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Renesas Electronics Corporation

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User's Manual

Peripheral Driver Generator V.1.02

Guide Book

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Preface

This manual provides detailed examples of operating the Peripheral Driver Generator (hereafter referred to as PDG). For information on how to operate the PDG or the High-performance Embedded Workshop (hereafter referred to as HEW), refer to the user's manual of the PDG and HEW.

Contents

1. Overview

This section gives an overview of developing applications with the PDG.
The PDG generates C source files including functions that reflect selected peripherals and settings.
Applications are developed by calling the functions generated by the PDG.
Basically, the development of an application is performed through the following steps:

(1) Setting peripheral I/O modules

Using the PDG, you will create a project, select a CPU group and peripherals, and generate necessary files.

(2) Creating an environment for build/debug

Using the HEW, you will create a workspace for developing the application.
Selecting [Create a new project workspace] or other similar menu items allows you to create a workspace for developing the application.
The directory in which the PDG is installed contains sample workspaces separately for M16C/28, H8/3687, and R8C/13.

(3) Creating an application

You will call the functions generated by the PDG.
These functions must be called in the right places of the application.
For example, call the following function to initialize a timer mode with timer A0.
_CreateTimer_TA0_p1( );

The header file generated simultaneously by the PDG must be included.
Name of the generated header file: <project name>.h

(4) Registering the source files generated by the PDG

Calling functions generated by the PDG is not the only step necessary for performing a build (or link) without errors.
It is required that the C source files containing the functions' bodies be registered in the workspace opened in the HEW.

(5) Build

You will register the options necessary for a build in the HEW build option. The options to be set are as follows:

- Path settings for include files with the –I compile option
- Specifying API libraries with the –L link option or other options.

These options are already set in the attached sample workspaces.
Other workspaces require these options.

(6) Debug and evaluation

The development of the application is completed by debugging and evaluating the built application.

2. Using the PDG

This section shows a procedure for creating objects by using a PDG sample project and a HEW sample workspace.
Note that the titles marked with **[PDG]** and **[HEW]** describe the operation of the PDG and HEW, respectively.

* Backup copies of the attached sample project file originals are stored in sample.bak under the PDG install directory (When recovering the files, copy the directories under sample.bak into the sample directory).

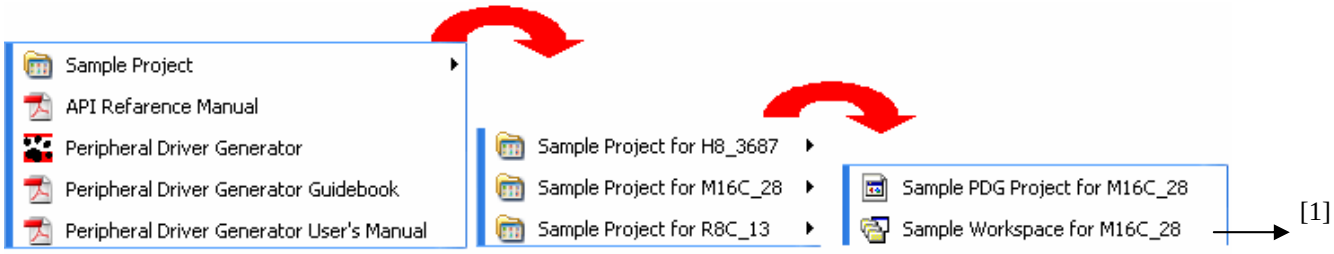
2.1 Creating a Workspace with the HEW [HEW]

In this section, you use an empty workspace for the HEW, which is included in the PDG package.

Select [Start] -> [Renesas] -> [Peripheral Driver Generator] -> [Sample Projects]. Then, open any one of the followings:

- Sample workspace for H8/3687
- Sample workspace for M16C/28
- Sample workspace for R8C/13

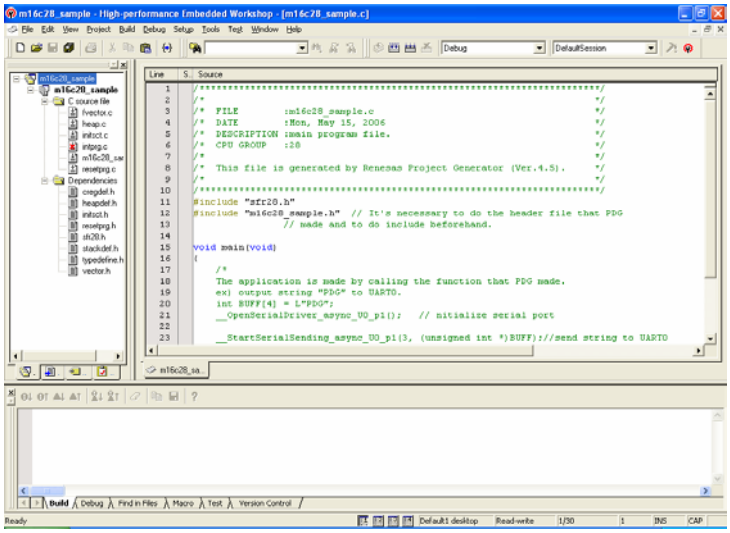
Here, the sample workspace for M16C/28 is used.



[1]: HEW sample workspace for M16C/28.

The HEW will be launched after [1] is selected. Proceed to the next step without closing the HEW.

Since this smaple workspace has been created with HEW V.4.00, a message dialog box asking whether to update or not will appear when the workspace is opened with a later version of the HEW. In this case, click [OK] to open it.



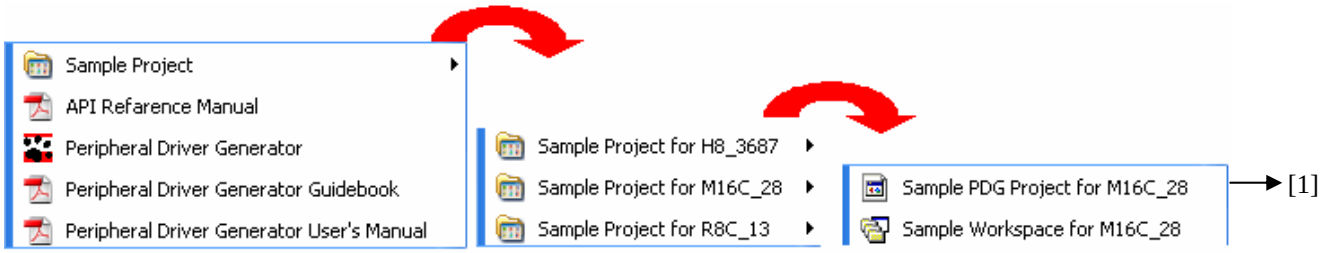
2.2 Creating a Project with the PDG [PDG]

In this section, you use an empty project for the PDG, which is included in the PDG package.

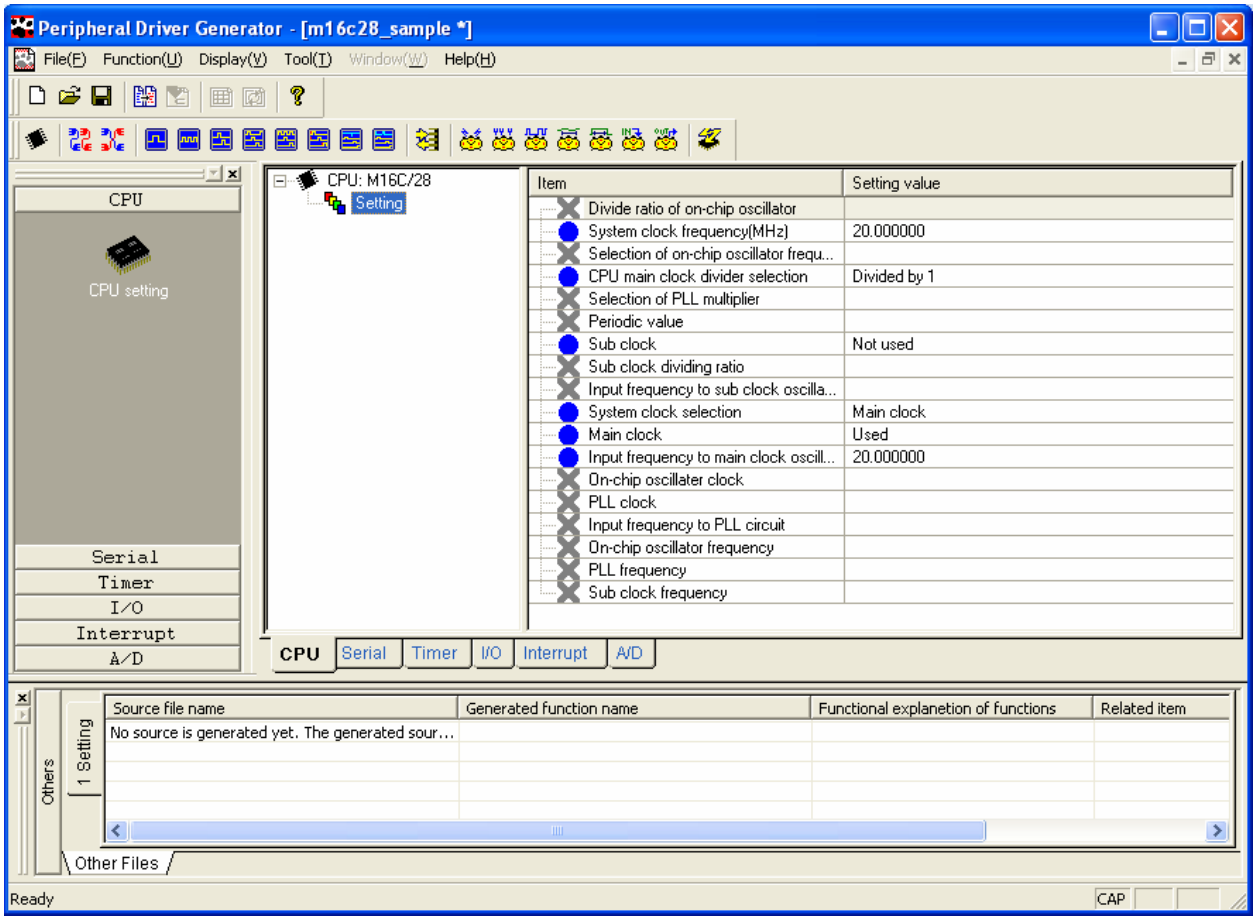
Select [Start] -> [Renesas] -> [Peripheral Driver Generator] -> [Sample Projects]. Then, open any one of the followings:

- Sample PDG project for H8/3687
- Sample PDG project for M16C/28
- Sample PDG project for R8C/13

Here, the sample PDG project for M16C/28 is used.



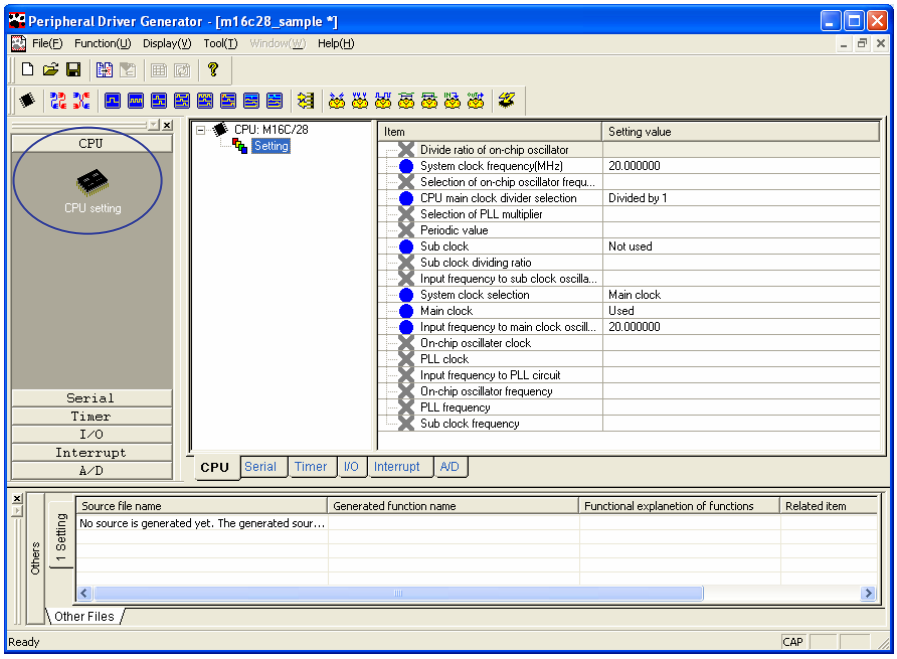
The PDG will be launched after [1] is selected.

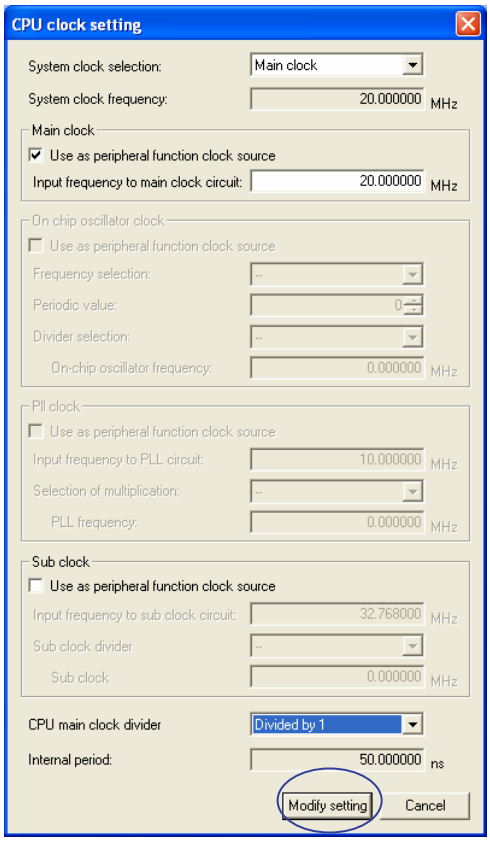


2.3 Setting the Peripheral I/O Modules [PDG]

The first thing to do here is to set CPU clocks.

Select **CPU setting** from the peripheral I/O window.





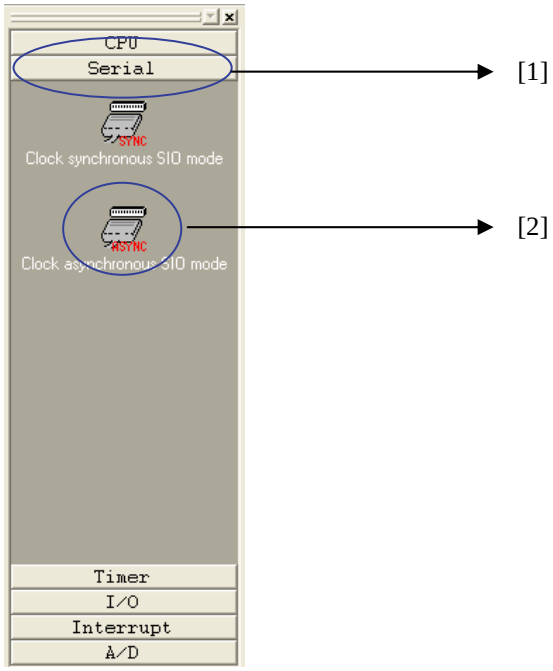
In the [CPU clock setting] dialog box, perform settings according to the program to be created and click [Modify setting] to complete the settings.

The next thing to do is to set the peripherals.

According to the program to be created, first **select a peripheral and then a function of the peripheral.**

For example, in order to create an asynchronous serial comunication program, follow the steps bellow:

[1] First, select the [Serial] tab in the peripheral setup window.
[2] Then, select [Clock asynchronous SIO mode].

