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FCC Part 90 Certification Application

FCC Form 731

For The

ViPR
UHF RADIO MODEM

FCC ID: NP4-5048-300

TABLE OF CONTENTS

NAME OF TEST: Transmitter Rated Power Output

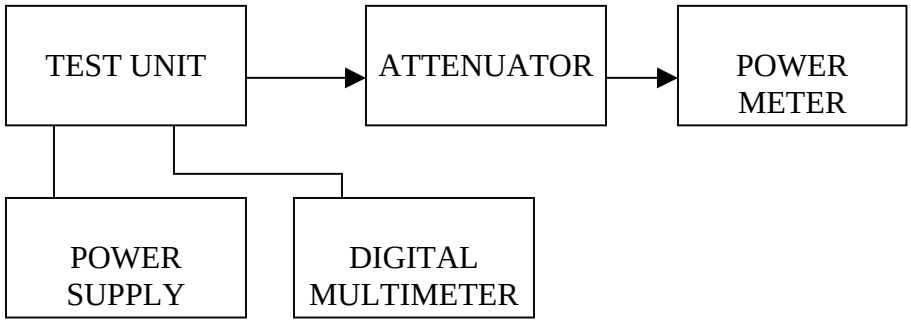
RULE PART NUMBER: FCC: 2.1046 (a) (c)
IC: RSS-119 5.4

TEST RESULTS: See results below

TEST CONDITIONS: Standard Test Conditions

TEST EQUIPMENT: 50-Ohm Attenuator, Bird 50-A-FFN-20 / 20 dB / 50 Watt
Power Supply, Instek Model GPS-3303
Digital Multimeter, Fluke 87
Power Meter, Model HP-8901B

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)
460.1	13.1	2.22	29.1	12.0
460.1	5.05	0.69	3.46	1.0

NAME OF TEST: Transmitter Spurious and Harmonic Outputs

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

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

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

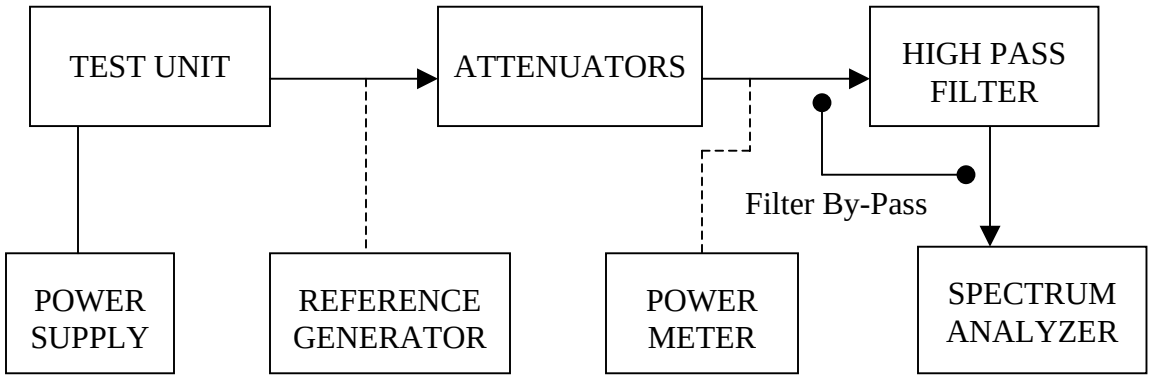
TEST RESULTS: Meets minimum standards (see data on following pages)

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

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

TEST EQUIPMENT: 50-Ohm Attenuator, Narda 765-10 / 10 dB / 50 Watts
50-Ohm Attenuator, Bird 10-A-MFN-10 / 10 dB / 10 Watts
Power Supply, Instek Model GPS-3303
Spectrum Analyzer, HP-8563E
Reference Generator, Agilent E8257D
High Pass Filter, Mini Circuits VHF-740, Fc = 740 MHz

TEST SET-UP:



MEASUREMENT PROCEDURE:

1. The transmitter carrier output frequency is 406.125, 460.100, and 511.975. The reference oscillator frequency is 23.040 MHz. The power amplifier has voltage levels at 13.1 Volts and 5.05 Volts for 12 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	406.125	MHz
Power	12	Watts
	40.8	dBm
Min. Specification	-65.0	dBc
Worse Case	-80.0	dBc

Spurious Frequency (MHz)	Relation to Carrier	Relative to Carrier (dBc)
812.250	2 fo	-113.8
1218.375	3 fo	-117.5
1624.500	4 fo	-115.0
2030.625	5 fo	-119.2
2436.750	6 fo	-122.3
2842.875	7 fo	-120.7
3249.000	8 fo	-119.7
3655.125	9 fo	-114.2
4061.250	10 fo	-111.7
4467.375	11 fo	-113.0
4873.500	12 fo	-110.2
5279.625	13 fo	-111.8
5685.750	14 fo	-111.2
6091.875	15 fo	-107.8
6498.000	16 fo	-80.0
6904.125	17 fo	-91.2
7310.250	18 fo	-109.2
7716.375	19 fo	-102.7
8122.500	20 fo	-90.0

Tuned Frequency	406.125	MHz
Power	1	Watt
	30.0	dBm
Min. Specification	-55.0	dBc
Worse Case	-70.0	dBc

Spurious Frequency (MHz)	Relation to Carrier	Relative to Carrier (dBc)
812.250	2 fo	-108.0
1218.375	3 fo	-109.7
1624.500	4 fo	-112.7
2030.625	5 fo	-112.5
2436.750	6 fo	-112.3
2842.875	7 fo	-110.7
3249.000	8 fo	-109.7
3655.125	9 fo	-104.2
4061.250	10 fo	-101.7
4467.375	11 fo	-103.0
4873.500	12 fo	-100.2
5279.625	13 fo	-108.0
5685.750	14 fo	-101.2
6091.875	15 fo	-97.8
6498.000	16 fo	-70.0
6904.125	17 fo	-81.2
7310.250	18 fo	-99.2
7716.375	19 fo	-92.7
8122.500	20 fo	-80.0

Tuned Frequency	460.1	MHz
Power	12	Watts
	40.8	dBm
Min. Specification	-65.0	dBc
Worse Case	-90.7	dBc

Spurious Frequency (MHz)	Relation to Carrier	Relative to Carrier (dBc)
920.2	2 fo	-107.3
1380.3	3 fo	-113.0
1840.4	4 fo	-114.8
2300.5	5 fo	-117.7
2760.6	6 fo	-120.5
3220.7	7 fo	-108.0
3680.8	8 fo	-95.5
4140.9	9 fo	-114.8
4601.0	10 fo	-112.7
5061.1	11 fo	-109.0
5521.2	12 fo	-107.7
5981.3	13 fo	-110.0
6441.4	14 fo	-95.8
6901.5	15 fo	-90.7
7361.6	16 fo	-103.1
7821.7	17 fo	-99.7
8281.8	18 fo	-96.7
8741.9	19 fo	-100.7
9202.0	20 fo	-93.3

Tuned Frequency	460.1	MHz
Power	1	Watt
	30.0	dBm
Min. Specification	-55.0	dBc
Worse Case	-80.7	dBc

Spurious Frequency (MHz)	Relation to Carrier	Relative to Carrier (dBc)
920.2	2 fo	-108.0
1380.3	3 fo	-110.5
1840.4	4 fo	-112.0
2300.5	5 fo	-112.3
2760.6	6 fo	-111.2
3220.7	7 fo	-108.2
3680.8	8 fo	-106.5
4140.9	9 fo	-104.8
4601.0	10 fo	-103.8
5061.1	11 fo	-104.5
5521.2	12 fo	-104.5
5981.3	13 fo	-100.0
6441.4	14 fo	-85.8
6901.5	15 fo	-80.7
7361.6	16 fo	-93.1
7821.7	17 fo	-89.7
8281.8	18 fo	-86.7
8741.9	19 fo	-90.7
9202.0	20 fo	-83.3

Tuned Frequency	511.975	MHz
Power	12	Watts
	40.8	dBm
Min. Specification	-65.0	dBc
Worse Case	-78.3	dBc

Spurious Frequency (MHz)	Relation to Carrier	Relative to Carrier (dBc)
1023.950	2 fo	-90.5
1535.925	3 fo	-103.3
2047.900	4 fo	-122.1
2559.875	5 fo	-118.5
3071.850	6 fo	-113.8
3583.825	7 fo	-93.0
4095.800	8 fo	-110.6
4607.775	9 fo	-113.5
5119.750	10 fo	-110.3
5631.725	11 fo	-109.8
6143.700	12 fo	-105.5
6655.675	13 fo	-84.1
7167.650	14 fo	-110.6
7679.625	15 fo	-103.8
8191.600	16 fo	-78.3
8703.575	17 fo	-104.8
9215.550	18 fo	-96.1
9727.525	19 fo	-105.0
10239.500	20 fo	-98.5

Tuned Frequency	511.975	MHz
Power	1	Watt
	30.0	dBm
Min. Specification	-55.0	dBc
Worse Case	-67.5	dBc

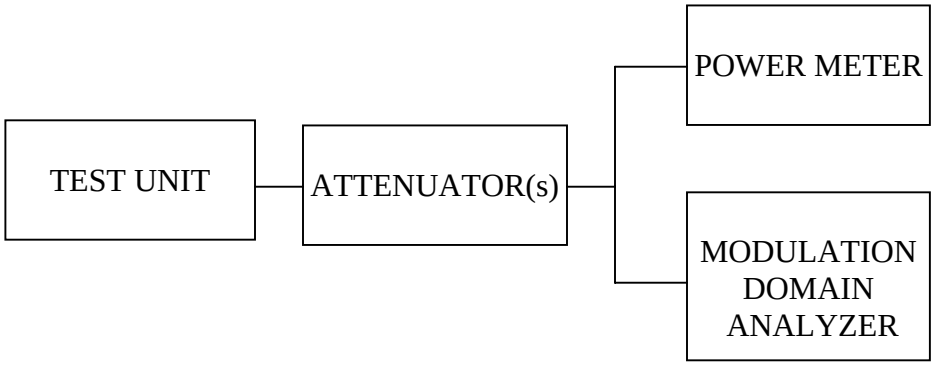
Spurious Frequency (MHz)	Relation to Carrier	Relative to Carrier (dBc)
1023.950	2 fo	-101.2
1535.925	3 fo	-106.3
2047.900	4 fo	-112.3
2559.875	5 fo	-112.7
3071.850	6 fo	-107.5
3583.825	7 fo	-99.5
4095.800	8 fo	-99.8
4607.775	9 fo	-102.7
5119.750	10 fo	-97.7
5631.725	11 fo	-104.2
6143.700	12 fo	-94.7
6655.675	13 fo	-73.3
7167.650	14 fo	-99.8
7679.625	15 fo	-93.0
8191.600	16 fo	-67.5
8703.575	17 fo	-94.0
9215.550	18 fo	-85.3
9727.525	19 fo	-94.2
10239.500	20 fo	-87.7

NAME OF TEST: Transient Frequency Behavior

RULE PART NUMBER: FCC: 90.214
IC: RSS-119 5.9

MINIMUM STANDARD: 6.25 kHz channel (used worst case numbers from 406.125 to 511.975 MHz)

TIME INTERVAL	MAXIMUM FREQUENCY DIFFERENCE (kHz)	TIME (ms)
T1	+/- 6.25	10
T2	+/- 3.125	25
T3	+/- 6.25	10



TEST RESULTS: Meets minimum standards, see data on following pages

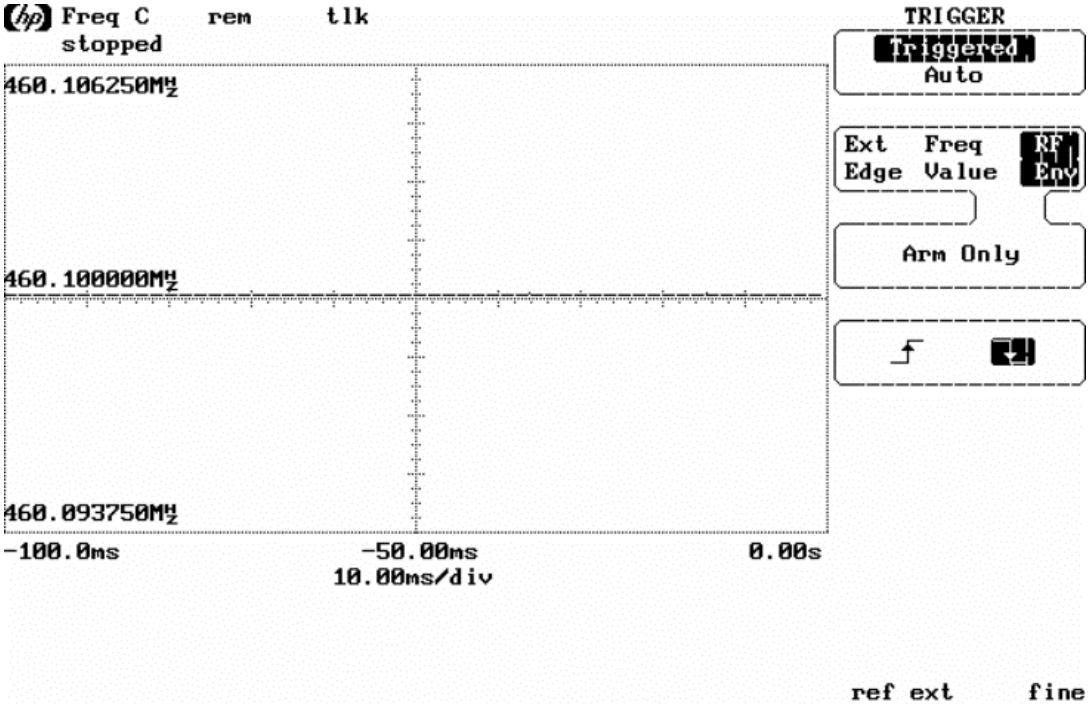
TEST CONDITIONS: RF Power Level = 12 Watts and 1.0 Watt
Standard Test Conditions, 25 C

