Exhibit 9 – Required Measurements

EXHIBIT 9 – REQUIRED MEASUREMENTS

The data required by Sections 2.1046 through 2.1057 inclusive, measured in accordance with the procedures set out in Section 2.1041. (2.1033 (c) (14))

TABLE 9-OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

9.1 Test Procedure and Compliance Matrix

This section documents the test procedures used, and records the results of tests to demonstrate compliance with the applicable requirements of parts 2 and 87 of the FCC Rules and Regulations.

The Table 9-1 below identifies the applicable sections of this document and its relationship between the Parts 2 and 87 requirements. The test results are included within each individual test section.

Table 9-1. Test Requirements Matrix

FCC Part 2 Section	FCC Part 87 Section	Test Description Summary	Section
2.1047	87.141	Modulation Characteristics	9.2
2.1046	87.131	RF Power Output	9.4
2.1055	87.133	Frequency Stability	9.5
2.1049	87.135	Occupied Bandwidth	9.6
2.1051	87.139	Spurious Emissions at Antenna Terminals	9.7
2.1053	87.139	Field Strength of Spurious Radiation	9.8

9.2 WXR-2100 Modulation Characteristics (2.1047)

Requirement:

Section 2.1047(d) states: "A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed."

The WRT-2100 utilizes un-modulated rectangular pulses.

The following paragraphs describe the transmitted output waveform and frequency utilization.

The WXR-2100 Weather Radar System utilizes two different sets of transmitter pulse patterns, pulse widths and operating frequencies depending on operating mode.

Weather/Turbulence/Map Operation

A single fixed pulse pattern is utilized for all Weather, Turbulence and Map modes of operation. This same pattern is utilized regardless of whether the system is in Manual operation or Automatic MultiScan operation.

The transmitter pulse pattern consists of a sequence of five pulses, a single 20 microsecond transmitter pulse for long-range weather detection and a series of 4 6 microsecond pulses for measuring weather and turbulence out to 40 nm. Figure 9-1 below shows this pattern. The time period for this group of 5 pulses is called an Epoch. A small variable delay is inserted between epochs to reduce mutual interference between radar systems by dithering the pulse timing.

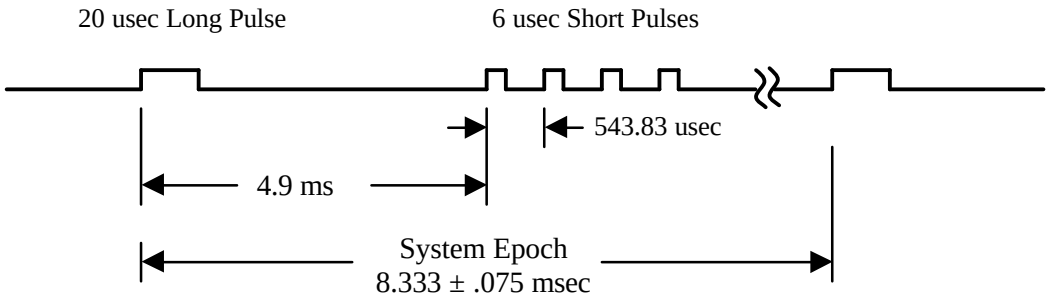

Figure 9-1. Transmit Pulse Pattern - Weather/Turbulence

Windshear Operation

Windshear mode is activated during the landing and takeoff phases of flight. In Windshear Mode, the transmitter operates at a 3000 Hz pulse repetition rate with a 2 microsecond pulse width. The pulse pattern for windshear mode is shown in Figure 9-2. A small variable delay is inserted between epochs to reduce mutual interference between radar systems by dithering the pulse timing. When Windshear Mode is active, the Windshear sweeps of the antenna are alternated with the normal Weather/Turbulence/Map Sweeps. The left to right sweep is Weather/Turbulence/Map mode with the transmit pulse pattern in Figure 9-1. The right to left sweep is Windshear mode with the transmit pulse pattern in Figure 9-2. Each sweep direction requires approximately 3 seconds to complete.

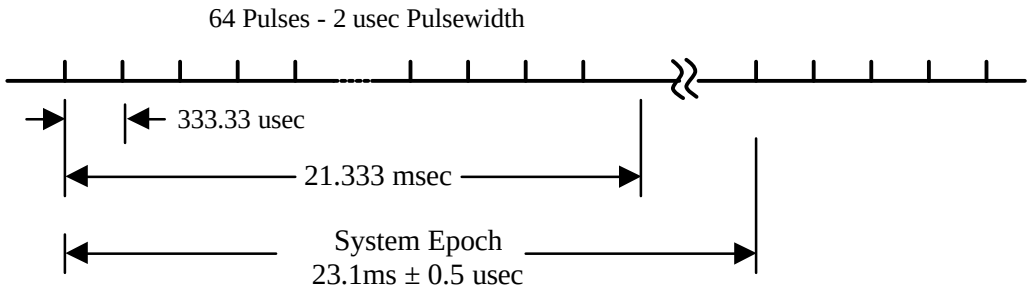

Figure 9-2. Transmit Pulse Pattern - Windshear Mode

Frequency Selection:

The WXR-2100 is capable of tuning to 64 different frequencies which are listed in Table 9-2 below. Use of multiple frequencies significantly improves the accuracy of weather and ground target amplitude estimations. Each operating mode uses a subset of the available frequencies.

Table 9-2. WRT-2100 Channel Frequencies

Channel No.	Transmit Frequency (Hz)	Channel No.	Transmit Frequency (Hz)
0	9327063906	32	9333063906
1	9327251406	33	9333251406
2	9327438906	34	9333438906
3	9327626406	35	9333626406
4	9327813906	36	9333813906
5	9328001406	37	9334001406
6	9328188906	38	9334188906
7	9328376406	39	9334376406
8	9328563906	40	9334563906
9	9328751406	41	9334751406
10	9328938906	42	9334938906
11	9329126406	43	9335126406
12	9329313906	44	9335313906
13	9329501406	45	9335501406
14	9329688906	46	9335688906
15	9329876406	47	9335876406
16	9330063906	48	9336063906
17	9330251406	49	9336251406
18	9330438906	50	9336438906
19	9330626406	51	9336626406
20	9330813906	52	9336813906
21	9331001406	53	9337001406
22	9331188906	54	9337188906
23	9331376406	55	9337376406
24	9331563906	56	9337563906
25	9331751406	57	9337751406
26	9331938906	58	9337938906
27	9332126406	59	9338126406
28	9332313906	60	9338313906
29	9332501406	61	9338501406
30	9332688906	62	9338688906
31	9332876406	63	9338876406

Weather Operation

Four frequencies from Table 9-2 are allocated for Weather, Turbulence and Mapping. These are:

F1 – 9329.501406 MHz (Channel 13)
F2 – 9330.063906 MHz (Channel 16)
F3 – 9330.626406 MHz (Channel 19)
F4 – 9331.188906 MHz (Channel 22)

The radar randomly selects one of the four frequencies for each Epoch and transmits a set of one 20 μsec pulse followed by four 6 μsec pulses on the same frequency. The next Epoch transmitted pulse set (one 20 μsec pulse and four 6 μsec pulses) occurs on one of the three remaining frequencies. This pattern is repeated until all four frequencies are used. The software ensures that the same frequency is not repeated between adjacent pulse sets.

Windshear Operation

One frequency from Table 9-3 is allocated to Windshear operation. This frequency is fixed for all pulse sets. Each Windshear Epoch transmits 64 2 microsecond pulses on the same frequency. The next epoch is transmitted on the same frequency. The Windshear frequency is:

F5 – 9331.938906 MHz (Channel 26)

During normal Weather/Turbulence/Map operation without windshear mode activated, both the left to right and right to left sweeps of the antenna utilize the four weather frequencies and pulse patterns from Figure 9-1 above. In this condition, each antenna sweep is 180 degrees wide and requires 4 seconds each direction.

When Windshear mode is activated along with Weather/Turbulence/Map mode, the right to left sweep of the antenna employs the windshear pulse pattern in Figure 9-2 and the windshear frequency. The left to right sweep of the antenna is per the weather pulse pattern and frequencies described above. In Windshear mode, the total width of the antenna scan is reduced to 120 degrees which requires 3 seconds each direction.

Internal Test Operation

At the end of each antenna sweep two test functions are performed.

1. The PIC controller for the Source Module DDS control is re-initialized which results in a transmitted output pulse on Channel 13 (9329.501406 MHz). This is the lowest of the four weather channels.

2. The Sampler performs a series of RF tests including a transmit test. This results in transmitter output pulses on Channel 26 (9331.938906 MHz) which is the Windshear frequency.

9.3 Special FCC Test Conditions

To demonstrate compliance of the WRT-2100 over the full range of frequencies listed in Table 9-3, it is necessary to conFigure 9-the R/T unit in a special test condition. Two types of special configurations were used.

1. Fixed Frequency Operation

The WRT-2100 can be locked onto a single fixed frequency by commands through the front panel RS-232 input. The radar operates identically in all respects to normal operation including transmitter pulse patterns with the exception that the transmit frequency is locked to a single channel. Six conditions were defined; five fixed frequency channels and one normal operating condition with the normal channel selections. The five fixed frequencies were selected to represent the lowest and highest channel extremes plus three channels spread through the range. These special test conditions were used during subsequent testing described in this exhibit.

2. Maximum Channel Frequency

To measure Occupied Bandwidth over the maximum channel extremes, a special software build was generated that switched the frequencies as described in the Weather and Windshear sections above but assigned channels at the lowest and highest extremes along with intermediate frequencies through the tuning range. The frequencies and assignments utilized for the Maximum Channel Frequency test configuration are listed below.

F1 – 9327063906 MHz	(Channel 0)	Weather/Turb/Map
F2 – 9329876406 MHz	(Channel 15)	Weather/Turb/Map
F3 – 9332876406 MHz	(Channel 31)	Weather/Turb/Map
F4 – 9335876406 MHz	(Channel 47)	Weather/Turb/Map
F5 – 9338876406 MHz	(Channel 63)	Windshear

Table 9-3 lists the Special FCC Test Conditions described above and lists which FCC test paragraphs utilized these conditions.

Table 9-3. Special FCC Test Conditions - Test Matrix

Test Condition	Frequency	Comments	2.1046 RF Pwr Out	2.1049 Occ BW	2.1051 Spur Emiss	2.1053 Spur Radiat	2.1055 Freq Stab
Normal	Switching	Normal Operation		X	X	X	
Fixed Channel 0	9327.063 MHz	Lowest Extreme	X	X	X	X	X
Fixed Channel 15	9329.876 MHz	Low-Mid	X	X	X	X	X
Fixed Channel 31	9332.876 MHz	Mid	X	X	X	X	X
Fixed Channel 47	9335.876 MHz	Upper-Mid	X	X	X	X	X
Fixed Channel 63	9338.876 MHz	Highest Extreme	X	X	X	X	X
Maximum Channel	Switching	Widest Freq Range		X			

9.4 WXR-2100 RF Power Output {2.1046)

Requirement:

Section 2.1046(a) "For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the value of current and voltage on circuit elements specified in 2.1033 (c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated."

Section 2.1033(c)(8) "The dc voltages applied to and dc currents into the several elements of the final radio frequency amplifying device for normal operation over the power range."

Section 87.131, Note 7 "Frequency, emission, and maximum power will be determined by appropriate standards during the certification process".

Test Procedure:

The peak power output of the WXR-2100 was measured using test equipment connected to the WRT-2100 antenna terminal. The equipment used for the RF Power Output Test is shown in Table 9-4.

Table 9-4. Test Equipment Used for RF Power Output Test

Equipment	Manufacturer/Model Number	Specific Identification
Receiver/Transmitter	Rockwell Collins WRT-2100 (822-1710-001)	S/N 9JAV
Control/Indicator	Rockwell Collins WXI-711 (622-6514-301)	S/N 133
Control Panel	Rockwell Collins WCP-702 (622-5130-611)	S/N N/A
Antenna Pedestal	Rockwell Collins WMA-701 (622-5136-201)	S/N 3808
Test Harness	Rockwell Collins J-Box System Test Harness	
Variable Power Source	Superior UC1M	029-0645-003
Directional Coupler (20dB)	HP X752D	SN 622 460-0132-809 Component of 460-0132-809
Waveguide Termination	CMT LPT90-1B	SN 970005-001 460-0133-413 Component of 460-0132-809
Waveguide to Coax Adapter	HP X281C	SN 3032A-06660 460-0210-312 Component of 460-0132-809
Attenuator (20 dB)	Weinschel WA1-20	460-0203-439 Component of 460-0132-809
Peak Power Meter	HP 8900D	

Test Setup:

A functional block diagram of the equipment setup for the RF Power Output Test is shown in Figure 9-3. The actual test equipment setup is shown in Figure 9-4.

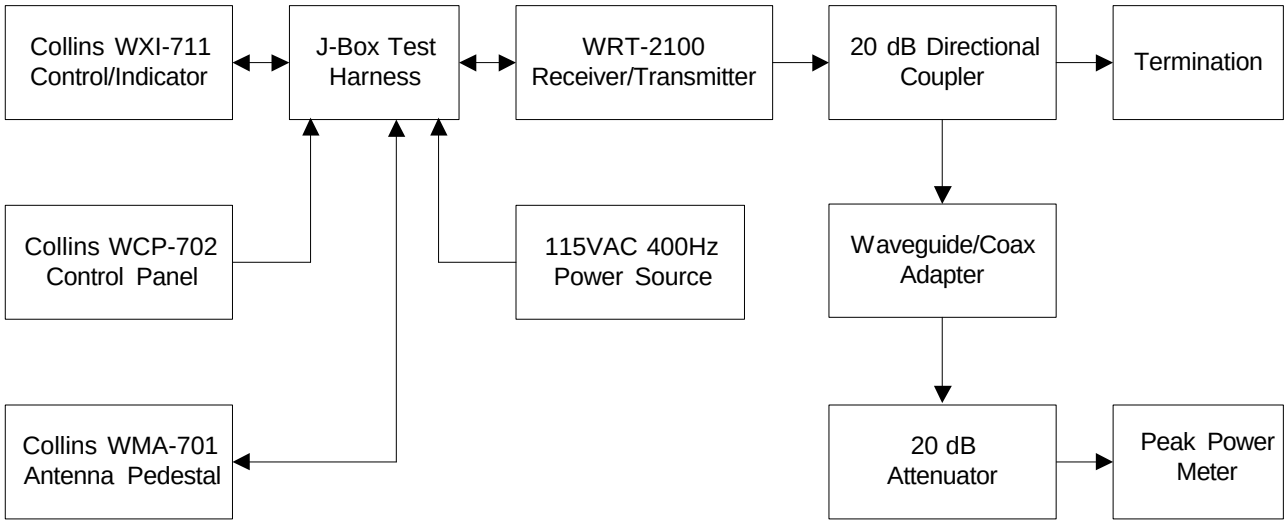

Figure 9-3. RF Power Output Test Setup

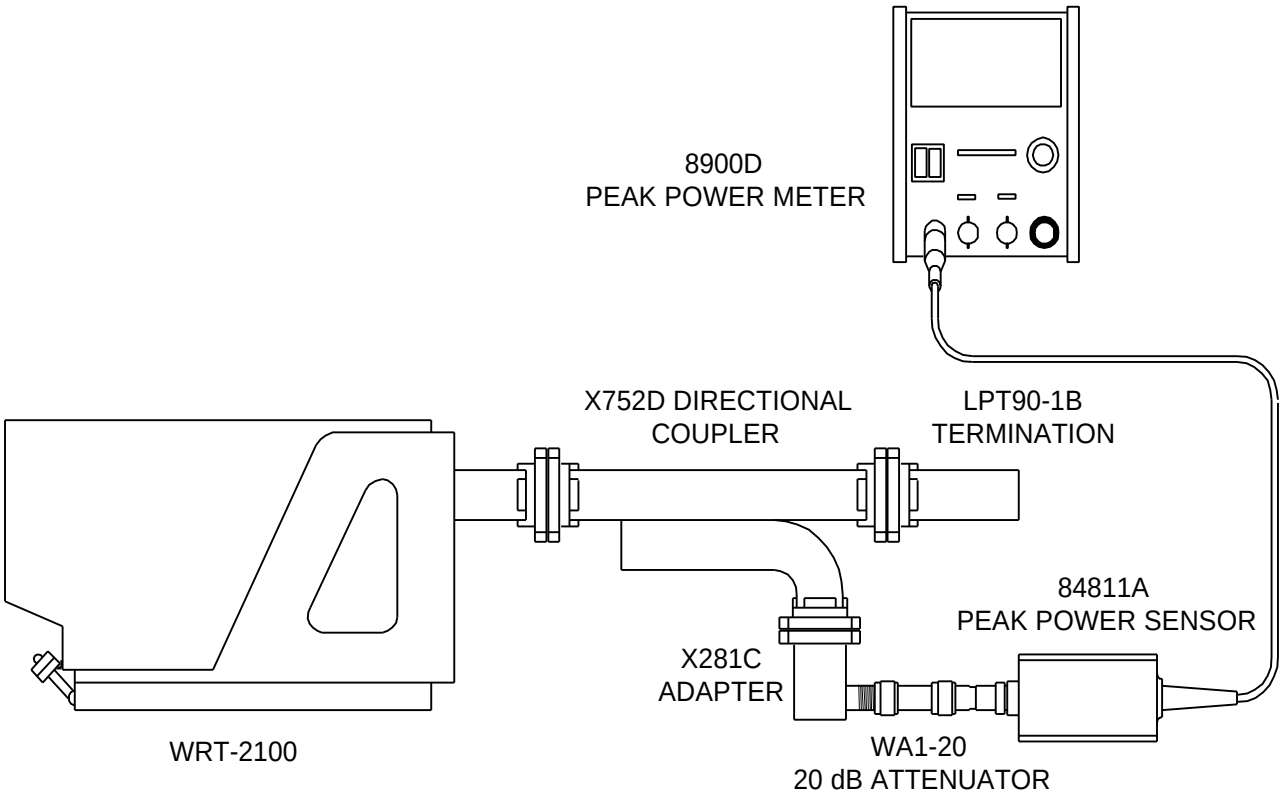

Figure 9-4. Setting Up for RF Power Output Test

Measurements:

Peak RF power output of the WRT-2100 transmitter was measured through 40 dB of attenuation. The power output was measured during the Weather plus Windshear plus Turbulence operating mode with the transmitter locked to one of five possible channels. The RF power output was measured with primary power input variations up to +/- 15%. The measured transmitter power output for each of the operating conditions is contained in Table 9-5.

Table 9-5. RF Power Output

Line Voltage (Vac)	Peak Transmitter Power Output (Watts)				
	Channel 0	Channel 15	Channel 31	Channel 47	Channel 63
97.750 (115-15%)	149	149	149	150	150
103.50 (115-10%)	149	149	149	150	150
109.25 (115-5%)	149	149	149	150	150
115.00	149	149	150	150	150
120.75 (115+5%)	149	149	150	150	150
126.50 (115+10%)	149	149	150	150	151
132.25 (115+15%)	149	149	150	150	151

9.5 Frequency Stability (2.1055)

Requirement:

(a) (2) The frequency shall be measured with variation of ambient temperature from -20° to +50° centigrade for equipment licensed for use aboard aircraft in the Aviation Services under part 87 of FCC Code of Federal Regulations Title 47.

(b) The frequency measurement shall be made at the extremes and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement.

(d) (1) (3) The frequency stability shall be measured with variation of primary supply voltage from 85 to 115 percent of the nominal value. The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided.

Per 87.133 (a) Frequency tolerance for Frequency band (8) 2450 to 10500 MHz - Note 9,

"Where specific frequencies are not assigned to radar stations, the bandwidth occupied by the emissions of such stations must be maintained within the band allocated to the service and the indicated tolerance (1250 ppm) does not apply."

Procedure:

The transmitted frequency of the WXR-2100 was measured using a temperature chamber and test equipment. The equipment used for the Frequency Stability test is shown in Table 9-6.

Table 9-6. Equipment Used for Frequency Stability Test

Equipment	Manufacturer/Model Number	Specific Identification
Receiver/Transmitter	Rockwell Collins WRT-2100 (822-1710-001)	S/N 9JAV
Control/Indicator	Rockwell Collins WXI-711 (622-6514-301)	S/N 133
Control Panel	Rockwell Collins WCP-702 (622-5130-611)	S/N N/A
Antenna Pedestal	Rockwell Collins WMA-701 (622-5136-201)	S/N 3808
Test Harness	Rockwell Collins J-Box System Test Harness	
Variable Power Source	Superior UC1M	029-0645-003
Waveguide to Coax Adapter	HP X281C	SN 3032A-06660 460-0210-312 Component of 460-0132-809
Attenuator (10 dB)	Weinschel 33-10-34	SN 9582 460-0070-249
Attenuator (20 dB)	Weinschel WA1-20	460-0203-439 Component of 460-0132-809
Spectrum Analyzer	Agilent 8563EC	SN 3946A00321 460-0129-958
Temperature Chamber	Thermotron M-8C	SN 21046 460-0203-302

Equipment Setup:

The test setup for the Frequency Stability test is shown in Figure 9-5.

