ECE 487 LAB 1

ÇANKAYA UNIVERSITY

Overview of DSP Board

DSP (Digital Signal Processor) boards are used in high performance, high throughput signal processing applications. You can find there processors in most of the electrical devices that you are using every day. These processors are produced by various companies; Motorola, NEC, SGS-Thompson, Conexant, Lucent Technologies and Texas Instruments (TI).

In this lab, we will learn how to access and program TI TMS320C6713 starter kit using Matlab/Simuling and/or CCS (Code Composer Studio) programs. In the course of this lab, we will use Simulink to design signal processing applications (Convolution,FIR filter, FFT, Modulation etc.) and specific signal generation.

For the first lab, we will start by designing .mdl project files with Matlab/Simulink and then CCS software tool will be used to generate TMS320C6x executable files. CCS includes the assembler, linker, compiler, and simulator and debugger utilities respectively. Figure 1 shows the intermediate steps involved for going from a source file to an executable file.

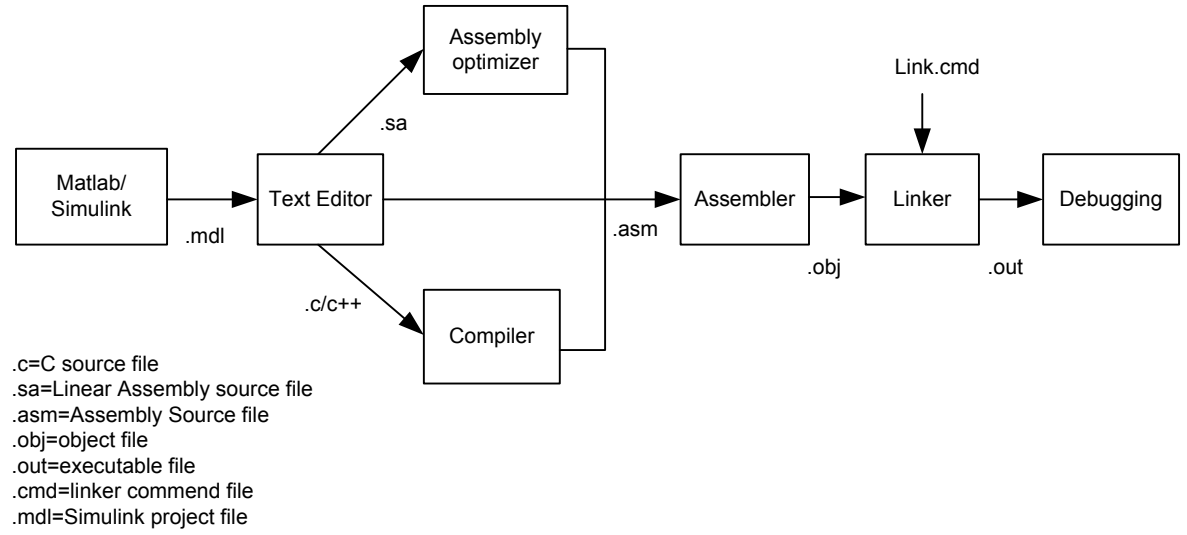


Figure 1. Software Tool

Thus we will focus to use only Simulink to design signal processing (Convolution,FIR filter, FFT, Modulation etc.) and specific signal generation. Highly motivated and attendant students can improve themselves in CCS without MATLAB/Simulink to the extent of their C code debugging agility at the future.

DSP Board Highlights

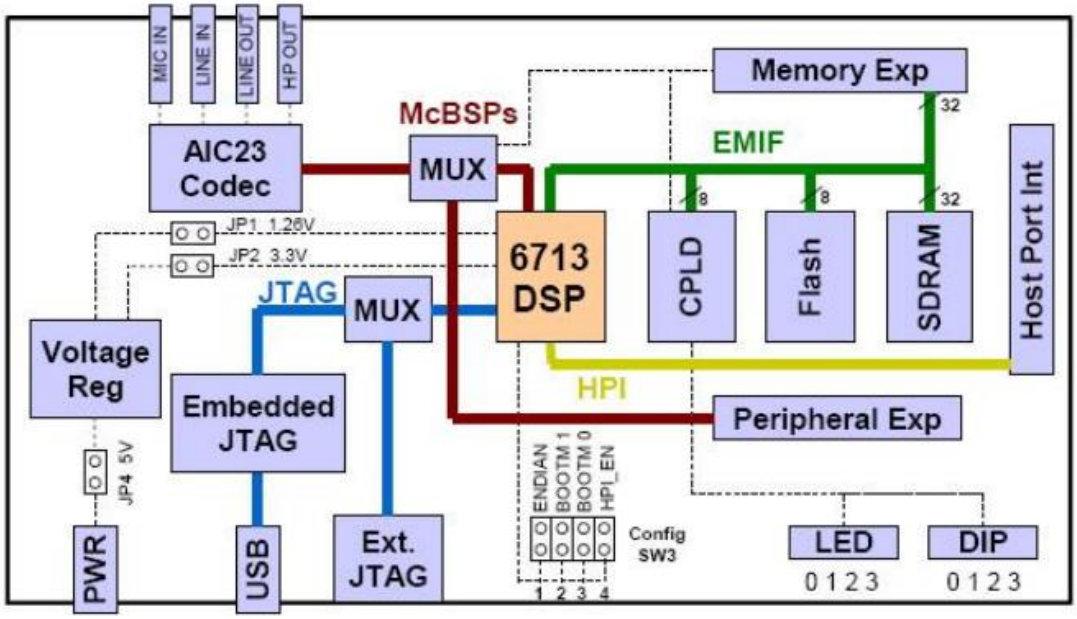


Figure 2: C6713 DSK block diagram

- Texas Instruments TMS320C6713 DSP operating at 225 MHz
- An AIC23 stereo codec
- 8 MB of synchronous DRAM
- 512 KB of non-volatile Flash memory
- 4 user accessible LEDs and DIP switches
- Configurable boot options.
- Standard expansion connectors for daughter card use
- JTAG emulation through on-board JTAG emulator with USB host interface on external emulator
- Single voltage power supply (+5V)

A DSK board can be connected through PC host through parallel or USB port easily like in Figure 2.

