Exhibit L – WRT-2100 Product Operational Description

Exhibit L – WRT-2100 Product Operational Description

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L-1. System Overview

The WRT-2100 MultiScan Weather Radar Receiver/Transmitter with the RF module upgrade is an updated version of the Rockwell Collins WRT-2100 Air Transport Weather Radar that has been in commercial service for several years. The RF Upgrade to the WRT-2100 is a complete redesign of the RF generation and amplification within the WRT.

The WRT-2100 is capable of Weather detection out to 320 nautical miles, Ground Mapping, Turbulence detection and Forward-Looking Windshear detection. In addition the WRT-2100 incorporates a new automatic operating mode called MultiScan. The purpose of MultiScan is to provide automatic superior weather hazard detection with an essentially clutter-free display to enable rapid pilot interpretation of weather hazards without the workload required for manual adjustment of the tilt control. Therefore, it is intended that the flight crew may turn on the MultiScan radar in AUTO mode prior to takeoff and fly the entire flight without use of the controls or adjustment of the radar. At the same time, however, if conditions warrant, all controls normally associated with radar operation - MODE, GAIN, and TILT, can be manually adjusted independently by the flight crew to enable a detailed assessment of the weather hazard or terrain situation.

MultiScan operates by automatically scanning the antenna over multiple tilt settings while saving the individual scan data in memory. This internal memory data is continually refreshed and corrected for aircraft motion. The display to the flight crew is a composite of multiple scans which have been processed to remove ground clutter and provide an optimal display for weather detection.

The Windshear Detection feature automatically activates during the takeoff and landing phases of flight to scan the region ahead of the aircraft for microburst windshear hazards. If a windshear event is detected, the radar provides both Aural and Visual warning alerts to the flight crew. This feature can provide up to 60 seconds of advanced warning of a windshear encounter enabling the flight crew to either reject a takeoff or execute a go-around on approach to avoid the windshear hazard.

L-2. System Components

The WXR-2100 system consists of the following components:

Equipment	Part Number	Description
WRT-2100	822-1710-0x2 (Boeing) 822-1710-2x3 (Airbus)	Receiver/Transmitter
WMA-701X WMA-702X	622-5135-8xx (Single) 622-5136-8xx (Dual)	Antenna Pedestal
WFA-701 X	622-6137-601	Antenna Flatplate
WCP-701 WCP-702	622-5129-8xx (Single) 622-5130-8xx (Dual)	Control Panel

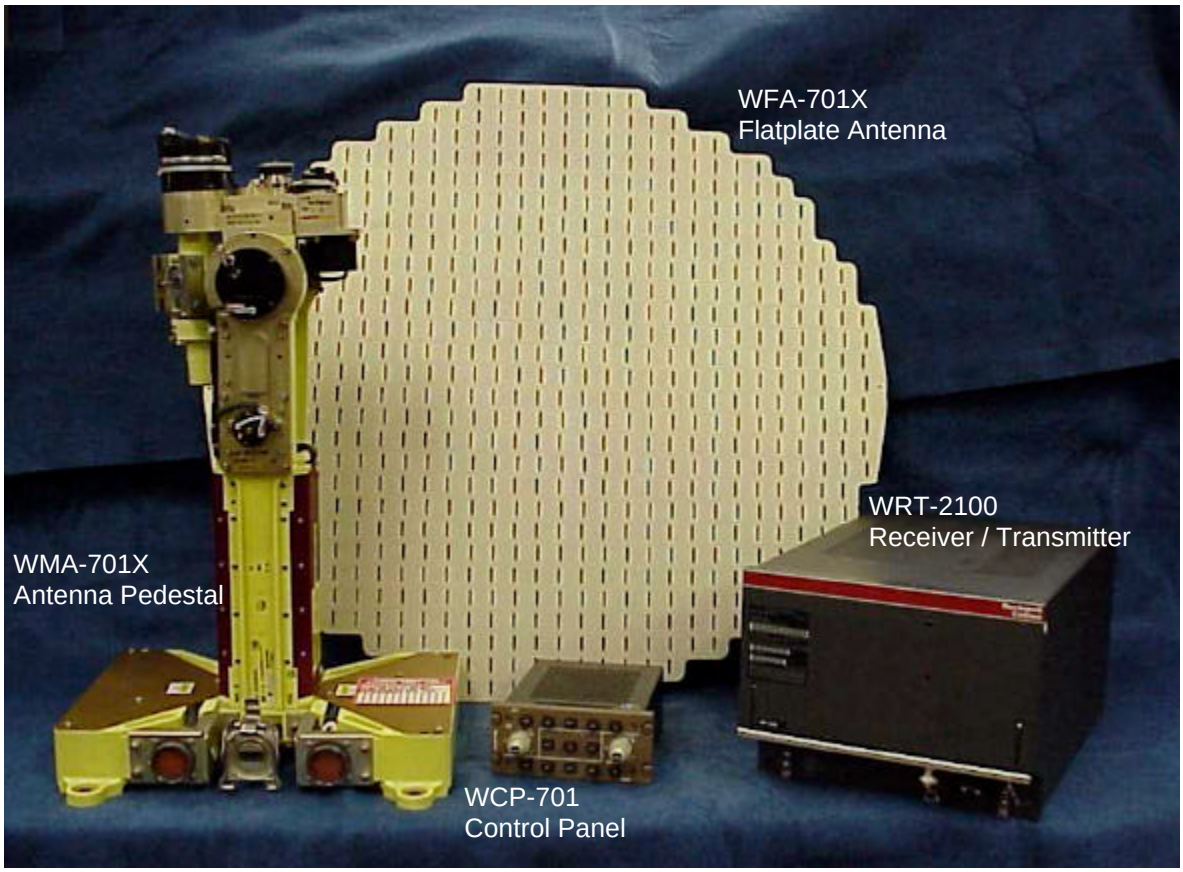

Figure L-1. WRT-2100 System Components

L-3. Aircraft Installation

The following figure illustrates a typical aircraft installation. The WRT-2100 Receiver-Transmitter is the heart of the radar system. The Receiver/Transmitter produces transmitted output pulses which are radiated through the antenna, it receives and processes the resulting return signals from weather and ground targets and provides a serial digital bus output used to generate a cockpit display of weather and ground targets. The WRT-2100 provides antenna elevation and scan commands to the antenna pedestal, receives and processes the control signals from the cockpit control panels and provides all interfaces to other aircraft systems. The WRT-2100 utilizes multiple sources of aircraft data including Air Data, Aircraft Attitude, Radio Altitude, and numerous discrete inputs.

