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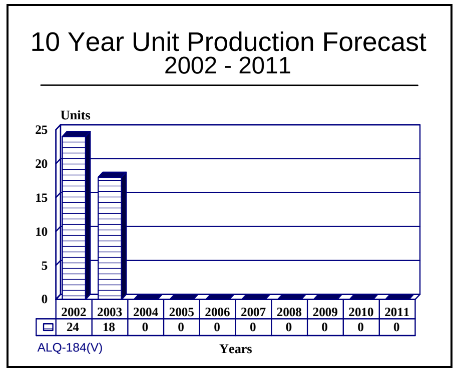
ALQ-184(V) – Archived 04/2003

Outlook

- In service; upgrades and logistics support continue
- Limited FMS market
- Some pods upgraded with MWS and towed decoy



Orientation

Description. Airborne noise/deception jamming pod. Incorporating towed decoy in select pods.

Sponsor

US Air Force
Warner Robins Air Logistics Center
Robins AFB, Georgia (GA) 31098
USA
Tel: +1 912 468 1001
Web site: http://www.wpafb.af.mil

Contractors

Raytheon Systems Company
Sensors & Electronic Systems
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Goleta, California (CA) 93117
USA
Tel: +1 805 967 5511
Fax: +1 805 964 0470
Web site: http://www.raytheon.com
(ALQ-184(V), ALE-50(V))

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

Total Produced. Through 2001, an estimated 1,049 pods had been produced.

Application. A-10A, F-15B/D and F-16A/B.

Price Range. The estimated cost for a pod modification kit is approximately US$850,000. New production FMS pods are estimated to cost US$950,000.

Price is estimated based on an analysis of contracting data and other available cost information and and a comparison with equivalent items. It represents the best-guess price of a typical system. Individual acquisitions may vary, depending on program factors.

Technical Data

	Metric	US
Dimensions		
Two-Band pod		
Length:	2.9 m	115.8 in

	Metric	**US**
Dimensions		
Height:	67.5 cm	12 in
Width:	32.5 cm	13 in
Weight:	209.5 kg	461 lb
Three-Band pod		
Length:	3.96 m	155.8 in
Height:	67.5 cm	12 in
Width:	32.5 cm	13 in
Weight:	288.6 kg	635 lb
ALQ-184(V)9		
Length:	396.2 cm	156 in
Height:	53.3 cm	21 in
Width:	45.7 cm	18 in
Weight:	337.8 kg	744 lb

Characteristics	
Prime Power	
Two-Band pod:	6.4 kVA
Three-Band pod:	9.1 kVA
Altitude:	to 50,000 ft
Temperature:	-54 to +85º C (to +120º C intermittently)
Shock:	15g, 11 ms
Frequency range:	2 to 10 GHz, continuous coverage
Power out (ERP):	>10dB greater than ALQ-119
Antenna:	Multi-beam array, 8 elements (with polarizer), forward and aft sector Lens produces up to 15 beams in each sector
Transmitter:	16 mini-TWTs, Gain and Phase Tracked, Solid-State Driver Amplifiers
MTBF	
Two-Band:	150 hr (warranted)
Three-Band:	80 hr
Desert Storm:	189.8 demonstrated
MTTR:	3.0 hr
Operating modes:	Repeater Noise Transponder
Probability of detection:	100%
Detect modes:	CW Pulse Pulse Doppler
BIT:	Flight line indication Detects >90% of the faults
Automatic Support Equipment:	ALM-233

Design Features. The ALQ-184(V) is an ALQ-119(V) modified with a Raytheon-supplied kit that installs new plug-in circuit boards (digital technology) to replace much of the analog hardware for the upper two frequency bands, and substituting Rotman electrically scannable antennas for the ALQ-119(V)'s fixed antennas. The modification replaced 80 of the original 93 circuit boards.

The result was a pod with higher effective radiated power (ERP) using phased array with 100 percent duty cycle transmit capability, reduced response time, instantaneous RF signal processing, wide open in angle and frequency; and a broader array of ECM techniques, software reprogrammable repeater, transponder, and noise. The system has wider frequency range, continuous coverage, 100 percent probability of detection with high sensitivity multi-beam receivers: CW, pulse, and pulse-Doppler detection; as well as direction finding on every received signal, independent of frequency. The upgraded pod features improved reliability and maintainability and programmable digital microprocessor control with techniques customized for maximum effectiveness against engaged emitters.

