AN1916

Integrating Microchip's LAN9252 SDK with Beckhoff's EtherCAT® SSC

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INTRODUCTION

The Microchip LAN9252 is a 2/3-port EtherCAT® Slave Controller (ESC) with dual integrated Ethernet PHYs. The LAN9252 is typically implemented in Industrial Automation solutions and includes the following main features:

- Integrated high-performance 100Mbps Ethernet transceivers
- 3 FMMUs, 4 SyncManagers, Distributed clock support, 4K bytes of DPRAM
- 8/16-bit host bus interface allowing connection to most 8/16/32-bit embedded controllers
- SPI / SQI slave interface
- Support for 5 different main configurations:
  - Digital I/O (DIGIO)
  - HBI
  - SPI with GPIO
  - SPI with MII - 3-port (MII upstream) mode
  - SPI with MII - 3-port (MII downstream) mode
- 3rd port for flexible network configurations
- Comprehensive power management features
- Low pin count and small package size

The purpose of this document is to explain how to integrate the LAN9252 SDK with Beckhoff's EtherCAT Slave Stack Code (SSC) for use with the EVB-LAN9252-HBI evaluation board. Once the SSC is integrated with the SDK, application code (depending on the required application) can be added to the SDK to design the EtherCAT slave device.

Writing application code is not within the scope of this document. To utilize the LAN9252 SDK, one must be a member of EtherCAT Technology Group (ETG) to gain access to the Beckhoff SSC. The current SDK is designed to work with the Microchip PIC32MX and PIC24 MCU. However, support can be extended to other SOCs.

References

- Microchip LAN9252 Data Sheet
- Microchip EVB-LAN9252-HBI Evaluation Board User's Guide
- Microchip PIC32MX Data Sheet
- Microchip LAN9252 EEPROM Configuration and Programming

System Requirements

HARDWARE REQUIREMENTS

- Microchip EVB-LAN9252-HBI Evaluation Board
- Microchip PICkit 3 In-Circuit Debugger/Programmer
- Windows Host Machine with minimum of 2GB RAM

SOFTWARE REQUIREMENTS

- Microchip MPLAB IDE v2.20 or higher
- Microchip MPLAB XC Compiler v1.33 or higher
- Beckhoff EtherCAT Slave Stack Code version 5.10
- Latest version of Microchip LAN9252 SDK

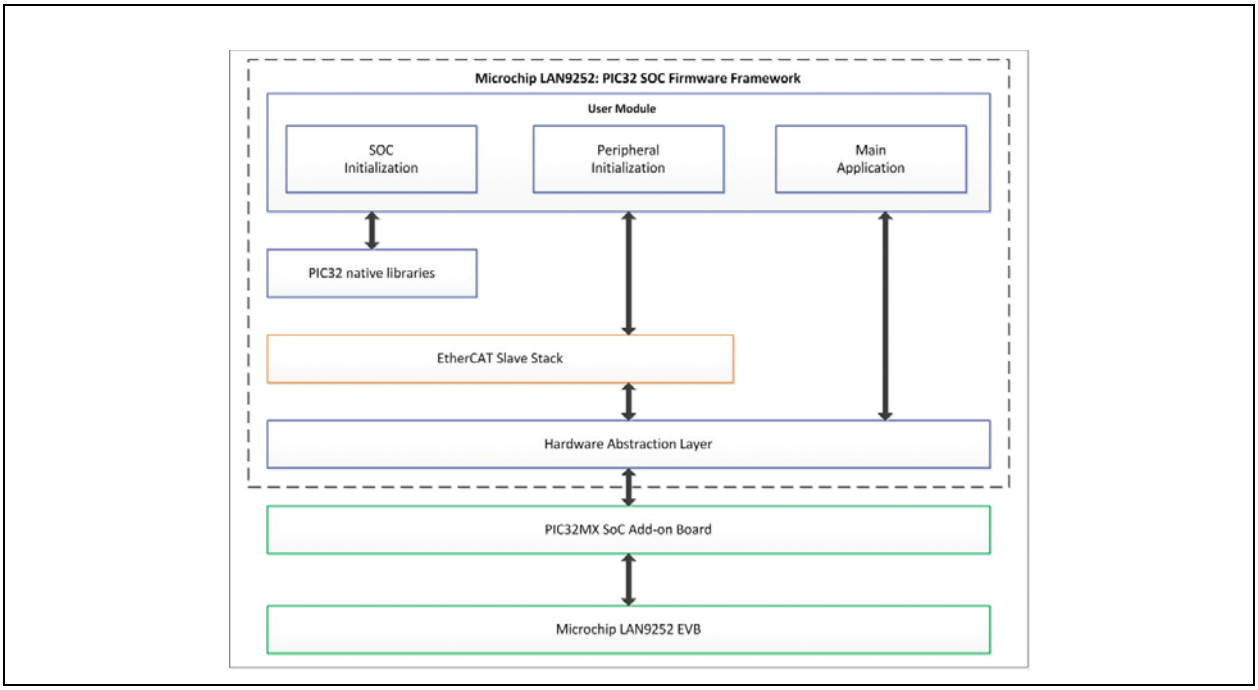
Terms and Abbreviations

TABLE 1: TERMS AND ABBREVIATIONS

Term	Definition
ESC	EtherCAT Slave Controller
ETG	EtherCAT Technology Group
EVB	Evaluation Board
HBI	Host Bus Interface
IDE	Integrated Development Environment
SDK	Software Development Kit
SPI	Serial Protocol Interface
SSC	Slave Stack Code

PIC32 SOC FIRMWARE FRAMEWORK

FIGURE 1: PIC32 SOC FIRMWARE FRAMEWORK

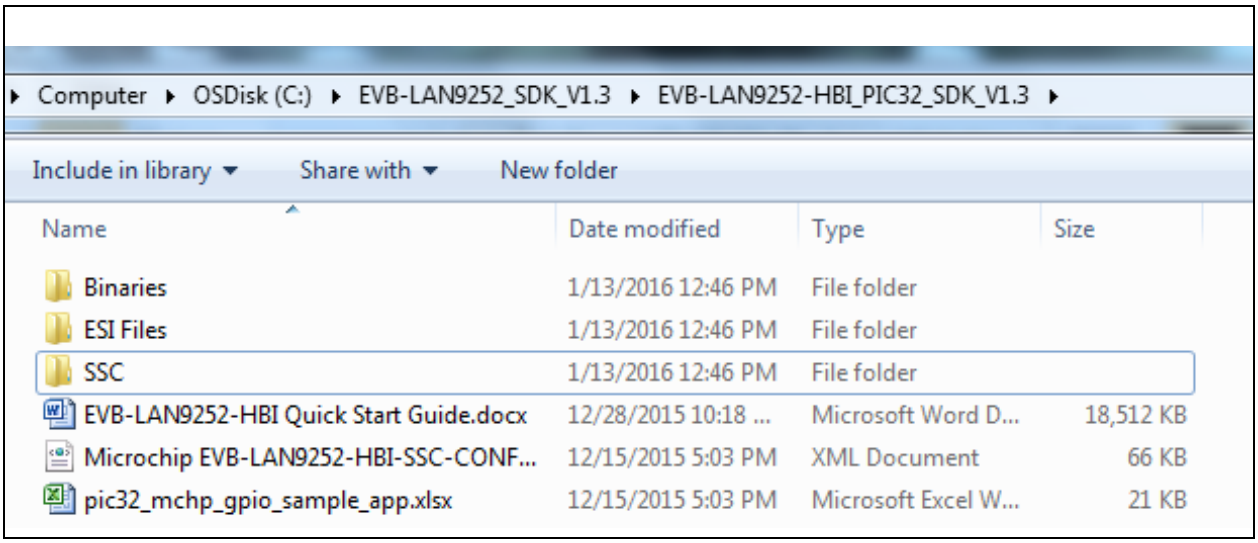


SDK DIRECTORY STRUCTURE

This section provides a high-level overview of the contents of the EVB-LAN9252 SDK. The main **EVB-LAN9252-HBI_PIC32_SDK_V1.3** folder contains the following items, as displayed in Figure 2:

- `ESI Files` - This folder contains ESI files for the different configurations supported by the evaluation board.
- `SSC` - This folder contains two MPLABX project folders, one for the SPI interface and one for the HBI interface.
- `Microchip EVB-LAN9252-HBI-SSC-CONFIG.xml` - This is the Slave Stack Code tool configuration file that is used to generate ESI files for different configurations supported by the EVB-LAN9252-HBI evaluation board.

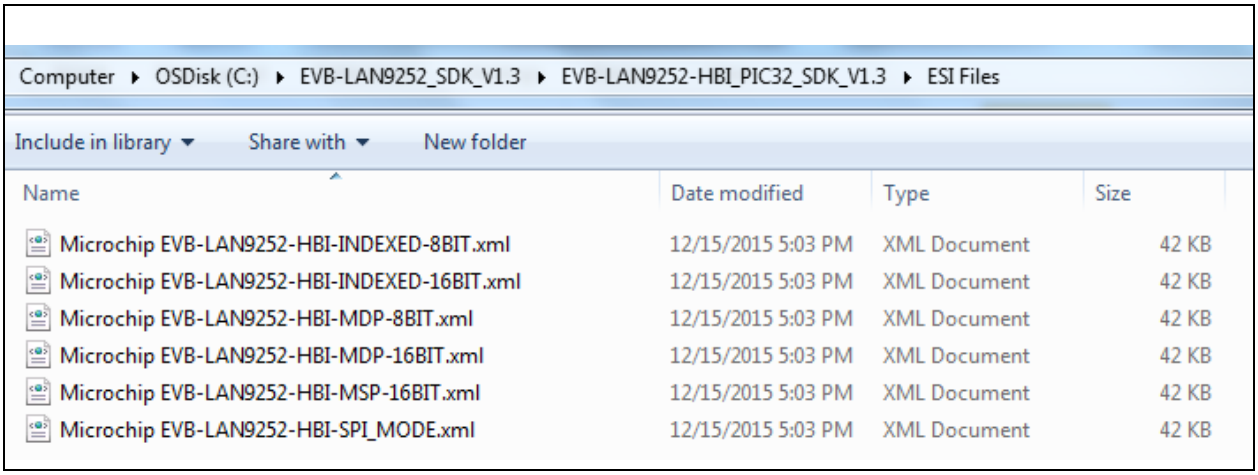
FIGURE 2: LAN9252-PIC32_SDK_V1.3 FOLDER CONTENTS



ESI Files Folder

The **ESI Files** folder contains EtherCAT slave information files for programming the LAN9252 EEPROM and configuring the LAN9252 via an EtherCAT Master tool (such as TwinCAT), as displayed in Figure 3. For detailed information on the different configurations of each EtherCAT slave information file in this folder, refer to the `ReadMe.txt` file located within the folder.

