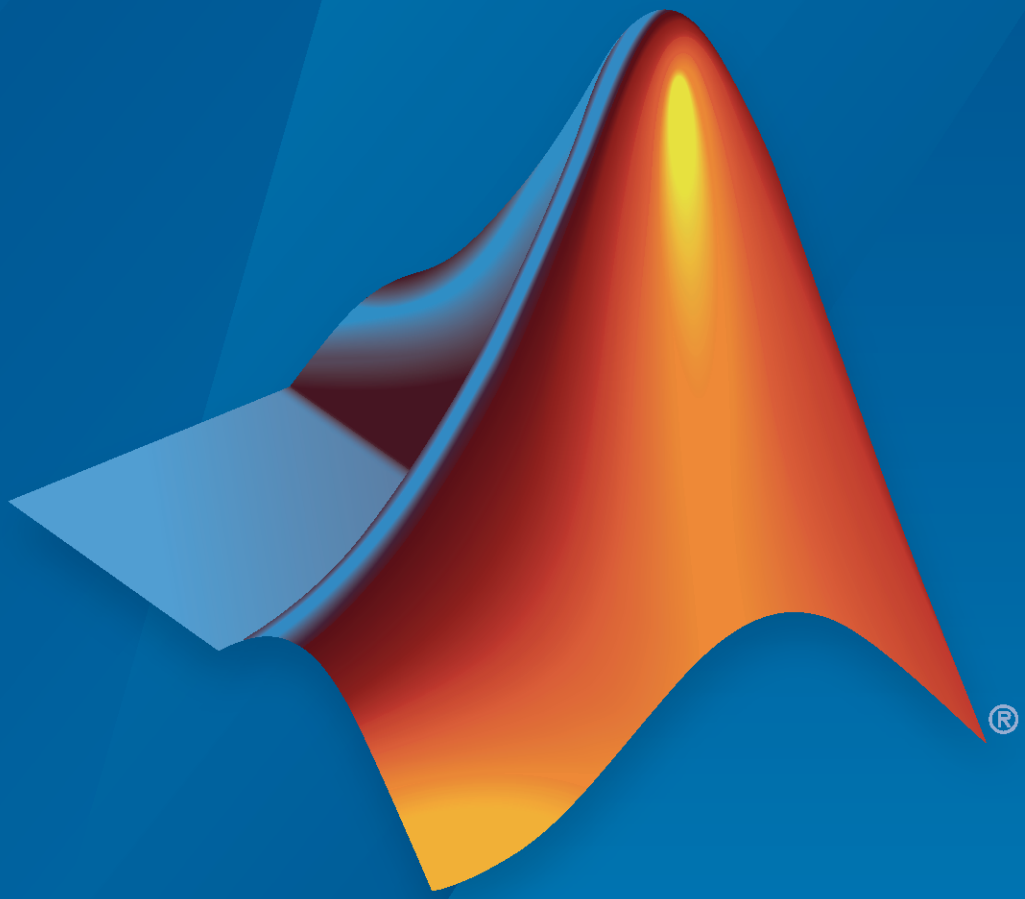
Motor Control Blockset™

Motor Swap of PMSM Using Microchip MCS MCLV-48V-300W Development Board and dsPIC33AK128MC106 MC DIM



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Revision History

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Contents

1 About This Example

2 Motor Swap of PMSM Using Microchip MCS MCLV-48V-300W Development Board and dsPIC33AK128MC106 MC DIM

About This Example

Introduction

This example implements the motor swap of Permanent Magnet Synchronous Motor (PMSM) using Microchip MCS MCLV-48V-300W Development Board and dsPIC33AK128MC106 Motor Control Dual In-line Module (DIM). Using this example, any 3-phase PMSM up to 300W can be run in closed loop speed, without the need to rebuild and update the software in the microcontroller.

The MCLV-48V-300W Inverter Board is targeted to drive a low-voltage (12-48V) three-phase PMSM or Brushless DC (BLDC) motor up to 25A RMS continuous per phase at 25°C.

