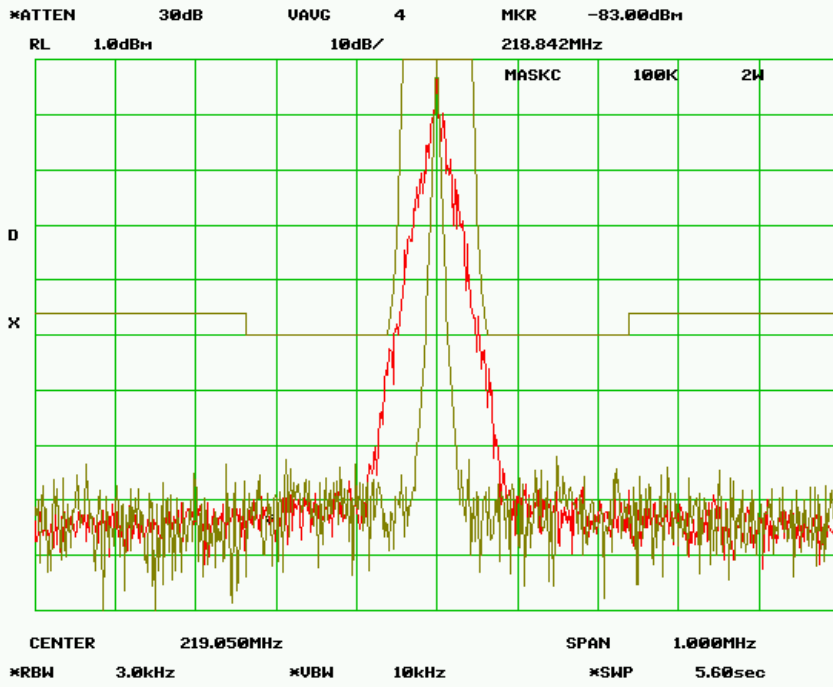
MASK C 100 kHz – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 55K0F1D
 Data Rate = 64 kbps
 PEAK DEVIATION = 12.32 kHz



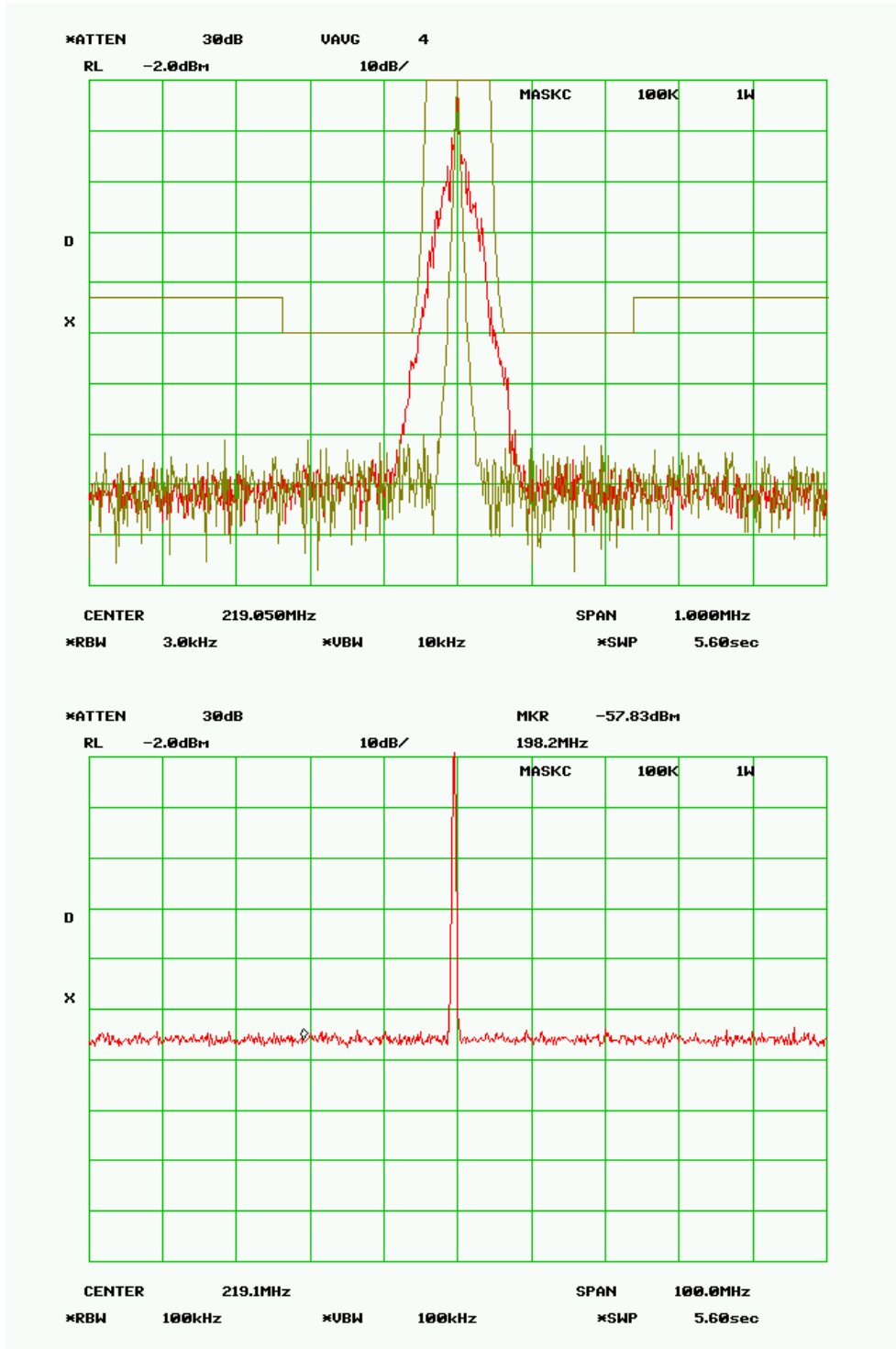
MASK C 100 kHz – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 53K3F1D
Data Rate = 128 kbps
PEAK DEVIATION = 12.50 kHz



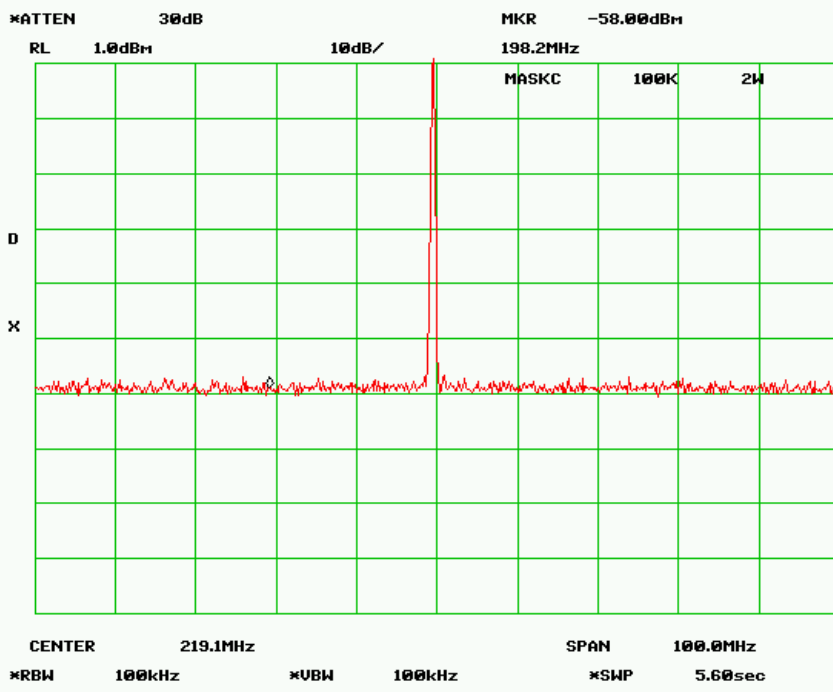
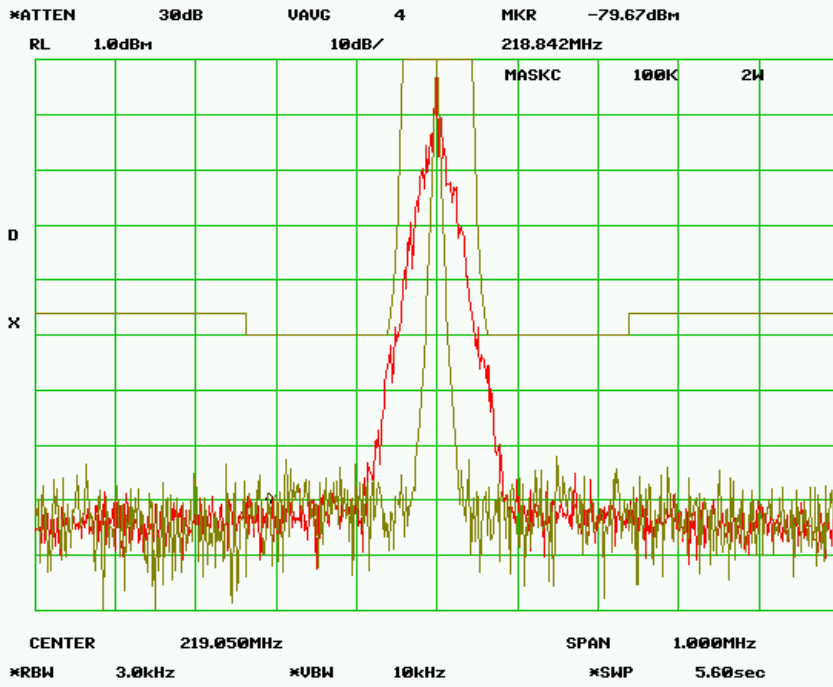
MASK C 100 kHz – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 53K3F1D
 Data Rate = 128 kbps
 PEAK DEVIATION = 12.50 kHz



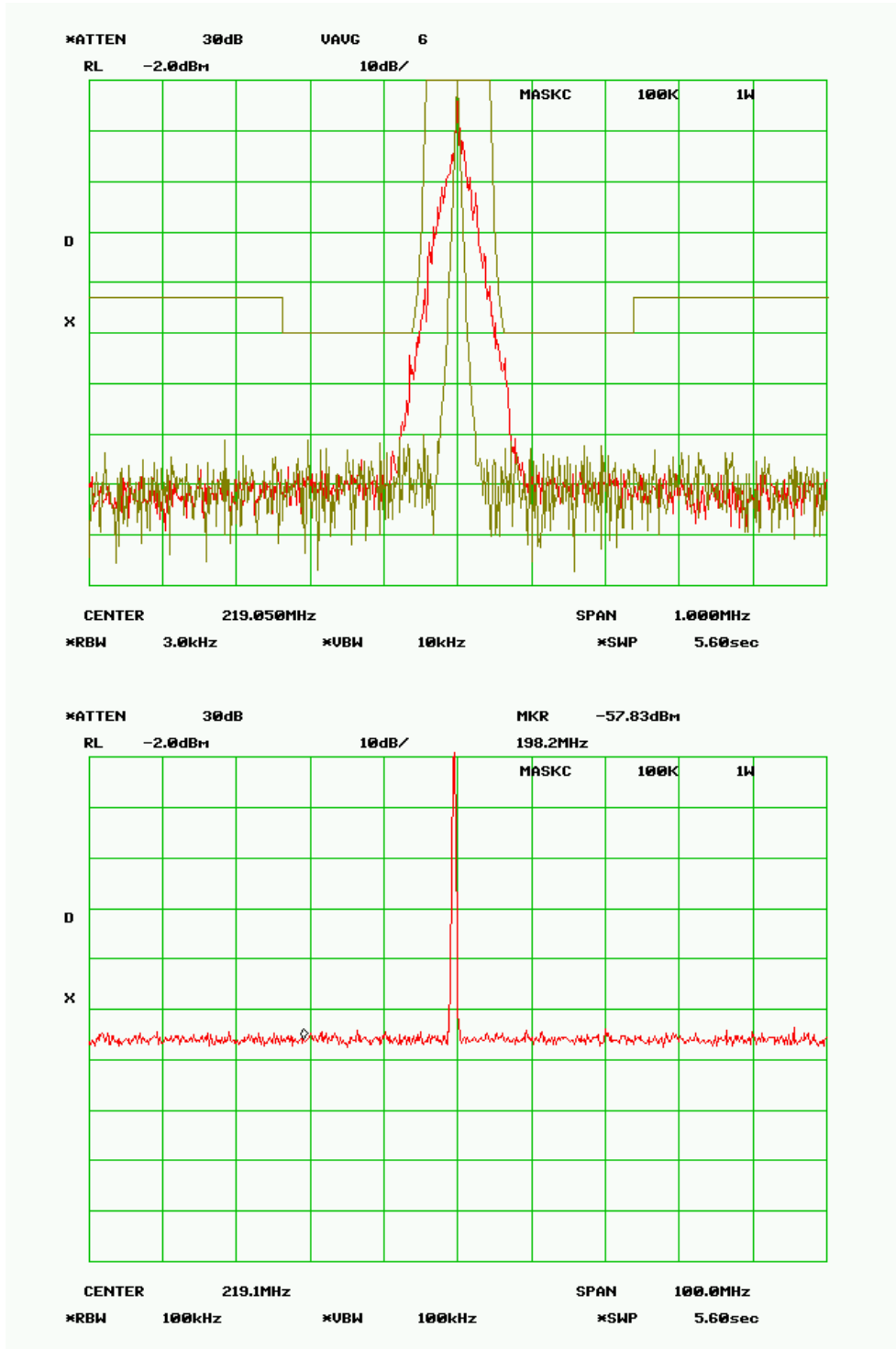
MASK C 100 kHz – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 51K7F1D
Data Rate = 192 kbps
PEAK DEVIATION = 13.17 kHz



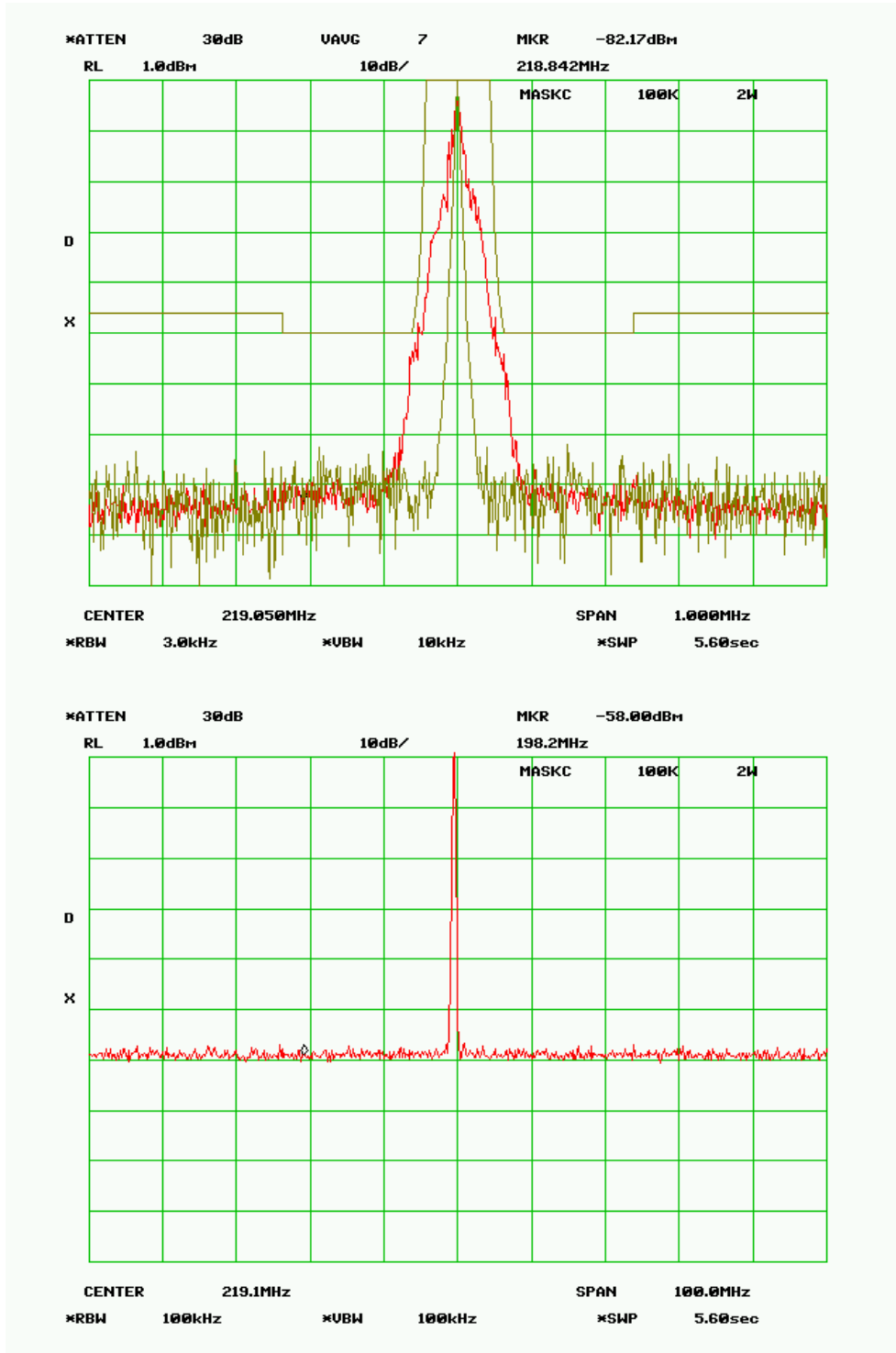
MASK C 100 kHz – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 51K7F1D
 Data Rate = 192 kbps
 PEAK DEVIATION = 13.17 kHz



MASK C 100 kHz – 1.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 52K5F1D
Data Rate = 256kbps
PEAK DEVIATION = 13.97 kHz



MASK C 100 kHz – 2.0 Watts
RF Frequency 219.050 MHz
SPECTRUM FOR EMISSION - 52K5F1D
Data Rate = 256kbps
PEAK DEVIATION = 13.97 kHz



16.0 Mask F Part 90.210(f) - 220-222 MHz – 6.25k

NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators
3K30F1D, 3K55F1D and 3K20F1D

RULE PART NUMBER: FCC: 2.202, 90.209(b)(5), 90.210(f), 2.1049(c) (1)

MINIMUM STANDARDS: **Mask F**
Sidebands and Spurious [Rule 90.210 (f), P = 12 Watts and P=1 Watt]
Authorized Bandwidth = 4 kHz [Rule 90.209(b)(5)]
From Fo to 2 kHz, down 0 dB.
Greater than 2 kHz to 3.75 kHz, down 30 + 20(fd -2) dB or 55 + 10 log (P), or 65 dB, whichever is the lesser attenuation.
On any frequency beyond 3.75 kHz removed from the center of the authorized bandwidth fd: At least 55 + 10 log (P) dB.

The equipment under test will not function inside a single channel in the 220 to 222MHz band. Therefore the EUT was tested using aggregate combinations of channels as follows:

- 3K30F1D 2 contiguous channels
 - 3K55F1D 2 contiguous channels
 - 3K20F1D 2 contiguous channels
- For emission designators 3K30F1D, 3K55F1D and 3K20F1D
Attenuation = 0 dB at Fo to 4.5 kHz
Attenuation = 30 dB at 4.5 kHz
Attenuation = 55 dB at 5.75 kHz @ 1W
Attenuation = 65.8 dB at 6.25 kHz @12W

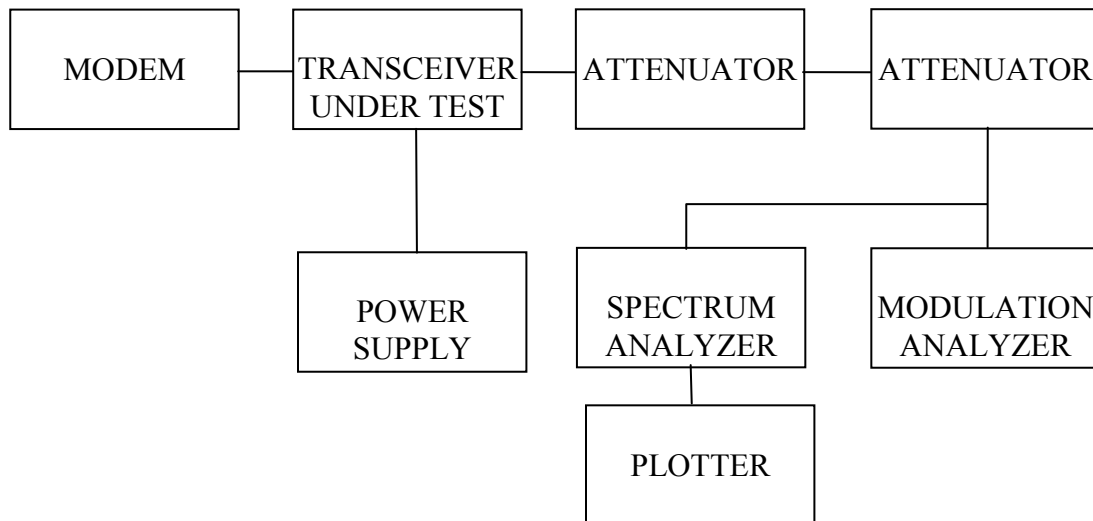
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C
RF Power Level = 1 Watt and 12 Watts
Voltage = 20VDC

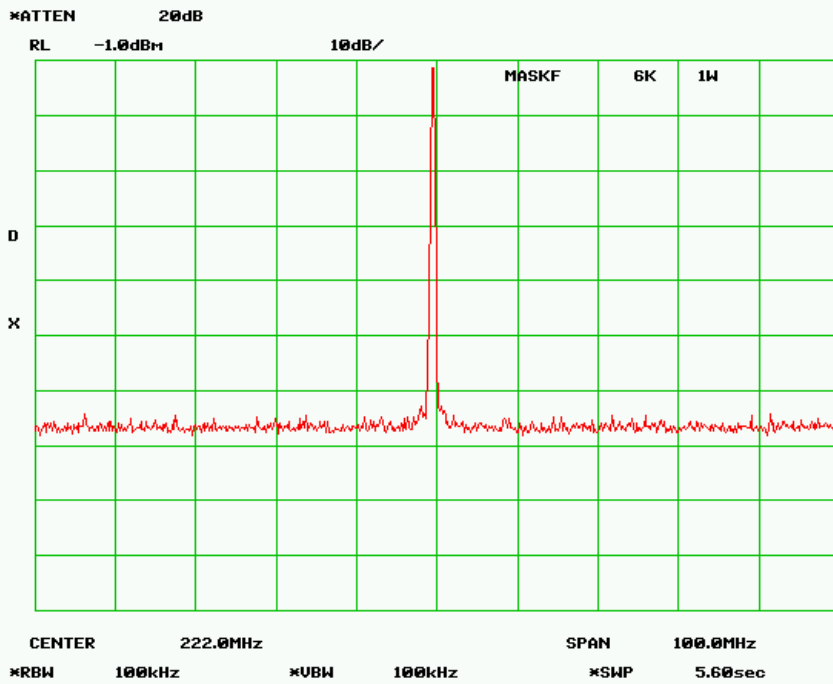
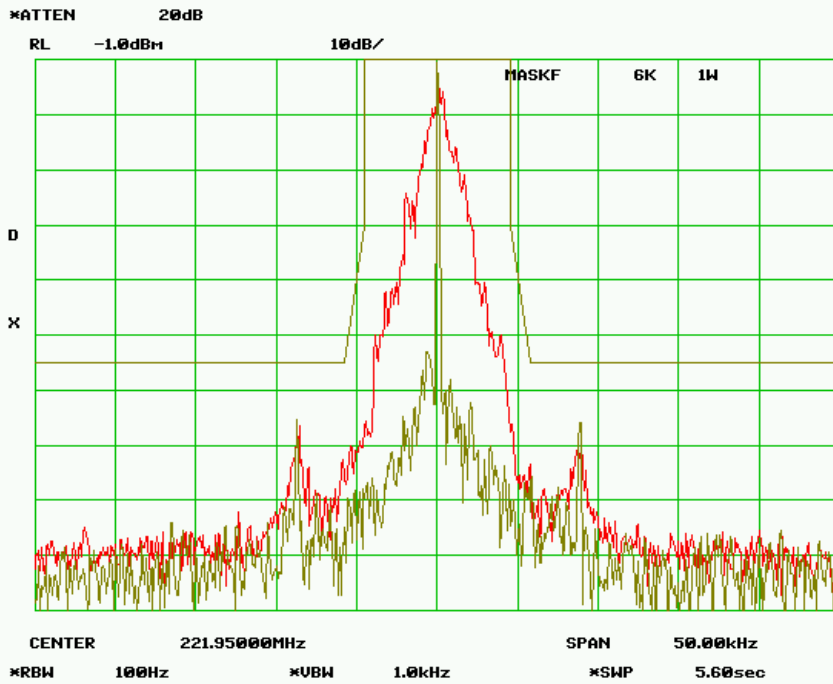
TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13, 3.2.11.2

