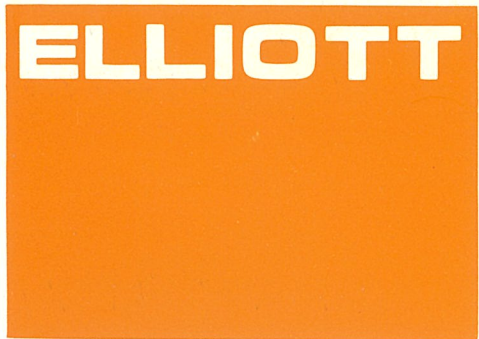


105C



E80 DIGITALLY CONTROLLED **AFCs**



**A STEP AHEAD
IN AUTOMATIC FLIGHT
CONTROL SYSTEMS FOR
THE 1970s & 80s**

E80 DIGITALLY CONTROLLED AFCS

A STEP AHEAD

in automatic flight control system technology, the E80AFCS is aimed at meeting advanced system requirements with economy. The E80AFCS is organised digitally to give an entirely new flexibility and system integration capability while retaining the reliability and integrity of present day systems.

DIGITAL CONTROL

of the E80AFCS is by means of a programmable digital computer which organises all the modes and parameters of the system – including test and check-out modes. The diagram opposite illustrates the extent of the E80AFCS package which includes two new features:

Director Autopilot Mode Organisation Computer – **DAMOC**

Mode Organisation Data Transmission System – **MODATS**

enabling the system to organise its information.

MORE CAPABILITY

is available in the E80AFCS because **DAMOC** and **MODATS** enable more information to be organised in the system. It also means that the same hardware can be made to do more jobs for the pilot without creating new engineering problems. Interface with area navigation and energy management systems is now straightforward. Additional AFCS modes and parameter changes to suit customer requirements, or 'stretched' aircraft, are incorporated via a programme adapter.

AND RELIABILITY

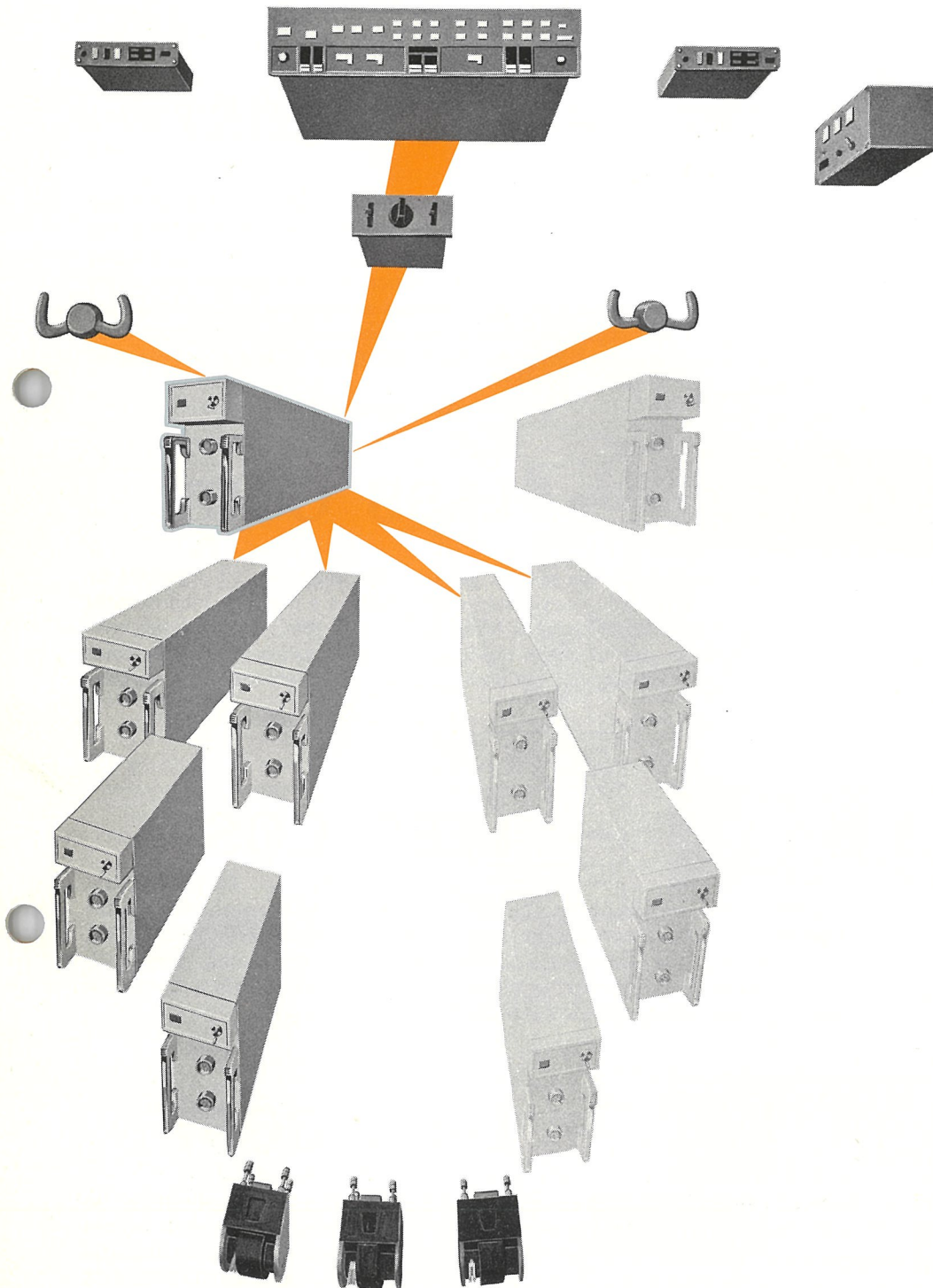
is a key feature of the unique E80AFCS design. The digital organisation computer **DAMOC** operates in parallel with standardised and simplified analogue control channels. This enables reversionary modes to be incorporated in the event **DAMOC** fails. It also means that failure-survival automatic landing integrity is not compromised by the digital features.

