CODE COMPOSER TUTORIAL

Importing and general code operation

Abstract

This is a general user guide on how to run the code that was produced for testing the flywheel and accompanying hardware during the summer term 2017.

Tyler Larson

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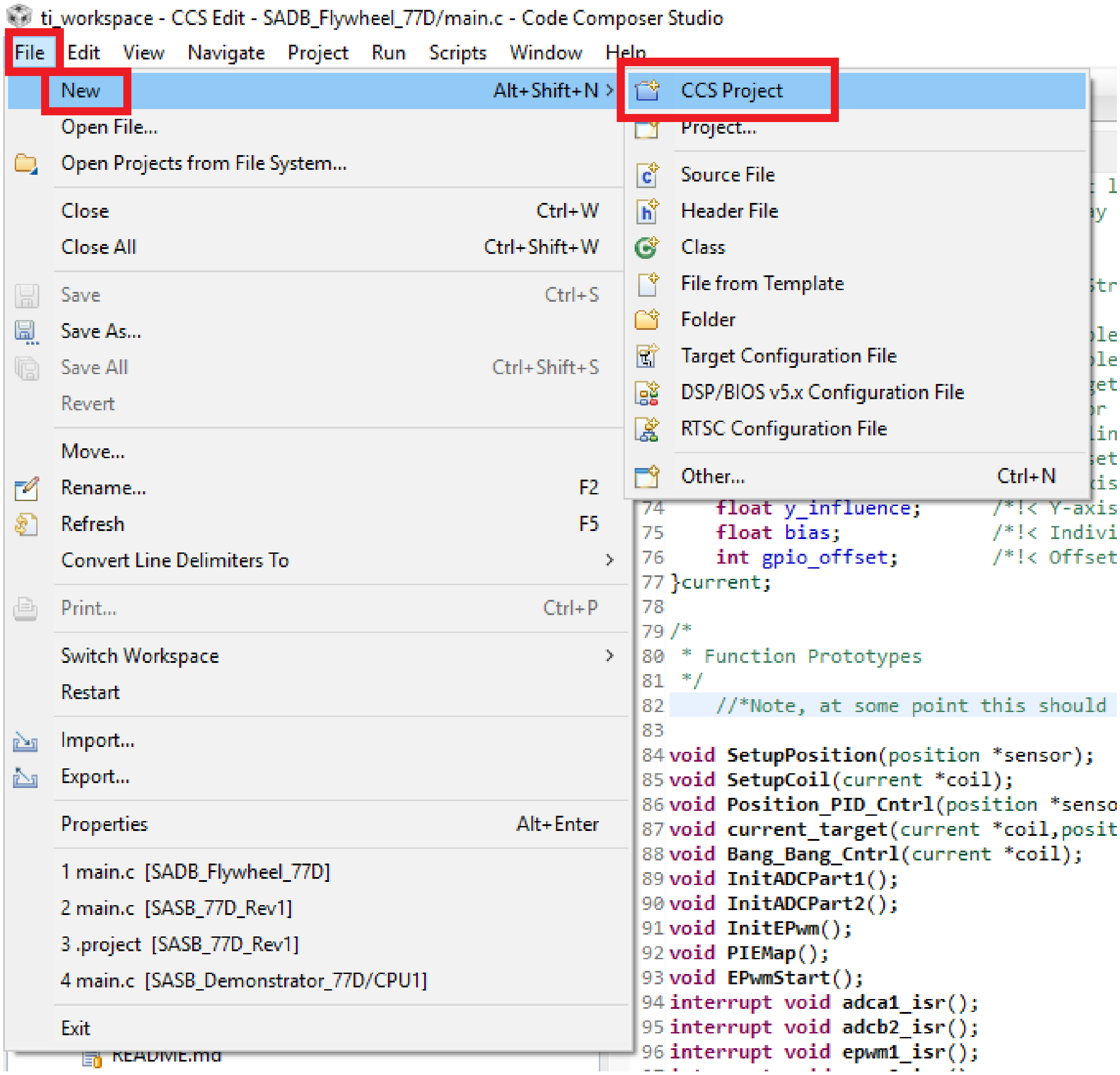
Contents

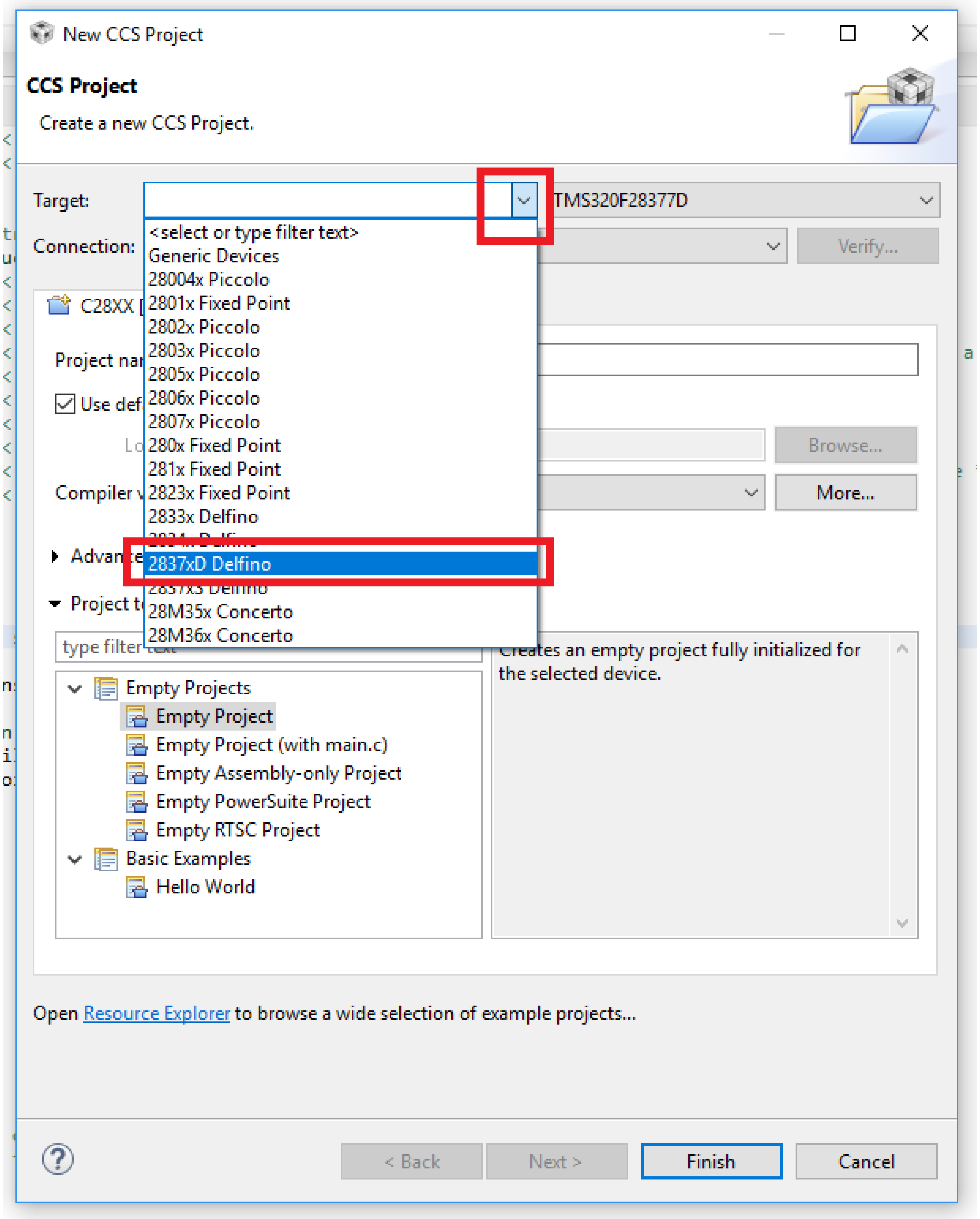
Importing

- Click on “File”, hover over “New”, then click on “CSS Project”



```
    float y_influence;         /*!< Y-axis
    float bias;                /*!< Indivi
    int gpio_offset;           /*!< Offset
}current;

/*
 * Function Prototypes
 */
    //*Note, at some point this should

void SetupPosition(position *sensor);
void SetupCoil(current *coil);
void Position_PID_Cntrl(position *senso
void current_target(current *coil,posit
void Bang_Bang_Cntrl(current *coil);
void InitADCPart1();
void InitADCPart2();
void InitEPwm();
void PIEMap();
void EPwmStart();
interrupt void adca1_isr();
interrupt void adcb2_isr();
interrupt void epwm1_isr();
```

- Next click on the Dropdown by “Target”, and select “2837xD Delfino”



New CCS Project

CCS Project

Create a new CCS Project.

Target: TMS320F28377D

Connection:

C28XX

Project nar

☑ Use def

Lo

Compiler v

Advan

Project t

type filter text

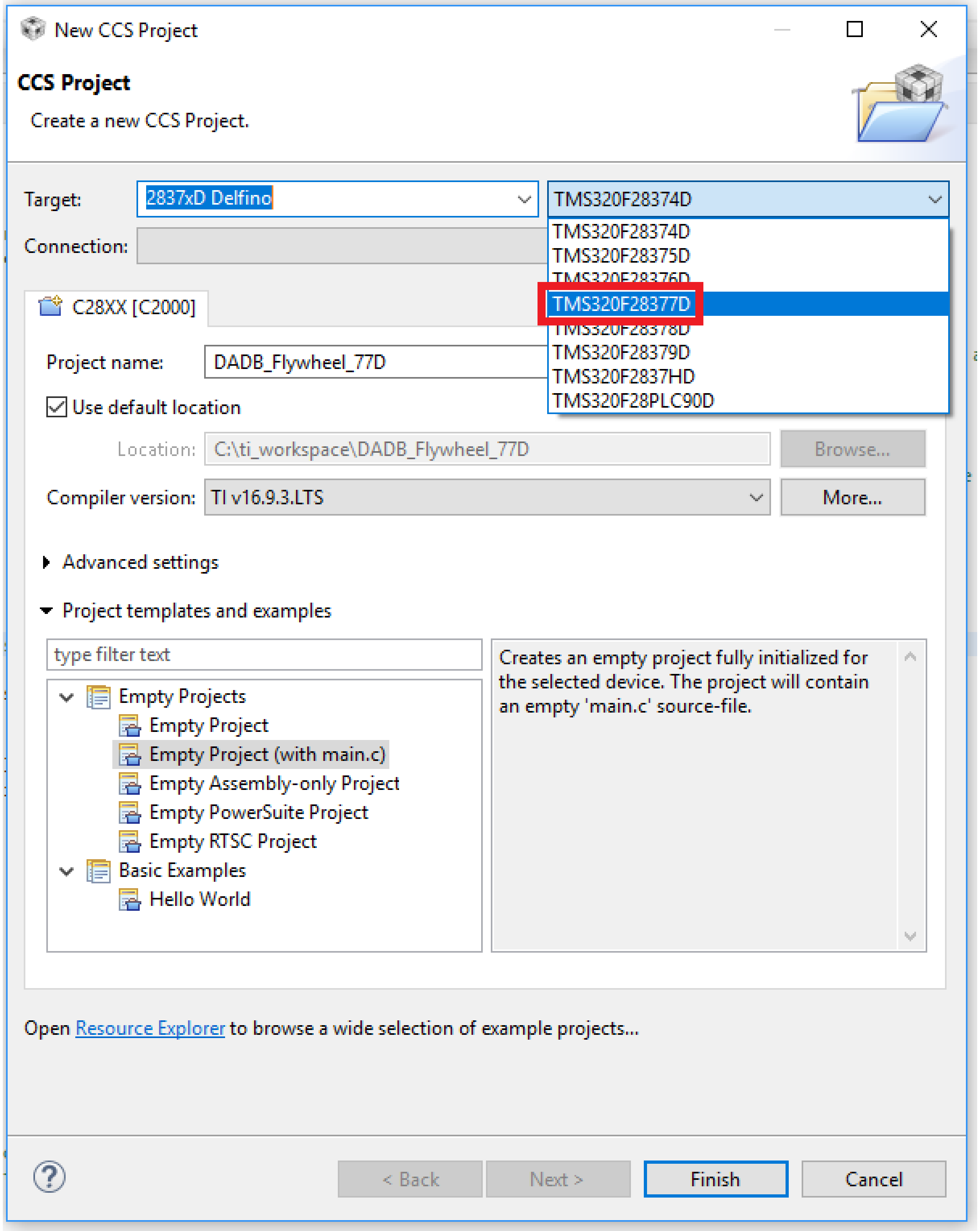
<select or type filter text>
Generic Devices
28004x Piccolo
2801x Fixed Point
2802x Piccolo
2803x Piccolo
2805x Piccolo
2806x Piccolo
2807x Piccolo
280x Fixed Point
281x Fixed Point
2823x Fixed Point
2833x Delfino
2834x Delfino
2837xD Delfino
2837xS Delfino
28M35x Concerto
28M36x Concerto

Empty Projects
Empty Project
Empty Project (with main.c)
Empty Assembly-only Project
Empty PowerSuite Project
Empty RTSC Project
Basic Examples
Hello World

Creates an empty project fully initialized for the selected device.