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
50-Ohm Attenuator, Pasternack Model PE7002-10 (10dB)
DC Power Supply, Hewlett Packard Model 6653A
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901B

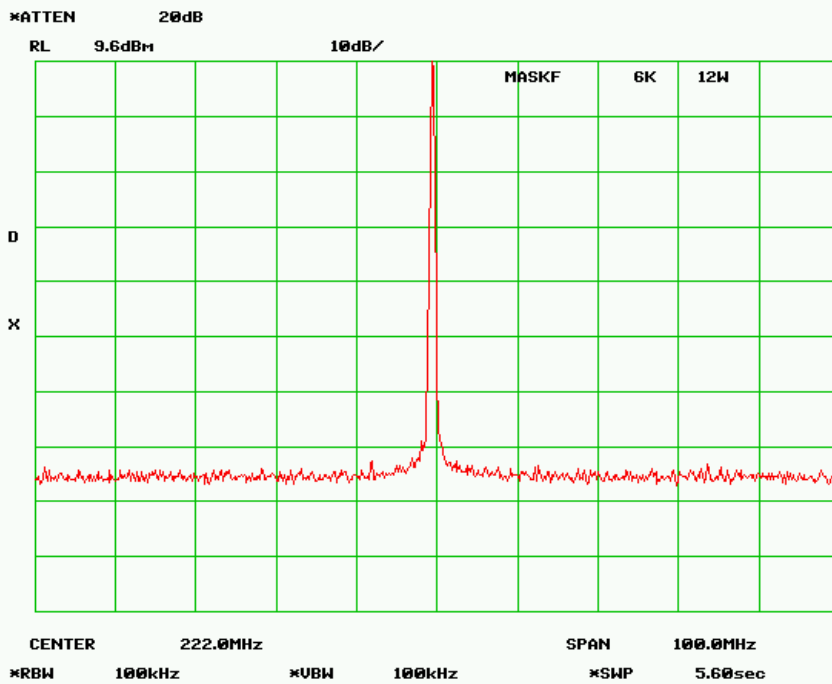
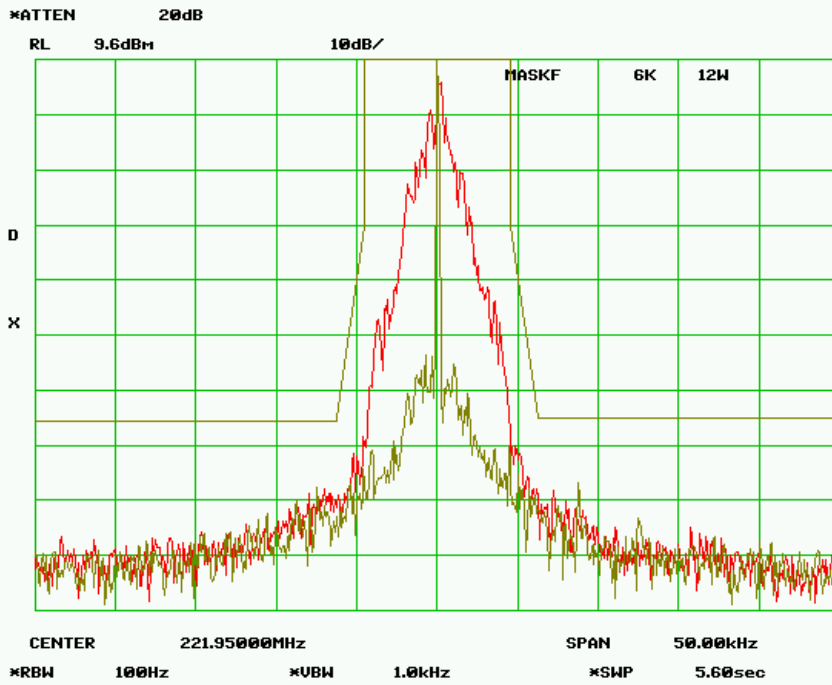
TEST SET-UP:



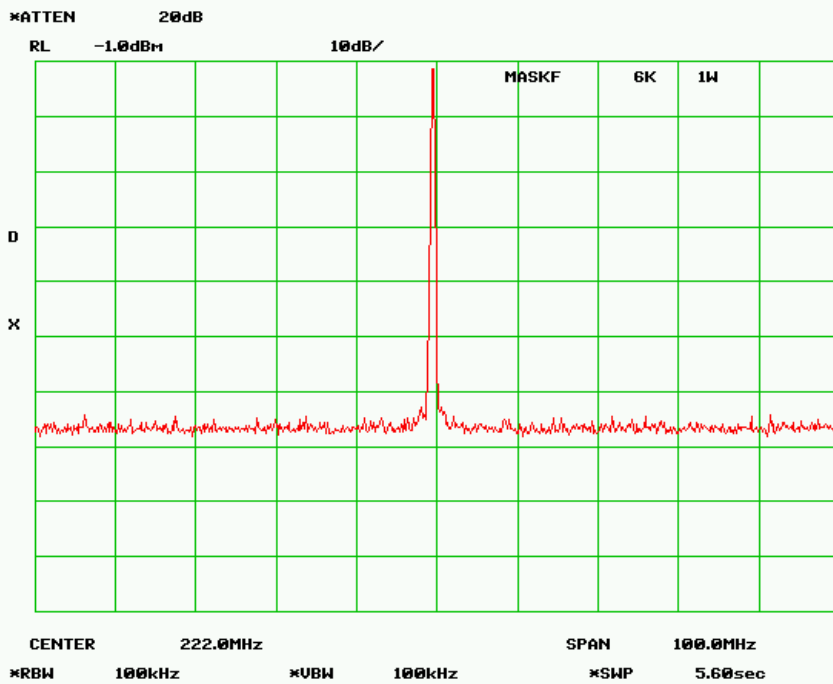
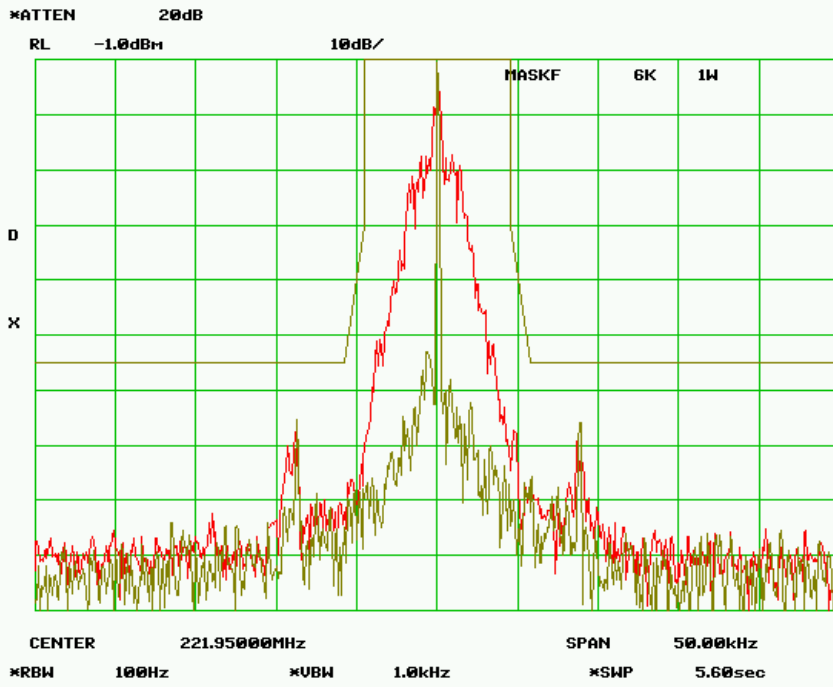
MASK F – 2 Aggregate MASKS – 1.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 3K30F1D
Data Rate = 4 kbps
PEAK DEVIATION = 1.15 kHz



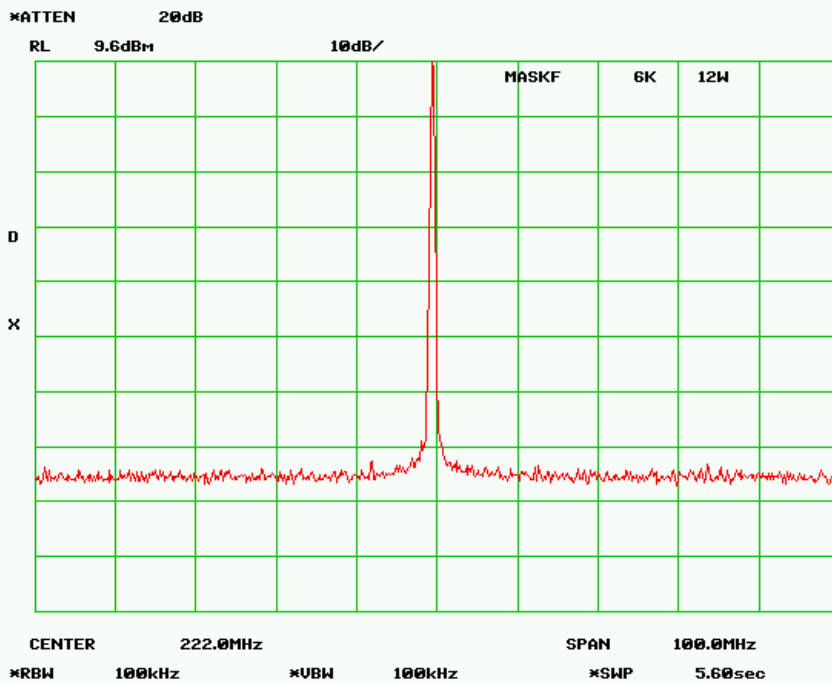
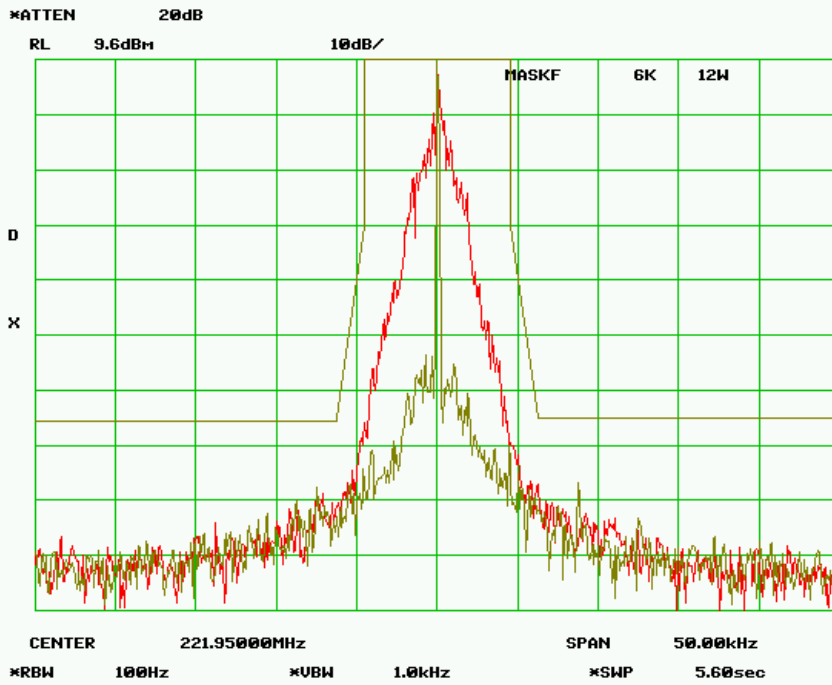
MASK F – 2 Aggregate MASKS – 12 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 3K30F1D
Data Rate = 4 kbps
PEAK DEVIATION = 1.15 kHz



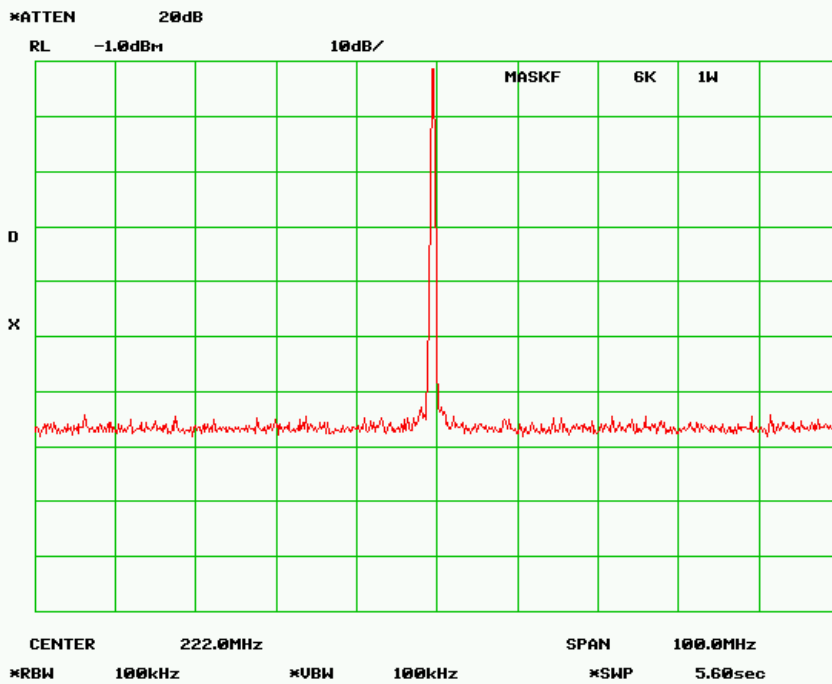
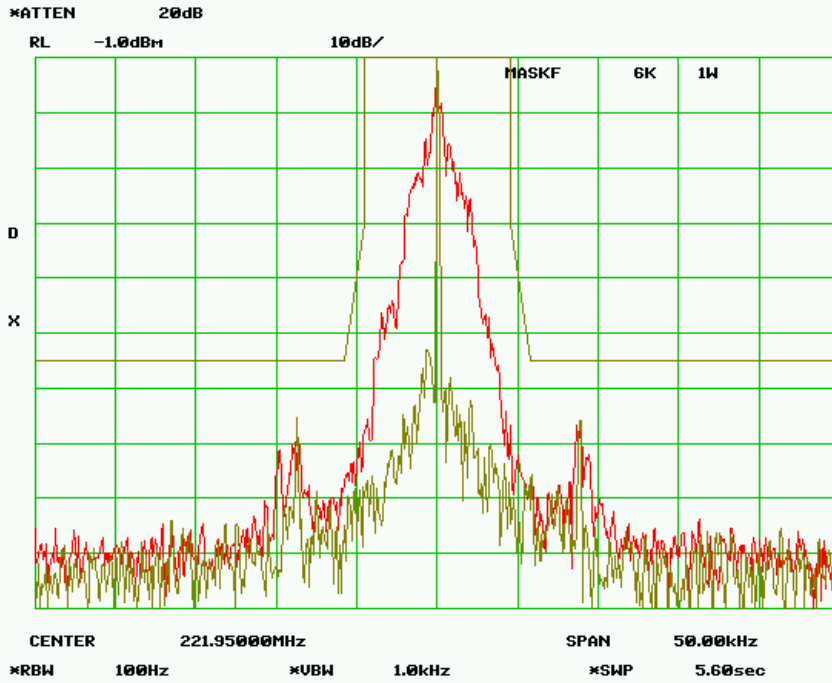
MASK F – 2 Aggregate MASKS – 1.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 3K55F1D
Data Rate = 8 kbps
PEAK DEVIATION = 1.09 kHz



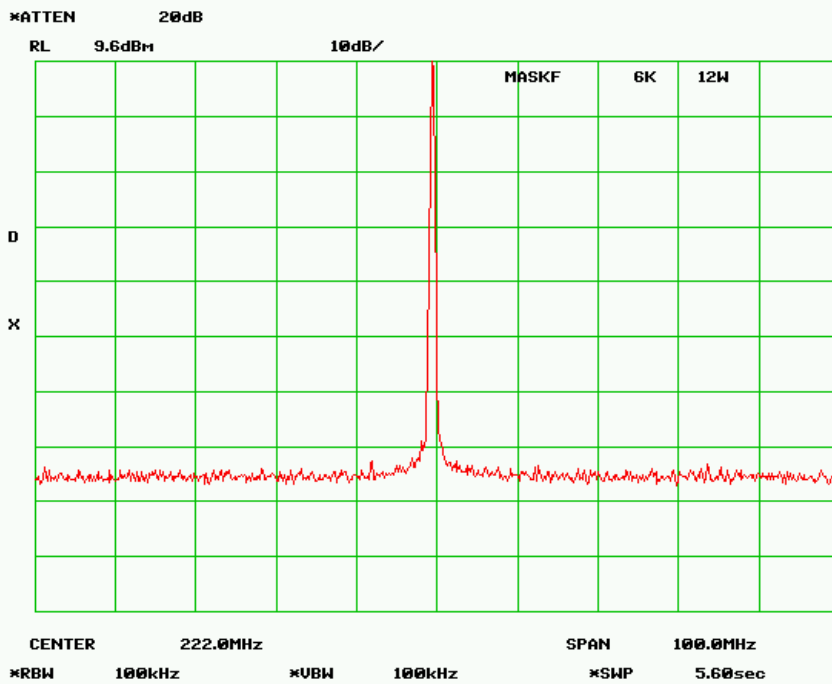
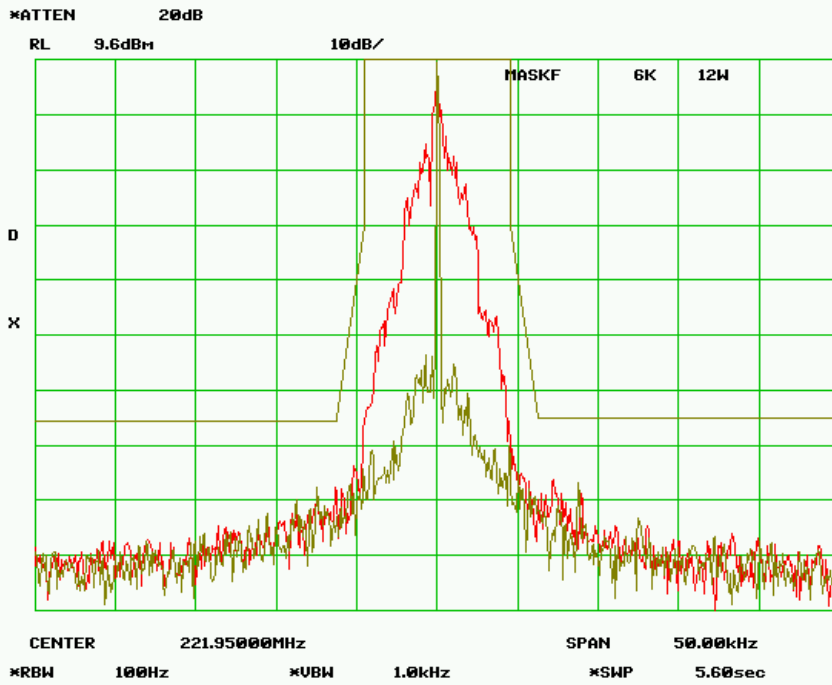
MASK F – 2 Aggregate MASKS – 12 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 3K55F1D
Data Rate = 8 kbps
PEAK DEVIATION = 1.09 kHz



MASK F – 2 Aggregate MASKS – 1.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 3K20F1D
Data Rate = 12 kbps
PEAK DEVIATION = 1.15 kHz



MASK F – 2 Aggregate MASKS – 12 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 3K20F1D
Data Rate = 12 kbps
PEAK DEVIATION = 1.15 kHz



17.0 Mask F Part 90.210(f) - 220-222 MHz – 12.5k

NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators
8K20F1D,8K30F1D, 8K50F1D and 8K08F1D

RULE PART NUMBER: FCC: 2.202, 90.209(b)(5), 90.210(f), 2.1049(c)(1)

MINIMUM STANDARDS: **Mask F**
 Sidebands and Spurious [Rule 90.210 (f), P = 12 Watts and P=1 Watt]
 Authorized Bandwidth = 4 kHz [Rule 90.209(b)(5)]
 From Fo to 2 kHz, down 0 dB.
 Greater than 2 kHz to 3.75 kHz, down 30 + 20(fd -2) dB or 55 + 10 log (P), or 65 dB,
 whichever is the lesser attenuation.
 On any frequency beyond 3.75 kHz removed from the center of the authorized
 bandwidth fd: At least 55 + 10 log (P) dB.

