# WRT-701X

## Exhibit F – Test Report

# EXHIBIT F – TEST REPORT

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)).

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## F.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.

Table F-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 F-1. Test Requirements Matrix

| FCC Part 2 Section | FCC Part 87 Section | Test Description Summary | Section |
|---|---|---|---|
| 2.1047 | 87.141 | Modulation Characteristics | F-2 |
| 2.1046 | 87.131 | RF Power Output | F-9 |
| 2.1055 | 87.133 | Frequency Stability | F-5 |
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## F1.1 Description of the WRT-701X Used for Testing

The WRT-701X used for testing is part number 622-5132-952. This is a Red Label Part Number, The unit was built by production personnel to meet all production requirements. When the unit goes into full production the part number will change to 622-5132-634 for Boeing units, and for Airbus units the part number will be 622-5132-624.

## F.2 WXR-701X Modulation Characteristics (2.1047)

**Requirements:**

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-701X utilizes un-modulated rectangular pulses.

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

The WRT-701X Weather Radar System utilizes six different sets of transmitter pulse patterns, pulse widths and operating frequencies depending on operating mode and range. The time period for one pulse pattern is called an epoch. A small variable delay is inserted between epochs to reduce mutual interference between radar systems by dithering the pulse timing. The transmitter pulse patterns, pulse widths and operating frequencies are summarized in Table F-2.

Table F-2. WRT-701X Transmitter Pulse Patterns and Pulse Widths

| Pulse Pattern | | | | | | Transmitter Frequency |
|---|---|---|---|---|---|---|
| Mode of Operation | | Range (nmi) | Pulse Width (µseconds) | Pulse Rate (Hz) | Epoch (msec) | |
| Weather, Turbulence, or Map | Short Range | 5 – 15 | 2.7 | 1278.8 / 699 | 5.6 | F1 |
| | | 20 – 30 | 5.2 | 1278.8 / 699 | 5.6 | F1 |
| | | 35 – 60 | 10.0 | 1278.8 / 699 | 5.6 | F1 |
| | Medium Range | 65 – 160 | 19.7 | 365.0 / 350 | 5.6 | F1 |
| | Long Range | 165 – 320 | 19.7 | 238.1 / 233 | 8.4 | F1 |
| Windshear | | NA | 2.0 | 3002.8 / 2724 | 23.1 | F2 |

## F.3 Weather/Turbulence/Map Operation:

Three pulse patterns are utilized for Weather, Turbulence and Map modes of operation. The pulse pattern and pulse width utilized is dependant upon the selected range (short, medium or long range.

The short range pulse pattern consists of a sequence of four pulses with pulse widths of 2.7, 5.2 or 10.0 µseconds depending upon the selected range. The short range epoch time is 5.6 milliseconds.

The medium range pulse pattern consists of a sequence of two pulses with pulse widths of 19.7 µseconds. The medium range epoch time is 5.6 milliseconds.

The long range pulse pattern consists of a sequence of two pulses with pulse widths of 19.7 µseconds. The long range epoch time is 8.4 milliseconds.

Figure F-1 illustrates the short, medium and long range pulse patterns and widths utilized for Weather, Turbulence and Map modes of operation.

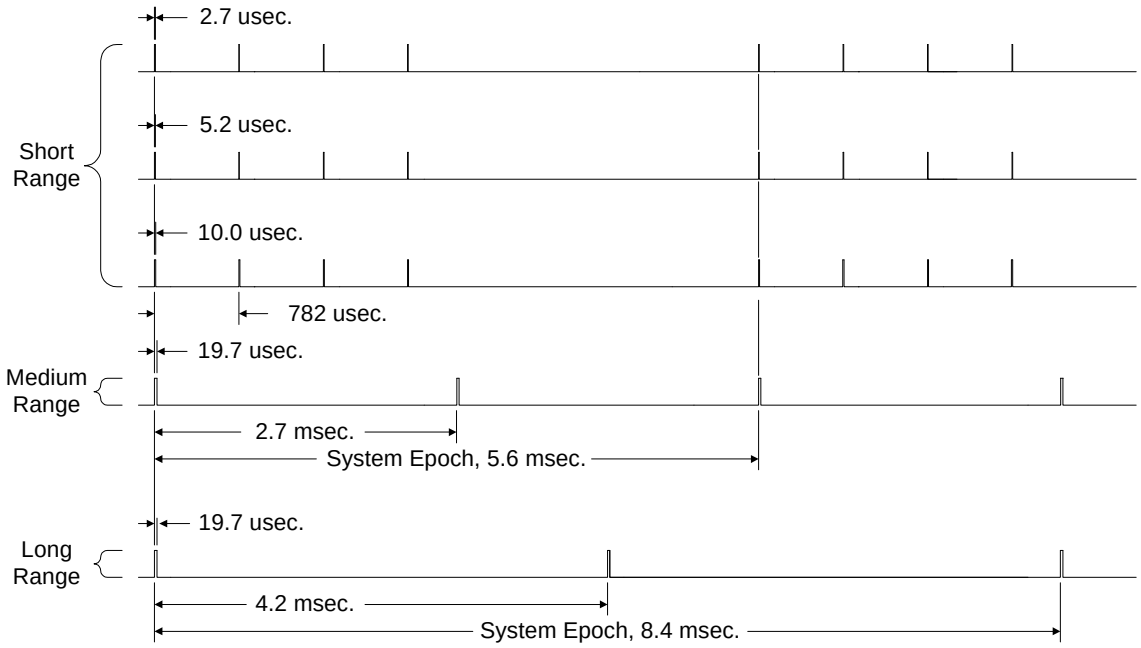


Figure F-1. Transmitter Pulse Pattern – Weather / Turbulence / Map Modes

## F.4 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 2.0 microsecond pulse width. The pulse pattern for windshear mode is shown in Figure F-2. 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 a transmit pulse pattern illustrated in Figure F-1. The right to left sweep is Windshear mode with the transmit pulse pattern illustrated in Figure F-2. Each sweep direction requires approximately 3 seconds for completion.

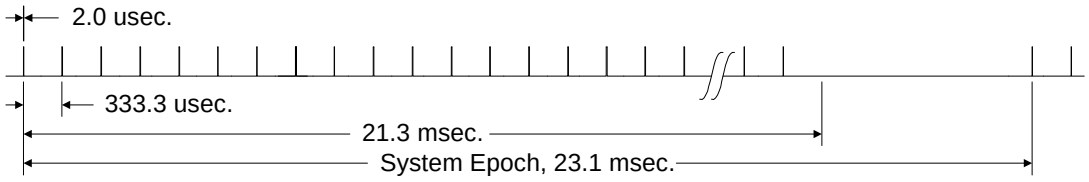


Figure F-2. Transmitter Pulse Pattern – Windshear Mode

## F.5 Frequency Selection:

The WRT-701X is capable of tuning to 64 different frequencies which are listed in Table F-3.

Table F-3. WRT-701X Channel Frequencies

| DDS CH | X Band TX | DDS CH | X Band TX |
|---|---|---|---|
| 0 | 9327424486 | 32 | 9333424486 |
| 1 | 9327611986 | 33 | 9333611986 |
| 2 | 9327799486 | 34 | 9333799486 |
| 3 | 9327986986 | 35 | 9333986986 |
| 4 | 9328174486 | 36 | 9334174486 |
| 5 | 9328361986 | 37 | 9334361986 |
| 6 | 9328549486 | 38 | 9334549486 |
| 7 | 9328736986 | 39 | 9334736986 |
| 8 | 9328924486 | 40 | 9334924486 |
| 9 | 9329111986 | 41 | 9335111986 |
| 10 | 9329299486 | 42 | 9335299486 |
| 11 | 9329486986 | 43 | 9335486986 |
| 12 | 9329674486 | 44 | 9335674486 |
| 13 | 9329861986 | 45 | 9335861986 |
| 14 | 9330049486 | 46 | 9336049486 |
| 15 | 9330236986 | 47 | 9336236983 |
| 16 | 9330424486 | 48 | 9336424486 |
| 17 | 9330611986 | 49 | 9336611986 |
| 18 | 9330799486 | 50 | 9336799486 |
| 19 | 9330986986 | 51 | 9336986986 |
| 20 | 9331174486 | 52 | 9337174486 |
| 21 | 9331361986 | 53 | 9337361986 |
| 22 | 9331549486 | 54 | 9337549486 |
| 23 | 9331736986 | 55 | 9337736983 |
| 24 | 9331924486 | 56 | 9337924486 |
| 25 | 9332111986 | 57 | 9338111986 |
| 26 | 9332290255 | 58 | 9338299486 |
| 27 | 9332486986 | 59 | 9338486986 |
| 28 | 9332674486 | 60 | 9338674486 |
| 29 | 9332861986 | 61 | 9338861986 |
| 30 | 9333049486 | 62 | 9348662720 |
| 31 | 9333236986 | 63 | 9348568734 |

## F.6 Weather Operation:

One frequency from Table F-3 is allocated for Weather, Turbulence and Mapping. This frequency is fixed for all pulse sets. The Weather, Turbulence and Map frequency is:

F1 – 9336.236983 MHz (Channel 47)

## F.7 Windshear Operation:

One frequency from Table F-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:

F2 – 9337.736983 MHz (Channel 55)

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 weather frequency and pulse patterns from Figure 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 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.

## F.8 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 47 (9336.236983 MHz). This is the weather/turbulence/map channel.

2. The Sampler performs a series of RF tests including a transmit test. This results in transmitter output pulses on Channel 55 (9337.736983 MHz) which is the Windshear frequency.

## F.9 WXR-701X RF Power Output (2.1046)

**Fequirement:**

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”.

## F.10 Test Procedure:

The peak power output of the WXR-701X was measured using test equipment connected to the WRT-701X antenna terminal. The equipment used for the RF Power Output Test is shown in Table F-4.

Table F-4. Test Equipment Used for Power Output Test

| Equipment | Manufacturer/Model Number | Specific Identification |
|---|---|---|
| Receiver/Transmitter | Rockwell Collins WRT-701X (622-5132-952*) | S/N 1JLRT |
| Indicator/Control | Rockwell Collins WXI-711 (622-6514-301) | S/N 133 |
| Control Panel | Rockwell Collins WCP-702 (622-5130-208) | S/N 1529 |
| Antenna Pedestal | Rockwell Collins WMA-701X (622-5136-803) | S/N L4TF |
| Test Harness | Rockwell Collins J-Box System Test Harness | N/A |
| Variable Power Source | HP 6812A AC/Power Source/Analyzer | SN US37290132 469-0068-857 |
| 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 | SN 3607U00446 460-0205-518 |
| Laptop P.C. | IBM Compatible with EM320 Terminal Emulation Software | HP OmniBook 4150 SN 94281113 4500000897 |

## F.11 Test Setup:

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

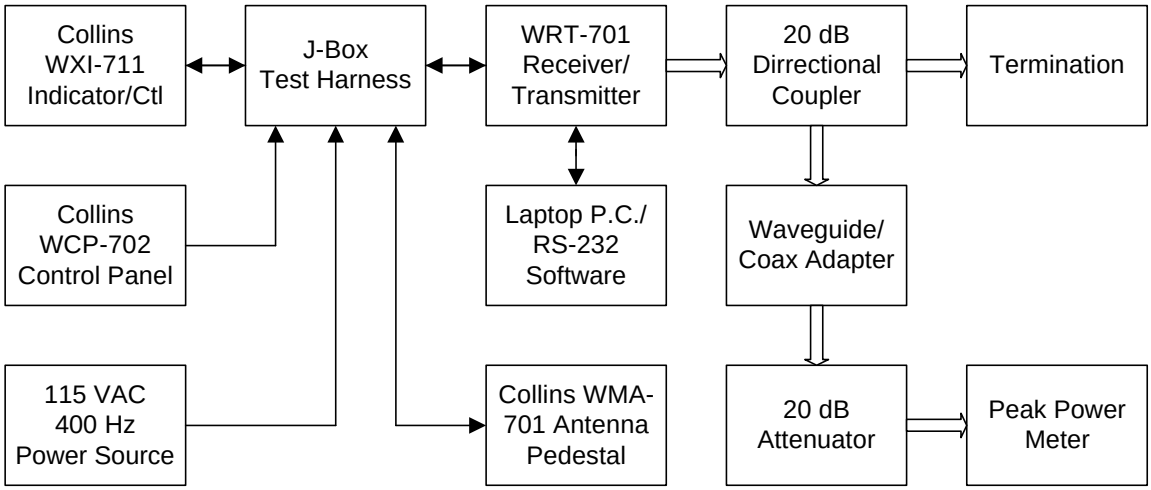


Figure F-3. RF Power Output Test Setup

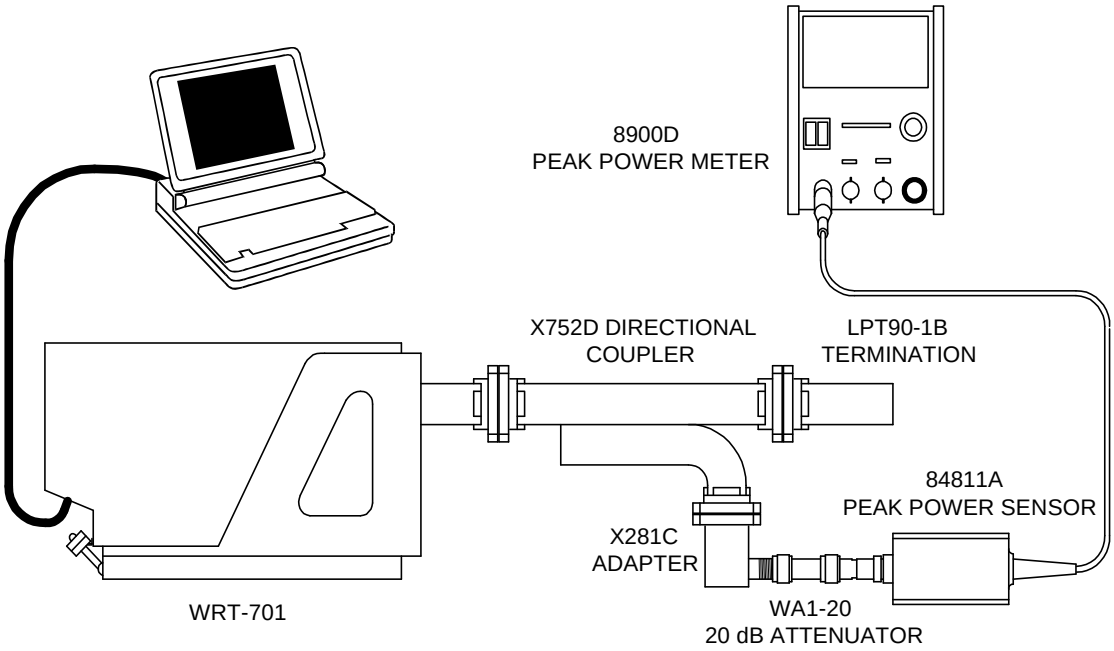


Figure F-4. Setting Up for RF Power Output Test

## F.12 Measurements:

Peak RF power output of the WRT-701X transmitter was measured through 40 dB of attenuation. The power output was measured during the Weather plus Turbulence sweep and Windshear sweeps. 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 F-5.

Table F-5. RF Power Output

| Line Voltage (Vac) | Peak Transmitter Power Output (Watts) | |
|---|---|---|
| | Weather, Turbulence or Map Channel 47 | Windshear Channel 55 |
| 97.750 (115-15%) | 183 | 183 |
| 103.50 (115-10%) | 183 | 183 |
| 109.25 (115-5%) | 183 | 183 |
| 115.00 | 183 | 183 |
| 120.75 (115+5%) | 183 | 183 |
| 126.50 (115+10%) | 183 | 183 |
| 132.25 (115+15%) | 183 | 183 |

## F.13 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.”

## F.14 Procedure:

The transmitted frequency of the WXR-701X was measured using a temperature chamber and test equipment. The equipment used for the Frequency Stability test is shown in Table F-6.

