Exhibit 1 – WRT-2100 Product Description

Exhibit 1 – WRT-2100 Product Description

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1.1 System Overview

The WRT-2100 MultiScan Weather Radar Receiver/Transmitter is an updated version of the Rockwell Collins WRT-701X Air Transport Weather Radar that has been in commercial service for over 20 years.

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.

MultiScan utilizes advanced multiple beam ground clutter suppression techniques which allow the radar beams to be optimized for superior long and short range weather detection while at the same time eliminating clutter from the screen. These techniques enable rapid, unambiguous weather hazard interpretation without the workload associated with excessive tilt management. Ground clutter can be switched in or out of the display by using the Ground Clutter Suppression (GCS) switch.

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.

1.2 System Components

The WXR-2100 system consists of the following components:

Equipment	Part Number	Description
WRT-2100	822-1710-0xx (Boeing) 822-1710-2xx (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

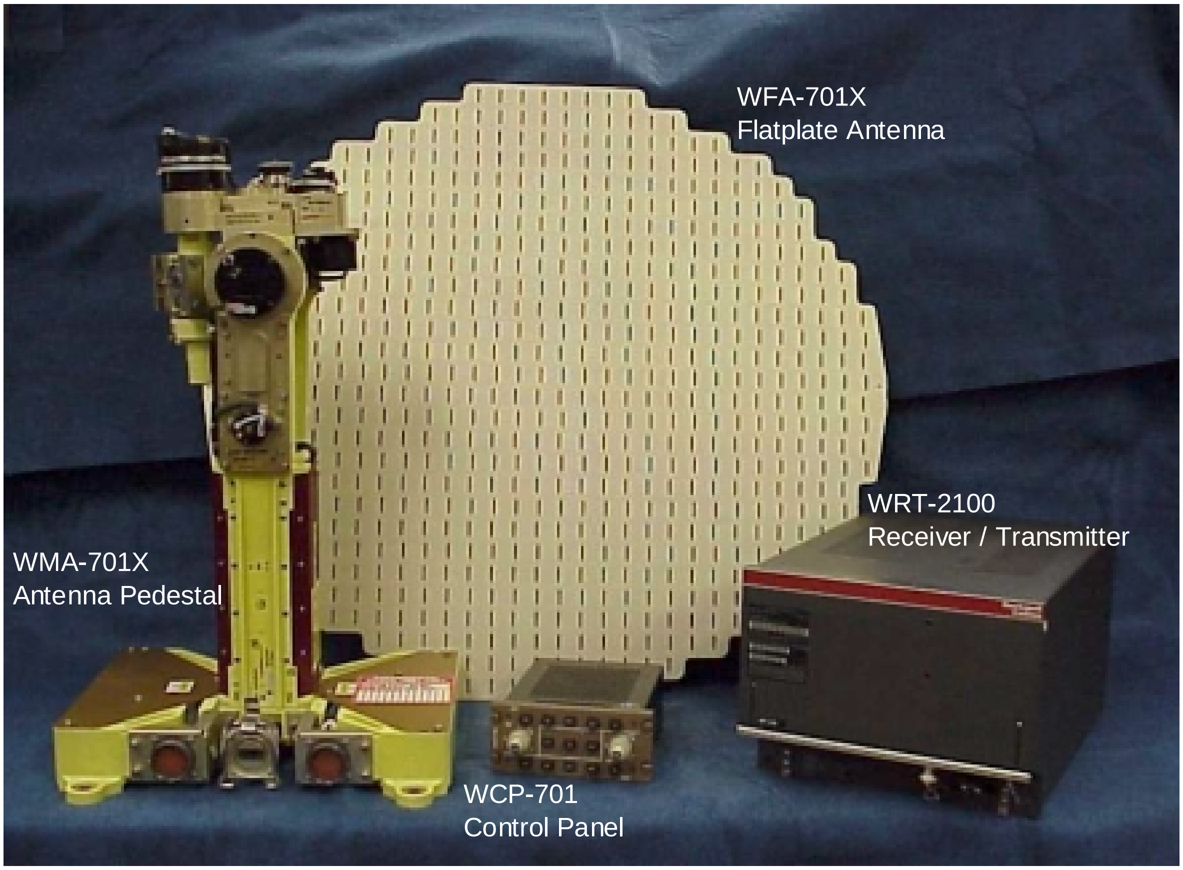

Figure 1-1. WRT-2100 System Components

1.3 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.