FOR THE 1970s & 80s

aircraft manufacturers are already studying the E80AFCS and their reaction to date is encouraging. The aim of this publication is to bring to your attention the advantages in automatic flight control and flight management which the E80 system can now make available to meet the challenge of modern systems requirements.

– AND FLEXIBILITY TO MEET YOUR REQUIREMENTS.....NOW

ELLIOTT



CONTROLS
AND
DISPLAYS

DATA MULTIPLEXER
AND INTERFACE **MODATS**

DIRECTOR-AUTOPILOT
MODE ORGANISATION
COMPUTER **DAMOC**

UP TO 4 INTEGRATED
AUTOPILOT-FLIGHT
DIRECTOR BOXES -
ALL ONE TYPE

1 OR 2 MONITORED
STABILITY AUGMENTATION
COMPUTERS

1 OR 2 MONITORED
SPEED CONTROL
COMPUTERS

FAILURE SURVIVAL
QUADRUPLIX ACTUATORS

THE E80 AFCS PACKAGE:-

A digital organiser and one standard type of box for each of the sub-systems:- Autopilot Flight Director
Stability Augmentation
Speed Control

The number of boxes defines the capability - from fail-passive to two-fault-survival automatic landing.

WHY DIGITAL CONTROL?

MORE CAPABILITY — **LESS COST**

Digital Computers **organise** information more effectively than their analogue counterparts but usually involve a complex interface. When this interface is in **series** with the control system, it can be costly and unreliable. The E80AFCS has simplified analogue channels of control whose parameters are organised by the Director Autopilot Mode Organisation Computer — **DAMOC**. This means that **DAMOC** is in **parallel** with the control function and can **organise** the system through simpler interface. The E80AFCS features an entirely standard microcircuit interface whose design unlocks the door to reliable digital system organisation. The self-test mode is also organised through the same interface components. Thus BITE is no longer a compromise between maintainability and reliability. With the E80AFCS, BITE is 'deeper and cheaper' and more reliable.