TableF- 6. Equipment Used for Frequency Stability Test

| Equipment | Manufacturer/Model Number | Specific Identification |
|---|---|---|
| Receiver/Transmitter | Rockwell Collins WRT-701X (622-5132-952) | S/N 1JLRT |
| Indicator/Control | Rockwell Collins WXI-711 (622-6514-301) | S/N 133 |
| Control Panel | Rockwell Collins WCP-702 (622-5130-208) | S/N 1529 |
| Antenna Pedestal | Rockwell Collins WMA-701X (622-5136-803) | S/N L4TF |
| Test Harness | Rockwell Collins J-Box System Test Harness | N/A |
| Variable Power Source | Agilent 6812A AC Power Source/Analyzer | SN US37290132 469-0068-857 |
| 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 4111A01362 460-0132-667 |
| Temperature Chamber | Thermotron M-8C | SN 21046 460-0203-302 |
| Laptop P.C. | IBM Compatable with EM320 Terminal Emulation Software | HP OmniBook 4150 SN 94281113 4500000897 |

## F.15 Equipment Setup:

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

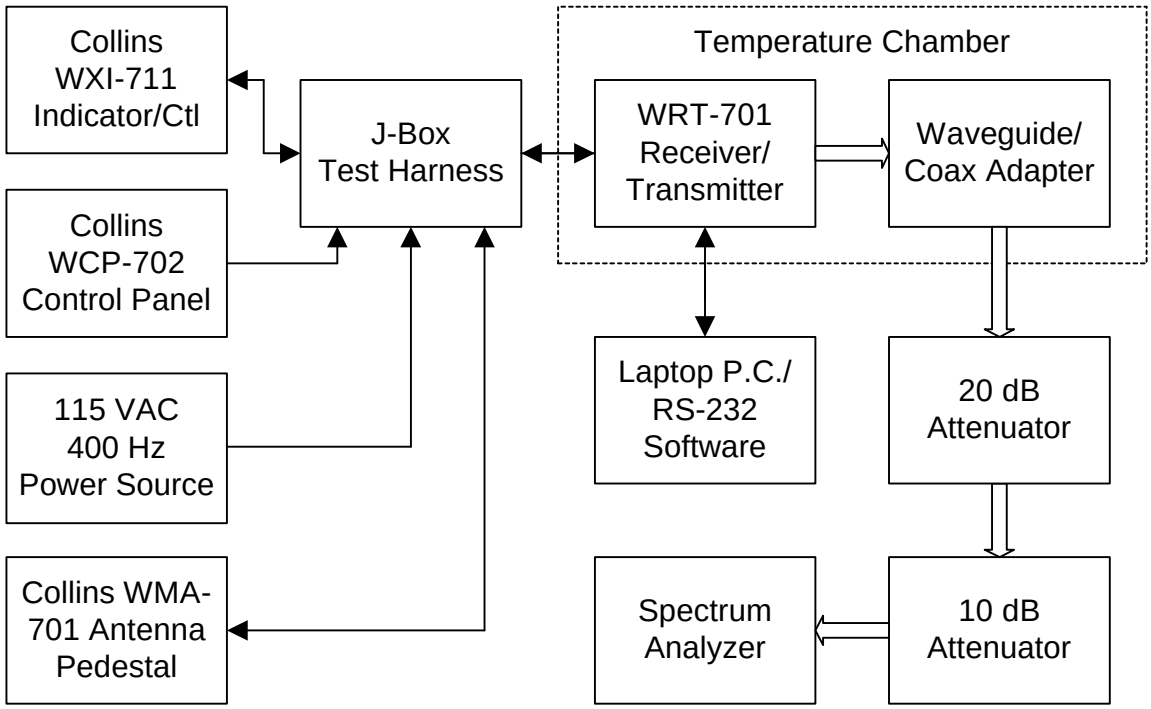


Figure F-5. Frequency Stability Test Setup

## F.16 Line Voltage Test:

The WRT-701X 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 Weather plus Turbulence plus Windshear mode with the frequency locked to a fixed channel specified in Table F-7 below.

## F.17 Line Voltage Test Measurements:

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

Table F-7. Transmitted Frequency Vs. Input Voltage

| Line Voltage (VAC) 400 Hz | Frequency (Spectrum Analyzer) (MHz) | |
|---|---|---|
| | Weather, Turbulence, or Map Channel 47 | Windshear Channel 55 |
| 97.750 (115-15%) | 9336.23 | 9337.697 |
| 103.50 (115-10%) | 9336.28 | 9337.697 |
| 109.25 (115-5%) | 9336.23 | 9337.697 |
| 115.00 | 9336.28 | 9337.713 |
| 120.75 (115+5%) | 9336.28 | 9337.713 |
| 126.50 (115+10%) | 9336.28 | 9337.713 |
| 132.25 (115+15%) | 9336.28 | 9337.713 |

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

## F.18 Temperature Test:

The WRT-701X 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-701X 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.

## F.19 Temperature Test Measurements:

Temperature Test results are shown in Table F-8 and Figure F-66.

Table F-8. Transmitted Frequency Vs. Temperature

| Temperature (ºC) | Frequency (Spectrum Analyzer) (MHz) | |
|---|---|---|
| | Weather, Turbulence, Map Channel 47 | Windshear Channel 55 |
| -55 | 9335.982 | 9337.463 |
| -50 | 9336.020 | 9337.506 |
| -40 | 9336.080 | 9337.576 |
| -30 | 9336.122 | 9337.606 |
| -20 | 9336.183 | 9337.669 |
| -10 | 9336.231 | 9337.722 |
| 0 | 9336.249 | 9337.739 |
| 10 | 9336.252 | 9337.747 |
| 20 | 9336.229 | 9337.704 |
| 30 | 9336.182 | 9337.677 |
| 40 | 9336.125 | 9337.617 |
| 50 | 9336.057 | 9337.556 |
| 60 | 9335.962 | 9337.443 |
| 70 | 9335.872 | 9337.348 |

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

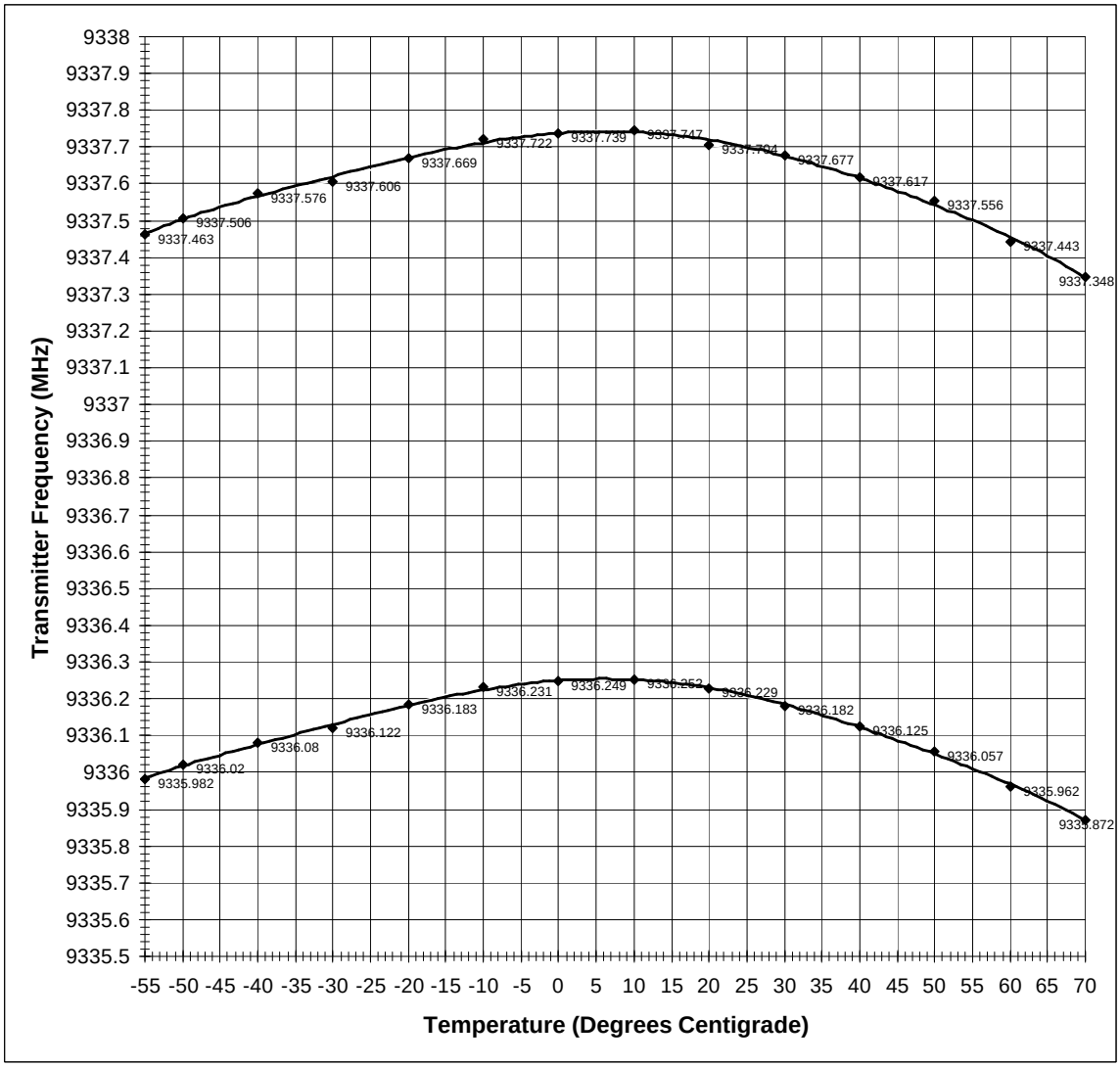


Figure F-6. Transmitter Frequency (Channels 47 and 55) vs. Temperature

## F.20 WXR-701X 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".

## F.21 Test Procedure:

The Occupied Bandwidth of the WXR-701X was measured using test equipment connected to the WRT-701X antenna terminal. The equipment used for the Occupied Bandwidth Test is shown in Table F-9.

Table F-9. Equipment Used for Occupied Bandwidth Tests

| Equipment | Manufacturer/Model Number | Specific Identification |
|---|---|---|
| Receiver/Transmitter | Rockwell Collins WRT-701X (622-5132-952) | S/N 1JLRT |
| Indicator/Control | Rockwell Collins WXI-711 (622-6514-301) | S/N 133 |
| Control Panel | Rockwell Collins WCP-702 (622-5130-208) | S/N 1529 |
| Antenna Pedestal | Rockwell Collins WMA-701X (622-5136-803) | S/N L4TF |
| Test Harness | Rockwell Collins J-Box System Test Harness | N/A |
| Power Source | HP 6812A AC/Power Source/Analyzer | SN US37290132 469-0068-857 |
| 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 4111A01362 460-0132-667 |
| Personal Computer | IBM Compatible with National Instruments GPIB Interface and Agilent E4444A Benchlink Software | Gateway 2000 P5-120 SN 4250149 |
| Laptop P.C. | IBM Compatible with EM320 Terminal Emulation Software | HP OmniBook 4150 SN 94281113 4500000897 |

## F.22 Test Setup:

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

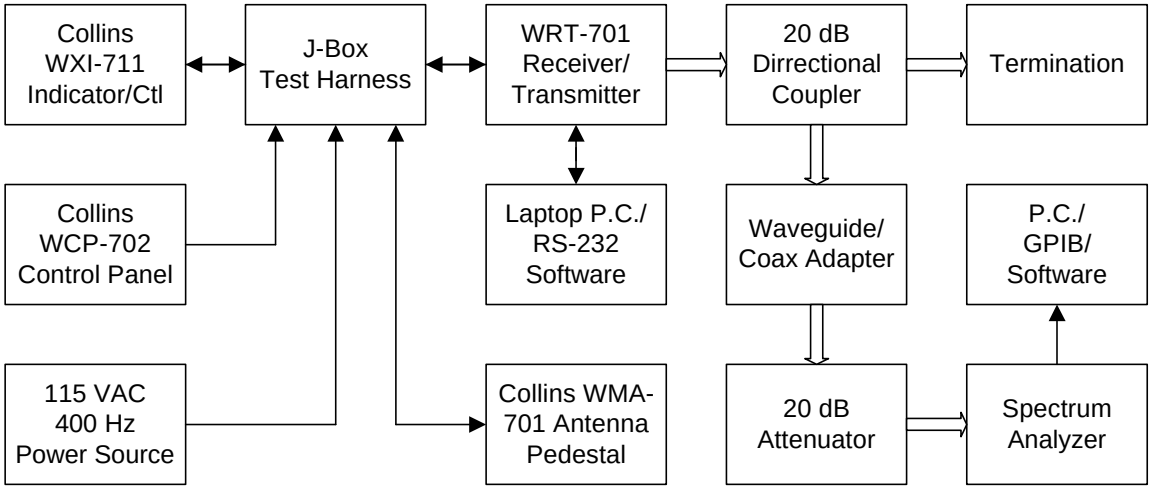


Figure F-7. Occupied Bandwidth Test Setup

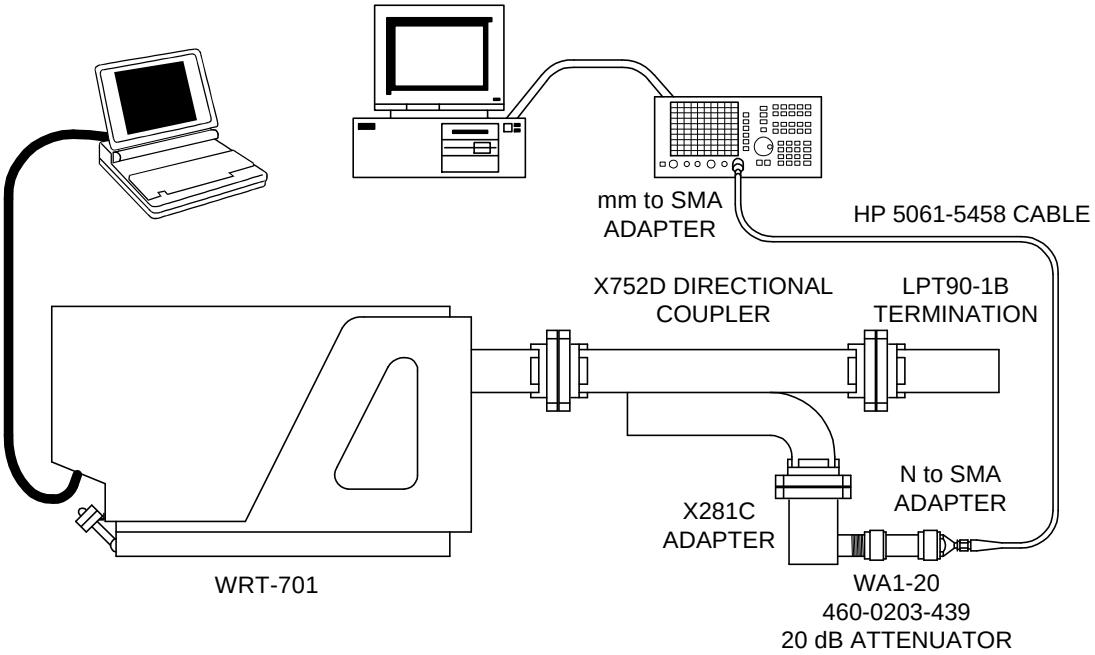


Figure F-8. Setting Up for Occupied Bandwidth Test

## F.23 Measurement Objectives:

The WRT-701X radar system is designed to operate on 2 separate frequencies in the band from 9.327424486 GHz to 9.338861986 GHz. During normal operation, one frequency is utilized for Weather, Turbulence and Map modes and the other frequency is utilized for Windshear mode. Different range selections utilize varying pulse patterns and pulse widths. The wind shear frequency and pulse pattern may be utilized depending on such parameters as radio altitude on approach or takeoff. A complete description of the frequency selection, pulse repetition frequencies, and pulse width selection is provided in Section 9.2 *WXR-701X Modulation Characteristics.*

## F.24 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 F-10 contains the test result for the Weather plus Turbulence plus Windshear operating mode.