TEST PROCEDURE: TIA/EIA – 603-B, 2.2.19.2

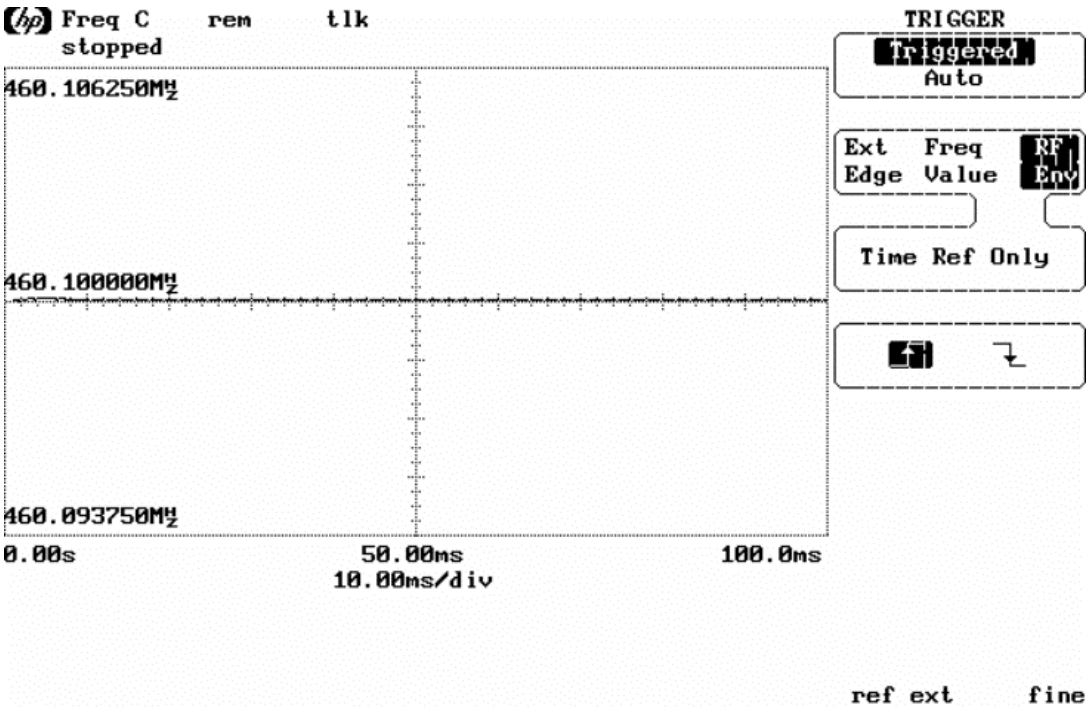
TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
Power Supply, Instek Model GPS-2303
Modulation Domain Analyzer, HP-53310A
Power Meter, Model HP436
Signal Generator, Model HP8657A

Frequency : 460.100000 MHz
Power: 12 W

Key-Down

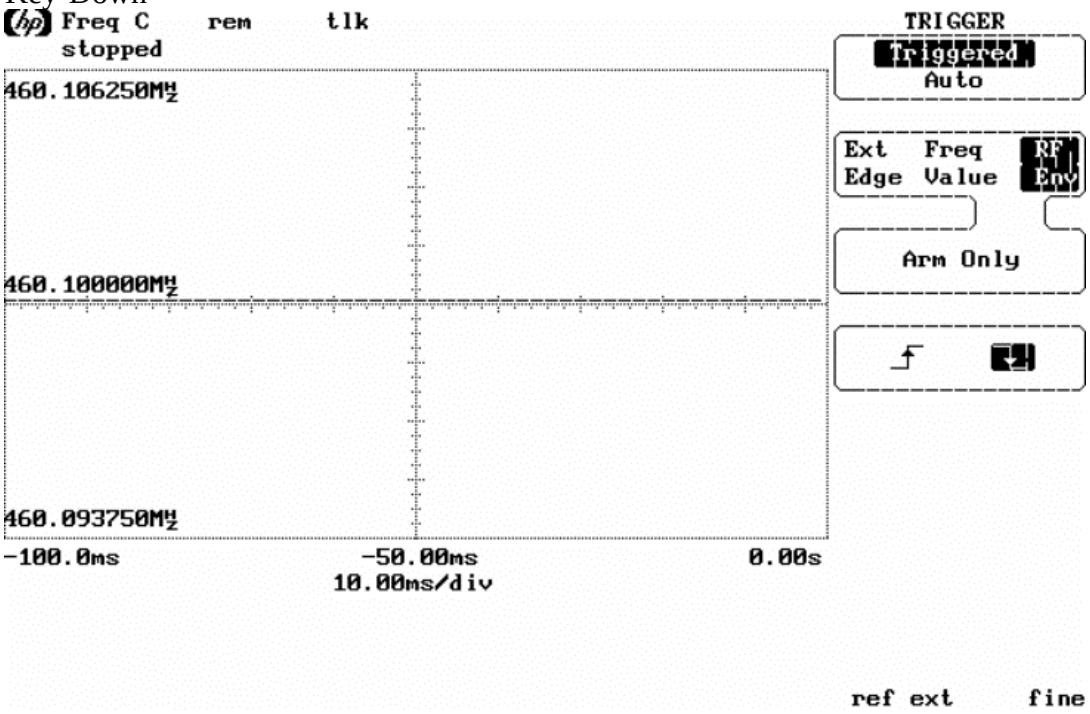


Key-up

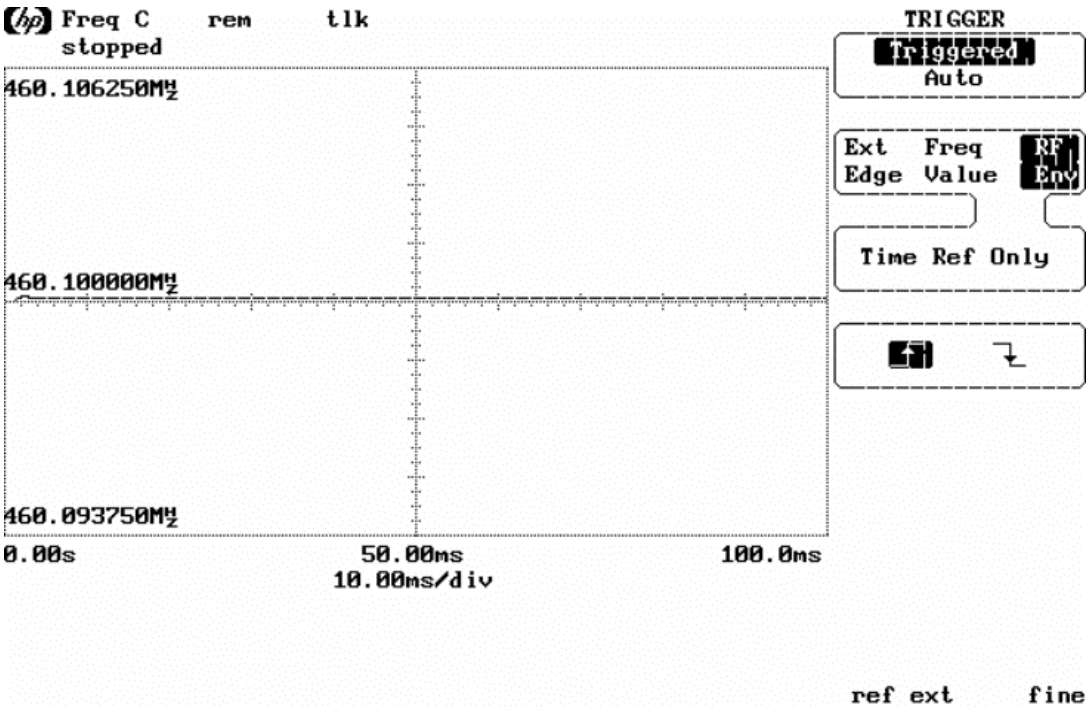


Frequency : 460.100000 MHz
Power: 1.0 W

Key-Down



Key-up



NAME OF TEST: Frequency Stability with Variation in Supply Voltage

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

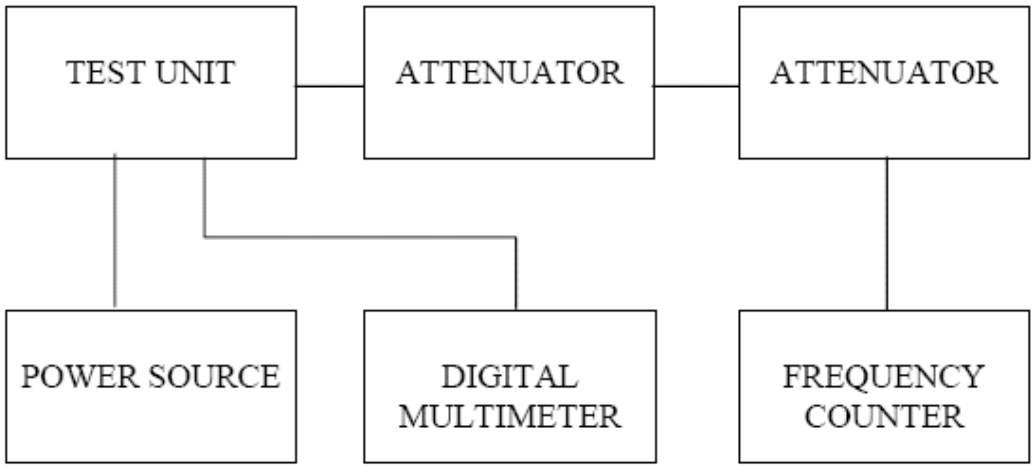
MINIMUM STANDARD: Shall not exceed 0.50 ppm.

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

TEST CONDITIONS: Standard Test Conditions, 25 C

TEST EQUIPMENT: Frequency Counter, Fluke 7220A
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:



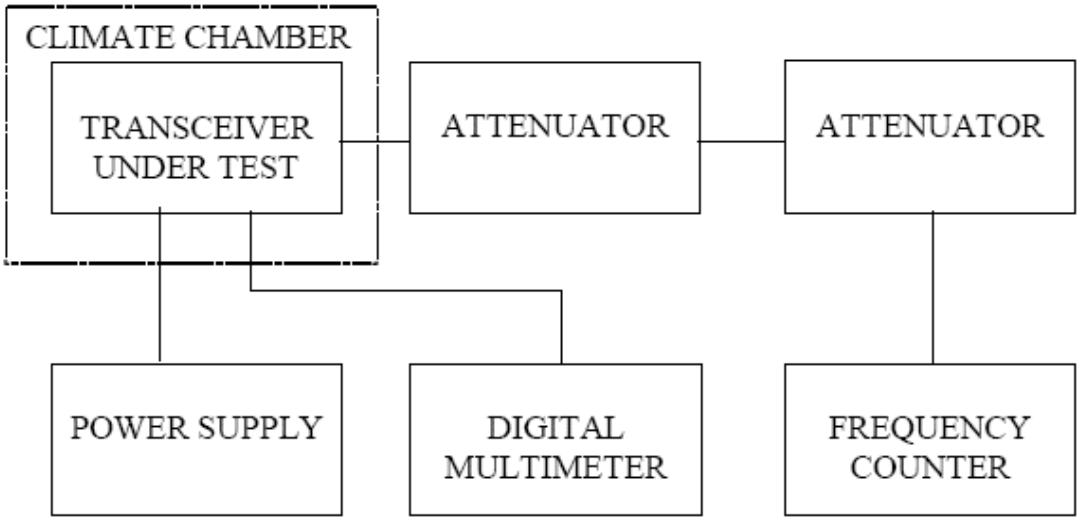
TEST SET-UP

Channel Frequency: 460.1000 MHz
Tolerance Requirements: 0.5ppm
Highest Variation: 0.04 ppm

Input Voltage (Vdc)	Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)
10	460.100020	20	0.04
20	460.100010	10	0.02
30	460.100000	0	0.00

NAME OF TEST:	Frequency Stability with Variation in Ambient Temperature
RULE PART NUMBER:	FCC: 2.1055 (a) (b), 90.213 (a) IC: RSS-119 5.3
MINIMUM STANDARD:	Shall not exceed 0.50 ppm from test frequency
TEST RESULTS:	Meets minimum standard, see data on following page
TEST CONDITIONS:	Standard Test Conditions
TEST EQUIPMENT:	Frequency Counter, Fluke 7220A 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: 460.10000 MHz
Voltage & Power Level: 20 Volts @ 12 Watts
Highest Variation: -0.26 ppm

Temperature (Deg C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)
-30	460.09992	-80	-0.17
-20	460.09996	-40	-0.09
-10	460.10000	0	0.00
0	460.10008	80	0.17
10	460.09998	-20	-0.04
20	460.09996	-40	-0.09
30	460.10004	40	0.09
40	460.09999	-10	-0.02
50	460.09997	-30	-0.07
60	460.09988	-120	-0.26

Channel Frequency: 460.10000 MHz
Voltage & Power Level: 20 Volts @ 1.0 Watts
Highest Variation: -0.30 ppm

Temperature (Deg C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)
-30	460.09993	-70	-0.15
-20	460.09994	-60	-0.13
-10	460.09999	-10	-0.02
0	460.10010	99	0.22
10	460.09997	-30	-0.07
20	460.09996	-40	-0.09
30	460.10003	30	0.07
40	460.10000	0	0.00
50	460.09996	-40	-0.09
60	460.09986	-140	-0.30

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)
IC: RSS-Gen 4.4.1

Necessary Bandwidth Measurement

This radio modem uses digital modulation signals, passing through a Squared Root Raised Cosine α=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	960 Hz	970 Hz	3.03 kHz	3.50 kHz	6.43 kHz	7.20 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

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

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.

