PSIM Tutorial

How to Use SimCoder with TI F28335 Target

With the SimCoder Module, PSIM can automatically generate generic code from the control schematic. With SimCoder and the TI F28335 Hardware Target, PSIM can generate ready-to-run code for hardware based on TI floating-point DSP F28335.

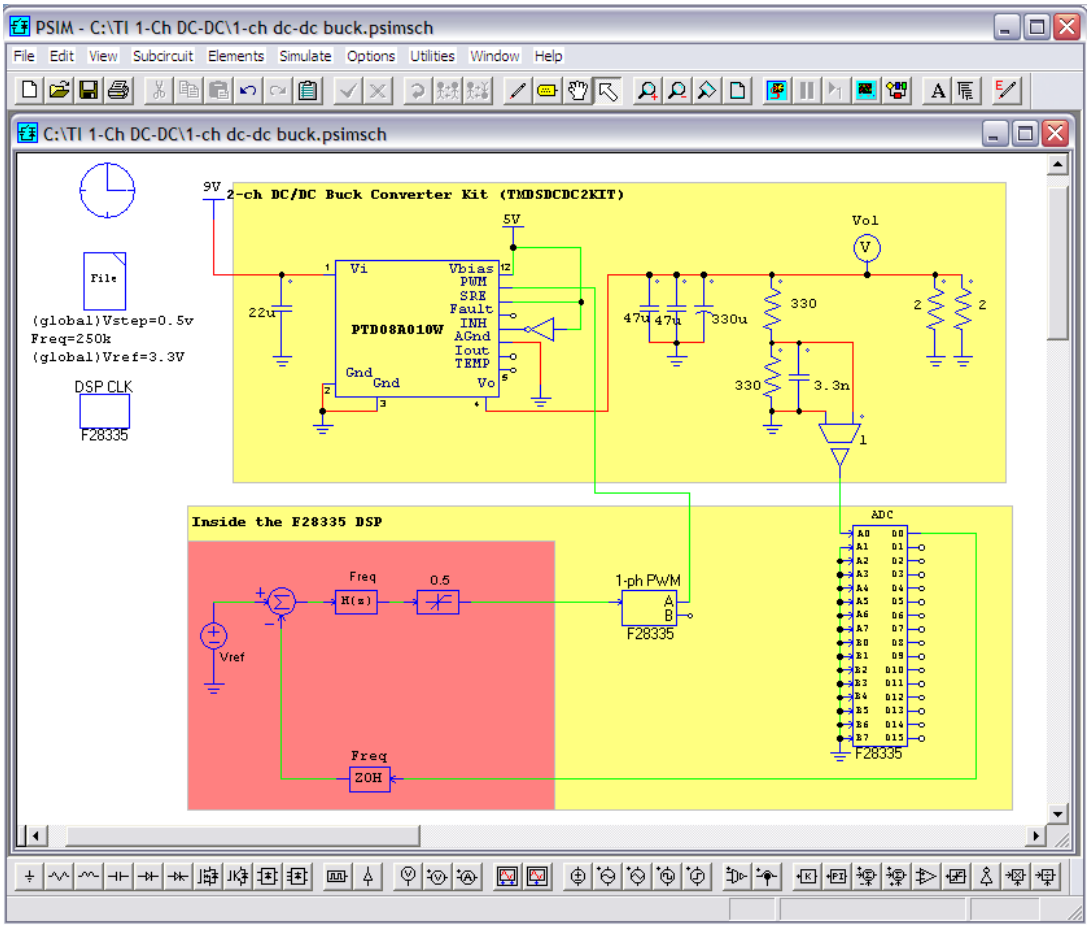
This tutorial describes, in step by step, how to generate code in PSIM, compile and upload the code in CodeComposer Studio, and run it on the DSP.

To illustrate the process, we use the circuit "TI 1-ch DC/DC buck.psimsch' as an example. This example is located in the sub-folder "examples\SimCoder\TI F28335 Target\TI 1-Ch DC-DC" in the PSIM directory.

To keep the original example unchanged, we will copy the whole folder to "c:\ TI 1-Ch DC-DC", and use this folder as the working folder in this tutorial.

1. Setting Up in PSIM

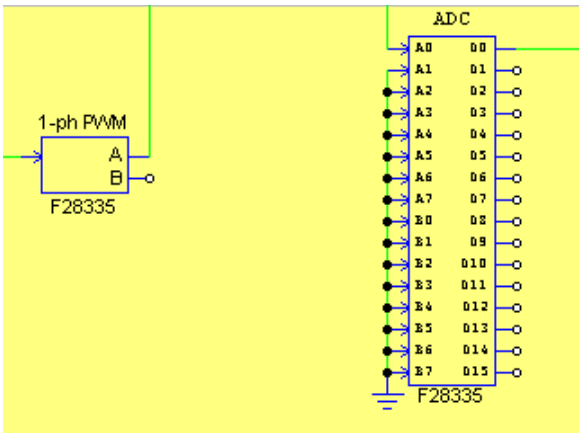
In PSIM, load the schematic file "1-ch dc-dc buck.psimsch" as shown below.