Open Resource Explorer to browse a wide selection of example projects...

- After it is selected, the next dropdown automatically opens. Select “TMS320F28377D”



New CCS Project

CCS Project

Create a new CCS Project.

Target: 2837xD Delfino | TMS320F28374D

Connection:

C28XX [C2000]

Project name: DADB_Flywheel_77D

☑ Use default location

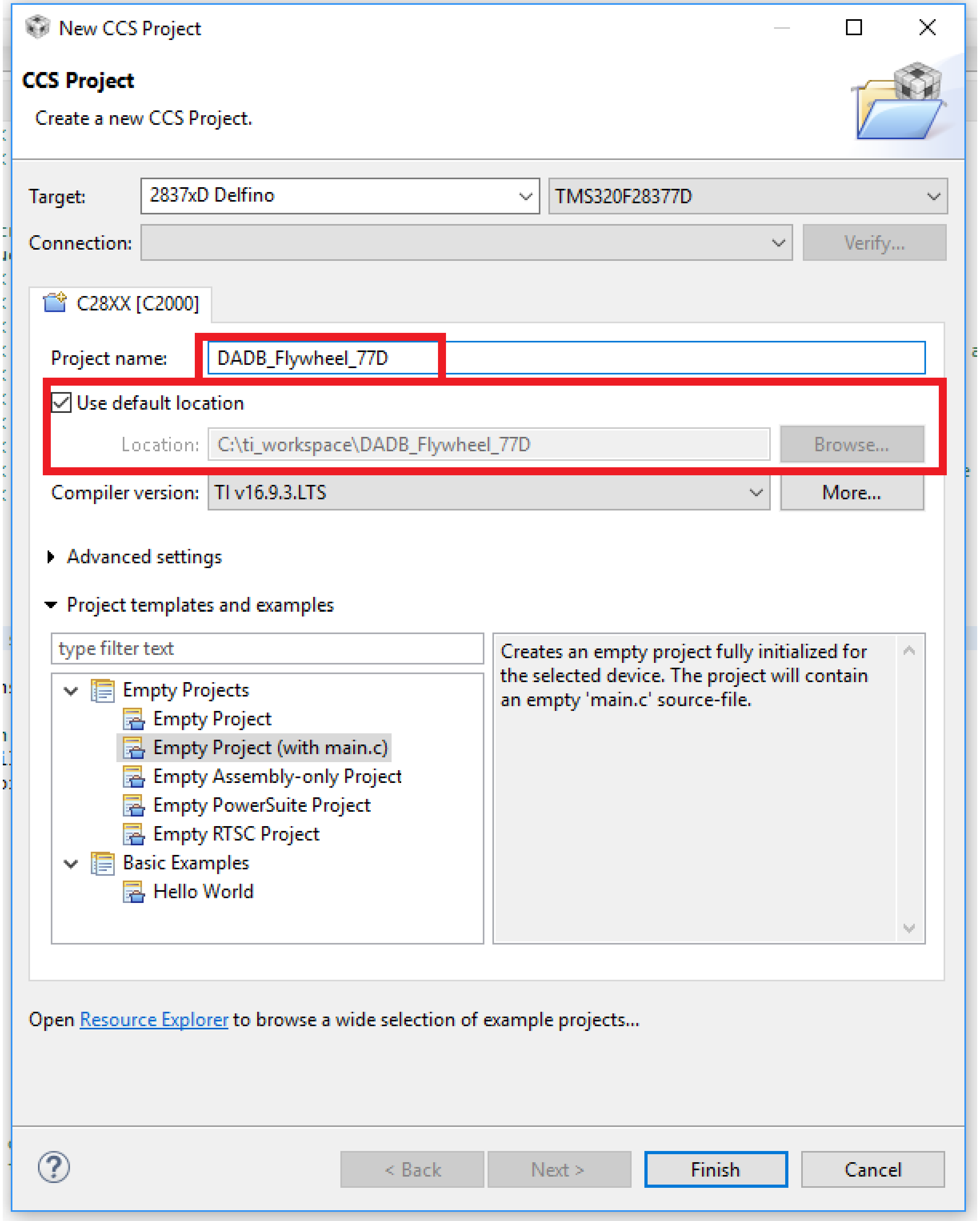
Location: C:\ti_workspace\DADB_Flywheel_77D

Compiler version: TI v16.9.3.LTS

Creates an empty project fully initialized for the selected device. The project will contain an empty 'main.c' source-file.

Open Resource Explorer to browse a wide selection of example projects...

- Next make a name for the project and select a location to save it



New CCS Project

CCS Project

Create a new CCS Project.

Target: 2837xD Delfino | TMS320F28377D

Connection:

C28XX [C2000]

Project name: DADB_Flywheel_77D

☑ Use default location

Location: C:\ti_workspace\DADB_Flywheel_77D

Compiler version: TI v16.9.3.LTS

Advanced settings

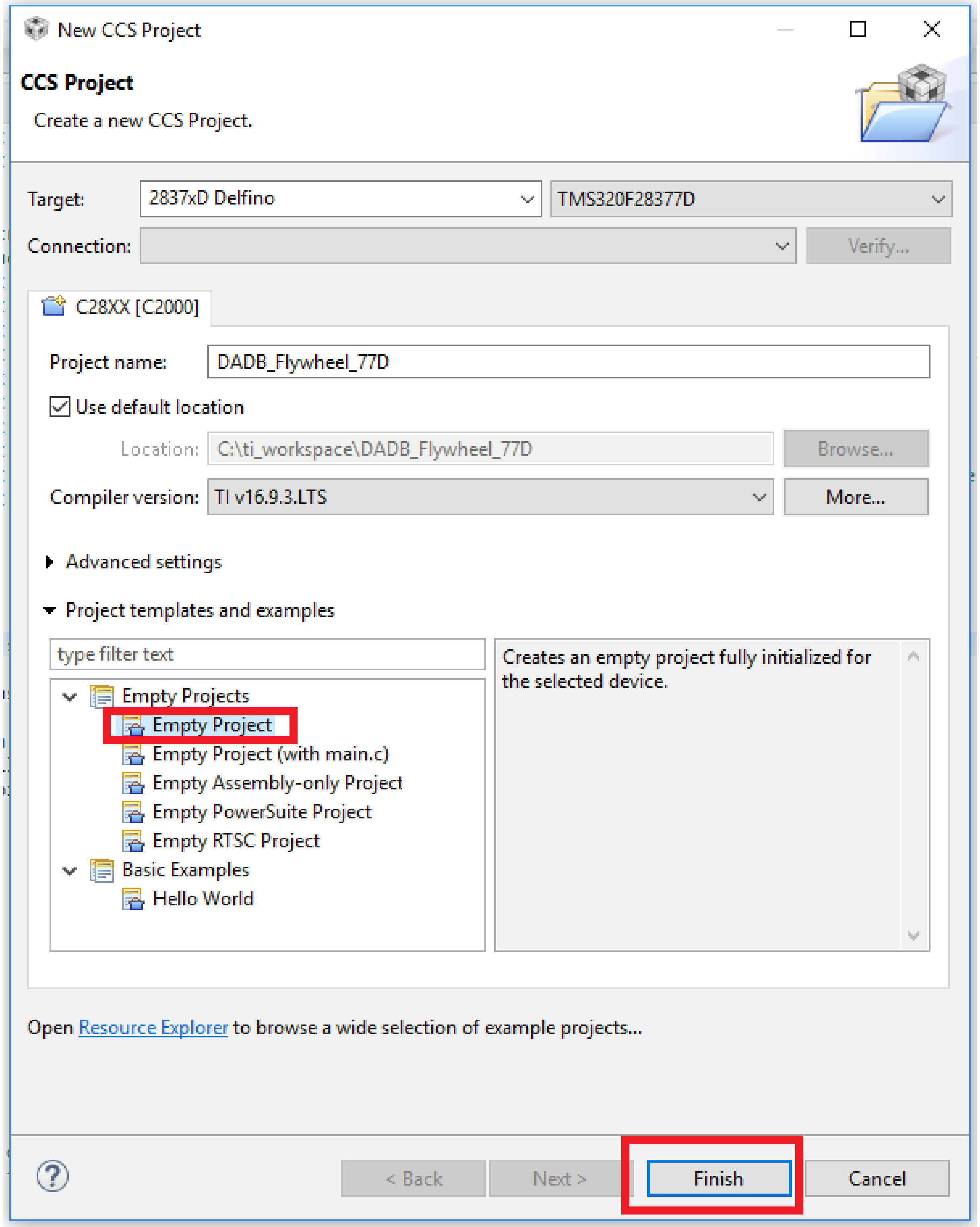
Project templates and examples

- Empty Projects
  - Empty Project
  - Empty Project (with main.c)
  - Empty Assembly-only Project
  - Empty PowerSuite Project
  - Empty RTSC Project
- Basic Examples
  - Hello World

Creates an empty project fully initialized for the selected device. The project will contain an empty 'main.c' source-file.

Open Resource Explorer to browse a wide selection of example projects...

- Lastly select “Empty Project”, then click “Finish”



New CCS Project

CCS Project

Create a new CCS Project.

Target: 2837xD Delfino | TMS320F28377D

Connection:

C28XX [C2000]

Project name: DADB_Flywheel_77D

☑ Use default location

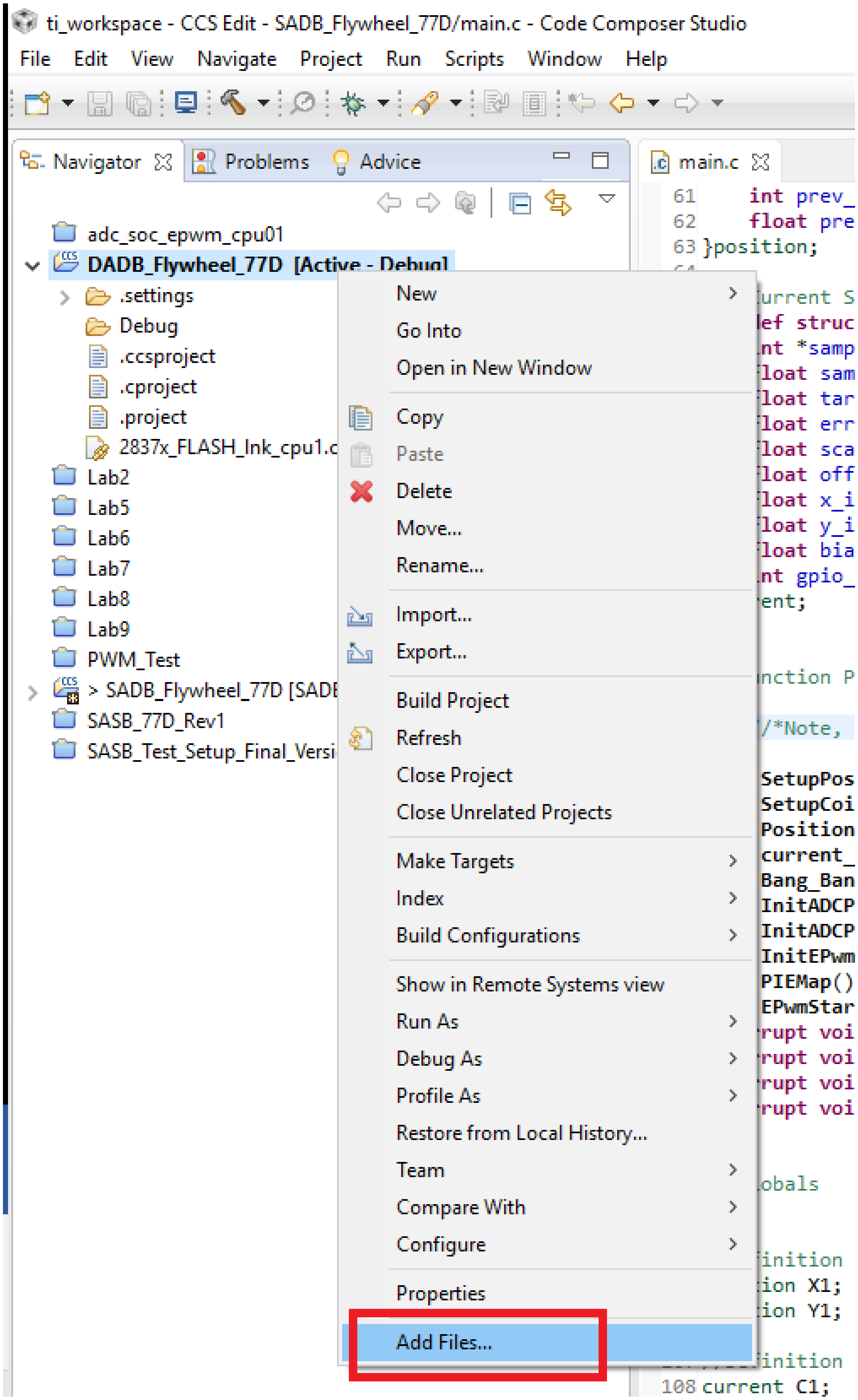
Location: C:\ti_workspace\DADB_Flywheel_77D

