RL78/Fx SERIES MOTOR CONTROL PERIPHERAL BLOCKSET

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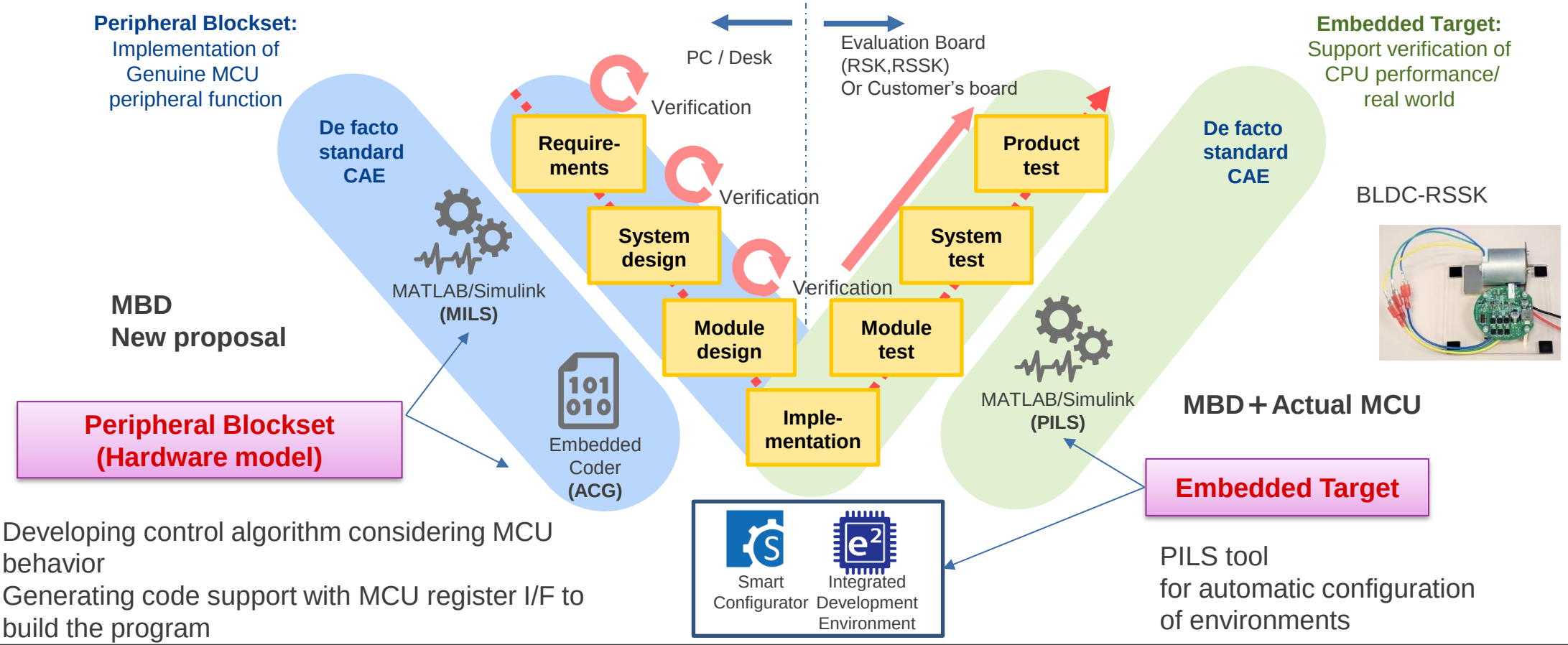
Renesas Electronics Corporation

MODEL BASED DEVELOPMENT SOLUTION

Design process utilizing MBD methodology is getting attention to improve efficiency.