The radar display for the flight crew is generally the Electronic Flight Instruments (EFIS) NAV display. A stand-alone radar indicator is utilized in some older installations. Range selection of the radar display is generally controlled from the EFIS NAV display control panel or radar indicator if installed.

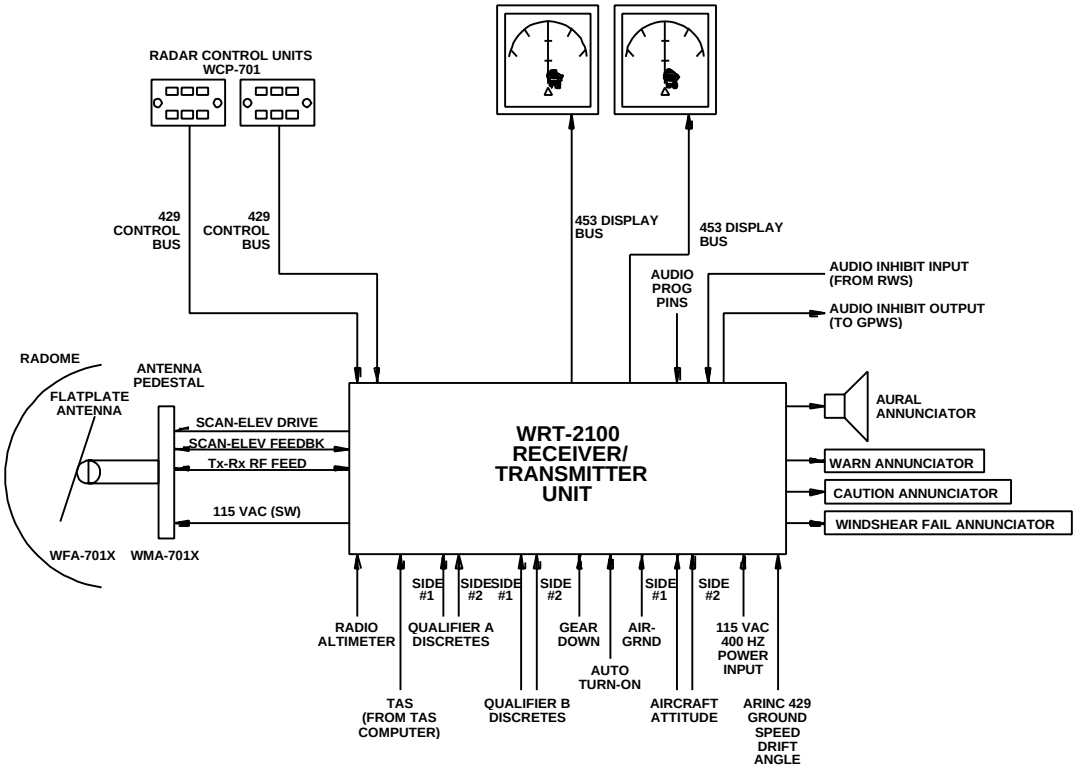

Figure L-2. Typical WXR-2100 Aircraft Installation

L-4. Operation of Controls

The WRT-2100 is a full function weather radar system intended for air transport category aircraft. It is capable of fully automatic operation utilizing the MultiScan AUTO mode or operating in manual mode with full pilot control of Mode, Range and Tilt.

The figure below illustrates a typical dual control panel.

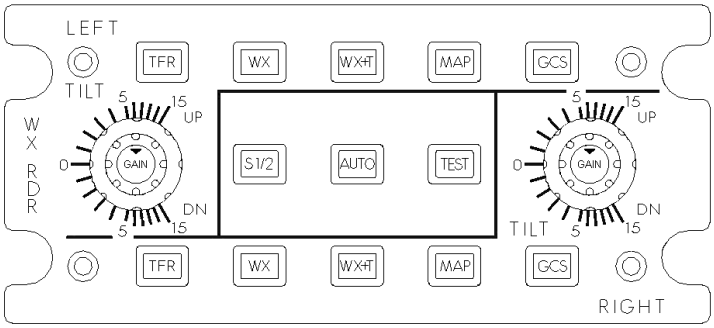

Figure L-3. WCP-702 Dual Control Panel

The following paragraphs describe the various operating modes.

The following describes the operation of each control during AUTOMATIC MultiScan operation.

AUTO

The MultiScan AUTO button switches between MANUAL mode and MultiScan AUTOMATIC mode. The AUTO button is a latching alternate action mechanism. When the AUTO button is depressed, both sides are in MultiScan AUTOMATIC mode. When the AUTO button is in the out position, both sides are in manual and all controls function as described in the Manual Operation section.

S1/2 (Dual Control Only)

This switch selects between System 1 and System 2 in a dual installation. The button is an alternate action latching design. The out position selects System 1, the depressed position selects System 2. (Note: Primary power is applied to the system through the EFIS “WXR” button on the EFIS control panel)

TEST

The TEST button is used to activate a Self TEST of the radar system. When TEST is selected, both sides are in test. During non-windshear operation, a full self test will be performed including a test pattern on the display, test of the aural and visual windshear alerts as well as the windshear fail indication. At the conclusion of the test sequence, the tilt value displayed will indicate any faults of external data sources required for windshear operation. A list of tilt codes representing external faults is provided in the equipment installation manual. Radar LRU faults are displayed in the normal locations on the display.

If TEST is selected while the windshear qualifiers are active, the system will continue operating in windshear mode. The system will perform a “silent” self test with a test pattern being displayed but no aural or visual windshear annunciations. If the qualifiers become active during the test sequence, the system will enter windshear mode canceling the full test sequence and reverting to the “silent” test described above.

MODE Selections

Four mode selections are available for the both Captain’s and First Officers positions. These are TFR, WX, WX+T and MAP. These are latching buttons such that pressing one releases any other that had been selected.

TFR (Transfer)

The TFR button allows the Captain or First Officer to select all of the control settings from the opposite side. Therefore, if the First Officer presses the TFR button, the First Officer’s radar control settings and display will be slaved to the Captain’s settings. Conversely, if the Captain presses the TFR button, all control settings and display will be slaved to the First Officer’s side. This function works for both AUTO and Manual modes of operation. During Manual operation, the TFR includes slaving of the TILT value selected on the opposite side.

