Quick Start Guide
Motor Control ToolKit for SPC5Studio

Quick guide to set up HW and SW
kit and run demo application

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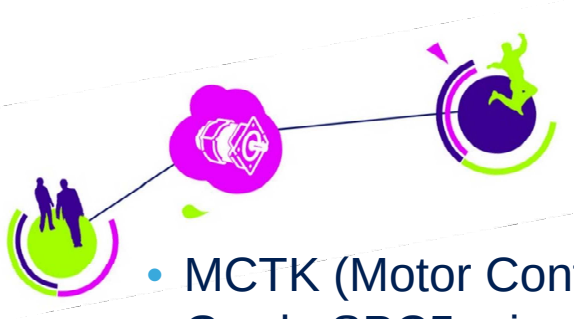
Overview

1. Introduction to the Motor Control Toolkit
2. Setup and configure HW parts
3. Setup, configure SW and run demo example
4. Documents & Related Resources

Motor control ToolKit



What is MCTK

- MCTK (Motor Control Tool Kit) is a development kit based on automotive Grade SPC5 microcontroller, to control 3-phase Permanent Magnet Synchronous Motors:
  - Easy to configure and monitor
  - Very flexible and customizable
  - Minimize the customer support effort
  - Reduced FW re-work time when moving from evaluation kits to final customer's production HW
  - FW structure easy to be ported on different SPC5 microcontroller
  - Integrated into a SPC5Studio software development environment ready for further customer improvement
- Available HW demo
  - with SPC560P-DISP discovery Platform and L9907-EVAL kit
  - With SPC56EL70L5-DISP discovery Platform and L9907-EVAL kit
- Firmware Library Based on Field Oriented Control (FOC)
  - Sensored and Sensorless support
  - 2 shunt topology

Supported Features

- Demo Kit with P-Line + L9907
- Demo kit with L-Line + L9907
  - Equipped with Maxon EC 40 motor
    - Validated with several others motors

- Supported microcontroller
  - SPC560P, SPC56EL

- Supported Sensors
  - Hall sensors
  - Encoder
  - Resolver
  - Sensor-less

- Control Algorithms
  - Single Vector FOC algorithm
  - Torque and Speed control
  - MTPA, Flux Weakening and Feed Forward technics

- Library deployed as SPC5Studio component
  - Library Configuration tool available into Motor Control Component
  - Dedicated SPC5Studio component for L9907
  - Update site with Motor control component can made available

- SPC5 MCU initialization provided via SPC5Studio
  - drivers/pin wizard/clock tree initialization

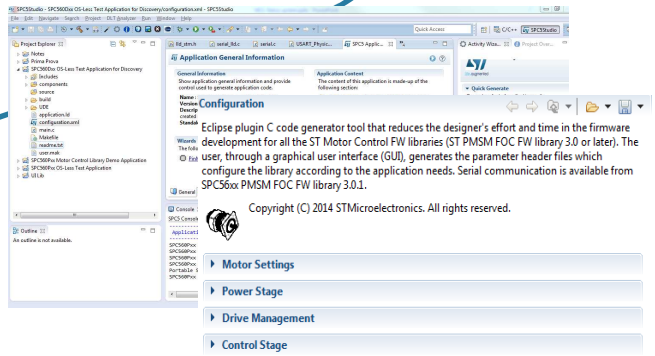
- Supported Compiler:
  - Green Hills
  - HighTec
  - Free GCC

- Current Sensing
  - 2 shunts current measurements on motor phases and inverter legs

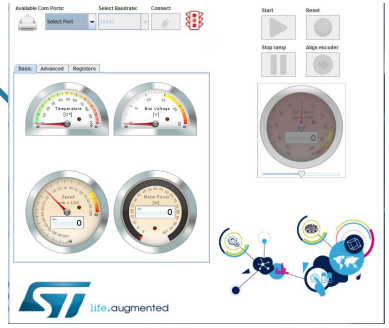
- Configuration/UI
  - SPC5Studio motor control component configuration to adapt library to customer motor, topology and application

- Power stage configuration
  - SPC5Studio L9907 component to Decoupling uC and Power
  - L9907 Fault management configuration
  - L99ASC03 smart driver support
  - STGAP1AS for High voltage applications

Hardware Demo Kit

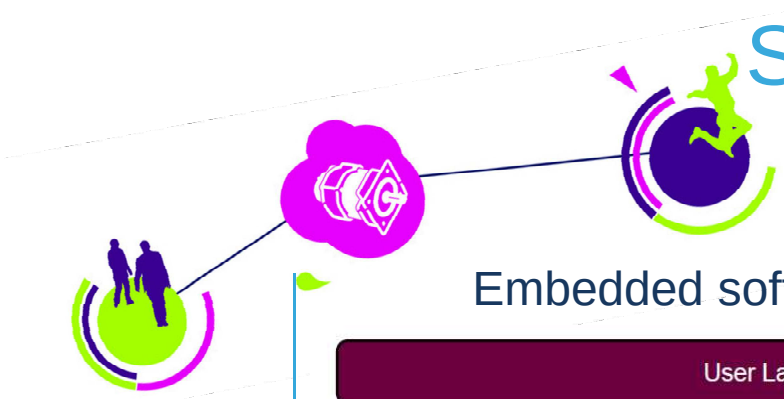


SPC5Studio configuration component



SPC5 Live Monitor

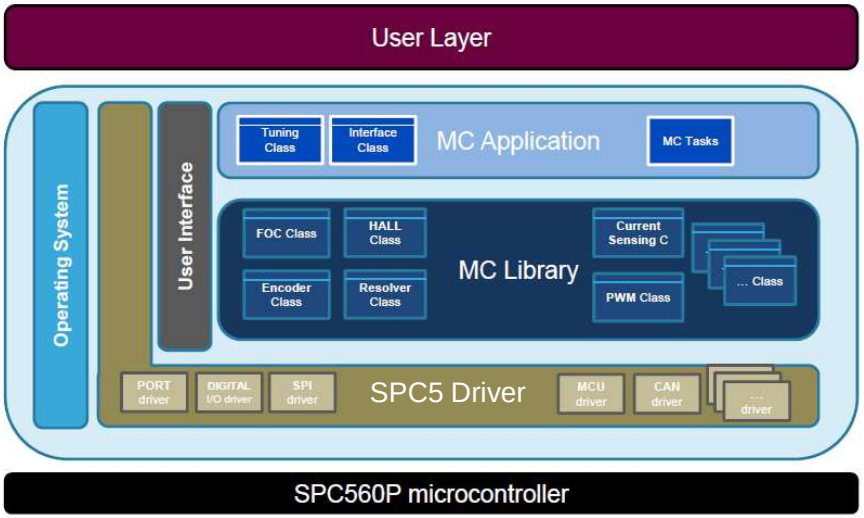
SPC5 MC ToolKit at Glance



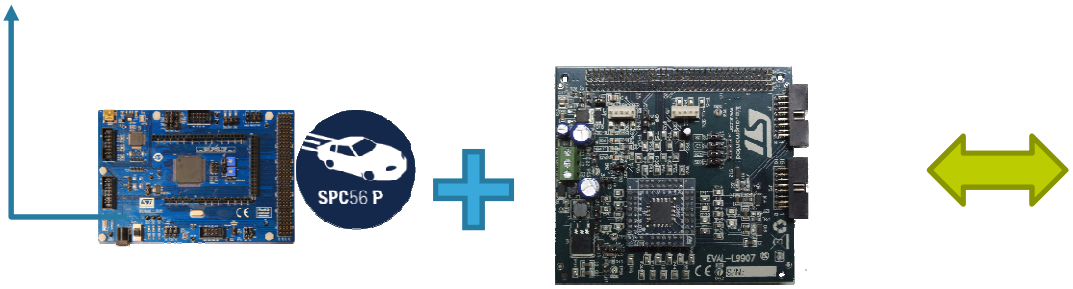
PC IDE

SPC5-Studio Configuration Plug-in

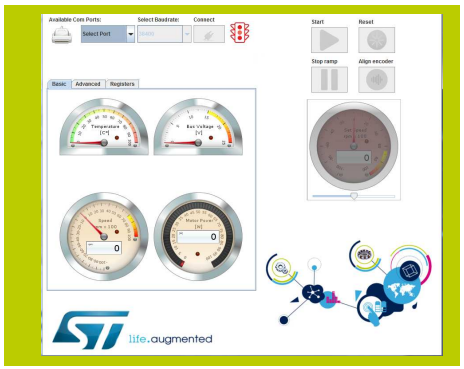
Embedded software



- **Motor Control Tool Kit key elements**
  - SPC5 FOC Lib Configuration (SPC5Studio plug-in)
  - Embedded Software Library (MC Lib)
  - Live Monitor
  - SPC5Studio (IDE and code gen)
  - Micro and Power Boards