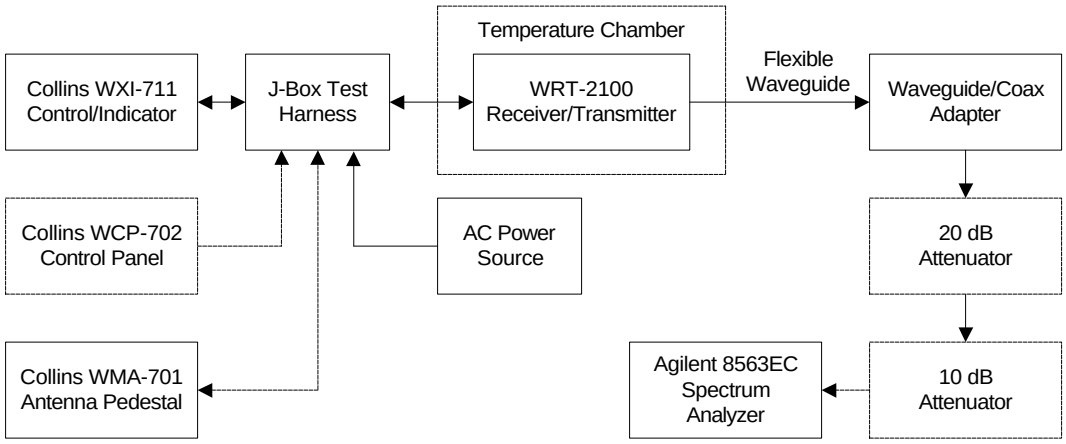

Figure 9-5. Frequency Stability Test Setup

Line Voltage Test:

The unit was operated on the bench at ambient temperature. The line voltage was varied from 85% to 115% of 115VAC (97.75VAC to 132.25VAC). All frequency stability tests were conducted with the Receiver/Transmitter operating in the bench test mode with the frequency locked to a fixed specified in Table 9-7 below.

Line Voltage Test Measurements:

Spectrum Analyzer Settings: Span 1 MHz. 30 sec sweep. RBW 10 KHz VBW 10 KHz.

Frequency Stability vs Line Voltage Test results are shown in Table 9-7.

Table 9-7. Transmitted Frequency Vs. Input Voltage

Line Voltage (VAC) 400 Hz	Frequency (Spectrum Analyzer) (MHz)				
	Channel 0	Channel 15	Channel 31	Channel 47	Channel 63
97.750 (115-15%)	9,327.376	9,330.195	9,333.191	9,336.190	9,339.191
103.50 (115-10%)	9,327.381	9,330.193	9,333.193	9,336.194	9,339.193
109.25 (115-5%)	9,327.378	9,330.193	9,333.196	9,336.197	9,339.191
115.00	9,327.378	9,330.190	9,333.193	9,336.192	9,339.190
120.75 (115+5%)	9,327.378	9,330.193	9,333.191	9,336.194	9,339.192
126.50 (115+10%)	9,327.375	9,330.188	9,333.191	9,336.189	9,339.188
132.25 (115+15%)	9,327.376	9,330.186	9,333.191	9,336.191	9,339.187

Results: There were no out of tolerance frequency variations as a result of line voltage variations from 97.75VAC to 132.25 VAC.

Temperature Test:

The WRT-2100 was placed in a temperature chamber with all other equipment outside at room ambient. The test unit was operated using nominal115VAC 400Hz primary power and the temperature varied from –55 ºC to +70 ºC. The WRT-2100 frequency was measured on the Spectrum Analyzer. Sufficient time was allowed to stabilize the unit after the chamber reached the desired temperature. Data was taken in 10 degree (or less) steps.

Spectrum Analyzer settings to measure transmitter frequency:

1 MHz span centered on channel. 60 second sweep.

Temperature Test Measurements:

Temperature Test results are shown in Table 9-8 and Figure 9-6.

Table 9-8. Transmitted Frequency Vs. Temperature

Temperature (ºC)	Frequency (Spectrum Analyzer) (MHz)				
	Channel 0	Channel 15	Channel 31	Channel 47	Channel 63
-55	9,327.090	9,329.897	9,332.895	9,335.895	9,338.897
-50	9,327.150	9,329.958	9,332.957	9,335.950	9,338.952
-40	9,327.221	9,330.032	9,333.028	9,336.030	9,339.032
-30	9,327.270	9,330.082	9,333.080	9,336.083	9,339.082
-20	9,327.341	9,330.150	9,333.152	9,336.150	9,339.150
-10	9,327.390	9,330.202	9,333.200	9,336.197	9,339.197
0	9,327.405	9,330.218	9,333.218	9,336.215	9,339.213
10	9,327.403	9,330.218	9,333.215	9,336.218	9,339.222
20	9,327.385	9,330.197	9,333.198	9,336.202	9,339.197
30	9,327.365	9,330.180	9,333.175	9,336.173	9,339.172
40	9,327.323	9,330.132	9,333.130	9,336.133	9,339.125
50	9,327.275	9,330.085	9,333.083	9,336.078	9,339.085
60	9,327.210	9,330.022	9,333.023	9,336.018	9,339.018
70	9,327.151	9,329.968	9,332.963	9,335.967	9,338.960

Results: There were no out of tolerance frequency variations as a result of temperature extremes from -55°C to +70°C.

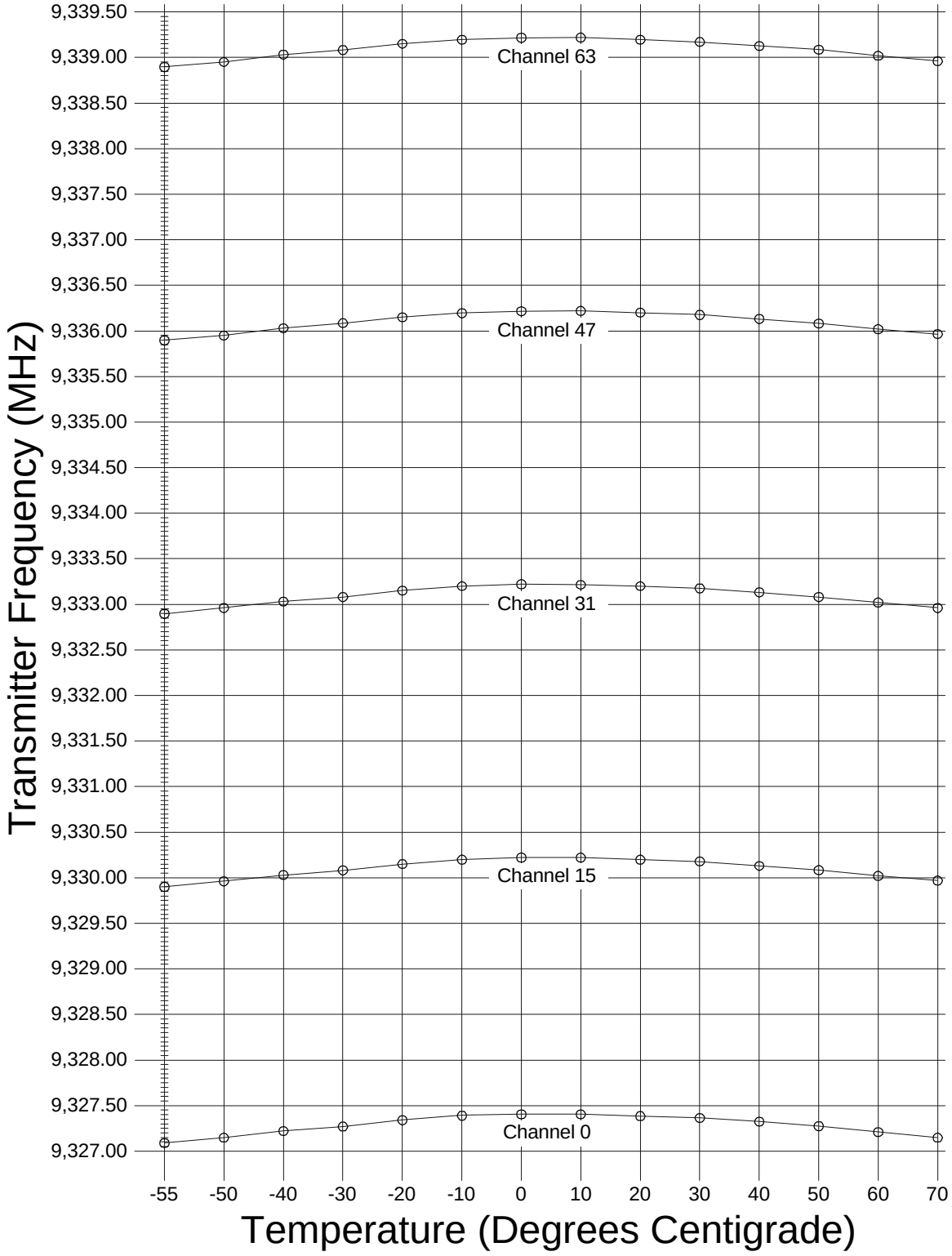

Figure 9-6. Transmitter Frequency Stability vs. Temperature

9.6 WXR-2100 Occupied Bandwidth {2.1049)

Requirement:

Section 2.1049 "The occupied bandwidth, that 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 shall be measured under the following conditions as applicable."

Section 2.1049 (I) "Transmitters designed for other types of modulation - when modulated by an appropriate signal of sufficient amplitude to be representative of the type of service in which used. A description of the input signal should be supplied."

Section 87.135

(a) Occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are equal to 0.5 percent of the total mean power of a given emission.

(b) The authorized bandwidth is the maximum occupied bandwidth authorized to be used by a station.

(c) The necessary bandwidth for a given class of emission is the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

Section 87.137 Authorized Bandwidth for Emission Type P0N - Note 9 "To be specified on license".

Test Procedure:

The Occupied Bandwidth of the WXR-2100 was measured using test equipment connected to the WRT-2100 antenna terminal. The equipment used for the Occupied Bandwidth Test is shown in Table 9-9.

Table 9-9. Equipment Used for Occupied Bandwidth Tests

Equipment	Manufacturer/Model Number	Specific Identification
Receiver/Transmitter	Rockwell Collins WRT-2100 (822-1710-001)	S/N 9JAV
Control/Indicator	Rockwell Collins WXI-711 (622-6514-301)	S/N 133
Control Panel	Rockwell Collins WCP-702 (622-5130-611)	S/N N/A
Antenna Pedestal	Rockwell Collins WMA-701 (622-5136-201)	S/N 3808
Test Harness	Rockwell Collins J-Box System Test Harness	
Power Source	115 VAC 400 Hz Primary Pwr	N/A
Directional Coupler (20dB)	HP X752D	SN 622 460-0132-809 Component of 460-0132-809
Waveguide Termination	CMT LPT90-1B	SN 970005-001 460-0133-413 Component of 460-0132-809
Waveguide to Coax Adapter	HP X281C	SN 3032A-06660 460-0210-312 Component of 460-0132-809
Attenuator (20 dB)	Weinschel WA1-20	460-0203-439 Component of 460-0132-809
Spectrum Analyzer	Agilent 8563EC	SN 3946A00321 460-0129-958
Personal Computer	IBM Compatible with National Instruments GPIB Interface and Agilent E4444A Benchlink Software	Gateway 2000 P5-120 SN 4250149

Test Setup:

A functional block diagram of the equipment setup for the Occupied Bandwidth Test is shown in Figure 9-7. The actual test equipment setup is shown in Figure 9-8.

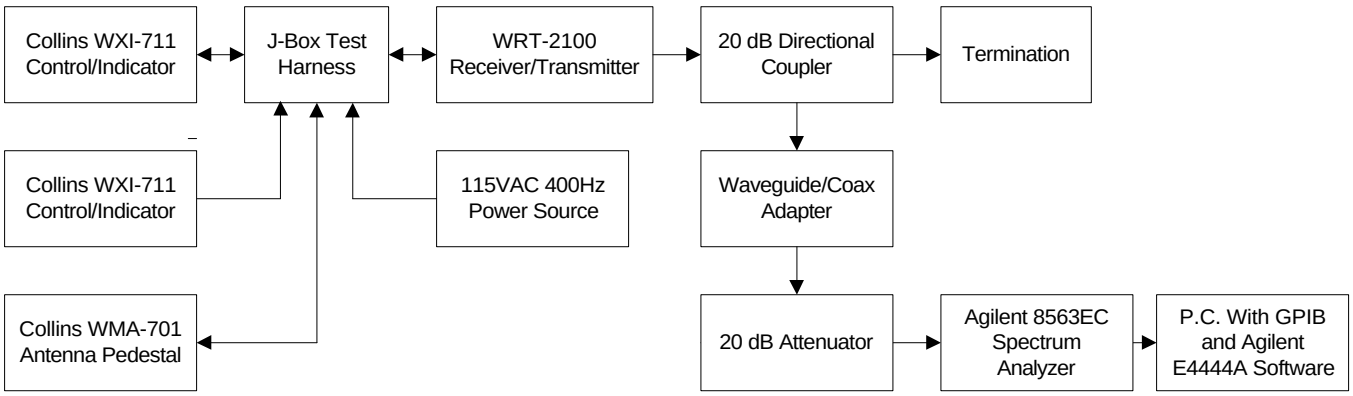

Figure 9-7. Occupied Bandwidth Test Setup

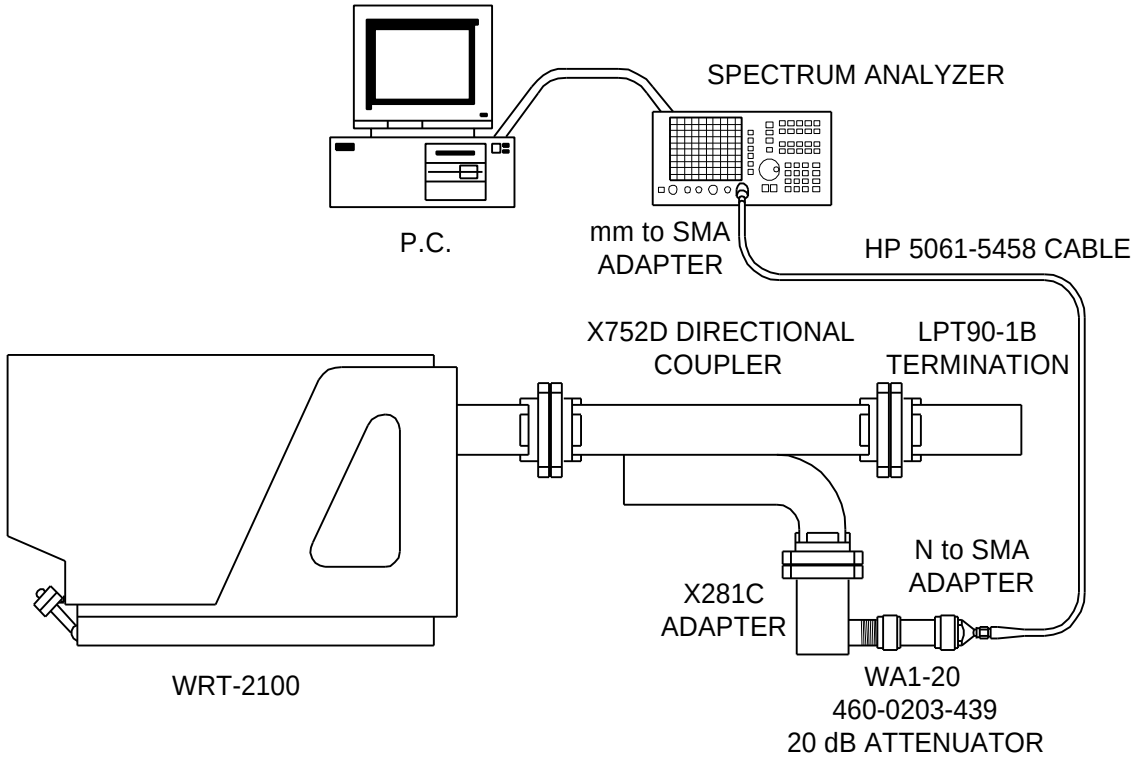

Figure 9-8. Setting Up for Occupied Bandwidth Test

Measurement Objectives:

The WXR-2100 radar system is designed to operate on 64 separate frequencies in the band from 9.32706 GHz to 9.33888 GHz. During normal operation, each selected mode utilizes multiple transmitter frequencies. Utilization of multiple frequencies enables the radar system to obtain significantly greater accuracy in estimation of echo signal strength from both ground targets and weather targets. Each selected mode utilizes a different subset of the available 64 channels and varying pulse widths. The choice of frequencies utilized for each mode can vary depending on such parameters as radio altitude on approach or takeoff. Although each mode may only use a subset of the available 64 channels, it is desired to have FCC certification for use of all 64 channels within the specified range. A complete description of the frequency selection, pulse repetition frequencies, and pulse width selection is provided in Section 9.2 *WXR-2100 Modulation Characteristics.*

To provide test data representing the extremes of possible operation, the occupied bandwidth measurements are grouped into two sets. The first set represents currently available normal operating modes with the unit operating on the subset of frequencies chosen for that mode. This normal channeling case is shown in Figure 9-9. The second measurement was made with the unit operating in Maximum Channel Frequency mode. This special configuration utilizes channels at the extremes of the channel frequencies described in Section 9.2 Special FCC Test Conditions. The Occupied Bandwidth plot for this Maximum Channel Frequency configuration is shown in Figure 9-10. In both cases , the unit is operating in Weather + Turbulence + Windshear mode which represents the extremes of transmitter prf and pulse widths. Additional Occupied Bandwidth data for single fixed individual channels included in Appendix A

Measurements:

The Agilent 8563EC spectrum analyzer was set up to automatically measure 99% occupied bandwidth. The measurements were made under each specified condition with the desired occupied bandwidth set to 99%. Table 9-10 contains the test result for the Weather plus Turbulence plus Windshear operating mode.

Table 9-10. WXR-2100 Occupied Bandwidth Measurement Results

Normal Operation	Test Condition	99% Occupied Bandwidth	Reference Figure
Weather plus Windshear plus Turbulence Mode	Normal Selection	3.683 MHz	Figure 9-5
	Maximum Channel Span	12.45 MHz	Figure 9-6

The occupied bandwidth measurement for Weather plus Windshear plus Turbulence mode is shown in Figure 9-9 and Figure 9-10.

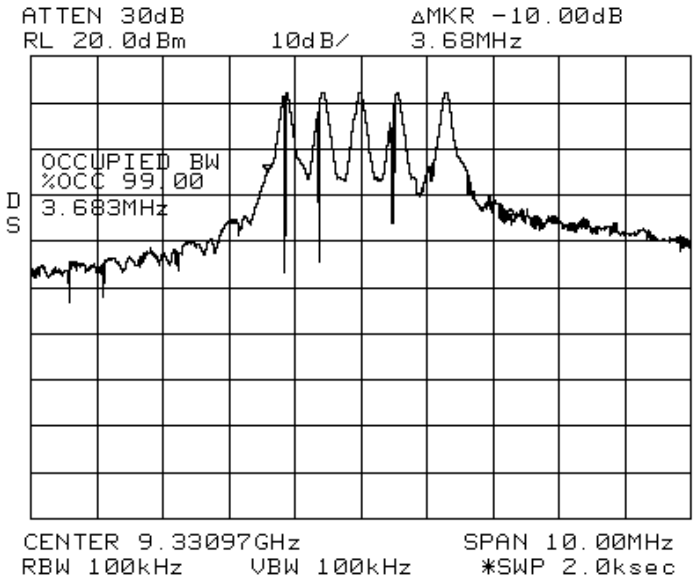

Figure 9-9. Occupied Bandwidth - Normal Channel Selections

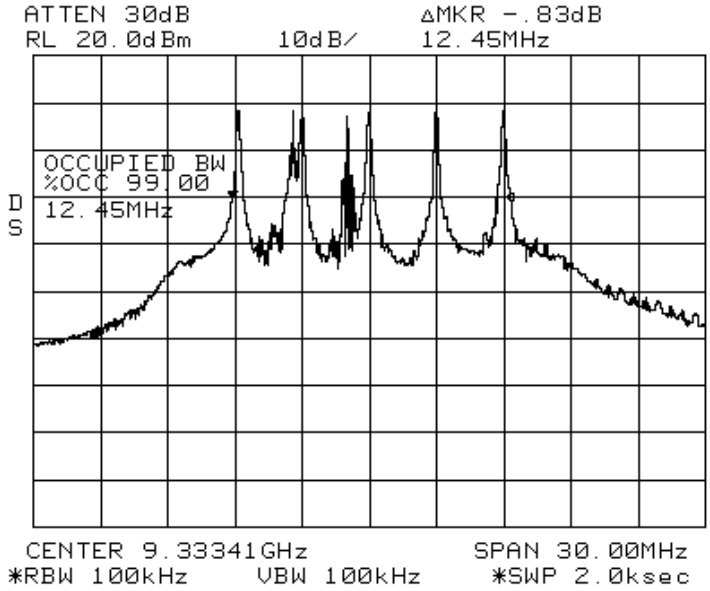

Figure 9-10. Occupied Bandwidth - Maximum Frequency Span

Additional Occupied Bandwidth Plots

Five additional scans were completed for reference purposes to show the Occupied Bandwidth for individual fixed channels 0,15, 31, 47, and 63. It should be noted that even though the radar is locked onto a fixed channel for it's operation, the end-of-sweep test pulses are still being emitted on separate channels as described in Section 9.2 - Modulation Characteristics. These test frequencies appear as additional lobes either beside the main lobe or in some cases merged with the main lobe. In these cases, the automatic Occupied Bandwidth calculation performed by the spectrum analyzer includes the additional lobe.

Table 9-11 below summarizes the additional Occupied Bandwidth plots for each channel.