The dsPIC33A family of Digital Signal Controller (DSC) with low latency responsiveness is designed for high-performance and real-time precision control applications. The dsPIC33AK128MC106 DSC features a 200 MHz, single-core DSC with a 64-bit Floating-Point Unit (FPU). It also features enhanced on chip peripherals like 40Msps 12-bit ADC, up to 2ns resolution PWM, QEI, UART and others, perfectly suited to run the real-time applications such as motor control and digital power.

Hardware Specifications

Hardware tools required to run the example:

- MCLV-48V-300W Motor Control Development Board (*EV18H47A*).
- dsPIC33AK128MC106 Motor Control DIM (*EV68M17A*).
- 24V Power Supply (*AC002013*) or any 24V DC Power Supply.
- 3-phase PMSM motor up to 300W.

Software Requirements

This section lists the software products from MathWorks® and Microchip that you need to simulate and run the example models on the MCLV-48V-300W Development Board with dsPIC33AK128MC106 MC DIM.

Required MathWorks Products

To simulate an example model:

- Motor Control Blockset
- Stateflow®

To generate code and deploy an example model:

- Motor Control Blockset
- Embedded Coder®
- MATLAB® Coder™
- Simulink® Coder

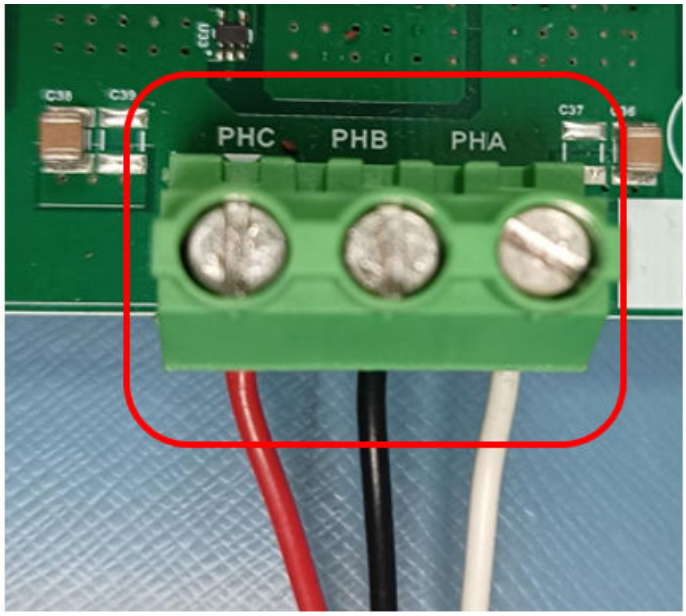
Required Microchip Products

- MPLAB X IDE and IPE (v6.25 or later)
- XC16 compiler (v3.21 or later)
- MPLAB Device Blocks for Simulink Toolbox (v3.59 or later)

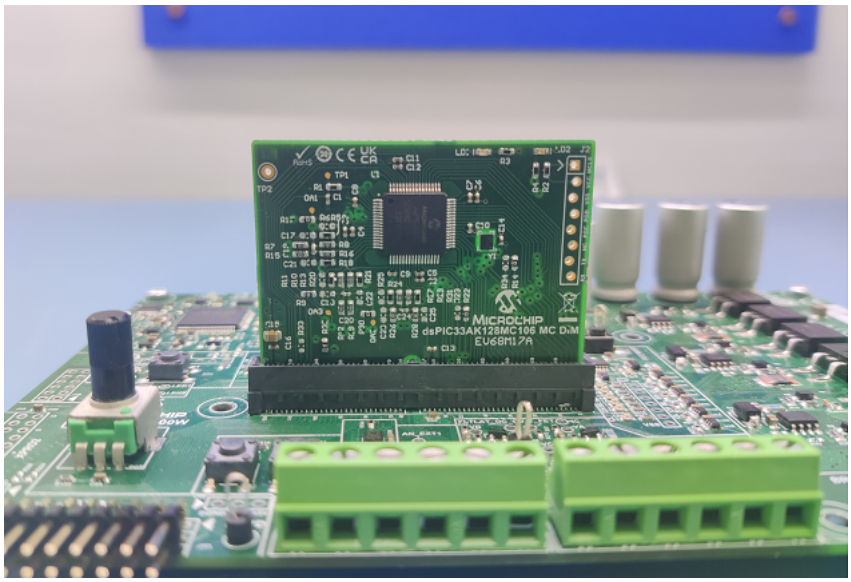
Hardware Setup

The hardware setup procedure is described below:

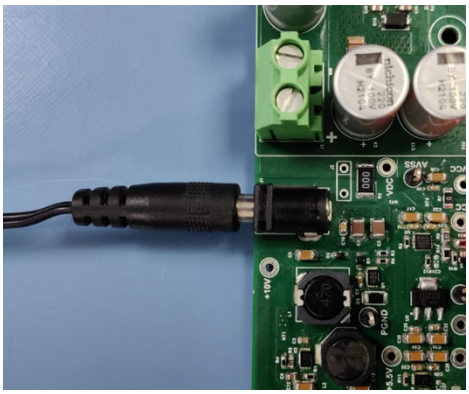
1. Connect the 3-phase wires from the motor to PHA, PHB and PHC of the **J4** connector, provided on the MCLV-48V-300W Development Board.



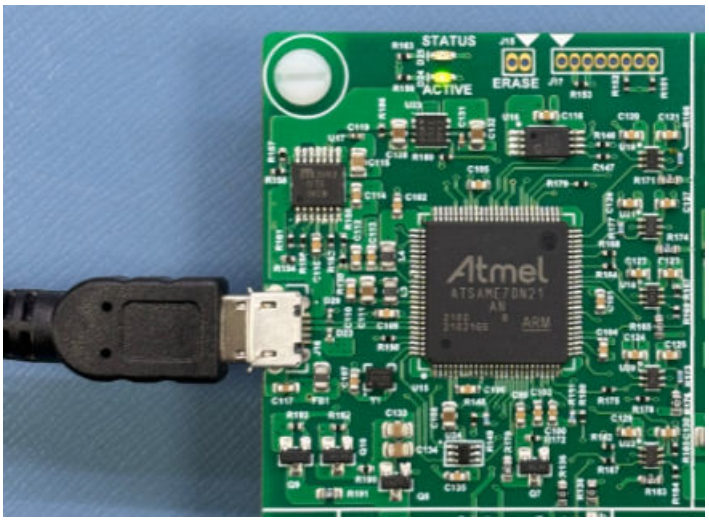
2. Insert the dsPIC33AK128MC106 Motor Control DIM into the DIM Interface connector **J8** on the MCLV-48V-300W Development Board. Ensure that the DIM is inserted and oriented correctly as shown in this figure, before proceeding with the next steps.



3 Plug the 24V power supply to connector **J1** on the MCLV-48V-300W Development Board. Alternatively, the board can also be powered through connector **J3**.



4 The board has an onboard programmer **PICkit™ On Board (PKoBv4)** , which can be used for programming or debugging the microcontroller or dsPIC DSC on the DIM. To use the onboard programmer, connect a micro-USB cable between the host computer and connector **J16** on the MCLV-48V-300W Development Board.



5 Alternatively, connect the Microchip programmer/debugger MPLAB® PICkit™ 5 In-Circuit Debugger between the host computer used for programming the device and the ICSP header **J9** on the MCLV-48V-300W Development Board. Ensure that PICkit 5 is oriented correctly as shown in this figure.

Contents of Downloaded ZIP Folder

The ZIP folder that you downloaded from the GitHub® repository, includes:

File Name	Description
`MicrochipTargetMotorControl.slx`	Target model
`MicrochipHostMotorControl.slx`	Host model
`MicrochipTargetMotorControlData.m`	Hardware parameters
`mcbMotorSwapData.m`	Motor control algorithm related parameters
`Motor_Swap_MCS_MCLV-48V-300W_FOC.pdf`	Documentation

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Simulate Target Model

This example supports simulation. Follow these steps to simulate the model.

1. Open the target model included in this workflow (`MicrochipTargetMotorControl.slx`).
2. Click **Run** on the **Simulation** tab to simulate the model.
3. Click **Data Inspector** on the **Simulation** tab to view and analyze the simulation results.

