ELLIOTT

Inertial Systems

for Military Aircraft

INERTIAL NAVIGATION

HEADING AND ATTITUDE SYSTEMS

COMPUTING

DISPLAYS

Elliott experience covers...

DIGITAL INERTIAL NAVIGATION SYSTEMS
ATTITUDE AND HEADING REFERENCE SYSTEMS
DOPPLER-INERTIAL HYBRID NAVIGATION SYSTEMS
DIGITAL WEAPON AIMING SYSTEMS
NAVIGATION DISPLAYS AND CONTROLS
SHIPS INERTIAL NAVIGATION SYSTEMS

with extensive facilities for...

RESEARCH AND DEVELOPMENT
SYSTEMS MANAGEMENT
QUALITY ASSURANCE
PRODUCTION
SUPPORT

...under one roof

ELLIOTT

a decade of Advanced Airborne Inertial Systems

1960 – Blue Steel

Elliott built the first production inertial navigation system in Europe for terminal guidance of Blue Steel and navigation of the carrier aircraft.

1965 – Nimrod

Elliott E3 provides the Attitude and Heading Reference System for the most advanced maritime warfare system in the world.

1970 – Jaguar

Elliott digital inertial navigation and weapon aiming system is at the heart of Jaguar's advanced avionics systems.

Future Developments

Variants of the present digital navigation and weapon aiming system can be provided without penalties of extensive development. These include the E3R Inertial Navigation System and the E3R(M) system.

E3 Heading Reference System for the HS Nimrod MR1

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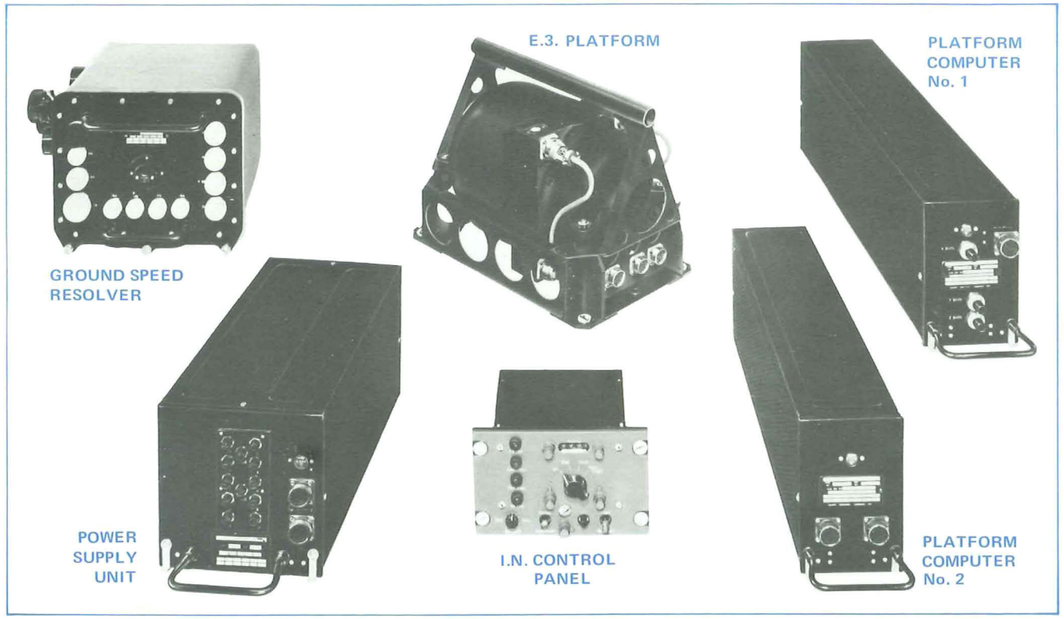


CHARACTERISTICS

Unit	Dimensions (cm)	Wt (kg)
PLATFORM (with mounting)	21.5 diam. x 33.0L	13.8
POWER SUPPLY UNIT	12.5 W x 49.6L x 19.4H (¾ ATR Short)	11.3
PLATFORM COMPUTER No. 1	12.5W x 49.6L x 19.4H (½ ATR Long)	10.2
PLATFORM COMPUTER No. 2	½ ATR Long	8.1
GROUND SPEED RESOLVER	40.7W x 38.1 L x 25.4H	20.8
CONTROL PANEL	20.0W x 15.1L x 12.7H	1.9

MAIN FEATURES

LOW AZIMUTH DRIFT 0.1° hr.