WX

Weather Mode enables display of weather targets without turbulence information. If GCS is enabled, the Weather display will be essentially free of ground clutter enabling rapid and accurate interpretation of weather hazards. Path Attenuation Compensation (PAC) and PAC Alert features are active to provide compensation for attenuation due to intervening rainfall and to alert the crew when the compensation limits have been exceeded.

WX_T

Weather Plus Turbulence Mode enables display of weather targets with turbulence information overlaid on the display. Turbulence will be displayed out to 40 nautical miles for all selected ranges. If GCS is enabled, the Weather plus Turbulence display will be essentially free of ground clutter enabling rapid and accurate interpretation of weather hazards. Path Attenuation Compensation (PAC) and PAC Alert features are active to provide compensation for attenuation due to intervening rainfall and to alert the crew when the compensation limits have been exceeded.

MAP

Map mode enables display of all radar echoes including terrain and weather information. The STC range correction is adjusted for terrain characteristics instead of weather. This mode enables identification of terrain features such as mountains, coastlines, bodies of water etc. No turbulence information is displayed. PAC and PAC Alert are not active in MAP mode.

TILT

The TILT control is active only during MANUAL operation and allows the flight crew to adjust the antenna tilt for the best display. Each side, the Captain and First Officer may independently adjust the tilt controls. During MultiScan AUTOMATIC operation, the TILT controls are not active since the antenna tilt settings are managed automatically by the MultiScan function.

Note: During MultiScan AUTOMATIC operation, the display bus contains the tilt settings representing the display information being transmitted to the flight crew. Therefore, it is highly recommended to display the TILT values during MultiScan AUTOMATIC operation. The 453 Display Bus Bit-15 is enabled during MultiScan to indicate automatic control of the antenna.

GAIN

The GAIN control allows manual adjustment of the radar sensitivity for more detailed assessment of weather conditions. The Calibrated (CAL) position, sets the radar sensitivity to the standard calibrated reflectivity levels and is the recommended position for normal operation. If desired, the radar GAIN may be adjusted to increase sensitivity by rotating clockwise from CAL or the sensitivity may be decreased by rotating counterclockwise from CAL. The GAIN control settings and the corresponding sensitivity changes are contained in the following table.

L-5. Equipment Specifications

Characteristic	Specification
FAA TSO	-C63c dated September 30, 2002
Size	8MCU
Weight	Less than 30 lb.
Power Requirement	115 V ac, 400 Hz Less than 5 amps
Transmitted Output	
Power	150 Watts (+51.8dBm) nominal
Frequency	X-band, 9327.424 MHz - 9348.568 MHz ± 2 MHz
Channels	64 Channels, 187.5KHz Spacing
Pulse Length	2.0, 6.0, 25.0 microseconds
Pulse Repetition Rate	900 pulses per second in WX, WX+T, Map modes 3000 pulses per second in Windshear mode.
Duty Factor	0.06
Receiver	
IF Bandwidths	10 MHz, 1MHz,
First IF Center Frequency	166.765 MHz
Second IF Center Frequency	13.9 MHz
MDS:	–124 dBm nominal
STC (Dynamic)	optimized for range and pulse width
Environmental	DO-160D Category
Temperature/Altitude	Cat A2 -15ºC to +70ºC Operating, 15,000 ft.
Temperature Variation	Cat B - Vary from -15ºC to +70ºC @5ºC rate
Humidity	Cat A – 48 Hours Non Operating
Shock	Cat B - Operational, Crash safety
Vibration	Cat S – Random Curve C, 1hr per axis, 4.12 grms
Explosion	N/A
Waterproofness	N/A
Fluid Susceptability	N/A
Sand and Dust	N/A
Fungus Resistance	N/A
Salt Spray	N/A
Magnetic Effect	Cat A– 0.3 to 1.0 meters for 1 degree deflection
Power Input	Cat E
Voltage Spike	Cat A – 600 Volt Peak
Audio Frequency Susceptibility	Cat E –AC input power
Induced Susceptibility	Cat C – Interference free operation
Radio Frequency Susceptibility	Cat R
Electromagnetic Interference	Cat M – Power Lines/Intct Cable-2MHz-6GHz, .
Lightning Induced Transient Susceptibility	Cat E3
Lightning Direct Effects	Boeing D6-16050-4C Multiple Burst, Single Stroke
Icing	N/A

Characteristic	Specification
Electrostatic Discharge	Cat A
Cooling	Forced Air per Arinc 600 or Fan in R/T Mount
Antenna Flatplate Beamwidth Gain	Phased Array, 28 Inches Wide X 26.5 Inches, High Half-height waveguide broadside radiators, Milled / Brazed Construction 3.85 º 34.5 dB
Data Bus Format Display Data output Control data input External data inputs	 ARINC 453 ARINC 429 ARINC 429
Stabilization Digital Analog	 High speed ARINC 429 3-wire synchro
Selectable Modes	TEST (test) MAP (ground mapping) WX (normal weather) WX+T (weather with turbulence detection) TURB (turbulence only) MultiScan AUTO
Special Features	GCS (ground clutter suppression) TFR (Transfer control to opposite side) PAC (Path Attenuation Compensation) MultiScan - Overflight Protection
Gain Control	Variable above and below CAL CAL – Calibrated, Above CAL +4, +8, +16 dB Below CAL -2,-4, -6, -8, -12, -14 dB
Tilt Control	-15 to +15 degrees.
Selectable Ranges (nmi)	5 to 320 nmi in 5 nmi increments (Aircraft Configuration Dependent)

L-6. Receiver-Transmitter

The WRT-2100 Receiver/Transmitter design includes a RF module, a Source module, a Sampler and a Digital Signal Processor (DSP) to implement MultiScan capability. The frequency source module is based on a Direct Digital Synthesis (DDS) design which enables the selection of 64 channels. The Sampler and DSP are to provide additional computational throughput needed for the advanced MultiScan algorithms.

Figure L-4 is a simplified block diagram showing the relationship of the various modules within the R/T unit. New modules for the WRT-2100 RF upgrade are outlined in bold red. The remainder of the modules are identical to the standard WRT-2100 which has been in airline service for several years. The RF Section is outlined in blue.

Figures L-4, L-5, and L-6 will be used for the following discussion of module functions.

