

AM437x Starterware Debug Introduction

Agenda

- AM437x StarterWare Introduction & Download & Install
- Using CCS to Connect AM437x GPEVM
- Compiling the StarterWare Project For AM437x GPEVM
- Debugging the StarterWare Project For AM437x GPEVM

AM437x StarterWare Introduction & Download & Install

StarterWare Introduction

- **Starterware**是一个非操作系统的软件开发包，包含SOC启动代码，DDR内存初始化代码，以及串口，I2C，USB，ethernet, LCD，中断等驱动。
- 由于没有操作系统复杂平台化功能，所以**Starterware**是一个轻量级的软件包。相应的，**Starterware**不支持多进程/线程。
- **Starterware**非常适合于需要高实时性，无并行性的应用领域，目前在工控，HMI，工业缝纫机，PLC等工业方向已经有了很多成功应用。

AM437x StarterWare Download

- 了解过StarterWare的朋友们应该知道，他可以理解成为一个裸奔的系统。在已知的AM335x的运用中，StarterWare以其清晰的架构、高效的执行效率受到不少应用的欢迎。在TI新出的ARM Cortex A9核处理器AM437x中，我们仍然提供了StarterWare，只是将该软件包放在了工业软件开发包SYS/BIOS中：
- 下载地址：<http://www.ti.com/tool/sysbiossdk-ind-sitara>

SYS/BIOS Industrial Software Development Kit (SDK) for Sitara™ Processors

(ACTIVE) SYSBIOSSDK-IND-SITARA



Description & Features



Technical Documents



Support & Community

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Part Number	Buy from Texas Instruments or Third Party	Alert Me	Status	Current Version	Version Date	OS
SYSBIOSSDK-IND-AM437X: SYS/BIOS Industrial Software Development Kit (SDK) for Sitara™ Processors	Free Get Software	Alert Me	ACTIVE	v02.00.00.02	04 Nov 2014	SYS/BIOS
SYSBIOSSDK-IND-AM335X: SYSBIOS Industrial SDK for AM335x Processors	Free Get Software	Alert Me	ACTIVE	v01.01.00.05	06 Oct-2014	SYS/BIOS

对于StarterWare的介绍，可以参考AM335x的相关资料，这里不再赘述。在AM437x的StarterWare中，包含了对AM335x和AM437x两个Soc平台的支持，本文主要针对AM437x的平台进行详细的介绍。

StarterWare Installation

安装完成后（以默认路径为例），下列路径即为StarterWare的相关文件：

C:\ti\am437x_sysbios_ind_sdk_2.0.0.2\sdk\starterware

其中，在该目录的docs文件夹中，有以下三个非常重要的文件：

UserGuide_02_01_00_03.pdf

非常重要！包含了StarterWare目录架构的介绍，环境的搭建，各个模块例程的详细介绍！刚接触时重点参考！

ReleaseNotes_02_01_00_03.pdf

包含了软件版本信息，对平台、各种接口功能的支持情况列表。

API Reference_02_01_00_03.chm

主要针对设备抽象层的API做了全面的介绍。

Using CCS to Connect AM437x GPEVM

AM437x GPEVM

AM437x GPEVM:

<http://www.ti.com/tool/TMDXEVM437X#1>

Features

Hardware	Software	Connectivity
<ul style="list-style-type: none">• AM4378 ARM Cortex-A9 Processor• 2GB DDR3• TPS65218 Power management IC• 7" capacitive touch screen LCD• 2 camera modules• On board NAND and eMMC memory• Connector for Wilink8	<ul style="list-style-type: none">• Linux	<ul style="list-style-type: none">• Gigabit Ethernet (1)• UART (1)• Micro SD/MMC (1)• USB2.0 OTG/HOST (1/1)• Audio in/out• JTAG• CAN (2)• HDMI (1)



GPEVM板上自帶了XDS100v2仿真器，在板卡背面有个JTAG USB口，使用Micro USB的连接线连到PC机，启动CCS即可进行调试。

AM437x CCS Connection Steps

1. When opening the CCS, you're in the "CCS Edit" page by default.
Click View -> Target Configurations;
1. Right click "User Defined", create a new target configuration, named "AM437x_Test.ccxml";
2. In the "AM437x_Test.ccxml" configuration page, choose "XDS100v2 USB Emulator" in the connection list, and choose EVMAM437x. Then save.
3. Right click "AM437x_Test.ccxml", then Launch.
4. After launch, you'll come to the "CCS Debug" page. In the debug tag, right click "Cortex A9", then choose "Connect Target".
5. After connecting, if succeeding, you'll be able to see the stopped current physical address. And the GEL file would run automatically to initialize the ARM and DDR.

AM437x CCS Connection Steps (demo)

Step 1: Choose The Target Configuration

The screenshot displays the CCS Edit - Code Composer Studio interface. The 'Target Configurations' menu is open, showing options like 'New Project', 'Browse Examples', and 'Simple'. The 'Simple' dialog box is visible, asking 'Would you like to use CCS in 'Simple' (Recommended for Energia and LaunchPad)'. Below the dialog, a 'PLAYLIST' window shows a video player with a 'PLAY ALL' button.

CCS Edit - Code Composer Studio

File Edit View Navigate Project Scripts Run Window Help

CCS App Center
Getting Started
Resource Explorer (Examples)
Grace Snippets
GUI Composer™ Applications
Project Explorer
Problems Alt+Shift+Q, X
Console Alt+Shift+Q, C
Advice
Debug
Memory Browser
Registers
Expressions
Variables Alt+Shift+Q, V
Disassembly
Breakpoints Alt+Shift+Q, B
Modules
Scripting Console
Target Configurations
Outline Alt+Shift+Q, O
Memory Allocation
Optimizer Assistant
Other... Alt+Shift+Q, Q

New Project
Browse Examples

Simple Would you like to use CCS in 'Simple' (Recommended for Energia and LaunchPad)