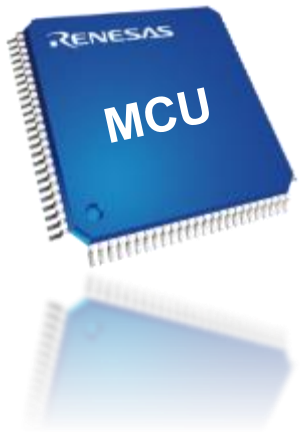
Renesas MBD Solution



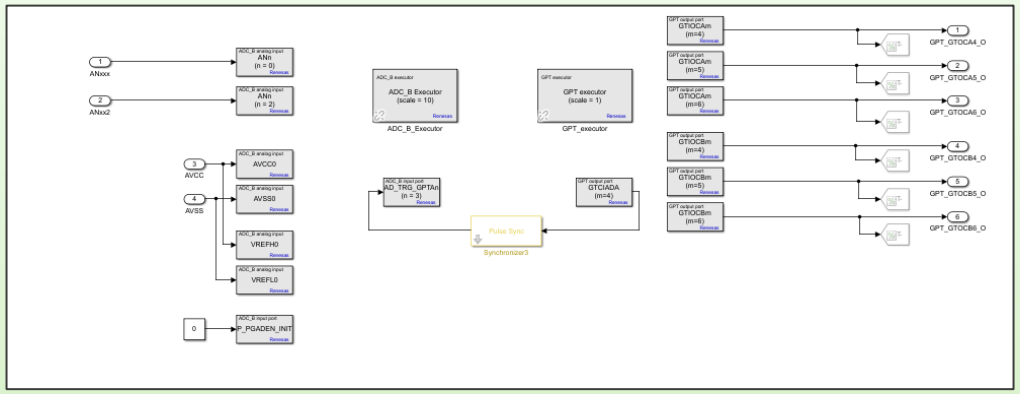
- Developing control algorithm considering MCU behavior
- Generating code support with MCU register I/F to build the program

MOTOR CONTROL PERIPHERAL BLOCKSET

Offer the Simulink® model with the same functional behavior of target MCU



Renesas Internal Design Information

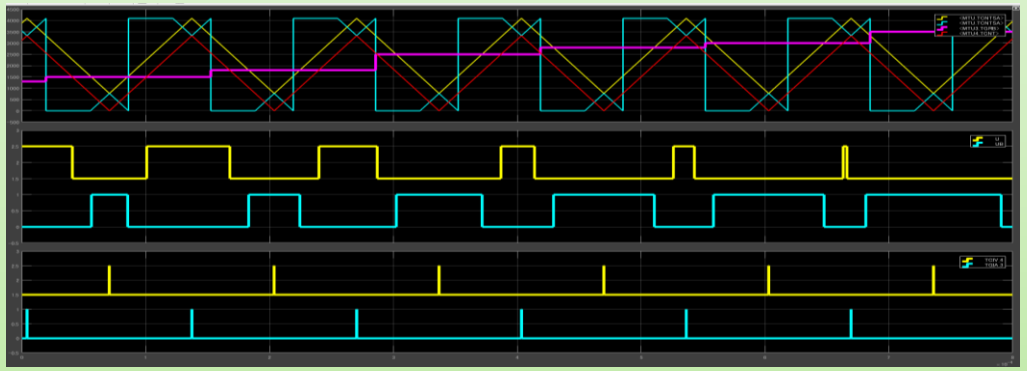


Peripheral Blocksets(Simulink® Model)

Register [Counter]

Output [PWM]

Interrupt signals



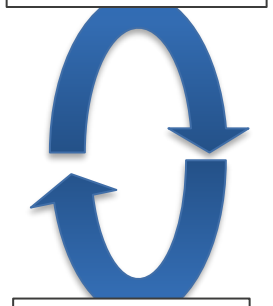
Achieve accurate function and behavior

PERIPHERAL BLOCKSET FEATURE : Improving control model design efficiency using Peripheral Blockset for MILS/ACG