Compiler version: TI v16.9.3.LTS

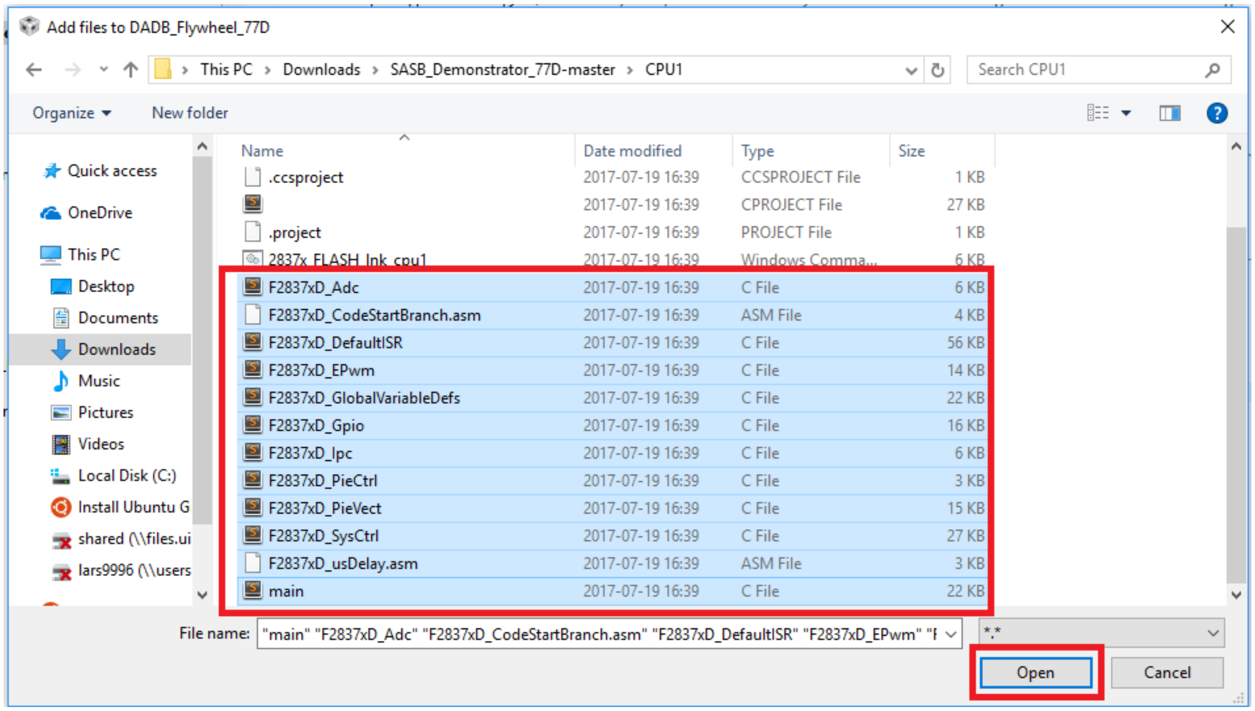
Creates an empty project fully initialized for the selected device.

Open Resource Explorer to browse a wide selection of example projects...

- Now right click on the new project and select “Add Files…”



- Select the files shown in the image below and select “Open”

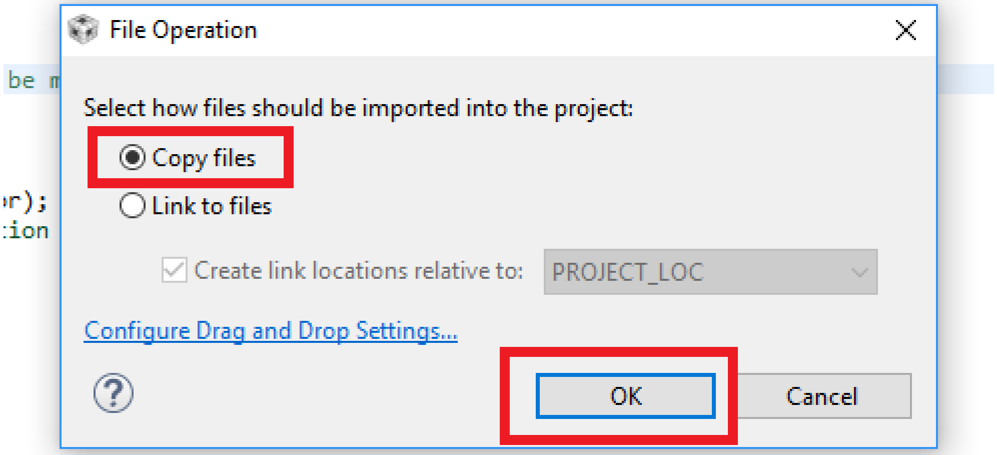


Name	Date modified	Type	Size
.ccsproject	2017-07-19 16:39	CCSPROJECT File	1 KB
	2017-07-19 16:39	CPROJECT File	27 KB
.project	2017-07-19 16:39	PROJECT File	1 KB
2837x_FLASH_lnk_cpu1	2017-07-19 16:39	Windows Comma...	6 KB
F2837xD_Adc	2017-07-19 16:39	C File	6 KB
F2837xD_CodeStartBranch.asm	2017-07-19 16:39	ASM File	4 KB
F2837xD_DefaultISR	2017-07-19 16:39	C File	56 KB
F2837xD_EPwm	2017-07-19 16:39	C File	14 KB
F2837xD_GlobalVariableDefs	2017-07-19 16:39	C File	22 KB
F2837xD_Gpio	2017-07-19 16:39	C File	16 KB
F2837xD_Ipc	2017-07-19 16:39	C File	6 KB
F2837xD_PieCtrl	2017-07-19 16:39	C File	3 KB
F2837xD_PieVect	2017-07-19 16:39	C File	15 KB
F2837xD_SysCtrl	2017-07-19 16:39	C File	27 KB
F2837xD_usDelay.asm	2017-07-19 16:39	ASM File	3 KB
main	2017-07-19 16:39	C File	22 KB

File name: "main" "F2837xD_Adc" "F2837xD_CodeStartBranch.asm" "F2837xD_DefaultISR" "F2837xD_EPwm" "F

.

- Make sure that “Copy files” is selected, then press “OK”



File Operation

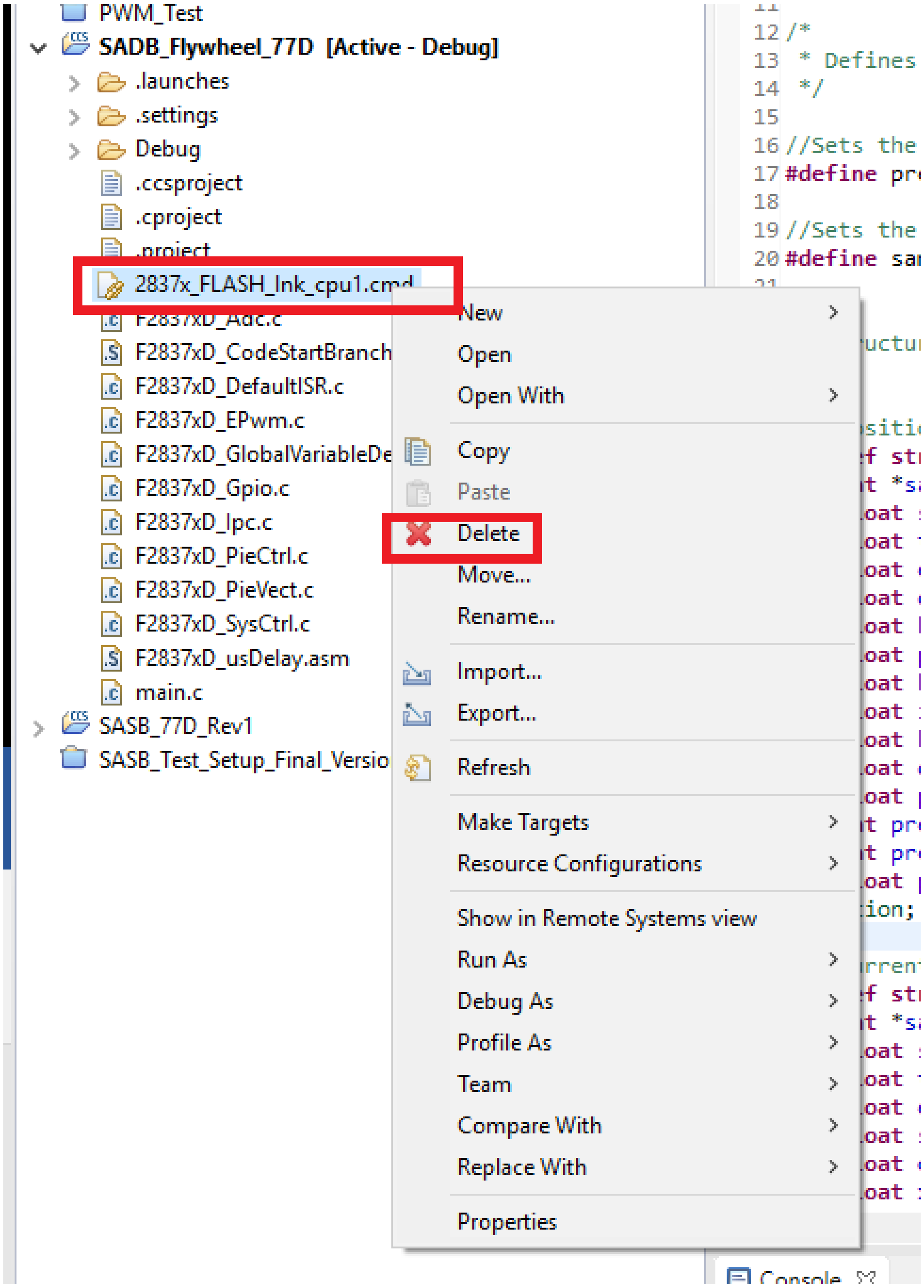
Select how files should be imported into the project:

● Copy files

○ Link to files

☑ Create link locations relative to: PROJECT_LOC

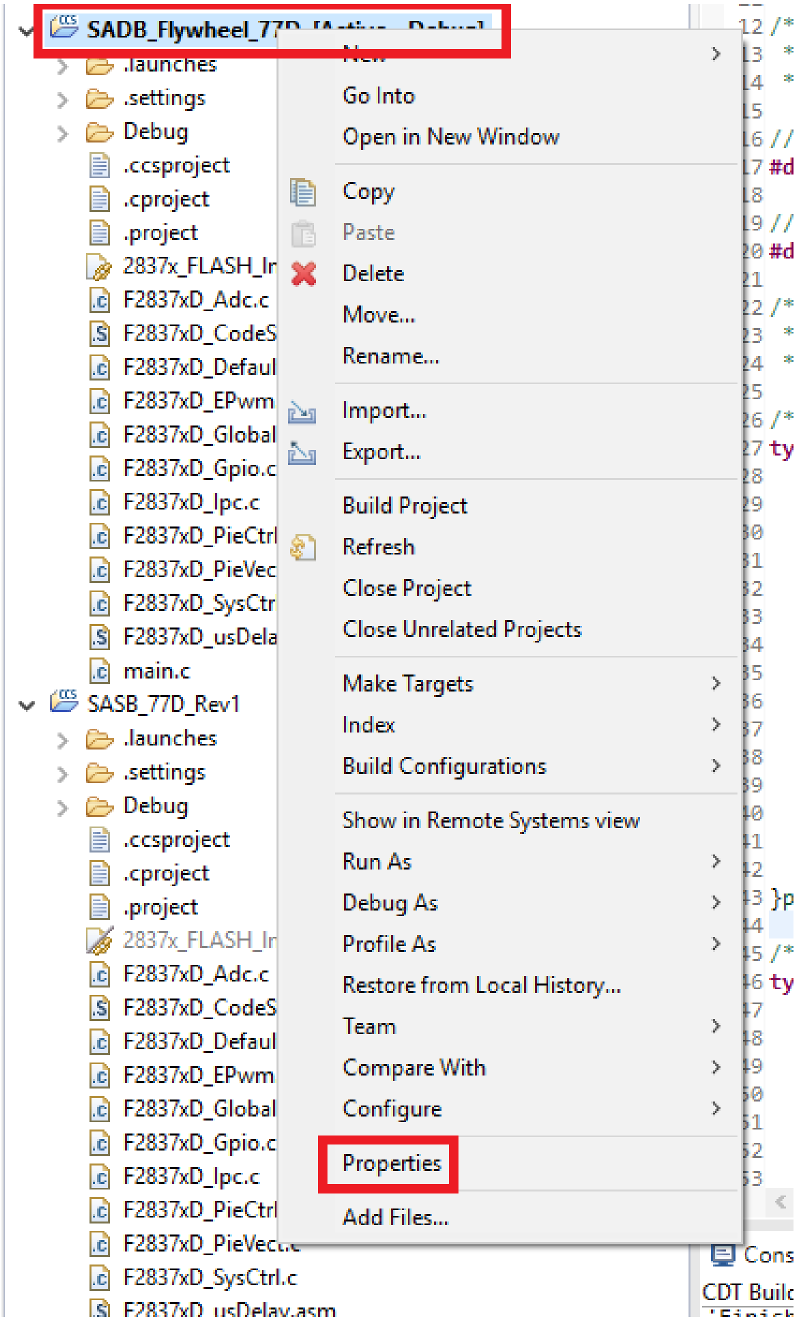
- The last step is to delete the “2837x_FLASH_lnk_cpu1.cmd” file from the resource list