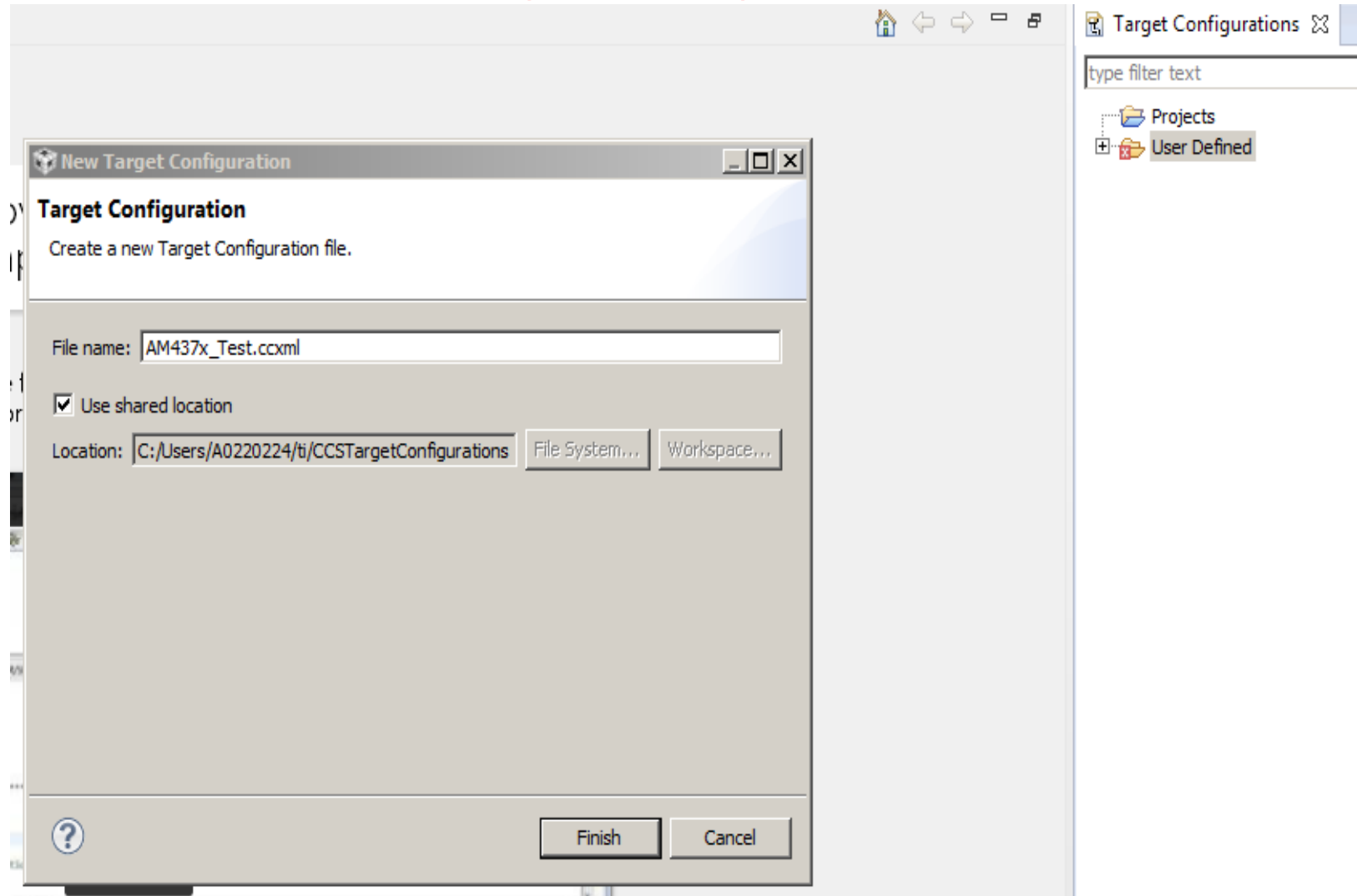
PLAYLIST Tools Showcase

```
Welcome to CCS  
12 //  
13 //  
14 //  
15 // 3. Simulation  
16 // Texas Instruments, Inc  
17 // July 2011  
18 // Built with Code Composer Studio v5  
19 //  
20  
21 #include csp43x.h  
22  
23  
24 MCFCTL = MCFPM | MCFM0; // Set watchdog timer  
25 PWDLR |= 0x01; // Set PLB to output direction  
26  
27 for(;;) {  
28     // ...  
29 }
```

PLAY ALL

AM437x CCS Connection Steps (demo)

Step 2: Name The Target Configuration



AM437x CCS Connection Steps (demo)

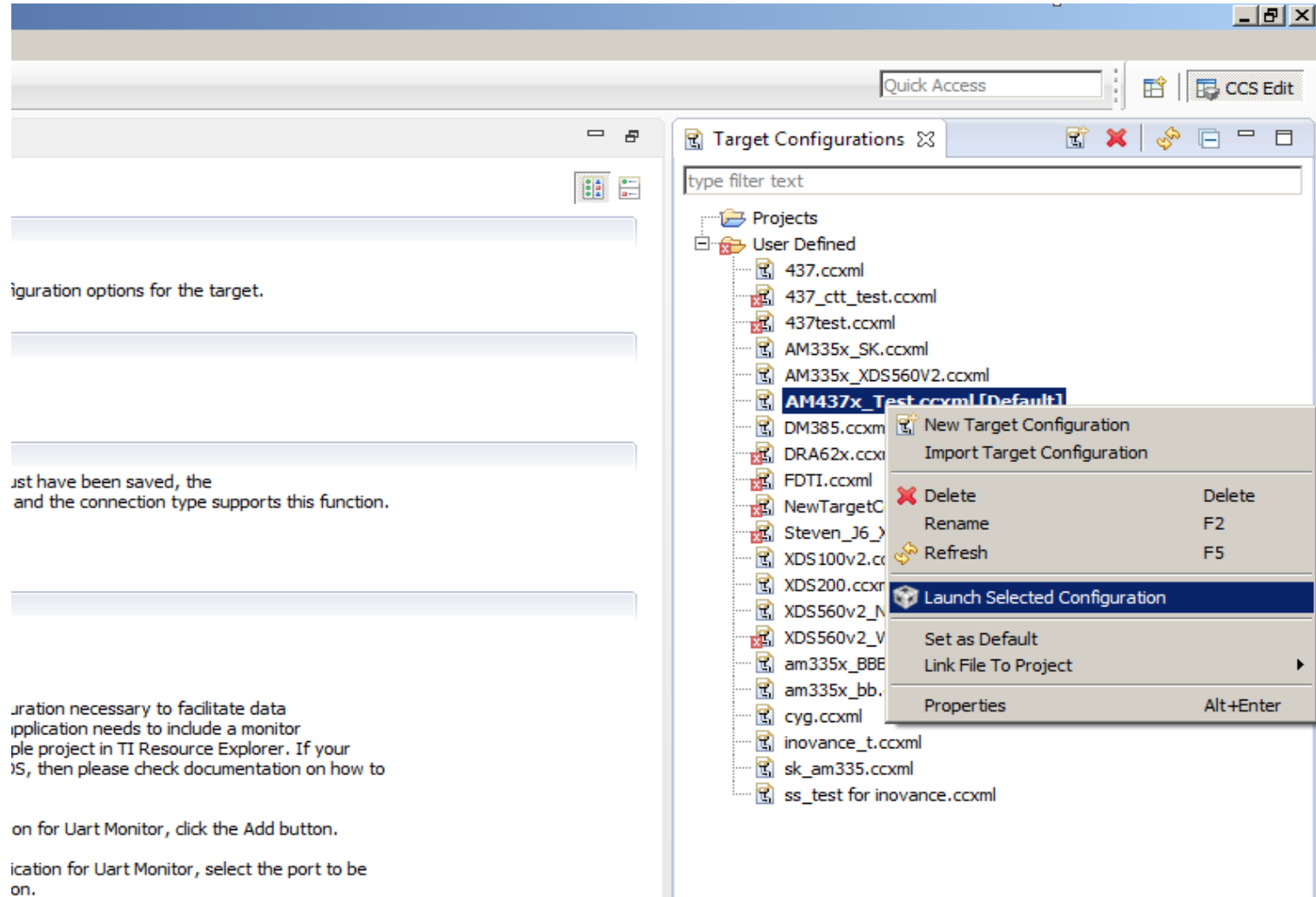
Step 3: Configure The Target Configuration