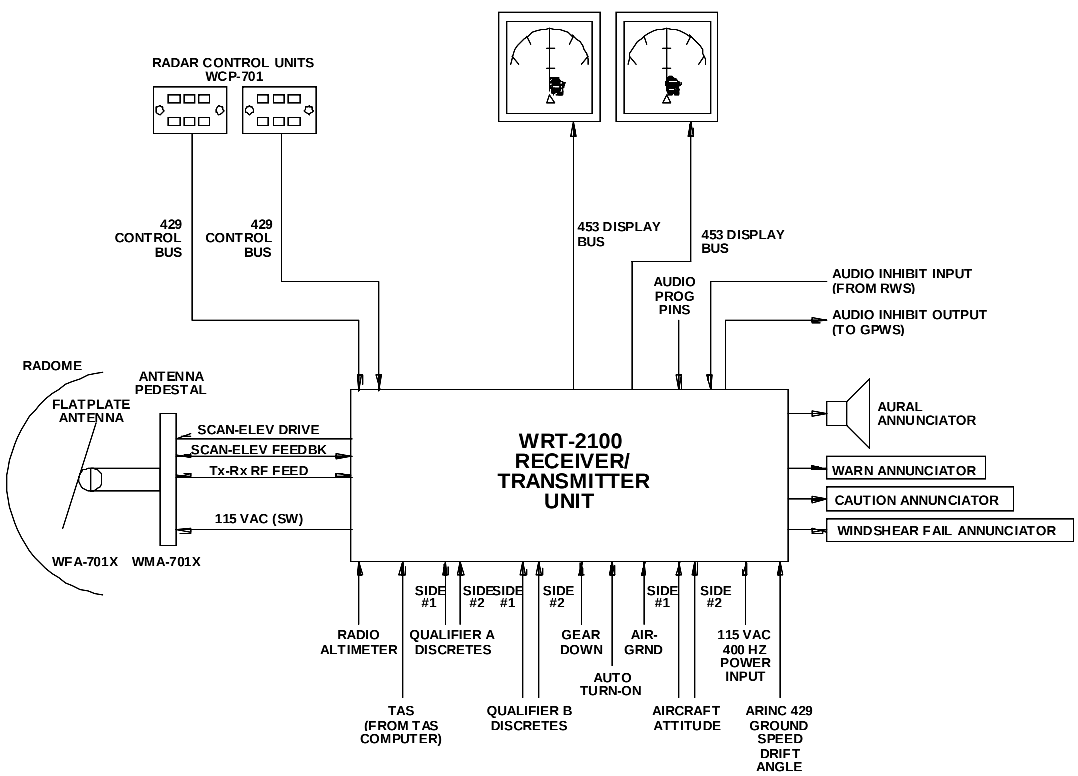

Figure 1-2. Typical WXR-2100 Aircraft Installation

1.4 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.

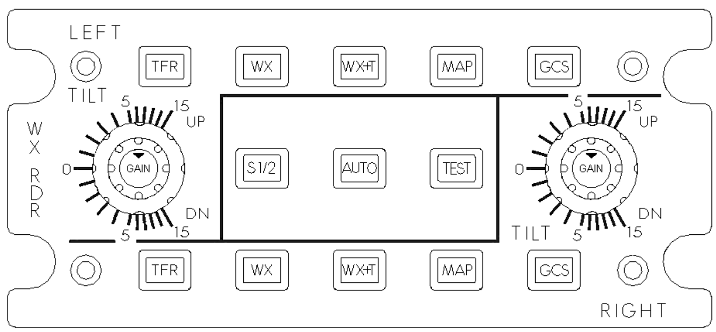

Figure 1-3. WCP-702 Dual Control Panel

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.

1.5 Equipment Specifications

Characteristic	**Specification**
FAA TSO	-C63c dated August 18, 1983
Size	8MCU
Weight	Less than 30 lb.
Power Requirement	115 V ac, 400 Hz Less than 5 amps
Transmitted Output Power Frequency Channels Pulse Length Pulse Repetition Rate Duty Factor	 150 Watts (+51.8dBm) nominal X-band, 9327.064 MHz - 9338.876 MHz ± 2 MHz 64 Channels, 187.5KHz Spacing 2.0, 6.0, 20.0 microseconds 900 pulses per second in WX, WX+T, Map modes 3000 pulses per second in Windshear mode. 0.06
Receiver IF Bandwidths First IF Center Frequency Second IF Center Frequency MDS: STC (Dynamic)	 10 MHz, 1MHz, 166.765 MHz 13.9 MHz –124 dBm nominal optimized for range and pulse width
Environmental	DO-160D Category
Temperature/Altitude	Cat A2 -15ºC to +70ºC Operating, 15,000 ft.
Temperature Variation	Cat C - Vary from -15ºC to +70ºC @2ºC 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)

1.6 Receiver-Transmitter

The WRT-2100 is an upgraded version of the existing WRT-701X. The WRT-2100 Receiver/Transmitter design includes a new Source module, a new Sampler and a new Digital Signal Processor (DSP) to implement MultiScan capability. The new frequency source module is based on a Direct Digital Synthesis (DDS) design which enables the selection of 64 channels. The Sampler and DSP are upgraded to provide additional computational throughput needed for the advanced MultiScan algorithms.