Table 9-11. WXR-2100 Occupied Bandwidth Measurement Results - Fixed Channels

Bench Test	99% Occupied Bandwidth	Reference Figure
Channel 0 9,327.063906 MHz	5.400 MHz	Figure 9-11
	896.7 kHz	Figure 9-12
Channel 15 9,329.876406 MHz	4.450 MHz	Figure 9-13
	1.180 MHz	Figure 9-14
Channel 31 9,332.876406 MHz	6.717 MHz	Figure 9-15
	943.3 kHz	Figure 9-16
Channel 47 9,334.751406 MHz	5.433 MHz	Figure 9-17
	933.3 kHz	Figure 9-18
Channel 63 9,338.876406 MHz	4.333 MHz	Figure 9-19
	896.7 kHz	Figure 9-20

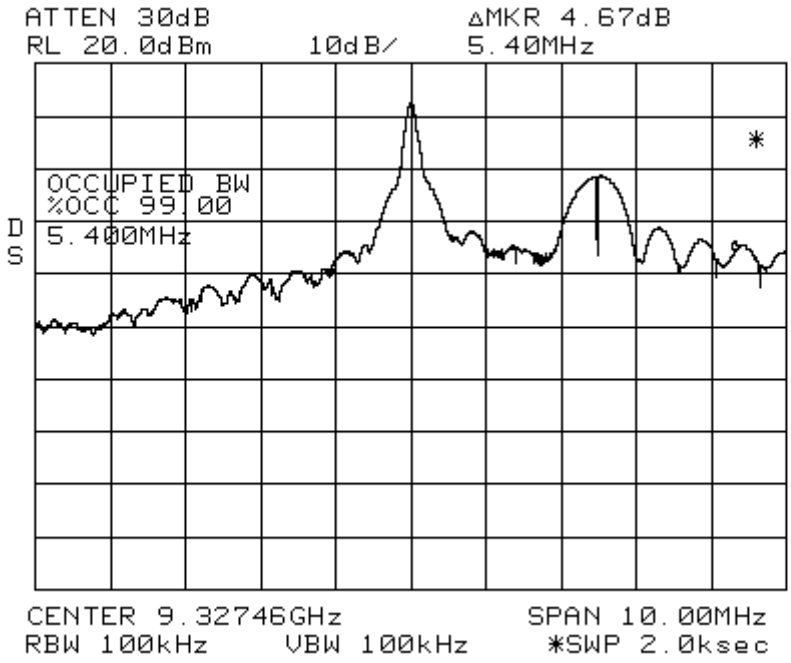

Figure 9-11. Channel 0, Occupied Bandwidth

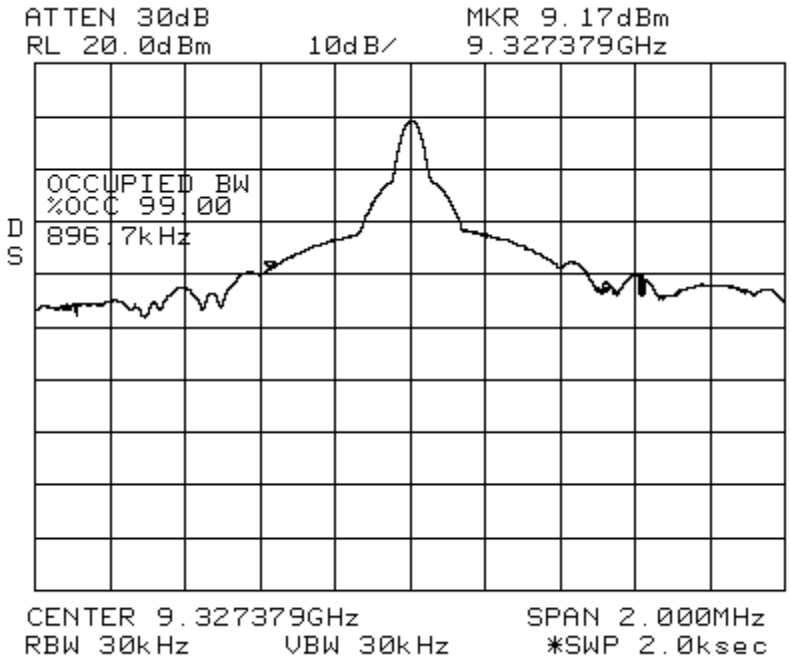

Figure 9-12. Channel 0, Occupied Bandwidth

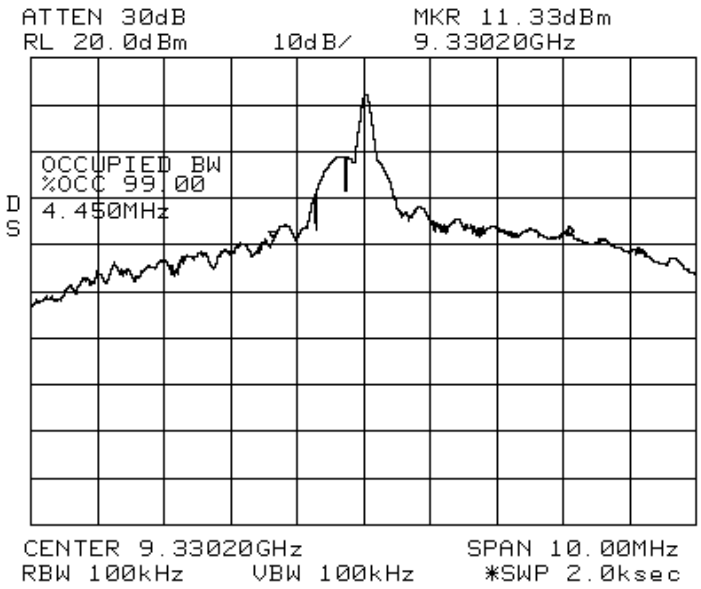

Figure 9-13. Channel 15, Occupied Bandwidth

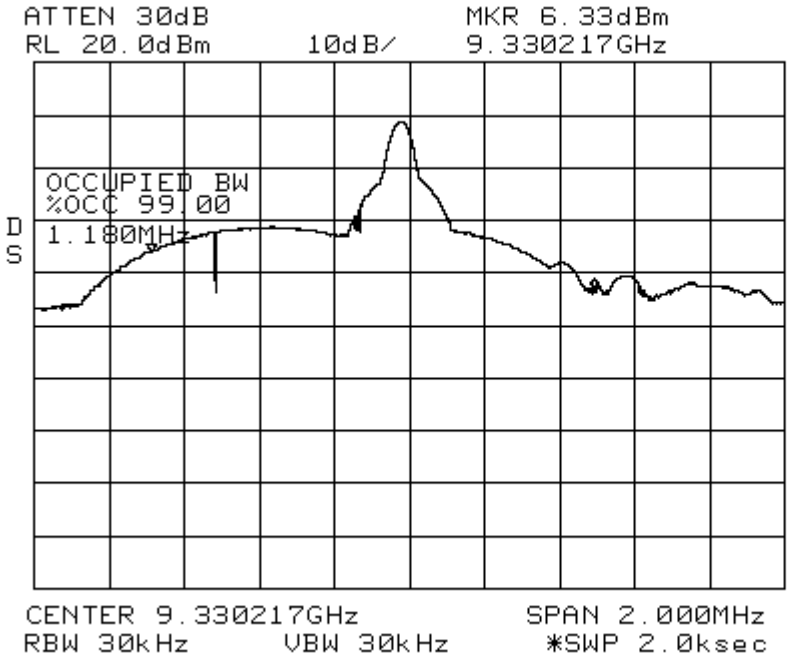

Figure 9-14. Channel 15, Occupied Bandwidth

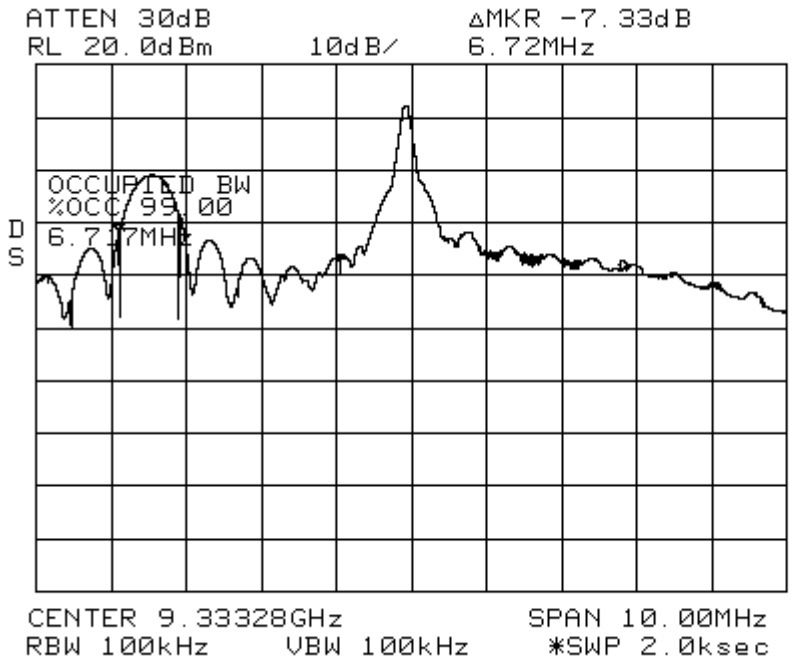

Figure 9-15. Channel 31, Occupied Bandwidth

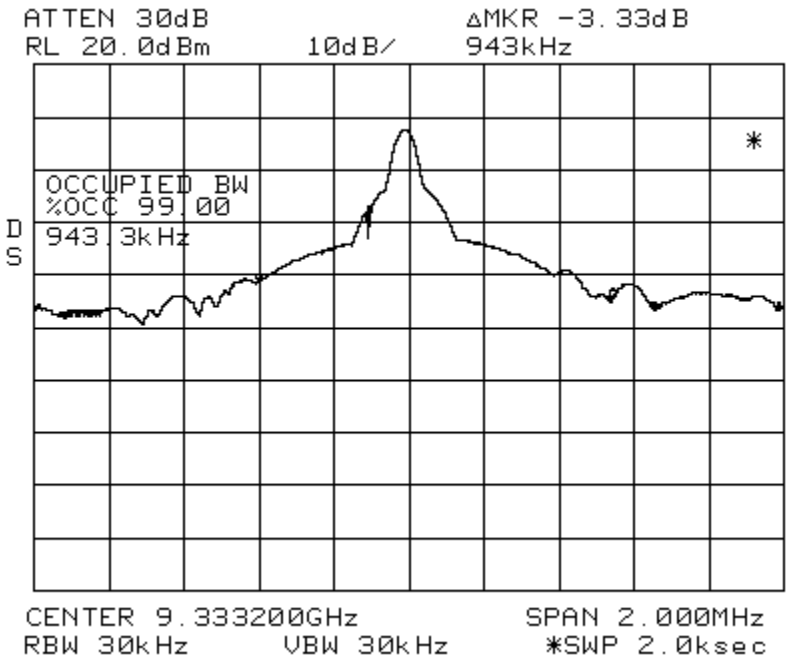

Figure 9-16. Channel 31, Occupied Bandwidth

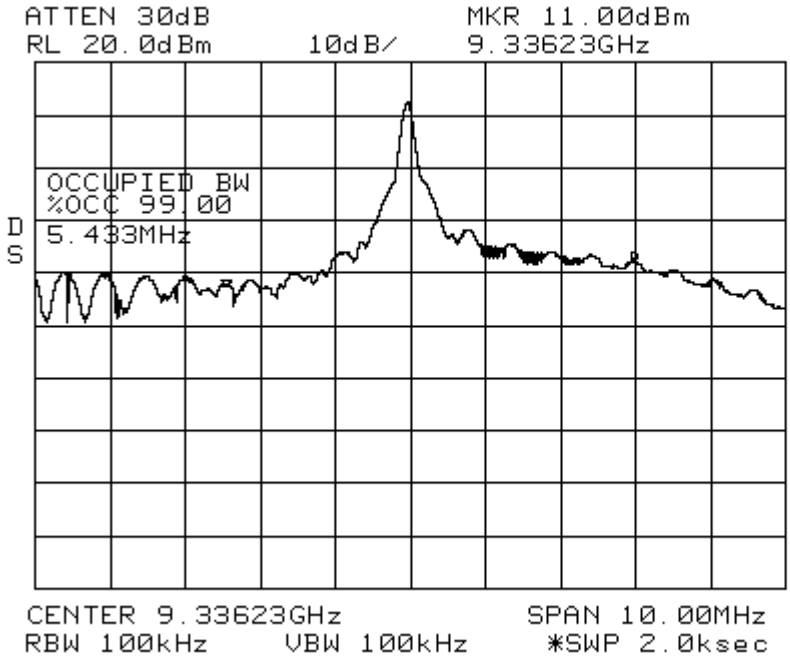

Figure 9-17. Channel 47, Occupied Bandwidth

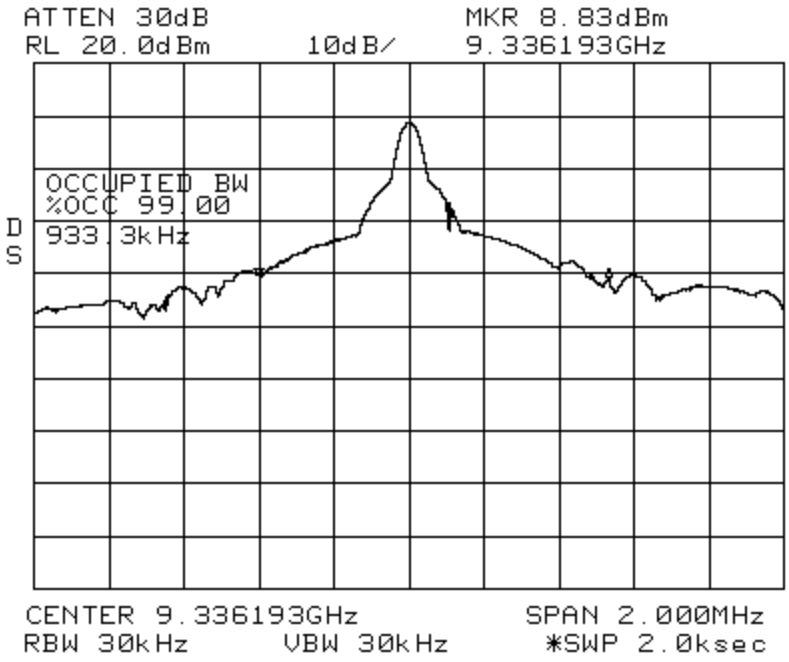

Figure 9-18. Channel 47, Occupied Bandwidth

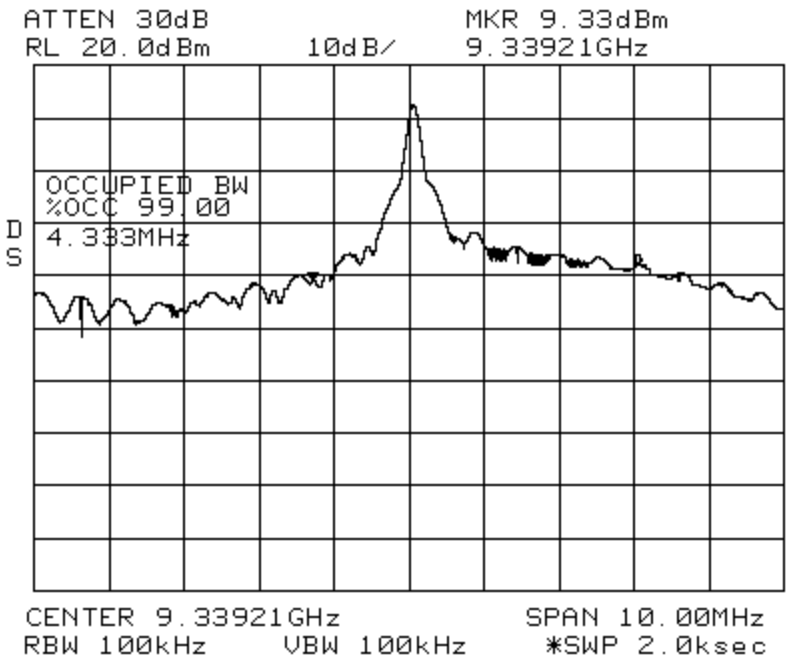

Figure 9-19. Channel 63, Occupied Bandwidth

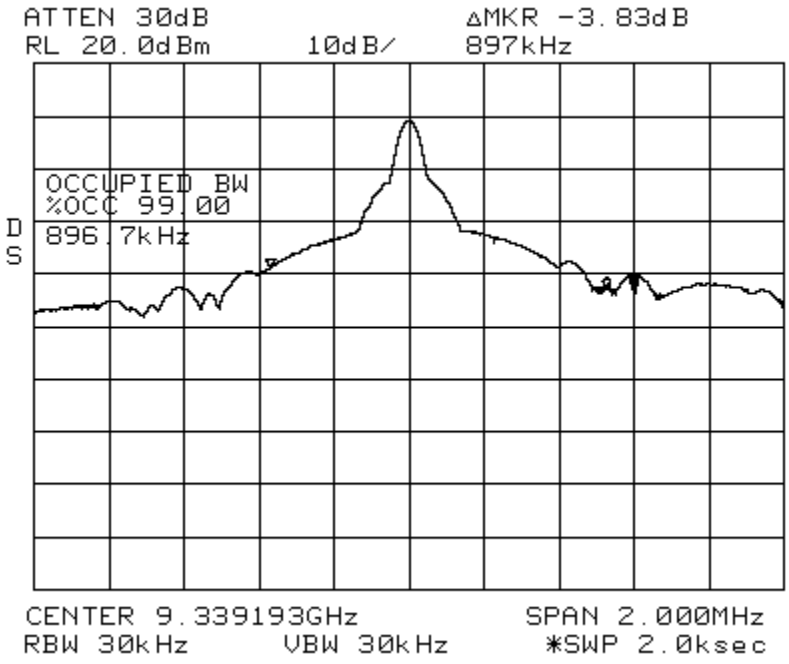

Figure 9-20. Channel 63, Occupied Bandwidth

9.7 Spurious Emissions at Antenna Terminal (2.1051)

Requirements:

Section 2.1051 The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suiTable 9-artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emissions that can be detected when the equipment is operated under the conditions specified in Section 2.1049 as appropriate. The magnitude of spurious emissions attenuated more than 20 dB below the permissible values need not be specified.

Section 87.139(a) "… the mean power of any emission must be attenuated below the mean power of the transmitter (pY) as follows:

(1) When the frequency is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth the attenuation must be at least 25 dB.

(2) When the frequency is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth the attenuation must be at least 35 dB.

(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least $43+\log_{10}(pY)$ dB.

Since the WRT-2100 clearly falls under the definition of an aircraft station transmitter defined in Section 2.101, the worst case limit is 40 dBc. The Authorized Bandwidth is assumed to be 9.3 - 9.5 GHz which is the frequency range allocated for radar.

The WRT-2100 Test Article had a peak power output of 150 watts. Based on this power level, the absolute limits are calculated as follows using 40 dBc as an example.

Ptx-peak = 150 Watts or 21.8 dBW = 51.8 dBm in all ranges.

FCC Limit = 40 dBc

Absolute Limit = Ptx-peak (dBm) – FCC Limit (dBc) = +11.8 dBm

Note: The FCC limit is specified in terms of mean power (pY). However, the test equipment utilized for these tests provides peak measurements. Calculation of the FCC limits based on mean power, then converting to peak readings will yield the same limits.

The requirements for the Spurious Emissions Test are contained in Table9-12.

Table 9-12. Spurious Emission Test Requirements (87.139(a)(3))

Frequency Band	Emission Level	Absolute FCC Limit (Peak)
From 9438.876 MHz to 9538.876 MHz	-25 dBc (dB relative to carrier level)	+26.8 dBm
From 9538.877 MHz to 9838.876 MHz	-35 dBc	+16.8 dBm
Over 9838.877 MHz	-40 dBc	+11.8 dBm

Spurious Emission Corrections for Antenna and Transmission Line Components:

The WFA-701X Antenna Flatplate radiator is a required part of the radar system along with the WMA-701X Antenna Pedestal and transmission line components. All conducted emissions (desired and spurious) must pass through the antenna before being radiated into space.

Each of these elements provides an attenuation to spurious emissions radiated into space. The following paragraphs describes these attenuation factors. These factors will then be applied to the spurious emission levels.

Flatplate Antenna Attenuation for Spurious Frequencies:

The WFA-701X Flatplate Antenna is a tuned waveguide structure with 34.5 dB of gain at the center frequency of 9333 MHz. The WFA-701X has substantial attenuation at frequencies removed from the center frequency.

Antenna gain measurements were made on the flatplate at spurious frequencies up to 18.666 GHz. The highest response was 12.49 dB at 11.666 GHz. Other frequencies were significantly lower.

Therefore, the attenuation for spurious outputs due to the antenna response is:

Attenuation Due To Antenna Response = 34.5 dB - 12.5 dB = 22 dB.

Other attenuating factors for spurious outputs include mismatch loss into the antenna and loss through the antenna pedestal transmission line and rotary joints. These losses will not be included here but serve to add extra margin to the 22 dB attenuation from the flatplate.

The Antenna Correction Factor of 22 dB will be applied to all spurious emissions recognizing that this is a conservative number and that the actual attenuation is larger in most cases.

60 dBc Limit:

For reference, the spurious emissions will be compared to a 40 dBc limit and a 60 dBc limit.

The limit for a 60 dBc attenuation is:

Absolute Limit (60 dBc) = Ptx-peak - 60 = 51.8 dBm - 60 = -8.2 dBm

Procedure:

The spurious emissions at the antenna terminal of the WXR-2100 were measured using test equipment connected to the Receiver/Transmitter antenna waveguide port on the rear of the R/T mount. The equipment used for the Spurious Emissions at the Antenna Terminal test is shown in Table 9-13 through Table 9-17.

