MCUEZLNK0508/D

February 1998

MCUez LINKER USER'S MANUAL

Important Notice to Users

While every effort has been made to ensure the accuracy of all information in this document, Motorola assumes no liability to any party for any loss or damage caused by errors or omissions or by statements of any kind in this document, its updates, supplements, or special editions, whether such errors are omissions or statements resulting from negligence, accident, or any other cause. Motorola further assumes no liability arising out of the application or use of any information, product, or system described herein; nor any liability for incidental or consequential damages arising from the use of this document. Motorola disclaims all warranties regarding the information contained herein, whether expressed, implied, or statutory, *including implied warranties of merchantability or fitness for a particular purpose*. Motorola makes no representation that the interconnection of products in the manner described herein will not infringe on existing or future patent rights, nor do the descriptions contained herein imply the granting or license to make, use or sell equipment constructed in accordance with this description.

Information contained in this document applies to REVision (0) MCUez.

Trademarks

This document includes these trademarks:

MCUez is a trademark of Motorola Inc.
EXORciser is a trademark of Motorola Inc.

The MCUez development, emulation, and debugging application is based on HI-WAVE; a software technology developed by HIWARE. HI-WAVE is a registered trademark of HIWARE AG.

AIX, IBM, and PowerPC are trademarks of International Business Machines Corporation.
SPARC is a trademark of SPARC international, Inc.
Sun and SunOS are trademarks of Sun Microsystems, Inc.
UNIX is a trademark of Novell, Inc., in the United States and other countries, licensed exclusively through X/Open Company, Ltd.
X Window System is a trademark of Massachusetts Institute of Technology.

CONTENTS

FIGURES

TABLES

CHAPTER 1
GENERAL INFORMATION

1.1 INTRODUCTION

This manual describes the MCUez Linker. The Linker merges the various object files of an application into one file; an “absolute file” (.ABS file for short). The file is termed an “absolute file” because it contains absolute code (not relocatable code) that can be burnt onto an EPROM or loaded into the target using the MCUez Debugger.

1.2 FUNCTIONAL DESCRIPTION

Linking is the process of assigning memory to all global objects (functions, global data, strings and initialization data) needed for a given application and combining these objects into a format suitable for downloading into a target system or an emulator.

The Linker is a smart linker. It only links those objects actually used by the application. Various optimization capablities ensure low memory requirements for the linked program. Unused functions and variables will not occupy memory in the target system. Also, initialization of global variables is stored in compact form and memory is reserved only once for equivalent strings.

1.3 FEATURES

The most important features supported by the Linker are:

- Complete control over placement of objects in memory: It is possible to allocate different groups of functions or variables to different memory areas (Segmentation, please see section on *Sections*).
- Initialization of vectors.

When linking High level Language modules (C, C++, ...), the linker should support the following features:

- User defined startup: The application startup script is in a separate file written in “inline assembly” and can be easily modified. The startup file is named `startup.c` / `startup.o`. This is a generic file name that has to be replaced by the real target startup file name given in the `\LIB\COMPILER` directory; as mentioned in the `README.TXT` file. Usually the file name is `start*.c` / `start*.o`, where `*` is the name or part of the MCU name and might also contain an abbreviation of the memory model.

- Mixed language linking: Modula-2, Assembly, and C object files can be mixed in the same application.

1.4 SUPPORT INFORMATION

For information about a Motorola sales or distribution office near you call:

AUSTRALIA, Melbourne – (61-3)887-0711
Sydney – 61(2)906-3855

BRAZIL, Sao Paulo – 55(11)815-4200

CANADA, B. C., Vancouver – (604)606-8502
ONTARIO, Toronto – (416)497-8181
ONTARIO, Ottawa – (613)226-3491
QUEBEC, Montreal – (514)333-3300

CHINA, Beijing – 86-10-68437222

DENMARK – (45)43488393

FINLAND, Helsinki – 358-9-6824-400

FRANCE, Paris – 33134 635900

GERMANY,
Langenhagen/Hannover – 49(511)786880
Munich – 49 89 92103-0
Nuremberg – 49 911 96-3190
Sindelfingen – 49 7031 79 710
Wiesbaden – 49 611 973050

HONG KONG, Kwai Fong – 852-6106888
Tai Po – 852-6668333

INDIA, Bangalore – (91-80)5598615

ISRAEL, Herzlia – 972-9-590222

ITALY, Milan – 39(2)82201

JAPAN, Fukuoka – 81-92-725-7583
Gotanda – 81-3-5487-8311
Nagoya – 81-52-232-3500
Osaka – 81-6-305-1802
Sendai – 81-22-268-4333
Takamatsu – 81-878-37-9972
Tokyo – 81-3-3440-3311

KOREA, Pusan – 82(51)4635-035
Seoul – 82(2)554-5118

MALAYSIA, Penang – 60(4)2282514

MEXICO, Mexico City – 52(5)282-0230
Guadalajara – 52(36)21-8977

PUERTO RICO, San Juan – (809)282-2300

SINGAPORE – (65)4818188

SPAIN, Madrid – 34(1)457-8204

SWEDEN, Solna – 46(8)734-8800

SWITZERLAND, Geneva – 41(22)799 11 11
Zurich – 41(1)730-4074

TAIWAN, Taipei – 886(2)717-7089

THAILAND, Bangkok – 66(2)254-4910

UNITED KINGDOM, Aylesbury – 441(296)395-252

UNITED STATES, Phoenix, AZ – 1-800-441-2447

For a list of the Motorola sales offices and distributors:
http://www.mcu.motsps.com/sale_off.html

CHAPTER 2
USER INTERFACE

2.1 INTRODUCTION

This chapter describes:

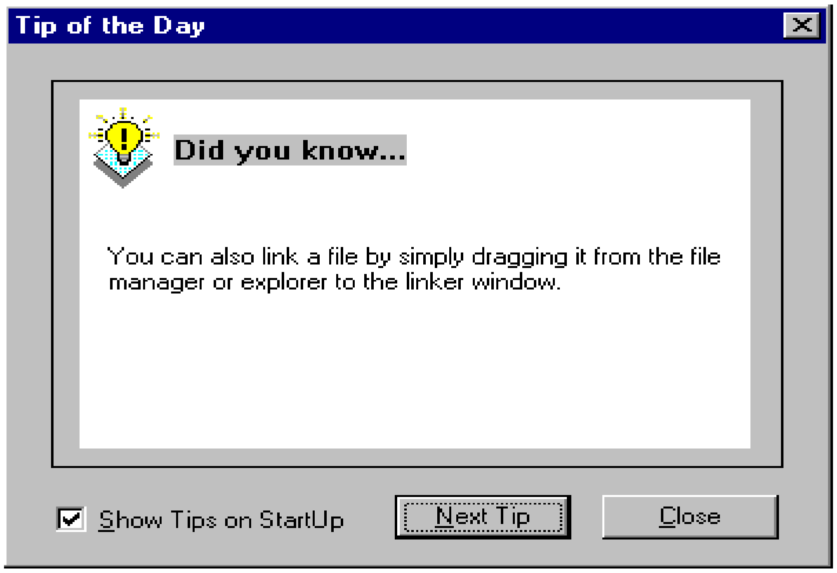
- The MCUez Linker User Interface
- How to start the Linker
- Environment variables

2.2 Interactive User Interface

Click the *Linker* icon on the shell tool bar to run the linker.

2.2.1 Starting the MCUez Linker

When the linker is started, a standard *Tip of the Day* window containing features about the linker is displayed.



You can also link a file by simply dragging it from the file manager or explorer to the linker window.

Figure 2-1. MCUez Linker Tip of The Day Window

Click *Next Tip* to view more information about the linker. Click *Close* to close the *Tip of the Day* dialog. If you do not want to view the *Tip of the Day* window when the linker is started, uncheck *Show Tips on StartUp*.

To re-enable the automatic display, choose *Help|Tip of the Day* .... The *Tip of the Day* dialog will display and you can check *Show Tips on StartUp*.

2.2.2 Linker Graphical Interface

Starting the MCUez Linker without specifying a filename will display the following window.

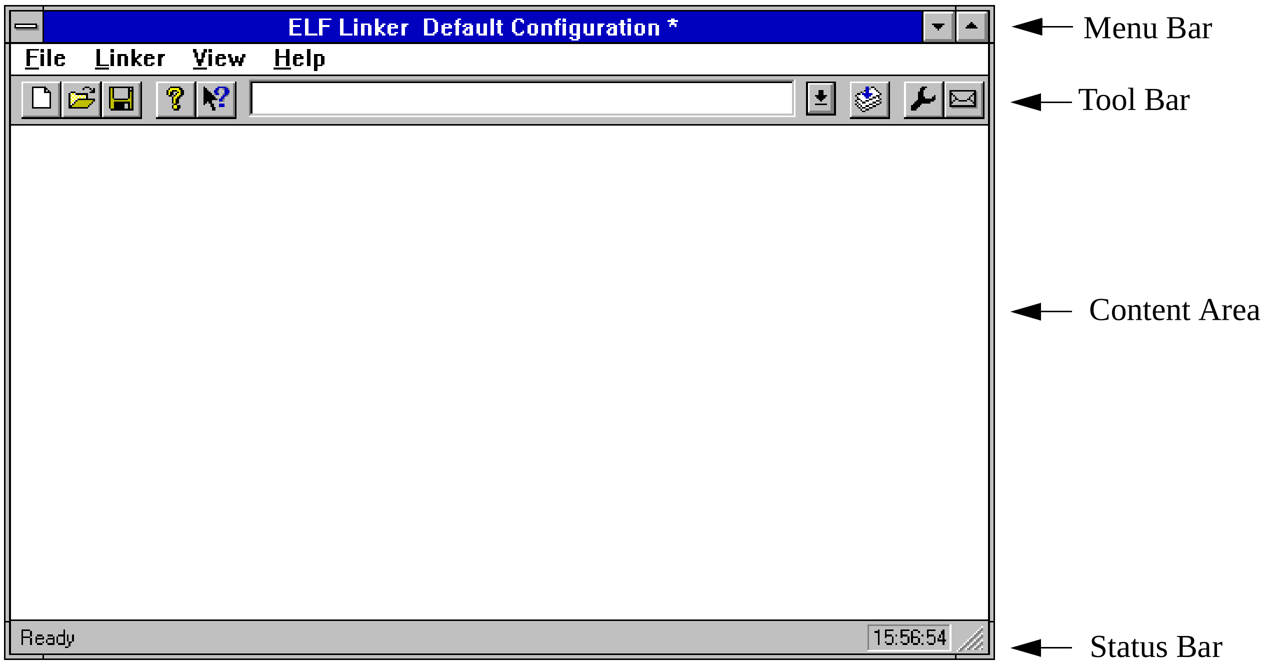


Figure 2-2. MCUez Linker Graphical User Interface

The Linker Window provides a Menu Bar, Tool Bar, Content Area, and Status Bar.

2.2.2.1 Window Title

The window title displays the linker name and project name. If no project is loaded, "Default Configuration" is displayed. A "*" after the configuration name indicates that some values have been changed. Changes in options, editor configuration, and appearance (Window position, size, font, ...) will cause the "*" to appear.

2.2.2.2 Content Area

The *Content Area* displays logging information about the link session. This logging information consists of:

- The name of the PRM file being linked.

- The name (including full path) of the files building the application.
- Thle list of errors, warnings, and information messages.

When a file name is dropped into the Linker window content area, the corresponding file is either loaded as configuration data or linked. It is loaded as configuration data if the file extension is “ini”. If not, the file is linked with the current option settings (See *Specifying the Input File* below).

The Linker window content area can have context information consisting of two items:

- a file name including a position inside of a file
- a message number

File context information is available for all output lines where a file name is displayed. If a file context is available for a line, double-clicking on this line opens the appropriate file in the editor specified in your MCUez configuration. Double-clicking the right mouse button alos opens a context menu. The menu contains an “Open ..” entry if a file context is available. If a file can not be opened although a context menu entry is present, see the section Editor Settings Dialog.

Note that under Win32s the context menu is not available. If a file can not be opened although a context menu entry is present, see the section on “Editor Settings” below.

The message number is available for any message output. To open the corresponding entry in the help file, do one of the following.

- Select one line of the message and press F1. If the selected line does not have a message number, the main help is displayed.
- Press Shift-F1 and then click on the message text. If the clicked point does not have a message number, the main help is displayed.
- Click the right mouse button at the message text and select “Help on ...”. This entry is only available if a message number is available. The context menu is not available under Win32s.

Once a link session has completed, an *Error Feedback* can be performed automatically by double clicking on the message in the content area. To allow *Error Feedback*, the desired editor must be configured (See *Error Feedback* below).

2.2.2.3 Tool Bar

The following illustrates the MCUez Linker Tool Bar.

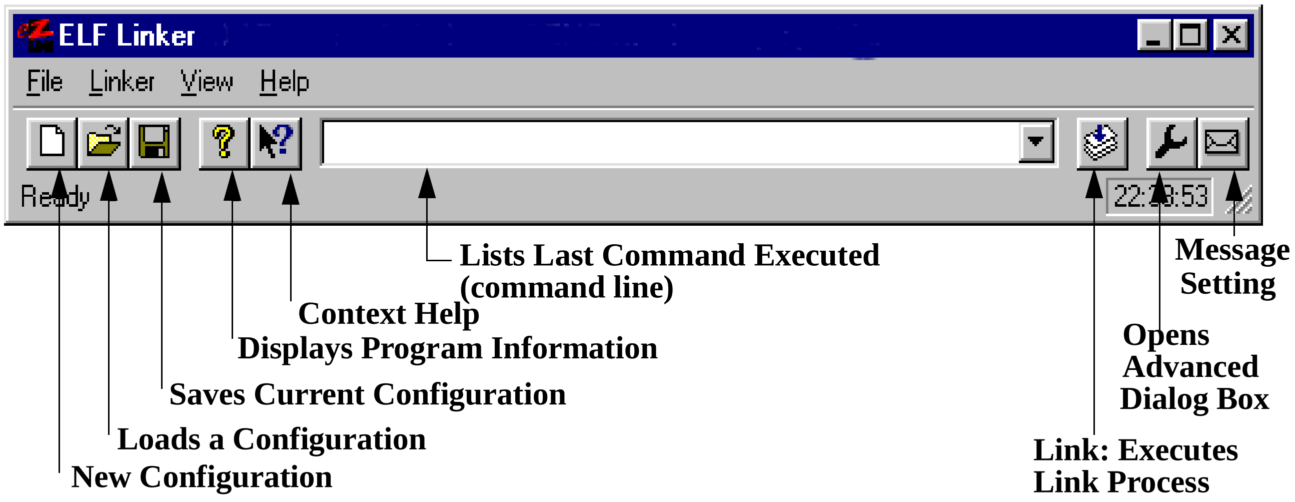

ELF Linker
File Linker View Help
Ready
22:28:53
Lists Last Command Executed (command line)
Context Help
Displays Program Information
Saves Current Configuration
Loads a Configuration
New Configuration
Message Setting
Opens Advanced Dialog Box
Link: Executes Link Process

Figure 2-3. MCUez Linker Tool Bar

- The *New*, *Load* and *Save* buttons are linked to the corresponding entries of the *File* menu.
- The *?* and *Context Help* buttons are linked to the corresponding entries of the *Help* menu.
- The editable combo box contains a list of the last commands executed. Once a command line has been selected or entered in this combo box, click *Link* to execute this command.
- The *Open Advanced Options* button opens the corresponding dialog.
- The *Message Setting* button opens the corresponding dialog.

2.2.2.4 Status Bar

Point at a menu entry or button in the *Tool Bar* to display the corresponding description in the message field. The following illustration shows the MCUez Linker Status Bar.

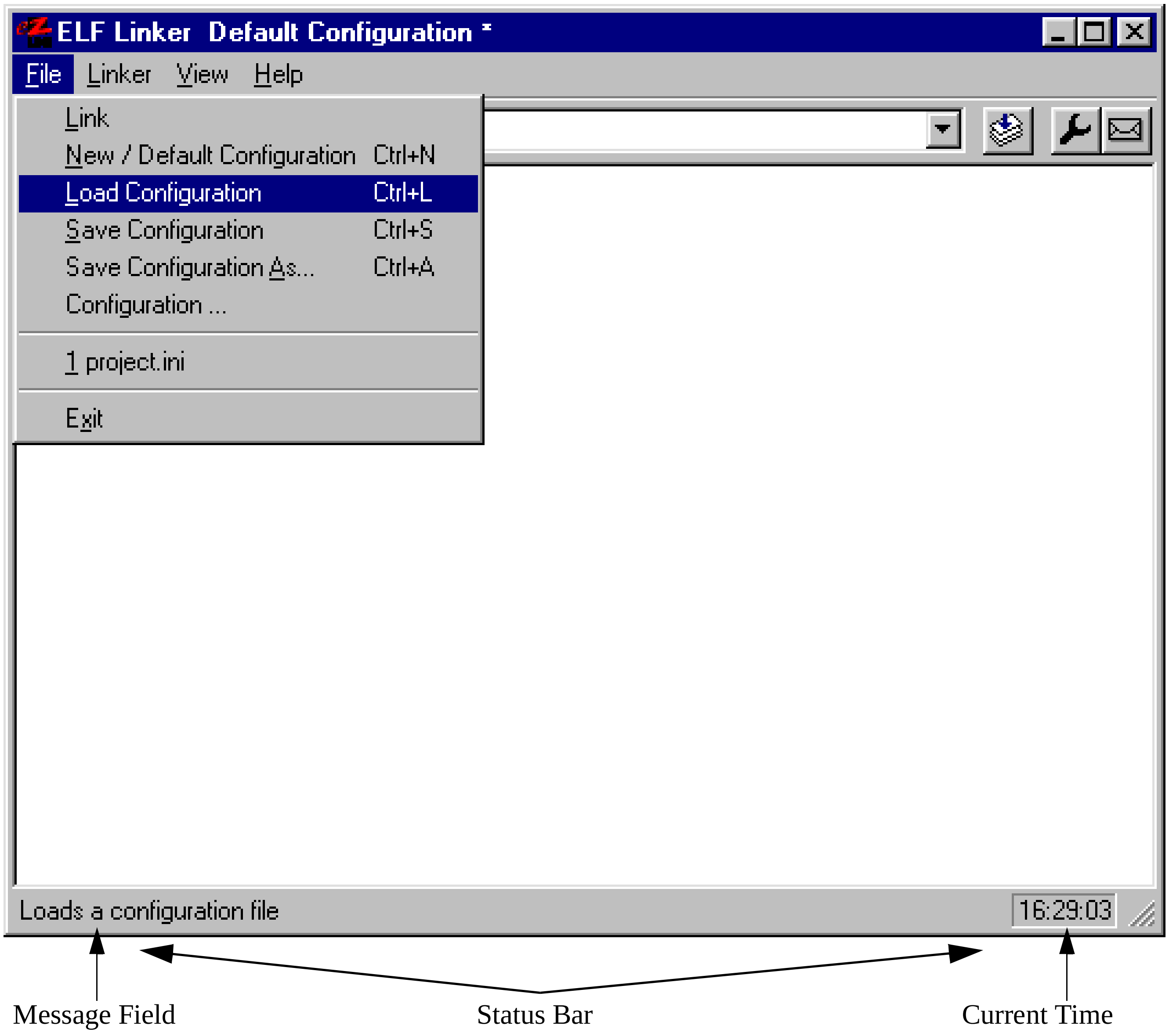

ELF Linker Default Configuration *
File
Linker
View
Help
Link
New / Default Configuration Ctrl+N
Load Configuration Ctrl+L
Save Configuration Ctrl+S
Save Configuration As... Ctrl+A
Configuration ...
1 project.ini
Exit
Loads a configuration file
16:29:03
Message Field
Status Bar
Current Time

Figure 2-4. MCUez Linker Status Bar

2.2.2.5 Linker Menu Bar

The following entries are available in the *Menu Bar*:

Menu entry	Description
File	Linker *Configuration File* management.
Linker	Linker option settings.
View	*Linker Window* settings.
Help	Standard Windows Help menu.

2.2.2.6 File Menu

A typical linker *Configuration File* contains the following information:

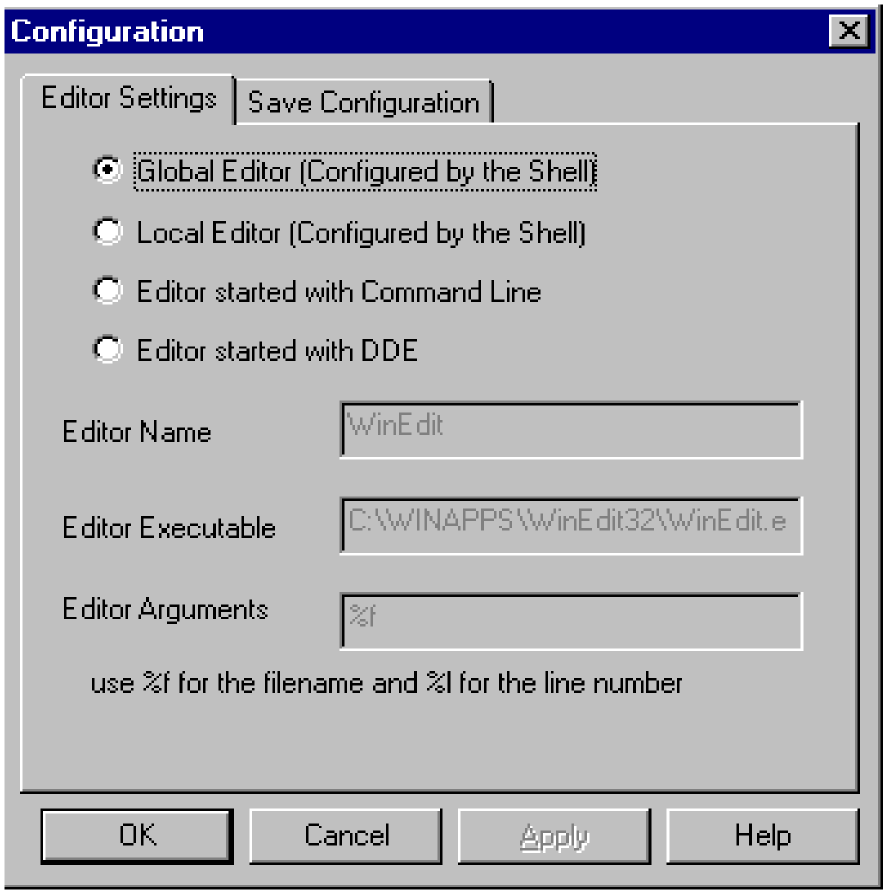
- The linker option settings specified in the *Advanced Options Settings* and *Message Settings* dialogs.
- List of commands executed.
- Window position, size and font used.
- The editor associated with the Linker.