E3 provides a true Heading reference with automatic compensation for earth's rotation and aircraft motion.

VERY ACCURATE VERTICAL ⩾ 0.1° error

Irrespective of aircraft manoeuvres; an essential feature of a precision heading reference-achieved by Schuler tuning.

ACCURATE INITIAL ALIGNMENT

Within ± 0.15° using the Elliott Runway Alignment Technique.

DOPPLER/INERTIAL MIXING giving:

Excellent dynamic response of the inertial system

Long term accuracy of Doppler velocity

Doppler velocity damping of Schuler oscillations

ACCURATE VELOCITY AND POSITION DATA

At all times including attack phase when doppler cuts out in turns and system reverts to pure I.N. mode.

OUTPUT DATA

ACCURATE HEADING FOR USE BY AIRCRAFT SYSTEMS –

E.C.M.	Navigator's Compass Repeater
Digital Computer	True Heading Repeater

VERY ACCURATE VERTICAL FOR USE BY AIRCRAFT SYSTEMS –

Autopilot

Radar

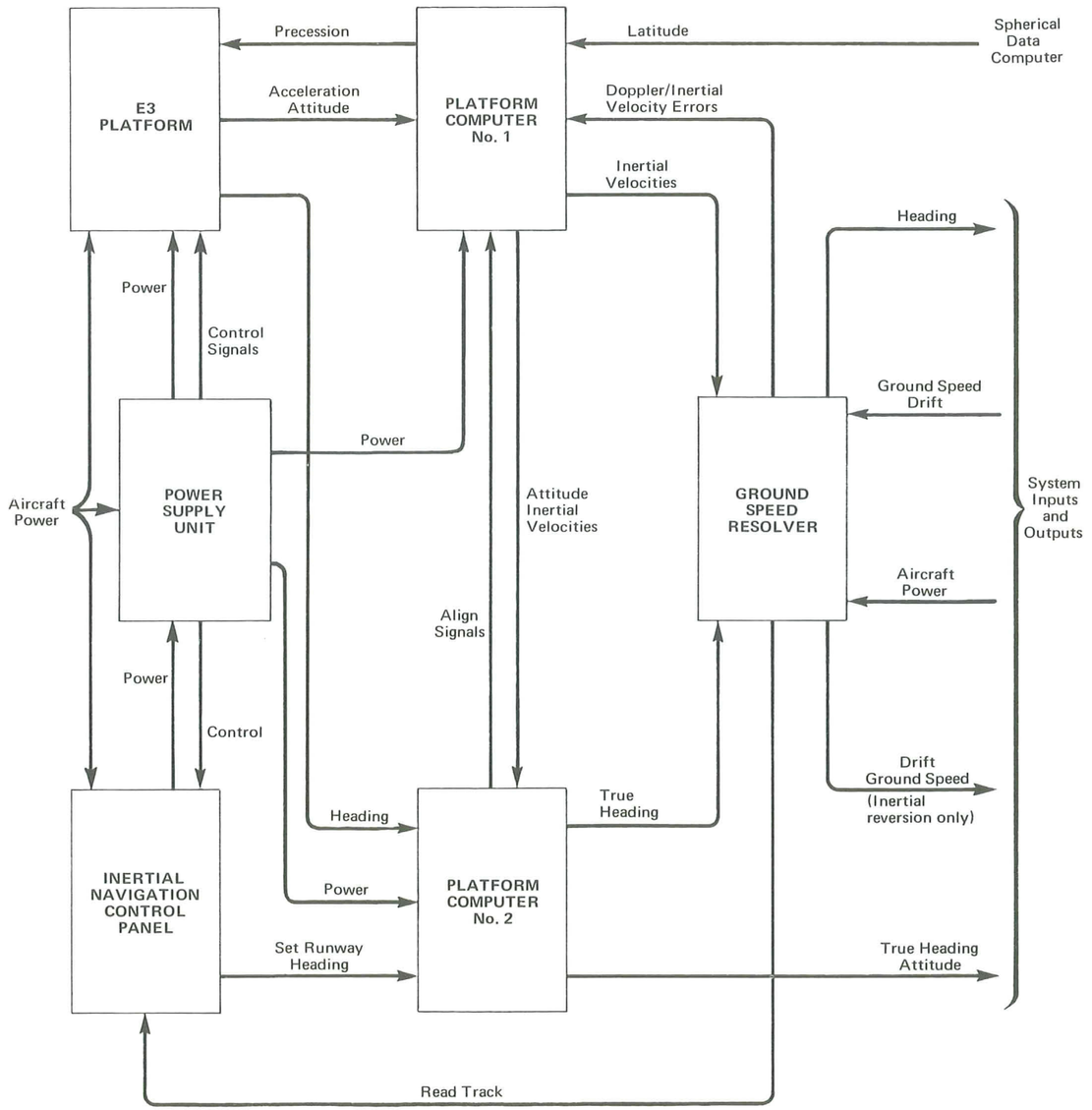
RESOLVED GROUNDSPEED FOR USE BY AIRCRAFT SYSTEMS –