Table 9-13. Equipment Used for Spurious Emissions Tests

Equipment	Manufacturer/Model Number	Specific Identification
Receiver/Transmitter	Rockwell Collins WRT-2100 (822-1710-001)	S/N 9JAV
Control/Indicator	Rockwell Collins WXI-711 (622-6514-301)	S/N 133
Control Panel	Rockwell Collins WCP-702 (622-5130-611)	S/N N/A
Antenna Pedestal	Rockwell Collins WMA-701 (622-5136-201)	S/N 3808
Test Harness	Rockwell Collins J-Box System Test Harness	N/A
Power Source	Agilent 6812B AC Power Source/Analyzer	
Personal Computer	IBM Compatible with National Instruments GPIB Interface and Agilent E4444A Benchlink Software	Gateway 2000 P5-120 SN 4250149
Spectrum Analyzer	Agilent 8563EC (30 Hz to	SN 3946A00321 460-0129-958
	Agilent 8565E (30 Hz to 50 GHz)	SN 3821A00919 460-0126-485

Table 9-14. Additional Test Equipment Used for X Band (8.2 to 12.4 GHx) Spurious Emissions Tests

Equipment	Manufacturer/Model Number	Specific Identification
Directional Coupler (20dB)	HP X752D	SN 622 460-0132-809
Waveguide Termination	CMT LPT90-1B	SN 970005-001 460-0133-413 Component of 460-0132-809
Waveguide to Coax Adapter	HP X281C	SN 3032A-06660 460-0210-312 Component of 460-0132-809
Attenuator (20 dB)	Weinschel WA1-20	460-0203-439 Component of 460-0132-809

Table 9-15. Additional Test Equipment Used for P Band (Ku) (12.4 to 18.0 GHz) Spurious Emissions Test

Equipment	Manufacturer/Model Number	Specific Identification
Directional Coupler (20dB)	HP P752D	SN 359 460-0132-825
Waveguide Taper (X to P Band)	Space Machine & Engineering	460-0133-402 Component of 460-0132-825
Waveguide Termination	CMT LPT62-1B	SN 970005-002 460-0133-414 Component of 460-0132-825
Waveguide to Coax Adapter	HP P281B	460-0133-418 Component of 460-0132-825

Table 9-16. Additional Test Equipment Used for K Band (18.0 to 26.5 GHz) Spurious Emissions Test

Equipment	Manufacturer/Model Number	Specific Identification
Directional Coupler (20dB)	HP K752D	SN 177 460-0132-826
Waveguide Taper (X to K Band)	Space Machine & Engineering	460-0133-404 Component of 460-0132-826
Waveguide Termination	CMT LPT42-1B	SN 970005-003 460-0133-416 Component of 460-0132-826
Waveguide to Coax Adapter	HP K281C	SN3032A-09068 460-0133-412 Component of 460-0132-826

Table 9-17. Additional Test Equipment Used for R Band (Ka) (26.5 to 40.0 GHz) Spurious Emissions Test

Equipment	Manufacturer/Model Number	Specific Identification
Directional Coupler (20dB)	HP R752D	SN 463 460-0132-827
Waveguide Taper (X to R Band)	Space Machine & Engineering	460-0133-406 Component of 460-0132-827
Waveguide Termination	CMT LPT28-1B	SN 970005-004 460-0133-415 Component of 460-0132-827
Waveguide to Coax Adapter	HP R281A	SN 02136 460-0133-417 Component of 460-0132-827

Setup:

A functional block diagram of the equipment setup for the X Band (8.2 to 12.4 GHz) Spurious Emissions at Antenna Terminal test is shown in Figure 9-21. The actual test equipment setup is shown in Figure 9-22.

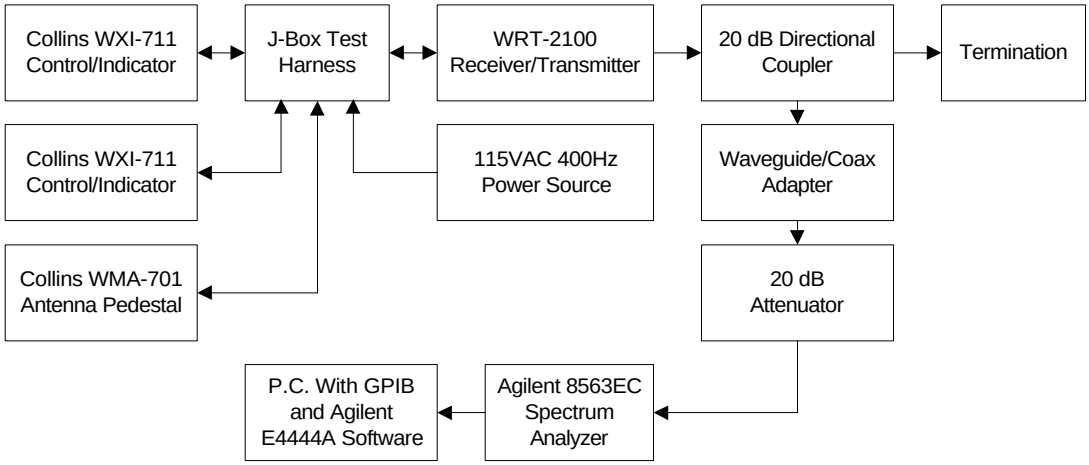

Figure 9-21. Spurious Emissions of Antenna Terminal Test Setup (8.2 to 12.4 GHz)

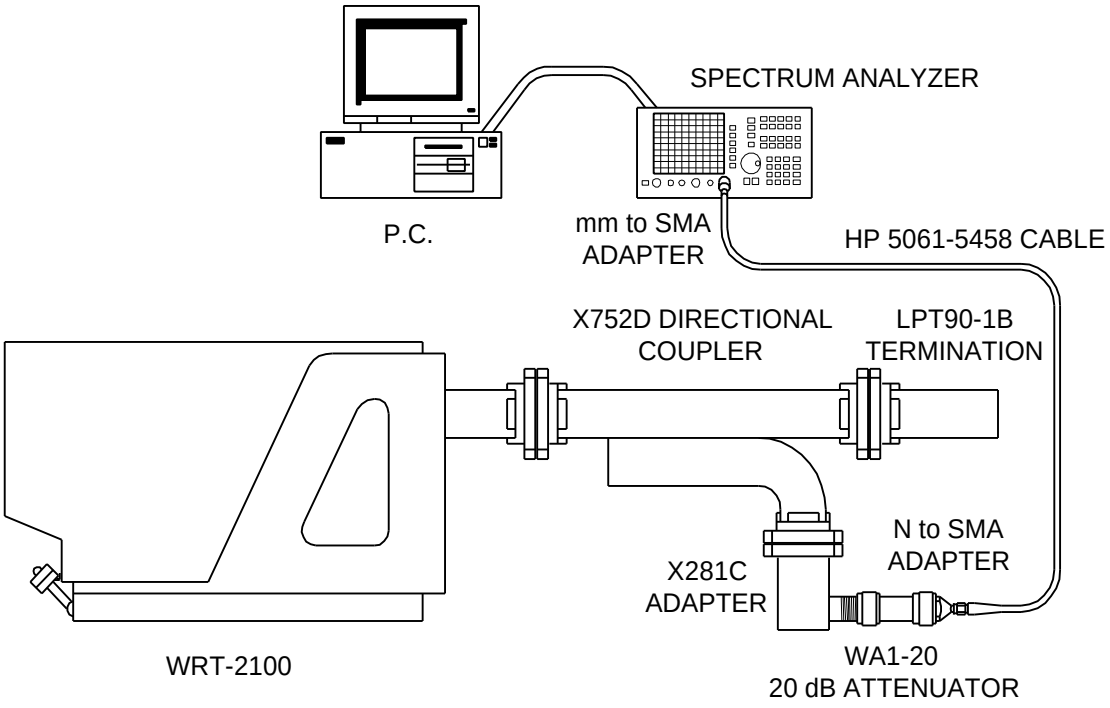

Figure 9-22. Setting Up for Spurious Emissions at Antenna Terminal Tests (8.2 to 12.4 GHz)

A functional block diagram of the equipment setup for the P Band (Ku) (12.4 to 18.0 GHz), K Band (18.0 to 26.5 GHz), and R Band (Ka) (26.5 to 40.0 GHz) Spurious Emissions at Antenna Terminal Tests is shown in Figure 9-23. The actual test equipment setup is shown in Figure 9-24.

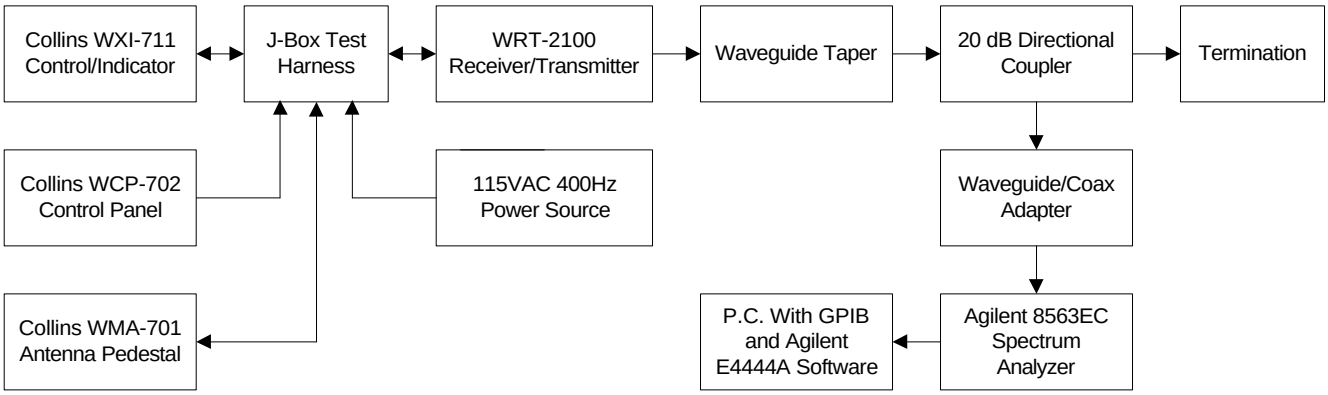

Figure 9-23. Spurious Emissions at Antenna Terminal Test Setup (12.4 t0 18.0 GHz), (18.0 to 26.5 GHz), and (26.5 to 40 GHz).

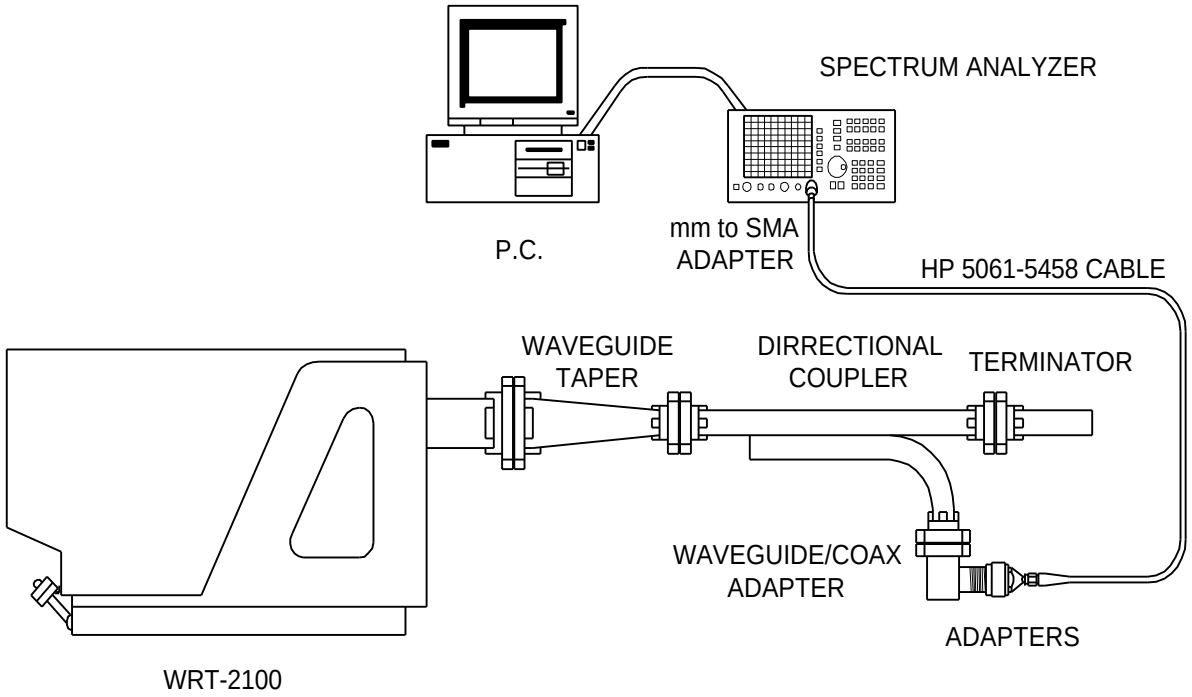

Figure 9-24. Setting Up for Spurious Emissions at Antenna Terminal Tests (12.4 to 18.0 GHz), (18.0 to 26.5 GHz), and (26.5 to 40 GHz).

Measurements:

Spurious Antenna Emission Test data was takes for six conditions:

Normal Frequency Switching
Fixed Channel 0
Fixed Channel 15
Fixed Channel 31
Fixed Channel 47
Fixed Channel 63

In each case, the radar was operating at the maximum operational mode:
Weather + Turbulence + Windshear.

Results:

The spectrum was checked from 8.2 to 40 GHz. This range included the fundamental to the fourth harmonic. When corrected for attenuation due to the Antenna Response to Spurious Frequencies described above, there were no emissions within 20 dB of the FCC Limit of 40 dBc. When compared to the 60 dBc limit included for reference, there were no emissions that exceeded the 60 dBc limit.

Note: Since the antenna terminal is X-Band waveguide (WR-90), frequencies below the cutoff frequency (7 GHz) were not measured. There were no conducted emissions ever observed below the fundamental frequency of 9.33 GHz.

The test results for the six conditions are listed in Tables 18-23. The tables contain all data that was within 20 dB of the FCC limit before correction with the Antenna Correction Factor (22 dB). Reference plots for each scan are indexed in the tables.

Table 9-18. Conducted Spurious Emissions - Normal Mode

Measurement Band	Spurious Frequency (GHz)	Emission Level (dBm)	Corrected Emission Level (-22dB)	40 dBc Limit (dBm)	60 dBc Limit (dBm)	Margin (dB) vs (40 dBc) Limit	Margin (dB) vs (60 dBc) Limit	Reference Figure
8.2 to 12.4 GHz	None	N/A		+11.8	-8.2			Figure 9-25
12.4 to 18.0 GHz	13.996	+5.17	-16.83.	+11.8	-8.2	+30.63	+8.63	Figure 9-26
	16.32	-2.0	-24	+11.8	-8.2	+27.8	+15.8	
18.0 to 26.5 GHz	18.75	+12	-10	+11.8	-8.2	+23.8	+1.8	Figure 9-27
	21.145	-2	-24	+11.8	-8.2	+35.8	+15.8	
	23.44	-10	-32	+11.8	-8.2	+43.8	+23.8	
	25.77	-8	-30	+11.8	-8.2	+41.8	+21.8	
26.5 to 40.0 GHz	None	N/A		+11.8	-8.2			Figure 9-28

Table 9-19. Conducted Spurious Emissions - Fixed Channel 0

Measurement Band	Spurious Frequency (GHz)	Emission Level (dBm)	Corrected Emission Level (-22dB)	40 dBc Limit (dBm)	60 dBc Limit (dBm)	Margin (dB) vs (40 dBc) Limit	Margin (dB) vs (60 dBc) Limit	Reference Figure 9- (Channel 0)
8.2 to 12.4 GHz	None	N/A		+11.8	-8.2			Figure 9-29
12.4 to 18.0 GHz	13.996	+8.67	-13.33	+11.8	-8.2	+25.13	+5.13	Figure 9-30
	16.322	-10	-32	+11.8	-8.2	+43.8	+23.8	
18.0 to 26.5 GHz	18.654	-2	-24	+11.8	-8.2	+35.8	+15.8	Figure 9-31
	21.074	-0.83	-22.83	+11.8	-8.2	+34.63	+14.63	
	23.318	-11	-33	+11.8	-8.2	+44.8	+24.8	
	25.649	-9	-31	+11.8	-8.2	+42.8	+22.8	
26.5 to 40.0 GHz	32.67	-8.67	-30.67	+11.8	-8.2	+42.47	+22.47	Figure 9-32

Table 9-20. Conducted Spurious Emissions - Fixed Channel 15

Measurement Band	Spurious Frequency (GHz)	Emission Level (dBm)	Corrected Emission Level (-22dB)	40 dBc Limit (dBm)	60 dBc Limit (dBm)	Margin (dB) vs (40 dBc) Limit	Margin (dB) vs (60 dBc) Limit	Reference Figure 9- (Channel 15)
8.2 to 12.4 GHz	None	N/A		+11.8	-8.2			Figure 9-33
12.4 to 18.0 GHz	13.996	+7.5	-14.5	+11.8	-8.2	+26.3	+6.3	Figure 9-34
	16.334	-10	-32	+11.8	-8.2	+43.8	+23.8	
18.0 to 26.5 GHz	18.66	+3.67	-18.33	+11.8	-8.2	+30.13	+20.13	Figure 9-35
	21.001	-2	-24	+11.8	-8.2	+35.8	+15.8	
26.5 to 40.0 GHz	32.67	-6	-28	+11.8	-8.2	+39.8	+19.8	Figure 9-36

Table 9-21. Conducted Spurious Emissions - Fixed Channel 31

Measurement Band	Spurious Frequency (GHz)	Emission Level (dBm)	Corrected Emission Level (-22dB)	40 dBc Limit (dBm)	60 dBc Limit (dBm)	Margin (dB) vs (40 dBc) Limit	Margin (dB) vs (60 dBc) Limit	Reference Figure 9- (Channel 31)
8.2 to 12.4 GHz	None	N/A		+11.8	-8.2			Figure 9-37
12.4 to 18.0 GHz	14.005	+6.5	-15.5	+11.8	-8.2	+27.3	+7.3	Figure 9-38
	16.334	-8	-30	+11.8	-8.2	+41.8	+21.8	
18.0 to 26.5 GHz	18.68	+3.53	-18.47	+11.8	-8.2	+30.27	+10.27	Figure 9-39
	21.001	-7	-29	+11.8	-8.2	+40.8	+20.8	
	25.669	-9	-31	+11.8	-8.2	+42.8	+22.8	
26.5 to 40.0 GHz	32.69	-7	-29	+11.8	-8.2	+40.8	+40.8	Figure 9-40

Table 9-22. Conducted Spurious Emissions - Fixed Channel 47

Measurement Band	Spurious Frequency (GHz)	Emission Level (dBm)	Corrected Emission Level (-22dB)	40 dBc Limit (dBm)	60 dBc Limit (dBm)	Margin (dB) vs (40 dBc) Limit	Margin (dB) vs (60 dBc) Limit	Reference Figure 9- (Channel 47)
8.2 to 12.4 GHz	None	N/A		+11.8	-8.2			Figure 9-41
12.4 to 18.0 GHz	14.005	+5.83	-16.17	+11.8	-8.2	+27.97	+7.97	Figure 9-42
	16.346	+4	-18	+11.8	-8.2	+29.98	+9.98	
18.0 to 26.5 GHz	18.68	+5.33	-16.67	+11.8	-8.2	+28.47	+8.47	Figure 9-43
	25.688	-9	-31	+11.8	-8.2	+42.8	+22.8	
26.5 to 40.0 GHz	32.69	-10.33	-32.33	+11.8	-8.2	+44.13	+24.13	Figure 9-44

Table 9-23. Conducted Spurious Emissions - Fixed Channel 63

Measurement Band	Spurious Frequency (GHz)	Emission Level (dBm)	Corrected Emission Level (-22dB)	40 dBc Limit (dBm)	60 dBc Limit (dBm)	Margin (dB) vs (40 dBc) Limit	Margin (dB) vs (60 dBc) Limit	Reference Figure 9- (Channel 63)
8.2 to 12.4 GHz	None	N/A		+11.8	-8.2			Figure 9-45
12.4 to 18.0 GHz	14.012	+5	-17	+11.8	-8.2	+28.8	+8.8	Figure 9-46
	16.348	+8.67	-13.33	+11.8	-8.2	+25.13	+5.3	
18.0 to 26.5 GHz	18.68	+4.67	-17.33	+11.8	-8.2	+29.13	+9.13	Figure 9-47
	25.689	-9	-31	+11.8	-8.2	+42.8	+22.8	
26.5 to 40.0 GHz	28.01	-9.5	-31.5	+11.8	-8.2	+43.3	+23.3	Figure 9-48

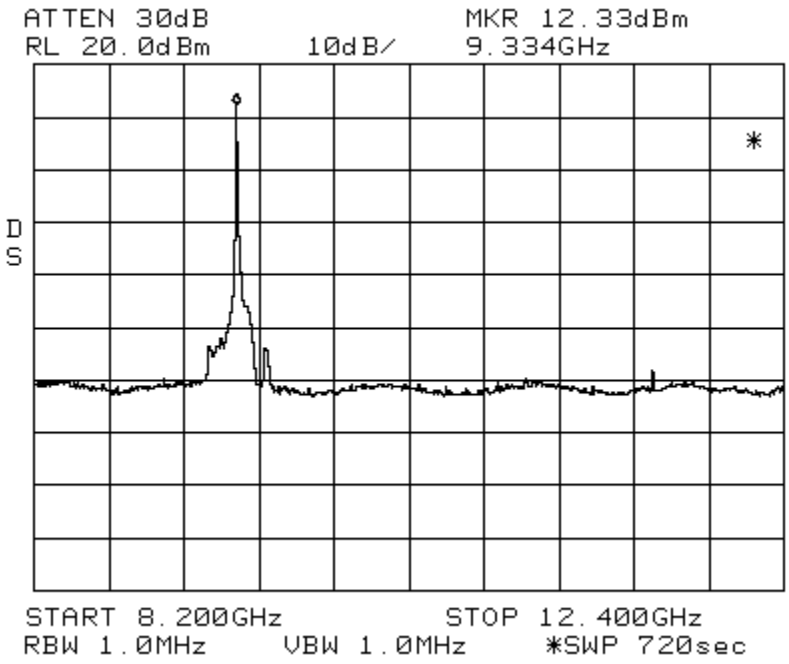

Figure 9-25. Conducted Spurious Emissions, Normal, 8.2 to 12.4 GHz.

