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**FCC Part 90 Certification Application**

**FCC Form 731**

**For The**

**ViPR  
UHF RADIO MODEM**

**FCC ID: NP4-5098-500**

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## Equipment Calibration Information

Equipment	Serial Number	Cal Date	Cal Due
HP 8563E Spectrum Analyzer	3221A00149	3/23/2008	3/23/2010
Agilent E8257D Signal Generator	MY44320507	3/23/2008	3/23/2010
HP 8901B Modulation Analyzer	3019A02779	3/21/2008	3/21/2010
HP Sensor Module 11722A	2716A03324	6/5/2008	6/5/2009

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

NAME OF TEST: Transmitter Rated Power Output

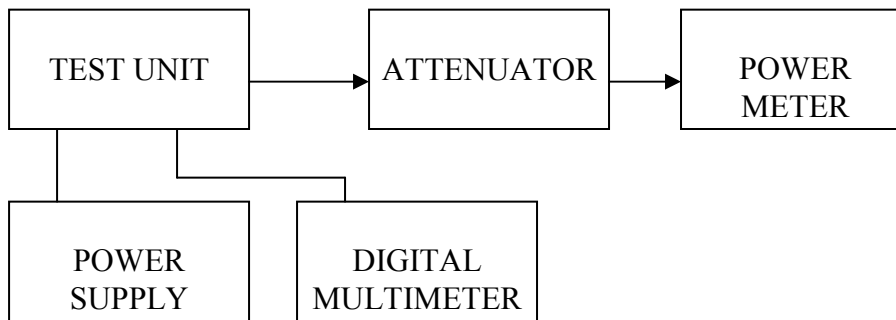
RULE PART NUMBER: FCC: 2.1046 (a) (c), 101.113 (a)  
IC: RSS-119 5.4

TEST RESULTS: See results below

TEST CONDITIONS: Standard Test Conditions

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, Instek Model GPS-2303  
Digital Multimeter, Fluke 8012A  
Power Meter, Model HP8901B with Sensor Module HP 11722A

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 )
928.1	14.0	2.51	35.1	10.0
928.1	8.0	0.90	7.2	1.0

NAME OF TEST: Transmitter Spurious and Harmonic Outputs

RULE PART NUMBER: FCC: 2.1051, 90.210 (c,3)(d,3)(e,3), 101.111(5)(6)  
IC: RSS-119 5.8.2, 5.8.3, 5.8.4

MINIMUM STANDARDS: For 10 Watts:  $55+10\text{Log}_{10}(10 \text{ Watts}) = -65.0 \text{ dBc}$   
or  $-65\text{dBc}$ , whichever is the lesser attenuation.

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

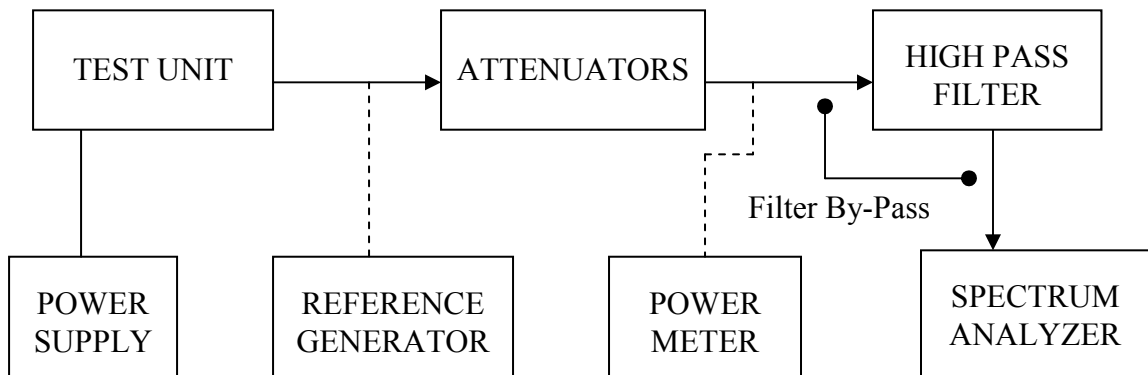
TEST RESULTS: Meets minimum standards ( see data on following pages )

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

TEST PROCEDURE: TIA/EIA – 603-C

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, Instek Model GPS-2303  
Spectrum Analyzer, HP8563E  
Power Meter, Model HP8901B with Sensor Module HP 11722A  
Reference Generator, Agilent E8257D  
High Pass Filter, Mini Circuits VHP-16

TEST SET-UP:



## MEASUREMENT PROCEDURE:

1. The transmitter carrier output frequency is 928.000, 944.000, and 960.000. The reference oscillator frequency is 23.040 MHz. The power amplifier has voltage levels at 14.0 Volts and 8.0 Volts for 10 watts and 1 watt, respectively.
2. The carrier reference was established on the spectrum analyzer with the filter by-pass 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 10<sup>th</sup> harmonic of the highest internally generated frequency.

Tuned Frequency	928.025	MHz
Power	10.0	Watts
	40.0	dBm
Min Specification	-65.0	dBc
Worse Case	-85.5	dBc

Tuned Frequency	928.025	MHz
Power	1.0	Watts
	30.0	dBm
Min Specification	-55.0	dBc
Worse Case	-77.2	dBc

Spurious Frequency (MHz)	Harmonic	Relative to Carrier (dBc)
1856.050	2	-85.5
2784.075	3	-90.0
3712.100	4	-119.5
4640.125	5	-101.0
5568.150	6	-109.7
6496.175	7	-103.3
7424.200	8	-118.3
8352.225	9	-108.5
9280.250	10	-115.3
10208.275	11	-87.2
11136.300	12	-111.0
12064.325	13	-109.5
12992.350	14	-113.7
13920.375	15	-116.2
14848.400	16	-103.0
15776.425	17	-106.5
16704.450	18	-113.7
17632.475	19	-98.0
18560.500	20	-96.0

Spurious Frequency (MHz)	Harmonic	Relative to Carrier (dBc)
1856.050	2	-88.5
2784.075	3	-97.2
3712.100	4	-109.5
4640.125	5	-102.7
5568.150	6	-99.7
6496.175	7	-111.3
7424.200	8	-108.3
8352.225	9	-106.5
9280.250	10	-105.3
10208.275	11	-77.2
11136.300	12	-101.0
12064.325	13	-99.5
12992.350	14	-103.7
13920.375	15	-106.2
14848.400	16	-93.0
15776.425	17	-96.5
16704.450	18	-103.7
17632.475	19	-88.0
18560.500	20	-86.0

Tuned Frequency	944.1	MHz
Power	10.0	Watts
	40.0	dBm
Min Specification	-65.0	dBc
Worse Case	-88.0	dBc

Tuned Frequency	944.1	MHz
Power	1.0	Watts
	30.0	dBm
Min Specification	-55.0	dBc
Worse Case	-78.0	dBc

Spurious Frequency (MHz)	Harmonic	Relative to Carrier (dBc)
1888.200	2	-93.5
2832.300	3	-91.7
3776.400	4	-120.5
4720.500	5	-106.8
5664.600	6	-114.7
6608.700	7	-104.0
7552.800	8	-113.5
8496.900	9	-110.2
9441.000	10	-114.8
10385.100	11	-97.4
11329.200	12	-109.0
12273.300	13	-117.3
13217.400	14	-117.5
14161.500	15	-108.5
15105.600	16	-101.7
16049.700	17	-112.2
16993.800	18	-104.2
17937.900	19	-88.0
18882.000	20	-93.0

Spurious Frequency (MHz)	Harmonic	Relative to Carrier (dBc)
1888.200	2	-95.2
2832.300	3	-99.2
3776.400	4	-110.5
4720.500	5	-104.8
5664.600	6	-104.7
6608.700	7	-113.0
7552.800	8	-108.5
8496.900	9	-100.2
9441.000	10	-104.8
10385.100	11	-87.4
11329.200	12	-99.0
12273.300	13	-107.3
13217.400	14	-107.5
14161.500	15	-98.5
15105.600	16	-91.7
16049.700	17	-102.2
16993.800	18	-94.2
17937.900	19	-78.0
18882.000	20	-83.0



Tuned Frequency	959.975	MHz
Power	10.0	Watts
	40.0	dBm
Min Specification	-65.0	dBc
Worse Case	-86.0	dBc

Tuned Frequency	959.975	MHz
Power	1.0	Watts
	30.0	dBm
Min Specification	-55.0	dBc
Worse Case	-76.0	dBc

Spurious Frequency (MHz)	Harmonic	Relative to Carrier (dBc)
1919.950	2	-92.8
2879.925	3	-91.2
3839.900	4	-119.8
4799.875	5	-102.7
5759.850	6	-115.5
6719.825	7	-103.5
7679.800	8	-114.5
8639.775	9	-90.2
9599.750	10	-111.7
10559.725	11	-108.0
11519.700	12	-106.7
12479.675	13	-115.5
13439.650	14	-120.0
14399.625	15	-100.8
15359.600	16	-104.8
16319.575	17	-116.3
17279.550	18	-105.8
18239.525	19	-86.0
19199.500	20	-95.2

Spurious Frequency (MHz)	Harmonic	Relative to Carrier (dBc)
1919.950	2	-82.8
2879.925	3	-81.2
3839.900	4	-109.8
4799.875	5	-92.7
5759.850	6	-105.5
6719.825	7	-93.5
7679.800	8	-104.5
8639.775	9	-80.2
9599.750	10	-101.7
10559.725	11	-98.0
11519.700	12	-96.7
12479.675	13	-105.5
13439.650	14	-110.0
14399.625	15	-90.8
15359.600	16	-94.8
16319.575	17	-106.3
17279.550	18	-95.8
18239.525	19	-76.0
19199.500	20	-85.2

NAME OF TEST: Frequency Stability with Variation in Supply Voltage

RULE PART NUMBER: FCC: 2.1055 (d)(1), 90.213 (a), 101.107  
IC: RSS-119 5.3

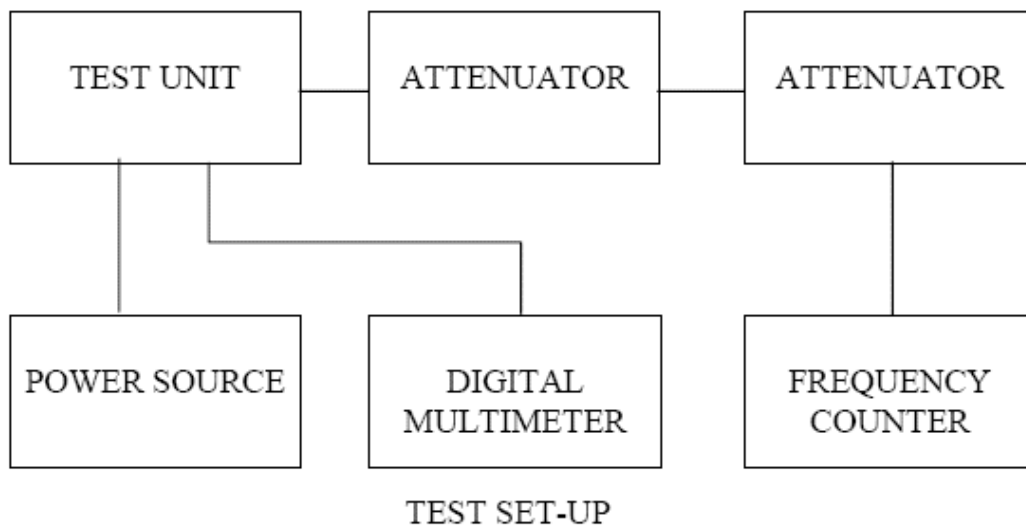
MINIMUM STANDARD: Shall not exceed 1.50 ppm.

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

TEST CONDITIONS: Standard Test Conditions, 25 C

TEST EQUIPMENT: Frequency Counter, HP 8901B  
DC Power Supply, Instek Model GPS-2303  
Digital Voltmeter, Fluke Model 8012A  
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:



Channel Frequency: 928.1500 MHz

Tolerance Requirements: 1.5ppm

Highest Variation: 0.05 ppm

Input Voltage (Vdc)	Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)
10	928.150050	50	0.05
20	928.150000	0	0.00
30	928.150050	50	0.05

NAME OF TEST: Frequency Stability with Variation in Ambient Temperature

RULE PART NUMBER: FCC: 2.1055 (d)(1), 90.213 (a), 101.107  
IC: RSS-119 5.3

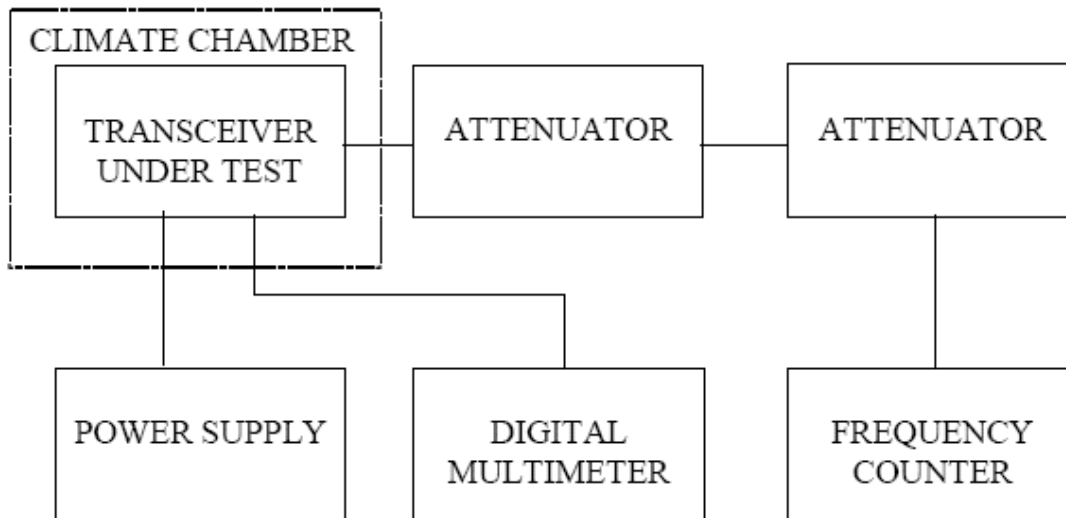
MINIMUM STANDARD: Shall not exceed 1.50 ppm from test frequency

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

TEST CONDITIONS: Standard Test Conditions

TEST EQUIPMENT: Frequency Counter, HP8901B  
DC Power Supply, Instek Model GPS-2303  
Digital Voltmeter, Fluke Model 8012A  
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, Test Equity Half Cube Model 105

TEST SET-UP:



Channel Frequency: 944.15000 MHz  
 Voltage & Power Level: 20 Volts @ 10 Watts  
 Highest Variation: 0.13 ppm

Temperature (Deg C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)
-30	928.150030	30	0.03
-20	928.150100	100	0.11
-10	928.150100	100	0.11
0	928.150120	120	0.13
10	928.150000	0	0.00
20	928.150100	100	0.11
30	928.150020	20	0.02
40	928.150040	40	0.04
50	928.150050	50	0.05
60	928.150060	60	0.06

Channel Frequency: 944.15000 MHz  
 Voltage & Power Level: 20 Volts @ 1.0 Watts  
 Highest Variation: 0.13 ppm

Temperature (Deg C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)
-30	928.150000	0	0.00
-20	928.150110	110	0.12
-10	928.150120	120	0.13
0	928.150100	100	0.11
10	928.150000	0	0.00
20	928.150110	110	0.12
30	928.150000	0	0.00
40	928.150060	60	0.06
50	928.150060	60	0.06
60	928.150050	50	0.05

NAME OF TEST: Transmitter Occupied Bandwidth

RULE PART NUMBER: FCC: 2.201, 2.202, 2.1033 (c)(14), 2.1049 (h), 2.1041;90.203(j)(3), 101.109(c)  
 IC: RSS-Gen 4.6.1

**Necessary Bandwidth Measurement**

This radio modem uses digital modulation signals, passing through a Squared Root Raised Cosine  $\alpha=0.2$  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	6.25 kHz	6.25 kHz	12.5 kHz	12.5 kHz	25 kHz	25 kHz
Emission Type	3K30 F1D	3K55 F1D	8K20 F1D	8K30 F1D	16K5 F1D	16K8 F1D
Data Rate	4 kbps	8 kbps	8 kbps	16 kbps	16 kbps	32 kbps
Baud Rate	4000	4000	8000	8000	16000	16000
Measured Peak Deviation	1.51 kHz	1.49 kHz	3.31 kHz	3.65 kHz	6.50 kHz	7.29 kHz
Measured 99% Occupied BW	3.3 kHz	3.55 kHz	8.20 kHz	8.30 kHz	16.5 kHz	16.8 kHz

**MODEM SETUP:**

For 2 FSK Modulation (3K30F1D, 8K20F1D, 16K5F1D) :  
 200-dsp.par.setup.deviation= 01 c2 01 f4 05 dc 07 6c 0c 80 0f 3c  
 200-dsp.par.setup.softSyncAmplitude= 32767 (0x7fff)

For 4 FSK Modulation (3K55F1D, 8K30F1D, 16K8F1D) :  
 200-dsp.par.setup.deviation= 01 c2 01 f4 05 dc 07 6c 0c 80 0f 3c  
 200-dsp.par.setup.softSyncAmplitude= 26200 (0x6658)

**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

$$TP = \int_0^{+\infty} PSD_{(f)} df = (1/T) \int_{-\infty}^{+\infty} |z(t)|^2 dt$$

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.

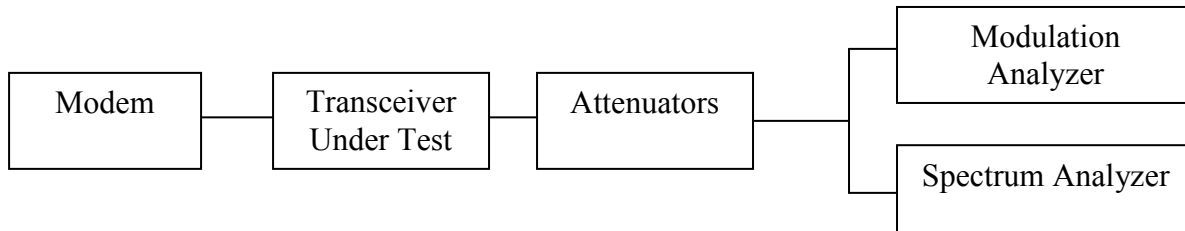
**TEST EQUIPMENT:**

- 50-Ohm Attenuator, Bird Electronics 50-A-FFN-20 (20dB, 50W)
- 50-Ohm Attenuator, Bird Electronics 10-A-MFN-10 (10dB, 10W)
- Power Supply, Instek Model GPS-2303
- 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 channels)
- VBW: 3 kHz
- SPAN: 100 kHz (6.25 and 12.5 kHz channels)
- SPAN: 150 kHz (25 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 8, 16, or 32 kbps references in the Installation Guide correspond to a transmitter baud rate of 4000, 8000 or 16000 baud. That digital signal is digitally filtered (Square Root Raised Cosine pulse shaping with  $\alpha=0.2$ ) by the DSP and converted to I&Q components, then fed to the digital to analog converter. This SRRC4FSK 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 and pulse shaping with SRRC  $\alpha=0.2$ . 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.



