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April 1st, 2010
Renesas Electronics Corporation

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M3T-ICC740 V.1.00

User's Manual

Cross Tool Kit for 740 Family<Included ICC740 of
IAR Systems>

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Preface

Before reading this user's manual, please read the release notes included with your product. Product configuration, product handling, precautions and other important information are written in it.

Target reader

This user's manual is written for:

- Those who have experience in developing and debugging embedded application programs in C language
- Those who use Renesas's integrated development environment for the first time

Reference manuals

For more information about the terms used and the functions of Renesas's integrated development environment (called TM) and details on how to use it, please refer to the manual given below. This manual can also be consulted on-line.

TM V.3.20A User's Manual (included with TM V.3.20A)

For more information about the terms used and the functions of the C compiler ICC740 from LAR Systems (hereafter referred to as the ICC740), and for details on how to use it, please refer to the PDF manual included with the ICC740.

1. Overview

The M3T-ICC740 is a cross tool kit for the 740 family of Renesas 8-bit microcomputers. The product package includes the C compiler ICC740 from LAR Systems (hereafter referred to as the ICC740) and the integrated development environment (TM), providing a powerful support for developing programs in C and assembly languages.

The following items of software are included in the M3T-ICC740:

- ICC740

This is the C compiler for the 740 family available from LAR Systems.

The right to use the ICC740 is granted under provisions of the license agreement of LAR Systems. The license agreement is displayed when you install the ICC740.

The product presented here adopts a command line input method, so that the embedded workbench available from LAR Systems is not included.

- TM

Comprised of a set of tools such as a compiler, assembler, debugger and editor that have been integrated into a common graphical user interface (GUI), this tool will help users improve the efficiency of software development.

- TW74

This tool is designed to set up data in order to make the ICC740 usable in the TM. An installer is launched when you invoke it, helping you make the necessary setup, and processing is completed with it.

Please note that this tool must once be installed before ICC740 projects can be developed in the TM.

Furthermore, the following software items are included with the package.

- M3T-PD38SIM

This is a simulator debugger for the 740 family.

- SC74

This is a source file converter that allows you to convert the source files created for Renesas's 740 family assembler M3T-SRA74 into the source file format of the assembler A740 included with the ICC740. This software is outside the scope of technical support by Renesas. For details on how to use the SC74, please refer to the included file `license.txt`.

This user's manual describes how to install each tool in your computer, and details on how to develop ICC740 projects in the TM.

2. Installing Tools

The M3T-ICC740 requires installing the following tools:

- ICC740
- TM
- TW74

The installation procedure is described below (Figure 1).

- ICC740

Execute **autorun.exe** in the **icc740** folder. **QuickStart Installation** information in the ensuing dialog box will show you how to install and the information on product registration for your reference.

Follow the instructions of the installer as you install. A license ID for the ICC740 is needed.

The available period to use the ICC740 with the QuickStart key is one month. Please be sure to receive the “permanent key” from IAR Systems within one month after you installed. For details on how to get and set up the permanent key, refer to **QuickStart Installation** information.

- TM

The necessary version of the TM is V3.20 or later.

If you do not have V3.20 or later installed in your computer, install it.

Follow the instructions of the installer as you install.

- TW74

Make sure the ICC740 and the TM are installed before you install the TW74.

Follow the instructions of the installer as you install.

The license for the M3T-ICC740 is authenticated in this tool.

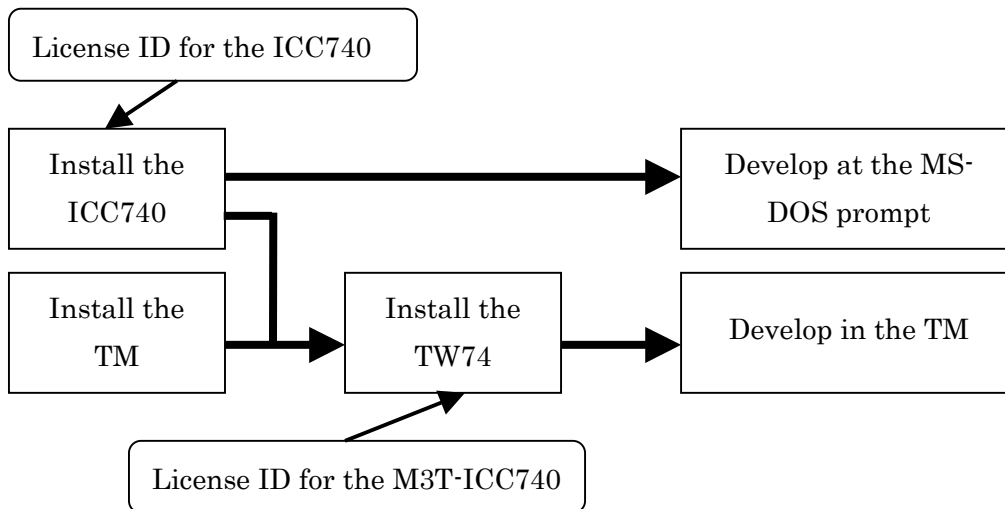


Figure 1 Procedure for installing the M3T-ICC740

Next, the following describes how to install the software that are included with the package.

- M3T-PD38SIM

Install this software if you wish to run a quick tour of this manual.
Follow the instructions of the installer as you install.

- SC74

The SC74 does not have an installer. You can use it directly.

3. Starting and Quitting the TM

3.1. Starting the TM

When the TM has been installed normally, you can start it from the Start menu by selecting
Programs → RENESAS-TOOLS → TM V.3.xx

When the TM has started up, the project bar in Figure 2 appears.

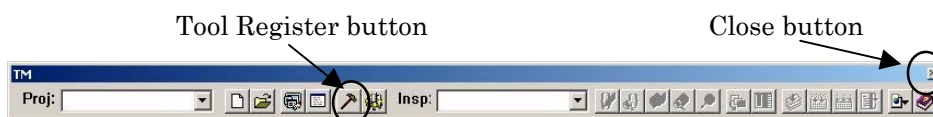


Figure 2 Project Bar

When started for the first time, the Project Bar is in a “floating” state. Grasp this window and bring it to the top of the screen, and you can have it located at the uppermost part of the desktop(Figure 3).



Figure 3 Project Bar pasted at the top

3.2. Registering the Editor

The TM does not internally have any specific editor. You can register any desired editor that is available on the market. To register an editor, click the Tool Register button. In the ensuing Tools Information dialog box (Figure 4), select the EDIT TOOL tab and register any editor you want.

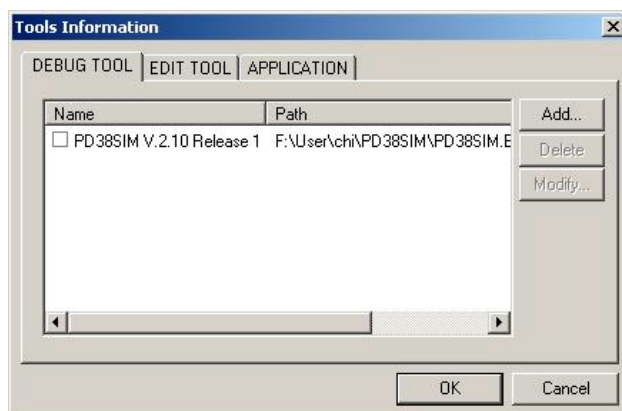


Figure 4 Tools Information dialog box

3.3. Quitting the TM

To quit the TM, click the [Close] button in the project bar (when in a floating state) or right-click in the project bar and select Exit from the context menu (Figure 5)

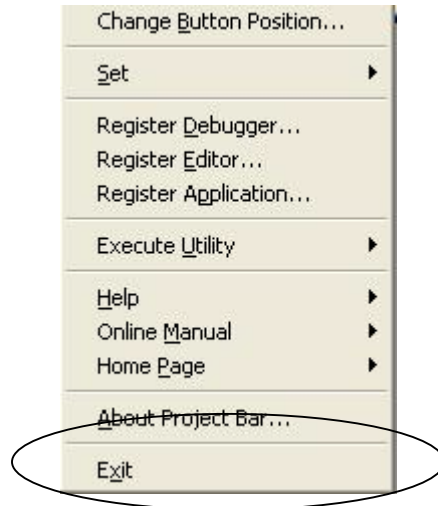


Figure 5 Context menu displayed by right-clicking

4. Quick Tour

Let's try using the TM actually following a quick tour.

In the TM, you need to specify a project name and a working directory before you can develop a project. In the quick tour, the TM is set up as shown below. This setting can be changed as necessary.

Working directory: c:\work\proj_1

Project name: proj_1

Source file: tutor3.c

The TM does not automatically generate a directory for each project you create. Projects are generated in the working directory. Users must create a working directory as necessary.

The source file `tutor3.c` was derived from the sample program of LAR Systems by altering it for use with the M3T-PD38SIM. Processing by this program and the source code of it are shown below.

Processing

The program comprises an infinite loop in a while statement of the main function.