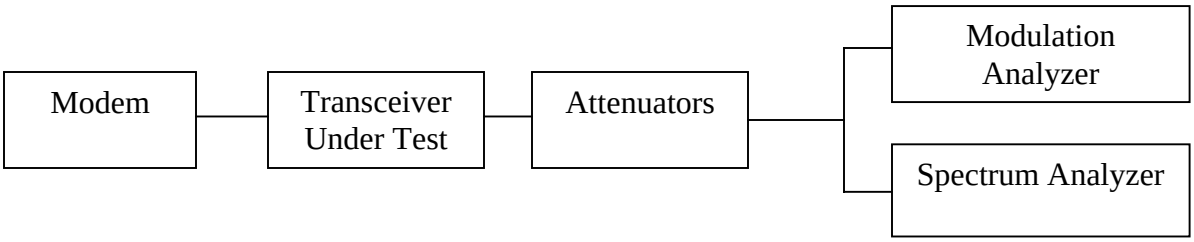
The Occupied Bandwidth measurement is in two parts relatively independent of each other. The first gives the RF spectrum profile, and the second calculates the frequency limits and they result in the Occupied bandwidth. While the first involves RF measurement instrumentation, the second is strictly a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

TEST EQUIPMENT:

50-Ohm Attenuator, Bird Electronics 50-A-FFN-20 (20dB, 50W)
50-Ohm Attenuator, Bird Electronics 10-A-MFN-10 (10dB, 10W)
Power Supply, Instek Model GPS-3303
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 α=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 α=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 [Rule 90.210 (e), 5.8.4, P = 12 Watts and P=1 Watt]
Authorized Bandwidth = 6 kHz [Rule 90.209(b) (5), 5.8.4]
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 12.5 kHz, at least $50+10\log_{10}(P)$ or 70 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 @ 12 Watts
Attenuation = 65 dB at frequencies greater than 4.6 kHz @ 12 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

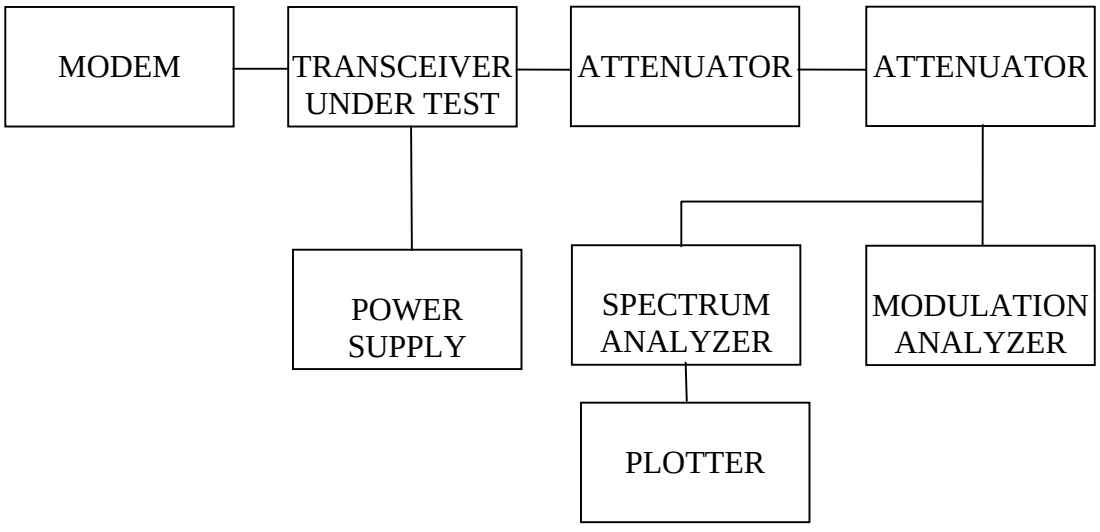
TEST RESULTS: Meets minimum standards (see data on following page)

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

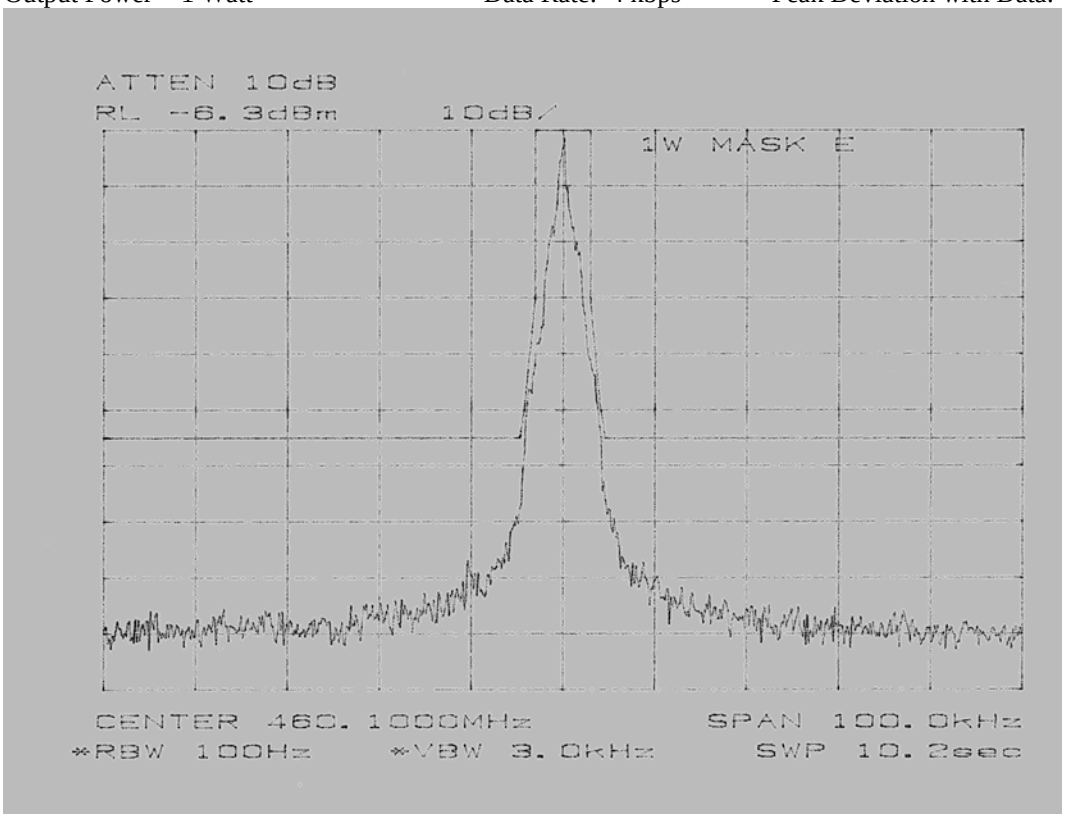
TEST PROCEDURE: TIA/EIA – 603-B, 2.2.13, 3.2.11.2

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-3303
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901B

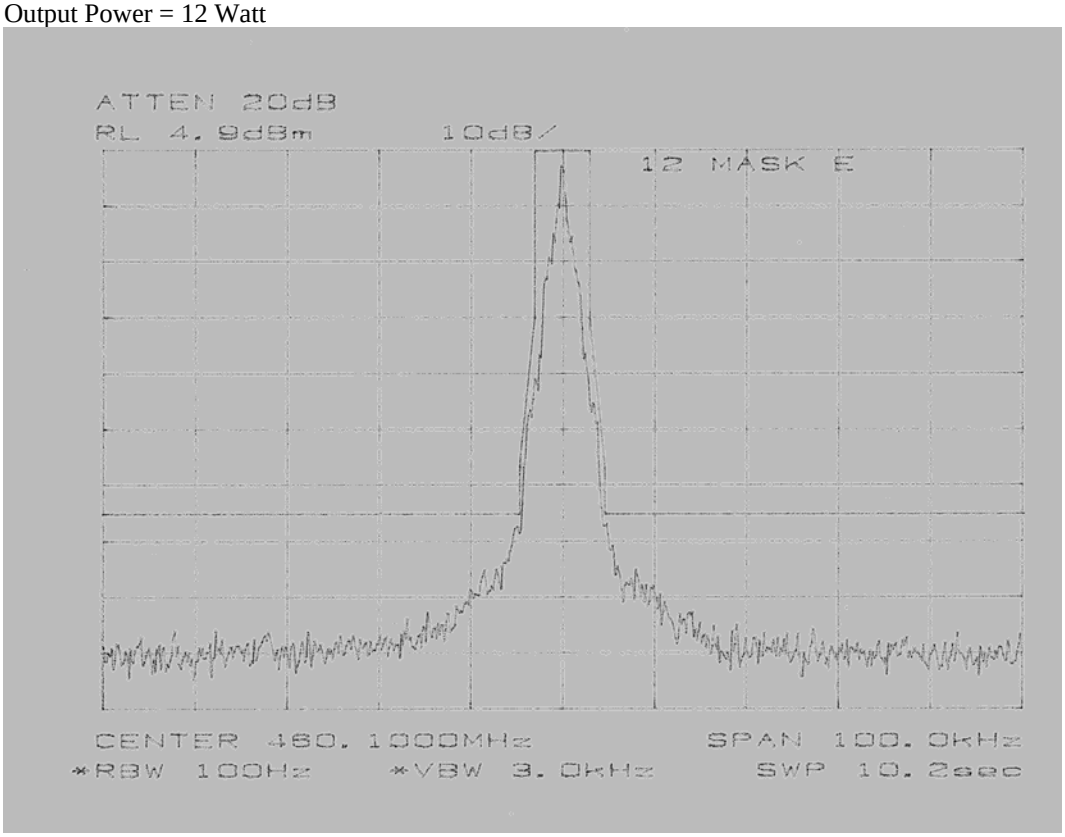
TEST SET-UP:



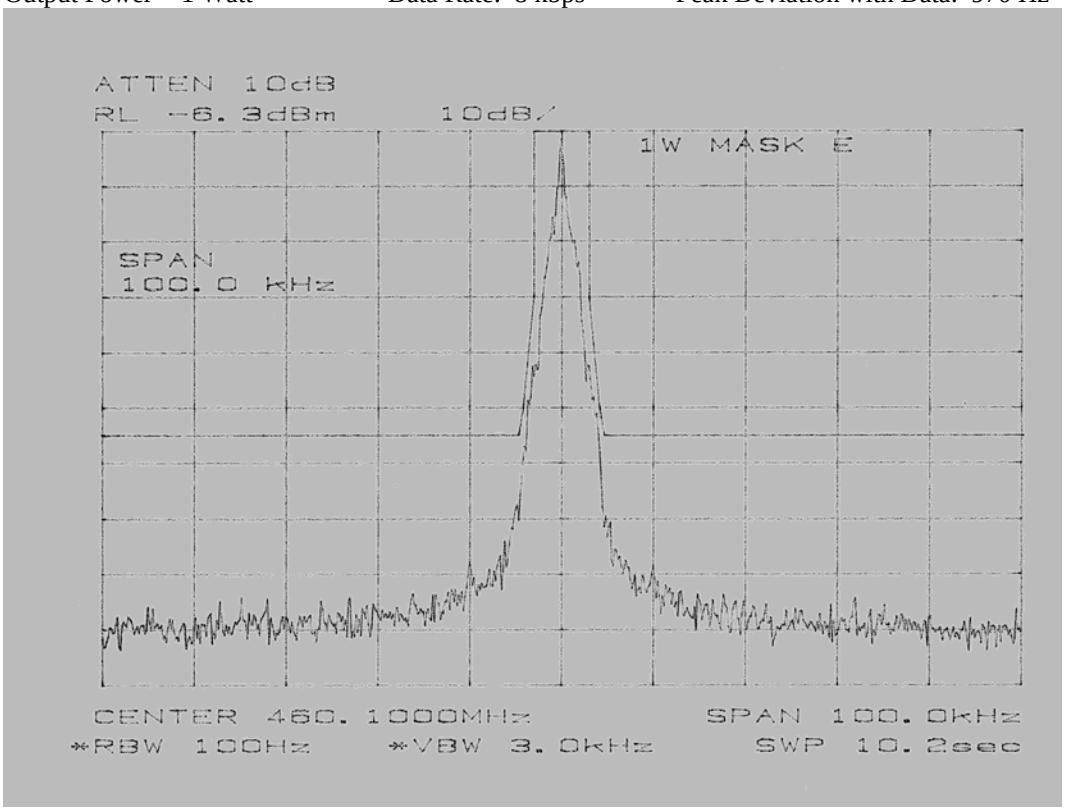
Mask: E, 1W Spectrum for Emission: 3K30 F1D
Output Power = 1 Watt Data Rate: 4 kbps Peak Deviation with Data: 960 Hz



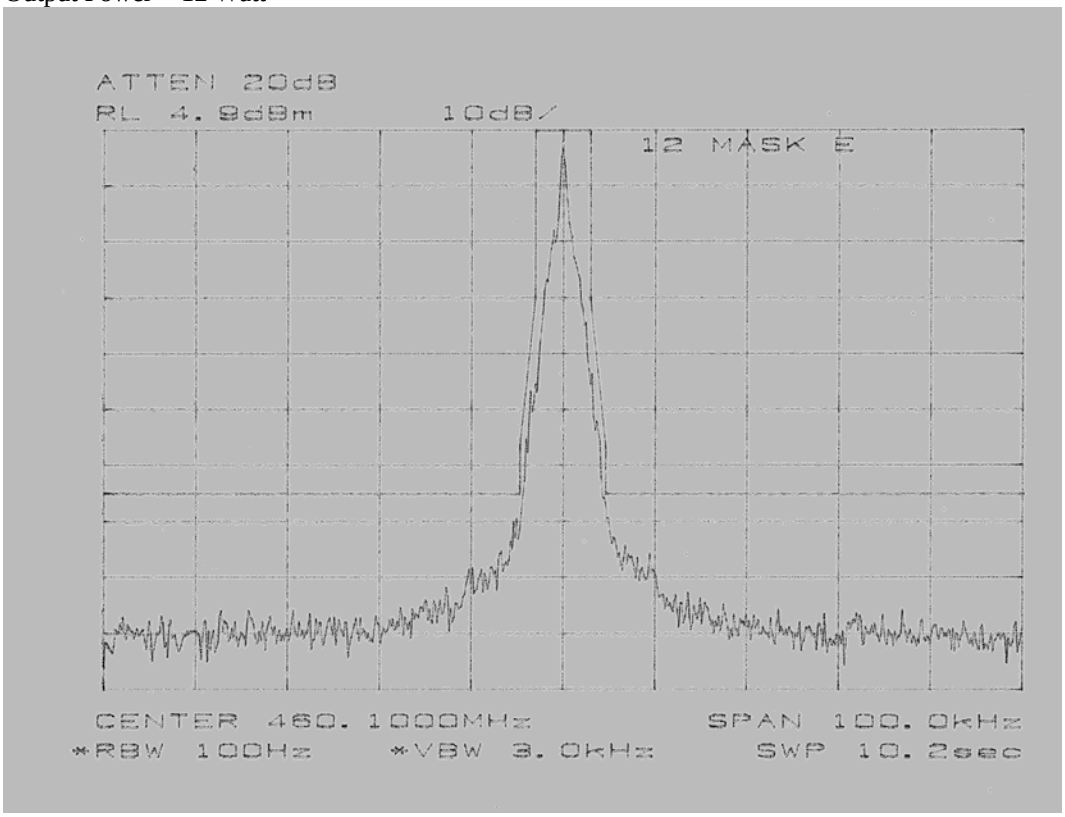
Output Power = 12 Watt



Mask: E, 1W Spectrum for Emission: 3K55 F1D
Output Power = 1 Watt Data Rate: 8 kbps Peak Deviation with Data: 970 Hz



Output Power = 12 Watt



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

RULE PART NUMBER: FCC: 2.202, 90.209 (b)(5), 90.210(d), 2.1049 (c) (1)
IC: RSS-119 5.8.3

MINIMUM STANDARDS: **Mask D**
Sidebands and Spurious [Rule 90.210 (d), 5.8.3, P = 12 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 @ 12 W
Attenuation = 50 dB at frequencies greater than 12.5 kHz @ 1 W

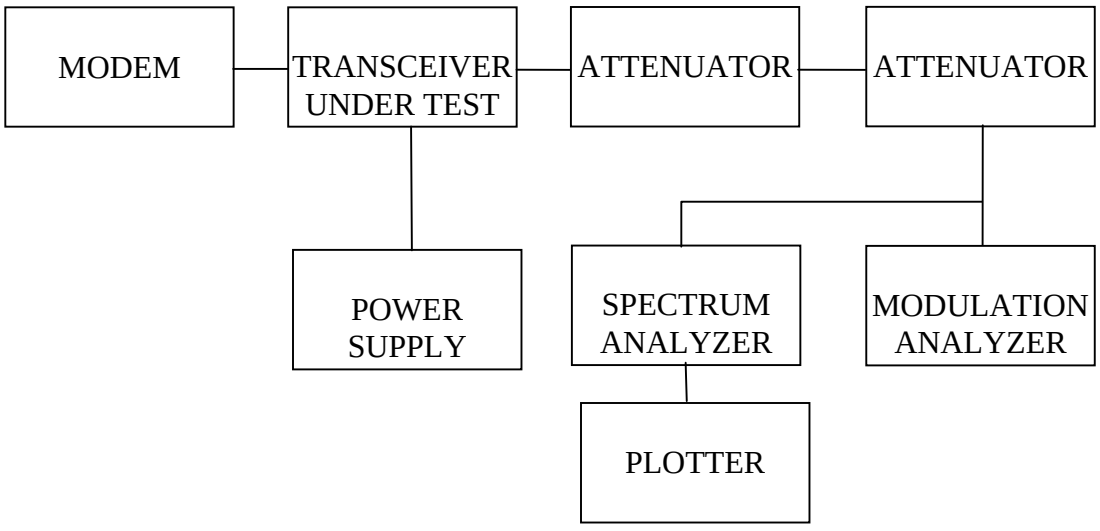
TEST RESULTS: Meets minimum standards (see data on following page)

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

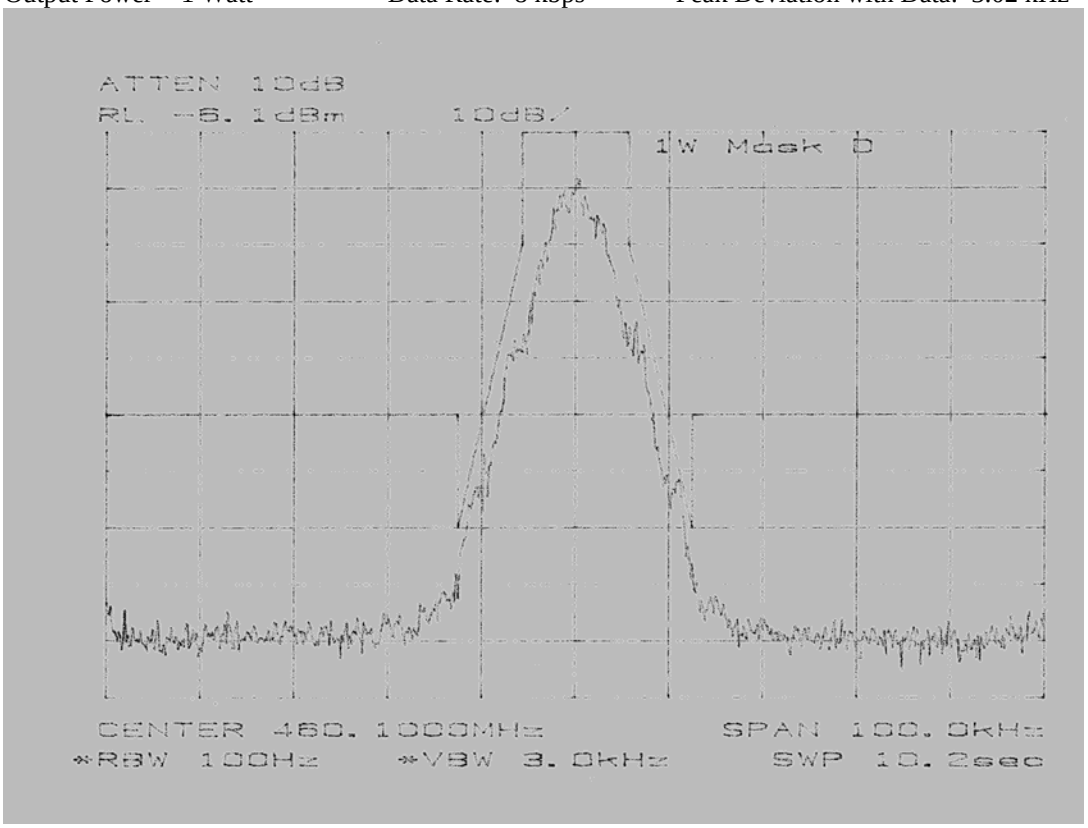
TEST PROCEDURE: TIA/EIA – 603-B, 2.2.13, 3.2.11.2

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-3303
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901B

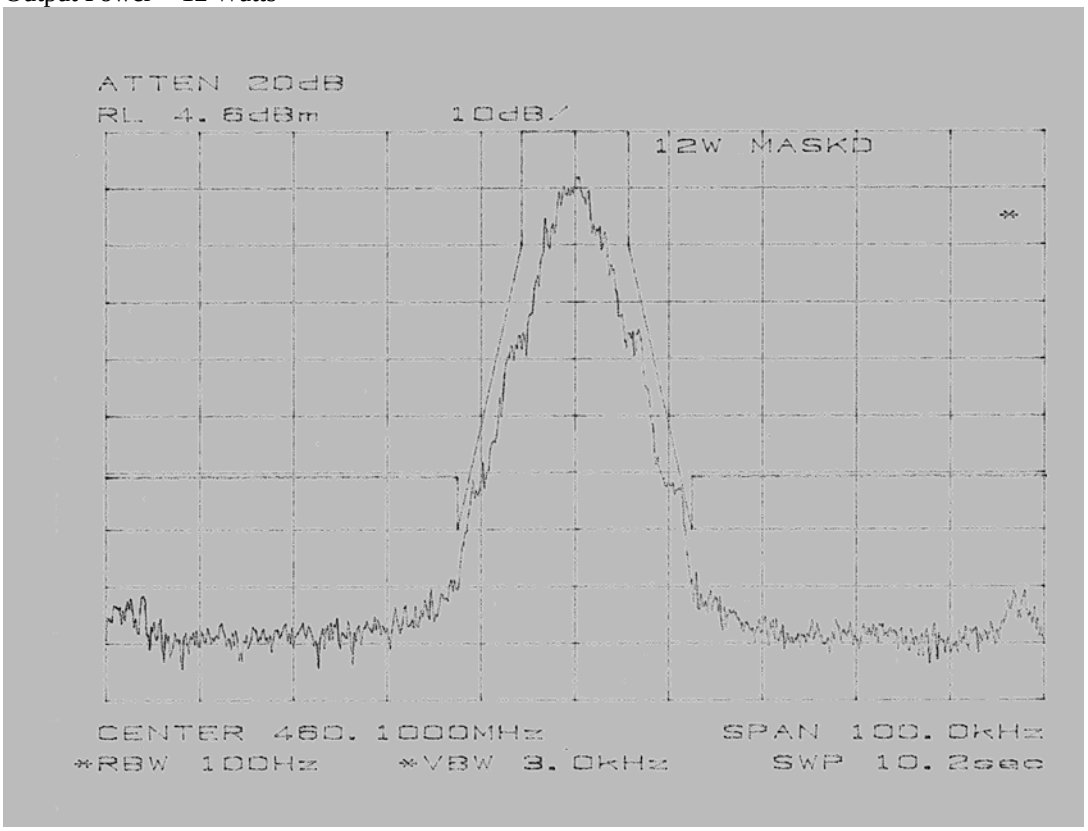
TEST SET-UP:



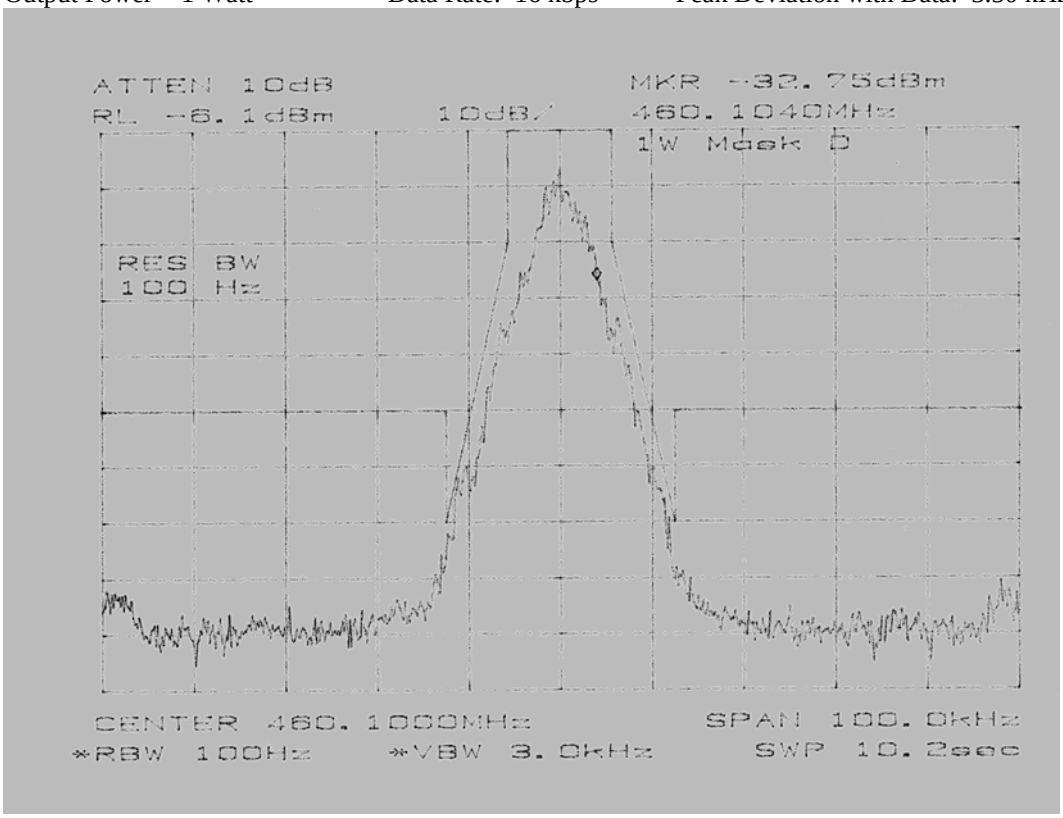
Mask: D, 1W Spectrum for Emission: 8K20 F1D
Output Power = 1 Watt Data Rate: 8 kbps Peak Deviation with Data: 3.02 kHz



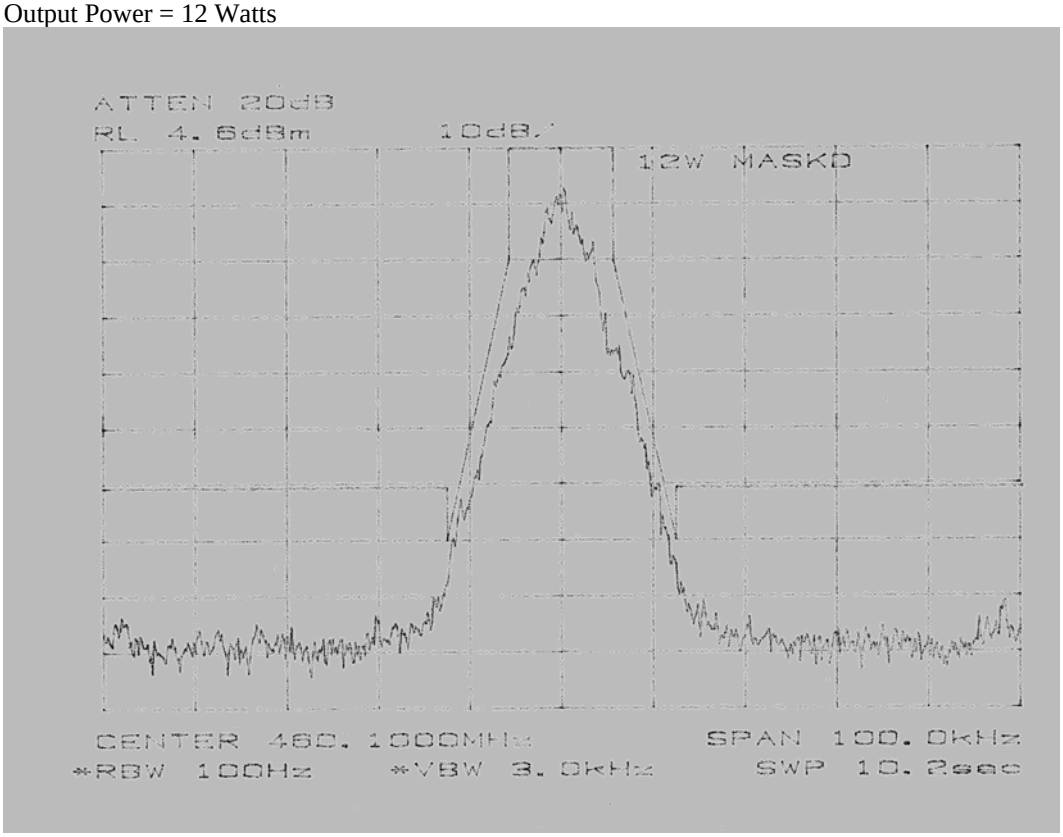
Output Power = 12 Watts



Mask: D, 1W Spectrum for Emission: 8K30 F1D
Output Power = 1 Watt Data Rate: 16 kbps Peak Deviation with Data: 3.50 kHz



Output Power = 12 Watts



NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators **16K5F1D** and **16K8F1D**

RULE PART NUMBER: FCC: 2.202, 90.209 (b)(5), 90.210(c), 2.1049 (c) (1)
IC: RSS-119 5.8.2

MINIMUM STANDARDS: **Mask C**
Sidebands and Spurious [Rule 90.210 (c), 5.8.2, P = 12 Watts and P=1 Watt]
Authorized Bandwidth = 20 kHz [Rule 90.209(b) (5), 5.8.2]
From Fo to 5 kHz, down 0 dB.
Greater than 5 kHz to 10 kHz, down 83 * $\log_{10}(f_d / 5)$ dB.
Greater than 10 kHz to 250% of authorized BW, at least
29 * $\log_{10}(f_d^2 / 11)$ or 50 dB, whichever is the lesser attenuation
Greater than 250% of authorized BW, 43 + $10\log_{10}(P)$

Attenuation = 0 dB at Fo to 5 kHz
Attenuation = 25 dB at 10 kHz
Attenuation = 50 dB at 24.1 kHz
Attenuation = 50 dB at 50 kHz
Attenuation = 53.8 dB at frequencies greater than 50 kHz @ 12 W
Attenuation = 43 dB at frequencies greater than 50 kHz @ 1 W

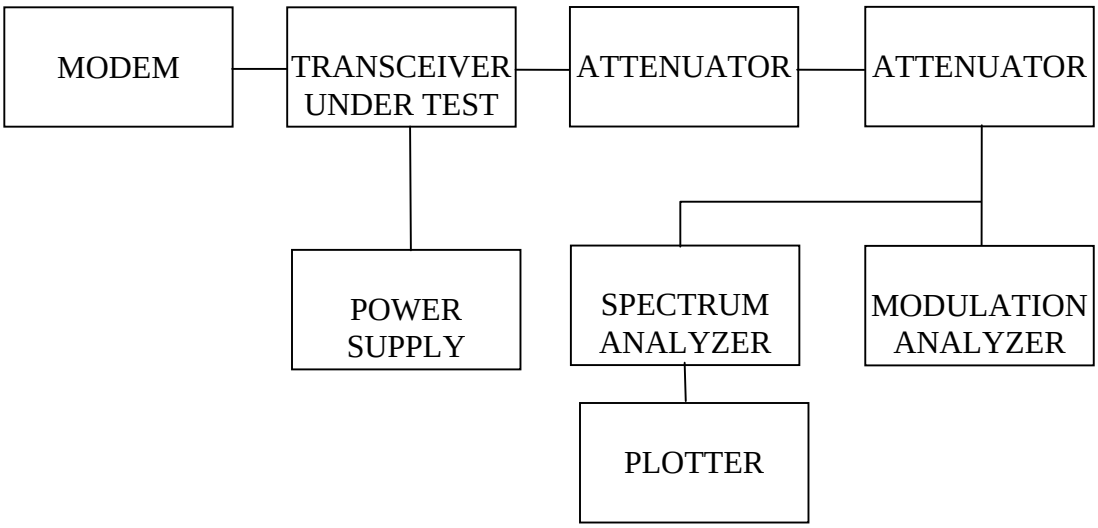
TEST RESULTS: Meets minimum standards (see data on following page)

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

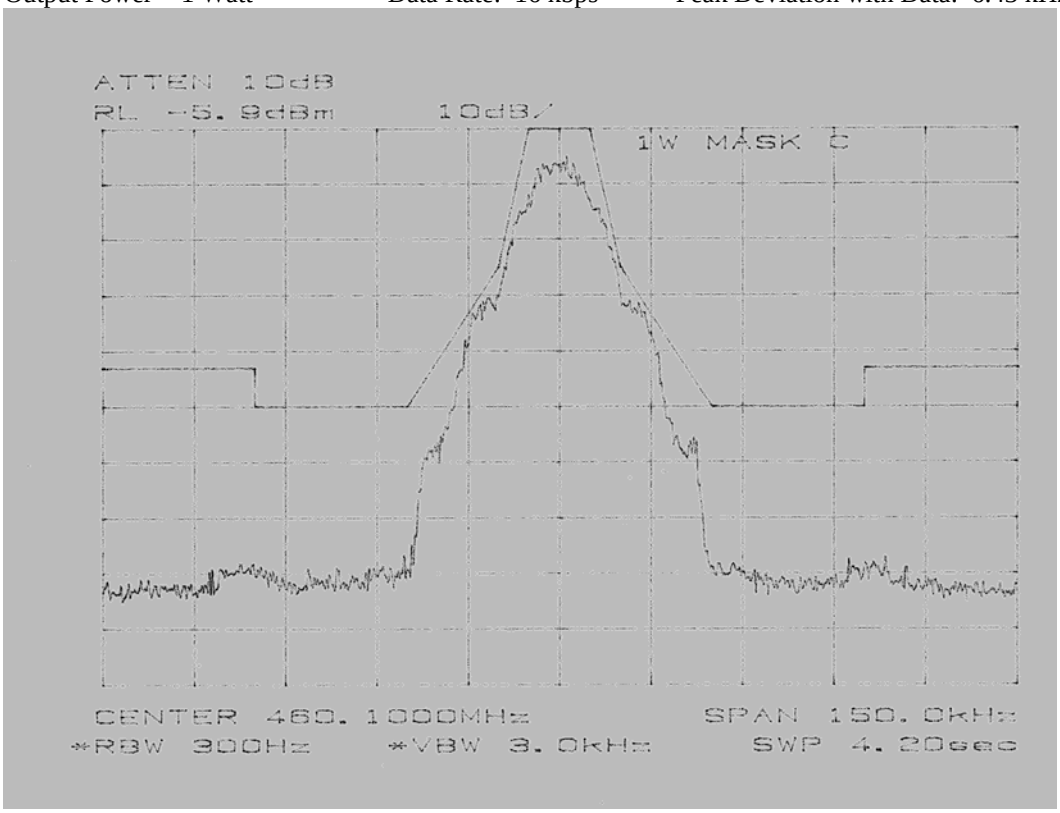
TEST PROCEDURE: TIA/EIA – 603-B, 2.2.13, 3.2.11.2

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-3303
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901B