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

RULE PART NUMBER: FCC: 2.202, 90.209 (b)(5), 90.210(e), 2.1049 (c) (1)  
IC: RSS-119 5.8.4

MINIMUM STANDARDS: **Mask E**  
Sidebands and Spurious [P = 10 Watts and P=1 Watt]  
Authorized Bandwidth = 6 kHz  
From Fo to 3 kHz, down 0 dB.  
Greater than 3 kHz to 4.6 kHz, down 30 +16.67(fd-3 kHz) dB or 55 +10 log(P) or 65 dB, whichever is the lesser attenuation.  
Greater than 4.6 kHz, at least 55+10log<sub>10</sub>(P) or 65 dB, whichever is the lesser attenuation.

Attenuation = 0 dB at Fo to 3 kHz  
Attenuation = 30 dB at 3 kHz and 56.7 dB at 4.6 kHz @ 10 Watts  
Attenuation = 65 dB at frequencies greater than 4.6 kHz @ 10 Watts  
Attenuation = 30 dB at 3 kHz and 50 dB at 4.2 kHz and 55 dB at 4.6 kHz @ 1 Watt  
Attenuation = 55 dB at frequencies greater than 4.6 kHz @ 1 Watt

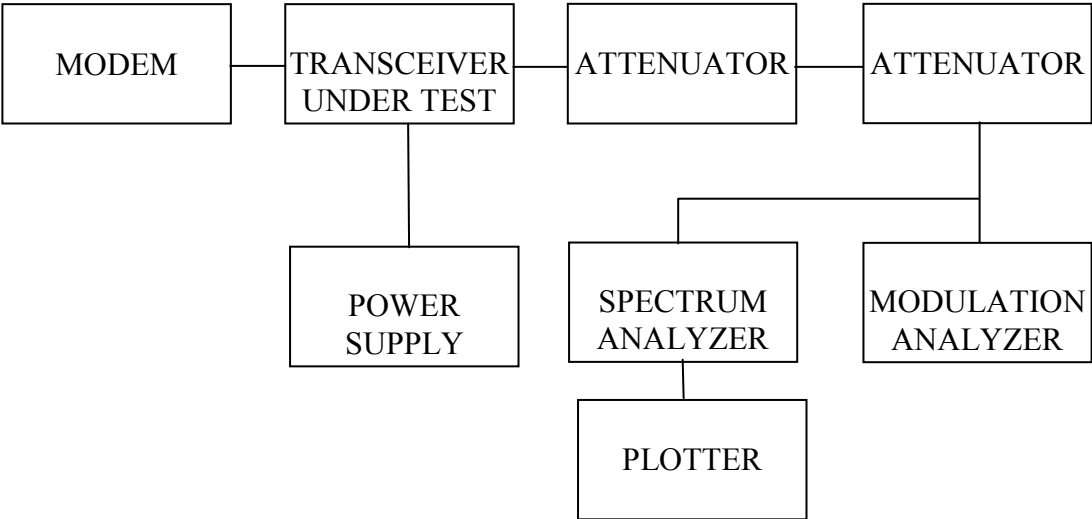
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C  
RF Power Level = 1 Watt and 10 Watts  
Voltage = 20VDC

TEST PROCEDURE: TIA/EIA – 603-C

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics 50-A-FFN-20 (20dB, 50W)  
50-Ohm Attenuator, Bird Electronics 10-A-MFN-10 (10dB, 10W)  
50-Ohm Attenuator, Pasternack PE7002-10 (10dB)  
Power Supply, Instek Model GPS-2303  
Spectrum Analyzer, Hewlett Packard Model HP8563E  
Modulation Analyzer, Hewlett Packard Model HP8901B

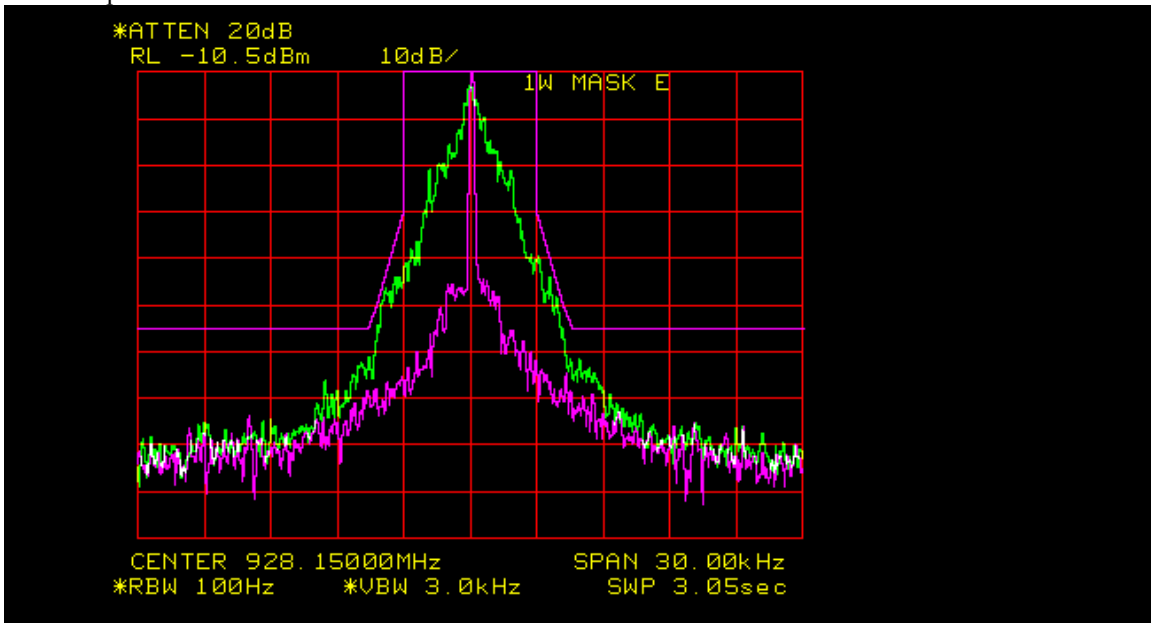
TEST SET-UP:



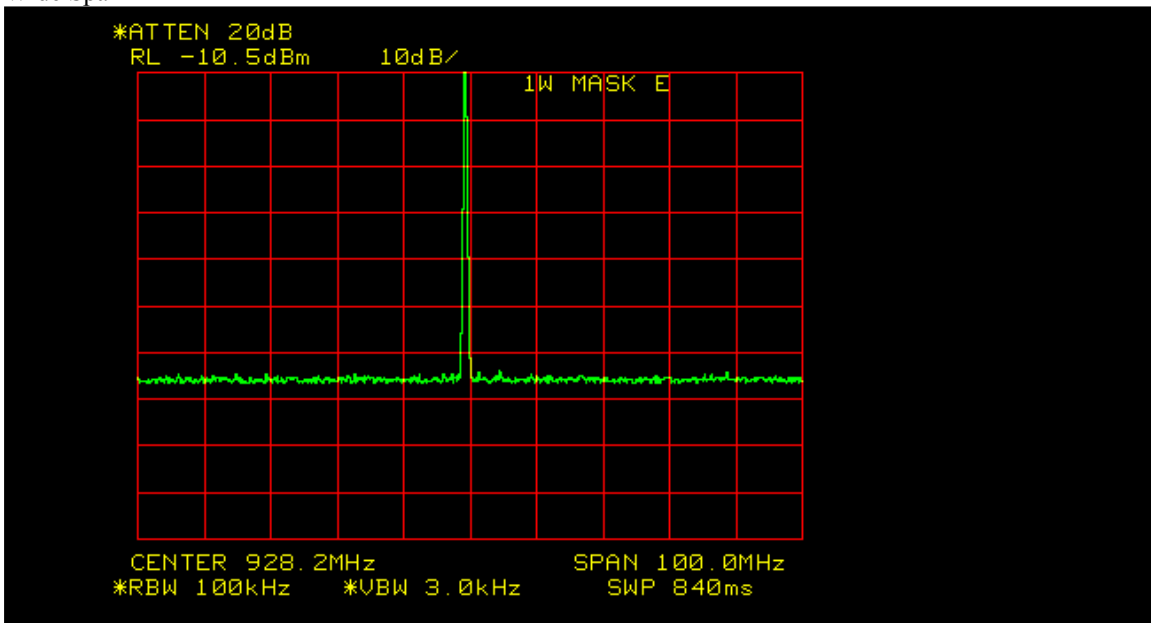
Mask: E  
Output Power = 1 Watt

Spectrum for Emission: 3K30 F1D  
Data Rate: 4 kbps      Peak Deviation with Data: 1.51kHz

Narrow Span

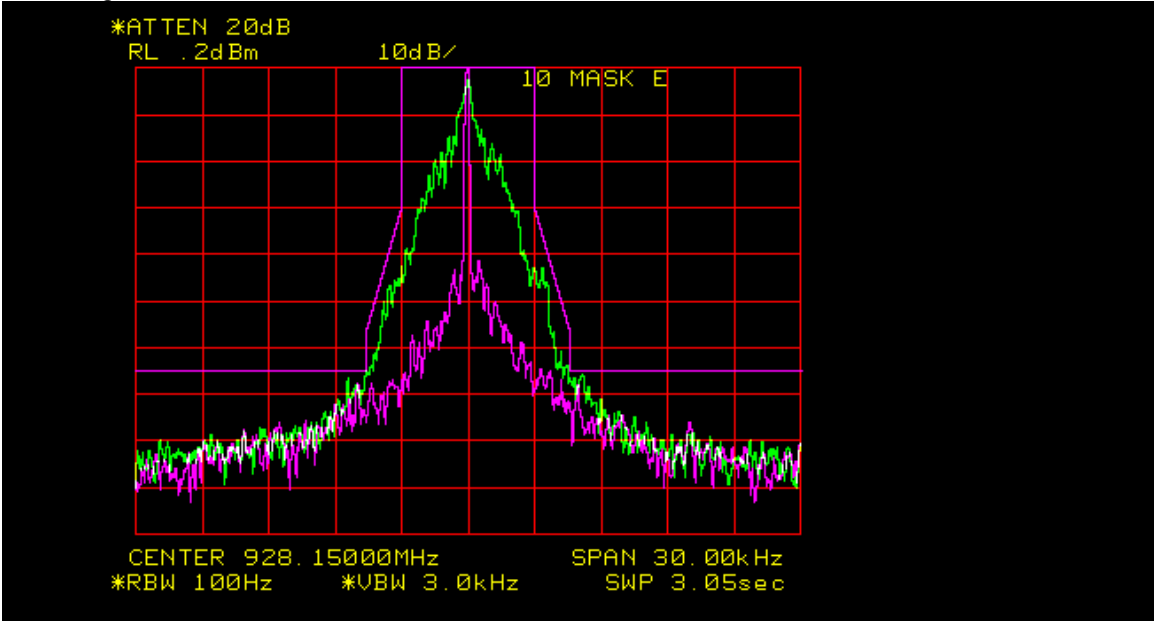


Wide Span

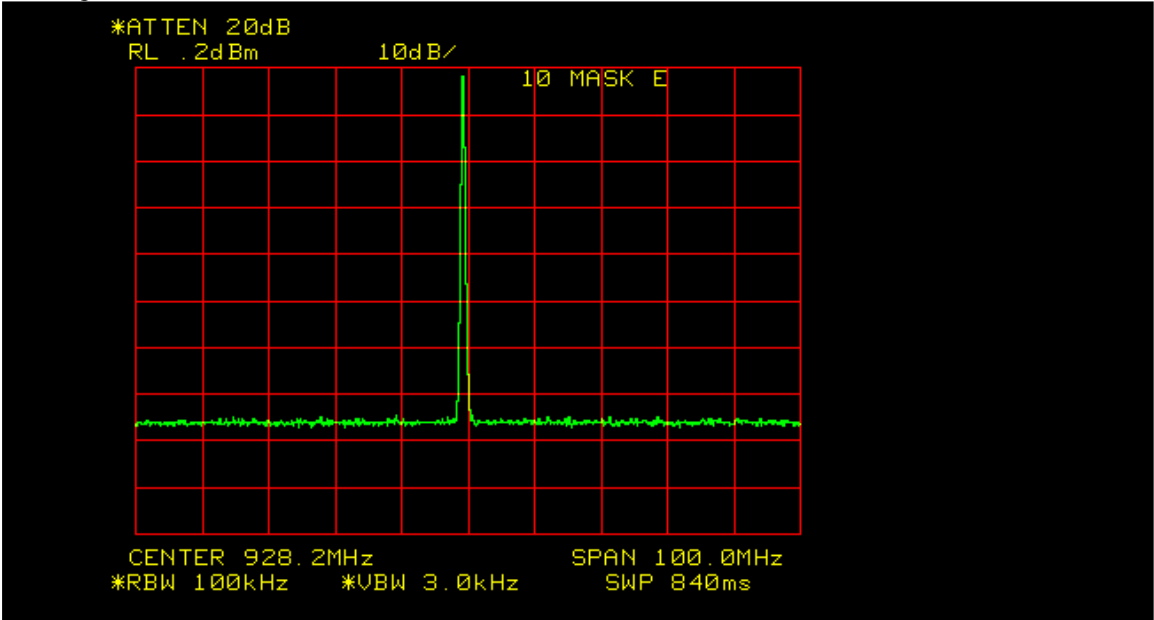


Output Power = 10 Watt

Narrow Span



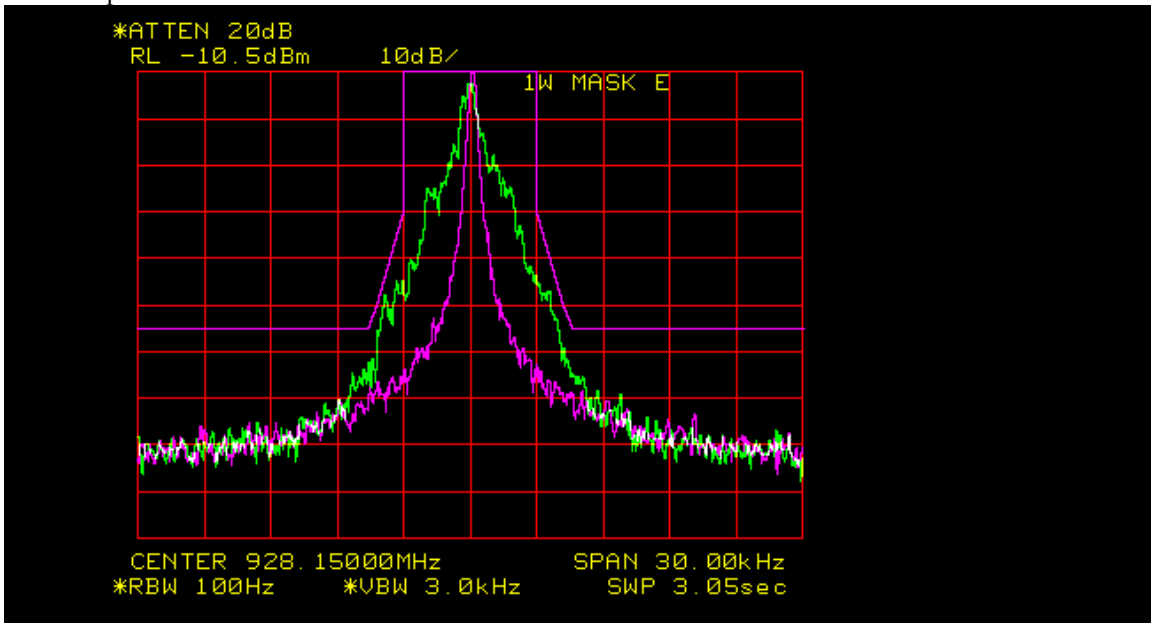
Wide Span



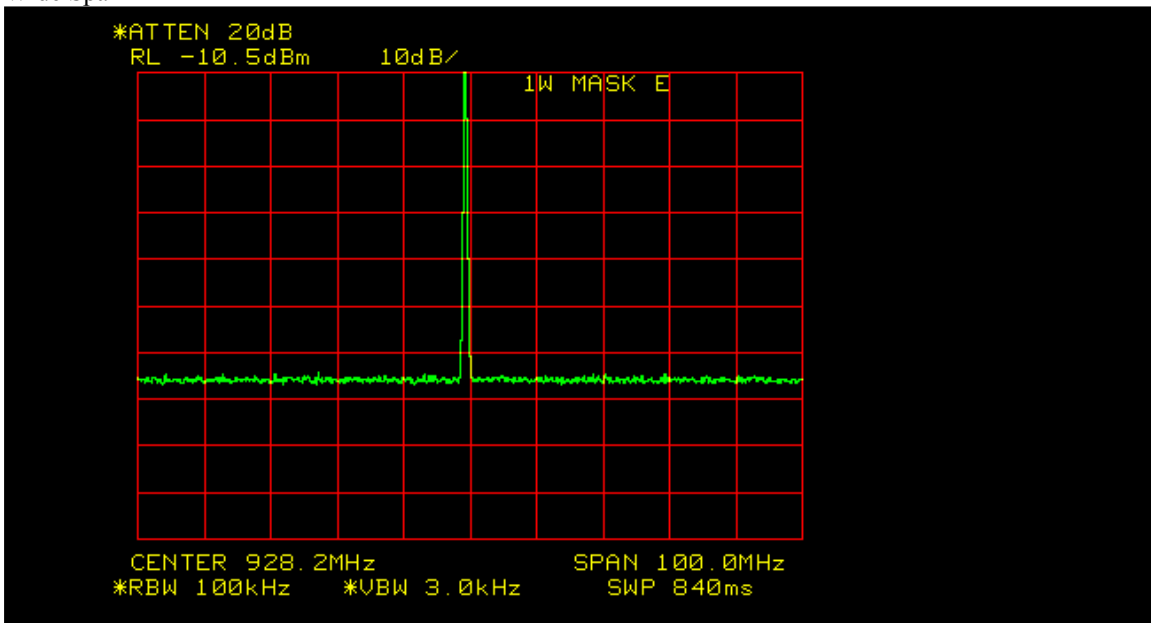
Mask: E  
Output Power = 1 Watt

Spectrum for Emission: 3K55 F1D  
Data Rate: 8 kbps      Peak Deviation with Data: 1.49 kHz