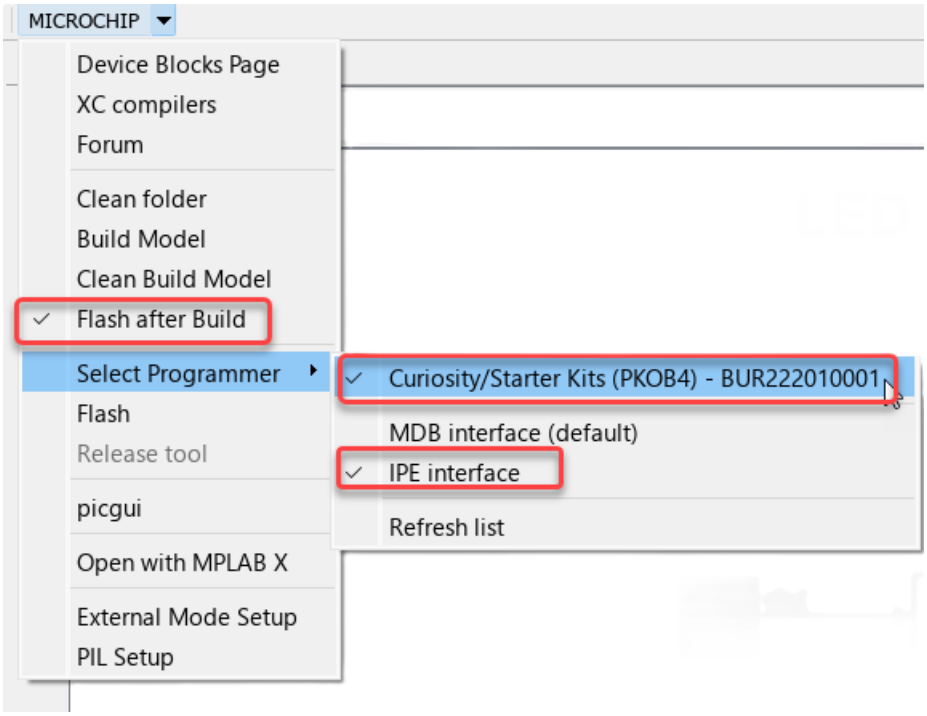
Generate Code and Deploy Model to Target Hardware

This section explains how to generate code and run the FOC algorithm on the target hardware.

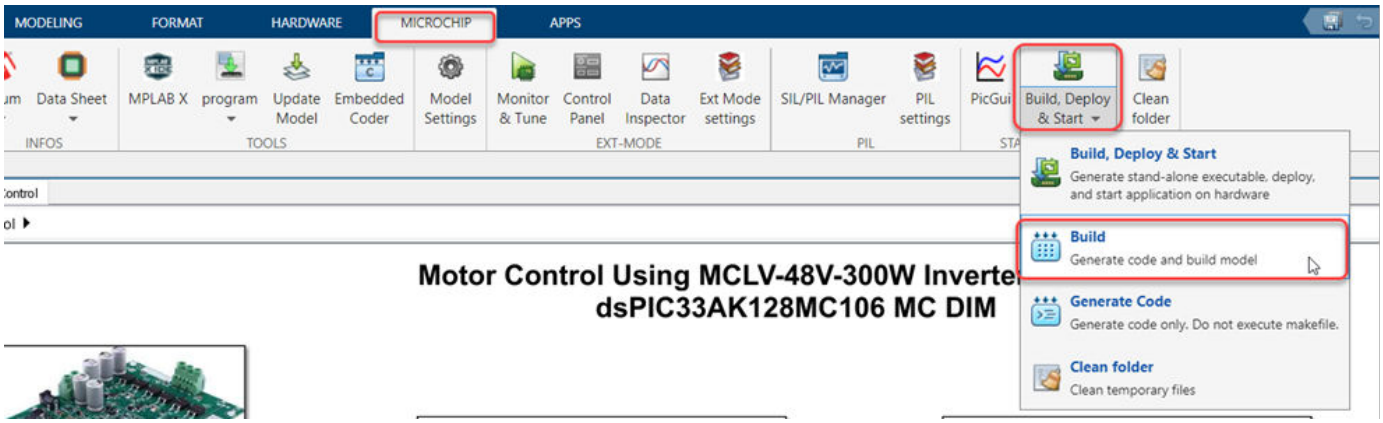
Follow these steps to deploy and run the target model.