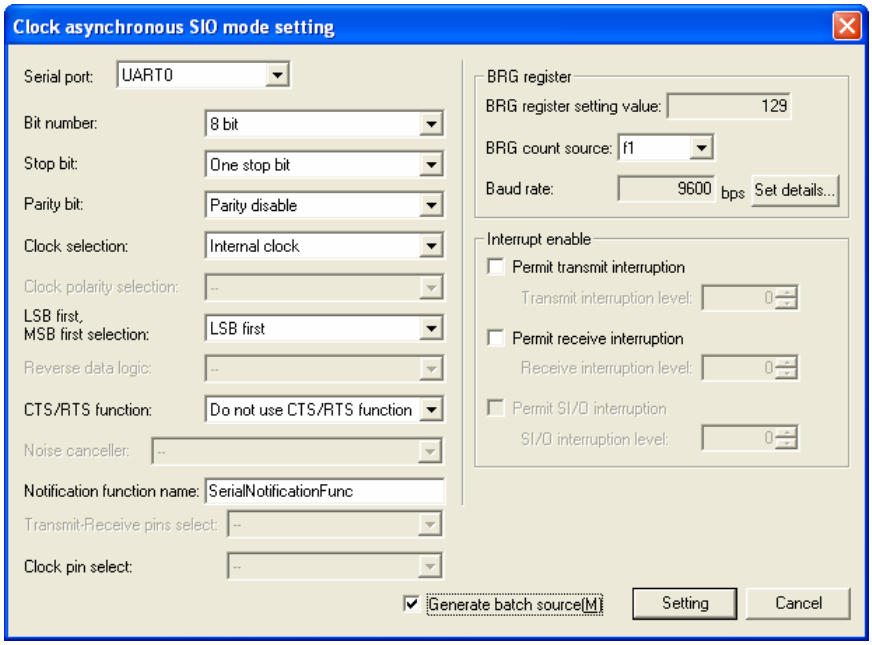


In the [Clock asynchronous SIO mode setting] dialog box, specify the items (bit number, parity bit, baud rate, etc,) and select a serial port (UART0, UART1, etc,).

Check [Generate batch source (M)] and click [Setting].

C source files reflecting these settings will be generated.

* C source files cannot be generated without specifing a serial port.

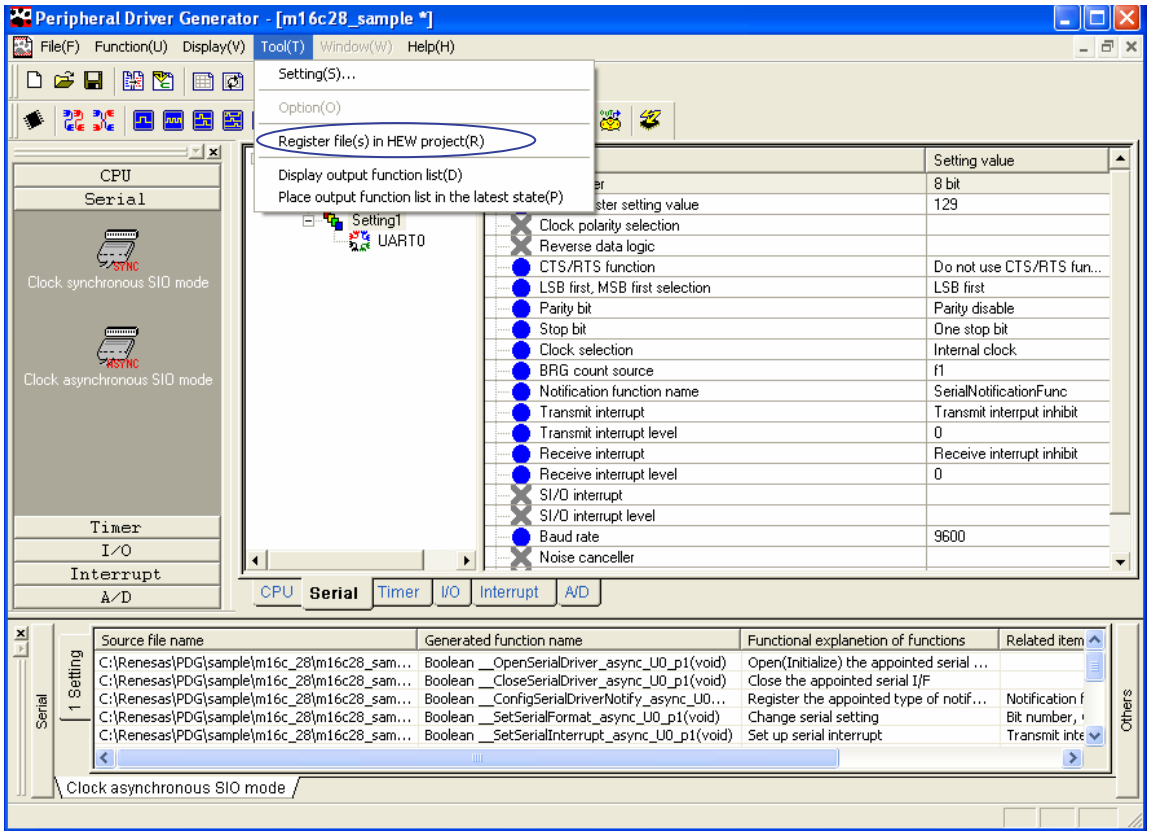


2.4 Registering the Output C Source files [PDG]

It is required that the C source files generated in section 2.3, Setting the Peripheral I/O Modules, be registered in the HEW.

This step is necessary for compile and link processes.

In order to register the files, select [Register file(s) in HEW project] from the PDG tool menu.

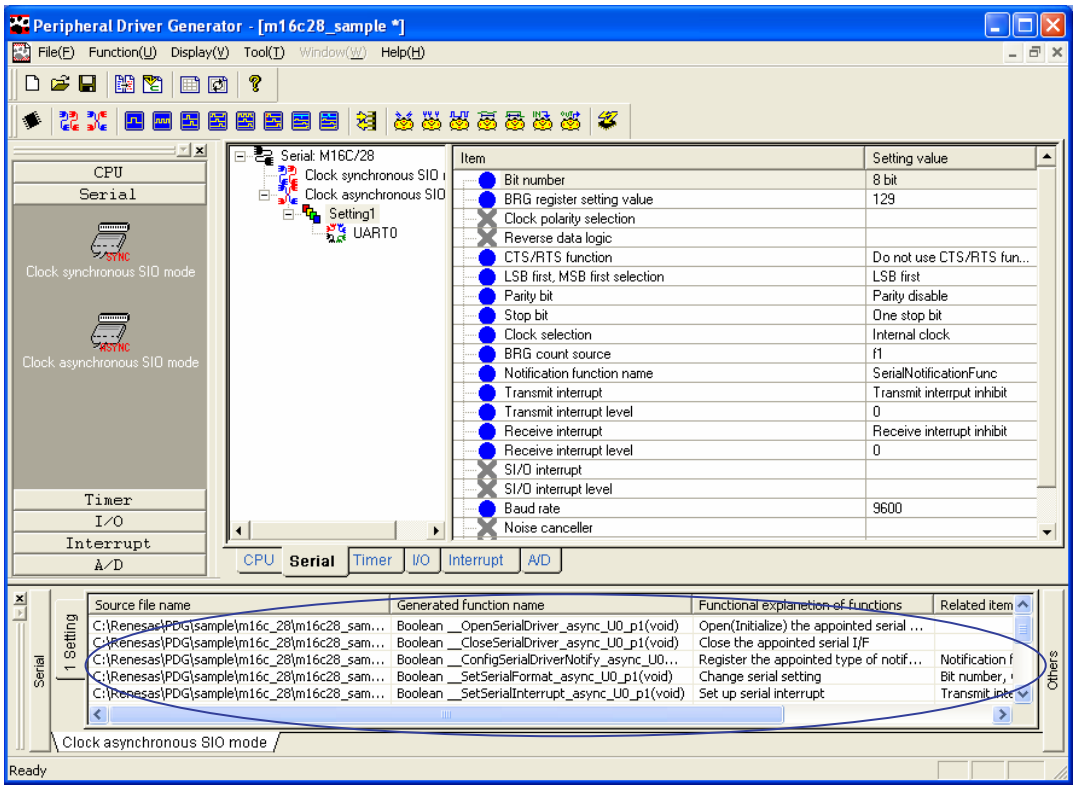


Note:

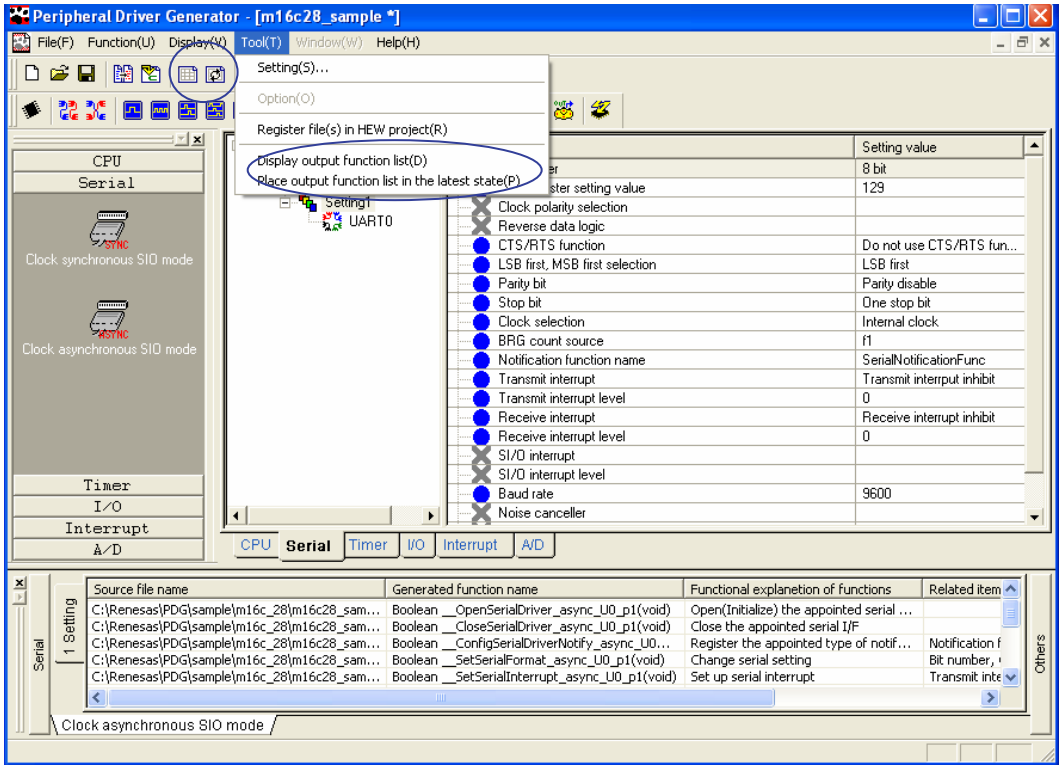
- Once the source files generated by the PDG are registered in the HEW, you cannot cancel their registration via the PDG. Cancel the registration via the HEW, if necessay.
- Make sure that the CPU group selected for the HEW workspace is the same as for the PDG project before registering the source files.

2.5 Viewing the Created Functions [PDG]

The application is created by calling the functions created in section 2.3, Setting the Peripheral I/O Modules. Available functions are listed in the source display window.

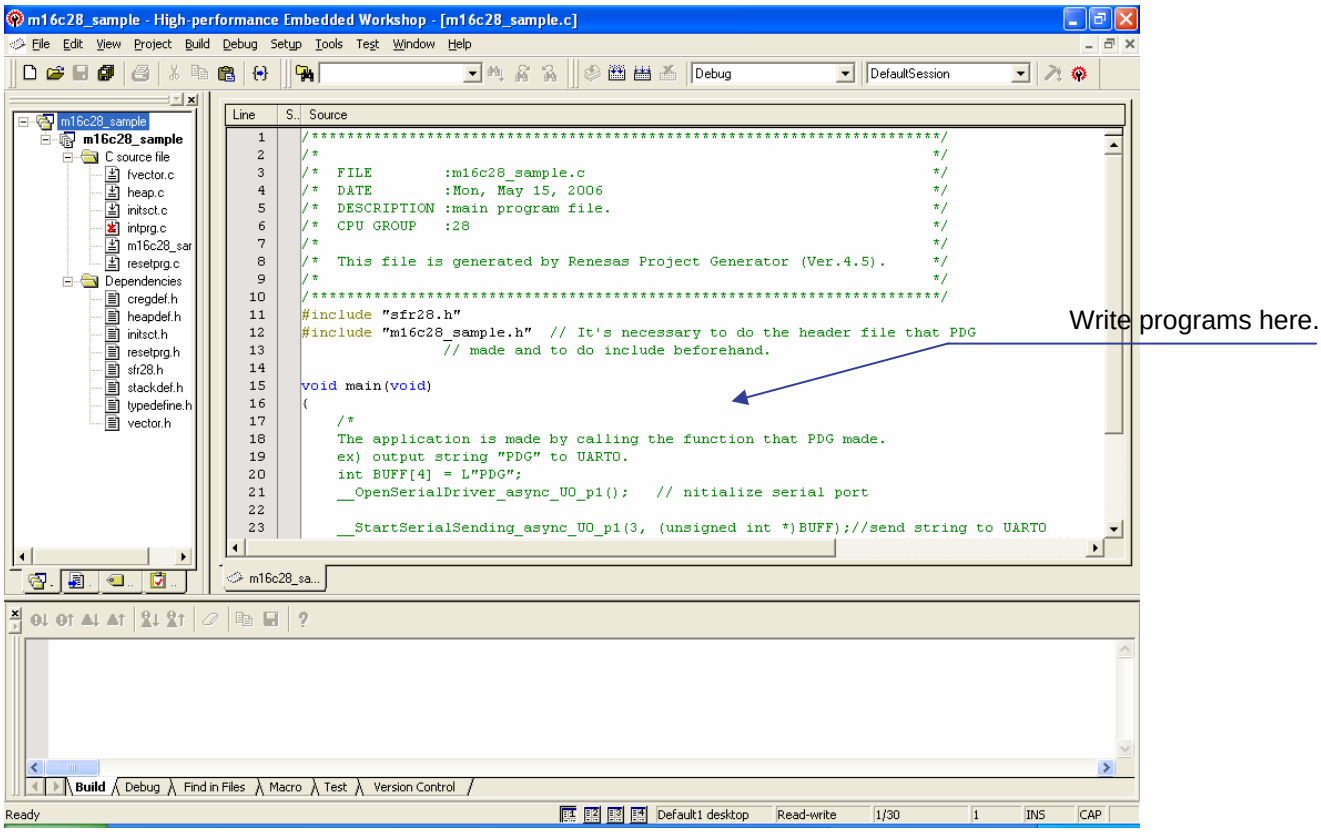


To list output functions in CSV file format, select [Display output function list] from the tool menu. The application associated with the *.csv extension will be launched.



2.6 Creating the Application [HEW]

The application is created by using the HEW.