MORE FLEXIBILITY — **LESS COST**

The selection of system modes, both automatic and manual, and the system gearing parameters, are all organised by **DAMOC**'s programme store. In the E80AFCS, **DAMOC** has a removable store which is a complex incorruptible system adapter. During flight development of the E80AFCS a flexible store is incorporated until the programme has been optimised for the aircraft. On certification, the programme is used to define the fixed store configuration. Flexible stores can be held ready so that system capability can be up-dated throughout the useful life of the aircraft type to meet later requirements.

HIGH INTEGRITY — **LESS COST**

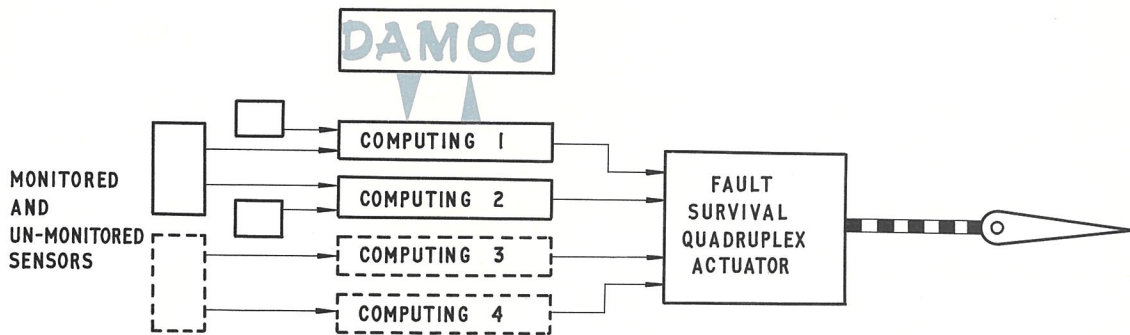
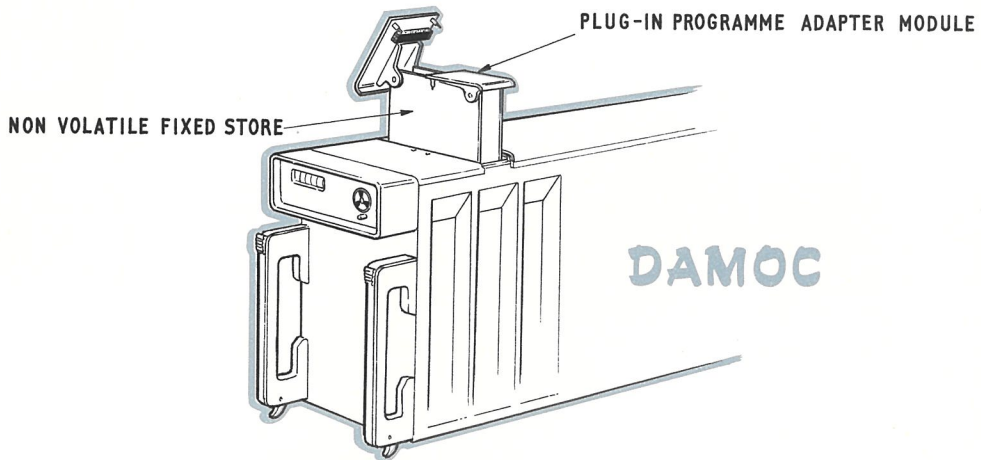
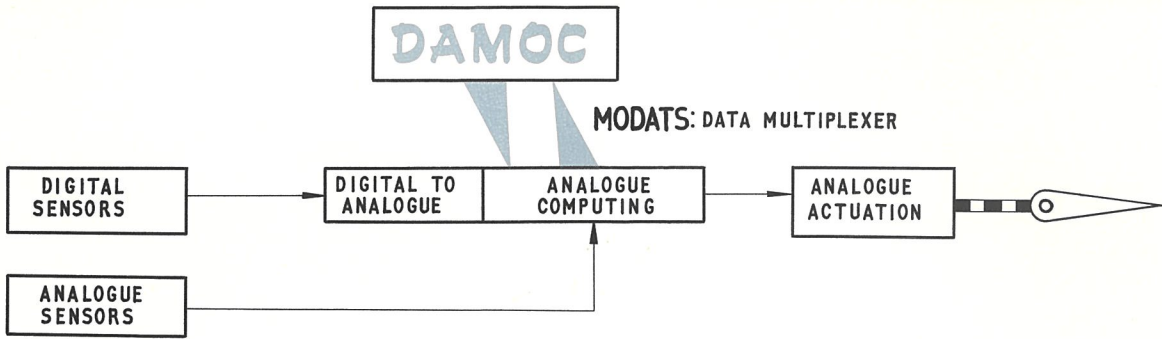
Being in parallel with the control system, **DAMOC** can organise both multiple and multiplexed channel alike. In the failure-survival automatic landing mode, **DAMOC** operates in the complex phases of ILS capture until final approach is established. During this time it also helps to trim out inter-lane errors in the control system. Once the landing approach is established, **DAMOC** reliably locks itself out and plays no further part in the operation. Thus the E80AFCS carries out the automatic landing using only simple "steady state" redundant analogue control channels.

