CAlamp Wireless Networks Corp.
299 Johnson Avenue, Suite 110
Waseca, MN 56093-0833 USA
Phone: 507-833-8819
Fax: 507-833-6748

FCC Part 90 Certification Application

FCC Form 731

For The

Guardian
VHF RADIO MODEM

FCC ID: NP4-5016-500

TABLE OF CONTENTS

NAME OF TEST: Transmitter Rated Power Output

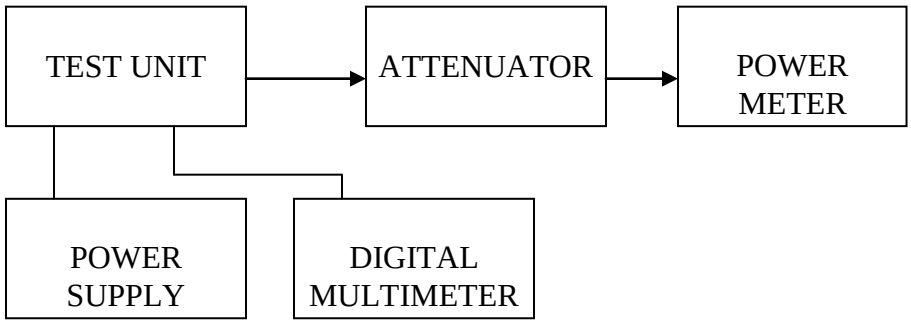
RULE PART NUMBER: FCC: 2.1046 (a) (c)

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 HP437B

TEST SET-UP:



TEST RESULTS:

Frequency (MHz)	DC Voltage at Final (Vdc)	DC Current into Final (Adc)	DC Power into Final (W)	RF Power Output (W)
155.1	12.0	2.34	28.1	12.0
155.1	8.2	0.71	5.8	1.0

NAME OF TEST: Transmitter Spurious and Harmonic Outputs

RULE PART NUMBER: FCC: 2.1051, 90.210 (c,3)(d,3)

MINIMUM STANDARDS: For 12 Watts: $50+10\text{Log}_{10}(12\text{ Watts}) = -60.8$ dBc
or -65dBc, whichever is the lesser attenuation.

For 1 Watt: $50+10\text{Log}_{10}(1\text{ Watt}) = -50$ dBc
or –65 dBc, whichever is the lesser attenuation.

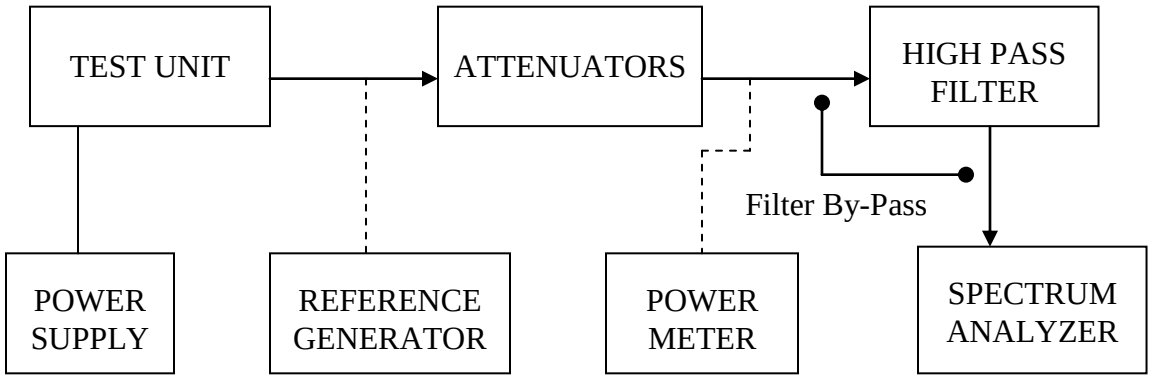
TEST RESULTS: Meets minimum standards (see data on following pages)

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, HP8561B
Power Meter, Model HP437B
Reference Generator, Agilent E8257D
High Pass Filter, Mini Circuits BHP-300

TEST SET-UP:



MEASUREMENT PROCEDURE:

1. The transmitter carrier output frequency is 136.025, 138.025, 150.1, 173.975MHz. The reference oscillator frequency is 23.040 MHz. The power amplifier has voltage levels at 12.0 Volts and 8.3 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	136.025	MHz
Power	12.0	Watts
	40.8	dBm
Min Specification	-60.8	dBc
Worse Case	-75	dBc

Spurious Frequency (MHz)	Harmonic	Relative to Carrier (dBc)
272.050	2	-75
408.075	3	-107
544.100	4	-116
680.125	5	-120
816.150	6	-124
952.175	7	-126
1088.200	8	-123
1224.225	9	-128
1360.250	10	-132

Tuned Frequency	136.025	MHz
Power	1.0	Watts
	30.0	dBm
Min Specification	-50.0	dBc
Worse Case	-69	dBc

Spurious Frequency (MHz)	Harmonic	Relative to Carrier (dBc)
272.050	2	-69
408.075	3	-113
544.100	4	-120
680.125	5	-122
816.150	6	-128
952.175	7	-128
1088.200	8	-128
1224.225	9	-128
1360.250	10	-128

Tuned Frequency	138.025	MHz
Power	12.0	Watts
	40.8	dBm
Min Specification	-60.8	dBc
Worse Case	-81	dBc

Spurious Frequency (MHz)	Harmonic	Relative to Carrier (dBc)
276.050	2	-81
414.075	3	-106
552.100	4	-116
690.125	5	-118
828.150	6	-123
966.175	7	-126
1104.200	8	-126
1242.225	9	-129
1380.250	10	-129

Tuned Frequency	138.025	MHz
Power	1.0	Watts
	30.0	dBm
Min Specification	-50.0	dBc
Worse Case	-71	dBc

Spurious Frequency (MHz)	Harmonic	Relative to Carrier (dBc)
276.050	2	-71
414.075	3	-111
552.100	4	-117
690.125	5	-120
828.150	6	-124
966.175	7	-128
1104.200	8	-128
1242.225	9	-128
1380.250	10	-128

Tuned Frequency	150.1	MHz
Power	12.0	Watts
	40.8	dBm
Min Specification	-60.8	dBc
Worse Case	-96	dBc

Spurious Frequency (MHz)	Harmonic	Relative to Carrier (dBc)
300.200	2	-96
450.300	3	-107
600.400	4	-116
750.500	5	-119
900.600	6	-123
1050.700	7	-125
1200.800	8	-130
1350.900	9	-132
1501.000	10	-134

Tuned Frequency	150.1	MHz
Power	1.0	Watts
	30.0	dBm
Min Specification	-50.0	dBc
Worse Case	-90	dBc

Spurious Frequency (MHz)	Harmonic	Relative to Carrier (dBc)
300.200	2	-90
450.300	3	-110
600.400	4	-118
750.500	5	-121
900.600	6	-123
1050.700	7	-128
1200.800	8	-128
1350.900	9	-128
1501.000	10	-128

Tuned Frequency	173.975	MHz
Power	12.0	Watts
	40.8	dBm
Min Specification	-60.8	dBc
Worse Case	-102	dBc

Spurious Frequency (MHz)	Harmonic	Relative to Carrier (dBc)
347.950	2	-102
521.925	3	-110
695.900	4	-116
869.875	5	-116
1043.850	6	-120
1217.825	7	-123
1391.800	8	-128
1565.775	9	-130
1739.750	10	-129

Tuned Frequency	173.975	MHz
Power	1.0	Watts
	30.0	dBm
Min Specification	-50.0	dBc
Worse Case	-105	dBc

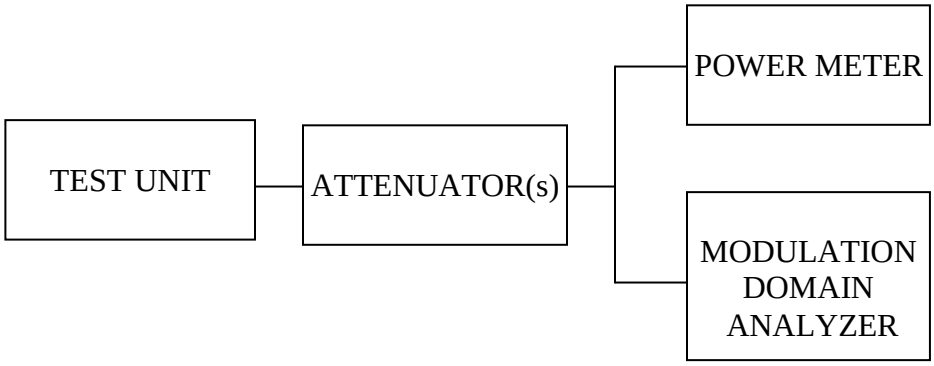
Spurious Frequency (MHz)	Harmonic	Relative to Carrier (dBc)
347.950	2	-105
521.925	3	-110
695.900	4	-117
869.875	5	-120
1043.850	6	-122
1217.825	7	-128
1391.800	8	-128
1565.775	9	-128
1739.750	10	-128

NAME OF TEST: Transient Frequency Behavior

RULE PART NUMBER: FCC: 90.214

MINIMUM STANDARD: 6.25 kHz channel (used worst case numbers from 136 to 174 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

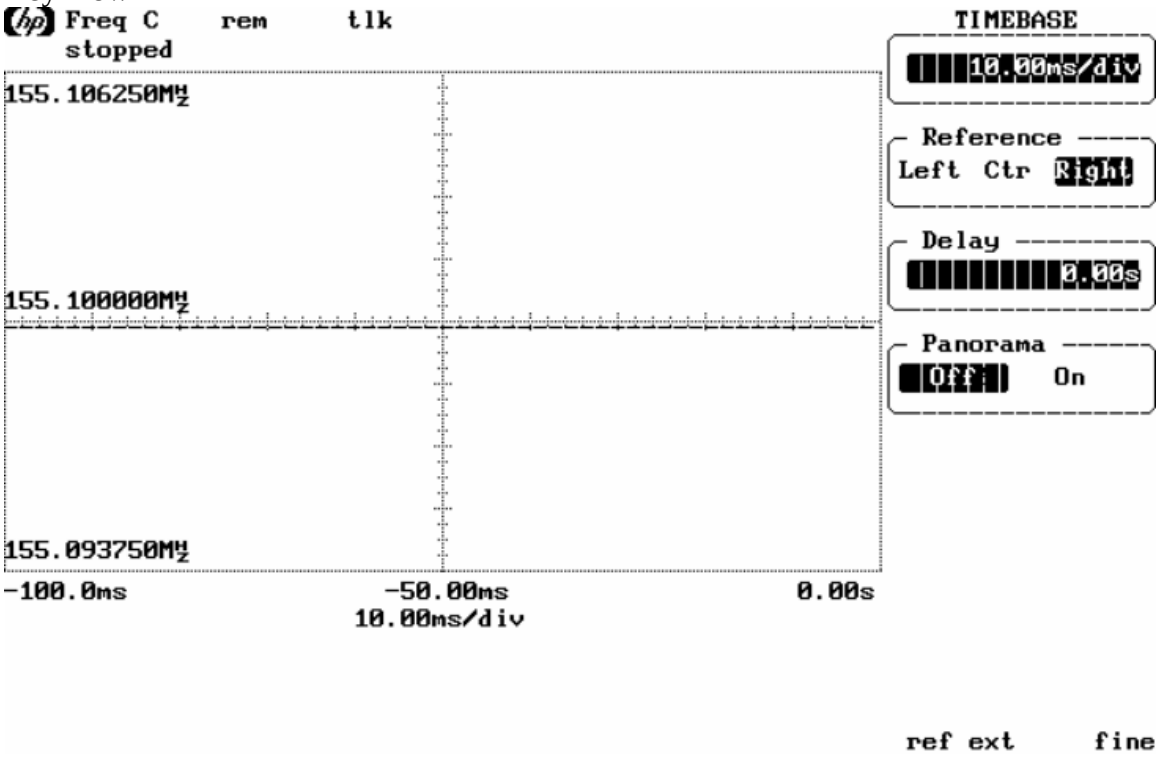
TEST CONDITIONS: RF Power Level = 12 Watts and 1.0 Watt
Standard Test Conditions, 25 C