The variable `my_char` assumes values 'a' to 'z' at random depending on the function.

When the variable `my_char` assumes the value 'i', a BRK instruction interrupt is generated by the function.

The function `brk_interrupt` is executed by a BRK instruction interrupt, setting the variable `my_char` to '.'. The statement `interrupt[0x00]` of this function sets the address of the function `brk_interrupt` in the BRK instruction interrupt vector for the 3803 group.

Thereafter, processing in an infinite loop of the main function is repeated.

Source program tutor3.c

```
/*-----
 * File: tutor3.c
 *
 * Purpose: Handling real time interrupts
 *
 * Usage: ICC -r -L -q tutor3.c
 *        XLINK -r -f <link file> tutor3
 *
 * Description: Using BRK vector to print a character
 *
 * Copyright 1997 IAR Systems
 *
 * $Id: tutor3.c 1.3 1998/01/15 09:24:55Z Laban Exp $
 *-----*/

#pragma language=extended /* enable use of extended keywords */

#include <stdlib.h>
#include <stdio.h>
#include "intr740.h" /* include intrinsics */

/*****
 * Variables
 *****/

char my_char = '!';
int call_count = 0;

/*****
 * Start of code
 *****/

void interrupt [0x00] brk_interrupt(void)
{
    // putchar('I');
    my_char='!';
}

void execute_brk(void)
{
    break_instruction(); /* Use intrinsic function */
}

void do_foreground_process(void)
{
    call_count++;
    // putchar(my_char);
    my_char = rand() % 26 + 'a';
}

void main(void)
{
    while (1)
    {
        do_foreground_process();
        if (my_char=='i') execute_brk();
    }
}
```

4.1. Creating a New Project

Click the New Project button in the project bar (Figure 6).



Figure 6 New Project Button in the Project Bar

A new project wizard of the project editor will be launched. In this wizard, make the necessary selection shown in Table 1.

Table 1 New Project Wizard Execution Steps

Step	Selection
Step 1	For the Target chip, select the 740 Family (ICC740).
Step 2	Select C Project.
Step Compiler	For the compiler package, select the TW74. When this is selected, the ICC740 will be used when you compile. For the Specify a startup program, select the check box titled “A default startup program is used”.
Step Finish	Click the Finish Button.

A new project will be displayed in the project editor (Figure 7).

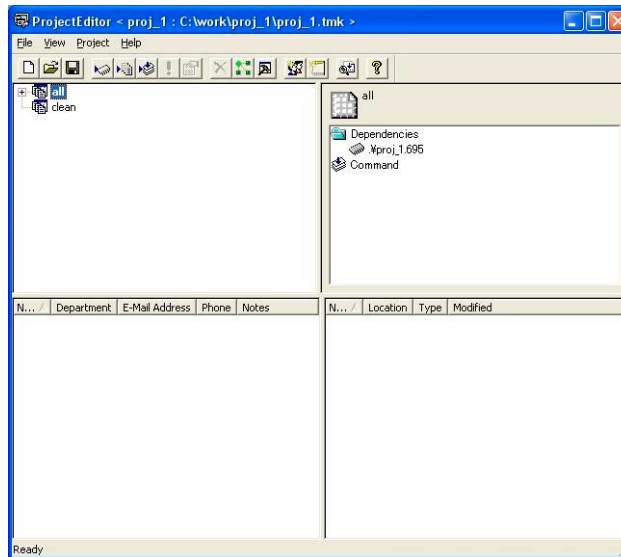


Figure 7 Project Editor

4.2. Complementing a New Project

To develop an ICC740 project in the TM, you need to complement the new project. Follow the procedure described below to complement your new project.

1. In the project tree of the project editor, click the plus sign [+] for [all] to display [.\proj_1.695].
2. Click [+] for [.\proj_1.695] following [all] to display [.\proj_1.cmd].
3. Click [.\proj_1.cmd] and then the Add File button (Figure 8 (a)).
4. In the ensuing Open dialog box, select “All Files” for File Types and add the lnk740.xcl file present in the working directory (Figure 8 (b)).
5. When you add the lnk740.xcl file, the screen changes to the one shown in Figure 8 (c), with lnk740.xcl added to the project.

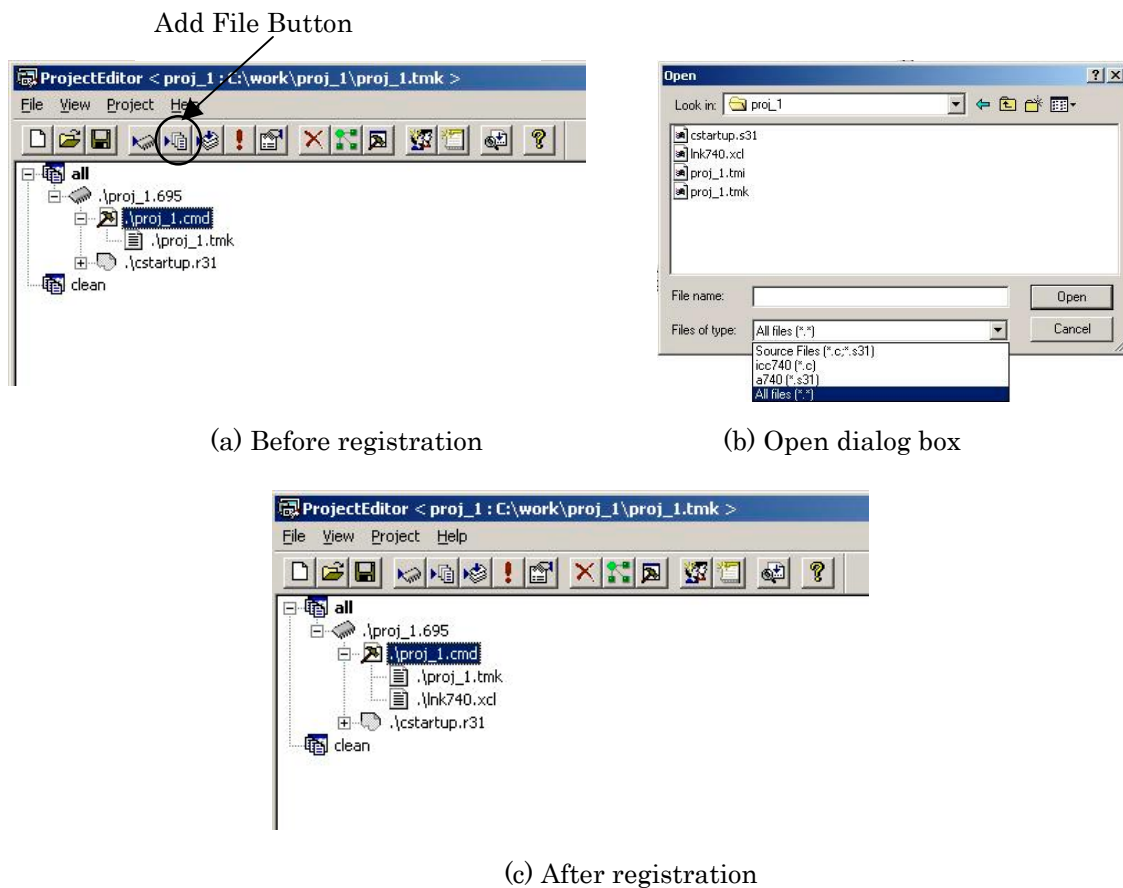


Figure 8 Complementing a new project

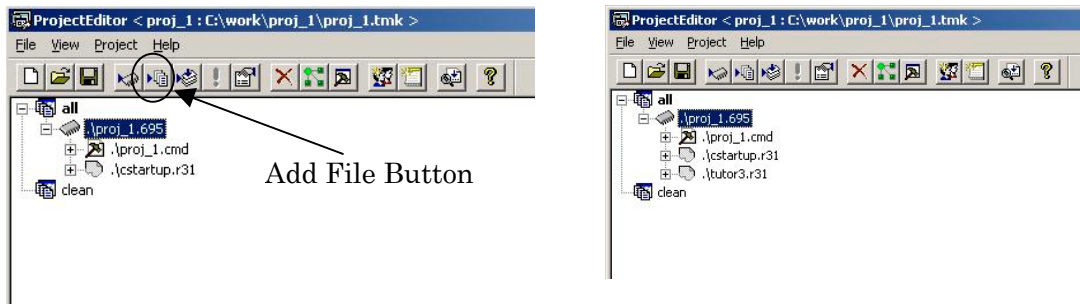
4.3. Creating a File

Create a source file using the editor. Because `tutor3.c` is located in the `SmpTw74` folder, copy it to the working directory. The `SmpTw74` folder is created in the folder in which you installed the TW74 (normally `\MTOOL`).