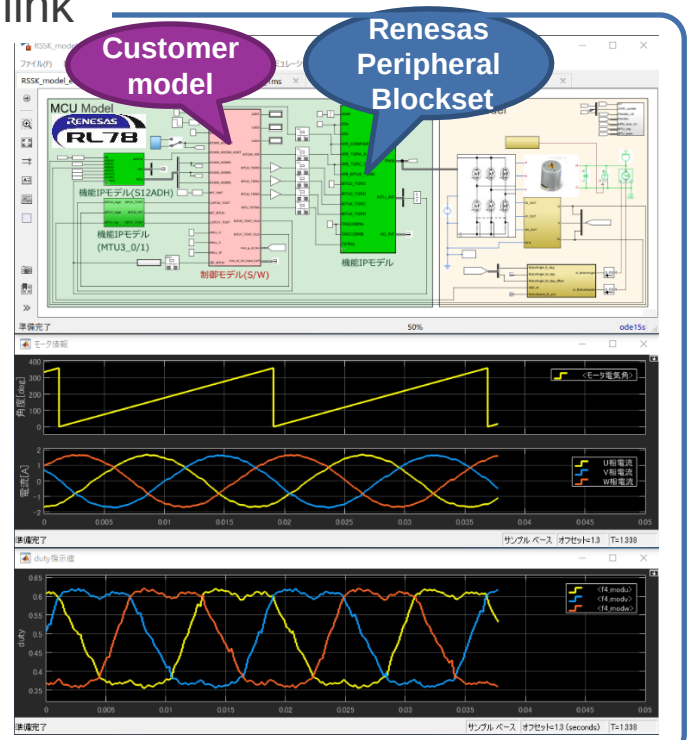
Enable to handle design iteration in model world with applicable MCU behavior

MATLAB/Simulink

Controller model design



Simulation w/o device



- Build a virtual system quickly by connecting with the user model.
- Examine and confirm the operation assuming an actual MCU behavior on the model.

Embedded Coder

Automatically generating Device evaluation code

Enable to generate the code and make software implementation easier

IDE

Renesas deliverables

Embedded Coder Generated code

Peripheral Blockset ACG support data(.h)

Initial settings/User function model (.c, .h)

Smart Configurator

Build/ Download

Actual environment

- Enables model development including device driver (register I / F)
- By generating code that is easy to implement on the MCU, the man-hours for software implementation can be significantly reduced.

TARGET PRODUCTS and PERIPHERAL FUNCTIONS

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- Target products
  - RL78/F24

- Fundamental motor/inverter control peripherals

MCU	RL78/F24
Timers	Timer RDe (TRD)
Analog	12-BIT A/D CONVERTER (AD)
Accelerator	APPLICATION ACCELERATOR UNIT (AAU)

INTRODUCTION TO DELIVERABLES

MOTOR CONTROL PERIPHERAL BLOCKSET SYSTEM REQUIREMENTS

- System requirements
- OS ：Windows10 64bit or later
- MATLAB Revision：R2018b or later
  - License requirements
    - MATLAB/Simulink
    - MATLAB Coder/Simulink Coder/Embedded Coder (for ACG)
    - Simscape (for the plant in the sample motor control system model)

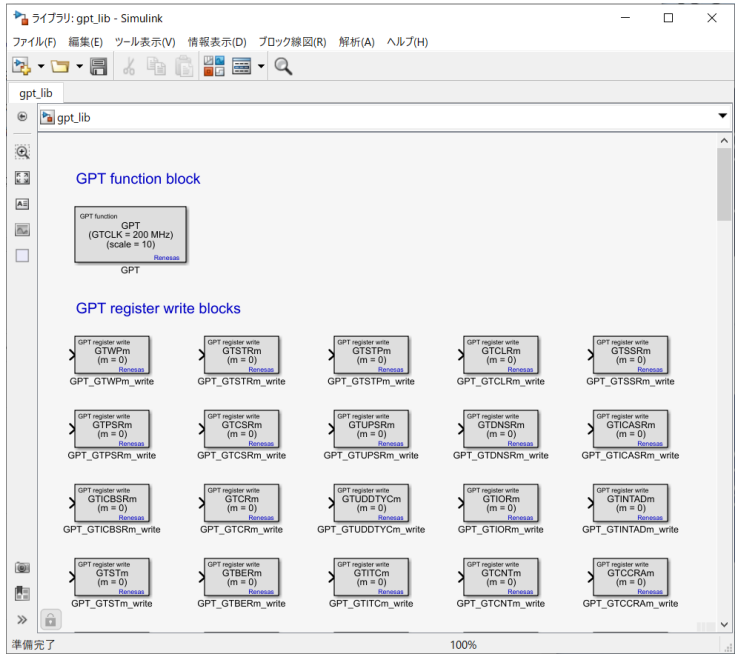
MOTOR CONTROL PERIPHERALS BLOCKSET DELIVERABLES