TEST PROCEDURE: TIA/EIA – 603-C

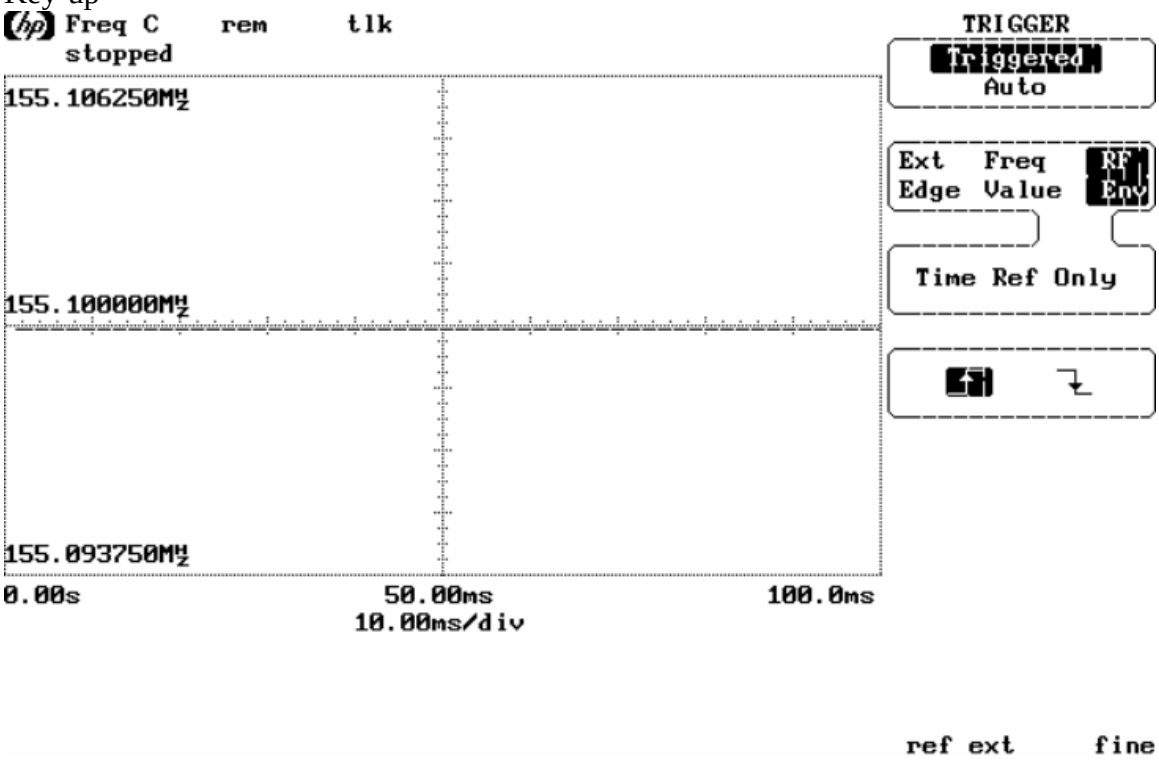
TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics Model 50-A-FFN-20 (20dB, 50W)
50-Ohm Attenuator, Bird Electronics Model 10-A-MFN-10 (10dB, 10W)
Power Supply, Instek Model GPS-2303
Modulation Domain Analyzer, HP-53310A
Power Meter, Model HP436A

Frequency : 155.100000 MHz
Power: 12 W

Key-Down

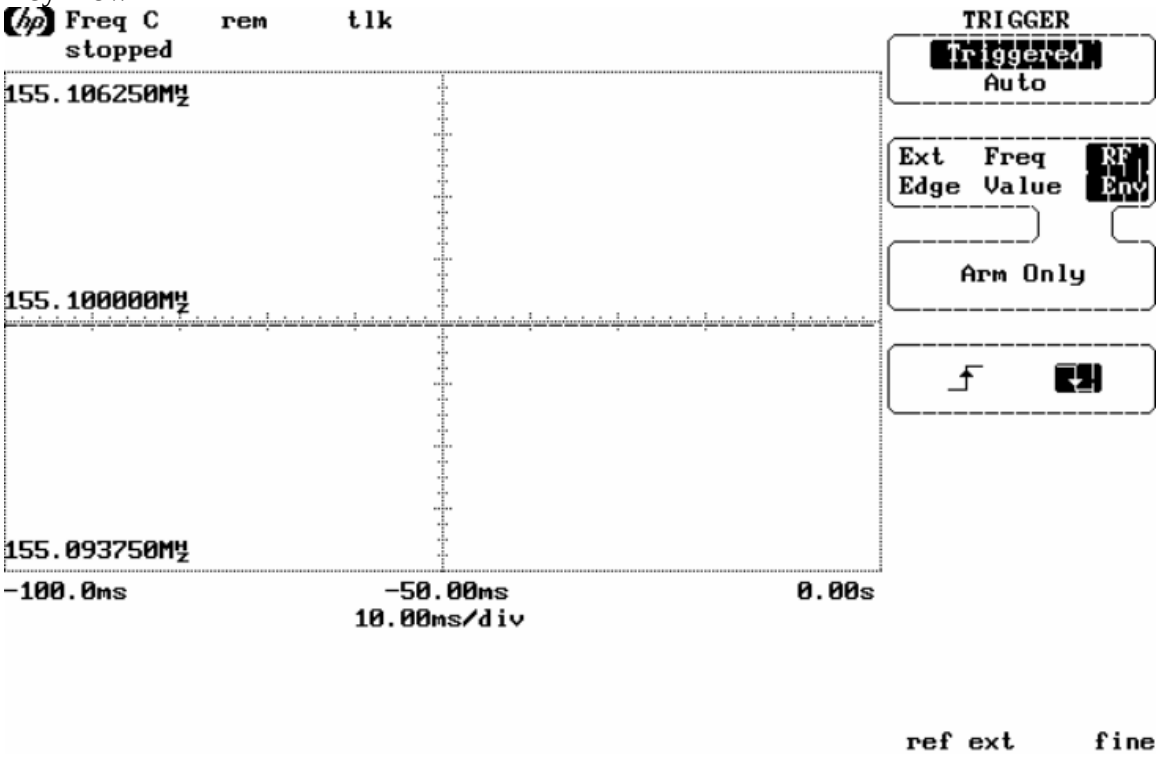


Key-up

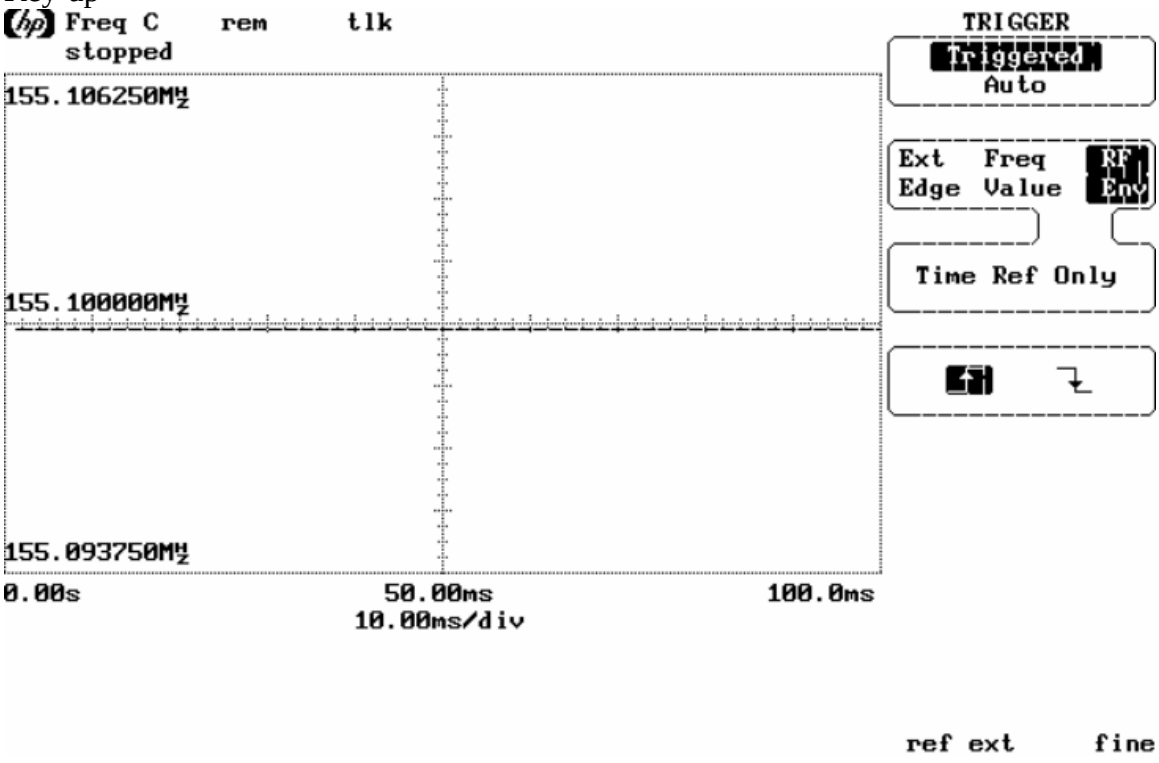


Frequency : 155.100000 MHz
Power: 1.0 W

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)

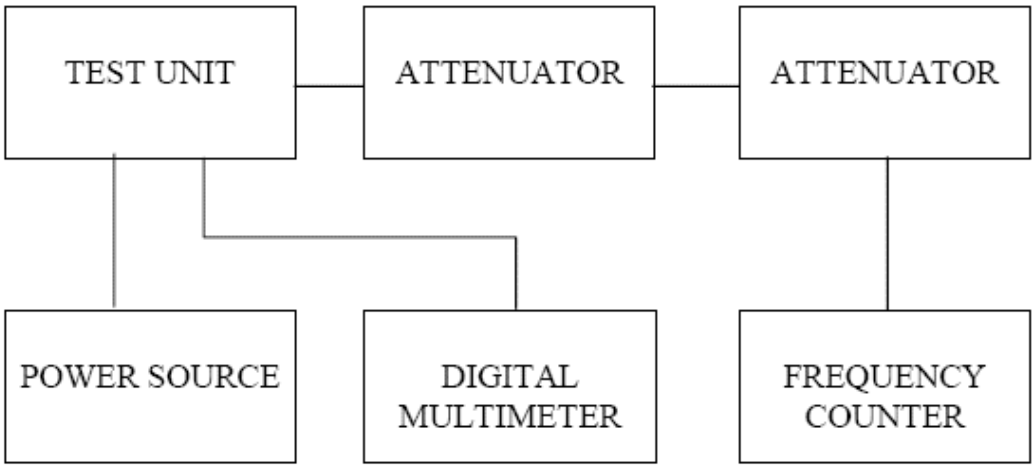
MINIMUM STANDARD: Shall not exceed 1.0 ppm.