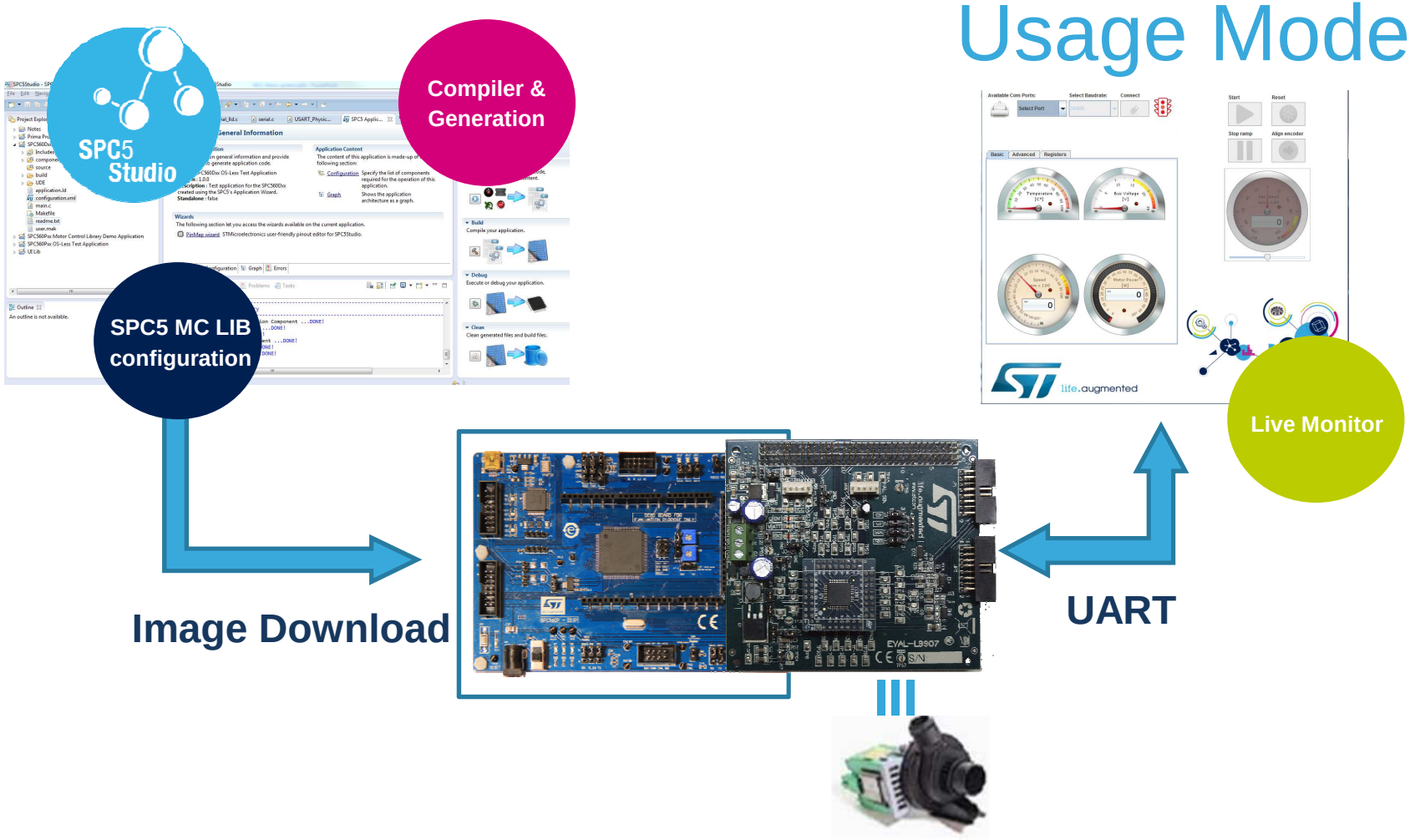


Micro and Power board



SPC5 Live Monitor

Usage Model



- Once the HW and SW are configured, use the SPC5Studio motor control configuration component for a complete and easy customization of the Motor Control library
- Generate, compile and program the binary image on the HW board
- Connect live Monitor via UART, to interact with the motor control library running on MCU, to start, stop, change reference speed, …

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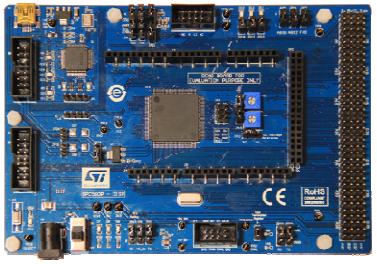
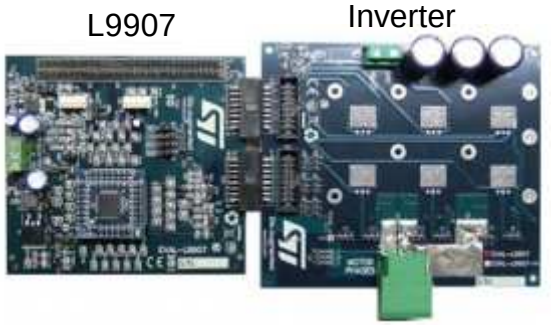
Setup and Configure HW parts

HW Prerequisites

- Get SPC560P Discovery platform (SPC560P-DISP) or SPC56EL70L5-DISP
- Get L9907 evaluation board for 3-phase BLDC motor pre-driver (EVAL-L9907)
- 3-phase BLDC motor (e.g. MAXON EC40 or similar)
- Power supply accordingly with application
- 1 x mini USB cable
- Windows 8/7 - Laptop/PC

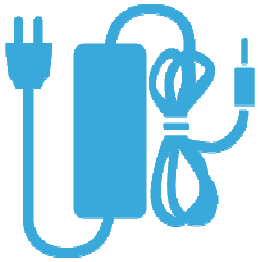


SPC560P-DISP



EVAL-L9907

Laptop/PC



Power Supply

Mini USB

BLDC Motor

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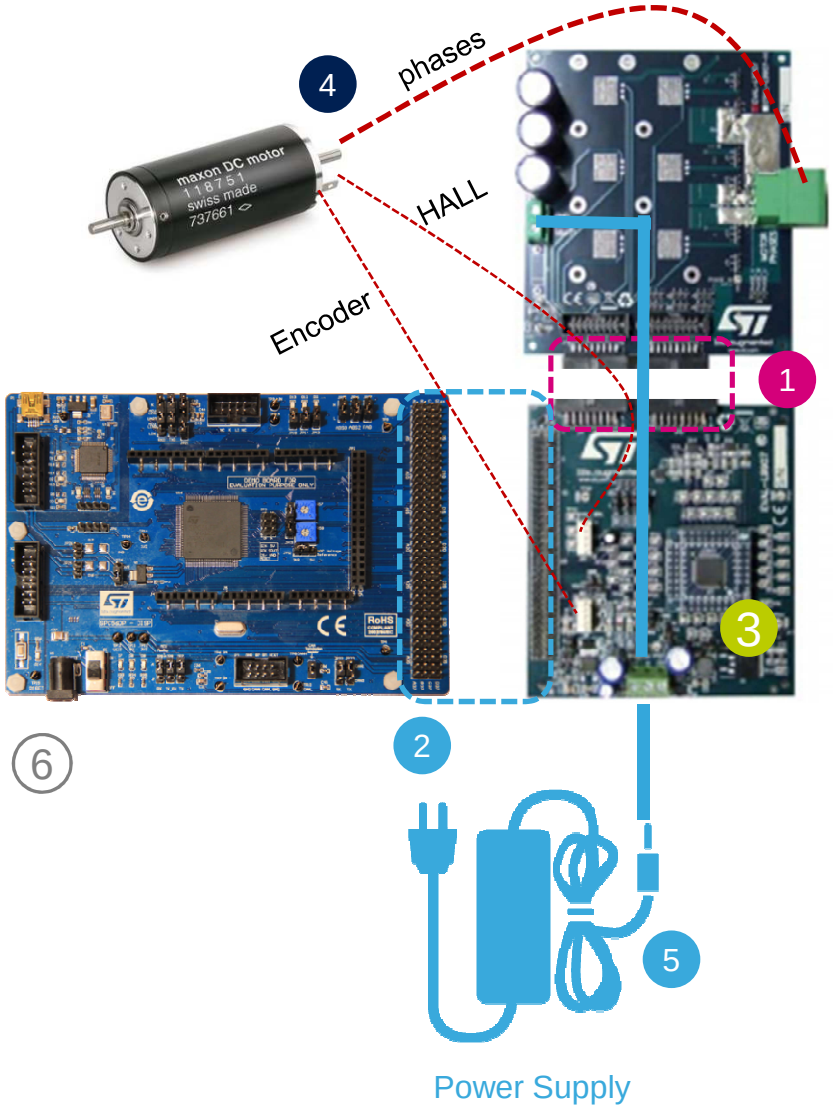
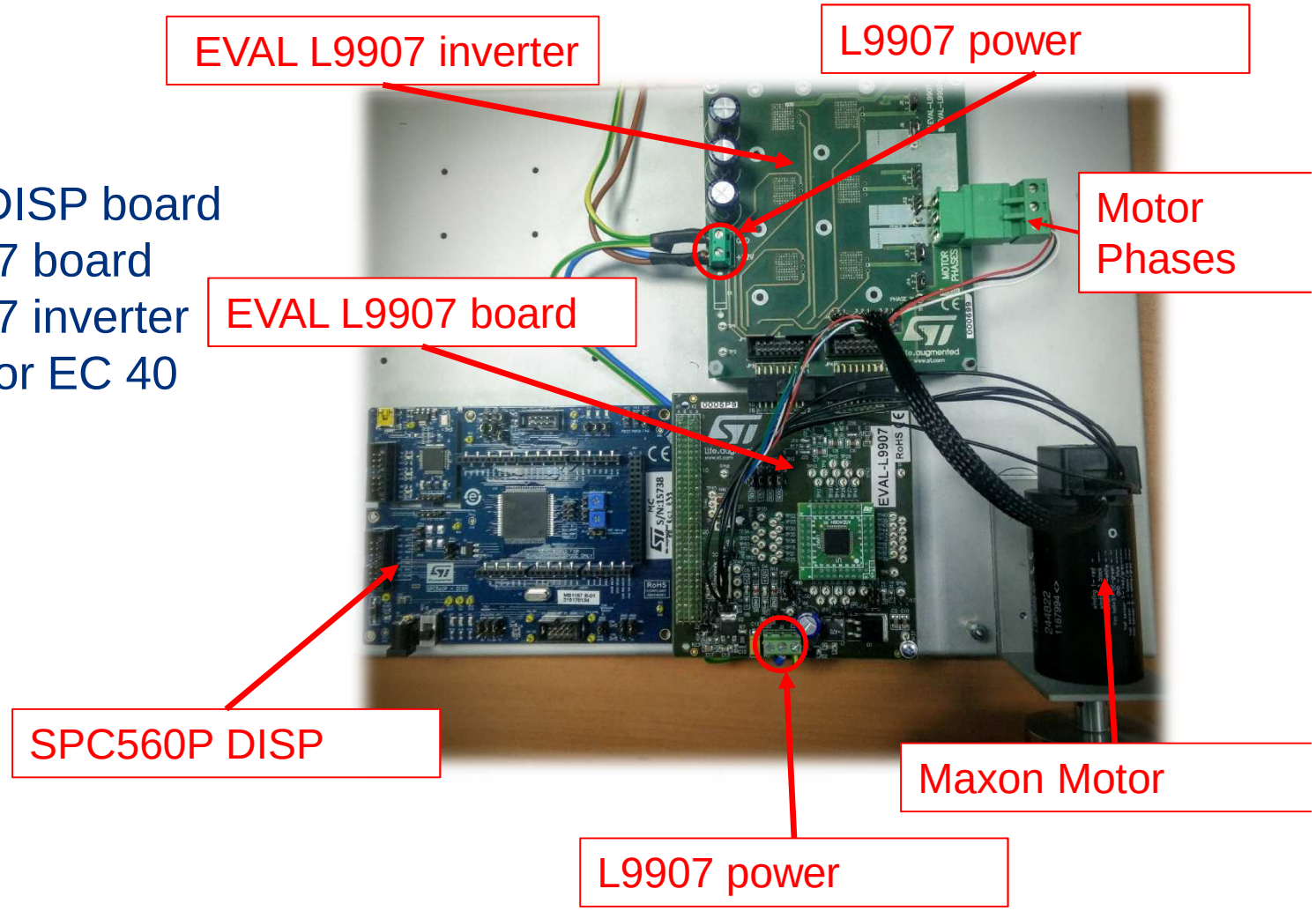
Assembling HW kit