Narrow Span

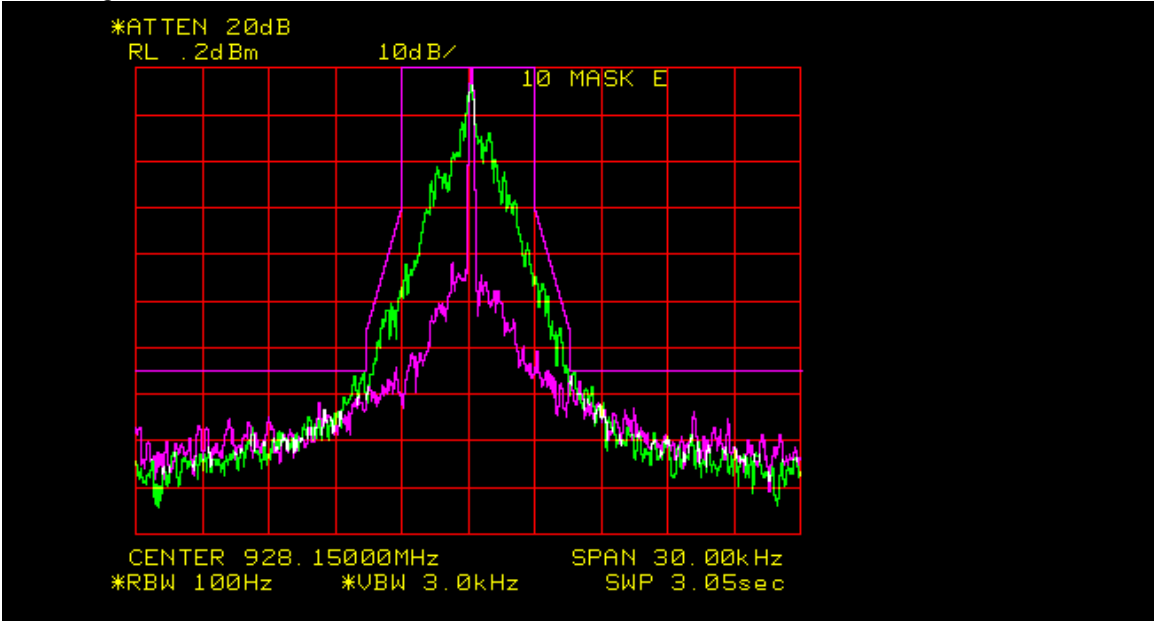


Wide Span

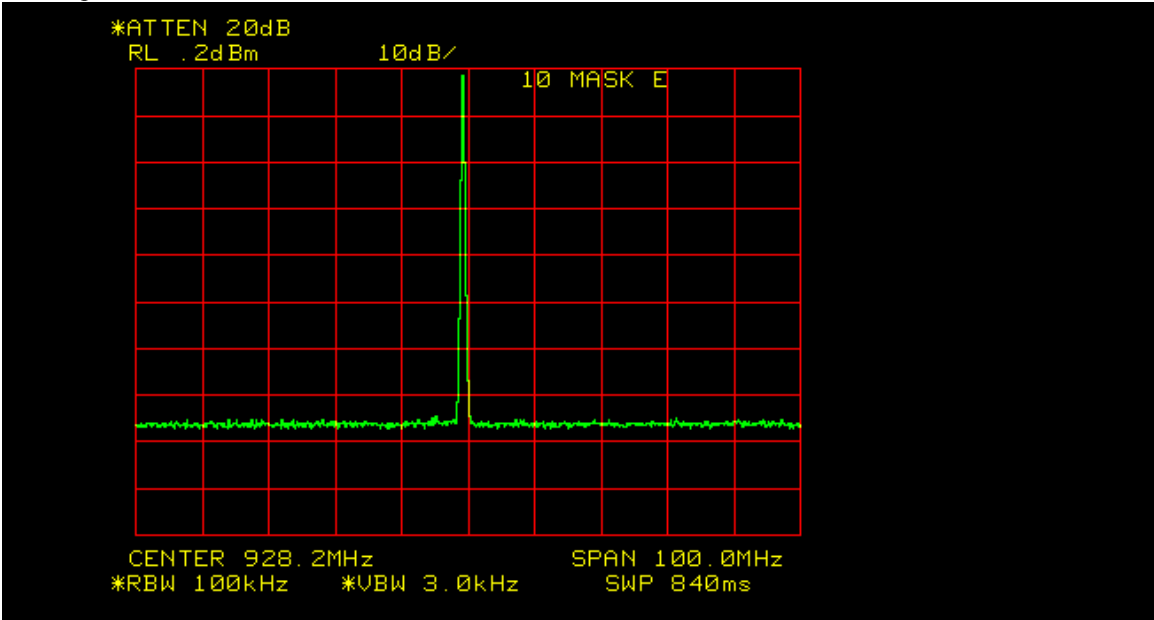


Output Power = 10 Watt

Narrow Span



Wide Span



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

RULE PART NUMBER: FCC: 2.202, 90.209 (b)(5), 90.210(j), 2.1049 (c) (1), 101.111 (a)(5)  
IC: RSS-119 5.8.3, RSS-199 5.8.6

MINIMUM STANDARDS: **Mask D**  
Sidebands and Spurious [P = 10 Watts and P=1 Watt]  
Authorized Bandwidth = 11.25 kHz  
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  $50 + 10\log_{10}(P)$  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 = 60.0 dB at frequencies greater than 12.5 kHz @ 10 W  
Attenuation = 50 dB at frequencies greater than 12.5 kHz @ 1 W

**Mask 101.111(a)(5)**  
Sidebands and Spurious [P = 10 Watts and P=1 Watt]  
Authorized Bandwidth = 12.5 kHz  
From Fo to 2.5 kHz, down 0 dB.  
Greater than 2.5 kHz to 6.25 kHz, down  $53\log(f_d/2.5)$   
Greater than 6.25 kHz to 9.5 KHz, down  $103\log(f_d/3.9)$   
Greater then 9.5 to 15 KHz,  $157\log(f_d/5.3)$   
Greater then 15 KHz,,  $50 + 10\log(P)$  or 70 dB

Attenuation = 0 db at Fo to 6.25 kHz  
Attenuation = 21.1 dB at 6.25 kHz  
Attenuation = 39.8 dB at 9.5 KHz  
Attenuation = 70.9 dB at 15 kHz  
Attenuation = 60 dB at > 15 KHz @ 10W or 50dB @ 1W

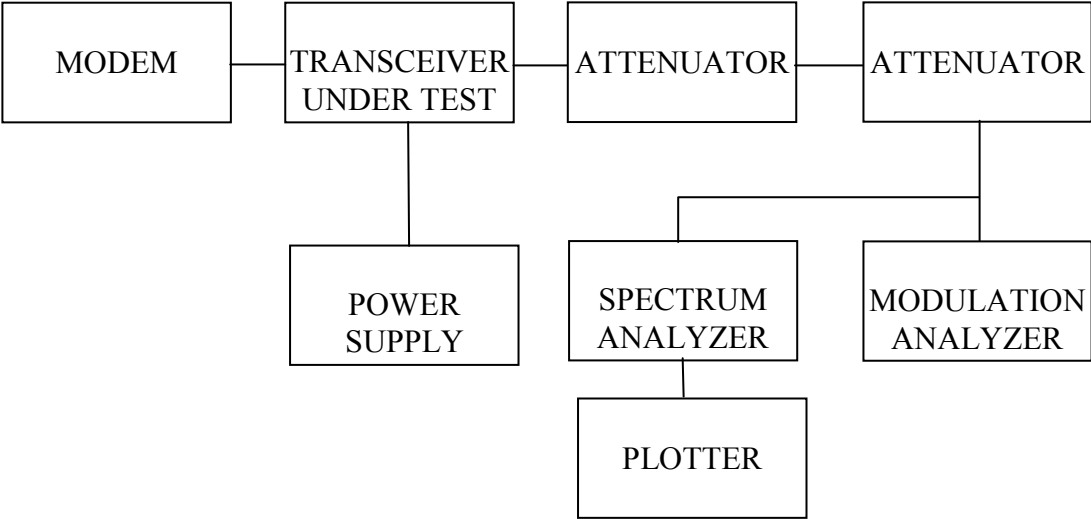
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C  
RF Power Level = 1 Watt and 10 Watts  
Voltage = 20VDC

TEST PROCEDURE: TIA/EIA – 603-C

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics 50-A-FFN-20 (20dB, 50W)  
50-Ohm Attenuator, Bird Electronics 10-A-MFN-10 (10dB, 10W)  
50-Ohm Attenuator, Pasternack PE7002-10 (10dB)  
Power Supply, Instek Model GPS-2303  
Spectrum Analyzer, Hewlett Packard Model HP8563E  
Modulation Analyzer, Hewlett Packard Model HP8901B

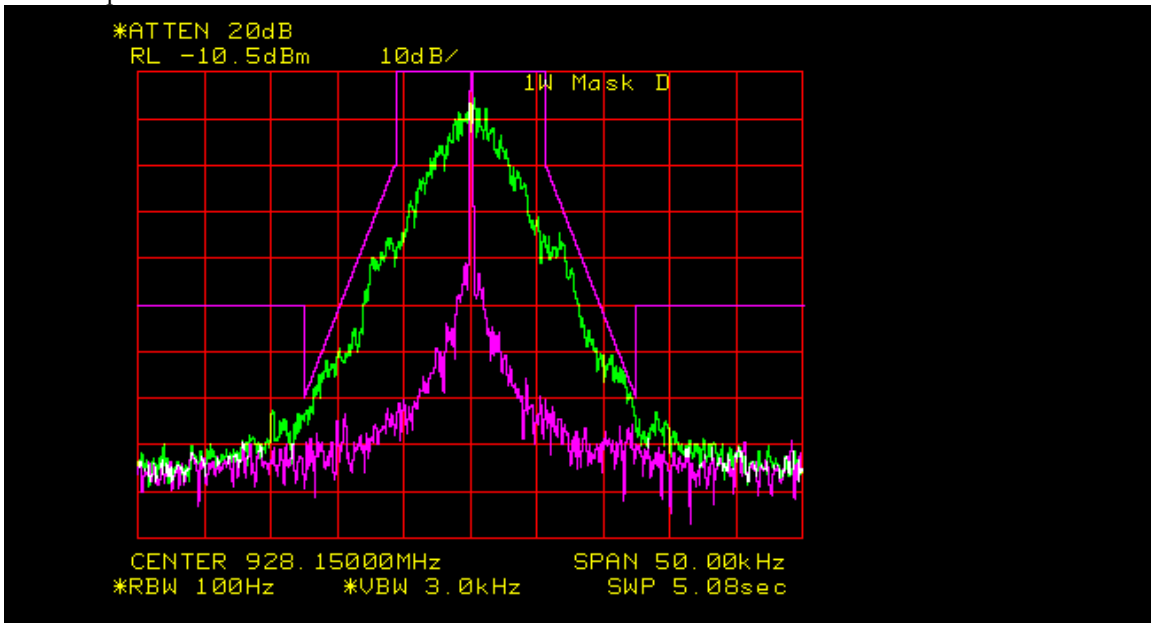
TEST SET-UP:



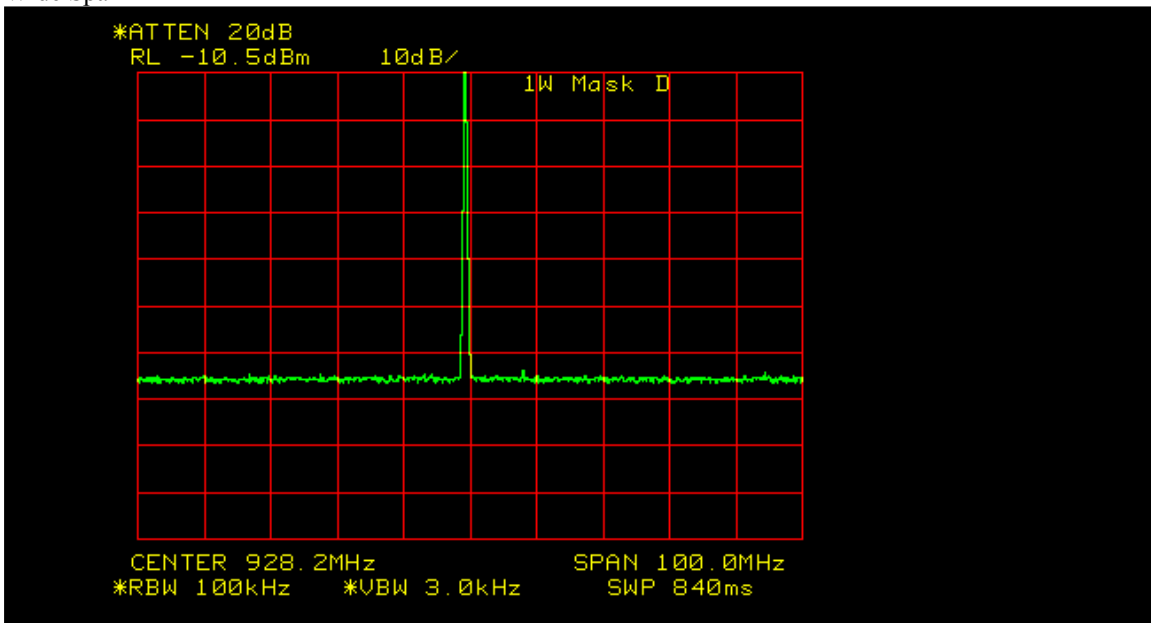
Mask: D  
Output Power = 1 Watt

Spectrum for Emission: 8K20 F1D  
Data Rate: 8 kbps      Peak Deviation with Data: 3.31 kHz

