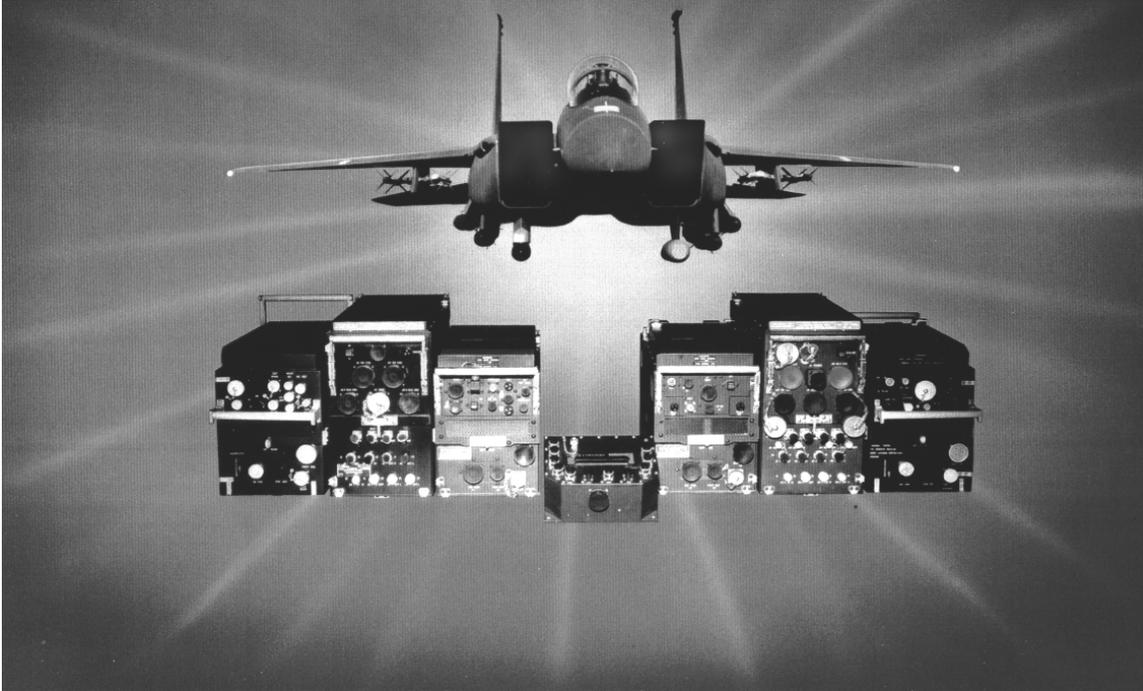


F-15 TACTICAL ELECTRONIC WARFARE SYSTEM (TEWS) (AN/ALQ-135 BAND 1.5)



Air Force ACAT III Program

Total Number of Systems:	162
Total Program Cost (TY\$):	\$368.7M
Average Unit Cost (TY\$):	\$2.057M

Prime Contractor

Northrop Grumman

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2010

The F-15 Tactical Electronic Warfare System (TEWS) AN/ALQ-135 Band 1.5 contributes to *full-dimensional protection* by improving individual aircraft probability of survival through improved air crew situation awareness of the radar guided threat environment, cueing both active and passive countermeasures in the Band 1.5 frequency spectrum, and adding a waveform select feature for jamming optimization against specific threats. The F-15 TEWS consists of the AN/ALR-56C radar warning receiver (RWR), the AN/ALQ-135 internal countermeasures set (ICS), the AN/ALQ-128 electronic warfare warning set, and the AN/ALE-40/45 countermeasures dispenser. TEWS provides electronic detection and identification of surface and airborne threats. In addition, it allows for activation of appropriate countermeasures, including electronic jamming and dispensing of expendables such as chaff and flares.

Integral to F-15 TEWS, the ALQ-135 is an internally mounted responsive radio frequency (RF) jammer designed to counter surface-to-air and air-to-air threats with minimum aircrew activity. The system is sized to fit into the limited space of the F-15E aircraft's ammunition bay although upgraded components have also been retrofitted into the F-15C air superiority variant. The system has an

improved reprogramming support capability that rapidly changes pre-flight message software in response to changing threat parameters and mission requirements. ALQ-135 has been fielded in several phases to provide incremental improvements to jamming coverage. Phase one provided an initial Band 3 capability, which included integrated operation with both the F-15E fire control radar and the ALR-56C RWR. ALQ-135 Band 3 capability currently allows full interoperability and robust jamming techniques against modern pulse-Doppler radar threat systems. Full system capability requires the installation and integration of Band 1.5 hardware to provide coverage against threats operating in the lower frequency ranges. Band 1.5 is completely dependent on Band 3 for signal reception, reception, and interfacing with the rest of aircraft avionics.

BACKGROUND INFORMATION

ALQ-135 is an outgrowth of an early 1980s feasibility demonstration and a follow-on quick reaction capability high band jammer developed to counter rapidly changing threats. Developmental problems precipitated a restructuring of the ALQ-135 program in 1988 to provide incremental capabilities. A TEWS EOA of Phase I Band 3 was planned in July 1989 to support F-15E IOC. However, technical problems delayed the start of EOA until July 1990. Fifteen sorties were flown against threat simulators on the Eglin AFB, FL range complex in air-to-air and air-to-ground mission scenarios. ALQ-135 demonstrated the capability to identify and counter most current threats in a limited density environment, but the test indicated that additional software and hardware development was necessary to achieve desired operational capabilities.