1. Plug Inverter to L9907 board through JP1 and JP2 connector
2. Plug L9907 to Discovery board through X (4x37) connector
3. Plug L9907 sample making sure the correct orientation
4. Connect BLDC Motor phases and sensors
5. Connect Power
6. Configure Jumpers: see next slides

Assembled Kit available

- HW
  - SPC560P DISP board
  - EVAL L9907 board
  - EVAL L9907 inverter
  - Maxon motor EC 40



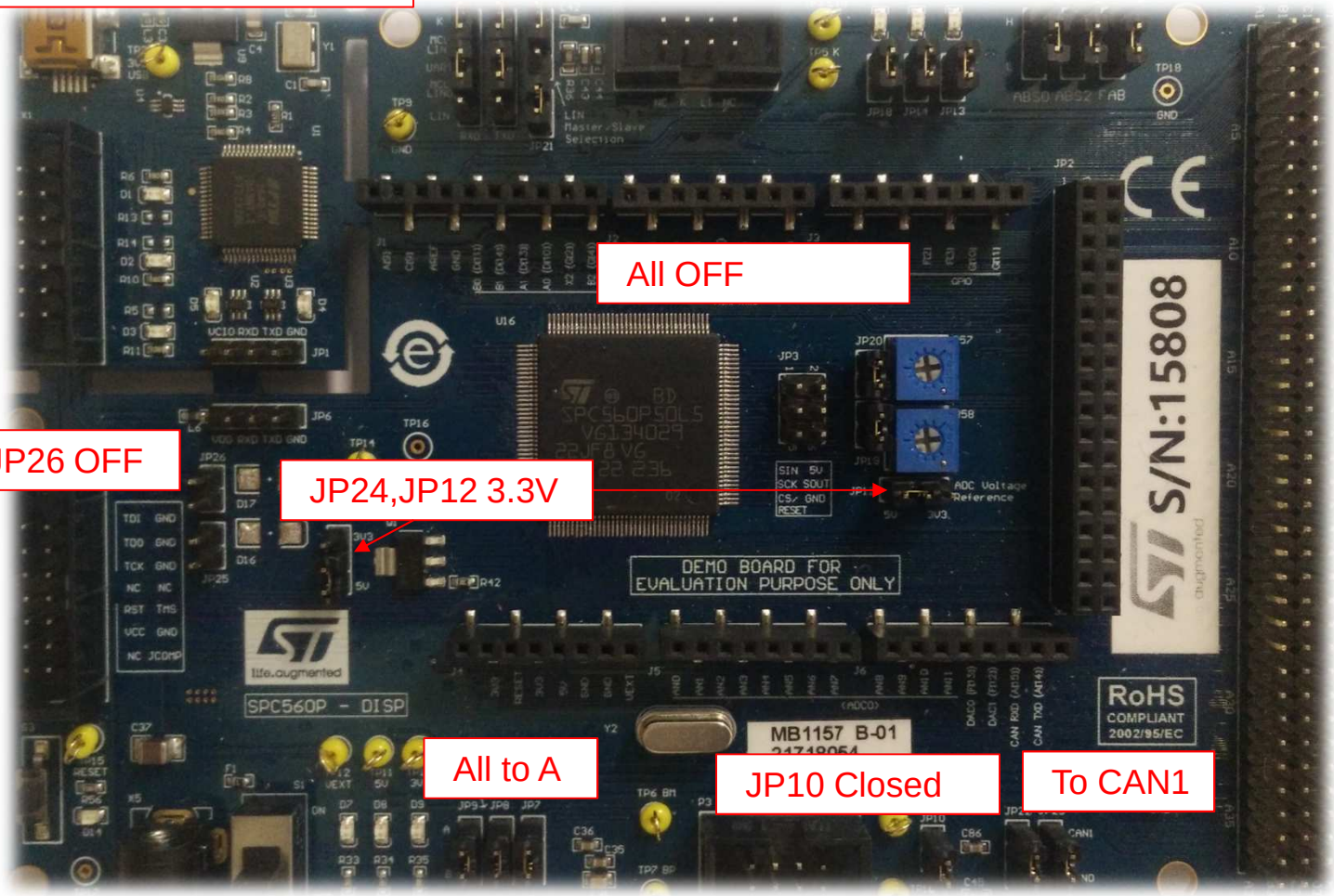
Note: Color of the board may be different

