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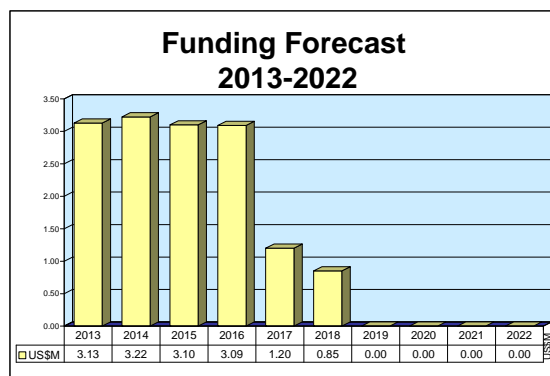
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ALQ-135(V)

Outlook

- Only known ALQ-135 platform is the F-15 aircraft
- Deliveries for the last remaining customer, the Singapore Air Force, for application on its F-15SGs ended in 2012
- Recent sales of the F-15 have included BAE Systems' DEWS EW system instead of the ALQ-135
- O&M contracts will sustain the value of the ALQ-135 program for several more years



Orientation

Description. The ALQ-135 is an internal electronic jamming system that forms part of the tactical electronic warfare system (TEWS) on F-15 aircraft.

Sponsor

U.S. Air Force

Web site: <http://www.af.mil>

Status. Out of production, with ongoing logistics support.

Application. F-15C/D, F-15E, F-15K, and F-15S.

Price Range. Forecast International estimates the price of the ALQ-135(V) to range between \$3 million and \$4 million. This is based on a \$74.6 million July 2008 contract for 21 ALQ-135 systems, which would yield a unit cost of \$3.55 million. Unit prices are generally higher for a small quantity buy and if additional options are included such as training, technical engineering support, logistics, and spares.

Contractors

Prime

Northrop Grumman Electronic Systems, Targeting Systems

<http://www.es.northropgrumman.com>, 600 Hicks Rd, Rolling Meadows, IL 60008-1098
United States, Tel: + 1 (847) 259-9600, Fax: + 1 (847) 870-5705,
Email: contact_dsd@ngc.com, Prime

Subcontractor

Ducommun LaBarge Technologies Inc

<http://www.ducommun.com/dti/Default.aspx>, 11616 E 51st St, Tulsa, OK 74146-5911
United States, Tel: + 1 (918) 459-2200 (Circuit Card Assembly)

Comprehensive information on Contractors can be found in Forecast International's "International Contractors" series. For a detailed description, go to www.forecastinternational.com (see Products & Services/Governments & Industries) or call + 1 (203) 426-0800.

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown,

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Technical Data

	<u>Metric</u>	<u>U.S.</u>
Dimensions		
Weight	136 kg	300 lb
Characteristics		
Frequency	2 to 20 GHz	
Coverage	360°	
Transmitter	Power managed	
LRUs	7	
Antennas	4	
MTBF	120 hr	
Modes	Multiple	
	Software reprogrammable	
Features	Look-through-while-jam	
	Large integrated threat library	
Integrates with (1553)	ALR-56C	
	ALQ-128(V)	
	ALE-45(V)	
	IDECM FOTD (proposed)	

Design Features. The F-15's protective system, the tactical electronic warfare system (TEWS), consists of the ALR-56C radar warning receiver (RWR), the ALQ-128(V) electronic warfare warning system, the ALE-45(V) countermeasures dispenser, and the ALQ-135(V) jamming system. It operates effectively over a wide range of frequencies.

The noise and deception jammer uses dual-mode, pulsed, continuous-wave traveling wave tube transmitters. Power management ensures effective radiated power across the threat band. The basic configuration includes two line replaceable units (LRUs) and the appropriate antennas and waveguides, as well as channelized receivers for fast system response.

Each LRU contains a radio frequency amplifier and a control oscillator, both of which are mission interchangeable. Twenty processors support task partitioning for fast response and flexibility. The system is reprogrammable. Due to its 120-hour mean time between failures (MTBF) and modular construction, the ALQ-135(V) has been a reliable internal countermeasures system.

The control/processing system features 20 micro-processors in a federated architecture with parallel processing for fast system response and flexibility / reprogrammability. The system responds quickly to threat-jamming needs with an effective, measured response in a dense signal environment.

The updated system features an enhanced Band 3 capability and an extension of the frequency band

coverage from 10 GHz to 20 GHz. To provide sufficient space for the new Band 3 hardware in the restricted confines of the dual-seat F-15E, designers combined and packaged the system's two original lower frequency jammers (Band 1 and Band 2) into half the volume, providing additional processing capacity. The result was a new Band 1.5 jammer.