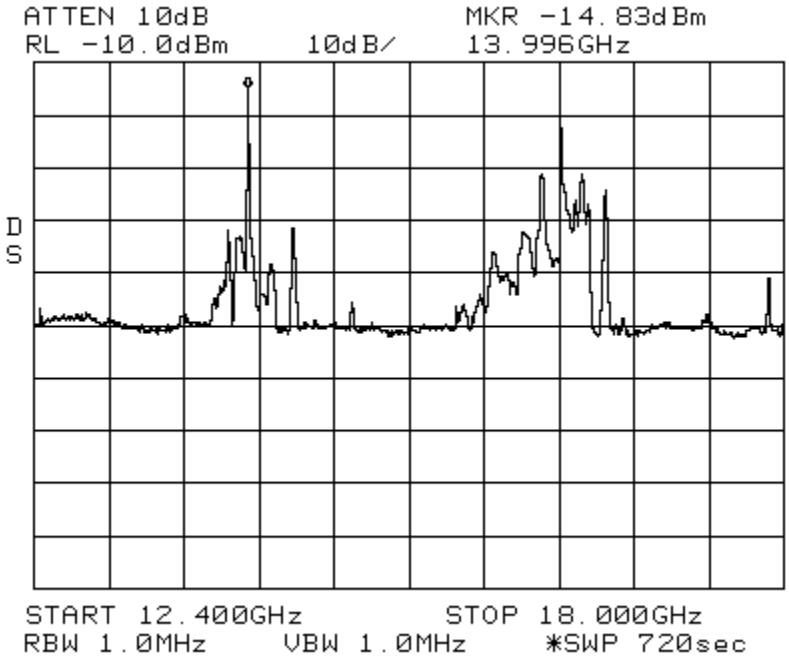

Figure 9-26. Conducted Spurious Emissions, Normal, 12.4 to 18.0 GHz.

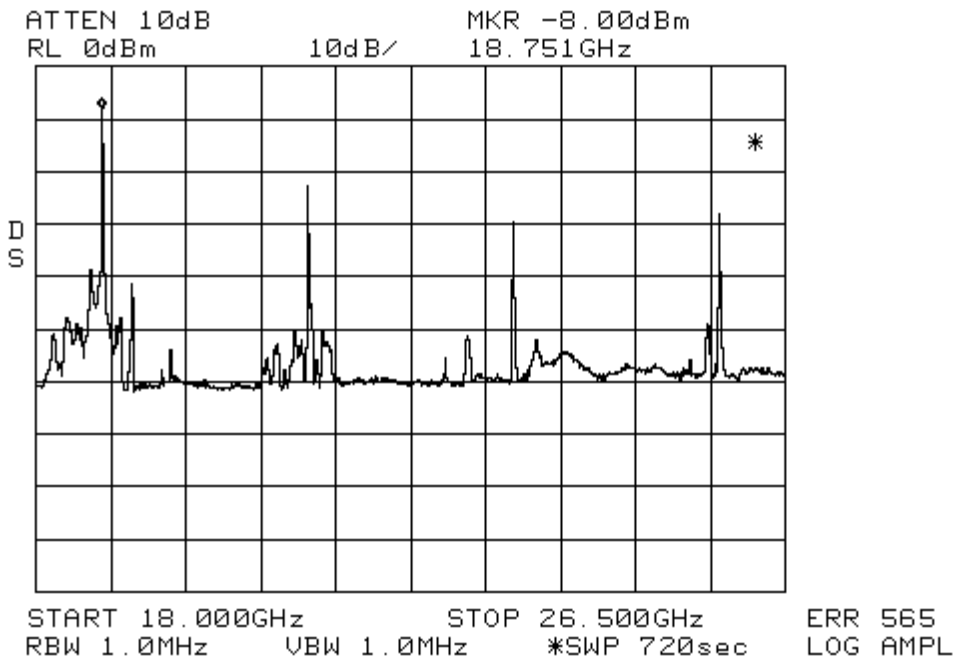

Figure 9-27. Conducted Spurious Emissions, Normal, 18.0 to 26.5 GHz.

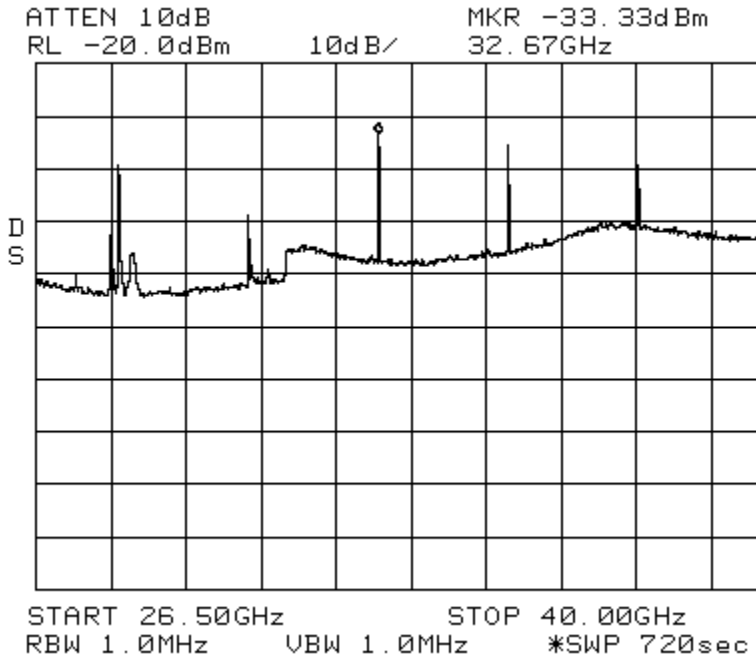

Figure 9-28. Conducted Spurious Emissions, Normal, 26.5 to 40.0 GHz.

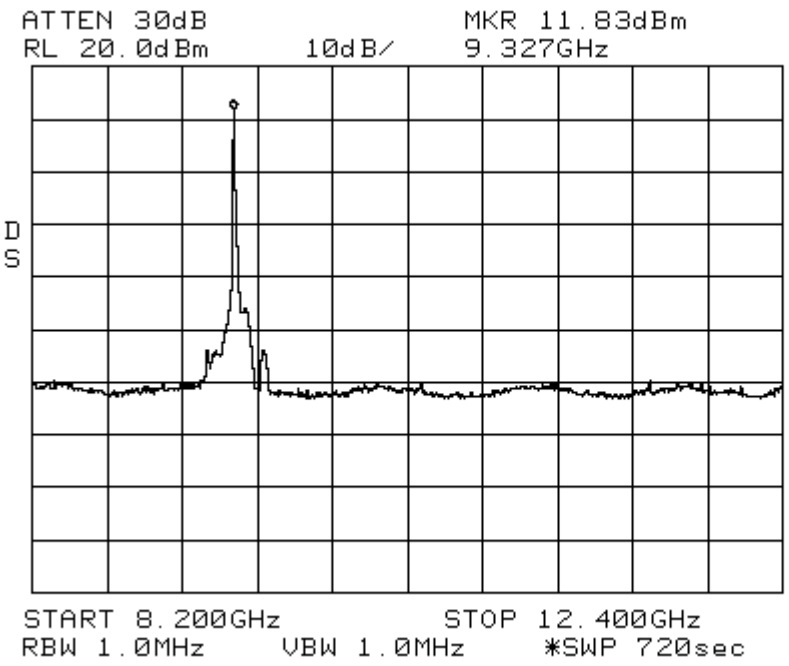

Figure 9-29. Channel 0, Conducted Spurious Emissions, 8.2 to 12.4 GHz.

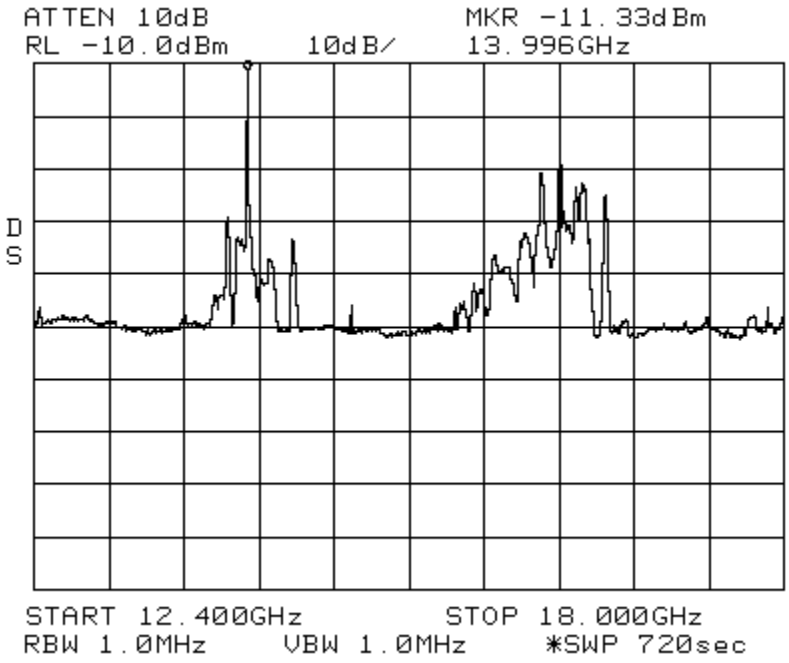

Figure 9-30. Channel 0, Conducted Spurious Emissions, 12.4 to 18.0 GHz.

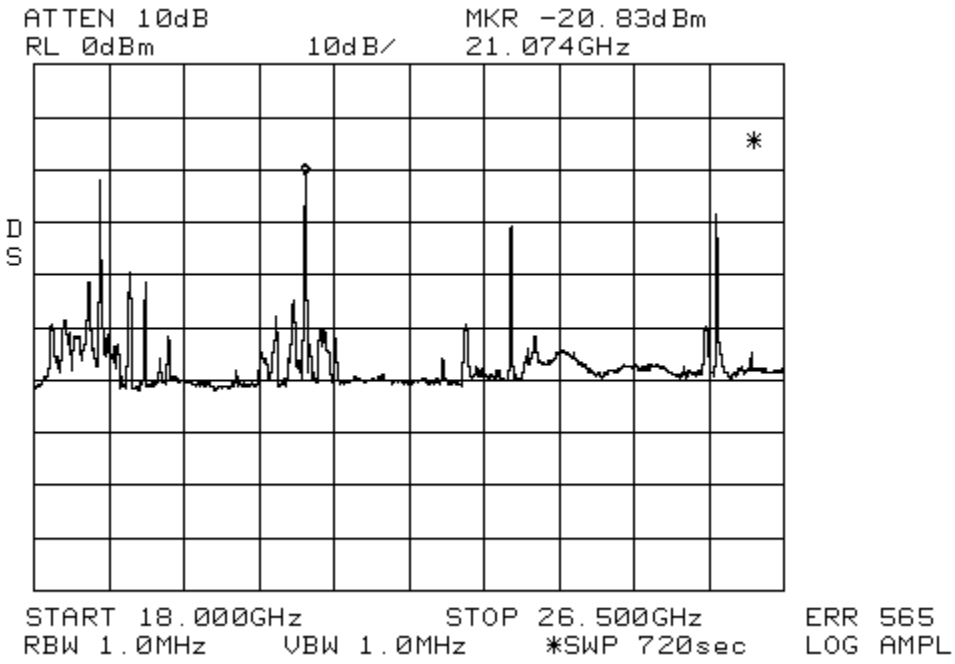

Figure 9-31. Channel 0, Conducted Spurious Emissions, 18.0 to 26.5 GHz.

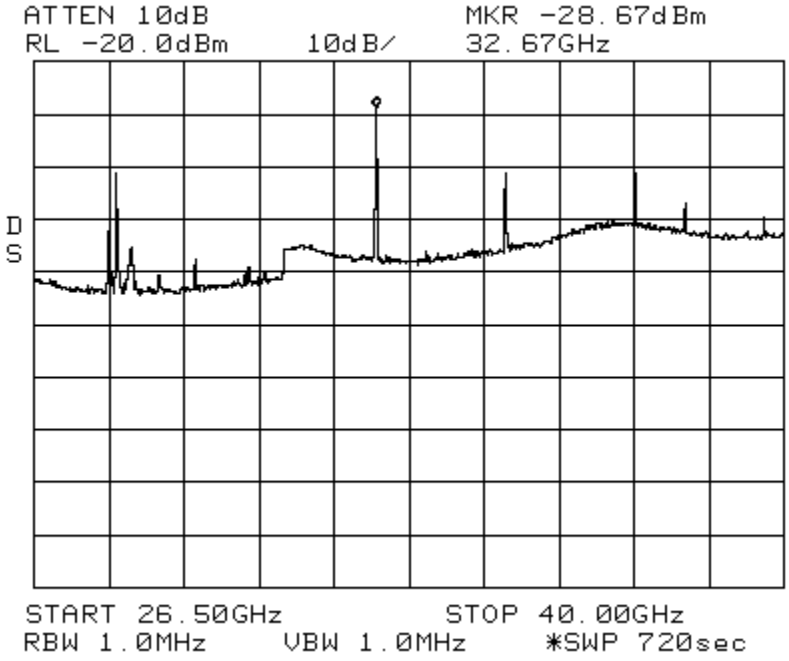

Figure 9-32. Channel 0, Conducted Spurious Emissions, 26.5 to 40.0 GHz.

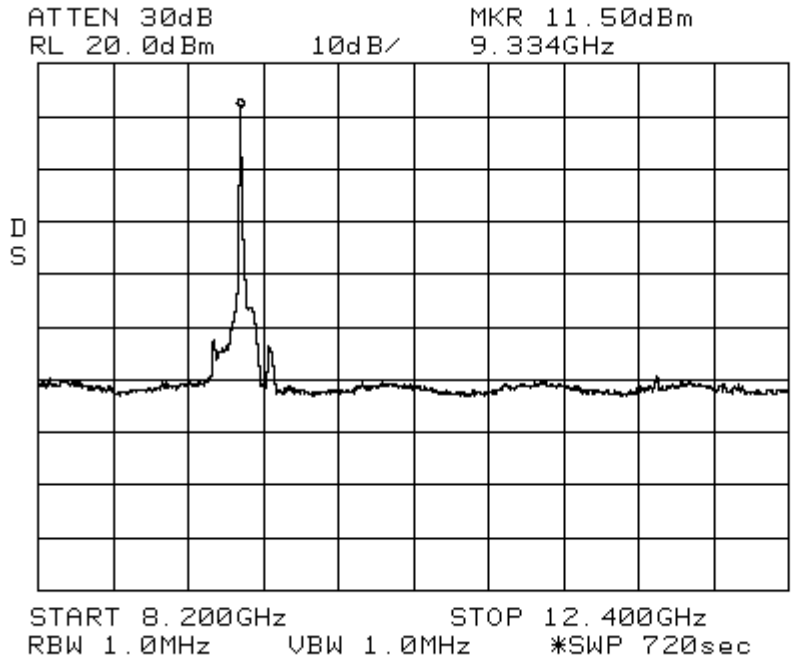

Figure 9-33. Channel 15, Conducted Spurious Emissions, 8.2 to 12.4 GHz.

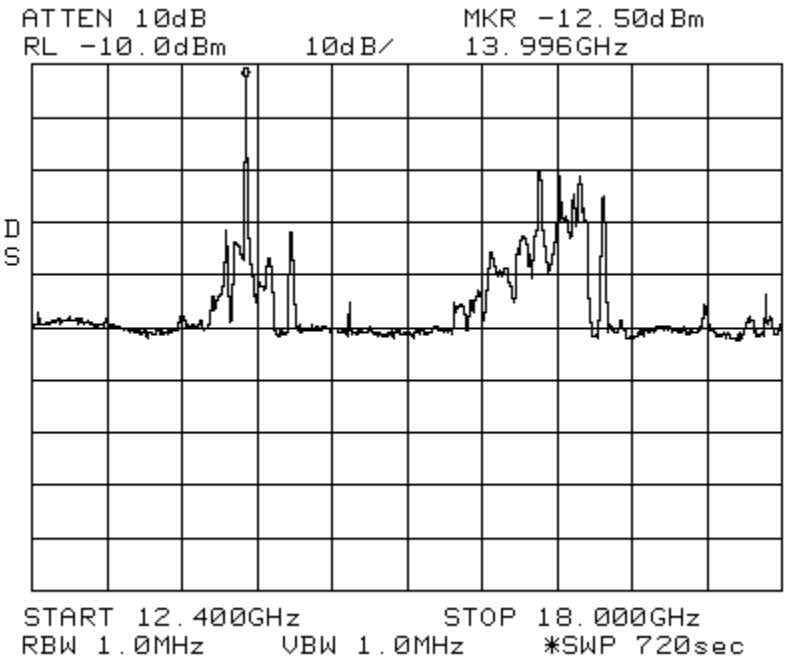

Figure 9-34. Channel 15, Conducted Spurious Emissions, 12.4 to 18.0 GHz.

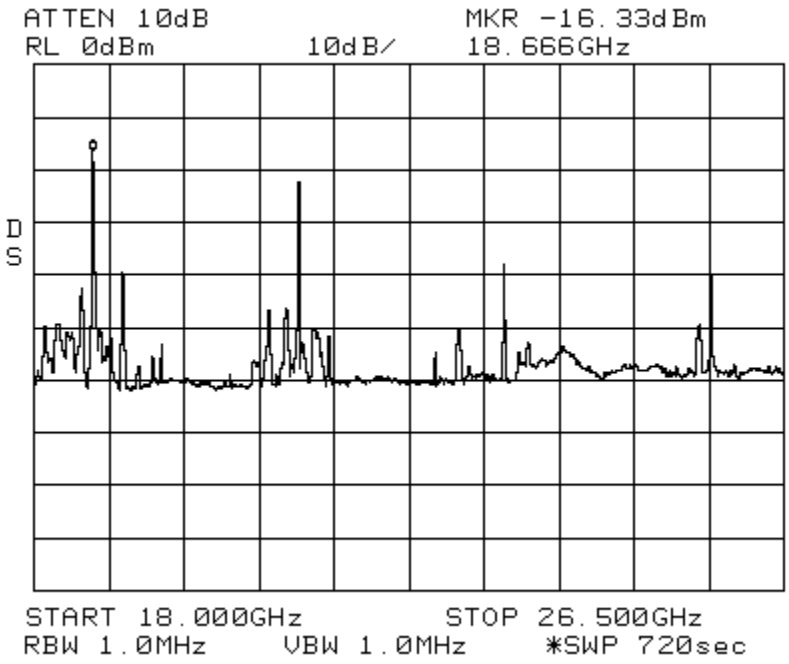

Figure 9-35. Channel 15, Conducted Spurious Emissions, 18.0 to 26.5 GHz.

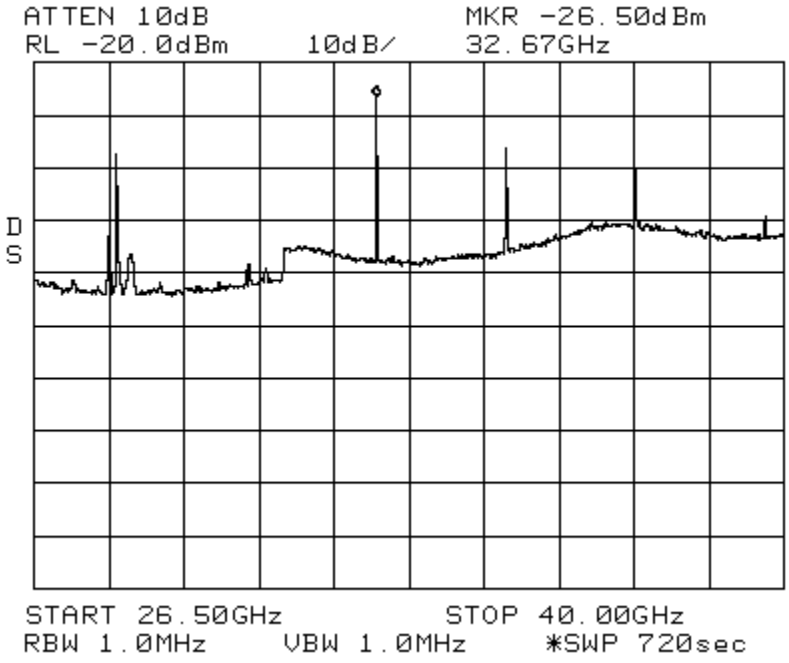

Figure 9-36. Channel 15, Conducted Spurious Emissions, 26.5 to 40.0 GHz.