Digital Computer	Spherical Data Computer
Wind Computer	Radar

INERTIAL GROUNDSPEED AND DRIFT FOR AUTOMATIC WIND COMPUTING

INERTIAL VELOCITIES FOR DOPPLER/INERTIA MIXING

E3 Heading Reference System - flow diagram



Runway Alignment

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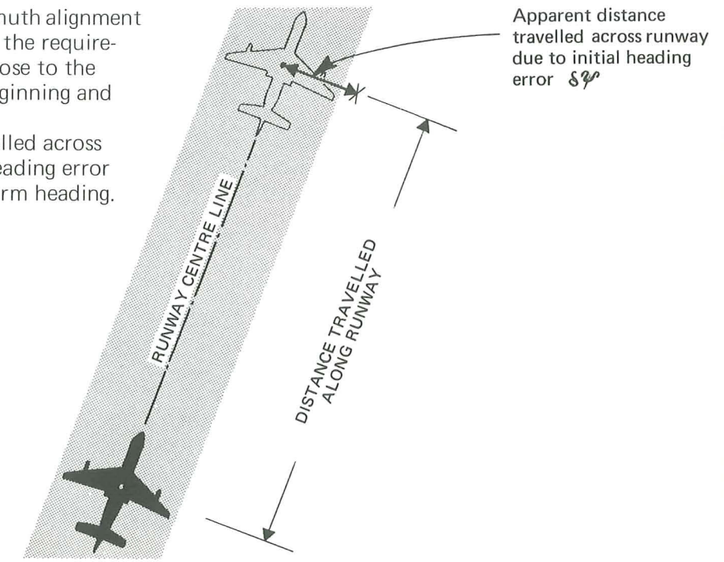
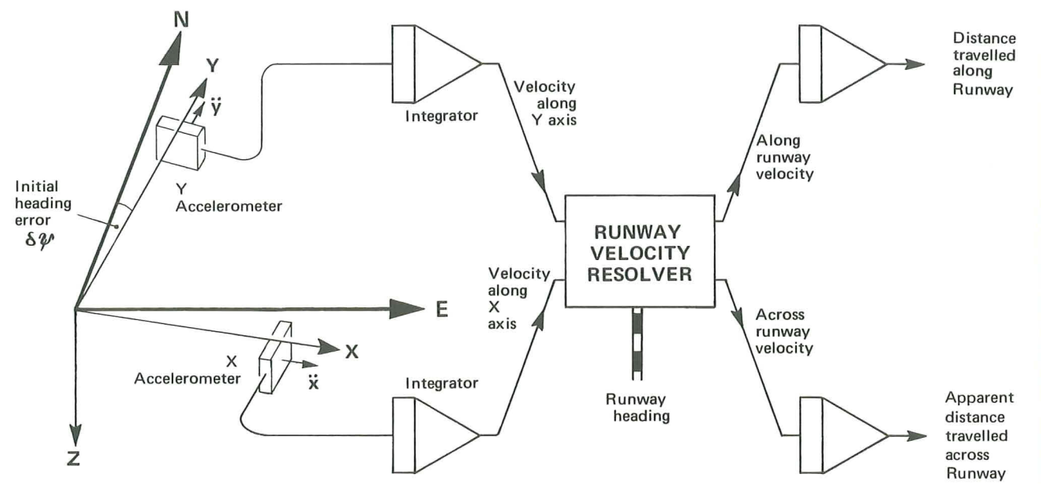
BRITISH PATENT 1,120,181

