AX58100 SoC EtherCAT SSC Porting Guide

Revision 1.01
May 5th, 2020

Revision History

Revision	Date	Description
1.00	2019/10/04	Initial release
1.01	2020/05/05	1. Updated Section 5-8. 2. Changed Master information to BECKHOFF TwinCAT

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1. Introduction

This document indicates the EtherCAT Slave Stack Code (SSC) porting guidelines for AX58100 with 3rd party microcontroller applications by taking the AX58100 + STM32F303RE MCU Motor Control reference design as an example. The reference design presents ASIX's complete industrial Ethernet EtherCAT solution, which includes Beckhoff TwinCAT Master and AX58100 + STM32F303RE MCU EtherCAT Slave Motor Control reference design solution.

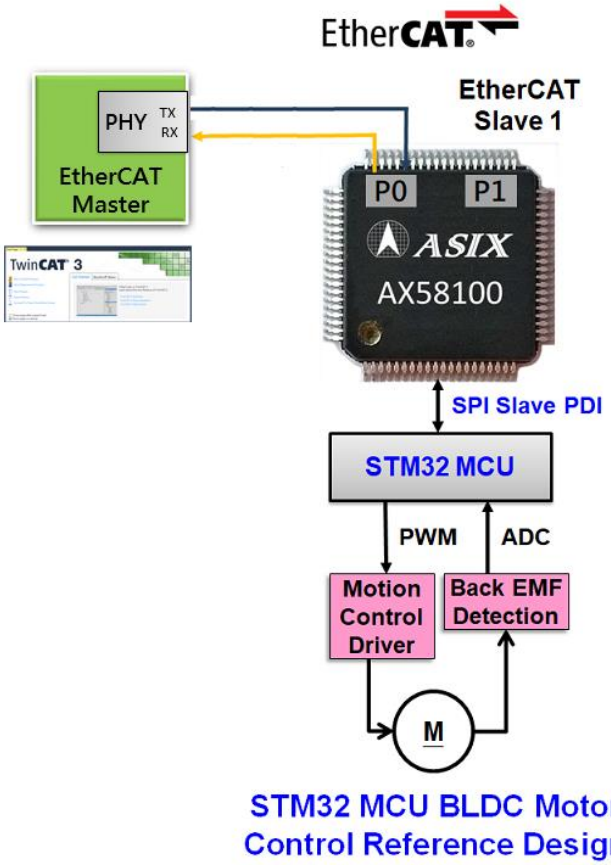


Figure 1-1. AX58100 + STM32F303RE MCU Motor Control Reference Design Block Diagram

2. AX58100 ESC Process Data Interface (PDI)

The AX58100 provides two Process Data Interfaces (PDI), SPI slave and Local Bus, support the connection with most popular microcontrollers and DSP on those traditional non-EtherCAT fieldbus applications. Please refer to "**AX58100 datasheet**" for details.

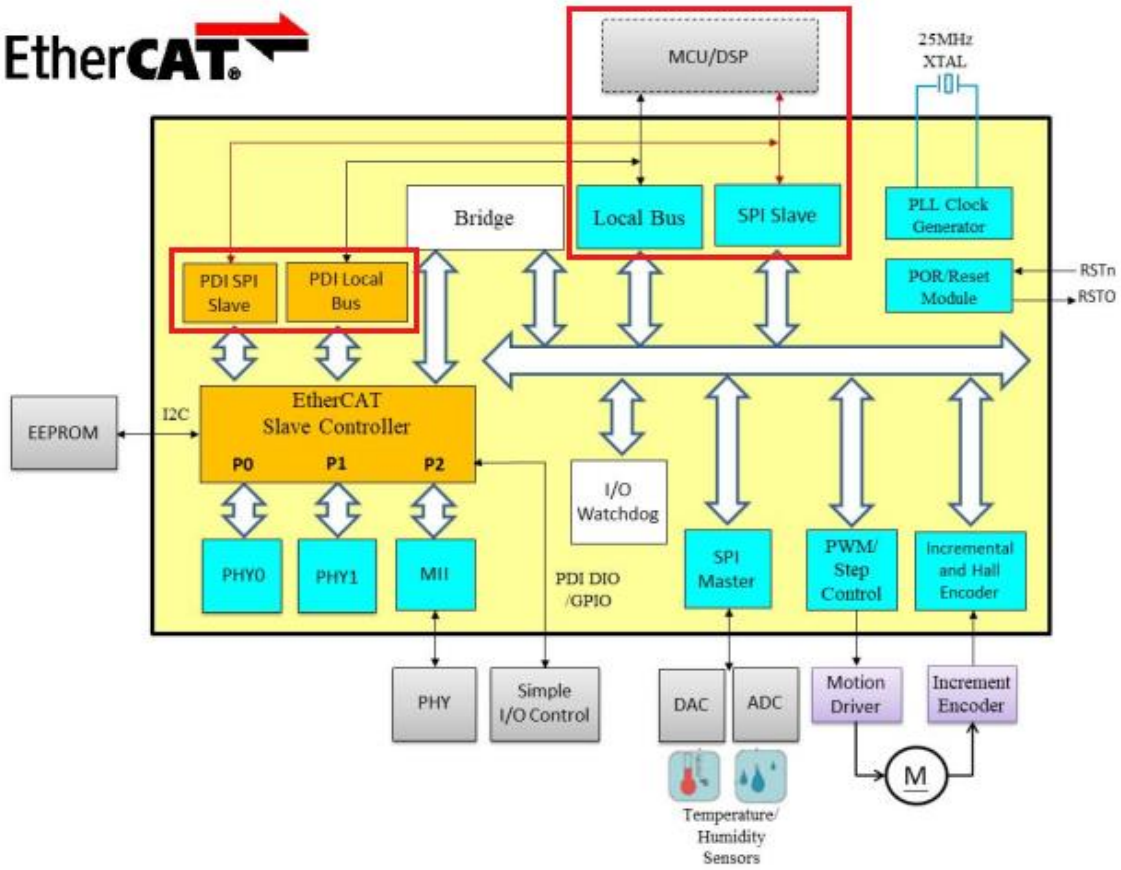


Figure 2-1. AX58100 EtherCAT Slave Controller Block Diagram

Designers should modify the ESC Configuration Area value of EtherCAT Slave Information (ESI) file based on different AX58100 hardware designs. Please refer to "**AX58100 ESI Design Note**" and "**Section 3.2 "Hardware Configuration EEPROM (HWCFGEE)" of AX58100 Datasheet**" for details.

The following is an example ESC Configuration Area value for AX58100 + STM32F303RE MCU Motor Control reference design.

```
<Eeprom>
    <ByteSize>2048</ByteSize>
    <ConfigData>050603440a00000000001a000000</ConfigData>
    <BootStrap>0010800000118000</BootStrap>
</Eeprom>
```

PDI Control (0x0140)

Name	PDI Control
Reset Value	0x00

Bit	Access		Description
	ECAT	PDI	
7:0	RO	RO	Process data interface: 0x00: Interface deactivated (no PDI) 0x04: Digital I/O 0x05: SPI Slave 0x08: 16-bit Asynchronous Local Bus interface 0x09: 8-bit Asynchronous Local Bus interface Others: Reserved Load from EEPROM byte address 0x0000

Figure 2-2. AX58100 PDI Control Register

Pin Name	Type	Pin No	Pin Description
SCS_ESC	I5	79	SPI Chip Select for ESC
SCS_FUNC	I5	80	SPI Chip Select for Function
SCLK	I5	64	SPI Clock
MOSI	I5	78	SPI data MOSI
MISO	O5	6	SPI data MISO
SINT	O5/T	1	SPI Interrupt
FSCLK	I5	9	Function SPI Clock
FMOSI	I5	12	Function SPI data MOSI
FMISO	O5	7	Function SPI data MISO
SFINT	O5/T	49	SPI Function Interrupt

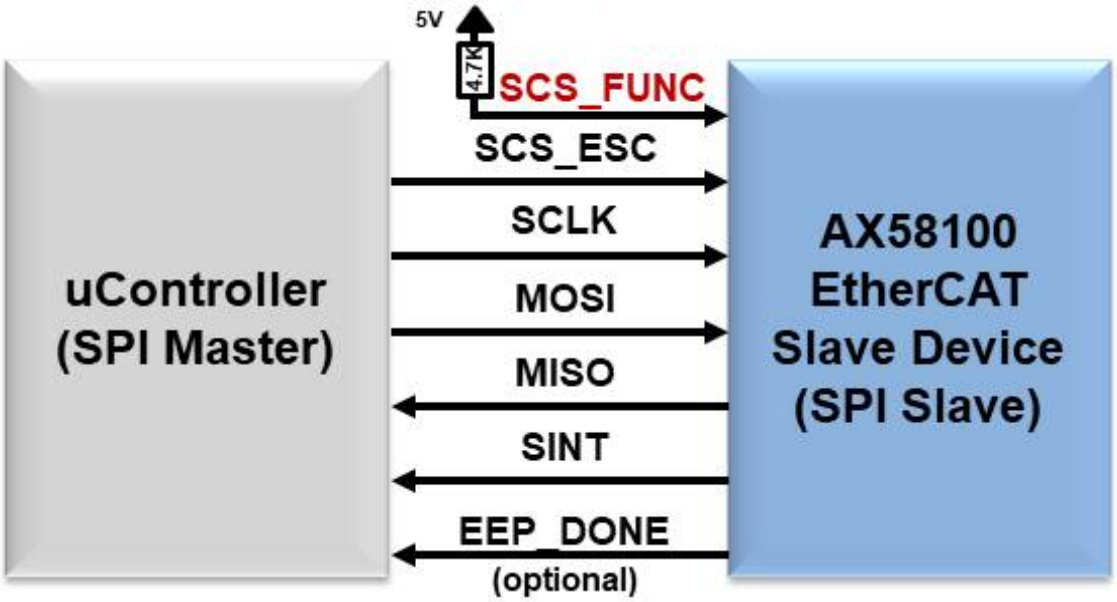


Figure 2-3. AX58100 ESC PDI SPI Slave Interface Connection

Pin Name	Type	Pin No	Pin Description
LECSn	I5	79	Local bus ESC Chip Select
LFCSn	I5	80	Local bus Function Chip Select
LRDn	I5	64	Local bus Read
LWRn	I5	78	Local bus Write
LBHE	I5	68	Local bus Byte High Enable (16-bit width only)
LRDY	O5/T	6	Local bus Ready
LINT	O5/T	1	Local bus Interrupt
LA[13:0]	I5	66, 42, 52, 50, 48, 44, 17, 14, 12, 9, 7, 49, 74, 71	Local bus Address bus
LDA[[15:8]	B5	18, 15, 13, 11, 8, 76, 75, 73	Local bus Data bus [15:8]
LDA[7:0]	B5	69, 67, 53, 60, 51, 4, 47, 43	Local bus Data bus [7:0]

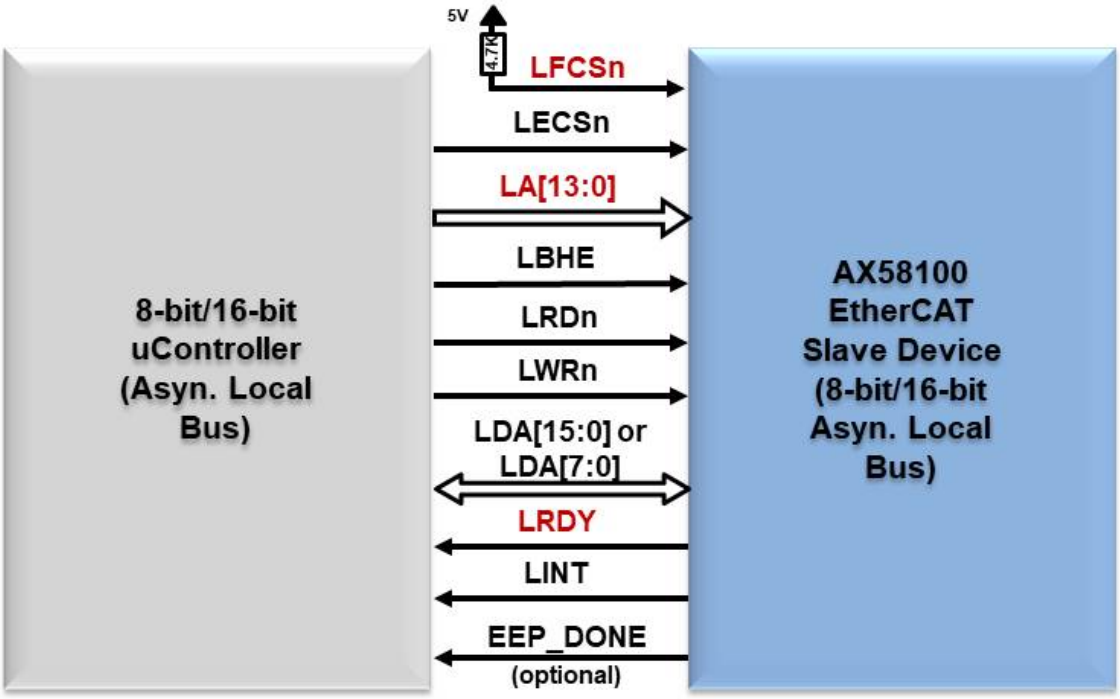


Figure 2-4. AX58100 ESC PDI Local Bus Interface Connection

3. EtherCAT SSC Overview

The EtherCAT Slave Stack Code (SSC) as seen in below figure consists of 3 parts:

- **PDI / Hardware Abstraction**
  Hardware specific, need to be implemented according the platform PDI.
  Ready to used samples/implementations are available for certain platforms.
  The interface to the generic stack.

- **Generic EtherCAT Stack**
  Implements the full EtherCAT state machine, mailbox communication and generic process data exchange. No further implementation need (only configured via the SSC Tool).

- **User Application**
  Need to be implemented (a table-based code generation for the application is available).
  Ready to used samples are available. The interface to the generic stack.

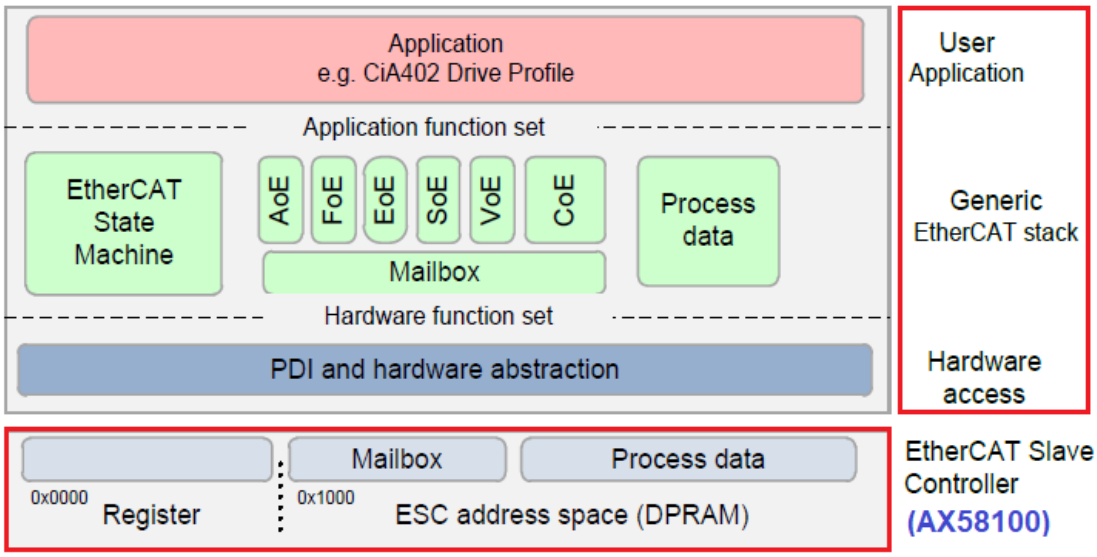


Figure 3-1. EtherCAT SSC Code Structure

The following figure shows the association between the Slave Stack Code layers and the source files.

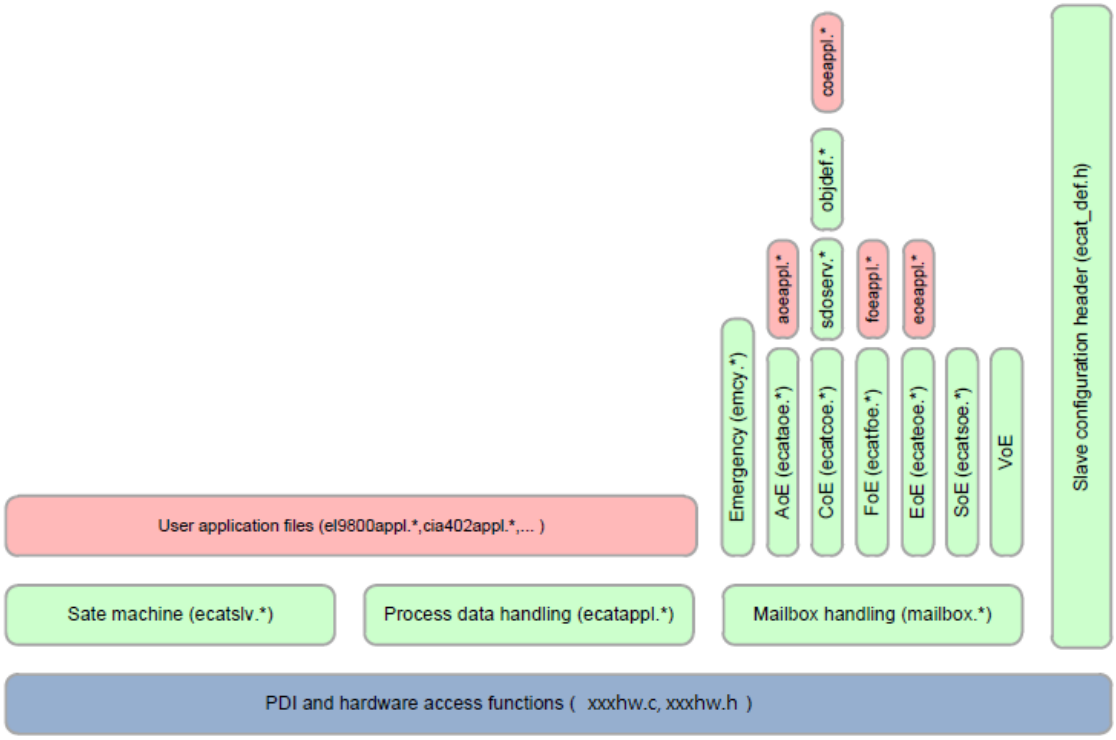


Figure 3-2. EtherCAT SSC Files Association

Please refer to the "**AX58100 Software API Design Guide**" from ASIX and the "**Application Note ET9300 EtherCAT Slave Stack Code (SSC)**" from Beckhoff Automation GmbH for more details.

4. Hardware/Software Requirements

The following are the hardware and software requirements in order to port the EtherCAT SSC on AX58100 + STM32F303RE MCU Motor Control reference design for example.

4-1. EtherCAT Master

4-1-1. Environment Requirements

Before starting to setup the environment, we should prepare some software and hardware. Of course, they are all running based on general desktop PC with windows 7 / 10 operation systems. We list software / hardware requirements as following:

[Software at EtherCAT master side]

- Windows 7 / 10 operation system
- Microsoft Visual Studio 2010 / 2013
- Beckhoff TwinCAT XAE v3.1.4022.28 or later
- AX58100 + STM32F303RE Motor Control TwinCAT PLC reference source
- AX58100 + STM32F303RE Motor Control reference ESI file

Figure 4-1. TwinCAT Master

4-2. EtherCAT Slave

The following hardware/software requirements are for this sample reference design and might be different from some requirements of other EtherCAT slave environments.

4-2-1. Hardware Requirements

Please prepare the following hardware in order to port the EtherCAT SSC on AX58100 + STM32F303RE MCU Motor Control reference design.

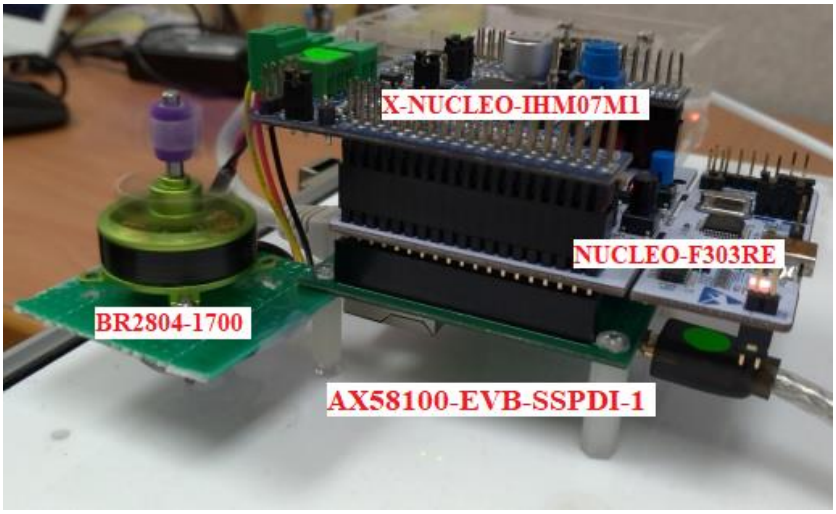


Figure 4-2. AX58100 + STM32F303RE MCU EtherCAT Slave Environment

Model Name	Descriptions
AX58100-EVB-SSPDI-1	AX58100 SPI Slave PDI board Please contact ASIX Sales (Sales@asix.com.tw) to get the AX58100-EVB-SSPDI-1 board.
NUCLEO-F303RE	STM32 Nucleo-64 development board with STM32F303RE MCU Please purchase the NUCLEO-F303RE MCU development board from STMicroelectronics Online Store.
X-NUCLEO-IHM07M1	Three-phase brushless DC motor driver expansion board based on L6230 for STM32 Nucleo Please purchase the X-NUCLEO-IHM07M1 BLDC motor driver board from STMicroelectronics Online Store. **Note:** The default circuits of X-NUCLEO-IHM07M1 board are for NUCLEO-F302R8 development board. Please refer to Section 4-2-1-1 to modify the circuits of X-NUCLEO-IHM07M1 board for NUCLEO-F303RE MCU development board.
BR2804-1700	BR2804 1700KV brushless DC motor Please find & purchase the BR2804-1700 brushless DC motor from Internet Online Store.