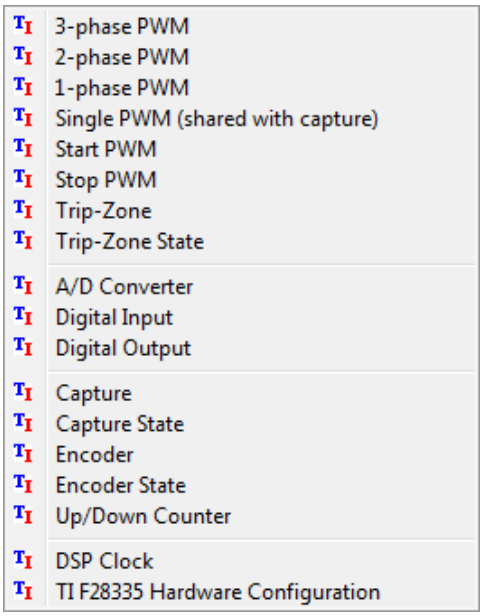
As compared to other PSIM circuits not for code generation, this circuit contains elements from the TI F28335 Hardware Target library. In this circuit, there are two F28335 Hardware Target library elements: a 16-channel A/D converter and a 1-phase PWM Generator, as shown below on the left.

The TI F28335 Hardware Target library can be accessed by going to **Elements** -> **SimCoder for Code Generation** -> **TI F28335 Target**. A list of the library is shown below on the right.

Hardware elements used in the circuit

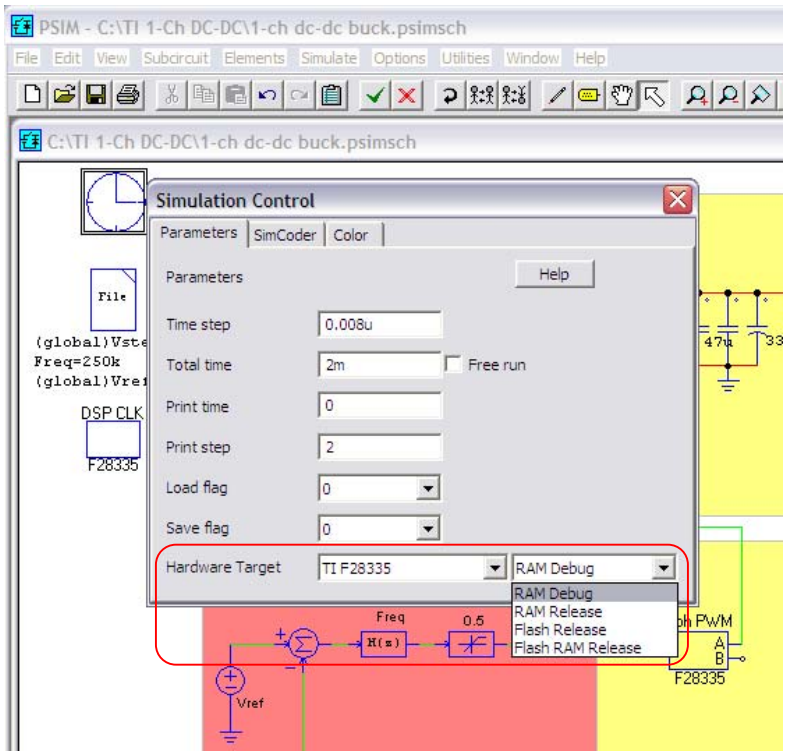


TI F28335 Target library list



Like any other circuits, this circuit can be simulated by selecting **Simulate** -> **Run Simulation**.