To enhance coverage, forward-looking receive/transmit antennas for both Band 1.5 and Band 3 were added at the wing root of the F-15E. The Band 3 upgrade was installed on the final F-15Cs built in 1989 as part of the Multi-Stage Improvement Program, and they will be retrofitted into existing F-15Cs as part of the TEWS upgrade. Because the F-15C is a single-seat aircraft, it retains its Band 1 and Band 2 jammers. The Band 3 jammer was designed to be installed on F-15E aircraft and retrofitted to selected F-15C/D aircraft.

Operational Characteristics. The ALQ-135(V) features automatic jamming of threat radars, and has a dual-mode capability that counters pulse and continuous wave threats. The system can adapt automatically to changes in the threat environment, since electronic countermeasure frequency sources are computer-managed.

A four-antenna array provides 360° jamming coverage. The ALR-56(V) RWR performs jamming system management, while built-in test equipment continuously monitors system performance.

The F-15E dual-role fighter makes extra demands on the ALQ-135(V). The equipment has to be effective in both air-to-air and air-to-ground realms, and has been

ALQ-135(V)

upgraded to adapt to a more intense ground threat environment. During Operation Desert Shield/Storm, the Air Force fielded three software versions to adjust

the threat library to support the operation. Each time, the changes were made in less than 72 hours.



ALQ-135(V)

Source: Northrop Grumman

Variants/Upgrades

ALQ-135(V) Updated Band 3 and Band 1.5 Systems. Development of the Band 3 subsystem was initiated in 1983 under a Quick Reaction Capability contract. The Band 3 jammer, housed in two LRUs, fits in the same volume as the Band 2 jammer. The frequency coverage of the Band 3 jammer overlaps the frequency coverage of the original Band 2 jammer.

The system for the F-15E is designated ALQ-135C. It is equipped with both the Band 3 and Band 1.5 system. A Band 1.5 system consists of one control oscillator and two RF amplifiers. Band 1.5 upgrades are in production.

BOL Chaff Dispensers (BOL-155, ALE-58(V)). Combat-coded F-15s can receive a new defensive capability for nighttime missions. Congress provided extra money in the defense budget to purchase the chaff and infrared countermeasures system.

BOL countermeasures are proactive and can be fired continuously while the aircraft is in a hostile

environment, preventing enemy missiles from locking on to the aircraft. The countermeasures are released mechanically rather than by firing pyrotechnics; the F-15 will not give away its position by employing the system, a critical benefit for night operations.

The F-15 design includes four dispensers per aircraft, and up to 640 expendable countermeasure rounds can be carried. The Air Force plans to modify the entire F-15 combat fleet.

ALQ-135M. This latest version is being installed on the Republic of Korea's F-15Ks. It has been updated with miniature microwave-power module transmitters and PowerPC processors. The changes will result in a system that is smaller (71 percent less volume), lighter (63 percent weight reduction), and 10 times more reliable (MPM Ultraband technology) than previous units.

Program Review

The ALQ-135(V) was developed under a 1971 contract to design and develop a protective system for the F-15 aircraft. In 1975, a contract was awarded for 44 units,

with the first production systems delivered in 1977. By 1981, Northrop (now Northrop Grumman) had delivered approximately 350 sets.

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During FY84, Northrop delivered prototype models of the ALR-56C and ALQ-135(V) Update (Band 3) systems. In FY85, ground and flight testing was completed and a full-up tactical electronic warfare system (TEWS) integration effort began.

ALQ-135 Upgrades and Contracts

In FY86, Band 3 subsystem flight tests were completed, as were integration and testing of ALR-56C and ALQ-135(V) updates. Additionally, the ALR-56C and ALQ-135(V) received software updates that would enable them to respond to new threats. Band 3 production began in 1986.

During FY87, software updates to the ALR-56C and ALQ-135(V) Quick Reaction Capability systems were tested. During 1989, Band 1 and Band 2 reliability and maintainability improvements were developed, and the integration of the ALE-45(V) countermeasures dispenser with the ALQ-135(V) continued to improve TEWS effectiveness.

In FY90, the USAF completed software development of Band 3, Phase 1. OT&E flight testing was completed, followed by the start of installations of the Band 3 enhancement on F-15Es. In FY91, Lot IV deliveries began. During FY92, the USAF completed F-15E ALR-56C/ALQ-135(V) Phase II developmental testing.