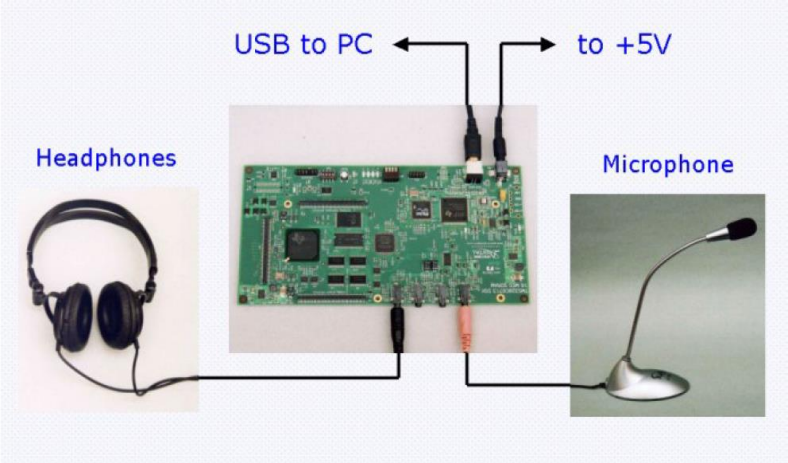


Figure 2. Texas Instruments C6713 DSK Setup

DSP board interfaces to analog signal through a codec which can select the microphone or the Line input as the active input. The analog out is connected to both the Line out and Headphone connectors. The DSK includes 4 LEDs and a 4 position DIP switch which allow for interactive feedbacks.

Starting with Code Composer Studio

Before we started to learn the building a project with Simulink we must understand the procedure of connecting the DSP Board and programming, building, compiling after all we must understand running the project with CCS.

By the way CCS is the programming, building and debugging interface of Texas Instrument. CCS communicate with the C6713 DSK board over embedded JTAG interface and exchange real-time data with the DSK board.

- Before starting the CCSv3.3 once the USB cable is connected to the computer and C6713 DSK , the computer will require a driver installation for C6713 DSK.
- After installation the specific driver from the TI driver CD run the 6713 DSK Diagnostic Utility to verify that the C6713 DSK connection. The result appear similar to figure 3 below. All diagnostic tests with the exception of the External Memory should pass. If not, disconnect the USB cable , reconnect the USB cable and reinstall the TI drivers and run the test again.

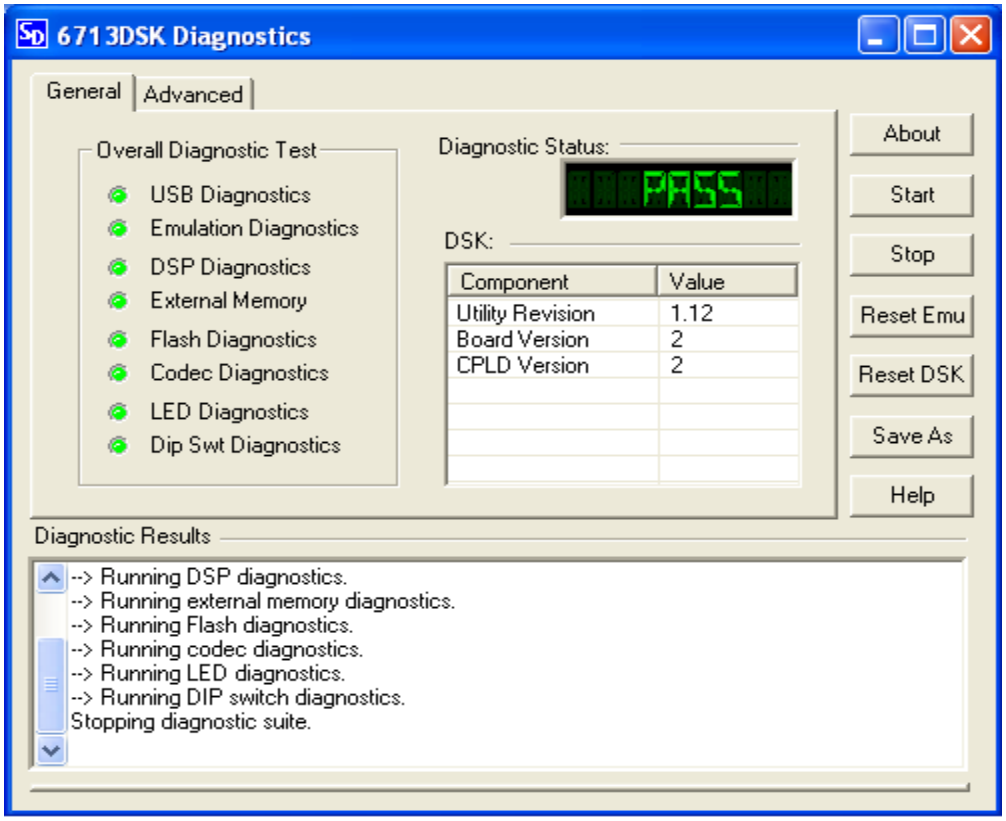
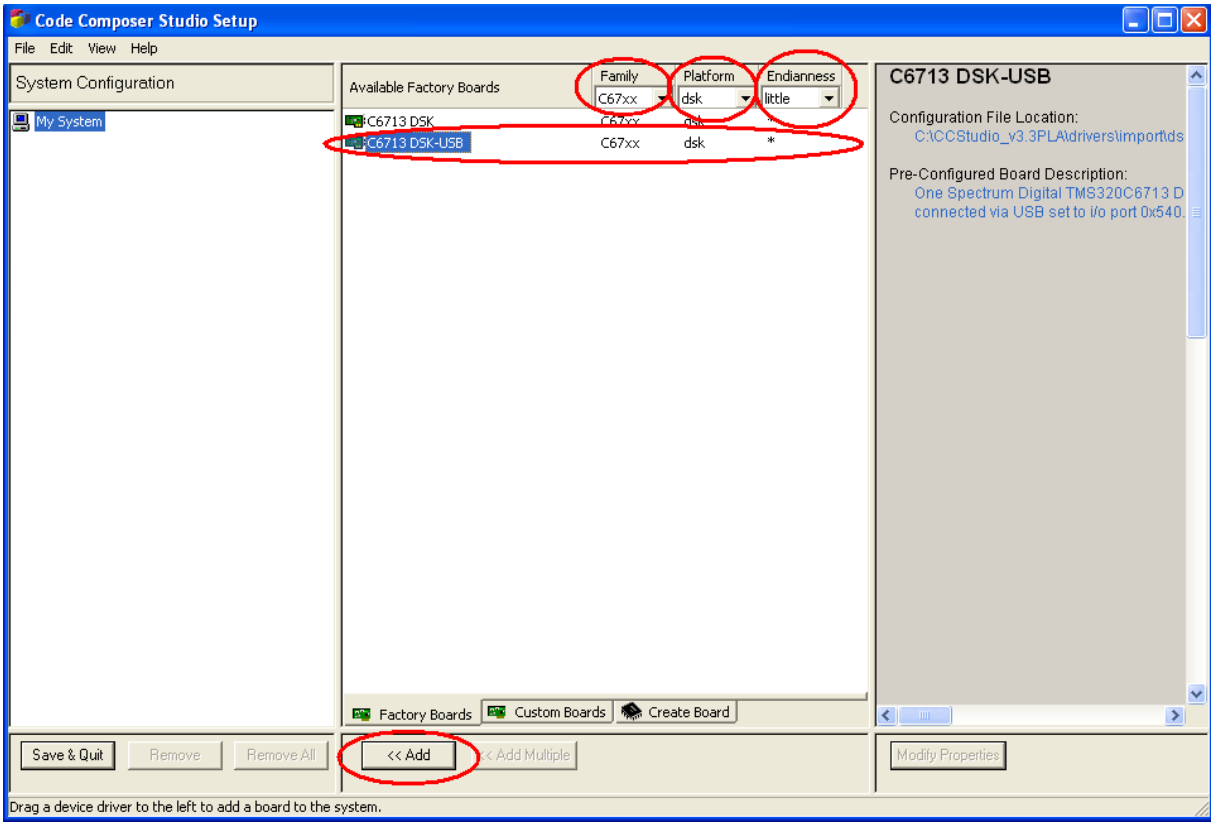
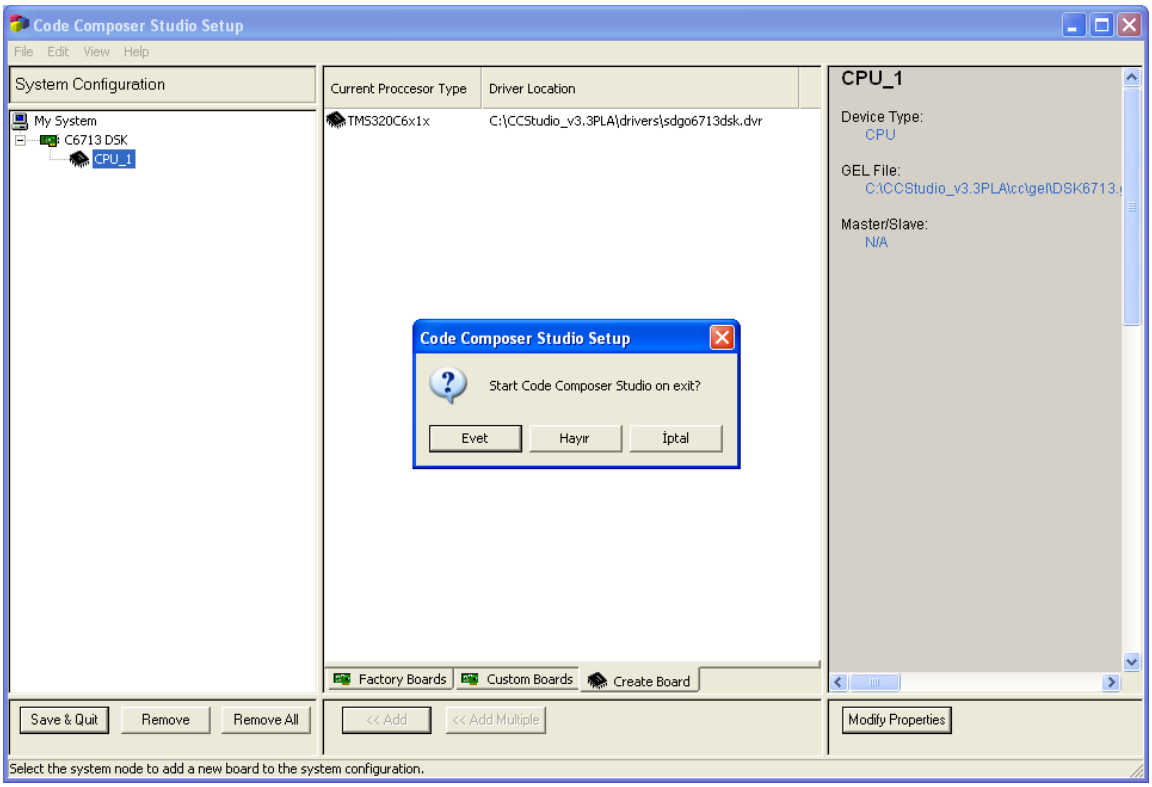


