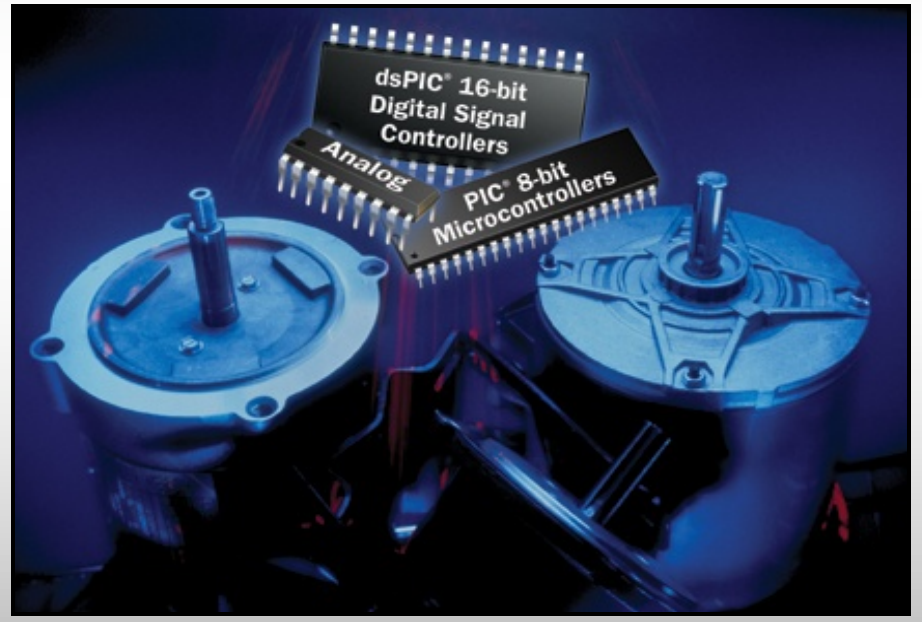
MICROCHIP



Motor Control

Thorsten Waclawczyk
Principal Field Application Engineer

Industry Trends: PMSM motors

- **Higher efficiency and environment friendly**
  - Energy efficiency regulations – appliances
  - Battery life – power tools, drones
- **Lower noise**
  - Consumer demand – appliances, HVAC, auto
- **Higher reliability**
  - Automotive applications
  - Reduced maintenance costs
- **Performance**
  - Higher speed & torque – drones, power tools
- **Smaller form factor, weight reduction**
  - Controller / motor integration, consumer applications

Microchip's Precision Motor Control

- **High-performance dsPIC® DSC and PIC32 MCU cores**
  - DSP instruction enhancements — ***Efficiency, Performance***
  - Speed and torque control — ***Efficiency, Reliability***
  - Field oriented control — ***Efficiency, Low Noise***
  - Sensorless control — ***Lower BOM cost***
- **Optimized peripherals & features**
  - Flexible, high resolution PWMs — ***Efficiency, Low noise***
  - Intelligent high-speed ADC — ***Efficiency***
  - Integrated op-amps and comparators — ***Lower BOM cost***
  - Dual motor control capabilities — ***Lower BOM cost***
  - Functional safety features & Class B SW — ***System Reliability, BOM***
- **Development tools, software algorithms and how-to**
  - BLDC, PMSM, ACIM motor support — ***Reduce time-to-market***
  - Sensorless Field Oriented Control — ***Lower BOM cost***

Motor Control Evolution

Increasing performance and integration

dsPIC33E

- 70 MIPS
- Improved PWM
- 12- bit ADC
- Op-Amps
- 32 – 512KB flash
- 5x5 mm package

dsPIC33C

- 100+ MIPS
- Improved MC PWM
- Dual dsPIC® DSC cores
- Integrated PGA
- Multiple high speed ADCs
  >3 Msps
- 12-bit DAC
- Dead-Man Timer

PIC32MK

- 32-bit core
- 100MHz / 125 DMIPS
- DSP and FPU
- Improved MC PWM
- Op-amps
- Up to 7 12-bit ADCs,
  >3 Msps
- 12-bit DAC

Motor Control Development Boards

Low Voltage Development Board

- Low voltage output , 48V/15A
- Single motor control with sensor input
- CAN, LIN, and UART ports

dsPICDEM MCLV-2 Development Board
(Part # DM330021-2)