FIGURE 3: ESI FILES FOLDER CONTENTS

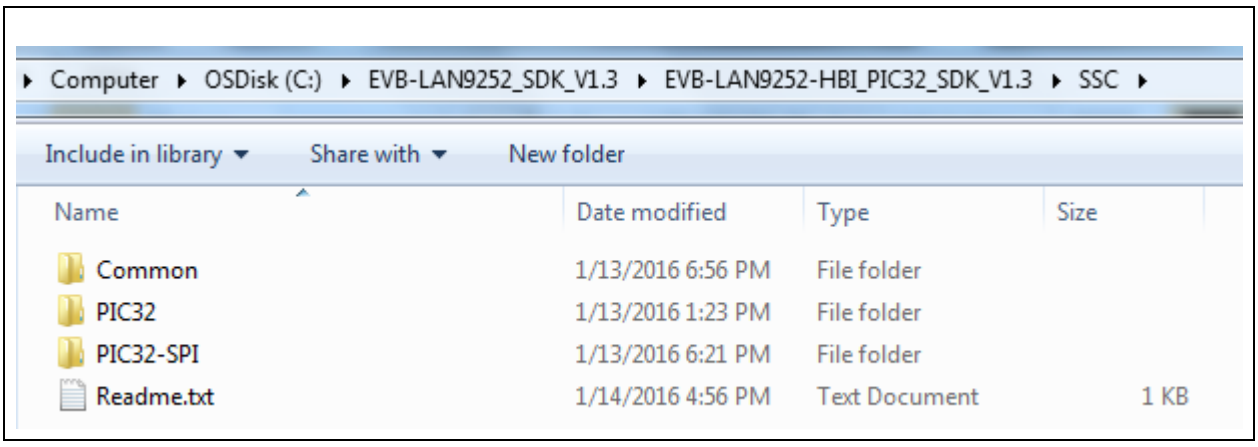


SSC Folder

The **SSC** folder contains the following files/folders, as displayed in Figure 4.

- `Common` - This folder contains the C source files for the Hardware Abstraction Layer and also the placeholder for the Beckhoff Slave Stack Code.
- `PIC32` - This is the PIC32 project folder configured for the HBI interface.
- `PIC32-SPI` - This is the PIC32 project folder configured for the SPI interface.
- `ReadMe.txt` - This file contains information on the directory structure of the MPLABX folders.

FIGURE 4: SSC FOLDER CONTENTS



BUILDING A FULL-FEATURED ETHERCAT APPLICATION

Installation

In order to properly use the EVB-LAN9252, users must obtain the Beckhoff EtherCAT Slave Stack Code (SSC). Without the SSC, when a Microchip EVB-LAN9252 SDK sample project is loaded into MPLAB, it will result in compilation errors and missing source files. This is due to SDK dependencies on generic Beckhoff's slave stack source files. Because of this, it is a pre-requisite to integrate Beckhoff's SSC with the LAN9252 SDK.

The examples in this document use:

- SSC version 5.11
- Configuration file version 1.3.0.0

The steps for building full-featured EtherCAT applications using the SSC are provided below.

1. Download the Microchip EVB-LAN9252 SDK and ensure the following directory structure contains the EtherCAT SDK source code:

   `{SDK_INSTALL_PATH}/EVB-LAN9252-HBI_PIC32_SDK_Vx.x/SSC`

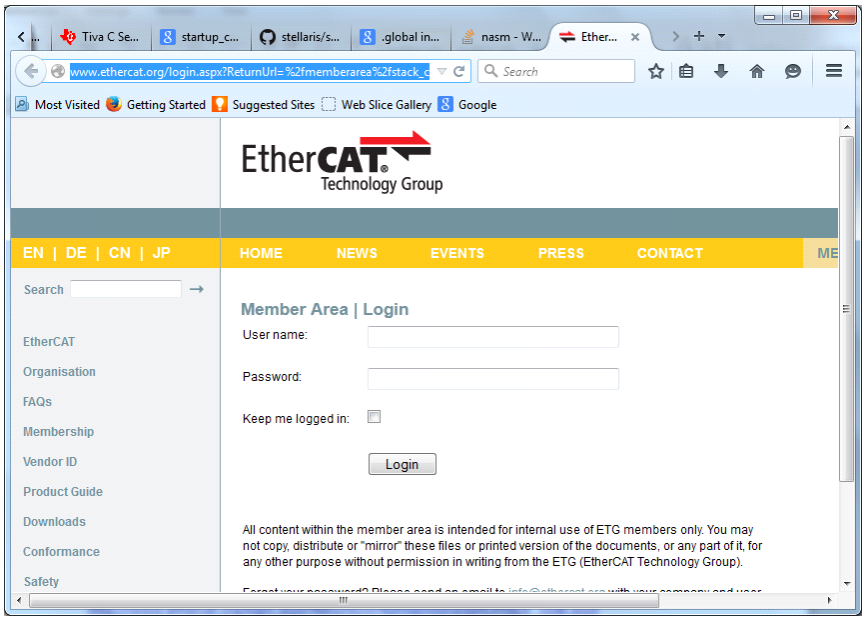
2. Download and install the Beckhoff EtherCAT Slave Stack Code (SSC) tool. Download the EtherCAT SSC from the following link:

   http://www.ethercat.org/login.aspx?ReturnUrl=%2fmemberarea%2fstack_code.aspx

3. To continue the download process, enter the ETG user name and password in the Member Area Login page, as displayed in Figure 5.

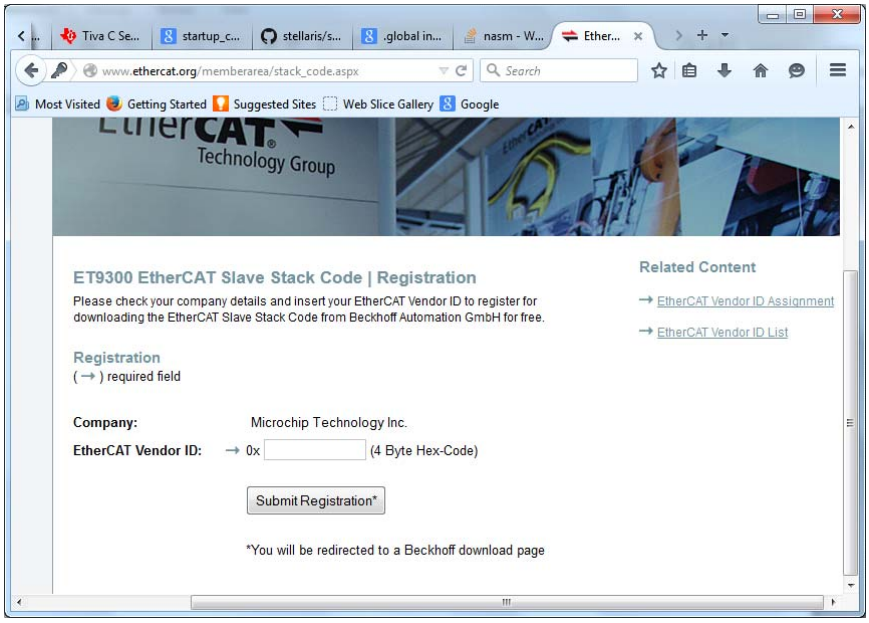
Note: You must be an EtherCAT Technology Group (ETG) Member to download the SSC Stack.

FIGURE 5: MEMBER AREA LOGIN



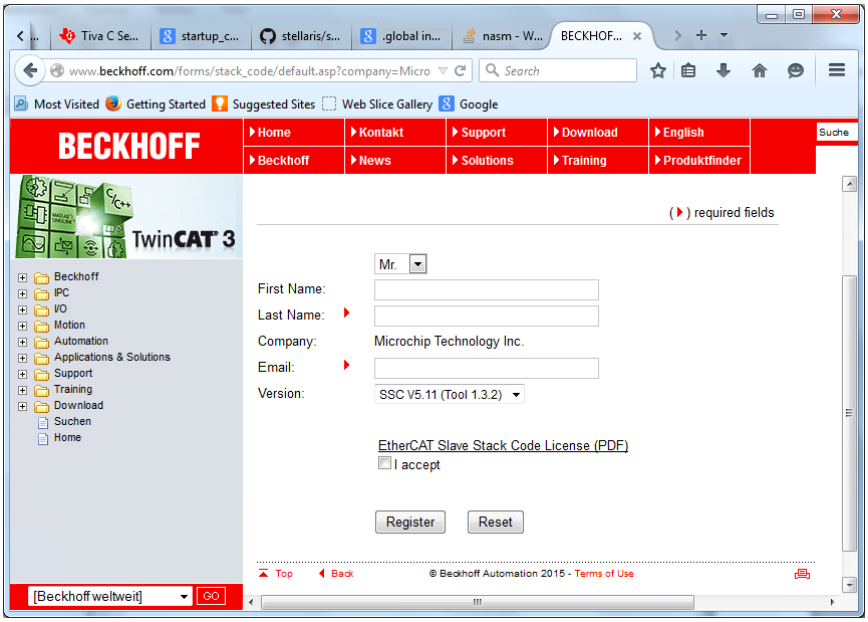
4. If prompted, enter the Vendor ID, and then click **Submit Registration**, as displayed in Figure 6.