Category	Item	Detail
Peripherals Blockset		Simulink model (slx, mexw64, dll) Library format for each target peripheral function
Document		User’s manual (GPT, AD)
ACG support data		Register access code generation file(.tlc), Register definition file(.h), Implementation Guide
Sample model	Simple function	Peripheral Blockset operation check model
	Motor control	Sensorless motor control system model

PERIPHERALS BLOCKSET DELIVERABLES and USAGE EXAMPLES

(1)Accurate simulation of control timing and function flow
(2)Register operations and device driver implementation equivalent to real MCUs are possible.

- File type : MATLAB/Simulink Model library (Internal logic is not editable)
- User I/F : Registers, ports (MCU external pins, internal triggers, interrupt triggers)

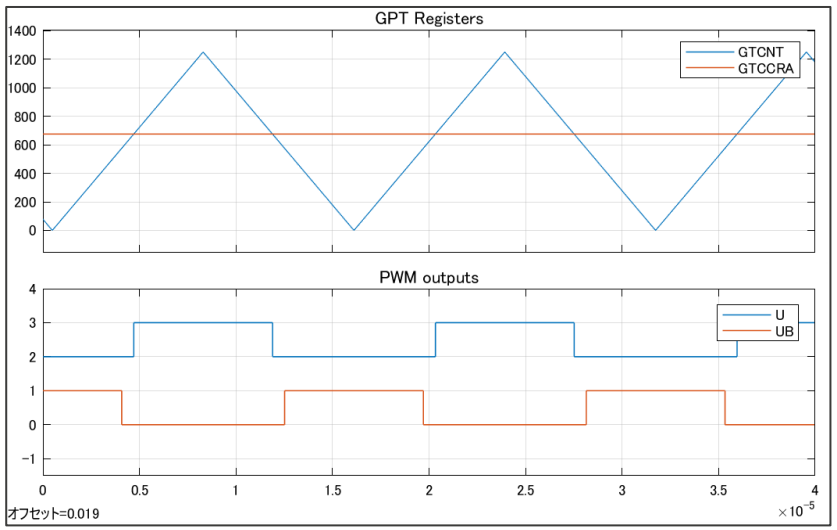


Peripheral Blockset library [Timer]

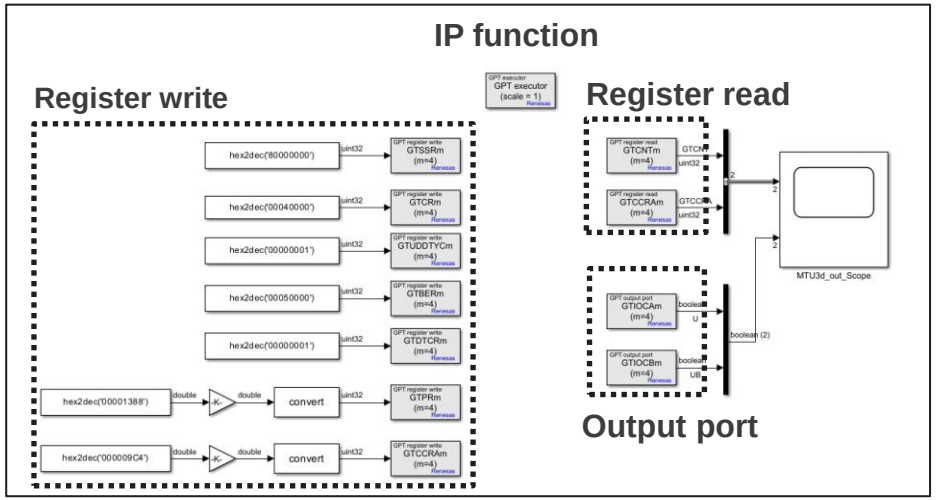
Select a block from the library for operation of peripheral functions.