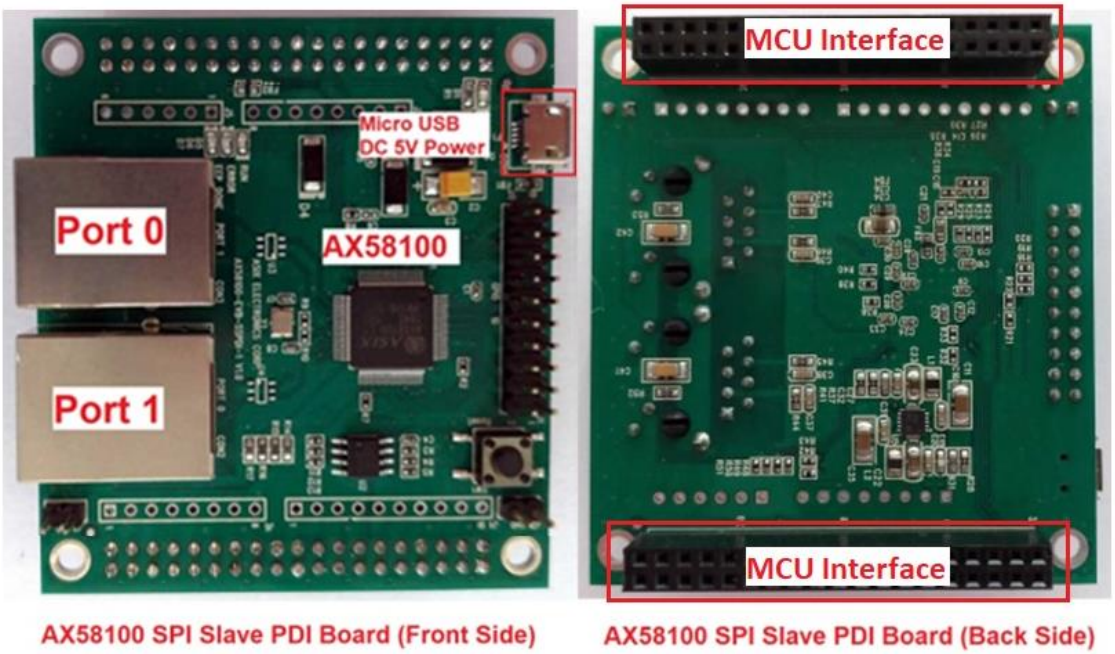


Figure 4-3. AX58100-EVB-SSPDI-1 SPI Slave PDI Board

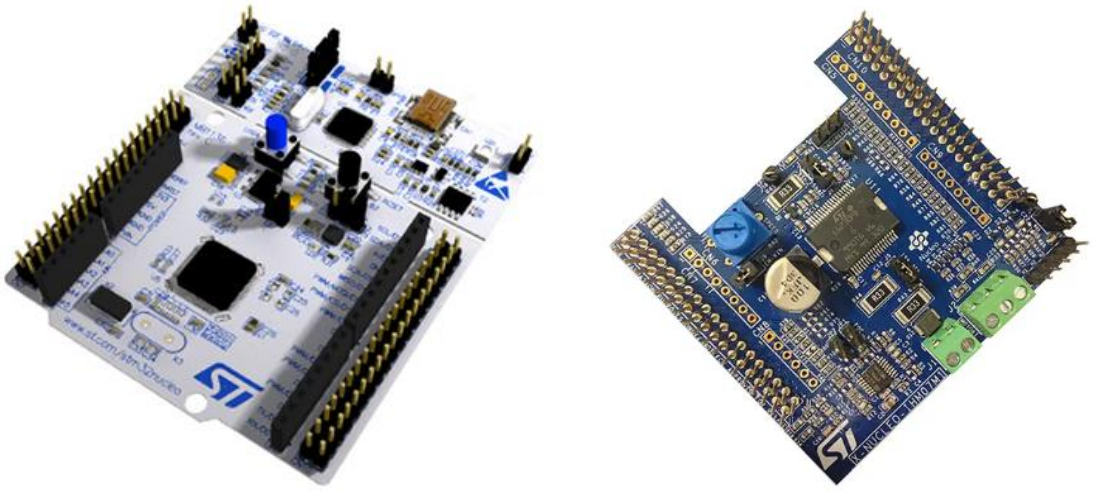


Figure 4-4. ST NUCLEO-F303RE MCU Board & X-NUCLEO-IHM07M1 BLDC Motor Driver Board

Model	KV(rpm/v)	Volate (v)	MotorWeight (g)AppROX	NoLoadCurrent (A)	No Load Speed (rpm)	Load Current(A)	Load Speed(rpm)	Prop	Pull (g)	G/A
BR2804-2300	2300	11.1	20	0.8	24830	10.8	14970	7035	380	35
BR2804-1700	1700	11.1	23	0.6	18000	5.6	12540	7035	257	46

Figure 4-5. BR2804-1700 Brushless DC Motor

4-2-1-1. X-NUCLEO-IHM07M1 Board Circuits Modification for NUCLEO-F303RE

The AX58100 board connects to NUCLEO-F303RE board via SPI interface (i.e. PB13~PB15 pins) so please modify the following circuits on X-NUCLEO-IHM07M1 board for normal operation.

- Remove **R82** resistor to disconnect from NUCLEO-F303RE PB13 (SPI2_SCK) pin.
- Remove **R49** resistor to disconnect from NUCLEO-F303RE PB14 (SPI2_MISO) pin.
- Remove **R66** resistor to disconnect from NUCLEO-F303RE PB15 (SPI2_MOSI) pin.

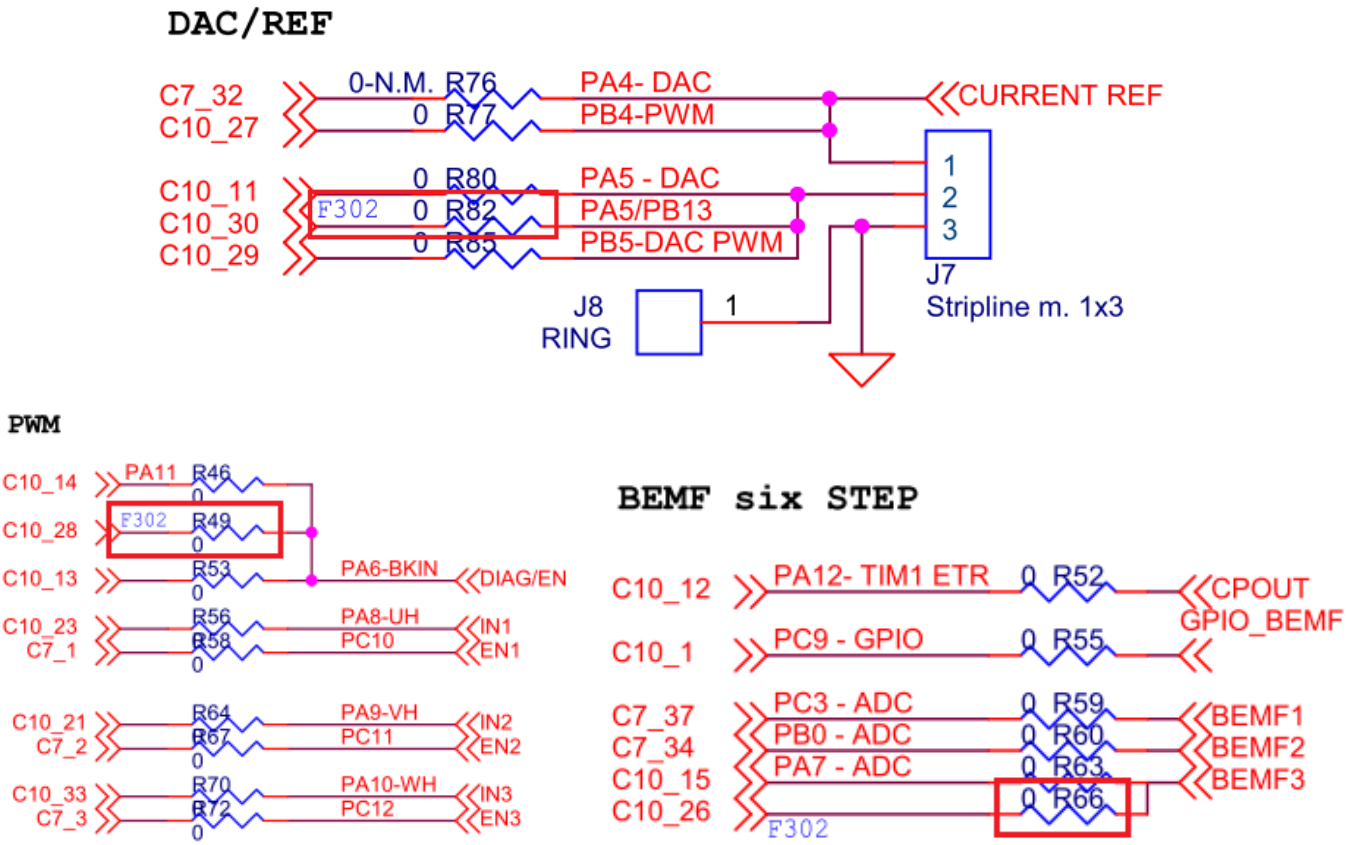


Figure 4-6. X-NUCLEO-IHM07M1 Board Circuits Modification for NUCLEO-F303RE

4-2-2. Software Requirements

The following are the software tools which are used to port the EtherCAT SSC on AX58100 + STM32F303RE MCU Motor Control reference design.

Software Tools	Version
AX58100_P-NUCLEO-IHMxxx_Demo_Firmware_ Source	v1.0.0 and later
Keil MDK-ARM uVision5 Development Tool	v5.22.0.0
Beckhoff TwinCAT 3.1 – eXtended Automation Engineering (XAE)	v3.1.4020.32
Beckhoff EtherCAT Slave Stack Code Tool (with SSC Code Version 5.11)	v1.3.2.0
STMicroelectronics STM32 ST-LINK Utility	v3.9.0
STMicroelectronics X-CUBE-MCSDK (Includes ST Motor Profiler and ST Motor Control Workbench v5.2.0.18503)	v5.2.0
STMicroelectronics STM32CubeMX Utility	v5.0.0

5. How to port AX58100 EtherCAT SSC for STM32 MCU

The following are the procedures to port the EtherCAT SSC on AX58100 + STM32F303RE MCU Motor Control reference design for example. For different microcontroller platforms, some of procedures might be different.

5-1. Prepare Software Development Environment

Please install the following tools on a Windows platform.

5-1-1. Install Keil MDK-ARM uVision5 Development Tool

Please purchase and install Keil MDK-ARM uVision5 Development Tool (e.g. "MDK522.exe") firstly and visit Keil MDK-ARM web site for details.

5-1-2. Install TwinCAT 3.1 – eXtended Automation Engineering (XAE) Tool

Download "TwinCAT 3.1 – eXtended Automation Engineering (XAE) Tool" from Beckhoff website and run TwinCAT 3 setup (e.g. "TC31-Full-Setup.3.1.4020.32.exe") to install TwinCAT 3 tool on Windows platform.

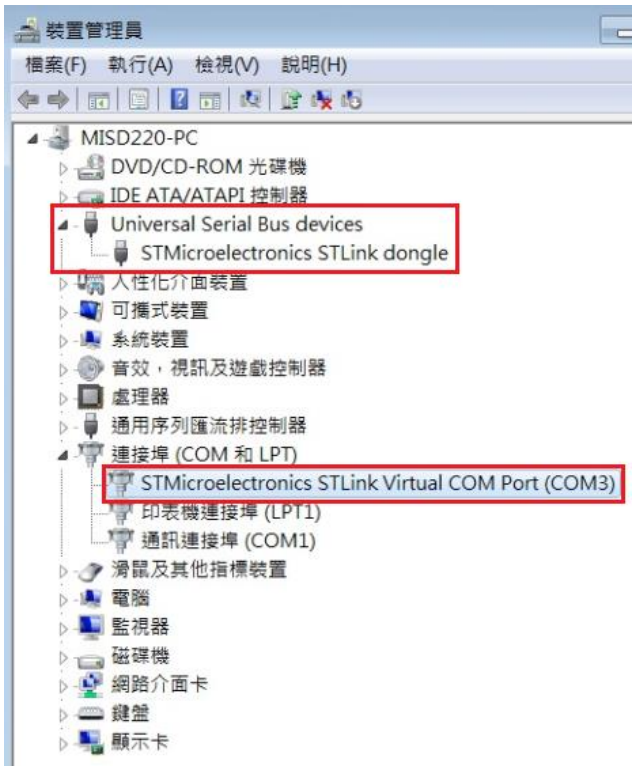
5-1-3. Install EtherCAT SSC Tool

Note please join ETG member (https://www.ethercat.org/en/membership_application.html) firstly before downloading the EtherCAT Slave Stack Code Tool.

Download the EtherCAT Slave Stack Code Tool from ETG website (https://www.ethercat.org/) and extract the downloaded file (e.g. "SSC_V5i11.zip") and run the SSC tool setup (e.g. "EtherCAT Slave Stack Code Tool.exe") to install the EtherCAT Slave Stack Code Tool on Windows platform.

5-1-4. Install STM32 ST-LINK Utility

Please download and install STM32 ST-LINK Utility (e.g. “STM32 ST-LINK Utility v3.9.0.exe”) from STMicroelectronics web site in order to install proper drivers for NUCLEO-F303RE MCU board Flash programming as below figure.



5-1-5. Install X-CUBE-MCSDK Tool for NUCLEO-F303RE Board

Please download and install X-CUBE-MCSDK motor control software development kit (e.g. “X-CUBE-MCSDK_5.2.0.exe”) from STMicroelectronics web site.

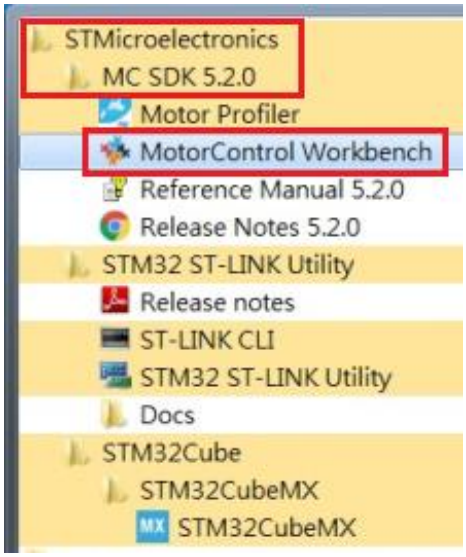
5-1-6. Install STM32CubeMX Utility for NUCLEO-F303RE Board

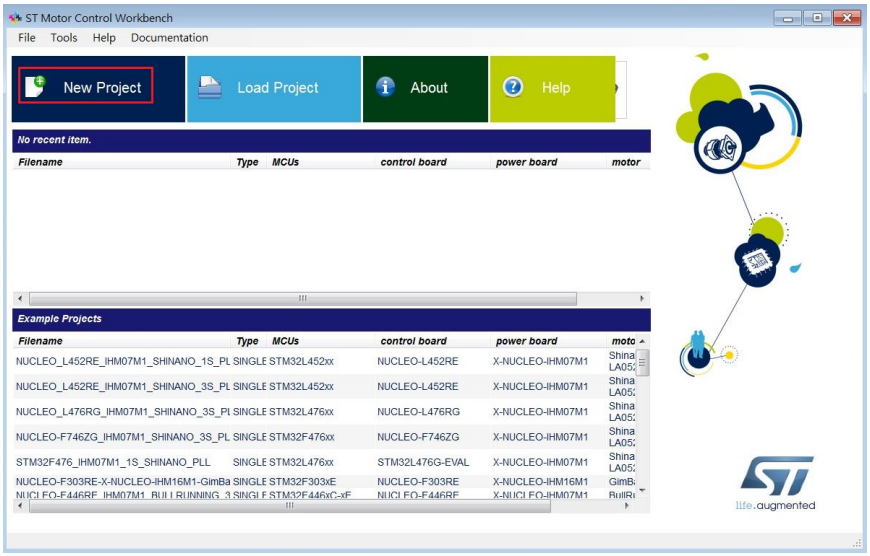
Please download and install STM32CubeMX Utility (e.g. “SetupSTM32CubeMX-5.0.0.exe”) from STMicroelectronics web site.

5-2. Create KEIL MDK-ARM uVision5 Source Files for STM32 Motor Control

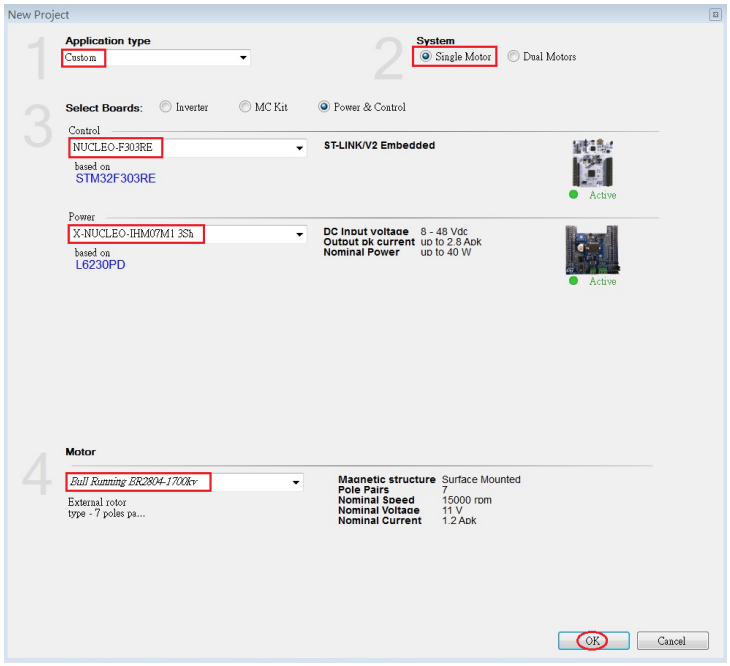
This section indicates how to create the KEIL MDK-ARM uVision5 project/source files for AX58100 + STM32F303RE MCU Motor Control reference design.

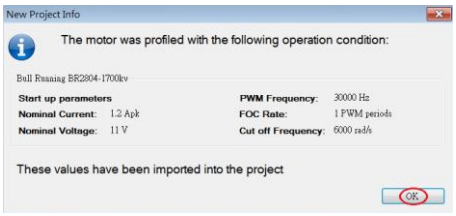
1. Run ST Motor Control Workbench and press "**New Project**" button to create a new KEIL MDK-ARM uVision5 project file.



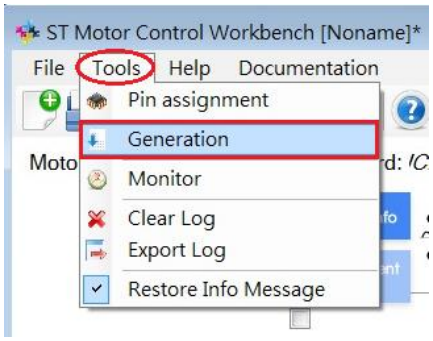


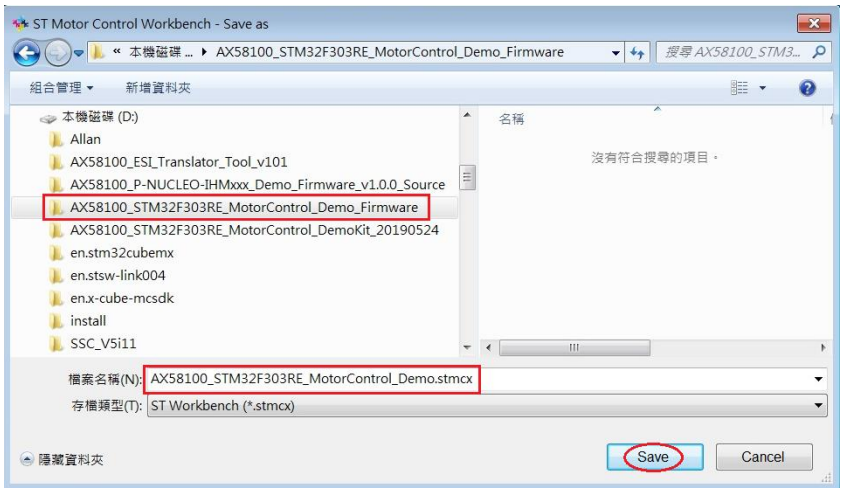
2. Select correct configurations for AX58100 + STM32F303RE MCU Motor Control reference design as below figure. (**1: Custom; 2: Single Motor; 3: NUCLEO-F303RE & X-NUCLEO-IHM07M1 3Sh; 4: Bull Running BR2804-1700kv**) and press "OK" button.



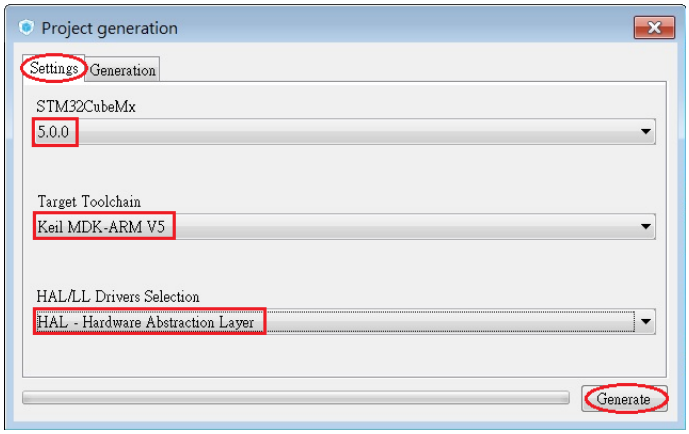


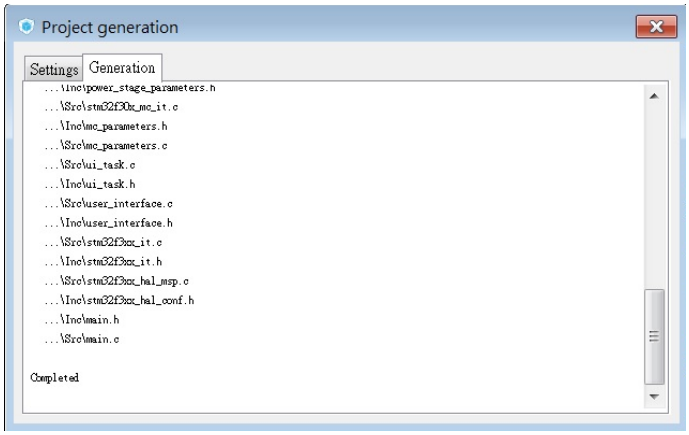
3. Select “Tools -> **Generation**” and select the destination folder (e.g. “D:\AX58100_STM32F303RE_MotorControl_Demo_Firmware”) to create a new KEIL MDK-ARM uVision5 project file (e.g. “AX58100_STM32F303RE_MotorControl_Demo.stmcx”).



