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FCC Part 24/90/101 Certification Application

FCC Form 731

For The

Viper
VHF RADIO MODEM

FCC ID: NP4-5098-502

TABLE OF CONTENTS

NAME OF TEST: Transmitter Rated Power Output

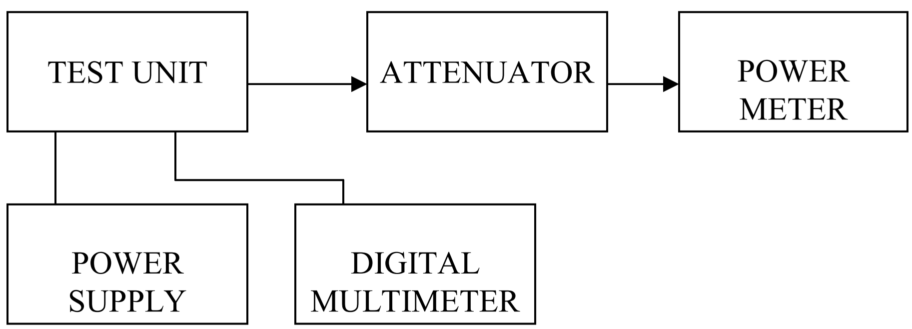
RULE PART NUMBER: FCC: 2.1046 (a) (c), 24.132, 101.113 (a)

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), 24.133;

MINIMUM STANDARDS: For 10 Watts: $43+10\text{Log}_{10}(10\text{ Watts}) = -53.0$ dBc
or -65 dBc, whichever is the lesser attenuation.

For 1 Watt: $55+10\text{Log}_{10}(1\text{ Watt}) = -43$ dBc
or –65 dBc, whichever is the lesser attenuation.

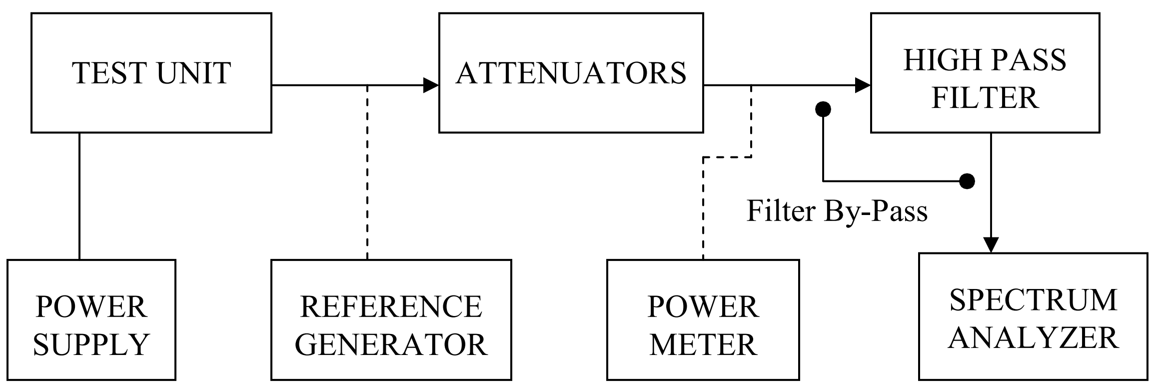
TEST RESULTS: Meets minimum standards (see data on following pages)

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

TEST PROCEDURE: TIA/EIA – 603-C

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 HP 437B Power Meter
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^{th} harmonic of the highest internally generated frequency.

Tuned Frequency	928.025	MHz
Power	10.0	Watts
	40.0	dBm
Min Specification	-53.0	dBc
Worse Case	-85.5	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

Tuned Frequency	928.025	MHz
Power	1.0	Watts
	30.0	dBm
Min Specification	-43.0	dBc
Worse Case	-77.2	dBc

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	-53.0	dBc
Worse Case	-88.0	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

Tuned Frequency	944.1	MHz
Power	1.0	Watts
	30.0	dBm
Min Specification	-43.0	dBc
Worse Case	-78.0	dBc

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	Tuned Frequency	959.975	MHz
Power	10.0	Watts	Power	1.0	Watts
	40.0	dBm		30.0	dBm
Min Specification	-53.0	dBc	Min Specification	-43.0	dBc
Worse Case	-86.0	dBc	Worse Case	-76.0	dBc

Spurious Frequency (MHz)	Harmonic	Relative to Carrier (dBc)	Spurious Frequency (MHz)	Harmonic	Relative to Carrier (dBc)
1919.950	2	-92.8	1919.950	2	-82.8
2879.925	3	-91.2	2879.925	3	-81.2
3839.900	4	-119.8	3839.900	4	-109.8
4799.875	5	-102.7	4799.875	5	-92.7
5759.850	6	-115.5	5759.850	6	-105.5
6719.825	7	-103.5	6719.825	7	-93.5
7679.800	8	-114.5	7679.800	8	-104.5
8639.775	9	-90.2	8639.775	9	-80.2
9599.750	10	-111.7	9599.750	10	-101.7
10559.725	11	-108.0	10559.725	11	-98.0
11519.700	12	-106.7	11519.700	12	-96.7
12479.675	13	-115.5	12479.675	13	-105.5
13439.650	14	-120.0	13439.650	14	-110.0
14399.625	15	-100.8	14399.625	15	-90.8
15359.600	16	-104.8	15359.600	16	-94.8
16319.575	17	-116.3	16319.575	17	-106.3
17279.550	18	-105.8	17279.550	18	-95.8
18239.525	19	-86.0	18239.525	19	-76.0
19199.500	20	-95.2	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, 24.135;

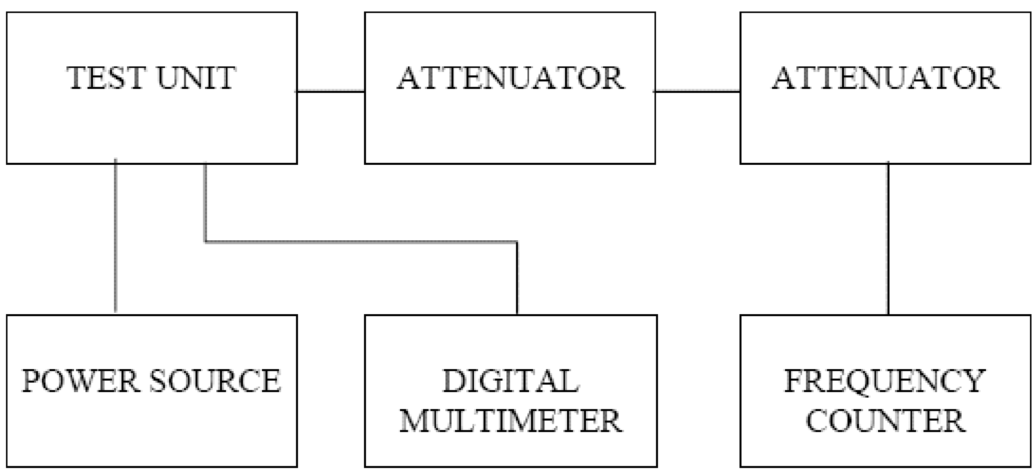
MINIMUM STANDARD: Shall not exceed 1.00 ppm.

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

TEST CONDITIONS: Standard Test Conditions, 25 C

TEST EQUIPMENT: Frequency Counter, HP 8901A
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:



TEST SET-UP

Channel Frequency: 928.1500 MHz
Tolerance Requirements: 1.0 ppm
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, 24.135;

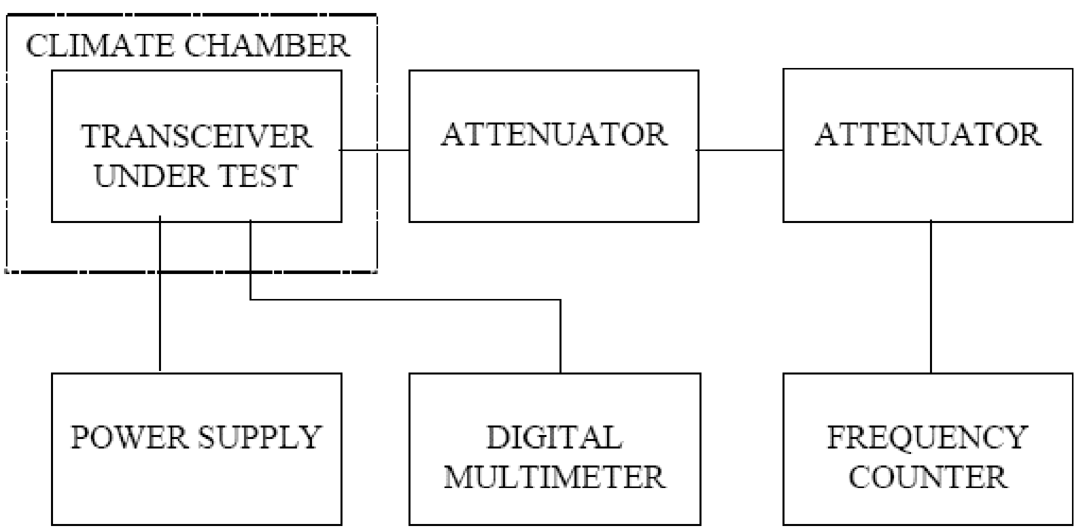
MINIMUM STANDARD: Shall not exceed 1.00 ppm from test frequency

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

TEST CONDITIONS: Standard Test Conditions

TEST EQUIPMENT: Frequency Counter, HP8901A
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), 24.131, 101.109;

Necessary Bandwidth Measurement

This radio modem uses digital modulation signals, passing through a Squared Root Raised Cosine α=0.2 or α=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	3K30 F1D	4 kbps	4000	1.51 kHz	3.3 kHz
6.25 kHz	3K55 F1D	8 kbps	4000	1.49 kHz	3.55 kHz
6.25 kHz	3K20 F1D	12 kbps	4000	1.15 kHz	3.20 kHz
6.25 kHz	3K45 F1D	16 kbps	4000	1.056 kHz	3.45 kHz
12.5 kHz	8K20 F1D	8 kbps	8000	3.31 kHz	8.20 kHz
12.5 kHz	8K30 F1D	16 kbps	8000	3.65 kHz	8.30 kHz
25 kHz	16K5 F1D	16 kbps	16000	6.50 kHz	16.5 kHz
25 kHz	16K8 F1D	32 kbps	16000	7.29 kHz	16.8 kHz
12.5 kHz	8K50 F1D	24 kbps	8000	3.725 kHz	8.50 kHz
12.5 kHz	8K08 F1D	32 kbps	8000	3.728 kHz	8.08 kHz
25 kHz	17K8 F1D	48 kbps	16000	7.590 kHz	17.8 kHz
25 kHz	17K0 F1D	64 kbps	16000	7.520 kHz	17.0 kHz
50 kHz	29K8 F1D	32 kbps	32000	9.36 kHz	29.8 kHz
50 kHz	30K0 F1D	64 kbps	32000	11.02 kHz	30.0 kHz
50 kHz	29K5 F1D	96 kbps	32000	10.81 kHz	29.5 kHz
50 kHz	30K5 F1D	128 kbps	32000	11.66 kHz	30.5 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

$$TP = \int_{0}^{+\infty} PSD_{(f)} df = (1/t) \int_{-\infty}^{+\infty} |z_{(t)}|^2 dt$$

and PSD (power spectral distribution) is

$$PSD_{(f)} = |Z_{(f)}|^2 + |Z_{(-f)}|^2 \qquad 0 \leq f < \infty$$

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.

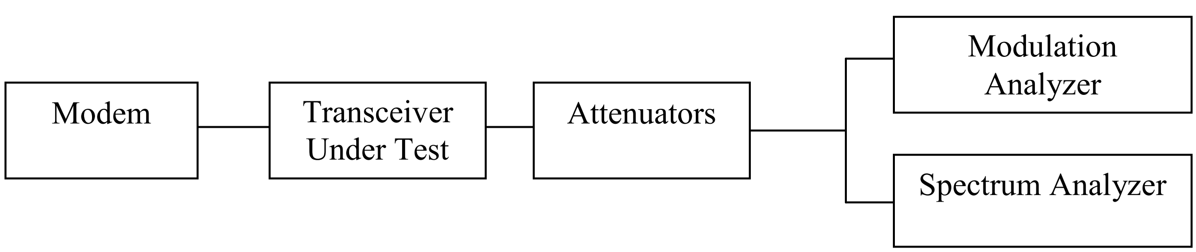
The Occupied Bandwidth measurement is in two parts relatively independent of each other. The first gives the RF spectrum profile, and the second calculates the frequency limits and they result in the Occupied bandwidth. While the first involves RF measurement instrumentation, the second is strictly a 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 HP8901A

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 α=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 α=0.2 or α=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.

NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators **3K55F1D**, **3K30F1D, 3K20F1D** and **3K45F1D**

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

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 $55+10\log_{10}(P)$ or 65 dB, whichever is the lesser attenuation.

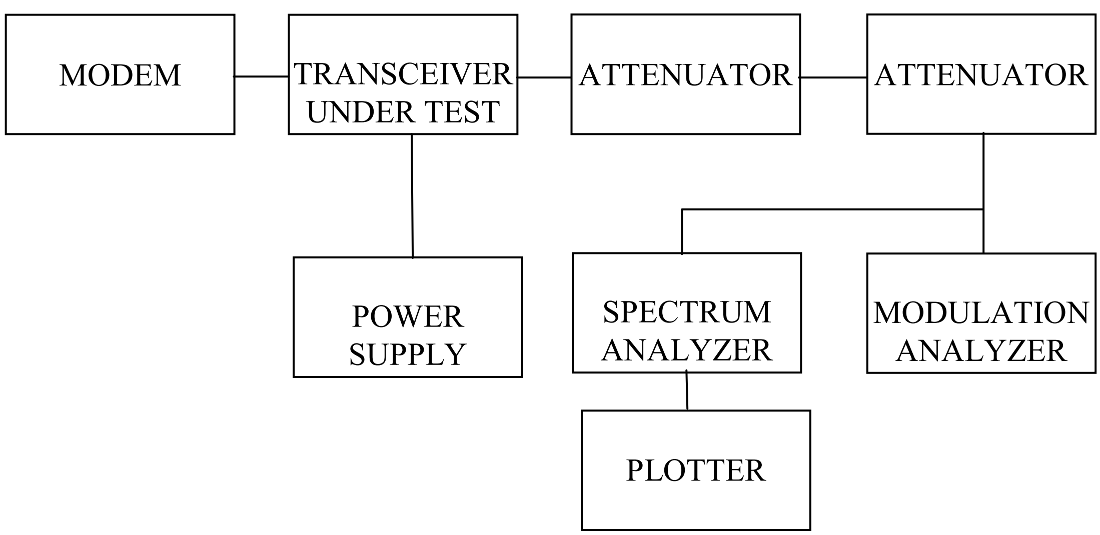
Attenuation = 0 dB at Fo to 3 kHz
Attenuation = 30 dB at 3 kHz and 56.7 dB at 4.6 kHz @ 10 Watts
Attenuation = 65 dB at frequencies greater than 4.6 kHz @ 10 Watts
Attenuation = 30 dB at 3 kHz and 50 dB at 4.2 kHz and 55 dB at 4.6 kHz @ 1 Watt
Attenuation = 55 dB at frequencies greater than 4.6 kHz @ 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 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 HP8901A

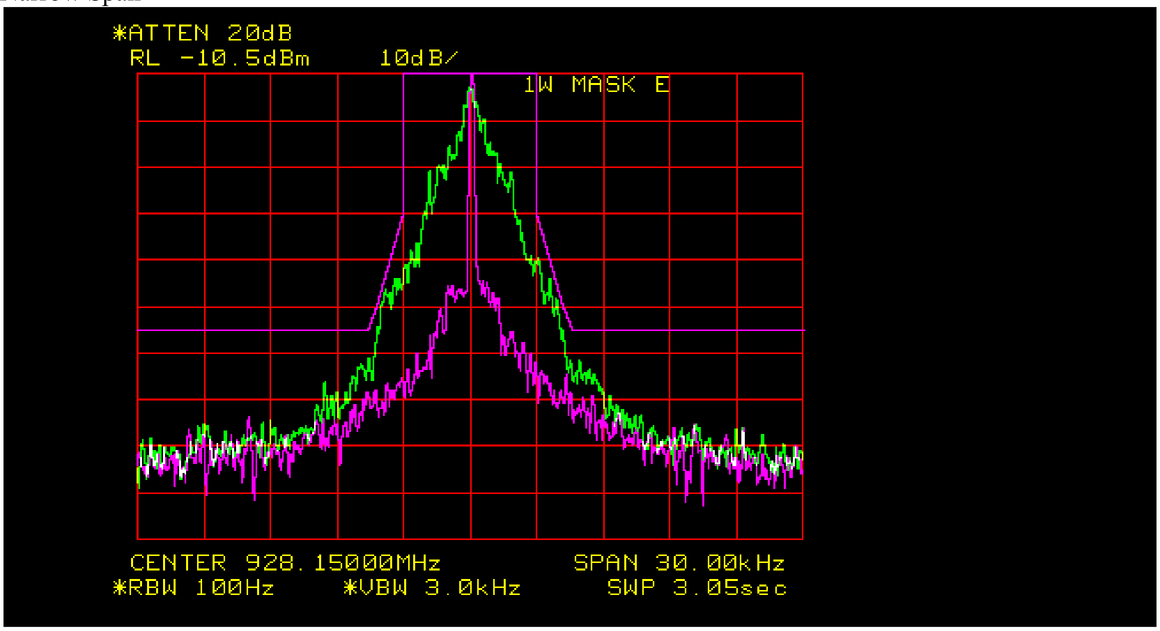
TEST SET-UP:



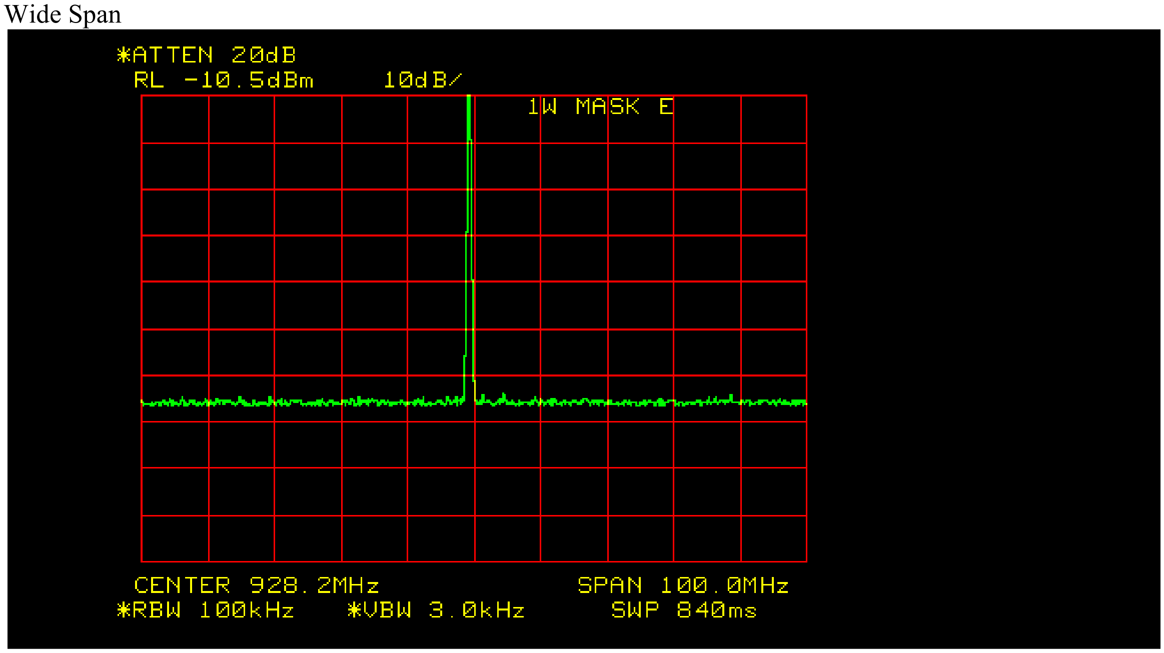
Mask: E
Output Power = 1 Watt

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

Narrow Span

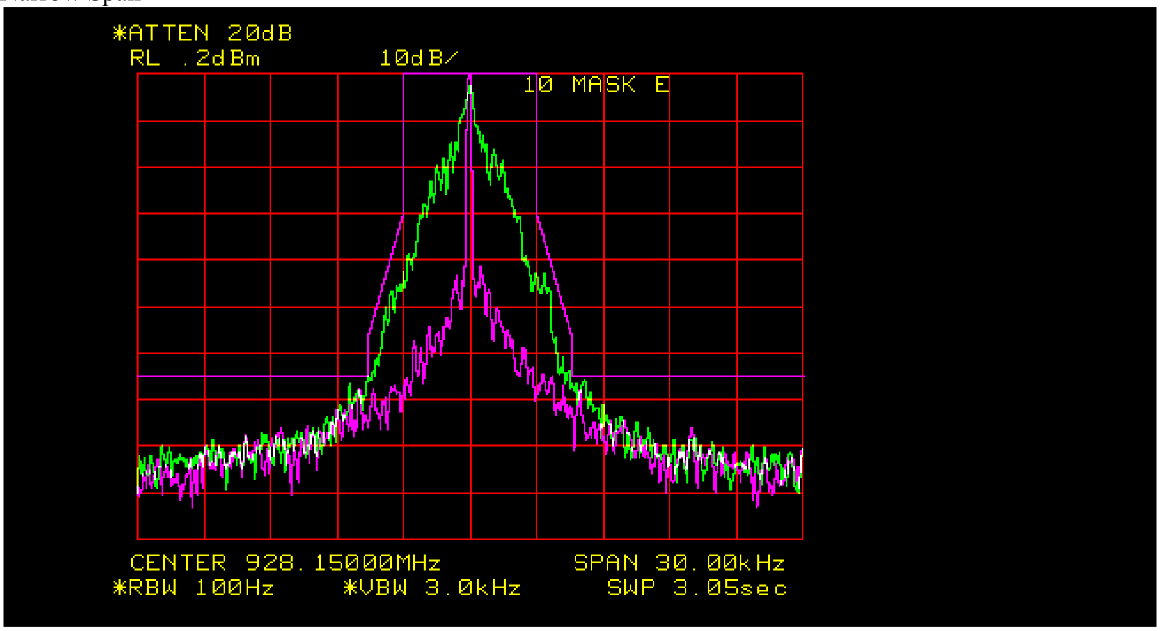


Wide Span

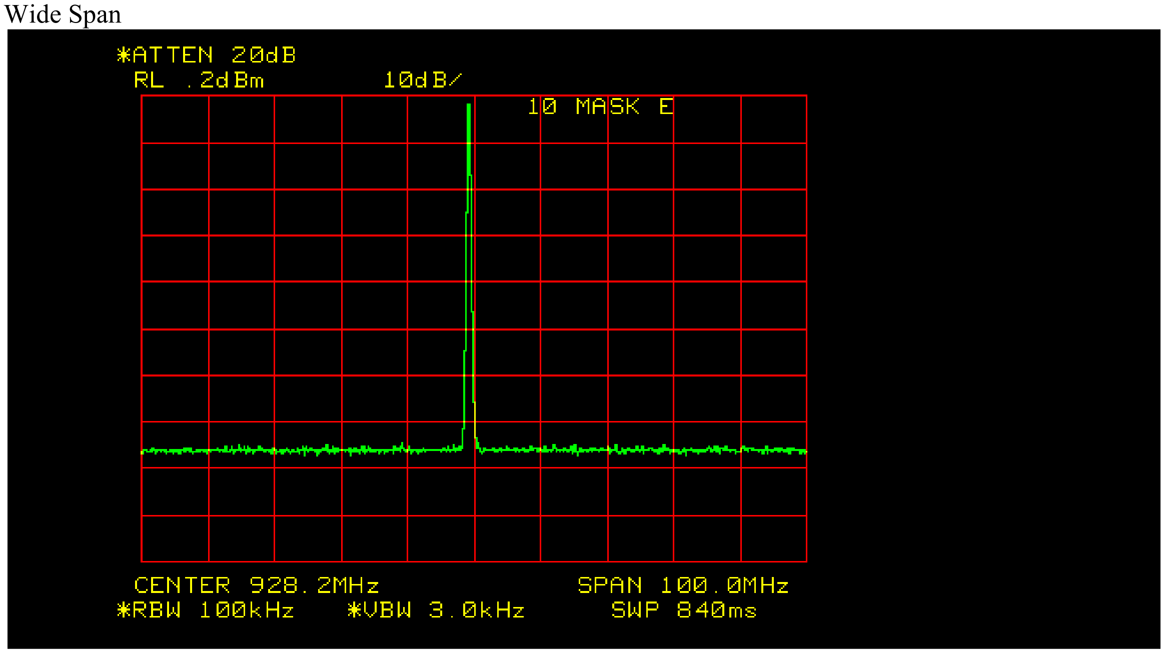


Output Power = 10 Watt

Narrow Span



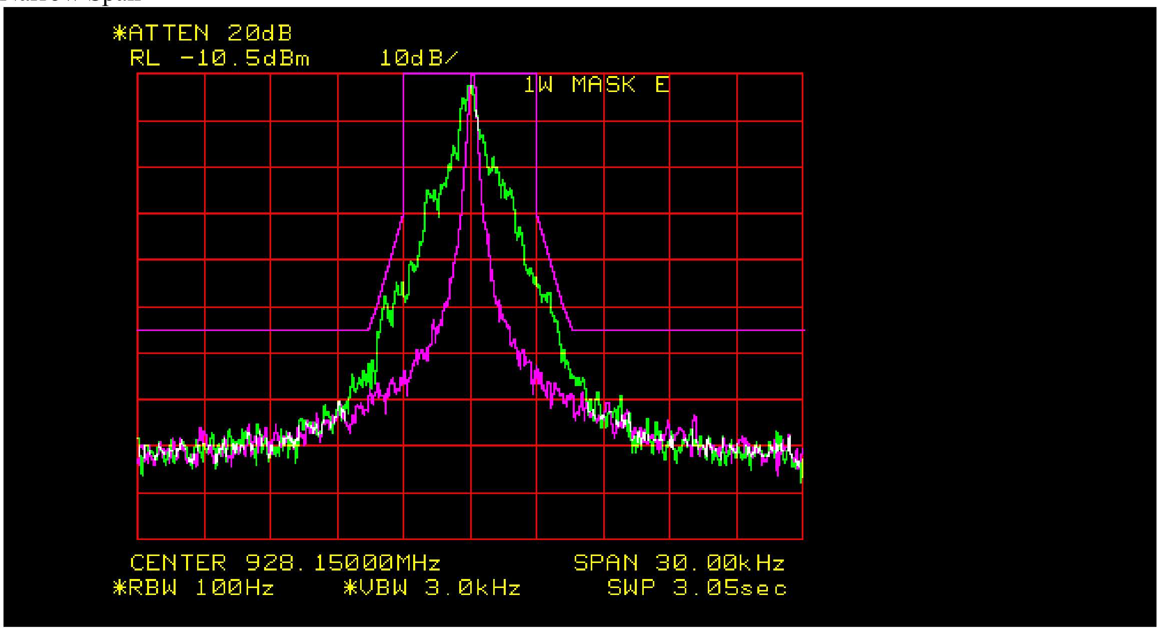
Wide Span



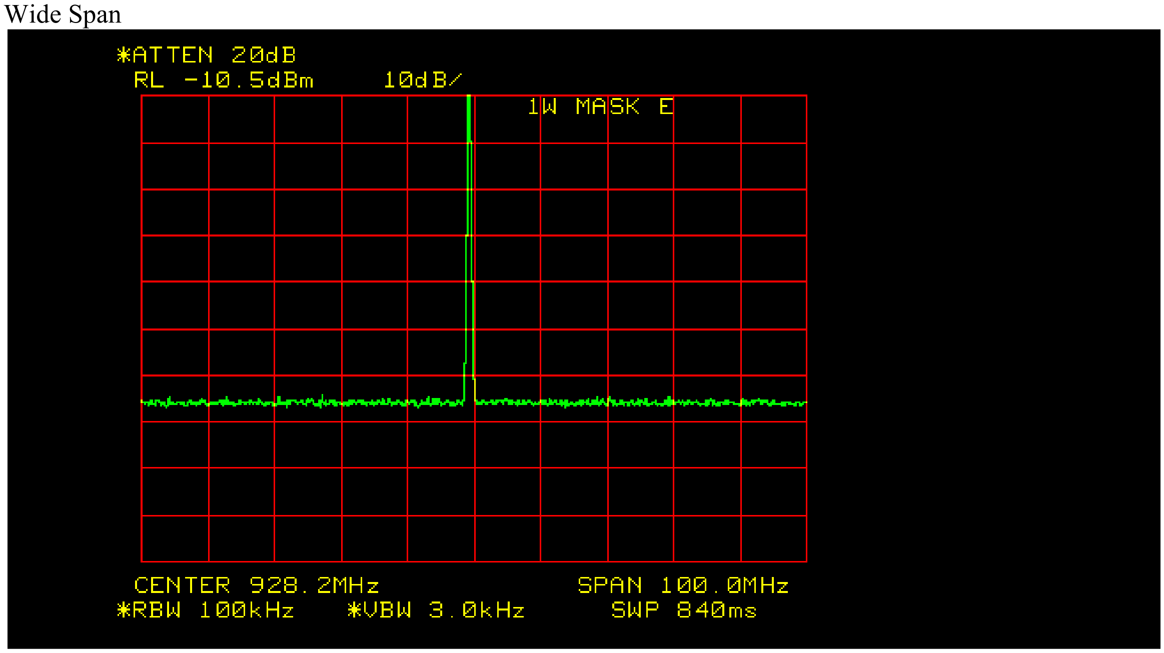
Mask: E
Output Power = 1 Watt

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

Narrow Span

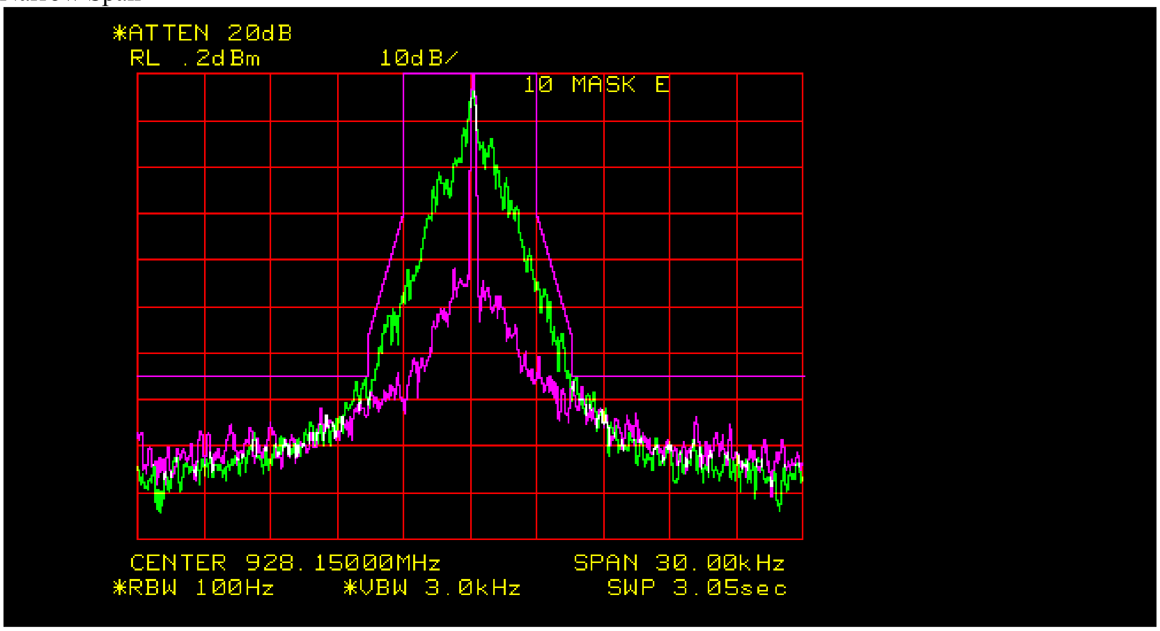


Wide Span

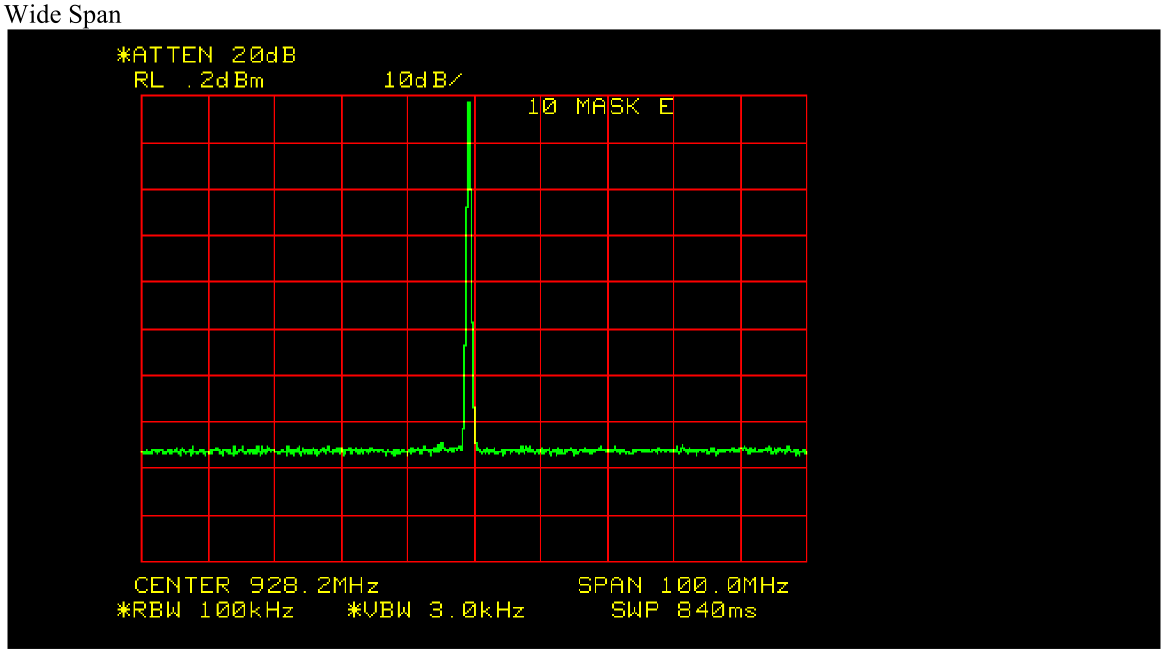


Output Power = 10 Watt

Narrow Span

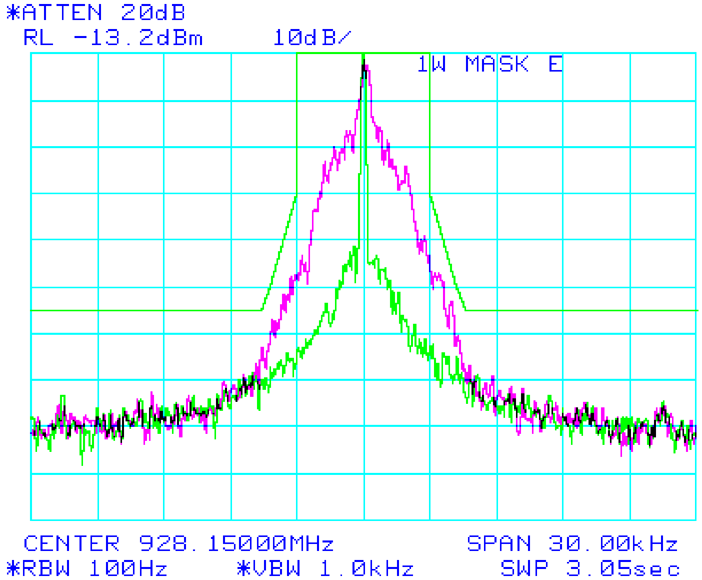


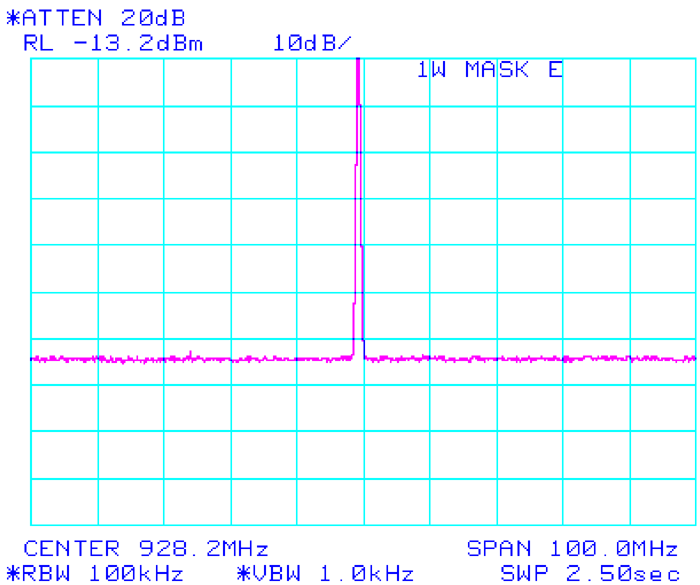
Wide Span



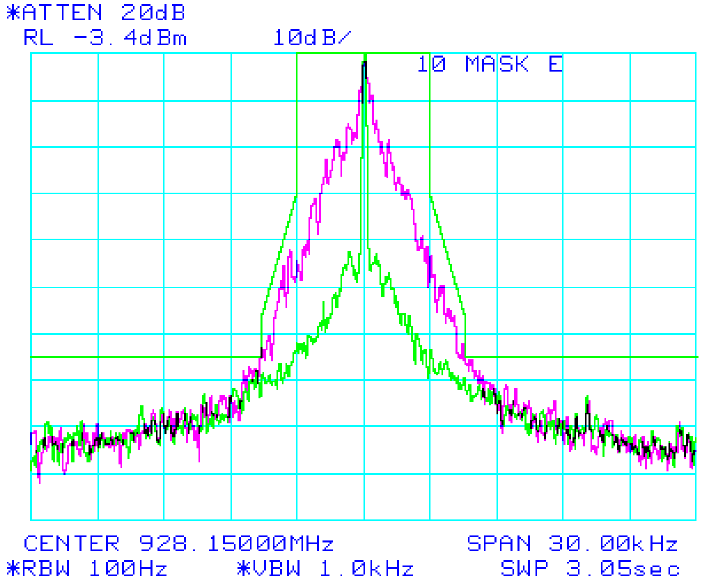
Mask: E
Output Power = 1 Watt

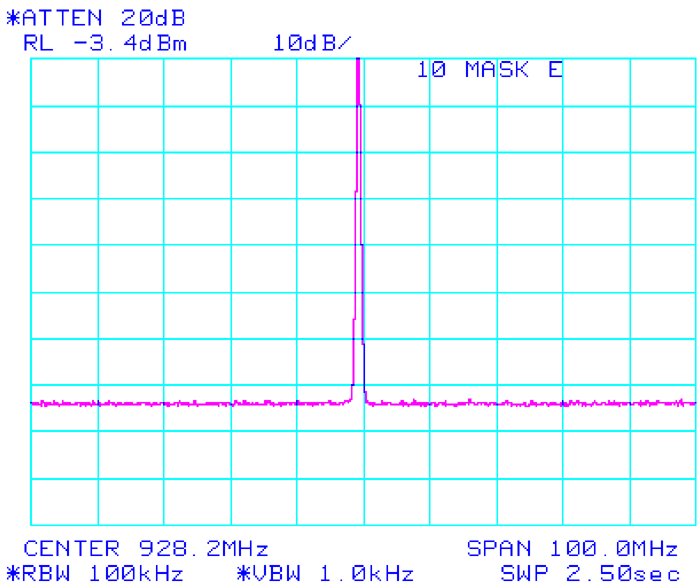
Spectrum for Emission: 3K20 F1D
Data Rate: 12 kbps
Peak Deviation with Data: 1.15kHz





