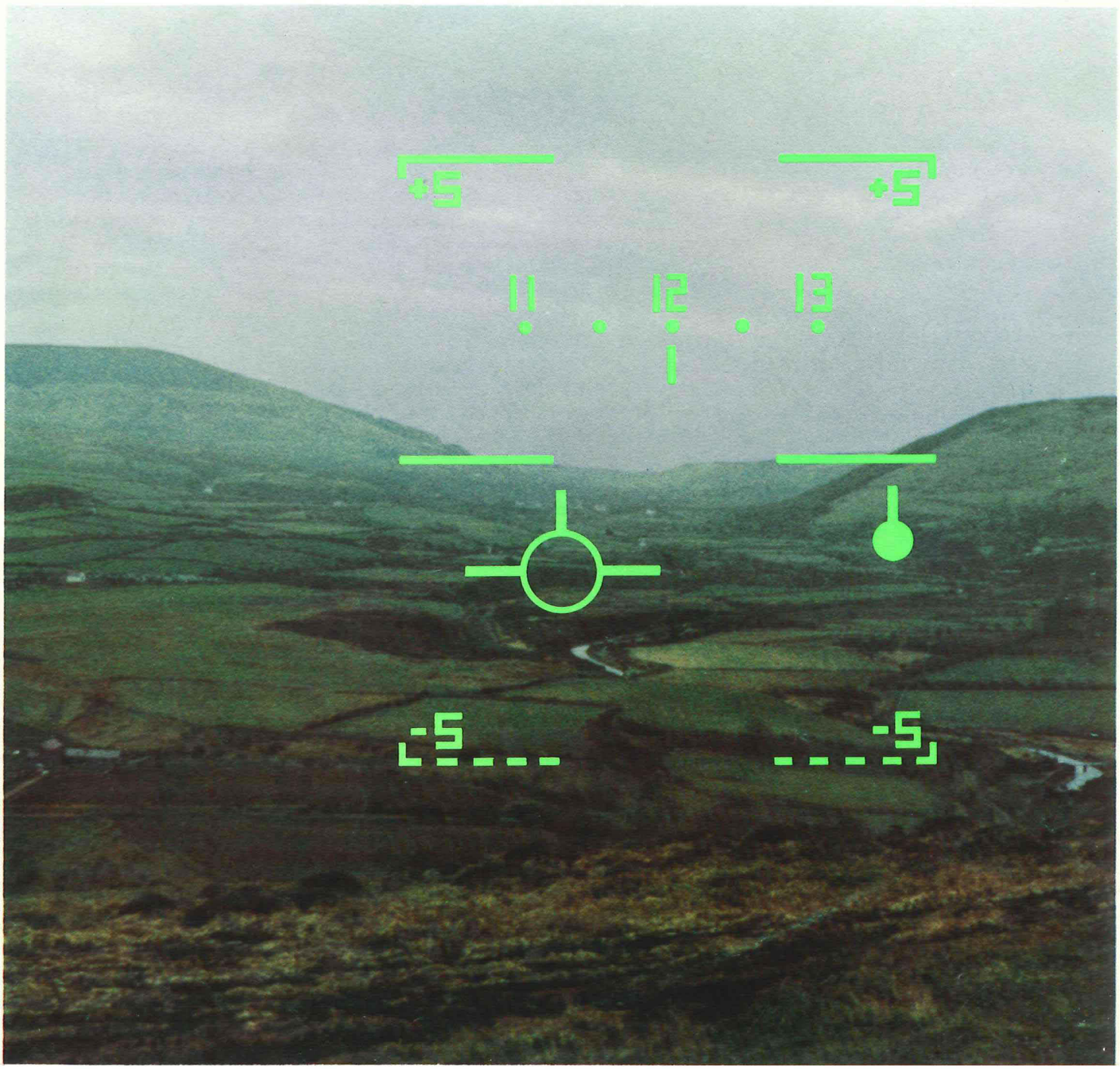
ELLIOTT

Military Head·up Display System



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MILITARY HEAD-UP DISPLAY SYSTEMS

ELLIOTT

What it does

The head-up display projects essential instrument information in symbolic form into the pilots field of view. Since the information is collimated at infinity, the pilot can observe terrain or sky at the same time as he follows the guidance and weapon aiming information.

Because the symbology is electrically generated, it can be switched to cover any particular stage of mission without leaving redundant symbols in view.

Advantages

Significantly improved mission success capability.

Reduced Pilot work load results.