The screenshot shows the CCS IDE interface with the following elements:

- Menu Bar:** File, Edit, View, Navigate, Project, Scripts, Run, Window, Help.
- Toolbar:** Standard IDE icons for file operations and execution.
- Project Explorer:** Shows a project named *AM437x_Test.ccxml.
- Basic Configuration Panel:**
 - General Setup:** This section describes the general configuration about the target.
 - Connection:** A dropdown menu set to "Texas Instruments XDS100v2 USB Emulator".
 - Board or Device:** A text field containing "437".
 - Device List:** A list of target devices with checkboxes. "EVMAM437X" is selected and highlighted with a red box. Other devices include EVM6437, IDK_AM437X, AM4376, AM4377, AM4378, AM4379, and TMS320DM6437.
 - Description:** A text area containing "AM437x Evaluation Module."
 - Note:** "Note: Support for more devices may be available from the update manager."
- Advanced Setup Panel:**
 - Target Configuration:** A link that lists the configuration options for the target.
 - Save Configuration:** A "Save" button highlighted with a red box.
 - Test Connection:** A "Test Connection" button.
 - Alternate Communication:** A "Uart Communication" dropdown menu.
 - Instructions:** Text explaining that to enable host side (i.e. PC) configuration necessary to facilitate data communication over UART, target application needs to include a monitor implementation. It also states that to add a port in the target application for Uart Monitor, click the Add button, and to remove a port, select the removed and click the Remove button.
 - Buttons:** "Add" and "Delete" buttons next to an empty list box.

AM437x CCS Connection Steps (demo)

Step 4: Launch The Target Configuration



The screenshot shows the CCS IDE interface. On the left, there are several text boxes with instructions, some of which are partially obscured. The main focus is the 'Target Configurations' window on the right. This window displays a tree view of target configurations under 'User Defined'. The configuration 'AM437x_Test.ccxml [Default]' is selected and highlighted. A context menu is open over this configuration, showing options such as 'New Target Configuration', 'Import Target Configuration', 'Delete', 'Rename', 'Refresh', 'Launch Selected Configuration', 'Set as Default', 'Link File To Project', and 'Properties'. The 'Launch Selected Configuration' option is highlighted in blue.

Configuration options for the target.

Just have been saved, the and the connection type supports this function.

uration necessary to facilitate data application needs to include a monitor ple project in TI Resource Explorer. If your IS, then please check documentation on how to

on for Uart Monitor, click the Add button.

ication for Uart Monitor, select the port to be on.

AM437x CCS Connection Steps (demo)

Step 5: Connect The Target

The screenshot displays the Code Composer Studio (CCS) interface. The main window shows a project named 'AM437x_Test.ccxml' with a tree view of targets. A context menu is open over the 'Texas Instruments XDS100v2 USB Emulator_0/CortexA9' target, listing various actions such as 'Connect Target', 'Disconnect Target', and 'Relaunch'. The 'General Setup' panel on the left shows the connection type as 'Texas Instruments XDS100v2 USB Emulator' and the board as '437'. The 'Board or Device' list includes 'EVMAM437X' (checked) and other options like 'EVMDM6437', 'IDK_AM437X', and various 'AM437x' models. The 'Advanced Setup' panel on the right shows 'Target Configuration' and 'Save Configuration' options.

File Edit View Project Tools Scripts Run Window Help

Debug [x] AM437x_Test.ccxml [Code Composer Studio - Device Debugging]

- Texas Instruments XDS100v2 USB Emulator_0/M3_wakeupSS_1 (Disconnected : Unknown)
- Texas Instruments XDS100v2 USB Emulator_0/CortexA9 (Disconnected : Unknown)
- Texas Instruments XDS100v2 USB Emulator_0/PRU_ICSS1_PRU0 (Disconnected : Unknown)
- Texas Instruments XDS100v2 USB Emulator_0/PRU_ICSS1_PRU1 (Disconnected : Unknown)
- Texas Instruments XDS100v2 USB Emulator_0/PRU_ICSS0_PRU0 (Disconnected : Unknown)
- Texas Instruments XDS100v2 USB Emulator_0/PRU_ICSS0_PRU1 (Disconnected : Unknown)

Variables Expressions Registers

Name	Type

Getting Started AM437x_Test.ccxml [x]

Basic

General Setup

This section describes the general configuration about the target.