Table F-10. Occupied Bandwidth Measurements

| **Test Condition** | | | **99%** | **Reference** |
|---|---|---|---|---|
| **Mode** | **Range** | | **Occupied Bandwidth** | **Figure** |
| Weather plus Turbulence plus Windshear | Short | 5 nmi | 2.800 MHz | Figure F-9 |
| | | 25 nmi | 2.283 MHz | Figure F-10 |
| | | 50 nmi | 2.250 MHz | Figure F-11 |
| | Medium | 100 nmi | 2.217 MHz | Figure F-12 |
| | Long | 250 nmi | 2.167 MHz | Figure F-13 |

The occupied bandwidth measurements for Weather plus Turbulence plus Windshear modes of operation are shown in Figure F-9 through Figure F-13.

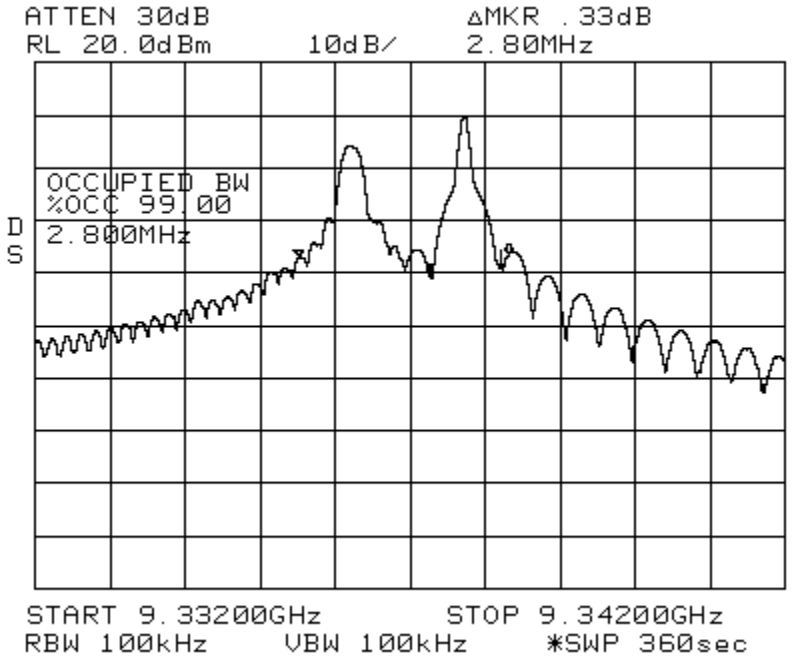


Figure F-9. Occupied Bandwidth, Windshear Plus Pulse Pattern 1

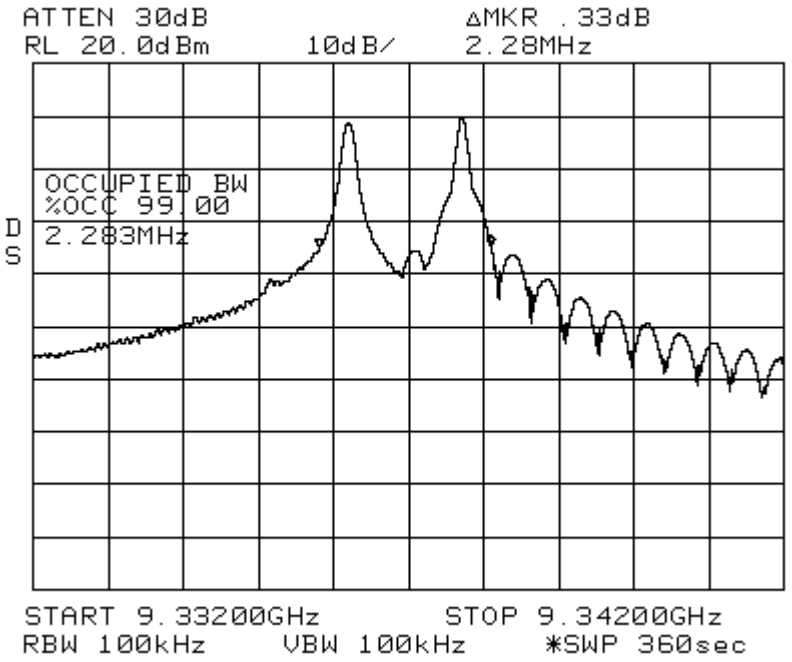


Figure F-10. Occupied Bandwidth, Windshear Plus Pulse Pattern 2

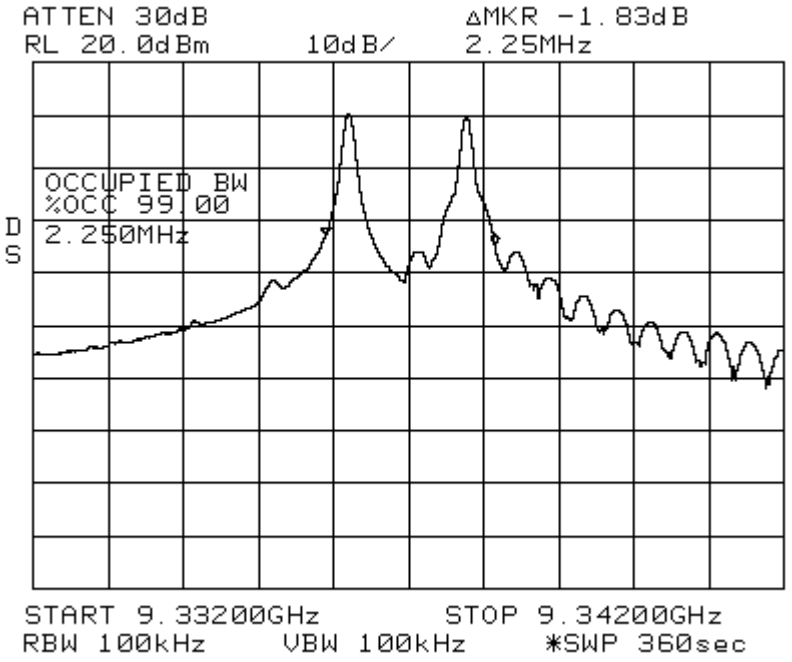


Figure F-11. Occupied Bandwidth, Windshear Plus Pulse Pattern 3

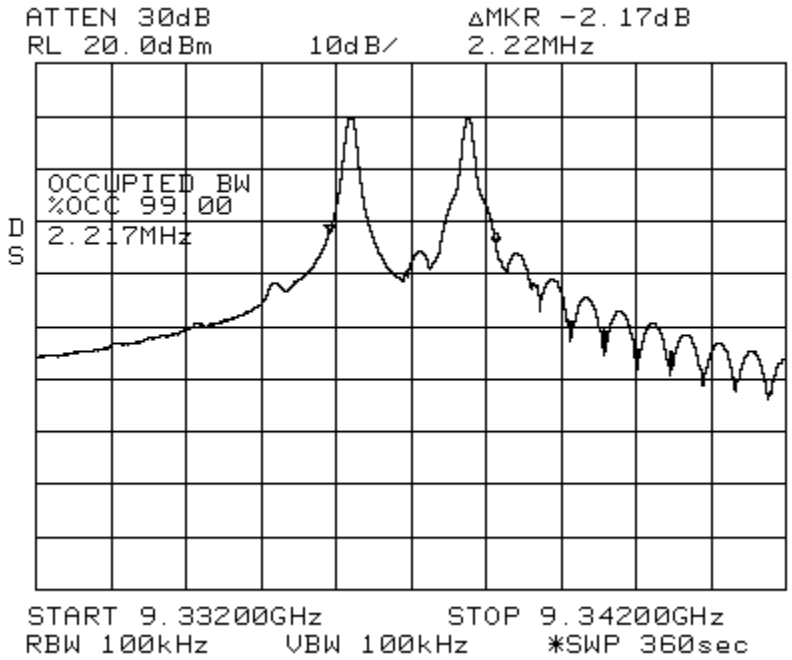


Figure F-12. Occupied Bandwidth, Windshear Plus Pulse Pattern 4

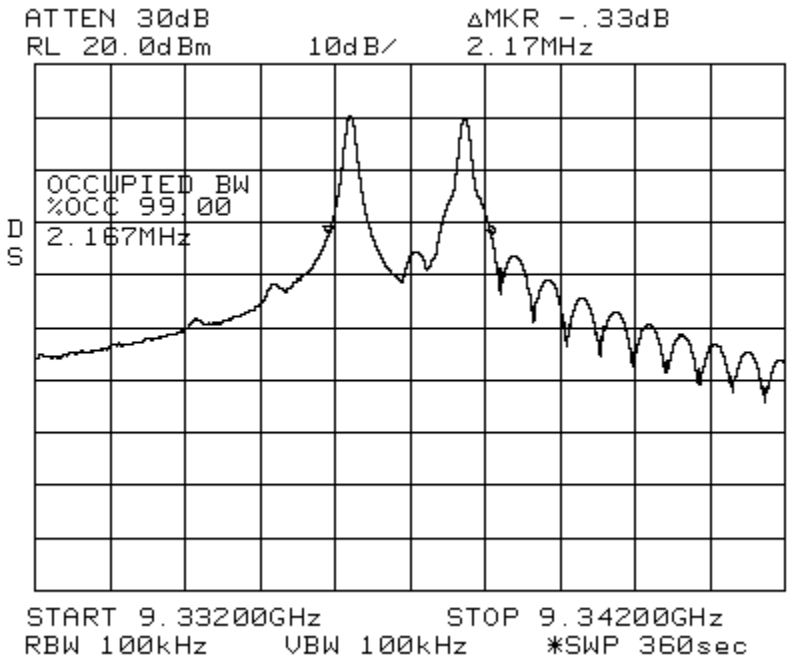


Figure F-13. Occupied Bandwidth, Windshear Plus Pulse Pattern 5

## F.25 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 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-701X 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-701X Test Article had a peak power output of 183 watts. Based on this power level, the absolute limits are calculated as follows using 40 dBc as an example.

Ptx-peak = 183 Watts or 22.62 dBW = 52.62 dBm in all ranges.

FCC Limit = 40 dBc

Absolute Limit = Ptx-peak (dBm) – FCC Limit (dBc) = +12.62 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 Table F-11.

Table F-11. 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) | +27.62 dBm |
| From 9538.877 MHz to 9838.876 MHz | -35 dBc | +17.62 dBm |
| Over 9838.877 MHz | -40 dBc | +12.62 dBm |

## F.26 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.

## F.27 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.

## F.28 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 = 52.62 dBm - 60 = -7.38 dBm

## F.29 Procedure:

The spurious emissions at the antenna terminal of the WXR-701X 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 F-12 through Table F-16.

Table F-12. Equipment Used for Spurious Emissions Tests

| Equipment | Manufacturer/Model Number | Specific Identification |
|---|---|---|
| Receiver/Transmitter | Rockwell Collins WRT-701X<br>(622-5132-952) | S/N 1JLRT |
| Indicator/Control | Rockwell Collins WXI-711<br>(622-6514-301) | S/N 133 |
| Control Panel | Rockwell Collins WCP-702<br>(622-5130-208) | S/N 1529 |
| Antenna Pedestal | Rockwell Collins WMA-701X<br>(622-5136-803) | S/N L4TF |
| Test Harness | Rockwell Collins<br>J-Box System Test Harness | N/A |
| Power Source | Agilent 6812A<br>AC Power Source/Analyzer | SN US37290132<br>469-0068-857 |
| Personal Computer | IBM Compatible with National Instruments GPIB Interface and Agilent E4444A Benchlink Software | Gateway 2000<br>P5-120<br>SN 4250149 |
| Laptop P.C. | IBM Compatible with<br>EM320 Terminal Emulation Software | HP OmniBook 4150<br>SN 94281113<br>4500000897 |
| Spectrum Analyzer | Agilent 8563EC (9 kHz to 26.5 GHz) | SN 4111A01362<br>460-0132-667 |
| | Agilent 8565EC (30 Hz to 50 GHz) | SN 3946A00238<br>460-0131-236 |

Table F-13. 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<br>460-0132-809 |
| Waveguide Termination | CMT LPT90-1B | SN 970005-001<br>460-0133-413<br>Component of 460-0132-809 |
| Waveguide to Coax Adapter | HP X281C | SN 3032A-06660<br>460-0210-312<br>Component of 460-0132-809 |
| Attenuator (20 dB) | Weinschel WA1-20 | 460-0203-439<br>Component of 460-0132-809 |

Table F-14. 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<br>460-0132-825 |
| Waveguide Taper (X to P Band) | Space Machine & Engineering | 460-0133-402<br>Component of 460-0132-825 |
| Waveguide Termination | CMT LPT62-1B | SN 970005-002<br>460-0133-414<br>Component of 460-0132-825 |
| Waveguide to Coax Adapter | HP P281B | 460-0133-418<br>Component of 460-0132-825 |

Table F-15. 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<br>460-0132-826 |
| Waveguide Taper (X to K Band) | Space Machine & Engineering | 460-0133-404<br>Component of 460-0132-826 |
| Waveguide Termination | CMT LPT42-1B | SN 970005-003<br>460-0133-416<br>Component of 460-0132-826 |
| Waveguide to Coax Adapter | HP K281C | SN3032A-09068<br>460-0133-412<br>Component of 460-0132-826 |

Table F-16. 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<br>460-0132-827 |
| Waveguide Taper (X to R Band) | Space Machine & Engineering | 460-0133-406<br>Component of 460-0132-827 |
| Waveguide Termination | CMT LPT28-1B | SN 970005-004<br>460-0133-415<br>Component of 460-0132-827 |
| Waveguide to Coax Adapter | HP R281A | SN 02136<br>460-0133-417<br>Component of 460-0132-827 |

## F.30 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 F-14. The actual test equipment setup is shown in Figure F-15.

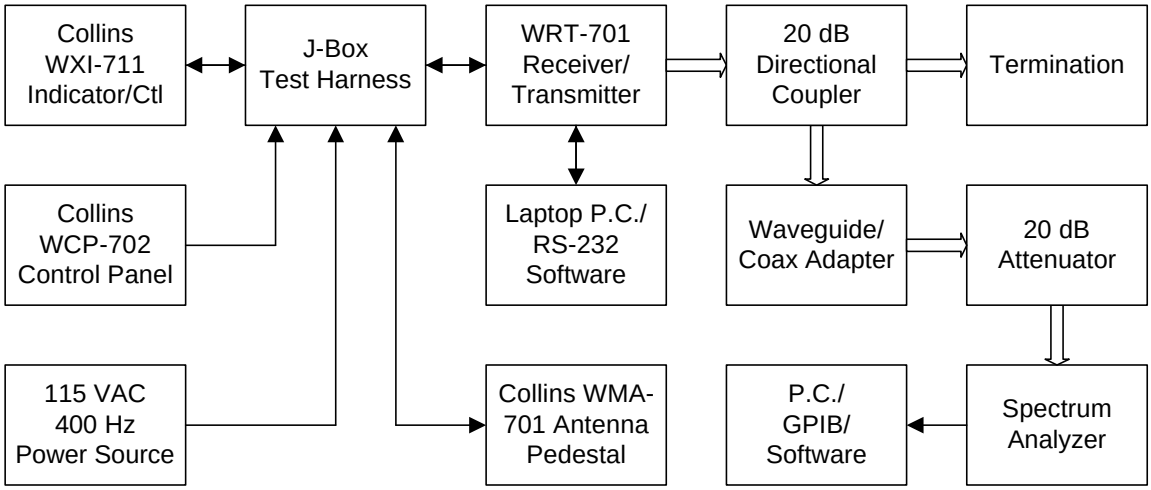


Figure F-14. Spurious Emissions at Antenna Terminal Test Setup
(8.2 to 12.4 GHz)

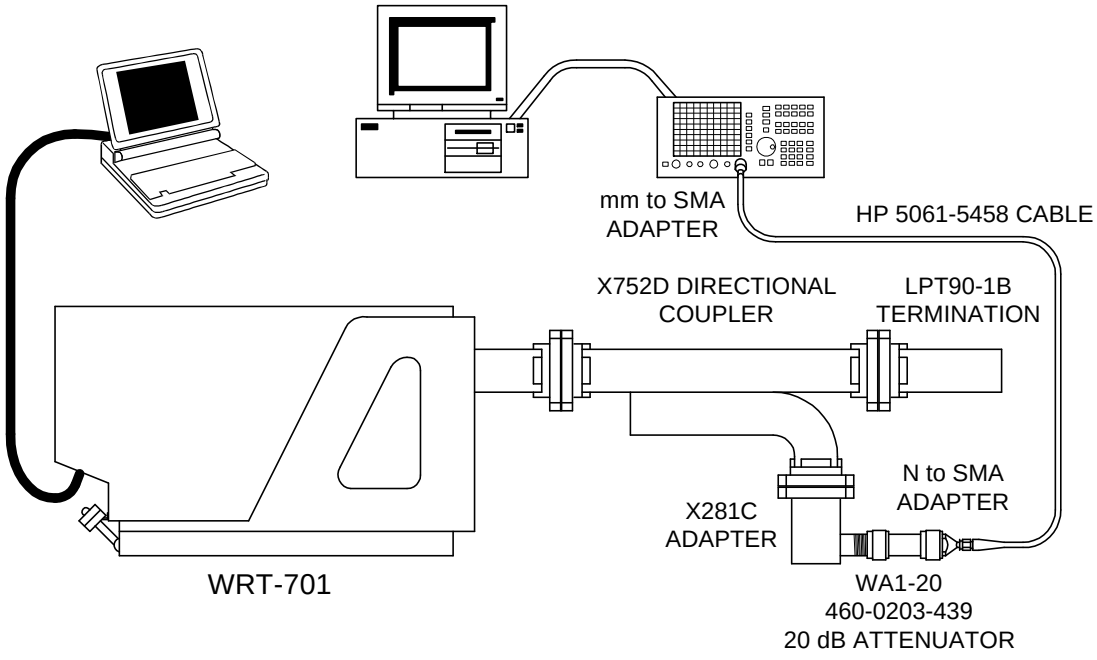


Figure F-15. Setting Up for Spurious Emissions at Antenna Terminal Test Setup
(8.2 to 12.4 GHz)

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 F-16. The actual test equipment setup is shown in Figure F-17.

