



MICROCHIP

LAN9252-SAME54 EtherCAT Application Quick Start Guide

Introduction

This document describes how to use the EVB-LAN9252-PICtail™ Software Development Kit as a development tool for the Microchip EVB LAN9252 EtherCAT® slave controller.

The following abbreviations are used in this Document:

- IDE - Integrated Development Environment
- ESC - EtherCAT Slave Controller
- EVB - Engineering Validation Board
- HAL - Hardware Abstraction Layer
- SPI - Serial Protocol Interface
- SSC - Slave Stack Code

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1. EtherCAT Pin Connection Guide Details

1.1 EtherCAT on SAME54

This document describes the hardware setup and I/O pin connections between the SAME54 Xplained Pro evaluation kit ([Part Number: ATSAME54-XPRO](#)) and the EVB-LAN9252-PICTail add-on board ([Part Number: EVB-LAN9252-PICTAIL](#)) through the Starter Kit I/O expansion board ([Part Number: DM320002](#)) required to run the EtherCAT solution on the SAME54 device.

This document provides a brief information about the development board, PICTail board, evaluation kits, respective I/O pins, and connectors required for this evaluation setup.

For detailed information and schematics for each of the boards described above, refer to the respective user guide's and Information sheets which are available for download from the following location:

- SAME54 Xplained Pro Evaluation Kit User Guide: <http://ww1.microchip.com/downloads/en/DeviceDoc/70005321A.pdf>
- EVB-LAN9252-PICTail Add-on Board User Guide: <http://ww1.microchip.com/downloads/en/DeviceDoc/50002427A.pdf>
- Starter Kit I/O Expansion Board Information Sheet: <http://ww1.microchip.com/downloads/en/DeviceDoc/51950B.pdf>

1.2 Hardware Setup

Soldering the required pins using smaller strands of wire is recommended, as shown in the following figure. The use of fly wires will cause SPI high frequency signal integrity issues.

Figure 1-1. SPI and Interrupt Pin HW Setup

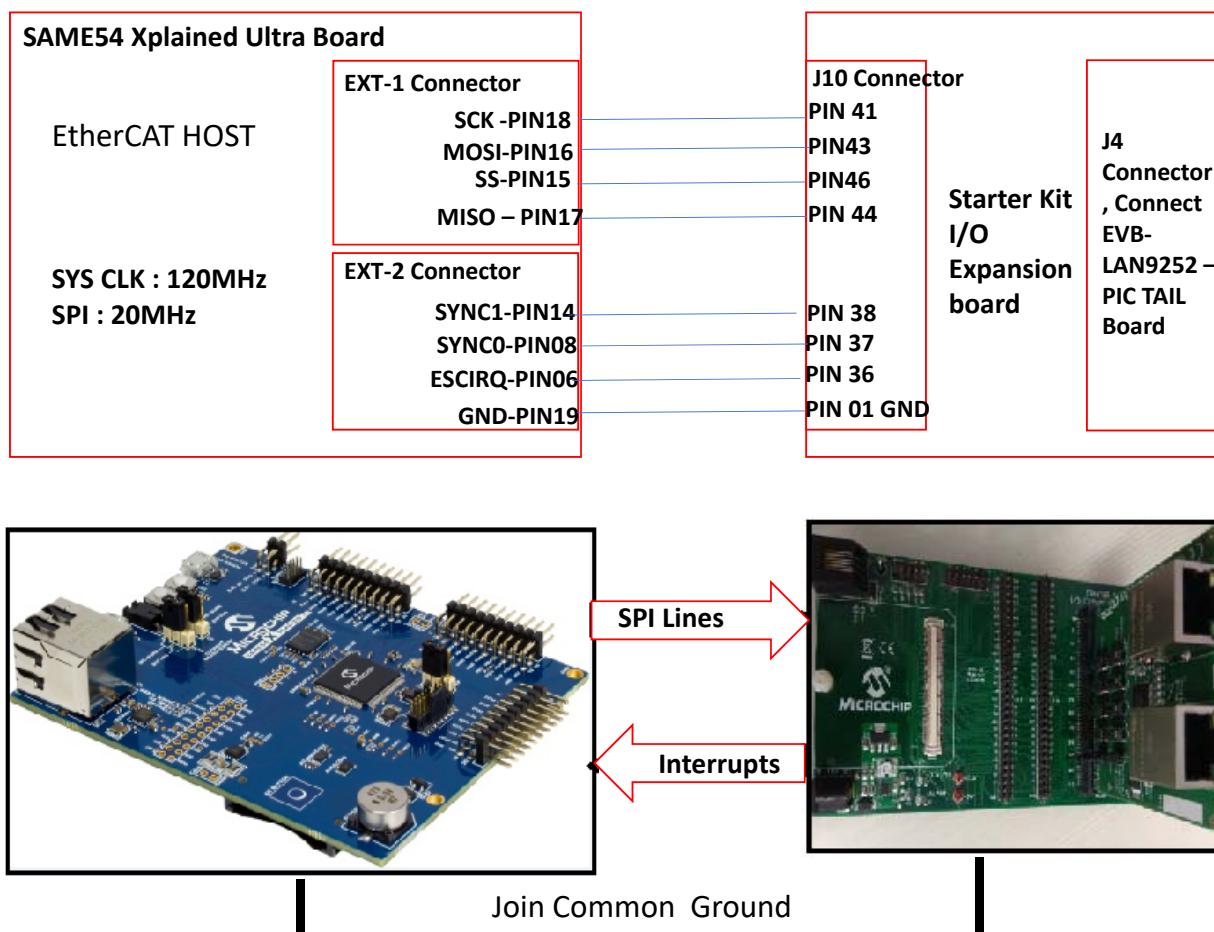


Table 1-1. SPI and Interrupt Board-to-Board Fly Wire Pin Connection

Functions	SAME54 Port Pins (Header-Pin)	Starter Kit I/O Expansion Board Pin Connections		LAN9252 EVB Pic-Tail Pin Connections
		J10 Test Point Headers	J4 Edge Connector	J1 Edge Connector
SPI SCK	PB26 (EXT1-18)	41	3	3 (SCK)
SPI MOSI	PB27 (EXT1-16)	43	7	7 (SDI)
SPI SS	PB28 (EXT1-15)	46	1	1 (CS)
SPI MISO	PB29 (EXT1-17)	44	5	5 (SDO)
SYNC1	PB16 (EXT2-14)	38	17	17 (SYNC1)
SYNC 0	PB15 (EXT2-8)	37	18	18 (SYNC 0)
ESCI IRQ	PB06 (EXT2-6)	36	49	49 (ESCI IRQ)

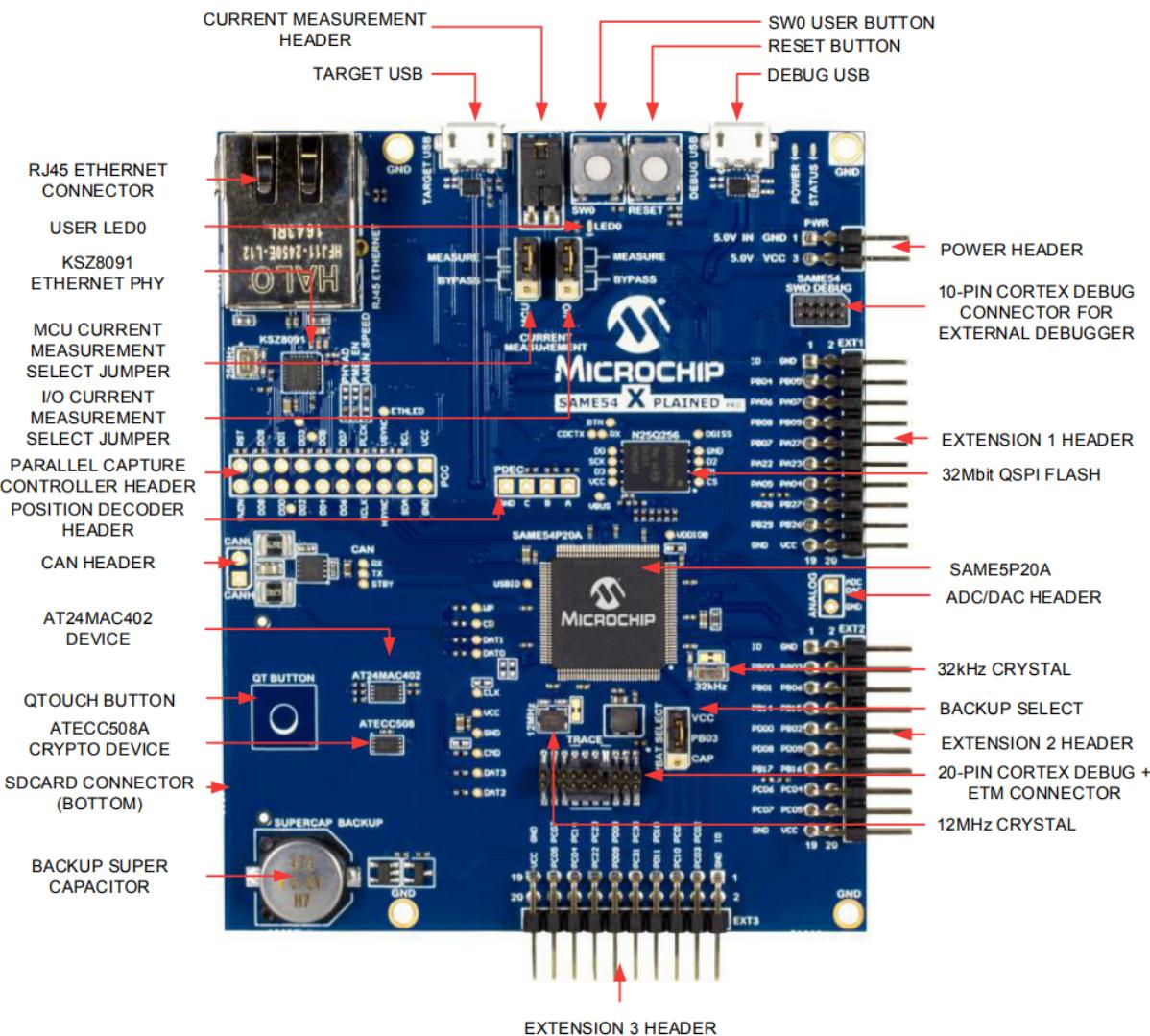
Users need to ensure that both the boards are on common GND.

1.3 SAME54 Xplained Pro Overview

The SAM E54 Xplained Pro evaluation kit is a hardware platform to evaluate the ATSAME54P20A.

The evaluation kit offers a set of features that enables the ATSAME54P20A users to get started with the SAM E54 peripherals and to have an understanding of how to integrate the device in their design.

Figure 1-2. SAM E54 Xplained Pro Evaluation Kit



1.4 EVB-LAN9252-PICTail Add-On Board

The EVB-LAN9252-PICTail add-on board is used for evaluating Microchip's LAN9252, a 2/3-port EtherCAT slave controller with dual integrated Ethernet PHYs.

Features

- The EVB-LAN9252-PICTail add-on board supports the option to select HBI PDI and SPI/SQI configurations

EtherCAT Pin Connection Guide Details

- An onboard EEPROM to configure the EtherCAT slave configuration
- The EVB-LAN9252-PICTail add-on board supports two Integrated PHY's through on board RJ45 Connectors

Figure 1-3. EVB-LAN9252-PICTAIL ADD-ON BOARD

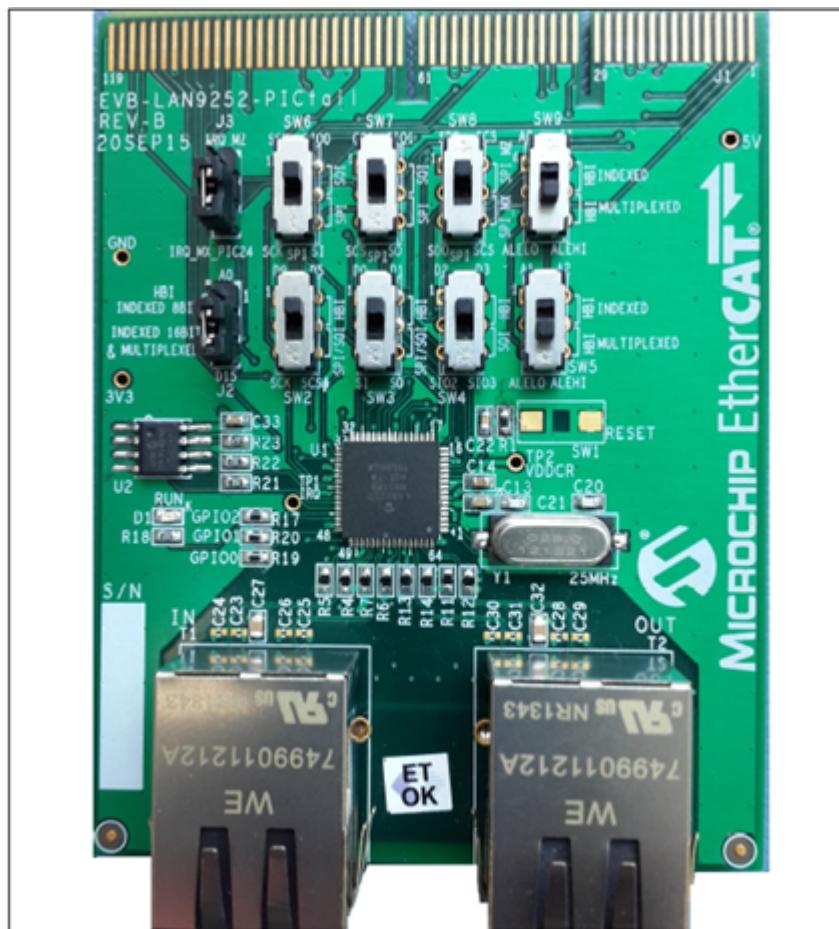
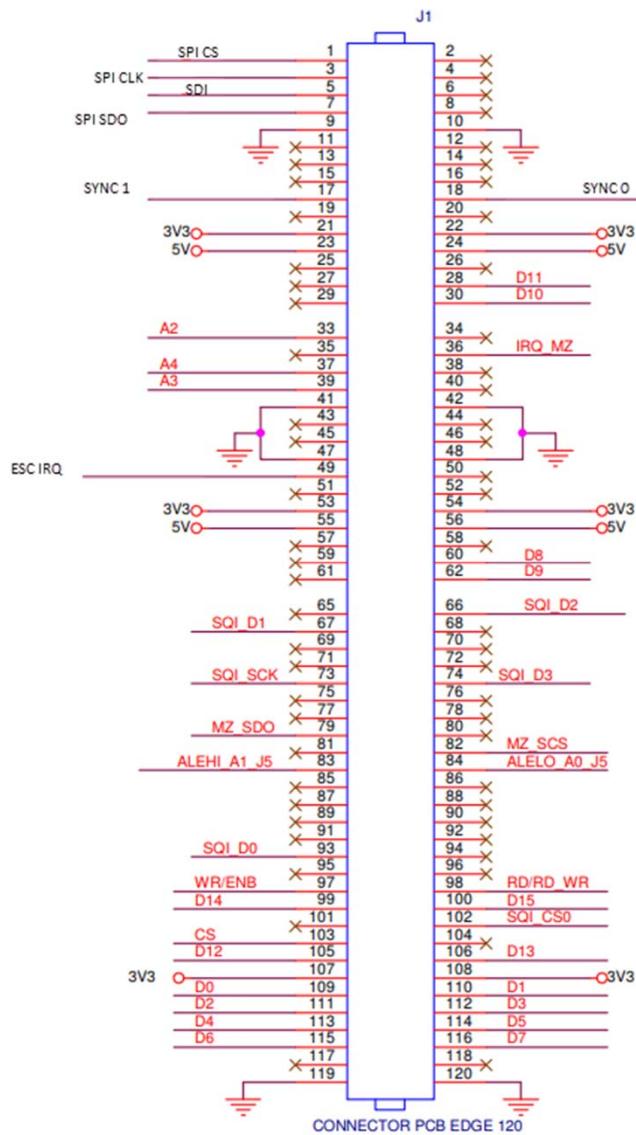


Figure 1-4. EVB-LAN9252-PICTail™ Add-On Board Edge Connector J1



1.5 Starter Kit I/O Expansion Board

The Starter Kit I/O expansion board provides the starter kit and starter board users with full access to MCU signals, additional debug headers, and connection of PICtail Plus daughter cards. The MCU signals are available for attaching prototype circuits, or monitoring signals with logic probes.

