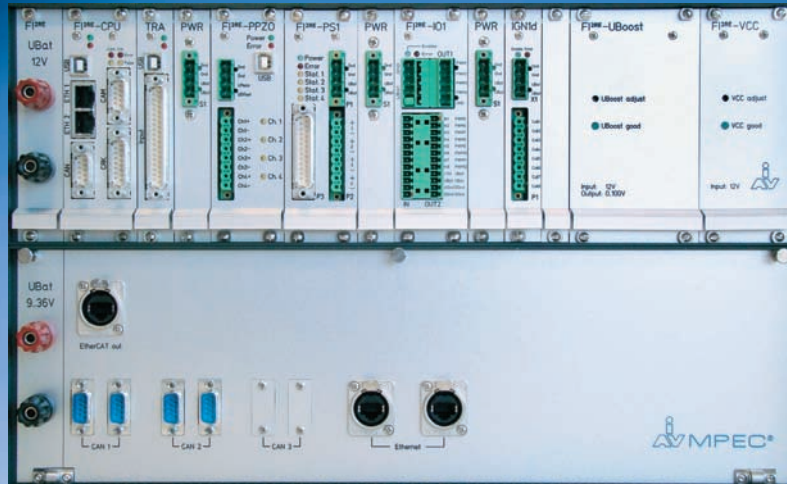


FI²RE, TRA and MPEC

All-In-One Solution for Controlling Engine Processes



Components for Controlling Engine Processes

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, particularly 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.

TRA - Angle-Synchronous Sensing and Processing of Measured Variables

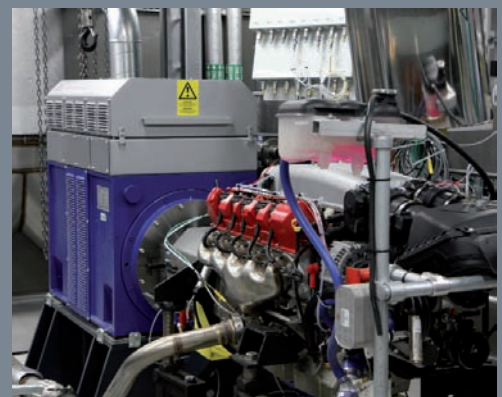
Thermodynamic Realtime Analysis (TRA) modules sense and process analog signals in synchrony with time and angle. The powerful hardware has been designed to meet the requirements of heat-release development analysis. Programming is done by model-based code generation (MATLAB®/Simulink®). The module comes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

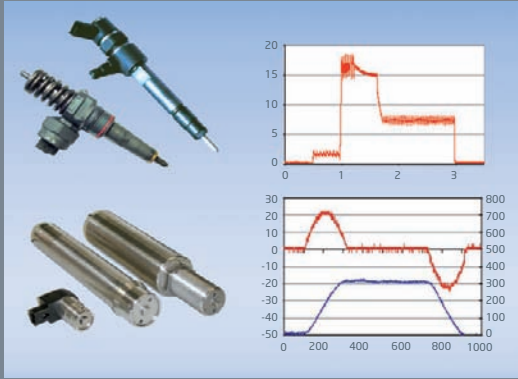
MPEC - Model-Based Computation of Complex Algorithms

The Modular Prototyping Environment Controller (MPEC) runs complex, computational-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 μ s. As communication takes place via an EtherCAT real-time bus, connected assemblies can be described and read 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.

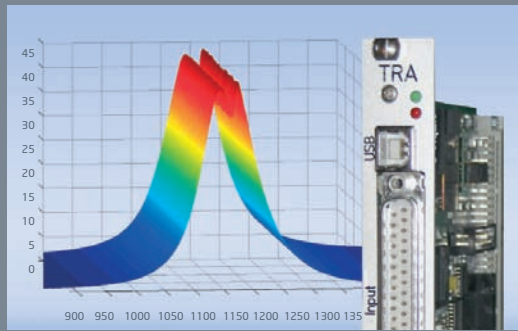
FI²RE, TRA and MPEC

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

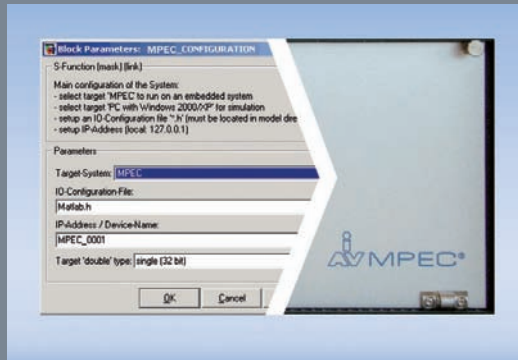




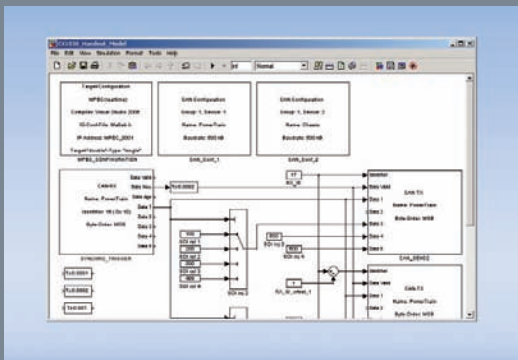
Solenoid and piezo injectors on the FI^{2RE}



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-fold injection as standard; more available upon 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 increments of 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