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:	155.1	MHz
Tolerance Requirements:	1.0 ppm	
Highest Variation:	0.13	
Spec:	<1.0ppm	

Input Voltage (Vdc)	Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)
10	155.100010	10	0.06
20	155.100010	10	0.06
30	155.100020	20	0.13

NAME OF TEST: Frequency Stability with Variation in Ambient Temperature

RULE PART NUMBER: FCC: 2.1055 (a) (b), 90.213 (a)

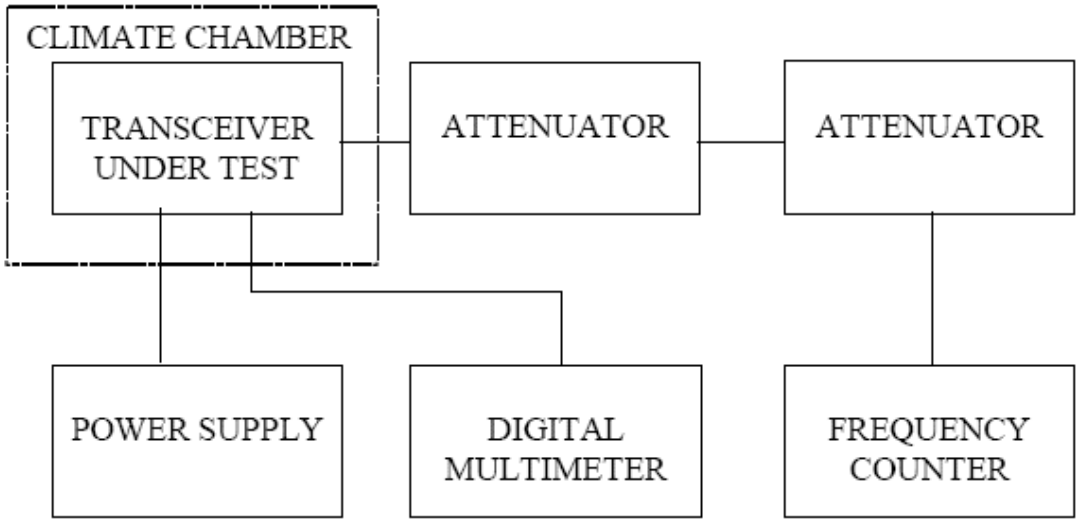
MINIMUM STANDARD: Shall not exceed 1.0 ppm from test frequency

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:	155.1	MHz	
Voltage & Power Level:	20 Volts @ 12 Watts		
Highest Variation:	0.71		
Spec:	< 1.0 ppm		

Temperature (Deg C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)
-30	155.100100	100	0.65
-20	155.100110	110	0.71
-10	155.100040	40	0.26
0	155.100090	90	0.58
10	155.100000	0	0.00
20	155.100090	90	0.58
30	155.100070	70	0.45
40	155.100020	20	0.13
50	155.100000	0	0.00
60	155.100090	90	0.58

Channel Frequency:	155.1	MHz	
Voltage & Power Level:	20 Volts @ 1 Watts		
Highest Variation:	0.65		

Temperature (Deg C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)
-30	155.100090	90	0.58
-20	155.100050	50	0.32
-10	155.100100	100	0.65
0	155.100010	10	0.06
10	155.100030	30	0.19
20	155.100020	20	0.13
30	155.100010	10	0.06
40	155.100000	0	0.00
50	155.100030	30	0.19
60	155.100090	90	0.58

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)

Necessary Bandwidth Measurement

This radio modem uses digital modulation signals, passing through a linear 8th order low-pass filter (Raise-Cosine alpha 1 approximation), to an FM transceiver. The necessary bandwidth calculation for this type of modulation (DRCMSK) 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	12.5 kHz	12.5 kHz	25 kHz	25 kHz	25 kHz
Emission Type	9K55 F1D	9K35 F1D	11K6 F1D	14K6 F1D	16K4 F1D
Data Rate	4800 bps	9600 bps	4800 bps	9600 bps	19200 bps
Measured Peak Deviation	3.55 Hz	2.76 kHz	4.43 kHz	4.40 kHz	4.30 kHz
Measured 99% Occupied BW	9.55 kHz	9.35 kHz	11.55 kHz	14.55 kHz	16.35 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

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

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.

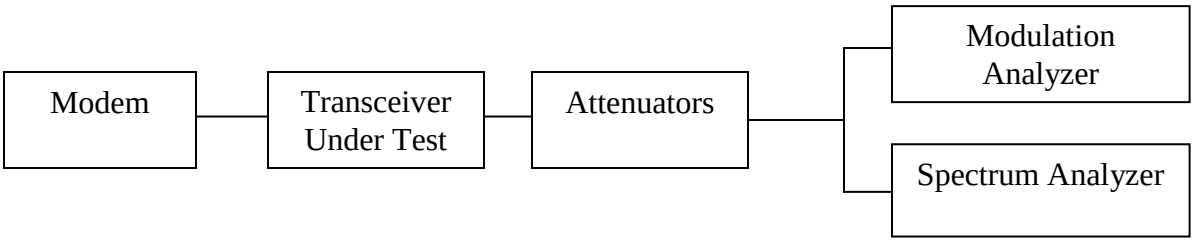
The Occupied Bandwidth measurement is in two parts relatively independent of each other. The first gives the RF spectrum profile, and the second calculates the frequency limits and they result in the Occupied bandwidth. While the first involves RF measurement instrumentation, the second is strictly a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

TEST EQUIPMENT:

50-Ohm Attenuator, Bird Electronics Model 25-A-MFN-20 (20dB, 25W)
50-Ohm Power Splitter, Mini Circuits Model ZFSC-3-4 (5.5dB IL at UHF)
DC Power Supply, Instek Model GPS-2303
Spectrum Analyzer, Advantest Model R3162
Modulation Analyzer, Hewlett Packard Model HP8901A

TEST SET-UP:

For the above requirements, the occupied bandwidth of a transmitter was measured using an Advantest Model R3162 using the following settings:
Occupied BW % Power: 99%
Trace: Max Hold A
RBW: 100 Hz (12.5 kHz channels)
RBW: 300 Hz (25 kHz channels)
VBW: 3 kHz
SPAN: 50 kHz (12.5 kHz channels)
SPAN: 150 kHz (25 kHz channels)



NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designators **9K55F1D** and 9**K35F1D**

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

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

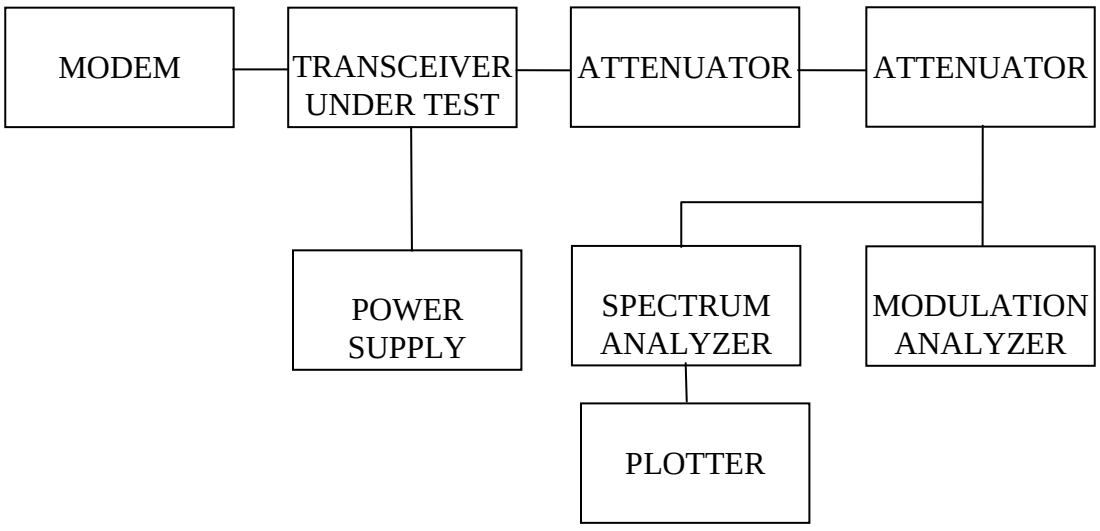
TEST RESULTS: Meets minimum standards (see data on following page)

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

TEST PROCEDURE: TIA/EIA – 603-C

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics 25-A-MFN-20 (20dB, 25W)
50-Ohm Power Splitter, Mini Circuits ZFSC-3-4 (5.5dB IL at UHF)
DC Power Supply, Instek Model GPS-2303
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901B

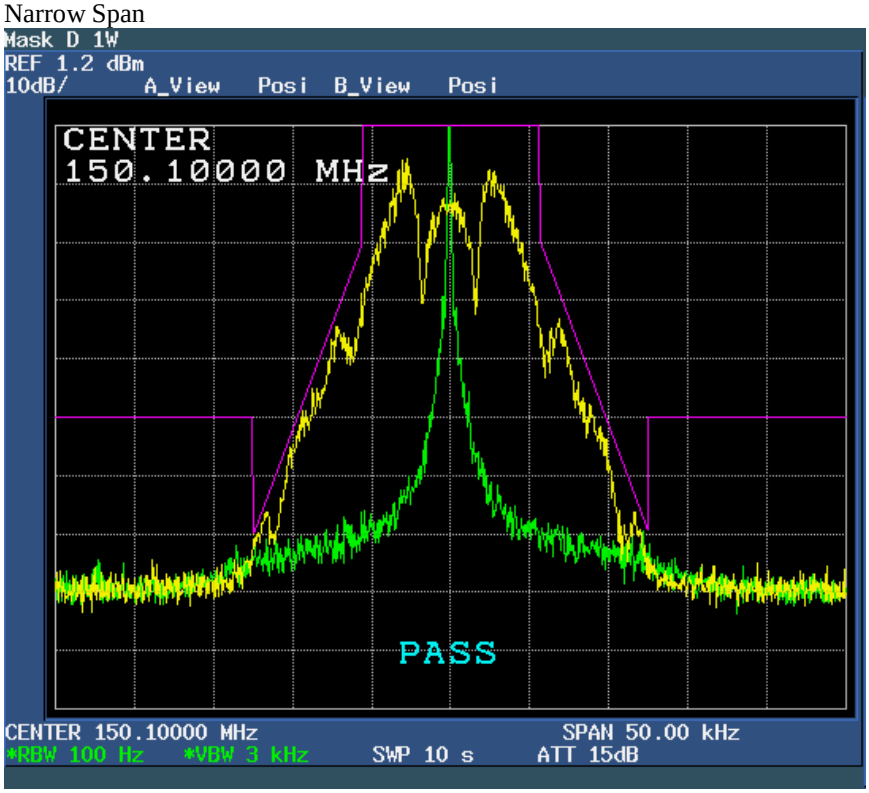
TEST SET-UP:



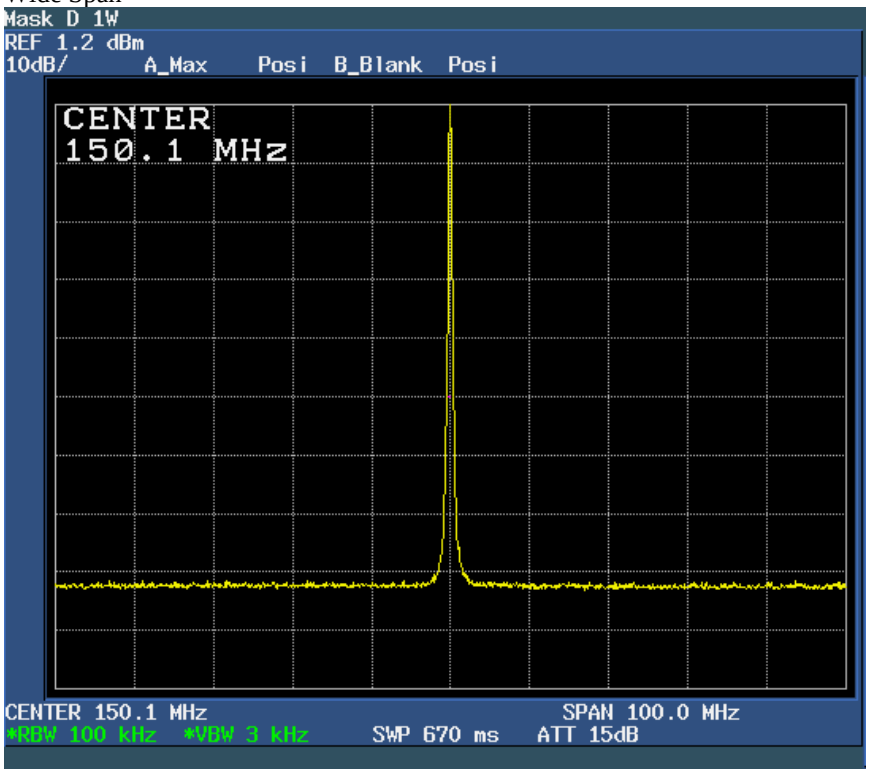
Mask: D, 1W
Output Power = 1 Watt

Spectrum for Emission: 9K55 F1D
Data Rate: 4800 bps Peak Deviation with Data: 3.55 kHz

