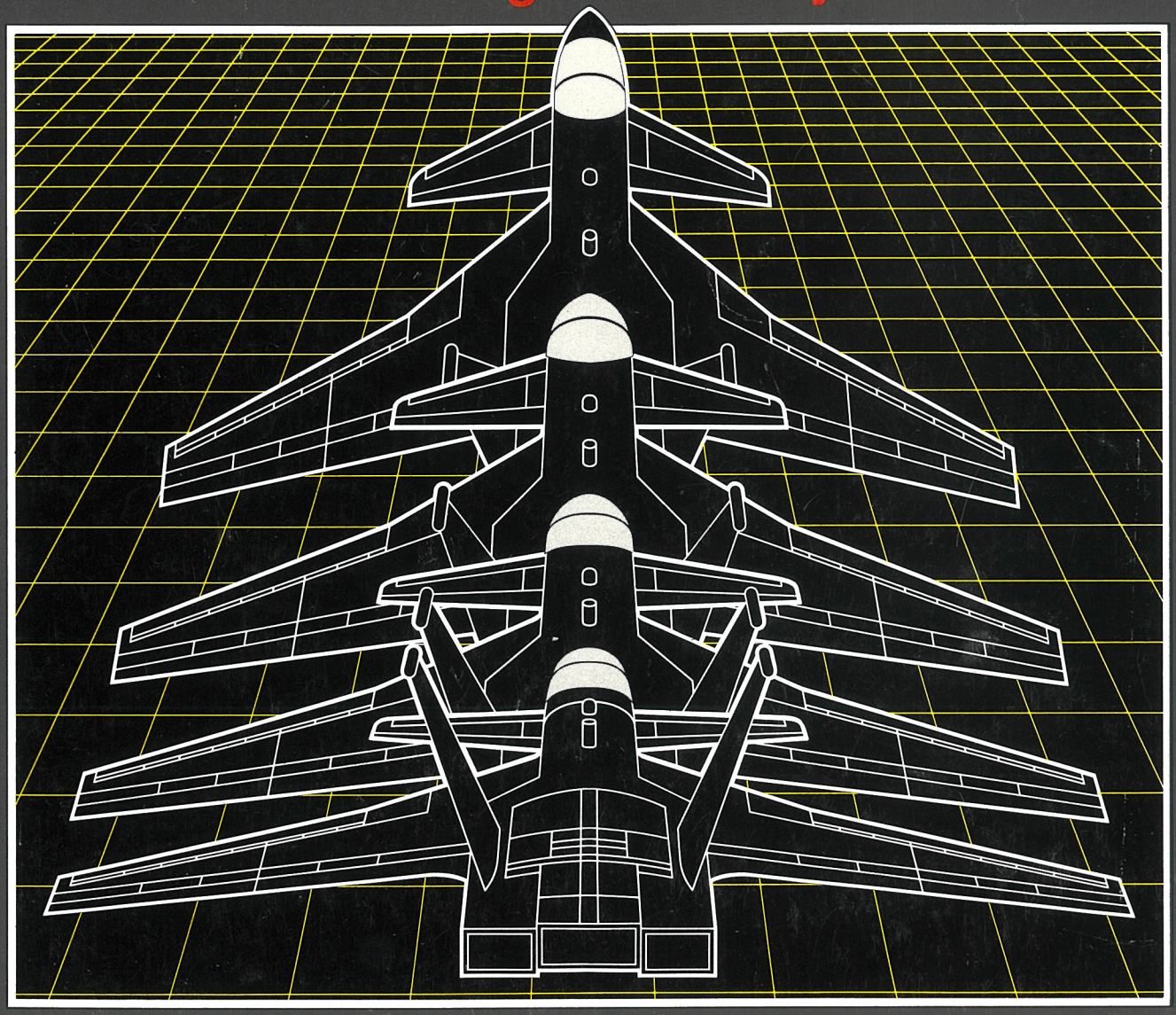
MARCONI
AVIONICS

Automatic Flight Control Systems

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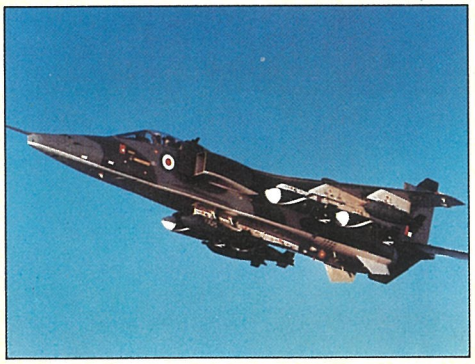
ROYAL NAVY


747


FLY


British airways




ROYAL NAVY

Automatic Flight Control Systems

Marconi Avionics – a world leader in the design and manufacture of Automatic Flight Control Systems for:

- **Combat Aircraft**
- **Civil and Military Transports**
- **Unmanned Aircraft**
- **Helicopters**

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

Command and stability augmentation systems (CSAS)

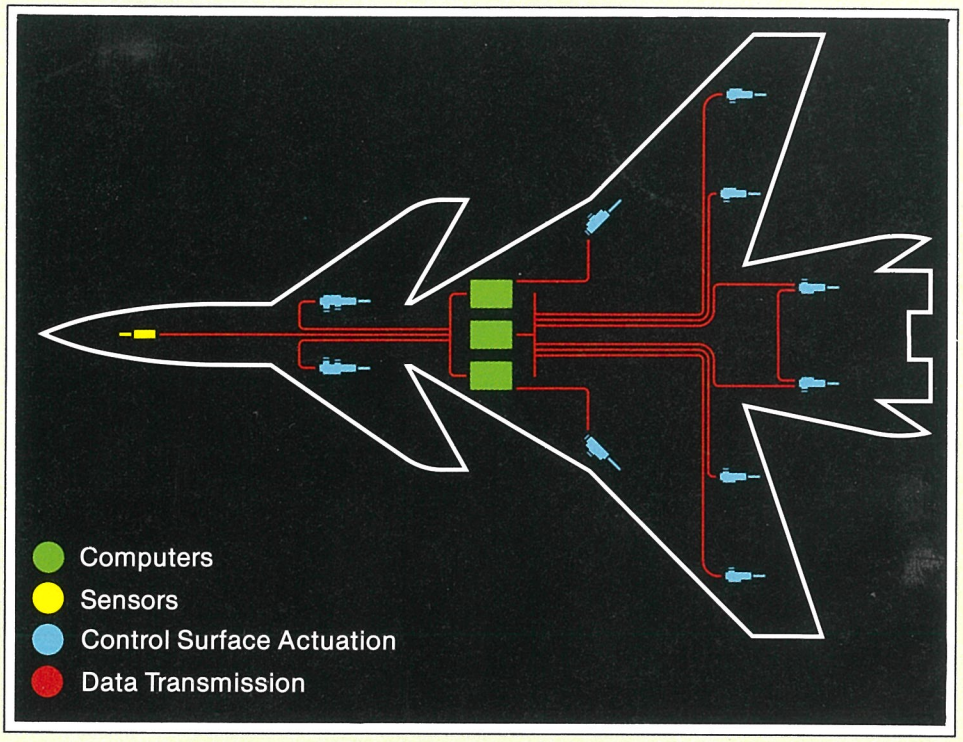
Full flight regime autothrottle systems

High performance autopilot functions such as automatic landing and terrain following.

These systems incorporate safety design features which are now being combined with the advantages of digital implementation to provide the active control technology for the next generation of aircraft.

The Company is actively engaged in the development of full time fly-by-wire systems which incorporate CSAS, direct signalling and full combat autopilot modes. To eliminate mechanical reversionary controls these systems rely on failure survival architecture for high system integrity. In addition, particular attention is paid to immunity to lightning strikes and tolerance of electromagnetic interference.