Jumper Configuration for SPC560P-DISP

JP4,JP5 Uart-MCULin0
JP11, K-MCULin1
JP21 ON

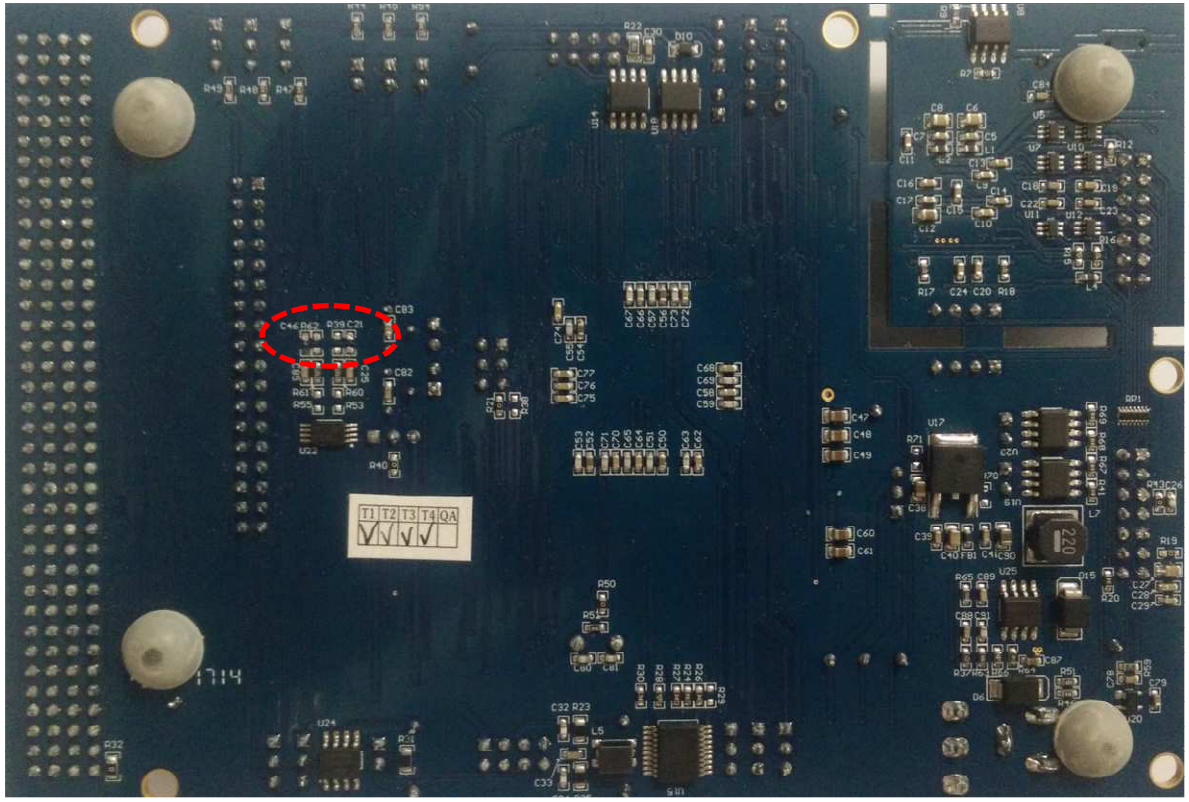
JP13,JP14,JP18 ON

JP15,JP16 OFF
JP17 L

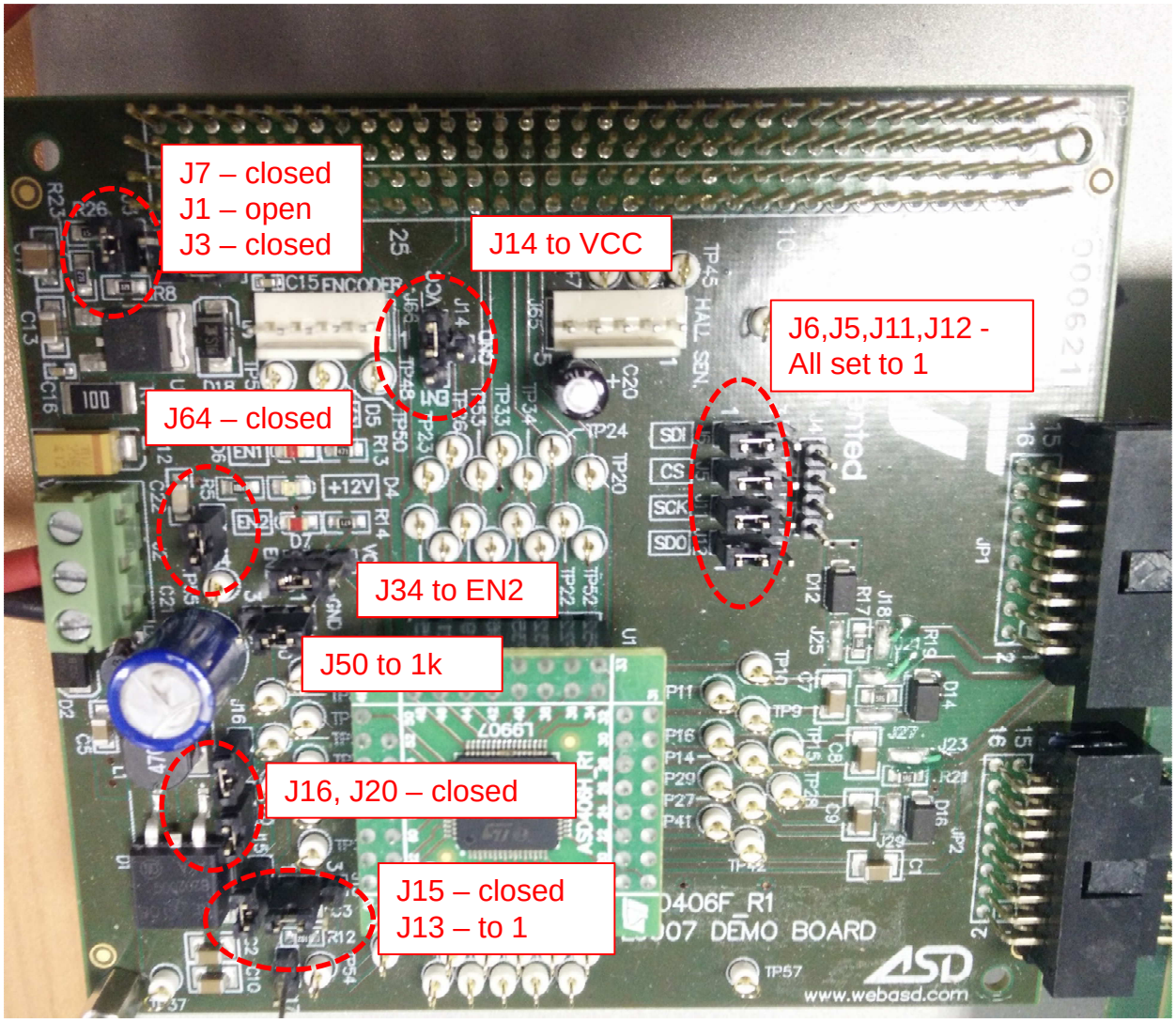


Modification to using Encoder

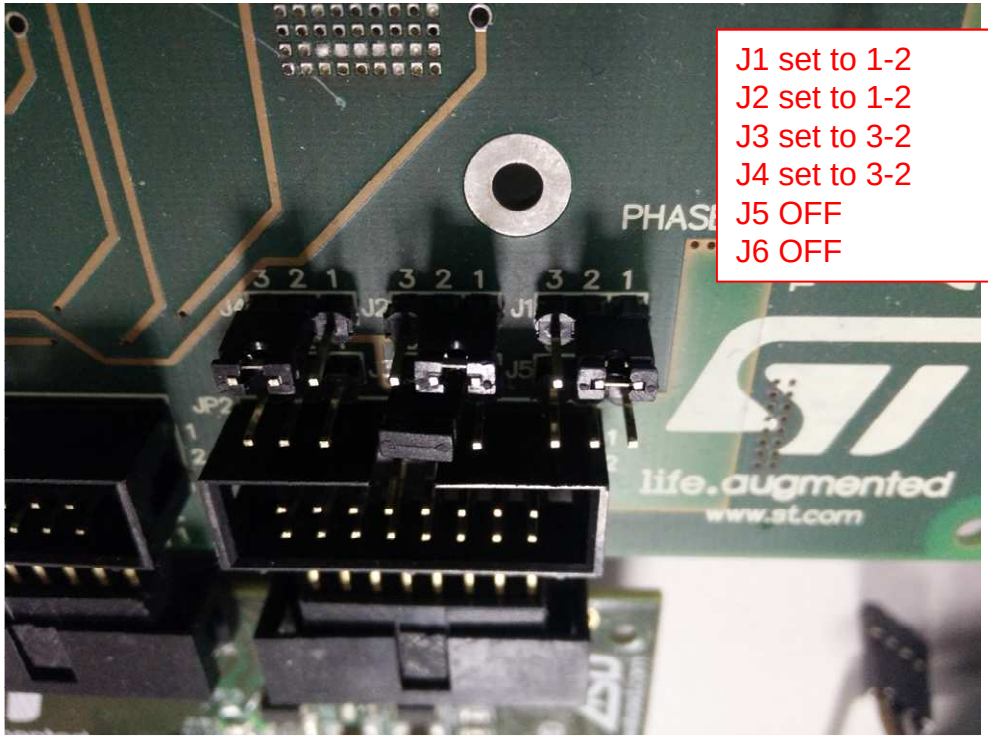
2 resistors (R39 and R62) and 2 capacitors (C21 and C46) on back side of the SPC560P-DISP must be removed to use ENCODER due to an incompatibility on pins. After this modification DAC0 and DAC1 will not work properly. Those modification are not needed if either HALL or Sensor-less are used



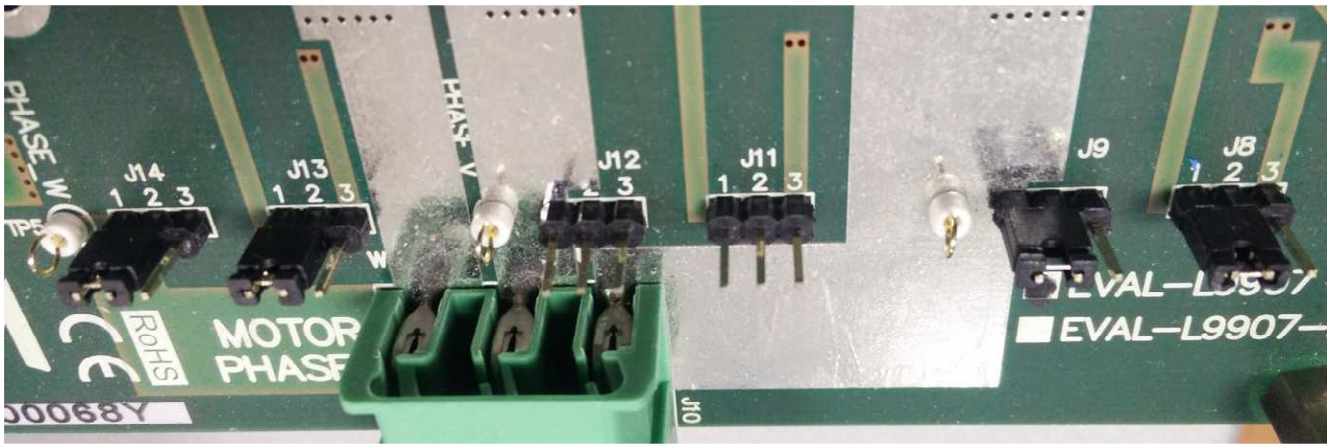
Jumper Configuration for L9907-Eval board