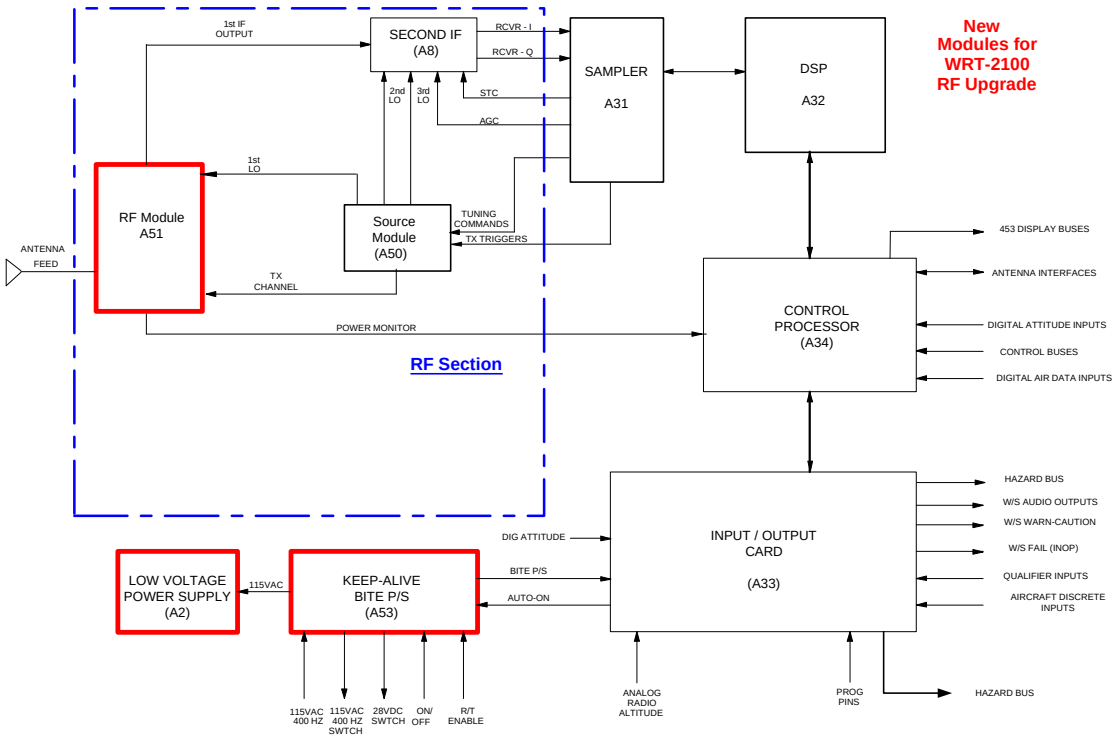

Figure L-4. WRT-2100 Receiver-Transmitter Simplified Block Diagram

RF Block Diagram WRT-2100 RF Upgrade R/T

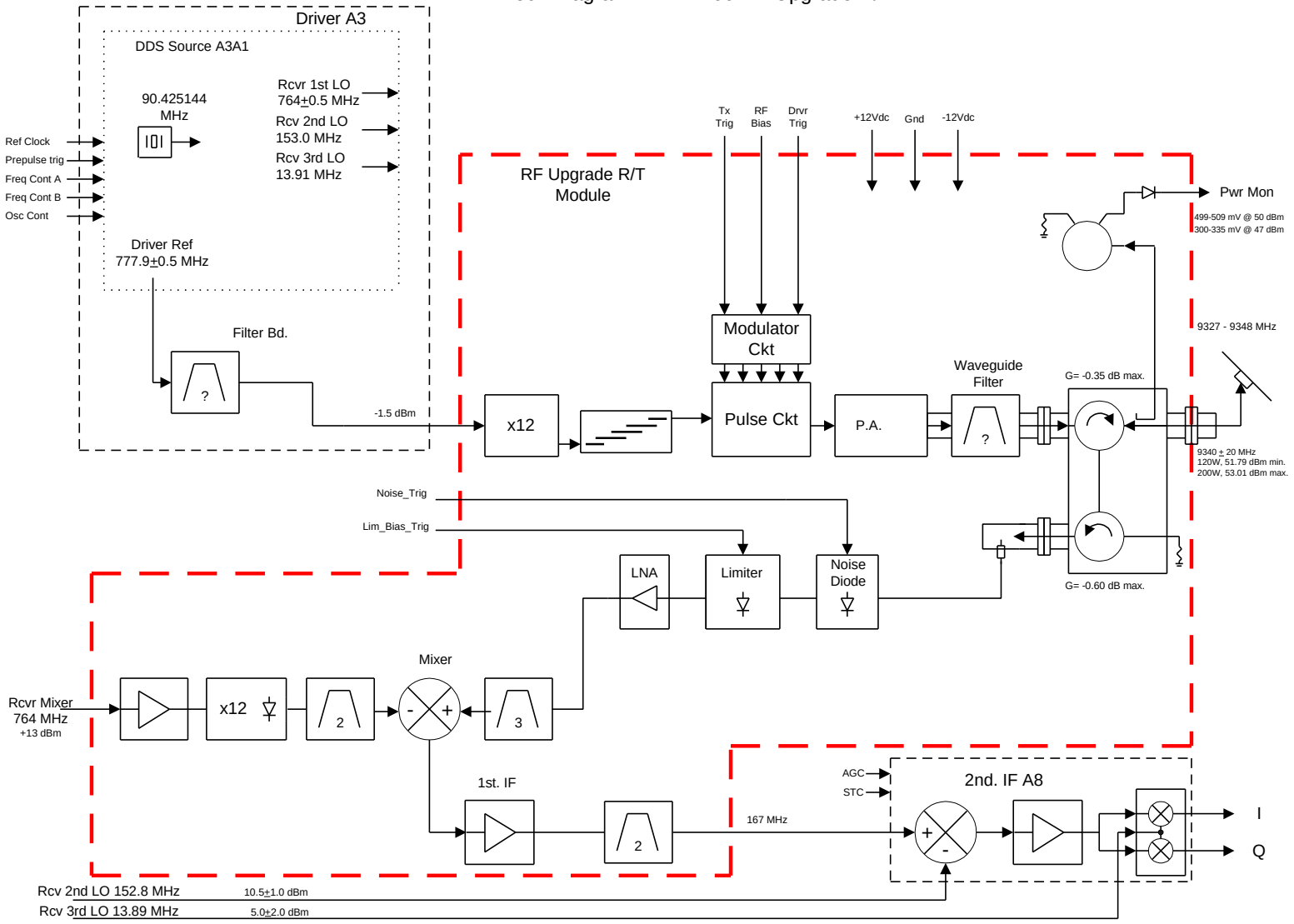

Figure L-5. WRT-2100 RF Section Block Diagram

L-7. Source (A50)

The Source Module (A50) is the primary frequency generating assembly within the Receiver/Transmitter unit. It provides the following outputs.