FIGURE 6: VENDOR ID SUBMISSION



5. Enter the required details, check the “I accept” box, and then click **Register**, as displayed in Figure 7.

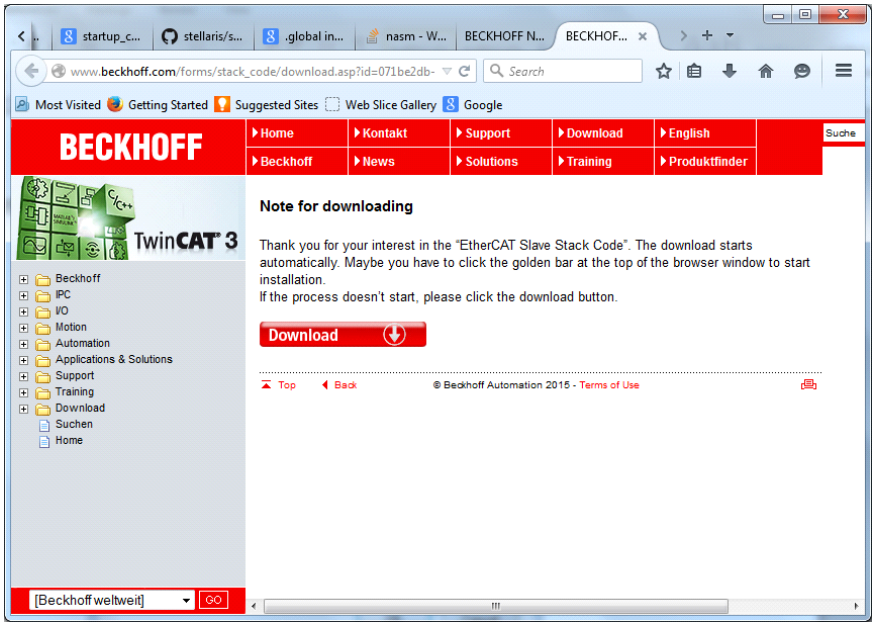
FIGURE 7: SLAVE STACK CODE DOWNLOAD



A download link will be sent to the registered email address.

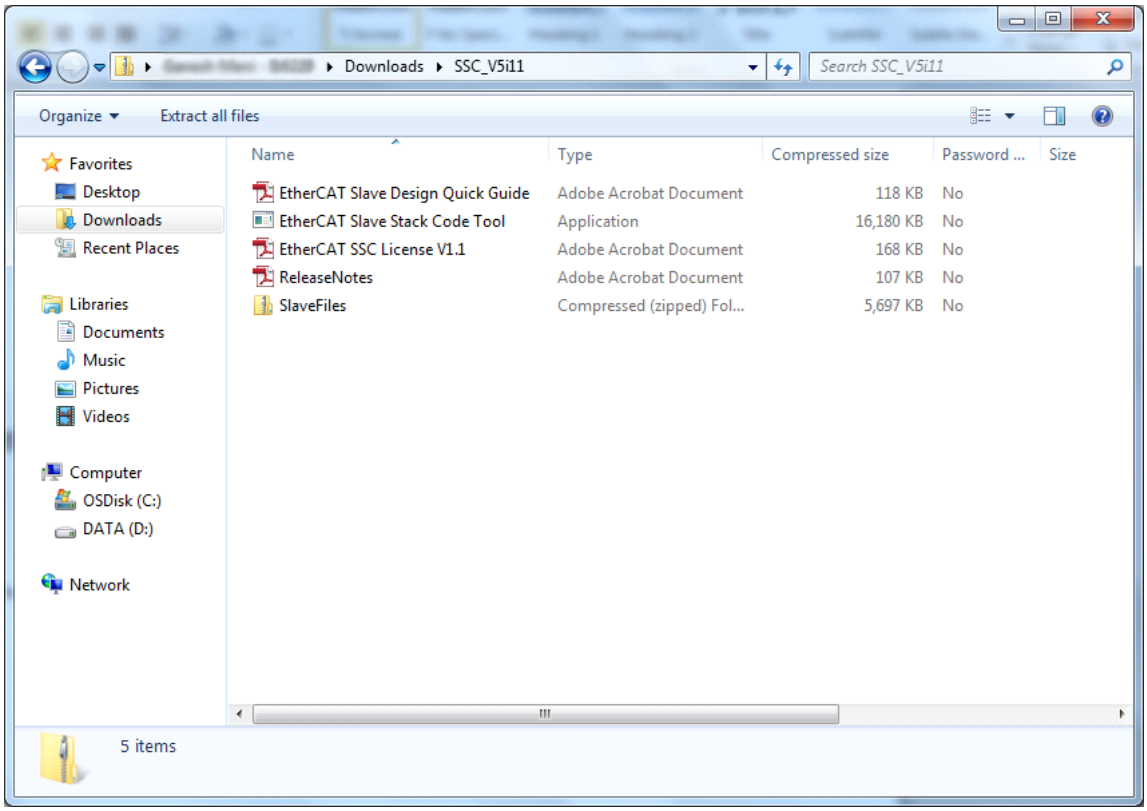
6. Click the emailed download link to download the EtherCAT Slave Stack Code, as displayed in Figure 8.

FIGURE 8: SLAVE STACK CODE DOWNLOAD



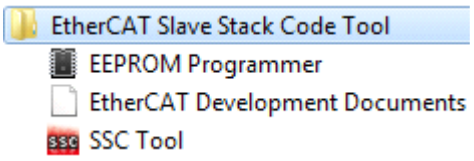
7. Extract the downloaded file `SSC_V5i11.zip`, which contains the directory structure displayed in Figure 9.

FIGURE 9: SLAVE STACK CODE DIRECTORY STRUCTURE



8. Install the EtherCAT Slave Stack Code Tool, accepting the defaults if prompted.
   Once installation is complete, ensure the tools displayed in Figure 10 are in the Start menu.

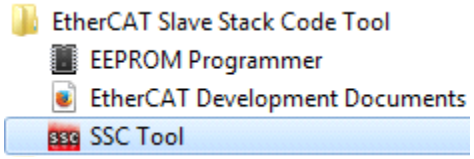
FIGURE 10: SLAVE STACK CODE TOOLS



SSC Tool

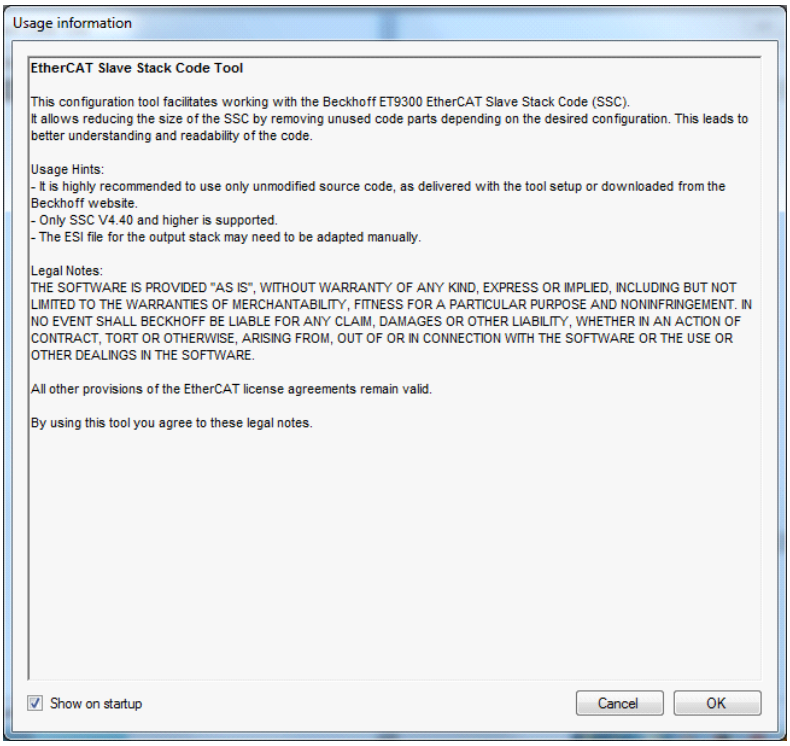
1. Start the SSC Tool from the Start menu, as displayed in Figure 11.

FIGURE 11: SSC TOOL



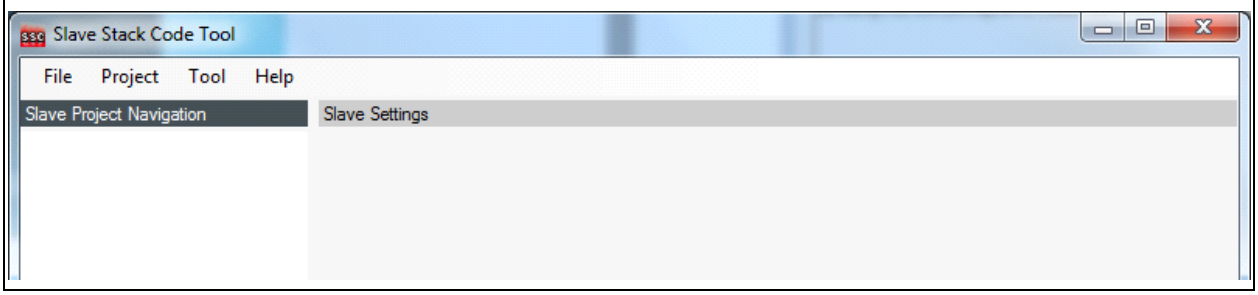
2. Click **OK** to agree to the usage information, as displayed in Figure 12.

FIGURE 12: SSC USAGE INFORMATION



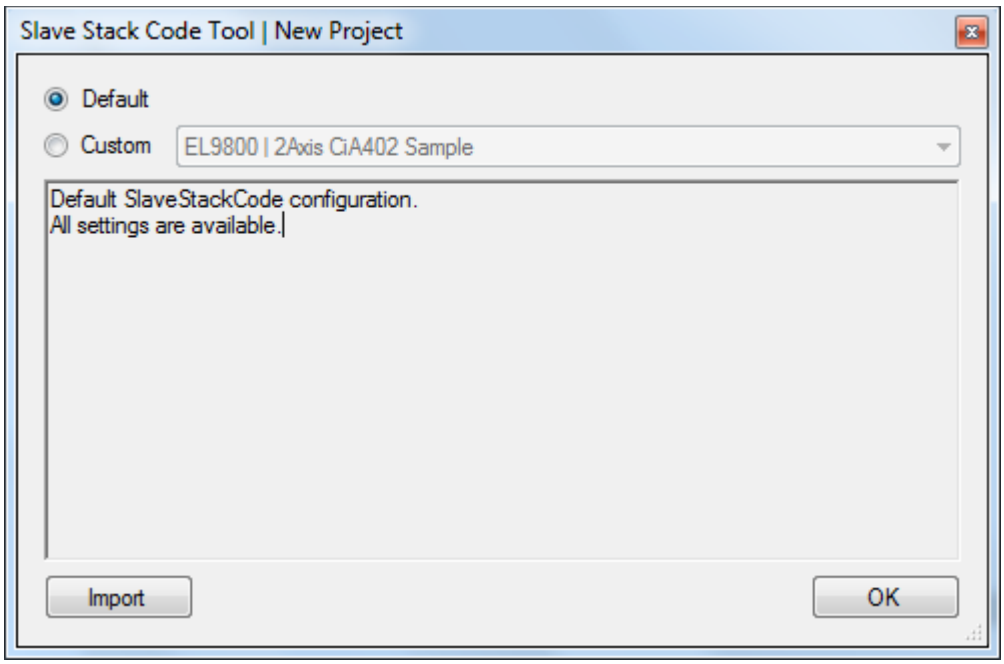
3. From the menu bar of the main screen displayed in Figure 13, click *File>New*.

