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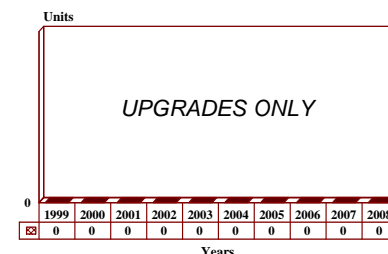
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APS-134(V) - Archived 01/2000

Outlook

- Production complete; ongoing logistics support continues
- ISAR upgrade attracting international attention
- Heavy competition for limited opportunities

10 Year Unit Production Forecast
1999-2008



Orientation

Description. Anti-submarine and maritime surveillance radar.

Sponsor

US Navy
Naval Air Systems Command
NAVAIR HQ
47123 Buse Rd Unit IPT
Patuxent River, Maryland (MD) 20670-1547
USA
Tel: +1 301 342 3000

Status. In service, in production, ongoing logistics support.

Total Produced. An estimated 88 APS-134 units have been produced. More than 300 radars of the APS-116/134 family were built.

Application. P-3B/C/K, BR.1150 Atlantique, Fokker Maritime Enforcer Mk.2, DeHavilland Dash 8, Series 200 Maritime Enforcer Patrol Aircraft.

Price Range. An estimated US\$1.2 million each.

Contractors

Raytheon Systems Company
Sensors & Electronic Systems
PO Box 660246 M/S 3131
Dallas, Texas (TX) 75243
USA
Tel: +1 214 480 3866
Fax: +1 214 480 6296

Technical Data

Dimensions

	<u>Metric</u>	<u>US</u>
Transmitter:	33 x 56 x 53 cm	13 x 22 x 21 in
Synchronizer/exciter:	25 x 25 x 10 cm	10 x 10 x 18 in
Rec./Pulse Compress.:	30 x 33 x 41 cm	11 x 13 x 16 in

	<u>Metric</u>	<u>US</u>
Signal Data Converter:	20 x 38 x 51 cm	8 x 15 x 20 in
Waveguide pressurizer:	33 x 13 x 13 cm	13 x 12 x 5 in
Radar Control/Display (optional):	41 x 58 x 58 cm	16 x 23 x 23 in
Power Supply:	23 x 13 x 48 cm	9 x 12 x 19 in
Antenna:	91 x 104 x 69 cm	63 x 41 x 27 in
Weight		
Transmitter:	79 kg	174 lb
Synchronizer/exciter:	16 kg	36 lb
Rec./Pulse Compress:	22 kg	48 lb
Signal Data Converter:	22 kg	50 lb
Waveguide pressurizer:	7 kg	15 lb
Radar Control/		
Display (optional) :	45 kg	98 lb
Power Supply:	20 kg	44 lb
Antenna:	28 kg	62 lb
Total:	239 kg	527 lb

Characteristics

Frequency:	Mode I & III - 9.5 to 10 GHz (Linear FM sweep) Mode II - 9.6 to 9.9 GHz (Random Frequency Agility)
Peak power:	500 kW
Average power:	500 W
Pulse Width:	0.5 μ sec
Pulse compression PW:	2.5 ns
PRF:	Mode I - 2,000 pps (Periscope detection) Mode II, III - 500 pps (High resolution/surveillance)
Range:	Mode I - 32 nm Mode II & III - 150 nm
Receiver Noise Figure:	4.5 dB
Antenna	
Beamwidth:	2.4° azimuth 4° elevation
Gain:	35 dB
Polarization:	Vertical
Scan rate:	Mode I - 150 rpm Mode II - 6 rpm Mode III - 40 rpm
Units:	Signal Data Converter CV-3672/APS-134 Radar Control/Display IP-1385/APS-134 Power Supply PP-7655/APS-134 Synchronizer/Exciter SN-460A/APS-116 Transmitter T-2190/APS-134 Receiver/Pulse Compressor R-2190/APS-134 Antenna AS-3467/APS-134

Design Features. The APS-134(V) ASW surveillance radar was designed to detect small targets in high sea states. It is a basic APS-116 modified for the international market. The system uses a 512 x 512 x 8 bit digital scan converter with multi-level (shades-of-gray) to provide a background clutter map with overriding target information.