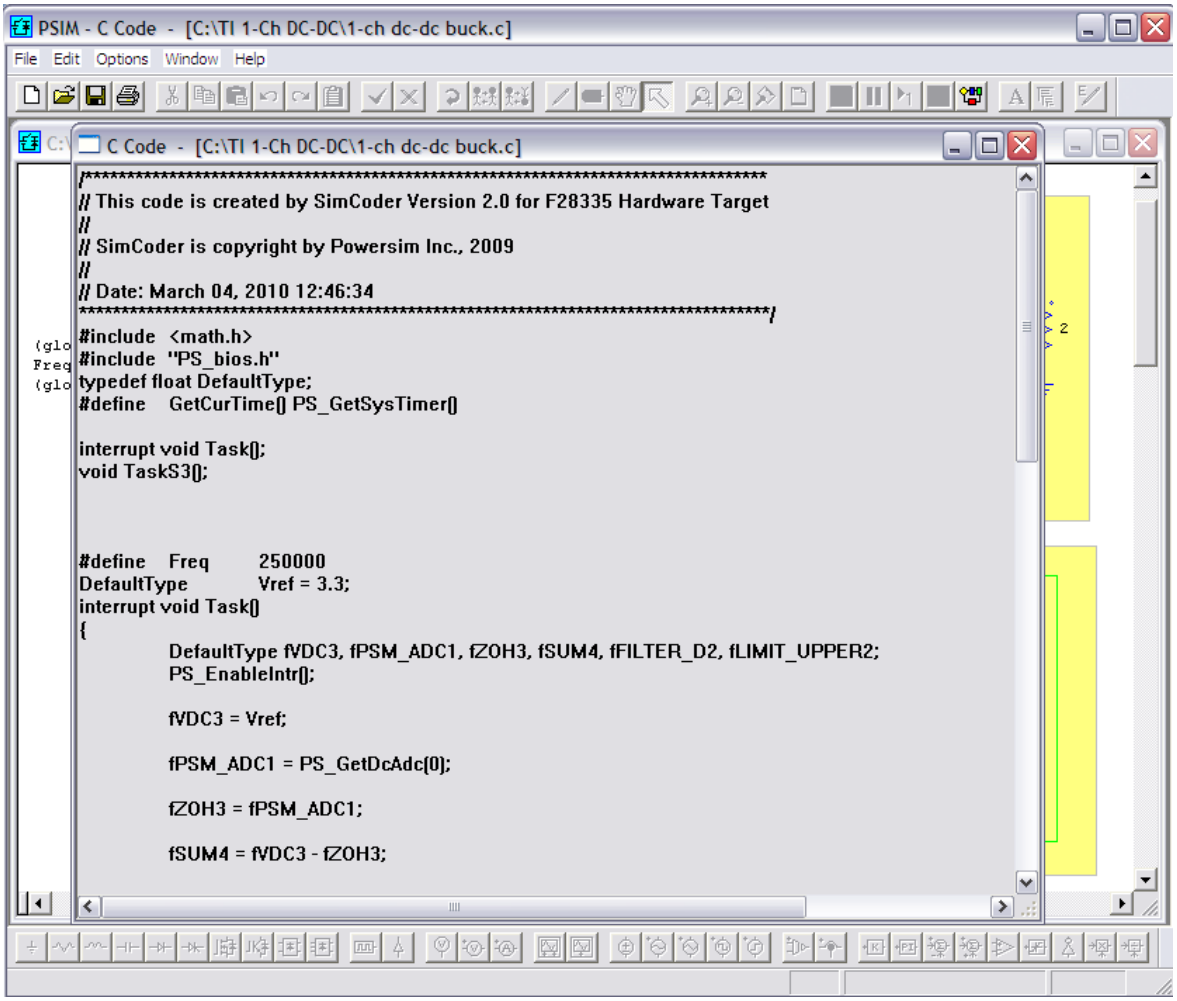
Before performing the code generation, first define the project configuration for Code Composer Studio. Double click on the Simulation Control block (the clock image). The **Hardware Target** should be set to *TI F28335*. Click on the drop-down menu to choose one of the four project settings. In this case, we will choose *RAM Debug*, as shown below.



With the RAM Debug setting, it is easy to debug the program and there is no need to write the program to the flash memory.

2. Generating Code

To generate code, select **Simulate** -> **Generate Code**. The generated code will be displayed in a separate window, as shown below.

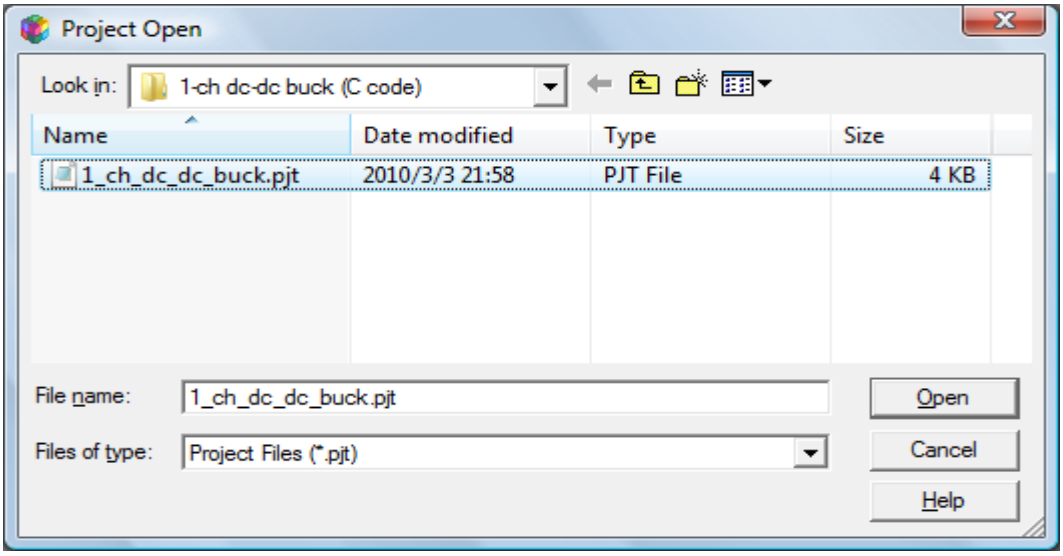


PSIM not only generates the code, but also generates all the necessary project files for four configurations: RAM Debug, RAM Release, Flash Release, and Flash RAM Release. The project file and all dependent files are stored in a sub-folder called "c:\TI 1-ch DC-DC\1-ch dc-dc buck (C code)".

