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User's Manual

RA78K0 Ver. 3.80

Assembler Package

Operation

Target Devices
78K0 Series

Document No. U17199EJ1V0UM00 (1st edition)
Date Published February 2005 CP(K)

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INTRODUCTION

This manual is intended to give users who wish to develop software using the RA78K0 an understanding of the functions of each program in the RA78K0 Series Assembler Package (hereafter referred to as "the RA78K0") and of the correct methods of using the package.
This manual does not cover the expressions of directives and source programs or language used in the RA78K0. Therefore, before reading this manual, read the **RA78K0 Series Assembler Package Language User's Manual (U17198E)** (hereinafter referred to as "the Language Manual").
The contents of this manual are intended for use with Ver. 3.80 or later of the RA78K0.

[Target Readers]
The RA78K0 is intended for users who understand the functions and instructions of the microcontroller for which software is being developed (78K0 Series).

[Organization]
This manual consists of the following eleven chapters and appendixes:

CHAPTER 1 GENERAL
Outlines the role of the RA78K0 in microcontroller software development and the features of the RA78K0.

CHAPTER 2 PRODUCT OUTLINE AND INSTALLATION
Explains the program file names and operating environment provided by the RA78K0.

CHAPTER 3 EXECUTION PROCEDURE OF RA78K0
Explains the procedure for developing software, using a sample program.
The purpose of this chapter is to provide an opportunity for actual use of each program. Those who wish to experience operating the RA78K0 should read this chapter.

CHAPTER 4 STRUCTURED ASSEMBLER PREPROCESSOR

CHAPTER 5 ASSEMBLER

CHAPTER 6 LINKER

CHAPTER 7 OBJECT CONVERTER

CHAPTER 8 LIBRARIAN

CHAPTER 9 LIST CONVERTER

CHAPTER 10 PROGRAM OUTPUT LIST
Explains the formats of the lists output by each program.

CHAPTER 11 EFFICIENT USE OF RA78K0
Introduces some measures for optimum utilization of the RA78K0.

CHAPTER 12 ERROR MESSAGES
Explains the error messages output by each program.

APPENDIXES Introduce a list of program options, a list of sample programs, and a list of notices on using the RA78K0.

The instruction sets are not detailed in this manual. For these instructions, refer to the user's manual of the microcontroller for which software is being developed.

[How to Read This Manual]

Those using an assembler for the first time are encouraged to read from **CHAPTER 1 GENERAL** of this manual. Those who have a general understanding of assembler programs may skip this chapter.

Before using the RA78K0, read **CHAPTER 3 EXECUTION PROCEDURE OF RA78K0**.

After you have become familiar with the operation of each program, you can proceed to utilize the lists in the **APPENDIXES**.

[Caution]

In this manual, it is assumed that a PC-9800 Series personal computer or an IBM PC/AT™ compatible is used as the host machine. When the HP9000 Series 700™ or SPARCstation™ family is used, keep the following differences in mind.

- File name format is different.
  - Extension .exe of an executable file is not suffixed with an EWS version such as the HP9000 Series 700.
  - Extension .bat of a batch file is rendered .sh with an EWS version such as the HP9000 Series 700.
  - The file names shown in uppercase are in lowercase with an EWS version such as the HP9000 Series 700.
- The execution examples and the environment set-up indicated in this manual differ.

[Conventions]

The following symbols and abbreviations are used throughout this manual:

⋮:	Indicates that the same expression is repeated.
[ ]:	Item(s) in brackets can be omitted.
' ':	Characters enclosed in ' ' (quotation marks) will be listed as they appear.
< >:	Names of dialog boxes and Windows
" ":	Characters enclosed in " " (double quotation marks) are titles of chapters, paragraphs, sections, diagrams or tables to which the reader is asked to refer.
___:	Indicates an important point, or characters that are to be input in a usage example.
□:	Indicates one blank space.
∆:	Indicates one or more blank or TAB.
∇:	Indicates zero or more blanks or TABs (i.e. blanks may be omitted).
/:	Indicates a break between characters.
~:	Indicates continuity.
[↵]:	Indicates pressing of the Return key.
Note:	Indicates a footnote for item marked with **Note** in the text.
Caution:	Indicates information requiring particular attention.
Remark:	Indicates supplementary information.

[Related Documents]

The documents related to this manual are listed below.

The related documents indicated in this publication may include preliminary versions. However, preliminary versions are not marked as such.

Document related to development tools (user's manuals)

Document Name		Document No.
RA78K0 Ver. 3.80 Assembler Package	Operation	This manual
	Language	U17198E
	Structured Assembly Language	U17197E
CC78K0 Ver. 3.70 C Compiler	Operation	U17201E
	Language	U17200E
SM+ System Simulator	Operation	U17246E
	User Open Interface	U17247E
SM78K0 Series Ver. 2.52 System Simulator	Operation	U16768E
PM plus Ver. 5.20		U16934E
ID78K0-NS Ver. 2.52 Integrated Debugger	Operation	U16488E
ID78K0-QB Ver .2.81 Integrated Debugger	Operation	U16996E
78K0 Series	Instruction	U12326E

Caution The related documents listed above are subject to change without notice. Be sure to use the latest version of each document for designing.

[MEMO]

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LIST OF TABLES

CHAPTER 1 GENERAL

This chapter describes the role of the RA78K0 in microcontroller software development and the features of the RA78K0.

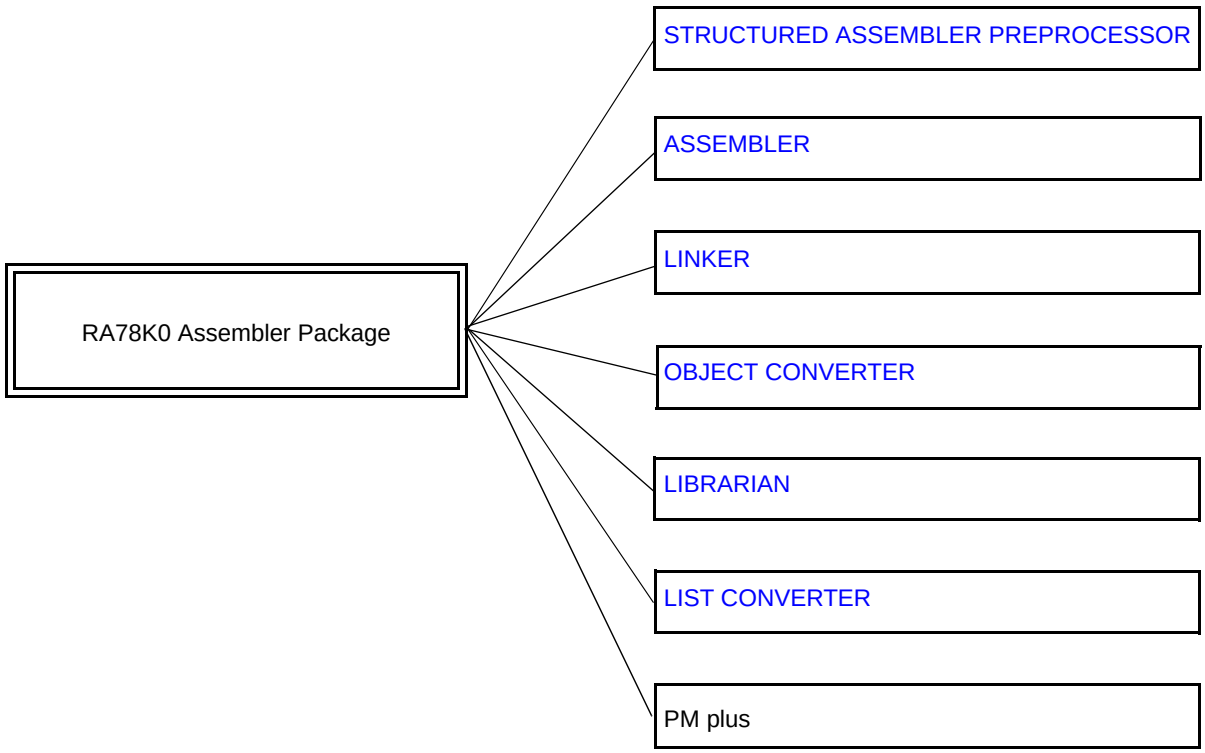
1.1 Assembler Overview

The RA78K0 Assembler Package (hereafter referred to as "the RA78K0") is a generic term for a series of programs designed to translate source programs coded in the assembly language for 78K0 Series microcontrollers into machine language coding.

The RA78K0 contains six programs : Structured Assembler Preprocessor, Assembler, Linker, Object Converter, Librarian, and List Converter.

In addition, a PM plus that helps you perform a series of operations including editing, compiling/assembling, linking, and debugging your program on Windows is also supplied with the RA78K0.

Figure 1-1 RA78K0 Assembler Package



1.1.1 What is an assembler?

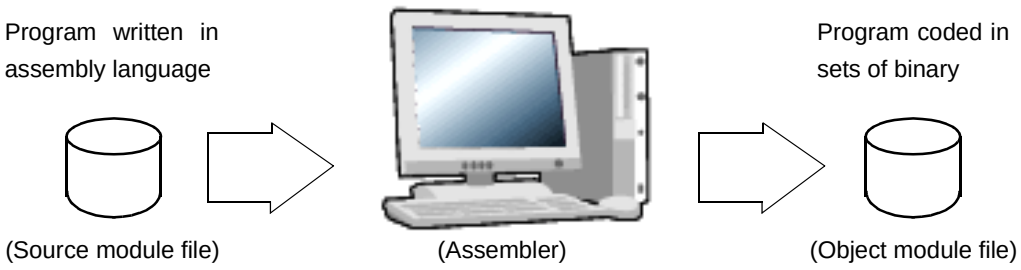
(1) Assembly language and machine language

An assembly language is the most fundamental programming language for a microcontroller.

Programs and data are required for the microprocessor in a microcontroller to do its job. These programs and data must be written by users to the memory of the microcontroller. The programs and data handled by the microcontroller are collections of binary numbers called machine language. For users, however, machine language code is difficult to remember, causing errors to occur frequently. Fortunately, methods exist whereby English abbreviations or mnemonics are used to represent the meanings of the original machine language codes in a way that is easy for users to comprehend. The basic programming language system that uses this symbolic coding is called an assembly language.

Since machine language is the only programming language in which a microcontroller can handle programs, however, another program is required that translates programs created in assembly language into machine language. This program is called an assembler.

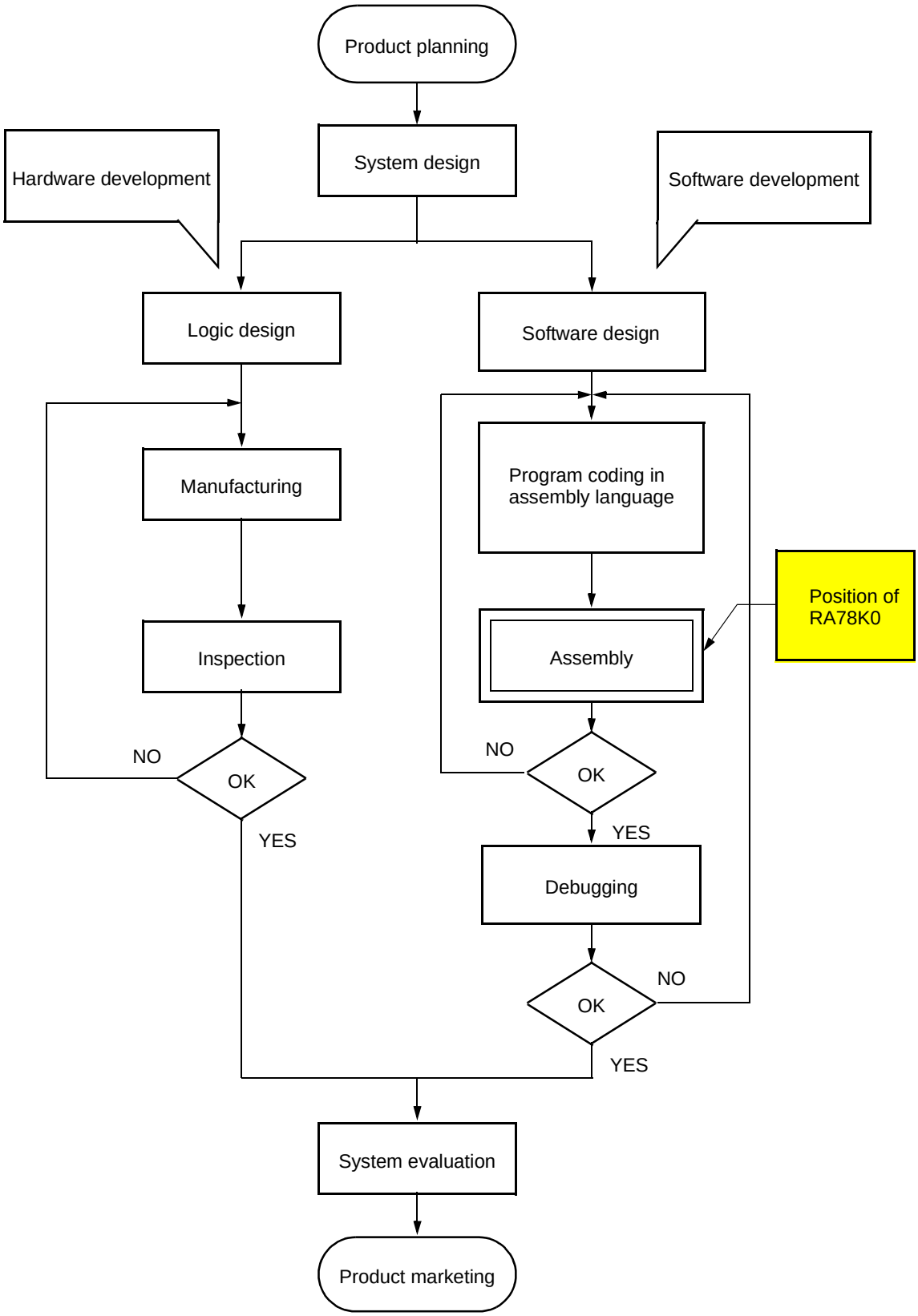
Figure 1-2 Flow of Assembler



1.1.2 Development process and RA78K0

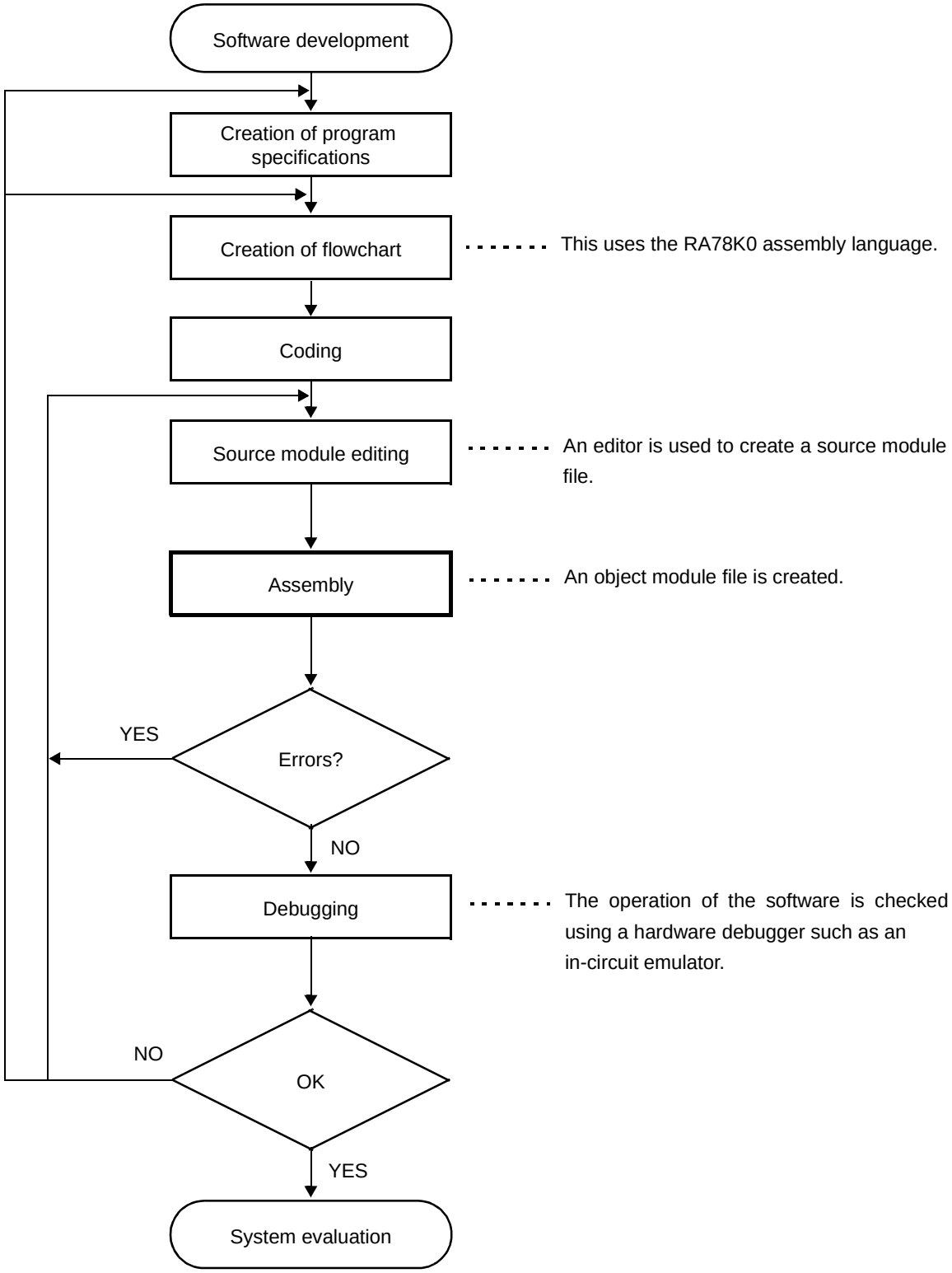
(1) Development of microcontroller-related products and the role of RA78K0
Figure 1-3 illustrates the position of "assembly-language programming in the product development process".

Figure 1-3 Development Process of Microcontroller-Applied Products



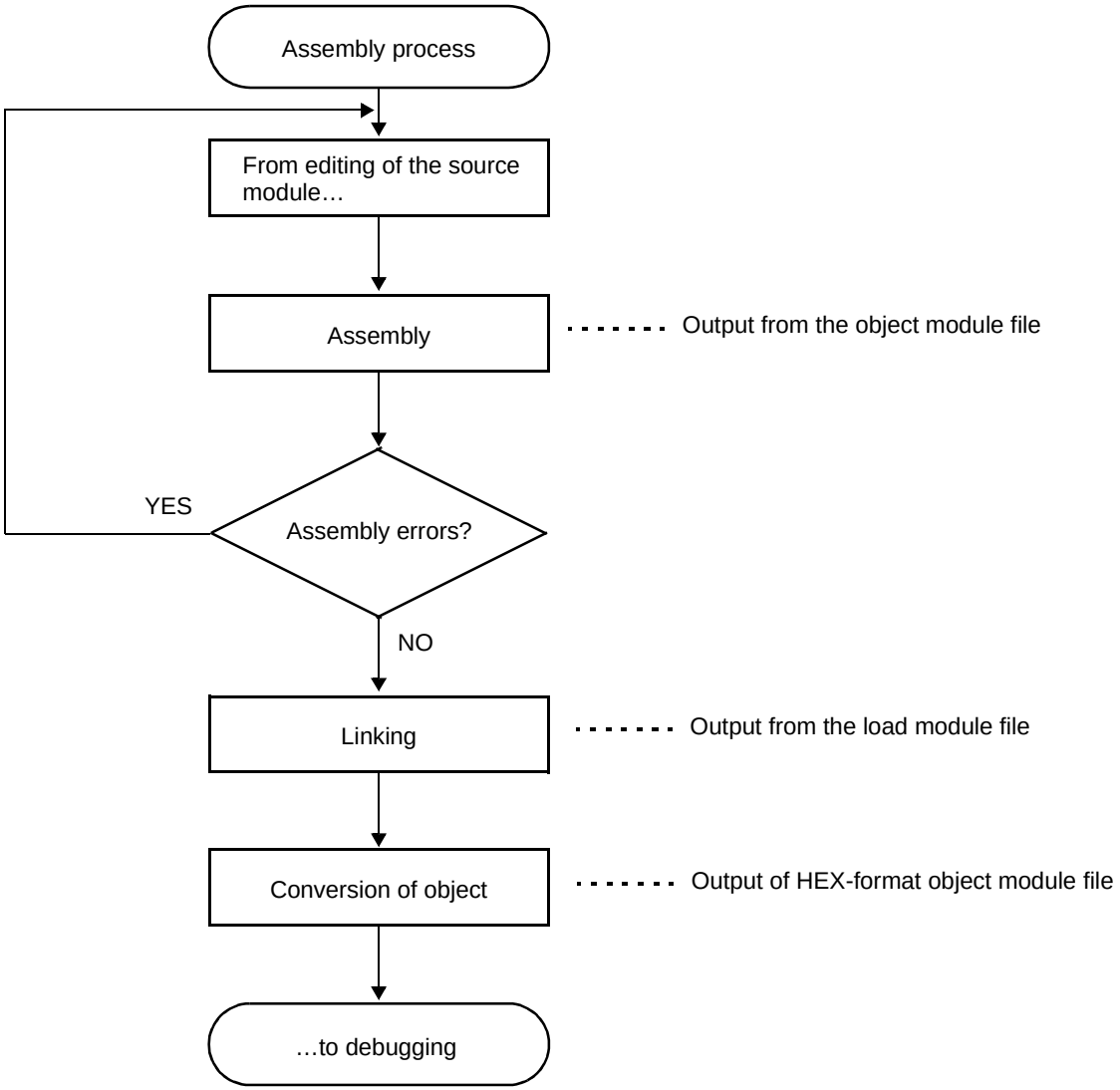
A more detailed explanation of the software development process appears in Figure 1-4.

Figure 1-4 Software Development Process



The RA78K0 is then applied to the assembly process.

Figure 1-5 RA78K0 Assembly Process



1.1.3 What is a relocatable assembler?

The machine language translated from a source language by the assembler is stored in the memory of the microcontroller before use. To do this, the location in memory where each machine language instruction is to be stored must already be determined.

Therefore, information is added to the machine language assembled by the assembler, stating where in memory each machine language instruction is to be located.

Depending on the method of locating addresses to machine language instructions, assemblers can be broadly divided into "absolute assemblers" and "relocatable assemblers".

- Absolute assembler

  An absolute assembler locates machine language instructions assembled from the assembly language to absolute addresses.

- Relocatable assembler

  In a relocatable assembler, the addresses determined for the machine language instructions assembled from the assembly language are tentative. Absolute addresses are determined subsequently by the linker.

In the past, when a program was created with an absolute assembler, programmers had to, as a rule, complete programming at the same time. However, if all the components of a large program are created as a single entity, the program becomes complicated, making analysis and maintenance of the program difficult. To avoid this, such large programs are developed by dividing them into several subprograms, called modules, for each functional unit. This programming technique is called modular programming.

1.1.4 Advantages of a relocatable assembler

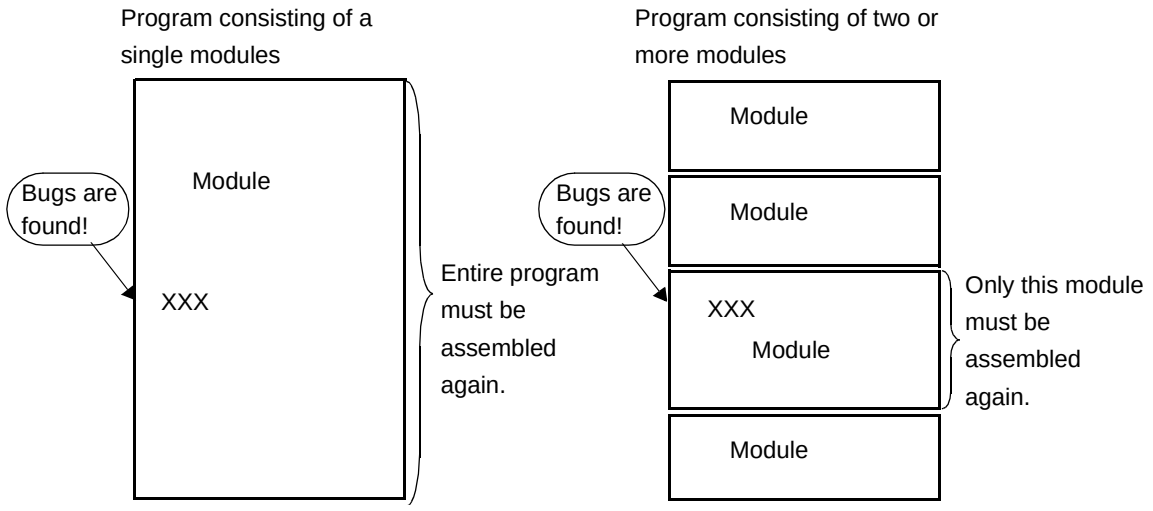
A relocatable assembler is an assembler suitable for modular programming, which has the following advantages:

(1) Increase in development efficiency

It is difficult to write a large program all at the same time. In such cases, dividing the program into modules for each function enables two or more programmers to develop subprograms in parallel to increase development efficiency.

Furthermore, if any bugs are found in the program, it is not necessary to assemble the entire program just to correct one part of the program, and only a module which must be corrected can be reassembled. This shortens debugging time.

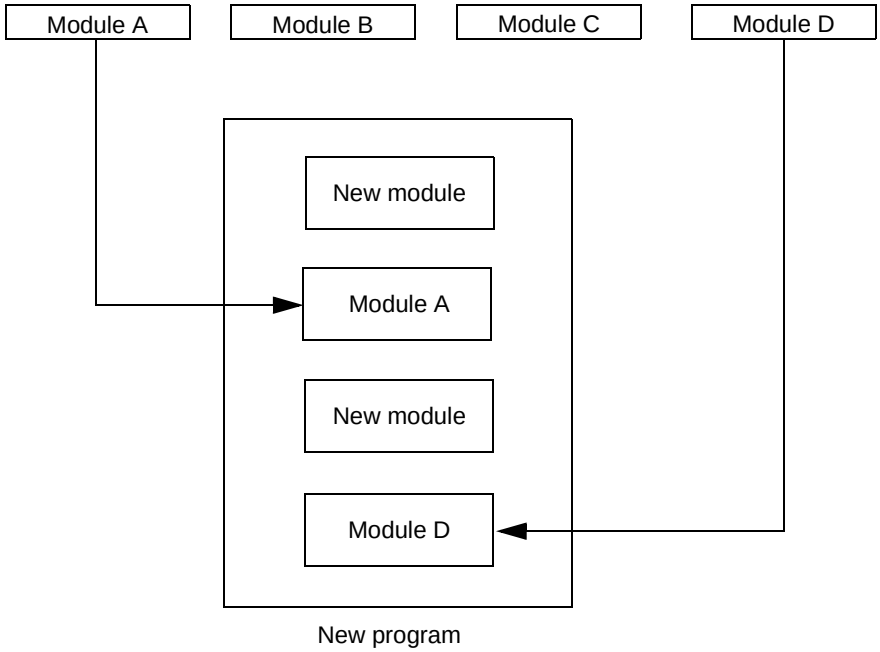
Figure 1-6 Reassembly for Debugging



(2) Utilization of resources

Highly reliable, highly versatile modules which have been previously created can be utilized for creation of another program. If you accumulate such high-versatility modules as software resources, you can save time and labor in developing a new program.

Figure 1-7 Program Development Using Existing Module

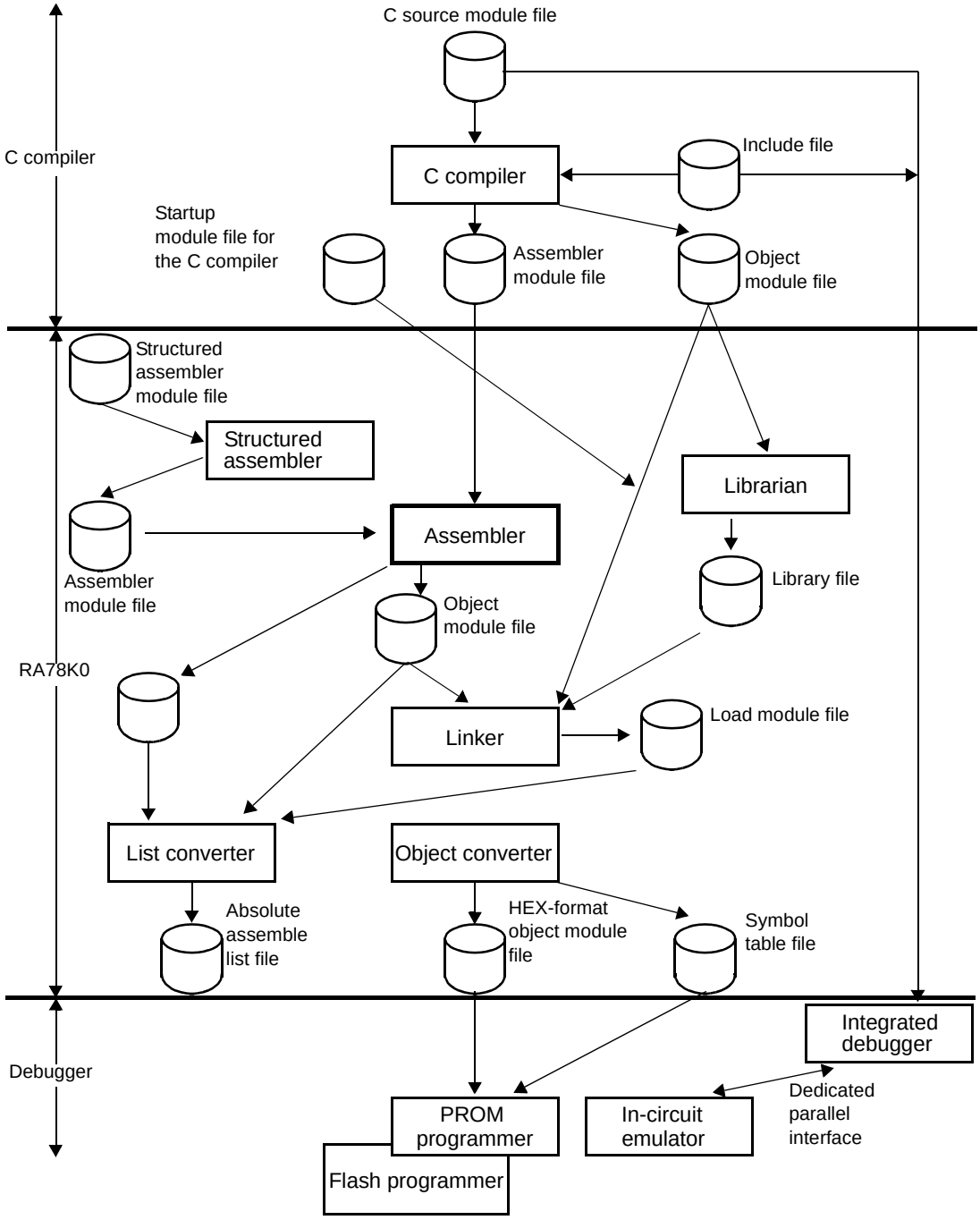


1.2 Overview of Features of RA78K0

The procedure for developing general programs appears in Figure 1-8. Program development essentially flows from the assembler to the linker to the object converter.