1. Simulate the target model (`MicrochipTargetMotorControl.slx`) and observe the simulation results.
2. Connect the MCS MCLV-48V-300W development board to the host computer using the Micro USB cable, as explained in *Hardware Setup* section.
3. To run the PMSM motor, MPLAB X project has to be generated.

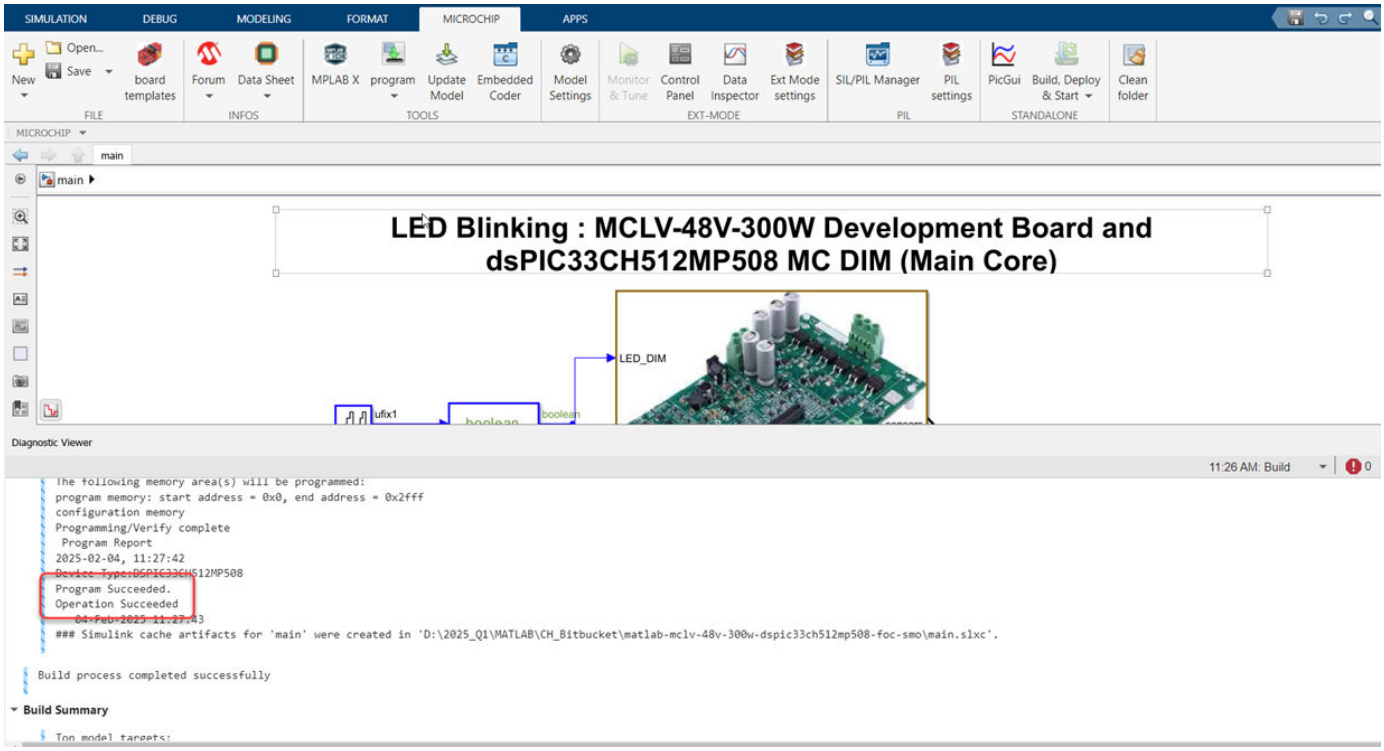
   To generate the code from the Simulink model, go to the **MICROCHIP** tab, and enable the three options as shown in the below figure.