Figure 1-4 is a simplified block diagram showing the relationship of the various modules within the R/T unit. New modules for the WRT-2100 are outlined in bold red. The remainder of the modules are identical to the standard WRT-701X which has been in airline service for many years. The RF Section is outlined in blue.

Figures 1-4, 1-5, and 1-6 will be used for the following discussion of module functions.

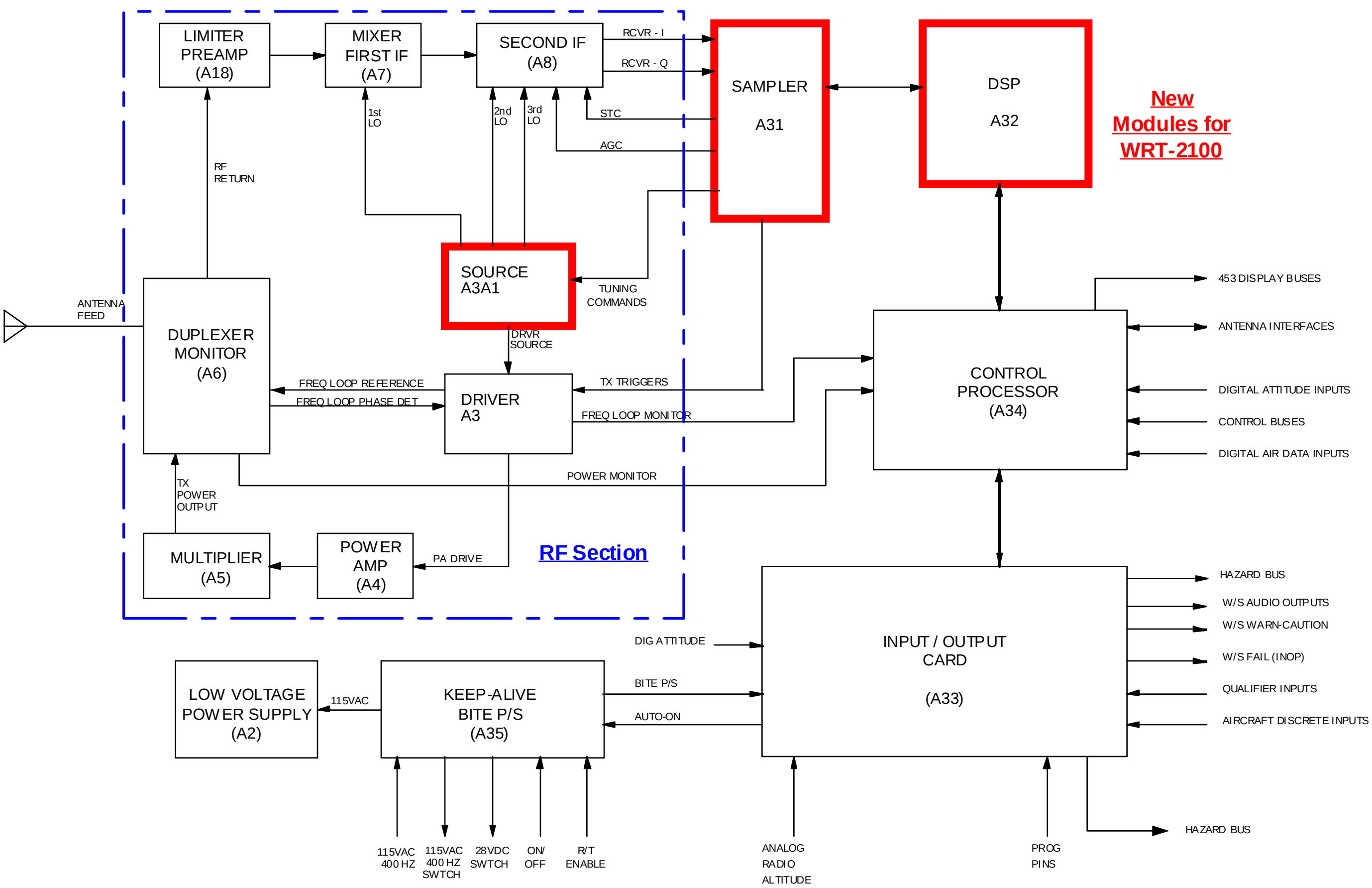

Figure 1-4. WRT-2100 Receiver-Transmitter Simplified Block Diagram