The pod has the same physical dimensions, volume and weight characteristics as the original ALQ-119(V) pod. The ALQ-184(V) is microprocessor-controlled, re-programmable, and more operationally flexible, operating continuously across its designed frequency band and incorporating the latest repeater, transponder, and noise modes of operation. In the transponder and noise modes, an internally generated signal is selected from a voltage-controlled oscillator (VCO) assembly. The signal is modulated by a techniques generator and fed through signal switches and mini-TWT amplifiers to the correct antenna array for transmission.

The loop is reduced for repeater operation, as antennas, RF switches, channelizers, and direction-finding (DF) receivers are located close to one another. This shortens the receiver-to-transmitter path length. The pod does not transmit until preset pulse-count thresholds are exceeded.

Rotman scannable antennas allow jamming energy to be aimed, making more efficient use of the pod's transmitter power. The Rotman lens multi-beam hardware was developed for the SLQ-32(V) surface ship ECM system. It is electrically, rather than mechanically, steered. Other design characteristics of the ALQ-184(V) include high-gain antennas, medium-power mini-traveling wave tubes, crystal video receivers, and more powerful signal processors.

Reliability is enhanced by using mini-TWTs, which are inherently more reliable than conventional high-power, high-voltage hardware. The mini-TWTs allow the pod to degrade gracefully rather than catastrophically, should any fail. A TWT failure does not disable the ALQ-184(V) but it does reduce the effective radiated power. An efficient cooling system lowers the heat-generated failures in the solid-state transmitter hardware.

Maintainability was improved by eliminating the need for extensive TWT balance and adjustments during repair or installation. An Automatic Gain Optimization (AGO) system dynamically adjusts system gain in each transmitter beam position to the maximum stable value for the installation configuration.

Built-in test diagnostics and compatibility with the ALM-233(V) Automatic Support and Test Equipment reduce the need for extensive maintenance and logistic support. The system can self-test, detecting over 90 percent of existing faults.

There are pre-planned product improvements for performance growth with technology inserts planned over the life of the pod. The program also includes a series of reliability enhancements.

Modifications to a three-band pod make it possible to add an ALE-50(V) Launch Controller and four-decoy Launcher, giving the pod a towed decoy capability. The original Low-Band Controller is modernized and made field programmable by replacing twelve 1970s-vintage circuit cards with two 1990s-technology circuit cards. The more reliable cards make up for the MTBF impact of adding the ALE-50(V), and actually improves overall MTBF.

Key new additions are the Electronic Countermeasures Control Processor, Advanced Correlation Processor (ACP), and Reprogrammable Low-Band. The ACP manages coordination between the pod and the towed decoy, deciding between the ALQ-184(V) and ALE-50(V) which threat responses to use to counter the threat. This improvement in communications capability enhances the pod's ability to interface with the carrying aircraft and other systems like RWR and MWS.

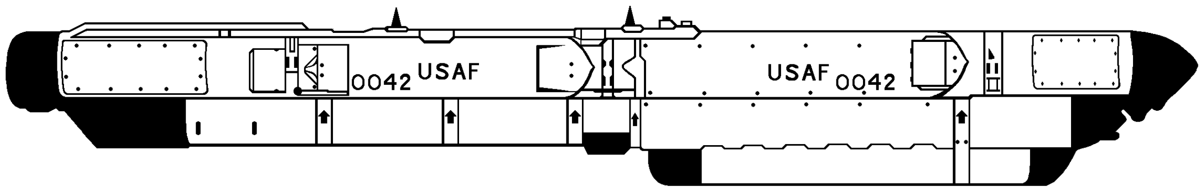
The decoy system is designed to accommodate future Fiber Optic Towed Decoys or towed IR decoys being developed. The ALE-50(V) towed decoy comes in a sealed container which carries the pay-out reel and has a shelf life of ten years.

Operational Characteristics. The pod was designed to operate in a modern threat environment. It uses instantaneous RF signal processing wide open in angle and frequency analysis and was designed for a 100 percent probability of detection of CW, pulse and pulse Doppler signals. The pod performs direction finding on every received signal, no matter what the frequency. It provides selective high-power countermeasures against multiple emitters. The ALQ-184(V) also generates rapid, retrodirective, automatic ECM response against identified threats. Once a received signal is determined to be a threat by comparing the signal characteristics to a library of threat parameters, the pod uses pre-programmed rules to select a response. It automatically initiates the necessary countermeasures in real time.