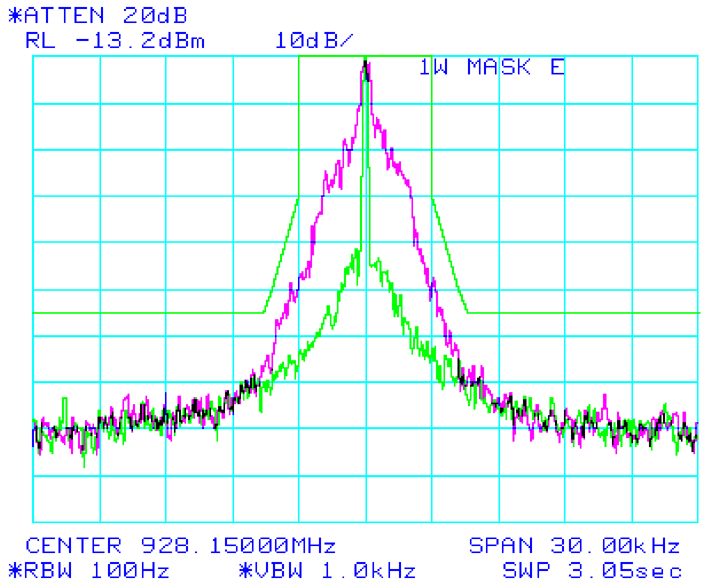
Mask: E | Spectrum for Emission: 3K20 F1D
Output Power = 10 Watt | Data Rate: 12 kbps | Peak Deviation with Data: 1.15kHz

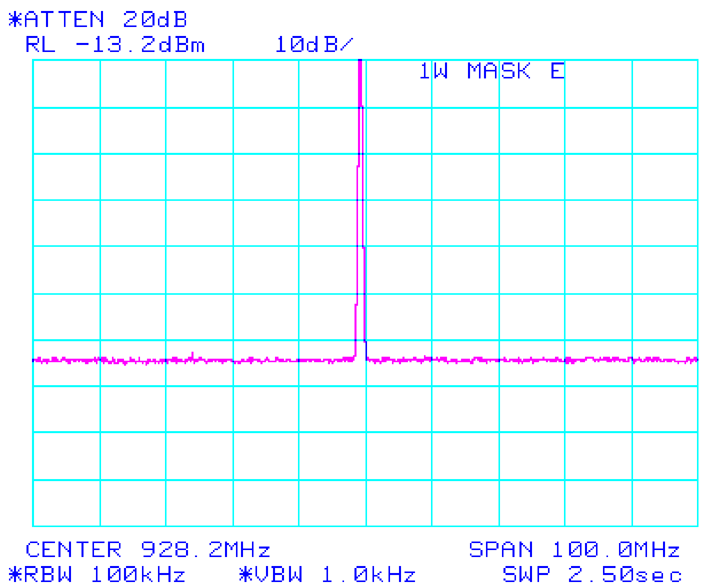




Mask: E
Output Power = 1 Watt

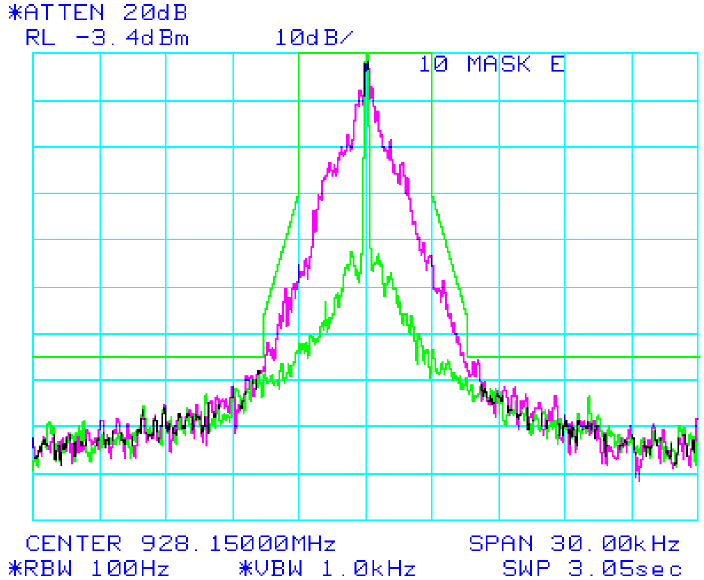
Spectrum for Emission: 3K45 F1D
Data Rate: 16 kbps
Peak Deviation with Data: 1.056 kHz

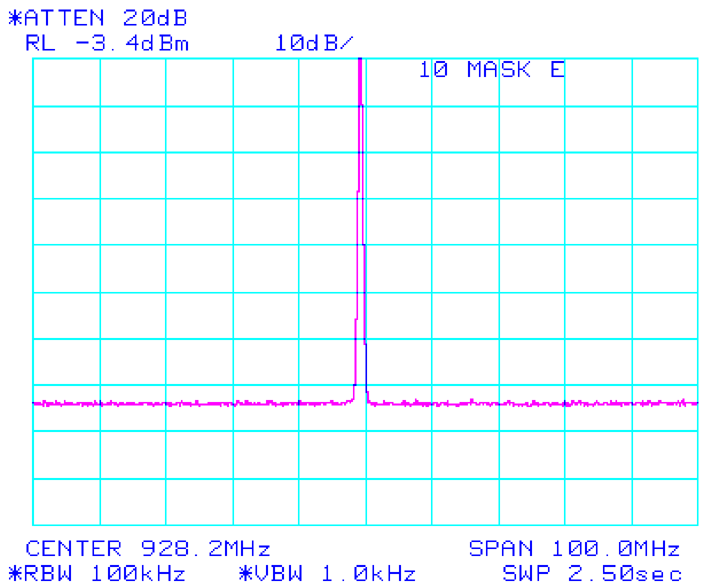




Mask: E
Output Power = 10 Watt

Spectrum for Emission: 3K45 F1D
Data Rate: 16 kbps
Peak Deviation with Data: 1.056 kHz





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), 101.111 (a)(5), 24.133 a2;

MINIMUM STANDARDS:

Mask D
Sidebands and Spurious [Rule 90.210 (d), 5.8.3, P = 10 Watts and P=1 Watt]
Authorized Bandwidth = 11.25 kHz [Rule 90.209(b) (5), 5.8.3]
From Fo to 5.625 kHz, down 0 dB.
Greater than 5.625 kHz to 12.5 kHz, down 7.27(f_d-2.88kHz) 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 = 60.8 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 53log(fd/2.5)
Greater than 6.25 kHz to 9.5 KHz, down 103log(fd/3.9)
Greater than 9.5 to 15 KHz, 157log(fd/5.3)
Greater than 15 KHz,, 50+10log(P) or 70 dB

Attenuation = 0 db at Fo to 6.25 kHz
Attenuation = 21.1dB 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

Mask 24.133(a)(2) 12.5 kHz
Sidebands and Spurious [P = 10 Watts and P=1 Watt]
Authorized Bandwidth = 10 kHz
From Fo to 5 kHz, down 0 dB.
From 5 kHz to 25 kHz, down 116 * $\log_{10}$ (f_d +5 / 3.05) dB, 50+10log(P) or 70 dB.
Greater than 25 kHz, 43+10$\log_{10}$(P) or 80 dB.

Attenuation = 0 db at Fo to 5 kHz
Attenuation = 25 dB at 5 kHz
Attenuation = 60 dB at 10 kHz @ 10W
Attenuation = 50 dB at 8.22 kHz @ 1W
Attenuation = 53 dB at 25 kHz @ 10W
Attenuation = 43 dB at 25 kHz @ 1W

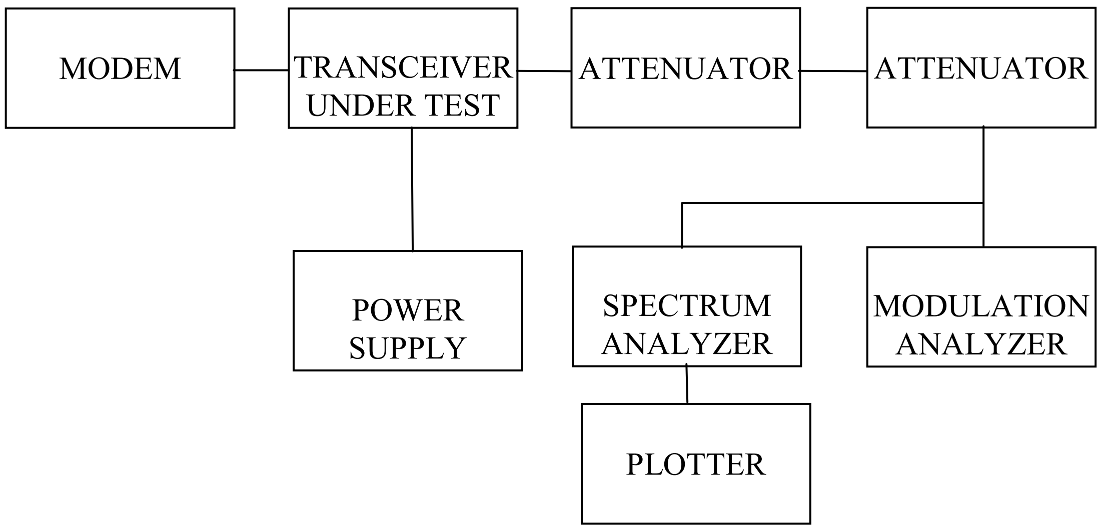
TEST RESULTS:	Meets minimum standards (see data on following page)
TEST CONDITIONS:	Standard Test Conditions, 25 C RF Power Level = 1 Watt and 10 Watts

Voltage = 20VDC

TEST PROCEDURE: TIA/EIA – 603-C, 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 HP8901A

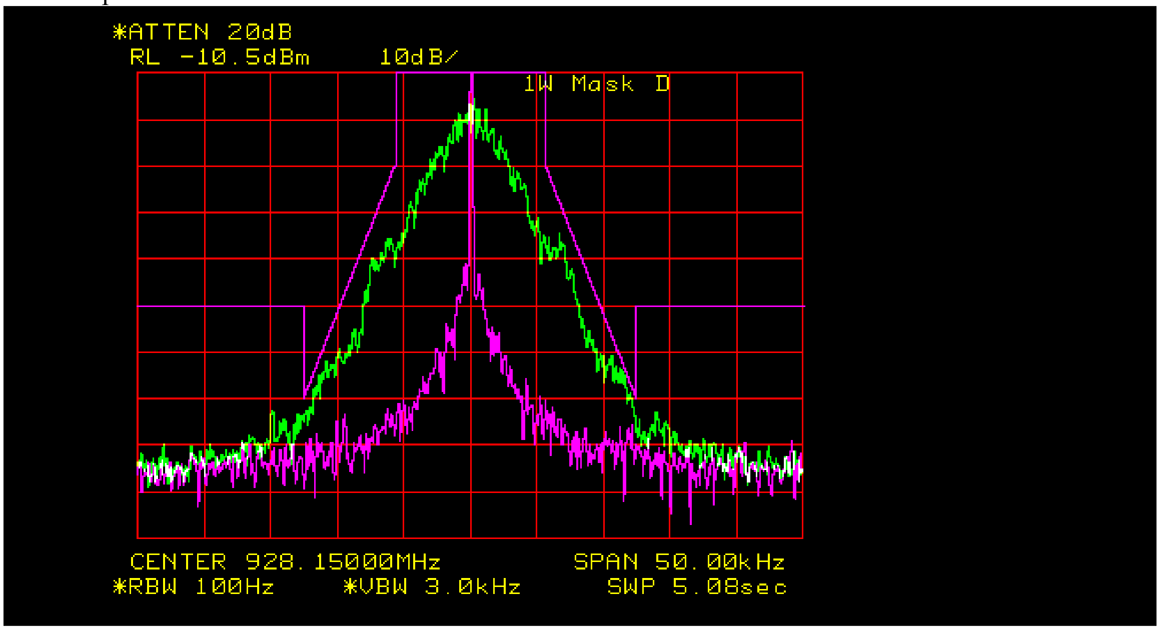
TEST SET-UP:



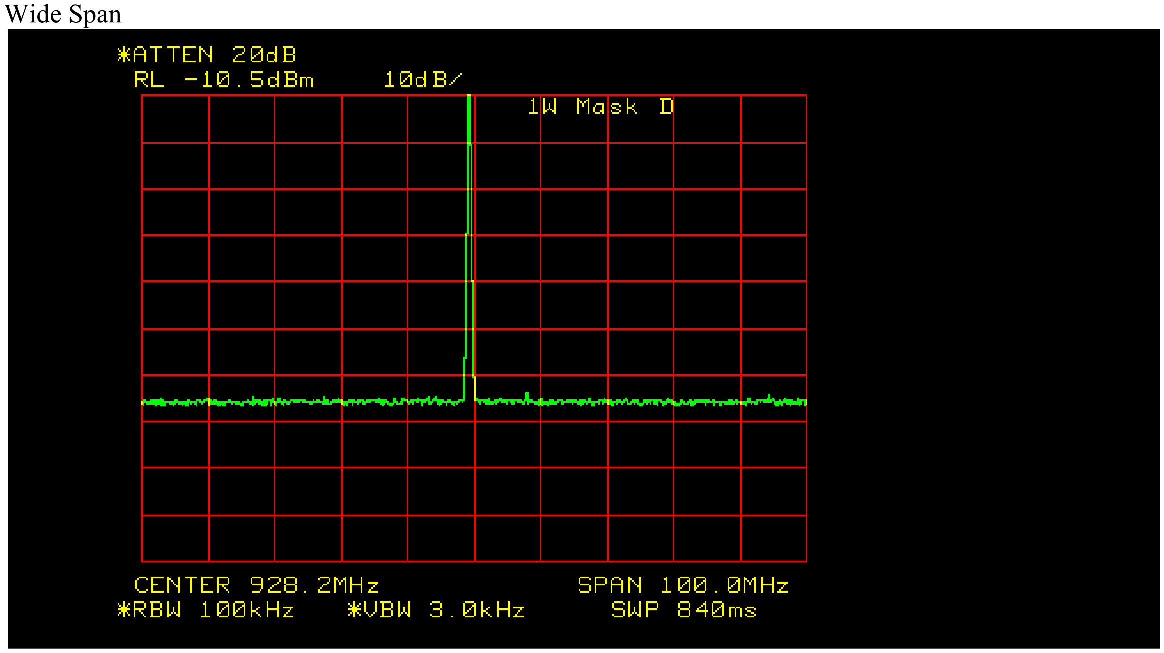
Mask: D
Output Power = 1 Watt

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

Narrow Span

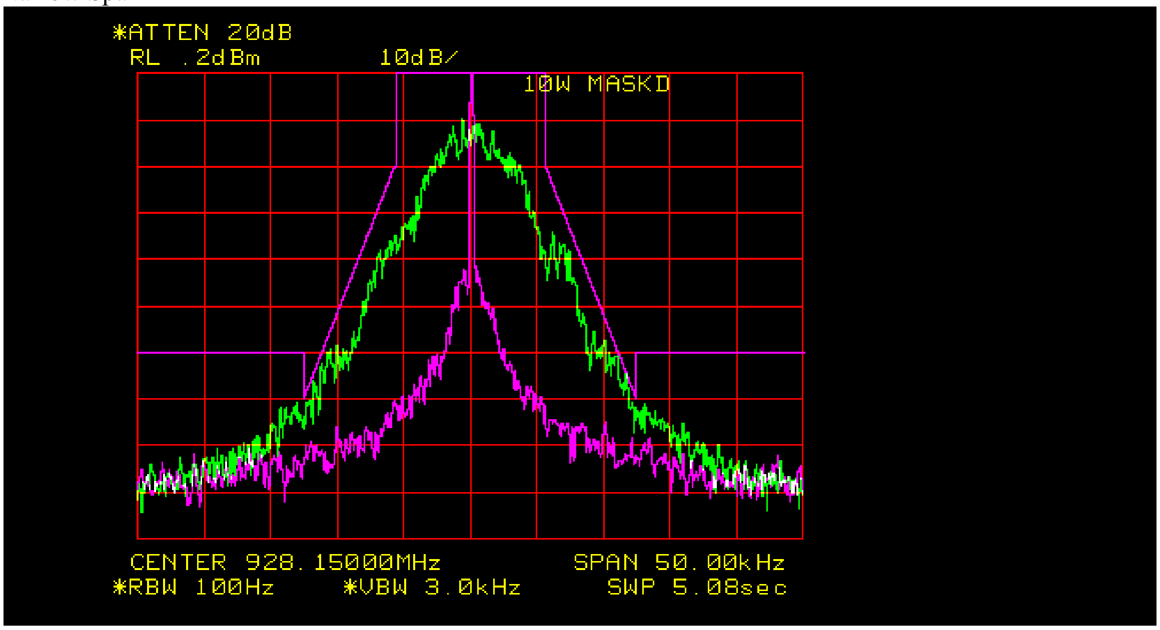


Wide Span

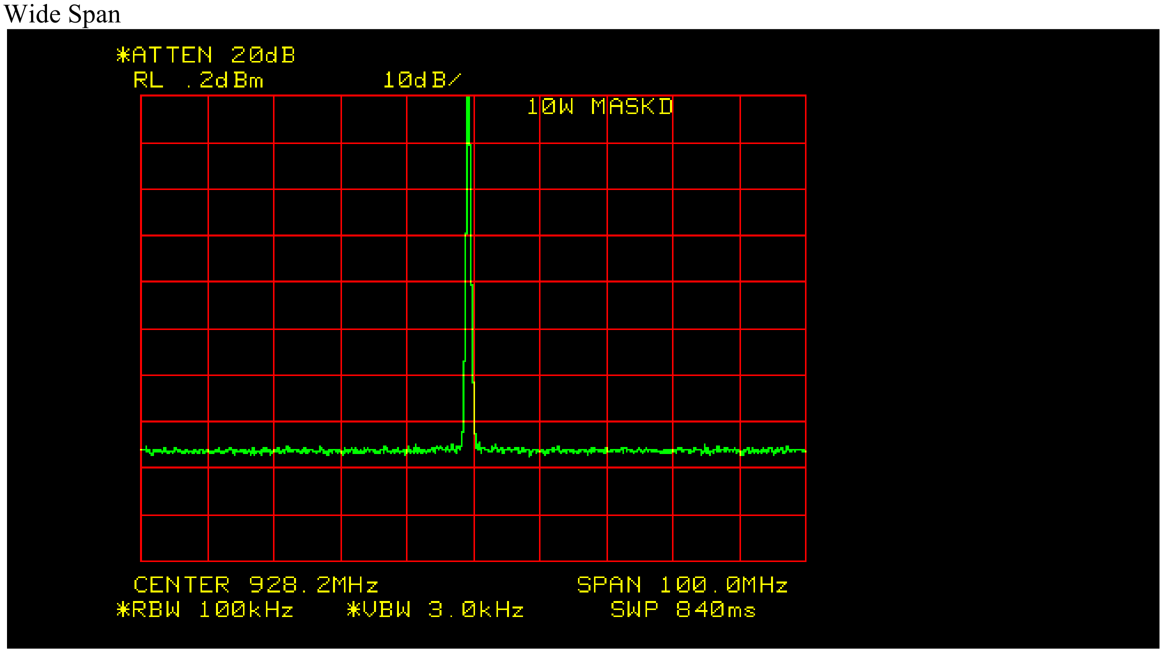


Output Power = 10 Watts

Narrow Span



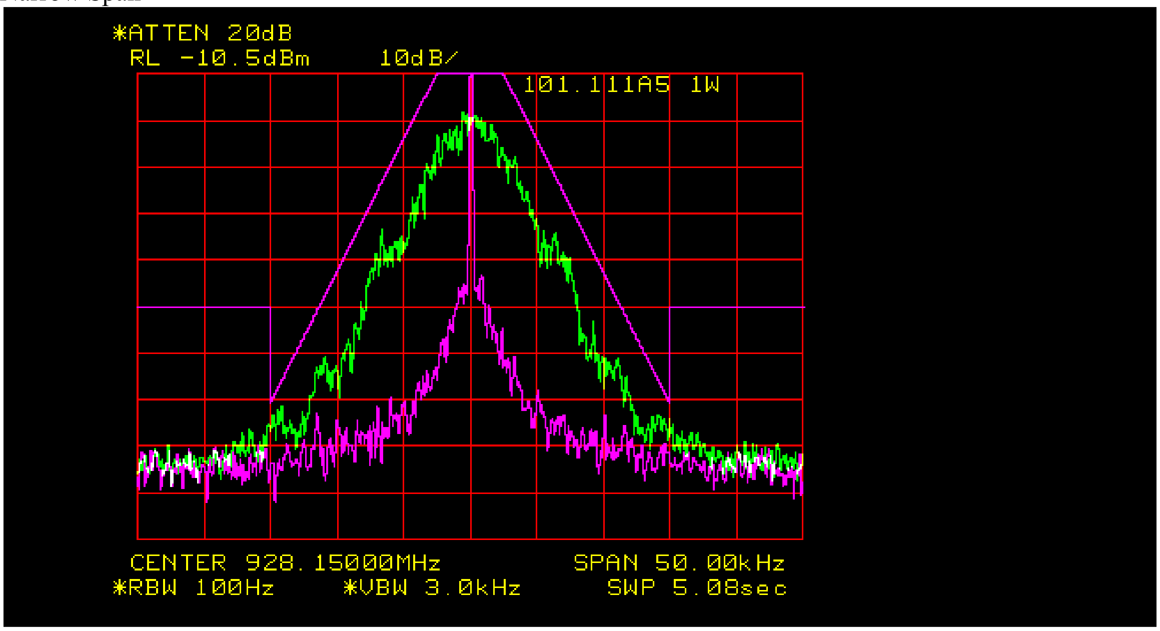
Wide Span



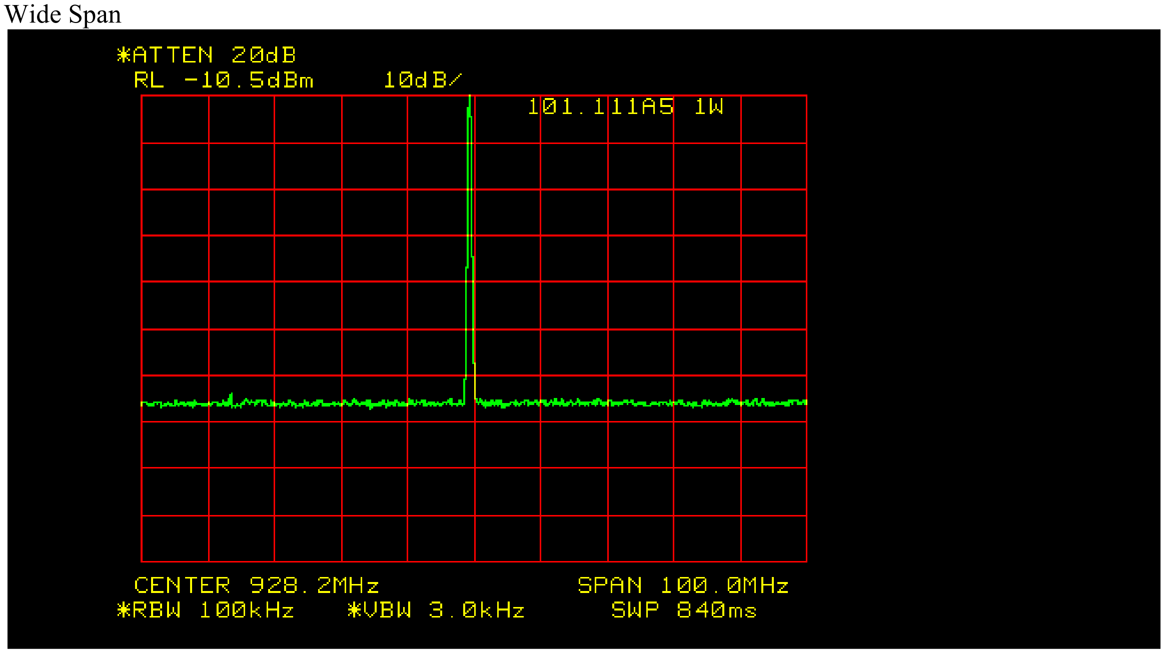
Mask: 101.111a5
Output Power = 1 Watt

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

Narrow Span

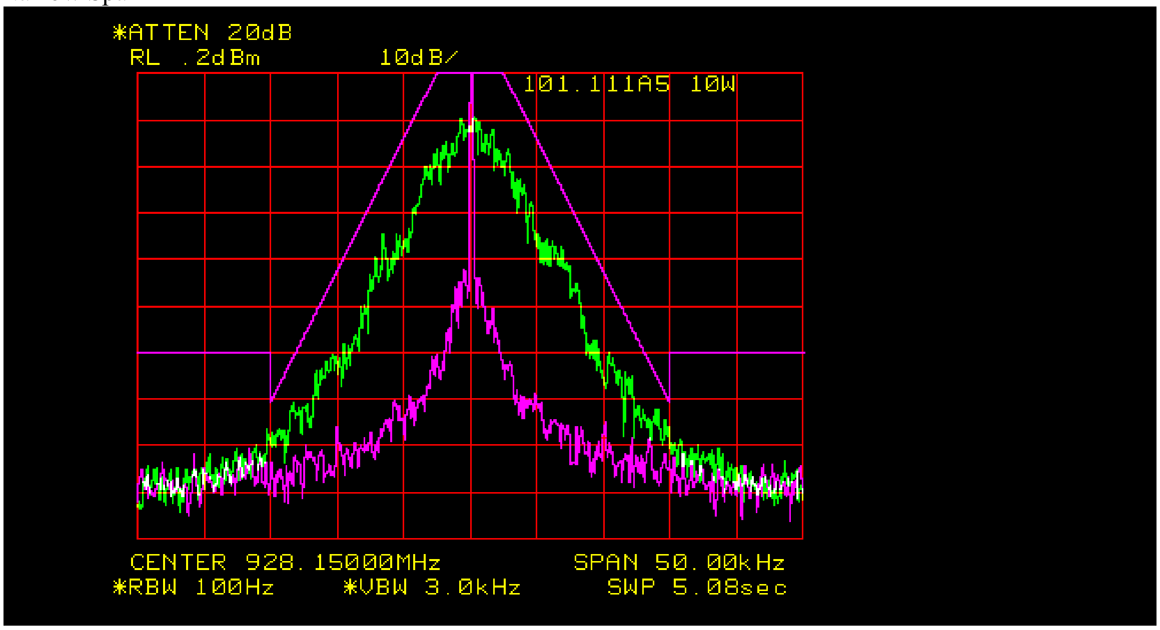


Wide Span

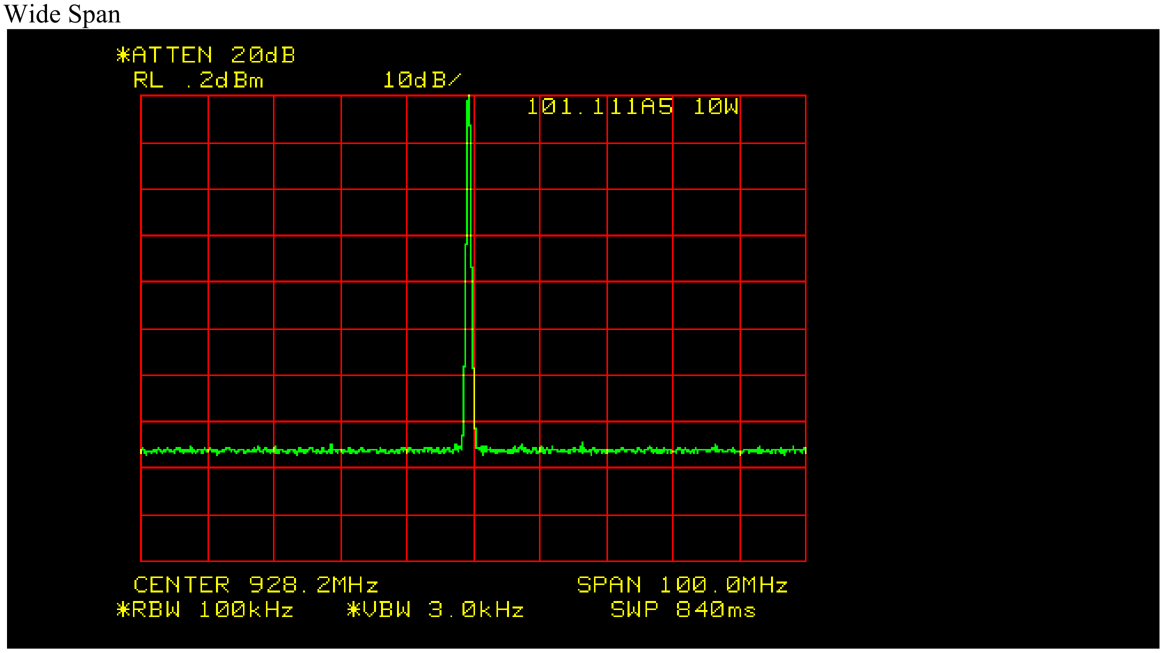


Output Power = 10 Watts

Narrow Span



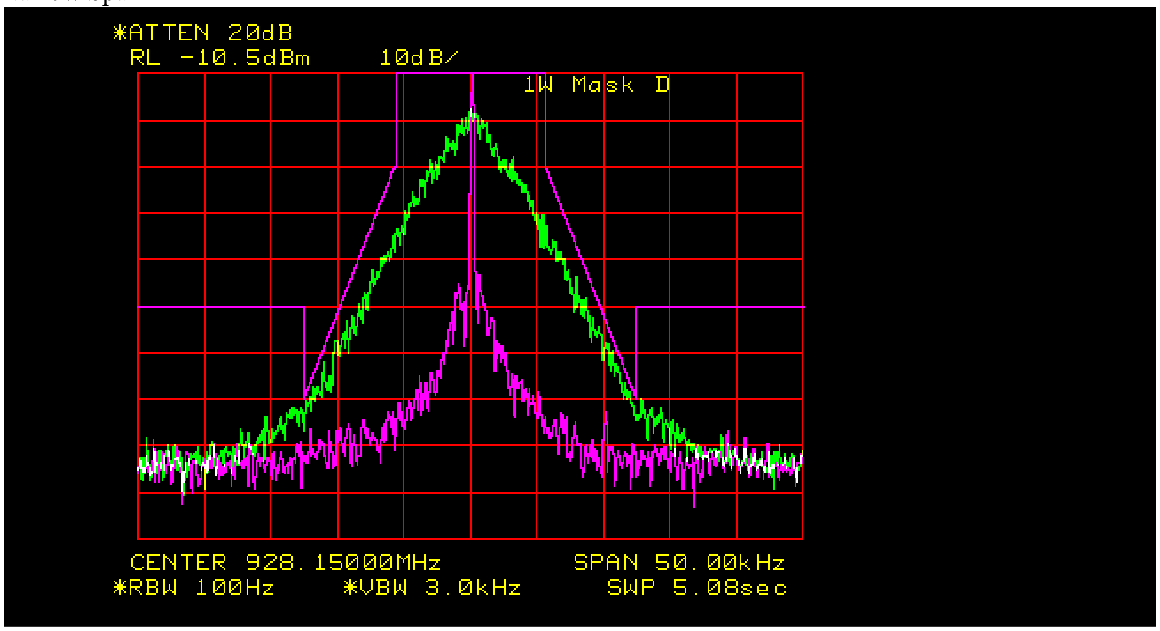
Wide Span



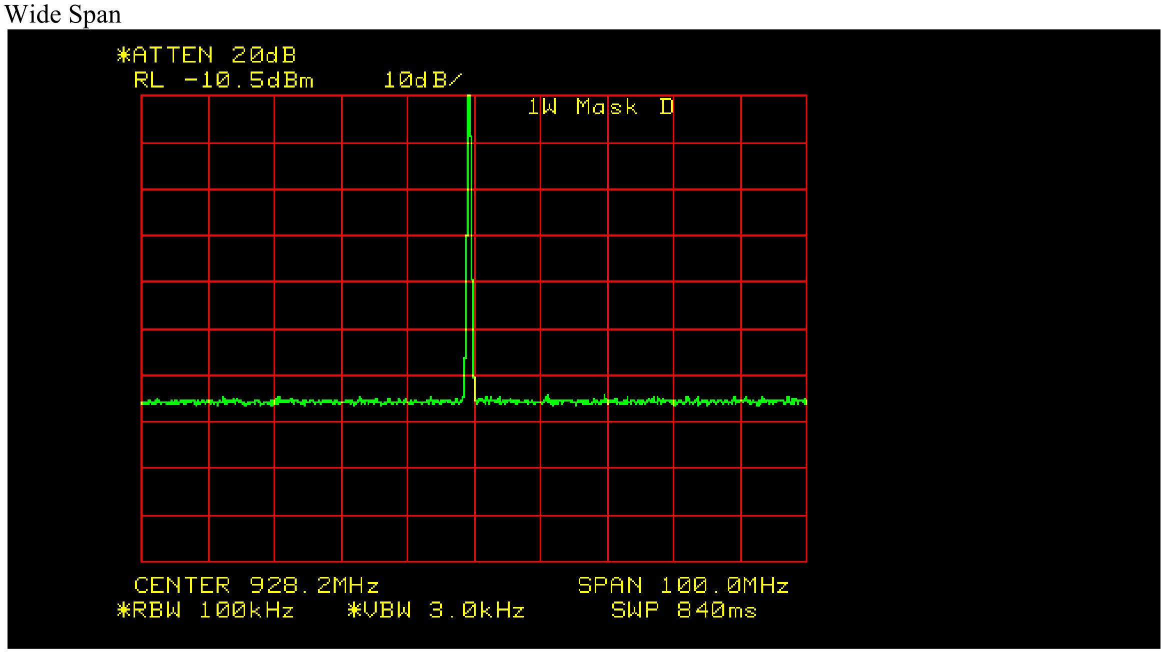
Mask: D
Output Power = 1 Watt

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

Narrow Span

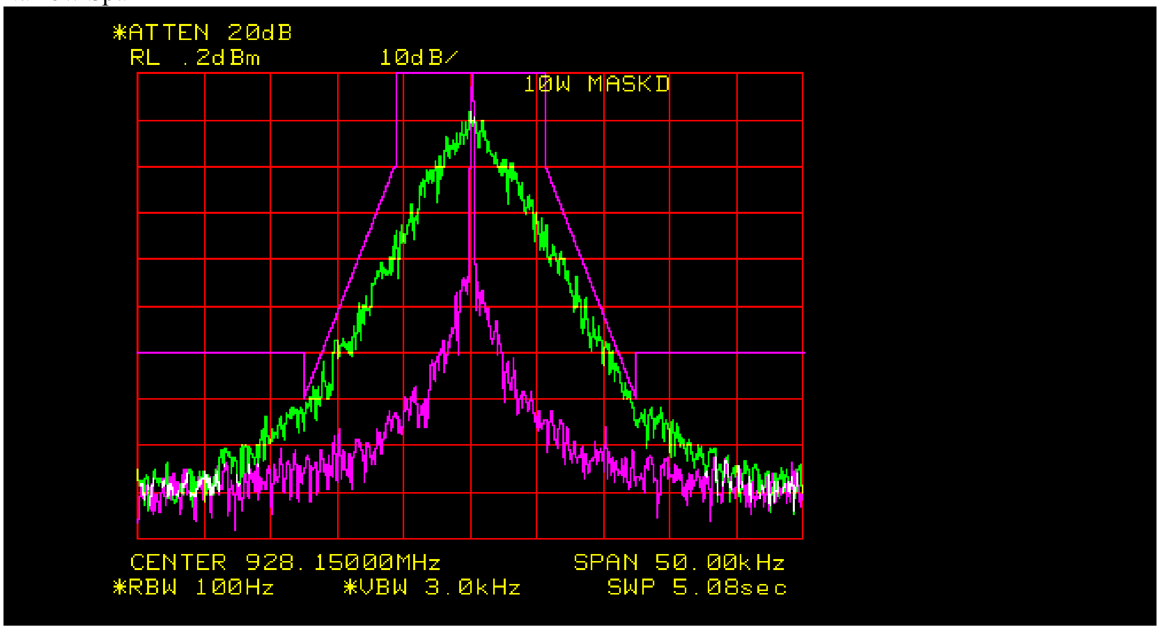


Wide Span

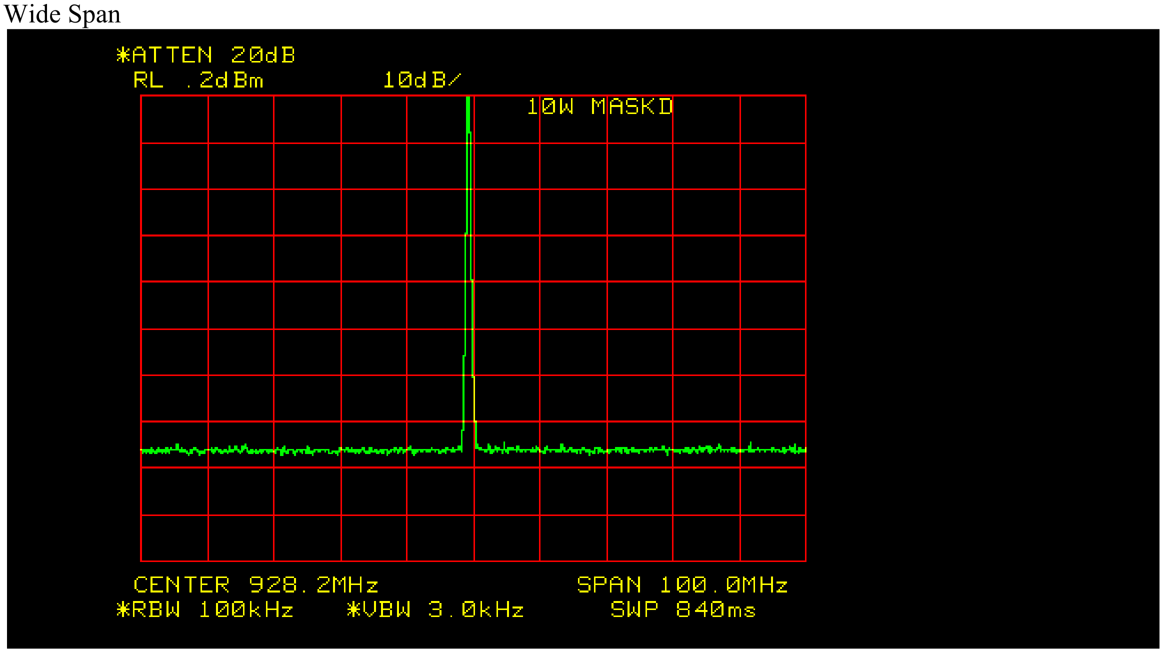


Output Power = 10 Watts

Narrow Span

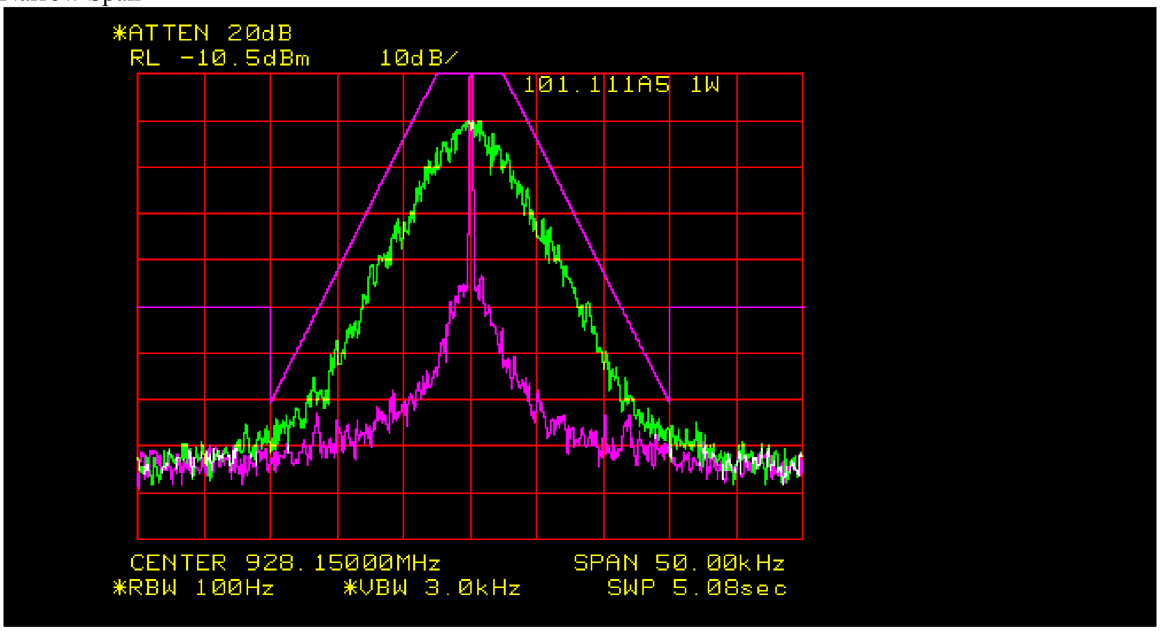


Wide Span

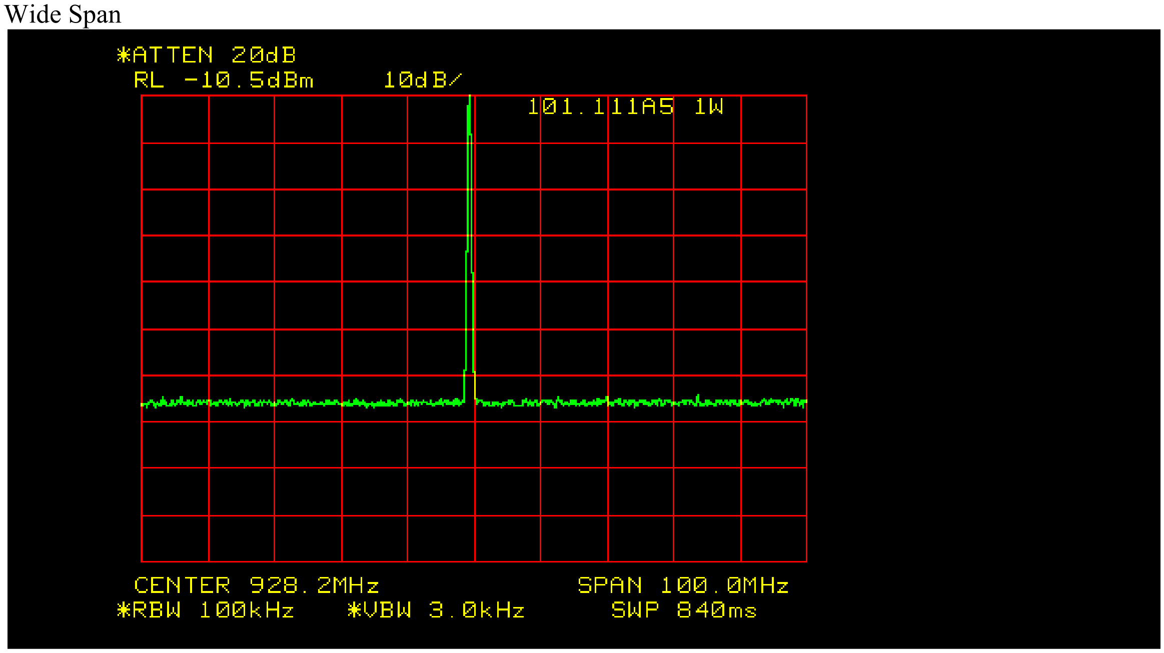


Mask: 101.111a5 | Spectrum for Emission: 8K30 F1D
Output Power = 1 Watt | Data Rate: 16 kbps | Peak Deviation with Data: 3.65 kHz

Narrow Span

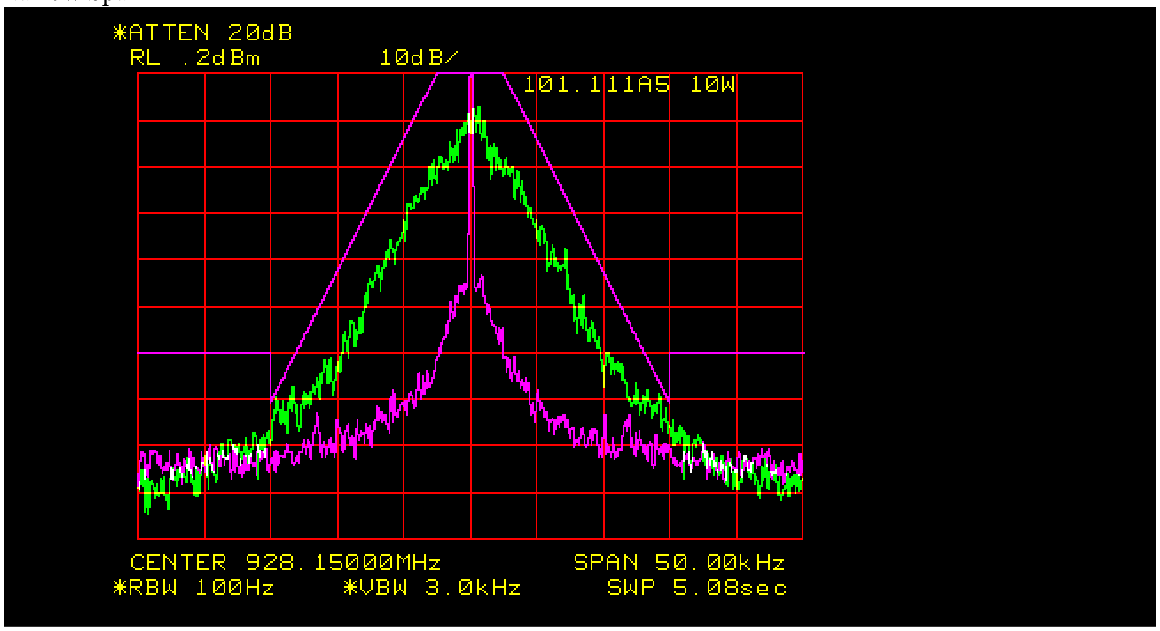


Wide Span

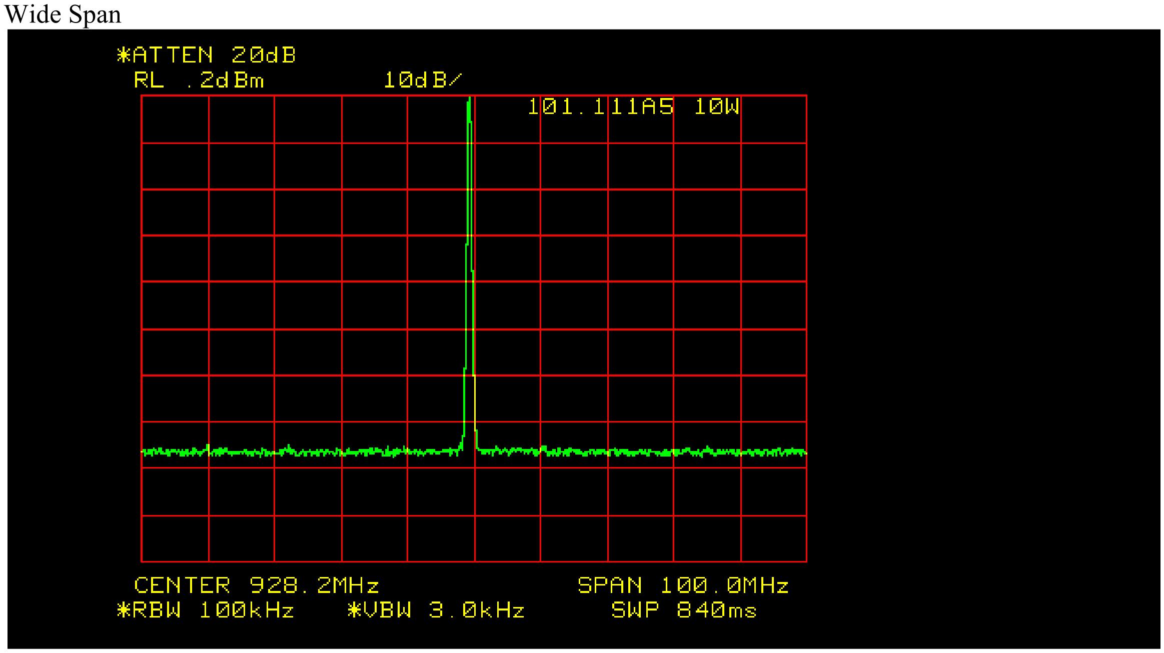


Output Power = 10 Watts

Narrow Span

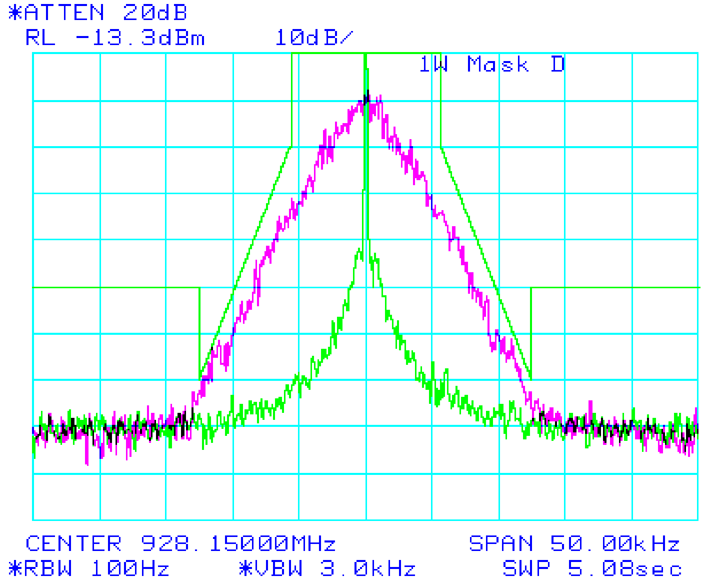


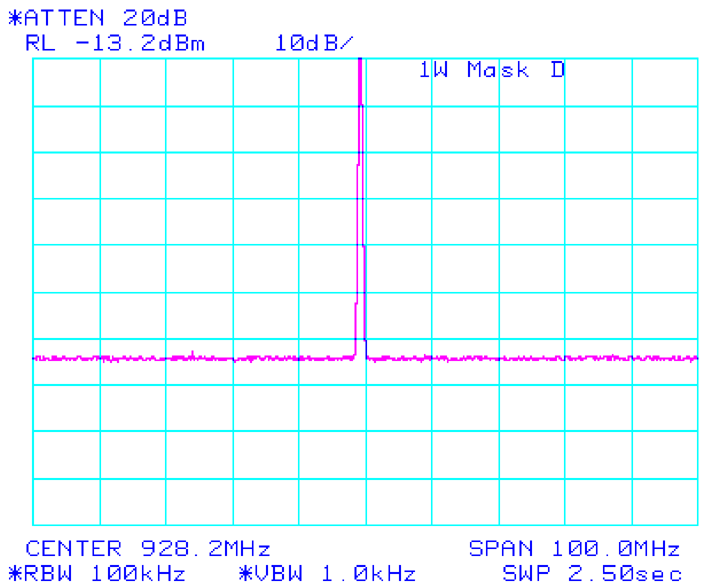
Wide Span



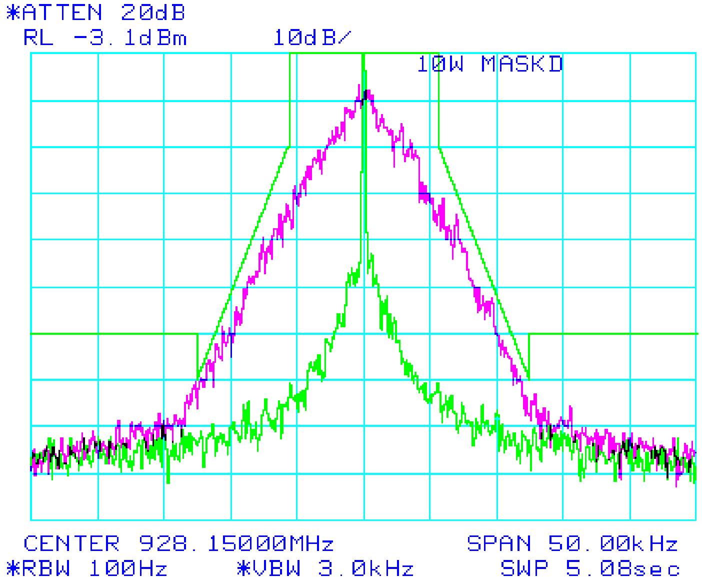
Mask: D, 1W
Output Power = 1 Watt

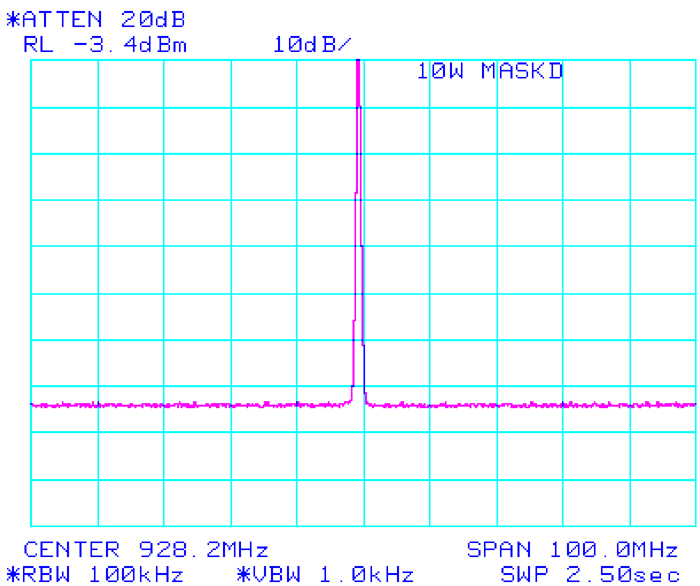
Spectrum for Emission: 8K50 F1D
Data Rate: 24 kbps
Peak Deviation with Data: 3.725 kHz



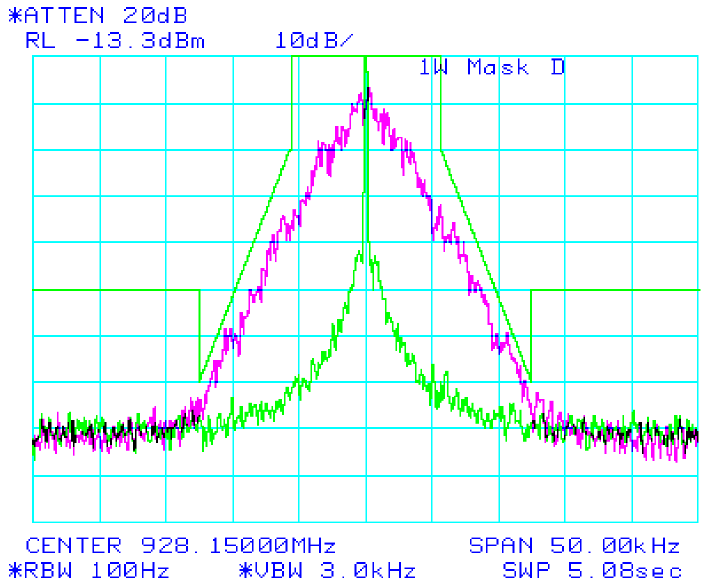


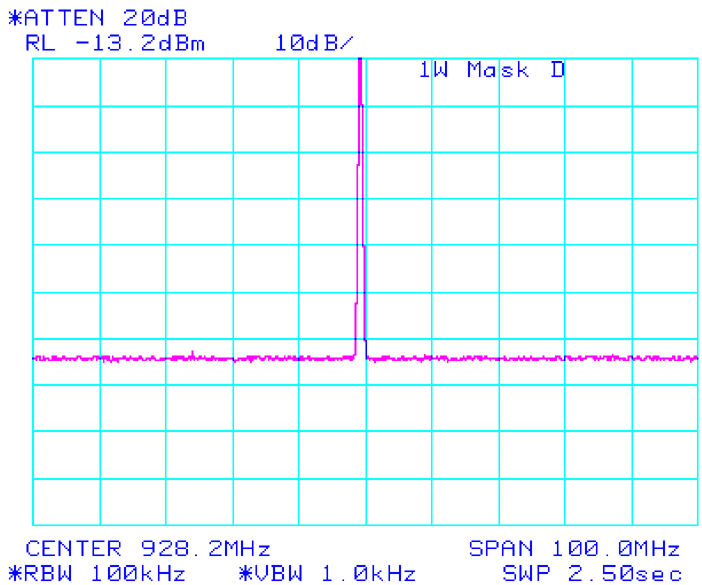
Mask: D, 1W | Spectrum for Emission: 8K50 F1D
Output Power = 10 Watts | Data Rate: 24 kbps | Peak Deviation with Data: 3.725 kHz





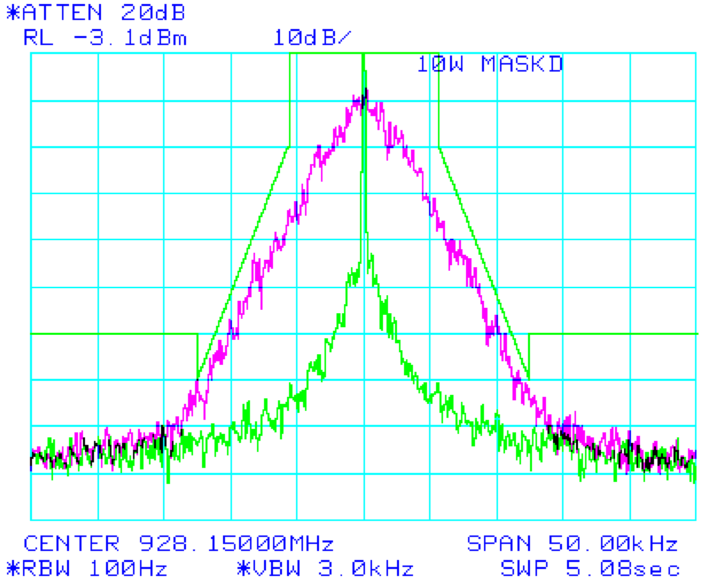
Mask: D, 1W | Spectrum for Emission: 8K08 F1D
Output Power = 1 Watt | Data Rate: 32 kbps | Peak Deviation with Data: 3.728 kHz

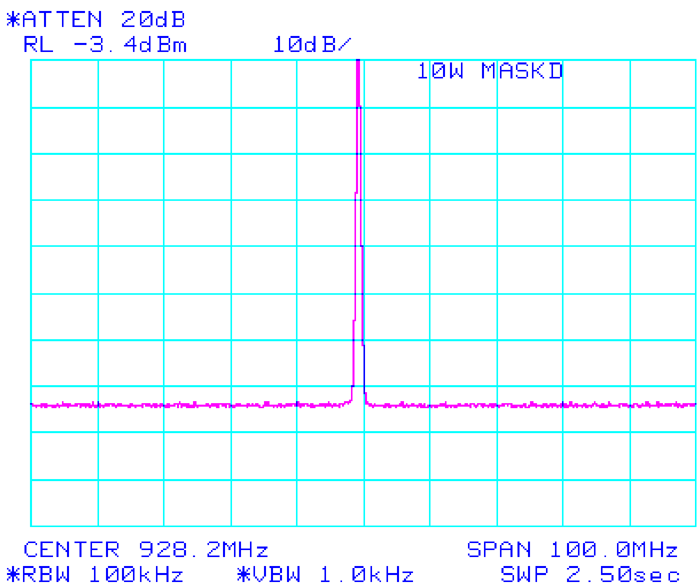




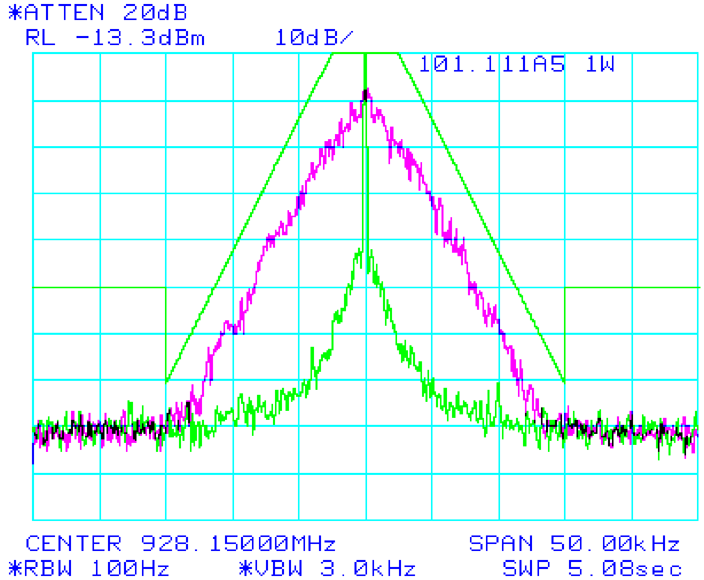
Mask: D, 1W
Output Power = 10 Watt

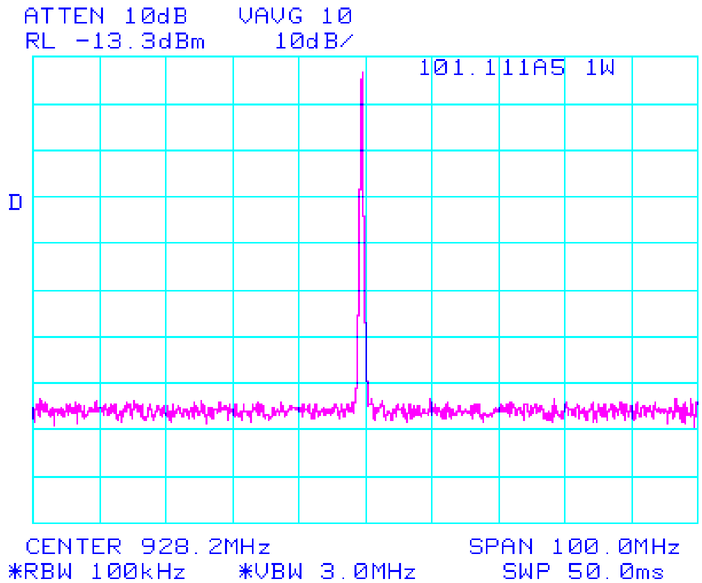
Spectrum for Emission: 8K08 F1D
Data Rate: 32 kbps Peak Deviation with Data: 3.728 kHz



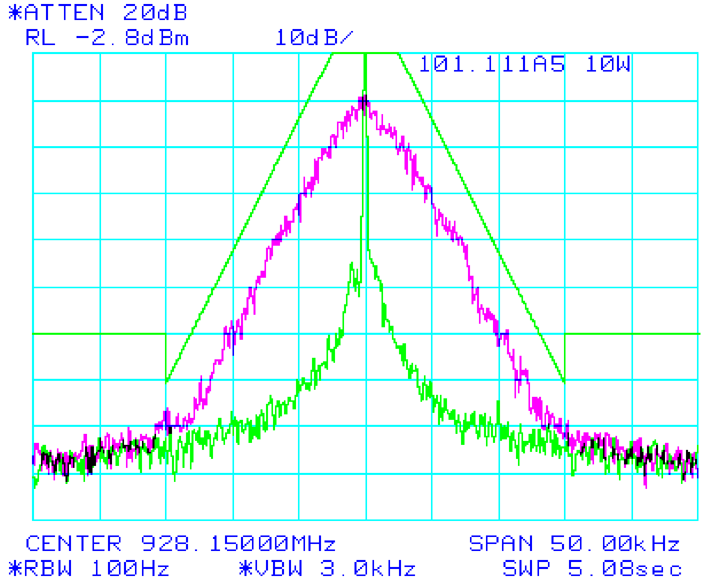


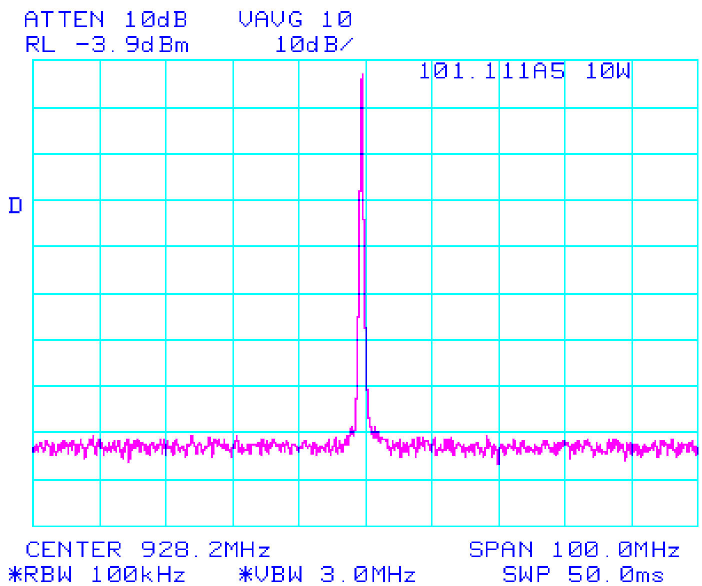
Mask: 101.11a5 Spectrum for Emission: 8K50 F1D
Output Power = 1 Watt Data Rate: 24 kbps Peak Deviation with Data: 3.725 kHz



