

GEC **AVIONICS**

Combat Aircraft Controls Division





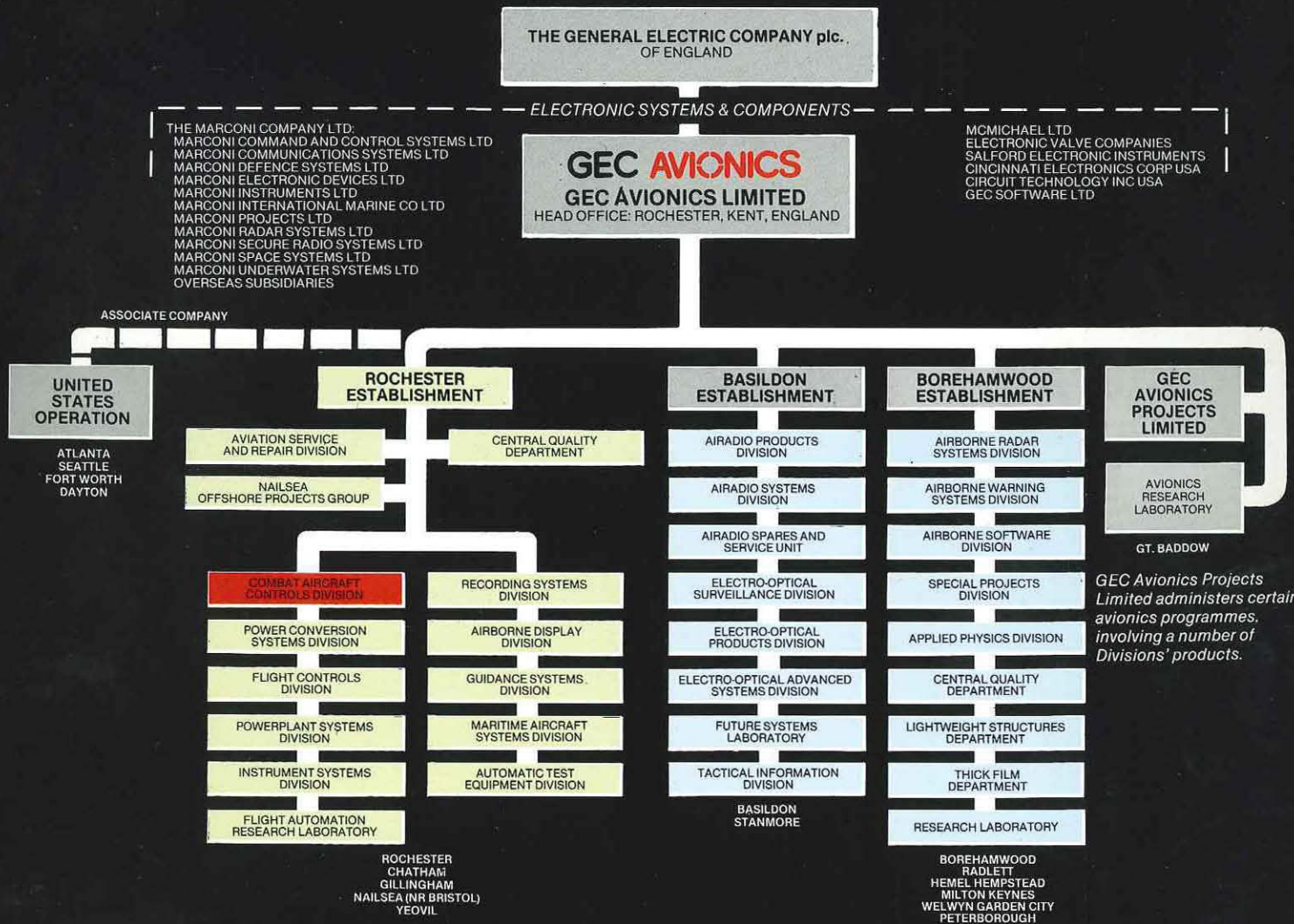
GEC AVIONICS

GEC Avionics is a wholly owned subsidiary of GEC, the United Kingdom's most powerful engineering group, with the resources and experience to tackle projects on an international scale.

Business is conducted by a number of long established divisions, each specialising in its own field and responsible to its own customers. This enables resources and expert attention to be dedicated to projects large and small.

The Company is a highly efficient team of 12,000 men and women, many of whom are professionally qualified scientists and engineers, supported by skilled technicians and craftspeople.

With over 2.4 million square feet of well equipped premises, the Company leads Europe in the production of avionics and supplies 15% of the combined UK capital electronics output of EEA member companies.



UK LOCATIONS



USA LOCATIONS



This schematic presentation should not be taken to represent the precise legal or trading relationships between the organisations shown.