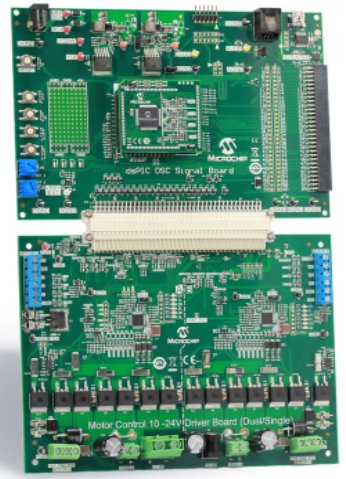
High Voltage Development Board

- 110/220VAC input, 1kWatt/400V
- Integrated PFC stage
- Single motor control with sensor input
- Isolated USB, UART, and programmer/debugger

dsPICDEM MCHV-2 Development Board
(Part # DM330023-2)

Low Voltage MC Bundle

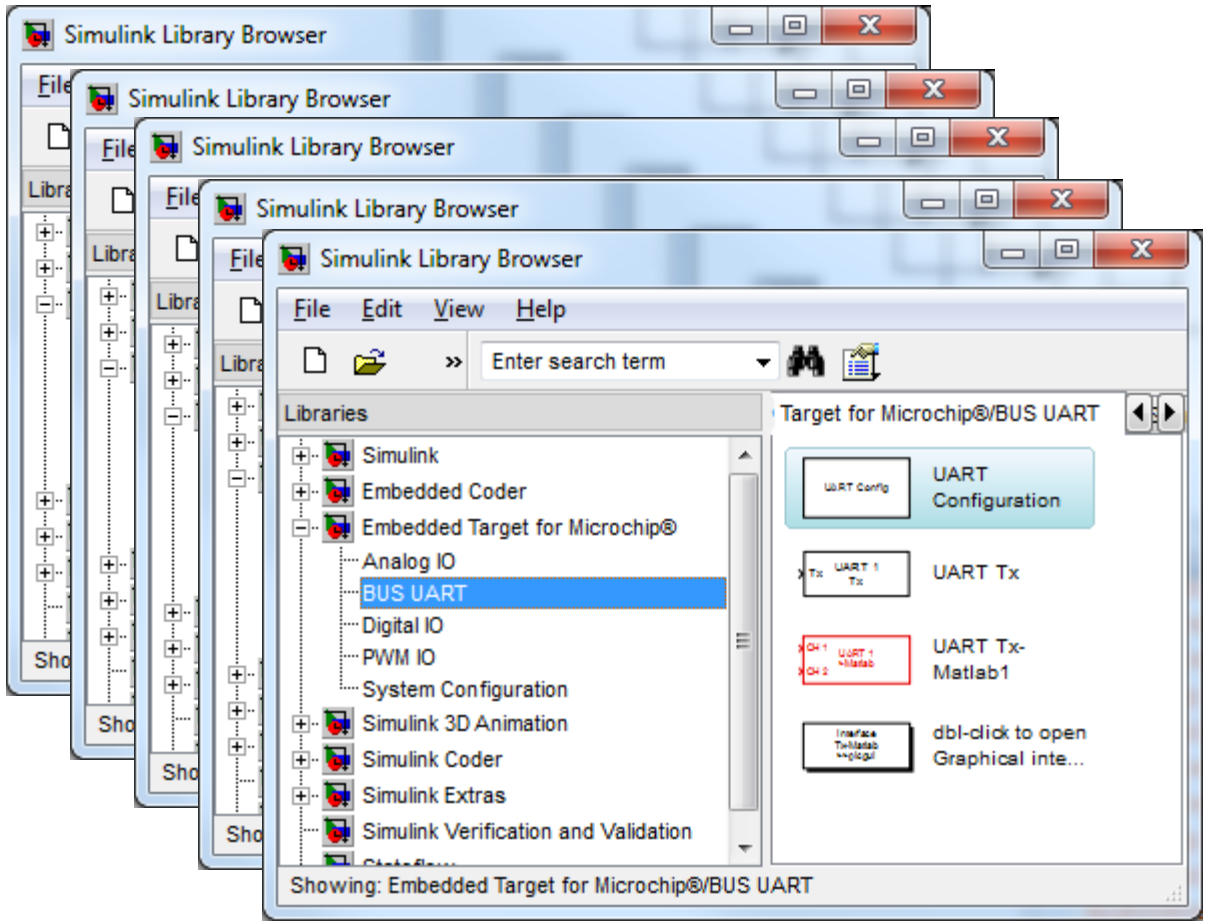
- Separate control and power boards
- Allows for customer developed power boards
- Power board supports dual motor drive