4.4. Registering the File

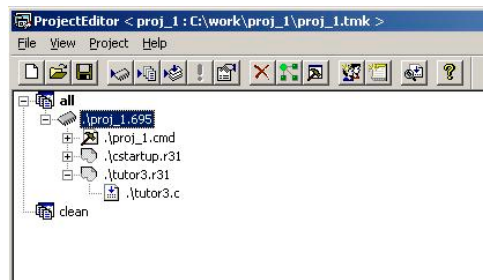
The source file you created need to be registered to the project. Since the source file cannot be registered by simply placing it in the working directory, follow the procedure described below to register it.

1. In the project editor, click on the `[.\proj_1.695]` file to select it and then click the Add File button (Figure 9 (a)).
2. In the ensuing Open dialog box, select “Source Files” for File Types and add the source file.
3. A source file whose extension changed to “.r31” will be registered below `[.\proj_1.695]` (Figure 9 (b)).
4. Click [+] for the source file whose extension changed to “.r31,” and the source file will be displayed (Figure 9 (c)).



(a) Before adding a source file

(b) After adding a source file



(c) Displaying a source file

Figure 9 Registering a source file

4.5. Saving the Project

The projected you created must be saved. Click the Save button of the project editor (Figure 10).

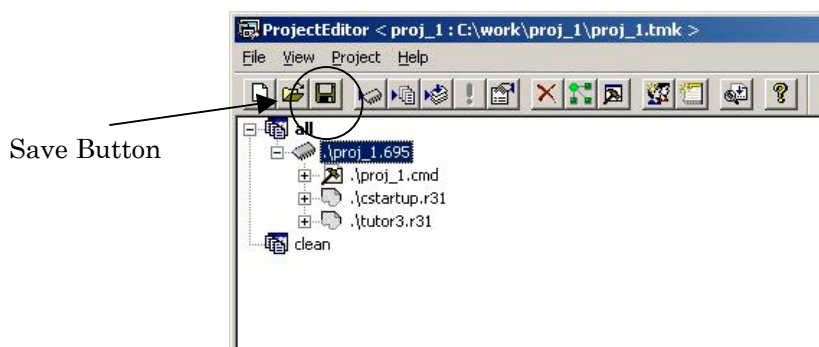


Figure 10 Save button of the Project Editor

4.6. Building a Project

To build a project, use the Build, the Rebuild or the Partial Build Button in the Project Bar. Here, click the Rebuild Button (Figure 11).

The builder will be launched, allowing you to build a project (Figure 12).

If you've finished building without causing any error, a proj_1.695 file will be generated in the working directory.

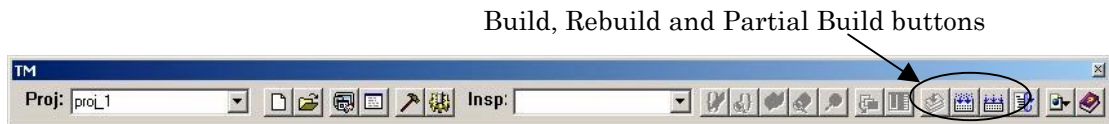


Figure 11 Build, Rebuild and Partial Build buttons in the Project Bar

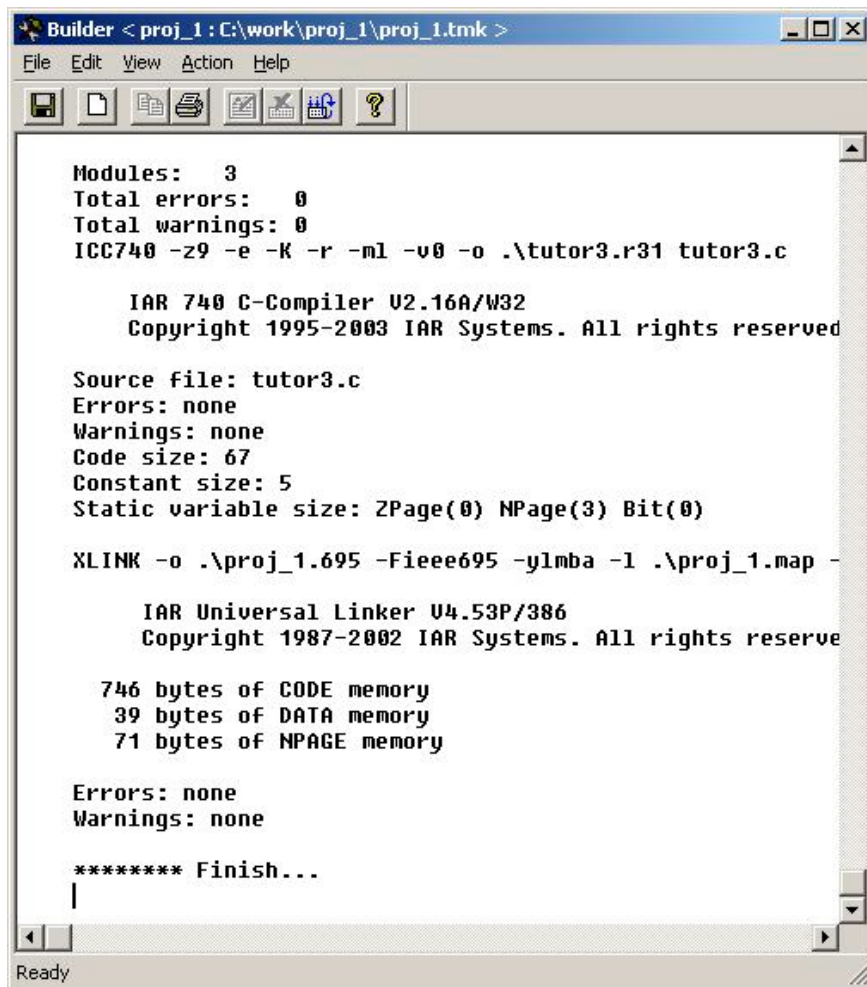


Figure 12 Builder

4.7. Starting the Debugger

For the project you've finished building, an absolute file *proj_1.695* is generated in the working directory.

This file *proj_1.695* can be debugged by the M3T-PD38 or M3T-PD38SIM. Click the Start Debug Button in the Project Bar (Figure 13).



Figure 13 Start Debugger button in the Project Bar

In the initial state, since there are no debuggers registered in your system, the Tools Information dialog box is displayed (Figure 14).

If the M3T-PD38SIM or M3T-PD38 was installed in your computer before you installed the TW74, the installed debuggers are displayed in the dialog box. So select the check box for the debugger you want to use (flagged by a check mark when selected).

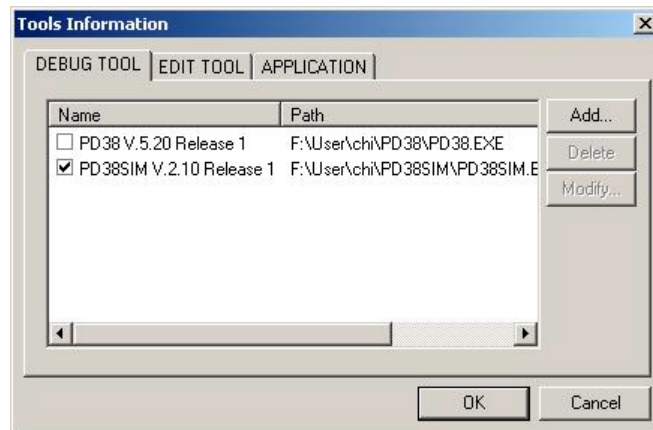


Figure 14 DEBUG TOOL tab of the Tools Information dialog box

If the M3T-PD38SIM and M3T-PD38 are not displayed in the dialog box, use the Add... button to register the debuggers. After registering the debuggers, select the check box for the debugger you want to use (Figure 15).

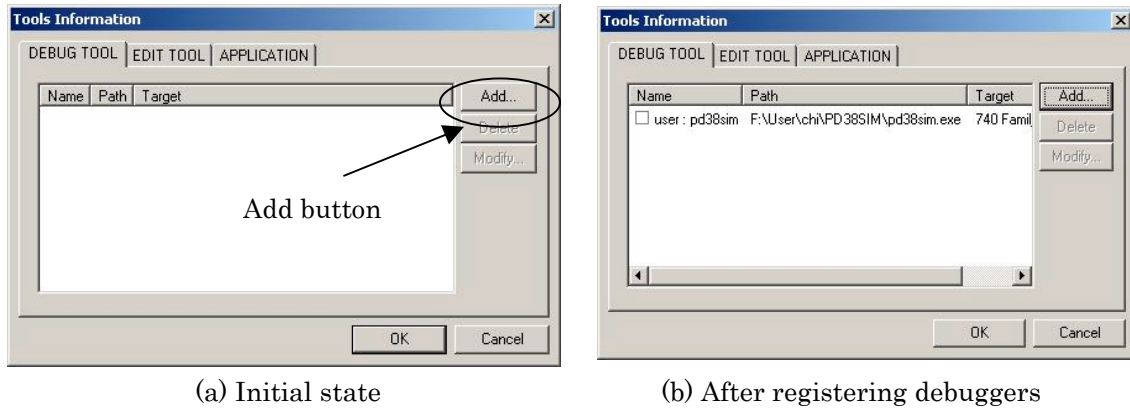


Figure 15 Registering debuggers

4.8. Debugging a Program

Use the M3T-PD38SIM to debug the program (Figure 16).