In the transponder and noise modes, the pod transmits an internally generated signal modulated by a programmable techniques generator and directed back at the threat signal source. A pre-programmed pulse-count based on known threat characteristics determines when the pod will transmit the signal.

In the receiver mode, the signal is received and re-transmitted back in the direction of the emitter with selected deceptive modulations applied.

The towed decoy improves to the ability of the ALQ-184(V) to protect an aircraft by generating a decoying/disrupting signal from a distance behind the aircraft. A threatening missile can explode within kill distance of the decoy without harming the aircraft. By carrying four decoys, the ALQ-184(V) provides defense in depth.



ALQ-184(V)

Source: Forecast International

Variants/Upgrades

ALQ-184(V)5. This version incorporates various engineering change proposals. The most recent upgrade involved a contract to install reprogrammable low-band kits to provide flight line reprogrammability, improve life-cycle costs, and add modulation jamming techniques.

ALQ-184(V) MWS. Missile Warning/Chaff Dispenser enhancement. Engineers added an ALQ-156(V) missile warning system to a test pod, with antennas added both front and rear to detect missile threats. Two ALE-40/47(V) dispensers can also be installed to provide a chaff-dispensing capability. Addition of an AAR-44(V) system or AAR-47A/B is also possible.

ALQ-184(V)9. This version has an ALE-50(V) Towed RF Decoy mounted under the rear of a standard ALQ-184(V) pod. A 1 x 4 Launcher carries four decoys. The design includes upgrades to an IO decoy when that development is complete, enhancing both the RF and IR threat protection available with this pod.

To make room for the ALE-50(V) Launch Controller, the low-band controller was modernized and made field programmable by converting twelve '70s vintage circuit cards into two '90's technology cards. This change also increased MTBF of the pod. Pod communication with the aircraft is enhanced with the installation of dual-redundant 1553B interfaces.

The processor, considered third-generation technology, decides on whether the ALQ-184(V) internal jammer or towed decoy is used to counter a particular threat.

ALQ-187. This is an internal jammer produced for FMS clients and based generally on ALQ-184(V) components and architecture. It has been offered as an alternative to the ASPJ.

Program Review

Background. After Raytheon demonstrated a Rotman antenna to the Air Force in 1978 and showed a 10 dB increase in effective radiated power, the USAF awarded the company a contract to modify two of the ALQ-119(V)'s three bands in a single pod that would be flight tested. The experimental pod flew 38 test missions in 1981 and 1982. A significant change was made in this experimental pod, including reversing some of the configuration for better transmitter cooling and enhanced reliability, as well as improved response time for deceptive-type countermeasures.

In August 1979, the Air Force conducted a review and update existing specifications for the pod. Engineers would participate in the development of specifications for the ALQ-119(V)15/17 Interim Threat Update program.

In July 1982, Raytheon won a contract to upgrade the ALQ-119(V) and developed a modification kit to completely upgrade the ALQ-119(V). Because of the extensive nature of the re-do, the pod was renamed the ALQ-184(V). The original contract called for five pre-production ALQ-184(V)s (for reliability and flight tests) and modification kits for 70 more pods.

On August 3, 1988, the pod had achieved Initial Operational Capability (IOC). Operational Test and Evaluation was completed at the Eglin AFB Test Range in Florida later that year.

Raytheon received a US$120.3 million contract on September 25, 1989, to produce and deliver 120 pods and six ALM-233(V) field support equipment units under the AF ECM Pod Competition program. In this competition, the Air Force was to have a split pod procurement over the next five years between the Northrop Grumman ALQ-131(V) and Raytheon. The selection of the ALQ-184(V) for the complete pod procurement for the year indicated that it had become the Air Force's pod of choice.

An estimated 27 ALQ-184(V) jamming pods were deployed to the Persian Gulf War with F-4G Wild Weasel aircraft from George AFB. They were carried by the Wild Weasels on defense suppression missions into the heart of the threat environment. The ability to rapidly reprogram them for non-standard threats was an important part of the successful application of electronic warfare during the conflict. These pods were returned to the US after the Ground War. ALQ-131(V) pods remained in-theater to support air Operation Deny Flight.