Part # DV330100

MPLAB 16/32-Bit Device Blocks for Simulink

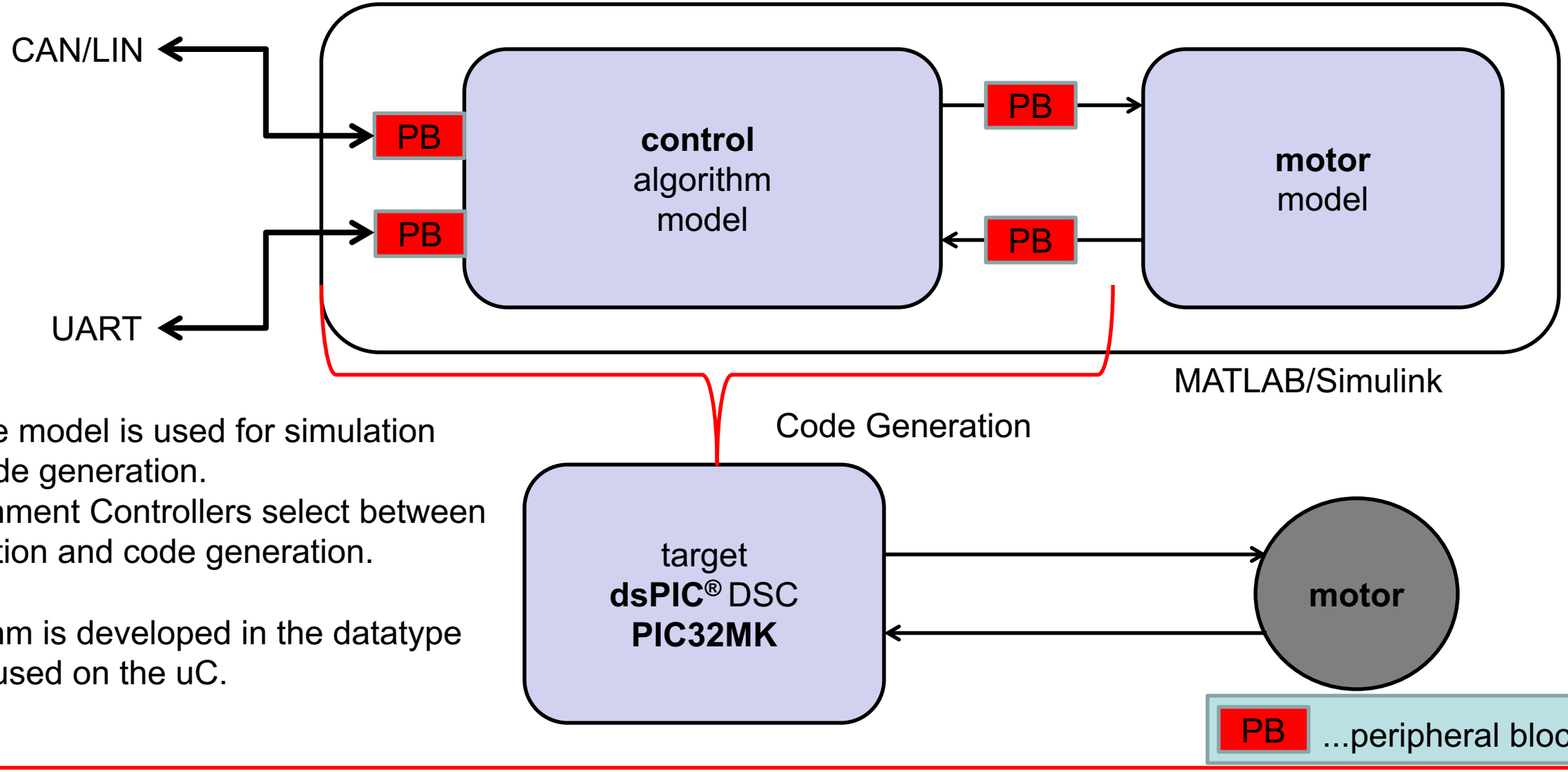
- **MPLAB® Device Blocks for dsPIC® DSC and PIC32MK**



Content
System Configuration
Digital IO
Analog IO
PWM IO
BUS UART

FREE VERSION available (limited to 8 IO pins)
dsPIC33EP256MC506 unlimited

Code Generation and Integration



A single model is used for simulation and code generation.
Environment Controllers select between Simulation and code generation.