Figure 3 Diagnostic Results

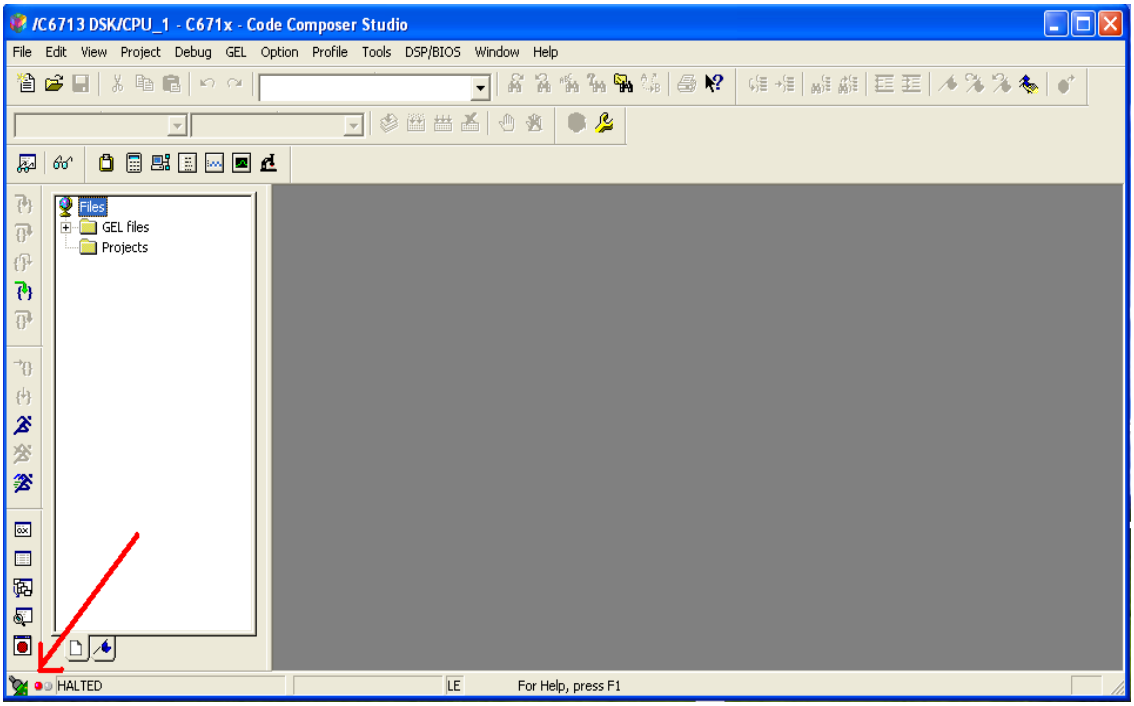
Next we must setup the CCS for C6713 DSP board. Double click the Setup CCS v3.3 icon. From the board selection list select the specific identity shown in Figure 3 below.



