

## Software

### Control System Design

TTControl offers various alternatives to program ECUs. The products support a big range of standardized modeling environments:

- **CoDeSys®** from 3S-Smart Software Solutions as one of the most common IEC 61131-3 programming systems for PLCs and industrial controllers
- **MATLAB®/Simulink®** from The Mathworks as one of the most suitable solutions for development of complex control algorithms
- **C programming** can be used for designing distributed CAN control systems
- **TTP Tools** offer an integrated software development environment for building fault-tolerant real-time networks with the TTP (Time-Triggered Protocol)



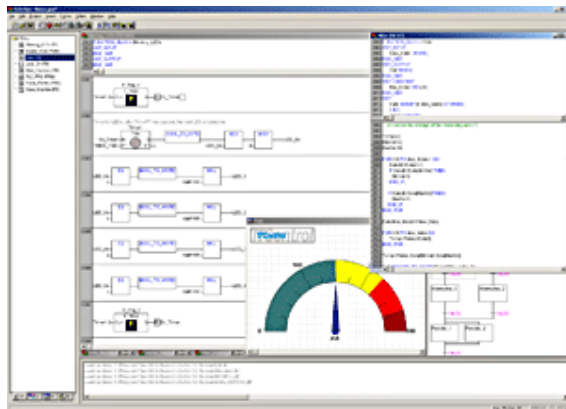
### Visualization Tools

Additional to electronic control units TTControl offers, as a complete system provider, keyboards and cockpit displays. For development of graphical human machine interfaces (HMI) in the vehicle cockpits, TTControl's customers benefit from the choice between two standard tools for visualization design: **CoDeSys** and **VAPS®**.

### CoDeSys/IEC 61131-3

TTControl's control units, TTC 100, TTC 200 and the Vision product family support development with CoDeSys. This programming system is a free-of charge development environment. Also no additional compiler or debugger software is required.

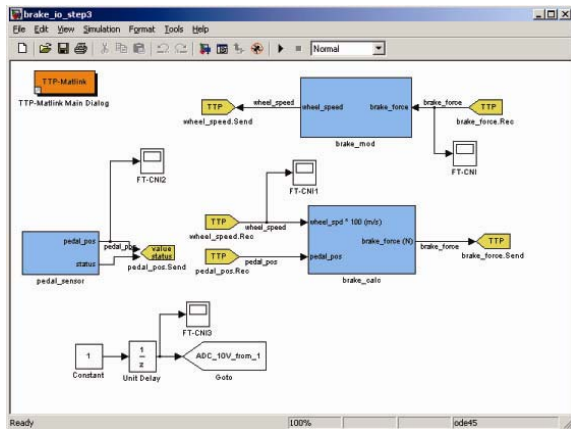
CoDeSys produces native machine code for all common processors and guarantees the optimal use of the TTControl control system by providing development functionalities such as offline simulation, application download and on-line debugging.



The CoDeSys programming system also contains an integrated visualization that allows the development of visualization masks in one and the same user interface. The visualization information can be turned into IEC 61131-3 code, downloaded to Vision<sup>Plus</sup> and shown on the display.

The visualization integrated in CoDeSys can directly access the controller variables. Due the close linkage of the visualization and the controller a conventional display device such as an extra PC is no longer required.

## MATLAB/Simulink



MATLAB/Simulink is a powerful tool for the development of complex control algorithms. TTControl offers blocksets integrated into MATLAB/Simulink such as <sup>TTP</sup>Matlink, a blockset that fully integrates the <sup>TTP</sup>Tools with MATLAB/Simulink. Additionally, TTControl's I/O Toolbox allows accessing the I/O resources of the TTControl hardware targets within MATLAB/Simulink.

The I/O Toolbox contains blocks for all available input and output ports of supported targets like the TTC 200. After verifying the Simulink model, Real-Time Workshop<sup>®</sup> Embedded Coder from The MathWorks can generate highly efficient C-code.

## Programming in C

TTControl supplies a complete installation package for programming the microcontroller and the I/Os. In addition, sample programs, written in C, are provided to aid the user of TTControl hardware and the CAN bus.

## <sup>TTP</sup>Tools

For the use with TTP, TTControl offers <sup>TTP</sup>Tools, the integrated software development environment by TTTech. With <sup>TTP</sup>Tools, the user can design communication architecture, generate a fault-tolerant communication layer with a specialized code generator, configure the time-triggered operating system, download the resulting configuration to the target, and then test the distributed application.

## VAPS

VAPS enables the development of dynamic, interactive, real-time graphical HMI. It is especially suitable for complex applications such as displays and controls for the instrumentation of an automobile or special vehicle.

VAPS allows designers to create driver information systems and other display-based information screens via an intuitive graphical user interface. Screen objects, such as a speedometer or tachometer, can react dynamically to sensor data being received from various nodes in a CAN or TTP network.

The code generator offered with VAPS automatically generates all the embeddable code to display the graphics, without any further programming.