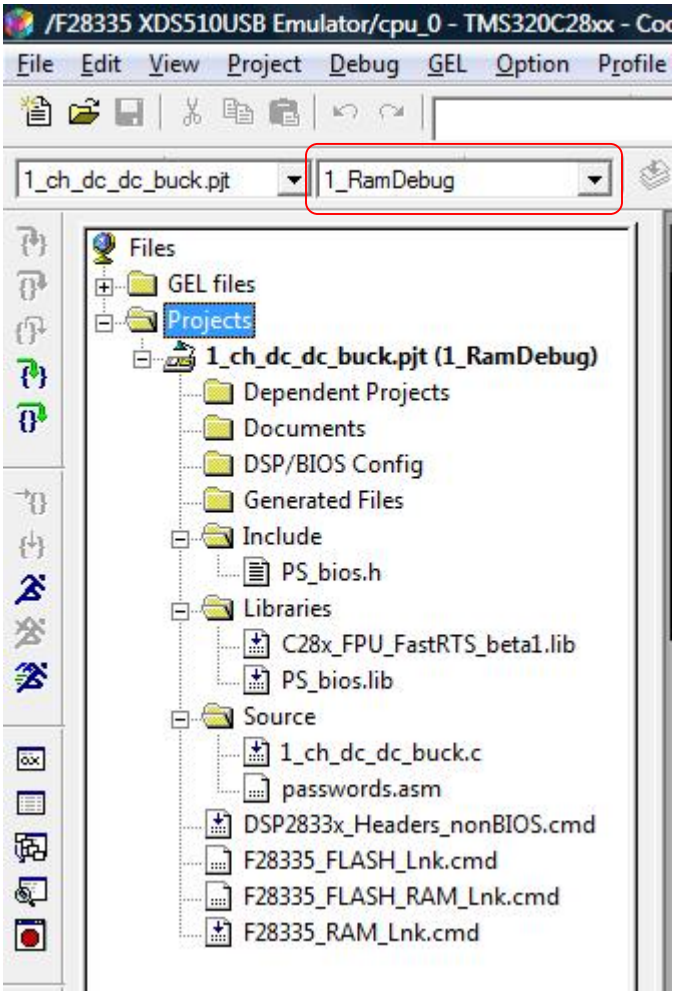
3. Compiling the Project in CodeComposer Studio (CCS)

The CodeComposer Studio (CCS) from TI should be version 3.3 or higher. If you are using CCS v3.3, and get the message "Unknown compiler option '--float_support=fpu32'", please follow the procedures in Appendix A to update your CCS v3.3.

Launch CCS, go to **Project** -> **Open**. Navigate to the folder "c:\TI 1-ch DC-DC\1-ch dc-dc buck (C code)" and select the project file "1_ch_dc_dc_buck.pjt", as shown below.

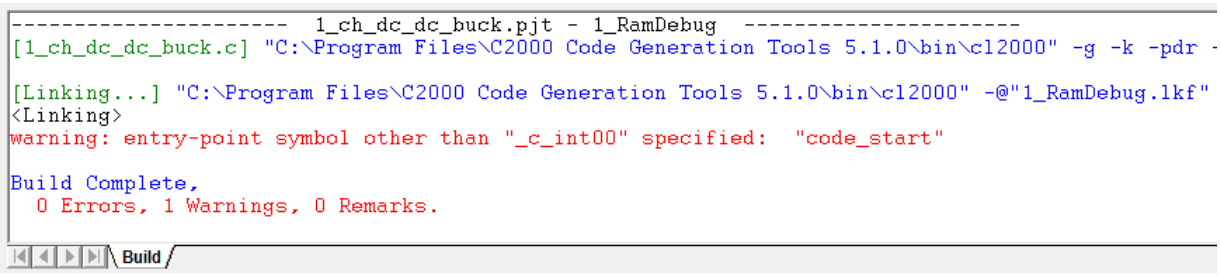


Click the **Open** button to continue. The CCS will appear as follows:



Note that the project configuration is set to RAM Debug. With this setting, all program and data will be loaded to the RAM memory.

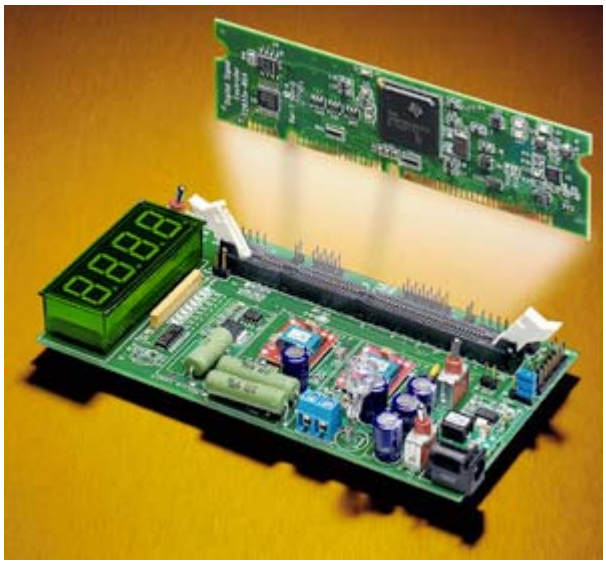
To compile the project, click on the icon  on the Toolbar or select **Project** -> **Build** to build the project (or click on  or select **Project** -> **Rebuild All** to rebuild the whole project). After the compiling is complete, CCS will display the following:



The warning message can be ignored. This warning message is displayed when program is not saved in the flash memory.

4. Uploading Code to DSP (RAM Debug Version)

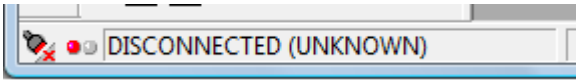
Insert TI's TMS320F28335 controlCARD into TI's 2-Channel DC/DC Buck Converter Kit (TMDSDCDC2KIT), as shown below.