AFOTEC was directed to conduct an interim TEWS OA to characterize the operational capabilities and limitations of the fielded systems and assess readiness for IOT&E. The OA concluded in September 1994 recommended five ALQ-135 improvements: (1) interoperability with the APG-70 radar; (2) system response times; (3) built-in-test (BIT) displays; (4) BIT accuracy; and (5) low band frequency coverage for the F-15E (i.e., Band 1.5).

Band 3 operational testing conducted by the United States Air Force Air Warfare Center (USAFAWC) concluded in August 1996 and addressed ALQ-135 Band 3 ICS interoperability with the APG-70 radar as well as improvements in BIT displays. USAFAWC conducted additional Band 3 operational tests at the Multi-Spectral Threat Environment range located at Eglin AFB to evaluate intra-flight (wing man) compatibility—the advanced threat de-interleave processor (for improved system response times) and jamming effectiveness and BIT upgrades.

TEST & EVALUATION ACTIVITY

The ALQ-135 Band 1.5 TEMP was approved in May 1998 and the Test Plan was approved in April 1999. Developmental testing of the ALQ-135 began in June 1998 with initial focus on integration and interoperability testing between the ALQ-135 ICS with Band 1.5 installed and other F-15E weapons systems such as the ALR-56C radar-warning receiver. The developmental tests were focused on response time measurements as well as correct RF threat identification and correct RF counter technique generation. Developmental testing was to have concluded by September 1998, but was delayed until 2QFY99 due to aircraft integration problems and software immaturity, most notably demonstrated by an unacceptably high number of system resets.

IOT&E began in April 1999. Testing was conducted at the Multi-Spectral Threat Environment (MSTE) range at Eglin AFB and at the Western Test Range at Nellis AFB. Operational testing analyzed

all major effectiveness and suitability performance parameters, with the focus of testing centered on: (1) testing against a variety of available airborne and ground based threats; (2) operating Band 1.5 equipment with aircraft systems (and jointly) during multi-ship formations; and (3) operating Band 1.5 equipment concurrently with other F-15 TEWS systems; e.g., Band 3 jamming equipment.

TEST & EVALUATION ASSESSMENT

Problems during IOT&E resulted first in a stop test, followed by an OT decertification of the system by AFOTEC. Partial analysis of test results indicate that Band 1.5 hardware is potentially operationally effective against threats for which it was designed, but the system was plagued by unpredictable and lengthy system resets, many of which are not displayed to the aircrew. BIT and system diagnostics are unsatisfactory as well. Although Band 1.5 hardware is reliable, overall suitability of the system is unsatisfactory due to OFP immaturity and system integration. The TEWS system (both Band 1.5 and Band 3) is inoperative during system resets, impacting jammer effectiveness. In October 1999, AFOTEC decertified the Band 1.5 OT effort and returned it to DT for correction of several major deficiencies noted during IOT&E.

During IOT&E, it was discovered that system resets only occurred when in a threat envelope with threat emitters actively targeting test aircraft. Resets occurred randomly; and because of inadequate aircrew cues as to actual system status and lack of a capable diagnostics system, aircrews were unaware they had no electronic protection. Lack of effective system status cues to aircrews and the unpredictable nature of system resets caused aircrews to unknowingly fly into threat envelopes without electronic protection. The effect of system resets is a major deficiency, and led to Band 1.5 OT decertification and return to developmental testing.

The degraded operational performance displayed by the Band 1.5 system was exacerbated by the lack of an effective diagnostics/BIT system. The integrated diagnostics effectiveness rate and BIT false alarm rate was 30 percent and 73 percent respectively, impacting field maintenance activity severely. While hardware system reliability was exceptional (no Band 1.5 hardware failures noted in 250 flight test hours), the OT community was unable to accurately determine Band 1.5 operational availability and other suitability metrics because of an ineffective BIT/diagnostics capability and other system shortfalls with the Band 3 suite.

The TEWS system BIT/Integrated Diagnostics capability is totally inadequate, and in operational practice, is ignored because of its unreliability. Based on the data analyzed during IOT&E, it is apparent that F-15E aircrews have a tactical jammer that is (1) unreliable; (2) unable to diagnose true systems status/operational capability; and (3) does not provide aircrew adequate cues or confidence of its actual operating status. The lack of a quality, trusted integrated diagnostics and BIT system is unsatisfactory.

An additional shortfall with the TEWS system is a long-standing problem with the ALR-56C. In a dense signal environment, ALR-56C lacks adequate processing capability as evidenced by incomplete and/or slow display of threat emitters to aircrews. The lack of timely threat cueing and processor throughput is recognized by the Air Force, but correction of this deficiency awaits higher priority in the F-15E funding program.

CONCLUSIONS, RECOMMENDATIONS, LESSONS LEARNED

Until TEWS architecture (comprised of the Band 1.5 and 3) system deficiencies are corrected, Band 1.5 will not be effective or suitable because Band 1.5 performance is inextricably dependent upon the Band 3 system. Prior to return to OT&E, the Air Force needs to: (1) identify and correct the casual factors for the unpredictable combination of system resets, degrades, and prolonged periods when TEWS is not operating; (2) devise a more robust system of aircrew cues that accurately portray actual system jammer status; and (3) develop a reliable BIT/integrated diagnostics system for aircrew and maintenance personnel to accurately assess system status.