Combat Aircraft Controls Division

GEC Avionics has a long record of success in both analogue and digital high integrity flight control systems. In particular the Company has pioneered the development of high authority, multiple redundant flight critical control systems for application in:

- Full time Fly-By-Wire
- Command and Stability Augmentation
- Full Flight Regime Autothrottle
- High Performance Autopilot Functions such as Automatic Landing and Terrain Following
- Aircraft Modernization

These systems combine modern technology and digital techniques to enhance the safety, reliability and maintainability qualities of flight control systems as well as meeting the performance needs.

Modern automatic flight control techniques give the aircraft designer new freedoms to exploit advances in aerodynamics, propulsion, materials and fabrications. For future systems GEC Avionics is developing:

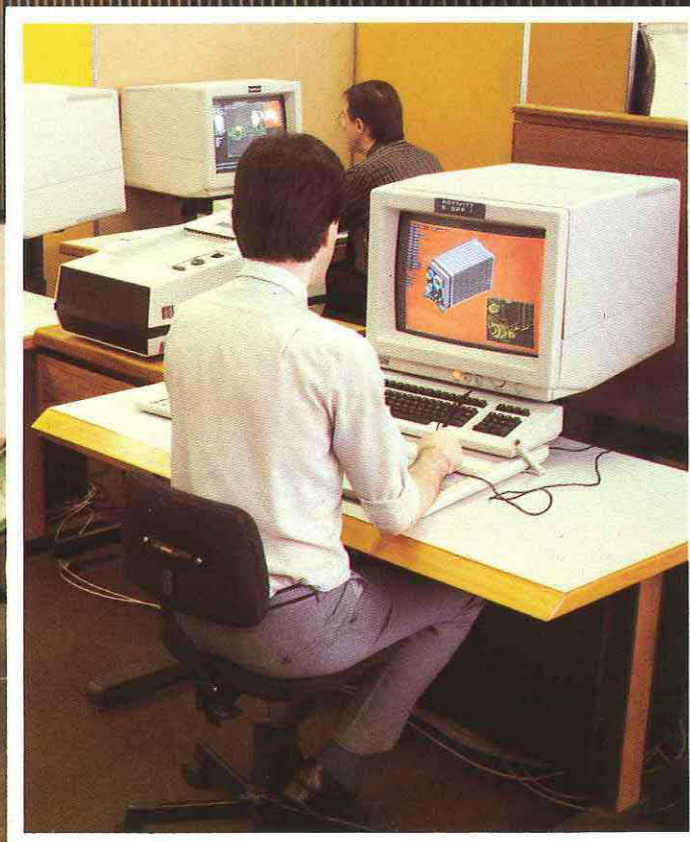
- Multiple redundant and self-monitored systems for high integrity
- Digital microprocessor designs for the functional versatility and reduced package size
- Sensor concepts and packaging
- Electrical and Optical data transmission techniques
- Electric Actuation
- Fly-By-Light Technology
- Active control techniques for Stability Augmentation, Automatic Control Configuration, Envelope Limiting, Direct Force Control and Weapon Aiming Enhancement

Full time Fly-By-Wire systems for unstable combat aircraft that have no reversionary controls of any kind rely on failure survival architecture for high system integrity. Particular attention is paid to immunity to lightning strikes and tolerance of electromagnetic interference.

Modern flight control technology also benefits existing aircraft with more reliable, lower life-cycle cost systems having lower weight, space and power penalties.

The Company possesses a total system capability ranging from preparation of the initial specification, through design, development, certification and production stages to in-service repair and logistic support.

Comprehensive engineering support facilities include Computer Aided Design, Hybrid Computer Simulation, Environmental Testing and extensive rigs for component testing and system validation.



The triplex fly-by-wire system for Tornado is produced by a consortium of UK, German and Italian companies with GEC Avionics as the prime contractor.

The Automatic Flight Control System incorporates extensive self monitoring and built-in-test capabilities and comprises:

Autopilot and Flight Director System (AFDS)

- Fail safe autothrottle
- Fail safe autopilot including terrain following
- Fail safe autotrim
- Fail operational flight director
- Digital computing

3-axis Command and Stability Augmentation System (CSAS)

- Automatic stabilisation
- High integrity fly-by-wire manoeuvre demand system
- Gain scheduling to optimise response over flight envelope
- Gain scheduling to optimise performance for various wing sweep configurations
- Interface with GEC Avionics designed quadruplex first stage actuation

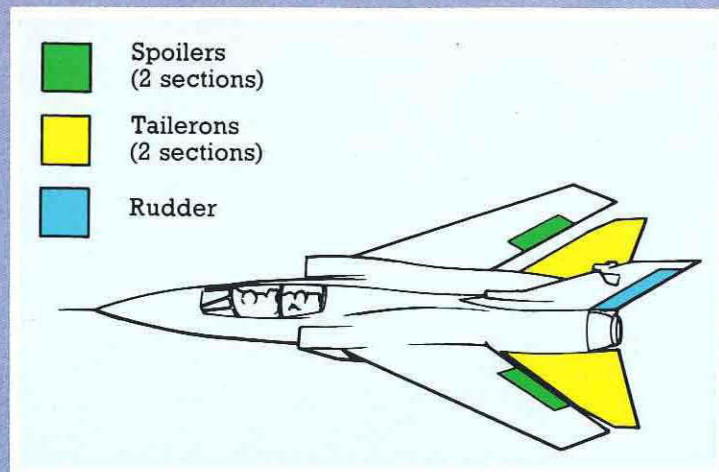
Spin and Incidence Limiting System (SPILS)