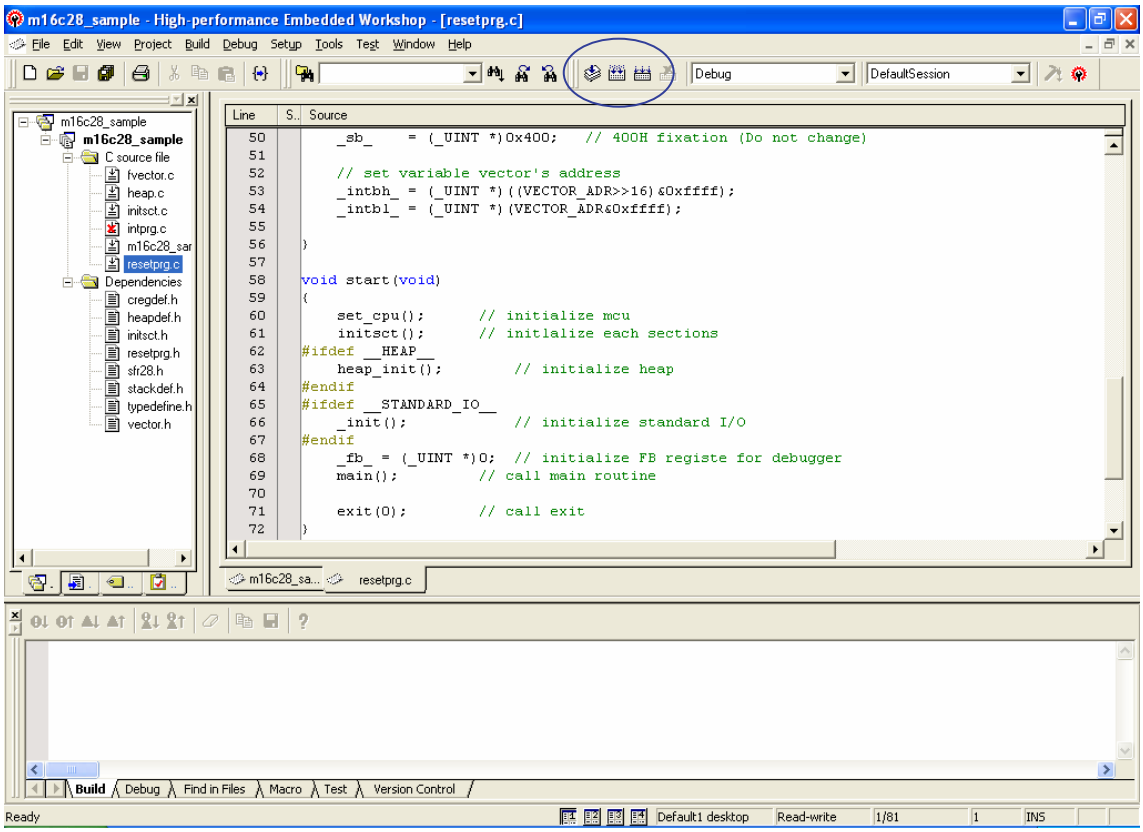
For example, to send data to the UART0 serial port, call the following function:

__StartSerialSending_async_U0_p1( )

```
if( __StartSerialSending_async_U0_p1(15,(unsigned int *)"hello PDG World") == 0)
        printf("False\n");          //Failed to send
```

2.7 Compile/Link [HEW]

Perform a build after creating the application by clicking the build button on the HEW.



Note:

(1) When a build is performed while the HEW is installed in other than the C drive, errors will occur during the link operation. In this case, specify the directory containing the API location (lib\M16C_Tiny, lib\H8_Tiny, or lib\R8C_Tiny under the PDG installation directory) by using link options.
For details on how to specify the API library, refer to section 3.2, Specifying Libraries.

(2) When the M3T-NC30WA V.5.40 Release 00 compiler package for M16C series is used, errors may occur during updating dependency information. Use version 5.42 or another method of specifying libraries.

All the development work is completed.

2.8 Execution [HEW]

This section explains how to use the simulator to evaluate the application after the development work. The following preparations for executing the application are required as explained so far:

(1) Uncomment the following lines written in the main function of the sample workspace to enable the program.

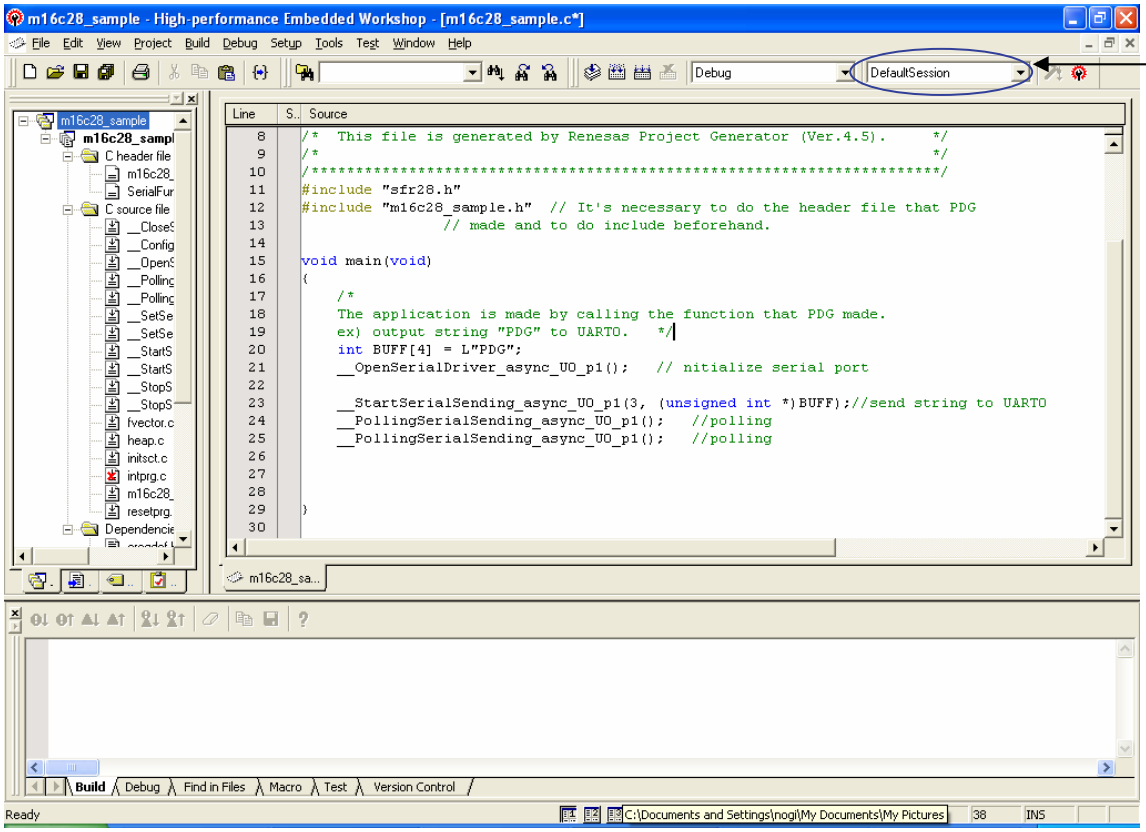
```
int BUFF[4] = L"PDG";
__OpenSerialDriver_async_U0_p1();                          //Initializes UART0

__StartSerialSending_async_U0_p1(3, (unsigned int *)BUFF);  //Sends to UART0
__PollingSerialSending_async_U0_p1();                      //Polling processing
__PollingSerialSending_async_U0_p1();                      //Polling processing
```

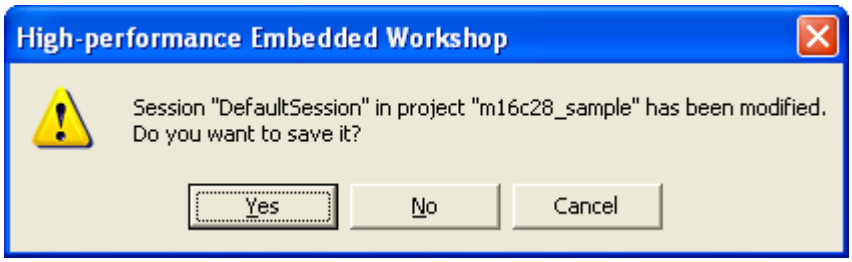
(2) Use the PDG to register the generated source files in the HEW.

(3) Perform a build.

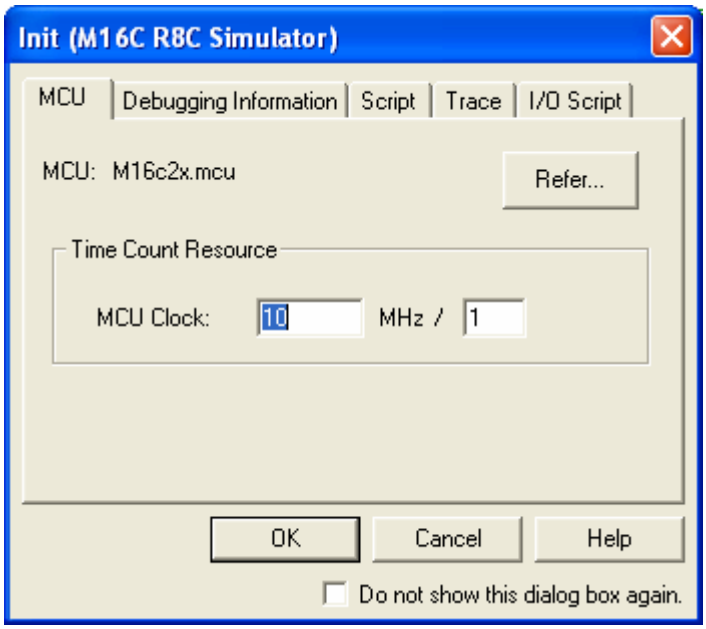
- Executing the simulator



[1] Select [SessionM16C_R8C_Simulator] for session.
[2] Select [Yes].



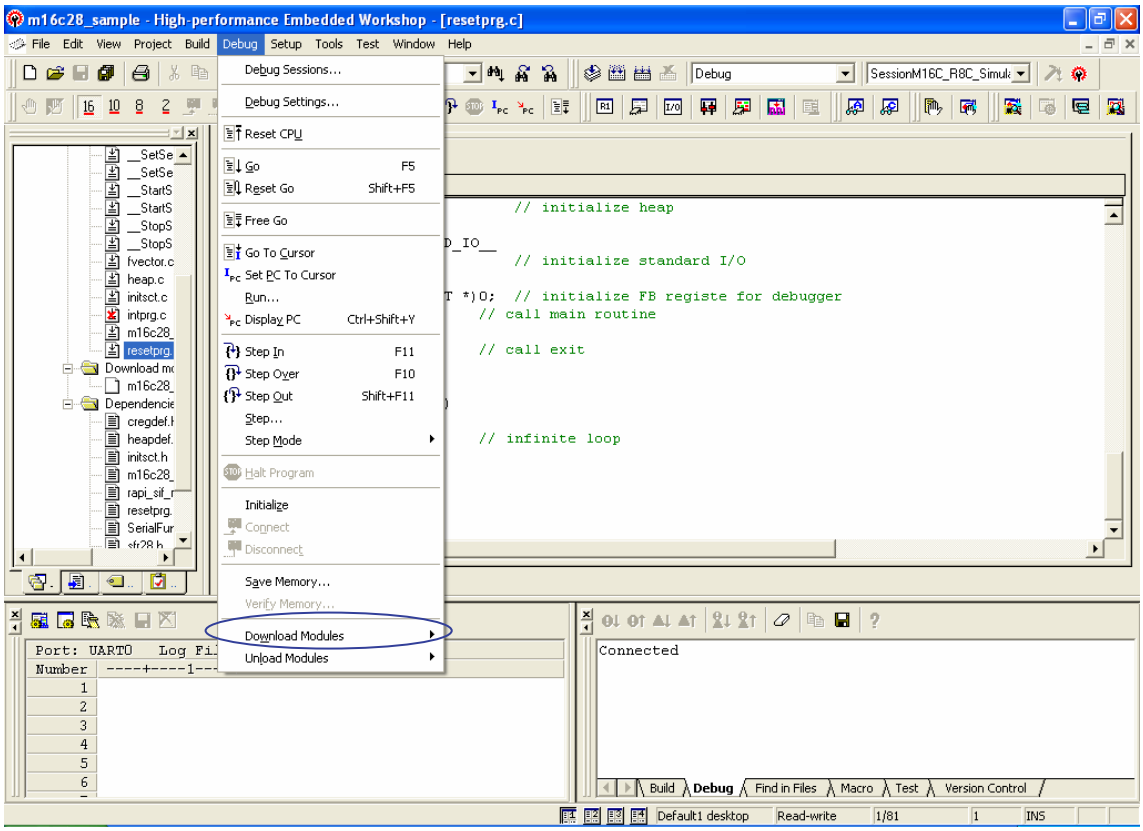
[3] Select [OK].



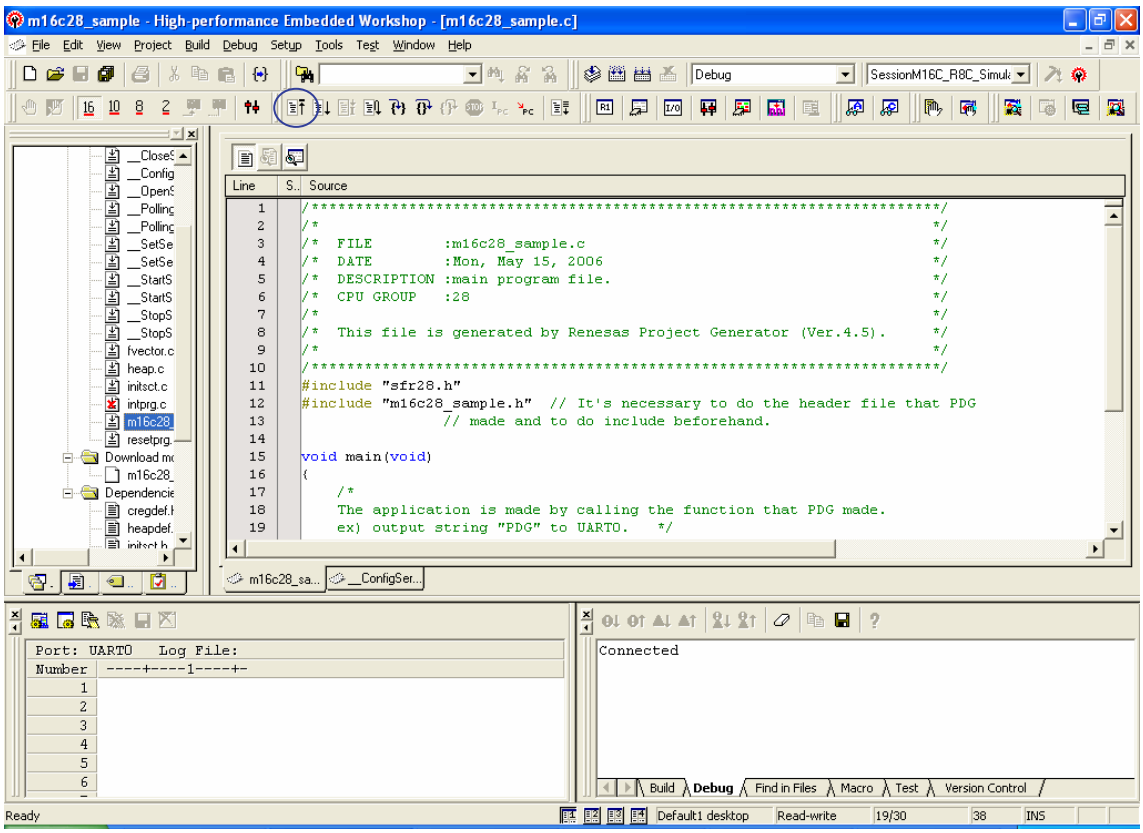
[4] Select [Download Modules] to download the following file.

C:\renesas\PDG\sample\m16c_28\m16c28_sample\debug\m16c28_sample.x30

(This file may automatically be downloaded after a build by following the steps [1] to [3].)



[5] Click the reset button.