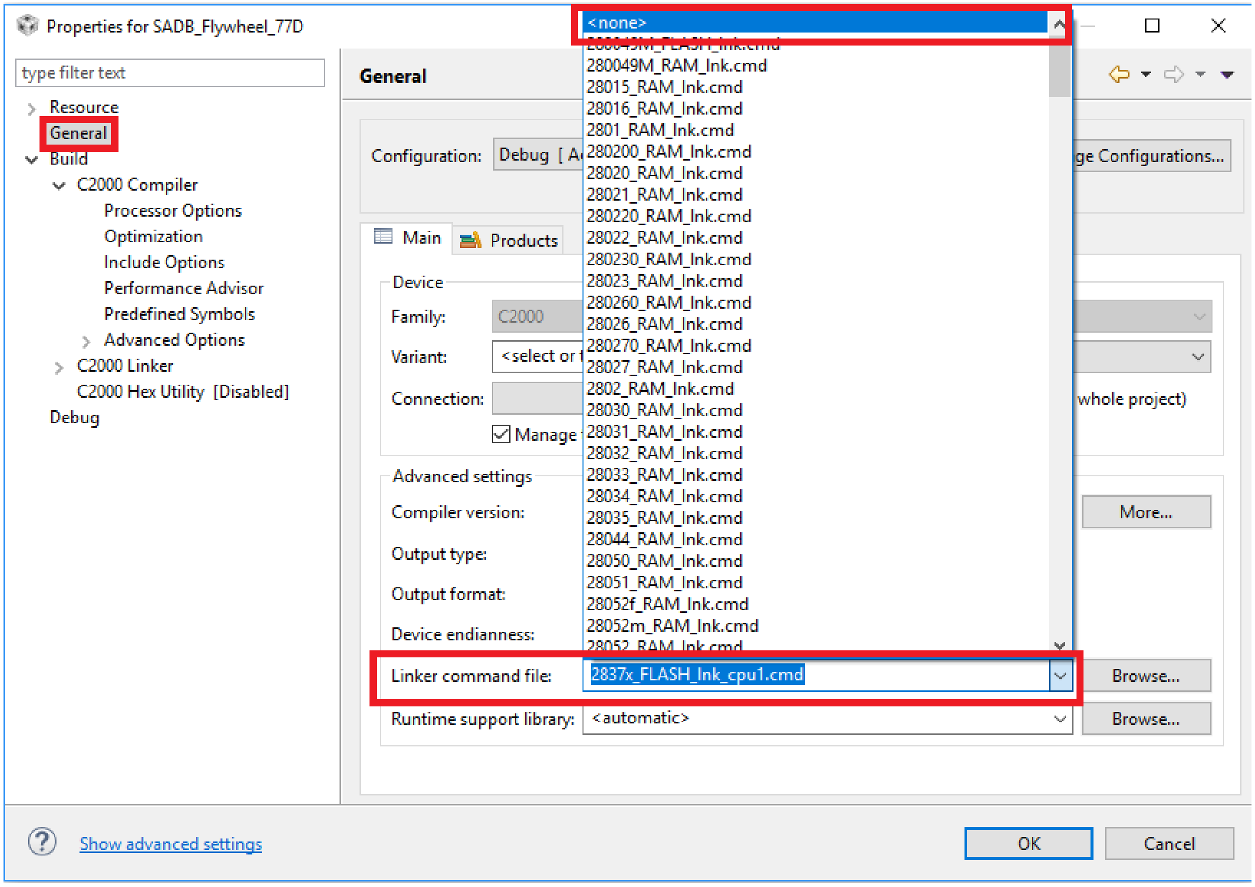
```
/*
 * Defines
 */

//Sets the
#define pr

//Sets the
#define sa
```

Properties Configuration

- Right click on the project and select “Properties”, to open the properties window



- In the left pane select “General”
  - In the right pane under the tab main, click on the drop down menu by “Linker command file:”
    - At the top of this list select “<none>”



Properties for SADB_Flywheel_77D

General

Configuration: Debug [Ac

Family: C2000

Variant: <select or t

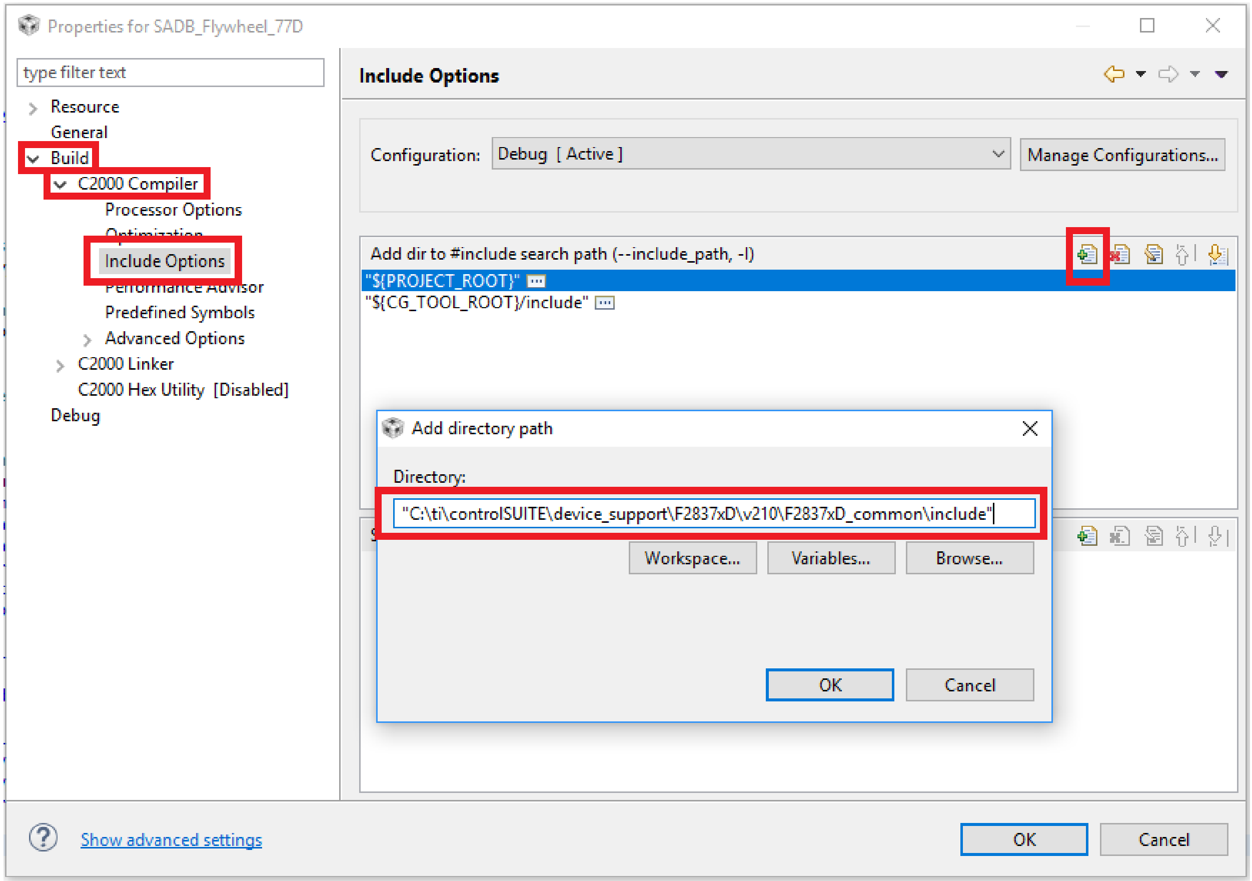
Connection:

☑ Manage

Linker command file: 2837x_FLASH_lnk_cpu1.cmd

Runtime support library: <automatic>

- Back in the left pane expand “Build” then under that expand “C2000 Compiler” then click on “Include Options”
    - In the top right pane titled “Add dir to…”, click the add to add these two paths separately
        - "C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_common\include"
        - "C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_headers\include"

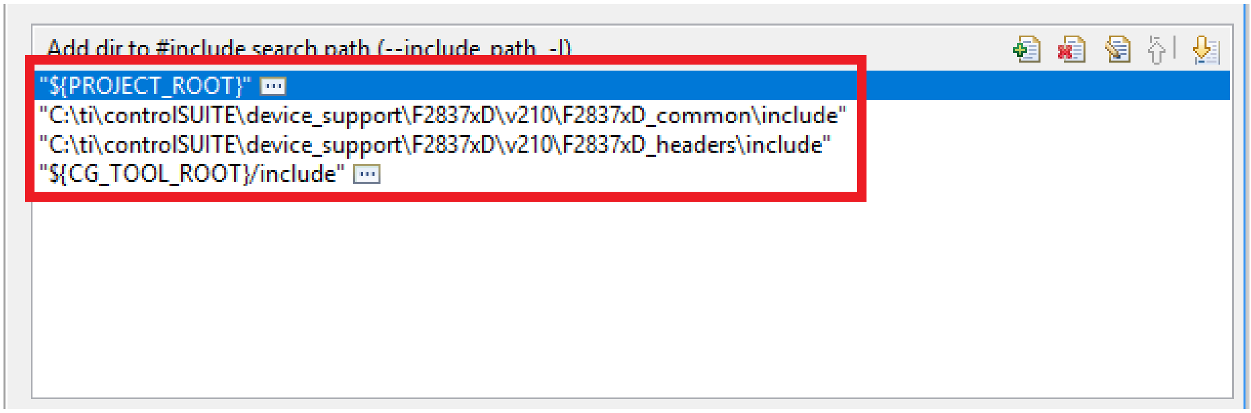


Configuration: Debug [Active]

Add dir to #include search path (--include_path, -I)

"${PROJECT_ROOT}"
"${CG_TOOL_ROOT}/include"

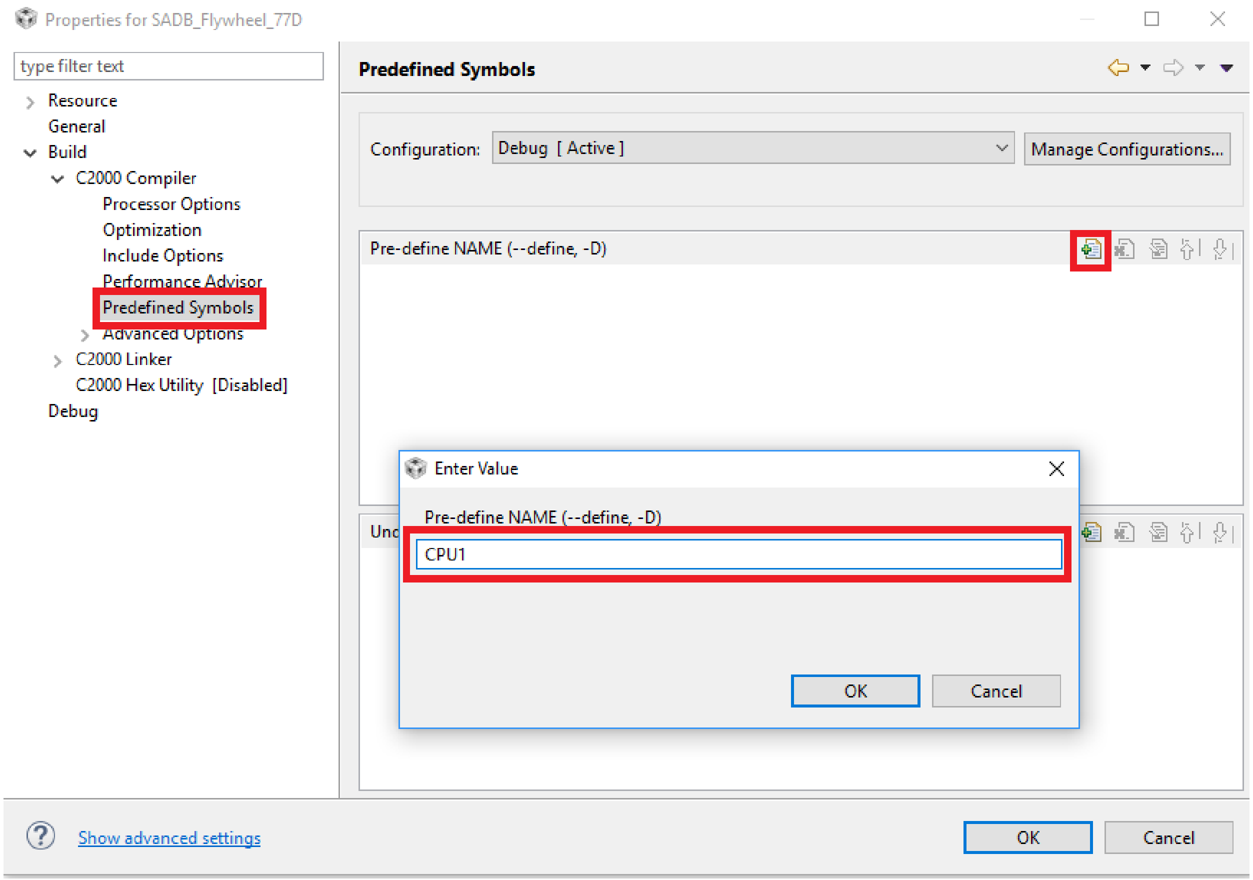
Directory:
"C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_common\include"