Linker Configuration information is stored in section [ELF_LINKER] in the specified configuration file.

Configuration Files are ASCII files with a .ini extension. You can define as many of these files as you need for any given project. You can switch between different *Configuration Files* by choosing *File|Load Configuration* and *File|Save Configuration* in the Linker Menu Bar, or by clicking the corresponding tool bar buttons.

- Choose *File|Linker* to open a standard *Open File* dialog box that displays a list of all .PRM files in the project directory. Select the input file to be linked and click *OK*.
- Choose *File|New/Default Configuration* to reset the linker settings to the default values. Default linker options are specified in the Command Line Options chapter in the Linker manual.
- Choose *File|Load Configuration* to open the *Open File* dialog box and display a list of all .INI files in the project directory. Select a configuration file containing the data to be loaded.
- Choose *File|Save Configuration* to store the current settings in the configuration file specified on the title bar.
- Choose *File|Save Configuration as ...* to open a standard *Save As* dialog box and display a list of all .INI files. Specify the name or location of the configuration file to store the current settings. Click *OK*.

- Choose *File|Configuration* ... to specify an editor to be used for error feedback and information to be saved in the configuration file.
- Global Editor (Configured by the Shell)



Configuration

Editor Settings | Save Configuration

(●) Global Editor (Configured by the Shell)
( ) Local Editor (Configured by the Shell)
( ) Editor started with Command Line
( ) Editor started with DDE

Editor Name: WinEdit

Editor Executable: C:\WINAPPS\WinEdit32\WinEdit.e

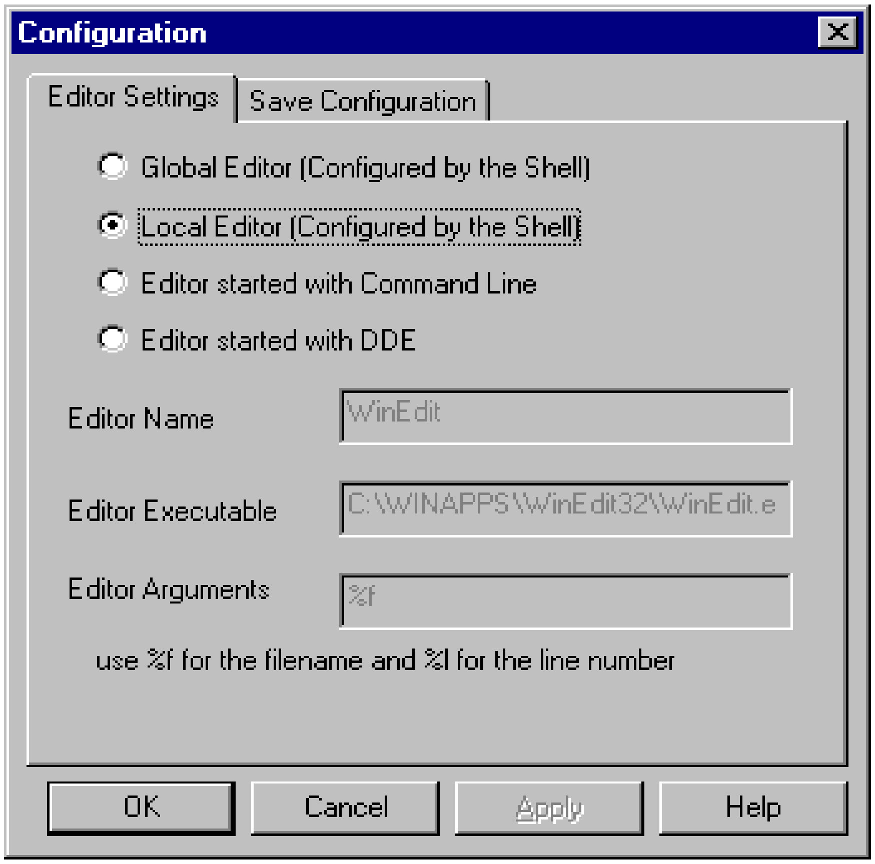
Editor Arguments: %f

use %f for the filename and %l for the line number

Figure 2-5. Configuration Dialog - Global Editor

This entry is enabled when an editor is configured in the [Editor] section of the global initialization file "MCUTOOLS.INI" .

- Local Editor (Configured by the Shell)



Global Editor (Configured by the Shell)
[✓ Local Editor (Configured by the Shell)]
Editor started with Command Line
Editor started with DDE

Editor Name: WinEdit
Editor Executable: C:\WINAPPS\WinEdit32\WinEdit.e
Editor Arguments: %f

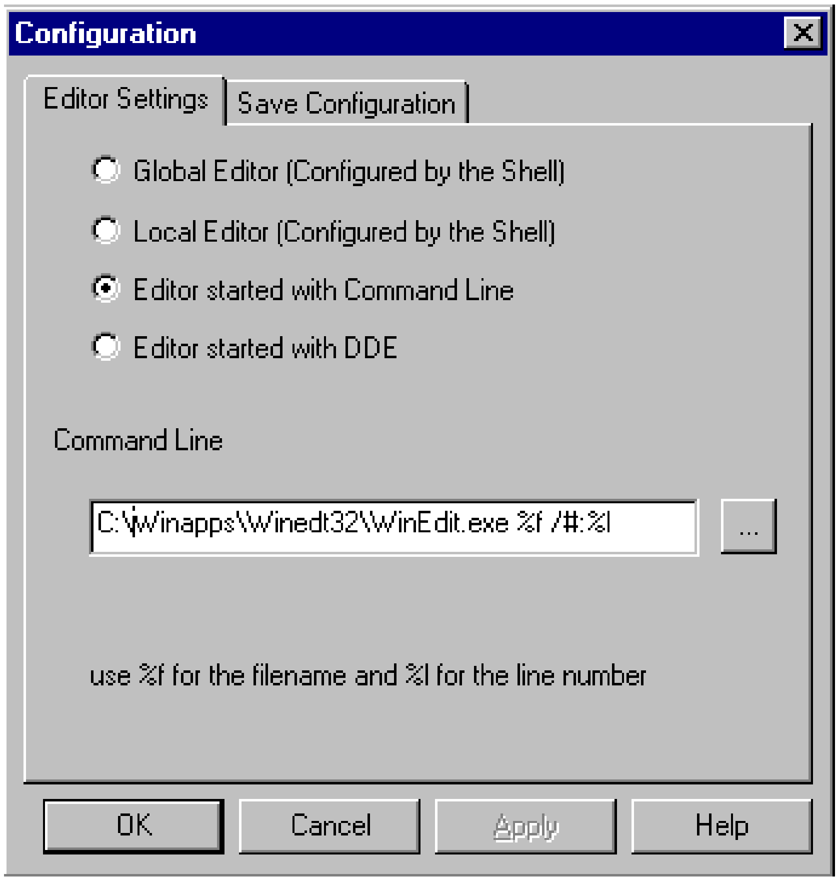
use %f for the filename and %l for the line number

Figure 2-6. Configuration Dialog - Local Editor

This entry is enabled when an editor is configured in the local configuration file; usually "project.ini" in the project directory.

The Global and Local Editor can be configured with the Shell (see separate Manual for the Shell Tool).

- Editor started with Command Line



( ) Global Editor (Configured by the Shell)
( ) Local Editor (Configured by the Shell)
(●) Editor started with Command Line
( ) Editor started with DDE

Command Line

C:\Winapps\Winedt32\WinEdit.exe %f /#:%l

use %f for the filename and %l for the line number

Figure 2-7. Configuration Dialog - Editor Started With Command Line

When this editor type is selected, a separate editor is associated with the Linker for error feedback. Enter the command line to start the editor. Modifiers can be specified on the command line.

Example:

For Winedit 32-bit version use (with an adapted path to the winedit.exe file)

```
C:\WinEdit32\WinEdit.exe %f /#:%l
```

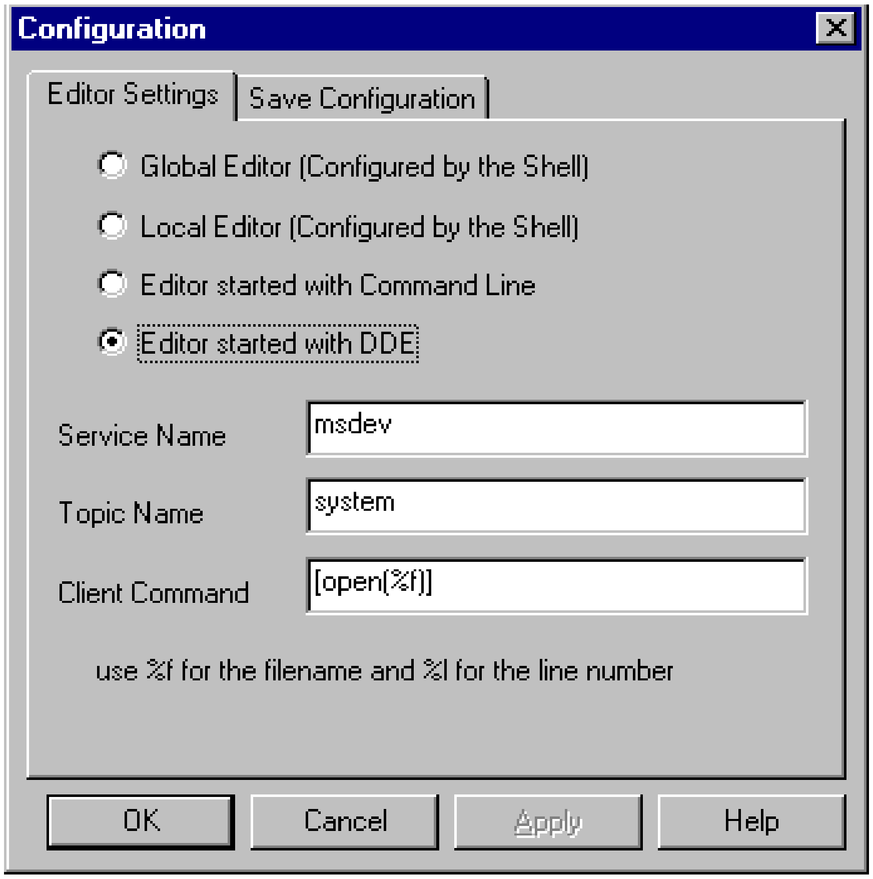
For Write.exe (with an adapted path to the Write.exe file, note that Write does not support line numbers).

```
C:\Winnt\System32\Write.exe %f
```

For Motpad.exe use (with an adapted path to the Motpad.exe file, note that Motpad supports line number).

```
C:\TOOLS\MOTPAD\MOTPAD.exe %f::%l
```

- Editor started with DDE



Global Editor (Configured by the Shell) [ ]
Local Editor (Configured by the Shell) [ ]
Editor started with Command Line [ ]
[✓ Editor started with DDE]

Service Name: msdev
Topic Name: system
Client Command: [open(%f)]

use %f for the filename and %l for the line number

Figure 2-8. Configuration Dialog - Editor Started With DDE

Enter the service, topic and client name to be used for a DDE connection to the editor. All entries can have modifiers for file name and line number as explained below.

Example:

For Microsoft Developer Studio use the following setting :

```
Service Name : "msdev"
Topic Name : "system"
ClientCommand : "[open(%f)]"
```

- Modifiers

When either entry ‘Editor Started with the Command line’ or ‘Editor started with DDE’ is selected, the configurations may contain some modifiers to tell the editor which file to open and at which line.

- The %f modifier refers to the file name (including path) where the error has been detected.
- The %l modifier refers to the line number where the message has been detected.

The format from the editor command depends on the syntax used to start the editor. Some modifiers can be specified in the editor command line. Please check your editor manual to define the command line which should be used to start the editor.

2.2.2.6.1 Important remarks

Caution should be taken using %l. This modifier can only be used with an editor that can be started with a line number as a parameter. Editors such as WinEdit version 3.1 or lower, Notepad, and Motpad do not allow this kind of parameter. This kind of editor can be started using the file name as a parameter. Choose *Go to* to jump to the line containing the error.

The *Command Line* looks like:

```
C:\WINAPPS\WINEDIT\Winedit.EXE %f
```

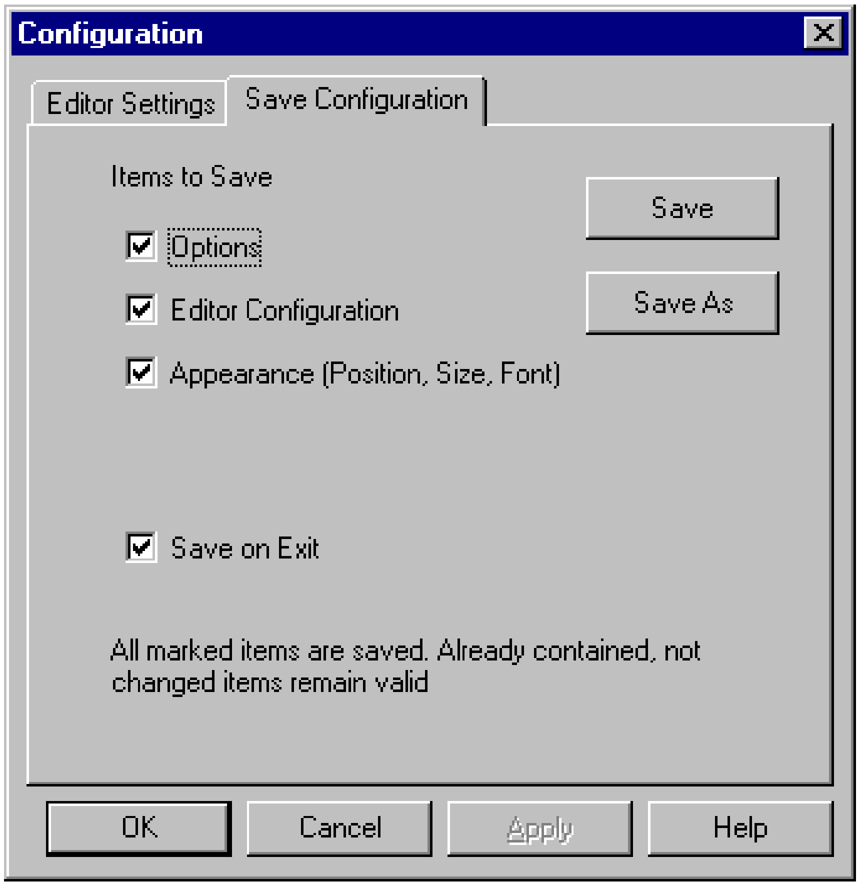
Check your editor manual to define the *Command Line* used to start the editor.

NOTE

If you are using a word processing editor (Microsoft Word, Wordpad, ...), save your input file as an **ASCII text** file.

2.2.2.6.2 Save Configuration Dialog

The second page of the configuration dialog contains options for the save operation. In the save configuration dialog, configure the parts to be stored in a project file.



Items to Save

- [✓] Options
- [✓] Editor Configuration
- [✓] Appearance (Position, Size, Font)
- [✓] Save on Exit

All marked items are saved. Already contained, not changed items remain valid

Figure 2-9. Save Configuration Dialog Window

This dialog box contains:

- Options: When set, the current option and message settings are stored in the configuration file. Disable this option to retain the data last saved.
- Editor Configuration: When set, the current editor settings are stored in a configuration file. Disable this option to retain the data last saved.
- Appearance: Saves the window position (only loaded at startup time) and the command line content and history. When this mark is set, these settings are saved in the configuration file.

NOTE

By disabling selective options only parts of a configuration file can be written. For example when the suitable editor is found, the save option mark can be removed. Then future save commands will not modify the editor setting.

- Save on Exit: If set, the Linker will write the configuration on exit. No confirmation prompt will appear. If options have changed, the Linker will not write the configuration unless this option is set.

NOTE

Almost all settings are stored in the configuration file, except for the recently used configuration list and all settings in this dialog.
These settings are stored in the [ELF_LINKER] section of the MCUTOOLS.INI initialization file.

NOTE

Linker configurations can coexist in the same file as the project configuration of the shell and other MCUez tools. When an editor is configured by the shell, the linker can read the content from the project file, if present. The project configuration file of the shell is named project.ini. This file name is therefore also suggested (but not mandatory) to the Linker.

2.2.2.7 Linker Menu

This menu allows you to customize the linker and set or reset linker options. Choose *Linker|Options* to define the options for linking an input file (See section 2.2.3.9, *Advanced Options Dialog Box*, in this chapter).

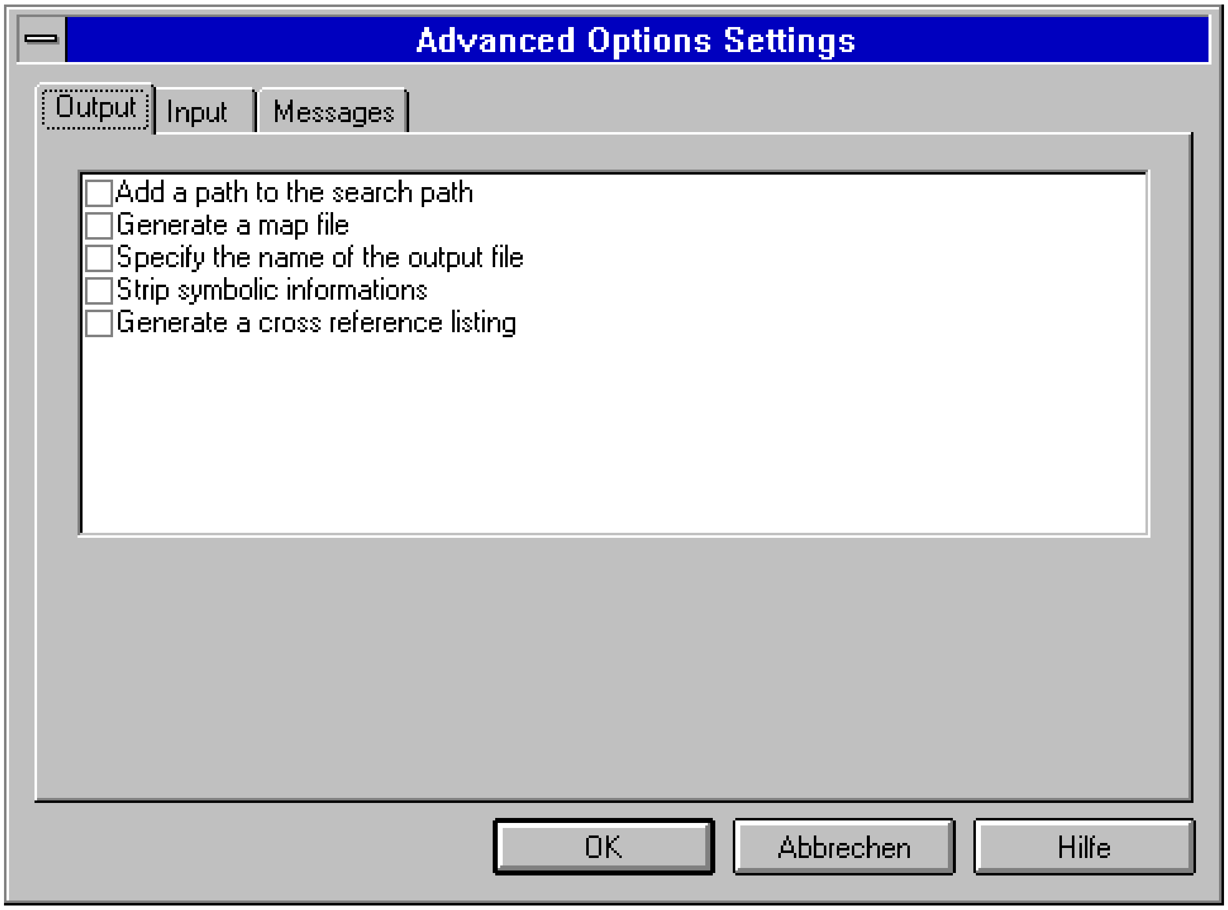
2.2.2.8 View Menu

This menu enables you to customize the *Linker Window*. You can define whether to display or hide the *Status Bar* or *Tool Bar*. You can also define the font used in the window or clear the window.

- Choose *View|Tool Bar* to switch on/off the *Linker Window Tool Bar.*
- Choose *View|Status Bar* to switch on/off the *Linker Window Status Bar.*
- Choose *View|Log ...* to customize the output in the *Linker Window Content Area*.
- Choose *View|Log ...|Change Font* to open a standard *Font Selection* dialog box. Options selected in this dialog are applied to the Linker Window Content Area.
- Choose *View|Log ...|Clear Log* to clear the Linker Window Content Area.

2.2.2.9 Advanced Options Dialog Box

This dialog box allows you to set/reset linker options. The options available are arranged in different groups. A register card is available for each group. The following figure shows the Advanced Options Dialog window.



- [ ] Add a path to the search path
- [ ] Generate a map file
- [ ] Specify the name of the output file
- [ ] Strip symbolic informations
- [ ] Generate a cross reference listing

Figure 2-10. Advanced Options Dialog Window

The content of the list box depends on the selected sheet:

Option Group	Description
Output	Lists options related to generated output files (type of files to be generated).
Input	Lists options related to input files.
Messages	Lists options controlling generation of error messages.

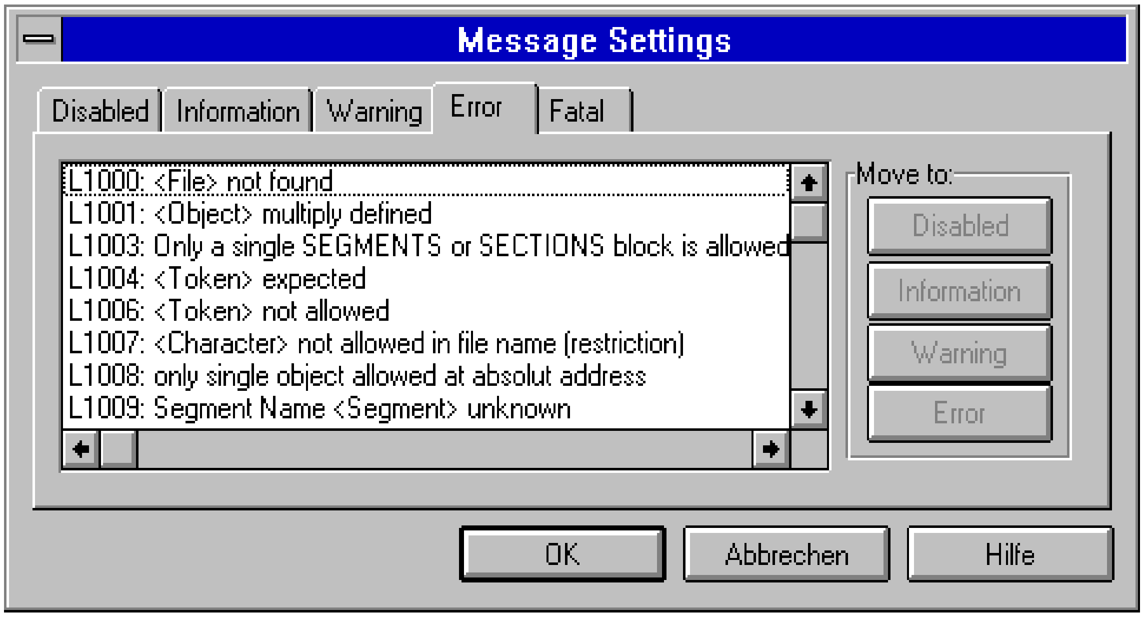
A linker option is set when the corresponding check box is checked.