The equipment under test will not function inside a single channel in the 220 to 222MHz band. Therefore the EUT was tested using aggregate combinations of channels as follows:

- 8K20F1D 5 contiguous channels
 - 8K30F1D 5 contiguous channels
 - 8K50F1D 5 contiguous channels
 - 8K08F1D 5 contiguous channels
- For emission designators 8K20F1D, 8K30F1D, 8K50F1D and 8K08F1D
 Attenuation = 0 dB at Fo to 12 kHz
 Attenuation = 30 dB at 12 kHz
 Attenuation = 55 dB at 13.25 kHz @1W
 Attenuation = 65.8 dB at 13.75 kHz @12W

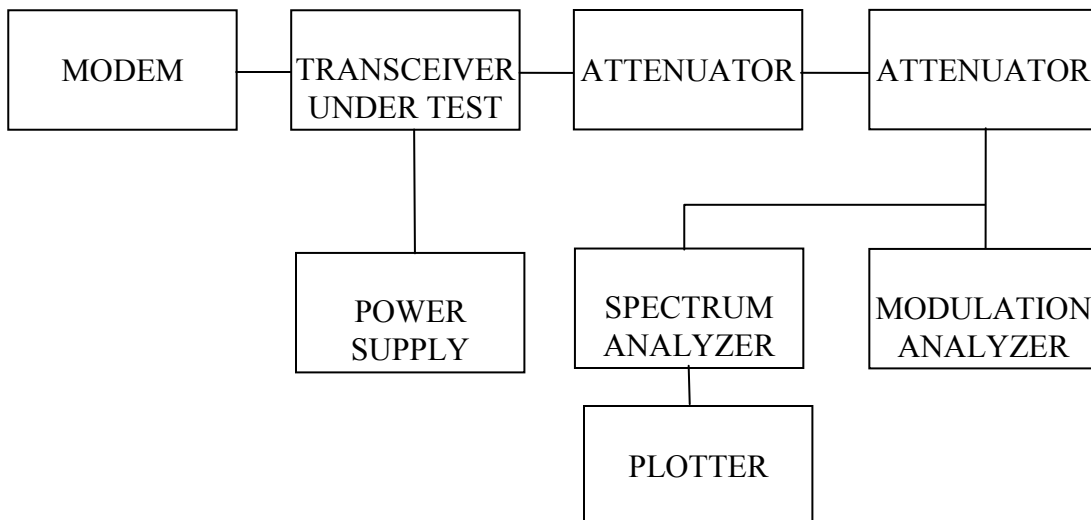
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C
 RF Power Level = 1 Watt and 12 Watts
 Voltage = 20VDC

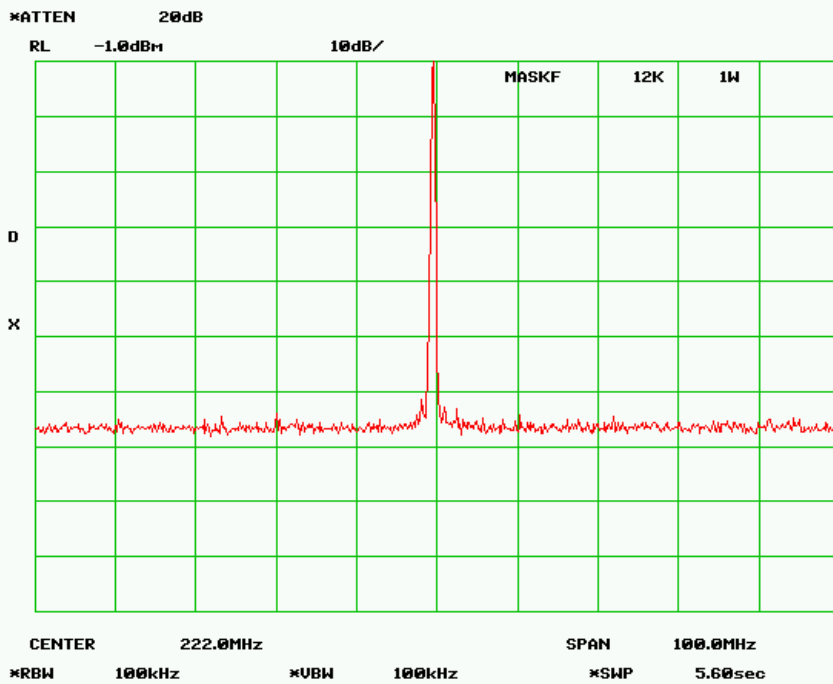
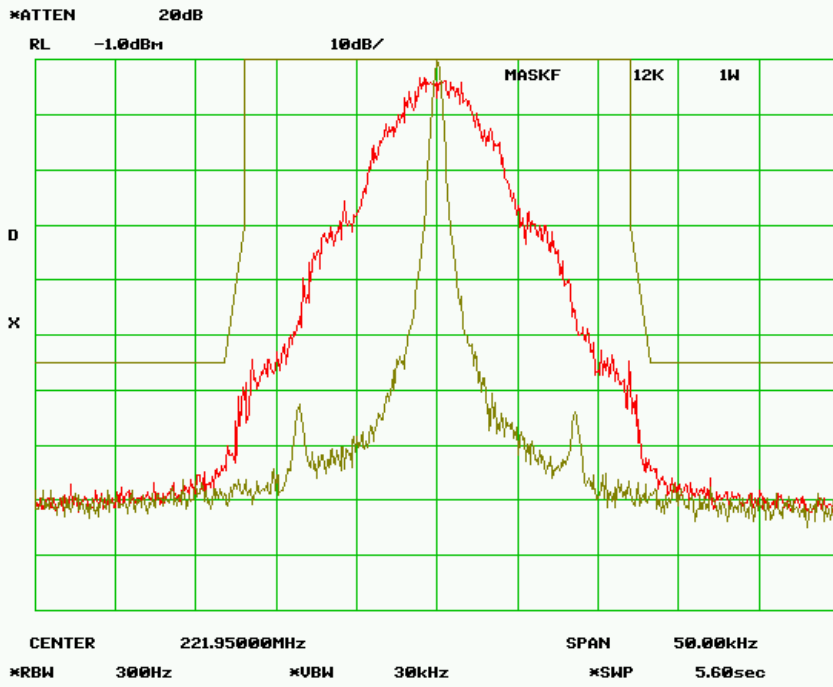
TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13, 3.2.11.2

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
 50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
 50-Ohm Attenuator, Pasternack Model PE7002-10 (10dB)
 DC Power Supply, Hewlett Packard Model 6653A
 Spectrum Analyzer, Hewlett Packard Model HP8563E
 Modulation Analyzer, Hewlett Packard Model HP8901B

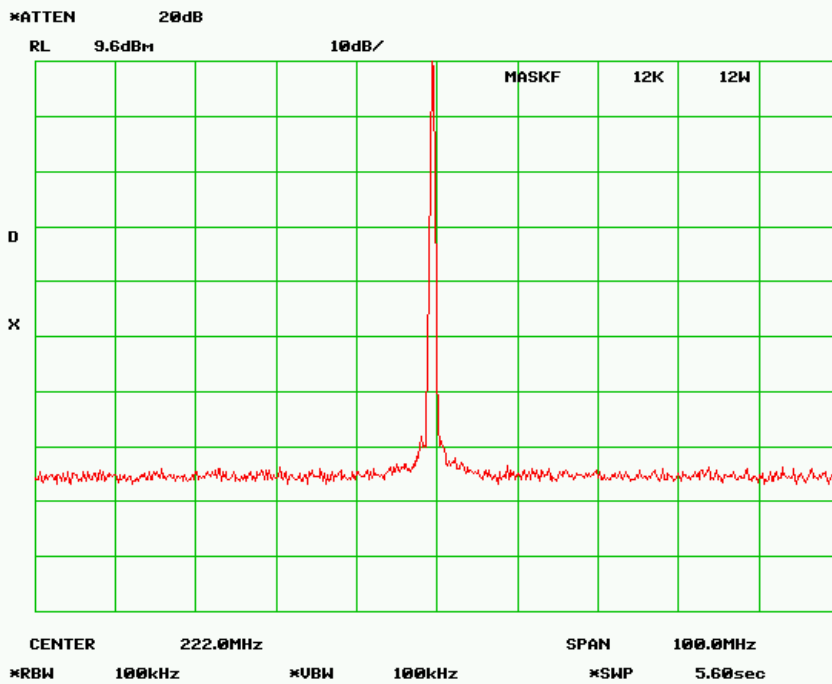
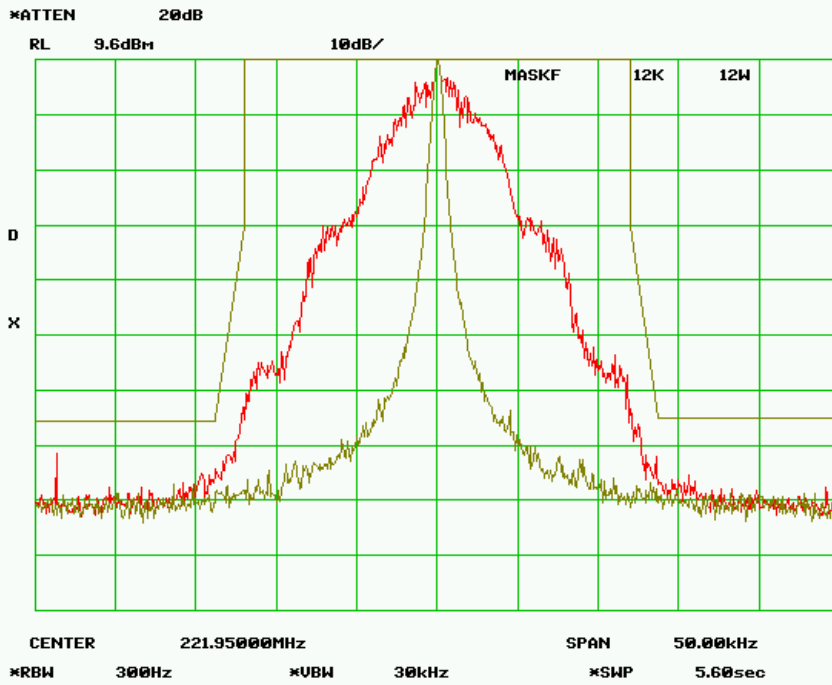
TEST SET-UP:



MASK F – 5 Aggregate MASKS – 1.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 8K20F1D
 Data Rate = 8 kbps
 PEAK DEVIATION = 3.05 kHz



MASK F – 5 Aggregate MASKS – 12 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 8K20F1D
 Data Rate = 8 kbps
 PEAK DEVIATION = 3.05 kHz



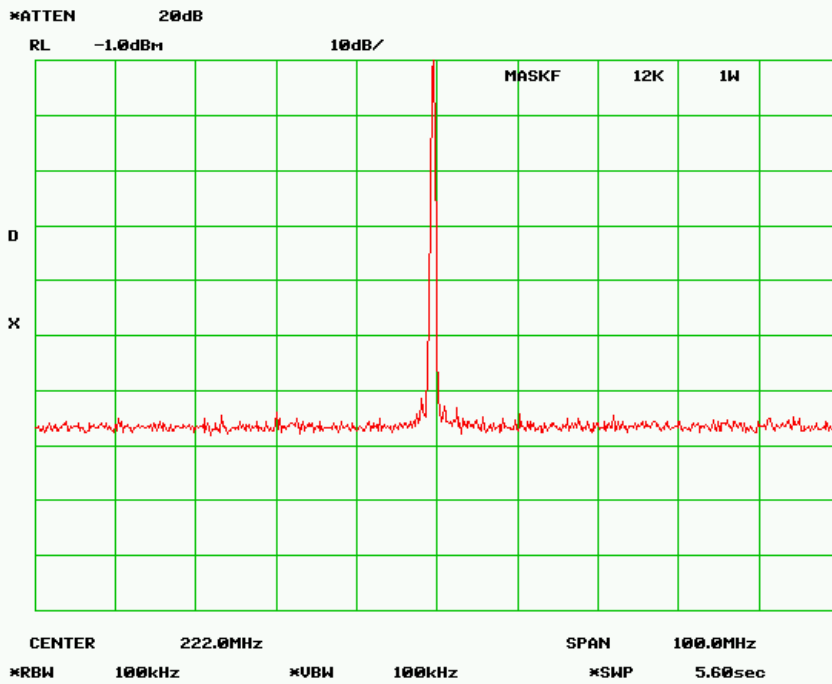
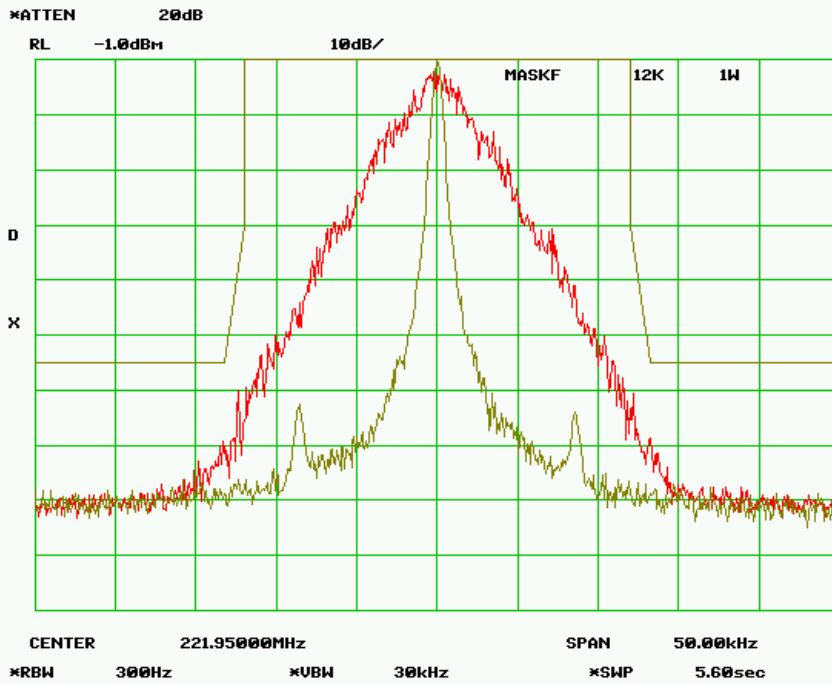
MASK F – 5 Aggregate MASKS – 1.0 Watts

RF Frequency 221.950 MHz

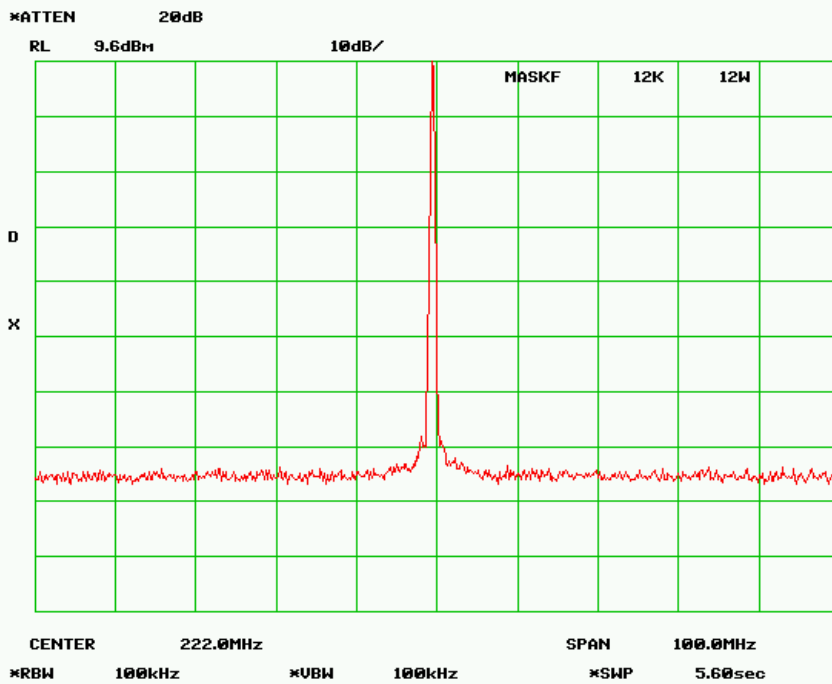
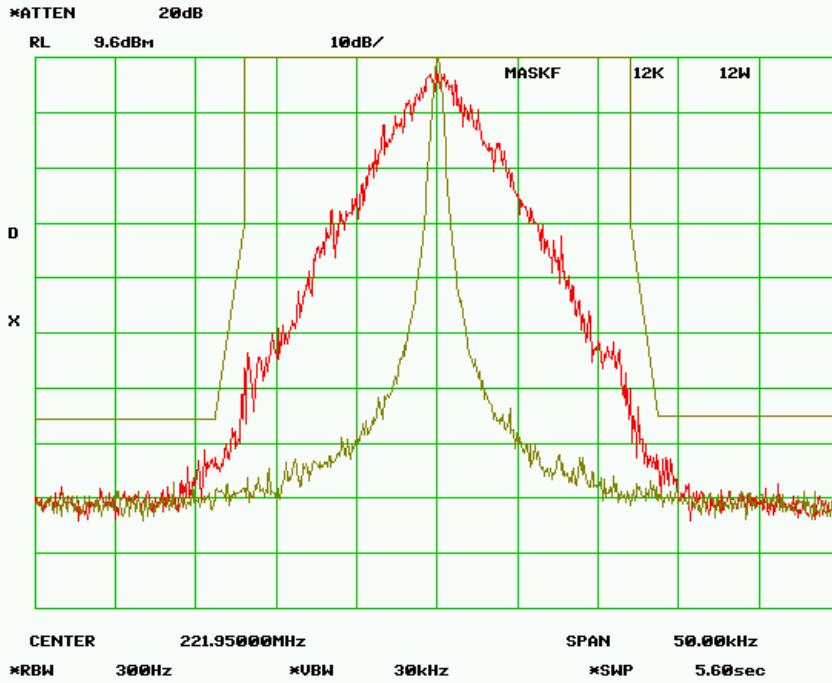
SPECTRUM FOR EMISSION - 8K30F1D

Data Rate = 16 kbps

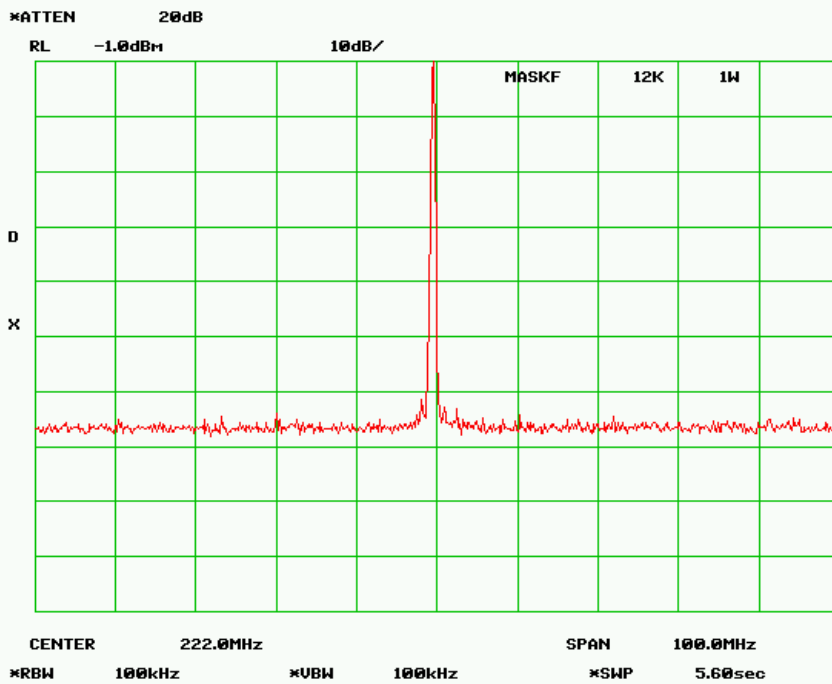
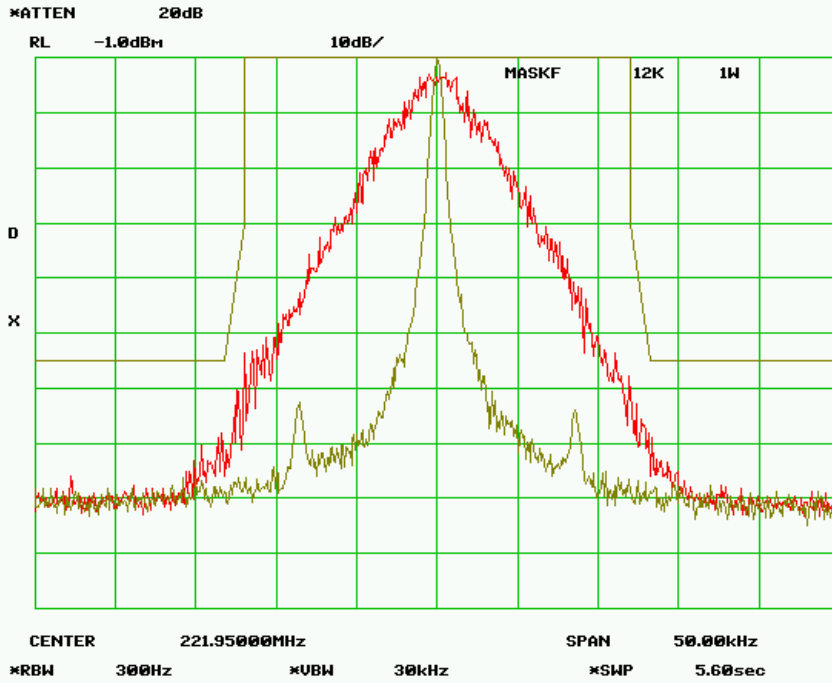
PEAK DEVIATION = 3.70 kHz



MASK F – 5 Aggregate MASKS – 12 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 8K30F1D
 Data Rate = 16 kbps
 PEAK DEVIATION = 3.70 kHz



MASK F – 5 Aggregate MASKS – 1.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 8K50F1D
Data Rate = 24 kbps
PEAK DEVIATION = 3.725 kHz



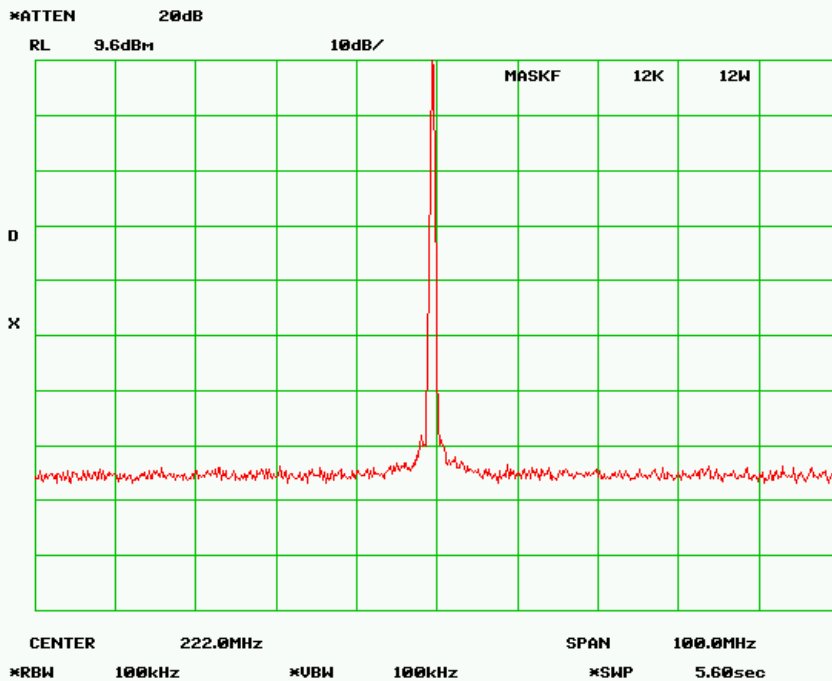
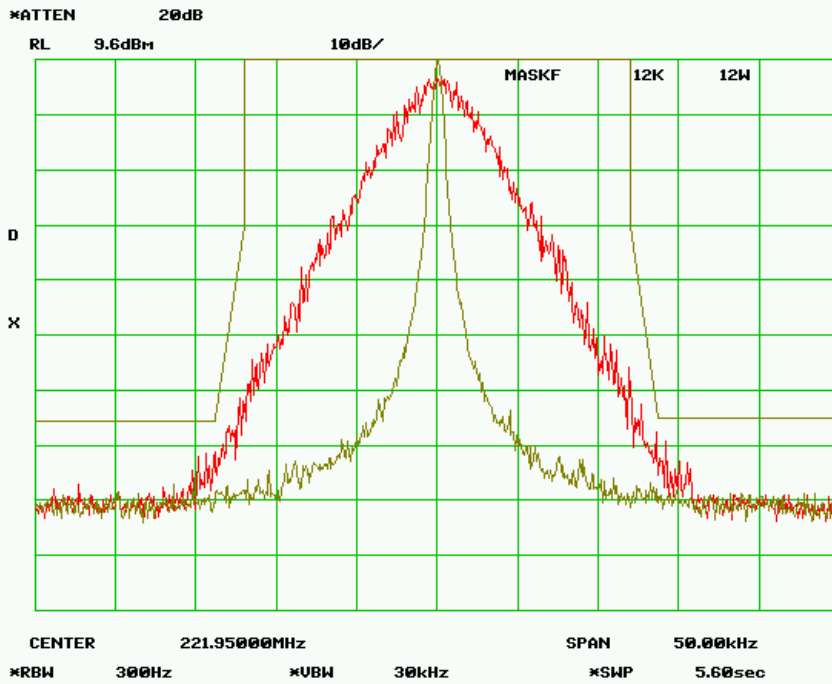
MASK F – 5 Aggregate MASKS – 12 Watts