Transmit Channel output to the Driver	777.28 MHz - 779.04 MHz,
RCVR 1st LO Drive	763.37 MHz - 765.13 MHz
RCVR 2nd LO Drive	153.02 MHz
RCVR 3rd LO Drive	13.9 MHz

The Transmit Channel output and Receiver 1st LO output are later multiplied by 12 for the on-channel transmit / receive functions.

The Source module also contains a PIC 16F873 micro-controller to control the DDS frequency selections.

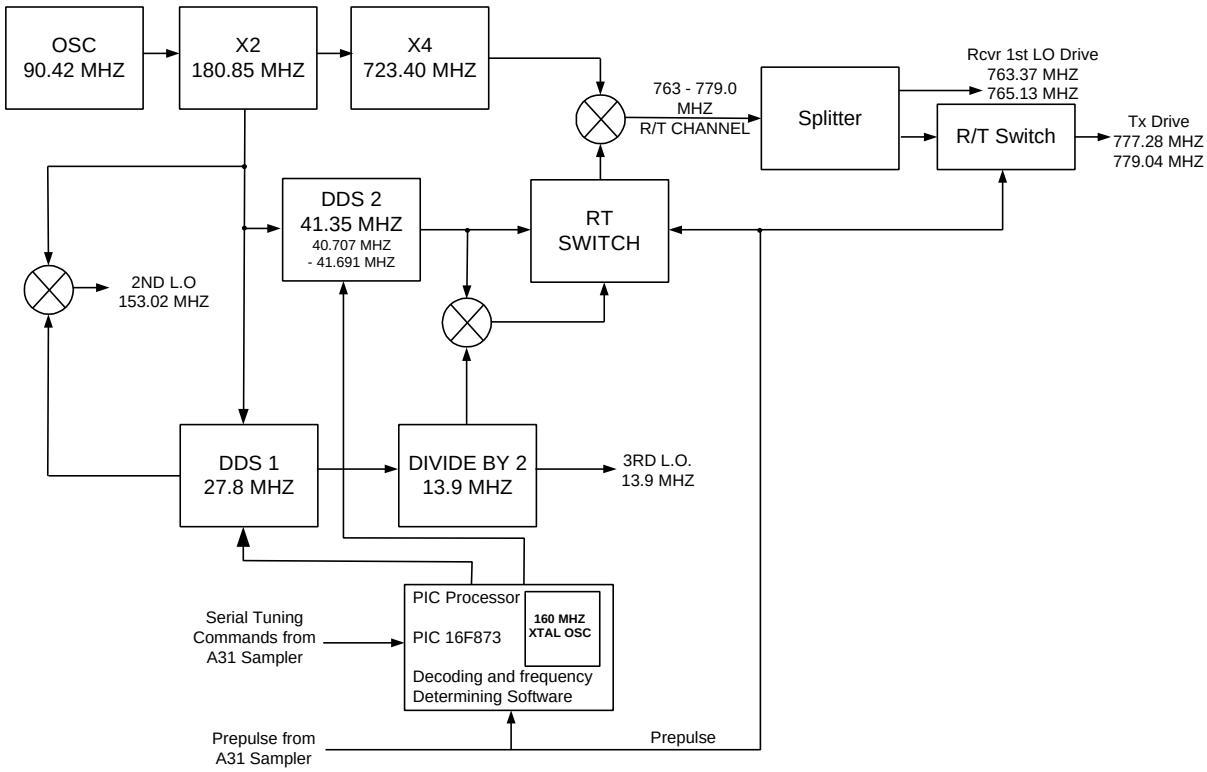

Figure L-6. Source Module (A50)

The Source Module contains three elements that determine the frequency of operation. A 90.42. MHz crystal oscillator, a Direct Digital Synthesizer (DDS 1) tuned to a fixed 27.8 MHz and a second DDS 2 with variable output frequencies between 40.707 MHz and 41.691 MHz depending on the operating channel. The second DDS will be referred to as the '41 MHz DDS' for ease of discussion recognizing that it's frequency changes with channel.

The 90.42 MHz oscillator is multiplied by two to get 180.85 MHz, which is used as a clock for the DDS ICs. One of the DDS IC outputs is 27.8 MHz and is mixed with the 180.85 MHz to produce 153.02 MHz for the 2nd LO. The 27.8 MHz signal is divided by two to produce the 13.9 MHz 3rd LO. The 180.85 MHz is multiplied by four to produce 723.40 MHz. When the R/T is in the receive mode the 723.40 MHz is mixed with the output of the second DDS output at 41MHz to produce the 764Mhz, the 1st LO frequency. The 13.9 MHz is mixed with the 41MHz to produce 55MHz, which when the R/T is in transmit is mixed with the 723.40 MHz to produce the 777MHz transmit channel frequency. (Note: The 777 MHz transmit channel frequency is subsequently multiplied by twelve by the Multiplier module to achieve the 9.33GHz transmit output frequency.) The output frequency range is 763.37 MHz - 765.13 MHz in Receive mode and 777.28 MHz - 779.04 MHz in Transmit mode.

The transmitter frequency is controlled by a tuning word sent serially from the A31 Sampler to the PIC processor located within the Source module. The PIC processor is a single chip microcontroller which receives tuning commands from the A31 Sampler, then sends the appropriate hexadecimal tuning commands to the DDS chips via the serial connection between the PIC and the DDSs. The PIC processor contains an on-chip 16MHz oscillator used for a clock. The 27MHz DDS output, the 2nd LO, and 3rd LO do not change frequency with channel number and are constant.

The following table contains the DDS Frequencies and channel assignments. It should be noted that the Tx Drive output of the Source module is multiplied by 12 later in the transmit chain to produce the 9327.42 MHz - 9348.56 MHz transmitter output frequency.

