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WXR-700 - Archived 11/2009

Outlook

- Production has ended for the WXR-700, as many airlines are choosing newer, more advanced radars to equip their aircraft
- Deliveries to U.S. Air Force for its KC-135s were completed in 2003
- No new contracts have been awarded to Rockwell Collins for the radar in recent years; barring further developments, Forecast International will archive this report in November 2009

Orientation

Description. A solid-state color weather radar with forward-looking windshear (FLW) detection suitable for new or retrofit commercial aircraft applications.

Status. Production ended; support ongoing.

Application. 707, 727, 737, 747, 757/67, 777, A-300, A-310, Avro, DC-8, DC-9, DC-10, Fokker-10/100, L-1011, MD-8X, MD-11.

Price Range. Based on contracts signed between Rockwell Collins and the U.S. Air Force in 1995, the average cost of a WXR-700 is $400,000.

Contractors

Prime

Rockwell Collins Inc	http://www.rockwellcollins.com, 400 Collins Rd NE, Cedar Rapids, IA 52498-0001 United States, Tel: + 1 (319) 295-1000, Fax: + 1 (319) 295-5429, Email: collins@rockwellcollins.com, Prime

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Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

WXR-700

Technical Data

	Metric	U.S.
Dimensions		
WRT-701X (Rx/Tx)		
Weight	14.1 kg	31 lb
Size	19.6 x 25.7 x 35.6 cm	7.7 x 10.1 x 14 in
WCP-701 (Mode Control Panel)		
Weight	0.8 kg	1.7 lb
Size	6.6 x 14.6 x 15.2 cm	2.6 x 5.75 x 6 in
MFD-255 (Multifunction Display)		
Weight	0.95 kg	2.1 lb
Size	12.9 x 12.9 x 22.2 cm	5.1 x 5.1 x 8.75 in
WMA-701X (Antenna Pedestal)		
Weight	12.7 kg	28 lb (including flat plate)
Flat-plate Antenna – 701X		
Weight	3.1 kg	6.8 lb
Size	71.1 x 86.4 cm	28 x 34 in
CP-255 (Range and Cursor Control Panel)		
Weight	0.95 kg	2.1 lb
Size	7.6 x 14.6 x 16.5 cm	3 x 5.75 x 6.5 in
Characteristics		
Frequency		
WXR-700X	9.3 GHz band	
Power out	150 W peak	
FLW		
Automatic detection activation	Below 2,300 ft	
Alerts become active in cockpit	At 1,200 ft	
	5 nm	
	± 30° aircraft heading	
Crew warnings	1.5 nm (on landing)	
	3.0 nm (on takeoff)	
Enhanced turbulence detection	Available to 20 nm (alerts to 40 nm)	
Key owner/user benefits	FLW detection to 5 nm	
	Real-time weather display behind windshear icon	
	Turbulence detection to 40 nm	
	Enhanced ground clutter suppression	
	Path attenuation compensation (PAC) and PAC alert	
	Full split function operation	
	Active gain in all modes	
	Windshear alert MVD data recording	
	EGPWS Interface (hazard bus)	
	Upgradeable to WXR-2100 MultiScan	

Design Features. The WXR-700 color weather radar is an all solid-state system suitable for new or retrofit applications with dedicated radar indicators or with electronic flight instruments.

It operates in the X-band and provides weather information to assist in hazardous weather avoidance. Ground-mapping capability provides an aid to navigation. The aircraft can be configured with or without navigator station equipment installed. If the navigator multifunction display, MFD control panel, and radar control panel are not installed, system operation is not affected. WXR information is provided by the WXR receiver/transmitter (R/T) and displayed by the flight display system.

The WXR detects weather to a maximum range of 320 nautical miles and is capable of detecting precipitation-

based turbulence to a range of 40 nautical miles. The radar detects windshear up to 0.25 nautical miles left or right of aircraft heading (0.50 nautical miles total). During approach, windshear is detected within 1.5 nautical miles ahead of aircraft. During takeoff, the warning region is increased to 3 nautical miles.

The antenna assembly, located behind the radome, consists of a flat plate antenna mounted on an antenna pedestal. The flat plate antenna is a phased array antenna that provides a beam 2.5º wide and approximately 2.1º high. The antenna radiation pattern has a maximum coverage of ±90º azimuth and ±30° elevation. The antenna pedestal contains wave-guide connections, drive motors, and the necessary circuitry required to tilt, scan, or stabilize the antenna, as required. The antenna pedestal receives 115-volt AC, single-phase primary power from the R/T.