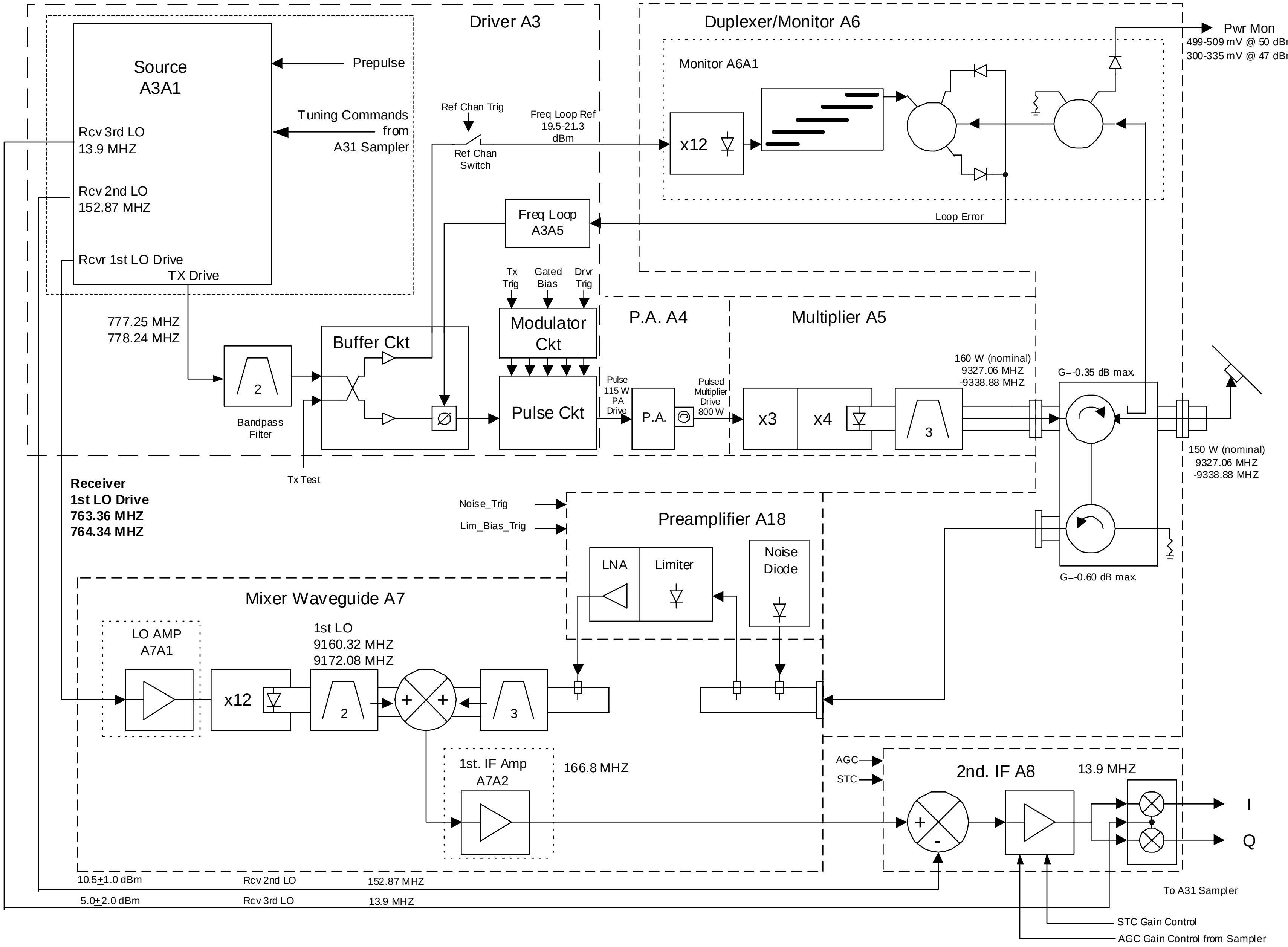

Figure 1-5. WRT-2100 RF Section Block Diagram

1.7 Source (A3A1)

The Source Module (A3A1) is located as a subassembly of the A3 Driver module and is the primary frequency generating assembly within the Receiver/Transmitter unit. It provides the following outputs.

Transmit Channel output to the Driver	777.25 MHz - 778.24 MHz,
RCVR 1st LO Drive	763.36 MHz - 764.34 MHz
RCVR 2nd LO Drive	152.87 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 microcontroller to control the DDS frequency selections.