In May 1995, the government of Taiwan procured 82 ALQ-184(V) pods to equip the F-16s it was acquiring for the ROCAF. The contract included automated support equipment, along with associated software and data packages. This was the first FMS sale of the pods.

In February 1996, the Air Force contracted Raytheon E-Systems to modify ten pods to the (V)9 configuration with the ALE-50(V) Towed RF Decoy installed.

In October 1996, The US Air Force awarded Raytheon E-Systems a contract to upgrade the ALQ-184(V) by building 225 reprogrammable low-band kits, which would provide the pods with rapid flight-line programming, improved life-cycle cost and additional modulation jamming techniques. The contract included options for upgrade kits to all ALQ-184(V) pods produced to date. That could add US$13 million to the value of the contract.

The Air Force published a June 1997 Sources Sought announcement for eight ALQ-184(V)9 pods for the Air National Guard. They would be used on F-16 Block 25/30 aircraft. The effort would include repair requirements for 18 -(V)9-unique circuit cards (electronic countermeasures control processor, advanced correlation processor, and reprogrammable low band), as well as associated interface maintenance, spares, support equipment, and training source data. Eight-(V)5 pods and eight multi-platform launch controllers would be provided as government-furnished equipment.

A November 1999 *Commerce Business Daily* notice of contract action from the Air Force announced that planners intended to issue a sole-source contract to Raytheon to produce eight ALQ-184(V9) Electronic Countermeasures(ECM) systems for the Air National Guard F-16 Block 25/30 aircraft. Also included in this effort was the repair requirements to support 18 sets of ALQ-184(V)9-unique circuit cards (Electronic Countermeasures Control Processor, Advanced Correlation Processor, and Reprogrammable Low Band), associated interface maintenance, spares, support equipment, and training source data. The government will provide eight ALQ-184(V)7 pods and eight Multi-Platform Launch Controllers as Government Furnished Property. The ALQ-184(V)9 production program will continue the integration of the ALE-50(V) towed decoy system in a three-band ALQ-184(V)9 pod. The ALE-50(V) towed decoy system cannot be carried on F-16 Block 25/30 aircraft without this modification.

This eight-pod production program would compliment ten pods previously developed by Raytheon under an Advanced Technology Demonstrator contract. As of 16 April 1999, these ten pods had been accepted by the Virginia, Air National Guard. Nine were operational, with the tenth pod being used for testing at Eglin AFB Florida. These additional (V)9 pods would enable an entire squadron of F-16 Block 25/30 aircraft to operate with a podded version of the ALE-50(V) system. No follow-on production buys were anticipated at the time, and the effort was budgeted at US$8 million.

In June 2000, the DoD announced a proposed sale of 48 ALQ-184(V) pods to Taiwan. With spares and support, the contract value was put at US$122 million.

Funding

Current funding is from O&M or logistics lines.

Recent Contracts

(Contracts over US$5 million.)

Contractor	**Award ($ millions)**	**Date/Description**
Raytheon	105.8	May 1995 – FFP contract for 82 ALQ-184 electronic attack pods. Six ALM-233 automated support equipment packages, as well as associated software and data. Completed December 1997 FMS to Taiwan. (F09603-95-C-0207)
Raytheon	5.2	Feb 1996 – CPFF contract to provide for integration of the ALE-50 Towed RF Decoy into ten ALQ-184 pods for the F-15 and F-16 aircraft. Completed December 1996. (F33657-96-C-0007)
Raytheon	5.8	Oct 1996 – Contract to build 225 reprogrammable low-band kits for ALQ-184. Includes options for additional kits.
Raytheon	6.7	Dec 1996 – FFP contract to provide for 312 line items of spare parts for the ALQ-184 pod on F-16 aircraft. Completed January 1998. (F09603-97/C-0061)
Raytheon	5.4	Apr 2000 – Mod to an CPFF contract to provide 298 modification kits (149 depot, 149 field installations) applicable to the ALQ-184(V) pod for the F-15, F-16, and A-10 aircraft. Complete September 2001. (F09603-96-C-0613 P00009)