Figure 1-5. Starter Kit I/O Expansion Board

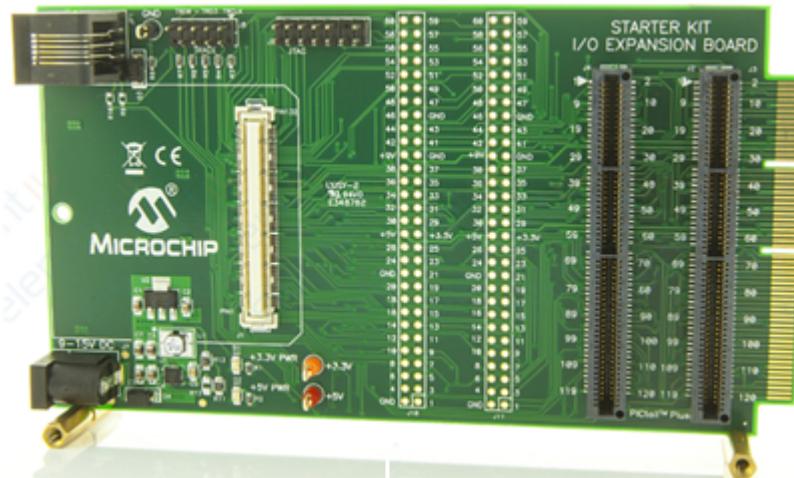


Figure 1-6. Starter Kit I/O Expansion Board J4 Connector

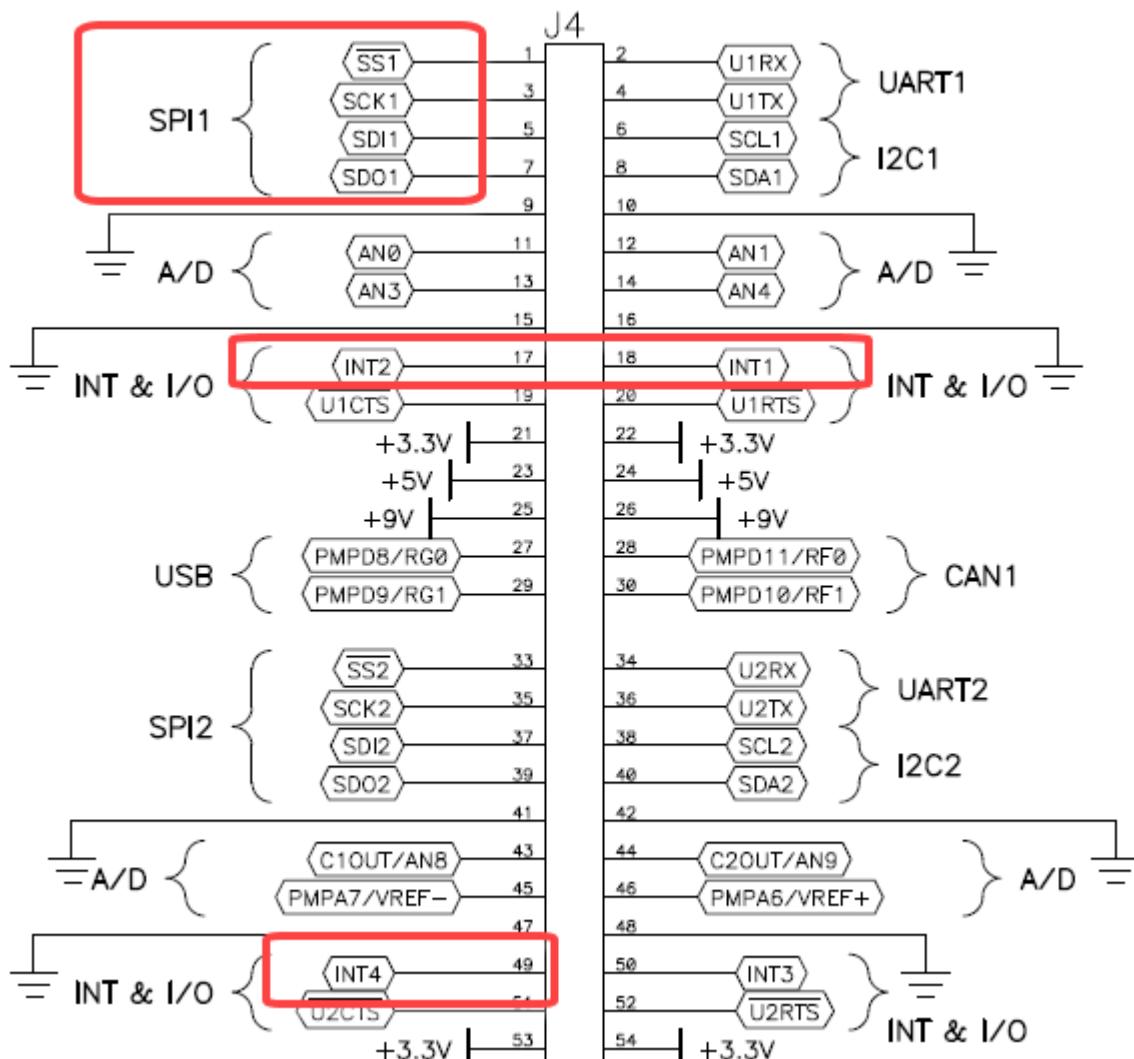
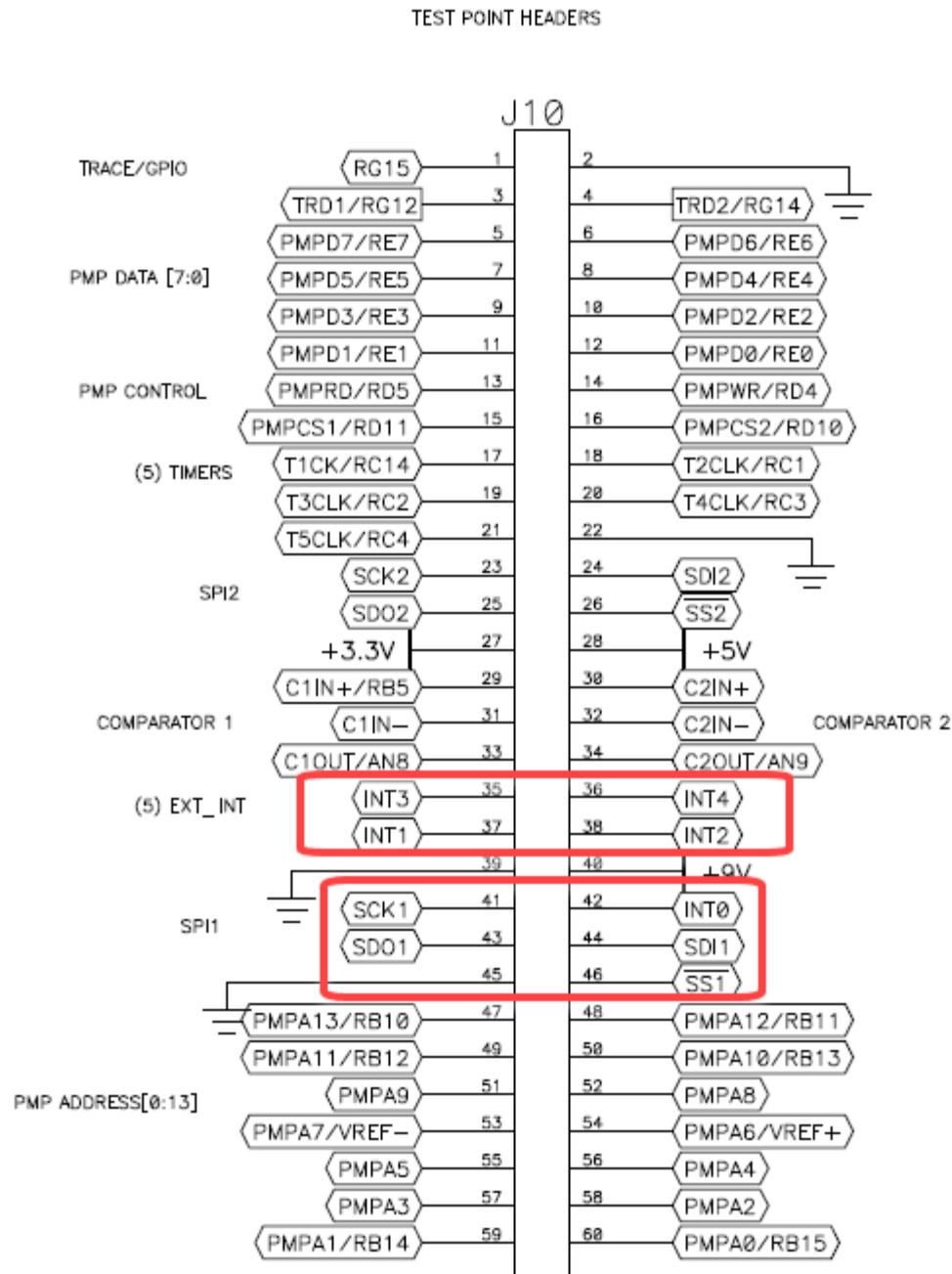


Figure 1-7. Starter Kit I/O Expansion Board J10 Connector



1.6 LAN9252 PICTAIL PLUS and I/O expansion INTERFACE

Plug in the EVB-LAN9252-PICTail add-on board J1 edge connector to the topmost position of the J4 slot on the Starter Kit I/O expansion board, as shown in the following figure.

EtherCAT Pin Connection Guide Details

Figure 1-8. LAN9252 PICTAIL-I/O Expansion Interface



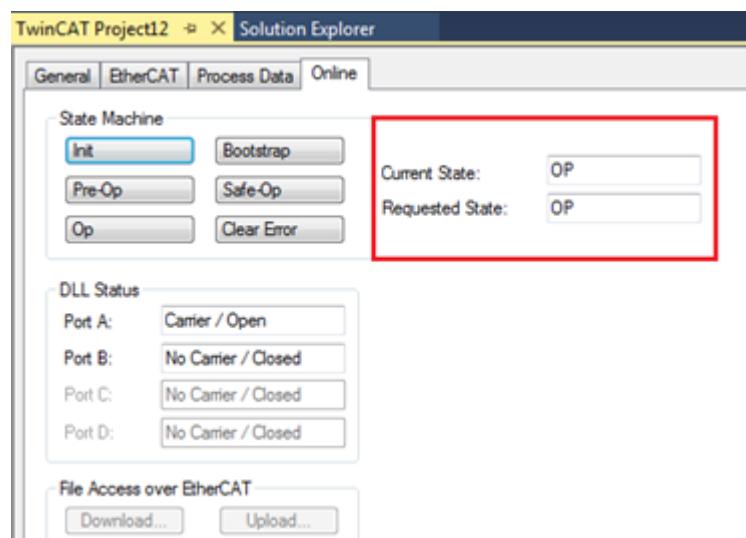
2. EVB LAN9252-PICTail Add On Board (SPI Mode)

2.1 EtherCAT Master and Slave Configuration

The following steps describe how to configure the EtherCAT master and slave.

1. Configure the master with the TwinCAT driver.
Note: Refer to [Appendix A](#) for information on Windows® configuration.
2. Unzip and extract the `LAN9252-SAME54-SDK-Vx.x.zip` file.
Note: Vx.x denotes the version number of the SDK.
3. In SDK, `\ESI\Files` directory contains the ESI file, which can be loaded to the EVB LAN9252-PICTail EEPROM using the TwinCAT utility, SAME54 EtherCAT slave.xml.
Note: Refer to [Appendix D](#) to change the vendor ID and the slave information in the ESI files.
4. Copy the `Microchip_LAN9252_SSC_Config.xml` file to the directory path: `C:\TwinCAT\3.1\Config\0\EtherCAT` for TwinCAT 3.1.
5. Configure the evaluation board in SPI mode. Refer to the EVB-LAN9252-PICTail Add-on Board User's Guide for additional information on configuration: <http://ww1.microchip.com/downloads/en/DeviceDoc/50002427A.pdf>.
6. To program the default ESI file of the SAME54 firmware for the SAME54 controller, refer to [Appendix D](#) and [Appendix E](#).
Note: The pre-built binaries are available in the Binaries directory.
7. Launch TwinCAT and then scan the EtherCAT slaves from TwinCAT. Refer to [Appendix C](#) for information on how to scan the slaves.
8. Program the EEPROM using the SAME54 EtherCAT Slave.xml file. Refer to [Appendix B](#) before programming the EEPROM. If the EEPROM is programmed successfully, the device state will enter into OP mode as shown below.