Jumper Configuration for L9907-Inverter board (configured for 2ICS)



J1 set to 1-2
J2 set to 1-2
J3 set to 3-2
J4 set to 3-2
J5 OFF
J6 OFF



J14 set to 1-2
J13 set to 1-2
J12 OFF
J11 OFF
J9 1-2
J8 1-2

Software Setup and Demo example

1 Introduction to the Motor Control Toolkit

2 Setup and configure HW parts

3 Setup, configure SW and run demo example

4 Documents & Related Resources

Software Setup in 6 steps

1

Get SPC5Studio and documentation from
www.st.com/spc5studio or
www.spc5studio.com

Install SPC5Studio by
reading carefully installation procedure
and additional document and tutorials

2

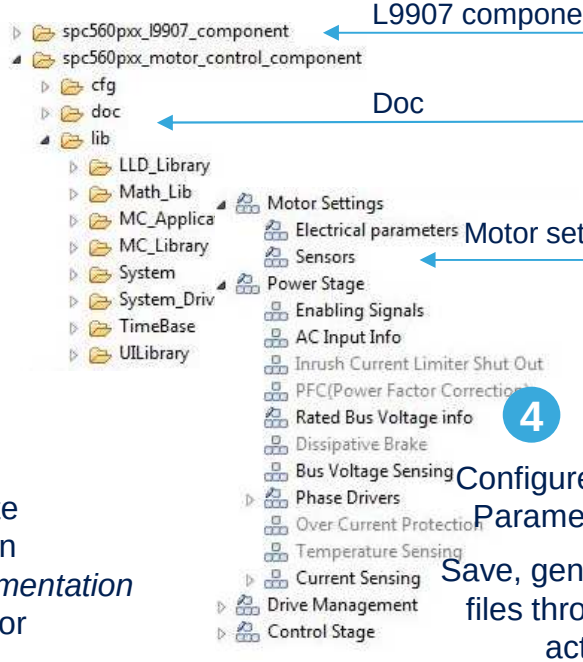
Get Motor Control SW package
(ask ST regional office):

- **MotorControlUpdateSite**
- **SPC56xx Demo Application**
- **Live Monitor Installer**

3

1) Install Motor Update Site
2) Import Demo Application
… see SPC5Studio documentation
3) Install SPC5 Live Monitor

Motor Control Component Structure



4

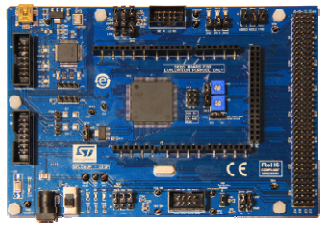
Configure Motor Electrical Parameter and sensors

Save, generate configuration files through SPC5Studio activity wizard

Compile through SPC5Studio activity wizard

5

Download binary to target board via Debug tool
(UDE 4.8 or Lauterbach)



6

Connect Live Monitor (set baud rate to 38400) and play with motor
Alternatively USB2CAN converter can be used in case of CAN communication

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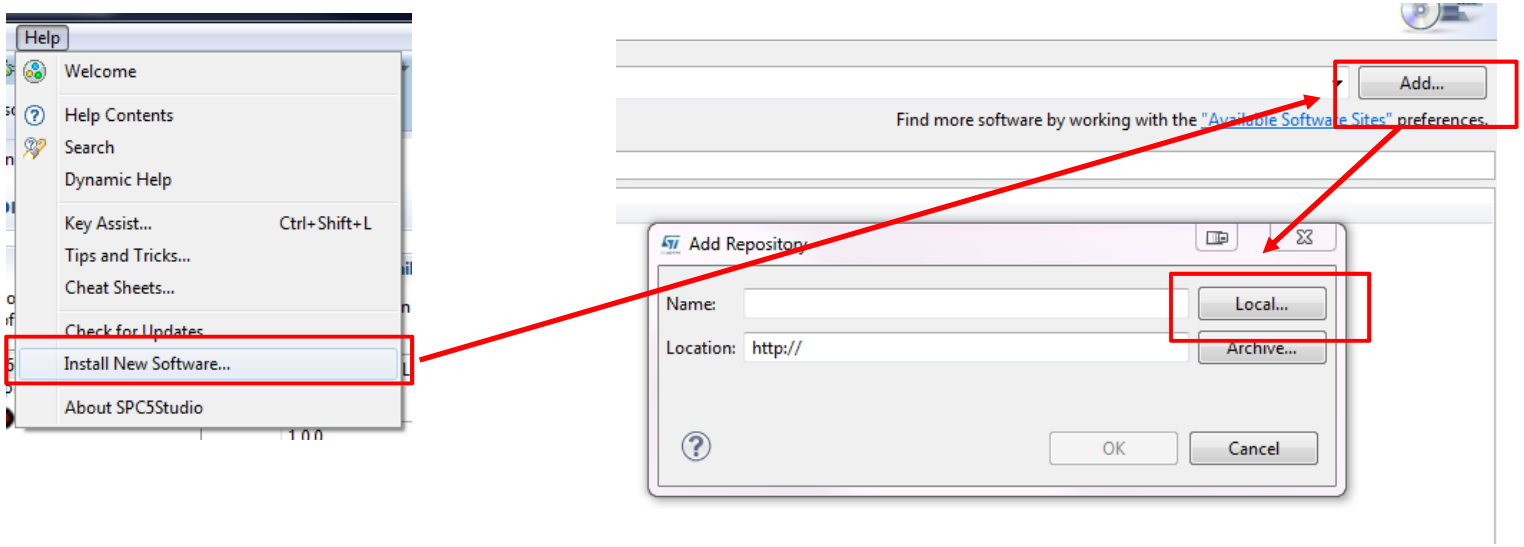
Step 3 - Install update site into SPC5Studio

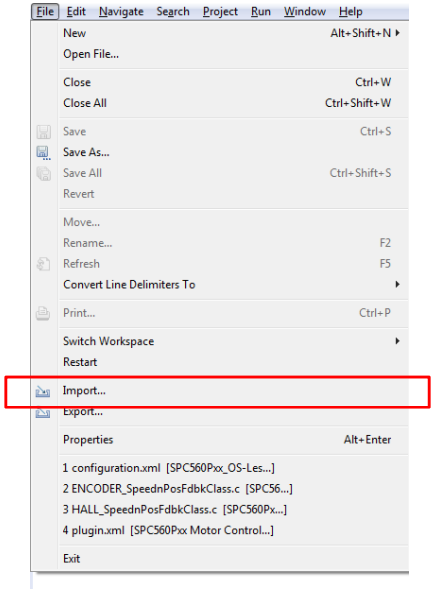
- Unzip the content of the update site in one directory of your choice
- ***Go to Help → Install New Software → Add → Local… →***
- select the directory where you un-zipped the update site and press OK
- Follow the on-screen instructions
  - Select Motor Control ToolKit
  - Read License Agreement and Accept

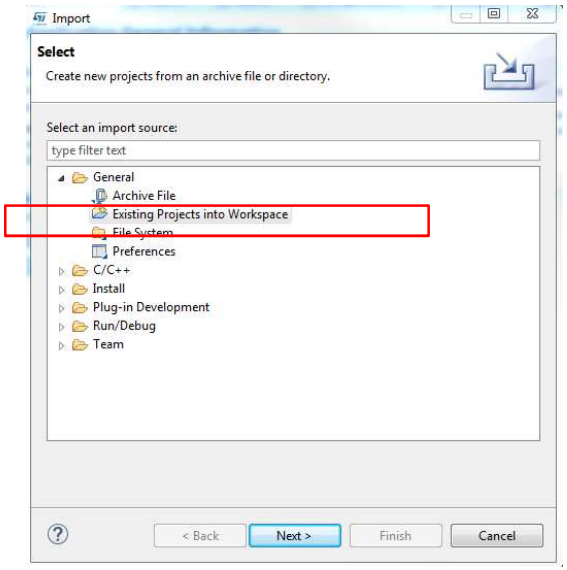


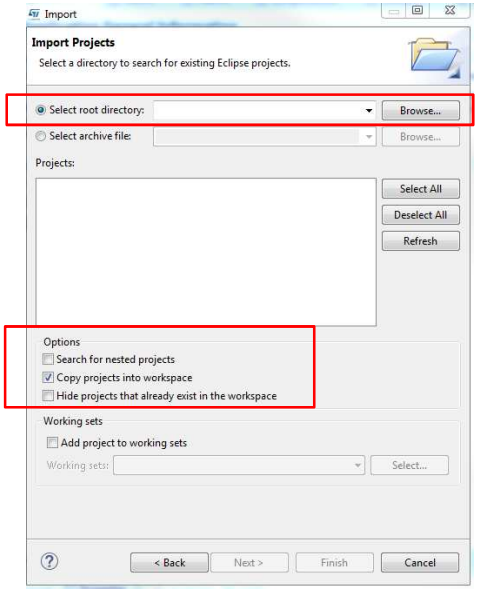
- Exit from SPC5Studio and Start it again