Flight trial programmes include fly-by-wire control of stable configurations and evaluation of active control techniques in aerodynamically unstable vehicles.



Panavia Tornado

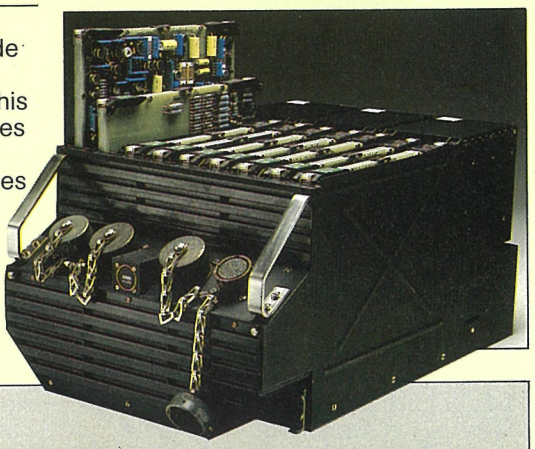
Command and Stability Augmentation System (CSAS)

The triplex analogue CSAS is a fly-by-wire manoeuvre demand system which provides the pilot with:

Electrically signalled pitch, roll and yaw control of the flight control surfaces

Automatic stabilization of the aircraft response to either pilot commands or turbulence by the use of rate gyro feedback.

Gain scheduling is employed to provide good handling qualities and control stability over the full flight envelope. This compensates for configuration changes and takes account of air data, wing-sweep and flap position. CSAS operates in conjunction with a duplex monitored Spin Prevention and Incidence Limiting System to provide 'carefree manoeuvring' which enables the aircraft's full lift capability to be exploited at low level.

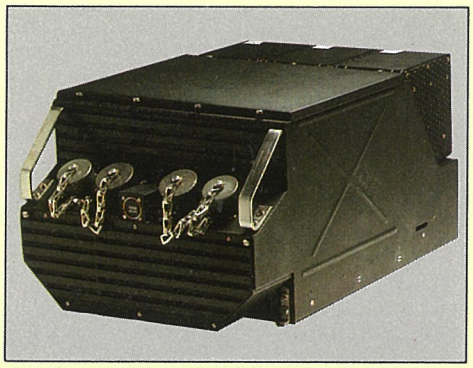


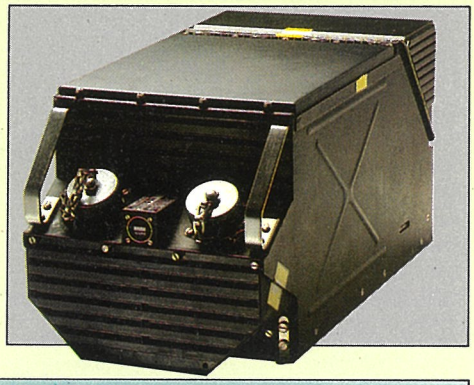
Autopilot and Flight Director System (AFDS)

The digital AFDS provides automatic control of the aircraft in a variety of operating modes. It also feeds signals to the pilot's instruments and head up display to enable the pilot to monitor autopilot performance and to fly the aircraft manually if an autopilot malfunction occurs. Autopilot facilities include:

- Autothrottle which provides airspeed hold
- Terrain following
- Pitch autotrim which continuously controls the pilot's stick to the pitch trim position.

The duplex, self monitored configuration provides safe automatic control especially at low altitude, and also enables the flight director to remain available after most single failures. Autopilot manoeuvre demand signals are fed to the CSAS.





Boeing 747

The Boeing 747 Full Flight Regime Autothrottle System is designed to optimise speed control and throttle activity from take off, through cruise to approach and landing. It offers improved fuel economy, reduced pilot workload and increased engine life.

The system responds to:

- Aircraft configuration changes
- Engine reference changes
- Flight path changes
- Gust disturbances

with smooth, optimised movements of the thrust levers.