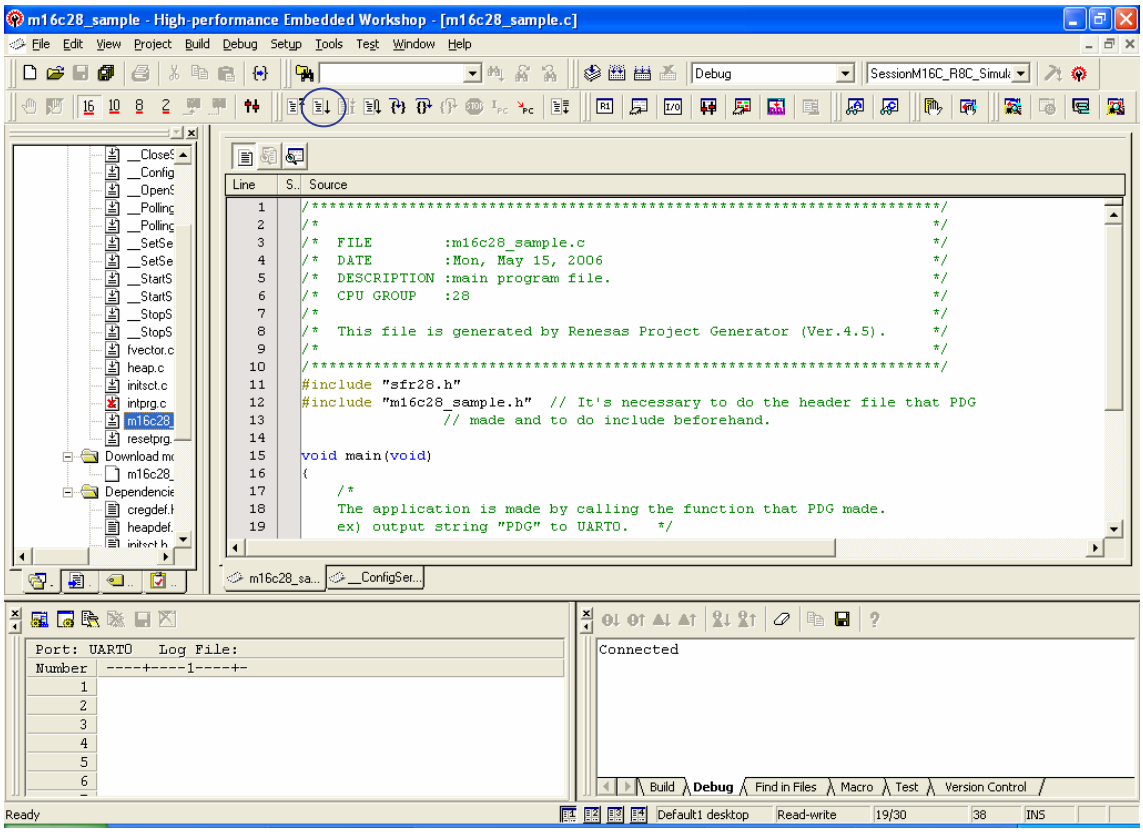


[6] Set a breakpoint at the place where exit(0) is called in resetprg.c.

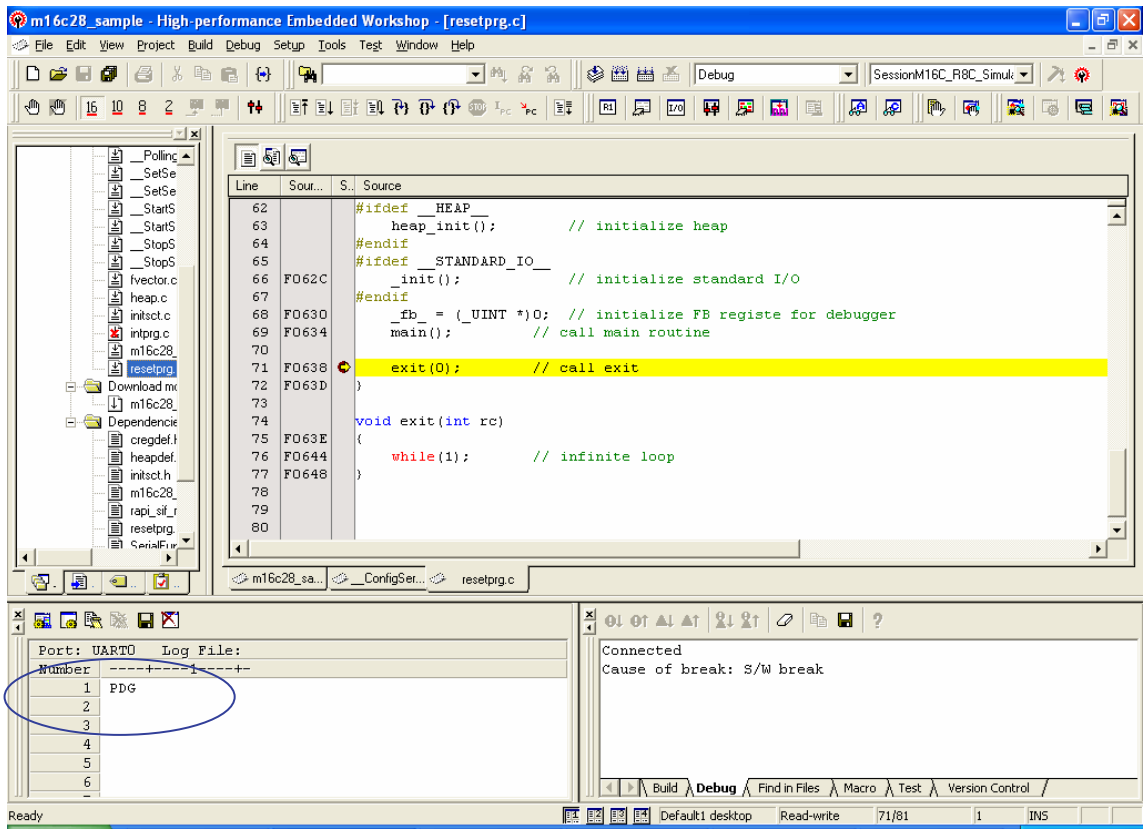
```
_fb_ = (_UINT *)0;          // initialize FB registe for debugger
main();                     // call main routine


exit(0);                    // call exit
```

[7] Click the run button.



[8] Make sure that “PDG” is displayed.



The operation using the samples is completed.

3. Setting a Build

In order to perform a build/compile with the HEW, the following settings are required as well as the steps for registering the generated source files as explained in section 2.

- **Specifying the directory of the reference header file (using -I option)**
- **Setting for linking API libraries (using –L option)** *

  * When the High-performance Embedded Workshop V.4.02 or earlier is used.

This section explains how to perform these settings.
Note that these are already set in the sample workspaces attached to the Peripheral Drive Generator package.

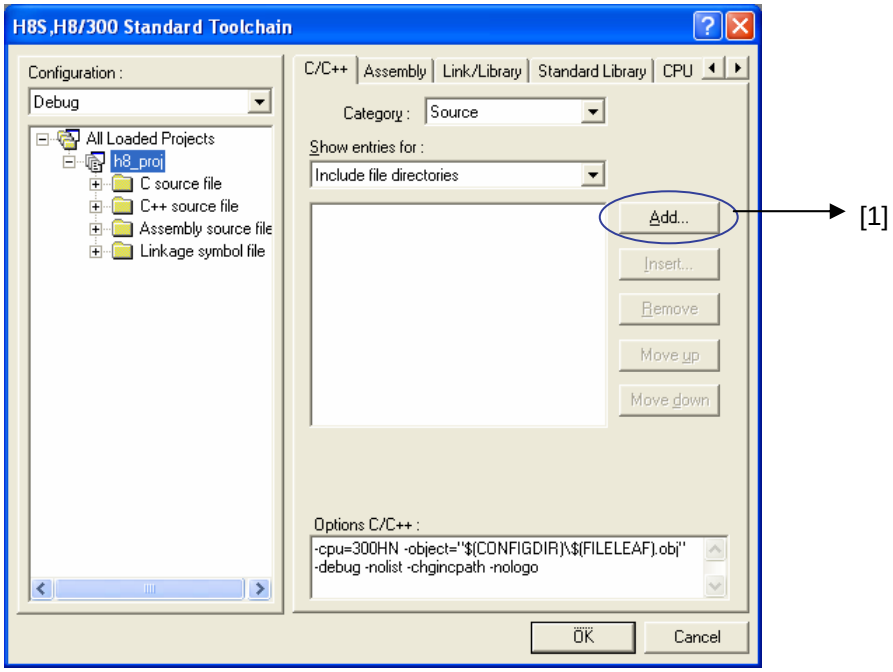
3.1 Specifying the Header File

To call the functions generated by the PDG, the header file containing the functions' prototype declarations must be included.
A header file name is <project name>.h.
When the directory created by the HEW is different from the project directory created by the PDG, the directory containing the header file, that is, the directory where the project is created, must be specified by using –I option.

```
<sample.c>
#include "m16c28_sample.h"

void main(void)
{
        __OpenSerialDriver_sync_U0_p1();
        __ConfigSerialDriverNotify_sync_U0_p1();
        __SetSerialFormat_sync_U0_p1();
                :
                :
                :
}
```

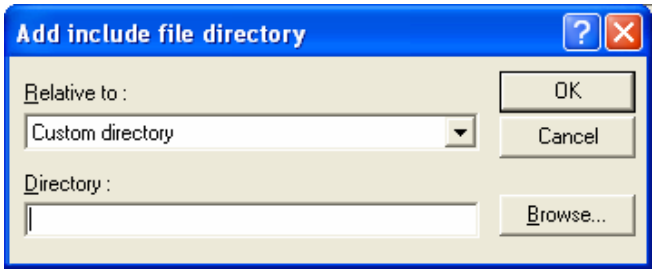
(1) From the build menu, select “Renesas M16C Standard Toolchain…” for M16C/Tiny and R8C/Tiny, or select “H8S,H8/300 Standard Toolchain…” for H8/300H Tiny.



(2) Select the [C/C++] tab ([C] tab for M16C/Tiny and R8C/Tiny).
When H8/300H Tiny is selected, select [Include file directories] for [Show entries for:].
When M16C/Tiny or R8C/Tiny is selected, select [Inlcude file directories] for [Show Entries For:].

[1] Click [Add...].

(3) Specify the directories containing include files.



In the [Add include file directory] dialog box, select the relative path category and enter the directory name.
For H8/300H Tiny, select and enter the followings:

- Relative to: HEW installation directory
- Sub-Directory: Directory name

For M16C/Tiny or R8C/Tiny, select and enter the followings:

- Relative to: Custom directory
- Directory: Directory name

(4) Close all the dialog boxes to complete the settings.

3.2 Specifying Libraries

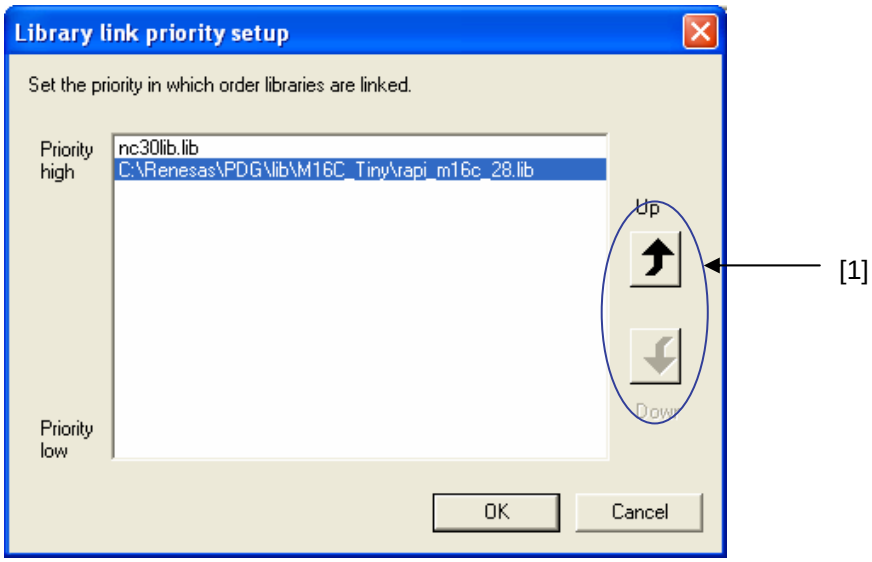
3.2.1 List of Libraries for Sample Projects

When a setting source of each peripheral I/O module is built, the libraries shown below must be linked.
For the names of all library files of supported microcomputers, refer to the PDG's users manual.

CPU	Directory	Library File Name
H8/3687	lib\h8_3687	rapi_h8_3687.lib
R8C/13	lib\r8c_13	rapi_r8c_13.lib
M16C/28	lib\m16c_28	rapi_m16c_28.lib

3.2.2 When Using HEW V.4.02 or Later

When the source is registered in the PDG while HEW V.4.02 or later is used, the following dialog box is displayed.

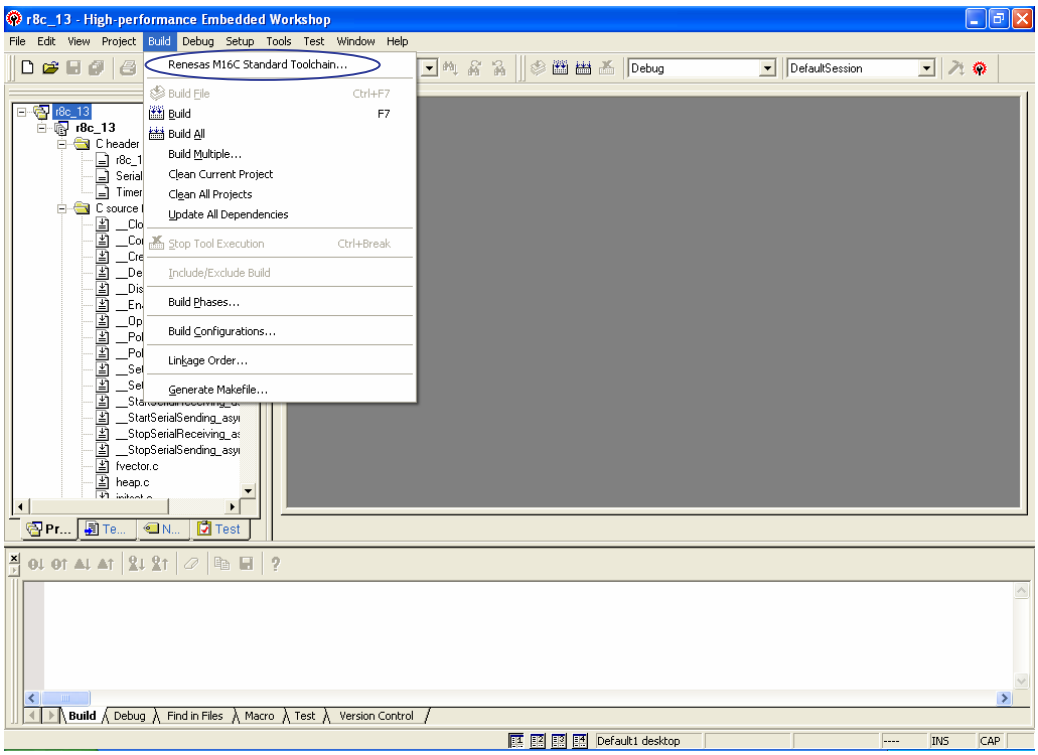


In this dialog box, determine the priorities of the libraries.
When the same symbol name exists in different libraries, the library that has the highest priority among them are selected.
When changing the priorities, select a library and click the buttons marked with [1]. A library with higher priority is listed higher.

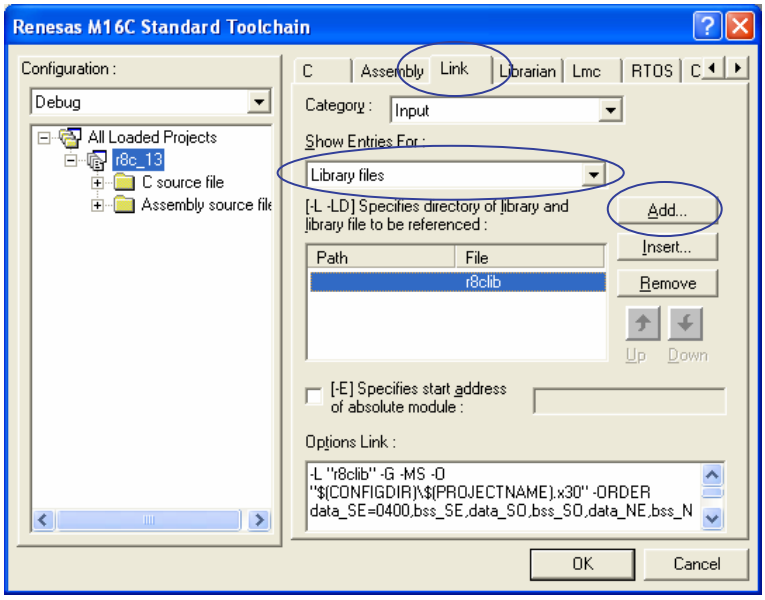
3.2.3 When Using Earlier Version than HEW V.4.02

When using an earlier HEW version than 4.02, follow the steps below to specify libraries.