Add dir to #include search path (--include_path, -I)

"${PROJECT_ROOT}"
"C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_common\include"
"C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_headers\include"
"${CG_TOOL_ROOT}/include"

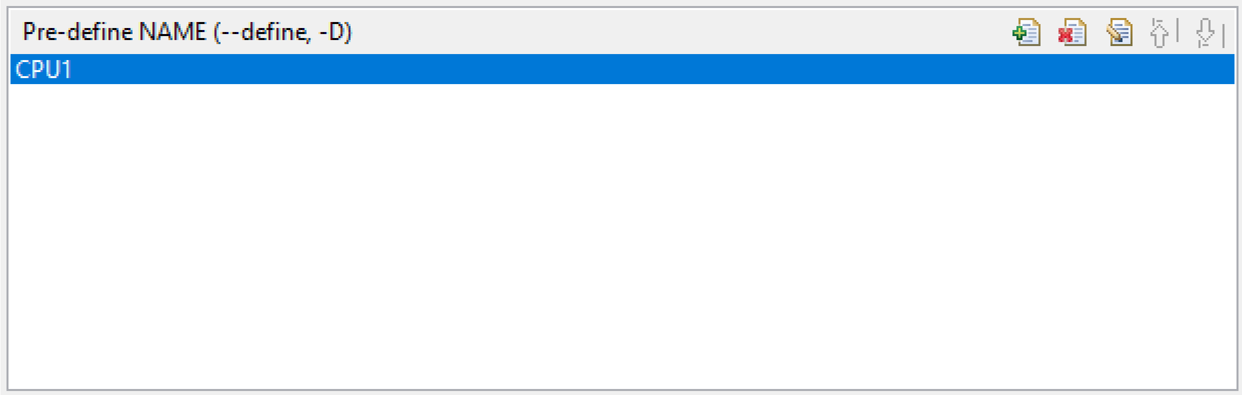
- Back in the left pane below “Include Options”, click on “Predefined Symbols”
    - In the top right window titled “Pre-define NAM…”, click on the add to add this name
        - CPU1



Configuration: Debug [Active]

Pre-define NAME (--define, -D)

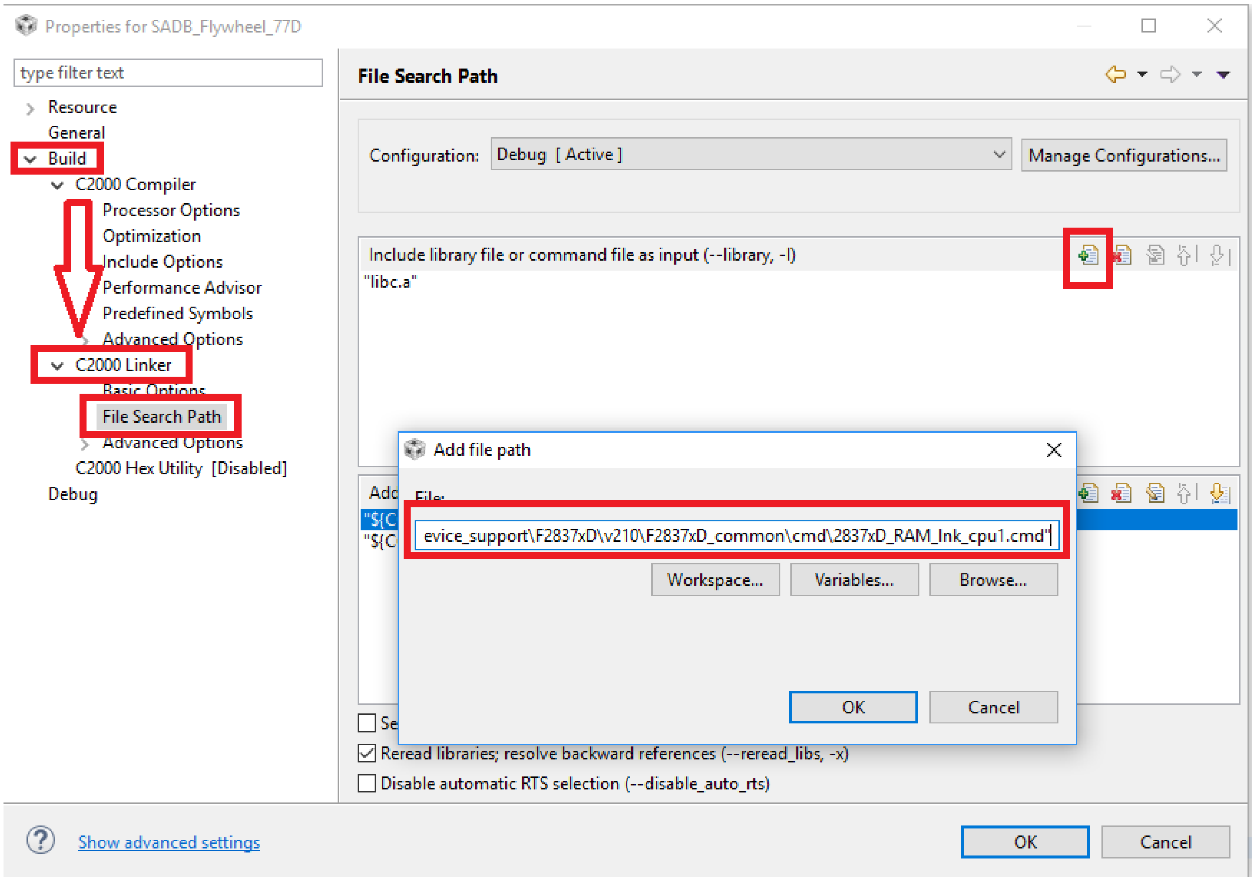
Pre-define NAME (--define, -D): CPU1



Pre-define NAME (--define, -D)

CPU1

- Back in the left pane, in “Build”, below “C2000 Compiler”, expand “C2000 Linker”. Then select “File Search Path”
  - In the top right pane titled “Include library file or…”, click on the add to add these three paths (*you will have to add them one at a time)
    - "C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_common\cmd\2837xD_RAM_lnk_cpu1.cmd"
    - "C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_headers\cmd\F2837xD_Headers_nonBIOS_cpu1.cmd"
    - "C:\ti\ccsv7\tools\compiler\ti-cgt-c2000_16.9.3.LTS\lib\rts2800_fpu32.lib"



File Search Path

Configuration: Debug [Active]

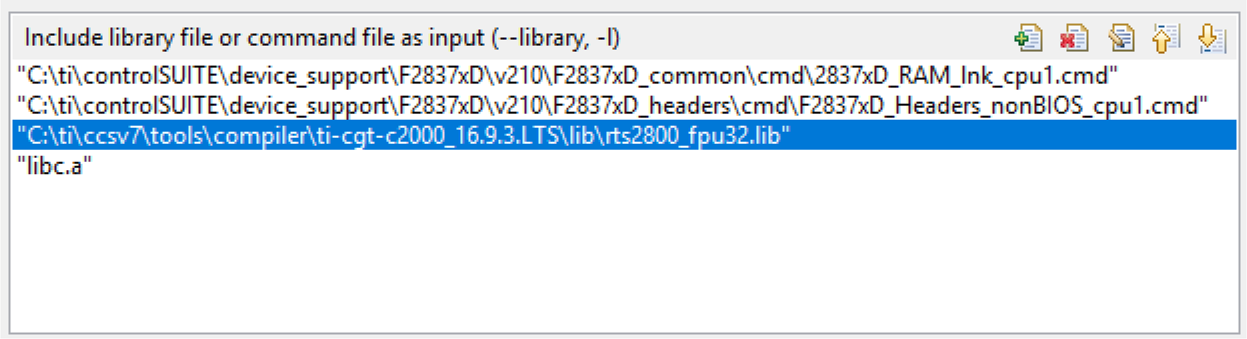
Include library file or command file as input (--library, -l)

"libc.a"

File: evice_support\F2837xD\v210\F2837xD_common\cmd\2837xD_RAM_lnk_cpu1.cmd"

☑ Reread libraries; resolve backward references (--reread_libs, -x)

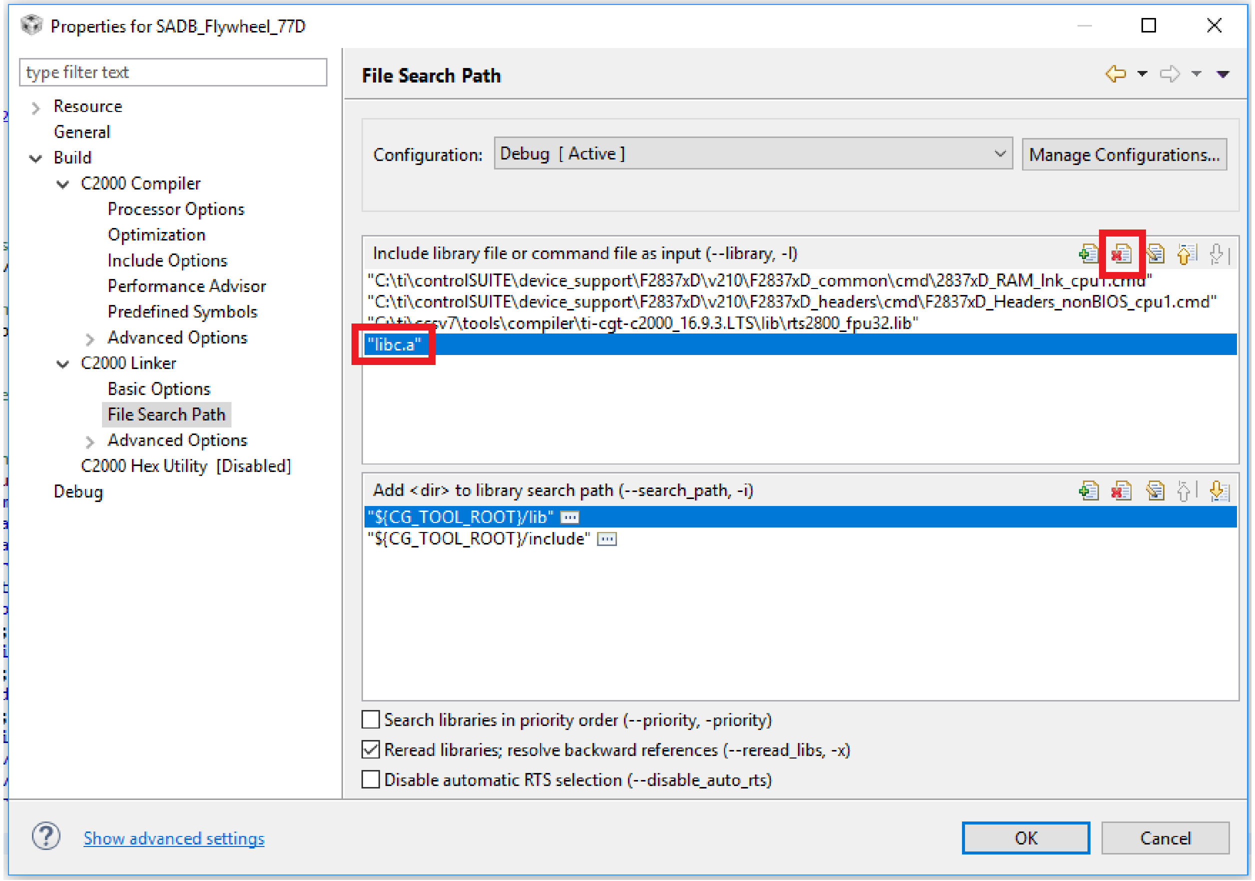
☐ Disable automatic RTS selection (--disable_auto_rts)



Include library file or command file as input (--library, -l)

"C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_common\cmd\2837xD_RAM_lnk_cpu1.cmd"
"C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_headers\cmd\F2837xD_Headers_nonBIOS_cpu1.cmd"
"C:\ti\ccsv7\tools\compiler\ti-cgt-c2000_16.9.3.LTS\lib\rts2800_fpu32.lib"
"libc.a"

- In this same pane select the line “libc.a” and delete it with the red x in the top right



Configuration: Debug [Active]

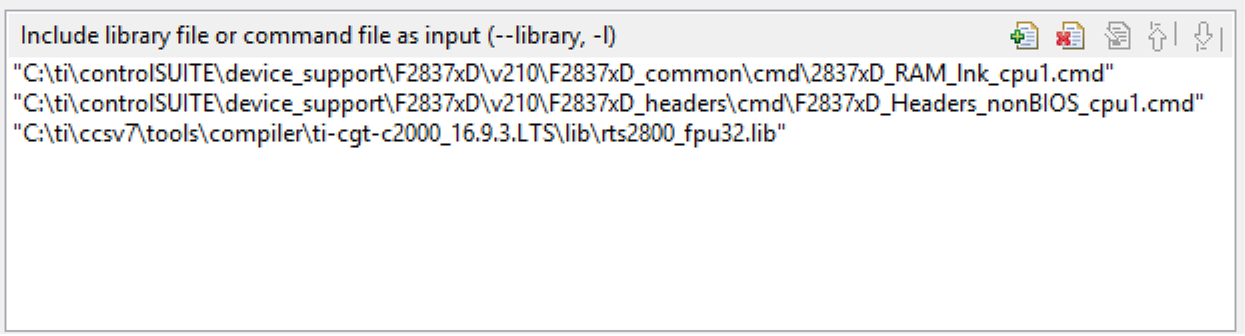
Include library file or command file as input (--library, -l)