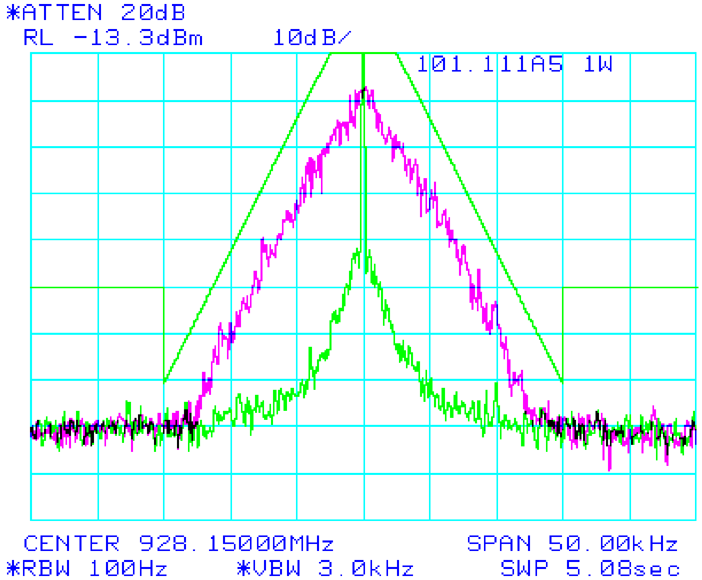


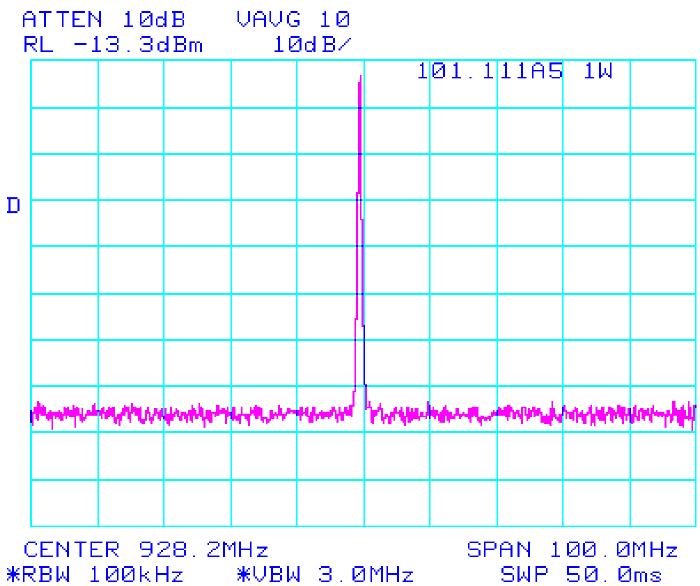
Mask: 101.11a5 Spectrum for Emission: 8K50 F1D
Output Power = 10 Watt Data Rate: 24 kbps Peak Deviation with Data: 3.725 kHz





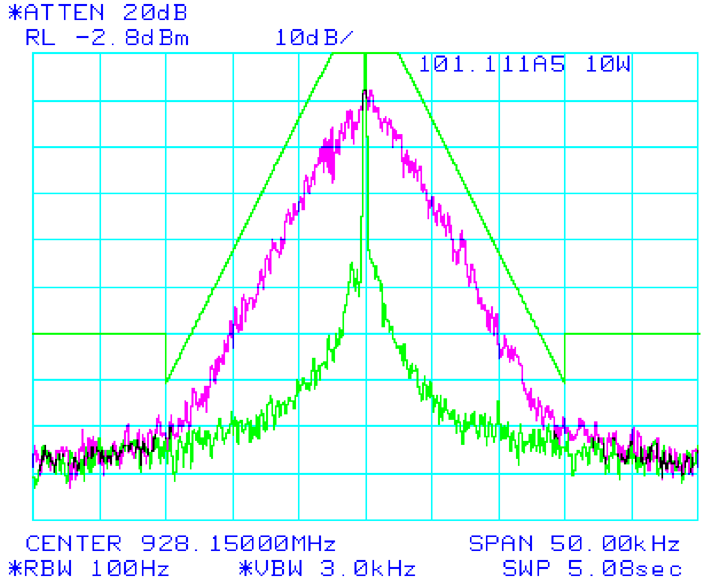
Mask: 101.11a5 Spectrum for Emission: 8K50 F1D
Output Power = 1 Watt Data Rate: 32 kbps Peak Deviation with Data: 3.728 kHz

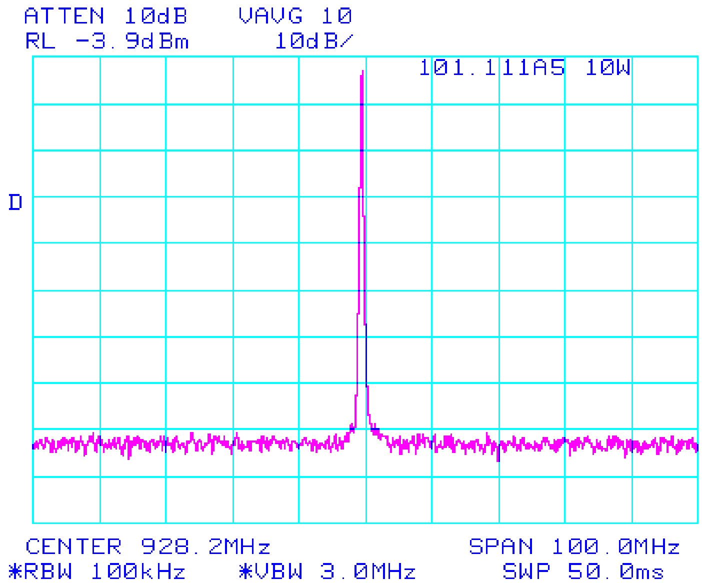




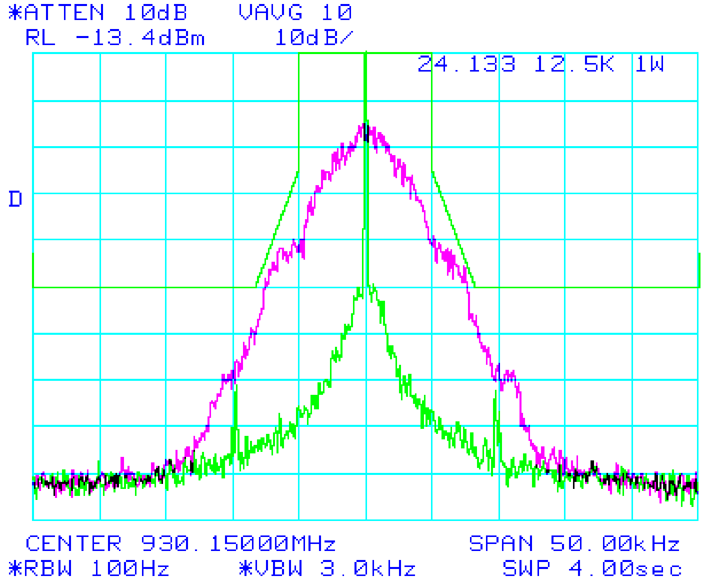
Mask: 101.11a5
Output Power = 10 Watt

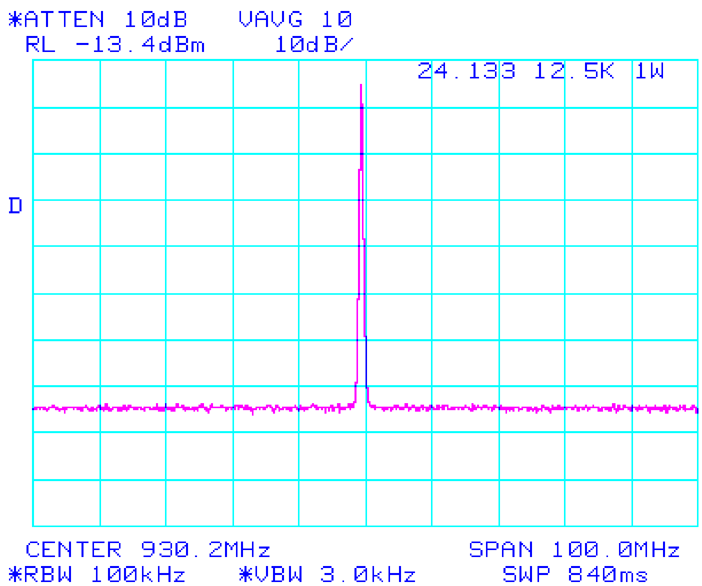
Spectrum for Emission: 8K50 F1D
Data Rate: 32 kbps
Peak Deviation with Data: 3.728 kHz



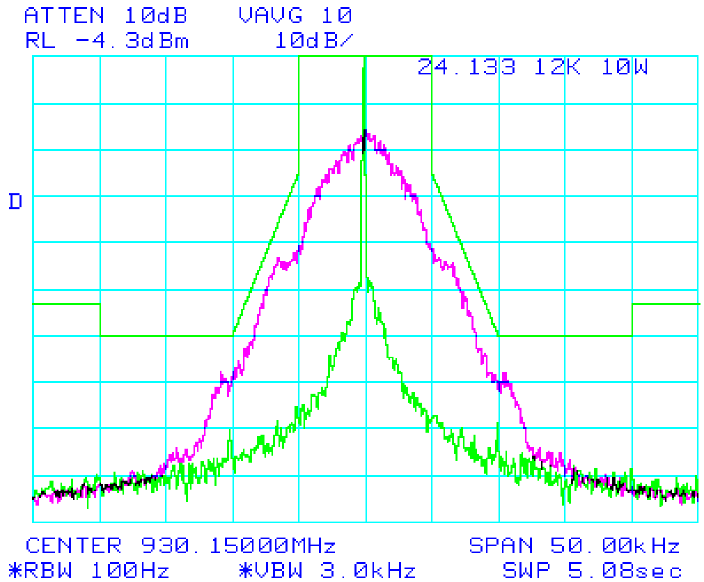


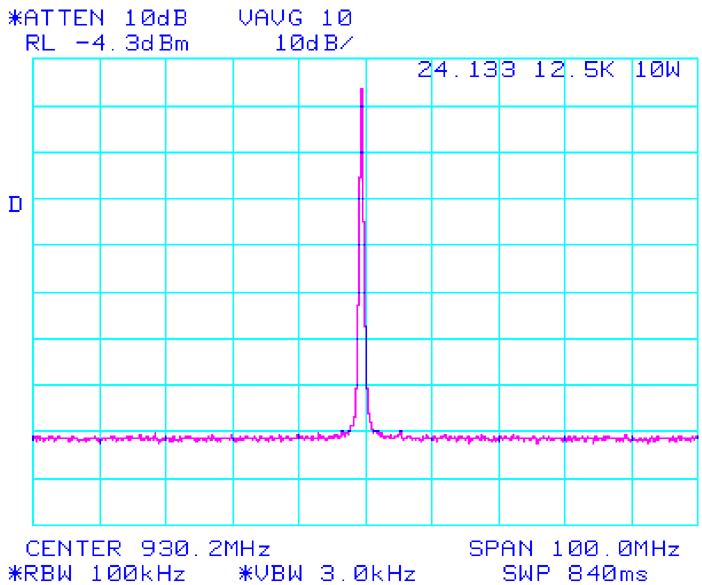
Mask: 24.133a2 | Spectrum for Emission: 8K20 F1D
Output Power = 1 Watt | Data Rate: 8 kbps | Peak Deviation with Data: 3.31 kHz





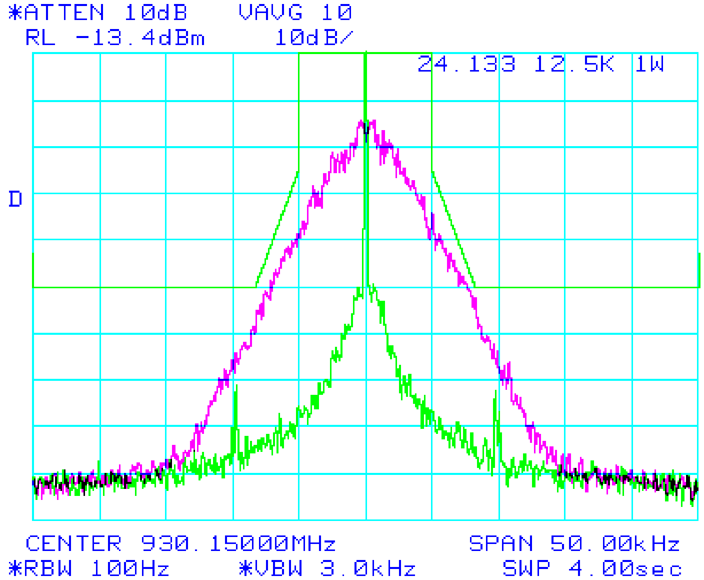
Mask: 24.133a2 | Spectrum for Emission: 8K20 F1D
Output Power = 10 Watt | Data Rate: 8 kbps | Peak Deviation with Data: 3.31 kHz

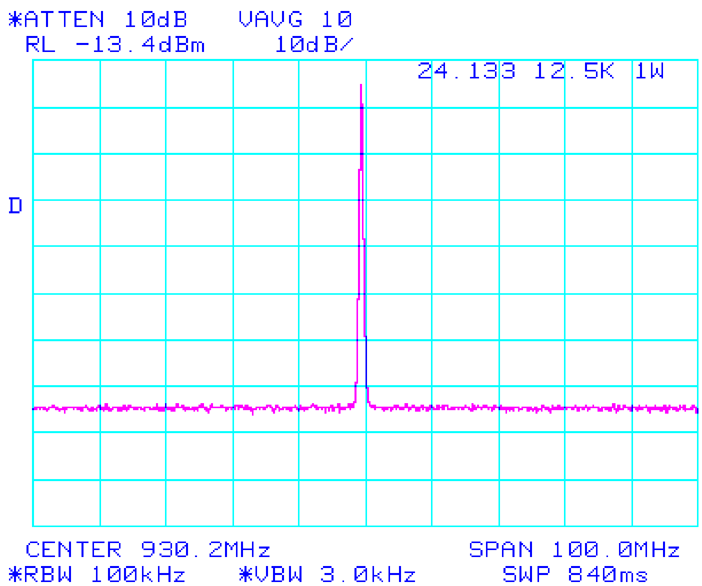




Mask: 24.133a2 | Spectrum for Emission: 8K30 F1D

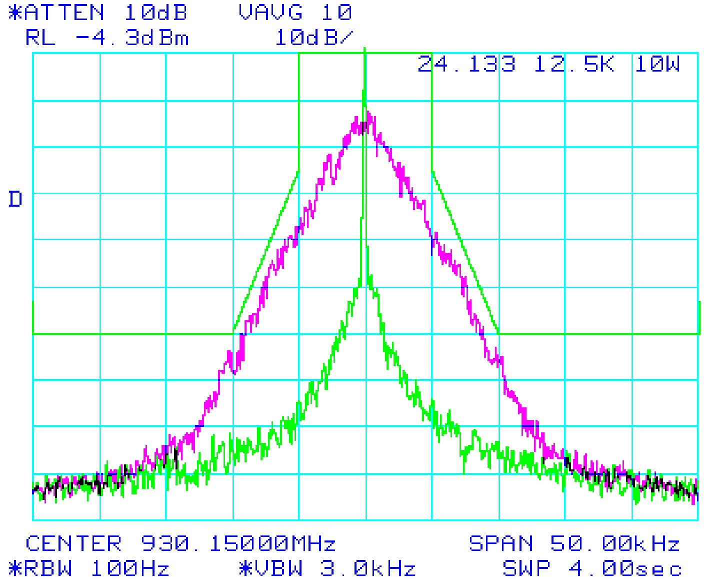
Output Power = 1 Watt | Data Rate: 16 kbps | Peak Deviation with Data: 3.65 kHz

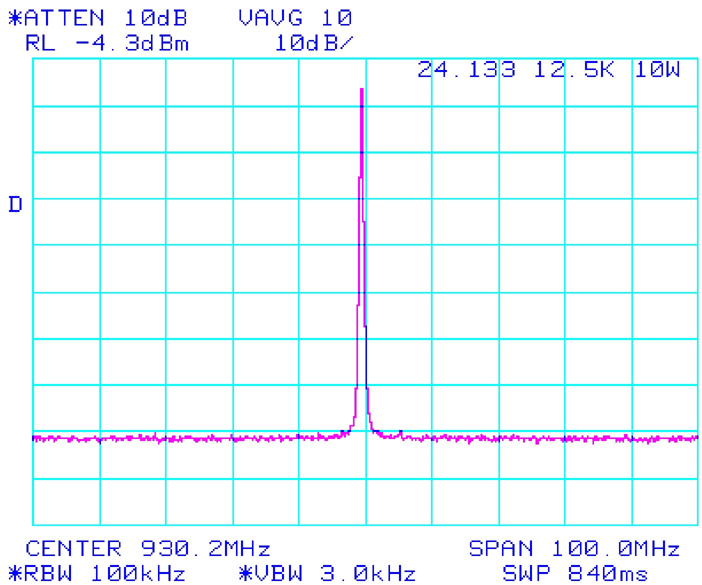




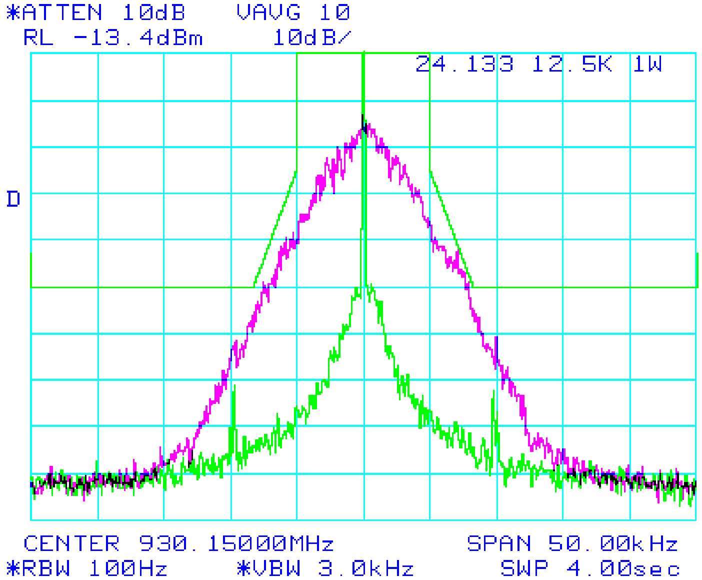
Mask: 24.133a2
Output Power = 10 Watt

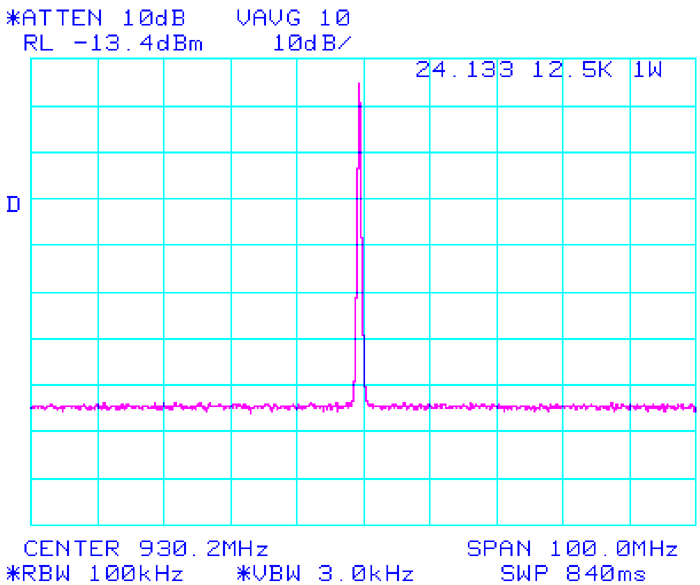
Spectrum for Emission: 8K30 F1D
Data Rate: 16 kbps
Peak Deviation with Data: 3.65 kHz



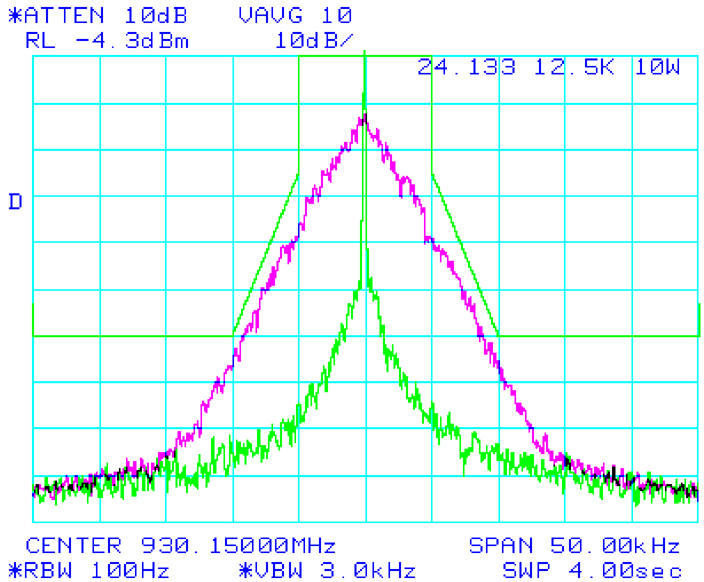


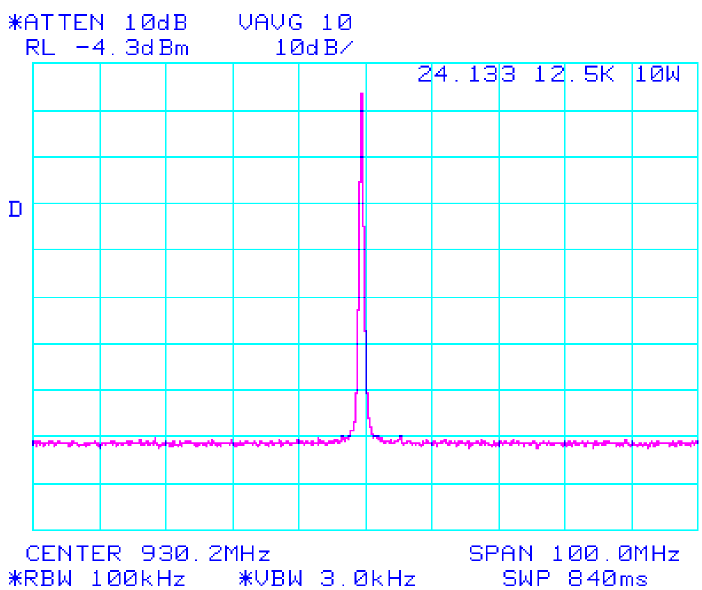
Mask: 24.133a2 | Spectrum for Emission: 8K50 F1D
Output Power = 1 Watt | Data Rate: 24 kbps | Peak Deviation with Data: 3.725 kHz





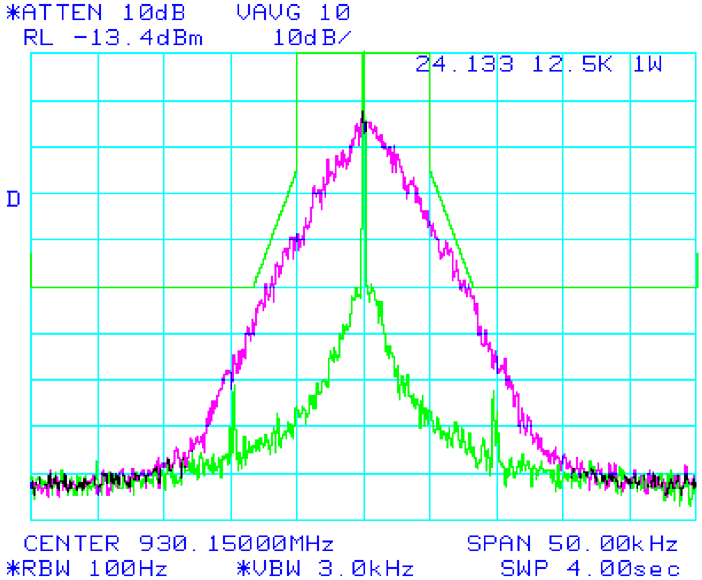
Mask: 24.133a2 Spectrum for Emission: 8K50 F1D
Output Power = 10 Watt Data Rate: 24 kbps Peak Deviation with Data: 3.725 kHz

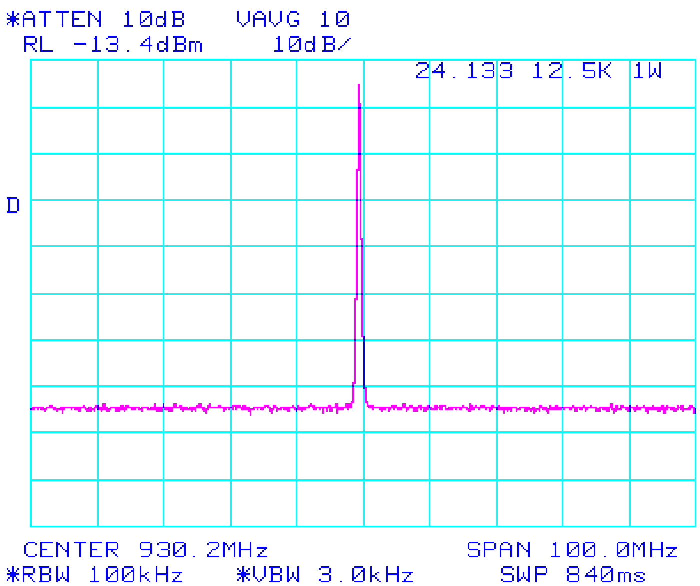




Mask: 24.133a2 Spectrum for Emission: 8K08 F1D

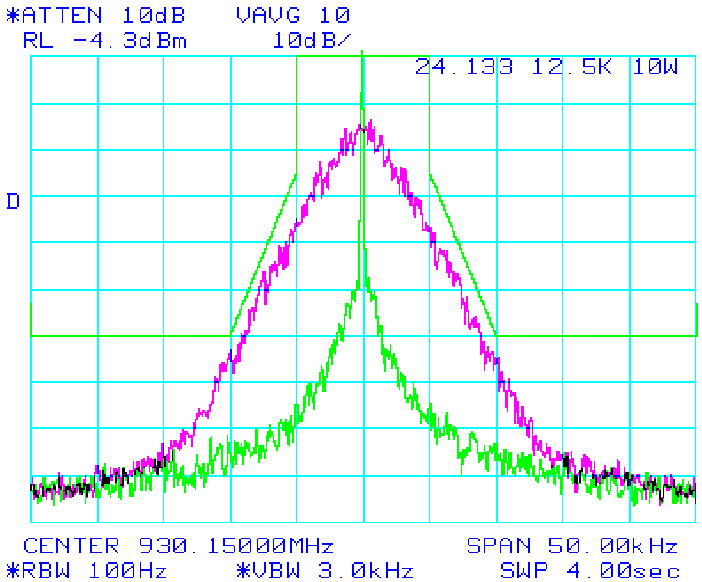
Output Power = 1 Watt Data Rate: 32 kbps Peak Deviation with Data: 3.728 kHz

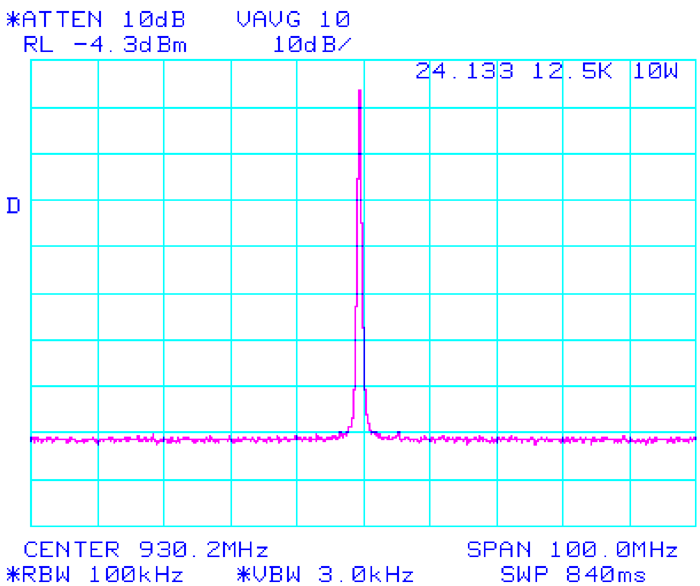




Mask: 24.133a2
Output Power = 10 Watt

Spectrum for Emission: 8K08 F1D
Data Rate: 32 kbps
Peak Deviation with Data: 3.728 kHz





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(g), 2.1049 (c) (1), 101.111 (a)(6) 24.133 (a)(1);

MINIMUM STANDARDS:

Mask G
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
116 * $\log_{10}(f_d / 6.1)$ or 50 + 10 log (P) 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, 43 + $10\log_{10}(P)$ [Greater than 50 kHz for IC Mask G]

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]

Mask 101.111(a)(6)
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 83 * $\log_{10}(f_d / 5)$ dB
Greater than 10.0 kHz to 250% auth BW, down 116log(fd/6.1) or 50+10log(P) or 70 dB.
Greater then 250% auth BW, 43+$10\log_{10}(P)$ or 80 dB.

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 > 62.5 kHz @ 10W or 43 dB @ 1W

Mask 24.133(a)(1) 25 kHz
Sidebands and Spurious [P = 10 Watts and P=1 Watt]
Authorized Bandwidth = 20 kHz
From Fo to 10 kHz, down 0 dB.
From 10 kHz to 50 kHz, down 116 * $\log_{10}(f_d +10 / 6.1)$ dB, 50+10log(P) or 70 dB.
Greater than 50 kHz, 43+$10\log_{10}(P)$ or 80 dB.

Attenuation = 0 db at Fo to 10 kHz
Attenuation = 25 dB at 10 kHz
Attenuation = 60 dB at 20 kHz @ 10W
Attenuation = 50 dB at 16.45 kHz @ 1W
Attenuation = 53 dB at 50 kHz @ 10W
Attenuation = 43 dB at 50 kHz @ 1W

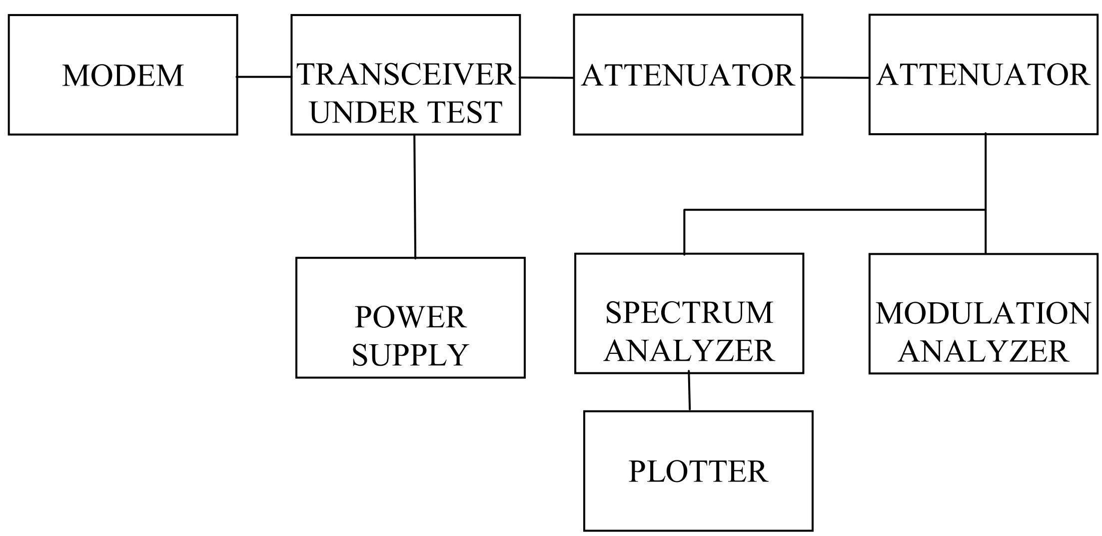
TEST RESULTS: Meets minimum standards (see data on following page)

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 HP8901A

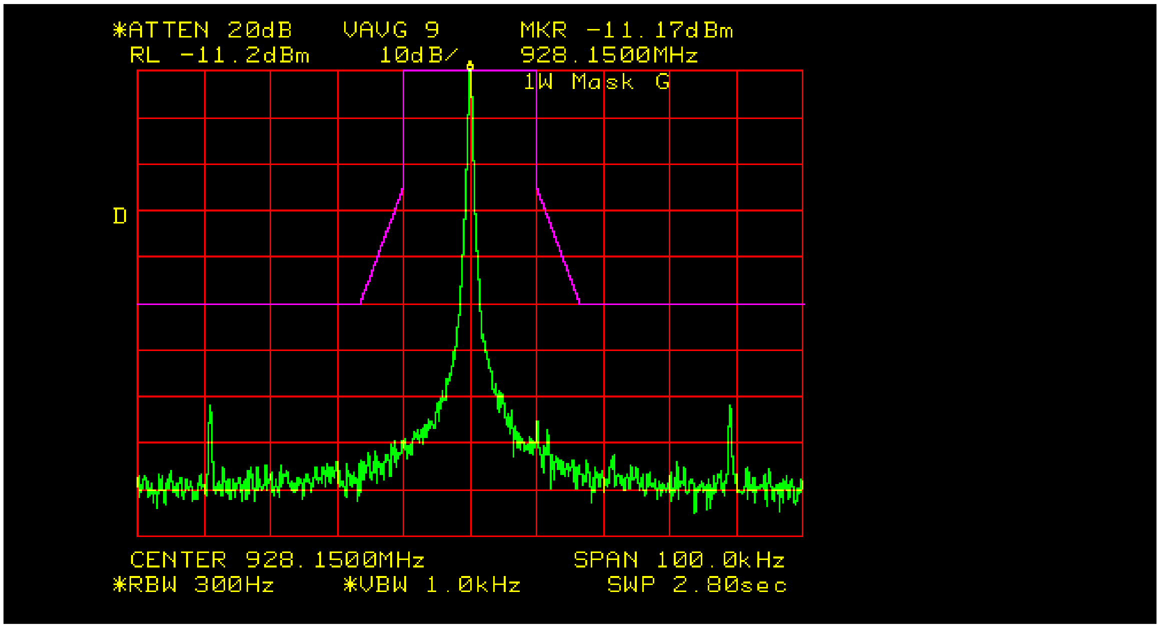
TEST SET-UP:



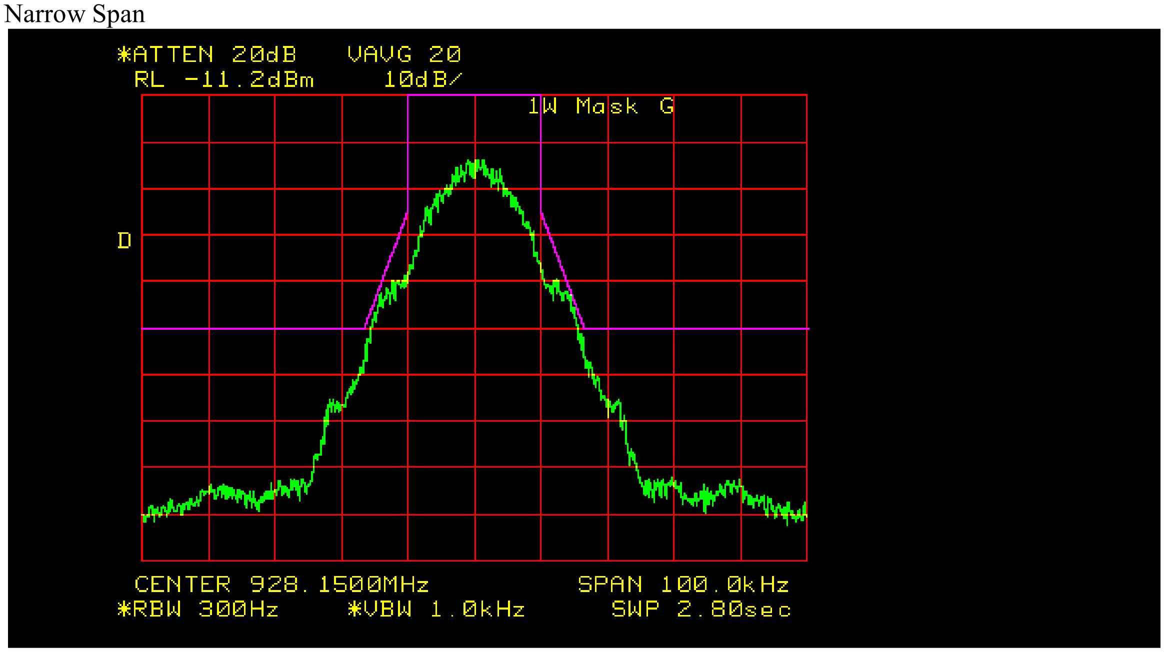
Mask: G
Output Power = 1 Watt

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

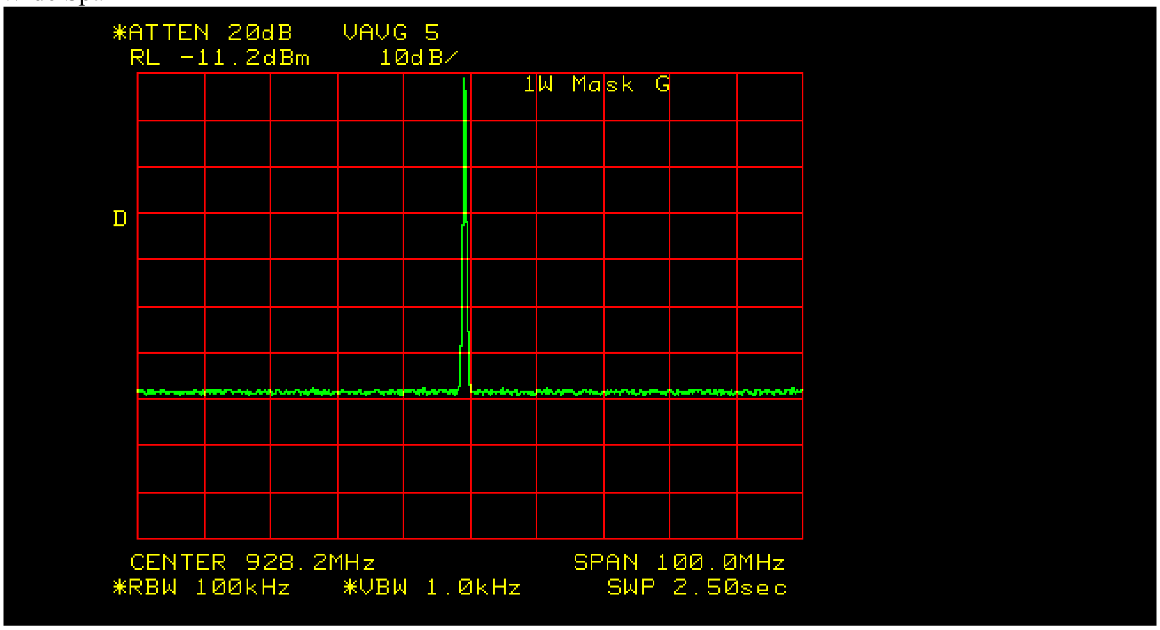
Unmodulated Carrier



Narrow Span

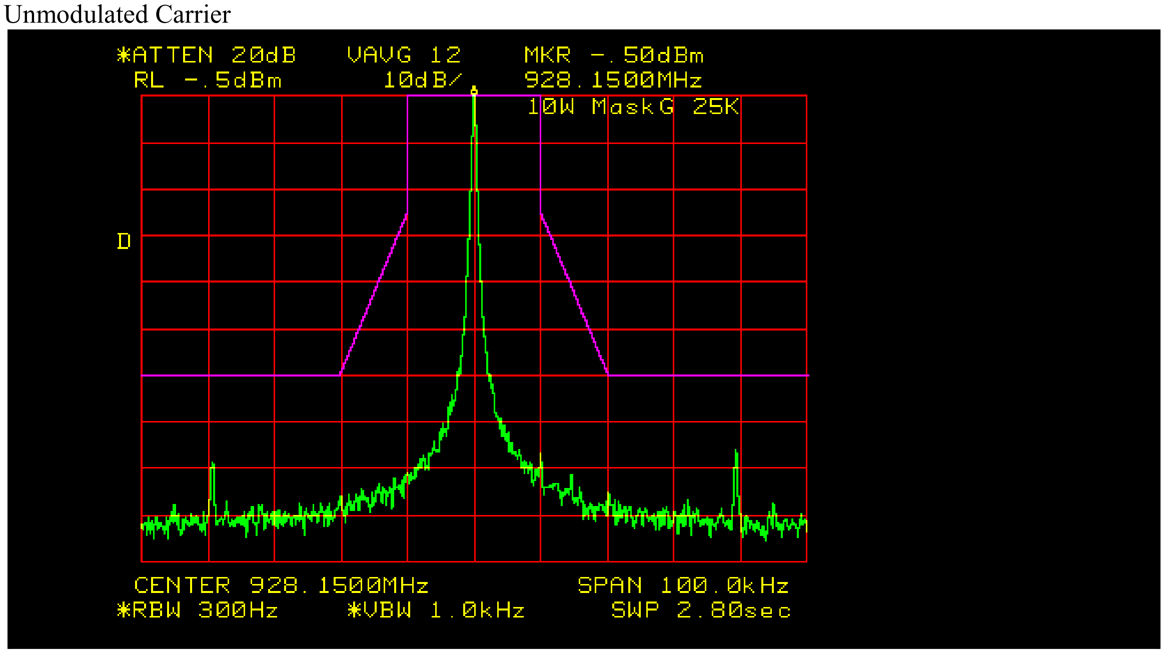


Wide Span

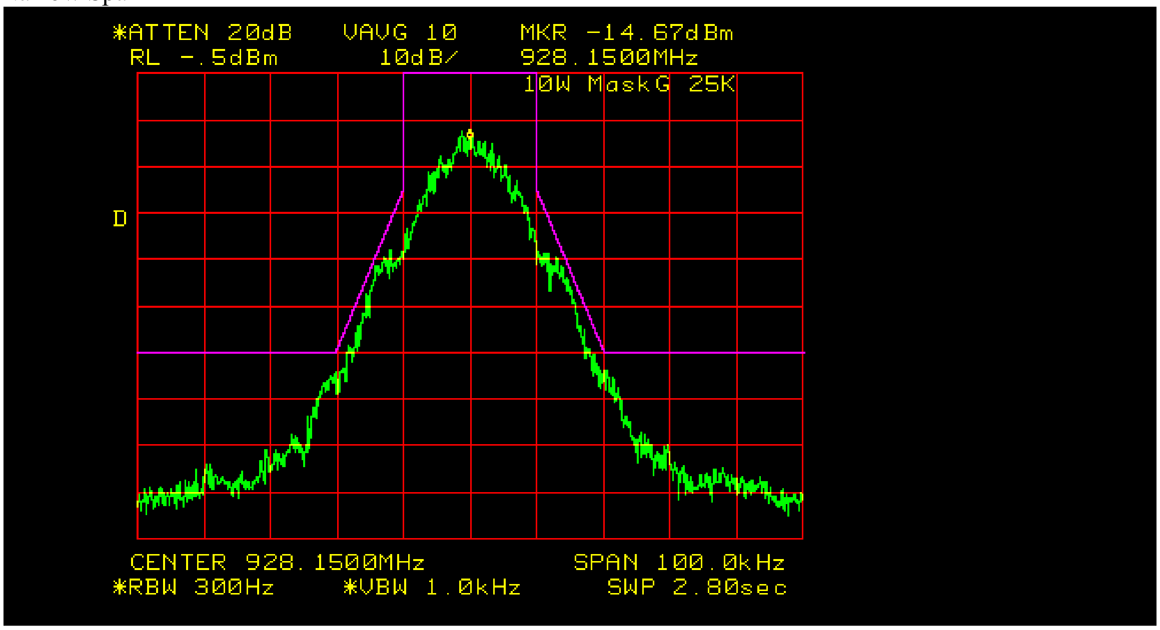


Output Power = 10 Watt

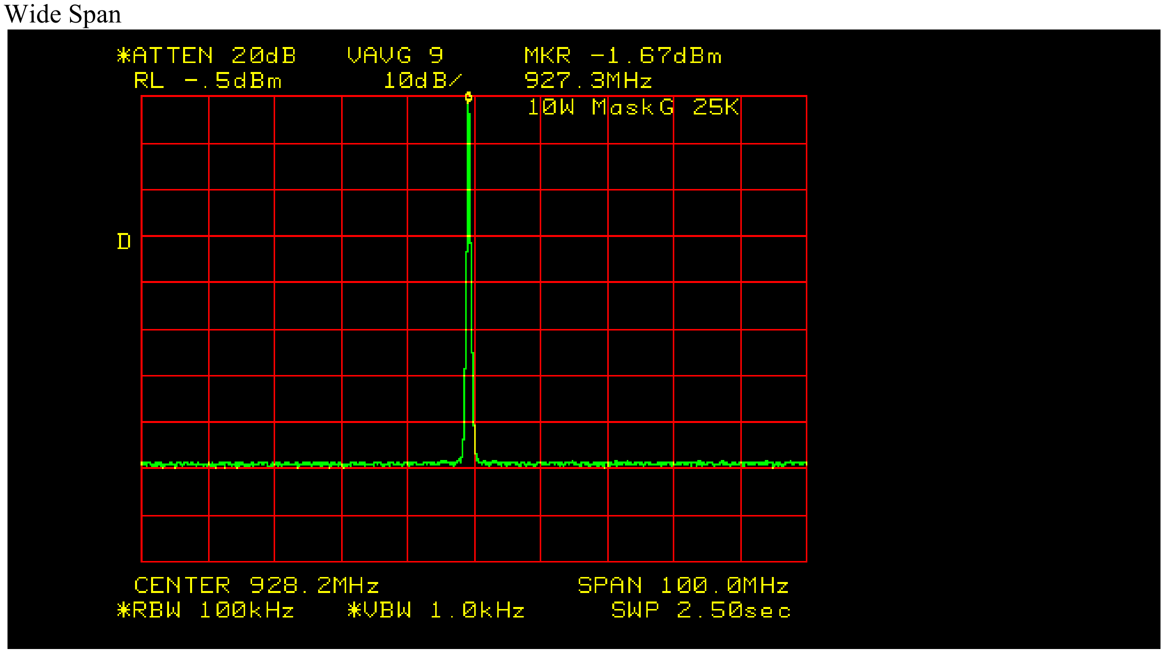
Unmodulated Carrier



Narrow Span



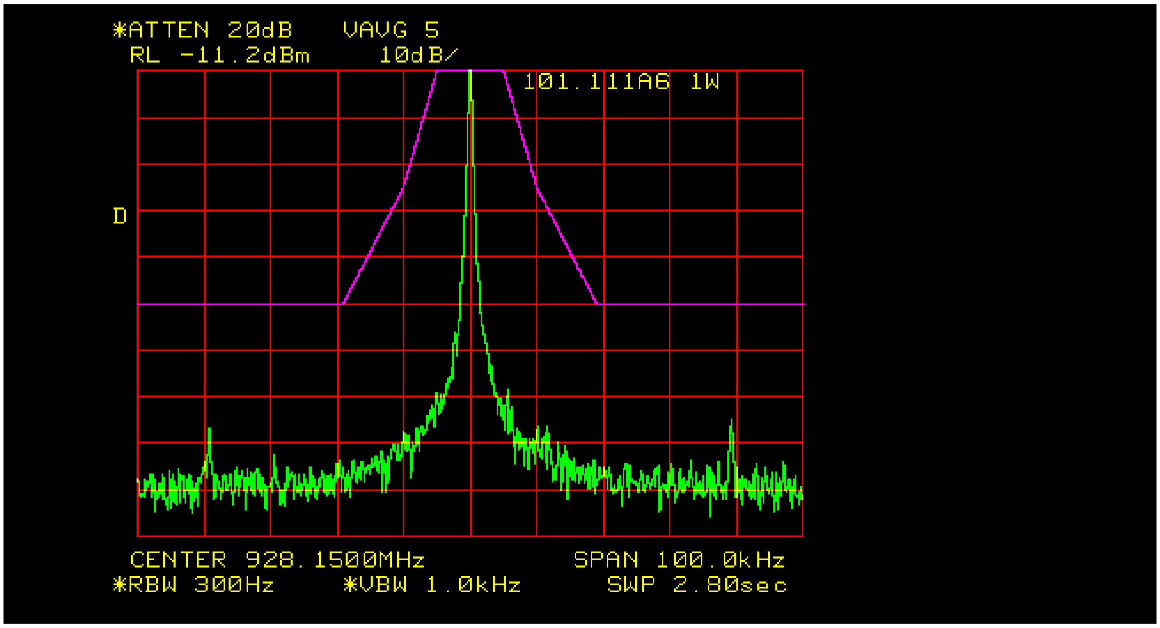
Wide Span



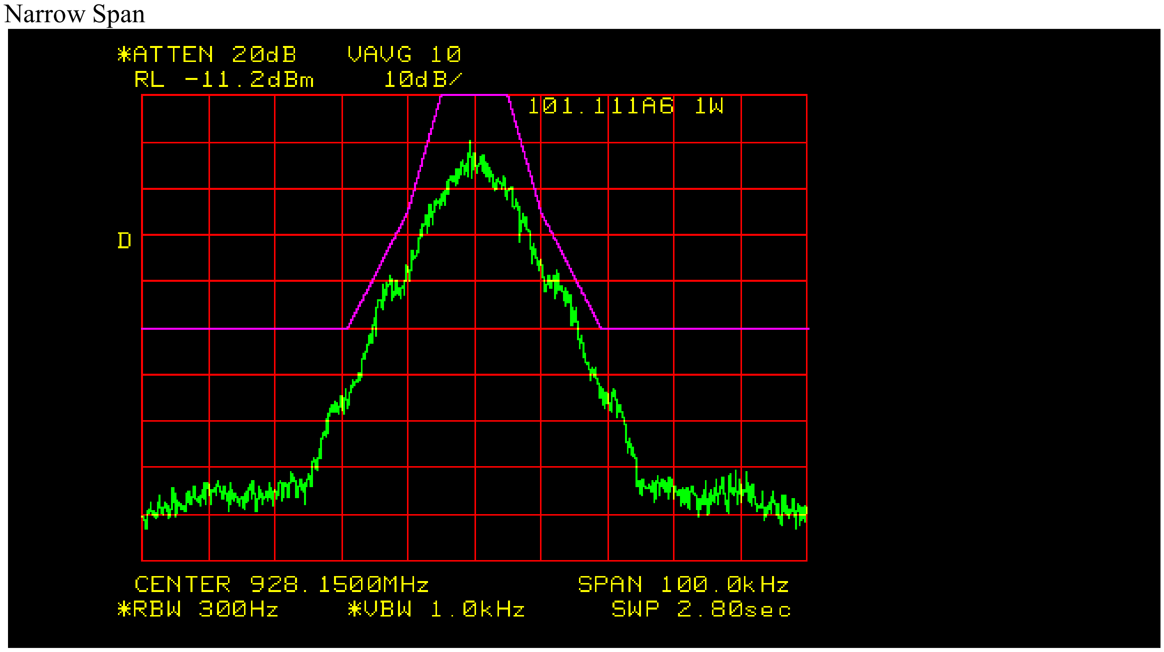
Mask: 101.11a6
Output Power = 1 Watt

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

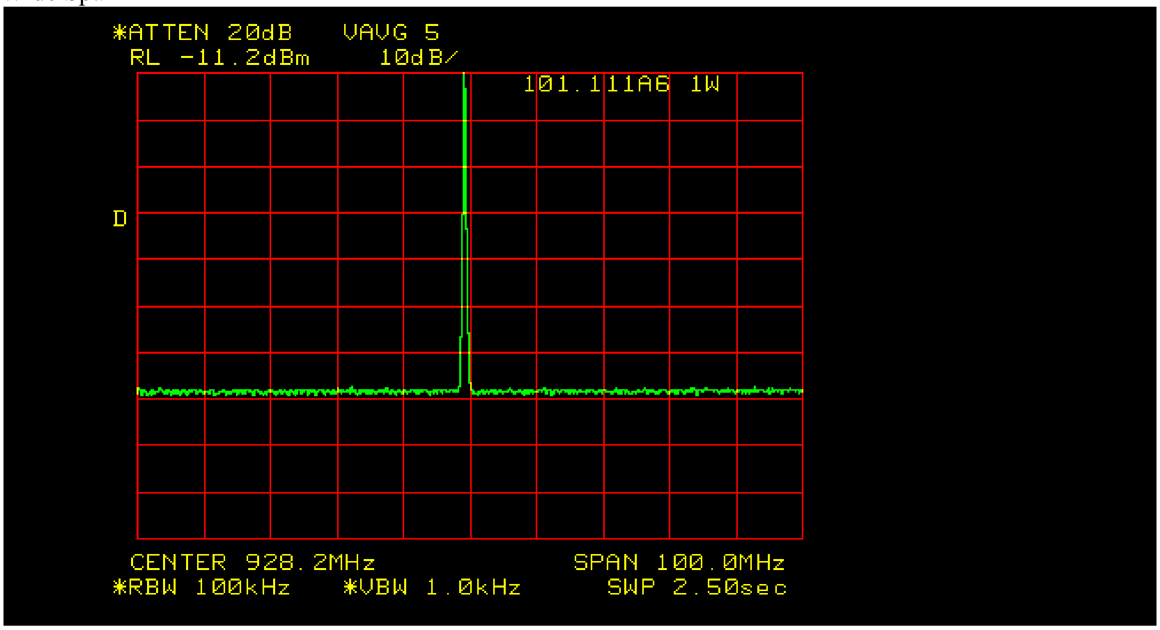
Unmodulated Carrier



Narrow Span

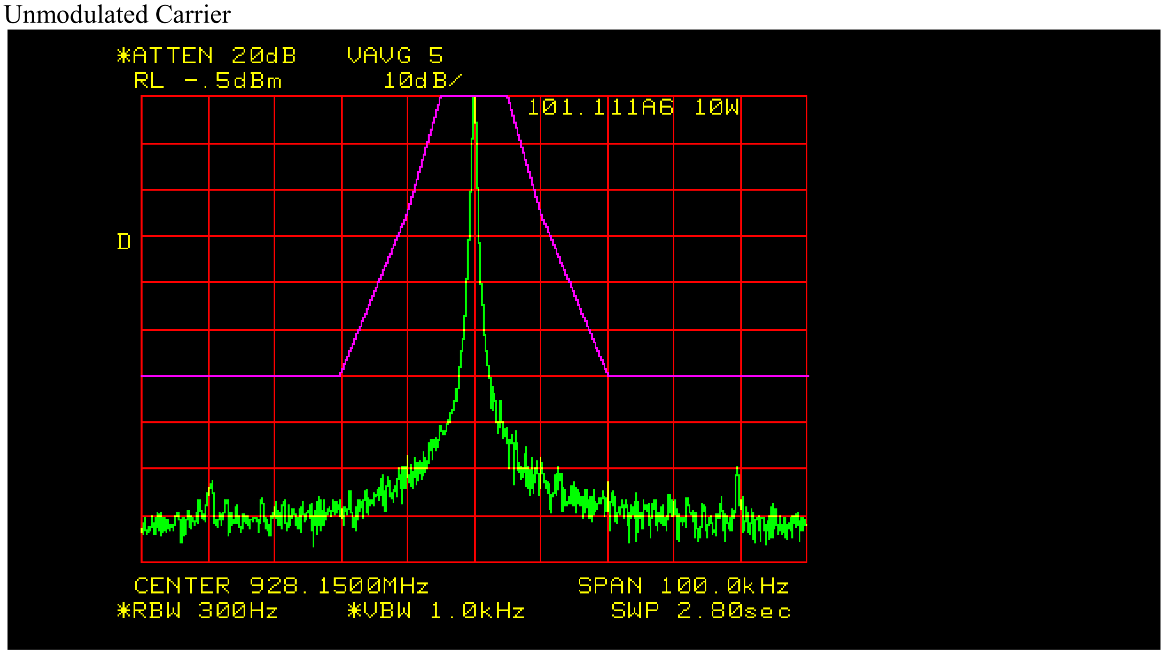


Wide Span

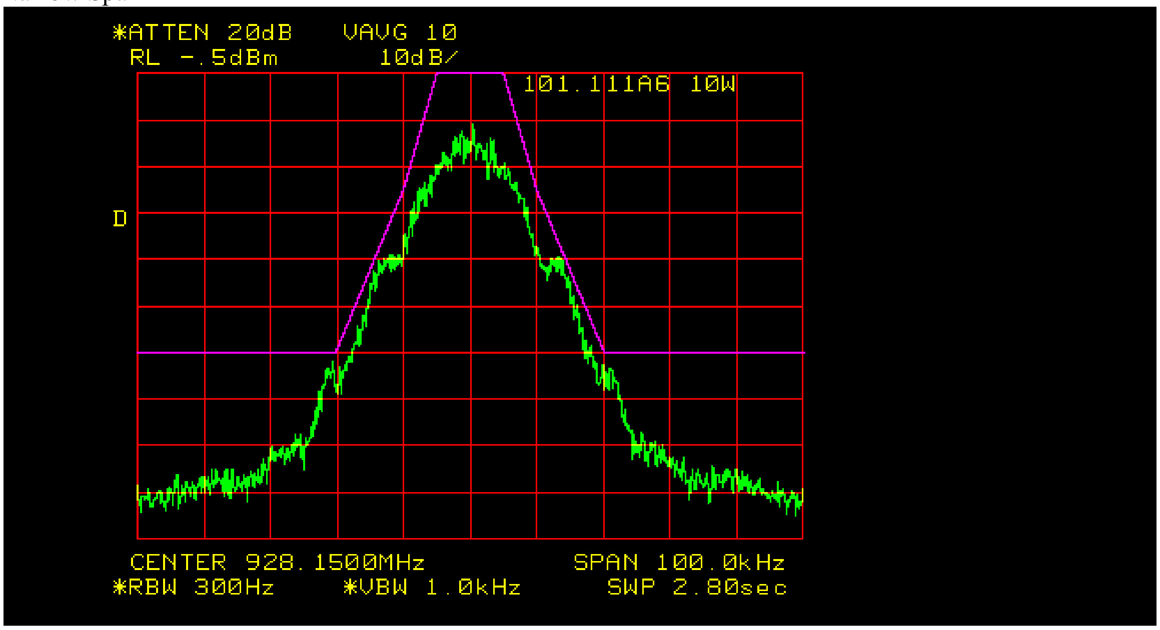


Output Power = 10 Watt

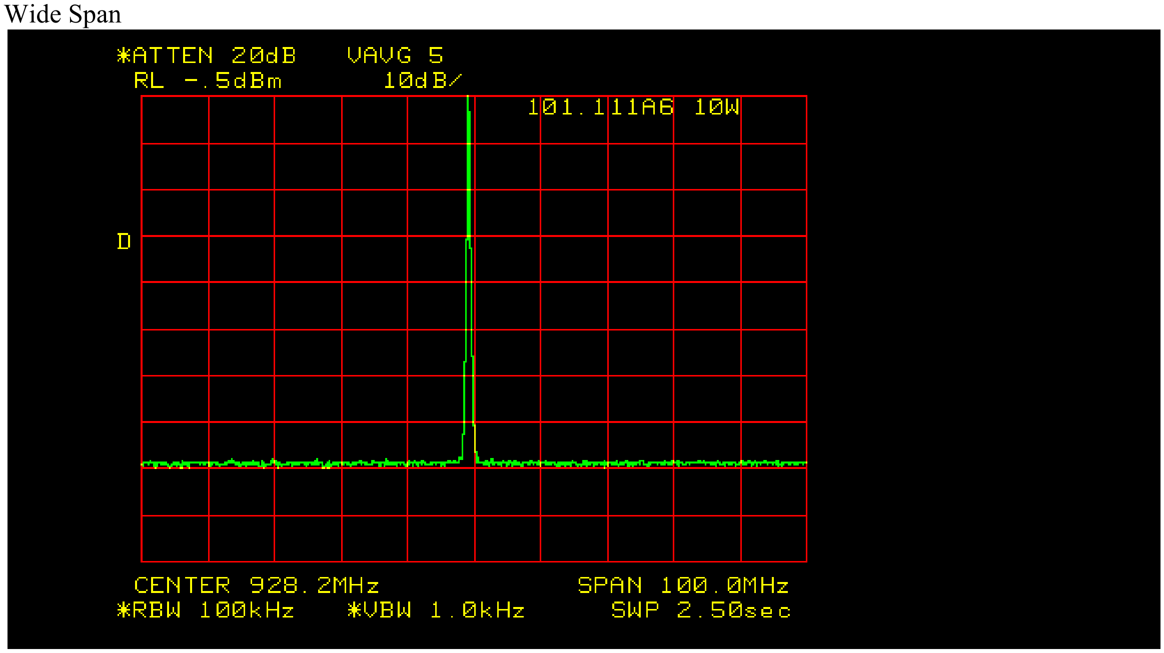
Unmodulated Carrier



Narrow Span



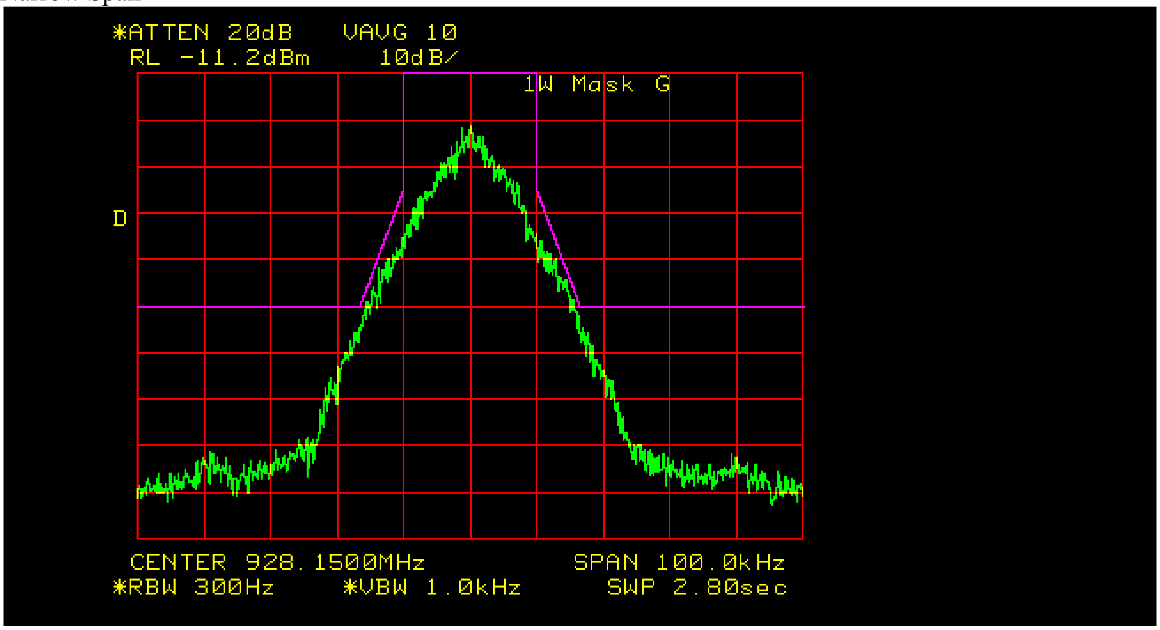
Wide Span



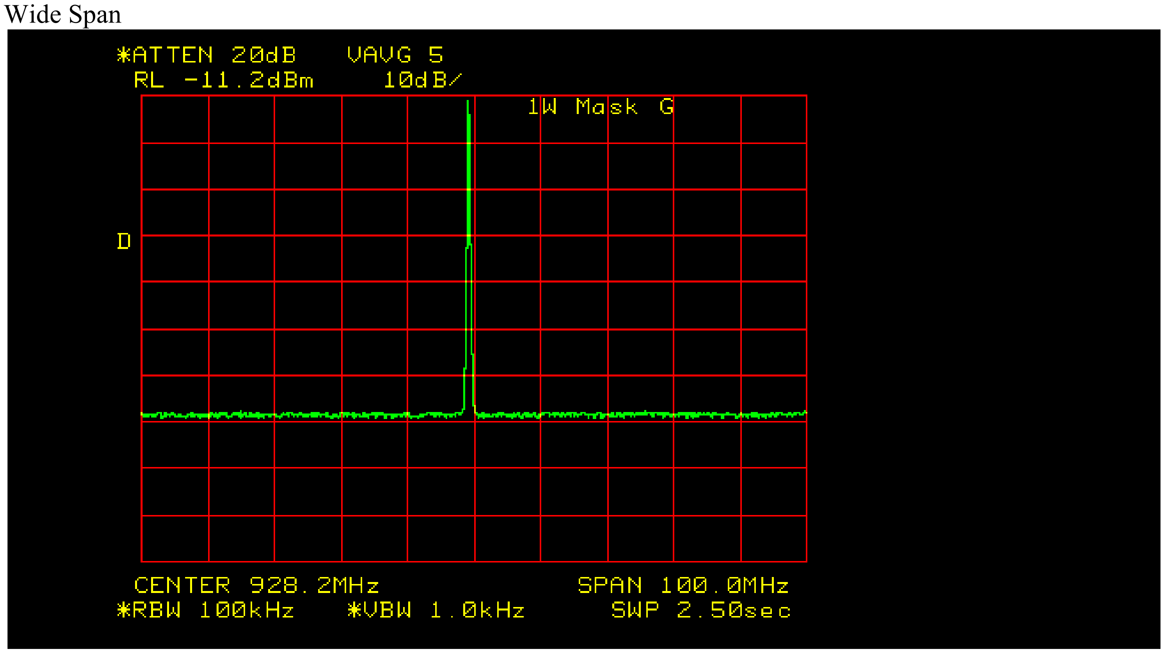
Mask: G
Output Power = 1 Watt

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

Narrow Span

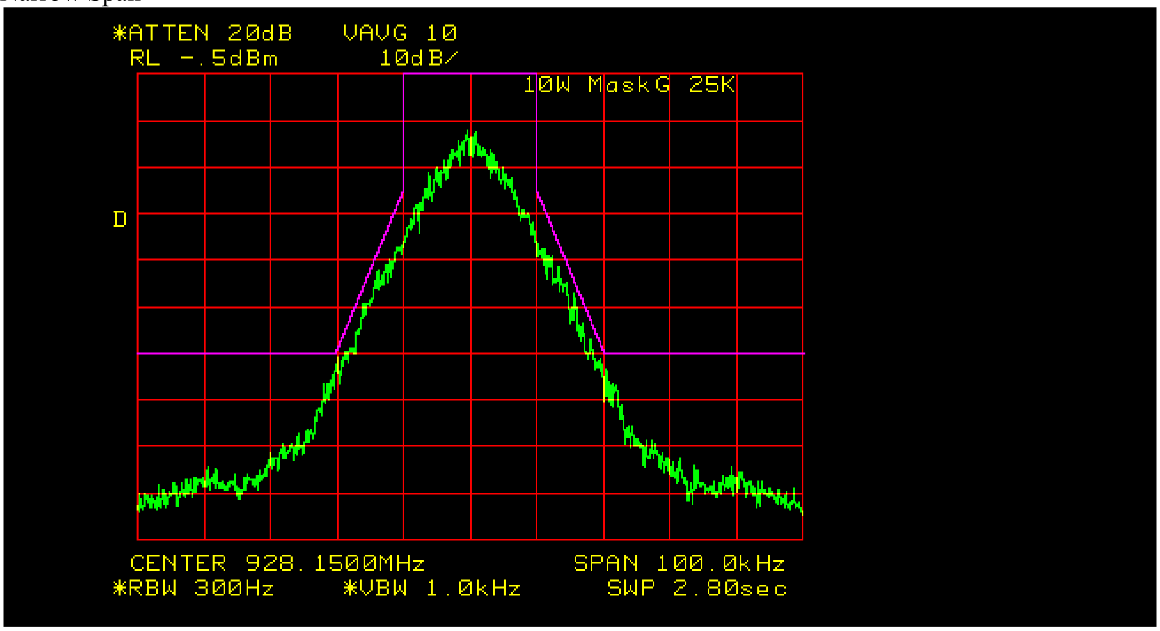


Wide Span

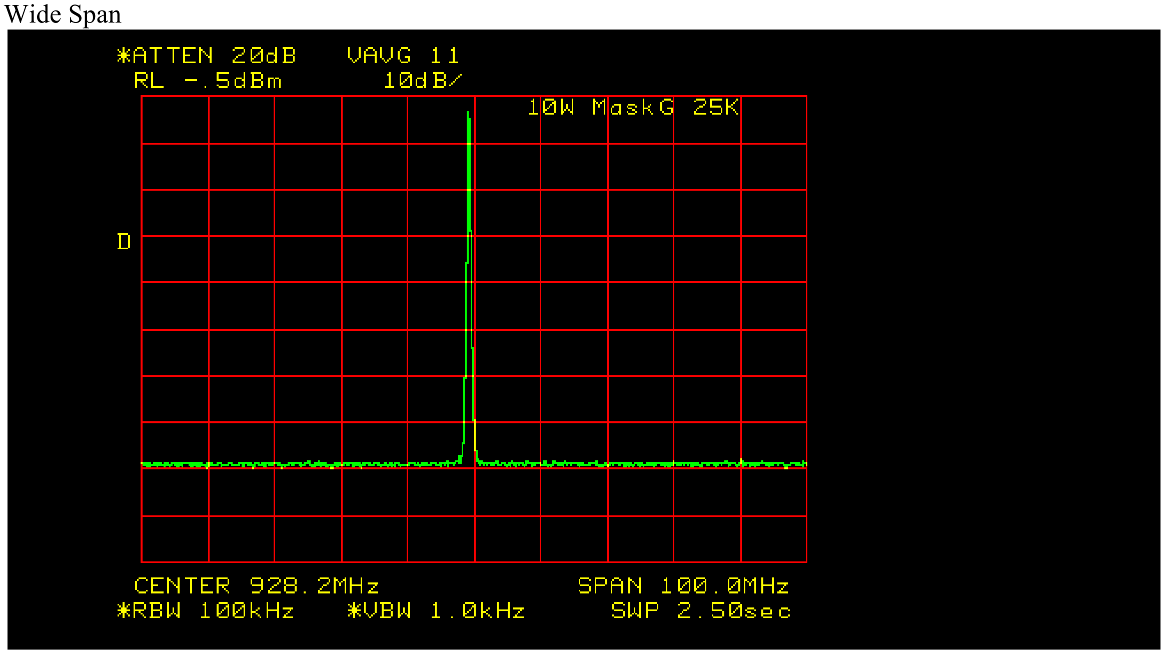


Output Power = 10 Watts

Narrow Span

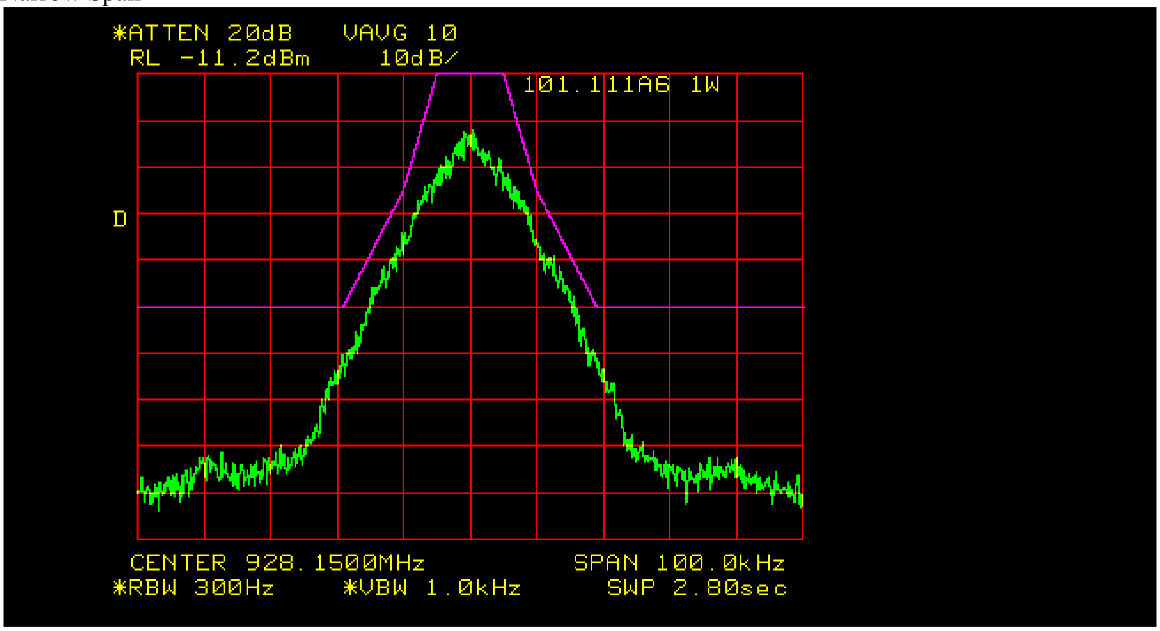


Wide Span

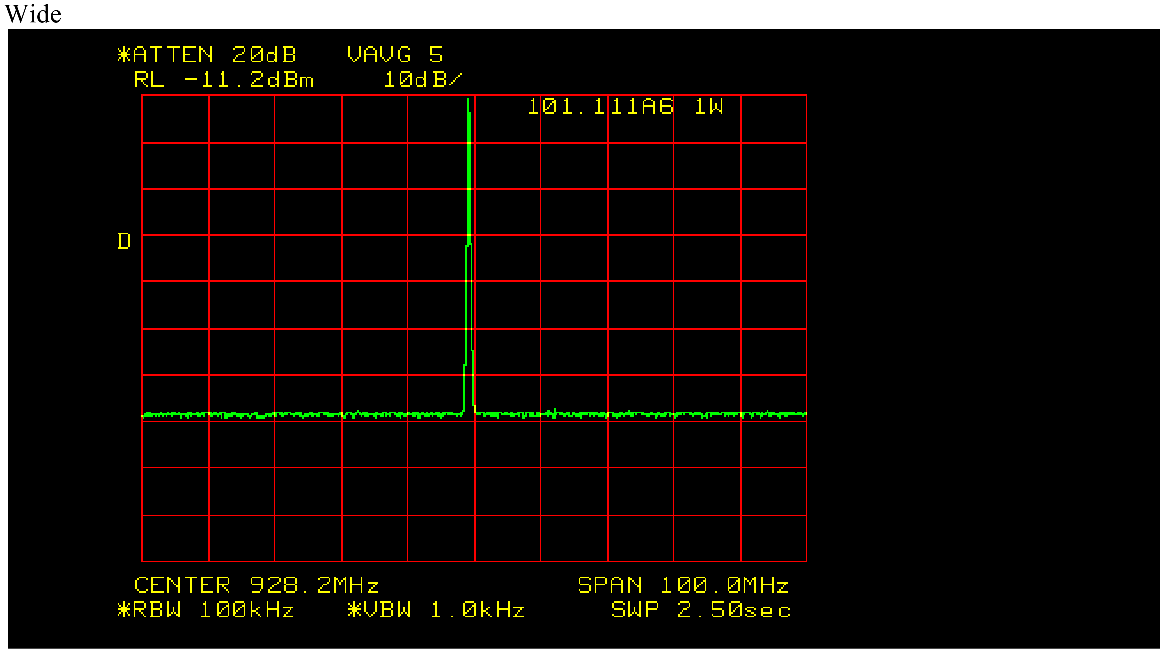


Mask: 101.11a6 | Spectrum for Emission: 16K8 F1D
Output Power = 1 Watt | Data Rate: 32 kbps | Peak Deviation with Data: 7.29 kHz