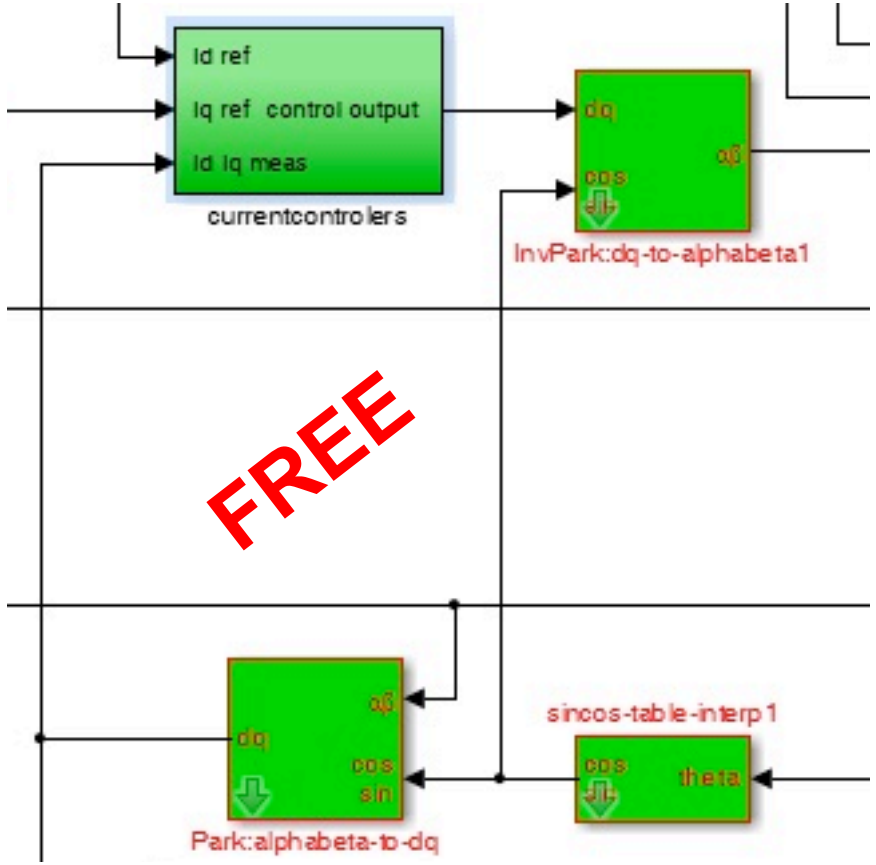
Algorithm is developed in the datatype that is used on the uC.

Motor Control Library

optimized MC library functions for FOC:

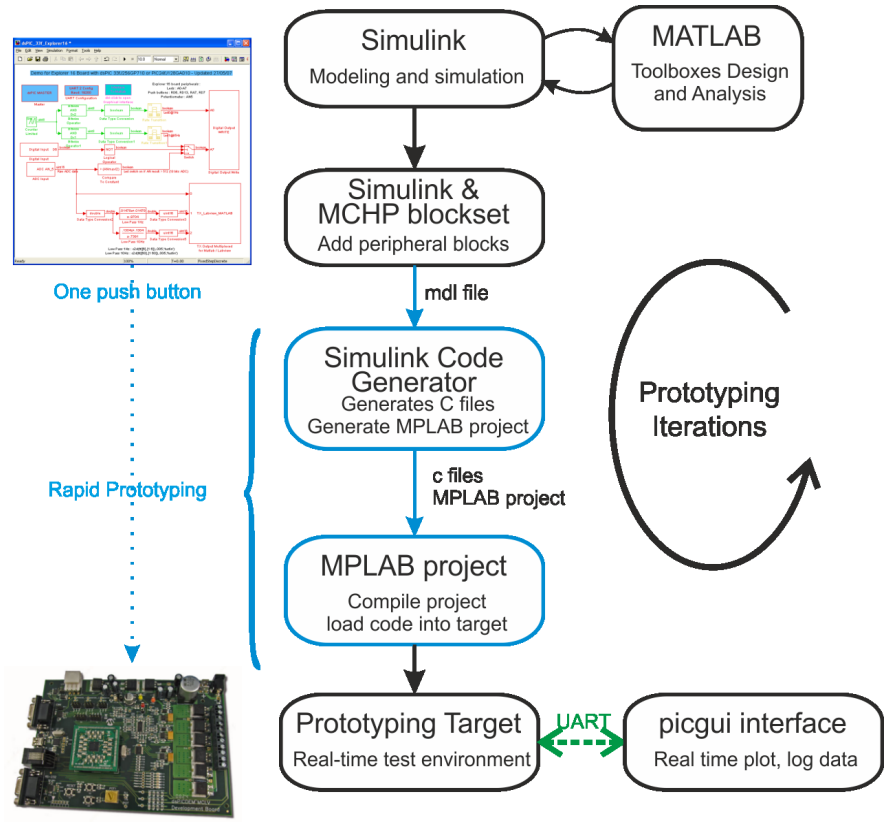
- transformations:
- park, clark, inv. clark, inv. park
- PI controller
- atan, sin, cos
- etc.