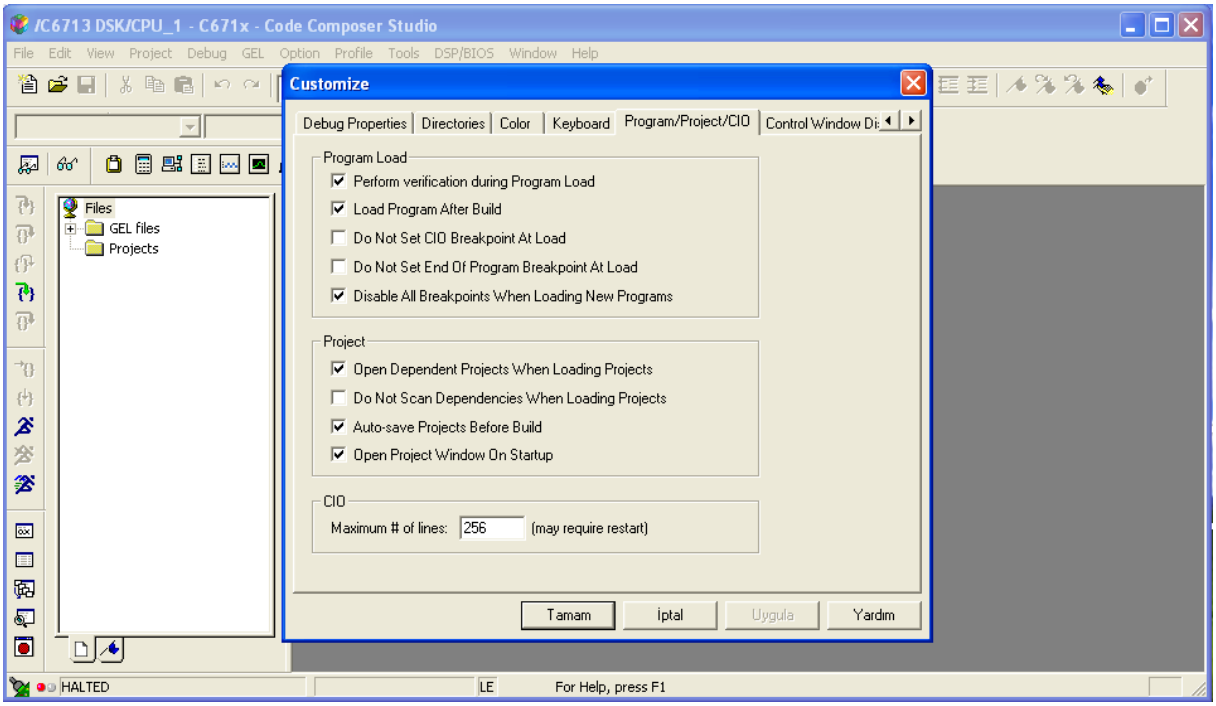
Then add the C6713 board to the system configuration. Click the Save & Quit button and confirm the question to open the CCS with specific settings shown as below.



After that CCS open automatically as shown as below. Notice that at the left bottom connection is complete with C6713 DSP board. From the Debug menu we can connect / disconnect pane rapidly.

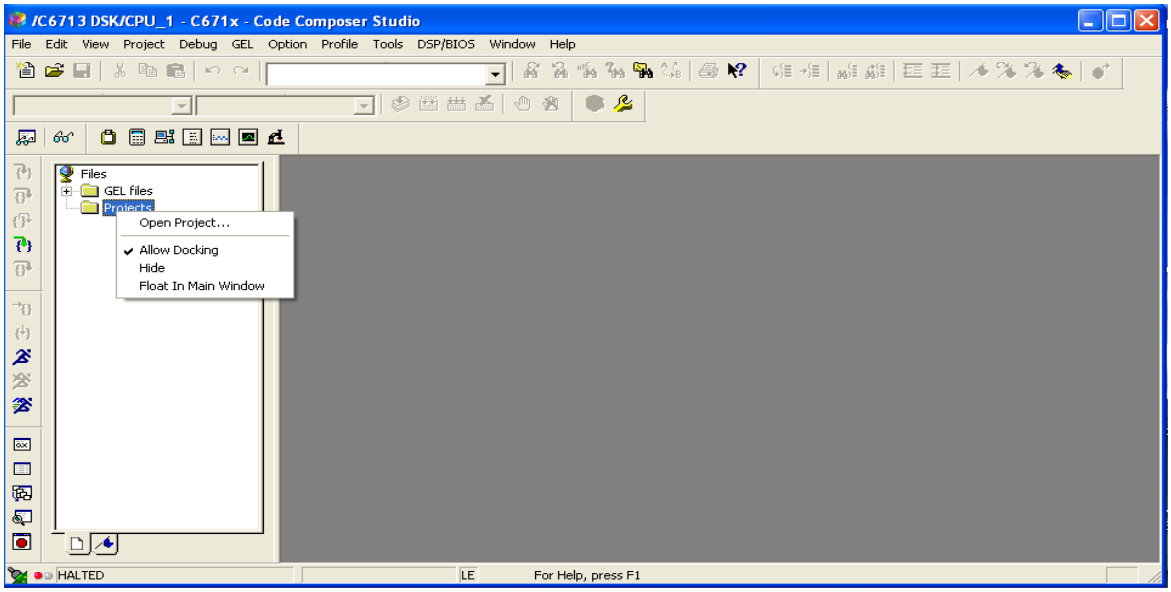


At the option menu click the customize and set the "Load Program After Build "box at the Program/Project/CIO pane as shown below by this way CCS loads the program automatically after the incremental building process.