NOTE

When options requiring additional parameters are selected, an edit box or another window can be opened to set the additional parameters.

2.2.3 Message Settings Dialog Box

The following figure shows the Message Settings Dialog window.



L1000: <File> not found
L1001: <Object> multiply defined
L1003: Only a single SEGMENTS or SECTIONS block is allowed
L1004: <Token> expected
L1006: <Token> not allowed
L1007: <Character> not allowed in file name (restriction)
L1008: only single object allowed at absolut address
L1009: Segment Name <Segment> unknown

Figure 2-11. Message Settings Dialog Window

This dialog box allows you to map messages to a different message class. A sheet is available for each error message class and the content of the list box depends on the selected sheet.

The table below identifies and defines each message group.

Table 2-1. Message Group Definitions

Message Group	Description
Disabled	Lists all disabled messages. Messages displayed in the list box will not be generated by the Linker.
Information	Lists all information messages. Information messages depict action taken by the Linker.
Warning	Lists all warning messages. When such a message is generated, linking continues and an absolute file is generated.
Error	Lists all error messages. When such a message is generated, linking of the input application continues but no absolute file will be generated.
Fatal	Lists all fatal error messages. When such a message is generated, linking stops immediately.

Each message has its own character (‘L’ for Linker message) followed by a 4-5 digit number. This number allows an easy search for the message both in the manual or online help.

2.2.3.1 Changing the Class Associated With a Message

You can configure your own mapping of messages in the different classes by using one of the buttons located on the right hand side of the dialog box. Each button refers to a message class. To change the class associated with a message, select the message in the list box and click the button associated with the class where you want to move the message.

Example

To define the message ‘L1201: No stack defined' (warning message) as an error message:

1. Click the Warning sheet to display the list of all warning messages in the list box.
2. Click on the string ‘L1201: No stack defined' in the list box to select the message.
3. Click Error to define this message as an error message.

Click on the 'OK' button to validate the modification to the error message mapping. If you close the dialog box with the 'Cancel' button, the previous message mapping remains valid.

2.2.3.2 Specifying the Input File

The input file to be linked can be specified in several ways. During the link session, the options will be set according to the configuration set by the user in the *Advanced Options Settings* dialog box. Before linking a file, ensure that you have associated a *Project Directory* with your linker.

2.2.3.2.1 Using the Editable Combo Box in the Tool Bar

- **Linking a New File -** A new file name and additional linker options can be entered in the editable combo box. Click the *Link* button in the tool bar to link the specified file.
- **Linking a File Which Has Already Been Linked** - The command executed previously can be displayed using the arrow on the right side of the editable combo box. Click a command line to select it and display it in the combo box. Click the Link button in the tool bar to assemble the specified file.

2.2.3.2.2 Using the Entry *File | Link ...*

Choose *File|Link* ..., to open a standard *Open File* dialog box. The desired file can then be browsed. Click *OK* to link the selected file.

2.2.3.2.3 Using Drag and Drop

A file name can be dragged from another program (e.g., the *File Manager*) and dropped into the *Linker Window*. The dropped file will be linked as soon as the mouse button is released in the *Linker Window*. A dragged file with a .ini extension is considered to be a configuration file and it is loaded and not linked. To link a parameter file with a .ini extension use another method.

2.2.4 Error Feedback

After a parameter file has been linked, you can detect error or warning locations with the following error message format.

```
‘>> <FileName>, line <line number>, col <column number>, pos
<absolute position in file>
<Portion of code generating the problem>
<message class> <message number>: <Message string>‘
```

Example

```
>> in "placemen\tstpla8.prm", line 23, col 0, pos 668
  fpm_data_sec INTO  MY_RAM2;

END

ERROR L1110: MY_RAM2 appears twice in PLACEMENT block
```

2.2.4.1 Error Feedback Using Information From the Linker Window

Once a file has been linked, the *Linker Window* Content Area displays a list of all errors or warnings detected. Any editor can then be used to open the source file and correct the errors.

2.2.4.2 Error Feedback Using a User-Defined Editor

The editor for *Error Feedback* must first be configured using either the MCUez Shell or the *Configuration* dialog box.

2.2.4.2.1 Line Number Can be Specified on the Command Line

Motpad, WinEdit V95 or higher, Codewright, or Motpad can be started with a line number in the command line. Properly configured editors will start automatically by double clicking on an error message. The configured editor will start and open the file containing the error and place the cursor on the line where the error occurred.

2.2.4.2.2 Line Number Cannot be Specified on the Command Line

WinEdit V31 or lower, Notepad, and Wordpad cannot be started with a line number in the command line. When correctly configured, these editors can be activated automatically by double clicking on an error message. The configured editor will start and open the file containing the error. To scroll to the error:

- Activate the linker again
- Click the line on which the message was generated. This line is highlighted on the screen.
- Copy the line to the clipboard pressing CTRL + C
- Activate the editor again.
- Select *Search*|*Find*, the standard Find dialog box is opened.
- Press CTRL + V to paste the line in the Edit box.
- Click *Forward* to jump to the detected error position.

CHAPTER 3

ENVIRONMENT VARIABLES

3.1 INTRODUCTION

This chapter describes environment variables used by the MCUez Linker. Some of the environment variables are also used by other tools (e.g. Macro Assembler, Compiler, ...). Consult their respective manuals for more information.

3.2 SETTING PARAMETERS

Various linker parameters may be set with environment variables. The syntax is:

```
KeyName=ParamDefinition
```

NOTE

No blanks are allowed in the definition of an environment variable.

Example:

```
GENPATH=C:\INSTALL\LIB;D:\PROJECTS\TESTS;\usr\local\lib;
```

These parameters may be defined in several ways:

- Using system environment variables supported by your operating system.
- Putting the definitions in a file called DEFAULT.ENV (.hidefaults for UNIX) in the project directory.
- Putting the definitions in a file given by the value of the system environment variable ENVIRONMENT.

NOTE

The default directory mentioned above can be set via the system environment variable `DEFAULTDIR`.

When looking for an environment variable, all programs first search the system environment, then the DEFAULT.ENV (.hidefaults for UNIX) file and finally the global environment file given by ENVIRONMENT. If no definition can be found, a default value is assumed.

3.3 PATH VARIABLES

Most environment variables contain path lists indicating where to look for files. A path list is a list of directory names separated by semicolons; as follows:

```
DirSpec;DirSpec;DirSpec
*DirectoryName
```

Example:

```
GENPATH=C:\INSTALL\LIB;D:\PROJECTS\TESTS;\usr\local\lib;
```

If a directory name is preceded by an asterisk ("*"), the programs recursively search the whole directory tree for a file, not just the given directory. Directories are searched in the order they appear in the path list.

Example:

```
LIBPATH=*C:\INSTALL\LIB
```

NOTE

Some DOS/UNIX environment variables (like GENPATH, LIBPATH, etc.) are used. For further details refer to “Environment” chapter.

We strongly recommend working with MCUez Shell and setting the environment by means of a DEFAULT.ENV file in your project directory. This project directory can be set in the MCUez Shell 'Configure...' dialog box. This way, you can have different projects in different directories, each with its own environment.

For some environment variables a synonym also exists. These synonyms may be used for older releases of the linker and will be removed in the future.

3.3.1 LINKOPTIONS

Synonym:	None
Syntax:	"LINKOPTIONS=" {<option>}.
Arguments:	<option>: Linker command line option
Description:	If this environment variable is set, the linker appends its contents to its command line each time a file is linked. It can be used to globally specify certain options that should always be set, so you don’t have to specify them each time a file is linked.
Example:	LINKOPTIONS=-W2
See also:	Linker options

3.3.2 GENPATH

Synonym:	HIPATH
Syntax:	"GENPATH=" {<path>}.
Arguments:	<path>: Paths separated by semicolons, without spaces.
Description:	The linker will look for the PRM file in the project directory, then in the directories listed in the environment variable GENPATH. The object and library files specified in the linker PRM file are searched for in the project directory, then in directories listed in the environment variable OBJPATH and finally in directories specified in GENPATH.

NOTE

If a directory specification in this environment variable starts with an asterisk ("*"), the whole directory tree is searched recursively, i.e. all subdirectories are also searched. Within one level in the tree, the search order of the subdirectories is indeterminate (not valid for Win32).

Example:	GENPATH=\obj;..\..\lib;
See also:	None

3.3.3 OBJPATH

Synonym:	None
Syntax:	"OBJPATH=" {<path>}.
Arguments:	<path>: Paths separated by semicolons, without spaces.
Description:	When this environment variable is defined, the linker searches the project directory for the object and library files specified in the linker PRM file. The linker then searches the directories listed in the environment variable OBJPATH and GENPATH.
Example:	OBJPATH=\sources\bin;..\..\headers;\usr\local\bin

3.3.4 ABSPATH

Synonym:	None
Syntax:	"ABSPATH=" {<path>}.
Arguments:	<path>: Paths separated by semicolons, without spaces.
Description:	When this environment variable is defined, the linker will store the absolute files it produces in the first directory specified. If ABSPATH is not set, the generated absolute files will be stored in the directory where the parameter file was found.

Example:	ABSPATH=\sources\bin;..\..\headers;\usr\local\bin
See also:	None

3.3.5 TEXTPATH

Synonym:	None
Syntax:	"TEXTPATH=" {<path>}.
Arguments:	<path>: Paths separated by semicolons, without spaces.
Description:	When this environment variable is defined, the linker will store the MAP file it produces in the first directory specified. If TEXTPATH is not set, the generated MAP file will be stored in the directory where the PRM file was found.
Example:	TEXTPATH=\sources ..\..\headers;\usr\local\txt
See also:	None

3.3.6 SRECORD

Synonym:	None
Syntax:	SRECORD=<RecordType>.
Arguments:	<Record Type>: Force the type for the Motorola S record that must be generated. This parameter value can be ‘S1’, ‘S2’ or ‘S3’.
Description:	When this environment variable is defined, the linker will generate a Motorola S file containing records from the specified type (S1 records when S1 is specified, S2 records when S2 is specified and S3 records when S3 is specified).

NOTE

If the environment variable SRECORD is set, it is the user responsibility to specify the appropriate S record type. If you specify S1 while your code is loaded above 0xFFFF, the Motorola S file generated will not be correct, as the addresses will all be truncated to 2-byte values.

NOTE

When this variable is not set, the type of S record generated will depend on the size of the address loaded. If the address can be coded on two bytes, a S1 record is generated. If the address is coded on three bytes, a S2 record is generated. Otherwise, a S3 record is generated.

Example:	SRECORD=S2
See also:	None

3.3.7 ERRORFILE

Synonym:	None.
Syntax:	ERRORFILE=<filename>
Arguments:	<filename>: File name with format specifiers.
Description:	The environment variable ERRORFILE specifies the name of the error file (used by the Linker).

Possible format specifiers are:

%n: Substitute with the file name, without the path.

%p: Substitute with the path of the source file.

%f: Substitute with the full file name, i. e. with the path and name (same as %p%n).

In case of an illegal error file name, a notification box is displayed.

Example: ERRORFILE=MyErrors.err

Lists all errors in the file “MyErrors.err” in the project directory.

ERRORFILE=\tmp\errors

Lists all errors in the file “errors” in the directory \tmp.

ERRORFILE=%f.err

Lists all errors in a file with the same name as the source file, but with extension .err. The error file is placed in the same directory as the source file. For example, if we link a file \sources\test.prm, an error list file \sources\test.err will be generated.

ERRORFILE=\dir1\%n.err

For a source file test.prm, an error list file \dir1\test.err will be generated.

ERRORFILE=%p\errors.txt

For a source file \dir1\dir2\test.prm, an error list file \dir1\dir2\errors.txt will be generated.

If the environment variable ERRORFILE is not set, the errors are written to the default error file. The default error file name is dependent upon how the assembler is configured and started. If a file name is provided in the assembler command line, errors are written to the EDOUT file (to the name-specified file) in the project directory. If no file name is provided, errors are written to the ERR.TXT file in the project directory.

Example: Another example shows the usage of this variable to support correct error feedback with the WinEdit Editor which looks for an error file called EDOUT:

```
Installation directory: E:\INSTALL\PROG
Project sources: D:\MEPHISTO
Common Sources for projects: E:\CLIB

Entry in default.env (D:\MEPHISTO\DEFAULT.ENV):
ERRORFILE=E:\INSTALL\PROG\EDOUT

Entry in WINEDIT.INI (in Windows directory):
OUTPUT=E:\INSTALL\PROG\EDOUT
```

See also: None

CHAPTER 4

FILES

4.1 INTRODUCTION

The following sections describe the files used and generated by the MCUez Linker.

4.2 PARAMETER FILE: INPUT

The linker takes any file as input. No special extension is required. However, we suggest that parameter file names have the extension `.prm`. Parameter files will be searched first in the project directory and then in the GENPATH directories. The parameter file must be an ASCII text file.

4.3 ABSOLUTE FILES: OUTPUT

After a successful link session, the linker generates an absolute file containing the target code as well as some debugging information. This file is written to the directory given in the environment variable ABSPATH. If the variable contains more than one path, the absolute file is written to the first directory specified. If this variable is not set, the absolute file is written to the directory where the parameter file was found. Absolute files always get the extension `.abs`.

4.4 MOTOROLA S FILES: OUTPUT

After a successful link session, the linker generates a Motorola S record file, which can be burnt into an EPROM. This file contains information stored in all the READ_ONLY sections in the application. The extension for the generated Motorola S record file depends on the setting from the SRECORD variable.

- If SRECORD = S1, the Motorola S record file gets the extension `.s1`.
- If SRECORD = S2, the Motorola S record file gets the extension `.s2`.
- If SRECORD = S3, the Motorola S record file gets the extension `.s3`.
- If SRECORD is not set, the Motorola S record file gets the extension `.sx`.

This file is written to the directory given in the environment variable ABSPATH. If the variable contains more than one path, the S record file is written to the first directory specified. If this variable is not set, the S record file is written to the directory where the parameter file was found.

4.5 MAP FILES

After a successful link session, the linker generates a MAP file containing information about the link process (see figure below). This file is written to the directory given in the environment variable TEXTPATH. If the variable contains more than one path, the MAP file is written to the first directory specified. If this variable is not set, the MAP file is written to the directory where the parameter file was found. MAP files always get the extension `.map`.

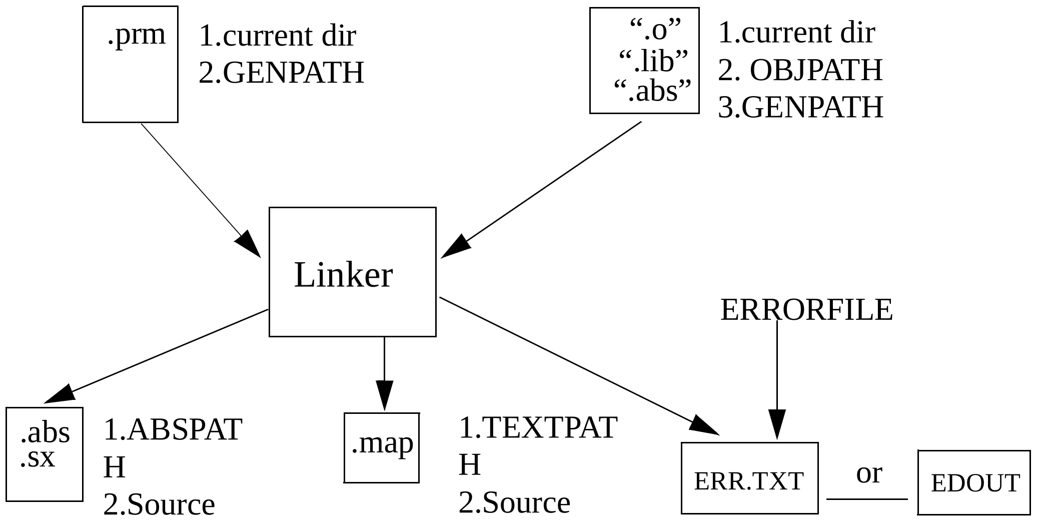


Figure 4-1. Link Process Conceptual Diagram

CHAPTER 5

LINKER OPTIONS AND ISSUES

5.1 INTRODUCTION

The MCUez Linker offers a number of options to control linker operation. Options are composed of a minus/dash ('-') followed by one or more letters or digits. Anything not starting with a dash/minus is assumed to be the name of a parameter file to be linked. Linker options may be specified on the command line or in the LINKOPTIONS variable. Typically, each option is specified once per linking session.

NOTE

Arguments for an option must not exceed 128 characters.

Command line options are not case sensitive. For example, "`–o=test.abs`" is the same as "`–O=TEST.ABS`".

When the LINKOPTIONS variable is set, the linker appends the variable settings to its command line each time a new file is linked. This variable can be used to globally specify options that should always be set. The remainder of this section describes each of the linker options. The options are listed in alphabetical order and divided into the following sections.

Table 5-1. MCUez Linker Options Descriptions

Topic	Description
Syntax	Specifies the syntax of the option in an EBNF format.
Arguments	Describes and lists optional and required arguments.
Default	Shows the default setting for the option.
Description	Provides a detailed description of the option and how to use it.
Example	Gives an example of usage and effects where possible. Linker settings, source code and/or Linker PRM files are displayed where applicable. The examples show an entry in the `default.env` file for PC or in the `.hidefaults` for UNIX.
See also	Names related options.

5.2 -E LINKER OPTION

-E:	Define Application Entry Point
Syntax:	"-E=" <FunctionName>.
Arguments:	<FunctionName>: Name of the function, which is considered to be the entry point in the application.
Default:	none.
Description:	This option specifies the name of the application entry point. When the entry point is located in an assembly object file, the corresponding symbol must be a global symbol (Specified in an XDEF directive).
Example:	`LINKOPTIONS=-E=entry`
	This is the same as using the command:
	`INIT entry`
	in the PRM file
See also:	Command INIT

5.3 -O LINKER OPTION

-O:	Define Absolute File Name
Syntax:	"-O=" <FileName>
Arguments:	<fileName>: Name of the absolute file to be generated by the linking session.
Default:	None.
Description:	This option defines the name of the ABS file that must be generated.
Example:	`LINKOPTIONS=-O=test.abs`
	This is the same as using the command:
	`LINK test.abs`
	in the PRM file
See also:	Command LINK

5.4 -M LINKER OPTION

-M:	Generate MAP File
Syntax:	"-M"
Arguments:	None.
Default:	None.
Description:	This option forces generation of a MAP file after a successful link session.

Example:	`LINKOPTIONS=-M`
	This is the same as using the command:
	`MAPFILE ALL`
	in the PRM file

See also:	Command MAPFILE

5.5 -S LINKER OPTION

-S:	Do not generate DWARF Information
Syntax:	"-S"
Arguments:	None.
Default:	None.
Description:	This option disables the generation of DWARF sections in the absolute file. This will reduce the amount of memory used on your PC.
Example:	`LINKOPTIONS=-S`
See also:	None

NOTE

If the absolute file does not contain DWARF information, you will not be able to debug it.

5.6 -V LINKER OPTION

-V:	Prints the Linker Version
Syntax:	"-V".
Arguments:	None.
Default:	None.
Description:	Prints the Linker version and the project directory.
Example:	-V produces the following list:

```
Directory: D:\mcuez\PROG
MCUez ELF Linker V-1.0.29
CCPP User Interface Module, V-1.0.4, Date Jul 18 1997
```

See also: None.

NOTE

This option can be used to determine the project directory.

5.7 -W1 LINKER OPTION

-W1:	No Information Messages
Syntax:	"-W1"
Arguments:	None.
Default:	None.
Description:	Suppresses all INFORMATION messages; WARNING and ERROR messages are printed.
Example:	`LINKOPTIONS=-W1`
See also:	None

5.8 -W2 LINKER OPTION

-W2:	No Information and Warning Messages
Syntax:	"-W2".
Arguments:	None.
Default:	None.
Description:	Suppresses all INFORMATION and WARNING messages, only ERRORs are printed.
Example:	`LINKOPTIONS=-W2`
See also:	None

5.9 LINKING ISSUES

The following sections identify specific application issues for the MCUez Linker.

5.9.1 Object Allocation

Object allocation is performed through the SEGMENTS and PLACEMENT blocks.

5.9.1.1 The SEGMENTS Block

The segments block is optional. It increases readability of the linker input file by assigning meaningful names to contiguous memory areas on the target board. Memory within such an area share common attributes:

- Qualifier
- Alignment Rules
- Filling Character

Two types of segments can be defined:

- Physical Segments
- Virtual Segments

Physical segments are closely related to hardware memory areas.

For example, there may be one READ_ONLY segment for each bank of the target board ROM area and another one covering the RAM area.

Example:

Using the small memory model you can define a segment for the RAM area and another one for the ROM area.

```
LINK   test.abs
NAMES  test.o startup.o END
SEGMENTS
  RAM_AREA = READ_WRITE 0x00000 TO 0x07FFF;
  ROM_AREA = READ_ONLY  0x08000 TO 0x0FFFF;
END
PLACEMENT
    .data             INTO RAM_AREA;
    .text             INTO ROM_AREA;
END
STACKSIZE 0x50
```

Using the banked memory model you can define a segment for the RAM area, another for the non-banked ROM area, and one for each target processor bank.

```
LINK   test.abs
NAMES  test.o startup.o END
```

```
SEGMENTS
  RAM_AREA        = READ_WRITE 0x00000 TO 0x07FFF;
  NON_BANKED_AREA = READ_ONLY  0x0C000 TO 0x0FFFF;
  BANK0_AREA      = READ_ONLY  0x08000 TO 0x0BFFF;
  BANK1_AREA      = READ_ONLY  0x18000 TO 0x1BFFF;
  BANK2_AREA      = READ_ONLY  0x28000 TO 0x2BFFF;
END
PLACEMENT
    .data              INTO RAM_AREA;
    .init, .startData,
    .rodata1,
    NON_BANKED, .copy INTO NON_BANKED_AREA;
    .text              INTO BANK0_AREA, BANK1_AREA,
                            BANK2_AREA;
END
STACKSIZE 0x50
```

A physical segment may be split into several virtual segments, allowing a better structuring of object allocation and taking advantage of some processor specific properties.