In 1994, deliveries of Lot V of 60 ALQ-135(V) Band 3 shipsets, as well as deliveries of Lot VI Band 3 hardware and "Group A" equipment, were completed. "ALQ-135(V) Phase II development and testing was completed in 1994.

The Lot VIII contract was awarded in 1995 for Band 3 hardware, with options for flight-test support, logistics support, engineering support, data, and other support as required. Deliveries ended in 1997. Deliveries of 63 shipsets produced as Lot IX ran through March 2000. Lot IX included options for another 18 shipsets.

RSAF Upgrades F-15 Aircraft

In 1992, the Royal Saudi Air Force (RSAF) began upgrading its F-15Cs with the ALQ-135(V), completing that work in 1993. In 1993, the RSAF signed a letter of agreement to acquire Peace Sun IX (F-15S) aircraft, committing \$196.9 million for TEWS avionics, which included the ALQ-135(V) Low Band 1.5 jammer. The

same year, it was announced that the RSAF would procure 75 sets of Band 3 Group B hardware, 78 sets of Band 1.5 Group B hardware, and 72 sets of Group A equipment, along with associated waveguides, cables, and antennas. These items were procured through Foreign Military Sales (FMS) channels. Deliveries ended in 1997.

Band 1.5 Production

In 1998, the USAF began working with Northrop Grumman to design and produce the ALQ-135 Band 1.5. By the end of 2000, the Band 1.5 subsystem had completed IOT&E, and a contract for 17 initial systems (Lot II) was awarded. The first Band 1.5 subsystem was installed on an F-15E in December 2000. After installation, the system was tested to verify successful threat jamming using the Northrop Grumman Virtual System Analyzer. The VSA was developed specifically for the ALQ-135(V) to test all the electronic components and inject threats into the system to ensure operational viability.

In 2002, a third contract for 28 Band 1.5 systems was awarded to Northrop Grumman. The effort was valued at \$65 million. This was the third of a planned five-lot program, with deliveries completed by 2003.

Selected for Korean and Singaporean F-15Ks

In October 2002, the Republic of Korea (South Korea) awarded Northrop Grumman, via Boeing, a \$160 million contract for the ALQ-135(V) radar jammer for its 40 F-15K Slam Eagle aircraft. Deliveries of the first batch of 40 were completed in early 2008. The F-15K TEWS includes the ALR-56C(V)1 and ALE-47(V).

South Korea purchased 20 additional F-15Ks in 2008. The order includes 21 ALQ-135Ms. Northrop Grumman was awarded a \$74.6 million contract in July 2008 to provide the electronic countermeasure (ECM) systems for the F-15s. In March 2005, Northrop Grumman delivered the first five production units for the Korean F-15Ks. These units are designated the ALQ-135M.

In December 2005, Singapore ordered the F-15SG for a 20-unit fighter requirement. Although the ALQ-135 has not officially been chosen for Singapore's new fighters, the F-15SG is reportedly configured similarly to the F-15K, which comes equipped with the ALQ-135.

ALQ-135(V)

Contracts/Orders & Options

(Contracts over \$5 million.)

Contractor	Award (\$ millions)	Date/Description
Northrop Grumman	10.7	Jan 2004 – FFP contract mod for F-15E ALQ-135(V) Band 1.5 Lot V. Completed Jun 2005. (F33657-98-C-0037)
Northrop Grumman	10.2	Feb 2004 – FFP contract mod for F-15E ALQ-135(V) Band 1.5 Lot V. Completed Jun 2005. (F33657-98-C-0037, P00057)
Teledyne Wireless	370	Sep 2006 – FFP, T/M, and cost-reimbursable-without-fee contract for spares (nine items), remanufacture/modernization/repair services (57 output items), engineering and logistics sustainment/modification services, and data that are sole source to Teledyne within the authority of the approved SAF/AQ class J&A #06-JA-013 (Jul 11, 2006). The class J&A covers supplies/services supporting communications and electronics items for the ALQ-131, ALQ-161, ALQ-135, ALQ-172, and Joint Helmet Mounted Cueing System. This work will be completed by Oct 2017. (FA8536-06-D-0002)
Northrop Grumman	74.6	Jul 2008 – Contract for 21 ALQ-135M systems for the Republic of Korea Air Force. Deliveries were to begin in Feb 2010 and end in Oct 2011.
Northrop Grumman	9.5	Sep 2009 – Contract for engineering services applicable to the ALQ-135. The 55 CONS/LGCD, Offutt Air Force Base, NE, is the contracting activity. (SP0700-03-D-1380, DO:0341)
Northrop Grumman	4.6	Jul 2010 – Contract for engineering services and system sustainment in support of the ALQ-135. Period of activity was 24 months following contract. (F09603-03-D-0002-0341)
Northrop Grumman	8.6	Sep 2011 – Contract for ALQ-135 ICS engineering services, covering the base year and second ordering period of a five-period ordering cycle. Period activity began 90 days following contract award and lasted for 12 months per ordering period. (FA8540-11-C-0017)