FIGURE 13: SSC TOOL MAIN SCREEN



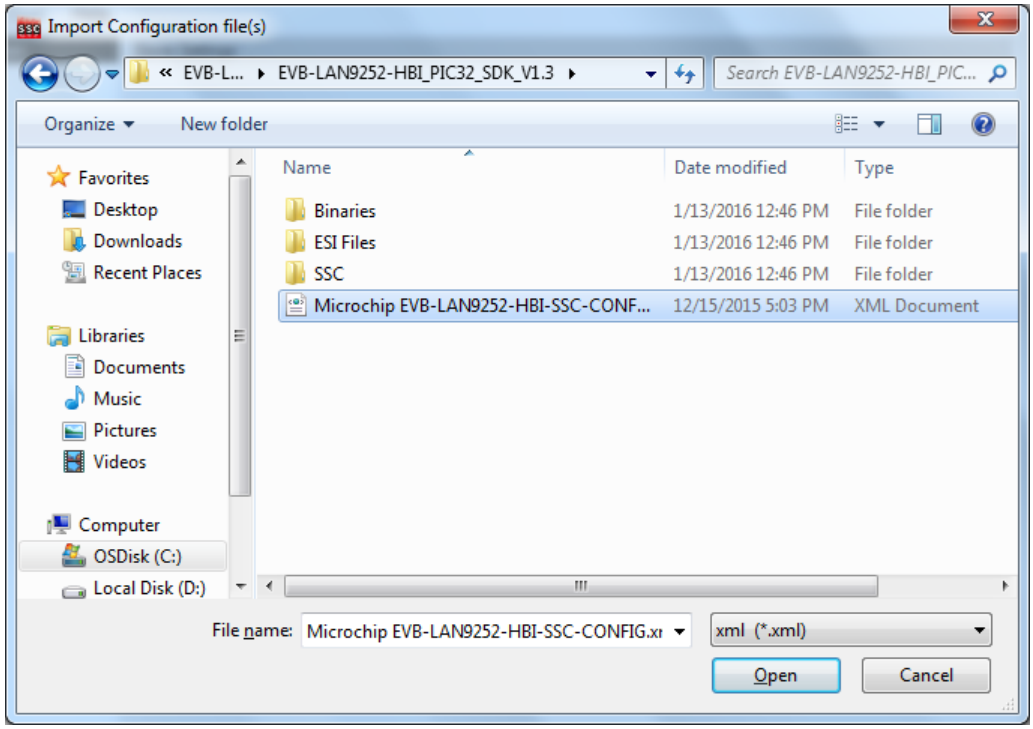
4. Click **Import** to import the SSC Tool configuration file `Microchip EVB-LAN9252-HBI-SSC-CONFIG.xml` from the directory `{SDK_INSTALL_PATH}/EVB-LAN9252-HBI-PIC32_SDK_Vx.x/` as in Figure 14.

FIGURE 14: SSC TOOL NEW PROJECT



5. After selecting the file, click **Open** to import the SSC Tool configuration file, as displayed in Figure 15.

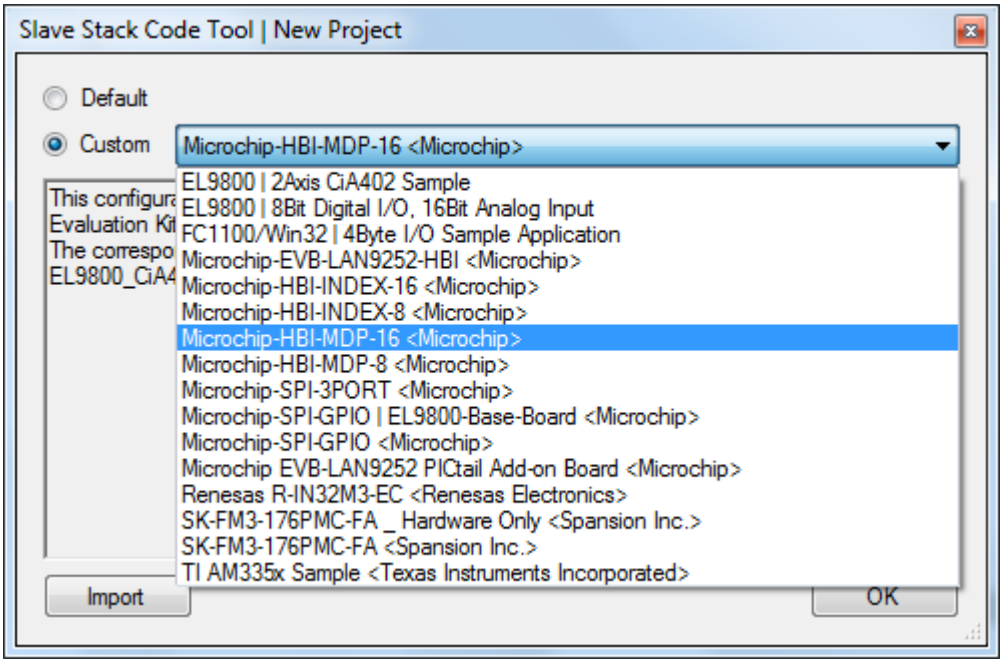
FIGURE 15: SSC TOOL NEW PROJECT IMPORT



6. Once imported, check the “Custom” drop-down box, select the appropriate Microchip configuration, and then click **OK**, as displayed in Figure 16.

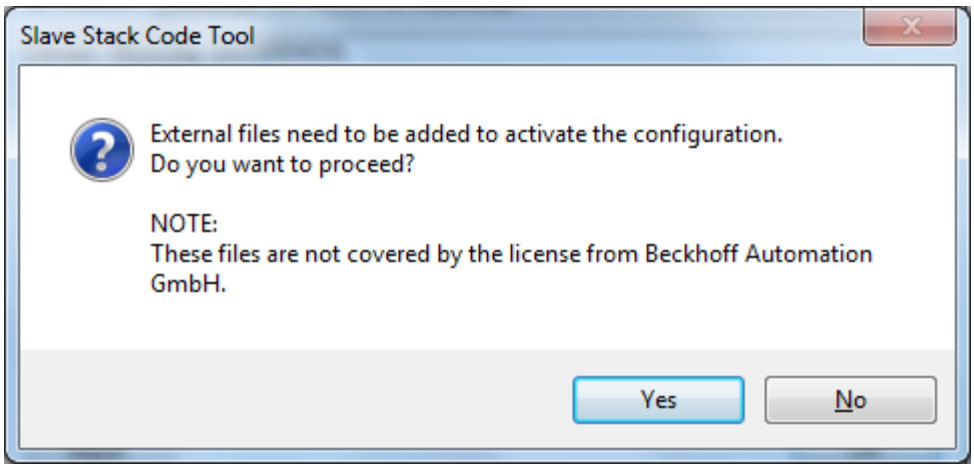
Note:	The EVB configuration should match the selected configuration in the drop-down box.

FIGURE 16: SSC TOOL NEW PROJECT CUSTOM



7. Click **Yes** in the pop-up window, as displayed in Figure 17.

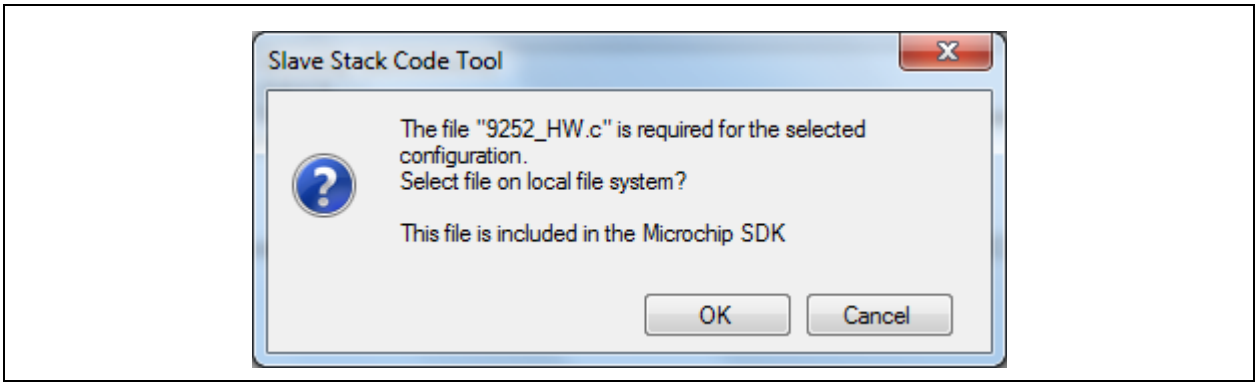
FIGURE 17: SSC TOOL EXTERNAL FILE CONFIRMATION



An additional pop-up window displays, requesting to add “9252_HW.c”, as displayed in Figure 18.