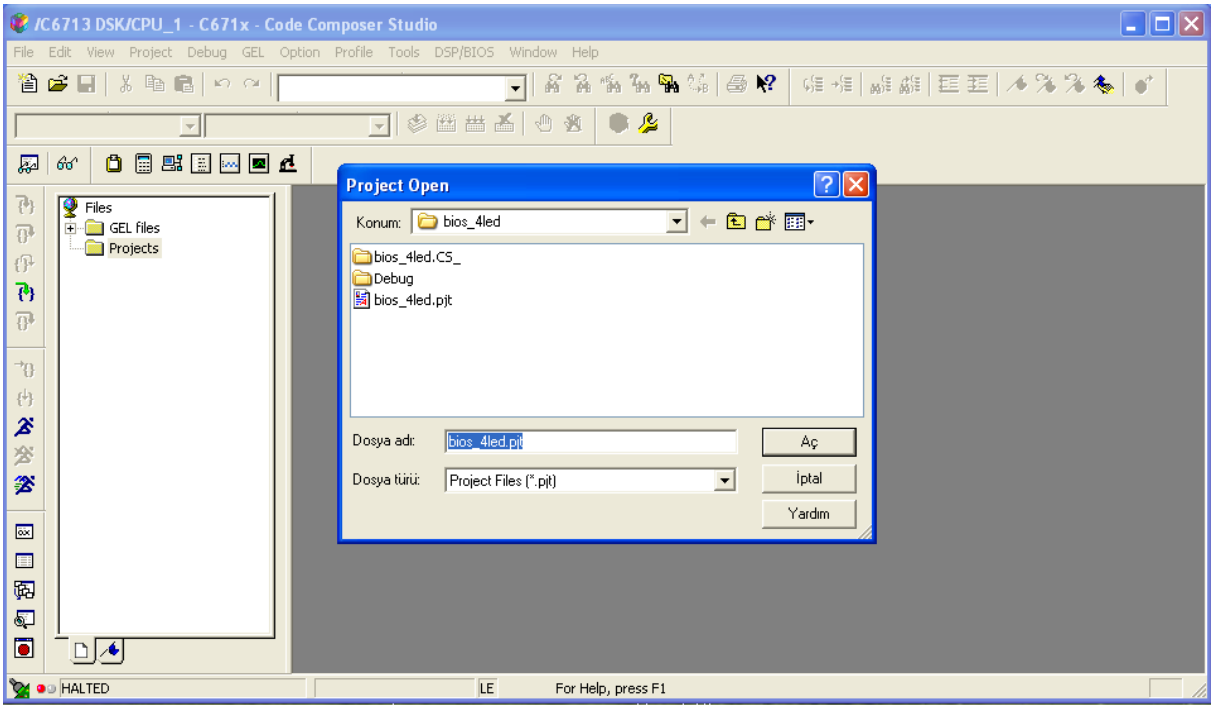


Now we are ready to open a project to programming, building and executing the DSP board.

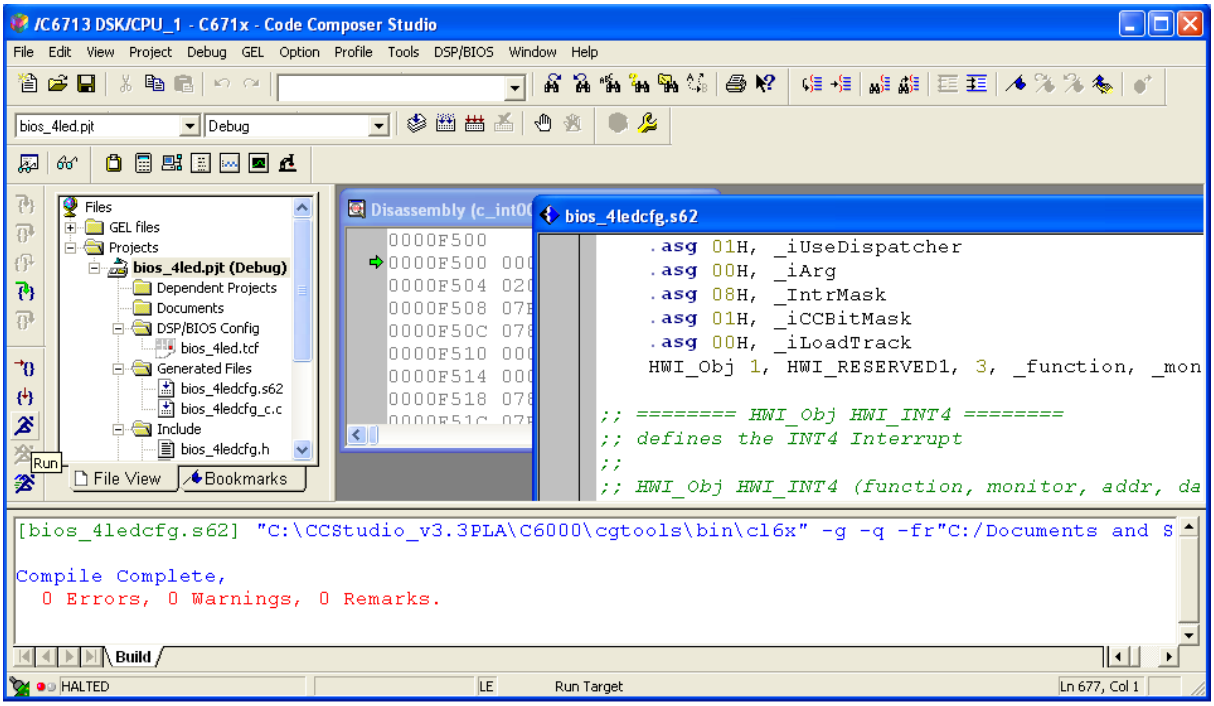
Right click the project file at the files tree and click the open project pane as shown below.



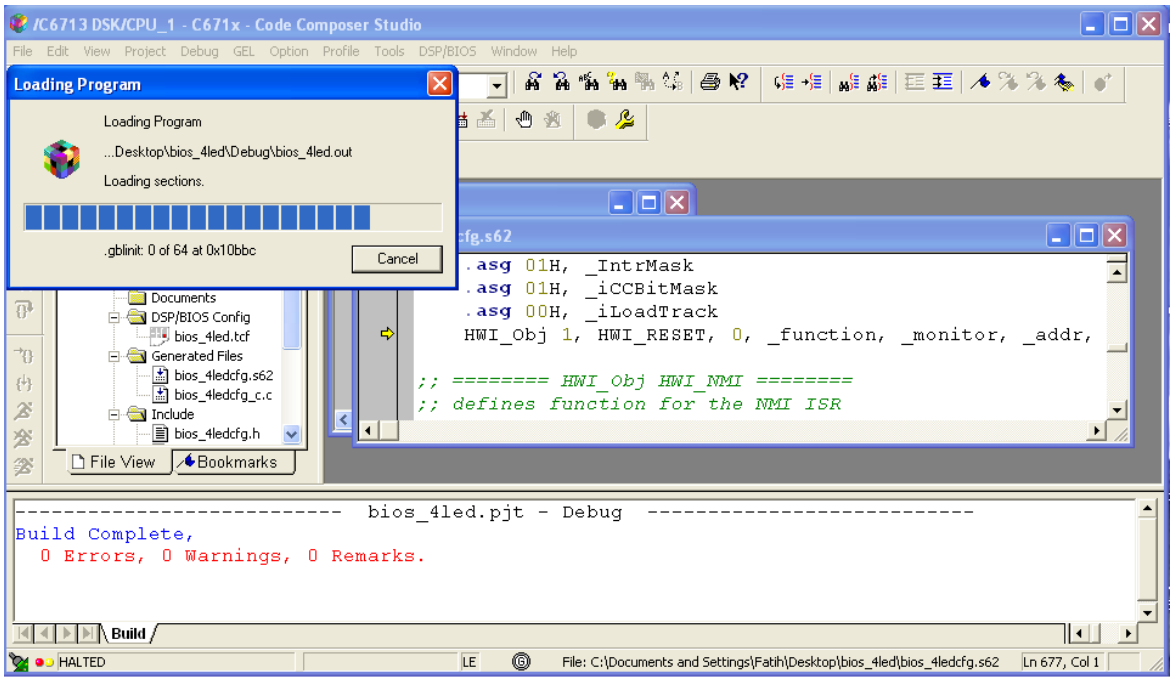
Open the bios_4led.CS_ file and choose the bios_4led.pjt sample project. Always select the .pjt extanted files in this process while programming with CCS.