Figure 2-1. Device OP Mode



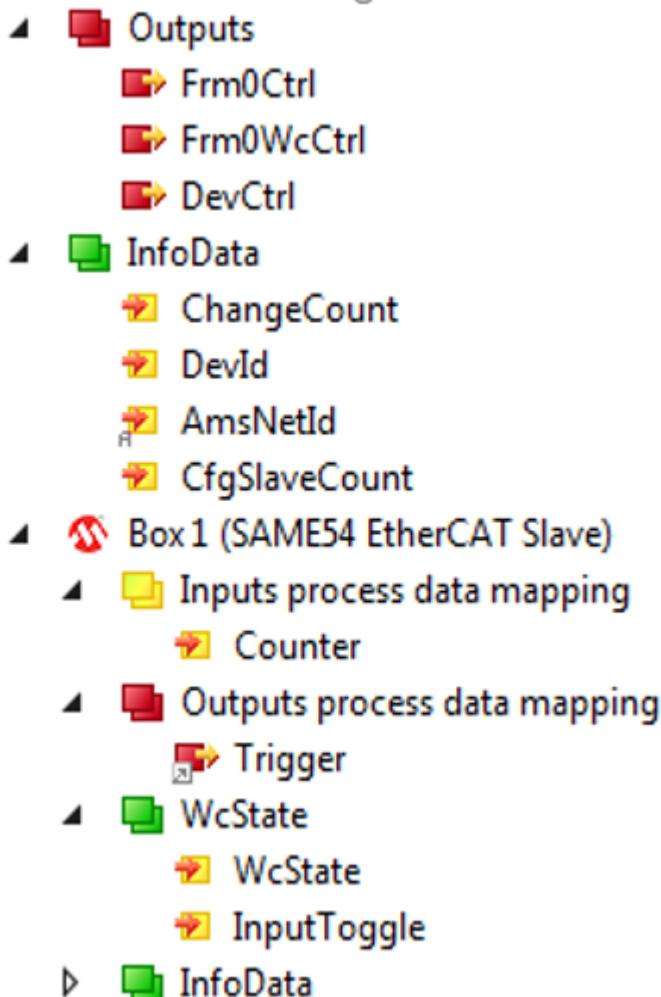
9. Once the EEPROM is programmed successfully, the state of the device will change to OP mode.
Note: If the device changes to OP mode, then the device is in an operational state. If the device is not in OP mode, then there is an issue with the setup.

2.2 Demonstration

This section describes the demonstration of the EVB-LAN9252-PICTail in SPI mode.

- Follow the steps as provided in [EtherCAT Master and Slave Configuration](#). There is one input and one output. The object variable can be seen in the solution explorer of the TwinCAT tool as shown in the following figure.

Figure 2-2. EtherCAT Slave Variable Addition



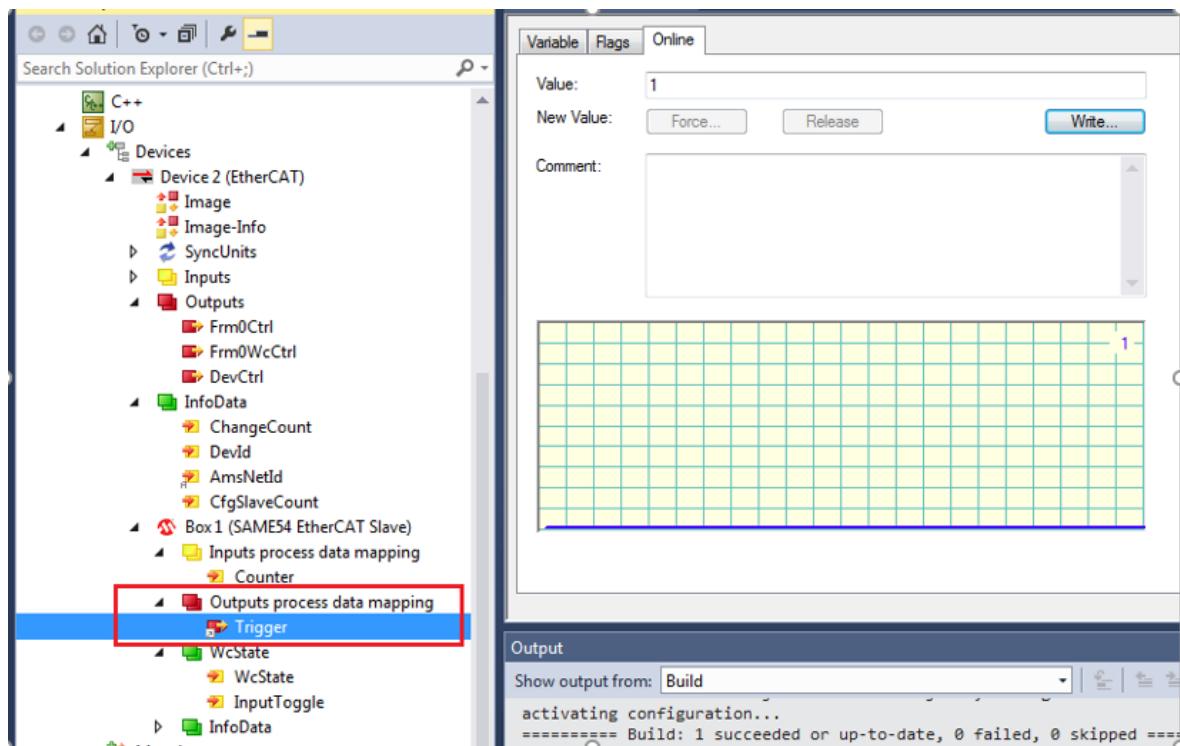
As part of this demonstration, two object variables are available and are described in the following table.

Table 2-1. Output Process Variable

Counter	Value of Counter is determined based on Trigger value. If the Trigger value is 0, then the Counter is cleared.
Trigger	Trigger value is used to determine the value of the Counter.

- To change the Trigger value, click on the Trigger which is available under 'Output process data mapping' in the Search Solution Explorer window as shown below. The TwinCAT project window will be displayed.

Figure 2-3. Twincat Project Window



3. Change the Trigger value to a *five* or zero as shown in the following figure (The Trigger value can be anything. The Trigger value used here is only an example).

Figure 2-4. Initial Trigger Variable

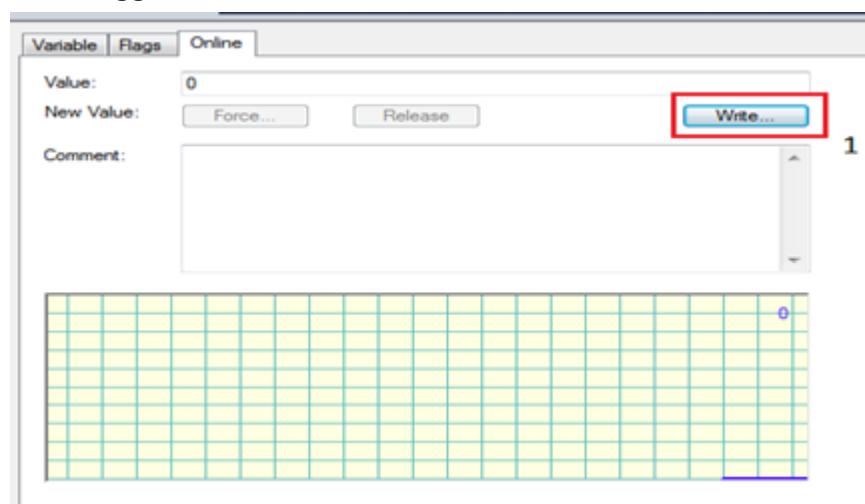
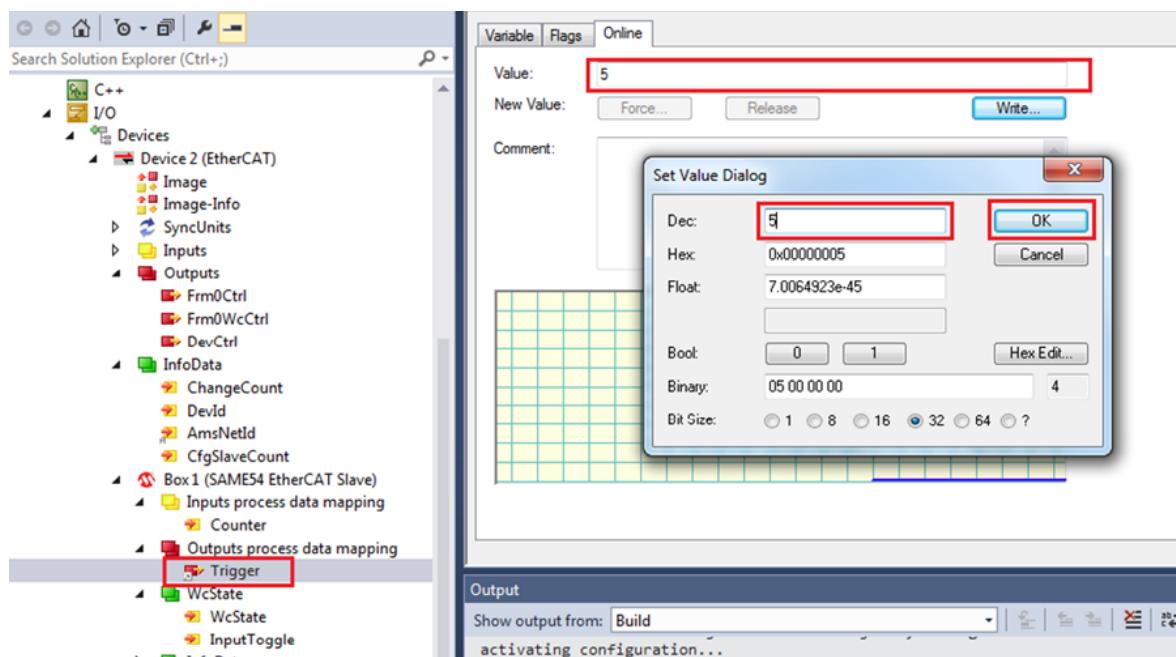
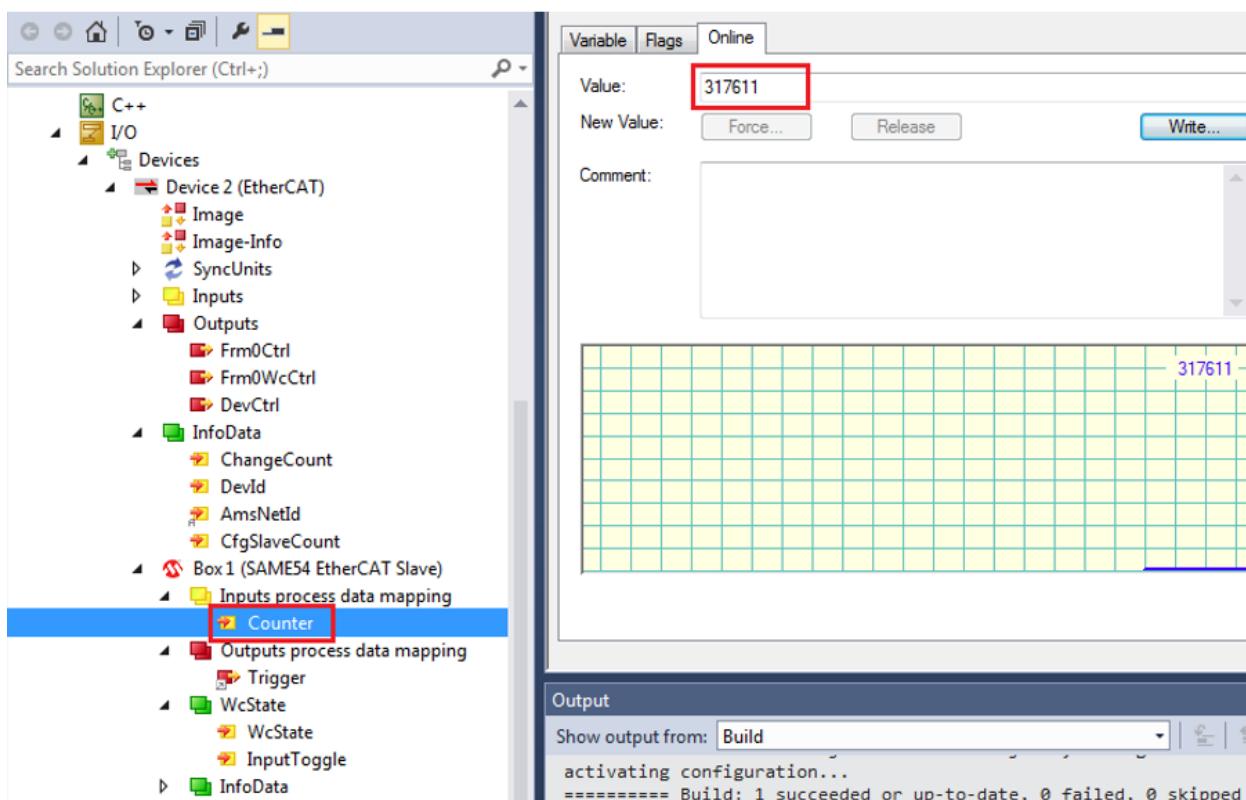


Figure 2-5. Configure Trigger Variable



4. The Counter value will be incremented based on the Trigger value as shown in the following figure. (The Counter value will not be a stable value, and will keep the increment based on the Trigger value. The following figure is shown as an example).

Figure 2-6. Counter Output



3. Appendix A

Setting up Master in Windows

To setup master in Windows, follow these steps:

1. Download and install TwinCAT 3.1 on Windows from the following location: <http://beckhoff.com/>.
2. TwinCAT Ethernet driver installation:
 - If the TwinCAT tool is installed successfully, a TwinCAT icon will be shown in bottom-right corner of the desktop. After clicking the icon, a pop-up window will be displayed. Select *TwinCAT XAE (VS XXXX)* as shown in the following figure.

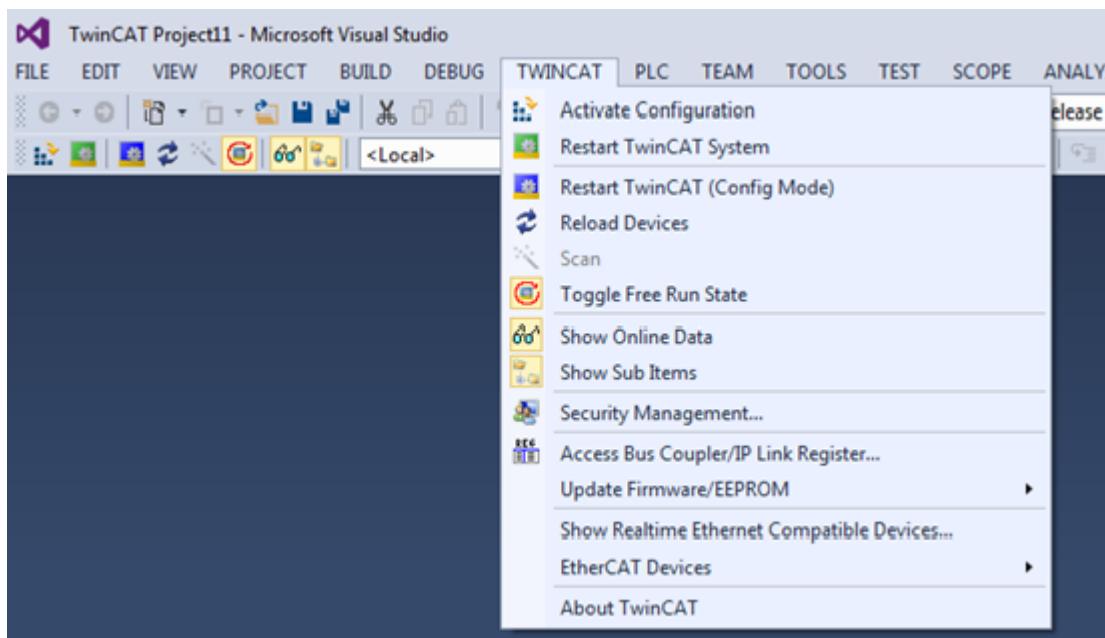
Note: VS XXXX refers to version of the Visual Studio installed on the computer.