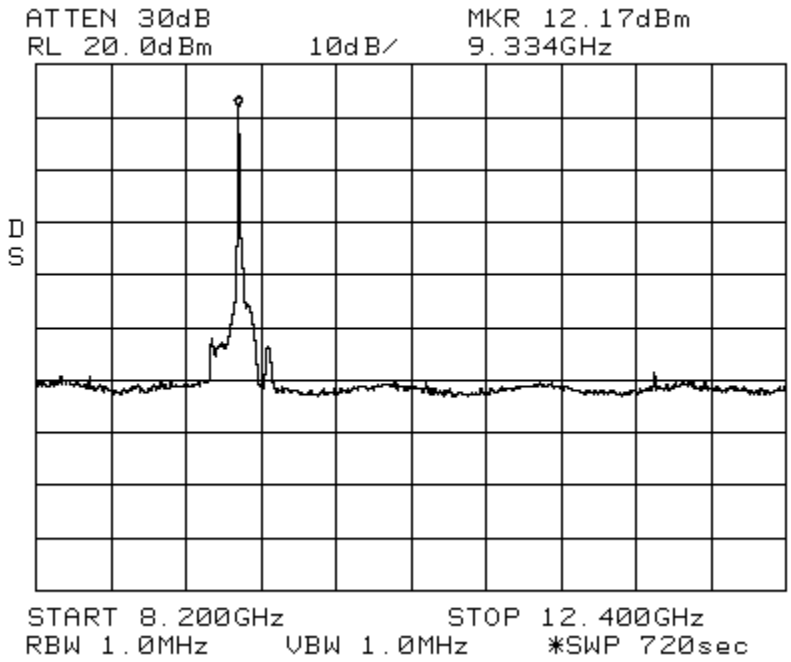

Figure 9-37. Channel 31, Conducted Spurious Emissions, 8.2 to 12.4 GHz.

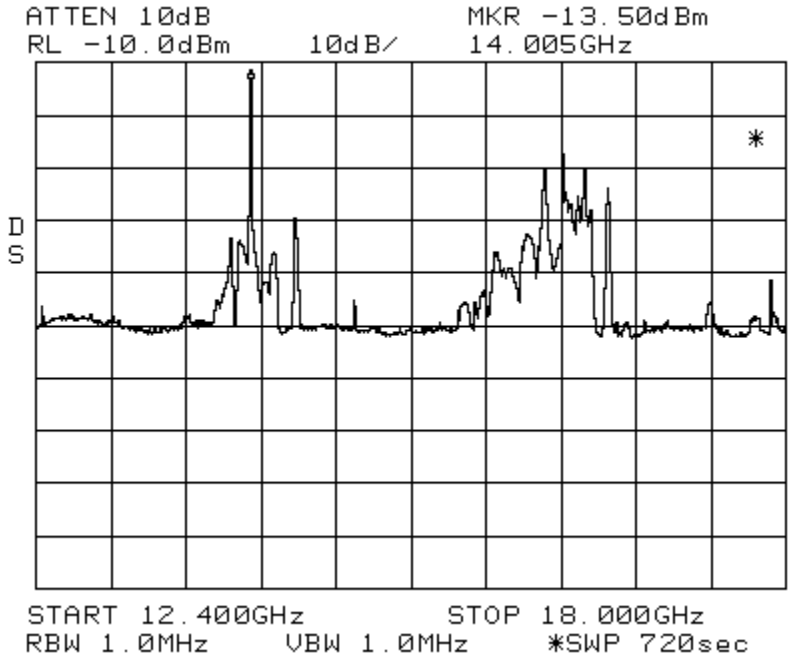

Figure 9-38. Channel 31, Conducted Spurious Emissions, 12.4 to 18.0 GHz.

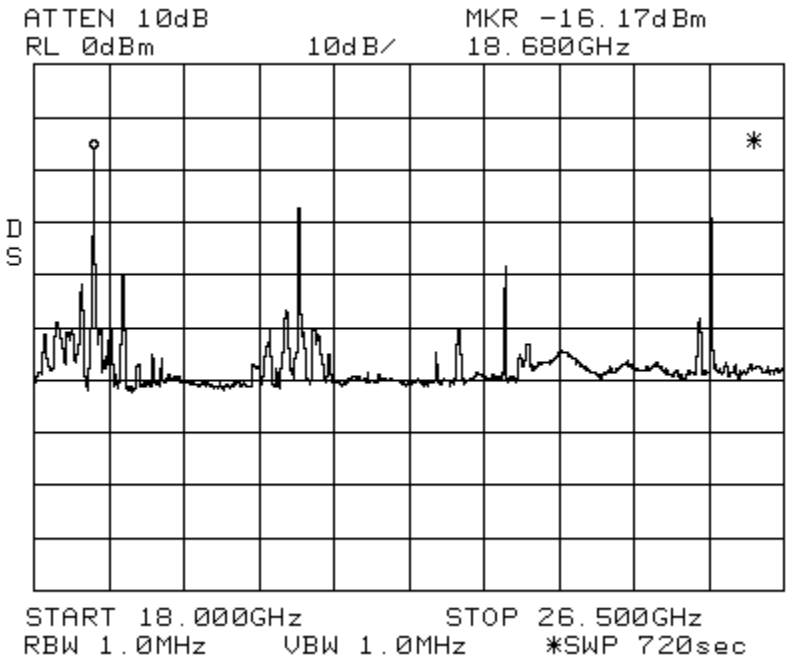

Figure 9-39. Channel 31, Conducted Spurious Emissions, 18.0 to 26.5 GHz.

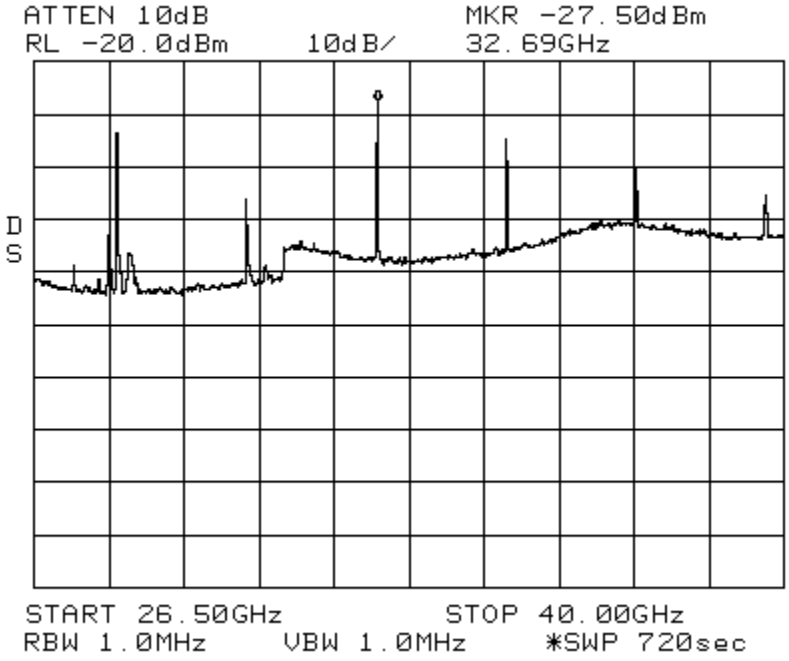

Figure 9-40. Channel 31, Conducted Spurious Emissions, 26.5 to 40.0 GHz.

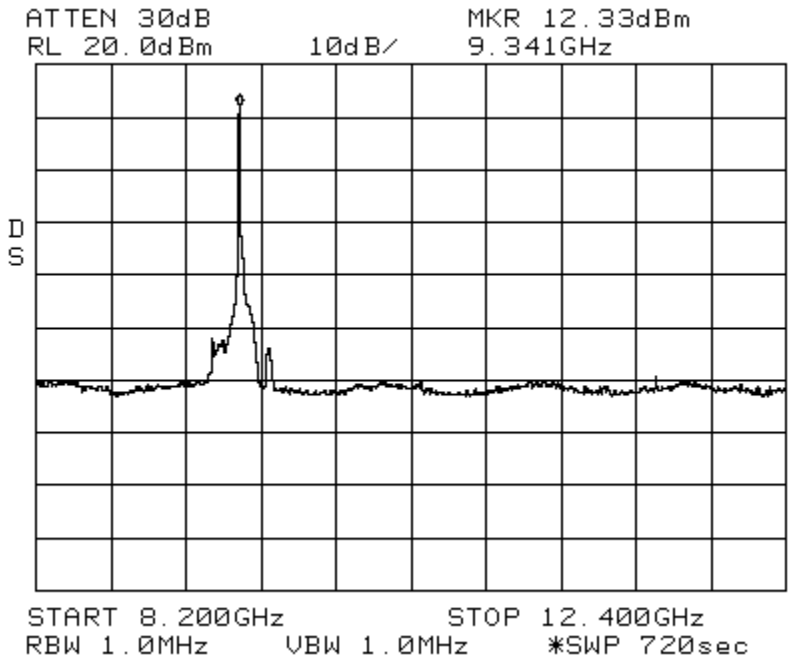

Figure 9-41. Channel 47, Conducted Spurious Emissions, 8.2 to 12.4 GHz.

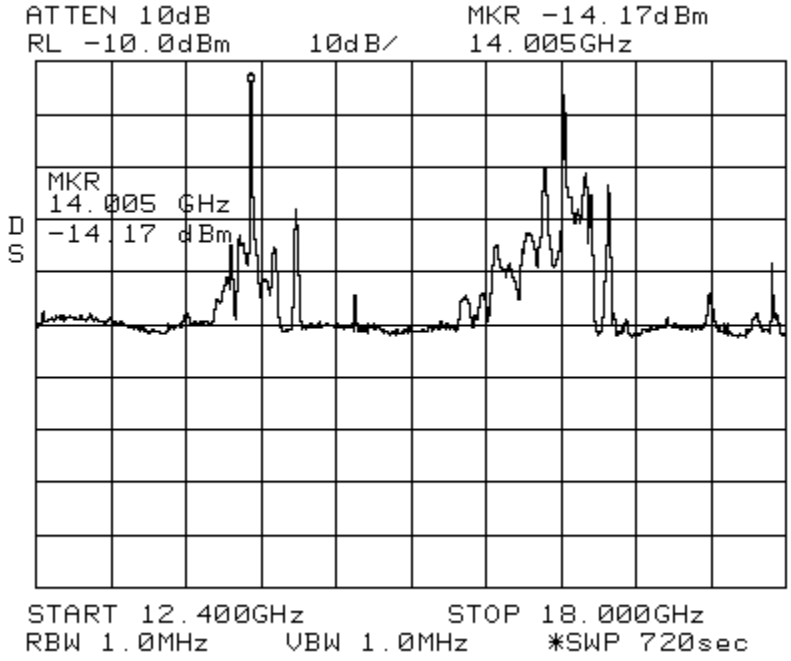

Figure 9-42. Channel 47, Conducted Spurious Emissions, 12.4 to 18.0 GHz.

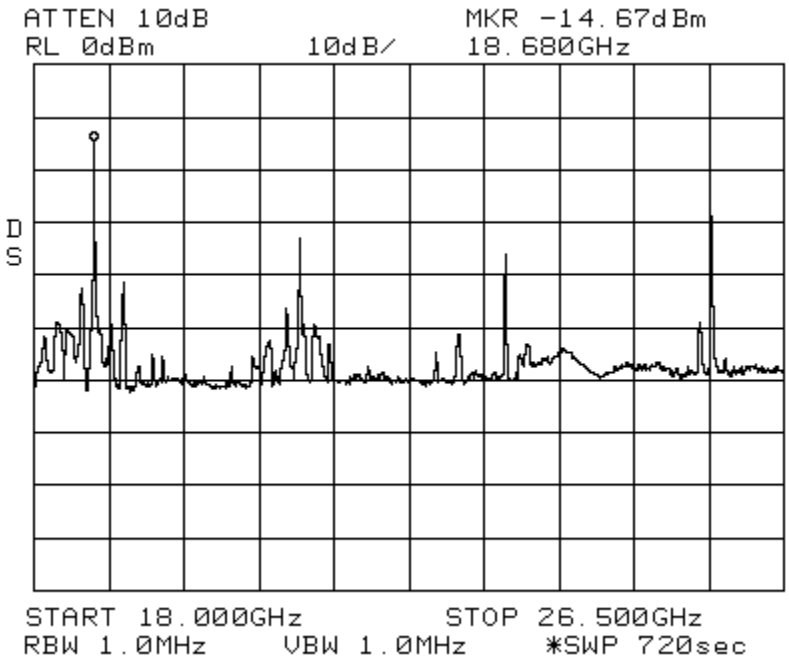

Figure 9-43. Channel 47, Conducted Spurious Emissions, 18.0 to 26.5 GHz.

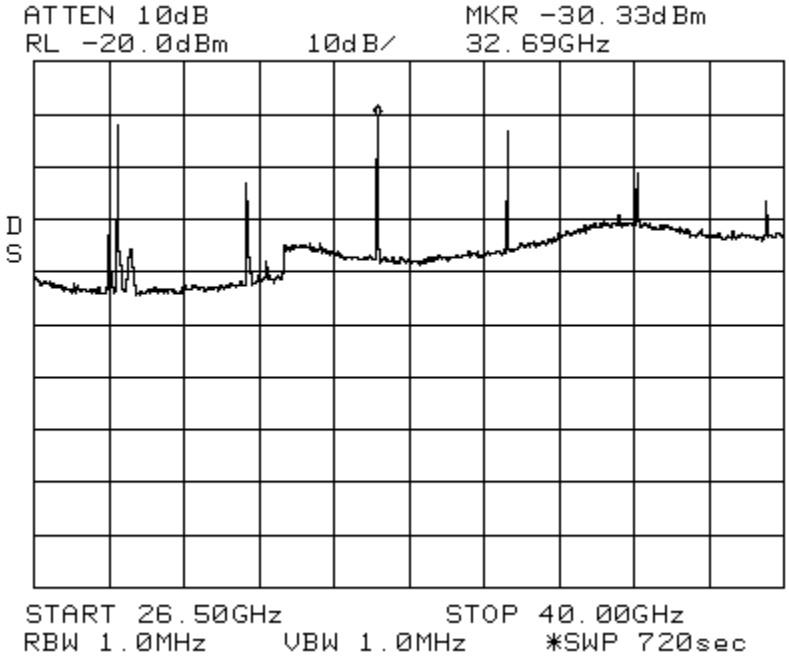

Figure 9-44. Channel 47, Conducted Spurious Emissions, 26.5 to 40.0 GHz.

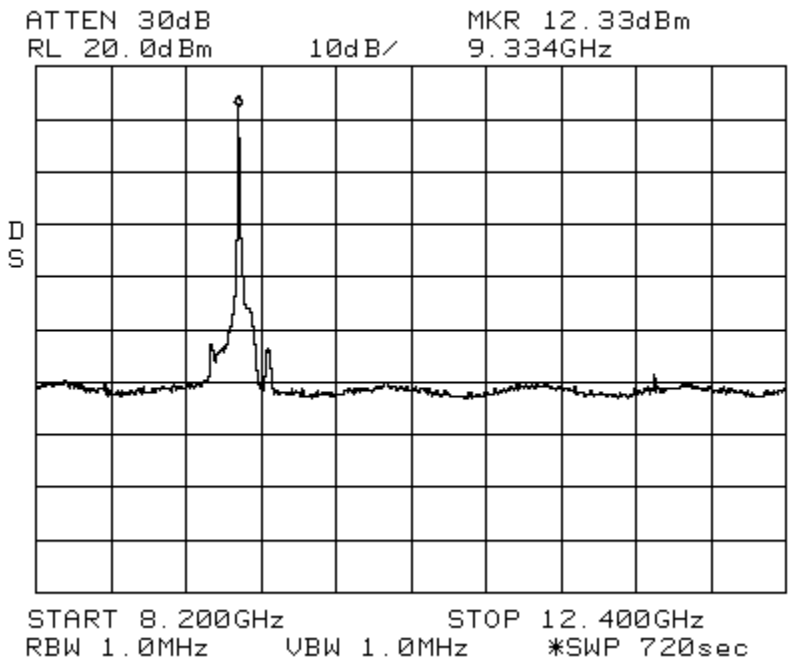

Figure 9-45. Channel 63, Conducted Spurious Emissions, 8.2 to 12.4 GHz.

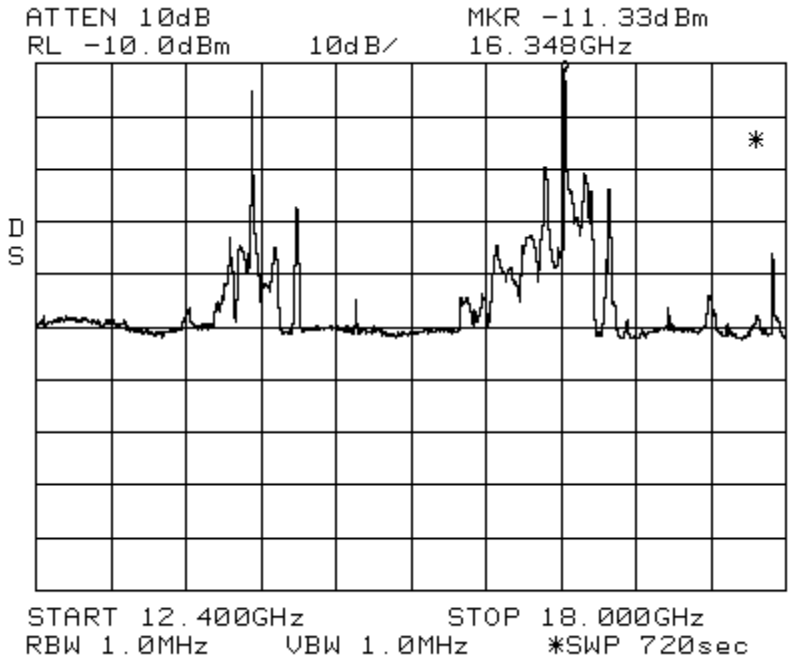

Figure 9-46. Channel 63, Conducted Spurious Emissions, 12.4 to 18.0 GHz.

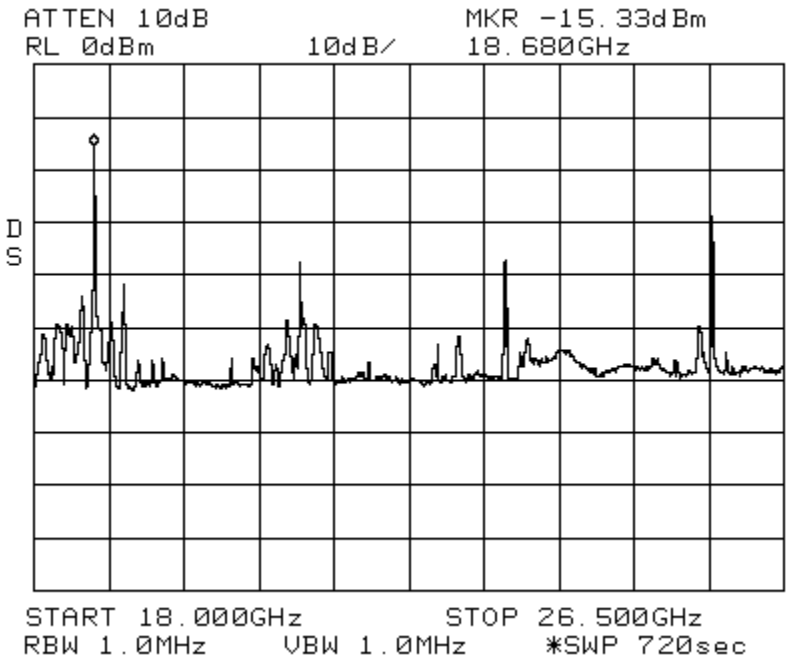

Figure 9-47. Channel 63, Conducted Spurious Emissions, 18.0 to 26.5 GHz.

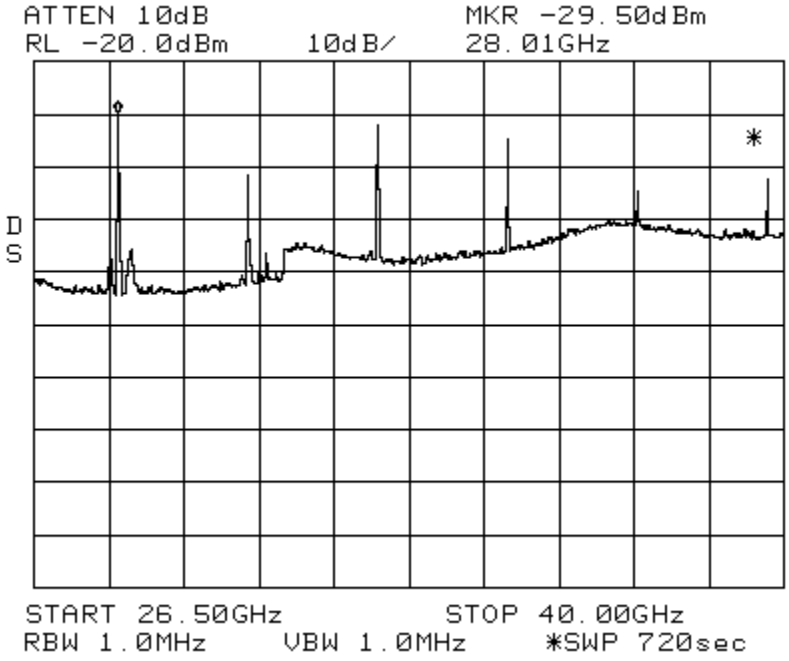

Figure 9-48. Channel 63, Conducted Spurious Emissions, 26.5 to 40.0 GHz.

9.8 Field Strength of Spurious Radiation (2.1053)

Requirement:

Section 2.1053 (a), (b)(2)

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emissions. … ….Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(2) All equipment operating on frequencies higher that 25 MHz.

Section 87.139(a) "… the mean power of any emission must be attenuated below the mean power of the transmitter (pY) as follows:

(1) When the frequency is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth the attenuation must be at least 25 dB.

(2) When the frequency is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth the attenuation must be at least 35 dB.