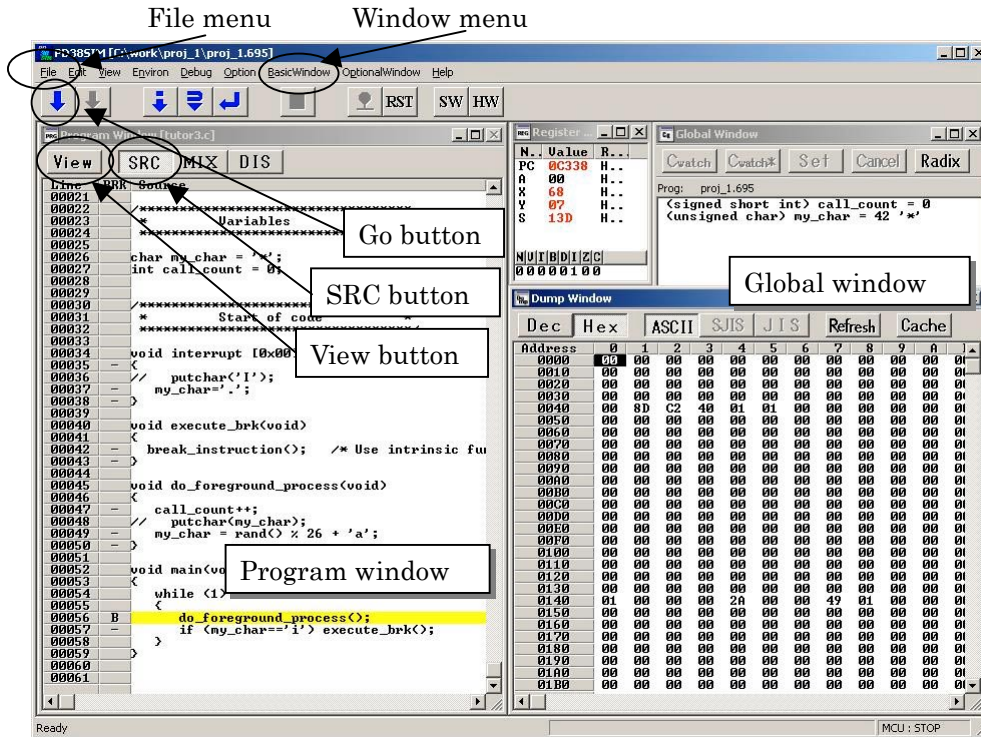


Figure 16 M3T-PD38SIM

If this is the first time you start the M3T-PD38SIM, you must set up the SFR file corresponding to the target MCU. Use the [Refer...] button at the top of the Init dialog box (Figure 17) to set up. Select the M38000.sfr file present in the folder in which you installed the M3T-PD38SIM.

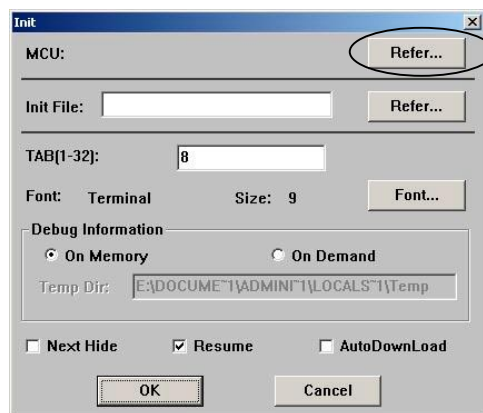


Figure 17 Init dialog box of the M3T-PD38SIM

4.8.1. Loading a Program

To load a program, use the File menu commands “Download” and “Load Module.” In the ensuing Download dialog box, select the *proj_1.695* file.

A program will be loaded, with part of the program at the position of the program counter displayed. The position of the program counter is marked by a yellow line.

4.8.2. Executing up to the main Function

First, run the program up to the `main` function.

To display the `main` function, select the View and the Source button and then select `tutor3.c` and `main`. Then click the OK button and select the SRC button.

You will notice that dashes “-” are shown in the BRK column of the Program Window. They indicate the positions at which you can set a breakpoint. Try double-clicking the dash “-” in the line 00056 of the Line column. The dash “-” will change to the letter “B,” indicating that a breakpoint has been set there.

While in this state, click the Go button. The program will be executed up to this position, with the line 00056 turned into yellow.

4.8.3. Confirming Interrupt Generation

We’ll now confirm interrupt generation.

The `brk_interrupt` function is not called from any function. It can only be called by executing the BRK instruction.

Execution of the BRK instruction is handled by the `break_instruction` function in the `execute_brk` function. This `break_instruction` function is an inline function that is replaced by the BRK instruction. The `execute_brk` function is called when the variable `my_char` is set to ‘i.’

The value of the variable `my_char` may be watched in the global window of the debugger. From the BasicWindow menu, choose C Watch Window and then Global Window.

Set a breakpoint in the line 00037 of the Line column and click the Go button several times. Then, when the variable `my_char` is set to ‘i,’ the line 00037 will have its color changed to yellow. This allows you to confirm that an interrupt has been generated.

To quit the debugger, choose Exit from the File menu of the M3T-PD38SIM.

5. Creating a New Project

The ICC740 requires setting up a processor group, memory model and stack area before you can develop a project. The M3T-ICC740 uses default settings in Table 2 as it creates a new project.

In this manual, the project is named “proj_1.”

Table 2 Processor Group, Memory Model and Stack Area

Select items	Choices	Initial settings of M3T-ICC740
Processor group	<ul style="list-style-type: none"> • with MUL/DIV (without extended memory access) • without MUL/DIV • with extended memory access (with MUL/DIV included) 	<ul style="list-style-type: none"> • with MUL/DIV (without extended memory access)
Memory model	<ul style="list-style-type: none"> • Tiny model • Large model 	<ul style="list-style-type: none"> • Large model
Stack area	<ul style="list-style-type: none"> • Zero page (000H–0FFH) • Page 1 (100H–1FFH) 	<ul style="list-style-type: none"> • Page 1 (100H–1FFH)

If initial settings and choices of the M3T-ICC740 differ from those shown above, the files and options listed in Table 3 must be altered.

Table 3 Files and Options to Alter

Select item	Where to alter (chapter numbers)
Processor group	Library (6.2.6) ICC740 options (6.3.1) A740 options (6.4.1)
Memory model	Library (6.2.6) ICC740 options (6.3.1) A740 options (6.4.1)
Stack area	cstartup.s31 file (6.1.1) lnk740.xcl file (6.2.1)

The cstartup.s31 and lnk740.xcl files have been edited for the M38037M8 (3803 group with 1-Kbyte RAM and 32-Kbyte ROM). Therefore, reedit these files to them suitable for your target microcomputer as necessary. Note that the *.tmk, *.tmi and *.cmd files generated in the working directory are managed by the TM, and cannot be rewritten by users.

5.1. New Project

To create a new project, you must first start the TM.

Launch the TM from the Start menu.

When the TM has started up, the project bar shown in Figure 18 appears.



Figure 18 Project Bar

The TM does not automatically generate a directory for each project you create. Projects are generated in the working directory. Users must create a working directory as necessary.

There are following three methods to create a new project:

1. Use the New Project button in the Project Bar
2. Use the New Project button of the Project Editor (Figure 19)
3. Select New Project from the File menu of the Project Editor

The project editor is invoked by clicking the Open Project Editor button in the project bar (Figure 18). Whichever method you may use, a new project wizard of the project editor is launched. So follow the execution steps of the wizard as you create a new project (see Table 4).

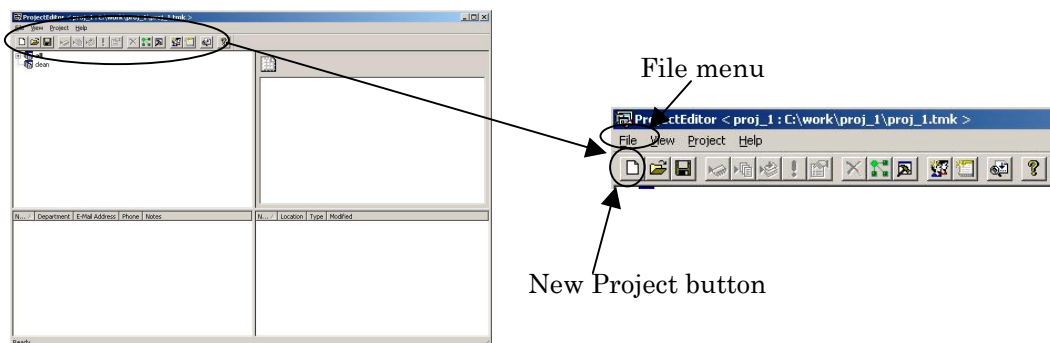


Figure 19 Project Editor

Table 4 New Project Wizard Execution Steps

Step	Selection
Step 1	For the target chip, select the “740 Family(ICC740)”. If the M3T-SRA74 is installed in your computer, you will see the “740 Family” also displayed for the target chip, but be sure to select the “740 Family(ICC740)”.
Step 2	Select a C Project.
Step Compiler	For the compiler package, select the “TW74”. When this is selected, the ICC740 will be used when you compile. For the startup program, select the check box titled “A default startup program is used”
Step Finish	Click the Finish button.