(1) From the build menu, select [Renesas M16C Standard Toolchain…] for M16C/Tiny and R8C/Tiny, or select [H8S,H8/300 Standard Toolchain…] for H8/300H Tiny.

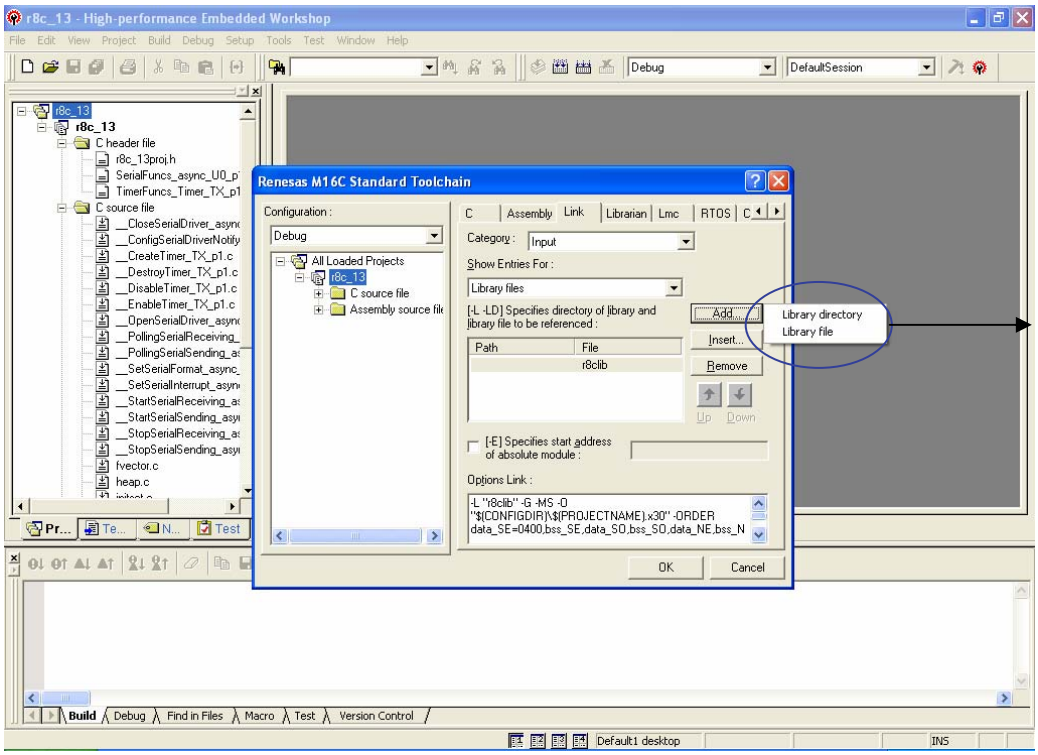


(2) Select the [Link] tab in the [Renesas M16C Standard Toolchain] dialog box, or select the [Optimization linker] tab in the [H8S,H8/300 Standard Toolchain] dialog box.

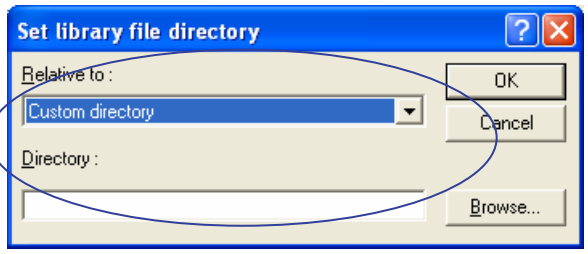


Select [Library files] ([Library files] for H8/300H Tiny) for [Show Entries For] and click [Add].

(3) Specify the directory containing the API libraries.



[1] Select [Library directory] (for R8C/Tiny, M16C/Tiny, and M16C/60).



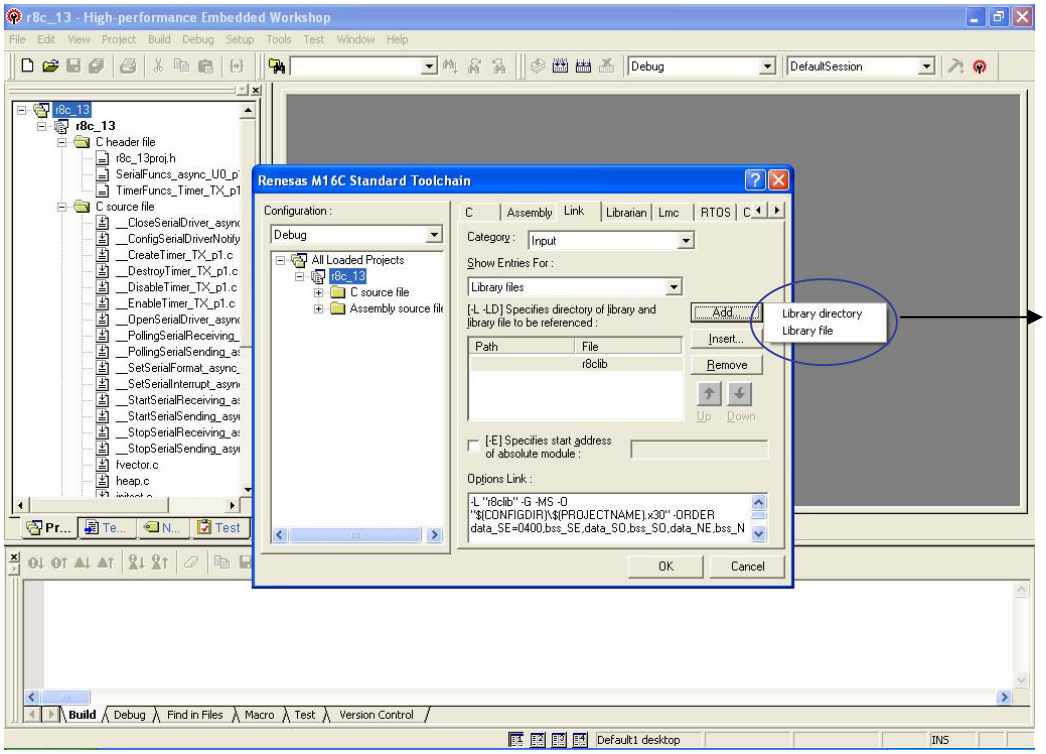
Relative to: Select [Custom directory].

Directory: Specify the directory containing the API libraries.

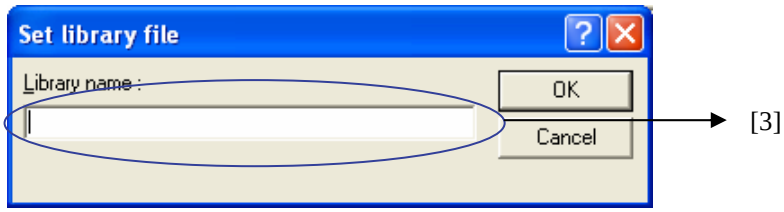
Example) C:\Renesas\PDG\lib\M16C_28

For H8/300H Tiny, specify the directory name and liblary file name.

(4) Specify the library name (For R8C/Tiny, M16C/Tiny, and M16C/60).



[2] Select [Library file].



[3] Enter the name of the peripheral API library file to be used.
Example) rapi_m16c28 (Do not add the .lib extension.)

(5) Close all the dialog boxes to complete the settings.

3.2.4 Exculding Interrupt Vector Table

The PDG creates an interrupt vector simultaniously.

Since another interrupt vector is created when a workspace and a startup file are created at the same time by the HEW, the interrupt vector for the startup needs to be excluded from the compile target.

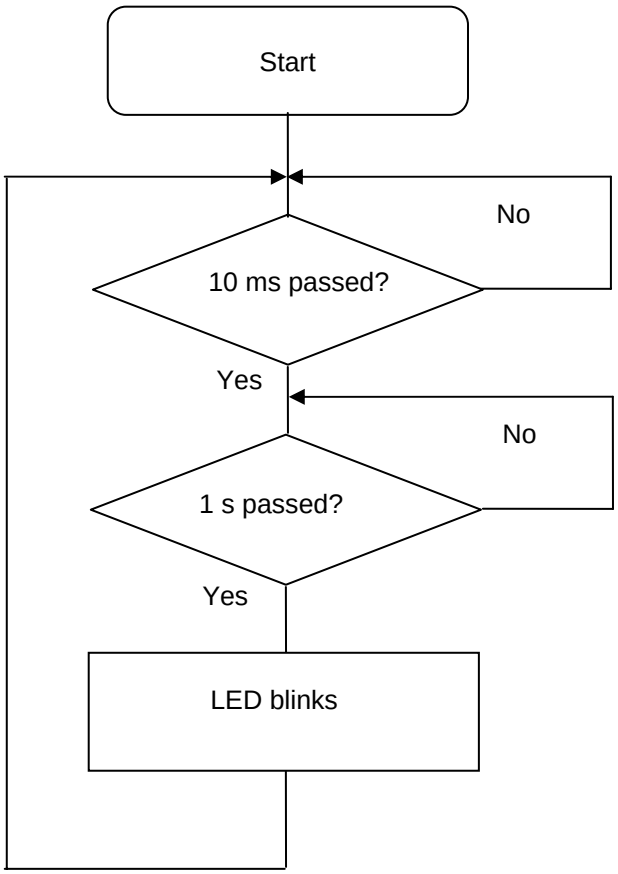
Note that when HEW V.4.02 or later is used, the interrupt vector is automatically excluded in the PDG.

4. Example of Creating an Application

This section describes a procedure for creating an application with the PDG.

4.1 Flow Chart of an Application to be created

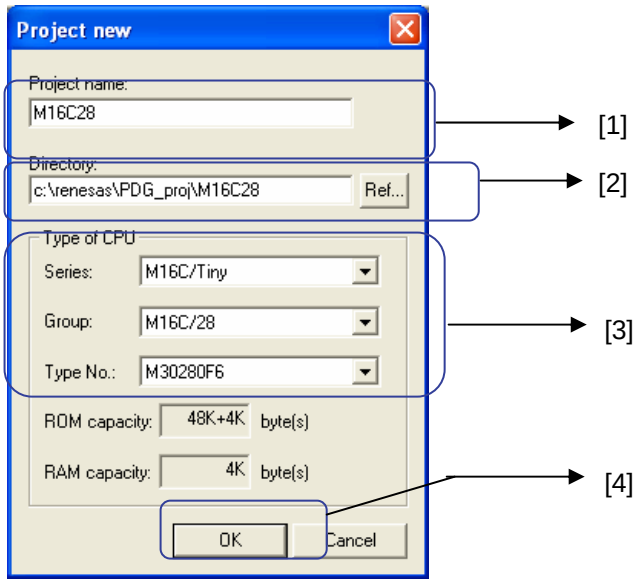
Create an application based on the flowchart below.
Microcomputer used for the application is M16C/28.



4.2 Setting Peripherals with the PDG

4.2.1 Creating a Project

Select [File] -> [Create New Project] to open the new project window.



[1] Enter a project name.
Here, “M16C28” is chosen.

Note: The Peripheral Driver Generator creates a header file with “<project name>.h”.
If an existing file has the same name, enter another project name.

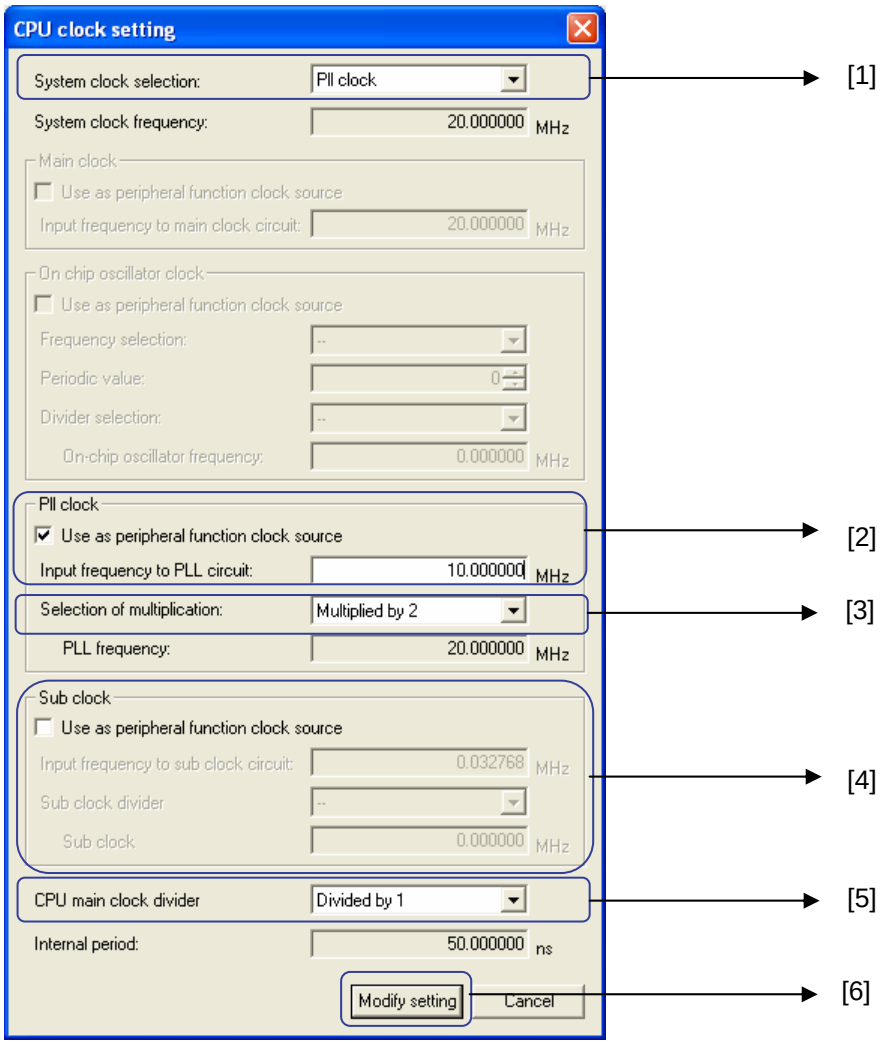
[2] Specify a directory to store the project file in.
By default, a directory with the same name as the project is created under c:\renesas\PDG_proj.

[3] Select a CPU.
Here, select the followings:
Series: M16C/Tiny
Group: M16C/28
Type No: M30280F6

[4] Click the [OK] button to complete creating a project.

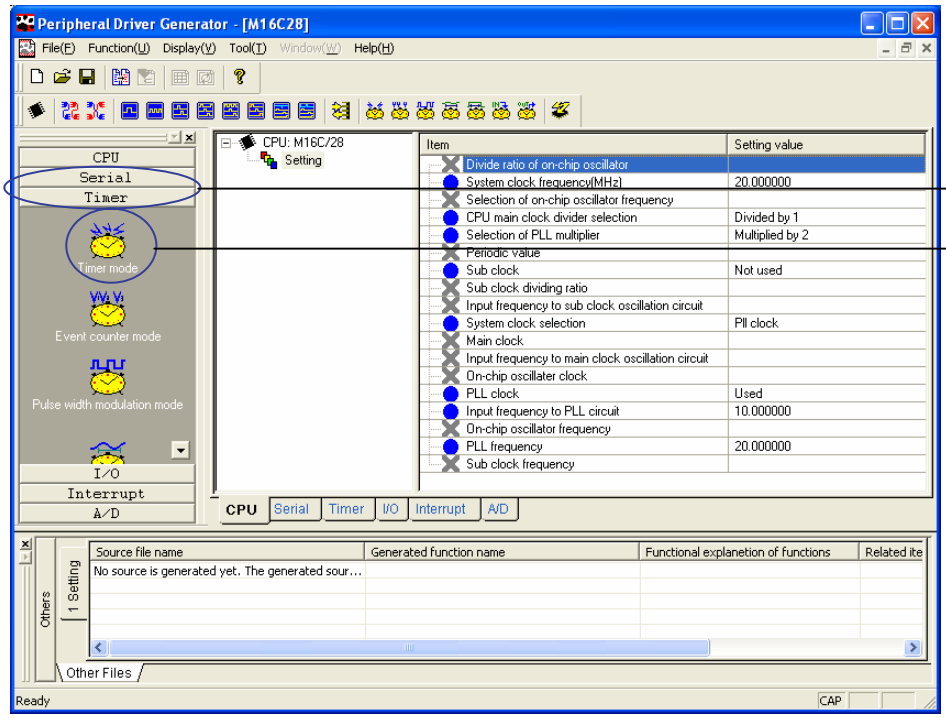
4.2.2 Setting Clocks

The [CPU clock setting] window appears after the steps for creating a project in section 4.2.1 is completed.