A fully automatic rapid azimuth alignment technique. Only restraint is the requirement to keep the aircraft close to the runway centreline at the beginning and end of the takeoff run.
The apparent distance travelled across the runway due to initial heading error is used to correct the platform heading.





Navigation and Weapon Aiming System for the Jaguar

CHARACTERISTICS

Sub System	Unit	Dimensions (cm.)	Wt.(Kg.)
INERTIAL VELOCITY SENSOR	PLATFORM (with mounting)	33.8W x 39.7L x 26.5H	23.6
	POWER SUPPLY UNIT	¾ ATR (Short)	15.4
	PLATFORM ELECTRONICS UNIT	¾ ATR (Short)	9.5
CENTRAL COMPUTING SYSTEM	INTERFACE UNIT	25.9W x 32.0L x 19.4H (1 ATR Short)	16.2
	920M COMPUTER	¾ ATR (Short)	14.0
DISPLAYS AND CONTROLS	PROJECTED MAP DISPLAY	18.8W x 45.8L x 18.8H	10.4
	NAVIGATION CONTROL UNIT	18.8W x 17.0L x 11.5H	3.3
	HAND CONTROLLER	6.1W x 14.5L x 19.8H	0.8

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MAIN FEATURES

HIGH ACCURACY

Precise velocity and attitude data essential for weapon delivery. Navigation accuracy better than 2nm/hr. C.E.P.

FLEXIBILITY

Changes in operational requirements for new weapons, sensors and displays can be accommodated primarily by software modifications.

RELIABILITY

All digital computation and use of rotational averaging techniques lead to high reliability and elimination of soft failures.

EASE OF MAINTENANCE

First line testing entirely by computer programme. Automatic bias calibration. Extensive in flight monitoring.

SELF ALIGNMENT

LOW COST COMPONENTS

E3R Rotational Averaging technique enables low-cost inertial components to be used and minimises stability problems.

ACCURATE DATA AT ALL TIMES

Inertial system gives output independant of attitude or position. It's self contained nature precludes jamming or interference.

INTEGRATED DISPLAYS

Presentation of data on headup display, projected map display and navigation controls minimises pilot workload and interpretation.

OUTPUT DATA

Aircraft present position displayed both as a topographical display and by means of numerical readouts.

