

FI²RE, TRA and MPEC

All-In-One Solution for Controlling Engine Processes

1. FI²RE – Flexible Actuation of Injection and Ignition Systems

Flexible Injection and Ignition for Rapid Engineering (FI²RE) provides the capability of actuating all crank-angle synchronous components, in particular for injection and ignition. FI²RE permits any number of injections and a wide range of options for triggering solenoid and piezo injectors as well as ignition modules and ignition coils. Rail pressure pumps, camshaft controllers, throttle valves etc. can also be operated. The flexible angle system can be used for a variety of sensors and signal shapes.

2. TRA – Angle-Synchronous Sensing and Processing of Measured Variables

Thermodynamic Realtime Analysis (TRA) Modules sense and process analog signals in synchrony with time and angle. The powerful hardware has been designed to meet the exacting requirements of analyzing heat-release development. Programming is done by model-based code generation (MATLAB®/Simulink®). The module comes complete with block sets for computing typical thermodynamic variables. It also includes flexible filter and sampling functions. Data recorded are analyzed in real time, with the results computed being transferred to downstream systems.

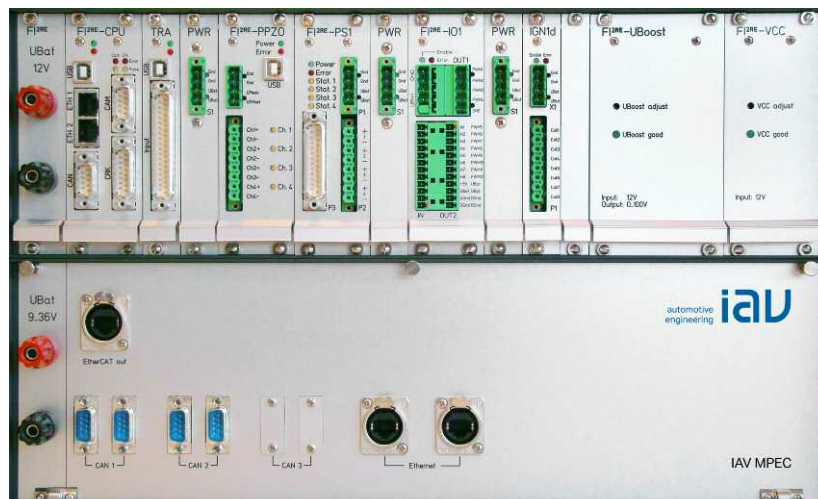
3. MPEC – Model-Based Computation of Complex Algorithms

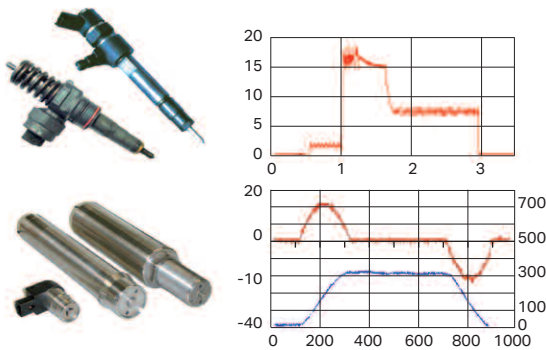
The Modular Prototyping Environment Controller (MPEC) runs complex, compute-intensive control-unit algorithms. These units are also programmed by means of model-based code generation (MATLAB®/Simulink®). They permit time slices down to 100 µs. As communication takes place via an EtherCAT real-time bus, assemblies can be connected with read and write access in real time. Inputs and outputs can be extended in any way on a modular basis. XCP-over-Ethernet permits the application of calibration tools, such as INCA® and CANape®. MPEC is ideal for use with FI²RE and TRA.