At the file tree CCS adds the specific files as shown below.



At this moment click the " Incremental Build "  icon. CCS compiles it and load the program automatically as shown below.



Finally it is ready to run. Click the run  icon for execute the program on our DSP C6713 DSK board in real time.

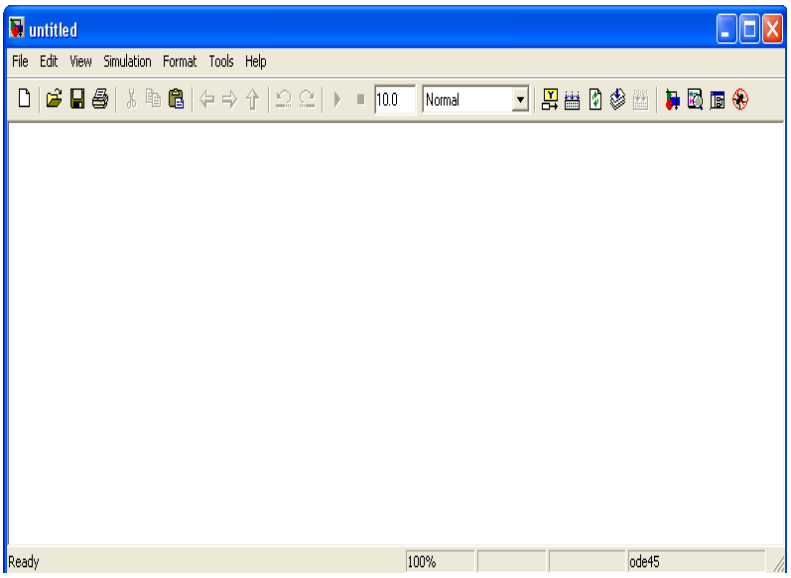
Generating Project with MATLAB/SIMULINK

We will see now how to build and execute the DSK C6713 DSP board with Matlab/Simulink. First notice that your Matlab version is compatible with the CCS version.

As can we see from the figure 1, first the model is generated by the Matlab/Simulink then the generated project is built with CCS. CCS includes a compiler for C6713 DSP and Matlab/Simulink starts CCS when you tell it to generate code for the model, and CCS will automatically compile and download the code to the DSK6713 and it is ready to running on DSP.

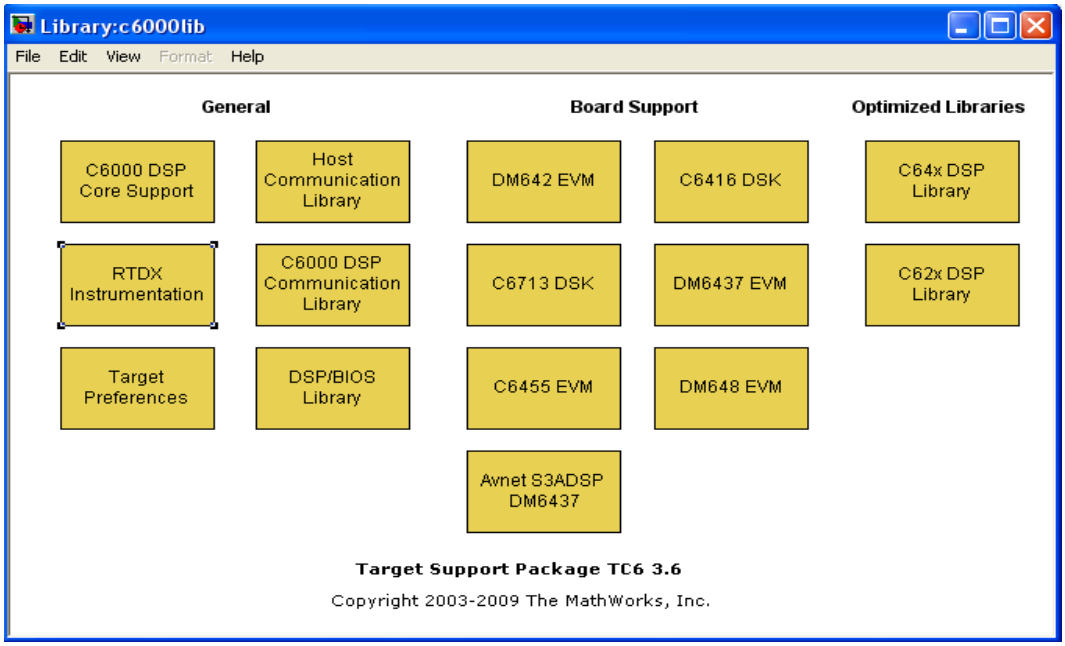
Creating the Simulink Model

- Log in to the PC and bring up Matlab r2009a.
- Change the working directory to your created folder to work on.
- Click the Simulink Library Browser icon 
- To create a new model click the  icon and now you will see an empty model window as below.