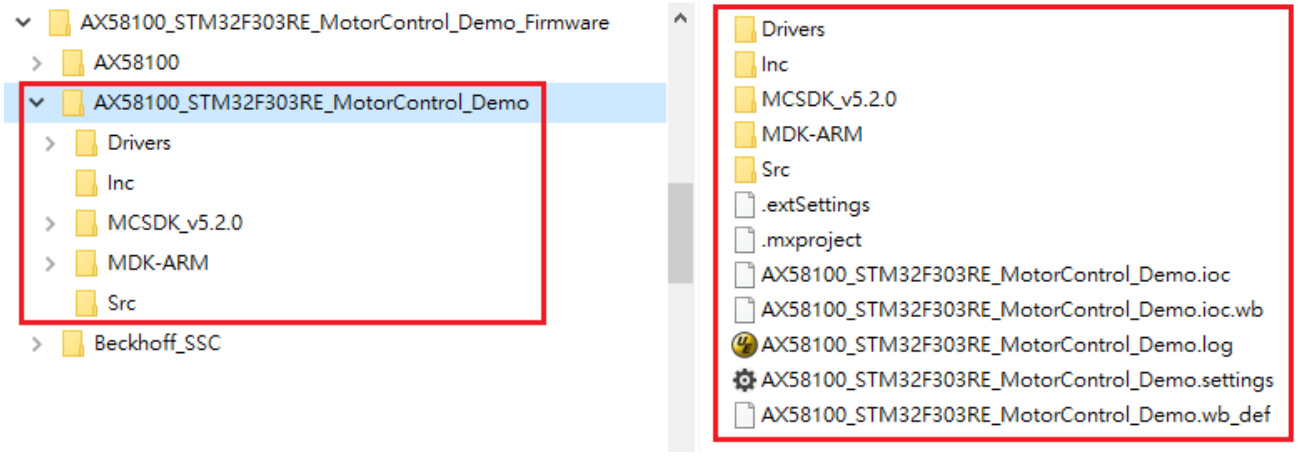


4. Select proper settings as below figure and press “**Generate**” button to create KEIL MDK-ARM uVision5 source files for AX58100 + STM32F303RE MCU Motor Control reference design. .





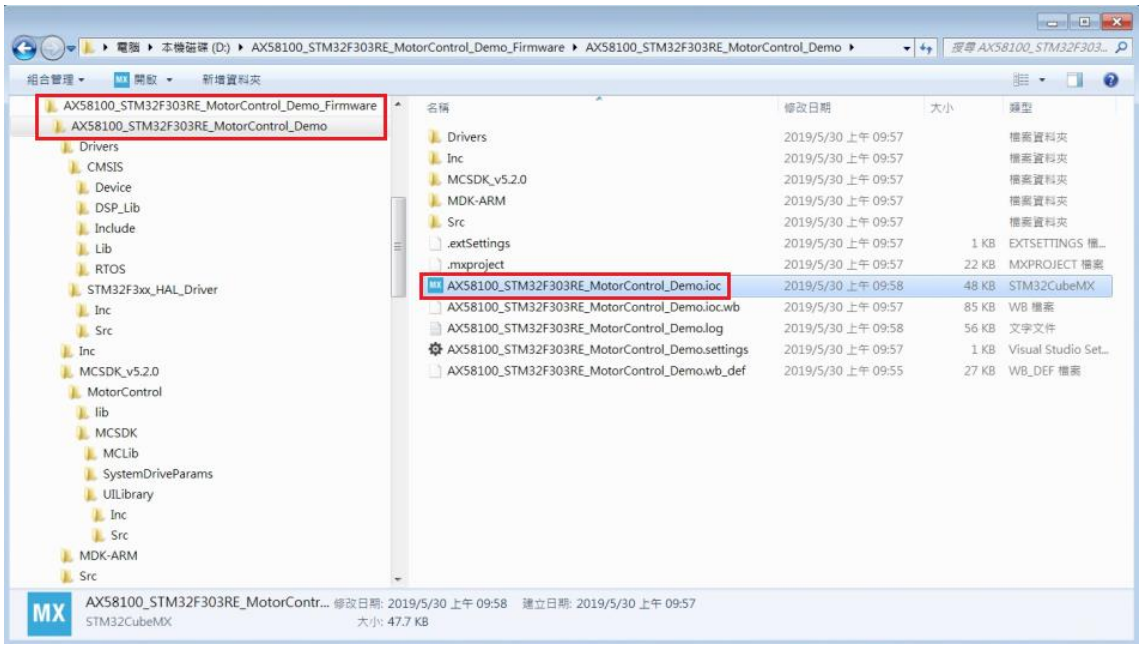
5. The KEIL MDK-ARM uVision5 project/source files are generated now. .

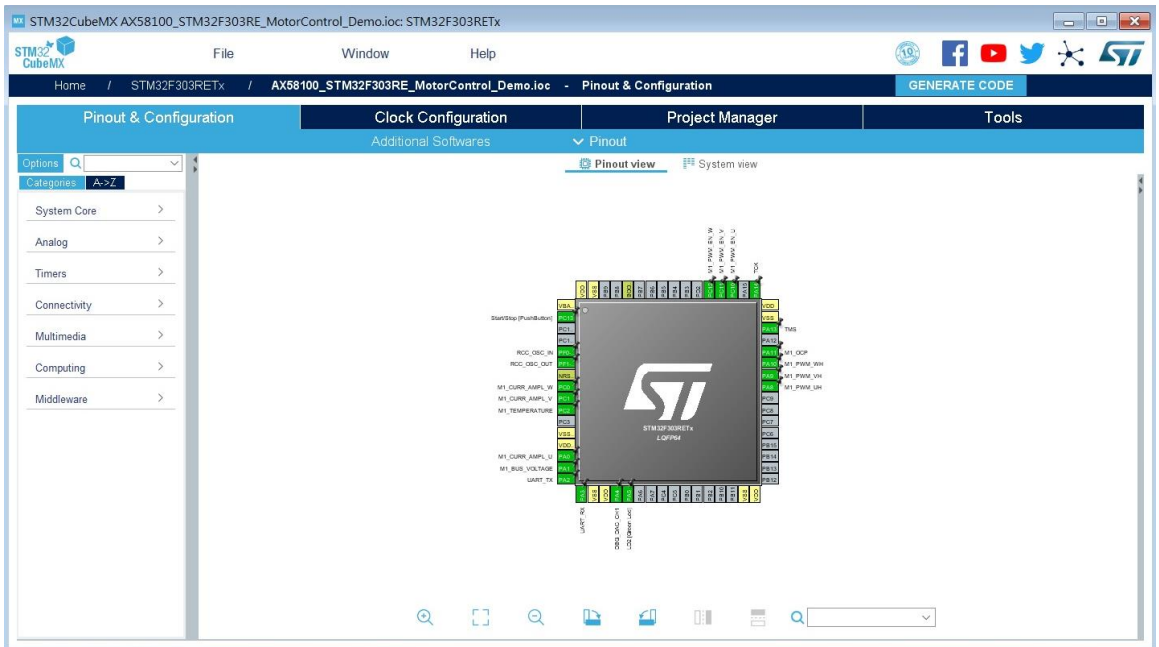


5-3. Configure STM32 Microcontroller via STM32CubeMX Utility

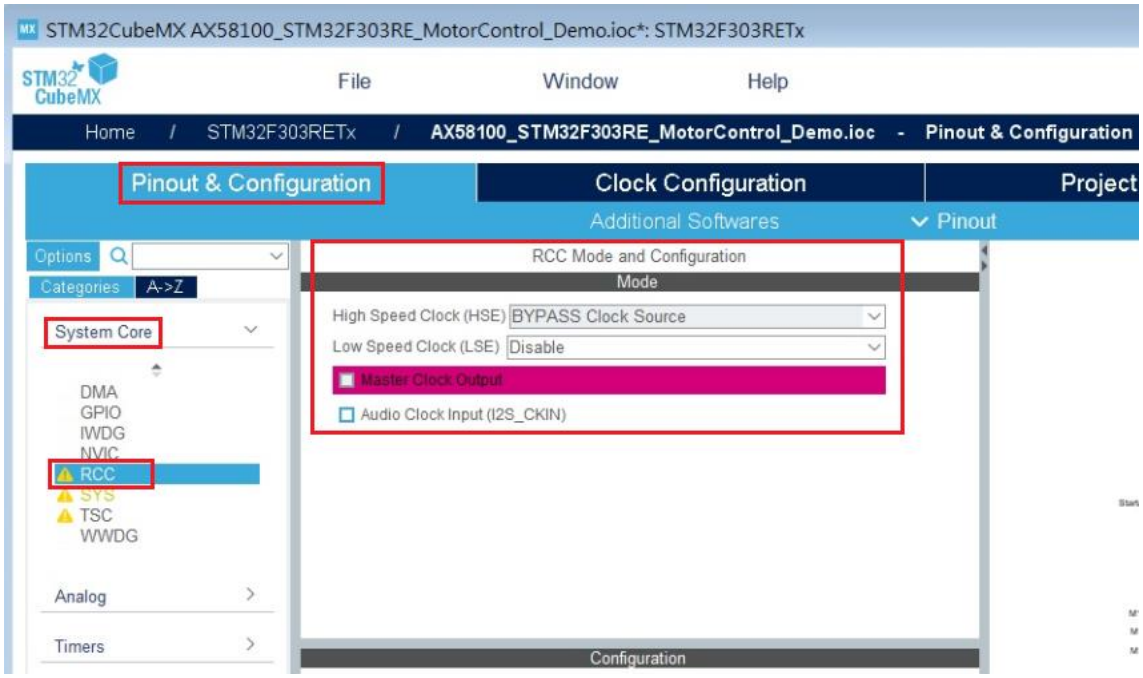
This section indicates how to configure STM32 microcontroller for AX58100 + STM32F303RE MCU Motor Control reference design.

1. Double click "**AX58100_STM32F303RE_MotorControl_Demo.ioc**" file to run STM32CubeMX utility to do proper STM32 microcontroller configurations for the STM32F303RE MCU motor control application.

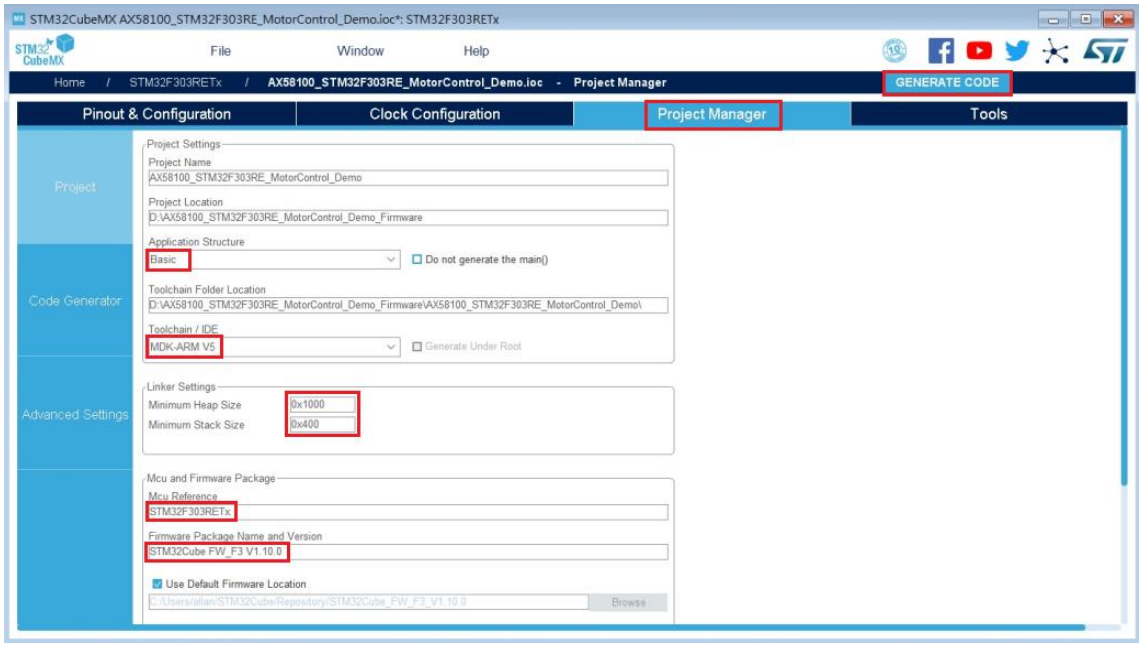




2. Select “Pinout & Configuration -> System Core -> **RCC**” to change “High Speed Clock (HSE)” to “BYPASS Clock Source”.



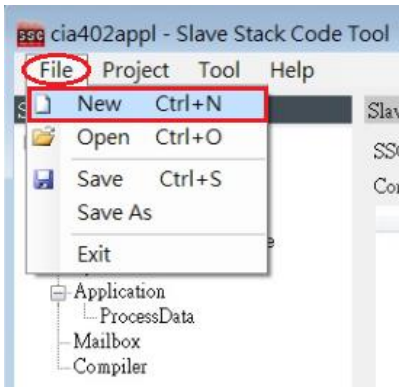
3. Select “**Project Manager**” to change “Minimum Heap Size” to “1000” in “Linker Settings” dialog. (Refer to below figure for details) Press “**GENERATE CODE**” button to update the STM32 microcontroller related source files.



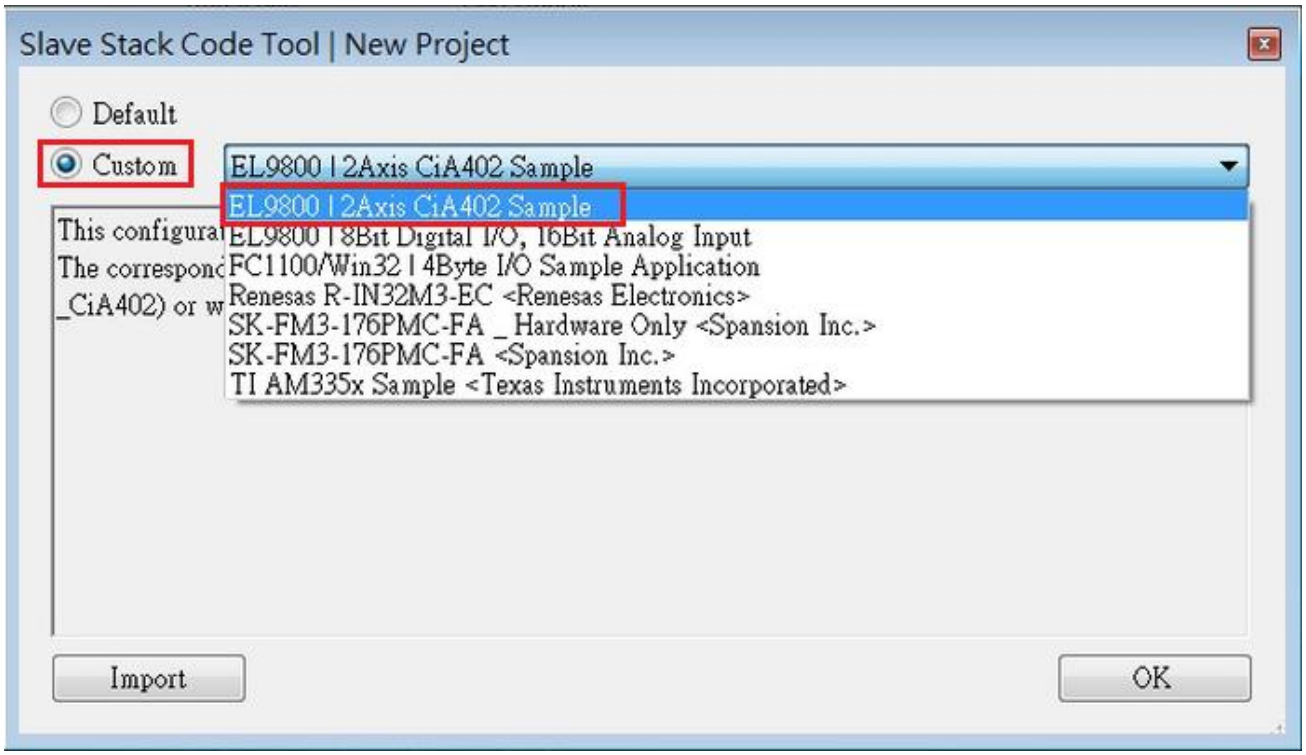
5-4. Create EtherCAT Slave Stack Code Source Files

This section indicates how to create the EtherCAT Slave Stack Code source files by using Beckhoff SSC Tool.

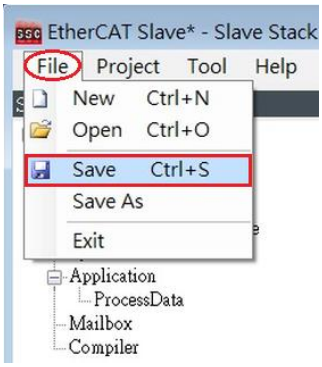
1. Run Beckhoff EtherCAT SSC Tool and select "File -> **New**" to create a new project file.

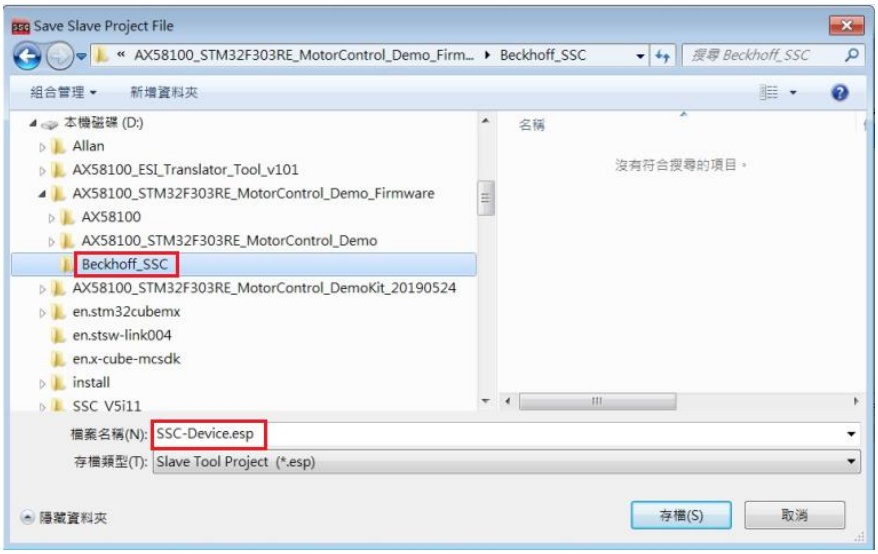


2. Click "Custom" checkbox and select "**EL9800 | 2Axis CiA402 Sample**" project file for AX58100 + STM32F303RE MCU Motor Control reference design.



3. Select “File -> **Save**” and create the target folder (e.g. “Beckhoff_SSC”) to save the SSC project file (e.g. “SSC-Device.esp”).

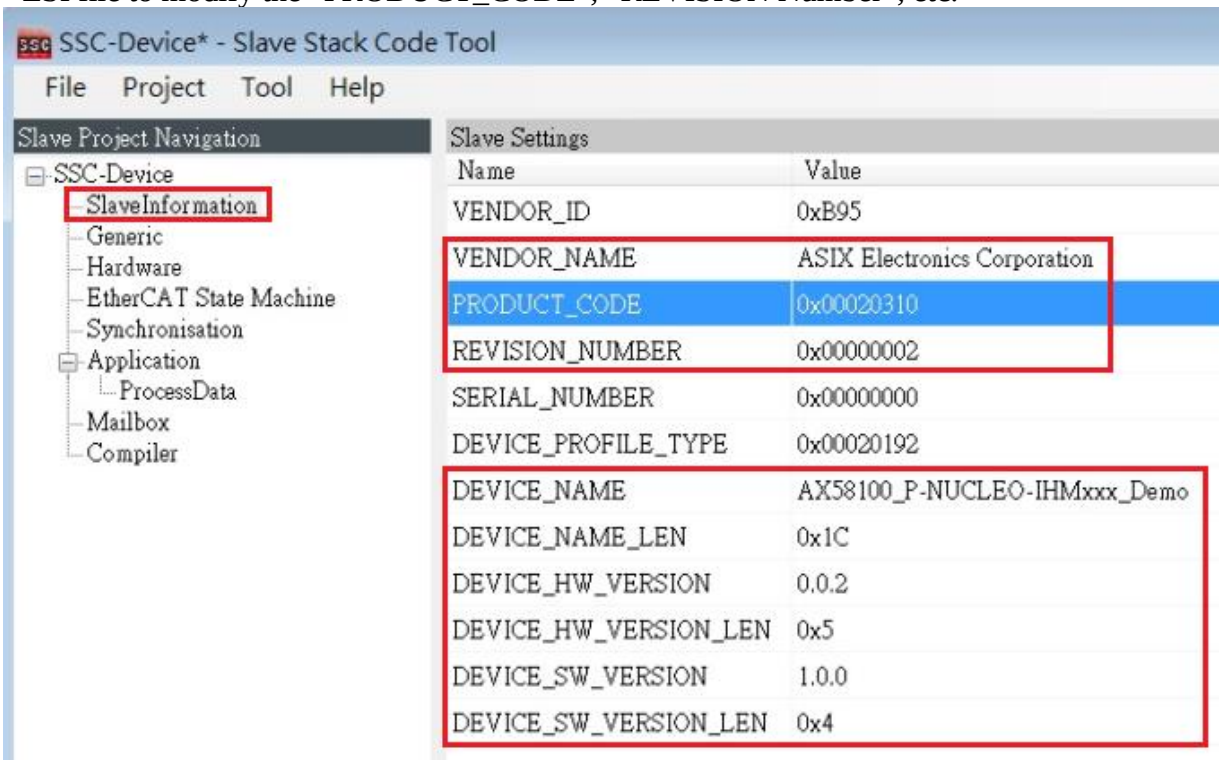




4. Please refer to the sample ESI file of AX58100 + STM32F303RE MCU Motor Control reference design (e.g. “AX58100_P-NUCLEO-IHMxxx_Demo_Rev02_ESI_20190530.xml”) and below figures to modify proper SSC Slave project settings based on the target platform configurations.