Narrow Span



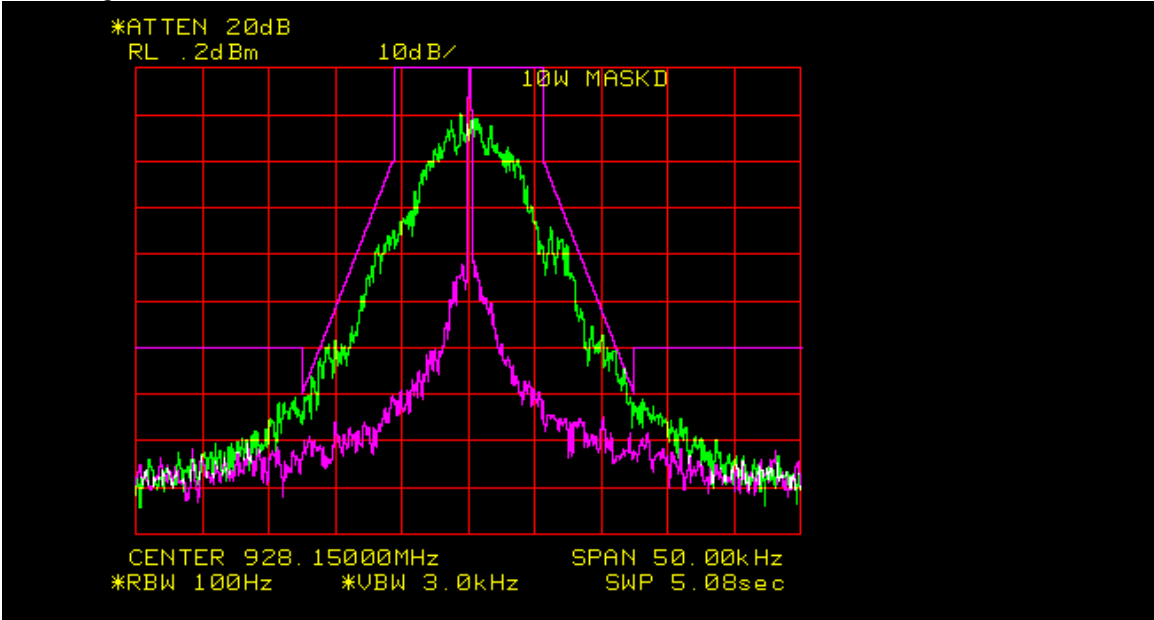
Wide Span



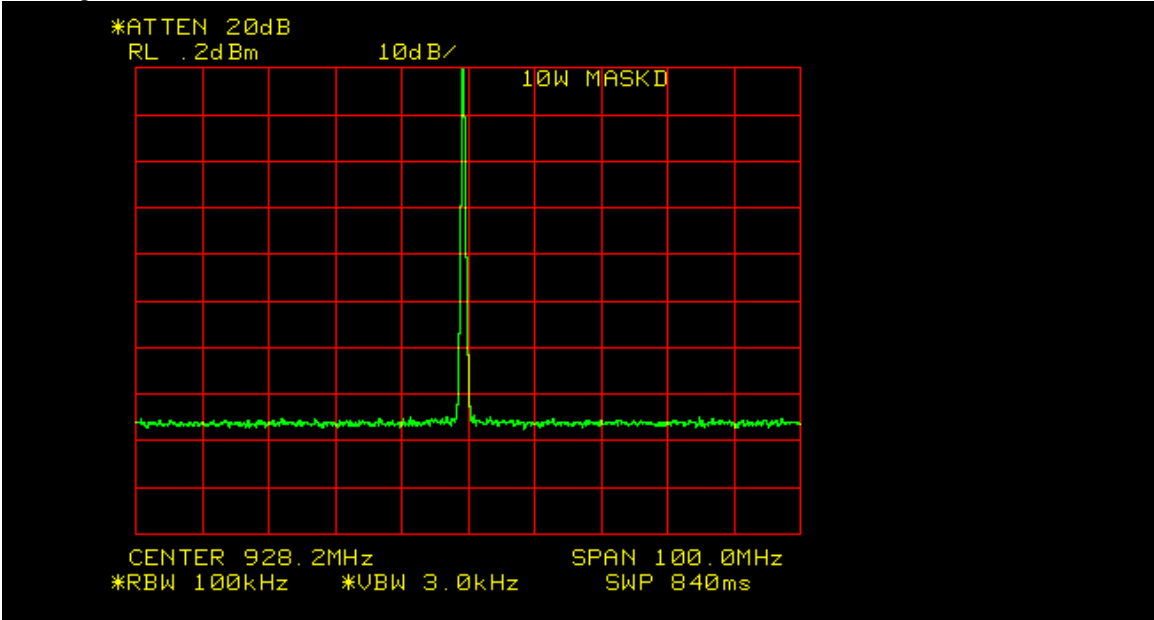


Output Power = 10 Watts

Narrow Span



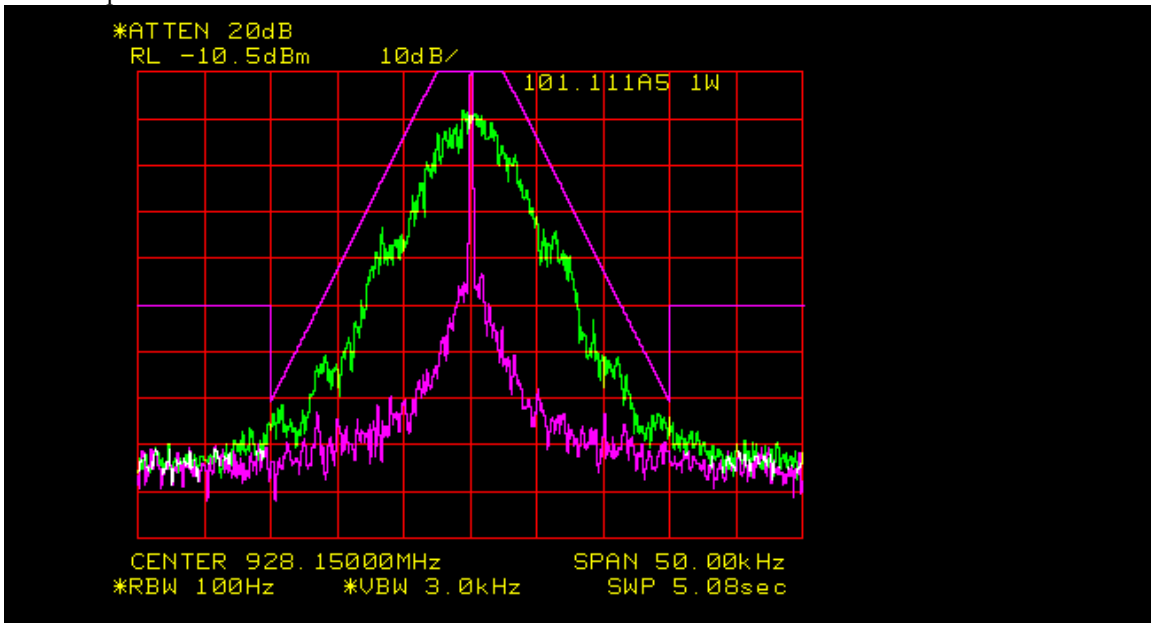
Wide Span



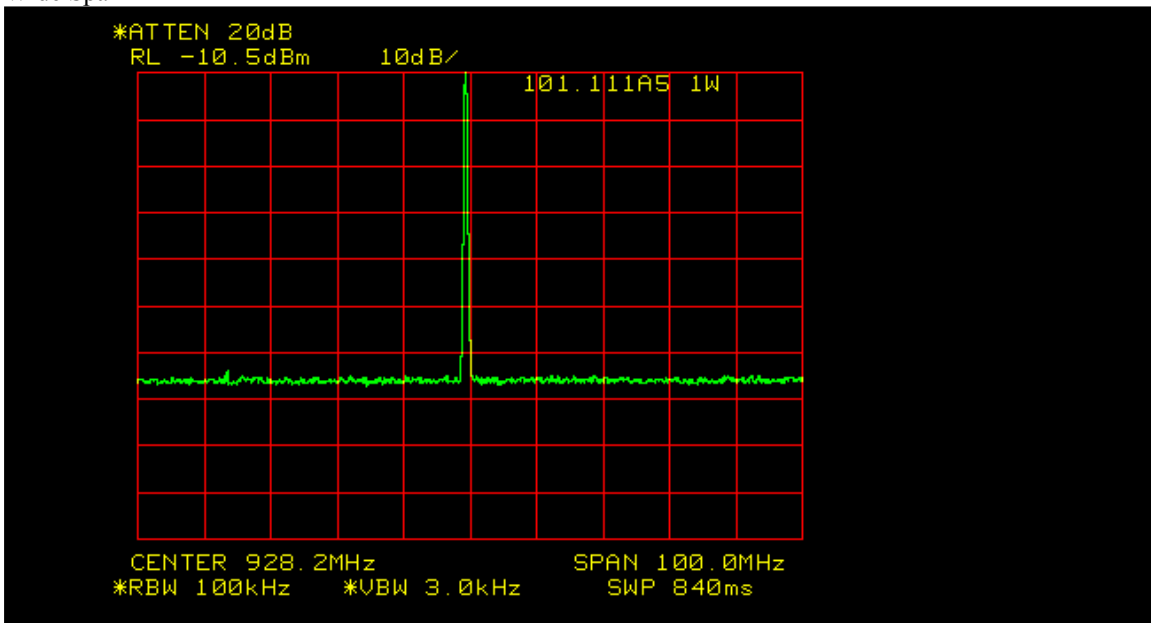
Mask: 101.111a5  
Output Power = 1 Watt

Spectrum for Emission: 8K20 F1D  
Data Rate: 8 kbps      Peak Deviation with Data: 3.31 kHz

Narrow Span

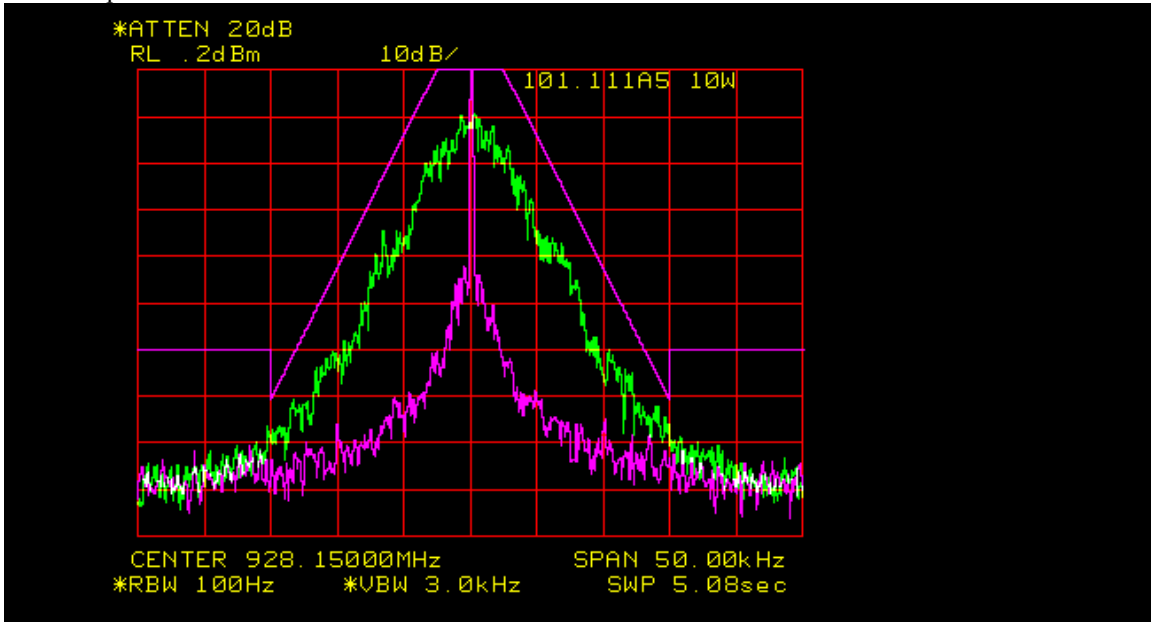


Wide Span

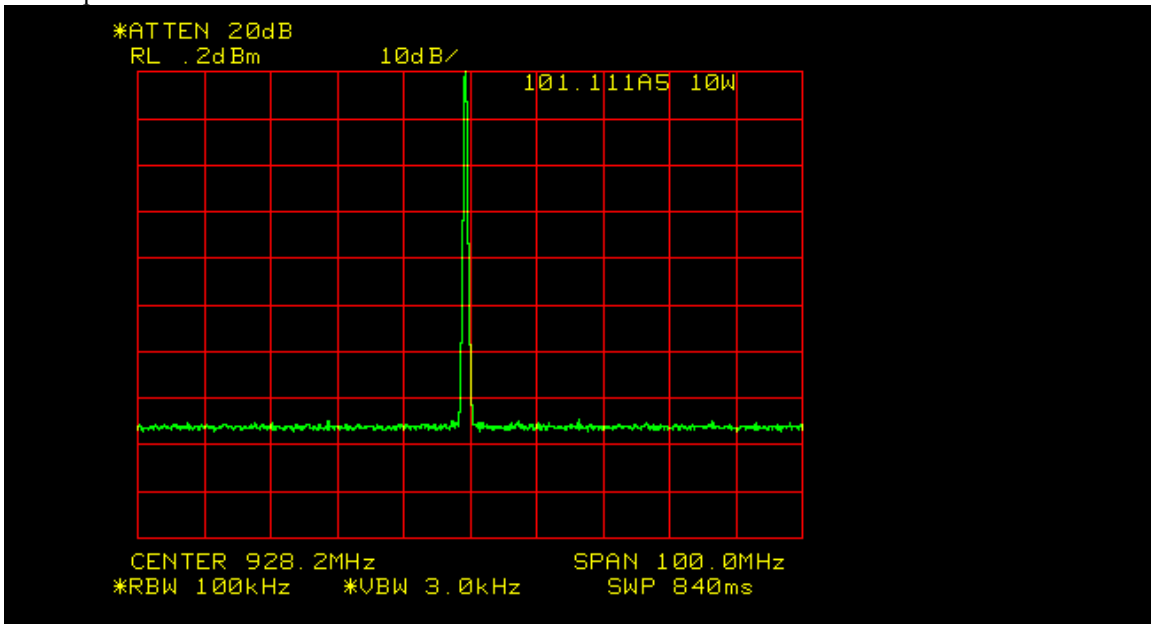


Output Power = 10 Watts

Narrow Span



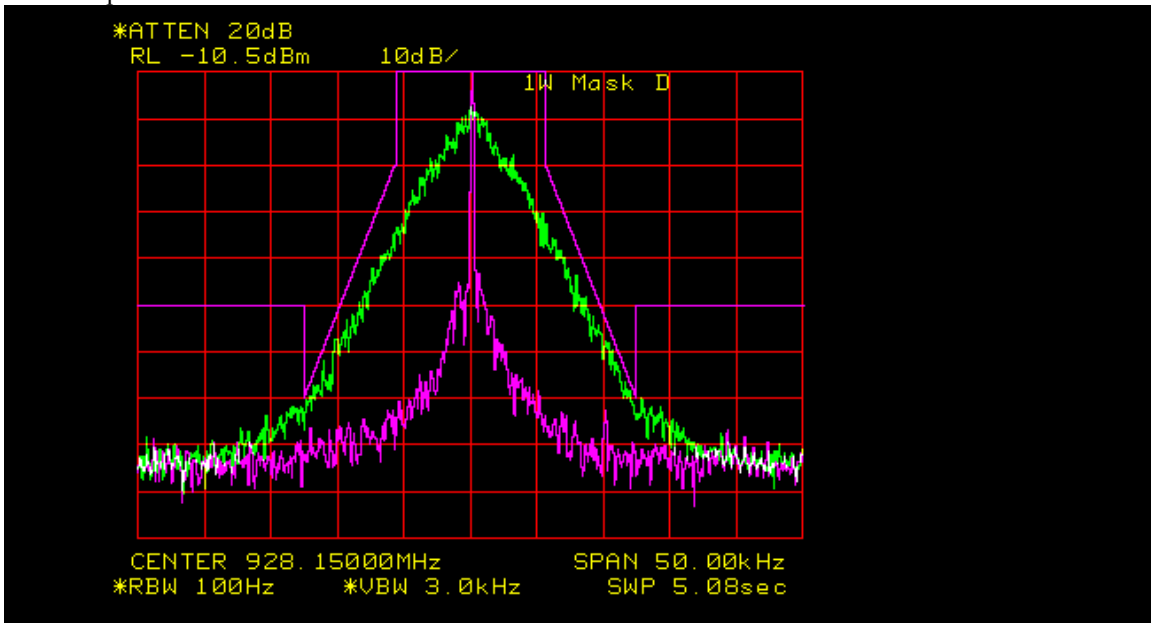
Wide Span



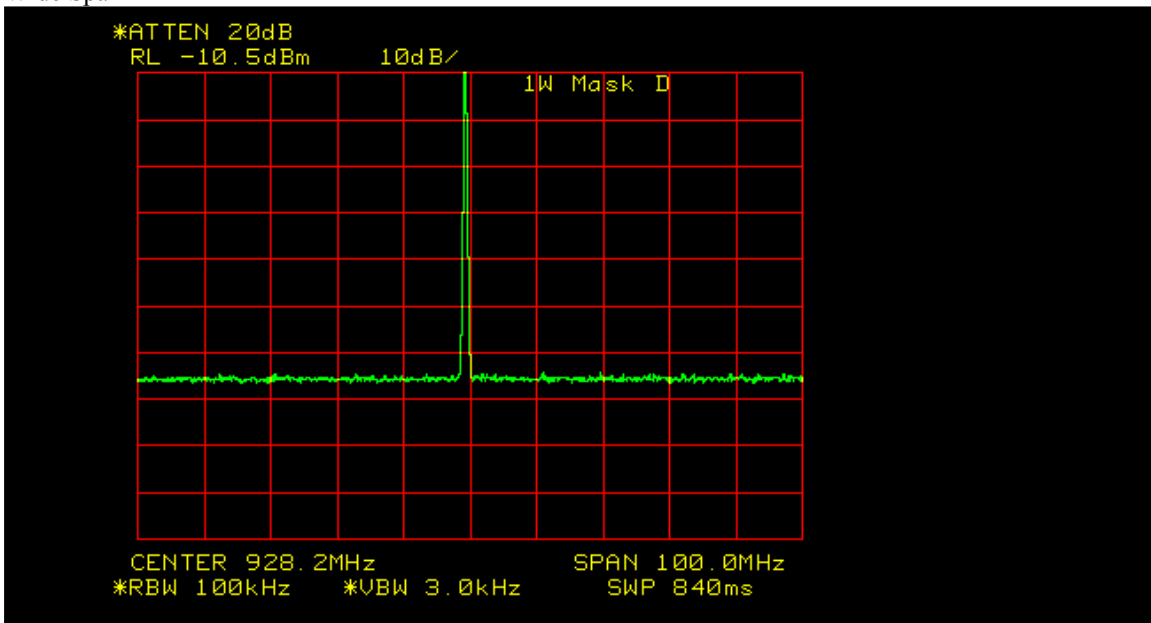
Mask: D  
Output Power = 1 Watt

Spectrum for Emission: 8K30 F1D  
Data Rate: 16 kbps      Peak Deviation with Data: 3.65 kHz