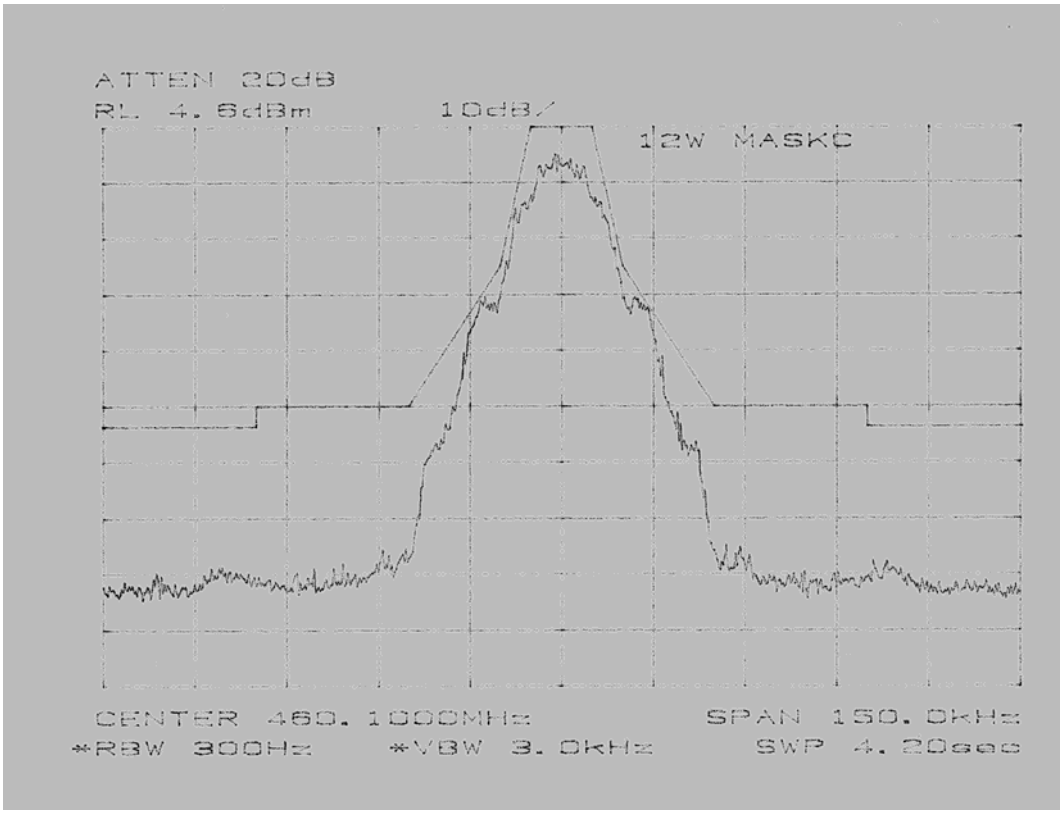
TEST SET-UP:



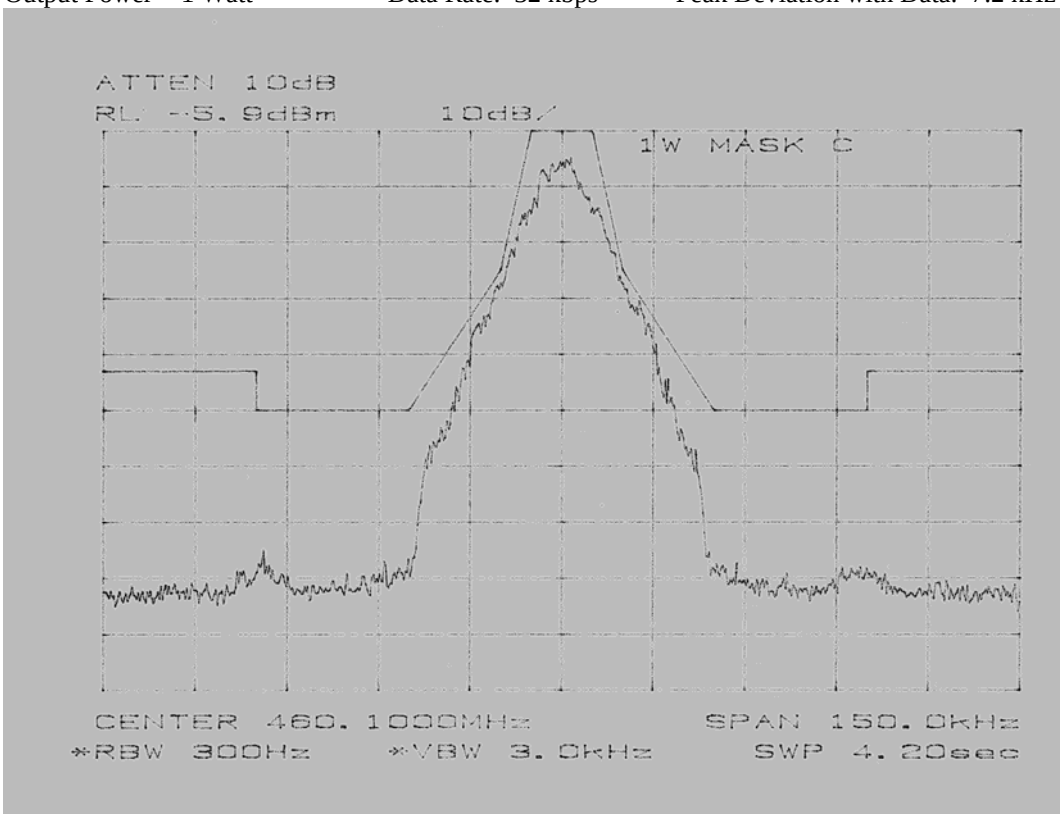
Mask: C, 1W Spectrum for Emission: 16K5 F1D
Output Power = 1 Watt Data Rate: 16 kbps Peak Deviation with Data: 6.43 kHz



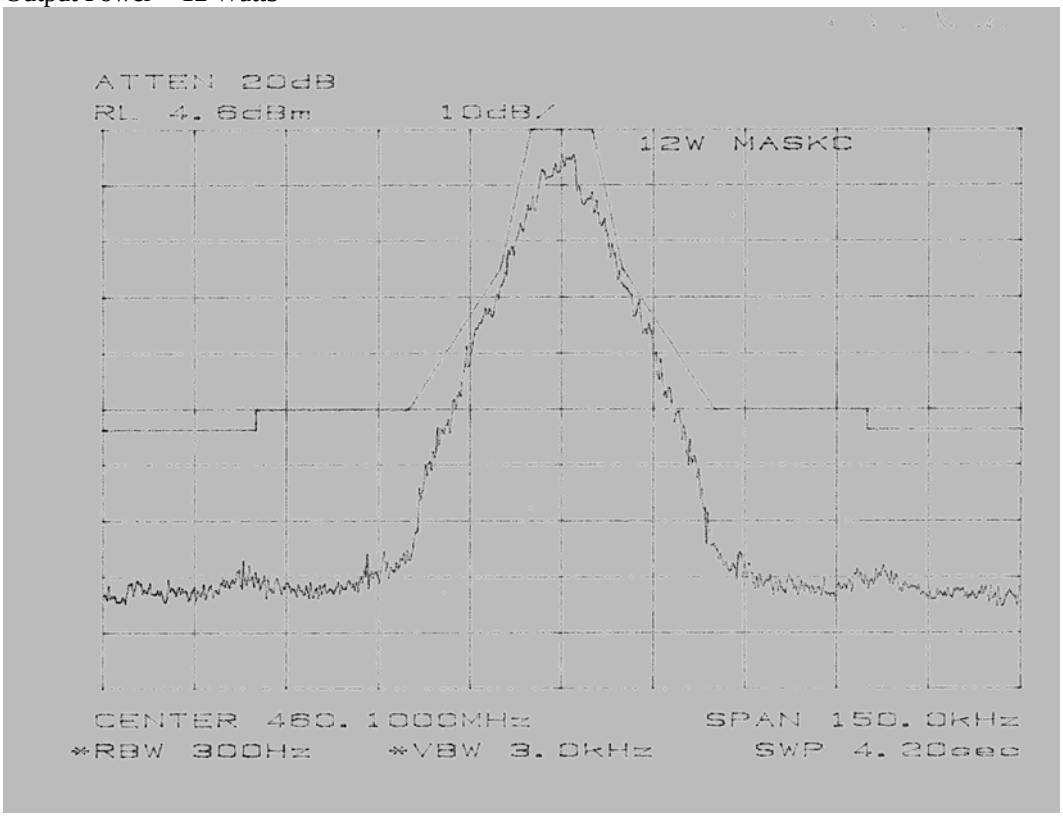
Output Power = 12 Watt


ATTEN 20dB
RL 4.6dBm
10dB/
12W MASK
CENTER 460.1000MHz
SPAN 150.0kHz
*RBW 300Hz
*VBW 3.0kHz
SWP 4.20sec

Mask: C, 1W Spectrum for Emission: 16K8 F1D
Output Power = 1 Watt Data Rate: 32 kbps Peak Deviation with Data: 7.2 kHz



Output Power = 12 WattS



NAME OF TEST: Field Strength of Spurious Radiation

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

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

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

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

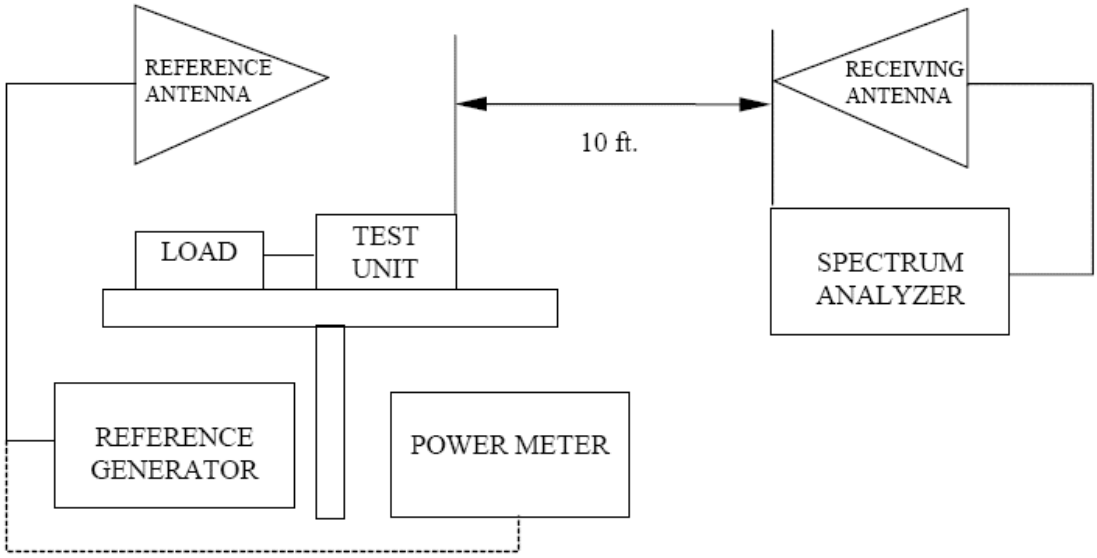
TEST CONDITIONS: Standard Test Conditions, 25 C
RF Power Level = 1 Watt and 12 Watts
Voltage = 20VDC

TEST PROCEDURE: TIA/EIA – 603-B, 2.2.12

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-3303
Spectrum Analyzer, Model HP-8563E
Reference Generator, Agilent Model E82570
Power Meter, Model HP436A
50-Ohm Attenuator, Bird Electronics 50-A-FFN-20 (20dB, 50W)
50-Ohm Load, Lucas Weinschel 58-30-43

MEASUREMENT PROCEDURE:
Radiated spurious attenuation was measured according to TIA/EIA Standard 603-B Section 2.2.12

TEST SET-UP:



Half Duplex Radio

Frequency: 406.125 MHz

Power: 12 Watts

Spec = -65.0

Highest Spur = -82.8

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
812.250	H	-95.0	-58.0	2.33	-0.46	-101.6
	V	-92.5	-51.2	2.33	-0.46	-94.8
1218.375	H	-92.7	-53.0	2.67	2.75	-93.7
	V	-94.7	-60.0	2.67	2.75	-100.7
1624.500	H	-97.7	-61.5	3.50	4.75	-101.0
	V	-99.8	-63.2	3.50	4.75	-102.7
2030.625	H	-98.8	-61.0	4.00	4.95	-100.8
	V	-94.7	-54.7	4.00	4.95	-94.5
2436.750	H	-95.7	-56.0	5.00	5.55	-96.2
	V	-92.2	-50.8	5.00	5.55	-91.1
2842.875	H	-101.0	-59.5	5.17	5.75	-99.7
	V	-98.7	-57.3	5.17	5.75	-97.6
3249.000	H	-97.8	-55.3	5.17	5.75	-95.5
	V	-99.2	-54.7	5.17	5.75	-94.9
3655.125	H	-92.3	-47.8	5.67	5.95	-88.3
	V	-88.3	-42.3	5.67	5.95	-82.8
4061.250	H	-100.8	-52.6	7.33	5.95	-94.8
	V	-99.5	-50.5	7.33	5.95	-92.7
4467.375	H	-102.5	-54.7	7.17	7.05	-95.6
	V	-97.2	-49.0	7.17	7.05	-89.9
4873.500	H	-102.2	-52.9	7.50	6.75	-94.4
	V	-101.8	-52.0	7.50	6.75	-93.5
5279.625	H	-101.0	-49.7	8.33	6.75	-92.0
	V	-100.2	-48.5	8.33	6.75	-90.9
5685.750	H	-102.0	-48.7	9.50	6.85	-92.1
	V	-100.0	-47.2	9.50	6.85	-90.6
6091.875	H	-102.2	-48.0	9.50	7.35	-91.0
	V	-102.8	-48.8	9.50	7.35	-91.7
6498.000	H	-101.7	-46.9	10.17	7.95	-89.9
	V	-101.5	-47.0	10.17	7.95	-90.0
6904.125	H	-102.7	-45.7	11.17	7.75	-89.9
	V	-102.8	-46.3	11.17	7.75	-90.5
7310.250	H	-103.0	-42.0	11.50	7.45	-86.8
	V	-101.8	-41.1	11.50	7.45	-86.0
7716.375	H	-101.5	-41.5	11.33	7.45	-86.2
	V	-102.2	-41.2	11.33	7.45	-85.9
8122.500	H	-102.8	-41.0	12.33	7.55	-86.5