At this point in time, the files in Table 5 are generated in the working directory.

Table 5 New Files Created in the Working Directory

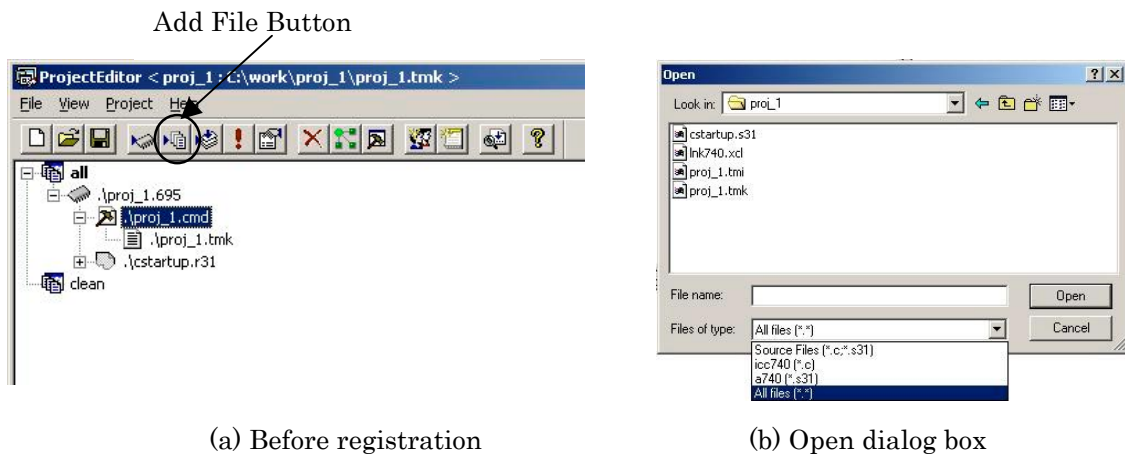
<i>proj_1.tmk</i>	Project file (makefile format)
<i>proj_1.tmi</i>	Project file (development member and document information)
<i>startup.s31</i>	Startup program
<i>lnk740.xcl</i>	Link command file for XLINK

5.2. Complementing the Project

If the new project you are creating is an ICC740 project, you must complement it before you can proceed.

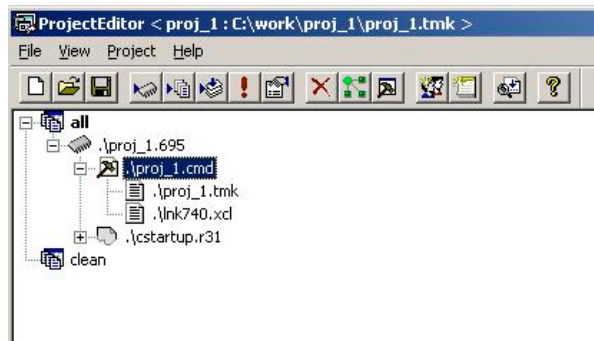
The *lnk740.xcl* file copied to the working directory when creating a new project is the command file for the linker XLINK. A method on how to locate segments and related other information are written in it. This file is not registered to the project yet. Therefore, register it following the procedure described below.

1. In the project tree of the project editor, click the plus sign [+] for all to display *.\proj_1.695*.
2. Click [+] for *.\proj_1.695* following all to display *.\proj_1.cmd*.
3. Click *.\proj_1.cmd* and then the Add File button (Figure 20 (a)).
4. In the ensuing Open dialog box, select “All files” for File Types and add the *lnk740.xcl* file present in the working directory (Figure 20 (b)).
5. When you add the *lnk740.xcl* file, the screen changes to the one shown in Figure 20 (c), with *lnk740.xcl* registered to the project.



(a) Before registration

(b) Open dialog box



(c) After registration

Figure 20 Registering the lnk740.xcl file

The `.proj_1.cmd` file is not needed when you create a new project. It is created when you build or rebuild. Because this file is managed by the TM, do not rewrite it.

6. Editing the Project

After you created a new project, you must edit `cstartup.s31` and `lnk740.xcl` and change options as necessary.

6.1. Editing `cstartup.s31`

In `cstartup.s31`, edit the items listed in Table 6 as necessary.

Table 6 Items to Edit in `cstartup.s31`

Edit item	Subject	Corresponding line
Stack page	Stack area	Line 137
Interrupt vector area	Target microcomputer	Line 375

6.1.1. Changing the Stack Page

The line 137 in `cstartup.s31` is used to set the stack page. Here, the stack page for the 3803 group CPU mode register is set to page 1.

```
LDM #0CH, 3BH ; set stack page : 3803 Group
```

Set the stack page to suit your target microcomputer.

If you set the stack page to page 0, you need to change `CSTACK` segment settings in the `lnk740.xcl` file.

6.1.2. Changing the Interrupt Vector Area

The line 375 is used to set the size of the interrupt vector area. Here, the size of the interrupt vector area in the 3803 group of microcomputers is set.

```
BLKB OFFFEH - OFFDCH - 2 ; 3803 Group
```

Area settings by `BLKB` requires that an amount equal to the vector size be subtracted by the set area (as subtracted by 2 in the above setting).

Note, however, that the beginning address of the interrupt vector area is set in the `lnk740.xcl` file.

6.2. Editing the Ink740.xcl File

You need to edit the Ink740.xcl file according to the target microcomputer, memory model and other settings you made.

Table 7 Items to Edit in Ink740.xcl

Edit item	Subject	Corresponding line in Ink740.xcl
Stack area	Memory model, target microcomputer	60
Beginning address of page 0	Target microcomputer	38
Ending address of page N	Target microcomputer	65
ROM area address	Target microcomputer	77
Interrupt vector	Target microcomputer	91
Library	Processor group	110

6.2.1. Changing the Stack Area

For the stack area to be used in the 740 family, select page 0 (00h–FFh) or page 1 (100h–1FFh).

The ICC740 uses this stack area as CSTACK segment.

With standard settings of the M3T-ICC740, the addresses 100h–13Fh in page 1 are used for the stack area.

```
-Z(NAPGE)CSTACK+40=100
```

The following shows a few examples of how to change.

Example 1: To use the addresses 120h–14Fh in page 1 for the stack area, alter the file as shown below.

```
-Z(NAPGE)CSTACK+30=120
```

Example 2: To change the stack area to page 0, alter the file as shown below.

```
-Z(ZPAGE)CSTACK+40
```

Page 0 contains the segments that must be located in the SFR area and in page 0. The above statement directs that 40h bytes of area following the INT_EXPR_STACK segment written in the line 54 be used.

Note, however, that if you change the stack area to page 0, you also need to alter the `cstartup.s31` file.

6.2.2. Changing the Beginning Address of Page 0

The ICC740 requires that the RAM area be set separately for page 0 and page N (from the address 100h on). To set page 0, specify `-Z(ZPAGE)`.

```
-Z(ZPAGE)ZPAGE,C_ARGZ,Z_UDATA,Z_IDATA=41-FF
```

The above setting directs that the ZPAGE, C_ARGZ, Z_UDATA and Z_IDATA segments be located in a RAM space from the address 41h to the address FFh following the SFR area (0h–40h). Because these segments are intended for use by the ICC740, do not delete them. An example of how to change is shown below.

Example: For the microcomputers whose SFR area is not set beginning with the address 0h as in the case of the 7220 series, change the settings of page 0 as follows:

```
-Z(ZPAGE)ZPAGE,C_ARGZ,Z_UDATA,Z_IDATA=0-BF
```

the case of the 7220 series, change the settings of page 0 as follows:

6.2.3. Changing the Ending Address of Page N

To set page N, specify `-Z(NPAGE)`.

For the ending address of page N, set the ending address of the RAM of the target microcomputer.

```
-Z(NPAGE)NPAGE,C_ARGN,N_UDATA,N_IDATA,ECSTR=100-43F
```

The above setting directs that the NPAGE, C_ARGN, N_UDATA, N_IDATA and ECSTR segments be located in a RAM space from the address 100h to the address 43Fh. Because these segments are intended for use by the ICC740, do not delete them.

If the CSTACK segment is located in one page, the NPAGE segment is located beginning with the address following the CSTACK segment (with standard settings, the address 140h). For the ending address of page N, set the last address of the RAM area in the target microcomputer. This setting will allow you to inspect overflow in the RAM area.