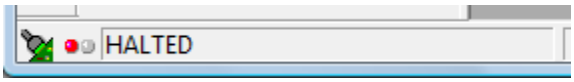
Connect the J1 connector of the board to the JTAG emulator, and then connect the JTAG emulator to the computer's USB port. After connecting the power to the board, turn on Switches SW1 and SW2 on the board. Switch SW3 is for displaying either Ch1 or Ch2 output. Set SW3 to the Ch2 position.

In CCS, select **Debug** -> **Connect** to connect the computer to the DSP. If the connection is successful, the bottom left corner of CCS will be changed from the disconnection state to the connection state, as shown below.

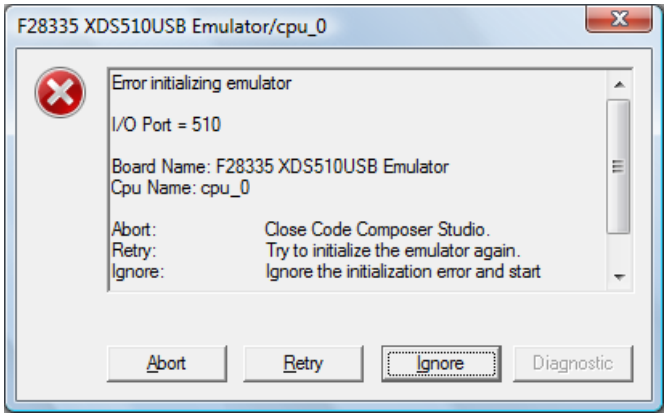
Disconnected



Connected



If connection cannot be established, an error message will appear as shown below:



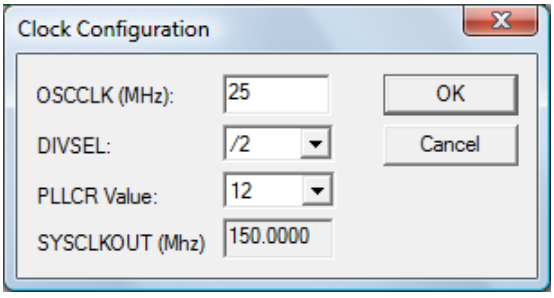
If this happens, remove the JTAG emulator cable from the computer's USB connector and turn off switch SW1 of the kit. Then reconnect the cable and turn on switch SW1. Select **Debug** -> **Reset Emulator**, then select **Debug** -> **Connect** again.

If connection still cannot be established, check if the proper JTAG driver is used.

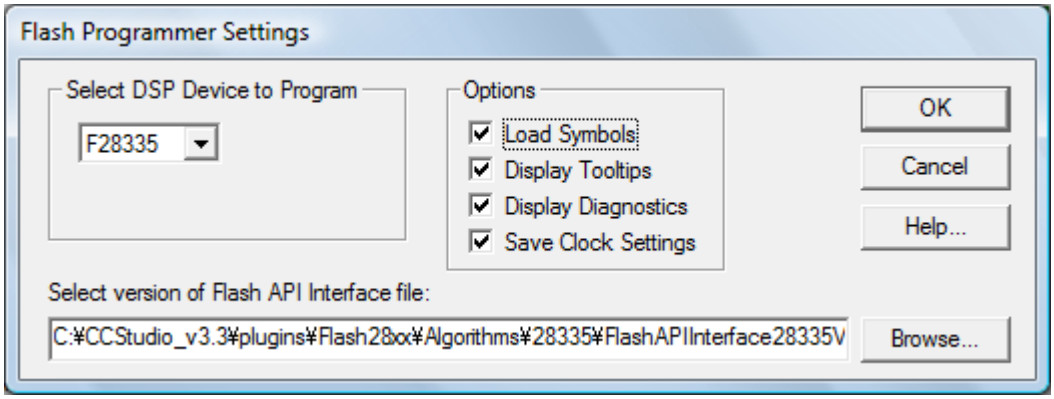
After the connection is established, there are two ways to upload the code to the DSP. One is to use the Load Program function. Go to **File** -> **Load Program**, and specify the .out file (in this example "C:\TI 1-Ch DC-DC\1-ch dc-dc buck (C code)\RamDebug\1_ch_dc_dc_buck.out"). CCS will automatically load the code to the RAM memory. Note that the Load Program function works only for the RAM Debug or RAM Release version.

Another way to upload the code to the DSP is to use the on-chip flash programmer function. This method works for both RAM and flash versions. Click on the icon of the loader tool in CCS Toolbar as shown below or select **Tools** -> **F28xx On-Chip Flash Programmer**.