Connection: Texas Instruments XDS100v2 USB Emulator

Board or Device: 437

- EVMAM437X
- EVMDM6437
- IDK_AM437X
- AM4376
- AM4377
- AM4378
- AM4379
- TMS320DM6437

Connect Target Ctrl+Alt+C

- Disconnect Target Ctrl+Alt+D
- Enable Global Breakpoints
- Enable Halt On Reset
- Enable OS Debugging
- Open GEL Files View

- Hide core(s)
- Show all cores
- Group core(s)
- Sync group core(s)
- Ungroup core(s)
- Rename...

- Remove All Terminated
- Relaunch
- Edit AM437x_Test.ccxml...
- Terminate and Remove
- Terminate/Disconnect All

Properties

Advanced Setup

[Target Configuration](#): lists the con...

Save Configuration

Save

Test Connection

To test a connection, all changes m...
configuration file contains no errors

Test Connection

Alternate Communication

Uart Communication

AM437x CCS Connection Steps (demo)

Step 6: Connection and GEL Runs successfully

The screenshot displays the Code Composer Studio (CCS) interface during a successful GEL run. The top toolbar shows the Run button (a green play icon) highlighted. The Debug console on the left shows a tree view of the device hierarchy, with the CortexA9 component highlighted in red. The main workspace shows the GEL output for the CortexA9 component, with the final line highlighted in red: "CortexA9: Output: **** AM43xx GP EVM Initialization is Done *****".

Debug Console:

- Texas Instruments XDS100v2 USB Emulator_0/M3_wakeupSS_1 (Disconnected : Unknown)
- Texas Instruments XDS100v2 USB Emulator_0/CortexA9 (Suspended)
- 0x0003A2AC (no symbols are defined for 0x0003A2AC)
- Texas Instruments XDS100v2 USB Emulator_0/PRU_ICSS1_PRU0 (Disconnected : Unknown)
- Texas Instruments XDS100v2 USB Emulator_0/PRU_ICSS1_PRU1 (Disconnected : Unknown)
- Texas Instruments XDS100v2 USB Emulator_0/PRU_ICSS0_PRU0 (Disconnected : Unknown)
- Texas Instruments XDS100v2 USB Emulator_0/PRU_ICSS0_PRU1 (Disconnected : Unknown)

Getting Started: AM437x_Test.ccxml | 0x3a2ac

No source available for "0x3a2ac"

View Disassembly...

Console:

```
AM437x_Test.ccxml
CortexA9: GEL Output:

DDR3 configuration is complete!!!

CortexA9: Output: **** AM43xx GP EVM Initialization is Done *****
```

Compiling the StarterWare Project For AM437x GPEVM

Compiling the StarterWare Project

AM437x的StarterWare工程的编译流程与AM335x类似。

二者相比，主要区别有以下两点：

1.由于AM437x的StarterWare支持AM437x和AM335x两个soc平台，所以在工程编译配置的时候，需要特别注意build configuration的配置，确认当前配置是目标的soc平台；

2.AM437x的StarterWare使用的编译工具，为Linaro工具链，因此，在安装CCSv6时，请勾选相应的编译工具选项；

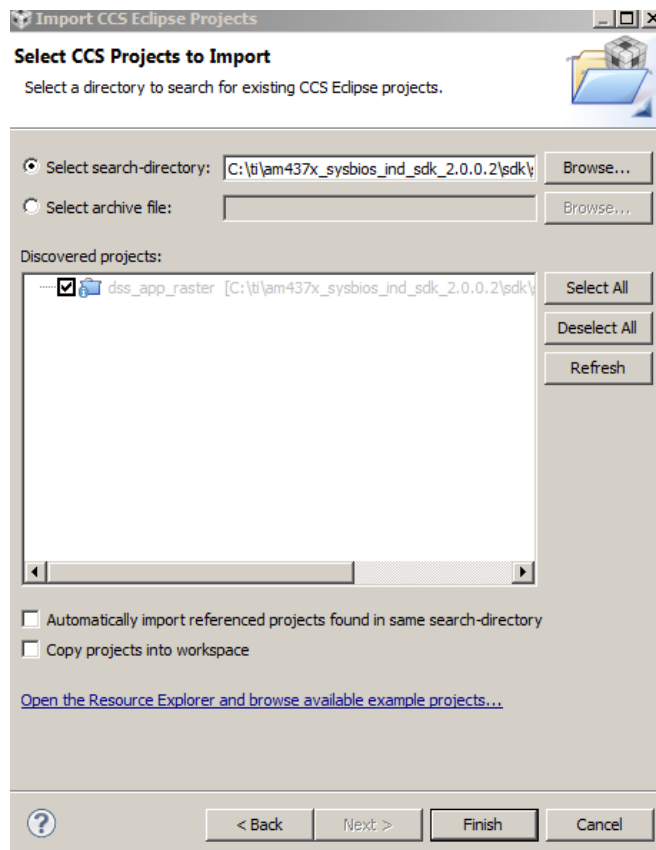
需要特别注意的是：编译工程时，需要确认工程间的依赖关系、导入相关工程，并进行正确的配置，否则，编译会在链接时因为找不到关联配置而失败。

下面，我们就以AM437x的显示例程-- dss_app_raster为示例，介绍编译的流程：

- 1.Import The DSS Project;
- 2.Import The Related Project;
- 3.Set the Projects' Build Configurations;
- 4.Rebuild The Whole Project.