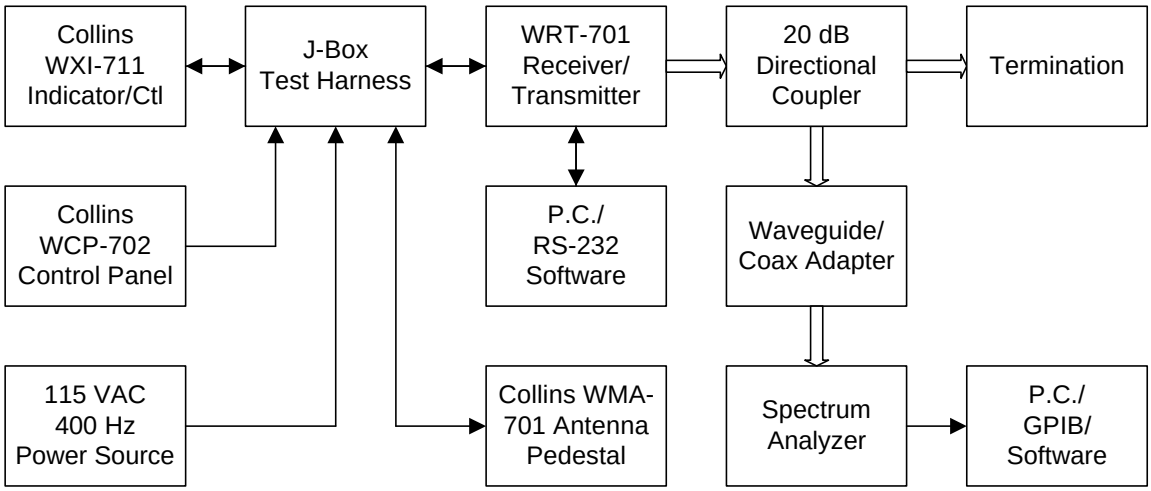


Figure F-16. Spurious Emissions at Antenna Terminal Test Setup
(12.4 t0 18.0 GHz), (18.0 to 26.5 GHz), and (26.5 to 40 GHz)

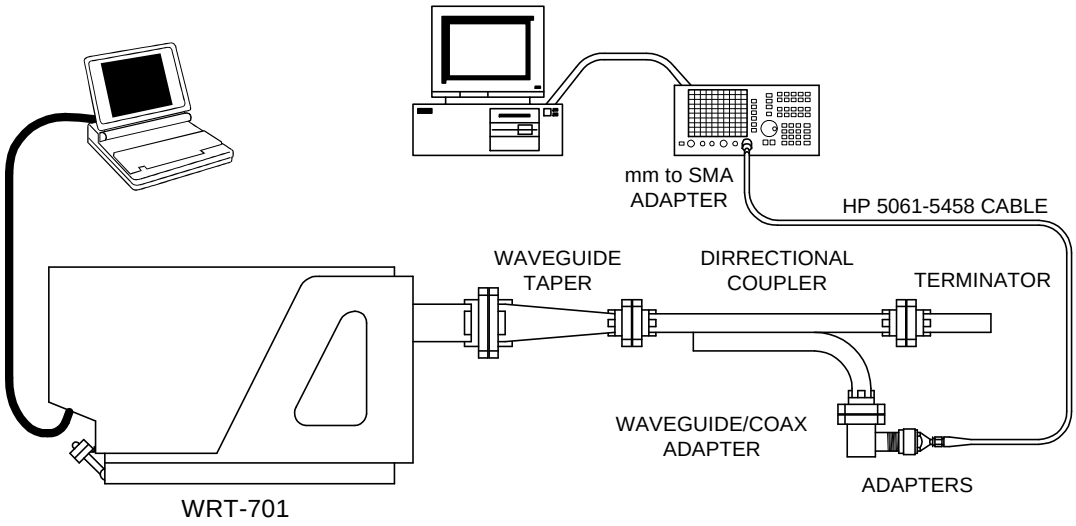


Figure 17. Setting Up for Spurious Emissions at Antenna Terminal Tests
(12.4 to 18.0 GHz), (18.0 to 26.5 GHz), and (26.5 to 40 GHz)

## F.40 Measurements:

Spurious Antenna Emission Test data was takes for five Weather plus Turbulence plus Windshear conditions as described in Table F-17:

Table F-17. Spurious Emission Test Conditions

| Mode of Operation | | Pulse Pattern | Range (nmi) | Pulse Width (µseconds) | Pulse Rate (Hz) | Epoch (msec) | Transmit Freq |
|---|---|---|---|---|---|---|---|
| Weather plus Turbulence | Short Range | 1 | 5 – 15 | 2.7 | 1278.8 / 699 | 5.6 | F1 |
| | | 2 | 20 – 30 | 5.2 | 1278.8 / 699 | 5.6 | F1 |
| | | 3 | 35 – 60 | 10.0 | 1278.8 / 699 | 5.6 | F1 |
| | Medium Range | 4 | 65 – 160 | 19.7 | 365.0 / 350 | 5.6 | F1 |
| | Long Range | 5 | 165 – 320 | 19.7 | 238.1 / 233 | 8.4 | F1 |
| Windshear | | NA | | 2.3 | 3002.8 / 2724 | 23.1 | F2 |

In each case, the radar was operating at the maximum operational mode:

Weather + Turbulence + Windshear.

## F.41 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.

The test results for the five conditions are listed in Table F-18 through Table F-21. 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 F-18. Conducted Spurious Emissions, 8.2 to 12.4 GHz

| Emission Band | Mode of Operation | 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 GHz to 12.4 GHz | Windshear Plus Pattern 1 | 11.413 | -3.17 | -25.17 | +12.62 | -7.38 | +37.79 | +17.79 | Figure F-18 |
| | Windshear Plus Pattern 2 | 8.473 | -3.0 | -25.00 | +12.62 | -7.38 | +37.62 | +17.62 | Figure F-19 |
| | Windshear Plus Pattern 3 | 8.396 | -3.33 | -25.33 | +12.62 | -7.38 | +37.95 | +17.95 | Figure F-20 |
| | Windshear Plus Pattern 4 | 9.726 | -2.67 | -24.67 | +12.62 | -7.38 | +37.29 | +17.29 | Figure F-21 |
| | Windshear Plus Pattern 5 | 8.662 | -3.0 | -25.00 | +12.62 | -7.38 | +37.62 | +17.62 | Figure F-22 |

Table F-19. Conducted Spurious Emissions 12.4 to 18.0 GHz

| Emission Band | Mode of Operation | 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 |
|---|---|---|---|---|---|---|---|---|---|
| 12.4 GHz to 18.0GHz | Windshear Plus Pattern 1 | 15.648 | -51.67 | -73.67 | +12.62 | -7.38 | +86.29 | +66.29 | Figure F-23 |
| | Windshear Plus Pattern 2 | 16.552 | -52.00 | -74.00 | +12.62 | -7.38 | +86.62 | +66.62 | Figure F-24 |
| | Windshear Plus Pattern 3 | 15.965 | -51.83 | -73.83 | +12.62 | -7.38 | +86.45 | +66.45 | Figure F-25 |
| | Windshear Plus Pattern 4 | 16.553 | -52.00 | -74.00 | +12.62 | -7.38 | +86.62 | +66.62 | Figure F-26 |
| | Windshear Plus Pattern 5 | 15.592 | -51.67 | -73.67 | +12.62 | -7.38 | +86.29 | +66.29 | Figure F-27 |

Table F-20. Conducted Spurious Emissions, 18.0 to 26.5 GHz

| Emission Band | Mode of Operation | 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 |
|---|---|---|---|---|---|---|---|---|---|
| 18.0 GHz to 26.5 GHz | Windshear Plus Pattern 1 | 18.680 | -25.83 | -47.83 | +12.62 | -7.38 | +60.45 | +40.45 | Figure F-28 |
| | Windshear Plus Pattern 2 | 18.680 | -24.33 | -46.33 | +12.62 | -7.38 | +58.95 | +38.95 | Figure F-29 |
| | Windshear Plus Pattern 3 | 18.680 | -23.50 | -45.50 | +12.62 | -7.38 | +58.12 | +38.12 | Figure F-30 |
| | Windshear Plus Pattern 4 | 18.680 | -23.00 | -45.00 | +12.62 | -7.38 | +57.62 | +37.62 | Figure F-31 |
| | Windshear Plus Pattern 5 | 18.680 | -23.00 | -45.00 | +12.62 | -7.38 | +57.62 | +37.62 | Figure F-32 |

Table F-21. Conducted Spurious Emissions, 26.5 to 40.0 GHz

| Emission Band | Mode of Operation | 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 |
|---|---|---|---|---|---|---|---|---|---|
| 26.5 GHz to 40.0 GHz | Windshear | 28.01 | -24.17 | -46.17 | +12.62 | -7.38 | +58.79 | +38.79 | Figure F-33 |
| | Plus Pattern 1 | 37.37 | -38.00 | -60.00 | +12.62 | -7.38 | +72.62 | +52.62 | Figure F-34 |
| | Windshear | 28.01 | -23.83 | -45.83 | +12.62 | -7.38 | +58.45 | +38.45 | Figure F-35 |
| | Plus Pattern 2 | 37.37 | -38.50 | -60.50 | +12.62 | -7.38 | +73.12 | +53.12 | Figure F-36 |
| | Windshear | 28.01 | -23.83 | -45.83 | +12.62 | -7.38 | +58.45 | +38.45 | Figure F-37 |
| | Plus Pattern 3 | 37.37 | -38.83 | -60.83 | +12.62 | -7.38 | +73.45 | +53.45 | Figure F-38 |
| | Windshear | 28.01 | -23.83 | -45.83 | +12.62 | -7.38 | +58.45 | +38.45 | Figure F-39 |
| | Plus Pattern 4 | 37.37 | -38.83 | -60.83 | +12.62 | -7.38 | +73.45 | +53.45 | Figure F-40 |
| | Windshear | 28.01 | -23.83 | -45.83 | +12.62 | -7.38 | +58.45 | +38.45 | Figure F-41 |
| | Plus Pattern 5 | 37.37 | -38.33 | -60.33 | +12.62 | -7.38 | +72.95 | +52.95 | Figure F-42 |

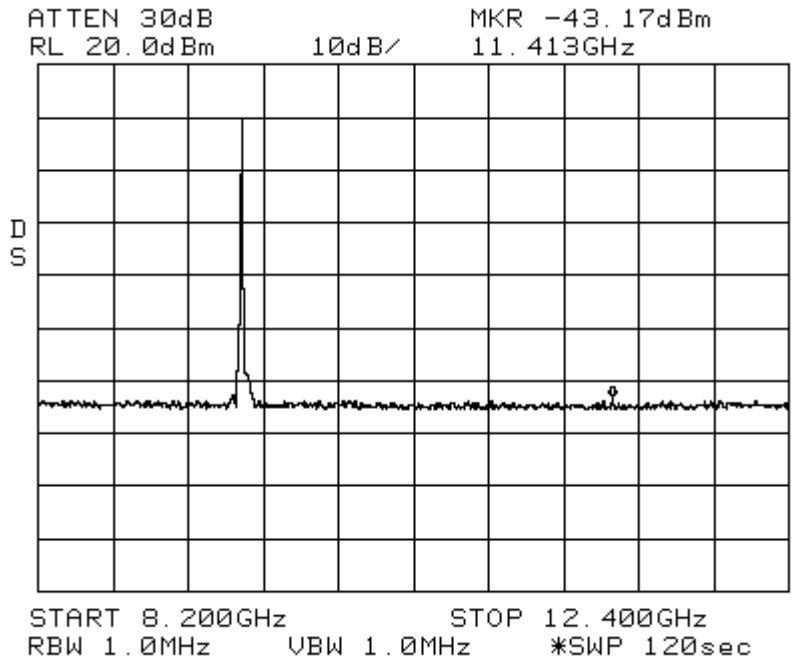


Figure F-18. Windshear Plus Pulse Pattern 1, (8.2 to 12.4 GHz, Peak 2)

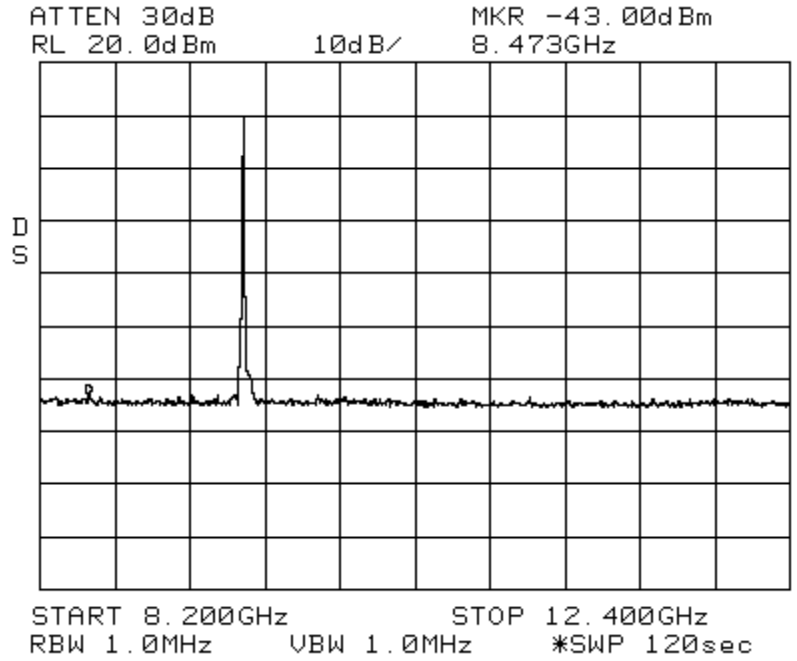


Figure **F-**19. Windshear Plus Pulse Pattern 2, (8.2 to 12.4 GHz, Peak 2)