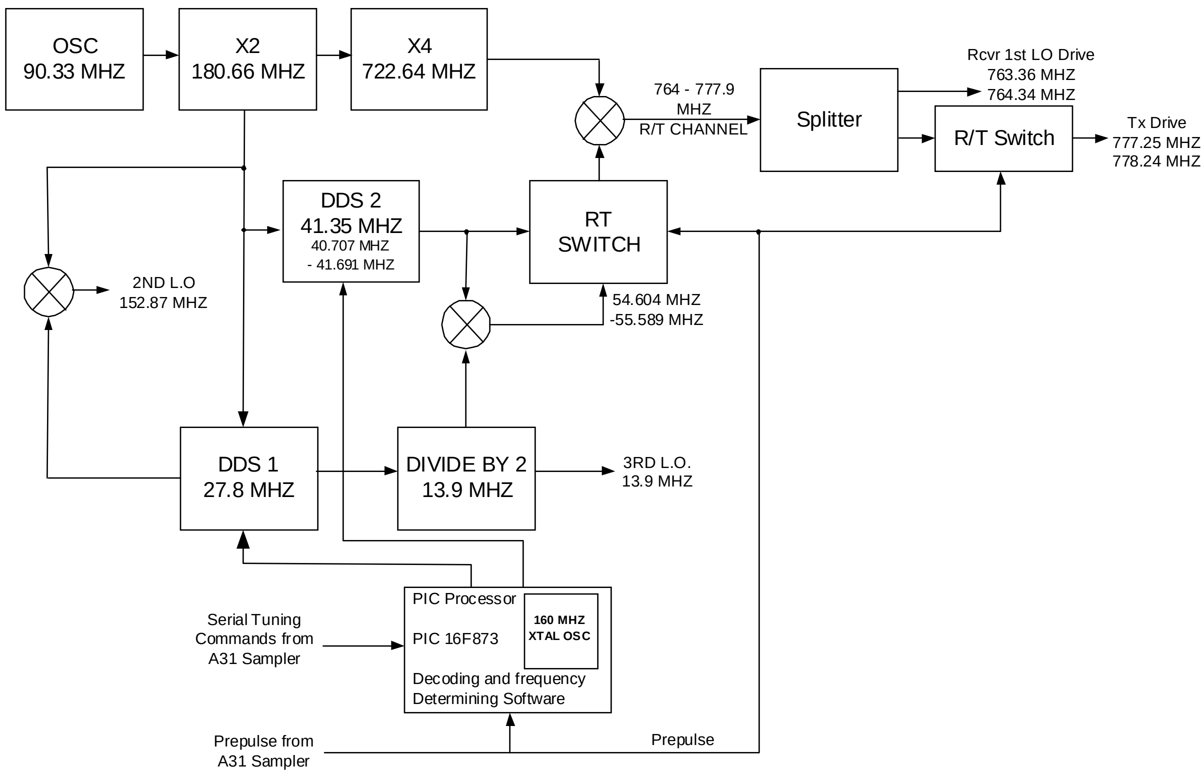

Figure 1-6. Source Module (A3A1)

The Source Module contains three elements that determine the frequency of operation.
A 90.33 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 90.33 MHz oscillator is multiplied by two to get 180.66 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 180.66 MHz to produce 152.87 MHz for the 2nd LO. The 27.8 MHz signal is divided by two to produce the 13.9 MHz 3rd LO. The 180.66 MHz is multiplied by four to produce 722.64 MHz. When the R/T is in receive mode the 722.64 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 722MHz 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 763.36 MHz - 764.34 MHz in Receive mode and 777.25 MHz - 778.24 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 9327.06 MHz - 9338.88 MHz transmitter output frequency.