(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least $43+\log_{10}(pY)$ dB.

Since the WRT-2100 clearly falls under the definition of an aircraft station transmitter defined in Section 2.101, the worst case limit is 40 dBc. The Authorized Bandwidth is assumed to be 9.3 - 9.5 GHz which is the frequency range allocated for radar. The limits for Radiated emissions are shown below in Table 9-24.

Table 9-24. Spurious Emission Test Requirements (87.139(a)(3))

Frequency Band	Emission Level	Absolute FCC Limit (Peak)
From 9438.876 MHz to 9538.876 MHz	-25 dBc (dB relative to carrier level)	+26.8 dBm
From 9538.877 MHz to 9838.876 MHz	-35 dBc	+16.8 dBm
Over 9838.877 MHz	-40 dBc	+11.8 dBm

Assuming the worst case requirement of 40dBc, the maximum field strength is computed by the following procedure:

FCC Limit = 40 dBc

Limit (Watts) = $P_{tx\text{-}average} * 10^{-(FCC\ Limit\ (dBc)/10)}$

This level is converted to a field strength value "E" based on a dipole radiator:

$E^2 = (30*G*L)/R$ Where: G = 1.64 (dipole gain)
L = Limit (Watts)
R = 1 meter (Test distance)
E = Field strength (volts/meter).

The WRT-2100 Test Article used for Field Strength of Spurious Radiation testing had a peak power of 150 Watt. The current system has a duty cycle of 1% however, this calculation will assume a maximum duty cycle of 5% for computation of average power. (Note: This assumption will not have a bearing on the specified limit.)

Peak Power = 51.76 dBm, Assumed Duty Cycle = 0.05

$P_{tx\text{-}average}$ = 7.5 Watts average

FCC Limit (dBc) = 40

Limit (Watts) = $7.5 * 10^{-(40/10)} = 7.5*10^{-4}$ W average

$E^2 = 30 * 1.64 * (7.5*10^{-4}) = 3.69*10^{-2}$

$E\ (V/m) = (3.69*10^{-2})^{1/2} = 192094\ \mu V/m$ average

E (dBμV/m) = 20 * log(192094 μV/m) = ***105.7 dBmV/m***

Since the FCC Limit is average power, and the receiver used to detect the radiated power is a peak power reading instrument, the FCC Limit must be converted to peak power, which can be accomplished in two ways. The first method is to simply convert the average limit to peak by taking it out of dB, squaring it, divide by the duty cycle, and convert it back to dB. The second method is to take the difference (in dB) between peak power and average power at a given duty cycle (Assumed maximum 5%) and add it to the average limit in dBμV/m.

Method 1

Limit (average) = 105.7 dBμV/m

Limit (average) = $10^{(105.7/20)} = 1920949\ \mu V/m$

Limit (peak) = $1920949^2 / .05 = 7.38*10^{11}\ \mu V/m$

Limit (peak) = 10 log ($7.38*10^{11}$ μV/m) = ***118.7 dBmV/m***

Method 2

Limit (average) = 105.7 dBµV/m

Peak Power (mW) = $10^{(51.8/10)}$ = 150,000 mW

Average Power (mW) = 150,000 mW * .05 = 7500 mW

Average Power (dBm) = 10 log (7500 mW) = 38.8 dBm

Difference (dB) = 51.8 dBm(peak) – 38.8 dBm(average) = 13.0 dB

Limit (peak) = 105.7 dBµV/m + 13.00 dB = ***118.7 dBµV/m***

Table 9-19 lists the requirements for the Field Strength of Spurious Radiation Test.

Therefore, the absolute limit of ***118.7 dBuV/m*** will be used for these tests.

Procedure:

FCC Part 2.1057(a) states that the spectrum shall be investigated from the lowest radio frequency generated in the equipment without going below 9 kHz up to the tenth harmonic of the carrier or 40GHz whichever is lower. This test procedure follows the methodology of DO-160D Section 21. DO-160D Section 21 only specifies testing to 6GHz. However, the same test setup and methodology was used to measure radiated emissions up to 40GHz.

The lowest RF oscillator frequency generated in the equipment is 12 MHz.

The frequency range investigated for radiated emissions was: ***150 kHz to 40 GHz***

The WRT-2100 was operated in Weather + Turb + Windshear + Auto modes. These modes represent the maximum operating condition for the unit.

Range	40 NM/160 NM
Mode	WX+TURB/Windshear
Altitude	1000 FT
W/S	Enabled
Auto	Selected

The WRT-2100 Radiated Emissions Data was taken with the unit operating on each of the six operating conditions specified in Table 9-25. The “Mode 1” condition represents the normal operating mode of the WRT-2100 with the unit automatically controlling the transmitter frequencies. Five additional fixed frequency selections were specified to demonstrate compliance over the complete range of channel capabilities. These are described in Section 9.2 Modulation Requirements of this document.

Table 9-25. WRT-2100 Radiated Emissions Test Operating Conditions

Test Condition	Channel	Tx Freq (MHz)	Remarks
Mode 1	Auto	Multiple	
Fixed 0	0	9327.06	Lowest Freq
Fixed 15	15	9329.88	
Fixed 31	31	9332.88	
Fixed 47	47	9335.88	
Fixed 63	63	9338.88	Highest Freq

The equipment used for the Field Strength of Spurious Radiation test is listed in Table 9-26.

Table 9-26. Test Equipment Used for Field Strength of Spurious Radiation Test

Equipment	Manufacturer/Model Number	Specific Identification	Calibration Due Date
Receiver/Transmitter	Rockwell Collins WRT-2100 (822-1710-001)	SN 9JAV	N/A
Control/Indicator (Qty 2)	Rockwell Collins WXI-711 (622-6514-205)	SN 312, SN 319	N/A
Test Harness	Rockwell Collins J-Box Test Harness		N/A
Power Supply	115VAC 400Hz Primary Power		N/A
RF Dummy Load	Airtron 452126	N/A	N/A
Active Monopole Antenna (150KHz - 25MHz)	Electro-Metrics RVA30	460-0118-548	8/31/03
Antenna (1GHz - 18GHz)	Emco 3115	460-0078-853	2/28/02
Biconical Antenna (25 MHz – 200 MHz)	Emco 3104C	460-0119-436	5/31/03
Antenna (200MHz - 1GHz)	Emco 3106	460-0133-794	1/31/04
Gain Horn (18 GHz – 26.5 GHz)	Emco 3160-9	N/A	N/A
Gain Horn (26 GHz – 40 GHz)	Emco 3160-10	N/A	N/A
Amplifier (18 - 26.5 GHz)	R & S 032001/002	N/A	N/A
Amplifier (26.5 - 40 GHz)	R & S 032001/003	N/A	N/A
EMI Test Receiver	Rohde & Schwarz ES140	460-0212-537	8/31/03
Antenna	Emco 3101	460-0113-397	1/31/04
LISN	FCC 5-50-01 Def Stn 59-41	460-0127-003	11/30/02

Equipment Setup:

The test setup for the Field Strength of Spurious Radiation test is shown in Figure 9-49.

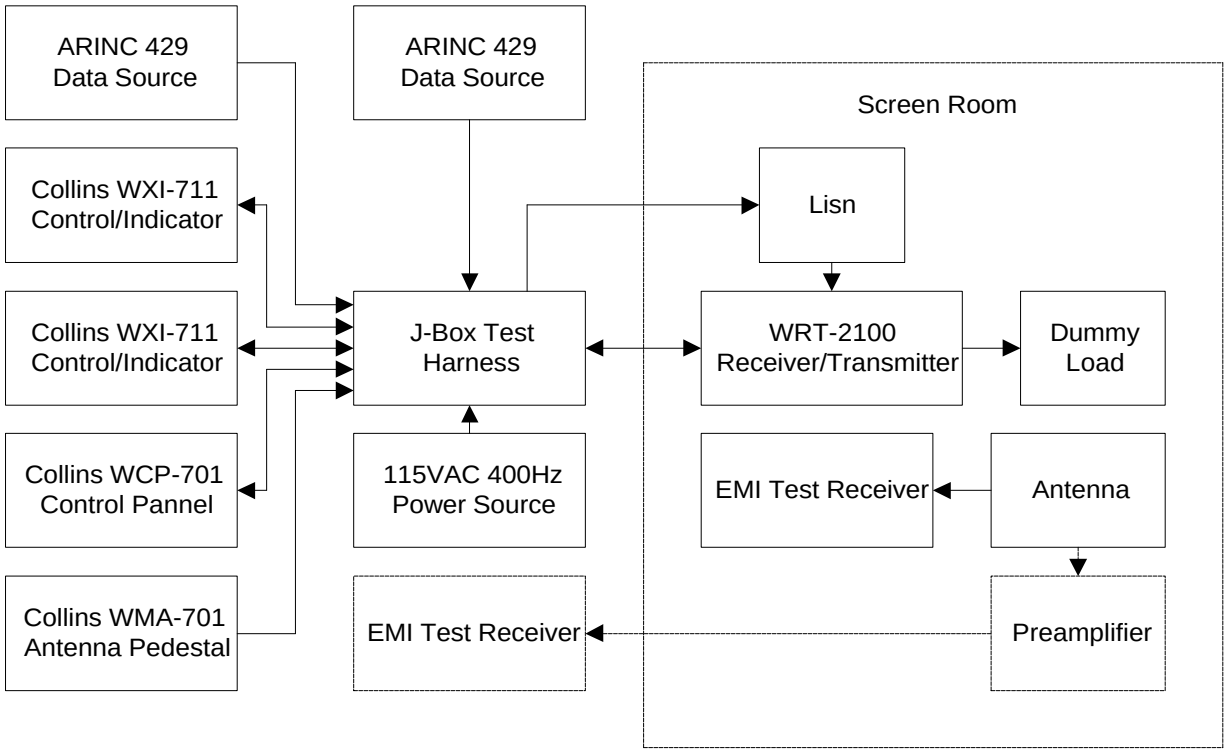

Figure 9-49. Field Strength of Spurious Radiation Test Setup.

Results:

No emissions (with the exception of the fundamental) exceeded the FCC Limit of 118.7 dBuV/m.
Note: The “Limit” line on the graphical plots was set to 116.7 dBuV/m instead of 118.7 dBuV/m.

Spectrum plots are included for the normal condition are contain in Figures 50 through 53.

Table 9-27. Field Strength of Spurious Radiation - Normal Mode

Field Strength of Spurious Radiation					
Transmitter Frequency	Measurement Band	Polarization	Emission		Reference
			Frequency (MHz)	Level (dBuV/m)	
Normal Mode	150 KHz to 1 GHz	Vertical		< 96.5	Figure 9-50
		Horizontal		< 96.5	Figure 9-51
	1 GHz to 40 GHz	Vertical	9,332.50	124.50	Figure 9-52
			16,331.50	115.00	
			20,996.50	93.70	
			20,997.50	100.60	
		Horizontal	9,332.50	125.10	Figure 9-53
			16,331.50	112.10	
			18,659.50	97.90	
			18,664.50	99.80	

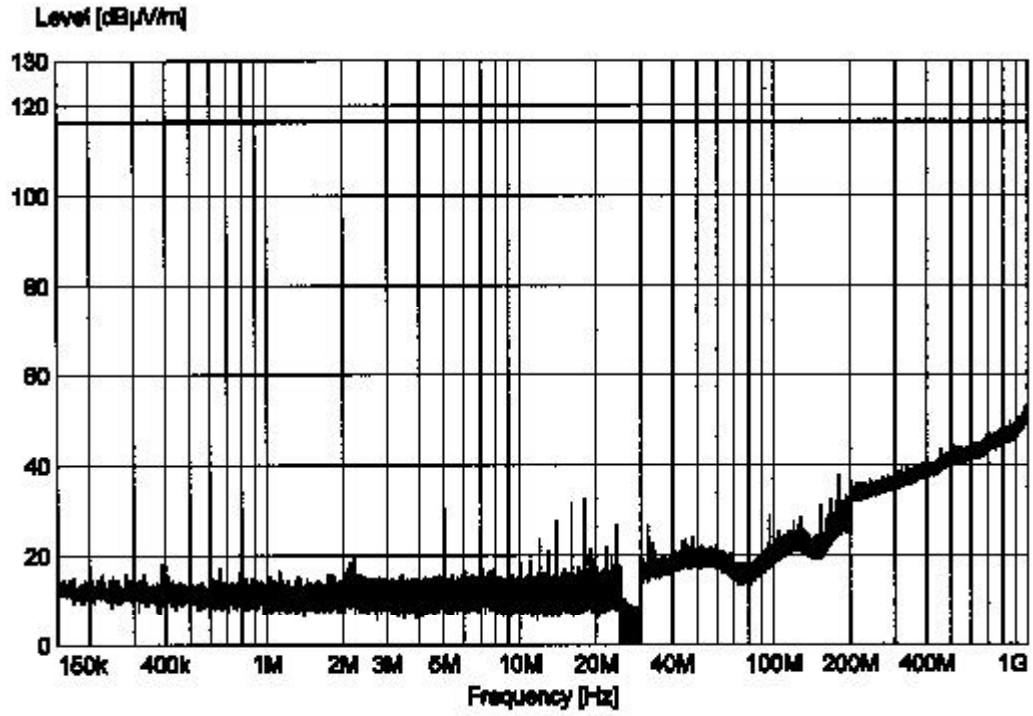

Figure 9-50. Radiated Spurious Emissions, Mode One, (Vertical polarization, 150 KHz to 1 GHz).

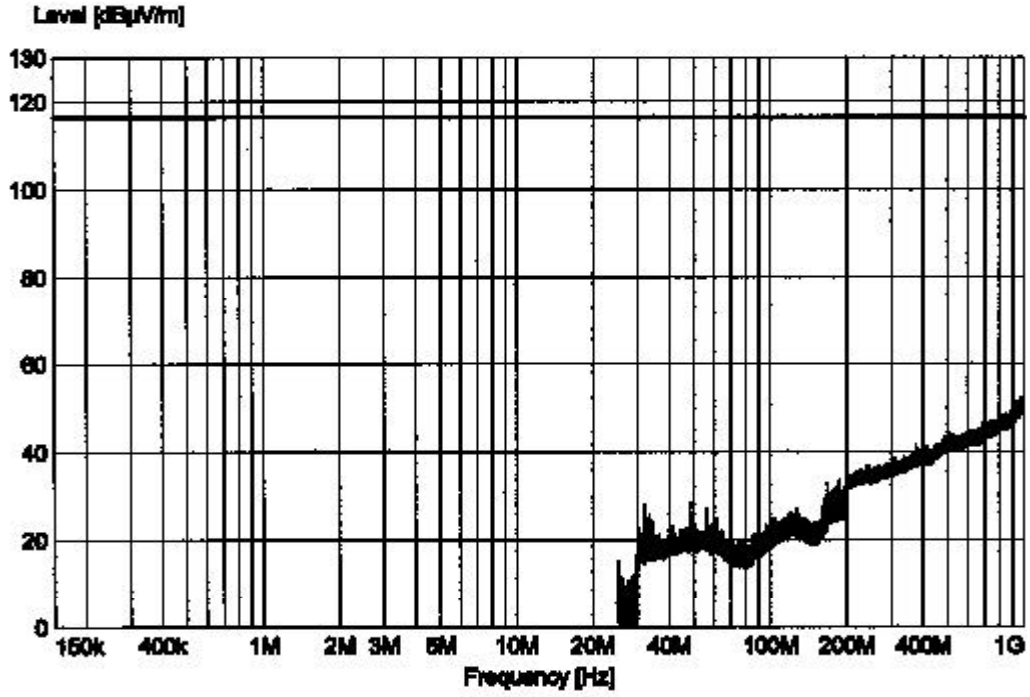

Figure 9-51. Radiated Spurious Emissions, Mode One, (Horizontal polarization, 150 KHz to 1 GHz).

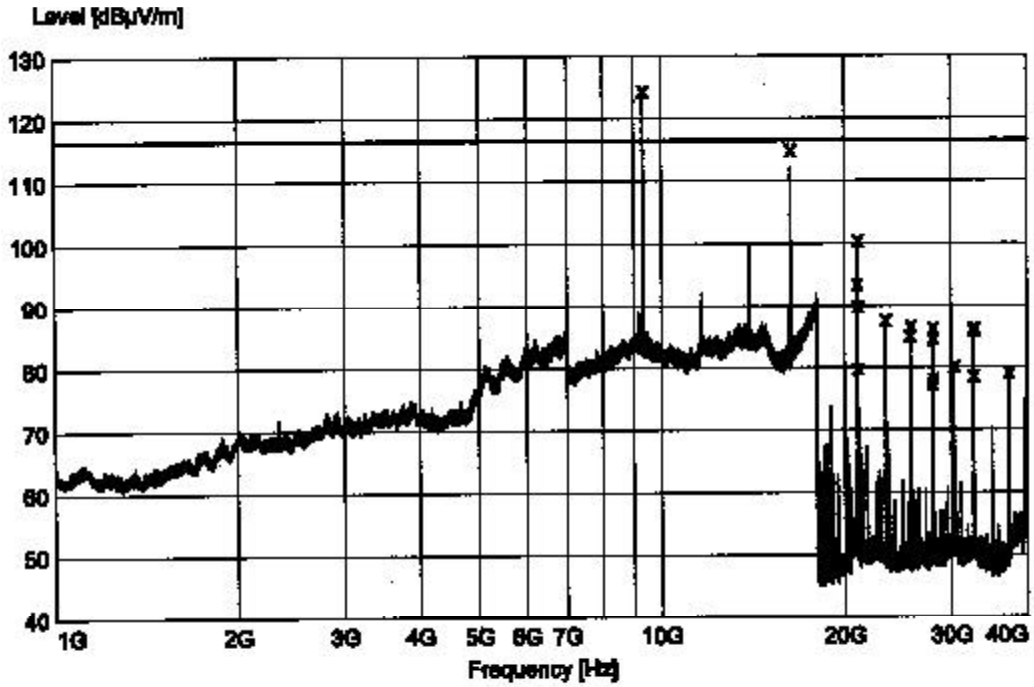

Figure 9-52. Radiated Spurious Emissions, Mode One, (Vertical polarization, 1 GHz to 40 GHz).

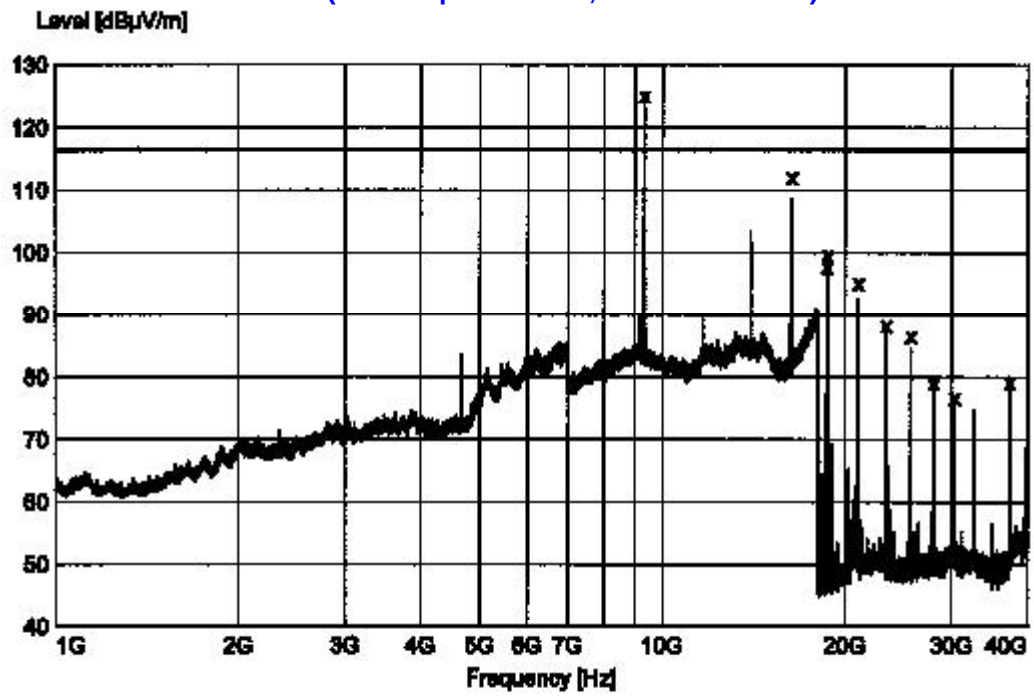

Figure 9-53. Radiated Spurious Emissions, Mode One, (Horizontal polarization, 1 GHz to 40 GHz).

Field Strength of Spurious Radiation - Fixed Channels

The following data are additional measurements with the Receiver/Transmitter operating on each of 5 fixed channels: Channel 0, 15, 31, 47, 63. These fixed channels represent the lowest and highest frequency extremes for the WRT-2100 along with three intermediate frequencies.

Results:

No emissions (with the exception of the fundamental) exceeded the FCC Limit of 118.7 dBuV/m.

Note: The "Limit" line on the graphical plots was set to 116.7 dBuV/m instead of 118.7 dBuV/m.

Spectrum plots for the fixed channel conditions are contained in Figures 54-73.