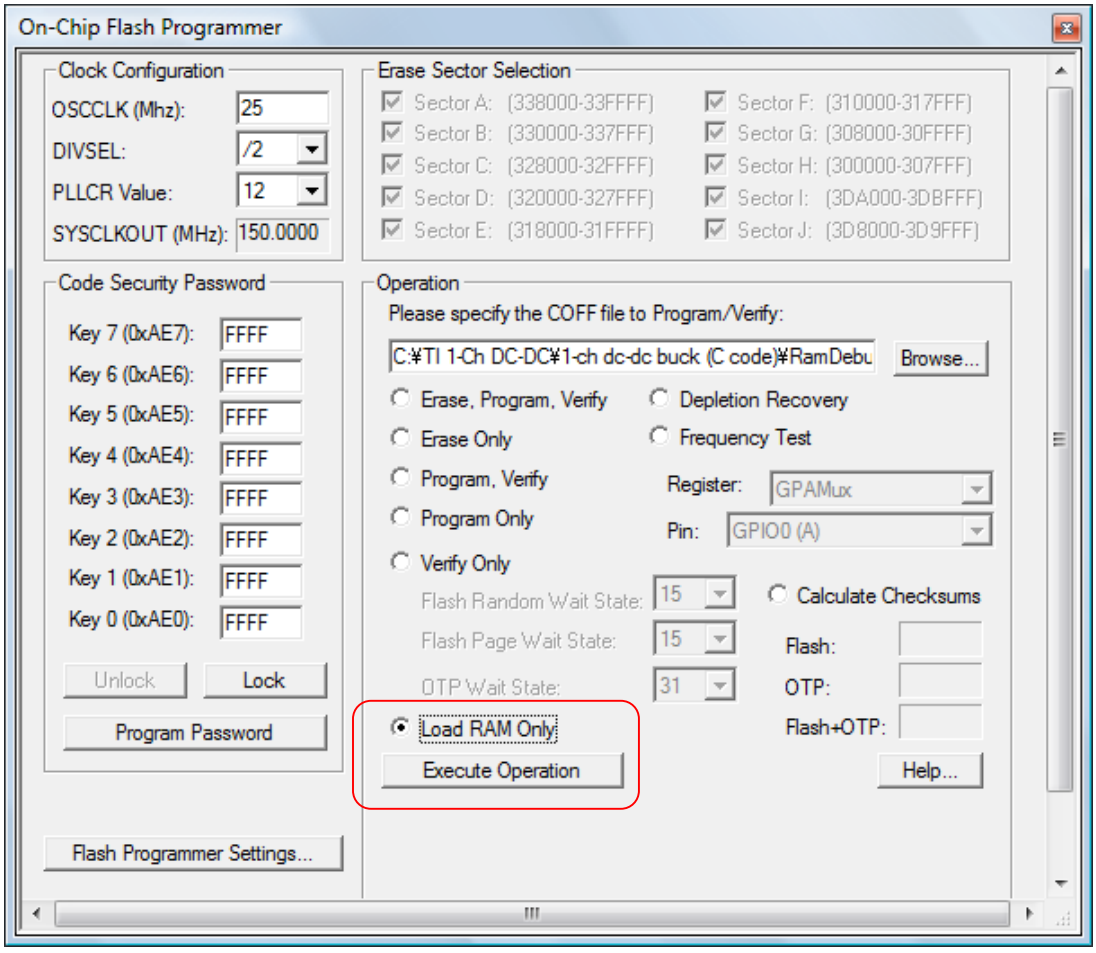
The following dialog will pop up. Enter the values and selection as shown below. Note that the DSP external clock of the TMS320F28335 controlCARD is 25MHz. Also, the DIVSEL value and PLLCR Value are set to /2 and 12 for this Converter Kit. They may be different for other hardware boards.



Click on the **OK** button, and the following dialog will appear.

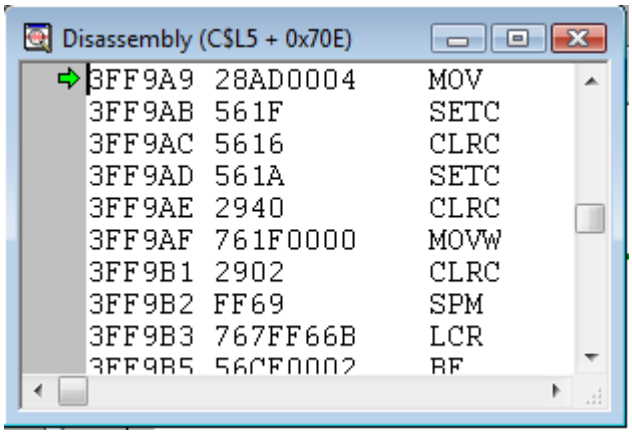


Click on **OK** again, and the dialog window below will appear. Since the project configuration is set to "RAM Debug", make sure to select *Load RAM Only* in this window. Click on the button **Execute Operation** to upload the code to the DSP. Close this window after the upload is finished.