- Peripheral Function Block
  - IP function block
- User I/F Block
  - Register write block
  - Register read block
  - Input port block
  - Output port block

Embedded in model



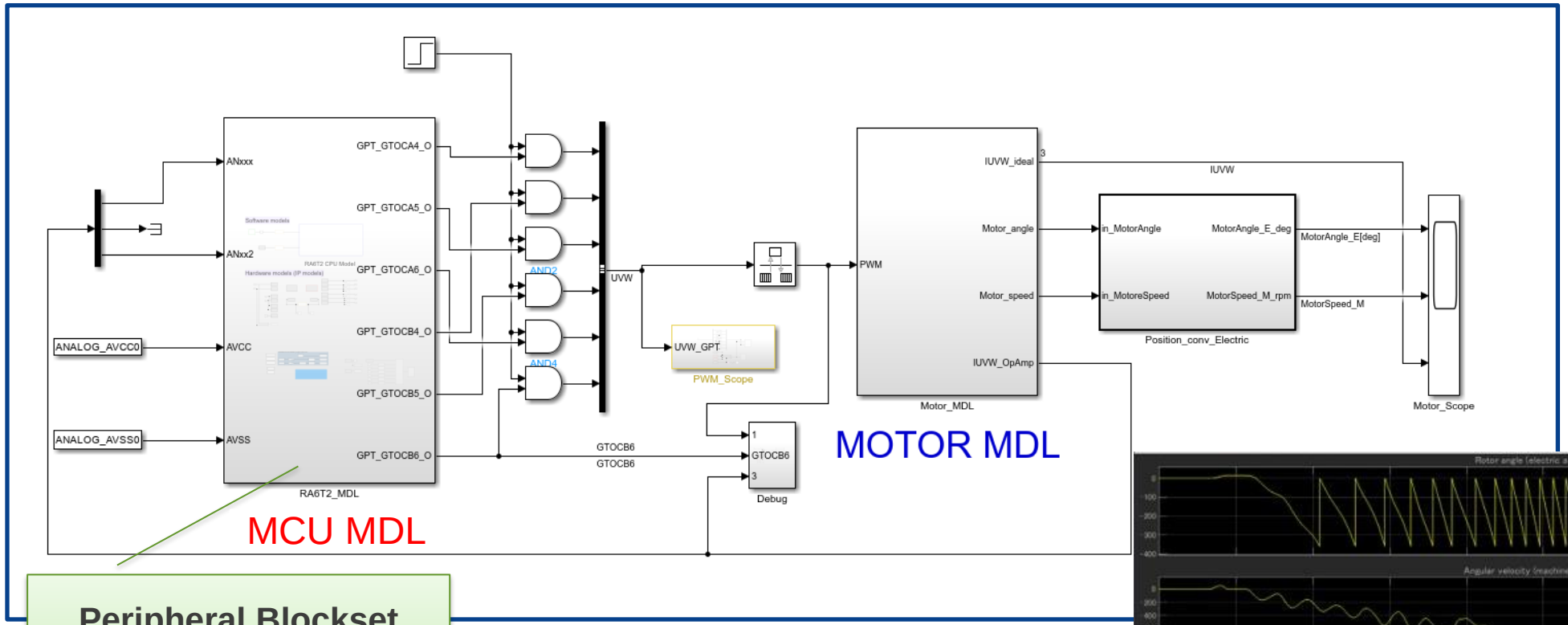
Simulation Results



Example model [Timer]