- Fail safe spin prevention and incidence limiting
- Carefree handling qualities at high incidence

Automatic Flight Control System For The Tornado Multi-Role Combat Aircraft



- | | |
|-----------------------|------------------------------------|
| 1 SPILS Computer | 7 Autothrottle Actuator |
| 2 Quadruplex Actuator | 8 Stick Force Transducer |
| 3 CSAS Control Panel | 9 Pitch Stick Position Transmitter |
| 4 CSAS Pitch Computer | 10 Triplex Rate Gyro |
| 5 AFDS Computer | 11 Roll/Yaw Position Transmitter |
| 6 AFDS Control Panel | 12 SPILS Control Panel |



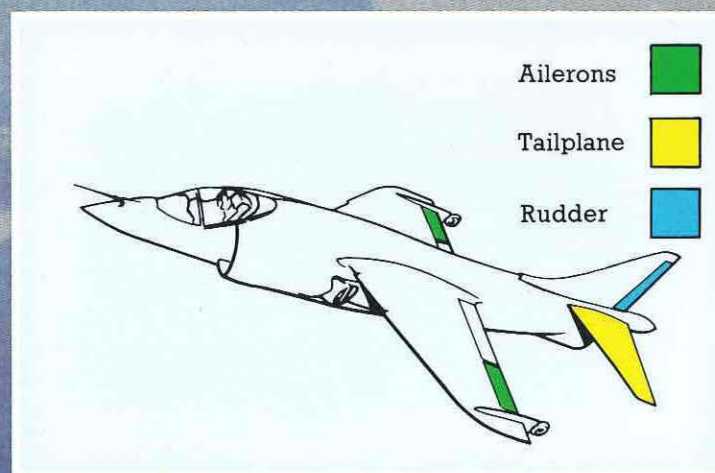
The world's first vertical take-off and landing (VTOL) aircraft to enter military service. The Harrier achieved a mission availability rate of 99% whilst operating at sea in the very harsh South Atlantic environment. No Harriers were destroyed as a result of air to air combat, demonstrating the unique handling capability of the aircraft.

This combat proven Automatic Flight Control System offers:

- Autostabiliser which provides three axis stability augmentation during take-off, transition and hover
- Autopilot to provide height, heading and attitude hold

An Autotrim function is currently being incorporated during the aircraft mid-life update to further enhance the AFCS.