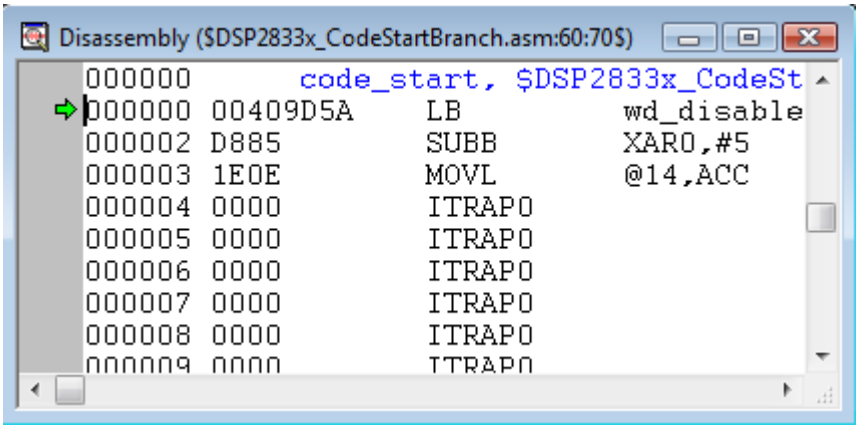


5. Running Code in DSP

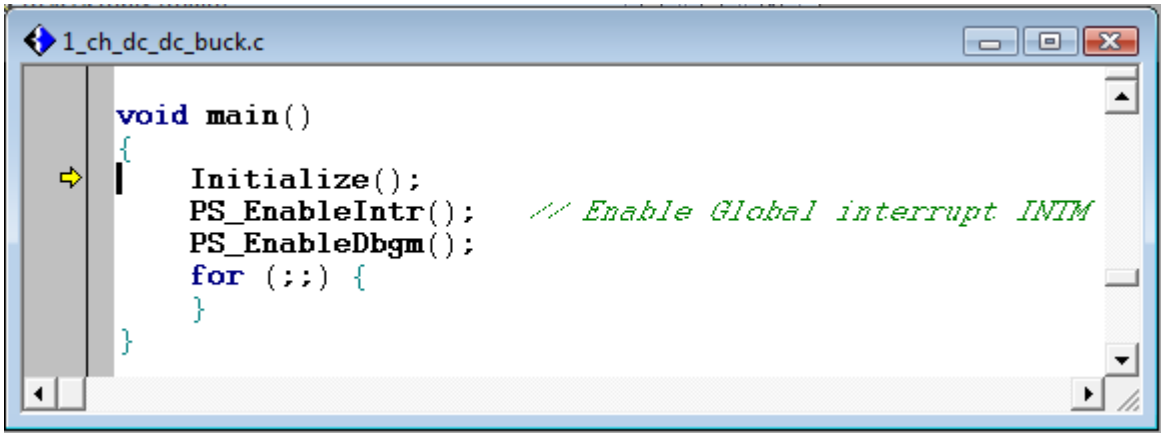
To run the program in the DSP, select **Debug** -> **Reset CPU**. The following window will appear.



Then select **Debug** -> **Restart**. The following window will appear.



Then select **Debug**-> **Go Main** to go to the beginning of the main program. The following window will appear.



Now click on the icon  in the Toolbar, or select **Debug** -> **Run** to run the program.

To stop the program, click on the icon  in the Toolbar box, or select **Debug** -> **Halt**.

To disconnect the kit, select **Debug** -> **Disconnect**. Then turn off Switch SW1 of the kit.

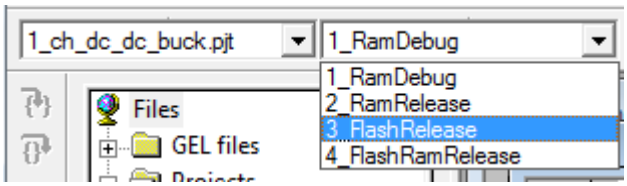
6. Uploading Code to DSP (RAM Release Version)

The procedure of compiling and uploading the RAM Release version is same as the RAM Debug version, except that the project configuration is set to *2_RamRelease* when compiling.

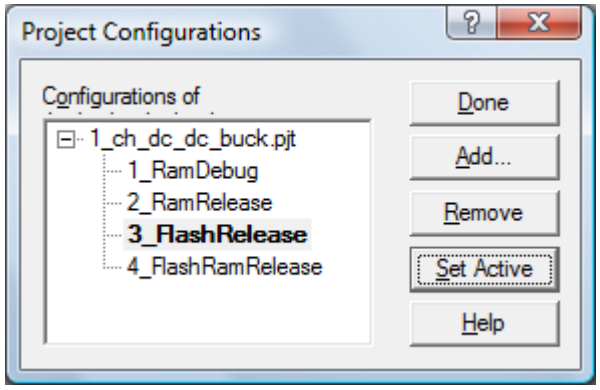
With the RAM release version, the speed of the code will be faster than the RAM Debug version, but certain debug information will not be available.

7. Uploading Code to DSP (Flash Release Version)

To upload the code to the flash memory of the DSP, in CCS, from the drop-down menu, change the project configuration to *3_FlashRelease* as shown below. In this configuration, the code will be saved and executed in the flash memory.



Alternatively, select **Project** -> **Configurations**. Click on *3_FlashRelease*, and then click on the **Set Active** and **Done** buttons.