Example:

In the small memory model you can define a segment for the direct page area, another for the rest of the RAM area, and another one for the ROM area.

```
LINK   test.abs
NAMES  test.o startup.o END

SEGMENTS
  DIRECT_RAM = READ_WRITE 0x00000 TO 0x000FF;
  RAM_AREA   = READ_WRITE 0x00100 TO 0x07FFF;
  ROM_AREA   = READ_ONLY  0x08000 TO 0x0FFFF;
END
PLACEMENT
    myRegister         INTO DIRECT_RAM;
    .data              INTO RAM_AREA;
    .text              INTO ROM_AREA;
END
STACKSIZE 0x50
```

5.9.1.1.1 Segment Qualifier

Different qualifiers are available for segments. The following table identifies and defines all available qualifiers.

Table 5-2. Segment Qualifier Descriptions

Qualifier	Meaning
READ_ONLY	Qualifies a segment, where read only access is allowed. Objects within such a segment are initialized at application loading time.
READ_WRITE	Qualifies a segment, where read and write accesses are allowed. Objects within such a segment are initialized at application startup. This is only the case when linking a High Level Language (ANSI C or C++) application.
NO_INIT	Qualifies a segment, where read and write accesses are allowed. Objects within such a segment remain unchanged during application startup. This qualifier may be used for segments refering to a battery backed RAM. Sections placed in a NO_INIT segment should not contain an initialized variable (variable defined as ‘int c = 8’).This is only the case when linking a High Level Language (ANSI C or C++) application.
PAGED	Qualifies a segment, where read and write accesses are allowed. Objects within such a segment remain unchanged during application startup. Additionally, objects located in two PAGED segments may overlap. This qualifier is used for memory areas, where some user defined page switching mechanism is required. Sections placed in a NO_INIT segment should not contain an initialized variable (variable defined as ‘int c = 8’).This is only the case when linking a High Level Language (ANSI C or C++) application.

5.9.1.1.2 Segment Alignment

The default alignment rule depends on the processor and memory model used. The HC12, HC08, and HC05 processors do not require alignment for code or data objects. One can choose to define their own alignment rule for a segment. The alignment rule defined for a segment block overrides the default alignment rules associated with the processor and memory model.

The alignment rule has the following format:

```
[defaultAlignment] {"["ObjSizeRange":"alignment"]"}
```

Table 5-3. Segment Alignment Rule Format

Item	Description
defaultAlignment	The alignment value for all objects that do not match the conditions of a range defined afterward.
ObjSizeRange	Defines a certain condition. The condition has the form: size : rule applies to objects, where size is equal to ‘size’ < size : rule applies to objects, where size is smaller than ‘size’ > size: rule applies to objects, where size is bigger than ‘size’ <= size: rule applies to objects, where size is smaller or equal to ‘size’ >= size: rule applies to objects, where size is bigger or equal to ‘size’ From size1 to size2: the rule applies to objects, where size is greater or equal to ‘size1’ and smaller or equal to ‘size2’.
alignment	Defines the alignment value for objects matching the condition defined in the current alignment block (enclosed in square brackets).

Example:

```
LINK   test.abs
NAMES  test.o startup.o END

SEGMENTS
  DIRECT_RAM = READ_WRITE 0x00000 TO 0x000FF
               ALIGN 2 [< 2: 1];
  RAM_AREA   = READ_WRITE 0x00100 TO 0x07FFF
               ALIGN [1:1] [2..3:2] [>=4:4];
  ROM_AREA   = READ_ONLY  0x08000 TO 0x0FFFF;
END
PLACEMENT
    myRegister        INTO DIRECT_RAM;
    .data             INTO RAM_AREA;
    .text             INTO ROM_AREA;
END
STACKSIZE 0x50
```

In previous example:

- In segment DIRECT_RAM, objects whose size is 1 byte are aligned on byte boundary, all other objects are aligned on 2-byte boundary.

- In segment RAM_AREA, 1 byte objects are aligned on byte boundary, objects equal to 2 or 3 bytes are aligned on 2-byte boundary, all other objects are aligned on 4-byte boundary.
- Default alignment rule applies to the ROM_AREA segment.

5.9.1.1.3 Segment Fill Pattern

The default fill pattern for code and data segments is the null character. You can define your own fill pattern for a segment. The fill pattern definition in the segment block overrides the default fill pattern. A fill pattern can be defined for the READ_WRITE memory area only when linking a high level language (ANSI C, C++) application.

Example:

```
LINK   test.abs
NAMES  test.o startup.o END

SEGMENTS
  DIRECT_RAM = READ_WRITE 0x00000 TO 0x000FF
               FILL 0xAA;
  RAM_AREA   = READ_WRITE 0x00100 TO 0x07FFF
               FILL 0x22;
  ROM_AREA   = READ_ONLY  0x08000 TO 0x0FFFF;
END
PLACEMENT
    myRegister        INTO DIRECT_RAM;
    .data             INTO RAM_AREA;
    .text             INTO ROM_AREA;
END
STACKSIZE 0x50
```

In previous example:

- In segment DIRECT_RAM, alignment bytes between objects are initialized with 0xAA.
- In segment RAM_AREA, alignment bytes between objects are initialized with 0x22.
- In segment ROM_AREA, alignment bytes between objects are initialized with 0x00.

5.9.1.2 PLACEMENT Block

The placement block allows you to physically place each section in a specific memory area (segment). The sections specified in a PLACEMENT block may be linker-predefined sections or user sections specified in one of the source files used to build the application.

A programmer may decide to organize data into sections:

- to enhance application structure
- to ensure that common purpose data is grouped together
- to take advantage of target processor specific addressing mode.

5.9.1.2.1 Specifying a List of Sections

When several sections are specified on a PLACEMENT statement, the sections are allocated in the sequence they are listed.

Example:

```
LINK   test.abs
NAMES  test.o startup.o END

SEGMENTS
  RAM_AREA   = READ_WRITE 0x00100 TO 0x002FF;
  STK_AREA   = READ_WRITE 0x00300 TO 0x003FF;
  ROM_AREA   = READ_ONLY  0x08000 TO 0x0FFFF;
END
PLACEMENT
    .data, dataSec1,
     dataSec2          INTO RAM_AREA;
    .text, myCode      INTO ROM_AREA;
    .stack             INTO STK_AREA;
END
```

In previous example:

- Inside of segment RAM_AREA, the objects defined in the .data section are allocated first, then objects defined in section dataSec1 and finally objects defined in section dataSec2.
- Inside of segment ROM_AREA, objects defined in the .text section are allocated, then objects defined in section myCode.

NOTE

Since the linker is case sensitive, section names specified in the PLACEMENT block must be valid predefined or user defined sections. Sections DataSec1 and dataSec1 are different sections.

5.9.1.2.2 Specifying a List of Segments

When several segments are specified on a PLACEMENT statement, the segments are used in the sequence they are listed. Allocation is performed for the first segment in the list, until this segment is full. Then allocation continues for the next segment in the list, an so on until all objects are allocated.

Example:

```
LINK   test.abs
 NAMES  test.o startup.o END
 SEGMENTS
   RAM_AREA        = READ_WRITE 0x00100 TO 0x002FF;
   STK_AREA        = READ_WRITE 0x00300 TO 0x003FF;
   NON_BANKED_AREA = READ_ONLY  0x0C000 TO 0x0FFFF;
```

```
    BANK0_AREA      = READ_ONLY  0x08000 TO 0x0BFFF;
    BANK1_AREA      = READ_ONLY  0x18000 TO 0x1BFFF;
    BANK2_AREA      = READ_ONLY  0x28000 TO 0x2BFFF;
  END
  PLACEMENT
      .data              INTO RAM_AREA;
      .stack             INTO STK_AREA;
      .init, .startData,
      .rodata1,
      NON_BANKED, .copy INTO NON_BANKED_AREA;
      .text              INTO BANK0_AREA, BANK1_AREA,
                              BANK2_AREA;
  END
```

In previous example:

- Functions implemented in section .text are allocated first in segment BANK0_AREA. When memory for this segment is filled, allocation continues in segment BANK_1_AREA, then in BANK2_AREA.

NOTE

Since the linker is case sensitive, segment names specified in the PLACEMENT block must be valid segment names defined in the SEGMENTS block. Segments Ram_Area and RAM_AREA are different segments.

5.9.2 Allocating User-Defined Sections

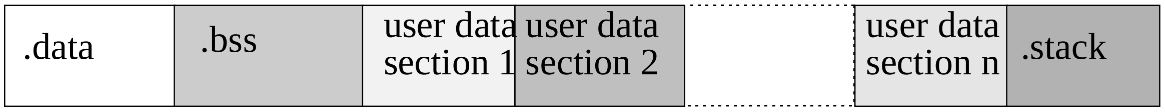
Not all sections need to be listed in the PLACEMENT block. Segments in which sections are allocated, depends on the type of section.

- Sections containing data are allocated next to the .data section.
- Sections containing code, constant variables, or string constants are allocated next to the .text section.

In the segment where .data is placed, allocation is performed as follows:

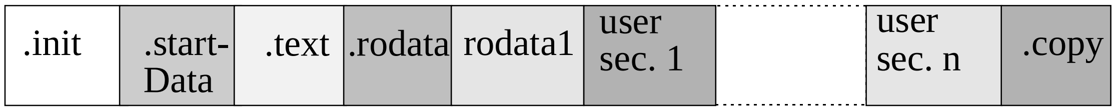
- Objects from section .data are allocated
- Objects from section .bss are allocated (if .bss is not specified in the PLACEMENT block).
- Objects from the first user defined data section, which is not specified in the PLACEMENT block, are allocated.
- Objects from the next user defined data section, which is not specified in the PLACEMENT block, are allocated.
- and so on until all user defined data sections are allocated.

- If the section .stack is not specified in the PLACEMENT block and is defined with a STACKSIZE command, the stack is allocated.



Allocation in the segment where .text is placed is performed as follows:

- Objects from section .init are allocated (if .init is not specified in the PLACEMENT block).
- Objects from section .startData are allocated (if .startData is not specified in the PLACEMENT block).
- Objects from section .text are allocated.
- Objects from section .rodata are allocated (if .rodata is not specified in the PLACEMENT block).
- Objects from section .rodata1 are allocated (if .rodata1 is not specified in the PLACEMENT block).
- Objects from the first user defined code section, which is not specified in the PLACEMENT block, are allocated.
- Objects from the next user defined code section, which is not specified in the PLACEMENT block, are allocated.
- and so on until all user defined code sections are allocated.
- Objects from section .copy are allocated (if .copy is not specified in the PLACEMENT block).



CHAPTER 6
OPERATING PROCEDURES

6.1 INTRODUCTION

This chapter defines operating procedures for the MCUez Linker application.

6.2 INITIALIZING THE VECTOR TABLE

The following sections describe how to initialize the vector table. The vector table can be initialized in the assembly source file or in the linker parameter file. Initialization in the PRM file is recommended.

6.2.1 VECTOR Command

This command initializes the vector table. The syntax “VECTOR <Number>” is only valid when the vector table starts at address 0x0000. The syntax VECTOR ADDRESS is valid in any case. The size of entries in the vector table depends on the target processor. Different syntaxes are available for the VECTOR command (Table 6-1).

Table 6-1. VECTOR Command Syntax

Command	Meaning
VECTOR ADDRESS 0xFFFE 0x1000	Indicates that the value 0x1000 must be stored at address 0xFFFE
VECTOR ADDRESS 0xFFFE FName	Indicates that the address of the FName function must be stored at address 0xFFFE
VECTOR ADDRESS 0xFFFE FName + 2	Indicates that the address of the FName function incremented by 2 must be stored at address 0xFFFE

The last syntax may be very useful, when working with a common interrupt service routine.

6.2.1.1 Initializing the Vector Table in the Linker PRM File

Initializing the vector table from the PRM file allows you to initialize single entries in the table (shown in the example below). The user can decide whether to initialize all entries in the vector table or not. The labels or functions, must be inserted in the vector table and implemented in the assembly source file. All labels must be published otherwise they cannot be addressed in the linker PRM file.

Example for HC08:

```
          XDEF IRQFunc, SWIFunc, ResetFunc
DataSec: SECTION
Data: DS.W 5 ; Each interrupt increments another element of table.
CodeSec: SECTION
; Implementation of the interrupt functions.
IRQ1Func:
           LDA  #0
           BRA int
SWIFunc:
           LDA  #4
           BRA int
ResetFunc:
           LDA  #8
           BRA entry
int:
           PSHH
           LDHX #Data ; Load address of symbol Data in X
           ; X <- address of the appropriate element in the table
Ofset:     TSTA
           BEQ  Ofset3
Ofset2:
           AIX  #$1
           DECA
           BNE  Ofset2
Ofset3:
           INC  0, X   ; The table element is incremented
           PULH
           RTI
entry:
           LDHX  #$0E00 ; Init Stack Pointer to $E00-$1=$DFF
           TXS
           CLRX
           CLRH

           CLI          ; Enables interrupts

loop:      BRA loop
```

NOTE

> The functions 'IRQFunc', 'XIRQFunc', 'SWIFunc', 'OpCodeFunc', and 'ResetFunc' are published. This is required, because they are referenced in the linker PRM file.

The HC08 processor automatically pushes the PC, X, A, and CCR registers on the stack when an interrupt occurs. The interrupt function does not need to save and restore the registers it is using. To maintain compatibility with the M6805 Family, the H register is not stacked, it is the user's responsibility to save and restore it prior to returning. All interrupt functions must be terminated with an RTI instruction. The vector table is initialized using the linker command VECTOR ADDRESS.

Example:

```
LINK test.abs
NAMES
  test.o
END
SEGMENTS
  MY_ROM   = READ_ONLY  0x0800 TO 0x08FF;
  MY_RAM   = READ_WRITE 0x0B00 TO 0x0CFF;
  MY_STACK = READ_WRITE 0x0D00 TO 0x0DFF;
END
PLACEMENT
  .data        INTO MY_RAM;
  .text        INTO MY_ROM;
  .stack       INTO MY_STACK;
END
INIT ResetFunc
VECTOR ADDRESS 0xFFF8 IRQ1Func
VECTOR ADDRESS 0xFFFC SWIFunc
VECTOR ADDRESS 0xFFFE ResetFunc
```

The statement 'INIT ResetFunc' defines the application entry point. Usually, this entry point is initialized with the same address as the reset vector. The statement 'VECTOR ADDRESS 0xFFF2 IRQFunc' specifies that the address of function 'IRQFunc' should be written at address 0xFFF2.

6.2.1.2 Initializing the Vector Table in the Assembly Source File Using a Relocatable Section

Initializing the vector table in the assembly source file requires that all entries in the table be initialized. Unused interrupts must be associated with a standard handler.

The labels or functions, which should be inserted in the vector table, must be implemented in one of the assembler source files. The vector table can be defined in an assembly source file in an additional section containing constant variables.

Example for HC08:

```
         XDEF ResetFunc
DataSec: SECTION
Data:     DS.W 5  ; Each interrupt increments an element of the
table.
CodeSec: SECTION
; Implementation of the interrupt functions.
IRQ1Func:
          LDA  #0
          BRA  int
SWIFunc:
          LDA  #4
          BRA  int
ResetFunc:
          LDA  #8
          BRA  entry
DummyFunc:
          RTI
int:
          PSHH
          LDHX  #Data  ; Load address of symbol Data in X
          ; X <- address of the appropriate element in the tab
Ofset:    TSTA
          BEQ  Ofset3
Ofset2:
          AIX  #$1
          DECA
          BNE  Ofset2
Ofset3:
          INC  0, X    ; The table element is incremented
          PULH
          RTI
entry:
          LDHX  #$0E00 ; Init Stack Pointer to $E00-$1=$DFF
          TXS
          CLRX
          CLRH
          CLI          ; Enables interrupts
loop:     BRA loop
VectorTable:   SECTION
; Definition of the vector table.
IRQ1Int:       DC.W IRQ1Func
IRQ0Int:       DC.W DummyFunc
SWIInt:        DC.W SWIFunc
ResetInt:      DC.W ResetFunc
```

Each constant in the section ‘VectorTable’ is defined as a word (2 Byte constant). Each word entry in the vector table is 16 bits wide. In the previous example, the constant ‘IRQ1Int’ is initialized with the address of the label ‘IRQ1Func’. The constant ‘SWIInt’ is initialized with the address of the label ‘SWIFunc’. All labels specified as an initialization value must be defined, published (using XDEF), or imported (using XREF) before the vector table section. Forward referencing is not allowed in the DC directive.

When developing a banked application, ensure that interrupt functions are located in the non-banked memory area.

The section should now be placed at the expected address. This is performed in the linker parameter file, shown in the example below.

Example:

```
LINK test.abs
NAMES
  test.o
END
SEGMENTS
  MY_ROM   = READ_ONLY  0x0800 TO 0x08FF;
  MY_RAM   = READ_WRITE 0x0B00 TO 0x0CFF;
  MY_STACK = READ_WRITE 0x0D00 TO 0x0DFF;
/* Define the memory range for the vector table */
  Vector   = READ_ONLY  0xFFF8 TO 0xFFFF;
END
PLACEMENT
  .data        INTO MY_RAM;
  .text        INTO MY_ROM;
  .stack       INTO MY_STACK;
/* Place the section 'VectorTable' at the appropriated address. */
  VectorTable  INTO Vector;
END
INIT ResetFunc
ENTRIES
  *
END
```

The statement ‘Vector = READ_ONLY 0xFFF8 TO 0xFFFF’ defines the memory range for the vector table. The statement ‘VectorTable INTO Vector’ specifies that the vector table should be loaded in the read only memory area Vector. The constant ‘IRQ1Int’ will be allocated at address 0xFFF8, the constant ‘XIRQ0Int’ will be allocated at address 0xFFFA, and so on. The constant ‘ResetInt’ will be allocated at address 0xFFFE. The statement ‘ENTRIES * END’ switches smart linking OFF. If this statement is missing from the PRM file, the vector table will not be linked with the application; because it is never referenced. The smart linker only links the objects referenced in the absolute file.

6.2.1.3 Initializing the Vector Table in the Assembly Source File Using an Absolute Section

Initializing the vector table in the assembly source file requires that all entries in the table be initialized. Unused interrupts must be associated with a standard handler. Labels or functions inserted in the vector table must be implemented in one of the assembly source files. The vector table can be defined in an assembly source file in an additional section containing constant variables, shown in the example below.

Example for HC08:

```
          XDEF ResetFunc
DataSec: SECTION
Data:     DS.W 5   ; Each interrupt increments an element of the
table.
CodeSec: SECTION
; Implementation of the interrupt functions.
IRQ1Func:
          LDA  #0
          BRA  int
SWIFunc:
          LDA  #4
          BRA  int
ResetFunc:
          LDA  #8
          BRA  entry
DummyFunc:
          RTI
int:
          PSHH
          LDHX  #Data  ; Load address of symbol Data in X
          ; X <- address of the appropriate element in the tab
Ofset:    TSTA
          BEQ  Ofset3
Ofset2:
          AIX  #$1
          DECA
          BNE  Ofset2
Ofset3:
          INC  0, X    ; The table element is incremented
          PULH
          RTI
entry:
          LDHX  #$0E00 ; Init Stack Pointer to $E00-$1=$DFF
          TXS
          CLRX
          CLRH
          CLI          ; Enables interrupts

loop:     BRA loop
```

```
               ORG $FFF8
; Definition of the vector table in an absolute section
; starting at address $FFF8.
IRQ1Int:       DC.W IRQ1Func
IRQ0Int:       DC.W DummyFunc
SWIInt:        DC.W SWIFunc
ResetInt:      DC.W ResetFunc
```

Each constant in the section ‘VectorTable’ is defined as a word (2 Byte constant). Each entry in the vector table is 16 bits wide. In the previous example, the constant ‘IRQ1Int’ is initialized with the address of the label ‘IRQ1Func’. In the previous example, the constant ‘SWIInt’ is initialized with the address of the label ‘SWIFunc’. All labels specified as an initialization value must be defined, published (using XDEF), or imported (using XREF) before the vector table section. Forward referencing is not allowed in DC directive. The statement ‘ORG $FFF8‘ specifies that the following section must start at address $FFF8.

When developing a banked application, ensure that interrupt functions are located in the non-banked memory area. The section should now be placed at the expected address. This is performed in the linker parameter file, shown in the following example.

Example:

```
LINK test.abs
NAMES
  test.o
END
SEGMENTS
  MY_ROM  = READ_ONLY  0x0800 TO 0x08FF;
  MY_RAM  = READ_WRITE 0x0A00 TO 0x0BFF;
END
PLACEMENT
  .data        INTO MY_RAM;
  .text        INTO MY_ROM;
END
INIT ResetFunc
ENTRIES
  *
END
```

The statement ‘ENTRY * END’ switches smart linking OFF. If this statement is missing in the PRM file, the vector table will not be linked with the application. The vector table is not a referenced entity. The linker links referenced objects only in the absolute file.

6.3 SMART LINKING

Smart linking links referenced objects with the application. Application entry points are:

- The application init function
- The functions or constants located in an absolute section (section defined with ORG in the assembly source file)
- The function specified in a VECTOR command.

All previously listed entry points and the objects they referenced are automatically linked with the application. You can specify additional entry points using the **ENTRIES** command in the PRM file.

6.3.1 Mandatory Linking From an Object

You can choose to link non-referenced objects in your application. This may be useful to ensure that a software version number is linked with the application and stored in the final product EPROM. This may also be useful to ensure that a vector table, which has been defined as a constant table of function pointers or as a constant section, is linked with the application.

Example :

```
ENTRIES
  myVar1 myVar2 myProc1 myProc2
END
```

In this example, the variables myVar1 and myVar2, and functions myProc1 and myProc2 are specified to be additional entry points in the application.

6.3.2 Mandatory Linking From All Objects Defined in a File

You can choose to link all objects defined in a specified object file.

Example :

```
ENTRIES
  myFile1.o:* myFile2.o:*
END
```

In this example, all objects (functions, variables, constant variables or string constants) defined in `myFile1.o` and `myFile2.o` are specified as additional entry points in the application.

6.3.3 Switching OFF Smart Linking for the Application

Switch smart linking off to link all objects in the application.

Example :

```
ENTRIES
  *
END
```

In this example:

Smart linking is switched OFF for the whole application. All objects, defined in one of the binary files that builds the application, are linked with the application.

6.4 BINARY FILES BUILDING AN APPLICATION

Specify binary file names in the NAMES block or ENTRIES block. Usually a NAMES block is sufficient.