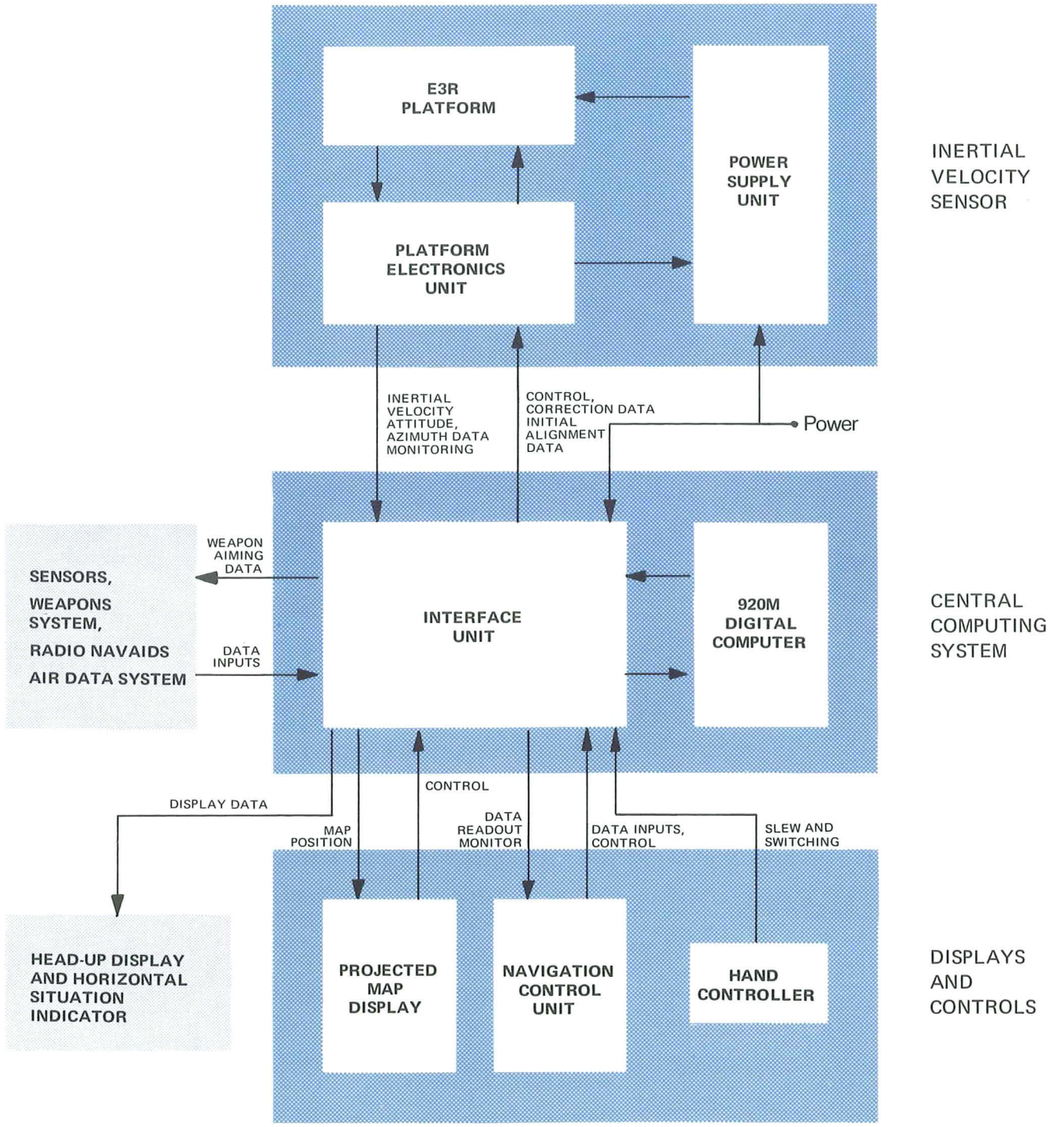
Steering signals to maintain pre-planned and pre-selected routes.

Steering instructions to give maximum assistance in target acquisition.

Information on the relative position of aircraft and target and release point for weapons.

Aircraft attitude, velocity and heading.

Navigation and Weapon Aiming System - flow diagram



The Inertial Velocity Sensor

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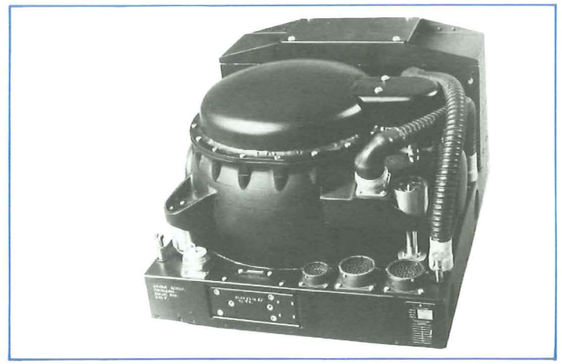
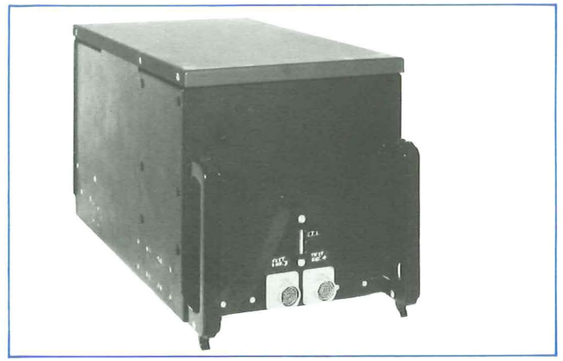
E3R PLATFORM (in mounting cradle)