The three primary control modes – Speed select, Mach hold and EPR (or N_1) – provide automatic control of aircraft speed (or Mach), or control of all four engines to an EPR (or N_1) limit value.

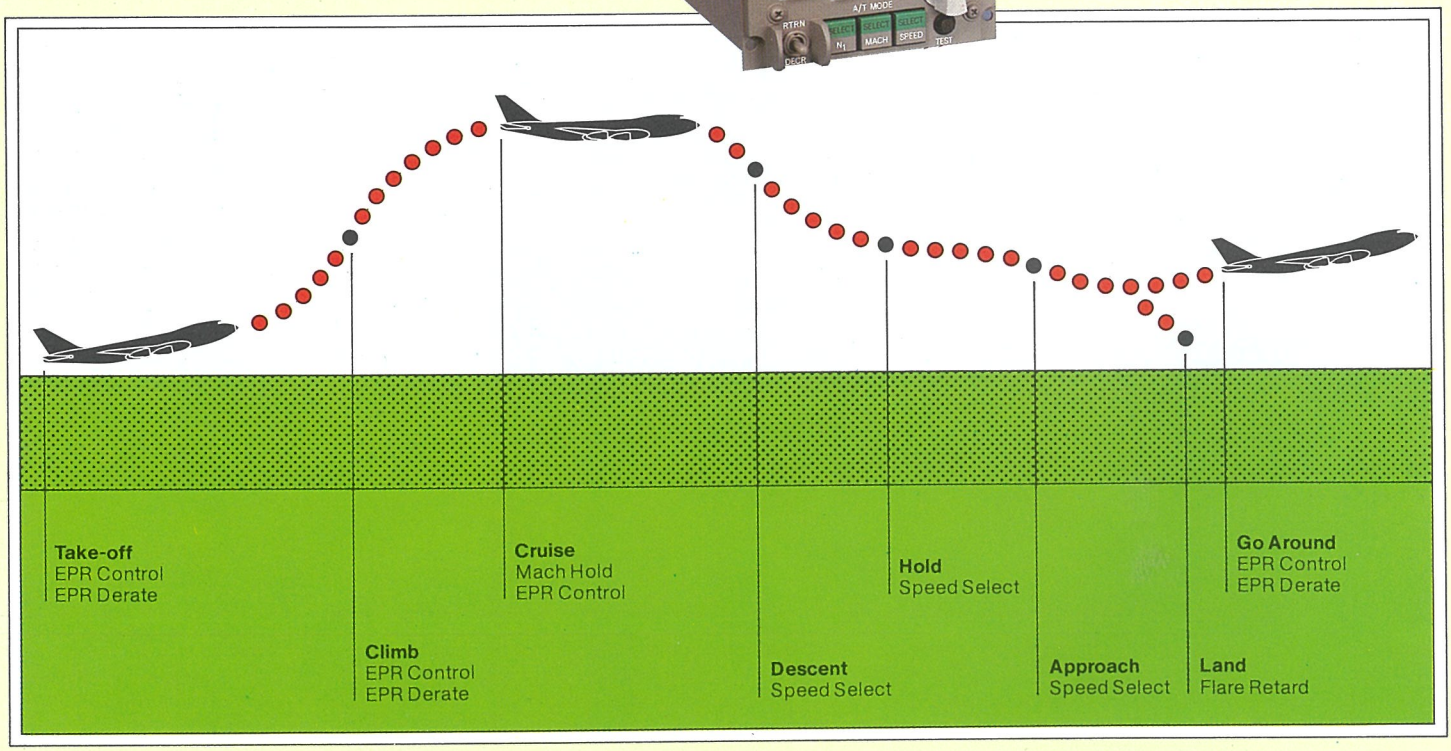
The equipment produced by Marconi Avionics consists of an autothrottle computer and a pilot's mode select panel, and is available for all Boeing 747 variants.