Simulink model for simulation and
ASM library for code generation
for maximum performance on the target



It can be so simple

- **Simulation**
  - control
  - motor
  - load
- **Code Generation**
- **Programing**
- **Validation**

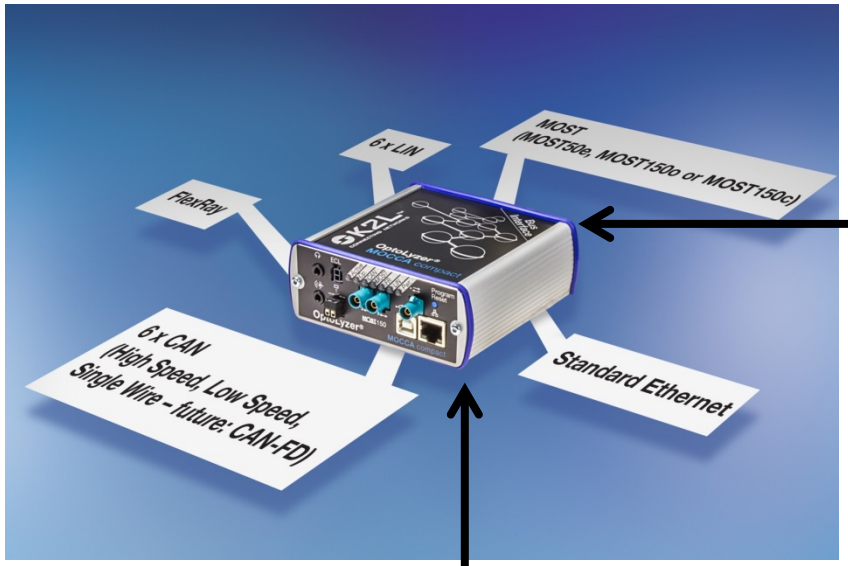


picgui:
high speed data visualisation
records up to 7 signal at 20kHz realtime

- **Seamless integration in Simulink**

  no additional IDE needs to be touched

Automotive Communication Interfaces
CAN/LIN support for MATLAB



CAN
application control

dsPICDEM MCLV-2 Development Board
(Part # DM330021-2)