Narrow Span

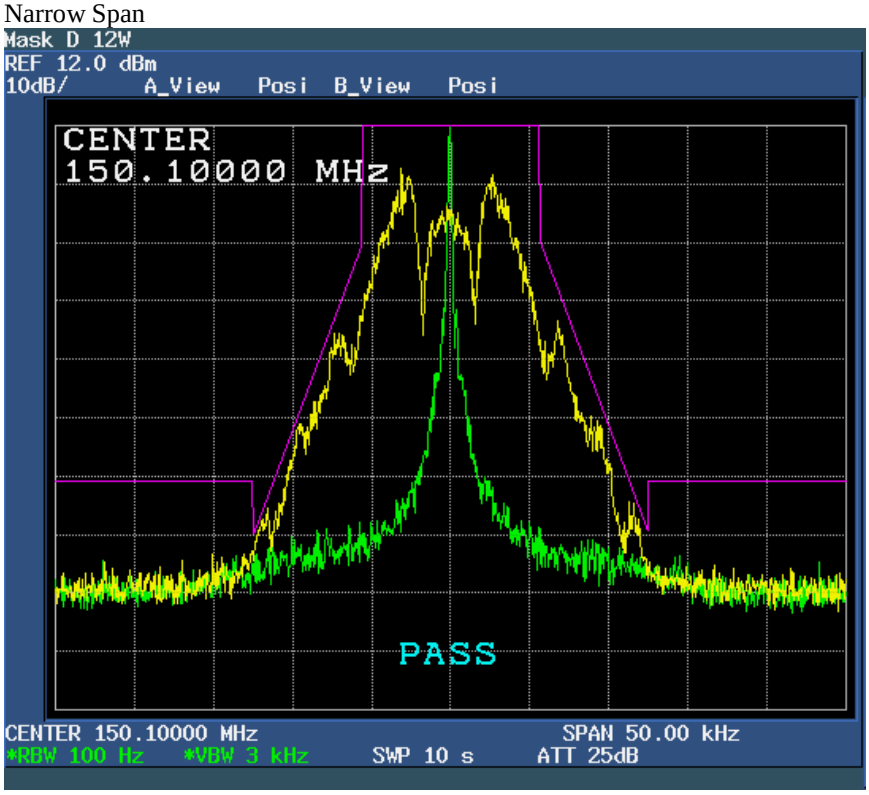


Wide Span

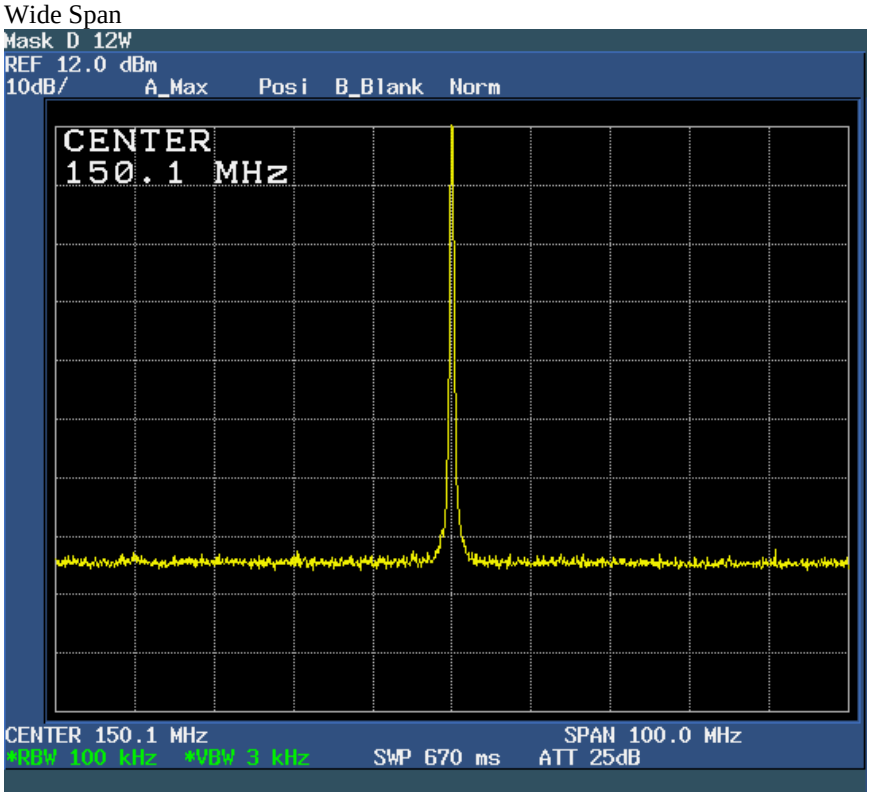


Output Power = 12 Watts

Narrow Span



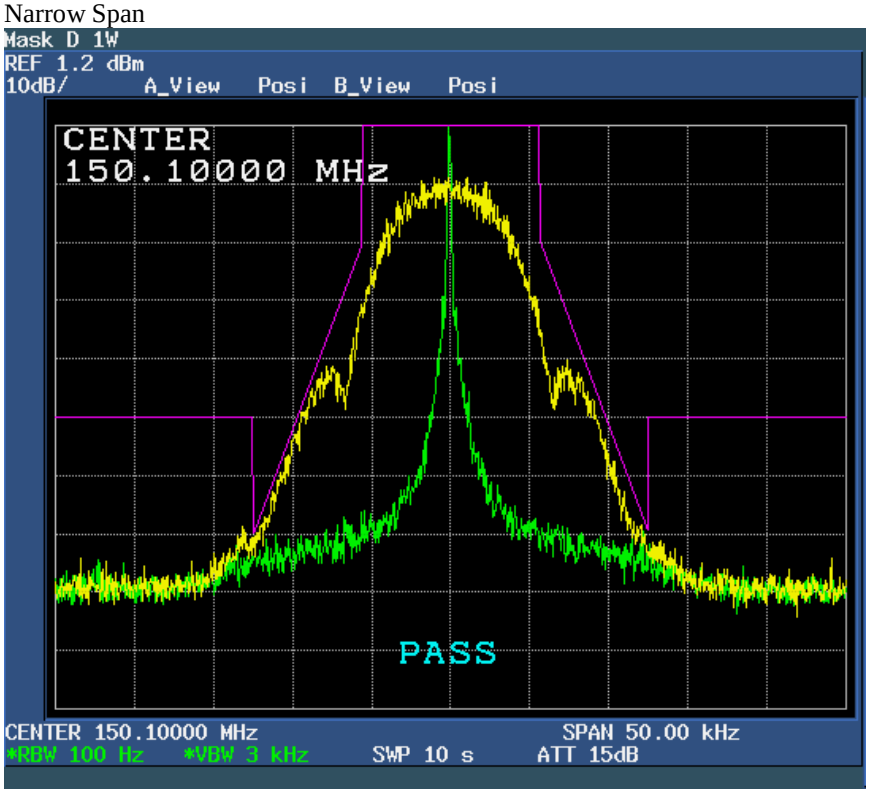
Wide Span



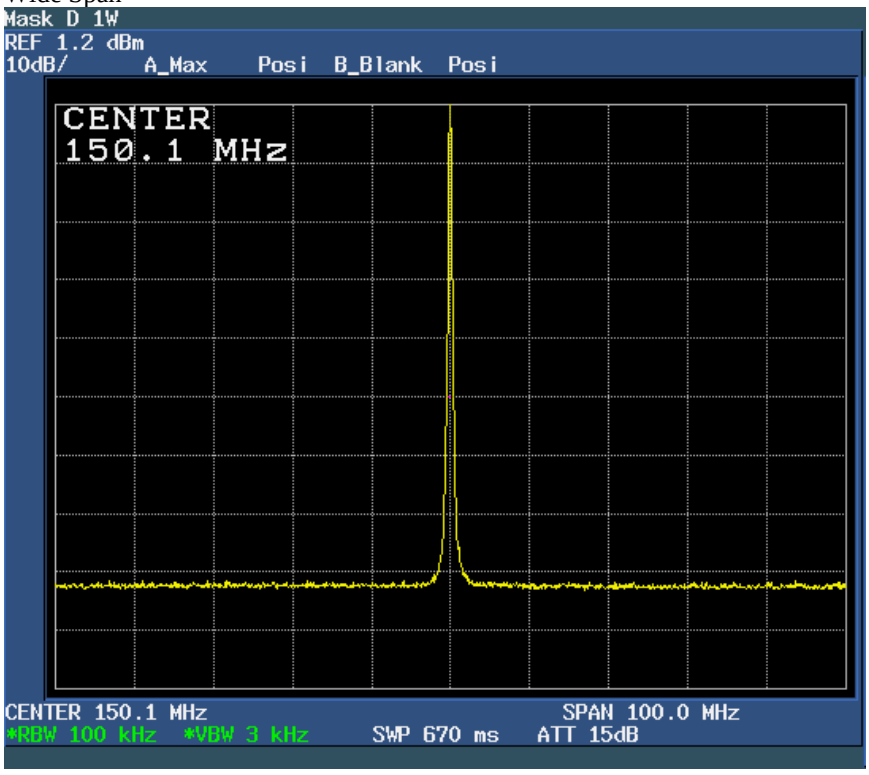
Mask: D, 1W
Output Power = 1 Watt

Spectrum for Emission: 9K35 F1D
Data Rate: 9600 bps Peak Deviation with Data: 2.76 kHz