Narrow Span

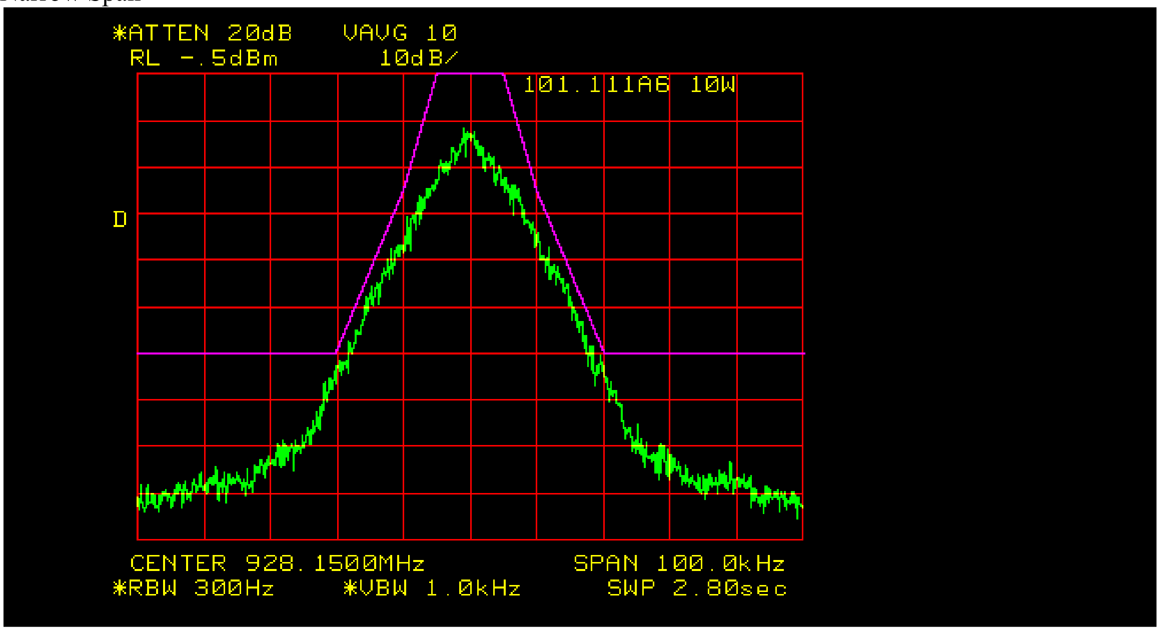


Wide

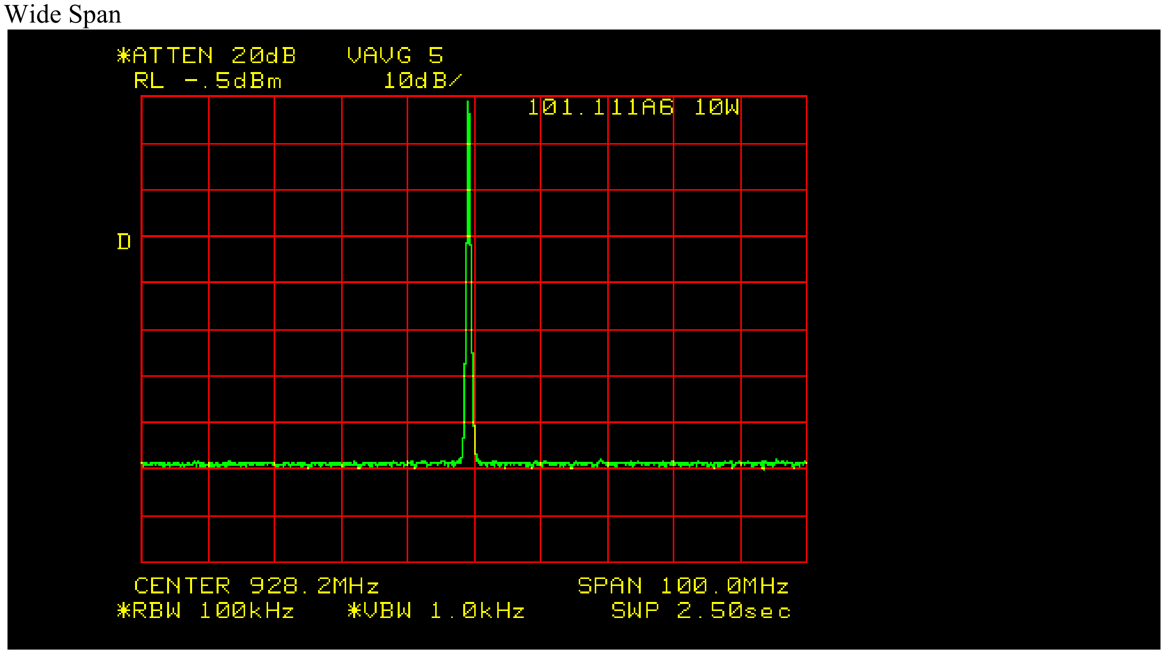


Output Power = 10 Watts

Narrow Span

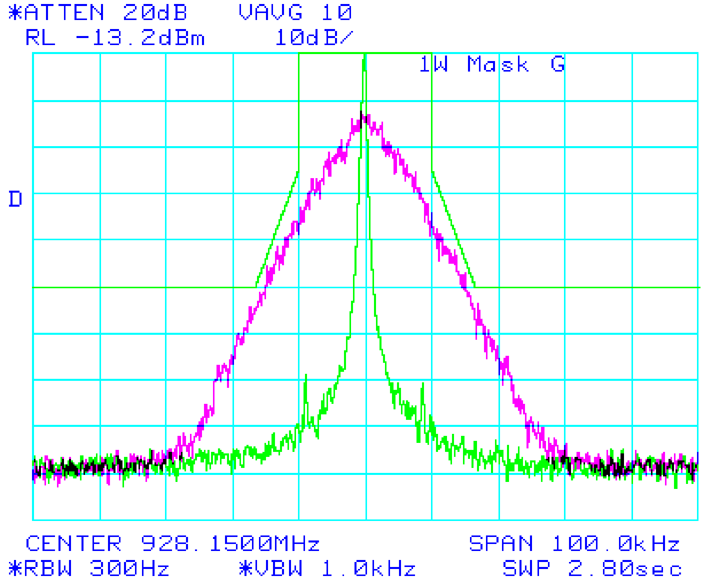


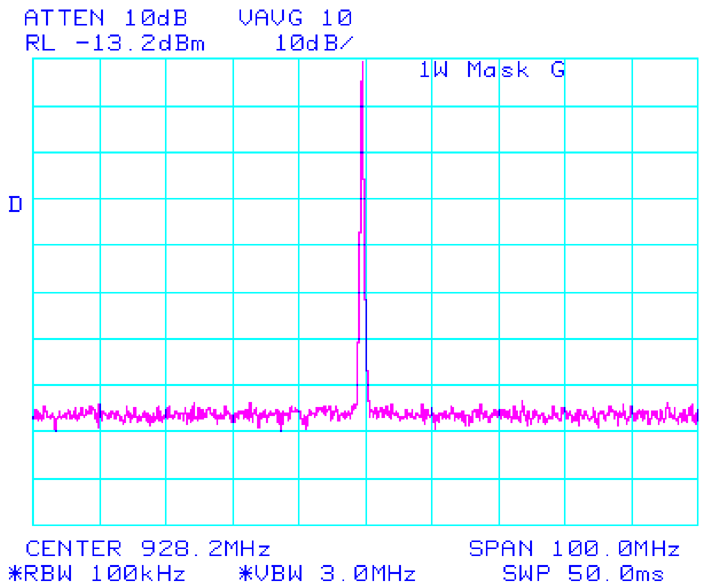
Wide Span



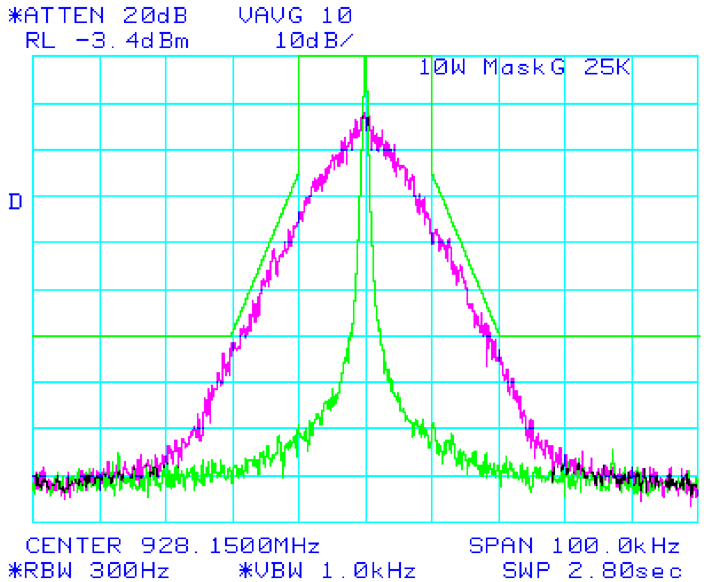
Mask: G
Output Power = 1 Watt

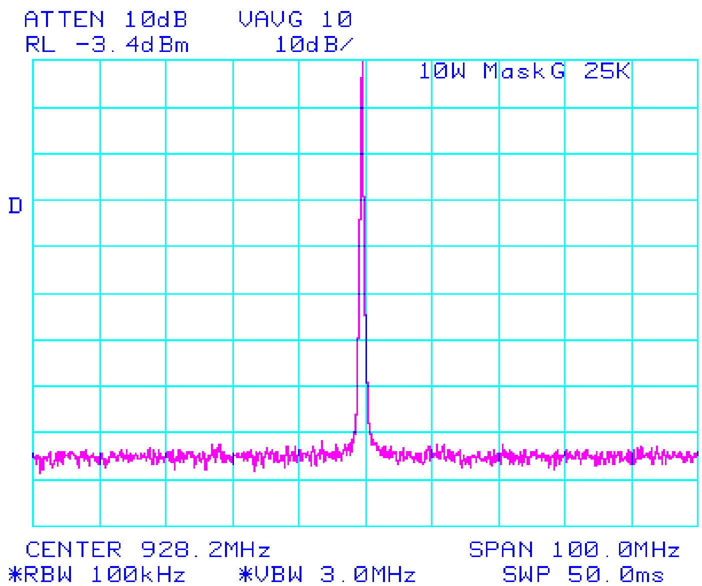
Spectrum for Emission: 17K8 F1D
Data Rate: 48 kbps
Peak Deviation with Data: 7.590 kHz





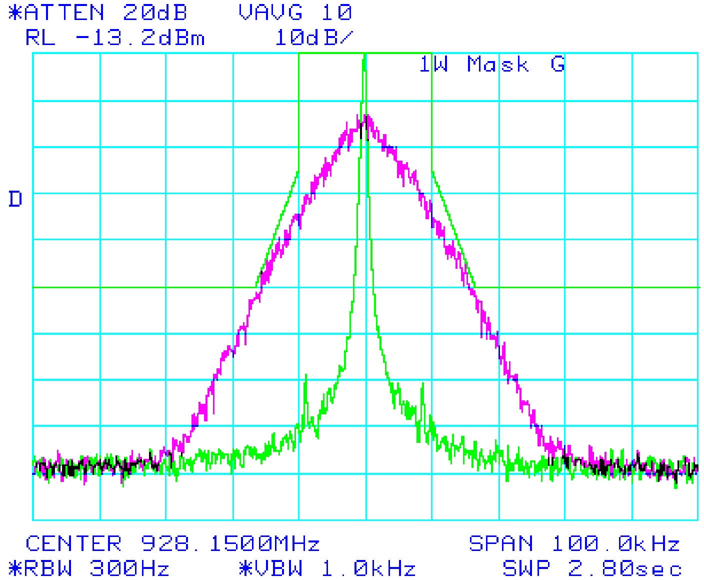
Mask: G | Spectrum for Emission: 17K8 F1D
Output Power = 10 Watts | Data Rate: 48 kbps | Peak Deviation with Data: 7.590 kHz

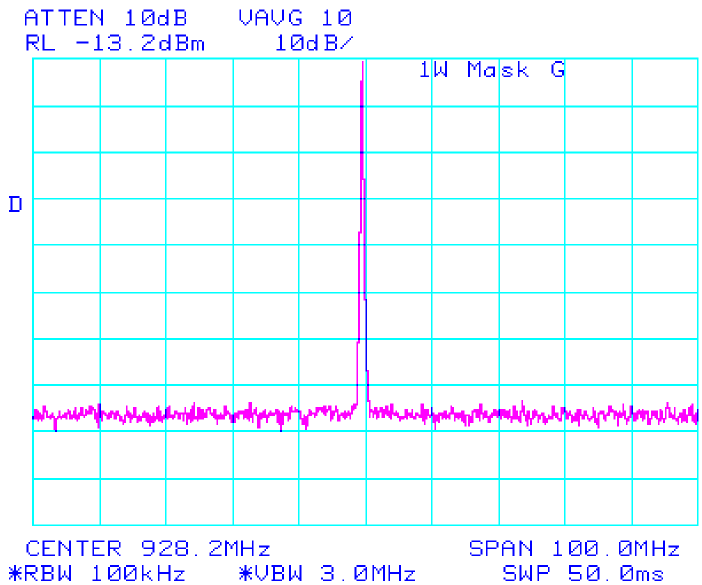




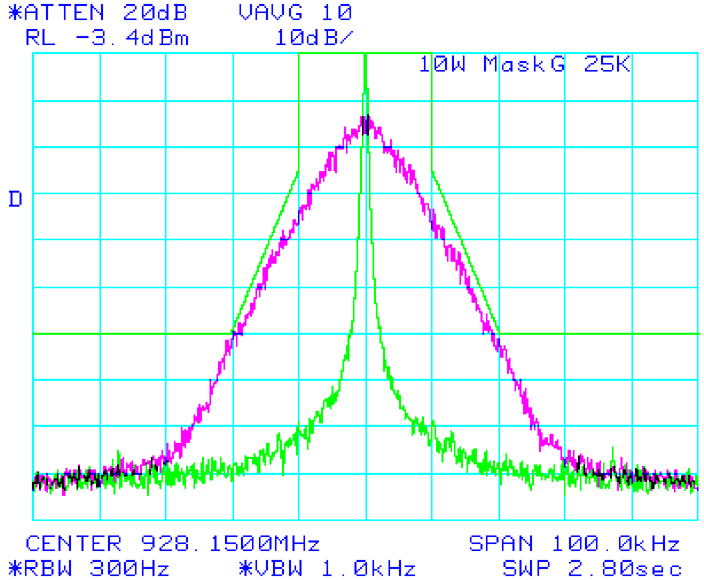
Mask: G
Output Power = 1 Watt

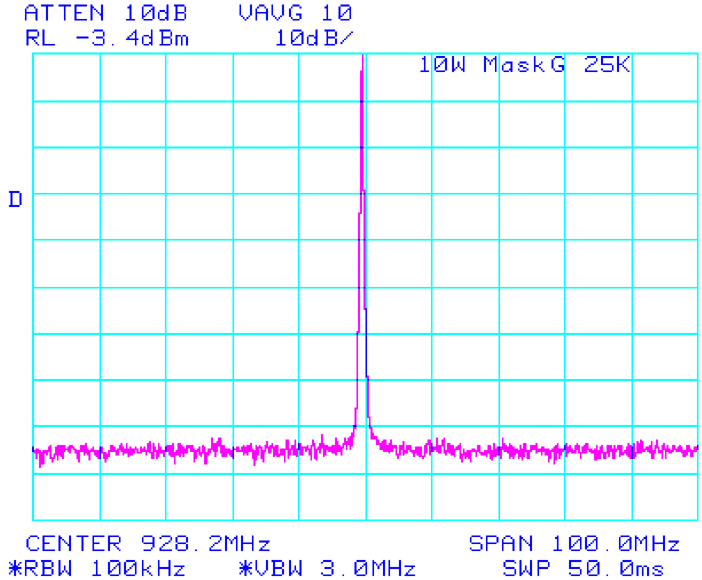
Spectrum for Emission: 17K0 F1D
Data Rate: 64 kbps
Peak Deviation with Data: 7.520 kHz





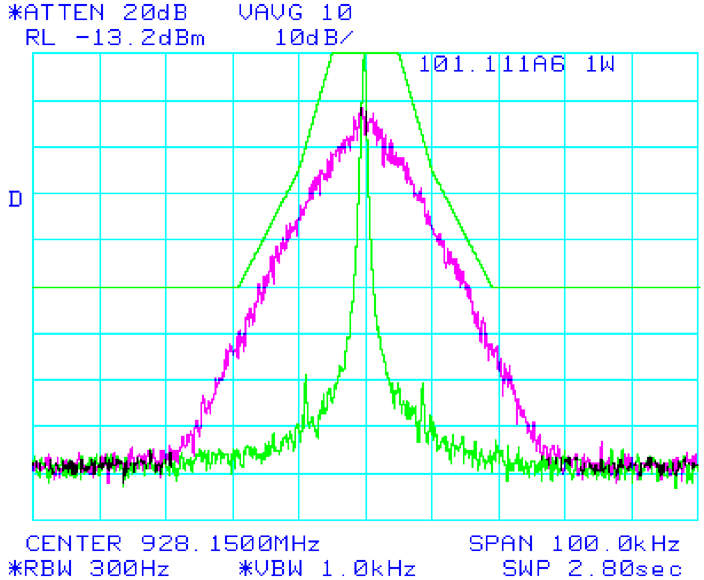
Mask: G | Spectrum for Emission: 17K0 F1D
Output Power = 10 Watts | Data Rate: 64 kbps | Peak Deviation with Data: 7.520 kHz

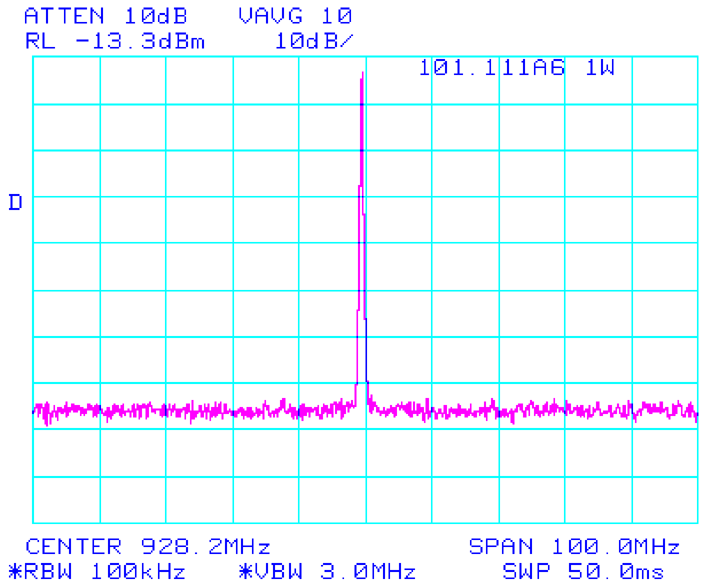




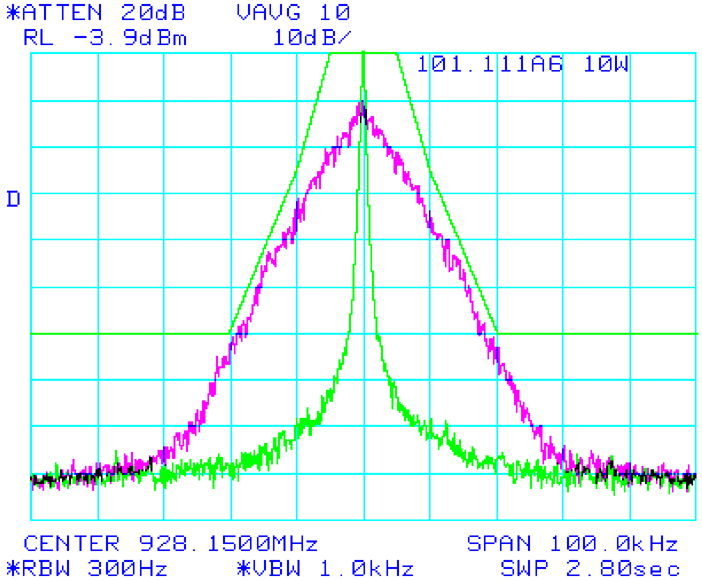
Mask: 101.11a6
Output Power = 1 Watt

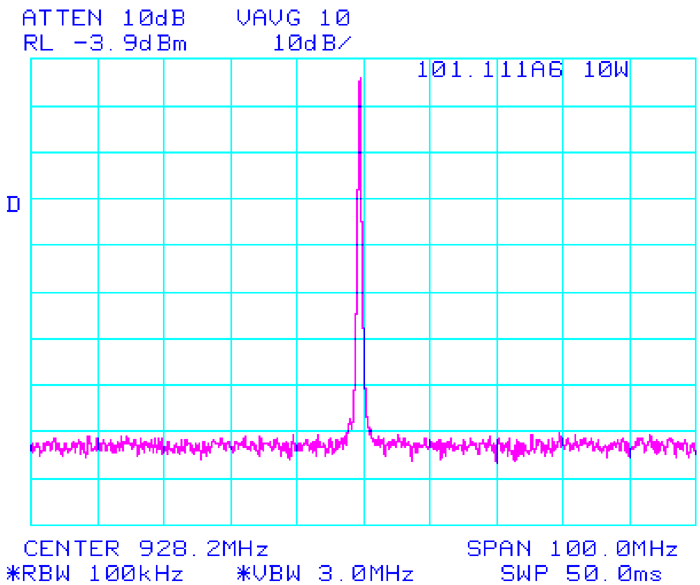
Spectrum for Emission: 17K8 F1D
Data Rate: 48 kbps
Peak Deviation with Data: 7.590 kHz



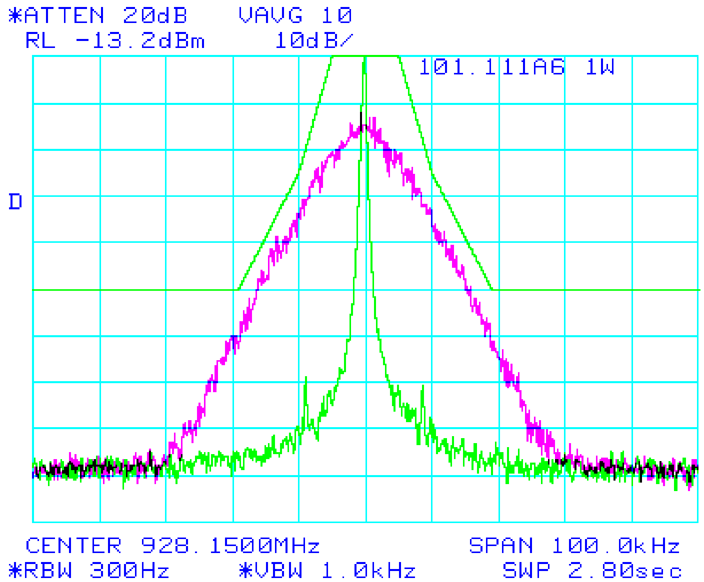


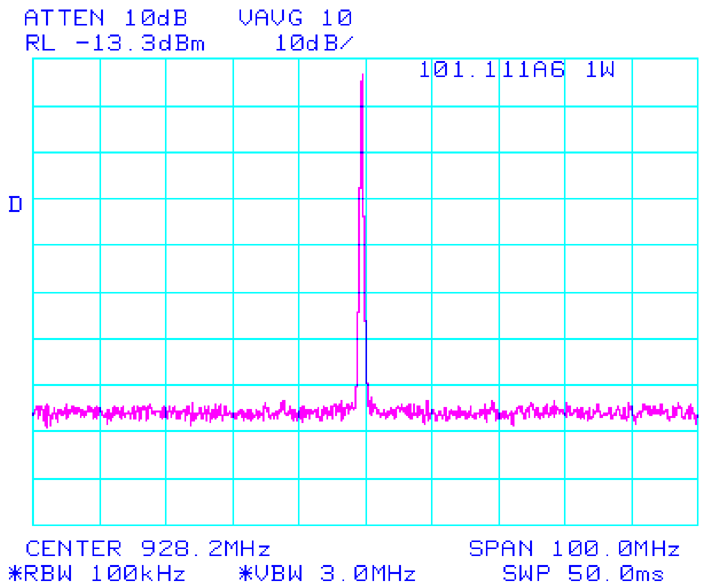
Mask: 101.11a6 Spectrum for Emission: 17K8 F1D
Output Power = 10 Watts Data Rate: 48 kbps Peak Deviation with Data: 7.590 kHz





Mask: 101.11a6 | Spectrum for Emission: 17K0 F1D
Output Power = 1 Watt | Data Rate: 64 kbps | Peak Deviation with Data: 7.520 kHz

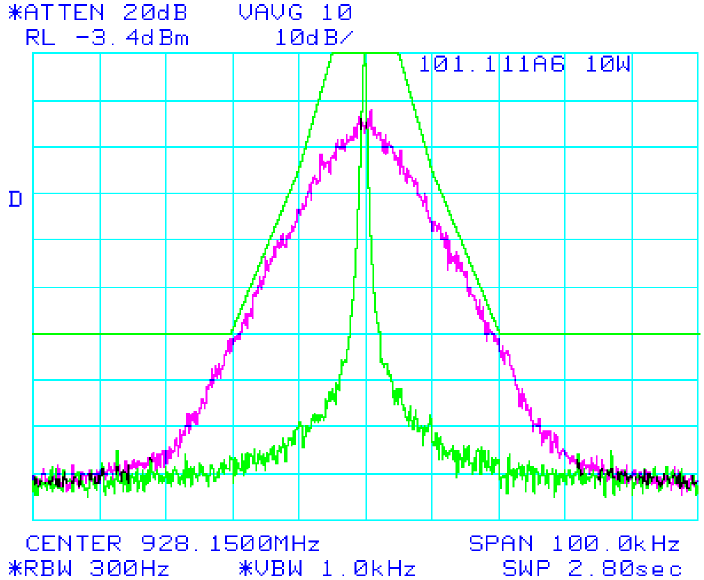


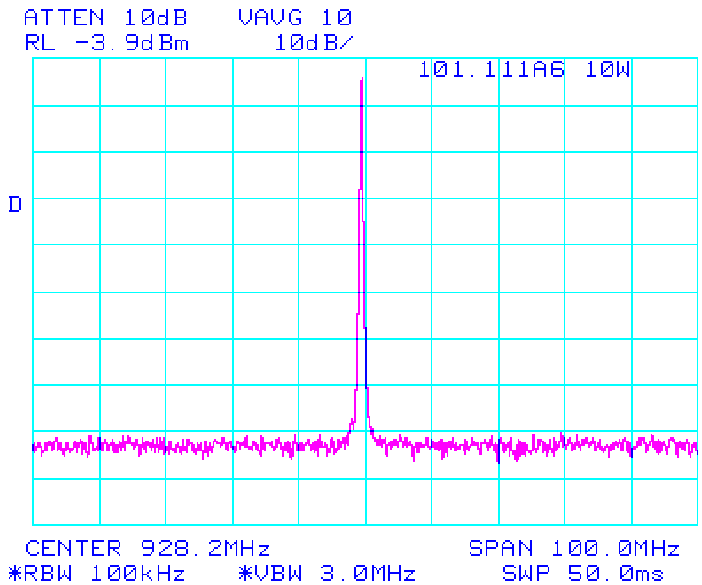


Mask: 101.11a6
Output Power = 10 Watts

Spectrum for Emission: 17K0 F1D
Data Rate: 64 kbps

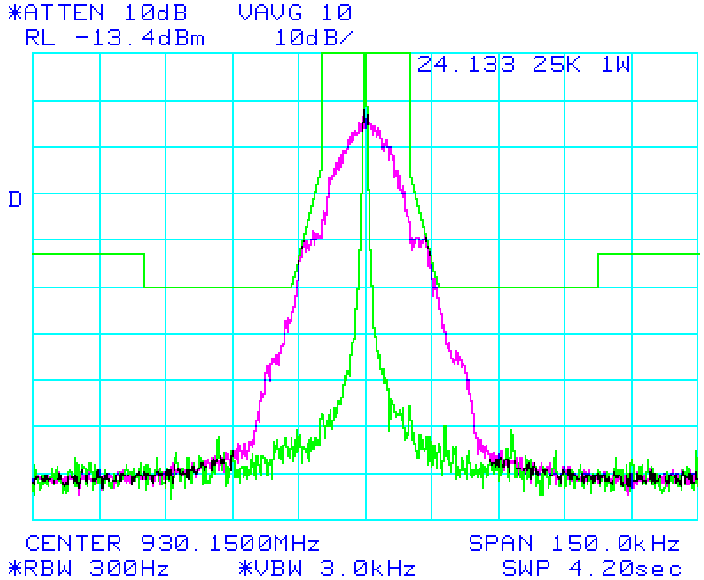
Peak Deviation with Data: 7.520 kHz

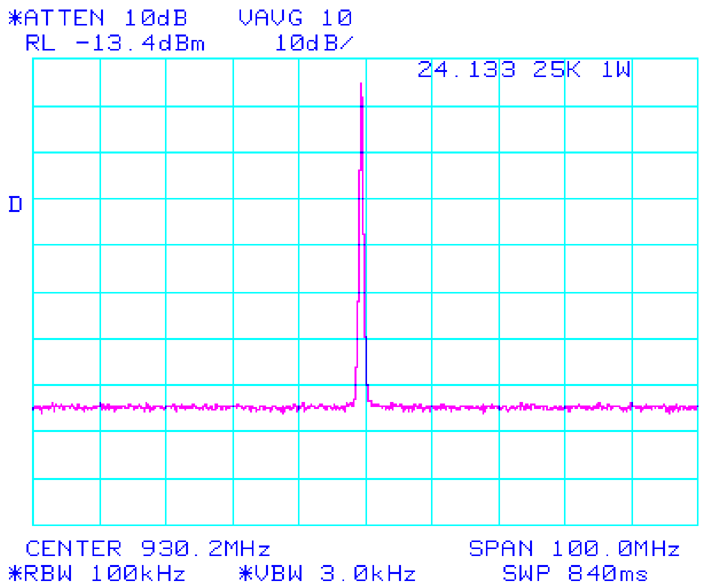




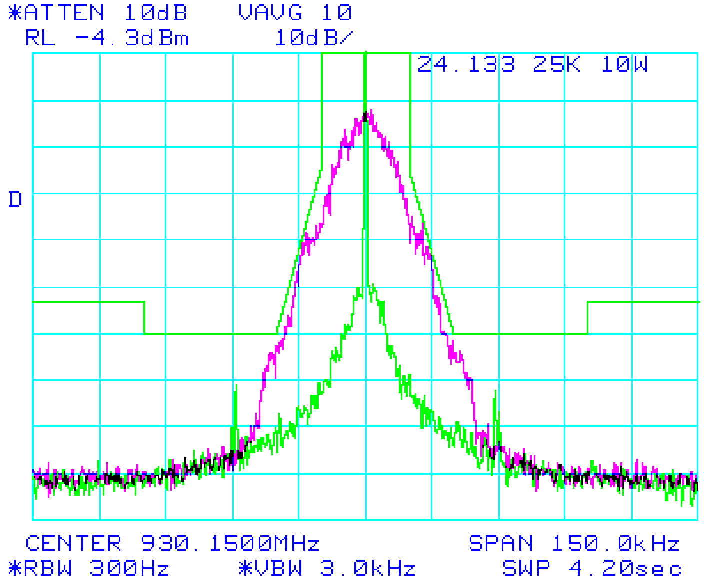
Mask: 24.133a1
Output Power = 1 Watt

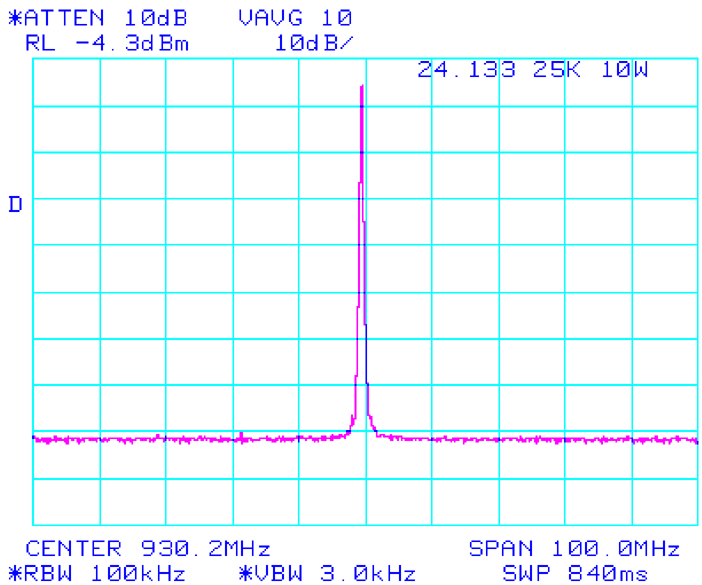
Spectrum for Emission: 16K5 F1D
Data Rate: 16 kbps
Peak Deviation with Data: 6.5 kHz