8. Click **OK**.

FIGURE 18: SSC TOOL 9252_HW.C CONFIRMATION

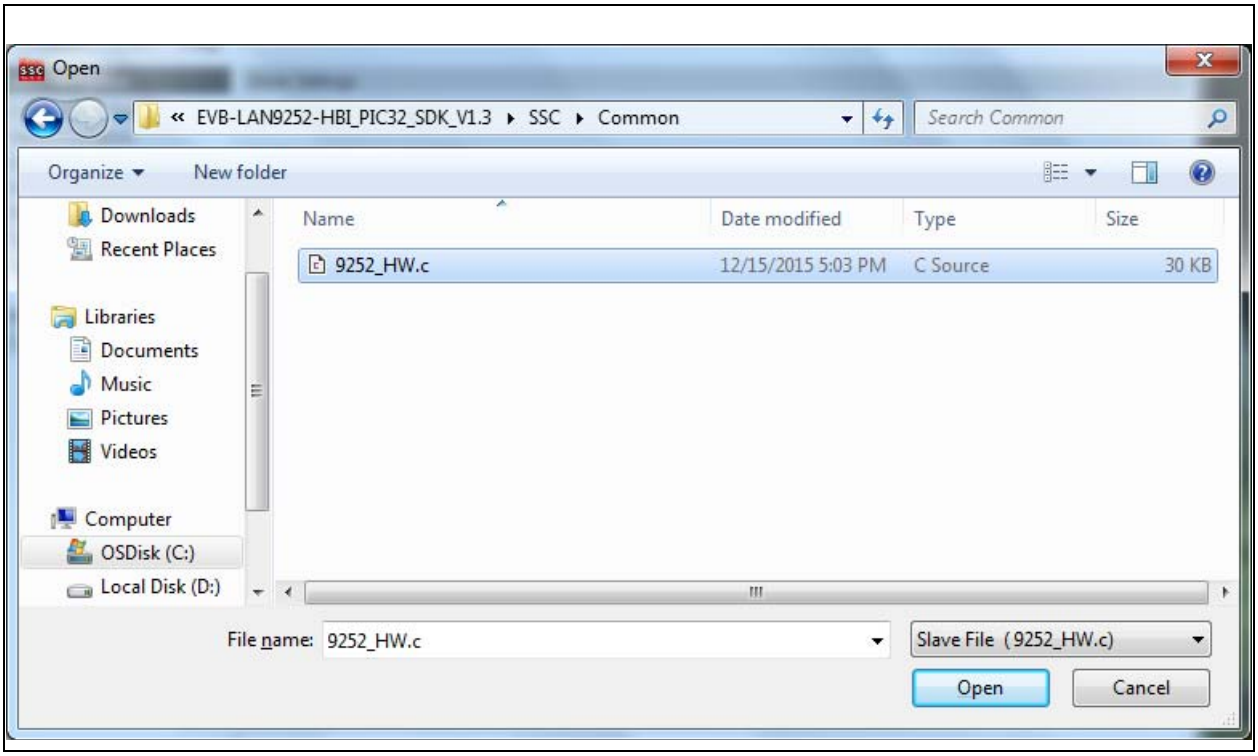


A file selection dialog displays.

9. Locate the **`9252_HW.c`** file, as displayed in Figure 19.

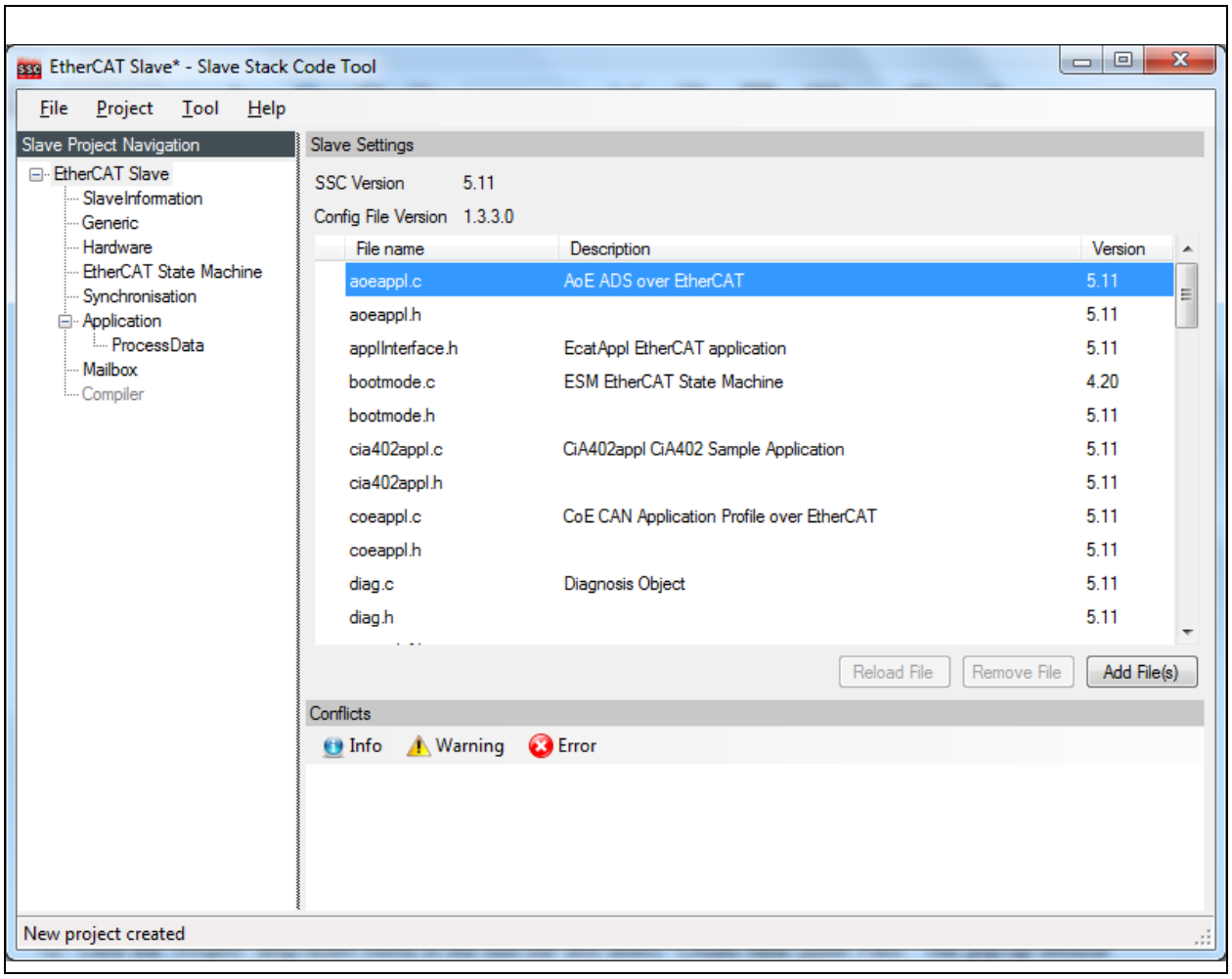
   This is available in the directory:
   `{SDK_INSTALL_PATH}/EVB-LAN9252-HBI_PIC32_SDK_V1.3/SSC/Common`.

FIGURE 19: SSC TOOL 9252_HW.C SELECTION



Once the 9252_HW.c file has been added, the SSC Tool window displays, as in Figure 20.

FIGURE 20: SSC TOOL NEW PROJECT CREATED

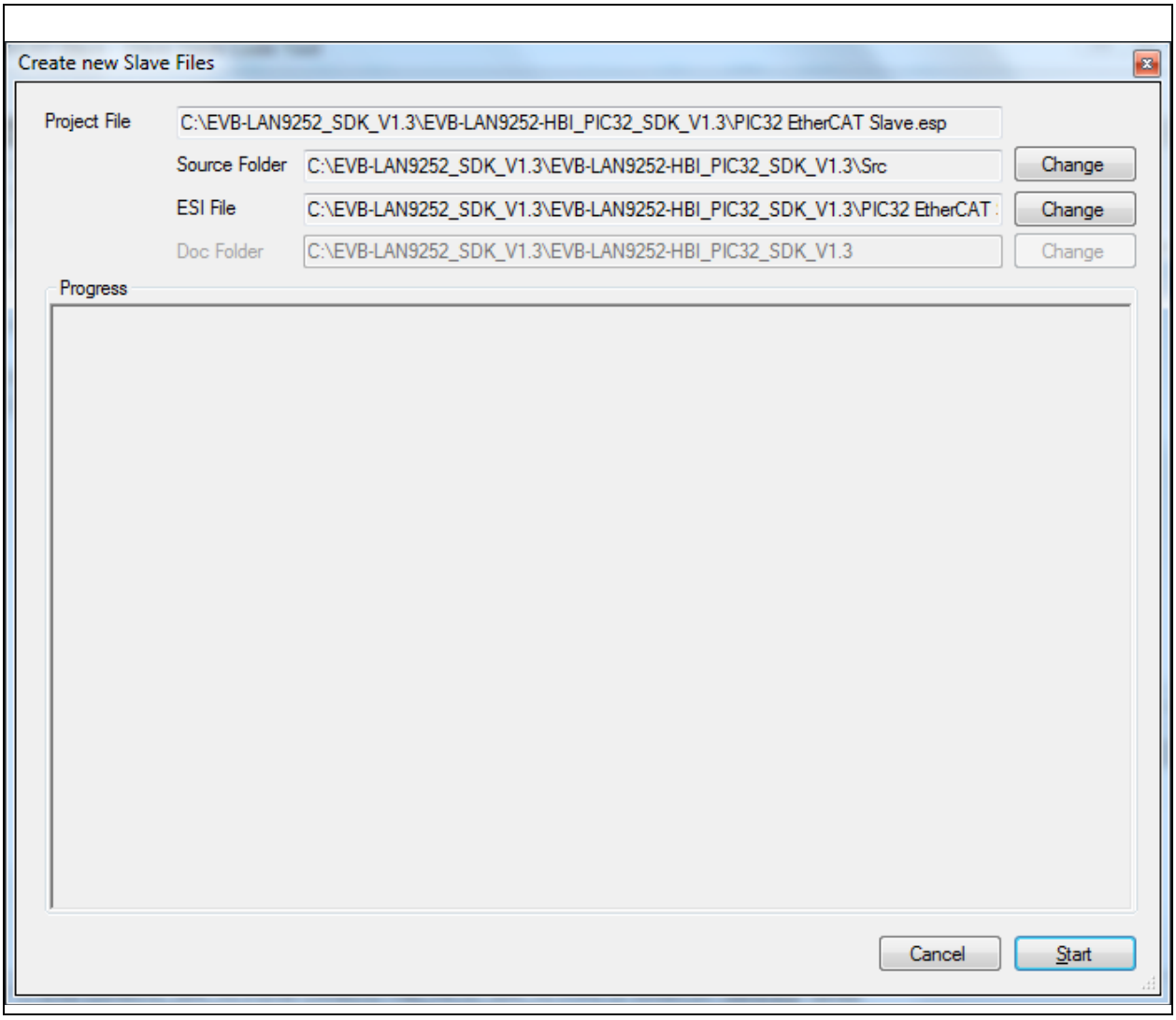


As displayed above in Figure 20, the left panel contains multiple categories where the Slave Stack Code can be configured. Refer to the “Help” menu in the tool bar for additional configuration information.