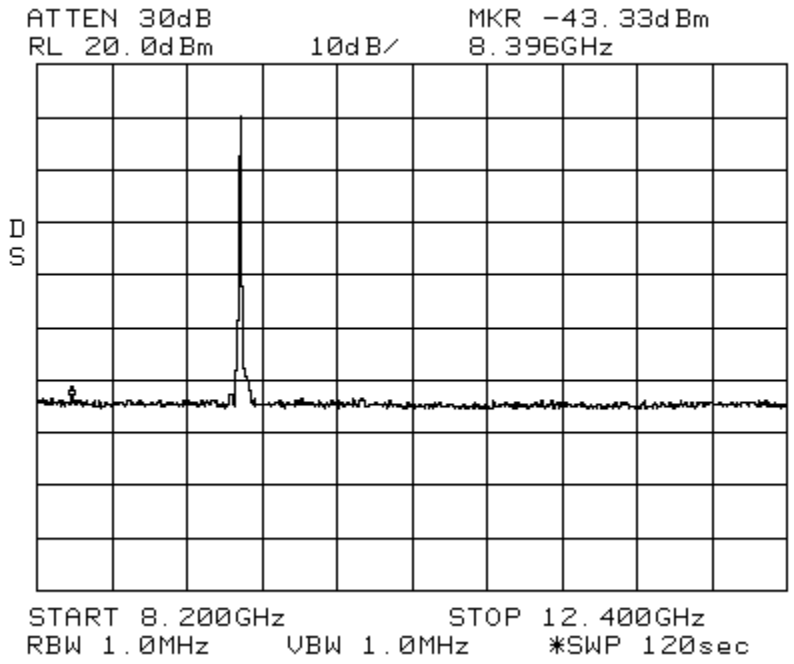


Figure **F-**20. Windshear Plus Pulse Pattern 3, (8.2 to 12.4 GHz, Peak 2)

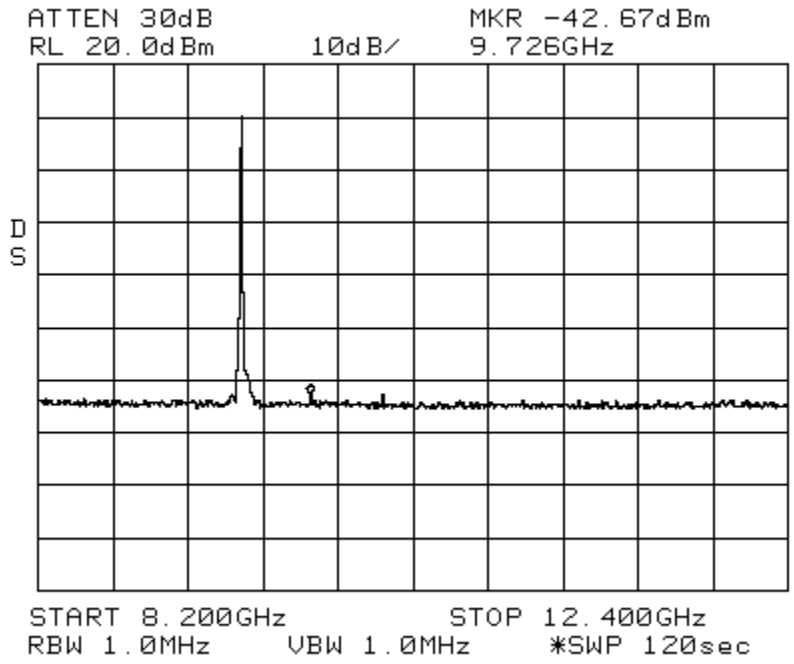


Figure F-21. Windshear Plus Pulse Pattern 4, (8.2 to 12.4 GHz, Peak 2)

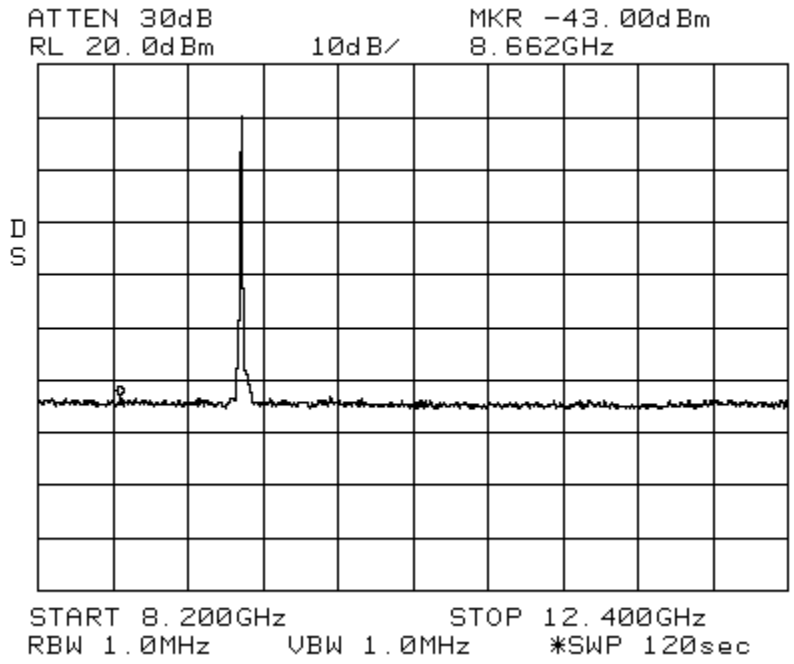


Figure F-22. Windshear Plus Pulse Pattern 5, (8.2 to 12.4 GHz, Peak 2)

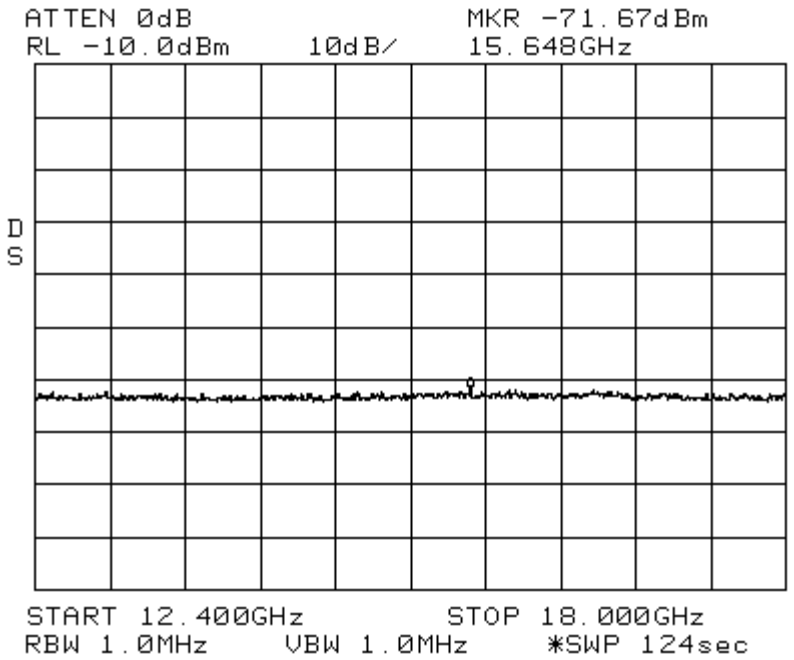


Figure F-23. Windshear Plus Pulse Pattern 1, (12.4 to 18.0 GHz)

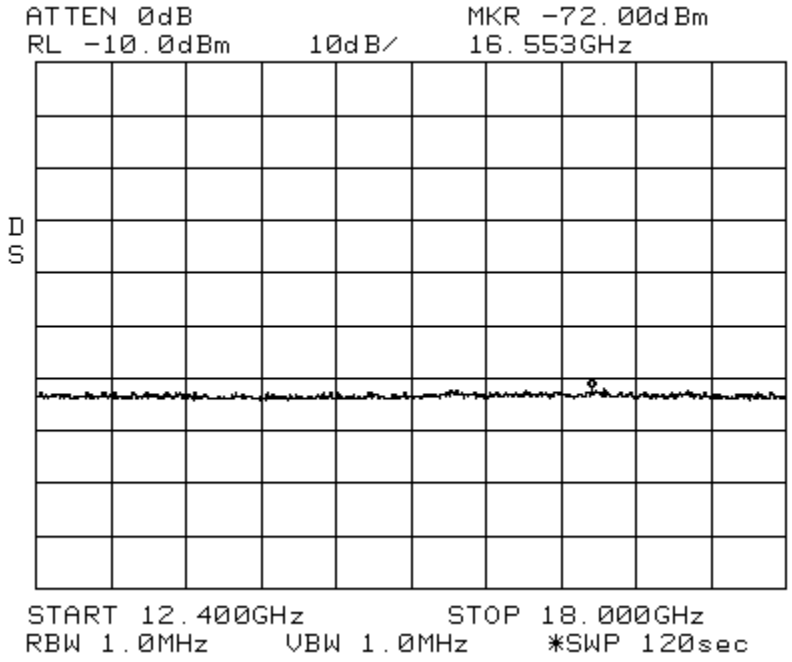


Figure F-24. Windshear Plus Pulse Pattern 2, (12.4 to 18.0 GHz)

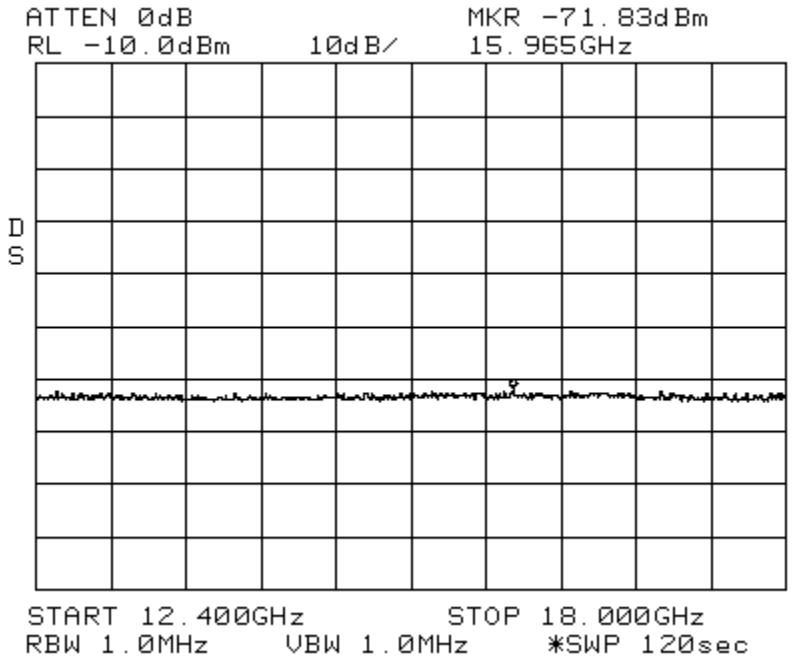


Figure F-25. Windshear Plus Pulse Pattern 3, (12.4 to 18.0 GHz)

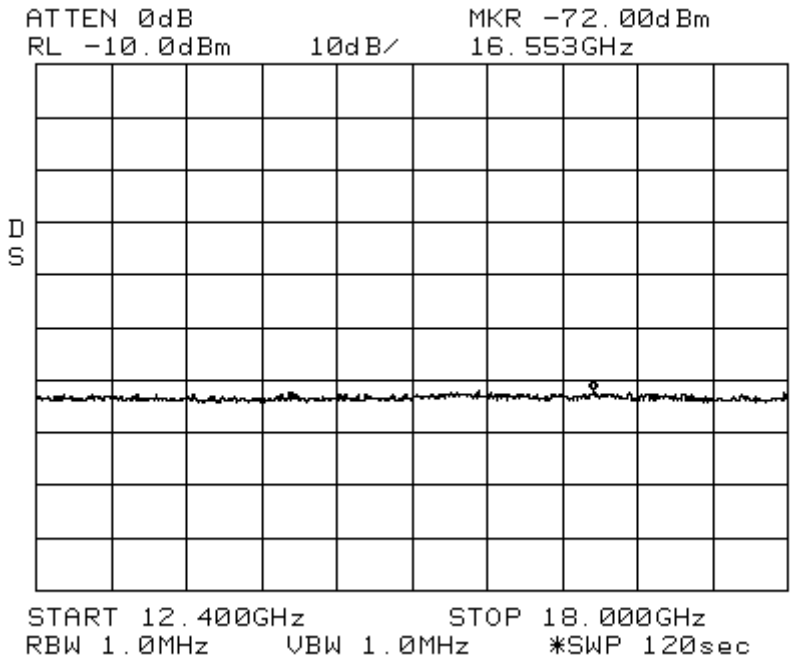


Figure F-26. Windshear Plus Pulse Pattern 4, (12.4 to 18.0 GHz)

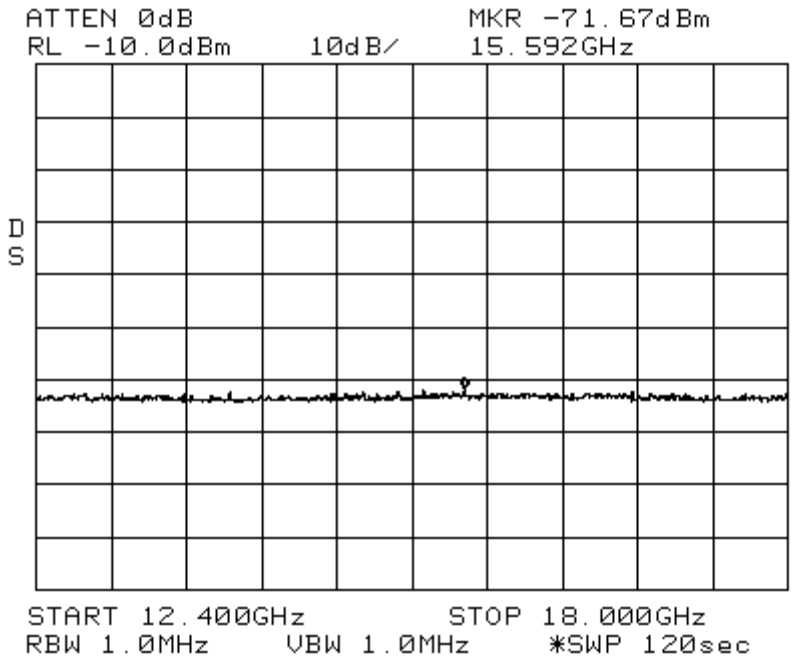


Figure F-27. Windshear Plus Pulse Pattern 5, (12.4 to 18.0 GHz)

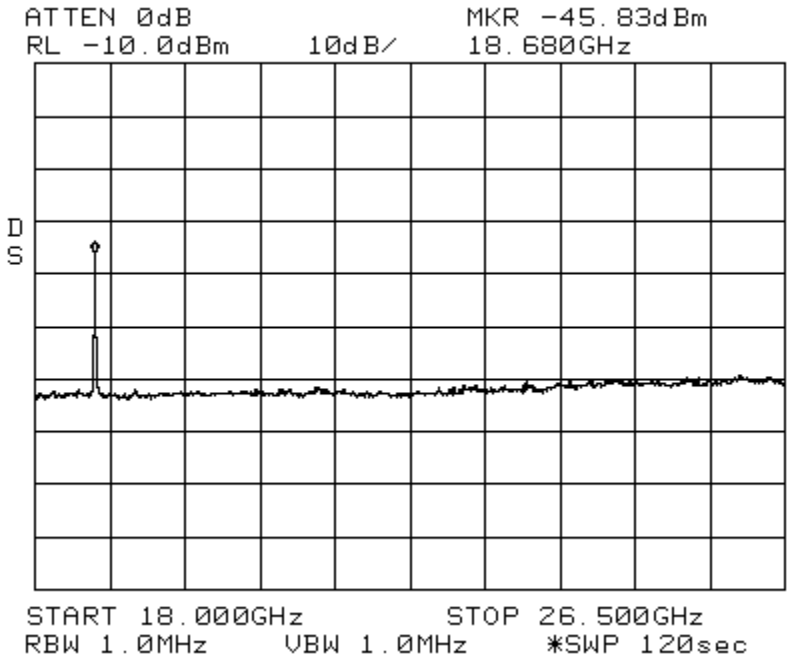


Figure F-28. Windshear Plus Pulse Pattern 1, (18.0 to 26.5 GHz)