Narrow Span

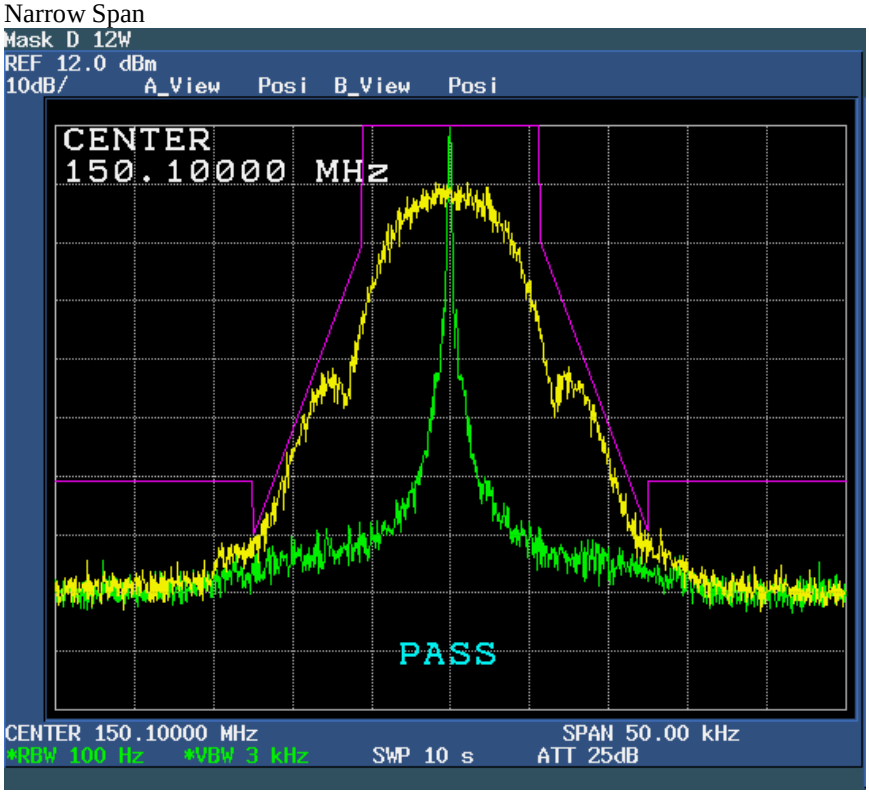


Wide Span

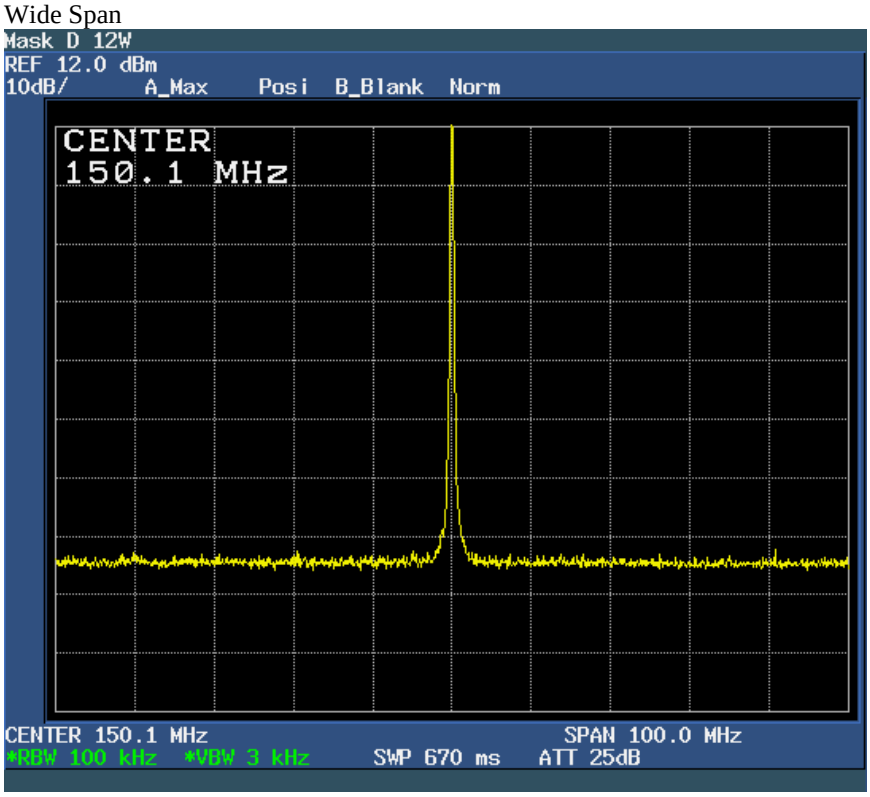


Output Power = 12 Watts

Narrow Span



Wide Span



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

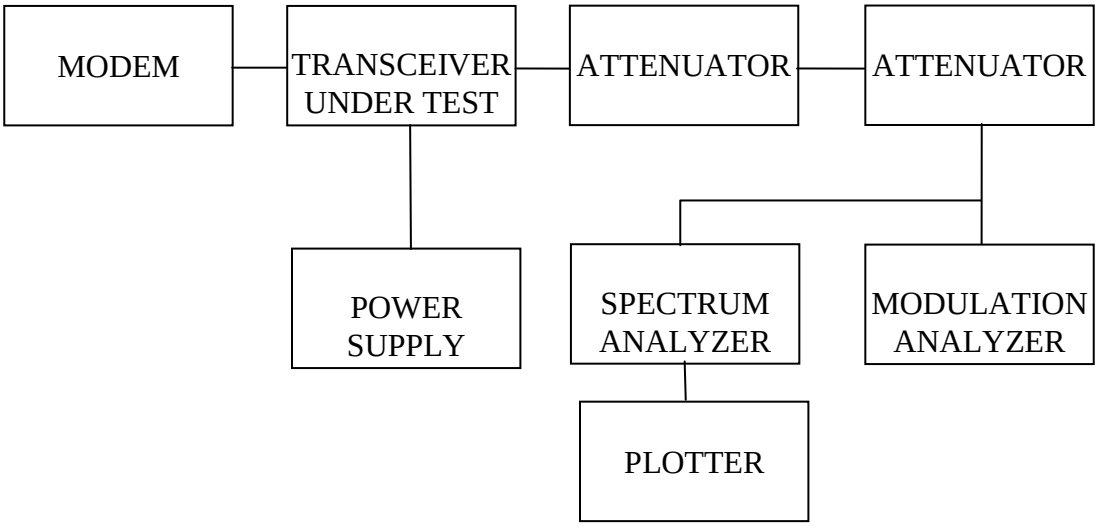
TEST RESULTS: Meets minimum standards (see data on following page)

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

TEST PROCEDURE: TIA/EIA – 603-C

TEST EQUIPMENT: 50-Ohm Attenuator, Bird Electronics 25-A-MFN-20 (20dB, 25W)
50-Ohm Power Splitter, Mini Circuits ZFSC-3-4 (5.5dB IL at UHF)
DC Power Supply, Instek Model GPS-2303
Spectrum Analyzer, Hewlett Packard Model HP8563E
Modulation Analyzer, Hewlett Packard Model HP8901B

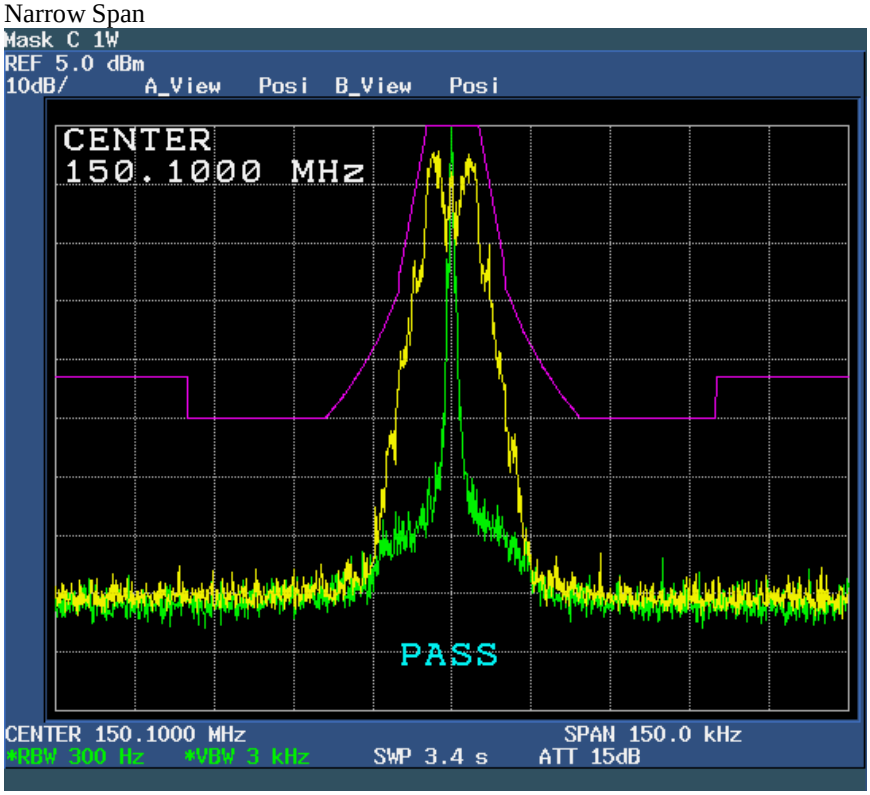
TEST SET-UP:



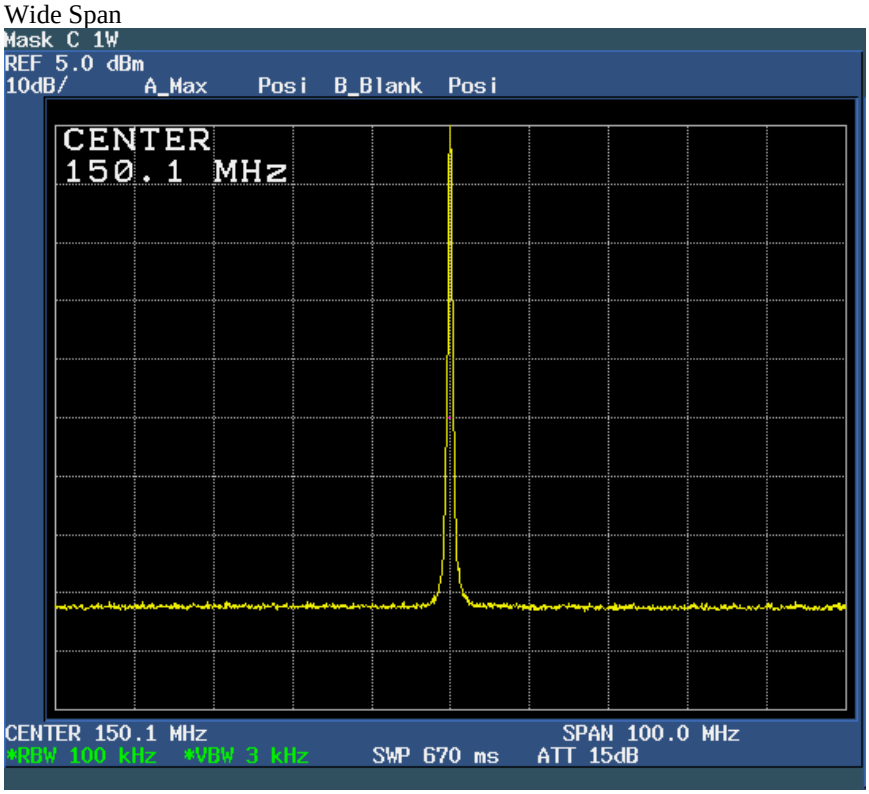
Mask: C, 1W
Output Power = 1 Watt

Spectrum for Emission: 11K6 F1D
Data Rate: 4800 bps Peak Deviation with Data: 4.43 kHz