Narrow Span

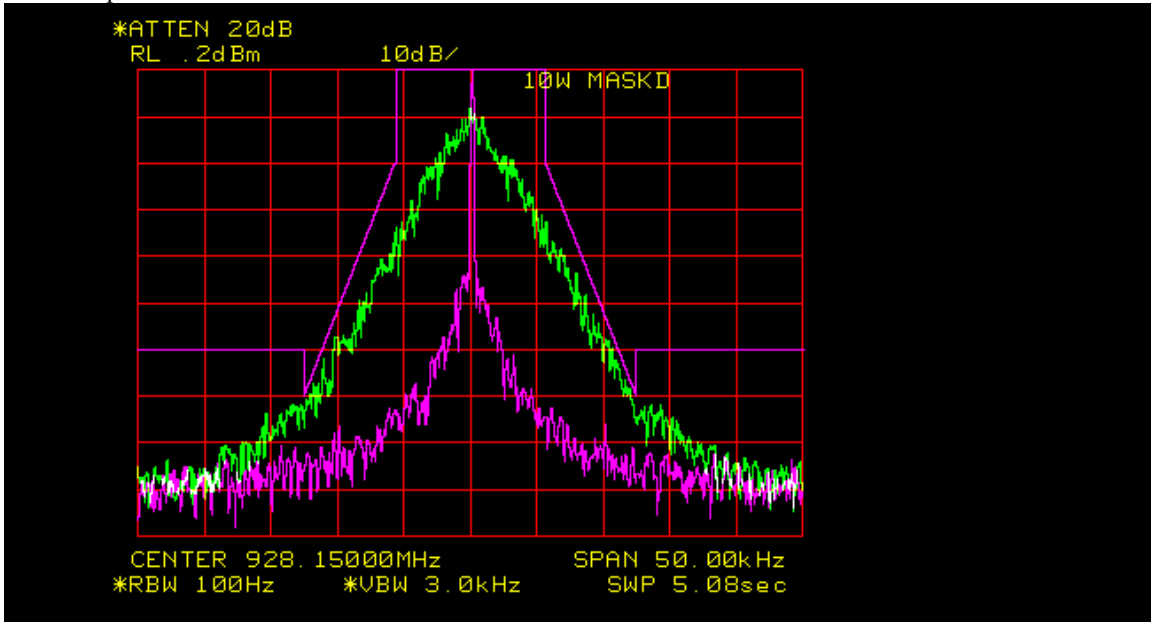


Wide Span

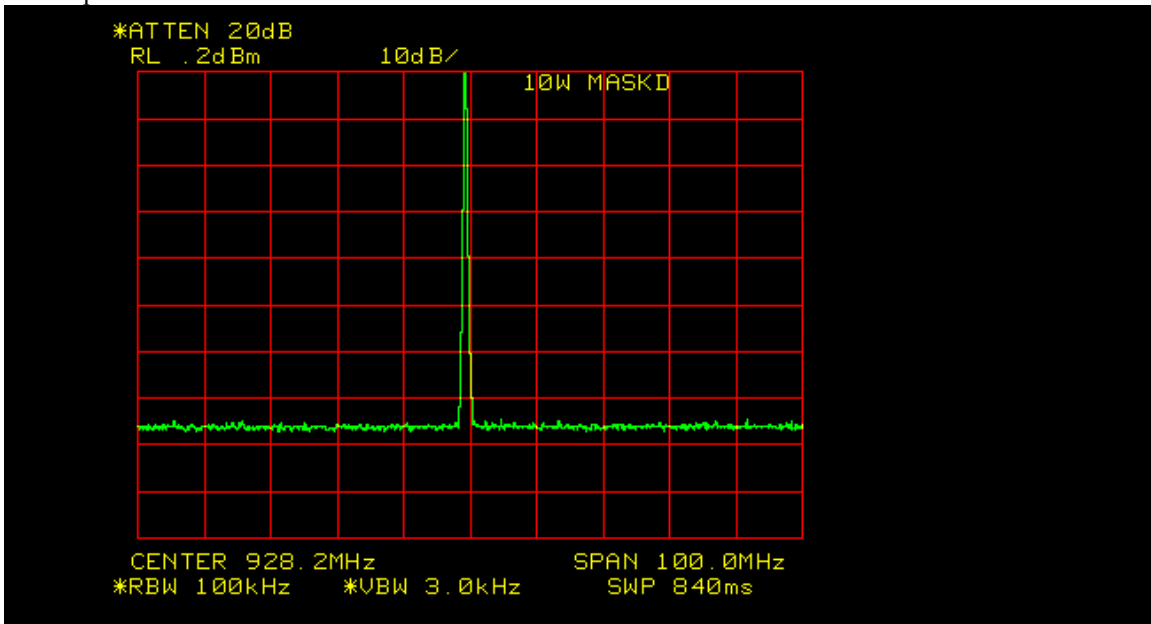


Output Power = 10 Watts

Narrow Span



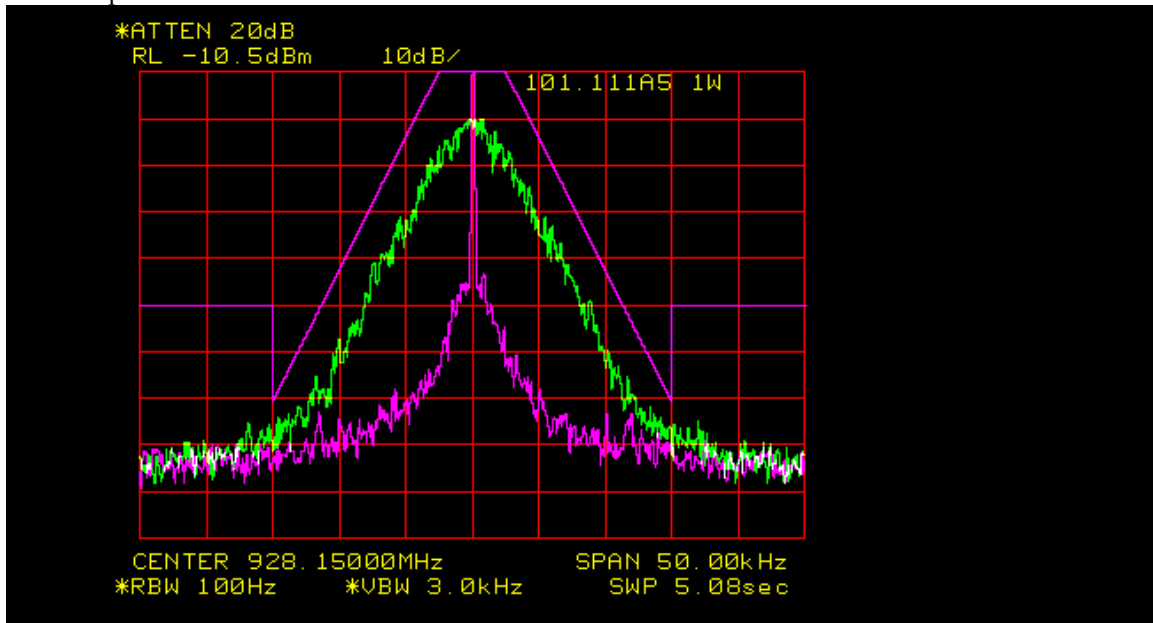
Wide Span



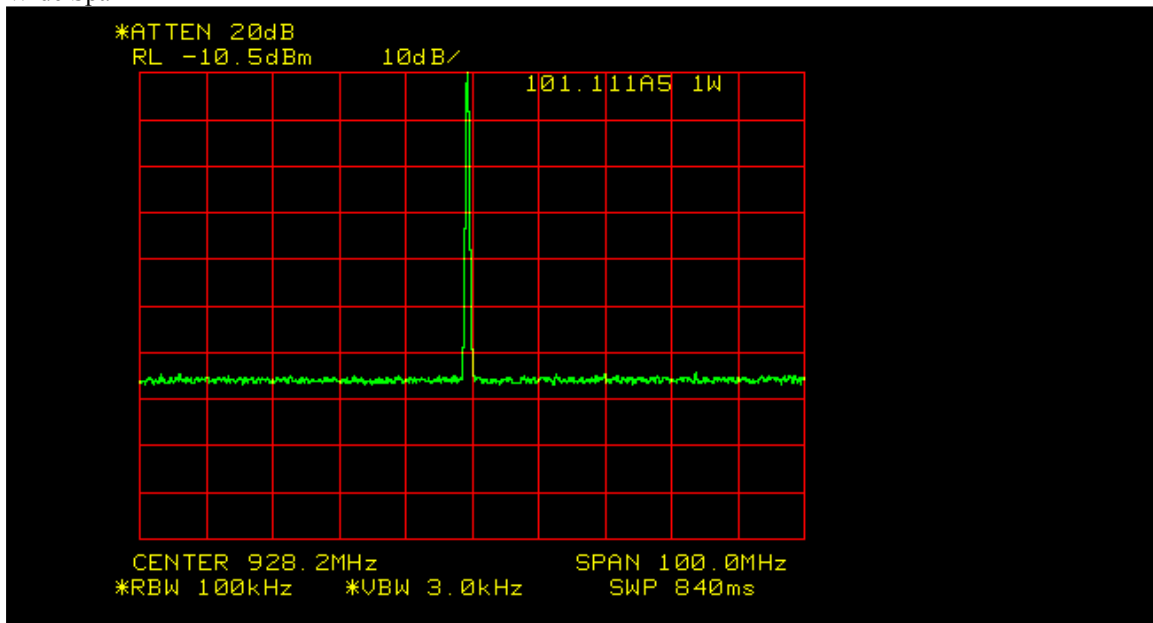
Mask: 101.111a5  
Output Power = 1 Watt

Spectrum for Emission: 8K30 F1D  
Data Rate: 16 kbps      Peak Deviation with Data: 3.65 kHz

Narrow Span

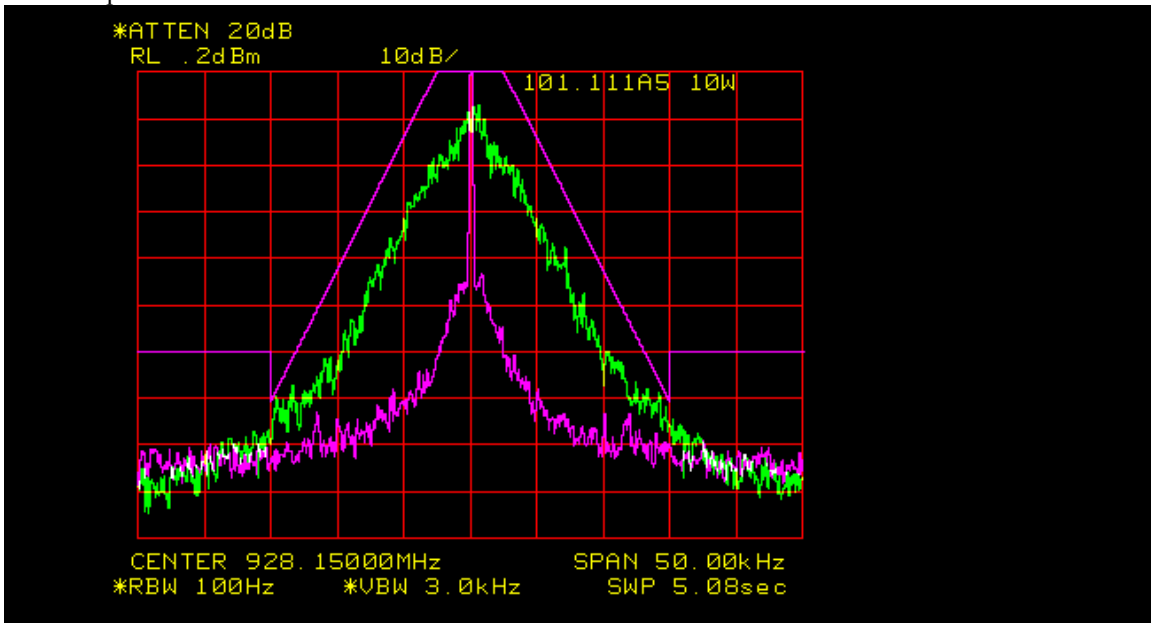


Wide Span

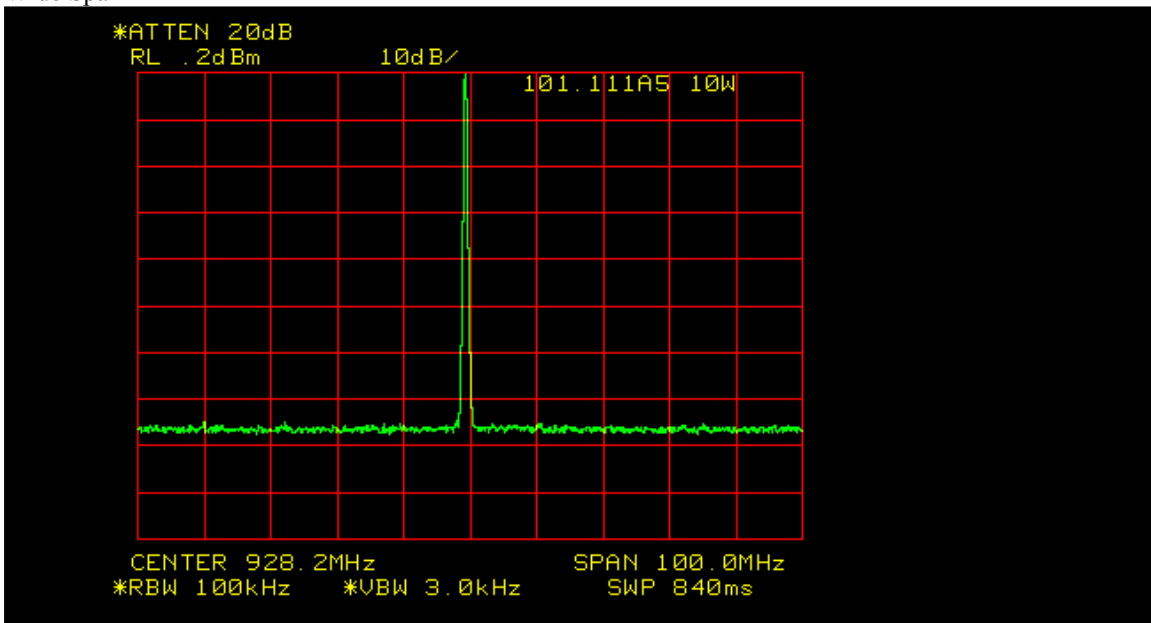


Output Power = 10 Watts

Narrow Span



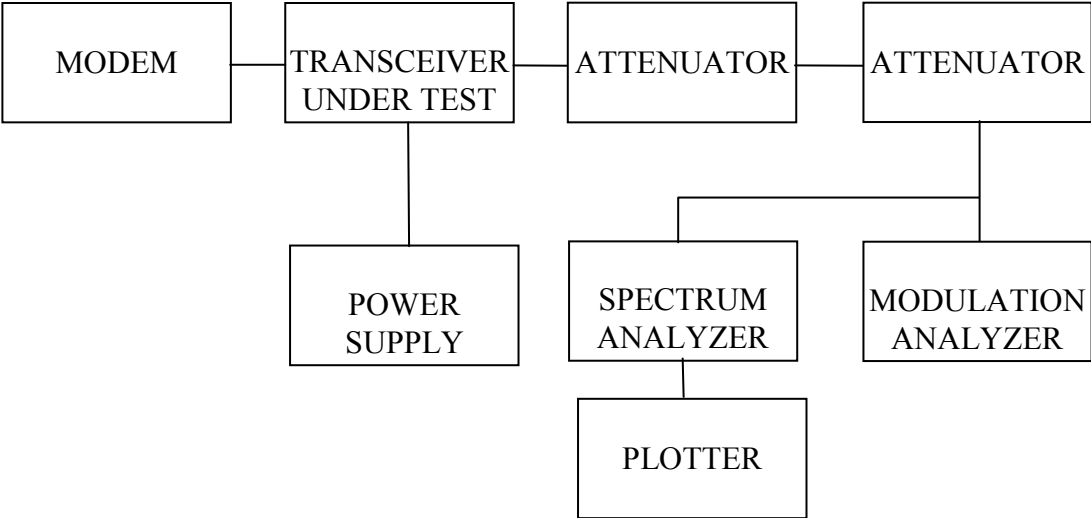
Wide Span



NAME OF TEST:	Transmitter Occupied Bandwidth for Emission Designators <b>16K5F1D</b> and <b>16K8F1D</b>
RULE PART NUMBER:	FCC: 2.202, 90.209 (b)(5), 90.210(g), 2.1049 (c) (1), 101.111 (a)(6) IC: RSS-119 5.8.6
MINIMUM STANDARDS:	<p><b>Mask G</b> Sidebands and Spurious [P = 10 Watts and P=1 Watt] Authorized Bandwidth = 20 kHz From Fo to 10 kHz, down 0 dB. Greater than 10 kHz to 250% of authorized BW, at least <math>116 * \log_{10}(f_d / 6.1)</math> or <math>50 + 10 \log(P)</math> or 70 dB, whichever is the lesser attenuation [Greater than 10 kHz to 50 kHz for IC Mask G] Greater than 250% of authorized BW, <math>43 + 10\log_{10}(P)</math> [Greater than 50 kHz for IC Mask G]</p> <p>Attenuation = 0 dB at Fo to 5 kHz Attenuation = 25 dB at 10 kHz Attenuation = 60 dB at 20.1 kHz Attenuation = 60 dB at 62.5 kHz [@ 50 kHz for IC Mask] Attenuation = 53.0 dB at frequencies greater than 62.5 kHz @ 10 W [greater than 50 kHz for IC Mask] Attenuation = 43 dB at frequencies greater than 62.5 kHz @ 1 W [greater than 50 kHz for IC Mask]</p> <p><b>Mask 101.111(a)(6)</b> Sidebands and Spurious [P = 10 Watts and P=1 Watt] Authorized Bandwidth = 25 kHz From Fo to 5.0 kHz, down 0 dB. From 5 kHz to 10 kHz, down <math>83 * \log_{10}(f_d / 5)</math> dB Greater than 10.0 kHz to 250% auth BW, down <math>116\log(fd/6.1)</math> or <math>50+10\log(P)</math> or 70 dB. Greater then 250% auth BW, <math>43+10\log_{10}(P)</math> or 80 dB.</p> <p>Attenuation = 0 db at Fo to 5 kHz Attenuation = 25 dB at 10 kHz Attenuation = 60 dB at 20.1 kHz @ 10W Attenuation = 50 dB at 16.5 kHz @ 1W Attenuation = 53 dB at &gt; 62.5 kHz @ 10W or 43 dB @ 1W</p>
TEST RESULTS:	Meets minimum standards (see data on following page)
TEST CONDITIONS:	Standard Test Conditions, 25 C RF Power Level = 1 Watt and 10 Watts Voltage = 20VDC
TEST PROCEDURE:	TIA/EIA – 603-C
TEST EQUIPMENT:	50-Ohm Attenuator, Bird Electronics 50-A-FFN-20 (20dB, 50W) 50-Ohm Attenuator, Bird Electronics 10-A-MFN-10 (10dB, 10W) 50-Ohm Attenuator, Pasternack PE7002-10 (10dB) Power Supply, Instek Model GPS-2303 Spectrum Analyzer, Hewlett Packard Model HP8563E Modulation Analyzer, Hewlett Packard Model HP8901B



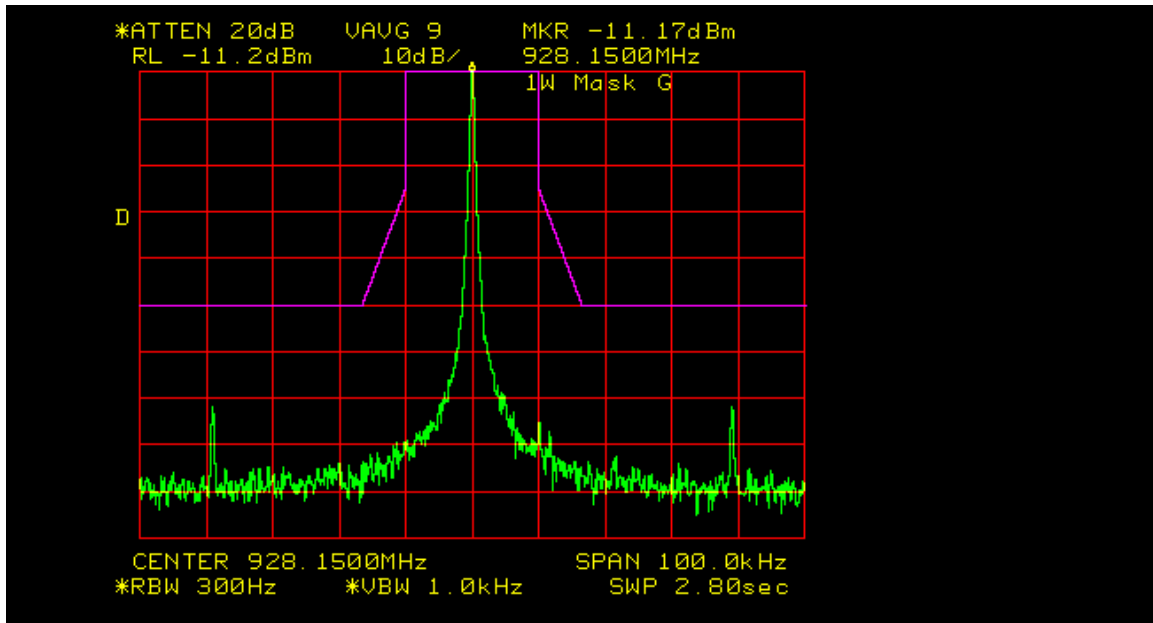
TEST SET-UP:



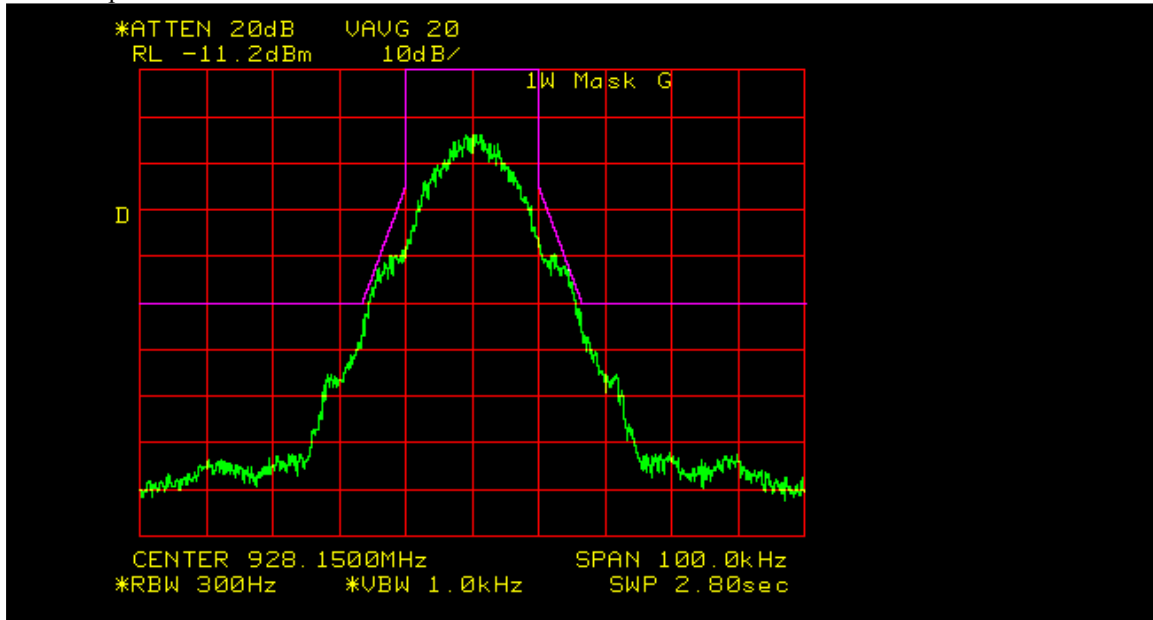
Mask: G  
Output Power = 1 Watt

Spectrum for Emission: 16K5 F1D  
Data Rate: 16 kbps      Peak Deviation with Data: 6.5 kHz