10. From the menu bar, click *Project>Create New Slave Files*.

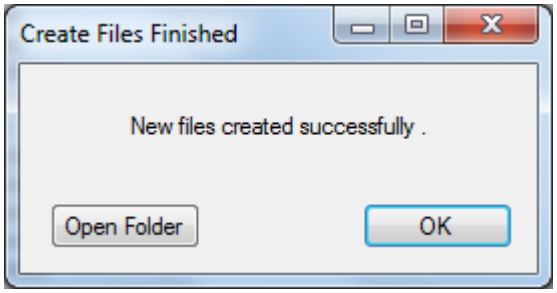
The Create new Slave Files window displays, as in Figure 21.

FIGURE 21: SSC TOOL CREATE NEW SLAVE FILES



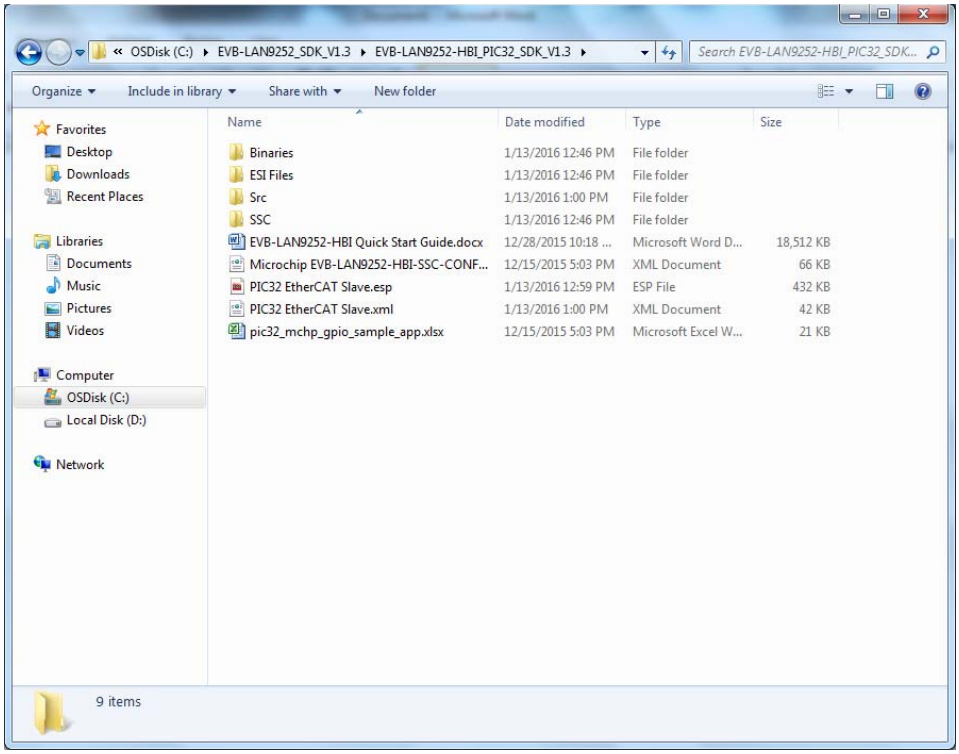
11. Click the **Start** button to create a new Project File, Source Folder, and ESI File in the specified Doc Folder. A pop-up window displays to indicate that the files have been successfully created, as in Figure 22.
12. Click **OK** to continue.

FIGURE 22: SSC TOOL FILE CREATION DIALOG



13. Browse to the directory where the new files were created, as displayed in the example:
    - `Src (Folder)` - This folder contains the Beckhoff Slave Stack code.
    - `PIC32 EtherCAT Slave (ESP)` - This is the SSC Tool project file.
    - `PIC32 EtherCAT Slave (XML)` - This is the EtherCAT slave information file that must be used as an input to the EtherCAT master tool to configure EtherCAT slave controllers.

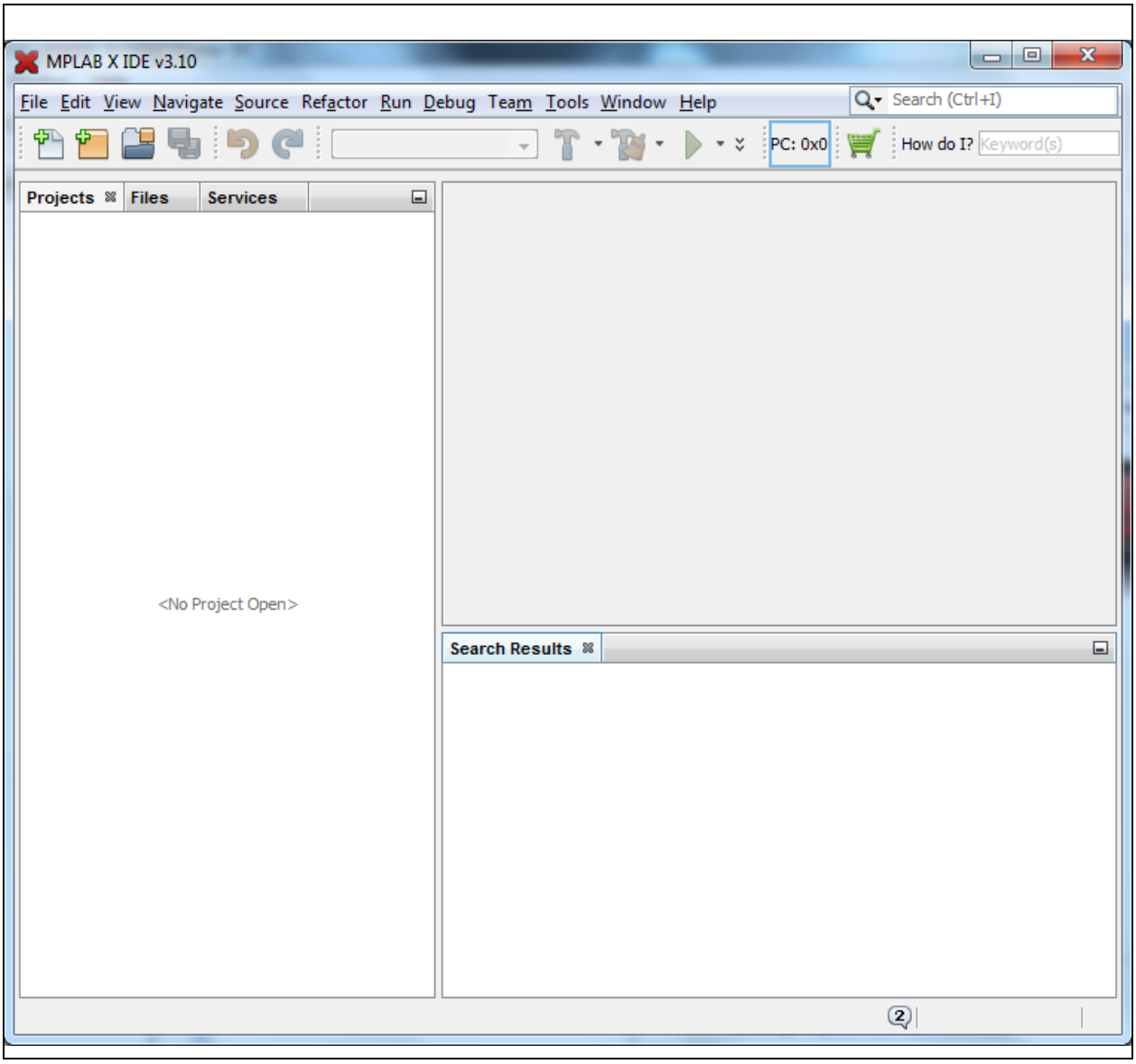
FIGURE 23: NEW SLAVE FILES



14. Copy all the files from the `Src` folder to the following directory:
    `{SDK_INSTALL_PATH}/EVB-LAN9252-HBI_PIC32_SDK_Vx.x/SSC/Common`
15. Start MPLAB X IDE, as displayed in Figure 24.

Note: If MPLAB X IDE has not been installed, it can be obtained from the Microchip website.