Narrow Span

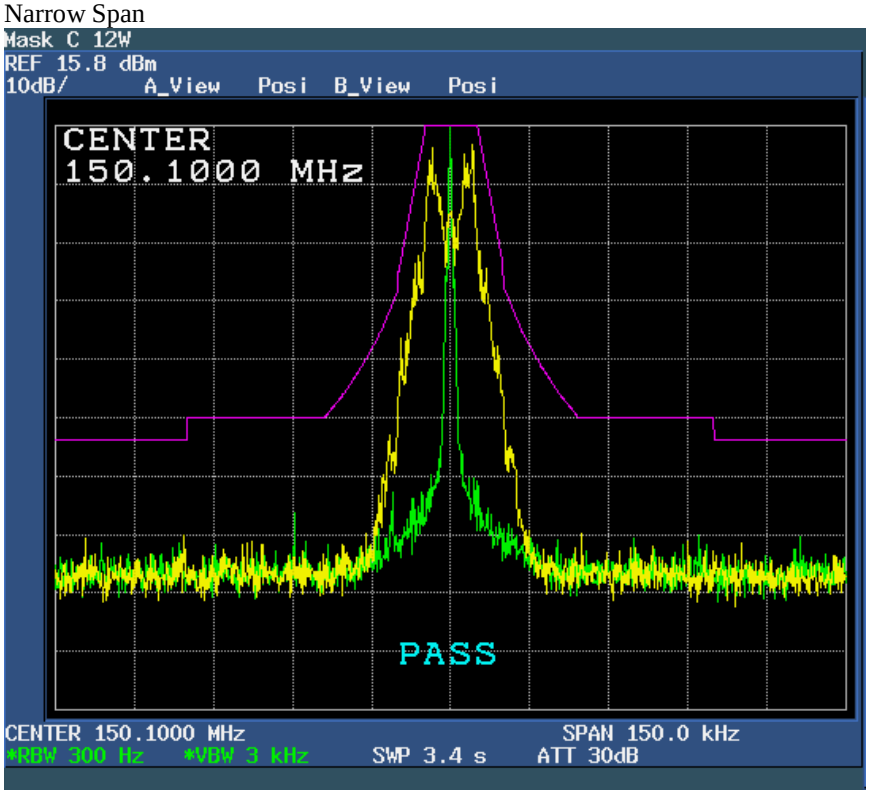


Wide Span

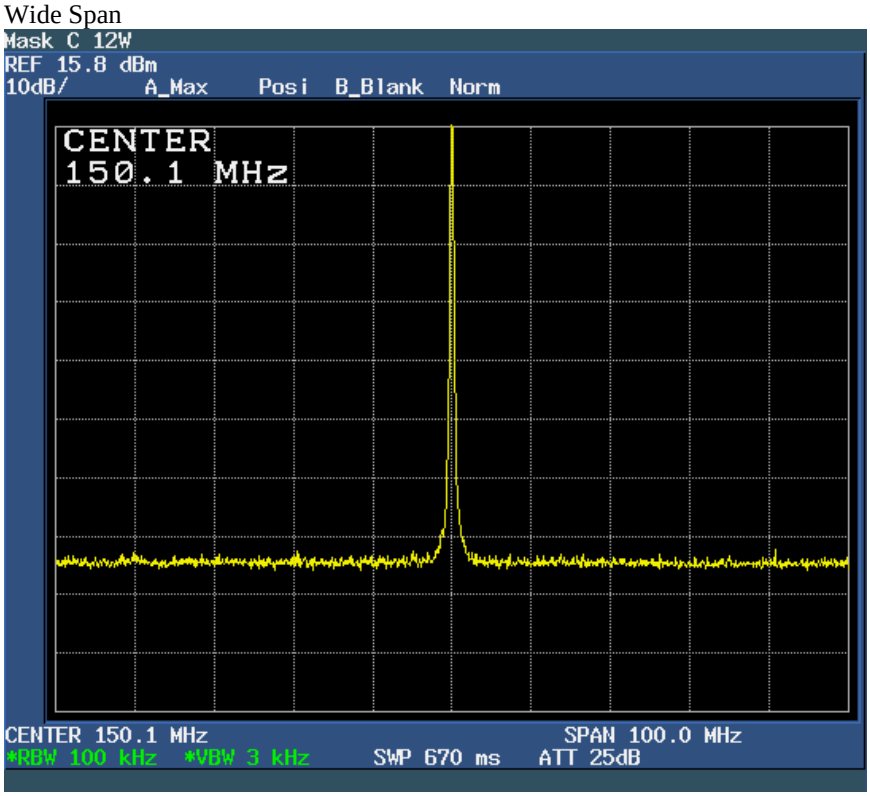


Output Power = 12 Watt

Narrow Span



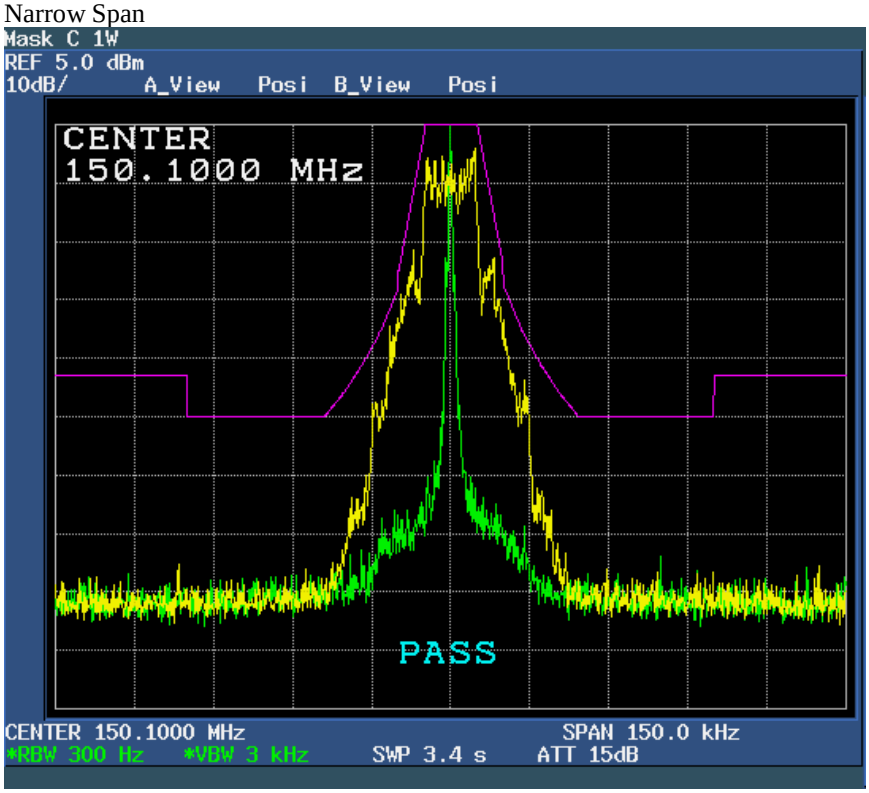
Wide Span



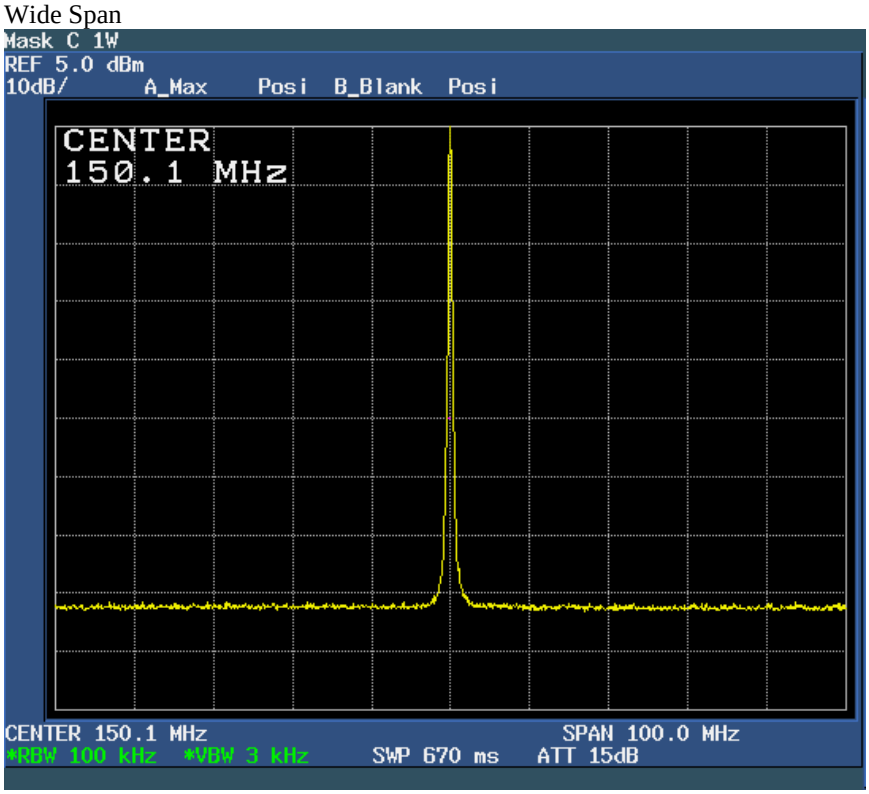
Mask: C, 1W Spectrum for Emission: 14K6 F1D