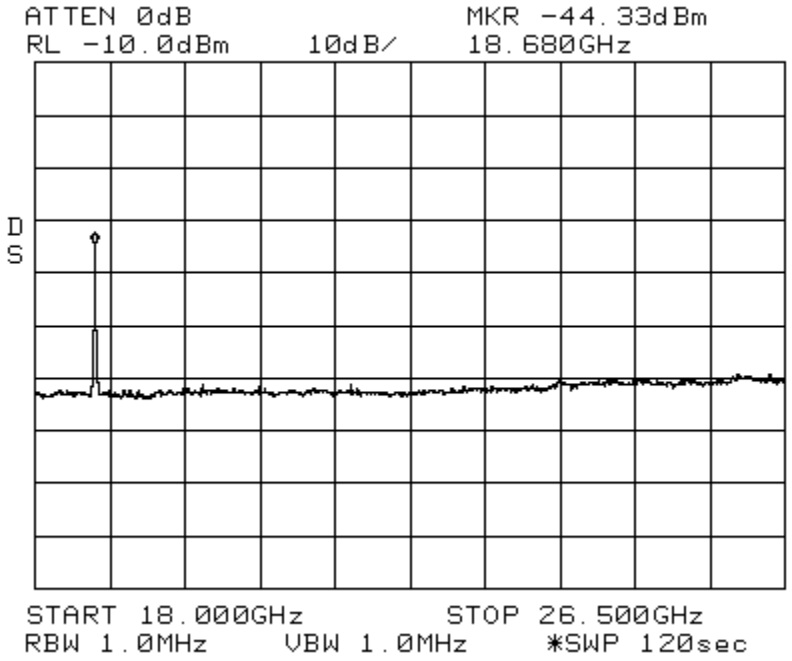


Figure F-29. Windshear Plus Pulse Pattern 2, (18.0 to 26.5 GHz)

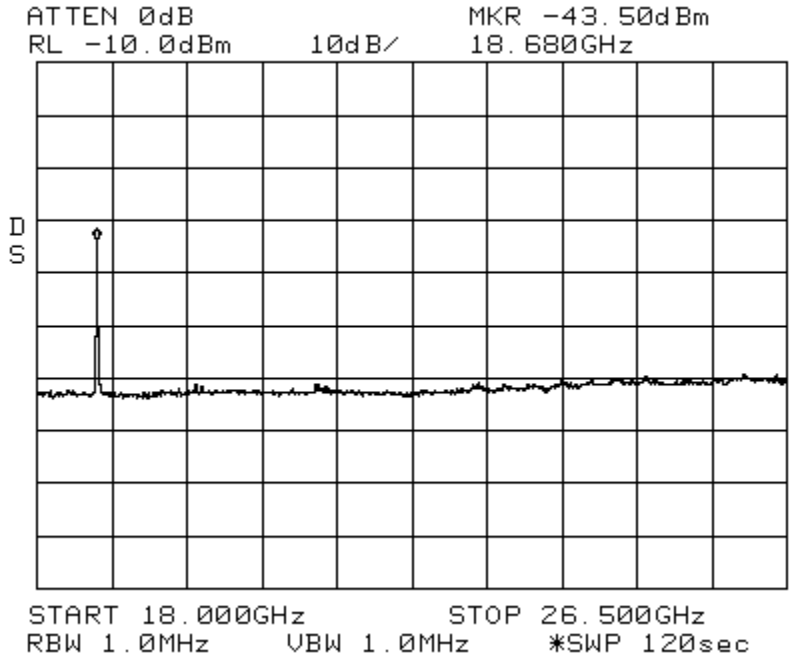


Figure F-30. Windshear Plus Pulse Pattern 3, (18.0 to 26.5 GHz)

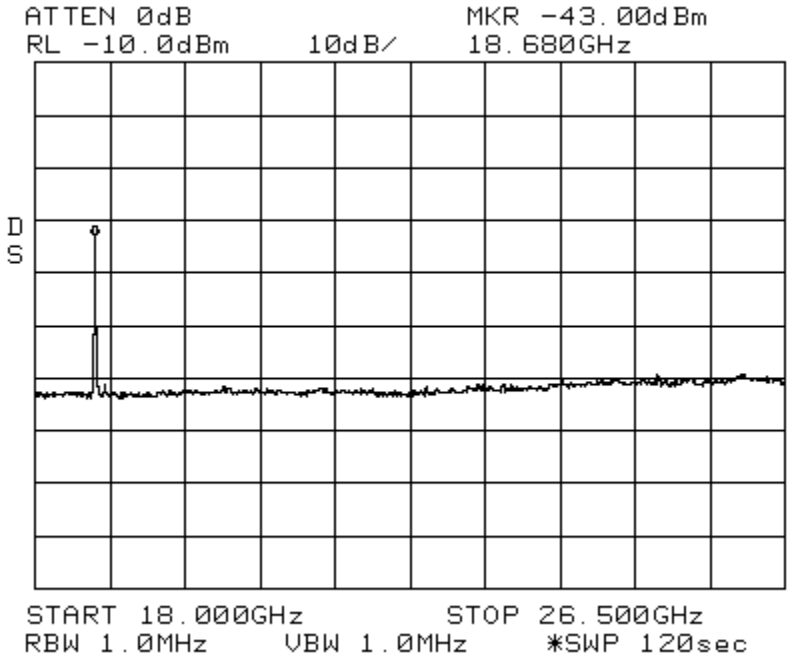


Figure F-31. Windshear Plus Pulse Pattern 4, (18.0 to 26.5 GHz)

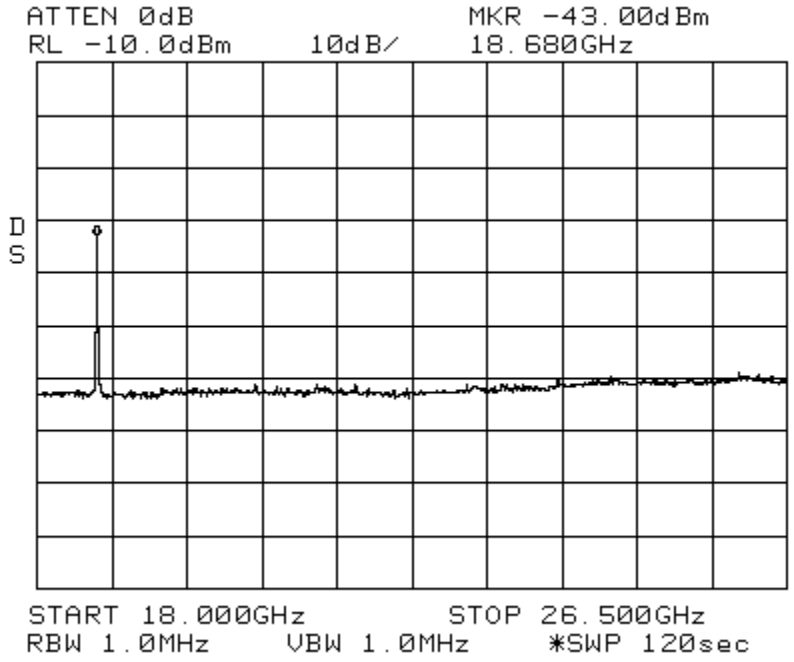


Figure F-32. Windshear Plus Pulse Pattern 5, (18.0 to 26.5 GHz)

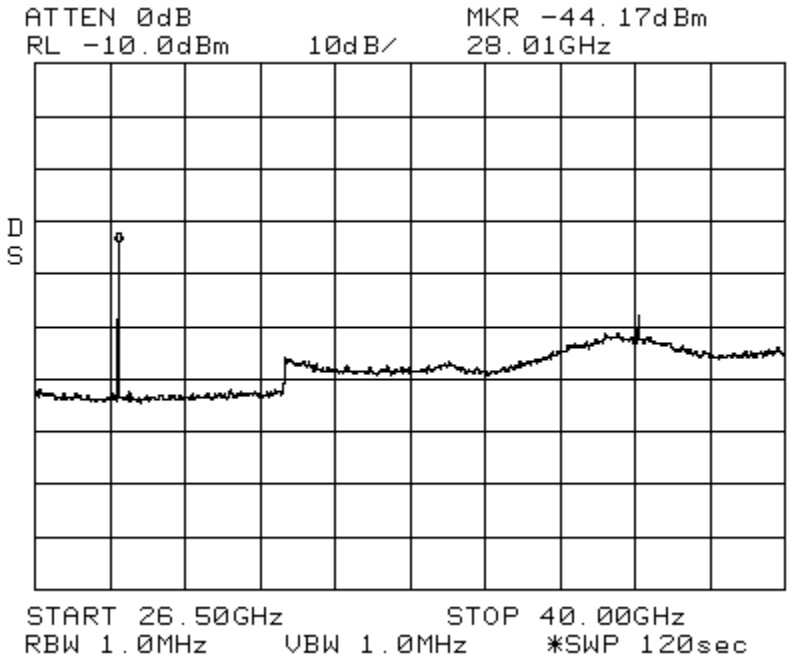


Figure F-33. Windshear Plus Pulse Pattern 1, (26.5 to 40.0 GHz, Peak 1)

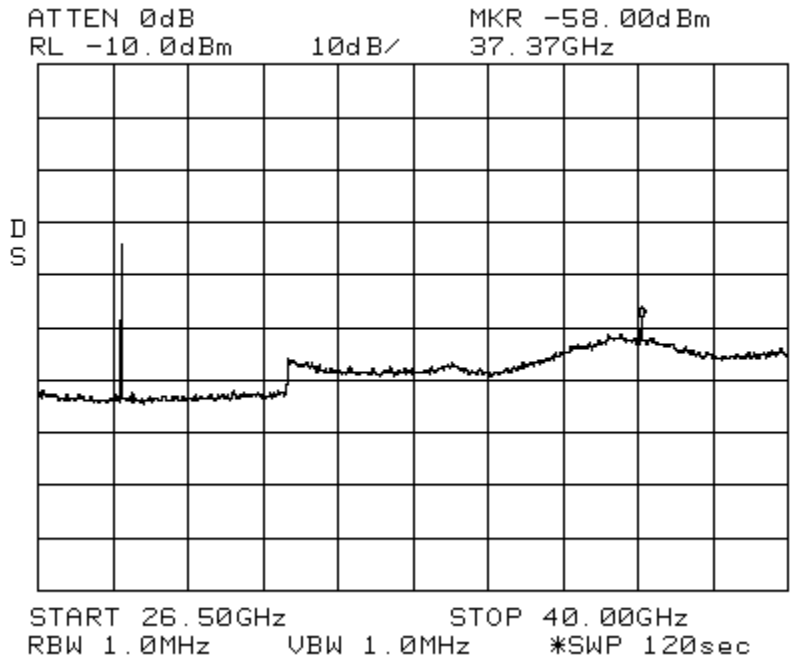


Figure F-34. Windshear Plus Pulse Pattern 1, (26.5 to 40.0 GHz, Peak 2)

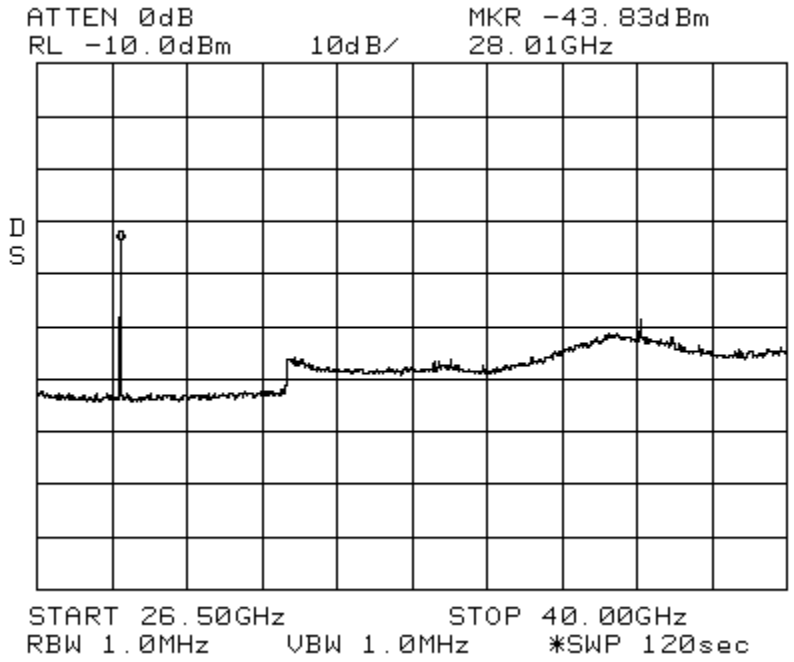


Figure F-35. Windshear Plus Pulse Pattern 2, (26.5 to 40.0 GHz, Peak 1)

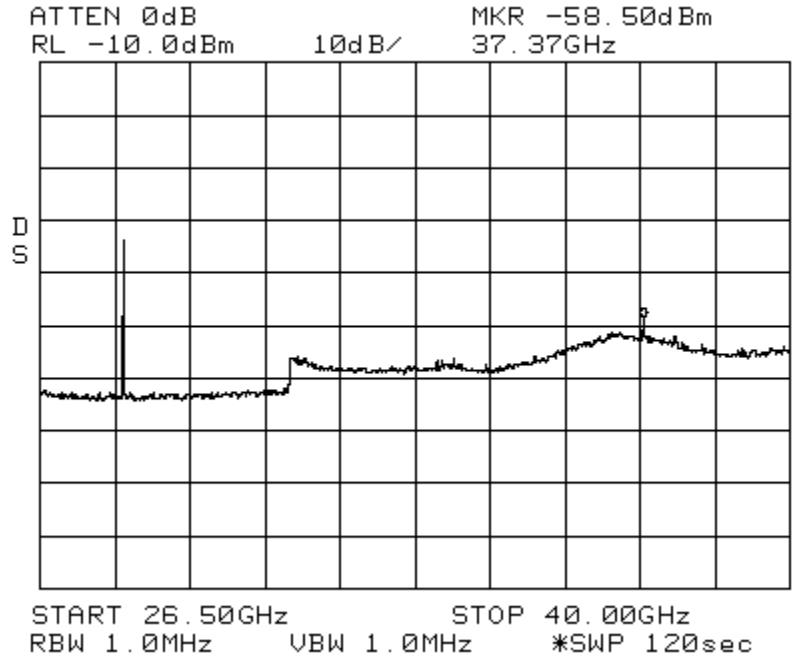


Figure F-36. Windshear Plus Pulse Pattern 2, (26.5 to 40.0 GHz, Peak 2)

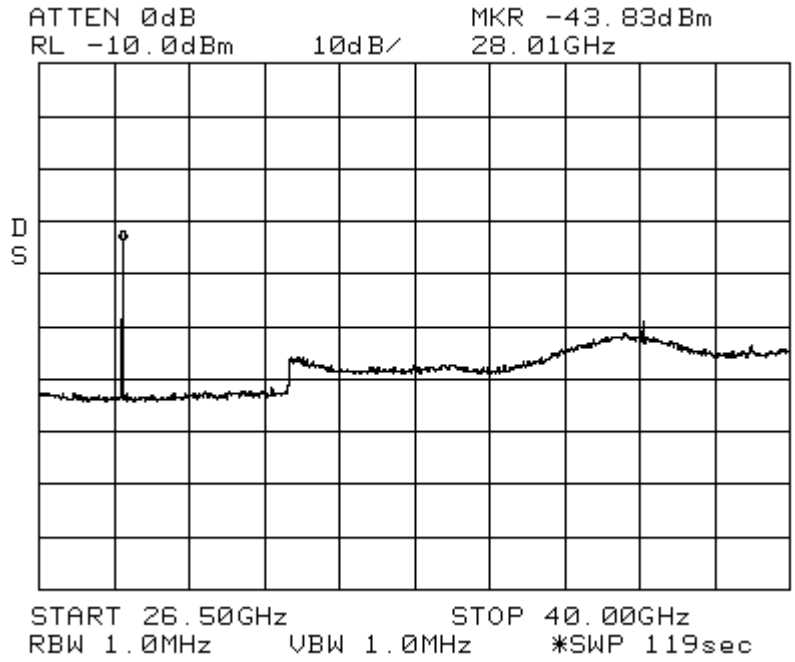


Figure F-37. Windshear Plus Pulse Pattern 3, (26.5 to 40.0 GHz, Peak 1)