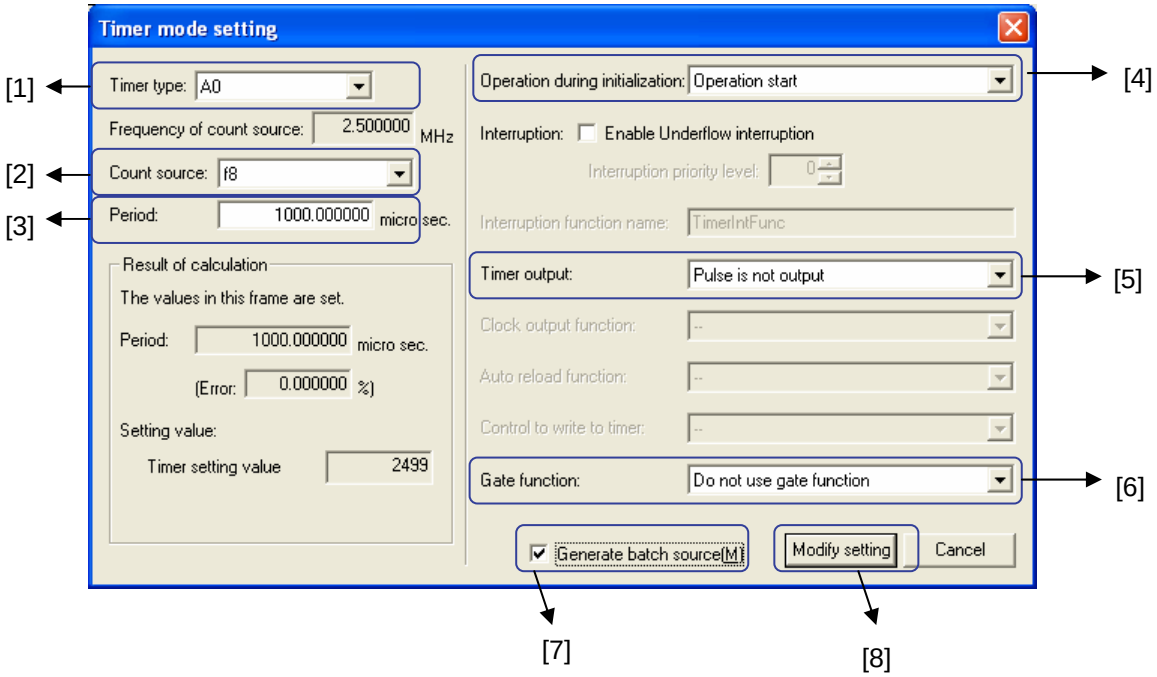
[1] Select [PLL clock] in the [System clock selection].
[2] Specify the frequency as 10 MHz.
[3] Select [Multiplied by 2] for [Selection of multiplication].
[4] Do not use sub-clock.
[5] Select [Devided by 1] for [CPU main clock divider].
[6] Click [Modify setting] to complete the settings.

4.2.3 Setting Timer Mode

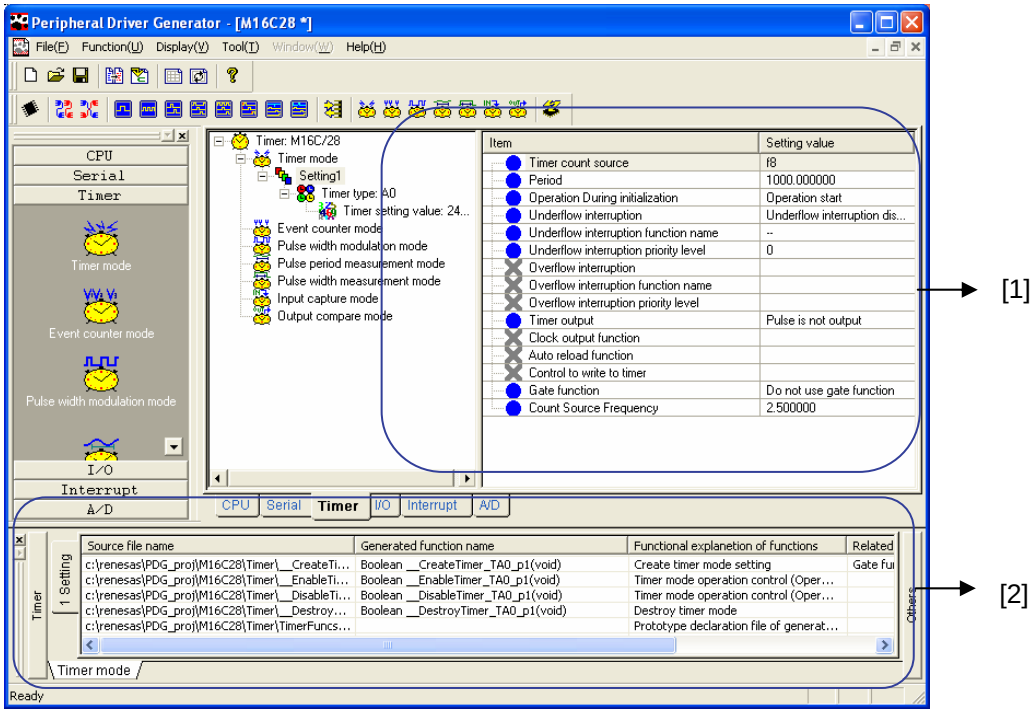


[1] Select the [Timer] tab.

[2] Select and click [Timer mode].



[1] Select [A0] as the timer.
[2] Select [f8] for the internal count source.
[3] Specify the counter value as 10 ms.
[4] Select [Operation start] for the operation after initialzation.
[5] Select [No pulse is output] for the timer output.
[6] Select [Do not use gate function] for the gate function.
[7] Check [Generate batch source] to generate sources reflecting these settings.
[8] Click [Setting] to complete the settings.

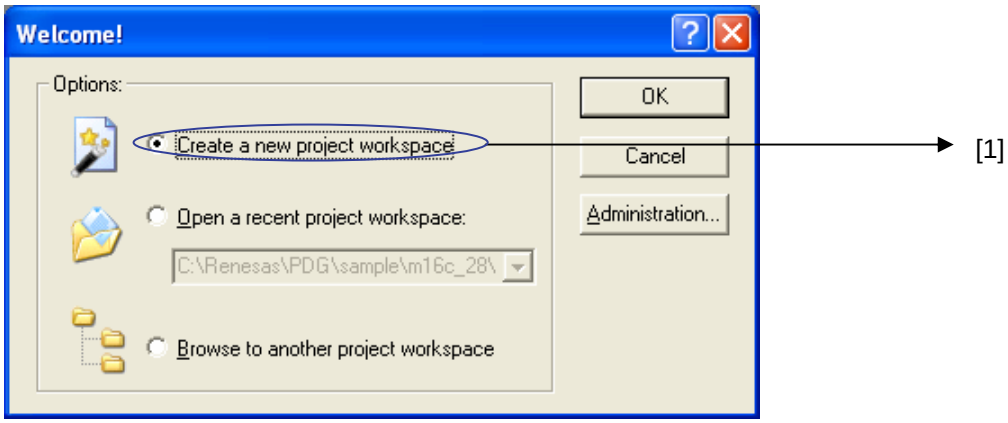


After the settings of the timer mode are completed, the settings are displayed in [1], and the generated source files, generated function names, and functional explanations are listed in [2].

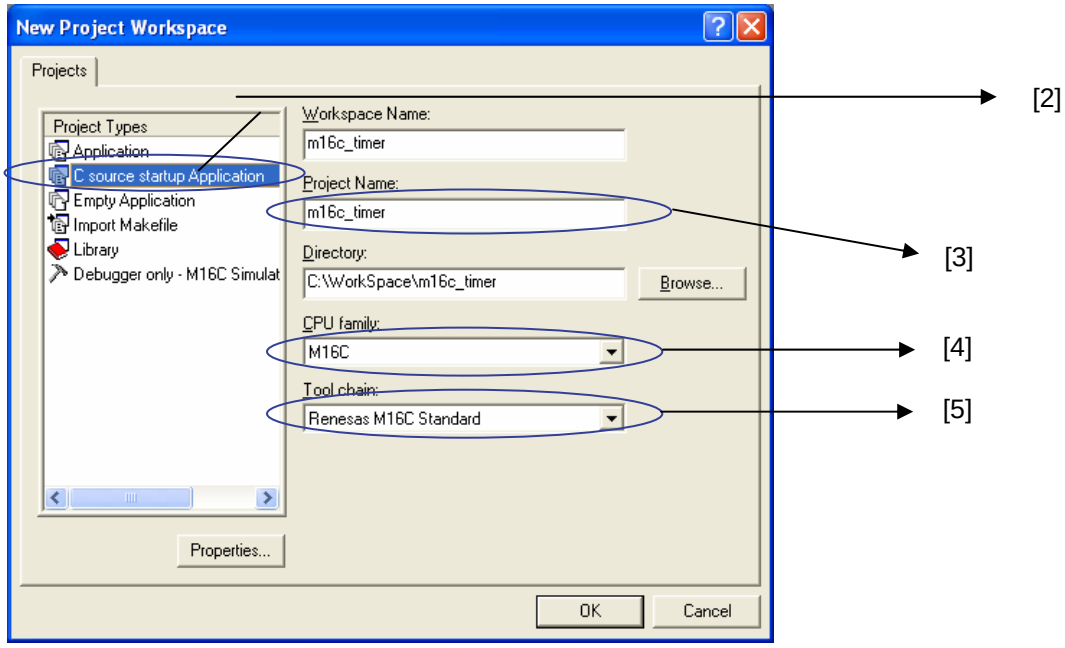
4.3 Creating a Program

A program is created with the HEW.

4.3.1 Creating a Workspace



[1] In the [Welcome!] dialog box, select [Create a new project workspace] and click [OK].



[2] Select [C source startup Application].

(When using an assembler startup, select [Application].)

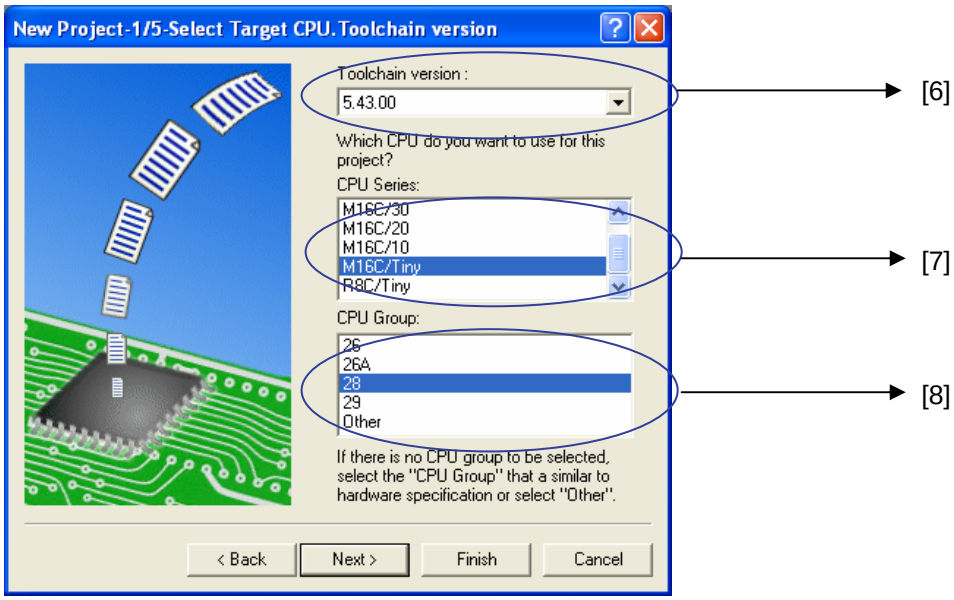
[3] Enter a workspace name.

Here, [m16c_timer] is selected.

[4] Select [M16C] for the CPU family.

[5] Select [Renesas M16C Standard] for the tool chain.

Click the [OK] button.



[6] Specify the compiler version as 5.40.00 or later.

[7] Select [M16C/Tiny] for [CPU Series:].

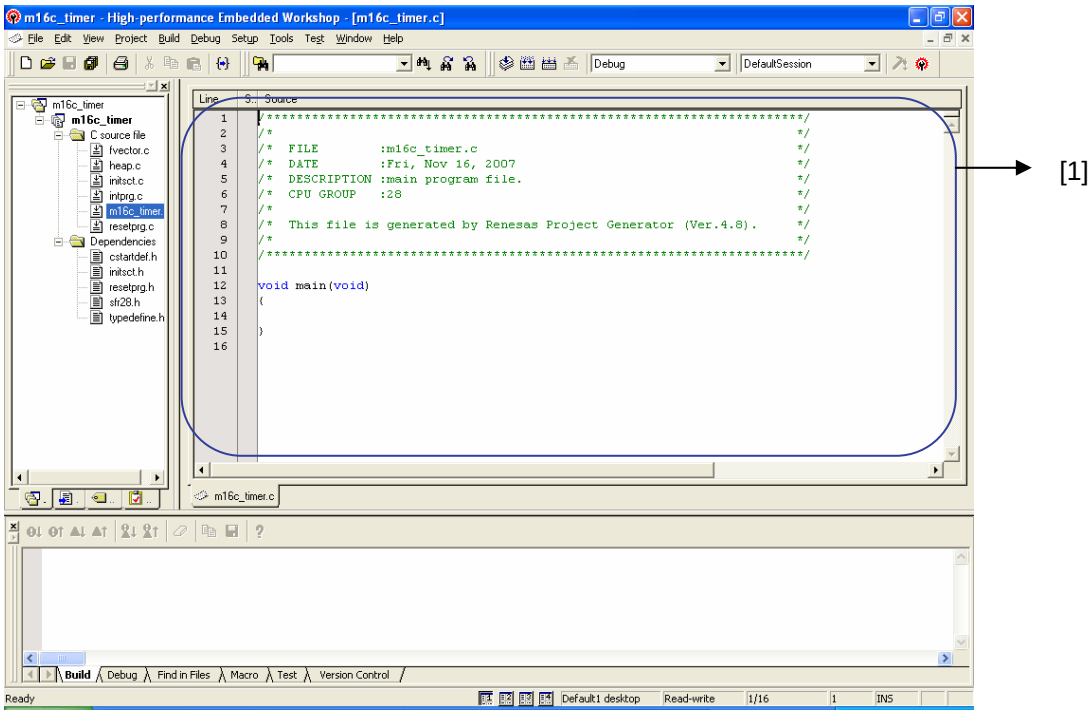
[8] Select [28] for [CPU Group].

Click the [Next] button to proceed.

Operate the new project creation wizard to compelet creating the new workspace.