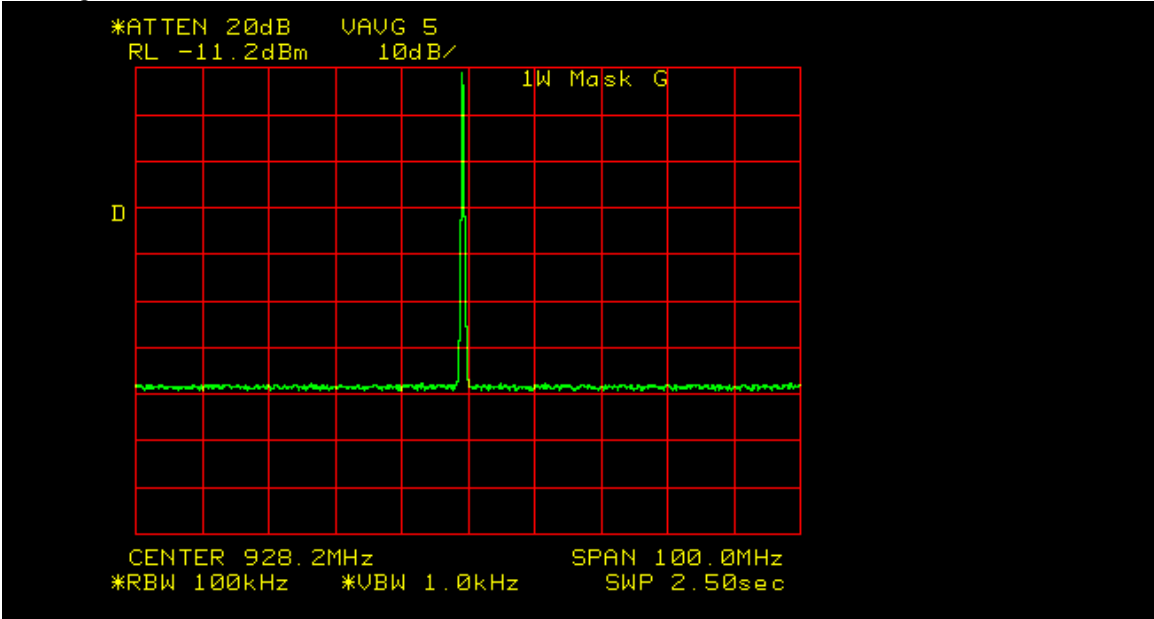
Unmodulated Carrier



Narrow Span

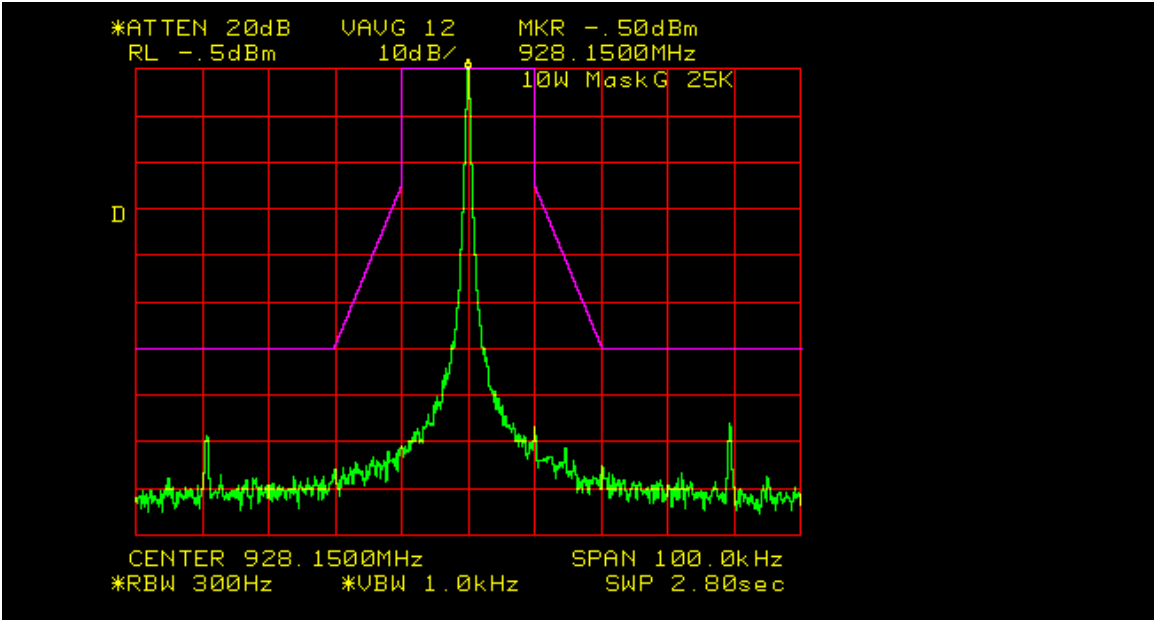


Wide Span

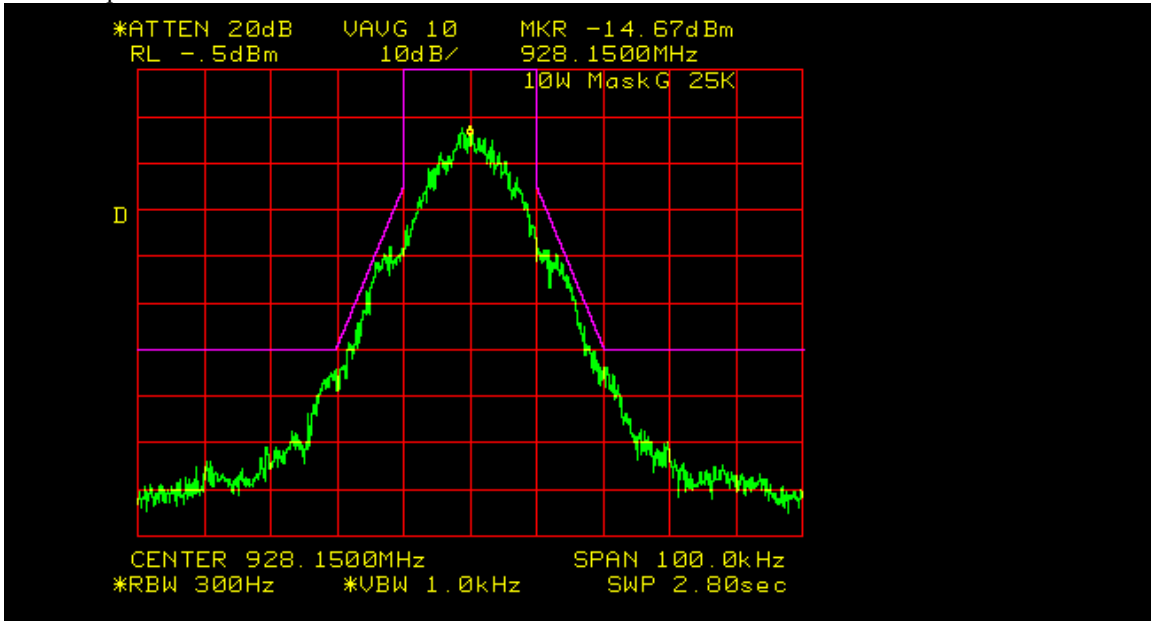


Output Power = 10 Watt

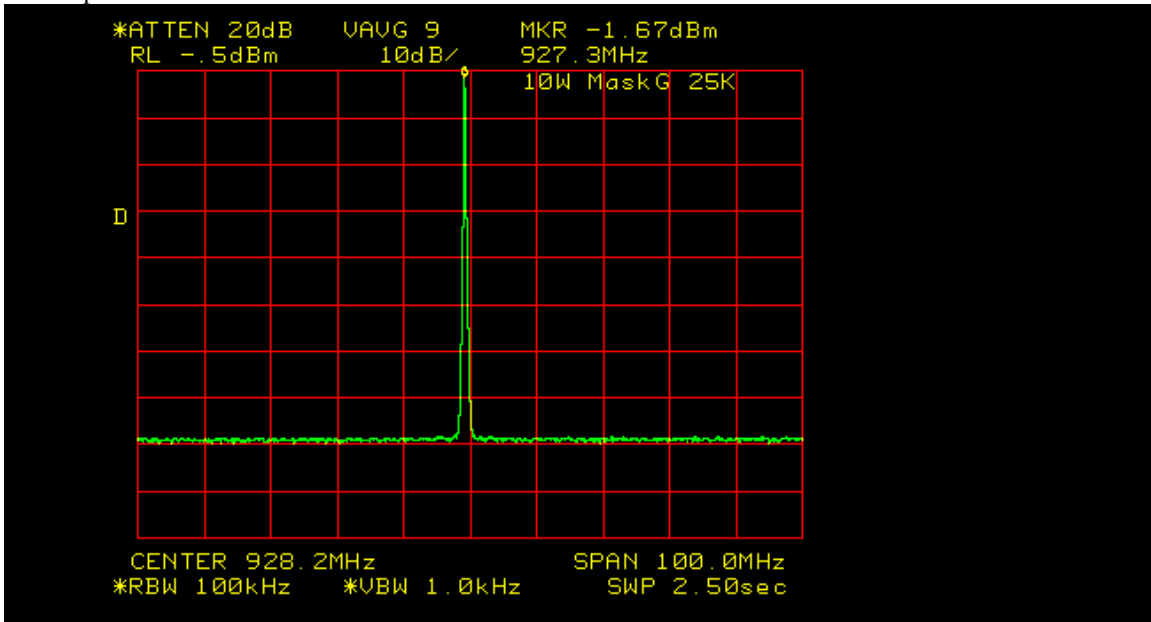
Unmodulated Carrier



Narrow Span



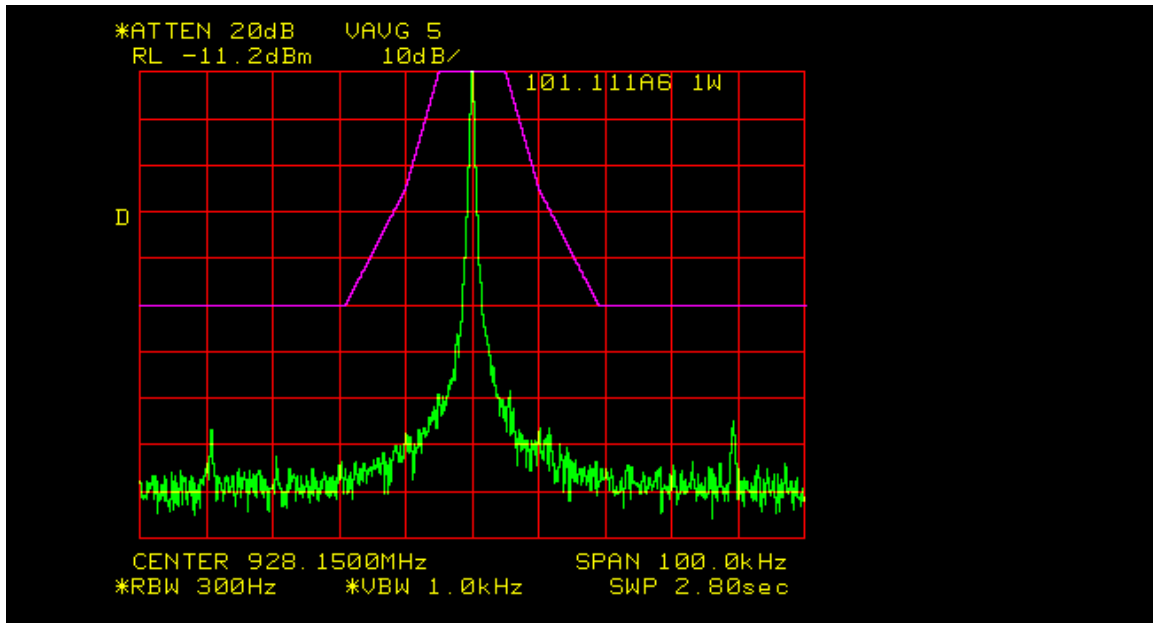
Wide Span



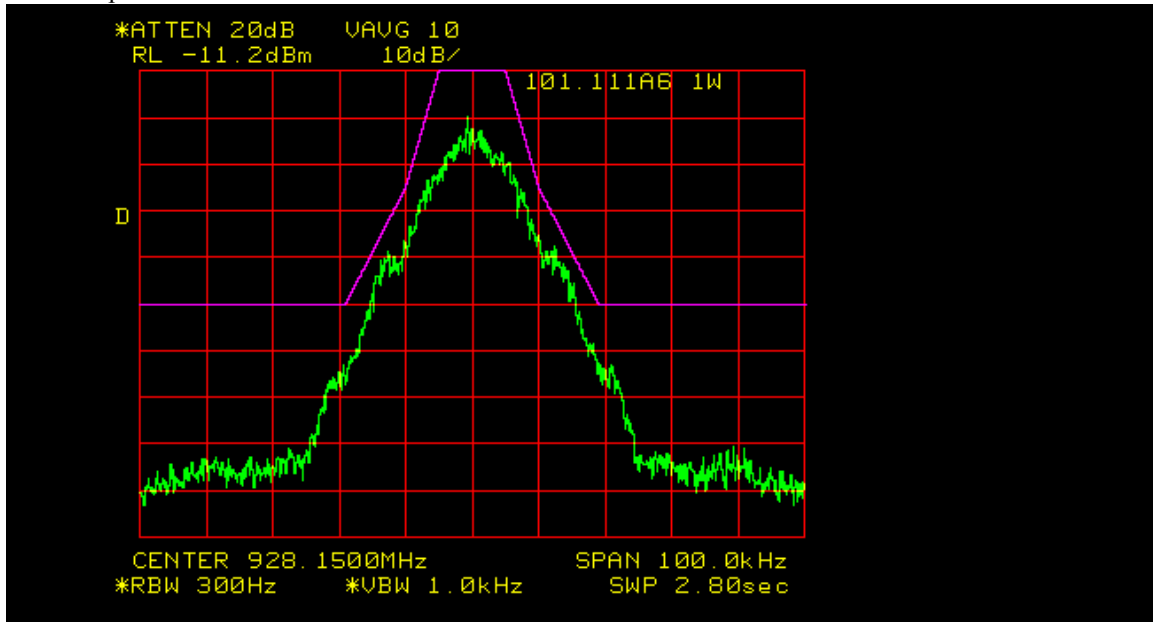
Mask: 101.11a6  
Output Power = 1 Watt

Spectrum for Emission: 16K5 F1D  
Data Rate: 16 kbps      Peak Deviation with Data: 6.5 kHz