Automatic Flight Control System For The Sea Harrier Aircraft



1
Yaw
Autostabiliser

2
Autopilot

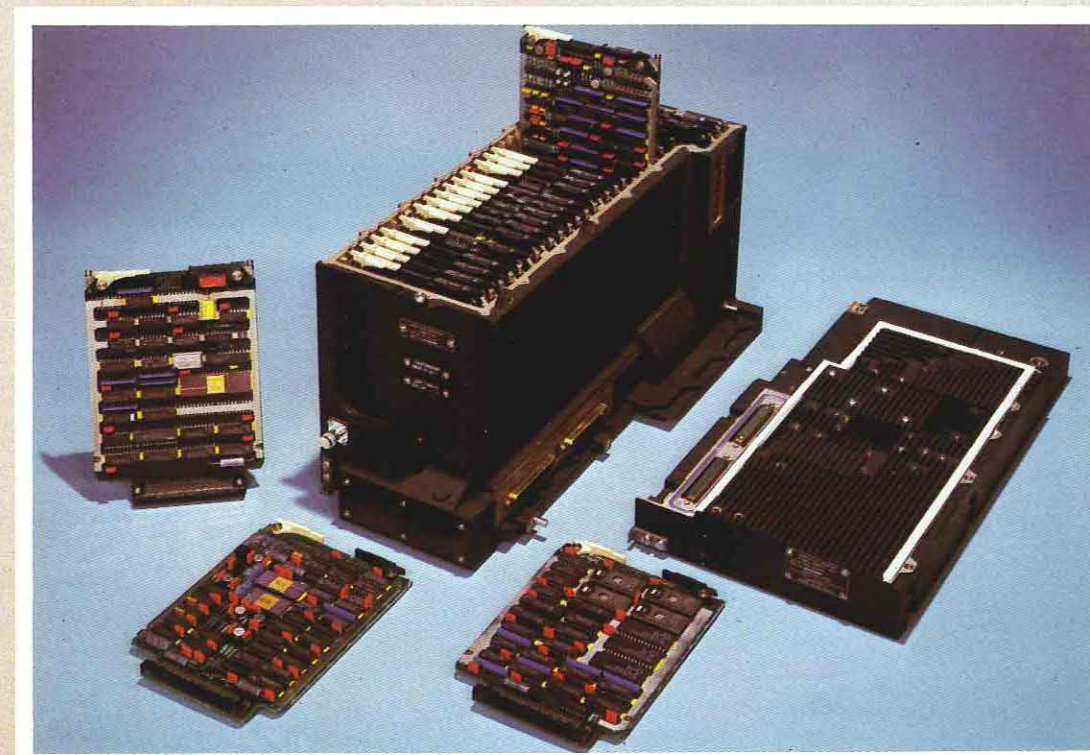
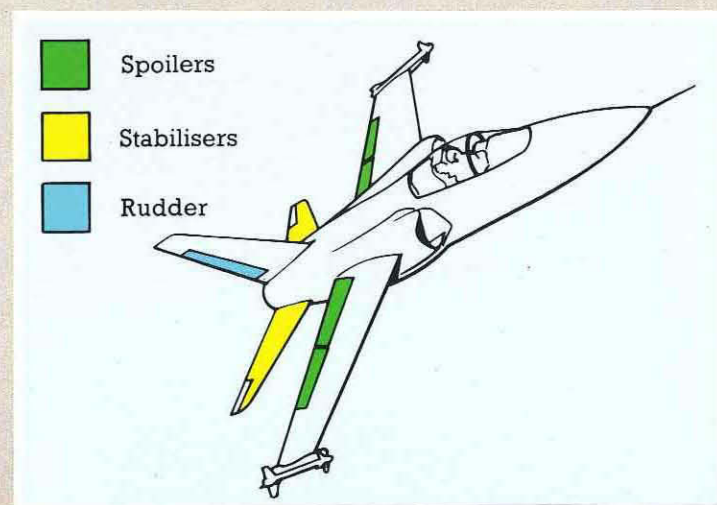
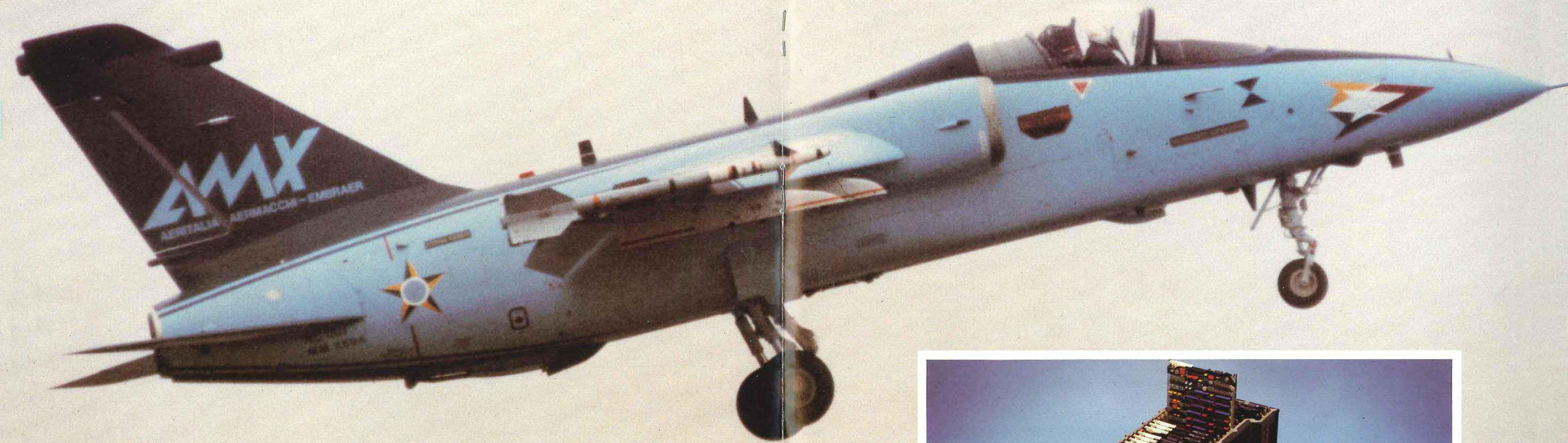
3
Pitch/Roll
Autostabiliser

The duplex monitored Automatic Flight Control System for the AM-X is being designed, developed and produced by GEC Avionics in collaboration with Aeritalia GE.