Table 9-28. Field Strength of Spurious Radiation - Channels 0, 15

Transmitter Frequency	Measurement Band	Polarization	Emission		Reference
			Frequency (MHz)	Level (dBuV/m)	
Channel 0 (9,327.063906 MHz)	150 KHz to 1 GHz	Vertical		< 96.5	Figure 9-54
		Horizontal		< 96.5	Figure 9-55
	1 GHz to 40 GHz	Vertical	9,327.50	122.10	Figure 9-56
			16,323.00	116.60	
			20,986.50	102.80	
		Horizontal	9,327.50	125.00	Figure 9-57
			9,328.50	117.00	
			16,323.00	114.8	
Channel 15 (9,329.876406 MHz)	150 KHz to 1 GHz	Vertical		< 96.5	Figure 9-58
		Horizontal		< 96.5	Figure 9-59
	1 GHz to 40 GHz	Vertical	9,330.00	121.80	Figure 9-60
			9,332.00	112.30	
			16,328.00	114.10	
			20,993.00	102.70	
		Horizontal	9,330.00	121.20	Figure 9-61
			16,328.00	113.70	
			20,993.00	96.60	

Table 9-29. Field Strength of Spurious Radiation - Channels 31, 47, 63

Field Strength of Spurious Radiation					
Transmitter Frequency	Measurement Band	Polarization	Emission		Reference
			Frequency (MHz)	Level (dBuV/m)	
Channel 31 (9,332.876406 MHz)	150 KHz to 1 GHz	Vertical		< 96.5	Figure 9-62
		Horizontal		< 96.5	Figure 9-63
	1 GHz to 40 GHz	Vertical	9,333.00	121.70	Figure 9-64
			16,333.00	115.70	
			20,999.50	101.20	
		Horizontal	9,333.00	123.40	Figure 9-65
			16,333.00	115.40	
			18,666.50	97.90	
Channel 47 (9,335.876406 MHz)	150 KHz to 1 GHz	Vertical		< 96.5	Figure 9-66
		Horizontal		< 96.5	Figure 9-67
	1 GHz to 40 GHz	Vertical	9,336.00	122.40	Figure 9-68
			16,338.50	115.60	
			21,006.00	98.20	
		Horizontal	9,336.00	121.60	Figure 9-69
			16,338.50	115.10	
			18,672.50	102.70	
Channel 63 (9,338.876506 MHz)	150 KHz to 1 GHz	Vertical		< 96.5	Figure 9-70
		Horizontal		< 96.5	Figure 9-71
	1 GHz to 40 GHz	Vertical	9,339.00	120.20	Figure 9-72
			16,343.50	113.00	
			18,678.00	96.70	
			21,013.00	101.30	
		Horizontal	9.339.50	120.20	Figure 9-73
			9,341.00	112.00	
			16,343.50	114.40	
			18,678.50	101.50	

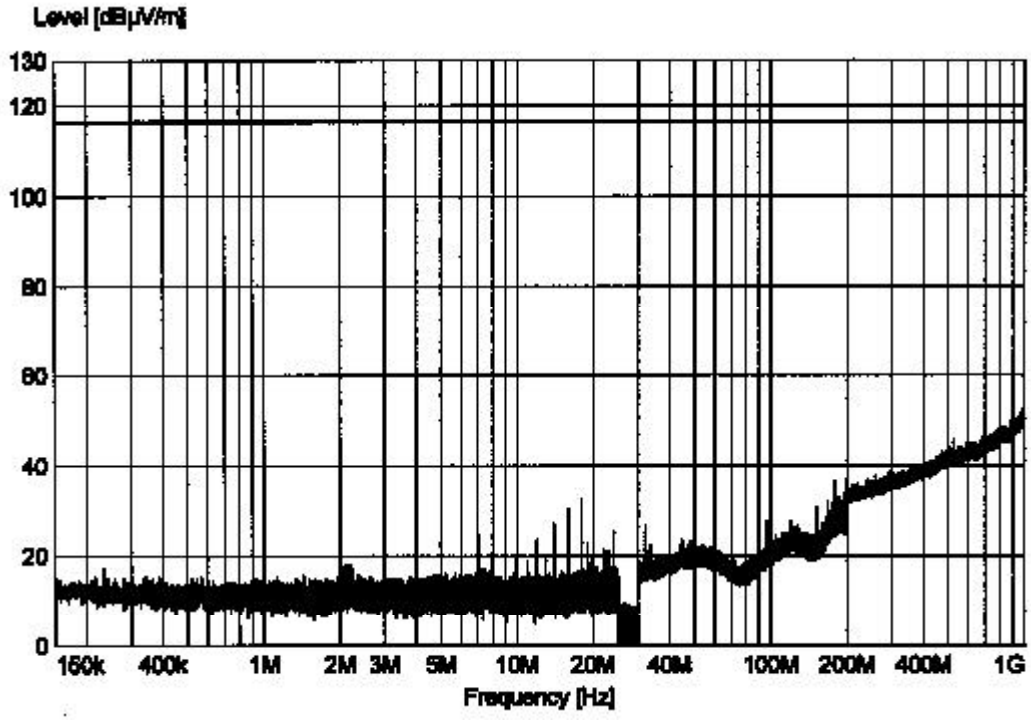

Figure 9-54. Radiated Spurious Emissions, Channel 0, (Vertical Polarization, 150 KHz to 1 GHz).

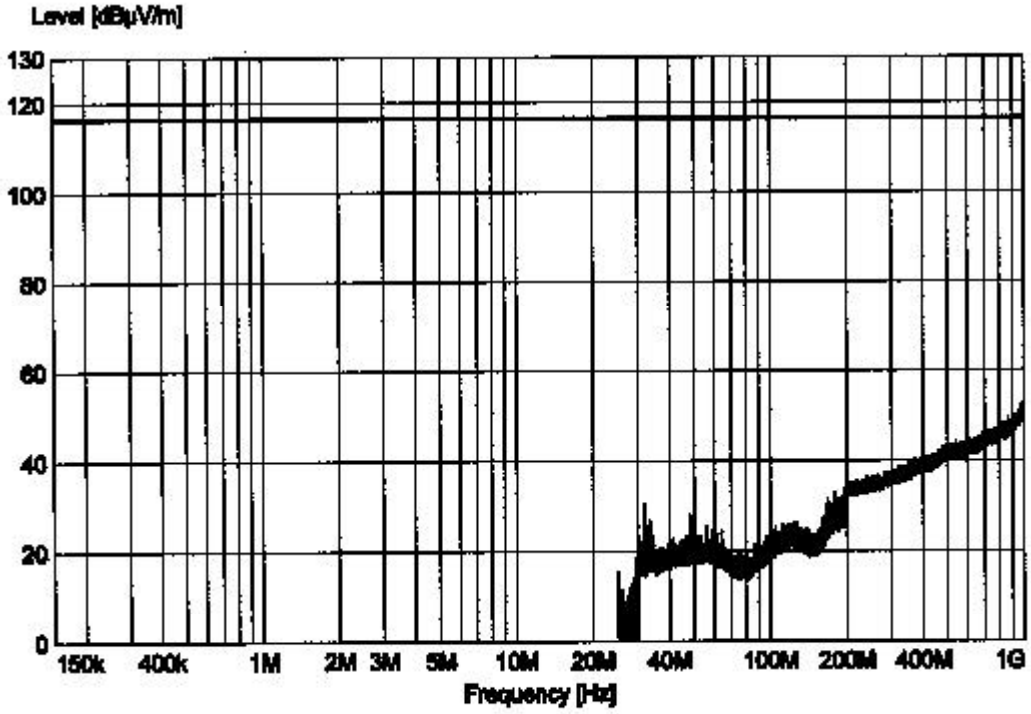

Figure 9-55. Radiated Spurious Emissions, Channel 0, (Horizontal Polarization, 150 KHz to 1 GHz).

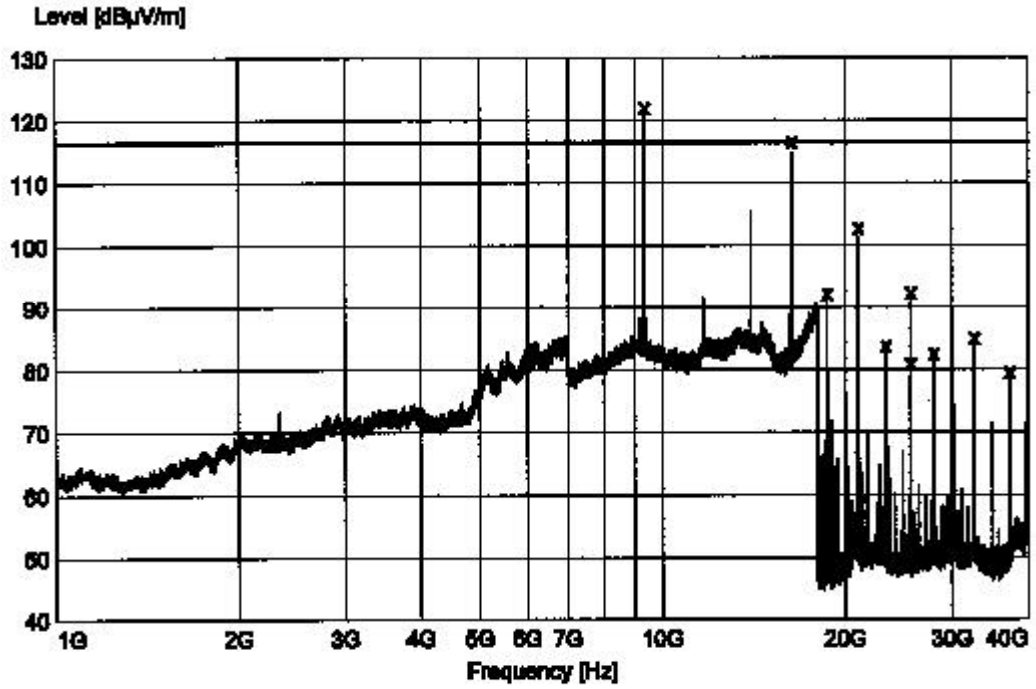

Figure 9-56. Radiated Spurious Emissions, Channel 0, (Vertical Polarization, 1 GHz to 40 GHz).

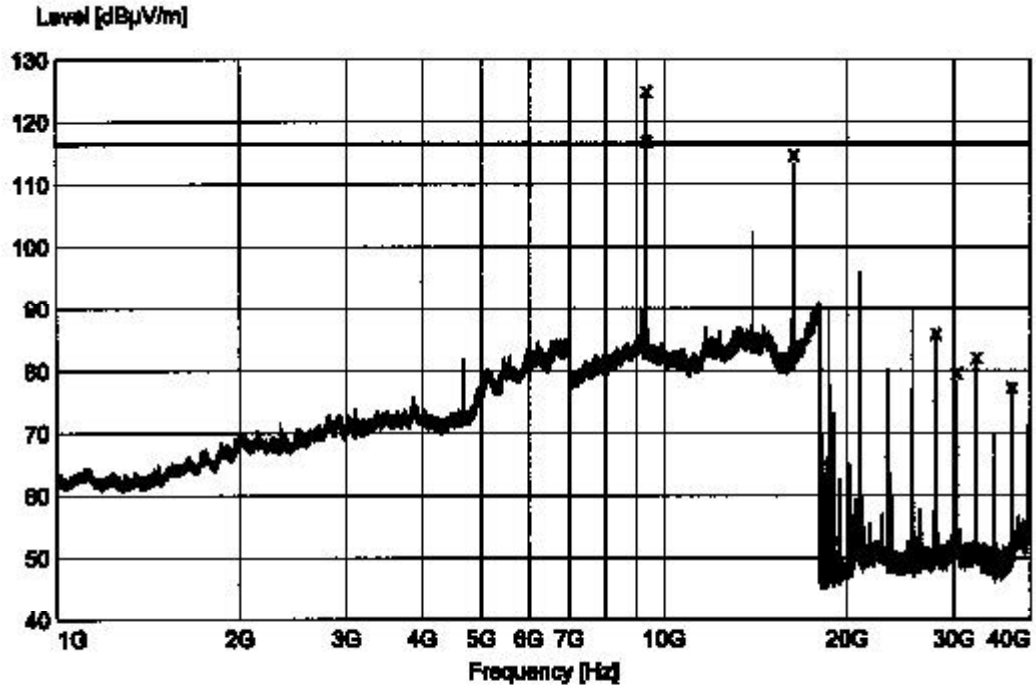

Figure 9-57. Radiated Spurious Emissions, Channel 0, (Horizontal Polarization, 1 GHz to 40 GHz).

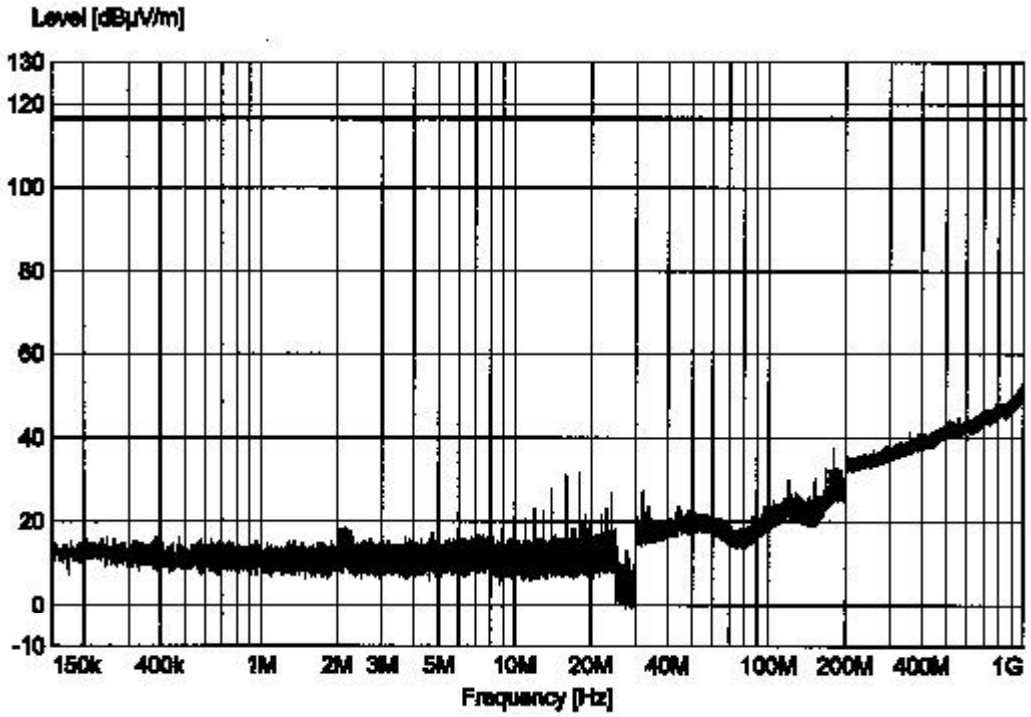

Figure 9-58. Radiated Spurious Emissions, Channel 15, (Vertical Polarization, 150 KHz to 1 GHz).

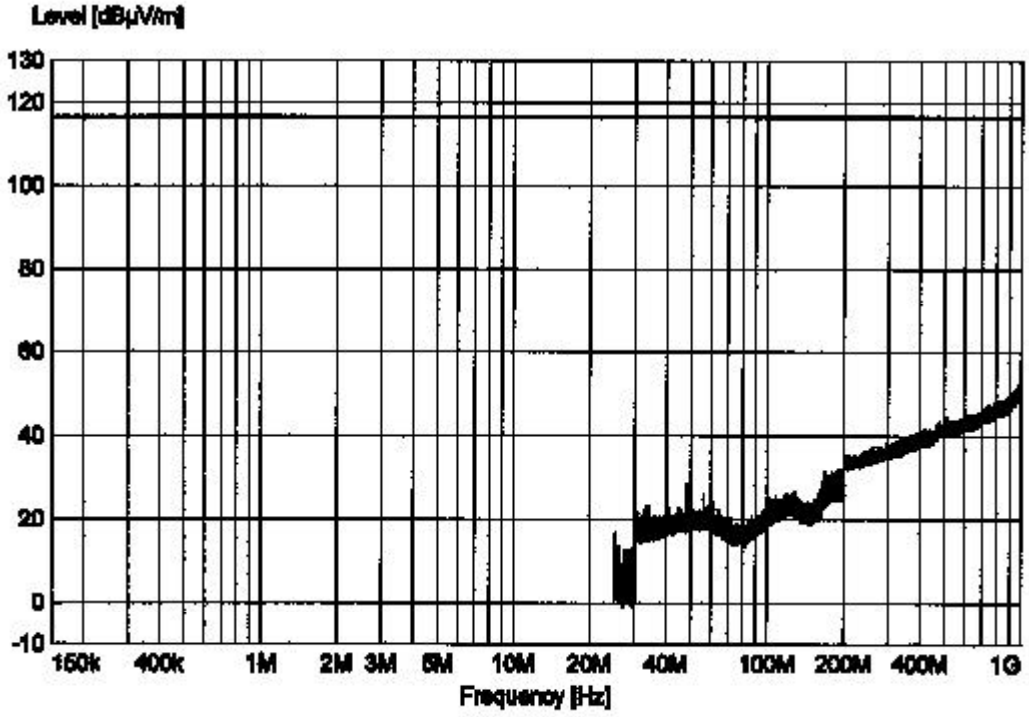

Figure 9-59. Radiated Spurious Emissions, Channel 15, (Horizontal Polarization, 150 KHz to 1 GHz).

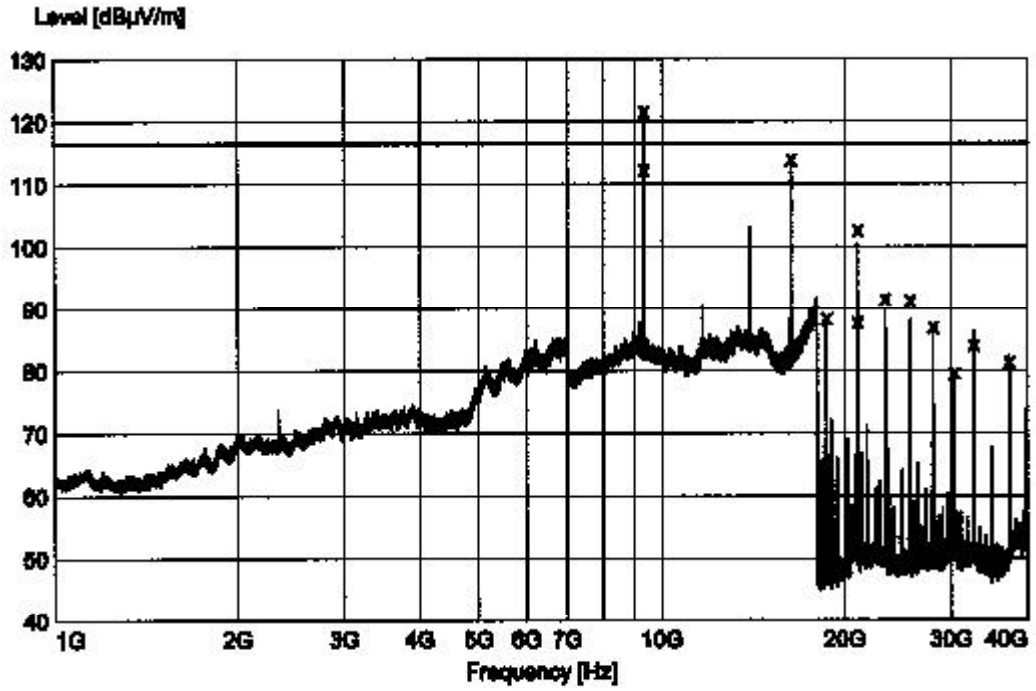

Figure 9-60. Radiated Spurious Emissions, Channel 15, (Vertical Polarization, 1 GHz to 40 GHz).

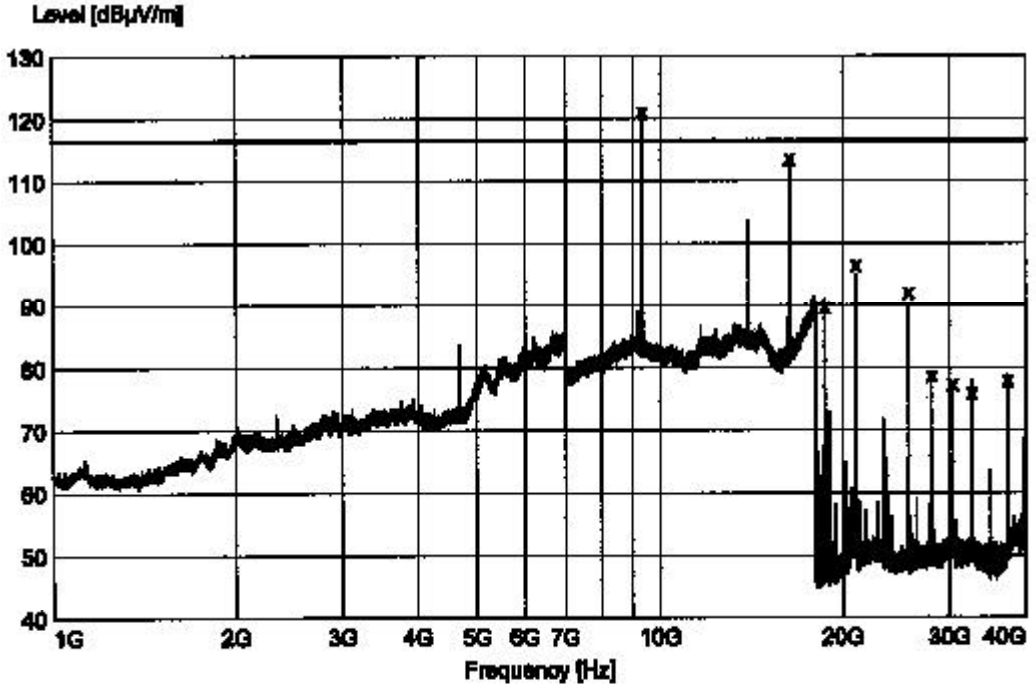

Figure 9-61. Radiated Spurious Emissions, Channel 15, (Horizontal Polarization, 1 GHz to 40 GHz).