(1) **SlaveInformation**

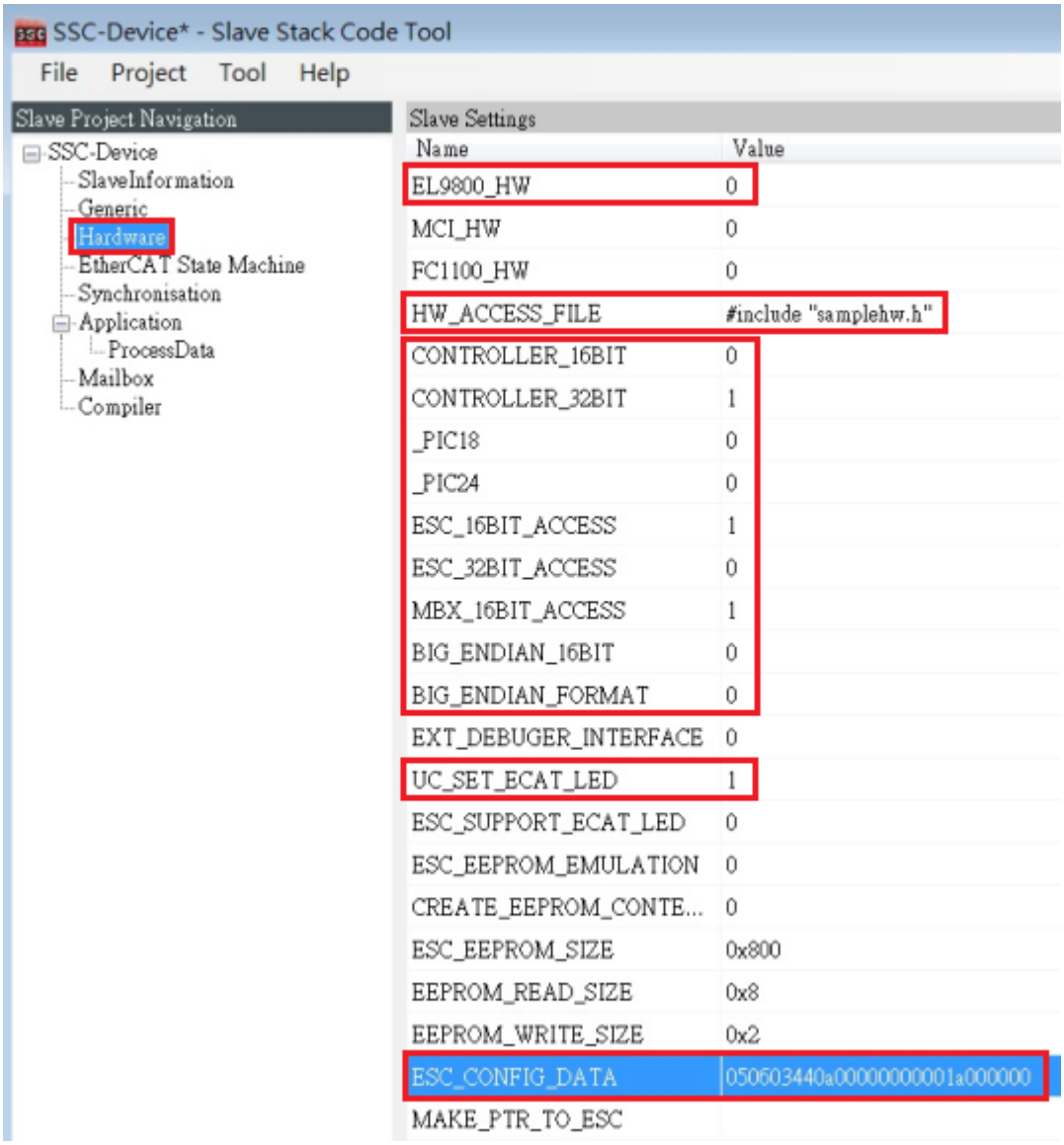
Please refer to the “AX58100_P-NUCLEO-IHMxxx_Demo_Rev02_ESI_20190530.xml” ESI file to modify the “PRODUCT_CODE”, “REVISION Number”, etc.



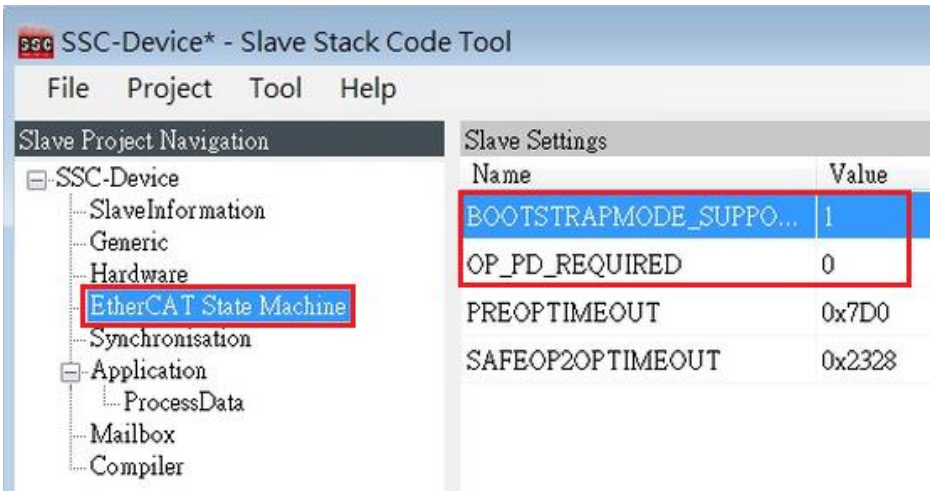
(2) **Hardware**

Please refer to the "AX58100_P-NUCLEO-IHMxxx_Demo_Rev02_ESI_20190530.xml" ESI file to modify the "ESC_CONFIG_DATA" setting and modify proper microcontroller settings based on the target platform.

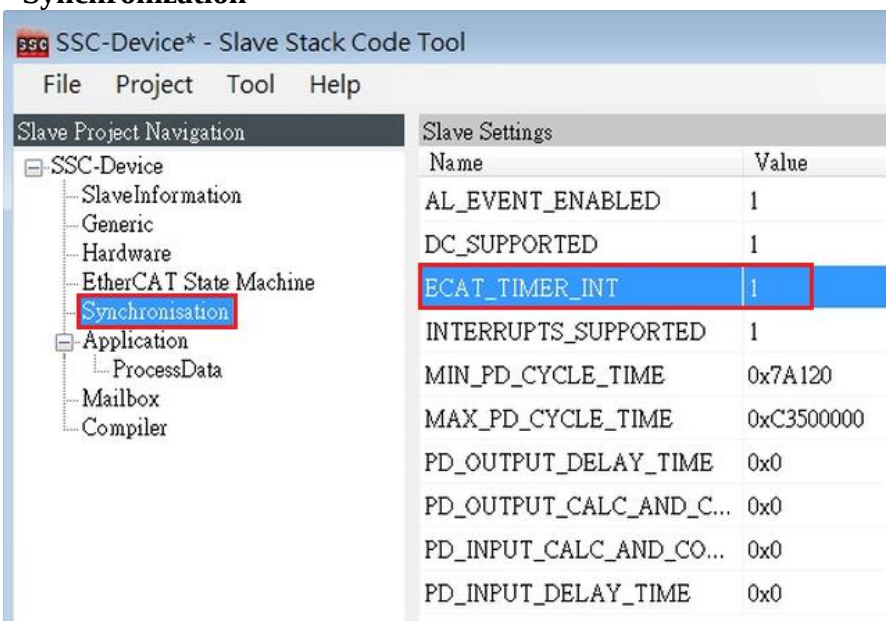
Note: Please correctly configure the "Hardware" settings based on the target microcontroller for normal operation.



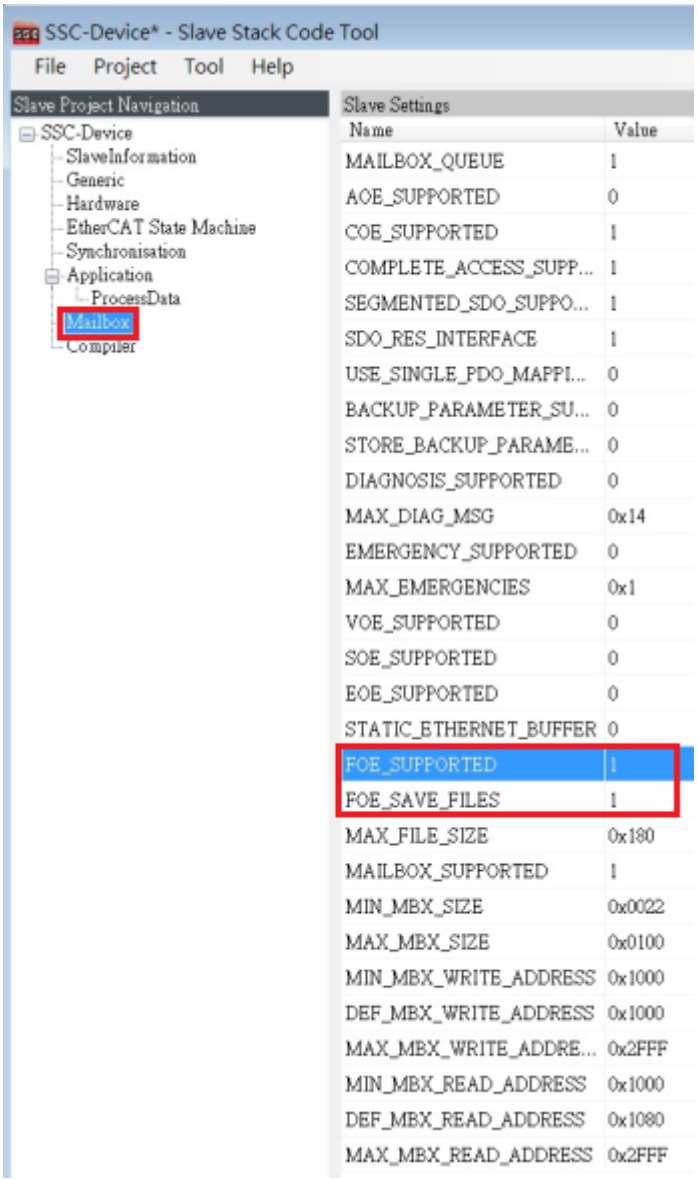
(3) **EtherCAT State Machine**



(4) **Synchronization**



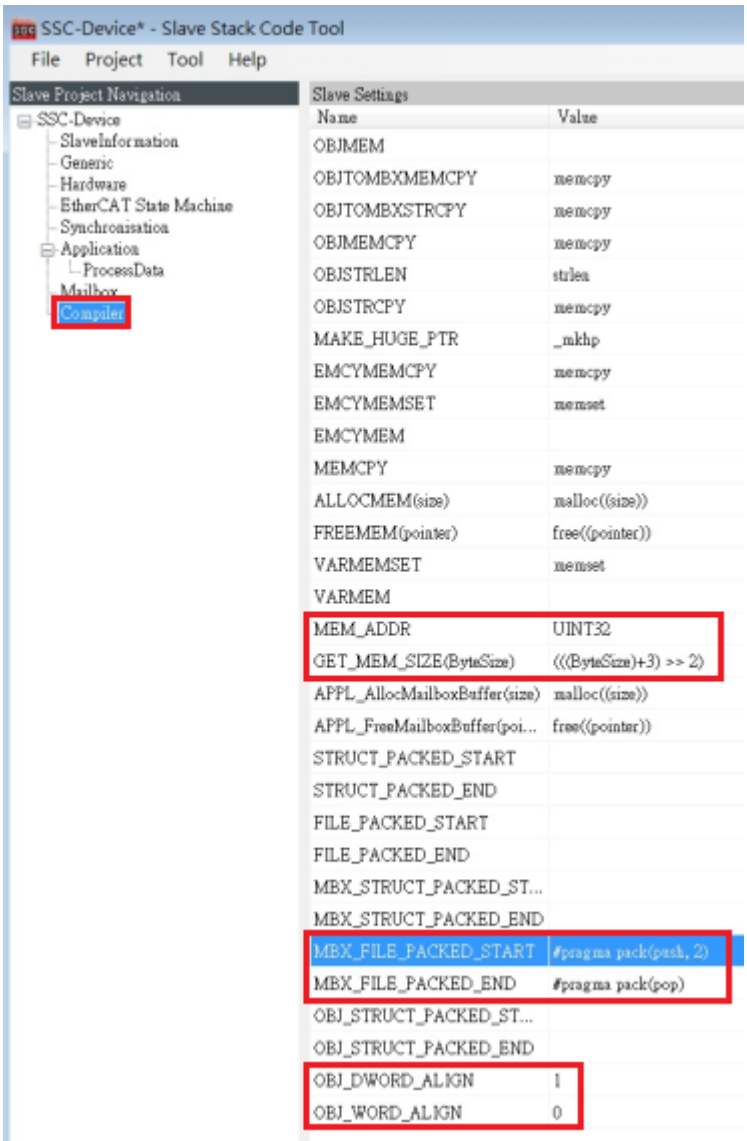
(5) **Mailbox**



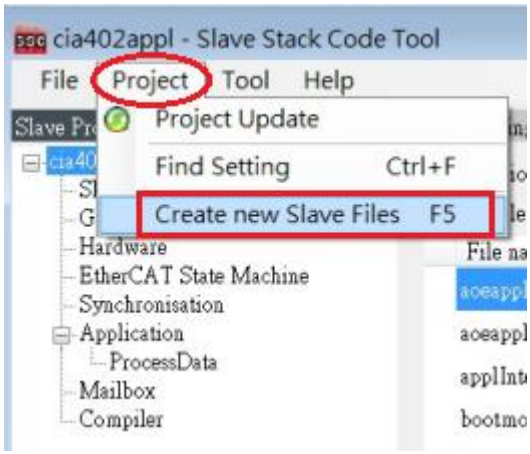
(6) **Compiler**

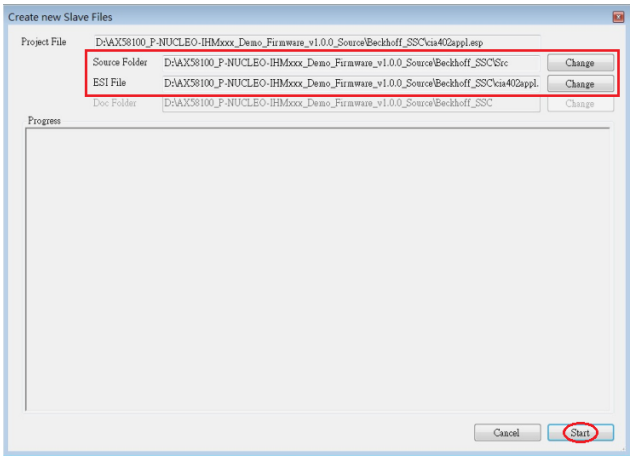
Please modify proper microcontroller memory address/alignment settings based on the target platform.

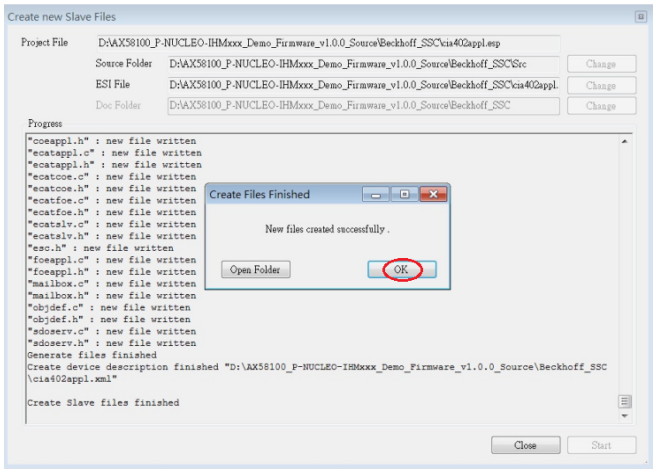
Note: Please correctly configure the "Compiler" settings based on the target microcontroller for normal operation.

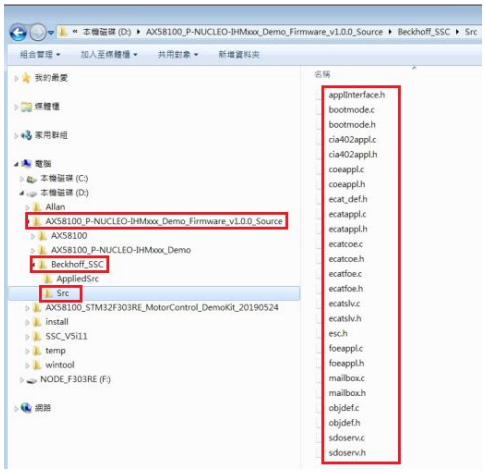


5. Select "**Create new Slave Files**" from "Project" menu to create the EtherCAT Slave Stack Code source files.





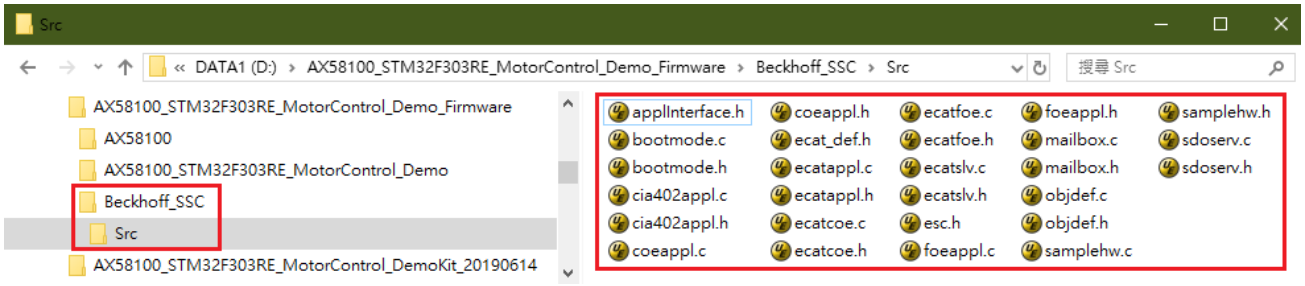




6. Copy the files in the "**AppliedSrc**" folder of AX58100 STM32F303RE Motor Control Demo Kit (see below figure) into the created EtherCAT SSC source folder (e.g. "**Beckhoff_SSC\src**") and overwrite the existing files (i.e. "cia402appl.c", "cia402appl.h", "ecatappl.c").

> **Note:** Please check the new "samplehw.c" and "samplehw.h" source files, and compare the revised "cia402appl.c", "cia402appl.h", "ecatappl.c" files and the original ones to understand the detailed source modifications for AX58100 + STM32F303RE MCU Motor Control reference design if necessary.

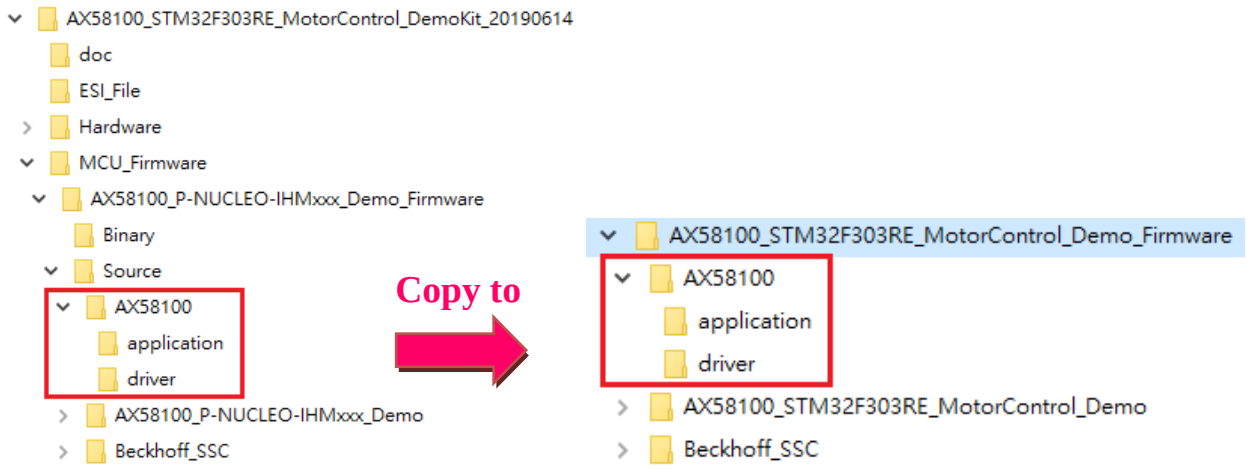
7. The EtherCAT SSC source files are created now.



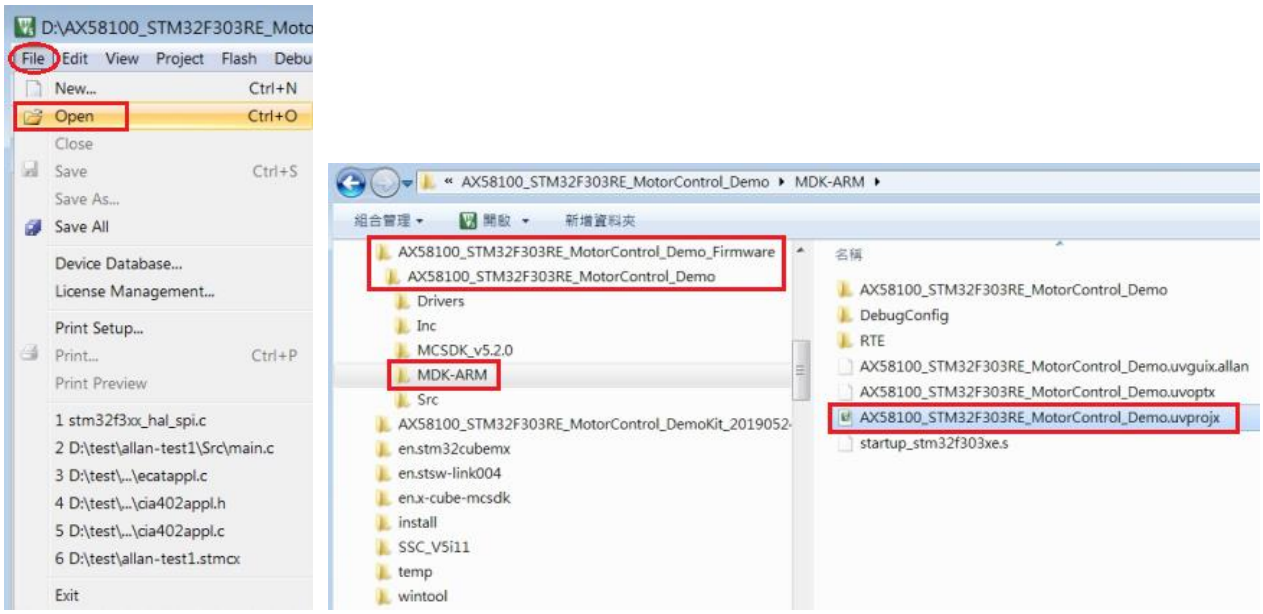
5-5. Build AX58100 + STM32F303RE Motor Control Demo Firmware Source

This section indicates how to build AX58100 + STM32F303RE MCU Motor Control demo firmware by using Keil MDK-ARM uVision5 Development Tool.