1. Import The DSS Project

1. 点击File -> Import;
2. 在Code Composer Studio文件夹下选择CCS Projects，点击下一步；
3. 点击”Browser..”按钮，并选择想要导入的示例工程所在文件夹
c:\ti\am437x_sysbios_ind_sdk_2.0.0.2\sdk\starterware\examples\dss\raster\ccs
4. 勾选上dss_app_raster，并点击Finish按钮。完成工程的导入。



2. Import The Related Project

在Starterware中，工程间是有依赖关系的。如果相关工程没有被导入编译过，工程编译就会失败。如何查看工程的依赖关系呢？

- 1.右键单击当前工程，选择**Properties**选项卡；
- 2.在选项卡的左侧点击**Build**条目；
- 3.点击**Dependencies**后，即可得到当前的工程依赖关系界面；
- 4.在本例中，编译**DSS**这个工程时，需要导入以下六个工程

➤ **Board工程:**

C:\ti\am437x_sysbios_ind_sdk_2.0.0.2\sdk\starterware\board\ccs

➤ **Dal工程:**

C:\ti\am437x_sysbios_ind_sdk_2.0.0.2\sdk\starterware\dal\ccs

➤ **Device工程:**

C:\ti\am437x_sysbios_ind_sdk_2.0.0.2\sdk\starterware\device\ccs

➤ **Example utils工程:**

C:\ti\am437x_sysbios_ind_sdk_2.0.0.2\sdk\starterware\examples\example_utils\ccs

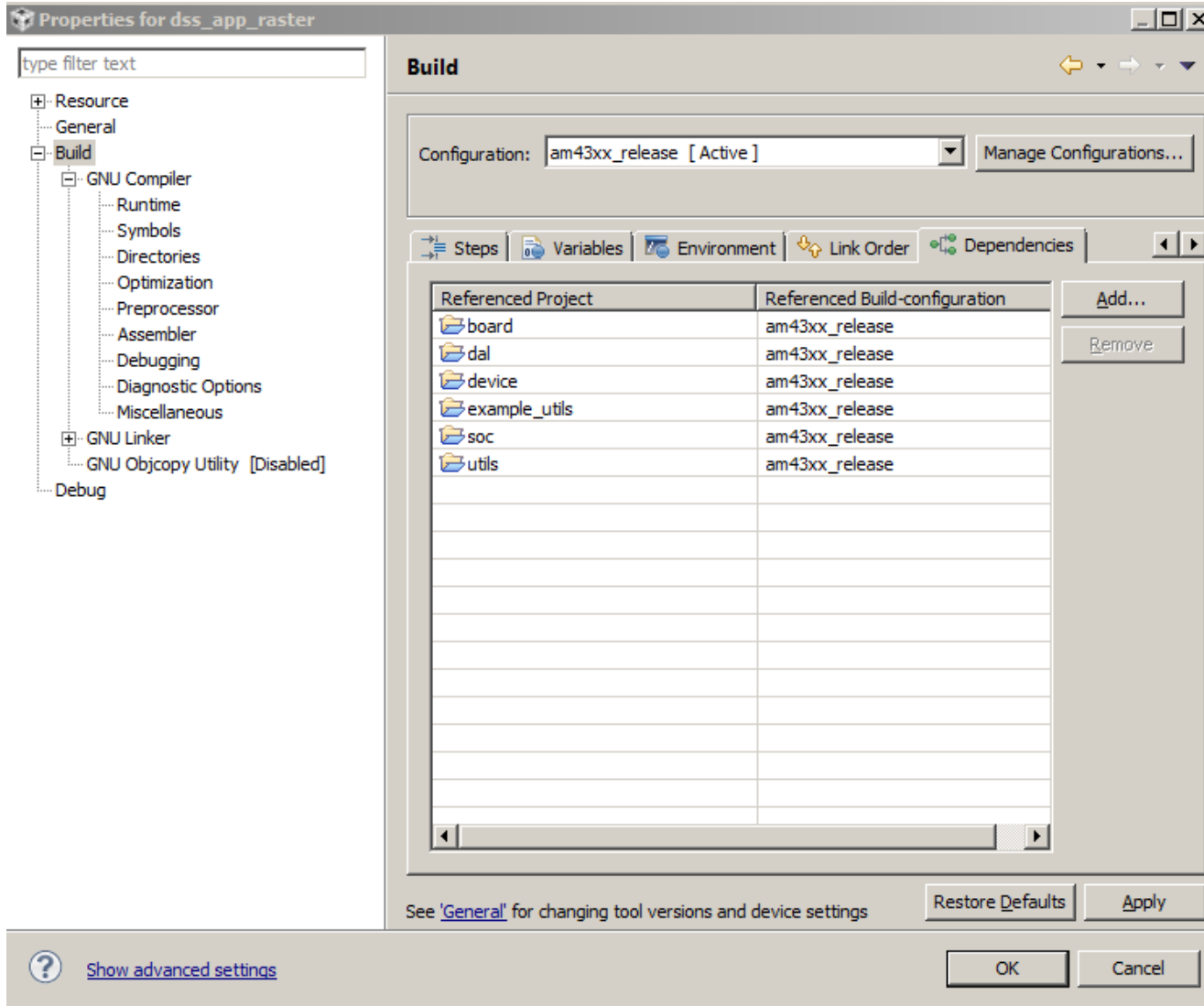
➤ **Soc工程:**

C:\ti\am437x_sysbios_ind_sdk_2.0.0.2\sdk\starterware\soc\ccs

➤ **Utils工程:**

C:\ti\am437x_sysbios_ind_sdk_2.0.0.2\sdk\starterware\utils\ccs

2. Import The Related Project



导入完相关的工程后，再次打开依赖关系选项卡，即可看到在Reference Build Configuration中，依赖项目的状态已经正常，不再是之前的无法识别状态。

3. Set Projects' Build Configurations

前面我们提到过，AM437x的StarterWare中既提供了对于AM437x的支持，也提供了对于AM335x的支持，工程编译属性中，会有AM335x和AM437x的区别。