RF Frequency 221.950 MHz

SPECTRUM FOR EMISSION - 8K50F1D

Data Rate = 24 kbps

PEAK DEVIATION = 3.725 kHz



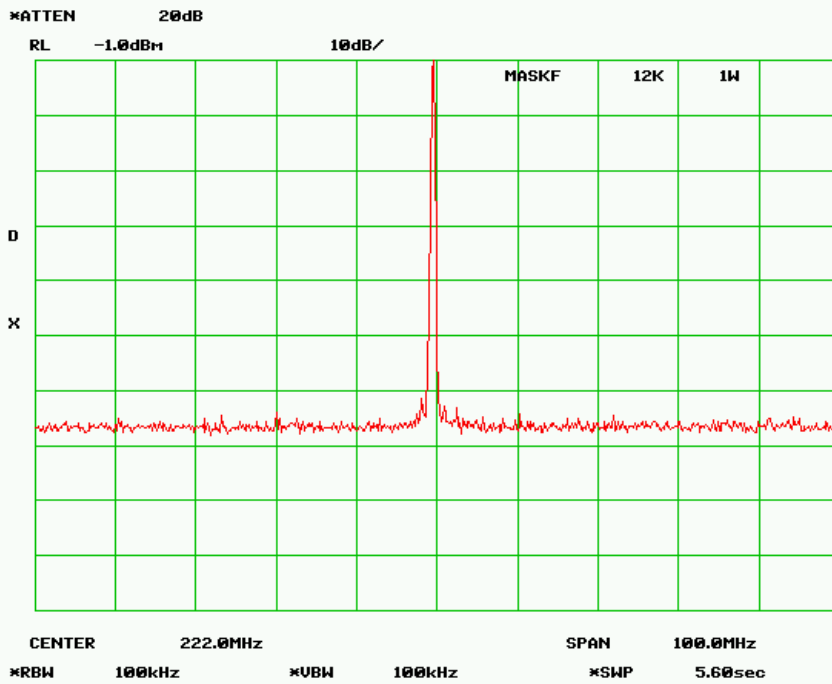
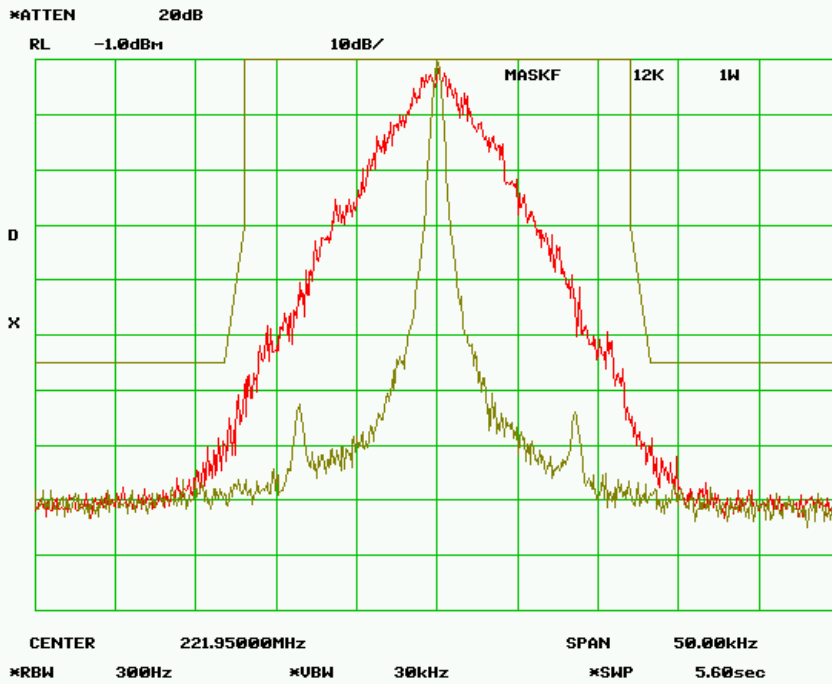
MASK F – 5 Aggregate MASKS – 1.0 Watts

RF Frequency 221.950 MHz

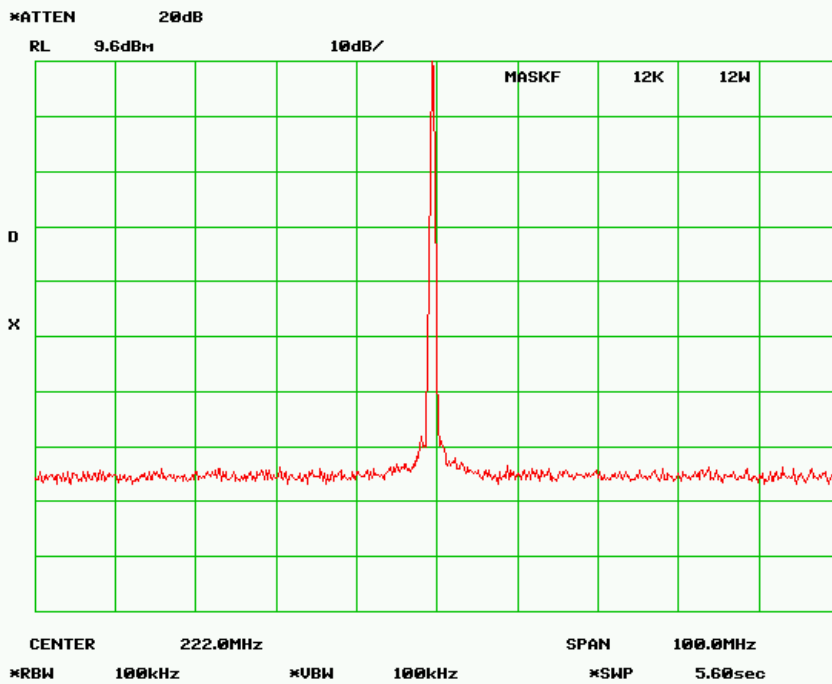
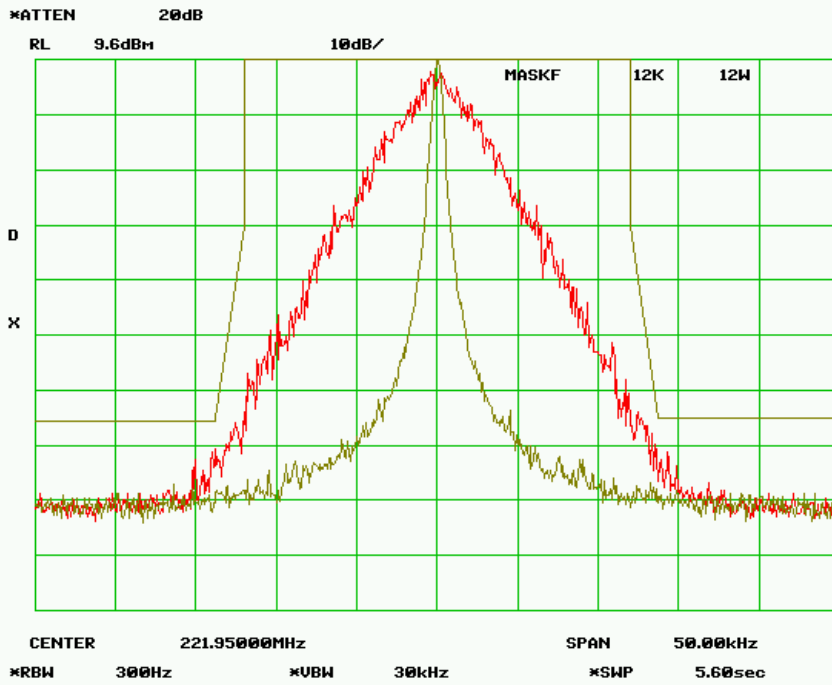
SPECTRUM FOR EMISSION - 8K08F1D

Data Rate = 32 kbps

PEAK DEVIATION = 3.728 kHz



MASK F – 5 Aggregate MASKS – 12 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 8K08F1D
 Data Rate = 32 kbps
 PEAK DEVIATION = 3.728 kHz



18.0 Mask F Part 90.210(f) - 220-222 MHz – 25k

NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators
16K5F1D, 16K8F1D, 17K8F1D and 17K0F1D

RULE PART NUMBER: FCC: 2.202, 90.209(b)(5), 90.210(f), 2.1049(c) (1)

MINIMUM STANDARDS: **Mask F**
Sidebands and Spurious [Rule 90.210 (f), P = 12 Watts and P=1 Watt]
Authorized Bandwidth = 4 kHz [Rule 90.209(b)(5)]
From Fo to 2 kHz, down 0 dB.
Greater than 2 kHz to 3.75 kHz, down 30 + 20(fd -2) dB or 55 + 10 log (P), or 65 dB, whichever is the lesser attenuation.
On any frequency beyond 3.75 kHz removed from the center of the authorized bandwidth fd: At least 55 + 10 log (P) dB.

The equipment under test will not function inside a single channel in the 220 to 222MHz band. Therefore the EUT was tested using aggregate combinations of channels as follows:

- 16K5F1D 10 contiguous channels
 - 16K8F1D 10 contiguous channels
 - 17K8F1D 10 contiguous channels
 - 17K0F1D 10 contiguous channels
- For emission designators 16K5F1D, 16K8F1D, 17K8F1D and 17K0F1D
Attenuation = 0 dB at Fo to 24.5 kHz
Attenuation = 30 dB at 24.5 kHz
Attenuation = 55 dB at 25.75 kHz @1W
Attenuation = 65.8 dB at 26.25 kHz @12W

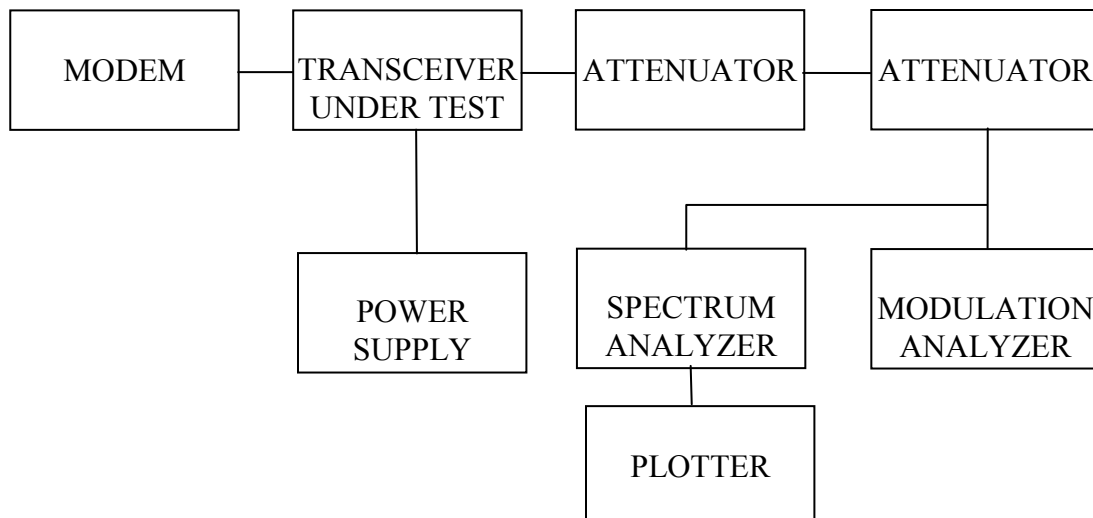
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C
RF Power Level = 1 Watt and 12 Watts
Voltage = 20VDC

TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13, 3.2.11.2

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
50-Ohm Attenuator, Pasternack Model PE7002-10 (10dB)
DC Power Supply, Hewlett Packard Model 6653A
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901B

TEST SET-UP:



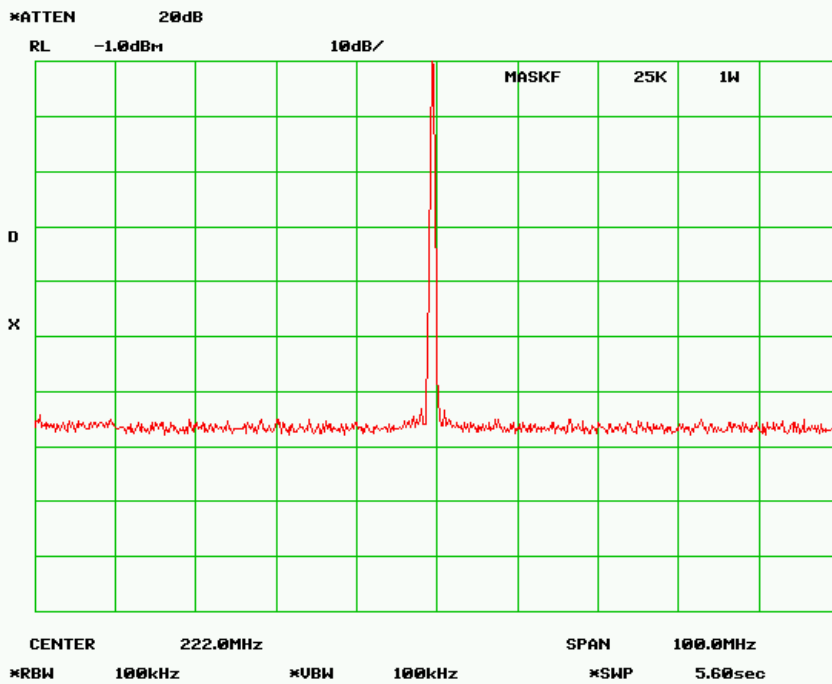
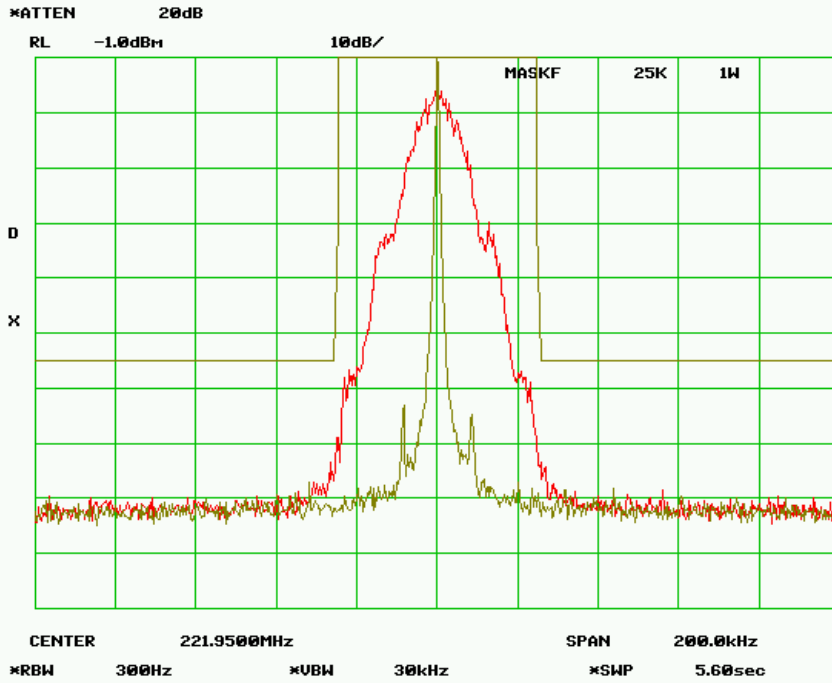
MASK F - 10 Aggregate MASKS – 1.0 Watts

RF Frequency 221.950 MHz

SPECTRUM FOR EMISSION - 16K5F1D

Data Rate = 16 kbps

PEAK DEVIATION = 6.30 kHz



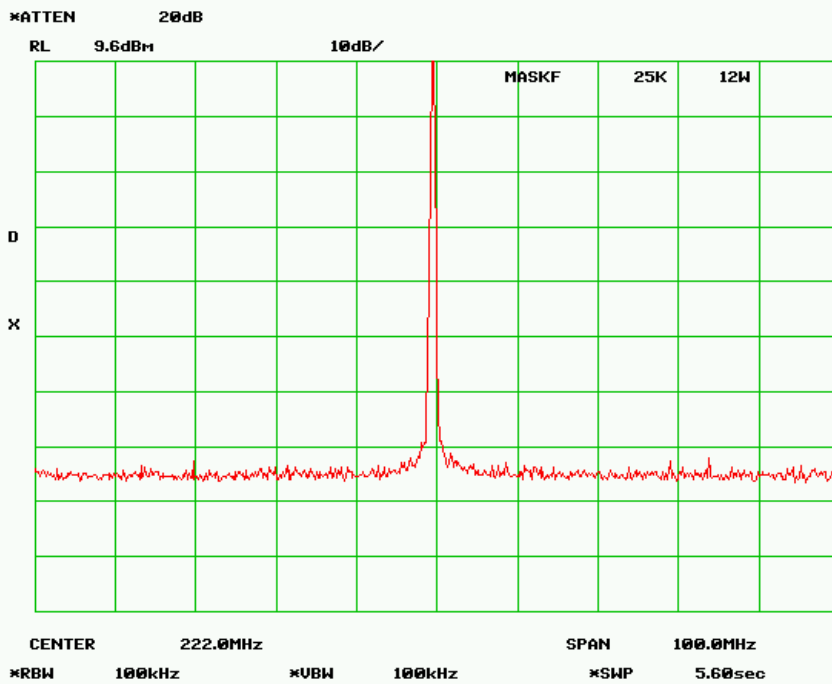
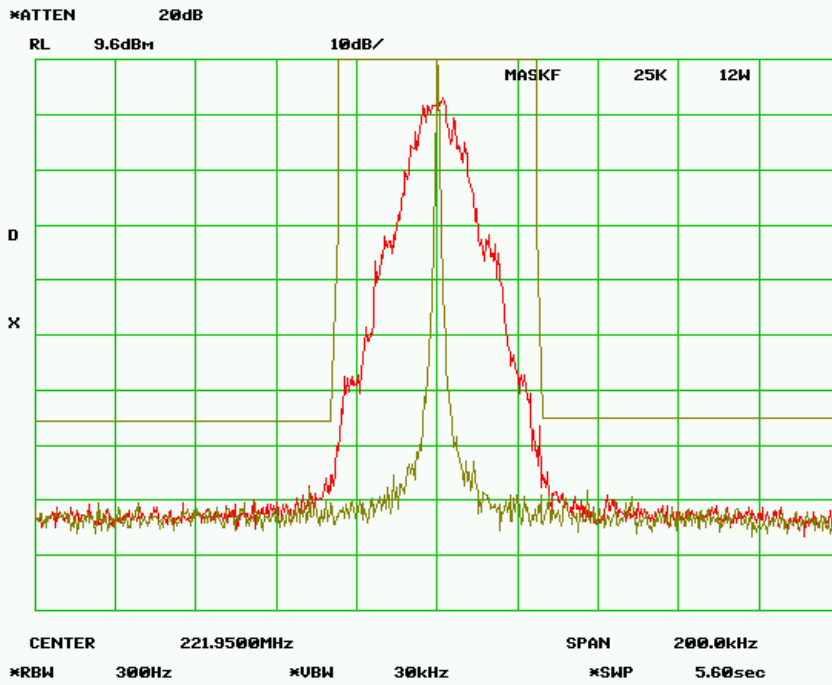
MASK F - 10 Aggregate MASKS – 12 Watts

RF Frequency 221.950 MHz

SPECTRUM FOR EMISSION - 16K5F1D

Data Rate = 16 kbps

PEAK DEVIATION = 6.30 kHz



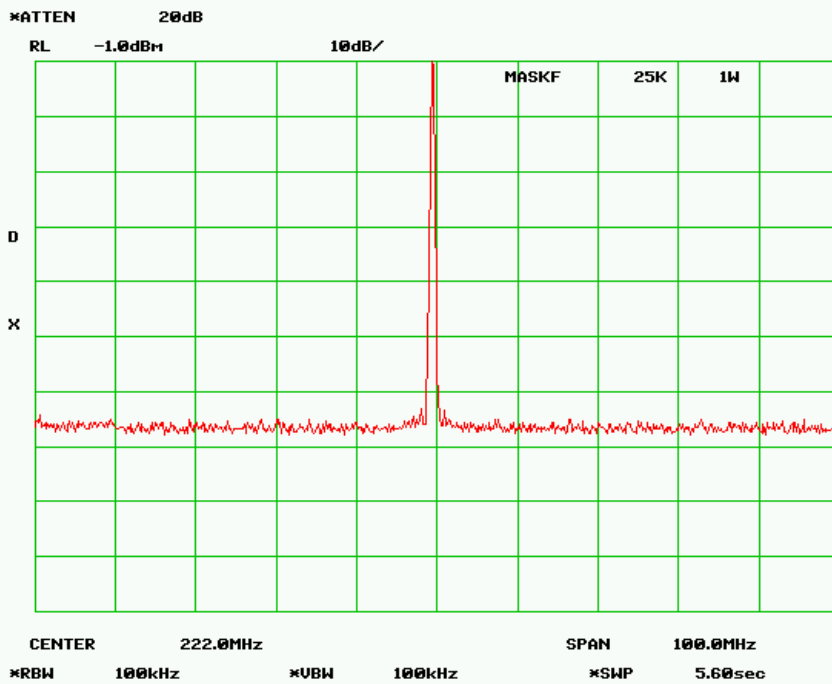
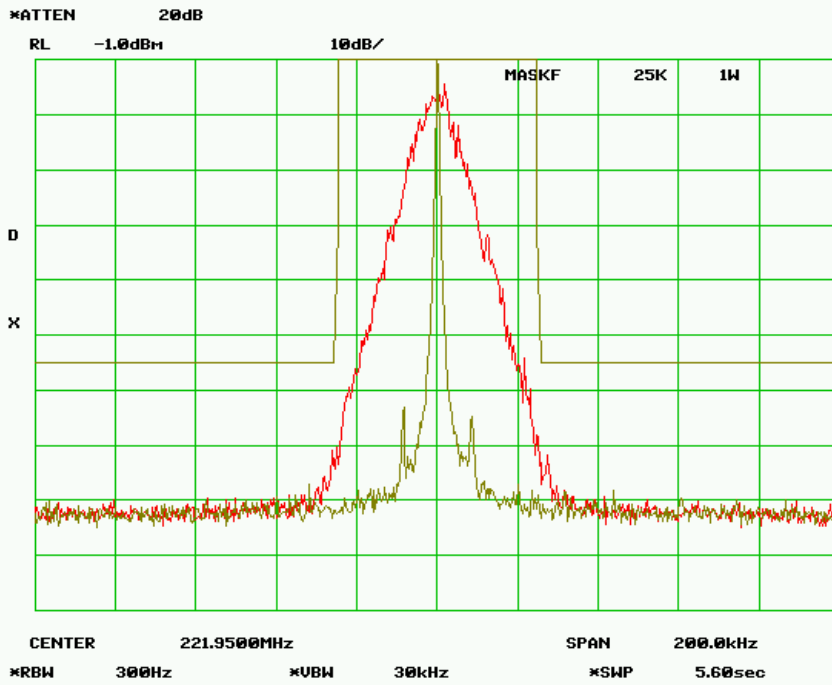
MASK F - 10 Aggregate MASKS – 1.0 Watts