Timetable

Month	Year	Major Development
Aug	1974	Initial developmental funding
Sep	1975	Production begins
	1982	Decision made to integrate ALQ-135(V)/ALR-56 with the F-15 TEWS
Feb	1983	ALQ-135(V) Quick Reaction Capabilities Band 3 development contract
Sep	1983	ALQ-135(V) Band 1.5 preliminary development contract
May	1985	ALQ-135(V) Band 1.5 development/Band 3 production qualification contract
Mid-	1986	ALQ-135(V) Band 3 production
Sep	1986	F-15 TEWS flight test
Mar	1987	ALQ-135(V) countermeasures development contract
Mar	1989	First Band 3 production units delivered
May	1990	First installations on the F-15E
	1990	Band 3 deployment
	1991	Flight tests of Band 1.5
Late	1991	Band 1.5 production units delivered, first F-15E installations
Oct	1994	RSAF Peace Sun IX procurement, 75 shipsets begun
3Q	FY97	Band 1.5 development begins
Oct	1997	RSAF Peace Sun deliveries complete
2Q	FY99	Band 1.5 OT begun

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<u>Month</u>	<u>Year</u>	<u>Major Development</u>
2Q	FY00	Band 1.5 DT/OT begun
Oct	2000	Band 1.5 IOT&E completed
Dec	2000	Band 1.5 upgrade approved for full-rate production; Lot II contract
Feb	2001	ROK FMS notice for F-15K (40 systems)
Dec	2001	First lot of Band 1.5 completed, Lot III awarded (congressional plus-up adds 15 shipsets)
Oct	2002	ROK contract for 40 F-15K tactical electronic warfare systems
Dec	2002	Band 1.5 Lot IV option (nine shipsets)
Mar	2003	Band 1.5 Lot IV+ (congressional plus-up adds eight shipsets)
Jan	2004	Band 1.5 Lot V option (four shipsets, with the remaining five of nine to be acquired on receipt of FY04 congressional plus-up – \$10 million)
	2005	FOTD integration
Mar	2005	The first five ALQ-135Ms delivered to South Korea
Jul	2008	South Korea purchases additional ALQ-135s for 20 additional F-15Ks
	2011	End of F-15 deliveries to South Korea
	2012	End of F-15 deliveries to Singapore

Worldwide Distribution/Inventories

Almost all countries that operate the F-15 also use the ALQ-135. Countries include **Saudi Arabia**, **Singapore**, **South Korea**, and the **United States**. The F-15 fleets of Israel and Japan do not use the ALQ-135(V).

Forecast Rationale

Northrop Grumman's ALQ-135 has potentially reached the culmination of its production life. Boeing has elected to propose BAE Systems' DEWS EW system for all recent fighter competitions for which the F-15 has been bid. This spells trouble for the production potential of the ALQ-135, as the F-15 is the jammer's sole platform.

Compounding the system's troubles, there is little chance of the ALQ-135 being ordered for an alternative aerial platform. The ALQ-135 was designed especially

for the F-15, making such cross-platform use next to impossible without significant changes to the system.

Looking forward, although no new units will be built, Northrop Grumman will continue to garner contracts for the ALQ-135. Forces operating the system will seek to maintain the ALQ-135's relevance. In particular, system sustainment components, plus engineering services, are being acquired by a U.S. Air Force program that will be active through at least 2016.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR O&M FUNDING (in millions \$)												
Designation or Program		High Confidence				Good Confidence			Speculative			Total
	Thru 2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	
Northrop Grumman Electronic Systems												
ALQ-135 <> United States <> Air Force <> F-15												
	10.12	3.13	3.22	3.10	3.09	1.20	.85	.00	.00	.00	.00	14.59
Total	10.12	3.13	3.22	3.10	3.09	1.20	.85	.00	.00	.00	.00	14.59