The assembler, linker, object converter and other programs are generically referred to as the "RA78K0." the assembler program is referred to as the "assembler."

Figure 1-8 Procedure for Program Development Using RA78K0



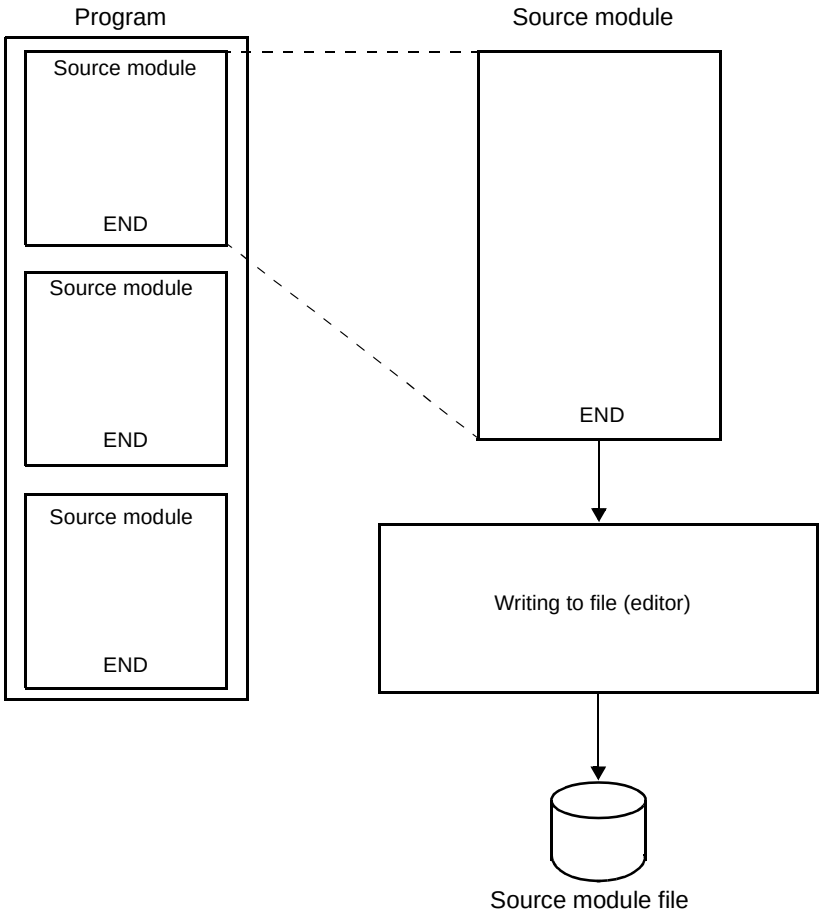
1.2.1 Creating a source module file using an editor

A single program can be divided into two or more modules according to function. A single module can be used as a coding unit or an assembler input unit.

A module which is used as an input unit for the assembler is called a source module. After the coding of each source module is finished, the source module is written to a file using an editor. The file created in this way is called a source module file.

A source module file is used as an assembler input file.

Figure 1-9 Creating Source Module File

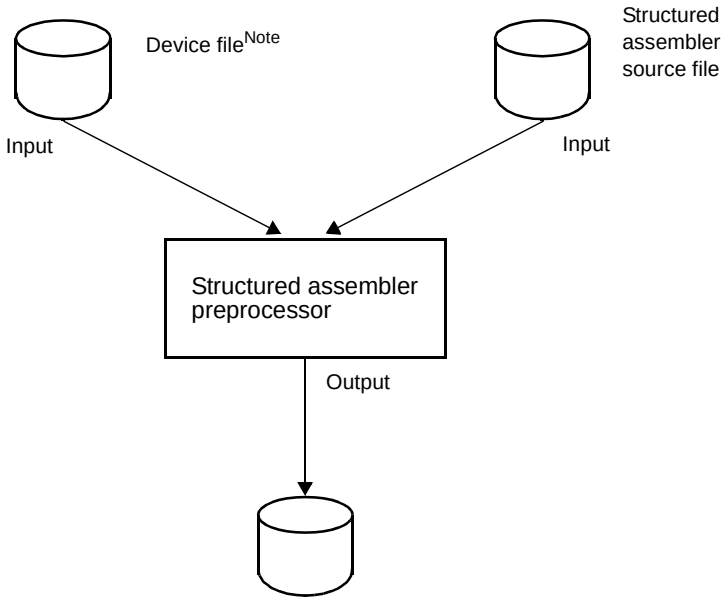


1.2.2 Structured assembler preprocessor

The structured assembler preprocessor is a program whose purpose is to create structured programming using assembly language instructions. The structured assembler preprocessor inputs source programs written in structured assembly language to input the source program for the assembler.

For more information on the structured assembler preprocessor and structured assembly language, refer to the separate RA78K0 Structured Assembly Language User's Manual.

Figure 1-10 Function of Structured Assembler Preprocessor



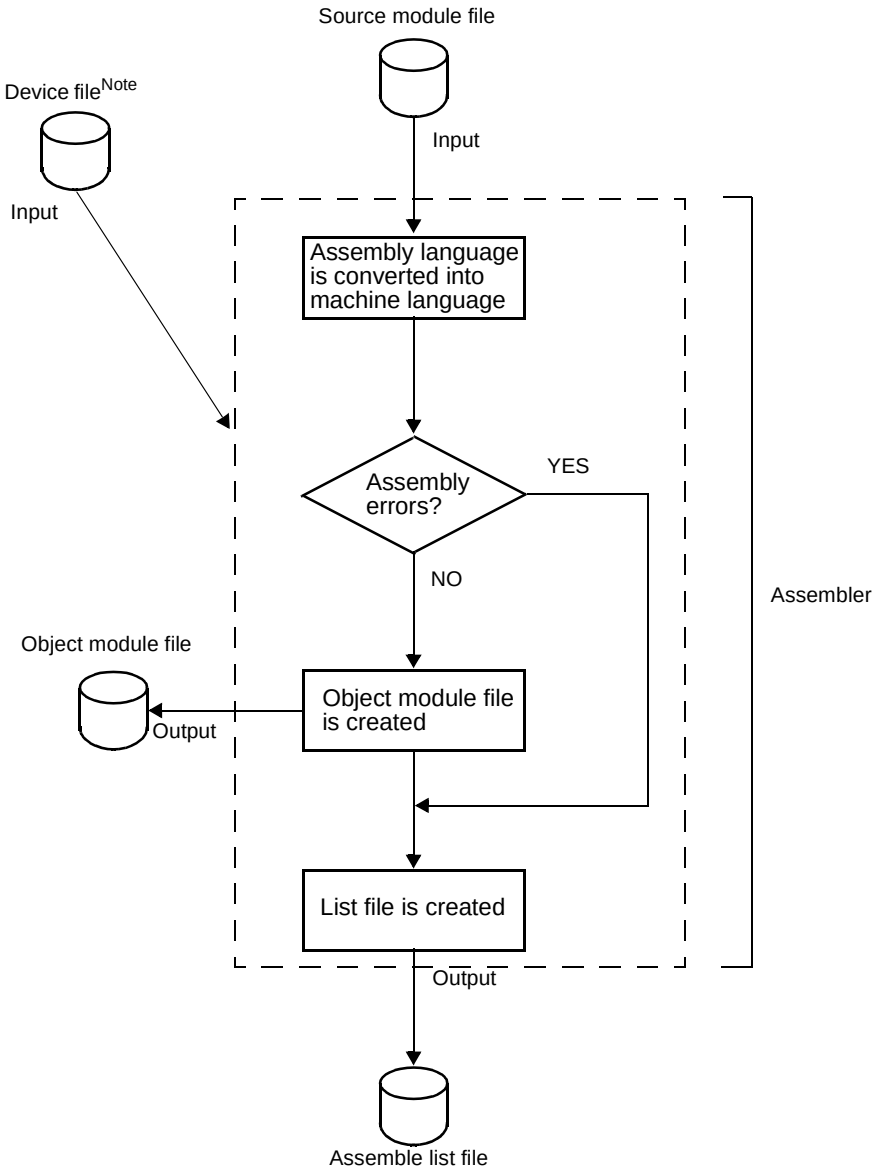
Note Obtain the device file by downloading it from the Online Delivery Service (ODS), which can be accessed from the following Website.

http://www.necel.com/micro/ods/eng/tool/DeviceFile/list.html

1.2.3 Assembler

The assembler is a program which inputs the source module file and converts the assembly language into a collection of binary instructions (machine language). If the assembler discovers errors in the descriptions in the source module, it outputs an assembly error. If no assembly errors are found, the assembler outputs an object module file which specifies location data such as where in memory the machine language data and each machine language should be stored. The assembly data is output as an assemble list file.

Figure 1-11 Function of Assembler



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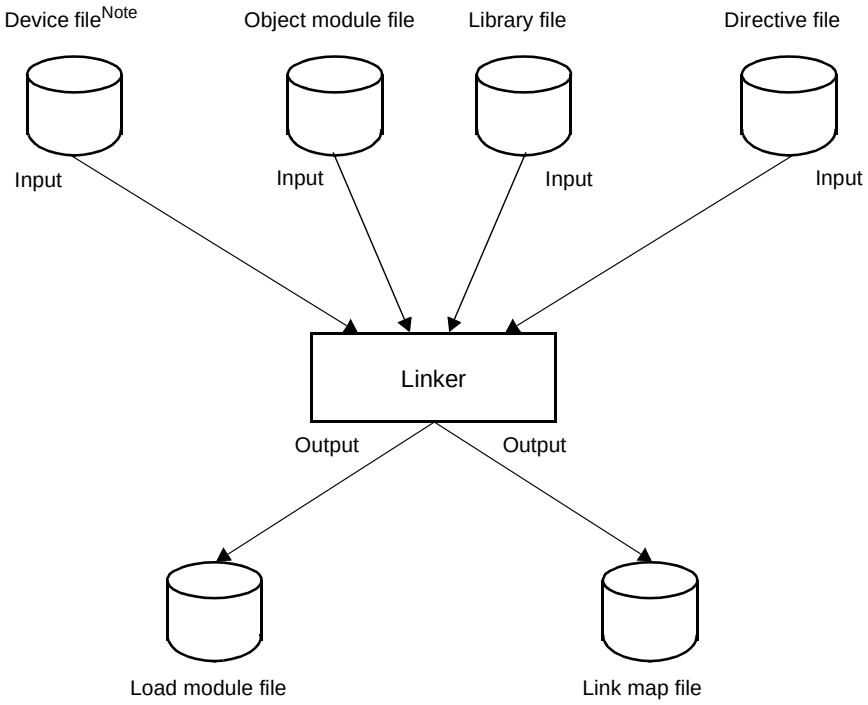
1.2.4 Linker

The linker inputs the multiple object module files output by the compiler and the assembler and links them to output a single load module file (linking must be performed even if only one object module file is input).

The linker determines the location addresses for the relocatable segments in the input modules. This determines the values for the relocatable symbols and external-reference symbols so that the correct values can be embedded in the load module file.

Figure 1-12 Function of Linker



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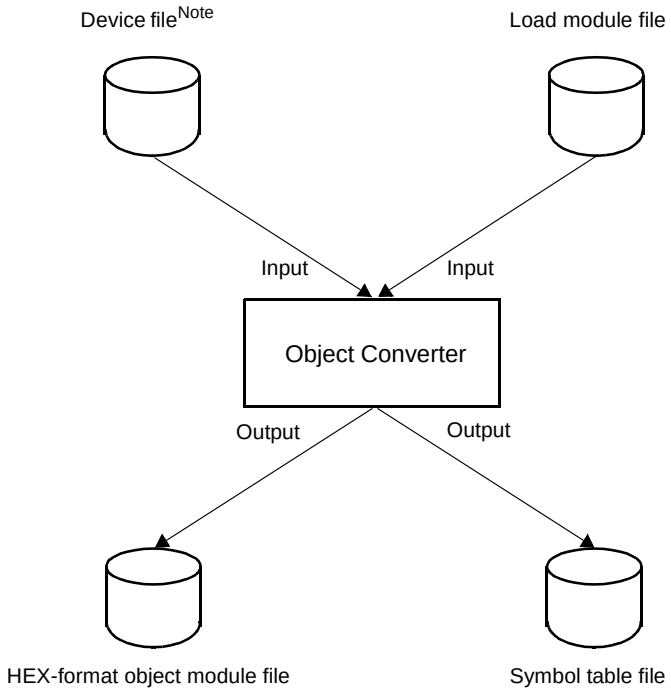
1.2.5 Object converter

The object converter inputs the load module file output by the linker and converts the file format. The resulting file is output as a HEX-format object module file.

The object converter also outputs symbol data necessary for symbolic debugging as a symbol table file.

Figure 1-13 Function of Object Converter



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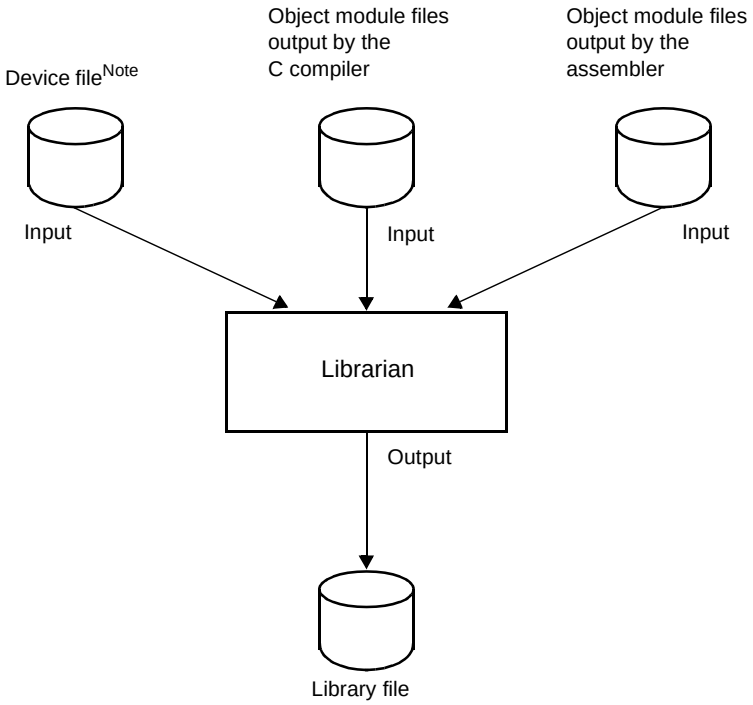
1.2.6 Librarian

For convenience and ease of use, a general-purpose module with a clear interface may be stored in a library. By creating a library, multiple object modules can be stored in a single file, making them easy to handle.

The linker incorporates a function which retrieves from the library file only the modules necessary. When multiple modules are registered in a single library file, the module files can be linked without the need to specify each individual module file name.

The librarian is the program used to create and update the library file.

Figure 1-14 Function of Librarian



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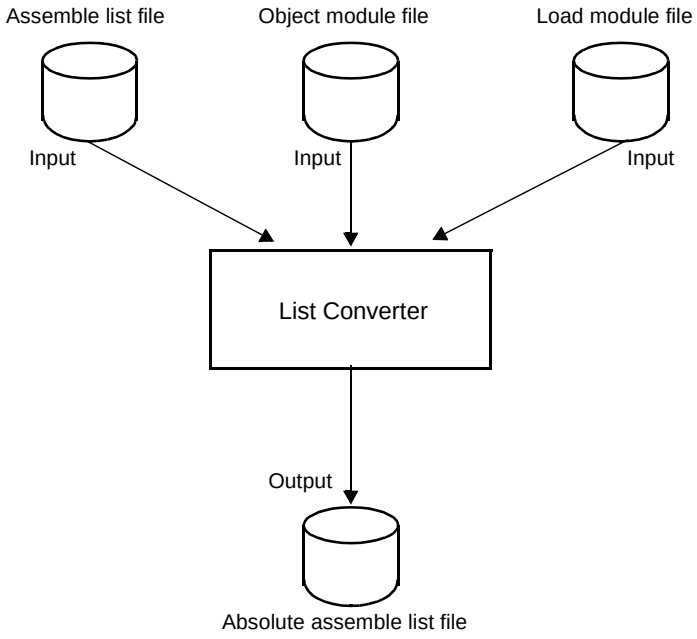
http://www.necel.com/micro/ods/eng/tool/DeviceFile/list.html

1.2.7 List converter

The list converter inputs the object module files and assemble list file output by the assembler and the load module file output by the linker, and outputs an absolute assemble list file.

Relocatable assemble list files have the disadvantage that addresses and relocatable values in the list may be different from their actual values. An absolute assemble list file determines these values, making debugging and program maintenance easier.

Figure 1-15 Function of List Converter



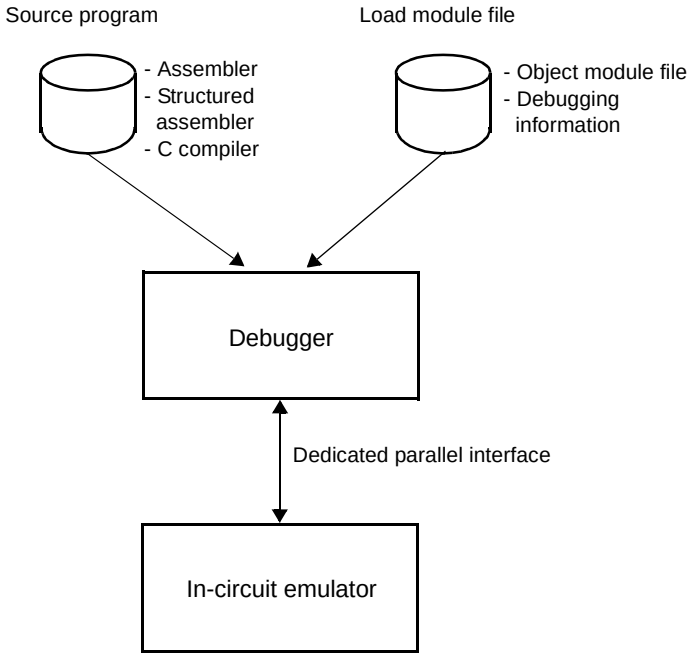
1.2.8 Debugger

The debugger for the 78K0 Series is a software tool which displays the data from source programs, registers and memories in their respective windows and performs debugging.

The debugger downloads the load module file output by the linker to the in-circuit emulator (IE) of the target system. It can also perform debugging at the source level by reading the source program file.

The debugger and IE are separate packages and are sold separately from the RA78K0.

Figure 1-16 Function of Debugger



1.3 Reminders Before Program Development

Refer to the following before beginning program development.

1.3.1 Maximum performance of RA78K0

(1) Maximum performance of structured assembler

Table 1-1 Maximum Performance of Structured Assembler

Item	Maximum Value
Line length (not including LF or CR)	2048 characters
Number of symbols registered in #define directive (excluding reserved words)	512 symbols
Character length of symbol registered in #define directive	31 characters
Nesting levels in control statement	31 levels
Nesting levels in #ifdef directive	8 levels
#defcallt directives	32
Nesting of #include directives	Not supported
Number of redefinitions by #define directive	31 times
Number of operands assigned in a series	33Note1
Logical operator operands	17Note2
Number of symbols defined by -D option	30
Number of library file paths specifiable by -I option	64

Notes 1 The maximum value is expressed as follows.

S1=S2= ... S32=S33

Up to 33 symbols and 32 equal (=) signs can be inserted.

Notes 2 The maximum value is expressed as follows.

expression 1&&expression 2&& ... &&expression 16&&expression 17

Up to 17 expression s and 16 "&&" (or "||") signs can be inserted.

(2) Maximum performance of assembler

Table 1-2 Maximum Performance of Assembler

Item	Maximum Performance
Number of symbols (local + public)	65535
Number of symbols that can be output to cross reference list	65534[Note1]
Maximum marco body size referenced by one marco	1 MB
Total size of all macro bodies	10 MB
Number of segments in 1 file	256
Macros and include specifications in 1 file	10000
Macros and include specifications in 1 include file	10000
Relocation information[Note2]	65535
Line number information	65535
BR quasi directives in 1 file	32767
Numbers of characters on 1 line of source code	2048[Note3]
Symbol length	256 characters
Number of switch name definitions[Note4]	1000
Character length of switch name[Note4]	31 characters
Character length of segment name	8 characters
Character length of module name (NAME quasi directive)	8 characters
Number of virtual parameters in MACRO quasi directive	16
Number of actual parameters in macro reference	16
Number of actual parameters in IRP quasi directive	16
Number of local symbols in macro body	64
Total number of local symbols in expanded macro	65535
Nesting levels in macro (macro reference, REPT quasi directive, IRP quasi directive)	8 levels
Number of characters specifiable by TITLE control instruction, -LH option	60[Note5]
Number of characters specifiable by SUBTITLE control instruction	72
Include file nesting levels in 1 file	8 levels
Conditional assembly nesting levels	8 levels
Number of include file paths specifiable by -I option	64
Number of symbols definable by -D option	30

Notes 1 Excluding the number of module names and section names.
Memory is used. If there is no memory, a file is used.

Notes 2 Information to be passed to the linker if the symbol value cannot be resolved by the assembler.
For example, if an externally referenced symbol is to be referenced by the MOV instruction, two pieces of relocation information are generated in a .rel file.

Notes 3 Including CR and LF codes. If more than 2048 characters are written on one line, a warning message is output and the 2049th character and those that follow are ignored.

Notes 4 The switch name is set as true/false by the SET/RESET quasi directive and is used by $IF, etc.

Notes 5 If the maximum number of characters that can be specified in one line of the assemble list file ("X") is 119, this figure will be "X - 60" or less.

(3) Maximum performance of linker

Table 1-3 Maximum Performance of Linker

Item	Maximum Performance
Number of symbols (local + public)	65535
Line number information of the same segment	65535
Number of segments	65535
Input modules	1024
Character length of memory area name	31 characters
Number of memory areas	100Note
Number of library files specifiable by -B option	10
Number of include file paths specifiable by -I option	64

Note Including those defined by default.

1.4 Features of RA78K0

The RA78K0 has the following features :

(1) Macro function

When the same group of instructions must be described in a source program over and over again, a macro can be defined by giving a single macro name to the group of instructions. By using this macro function, coding efficiency and readability of the program can be increased.

(2) Optimize function of branch instructions

The RA78K0 has a directive to automatically select a branch instruction (BR directive).

To create a program with high memory efficiency, a byte branch instruction must be described according to the branch destination range of the branch instruction. However, it is troublesome for the programmer to describe a branch instruction by paying attention to the branch destination range for each branching. By describing the BR directive, the assembler generates the appropriate branch instruction according to the branch destination range. This is called the optimization function of branch instructions.

(3) Conditional assembly function

With this function, a part of a source program can be specified for assembly or non-assembly according to a predetermined condition. If a debug statement is described in a source program, whether or not the debug statement should be translated into machine language can be selected by setting a switch for conditional assembly. When the debug statement is no longer required, the source program can be assembled without major modifications to the program.

CHAPTER 2 PRODUCT OUTLINE AND INSTALLATION

This chapter explains the procedure used to install the files stored in the supply media of the RA78K0 in the user development environment (host machine) and the procedure to uninstall these files from the user development environment.

2.1 Host Machine and Supply Medium

The assembler package supports the development environments shown in Table 2-1. The supply medium differs depending on the host machine.

Table 2-1 Supply Medium of Assembler Package

Host Machine	OS	Supply Medium
IBM PC/AT compatible	Japanese Windows (98/Me/2000/XP/NT 4.0)Note English Windows (98/Me/2000/XP/NT 4.0)Note	CD-ROM
HP9000 Series 700™	HP-UX™ (Rel. 10.10 or later)	CD-ROM
SPARCstation Series	SunOS™ (Rel. 4.1.4 or later) Solaris™ (Rel. 2.5.1 or later)	

Note To use the assembler in Windows, PM plus is necessary.
If PM plus is not used, each tool included in the RA78K0 assembler package can be used from the DOS prompt (Windows 98/Me) or command prompt (Windows 2000/XP/NT 4.0)

2.2 Installation

The procedure for installing to the host machine the files provided in the RA78K0's supply media is described below.

2.2.1 Installation of Windows version

(1) Starting up Windows

Power on the host machine and peripherals and start Windows.

(2) Set supply media

Set the RA78K0's supply media in the appropriate drive (CD-ROM drive) of the host machine. The setup programs will start automatically. Perform the installation by following the messages displayed in the monitor screen.

Caution If the setup program does not start automatically, execute SETUP.EXE in the RA78K0\DISK1 folder.

(3) Confirmation of files

Using Windows Explorer, etc., check that the files contained in the RA78K0's supply media have been installed to the host machine.

For the details of each folder, refer to "2.4 Directory Configuration".

2.2.2 Installation of UNIX version

Install the UNIX version with the following procedure. Installation to /nectools/bin is assumed here.

(1) Login

Log in to the host machine.

(2) Directory selection

Go to the install directory.

%cd /nectools/bin

(3) Setting of supply media

Set the CD-ROM in the CD-ROM drive.

(4) Copying of files

Execute the cp command to copy the files from the CD-ROM (copy the files after checking that the CD-ROM has been set in the CD-ROM drive).

(5) Setting of environmental variable PATH

Add /nectools/bin to the environmental variable PATH.

2.3 Installation of Device Files

Obtain the device file by downloading it from the Online Delivery Service (ODS), which can be accessed from the following Website.

http://www.necel.com/micro/ods/eng/tool/DeviceFile/list.html

2.3.1 Installation of Windows version

Use the "device file installer" to install the device files. The "device file installer" is installed at the same time as the RA78K0.

2.3.2 Installation of UNIX version

Either specify the directory for device files with the -y option, or specify the directory (example : -y/nectools/dev), and copy the device files to a directory with the assembler execution format (example : /nectools/bin).

2.3.3 Registry registration of device files

If the device files are already installed, a message prompting you to perform registry registration of the device files may be displayed during RA78K0 installation.

If currently using a 32-bit environment, register the device file used for the RA78K0 (Ver. 3.30 or earlier, 16-bit environment) to a registry (32-bit environment).

Registry registration can also be done using the device file installer after RA78K0 installation has been completed.

The registry registration procedure is as follows.

(1) Startup of "device file installer"

(2) Source selection

Click the [Browse] button and select "NECDEV.INI" used in the 16-bit environment.

Select a file registered to a registry from the device file displayed in the source list box.

(3) Move

Register the file to the registry (32-bit environment) by clicking the [Move] button.

2.4 Directory Configuration

2.4.1 Windows version directory configuration

The standard directory displayed during installation is "NECTools32\" on the drive where Windows is installed. The configuration of the install directory is as shown below. The drive and install directory may be changed during installation. Install PM plus and the RA78K0 in the same directory.

Figure 2-1 Directory Configuration

\NECTools32\		
├ bin\		
	st78k0.exe	Execution format of structured assembler preprocessor
	ra78k0.exe	Execution format of assembler
	lk78k0.exe	Execution format of linker
	oc78k0.exe	Execution format of object converter
	lb78k0.exe	Execution format of librarian
	lcnv78k0.exe	Execution format of list converter
	lb78k0e.exe	Interface tool between library and DLL of PM plus environment
	lb78k0p.exe	Standalone start up library
	ra78k0.is*	File used by assembler
	*78k0p.dll	DLL tool for PM plus
	*78k0.hlp	Help file for starting command line (text file)
├ doc\		User's manual and supplementary explanations
├ hlp\		Online manual
├ setup\		Data files for installation and uninstallation
└ smp78k0\ra78k0\		
	k0main.asm	Assembler sample program
	k0sub.asm	Assembler sample program
	ra.bat	Batch file for assembler sample program
	readme.doc	Explanation of sample program and batch file (text file)
	test1.s	Structured assembler sample program
	test2.s	Structured assembler sample program
	testinc.s	Structured assembler sample program
	st.bat	Batch file for structured assembler sample program

Remark The explanations in this manual assume installation to the standard directory with the default program folder name "NECTools32" according to the default directions of the setup program.

2.4.2 UNIX version directory configuration

The file configuration after installation is as follows. The following assumes installation in /nectools/bin.

Figure 2-2 Directory Configuration

/nectools/
└ bin/

st78k0	Executable format of structured assembler preprocessor
ra78k0	Executable format of assembler
lk78k0	Executable format of linker
oc78k0	Executable format of object converter
lb78k0	Executable format of librarian
lcnv78k0	Executable format of list converter
*.hlp	Help file corresponding to each program (text file)
ra78k0.is*	Table file defining instruction set used by assembler
*.asm , *.s	Sample program for installation confirmation
*.sh	Batch file for installation confirmation
*.sh	Batch file for installation confirmation
readme.doc	Explanation of use of install confirmation shell file (text file)

It is recommended to install the C compiler integrated debugger, system simulator, and device file to the directory to which the assembler package has been installed.

2.5 Uninstallation Procedure

2.5.1 Uninstallation of Windows version

The procedure for uninstalling the files installed to the host machine is described below.

(1) Windows startup

Power on the host machine and peripherals and start Windows.

(2) Opening [Control Panel] window

Press the [Start] button and select [Settings]-[Control Panel] to open the [Control Panel] window.

(3) Opening of [Add/Remove Programs] window

Double-click the [Add/Remove Programs] icon in the [Control Panel] window to open the [Add/Remove Programs] window.

Caution On Windows XP, [Add or Remove Programs] is displayed instead of [Add/Remove Programs]

(4) Removing RA78K0

After selecting "NEC RA78K0 78K/0 Assembler Vx.xx" from the list of installed software displayed in the [Install/Uninstall] tab in the [Add/Remove Programs] window, click the [Add/Remove] button.

When the [System Settings Change] window is opened, click the [Yes] button.

(5) Confirmation of files

Using Windows Explorer, etc., check that the files installed to the host machine have been uninstalled. For the details of each folder, refer to "2.4 Directory Configuration".

2.5.2 Uninstallation of UNIX version

The files copied in "2.2.2 Installation of UNIX version" with the rm command.

2.6 Environment Settings

2.6.1 Host machine (IBM PC/AT compatibles)

The RA78K0 runs on a machine with a 32-bit CPU such as i386™ or above.

Because the assembler package runs with a 32-bit CPU by using DOS Extender, it is designed to run on the following OSs :

- DOS prompt of Windows 98/Me
- Command prompt of Windows 2000/XP/NT 4.0

A protect memory of 7M bytes or more is necessary for operation.

The restrictions on the environmental variables of each OS are as follows :

2.6.2 Environmental variables

Set the following environmental variables. If the assembler package has been installed using the Windows installer, the necessary environmental variables are automatically set.

PATH : Specifies the directory to which the executable format of the assembler is stored.

TMP : Specifies a directory where a temporary file is to be created
(valid only with the IBM PC/AT compatibles)

INC78K0 : Specifies a directory where the include file is searched.

LIB78K0 : Specifies the directory where a library is searched, if the library is used.

LANG78K : Specifies the kanji code (2-byte code) described in the comment.