6.4.1 NAMES Block

All binary files building the application are usually listed in the NAMES block. This is the only place where absolute, library, or object library files may be specified.

Example :

```
NAMES
  myFile1.o myFile2.o
END
```

In this example, the binary files `myFile1.o` and `myFile2.o` build the application.

6.4.2 ENTRIES Block

If a file name is specified in the ENTRIES block, the corresponding file is considered to be part of the application, even if it does not appear in the NAMES block. The file specified in the ENTRIES block may also be present in the NAMES block (shown in the example below). Names of absolute, ROM library or library files are not allowed in the ENTRIES block.

Example:

```
LINK   test.abs
NAMES  test.o startup.o END

SEGMENTS
  DIRECT_RAM = READ_WRITE 0x00000 TO 0x000FF;
  STK_AREA   = READ_WRITE 0x00200 TO 0x002FF;
  RAM_AREA   = READ_WRITE 0x00300 TO 0x07FFF;
  ROM_AREA   = READ_ONLY  0x08000 TO 0x0FFFF;
```

```
END
PLACEMENT
    myRegister         INTO DIRECT_RAM;
    .data              INTO RAM_AREA;
    .text              INTO ROM_AREA;
    .stack             INTO STK_AREA;
END
ENTRIES
  test1.o:* test.o:*
END
```

In previous example, the files `test.o`, `test1.o`, and `startup.o` build the application. All objects defined in the modules test1.o and test.o will be linked with the application.

6.4.3 Linking an Assembly Application

The following example shows how to link an application.

When an application consists only of assembly files, the linker PRM file can be simplified.

- No startup structure is required.
- No stack initialization is required, because the stack is directly initialized in the source file.
- No main function is required.
- An entry point in the application is required.
- All symbols referenced in the PRM file must be published (specified in a XDEF directive). There is no local symbol defined in the assembler.

Example:

```
LINK   test.abs
NAMES  test.o test2.o END
SEGMENTS
  DIRECT_RAM = READ_WRITE 0x00000 TO 0x000FF;
  RAM_AREA   = READ_WRITE 0x00300 TO 0x07FFF;
  ROM_AREA   = READ_ONLY  0x08000 TO 0x0FFFF;
END
PLACEMENT
    myRegister         INTO DIRECT_RAM;
    .data              INTO RAM_AREA;
    .text              INTO ROM_AREA;
END
INIT Start                    ; Application entry point
VECTOR ADDRESS 0xFFFE Start ; Initialize Reset Vector
```

In the previous example:

- All data sections defined in the assembly input files are allocated in the segment RAM_AREA.
- All code and constant sections defined in the assembly input files are allocated in the segment ROM_AREA.
- The START function defines an application entry point and a reset vector. START must be a global symbol defined in one of the assembly modules.

6.4.4 Warning Messages

An assembly application does not need a startup structure or root function.

The two warnings:

```
 ‘WARNING: _startupData not found‘
```

and

```
 ‘WARNING: Function main not found‘
```

can be ignored.

- **Smart Linking** - When an assembly application is linked, smart linking is performed on section level instead of object level. Sections containing referenced objects are linked with the application.

Example for HC08:

Assembly source file

```
            XDEF entry
dataSec1:   SECTION SHORT
data1:      DS.W 1
dataSec2:   SECTION SHORT
data2:      DS.W 2
codeSec:    SECTION
entry:
            NOP
            NOP
            LDX  #data1
            LDA  #$45
            STA  0, X
loop:       BRA loop
```

Linker PRM file

```
LINK    test.abs
NAMES   test.o END
```

```
SEGMENTS
  RAM_AREA   = READ_WRITE 0x00050 TO 0x000FF;
  ROM_AREA   = READ_ONLY  0x08000 TO 0x0FFFF;
END
PLACEMENT
    .data             INTO RAM_AREA;
    .text             INTO ROM_AREA;
END
INIT entry
VECTOR ADDRESS 0xFFE entry
```

In the previous example:

- The ENTRY function is defined as an application entry point and also specified as reset vector.
- The data section ‘dataSec1’ defined in the assembly input file is allocated in the segment RAM_AREA at address 0x50. This section is linked with the application, because the label ‘data1’ is referenced in the function ‘entry’.
- The code section ‘codeSec’ defined in the assembly input file is allocated in the segment ROM_AREA at address 0x8000. It is linked with the application, because ‘entry’ is the application entry point.
- The data section ‘dataSec2’ defined in the assembly input file is not linked with the application, because the symbol ‘data2’ is never referenced.

You can choose to switch smart linking OFF, so that assembly code and objects will be linked with the application.

For the previous example, the PRM file used to switch smart linking OFF will look as follows:

```
LINK   test.abs
NAMES  test.o END

SEGMENTS
  RAM_AREA   = READ_WRITE 0x00050 TO 0x000FF;
  ROM_AREA   = READ_ONLY  0x08000 TO 0x0FFFF;
END
PLACEMENT
    .data             INTO RAM_AREA;
    .text             INTO ROM_AREA;
END
INIT entry
VECTOR ADDRESS 0xFFE entry
ENTRIES * END
```

In the previous example:

- The ENTRY function is defined as an application entry point and also specified as a reset vector.

- The data section ‘dataSec1’ defined in the assembly input file is allocated in the segment RAM_AREA at address 0x50.
- The data section ‘dataSec2’ defined in the assembly input file is allocated next to the section ‘dataSec1’ at address 0x52.
- The code section ‘codeSec’ defined in the assembly input file is allocated in the segment ROM_AREA at address 0x8000.

6.5 THE PARAMETER FILE

The linker parameter file is an ASCII text file that is required for each application. It contains linker commands that define the linking process. This section describes the parameter file in detail, giving examples you may use as templates for your own parameter files. You might also want to take a look at the example parameter files included in your installation version.

6.5.1 The Syntax of the Parameter File

Following is the EBNF syntax of the parameter file.

```
ParameterFile={Command}
Command= LINK NameOfABSFile
|  NAMES ObjFile {ObjFile} END
|  SEGMENTS {SegmentDef} END
|  PLACEMENT {Placement} END
|  (STACKTOP | STACKSIZE) exp
|  MAPFILE MapSecSpecList
|  ENTRIES EntrySpec {EntrySpec } END
|  VECTOR (InitByAddr | InitByNumber)
|  INIT FuncName
|  MAIN FuncName
NameOfABSFile= FileName
ObjFile= FileName [”+”]
ObjName= Ident
QualIden = FileName “:” Ident
FuncName= ObjName | QualIdent
MapSecSpecList= MapSecSpec “,” { MapSecSpec }
EntrySpec= [FileName“:”] (* | ObjName)
MapSecSpec= ALL | NONE | TARGET | FILE | STARTUP | SEC_ALLOC |
    OBJ_ALLOC | OBJ_DEP | OBJ_UNUSED | COPYDOWN |
    STATSTIC
SegmentDef= SegmentName “=“ SegmentSpec “;”
SegmentName= Ident
SegmentSpec= StorageDevice Range [Alignment] [FILL CharacterList]
StorageDevice= READ_ONLY | READ_WRITE | PAGED | NO_INIT
Range= exp (TO | SIZE) exp
Alignment= ALIGN [exp] {“[“ObjSizeRange“:” exp”]”}
ObjSizeRange=  Number | Number TO Number | CompareOp Number
CompareOp= (“<“ | “>=“ | “>“ | “>=“)
CharacterList= HexByte { HexByte}
Placement= SectionList INTO SegmentList “;”
SectionList= SectionName {“,” SectionName}
SectionName=Ident
SegmentList= Segment {“,” Segment}
Segment= SegmentName | SegmentSpec
InitByAddr= ADDRESS Address Vector
InitByNumber= VectorNumber Vector
Address= Number
VectorNumber= Number
Vector= (FuncName [OFFSET exp] | exp) [“,” exp]
Ident= <any C style identifier>
FileName= <any file name>
exp= Number
Number= DecimalNumber | HexNumber | OctalNumber
HexNumber= 0xHexDigit{HexDigit}
DecimalNumber= DecimalDigit{DecimalDigit}
HexByte= HexDigit HexDigit
HexDigit= “0” | “1”| “2” | “3” | “4” | “5” | “6” | “7” | “8” | “9”|
   “A” | “B” | “C” | “D” | “E” | “F” |
   “a” | “b” | “c” | “d” | “e” | “f”
DecimalDigit= “0” | “1”| “2” | “3” | “4” | “5” | “6” | “7” | “8” |
"9" |
```

- Comments may appear anywhere in a parameter file, except where file names are expected. You may use either C style comments (/* */) or C++(//) style comments.
- File names should not contain paths. This keeps your sources portable. Otherwise, if you copy the sources to another directory, the linker might not find all files needed. The linker uses the paths in the environment variables `GENPATH`, `OBJPATH`, `TEXTPATH` and `ABSPATH` to decide where to look for files and where to write output files.
- The order of commands in the parameter file does not matter. However, ensure that the SEGMENTS block is specified before the PLACEMENT block.
- There are default sections named `.data`, `.text`, `.stack`, `.copy`, `.rodata1`, `.rodata`, `.startData` and `.init`.

6.5.2 Mandatory Parameter File Linker Commands

A linker parameter file always contains at least the entries for `LINK`, `NAMES`, and `PLACEMENT`. All other commands are optional. The following example shows the minimal parameter file:

```
LINK mini.abs  /* Name of resulting ABS file */
NAMES
  mini.o startup.o  /* Files to link */
END
STACKSIZE 0x20       /* in bytes */
PLACEMENT
  .text INTO READ_ONLY  0xA00 TO 0xBFF;
  .data INTO READ_WRITE 0x800 TO 0x8FF;
END
```

The first placement statement

```
.text INTO READ_ONLY 0xA00 TO 0xBFF;
```

reserves the address range from `0xA00` to `0xBFF` for allocation of read-only objects (hence the qualifier `READ_ONLY`). The `.text` section includes all linked functions, constant variables, string constants and initialization parts of variables copied to RAM at startup.

The second placement statement

```
.data INTO READ_WRITE 0x800 TO 0x8FF;
```

reserves the address range from `0x800` to `0x8FF` for allocation of variables.

6.6 LINKER COMMANDS

The following sections describe all Linker commands.

6.6.1 ENTRIES: List of Objects to Link With the Application

Syntax:

```
ENTRIES [Filename”:”] (*|objName)
```

Description:

The ENTRIES block is optional in a PRM file.

Use the ENTRIES block to list objects (referenced or not) that are always linked with the application. The specified objects are used as additional entry points in the application. All objects referenced within these objects will also be linked with the application.

The table below identifies the notation supported in the ENTRIES block.

Table 6-2. ENTRIES Block Supported

Notation	Meaning
<Object Name>	The specified global object will be linked with the application.
<File Name>:<Object Name>	The local object defined in the binary file will be linked with the application. This notation is only valid when referring to a symbol defined in a high level language (ANSI C or C++) module.
<File Name>:*	All objects defined within the specified file will be linked with the application.
*	All objects will be linked with the application. This switches OFF smart linking for the application.

If a file name specified in the ENTRIES block is not present in the NAMES block, the file name will be inserted in the list of binary files building the application.

Symbols defined in an assembly module, which are used as additional entry points, must be published (specified in a XDEF directive).

Example:

```
NAMES
  startup.o
END

ENTRIES
  fibo.o:*
END
```

In the previous example, the application is built from the files `fibo.o` and `startup.o`.

Example:

```
NAMES
  fibo.o startup.o
END

ENTRIES
  fibo.o:*
END
```

In the previous example, the application is built from the files `fibo.o` and `startup.o`. The file ‘`fibo.o`’ specified in the NAMES block is the same as the one specified in the ENTRIES block.

NOTE

We strongly recommend to avoid switching smart linking OFF, when the ANSI library is linked with the application. The ANSI library contains the implementation of all run time functions and standard functions. This generates a large amount of code, which is not required by the application.

6.6.2 INIT: Specify the Application Entry Point

Syntax:

```
INIT  FuncName
```

Description:

The INIT command is mandatory for an assembly application and cannot be specified several times in the PRM file. This command defines the entry point for the application. When INIT is not specified in the PRM file, the linker looks for a function named ‘_Startup’ and uses it as the application entry point. If an INIT command is specified in the PRM file, the linker uses the specified function as the application entry point.

You can specify any static or global function as an entry point.

Example:

```
INIT MyGlobStart /* Specify a global variable as
                    application entry point.*/
INIT myFile.o:myLocStart /* Specify a local variable
                            as application entry point.*/
```

Local symbols defined in an assembly module cannot be specified as an entry point for an application.

6.6.3 LINK - Specify Name of the Output File

Syntax:

```
LINK <NameOfABSFile>
```

Description:

The LINK command defines the file to be generated by the link session. This command is mandatory and can only be specified once in a PRM file. After a successful link session the file “NameOfABSFile” is created. If the environment variable ABSPATH is defined, the absolute file is generated in the first directory listed. Otherwise, it is written to the directory where the parameter file was found. If a file with this name already exists, it is overwritten.

A successful link session also creates a MAP file with the same base name as “NameOfABSFile” and with extension .MAP. If the environment variable TEXTPATH is defined, the MAP file is generated in the first directory listed. Otherwise, it is written to the directory where the parameter file was found. If a file with this name already exists, it is overwritten.

A successful link session also creates an S record file with the same base name as “NameOfABSFile” and with extension .Sx. If the environment variable ABSPATH is defined, the S Record file is generated in the first directory listed. Otherwise, it is written to the directory where the parameter file was found. If a file with this name already exists, it is overwritten.

The LINK command is mandatory in a PRM file. If the LINK command is missing, the linker generates an error message unless the option -O is specified on the command line.

Example:

```
LINK fibo.abs

NAMES  fibo.o startup.o END
SEGMENTS
    MY_RAM = READ_WRITE 0x1000 TO 0x18FF;
    MY_ROM = READ_ONLY  0x8000 TO 0x8FFF;
    MY_STK = READ_WRITE 0x1900 TO 0x1FFF;
PLACEMENT
    DEFAULT_ROM   INTO  MY_ROM;
    DEFAULT_RAM   INTO  MY_RAM;
    SSTACK        INTO  MY_STK;
END
VECTOR ADDRESS 0xFFFE _Startup /* set reset vector */
```

The files fibo.abs, fibo.sx and fibo.map are generated after a successful link process from the previous PRM file.

6.6.4 MAIN

Syntax:

```
MAIN  FuncName
```

Description:

The MAIN command is optional. This command defines the root function for an ANSI C or C++ application (function invoked at the end of startup function). When MAIN is not specified in the PRM file, the linker looks for a function named ‘main’ and uses it as root.

Assembly applications do not require a MAIN function.

If a MAIN command is specified in the PRM file, the linker uses the specified function as root. You can specify any static or global function as the application root function.

Example:

```
MAIN MyGlobMain /* Specify a global variable as
                   application root.*/
MAIN myFile.o:myLocMain /* Specify a local variable as
                           application root.*/
```

Local symbols defined in an assembly module cannot be specified as the root function.

6.6.5 MAPFILE: Configure the MAP File Content

Syntax:

```
MAPFILE (ALL|NONE|TARGET|FILE|STARTUP_STRUCT|SEC_ALLOC|
 OBJ_ALLOC|OBJ_DEP|OBJ_UNUSED|COPYDOWN|STATISTIC)
[,{(ALL|NONE|TARGET|FILE|STARTUP_STRUCT|SEC_ALLOC|
OBJ_ALLOC|OBJ_DEP|OBJ_UNUSED|COPYDOWN|STATISTIC)}]
```

Description:

This command is optional and controls the generation of the MAP file. Per default, the command MAPFILE ALL is activated. This indicates that a map file must be created and contain all linking time information. The following table lists all available MAP file specifiers.

Table 6-3. MAP File Specifiers

Specifier	Meaning
ALL	A map file will be generated containing all information available.
COPYDOWN	Information about the initialization value for objects allocated in RAM will be written to the MAP file (Section COPYDOWN in the map file). This section is only relevant for High level language (ANSI C or C++) applications.
FILE	Information about application source files will be inserted in the MAP file.
NONE	No map file will be generated.
OBJ_ALLOC	Information about allocated objects will be inserted in the map file (Section OBJECT ALLOCATION in the map file).
OBJ_UNUSED	List of all unused objects will be inserted in the map file (Section UNUSED OBJECTS in the map file).
OBJ_DEP	Dependencies between objects in the application will be inserted in the map file (Section OBJECT DEPENDENCY in the map file).
SEC_ALLOC	Information about sections used in the application will be inserted in the map file (Section SECTION ALLOCATION in the map file).
STARTUP_STRUCT	Information about the startup structure will be inserted in the map file (Section STARTUP in the map file). This section is only relevant for High level language (ANSI C or C++) applications.
STATISTIC	Statistic information about the link session will be inserted in the map file (Section STATISTICS in the map file).
TARGET	Information about the target processor and memory model will be inserted in the map file (Section TARGET in the map file).

Information generated for each specifier is described in the MAP file chapter. If ALL is specified in the MAPFILE command, all sections are inserted in the MAP file.

Example:

Following commands are all equivalent. A map file is generated, which contains all possible information about the linking session.

```
MAPFILE ALL
MAPFILE TARGET, ALL
MAPFILE TARGET, ALL, FILE, STATISTIC
```

If NONE is specified in the MAPFILE command, no map file is generated.

Example:

Following commands are all equivalent. No map file is generated.

```
MAPFILE NONE
MAPFILE TARGET, NONE
MAPFILE TARGET, NONE, FILE, STATISTIC
```

NOTE

The following map file commands are also supported:

- MAPFILE OFF is equivalent to MAPFILE NONE
- MAPFILE ON is equivalent to MAPFILE ALL

6.6.6 NAMES: List the Files building the Application.

Syntax:

```
NAMES <FileName>['+'] {<FileName>['+']} END
```

Description:

The NAMES block contains the list of all binary files building the application. This block is mandatory and can only be specified once in a PRM file. The linker reads all files given between NAMES and END. The files are searched for in the project directory, then in the directories specified in the environment variables OBJPATH and GENPATH. The files may be either object files, absolute, or ROM library files or libraries.

Since the linker is a smart linker, only referenced objects (variables and functions) are linked to the application.

A plus sign after a file name (e.g. FileName+) switches OFF smart linking for the specified file. No blank is allowed between the file name and the plus sign. All objects defined in this file will be linked with the application, regardless of whether they are used or not. This is equivalent to specifying the file name followed by a * (fileName:*) in the ENTRIES block.

Example:

```
LINK fibo.abs

NAMES  fibo.o startup.o END
SEGMENTS
    MY_RAM = READ_WRITE 0x1000 TO 0x18FF;
    MY_ROM = READ_ONLY  0x8000 TO 0x8FFF;
    MY_STK = READ_WRITE 0x1900 TO 0x1FFF;
PLACEMENT
    DEFAULT_ROM   INTO  MY_ROM;
    DEFAULT_RAM   INTO  MY_RAM;
    SSTACK        INTO  MY_STK;
END
VECTOR ADDRESS 0xFFFE _Startup /* set reset vector */
```

In this example, the application fibo is built from the files ‘fibo.o’ and ‘startup.o’.

6.6.7 PLACEMENT: Place Sections Into Segments

Syntax:

```
PLACEMENT
  SectionName{,sectionName} INTO SegSpec{,SegSpec};
  {SectionName{,sectionName} INTO SegSpec{,SegSpec};}
END
```

Description:

The PLACEMENT block is mandatory in a PRM file. Each placement statement between the PLACEMENT and END defines a relation between logical sections and physical memory ranges called segments.

Example:

```
SEGMENTS
   MY_RAM = READ_WRITE 0x1000 TO 0x18FF;
   ROM_1   = READ_ONLY  0x8000 TO 0x8FFF;
END
PLACEMENT
  .text, .rodata INTO ROM_1;
END
```

In the previous example, objects from section ‘.text’ are allocated first and then objects from section ‘.rodata’.

Starting with the first section, objects are allocated in the first memory range in the list. If a segment is full, allocation continues in the next segment.

Example:

```
 SEGMENTS
   MY_RAM = READ_WRITE 0x1000 TO 0x18FF;
   ROM_1   = READ_ONLY  0x8000 TO 0x8FFF;
   ROM_2   = READ_ONLY  0xA000 TO 0xAFFF;
END
```

```
PLACEMENT
  .text INTO ROM_1, ROM_2;
END
```

In the previous example, objects from section '.text' are allocated first in segment 'ROM_1' and continues in section 'ROM_2'. A statement inside the PLACEMENT block can be split over several lines and terminated with a semicolon. The SEGMENTS block must always be defined before the PLACEMENT block, because segments referenced in the PLACEMENT block must previously be defined in the SEGMENTS block.

Some restrictions apply to commands specified in the PLACEMENT block:

- The .copy section should be the last section in the section list to be specified in the PLACEMENT block.
- When the .stack section is specified in the PLACEMENT block along with other sections, an additional STACKSIZE command is required in the PRM file.
- Predefined sections .text and .data must always be specified in the PLACEMENT block. They are used to retrieve the default placement for code or variable sections. All code or constant sections, which do not appear in the PLACEMENT block, are allocated in the same segment list as the .text section. All variable sections, which do not appear in the PLACEMENT block, are allocated in the same segment list as the .data section.

6.6.8 SEGMENTS: Define Memory Map

Syntax:

```
SEGMENTS {(READ_ONLY|READ_WRITE|NO_INIT|PAGED)
           <startAddr> (TO <endAddr> | SIZE <size>)
          [ALIGN <alignmentRule>] [FILL <fillPattern>]}
END
```

Description:

The **SEGMENTS** block is optional in a PRM file. The **SEGMENTS** command allows the user to assign meaningful names to address ranges. These names can then be used in subsequent placement statements, thus increasing the readability of the parameter file.

Each address range you define is associated with:

- A qualifier.
- A start and end address or a start address and a size.
- An optional alignment rule.
- An optional fill pattern.

The following qualifiers are available for segments:

- READ_ONLY: Used for address ranges, where read only accesses are allowed.

- READ_WRITE: Used for address ranges, where read write accesses are allowed. Memory area defined with this qualifier will be initialized with 0 at application startup. This is only the case when linking a High Level Language (ANSI C or C++) application.
- NO_INIT: Used for address ranges, where read write accesses are allowed. Memory area defined with this qualifier will not be initialized with 0 at application startup. This may be useful if your target has a battery buffered RAM. This is only the case when linking a High Level Language (ANSI C or C++) application.
- PAGED: Used for address ranges, where read write accesses are allowed. Memory area defined with this qualifier will not be initialized with 0 at application startup. Additionally, the linker will not maintain control if there is an overlap between segments. When overlapped segments are used, it is the user's responsibility to select the correct page before accessing data allocated on a page. This is only the case when linking a High Level Language (ANSI C or C++) application.