Minimal Data acquisition time

Since the head movement, eye refocusing and light level accommodation associated with conventional instrument/visual flight are almost entirely eliminated.

Principles of operation

A high light intensity cathode ray tube is used to produce a symbol group image which is projected by a collimating lens system to a reflector. The image on this reflector is viewed by the pilot simultaneously with the outside world.

The special digital computer accepts both analogue and digital data from the other relevant aircraft systems. This data is processed to write and manoeuvre the display symbology for any of the aircrafts navigation and attack modes, as well as take-off, approach and landing, if required.

Symbology

The first illustration shows the typical maximum display and form potential available in the computer. The display modes never utilise all these symbols at any one time. This illustration also shows an illuminated reticle standby sight which is manually selected in the event of display failure. The second illustration shows a typical decluttered presentation used in the attack mode.

Electronics

The essential elements of the system consist of a pilots display unit which contains the high brightness CRT, power supply units, deflection amplifiers and built in test equipment (BITE) card.

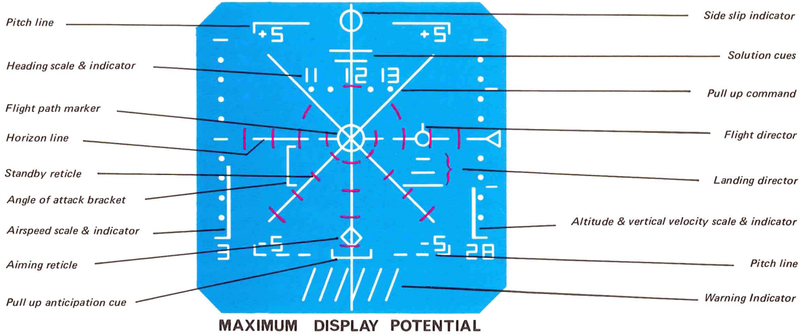
The digital computer consists of micro-circuits on multi-layer printed circuit cards, together with a hard-wired programme store module. Cooling air is drawn through the central cold wall of the unit by the centrifugal fan at the front. The individual cards are thermally joined to this cold wall.

The computer processes incoming data from the aircraft nav/attack and other systems and supplies deflection and bright-up voltages to the display unit. These voltages define the type and position of the display symbols, dependent on the particular mode of operation of the aircraft.

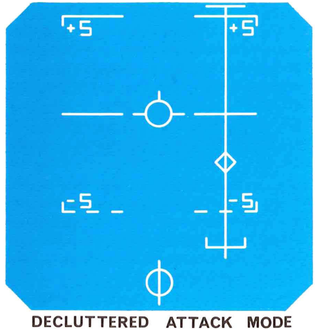
By suitable compromises regarding symbology requirements, the available store space can be employed to perform certain weapon aiming and ballistic computations.

Type of display unit

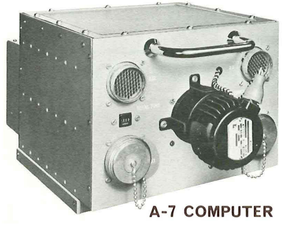
Elliott design experience enables the company to offer a wide variety of display units including a binocular version. The weight of these display units varies between 10 - 45 lbs., dependent upon system requirements.



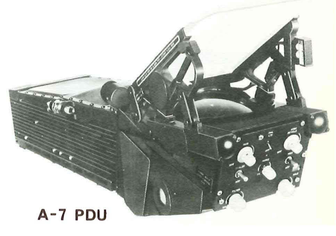
MAXIMUM DISPLAY POTENTIAL



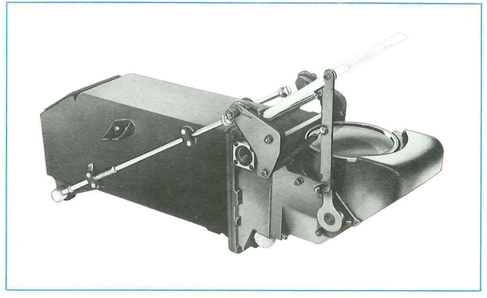
DECLUTTERED ATTACK MODE



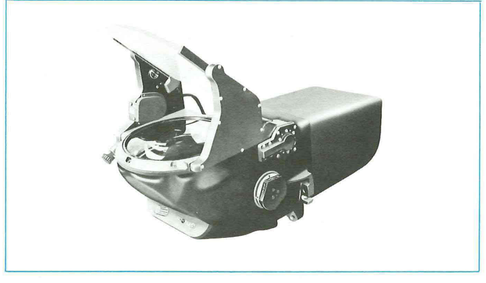
A-7 COMPUTER



A-7 PDU



BUCCANEER PDU



ILAAS P.D.U.