[Example]

- With IBM PC/AT compatibles

```
PATH = %PATH% ; c:\NECTools32\bin
set      TMP = c:\tmp
set      INC78K0 = c:\NECTools32\inc78k0
set      LIB78K0 = c:\NECTools32\lib78k0
set      LANG78K = SJIS
```

- With HP9000 Series 700 or SPARCstation Series

< Example when csh is used >

```
set      path = ( $path /ra78k0 )
setenv   INC78K0 /ra78k0
setenv   LIB78K0 /ra78k0
setenv   LANG78K EUC
```

< Example when sh is used >

```
PATH = $PATH:/ra78k0
INC78K0 = /ra78k0
LIB78K0 = /ra78k0
LANG78K = EUC
export    PATH INC78K0 LIB78K0 LANG78K
```

2.6.3 Kanji code in source file

- Kanji (2-byte characters) can be used in specific places (comments, etc.) in the source file.
- Specify the kanji code type using an environmental variable (LANG78K), kanji code control instruction (KANJICODE), or kanji code specification option (-ZE/-ZS/-ZN).

CHAPTER 3 EXECUTION PROCEDURE OF RA78K0

This chapter explains the procedures for using the assembler package RA78K0, from assembling to object conversion.

Sample programs "k0main.asm" and "k0sub.asm" are assembled, linked, and converted into objects in accordance with the execution procedures explained.

In this section, how to run the assembler package on command line is explained.

3.1 Before Executing RA78K0

3.1.1 Sample programs

Among the files stored on the system disk are "k0main.asm" and "k0sub.asm". These files are a sample program for use in verifying the operation of the assembler package.

In later assembler operation, these files will be input to the assembler as source program files.

k0main.asm : Main module

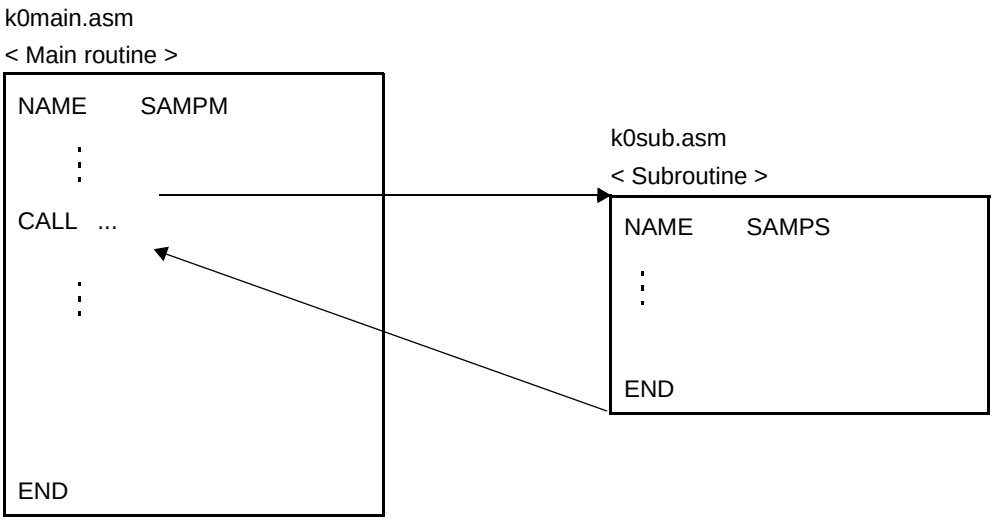
k0sub.asm : Sub module

These programs consist of hexadecimal data converted to ASCII code. The program consists of two modules, a main routine and a subroutine.

The name of the main routine module is SAMPM, and it is stored in (k0main.asm).

The name of the subroutine module is SAMPS, and it is stored in (k0sub.asm).

Figure 3-1 Structure of Sample Program



- k0main.asm (Main routine)

```
        NAME    SAMPM
; ****************************************************
; *                                                  *
; *       HEX -> ASCII Conversion Program            *
; *                                                  *
; *       main-routine                               *
; *                                                  *
; ****************************************************

        PUBLIC  MAIN , START
        EXTRN   CONVAH
        EXTRN   _@STBEG

DATA    DSEG    saddr
HDTSA : DS      1
STASC : DS      2

CODE    CSEG    AT 0H
MAIN :  DW      START

        CSEG
START :
        ; chip initialize
        MOVW    SP , #_STBEG

        MOV     HDTSA , #1AH
        MOVW    HL , #HDTSA             ; set hex 2-code data in HL register

        CALL    !CONVAH                 ; convert ASCII <- HEX
                                        ; output BC-register <- ASCII code
        MOVW    DE , #STASC             ; set DE <- store ASCII code table
        MOV     A , B
        MOV     [ DE ] , A
        INCW    DE
        MOV     A , C
        MOV     [ DE ] , A

        BR      $$

        END
```

- k0sub.asm (Subroutine)

```
        NAME    SAMPS
; ************************************************************************
; *                                                                      *
; *       HEX -> ASCII Conversion Program                                *
; *                                                                      *
; *       sub-routine                                                    *
; *                                                                      *
; *       input condition : ( HL ) <- hex 2 code                          *
; *                                                                      *
; *       output condition   :BC-register <- ASCII 2 code                *
; *                                                                      *
;************************************************************************

        PUBLIC CONVAH

        CSEG
CONVAH : XOR  A , A
        ROL4    [ HL ]                  ; hex upper code load
        CALL    !SASC
        MOV     B , A                   ; store result

        MOV     A , A
        ROL4    [ HL ]                  ; hex lower code load
        CALL    !SASC
        MOV     C , A                   ; store result

        RET

; ****************************************************************
; *       subroutine convert ASCII code                          *
; *       input Acc ( lower 4bits ) <- hex code                  *
; *       output Acc          <-  ASCII code                     *
; ****************************************************************

SASC :  CMP     A , #0AH                ; check hex code > 9
        BC      $SASC1
        ADD     A , #07H                ; bias ( +7 )
SASC1 : ADD     A , #30H                ; bias ( +30 )
        RET

        END
```

Remarks 1 This sample program is a reference program, prepared for the purpose of teaching you about the functions and operation of the RA78K0. It cannot be used as an application program.

Remarks 2 This sample program does not operate the default settings of the register bank selection flags (RBS0, RBS1). The settings for these items are therefore as follows.

Register bank 0 (FEF8H to FEFFH)

3.1.2 Configuration of sample program

The following describes the sample program that is used as an example for the operations described below.

k0main.asm : Main module
k0sub.asm : Sub module
mylib.lib : Library file (this is not used here.)
sample.dr : Directive file

3.2 Execution Procedure of RA78K0

The batch files (ra.bat) in the system disk are used for the RA78K0 operation.

The assembler, linker, object converter, and list converter are executed in this order using "k0main.asm" and "k0sub.asm", which are written in assembly language in ra.bat, as source files. If an error occurs, a message is output and the batch file terminates.

Specification of the type of device to be used as the target is input to this batch file (Obtain the device file by downloading it from the Online Delivery Service (ODS)).

The following explanation uses the "uPD780058" as the target device.

- ra.bat (batch program for verifying RA78K0 operation)

```
        echo off
        cls
        set LEVEL = 0

        if " %1 " == "" goto ERR_BAT

        ra78k0 -C%1 k0main.asm
        if errorlevel 1 set LEVEL = 1
        ra78k0 -C%1 k0sub.asm
        if errorlevel 1 set LEVEL = 1
        if %LEVEL% == 1 echo Assemble error !!
        if %LEVEL% == 1 goto END

        cls
        lk78k0 k0main.rel k0sub.rel -s -orasample.lmf -prasample.map
        if errorlevel 1 echo Link error !!
        if errorlevel 1 goto END

        cls
        oc78k0 rasample
        if errorlevel 1 echo Object conversion error !!
        if errorlevel 1 goto END
        cls
        set LEVEL = 0
        lcnv78k0 -lrasample.lmf -rk0main.rel k0main.prn
        if errorlevel 1 set LEVEL = 1
        lcnv78k0 -lrasample.lmf -rk0sub.rel k0sub.prn
        if errorlevel 1 set LEVEL = 1
        if %LEVEL% == 1 echo List conversion error !!
        if %LEVEL% == 1 goto END

        cls
        echo No error.
        goto END

: ERR_BAT

        echo Usage : ra.bat chiptype

: END
        echo on
```

(1) Execute the batch file.

Specify the target device type and execute the RA78K0-operation verification batch program.

```
C>ra.bat 0058
```

The following message is output to the display.

```
78K/0 Series Assembler Vx.xx  [ xx xxx xxxx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

Pass1 Start
Pass2 Start

 Target chip : uPD780058
 Device file : Vx.xx

Assembly complete ,     0 error ( s ) and     0 warning ( s ) found.

78K/0 Series Assembler Vx.xx  [ xx xxx xxxx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

Pass1 Start
Pass2 Start

 Target chip : uPD780058
 Device file : Vx.xx

Assembly complete ,     0 error ( s ) and     0 warning ( s ) found.
```

Clear the screen.

```
78K/0 Series Linker Vx.xx  [ xx xxx xxxx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

 Target chip : uPD780058
 Device file : Vx.xx

Link complete ,     0 error ( s ) and     0 warning ( s ) found.
```

Clear the screen.

```
78K/0 Series Object Converter Vx.xx  [ xx xxx xxxx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

 Target chip : uPD780058
 Device file : Vx.xx

Object Conversion Complete ,      0 error ( s ) and     0 warning ( s ) found.
```

Clear the screen.

```
List Conversion Program for RA78K/0 Vx.xx  [ xx xxx xxxx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

Pass1 : start...
Pass2 : start...
Conversion complete.

List Conversion Program for RA78K/0 Vx.xx  [ xx xxx xxxx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

Pass1 : start...
Pass2 : start...
Conversion complete.
```

Clear the screen.

```
No error.
```

(2) Check the contents of drive C.

The following files are output.

k0main.rel :	Object module file
k0main.prn :	Assemble list file
k0sub.rel :	Object module file
k0sub.prm :	Assemble list file
rasample.lmf :	Load module file
rasample.map :	Link list file
rasample.hex :	HEX format object module file
rasample.sym :	Symbol table file
k0main.p :	Absolute assemble list file
k0su.p :	Absolute assemble list file

(3) Summary of RA78K0 execution procedure

The following is a brief summary of the execution procedure of RA78K0.

Figure 3-2 RA78K0 Execution Procedure 1

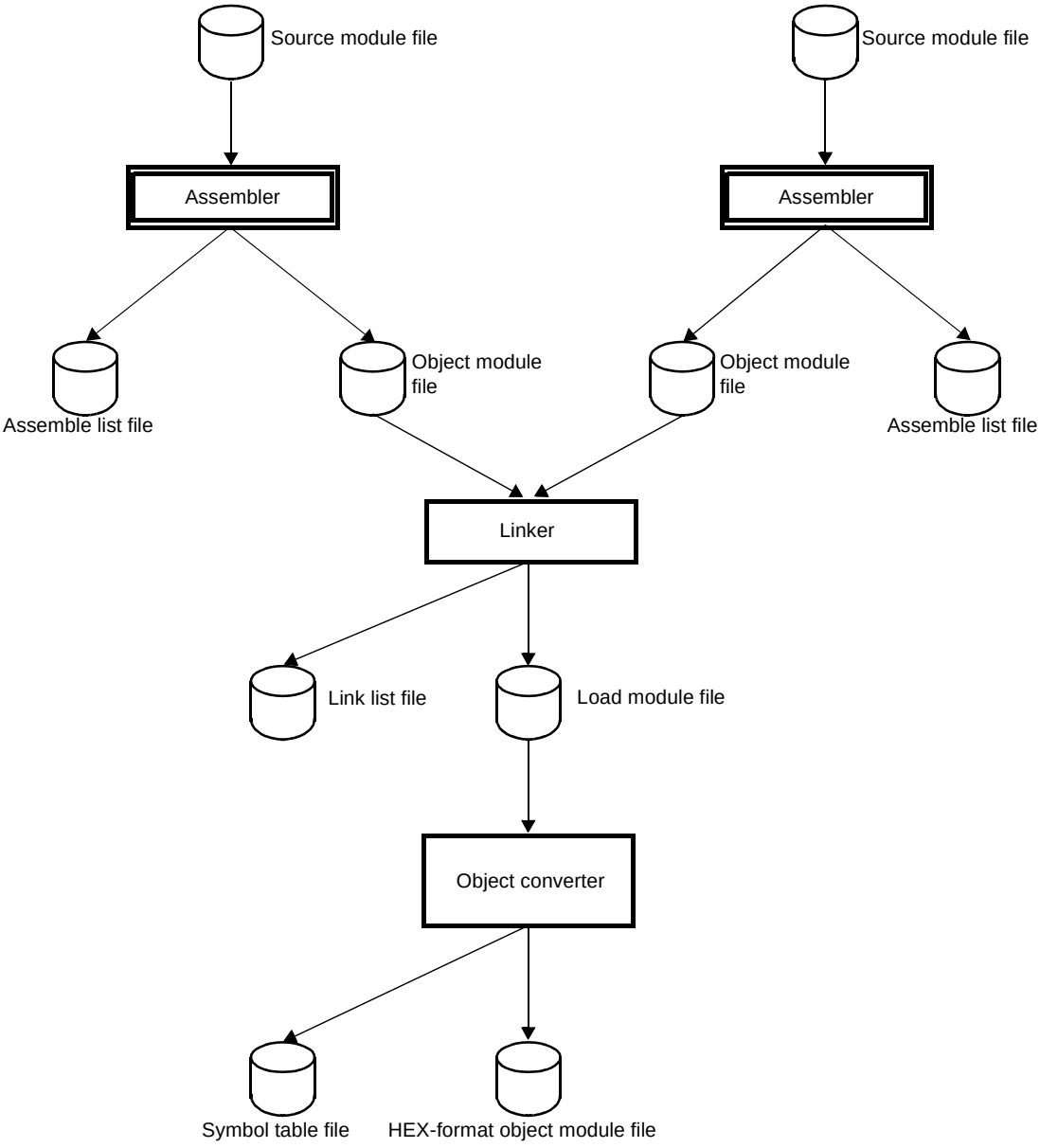
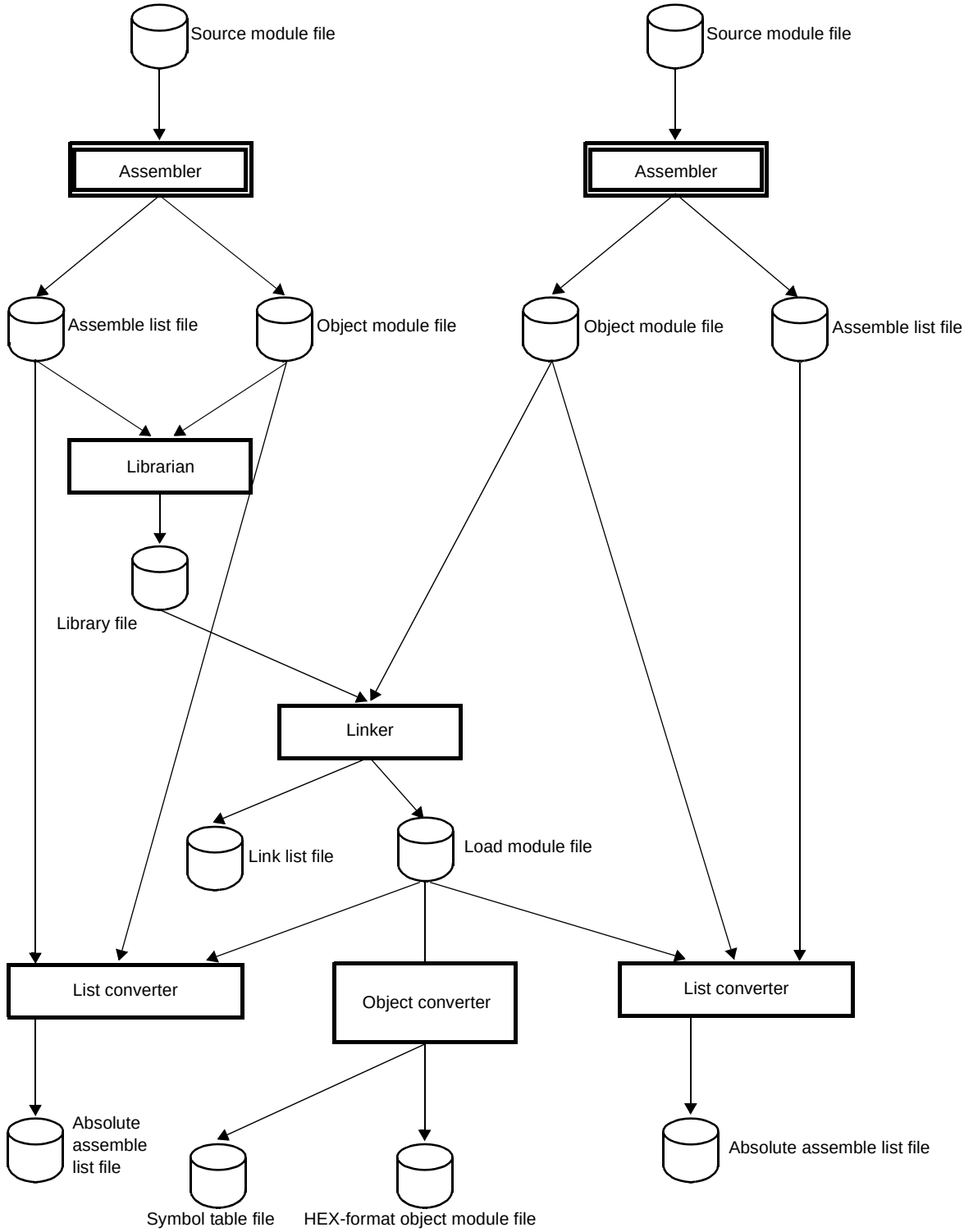


Figure 3-3 RA78K0 Execution Procedure 2



3.3 Execution Procedure of ST78K0

To verify the operation of the ST78K0, use the batch file (st.bat) stored on the system disk.

The structured assembler preprocessor, assembler, linker, object converter, and list converter are executed in order using the sample programs "test1.s" and "test2.s", which are written in structured assembly language in st.bat, as source files. The batch file then terminates following output of any error messages.

Specification of the type of the target device can be input to this batch file (the device file is sold separately).

The following explanation uses the uPD780058 as the target device.

- st.bat (ST78K0-operation verification batch program)

```
        echo off
        cls
        set LEVEL = 0

        if " %1 " == "" goto ERR_BAT

        st78k0 -C%1 test1.s
        ra78k0 test1.asm
        if errorlevel 1 set LEVEL = 1
        st78k0 -C%1 test2.s
        ra78k0 test2.asm
        if errorlevel 1 set LEVEL = 1
        if %LEVEL% == 1 echo Assemble error !!
        if %LEVEL% == 1 goto END

        cls
        lk78k0 test1.rel test2.rel -s -ostsample.lmf -pstsample.map
        if errorlevel 1 echo Link error !!
        if errorlevel 1 goto END

        cls
        oc78k0 stsample
        if errorlevel 1 echo Object conversion error !!
        if errorlevel 1 goto END

        cls
        set LEVEL = 0
        lcnv78k0 -lstsample.lmf -rtest1.rel test1.prn
        if errorlevel 1 set LEVEL = 1
        lcnv78k0 -lstsample.lmf -rtest2.rel test2.prn
        if errorlevel 1 set LEVEL = 1
        if %LEVEL% == 1 echo List conversion error !!
        if %LEVEL% == 1 goto END

        cls
        echo No error.
        goto END

: ERR_BAT

        echo Usage : st.bat chiptype

: END
        echo on
```

(1) Execute the batch file.

Specify the target device type and execute the ST78K0-operation verification batch program.

```
C>st.bat 0058
```

The following message is output to the display.

```
Structured assembler preprocessor for RA78K/0 Vx.xx  [ xx xxx xxxx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

start

 Target chip : uPD780058
 Device file : Vx.xx

Conversion complete , 0 error ( s ) found.

78K/0 Series Assembler Vx.xx  [ xx xxx xxxx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

Pass1 Start
Pass2 Start

 Target chip : uPD780058
 Device file : Vx.xx

Assembly complete ,     0 error ( s ) and     0 warning ( s ) found.

Structured assembler preprocessor for RA78K/0 Vx.xx  [ xx xxx xxxx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

start

 Target chip : uPD780058
 Device file : Vx.xx

Conversion complete , 0 error ( s ) found.

78K/0 Series Assembler Vx.xx  [xx xxx xxxx]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

Pass1 Start
Pass2 Start

 Target chip : uPD780058
 Device file : Vx.xx

Assembly complete ,     0 error ( s ) and     0 warning ( s ) found.
```

Clear the screen.

```
78K/0 Series Linker Vx.xx  [ xx xxx xxxx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

 Target chip : uPD780058
 Device file : Vx.xx

Link complete ,     0 error ( s ) and     0 warning ( s ) found.
```

Clear the screen.

```
78K/0 Series Object Converter Vx.xx  [ xx xxx xxxx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

 Target chip : uPD780058
 Device file : Vx.xx

Object Conversion Complete ,      0 error ( s ) and     0 warning ( s ) found.
```

Clear the screen.

```
List Conversion Program for RA78K/0 Vx.xx  [ xx xxx xxxx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

Pass1 : start..
Pass2 : start..
Conversion complete.

List Conversion Program for RA78K/0 Vx.xx  [ xx xxx xxxx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

Pass1 : start..
Pass2 : start..
Conversion complete.
```

Clear the screen.

```
No error.
```

(2) Check the contents of Drive C.

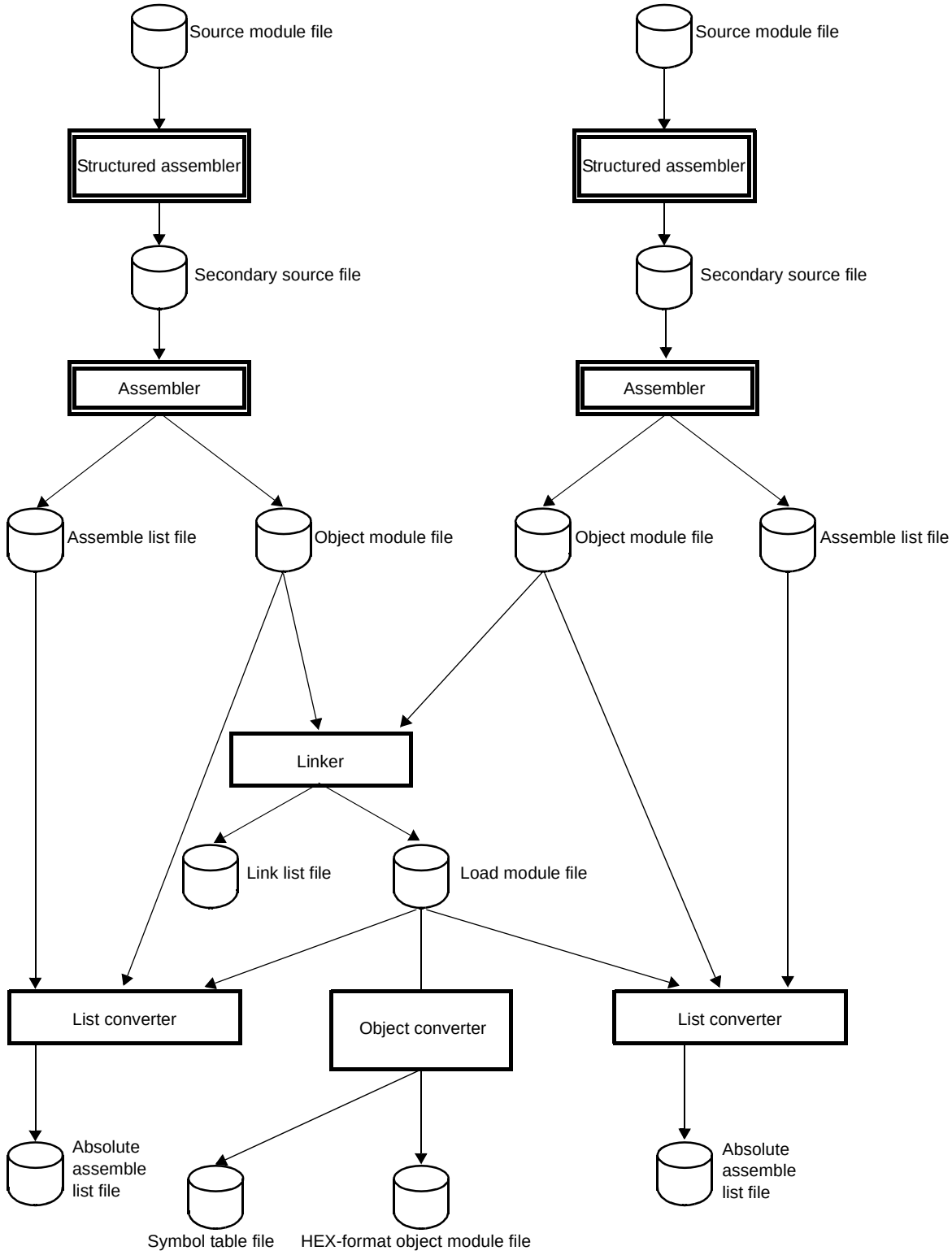
The following files are output.

test1.asm :	Secondary source file
test1.rel :	Object module file
test1.prn :	Assemble list file
test2.asm :	Secondary source file
test2.rel :	Object module file
test2.prn :	Assemble list file
stsample.lmf :	Load module file
stsample.map :	Link list file
stsample.hex :	HEX-format object module file
stsample.sym :	Symbol table file
test1.p :	Absolute assemble list file
test2.p :	Absolute assemble list file

(3) Summary of ST78K0 execution procedure

The following is a summary of execution procedure of ST78K0

Figure 3-4 ST78K0 Execution Procedure



3.4 Assembling, Linking and Object Conversion from Command Line (DOS Prompt, UNIX)

This section explains how to execute assembly and object conversion from the command line.

(1) Assemble the sample program k0main.asm.

Input the following on the command line.

```
C>ra78k0 -c054 k0main.asm
```

The following message is output to the display.

```
78K/0 Series Assembler Vx.xx [ xx xxx xx ]
   Copyright ( C ) NEC Electronics Corporation xxxx

Pass1 Start
Pass2 Start

 Target chip : uPD78054
 Device file : Vx.xx

Assembly complete ,       0 error ( s ) and       0 warning ( s ) found.
```

(2) Check the contents of drive C.

The assembler outputs the object module file (k0main.rel) and the assemble list file (k0main.prn).

If the option -E is specified during assembly, the assembler outputs an error list file (a list of the lines containing assembly errors and the contents of their error messages).

(3) Assemble the sample program k0sub.asm.

Input the following on the command line.

```
C>ra78k0 -c054 k0sub.asm
```

The following message is output to the display.

```
78K/0 Series Assembler  Vx.xx [ xx xxx xx ]
   Copyright (C) NEC Electronics Corporation xxxx

Pass1 Start
Pass2 Start

 Target chip : uPD78054
 Device file : Vx.xx

Assembly complete ,       0 error ( s ) and       0 warning ( s ) found.
```

(4) Check the contents of drive C.

The assembler outputs the object module file (k0sub.rel) and the assemble list file (k0sub.prn).

During assembly, if the option -E is specified, the assembler outputs an error list file.

(5) Create a directive file.

A directive file is a file which indicates the location of segments for the linker.

Create a directive file when you need to expand the default ROM/RAM area or define a new memory area.

You will also need to create a directive file when you wish to locate segments not defined as absolute segments within a source module file to a specific address in memory.

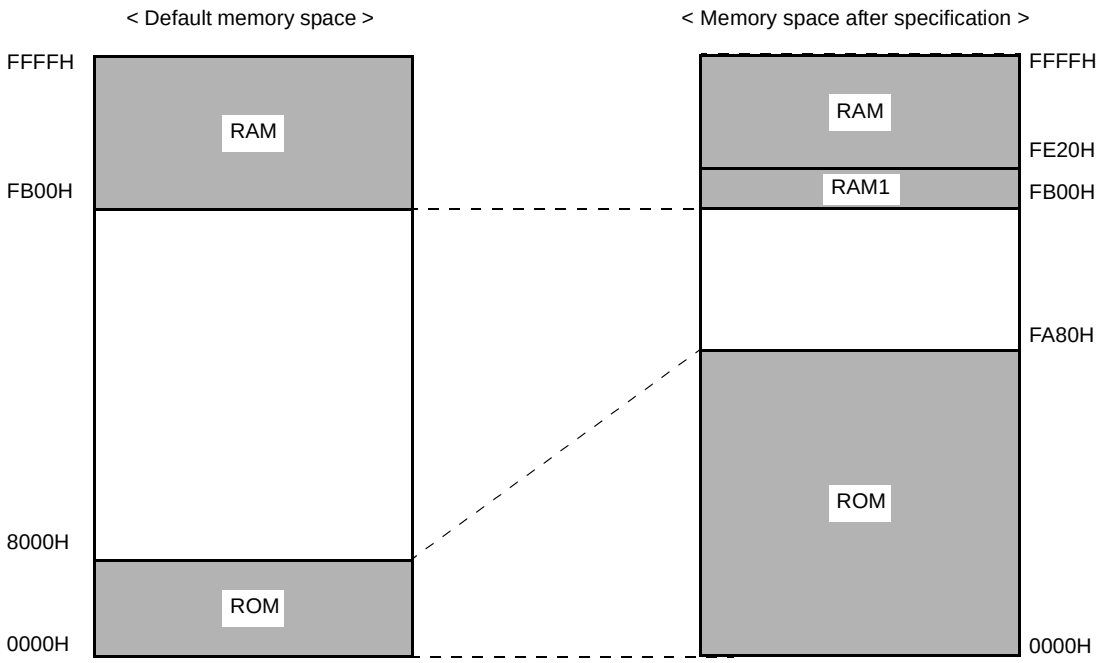
During linking, use the -D option to enter the directive file to the linker.

Example To extend the ROM area (0H to 7FFFH) to (0H to FA7FH), and extend the RAM area to (FE20H to FFFFH) and RAM1 (FB00H to FE1FH).

Write the following to the directive file.

```
MEMORY ROM : ( 0H , 0FA80H )
MEMORY RAM1 : ( 0FB00H , 320H )
MEMORY RAM : ( 0FE20H , 1E0H )
```

Figure 3-5 Link Directive



(6) As the result of the assembly, the output object module files "k0main.rel" and "k0sub.rel" are linked.

Enter k0.dr as the directive file.

Enter the following on the command line.

C>lk78k0 k0main.rel k0sub.rel -dk0.dr[Note 1] -ok0.lmf -pk0.map -S[Note 2]

Notes 1 Not necessary if a directive file is not specified.

Notes 2 Stack resolution symbol (_@STBEG) creation option

The following message is output to the display.

```
78K/0 Series Linker Vx.xx [ xx xxx xx ]
   Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

 Target chip : uPD78054
 Device file : Vx.xx

Link complete ,       0 error ( s ) and        0 warning ( s ) found.
```

(7) Check the contents of drive C.

The linker outputs the load module file (k0.lmf) and the link list file (k0.map).

If the option -E is specified during linking, the linker outputs an error list file.

(8) As the result of linking, the output load module file (k0.lmf) is converted to a HEX-format file.

Enter the following on the command line.

```
C>oc78k0 k0.lmf -r -u0FFH
```

The following message is output on the display.

```
78K/0 Series Object Converter Vx.xx [ xx xxx xx ]
   Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

 Target chip : uPD78054
 Device file : Vx.xx

Object Conversion Complete ,       0 error ( s ) and        0 warning ( s ) found.
```

(9) Check the contents of drive C.