RF Frequency 221.950 MHz

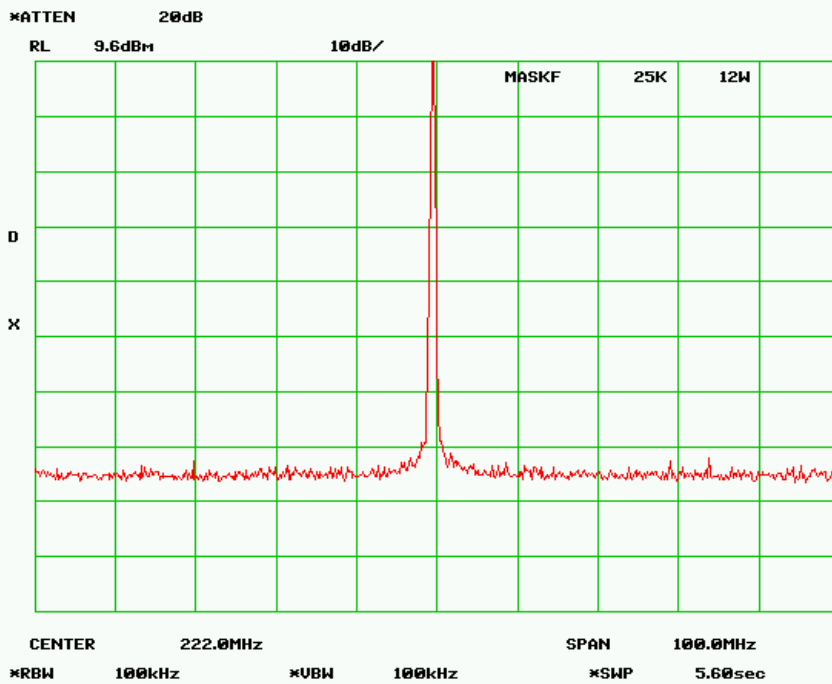
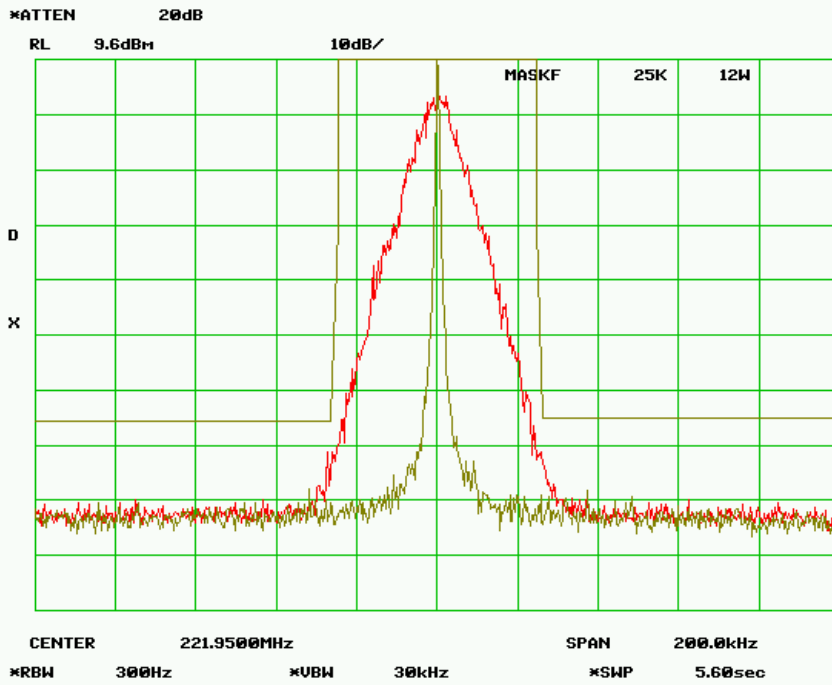
SPECTRUM FOR EMISSION - 16K8F1D

Data Rate = 32 kbps

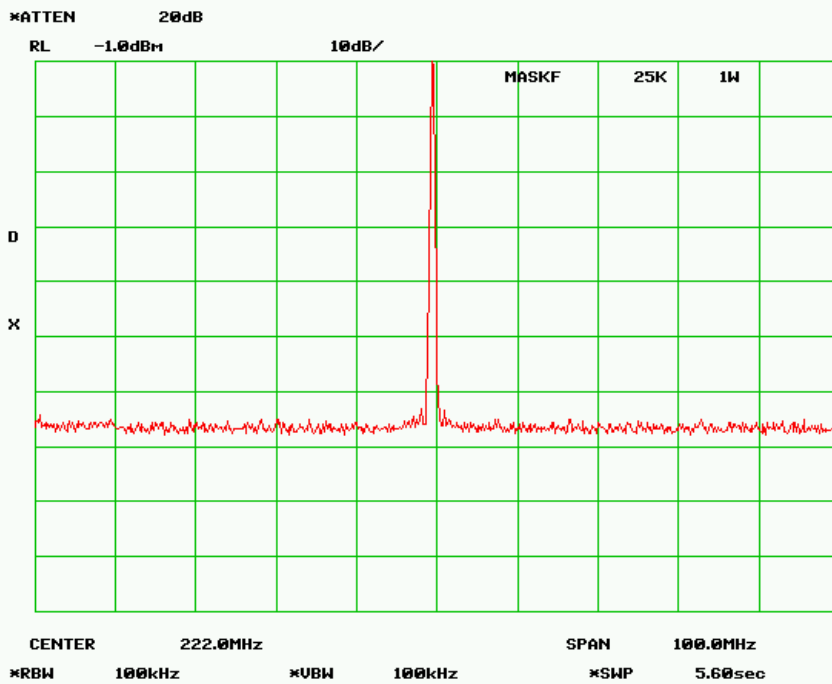
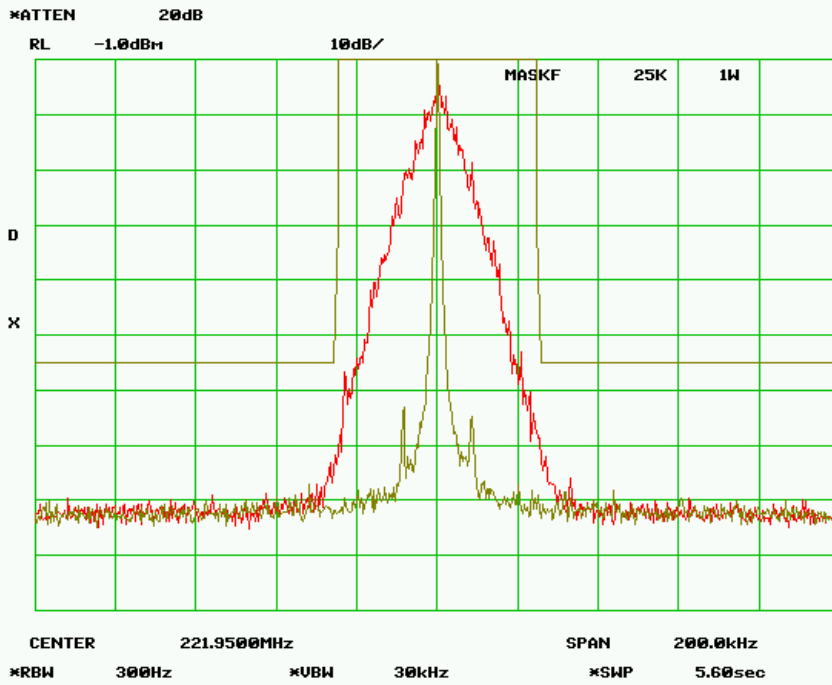
PEAK DEVIATION = 6.30 kHz



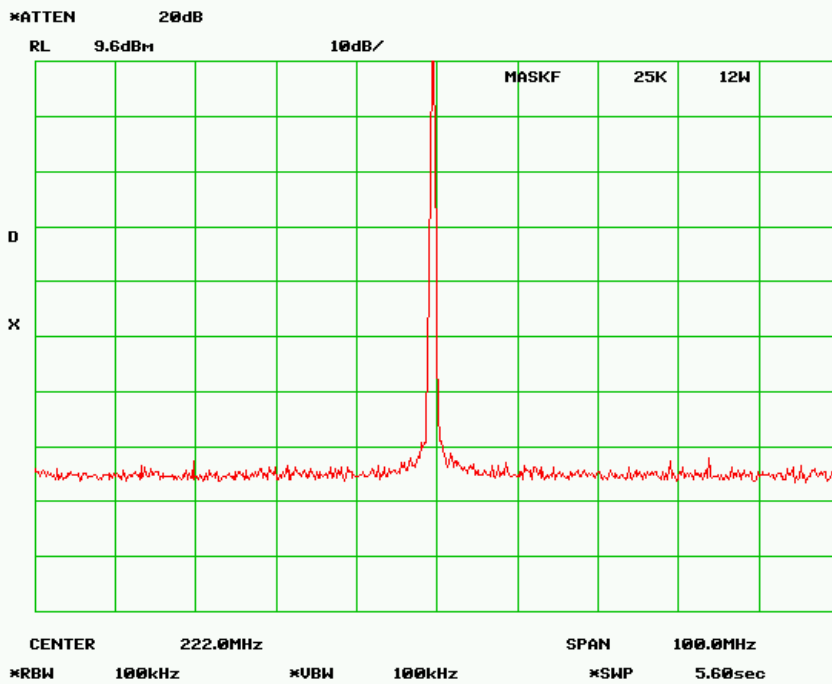
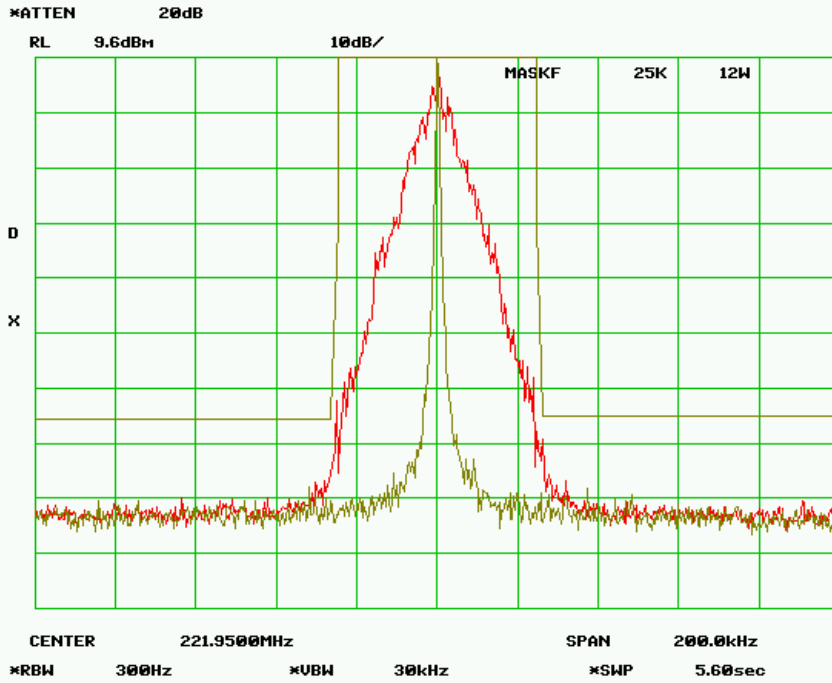
MASK F - 10 Aggregate MASKS – 12 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 16K8F1D
Data Rate = 32kbps
PEAK DEVIATION = 6.30 kHz



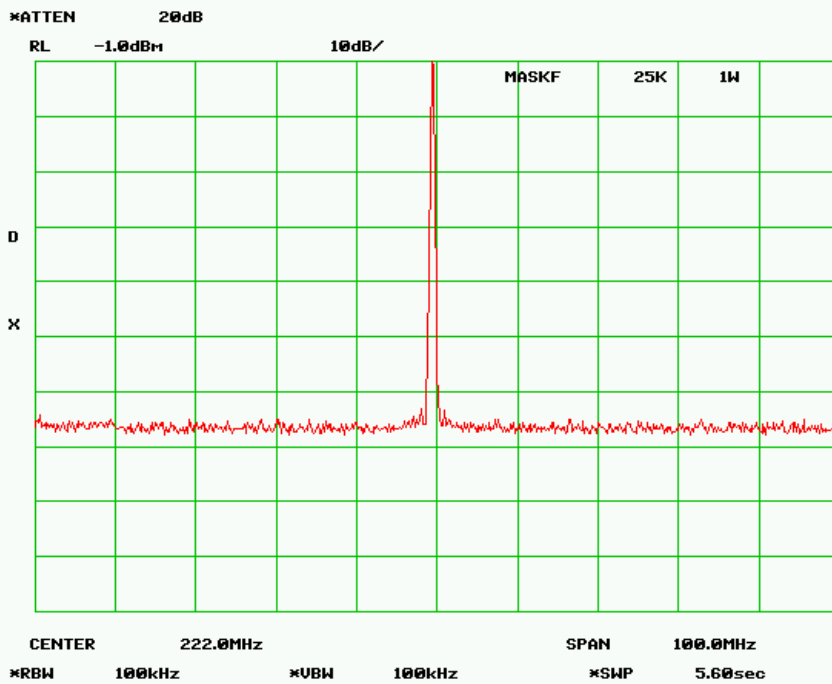
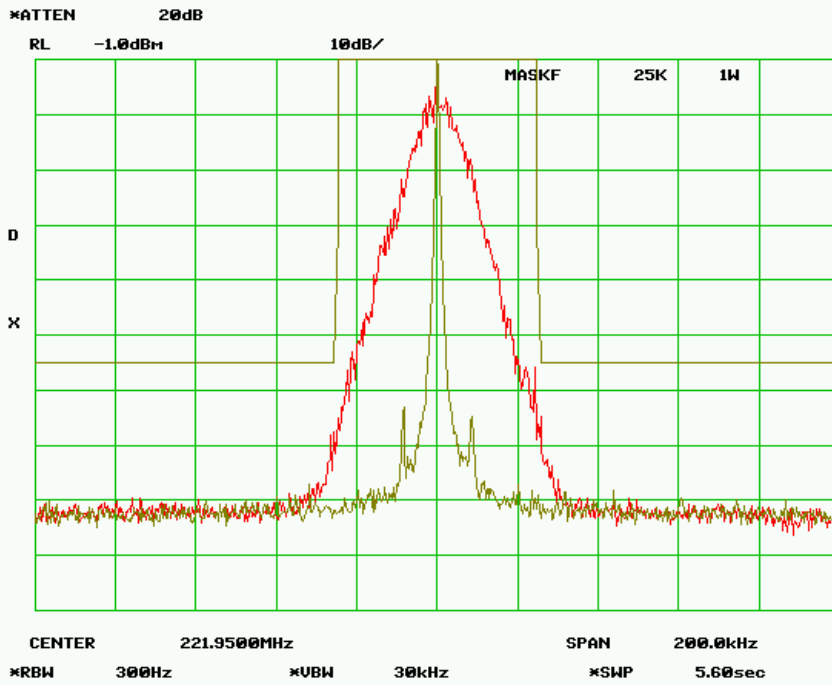
MASK F - 10 Aggregate MASKS – 1.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 17K8F1D
Data Rate = 48 kbps
PEAK DEVIATION = 7.59 kHz



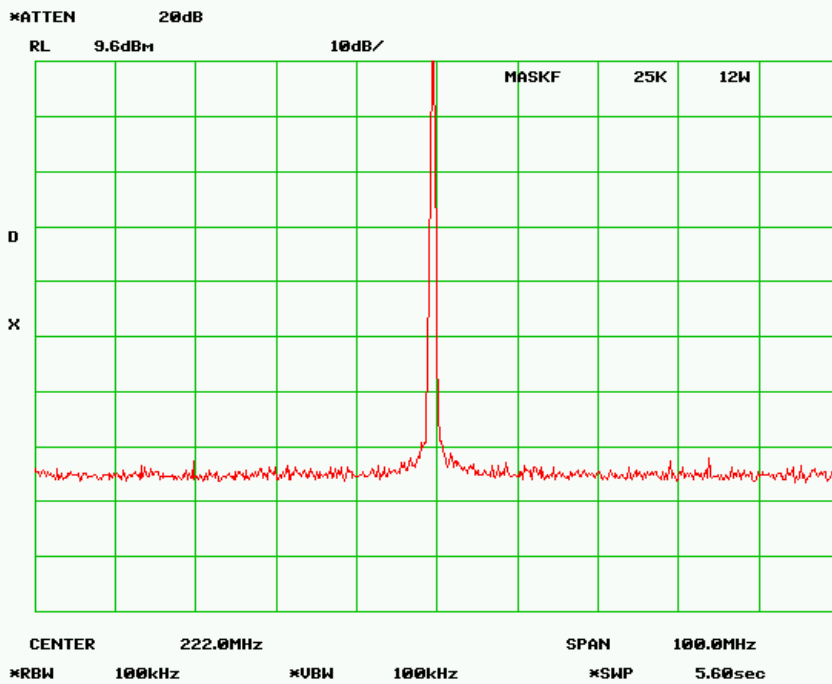
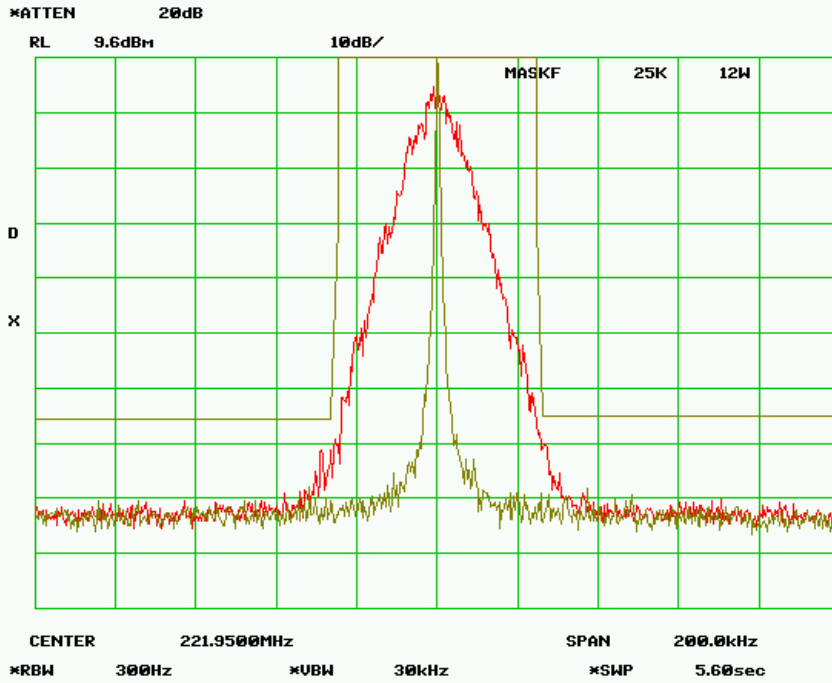
MASK F - 10 Aggregate MASKS – 12 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 17K8F1D
 Data Rate = 48 kbps
 PEAK DEVIATION = 7.59 kHz



MASK F - 10 Aggregate MASKS – 1.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 17K0F1D
 Data Rate = 64 kbps
 PEAK DEVIATION = 7.52 kHz



MASK F - 10 Aggregate MASKS – 12 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 17K0F1D
Data Rate = 64 kbps
PEAK DEVIATION = 7.52 kHz



19.0 Mask F Part 90.210(f) - 220-222 MHz – 50k

NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators
33K3F1D, 34K0F1D, 36K0F1D, 33K0F1D

RULE PART NUMBER: FCC: 2.202, 90.209(b)(5), 90.210(f), 2.1049(c) (1)

MINIMUM STANDARDS: **Mask F**
 Sidebands and Spurious [Rule 90.210 (f), P = 12 Watts and P=1 Watt]
 Authorized Bandwidth = 4 kHz [Rule 90.209(b)(5)]
 From Fo to 2 kHz, down 0 dB.
 Greater than 2 kHz to 3.75 kHz, down 30 + 20(fd -2) dB or 55 + 10 log (P), or 65 dB,
 whichever is the lesser attenuation.
 On any frequency beyond 3.75 kHz removed from the center of the authorized
 bandwidth fd: At least 55 + 10 log (P) dB.