Figure 3-1. TwinCAT Manager

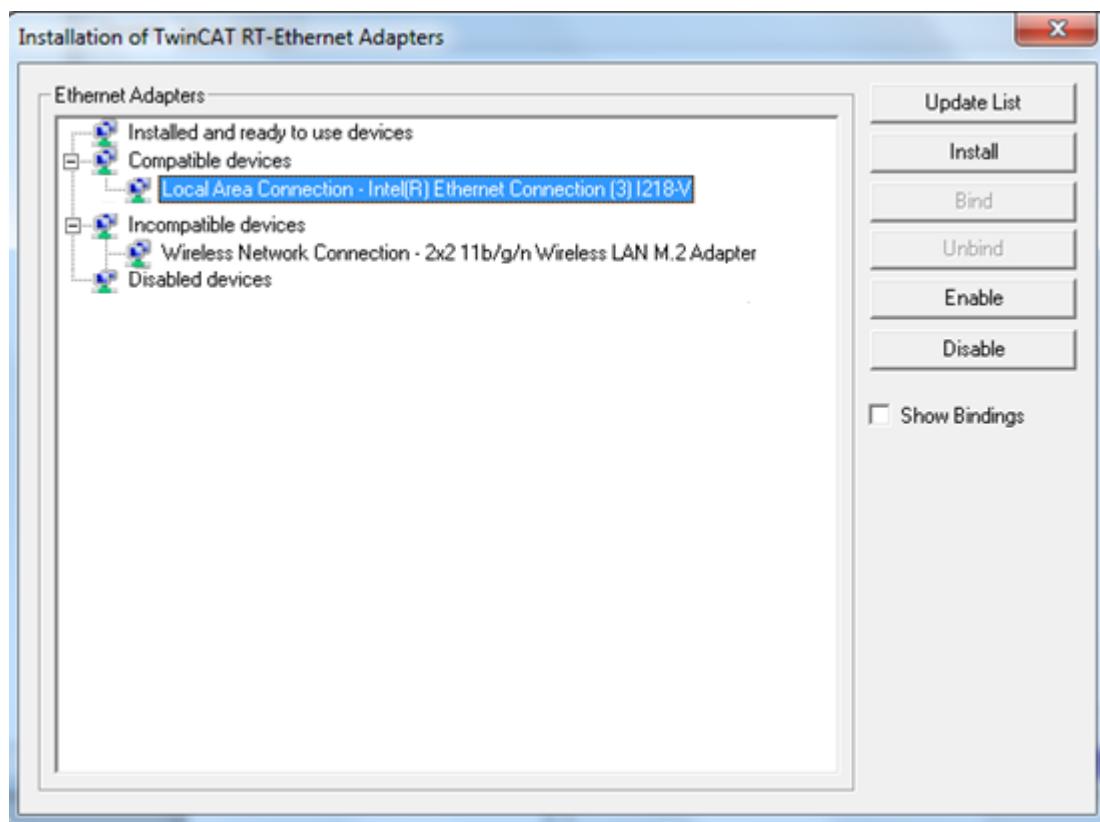


3. On the TwinCAT Project1 window, from TWINCAT > Show RealTime Ethernet Compatible Devices.

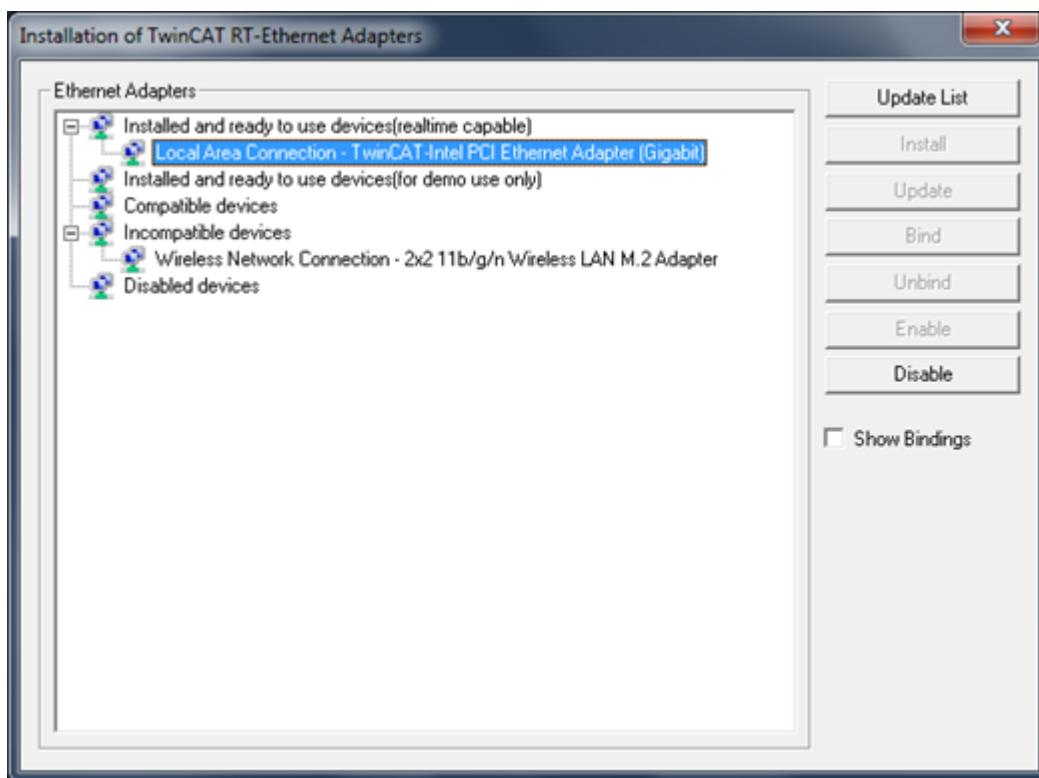
Figure 3-2. Show Real Time Ethernet Compatible Devices



4. Select the Network adapter, and then install the TwinCAT driver.

Figure 3-3. Select Network Adapter

5. Once the TwinCAT driver is installed successfully, the driver is compatible with the TwinCAT master. Now the network adapter is moved under *Installed and ready to use devices* as shown in the following figure.

Figure 3-4. TwinCAT Ethernet Adapter Installed And Ready To Use

6. Go to the corresponding network adapter properties by clicking *View network status and tasks* and *Change adapter settings* in the Control Panel.

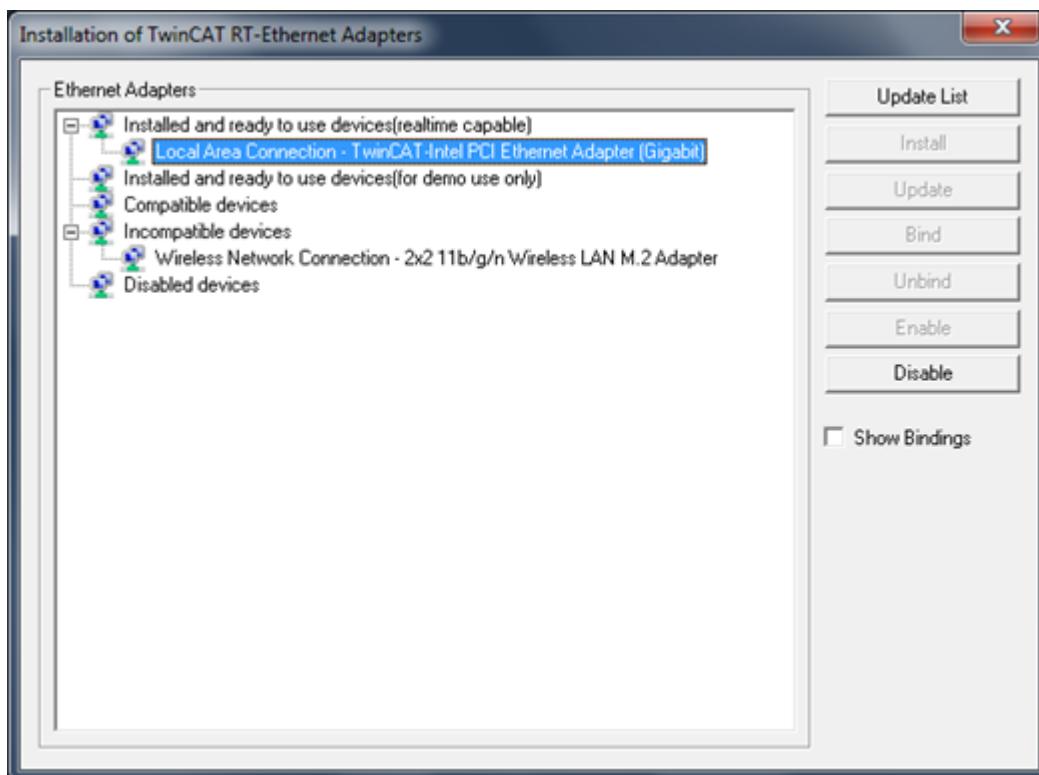
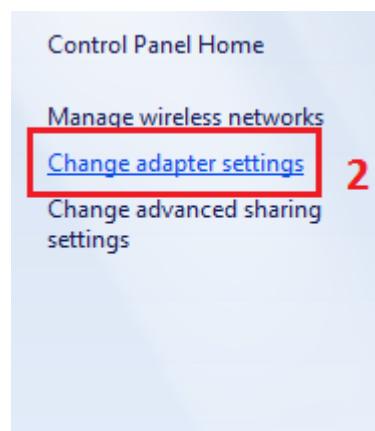
Figure 3-5. Configure Network Adapter Properties

Figure 3-6. Ethernet Adapter Setting

7. Select the TwinCAT drivers as shown in the following figures. Right-click on Local Area Connection and then select Properties from the short-cut menu. The Local Area Connection properties window will be displayed, see below image.

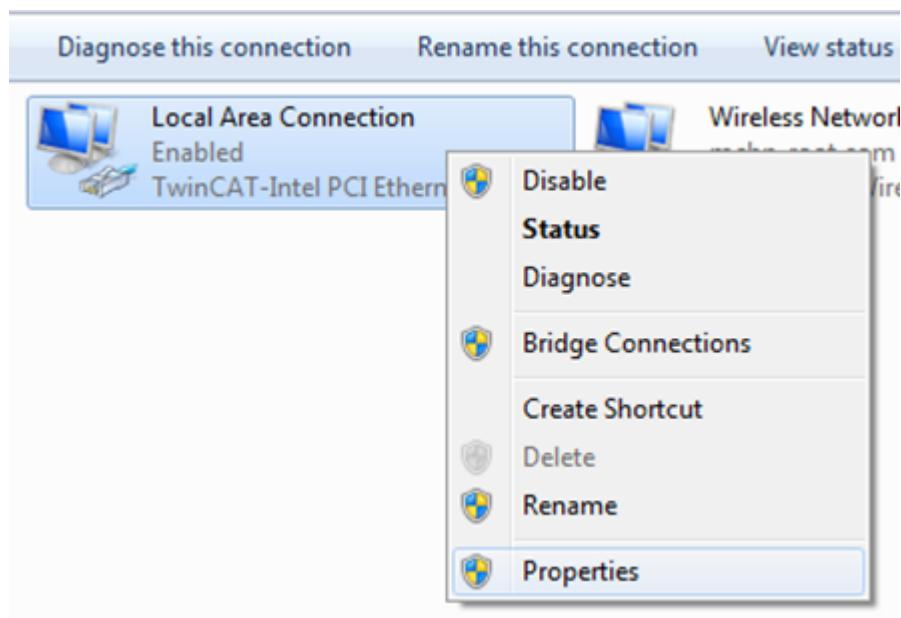
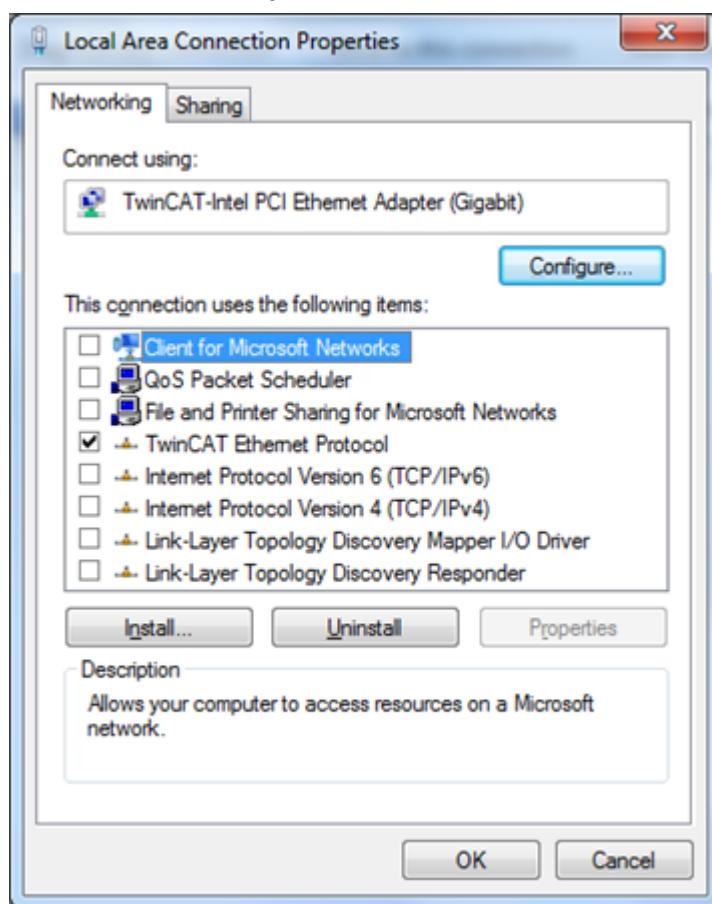
Figure 3-7. Network Adapter Properties Menu