The WXR-700X is available at 9.3-GHz X-band. The WRT-701X receiver/transmitter features a crystal-controlled multi-pulsewidth transmitter and a coherent receiver with programmable bandwidth signal processing. These features provide pulse-pair processing to allow ground-clutter suppression, path attenuation compensation, Doppler turbulence detection, and "unparalleled" picture resolution when used with an EHSI or 5ATI liquid crystal display (LCD). Microprocessor control results in superior stabilization performance (with both digital and analog attitude inputs), flexible installation configuration, and programmable growth for future requirements.

Quality enhancements in the WRT-701X R/T included a single-channel multiplier assembly, a redesigned power supply and amplifier, and a 150-W reduction in power consumption, while maintaining 150-W peak power output. In support of decisions to include FLW radar on most production aircraft, Collins introduced the -612, -623, and -633 versions of the WRT-701X FLW radar with the newly required Enhanced Ground Proximity Warning System (EGPWS) interface, enhanced built-in test equipment, and enhanced fault-logging memory.

Key enhancements included data-loadable software to reduce software upgrade costs and backward compatibility with existing FLW installations to allow common part numbering.

A WFA-701 flat plate radiator provides the WXR-700 color weather radar with excellent side-lobe reduction. WFA-701X is an integral part of the FLW capability and, according to the manufacturer, provides less than 30-dB side-lobe performance to allow certification of the windshear system with Class C radomes per the DO-213 standard of the Radio Technical Commission for Aeronautics (RTCA, a federal advisory committee).

New multimode radar software was designed and certified to RTCA DO-178B level D standards. The system has been qualified to meet the RTCA DO-160C environmental standards, with a few exceptions. Mil-STD-461D is used for radiated emissions, antenna spurious and harmonics. All operations other than the skin paint mode, 16-level mapping, and minor display and control bus modifications are defined in accordance with the ARINC 708A airborne weather radar, with forward-looking windshear detection capability.

A new family of dual R/T WMT-702X mounts and wave-guide switches has been created to include a new monitored wave-guide switch.

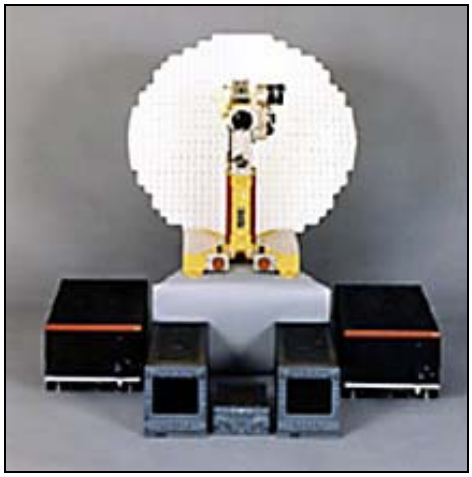
Operational Characteristics. The Collins WXR-700X FLW radar system automatically alerts flight crews of potential windshear and microburst dangers during takeoff and landing. Windshear detection is automatically activated anytime an aircraft is below 2,300 feet radio altimeter altitude. Alerts become active in the cockpit at 1,200 feet. All other selected radar information is continuously displayed once windshear has been detected.

The flight crew is alerted to detected windshear events occurring within 5 nautical miles and ±30º of the aircraft heading. Depending on the location of the windshear event, the crew will receive a caution to "monitor radar" or a warning to "go around" the event. All windshear events within 5 nautical miles and ±30º are displayed on the radar indicator or the Electronic Flight Instrumentation System (EFIS). Crew warnings are issued out to 1.5 nautical miles on landing and 3 nautical miles on takeoff. When windshear detection is active, the radar antenna is time-shared between flight crew radar parameters and the automatic windshear detection parameters.

Alerts are issued in three forms: windshear icons displayed on the MFD, aural messages, and WS caution and warning annunciations on the MFD. The skin paint mode detects airborne targets out to 15 nautical miles. Skin paint targets are displayed as diamond-shaped icons in one of 16 levels of gray, with white representing the strongest returns.

The Collins Path Attenuation Compensation (PAC) alert system helps prevent the problem of flying into areas of severe weather beyond the range of the radar images. In these areas, the radar signal may be significantly degraded, causing a radar shadow. The radar compensates for attenuation at ranges of up to 80 nautical miles. When the compensation limit is reached, a yellow alert bar is displayed on the outer range scale of the display, giving an automatic warning of areas of potentially dangerous weather.