Table L-1. DDS Source Frequencies

DDS Source Frequencies						
Crystal Oscillator	90425144					
Crystal times 2	180850288					
Crystal times 8	723401152		**CHAN 26, 47, 55 & 63**	**CHANNEL 62**		
27MHz DDS	27824659.6923078		27823121.2307752	27821582.7692310		
3rd LO	13912329.8461539		13911560.62	13910791.38462		
2nd LO	153025628.3076920		153027166.77	153028705.23077		
1st IF	166947958.1538470		166938727.38	166929496.61539		
2nd IF	13922329.8461545		13911560.62	13900791.38462		
DDS CH	**42MHz Freq.**	**55MHZ Freq.**	**REC Freq. (¸12)**	**1st LO**	**TX Freq. (¸12)**	**TX Freq**
	(Hz)	(Hz)	(Hz)	(Hz)	(Hz)	(Hz)
0	39971892	53884222	763373044	9160476528	777285374	9327424486
1	39987517	53899847	763388669	9160664028	777300999	9327611986
2	40003142	53915472	763404294	9160851528	777316624	9327799486
3	40018767	53931097	763419919	9161039028	777332249	9327986986
4	40034392	53946722	763435544	9161226528	777347874	9328174486
5	40050017	53962347	763451169	9161414028	777363499	9328361986
6	40065642	53977972	763466794	9161601528	777379124	9328549486
7	40081267	53993597	763482419	9161789028	777394749	9328736986
8	40096892	54009222	763498044	9161976528	777410374	9328924486
9	40112517	54024847	763513669	9162164028	777425999	9329111986
10	40128142	54040472	763529294	9162351528	777441624	9329299486
11	40143767	54056097	763544919	9162539028	777457249	9329486986
12	40159392	54071722	763560544	9162726528	777472874	9329674486
13	40175017	54087347	763576169	9162914028	777488499	9329861986
14	40190642	54102972	763591794	9163101528	777504124	9330049486
15	40206267	54118597	763607419	9163289028	777519749	9330236986
16	40221892	54134222	763623044	9163476528	777535374	9330424486
17	40237517	54149847	763638669	9163664028	777550999	9330611986
18	40253142	54165472	763654294	9163851528	777566624	9330799486
19	40268767	54181097	763669919	9164039028	777582249	9330986986
20	40284392	54196722	763685544	9164226528	777597874	9331174486
21	40300017	54212347	763701169	9164414028	777613499	9331361986
22	40315642	54227972	763716794	9164601528	777629124	9331549486
23	40331267	54243597	763732419	9164789028	777644749	9331736986
24	40346892	54259222	763748044	9164976528	777660374	9331924486
25	40362517	54274847	763763669	9165164028	777675999	9332111986

26	40378142	54289703	763779294	9165351528	777690855	9332290255
	(Hz)	**(Hz)**	**(Hz)**	**(Hz)**	**(Hz)**	**(Hz)**
27	40393767	54306097	763794919	9165539028	777707249	9332486986
28	40409392	54321722	763810544	9165726528	777722874	9332674486
29	40425017	54337347	763826169	9165914028	777738499	9332861986
30	40440642	54352972	763841794	9166101528	777754124	9333049486
31	40456267	54368597	763857419	9166289028	777769749	9333236986
32	40471892	54384222	763873044	9166476528	777785374	9333424486
33	40487517	54399847	763888669	9166664028	777800999	9333611986
34	40503142	54415472	763904294	9166851528	777816624	9333799486
35	40518767	54431097	763919919	9167039028	777832249	9333986986
36	40534392	54446722	763935544	9167226528	777847874	9334174486
37	40550017	54462347	763951169	9167414028	777863499	9334361986
38	40565642	54477972	763966794	9167601528	777879124	9334549486
39	40581267	54493597	763982419	9167789028	777894749	9334736986
40	40596892	54509222	763998044	9167976528	777910374	9334924486
41	40612517	54524847	764013669	9168164028	777925999	9335111986
42	40628142	54540472	764029294	9168351528	777941624	9335299486
43	40643767	54556097	764044919	9168539028	777957249	9335486986
44	40659392	54571722	764060544	9168726528	777972874	9335674486
45	40675017	54587347	764076169	9168914028	777988499	9335861986
46	40690642	54602972	764091794	9169101528	778004124	9336049486
47	40707036	54618597	764108188	9169298256	778019749	9336236983
48	40721892	54634222	764123044	9169476528	778035374	9336424486
49	40737517	54649847	764138669	9169664028	778050999	9336611986
50	40753142	54665472	764154294	9169851528	778066624	9336799486
51	40768767	54681097	764169919	9170039028	778082249	9336986986
52	40784392	54696722	764185544	9170226528	778097874	9337174486
53	40800017	54712347	764201169	9170414028	778113499	9337361986
54	40815642	54727972	764216794	9170601528	778129124	9337549486
55	40832036	54743597	764233188	9170798256	778144749	9337736983
56	40846892	54759222	764248044	9170976528	778160374	9337924486
57	40862517	54774847	764263669	9171164028	778175999	9338111986
58	40878142	54790472	764279294	9171351528	778191624	9338299486
59	40893767	54806097	764294919	9171539028	778207249	9338486986
60	40909392	54821722	764310544	9171726528	778222874	9338674486
61	40925017	54837347	764326169	9171914028	778238499	9338861986
62	41743283.24	55654075	765144435.2	9181733223	779055227	9348662720
63	41734681.85	55646242	765135833.8	9181630006	779047394	9348568734

L-8. RF Module (A51)

The RF Module consist of a 130W Transmitter and a low noise receiver connected through a circulator duplexer to a common antenna port. The complete Transmitter is built from solid state components.
The transmitter section is comprised of the Tx multiplier, the input microstrip splitter, the 4:1 combiner, the four 35W modules, the 40dB coupler with a power monitor section, a duplexer, termination and the WG output. The coaxial input of the Tx multiplier is the input for the transmitter section. The input splitter is a passive power divider constructed from microstrip elements. The interface between the splitter and the multiplier is coaxial connection. The interfaces among the splitter and the four 35W modules are GPO push-on connections. The upper two 35W modules are combined using a planar microstrip structure. By symmetry, the lower 35W modules are combined in a similar fashion. The top and bottom pairs are, in turn combined using a 2:1 waveguide combiner. The assembly that comprises the two planar and one waveguide combiners is called the 4:1 combiner. The waveguide output of the 4:1 combiner is fed through a waveguide section, upon which a 40dB coupler and power monitor circuit are attached to monitor the strength of the output signal.

The receiver is built as a hybrid assembly with WR-90 waveguide input and coaxial cable output. It consists of WR-90 waveguide-to-coaxial transition with built- in noise diode assembly for BITE. This stage is realized in SMT using readily available packaged MMIC gain blocks and a PIN-diode attenuator. IF filtering is a critical element for signal processing. A PIN attenuator is used for temperature compensation in an open loop configuration with LM50 temperature sensor and OP-AMP circuitry for adjustment and offset. The IF mixer is a Surface Mount Device as well. The IF board is located in a separate housing and is attached to the LNA via GPO interface.