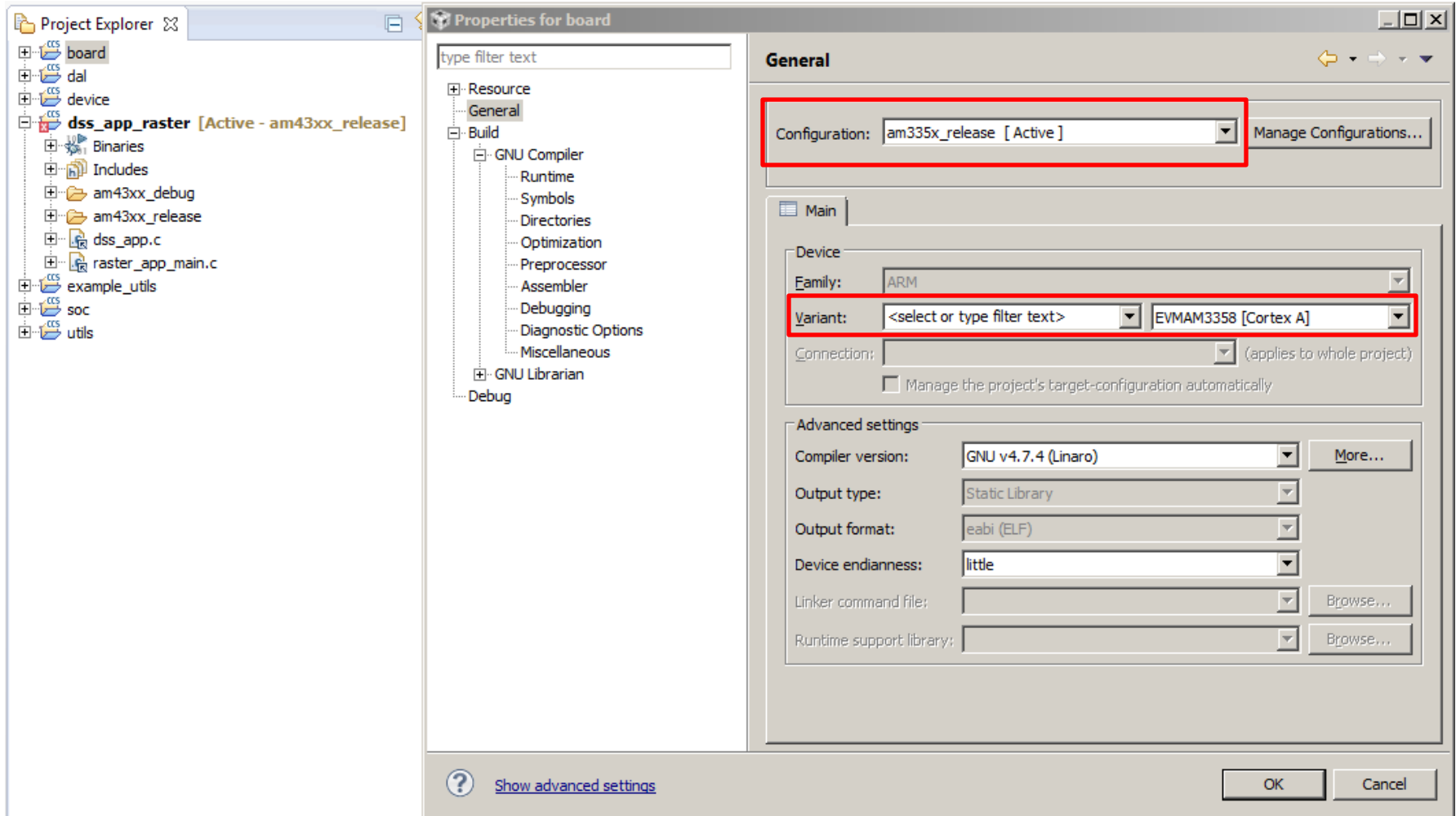
因此，在导入完所有的project后，需要检查确认：当前导入的所有工程，编译配置是否都符合当前的平台配置。

以AM437x的DSS工程作为示例，

1. 导入相关的依赖工程board后，打开board工程的properties选项卡，
 2. 在General选项卡中，确认configuration、Variant选项是否为AM437x的属性，如果为am335x_release配置，则需要修改修改配置属性；
 3. 右键点击工程，选择Build Configurations -> Set Active -> am43xx_release；
 4. 通过General选项卡确认工程配置，正常为am43xx_release，则可进行编译。
- 类似的，需要检查当前所有的工程项目，都已经被正确配置，当一切配置正常后，即可进行工程的编译。

3. Set Projects' Build Configurations

打开board工程的properties选项卡，在General选项卡中，确认configuration、Variant选项是否为AM437x的相关属性，如果不是，则需要进行修改。



3. Set Projects' Build Configurations

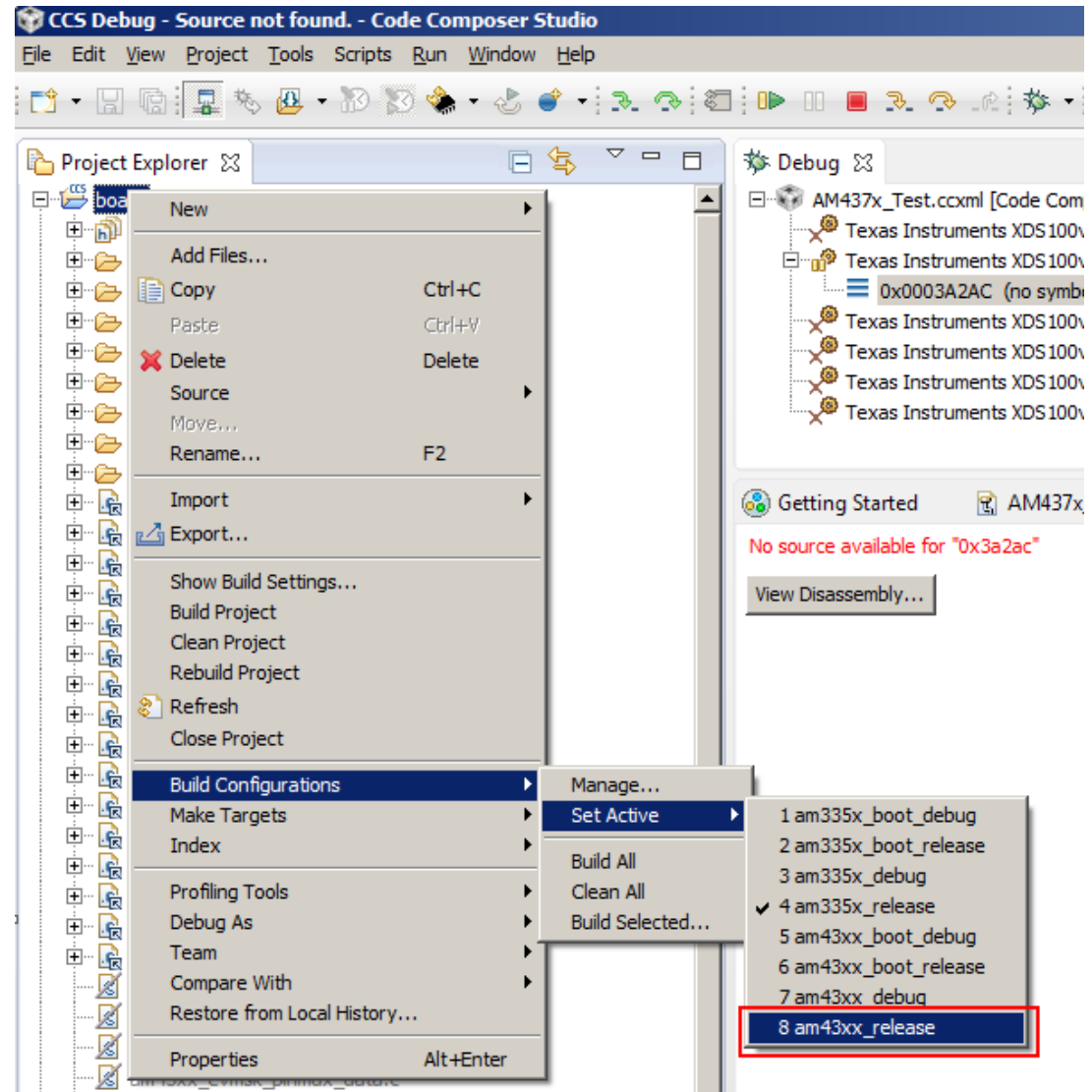
修改方法:

右键点击工程,

选择Build Configurations

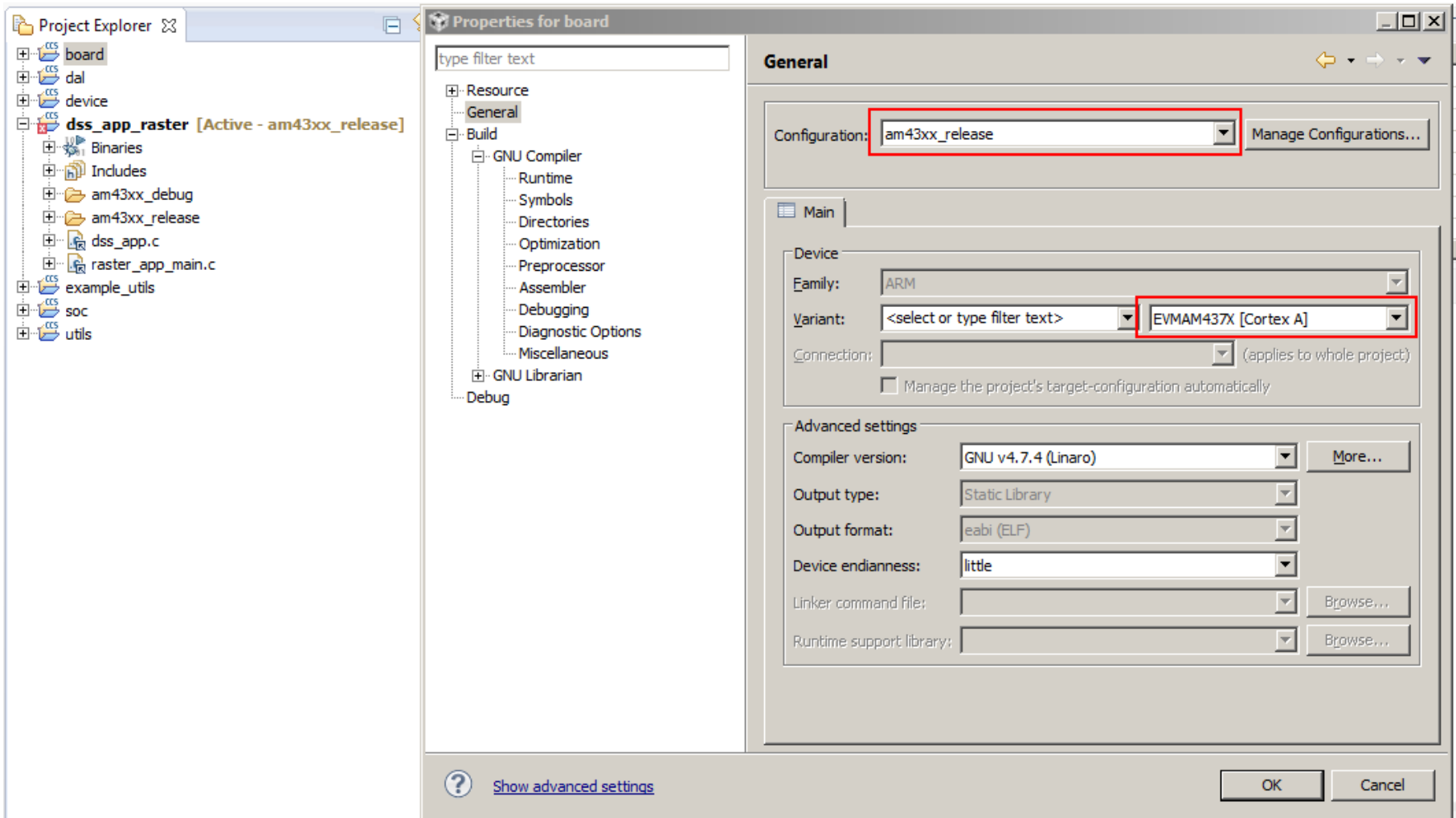
-> Set Active

-> am43xx_release



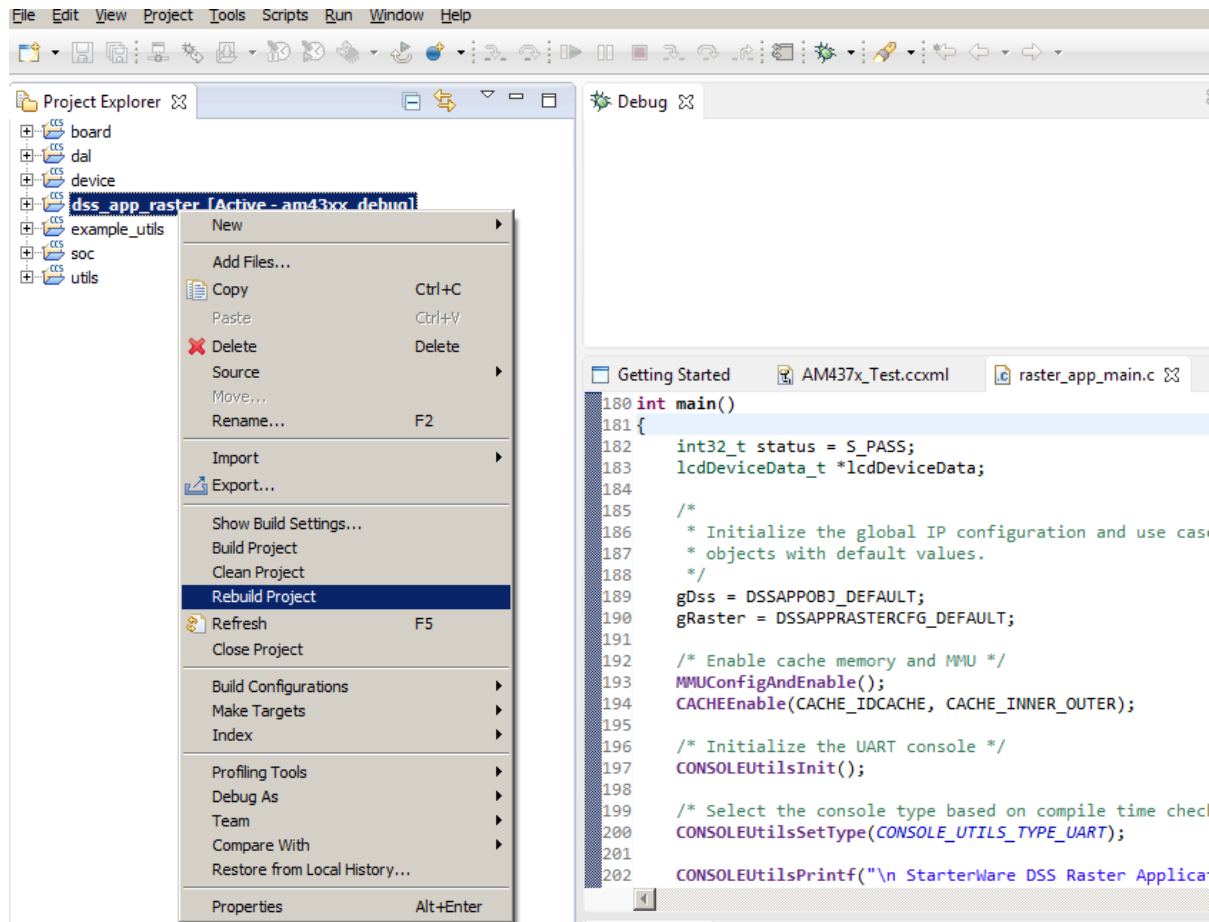
3. Set Projects' Build Configurations

再次通过General选项卡确认工程配置，正常为am43xx_release，则可进行编译。



4. Rebuild The Whole Project

设置完以上步骤后，右键点击dss工程，选择Rebuild Project。正常情况下，可正常编译生成dss_app_raster_a9host_debug.out文件，CCS可以load该文件，位置：
C:\ti\am437x_sysbios_ind_sdk_2.0.0.2\sdk\starterware\binary\dss_app_raster\bin\am43xx-evm\ccs



Debugging the StarterWare Project For AM437x GPEVM

AM437x StarterWare Debugging

在CCS连接A9，完成初始化后，即可通过Run -> Load -> Load program，把编译成功的out 文件下载到开发板上，Load成功后，即可看到如下界面，指针停在main函数的入口处。PS: 如果无法看到关联的源码，请确认当前工程的配置是否为debug模式。

The screenshot displays the Code Composer Studio (CCS) interface during a debug session. The main window shows the source code for `raster_app_main.c`, with the `main` function selected. The console window at the bottom shows the output of the application, including the message "AM437x GP EVM Initialization is Done". The Disassembly window on the right shows the assembly code for the `main` function, with the entry point reached.

```
180 int main()
181 {
182     int32_t status = S_PASS;
183     lcdDeviceData_t *lcdDeviceData;
184
185     /*
186      * Initialize the global IP configuration and use case data structure
187      * objects with default values.
188      */
189     gDss = DSSAPPOB1_DEFAULT;