The coherent pulse Doppler system uses high transmitted power, a high gain antenna, and a low-noise preamplifier to achieve long-range performance. The scanner is located in a nose radome. The APS-134(V) transmitted waveform is frequency modulated ("chirped") in linear sweeps over a 500-MHz bandwidth. The receiver signal is pulse compressed, using state-of-the-art surface acoustic wave devices, to a 1.5-ft equivalent pulse/range discrimination.

To diminish the effects of sea spikes (clutter spikes with a life of three seconds or more) the APS-134(V) uses fast-scan processing to time decorrelate the clutter. Radar returns are processed on a scan-by-scan basis over a period of several seconds. The digital processing circuitry integrates the correlated target signals while rejecting the uncorrelated clutter. The rapid scan antenna turns at 150 rpm in the periscope detection mode to maximize the processing gain on a limited-exposure target.

The signal data converter interfaces with the controller and radar, providing a processed video output. In the data converter, the digital scan converter section processes the radar video on a pulse-by-pulse basis, and integrates it on a scan-by-scan basis in the fast and medium scan modes. Once processed, the data are stored; they are converted to analog signals and combined with synchronization signals for display. The system can interface with other aircraft systems via a MIL-STD-1553 digital data bus.

Operational Characteristics. The APS-134(V)'s modes of operation are:

Mode I. The periscope detection mode has a high-resolution (1.5 ft, the approximate size of a periscope

and snorkel) pulse compression which is employed with a high pulse repetition frequency and a fast-scan antenna. The display range is selectable to 32 nautical miles. There is an adjustable false-alarm rate (CFAR) to set the prevailing sea conditions, and a scan-to-scan process is used.

Mode II. The long-range search and navigation mode operates at medium resolution (250 feet) and with a low pulse repetition frequency. It also operates on a slow scan and an operating display range selectable to 150 nautical miles.

Mode III. Operates at high resolution for maritime surveillance. A low pulse repetition frequency (500 PPS) is used with an intermediate scan speed of 40 RPM. The display ranges are selectable to 150 nautical miles. An adjustable false-alarm rate is used in conjunction with scan-to-scan processing. It is particularly effective in detecting patrol and fishing-size vessels in a variety of sea conditions.

The radar has demonstrated the ability to detect a one-square-meter target at over 22 nm in sea state 3. In the maritime surveillance mode the system has demonstrated detection of larger targets out to 150 nm in sea state 5.

Variants/Upgrades

APS-134 (Plus). This variant builds on technological improvements to the original system. It improves periscope detection through advanced signal processing, multiple track-while-scan (TWS), dual channel digital scan conversion, and ESM capabilities. The system reportedly can include a record function and Forward Looking Infrared (FLIR). The system is capable of tracking 32 targets simultaneously.

APS-134(V)6. This version features an Inverse Synthetic Aperture Radar upgrade. This variant can be upgraded to the APS-137(V)6 ISAR.

APS-134(V)7. This is the latest version of the maritime search radar and was designed specifically for periscope and small-target detection under high sea conditions. It is installed in the Fokker Maritime Enforcer Mk.2 and provides 360° coverage out to 200 nm.

Program Review

Background. Texas Instruments originally designated the APS-134(V) radar as the "international successor" to its APS-116 radar system. The new radar incorporated all the characteristics of the original system, but added increased performance which is highlighted by a unique surveillance mode. While the APS-134 is still available from Texas Instruments, it is being superseded by the company's newer APS-137(V) for most new P-3 applications.

In 1978, Dornier was awarded a DM170 million contract to update 19 Federal German Navy BR.1150 Atlantique twin-engine surveillance aircraft with more advanced operational equipment. Under the Atlantique

KWS program (*Kampfwertsteigerung*: enhanced combat capability), the aircraft received equipment from a number of US and European companies, including the Texas Instruments APS-134(V) radar.

In 1984, the US Coast Guard began procurement of six HC-130Hs for the APS-134. In May 1985, the Navy Aviation Supply Office awarded Texas Instruments a contract worth US\$9.7 million for nine sets of APS-134(V) radar weapons replacement assemblies.

In December 1992, Texas Instruments announced that it was delivering the first six APS-134(V)7 radars to Fokker Aircraft B.V. for installation in the new Fokker

Maritime Enforcer Mk.2 patrol aircraft. It was part of a US\$26 million contract to provide radars, spares, support equipment and technical support to Fokker Aircraft. Work had continued through 1996. A user was not identified.