The object converter outputs the HEX-format object module file (k0.hex) and the symbol table file (k0.sym).

(10) Create a library file as follows.

Register the object module file (k0sub.rel) output by the assembler as a library file.

Enter the following on the command line.

```
C>lb78k0 < k0.job
```

The following message is output on the display.

```
78K/0 Series Librarian Vx.xx [ xx xxx xx ]
   Copyright ( C ) NEC Electronics Corporation xxxx , xxxx
*create k0.lib                                          ; Contents of "k0.job"
*add k0.lib k0sub.rel                                   ; Contents of "k0.job"
*exit
```

(11) Check the contents of drive C.

The librarian outputs the library file (k0.lib).

(12) Create an absolute assemble list as follows.

To create the absolute assemble list k0main.asm, input "k0main.rel", "k0main.asm" and "k0.lmf" to the list converter.

Enter the following on the command line.

```
C>lcnv78k0 k0main -lk0.lmf
```

The following message is output on the display.

```
List Conversion Program for RA78K/0 Vx.xx [ xx xxx xx ]
   Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

Pass1 : start...
Pass2 : start...
Conversion complete.
```

(13) Check the contents of drive C.

The list converter outputs the absolute assemble list file (k0main.p).

3.5 Using Parameter File

If two or more options are input when the assembler or linker is started, the information necessary for starting cannot be completely specified on the command line, or the same specification may be repeatedly made. In this case, the parameter file is used.

To use the parameter file, specify the parameter file specification option on command line.

Assembler or linker is started by the parameter file as follows :

```
>[ path-name ] ra78k0 Δ -F parameter-file-name
>[ path-name ] lk78k0 Δ -F parameter-file-name
>[ path-name ] oc78k0 Δ -F parameter-file-name
```

Here is an example of its use.

```
C>ra78k0 -Fpara.pra
C>lk78k0 -Fpara.plk
C>oc78k0 -Fpara.poc
```

The parameter file is created with an editor. All the options and output file names that should be specified on the command line can be written in the parameter file.

Here is an example of creating a parameter file with an editor.

< Contents of para1.pra >

```
-c054 k0main.asm -e
```

< Contents of para1.plk >

```
k0main.rel k0sub.rel -bmylib.lib -osample.lmf -S
```

< Contents of para1.poc >

```
sample.lmf -u0FFH -osample.hex -r
```

CHAPTER 4 STRUCTURED ASSEMBLER PREPROCESSOR

The structured assembler preprocessor inputs source module files written in the structured assembly language of 78K0 Series microcontrollers, converts them into assembly language, and outputs them as secondary source module files.

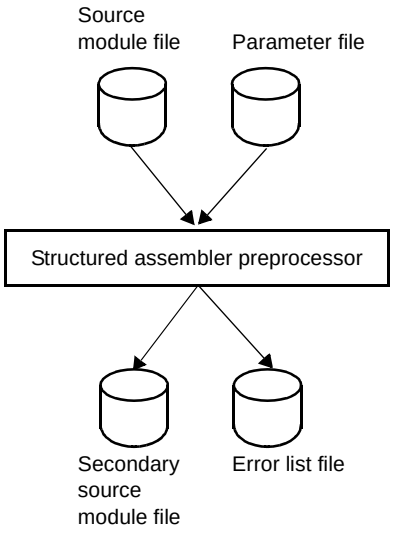
4.1 I/O Files of Structured Assembler Preprocessor

The I/O files of the structured assembler preprocessor are as shown below.

Table 4-1 I/O Files of Structured Assembler Preprocessor

Type	File Name	Explanation	Default File Type
Input files	Source module files	- These are source module files written in structured assembly language. - These files are created by the user.	None
	Parameter files	- These are files that contain the options for specifying the structured assembler preprocessor options from the file. - These files are created by the user.	.pst
Output files	Secondary source module files	- These are source module files written in assembly language.	.asm
	Error list file	- These are files containing structured assembler preprocessor error data.	.est

Figure 4-1 I/O Files of Structured Assembler Preprocessor



4.2 Functions of Structured Assembler Preprocessor

(1) The structured assembler preprocessor reads source module files, converts them into assembler input source files, and outputs them as assembler source files.

(2) If an error related to the file or system occurs, the structured assembler preprocessor outputs an abort error, and if a write error is found in the source module, it outputs a fatal error or warning error.
If an abort error or fatal error occurs, the secondary source file cannot be output normally. However, when the -J option has been specified, the secondary source file can be output even if a fatal error has occurred.

(3) Structured assembly preprocessor processing is performed in accordance with the option specified at startup. For a detailed explanation of the structured assembler preprocessor options, refer to "4.4 Structured Assembler Options".

(4) If the structured assembly preprocessor processing has been completed correctly, the structured assembler preprocessor outputs a "completed" message, and returns control to the OS.

4.3 Structured Assembler Preprocessor Startup

4.3.1 Structured assembler preprocessor startup

Two methods can be used to start up the structured assembler preprocessor.

(1) Command-line startup

Start up the structured assembler preprocessor by inputting the following command.

```
X>[ path-name ] st78k0 [ Δ option ]  ... source-module-file-name  [ Δ option ]...
↑      ↑        ↑        ↑                    ↑              ↑
(a)    (b)      (c)      (d)                  (e)            (d)
```

(a) Current drive name

(b) Current directory name

(c) Structured assembler preprocessor command file name

(d) Enter detailed instructions for the operation of the structured assembler preprocessor. When specifying more than one option, delimit the options with a space. For a detailed explanation of the structured assembler options, refer to "4.4 Structured Assembler Options".

Enclose a path that includes a space in a pair of double quotation marks (" ").

(e) File name of source module to undergo structured assembly.

Specify the file name of a path that includes a space by enclosing it in a pair of double quotation marks (" ").

Example C>st78k0 -c054 test1.s -e

(2) Startup from a parameter file

Use a parameter file to avoid the inconvenience involved when repeating the same structured assembler preprocessor option at startup for two or more structured assembly operations.

To start up the structured assembler from a parameter file, specify the parameter file specification option (-F) on the command line.

The procedure for starting up the structured assembler from a parameter file is shown below.

```
X> [ path-name ] st78k0 [ Δ source-module-file-name ] Δ -F parameter-file-name
↑      ↑                      ↑                        ↑
(a)    (b)                    (c)                      (d)
```

(a) Current drive name

(b) Current directory name

(c) Parameter file specification option

(d) Parameter file name

The rules for writing the contents of a parameter file are as follows.

```
[ [ [ Δ ] option [ Δ option ] ... [ Δ ] Δ ] ] ...
```

If the source module file name is omitted from the command line, only one source module file name can be specified in the parameter file.

The source file name can also be written after the option.

Write in the parameter file all options and output file names specified in the command line.

Example Creating a parameter file (test1.pst) using the editor.

< Contents of test1.pst >

```
; Parameterfile
test1.s -osample.asm
-esample.est -c054
```

The parameter file (test1.pst) is used to start up the structured assembler preprocessor.

```
C>st78k0 -ftest1.pst
```

4.3.2 Execution start and end messages

(1) Execution start message

When the structured assembler preprocessor is activated, an execution start message appears on the display.

```
Structured assembler preprocessor for RA78K/0 Vx.xx [ xx xxx xx ]
      Copyright ( C ) NEC Electronics Corporation xxxx , xxxx
```

(2) Processing display message

"." is displayed every 100 lines of the structured assembler preprocessor processing.

```
start…….
```

(3) Execution end message

If no errors are detected, the following message is output to the display, and control is returned to the OS.

```
  Target chip : uPD78xxxx
  Device file : Vx.xx

Conversion complete , 0 error ( s ) found.
```

If errors are detected, the number of detected errors is output to the display, and control is returned to the OS.

```
TEST1.S ( 8 ) :   RA78K0 error E1209 : Syntax error

  Target chip : uPD78xxxx
  Device file : Vx.xx

Conversion complete , 1 error ( s ) found.
```

If a fatal error is detected during structured assembly which makes it impossible to continue structured assembly processing, the structured assembler preprocessor outputs a message to the display, cancels the structured assembly processing, and returns control to the OS.

Example 1. When a non-existent source module file is specified

```
C>st78k0 sample.s

Structured assembler preprocessor for RA78K/0 Vx.xx [ xx xxx xx ]
      Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

RA78K0 error F1006 : File not found ' SAMPLE.S '

Program aborted.
```

In the above example, the specification of a non-existent source module file results in an error, and assembly is stopped.

Example 2. When a non-existent option is specified

```
C>st78k0 test1.s -z

Structured assembler preprocessor for RA78K/0 Vx.xx [ xx xxx xx ]
     Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

RA78K0 error F1012 : Missing parameter ' -z '
Please enter ' ST78K0 -- ' , if you want help messages.

Program aborted.
```

In the above example, the specification of a non-existent option results in an error, and assembly is stopped.

When an error message is displayed and assembly is stopped, search for the cause of the error in "CHAPTER 12 ERROR MESSAGES" and take action accordingly.

4.4 Structured Assembler Options

4.4.1 Types of structured assembler options

The structured assembler preprocessor options give detailed instructions for the operation of the structured assembler preprocessor.

The structured assembler preprocessor options are classified into the following 13 types.

Table 4-2 Structured Assembler Options

Classification	Option	Description
Device type specification	-C	Specifies the type of the target device
Word symbol character specification	-SC	Specifies the final character of the word symbol name
Symbol definition specification	-D	Specifies the symbol given to the #IFDEF directive, etc.
Tab number specification	-WT	Specifies the output position of the converted instruction.
Include file read path specification	-I	Reads from the path specified in an include file.
Secondary source file specification	-O	Specifies the secondary source file name.
Error list file specification	-E	Specifies the error list file name.
Parameter file specification	-F	Specifies the parameter file name.
Debug data output specification	-GS	Specifies the output of structured-assembler source-level debug data.
	-NGS	
Secondary source file forcible output specification	-J	Specifies the forcible output of the secondary source file.
Kanji code (2-byte code) specification	-ZS	Specifies the kanji code type to be described in the comment statement.
	-ZE	
	-ZN	
Device file search path specification	-Y	Specifies the path via which the device file will be searched
Help specification	--	Outputs the help message to the display.

4.4.2 Explanation of structured assembler options

The structured assembler options are described in detail on the following pages.

(1) Device type specification

Device type specification (-C)

[Syntax]

-C device-type

- Default assumption

  Cannot be omitted

[Function]

- Specifies the device that is the target of structured assembler preprocessor.

[Explanation]

- Always specify the -C option. The structured assembler preprocessor performs preprocessing on the specified target device and generates the assembler source code.
  Note that if the -C option is omitted, an error will occur.
- If the device types specified by the -C option and by the processor device type specification control instruction differ, a warning is issued. In this case, the structured assembler preprocessor will prioritize the device type specified by the -C option.
- The device type specified by the -C option is output to the secondary source file as a processor device type specification control instruction. However, this does not occur if a device type with the same name as a processor device type specification control instruction is specified.

[Example of use]

- The uD78054 is specified as the target device.

```
C>st78k0 test.s -c054
```

[Notice]

- The -C option cannot be omitted. However, if a processor device type specification control instruction ($PROCESSOR) is written at the top of the source file, specification in the command line can be omitted.
  Refer to "Notes on Use in the device file" of each device for details concerning device types.

(2) Word symbol character specification

Word symbol character specification (-SC)

[Syntax]

```
-SC character
```

- Default assumption

  -SCP

[Function]

- Specifies the final character of the symbol that is the target of judgment in cases when bytes/words must be differentiated a symbol name.

[Explanation]

- The structured assembler preprocessor generates different instructions depending on whether the data to be handled is a byte or a word.
  If it is a substitution, the MOV instruction is generated for a byte and the MOVW for a word.
  If it is a word symbol reserved word, a word instruction is generated.
- If a symbol that is not a reserved word is specified, the symbol is judged to be either a byte symbol or a word symbol based on its final character, and an instruction is generated.
- If the -SC option is not specified, a symbol ending with "P" or "p" is judged to be a word symbol.
- Characters to be judged are alphabet-equivalent characters only. Note that alphabet letters are not case sensitive.
- If more than one specification is made, the item specified last is valid.

[Example of use]

- A symbol ending with "@" is specified as a word symbol.

  C>st78k0 test.s -sc@

  < test.s >

```
A = #3
AX = #3
SYM = #3
SYM@ = #3
```

  < test.asm >

```
MOV     A , #3      ; A = #3
MOVW    AX , #3     ; AX = #3
MOV     SYM , #3    ; SYM = #3
MOVW    SYM@ , #3   ; SYM@ = #3
```

(3) Symbol definition specification

Symbol definition specification (-D)

[Syntax]

```
-D symbol-name [ = numerical-value ] [ , symbol-name [ = numerical-value ] ... ]
```

[Function]

- Defines the symbol.

[Explanation]

- The numerical value given to a symbol can be binary, octal, decimal, or hexadecimal.
  If the numerical value specification is omitted, the value becomes 1.
- Defining a symbol using this option is identical to defining a symbol using the #define directive.
- Up to 30 items can be defined in the command line by using commas as delimiters.
- Up to 31 characters can be described for a symbol name.
- This option is usually used in combination with the #idef directive.
- If more than one specification is made, the item specified last is valid.
- If this option is specified together with the #define directive, a warning message is output and the #define directive is taken as valid.
- Alphabet letters are not case sensitive.

[Example of use]

- The symbol "TRUE" is defined as 1.

```
C>st78k0 test.s -dTRUE = 1
```

(4) Tab number specification

Tab number specification (-WT)

[Syntax]

```
-WT numerical-value-1
-WT [ numerical-value-1 ] , numerical-value-2
-WT [ numerical-value-1 ] , [ numerical-value-2 ] , numerical-value-3
```

- Default assumption

  -WT2, 3, 4

[Function]

- Specifies the number of tabs of the converted assembly language.

[Explanation]

- The -WT option allows the output position of the assembler source instructions to be freely adjusted, thus improving the program's readability.
- Numerical value 1 specifies the number of tabs until the instruction is output.
  Numerical value 2 specifies the number of tabs until the instruction operand is output.
  Numerical value 3 specifies the number of tabs until the instruction command is output.
  Specify the numerical value as a decimal number from within the following ranges.
  Numerical value 1 : 0 to 97
  Numerical value 2 : 1 to 98
  Numerical value 3 : 2 to 99
  Numerical value 1 < numerical value 2 < numerical value 3
- If more than one specification is made, the item specified last is valid.

[Example of use]

- "3" is specified for numerical value 1, "4" for numerical value 2, and "5" for numerical value 3.

```
C>st78k0 test.s -wt3,4,5
```

(5) Include file read path specification

Include file read path specification (-I)

[Syntax]

-I path name [, path name] ... (Two or more path names may be specified.)

- Default assumption

  The include file is searched in the following sequence.

  (i) 1. Path where the source file exists

  (ii) 2. Path specified by an environmental variable (INC78K0)

[Function]

- Specifies the path name of the include file that is input to the structured assembler.

[Explanation]

- Two or more path names can be specified at one time, with each delimited by a comma ",".
- A space must not be inserted before or after ",".
- The include file is searched in the following sequence.

  (i) - If two or more path names are specified following the -I option, the include file is searched in the specified order.

  (ii) - If two or more -I options are specified, the include file is searched with the option specified later taking precedence.

  (iii) After the path specified by the -I option is searched, the include file is searched in the same order as the default assumption.
- If a name other than a path name is specified following -I or if no path name is specified, an abort error occurs.
- An abort error occurs if 65 or more -I options are specified.

[Example of use]

- The directory with the include file is specified as c:\include.

```
C>st78k0 test.s -ic:\include
```

(6) Secondary source file specification

Secondary source file specification (-O)

[Syntax]

-O [[[drive :] directory] file-name]

- Default assumption

  -O input-file-name.asm

[Function]

- Specifies the output destination of the post-conversion secondary source file and the file name.

[Explanation]

- Specify the output drive, directory, and file name of the post-conversion secondary source file.
- If the -O option is omitted, the output file is created in the current directory by replacing the file type of the input file with .ASM.
- Either "NUL" or "AUX" can be specified as the file name.
- The secondary source file is not output when processing is stopped due to a fatal error.
- If more than one specification is made, the item specified last is valid.

[Example of use]

- "sample.asm" is specified as the secondary source file.

  C>st78k0 test.s -osample.asm

(7) Error list file specification

Error list file specification (-E)

[Syntax]

-E [[drive :] [directory] file-name]

- Default assumption

  -E input-file-name.est

[Function]

- Specifies the output destination of the error list file and the file name.

[Explanation]

- Specify the output drive, directory, and file name of the error list file.
- If the -E option is omitted, the error list file is created in the current directory by replacing the file type of the input file with ".est".
- Either "NUL" or "AUX" can be specified as the file name.
- If more than one specification is made, the item specified last is valid.

[Example of use]

- "sample.est" is specified as the error list file.

  C>st78k0 test.s -esample.est

(8) Parameter file specification

Parameter file specification (-F)

[Syntax]

```
-F [ [ drive : ] directory ] file-name
```

- Default assumption

  With no input file.

[Function]

- Specifies the file name of the parameter file.

[Explanation]

- Specify the input drive, directory, and file name of the parameter file.
- The file name cannot be omitted. If the file type is omitted, the type is assumed to be ".pst".
- This option is effective when a large number of symbols are defined in the command line using option -D.
- Multiple specification of this option results in an error.
- Parameter-file nests are prohibited, and their specification results in an error.
- The characters following ";" or "#" in a parameter file are all assumed to be comments, up to the line feed code (LF) or EOF.

[Example of use]

- "sample.pst" is specified as a parameter file.

  C>st78k0 -fsample.pst

(9) Debug data output specification

Debug data output specification (-GS/-NGS)

[Syntax]

```
-GS
-NGS
```

- Default assumption

  -GS

[Function]

- Specifies the output of structured-assembler source-level debug data.

[Explanation]

- The -GS option specifies the output of debug data to the secondary source file.
- The -NGS option disables the -GS option setting.
- If there is compiler debug data in the input source file, the -GS option replaces "$" with ";" at the top of the file.
- If the -GS and -NGS options are both specified, the option specified later is taken as valid.

[Notice]

- When debugging at the structured assembler source level, be sure to specify the debug data output specification (-GS/-NGS). When assembling the secondary source file, be sure to specify the debug data output specification option (-G/-GA). The structured assembler preprocessor outputs the required option to the secondary source file as a control instruction.

[Example of use]

- The output of debug data to the secondary source file is specified.

  C>st78k0 test.s -gs

(10) Secondary source file forcible output specification

Secondary source file forcible output specification (-J)

[Syntax]

```
-J
```

- Default assumption

  The secondary source file is not output when processing is stopped due to a fatal error

[Function]

- Forcibly outputs the secondary source file when processing is stopped due to a fatal error.

[Explanation]

- The secondary source file is forcibly output when processing is stopped due to a fatal error.
- The fatal error line outputs the image of the input source file as is to the secondary source file.

[Example of use]

- Forcible output of the secondary source file is specified.

```
C>st78k0 test.s -j
```

(11) Kanji code (2-byte code) specification

Kanji code specification (-ZS/-ZE/-ZN)

[Syntax]

```
-ZS
-ZE
-ZN
```

- Default assumption

  nterpreted as follows depending on the OS.

  Windows, HP-UX :-ZS

  SunOS, Solaris : -ZE

[Function]

- Specifies the type of the kanji code to be described in the comment.

[Explanation]

- Specify the kanji code as follows

  -ZS : Interpreted as shift JIS code.

  -ZE : Interpreted as EUC code.

  -ZN : Not interpreted as kanji.

- These options correspond to the kanji code specification control instructions as follows.

  -ZS : $KANJICODE SJIS

  -ZE : $KANJICODE EUC

  -ZN : $KANJI CODE NOTE

- The priority order of specifications of the kanji code is as follows.

  (i) Specification of -ZS/-ZE/-ZN option

  (ii) Specification of the kanji code specification control instruction ($KANJICODE)

  (iii) Specification of the environmental variable LANG78K

  (iv) Specification of default settings of each OS

[Example of use]

- It is specified that the kanji is interpreted as shift JIS code.

  C>st78k0 test.s -zs

(12) Device file search path specification

Device file search path specification (-Y)

[Syntax]

-Y [drive :] directory

- Default assumption

  Default assumption : The device file will be searched in the following order.

  (i) <..\dev> (for the path that activated st78k0.exe)

  (ii) The path that started up st78k0.exe

  (iii) The current path

  (iv) The path that was specified by the environment variable PATH

[Function]

- Specifies the path via which a device file will be searched.

[Explanation]

- The device file is read from the specified path
- If other than a path name is specified, an error will occur.
- Even if the directory specification symbol has not been written on the end of the directory, the assumption will be that it has.
- The device file will be searched in the following order.

  (i) The path specified by the -Y option

  (ii) <..\dev> (for the path that activated st78k0.exe)

  (iii) The path that activated st78k0.exe

  (iv) The current path

  (v) The path that was specified by the environment variable PATH

[Example of use]

- It is specified that the device file be read from the directory c:\NECTools32\dev.

```
C>st78k0 test.s -yc:\NECTools32\dev
```

(13) Help specification

Help specification (--)

[Syntax]

--

- Default assumption

  No display

[Function]

- The -- option displays the help message on the screen.

[Application]

- The help message is a list of structured assembler options and their definitions. Refer to this when executing the structured assembler preprocessor.

[Explanation]

- When the -- option is specified, all other structured assembler options become invalid.

Caution This option cannot be specified from PM plus.
To reference PM plus help, click the [Help] button in the <Structured Assembler Preprocessor Options> dialog box.

[Example of use]

- When the -- option is specified, the help message is output to the display.

```
C>st78k0 --

Structured assembler preprocessor for RA78K/0 Vx.xx [ xx xxx xx ]
      Copyright ( C ) NEC Electronics Corporation xxxx

Usage : st78k0 [ option [ ... ] ] input-file [ option [ ... ] ]

The option is as follows ( [ ] means omissible , ...means repetition ).
   -cx              : Select target chip. ( x = 000 , 012 , etc. ) * Must be specified.
   -o [ file ]      : Create the assembler source file [ with the specified name ].
   -e [ file ]       : Create the error list file [ with the specified name ].
   -ffile           : Input options or source file name from specified file.
   -idirectory      : Set include search path.
   -sc [ character ] :Specify the last character of word symbol.
   -wtn1/-wt [ n1 ] , n2/-wt [ n1 ] , [ n2 ] , n3
                    : Specify the number of tabs up to output position of each field.
                      n1 : Output position mnemonic field.
                      n2 : Output position operand field.    *Must be
                      n3 : Output position comment field.  0 <= n1 < n2 < n3 < 100.
   -dname [ = data ] [ , name [ = data ] [ ... ] ]
                    : Define name [ with data ].
   -gs/-ngs         : Output the structured assembler source debug information to assembler source file
                      / Not.
   -j               : Create the assembler source file if fatal error occurred.
   -zs/-ze/-zn      : Change source regulation.
                        -zs     : SJIS code usable in comment.

Press RETURN to continue...
   -ze              : EUC code usable in comment.
   -zn              : no multibyte code in comment.
   -ydirectory      : Set device file search path.
   --               : Show this message.

DEFAULT ASSIGNMENT : -o -e -scp -wt2 , 3 , 4 -gs
```

4.5 Option Settings from PM plus

This section will explain how to set up the structured assembler from PM plus.

4.5.1 Setting options

The < Structured Assembler Options > dialog box is opened if [Structured Assembler Options] is selected from the [Tools] menu of PM plus or if the [ST] button on the toolbar is pressed.

By entering the required options in this dialog box, the structured assembler options can be set.

Figure 4-2 < Structured Assembler Options > Dialog Box (When << Output >> Tab Is Selected)

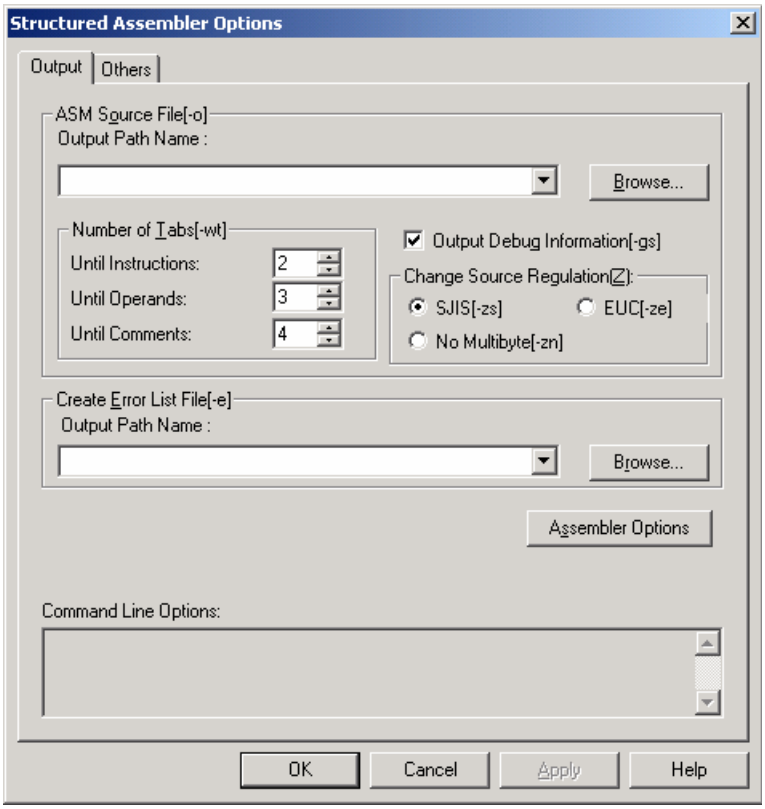


Figure 4-3 < Assembler Source Options > Dialog Box (When [Assembler Options] button Is Selected)

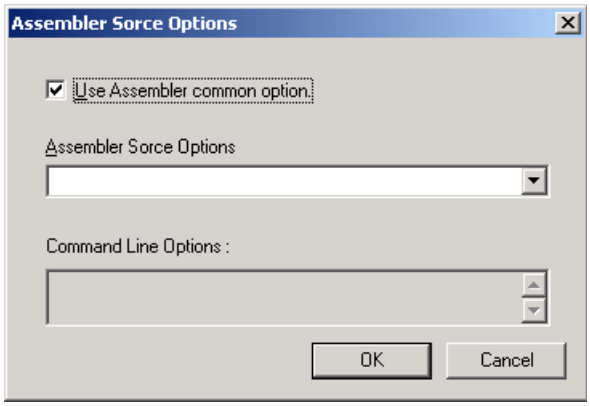
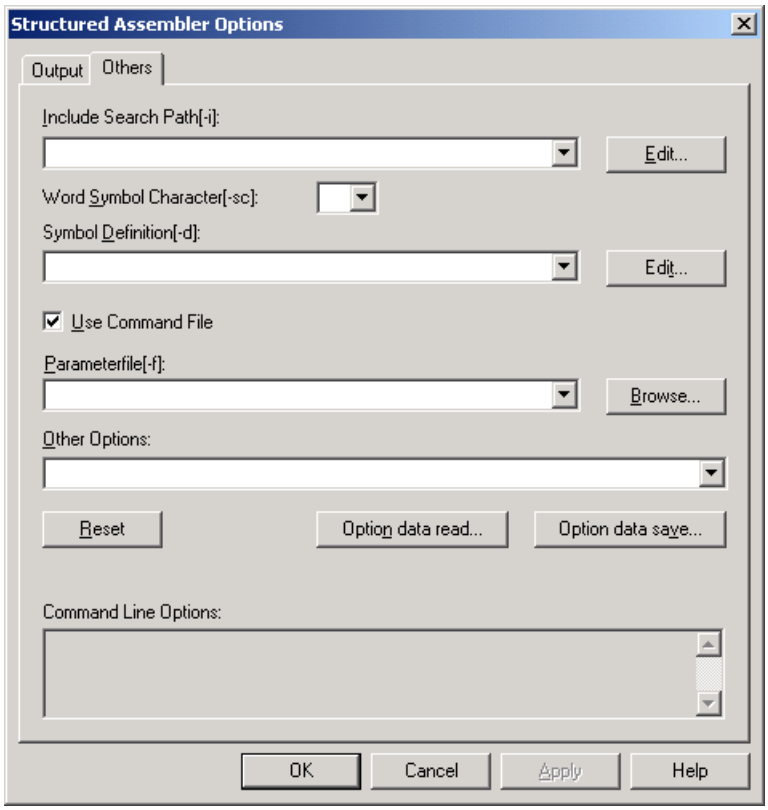


Figure 4-4 < Structured Assembler Options > Dialog Box (When << Others >> Tab Is Selected)



4.5.2 Options

The following is an explanation of each option in the < Structured Assembler Options > dialog box.

<< Output >> Tab

- ASM Source File [-o]

  (When specified by common option) Output Path Name

  Specify the path of the ASM source (secondary source file) by using the [Browse] button or directly inputting a path name.

  (When specified by individual option) Output File Name

  Specify the path and file name of the ASM source (secondary source file) by using the [Browse] button or directly inputting a path and file name.

- Number of Tabs [-wt]

  Specify the number of tabs of the translated assembly language.

  The number of tabs up to an instruction, the number of tabs up to an operand, and the number of tabs up to a comment can be individually set.

- Output Debug Information [-gs]

  Check this option to output debug information in the ASM source (secondary source file).

- Change Source Regulation [Z]

  Select the type of Kanji code (SJIS[-zs], UEC[-ze], or no Kanji code [-zn]) to be used in the comments of the source.

- Create Error List File [-e]

  (When specified by common option) Output Path Name

  To output an error list file, specify the path of the error list file by using the [Browse] button or directly inputting a path name.

  (When specified by individual option) Output File Name

  To output an error list file, specify the path and file name of the error list file by using the [Browse] button or directly inputting a path and file name.

- Assembler Options

  Specify the assembler option for an assembler source module file.

- Command Line Options

  This edit box is read-only. The currently set option character string is displayed.

- Use Assembler common option

  Check this option to enable the common option set in the < Assembler Options > dialog box.

- Assembler Source Options

  Input a character string including an option name to enable the option for an output assembler source.

- Command Line Options

  This edit box is read-only. The currently set option character string is displayed.

<< Others >> Tab

- Include Search Path [-i]

  Specify the path via which the include file is to be read, by pressing the [Edit] button or directly inputting a path name.

- Word Symbol Character [-sc]

  Specify the last character of a symbol when it is necessary to distinguish between bytes and words.

- Symbol Definition [-d]

  Inputs the value to be defined as a symbol, by pressing the [Edit] button or directly inputting a value.

- Use Command File

  Check this option to create a command file.

- Parameterfile [-f]

  Read a user-defined parameter file by pressing the [Browse] button or directly inputting a parameter file name.

- Other Options

  To specify an option other than those that can be set in the dialog box, enter it in the input box.

  Caution The help specification (--) option cannot be specified on PM plus.

- Reset

  Resets the input contents.

- Option data read

  Opens the < Read Option Data > dialog box and after the option data file has been specified, reads this file.

- Option data save

  Opens the < Save Option Data > dialog box and saves the option data to the option data file under the specified name.

- Command Line Options

  This edit box is read-only. The currently set option character string is displayed.

4.5.3 Edit option dialog box

Items are edited in list format in the < Edit Option > dialog box.

The < Edit Option > dialog box is described below.