For the microcomputers whose SFR area exists also in page N as in the case of the 38C2

group, remove the SFR area from page N.

6.2.4. Changing the ROM Area Address

Set the ROM area as suitable for your target microcomputer. Here, you set a general program area and a special page.

Set a general program area, as shown below.

```
-Z(CODE)RCODE,Z_CDATA,N_CDATA,C_ICALL,C_RECFN,CSTR,  
CCSTR,CODE,CONST=C080-FE FF
```

The above setting directs that segments for the ROM area be located in a ROM space ranging from the beginning address C080h of the ROM area to the address FEFFh preceding the special page.

For the microcomputers that have a reserved ROM area, however, the ROM segment space must be set to begin from an address following that reserved area. Also make sure the ROM segment space is set to end at an address preceding the special page or the interrupt vector area.

The special page area must be set to end at an address preceding the interrupt vector area.

The C_FNT segment indicates the special page area.

This setting will allow you to check to see if the ROM segments are located overlapping the interrupt vector area.

```
-Z(CODE)C_FNT=FF00-FFDB
```

6.2.5. Changing the Interrupt Vector Area

Change the interrupt vector area.

In the ICC740, the INTVEC segment indicates the interrupt vector area.

```
-Z(CODE)INTVEC=FFDC-FFFD
```

The above shows how to set the interrupt vector area in the 3803 group of microcomputers.

Make this setting as suitable for your target microcomputer.

6.2.6. Changing the Library

Select the library that suits the processor group and memory model of your target microcomputer from Table 8.

Table 8 Processor Group, Memory Model and Library

	Tiny model	Large model
with MUL/DIV	cl7400t.r31	cl7400l.r31
without MUL/DIV	cl7401t.r31	cl7401l.r31
with extended memory access	cl7402t.r31	cl7402l.r31

There is a “-C” statement at the place where you specify a library. Do not delete it.

6.3. Changing the ICC740 Options

Default options of the ICC740 are set as listed in Table 9.

Table 9 ICC740 Options

Option	Category	Description
-z9	Code generation	Specifies code size prioritized optimization.
-e	Code generation	Enables extended specification (e.g., zpage and npage).
-K	Code generation	Enables C++ comment (“//”).
-r	Debug	Outputs debugging information.
-ml	Target	Selects Large model for the memory model.
-v0	Target	Selects an MCU with MUL/DIV.
-o	Command line	Sets an object file name.

To change the ICC740 options, use the Option Browser of the project editor. To launch the Option Browser, choose Option Browser from the Project menu or click the Option Browser button (Figure 21). When you choose Option Browser, the Option Browser dialog box in Figure 22 is displayed.

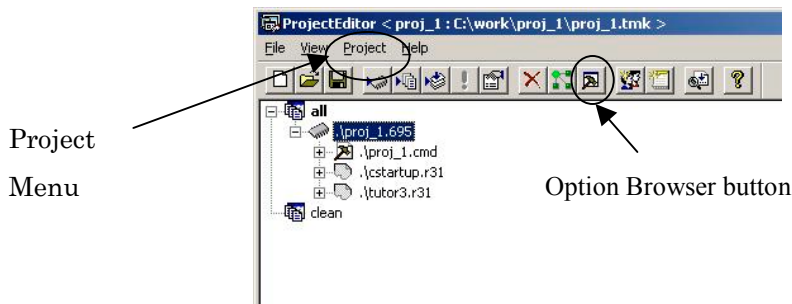


Figure 21 Launching the Option Browser

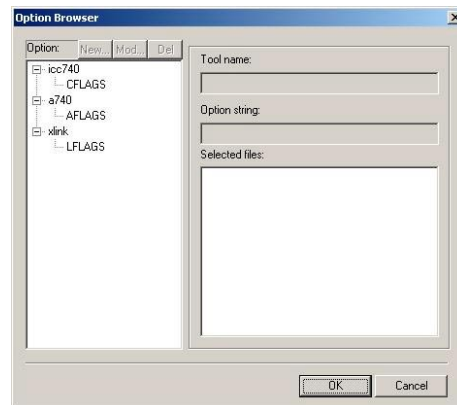


Figure 22 Option Browser dialog box

In this dialog box, click the option macro CFLAGS and then the Edit button. The Options dialog box for the ICC740 will appear (Figure 23 (a)).

Before setting each option here, select a category first (Figure 23 (b)).

For details about the options, refer to the manual included with the ICC740.

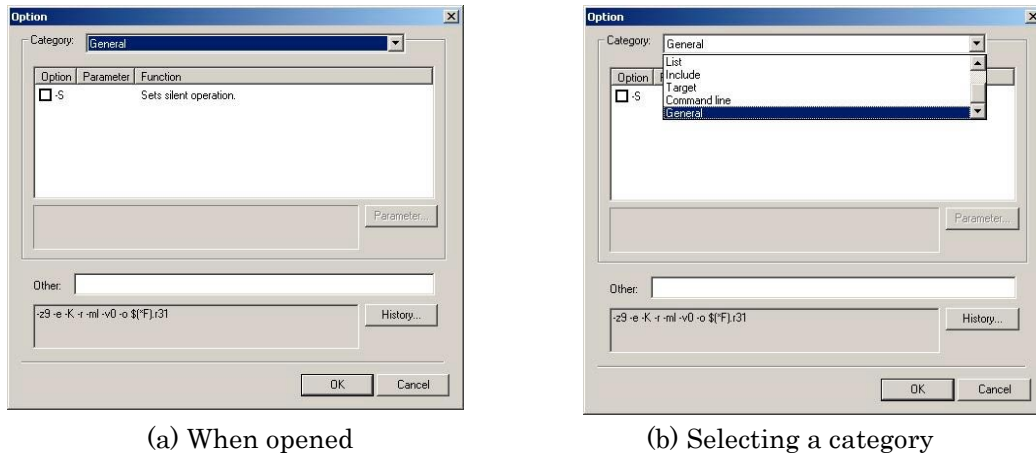


Figure 23 Options dialog box for the ICC740

6.3.1. Changing the Processor Group

In the Options dialog box, select Target for the category (Figure 24). In the ensuing dialog box, click the list “-v0, -v1, -v2” and then the Select button. The Select Options dialog box will be displayed, allowing you to select a processor group.

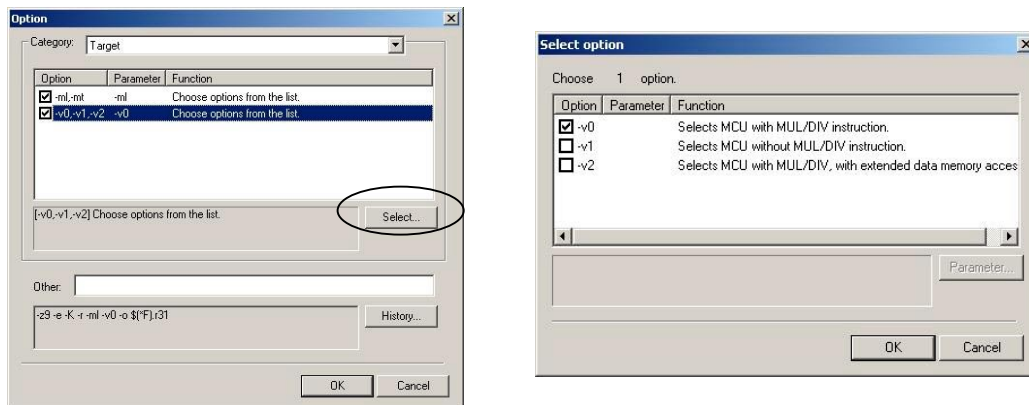


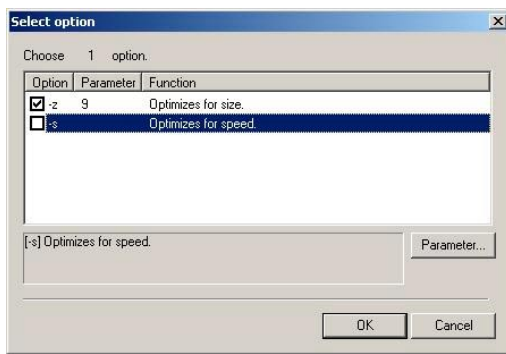
Figure 24 Selecting Target for the category and the Select Options dialog box

6.3.2. Changing the Memory Model

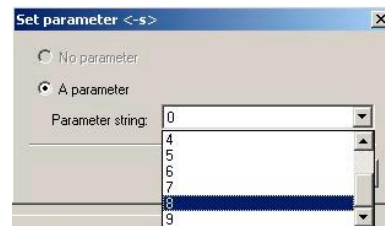
Select Target for the category. In the ensuing dialog box, click the list “-ml, -mt” and then the Select button. The Select Options dialog box will be displayed, allowing you to select the appropriate memory model.