The magnitude, velocity, deviation (MVD) automatic data recording system stores up to three windshear events, making it possible to analyze windshear-related phenomena using actual in-flight data. This makes it possible to develop an understanding of weather phenomena not envisioned in the original NASA windshear specifications. The radars can subsequently be upgraded to provide accurate windshear information on a wider variety of phenomena.



WXR-700

Source: Rockwell Collins

Variants/Upgrades

Collins added the FMR-200X system for military applications.

The FMR-200X Flight Multi-Mode Radar System is a standard non-developmental item/commercial off-the-shelf (NDI/COTS), X-band, coherent, Doppler color weather radar system. This system provides full precipitation detection, turbulence detection, and forward-looking windshear detection, and offers an active skin paint mode capable of detecting tanker-size aircraft at ranges up to 15 nautical miles.

The antenna pedestal has undergone extensive reliability enhancements. Operation is quieter, with less heat and power consumption, reduced gear stress, and improved reliability. The gear train was made more reliable, and expanded R/T monitoring software was added.

Program Review

Weather detection technology has improved considerably over the years. Color displays can identify the intensity of a weather event detected by the radar. Pilots have come to rely on this information to avoid dangerous conditions and to plan fuel-saving paths through non-hazardous weather.

WXR-700 Certified in 1995. In the late 1980s, a modified WXR-700 was used by NASA's Langley Research Center to demonstrate microburst windshear detection. This led to the development of certification criteria for radar-based predictive detection of microburst activity. The WXR-700, with the modifications, was flight-certified by the FAA for the 737-300 in 1995. This automatic mode was widely incorporated into new air transport weather radars after 1995.

At one time, the only way pilots could ensure they were not flying into danger was to fly completely around adverse weather. Color presentations of intensity made it possible to select a path through non-threatening areas and avoid danger, while reducing flying costs and ATC scheduling problems. Adverse weather in one area can ripple through an entire system, creating delays that impact the system for hours.

As radar sensitivity and processing capabilities improved, it became possible to go beyond the data provided by color weather systems. A radar could detect the existence of deadly windshear as well as the conditions that spawned the development of microburst phenomena, a true killer. This is particularly important during landing and takeoff. The FAA and the National

Weather Service have ground-based sensors such as the Terminal Doppler Weather Radar (TDWR) and the Next-Generation Weather Radar (NEXRAD), but it is crucial that individual aircraft carry this capability. The WXR-700 provides this capability.

Alerts Crew to Hazards

The WXR-700 not only senses danger but also alerts the flight crew of hazards detected during landing and takeoff. It also provides information on areas shadowed by close-in weather so pilots do not misinterpret as safe those areas that the radar is unable to detect and display with full accuracy.

Advanced weather radars, especially those with wind-shear capabilities, are standard on most new-build aircraft and popular as a retrofit, although the retrofit market is bound by cost concerns.

In 1995, the U.S. Air Force awarded Rockwell Collins a $35 million contract to provide avionics systems, including the WXR-700, for its C/KC-135s. The contract was under the Air Force's Compass, Radar, and Global positioning system upgrade program. Work was completed in 2003.

Timetable

Month	Year	Major Development
	1995	Radar FAA flight-certified for the 737-300
Dec	1995	Rockwell Collins provides WXR-700 to U.S. Air Force KC-135s
May	1997	TAP-Air Portugal chooses the WXR-700 for its new A319s and A320s
Jul	1998	Certified for installation on Airbus A320, A330, and A340
	2003	Deliveries to U.S. Air Force end
	2008	Production ends

Worldwide Distribution/Inventories

The **U.S. Air Force** installed the WXR-700 on its KC-135s. Commercial airlines around the world have chosen the WXR-700 for their aircraft.

Forecast Rationale

The WXR-700 is facing increasing competition from new radars, such as Rockwell Collins' own WXR-2100. Many airlines are choosing more modern and more capable systems over the older WXR-700. Newer aircraft, such as the Boeing 777 and 787 and the Airbus A350 and A380, are especially likely to be equipped with newer radar systems.

For some time, lower budget airlines continued to purchase the WXR-700. However, no new contracts have been awarded to Rockwell Collins for the radar in recent years. Production continued to fulfill older orders, but with no new orders, production has ended. Forecast International will therefore archive this report in 2009.

Ten-Year Outlook

Barring any further developments, Forecast International will archive this report in November 2009.

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