HIGH RELIABILITY — **LESS COST**

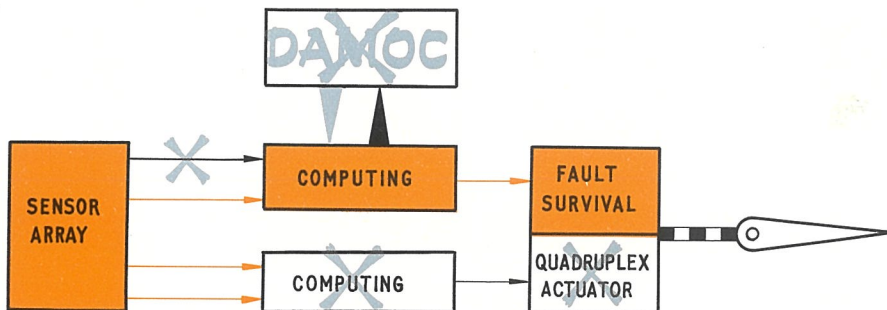
Here again, organisation and control by **DAMOC** in parallel with the control system makes for a high "survivability" in the event of failures. Analogue systems are also designed with circuits in parallel rather than in series so that several failures may be necessary to put a system completely out of operation. With the E80AFCS the parallel redundancy of its analogue components is also reflected in the digital control. Complete failures of **DAMOC** do not mean a loss of all the E80AFCS facilities.

.....WITH SAFETY.....