6.3.3. Changing the Optimization Level

To change the optimization level, select Code Generation for the category. Click the displayed list “-z, -s” and then the Select button. In the ensuing Select Options dialog box (Figure 25 (a)), select “-z” or “-s.” Because you need to set the optimization level, go on and select the Parameters button. In the ensuing Specify Parameters dialog box (Figure 25 (b)), select a value from 0 to 9 and click the OK button.



(a) Select option dialog box



(b) Set parameter dialog box

Figure 25 Changing the optimization level in the Select option dialog box

6.4. Changing the A740 Options

Default options of the A740 are set as listed in Table 10.

Table 10 Default Options of the A740

Option	Category	Description
-uN	Code generation	Sets 16-bit addressing.
-v0	Target	Selects a MCU with MUL/DIV.
-o	Command line	Sets an object file name.

To change the A740 options, use the Option Browser dialog box as for the ICC740 options. Click the option macro AFLAGS and then the Edit button. The Options dialog box for the A740 will be displayed (Figure 26).

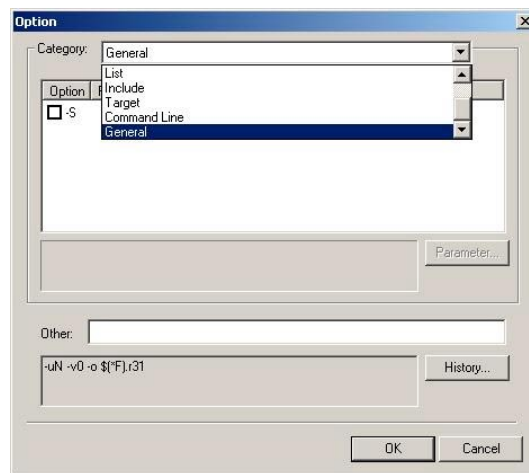


Figure 26 Options dialog box for the A740

6.4.1. Changing the Processor Group

Select Target for the category. In the ensuing dialog box, click the list “-v0, -v1, -v2” and then the Select button. The Select Options dialog box will be displayed, allowing you to select a processor group.

6.4.2. Changing the Memory Model

Select Code Generation for the category. If all of the referenced symbols are located in page 0, deselect the “-uN” option from the list in the displayed dialog box. Although the “-uN” option can be left intact without causing any adverse effects on program behavior, deselecting it will help to reduce the ROM size and increase the processing speed.

Note, however, that if the “-uN” option is deselected while the referenced symbols are located in other than page 0, an error may occur in XLINK. For the countermeasures to be taken in that case, refer to Section 8.2.

6.5. Changing the XLINK Options

The XLINK options are set in the `lnk740.xcl` file and in the TM.

Default options of XLINK in the TM are set as listed in Table 11.

Table 11 Default Options of XLINK (Command Line)

Option	Category	Description
-o	Output file	Sets an object file name.
-Fieee695	Output file	Specifies a format. To allow the file to be debugged in the M3T-PD38 or M3T-PD38SIM, specify <code>ieee695</code> that indicates the IEEE-695 format.
-ylmba	Output file	Additional information of IEEE-695. For the M3T-PD38 and M3T-PD38SIM, specify <code>"lmba"</code> .
-l	List control	Outputs a map file.
-x	List control	Outputs a cross reference list to the map file.
-f	Include	Specifies a command file. This is automatically set by the TM.

To change the XLINK options, use the Option Browser dialog box as for the ICC740 options. Click the option macro `LFLAGS` and then the Edit button. The Options dialog box for the XLINK will be displayed.

There are no XLINK options that are associated with the editing of a project.

7. Developing a Project

7.1. Creating and Registering the Source Files

Use your desired editor to create the C source and assembly language source files. If your desired editor is registered in the project bar, click the Open Editor button to invoke it (Figure 27).



Figure 27 Editor Start button in the Project Bar

The source files you created must be registered to the project. These files are not registered by simply placing them in the working directory. Follow the procedure described below to register the source files.

1. In the project editor, click on the `.\proj_1.695` file to select it and then click the Add File button (Figure 28 (a)).
2. In the ensuing Open dialog box, select “Source Files” for File Types and add the source file.
3. A source file whose extension changed to “.r31” will be registered below `.\proj_1.695` (Figure 28 (b)).
4. Click [+] for the source file whose extension changed to “.r31,” and the source file will be displayed.

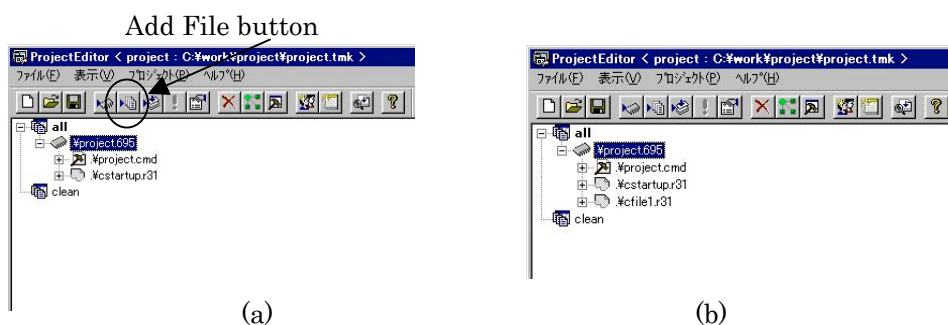


Figure 28 Registering a source file

7.2. Altering the lnk740.xcl File

If you've created new segments in an assembler source file, etc., you must set the locations of those segments in the lnk740.xcl file.

An example is shown below.

```
< sample.s31 >
...
RSEG RAM_DATA
BLKB 10
...
RSEG ROM_DATA
BYTE 'Please enter your name'
...
```

```
< lnk740.xcl >
...
-Z(NPAGE)NPAGE,C_ARGN,N_UDATA,N_IDATA,ECSTR=100-43F

-Z(NPAGE) RAM_DATA=100-43F
...
-Z(CODE)RCODE,Z_CDATA,N_CDATA,C_ICALL,C_RECFN,CSTR,CCSTR,CODE,
CONST=C080-FEFF

-Z(CODE) ROM_DATA= C080-FEFF
...
```

In the above example, the RAM_DATA segment is located after the ECSTR segment, and the ROM_DATA segment is located after the CONST segment.

8. Building a Project

When you've finished creating and registering the source files, execute Build to generate an absolute module from the source files. To execute Build, click the Build, the Rebuild or the Partial Build button in the project bar (Figure 29).



Figure 29 Build buttons located in the Project Bar



When you click one of the Build buttons, the builder is launched.

The builder builds a project according to the button you've clicked, and displays the result.

If an error occurs, correct the project according to the displayed message.

8.1. Errors in the C Compiler ICC740 and the Assembler A740

If an error occurs while you are executing the C compiler ICC740 or the assembler A740, correct the file in which the error occurred.

In the builder, when an error occurs, the relevant line is marked by , and when a warning occurs, the relevant line is marked by . If the editor registered in the TM has a function to open the file by specifying its line number, you can display the spot in error by double-clicking on the marked line. This helps you identify the spot in error easily.

8.2. Errors in the Linker XLINK

If an error occurs while you are executing the linker XLINK, correct the project according to the displayed messages.

The following describes the errors that are frequently encountered in the linker and the corrective actions to be taken.

- Error[e16]

If data cannot all fit into a segment, XLINK outputs the following error.

Error[e16]: Segment *Segment* is too long for segment definition.

In this case, change the segment size or move the segment to another location. Note, however, that the following segments cannot be moved out of page 0.

ZPAGE, Z_UDATA, Z_IDATA, C_ARGZ, EXPR_STACK, INT_EXPR_STACK

The Z_UDATA, Z_IDATA and C_ARGZ segments are the segments in which variables are located. By attaching `npage` to any variable, you can move that variable to the N_UDATA, N_IDATA or C_ARGZ segment. However, do not forget `npage` in the external declaration of the function that references the variable and in the prototype declaration as well.

- Error[e18]

If the data located in page N is accessed in zero-page addressing mode, the error shown below occurs.

Error[e18]: Range error in (*module*), segment *segment* at address *address*. Value *value*, in tag *tag*, is out of bounds (0x0-0xff)

In this case, relocate the data in page N to page 0 or change the method by which the data is referenced.

Method of relocating the data in page N to page 0:

In C sources, attach `zpage` when defining the location.

In assembler sources, make sure the relevant symbol will be located in page 0

Method of reference when located in page N:

In C sources, attach `npage` when defining the function externally. If `npage` is specified in the argument to the function, `npage` is also required for the prototype

declaration.

```
extern npage int n_i1;  
void func( char a, npage int n_b );
```

In assembler sources attach “np.” when referencing the data.

```
lda np:n_data
```

- Error[e27]

If a symbol with the same name (including any C language variable or function) is defined in multiple files, the error shown below occurs.

```
Error[e27]: Entry " symbol " in module module 1 ( file 1) redefined in module  
module 2 (file 2)
```

In this case, examine the relevant file and alter it so that there will be no duplicate symbol name.