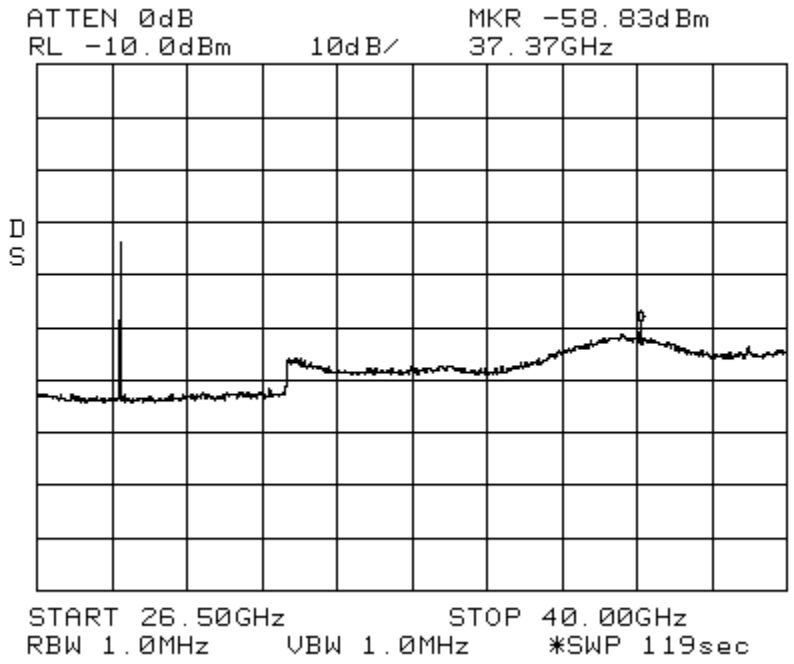


Figure F-38. Windshear Plus Pulse Pattern 3, (26.5 to 40.0 GHz, Peak 2)

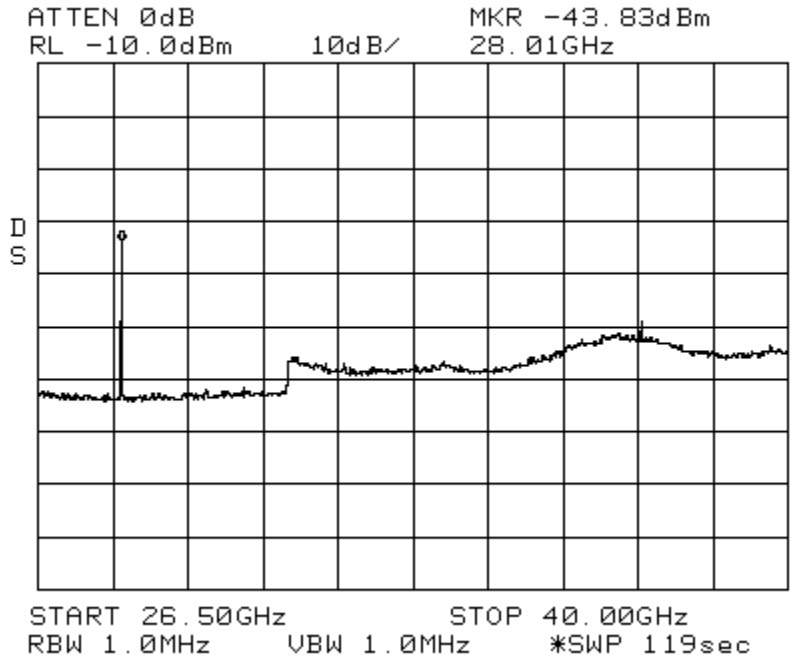


Figure F-39. Windshear Plus Pulse Pattern 4, (26.5 to 40.0 GHz, Peak 1)

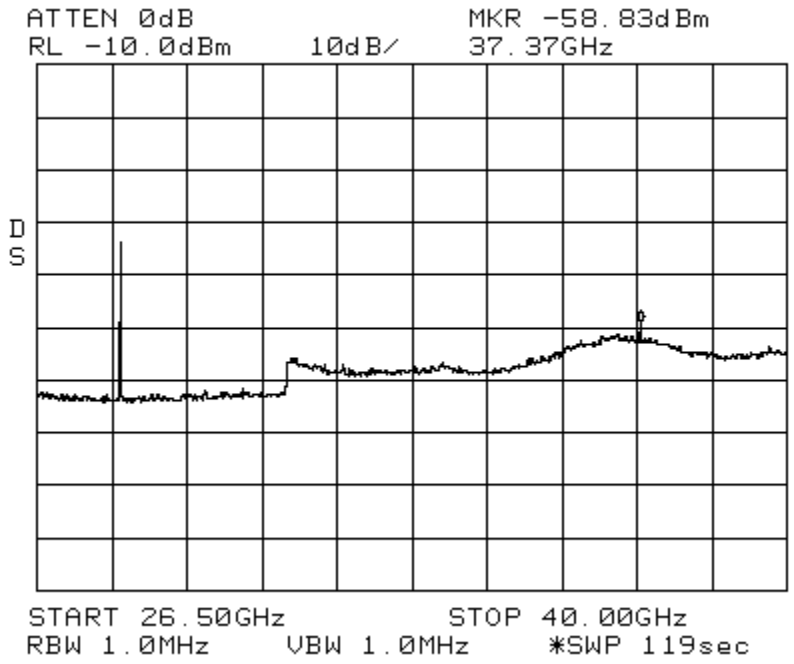


Figure F-40. Windshear Plus Pulse Pattern 4, (26.5 to 40.0 GHz, Peak 2)

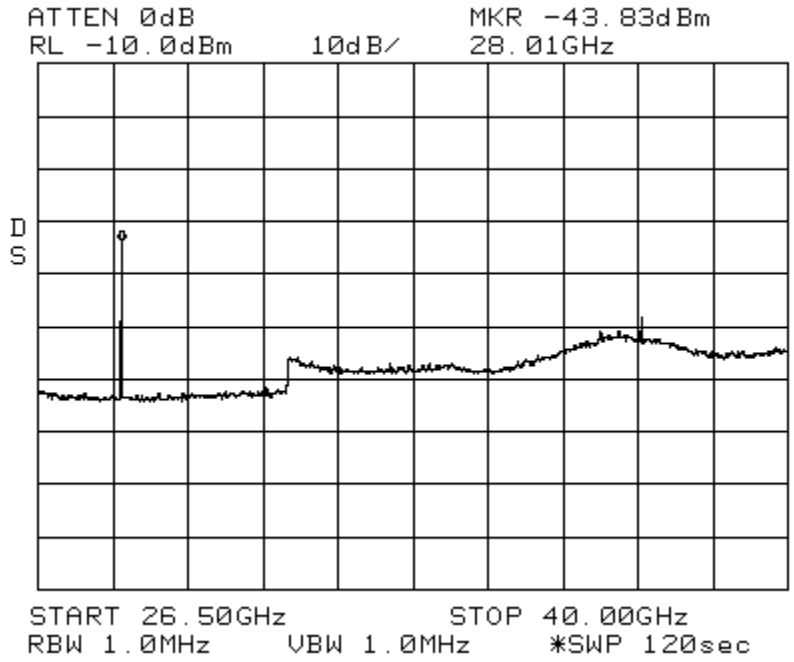


Figure F-41. Windshear Plus Pulse Pattern 5, (26.5 to 40.0 GHz, Peak 1)

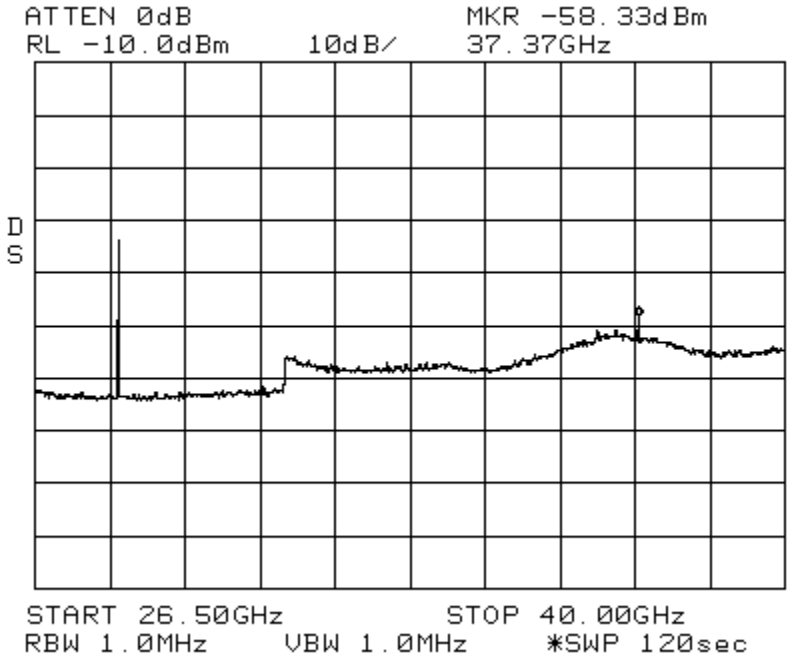


Figure F-42. Windshear Plus Pulse Pattern 5, (26.5 to 40.0 GHz, Peak 2)

## F.42 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+log10(pY) dB.

Since the WRT-701X 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 F-22.

The WRT-701X Test Article used for Field Strength of Spurious Radiation testing had a peak power of 183 Watts.

Table F-22. 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) | +27.625 dBm |
| From 9538.877 MHz to 9838.876 MHz | -35 dBc | +17.625 dBm |
| Over 9838.877 MHz | -40 dBc | +12.625 dBm |

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

FCC Limit = 40 dBc

Limit (Watts) = Ptx(average) $\times$ $10^{\frac{-FCC\ Limit(dBc)}{10}}$

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

E2 = (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-701X Test Article used for Field Strength of Spurious Radiation testing had a peak power of 183 Watts. The current system has a maximum duty cycle of 0.7% 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 = 52.62 dBm, Assumed Duty Cycle = 0.05

Ptx(average) = 9.15 Watts average

FCC Limit (dBc) = 40

Limit (Watts) = $9.15\times10^{-40/10} = 9.15\times10^{-4}$ W average

E2 = $30\times1.64\times9.15\times10^{-4} = 4.502\times10^{-2}$

E (V/m) = $\sqrt{4.502\times10^{-2}}$ = 212174.457 µV/m average

E (dBµV/m) = 20 $\times$ log (212174.457 µV/m) = 106.534 dBµV/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) = 106.534 dBμV/m

Limit (average) = $10^{106.534/20}$ = 212174.457 μV/m

Limit (peak) = $\frac{212174.457^2}{0.05}$ = $9.0036 \times 10^{11}$ μV/m

***Limit (peak)*** = $10 \times \log(9.0036 \times 10^{11}$ μV/m) ***= 119.544 dBmV/m***

**Method 2:**

Limit (average) = 106.534 dBμV/m

Peak Power (mW) = $10^{(52.62/10)}$ = 182,810.022 mW

Average Power (mW) = 1182,810.022 mW $\times$ .05 = 9140.501 mW

Average Power (dBm) = 10 log (9140.501 mW) = 39.610 dBm

Difference (dB) = 52.620 dBm(peak) – 39.610 dBm(average) = 13.01 dB

***Limit (peak)*** = 106.534 dBμV/m + 13.01 dB ***= 119.544 dBmV/m***

Therefore, the absolute limit of ***119.544 dBmV/m*** was used for these tests.

## F.43 Test 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 shall be 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-701X was operated in Weather + Turbulence + Windshear mode with an active two problem case configuration. The active two problem case configuration enabled the three operating conditions specified in Table F-23 during alternating antenna sweeps.

Table F-23. WRT-701X Radiated Emissions Test Operating Conditions

| Test Condition | | Channel | Tx Freq (MHz) | Remarks |
|---|---|---|---|---|
| Mode | Range | | | |
| Weather Plus Turbulance | Range 35-60 nmi | 47 | 9336.236983 | 0.71% Duty Cycle (Highest Duty Cycle) |
| Weather Plus Turbulance | Range 165-320 nmi | 47 | 9336.236983 | 0.47% Duty Cycle |
| Windshear | N/A | 55 | 9337.736983 | 0.55% Duty Cycle |

The equipment used for the Field Strength of Spurious Radiation test is listed in Table F-24.

Table F-24. Test Equipment Used for Field Strength of Spurious Radiation Test

| Equipment | Manufacturer/Model Number | Specific Identification | Calibration Due Date |
|---|---|---|---|
| Receiver/Transmitter | Rockwell Collins WRT-701X (622-5132-952) | SN 1JLRT | N/A |
| Indicator/Control (Qty 2) | Rockwell Collins WXI-711 (622-5128-301) (622-6514-203) | SN 2206, SN 421 | N/A N/A |
| Control Pannel | Rockwell Collins WCP-701 (622-5129-801) | SN 5184 | N/A |
| Antenna Pedestal | Rockwell Collins WMA (622-5735-803) | SN 753T | N/A |
| ARINC Bus Transmitter Receiver (Qty 2) | JCAir 429E | 460-0206-166 (SN 181) 460-0206-290 (SN 249) | N/A |
| 28 VDC Power Supply | Sorensen QRD40-2 | 460-0055-340 SN 00003454 | N/A |
| Test Harness | Rockwell Collins Test Harness | N/A | N/A |
| LapTop P.C. | Toshiba 430CDT | SN 01768919 | N/A |
| Power Supply VariAC | Collins AC Control 779-9459-006 | 460-0062-208 | 10-31-2005 |
| RF Dummy Load | AirTron 252126 | SN 7019 | N/A |
| Active Monopole Antenna (150KHz - 25MHz) | Electro-Metrics RVA30 | 460-0118-546 | 04-30-2005 |
| Antenna (1GHz - 18GHz) | Emco 3115 | 460-0078-854 | 04-30-2007 |
| Biconical Antenna (25 MHz – 200 MHz) | Emco 3104C | 460-0133-792 | 02-28-2006 |
| Antenna (200MHz - 1GHz) | Emco 3106 | 460-0133-794 | N/A |
| Gain Horn (18 GHz – 26.5 GHz) | Emco 3160-9 | N/A | N/A |
| Gain Horn (26 GHz – 40 GHz) | MI Technologies 12A-26 | 460-1213-955 | 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 ESIB40 | 460-0212-537 SN 8378081001 | 11-30-2005 |
| Antenna | Emco 3101 | 460-0113-396 | 05-31-2005 |
| LISN | FCC 5-10-01 Def Stn 59-41C | 460-0211-578 | 11-30-2007 |

## F.44 Equipment Setup:

The test setup for the Field Strength of Spurious Radiation test is shown in Figure F-43.

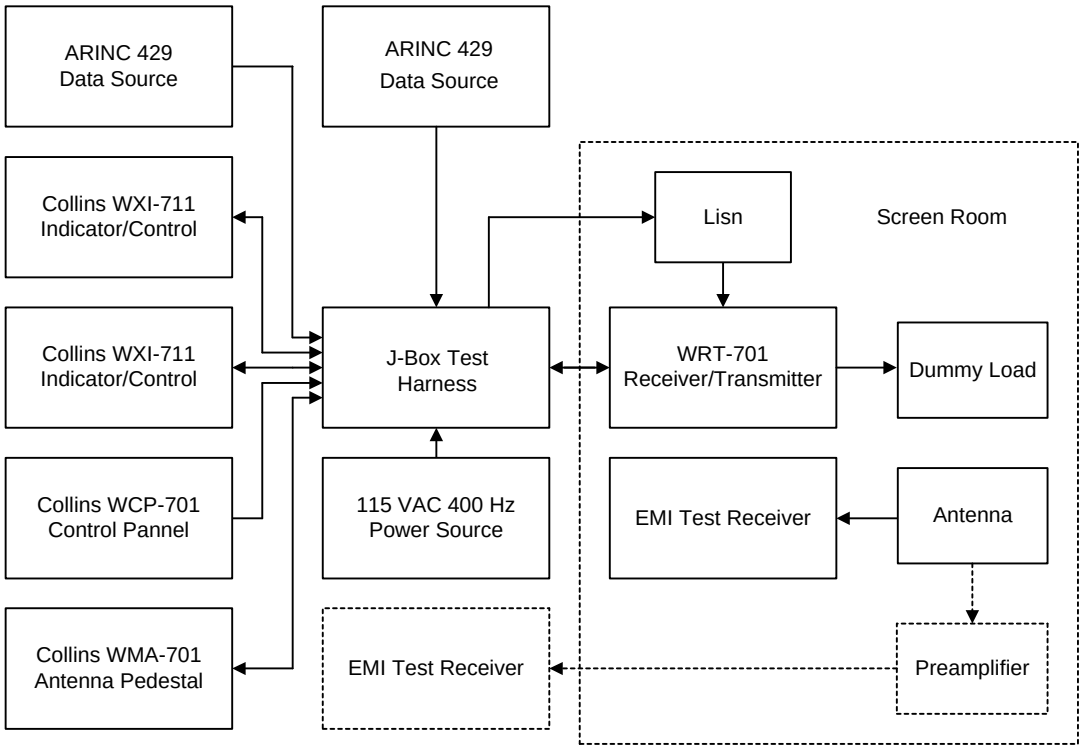


Figure F-43. Field Strength of Spurious Radiation Test Setup

## F. 45 Results:

Results are provided in table and spectral plot forms and are provided for ***vertical*** and ***horizontal polarizations*** from ***150 KHz to 40 GHz.***

## F.46 Emissions Measurements

Spectrum measurements for the Weather plus Turbulence plus Windshear mode of operation are presented in Table F-25.