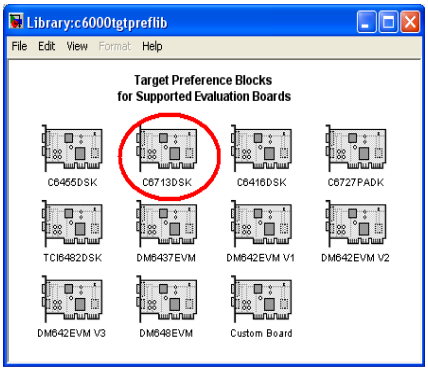


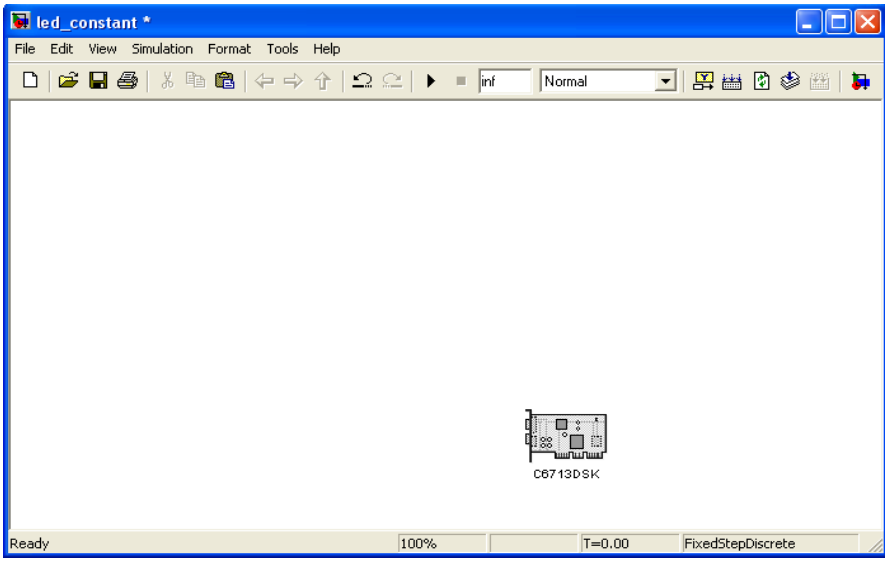
Give a name to your model and save it to your working folder. Notice that appearance of the file is .mdl. This is the model files general append is created by Simulink.

Now type to the Matlab command window c6000lib and notice that a window will pop up as below.

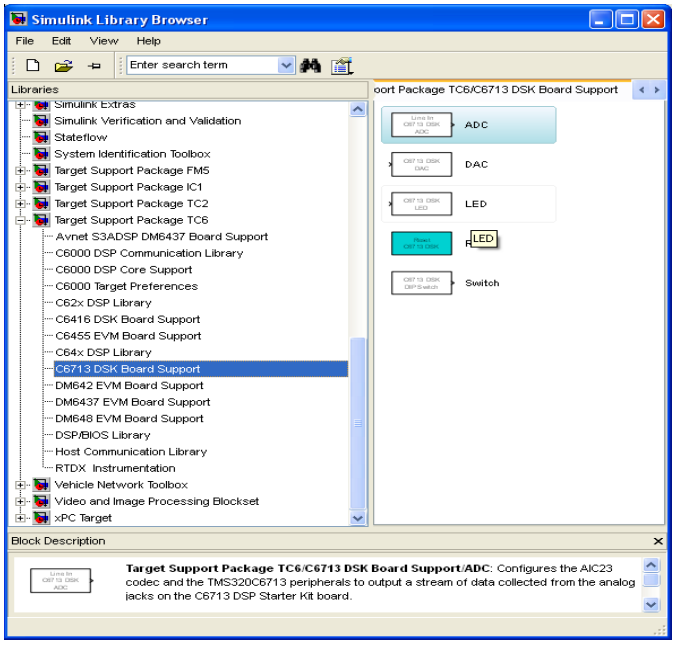


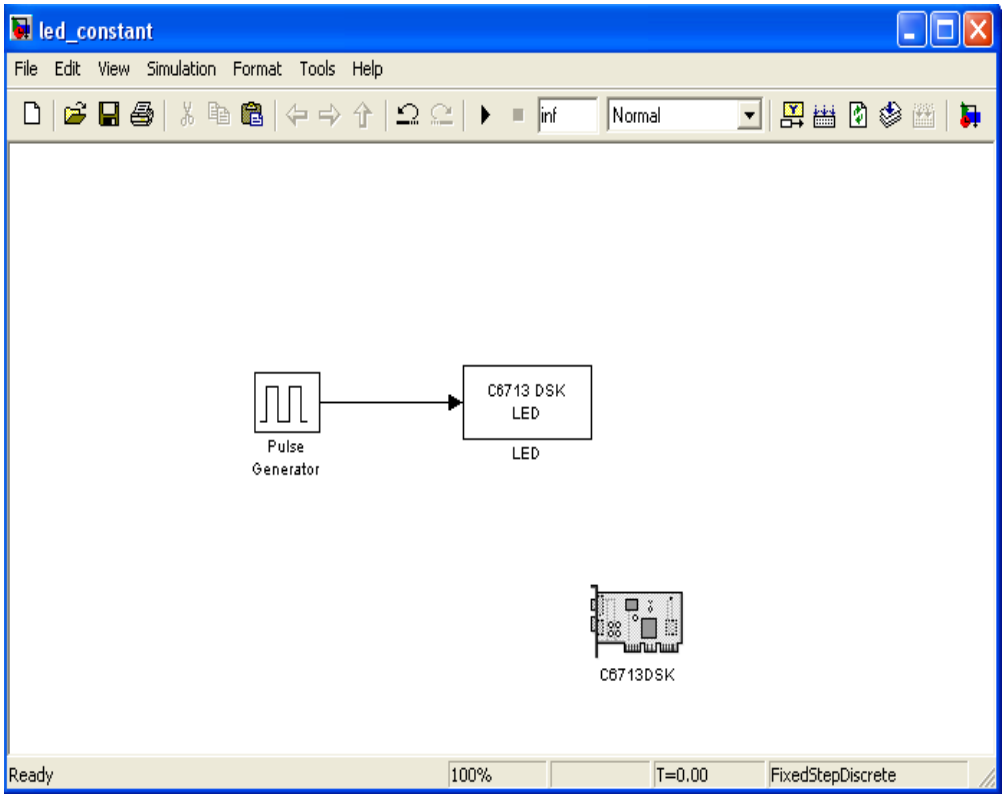
Double click the Target Preferences, select the c6713DSK seen as below and drop it out our Simulink model window by this way we can generate Simulink model for our specific DSP board.





Now we are ready to construct a model by using the Simulink Library Browser. For our first experiment, we will on/off the LEDs where are located on our board. Simulink facilitates our work by addressing the LEDs for programing. Find the LEDs seen as below and add LEDs block and also drag the Pulse Generator to our model from the Simulink tree at the Source pane under the Simulink Library Browser window.