190     gRaster = DSSAPPRASTERCFG_DEFAULT;
191
192     /* Enable cache memory and MMU */
193     MMUConfigAndEnable();
194     CACHEEnable(CACHE_IDCACHE, CACHE_INNER_OUTER);
195
196     /* Initialize the UART console */
197     CONSOLEUtilsInit();
198
199     /* Select the console type based on compile time check */
200     CONSOLEUtilsSetType(CONSOLE_UTILS_TYPE_UART);
201
202     CONSOLEUtilsPrintf("\n StarterWare DSS Raster Application!!\n");
```

Name	Type	Value
lcdDeviceData	struct lcdDeviceData *	0x4033FC00
status	long	14

```
0003a2d0: E5C10000 STRB    R0, [R1]
0003a2d4: E5C12001 STRB    R2, [R1]
0003a2d8: E1A02820 MOV     R2, R0,
0003a2dc: E5C12002 STRB    R2, [R1]
0003a2e0: E1A02C20 MOV     R2, R0,
0003a2e4: E5C12003 STRB    R2, [R1]
0003a2e8: E12FFF1E BX     R14
0003a2ec: E1903001 ORRS   R3, R0,
0003a2f0: 4A000021 BMI     0x3A37C
0003a2f4: E3B02000 MOVS   R2, #0
0003a2f8: E07130A0 RSBS   R3, R1,
0003a2fc: 3A00001A BCC    0x3A36C
0003a300: E0713220 RSBS   R3, R1,
0003a304: 3A00000F BCC    0x3A348
0003a308: E0713420 RSBS   R3, R1,
0003a30c: 3A000001 BCC    0x3A318
0003a310: E3A0C000 MOV     R12, #0
0003a314: EA000020 B     0x3A39C
0003a318: E07133A0 RSBS   R3, R1,
0003a31c: 704003R1 SUBCS  R0, R0,
```

```
AM437x_Test.ccxml
CortexA9: GEL Output:

DDR3 configuration is complete!!!

CortexA9: Output: **** AM43xx GP EVM Initialization is Done *****
```

Thank you!