L-9. Second IF Module (A8)

The Second IF (A8) contains an amplifier, Mixer, 13.9MHz Gain Stages, AGC and STC gain control inputs and a Quadrature Detector.

The 166.8 MHz received signal from the 1st IF is filtered and applied to a mixer amplifier in the Second IF. This signal is mixed with the 152.87MH 2nd LO signal from the Source Module (A3A1). The resulting 13.9MHz third IF signal is amplified and passed through AGC and STC controlled gain stages. The Automatic Gain Control (AGC) is controlled to set the noise floor of the receiver. The Sensitivity Time Control (STC) is a fast bin-to-bin gain control function to maintain the return signal at a normalized level 10 dB below saturation. The AGC and STC functions are controlled by the Sampler (A31).
The amplified 13.9 MHz Second IF signal is power divided into two signals that are mixed with a third local oscillator (Third LO) signal, developed by Source (A3A1) to produce the I (In phase) and Q (Quadrature phase) RETURN signals. The I and Q signals are applied to the Sampler (A31).

L-10. Sampler Card (A31)

The I and Q RETURN signals are applied to the digital weather data processing portion of the R/T. The Sampler Card contains three TMS320C44 Digital Signal Processor chips. These operate from a 40 MHz crystal oscillator clock located on the circuit card. The Sampler converts the I and Q RETURN signals to digital and originates the STC (Sensitivity Time Control) and AGC feedback signals used in the Second IF. The sampler (DSP00) also provides timing and receive/transmitter control pulses to the receiver-transmitter section of the unit. Digital signal processors DSP01 and DSP02 on the sampler board are currently not used (they will be used for Enhanced turbulence detection capability). The Sampler also controls the Noise Diode in the Limiter/Preamplifier module (A18) to perform the receiver self test functions.

L-11. DSP Card (A32)

The digital information is then passed to the DSP circuit card. The DSP circuit card contains 5 digital signal processors, which perform different functions in processing the returned signals, including formatting the digitized data for the display. The DSP card contains three Texas Instruments TMS320VC33 DSP chips and two Analog Devices 21065L DSP chips. The two Analog Devices ADSP21065L processors (DSP M and DSP M') are dedicated to the MultiScan function. These processors perform the computational task of intelligently merging multiple weather sweep data sets. They also perform the rotation and translation function necessary to provide a display image that is coordinated with aircraft movement. DSP3 is responsible for sending the weather data to the display on the 453 bus. The 453 display bus drivers are located on the CPU board.

Two crystal controlled oscillators are located on the DSP circuit card to provide clock signals for the DSP chips. The TMS320C44 DSPs utilize a 30 MHz clock oscillator and the ADSP21065L DSPs utilize a 12 MHz clock oscillator. The ADSP21065L DSPs contain an internal X5 clock multiplier to run internally at 60 MHz.

L-12. CPU Card (A34)

The control Processor (CPU) manages virtually all of the radar system operation. The CPU receives and decodes all aircraft data inputs, receives control commands from the cockpit control panel, manages the processing modes of the Sampler and DSP modules. The CPU also performs the antenna scanning and attitude stabilization functions. The CPU manages the internal test and monitoring functions. The CPU is an Intel 80196 processor running at 16 MHz. The CPU communicates with DSP1 through a dual port memory. The interface to the I/O card is through a bi-directional latch.

The CPU utilizes a 16 MHz crystal controlled clock oscillator.

L-13. I/O Card (A33)

The I/O Card (A33) contains interfaces to various aircraft data sources including synchro attitude, synchro airspeed and heading, along with several Arinc 429 data sources. The CPU communicates with the I/O card through a bi-directional latch. An Intel 8031 BITE processor is also located on the I/O card. This processor stores detected faults in non-volatile memory and interfaces with the aircraft on-board maintenance systems. The BITE processor utilizes a 12 MHz crystal oscillator for a clock.

L-14. Low Voltage Power Supply (A2)

The Low Voltage Power Supply operates from the 115VAC 400Hz aircraft power bus and provides the power to all of the internal cards and modules. The power supply also supplies power to the external control panel, waveguide switch (dual installation) and antenna pedestal. All of the power lines that come into or leave the WRT-2100 have the appropriate filtering and isolation to meet EMI requirements.

L-15. Rear Interconnect Module (A1)

The rear interconnect module provides the interconnect wiring between the WRT-2100 rear connector and the power supply, circuit cards and modules contained within the WRT-2100.

L-16. Front Panel

The front panel contains a 15 pin circular test connector which provides an interface to an RS-232 terminal such as a laptop PC. The RS-232 interface is used for test and diagnostic purposes and is not connected to the aircraft. Functions available through the RS-232 interface include Programming of the CPU and DSP code, internal fault diagnostics, monitoring of external aircraft inputs and parameters, control of specialized test modes, and downloading of internally stored windshear events captured in flash memory. The front panel also includes a BNC Reference Output for locking an RF signal generator to the transmit/receive frequency during bench test.

L-17. WRT-2100 Oscillators and Critical Frequencies

The following table lists the oscillators contained within the R/T unit and critical frequencies.

Table L-2. WRT-2100 Oscillators and Critical Frequencies

Function	Frequency	KHz/MHz
(A33) Universal I/O ARINC 429 Bus High	100.0	kHz
(A33) Universal I/O ARINC 453 Bus	1.0	MHz
(A33) Universal I/O UART Clock	2.0	MHz
(A33) Universal I/O Clock	12.0	MHz
(A33) BITE Processor Clock	12.0	MHz
(A34) Main CPU Clock	16.0	MHz
(A34) Processor UART Clock	2.0	MHz
(A32) DSP – DSP1,DSP2,DSP3 Clock	12.0	MHz
(A32) DSP - ARIES ARINC 429 High Speed UART	20.0	MHz
(A32) DSP – DSP1,DSP2,DSP3 Data Bus	30.0	MHz
(A32) DSP – DSPM, DSPM2 (SHARC) Clock	30.0	MHz
(A32) DSP – DSPM, DSPM2 Data Bus	60.0	MHz
(A31) Sampler DSP00, DSP01,DSP02 Data Bus	20.0	MHz
(A31) Sampler – DPS00,DSP01,DSP02 Clock	40.0	MHz
(A50) Source - PIC 16F873 Microcontroller Clock	16.0	MHz
(A50) Source XTAL Oscillator	90.425144	MHz
(A50) Source – DDS1	27.824659	MHz
(A50) Source – DDS2	39.971892 - 41.734681	MHz MHz
(A50) Source - 3rd LO Drive	13.912329	MHz
(A50) Source - 2nd LO Drive	153.025628	MHz
(A50) Source - 1st LO Drive	763.373044 765.135833	MHz MHz
(A50) Source - Tx Drive	777.285374 779.047394	MHz MHz
(A51) Multiplier Tx Output / Rx RCV Frequency	9327.4244 - 9348.5687	MHz MHz
(A51) 1st IF Frequency	166.947958	MHz
(A8) 2nd IF Frequency	13.922329	MHz