A RELIABLE
STEP AHEAD



SURVIVABILITY OF
PARALLEL SYSTEMS

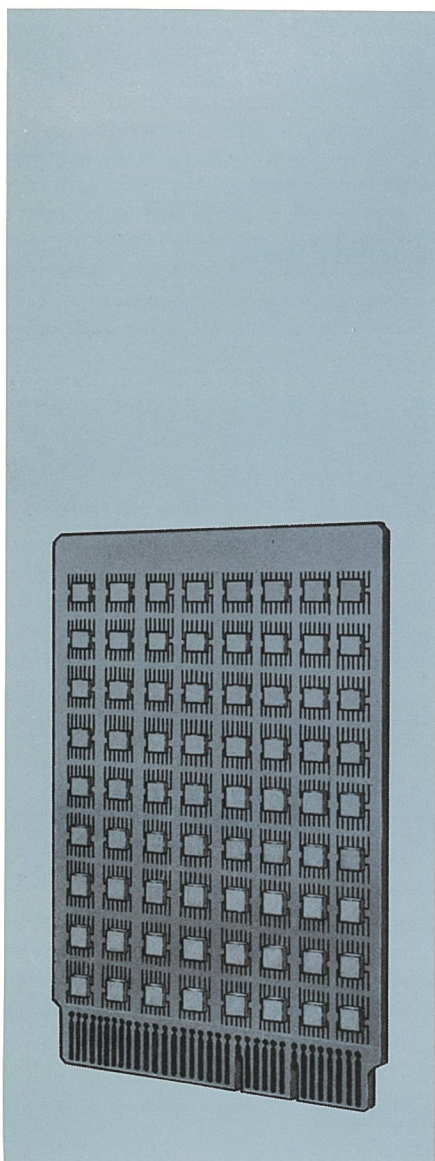


DAMOC is a miniature $\frac{1}{2}$ ATR (long) digital processor with a big part to play in the E80AFCS. It is a special purpose processor derived from the 102C general purpose computer, the latest addition to the successful 900 series digital range (illustrated opposite).

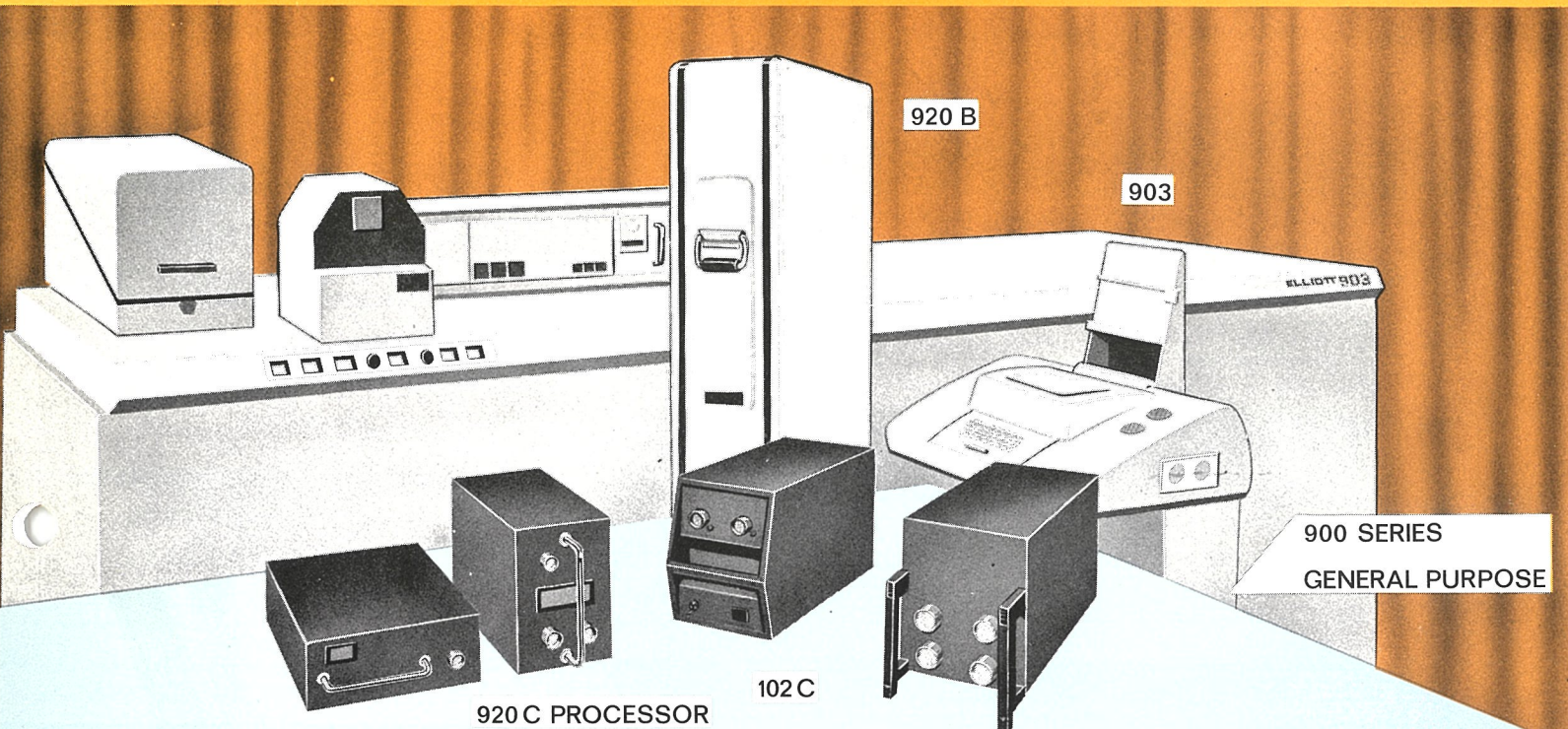
The 900 series equipment is specifically designed for on-line control and its present use ranges from road traffic control to advanced airborne systems. Examples of the 920 series airborne equipment applications are LTV-A-7 Head Up Display, Jaguar Navigation and weapon aiming system and Nimrod maritime search and attack system.