"C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_common\cmd\2837xD_RAM_lnk_cpu1.cmd"
"C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_headers\cmd\F2837xD_Headers_nonBIOS_cpu1.cmd"
"C:\ti\ccsv7\tools\compiler\ti-cgt-c2000_16.9.3.LTS\lib\rts2800_fpu32.lib"
"libc.a"

Add <dir> to library search path (--search_path, -i)

"${CG_TOOL_ROOT}/lib"
"${CG_TOOL_ROOT}/include"

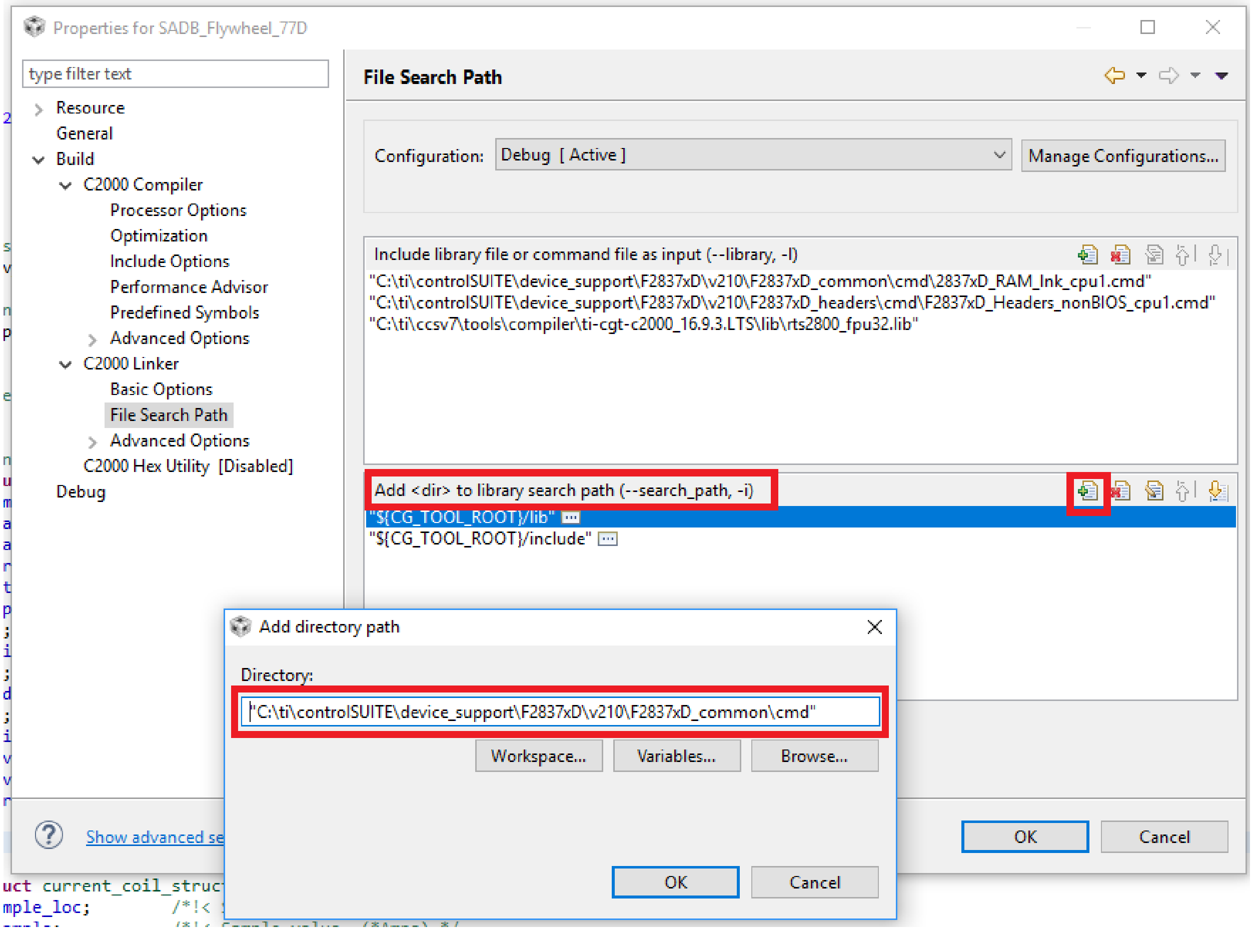
☐ Search libraries in priority order (--priority, -priority)
☑ Reread libraries; resolve backward references (--reread_libs, -x)
☐ Disable automatic RTS selection (--disable_auto_rts)



Include library file or command file as input (--library, -l)

"C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_common\cmd\2837xD_RAM_lnk_cpu1.cmd"
"C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_headers\cmd\F2837xD_Headers_nonBIOS_cpu1.cmd"
"C:\ti\ccsv7\tools\compiler\ti-cgt-c2000_16.9.3.LTS\lib\rts2800_fpu32.lib"

- In the lower right pane titled “Add <dir> to…” click on the add to add these paths
  - "C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_common\cmd"
  - "C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_headers\cmd"



Configuration: Debug [Active]

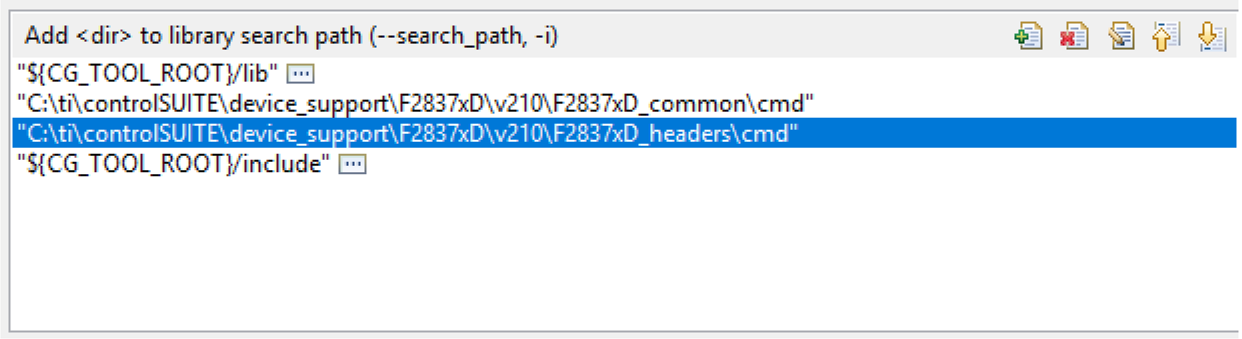
Include library file or command file as input (--library, -l)

```
"C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_common\cmd\2837xD_RAM_lnk_cpu1.cmd"
"C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_headers\cmd\F2837xD_Headers_nonBIOS_cpu1.cmd"
"C:\ti\ccsv7\tools\compiler\ti-cgt-c2000_16.9.3.LTS\lib\rts2800_fpu32.lib"
```

Add <dir> to library search path (--search_path, -i)

```
"${CG_TOOL_ROOT}/lib"
"${CG_TOOL_ROOT}/include"
```

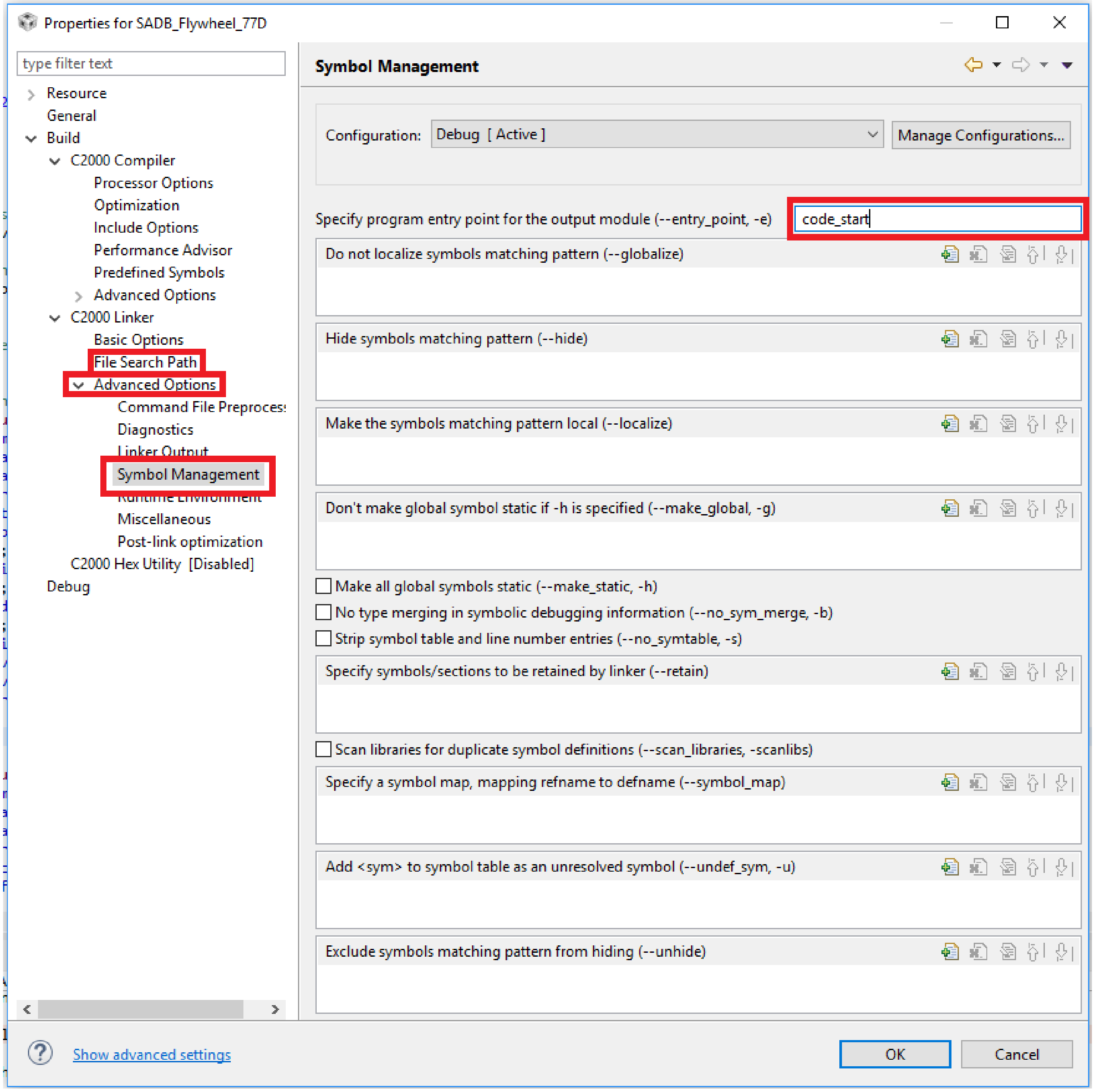
Directory: "C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_common\cmd"



Add <dir> to library search path (--search_path, -i)

```
"${CG_TOOL_ROOT}/lib"
"C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_common\cmd"
"C:\ti\controlSUITE\device_support\F2837xD\v210\F2837xD_headers\cmd"
"${CG_TOOL_ROOT}/include"
```

- Back in the left pane below “File Search Path”, expand “Advanced Options” and click on “Symbol Management”
    - Near the top of the right side of the window is a text entry box, in which type
        - code_start



Symbol Management

Configuration: Debug [Active]

Specify program entry point for the output module (--entry_point, -e) code_start

Do not localize symbols matching pattern (--globalize)

Hide symbols matching pattern (--hide)

Make the symbols matching pattern local (--localize)

Don't make global symbol static if -h is specified (--make_global, -g)

☐ Make all global symbols static (--make_static, -h)

☐ No type merging in symbolic debugging information (--no_sym_merge, -b)

☐ Strip symbol table and line number entries (--no_symtable, -s)

Specify symbols/sections to be retained by linker (--retain)