Figure 3-8. Local Area Connection Properties

8. Select TwinCAT Ethernet Protocol, and then click **OK**.

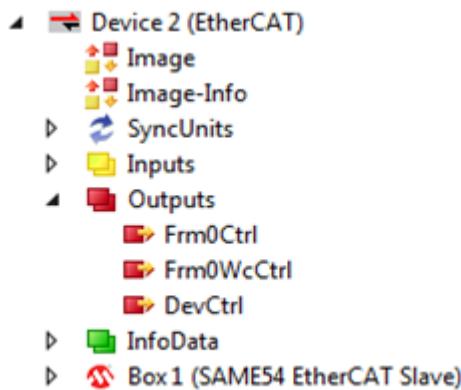
4. Appendix B

EEPROM Programming

To program the EEPROM, follow these steps:

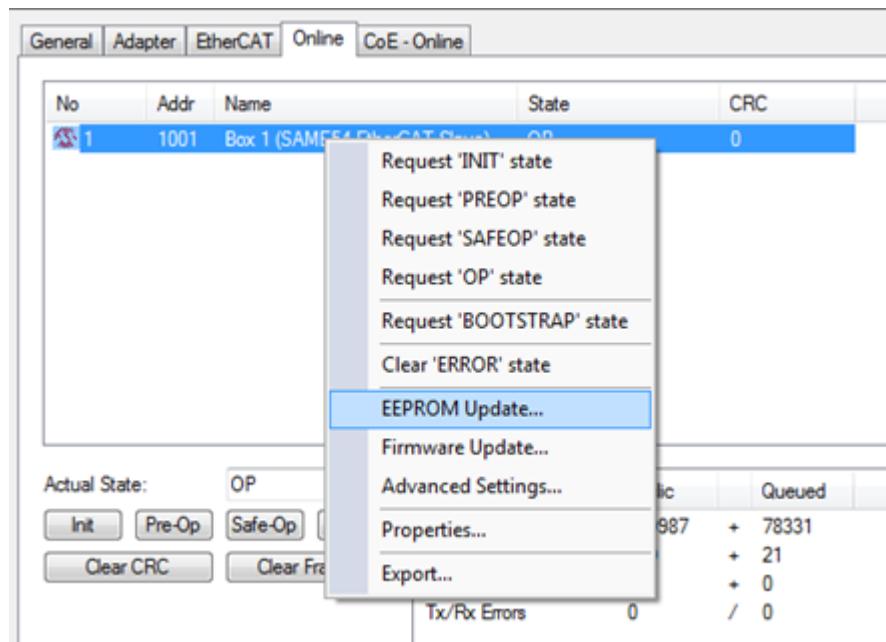
1. After a successful scan, click on *Device 2 (EtherCAT)* in the solution explorer window of the TwinCAT tool as shown in the following figure.

Figure 4-1. TwinCAT Scans EtherCAT Device2

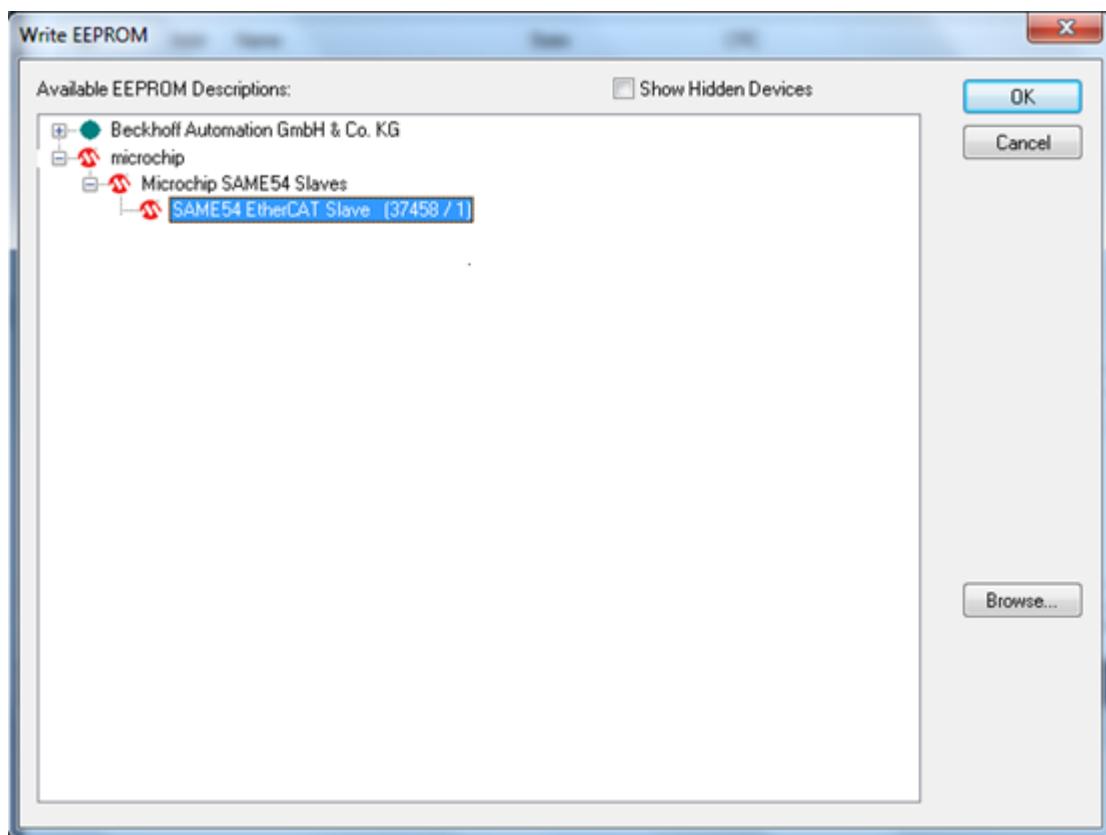


2. Click **Online** in the TwinCAT project window.
3. Right-click on the LAN9252 listings, and then select **EEPROM Update** from the contextual menu.

Figure 4-2. Select LAN9252 Setting for EEPROM Update



4. Upon selecting **EEPROM Update**, the Write EEPROM window will be displayed. Choose the corresponding EEPROM configuration, and then Click **OK** to initiate the EEPROM programming.

Figure 4-3. Write EEPROM Dialog

5. The above figure shows an example of the LAN9252 SPI configuration selected for EEPROM programming in the TwinCAT.

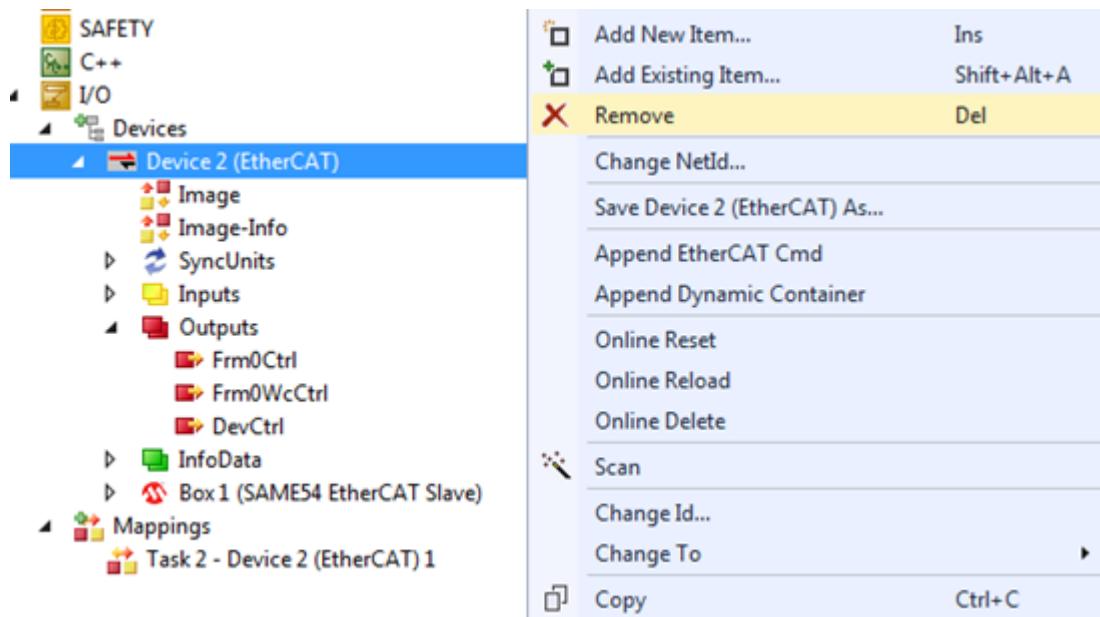
5. Appendix C

Scanning EtherCAT Slaves

To scan EtherCAT Slaves, perform these actions:

1. Connect Port zero of the device to the master using a RJ45 Ethernet cable, and then power up the board. The Link/Act LED should be ON at Port zero when the cable is present. If the Link/Act LED is not ON, it indicates there is an issue with the connection or cable.
2. If any devices are present, delete them by right-clicking the device and select **Remove** as shown in the following figure. If there are no devices in the solution explorer, then skip this step.

Figure 5-1. Remove Previous Scanned EtherCAT Slave Devices

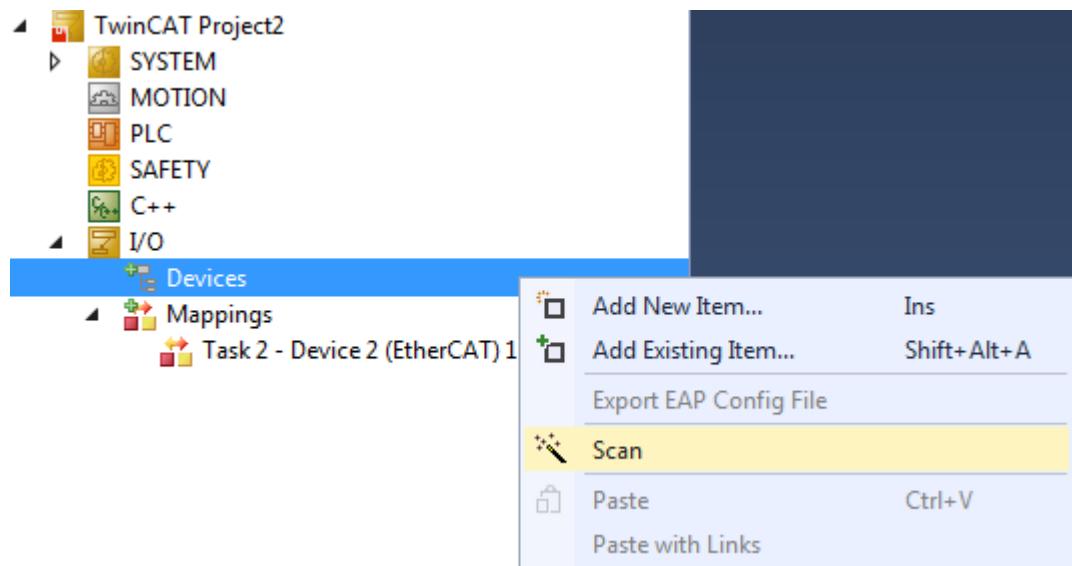


3. If master is in RUN mode, then it will not detect the slave as described in the steps five and six.

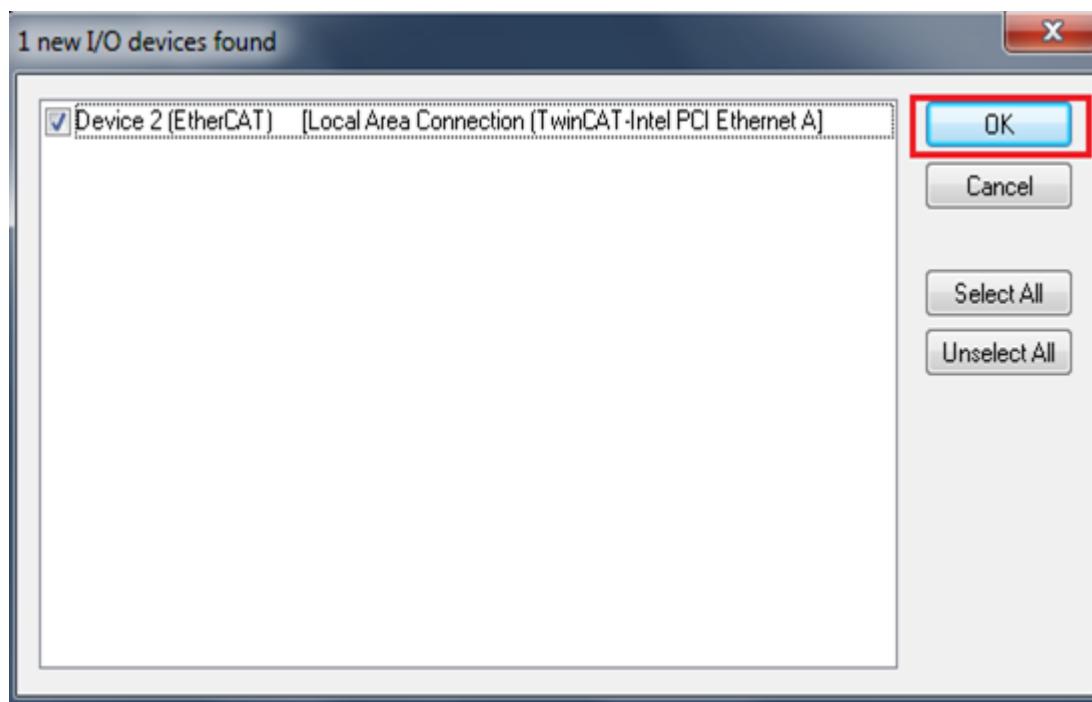
Ensure that the master is in Config mode, by clicking **Restart TwinCAT**.

Figure 5-2. Restart TwinCAT

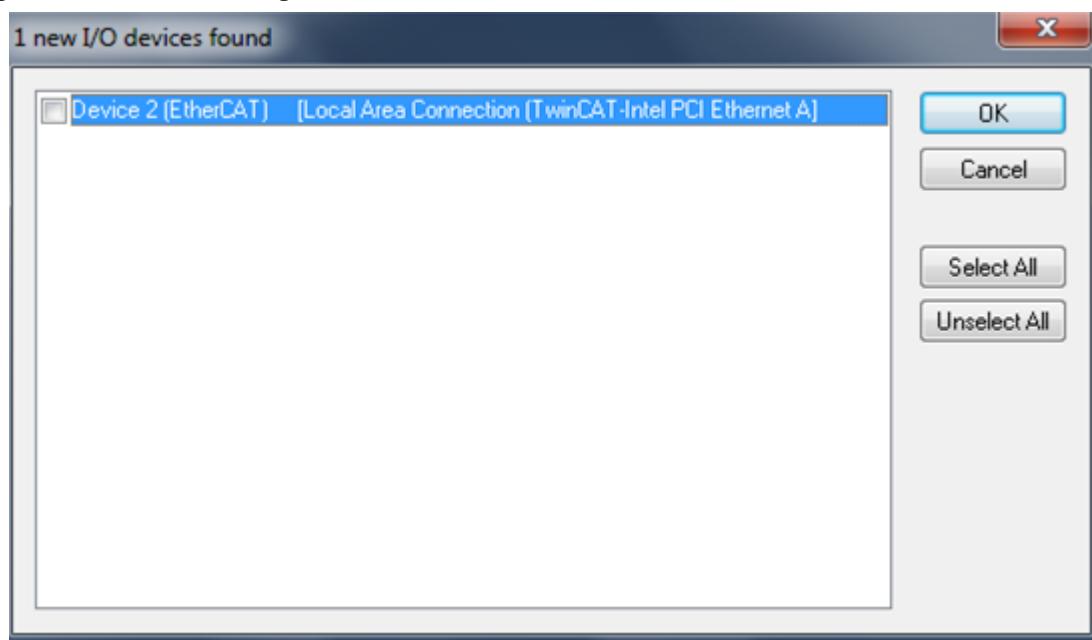
- Scan for EtherCAT slave devices by right clicking Devices and then select **Scan** as shown in the following figure.