VIGGEN P.D.U.

Salient features

Built to DEF and MIL Specs.
Maintainability concepts are compatible with USAF and USN practice.
General applicability to a wide range of military aircraft.

The system is capable of displaying all normal flight command and attack information in the various flight modes.

The projection unit features a rugged cathode ray tube and an integral stand-by sight. Modular construction allows the exchange of video modules without affecting optical alignment.

Automatic brilliance control maintains virtually constant contrast of the display with background levels between 10 - 10000 ft/lamberts.

The electronics unit is a microminiaturised general purpose computer.

Symbology and scale factors can be changed rapidly by insertion of a new store with modified internal wiring.

Built-in test equipment to detect and isolate faults to Line Replaceable Unit level.

History

The first production head-up display system was produced by Elliott Automation for use on the Royal Navy Buccaneer Strike Aircraft in 1962. More recently, head-up display systems have been fitted to all Belfast freighters for the Royal Air Force, as a sub-system of the flight control system.Production digital military head-up display systems are also being delivered to the United States for the A-7D/E (Corsair II) programme and to the Swedish airforce for the Viggen aircraft. Head-up display systems fully integrated with automatic landing control systems have been installed in Comet, Noratlas and DC-9 aircraft. Twelve types of military aircraft have also been fitted with Elliott head-up display systems and a total of over 500 military and civil production head-up displays have been delivered.

Company Background

Elliott Flight Automation specialises in the design and production of flight control, navigation and flight management avionic equipment for super-sonic, transport and VTOL aircraft. Its design teams have for the past 15 years consistently pioneered new techniques in fail-operative flight control, inertial navigation, electronic display systems and airborne digital control. These techniques have been applied to airliners including the VC.10 and One-Eleven, the Lightning supersonic intercepter, Buccaneer and TSR.2 attack aircraft and a number of VTOL projects in Britain and abroad. Aircraft in which Elliott has a major avionic contribution include the Swedish Viggen, Anglo-French Jaguar and Concorde, USAF/USN A-7D and E, USAF C5A, RAF Nimrod, Harrier and WG.13.
Current sales are in the region of £20 million annually, with over 4,000 employees and over 540,000 sq. ft. of factory space at Rochester, Kent. The company has established itself in world markets as a prime supplier of advanced avionic control equipment. Elliott has demonstrated capability in design, manufacture and the maintenance of delivery schedules, in fulfilling avionic equipment contracts for US aircraft manufacturers.
Whilst operating under autonomous management, Elliott Flight Automation is a member of the £1,000 million General Electric Company — English Electric group and can thereby call on the resources of other group members who specialise in such areas as microelectronics, airborne radar and computers.

System Weight (inc. mounting tray)	35 - 76 lb., dependent on type of equipment	
Dimensions (typical)	12.5 x 7.6 x 4.8 in. E.U. 12.5 x 8.0 x 9.5 in. E.U.	15.25 x 6.5 x 7.5 in. P.D.U. 25.0 x 8.4 x 11.0 in. P.D.U.
Power requirements	200 VA at 400 HZ 40 W at 28 V d.c.	312 VA at 400 HZ 80 W at 28 V d.c. MIL-STD-704
Total field of view (instantaneous)	20^o, 25^o, 30^o. Circular (Stby sight optional)	dependent on choice of optical requirement
Ambient Brightness range	0 - 10000 ft. lamberts. Control : manual/auto	
Line width	1.0 $\pm$ 0.2 milliradians at 1000 ft lamberts	
Display Colour	Green P_1 Phospor	
Maximum image brightness at combiner glass	1600 ft lamberts	
Combiner glass transmissibility	80% max	
Modes of operation	Navigation, Terrain following, Attack, Landing	
M.T.B.F. (typical)	1527 hrs. P.D.U. 1276 hrs. E.U.	
M.T.T.R. (organisation level)	11 min.	
Operating life	10,000 hrs.	
Operation stability	500 hrs.	
Cooling Air	Desirable for enhanced M.T.B.F.	
Accuracies - 1 sigma (Digital and analogue inputs)	0.67 milliradians at 0^o 0.9 milliradians within $\pm 5^o$ 1.5 milliradians within $\pm 10^o$	

ELLIOTT

AIRBORNE DISPLAY DIVISION

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