	V	-103.3	-41.1	12.33	7.55	-86.7

Half Duplex Radio

Frequency: 451.025 MHz

Power: 12 Watts

Spec = -65.0

Highest Spur = -79.9

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
902.05	H	-93.8	-57.3	2.50	-0.51	-101.1
	V	-95.7	-56.8	2.50	-0.51	-100.6
1353.075	H	-99.7	-63.8	3.50	4.75	-103.4
	V	-101.2	-67.2	3.50	4.75	-106.7
1804.1	H	-98.3	-60.8	3.67	4.95	-100.3
	V	-97.2	-59.7	3.67	4.95	-99.2
2255.125	H	-94.2	-55.0	4.33	5.55	-94.6
	V	-82.3	-40.3	4.33	5.55	-79.9
2706.15	H	-104.5	-63.5	5.17	5.55	-103.9
	V	-104.8	-64.5	5.17	5.55	-104.9
3157.175	H	-98.8	-53.7	5.50	5.75	-94.2
	V	-93.7	-50.8	5.50	5.75	-91.4
3608.2	H	-97.5	-52.3	6.00	5.95	-93.2
	V	-96.8	-52.3	6.00	5.95	-93.2
4059.225	H	-105.3	-58.8	7.00	5.95	-100.6
	V	-105.8	-57.1	7.00	5.95	-99.0
4510.25	H	-99.2	-51.3	7.67	7.05	-92.8
	V	-96.8	-48.5	7.67	7.05	-89.9
4961.275	H	-104.8	-56.0	8.00	6.75	-98.0
	V	-104.0	-56.5	8.00	6.75	-98.5
5412.3	H	-102.3	-50.8	8.67	6.85	-93.4
	V	-103.8	-53.0	8.67	6.85	-95.6
5863.325	H	-97.8	-45.2	9.50	7.35	-88.1
	V	-93.3	-41.2	9.50	7.35	-84.1
6314.35	H	-100.0	-45.3	10.33	7.95	-88.5
	V	-96.2	-41.8	10.33	7.95	-85.0
6765.375	H	-105.3	-49.6	10.50	7.75	-93.2
	V	-105.0	-49.3	10.50	7.75	-92.9
7216.4	H	-103.2	-44.2	11.50	7.75	-88.7
	V	-96.7	-37.7	11.50	7.75	-82.2
7667.425	H	-105.8	-45.1	12.17	7.45	-90.6
	V	-104.5	-44.0	12.17	7.45	-89.5
8118.45	H	-105.3	-44.5	12.50	7.55	-90.2
	V	-100.2	-39.2	12.50	7.55	-84.9
8569.475	H	-104.7	-42.7	13.50	7.75	-89.2

	V	-105.3	-43.6	13.50	7.75	-90.2
9020.5	H	-104.2	-39.7	14.17	7.95	-86.7
	V	-105.3	-42.6	14.17	7.95	-89.6

Full Duplex Radio

Frequency: 460.1 MHz Spec = -65.0

Power: 12 Watts Highest Spur = -81.5

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
920.2	H	-103.0	-67.0	2.17	-0.48	-110.4
	V	-103.0	-63.0	2.17	-0.48	-106.4
1380.3	H	-93.8	-58.5	3.17	4.75	-97.7
	V	-95.2	-57.8	3.17	4.75	-97.1
1840.4	H	-98.3	-57.8	3.67	4.95	-97.3
	V	-100.8	-62.8	3.67	4.95	-102.3
2300.5	H	-95.5	-56.0	4.50	5.55	-95.7
	V	-93.0	-53.0	4.50	5.55	-92.7
2760.6	H	-102.7	-60.0	5.00	5.75	-100.1
	V	-102.0	-60.0	5.00	5.75	-100.0
3220.7	H	-99.7	-57.3	5.50	5.75	-97.9
	V	-97.5	-53.0	5.50	5.75	-93.5
3680.8	H	-87.8	-43.2	5.83	5.95	-83.8
	V	-90.8	-44.3	5.83	5.95	-85.0
4140.9	H	-87.5	-39.8	7.67	5.95	-82.3
	V	-87.8	-39.0	7.67	5.95	-81.5
4601.0	H	-97.7	-49.7	7.33	7.05	-90.7
	V	-97.2	-48.3	7.33	7.05	-89.4
5061.1	H	-102.5	-52.8	7.83	6.75	-94.7
	V	-103.0	-53.5	7.83	6.75	-95.4
5521.2	H	-97.8	-45.5	9.00	6.85	-88.4
	V	-99.5	-47.7	9.00	6.85	-90.6
5981.3	H	-102.7	-49.7	9.50	7.35	-92.6
	V	-102.3	-49.1	9.50	7.35	-92.1
6441.4	H	-103.0	-48.3	9.83	7.95	-91.0
	V	-102.0	-47.5	9.83	7.95	-90.2
6901.5	H	-102.0	-45.0	11.00	7.75	-89.0
	V	-102.0	-45.5	11.00	7.75	-89.5
7361.6	H	-103.0	-40.2	11.67	7.45	-85.2
	V	-102.8	-41.8	11.67	7.45	-86.8
7821.7	H	-102.2	-39.7	12.00	7.55	-84.9
	V	-102.2	-40.2	12.00	7.55	-85.4
8281.8	H	-102.2	-39.0	12.33	7.75	-84.4

	V	-102.3	-39.8	12.33	7.75	-85.2
8741.9	H	-102.7	-38.2	12.83	7.75	-84.1
	V	-102.8	-38.8	12.83	7.75	-84.7
9202.0	H	-102.8	-36.6	13.67	7.95	-83.1
	V	-103.0	-37.3	13.67	7.95	-83.8

Half Duplex Radio

Frequency: 469.975 MHz Spec = -65.0

Power: 12 Watts Highest Spur = -66.2

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
939.950	H	-96.8	-60.0	2.33	-0.54	-103.7
	V	-93.3	-54.2	2.33	-0.54	-97.8
1409.925	H	-86.7	-50.2	3.17	4.75	-89.4
	V	-90.7	-56.8	3.17	4.75	-96.1
1879.900	H	-97.7	-58.7	4.17	4.95	-98.7
	V	-96.0	-56.7	4.17	4.95	-96.7
2349.875	H	-99.8	-58.8	4.50	5.55	-98.6
	V	-96.7	-55.8	4.50	5.55	-95.6
2819.850	H	-102.8	-61.0	5.00	5.75	-101.0
	V	-99.0	-59.2	5.00	5.75	-99.2
3289.825	H	-89.5	-46.5	5.67	5.95	-87.0
	V	-87.7	-43.8	5.67	5.95	-84.4
3759.800	H	-97.8	-52.8	6.17	5.95	-93.8
	V	-94.5	-47.0	6.17	5.95	-88.0
4229.775	H	-73.5	-23.7	7.67	5.95	-66.2
	V	-73.0	-25.7	7.67	5.95	-68.2
4699.750	H	-99.0	-49.7	7.67	7.05	-91.1
	V	-90.5	-41.3	7.67	7.05	-82.7
5169.725	H	-100.8	-50.5	8.17	6.75	-92.7
	V	-100.0	-49.8	8.17	6.75	-92.0
5639.700	H	-98.5	-45.8	9.50	6.85	-89.3
	V	-98.8	-46.7	9.50	6.85	-90.1
6109.675	H	-103.5	-49.7	9.83	7.35	-92.9
	V	-102.2	-48.5	9.83	7.35	-91.8
6579.650	H	-103.3	-48.8	10.33	7.95	-92.0
	V	-103.0	-48.8	10.33	7.95	-92.0
7049.625	H	-102.7	-45.0	11.17	7.75	-89.2
	V	-102.5	-45.3	11.17	7.75	-89.5
7519.600	H	-102.7	-41.2	12.00	7.45	-86.5
	V	-102.5	-41.8	12.00	7.45	-87.2
7989.575	H	-101.5	-40.5	12.83	7.55	-86.6

	V	-100.2	-39.5	12.83	7.55	-85.6
8459.550	H	-101.5	-38.7	13.00	7.75	-84.7
	V	-102.7	-40.2	13.00	7.75	-86.2
8929.525	H	-101.5	-36.7	14.00	7.95	-83.5
	V	-103.2	-39.7	14.00	7.95	-86.5
9399.500	H	-101.5	-34.7	15.67	8.05	-83.1
	V	-103.0	-37.5	15.67	8.05	-85.9

Half Duplex Radio

Frequency: 511.975 MHz

Power: 12 Watts

Spec = -65.0

Highest Spur = -78.2

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
1023.950	H	-91.3	-58.5	2.67	2.75	-99.2
	V	-86.3	-51.2	2.67	2.75	-91.9
1535.925	H	-96.8	-60.8	3.17	4.75	-100.0
	V	-98.8	-64.2	3.17	4.75	-103.4
2047.900	H	-100.2	-61.5	4.50	4.95	-101.9
	V	-98.0	-56.8	4.50	4.95	-97.2
2559.875	H	-99.5	-56.0	4.83	5.55	-96.1
	V	-102.5	-57.2	4.83	5.55	-97.2
3071.850	H	-100.3	-53.5	5.33	5.75	-93.8
	V	-101.5	-57.7	5.33	5.75	-98.0
3583.825	H	-91.2	-46.2	5.67	5.95	-86.7
	V	-89.5	-45.0	5.67	5.95	-85.5
4095.800	H	-96.8	-48.8	7.67	5.95	-91.3
	V	-92.2	-43.0	7.67	5.95	-85.5
4607.775	H	-96.8	-48.7	7.17	7.05	-89.6
	V	-96.7	-48.0	7.17	7.05	-88.9
5119.750	H	-92.8	-42.3	7.83	6.75	-84.2
	V	-92.0	-42.2	7.83	6.75	-84.0
5631.725	H	-102.3	-49.0	9.17	6.85	-92.1
	V	-104.7	-52.0	9.17	6.85	-95.1
6143.700	H	-95.3	-40.7	9.67	7.35	-83.8
	V	-96.3	-42.3	9.67	7.35	-85.4
6655.675	H	-102.5	-47.0	9.67	7.95	-89.5
	V	-103.5	-48.2	9.67	7.95	-90.7
7167.650	H	-101.5	-41.5	11.67	7.75	-86.2
	V	-101.7	-42.4	11.67	7.75	-87.1
7679.625	H	-102.0	-41.0	11.83	7.45	-86.2
	V	-103.0	-42.0	11.83	7.45	-87.2
8191.600	H	-97.0	-34.5	11.83	7.55	-79.6

	V	-95.3	-33.2	11.83	7.55	-78.2
8703.575	H	-102.7	-38.2	12.67	7.75	-83.9
	V	-102.5	-38.7	12.67	7.75	-84.4
9215.550	H	-102.7	-36.4	13.67	7.95	-82.9
	V	-103.5	-37.7	13.67	7.95	-84.2
9727.525	H	-101.5	-32.5	15.83	8.05	-81.1
	V	-102.7	-34.4	15.83	8.05	-82.9
10239.500	H	-103.0	-28.7	17.50	8.05	-78.9
	V	-102.7	-28.9	17.50	8.05	-79.1

