Full Authority Digital Engine Control Systems
Honeywell's TTP-Based Modular Aerospace Control

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Honeywell's Modular Aerospace Control (MAC) is a powerful development platform for the cost-effective design of aerospace control systems. As such, it relies on a system of upgradeable processes and reusable products that considerably shorten development cycle time, reduce cost, and minimize risk. Adopting this modular approach improves data flow and fault tolerance, allows for a more proactive approach to obsolescence, and provides robust system-level partitioning with independence of safety-critical functions and a more efficient management of redundancy.
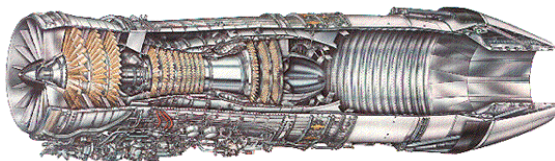
The MAC architecture is Honeywell's latest development for aerospace electronic controls. Among many other fields of application, it will be employed in auxiliary power unit controls, engine monitors, integrated utility systems, data concentrators, distributed controls, and multi-function Full Authority Digital Engine (FADEC) controls. When to be used in a FADEC system, MAC eliminates the need to develop engine-specific controls and replaces them with a customizable platform designed to meet the demands for highly reliable, fault-tolerant engine control systems.


TTTech Computertechnik AG is the leading supplier of technology and software products in the field of time-triggered systems. Headquartered in Vienna, Austria, the high-tech company is supporting Honeywell in the development and advancement of the MAC architecture. Honeywell's innovative development platform integrates modular electronics, standardized hardware devices, off-the-shelf software tools, and TTTech's proven Time-Triggered Protocol (TTP®) to make the design of aerospace controls as flexible and affordable as possible.

"MAC delivers improved data flow and redundancy management as compared to traditional dual channel electronic engine controls. Using TTP communications protocol, the MAC FADEC provides independence of safety-critical functions in the engine."

Nick Stanage, Vice President & General Manager "Engines Systems & Accessories" at Honeywell

TTP is a fault-tolerant deterministic protocol that involves continuous communication of all connected nodes via redundant data buses at predefined periods of time. TTP has effective built-in system health monitoring, fault handling and system-level redundancy services, and data consistency mechanisms to provide new levels of engine safety and operational availability. A communication network designed with TTP prevents an overload in the bus system even if several important events occur simultaneously. All events are safely processed according to a schedule without data collision.
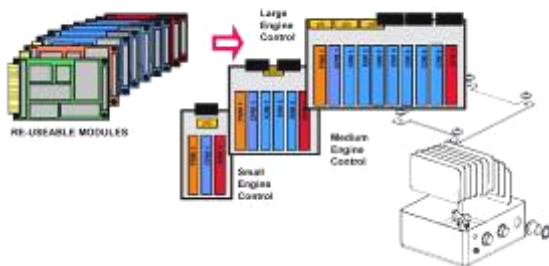
In MAC-based FADEC systems TTP is used as a backplane data bus for intermodule communication. TTP-based systems operate as an embedded fault-tolerant distributed computer and remove the complex interdependencies among the modules, simplifying initial application development as well as integration, maintenance, in-service changes and upgrades. As the protocol provides all data on the bus to both FADEC channels, there is no need for channel transfers when one channel's data is unavailable. TTP allows all modules in a system to see all information all of the time, thereby ensuring a seamless fault accommodation without complex channel logic.

TTP-based MAC provides a highly affordable and highly capable development platform. The flexibility of Honeywell's architecture and the reliability of TTTech's protocol enable the design of scalable, adaptable, and fault-tolerant electronic engine controls for future growth and use in different systems with minor modifications. So far Honeywell uses TTP-based MAC in General Electric's F110 FADEC system to be employed on the Lockheed Martin F-16 fighter aircraft. In addition, TTP is incorporated on the Honeywell F124 FADEC system to be used by the M-346 fighter trainer aircraft made by the Italian aircraft manufacturer Aermacchi.

About TTTech Computertechnik AG

TTTech Computertechnik AG is the leading supplier of technology and software products in the field of time-triggered systems and TTP$^®$ (Time-Triggered Protocol). TTTech products enable developers of automotive, aerospace, and industrial control equipment to deliver reliable embedded systems quickly and efficiently. TTTech's products comprise a complete software development environment for TTP-based systems, including hardware as well as TTP chip models. In addition, TTTech provides a broad range of services, from training courses on time-triggered technology to worldwide product and project support. TTTech especially emphasizes by-wire systems, integrated vehicle control systems, and driver assistance systems.

Further information on TTTech is available at **www.tttech.com**

About Honeywell International

Honeywell International is a $23 billion diversified technology and manufacturing leader, serving customers worldwide with aerospace products and services; control technologies for buildings, homes and industry; automotive products; turbochargers; and specialty materials. Based in Morris Township, New Jersey, Honeywell's shares are traded on the New York, London, Chicago and Pacific Stock Exchanges. It is one of the 30 stocks that make up the Dow Jones Industrial Average and is also a component of the Standard & Poor's 500 Index.

Further information on Honeywell is available at **www.honeywell.com**

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