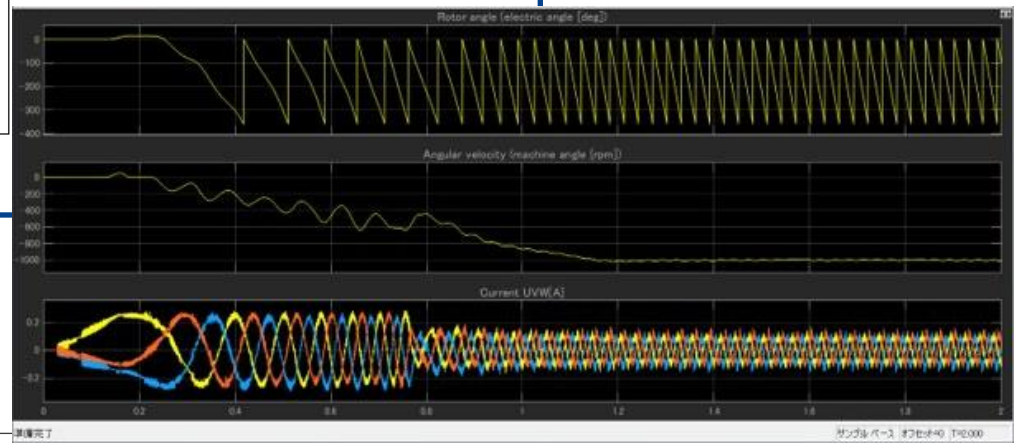
EXAMPLE of MOTOR CONTROL SYSTEM MODEL

- Example of motor control system model using Peripherals Blockset.

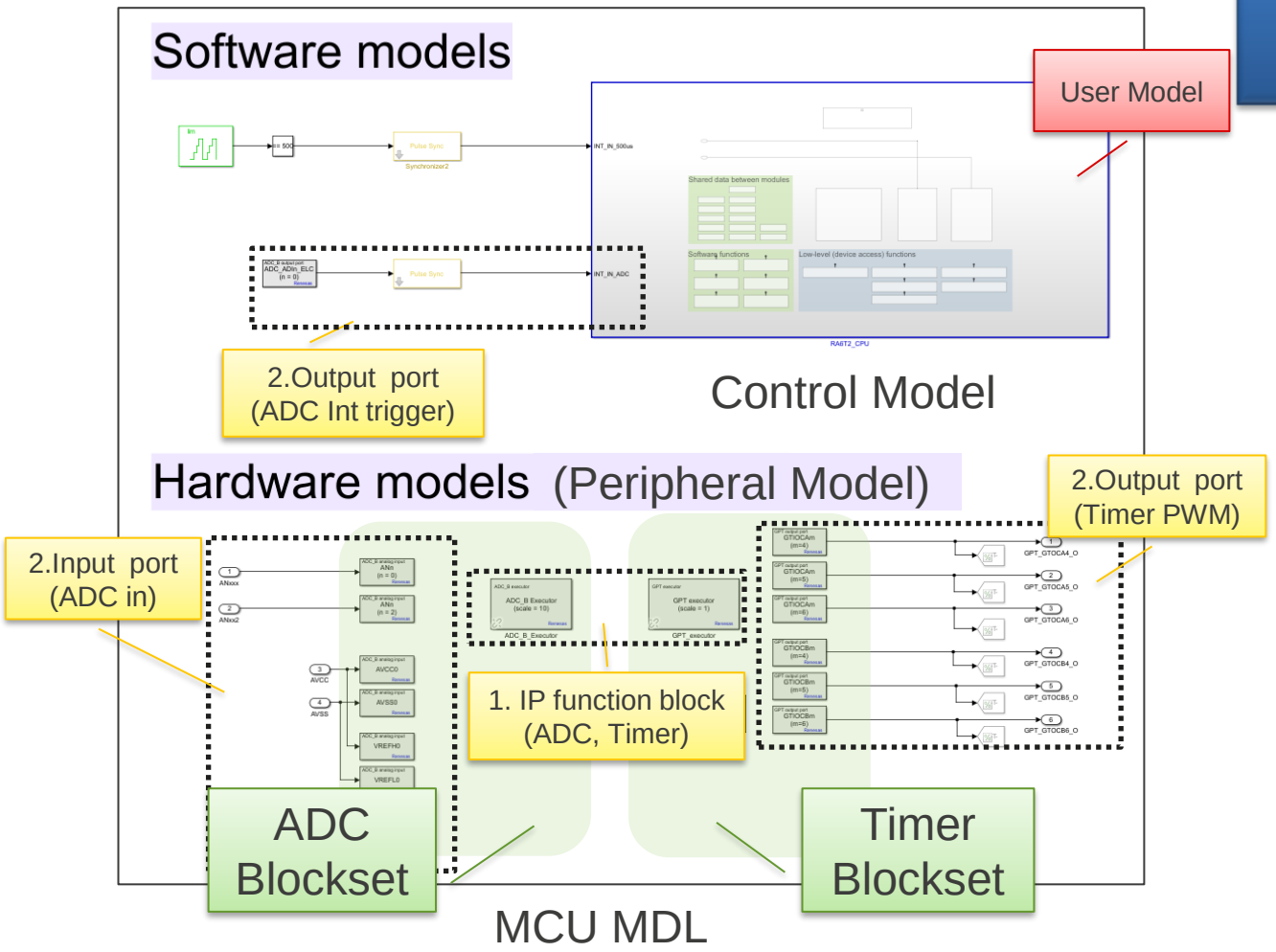


Peripheral Blockset embedded in MCU MDL (see next page)