PC

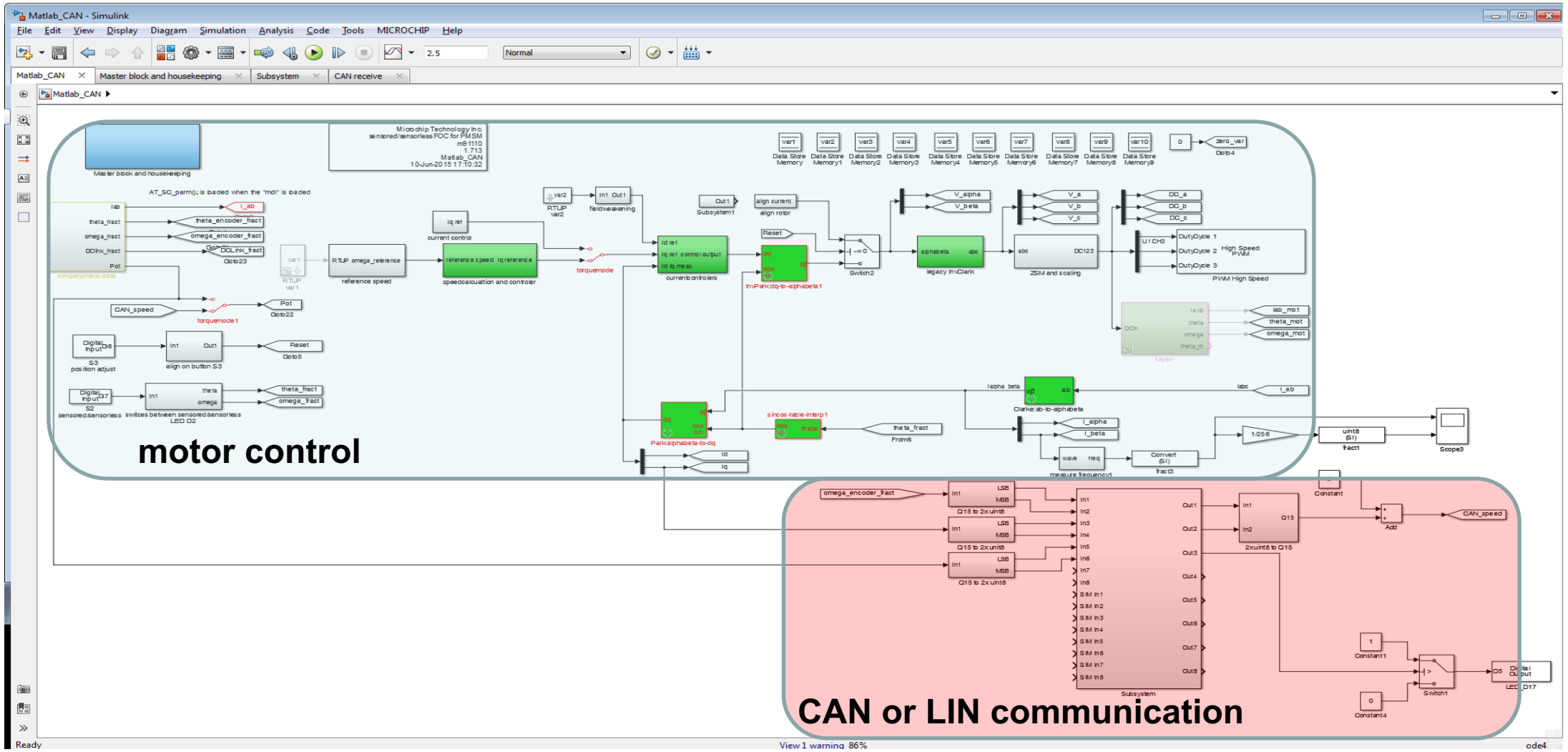
UART
MC debugging

certified LIN Stack from IHR (www.ihr.de)