This is a pure inertial, fully manoeuverable platform incorporating 3 single-degree-of-freedom gyros and 3 accelerometers. A Rotational Averaging Technique confers upon the system an accuracy in excess of that normally obtainable from the unsophisticated components used.



PLATFORM ELECTRONICS UNIT

Contains the necessary circuits to convert analogue inputs of horizontal and vertical acceleration into digital form for transmission to the digital computer. Platform correction terms are also generated within this unit.



POWER SUPPLY UNIT

Accepting raw aircraft power, the power supply unit generates all the stabilised supplies and precision frequencies required by the inertial system. In addition it contains the sequence and protection unit.

Central Computing System

920M DIGITAL COMPUTER

The MCS 920M is a microminiature general purpose digital computer operating in the parallel mode. It has a random access, 8192 word, 18 bit store with a 2μs cycle time. In addition to performing navigation and weapon aiming calculators, the computer caters for in-flight monitoring, initial alignment and in situ first line system testing.

INTERFACE UNIT

Enables the digital computer to receive and transmit information from and to other units in the aircraft in compatible signal form. It also supplies the power for the computer and navigation control unit.

Displays and Controls

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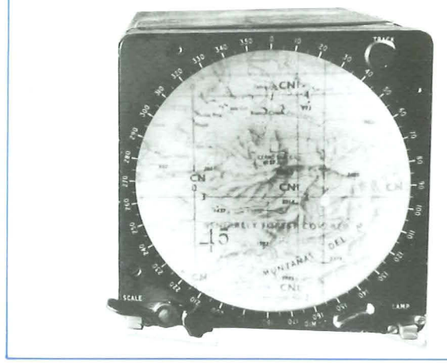
PROJECTED MAP DISPLAY

The pilot has a continuous reference to the aircraft present position and track superimposed on the projected image of air topographical maps. He may also select a destination (waypoint) to be displayed. Automatic frame changing is provided and aircraft position is continuously updated by a closed loop drive system. Two scales are available on selection. Meridian convergence and curvature of parallels are compensated for in the digital computer. An area approximately 750 x 750nm. is contained in a single cassette of 35mm. coloured film.



NAVIGATION CONTROL UNIT

The Navigation Control Unit enables the operator to control the navigation system through switch-on, alignment, waypoint setting and selection, fixing and reversionary operation. This unit provides read-outs of navigation data and system malfunction indications. 12 waypoints may be inserted as well as information on wind, off-sets, heading etc. 20 quantities may be displayed, including latitude, longitude, heading, groundspeed and magnetic variation or other information as required.

HAND CONTROLLER

The Hand Controller is used for fix correcting and waypoint setting in conjunction with the Projected Map Display. It is also used during weapon aiming.