Simulation Results



EXAMPLE of MOTOR CONTROL SYSTEM MODEL:
Embedding Hardware Models



Input port block/Output port block provides input/output ports and internal triggers that operate the same as real MCUs.

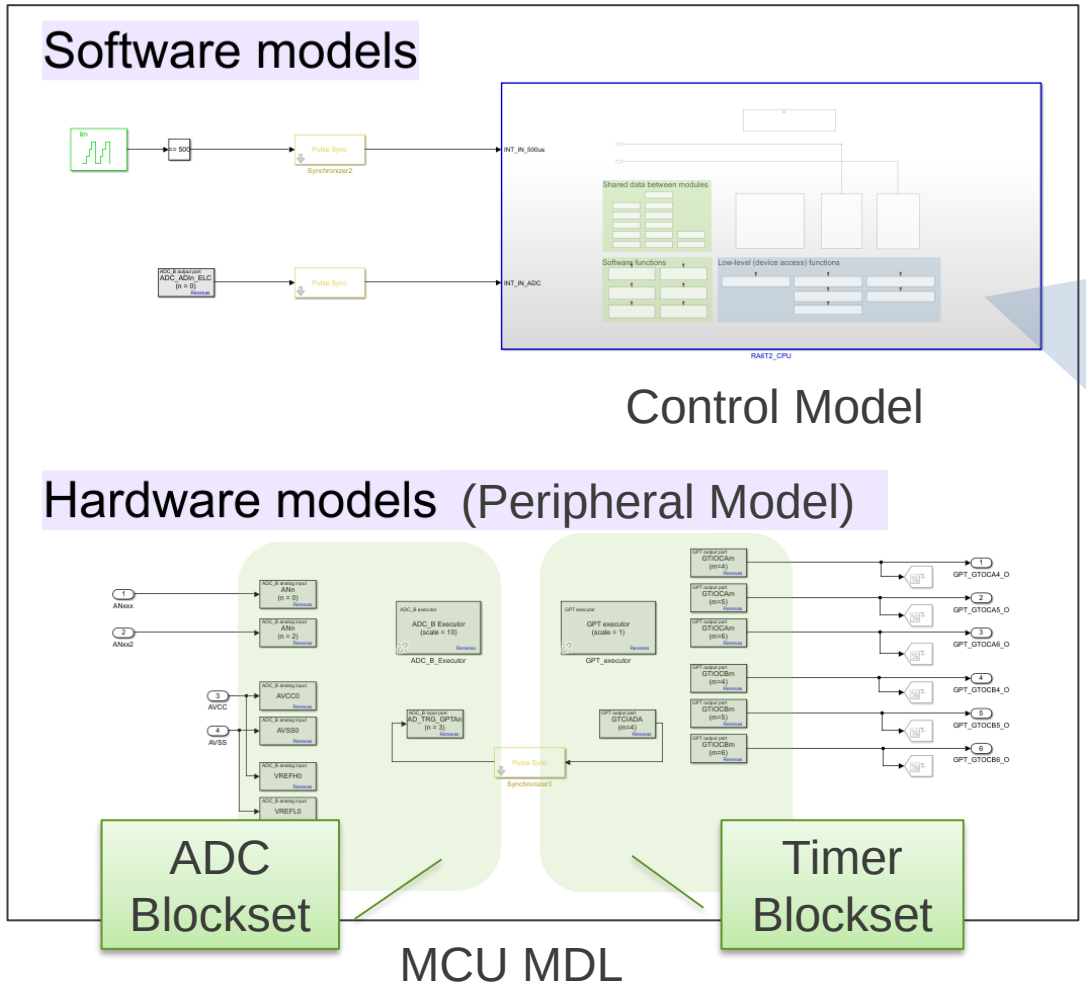
1. IP function block
   - Simulation block of peripheral functions
     Hardware operation settings (operating frequency, etc.)