Figure 5-3. Scan EtherCAT Slaves

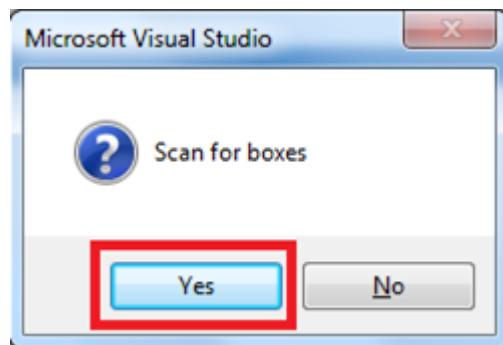
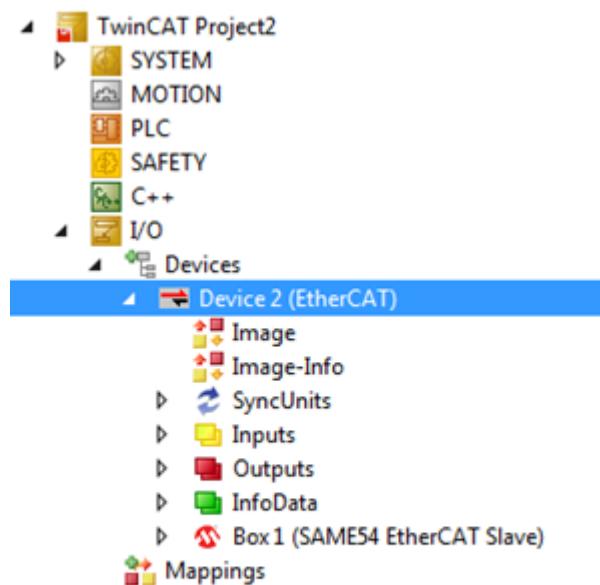
- Click **OK** to continue scanning as shown in the below image.

Figure 5-4. Device Dialog

6. If the check box is not selected as shown in the following figure then either the device is not functional, or the driver is not installed properly.

Figure 5-5. Device Dialog, Unchecked

7. Click **Yes** to choose to scan for boxes.

Figure 5-6. Confirmation Dialog**Figure 5-7. Select Scanned EtherCAT Device2 (Device List)**

8. After a successful scan, there will be activity on Link/Act LED at Port zero.

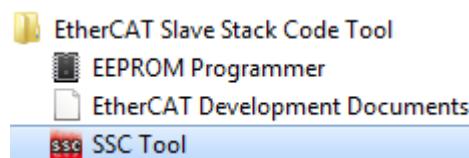
6. Appendix D

Generating EtherCAT Slave Stack Code (SSC) files

To generate the SSC files, follow these steps:

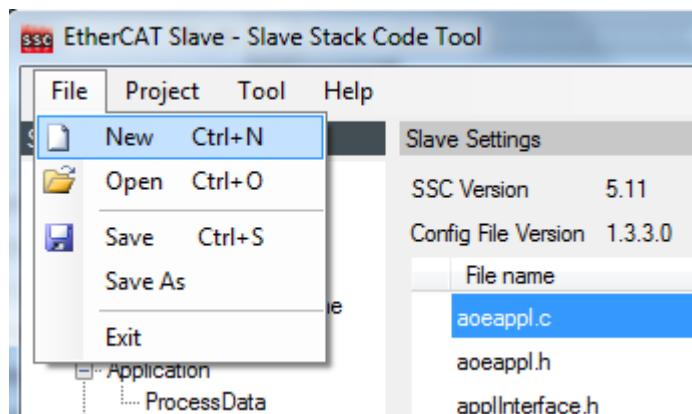
1. Select the SSC tool (Version 5.11) from the Start menu, as shown in the following figure.

Figure 6-1. SSC Tool Installation Steps

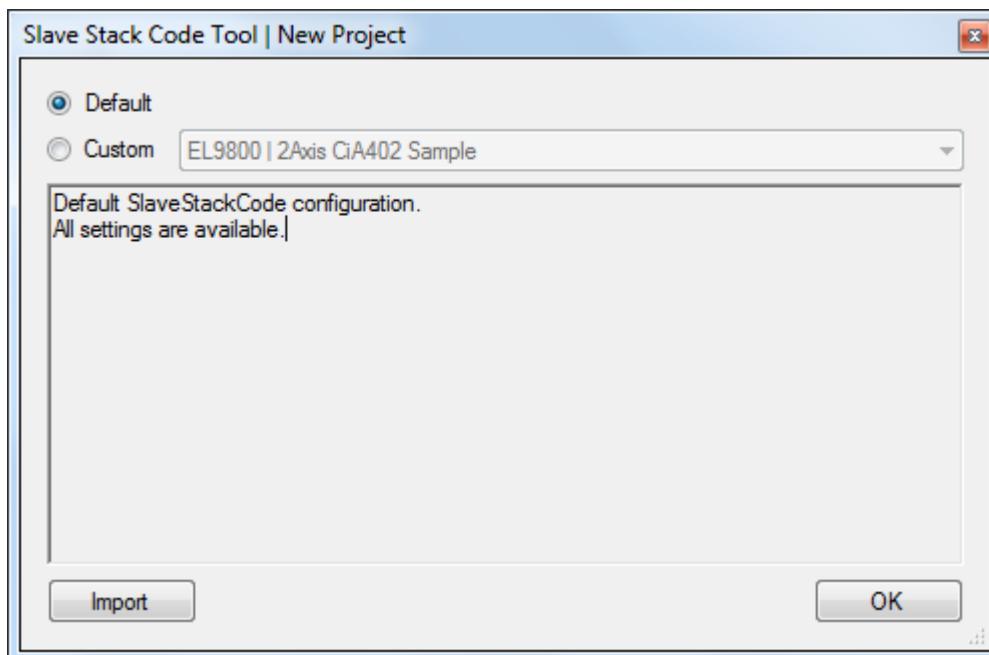


2. From the **File** menu select **New** to continue.

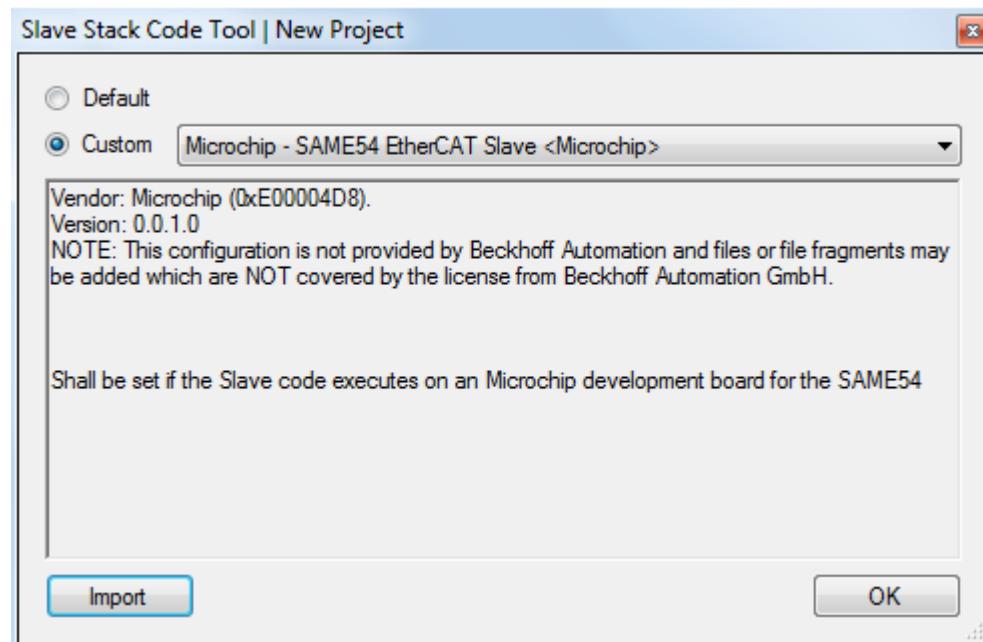
Figure 6-2. New EtherCAT Slave



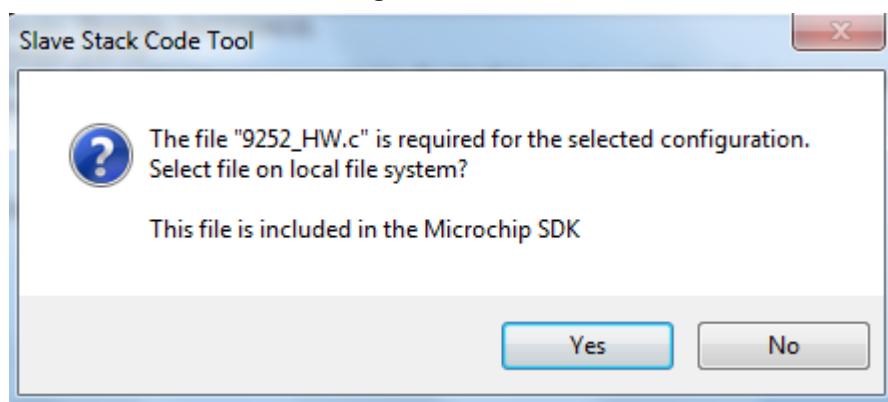
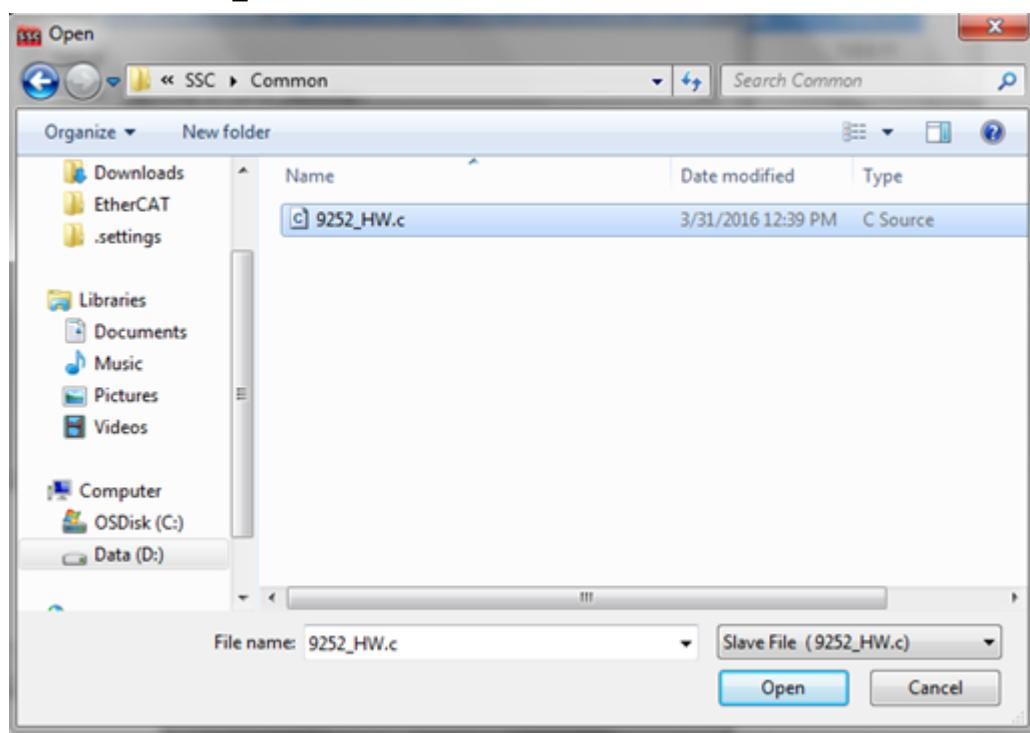
3. Click **Import** to import the SSC Tool configuration file, Microchip-SAME54-EtherCAT-Slave_SSC_Config.xml, from the directory {SDK_INSTALL_PATH}/LAN9252-SAME54-SDK-Vx.x/.

Figure 6-3. Import Project

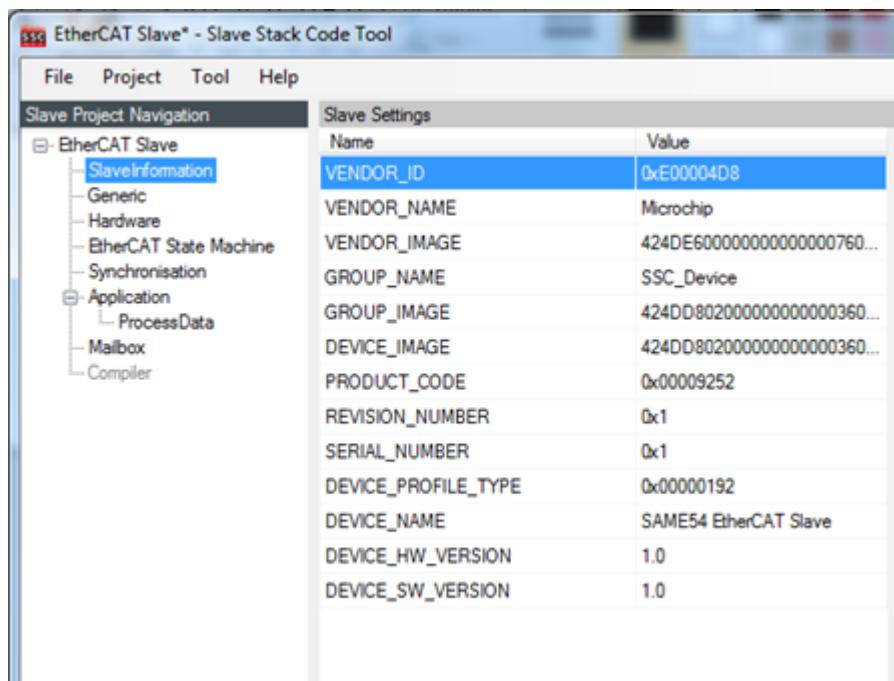
4. After selecting the file, click **Open** to import the SSC Tool configuration file.
5. Once imported, from the Custom drop-down menu, select the **Microchip_LAN9252_SSC_Config**, and then click **OK**.