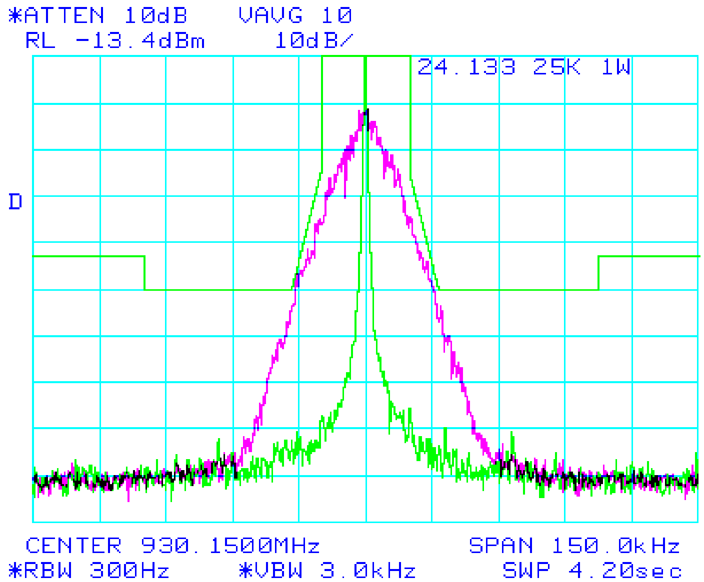


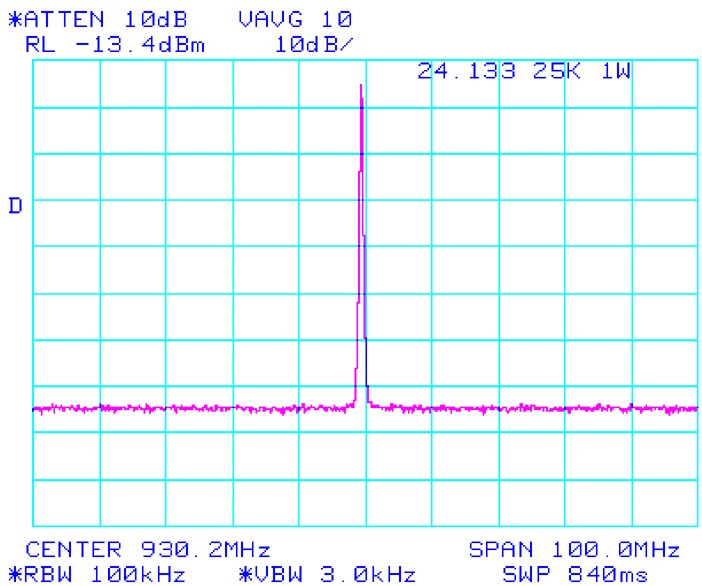
Mask: 24.133a1 | Spectrum for Emission: 16K5 F1D
Output Power = 10 Watts | Data Rate: 16 kbps | Peak Deviation with Data: 6.5 kHz



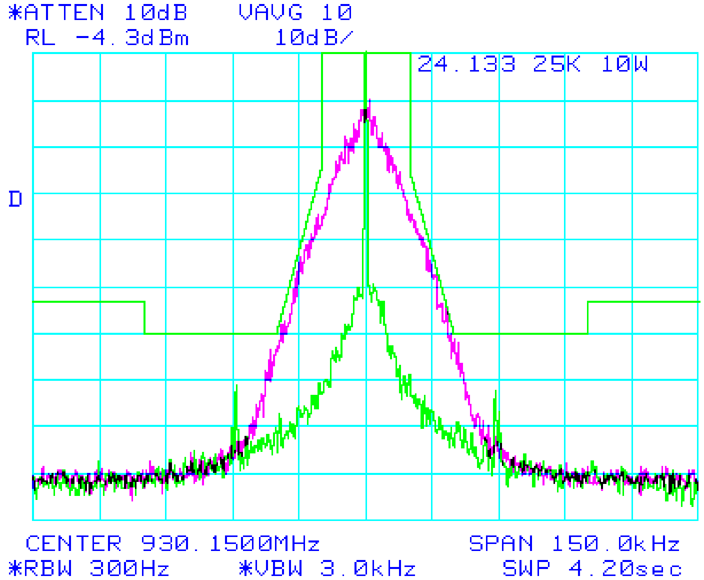


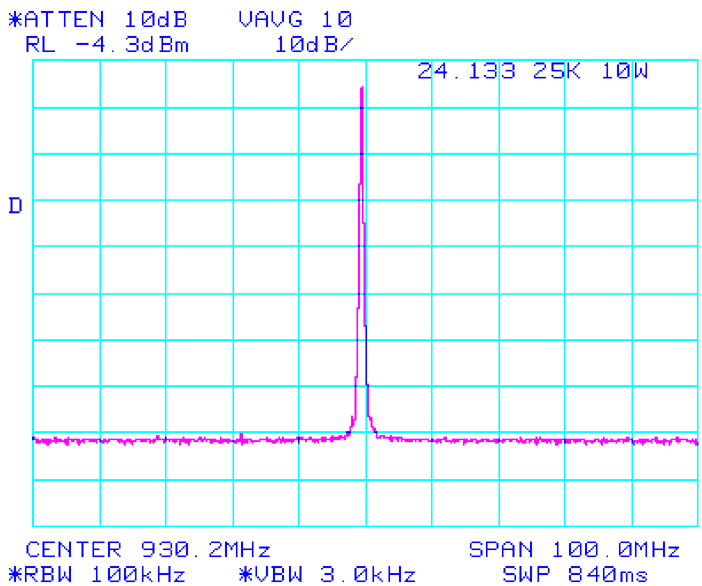
Mask: 24.133a1 | Spectrum for Emission: 16K8 F1D
Output Power = 1 Watt | Data Rate: 32 kbps | Peak Deviation with Data: 7.29 kHz





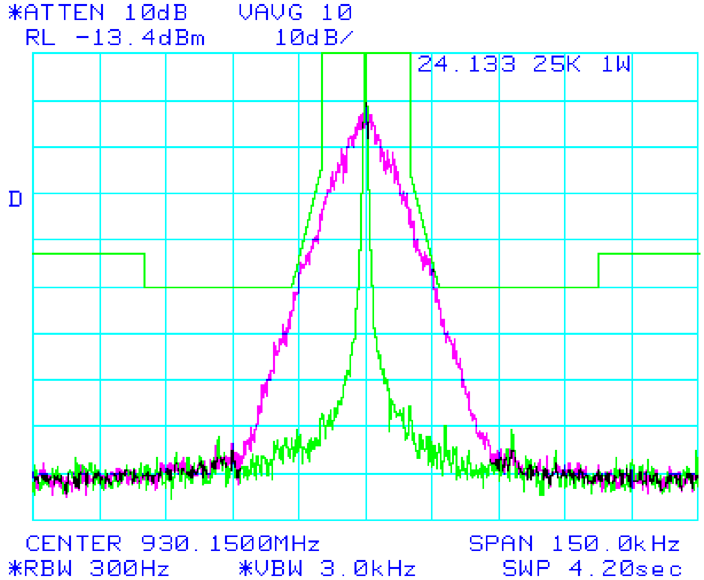
Mask: 24.133a1 Spectrum for Emission: 16K8 F1D
Output Power = 10 Watts Data Rate: 32 kbps Peak Deviation with Data: 7.29 kHz

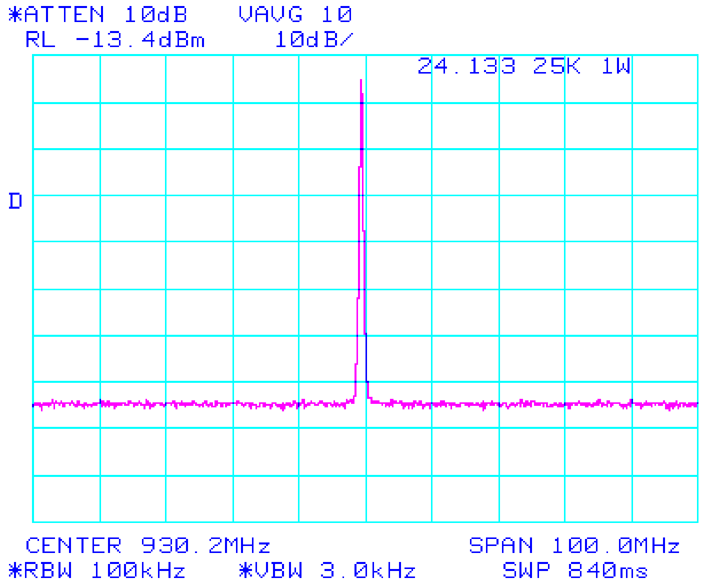




Mask: 24.133a1
Output Power = 1 Watt

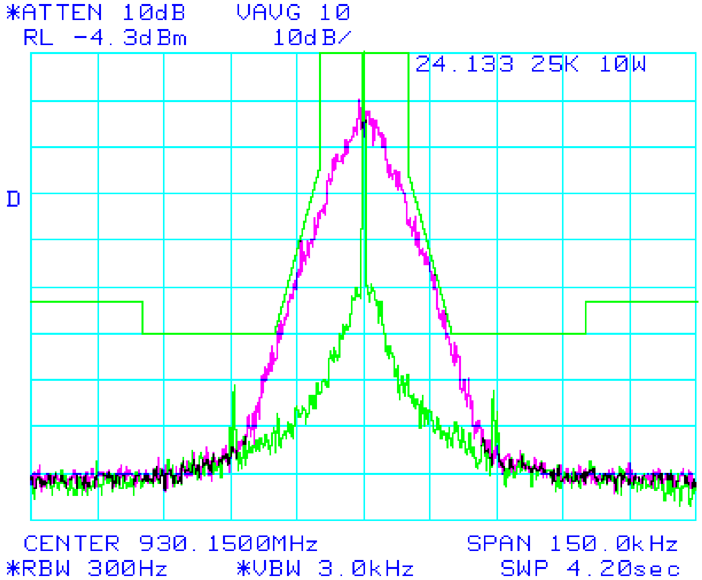
Spectrum for Emission: 17K8 F1D
Data Rate: 48 kbps
Peak Deviation with Data: 7.590 kHz

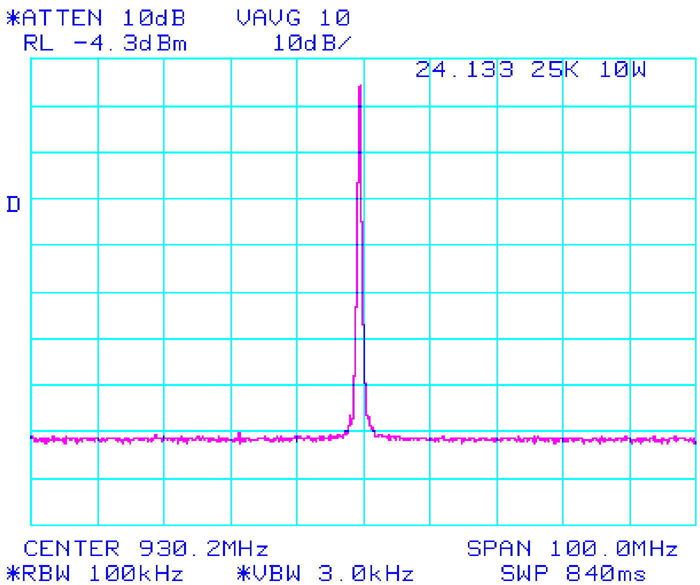




Mask: 24.133a1
Output Power = 10 Watts

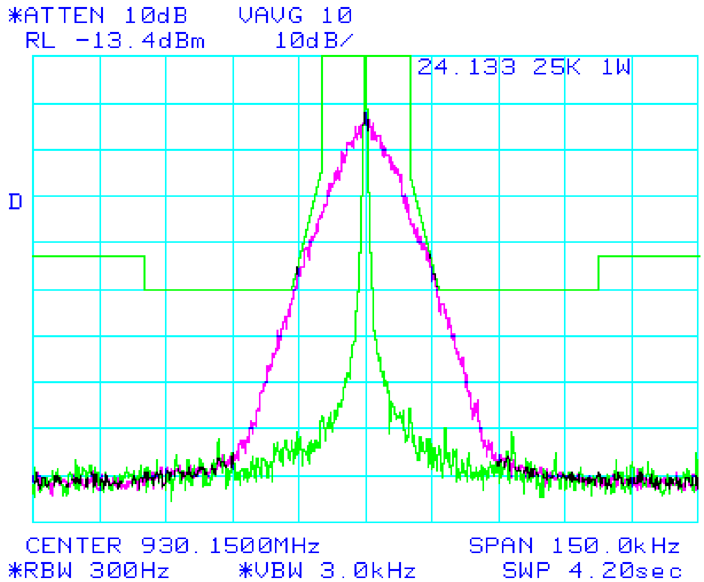
Spectrum for Emission: 17K8 F1D
Data Rate: 48 kbps
Peak Deviation with Data: 7.590 kHz

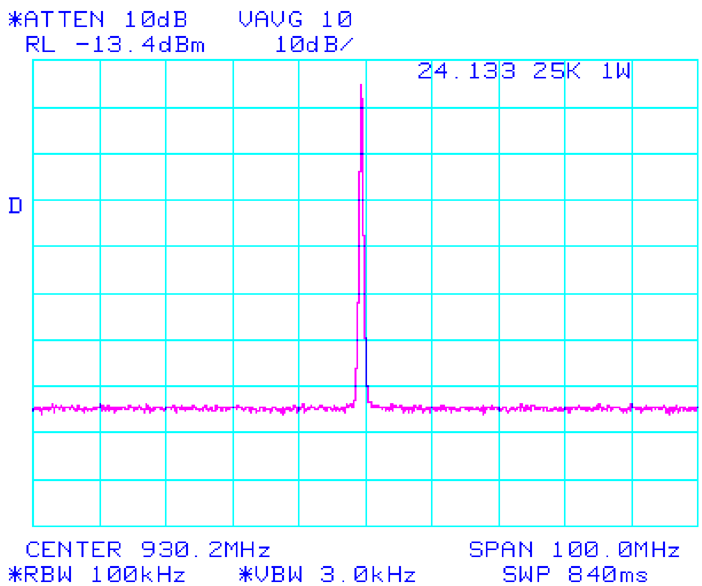




Mask: 24.133a1 Spectrum for Emission: 17K0 F1D

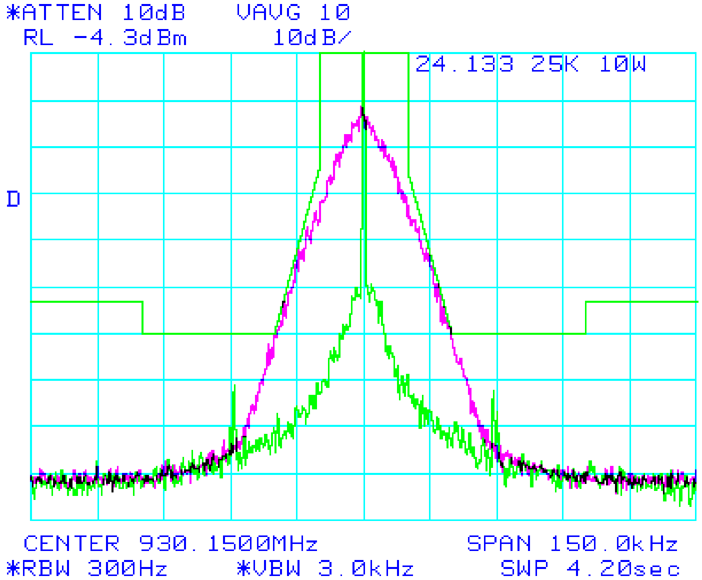
Output Power = 1 Watt Data Rate: 64 kbps Peak Deviation with Data: 7.520 kHz

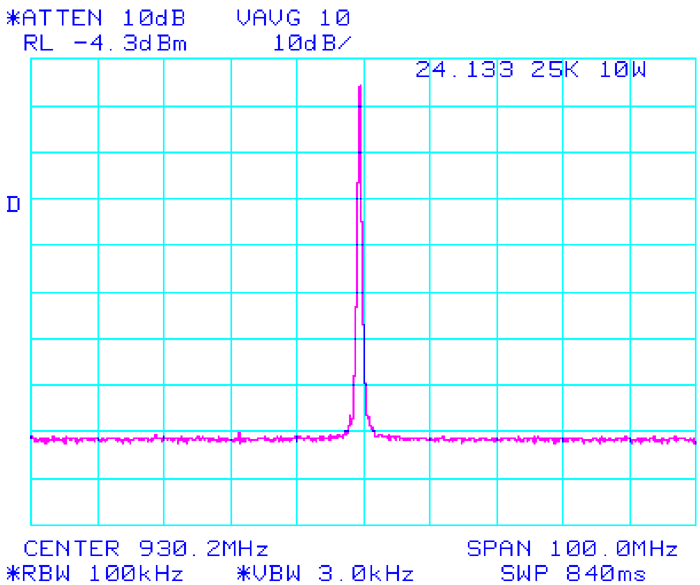




Mask: 24.133a1
Output Power = 10 Watts

Spectrum for Emission: 17K0 F1D
Data Rate: 64 kbps
Peak Deviation with Data: 7.520 kHz





NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators **29K8F1D, 30K0F1D, 29K5F1D** and **30K5F1D**

RULE PART NUMBER: FCC: 2.202, 2.1049 (c) (1), 24.133 (a)(1), 101.109, 101.111 (a)(6), 24.133(a)(1);

MINIMUM STANDARDS:

Mask 101.111(a)(6) 50 kHz
Sidebands and Spurious [P = 10 Watts and P=1 Watt]
Authorized Bandwidth = 50 kHz
From Fo to 17.5 kHz, down 0 dB.
From 17.5 kHz to 22.5 kHz, down 83 * $\log_{10}(f_d / 5)$ dB
Greater than 10.0 kHz to 250% auth BW, down 116log(fd/6.1) or 50+10log(P) or 70 dB.
Greater then 250% auth BW, 43+10$\log_{10}$(P) or 80 dB.

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 > 62.5 kHz @ 10W or 43 dB @ 1W

Mask 24.133(a)(1) 50 kHz
Sidebands and Spurious [P = 10 Watts and P=1 Watt]
Authorized Bandwidth = 45 kHz
From Fo to 22.5 kHz, down 0 dB.
From 22.5 kHz to 62.5 kHz, down 116 * $\log_{10}(f_d + 10 / 6.1)$ dB, 50+10log(P) or 70 dB.
Greater than 52.5 kHz, 43+10$\log_{10}$(P) or 80 dB.

Attenuation = 0 db at Fo to 22.5 kHz
Attenuation = 25 dB at 22.5 kHz
Attenuation = 60 dB at 32.5 kHz @ 10W
Attenuation = 50 dB at 29.0 kHz @ 1W
Attenuation = 53 dB at 62.5 kHz @ 10W
Attenuation = 43 dB at 62.5 kHz @ 1W

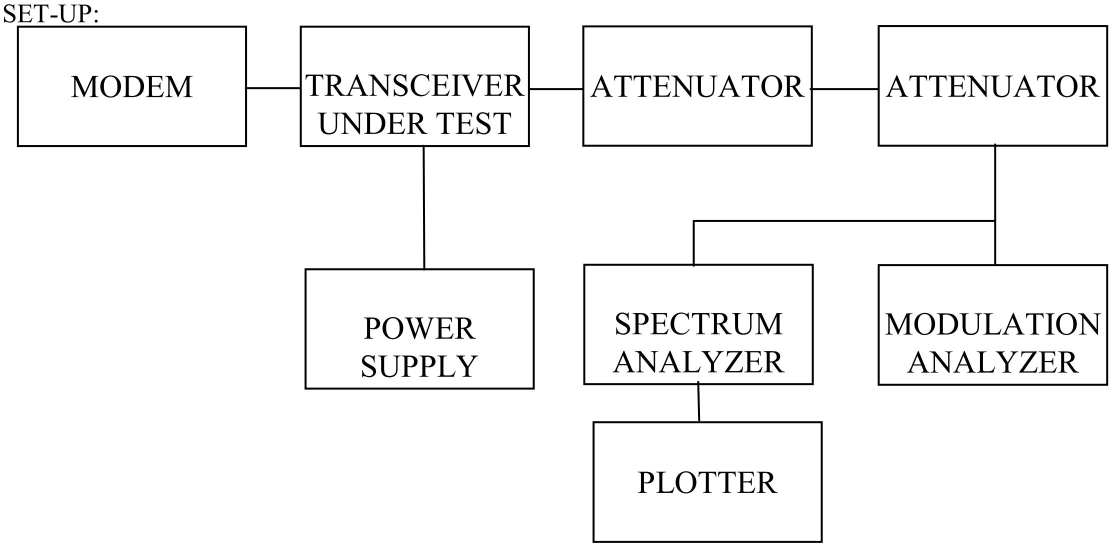
TEST RESULTS: Meets minimum standards (see data on following page)

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

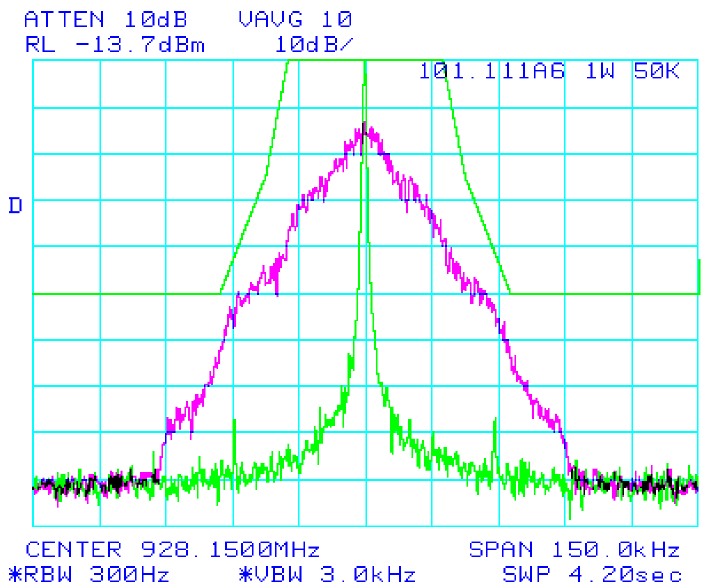
TEST PROCEDURE: TIA/EIA – 603-C, 2.2.13, 3.2.11.2

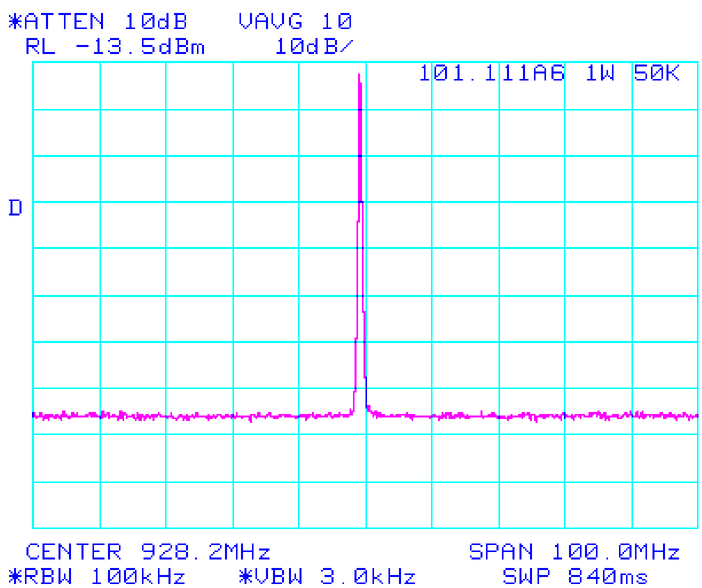
TEST EQUIPMENT:
50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
50-Ohm Attenuator, Pasternack Model PE7002-10 (10dB)
DC Power Supply, Hewlett Packard Model 6653A
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901A

TEST SET-UP:

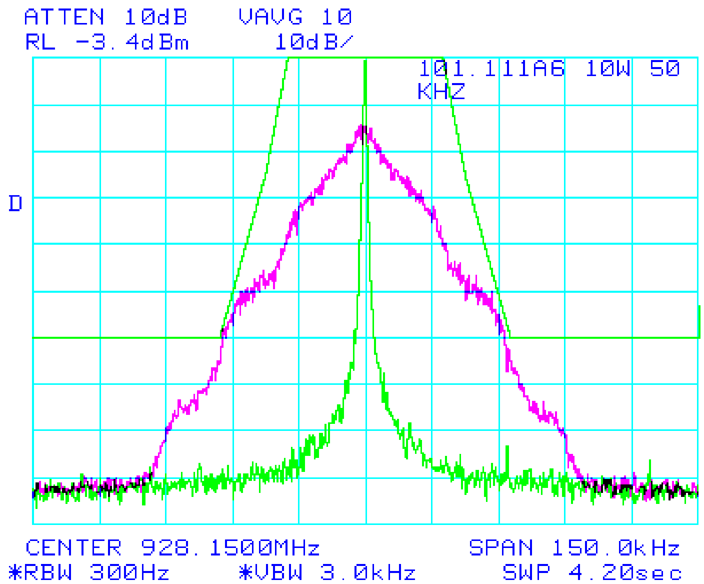

MODEM
TRANSCEIVER UNDER TEST
ATTENUATOR
ATTENUATOR
POWER SUPPLY
SPECTRUM ANALYZER
MODULATION ANALYZER
PLOTTER

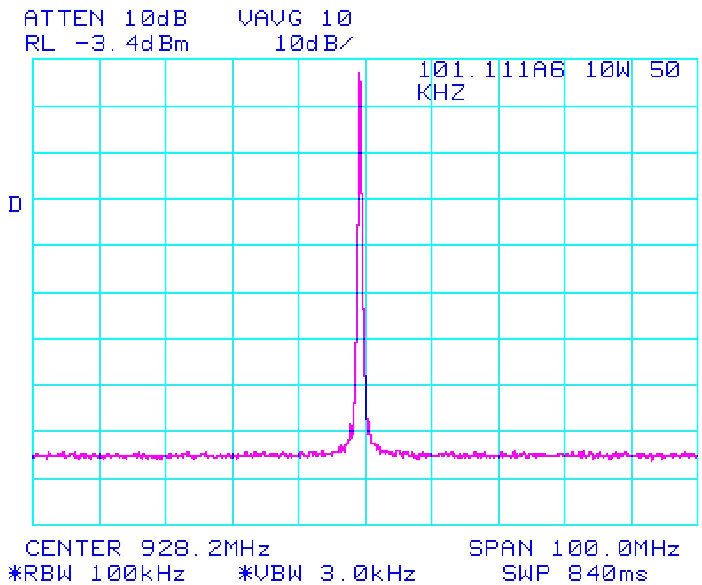
Mask: 101.111a6 50 kHz | Spectrum for Emission: 29K8 F1D
Output Power = 1 Watt | Data Rate: 32 kbps | Peak Deviation with Data: 9.36 kHz



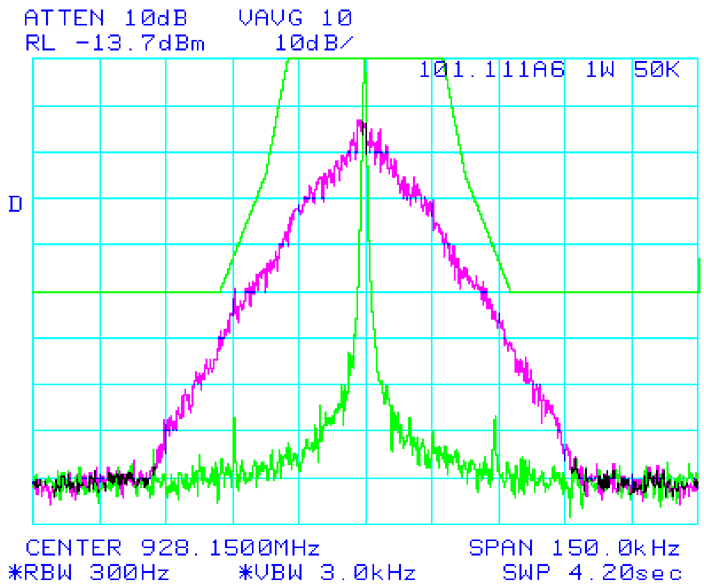


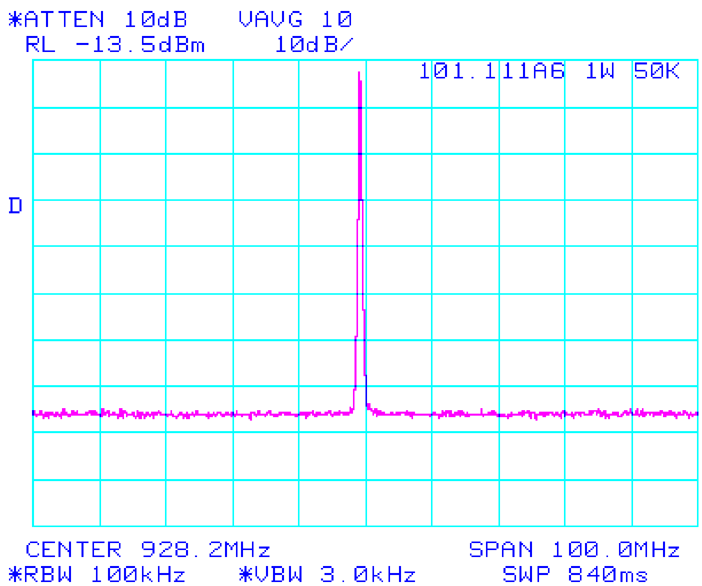
Mask: 101.111a6 50 kHz
Spectrum for Emission: 29K8 F1D
Output Power = 10 Watt
Data Rate: 32 kbps
Peak Deviation with Data: 9.36 kHz



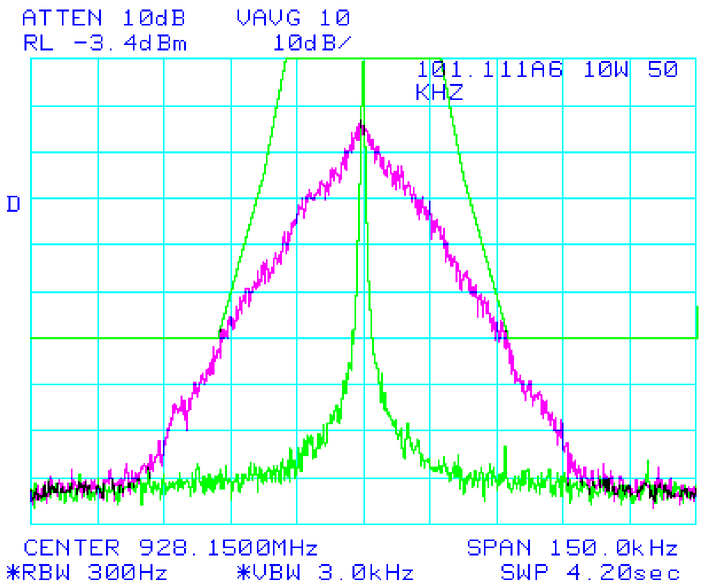


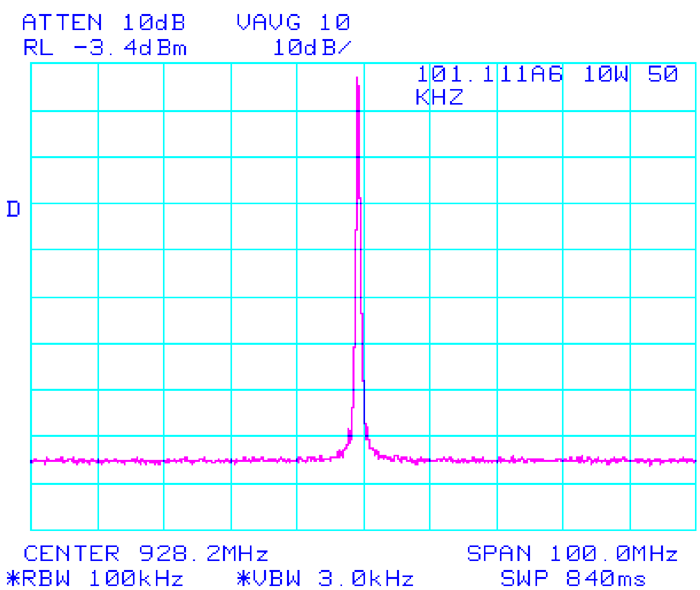
Mask: 101.111a6 50 kHz Spectrum for Emission: 30K0 F1D
Output Power = 1 Watt Data Rate: 64 kbps Peak Deviation with Data: 11.02 kHz





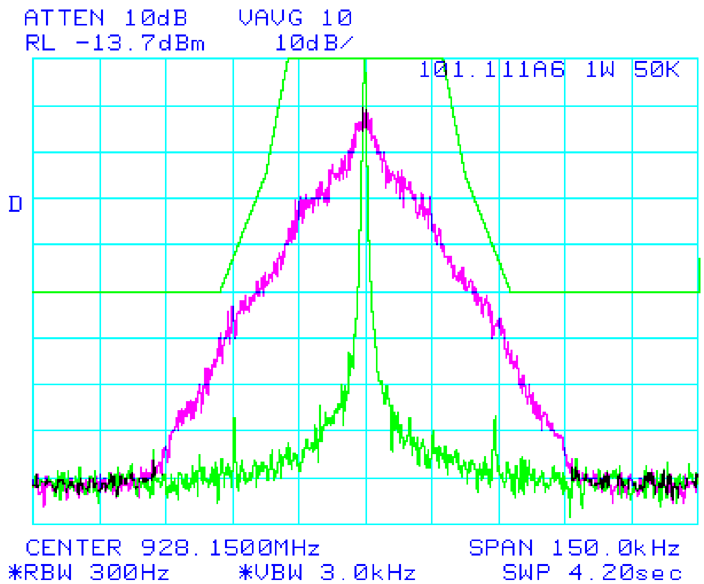
Mask: 101.111a6 50 kHz Spectrum for Emission: 30K0 F1D
Output Power = 10 Watt Data Rate: 64 kbps Peak Deviation with Data: 11.02 kHz