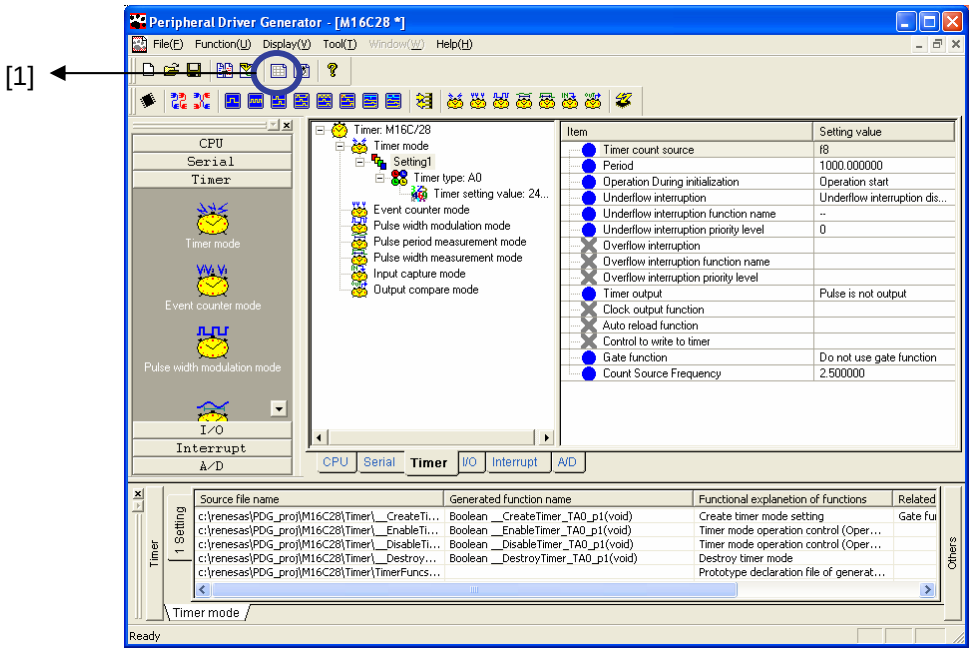
4.3.2 Creating a Program

Code a program on [1] of the HEW.



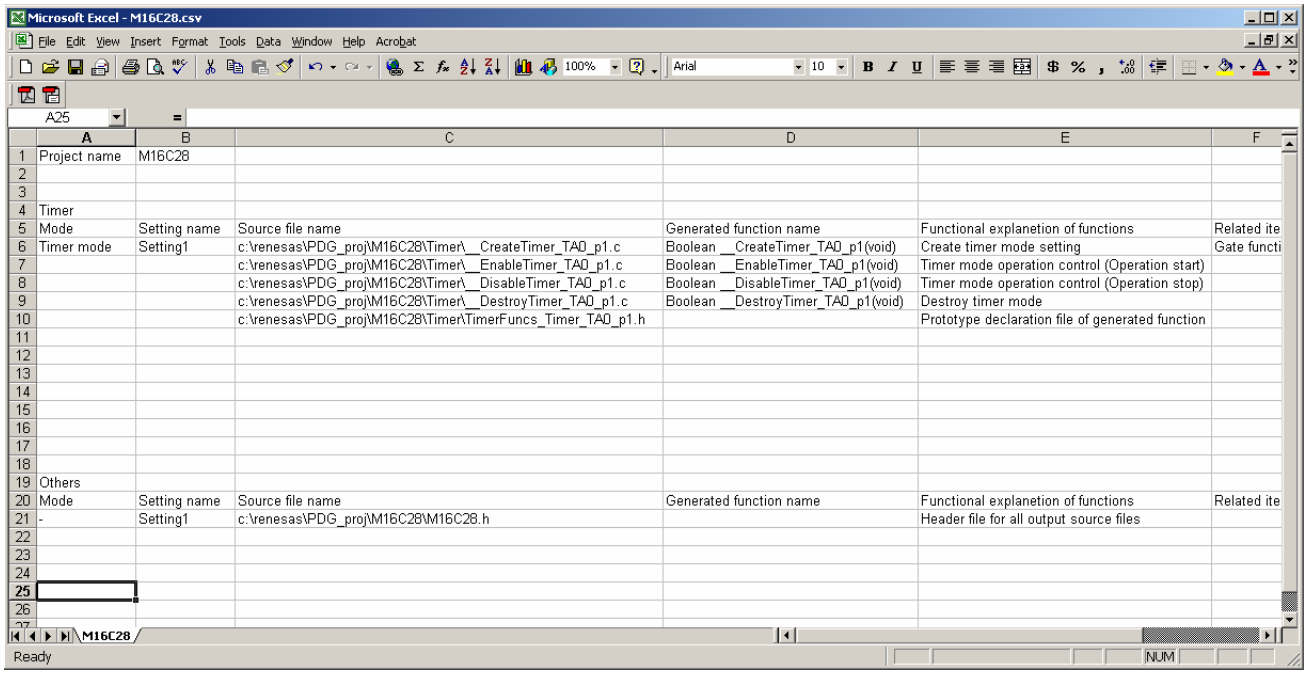
When coding a program, use the functions created with the PDG.

The generated functions can be viewed as Excel data as well as in the PDG's graphical user interface.



By clicking the button, Excel is launched and the functions are listed.

Note that since the extension of the output files is .csv, *.csv files must be associated with Excel. (Otherwise, the files are displayed as text files.)



The figure above is the displayed Excel data.

4.3.3 Sample Programs

The header file and the functions shown in red are generated by the PDG.

```
#include "sfr28.h"

#include "m16c28.h"              // When the functions generated by the Peripheral Driver Generator are used,
                                 // this header file must be included.
#define _1SCNT (1000/10)
#define PLL_WAIT_1MS 10000   /* 1msec @10MHz */
#define PLL_WAIT_CNT 20      /* 20msec */

void main(void)
{
        int     counter = _1SCNT;
        int     onoff = 1;
        unsigned int   i,j;

        /* PLL clock setting */
        prcr = 0x01;                /* protect register off */
        cm2    = 0x00;              /* system register2 Initialize */
        cm07 = 0;
        cm1 &= 0x3f;
        cm06 = 0;
        plc0 = 0x11;                /* 2 multiplying */
        pm20 = 0;                   /* 2 wait */
        plc07 = 1;                  /* PLL operation */

        for (i = 0; i < PLL_WAIT_CNT; i++) {            /* about 20ms wait */
                for (j = 0; j < PLL_WAIT_1MS; j++) {    /* Main clock 10MHz */
                }
        }
        cm11 = 1;
        prcr = 0x00;                /* protect register on    */

        prcr = 0x04;                /* protect register off */
        pacr = 0x03;                /* 80pin type */
        prcr = 0x00;                /* protect register on */
↓
[1]
```

```
[1]
↓
        p0 = 0xff;
        p1 = 0xff;
        pd0 = 0xff;
        pd1 = 0xff;

        if(   __CreateTimer_TA0_p1( ) == TRUE    )          /* timer setting */
        {
                if( __EnableTimer_TA0_p1(    ) == TRUE )     /* timer start */
                {
                        while( 1 )
                        {
                                while( ( ta1ic & 0x08 ) == 0 );      /* 10ms? */
                                ir_ta1ic = 0;
                                counter--;
                                if( counter == 0 )                   /* 1s? */
                                {
                                        p1 = 0xfe;
                                        if( onoff )
                                                p0 = 0xf9;     /* LED1 on */
                                        else
                                                p0 = 0xff;     /* LED1 off */
                                        onoff ^= 1;
                                        counter = _1SCNT;  /* counter reset */
                                }
                        }
                }
        }
        return;
}
/* end */
```

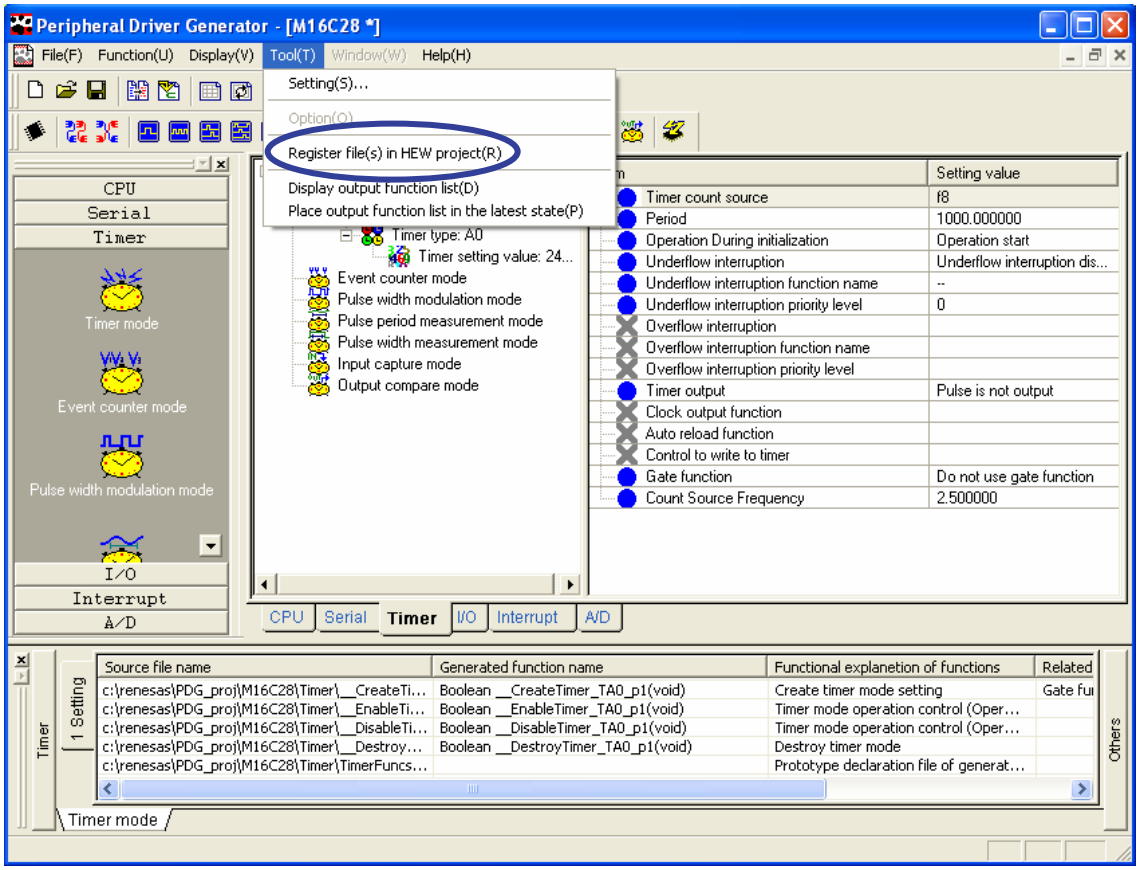
4.4 Build Work

In order to perform a compile/link after completing coding a program, the following steps are required:

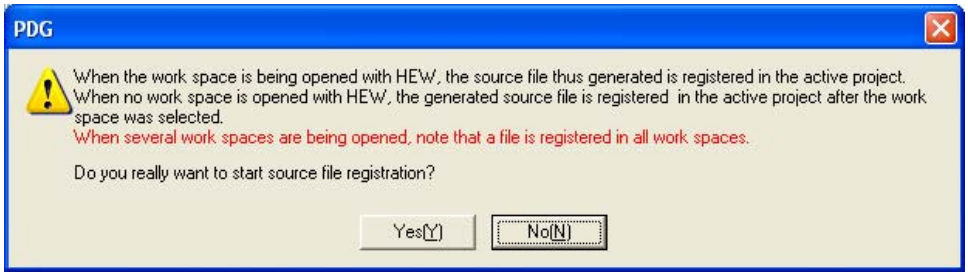
- Registering the files generated by the Peripheral Driver Generator in the High-performance Embedded Workshop.
- Setting the options necessary for a compile (specifying the header file include destination)
- Setting the options necessary for a link (specifying Renesas Embedded Library)

4.4.1 Registering the Generated Filies

You will register the files generated by the Peripheral Driver Generator in a workspace of the High-performance Embedded Workshop.

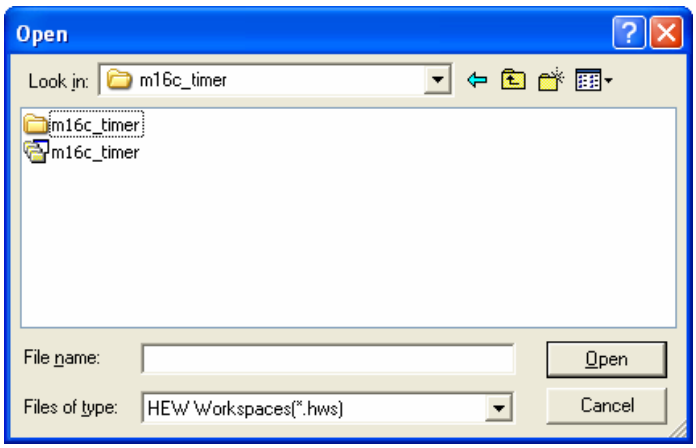


Select [Tool] -> [Register file(s) in HEW project].



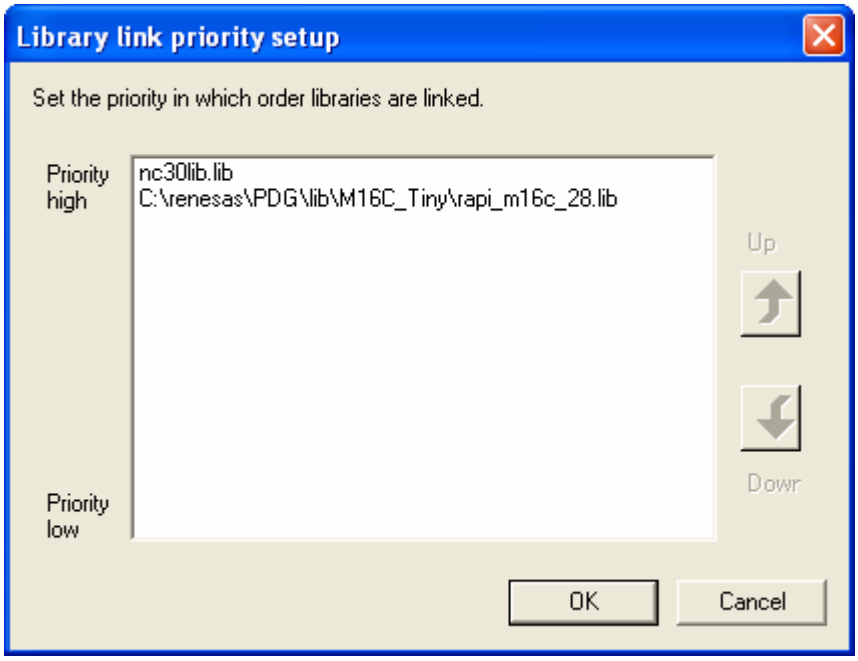
The dialog box will appear asking whether to register the files or not. Select [Yes].
The files will be registered in the project currently opend by the HEW.

When registering them in another project, close the currently opend project.
When you attempt to register them while no workspaces are opend, the dialog box appears prompting you to select a workspace for the regstration. Select one in the dialog box.

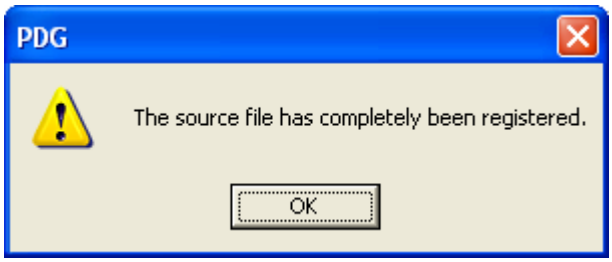


When HEW V.4.02 or later is used, the [Library link priority setup] dialog box appears. Move the libraries up and down in the dialog box, according to their priorities. When [OK] is clicked, the files begin to be registered in the HEW project that you selected. *

* When several HEW workspaces are opened, files are registered in all active projects, as stated in the dialog box that asks whether to register the files. Close workspaces that you do not register the files in before performing registration.



The message dialog box appears telling you that the registration is completed.