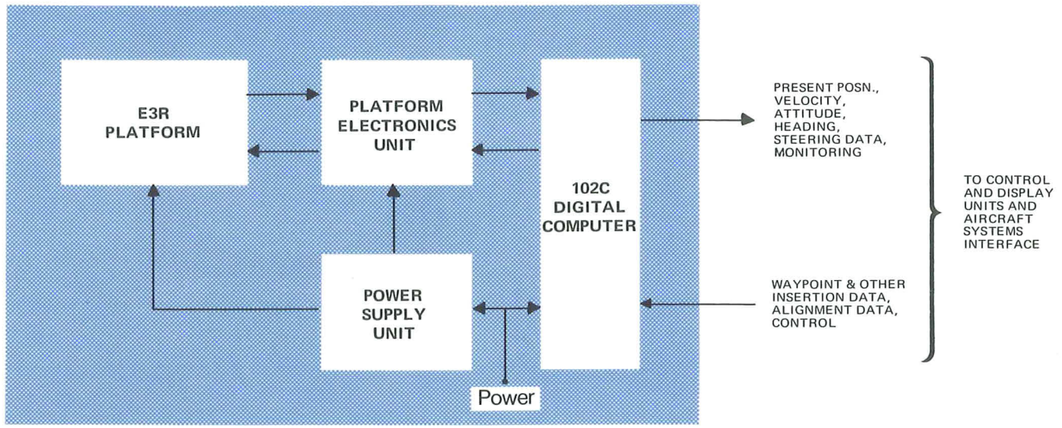
OTHER DISPLAYS

Other displays associated with the Navigation and Weapon Aiming System are a Head-Up Display and a Horizontal Situation Indicator. These provide steering, situation and weapon aiming information to the pilot from data calculated by the digital computer.

E3R System Options...

E3R INERTIAL NAVIGATION SYSTEM

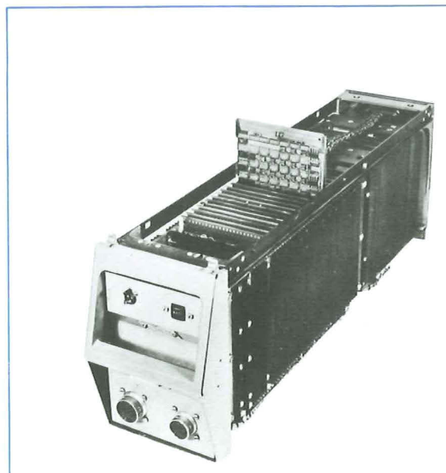
FOR USE WITHIN DISTRIBUTED COMPUTING AVIONICS SYSTEMS



102C DIGITAL COMPUTER

The 102C is a modular microminiature digital computer with integral interface and power supplies. The store module for this application has a combined fixed and data storage capacity of approximately 4000 words of 12 bit length.
Computations performed include navigation, steering,alignment and in-flight monitoring.

Dimensions: ½ ATR long.
Weight: 13.5Kg.

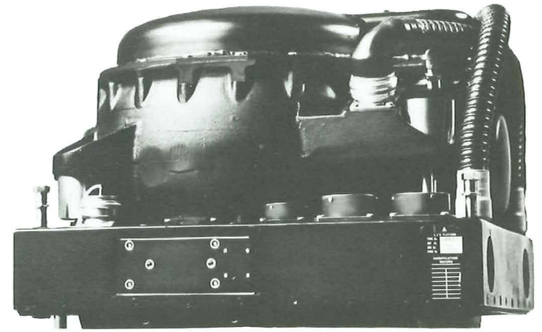


and future trends

E3R(M) INERTIAL NAVIGATION SYSTEM USES BASIC E3R PLATFORM TECHNOLOGY COUPLED WITH LSI/MSI ELECTRONICS AND COMPUTING.

E3R (M) PLATFORM (in Cradle)

Dimensions: 26.5W x 33.8L x 26.5H
Weight: 20.4 Kg.