The equipment under test will not function inside a single channel in the 220 to 222MHz band. Therefore the EUT was tested using aggregate combinations of channels as follows:

- 33K3F1D 19 contiguous channels
 - 34K0F1D 19 contiguous channels
 - 36K0F1D 19 contiguous channels
 - 33K0F1D 19 contiguous channels
- For emission designators 33K3F1D, 34K0F1D, 36K0F1D, 33K0F1D
 Attenuation = 0 dB at Fo to 47 kHz
 Attenuation = 30 dB at 47 kHz
 Attenuation = 55 dB at 48.25 kHz @1W
 Attenuation = 65.8 dB at 48.75 kHz @12W

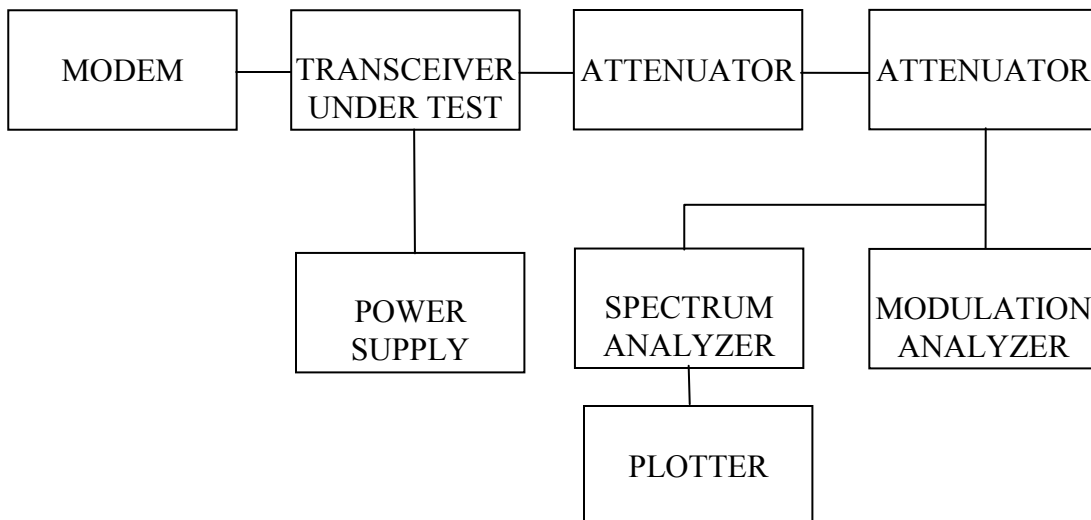
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C
 RF Power Level = 1 Watt and 12 Watts
 Voltage = 20VDC

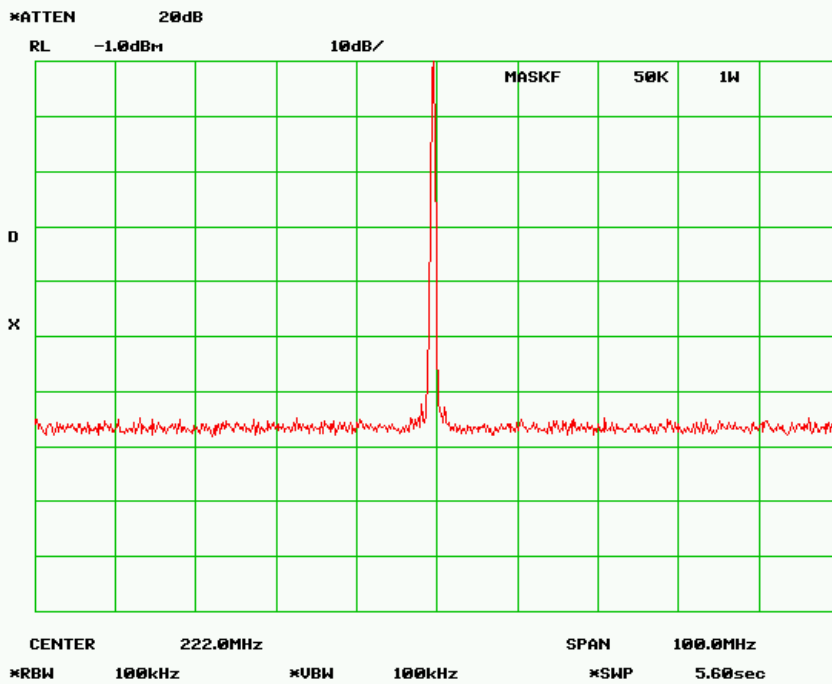
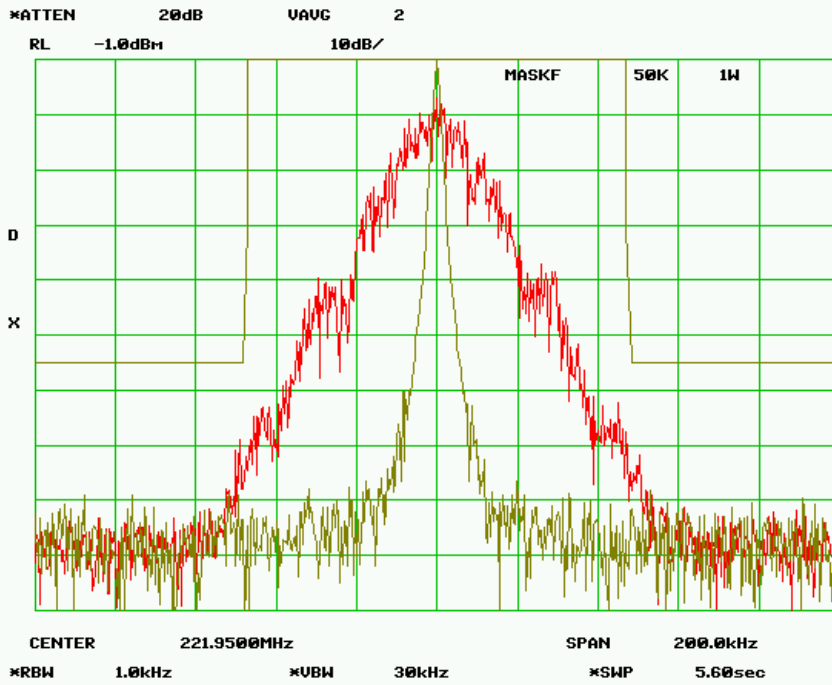
TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13, 3.2.11.2

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
 50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
 50-Ohm Attenuator, Pasternack Model PE7002-10 (10dB)
 DC Power Supply, Hewlett Packard Model 6653A
 Spectrum Analyzer, Hewlett Packard Model HP8563E
 Modulation Analyzer, Hewlett Packard Model HP8901B

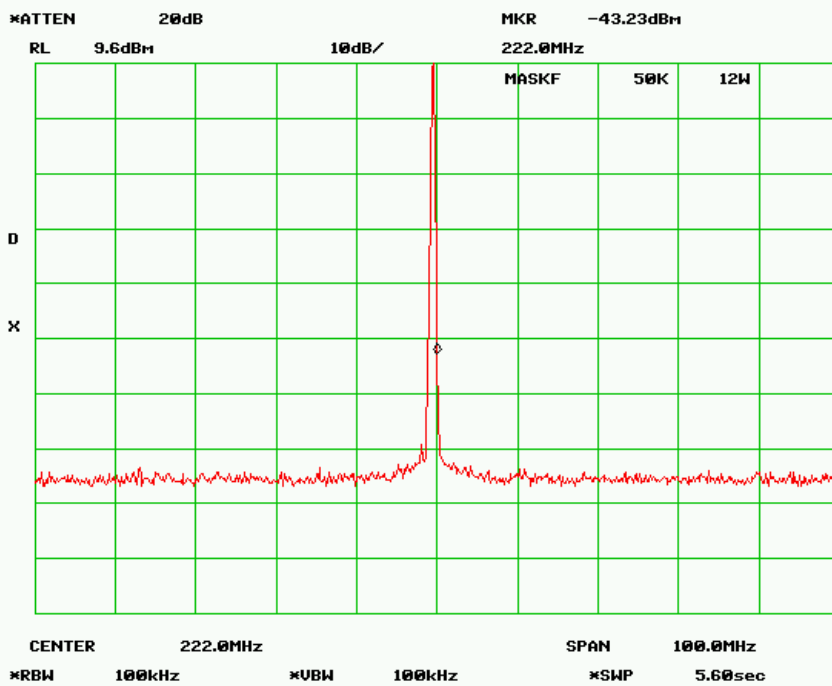
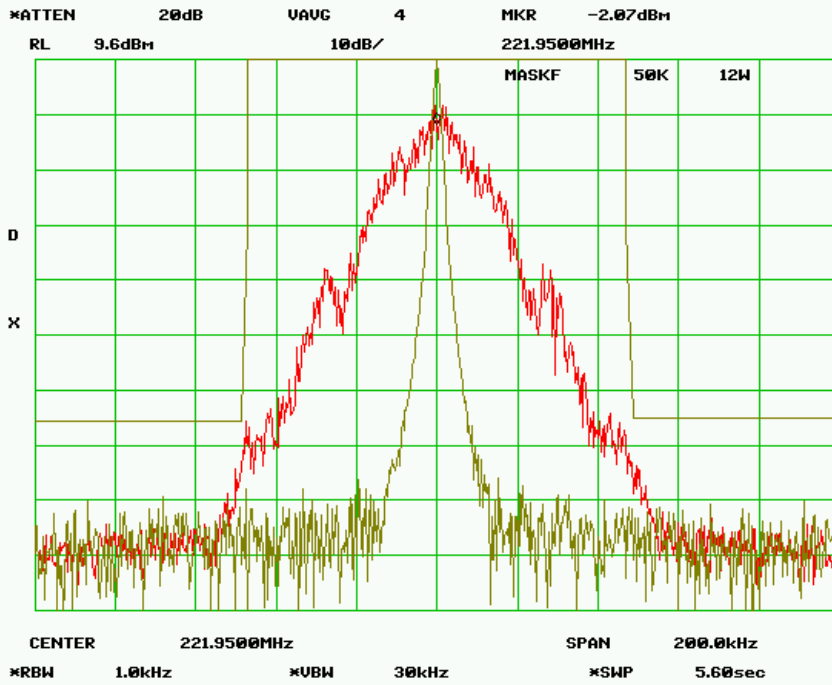
TEST SET-UP:



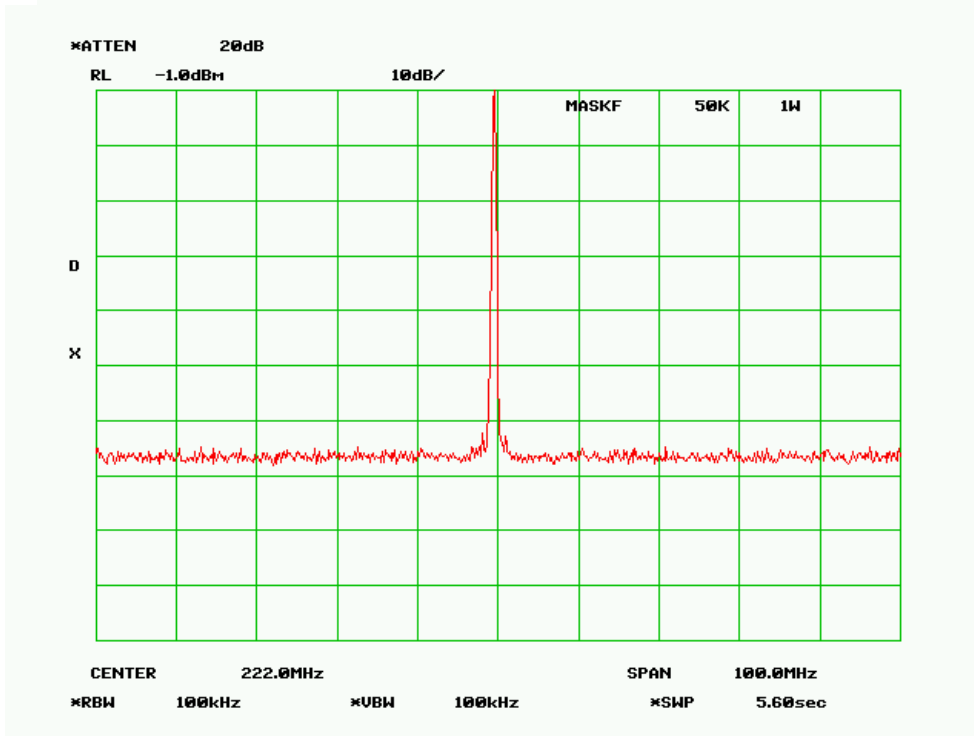
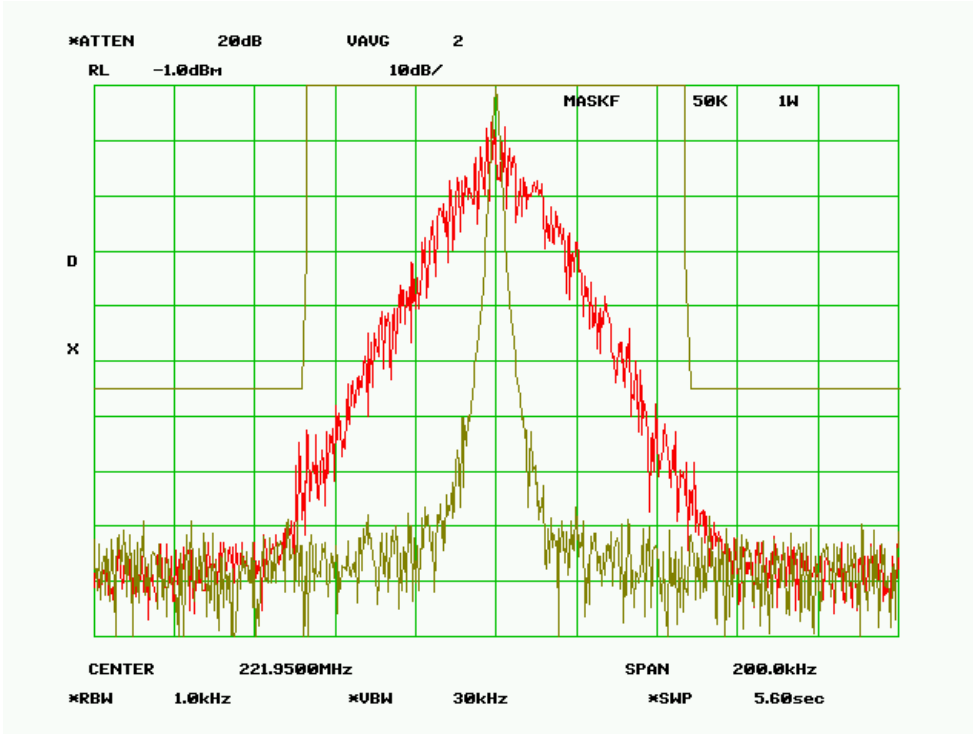
MASK F - 19 Aggregate Masks– 1.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 33K3F1D
 Data Rate = 32 kbps
 PEAK DEVIATION = 12.31 kHz



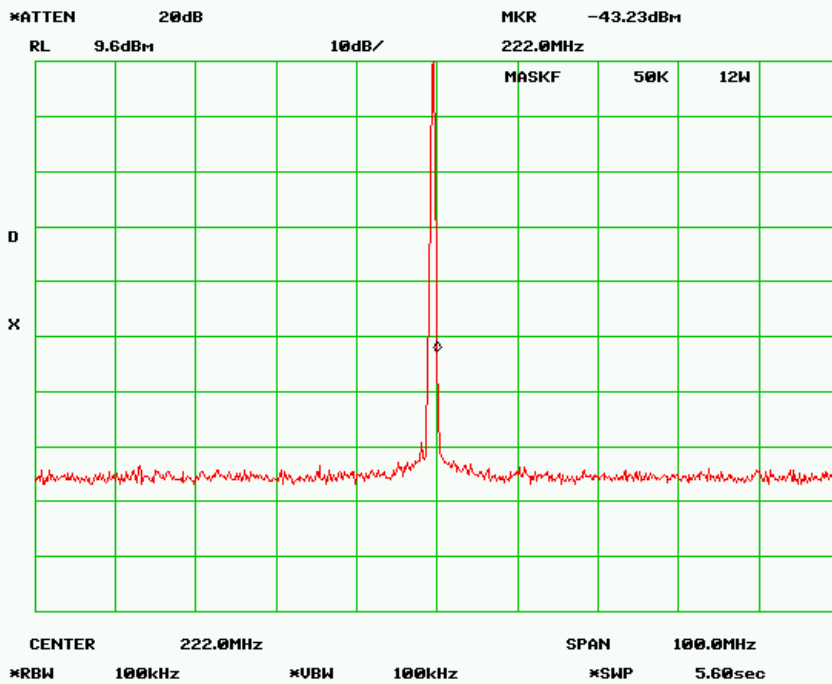
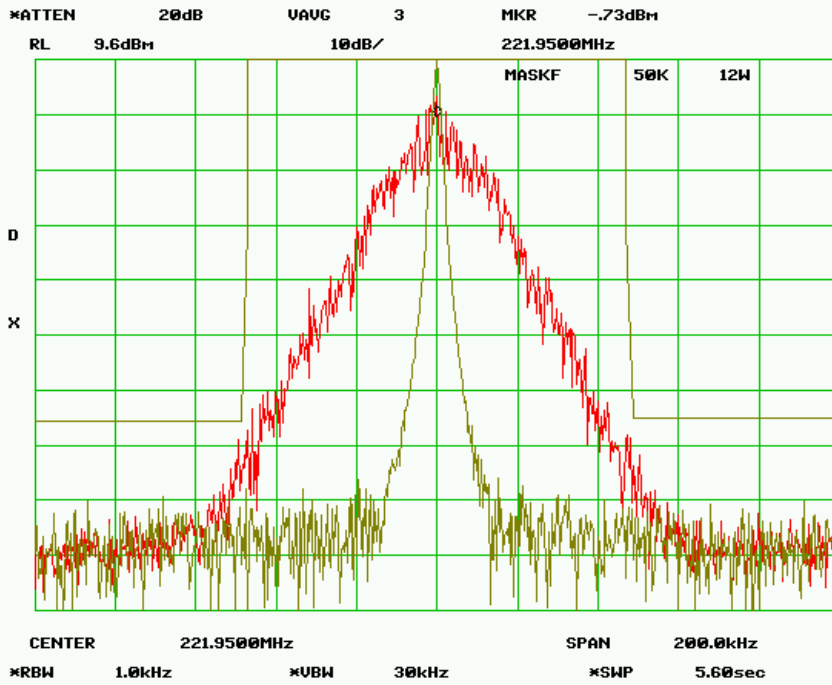
MASK F - 19 Aggregate Masks– 12.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 33K3F1D
 Data Rate = 32 kbps
 PEAK DEVIATION = 12.31 kHz



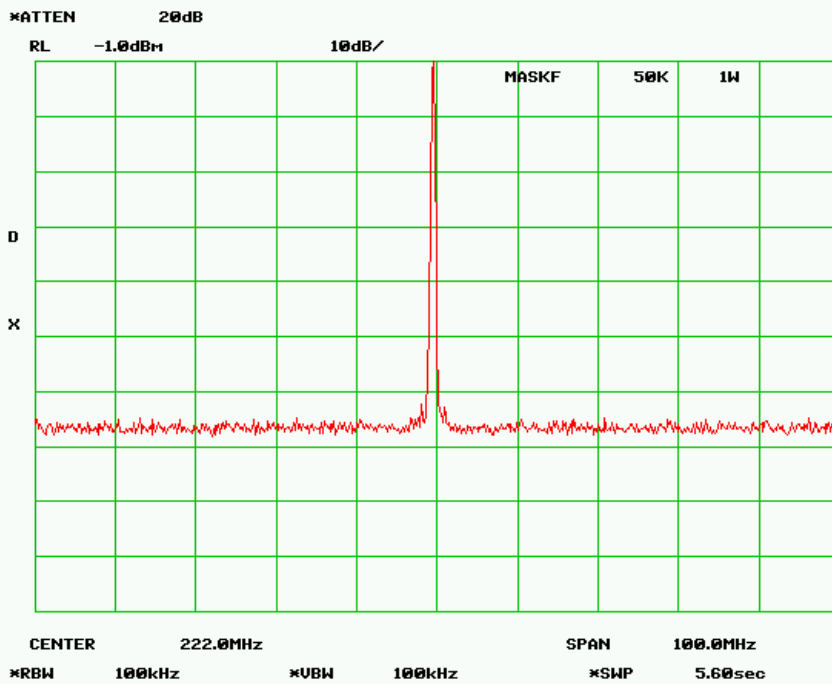
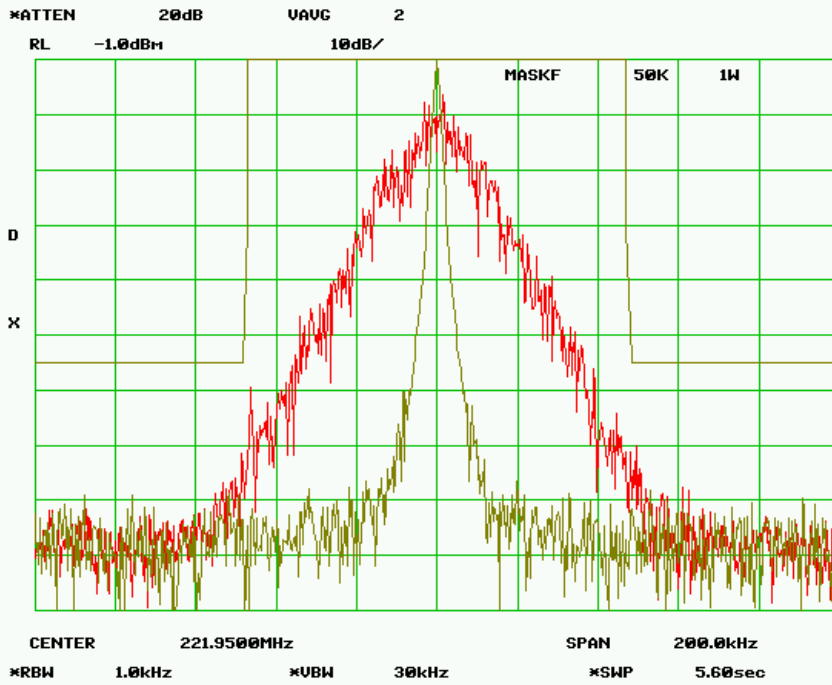
MASK F - 19 Aggregate Masks– 1.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 34K0F1D
Data Rate = 64 kbps
PEAK DEVIATION = 14.45 kHz



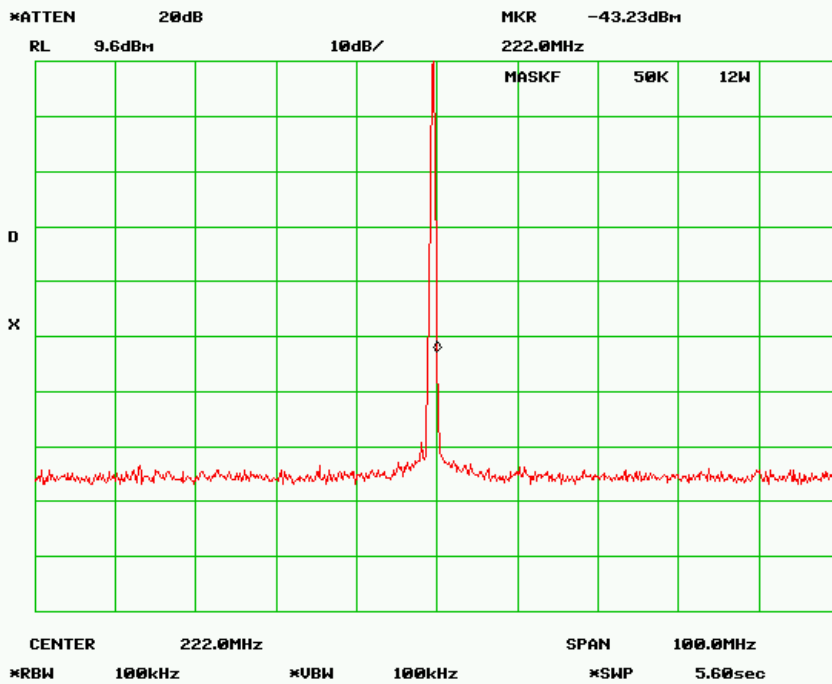
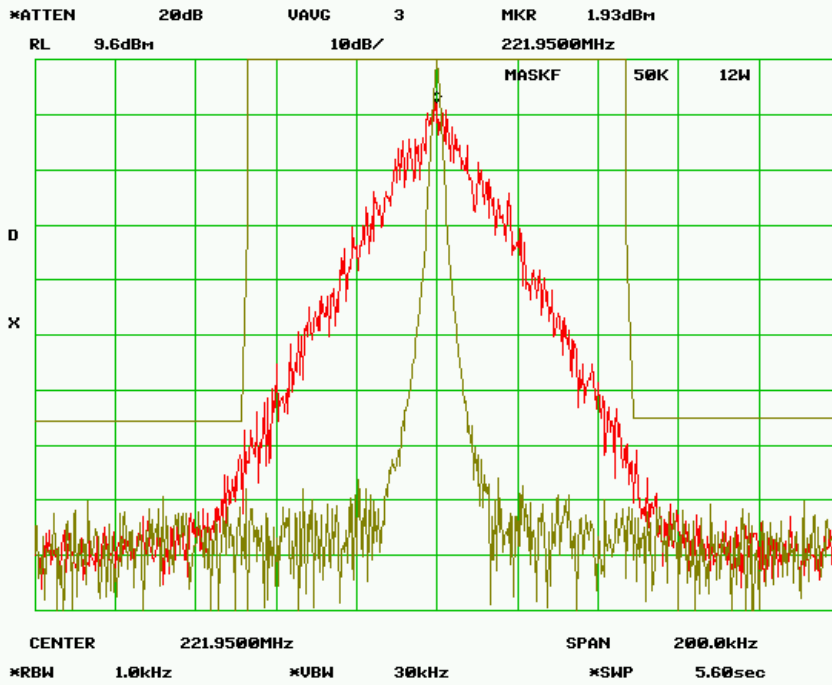
MASK F - 19 Aggregate Masks– 12.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 34K0F1D
 Data Rate = 64 kbps
 PEAK DEVIATION = 14.45 kHz