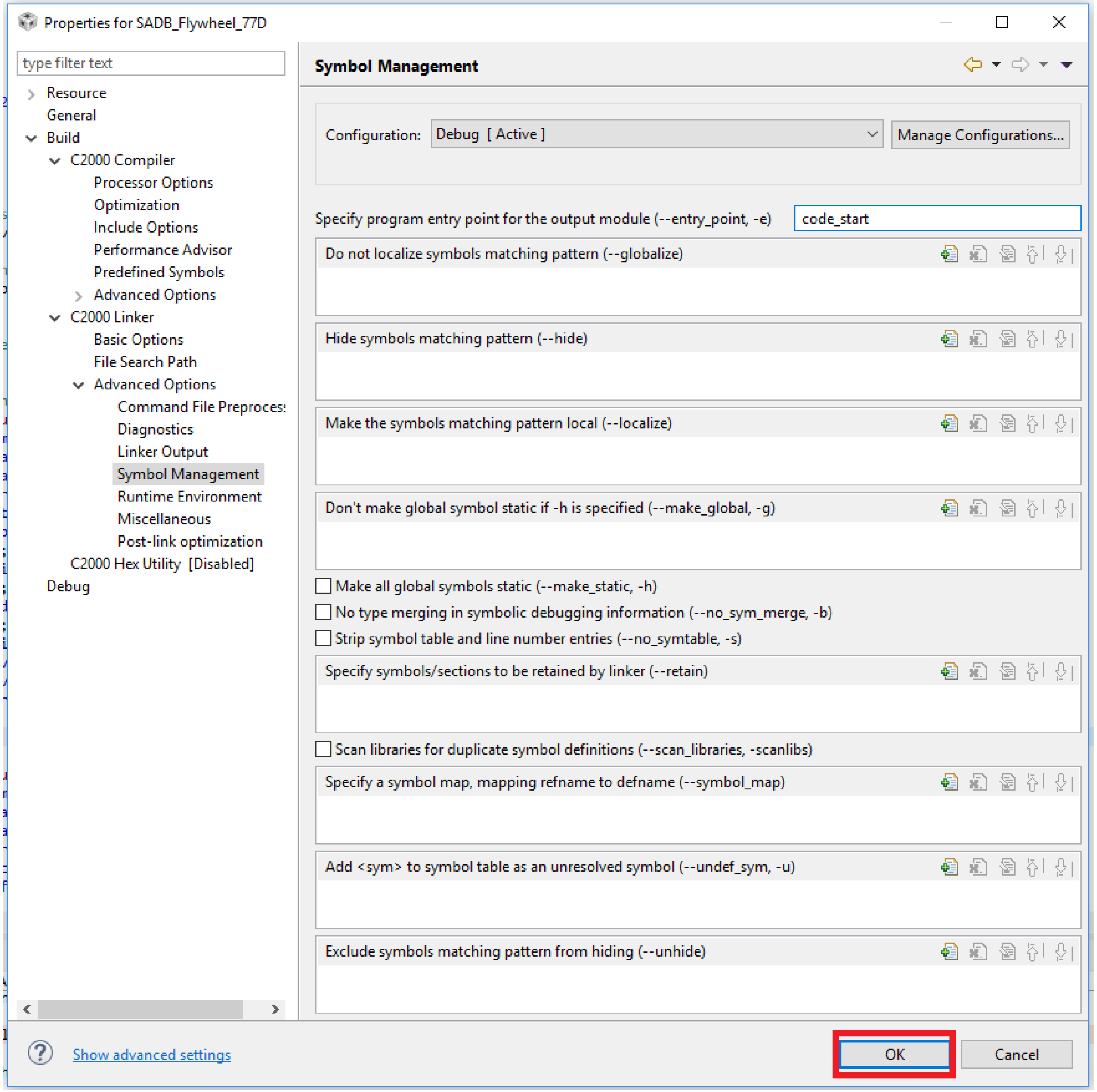
☐ Scan libraries for duplicate symbol definitions (--scan_libraries, -scanlibs)

Specify a symbol map, mapping refname to defname (--symbol_map)

Add <sym> to symbol table as an unresolved symbol (--undef_sym, -u)

Exclude symbols matching pattern from hiding (--unhide)

- At this point all the necessary changes have been made to the properties. Click the “OK” at the bottom of the window to close.



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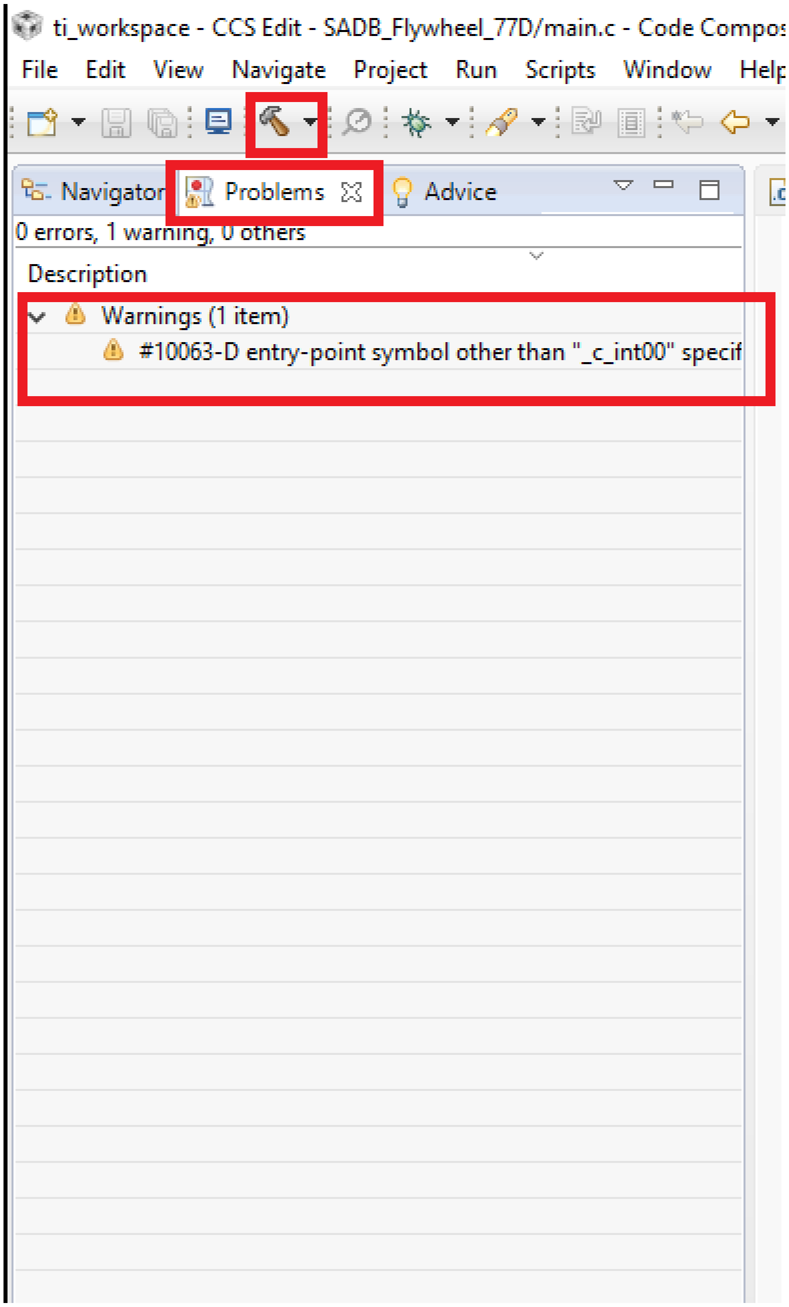
Exclude symbols matching pattern from hiding (--unhide)

Running

- At this point click on the image of the hammer to build
    - There should only be one warning and no errors, and the one warning is fine



ti_workspace - CCS Edit - SADB_Flywheel_77D/main.c - Code Compos

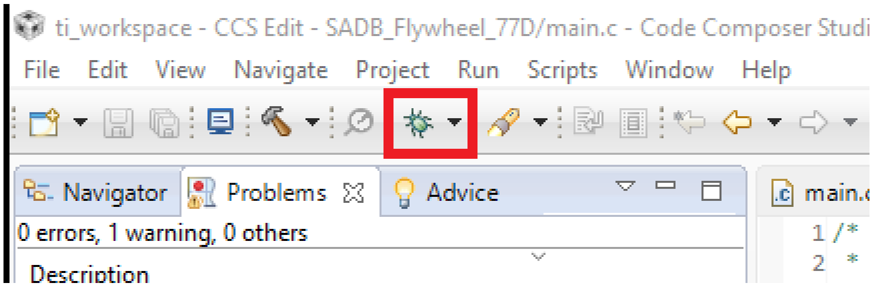
0 errors, 1 warning, 0 others

Description

Warnings (1 item)

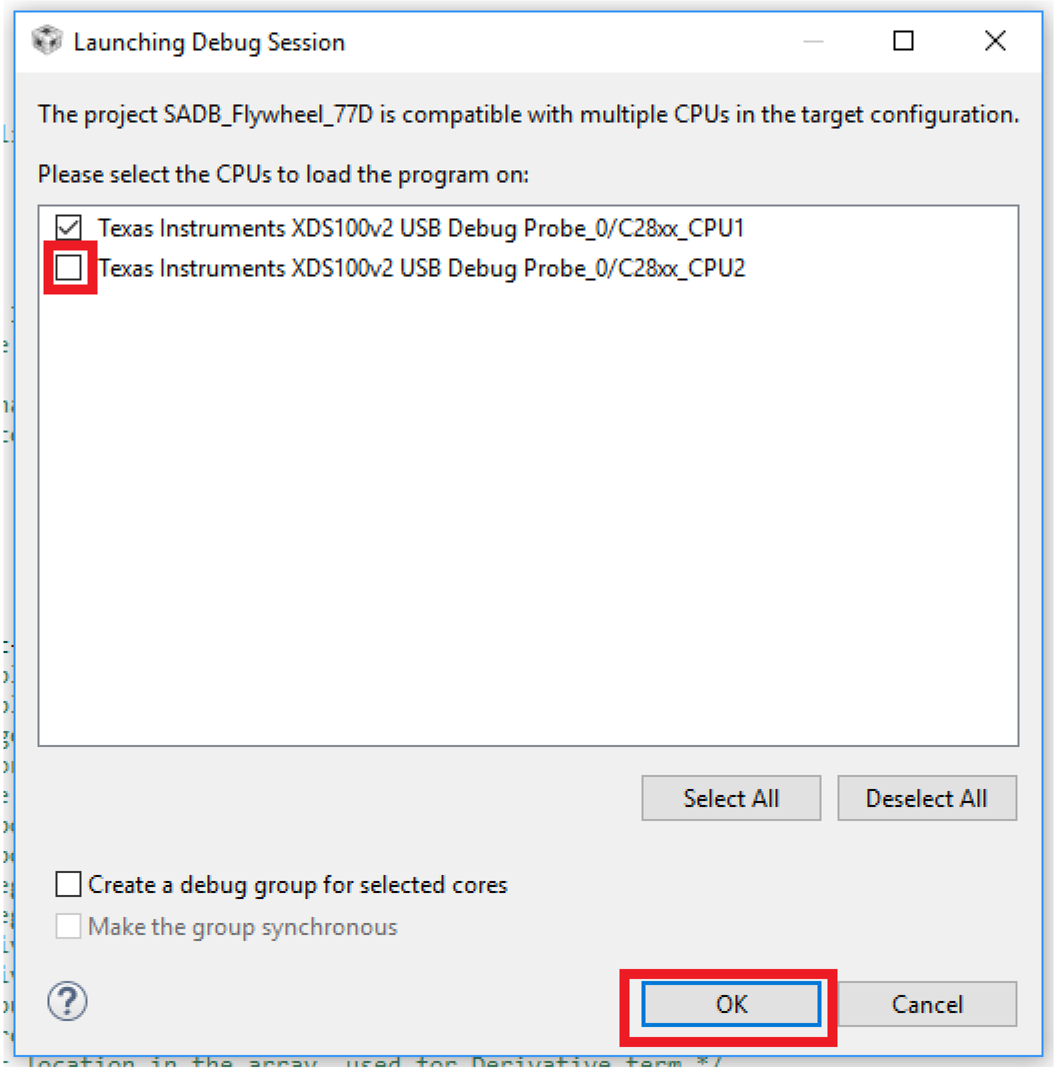
#10063-D entry-point symbol other than "_c_int00" specif

- Next click on the green bug to debug the program (same as running the program, but we get a few more options to change settings while the setup is running)


ti_workspace - CCS Edit - SADB_Flywheel_77D/main.c - Code Composer Studi

0 errors, 1 warning, 0 others

- After clicking on the debug button, a window will pop up
    - Uncheck the box for CPU2 and press OK



Launching Debug Session

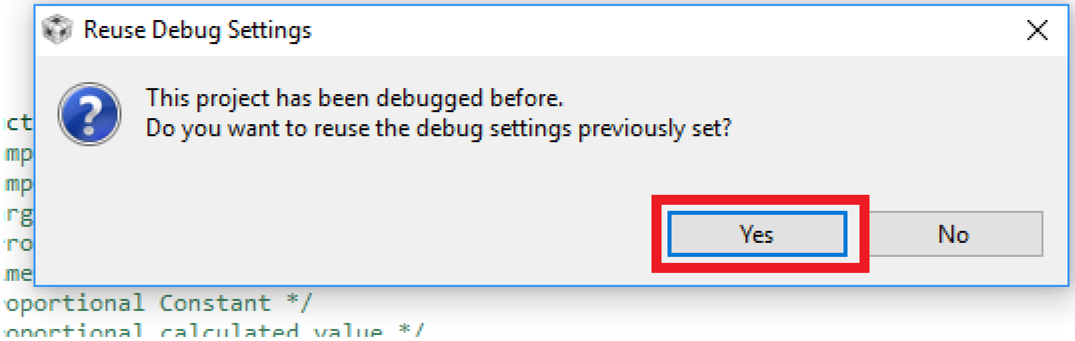
The project SADB_Flywheel_77D is compatible with multiple CPUs in the target configuration.