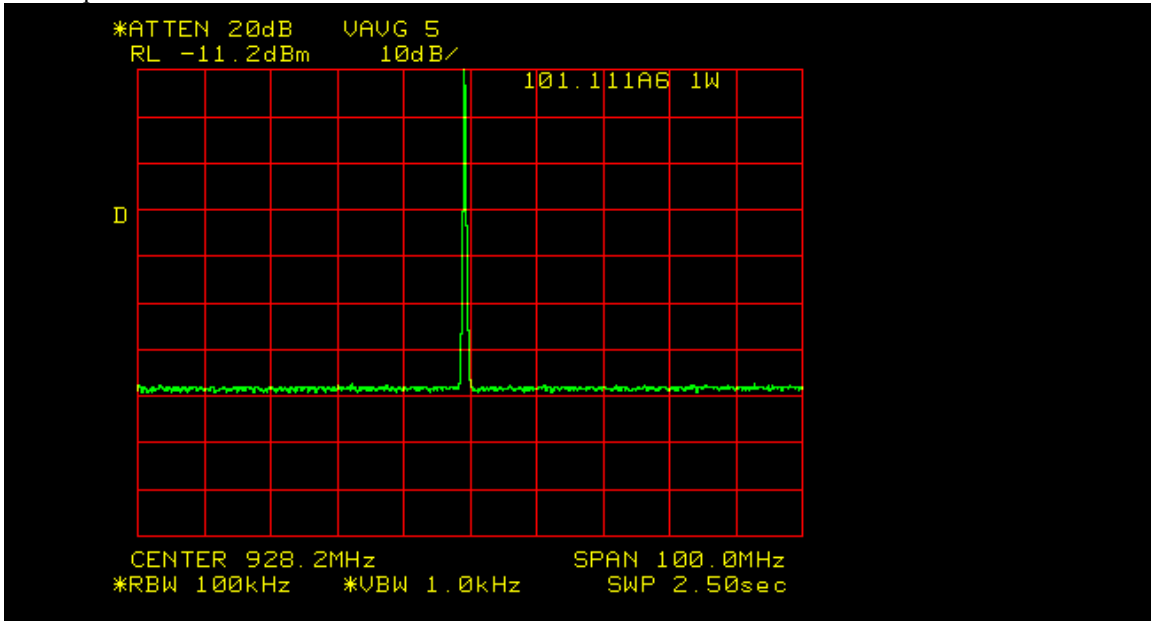
Unmodulated Carrier



Narrow Span

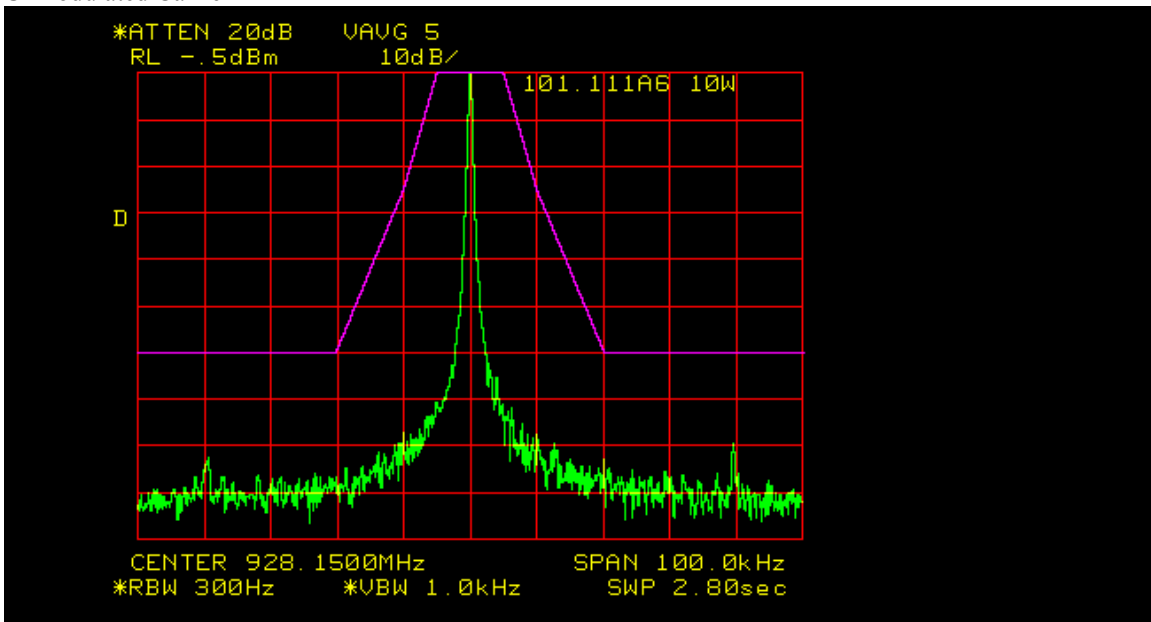


Wide Span

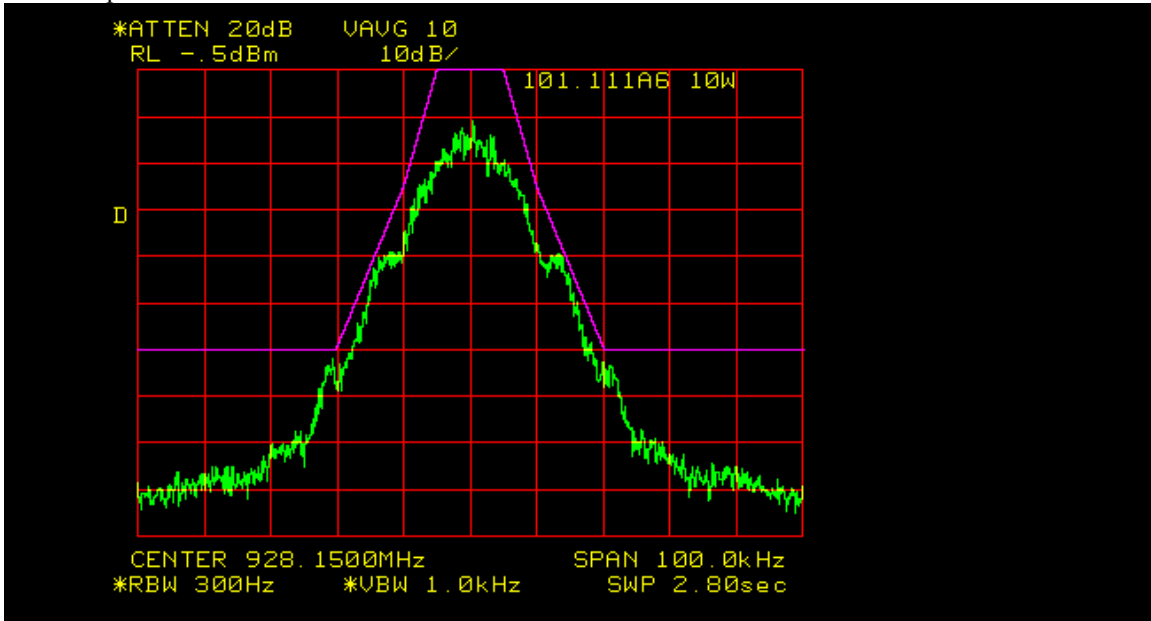


Output Power = 10 Watt

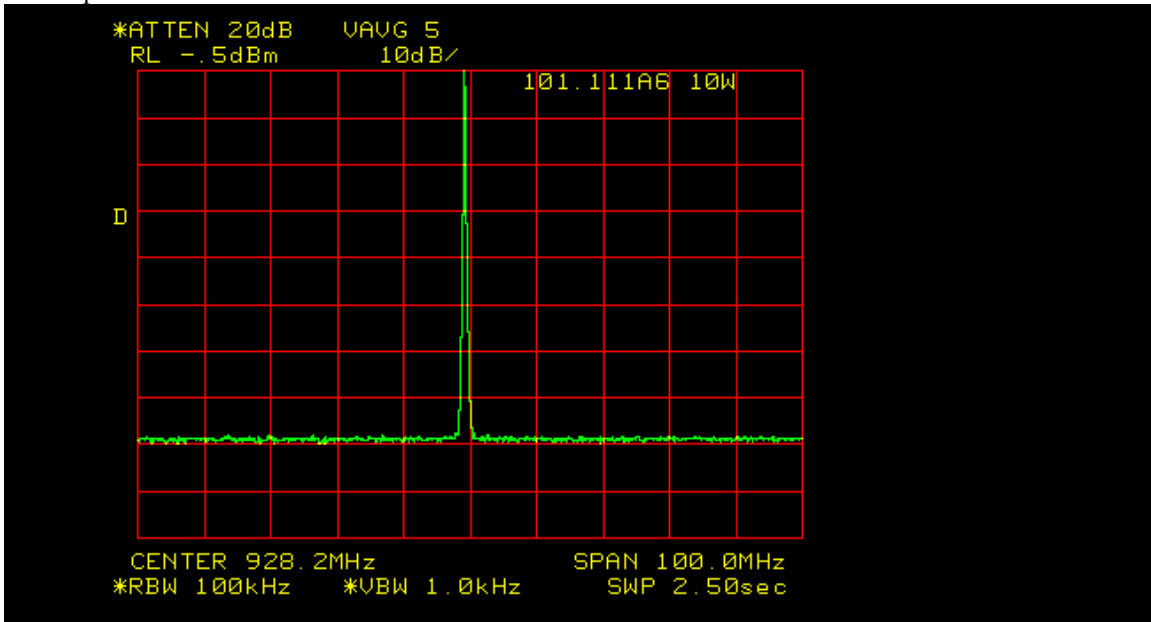
Unmodulated Carrier



Narrow Span



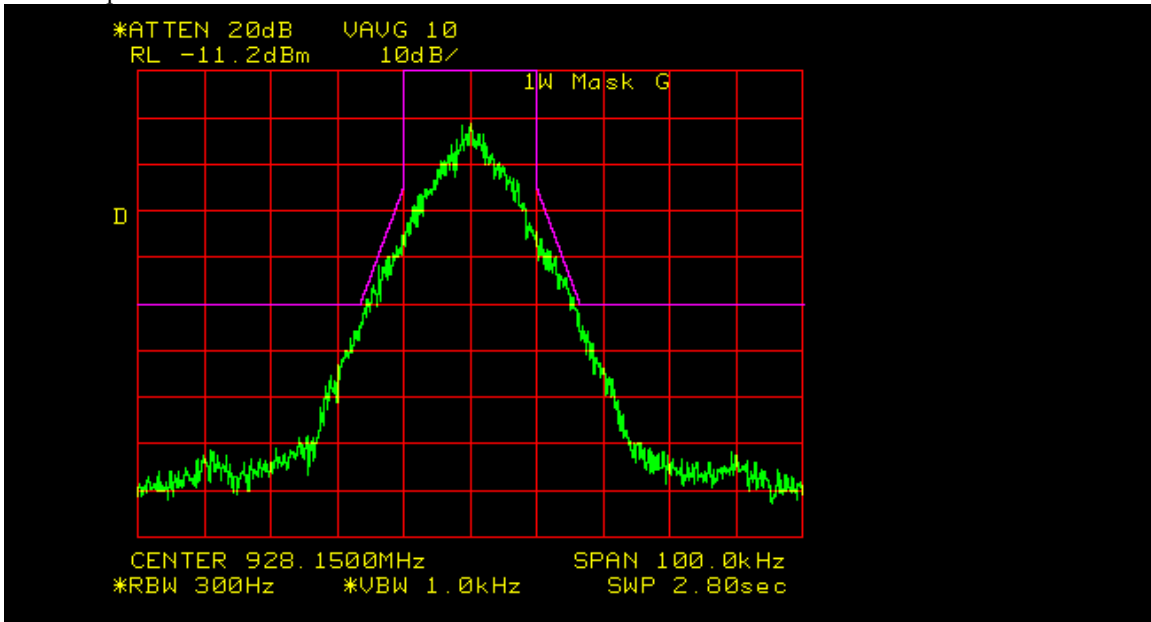
Wide Span



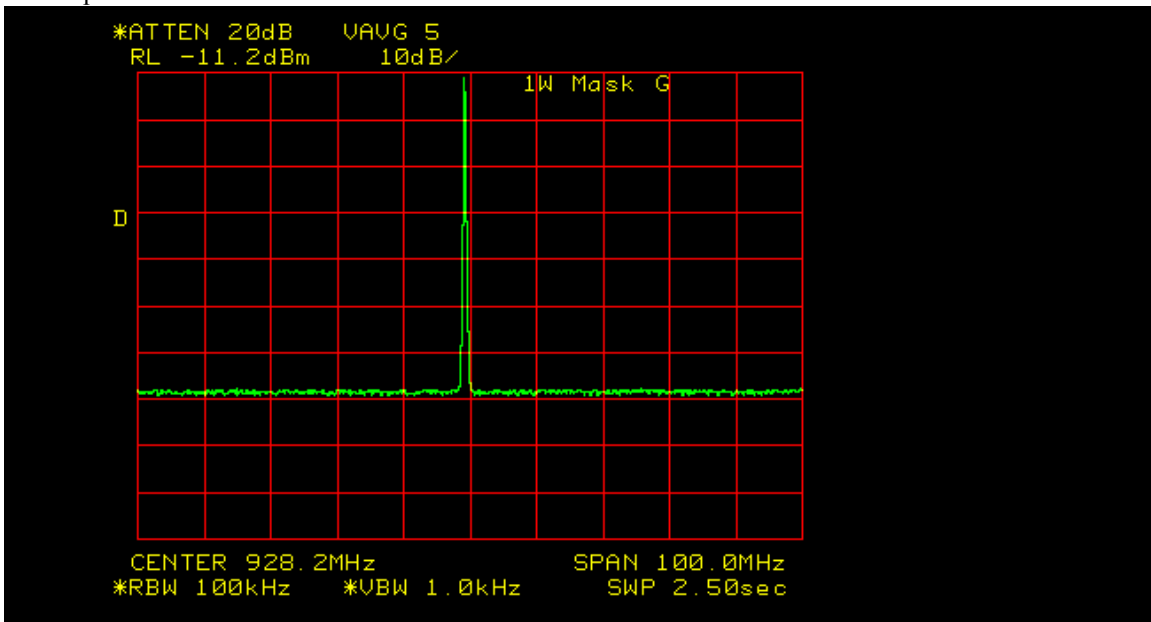
Mask: G  
Output Power = 1 Watt

Spectrum for Emission: 16K8 F1D  
Data Rate: 32 kbps      Peak Deviation with Data: 7.29 kHz

Narrow Span



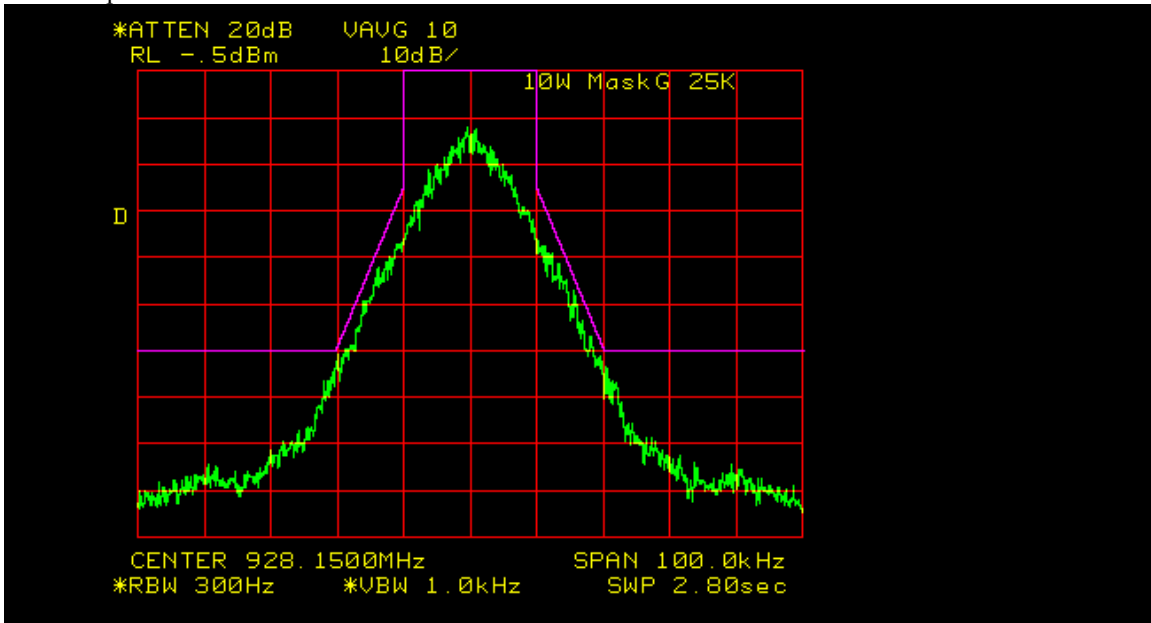
Wide Span



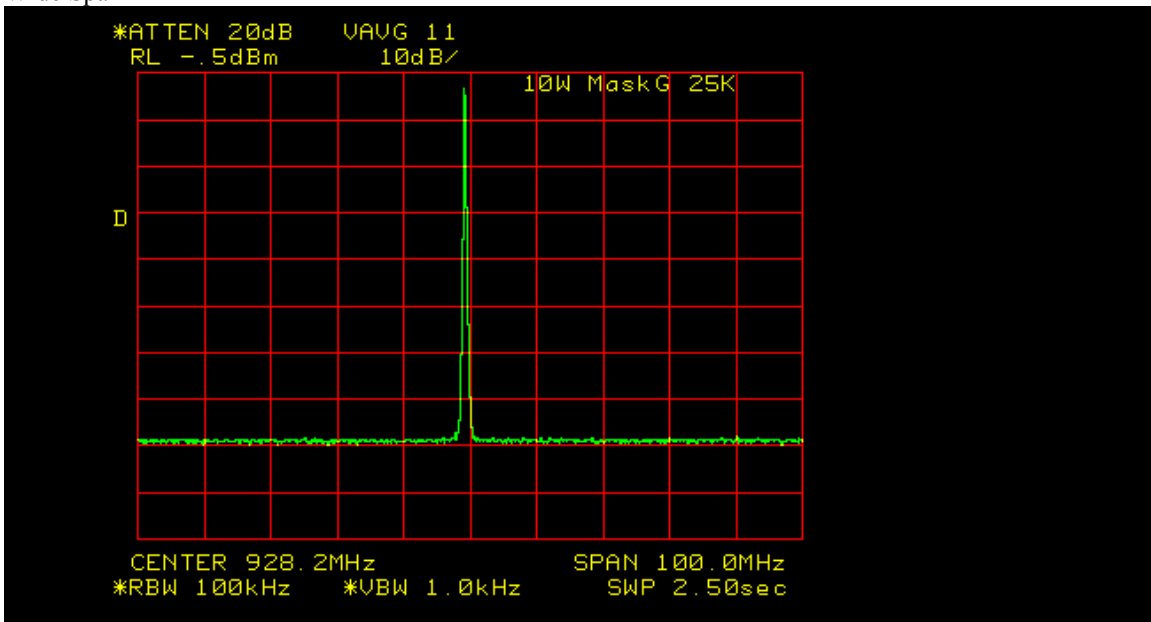


Output Power = 10 Watts

Narrow Span



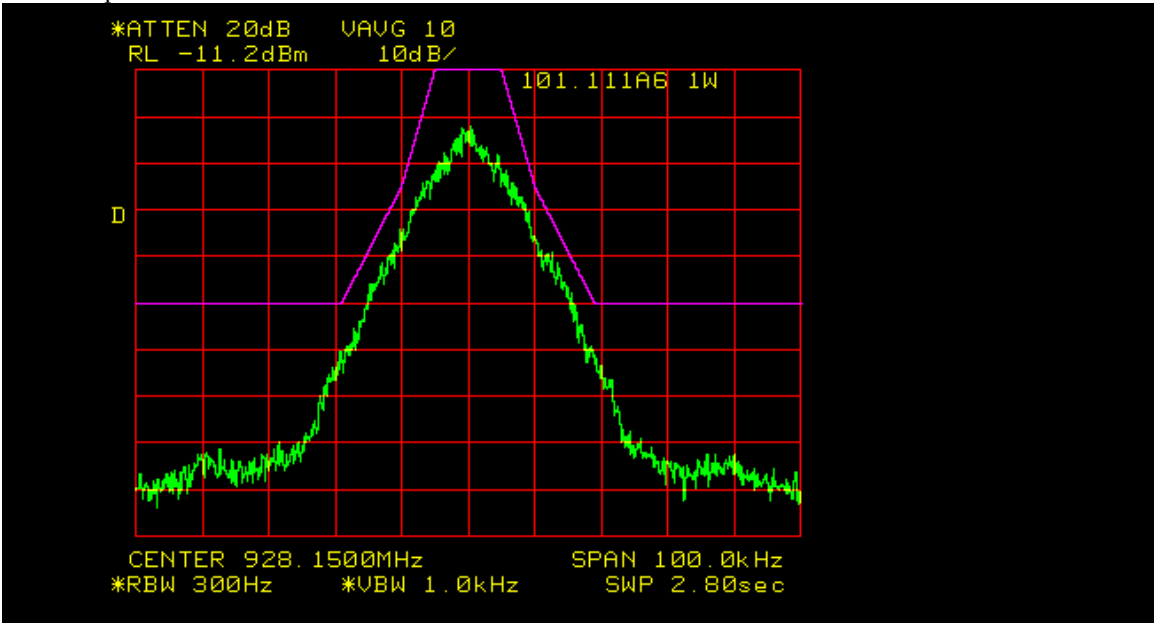
Wide Span



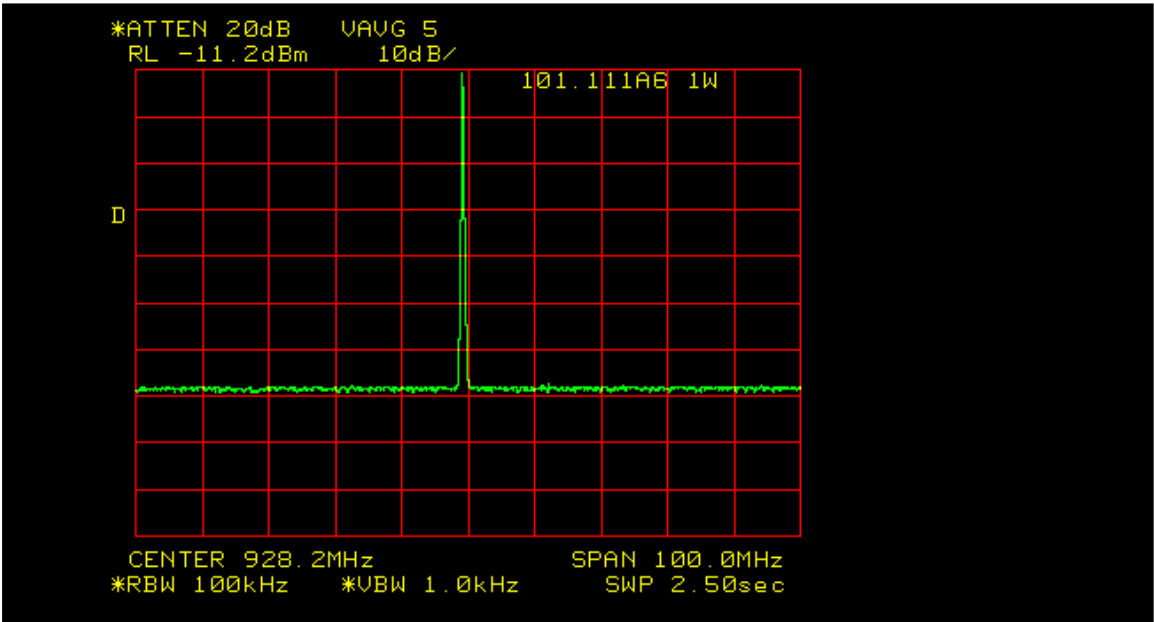
Mask: 101.11a6  
Output Power = 1 Watt

Spectrum for Emission: 16K8 F1D  
Data Rate: 32 kbps      Peak Deviation with Data: 7.29 kHz