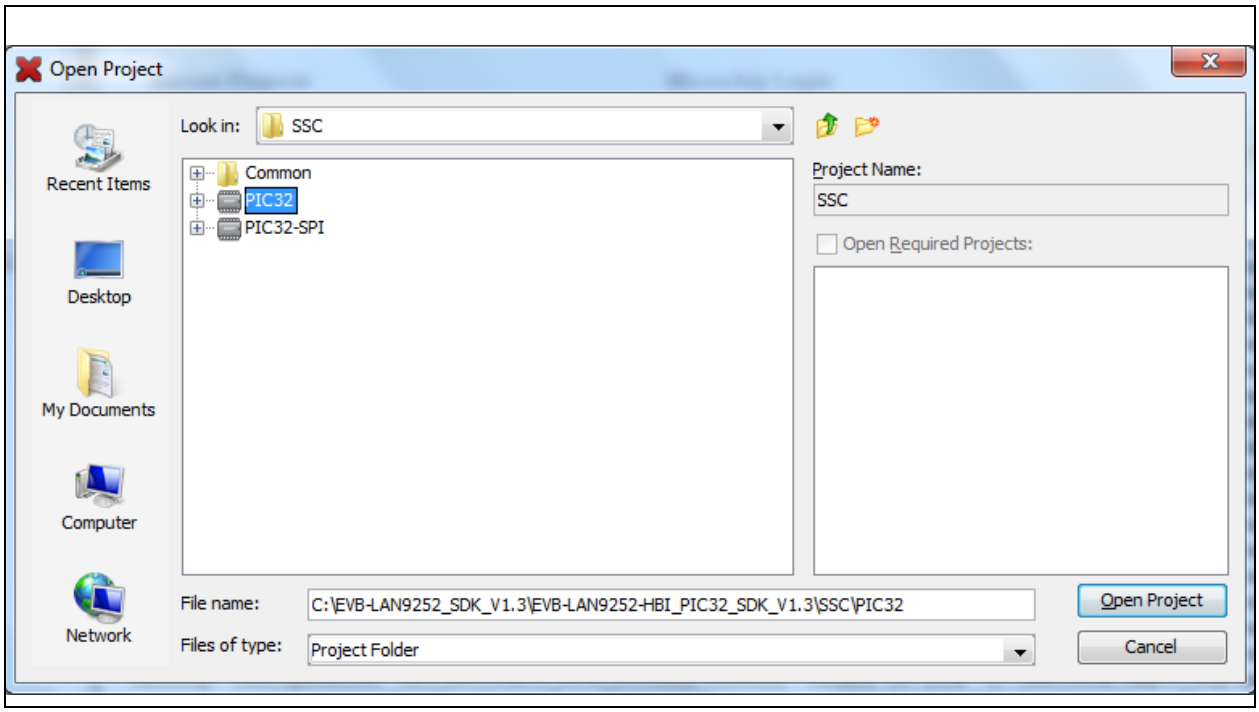
FIGURE 24: MPLAB X IDE



16. Click *File>Open Project*.

17. Select the appropriate project: PIC32 (HBI Interface) or PIC32-SPI (SPI Interface), and then click **Open**.

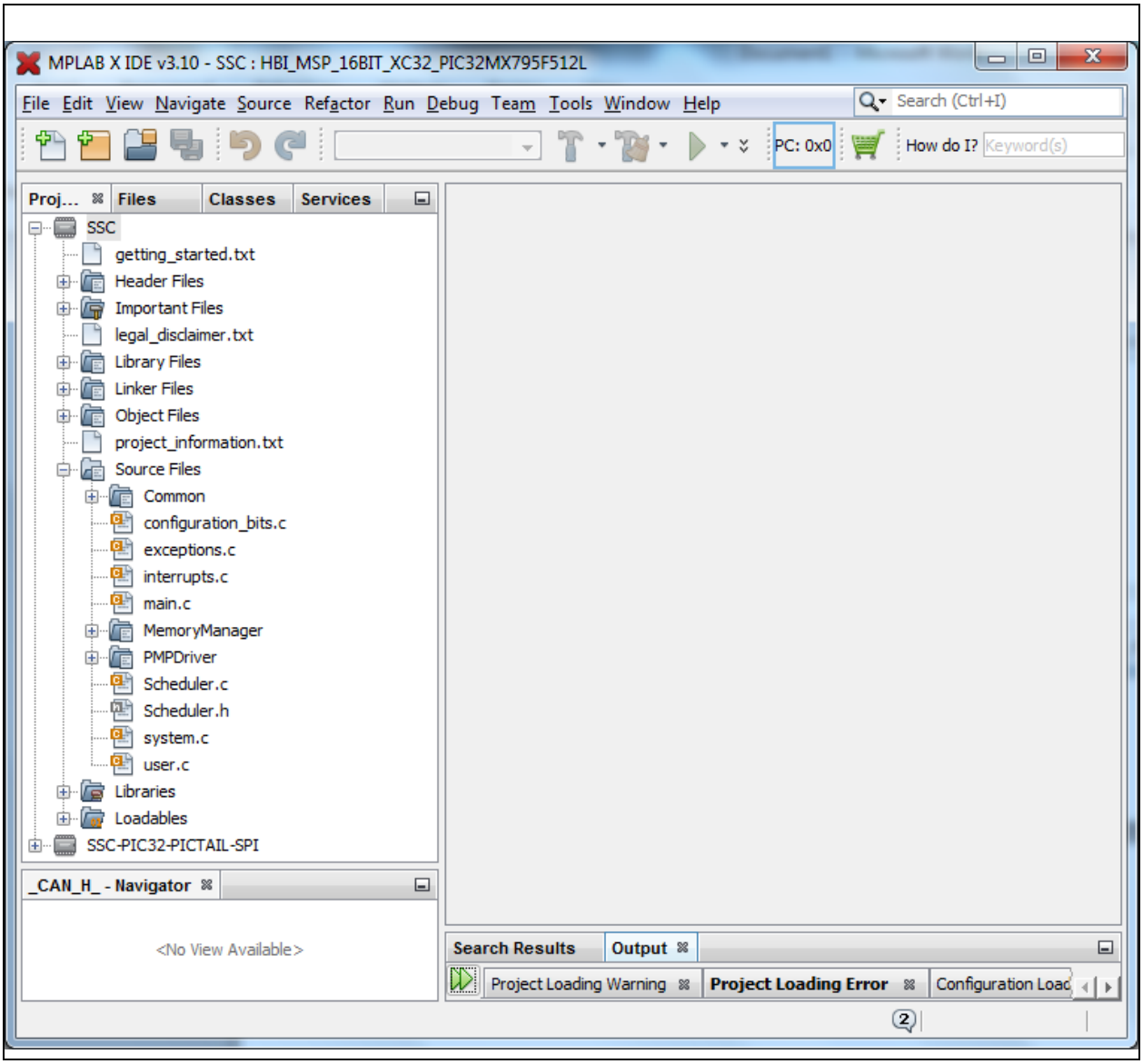
FIGURE 25: MPLAB X IDE OPEN PROJECT



After loading the project, the MPLAB X IDE interface should appear as displayed in Figure 26.

18. Ensure the HAL header file (`9252_HW.h`) is included in the following C source files:
    - `9252_HW.c`
    - `ecatappl.c`
    - `ecatslv.h`
    - `main.c`

FIGURE 26: MPLAB X IDE PROJECT LOADED

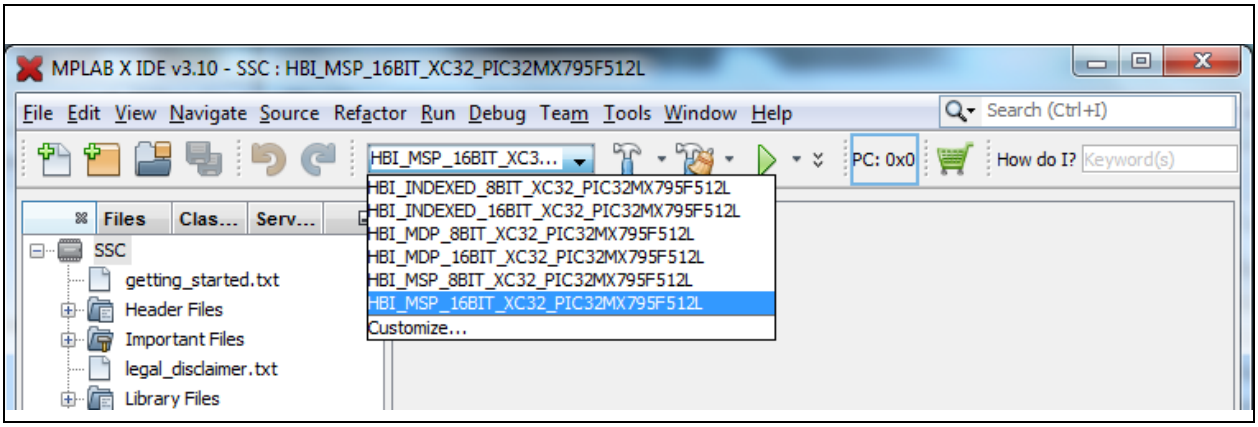


19. Select the appropriate configuration from the drop-down list displayed in Figure 27.

    The `ReadMe.txt` file in the SDK directory provides descriptions of the drop-down list contents.

Note: The selected configuration should match the EVB configuration as well as the configuration selected in Figure 16.

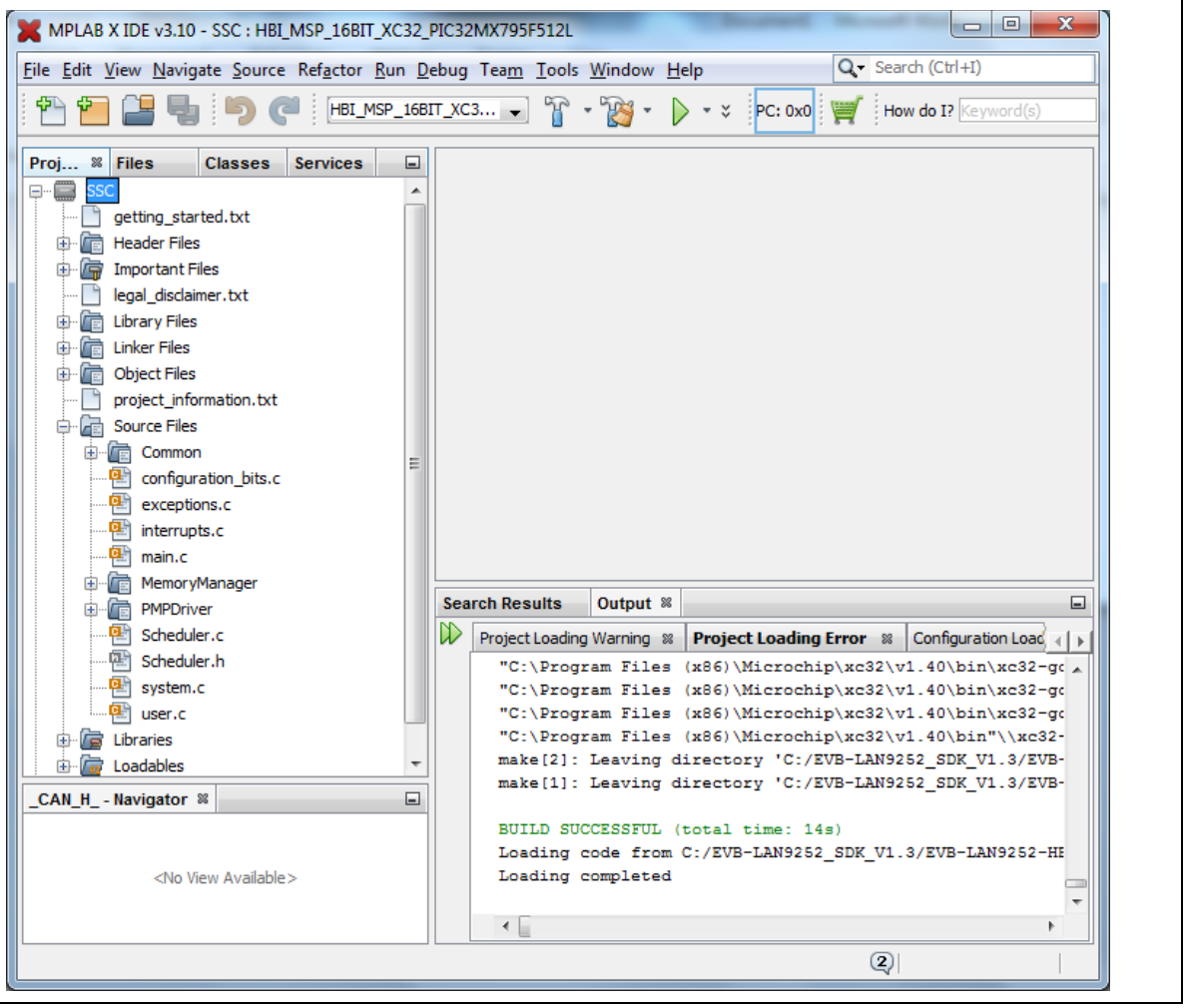
FIGURE 27: MPLAB X IDE CONFIGURATION SELECTION



20. Click the **Clean and Build Project** button (hammer and brush icon) to build the project.

If the project is built successfully, the debug message should display “BUILD SUCCESSFUL”, as displayed in Figure 28.