Example:

```
SEGMENTS
  ROM   = READ_ONLY  0x1000 SIZE 0x2000;
  CLOCK = NO_INIT    0xFF00 TO   0xFFFF;
  RAM   = READ_WRITE 0x3000 TO   0x3EFF;
  Page0 = PAGED      0x4000 TO   0x4FFF;
  Page1 = PAGED      0x4000 TO   0x4FFF;
END
```

In the previous example:

- Segment 'ROM' is a READ_ONLY memory area. It starts at address 0x1000 and is 0x2000 bytes (from address 0x1000 to 0x2FFF).
- Segment 'RAM' is a READ_WRITE memory area. It starts at address 0x3000 and ends at 0x3FFF (size = 0x1000 bytes).
- Segment 'CLOCK' is a READ_WRITE memory area. It starts at address 0xFF00 and ends at 0xFFFF (size = 100 bytes).
- Segments 'Page0' and 'Page1' are READ_WRITE memory areas. These are overlapping segments. It is the user responsibility to select the correct page before accessing data from these segments.

6.6.8.1 Defining an Alignment Rule

An alignment rule can be associated with each segment in the application. This may be useful when specific alignment rules are expected on a certain memory range due to hardware restrictions.

An alignment rule can be specified as follows:

```
ALIGN [<defaultAlignment>] [{'['(<Number>|
    <Number> 'TO' <Number>|
    ('<' | '>' | '<=' | '>=')<Number>)']:'<alignment>}]
```

`defaultAlignment`: Used to specify the alignment factor for objects that do not match a condition in the following alignment list. If no alignment list is specified, the default alignment factor applies to all objects allocated in the segment. The default alignment factor is optional.

The alignment list contains items of the following form. The specified alignment applies to each object inside the segment.

Table 6-4. Segment Alignment Items List

Notation	Meaning
[<size>:<align.>]	Size is equal to <size>.
[<sz1> TO <sz2>:<align.>]	Size is bigger or equal to <sz1> and smaller or equal to <sz2>.
[<<size>:<align.>]	Size is smaller than <size>.
[<=<size>:<align.>]	Size is smaller or equal to <size>.
[><size>:<align.>]	Size is bigger than <size>.
[>=<size>:<align.>]	Size is bigger or equal to <size>.

Example:

```
SEGMENTS
    RAM_1  = READ_WRITE 0x800 TO 0x8FF
             ALIGN 2 [1:1];
    RAM_2  = READ_WRITE 0x900 TO 0x9FF
             ALIGN [2 TO 3:2] [>= 4:4];
    RAM_3  = READ_WRITE 0xA00 TO 0xAFF
             ALIGN 1 [>=2:2];
END
```

In the previous example:

- Inside of segment RAM_1, all objects with size equal to 1 byte are aligned on a 1 byte boundary and all other objects are aligned on a 2 byte boundary.
- Inside of segment RAM_2, all objects with size equal to 2 or 3 bytes are aligned on a 2 byte boundary and all objects bigger or equal to 4 are aligned on a 4 byte boundary. One byte objects follow the default processor alignment rule.

- Inside of segment RAM_3, all objects bigger or equal to 2 bytes are aligned on a 2 byte boundary and all other objects are aligned on a 1 byte boundary.

6.6.8.2 Defining a Fill Pattern

A fill pattern can be associated with each segment in the application. This may be useful to automatically initialize uninitialized variables in the segments with a predefined pattern. For assembly applications, the fill pattern can only be used in READ_ONLY segments.

A fill pattern can be specified as follows:

```
FILL <HexByte> {<HexByte>}
```

Example:

```
SEGMENTS
    ROM_1  = READ_ONLY 0x800 TO 0x8FF
             FILL 0xAA 0x55;
END
```

In the previous example, fill bytes are initialized with the pattern 0xAA55.

If the size of an object to initialize is higher than the size of the specified pattern, the pattern is repeated as many times as required to fill the objects. In the previous example, an object of four bytes will be initialized with 0xAA55AA55.

If the size of an object to initialize is smaller than the size of the specified pattern, the pattern is truncated to match the size of the object. In the previous example, an object of one byte will be initialized with 0xAA.

When the value specified in an element of a fill pattern does not fit in a byte, it is truncated to a byte value.

Example:

```
SEGMENTS
    ROM_1  = READ_ONLY 0x800 TO 0x8FF
             FILL 0xAA55;
END
```

In the previous example, fill bytes are initialized with the pattern 0x55. The specified fill pattern is truncated to a 1-byte value. Fill patterns provide an initial value to the padding bytes inserted between two objects during object allocation. This marks the unused position with a specific marker and can be detected inside the application. For example, an unused position inside a code section can be initialized with the hexadecimal code for the NOP instruction.

6.6.9 STACKSIZE: Define Stack Size

Syntax:

```
STACKSIZE Number
```

Description:

The STACKSIZE command is optional in a PRM file. Additionally, you cannot specify both STACKTOP and STACKSIZE commands in a PRM file. The STACKSIZE command defines the stack size. We recommend using this command if you do not care where the stack is allocated but only how large it is. When the stack is defined by a STACKSIZE command alone, the stack is placed next to the `.data` section.

Example:

```
SEGMENTS
  MY_RAM = READ_WRITE 0xA00 TO 0xAFF;
  MY_ROM = READ_ONLY  0x800 TO 0x9FF;
END
PLACEMENT
  .text   IN MY_ROM;
  .data   IN MY_RAM;
END
STACKSIZE 0x60
```

In the previous example, if the section `.data` is four bytes wide (from address 0xA00 to 0xA03), the section `.stack` is allocated next to it from address 0xA63 down to address 0xA04. The stack initial value is set to 0xA62.

When the stack is defined by a STACKSIZE command associated with the placement of the `.stack` section, the stack should start at the segment start address. It is incremented by the specified value and defined to the start address of the segment, where `.stack` has been placed.

Example:

```
SEGMENTS
  MY_STK = NO_INIT    0xB00 TO 0xBFF;
  MY_RAM = READ_WRITE 0xA00 TO 0xAFF;
  MY_ROM = READ_ONLY  0x800 TO 0x9FF;
END
PLACEMENT
  .text   IN MY_ROM;
  .data   IN MY_RAM;
  .stack  IN MY_STK;
END
STACKSIZE 0x60
```

In the previous example, the section `.stack` is allocated from address 0xB5F down to address 0xB00. The stack initial value is set to 0xB5E.

In an assembly application, the stack pointer must be initialized in the source code. Defining the stack in the PRM file only ensures no overlap between your stack and the code or data sections in your application.

6.6.10 STACKTOP: Define Stack Pointer Initial Value

Syntax:

```
STACKTOP Number
```

Description:

The STACKTOP command is optional in a PRM file. Additionally, you cannot specify both STACKTOP and STACKSIZE commands in a PRM file. The STACKTOP command defines the initial value for the stack pointer.

Example:

If STACKTOP is defined as:

```
STACKTOP 0xBFF
```

the stack pointer will be initialized with 0xBFF at application startup.

When the stack is defined by a STACKTOP command alone, a default size is assigned to the stack. This size depends on the processor and is big enough to store the target processor PC. When the stack is defined by a STACKTOP command associated with the placement of the `.stack` section, the stack should start at the specified address. It is defined down to the start address of the segment, where `.stack` has been placed.

Example:

```
SEGMENTS
  MY_STK = NO_INIT    0xB00 TO 0xBFF;
  MY_RAM = READ_WRITE 0xA00 TO 0xAFF;
  MY_ROM = READ_ONLY  0x800 TO 0x9FF;
END
PLACEMENT
  .text   IN MY_ROM;
  .data   IN MY_RAM;
  .stack  IN MY_STK;
END
STACKTOP 0xB7E
```

In the previous example, the stack pointer will be defined from address 0xB7E down to address 0xB00.

In an assembly application, the stack pointer must be initialized in the source code. Defining the stack in the PRM file only ensures no overlap between your stack and the code or data sections in your application.

6.6.11 VECTOR: Initialize Vector Table

Syntax:

```
VECTOR  (InitByAddr | InitByNumber)
```

Description:

The VECTOR command is optional in a PRM file.

A vector is a small amount of memory about the size of a function address. This command allows the user to initialize the processor vectors while downloading the absolute file. A VECTOR command consists of a vector location part (containing vector location) and a vector target part (containing the value to store in the vector).

The vector location part can be specified:

- Through a vector number (only valid when the processor vector table starts at address 0). The address where the vector is allocated is evaluated as <Number> * <Size of a Function Pointer>.
- Through a vector address. The keyword ADDRESS must be specified in the vector command.

The vector target part can be specified:

- As a function name
- As an absolute address

Example:

```
VECTOR ADDRESS 0xFFFE _Startup
VECTOR ADDRESS 0xFFFC 0xA00
VECTOR 0 _Startup
VECTOR 1 0xA00
```

In the previous example, if the size of a function pointer is coded on two bytes:

- The vector located at address 0xFFFE is initialized with the address of the function ‘_Startup’.
- The vector located at address 0xFFFC is initialized with the absolute address 0xA00.
- Vector number 0 (located at address 0x000) is initialized with the address of the function ‘_Startup’.
- Vector number 1 (located at address 0x002) is initialized with the absolute address 0xA00.

You can specify an additional offset when the vector target is a function name. In this case, the vector will be initialized with the address of the object plus the specified offset.

Example:

```
VECTOR ADDRESS 0xFFFE CommonISR + 0x10
```

In the previous example, the vector located at address 0xFFE is initialized with the address of the function 'CommonISR' plus 0x10 bytes. If 'CommonISR' starts at address 0x800, the vector will be initialized with 0x810. This notation is useful for the common interrupt handler. All objects specified in a VECTOR command are entry points in the application. They are always linked with the application, as well as the objects they refer to.

6.7 SECTIONS

The `concept` section gives you complete control over allocation of objects in memory. A section is a named group of global objects (variables or functions) associated with a memory area that may be non-contiguous. Objects belonging to a section are allocated in its associated memory range. This chapter describes the use of segmentation in detail.

There are many ways to make use of the `concept` section, the most important being:

- Distribution of two or more groups of functions and other read-only objects to different ROMs.
- Allocating a single function or variable to a fixed absolute address (e.g. to access processor ports using high level language variables).
- Allocating variables in memory locations where special addressing modes may be used.

6.7.1 Terms: Segments and Sections

A *Section* is a named group of global objects declared in the source file, i.e. functions and global variables. A *Segment* is not necessarily a contiguous memory range. In the linker parameter file, each section is associated with a segment so the linker knows where to allocate objects belonging to a section.

6.7.2 Definition of Section

A section definition always consists of two parts: the definition of objects belonging to it, and the memory area(s) associated with it, called segments. The first is done in the source files using pragmas or directives, see *Compiler or Assembler* Manual. The second is done in the parameter file using the `SEGMENTS` and `PLACEMENT` commands (see section on *The Semantics of the Linker Commands*).

6.7.3 Predefined Sections

When linking a high level language (ANSI C or C++) application, a couple of predefined section names can be grouped into sections named by the run-time routines.

- Sections for things besides variables and functions: `.rodata1`, `.copy`, `.stack`.
- Sections for grouping large sets of objects:
  `.data`, `.text`.
- A section for placing objects initialized by the linker: `.startData`.
- A Section to allocate read-only variables: `.rodata`.

NOTE

The sections `.data` and `.text` provide default sections for allocating objects.

Subsequently we will discuss each of these predefined sections.

`.rodata1` All string literals (e.g. “This is a string”) are allocated in section `.rodata1`. If this section is associated with a segment qualified as `READ_WRITE`, the strings are copied from ROM to RAM at startup.

If this section is not mentioned in the `PLACEMENT` block in the parameter file, the string litterals are allocated next to the section `.text`.

`.rodata` Any constant variable declared as `const` in a C module or as DC in an assembler module, which is not allocated in a user-defined section, is allocated in section `.rodata`. Usually, the `.rodata` section is associated with the `READ_ONLY` segment.

If this section is not mentioned in the `PLACEMENT` block in the parameter file, the constant variables are allocated next to the section `.text`.

`.copy` Initialization data belongs to section `.copy`. If a source file contains the declaration

```
int a[] = {1, 2, 3};
```

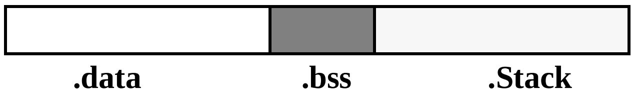
the hex string `000100020003` (6 bytes), which is copied to `a` location in RAM at program startup, belongs to segment `.copy`.

If the `.rodata1` or `.rodata` section is allocated to a `READ_WRITE` segment, all strings or constants also belong to the `.copy` section. Objects in this section are copied at startup from ROM to RAM.

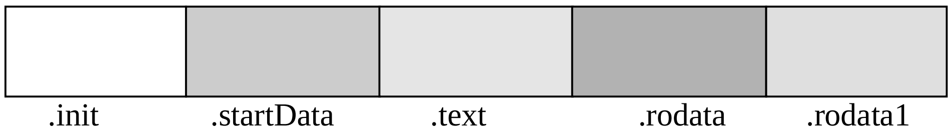
`.stack` The runtime stack has its own segment named `.stack`. It should always be allocated to a `READ_WRITE` segment.

If this section is not mentioned in the `PLACEMENT` block in the parameter file, the constant variables are allocated next to the section `.data`.

.data This is the default section for all objects normally allocated to RAM. It is used for variables not belonging to any section or to a section not assigned a segment in the `PLACEMENT` block. If the `.bss` or `.stack` sections are not associated with a segment, they are included in the `.data` memory area in the following structure.



.text This is the default section for all functions. If a function is not assigned to a certain section in the source code or if its section is not associated with a segment in the parameter file, it is automatically added to section `.text`. If the `.rodata, .rodata1, .startData` or `.init` sections are not associated with a segment, they are included in the `.text` memory area in the following structure.



.startData The startup description data initialized by the linker and used by the startup routine is allocated to segment `.startData`. This section must be allocated to a `READ_ONLY` segment.

.init The application entry point is stored in the `.init` section. This section also has to be associated with a `READ_ONLY` segment.

NOTE

The `.data` and `.text` sections must always be associated with a segment.

6.8 EXAMPLES

Examples 1 and 2 illustrate the use of sections to control allocation of variables and functions precisely.

Example 1:

Distributing code into two different ROMs:

```
LINK first.ABS
NAMES first.o strings.o startup.o END
STACKSIZE 0x200
SECTIONS
  ROM1 = READ_ONLY 0x4000 TO 0x4FFF;
  ROM2 = READ_ONLY 0x8000 TO 0x8FFF;
PLACEMENT
  .text       INTO ROM1, ROM2;
  .data       INTO READ_WRITE 0x1000 TO 0x1FFF;
END
```

Example 2:

Allocation in battery buffered RAM:

```
/* Extract from source file "bufram.c" */
#pragma DATA_SEG Buffered_RAM
  int done;
  int status[100];
#pragma DATA_SEG DEFAULT
/* End of extract from "bufram.c" */
```

Linker parameter file:

```
LINK bufram.ABS
NAMES
  bufram.o startup.o
END
STACKSIZE 0x200
SECTIONS
  BatteryRAM = NO_INIT    0x1000 TO 0x13FF;
  MyRAM      = READ_WRITE 0x5000 TO 0x5FFF;
PLACEMENT
  .text        INTO READ_ONLY 0x2000 TO 0x2800;
  .data        INTO MyRAM;
  Buffered_RAM INTO BatteryRAM;
END
```

6.9 PROGRAM STARTUP

This section deals with advanced material and is only relevant for high level language (ANSI C or C++) applications. First time users of MCUez may skip this section. Standard startup modules are delivered with the MCUez programs and examples. Include startup modules to link the parameter file. For more information about startup modules see the file `Startup.TXT` in directory `LIB.`

Prior to calling root function (`main`):

- initialize the processor registers
- zero out memory
- copy initialization data from ROM to RAM.

Depending on the processor and application needs different startup routines may be necessary. In MCUez, there are standard startup routines for every processor and memory model. Startup routines are based on a startup descriptor containing all information.

6.9.1 The Startup Descriptor

The linker startup descriptor is declared as:

```
typedef struct{
  unsigned char *far beg;int size;
} _Range;
typedef struct{
    int size; unsigned char * far dest;
} _Copy;
typedef void (*_PFunc)(void);
typedef struct{
    _PFunc  *startup;   /* address of startup desc */
} _LibInit;
typedef struct{
    _PFunc  *initFunc;  /* address of init function */
} _Cpp;
extern struct _tagStartup {
     unsigned short  flags;
     _PFunc          main;
     unsigned short  stackOffset;
     unsigned short  nofZeroOuts;
     _Range          *pZeroOut;
     _Copy           *toCopyDownBeg;
     unsigned short  nofLibInits;
     _LibInit        *libInits;
     unsigned short  nofInitBodies;
     _PFunc          *initBodies;
} _startupData;
```

The linker expects the `_startupData` variable to be declared somewhere in your application.

```
struct _tagStartup _startupData;
```

Fields of this `struct` are initialized by the linker and `struct` is allocated in ROM in section `.startData`. If this variable is not declared, the linker does not create a startup descriptor. In this case, there is no `.copy` section and the stack is not initialized. Furthermore, the global C++ constructor and ROM libraries are not initialized.

The fields have the following semantics:

`flags` Contains flags to detect special conditions at startup. Currently two bits are used.

Table 6-5. Setting Startup Descriptor Flags

Bit Number	Set If ...
0	The application has been linked as a ROM Library
1	There is no stack specification.

This flag is tested in the startup code, to determine if the stack pointer should be initialized.

`main` is a function pointer set to the application's root function. In a C program, this is usually function `main` unless a `MAIN` entry in the parameter file specifies another function as root. In a ROM library, this field is zeroed out. The standard startup code jumps to this address once initialization completes.

`stackOffset` is valid only if `flags == 0`. This field contains the initial value of the stack pointer.

`nofZeroOuts` is the number of `READ_WRITE` segments to fill with zero bytes at startup.

This field is not required if you do not have a RAM memory area that should be initialized at startup. Be careful, if this field is not present in the startup structure, the field **`pZeroOut`** must not be present either.

`pZeroOut` is a pointer to a vector with elements of type `_Range`. It has exactly **`nofZeroOuts`** elements, each describing a memory area to be cleared. This field is not required if you do not have a RAM memory area that should be initialized at startup. Be careful, if this field is not present, the field **`nofZeroOuts`** must not be present either.

`toCopyDownBeg` contains the address of the first item to be copied from ROM to RAM at runtime. All data to be copied is stored in a contiguous piece of ROM memory and has the following format:

$\texttt{CopyData = \{Size}_{[2]}\ \texttt{TargetAddr \{Byte\}}^{\texttt{Size}}\texttt{\} 0x0}_{[2]}.$

The size is a binary number whose most significant byte is stored first. This field is not required if you do not have a RAM memory area that should be initialized at startup.

`nofLibInits` is the number of ROM libraries linked with the application that must be initialized at startup. This field is not required if you do not link any ROM libraries with your application. Be careful, if this field is not present in the startup structure, the field **`libInits`** must not be present.

`libInits` is a vector of pointers to the `_startupData` records of all ROM libraries in the application. It has exactly **`nofLibInits`** elements. These addresses are needed to initialize the ROM libraries. This field is not required if you do not link any ROM libraries with your application. Be careful, if this field is not present, the field **`nofLibInits`** must not be present.

`nofInitBodies` is the number of C++ global constructors that must be executed prior to invoking the application root function. This field is not required if your application does not contain any C++ modules. If this field is not present in the startup structure, the field **`initBodies`** must not be present.

`initBodies` is a pointer to a vector of function pointers containing addresses of the global C++ constructors. They are sorted in the order they need to be called. It has exactly **`nofInitBodies`** elements. If an application does not contain any C++ modules, the vector is empty. This field is not required if your application does not contain any C++ modules. If this field is not present in the startup structure, the field **`nofInitBodies`** must not be present.

6.9.2 User-Defined Startup Structure:

The user can define a startup structure. If you change the startup structure, adapt the startup function to match the modifications.

Example:

If there is no RAM area to initialize at startup and no ROM libraries and C++ modules, you can define the startup structure as follows:

```
 extern struct _tagStartup {
     unsigned short  flags;
     _PFunc          main;
     unsigned short  stackOffset;
 } _startupData;
```

The startup code must be adapted accordingly:

```
 extern void near _Startup(void) {
 /*  purpose:  1)  initialize the stack
               2)  call main;
     parameters: NONE */
   do { /* forever: initialize the program; call the root-procedure
*/
```

```
        asm{
          LDD  _startupData.flags
          BNE  Initialize
          LDS  _startupData.stackOffset
        Initialize:
        }
        /* Here user defined code could be inserted,
           the stack can be used
        */
        /* call main() */
        (*_startupData.main)();
      } while(1); /* end loop forever */
    }
```

NOTE

Field names in the startup structure should not be changed. You can remove fields inside the structure, but do not change the names of the different fields.

6.9.3 User-Defined Startup Routines

Two ways to replace the standard startup routine with one of your own:

1. Provide a startup module containing a function named `_Startup` and link it with the application.
2. Implement your own function and define it as an entry point for your application using the command INIT.

```
INIT function_name
```

6.10 THE MAP FILE

If linking succeeds, a protocol of the link process is written to a list file; referred to as the MAP file. The name of the map file is the same as the .ABS file, but with extension .MAP. The map file is written to the directory given by the environment variable TEXTPATH.

The map file consists of up to 9 sections. The following table lists and defines each section.

Table 6-6. MAP File Sections

Alignment Item	Description
TARGET	This section names the target processor and memory model.
FILE	This section lists the names of all files from which objects were used or referenced during the link process. In most cases, these are the same names that are also listed in the linker parameter file between the keywords NAMES and END.
STARTUP	This section lists the prestart code and the values used to initialize the startup descriptor `_startupData`. The startup descriptor is listed member by member with the initialization data at the right hand side of the member name.
SEGMENT ALLOCATION	This section lists segments, in which at least one object was allocated. At the right hand side of the segment name there is a pair of numbers, which gives the address range the objects belonging to the segment were allocated.
OBJECT ALLOCATION	This section contains the names of all allocated objects and their addresses. The objects are grouped by module. If an address of an object is followed by the “@” sign, the object comes from a ROM library. In this case the absolute file contains no code for the object (if it is a function), but the object’s address was used for linking. If an address of a string object is followed by a dash “–”, the string is a suffix of some other string. As an example, if the strings "abc" and "bc" are present in the same program, the string "bc" is not allocated and its address is the address of "abc" plus one.
OBJECT DEPENDENCY	This section lists the names of global objects used by functions and variables.
UNUSED OBJECTS	This section lists all objects found in the object files that were not linked.
COPYDOWN	This section lists all blocks that are copied from ROM to RAM at program startup.
STATISTICS	This section generates information about the size or code generated.