1. Copy the whole "**AX58100**" folder from the "MCU_Firmware\AX58100_P-NUCLEO-IHMxxx_Demo_Firmware\Source\" folder of AX58100 + STM32F303RE MCU Motor Control Demo Kit into the created AX58100 source folder (e.g. "AX58100_STM32F303RE_MotorControl_Demo_Firmware") as below figure.

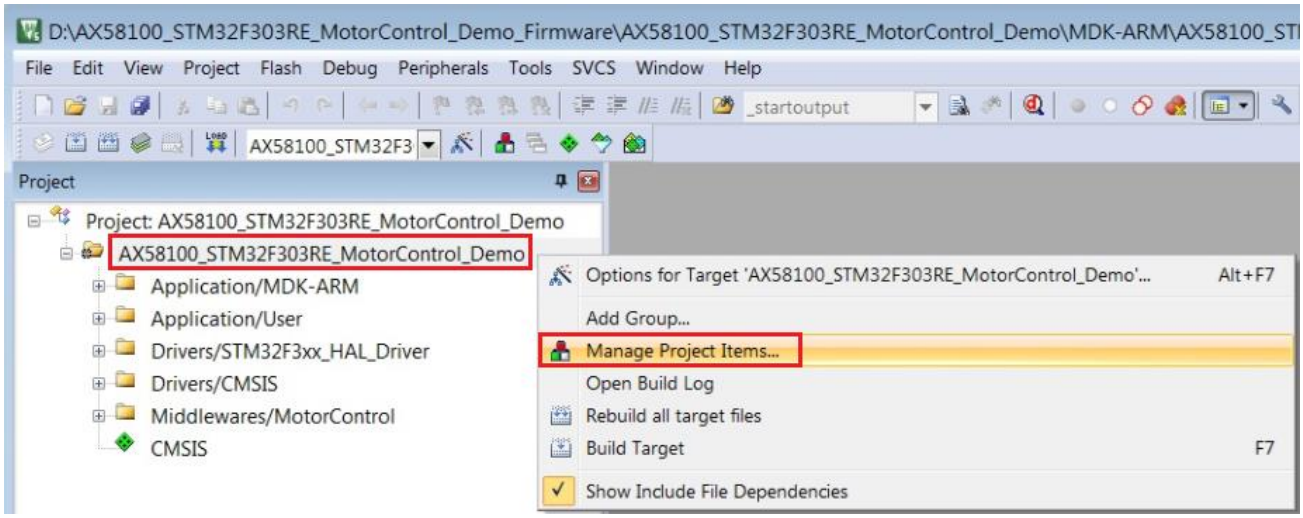


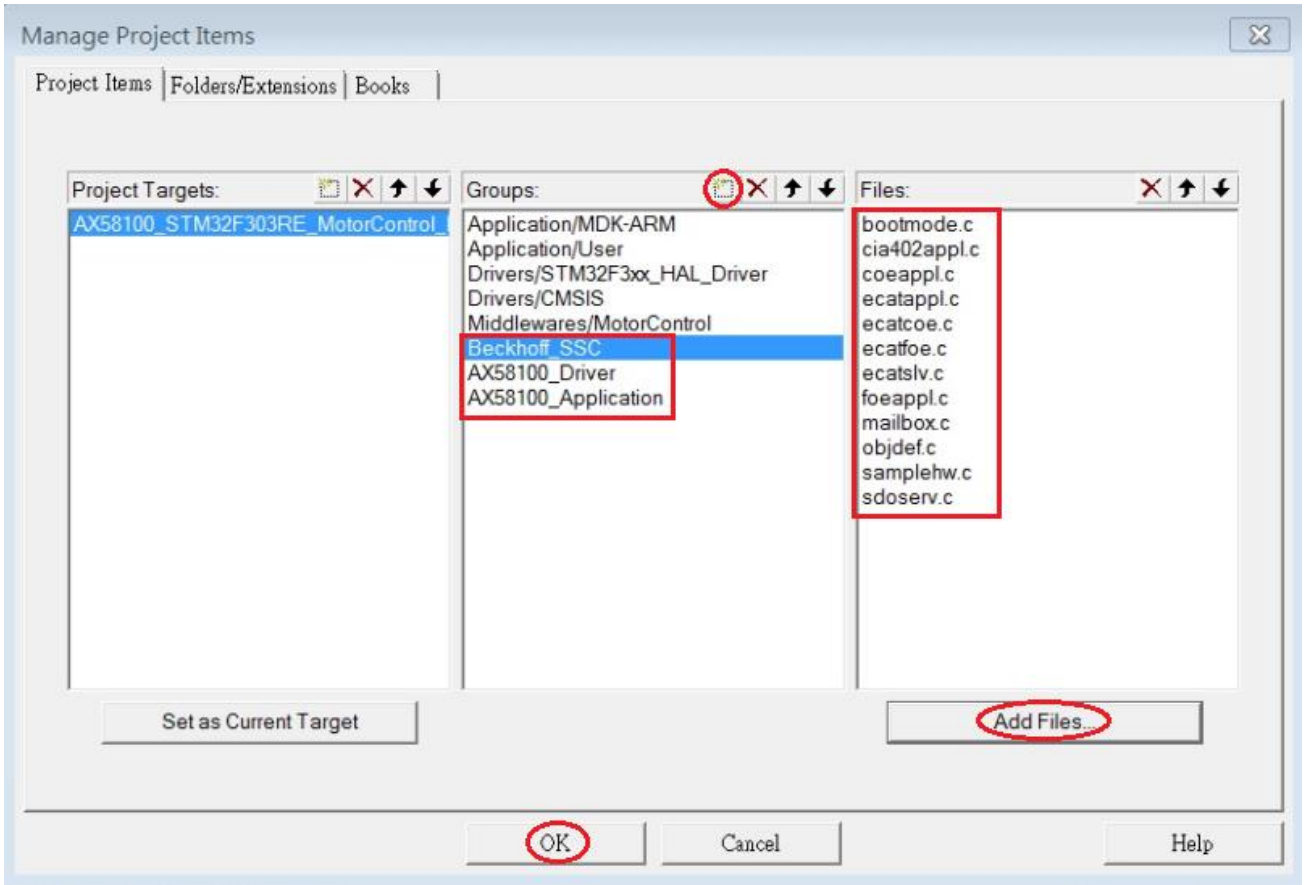
2. Run Keil MDK-ARM uVision5 tool to open AX58100 firmware uVision5 project file (e.g. "**AX58100_STM32F303RE_MotorControl_Demo.uvprojx**").

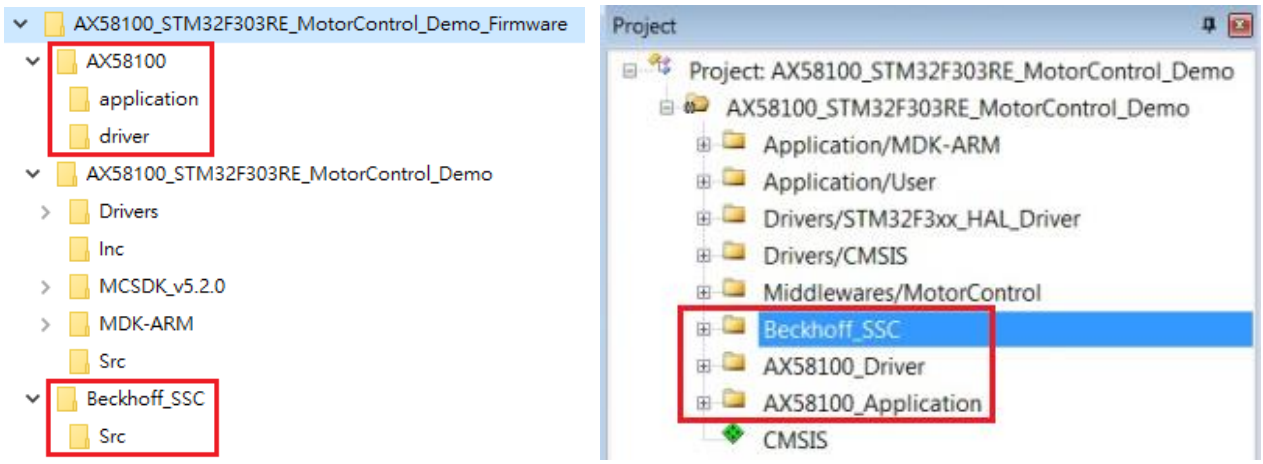


3. Right click “AX58100_STM32F303RE_MotorControl_Demo” and select “**Manage Project Items**” to manually add “**Beckhoff_SSC**”, “**AX58100_Driver**”, “**AX58100_Application**” groups, and then add the source files into these groups from the “Beckhoff_SSC\Src”, “AX58100\driver” and “AX58100\application” folders of respectively.

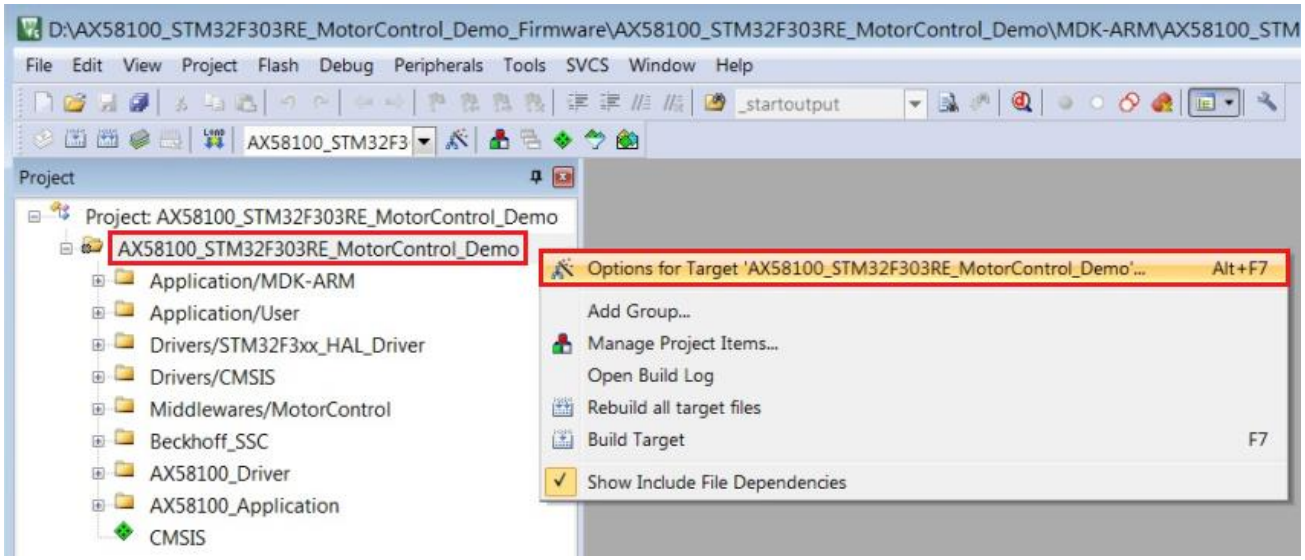
Note: Please refer to the “**AX58100 Software API Design Guide**” for details of AX58100 Driver/Application software APIs.

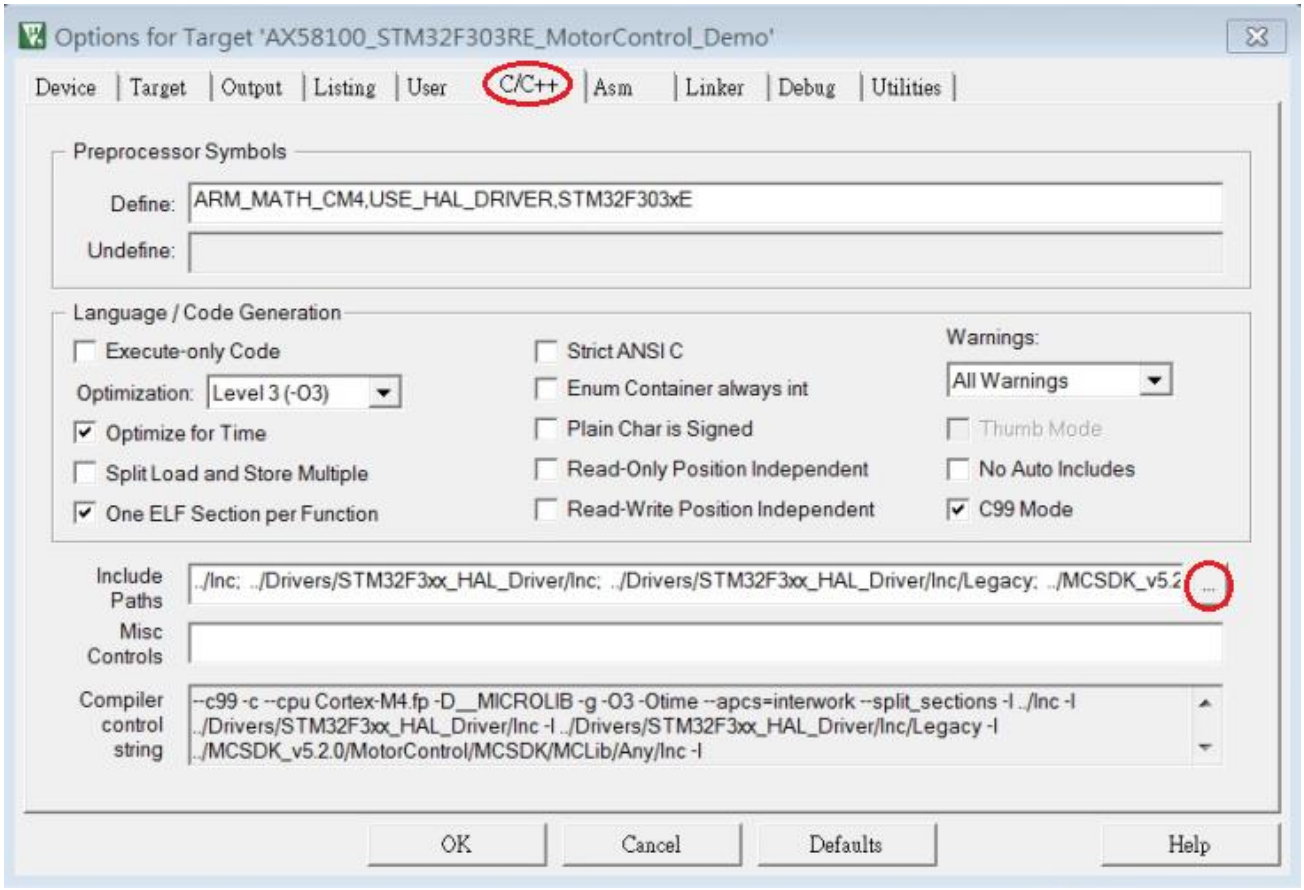


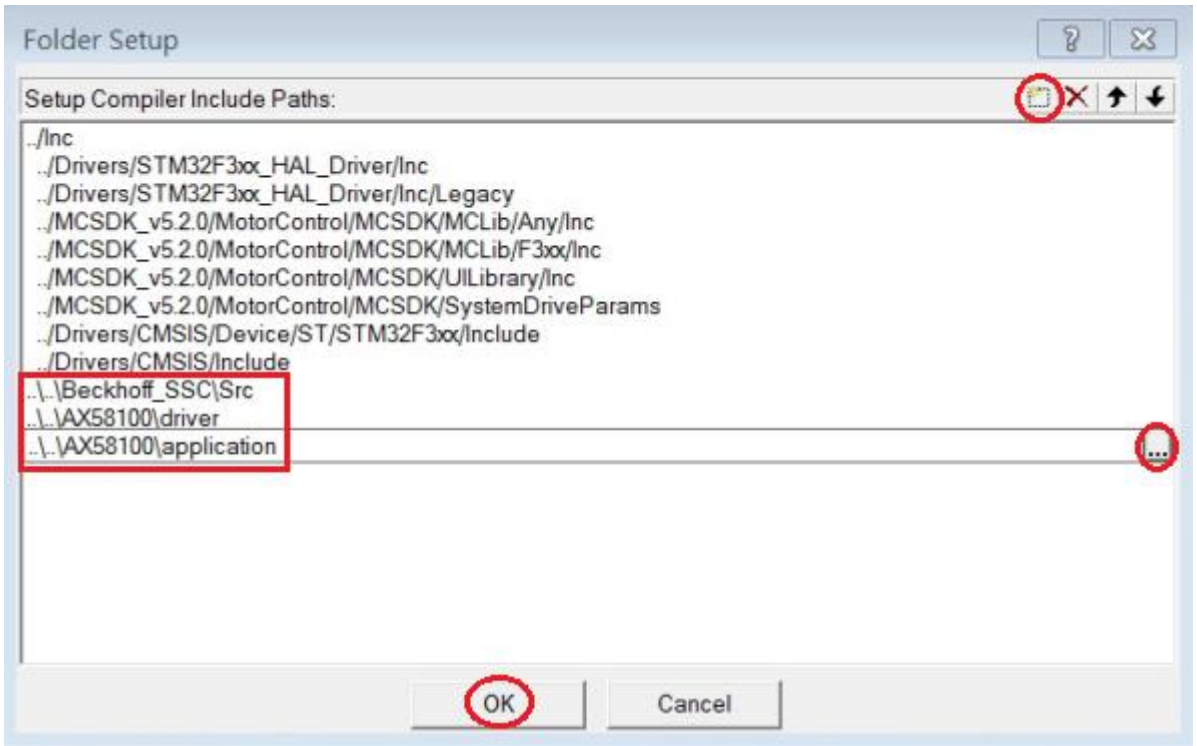




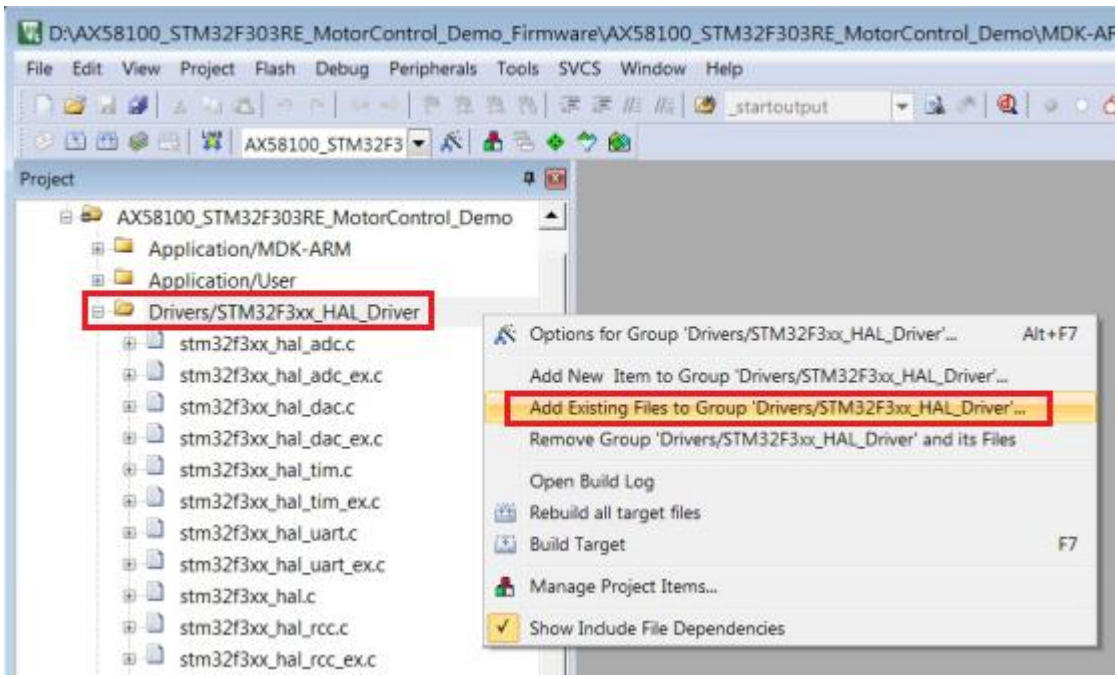
4. Right click "AX58100_STM32F303RE_MotorControl_Demo" and select "**Options for Target 'AX58100_STM32F303RE_MotorControl_Demo'**" to add the "Beckhoff_SSC\Src", "AX58100\driver", "AX58100\application" folders into the "**Include Paths**" of "C/C++" settings.