L-18. Technical Report - Name and Address (Section 2.1033 (c) (1))

The name and address of the manufacturer of the **WRT-2100 MultiScan Weather Radar Receiver/Transmitter** and applicant for certification is Rockwell Collins, Inc., 1300 Wilson Boulevard, Suite 200, Arlington, Virginia 22209.

L-19. FCC Identifier (Section 2.1033 (c) (2))

FCC ID	Description	Collins P/N
AJK8221710-001	**Receiver/Transmitter Unit (WRT-2100)**	**822-1710-0X2**
AJK8221710-001	**Receiver/Transmitter Unit (WRT-2100)**	**822-1710-2X3**

L-20. Installation and Operation Manuals (Section 2.1033 (c) (3))

See **Exhibit H**.

L-21. WRT-2100 Emission Type is 12M5P0N

The transmitter output pulses are rectangular unmodulated pulses ranging from 2 to 25 microseconds in width. Pulse repetition frequencies are from 900 Hz to 3000 Hz depending on operating mode.

Three separate pulsewidths are utilized in the maximum operating condition, 2, 6, and 25 microseconds. The Necessary Bandwidth and emission type for each of these three pulsewidths is calculated per the equation contained in Section 2.202 (g) “Table of Necessary Bandwidths” entry for “Unmodulated Pulse Emissions” : Bn = 2K ÷ t, where K=1.5, t = pulse duration

Pulse Width	Emission Type
2 uSec	1M50P0N
6 uSec	500KP0N
25 uSec	120KP0N

During operation, the WRT-2100 Receiver/Transmitter utilizes multiple frequencies over the frequency range 9327.424 MHz to 9348.568 MHz described in Exhibit 1- Product Description and described in further detail in Exhibit 9 - Required Measurements: Section 9.2-Modulation Characteristics. The Maximum Channel Span condition is when the system is utilizing frequencies including the highest and lowest extreme channels (i.e. Channels 0-63).
The Occupied Bandwidth while operating in the Maximum Channel Span condition is 12.5 MHz. Data for this Maximum Channel condition is included in Exhibit 9-Occupied Bandwidth. Therefore, the Emission Type for the Maximum Channel Span condition is 12M5P0N.

L-22. Frequency Range (Section 2.1033 (c) (5))

The **WRT-2100** frequency range is 9327.424 MHz to 9348.568 MHz. The system can operate on any of 64 channels spaced at 187.5KHz over the above frequency range. The WRT-2100 transmits and receives on the same frequency. The following table lists the transmit frequencies for each channel.

The Frequency Tolerance is +/- 1 MHz which equates to 0.0107%.

Table 3. WRT-2100 Channel Frequencies (Mhz)

DDS CH	X Band TX	DDS CH	X Band TX
0	9327.424486	32	9333.424486
1	9327.611986	33	9333.611986
2	9327.799486	34	9333.799486
3	9327.986986	35	9333.986986
4	9328.174486	36	9334.174486
5	9328.361986	37	9334.361986
6	9328.549486	38	9334.549486
7	9328.736986	39	9334.736986
8	9328.924486	40	9334.924486
9	9329.111986	41	9335.111986
10	9329.299486	42	9335.299486
11	9329.486986	43	9335.486986
12	9329.674486	44	9335.674486
13	9329.861986	45	9335.861986
14	9330.049486	46	9336.049486
15	9330.236986	47	9336.236983
16	9330.424486	48	9336.424486
17	9330.611986	49	9336.611986
18	9330.799486	50	9336.799486
19	9330.986986	51	9336.986986
20	9331.174486	52	9337.174486
21	9331.361986	53	9337.361986
22	9331.549486	54	9337.549486
23	9331.736986	55	9337.736983
24	9331.924486	56	9337.924486
25	9332.111986	57	9338.111986
26	9332.290255	58	9338.299486
27	9332.486986	59	9338.486986
28	9332.674486	60	9338.674486
29	9332.861986	61	9338.861986
30	9333.049486	62	9348.662720
31	9333.236986	63	9348.568734

L-23. Range of Operating Power Values (Section 2.1033 (c) (6))

The nominal power output for the WRT-2100 is 150 Watts Peak (21.8dBW). There are no means for varying the transmitter power other than in bench test conditions. There are no operator controls that affect power output.

L-24. Maximum Power Rating as Defined in Part 87

According to Section 87.131, there is no maximum power specified for the P0N class of emission. Note 9 states; “To be specified on license”

Due to production variations, the transmitter power can range up to 250 watts. Therefore, the maximum transmitter output power is 250 Watts Peak (23dBW).

L-25. DC Voltages and Currents (Section 2.1033 (c) (8))

The DC Voltage and Current applied to the RF Module (A514) power stages is shown in the following table.

DC Supply Voltage	Maximum DC Current During Transmit Pulse	Average DC Supply Current	
+12.0 VDC	16.0 Amps	7.0 Amps	Typical

L-26. Tune Up Procedures (Section 2.1033 (c) (9))

See Exhibit J - Part 2.

L-27. Schematics and Circuit Diagrams (Section 2.1033 (c) (10))

See Exhibit E.

L-28. Nameplate Label Drawings (Section 2.1033 (c) (11))

See Exhibit A.

L-29. Equipment Photographs: External Views (Section 2.1033 (c) (12))

See Exhibit C.

L-30. Equipment Photographs: Internal Views (Section 2.1033 (c) (12))

See Exhibit I.

L-31. Digital Modulation System (Section 2.1033 (c) (13))

Not Applicable

L-32. Required Measurements (Section 2.1033 (c) (14))

See Exhibit F.