Narrow Span

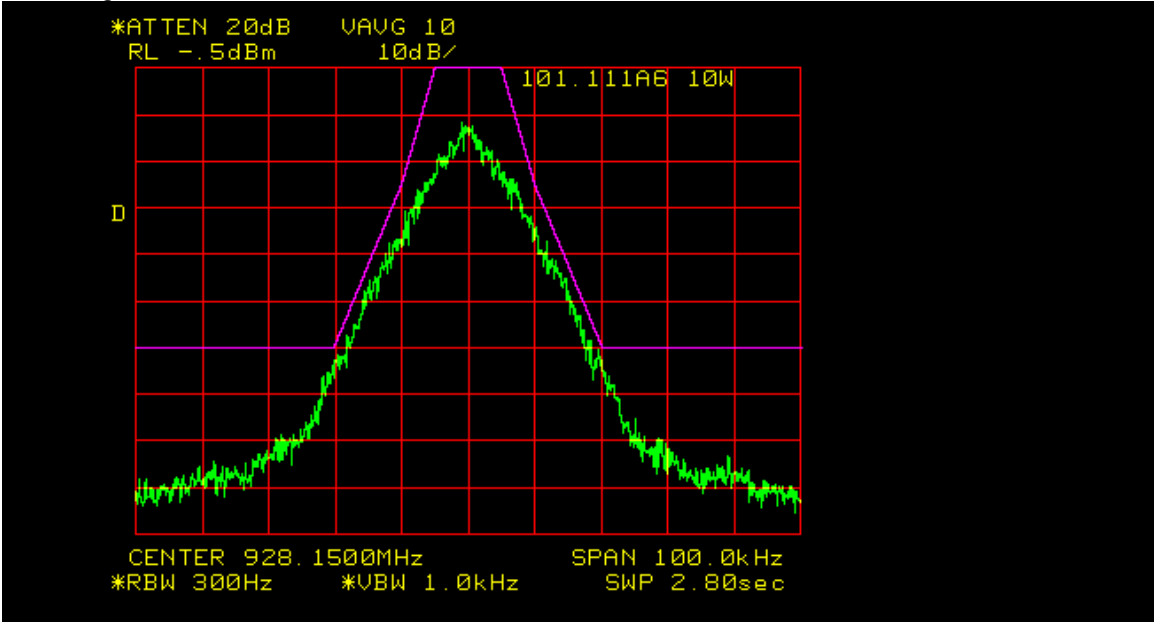


Wide

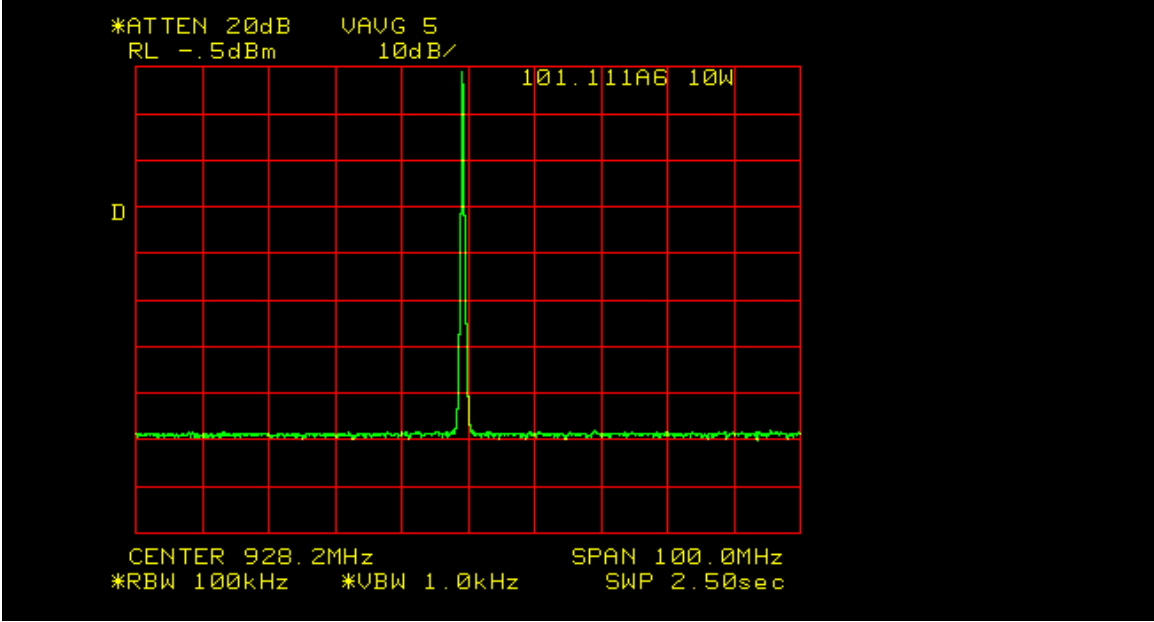


Output Power = 10 Watts

Narrow Span



Wide Span



NAME OF TEST: Field Strength of Spurious Radiation

RULE PART NUMBER: FCC: 2.1053, 90.210 (c,3)(d,3)(e,3), 101.111(a)  
IC: RSS-119 5.8.2, 5.8.3, 5.8.4

MINIMUM STANDARDS: For 10 Watts:  $55+10\text{Log}_{10}(10 \text{ Watts}) = -65.0 \text{ dBc}$   
or  $-65\text{dBc}$ , whichever is the lesser attenuation.

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

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

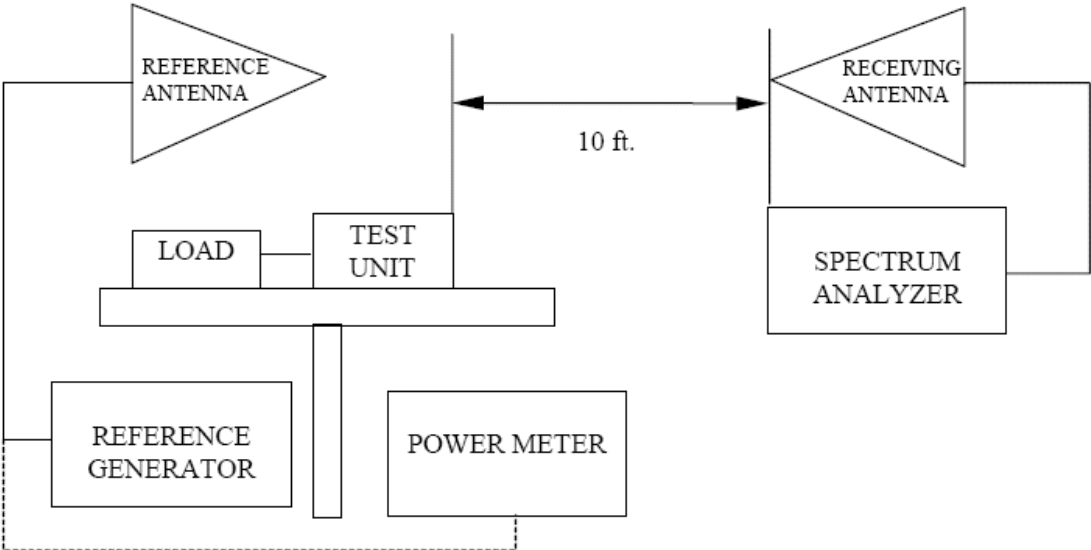
TEST CONDITIONS: Standard Test Conditions, 25 C  
RF Power Level = 1 Watt and 10 Watts  
Voltage = 20VDC

TEST PROCEDURE: TIA/EIA – 603-C

TEST EQUIPMENT: Waveguide Horn Antenna, EMCO Model 3115  
Waveguide Horn Antenna, Electro-Metrics EM-6961  
Bilog Antenna, Chase Model CBL6111B  
Dipole Antenna, Electro-Metrics Model EM-6924  
Power Supply, Model Instek GPS-2303  
Spectrum Analyzer, Model HP8563E  
Reference Generator, Agilent Model E8257D  
Power Meter, Model HP8901B with Sensor Module HP 11722A  
50-Ohm Load, S.M. Electronics ST6S-20(20W)

MEASUREMENT PROCEDURE: Measurements were made from the lowest radio frequency generated in the equipment to the tenth harmonic of the carrier.

TEST SET-UP:



Half Duplex Radio

Frequency: 928.025 MHz Spec = -65.0  
 Highest  
 Power: 10 Watts Spur = -74.8  
 40.0 dBm

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
1856.05	H	-99.8	-65.8	0.67	4.85	-101.7
	V	-110.0	-71.8	0.67	4.85	-107.7
2784.075	H	-105.5	-67.5	1.00	5.65	-102.9
	V	-110.0	-70.0	1.00	5.65	-105.4
3712.1	H	-108.7	-65.7	1.50	5.95	-101.3
	V	-110.0	-64.3	1.50	5.95	-99.9
4640.125	H	-86.2	-40.2	1.67	7.05	-74.8
	V	-90.7	-43.2	1.67	7.05	-77.8
5568.15	H	-104.7	-54.4	2.33	6.85	-89.9
	V	-107.0	-56.5	2.33	6.85	-92.0
6496.175	H	-106.8	-54.8	2.33	7.95	-89.2
	V	-105.8	-54.1	2.33	7.95	-88.5
7424.2	H	-106.0	-48.0	3.83	7.45	-84.4
	V	-110.0	-53.2	0.38	7.45	-86.1
8352.225	H	-107.2	-47.2	3.33	7.65	-82.9
	V	-110.0	-51.0	3.33	7.65	-86.7
9280.25	H	-108.3	-38.3	4.67	8.00	-75.0
	V	-110.0	-41.5	4.67	8.00	-78.2

Frequency: 928.025 MHz Spec = -55.0  
 Highest  
 Power: 1 Watts Spur = -66.7  
 30.0 dBm

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
1856.05	H	-105.2	-71.2	0.67	4.85	-97.0
	V	-104.3	-66.1	0.67	4.85	-92.0
2784.075	H	-104.5	-66.5	1.00	5.65	-91.9
	V	-106.0	-66.0	1.00	5.65	-91.4
3712.1	H	-110.0	-67.0	1.50	5.95	-92.6
	V	-106.5	-60.8	1.50	5.95	-86.4
4640.125	H	-103.0	-57.0	1.67	7.05	-81.6
	V	-96.7	-49.2	1.67	7.05	-73.8
5568.15	H	-108.3	-58.0	2.33	6.85	-83.5
	V	-109.0	-58.5	2.33	6.85	-84.0

6496.175	H	-110.0	-58.0	2.33	7.95	-82.4
	V	-110.0	-58.3	2.33	7.95	-82.7
7424.2	H	-110.0	-52.0	3.83	7.45	-78.4
	V	-110.0	-53.2	0.38	7.45	-76.1
8352.225	H	-110.0	-50.0	3.33	7.65	-75.7
	V	-110.0	-51.0	3.33	7.65	-76.7
9280.25	H	-110.0	-40.0	4.67	8.00	-66.7
	V	-110.0	-41.5	4.67	8.00	-68.2

Half Duplex Radio

Frequency: 944.1 MHz Spec = -65.0  
 Highest  
 Power: 10 Watts Spur = -72.3  
 40.0 dBm

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation (dBc)
1888.2	H	-104.0	-68.3	0.67	4.85	-104.2
	V	-102.2	-65.0	0.67	4.85	-100.9
2832.3	H	-104.8	-64.1	1.00	5.65	-99.5
	V	-103.2	-63.2	1.00	5.65	-98.6
3776.4	H	-109.0	-64.7	1.50	5.95	-100.2
	V	-107.7	-61.7	1.50	5.95	-97.3
4720.5	H	-88.5	-41.5	2.33	7.05	-76.8
	V	-84.2	-37.0	2.33	7.05	-72.3
5664.6	H	-105.3	-53.6	2.33	6.85	-89.1
	V	-103.5	-52.5	2.33	6.85	-88.0
6608.7	H	-106.3	-53.6	2.33	7.95	-88.0
	V	-103.3	-50.3	2.33	7.95	-84.7
7552.8	H	-106.3	-50.5	3.17	7.45	-86.2
	V	-106.0	-49.5	3.17	7.45	-85.2
8496.9	H	-108.3	-46.8	3.67	7.65	-82.8
	V	-107.5	-46.2	3.67	7.65	-82.2
9441	H	-107.8	-40.5	4.67	8.00	-77.1
	V	-108.2	-38.4	4.67	8.00	-75.0

Frequency: 944.1 MHz Spec = -55.0  
 Highest  
 Power: 1 Watts Spur = -64.3  
 30.0 dBm

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation (dBc)
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1888.2	H	-106.2	-70.5	0.67	4.85	-96.4
	V	-106.0	-68.8	0.67	4.85	-94.7
2832.3	H	-106.3	-65.6	1.00	5.65	-91.0
	V	-105.7	-65.7	1.00	5.65	-91.1
3776.4	H	-109.8	-65.5	1.50	5.95	-91.0
	V	-109.3	-63.3	1.50	5.95	-88.9
4720.5	H	-104.2	-57.2	2.33	7.05	-82.5
	V	-100.7	-53.5	2.33	7.05	-78.8
5664.6	H	-110.5	-58.8	2.33	6.85	-84.3
	V	-110.0	-59.0	2.33	6.85	-84.5
6608.7	H	-107.2	-54.5	2.33	7.95	-78.9
	V	-107.7	-54.7	2.33	7.95	-79.1
7552.8	H	-106.7	-50.9	3.17	7.45	-76.6
	V	-107.3	-50.8	3.17	7.45	-76.5
8496.9	H	-108.0	-46.5	3.67	7.65	-72.5
	V	-107.5	-46.2	3.67	7.65	-72.2
9441	H	-108.0	-40.7	4.67	8.00	-67.3
	V	-107.5	-37.7	4.67	8.00	-64.3

## Half Duplex Radio

Frequency: 959.975 MHz Spec = -65.0  
 Highest  
 Power: 10 Watts Spur = -73.5  
 40.0 dBm

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation (dBc)
1919.95	H	-100.5	-61.5	0.67	4.85	-97.3
	V	-100.3	-63.0	0.67	4.85	-98.8
2879.925	H	-103.7	-61.0	0.83	5.65	-96.2
	V	-104.7	-64.0	0.83	5.65	-99.2
3839.9	H	-105.8	-59.5	1.00	5.95	-94.5
	V	-106.0	-61.5	1.00	5.95	-96.6
4799.875	H	-86.8	-38.8	1.67	7.05	-73.5
	V	-90.0	-43.3	1.67	7.05	-78.0
5759.85	H	-100.8	-50.1	2.17	6.85	-85.5
	V	-100.0	-49.7	2.17	6.85	-85.0
6719.825	H	-103.0	-48.5	2.67	7.95	-83.2
	V	-104.3	-49.5	2.67	7.95	-84.2
7679.8	H	-100.3	-43.6	3.33	7.45	-79.5
	V	-103.0	-46.0	3.33	7.45	-81.9
8639.775	H	-107.3	-45.8	4.67	7.65	-82.8

	V	-107.0	-45.2	4.67	7.65	-82.2
9599.75	H	-107.8	-40.3	5.00	8.00	-77.3
	V	-107.2	-39.0	5.00	8.00	-76.0

Frequency: 959.975 MHz Spec = -55.0  
Highest  
Power: 1 Watts Spur = -68.8  
30.0 dBm

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation (dBc)
1919.95	H	-103.8	-64.8	0.67	4.85	-90.6
	V	-103.8	-66.5	0.67	4.85	-92.3
2879.925	H	-105.8	-63.1	0.83	5.65	-88.3
	V	-105.8	-65.1	0.83	5.65	-90.3
3839.9	H	-109.5	-63.2	1.00	5.95	-88.2
	V	-109.7	-65.2	1.00	5.95	-90.3
4799.875	H	-100.8	-52.8	1.67	7.05	-77.4
	V	-99.0	-52.3	1.67	7.05	-77.0
5759.85	H	-109.0	-58.3	2.17	6.85	-83.7
	V	-107.7	-57.4	2.17	6.85	-82.7
6719.825	H	-106.7	-52.2	2.67	7.95	-76.9
	V	-107.2	-52.4	2.67	7.95	-77.1
7679.8	H	-110.0	-53.3	3.33	7.45	-79.2
	V	-110.0	-53.0	3.33	7.45	-78.9
8639.775	H	-110.0	-48.5	4.67	7.65	-75.5
	V	-110.0	-48.2	4.67	7.65	-75.2
9599.75	H	-110.0	-42.5	5.00	8.00	-69.5
	V	-110.0	-41.8	5.00	8.00	-68.8

### Full Duplex Radio

Frequency: 944.1 MHz Spec = -65.0  
Highest  
Power: 10 Watts Spur = -74.0  
40.0 dBm

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation (dBc)
1888.2	H	-104.3	-68.6	0.67	4.85	-104.5
	V	-106.5	-69.3	0.67	4.85	-105.2
2832.3	H	-103.0	-62.3	1.00	5.65	-97.7
	V	-104.3	-64.3	1.00	5.65	-99.7
3776.4	H	-90.8	-46.5	1.50	5.95	-82.1



	V	-89.7	-43.7	1.50	5.95	-79.2
4720.5	H	-100.8	-53.8	2.33	7.05	-89.1
	V	-98.8	-51.7	2.33	7.05	-86.9
5664.6	H	-104.5	-52.8	2.33	6.85	-88.3
	V	-105.5	-54.5	2.33	6.85	-90.0
6608.7	H	-106.5	-53.8	2.33	7.95	-88.2
	V	-106.5	-53.5	2.33	7.95	-87.9
7552.8	H	-106.8	-51.0	3.17	7.45	-86.7
	V	-108.0	-51.5	3.17	7.45	-87.2
8496.9	H	-108.0	-46.5	3.67	7.65	-82.5
	V	-109.0	-47.7	3.67	7.65	-83.7
9441	H	-107.3	-40.0	4.67	8.00	-76.6
	V	-107.2	-37.4	4.67	8.00	-74.0

Frequency: 944.1 MHz Spec = -55.0  
 Highest  
 Power: 1 Watts Spur = -65.8  
 30.0 dBm

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
1888.2	H	-107.0	-71.3	0.67	4.85	-97.2
	V	-107.0	-69.8	0.67	4.85	-95.7
2832.3	H	-106.2	-65.5	1.00	5.65	-90.9
	V	-106.3	-66.3	1.00	5.65	-91.7
3776.4	H	-109.7	-65.4	1.50	5.95	-90.9
	V	-110.0	-64.0	1.50	5.95	-89.6
4720.5	H	-110.0	-63.0	2.33	7.05	-88.3
	V	-104.5	-57.3	2.33	7.05	-82.6
5664.6	H	-110.0	-58.3	2.33	6.85	-83.8
	V	-107.3	-56.3	2.33	6.85	-81.8
6608.7	H	-108.2	-55.5	2.33	7.95	-79.9
	V	-107.5	-54.5	2.33	7.95	-78.9
7552.8	H	-107.5	-51.7	3.17	7.45	-77.4
	V	-107.7	-51.2	3.17	7.45	-76.9
8496.9	H	-108.3	-46.8	3.67	7.65	-72.8
	V	-107.8	-46.5	3.67	7.65	-72.5
9441	H	-108.3	-41.0	4.67	8.00	-67.6
	V	-109.0	-39.2	4.67	8.00	-65.8