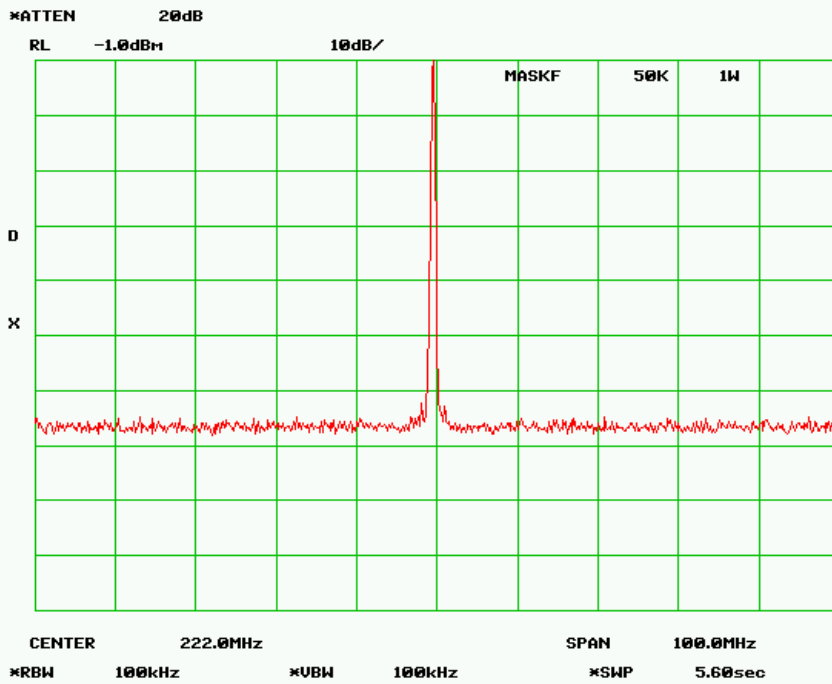
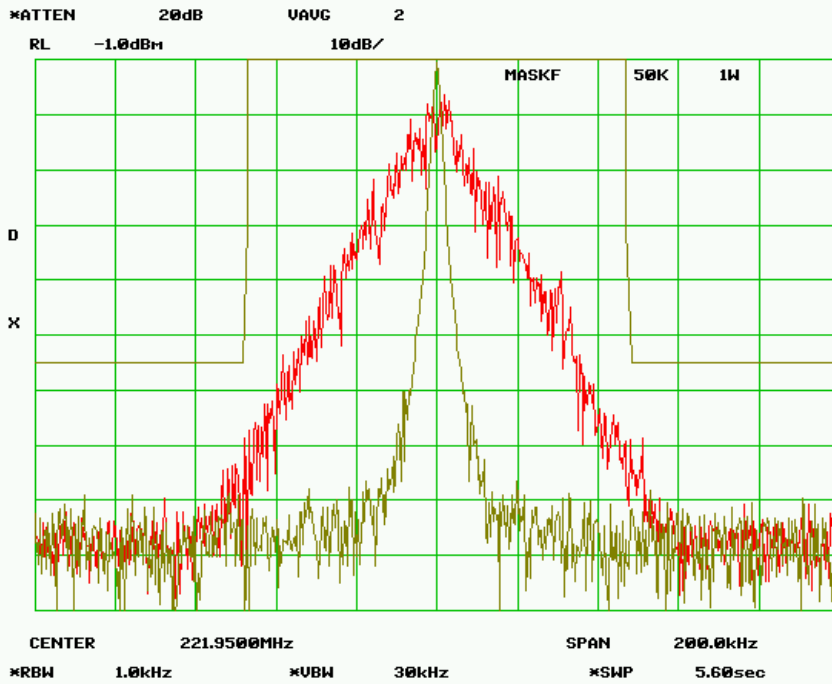
MASK F - 19 Aggregate Masks- 1.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 36K0F1D
Data Rate = 96 kbps
PEAK DEVIATION = 15.33 kHz



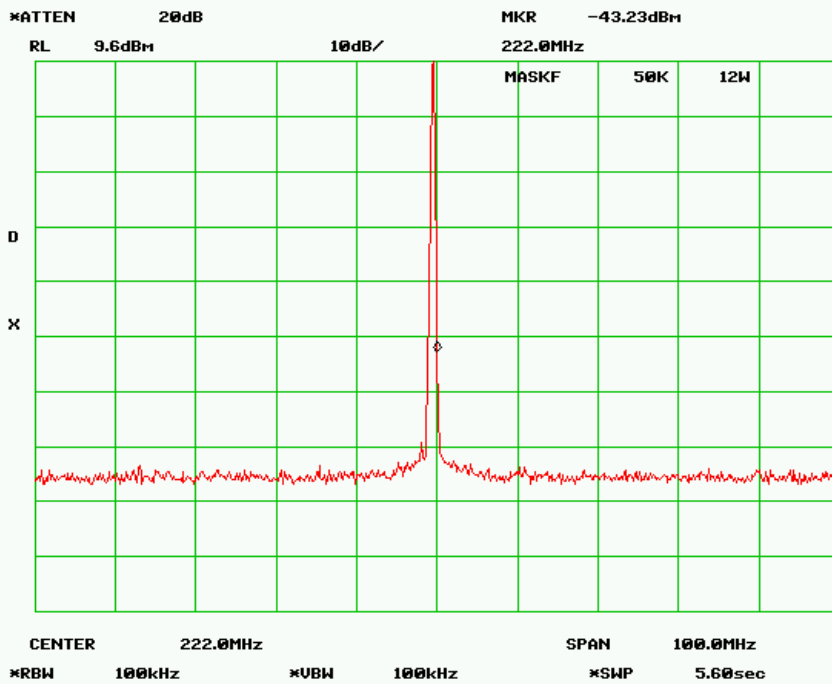
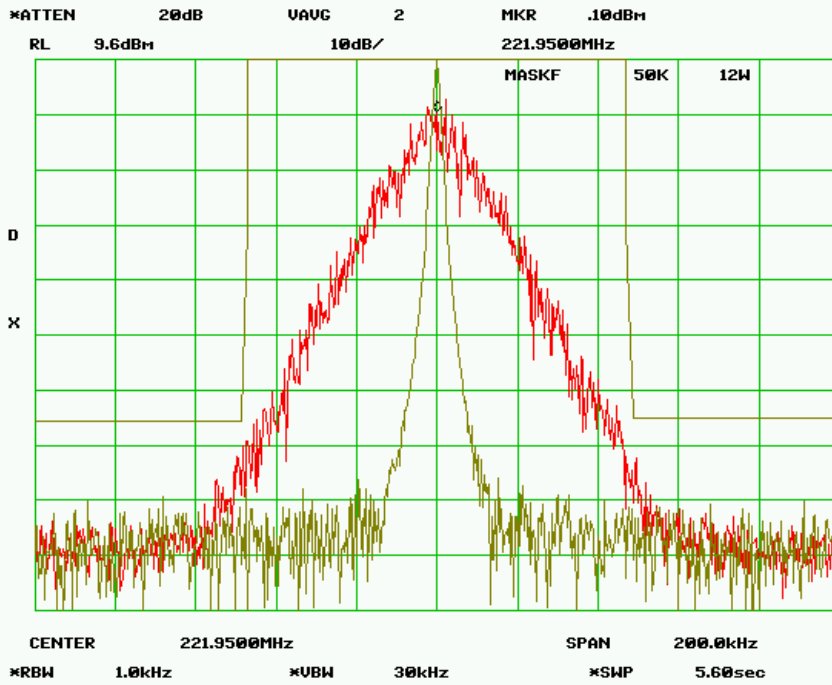
MASK F - 19 Aggregate Masks– 12.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 36K0F1D
 Data Rate = 96 kbps
 PEAK DEVIATION = 15.33 kHz



MASK F - 19 Aggregate Masks- 1.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 33K0F1D
Data Rate = 128 kbps
PEAK DEVIATION = 11.66 kHz



MASK F - 19 Aggregate Masks– 12.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 33K0F1D
 Data Rate = 128 kbps
 PEAK DEVIATION = 11.66 kHz



20.0 Mask F Part 90.210(f) - 220-222 MHz – 100k

NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators
55K0F1D, 53K3F1D, 51K7F1D and 52K5F1D

RULE PART NUMBER: FCC: 2.202, 90.209(b)(5), 90.210(f), 2.1049(c) (1)

MINIMUM STANDARDS: **Mask F**
Sidebands and Spurious [Rule 90.210 (f), P = 12 Watts and P=1 Watt]
Authorized Bandwidth = 4 kHz [Rule 90.209(b)(5)]
From Fo to 2 kHz, down 0 dB.
Greater than 2 kHz to 3.75 kHz, down 30 + 20(fd -2) dB or 55 + 10 log (P), or 65 dB, whichever is the lesser attenuation.
On any frequency beyond 3.75 kHz removed from the center of the authorized bandwidth fd: At least 55 + 10 log (P) dB.

The equipment under test will not function inside a single channel in the 220 to 222MHz band. Therefore the EUT was tested using aggregate combinations of channels as follows:

- 55K0F1D 29 contiguous channels
 - 53K3F1D 29 contiguous channels
 - 51K7F1D 29 contiguous channels
 - 52K5F1D 29 contiguous channels
- For emission designators 55K0F1D, 53K3F1D, 51K7F1D and 52K5F1D
Attenuation = 0 dB at Fo to 72.0kHz
Attenuation = 30 dB at 72.0 kHz
Attenuation = 55 dB at 73.25 kHz @1W
Attenuation = 65.8 dB at 73.75 kHz @12W

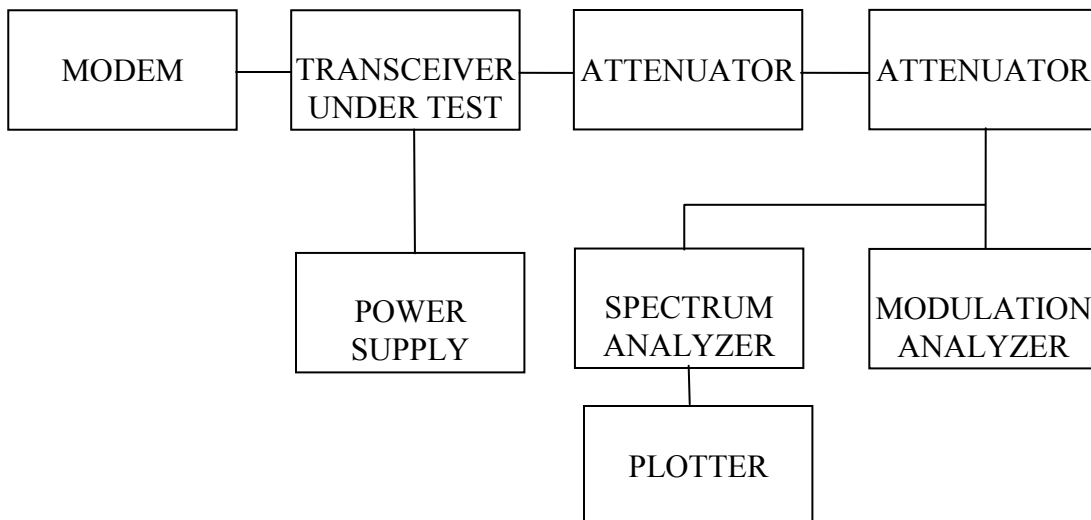
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C
RF Power Level = 1 Watt and 12 Watts
Voltage = 20VDC

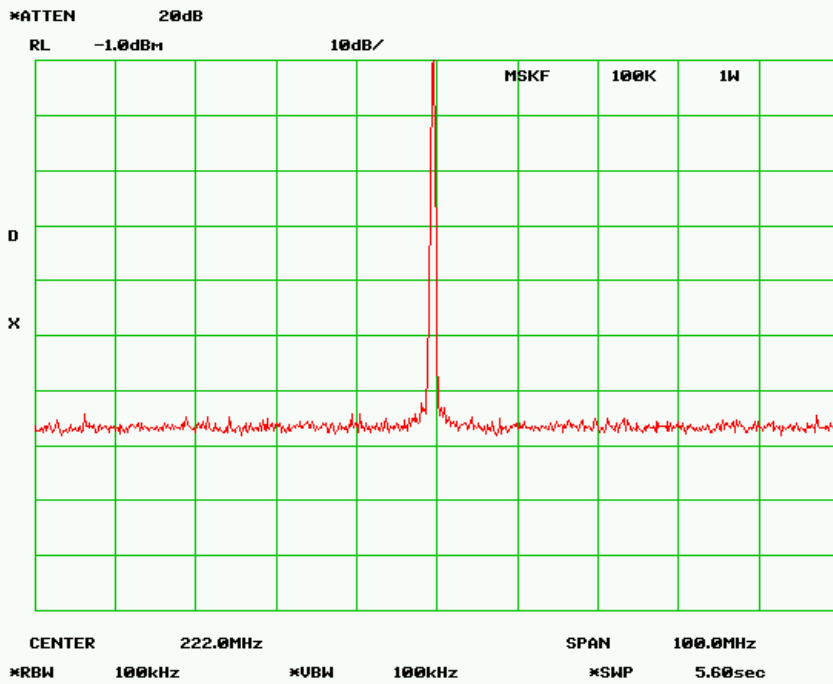
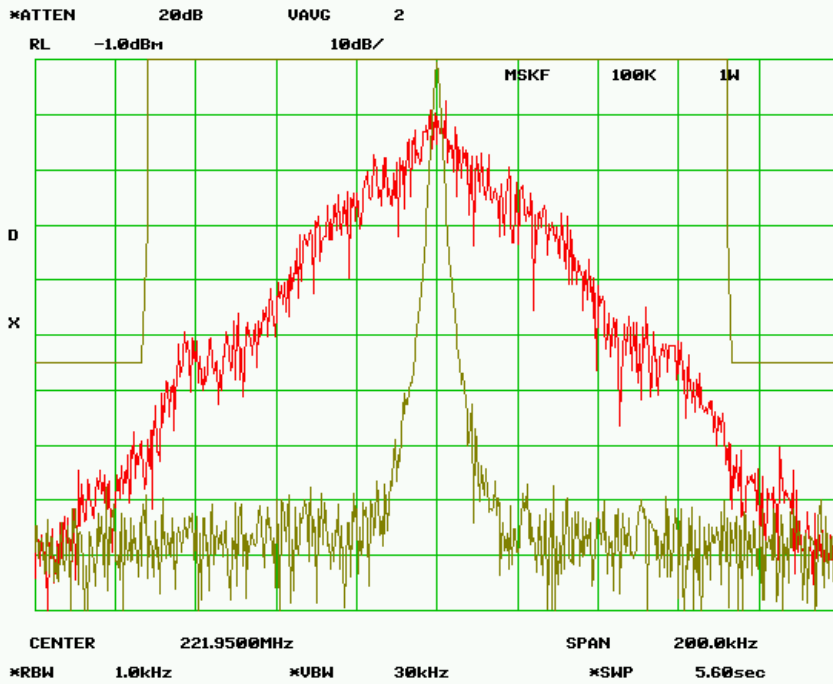
TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13, 3.2.11.2

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
50-Ohm Attenuator, Pasternack Model PE7002-10 (10dB)
DC Power Supply, Hewlett Packard Model 6653A
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901B

TEST SET-UP:



MASK F - 29 Aggregate Masks– 1.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 55K0F1D
 Data Rate = 64 kbps
 PEAK DEVIATION = 12.32 kHz



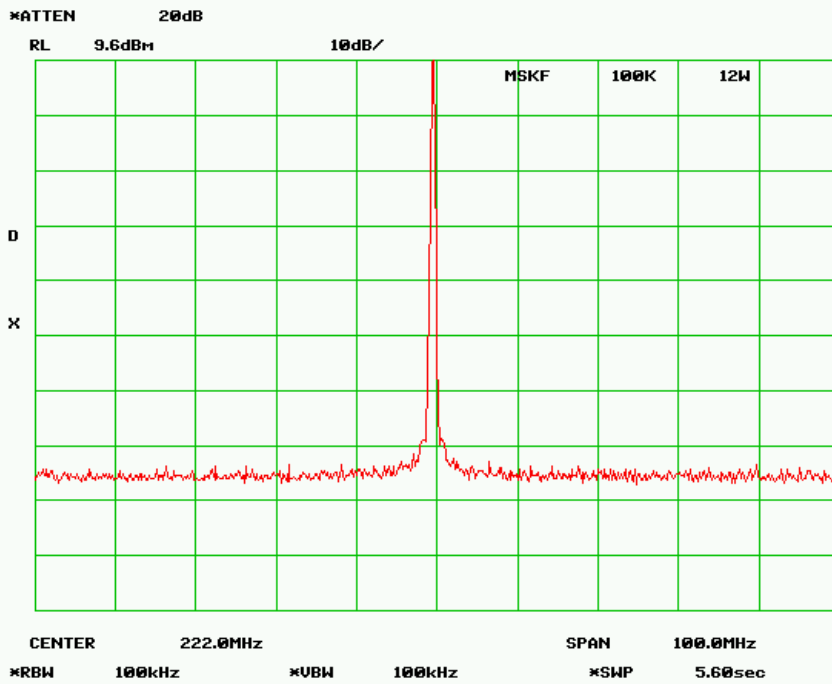
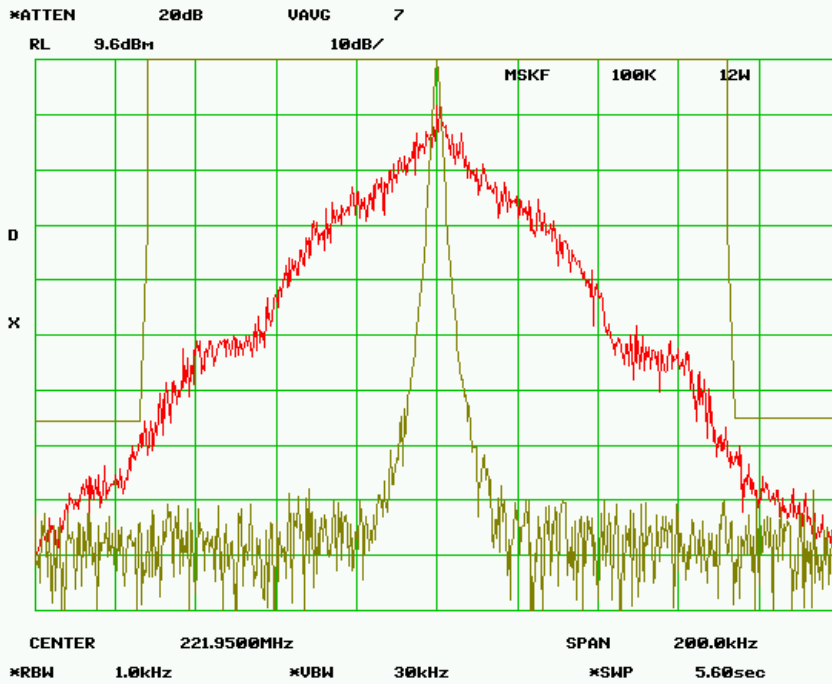
MASK F - 29 Aggregate Masks- 12.0 Watts

RF Frequency 221.950 MHz

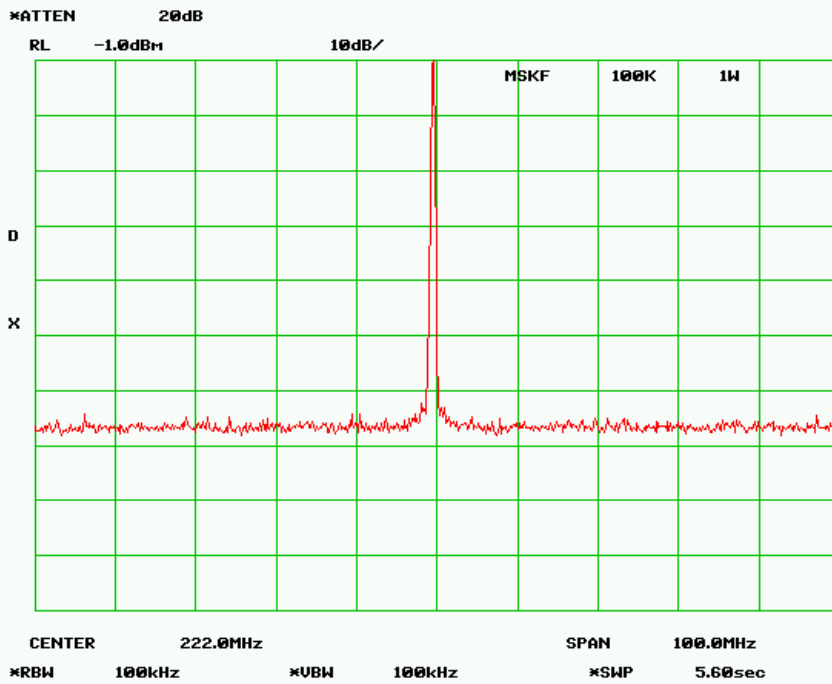
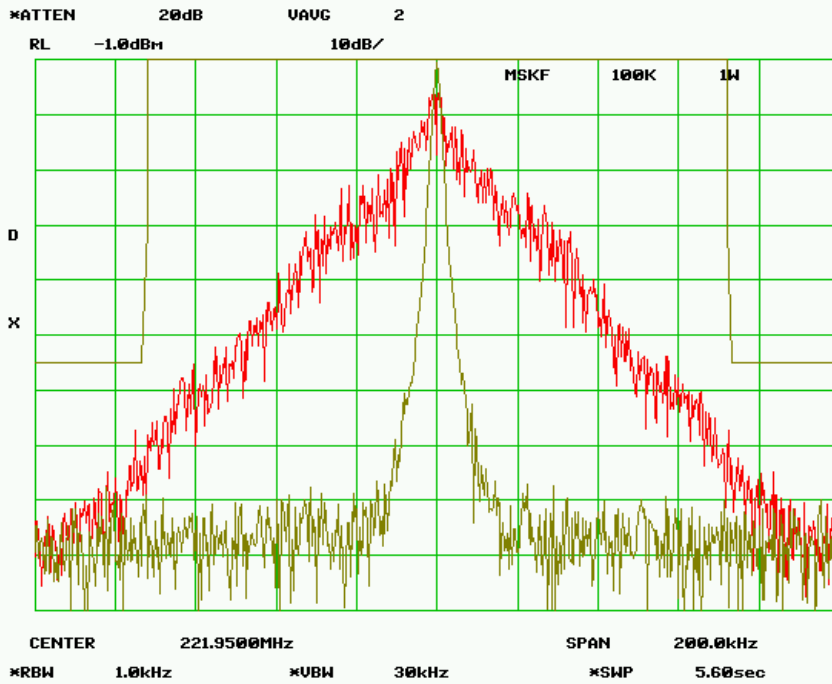
SPECTRUM FOR EMISSION - 55K0F1D