Figure 6-4. Custom SSC File Selected

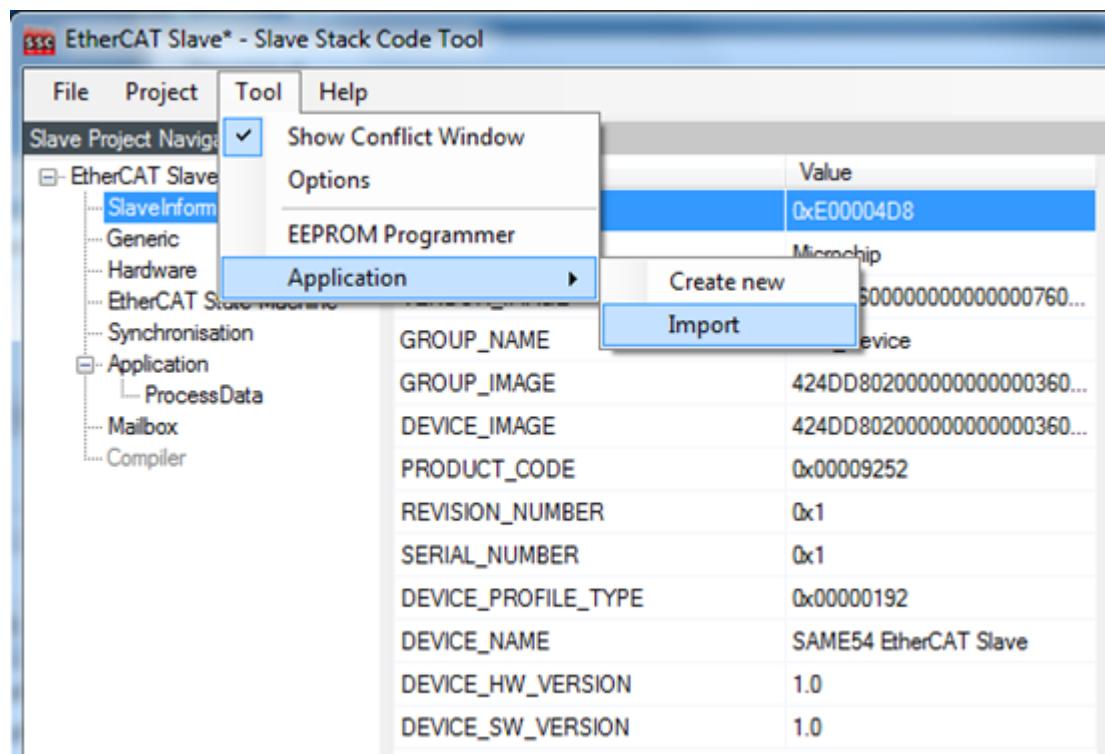
6. After selecting the configuration, the SSC will prompt for the `9252_HW.c` file. Click **OK** and choose the `9252_HW.c` file from this path: `{SDK_INSTALL_PATH}/ LAN9252-SAME54-SDK-Vx.x / SSC / Common`.

Figure 6-5. Slave Stack Code Tool Dialog**Figure 6-6. Select 9252_hw.c File**

7. All listed parameters under **Slave Information** can be changed as shown in the following figure.
Note: By default, SDK ESI files have an object configuration with a Microchip vendor ID.

Figure 6-7. Slave Information Setting

8. *Tool >Application > Import.*

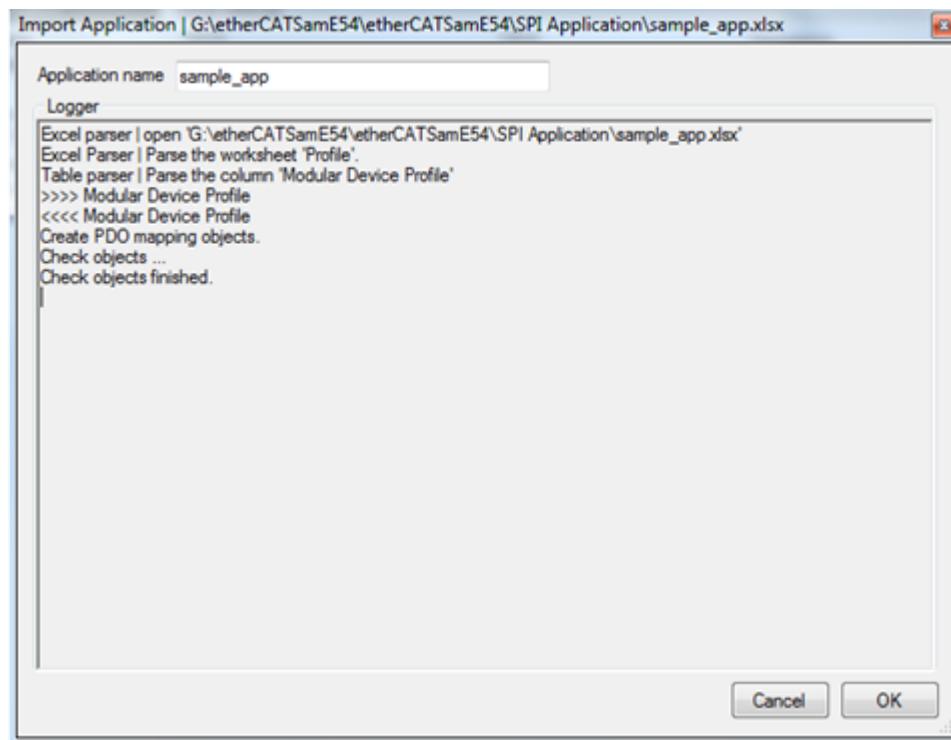
Figure 6-8. Import EtherCAT Slave Application Code

9. Select the `sample_app.xlsx` file, which is available in the directory `{SDK_INSTALL_PATH}/LAN9252-SAME54-SDK-Vx.x / Sample application`.

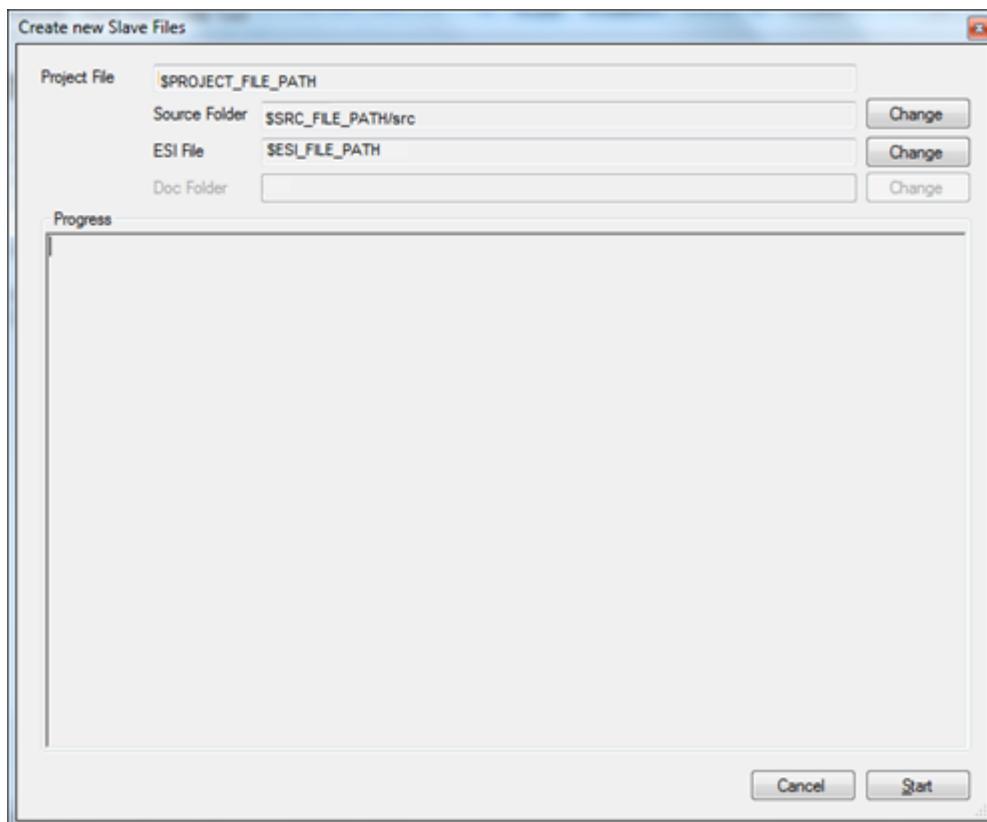
The `sample_app.xlsx` object file contains the information about application objects.

10. Once the file is selected, status message will be displayed as shown in the following figure. Click **OK** to continue.

Figure 6-9. Status Message



11. Click the **Project** drop-down menu in the tool bar, and then select **Create New Slave Files**. The following figure shows the pop up window.

Figure 6-10. Create New Slave Files**Note:**

\$PROJECT_FILE_PATH – The location where the SSC project file is saved.

\$SRC_FILE_PATH – Default path is \$PROJECT_FILE_PATH. It can be changed by clicking the **Change** button in the pop up.

\$ESI_FILE_PATH – Default path is \$PROJECT_FILE_PATH. It can be changed by clicking the **Change** button in the pop up.

12. Click **Start** to create a new project file, the SRC folder, and the ESI file (Slave Information file) in the desired directory path.
13. A pop-up window indicates that the files are successfully created. Click **OK** to continue.
14. Along with generated new slave files, the ESI file (.xml file) also will be generated. This ESI file will have information about the new vendor ID and object configuration. Program this ESI file into the EEPROM as mentioned in [Appendix B](#).
15. Replace the generated application files in the SRC folder with the SDK application files as shown in the following figure.
 - The SDK Application files can be found in **Sample application**.

Figure 6-11. SDK Application Files

Name	Type	Size
sample_app.c	C Source File	13 KB
sample_app.h	H File	2 KB
sample_appObjects.h	H File	9 KB
sample_app.xlsx	Microsoft Excel W...	21 KB

16. Application files are named as sample_app.

In this demonstration, the input object file is named as sample_app.xlsx.

Figure 6-12. Copy The Generated Application Files

9252_HW.c	C Source File	20 KB
9252_HW.h	H File	9 KB
applInterface.h	H File	5 KB
coeappl.c	C Source File	32 KB
coeappl.h	H File	2 KB
ecat_def.h	H File	41 KB
ecatappl.c	C Source File	30 KB
ecatappl.h	H File	6 KB
ecatcoe.c	C Source File	6 KB
ecatcoe.h	H File	5 KB
ecatslv.c	C Source File	103 KB
ecatslv.h	H File	30 KB
emcy.c	C Source File	10 KB
emcy.h	H File	5 KB
esc.h	H File	13 KB
mailbox.c	C Source File	38 KB
mailbox.h	H File	9 KB
objdef.c	C Source File	74 KB
objdef.h	H File	15 KB
sample_app.c	C Source File	13 KB
sample_app.h	H File	2 KB
sample_appObjects.h	H File	9 KB
sdoserv.c	C Source File	60 KB
sdoserv.h	H File	33 KB

17. Browse to the directory where new files are created:

- SRC (Folder): Contains the Beckhoff Slave Stack code.
- SAME54 EtherCAT Slave (ESP): The SSC Tool project file.
- SAME54 EtherCAT Slave (XML): The EtherCAT slave information file, must be used as an input to the EtherCAT master tool to configure the EtherCAT slave controllers.

18. Copy above mentioned files into the **SRC** folder under the directory: *{SDK_INSTALL_PATH}/LAN9252-SAME54-SDK-VX.X /SSC/Common.*

Note: The file replacement is required for these reasons:

- The default `sample_app.c` file does not have the counter and trigger configuration details, hence the user can add the modifying code for the counter and trigger.
- The generated application files will not have the code for modifying the Output Counter. Modifying the Output Counter based on the Input trigger value in the sample application provided, is delivered in the SDK application files. It is required to run the demonstration application.

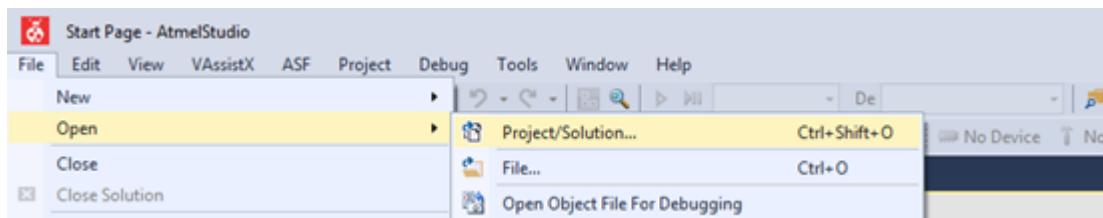
7. Appendix E

Compiling and Programming SOC Firmware

To compile and program the SOC firmware, follow these steps:

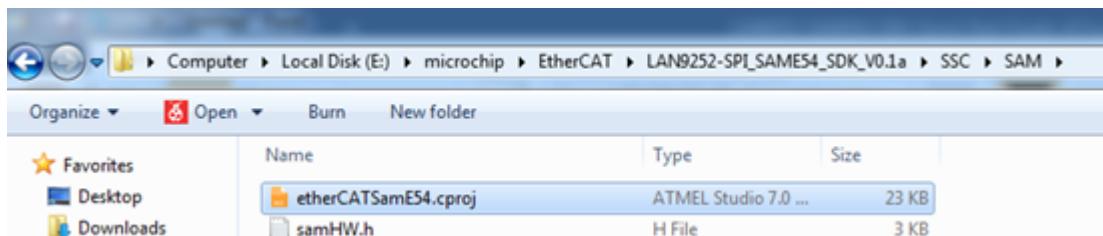
1. Open Atmel Studio 7. From *File > Open > Project/Solution* and then import the SSC project into the IDE. The Atmel Studio Project file is located under *{SDK_INSTALL_PATH}/LAN9252-SAME54-SDK-VX.X/SSC/SAM*.