Please select the CPUs to load the program on:

☑ Texas Instruments XDS100v2 USB Debug Probe_0/C28xx_CPU1
☐ Texas Instruments XDS100v2 USB Debug Probe_0/C28xx_CPU2

☐ Create a debug group for selected cores
☐ Make the group synchronous

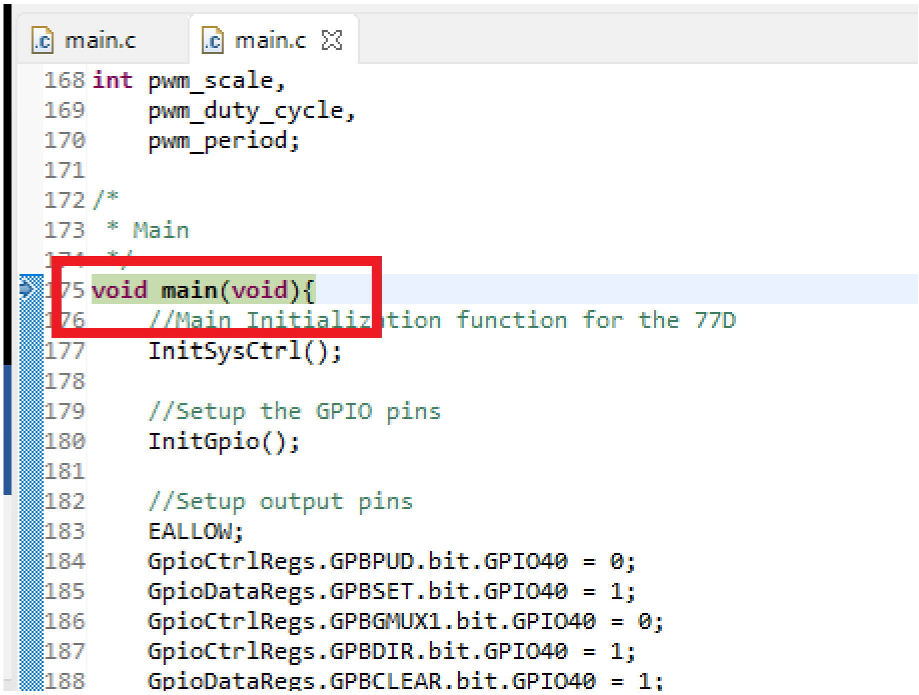
- Another prompt will come up asking if you want to reuse the debug settings previously set, click yes



Reuse Debug Settings

This project has been debugged before.
Do you want to reuse the debug settings previously set?

- Assuming all has gone well up until this point, a little arrow will appear next to the first line of the main() function, indicating that it is paused at this point in the code



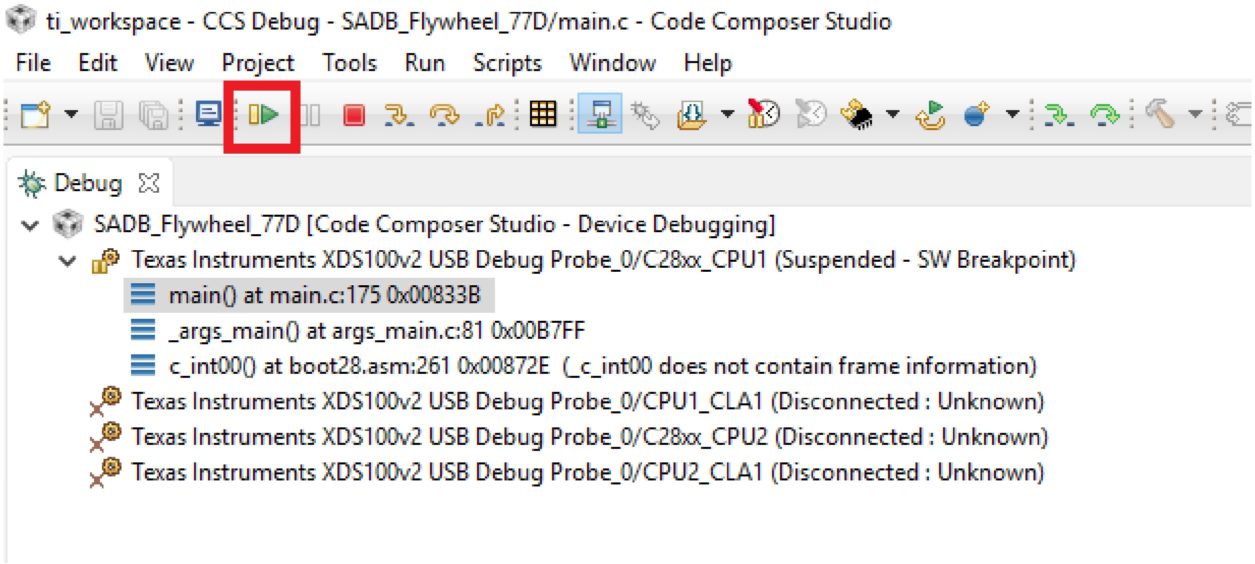
```
int pwm_scale,
    pwm_duty_cycle,
    pwm_period;

/*
 * Main
 */
void main(void){
    //Main Initialization function for the 77D
    InitSysCtrl();

    //Setup the GPIO pins
    InitGpio();

    //Setup output pins
    EALLOW;
    GpioCtrlRegs.GPBPUD.bit.GPIO40 = 0;
    GpioDataRegs.GPBSET.bit.GPIO40 = 1;
    GpioCtrlRegs.GPBGMUX1.bit.GPIO40 = 0;
    GpioCtrlRegs.GPBDIR.bit.GPIO40 = 1;
    GpioDataRegs.GPBCLEAR.bit.GPIO40 = 1;
```

- From here we can begin the code by clicking on the green arrow to run



ti_workspace - CCS Debug - SADB_Flywheel_77D/main.c - Code Composer Studio

SADB_Flywheel_77D [Code Composer Studio - Device Debugging]

Texas Instruments XDS100v2 USB Debug Probe_0/C28xx_CPU1 (Suspended - SW Breakpoint)

main() at main.c:175 0x00833B

_args_main() at args_main.c:81 0x00B7FF

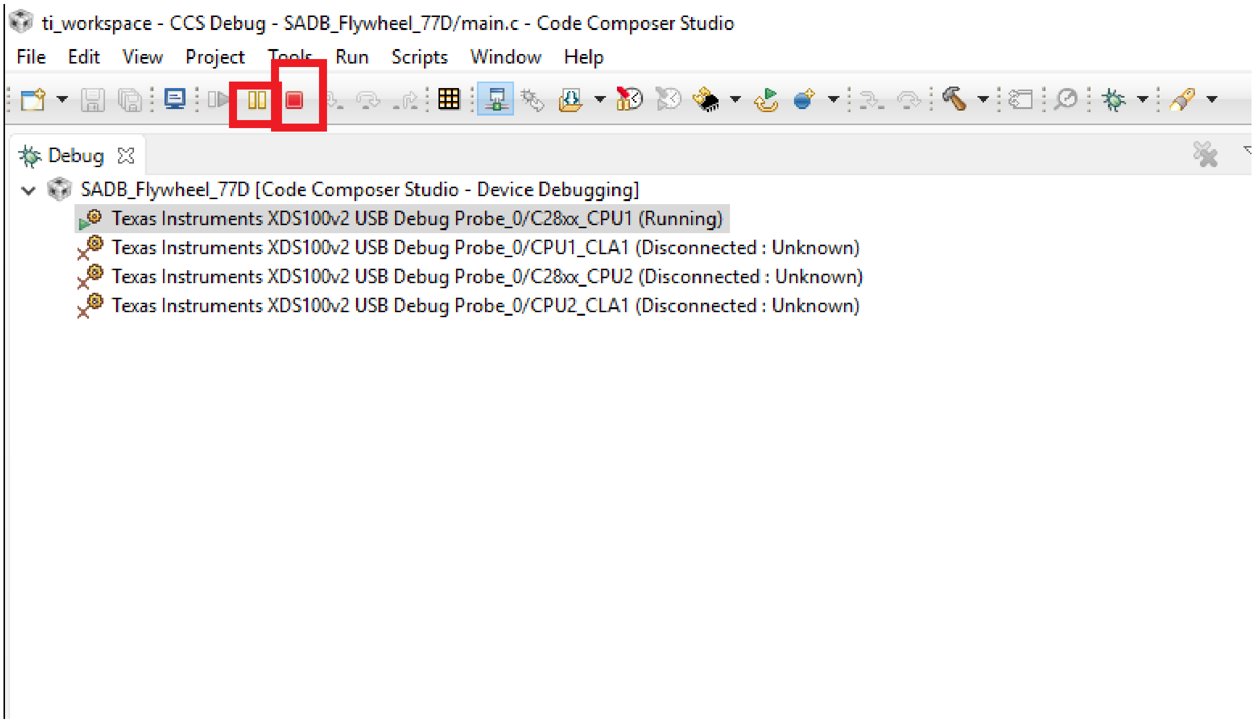
c_int00() at boot28.asm:261 0x00872E (_c_int00 does not contain frame information)

Texas Instruments XDS100v2 USB Debug Probe_0/CPU1_CLA1 (Disconnected : Unknown)

Texas Instruments XDS100v2 USB Debug Probe_0/C28xx_CPU2 (Disconnected : Unknown)

Texas Instruments XDS100v2 USB Debug Probe_0/CPU2_CLA1 (Disconnected : Unknown)

- While the code is running one can pause the code by pressing the yellow pause, or quit back to the code editing view by clicking on red square



ti_workspace - CCS Debug - SADB_Flywheel_77D/main.c - Code Composer Studio

SADB_Flywheel_77D [Code Composer Studio - Device Debugging]

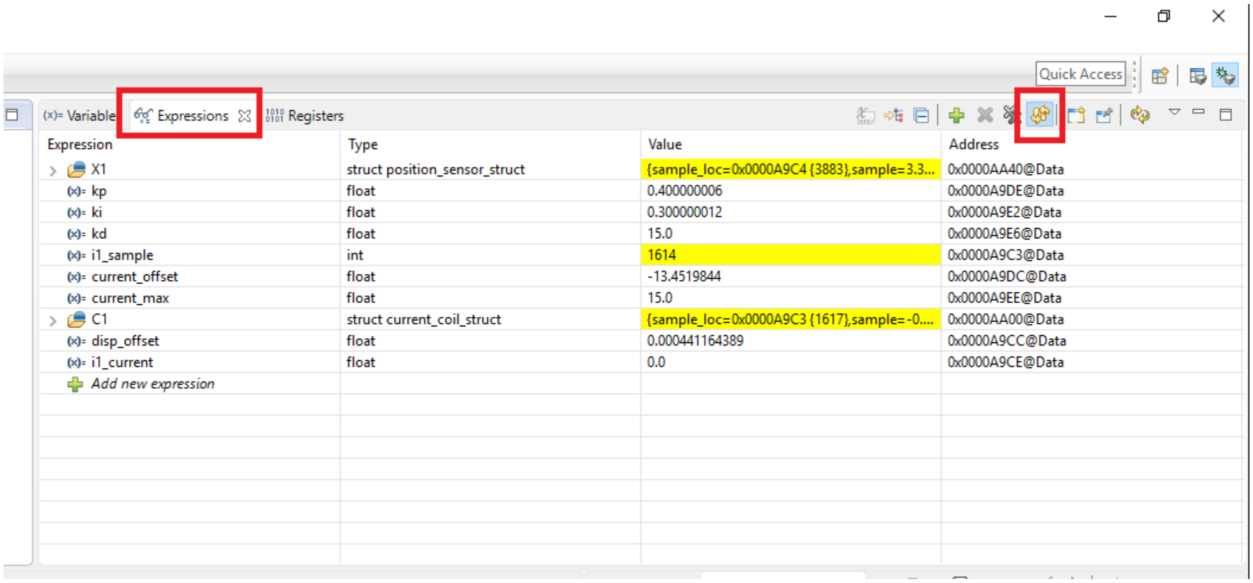
Texas Instruments XDS100v2 USB Debug Probe_0/C28xx_CPU1 (Running)

Texas Instruments XDS100v2 USB Debug Probe_0/CPU1_CLA1 (Disconnected : Unknown)

Texas Instruments XDS100v2 USB Debug Probe_0/C28xx_CPU2 (Disconnected : Unknown)

Texas Instruments XDS100v2 USB Debug Probe_0/CPU2_CLA1 (Disconnected : Unknown)

- Additionally, in the top right pane of the window is a list of some of the variables in use in the code at the moment. By clicking on the yellow pause/refresh sign in the top bar, the values will update to show what they currently are.



Expression	Type	Value	Address
X1	struct position_sensor_struct	{sample_loc=0x0000A9C4 {3883},sample=3.3...	0x0000AA40@Data
kp	float	0.400000006	0x0000A9DE@Data
ki	float	0.300000012	0x0000A9E2@Data
kd	float	15.0	0x0000A9E6@Data
i1_sample	int	1614	0x0000A9C3@Data
current_offset	float	-13.4519844	0x0000A9DC@Data
current_max	float	15.0	0x0000A9EE@Data
C1	struct current_coil_struct	{sample_loc=0x0000A9C3 {1617},sample=-0....	0x0000AA00@Data
disp_offset	float	0.000441164389	0x0000A9CC@Data
i1_current	float	0.0	0x0000A9CE@Data
Add new expression			