DAMOC is a modular computer using card modules which are common to the 102C and the 920 series special purpose range. These modules have high reliability, a unique thermal design, are extremely rugged and maintainable and are in large quantity production. Automated assembly and test methods and reliability screened components, coupled with automated 'end of assembly line' environmental testing have enabled a high quality to be achieved at a competitive price.

Of **DAMOC** 4096 word built-in store, approximately 2000 words are required to organise the E80AFCS. Store capacity may be limited for AFCS operation leaving a good margin for growth. Spare capacity can be utilised for navigation and flight management purposes. Ultimate store capacity is 32,768 words.



.....SMALL MEMBER OF A **BIG** FAMILY



920 B

903

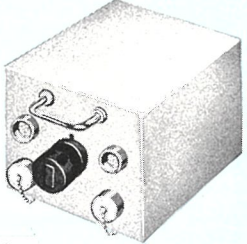
900 SERIES
GENERAL PURPOSE

920 C STORE

920 C PROCESSOR

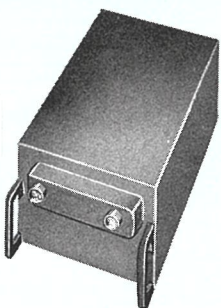
102 C

920 M

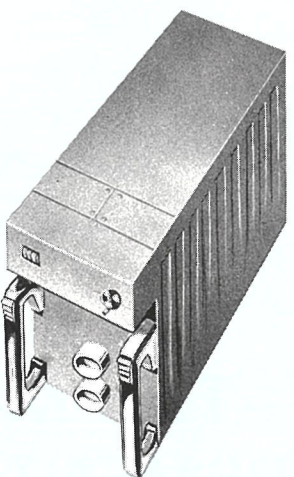


DIGITAL ELECT.
FOR H.U.D.

920M
SPECIAL PURPOSE



900 SERIES
SPECIAL PURPOSE



DAMOC

E80 DIGITALLY CONTROLLED **AFCS**

A STEP AHEAD

DIGITAL CONTROL

MORE CAPABILITY

AND RELIABILITY

FOR THE 1970s & 80s

**AND FLEXIBILITY TO MEET YOUR
REQUIREMENTS.....NOW**

ELLIOTT CAPABILITY AND SUPPORT.....

.....WHAT IT MEANS TO YOU.....

The E80AFCS is designed to keep ahead of the expanding automatic flight guidance and control system requirements with a minimum of hardware. By means of programming and **DAMOC**'s extendable store, the E80 system can 'grow' from a competitively-priced installation to meet today's needs — into a more and more advanced capability system during the long operating life of new transport aircraft. This is due to the flexibility inherent in the digital organisation and the access to more information due to the new data multiplexers and interface.

This is not a new concept although the E80AFCS is the first automatic flight control system to use it. Experience gained with inertial navigation and head up display systems has proved that this technique is not only viable — it brings new benefits to aircraft manufacturer and airline operator alike.

Relative to systems already in service, the E80AFCS offers more operational modes and fail-operational capability — without attendant hardware complexity and weight penalty. Beyond this datum, capability can be expanded through the organisation programme with minimum hardware impact. Expansion can take place when the customer needs it.

Because the E80AFCS applies automation to already-proven principles of automatic flight control system reliability and safety, it is capable of meeting and beating present day standards.