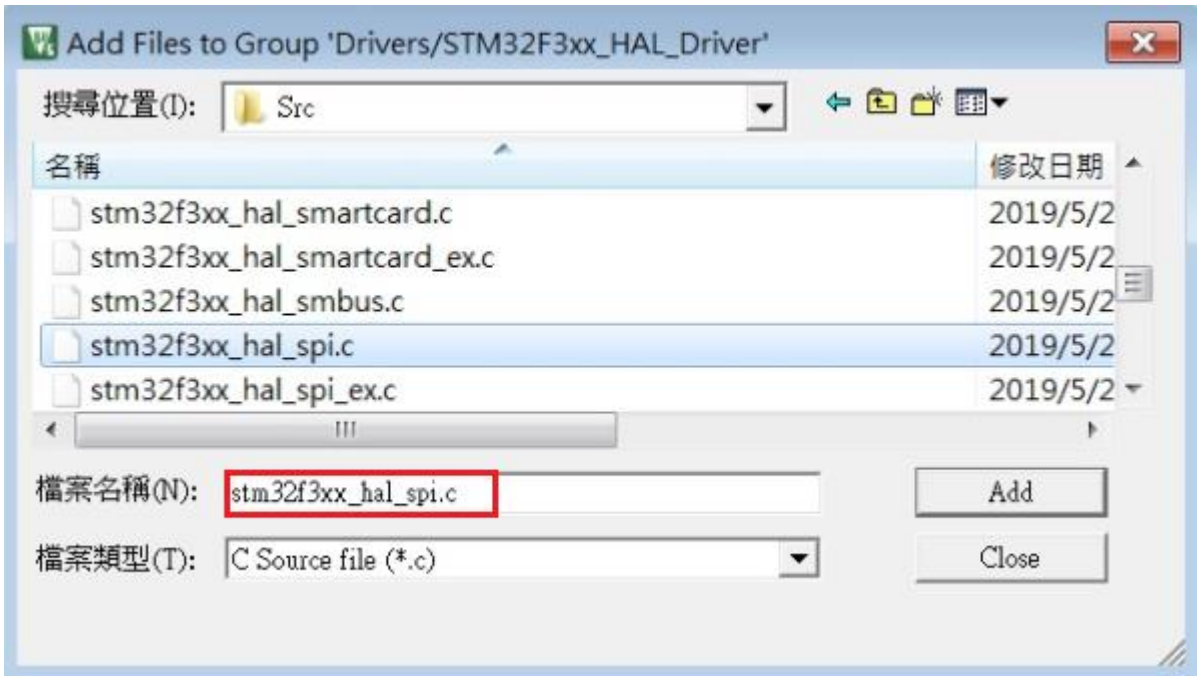




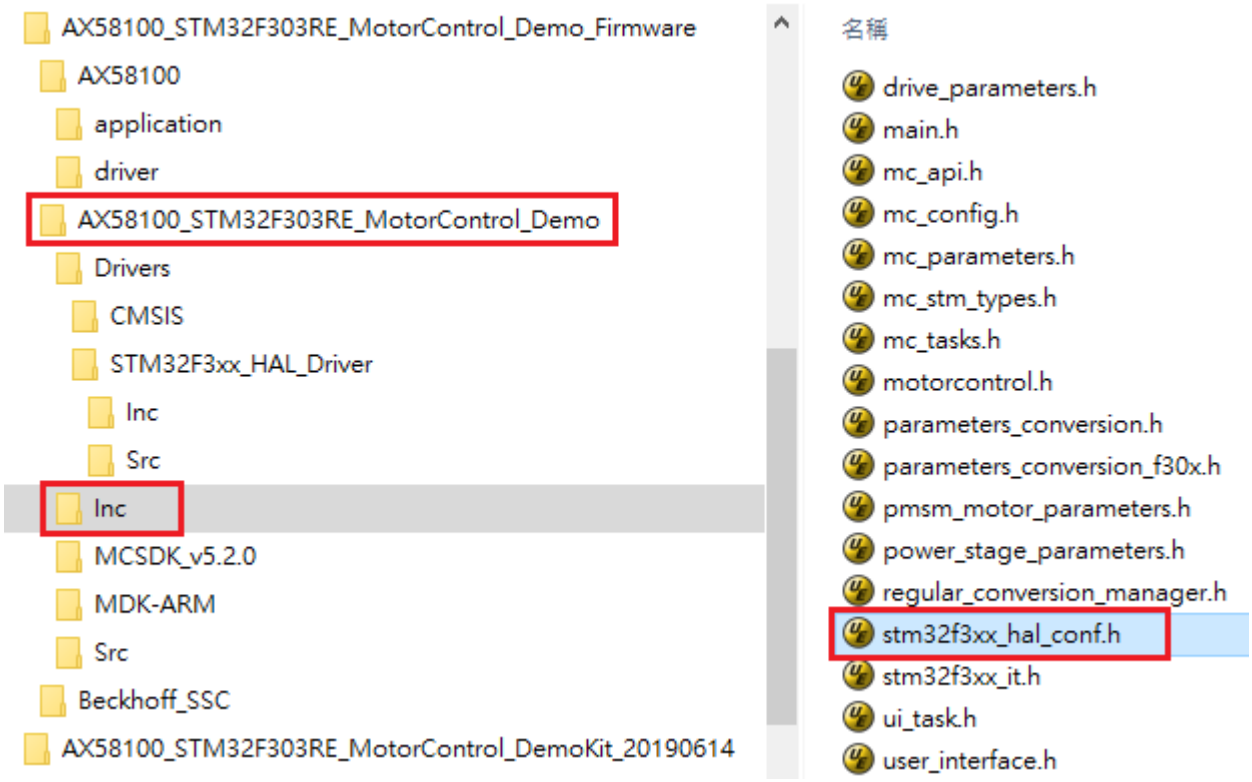


5. Right click “Drivers/STM32F3xx_HAL_Driver” and select “**Add Existing Files to Group ‘Drivers/STM32F3xx_HAL_Driver’…**” to manually add “**stm32f3xx_hal_spi.c**” source file in order to support AX58100 and STM32F303RE MCU communication via SPI interface.





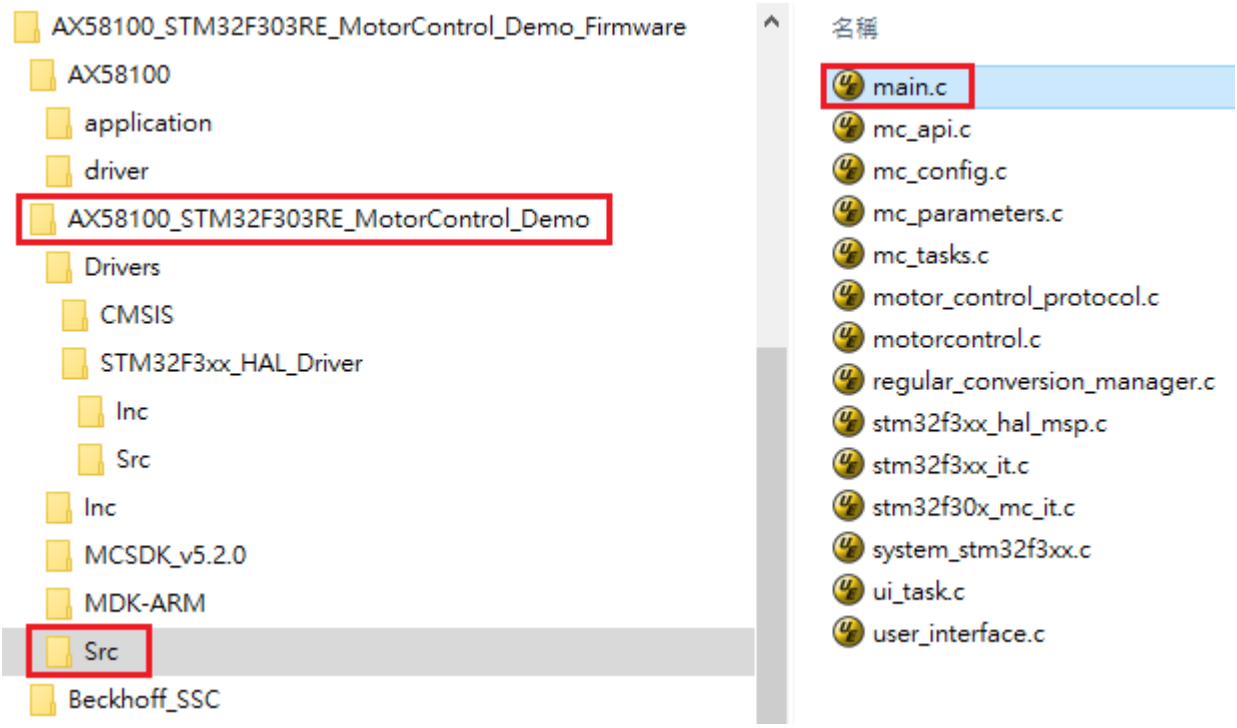
6. Edit "**stm32f3xx_hal_conf.h**" header file to enable the "HAL_SPI_MODULE_ENABLED" definition.



stm32f3xx_hal_conf.h

```
72  /*#define HAL_RNG_MODULE_ENABLED    */
73  /*#define HAL_RTC_MODULE_ENABLED    */
74  #define HAL_SPI_MODULE_ENABLED
75  #define HAL_TIM_MODULE_ENABLED
76  #define HAL_UART_MODULE_ENABLED
77  /*#define HAL_USART_MODULE_ENABLED    */
78  /*#define HAL_IRDA_MODULE_ENABLED    */
79  /*#define HAL_SMARTCARD_MODULE_ENABLED    */
80  /*#define HAL_SMBUS_MODULE_ENABLED    */
81  /*#define HAL_WWDG_MODULE_ENABLED    */
82  /*#define HAL_PCD_MODULE_ENABLED    */
83  /*#define HAL_EXTI_MODULE_ENABLED    */
```

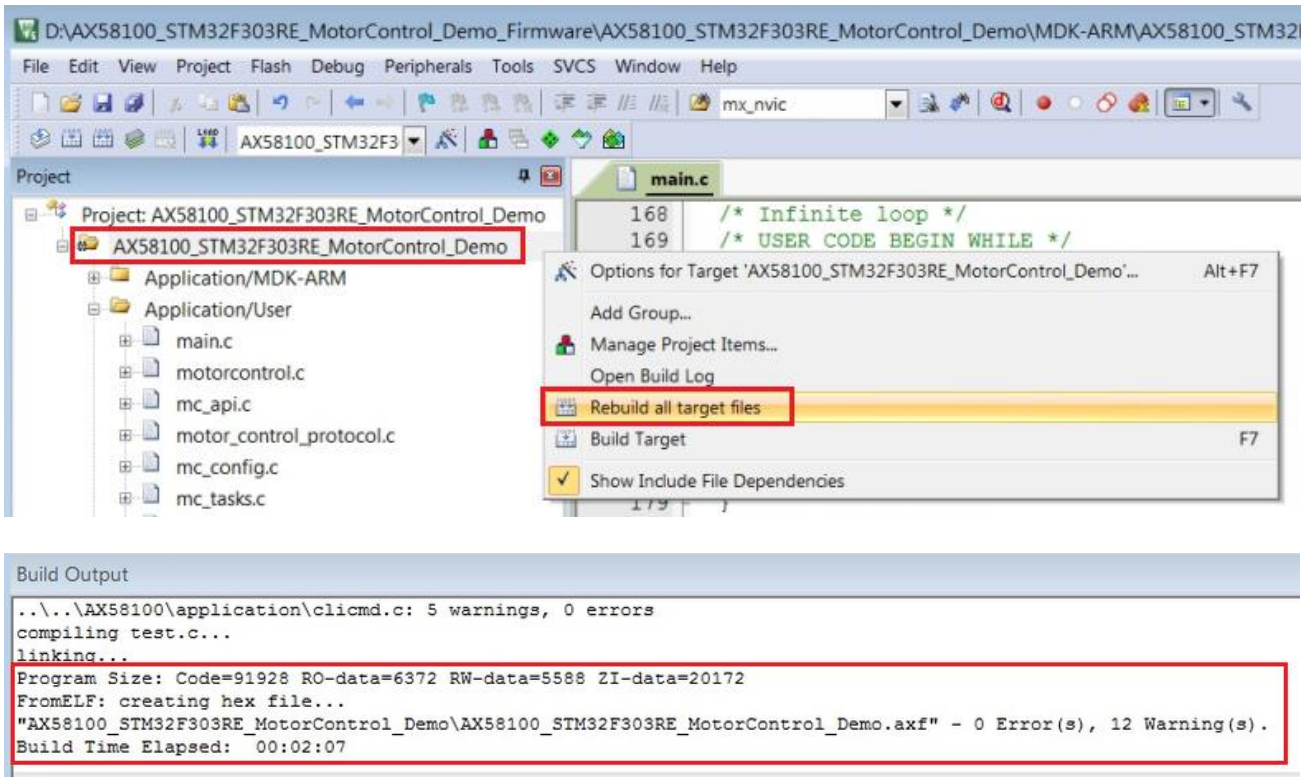
7. Refer to the following blue texts to edit "**main.c**" source file.



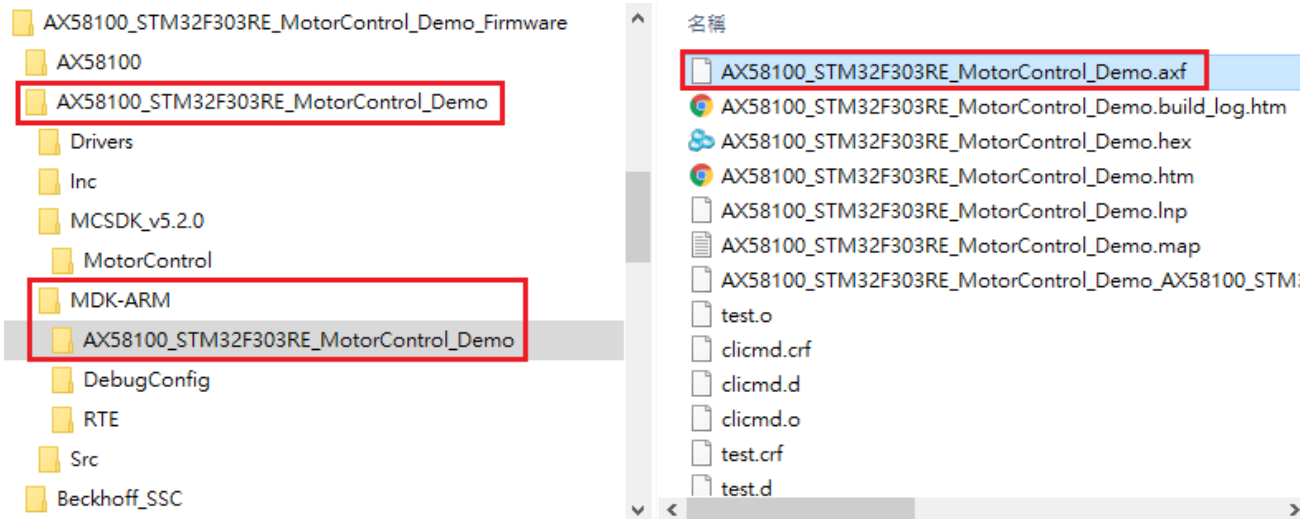

```
==========
/* Includes ------------------------------------------------------------------*/
#include "main.h"
#include "motorcontrol.h"

/* Private includes ----------------------------------------------------------*/
/* USER CODE BEGIN Includes */
#include "applInterface.h"
#include "ax_uart.h"
#include "console.h"
/* USER CODE END Includes */
…
int main(void)
{
…
  /* Initialize interrupts */
  MX_NVIC_Init();
  /* USER CODE BEGIN 2 */
AX_UART_Init();
ESC_DEBUG("\r\n %s Firmware v%s, %s \r\n", DEVICE_NAME, DEVICE_SW_VERSION,
__DATE__);

if (HW_Init())
{
```

```
        ESC_DEBUG("Initializa ESC hardware timeout!\r\n");
        HW_Release();
    }
    else
    {
    #if (ETHERCAT_SLAVE_STACK_ENABLE)
        MainInit();
        ESC_DEBUG("Start EtherCAT slave stack OK!\r\n");
    #else
        ESC_DEBUG("EtherCAT slave stack has disabled!\r\n");
    #endif
    }

    CONSOLE_Init();
  /* USER CODE END 2 */

  /* Infinite loop */
  /* USER CODE BEGIN WHILE */
  while (1)
  {
    /* USER CODE END WHILE */
        CONSOLE_Task();
        #if (ETHERCAT_SLAVE_STACK_ENABLE)
                HW_IntrDequeue();
                MainLoop();
        #endif
    /* USER CODE BEGIN 3 */
  }
  /* USER CODE END 3 */
}
```

8. Right click “AX58100_STM32F303RE_MotorControl_Demo” and select “**Rebuid all target files**” to build the AX58100 + STM32F303RE MCU Motor Control demo firmware source.



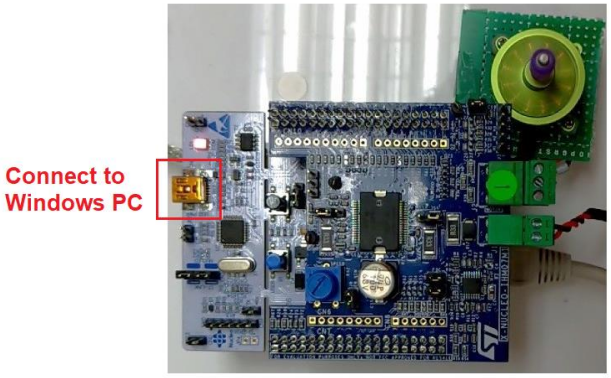
9. The demo firmware is ready for operation now (i.e. “AX58100_STM32F303RE_MotorControl_Demo.axf”).

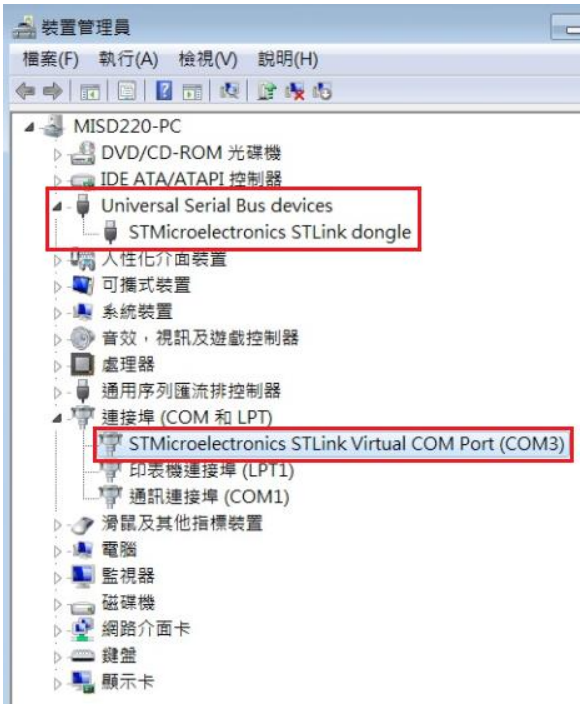


5-6. Program Demo Firmware onto NUCLEO-F303RE MCU Board Flash Memory

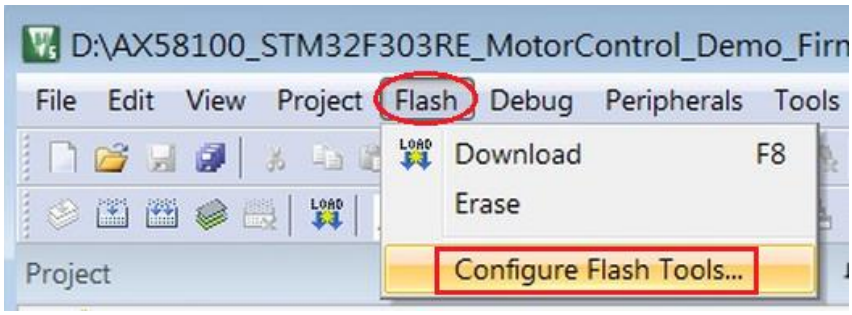
This section indicates how to program AX58100 + STM32F303RE MCU Motor Control demo firmware code onto NUCLEO-F303RE MCU board by using Keil MDK-ARM uVision5 Development Tool.

1. Please install STM32 ST-LINK Utility firstly, connect the NUCLEO-F303RE MCU board to Windows platform via Micro-USB cable and then make sure the following "**STLink Virtual COM Port**" drivers of NUCLEO-F303RE MCU board are installed properly.