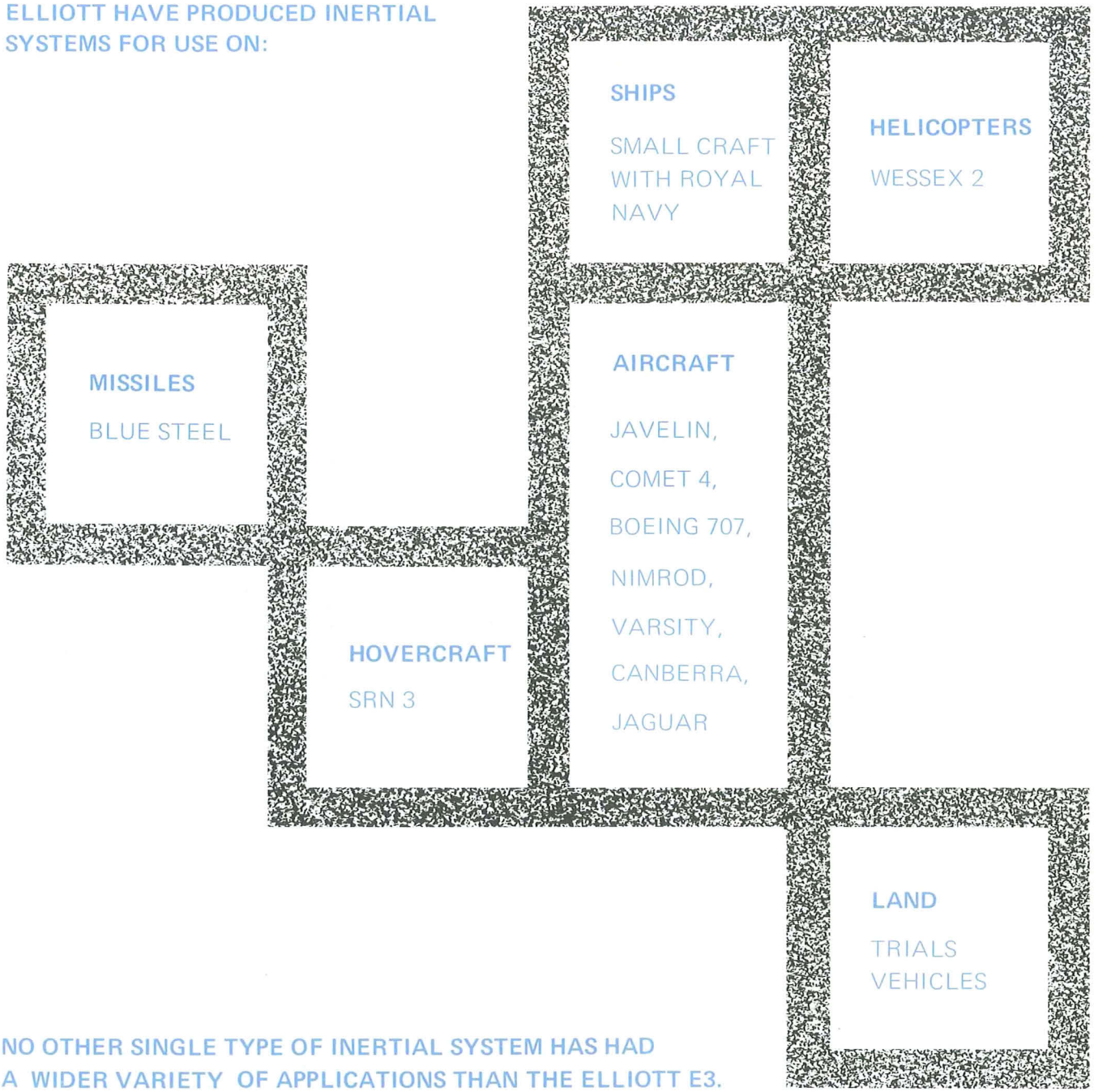


THIS SYSTEM OFFERS THE FLEXIBILITY AND COST-EFFECTIVENESS OF THE EXISTING E3R SYSTEMS WITH SMALL SIZE AND WEIGHT. IT ALSO LEADS THE WAY TOWARDS FURTHER DEVELOPMENTS IN MINIATURE PLATFORM SYSTEMS.

ELECTRONICS UNIT

Dimensions: 25.9W x 49.6L x 19.4H
(1ATR long)
Weight: 18.2kg.

ELLIOTT HAVE PRODUCED INERTIAL SYSTEMS FOR USE ON:



NO OTHER SINGLE TYPE OF INERTIAL SYSTEM HAS HAD A WIDER VARIETY OF APPLICATIONS THAN THE ELLIOTT E3.

ELLIOTT

Inertial Navigation Division

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