Table 1-1. DDS Source Frequencies

DDS Source Frequencies						
Crystal Oscillator		90331394				
Crystal times 2		180662788				
Crystal times 8		722651152				
27MHz DDS		27794275.0769				
3rd LO		13897137.5385				
2nd LO		152868512.9231				
1st IF		166765650.4615				
2nd IF		13897137.5385				
DDS CH	**Hex Value**	**42MHz Freq.**	**55MHZ Freq.**	**REC Freq. (÷12)**	**1st LO**	**TX Freq. (÷12)**
		(Hz)	(Hz)	(Hz)	(Hz)	(Hz)
0	39AE9B47D4AE	40707036	54604173.54	763358188	9160298256	777255325.5
1	39B4464B150E	40722661	54619798.54	763373813	9160485756	777270950.5
2	39B9F14E556F	40738286	54635423.54	763389438	9160673256	777286575.5
3	39BF9C5195D0	40753911	54651048.54	763405063	9160860756	777302200.5
4	39C54754D631	40769536	54666673.54	763420688	9161048256	777317825.5
5	39CAF2581691	40785161	54682298.54	763436313	9161235756	777333450.5
6	39D09D5B56F2	40800786	54697923.54	763451938	9161423256	777349075.5
7	39D6485E9753	40816411	54713548.54	763467563	9161610756	777364700.5
8	39DBF361D7B3	40832036	54729173.54	763483188	9161798256	777380325.5
9	39E19E651814	40847661	54744798.54	763498813	9161985756	777395950.5
10	39E749685875	40863286	54760423.54	763514438	9162173256	777411575.5
11	39ECF46B98D6	40878911	54776048.54	763530063	9162360756	777427200.5
12	39F29F6ED936	40894536	54791673.54	763545688	9162548256	777442825.5
13	39F84A721997	40910161	54807298.54	763561313	9162735756	777458450.5
14	39FDF57559F8	40925786	54822923.54	763576938	9162923256	777474075.5
15	3A03A0789A58	40941411	54838548.54	763592563	9163110756	777489700.5
16	3A094B7BDAB9	40957036	54854173.54	763608188	9163298256	777505325.5
17	3A0EF67F1B1A	40972661	54869798.54	763623813	9163485756	777520950.5
18	3A14A1825B7B	40988286	54885423.54	763639438	9163673256	777536575.5
19	3A1A4C859BDB	41003911	54901048.54	763655063	9163860756	777552200.5
20	3A1FF788DC3C	41019536	54916673.54	763670688	9164048256	777567825.5
21	3A25A28C1C9D	41035161	54932298.54	763686313	9164235756	777583450.5
22	3A2B4D8F5CFD	41050786	54947923.54	763701938	9164423256	777599075.5
23	3A30F8929D5E	41066411	54963548.54	763717563	9164610756	777614700.5
24	3A36A395DDBF	41082036	54979173.54	763733188	9164798256	777630325.5
25	3A3C4E991E20	41097661	54994798.54	763748813	9164985756	777645950.5
26	3A41F99C5E80	41113286	55010423.54	763764438	9165173256	777661575.5

DDS Source Frequencies						
DDS CH	**Hex Value**	**42MHz Freq.**	**55MHZ Freq.**	**REC Freq. (÷12)**	**1st LO**	**TX Freq. (÷12)**
		(Hz)	(Hz)	(Hz)	(Hz)	(Hz)
27	3A47A49F9EE1	41128911	55026048.54	763780063	9165360756	777677200.5
28	3A4D4FA2DF42	41144536	55041673.54	763795688	9165548256	777692825.5
29	3A52FAA61FA2	41160161	55057298.54	763811313	9165735756	777708450.5
30	3A58A5A96003	41175786	55072923.54	763826938	9165923256	777724075.5
31	3A5E50ACA064	41191411	55088548.54	763842563	9166110756	777739700.5
32	3A63FBAFE0C5	41207036	55104173.54	763858188	9166298256	777755325.5
33	3A69A6B32125	41222661	55119798.54	763873813	9166485756	777770950.5
34	3A6F51B66186	41238286	55135423.54	763889438	9166673256	777786575.5
35	3A74FCB9A1E7	41253911	55151048.54	763905063	9166860756	777802200.5
36	3A7AA7BCE247	41269536	55166673.54	763920688	9167048256	777817825.5
37	3A8052C022A8	41285161	55182298.54	763936313	9167235756	777833450.5
38	3A85FDC36309	41300786	55197923.54	763951938	9167423256	777849075.5
39	3A8BA8C6A36A	41316411	55213548.54	763967563	9167610756	777864700.5
40	3A9153C9E3CA	41332036	55229173.54	763983188	9167798256	777880325.5
41	3A96FECD242B	41347661	55244798.54	763998813	9167985756	777895950.5
42	3A9CA9D0648C	41363286	55260423.54	764014438	9168173256	777911575.5
43	3AA254D3A4EC	41378911	55276048.54	764030063	9168360756	777927200.5
44	3AA7FFD6E54D	41394536	55291673.54	764045688	9168548256	777942825.5
45	3AADAADA25AE	41410161	55307298.54	764061313	9168735756	777958450.5
46	3AB355DD660F	41425786	55322923.54	764076938	9168923256	777974075.5
47	3AB900E0A66F	41441411	55338548.54	764092563	9169110756	777989700.5
48	3ABEABE3E6D0	41457036	55354173.54	764108188	9169298256	778005325.5
49	3AC456E72731	41472661	55369798.54	764123813	9169485756	778020950.5
50	3ACA01EA6791	41488286	55385423.54	764139438	9169673256	778036575.5
51	3ACFACEDA7F2	41503911	55401048.54	764155063	9169860756	778052200.5
52	3AD557F0E853	41519536	55416673.54	764170688	9170048256	778067825.5
53	3ADB02F428B4	41535161	55432298.54	764186313	9170235756	778083450.5
54	3AE0ADF76914	41550786	55447923.54	764201938	9170423256	778099075.5
55	3AE658FAA975	41566411	55463548.54	764217563	9170610756	778114700.5
56	3AEC03FDE9D6	41582036	55479173.54	764233188	9170798256	778130325.5
57	3AF1AF012A36	41597661	55494798.54	764248813	9170985756	778145950.5
58	3AF75A046A97	41613286	55510423.54	764264438	9171173256	778161575.5
59	3AFD0507AAF8	41628911	55526048.54	764280063	9171360756	778177200.5
60	3B02B00AEB59	41644536	55541673.54	764295688	9171548256	778192825.5
61	3B085B0E2BB9	41660161	55557298.54	764311313	9171735756	778208450.5
62	3B0E06116C1A	41675786	55572923.54	764326938	9171923256	778224075.5
63	3B13B114AC7B	41691411	55588548.54	764342563	9172110756	778239700.5