Timetable

Month	**Year**	**Major Development**
Late	1970s	Raytheon proposes an upgrade to the ALQ-119(V)
	1978	Raytheon demonstrates Rotman lens array for ALQ-119(V); USAF contracted to modify two of ALQ-119(V)'s frequency bands
	1980/1	Experimental pod flight-tested
	1982	New pod given ALQ-184(V) designation; Raytheon awarded contract for five pre-production ALQ-184(V)s and modifications for 70 more pods
	1984	First pre-production pod tested
Sep	1985	Raytheon awarded contract to modify ALQ-119's low-band jammer
Spring	1986	Fourth and fifth pre-production pods begin flight testing
Mar	1987	Pre-production ALQ-184(V)s delivered
Mid	1987	Delivery of experimental pod with modified low-band jammer
	1988	ALQ-184(V) low-band modification complete
Aug	1988	ALQ-184(V) achieves initial operating capability (IOU)
Jun	1992	Lot III production contract
Jan	1993	Lot III production complete
Oct	1994	Lot IV production contract
May	1995	First FMS sale (Taiwan)
Sep	1995	Lot IV deliveries begin
Oct	1995	Lot IV production complete
Dec	1997	Taiwan production complete (82 pods)
Oct	1999	ANG purchase of first ten ALQ-184(V)9 pods
Apr	2001	ANG squadron fully equipped with ALQ-184(V)9

Worldwide Distribution

The ALQ-184(V) is used by the **US** and is being procured by **Taiwan**.

Forecast Rationale

The ALQ-184(V) is one of the Air Force's prime, combat-proven jamming pods and has been procured to support operational aircraft and to build up wartime stocks. The ALQ-184(V), ALQ-131(V) and ALQ-119(V) are carried by the Air Force. The -184(V) and -131(V) are used on those missions requiring the most capable threat protection, and the -119(V) for backup and lighter-threat missions. All three were deployed to the Persian Gulf in support of Operation Desert Storm. There is a major need to integrate other systems, such as missile warning and expendable dispensers, into existing EW pods, broadening their spectrum of protection.

The outlook for podded EW systems for high-performance aircraft is limited. The ALQ-184(V) is relatively state-of-the-art, but pods cause aerodynamic drag and take up weapons pylon space, so the trend is toward internal systems; but it is not practical, or even possible, to install internal jammers in many of today's operational aircraft. The next-generation aircraft are being designed to have internally mounted electronic combat equipment.

Retrofitting missile warning components into existing pods and adding ALE-50(V) towed decoys to selected pods is the future market opportunity, adding to an active upgrade effort. The number of ALQ-184(V)s in use supports a significant spares/repairs market. A wartime resources requirement also exists. Several aircraft types that carry pods, namely the A-7D, F-4E/G and RF-4C, are being retired.

Taiwan was the first FMS acquisition, and it may increase its purchase beyond the current 82; although a one-per-new-F-16 procurement is not likely. Egypt was considering producing some pods for its F-16s, although a request for upgrading its ALQ-131(V) pods from Block I to Block II configuration indicated that the country has opted against ALQ-184(V) acquisition, probably for fiscal reasons. The Finnish, Swiss and South Korean decisions to procure the ALQ-165(V) ASPJ reduce the overall number of pods that will be needed by eligible forces. A Missile Warning System may be exported to the ROCAF, but the ALE-50(V) addition should remain US-only for some time.

A series of tests with the ALQ-184(V) found that, by using sophisticated modeling algorithms, improved jamming techniques could be developed. Individual variations in the manufacture of threat radars and missile seeker heads have reduced the overall effectiveness of jamming based on known design characteristics of the threat systems. Testers, using the pod at both Air Force and Navy test ranges, found that when individual variations in fielded hardware were taken into consideration in developing ECM techniques, jamming effectiveness improved considerably. Using more detailed simulation models has direct implications for the programming of pods and other jammers, and is being implemented by the Services.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

			High Confidence Level			Good Confidence Level			Speculative			
Designation	**Application**	**Thru 01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**Total 02-11**
ALQ-184	Prior Prod'n:	961	0	0	0	0	0	0	0	0	0	0	0
ALQ-184(V)	TACTICAL AIRCRAFT (ROCAF)	88	24	18	0	0	0	0	0	0	0	0	42
Total Production		1049	24	18	0	0	0	0	0	0	0	0	42