Step 3 - Import demo application into SPC5Studio

- Unzip the content of the demo application in one directory of your choice
- ***Go to File→ Import***
- select “Existing Project into Workspace” and click next
- Select the directory where you un-zipped the demo application
- It is strongly advised to select the option “Copy projects into workspace”, In this way the original version of the demo is not changed as you have created a copy into your default workspace)



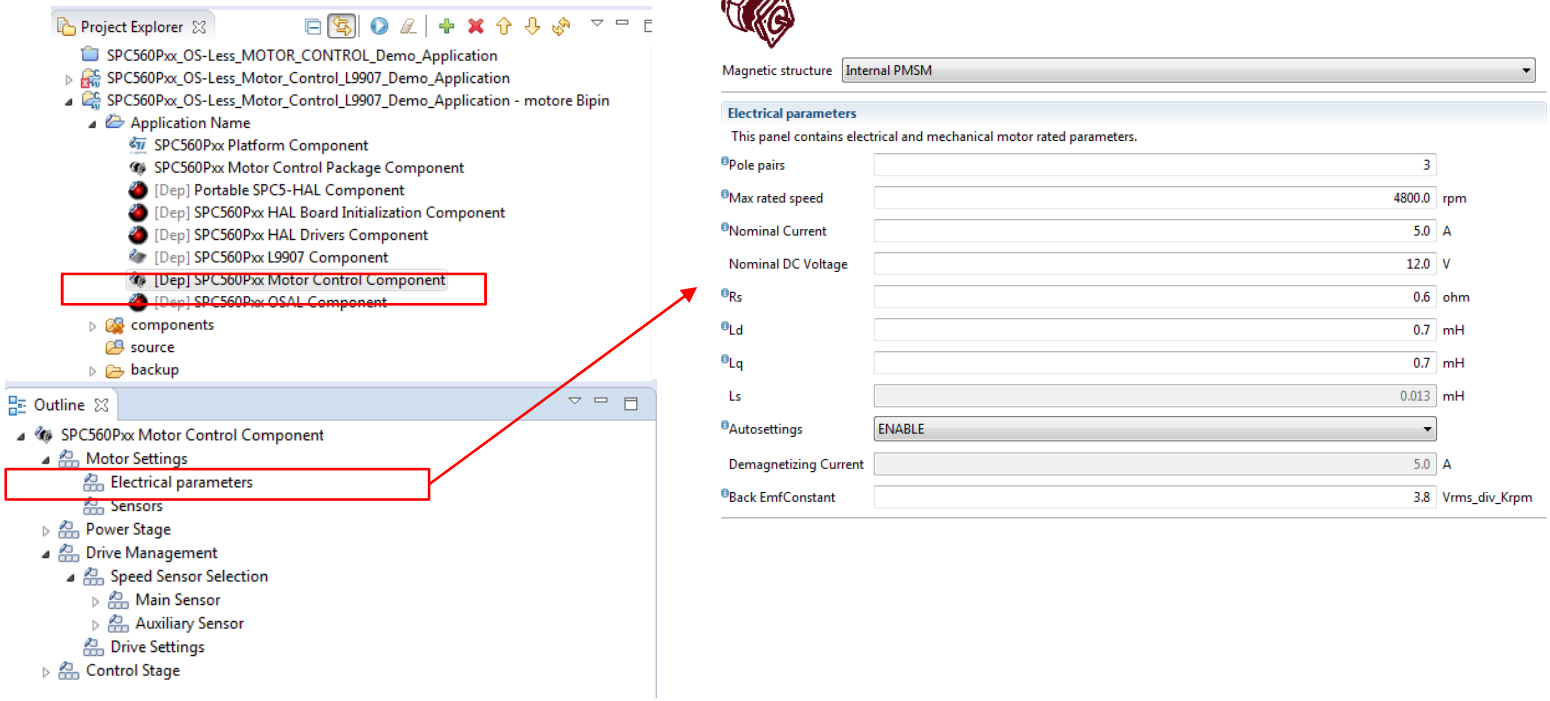




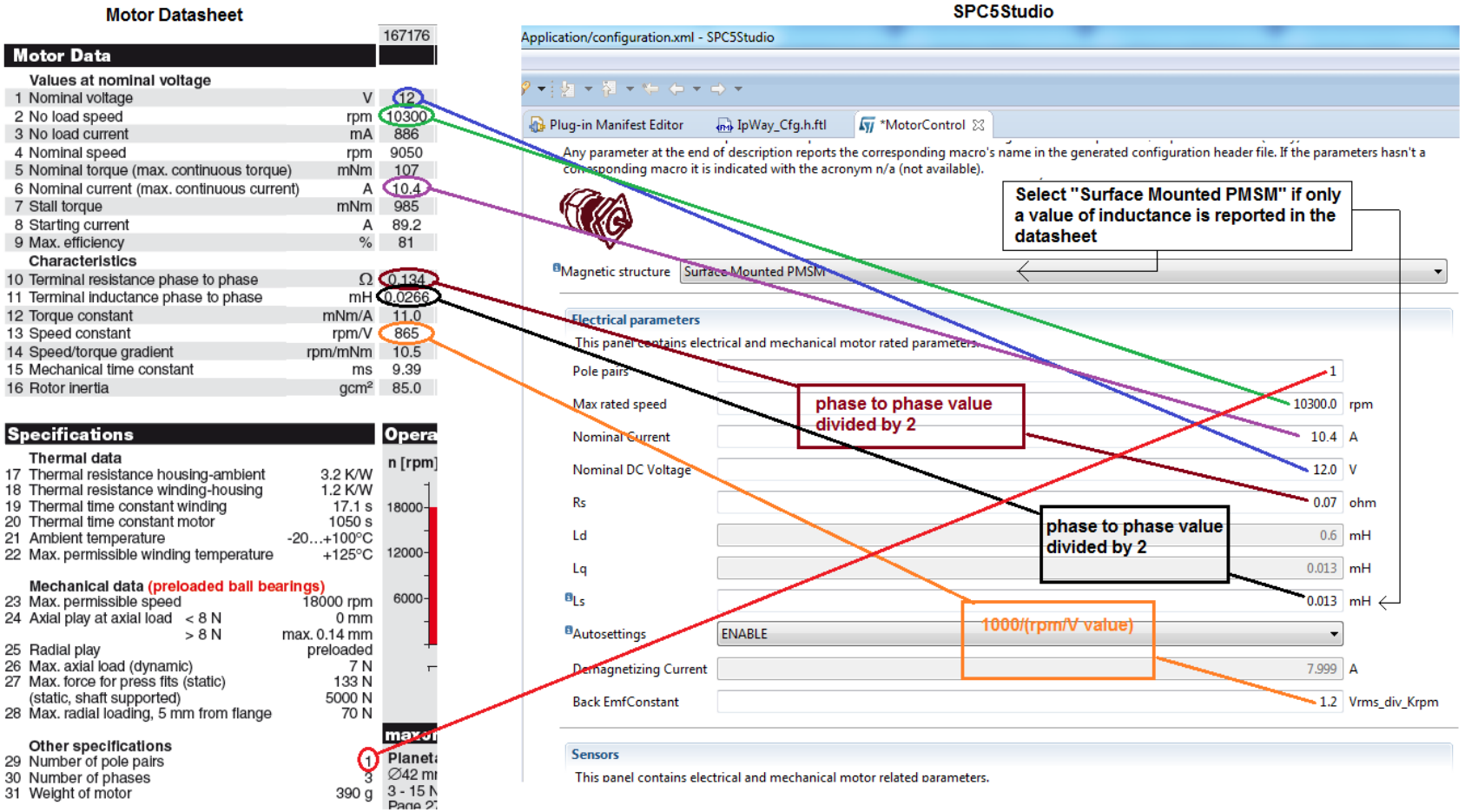
Step 4 - Configure Motor Control Component: Electrical Parameter

Demo Application is preconfigured to run on Maxon EC40 motor. Configuration can be customized to fit customer application.