Figure 7-1. Open Project in Atmel Studio

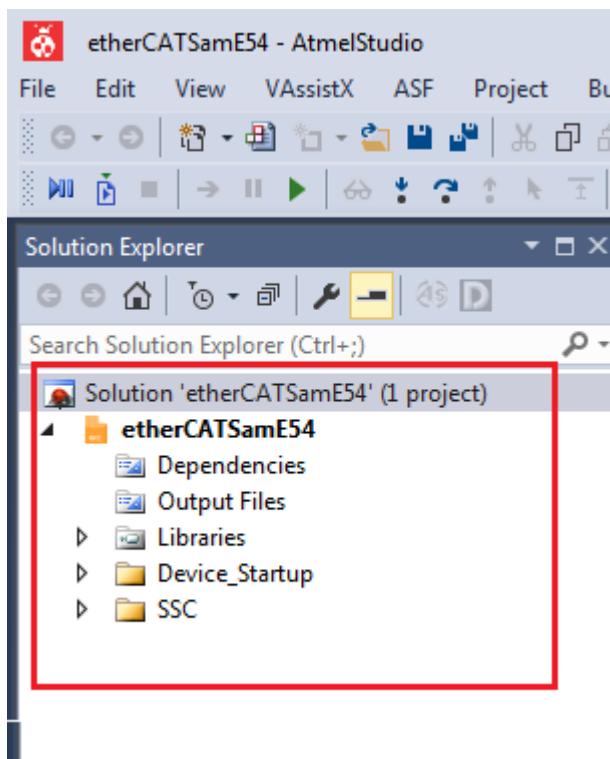


2. Browse to the project location and then open the Atmel Studio solution file *etherCATSamE54.cproj*.

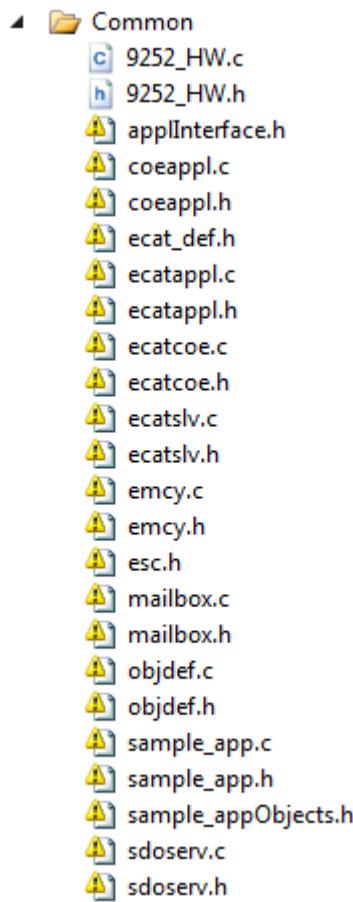
Figure 7-2. EtherCAT Project Path



3. Project will be loaded as shown in the following figure.

Figure 7-3. EtherCAT Project with E54

4. The SSC generated files are not added into the SDK distribution. Therefore, as the project is loaded into the IDE, the following files are not located by the IDE.

Figure 7-4. EtherCAT Library SSC Generated Files

Ensure that required files are generated and added to the appropriate location
`{SDK_INSTALL_PATH}\LAN9252-SPI_SAME54_SDK_V1.0_apl\ha\etherCATSamE54\SSC\Common.`

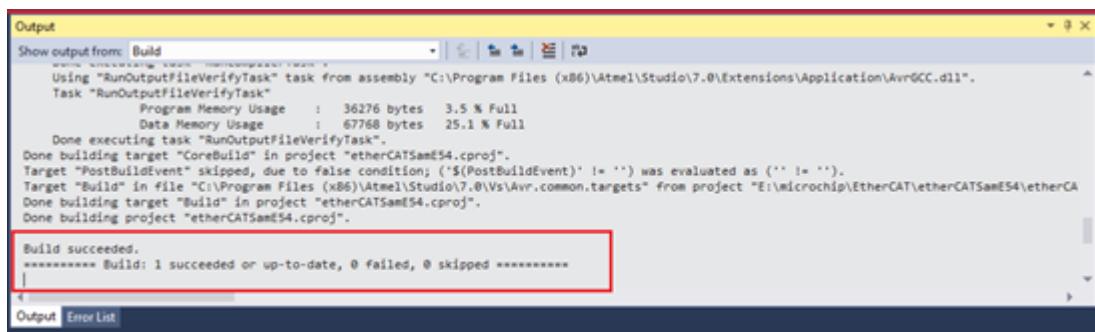
Refer to [Appendix D](#) on how to generate the EtherCAT Slave Stack files using the SSC tool.

The application files are required to be generated and added to the appropriate location. Refer to [Appendix D](#).

5. Compile the source code as shown in the following figure.

Figure 7-5. Compile the EtherCAT Project

6. Once the source code is compiled successfully, the output window will display a build successful message as shown in the following figure.

Figure 7-6. Project Build Result


The screenshot shows the Atmel Studio Output window with the following text:

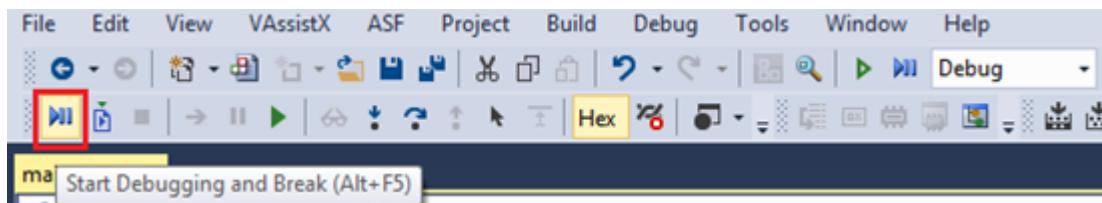
```

Output
Show output from: Build
Using "RunOutputFileVerifyTask" task from assembly "C:\Program Files (x86)\Atmel\Studio\7.0\Extensions\Application\AvrGCC.dll".
Task "RunOutputFileVerifyTask"
    Program Memory Usage : 36276 bytes 3.5 % Full
    Data Memory Usage : 67768 bytes 25.1 % Full
Done executing task "RunOutputFileVerifyTask".
Done building target "CoreBuild" in project "etherCATSamE54.cproj".
Target "PostBuildEvent" skipped, due to false condition; ('$(PostBuildEvent)' != '') was evaluated as ('' != '').
Target "Build" in file "C:\Program Files (x86)\Atmel\Studio\7.0\Vs\Avr.common.targets" from project "E:\microchip\EtherCAT\etherCATSamE54\etherCA
Done building target "Build" in project "etherCATSamE54.cproj".
Done building project "etherCATSamE54.cproj".
Build succeeded.
***** Build: 1 succeeded or up-to-date, 0 failed, 0 skipped *****

```

The last line of the output, "Build succeeded.", is highlighted with a red rectangular box.

7. Before initiating the firmware download, ensure that the debugger, programmer, and Xplained Pro board are connected to the device which is running Atmel Studio.
8. To debug the SAME54 host, click **Debug Main Project**.

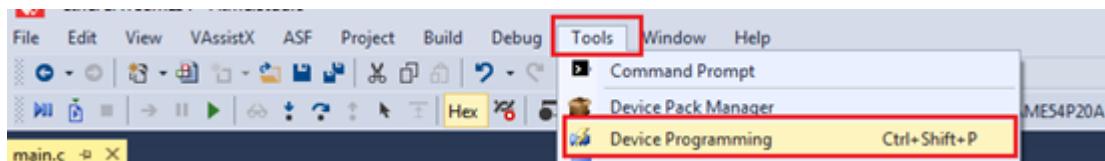
Figure 7-7. Debug Main Project

8. Appendix F

Programming the SAME54 Firmware Using Pre-Built Binaries

1. Download and install Atmel Studio v7.0 from the following location: <https://www.microchip.com/avr-support/atmel-studio-7>.
2. Before initiating the firmware download, ensure that the debugger, programmer, and Xplained Pro board is connected to the device running Atmel Studio 7.
3. Open Atmel Studio and from *Tools > Device Programming*.

Figure 8-1. Select Device Program Option



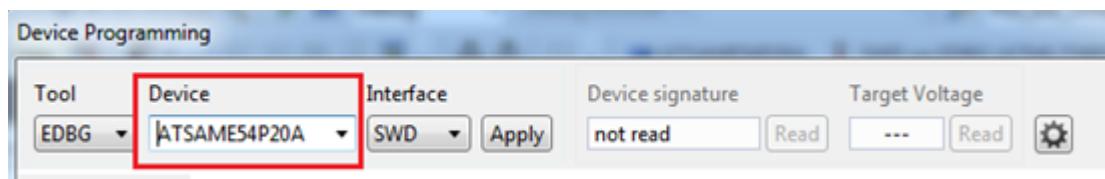
4. In the Device Programming window, under Tools, select the options as shown in the following figure.

Figure 8-2. Select Device to Program



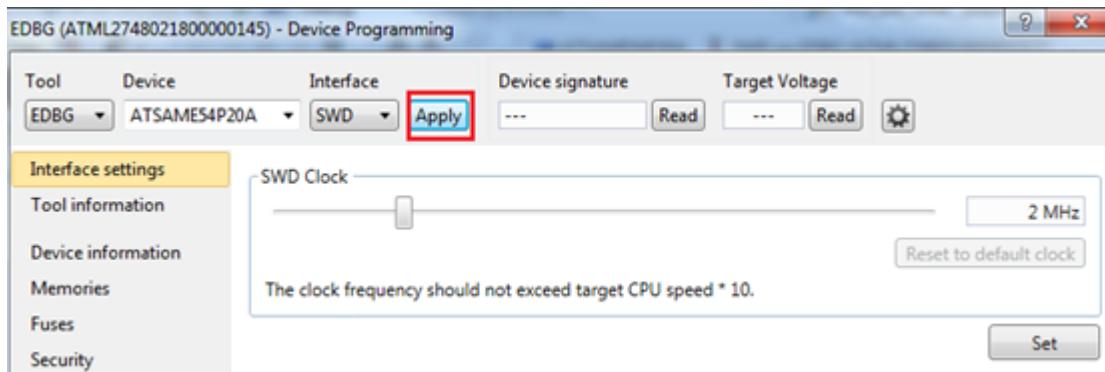
5. Select the options under Device as shown in the following figure.

Figure 8-3. Select Atmel Device

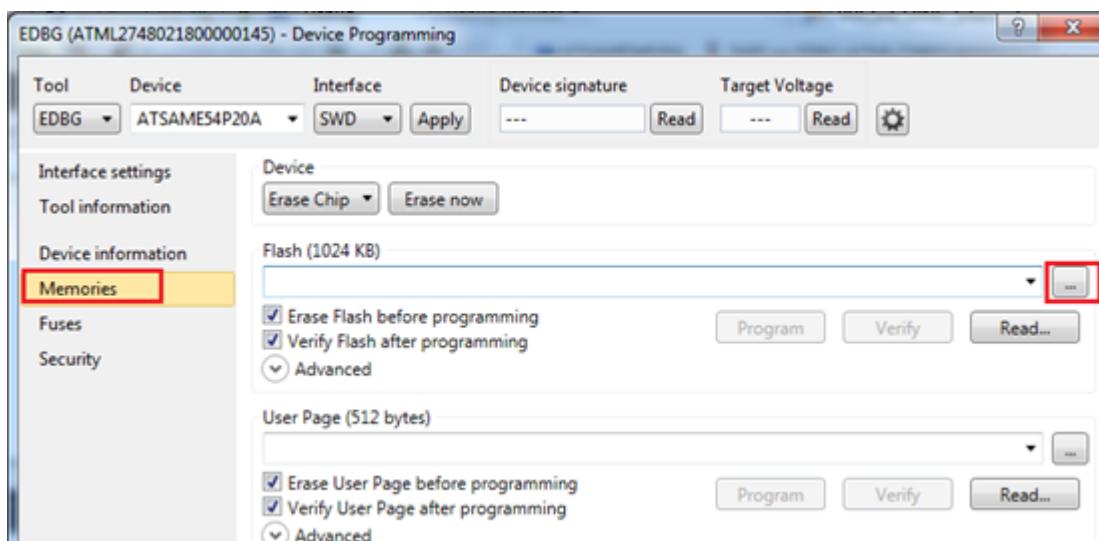


6. Click **Apply**.

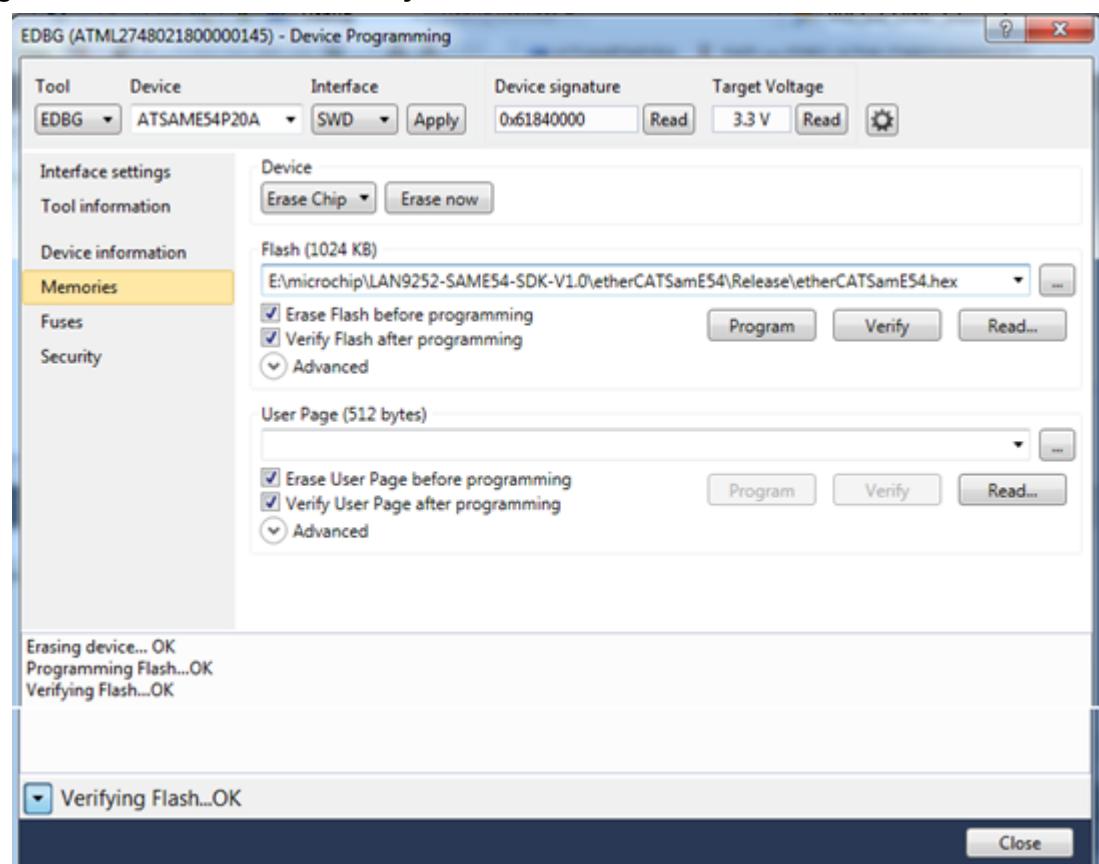
Figure 8-4. Apply Programming



7. Click **Memories** and then browse to the .hex file location.

Figure 8-5. Erase Flash Memory

8. Once the .hex files are loaded, click **Program** to program the SAME54 firmware.

Figure 8-6. Select EtherCAT Binary File

9. Appendix: Revision History

November 2018

This is the initial released version of this document.

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