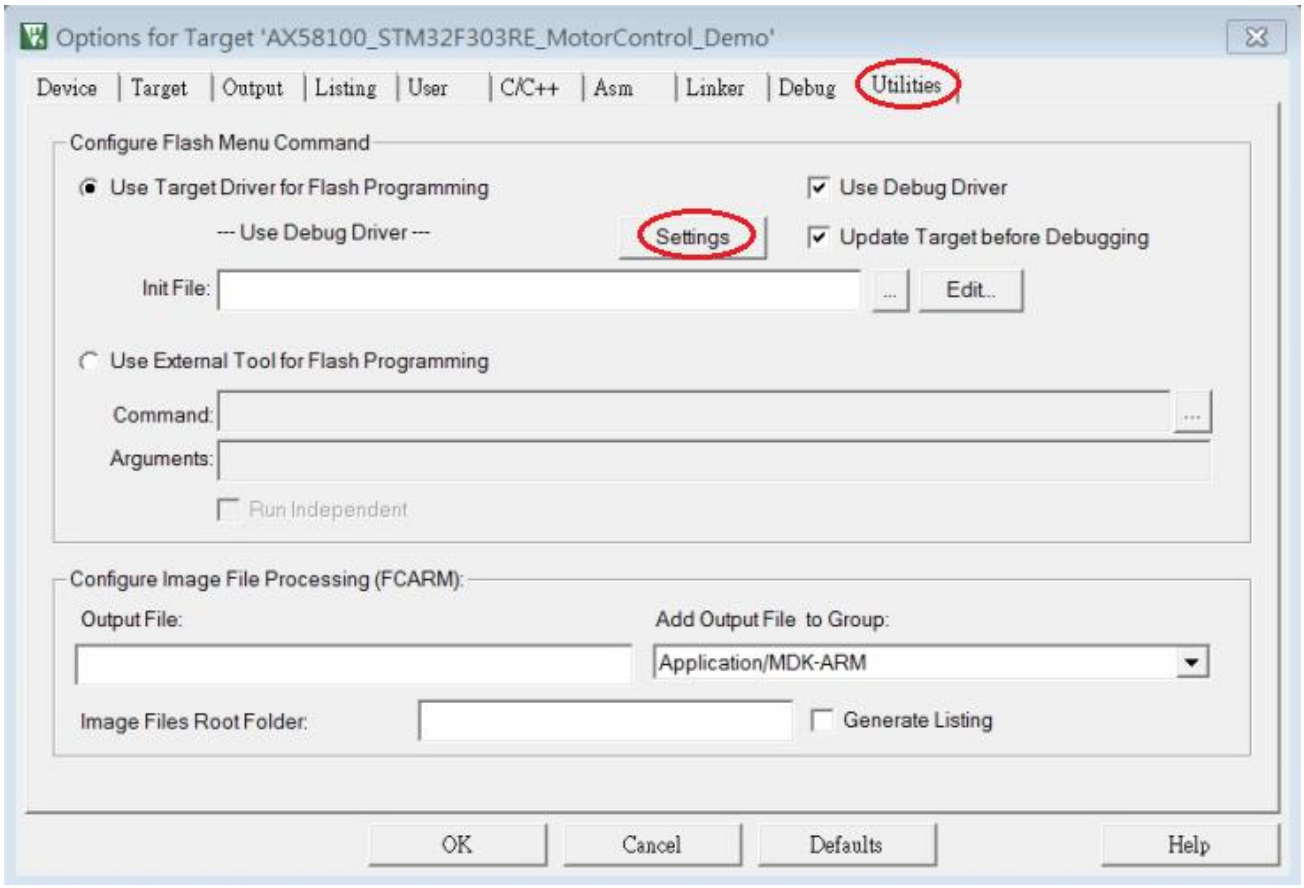


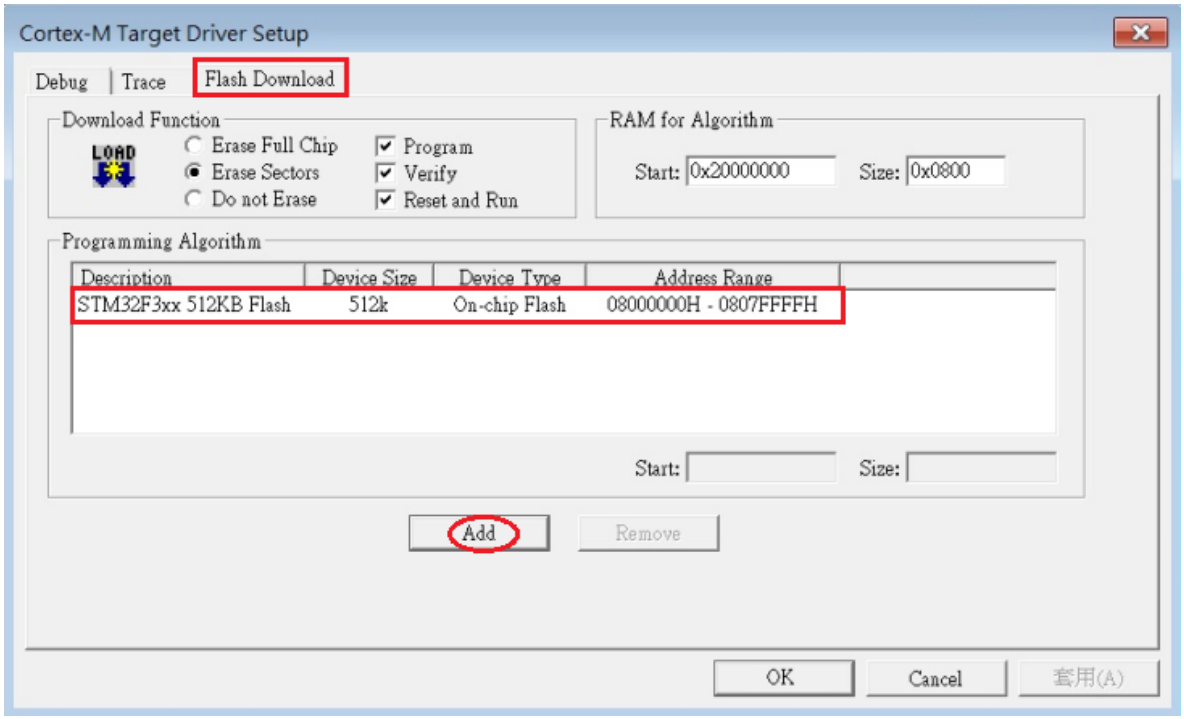


2. Select "**Configure Flash Tools**" from "Flash" menu of Keil MDK-ARM uVision5 Tool.

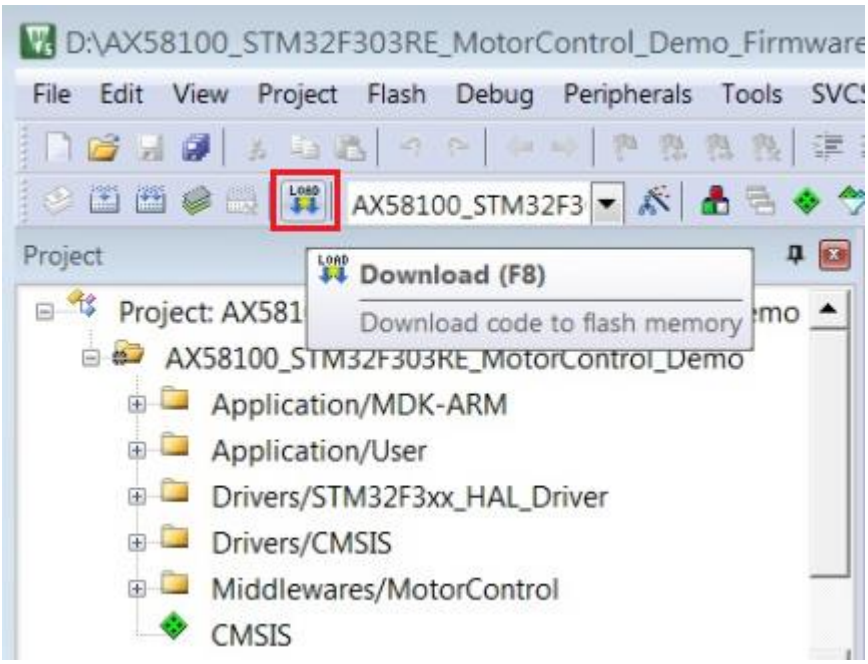


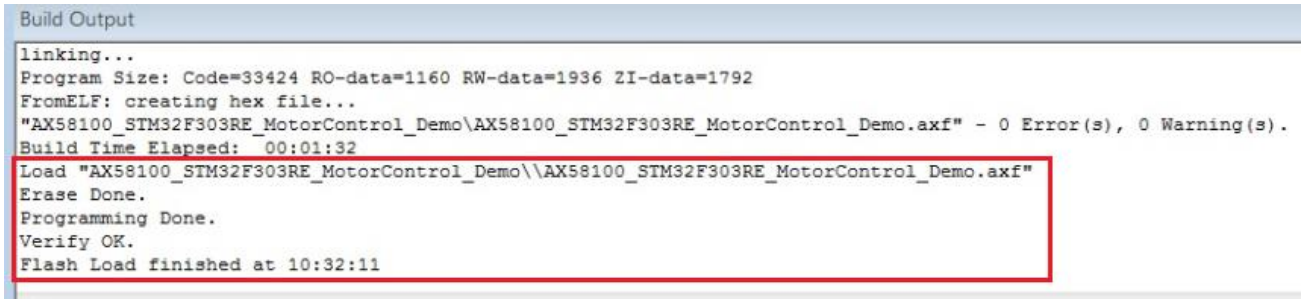
3. Select “Utilities” tab and press “**Setting**” button to manually add “**STM32F3xx 512KB Flash**” Flash Programming Algorithm for NUCLEO-F303RE MCU board.





4. Press  button to start downloading the compiled AX58100 + STM32F303RE MCU Motor Control demo firmware code (e.g. "**AX58100_STM32F303RE_MotorControl_Demo.axf**") onto NUCLEO-F303RE MCU board Flash memory.

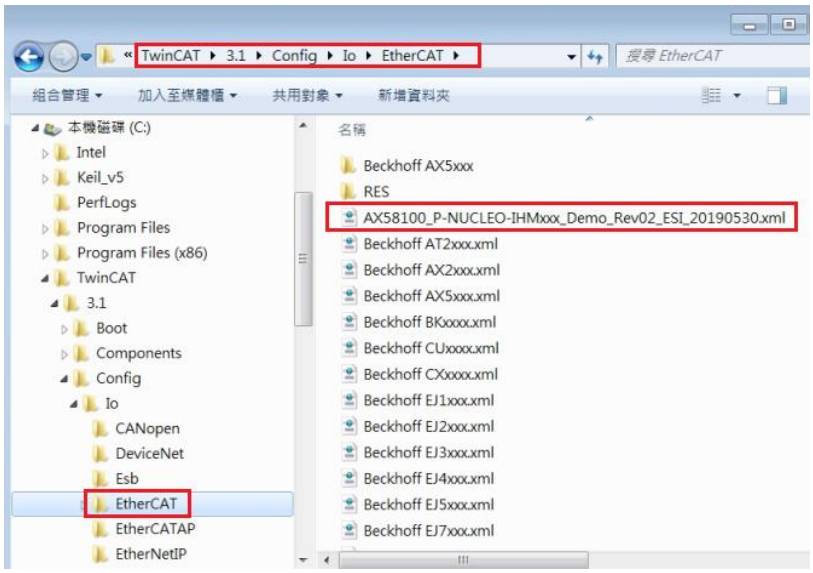




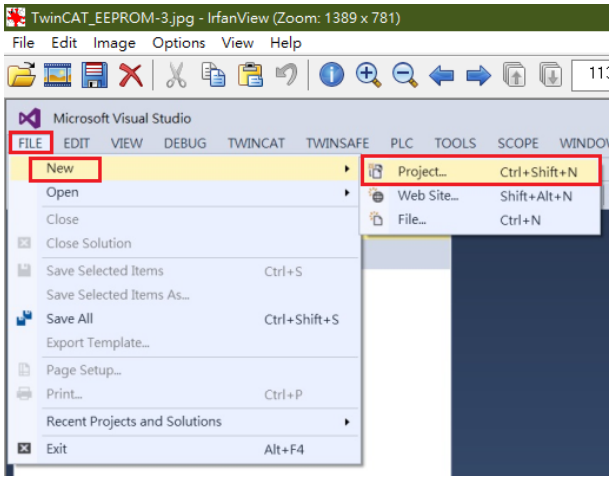
5-7. How to update AX58100 EEPROM by TwinCAT tool

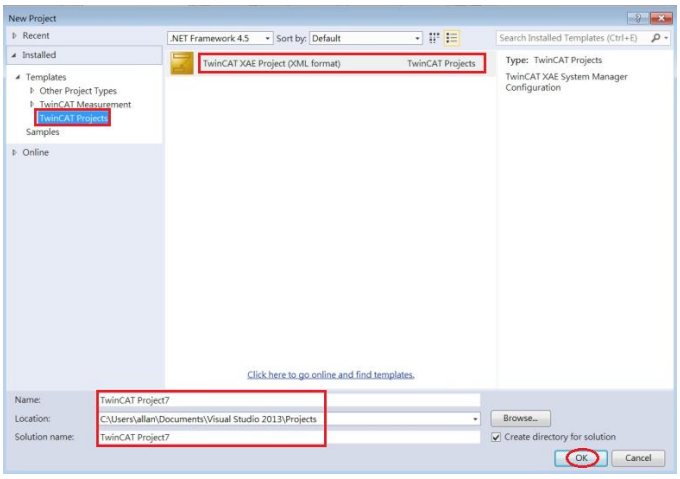
This section indicates how to update AX58100 EEPROM by using TwinCAT tool.

1. Copy the ESI file of AX58100 + STM32F303RE MCU Motor Control reference design (e.g. "**AX58100_P-NUCLEO-IHMxxx_Demo_Rev02_ESI_20190530.xml**") into the default folder of TwinCAT3 ESI files (e.g. "**C:\TwinCAT\3.1\Config\Io\EtherCAT**").

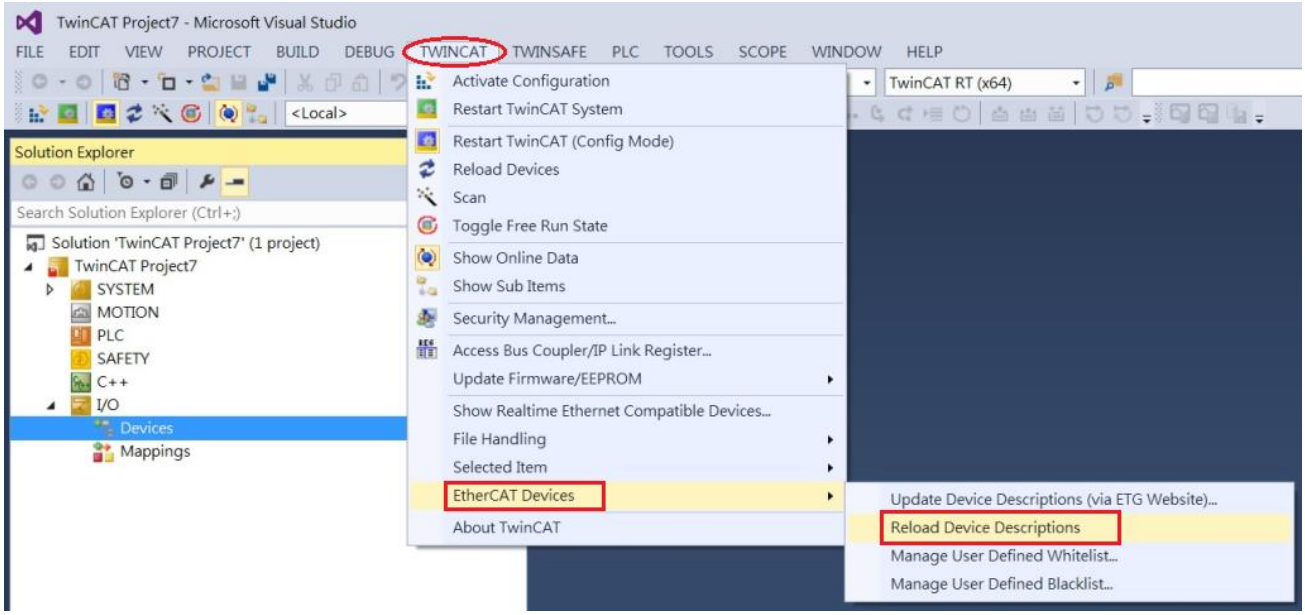


2. Create a new project on TwinCAT 3 Tool.

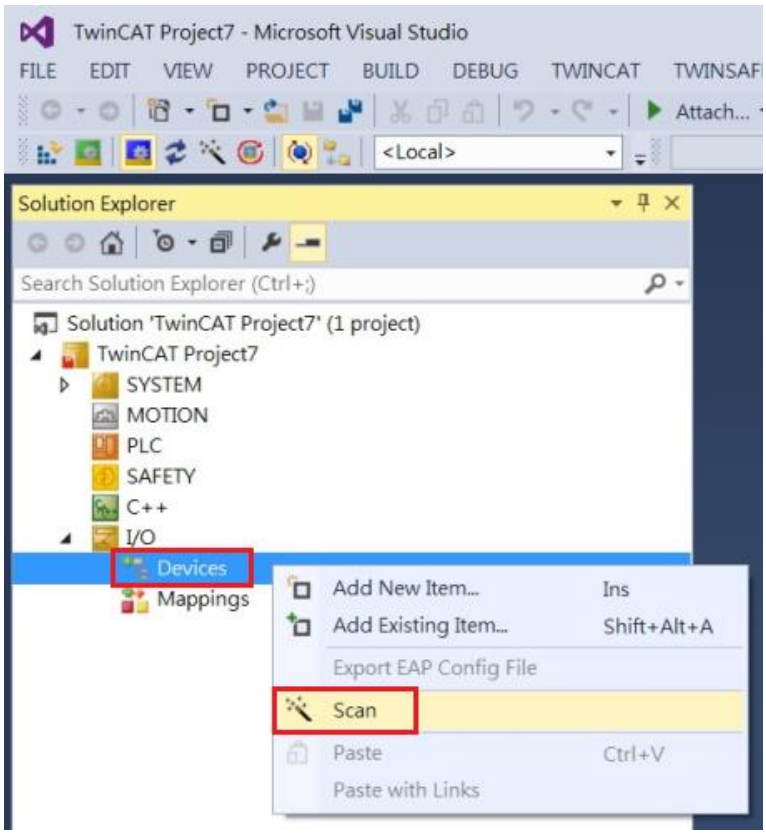


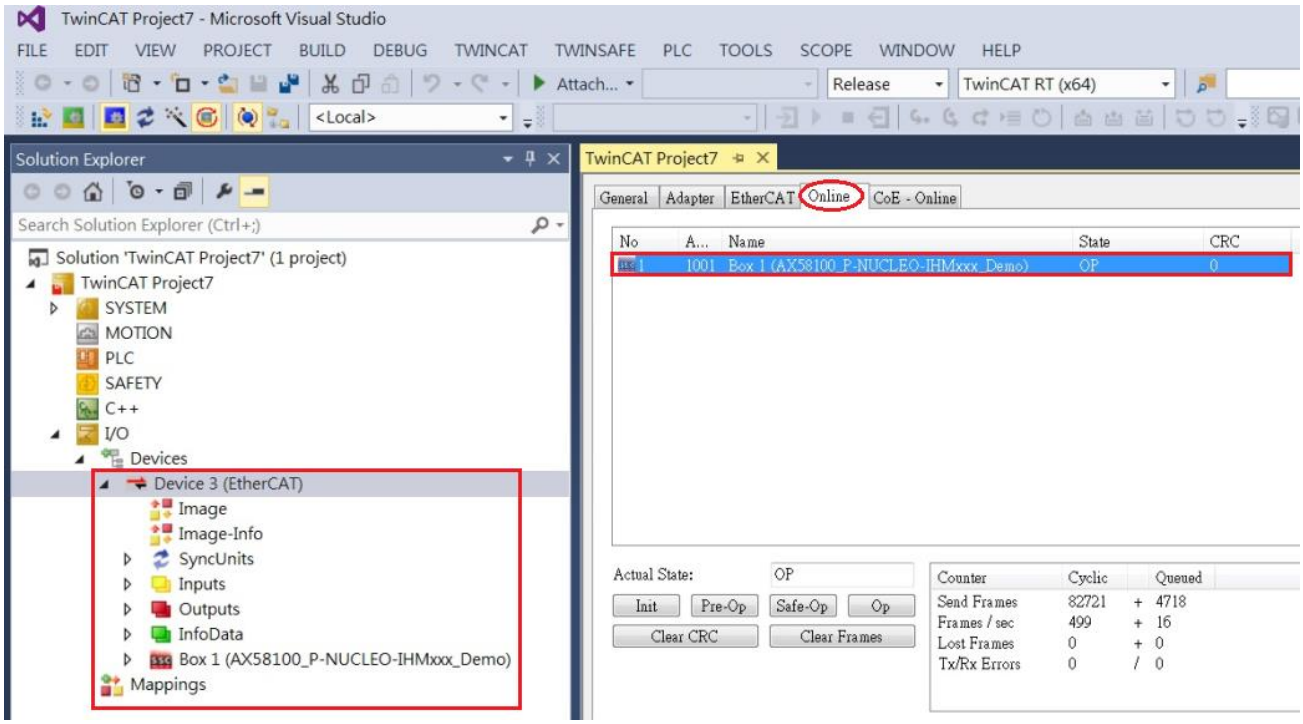


3. Select **“TWINCAT” -> “EtherCAT Devices” -> “Reload Device Descriptions”** to take effect the new ESI file of AX58100 + STM32F303RE MCU Motor Control reference design.

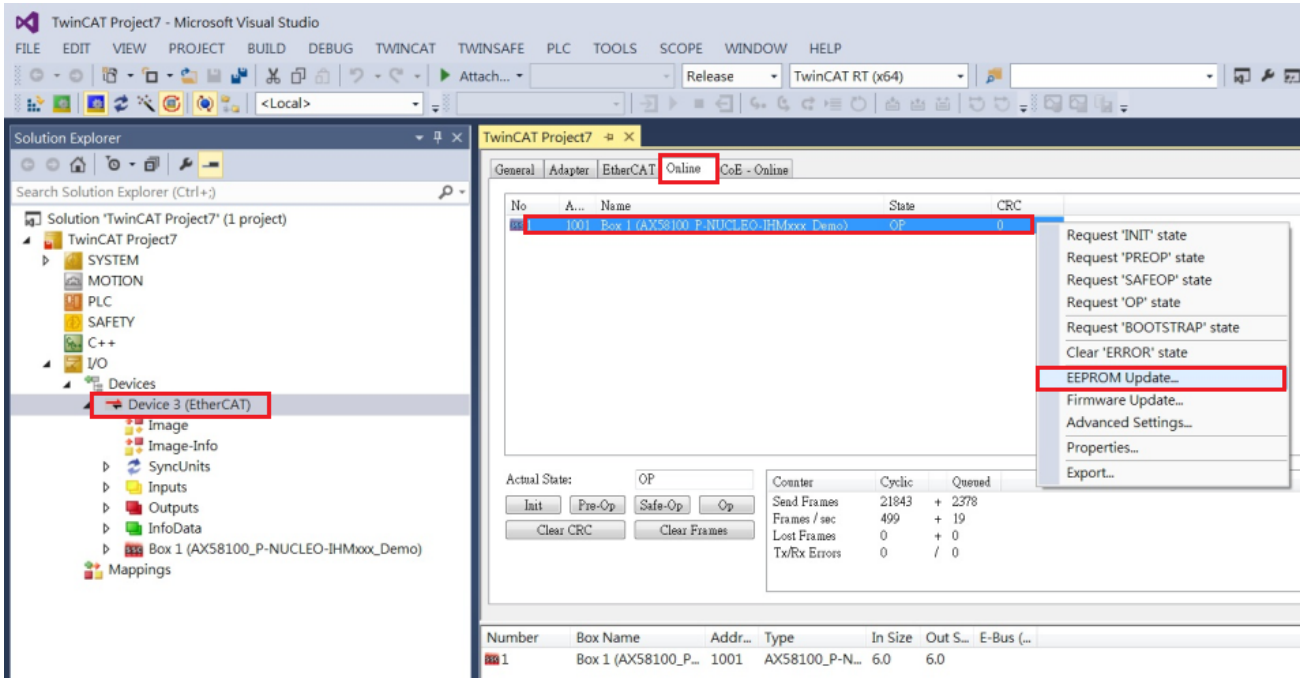


4. Select “**Scan**” to find out the “**AX58100_P-NUCLEO-IHMxxx_Demo**” device and make sure the scanned device is in “**OP**” mode.





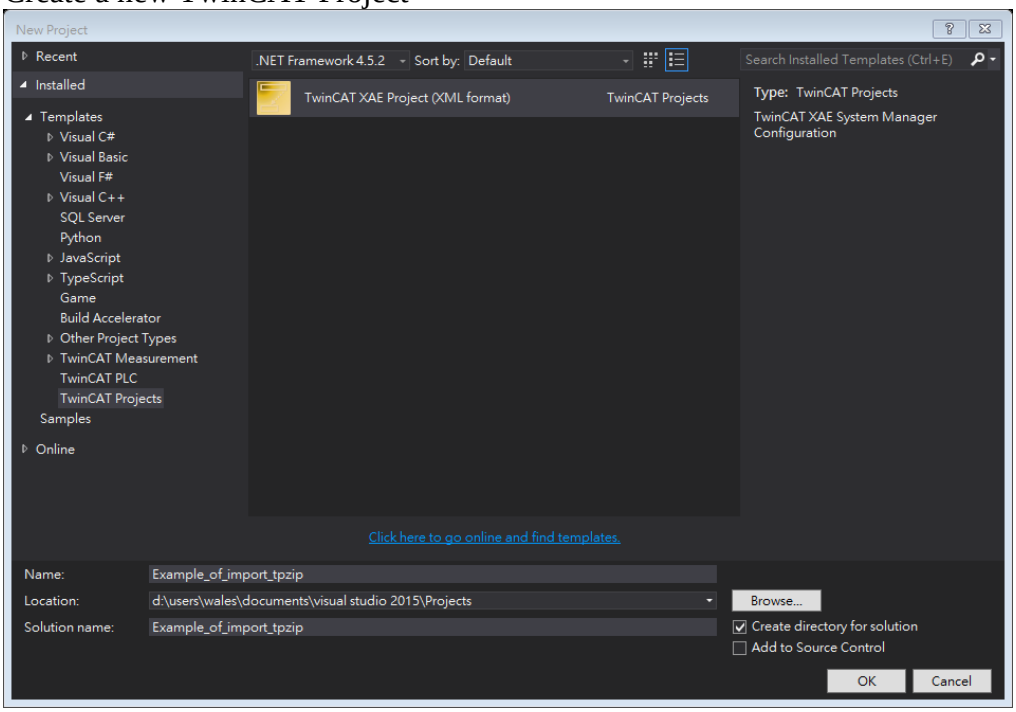
5. Select "**EEPROM Update**" from the "**AX58100_P-NUCLEO-IHMxxx_Demo**" device to start updating AX58100 EEPROM.