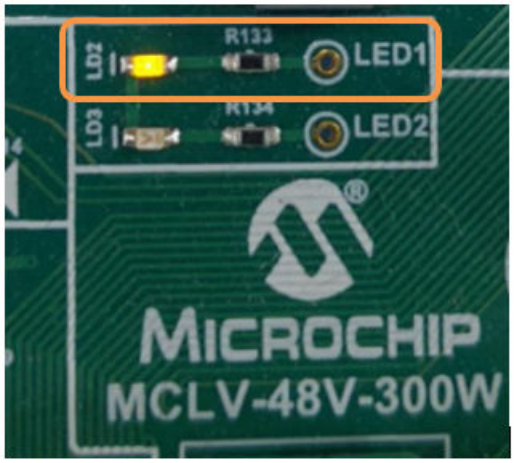
4 To generate the code and run the motor, click the **Build** option under the **Microchip > Build, Deploy & Start** menu. This action generates the MPLAB X project from the Simulink model and program both the cores of dsPIC33CH512MP508 device.



5 Verify that the process is completed by checking for `Operation Succeeded` message in the Diagnostic Viewer.

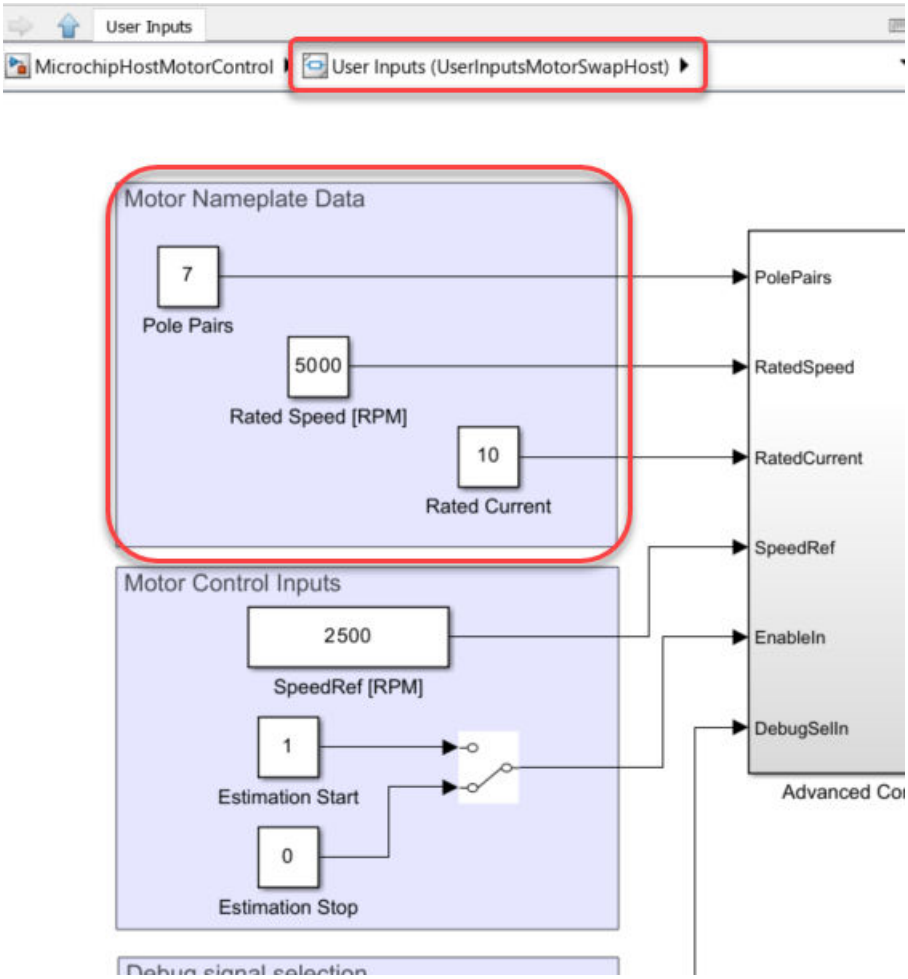


6 If the device is successfully programmed, LED1 - LD1 and LED2 - LD2 start blinking.

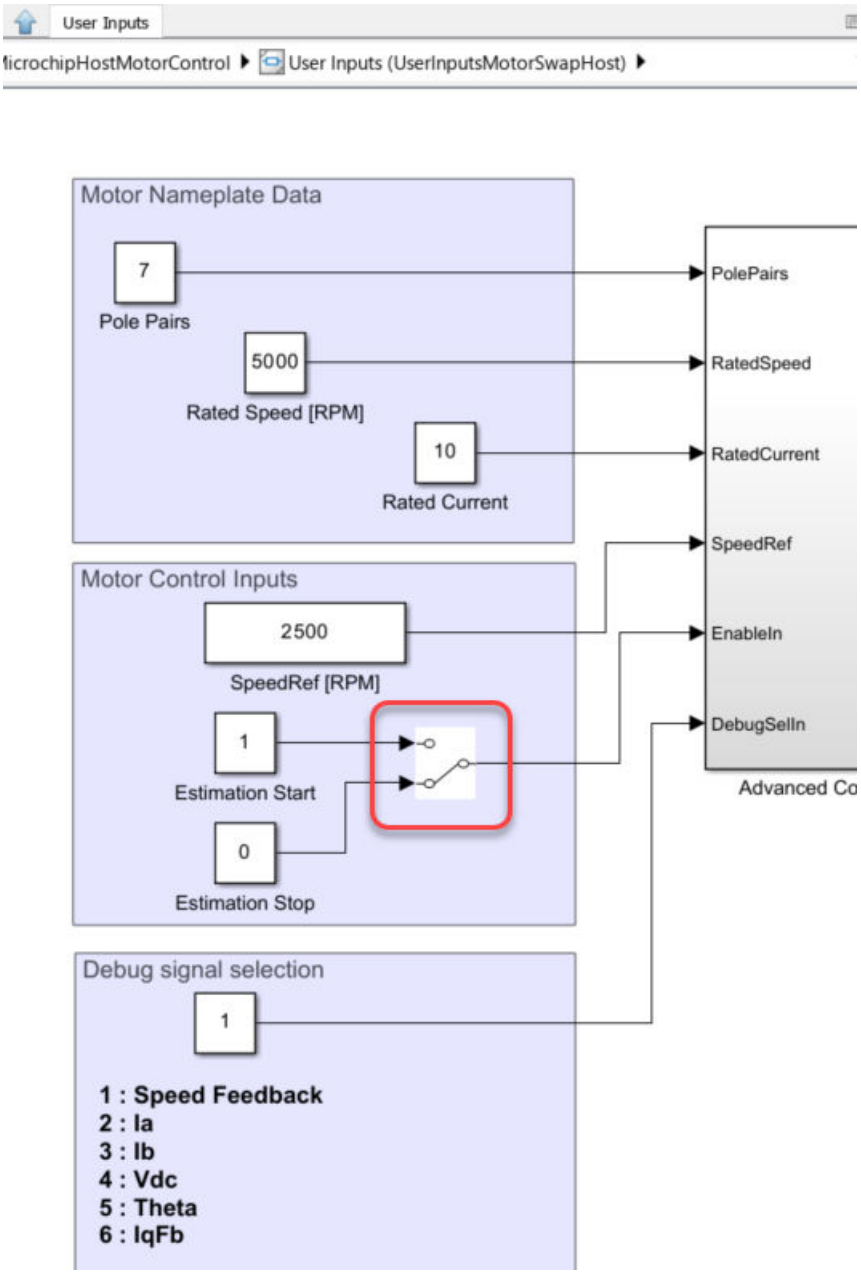


Controlling Motor Operation from Host Model

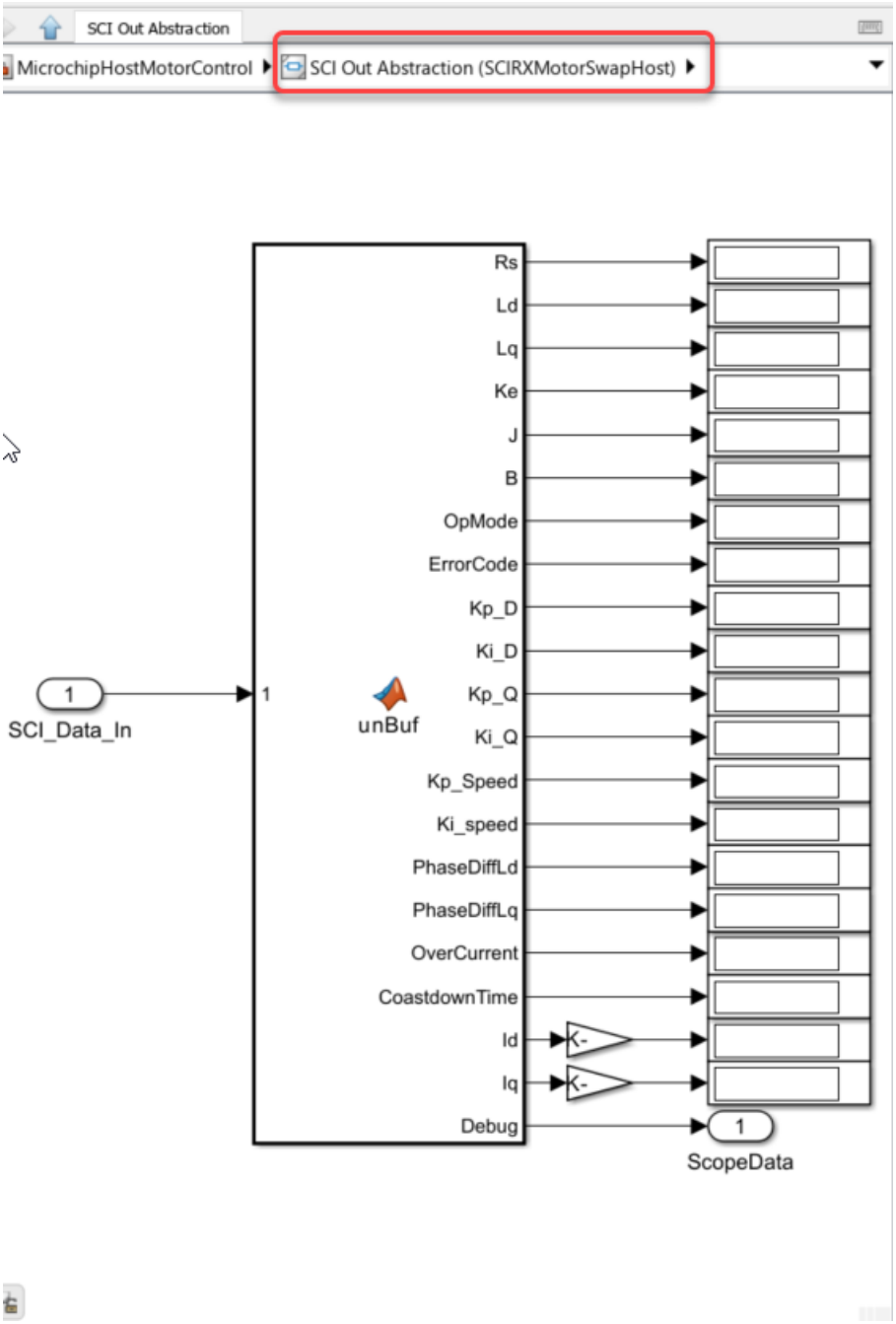
1. Open the host model `MicrochipHostMotorControl.slx`.
2. Enter the motor nameplate data of PMSM in the `User Inputs` subsystem reference.



3 Start the motor operation by changing the switch position to **Estimation Start**.



4 The motor parameter estimation starts and the results appear in the `SCI Out Abstraction` subsystem reference.



5 The PI controller gains are also computed and displayed in the respective display blocks in the `SCI Out Abstraction` subsystem reference.

6. The motor stops briefly after the estimation and starts again. The motor remains in I-F controller mode until the reference speed in host model is less than 20% of the Rated Speed. Beyond this speed reference, motor switches to closed loop operation.
7. To test the new motor, connect the new motor to the MCLV-48V-300W Development Board and repeat the above steps from 1 to 6.

References

For more information, refer to the following links.

- *Motor Control Blockset* and the example *Swap Motors with Single Deployment of Sensorless FOC Algorithm*
- *MPLAB Device Blocks for Simulink :dsPIC, PIC32 and SAM mcu*
- MCLV-48V-300W Development Boards User's Guide (*DS50003297*)
- dsPIC33AK128MC106 Motor Control DIM Information Sheet (*DS70005527*)
- *MPLAB® XC-DSC Compiler installation*