The System offers:

- Full authority fly-by-wire control of designated surfaces
- Interface with duplex force summed actuators
- Digitally implemented pitch and yaw trim
- 3-axis rate feedback damping
- Symmetrical control of spoilers to give airbrakes and lift dump functions
- Autopilot facility interfaced with a MIL-STD-1553B aircraft data bus
- Extensive pre-flight/self-check capability

Automatic Flight Control System For The Aeritalia-Macchi-Embraer AM-X Attack Aircraft

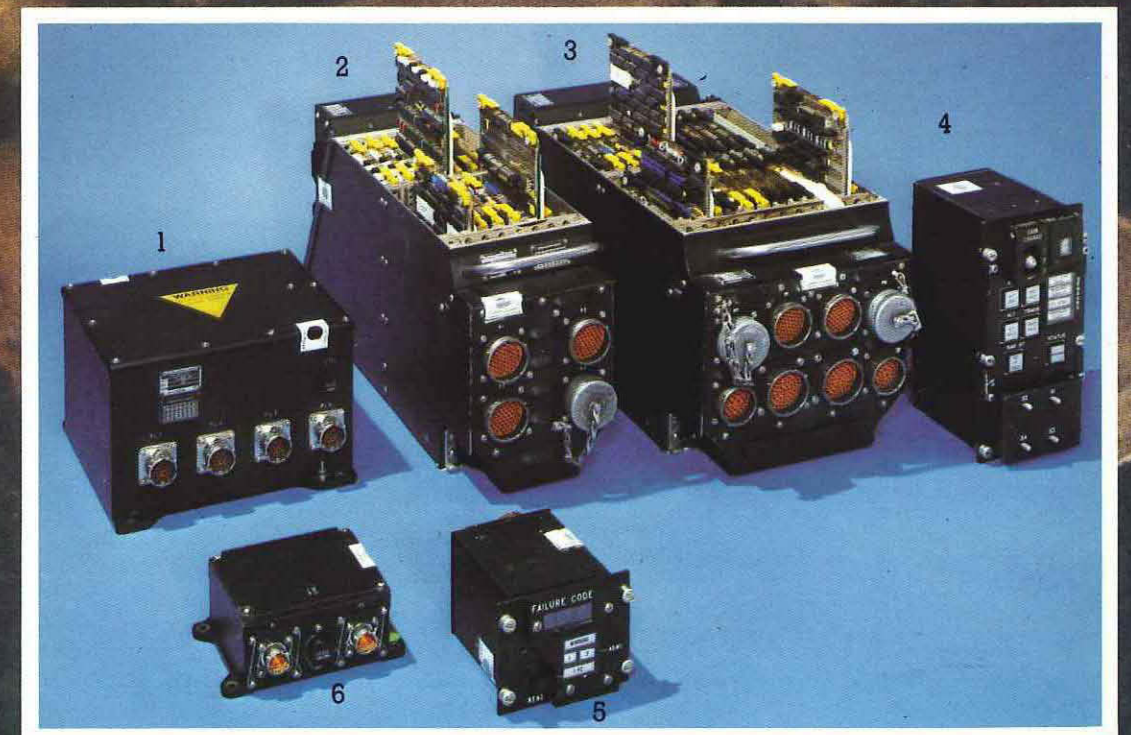
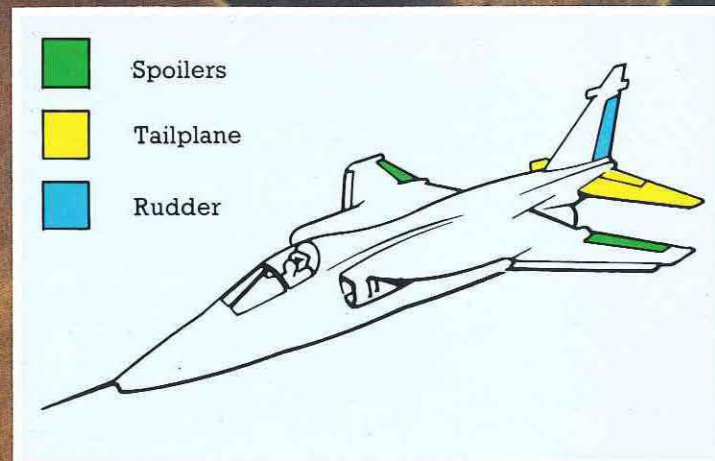


Combat Aircraft Controls Division of GEC Avionics supplied the first full time quadruplex digital fly-by-wire control system

The fly-by-wire Jaguar first flew on 20 October 1981 in a stable configuration and on 16 May 1984 flew with over 10% negative stability and demonstrated that a full time digital fly-by-wire system can be implemented safely and meet airworthiness criteria similar to those of other modern high performance aircraft.