1.8 Driver Module (A3)

The Driver Module contains two major sections; the Source Module (A3A1) described above and the Driver which amplifies the signal used to drive the PA Module.

The driver contains pulse amplifier circuits to drive the PA, a frequency control loop, and a reference circuit. The driver receives the 777.25 MHz - 778.24 MHz Tx Drive output from the Source Module (at approximately 30 mW) and amplifies this to approximately 115 Watts which is then used to drive the PA Module (A4). The driver output is modulated by a rectangular "prepulse".

The reference channel provides a separate 777.25 MHz - 778.24 MHz signal to the Duplexer/Monitor (A6) which is multiplied by 12 and used as a phase reference for the transmitted output pulse.

The frequency control loop receives a phase detector output signal from the Duplexer/Monitor (A6) module which indicates a phase error between the reference channel and the transmitter output frequency. This phase detector "error" signal is passed through a 'frequency loop' amplifier which then provides a correction signal to a phase shifter in the Driver transmit frequency path. This frequency control loop is intended to cancel out phase shift during the transmit pulse induced by heating effects in the PA and Multiplier devices.

1.9 PA Module (A4)

The Power Amplifier receives the approximately 115 watt pulsed output from the Driver and amplifies it to an 800 Watt pulsed signal to drive the Power Multiplier (A5). The PA module contains a bipolar first stage which amplifies the signal to approximately 180 watts. This signal is fed to a hybrid splitter that sends the signal to two parallel bipolar power devices. The outputs from these two devices are combined with a hybrid combiner to produce an approximately 800 watt output over the frequency 777.25 MHz - 778.24 MHz.

The PA module receives a +66 Volt unregulated DC input from the A2 Power Supply module. The +66 volt power is regulated to approximately +42VDC which charges large storage capacitors to supply the power amplifier devices during the transmit pulses.

The DC Input to the PA devices during the transmit pulse is 42VDC at approximately 60 amperes.

The PA module contains a circulator at the output to provide isolation between the PA and Multiplier Modules.

1.10 Power Multiplier Module (A5)

The Power Multiplier module (A5) multiplies the 800 watt 777.25 MHz - 778.24 MHz drive signal from the PA to produce a single 9327.06 MHz - 9338.88 MHz output at a nominal 150 watts. This signal is then applied to the Duplexer/Monitor (A6) and directed to the antenna as the Transmitted output signal. The Power Multiplier contains X3 and X4 passive diode multiplication stages.

The X3 multiplier diode is reverse biased by a -220 volt bias signal from the Multiplier Bias board to act as a non-linear reactance. The 777.25 MHz - 778.24 MHz drive signal is applied to the X3 diode through a microstrip matching network which produces harmonic outputs. The third harmonic of the drive signal is filtered through a microstrip-coupled line filter to produce a 2332.75 MHz - 2334.72 MHz signal which is fed to the X4 stage through a tunable coaxial line filter. The filter is tuned by a coaxial slider which is tuned to optimize the bandpass around 2333 MHz.

The slider cavity directs the 2333 MHz signal to the X4 multiplier diode mounted in a waveguide cavity structure. The fourth harmonic of the 2332.75 MHz - 2334.72 MHz signal is tuned for optimum peak power output with a tunable waveguide idler structure. The 9327.06 MHz - 9338.88 MHz output signal is then passed through a 3-pole waveguide filter to reject higher harmonics. The output power from the Multiplier A5 is nominally 160 watts peak. The output pulse widths range between 2 and 20 microseconds.