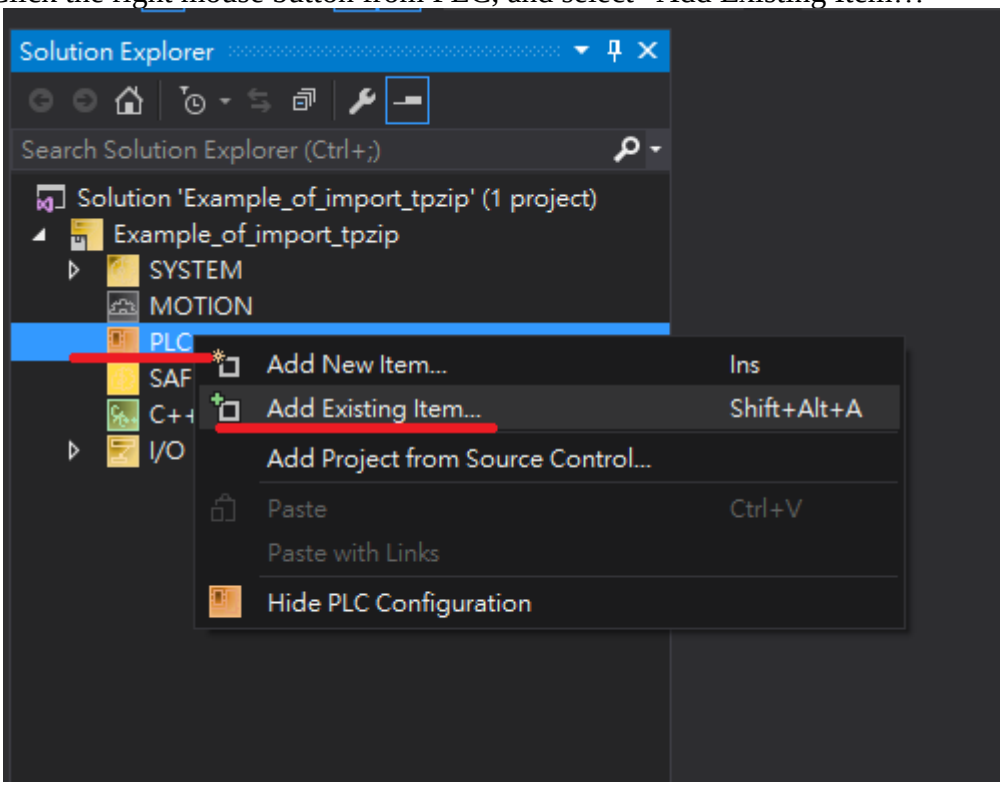
6. Power OFF and then ON AX58100 board to take effect the new AX58100 EEPROM hardware configuration.

5-8. Verify AX58100 + STM32F303RE MCU Motor Control Demo Firmware

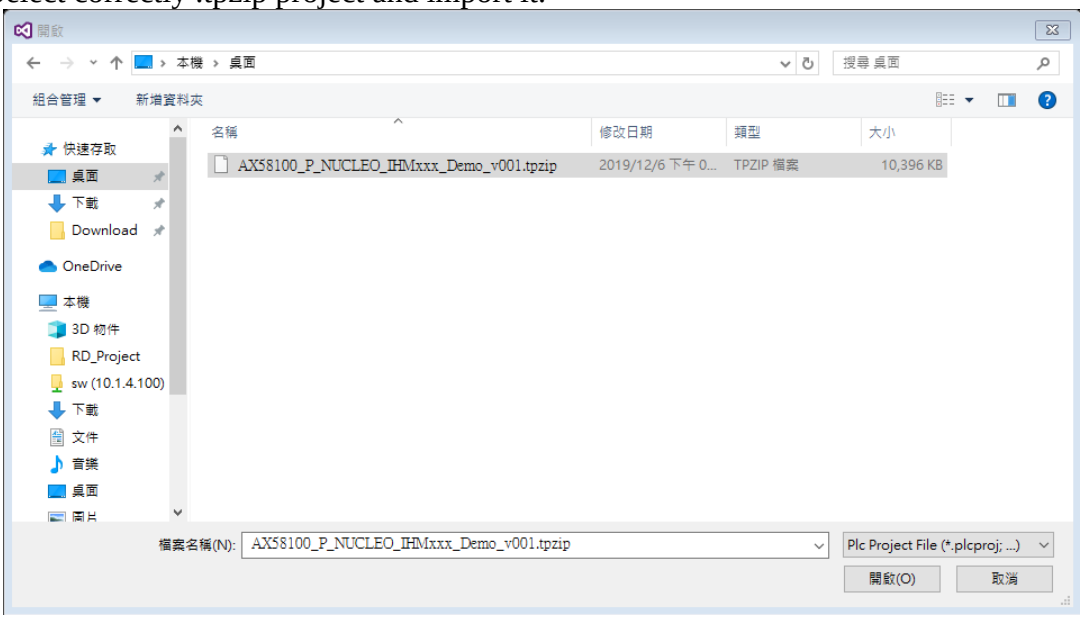
1. Import tpzip of PCL file
   - Create a new TwinCAT Project



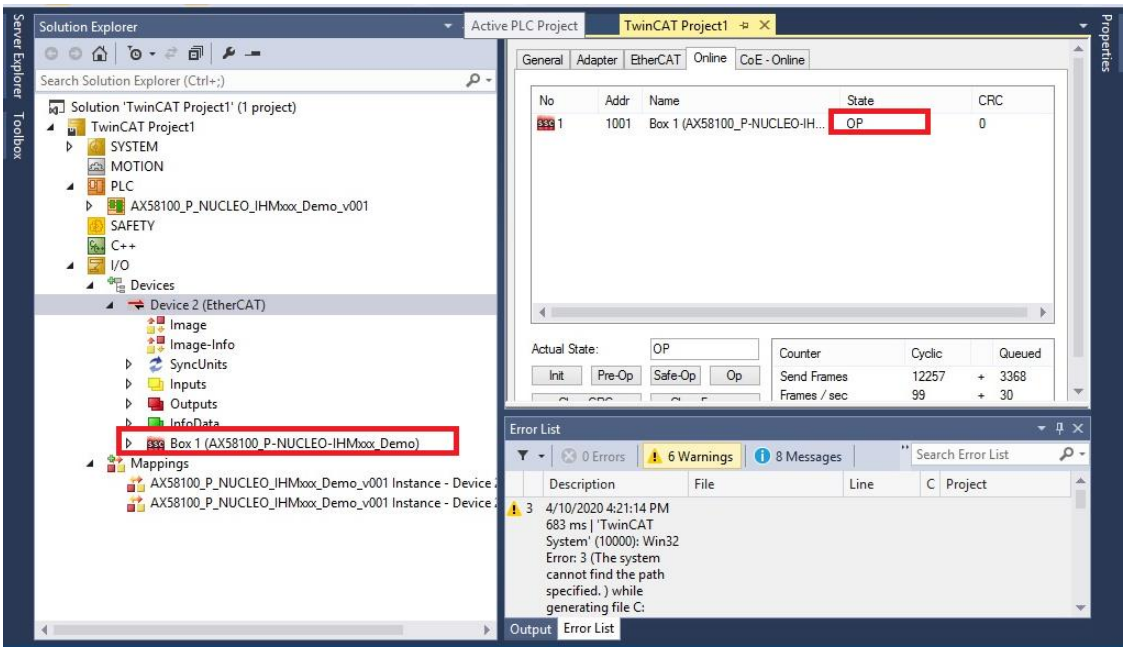
   - Click the right mouse button from PLC, and select “Add Existing Item…”



- Select correctly .tpzip project and import it.

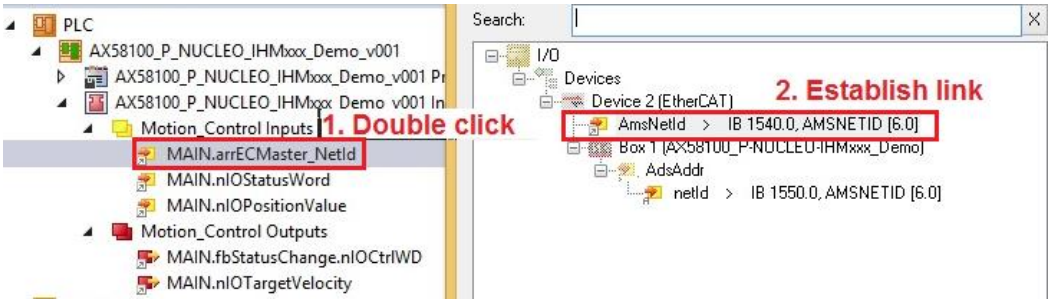


2. Re-scan the configured slave and make sure it has entered OP mode.

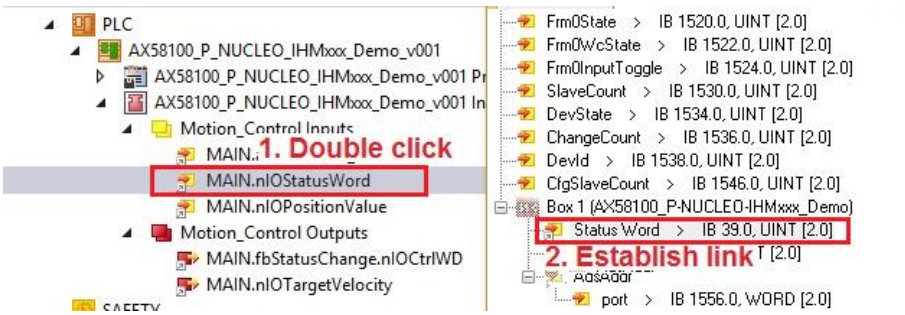


3. Establish links of PLC variables

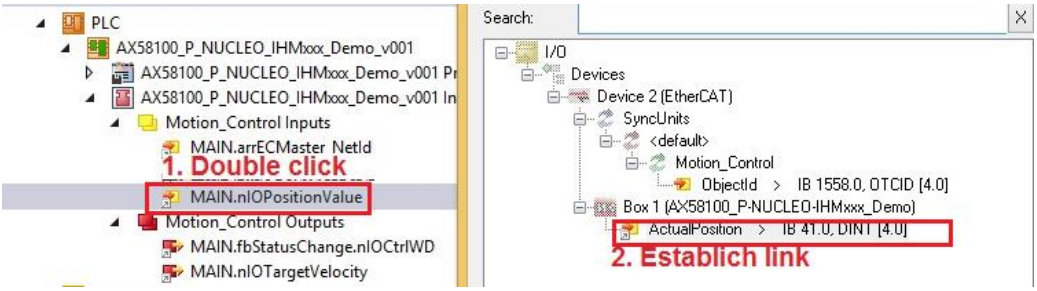
- Link **MAIN.arrECMaster_NetId** variable



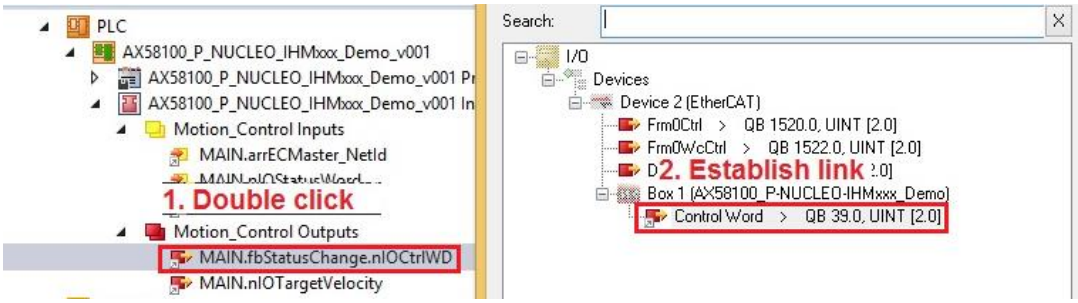
- Link **MAIN.nIOStatusWord** variable



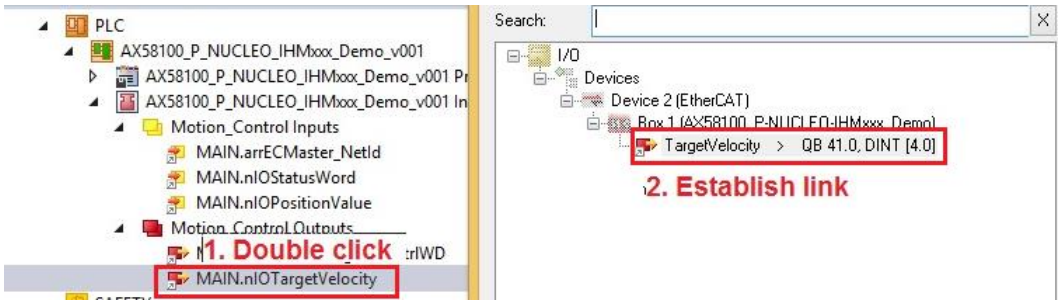
- Link **MAIN.nIOPositionValue** variable



- Link **MAIN.fbStatusChange.nIOCtrlWD** variable



- Link **MAIN.nIOTargetVelocity** variable



Now, you can forward to next step to execute the TwinCAT PLC program.

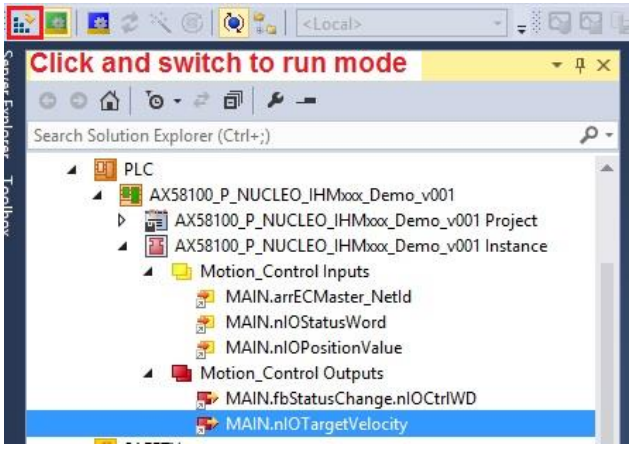
4. Execution.

After done the environment setup, you can start to execute the TwinCAT PLC program to control the BLDC motor speed with open loop drive, here we will introduce how to hook on/off PLC program and control motor speed on TwinCAT platform.

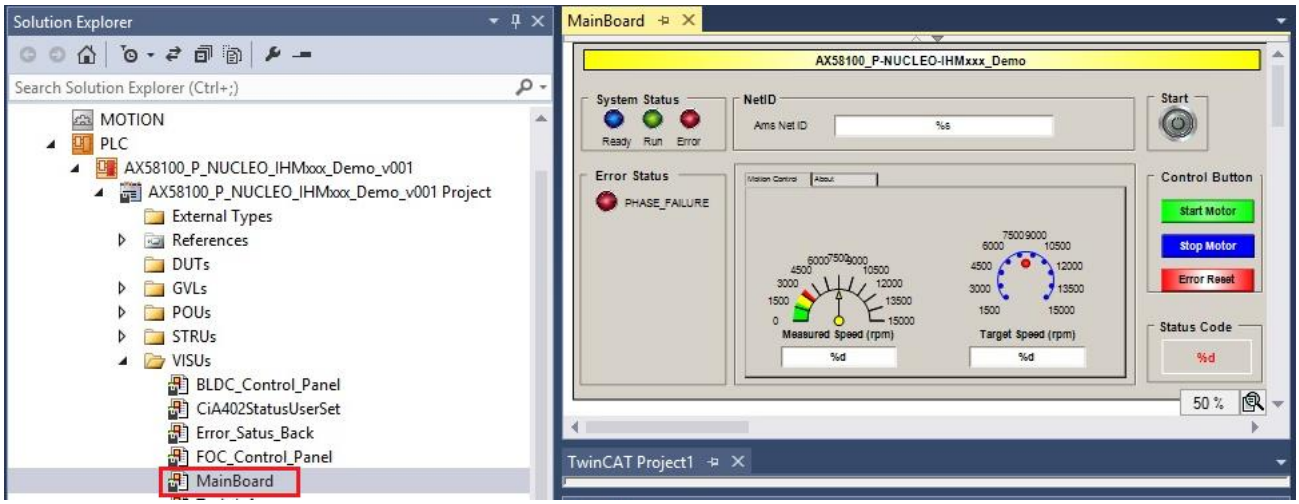
- Hook on PLC Program

Before starting PLC program, you shall make sure the EtherCAT slave has entered OP mode without any exception. And then please refer steps below to start PLC program.

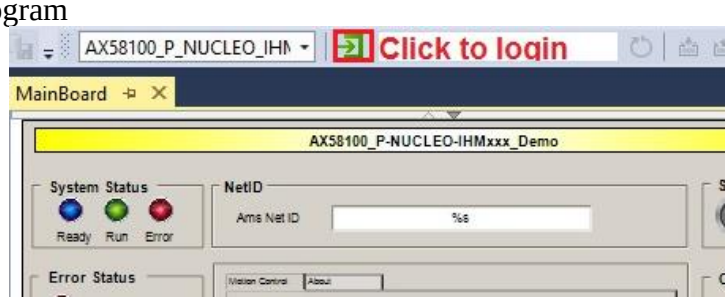
Step1: Switch TwinCAT into "**run mode**"



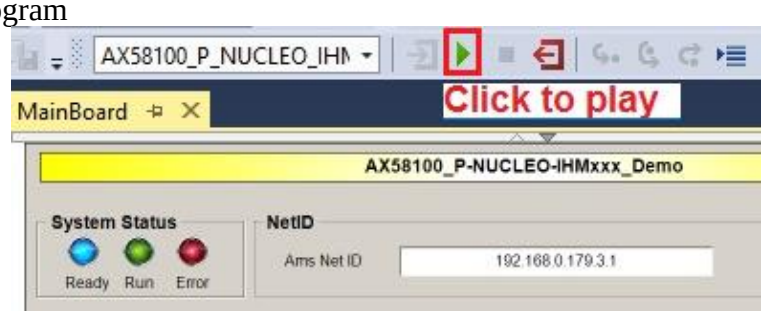
Step2: Open motor control dash board by click
[PLC>AX58100_P_NUCLEO_IHMxxxx_Demo_v001>
AX58100_P_NUCLEO_IHMxxxx_Demo_v001 Project>VISUs>MainBoard]



Step3: Login PLC program

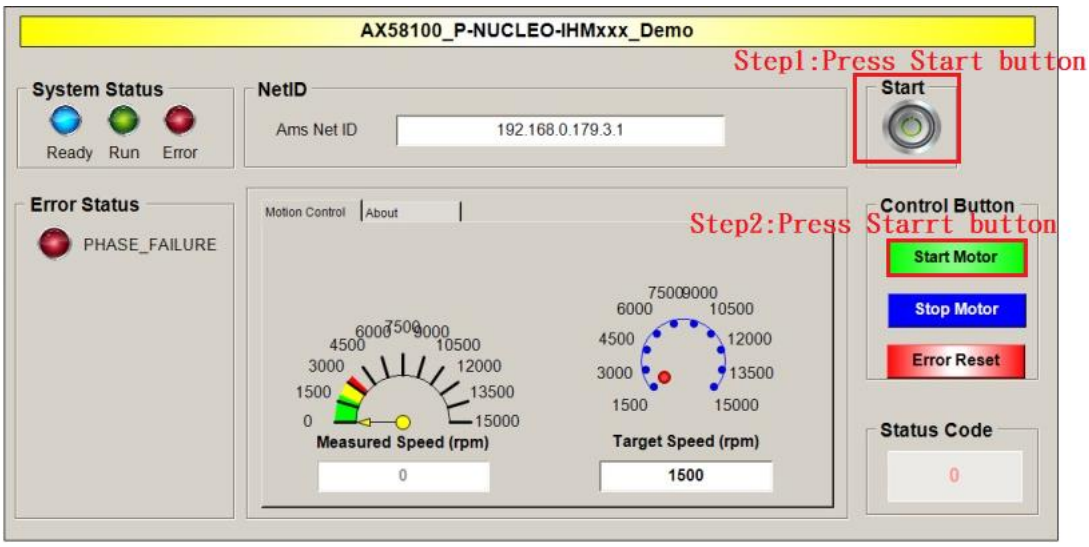


Step4: Play PLC program



5. Manipulation of PLC Program

As below figure, the Motor Control dash board consists of various components, you shall press "**Start**" button firstly on right-top corner before any further manipulation.



The usage of components is described in below table, you shall take care on that if there is any error condition occurs, the motor will be stopped and you cannot restart motor before cleared the error condition by pressing "**Error Reset**" button.

AX58100 Six-Step PWM BLDC Motor Control Dash Board		
Items	Sub-items	Description
System Status	Ready	This indicator will be lighted up after user pressed "**Start**" button and PLC program passed the self-check.
	Run	This indicator will be lighted up after "**Start Motor**" button be pressed and no error occurs.
	Error	This indicator will be lighted up if any errors occurred.
Error Status	PHASE_FAILURE	This indicator will be lighted up if the HALL phase detected is unexpected or phase change timeout.
NetID	Ams Net ID	This is used to show Net ID of EtherCAT device.
Motion Control	Measured Speed (rpm)	This component will show the motor speed measured.
	Target Speed (rpm)	This component is used to change motor Target Speed; it has an initial value at 1500rpm.
About		Where shows the PLC program version information.
Start		Start PLC task, it shall be pressed firstly.
Control Button	Start Motor	Start motor rotating according to Target Speed.
	Stop Motor	Stop motor rotating without ramp function.
	Error Reset	This button is used to clear error condition and allow the motor can be started again.

Status Code		This component is used to show error code if error occurred.

- Hook off PLC Program

After demonstration, recommend you to refer steps below to close the PLC program.

Step1: Please make sure the motor has been stopped.

Step2: Click  icon to stop PLC task.

Step3: Click  icon to logout PLC program.

Step4: Now, you can close TwinCAT project.

4F, No.8, Hsin Ann Rd., Hsinchu Science Park,
Hsinchu, Taiwan, R.O.C.

TEL: +886-3-5799500
FAX: +886-3-5799558

Email: support@asix.com.tw
Web: http://www.asix.com.tw