- High integrity system to explore relaxed stability characteristics
- Enhanced manoeuvrability using active controls
- No reversionary flight controls, electrical or mechanical
- Automatic self-test monitoring capabilities
- Integral autopilot
- Fully meets Electromagnetic compatibility and lightning strike requirements
- Manufactured to production standards to provide a ready basis for future advanced flight control applications

Digital Flight Control System For The Jaguar Active Control Technology Demonstrator Aircraft



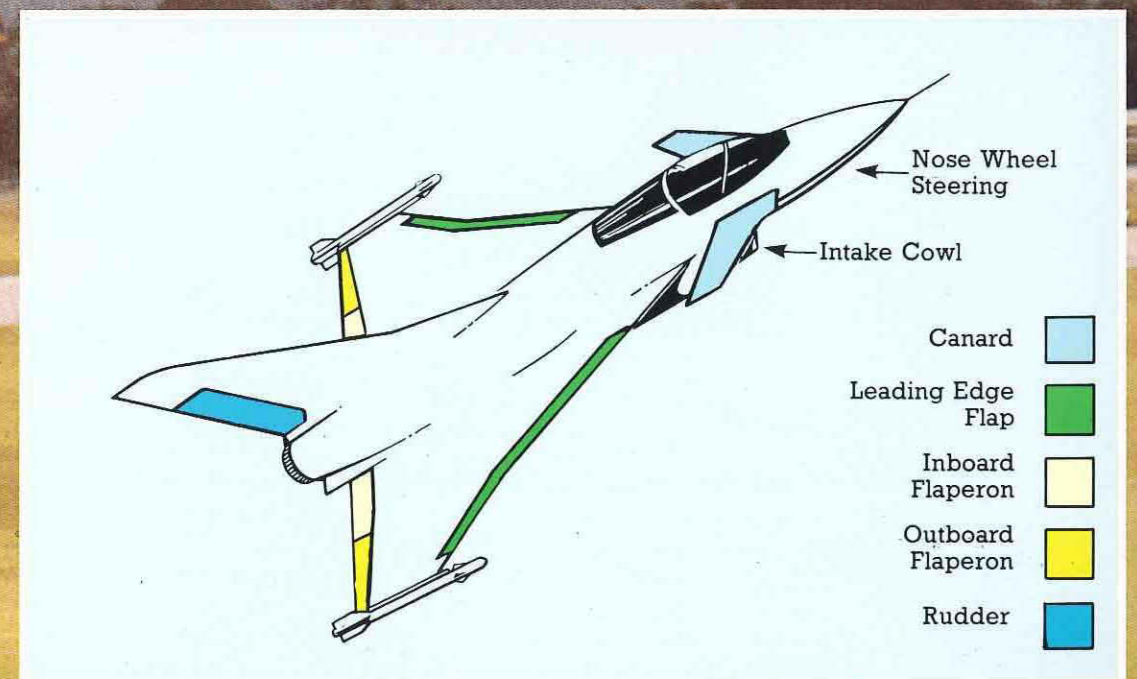
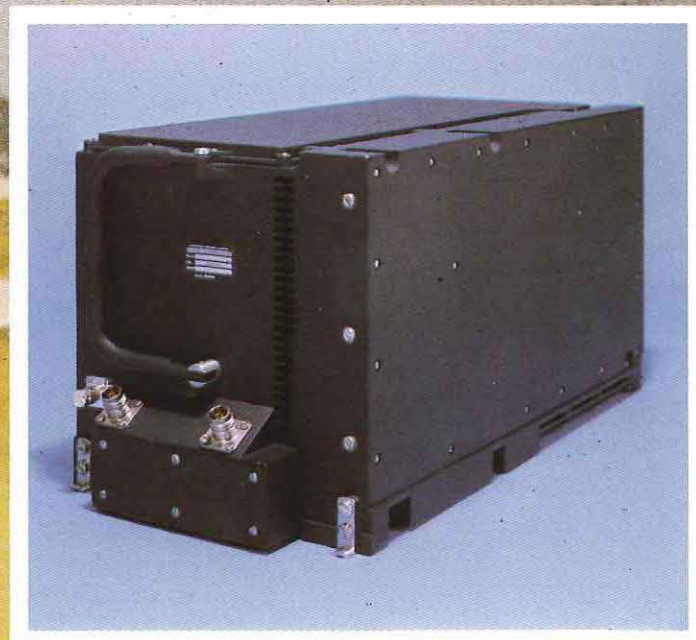
1 Quadruplex Rate Gyro
2 Actuator Drive and Monitor Computer
3 Flight Control Computer

4 Pilot's Control Panel
5 Diagnostic Display Unit
6 Duplex Accelerometer

Active Digital Flight Control System For The UK Experimental Aircraft Programme

The Combat Aircraft Controls Division of GEC Avionics is supplying the Flight Control System for the agile combat aircraft being developed by British Aerospace PLC in collaboration with Aeritalia GE as part of the UK Experimental Aircraft Programme.

- Full time quadruplex digital fly-by-wire control system
- No reversionary flight controls, electrical or mechanical
- Digital computation of all flight control laws
- Two fail operational control of canards, inboard and outboard flaperons and rudder
- Control of the leading edge flap, engine intake cowls and nose wheel
- MIL-STD-1553 multiplexed buses interface the flight control system to other aircraft systems
- Reversionary instrumentation is supplied with data via a dedicated serial link



Aircraft Modernization

GEC Avionics has, over the past few years, recognised the need for effective systems management and capability to fully support the ever increasing number of aircraft modernization programmes.