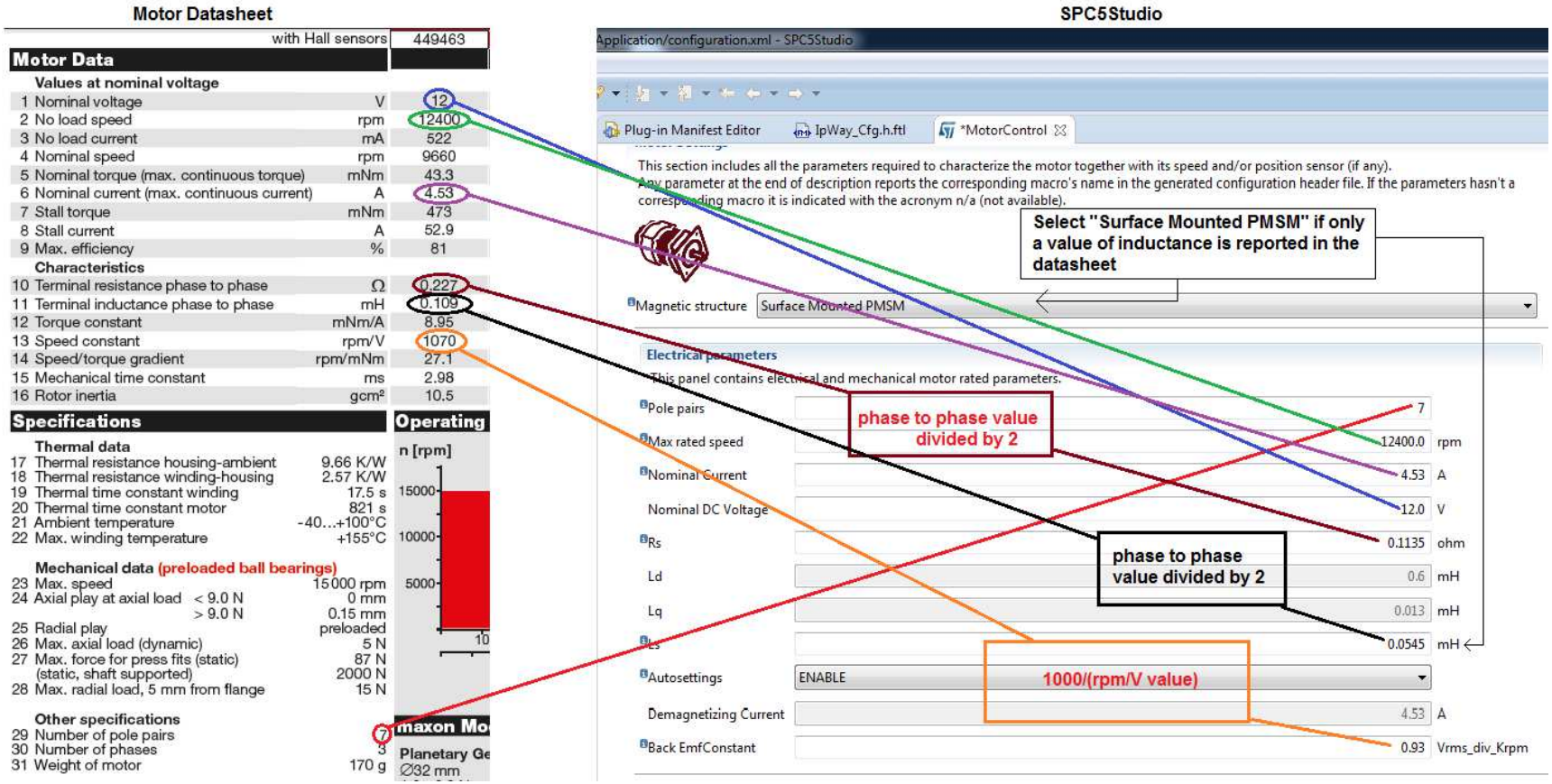
- select “Motor Control Component” down to the Application name in the demo application.
- configure **Motor Settings** tabs from Outline box (down left SPC5Studio tool corner) to configure the library



Step 4 - Motor configuration example for the Maxon Motor EC 40 starting from the motor datasheet



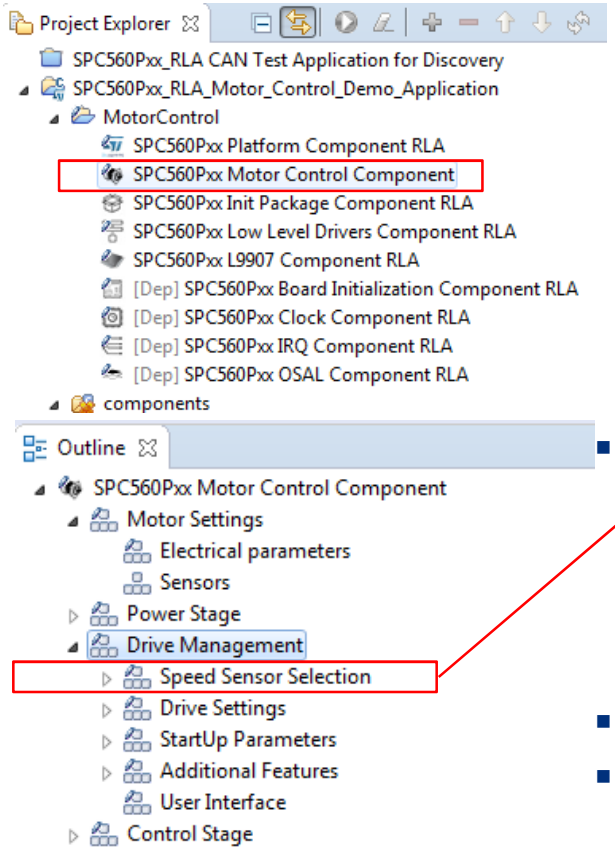
Step 4 - Motor configuration example for the Maxon Motor EC-i 40 starting from the motor datasheet

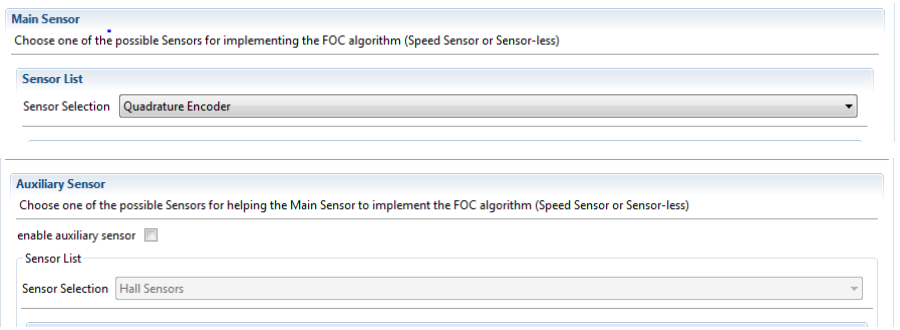


Step 4 - Configure Motor Control Component: Speed Sensor Selection

Demo Application is preconfigured to run on Maxon EC40 motor. Configuration can be customized to fit customer application.

- configure **Drive Management** tabs from Outline box (down left SPC5Studio tool corner) to configure Speed sensor to be used by the library





- Select Main Sensor between:
  - Sensorless + PLL
  - Hall Sensor
  - Quadrature Encode
  - Resolver (Need additional HW)
- "Enable Auxiliary Sensor" checkbox is used for debugging only.
- Quadrature Encode is the most reliable sensor and it is encouraged to use this mode. It is available only removing resistor from the back of the Pictus Discovery board

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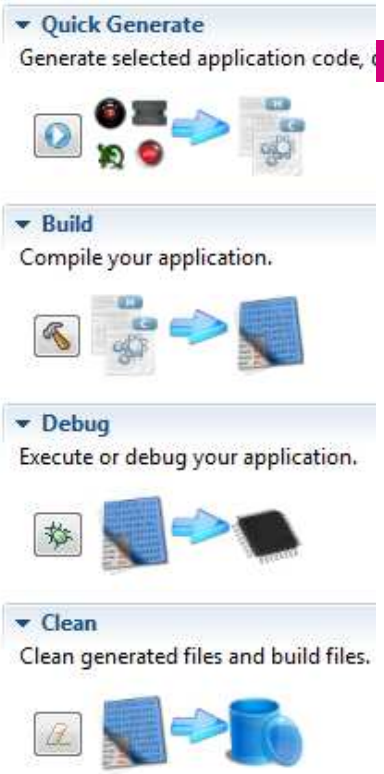
Step 4 - Configure Motor Control Component: Generate Build and Debug

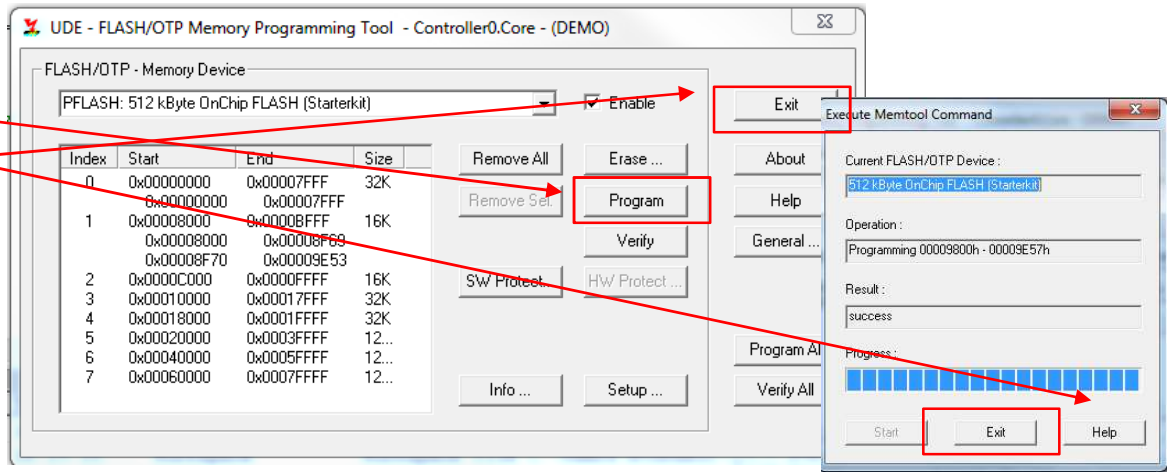
After the configuration phase you need to generate configuration file:

- `PMSM motor parameters.h`
- `Power stage parameters.h`
- `Drive parameters.h`
- `Control stage parameters.h`

They will be available under `components/spc560pxx_motor_control_compo`



- Click on Quick Generate to create configuration file based on your settings
- Click on Build to compile your application
- Click on Debug to use Pls for download your code on Pictus
  - The UDE Visual Platform will be opened
  - Press Load in “Load binary target file” to open the programming tool
  - Press Program
  - Than Press Exit 2 times
  - Than Start Program or F5



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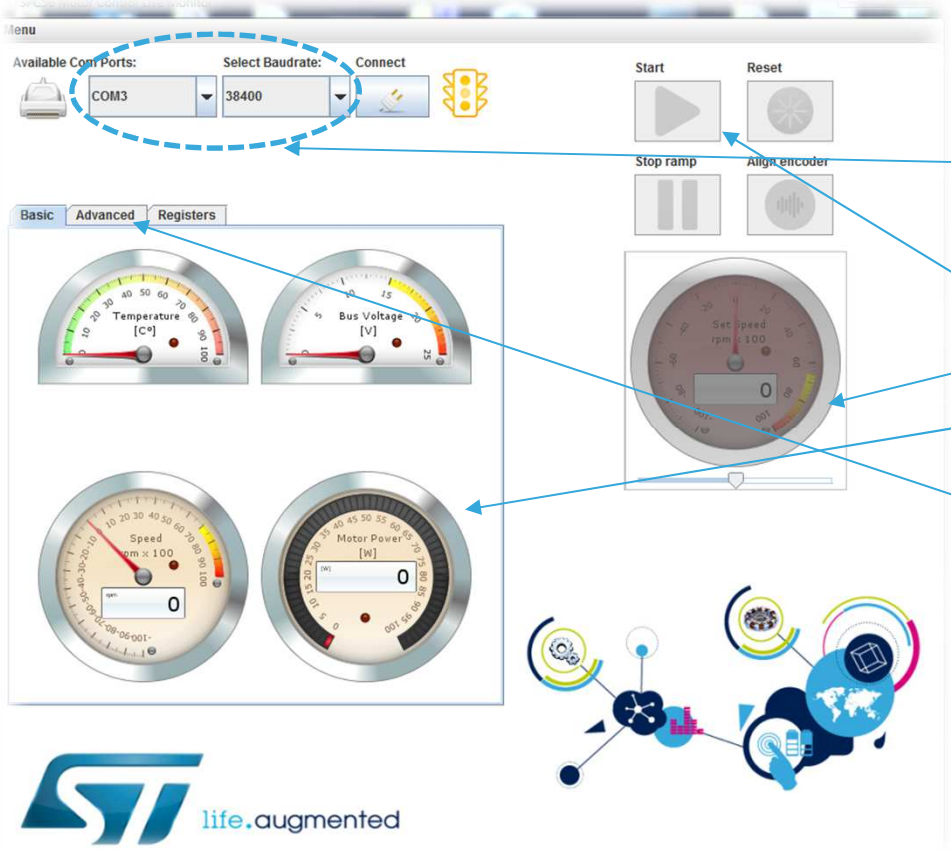
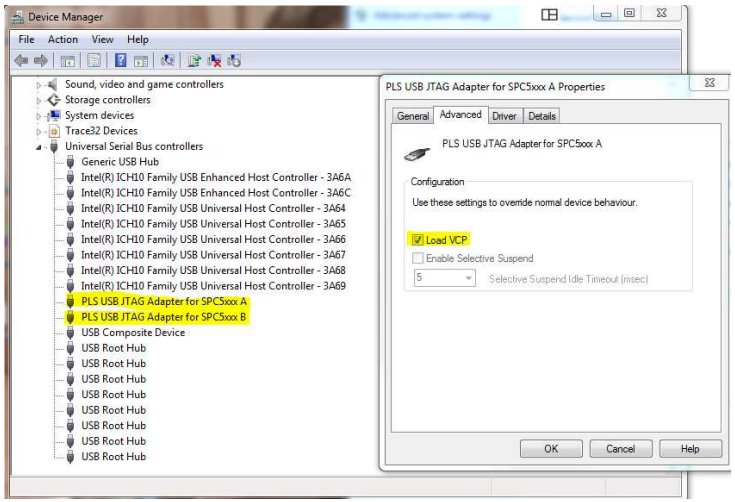
Step 6 - Connect Live Monitor



- Install and Open SPC5 Live Monitor
- Select virtual COM* and set baud rate
- Click on Connect Button
- Start the Motor
- Change the reference speed
- Monitor actual speed, temp and power
- Go the advanced option to change amplification gain or set ramp speed
- Go to register view to check all library parameters



* Virtual COM should be enabled in:
Window Device Manager ->USB Controllers
Note: in case there is no Advanced Tab
remove and insert again usb cable from
Pictus Discovery board

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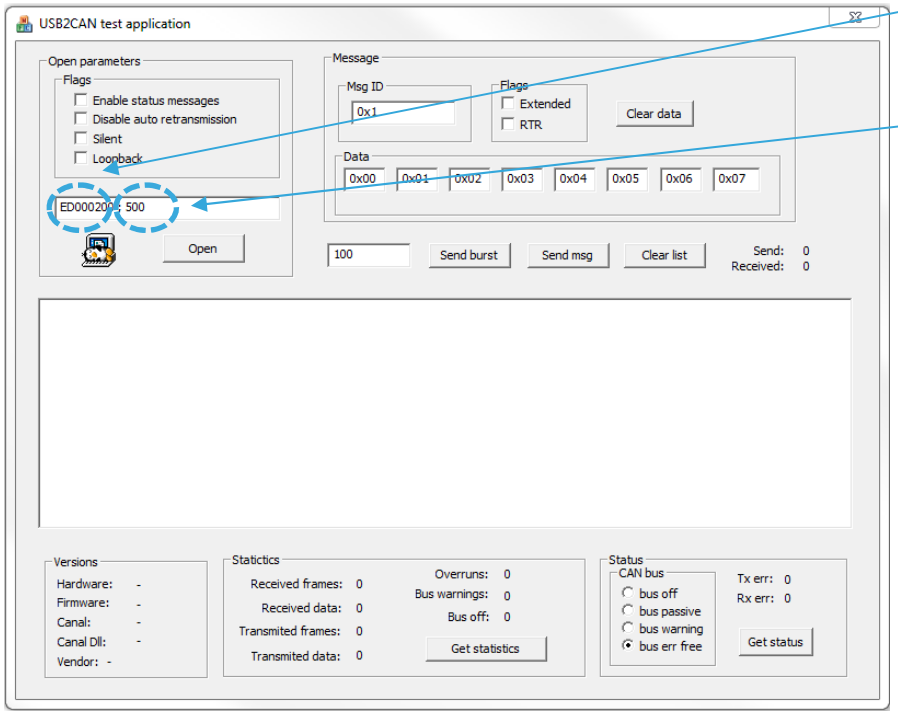
Step 6 - Using CAN with USB2CAN converter



- From http://www.8devices.com
  - Buy USB2CAN converter
  - Download and Install USB driver
  - Download USB2CAN Test application v1.0
- Set the correct ED code from back of your USB2CAN converter
- Set baudrate according to motor control configuration (drive management -> user interface -> can details) component and Opne the connection
- Set the CAN message as specified into the User Manual into the motor control component documentation folder:

Command	Can ID STD	Can Data
RAMP FINAL SPEED (2000 rpm)	01	05 5B D0 07 00 00 39
BUS VOLTAGE	02	01 19 1C
START/STOP MOTOR	03	01 06 0A
GET BOARD INFO	06	01 00 07
EXEC RAMP(1000,2000)	07	06 E8 03 00 00 D0 07 D0
GET REV UP	08	01 Stage CRC
SET REF	0A	04 Iq_LB Iq_HB Id_LB Id_HB CRC

Table 1: Can Frame Example

Overview

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4 Documents & Related Resources

Documents & related resources

All documents are available in the release package

- Release Note

  Content of the release package
- Data Brief

  One page description of the Motor Control ToolKit
- User Manual Chm

  Compressed chm manual available in the SPC5Studio motor control component doc folder
- Quick Start Guide

  Presentation to quickly configure HW and SW and run demo application
- MCTK SPC5Studio Motor Configuration Quick Guide

  Pdf doc describing how to configure HW and SW and run demo application

Consult www.st.com for the complete list

Thanks