2. Input port block/Output port block
   - Input/output ports of MCU
   - Internal trigger to connect to other peripheral functions
   - Interrupt trigger to software model

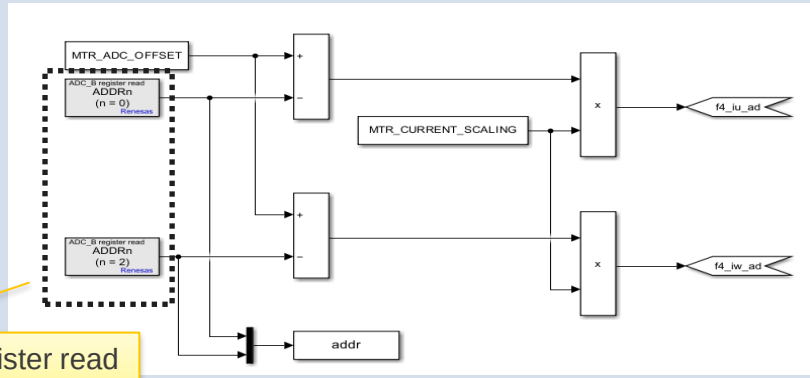
3. Register write block/Register read block
   - Access to peripheral function registers
     (see next page)

EXAMPLE of MOTOR CONTROL SYSTEM MODEL:
Embedding Register Access into the Software Model

Register write block/Register read block provides register access to peripheral functions that operate the same as real MCUs.

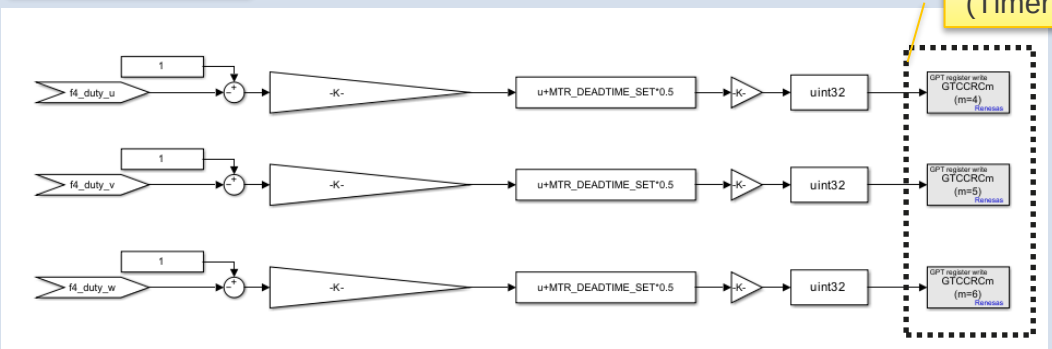


Register access section



3.Register read (ADC result)

3.Register write (Timer compare)



SUPPORT for CODE GENERATION from REGISTER ACCESS BLOCKS

Supports code generation for register access blocks
(Register write block/Register read block).
Generates access codes to target MCU peripheral function registers.

ACG

```
real32_T tmp;
tmp = ((1.0F – f4_duty_u) * 5000.0F + 200.0F) * 0.25F;
if (tmp < 4.2949673E+9F) {
if (tmp >= 0.0F) {
/* DataTypeConversion: '<S1>/Data Type Conversion3' */
localDW->DataTypeConversion3 = (uint32_T)tmp;
} else {
/* DataTypeConversion: '<S1>/Data Type Conversion3' */
localDW->DataTypeConversion3 = 0U;
} } else {
/* DataTypeConversion: '<S1>/Data Type Conversion3' */
localDW->DataTypeConversion3 = MAX_uint32_T;
}
/* S-Function (GPT_GTCCRCm_write): '<S1>/GPT_GTCCRCm_write' */
TLC_GPT_GTCCRC(4) = localDW->DataTypeConversion3;
```

Register access code

Variables are converted to MCU register addresses by h files.

*The following toolbox is required for code generation.
MATLAB Coder/Simulink Coder/Embedded Coder

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