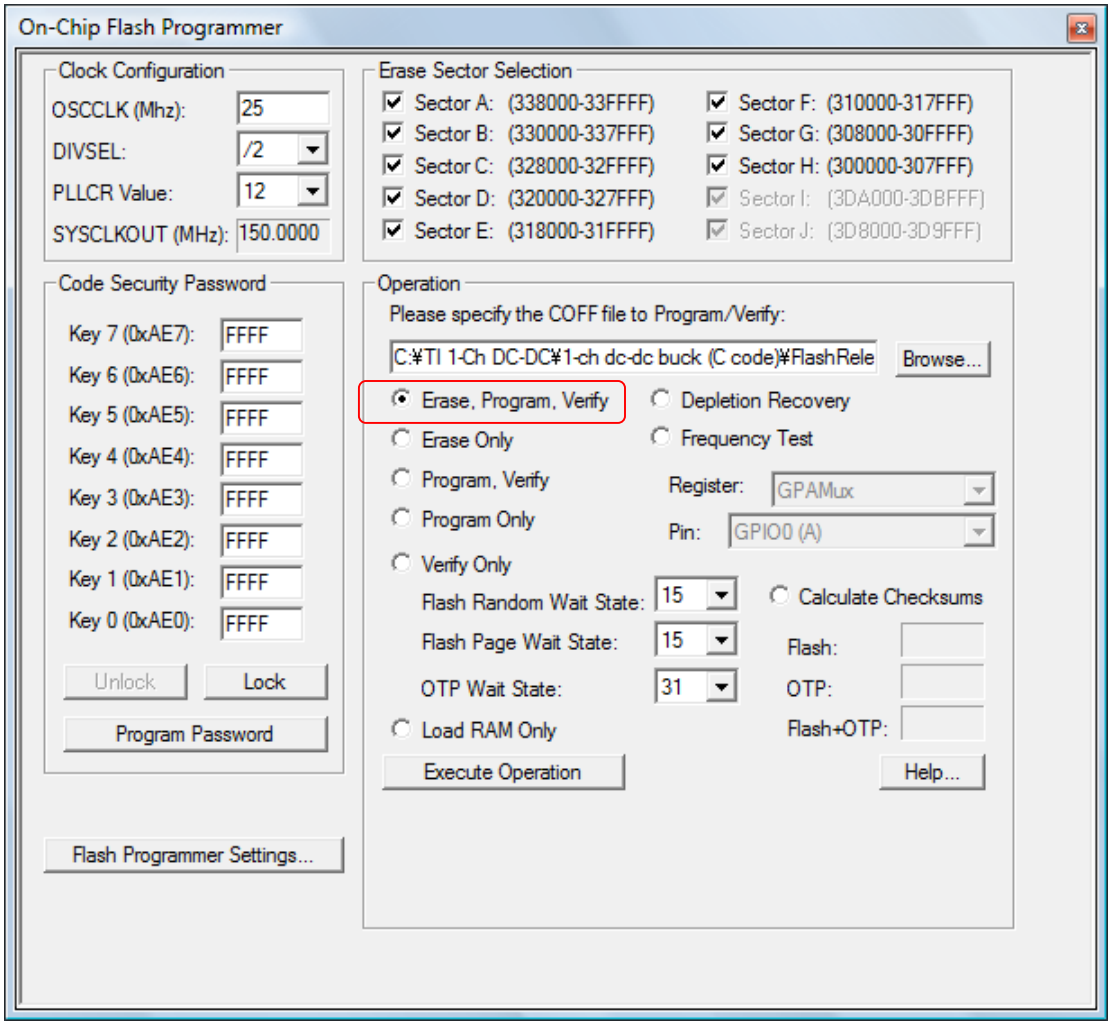


To compile the program, click on the icon  or select **Project** -> **Build** to build the project (or click on the icon  or select **Project** -> **Rebuild All** to rebuild the whole project).

The process of connecting the computer to the DSP is the same as described in Step 4.

Once the DSP is connected to the computer, click the loader tool in toolbar box of CCS or select **Tools** -> **F28xx On-Chip Flash Programmer** to upload program to the DSP. Note that, in the upload dialog window, make sure to check the option *Erase, Program, Verify*. Then click on the **Execute Operation** button to upload the code.

After the program is uploaded to the flash memory. Disconnect the JTAG cable from the computer and turn off switch SW1. Then turn on switch SW1 to start running the code. The lamp in the kit will be turned on, and the LED on the board will display the output voltage.



8. Uploading Code to DSP (Flash RAM Release Version)

The procedure of compiling and uploading the flash RAM release version is same as the flash release version, except that the project configuration is set to *4_FlashRamRelease* when compiling.

With the flash RAM release version, the code will be automatically copied from the flash memory to the RAM memory first, and then it will run in the RAM memory. The speed of the code will be faster as compared to the flash release version.

Appendix A: Upgrading CodeComposer Studio V3.3

If you have the F28335 DSP and get the error message "Uknown compiler option '—float_support=fpu32' " when compiling for the F2833x target, you need to update your CCS C2000 compiler. Below are the steps :

1. Launch CCS v3.3
2. Select **Help** -> **Update Advisor** -> **Check for Updates**. You will have to have an account on the TI site to access the download section.
3. Log in to your account, and you will be re-directed to the page **Available Updates** for CCS v3.3. Download and install the following:
   - CCSv3.3 Service Release 10 (or higher), and
   - C2000 Code Generation Tools
     Use this link to get the latest version of the TI v5.0 C2000 Code Generation Tools with the floating point updates: https://www-a.ti.com/downloads/sds_support/CodeGenerationTools.htm, and download the "C2000 Code Generation Tools v5.0.2" or newer.
4. Specify CCS to use the new code generator you downloaded and installed. To do so, start CCS. Click on **Help** -> **About** -> **Component Manager**. In Component Manager, click on the + sign next to the CCS version you just installed. Then click on the + sign next to "TMS320C28XX". Check the box next to the v5.0.x Code Generation Tools that you installed from 5. Choose **File** -> **Save and File** -> **Exit**, and exit CCS.