The bias voltage to the X3 and X4 multiplier diodes is switched on and off by the transmit trigger signal from the A31 Sampler. This bias switching allows the PA power to reach maximum before the multiplier is switched on to produce fast transmitter output pulse rise and fall times.

The output of the Power Multiplier is applied to the transmitter input port of the Duplexer/Monitor.

1.11 Duplexer/Monitor(A6)

The Duplexer/Monitor (A6) performs three functions; 1)couples the transmitter output of the A5 Power Multiplier to the Antenna, 2) directs the antenna input signal to the receiver Limiter/Preamplifier (A18), and 3) provides a monitor of the transmitter output power and phase.

The Duplexer/Monitor couples the transmitter output to the antenna through a 4-port circulator. The circulator also functions to match the impedance of the transmitter output. The 4-port circulator also couples received energy from the antenna port to the receiver Limiter/Preamplifier input. The fourth port of the circulator is terminated into a load resistor.

The Duplexer/Monitor function includes a microstrip coupler and detector to sample the transmitted power output. This detected output is used to monitor transmitter power output.

The monitor function also contains a phase detector function which compares the transmitted output frequency to an on-channel reference signal. The phase detector output is fed back to the frequency loop amplifier in the A3 Driver module and is used to correct the phase of the transmitter output. The phase detector reference is derived from the A3 Driver 777.25 MHz - 778.24 MHz Reference output which is multiplied by twelve in the Duplexer/Monitor to produce the on-channel reference to the phase detector. The X12 reference multiplier is a passive varacter diode with a stripline filter.

1.12 Limiter/Preamplifier (A18)

The Limiter/Preamplifier (A18) contains a limiter section to protect the input of the receiver and a preamplifier to amplify the received signal. The Limiter/Preamplifier also contains a noise diode assembly which is used during test mode to test the receiver noise figure and STC gain response.

The limiter section consists of a three stage microstrip diode limiter. During transmit operation, the diodes are forward biased by a +5V dc bias source to provide a low impedance shunt to ground for RF energy. This limiter prevents damage to the receiver front-end from reflected transmit energy caused by high VSWR conditions at the antenna or transmitter leakage through the duplexer. The limiter also contains a self-bias detector to apply limiting in case of high energy received from another radar or RF source during receive time.

The Preamplifier consists of a two stage FET preamplifier. Each stage contributes approximately 9.5dB of gain at 9333 MHz. The overall gain is +18 dB minimum with a 3dB noise figure. Gate and drain bias for the FET amplifiers is generated on the preamplifier bias circuit board.

1.13 Mixer/1^{st} IF Module (A7)

The Mixer/1^{st} IF Module (A7) contains a X12 LO Multiplier, Mixer, and 1^{st} IF Amplifier. The 763.36 MHz - 764.34 MHz 1^{st} LO Drive signal from the Source Module (A3A1) is applied to a buffer amplifier and a X12 diode multiplier/filter. The output from the X12 multiplier is the 9160.32 MHz - 9172.08 MHz 1^{st} LO signal which is applied to a waveguide mixer. This 1^{st} LO signal is mixed with the incoming radar signal from the preamplifier to produce the 1^{st} IF signal at 166.8 MHz. This received 1^{st} IF signal is amplified by the 1^{st} IF Amplifier and passed to the Second IF Module (A8).

1.14 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 1^{st} IF is filtered and applied to a mixer amplifier in the Second IF. This signal is mixed with the 152.87MH 2^{nd} 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).

1.15 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.

1.16 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.

1.17 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.

1.18 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.

1.19 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.

1.20 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.

1.21 Front Panel

The front panel contains a 15 pin Cannon ‘D’ 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.

1.22 WRT-2100 Oscillators and Critical Frequencies

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

Table 1-2. 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
(A3) Source - PIC 16F873 Microcontroller Clock	16.0	MHz
(A3) Source XTAL Oscillator	90.331394	MHz
(A3) Source – DDS1	27.794275	MHz
(A3) Source – DDS2	40.707036 - 41.691411	MHz MHz
(A3) Source - 3rd LO Drive	13.897137	MHz
(A3) Source - 2nd LO Drive	152.868512	MHz
(A3) Source - 1st LO Drive	763.358188 764.342563	MHz MHz
(A3) Source - Tx Drive	777.255325 778.239700	MHz MHz
(A5) Multiplier Tx Output / Rx RCV Frequency	9327.0639 - 9338.8764	MHz MHz
(A7) 1st IF Frequency	166.765650	MHz
(A8) 2nd IF Frequency	13.897137	MHz