Half Duplex Radio

Frequency: 406.125 MHz Spec = -55.0

Power: 1 Watts Highest Spur = -86.3

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
812.250	H	-98.7	-61.7	2.17	-0.46	-94.3
	V	-97.3	-56.0	2.17	-0.46	-88.6
1218.375	H	-93.5	-53.8	3.17	-2.15	-89.2
	V	-96.2	-61.5	3.17	-2.15	-96.8
1624.500	H	-102.2	-66.0	3.67	-2.15	-101.9
	V	-99.0	-62.3	3.67	-2.15	-98.2
2030.625	H	-101.5	-63.7	4.50	-2.15	-100.3
	V	-102.5	-62.5	4.50	-2.15	-99.2
2436.750	H	-98.2	-58.5	5.00	-2.15	-95.7
	V	-102.5	-61.2	5.00	-2.15	-98.3
2842.875	H	-101.8	-60.3	5.50	-2.15	-98.0
	V	-101.9	-60.6	5.50	-2.15	-98.2
3249.000	H	-102.2	-59.7	5.83	-2.15	-97.7
	V	-102.3	-57.8	5.83	-2.15	-95.8
3655.125	H	-102.7	-58.2	7.67	-2.15	-98.0
	V	-102.5	-56.5	7.67	-2.15	-96.3
4061.250	H	-100.8	-52.6	7.33	-2.15	-92.1
	V	-99.5	-50.5	7.33	-2.15	-90.0
4467.375	H	-103.5	-55.7	7.83	-2.15	-95.7
	V	-101.3	-53.1	7.83	-2.15	-93.1
4873.500	H	-103.0	-53.7	9.00	-2.15	-94.8
	V	-102.0	-52.2	9.00	-2.15	-93.3
5279.625	H	-102.3	-51.0	9.50	-2.15	-92.6
	V	-102.5	-50.8	9.50	-2.15	-92.5
5685.750	H	-103.3	-50.0	9.83	-2.15	-92.0
	V	-102.0	-49.2	9.83	-2.15	-91.2
6091.875	H	-102.5	-48.3	11.00	-2.15	-91.5

	V	-103.7	-49.7	11.00	-2.15	-92.9
6498.000	H	-102.8	-48.0	11.67	-2.15	-91.8
	V	-102.0	-47.5	11.67	-2.15	-91.3
6904.125	H	-101.7	-44.7	12.00	-2.15	-88.9
	V	-102.7	-46.2	12.00	-2.15	-90.4
7310.250	H	-102.8	-41.8	12.33	-2.15	-86.3
	V	-102.5	-41.8	12.33	-2.15	-86.3
7716.375	H	-102.7	-42.7	12.83	-2.15	-87.7
	V	-102.3	-41.3	12.83	-2.15	-86.3
8122.500	H	-103.2	-41.4	13.67	-2.15	-87.2
	V	-102.7	-40.5	13.67	-2.15	-86.4

Half Duplex Radio

Frequency: 451.025 MHz Spec = -55.0

Power: 1 Watts Highest Spur = -73.6

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
902.05	H	-98.7	-62.2	2.50	-0.51	-95.2
	V	-95.8	-57.0	2.50	-0.51	-90.0
1353.075	H	-103.8	-68.0	3.50	4.75	-96.7
	V	-104.0	-70.0	3.50	4.75	-98.8
1804.1	H	-101.2	-63.7	3.67	4.95	-92.4
	V	-100.2	-62.7	3.67	4.95	-91.4
2255.125	H	-106.0	-66.8	4.33	5.55	-95.6
	V	-102.2	-60.2	4.33	5.55	-89.0
2706.15	H	-104.8	-63.8	5.17	5.55	-93.4
	V	-104.0	-63.7	5.17	5.55	-93.3
3157.175	H	-105.3	-60.1	5.50	5.75	-89.9
	V	-101.5	-58.7	5.50	5.75	-88.4
3608.2	H	-106.0	-60.8	6.00	5.95	-90.9
	V	-104.0	-59.5	6.00	5.95	-89.6
4059.225	H	-104.7	-58.2	7.00	5.95	-89.3
	V	-104.0	-55.3	7.00	5.95	-86.4
4510.25	H	-105.0	-57.2	7.67	7.05	-87.8
	V	-100.3	-52.0	7.67	7.05	-82.6
4961.275	H	-106.0	-57.2	8.00	6.75	-88.4
	V	-104.0	-56.5	8.00	6.75	-87.8
5412.3	H	-102.8	-51.3	8.67	6.85	-83.1
	V	-102.2	-51.4	8.67	6.85	-83.2
5863.325	H	-105.7	-53.0	9.50	7.35	-85.2
	V	-104.0	-51.8	9.50	7.35	-84.0
6314.35	H	-99.2	-44.5	10.33	7.95	-76.9

	V	-95.5	-41.2	10.33	7.95	-73.6
6765.375	H	-105.0	-49.3	10.50	7.75	-82.1
	V	-104.0	-48.3	10.50	7.75	-81.1
7216.4	H	-102.8	-43.8	11.50	7.75	-77.6
	V	-100.3	-41.3	11.50	7.75	-75.1
7667.425	H	-105.7	-45.0	12.17	7.45	-79.8
	V	-104.0	-43.5	12.17	7.45	-78.2
8118.45	H	-105.8	-45.0	12.50	7.55	-79.9
	V	-100.7	-39.7	12.50	7.55	-74.7
8569.475	H	-106.2	-44.2	13.50	7.75	-80.0
	V	-104.0	-42.3	13.50	7.75	-78.1
9020.5	H	-105.5	-41.0	14.17	7.95	-77.2
	V	-104.0	-41.3	14.17	7.95	-77.6

Full Duplex Radio

Frequency: 460.1 MHz Spec = -55.0

Power: 1 Watts Highest Spur = -71.6

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
920.2	H	-102.5	-66.5	2.17	-0.48	-99.2
	V	-103.0	-63.0	2.17	-0.48	-95.7
1380.3	H	-102.5	-67.2	3.17	4.75	-95.6
	V	-102.5	-65.2	3.17	4.75	-93.6
1840.4	H	-102.5	-62.0	3.67	4.95	-90.7
	V	-102.5	-64.5	3.67	4.95	-93.2
2300.5	H	-102.5	-63.0	4.50	5.55	-92.0
	V	-102.5	-62.5	4.50	5.55	-91.5
2760.6	H	-102.3	-59.6	5.00	5.75	-88.9
	V	-101.8	-59.8	5.00	5.75	-89.1
3220.7	H	-101.5	-59.2	5.50	5.75	-88.9
	V	-103.2	-58.7	5.50	5.75	-88.5
3680.8	H	-102.8	-58.1	5.83	5.95	-88.0
	V	-102.8	-56.3	5.83	5.95	-86.2
4140.9	H	-103.5	-55.8	7.67	5.95	-87.6
	V	-103.3	-54.5	7.67	5.95	-86.2
4601.0	H	-103.0	-55.0	7.33	7.05	-85.3
	V	-101.8	-53.0	7.33	7.05	-83.3
5061.1	H	-103.5	-53.8	7.83	6.75	-84.9
	V	-103.3	-53.8	7.83	6.75	-84.9
5521.2	H	-98.3	-46.0	9.00	6.85	-78.2
	V	-98.8	-47.0	9.00	6.85	-79.2
5981.3	H	-102.2	-49.2	9.50	7.35	-81.4

	V	-102.7	-49.5	9.50	7.35	-81.7
6441.4	H	-103.0	-48.3	9.83	7.95	-80.2
	V	-102.3	-47.8	9.83	7.95	-79.7
6901.5	H	-102.3	-45.3	11.00	7.75	-78.6
	V	-102.5	-46.0	11.00	7.75	-79.3
7361.6	H	-101.8	-39.0	11.67	7.45	-73.2
	V	-102.7	-41.7	11.67	7.45	-75.9
7821.7	H	-102.0	-39.5	12.00	7.55	-74.0
	V	-102.2	-40.2	12.00	7.55	-74.7
8281.8	H	-102.0	-38.8	12.33	7.75	-73.4
	V	-103.3	-40.8	12.33	7.75	-75.4
8741.9	H	-102.0	-37.5	12.83	7.75	-72.6
	V	-103.0	-39.0	12.83	7.75	-74.1
9202.0	H	-102.0	-35.8	13.67	7.95	-71.6
	V	-102.5	-36.8	13.67	7.95	-72.6

Half Duplex Radio

Frequency: 469.975 MHz

Power: 1 Watts

Spec = -55.0

Highest Spur = -73.1

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
939.950	H	-97.8	-61.0	2.33	-0.54	-93.9
	V	-92.3	-53.2	2.33	-0.54	-86.0
1409.925	H	-102.5	-66.0	3.17	4.75	-94.4
	V	-102.2	-68.4	3.17	4.75	-96.8
1879.900	H	-102.5	-63.5	4.17	4.95	-92.7
	V	-101.8	-62.5	4.17	4.95	-91.7
2349.875	H	-103.0	-62.0	4.50	5.55	-91.0
	V	-101.8	-61.0	4.50	5.55	-89.9
2819.850	H	-102.7	-60.9	5.00	5.75	-90.1
	V	-102.2	-62.4	5.00	5.75	-91.6
3289.825	H	-101.5	-58.5	5.67	5.95	-88.2
	V	-100.2	-56.4	5.67	5.95	-86.1
3759.800	H	-103.7	-58.7	6.17	5.95	-88.9
	V	-103.5	-56.0	6.17	5.95	-86.2
4229.775	H	-102.0	-52.2	7.67	5.95	-83.9
	V	-100.8	-53.5	7.67	5.95	-85.2
4699.750	H	-103.0	-53.7	7.67	7.05	-84.3
	V	-102.8	-53.6	7.67	7.05	-84.3
5169.725	H	-103.0	-52.7	8.17	6.75	-84.1
	V	-102.0	-51.8	8.17	6.75	-83.3
5639.700	H	-103.2	-50.5	9.50	6.85	-83.2

	V	-103.3	-51.1	9.50	6.85	-83.8
6109.675	H	-103.2	-49.4	9.83	7.35	-81.9
	V	-101.8	-48.1	9.83	7.35	-80.6
6579.650	H	-103.0	-48.5	10.33	7.95	-80.9
	V	-101.5	-47.3	10.33	7.95	-79.7
7049.625	H	-102.5	-44.8	11.17	7.75	-78.3
	V	-102.3	-45.1	11.17	7.75	-78.6
7519.600	H	-103.0	-41.5	12.00	7.45	-76.1
	V	-103.5	-42.8	12.00	7.45	-77.4
7989.575	H	-102.2	-41.2	12.83	7.55	-76.5
	V	-102.7	-42.0	12.83	7.55	-77.3
8459.550	H	-103.5	-40.7	13.00	7.75	-75.9
	V	-102.7	-40.2	13.00	7.75	-75.5
8929.525	H	-103.5	-38.7	14.00	7.95	-74.7
	V	-102.7	-39.2	14.00	7.95	-75.3
9399.500	H	-102.3	-35.5	15.67	8.05	-73.1
	V	-103.3	-37.8	15.67	8.05	-75.4

Half Duplex Radio

Frequency: 511.975 MHz

Power: 1 Watts

Spec = -55.0

Highest Spur = -70.5

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
1023.950	H	-99.0	-66.2	2.67	2.75	-96.1
	V	-88.7	-53.5	2.67	2.75	-83.4
1535.925	H	-105.8	-69.8	3.17	4.75	-98.2
	V	-103.5	-68.8	3.17	4.75	-97.3
2047.900	H	-104.0	-65.3	4.50	4.95	-94.9
	V	-104.7	-63.5	4.50	4.95	-93.1
2559.875	H	-105.8	-62.3	4.83	5.55	-91.6
	V	-104.7	-59.4	4.83	5.55	-88.7
3071.850	H	-105.7	-58.9	5.33	5.75	-88.5
	V	-101.5	-57.7	5.33	5.75	-87.3
3583.825	H	-106.0	-61.0	5.67	5.95	-90.7
	V	-105.5	-61.0	5.67	5.95	-90.7
4095.800	H	-101.5	-53.5	7.67	5.95	-85.2
	V	-99.8	-50.7	7.67	5.95	-82.4
4607.775	H	-106.5	-58.3	7.17	7.05	-88.5
	V	-104.5	-55.8	7.17	7.05	-86.0
5119.750	H	-93.0	-42.5	7.83	6.75	-73.6
	V	-90.5	-40.7	7.83	6.75	-71.8
5631.725	H	-106.5	-53.2	9.17	6.85	-85.5

	V	-106.2	-53.5	9.17	6.85	-85.9
6143.700	H	-94.5	-39.8	9.67	7.35	-72.2
	V	-95.3	-41.3	9.67	7.35	-73.7
6655.675	H	-103.0	-47.5	9.67	7.95	-79.2
	V	-105.0	-49.7	9.67	7.95	-81.4
7167.650	H	-104.5	-44.5	11.67	7.75	-78.4
	V	-98.2	-38.8	11.67	7.75	-72.8
7679.625	H	-103.0	-42.0	11.83	7.45	-76.4
	V	-104.0	-43.0	11.83	7.45	-77.4
8191.600	H	-104.0	-41.5	11.83	7.55	-75.8
	V	-104.3	-42.2	11.83	7.55	-76.4
8703.575	H	-105.0	-40.5	12.67	7.75	-75.4
	V	-104.3	-40.5	12.67	7.75	-75.4
9215.550	H	-104.3	-38.0	13.67	7.95	-73.7
	V	-104.0	-38.2	13.67	7.95	-73.9
9727.525	H	-105.5	-36.5	15.83	8.05	-74.3
	V	-104.3	-36.0	15.83	8.05	-73.8
10239.500	H	-105.3	-31.0	17.50	8.05	-70.5
	V	-105.3	-31.5	17.50	8.05	-70.9