Figure 4-5 < Edit Option > Dialog Box

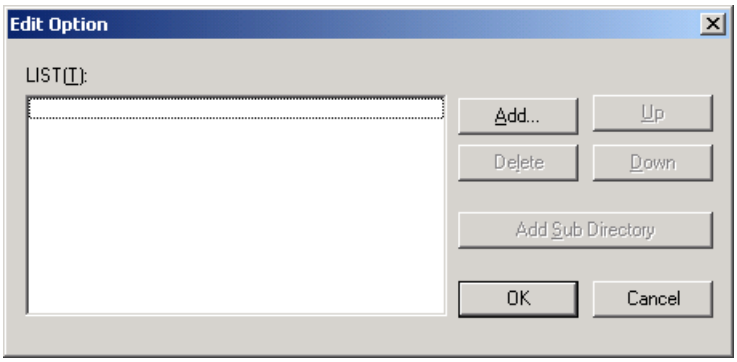
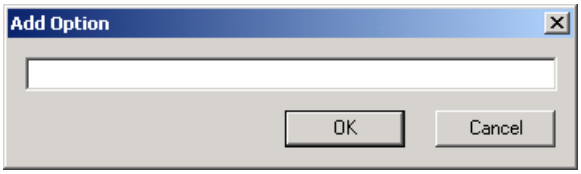


Figure 4-6 < Add Option > Dialog Box



- [Add] button

  Adds a list item.

  If the item to be added is a file or directory, the corresponding < Browse for Folder > dialog box opens.

  In all other cases, the < Add Option > dialog box opens. Specify details of the item to be added in this box.

- [Delete] button

  Deletes the selected list item.

- [Up] button

  Moves the selected list item up.

- [Down] button

  Moves the selected list item down.

- [Add Sub Directory] button

  A subdirectory can be added to the selected list item when the item is specified as Include Search Path[-i](I) on the << Others >> Tab.

CHAPTER 5 ASSEMBLER

The assembler inputs source module files written in the assembly language for 78K0 Series microcontrollers and converts them into machine language coding.

The assembler also outputs list files such as assemble list files and error list files.

If assembly errors occur, an error message is output to the assemble list file and error list file to clarify the cause of the error.

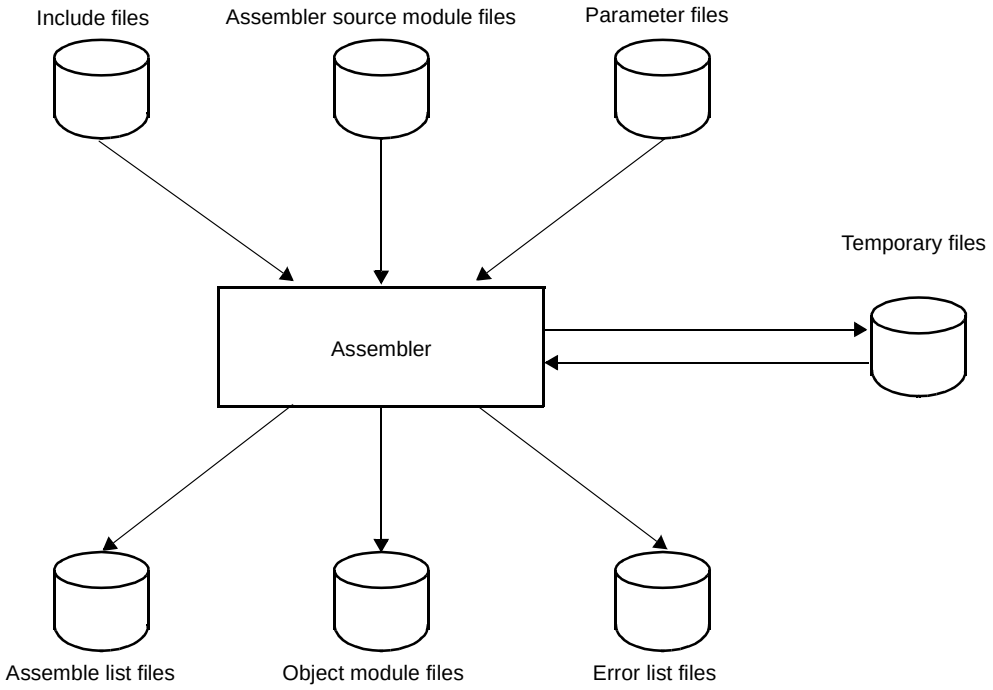
5.1 I/O Files of Assembler

The I/O files of the assembler are as shown below.

Table 5-1 I/O Files of Assembler

Type	File Name	Explanation	Default File Type
Input files	Assembler source module files	- These are source module files written in assembly language for 78K0 Series microcontrollers - These files are created by the user.	.asm
	Include files	- These files are used for reference with assembler source module files. - These are files written in assembly language for 78K0 Series microcontrollers. - These files are created by the user.	-
	Parameter files	- These files contain the parameters for the executed files. - These files are created by the user.	.pra
Output files	Object module files	- These are binary files including relocation data and symbol data regarding machine language data and machine language location addresses.	.rel
	Assemble list files	- These are files containing assembly data such as assemble lists and cross-reference lists.	.prn
	Error list files	- These are files containing error data generated during assembly.	.era
I/O files	Temporary files	- These are files created automatically by the assembler for assembly purposes. Temporary files are deleted when assembly ends.	RAxxxxx.$$n (n = 1-4)

Figure 5-1 I/O Files of Assembler



5.2 Functions of Assembler

(1) The assembler reads source module files and converts them from assembly language files into machine language files.

(2) If errors occur, the assembler outputs an abort error. If it finds the write error in the source module, the assembler outputs a "fatal error" or "warning error" message.
If an "abort error" or "fatal error" message is output, the object module file cannot be output normally. However, even if a fatal error has occurred the object module file can be output in case of specifying option -J.

(3) The assembler performs assembly according to the assembler option specified at assembler startup. For a detailed explanation of the assembler options, refer to "5.4 Assembler Options".

(4) If assembly is completed correctly the assembler outputs an "Assembly Finished" message and returns control to the operating system.

5.3 Assembler Startup

Two methods can be used to start up the assembler.

5.3.1 Command-line startup

```
X>[ path-name ] ra78k0 [ Δ option ]  ... source-module-file-name  [ Δ option ] ... [ Δ ]
 ↑      ↑        ↑        ↑                    ↑                  ↑
(a)    (b)      (c)      (d)                  (e)                (d)
```

(a) Current drive name

(b) Current directory name

(c) Command file name of the assembler

(d) Enter detailed instructions for the operation of the assembler.

When specifying two or more assembler options, separate the assembler options with a blank space. For a detailed explanation of assembler options, refer to "5.4 Assembler Options".

Enclose a path that includes a space in a pair of double quotation marks (" ").

(e) File name of source module to be assembled

Specify the file name of a path that includes a space by enclosing it in a pair of double quotation marks (" ").

Example C>ra78k0 -c054 k0main.asm -e -np

5.3.2 Startup from a parameter file

Use the parameter file when the data required to start up the assembler will not fit on the command line, or when repeating the same assembler option for two or more assembly operations.

To start up the assembler from a parameter file, specify the parameter file option (-F) on the command line.

Start up the assembler from a parameter file as follows.

```
X>ra78k0 [ Δ source-module-file ] Δ -F parameter-file-name
                                    ↑          ↑
                                   (b)        (a)
```

(a) A file which includes the data required to start up the assembler

(b) Parameter file (the specified option)

Create the parameter file using an editor.

The rules for writing the contents of a parameter file are as follows.

```
[ [ [ Δ ]option [ Δ option ] ... [ Δ ] Δ ] ] ...
```

If the source module file name is omitted from the command line, only 1 source module file name can be specified in the parameter file.

The source module file name can also be written after the option.

Write in the parameter file all assembler options and output file names specified in the command line.

For a detailed explanation of parameter files, refer to "5.4.3 Explanation of assembler options".

Example Create the parameter file (k0main.pra) using an editor.

< Contents of k0main.pra >

```
; parameter file
k0main.asm -osample.rel
-psample.prn
```

Use parameter file (k0main.pra) to start up the assembler.

```
C>ra78k0 -fk0main.pra
```

5.3.3 Execution start and end messages

(1) Execution start message

When the assembler is started up, an execution startup message appears on the display.

```
78K/0 Series Assembler Vx.xx [ xx xxx xx ]
    Copyright ( C ) NEC Electronics Corporation xxxx , xxxx
```

(2) Execution end message

If it detects no assembly errors resulting from the assembly, the assembler outputs the following message to the display and returns control to the operating system.

```
Pass1 Start
Pass2 Start

 Target chip : uPD78xxx
 Device file : Vx.xx

Assembly complete ,       0 error ( s ) and       0 warning ( s ) found.
```

If it detects an assembly error resulting from the assembly, the assembler outputs the error number to the display and returns control to the operating system.

```
Pass1 Start
K0MAIN.ASM ( 12 ) : RA78K0 error E2201 : Syntax error
Pass2 Start
K0MAIN.ASM ( 12 ) : RA78K0 error E2201 : Syntax error
K0MAIN.ASM ( 29 ) : RA78K0 error E2407 : Undefined symbol reference ' CONVAH '
K0MAIN.ASM ( 29 ) : RA78K0 error E2303 : Illegal expression

 Target chip : uPD78xxx
 Device file : Vx. xx

Assembly complete ,       3 error ( s ) and       0 warning ( s ) found.
```

If the assembler detects a fatal error during assembly which makes it unable to continue assembly processing, the assembler outputs a message to the display, cancels assembly and returns control to the operating system.

Example 1. A non-existent source module file is specified.

```
C>ra78k0 sample.asm

78K/0 Series Assembler Vx.xx [ xx xxx xx ]
   Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

RA78K0 error F2006 : File not found 'SAMPLE.ASM'
Program aborted.
```

In the above example, a non-existent source module file is specified. An error results and the assembler aborts assembly.

Example 2. A non-existent assembler option is specified.

```
C>ra78k0 k0main.asm -z

78K/0 Series Assembler Vx.xx [ xx xxx xx ]
   Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

RA78K0 error F2012 : Missing parameter ' -z '
Please enter ' RA78K0-- ' , if you want help messages.
Program aborted.
```

In the above example, a non-existent assembler option is specified. An error results and the assembler aborts assembly.

When an error message is displayed and assembly is aborted, look for the cause in "CHAPTER 12 ERROR MESSAGES" and take action accordingly.

5.4 Assembler Options

5.4.1 Types of assembler options

The assembler options are detailed instructions for the operation of the assembler. Assembler options are classified into 17 types.

Table 5-2 Assembler Options

Classification	Option	Explanation
Device type specification	-C	Specifies the device type of the target device.
Object module file output specification	-O	Specifies the output of an object module file.
	-NO	
Forced object module file output specification	-J	Forces output of an object module file.
	-NJ	
Debug data output specification	-G	Outputs debugging data (local symbol data) to an object module file.
	-NG	
	-GA	Outputs assembler source debugging data to an object module file.
	-NGA	
Include file read path specification	-I	Reads from the path specified in an include file.
Assemble list file output specification	-P	Specifies output of an assemble list file.
	-NP	
Assemble list file data specification	-KA	Outputs an assemble list into an assemble list file.
	-NKA	
	-KS	Outputs a symbol list into an assemble list file.
	-NKS	
	-KX	Outputs a cross-reference list into an assemble list file.
	-NKX	
Assemble list file format specification	-LW	Changes the number of characters that can be printed in 1 line in an assemble list file.
	-LL	Changes the number of lines that can be printed in 1 page in an assemble list file.
	-LH	Outputs the character string specified in the header of an assemble list file
	-LT	Changes the number of spaces in a tab.
	-LF	Inserts a line feed code at the end of an assemble list file.
	-NLF	
Error list file output specification	-E	Outputs an error list file.
	-NE	

Table 5-2 Assembler Options

Classification	Option	Explanation
Parameter file specification	-F	Inputs the input file name and assembler options from a specified file.
Specification of path for temporary file creation	-T	Creates a temporary file in a specified path.
Kanji code specification	-ZS	Kanji described in the comment is interpreted as shift JIS code.
	-ZE	Kanji described in the comment is interpreted as EUC code.
	-ZN	Characters described in the comment are not interpreted as kanji.
Device file search path specification	-Y	Reads a device file from a specified path.
Symbol definition specification	-D	Defines a symbol.
Series common object specification	-COMMON	Specifies output of an object module file common to the 78K0 Series.
Self programming specification	-SELF	Specify when using self programming.
Help specification	--	Displays a help message on the display.

5.4.2 Order of precedence of assembler options

The following table indicates which assembler option takes precedence when two assembler options are specified at the same time.

Table 5-3 Order of Precedence of Assembler Options

	-NO	-NP	-NKA	-NKS	-KX	-NKX	--
-J	NG						NG
-G	NG						NG
-P			Δ	Δ		Δ	NG
-KA		NG					NG
-KS		NG			NG		NG
-KX		NG					NG
-LW		NG					NG
-LL		NG					NG
-LH		NG					NG
-LT		NG					NG
-LF		NG					NG

[Items marked with an NG]

When the option in the horizontal axis is specified, the option shown in the vertical axis option is unavailable.

Example C>ra78k0 -c054 k0main.asm -no -lw80 -lf

The options -LW and -LF are unavailable.

[Items marked with a Δ]

When all three of the options in the horizontal axis are specified, the option shown in the vertical axis option is unavailable.

Example C>ra78k0 -c054 k0main.asm -p -nka -nks -nkx

The options -NKA, -NKS and -NKX are all specified at the same time, so option -P is unavailable.

When an option and its "N" counterpart are specified at the same time (for example, both -O and -NO), only the last of the 2 options is available.

Example C>ra78k0 -c054 k0main.asm -o -no

The option -NO is specified after -O, so option -O is unavailable and -NO is available.

Options not described in Table 5-3 have no particular effect on other options. However, when the help option (--) is specified, all other options become unavailable.

5.4.3 Explanation of assembler options

The assembler options are described in detail on the following pages.

(1) Device type specification

Device type specification (-C)

[Syntax]

-C device-type

- Default assumption

  Cannot be omitted

[Function]

- Option -C specifies the device type of the target device.

[Application]

- Use option -C sparingly. The assembler performs assembly for the target device and generates an object code for that device.

[Explanation]

- For the target devices that can be specified by option -C, refer to "Considerations when using device files."

[Notice]

- Option -C cannot be omitted. However, if a control instruction with the same function is described at the beginning of the source module, command-line specification can be omitted.

Δ $ Δ PROCESSOR Δ (Δ device-type Δ) Δ $ Δ PCΔ(Δdevice-type Δ) ; Abbreviated form

For information on control instructions, refer to RA78K0 Assembler Package Language User's Manual.

[Example of use]

- Specify option -C on the command line as follows.

  C>ra78k0 -c054 k0main.asm

(2) Object module file output specification

Object module file output specification (-O/-NO)

[Syntax]

```
-O [ output-file-name ]
-NO
```

- Default assumption

  -O (input-file-name).rel

[Function]

- Option -O specifies the output of an object module file. It also specifies the location to which it is output and the file name.
- Option -NO makes option -O, -J, -G, and -GA unavailable.

[Application]

- Use option -O to specify the location to which an object module file is output or to change its file name. Specify option -NO when performing assembly only to output an assemble list file. This will shorten assembly time.

[Explanation]

- The disk type file name, device type file names NUL and AUX, and the path name can be specified in [output file name]. When the device type file names CON, PRN, and CLOCK are specified, an abort error results.
- Even if option -O is specified, if a fatal error occurs the object module file cannot be output.
- If the drive name is omitted when option -O is specified, the object module file will be output to the current drive.
- If the output file name is omitted when option -O is specified, the output file name will be "input-file-name.rel".
- If both options -O and -NO are specified at the same time, the option specified last takes precedence.

[Example of use]

- Specify output of object module file (sample.rel).

  C>ra78k0 -c054 k0main.asm -osample.rel

(3) Forced object module file output specification

Forced object module file output specification (-J/-NJ)

[Syntax]

```
-J
-NJ
```

- Default assumption

  -NJ

[Function]

- Option -J specifies that the object module file can be output even if a fatal error occurs.
- Option -NJ makes option -J unavailable.

[Application]

- Normally, when a fatal error occurs, the object module file cannot be output. When you wish to execute the program with a notice that a fatal error has occurred, specify option -J to output the object module file.

[Explanation]

- When option -J is specified, the object module file will be output even if a fatal error occurs.
- If both options -J and -NJ are specified at the same time, the option specified last takes precedence.
- If option -NO is specified, option -J is unavailable.

[Example of use]

- Specify output of object module file even if a fatal error occurs.

  C>ra78k0 -c054 k0main.asm -j

(4) Debug data output specification

Debug data output specification (-G/-NG, -GA/-NGA)

(a) -G/-NG

[Syntax]

```
-G
-NG
```

- Default assumption

  -G

[Function]

- Option -G specifies that debugging data (local symbol data) is to be added to an object module file.
- Option -NG makes option -G unavailable.

[Application]

- Use option -G when performing symbolic debugging of data that includes local symbol data.
- Use option -NG in the following 3 cases.

  (i) Symbolic debugging of global symbols only

  (ii) Debugging without symbols

  (iii) When only the object is required (evaluation using PROM, etc.)

[Explanation]

- If both options -G and -NG are specified at the same time, the option specified last takes precedence.
- Option -GA takes precedence over other options regardless of the position in which it is specified.
- If option -NO is specified, option -G is unavailable.

[Notice]

- A control instruction with the same function as options -G and -NG can be written at the beginning of a source module.

```
Δ $ Δ DEBUG
Δ $ Δ DG              ; abbreviated form
Δ $ Δ NODEBUG
Δ $ Δ NODG            ; abbreviated form
```

For information on control instructions, refer to RA78K0 Assembler Package Language User's Manual.

[Example of use]

- Specify addition of debug data to an object module file.

```
C>ra78k0 -c054 k0main.asm -g
```

(b) -GA/-NGA

[Syntax]

```
-GA
-NGA
```

- Default assumption

  -GA

[Function]

- Option -GA specifies that source debugging data is to be added to an object module file by the structured assembler.
- Option -NGA makes option -GA unavailable.

[Application]

- Use option -GA when performing debugging at the source level of the assembler or structured assembler. To perform debugging at the source level, you will need the separately available integrated debugger.
- Use option -NGA in the following 2 cases.

  (i) Debugging without an assembler source

  (ii) When only the object is required (evaluation using PROM, etc.)

  (iii) Debugging at the source level of the C compiler / structured assembler

[Explanation]

- If both options -GA and -NGA are specified at the same time, the option specified last takes precedence.
- Option -GA takes precedence over other options regardless of the position in which it is specified.
- If option -NO is specified, option -GA is unavailable.

[Notice]

- A control instruction with the same function as options -GA and -NGA can be written at the beginning of a source module.

```
Δ $ Δ DEBUGA
Δ $ Δ NODEBUGA
```

For information on control instructions, refer to RA78K0 Assembler Package Language User's Manual.

[Example of use]

- Specify addition of assembler source debug data to an object module file.

```
C>ra78k0 -c054 k0main.asm -ga
```

(5) Include file read path specification

Include file read path specification (-I)

[Syntax]

-I path-name [, path-name] ... (two or more path names can be specified)

- Default assumption

  The include file is searched in the following sequence.

  (i) Path where the source file exists

  (ii) Path specified by the environmental variable (INC78K0)

[Function]

- Option -I specifies input of an include file specified by "$include"in a source module from a specified path.

[Application]

- Use option -I to retrieve an include file from a certain path.

[Explanation]

- Two or more path names can be specified at once by separating them with ",".
- A space cannot be entered before or after the ",".
- The include file specified by "$include" is searched in the following sequence.

  (i) If two or more path names are specified following the -I option, the include file is searched in the specified order.

  (ii) If two or more -I options are specified, the include file is searched with the option specified later taking precedence.

  (iii) After the path specified by the -I option is searched, the include file is searched in the same order as the default assumption.
- If anything other than a path name is specified after -I, or if the path name is omitted, an abort error occurs.
- If -I is used to specify 65 or more path names, an abort error occurs.

[Example of use]

- Read an include file from directory c:\sample

```
C>ra78k0 -c054 k0main.asm -ic:\sample
```

(6) Assemble list file output specification

Assemble list file output specification (-P/-NP)

[Syntax]

```
-P [ output-file-name ]
-NP
```

- Default assumption

  -P input-file-name.prn

[Function]

- Option -P specifies output of an assemble list file. It also specifies the destination and file name of the output file.
- Option -NP makes option -P, -KA, -KS, -KX, -LW, -LL, -LH, -LT, and -LF unavailable.

[Application]

- Specify option -P to change the output destination or output file name of an assemble list file.
- Specify option -NP when performing assembly only to output an object module file. This will shorten assembly time.

[Explanation]

- A file name can be specified as a disk-type file name or as a device-type file name. However, only CON, PRN, NUL, and AUX can be specified as device-type file names. If CLOCK is specified, an abort error will occur.
- If the output file name is omitted when option -P is specified, the assemble list file name becomes "input-file-name.prn".
- If the drive name is omitted when option -P is specified, the assemble list file will be output to the current drive.
- If both options -P and -NP are specified at the same time, the option specified last takes precedence.

[Example of use]

- Create an assemble list file (sample.prn).

  C>ra78k0 -c054 k0main.asm -psample.prn

(7) Assemble list file data specification

Assemble list file data specification (-KA/-NKA, -KS/-NKS, -KX/-NKX)

(a) -KA/-NKA

[Syntax]

-KA -NKA

- Default assumption

  -KA

[Function]

- Option -KA outputs an assemble list into an assemble list file.
- Option -NKA makes option -KA unavailable.

[Application]

- Specify option -KA to output an assemble list.

[Explanation]

- If both options -KA and -NKA are specified at the same time, the option specified last takes precedence.
- If options -NKA, -NKS, and -NKX are all specified, the assemble list file cannot be output.
- If option -NP is specified, option -KA is unavailable.

[Example of use]

- Output an assembly list file.

  C>ra78k0 -c054 k0main.asm -ka

  Reference k0main.prn.

```
          Assemble list

ALNO  STNO   ADRS   OBJECT  M I    SOURCE STATEMENT
1     1
2     2                             NAME   SAMPM
3     3                            ; ************************************************
4     4                            ; *                                              *
5     5                            ; *        HEX -> ASCII Conversion Program       *
6     6                            ; *                                              *
7     7                            ; *                main-routine                  *
8     8                            ; *                                              *
9     9                            ; ************************************************
10    10
11    11                                    PUBLIC MAIN , START
12    12                                    EXTRN  CONVAH
13    13
14    14       ----                 DATA     DSEG   AT 0FE20H
15    15       FE20                 HDTSA :  DS     1
16    16       FE21                 STASC :  DS     2
17    17
18    18       ----                 CODE     CSEG   AT 0H
19    19       0000   R0000         MAIN:    DW     START
20    20
21    21       ----                          CSEG
22    22       0000                 START :
23    23
24    24
25    25
26    26       0000   11201A                MOV    HDTSA , #1AH
27    27       0003   1620FE                MOVW   HL , #HDTSA  ; set hex 2-code data in HL
        :
```

(b) -KS/-NKS

[Syntax]

```
-KS
-NKS
```

- Default assumption

  -NKS

[Function]

- Option -KS outputs an assemble list followed by a symbol list into an assemble list file.
- Option -NKS makes option -KS unavailable.

[Application]

- Specify option -KS to output a symbol list.

[Explanation]

- If both options -KS and -NKS are specified at the same time, the option specified last takes precedence.
- If options -KS and -KX are specified at the same time, -KS is ignored.
- If options -NKA, -NKS, and -NKX are all specified, the assemble list file cannot be output.
- If option -NP is specified, option -KS is unavailable.

[Example of use]

- Output a symbol list.

  C>ra78k0 -c054 k0main.asm -ks

  Reference k0main.prn.

  (The assemble list is output, followed by the symbol list.)

```
          Symbol Table List

VALUE  ATTR    RTYP     NAME              VALUE  ATTR    RTYP     NAME

       CSEG             ?CSEG                    CSEG             CODE
----H                   CONVAH                   DSEG             DATA
FE20H  ADDR             HDTSA               0H   ADDR    PUB      MAIN
       MOD     SAMPM                       0H   ADDR    PUB      START
FE21H  ADDR             STASC
```

(c) -KX/-NKX

[Syntax]

```
-KX
-NKX
```

- Default assumption

  -NKX

[Function]

- Option -KX outputs an assemble list followed by a cross-reference list into an assemble list file.
- Option -NKX makes option -KX unavailable.

[Application]

- Specify option -KX to output a cross-reference list when you wish to know where and to what degree each symbol defined in a source module file is referenced in the source module, or when you wish to know such information as which line of the assemble list a certain symbol is referenced on.

[Explanation]

- If both options -KX and -NKX are specified at the same time, the option specified last takes precedence.
- If options -KS and -KX are specified at the same time, -KS is ignored.
- If options -NKA, -NKS, and -NKX are all specified, the assemble list file cannot be output.
- If option -NP is specified, option -KX is unavailable.

[Notice]

- A control instruction with the same function as option -KX/-NKX can also be written at the beginning of a source module.

```
Δ $ Δ XREF
Δ $ Δ XR            ; abbreviated form
Δ $ Δ NOXREF
Δ $ Δ NOXR          ; abbreviated form
```

For information on control instructions, refer to RA78K0 Assembler Package Language User's Manual.

[Example of use]

- Output a cross-reference list.

  C>ra78k0 -c054 k0main.asm -kx

  Reference k0main.prn.

  The assemble list is output, followed by a cross-reference list.

Cross-Reference List

NAME	VALUE	R	ATTR	RTYP	SEGNAME	XREFS		
?CSEG			CSEG		?CSEG	21#		
CODE			CSEG		CODE	18#		
CONVAH	----H	E		EXT		12@	29	
DATA			DSEG		DATA	14#		
HDTSA	FE20H		ADDR		DATA	15#	26	27
MAIN	0H		ADDR	PUB	CODE	11@	19#	
SAMPM			MOD			2#		
START	0H	R	ADDR	PUB	?CSEG	11@	19	22#
STASC	FE21H		ADDR		DATA	16#	31	

(8) Assemble list file format specification

Assemble list file format specification (-LW, -LL, -LH, -LT, -LF/-NLF)

(a) -LW

[Syntax]

-LW [number-of-characters]

- Default assumption

  -LW132 (80 characters in the case of display output)

[Function]

- Option -LW changes the number of characters that can be printed in 1 line in a list file.

[Application]

- Specify option -LW to change the number of characters that can be printed in 1 line in any type of list file.

[Explanation]

- The range of number of characters that can be specified with option -LW is shown below.
  (80 characters in the case of display output)

  72 ≤ number of characters printed on 1 line ≤ 2046

  If a numerical value outside this range, or something other than a numerical value, is specified, an abort error occurs.
- If the number of characters is omitted, 132 will be specified.
  However, when an assemble list file is output to display, 80 will be specified.
- The specified number of characters does not include the terminator (CR, LF).
- If option -NP is specified, option -LW is unavailable.

[Notice]

- A control instruction with the same function as option -LW can also be written at the beginning of a source module.

Δ $ Δ WIDTH

  For information on control instructions, refer to RA78K0 Assembler Package Language User's Manual.

[Example of use]

- Specify 80 as the number of characters per line in an assemble list file.

  C>ra78k0 -c054 k0main.asm -lw80

  This references the assemble list.

```
          Assemble list

ALNO  STNO   ADRS    OBJECT  M I     SOURCE STATEMENT

1       1
2       2                                       NAME   SAMPM
3       3                               ; ************************************************
4       4                               ; *                                              *
5       5                               ; *       HEX -> ASCII Conversion Program        *
6       6                               ; *                                              *
7       7                               ; *              main-routine                    *
8       8                               ; *                                              *
9       9                               ; ************************************************
10      10
11      11                                      PUBLIC MAIN , START
12      12                                      EXTRN  CONVAH
13      13
14      14      ----                    DATA    DSEG   AT 0FE20H
15      15      FE20                    HDTSA : DS     1
16      16      FE21                    STASC : DS     2
17      17
18      18      ----                    CODE    CSEG   AT 0H
19      19      0000 R0000              MAIN :  DW     START
20      20
21      21      ----                            CSEG
22      22      0000                    START :
23      23
24      24
25      25
          :
```

(b) -LL

[Syntax]

```
-LL [ number-of-lines ]
```

- Default assumption

  -LL66 (No page breaks in the case of display output)

[Function]

- Option -LL changes the number of lines that can be printed in 1 page in an assemble list file.

[Application]

- Specify option -LL to change the number of lines that can be printed in 1 page in an assemble list file.

[Explanation]

- The range of number of lines that can be specified with option -LL is shown below.

  20 ≤ number of lines printed on 1 page ≤ 32767

  If a numerical value outside this range, or something other than a numerical value, is specified, an abort error occurs.
- If the number of lines is omitted, 66 will be specified.
- If the number of lines specified is 0, no page breaks will be made.
- If option -NP is specified, option -LL is unavailable.

[Notice]

- A control instruction with the same function as option -LL can also be written at the beginning of a source module.

  ```
  Δ $ Δ LENGTH
  ```

  For information on control instructions, refer to RA78K0 Assembler Package Language User's Manual.

[Example of use]

- Specify 20 as the number of lines per page in an assemble list file.

  C>ra78k0 -c054 k0main.asm -ll20

  This references k0main.prn.

```
78K/0 Series Assembler Vx.xx                              Date:xx xxx xxxx Page:    1

Command:-c054 k0main.asm -ll20
Para-file:
In-file:K0MAIN.ASM
Obj-file:K0MAIN.REL
Prn-file:K0MAIN.PRN

            Assemble list

--------------------------------------------------------------------------------


78K/0 Series Assembler Vx.xx                              Date:xx xxx xxxx Page:    2

ALNO  STNO    ADRS    OBJECT  M I     SOURCE STATEMENT

1       1
2       2                                       NAME  SAMPM
3       3                                 ; ************************************************
4       4                                 ; *                                              *
5       5                                 ; *   HEX -> ASCII Conversion Program        *
6       6                                 ; *                                              *
7       7                                 ; *            main-routine *

--------------------------------------------------------------------------------


78K/0 Series Assembler Vx.xx                              Date : xx xxx xxxx Page:   3


ALNO  STNO    ADRS    OBJECT  M I     SOURCE STATEMENT

8       8                                 ; *                                              *
9       9                                 ; ************************************************
10      10
11      11                                        PUBLIC MAIN , START
          :
```

(c) -LH

[Syntax]

-LH character-strin

- Default assumption

  None

[Function]

- Option -LH specifies the character string printed in the title column of the header of an assemble list file.

[Application]

- Specify option -LH to display a title that briefly explains the contents of an assemble list file.
- By printing the title on each page, the contents of the assemble list file can be understood at a glance.

[Explanation]

- Up to 60 characters can be specified in the title. The character string cannot include blank spaces.
- If more than 61 characters are written, the first 60 characters will be recognized and no error message will be output.

  A 2-byte character is calculated as two characters.

  If the maximum number of characters per line is 119 or less, the length of the effective character string changes as follows.

  Effective length = (Max. number of characters per line) - 60
- If the length of the character string is not specified, an abort error will occur.
- If option -NP is specified, option -LH is unavailable.
- If option -LH is omitted, the title column of the assemble list file will be blank.
- The character set that can be written in the title column is as follows.