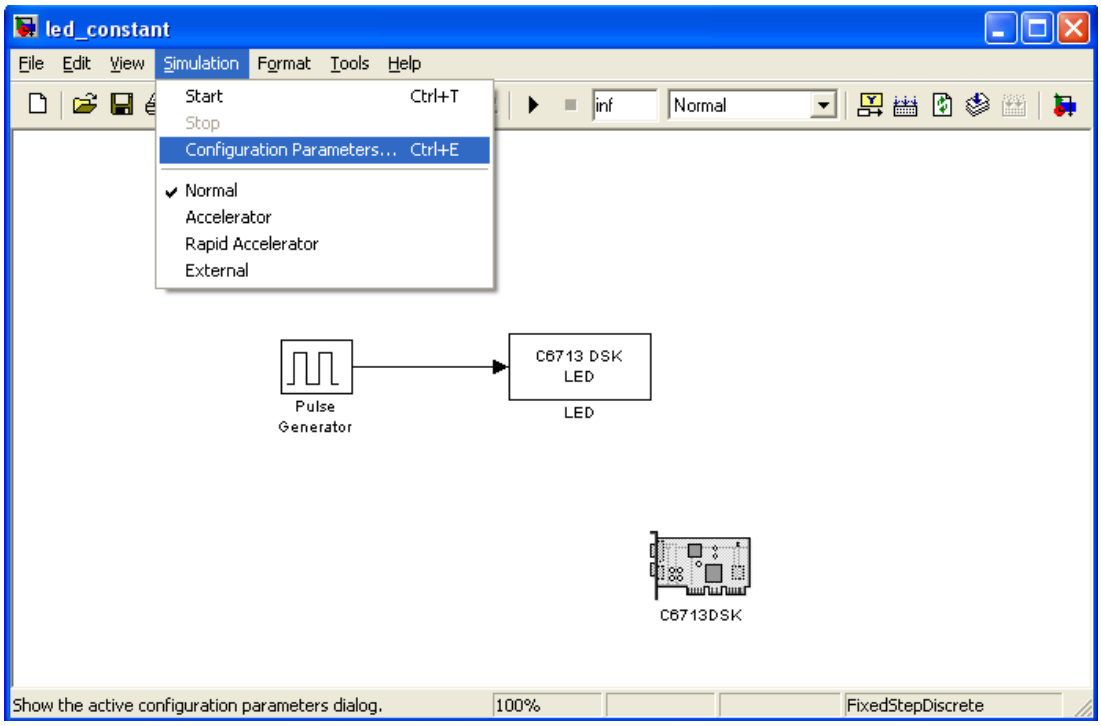
- Double-click on the Pulse Generator block. Set the
  Pulse type=Time based
  Time(t)=Use simulation time

Amplitude=1
Period=0.5 sn
Pulse width=0.5

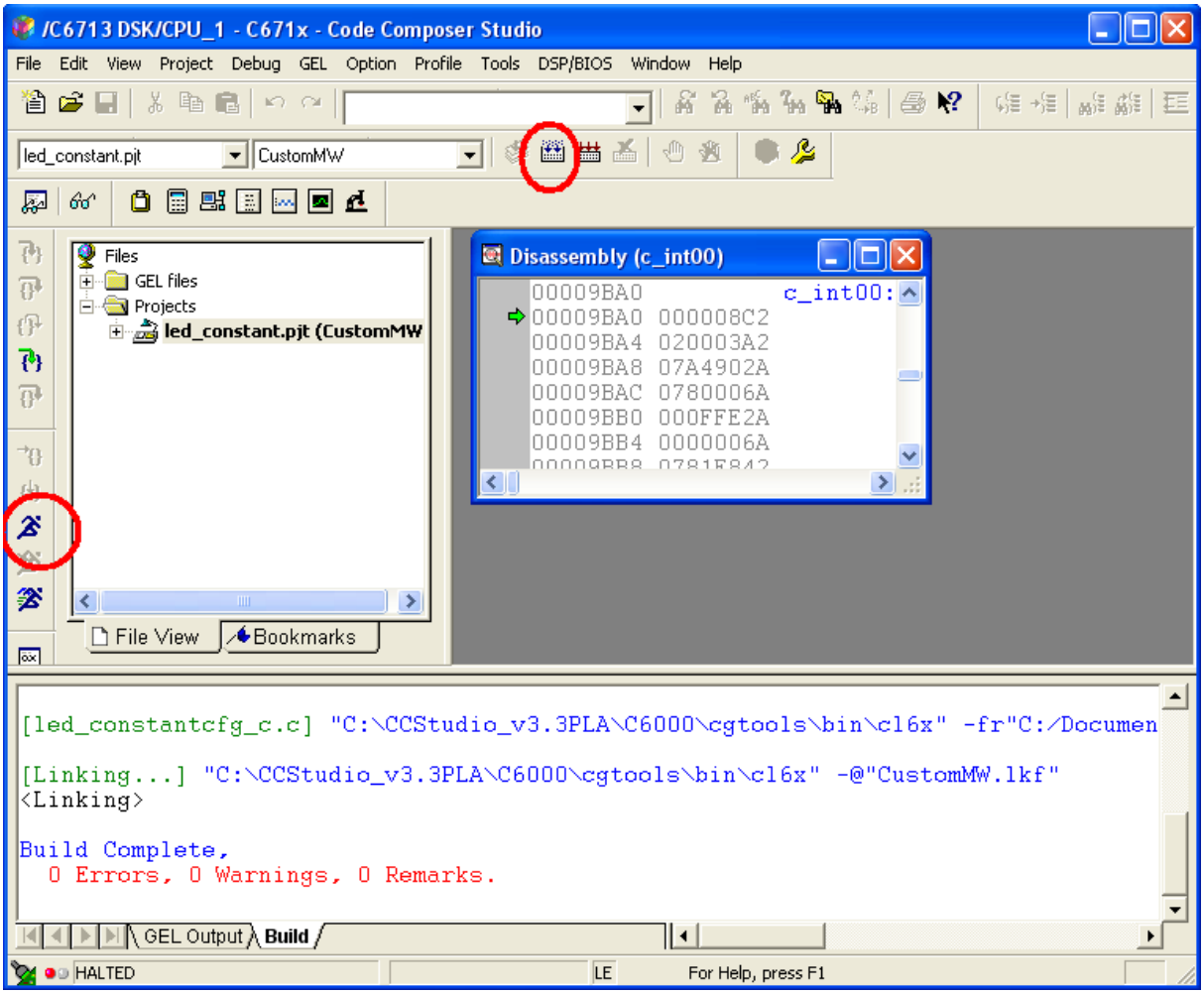
- Click the start simulation icon and set the simulation stop time inf. If there is no warring pop up window it is ready to generate and build our model to the DSK C6713 DSP board.

Connecting To Hardware

- Click the Simulation and open the Configuration Parameters dialog box as seen below.



- On the **Solver** category for your model set Start time 0.0 and stop time inf (Model run without stopping)
- Under **Solver Options**, select the *Fixed-step* and *Discrete* settings from the lists.
- From the select tree, choose **Real-Time Workshop.** Verify that the system target file is *ccslink_ert.tlc* and Language C
- From the select tree, choose the **Embedded IDE Link CC** among the runtime options, set **Build action** *Create Project* . Click OK and close the window.
- Before to start building and execution write clear all to the Matlab Command Window then select the Simulink Model window and click the incremental build icon to generate project.
- Finally build and run the project as described previously as seen below.



Experiment

Note: Save your models and projects in a folder named with your name and number.

1) Execute the steps above to blink the 3rd LED from the left with 1 sec blinking period.

2) Build a program that blinks the LEDs in sequential order of 250msec, 500 msec, 1sec, 2 sec.