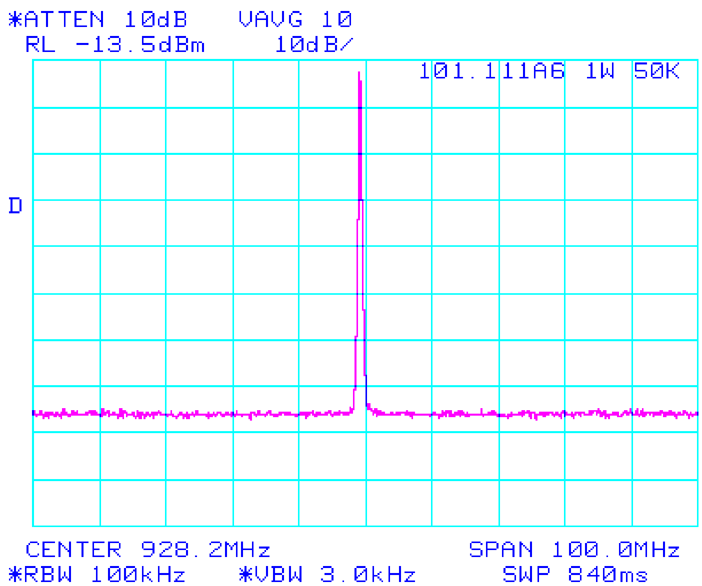




Mask: 101.111a6 50 kHz   Spectrum for Emission: 29K5 F1D

Output Power = 1 Watt   Data Rate: 96 kbps   Peak Deviation with Data: 10.81 kHz





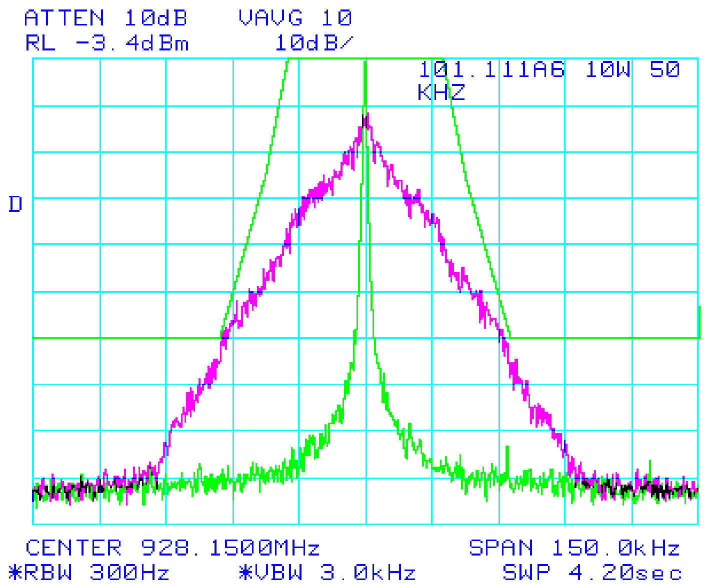
Mask: 101.111a6 50 kHz

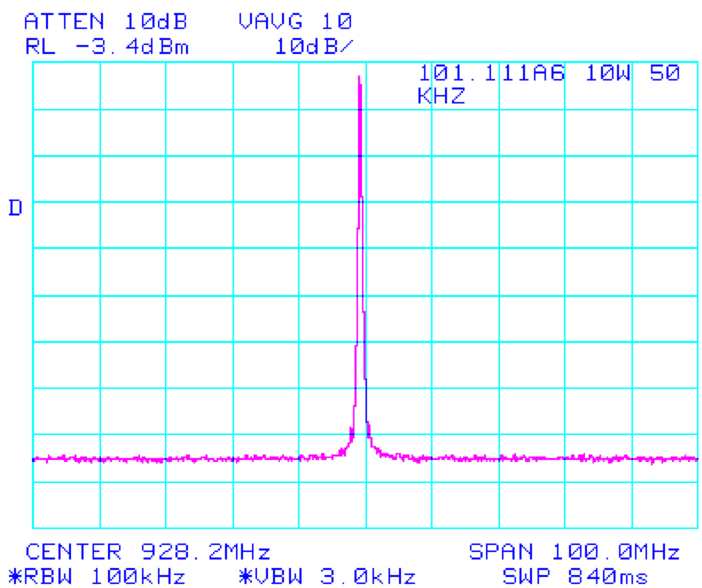
Spectrum for Emission: 29K5 F1D

Output Power = 10 Watt

Data Rate: 96 kbps

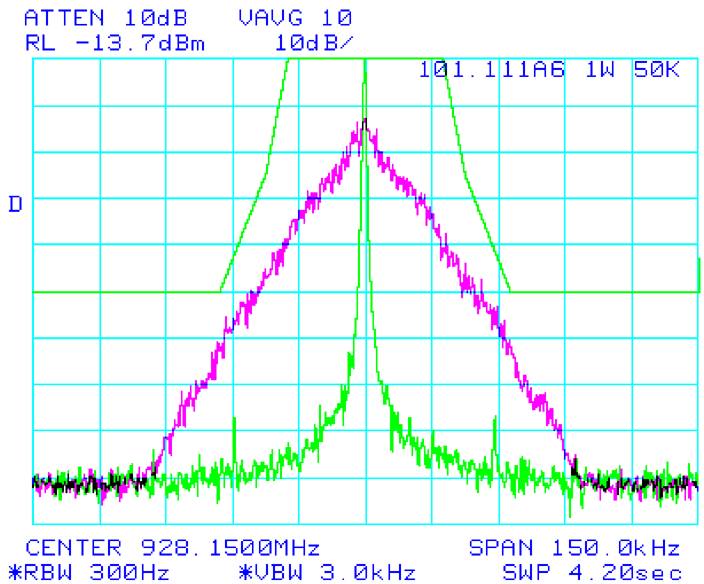
Peak Deviation with Data: 10.81 kHz

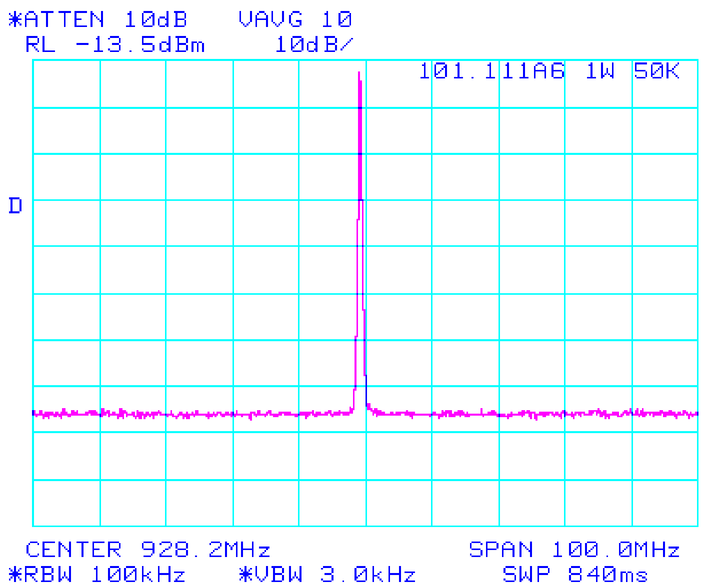




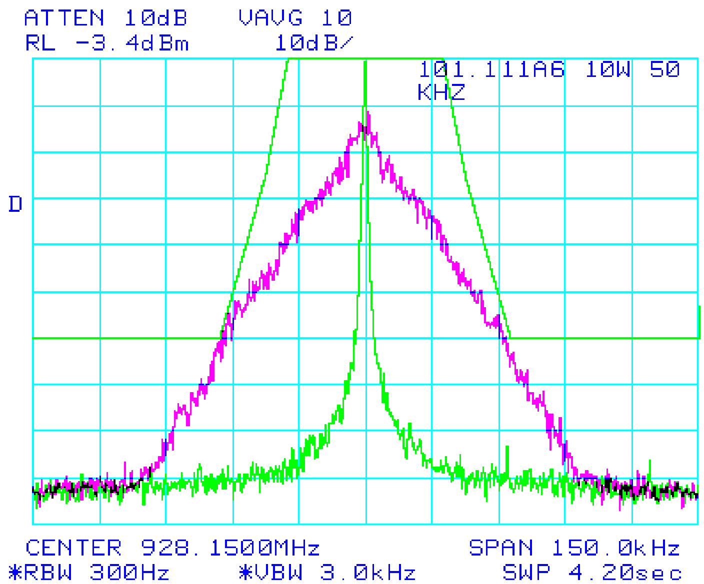
Mask: 101.111a6 50 kHz Spectrum for Emission: 30K5 F1D

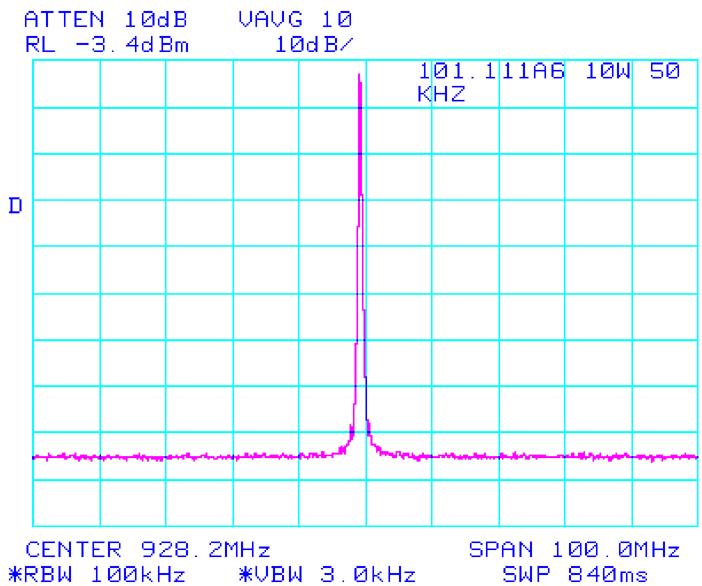
Output Power = 1 Watt Data Rate: 128 kbps Peak Deviation with Data: 11.66 kHz





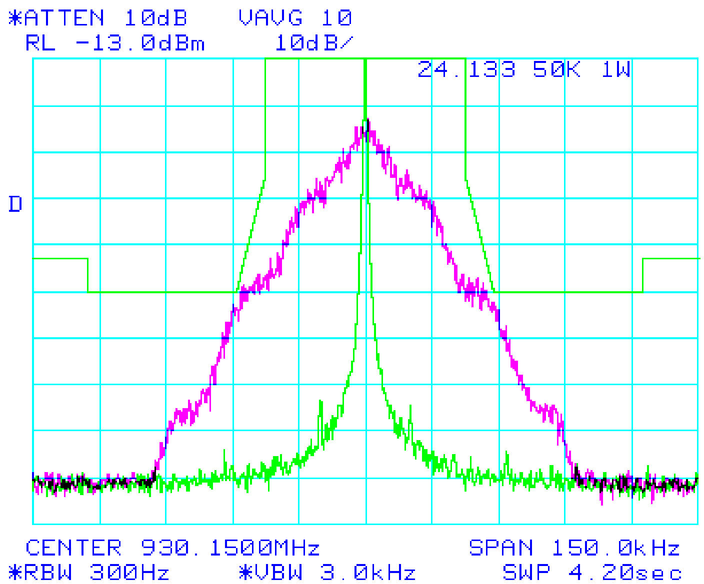
Mask: 101.111a6 50 kHz Spectrum for Emission: 30K5 F1D
Output Power = 10 Watt Data Rate: 128 kbps Peak Deviation with Data: 11.66 kHz

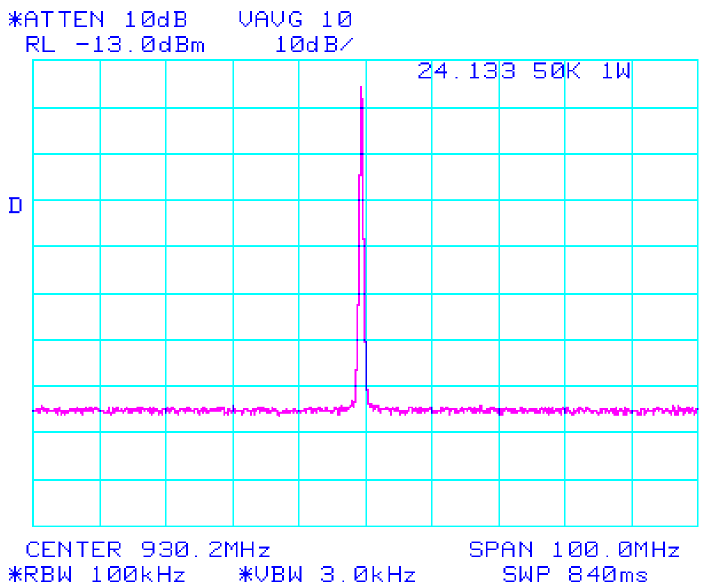




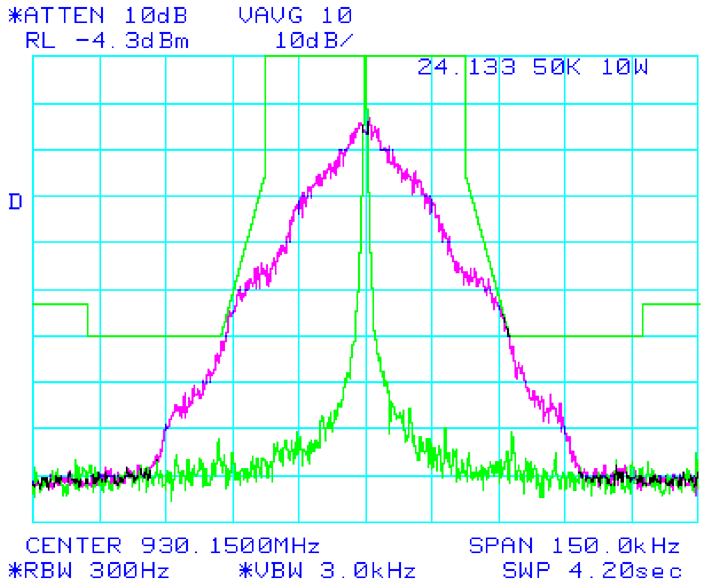
Mask: 24.133a1 50 kHz Spectrum for Emission: 29K8 F1D

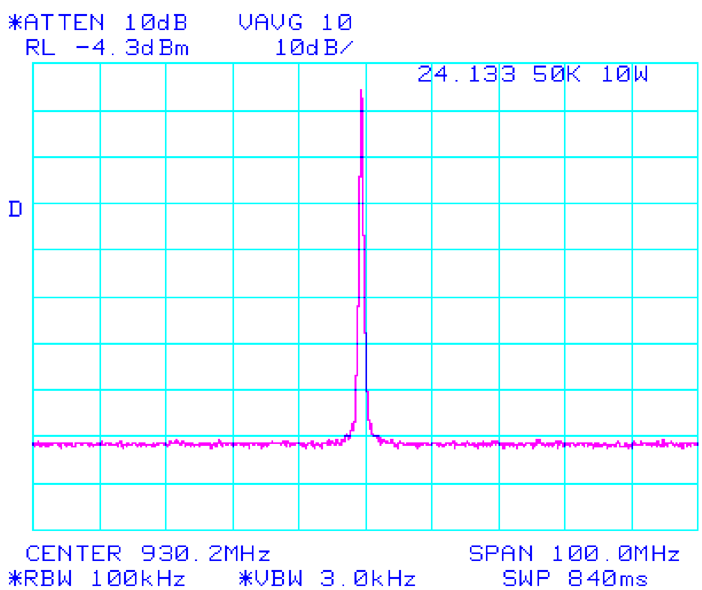
Output Power = 1 Watt Data Rate: 32 kbps Peak Deviation with Data: 9.36 kHz





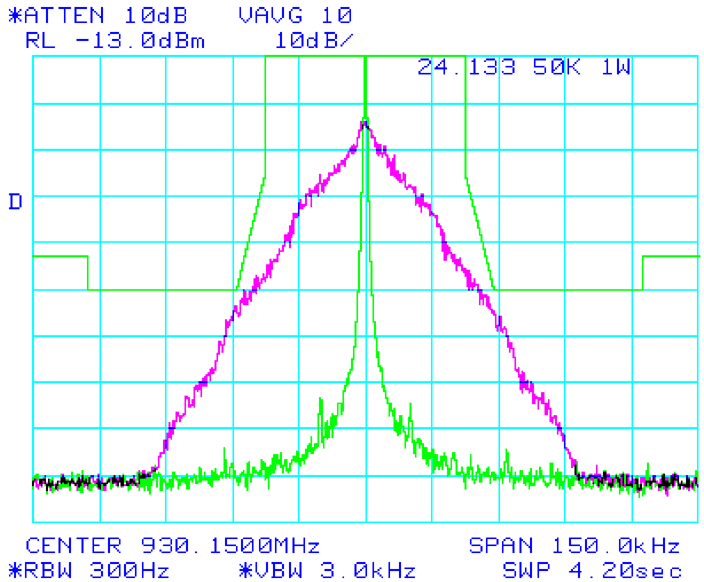
Mask: 24.133a1 50 kHz Spectrum for Emission: 29K8 F1D
Output Power = 10 Watt Data Rate: 32 kbps Peak Deviation with Data: 9.36 kHz

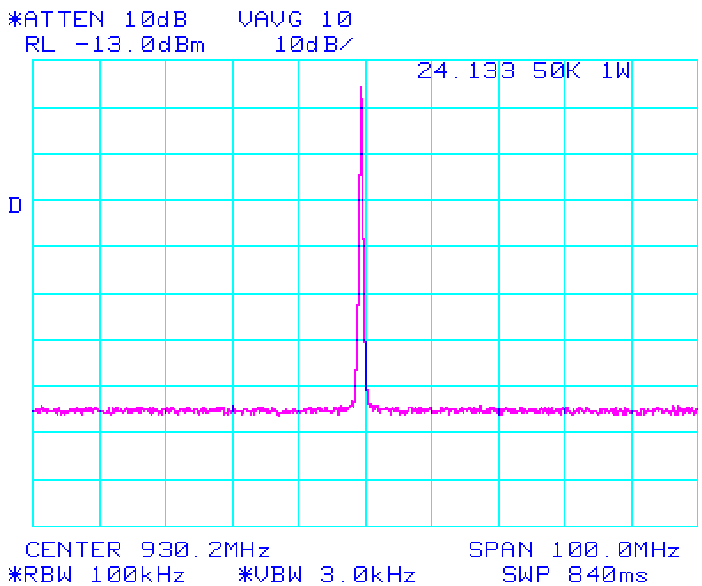




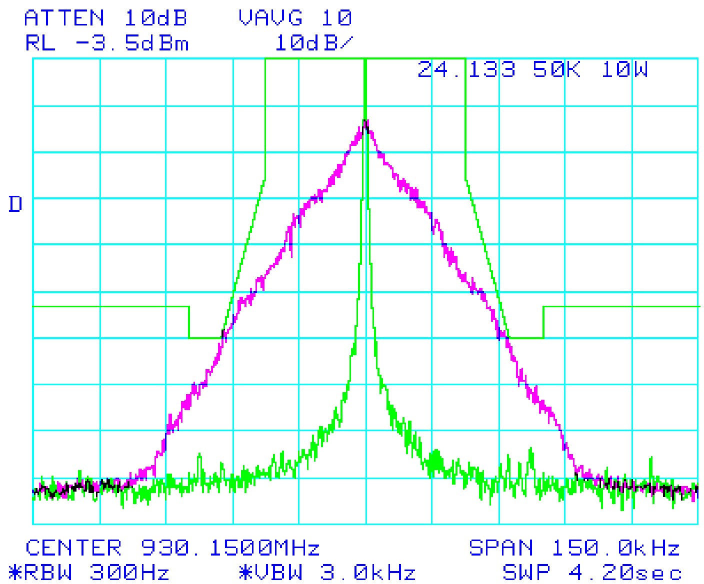
Mask: 24.133a1 50 kHz Spectrum for Emission: 30K0 F1D

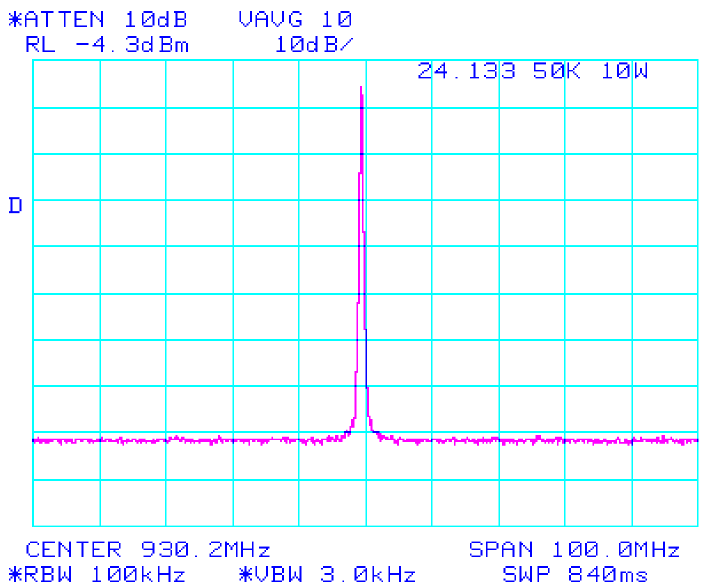
Output Power = 1 Watt Data Rate: 64 kbps Peak Deviation with Data: 11.02 kHz



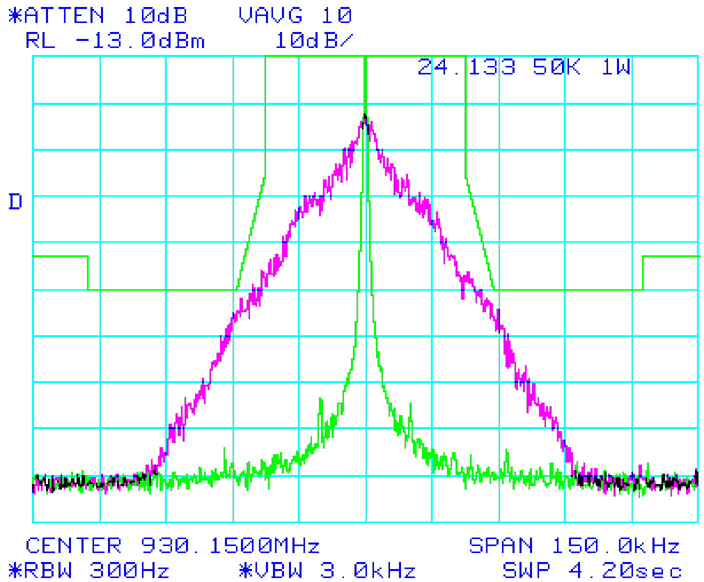


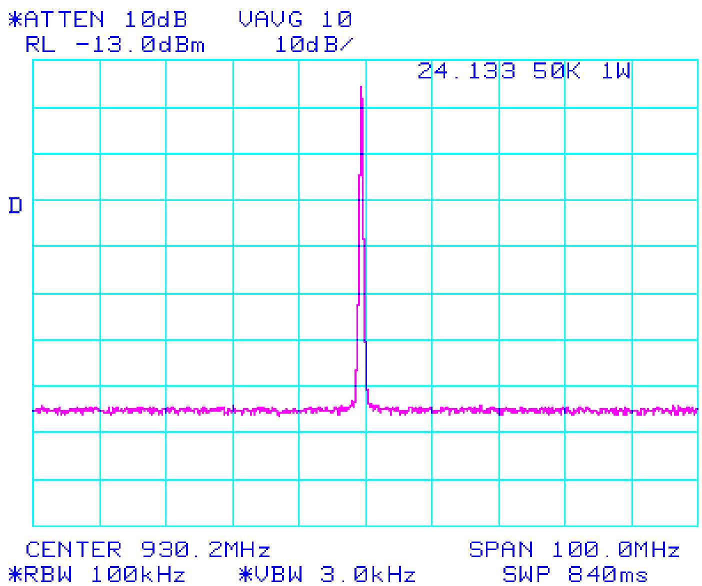
Mask: 24.133a1 50 kHz Spectrum for Emission: 30K0 F1D
Output Power = 10 Watt Data Rate: 64 kbps Peak Deviation with Data: 11.02 kHz





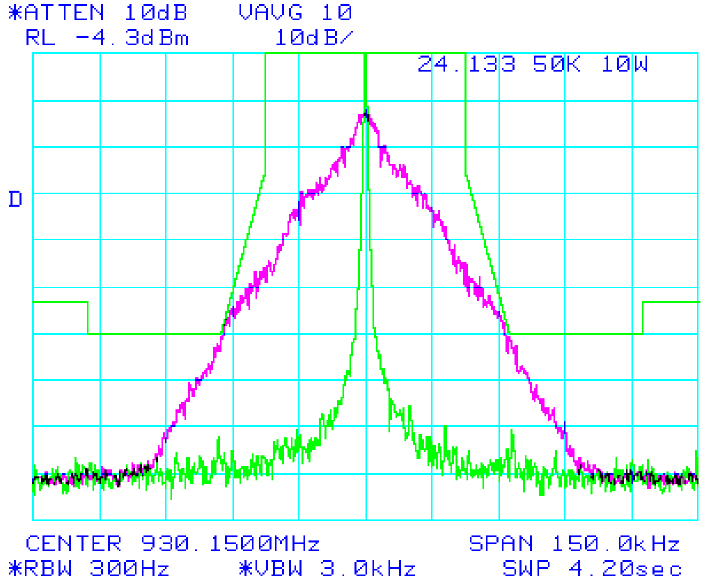
Mask: 24.133a1 50 kHz Spectrum for Emission: 29K5 F1D
Output Power = 1 Watt Data Rate: 96 kbps Peak Deviation with Data: 10.81 kHz

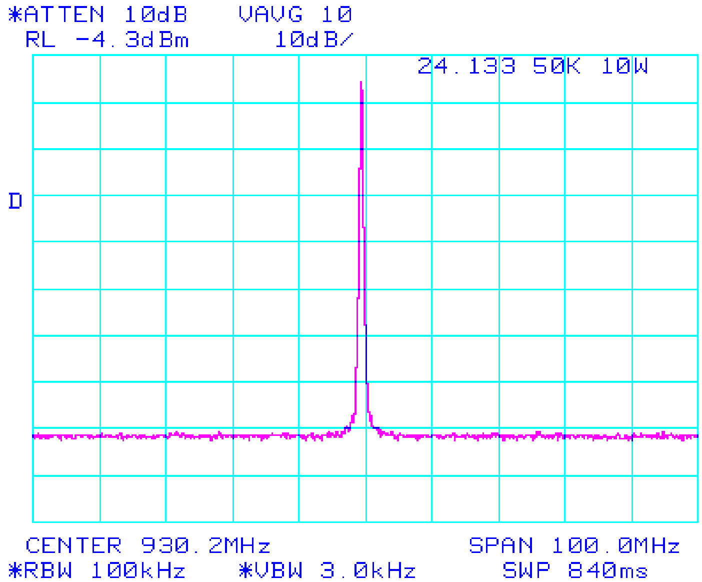




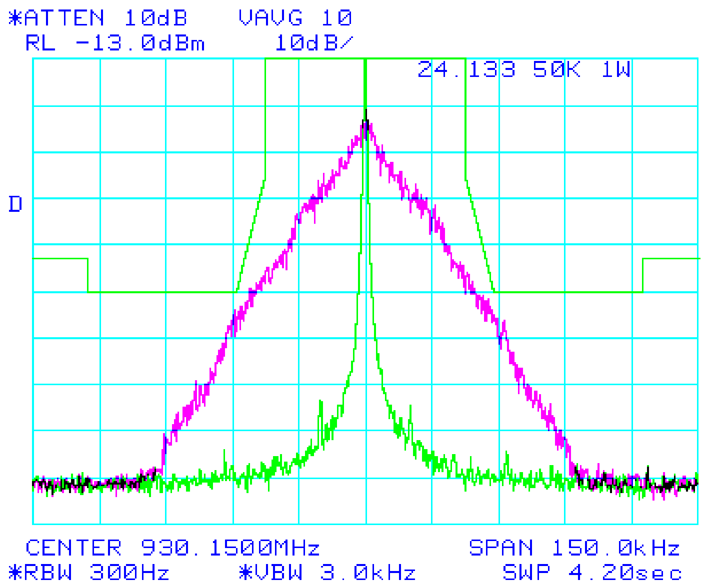
Mask: 24.133a1 50 kHz Spectrum for Emission: 29K5 F1D

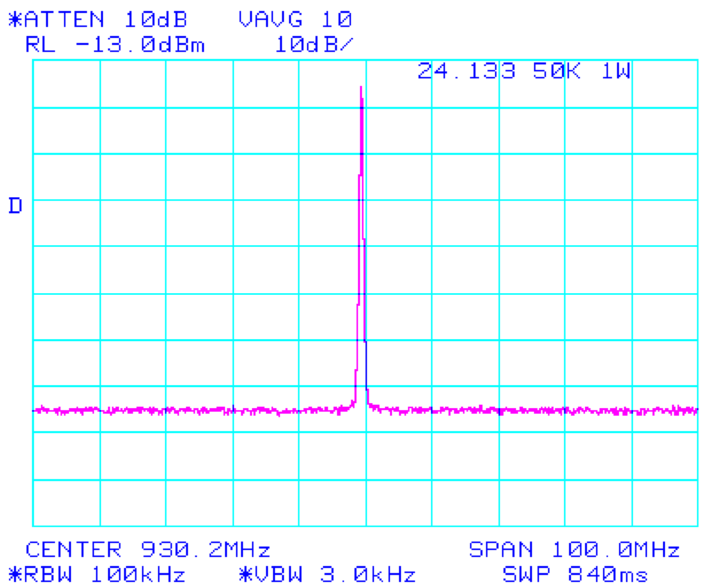
Output Power = 10 Watt Data Rate: 96 kbps Peak Deviation with Data: 10.81 kHz



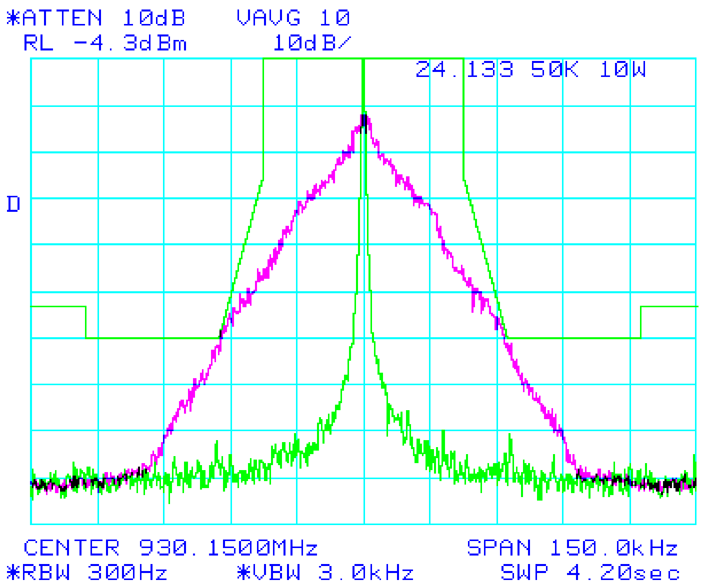


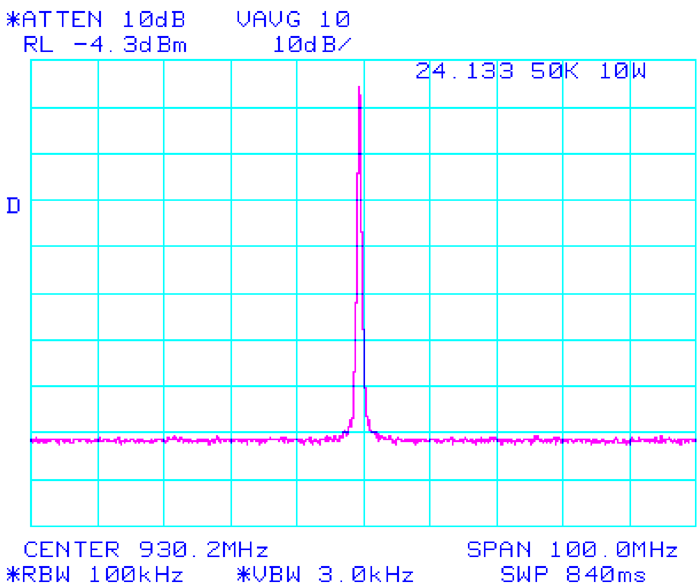
Mask: 24.133a1 50 kHz Spectrum for Emission: 30K5 F1D
Output Power = 1 Watt Data Rate: 128 kbps Peak Deviation with Data: 11.66 kHz





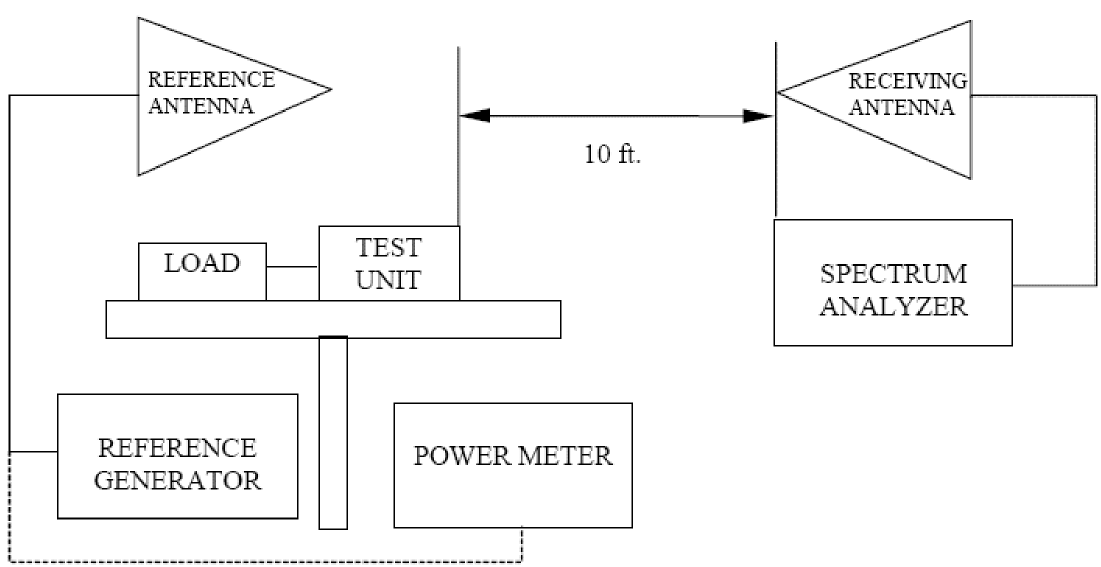
Mask: 24.133a1 50 kHz
Spectrum for Emission: 30K5 F1D
Output Power = 10 Watt
Data Rate: 128 kbps
Peak Deviation with Data: 11.66 kHz





NAME OF TEST:	Field Strength of Spurious Radiation
RULE PART NUMBER:	FCC: 2.1053, 24.133, 90.210 (c,3)(d,3)(e,3), 101.111(a)
MINIMUM STANDARDS:	For 10 Watts: $43+10Log_{10}$(10 Watts) = -53.0 dBc or -65 dBc, whichever is the lesser attenuation. For 1 Watt: $55+10Log_{10}$(1 Watt) = -43 dBc or –65 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, HP 437B Power Meter 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 =	-53.0
Power:	10	Watts	Highest 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 =	-43.0
Power:	1	Watts	Highest 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 = -53.0

Power: 10 Watts — Highest 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 = -43.0

Power: 1 Watts — Highest 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
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 =	-53.0
Power:	10	Watts	Highest 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

Power: 1 Watts

30.0 dBm

Spec = -43.0

Highest Spur = -68.8

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

Power: 10 Watts

40.0 dBm

Spec = -53.0

Highest Spur = -74.0

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

Power: 1 Watts

30.0 dBm

Spec = -43.0

Highest Spur = -65.8

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

Equipment Calibration Information

Equipment	Serial Number	Cal Date	Cal Due
HP 8563E Spectrum Analyzer	3221A00149	4/15/2010	4/15/2012
Agilent E8257D Signal Generator	MY44320507	4/20/2010	4/20/2012
HP 8901A Modulation Analyzer	2950A05551	4/12/2010	4/12/2012
HP 437B Power Meter	3125U13882	4/12/2010	4/12/2012

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