Table 5-4 Characters That Can Be Written as Titles

Character	In command line	In parameter file
*?><|	Can be written if enclosed in " ".	Can be written. Interpreted in the same way as in the command line even if enclosed in " ".
;	Can be written if enclosed in " ".	Cannot be written. (Assumed to be a comment.)
#	Can be written.	Cannot be written. (Assumed to be a comment.)
" (double quotation mark)	Cannot be written as an effective character.	Cannot be written as an effective character.

Table 5-4 Characters That Can Be Written as Titles

Character	In command line	In parameter file
00H	Cannot be written.	Can be written. However, it is interpreted as the end of the character string.
03H, 06H, 08H, 0DH, 0EH, 10H, 15H, 17H, 18H, 1BH, 7FH	Cannot be written.	Can be written. However, these will appear in the assemble list file as '!' (A single 0DH will not be output to the list.)
01H, 02H, 04H, 05H, 07H, 0BH, 0CH, 0FH, 11H, 12H, 13H, 14H, 16H, 19H, 1CH, 1DH, 1EH, 1FH	Can be written. However, these will appear in the assemble list file as '!'	Can be written. However, these will appear in the assemble list file as '!'
1AH	Can be written. However, this will appear in the assemble list file as '!'	Cannot be written. (end of file)
Alphabetic characters	Uppercase and lowercase characters are input as is.	Uppercase and lowercase characters are input as is.
Other	Can be written.	Can be written.

Remark If an asterisk (*) on the startup line is not a target for Wild Card expansion, it can be written even if it is not enclosed in " ".

[Notice]

- A control instruction with the same function as option -LH can also be written at the beginning of the startup line.

```
Δ $ Δ TITLE Δ ( Δ 'character-string' Δ )
Δ $ Δ TT Δ ( Δ 'character-string' Δ )          ; abbreviated form
```

For information on control instructions, refer to RA78K0 Assembler Package Language User's Manual.

[Example of use]

- Print the title in the header of an assemble list file.

  C>ra78k0 -c054 k0main.asm -lhRA78K0_MAINROUTINE

  This references 78k0main.prn.

```
78K/0 Series Assembler Vx.xx RA78K0_MAINROUTINE              Date:xx xxx xxx Page : 1
                                          |
                                        Title

Command : -c054 k0main.asm -lhRA78K0_MAINROUTINE
Para-file :
In-file : K0MAIN.ASM
Obj-file : K0MAIN.REL
Prn-file : K0MAIN.PRN

          Assemble list

ALNO  STNO    ADRS    OBJECT  M I      SOURCE STATEMENT
1       1
2       2                                  NAME  SAMPM
3       3                                ; ************************************************
4       4                                ; *                                              *
5       5                                ; *   HEX -> ASCII Conversion Program        *
6       6                                ; *                                              *
7       7                                ; *            main-routine*
          :
```

(d) -LT

[Syntax]

-LT [number-of-characters]

- Default assumption

  -LT8

[Function]

- Option -LT performs tabulation processing by specifying a number of characters for any type of list for which to substitute and output a number of blank spaces for the HT (horizontal tabulation) code in a source module.

[Application]

- When specifying a small number of characters per line for any type of list using option -LW, specify option -LT to insert a tab instead of a series of blank spaces, thus saving on the number of characters used.

[Explanation]

- The range of number of characters that can be specified with option -LT is shown below.

  0 ≤ number of characters that can be specified ≤ 8

  If a numerical value outside this range, or something other than a numerical value, is specified, an abort error occurs.
- If -LT0 is specified, tabulation processing will not be performed, and a tabulation code will be output.
- If option -NP is specified, option -LT is unavailable.

[Notice]

- A control instruction with the same function as option -LT can also be written at the beginning of a source module.

Δ $ Δ TAB Δ number-of-tabs

  For information on control instructions, refer to RA78K0 Assembler Package Language User's Manual.

[Example of use]

Example 1. sample.prn is referenced when option -LT is omitted.

```
          Assemble list

ALNO   STNO   ADRS     OBJECT   M I  SOURCE STATEMENT

1         1                                    NAME SAMPLE
2         2
3         3          ----                CODE    CSEG
4         4          0000     63                 MOV   A , B
5         5          0001     619A               SET1  A.1
6         6                                    END
```

Example 2. 1 blank is specified using the HT code.

C>ra78k0 -c054 sample.asm -lt1

This references sample.prn.

```
          Assemble list

ALNO   STNO   ADRS     OBJECT   M I  SOURCE  STATEMENT

1         1                                    NAME SAMPLE
2       2
3       3          ----                CODE    CSEG
4       4          0000     63                 MOV   A , B
5       5          0001     619A               SET1  A.1
6       6                                    END
```

Remark The number of blanks entered by the HT code is 1.

(e) -LF/-NLF

[Syntax]

```
-LF
-NLF
```

- Default assumption

  -NLF

[Function]

- Option -LF inserts a form feed (FF) code at the end of an assemble list file.
- The -NLF option makes the option -LF unavailable.

[Application]

- If you wish to add a page break after the contents of an assemble list file are printed, specify option -LF to add a form feed code.

[Explanation]

- If option -NP is specified, option -LF is unavailable.
- If both options -LF and -NLF are specified at the same time, the option specified last takes precedence.

[Notice]

- A control instruction with the same function as option -LF/-NLF can also be written at the beginning of a source module.

```
Δ $ Δ FORMFEED
Δ $ Δ NOFORMFEED
```

  For information on control instructions, refer to RA78K0 Assembler Package Language User's Manual.

[Example of use]

- Add a form feed code at the end of an assemble list file.

```
C>ra78k0 -c054 k0main.asm -pprn -lf
```

(9) Error list file output specification

Error list file output specification (-E/-NE)

[Syntax]

```
-E [ output-file-name ]
-NE
```

- Default assumption

  -NE

[Function]

- Option -E outputs an error list file, and specifies the output destination and output file name of the error list file.
- The option -NE makes the option -E unavailable.

[Application]

- Specify option -E to save an error message into a file.
- Specify option -E to change the output destination and output file name of the error list file.

[Explanation]

- The error list file can be saved as a disk-type file or as a device-type file. However, if the device-type file name CLOCK is specified, an abort error will occur.
- When option -E is specified and the output file name is omitted, the error list file name will be "input-file-name.era".
- When option -E is specified and the drive name is omitted, the error list file will be output to the current directory.
- If both options -E and -NE are specified at the same time, the option specified last takes precedence.

[Example of use]

- Create an error list file (k0main.era).

  C>ra78k0 -c054 k0main.asm -ek0main.era

```
78K/0 Series Assembler Vx.xx [ xx xxx xx ]
    Copyright ( C ) NEC Electronics Corporation xxxx ,  xxxx

Pass1 Start
K0MAIN.ASM ( 31 ) : RA78K0 error E2202 : Illegal operand
Pass2 Start
K0MAIN.ASM ( 26 ) : RA78K0 error E2312 : Operand out of range ( byte )
K0MAIN.ASM ( 31 ) : RA78K0 error E2202 : Illegal operand

 Target chip : uPD78054
 Device file : Vx.xx

Assembly complete ,       2 error ( s) and       0 warning ( s ) found.
```

This references the error list file (k0main.era).

```
Pass1 Start
K0MAIN.ASM ( 31 ) : RA78K0 error E2202 : Illegal operand
Pass2 Start
K0MAIN.ASM ( 26 ) : RA78K0 error E2312: Operand out of range ( byte )
K0MAIN.ASM ( 31 ) : RA78K0 error E2202: Illegal operand
```

(10) Parameter file specification

Parameter file specification (-F)

[Syntax]

-F file-name

- Default assumption

  With no input file.

[Function]

- Option -F inputs assembler options and the input file name from a specified file.

[Application]

- Specify option -F when the data required to start up the assembler will not fit on the command line.
- Specify option -F to repeatedly specify the same options each time assembly is performed and to save those options to a parameter file.

[Explanation]

- Only a disk-type file name can be specified as "file name". If a device-type file name is specified, an abort error will occur.
- If the file name is omitted, an abort error will occur.
- Nesting of parameter files is not permitted. If option -F is specified within a parameter file, an abort error will occur.
- The number of characters that can be written within a parameter file is unlimited.
- Separate options or file names with a blank space, a tab or the line feed code (LF).
- Parameters and input file names within a parameter file will be expanded at the position specified for the parameter file on the command line.
- The expanded options specified last will take precedence.
- The characters following ";" or "#" in a parameter file are all assumed to be comments, up to the line feed code (LF) or EOF.
- If option -F is specified two or more times, an abort error will occur.

[Example of use]

- Perform assembly using a parameter file.

  Set the contents of the parameter file (k0main.pra) as follows.

```
; parameter file
k0main.asm -osample.rel -g -c054
-psample.prn
```

  Enter the following on the command line.

```
C>ra78k0 -fk0main.pra
```

(11) Specification of path for temporary file creation

Specification of path for temporary file creation (-T)

[Syntax]

-T path-name

- Default assumption

  Creates a temporary file in the path specified by the environmental variable TMP.

  When no path is specified, the temporary file is created in a current path.

[Function]

- Option -T specifies a path in which a temporary file is created.

[Application]

- Use option -T to specify the location for creation of a temporary file.

[Explanation]

- Only a path can be specified as a path name.
- The path name cannot be omitted.
- Even if a previously created temporary file exists, if the file is not protected it will be overwritten.
- As long as the required memory size is available, the temporary file will be expanded in memory. If not enough memory is available, the contents of the temporary file will be written to a disk.
  Such temporary files may be accessed later through the saved disk file.
- Temporary files are deleted when assembly is finished. They are also deleted when assembly is aborted by pressing (CTRL-C).
- The path in which the temporary file is to be created is determined according to the following sequence.

  (i) The path specified by option -T

  (ii) The path specified by environmental variable TMP (when option -T is omitted)

  (iii) The current path (when TMP is not set)

  When a. or b. is specified, if the temporary file cannot be created in the specified path an abort error occurs.

[Example of use]

- Specify output of a temporary file to directory c:\tmp.

  C>ra78k0 -c054 k0main.asm -tc:\tmp

(12) Kanji code specification

Kanji code specification (-ZS/-ZE/-ZN)

[Syntax]

```
-ZS
-ZE
-ZN
```

- Default assumption

  Interpreted as follows depending on the OS.

  -ZS (Windows/HP-UX)

  -ZE (SunOS/Solaris)

[Function]

- Kanji described in the comment is interpreted as the specified kanji code.
- Kanji code is interpreted as follows depending on the option.

  -ZS : Shift JIS code

  -ZE : EUC code

  -ZN : Not interpreted as kanji.

[Application]

- These options are used to specify the interpretation of the kanji code of the kanji in the comment line.

[Explanation]

- If the -ZS, -ZE, and -ZN options are specified at the same time, the one specified later takes priority.
- The control instruction that functions as the -ZS, -ZE, and -ZN options can be described at the start of the source module.

  The syntax is shown below.

```
Δ $ Δ KANJICODE Δ SJIS
Δ $ Δ KANJICODE Δ EUC
Δ $ Δ KANJICODE Δ NONE
```

  For details of the control instruction, refer to RA78K0 Assembler Package Language User's Manual.
- Kanji code can also be specified by using the environmental variable LANF78K. For details of the environmental variables, refer to "11.2 Preparing Development Environment (Environmental Variables)".

[Example of use]

- The kanji code is interpreted as EUC code

```
C>ra78k0 k0main.asm -c054 -ze
```

(13) Device file search path specification

Device file search path specification (-Y)

[Syntax]

-Y path-name

- Default assumption

  Device files will be read from the path determined in the following order.

  (i) 1) < ..\dev > (for the ra78k0.exe startup path)

  (ii) 2) Path by which RA78K0 was started up

  (iii) 3) Current directory

  (iv) 4) The environmental variable PATH

[Function]

- Reads a device file from the specified path.

[Application]

- Specify a path where a device file exists.

[Explanation]

- If anything other than a path name is specified after option -Y, an abort error occurs.
- If the path name is omitted after option -Y, an abort error occurs.
- The path from which the device file is read in the order determined as follows.

  (i) Path specified by option -Y

  (ii) < ..\dev > (for the ra78k0.exe startup path)

  (iii) Path by which RA78K0 was started up

  (iv) Current directory

  (v) The environmental variable PATH

[Example of use]

- Specify the path for the device file as directory c:\78k0\dev

```
C>ra78k0 -k0main.asm -c054 -yc:\78k0\dev
```

(14) Symbol definition specification

Symbol definition specification (-D)

[Syntax]

```
-D symbol-name [ = value ] [ , symbol-name [ = value ] … ]
```

- Default assumption

  None

[Function]

- Option -D defines symbols.

[Application]

- Specify option -D when defining symbols.

[Explanation]

- The value given to a symbol is binary, octal, decimal, or hexadecimal. When value specification is omitted, 1 will be specified.
- Up to 30 symbols can be specified by using a comma as a delimiter.
- Up to 31 characters can be described for a symbol name.
- When duplicate names are specified, the latest one specified is valid.
- Symbol names are case sensitive.
  Symbols defined with -D are used instead of EQU/$SET/$RESET. If a symbol name specified for -D was also defined in the source, an error results.

[Example of use]

- When specifying 2 as the symbol definition :

  C>ra78k0 k0main.asm -c054 -dSYM = 2

(15) Series common object specification

Series common object specification (-COMMON)

[Syntax]

-COMMON

- Default assumption

  The object file supporting the specified device is output.

[Function]

- The -COMMON option specifies output of an object module file common to the 78K0 Series.

[Application]

- This option generates an object code that can be used commonly in the 78K0 Series, regardless of the device type specification (-C) option.

  The output object module file can be linked with an object file for which a different device in the 78K0 Series is specified.

[Explanation]

- Specify this option to generate an object code that can be used commonly in the 78K0 Series.

[Notice]

- Even when the -COMMON option is specified, the device type specification (-C) option or control instruction of the same function must not be omitted.

  If the series common object specification (-COMMON) option is specified for all the input object module files to be linked, an error occurs.

[Example of use]

```
C>ra78k0 k0sub.c -c054 -common
```

(16) Self programming specification

Self programming specification (-SELF)

[Syntax]

-SELF

- Default assumption

  None

[Function]

- The -SELF option stops an error occurring when "CALL!8100H" is described even if address 8100H is outside the access range (i.e., there is no internal ROM).

[Application]

- Specify the -SELF option when using self programming.

[Explanation]

- Specify this option if an error occurs when "CALL!8100H" is described during self programming.

(17) Help specification

Help specification (--)

[Syntax]

```
--
```

- Default assumption

  No display

[Function]

- Option -- displays a help message.

[Application]

- The help message is a list of explanations of the assemble options. Refer to these when executing the assembler.

[Explanation]

- When option -- is specified, all other options are unavailable.
- To read the next part of the help message, press the return key.
  To quit the help display, press any key other than the return key and then press the return key.

  Caution This option cannot be specified on PM plus.
  To reference PM plus help, click the [Help] button in the < Assembler Options > dialog box.

[Example of use]

- When option -- is specified, a help message is output on the display.

C>ra78k0 --

```
78K/0 Series Assembler Vx.xx [ xx xxx xxxx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

usage : ra78k0 [ option [ ... ] ] input-file [ option [ .. .] ]
The option is as follows ( [ ] means omissible ).
-cx                : Select target chip.  ( x = 012 , 014 etc. ) * Must be specified.
-o [ file ] / -no  : Create the object module file [ with the specified name ] / Not.
-e [ file ] / -ne  : Create the error list file [ with the specified name ] / Not.
-p [ file ] / -np  : Create the print file [ with the specified name ] / Not.
-ka / -nka         : Output the assemble list to print file / Not.
-ks / -nks         : Output the symbol table list to print file / Not.
-kx / -nkx         : Output the cross reference list to print file / Not.
-lw [ width ]      : Specify print file columns per line.
-ll [ length ]     : Specify print file lines per page.
-lf / -nlf         : Add Form Feed at end of print file / Not.
-lt [ n ]          : Expand TAB character for print file ( n = 1 to 8 ) / Not expand ( n = 0 ).
-lhstring          : Print list header with the specified string.
-g / -ng           : Output debug information to object file / Not.
-j / -nj           : Create object file if fatal error occurred / Not.
-idirectory [ , directory .. ]  : Set include search path.
-tdirectory        : Set temporary directory.
-ydirectory        : Set device file search path.
-ffile             : Input option or source module file name from specified file.
-ga / -nga         : Output assembler source debug information to object file / Not.
-dname [ = data ] [ , name [ = data ] [ ... ] ] : Define name [ with data ].
-common            : Create the common object module file for 78K0 Series.
-self              : Use Self-programming.
-zs / -ze / -zn    : Change source regulation.
                        -zs : SJIS code usable in comment.
                        -ze : EUC code usable in comment.
                        -zn : no multibyte code in comment.
--                 : Show this message.
DEFAULT ASSIGNMENT :
          -o -ne -p -ka -nks -nkx -lw132 -ll66 -nlf -lt8 -g -nj -ga
```

5.5 Options Settings in PM plus

This section describes the method for setting assembler options from PM plus.

5.5.1 Option setting method

The < Assembler Options > dialog box is opened if [Assembler Options] is selected from the [Tools] menu of PM plus or if the [RA] button on the toolbar is pressed.

Assembler options can be set by inputting the required options in this dialog box.

Figure 5-2 < Assembler Options > Dialog Box (When << Output1 >> Tab Is Selected)

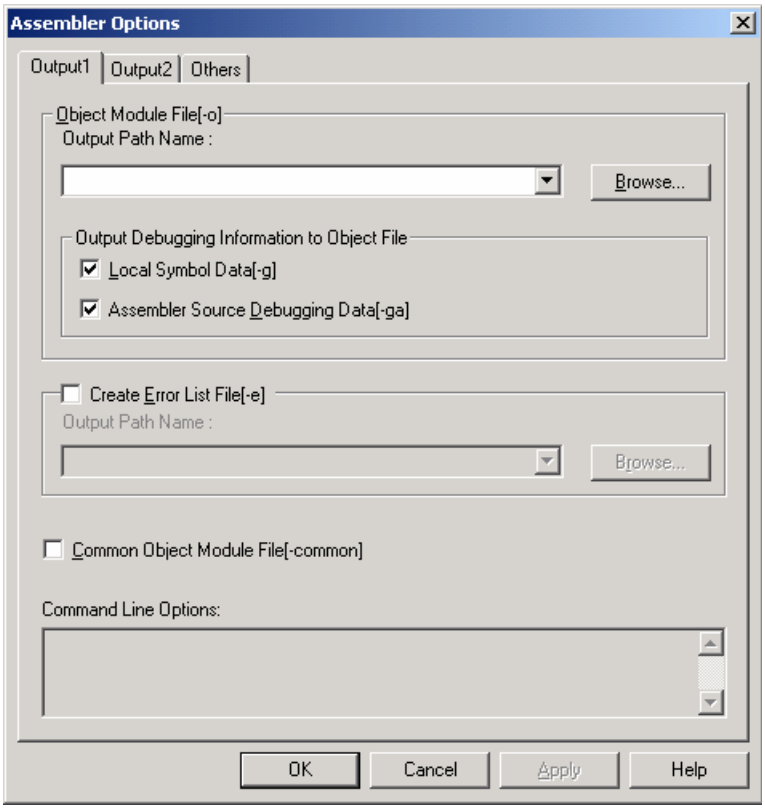


Figure 5-3 < Assembler Options > Dialog Box (When << Output2 >> Tab Is Selected)

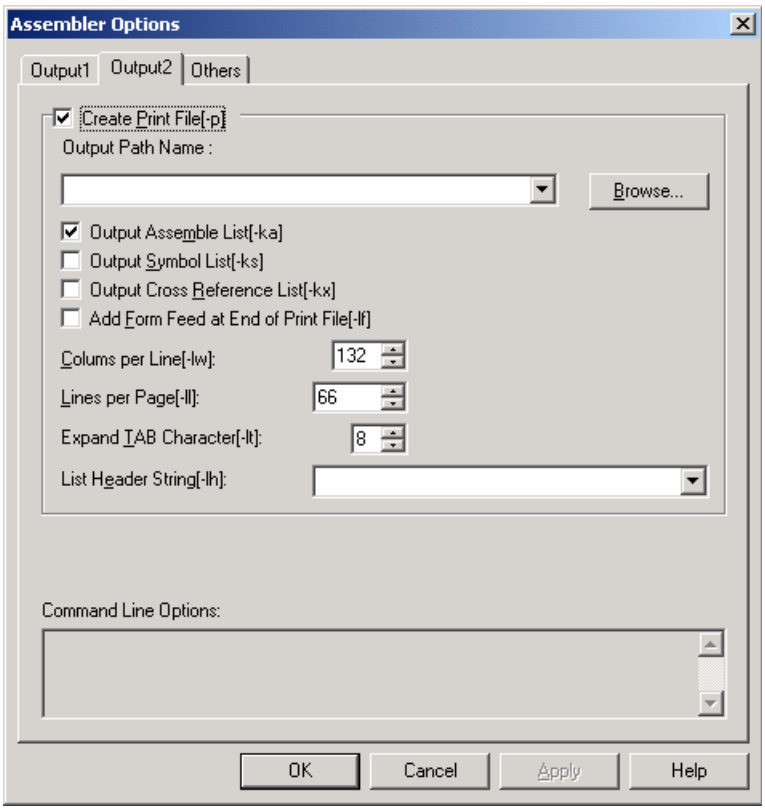
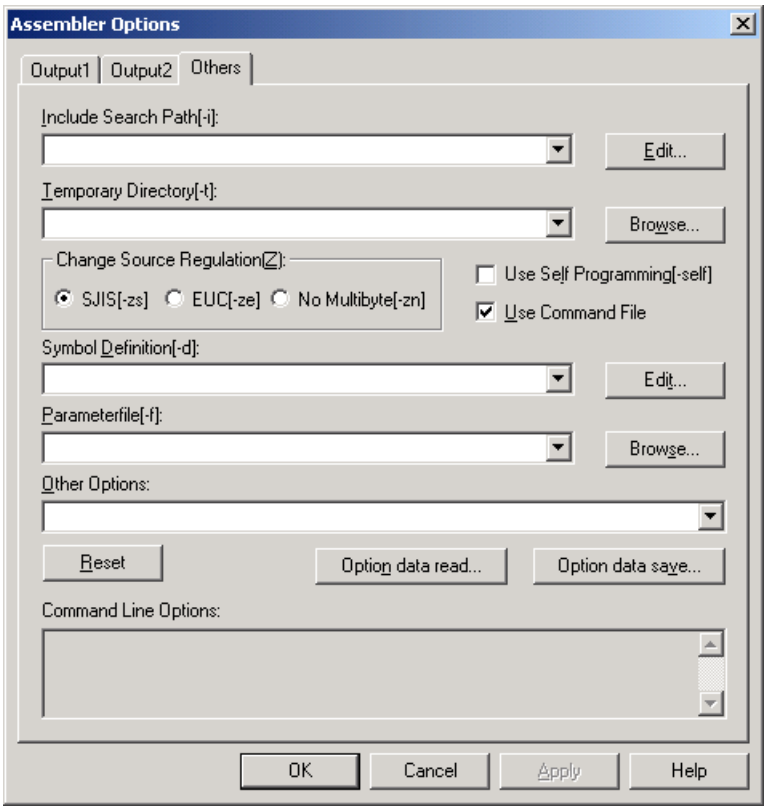


Figure 5-4 < Assembler Options > Dialog Box (When << Others >> Tab Is Selected)



5.5.2 Option settings

The various options in the < Assembler Options > dialog box are described below.

<< Output1 >> Tab

- Object Module File [-o]

  When specified by common option) Output Path Name

  Specify the path of the object module file by using the [Browse] button or directly inputting a path name.

  (When specified by individual option) Output File Name

  Specify the path and file name of the object module file by using the [Browse] button or directly inputting a path and file name.

- Local Symbol Data [-g]

  Check this option to add debug information (local symbol information) to the object module file.

- Assembler Source Debugging Data [-ga]

  Check this option to add source debug information to the object module file.

- Create Error List File [-e]

  Check this option to output an error list file.

  (When specified by common option) Output Path Name

  Specify the path of the error list file by using the [Browse] button or directly inputting a path name.

  (When specified by individual option) Output File Name

  Specify the path and file name of the error list file by using the [Browse] button or directly inputting a path and file name.

- Command Object Module File [-common]

  Check this option to output an object module file common to the 78K0 Series.

- Command Line Options

  This edit box is read-only. The currently set option character string is displayed.

<< Output2 >> Tab

- Create Print File [-p]

  Check this option to output an assemble list file.

  (When specified by common option) Output Path Name

  Specify the path of the assemble list file by using the [Browse] button or directly inputting a path name.

  (When specified by individual option) Output File Name

  Specify the path and file name of the assemble list file by using the [Browse] button or directly inputting a path and file name.

- Output Assemble List [-ka]

  Check this option to output an assemble list in the assemble list file.

- Output Symbol List [-ks]

  Check this option to output a symbol list file, following the assemble list, in the assemble list file.

- Output Cross Reference List [-kx]

  Check this option to output a cross reference list, following the assemble list, in the assemble list file.

- Add Form Feed at End of Print File [-lf]

  Check this option to suffix a form feed code (FF) to the assemble list file.

- Columns per Line [-lw]

  Specify the number of characters on one line of the assemble list file, in a range of 72 to 2046.

- Lines per page [-ll]

  Specify the number of lines on one page of the assemble list file, in a range of 20 to 32767.

- Expand TAB character [-lt]

  Specify the length of the tab character, in a range of 0 to 8.

- List Header String [-lh]

  Specify the character string to be printed in the title column of the header of the assemble list file. The number of characters that can be input is up to 60.

- Command Line Options

  This edit box is read-only. The currently set option character string is displayed.

<< Others >> Tab

- Include Search Path [-i]

  Specify the path via which the include file is to be read by using the [Edit] button or directly inputting a path name.

- Temporary Directory [-t]

  Specify the path where a temporary file is to be created by using the [Browse] button or directly inputting a path name.

- Change Source Regulation [Z]

  This option selects the type of Kanji code (SJIS[-zs], EUC[-ze], or No Multibyte [-zn]) to be used in the comment of the source.

- Use Self Programming[-self]

  Check this option to use the self-programming function.

- Use Command File

  Check this option to create a command file.

- Symbol Definition [-d]

  Input a numeric value to be defined as a symbol by using the [Edit] button or directly inputting a value.

- Parameterfile [-f]

  Specify the file to be input as a user-defined parameter file by using the [Browse] button or directly inputting a file name.

- Other Options

  To specify an option other than the options that can be set in this dialog box, enter the option in the input box.

  Caution The help specification (--) option cannot be specified on PM plus.

- Reset

  Resets the input contents.

- Option data read

  Opens the < Read Option Data > dialog box and after the option data file has been specified, reads this file.

- Option data save

  Opens the < Save Option Data > dialog box and save the option data to the option data file with a name.

- Command Line Options

  This edit box is read-only. The currently set option character string is displayed.

5.5.3 Edit option dialog box

Items are edited in list format in the < Edit Option > dialog box.

The < Edit Option > dialog box is described below.

Figure 5-5 < Edit Option > Dialog Box

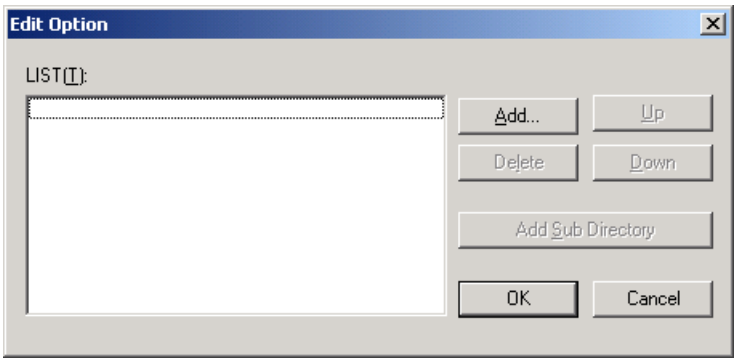
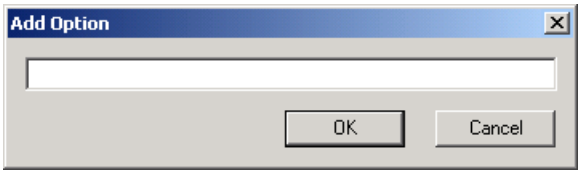


Figure 5-6 < Add Option > Dialog Box



- [Add] button

  Adds a list item.

  If the item to be added is a file or directory, the corresponding < Browse for Folder > dialog box opens.

  In all other cases, the < Add Option > dialog box opens. Specify details of the item to be added in this box.

- [Delete] button

  Deletes the selected list item.

- [Up] button

  Moves the selected list item up.

- [Down] button

  Moves the selected list item down.

- [Add Sub Directory] button

  A subdirectory can be added to the selected list item when the item is specified as Include Search Path[-i](I) on the << Others >> tab.

CHAPTER 6 LINKER

The linker inputs a number of object module files output by the 78K0 assembler, determines a location address and outputs them as a single load module file.

The linker also outputs list files such as a link list file and an error list file.

If a link error occurs, an error message is output to an error list file to clarify the cause of the error. When an error occurs, the load module file will not be output.

6.1 I/O Files of Linker

The I/O files of the linker are as follows.

Table 6-1 I/O Files of Linker

Type	File Name	Explanation	Default File Type
Input files	Object module files	- These are binary files which contain relocation and symbol data for machine language data and the location addresses of machine language data. - These files are output by the assembler.	.rel
	Library files	- These are files in which two or more object module files are included. - These files are output by the librarian.	.lib
	Directive files	- These are files which contain link commands used during linking. - These files are created by the user.	.dr
	Parameter files	- These files contain the parameters for program execution. - These files are created by the user.	.plk
Output files	Load module files	- These are binary image files which contain all data created as a result of linking. These files are input to the object converter.	.lmf
	Link list files	- These are list files which display the result of linking.	.map
	Error list files	- These files contain error data generated during linking.	.elk
I/O files	Temporary files	- These files are automatically generated by the linker for use in linking. They are deleted when assembly is complete.	LKxxxxx.$$n (n = 1-3)

6.2 Functions of Linker

The functions of the linker are as follows.

(1) Joining of input segments

The linker determines and controls the location address of each segment.

The linker identifies identical segments and joins them into a single segment, even if they are in separate object module files.

(2) Determination of input modules

When a library file is specified for input, the module to which an input object module file refers is retrieved from the library and handled as an input module.

(3) Determination of location addresses for input segments

The linker determines location addresses for each segment of an input module. If location attributes for a segment are specified in the source module file, the segment is located according to those attributes. The linker can also specify location attributes in the link directive file of the linker.

(4) Correction of object codes

When location addresses are buried in object codes, the linker corrects the object code according to the location address determined in (3) above.

6.3 Memory Spaces and Memory Areas

A memory space is a space provided for defining memory areas. A memory area is an area defined in memory for the allocation of segments.

Memory space : 64 KB each

Memory area : Each memory space is divided into several memory areas.

The memory area declares the memory addresses for the installed memory.

Table 6-2 Segment Allocation Groups (External ROM, etc.)