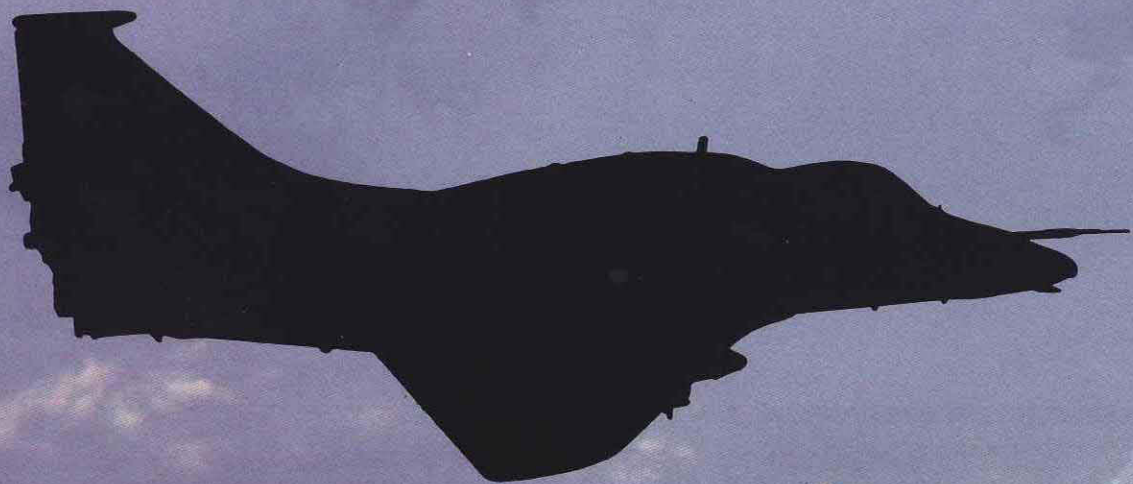
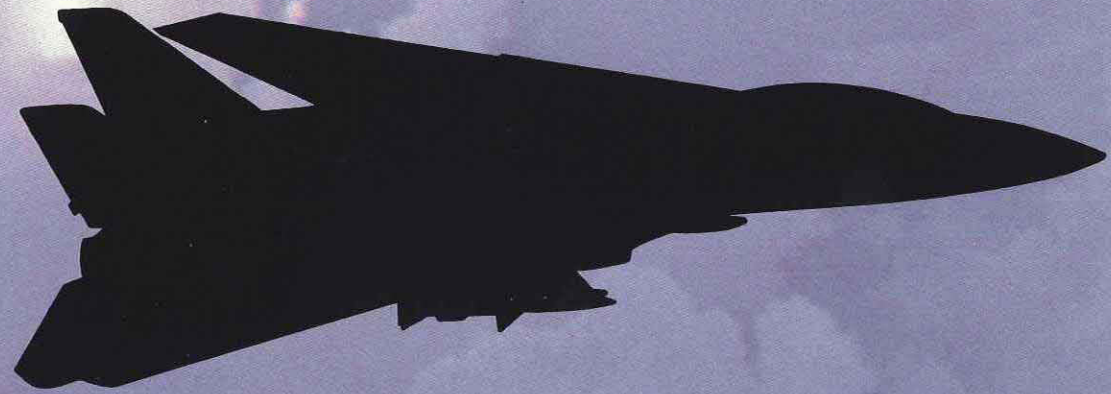
To support these programmes GEC Avionics can offer either a total management package incorporating:

- The establishment of direct liaison with aircraft manufacturing companies' design staff or in some instances, responsibility for specific installation design
- Technology transfer

- Extensive system simulation of all types
- Operational analysis and establishment of system performance goals when installed in aircraft
- Design, manufacture and operation of rigs
- Flight clearance and authorisation of systems after installation in aircraft
- Design of flight trials programmes, analysis of results and overall engineering and maintenance of support trials
- Familiarisation of service operators with system design philosophy and introduction of system operation into service
- Extensive reliability predictions, testing and failure reporting programmes
- Maintainability studies and design, together with support and logistics programmes

Or an individually designed fully compliant flight control system solution incorporating:

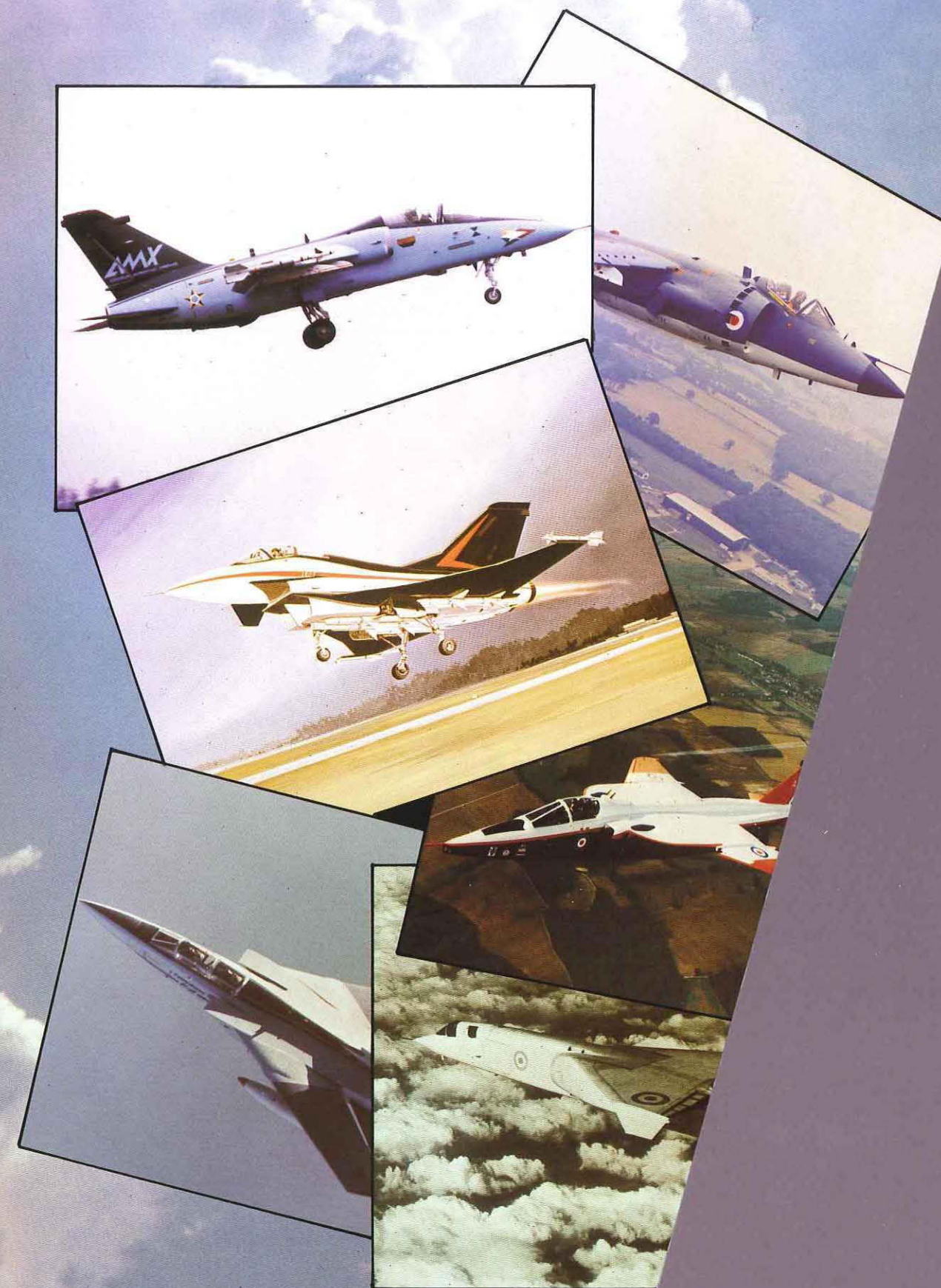
- State of the art technology
- Low life-cycle cost
- Increased reliability and maintainability
- Potential improvement of performance parameters
- Full equipment interface capabilities including MIL-STD-1553 highways
- Reduced space, weight and power penalties



Flight Control Systems—Combat Airplanes

<i>Airplane</i>	<i>Manufacturer</i>	<i>Equipment</i>	<i>Ship sets Ordered</i>	<i>Ship sets Delivered</i>
TSR2	British Aerospace	Fly-by-wire AFCS	16	16
G95	FIAT	Quadruplex Autostab System	1	1
Buccaneer	British Aerospace	Autostab and Autopilot Systems	250	250
Lightning	British Aerospace	Autostab and Autopilot Systems	300	300
Harrier AV8A	British Aerospace	Autostab System	300	300
YAV8B	McDonnell Douglas	Prototype Autostab System	2	2
Sea Harrier	British Aerospace	Autostab and Autopilot Systems	64	47
YC-14	Boeing	AFCS	2	2
Tornado	Panavia	Command and Stability Augmentation System	833	614
Tornado	Panavia	AFDS Including Terrain Following	694	527
Tornado	Panavia	Spin Prevention and Incidence Limiting System	454	116
AM-X	Aeritalia/Embraer	Duplex Monitored Microprocessor	12	11
Jaguar FBW	British Aerospace	Full-time FBW FCS	3	3
EAP	British Aerospace	Full-time FBW FCS	2	0

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Front Cover
 Red Shouldered Hawk
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