Data Rate = 64 kbps

PEAK DEVIATION = 12.32 kHz



MASK F - 29 Aggregate Masks- 1.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 53K3F1D
 Data Rate = 128 kbps
 PEAK DEVIATION = 12.50 kHz



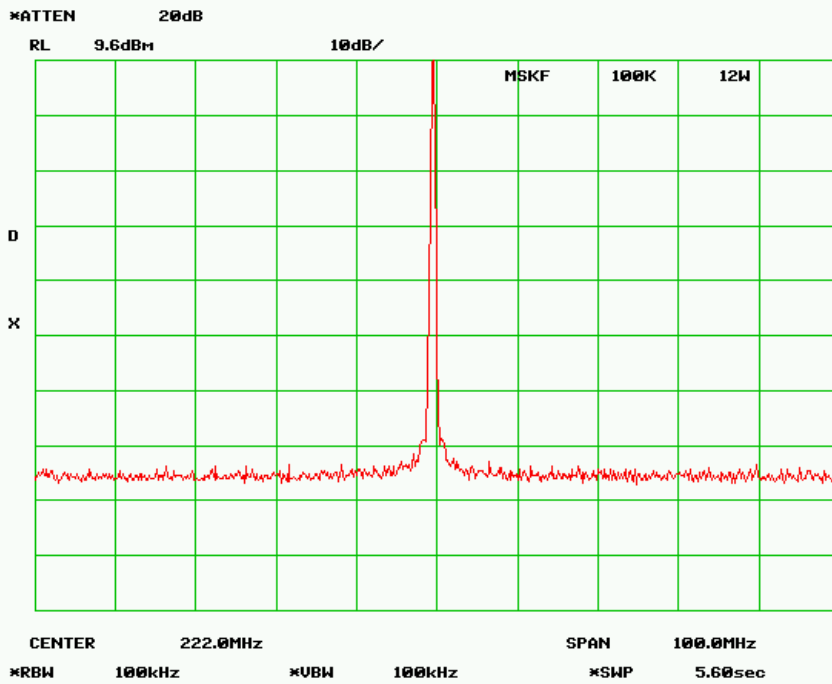
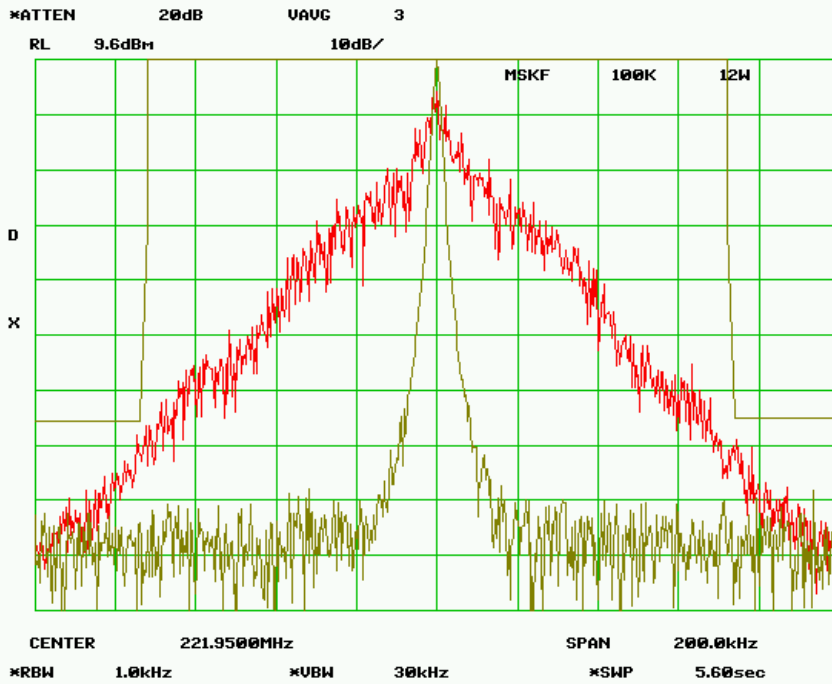
MASK F - 29 Aggregate Masks– 12.0 Watts

RF Frequency 221.950 MHz

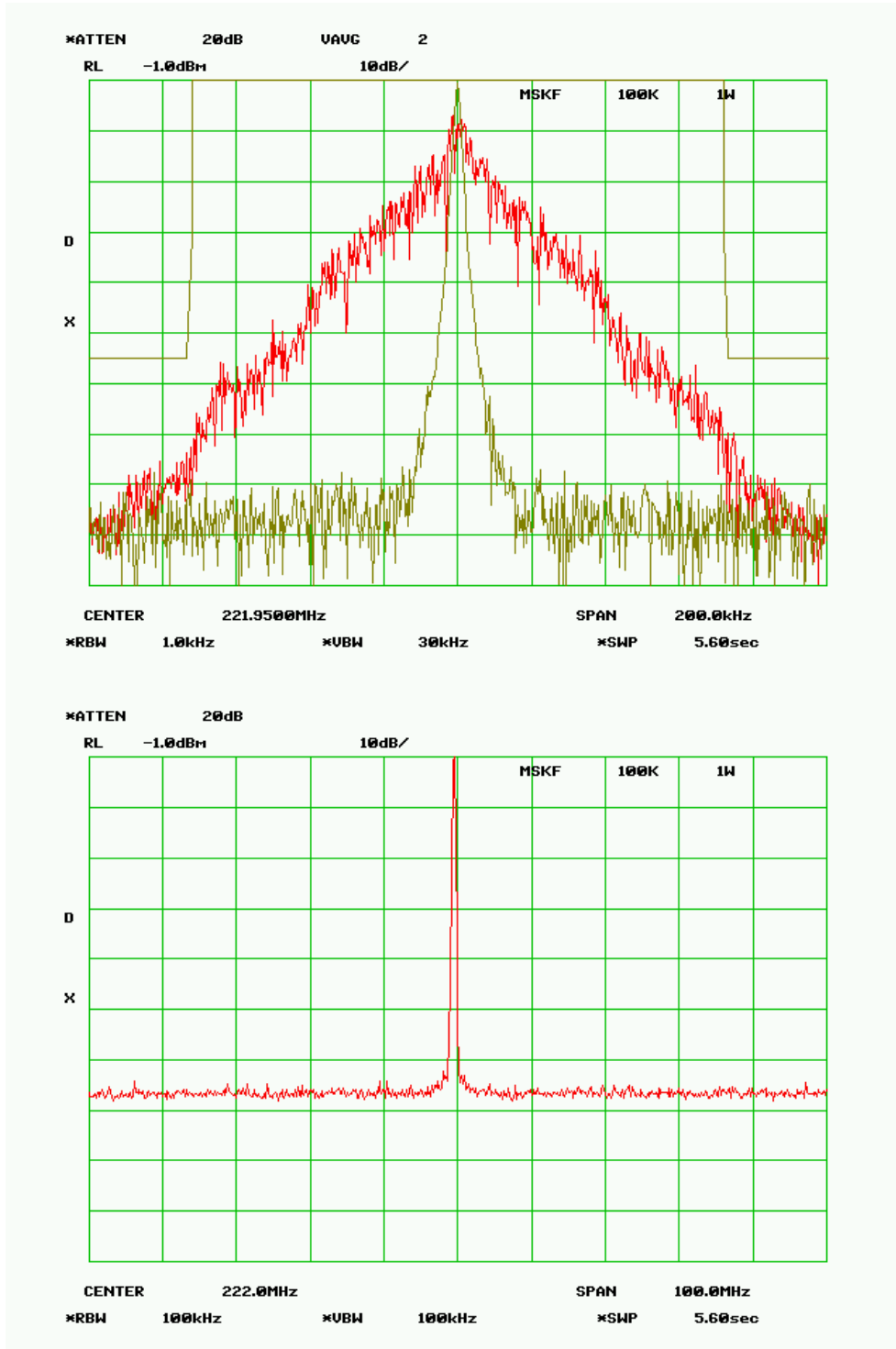
SPECTRUM FOR EMISSION - 53K3F1D

Data Rate = 128 kbps

PEAK DEVIATION = 12.50 kHz



MASK F - 29 Aggregate Masks– 1.0 Watts
RF Frequency 221.950 MHz
SPECTRUM FOR EMISSION - 51K7F1D
Data Rate = 192 kbps
PEAK DEVIATION = 13.17 kHz



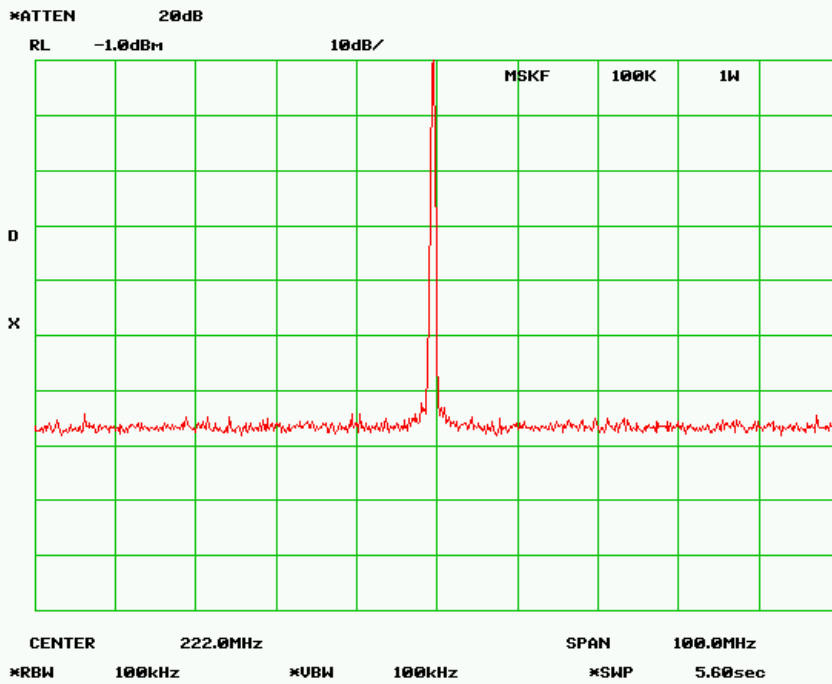
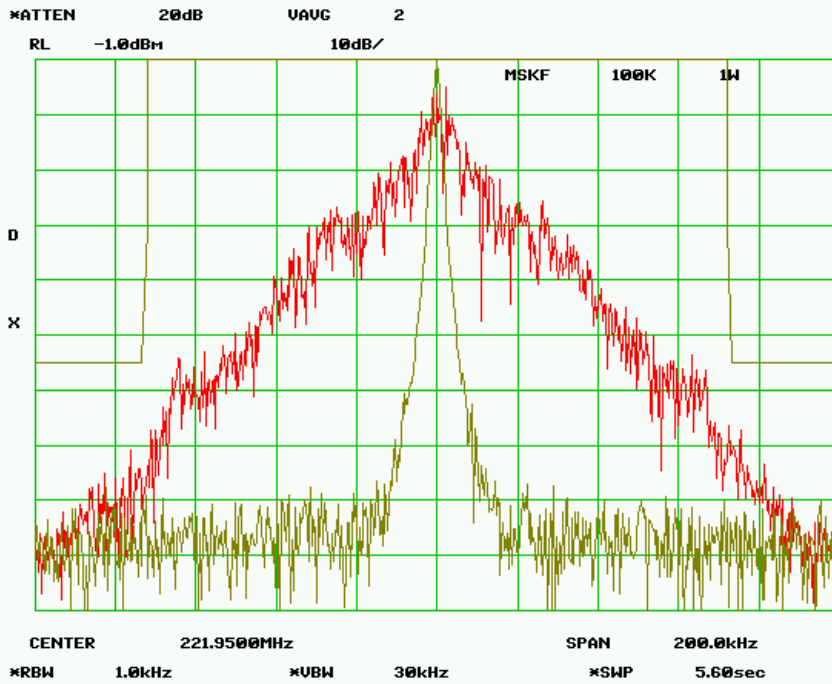
MASK F - 29 Aggregate Masks- 1.0 Watts

RF Frequency 221.950 MHz

SPECTRUM FOR EMISSION - 52K5F1D

Data Rate = 256 kbps

PEAK DEVIATION = 13.97 kHz



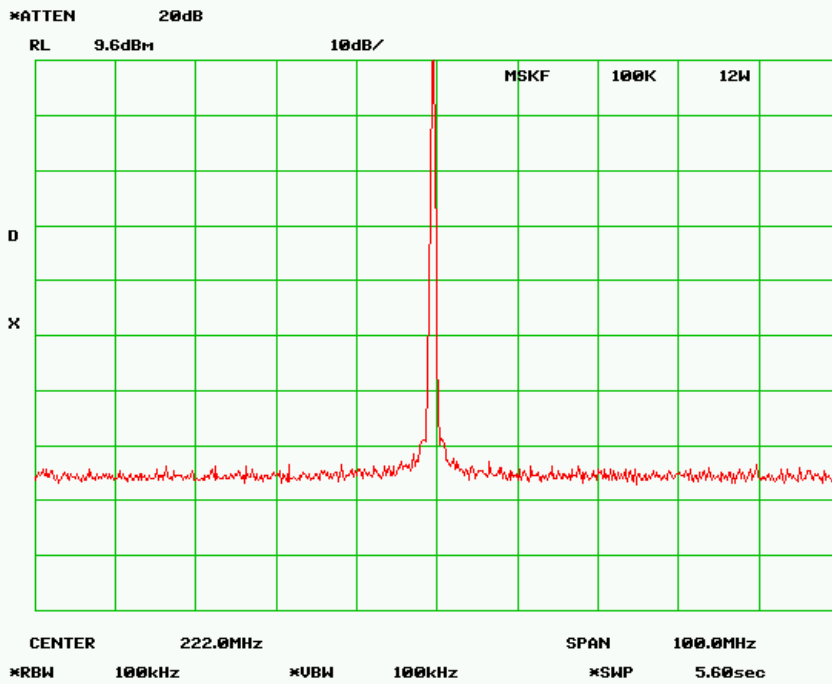
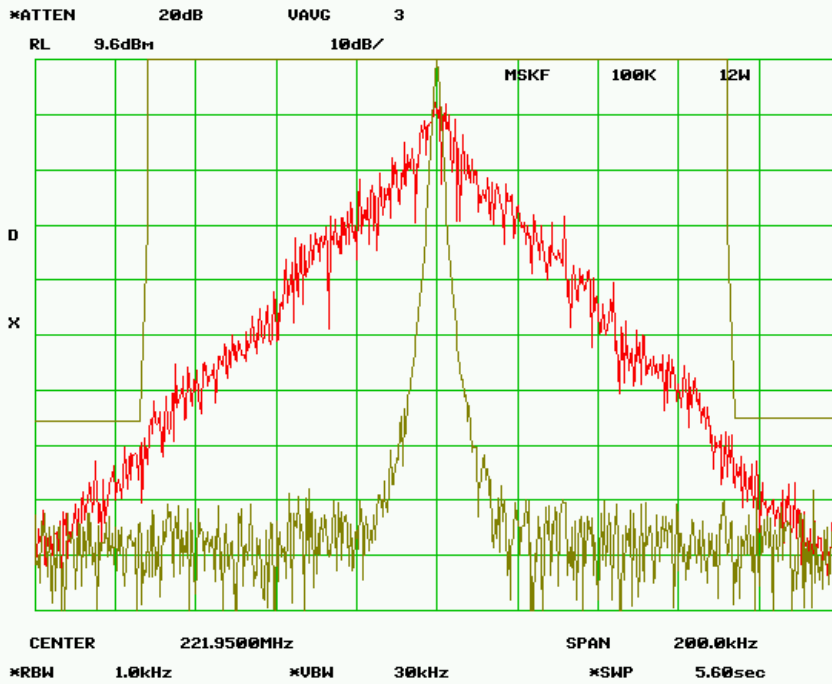
MASK F - 29 Aggregate Masks– 12.0 Watts

RF Frequency 221.950 MHz

SPECTRUM FOR EMISSION - 52K5F1D

Data Rate = 256 kbps

PEAK DEVIATION = 13.97 kHz



21.0 Part 95 - 218-219 MHz

NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators
3K30F1D, 3K55F1D, and 3K20F1D
8K20F1D, 8K30F1D, 8K50F1D and 8K08F1D
16K5F1D, 16K8F1D, 17K8F1D and 17K0F1D
33K3F1D, 34K0F1D, 36K0F1D and 33K0F1D
55K0F1D, 53K3F1D, 51K7F1D and 52K5F1D

RULE PART NUMBER: FCC: 2.202, 2.1049(c) (1), 95.857

MINIMUM STANDARDS: **Part 90.857**
 (a) All transmissions by each CTS and by each RTU shall use an emission type that complies with the following standard for unnecessary radiation.
 (b) 0 dB on any frequency within the authorized frequency segment.
 28 dB from Fo to more than 250 kHz up to and including 750 kHz;
 35 dB from Fo to more than 750 kHz up to and including 1250 kHz;
 43 plus 10 log (base 10) (mean power in watts) dB from Fo to > 1250 kHz.
 (c) When testing for certification, all measurements of unnecessary radiation are performed using a carrier frequency as close to the edge of the authorized frequency segment as the transmitter is designed to be capable of operating.
 (d) The resolution bandwidth of the instrumentation used to measure the emission power shall be 100 Hz for measuring emissions up to and including 250 kHz from the edge of the authorized frequency segment, and 10 kHz for measuring emissions more than 250 kHz from the edge of the authorized frequency segment. If a video filter is used, its bandwidth shall not be less than the resolution bandwidth. The power level of the highest emission within the frequency segment, to which the attenuation is referenced, shall be remeasured for each change in resolution bandwidth.

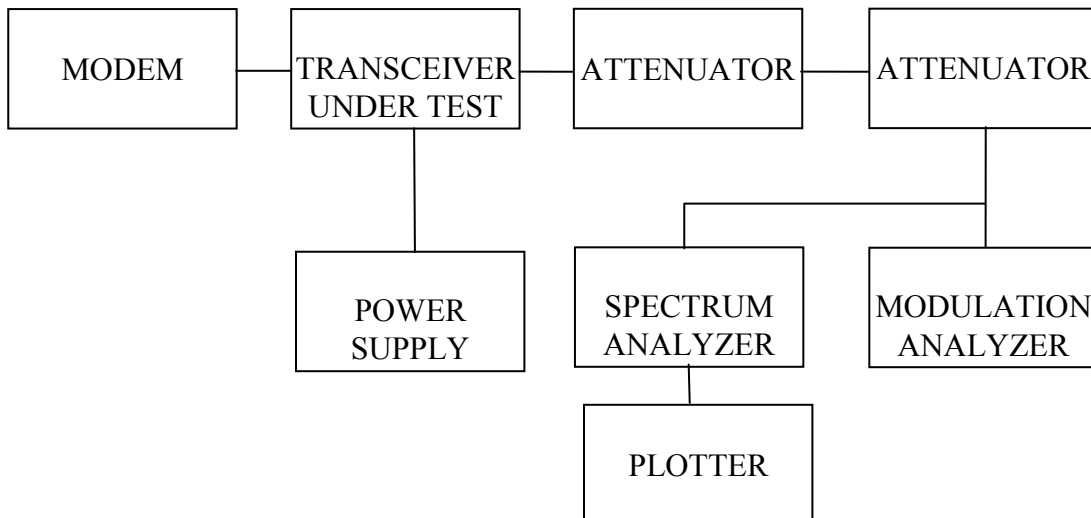
TEST RESULTS: Meets minimum standards (see the table on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C
 RF Power Level = 1 Watt and 12 Watts
 Voltage = 20VDC

TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13, 3.2.11.2

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
 50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
 50-Ohm Attenuator, Pasternack Model PE7002-10 (10dB)
 DC Power Supply, Hewlett Packard Model 6653A
 Spectrum Analyzer, Hewlett Packard Model HP8563E
 Modulation Analyzer, Hewlett Packard Model HP8901B

TEST SET-UP:



The table below in conjunction with the Part 80.211(f) plots of Sections 6, 8, 10, 12 and 14 are being submitted to show compliance with Part 95.857.

The table defines the lowest and highest allowed frequencies that CalAmp's device can use and be in compliance with Part 95.857(c). The frequencies were chosen to be at the band edges of Part 95.853 Segments A and B and to be in compliance with Part 95.857.

Part 80.211(f) plots are generally more stringent than the 95.857 mask requirements. The only questionable point is the 28 dB requirement. The table below verifies compliance. For all other 95.857 mask attenuation requirements, the Part 80.211(f) mask is more stringent.

CalAmp believes the intent of 95.857(c) is to stay within the boundaries of the 218-219 MHz band while using the spectrum efficiently.

The Part 80.211(f) masks were measured in a 100 Hz bandwidth or greater as needed to accurately plot the spectrum.

It is the responsibility of the Licensee to operate the device within the limits stated below.

Channel Spacing	Segment A Operating Frequencies	Segment B Operating Frequencies	Reference Masks used to determine compliance	Operating Frequencies to the band edge	Maximum Frequency Deviation observed at the -28 dB point
6.25 kHz 3K30F1D, 3K55F1D 3K20F1D	A:218.003750 A:218.496250	B:218.504750 B:218.996250	Section 6 Pages 15-21	+/- 3.75 kHz	+/- 2.75 kHz
12.5 kHz 8K20F1D 8K30F1D 8K50F1D 8K08F1D	A:218.006250 A:218.493750	B:218.507250 B:218.993750	Section 8 Pages 29-37	+/- 6.25 kHz	+/- 6.00 kHz
25.0 kHz 16K5F1D 16K8F1D 17K8F1D 17K0F1D	A:218.012500 A:218.487500	B:218.513500 B:218.987500	Section 10 Pages 47-55	+/- 12.5 kHz	+/- 10.00 kHz
50.0 kHz 33K3F1D 34K0F1D 36K0F1D 33K0F1D	A:218.025000 A:218.475000	B:218.526000 B:218.975000	Section 12 Pages 65-73	+/- 25.0 kHz	+/- 20.00 kHz
100.0 kHz 55K0F1D 53K3F1D 51K7F1D 52K5F1D	A:218.050000 A:218.450000	B:218.551000 B:218.950000	Section 14 Pages 83-91	+/- 50.0 kHz	+/- 40.00 kHz

22.0 Calibration Information

Equipment	Serial Number	Cal Date	Cal Due
HP 8563E Spectrum Analyzer	3350A01938	6/19/2013	6/19/2014
Agilent E8257D Signal Generator	MY44320507	6/19/2013	6/19/2014
HP 8901A Modulation Analyzer	2924A02774	6/19/2013	6/19/2014
HP 437B Power Meter	3125U22336	6/19/2013	6/19/2014

Instruments have been calibrated using standards with accuracies traceable to NIST standards.