In EPR control mode the system ensures that the engine with the highest EPR indication acquires and maintains the selected EPR limit value minus any decrement selected. All four engine EPR are continuously compared and the one with the highest EPR is selected as the controlling unit. The flight crew may adjust each engine thrust lever to attain agreement in the EPR reading of the four engines. EPR mode is used for take off, climb, cruise, maximum continuous thrust, and go-around regimes of flight.

In Mach hold mode, normally used during cruise, the system ensures that the aircraft maintains the Mach number existing at the time of mode engagement.

In Speed select mode, the system ensures that the aircraft acquires and maintains the selected airspeed. A bias function is included to compensate for gusts during the approach. This mode is typically used for descent, holding, approach and landing.

Submodes include minimum speed protection, flap speed limit protection and EPR limit protection in all modes.

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The Future

Modern automatic flight control techniques give the aircraft designer new freedoms to exploit advances in aerodynamics, propulsion, materials and fabrication.

For future systems Marconi Avionics is developing:

- Multiple redundant and self-monitored systems for high integrity
- Digital microprocessor designs for functional versatility and reduced package size
- Sensor packaging
- Electrical and optical data transmission techniques
- Electric actuation

Active control techniques for stability augmentation, automatic control configuration, envelope limiting, direct force control and weapon aiming enhancement.

The Company possesses a total system capability ranging from preparation of the initial test specification, through the 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.

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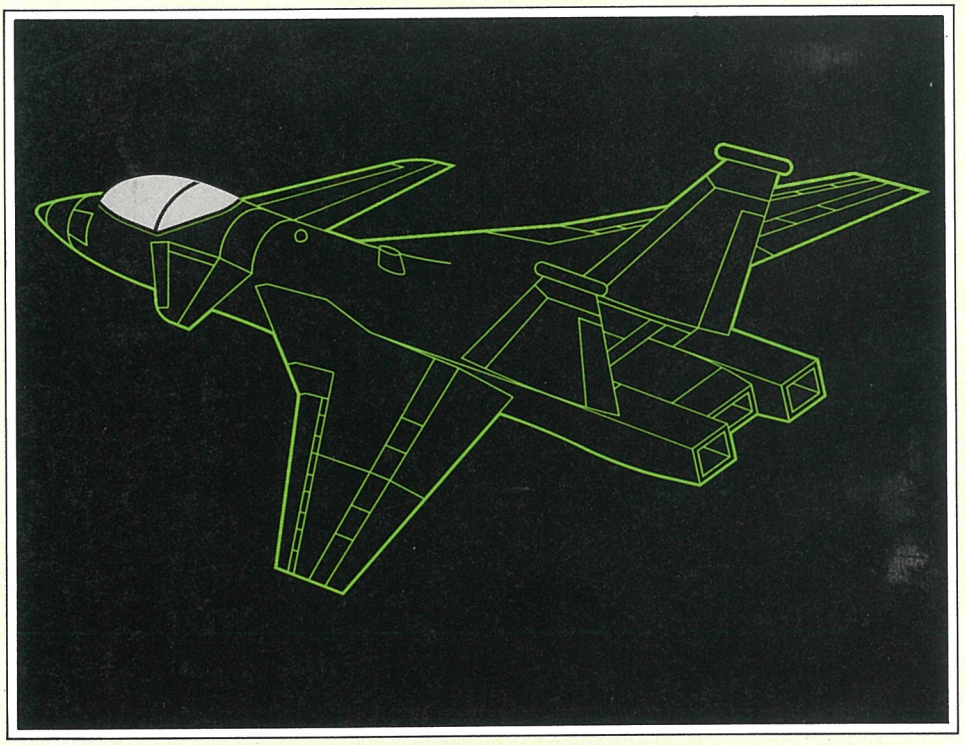