Output Power = 1 Watt Data Rate: 9600 bps Peak Deviation with Data: 4.40 kHz

Narrow Span

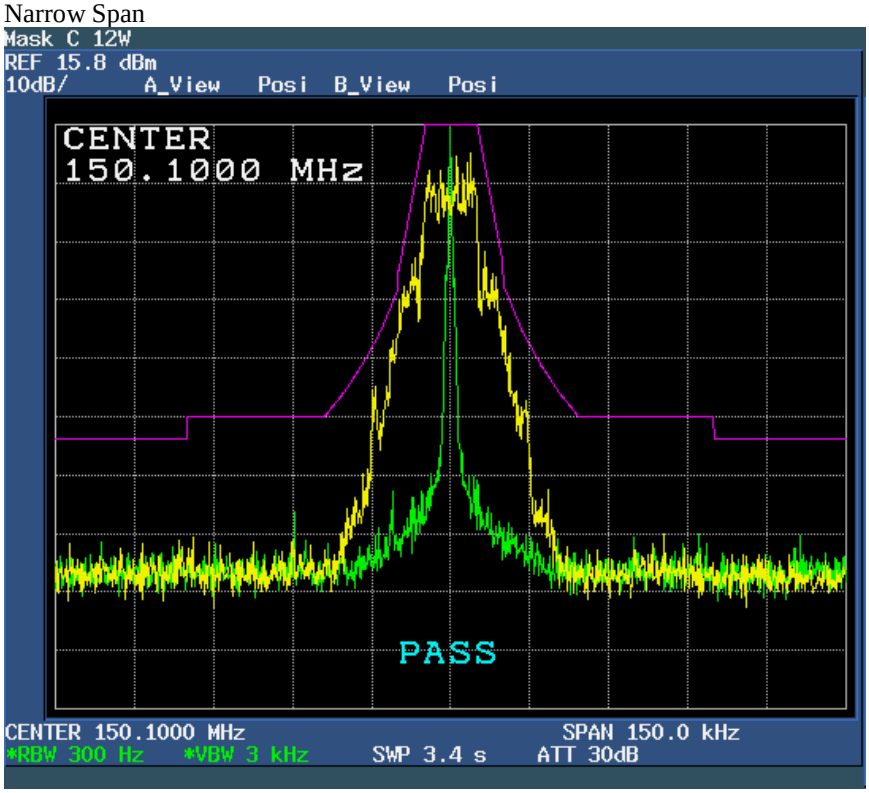


Wide Span

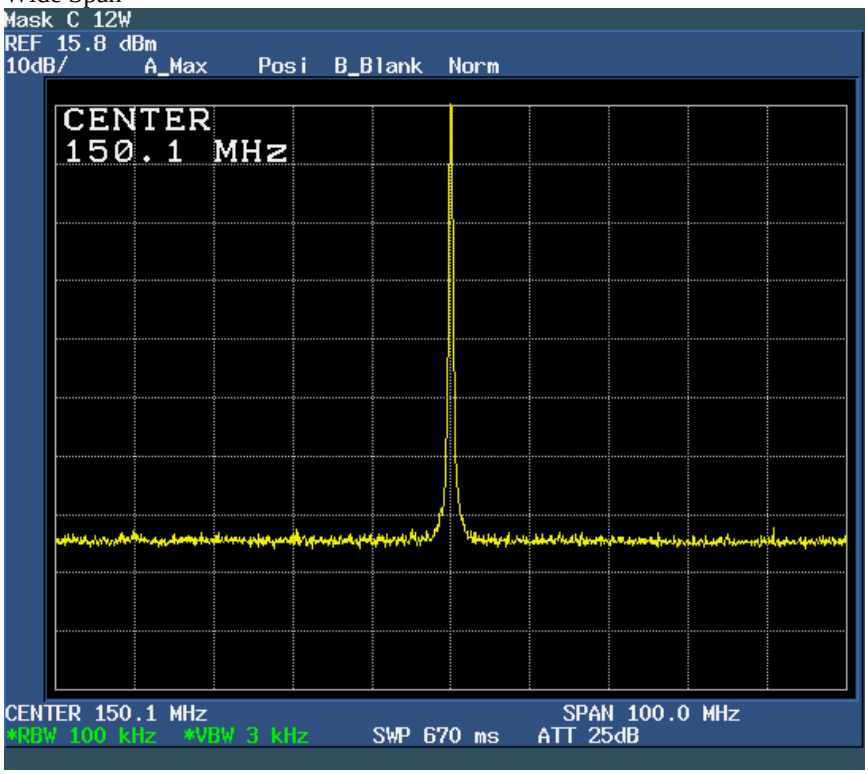


Output Power = 12 WattS

Narrow Span



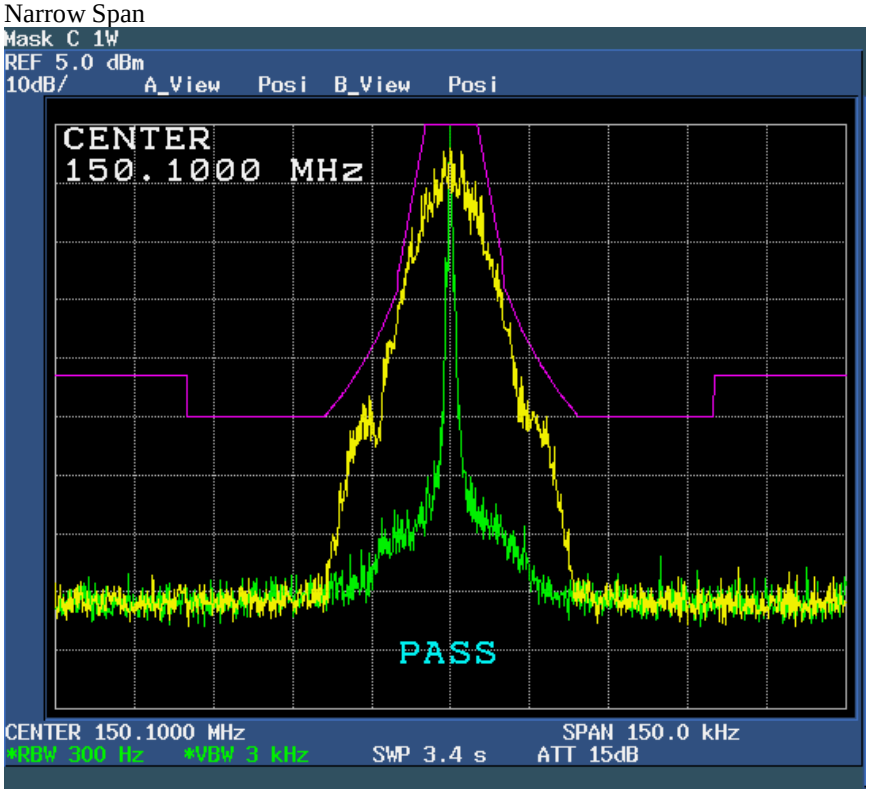
Wide Span



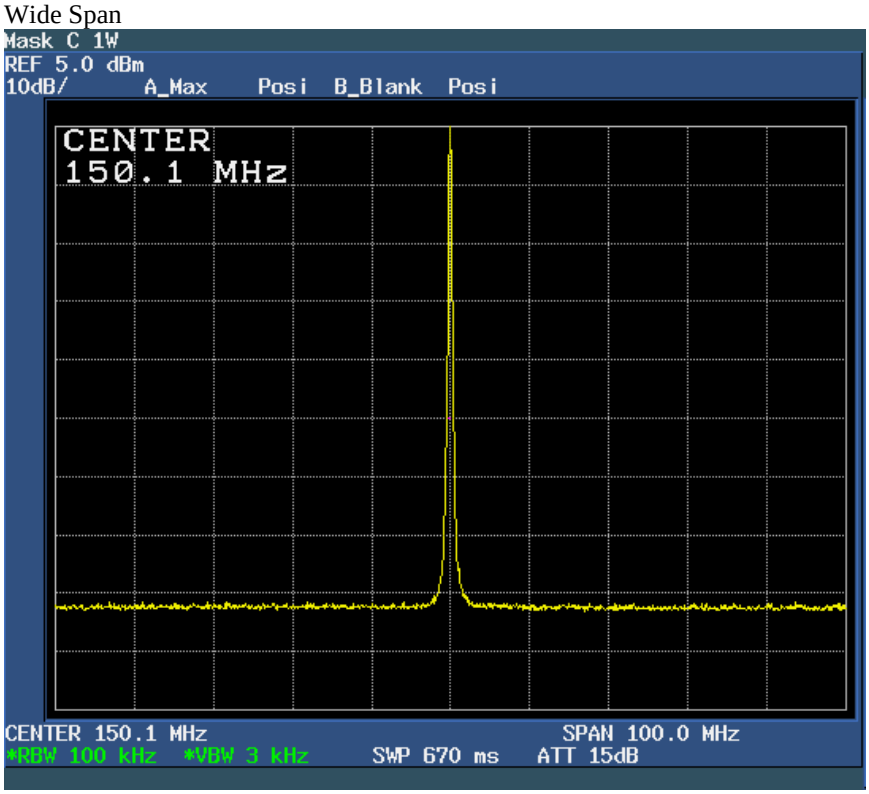
Mask: C, 1W Spectrum for Emission: 16K4 F1D

Output Power = 1 Watt Data Rate: 19200 bps Peak Deviation with Data: 4.30 kHz

Narrow Span

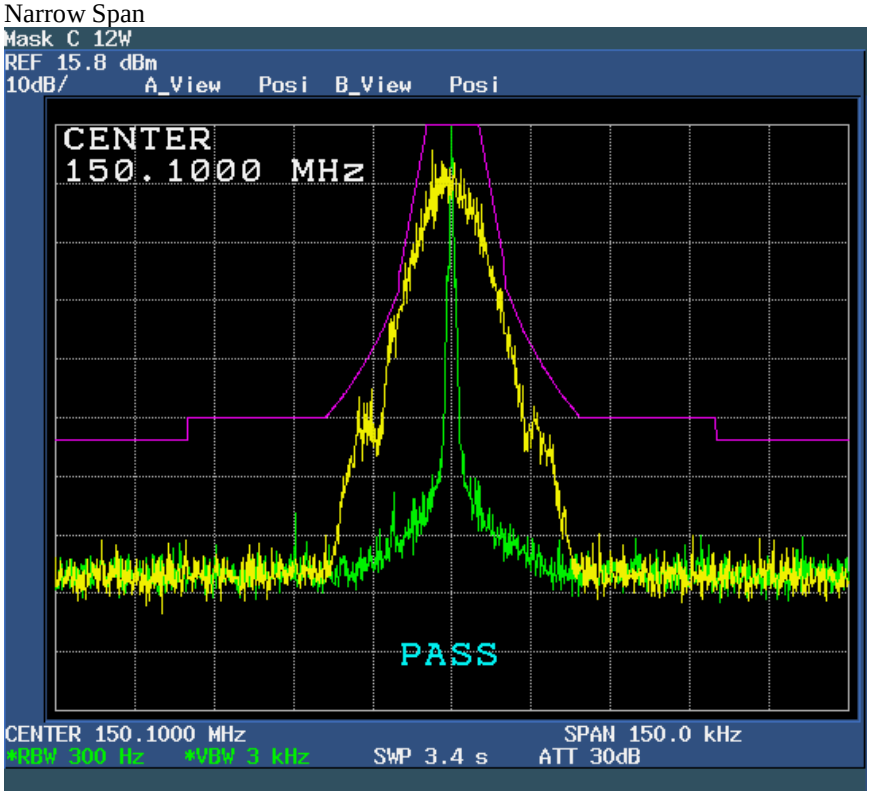


Wide Span

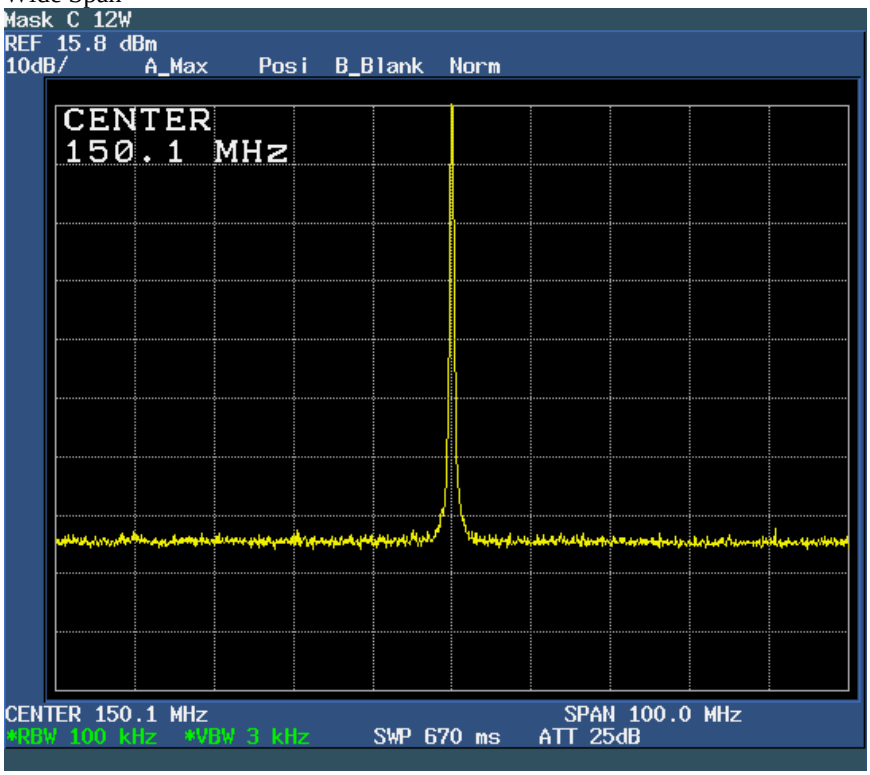


Output Power = 12 WattS

Narrow Span



Wide Span



NAME OF TEST: Field Strength of Spurious Radiation

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

MINIMUM STANDARDS: For 12 Watts: $50+10\text{Log}_{10}(12\text{ Watts})$ = -60.8 dBc
or -65dBc, whichever is the lesser attenuation.

For 1 Watt: $50+10\text{Log}_{10}(1\text{ Watt})$ = -50 dBc
or –65dBc, whichever is the lesser attenuation.

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

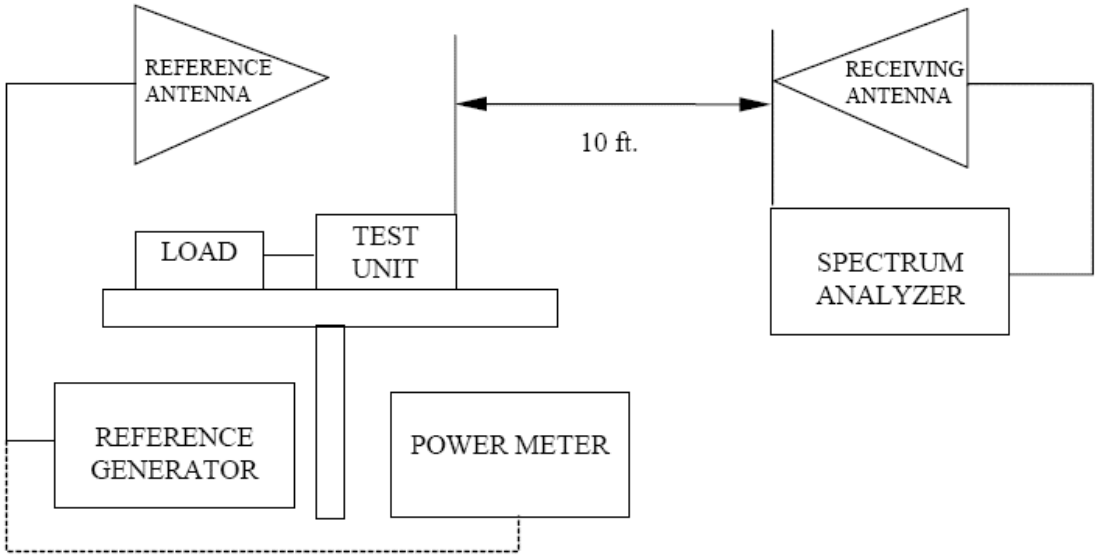
TEST CONDITIONS: Standard Test Conditions, 25 C
RF Power Level = 1 Watt and 12 Watts
Voltage = 20VDC

TEST PROCEDURE: TIA/EIA – 603-C

TEST EQUIPMENT: Waveguide Horn Antenna, EMCO Model 3115
Log Periodic Linear Polarization Antenna, AILTECH Model 94612-1
Bilog Antenna, Chase Model CBL6111B
Dipole Antenna, Electro-Metrics Model EM-6924
Power Supply, Model Instek GPS-3303
Spectrum Analyzer, Model HP-8561B
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-C

TEST SET-UP:



Half Duplex

Freqency:	136.025	MHz	Spec =	-60.8	dBc
			Highest		
Power:	12	Watts	Spur =	-101.5	dBc
	40.8	dBm			

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
272.05	H	-98.6	-75.1	2.00	-0.47	-118.3
	V	-96.2	-72.2	2.00	-0.47	-115.5
408.075	H	-107.4	-71.4	2.33	-0.46	-115.0
	V	-107.6	-80.9	2.33	-0.46	-124.5
544.1	H	-95.9	-67.9	2.67	-0.49	-111.9
	V	-94.9	-57.6	2.67	-0.49	-101.5
680.125	H	-103.2	-66.9	3.00	-0.51	-111.2
	V	-102.9	-69.4	3.00	-0.51	-113.7
816.15	H	-110.6	-73.6	3.50	-0.47	-118.4
	V	-102.6	-65.1	3.50	-0.47	-109.9
952.175	H	-114.4	-77.6	3.83	-0.54	-122.7
	V	-103.4	-59.7	3.83	-0.54	-104.9
1088.2	H	-114.3	-80.1	4.17	2.55	-122.5
	V	-113.0	-75.0	4.17	2.55	-117.4
1224.225	H	-116.0	-79.5	4.33	4.73	-119.9
	V	-112.2	-76.5	4.33	4.73	-116.9
1360.25	H	-116.0	-77.5	5.00	4.73	-118.5
	V	-115.0	-78.1	5.00	4.73	-119.2

Freqency:	136.025	MHz	Spec =	-50.0	dBc
			Highest		
Power:	1	Watts	Spur =	-103.2	dBc
	30.0	dBm			