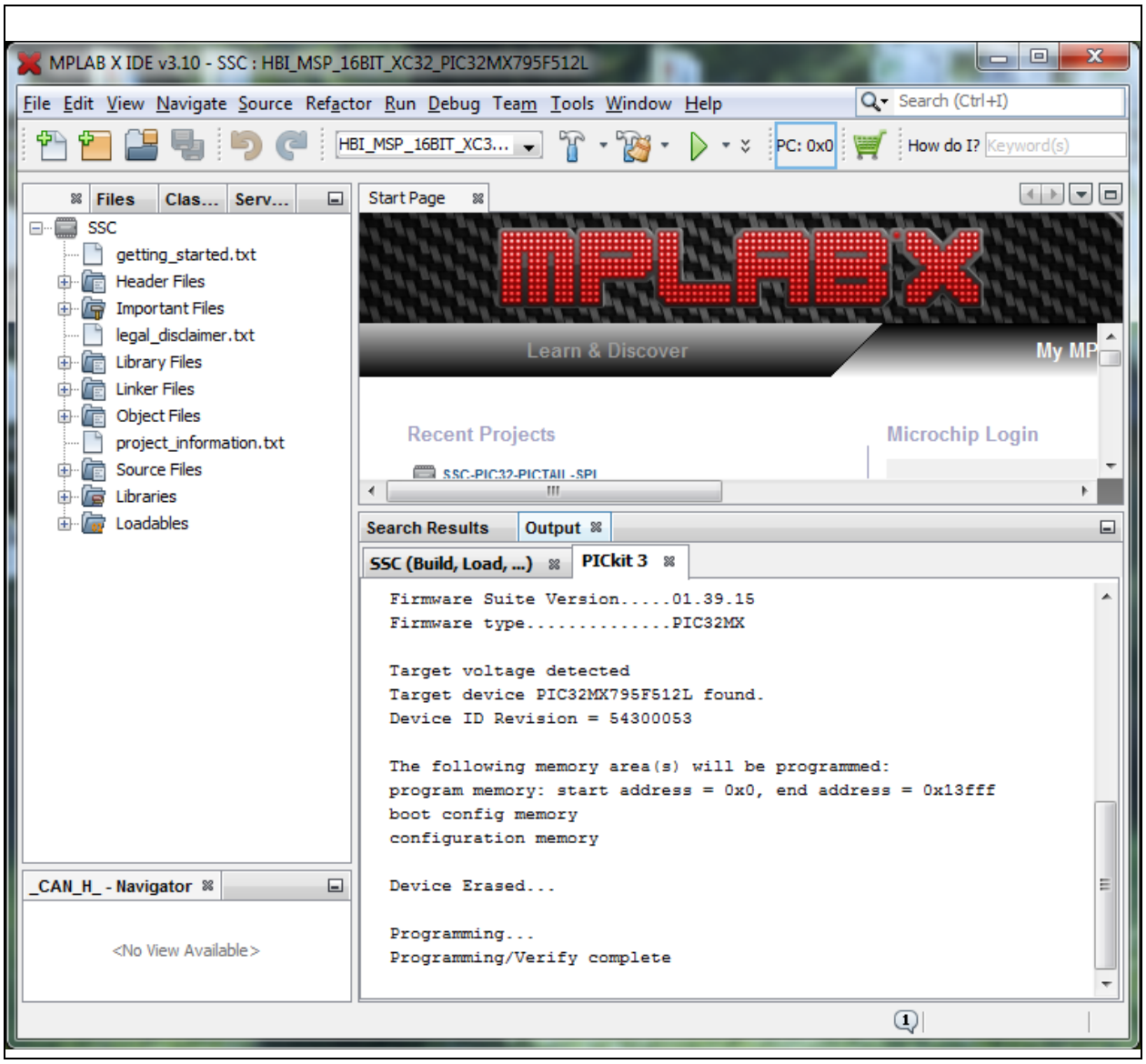
FIGURE 28: MPLAB X IDE CLEAN AND BUILD PROJECT



21. Connect the PICKit3 debugger to the EVB-LAN9252-HBI evaluation board.
22. Click the **Make and Program Device** button (rectangular box with downward facing arrow icon), as displayed in Figure 29.

This will program the PIC microcontroller.

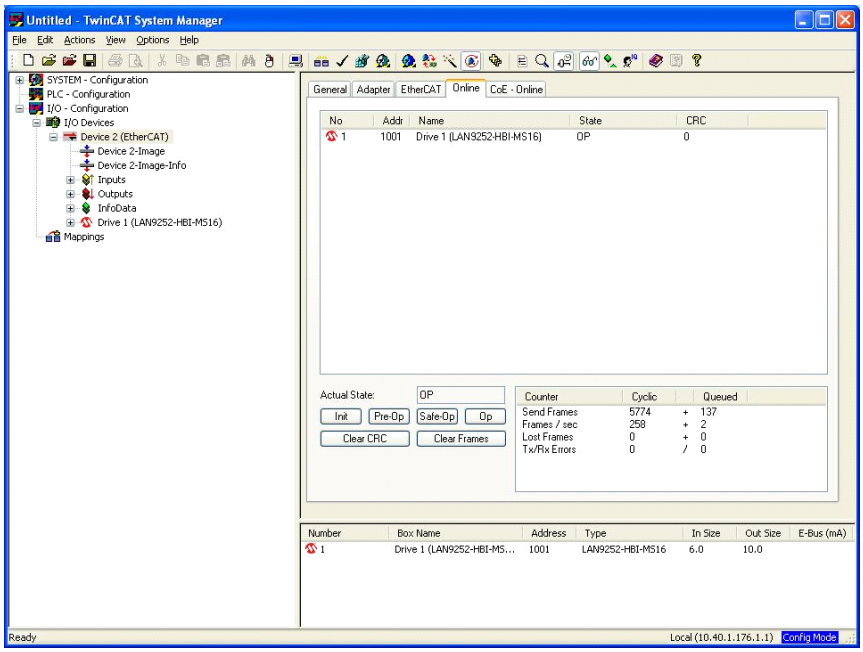
FIGURE 29: MPLAB X IDE MAKE AND PROGRAM DEVICE



The ESI file (.XML) will be generated from the SSC tool in the same directory as the C source files. This ESI file has to be programmed into LAN9252 EEPROM using the TwinCAT. Once the EEPROM programming is complete, the controller state changes to “OP” as displayed in Figure 30.

Note: Refer to *EVB-LAN9252-HBI Software Quick Start Guide* (http://ww1.microchip.com/downloads/en/DeviceDoc/50002425A.pdf) for further details.

FIGURE 30: TWINCAT MASTER VIEW



APPENDIX A: APPLICATION NOTE REVISION HISTORY

TABLE A-1: REVISION HISTORY

Revision Level & Date	Section/Figure/Entry	Correction
DS00001916B (01-29-16)	Throughout document.	Updated all instances of EtherCAT so only title and first instance has the registered trademark symbol.
	Trademarks on page 25.	Updated entire page.
	Introduction on page 1	Updated last paragraph.
	Software Requirements on page 2	Updated second bulleted item.
	Table 1, “Terms and Abbreviations,” on page 2	Corrected definition of EVB.
	SDK Directory Structure on page 3	Updated section.
	FIGURE 2: LAN9252-PIC32_SDK_V1.3 Folder Contents on page 3	Updated image.
	FIGURE 3: ESI Files Folder Contents on page 3	Updated image.
	Building a Full-Featured EtherCAT Application on page 4	Updated title to include hyphen. Updated section.
	FIGURE 4: SSC Folder Contents on page 4	Updated image.
	SSC Tool on page 8	Updated section.
	FIGURE 14: SSC Tool New Project on page 9	Updated image.
	FIGURE 15: SSC Tool New Project Import on page 9	Updated image.
	FIGURE 16: SSC Tool New Project Custom on page 10	Updated image.
	FIGURE 17: SSC Tool External File Confirmation on page 10	Updated image.
	FIGURE 18: SSC Tool 9252_HW.c Confirmation on page 11	Updated image.
	FIGURE 19: SSC Tool 9252_HW.c Selection on page 11	Updated image.
	FIGURE 20: SSC Tool New Project Created on page 12	Updated image.

TABLE A-1: REVISION HISTORY (CONTINUED)

Revision Level & Date	Section/Figure/Entry	Correction
DS00001916B (01-29-16) [continued]	FIGURE 21: SSC Tool Create New Slave Files on page 13	Updated image.
	FIGURE 22: SSC Tool File Creation Dialog on page 13	Updated image.
	FIGURE 23: New Slave Files on page 14	Updated image.
	FIGURE 24: MPLAB X IDE on page 15	Updated image.
	FIGURE 25: MPLAB X IDE Open Project on page 16	Updated image.
	FIGURE 26: MPLAB X IDE Project Loaded on page 17	Updated image.
	FIGURE 27: MPLAB X IDE Configuration Selection on page 18	Updated image.
	FIGURE 28: MPLAB X IDE Clean and Build Project on page 19	Updated image.
	FIGURE 29: MPLAB X IDE Make and Program Device on page 20	Updated image.
DS00001916A (04-10-15)	Initial release.	

THE MICROCHIP WEB SITE

Microchip provides online support via our WWW site at www.microchip.com. This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the web site contains the following information:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQ), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

CUSTOMER CHANGE NOTIFICATION SERVICE

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- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

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Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
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═ ISO/TS 16949 ═

Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

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