NOTE

No map file is written when objects can not be found in an object file and the linking process fails.

CHAPTER 7

LINKER MESSAGES

7.1 INTRODUCTION

This chapter lists and defines all messages generated by the MCUez Linker.

7.2 LINKER MESSAGES REFERENCE

Three kinds of messages are generated by the linker.

- **WARNING** - A message is printed and linking continues. Warning messages are used to indicate possible programming errors.
- **ERROR** - A message is printed and linking is stopped. Error messages are used to indicate illegal syntax in the PRM file.
- **FATAL** - A message is printed and linking is aborted. A fatal message indicates a severe error.

If the linker prints a message, the message contains a message code (‘L’ for Linker) and a four to five digit number. Error message numbers are referenced in the manual and documented in increasing order. Each message has a description and if available a short example with a possible solution or tips to fix a problem. The type of message is also noted, (e.g. ERROR).

L1000 <Command Name> Not Found

Type: [ERROR]

Description

This message is generated when a mandatory linker command is missing from the PRM file. Mandatory commands are:

- LINK, which contains the name of the absolute file to generate. If the option –O is specified on the command line and the LINK command is missing from the PRM file, this message is not generated.
- NAMES, lists the files building the application.
- PLACEMENT, associates at least the predefined sections ‘.text’ and ‘.data’ with a memory range.

When the LINK command is missing the message is: **‘LINK not found**‘.

When the NAMES command is missing the message is: **‘NAMES not found‘.**

When the PLACEMENT command is missing the message is: **‘PLACEMENT not found‘.**

Example:

```
NAMES  fibo.o start12s.o ansis.lib END
SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
PLACEMENT
    .text   INTO MY_ROM;
    .data   INTO MY_RAM;
    .stack  INTO MY_STK;
END
/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Insert the missing command in the PRM file.

Example

```
LINK   fibo.abs
NAMES  fibo.o start12s.o ansis.lib END
SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
PLACEMENT
    .text   INTO MY_ROM;
    .data   INTO MY_RAM;
    .stack  INTO MY_STK;
END
/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

L1001 <Command Name> Multiply Defined

Type: [ERROR]

Description:

This message is generated when a linker command is detected more than once in the PRM file.

The following linker commands cannot be specified more than once in a PRM file.

- LINK, which contains the name of the absolute file to generate.
- NAMES, where files building the application are listed.
- SEGMENTS, where a name can be associated with a memory area.
- PLACEMENT, where sections used in the application are assigned to a memory range.

- ENTRIES, where objects linked with the application are listed.
- MAPFILE, where information stored in the MAP file is specified.
- MAIN, defines the application main function.
- INIT, defines the application entry point.
- STACKSIZE, defines the stack size.
- STACKTOP, defines the stack pointer initial value.

When the LINK command is detected more than once, the message will be:

```
‘LINK multiply defined‘
```

Example:

```
LINK   fibo.abs
NAMES  fibo.o start12s.o ansis.lib END
SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
END
PLACEMENT
    .text   INTO MY_ROM;
    .data   INTO MY_RAM;
    .stack  INTO MY_STK;
END
LINK   fibo.abs
/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Remove one of the duplicated commands.

Example:

```
LINK   fibo.abs
NAMES  fibo.o start12s.o ansis.lib END
SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
END
PLACEMENT
    .text   INTO MY_ROM;
    .data   INTO MY_RAM;
    .stack  INTO MY_STK;
END
/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

L1002 Command <Command Name> Overwritten by Option <Option Name>

Type: [WARNING]

Description

This message is generated when a command line option overrides a command in the PRM file.

<command name>: Name of the command in the PRM file

<option name>: Linker command line option

Commands that may be overridden by a command line option are:

- LINK, overridden by the option –O (defines the output file name)
- MAPFILE, overridden by the option –M (enables generation of the MAP file)
- INIT, overridden by the option –E (defines the application entry point)

When the LINK command is detected in the PRM file and the option –O is specified on the command line, the following message is generated:

```
‘Command LINK overwritten by option -O‘
```

Tips

Remove either the command in the PRM file or the command line option.

L1003 Only a Single SEGMENTS or SECTIONS Block is Allowed

Type: [ERROR]

Description

This error occurs when the PRM file contains both a SECTIONS and a SEGMENTS block. The SECTIONS block is a synonym for the SEGMENTS block. It is supported for compatibility with an old style MCUez PRM file.

Example

```
LINK   fibo.abs
NAMES  fibo.o start12s.o ansis.lib END
SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
END
SECTIONS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
PLACEMENT
    .text   INTO MY_ROM;
```

```
        .data    INTO MY_RAM;
        .stack   INTO MY_STK;
    END
    /* Set reset vector on _Startup */
    VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Remove either the SEGMENTS or SECTIONS block.

L1004 <Separator> Expected

Type: [ERROR]

Description

This message is generated when the specified <separator> is missing from an expected position.

<separator>: character or expression expected

Example 1:

```
SEGMENTS
  MY_RAM    = READ_WRITE 0x800 TO 0x8FF
              ALIGN [2TO 4, 4]
                          ^
ERROR: : expected.
```

Tips

Insert the specified separator at the expected position.

L1005 Fill Pattern Will Be Truncated (>0xFF)

Type: [WARNING]

Description

This message is generated when the constant specified as a fill pattern cannot be coded on a byte. The constant truncated to a byte value will be used as the fill pattern.

Example

```
SEGMENTS
    MY_RAM = READ_WRITE 0x0800 TO 0x8FF FILL 0xA34;
END
```

Tips

To avoid this message, split the constant into two byte constants.

Example

```
    SEGMENTS
        MY_RAM = READ_WRITE 0x0800 TO 0x8FF FILL 0xA 0x34;
    END
```

L1007 <Character> Not Allowed in File Name (Restriction)

Type: [ERROR]

Description

A file name specified in the PRM file contains an illegal character.

<character>: characters not allowed in a file name at the indicated position.

Following characters are not allowed in a file name:

- Colon (:), Used as separator to specify a local object (function or variable) in a PRM file.
- Semi-colon(;), Used as delimiter for a command line in a LAYOUT or OBJECT_ALLOCATION block.
- Greater than symbol (>), Used as separator to refer to an object located in a section inside a LAYOUT or OBJECT_ALLOCATION block.

Avoid putting characters ‘+’ and ‘-‘ in a file name. This may cause a problem when used as a file name suffix in the NAMES block.

Example

```
    NAMES
        file:1.o;
            ^
    ERROR: ':' or '>' not allowed in file name (restriction)
    END
```

or

```
    NAMES
        file1.o file>2.lib;
                    ^
    ERROR: ':' or '>' not allowed in file name (restriction)
    END
```

Tips

Change the file name and avoid the illegal characters.

L1009 Segment Name <Segment Name> Unknown

Type: [ERROR]

Description

Segment specified in a PLACEMENT or LAYOUT command line was not previously defined in the SEGMENTS block.

<segment name>: name of the segment, which is not known

Example

```
LINK   fibo.abs
NAMES  fibo.o start12s.o ansis.lib END
SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
END
PLACEMENT
    .text   INTO ROM_AREA;
                         ^
ERROR: Segment Name ROM_AREA unknown
    .data   INTO MY_RAM;
    .stack  INTO MY_STK;
END
/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Define the segment names in the SEGMENTS block.

Example

```
LINK   fibo.abs
NAMES  fibo.o start12s.o ansis.lib END
SEGMENTS
    RAM_AREA = READ_WRITE 0x800 TO 0x80F;
    ROM_AREA = READ_ONLY  0x810 TO 0xAFF;
    STK_AREA = READ_WRITE 0xB00 TO 0xBFF;
END
PLACEMENT
    .text   INTO ROM_AREA;
    .data   INTO RAM_AREA;
    .stack  INTO STK_AREA;
END
/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

L1011 Incompatible Segment Qualifier: <Qualifier1> in Previous Segment and <Qualifier> in <Segment Name>

Type: [ERROR]

Description

Two segments specified in the same statement in the PLACEMENT block are not defined with the same qualifier.

<qualifier1>: Segment qualifier associated with the previous segment in the list. This qualifier may be READ_ONLY, READ_WRITE, NO_INIT, or PAGED.

<qualifier2> Segment qualifier associated with the current segment in the list. This qualifier may be READ_ONLY, READ_WRITE, NO_INIT, or PAGED.

<segment name >: Name of the current segment in the list.

Example

```
LINK    fibo.abs
NAMES   fibo.o start12s.o ansis.lib END
SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    SEC_RAM= READ_WRITE 0x020 TO 0x02F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
END
PLACEMENT
    .data     INTO MY_RAM;
    .text     INTO MY_ROM, SEC_RAM;
                                  ^
ERROR: Incompatible segment qualifier: READ_ONLY in previous
segment and READ_WRITE in SEC_RAM
    .stack    INTO MY_STK;
END
/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Modify the qualifier associated with the specified segment.

Example

```
LINK    fibo.abs
NAMES   fibo.o start12s.o ansis.lib END
SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    SEC_ROM= READ_ONLY  0x020 TO 0x02F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
END
PLACEMENT
    .data     INTO MY_RAM;
    .text     INTO MY_ROM, SEC_ROM;
    .stack    INTO MY_STK;
END
/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

L1015 No Binary Input File Specified

Type: [ERROR]

Description

No file names specified in the NAMES block.

Example

```
LINK   fibo.abs
NAMES END
SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
END
PLACEMENT
    .text     INTO MY_ROM;
    .data     INTO MY_RAM;
    .stack    INTO MY_STK;
END
/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Specify at least one file name in the NAMES block.

L1016 File <File Name> Found Twice in The NAMES Block

Type: [ERROR]

Description

A file name is detected twice in the NAMES block.

<file name >: Name of file detected twice in the NAMES block.

Example

```
LINK   fibo.abs
NAMES fibo.o startup.o fibo.o END
                              ^
ERROR: File fibo.o found twice in the NAMES block
SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
END
PLACEMENT
    .text     INTO MY_ROM;
```

```
        .data     INTO MY_RAM;
        .stack    INTO MY_STK;
    END
    /* Set reset vector on _Startup */
    VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Remove the second occurrence of the specified file.

L1100 Segments <Segment1 Name> and <Segment2 Name> Overlap

Type: [ERROR]

Description

Two segments defined in the PRM file overlap each other.

<segment1 name >: Name of the first overlapping segment.

<segment2 name >: Name of the second overlapping segment.

Example

```
    ^
    Segments MY_RAM and MY_ROM overlap
    LINK   fibo.abs
    NAMES fibo.o startup.o END
    SEGMENTS
        MY_RAM = READ_WRITE 0x800 TO 0x80F;
        MY_ROM = READ_ONLY  0x805 TO 0xAFF;
        MY_STK = READ_WRITE 0xB00 TO 0xBFF;
    END
    PLACEMENT
        .text     INTO MY_ROM;
        .data     INTO MY_RAM;
        .stack    INTO MY_STK;
    END
    /* Set reset vector on _Startup */
    VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Modify the segment definition to remove the overlap.

Example

```
    LINK   fibo.abs
    NAMES fibo.o startup.o END
    SEGMENTS
        MY_RAM = READ_WRITE 0x800 TO 0x80F;
        MY_ROM = READ_ONLY  0x810 TO 0xAFF;
        MY_STK = READ_WRITE 0xB00 TO 0xBFF;
    END
    PLACEMENT
        .text     INTO MY_ROM;
        .data     INTO MY_RAM;
        .stack    INTO MY_STK;
    END
    /* Set reset vector on _Startup */
    VECTOR ADDRESS 0xFFFE _Startup
```

L1102 Out of Allocation Space in Segment <Segment Name> at Address <First Address Free>

Type: [ERROR]

Description

The specified segment is not big enough to contain all objects from sections placed in it.

<segment name> : Name of the undersized segment.

<first address free>: First address free in this segment (i.e. address following the last address used).

Example

In the following example, assume the section '.data' contains a character variable and a structure of 5 bytes.

```
^
Out of allocation space in segment MY_RAM at address 0x801
LINK   fibo.abs
NAMES fibo.o startup.o END
SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x803;
    MY_ROM = READ_ONLY  0x805 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
END
PLACEMENT
    .text     INTO MY_ROM;
    .data     INTO MY_RAM;
    .stack    INTO MY_STK;
END
/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Set the end address of the specified segment to a higher value.

L1103 <Section Name> Not Specified in The PLACEMENT Block

Type: [ERROR]

Description

Indicates that a mandatory section is not specified in the placement block. Sections always specified in the PLACEMENT block are .text and .data.

Example

```
^
ERROR: .text not specified in the PLACEMENT block
LINK   fibo.abs
NAMES fibo.o startup.o END
SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
END
PLACEMENT
    .init, .rodata     INTO MY_ROM;
    .data     INTO MY_RAM;
    .stack    INTO MY_STK;
END
/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Insert the missing section in the PLACEMENT block.

Note:

The section DEFAULT_RAM is a synonym for .data and DEFAULT_ROM is a synonym for .text. These two section names have been defined for compatibility with the old MCUez Linker.

L1106 <Object Name> Not Found

Type: [ERROR|WARNING]

Description

An object referenced in the PRM file or in the application is not found. This message is generated when:

- An object specified in a VECTOR or VECTOR ADDRESS command is not found (ERROR).
- No startup structure detected in the application (WARNING).

- An object (function or variable) referenced in another object is not found in the application (ERROR).
- An object (function or variable) specified in the ENTRIES block is not found (ERROR).

Example

```
^
ERROR: globInt not found
LINK   fibo.abs
NAMES fibo.o startup.o END

SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
END
PLACEMENT
    .text, .rodata     INTO MY_ROM;
    .data      INTO MY_RAM;
    .stack     INTO MY_STK;
END

ENTRIES
      globInt;
END

/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

Tips

The missing object must be implemented in one of the modules building the application.

Ensure that your definition of OBJPATH and GENPATH is correct and the linker uses the latest version of the object files.

Check the NAMES block to ensure all binary files building the application are listed.

L1109 <Segment Name> Appears Twice in SEGMENTS Block

Type: [ERROR]

Description

A segment name is specified twice in a PRM file. This is not allowed. When this segment name is referenced in the PLACEMENT block, the linker cannot detect which memory area is referenced.

Example

```
LINK   fibo.abs
```

```
NAMES fibo.o startup.o END

SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
    MY_RAM = READ_WRITE 0xC00 TO 0xCFF;
           ^
ERROR: MY_RAM appears twice in SEGMENTS block
END
PLACEMENT
    .text, .rodata     INTO MY_ROM;
    .data     INTO MY_RAM;
    .stack    INTO MY_STK;
END

/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Change one of the segment names, to generate unique segment names. If the same memory area is defined twice, you can remove one of the definitions.

L1110 <Segment Name> Appears Twice in PLACEMENT Block

Type: [ERROR]

Description

The specified segment appears twice in a PLACEMENT block, and one of the PLACEMENT lines is part of a segment list. A segment name may appear in several lines in the PLACEMENT block, if it is the only segment specified in the segment list. Sections specified in both PLACEMENT lines are merged into one list of sections, which are allocated in the specified segment.

Example

```
LINK   fibo.abs
NAMES fibo.o startup.o END

SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
    ROM_2  = READ_ONLY  0x500 TO 0x7FF;
END
PLACEMENT
    .text, .rodata     INTO MY_ROM;
    .data              INTO MY_RAM;
```

```
            .stack              INTO MY_STK;
            codeSec1, codeSec2  INTO ROM_2, MY_ROM;
                                                  ^
        ERROR: MY_ROM appears twice in PLACEMENT block
        END

        /* Set reset vector on _Startup */
        VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Remove one instance of the segment from the PLACEMENT block.

L1111 <Section Name> Appears Twice in PLACEMENT Block

Type: [ERROR]

Description

The specified section appears multiple times in a PLACEMENT block.

Example

```
        LINK   fibo.abs
        NAMES fibo.o startup.o END

        SEGMENTS
            MY_RAM = READ_WRITE 0x800 TO 0x80F;
            MY_ROM = READ_ONLY  0x810 TO 0xAFF;
            MY_STK = READ_WRITE 0xB00 TO 0xBFF;
            ROM_2  = READ_ONLY  0x500 TO 0x7FF;
        END
        PLACEMENT
            .text, .rodata     INTO MY_ROM;
            .data              INTO MY_RAM;
            .stack             INTO MY_STK;
            .text              INTO ROM_2;
                 ^
        ERROR: .text appears twice in PLACEMENT block
        END

        /* Set reset vector on _Startup */
        VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Remove one occurrence of the specified section from the PLACEMENT block.

L1112 The <Section name> Section Has Segment Type <Segment Qualifier> (Illegal)

Type: [ERROR]

Description

A section is placed in a segment defined with an incompatible qualifier. This message is generated when:

- The section '.stack' is placed in a READ_ONLY segment.
- The section '.bss' is placed in a READ_ONLY segment.
- The section '.startData' is placed in a READ_WRITE, NO_INIT or PAGED segment.
- The section '.init' is placed in a READ_WRITE, NO_INIT or PAGED segment.
- The section '.copy' is placed in a READ_WRITE, NO_INIT or PAGED segment.
- The section '.text' is placed in a READ_WRITE, NO_INIT or PAGED segment.
- The section '.data' is placed in a READ_ONLY segment.
- A data section is placed in a READ_ONLY segment.
- A code section is placed in a READ_WRITE segment.

Example

```
^
ERROR: The .data section has segment type READ_ONLY (illegal)
LINK   fibo.abs
NAMES fibo.o startup.o END

SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
    ROM_2  = READ_ONLY  0x500 TO 0x7FF;
END
PLACEMENT
    .text, .rodata     INTO MY_ROM;
    .data              INTO ROM_2;
    .stack             INTO MY_STK;
END

/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Place the specified section in a segment that has been defined with an appropriate qualifier.

Example

```
LINK   fibo.abs
NAMES fibo.o startup.o END

SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
    ROM_2  = READ_ONLY  0x500 TO 0x7FF;
END
PLACEMENT
    .text     INTO MY_ROM;
    .data     INTO MY_RAM;
    .stack    INTO MY_STK;
END

/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

L1114 The <Section Name> Section Has Segment Type <Segment Qualifier> (Initialization Problem)

Type: [WARNING]

Description

The specified section is loaded in a segment that has been defined with the qualifier NO_INIT or PAGED. This may generate a problem because the section contains some initialized constants, which will not be initialized at application startup. This message is generated when:

- The section '.rodata' is placed in a NO_INIT or PAGED segment.
- The section '.rodata1' is placed in a NO_INIT or PAGED segment.

Example

```
 ^
 WARNING: The .rodata section has segment type NO_INIT (initial-
ization problem)
 LINK   fibo.abs
 NAMES fibo.o startup.o END

 SEGMENTS
     MY_RAM = READ_WRITE 0x800 TO 0x80F;
     MY_ROM = READ_ONLY  0x810 TO 0xAFF;
     MY_STK = READ_WRITE 0xB00 TO 0xBFF;
     RAM_2  = NO_INIT    0x500 TO 0x7FF;
 END
 PLACEMENT
     .text   INTO MY_ROM;
     .data   INTO MY_RAM;
```

```
    .stack  INTO MY_STK;
    .rodata INTO RAM_2;
END

/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Place the specified section in a segment defined with the READ_ONLY or READ_WRITE qualifier.

Example

```
LINK   fibo.abs
NAMES fibo.o startup.o END

SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
    RAM_2  = NO_INIT    0x500 TO 0x7FF;
END
PLACEMENT
    .text     INTO MY_ROM;
    .data     INTO MY_RAM;
    .stack    INTO MY_STK;
    .rodata   INTO MY_ROM;
END

/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

L1115 Function <Function Name> Not Found

Type: [ERROR|WARNING]

Description

The specified function is not found in the application. This message is generated when:

- No main function is available in the application. This function is not required for an assembly application. For ANSI C applications, if no main function is available, the programmer must ensure that application startup is performed correctly. Usually the main function is called ‘main’, but you can define your own main function using the linker command MAIN.
- No init function is available. The init function defines the entry point in the application. This function is required for ANSI C and assembly applications. Usually the init function is called ‘_Startup’, but you can define your own init function using the linker command INIT.

Tips

Provide the application with the requested function.

L1118 Vector Allocated at Absolute Address <Address> Overlaps With Another Vector or an Absolutely Allocated Object

Type: [ERROR]

Description

A vector overlaps with an absolute object or another vector.

Example

```
 ^
ERROR: Vector allocated at absolute address 0xFFFE overlaps with
another vector or an absolutely allocated object
 LINK   fibo.abs
 NAMES fibo.o startup.o END

 SEGMENTS
     MY_RAM = READ_WRITE 0x800 TO 0x80F;
     MY_ROM = READ_ONLY  0x810 TO 0xAFF;
     MY_STK = READ_WRITE 0xB00 TO 0xBFF;
 END
 PLACEMENT
     .text, .rodata     INTO MY_ROM;
     .data     INTO MY_RAM;
     .stack    INTO MY_STK;
 END

 /* Set reset vector on _Startup */
 VECTOR ADDRESS 0xFFFE _Startup
 VECTOR ADDRESS 0xFFFF 0x000A
```

Tips

Move the object or vector to a free position.

L1119 Vector Allocated at Absolute Address <Address> Overlaps With Sections Placed in Segment <Segment Name>

Type: [ERROR]

Description

The specified vector is allocated inside a segment, which is specified in the PLACEMENT block. This is not allowed because the vector may overlap with objects defined in the sections.

A vector may be allocated inside a segment that does not appear in the PLACEMENT block.

Example

```
 ^
 ERROR: Vector allocated at absolute address 0xFFFE overlaps with
sections placed in segment ROM_2
 LINK   fibo.abs
 NAMES fibo.o startup.o END

 SEGMENTS
     MY_RAM = READ_WRITE 0x800  TO 0x80F;
     MY_ROM = READ_ONLY  0x810  TO 0xAFF;
     MY_STK = READ_WRITE 0xB00  TO 0xBFF;
     ROM_2  = READ_ONLY  0xFF00 TO 0xFFFF;
 END
 PLACEMENT
     .text   INTO MY_ROM;
     .data   INTO MY_RAM;
     .stack  INTO MY_STK;
     .rodata INTO ROM_2;
 END

 /* Set reset vector on _Startup */
 VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Define the specified segment outside the vector table.

Example

```
LINK   fibo.abs
NAMES fibo.o startup.o END

SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
    ROM_2  = READ_ONLY  0xC00 TO 0xCFF;
END
PLACEMENT
    .text   INTO MY_ROM;
    .data   INTO MY_RAM;
    .stack  INTO MY_STK;
    .rodata INTO ROM_2;
END

/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

L1120 Vector Allocated at Absolute Address <Address> Placed in Segment <Segment Name>, Which Has No READ_ONLY qualifier.