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
272.05	H	-102.9	-79.4	2.00	-0.47	-111.9
	V	-96.2	-72.2	2.00	-0.47	-104.7
408.075	H	-116.0	-80.0	2.33	-0.46	-112.8
	V	-116.0	-89.3	2.33	-0.46	-122.1
544.1	H	-116.0	-88.0	2.67	-0.49	-121.2
	V	-111.9	-74.6	2.67	-0.49	-107.7
680.125	H	-116.0	-79.7	3.00	-0.51	-113.2
	V	-116.0	-82.5	3.00	-0.51	-116.0
816.15	H	-113.1	-76.1	3.50	-0.47	-110.1
	V	-106.7	-69.2	3.50	-0.47	-103.2
952.175	H	-116.0	-79.2	3.83	-0.54	-113.5
	V	-116.0	-72.3	3.83	-0.54	-106.7
1088.2	H	-116.0	-81.8	4.17	2.55	-113.4
	V	-115.0	-77.0	4.17	2.55	-108.6
1224.225	H	-116.0	-79.5	4.33	4.73	-109.1
	V	-116.0	-80.3	4.33	4.73	-109.9
1360.25	H	-115.0	-76.5	5.00	4.73	-106.7
	V	-113.0	-76.1	5.00	4.73	-106.4

Half Duplex

Freqency:	138.025	MHz	Spec =	-60.8	dBc
Power:	12	Watts	Highest Spur =	-101.4	dBc
	40.8	dBm			

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
276.05	H	-100.6	-77.1	1.67	-0.47	-120.0
	V	-97.2	-73.2	1.67	-0.47	-116.2
414.075	H	-107.1	-70.1	2.17	-0.46	-113.5
	V	-104.6	-77.9	2.17	-0.46	-121.4
552.1	H	-98.9	-70.1	2.83	-0.49	-114.2
	V	-94.6	-57.2	2.83	-0.49	-101.4
690.125	H	-102.1	-64.1	3.17	-0.51	-108.6
	V	-99.9	-67.2	3.17	-0.51	-111.7
828.15	H	-116.0	-79.3	3.50	-0.47	-124.1
	V	-108.6	-70.3	3.50	-0.47	-115.0
966.175	H	-114.7	-76.5	3.67	-0.54	-121.5
	V	-113.2	-69.5	3.67	-0.54	-114.5
1104.2	H	-114.2	-79.7	4.00	2.15	-122.3
	V	-113.2	-74.5	4.00	2.15	-117.1
1242.225	H	-111.8	-74.1	4.17	2.15	-116.9
	V	-112.2	-76.0	4.17	2.15	-118.8
1380.25	H	-114.0	-76.0	4.83	2.15	-119.4
	V	-112.7	-74.3	4.83	2.15	-117.8

Freqency:	138.025	MHz	Spec =	-50.0	dBc
			Highest		
Power:	1	Watts	Spur =	-101.7	dBc
	30.0	dBm			

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
276.05	H	-103.2	-79.7	1.67	-0.47	-111.8
	V	-98.6	-74.6	1.67	-0.47	-106.7
414.075	H	-112.7	-75.7	2.17	-0.46	-108.3
	V	-114.9	-88.2	2.17	-0.46	-120.9
552.1	H	-116.0	-87.2	2.83	-0.49	-120.5
	V	-112.7	-75.4	2.83	-0.49	-108.7
690.125	H	-113.4	-75.4	3.17	-0.51	-109.1
	V	-113.2	-80.5	3.17	-0.51	-114.2
828.15	H	-116.0	-79.3	3.50	-0.47	-113.3
	V	-106.1	-67.8	3.50	-0.47	-101.7
966.175	H	-116.0	-77.8	3.67	-0.54	-112.0
	V	-116.0	-72.3	3.67	-0.54	-106.5
1104.2	H	-112.8	-78.3	4.00	2.15	-110.1
	V	-116.0	-77.3	4.00	2.15	-109.2
1242.225	H	-116.0	-78.3	4.17	2.15	-110.3
	V	-116.0	-79.8	4.17	2.15	-111.8
1380.25	H	-116.0	-78.0	4.83	2.15	-110.7
	V	-112.8	-74.4	4.83	2.15	-107.1

Half Duplex

Freqency:	150.1	MHz	Spec =	-60.8	dBc
Power:	12	Watts	Highest Spur =	-99.0	dBc
	40.8	dBm			

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
300.2	H	-102.1	-77.1	1.50	-0.46	-119.9
	V	-100.2	-74.4	1.50	-0.46	-117.1
450.3	H	-109.4	-76.6	2.00	-0.53	-119.9
	V	-108.2	-79.2	2.00	-0.53	-122.5
600.4	H	-98.1	-68.6	2.50	-0.54	-112.4
	V	-95.4	-57.7	2.50	-0.54	-101.6
750.5	H	-102.7	-54.9	2.83	-0.50	-99.0
	V	-103.1	-70.1	2.83	-0.50	-114.2
900.6	H	-111.6	-77.6	3.33	-0.51	-122.2
	V	-108.1	-64.4	3.33	-0.51	-109.1
1050.7	H	-111.7	-75.2	3.83	2.55	-117.2
	V	-112.5	-77.0	3.83	2.55	-119.0
1200.8	H	-109.2	-74.0	4.17	4.73	-114.2
	V	-109.5	-73.5	4.17	4.73	-113.7
1350.9	H	-112.0	-72.8	4.83	4.73	-113.7
	V	-108.2	-71.5	4.83	4.73	-112.4
1501	H	-109.7	-73.5	4.83	4.03	-115.1
	V	-105.8	-68.3	4.83	4.03	-109.9

Freqency:	150.1	MHz	Spec =	-50.0	dBc
			Highest		
Power:	1	Watts	Spur =	-96.9	dBc
	30.0	dBm			

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
300.2	H	-104.9	-79.9	1.50	-0.46	-111.9
	V	-102.7	-76.9	1.50	-0.46	-108.8
450.3	H	-116.0	-83.2	2.00	-0.53	-115.7
	V	-114.4	-85.4	2.00	-0.53	-117.9
600.4	H	-116.0	-86.5	2.50	-0.54	-119.5
	V	-114.6	-76.9	2.50	-0.54	-110.0
750.5	H	-116.0	-68.2	2.83	-0.50	-101.5
	V	-116.0	-83.0	2.83	-0.50	-116.3
900.6	H	-111.2	-77.2	3.33	-0.51	-111.0
	V	-106.7	-63.0	3.33	-0.51	-96.9
1050.7	H	-116.0	-79.5	3.83	2.55	-110.8
	V	-116.0	-80.5	3.83	2.55	-111.8
1200.8	H	-116.0	-80.8	4.17	4.73	-110.2
	V	-113.3	-77.3	4.17	4.73	-106.7
1350.9	H	-116.0	-76.8	4.83	4.73	-106.9
	V	-114.0	-77.3	4.83	4.73	-107.4
1501	H	-112.5	-76.3	4.83	4.03	-107.1
	V	-107.7	-70.2	4.83	4.03	-101.0

Half Duplex

Freqency:	173.975	MHz	Spec =	-60.8	dBc
Power:	12	Watts	Highest Spur =	-100.2	dBc
	40.8	dBm			

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
347.95	H	-98.2	-67.5	2.00	-0.52	-110.8
	V	-98.3	-66.8	2.00	-0.52	-110.1
521.925	H	-101.5	-73.3	2.33	-0.50	-117.0
	V	-97.7	-64.8	2.33	-0.50	-108.5
695.9	H	-104.0	-65.2	2.67	-0.50	-109.1
	V	-103.2	-70.7	2.67	-0.50	-114.7
869.875	H	-103.8	-69.5	3.00	-0.46	-113.7
	V	-103.7	-60.2	3.00	-0.46	-104.5
1043.85	H	-113.2	-76.7	3.50	2.55	-118.4
	V	-111.0	-75.8	3.50	2.55	-117.5
1217.825	H	-111.0	-74.6	3.83	4.73	-114.5
	V	-109.2	-73.2	3.83	4.73	-113.1
1391.8	H	-114.0	-76.1	4.17	4.73	-116.4
	V	-106.8	-67.8	4.17	4.73	-108.0
1565.775	H	-108.3	-69.8	4.33	4.03	-110.9
	V	-103.7	-66.5	4.33	4.03	-107.6
1739.75	H	-108.2	-69.3	5.00	3.09	-112.0
	V	-104.5	-57.5	5.00	3.09	-100.2

Freqency:	173.975	MHz	Spec =	-50.0	dBc
			Highest		
Power:	1	Watts	Spur =	-92.2	dBc
	30.0	dBm			

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
347.95	H	-105.8	-75.1	2.00	-0.52	-107.7
	V	-100.0	-68.5	2.00	-0.52	-101.0
521.925	H	-116.0	-87.8	2.33	-0.50	-120.7
	V	-116.0	-83.2	2.33	-0.50	-116.0
695.9	H	-114.3	-75.5	2.67	-0.50	-108.6
	V	-116.0	-83.5	2.67	-0.50	-116.7
869.875	H	-116.0	-81.7	3.00	-0.46	-115.1
	V	-116.0	-72.5	3.00	-0.46	-106.0
1043.85	H	-116.0	-79.5	3.50	2.55	-110.4
	V	-112.2	-77.0	3.50	2.55	-108.0
1217.825	H	-114.8	-78.4	3.83	4.73	-107.5
	V	-115.5	-79.5	3.83	4.73	-108.6
1391.8	H	-110.7	-72.8	4.17	4.73	-102.3
	V	-103.3	-64.3	4.17	4.73	-93.7
1565.775	H	-116.0	-77.5	4.33	4.03	-107.8
	V	-109.8	-72.6	4.33	4.03	-102.9
1739.75	H	-113.3	-74.4	5.00	3.09	-106.3
	V	-107.3	-60.3	5.00	3.09	-92.2

Full Duplex

Freqency:	138.025	MHz	Spec =	-60.8	dBc
Power:	12	Watts	Highest Spur =	-97.5	dBc
	40.8	dBm			

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
276.05	H	-97.5	-74.0	1.67	-0.47	-116.9
	V	-94.8	-70.8	1.67	-0.47	-113.8
414.075	H	-103.2	-66.2	2.17	-0.46	-109.6
	V	-100.3	-73.6	2.17	-0.46	-117.1
552.1	H	-94.5	-65.7	2.83	-0.49	-109.8
	V	-91.2	-53.8	2.83	-0.49	-98.0
690.125	H	-94.5	-56.5	3.17	-0.51	-101.0
	V	-85.7	-53.0	3.17	-0.51	-97.5
828.15	H	-111.5	-74.8	3.50	-0.47	-119.6
	V	-106.3	-68.0	3.50	-0.47	-112.7
966.175	H	-114.0	-75.8	3.67	-0.54	-120.8
	V	-108.3	-64.6	3.67	-0.54	-109.6
1104.2	H	-112.0	-77.5	4.00	2.15	-120.1
	V	-111.2	-72.5	4.00	2.15	-115.1
1242.225	H	-116.0	-78.3	4.17	2.15	-121.1
	V	-114.3	-78.1	4.17	2.15	-120.9
1380.25	H	-114.5	-76.5	4.83	2.15	-119.9
	V	-114.5	-76.1	4.83	2.15	-119.6

Freqency:	138.025	MHz	Spec =	-50.0	dBc
			Highest		
Power:	1	Watts	Spur =	-103.4	dBc
	30.0	dBm			

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
276.05	H	-101.0	-77.5	1.67	-0.47	-109.6
	V	-97.3	-73.3	1.67	-0.47	-105.5
414.075	H	-114.0	-77.0	2.17	-0.46	-109.6
	V	-115.7	-89.0	2.17	-0.46	-121.7
552.1	H	-111.3	-82.5	2.83	-0.49	-115.8
	V	-108.5	-71.2	2.83	-0.49	-104.5
690.125	H	-111.5	-73.5	3.17	-0.51	-107.2
	V	-106.8	-74.1	3.17	-0.51	-107.8
828.15	H	-110.7	-74.0	3.50	-0.47	-108.0
	V	-107.8	-69.5	3.50	-0.47	-103.4
966.175	H	-116.0	-77.8	3.67	-0.54	-112.0
	V	-116.0	-72.3	3.67	-0.54	-106.5
1104.2	H	-116.0	-81.5	4.00	2.15	-113.3
	V	-116.0	-77.3	4.00	2.15	-109.2
1242.225	H	-116.0	-78.3	4.17	2.15	-110.3
	V	-116.0	-79.8	4.17	2.15	-111.8
1380.25	H	-114.0	-76.0	4.83	2.15	-108.7
	V	-114.0	-75.6	4.83	2.15	-108.3

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
Advantest R3162	111000901	7/24/2009	7/24/2011
HP 437B Power Meter	3125U13882	4/12/2010	4/12/2012

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