Two decades during which the E80AFCS is designed to stay "in vogue". It offers a unique opportunity for systems integration which is being actively studied by aircraft manufacturers faced with this task in the future. Elliott is continuing its development of the E80AFCS to be ready to meet this challenge.

.....AT YOUR SERVICE.....WORLD WIDE

BEHIND THE E80 AFCS :

ELLIOTT CIVIL AFCS PROGRAMMES.....

VC 10



STANDARD VC10

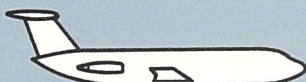
In service with BOAC, BUA, GHANA and, in a special version, the RAF



SUPER VC10

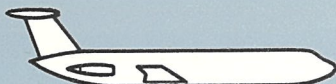
In service with BOAC and EAA

BAC ONE-ELEVEN

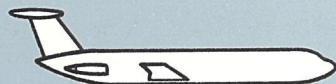


BAC ONE ELEVEN 200 & 400 SERIES

In service with AER LINGUS, ALOHA, AMERICAN, AUSTRAL, AUTAIR, BAHAMA, BAVARIAN, BRANIFF, BRAZILIAN GOV'T, BUA, CALEDONIA, CHANNEL, DAN AIR, ENGLEHARD, GERMANAIR, HORTEN, LACSA, LAKER, LANICA, MOHAWK, PAL, PAN AIR, QUEBECAIR, RAAF, SADIA, TACA, TAE, TAROM, TENNECO, VASP, VICTOR COMPT, ZAMBIA.



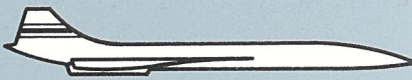
500 SERIES



BEA 510 SERIES

A special version of the BAC One Eleven 500 series is in service with BEA

CONCORDE




CONCORDE

Options held by AIR CANADA, AIR FRANCE, AIR INDIA, AMERICAN, BOAC, BRANIFF, CONTINENTAL, EASTERN, JAL, LUFTHANSA, MEA, PANAM, QANTAS, SABENA, TWA, UNITED

ELLIOTT CAPABILITY AND SUPPORT.....


.....AND EQUIPMENT

VC10's are fitted with Elliott dual-monitored autopilots and autothrottle system as standard equipment. This system was to set a new standard in en-route reliability and system availability, now taken for granted as a requirement for new aircraft types yet to enter service.

 Super VC10's are also fitted with the Elliott dual-monitored autopilot and BOAC is in process of up-dating its fleet to the full failure-survival automatic landing standard. BOAC has already commenced service use of the equipment and was the first airline to have an automatic failure survival system in service. Elliott has now completed its VC10 automatic landing programme in readiness for BOAC crew training to begin in earnest.

BAC One Elevens are fitted with the Elliott E2000 series autopilot. The system entered service on 400 series aircraft and introduced new forms of automatic approach control which have set a standard for aircraft of the future. The accuracy of control has prompted American Airlines to incorporate the E2000 autopilot in their Category II programme.

500 series machines are fitted with autopilots up-dated towards the E2100 passive failure standard. Elliott autothrottle and E2200 autoflare systems are also optional equipment for these machines.

 A special version of the E2200 automatic landing system was specified for the BEA fleet of BAC One Elevens. This system embodies entirely new cruise autopilot features aimed at reducing pilot work load and is different in operation from the E2000 standard equipment. The system has completed its first full year of service with BEA and is being developed to incorporate the Category II and automatic landing features.

With French participation, Elliott is producing the automatic flight control system for Concorde. This system embodies the safety and reliability features now proven successfully on the VC10 and implemented by advanced microcircuit technology. Concorde is still the only civil aircraft type flying with such advanced failure-survival equipment. Dependability of the system was demonstrated on the maiden flights of both British and French Concordes and this again has set a new standard which will be maintained on future aircraft. Elliott is proud to have the cooperation and interest of the world's airlines in continuing this programme.

.....RIGHT THROUGH THE JOB.....TO SUCCESS

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