Microchip CAN driver

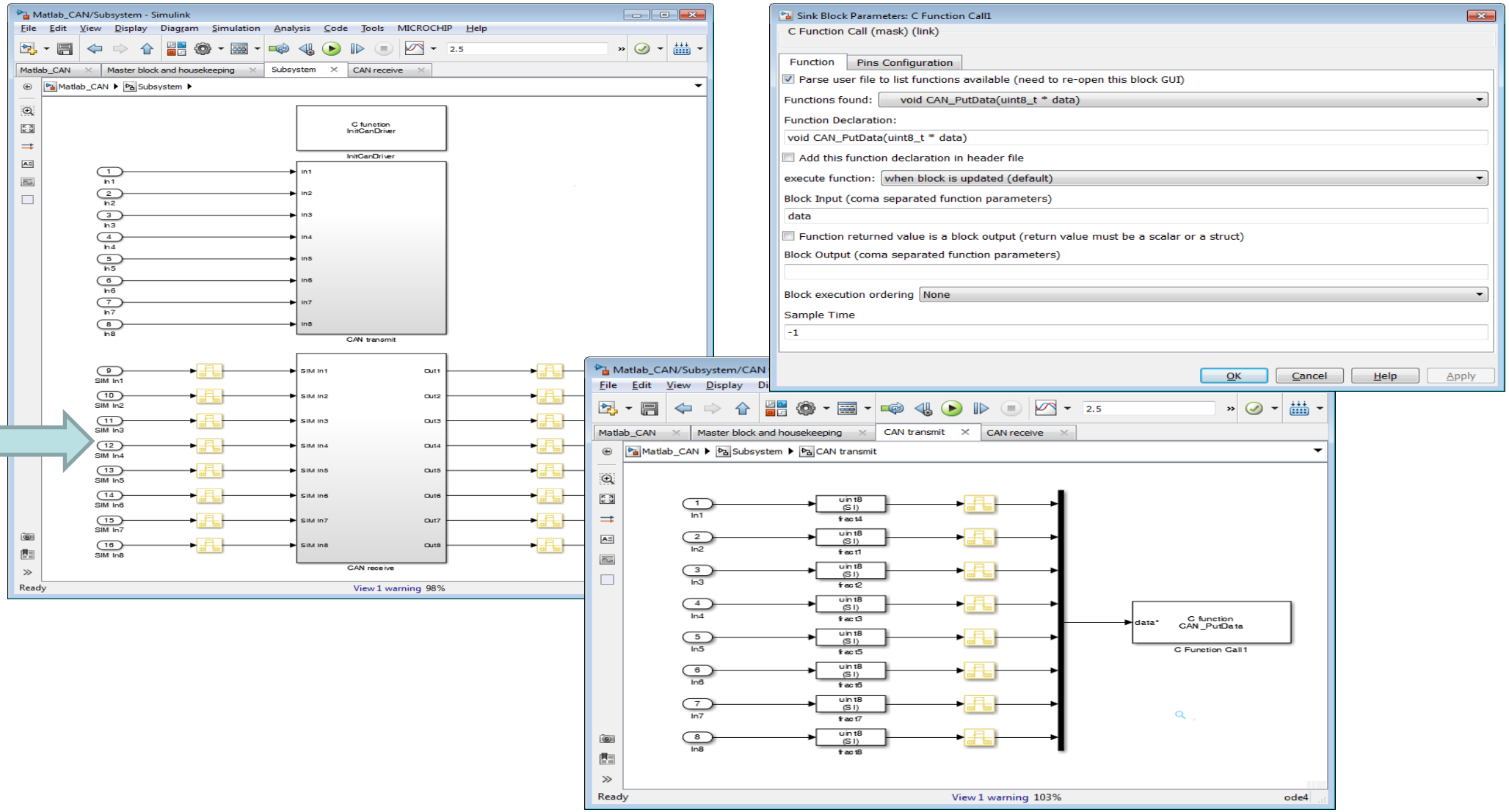
CAN/LIN debugtools: K2L MOCCA box (www.k2l.de)

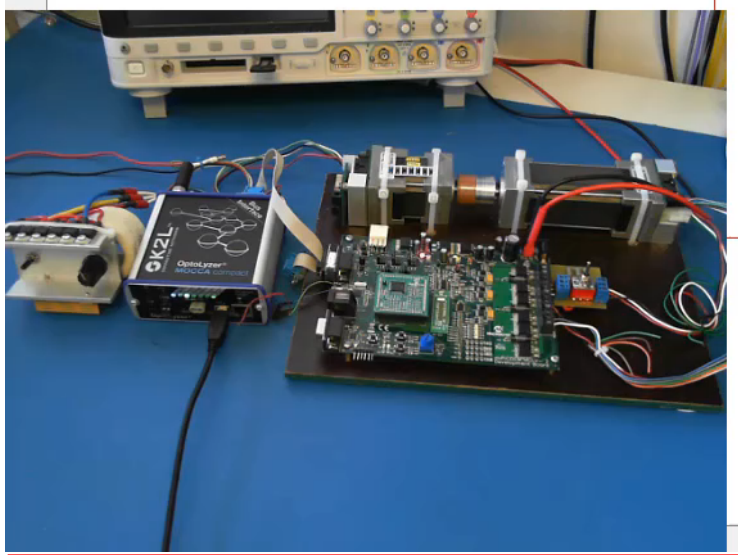
CAN/LIN support for MATLAB



CAN/LIN support for MATLAB

simulatable CAN/LIN messages





Take aways

- Rapid Prototyping incl. existing C-libraries
- Automotive application developement
- Seamless integration with Simulink environment