Engine Test Bench (pictured below)

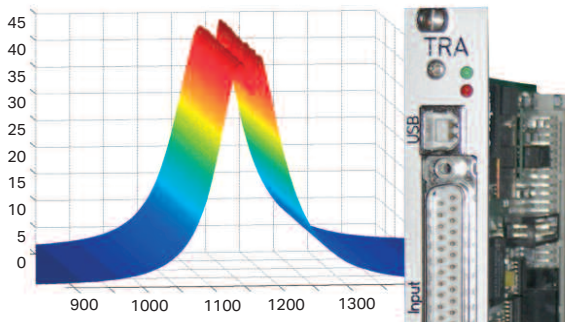
FI²RE, TRA and MPEC

- *Sensors, actuators and efficient modeling*
- *Automated code generation and real-time-capable hardware*
- *All-in-one solution for controlling your engine processes*

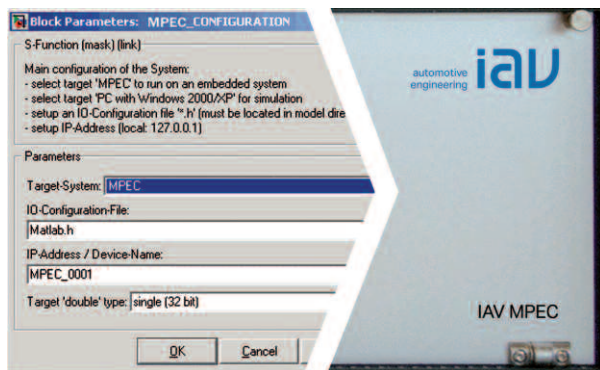




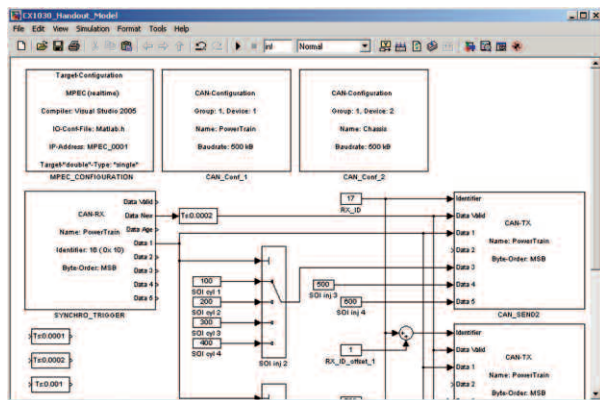
Solenoid and piezo injectors on the FI^{2RE}



Thermodynamics with the TRA module



MATLAB®/Simulink® block sets for MPEC



Programming with MATLAB®/Simulink®

Injection and Ignition: FI^{2RE}

“Flexible Injection and Ignition for Rapid Engineering”

- Crank-angle-based actuation of all solenoid and piezo injectors as well as all ignition systems
- 5 injections per cycle as standard - more on request
- Evaluation of digital and analog (inductive) sensors
- Signals: “60 minus 2-wheel”, 0.5 °CA, 1 °CA, 0.1 °CA, ABN etc.
- Various trigger inputs
- Capability of simulating engine speed internally
- Rail pressure control, any systems
- Control of throttle and EGR valve positions
- Camshaft control
- Windows™ user interface
- CAN, USB 2.0, Ethernet, ASAP3

Cylinder Pressure Sensing and Analysis: TRA Module Thermodynamic Realtime Analysis

- 8 differential analog inputs, ±10 V, electrically isolated
- 16-bit resolution in amplitude. Sample rate 0.1 °CA up to 8000 rpm.
- Angle and time-based sensing, real-time processing
- Steep-slope, digital filters in hardware (FPGA)
- Powerful floating-point signal processor (DSP)
- Evaluation by means of user algorithms generated in MATLAB®/Simulink® and automatic code generation
- Complete with Simulink® block sets for standard parameters (e.g. COHR, IMEP)
- Interfaces: USB 2.0, CAN, 10 Mbits/s SSI, RS232

Models for Engine Functions: MPEC Modular Prototyping Environment Controller

- Based on powerful Pentium® processors
- Programming by MATLAB®/Simulink® models
- 100 Mbit EtherCAT as I/O interface (real-time Ethernet)
- Cycle time down to 100 µs
- I/O modules available for many signals
- Connection to FI^{2RE}, TRA and other (control) units
- Unlimited number of I/O modules
- XCP as calibration interface (e.g. INCA, CANape)
- Capability of interconnection with test-bench control systems (CAN, RS232, Ethernet)
- Simulation on PC, also without MPEC hardware

Model-based Code Generation with MATLAB®/Simulink®

- Straightforward, graphic programming
- Short compilation and downloading times
- Block sets for FI^{2RE}, TRA and MPEC
- Access to all model parameters with XCP over Ethernet