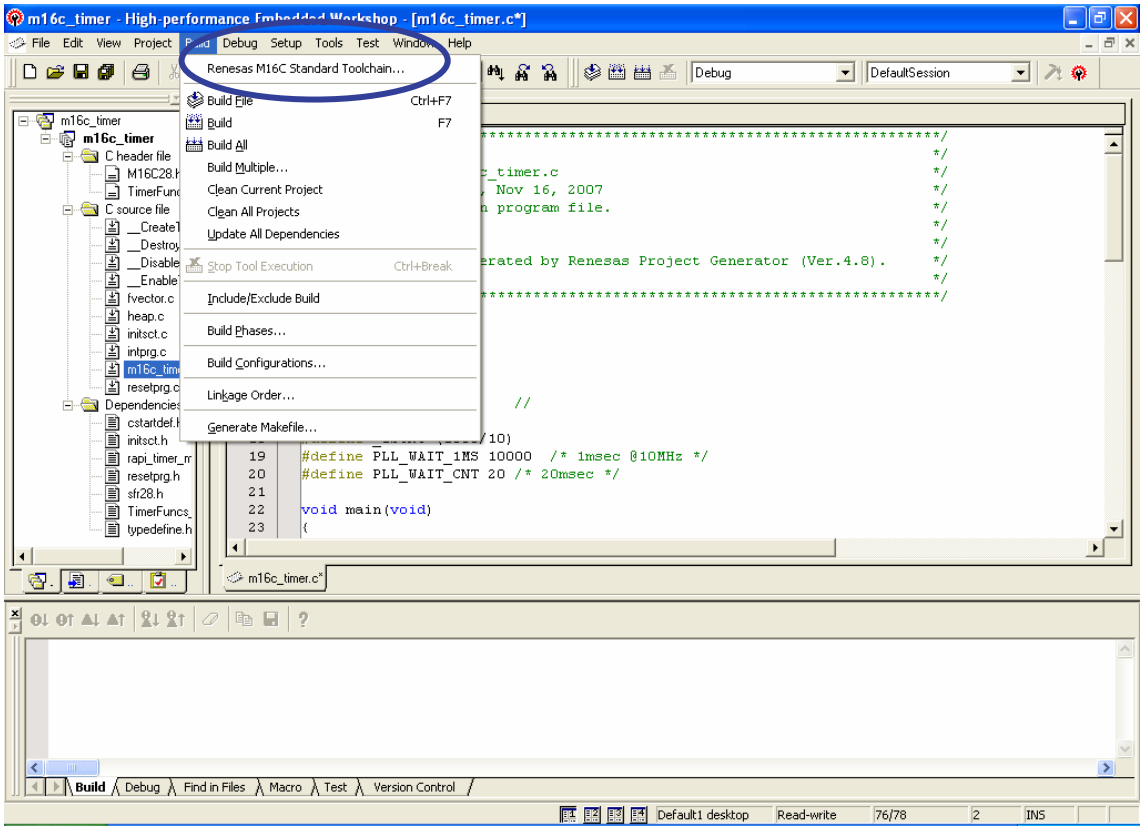
4.4.2 Setting Compile Options

In order to call the functions generated by the PDG, their header file must be included.

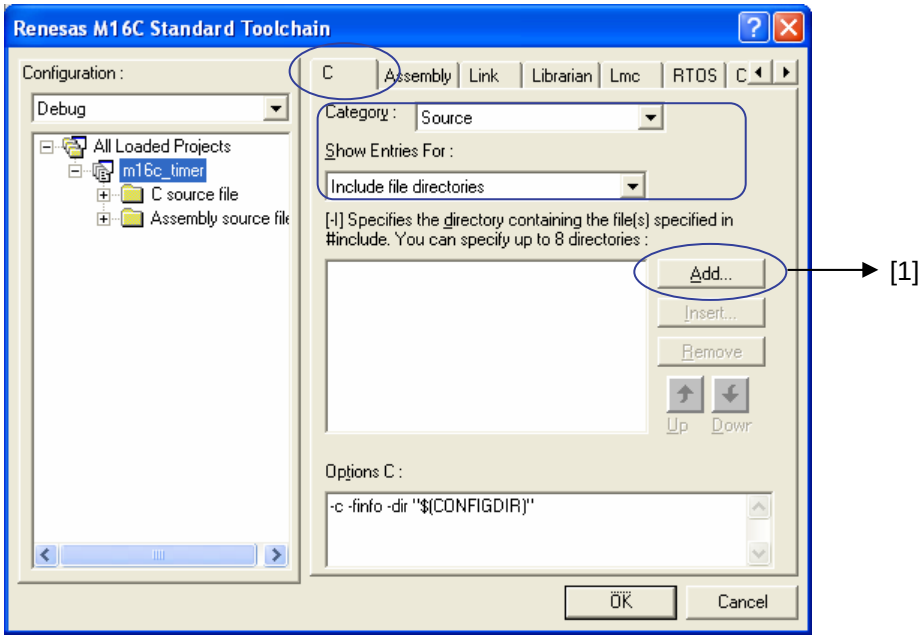
```
#include "sfr28.h"

#include “m16c28.h”          //When the functions generated by the Peripheral Driver Generator are used,
                             //this header file must be included.
#define _1SCNT (1000/10)
```

Compiling source files that includes this header file requires to specify its directory.



Select [Renesas M16C Standard Toolchain...] from the HEW build menu.

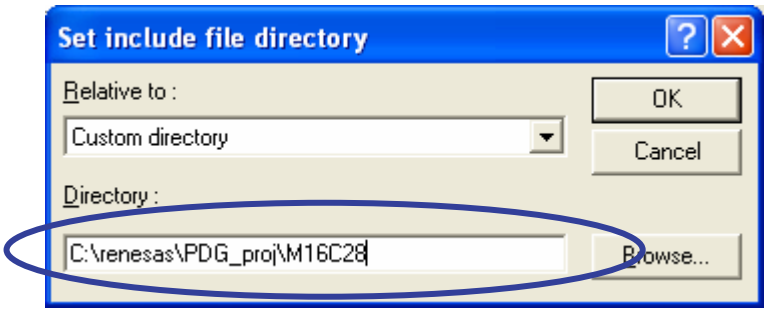


Select the [C] tab in the option dialog box and select the followings:

Category: Source

Show Entries For: Include file directories

Click the [Add] button marked with [1].



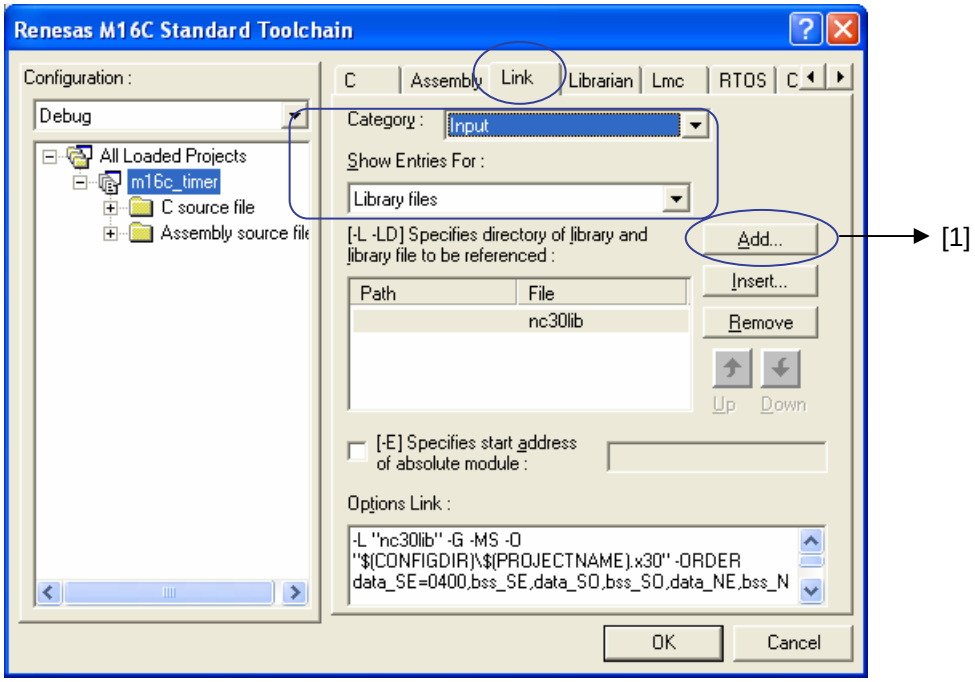
Specify the directory that contains the header file generated by the PDG.
This is a project directory created by the PDG.

Click the [OK] button to complete the settings.

4.4.3 Setting Link Options

When HEW V.4.02 or later is used, it is not required to specify libraries.

(1) Select [Renesas M16C Standard Toolchain…] from the build menu.



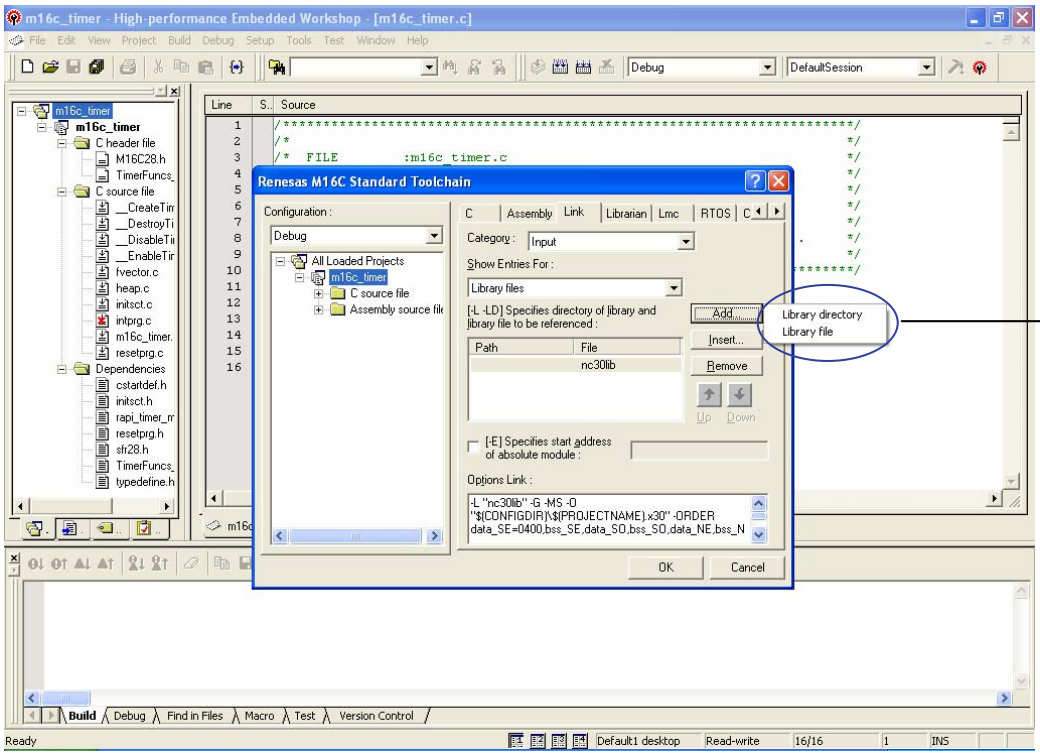
Select the [Link] tab in the option dialog box and select the followings:

Category: Input

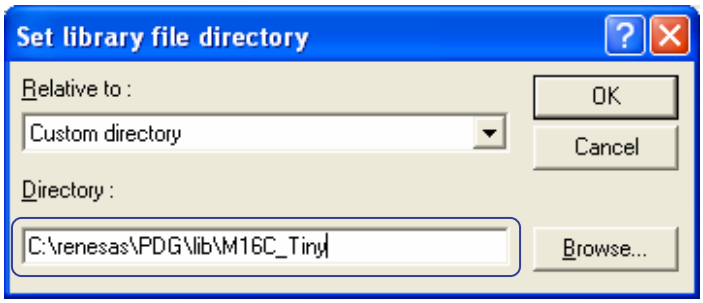
Show Entries For: Library files

Click the [Add] button marked with [1].

(2) Specify the directory that contains the API library.



Select [Library directory] from [1].

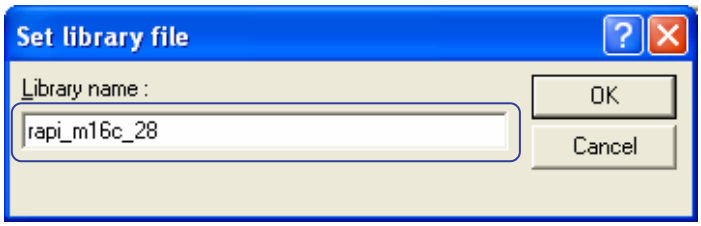


Relative to: Select [Custom directory].
Directory: Specify the directory that contains the API library:
C:\Renesas\PDG\lib\m16c_tiny

After entering the directory name, click [OK].

(3) Specify the API library name.

Click [Add] again and select [Library file] in [1].



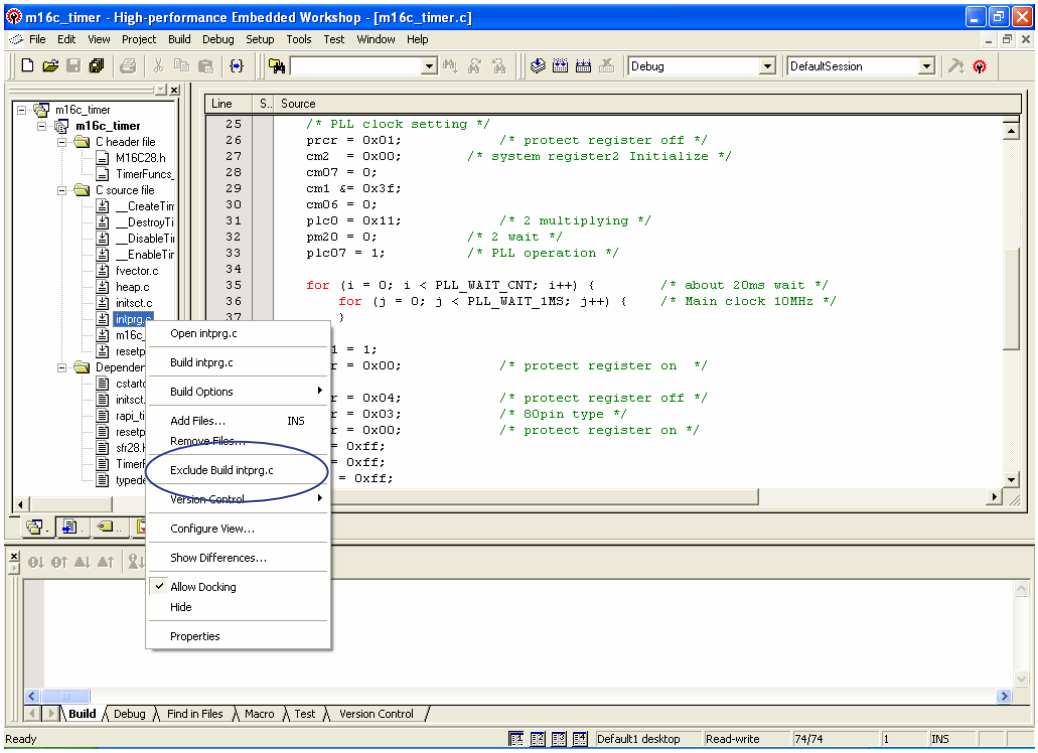
Enter the library name, “rapi_m16c_28.” (Do not add the.lib extension.)

4.4.4 Excluding Interrupt Vector Files

Creating a workspace with the HEW registers intprg.c, which is one of several startup files. (When the H8 300H/Tiny is used, the workspace creation wizard asks whether to create intprg.c or not.)

Since the PDG creates interrupt vector functions, intprg.c is redundant for vectors. Therefore, intprg.c needs to be excluded from the build target.

Note that when HEW V.4.02 or later is used, the interrupt vector functions are automatically excluded from the PDG.



Select intprg.c and right-click on it.

The pop-up menu opens. Select [Exclude Build intprg.c].

All the settings are completed.

Perfom a build and execute the application by using the debugger.

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