Memory Area Name	Default Address	Segments Allocated by Default
ROM	Internal ROM : Until beginning of RAM if no ROM is installed	CSEG
RAM	Internal RAM	DSEG, BSEG

Remarks 1 Use a directive file to change the default address of a memory area or to specify the location of each segment written in a program.

Remarks 2 For specific examples, refer to "3.4 (5) Create a directive file.".

6.4 Link Directives

A link directive (hereinafter referred to as a "directive") is a group of instructions used to perform various directions during linking, such as file input, usable memory area and allocation of segments.

The role of the directive file is to :

(1) Declare addresses in the installed memory

(2) Divide memory into two or more areas

Example CALLT area
Internal ROM
External ROM
SADDR
Internal RAM other than SADDR

(3) Segment allocation is specified by the linker

The following items are specified for each segment.

- Absolute address
- Specification of memory address only

Use an editor to create a directive file (a file which specifies directives). When the linker is started up, specify option -D to read the created file.

The linker reads the directives from the file and interprets them to perform linking.

Two types of directives can be used as follows.

Table 6-3 Types of Directives

Directive Type	Explanation
Memory directive	- Declares an address in installed memory - Divides memory into two or more areas and specifies a memory area
Segment location directive	- Specifies location of a segment

6.4.1 Directive files

The formats for specifying directives in a directive file are as follows.

A number of directives can be specified in a single directive file.

- Memory directives

  MEMORY memory area name :(start-address-value, size)[/memory-space-name]

- Segment allocation directives

  MERGE segment name : [AT Δ (Δ start-address Δ)]

  [=memory-area-name-specification][/memory-space-name]

(1) Reserved words

The following words are reserved words in a directive file.

MEMORY, MERGE, AT, SEQUENT, COMPLETE

Reserved words cannot be used in a directive file for other meanings (segment name, memory area name, etc.).

Reserved words can be written in uppercase or lowercase characters, but not in a mixture of the two.

Example MEMORY
memory
Memory : Cannot be used

If two or more segments with the same name exist in the source, specify "COMPLETE" in order not to merge the segments, and generate an error. To merge the segments, specify "SEQUENT (default)" in the directive.

SEQUENT : Merges the segments in the order in which they appear, so that no gaps are created. BSEG merges the segments in bit units in the order in which they appear.

COMPLETE : An error occurs if two or more segments with the same name exist.

Example MERGE DSEG1 : COMPLETE=RAM

(2) Symbols

Uppercase and lowercase characters are distinguished when specifying segment names, memory area names and memory space names.

(3) Numerical values

To specify a numerical constant for each item in a directive, write the constant in decimal or hexadecimal form. The method is the same as for source programs; add "H" at the end for hexadecimals. If A-F appear at the beginning, place "0" first.

Example 23H, 0FC80H

(4) Comments

When a ";" or "#" is written in a directive file, all characters entered from that point to carriage return (LF) are handled as a comment. If the directive file ends before a carriage return, everything before the end of the file is handled as a comment.

Example The underlined portion is a comment.

;DIRECTIVE FILE FOR 78054
MEMORY MEM1: (01000H, 1000H) #SECOND MEMORY AREA

6.4.2 Memory directives

A memory directive is a directive which defines a memory area (name of an address in the installed memory). The name of a defined memory area (the memory area name) is used to reference a segment location directive. Up to 100 memory areas can be defined, including the default memory area.

[Syntax]

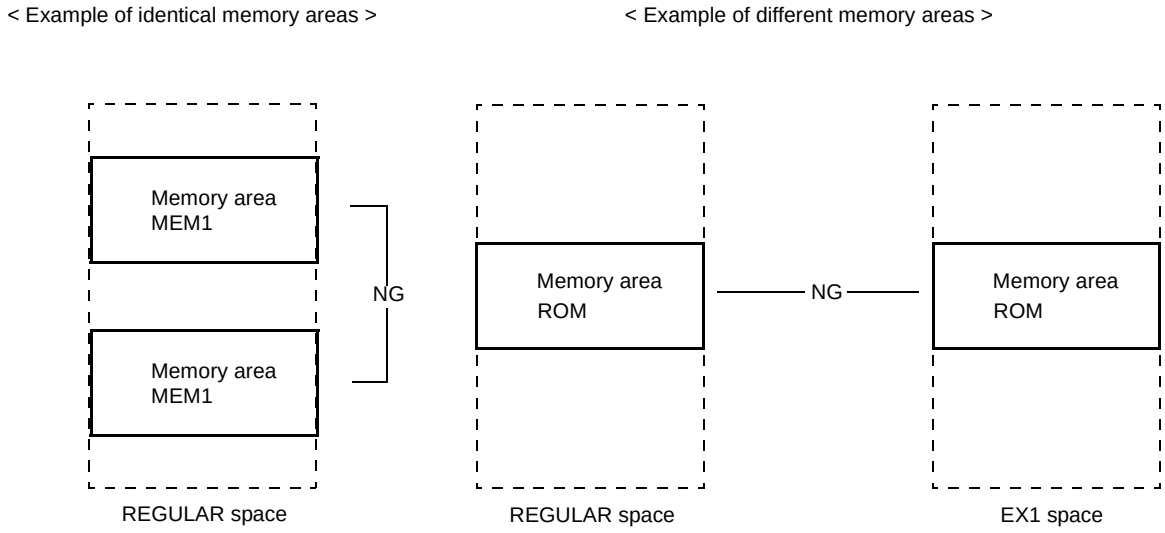
MEMORY Δ memory-area-name Δ : Δ (Δ start-address-value Δ , Δ sizeΔ) [/ Δ memory-space-name]

(1) Memory area names

Specify a name for the defined memory area. Conditions for specification of memory area names are as follows.

- The characters which can be used to describe a memory area name are A-Z, a-z, 0-9, _, ?, and @. However, a memory area name cannot begin with 0-9.
- Uppercase and lowercase characters are interpreted as separate characters.
- Uppercase and lowercase characters can be mixed together.
- Maximum length of a memory area name is 31 characters. If 32 or more characters are described, an error results.
- Each memory area name must exist in only 1 location in the entire memory space. The same memory area name cannot be used for a different memory area, even if they are in different memory spaces.

Figure 6-1 Memory Area Names



(2) Start addresses

Specify the start address of the memory area to be defined.

Describe a numerical value from 0H to FFFFFH.

(3) Size

Specify the size of the memory area to be defined. Specification conditions are as follows.

- Describe a numerical value of 1 or higher.
- If the size specification is changed to the default memory area size defined by the linker, limitations on the definable range apply.

For the default memory area size defined for each device and the redefinable range for each device, see the "Notes on Use" for each device file.

(4) Memory space names

The following 16 memory space names are displayed for 16 memory spaces of 64 KB each.

REGULAR, EX1, EX2, EX3, EX4, EX5, EX6, EX7, EX8, EX9, EX10, EX11, EX12, EX13, EX14, EX15

Use memory space names to assign a memory area to a particular memory space. The following conditions on specification of memory space names apply.

- Memory space names must be specified entirely in uppercase characters.
- When a memory space name is omitted, REGULAR is assumed to be specified.
- If the memory space name is omitted after "/" is written, an error occurs.

[Function]

- Define a specified memory space for a memory area specified with a memory area name.
- 1 memory area can be defined with 1 memory directive.
- A memory directive can be specified more than once. However, multiple definitions in the specified order will result in an error.
- The default memory area is effective as long as the same memory area is not redefined in a memory directive. If the specification of a memory directive is omitted, only the default memory area carried by the linker for each device will be specified.
- If you wish to use a different memory area without using the default memory space, specify the size of the default area name as "0".

[Example of Use]

- Define the addresses 0H to 1FFH in the memory space (EX1) as ROMA.

```
MEMORY ROMA : ( 0H , 200H ) / EX1
```

6.4.3 Segment location directives

A segment location directive is a directive which locates a specified segment in a specified area of memory or a specific address.

[Syntax]

MERGE Δ segment-name Δ : Δ [AT Δ (Δ start-address Δ)] [Δ = Δ memory-area-name] [Δ / Δ memory-space-name]

(1) Segment name

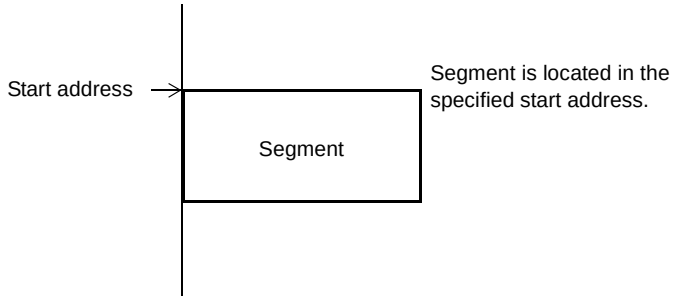
The segment name is the name of a segment included in an object module file input to the linker.

- Only an input segment can be specified with a segment name.
- The segment name must be specified in the same way as in the source.

(2) Start address

The start address allocates a segment to the area specified by "start address."

- The reserved word AT must be specified entirely in either uppercase or lowercase characters. It cannot be specified in a mixture of uppercase and lowercase characters.
- The start address specifies a numerical constant.



Cautions 1. When a segment is located in the specified start address, if it exceeds the memory area range for the memory area in which it is located, an error will result.

Cautions 2. A link directive cannot be used to specify a start address for a segment whose location address is specified by the AT instruction of a segment directive or by an ORG directive.

(3) Memory space names

A memory space name specifies the memory area to which a segment is allocated.

- Any of the following 16 names can be specified as a memory area name.
  REGULAR, EX1, EX2, EX3, EX4, EX5, EX6, EX7, EX8, EX9, EX10, EX11, EX12, EX13, EX14, EX15
- Memory space names must be specified entirely in uppercase characters.
- When a memory space name is omitted, REGULAR is assumed to be specified.

Segment location destinations are determined as follows.

Table 6-4 Segment Location According to Combination of Memory Area Name Specification and Memory Space Name

Memory Area Name	Memory Space Name	Segment Location Destination
No specification	No specification	Default memory area in the REGULAR space
No specification	Memory space name	A selected memory area in the specified memory space
Memory area name	No specification	Specified memory area in the REGULAR space
Memory area name	Memory space name	Specified memory area in the specified memory space

This table focuses on defining the memory area to which the segment is located. When the actual location address is determined, if [AT (start address)] is specified, the segment is allocated to a location beginning at that address.

For example, if the memory space name "EX1" is specified for a segment with the relocation characteristic "CSEG.FIXED", the segment will be located to fit within 800H to FFFH.

[Notice]

- The location address of an input segment for which no segment location directive is specified will be determined according to the relocation characteristics specified by a segment definition directive during assembly.
- If no segment exists for which a segment name has been specified, an error will occur.
- If more than one segment location directive is specified for the same segment, an error will occur.

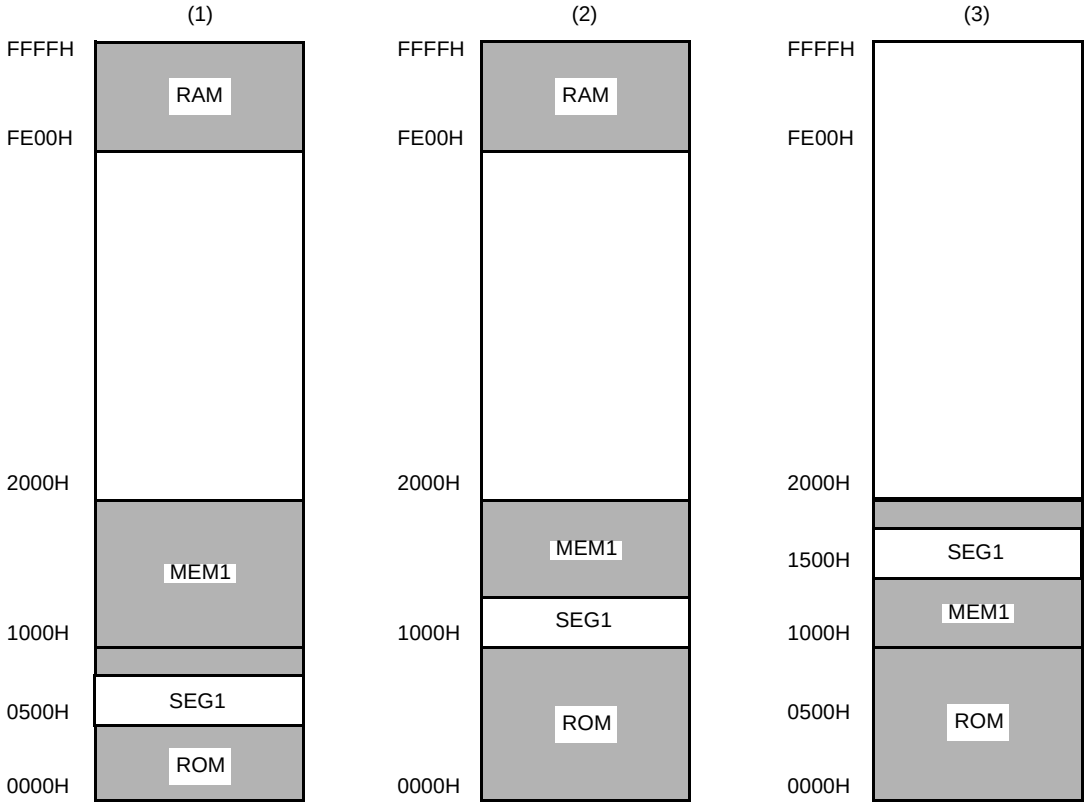
[Example of Use]

- Allocate an address for a segment SEG1, which has the segment type and relocation characteristic "CSEG UNIT". In this example the declared memory area is as follows.

```
MEMORY ROM : ( 0000H , 1000H )
MEMORY MEM1 : ( 1000H , 2000H )
MEMORY RAM : ( 0FE00H , 200H )
```

  - When input segment SEG1 is allocated to 500H in memory area ROM (refer to Figure 6-2 (1)).
    MERGE SEG1 : AT (500H)
  - When input segment SEG1 is allocated to memory area MEM1 (refer to Figure 6-2 (2)).
    MERGE SEG1 : =MEM1
  - When input segment SEG1 is allocated to 1500H in memory area MEM1 (refer to Figure 6-2 (3)).
    MERGE SEG1 : AT (1500H)=MEM1

Figure 6-2 Specific Examples of Segment Allocation



6.5 Linker Startup

6.5.1 Linker startup

The following 2 methods can be used to start up the linker.

(1) Startup from the command line

```
X>[ path-name ] lk78k0 [ Δ option ] ... object-module-file-name [ Δ option ] ... [ Δ ]
 ↑      ↑       ↑      ↑                    ↑                  ↑
(a)    (b)     (c)    (d)                  (e)                (d)
```

(a) Current drive name

(b) Current directory name

(c) Linker command file name

(d) This contains detailed directions for the action of the linker.

If more than one linker option is specified, separate the options with a space.

Enclose a path that includes a space in a pair of double quotation marks (" ").

(e) This contains detailed directions for the action of the linker.

A maximum of 1024 items can be input in an input module.

Specify the file name of a path that includes a space by enclosing it in a pair of double quotation marks (" ").

Example C>lk78k0 k0main.rel k0sub.rel -ok0.lmf -g

(2) Startup from a parameter file

Use the parameter file when the data required to start up the linker will not fit on the command line, or when repeating the same linker option for two or more assembly operations.

To start up the linker from a parameter file, specify the parameter file specification option (-F) on the command line.

Start up the linker from a parameter file as follows.

```
X>LK78K0 [ Δ object-module-file] Δ -f parameter-file-name
                                    ↑          ↑
                                   (a)        (b)
```

(a) Parameter file specification option

(b) A file which includes the data required to start up the linker

Remark An editor is used to create the parameter file.

The rules for writing the contents of a parameter file are as follows.

```
[ [ [ Δ ] option [ Δ option] ... [ Δ ] Δ ] ] ...
```

- If the object module file name is omitted from the command line, specify the object module file name in the parameter file.
- The object module file name can also be written after the option.
- Write in the parameter file all linker options and output file names that should be specified in the command line.

Example Create the parameter file (k0.plk) using an editor.

< Contents of the parameter file k0.plk >

```
; parameter file
k0main.rel k0sub.rel -ok0.lmf -pk0.map -e
-tc:\tmp
```

Use parameter file k0.plk to start up the linker.

```
C>lk78k0 -fk0.plk
```

6.5.2 Execution start and end messages

(1) Execution start message

When the linker is started up, an execution startup message appears on the display.

```
78K/0 Series Linker Vx.xx [ xx xxx xx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx
```

(2) Execution end message

If it detects no link errors resulting from the link, the linker outputs the following message to the display and returns control to the operating system.

```
Target chip : uPD78xxx
 Device file : Vx.xx

Link complete ,       0 error ( s ) and       0 warning ( s ) found.
```

If it detects a link error resulting from the link, the linker outputs the error number to the display and returns control to the operating system.

```
Target chip : uPD78xxx
 Device file : Vx.xx

Link complete ,       1 error ( s ) and       0 warning ( s ) found.
```

If the linker detects a fatal error during linking which makes it unable to continue link processing, the linker outputs a message to the display, cancels linking and returns control to the operating system.

Example 1 A non-existent object module file is specified.

```
C>lk78k0 samp1.rel samp2.rel
```

```
78K/0 Series Linker Vx.xx [ xx xxx xx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

RA78K0 error F3006 : File not found ' SAMP1.REL '
RA78K0 error F3006 : File not found ' SAMP2.REL '
Program Aborted.
```

In the above example, a non-existent object module file is specified. An error results and the linker aborts the link.

Example 2 A non-existent linker option is specified.

```
C>lk78k0 k0main.rel k0sub.rel -z
```

```
78K/0 Series Linker Vx.xx [ xx xxx xx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

RA78K0 error F3018 : Option is not recognized ' -z '
Please enter ' LK78K0 -- ' , if you want help messages.
Program Aborted.
```

In the above example, a non-existent linker option is specified. An error results and the linker aborts the link.

When an error message is displayed and link is aborted, look for the cause in "CHAPTER 12 ERROR MESSAGES" and take action accordingly.

6.6 Linker Options

6.6.1 Types of linker options

The linker options are detailed instructions for the operation of the linker. Linker options are classified into 19 types.

Table 6-5 Linker Options

Classification	Option	Explanation
Load module file output specification	-O	Specifies the output of a load module file.
	-NO	
Forced load module file output specification	-J	Forces output of a load module file.
	-NJ	
Debug data output specification	-G	Outputs debugging data to a load module file.
	-NG	
Generation of stack decision symbols specification	-S	Automatically generates public symbols for stack decision.
	-NS	
Directive file specification	-D	Inputs the specified file as a directive file.
Link list file output specification	-P	Specifies output of a link list file.
	-NP	
Link list file data specification	-KM	Outputs a map list into a link list file.
	-NKM	
	-KD	Outputs a link directive file into a link list file.
	-NKD	
	-KP	Outputs a public symbol list into a link list file.
	-NKP	
	-KL	Outputs a local symbol list into a link list file.
	-NKL	
Link list format specification	-LL	Changes the number of lines that can be printed in 1 page in a link list file.
	-LF	Inserts a page feed code at the end of a list file.
	-NLF	
Error list file output specification	-E	Outputs an error list file.
	-NE	
Library file specification	-B	Inputs the specified file as a library file.
Library file read path specification	-I	Reads a library file from a specified path.
Parameter file specification	-F	Inputs file names and options from a specified file.

Table 6-5 Linker Options

Classification	Option	Explanation
Specification of path for temporary file creation	-T	Creates a temporary file in a specified path.
Device file search path specification	-Y	Reads a device file from a specified path.
Warning message output specification	-W	Specifies whether or not to output a warning message to the console.
Link specification of boot area ROM program of flash ROM model	-ZB	Specifies the first address of the flash ROM area.
On-chip debug program size specification	-GO	Specifies the on-chip debug program size.
Security ID specification	-GI	Specifies a security ID.
Help specification	--	Displays a help message on the display.

6.6.2 Order of precedence of linker options

The following table indicates which linker option takes precedence when two linker options are specified at the same time.

Table 6-6 Order of Precedence of Linker Options

	-NO	-NG	-NP	-NKM	-NKP	-NKL	--
-J	NG						NG
-G	NG						NG
-P				Δ	Δ	Δ	NG
-KM			NG				NG
-KD			NG	NG			NG
-KP		NG	NG				NG
-KL		NG	NG				NG
-LL			NG				NG
-LF			NG				NG

[Items marked with an NG]

When the option in the horizontal axis is specified, the option shown in the vertical axis option is unavailable.

Example C>lk78k0 k0main.rel k0sub.rel -np -km

The option -KM is unavailable.

[Items marked with a Δ]

When all three of the options in the horizontal axis are specified, the option shown in the vertical axis option is unavailable.

Example C>lk78k0 k0main.rel k0sub.rel -p -nkm -nkp -nkl

The options -NKM, -NKP, and -NKL are all specified at the same time, so option -P is unavailable.

When an option and its "N" counterpart are specified at the same time (for example, both -O and -NO), only the last specified of the 2 options is available.

Example C>lk78k0 k0main.rel k0sub.rel -o -no

The option -NO is specified after -O, so option -O is unavailable and -NO is available.

Options not specified in Table 6-6 have no particular effect on other options. However, when the help option (--) is specified, all other options become unavailable.

6.6.3 Explanation of linker options

This section contains detailed explanations of each linker option.

(1) Load module file output specification

Load module file output specification (-O/-NO)

[Syntax]

```
-O [ output-file-name ]
-NO
```

- Default assumption

  -O input-file-name.lmf

[Function]

- Option -O specifies the output of a load module file. It also specifies the location to which it is output and the file name.
- Option -NO makes option -O, -J, and -G unavailable.

[Application]

- Use option -O to specify the location to which a load module file is output or to change its file name.
- Specify option -NO when performing a link only to output a link list file. This will shorten link time.

[Explanation]

- The disk type file name and device type file name, NUL and AUX can be specified as output file names.
- Even if option -O is specified, if a fatal error occurs the load module file cannot be output.
- If "output-file-name" is omitted when option -O is specified, the load module file "input-file-name.lmf" will be output to the current directory.
- If only the path name is specified in "output-file-name", "input-file-name.lmf" will be output to the specified path.
- If both options -O and -NO are specified at the same time, the option specified last takes precedence.

[Example of use]

- Output a load module file k0.lmf.

  C>lk78k0 k0main.rel k0sub.rel -ok0.lmf

(2) Forced load module file output specification

Forced load module file output specification (-J/-NJ)

[Syntax]

```
-J
-NJ
```

- Default assumption

  -NJ

[Function]

- Option -J specifies that the load module will be output even if a fatal error occurs.
- Option -NJ makes option -J unavailable.

[Application]

- Normally, when a fatal error occurs, the load module file cannot be output. When you wish to execute the program with a notice that a fatal error has occurred, specify option -J to output the load module file.

[Explanation]

- When option -J is specified, the load module will be output even if a fatal error occurs.
- If both options -J and -NJ are specified at the same time, the option specified last takes precedence.
- If option -NO is specified, option -J is unavailable.

[Example of use]

- Specify output of a load module file even if a fatal error occurs.

  C>lk78k0 k0main.rel k0sub.rel -j

(3) Debug data output specification

Debug data output specification (-G/-NG)

[Syntax]

```
-G
-NG
```

- Default assumption

  -G

[Function]

- Option -G specifies that debugging data (local symbol data) is to be added to a load module file.
- Option -NG makes option -G, -KP, and -KL unavailable.

[Application]

- Be sure to use option -G when performing symbolic debugging with a source debugger.

[Explanation]

- When option -NG is specified, the public symbol list and local symbol list cannot be output.
- If both options -G and -NG are specified at the same time, the option specified last takes precedence.
- If option -NO is specified, option -G is unavailable.

[Example of use]

- Specify addition of debug data to a load module file.

```
C>lk78k0 k0main.rel k0sub.rel -g
```

(4) Generation of stack decision symbols specification

Generation of stack decision symbols specification (-S/-NS)

[Syntax]

```
-S [ area-name ]
-NS
```

- Default assumption

  -NS

[Function]

- Option -S generates the stack decision public symbols "_@STBEG" and "_@STEND".
- Option -NS makes option -S unavailable.

[Application]

- Specify option -S to reserve a stack area.

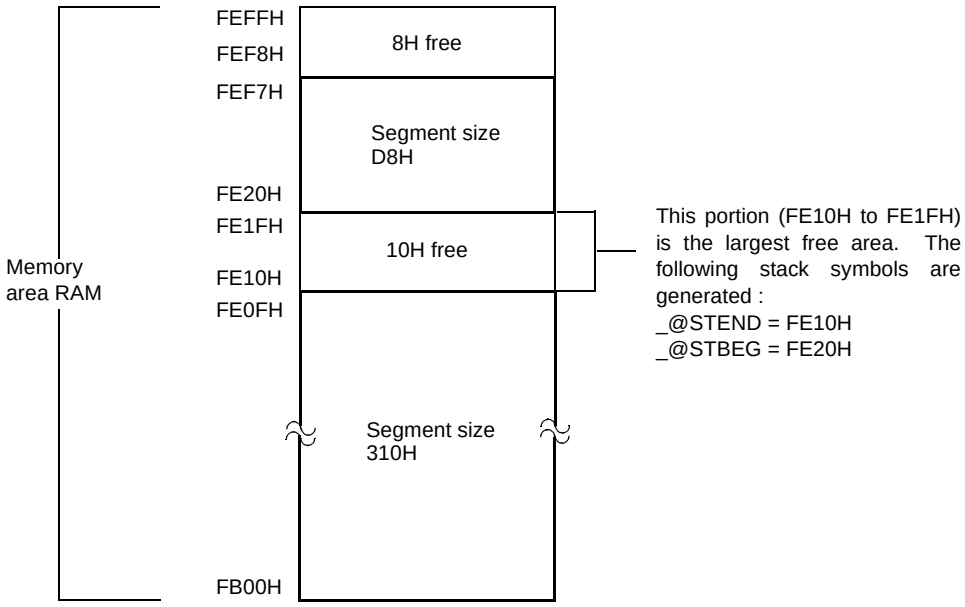
[Explanation]

- An "area-name" is a name in which an area memory name defined by the user or an area memory name defined by default is specified.
- "area-names" distinguish between uppercase and lowercase characters.
- The linker searches the memory area specified by option -S for the largest address in which no segment is located. The linker then generates public symbol "_@STEND", which holds the lead address of the largest address area as its value, and public symbol "_@STBEG", which holds the last address +1 as its value. These symbols are handled as publicly declared NUMBER attribute symbols, and are registered at the end of the linker's symbol table. When these symbols are output to a link list file, the module name column is left blank.
- If the largest open area is 10 bytes or smaller, a warning message is output.
- If no free area exists, a warning message is output and both "_@STEND" and "_@STBEG" hold the last address +1 as their values.
- If "area name" is omitted, "RAM" is specified.
- If both options -S and -NS are specified at the same time, the option specified last takes precedence.

[Example of use]

- Reserve the stack area in memory area RAM (however, the linker will assume that a segment of size 310H in RAM and a segment of size D8H located in the saddr area are input).

C>lk78k0 k0main.rel k0sub.rel -s



(5) Directive file specification

Directive file specification (-D)

[Syntax]

```
-D file-name
```

- Default assumption

  None

[Function]

- Option -D specifies that a specified file is to be input as a directive file.

[Application]

- When you wish to define a new memory area, redefine the default memory area, or locate a segment to a specific address or memory area, you will need to create a directive file. Specify option -D to input this directive file to the linker.

[Explanation]

- Only disk-type file names can be specified as a "file name". If a device-type file name is specified, an abort error will result.
- If the file name is omitted, an abort error will result.
- Nesting of directive files is not permitted.
- The number of characters that can be specified in a directive file is unlimited.
- If option -D is specified more than once, or if more than one file name is specified, an abort error will occur.
- For a detailed explanation of directive files, refer to "6.4 Link Directives".

[Example of use]

- Redefine the default memory area ROM/RAM.

  < Contents of the directive file k0.dr >

```
memory ROM : ( 0000h , 1000h )
memory RAM : ( 0FE20h , 1E0h )
```

  Perform link using k0.dr.

```
C>lk78k0 k0main.rel k0sub.rel -dk0.dr
```

(6) Link list file output specification

Link list file output specification (-P/-NP)

[Syntax]

```
-P [ output-file-name ]
-NP
```

- Default assumption

  -P input-file-name.map

[Function]

- Option -P specifies output of a link list file. It also specifies the destination and file name of the output file.
- Option -NP makes option -P, -KM, -KD, -KP, -KL, -LL, and -LF unavailable.

[Application]

- Specify option -P to change the output destination or output file name of a link list file.
- Specify option -NP when performing link only to output a load module file. This will shorten link time.

[Explanation]

- A file name can be specified as a disk-type file name or as a device-type file name. However, only CON, PRN, NUL, and AUX can be specified as device-type file names. If CLOCK is specified, an abort error will occur.
- If the "output-file-name" is omitted when option -P is specified, the link list file name in the current directory becomes "input-file-name.map".
- If only the "output-file-name" is specified, "input-file-name.map" is output to the specified path.
- If both options -P and -NP are specified at the same time, the option specified last takes precedence.

[Example of use]

- Create a link list file (k0.map).

  C>lk78k0 k0main.rel k0sub.rel -pk0.map

(7) Link list file data specification

Link list file data specification (-KM/-NKM, -KD/-NKD, -KP/-NKP, -KL/-NKL)

(a) -KM/-NKM

[Syntax]

```
-KM
-NKM
```

- Default assumption

  -KM

[Function]

- Option -KM outputs a map list into a link list file.
- Option -NKM makes option -KM unavailable.

[Application]

- Specify option -KM to output a map list to a link list file.

[Explanation]

- If options -NKM, -NKP, and -NKL are all specified, the link list file cannot be output.
- If option -NKM is specified, the link directive file cannot be output to a link list file.
- If both options -KM and -NKM are specified at the same time, the option specified last takes precedence.
- If option -NP is specified, option -KM is unavailable.

[Example of use]

- Output a map list into link list file k0.map.

  C>lk78k0 k0main.rel k0sub.rel -pk0.map -km

  This references k0.map.

78K/0 Series Linker Vx.xx Date : xx xxx xxxx Page : 1

Command:k0main.rel k0sub.rel -pk0.map -km
Para-file :
Out-file : K0MAIN.LMF
Map-file : K0.MAP
Direc-file :
Directive :

*** Link information ***

3 output segment (s)
2FH byte (s) real data
23 symbol (s) defined

*** Memory map ***

SPACE = REGULAR

MEMORY = ROM
BASE ADDRESS = 0000H SIZE = 8000H

	OUTPUT SEGMENT	INPUT SEGMENT	INPUT MODULE	BASE ADDRESS	SIZE	
	CODE			0000H	002H	CSEG AT
	CODE	SAMPM		0000H	0002H	
* gap *			0002H	007EH		
	?CSEG			0080H	0020H	CSEG
		?CSEG	SAMPM	0080H	0013H	
		?CSEG	SAMPS	0093H	001AH	
* gap *				00ADH	7F53H	

MEMORY = LRAM
BASE ADDRESS = FAC0H SIZE = 0020H

	OUTPUT SEGMENT	INPUT SEGMENT	INPUT MODULE	BASE ADDRESS	SIZE
* gap *					

MEMORY = RAM
BASE ADDRESS = FB00H SIZE = 0500H

	OUTPUT SEGMENT	INPUT SEGMENT	INPUT MODULE	BASE ADDRESS	SIZE	
* gap *				FB00H	03H	
	DATA			FE20H	0003H	DSEG AT
		DATA	SAMPM	FE20H	0003H	
* gap *				FE23H	00DDH	
* gap (Not Free Area) *				FF00H	0100H	

Map list

(b) -KD/-NKD

[Syntax]

```
-KD
-NKD
```

- Default assumption

  -KD

[Function]

- Option -KD outputs a link directive file into a link list file.
- Option -NKD makes option -KD unavailable.

