Technology

In view of the ever more exacting requirements placed on present-day and future aero engines creative and innovative solutions are needed in the field of control and monitoring systems. MTU's control and monitoring systems department is well positioned to offer such solutions.

To meet these high demands, MTU is actively engaged in various technology projects with its engine partners, suppliers, technical research institutes and universities. The technology projects may be grouped into the following broad areas:

- **System architectures**
  distributed intelligence and more electric engine solutions
- **Control techniques**
  model-based control, multivariable control
- **Monitoring techniques**
  sensor technology, model-based diagnostics/prognostics and employment of artificial intelligence techniques, offline engine trending monitoring
- **Equipment design**
  high-temperature sensors and electronics, use of commercial components, advances in electric motors and micro actuators

Having developed the enabling technologies, the department's activities progress hand in hand with engine development, from the concept phase through to product support. Here, the benefits of having a competent and flexible partner, capable of not only specifying but also implementing control and monitoring solutions, become clearly evident.

MTU's control and monitoring systems department offers the complete range of skills, facilities and experience to cover the processes and tasks involved in the design and development of control and monitoring systems and the associated equipment. In particular, the department has specialized in the design, development and production of electronic control and monitoring units tailored to its customer's needs.

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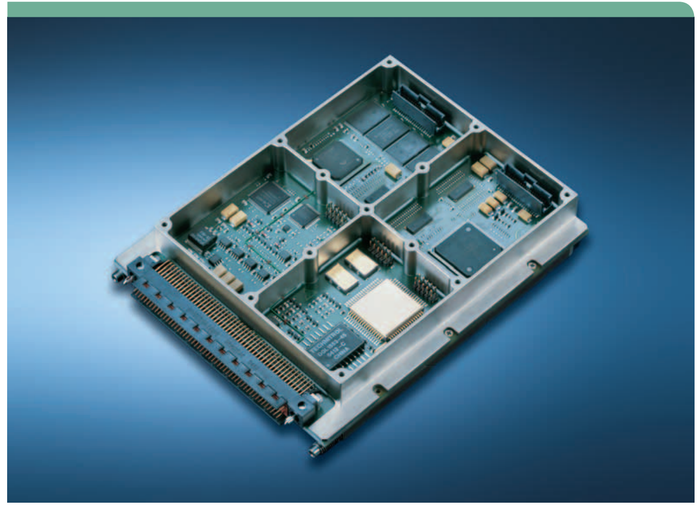
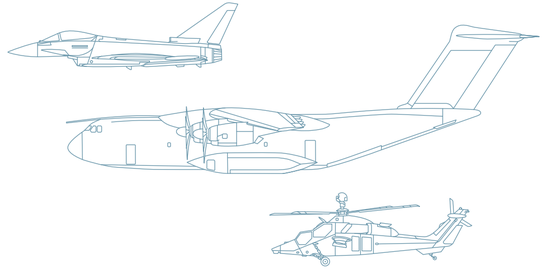


Control and monitoring systems



Competence and facilities

The control and monitoring systems department of MTU Aero Engines possesses the necessary resources, skills and facilities to support the complete life cycle of control and monitoring systems from system design through to system certification of both on-board and off-board systems and the associated equipment and application software.

The department's processes and procedures are compliant with internationally recognized airworthiness, safety and manufacturing requirements (RTCA, DoD specifications, IEEE, U.S. military standards, IEC, IPC, etc.).

The engineers are supported by state-of-the-art CASE tools addressing all aspects of system, hardware and software design and development.

Within the electronic hardware design and development team, extensive use is made of an integrated Mentor Graphics support environment.

This development environment supports the complete spectrum of tasks involved in electronic systems design and material technologies, e.g. VHDL, FPGA, Pictures to Code, SMD, Micro Via PCBs.

MTU's system test facilities allow the complete control system and hydro-mechanical system performance and qualification tests to be performed including EMC/EMI, lightning strike, hot fuel, cold fuel, fuel icing and fuel contamination testing.

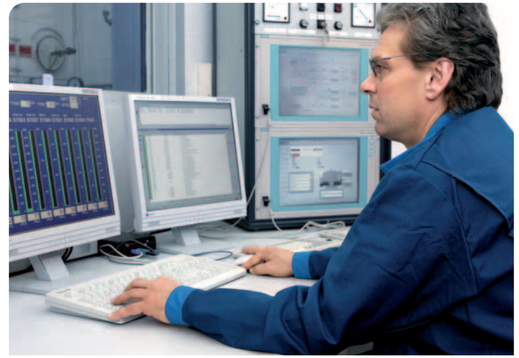
The department, supported by the engine component development functions, has ready access to virtually all the facilities necessary to conduct airworthiness qualification testing of engine control and monitoring systems and associated equipment.

At equipment level, MTU has the capabilities to conduct all the mechanical stress testing (vibration, shock, temperature, pressure, ultimate strength, cyclic testing, etc.), contamination testing and fire testing.

Other rig facilities are available for such tasks as pneumatic and hydro-mechanical performance testing, lubrication and bearing system tests, defect evaluations, combustion chamber fuel spray investigations and visualization.

The electronic unit production facilities provide an integrated environment for inspection, assembly, fully automated burn-in, fully automated pass-off and delivery of the safety critical electronic control units. The department also has the capabilities for repair and overhaul of development and production units.

Product portfolio



The department's successes in the field of electronic hardware and software design and development have now established the design, development, production and product support of electronic control units as a key competence of MTU and a valuable addition to the company's product and service portfolio.

The control and monitoring systems department holds unit integration and production responsibility for electronic control units.

MTU provides intelligent product solutions for the major European military engine projects:

- EJ200 DECU, DECMU
- RB199 DECU
- MTR390-E ECMU
- TP400-D6 EPMU

In addition demonstrator flight hardware for UCAV/FCC's have been successfully developed.

The MTU specialists are also responsible for the TP400-D6 control and monitoring software and the MTR390 monitoring system. Utilizing its proven pedigree and experience, MTU is also engaged in safety critical applications for aerospace systems as well as the industrial and automotive sectors.

In the field of supplier-furnished equipment MTU has system design responsibility (SDR) for the complete range of engine control and monitoring system equipment, e.g. sensors, hydraulics, pneumatics, motors, generators, ignition systems, coolers, etc.

For all its products MTU designs and develops the associated test systems and aircraft ground equipment (AGE) for customer support, e.g. for the European air forces and aircraft simulation facilities.