Type: [ERROR]

Description

The specified vector is defined inside a segment not defined with the qualifier READ_ONLY. The vector table should be initialized at application load time during the debug phase. It should be burned into the EPROM when application development is terminated. For this reason, the vector table must always be located in a READ_ONLY memory area.

Example

```
 ^
 ERROR: Vector allocated at absolute address 0xFFFE placed in
segment RAM_2 which has not READ_ONLY qualifier
 LINK   fibo.abs
 NAMES fibo.o startup.o END

 SEGMENTS
     MY_RAM = READ_WRITE 0x800  TO 0x80F;
     MY_ROM = READ_ONLY  0x810  TO 0xAFF;
     MY_STK = READ_WRITE 0xB00  TO 0xBFF;
     RAM_2  = READ_WRITE 0xFF00 TO 0xFFFF;
 END
 PLACEMENT
     .text   INTO MY_ROM;
     .data   INTO MY_RAM;
     .stack  INTO MY_STK;
 END

 /* Set reset vector on _Startup */
 VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Define the specified segment with the READ_ONLY qualifier.

L1121 Out of Allocation Space at Address <Address> for .copy Section

Type: [ERROR]

Description

Insufficient memory to store information for initialized variables in the '.copy' section.

Tips

Specify a higher end address for the segment, where the '.copy' section is allocated.

L1122 Section .copy Must be The Last Section in The Section List

Type: [ERROR]

Description

The '.copy' section is not specified at the end of a section list from the PLACEMENT block. Since the size of this section cannot be evaluated before all initialization values are written, the .copy section must be the last section in a section list.

Example

```
^
ERROR: Section .copy must be the last section in the section list
LINK   fibo.abs
NAMES fibo.o startup.o END

SEGMENTS
    MY_RAM = READ_WRITE 0x800  TO 0x80F;
    MY_ROM = READ_ONLY  0x810  TO 0xAFF;
    MY_STK = READ_WRITE 0xB00  TO 0xBFF;
END
PLACEMENT
    .copy, .text   INTO MY_ROM;
    .data          INTO MY_RAM;
    .stack         INTO MY_STK;
END

/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Move the section .copy to the last position in the section list or define it on a separate PLACEMENT line in a separate segment.

Example

```
LINK   fibo.abs
NAMES fibo.o startup.o END

SEGMENTS
    MY_RAM = READ_WRITE 0x800 TO 0x80F;
    MY_ROM = READ_ONLY  0x810 TO 0xAFF;
    MY_STK = READ_WRITE 0xB00 TO 0xBFF;
    ROM_2  = READ_ONLY  0xC00 TO 0xDFF;
END
PLACEMENT
    .text   INTO MY_ROM;
    .data   INTO MY_RAM;
    .stack  INTO MY_STK;
```

```
        .copy   INTO ROM_2;
    END

    /* Set reset vector on _Startup */
    VECTOR ADDRESS 0xFFFE _Startup
```

L1123 Invalid Range Defined For Segment <Segment Name> - End Address Must Be Bigger Than Start Address

Type: [ERROR]

Description

The memory range specified in the segment definition is not valid. The segment end address is smaller than the segment start address.

Example

```
    LINK   fibo.abs
    NAMES fibo.o startup.o END

    SEGMENTS
        MY_RAM = READ_WRITE 0x800  TO 0x7FF;
                                           ^
    ERROR: Invalid range defined for segment MY_RAM. End address must
   be bigger than start address
        MY_ROM = READ_ONLY  0x810  TO 0xAFF;
        MY_STK = READ_WRITE 0xB00  TO 0xBFF;
    END
    PLACEMENT
       .text           INTO MY_ROM;
        .data          INTO MY_RAM;
        .stack         INTO MY_STK;
    END

    /* Set reset vector on _Startup */
    VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Change the segment start or end address to define a valid memory range.

L1124 '+' or '-' Should Directly Follow The File Name

Type: [ERROR]

Description

The '+' or '-' suffix specified after a file name in the NAMES block does not directly follow the file name. A space probably exists between the file name and suffix.

Example

```
LINK   fibo.abs
NAMES fibo.o + startup.o END
              ^
ERROR: '+' or '-' should directly follow the file name
SEGMENTS
    MY_RAM = READ_WRITE 0x800  TO 0x80F;
    MY_ROM = READ_ONLY  0x810  TO 0xAFF;
    MY_STK = READ_WRITE 0xB00  TO 0xBFF;
END
PLACEMENT
    .text          INTO MY_ROM;
    .data          INTO MY_RAM;
    .stack         INTO MY_STK;
END

/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Remove the extra space after the file name.

Example

```
LINK   fibo.abs
NAMES fibo.o+ startup.o END
SEGMENTS
    MY_RAM = READ_WRITE 0x800  TO 0x80F;
    MY_ROM = READ_ONLY  0x810  TO 0xAFF;
    MY_STK = READ_WRITE 0xB00  TO 0xBFF;
END
PLACEMENT
    .text          INTO MY_ROM;
    .data          INTO MY_RAM;
    .stack         INTO MY_STK;
END

/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

L1125 In Small Memory Model, Code and Data Must Be Located on Bank 0

Type: [ERROR]

Description

The application has been assembled or compiled in a small memory model and the memory area specified for a segment is not located on the first 64K (0x0000 to 0xFFFF).

Example

```
 ^
 ERROR: In small memory model, code and data must be located on
bank 0
 LINK   fibo.abs
 NAMES fibo.o startup.o END
 SEGMENTS
     MY_RAM = READ_WRITE 0x800  TO 0x80F;
     MY_ROM = READ_ONLY  0x10810  TO 0x10AFF;
     MY_STK = READ_WRITE 0xB00  TO 0xBFF;
 END
 PLACEMENT
     .text          INTO MY_ROM;
     .data          INTO MY_RAM;
     .stack         INTO MY_STK;
 END

 /* Set reset vector on _Startup */
 VECTOR ADDRESS 0xFFFE _Startup
```

Tips

If memory higher than 0xFFFF is required for the application, the application must be assembled or compiled using the banked memory model. If no memory above 0xFFFF is required, modify the memory range and place it on the first 64K of memory.

L1200 Both STACKTOP and STACKSIZE Defined

Type: [ERROR]

Description

The STACKTOP and STACKSIZE commands are specified in the PRM file. This is not allowed, because it generates ambiguity for the definition of the stack.

Example

```
 ^
 ERROR: Both STACKTOP and STACKSIZE defined
 LINK   fibo.abs
 NAMES fibo.o startup.o END

 STACKTOP 0xBFE
 SEGMENTS
     MY_RAM = READ_WRITE 0x800  TO 0x80F;
     MY_ROM = READ_ONLY  0x810  TO 0xAFF;
 END
 PLACEMENT
     .text           INTO MY_ROM;
     .data          INTO MY_RAM;
```

```
        END
        STACKSIZE 0x60
        /* Set reset vector on _Startup */
        VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Remove either the STACKTOP or STACKSIZE command from the PRM file.

L1201 No Stack Defined

Type: [WARNING]

Description

The PRM file does not contain a stack definition. In that case, it is the programmer responsibility to initialize the stack pointer inside the application code. The stack can be defined in the PRM file in one of the following ways:

- Through the STACKTOP command in the PRM file.
- Through the STACKSIZE command in the PRM file.
- Through the specification of the .stack section in the placement block.

Example

```
     ^
    WARNING: No stack defined
     LINK   fibo.abs
     NAMES fibo.o startup.o END

     SEGMENTS
         MY_RAM = READ_WRITE 0x800  TO 0x80F;
         MY_ROM = READ_ONLY  0x810  TO 0xAFF;
     END
     PLACEMENT
         .text          INTO MY_ROM;
         .data          INTO MY_RAM;
     END
     /* Set reset vector on _Startup */
     VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Define the stack in one of the three ways specified above.

Note that if the programmer initializes the stack pointer inside the source code, initialization from the linker will be overridden.

L1202 Stack Cannot Be Allocated on More Than One Segment

Type: [ERROR]

Description

The section .stack is specified on a PLACEMENT line where several segments are listed. This is not allowed, because the memory area reserved for the stack must be contiguous and cannot be split over different memory ranges.

Example

```
^
ERROR: stack cannot be allocated on more than one segment
LINK   fibo.abs
NAMES fibo.o startup.o END
SEGMENTS
    MY_RAM = READ_WRITE 0x800  TO 0x80F;
    MY_ROM = READ_ONLY  0x810  TO 0xAFF;
    STK_1 = READ_WRITE 0xB00  TO 0xBFF;
    STK_2 = READ_WRITE 0xD00  TO 0xDFF;
END
PLACEMENT
    .text          INTO MY_ROM;
    .data          INTO MY_RAM;
    .stack         INTO STK_1, STK_2;
END

/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Define a single segment with the READ_WRITE or NO_INIT qualifier to allocate the stack.

L1203 STACKSIZE Command Defines a Size of <Size> But .stack Specifies a Stacksize of <Size>

Type: [ERROR]

Description

The stack is defined through both a STACKSIZE command and placement of the .stack section in a READ_WRITE or NO_INIT segment. However, the size specified in the STACKSIZE command is bigger than the size of the segment where the stack is allocated.

Example

```
 ^
 ERROR: STACKSIZE command defines a size of 0x120 but .stack
specifies a stacksize of 0x100
 LINK   fibo.abs
```

```
NAMES fibo.o startup.o END
SEGMENTS
    MY_RAM = READ_WRITE 0x800  TO 0x80F;
    MY_ROM = READ_ONLY  0x810  TO 0xAFF;
    STK_1  = READ_WRITE 0xB00  TO 0xBFF;
END
PLACEMENT
    .text          INTO MY_ROM;
    .data          INTO MY_RAM;
    .stack         INTO STK_1;
END

STACKSIZE 0x120
/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

Tips

To avoid this message you can either adapt the size specified in the STACKSIZE command to fit into the segment where .stack is allocated or simply remove the command STACKSIZE.

If you remove the command STACKSIZE from the previous example, the linker will initialize a stack from 0x100 bytes. The stack pointer initial value will be set to 0xBFE.

Example

```
LINK   fibo.abs
NAMES fibo.o startup.o END
SEGMENTS
    MY_RAM = READ_WRITE 0x800  TO 0x80F;
    MY_ROM = READ_ONLY  0x810  TO 0xAFF;
    MY_STK = READ_WRITE 0xB00  TO 0xBFF;
END
PLACEMENT
    .text          INTO MY_ROM;
    .data          INTO MY_RAM;
    .stack         INTO MY_STK;
END

/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

If the size specified in a STACKSIZE command is smaller than the size of the segment where the section .stack is allocated, the stack pointer initial value will be evaluated as follows:

```
<segment start address> + <size in STACKSIZE> -
<Additional Byte Required by the processor.>
```

Example

```
LINK   fibo.abs
NAMES fibo.o startup.o END
```

```
SEGMENTS
    MY_RAM = READ_WRITE 0x800  TO 0x80F;
    MY_ROM = READ_ONLY  0x810  TO 0xAFF;
    MY_STK = READ_WRITE 0xB00  TO 0xBFF;
END
PLACEMENT
    .text          INTO MY_ROM;
    .data          INTO MY_RAM;
    .stack         INTO MY_STK;
END
STACKSIZE 0x60
/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

In the previous example, the initial value for the stack pointer is evaluated as:

```
0xB00 + 0x60s -2 = 0xB5E
```

L204 STACKTOP Command Defines an Initial Value of <Stack Top> But .stack Specifies an Initial Value of <Initial Value>

Type: [ERROR]

Description

The stack is defined through both a STACKTOP command and placement of the .stack section in a READ_WRITE or NO_INIT segment. However, the value specified in the STACKTOP command is bigger than the end address of the segment where the stack is allocated.

Example

```
 ^
 ERROR: STACKTOP command defines an initial value of 0xCFE but
.stack specifies an initial value of 0xBFF
 LINK   fibo.abs
 NAMES fibo.o startup.o END
 SEGMENTS
     MY_RAM = READ_WRITE 0x800  TO 0x80F;
     MY_ROM = READ_ONLY  0x810  TO 0xAFF;
     STK_1  = READ_WRITE 0xB00  TO 0xBFF;
 END
 PLACEMENT
     .text          INTO MY_ROM;
     .data          INTO MY_RAM;
     .stack         INTO STK_1;
 END

 STACKTOP 0xCFE
 /* Set reset vector on _Startup */
 VECTOR ADDRESS 0xFFFE _Startup
```

Tips

To avoid this message you can either adapt the address specified in the STACKTOP command to fit into the segment where .stack is allocated, or simply remove the command STACKTOP.

If you remove the command STACKTOP from the previous example, the stack pointer initial value will be set to 0xBFE.

Example

```
LINK   fibo.abs
NAMES fibo.o startup.o END
SEGMENTS
    MY_RAM = READ_WRITE 0x800  TO 0x80F;
    MY_ROM = READ_ONLY  0x810  TO 0xAFF;
    MY_STK = READ_WRITE 0xB00  TO 0xBFF;
END
PLACEMENT
    .text          INTO MY_ROM;
    .data          INTO MY_RAM;
    .stack         INTO MY_STK;
END

/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

L1205 STACKTOP Command Incompatible With .stack Being Part of a List of Sections

Type: [ERROR]

Description

The stack is defined through both a STACKTOP command and placement of the .stack section in a READ_WRITE or NO_INIT segment. The .stack section is specified in a list of sections in the PLACEMENT block.

Example

```
 ^
 ERROR: STACKTOP command incompatible with .stack being part of a
list of sections
 LINK   fibo.abs
 NAMES fibo.o startup.o END
 SEGMENTS
     MY_RAM = READ_WRITE 0x800  TO 0x80F;
     MY_ROM = READ_ONLY  0x810  TO 0xAFF;
     STK_1  = READ_WRITE 0xB00  TO 0xBFF;
 END
 PLACEMENT
     .text          INTO MY_ROM;
```

```
    .data, .stack  INTO STK_1;
END

STACKTOP 0xBFE
/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Specify the .stack section in a placement line, where the stack alone is specified.

L1206 Stack Overlaps With a Segment Which Appears in The PLACEMENT Block

Type: [ERROR]

Description

The stack is defined through the command STACKTOP and the initial value is inside a segment, which is used in the PLACEMENT block.

This is not allowed because the stack may overlap with allocated objects.

Example

```
 ^
 ERROR: .stack overlaps with a segment which appears in the
PLACEMENT block
 LINK   fibo.abs
 NAMES fibo.o startup.o END
 SEGMENTS
     MY_RAM = READ_WRITE 0x800  TO 0x80F;
     MY_ROM = READ_ONLY  0x810  TO 0xAFF;
     STK_1  = READ_WRITE 0xB00  TO 0xBFF;
 END
 PLACEMENT
     .text          INTO MY_ROM;
     .data          INTO STK_1;
 END

 STACKTOP 0xBFE
 /* Set reset vector on _Startup */
 VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Define the stack initial value outside all segments specified in the PLACEMENT block.

Example

```
LINK   fibo.abs
NAMES fibo.o startup.o END
```

```
SEGMENTS
    MY_RAM = READ_WRITE 0x800  TO 0x80F;
    MY_ROM = READ_ONLY  0x810  TO 0xAFF;
    MY_STK = READ_WRITE 0xB00  TO 0xBFF;
END
PLACEMENT
    .text          INTO MY_ROM;
    .data          INTO MY_RAM;
END
STACKTOP 0xBFE

/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

L1207 STACKSIZE Command is Missing

Type: [ERROR]

Description

The stack is defined by placing the .stack section in a READ_WRITE or NO_INIT segment, although the .stack section is not alone in the section list. In this case, a STACKSIZE command is required to specify the stack size.

Example

```
^
ERROR: STACKSIZE command is missing
LINK   fibo.abs
NAMES fibo.o startup.o END
SEGMENTS
    MY_RAM = READ_WRITE 0x800  TO 0x80F;
    MY_ROM = READ_ONLY  0x810  TO 0xAFF;
    STK_1  = READ_WRITE 0xB00  TO 0xBFF;
END
PLACEMENT
    .text          INTO MY_ROM;
    .data, .stack  INTO STK_1;
END

/* Set reset vector on _Startup */
VECTOR ADDRESS 0xFFFE _Startup
```

Tips

Specify the stack size in a STACKSIZE command.

L1301 Cannot Open File <File Name>

Type: [ERROR]

Description

The linker is unable to open the application map file, absolute file or one of the binary files used to build the application.

Tips

If the abs or map file cannot be found, ensure that memory is available for the directory to store the file and the directory has read/write access.

If the environment variable TEXTPATH is defined, the MAP file is stored in the first directory specified, otherwise it is created in the directory where the source file is detected.

If the environment variable ABSPATH is defined, the absolute file is stored in the first directory specified, otherwise it is created in the directory where the PRM file is detected.

If a binary file cannot be found, make sure the file exists and spelled correctly. Check if paths are defined correctly. The binary files must be located in one of the paths listed in the environment variables OBJPATH or GENPATH, or in the working directory.

L1302 File <File Name> Not Found

Type: [ERROR]

Description

A file required during the link session cannot be found. This message is generated when:

- The parameter file specified on the command line cannot be found.

Tips

Make sure the file really exists and spelled correctly.

Check if paths are defined correctly. The PRM file must be located in one of the paths listed in the environment variable GENPATH or in the project directory.

L1303 <File Name> Is Not a Valid ELF File

Type: [ERROR]

Description

The specified file is not a valid ELF binary file. The linker is only able to link ELF binary files.

Tips

Check that you have compiled or assembled the specified file with the correct option to generate an ELF binary file.

Check if paths are defined correctly. The binary files must be located in one of the paths listed in the environment variables OBJPATH or GENPATH, or in the project directory.

L1400 Incompatible Processor: <Processor Name> in Previous Files and <Processor Name> in Current File

Type: [ERROR]

Description

The binary files building the application have been generated for a different target processor. In this case, the linked code cannot be compatible.

Tips

Make sure you are compiling or assembling all your sources for the same processor.

Check if paths are defined correctly. The binary files must be located in one of the paths listed in the environment variables OBJPATH or GENPATH, or in the project directory.

L1401 Incompatible Memory Model: <Memory Model Name> in Previous Files and <Memory Model Name> in Current File

Type: [ERROR]

Description

The binary files building the application have been generated for a different memory model. In this case, the linked code cannot be compatible.

Tips

Make sure you are compiling or assembling all sources in the same memory model.

Check if paths are defined correctly. The binary files must be located in one of the paths listed in the environment variables OBJPATH or GENPATH, or in the project directory.

L1403 Unknown Processor <Processor Constant>

Type: [ERROR]

Description

The processor encoded in the binary object file is not a valid processor constant.

Tips

Check if paths are defined correctly. The binary files must be located in one of the paths listed in the environment variables OBJPATH or GENPATH, or in the project directory.

L1404 Unknown Memory Model <Memory Model Constant>

Type: [ERROR]

Description

The memory model encoded in the binary object file is not valid for the target processor.

Tips

Check if paths are defined correctly. The binary files must be located in one of the paths listed in the environment variables OBJPATH or GENPATH, or in the project directory.

L1600 Main Function Detected in ROM Library

Type: [WARNING]

Description

A main function has been detected in a ROM library. A main function is not required in a ROM library since they are not self executable applications.

Tips

Remove the MAIN command from the PRM file.

If the application contains a ‘main’ function, rename it.

L1601 Startup Function detected in ROM library

Type: [WARNING]

Description

An application entry point has been detected in a ROM library. An application entry point is not required in a ROM library.

Tips

Remove the INIT command from the PRM file.

If the application contains a ‘_Startup’ function, rename it.

L1700 File <File Name> Should Contain DWARF Information

Type: [ERROR]

Description

The binary file that defines the startup structure does not contain DWARF information. This is required because the type of startup structure is not fixed by the linker and depends on the field and field position inside the user defined structure.

Tips

Insert DWARF information and recompile the ANSI C file containing the startup structure definition.

L1701 Start Up Data Structure is Empty

Type: [ERROR]

Description

The size of the user defined startup structure is 0 bytes.

Tips

Check if you actually need a startup structure.

If a startup structure is available, ensure that the correct field name is listed.

L1803 Out of Memory in <Function Name>

Type: [ERROR]

Description

Insufficient memory to allocate the internal structure required by the linker.

L1804 No Elf Section Header Table Found in <File Name>

Type: [ERROR]

Description

Section header table not detected in the binary file.

Tips

Ensure that you are using the correct binary file.

Check if paths are defined correctly. The binary files must be located in one of the paths listed in the environment variables OBJPATH or GENPATH, or in the project directory.

L1806 Elf file <File Name> appears to be corrupted

Type: [ERROR]

Description

The specified binary file is not a valid ELF binary file.

Tips

Ensure that you are using the correct binary file.

Check if paths are defined correctly. The binary files must be located in one of the paths listed in the environment variables OBJPATH or GENPATH, or in the project directory.

L1808 String overflow in <Function Name>, contact vendor

Type: [ERROR]

Description

A section name detected in a section table is longer than 100 characters.

Tips

Ensure all section names are smaller than 100 characters.

L1809 Section <Section Name> located in a segment with invalid qualifier.

Type: [ERROR]

Description

Attributes associated with a section and used in several binary files are not compatible. In one file, the section contains variables in the other it contains constants, variables, or code.

Tips

Check usage of the different sections in all binary files. A specific section should contain the same type of information throughout the project.

L1811 Symbol <Symbol Number> - < Symbol Name> duplicated in <First File Name> and <Second file Name>

Type: [ERROR]

Description

The specified global symbol is defined in two different binary files.

Tips

Rename the symbol defined in one of the specified files.

L1820 Weak symbol <Symbol Name> duplicated in <First File Name> and <Second file Name>

Type: [WARNING]

Description

The specified weak symbol is defined in two different binary files.

Tips

Rename the symbol defined in one of the specified files.

L1822 Symbol <Symbol Name> in file <File Name> is Undefined

Type: [ERROR]

Description

The specified symbol is referenced in the file, but not defined anywhere in the application.

Tips

Check if an object file is missing in the NAMES block and if you are using the correct binary file.

Check if paths are defined correctly. The binary files must be located in one of the paths listed in the environment variables OBJPATH or GENPATH, or in the project directory.

L1823 External Object <Symbol Name> in <File Name> Created by Default

Type: [WARNING]

Description

The specified symbol is referenced in the file, but not defined in the application. However, an external declaration for this object is available in at least one of the binary files. The object should be defined in the first binary file where it is externally defined.

This is only valid for ANSI C applications.

In this case an external definition for a variable var looks like:

```
extern int var;
```

The definition of the corresponding variable looks like:

```
int var;
```

Tips

Define the specified symbol in one of the files building the application.

Index