In late 1994, Australia announced that it was contracting to develop its four-element "Coastwatch" program intended to upgrade Surveillance Australia, a commercial surveillance operation used for the nation's customs service. A centerpiece of the program would be three de Havilland Dash 8 Series 200 Maritime

Patrol Aircraft carrying the APS-134 along with other FLIR/TV sensors. This would be the launch customer for the new aircraft.

In mid-1997, a *Commerce Business Daily* announcement noted that the republic of Korea intended to contract for the ISAR upgrade to the APS-134(V)6 radars on their P-3C aircraft. A February 1998 contract award exercised an option to an existing contract to accomplish the upgrades and convert the systems to the APS-137(V)6 ISAR.

Funding

Funding for support is from Operations and Maintenance or FMS accounts. Procurement is from specific platform procurement lines.

Recent Contracts

(Contracts over \$5 million.)

<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
Raytheon	28.8	Dec 1997 – Modification to previously awarded contract to upgrade the APS-134(V)6 to the APS-137(V)6 Inverse Synthetic Aperture radar on eight purchaser P-3C Update III aircraft belonging to the Republic of Korea under the FMS program. Complete Jan 2000. (N00019-95-C-0198)
Raytheon	18.7	Feb 1998 – Modification to previously awarded contract to exercise an option for non-recurring efforts associated with the upgrade of the APF-134(V)6 radar to the APS-137(V)6 Inverse Synthetic Aperture radar. Efforts include engineering, data prototyping, functional/physical configuration audits, technical manuals, source data development, data collection, contractual engineering/technical support, integrated logistics support, spare and repair parts, and support and auxiliary equipment. Complete May 2000. (N00019-95-C-0198)

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
	1969	Design conceived
	1974	Flight testing
	1984	German order for Atlantique surveillance aircraft completed
	1987	Pakistan ordered five APS-134(V)s for its P-3Cs
	1989	TI offered both the APS-134(V) and the APS-137(V) for Spanish P-3 program. Searchwater II selected
Dec	1992	First APS-134(V)7 delivered for Fokker Maritime Enforcer Mk.2 installation
	1996	End of current Fokker contract
Feb	1998	Upgrade contract for Republic of Korea

Worldwide Distribution

Identified installations:

Australia. To be carried by three de Havilland Dash 8 Series 200 Maritime Surveillance Aircraft.

Germany. Procured for modifying 19 Atlantique aircraft.

New Zealand. Carried on six P-3Ks.

Republic of Korea. Carries the APS-134(V)6 on its eight P-3 aircraft.

Forecast Rationale

The APS-134 attracted some international customers, in spite of competition from other US and European radars. The older system was available as a low-cost option to fill the ASW and maritime surveillance needs of Third World nations. The Fokker procurement targeted the Pacific Rim market.

Submarine surveillance is a concern of many nations developing their military forces; but not all nations can afford the latest high-tech equipment. This provided a small, short-term niche for systems such as the APS-134, especially in the Pacific Rim. The sensor has the advantage of being able to serve as a small-vessel surveillance sensor as well as a periscope detection radar.

This radar faced heavy competition from other equipment as manufacturers fought to capture an ever-decreasing market. There is increasing interest in IR/EO sensors as an adjunct to, and sometimes replacement for, radar.

There is heavy competition in the maritime surveillance market for low-end systems. Spain selected the Thorn EMI Searchwater II radar for its P-3s, and Portugal cannot afford upgrades presently. Brunei has selected ARGOSystems to integrate its new fleet of CN-235 maritime patrol aircraft. Once the APS-504 radar was rejected as an option to outfit the aircraft, three systems were selected as possibilities: the APS-134, the Seaspray 4000, and Ocean Master 100. The first of three aircraft are planned for delivery in 1999.

A limited number of unlisted sales were possible in the Pacific rim, but competition from European and Asian manufacturers is intense. New procurement is tending to go with other sensor suites instead of the APS-134. Upgrades of existing APS-134 radars with ISAR is attracting some attention. The contract award for the Republic of Korea, which implements the option of converting the system to the APS-137(V)6 ISAR, is an interesting approach, and may generate limited future interest in the Pacific Rim.

Ten-Year Outlook

No significant further production expected; upgrades only.

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