- Error[e46]

If any undefined symbol exists, the error shown below occurs.

```
Error[e46]: Undefined external " symbol" referred in module ( file)
```

In this case, check the symbol name.

8.3. Setting Options in Source File Units

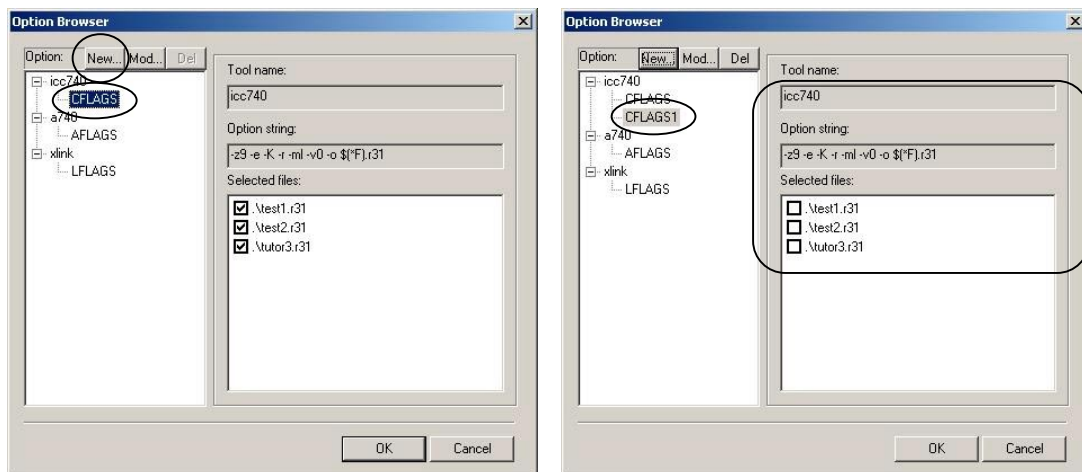
In C and assembler source files, it may sometimes be necessary to set options in file units.

In such a case, create additional option macros in file units.

These option macros can be created in the same way for both C and assembler source files.

Therefore, explanation is given by using a C source file as an example below.

In the Option Browser dialog box, click “icc740” or “CFLAGS” (Figure 30 (a)). The New button will become active, so click it. The Options dialog box will be displayed. Because the values of the respective options in this dialog box are the same as those of CFLAGS, change the values as necessary and click the OK button. A CFLAGS option macro will be created. As you repeat this operation, the number of option macros increases (Figure 30 (b)).



(a) Before setting option macros

(b) After adding option macros

Figure 30 Setting options in source file units in the Option Browser dialog box

The new option macros you’ve created are not assigned to any file yet. Click on an option macro and in the Selected Files section, click on a file name. The selected option macro will be enabled.

9. Debugging a Project

For the project you've finished building, an absolute file `proj_1.695` is generated in the working directory.

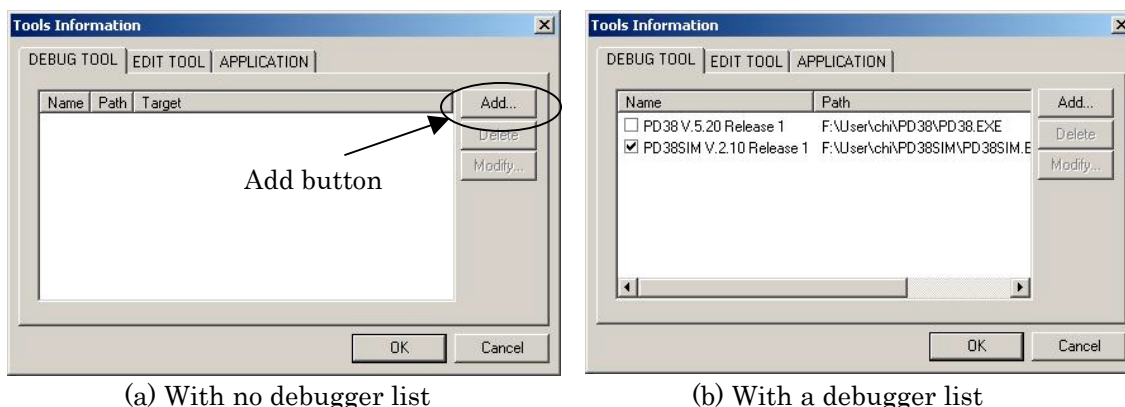
This file can be debugged in the M3T-PD38 or M3T-PD38SIM. In the TM, you can use the Debug button in the project bar to invoke the debugger (Figure 31).



Figure 31 Debug button in the Project Bar

The debugger invoked this way is the one that you registered to the TM.

If there are no registered debuggers, the Tool Information dialog box will be displayed. So register a debugger on the DEBUG TOOL tab of this dialog box (Figure 32).



(a) With no debugger list

(b) With a debugger list

Figure 32 DEBUG TOOL tab of the Tool Information dialog box

In the TM, furthermore, if the M3T-PD38 or M3T-PD38SIM was already installed before you installed the TW74, the installed debuggers are automatically listed (Figure 32 (b)). If you installed the M3T-PD38 or M3T-PD38SIM after installing the TW74, no debuggers are listed. In this case, the installed debuggers are automatically listed when you reinstall the TW74.

To register one of the listed debuggers, select its check box (marked by a check mark when selected).

Other debug tools are not automatically listed. Therefore, use the Add button to register any debug tool you want.

If you installed the M3T-PD38 or M3T-PD38SIM after installing the TW74, you must register the installed debugger in the same way as you do for other debug tools. In this case, the registered debugger will have “user” appended in the Name column as for other debug tools. The difference is whether or not the .695 file for the project is automatically loaded when you invoked the debug tool using the Launch Debugger button.

For the debuggers marked by “user” in the Name column, the file is not automatically loaded. Therefore, you need to load the .695 file for the project from the File menu of the M3T-PD38 or M3T-PD38SIM.

If you want the file to be automatically loaded by the M3T-PD38 or M3T-PD38SIM by clicking the Launch Debugger button, reinstall the TW74.

10. Creating a Hex File

Before you can create a Hex file, you must first register `xlink(lmc)` as a load module converter to the TM.

First, choose Information from the Project menu of the project editor. The Project Properties dialog box (Figure 33) will be displayed. Select the Tools tab of this dialog box.

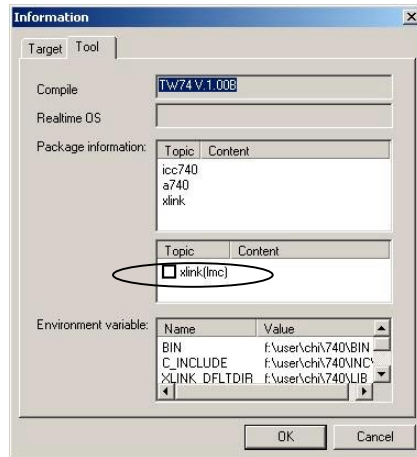


Figure 33 Project Properties dialog box

Next, select the “`xlink(lmc)`” check box in the package information section and click the OK button.

You will see that `xlink(lmc)` is registered in the Option Browser dialog box (Figure 34), so that `xlink(lmc)` will henceforth be executed after `xlink`.

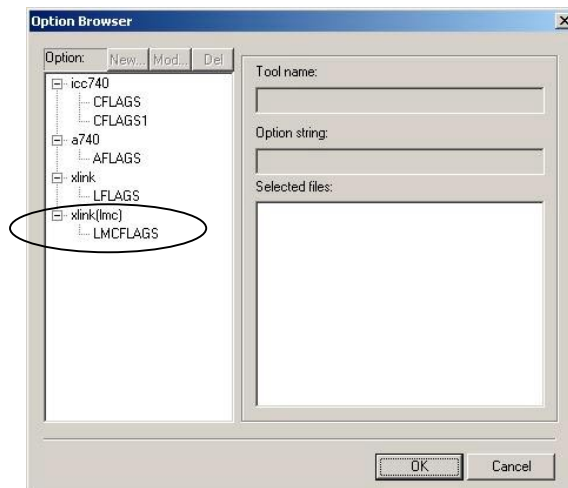


Figure 34 Option Browser dialog box with `xlink(lmc)` registered

Note that the options of `xlink(lmc)` in the TM are set as listed in Table 12.

Table 12 Default Options of `xlink(lmc)` (Command Line)

Option	Category	Description
-o	Output file	Sets an object file name.
-Fintel-standard	Output file	Specifies a format. For the Intel Hex files to be output, specify "intel-standard".
-Y0	Output file	Additional information of intel-standard. For use in the mask file conversion utility MM, specify "0".
-f	Include	Specifies a command file. This is automatically set by the TM.

When you execute Build, the builder creates two files, IEEE695 and Hex.

`xlink(lmc)` converts the formats of the files generated by `xlink` from IEEE695 to Hex. It uses the same `lnk740.xcl` file as does `xlink`.

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Rev. 1.00
July 16, 2004
REJ10J0750-0100Z

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User's Manual



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REJ10J0750-0100Z