Spectrum plots for the Weather plus Turbulence plus Windshear mode of operation are provided as Figure F-44 through Figure F-49.

**Table F-25. Field Strength of Spurious Radiation**

| Field Strength of Spurious Radiation | | | | | | |
|---|---|---|---|---|---|---|
| Emission Band | Mode of Operation | | Polarization | Peak Emission | | Reference |
| | Mode | Range | | Frequency (MHz) | Level (dBµV/m) | |
| 150 KHz to 200 MHz | Weather Plus Turbulance Plus Windshear (0.55% Duty Cycle) | 35-60 nmi (0.71% Duty Cycle) 165-320 nmi (0.47% Duty Cycle) | Vertical | N/A | All emissions < 40 | Figure F-44 |
| 25 MHz to 1 GHz | Weather Plus Turbulance Plus Windshear (0.55% Duty Cycle) | 35-60 nmi (0.71% Duty Cycle) 165-320 nmi (0.47% Duty Cycle) | Horizontal | N/A | All emissions < 40 | Figure F-45 |
| 1 GHz to 18 GHz | Weather Plus Turbulance Plus Windshear (0.55% Duty Cycle) | 35-60 nmi (0.71% Duty Cycle) 165-320 nmi (0.47% Duty Cycle) | Vertical | N/A | All emissions < 80 | Figure F-46 |
| | | | Horizontal | N/A | All emissions < 80 | Figure F-47 |
| 18 GHz to 40 GHz | Weather Plus Turbulance Plus Windshear (0.55% Duty Cycle) | 35-60 nmi (0.71% Duty Cycle) 165-320 nmi (0.47% Duty Cycle) | Vertical | 28,045.50 | 113.70 | Figure F-48 |
| | | | Horizontal | N/A | All emissions < 100 | Figure F-49 |

## F.47 Spectrum Plots

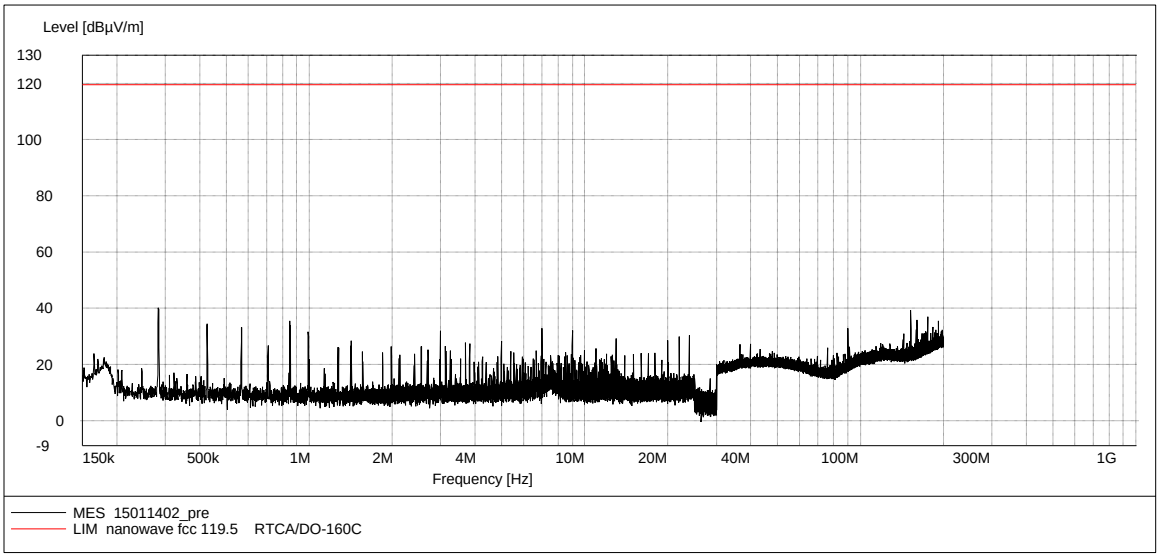


Figure F-44. Radiated Spurious Emissions, 150 KHz to 200 MHz, (Vertical Polarization)

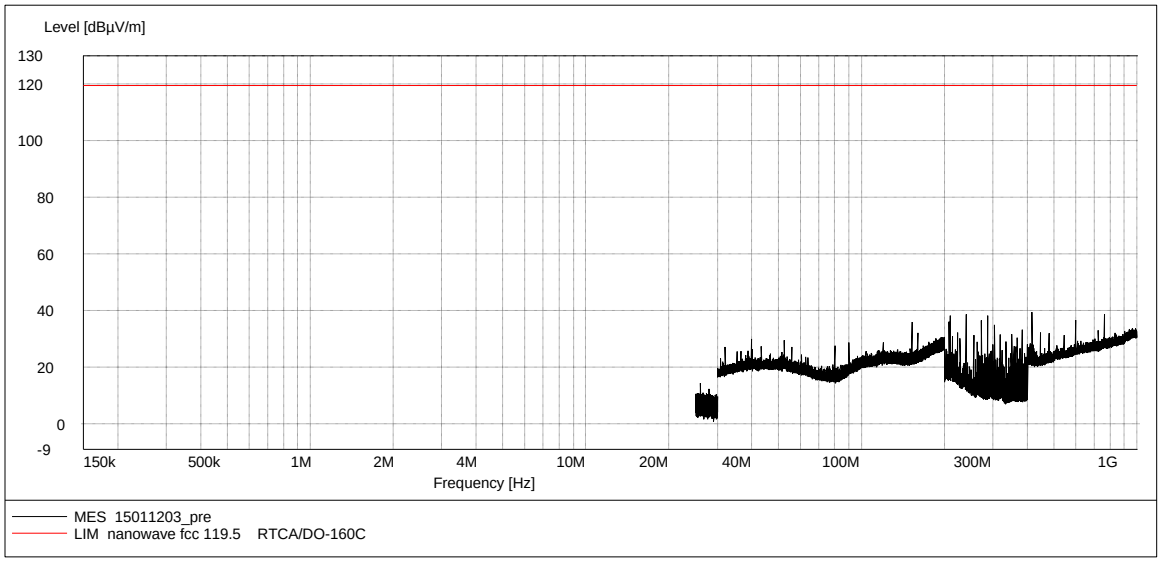


Figure F-45. Radiated Spurious Emissions, 25 MHz to 1 GHz,
(Horizontal Polarization)

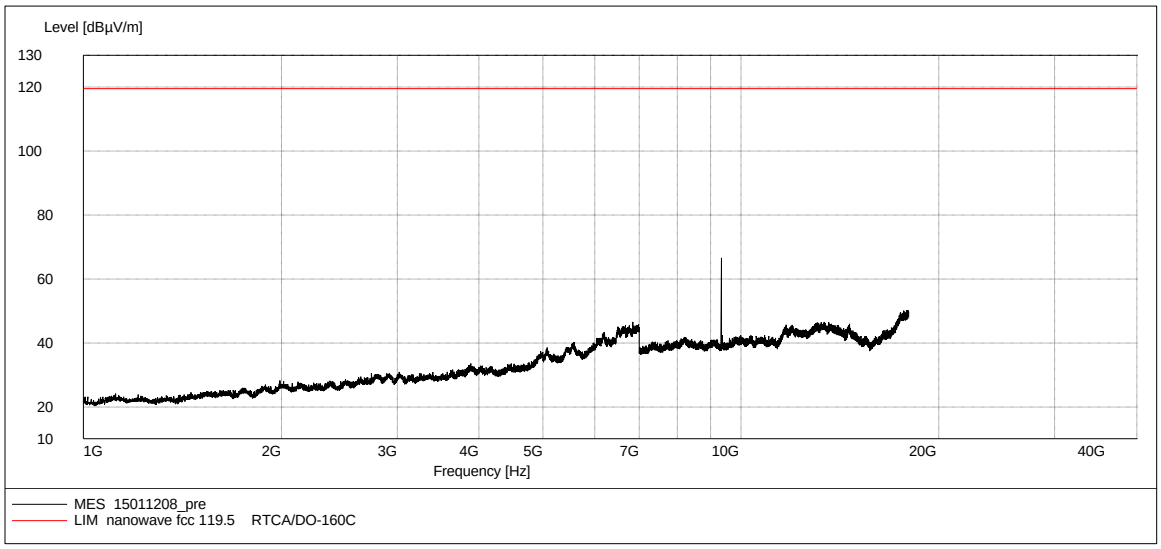


Figure F-46. Radiated Spurious Emissions, 1 GHz to 18 GHz,
(Vertical Polarization)

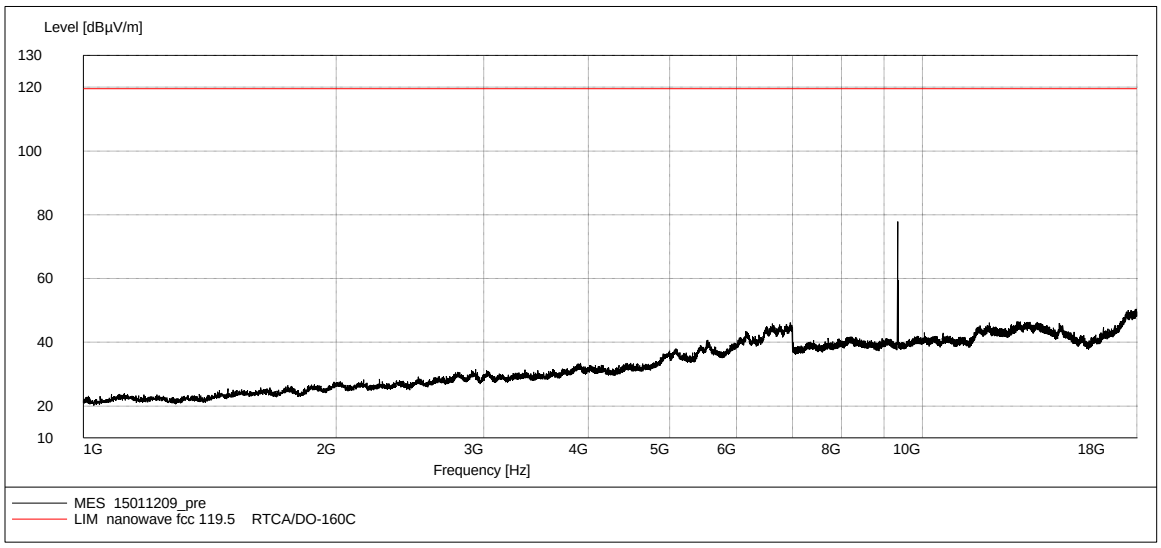


Figure F-47. Radiated Spurious Emissions, 1 GHz to 18 GHz,
(Horizontal Polarization)

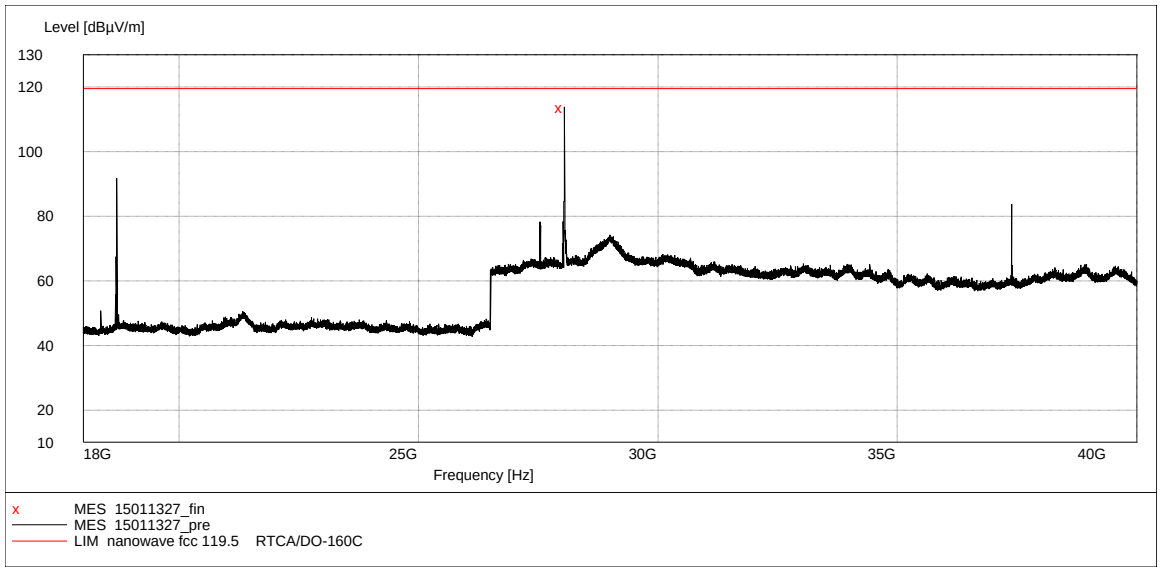


Figure F-48. Radiated Spurious Emissions, 18 GHz to 40 GHz,
(Vertical Polarization)

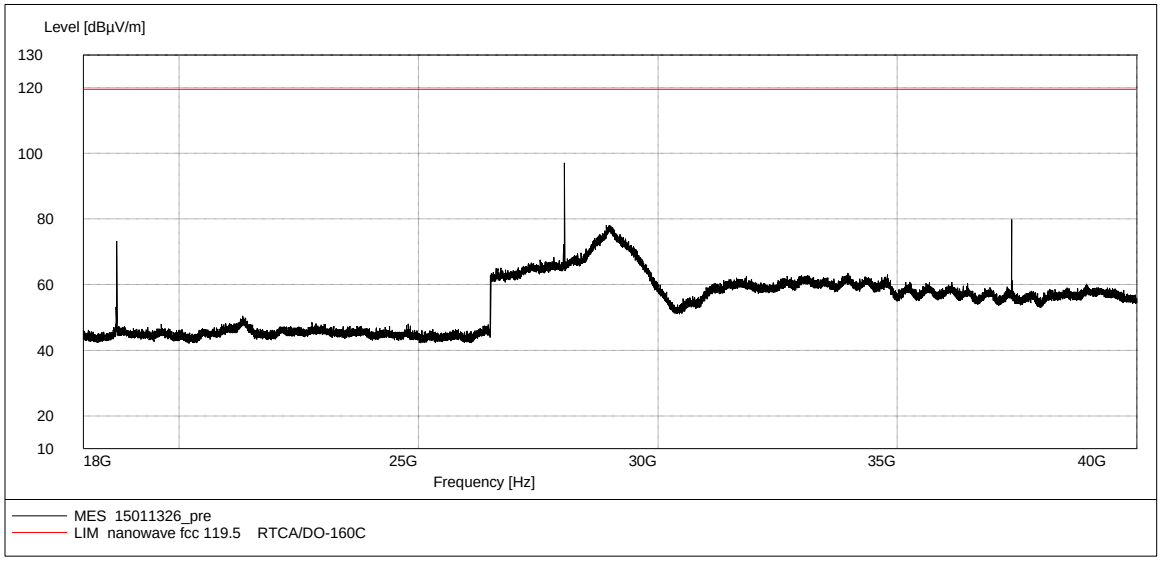


Figure F-49. Radiated Spurious Emissions, 18 GHz to 40 GHz, (Horizontal Polarization)