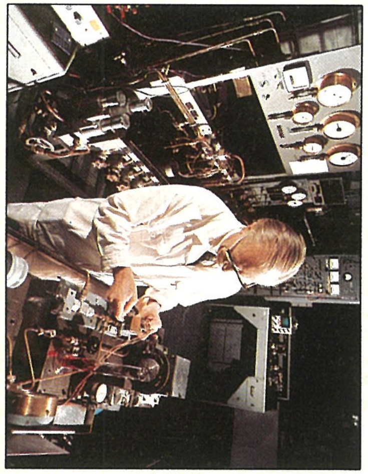
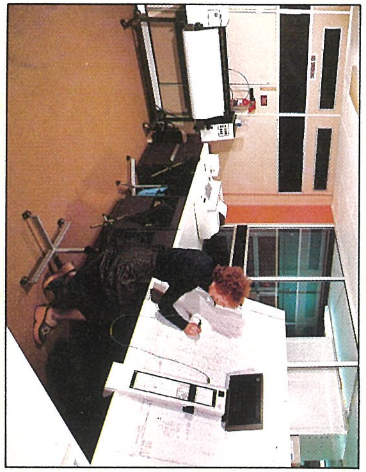
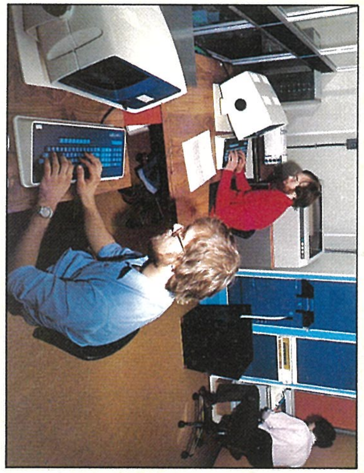
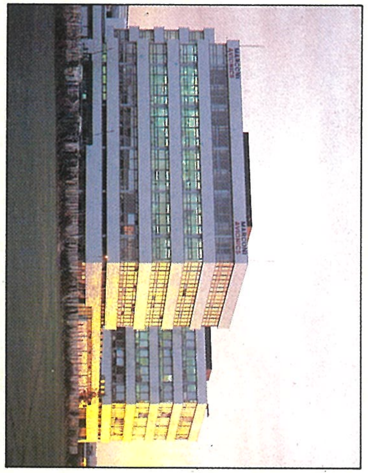
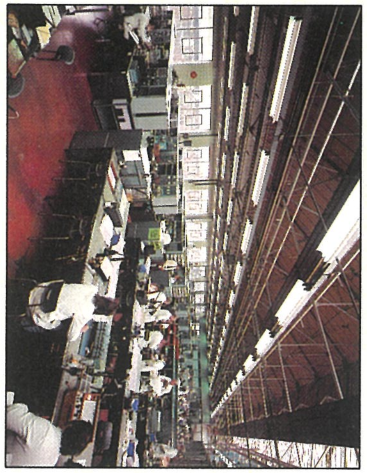
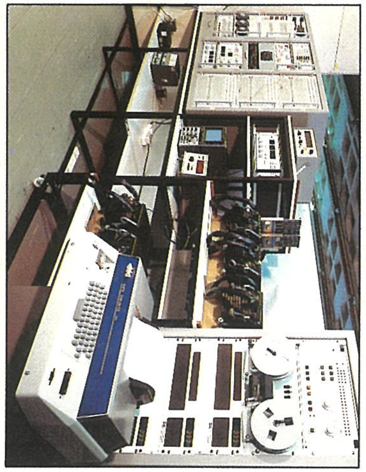

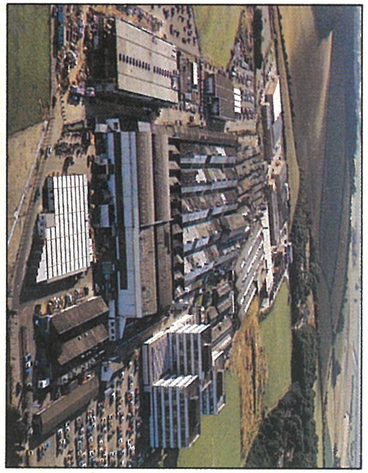

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