[Application]

- Specify option -KD to output a link directive file into a link list file.

[Explanation]

- If options -NKM, -NKP, and -NKL are all specified, a link list file cannot be output.
- If option -NKM is specified, a link directive file cannot be output into a link list file.
- If both options -KD and -NKD are specified at the same time, the option specified last takes precedence.
- If option -NP is specified, option -KD is unavailable.

[Example of use]

- Output a link directive file into a link list file (k0.map).

  C>lk78k0 k0main.rel k0sub.rel -dk0.dr -pk0.map -kd

  This references k0.map.

```
78K/0 Series Linker Vx.xxDate:xx xxx xxxx Page :   1

Command : k0main.rel k0sub.rel -dk0.dr -pk0.map -kd
Para-file :
Out-file : K0MAIN.LMF
Map-file : K0.MAP
Direc-file : K0.DR                                  <-- Directive file name
Directive : memory ROM : ( 0h , 4000h )             <-- Contents of directive file
            memory RAM : ( 0fe20h , 1000h )

*** Link information ***

          3         output segment ( s )
          48H       byte ( s ) real data
          23        symbol ( s ) defined

*** Memory map ***

          SPACE = REGULAR

          MEMORY = ROM
          BASE ADDRESS = 0000H      SIZE = 1000H
                    OUTPUT          INPUT           INPUT           BASE    SIZE
                    SEGMENT         SEGMENT         MODULE          ADDRESS
                    CODE                                            0000H   0002H   CSEG AT
                       :
```

(c) -KP/-NKP

[Syntax]

```
-KP
-NKP
```

- Default assumption

  -NKP

[Function]

- Option -KP outputs a public symbol list into a link list file.
- Option -NKP makes option -KP unavailable.

[Application]

- Specify option -KP to output a public symbol list into a link list file.

[Explanation]

- If options -NKM, -NKP, and -NKL are all specified, the link list file cannot be output.
- If options -NG is specified, the public symbol list cannot be output.
- If both options -KP and -NKP are specified at the same time, the option specified last takes precedence.
- If option -NP is specified, option -KP is unavailable.

[Example of use]

- Output a public symbol list into a link list file (k0.map).

  C>lk78k0 k0main.rel k0sub.rel -g -pk0.map -kp

  This references k0.map.

```
78K/0 Series Linker Vx.xx                                Date : xx xxx xxxx Page :   1

Command : k0main.rel k0sub.rel -g -pk0.map -kp
Para-file :
Out-file : K0MAIN.LMF
Map-file : K0.MAP
Direc-file :
Directive :

*** Link information ***

          3         output segment ( s )
          2FH       byte ( s ) real data
          23        symbol ( s ) defined

*** Memory map ***

          SPACE = REGULAR

          MEMORY = ROM
          BASE ADDRESS = 0000    SIZE = 8000H
             :

--------------------------------------------------------------------------------

78K/0 Series Linker Vx.xx                              Date:xx xxx xxx Page :   2

*** Public symbol list ***
MODULE          ATTR    VALUE   NAME

SAMPM           ADDR    0000H   MAIN
SAMPM           ADDR    0080H   START
SAMPS           ADDR    0093H   CONVAH

 Target chip : uPD78xxx
 Device file : Vx.xx
```

Public symbol list

(d) -KL/-NKL

[Syntax]

```
-KL
-NKL
```

- Default assumption

  -NKL

[Function]

- Option -KL outputs a local symbol list into a link list file.
- Option -NKL makes option -KL unavailable.

[Application]

- Specify option -KL to output a local symbol list into a link list file.

[Explanation]

- If options -NKM, -NKP, and -NKL are all specified, the link list file cannot be output.
- If options -NG is specified, the local symbol list cannot be output.
- If both options -KL and -NKL are specified at the same time, the option specified last takes precedence.
- If option -NP is specified, option -KL is unavailable.

[Example of use]

- Output a local symbol list into a link list file (k0.map).

  C>lk78k0 k0main.rel k0sub.rel -g -pk0.map -kl

  This references k0.map.

```
78K/0 Series Linker Vx.xx                                  Date:xx xxx xxxx Page :   1

Command:k0main.rel k4sub.rel -g -pk0.map -kl
Para-file :
Out-file : K0MAIN.LMF
Map-file : K0.MAP
Direc-file :
Directive :

*** Link information ***

          3        output segment ( s )
          2FH      byte ( s ) real data
          23       symbol ( s ) defined

*** Memory map ***

          SPACE = REGULAR
            :
--------------------------------------------------------------------------------

78K/0 Series Linker Vx.xx                                  Date:xx xxx xxx Page :   2

*** Local symbol list ***
MODULE          ATTR            VALUE   NAME

SAMPM           MOD                     SAMPM
SAMPM           DSEG                    DATA
SAMPM           ADDR            FE20H   HDTSA
SAMPM           ADDR            FE21H   STASC
SAMPM           CSEG                    CODE
SAMPM           CSEG                    ?CSEG
SAMPS           MOD                     SAMPS
SAMPS           CSEG                    ?CSEG
SAMPS           ADDR            00A4H   SASC
SAMPS           ADDR            00AAH   SASC1

 Target chip : uPD78xxx
 Device file : Vx.xx
```

Local symbol list

(8) Link list format specification

Link list format specification (-LL, -LF/-NLF)

(a) -LL

[Syntax]

-LL [number-of-lines]

- Default assumption

  -LL66 (No page breaks in the case of display output)

[Function]

- Option -LL changes the number of lines that can be printed in 1 page in a link list file.

[Application]

- Specify option -LL to change the number of lines that can be printed in 1 page in a link list file.

[Explanation]

- The range of number of lines that can be specified with option -LL is shown below.

  20 ≤ number of lines printed on 1 page ≤ 32767

  If a numerical value outside this range, or something other than a numerical value, is specified, an abort error occurs.
- If the number of lines is omitted, 66 will be specified.
- If the number of lines specified is 0, no page breaks will be made.
- If option -NP is specified, option -LL is unavailable.

[Example of use]

- Specify 20 as the number of lines per page in a link list file.

  C>lk78k0 k0main.rel k0sub.rel -pk0.map -ll20

  This references k0.map.

```
78K/0 Series Linker Vx.xx                                   Date : xx xxx xxxx Page :   1

Command:k0main.rel k0sub.rel -pk0.map -ll20
Para-file :
Out-file : K0MAIN.LMF
Map-file : K0.MAP
Direc-file :
Directive :

*** Link information ***

          3         output segment ( s )
          2FH       byte ( s ) real data

--------------------------------------------------------------------------------

78K/0 Series Linker Vx.xxDate:xx xxx xxxx Page :   2

          23 symbol ( s ) defined

*** Memory map ***

 SPACE = REGULAR

 MEMORY = ROM
 BASE ADDRESS = 0000H      SIZE = 8000H
          OUTPUT          INPUT           INPUT           BASE            SIZE
          SEGMENT         SEGMENT         MODULE          ADDRESS

--------------------------------------------------------------------------------

78K/0 Series Linker Vx.xx                                   Date : xx xxx xxxx Page :   3
          CODE                            0000H   00000002H    CSEG AT
                          CODE            SAMPM           0000H           00000002H
* gap *                                                   0002H           0000007EH
          ?CSEG                                           0080H           00000046H  CSEG
                          ?CSEG           SAMPM           0080H           0000002AH
                          ?CSEG           SAMPS           0093H           0000001CH
* gap *                                                   00ADH           0000FF3AH

 MEMORY = LRAM
 BASE ADDRESS = FAC0H      SIZE = 0020H
          OUTPUT          INPUT   INPUT   BASE    SIZE
             :
```

(b) -LF/-NLF

[Syntax]

```
-LF
-NLF
```

- Default assumption

  -NLF

[Function]

- Option -LF inserts a form feed (FF) code at the end of a link list file.
- The option -NLF makes the option -LF unavailable.

[Application]

- If you wish to add a page break after the contents of a link list file are printed, specify option -LF to add a form feed code.

[Explanation]

- If option -NP is specified, option -LF is unavailable.
- If both options -LF and -NLF are specified at the same time, the option specified last takes precedence.

[Example of use]

- Add a form feed code at the end of a link list file.

```
C>lk78k0 k0main.rel k0sub.rel -pk0.map -lf
```

(9) Error list file output specification

Error list file output specification (-E/-NE)

[Syntax]

```
-E [ file-name ]
-NE
```

- Default assumption

  -NE

[Function]

- Specify option -E to specify the output destination and file name of an error list file.
- Option -NE makes option -E unavailable.

[Application]

- Specify option -E to change the output destination and output file name of the error list file.

[Explanation]

- The file name of the error list file can be specified as a disk-type file name or as a device-type file name. However, if the device-type file name CLOCK is specified, an abort error will occur.
- When option -E is specified and the output file name is omitted, the error list file name will be "input-file-name.elk".
- When option -E is specified and the drive name is omitted, the error list file will be output to the current drive.
- If both options -E and -NE are specified at the same time, the option specified last takes precedence.

[Example of use]

- Create an error list file (k0.elk).

  C>lk78k0 k0main.rel k0sub.rel -dk0.dr -ek0.elk

  An error has occurred in the contents of the directive file. k0.elk is referenced.

```
K0.DR ( 3 ) : RA78K0 error E3102: Directive syntax error
```

(10) Library file specification

Library file specification (-B)

[Syntax]

-B file-name

- Default assumption

  None

[Function]

- Option -B specifies a file to be input as a library file.

[Application]

- The linker retrieves the module referenced by the input module from a library file and joins only that module to the input module.
- The purpose of a library file is to register two or more modules in a single file.
- By creating library files that can be used in common with many programs, file management and operation become easier and more efficient. Specify option -B to input a library file to the linker.

[Explanation]

- Only a disk-type file name can be specified as the file name.
- The file name cannot be omitted.
- If a file name which includes a path name is specified, a library file will be input from that path. If no library file exists in the specified path, an error occurs.
- If a file name which does not include a path name is specified, a library file will be input from a path specified by option -I or from the default search path.
- If option -B is specified two or more times, a library file will be input in a specified sequence. Up to 10 -B options may be specified.

  Caution When specifying two or more libraries in the < Linker Options > dialog box in PM plus, delimit them with commas (,).

- For a detailed explanation of the method of creating library files, refer to "CHAPTER 8 LIBRARIAN".

[Example of use]

- Input a library file (k0.lib).
  (k0sub.rel is registered in the library file).

  C>lk78k0 k0main.rel -bk0.lib

(11) Library file read path specification

Library file read path specification (-l)

[Syntax]

-l path-name [, path-name] ... (two or more path names can be specified)

- Default assumption

  Path specified by environmental variable "LIB78K0"

  Current path, if no path is specified

[Function]

- Option -l specifies input of a library file from a specified path.

[Application]

- Use option -l to retrieve a library file from a certain path.

[Explanation]

- Option -l is only available when a library file name is specified by option -B without including a path name.
- Two or more specifications of -l are possible. Two or more paths can be specified by separating them with ",". A blank space cannot be inserted before or after the ",".
- Up to 10 path names can be specified per link. When two or more path names are specified, the linker searches for library files in the specified order.
- Even if no library file exists in the specified path, an error will not result.
- If the path name is omitted, an abort error occurs.
- If a library file is specified by option -B without including a path name, the linker will search paths in the following sequence.

  (i) Path specified by option -l

  (ii) Path specified by environmental variable "LIB78K0".

  (iii) The current path

  If a library file with the specified name is not found in any of these paths, an error will occur.

[Example of use]

- Search for a library file file from path c:\libB.

  C>lk78k0 k0main.rel k0sub.rel -bk0.lib -ic:\lib

(12) Parameter file specification

Parameter file specification (-F)

[Syntax]

-F file-name

- Default assumption

  With no input file.

[Function]

- Option -F specifies input of linker options and the input file name from a specified file.

[Application]

- Specify option -F when the data required to start up the linker will not fit on the command line. When you wish to repeatedly specify the same options each time assembly is performed, specify those options in a parameter file and specify option -F.

[Explanation]

- Only a disk-type file name can be specified as "file-name". If a device-type file name is specified, an abort error will occur.
- If the file name is omitted, an abort error will occur.
- Nesting of parameter files is not permitted. If option -F is specified within a parameter file, an abort error will occur.
- The number of characters that can be written within a parameter file is unlimited.
- Separate options or file names with a blank space, a tab or a line feed code (LF).
- Options and input file names written in a parameter file will be expanded at the position specified for the parameter file on the command line.
- The expanded options specified last will take precedence.
- The characters following ";" or "#" in a parameter file are all assumed to be comments, up to the line feed code (LF) or EOF.
- If option -F is specified two or more times, an abort error will occur.

[Example of use]

- Perform link using a parameter file.

< contents of the parameter file (k0.plk) >

```
; parameter file
k0main.rel k0sub.rel -ok0.lmf -pk0.map -e
-tc:\tmp -g
```

Enter the following on the command line.

```
C>lk78k0 -fk0.plk
```

(13) Specification of path for temporary file creation

Specification of path for temporary file creation (-T)

[Syntax]

-T path-name

- Default assumption

  Creates a temporary file in the path specified by the environmental variable "TMP".

  When no path is specified, the temporary file is created in a current path.

[Function]

- Option -T specifies a path in which a temporary file is created.

[Application]

- Use option -T to specify the location for creation of a temporary file.

[Explanation]

- Only a path can be specified as a path name.
- The path name cannot be omitted.
- Even if a previously created temporary file exists, if the file is not protected it will be overwritten.
- As long as the required memory size is available, the temporary file will be expanded in memory. If not enough memory is available, the contents of the temporary file will be written to a disk. Such temporary files may be accessed later through the saved disk file.
- Temporary files are deleted when assembly is finished. They are also deleted when assembly is aborted by pressing (CTRL-C).
- The path in which the temporary file is to be created is determined according to the following sequence.

  (i) The path specified by option -T

  (ii) The path specified by environmental variable TMP (when option -T is omitted)

  (iii) The current path (when TMP is not set)

  When (i) or (ii) is specified, if the temporary file cannot be created in the specified path an abort error occurs.

[Example of use]

- Specify output of a temporary file to directory "TMP".

```
C>lk78k0 k0main.rel k0sub.rel -t\tmp
```

(14) Device file search path specification

Device file search path specification (-Y)

[Syntax]

-Y path-name

- Default assumption

  Device files will be read from the path determined in the following order.

  (i) <..\dev> (for the lk78k0.exe startup path)

  (ii) Path by which LK78K0 was started up

  (iii) Current directory

  (iv) The environmental variable PATH

[Function]

- Reads a device file from the specified path.

[Application]

- Specify a path where a device file exists.

[Explanation]

- If anything other than a path name is specified after option -Y, an abort error occurs.
- If the path name is omitted after option -Y, an abort error occurs.
- The path from which the device file is read in the order determined as follows.

  (i) Path specified by option -Y

  (ii) <..\dev> (for the lk78k0.exe startup path)

  (iii) Path by which LK78K0 was started up

  (iv) Current directory

  (v) The environmental variable PATH

[Example of use]

- Specify the path for the device file as directory c:\78k0\dev

```
C>lk78k0 k0main.rel k0sub.rel -yc:\78k0\dev
```

(15) Warning message output specification

Warning message output specification (-W)

[Syntax]

-W [level]

- Default assumption

  -W1

[Function]

- Option -W specifies whether or not a warning message is output to the console.

[Application]

- Specify the level at which a warning message will be output

[Explanation]

- If anything other than a level is specified following the -W option, an abort error occurs.
- Only levels 0, 1 and 2 can be specified.
- The following output levels are available :

  0 : No warning message is output.

  1 : Normal warning message is output.

  2 : Detailed warning message is output.

  For a detailed explanation conditions under which warnings are output, refer "12.4 Linker Error Messages".

[Example of use]

- Specify level 2 in option -W.

  ```
  C>lk78k0 k0main.rel k0sub.rel -w2
  ```

(16) Link specification of boot area ROM program of flash ROM model

Link specification of boot area ROM program of flash ROM model (-ZB)

[Syntax]

-ZB

- Default assumption

  No link specification

[Function]

- Specifies the first address of the flash ROM area.

[Explanation]

- Specifies linking of the boot area ROM program of a flash ROM model and the first address of the flash ROM area.
- If no address is specified, an error occurs.

  Caution Do not specify this option for a device that does not have a flash memory area self-programming function.

[Example of use]

```
C>lk78k0 k0main.asm -zb2000h
```

(17) On-chip debug program size specification

On-chip debug program size specification (-GO)

[Syntax]

-GO [size]

- Default assumption

  On-chip debug is not used.

[Function]

- Specifies whether on-chip debug is used or not.

[Application]

- Specify the -GO option to change the on-chip debug program size.

[Explanation]

- If anything other than a numeric value is specified, an abort error occurs.
- If no program size is specified, 256 bytes are assumed.
  For details of the program size, refer to the document supplied with the ID78K0.
- If the -GO option is specified, no segment can be allocated to addresses 02H to 03H and 84H, and in an area of specified program size +1 that starts from address 8FH.
- If this option is specified for a device that does not have an on-chip debug function, an error occurs.

[Example of use]

- Allocate addresses 8FH to 18FH (256 bytes + 1 byte) as the program allocation area for on-chip debugging.

  C>lk78k0 k0main.rel -go256

(18) Security ID specification

Security ID specification (-GI)

[Syntax]

-GI security ID

- Default assumption

  A security ID is not set.

[Function]

- Specifies a security ID.

[Application]

- Specify the -GI option to set a security ID.

[Explanation]

- Specify a hexadecimal value that ends with "H". If any other value is specified, an abort error occurs.
- Specify a security ID within 10 bytes. If the specified security ID falls short of 10 bytes, the higher bits are filled with 0.
- The security ID is set at addresses 85H to 8EH. If a security ID is set, no segment can be located at addresses 85H to 8EH.
- If this option is specified for a device that does not have a security ID function, an error occurs.
- A security ID can also be specified by defining the following relocation attribute segment in the assembler source. However, be sure to specify SECUR_ID as the relocation attribute of the segment.

```
[ Any segment name ]    CSEG    SECUR_ID
                        DB      11H
                        DB      22H
                        DB      33H
                        DB      44H
                        DB      55H
                        DB      66H
                        DB      77H
                        DB      88H
                        DB      99H
                        DB      0AAH
```

If specification of the assembler source and specification of this option are made in duplicate, this option takes precedence.

[Caution]

- If this option is not specified for a device that has a security ID function, any code may be allocated.

[Example of use]

- Specify the same "112233445566778899AA" as the specification of the above assembler source.

```
C>lk78k0 k0main.rel -gi112233445566778899aah
```

(19) Help specification

Help specification (--)

[Syntax]

```
--
```

- Default assumption

  No display

[Function]

- Option -- displays a help message on the display.

[Application]

- The help message is a list of explanations of the linker options. Refer to these when executing the linker.

[Explanation]

- When option -- is specified, all other options are unavailable.

  Caution This option cannot be specified on PM plus.

  To reference PM plus help, click the [Help] button in the < Linker Options > dialog box.

[Example of use]

- When option -- is specified, a help message is output on the display.

C>lk78k0 --

```
78K/0 Series Linker Vx.xx [ xx xxx xx ]
   Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

usage:lk78k0 [ option [ ... ] ] input-file [ option [ ... ] ]
The option is as follows ( [ ] means omissible ).
-ffile                : Input option or input-file name from specified file.
-dfile                : Read directive file from specified file.
-bfile                : Read library file from specified file.
-idirectory [ , directory.. ] : Set library file search path.
-o [ file ] / -no     : Create load module file [ with specified name ] / Not.
-p [ file ] / -np     : Create link map file [ with specified name ] / Not.
-e [ file ] / -ne     : Create error list file [ with specified name ] / Not.
-tdirectory           : Set temporary directory.
-km / nkm             : Output map list to link map file / Not.
-kd / -nkd            : Output directive file image to link map file / Not.
-kp / -nkp            : Output public symbol list to link map file / Not.
-kl / -nkl            : Output local symbol list to link map file / Not.
-ll [ page length ]   : Specify link map file lines per page.
-lf / -nlf            : Add Form Feed at end of the link map file / Not.
-s [ memory area ] / -ns   : Create stack symbol [ in specified memory area ] / Not.
-g / -ng              : Output symbol information to load module file / Not.
-ydirectory           : Set device file search path.
-j / -nj              : Create load module file if fatal error occurred / Not.
-w [ n ]              : Change warning level ( n = 0 to 2 ).
-zbaddress            : Create Boot file ( address:flash start address ).
-go [ n ]             : Change On-chip debug program size ( n = 256 to 1024 ).
-giid                 : Set Security ID.
--                    : Show this message.

  Press RETURN to continue ...
DEFAULT ASSIGNMENT : -o -p -ne -km -kd -nkp -nkl -ll66 -nlf -ns -g -nj -w1

directive file usage :
 MEMORY memory-area-name : ( origin-value , size ) [ / memory-space-name ]
 MERGE segment-name : [ location-type-definition ] [ merge-type-definition ]
       [ = memory-area-name] [ / memory-space-name ]

 example : MEMORY ROM : ( 0H , 4000H )
           MEMORY RAMA : ( 0H , 100H ) / EX1
           MERGE CSEG1 : = ROM
           MERGE DSEG1 : AT ( 80H )
```

6.7 Option Settings in PM plus

This section describes the method for setting linker options from PM plus.

6.7.1 Option setting method

The < Linker Options > dialog box is opened if [Linker Options] is selected from the [Tools] menu of PM plus or if the [LK] button on the toolbar is pressed.

Linker options can be set by inputting the required options in this dialog box.

Figure 6-3 < Linker Options > Dialog Box (When << Output1 >> Tab Is Selected)

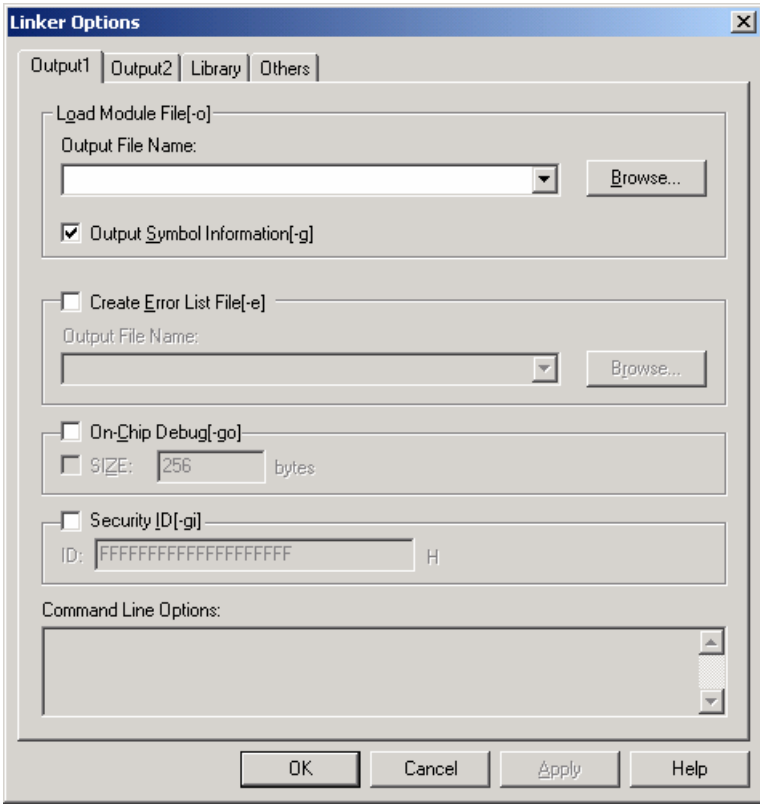


Figure 6-4 < Linker Options > Dialog Box (When << Output2 >> Tab Is Selected)

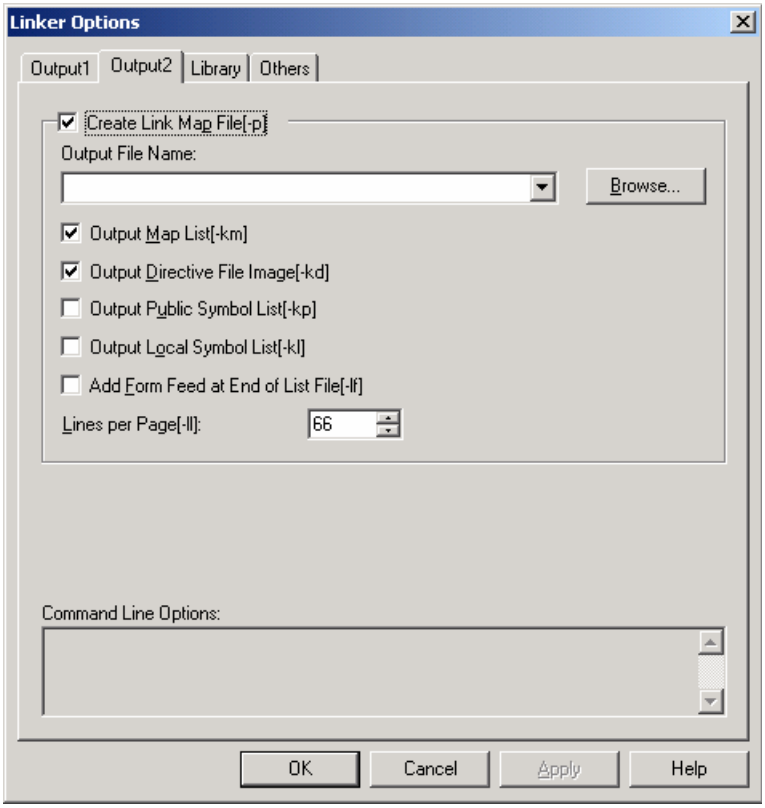


Figure 6-5 < Linker Options > Dialog Box (When << Library >> Tab Is Selected)

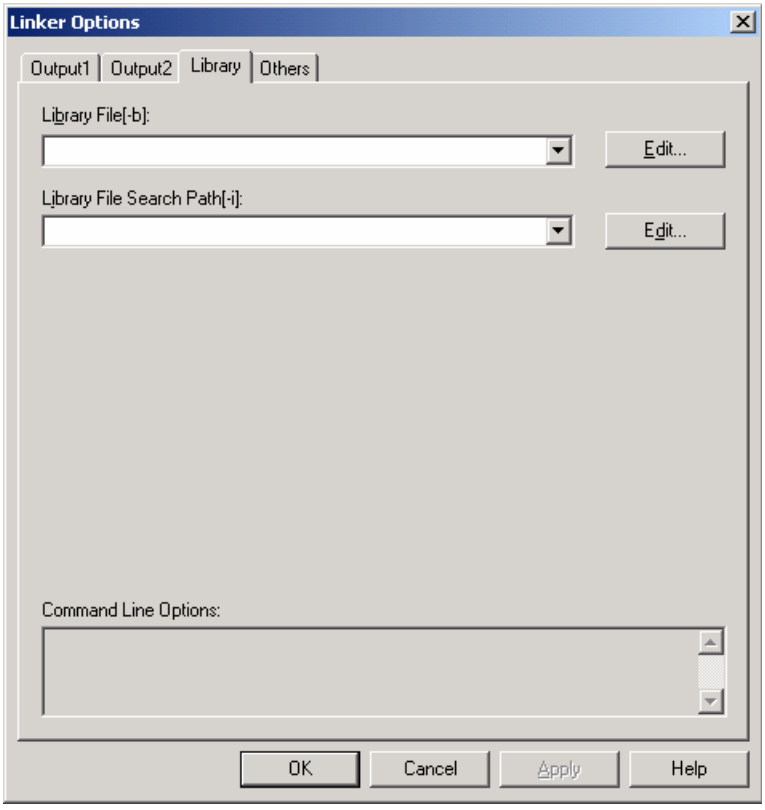
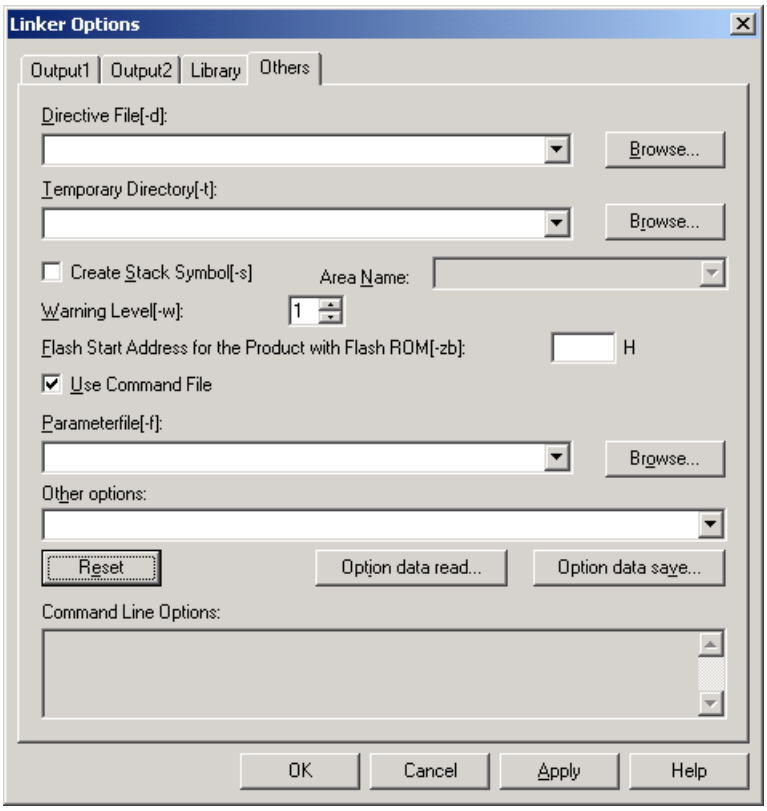


Figure 6-6 < Linker Options > Dialog Box (When << Others >> Tab Is Selected)



6.7.2 Option settings

The various options in the < Linker Options > dialog box are described below.

<< Output1 >>Tab

- Load Module File [-o]

  Output File Name

  Specify the path and file name of the load module file by using the [Browse] button or directly inputting a path and file name.

- Output Symbol Information [-g]

  Check this option to add debug information (local symbol information) to the load module file.

- Create Error List File [-e]

  Check this option to output an error list file.

  Output File Name

  Specify the path name and file name of the error list file by using the [Browse] button or directly inputting a path and file name.

- On-Chip Debug [-go]

  Check this option to use the on-chip debug function.

  SIZE

  Specify the on-chip debug program size.

- Security ID [-gi]

  Check this option to set a security ID.

  ID

  Specify a security ID.

- Command Line Options

  This edit box is read-only. The currently set option character string is displayed.

<< Output2 >> Tab

- Create Link Map File [-p]

  Check this option to output a link list file.

  Output File Name

  Specify the path and file name of the link list file by using the [Browse] button or directly inputting a path and file name.

- Output Map List [-km]

  Check this option to output a map file in the link list file.

- Output Directive File Image [-kd]

  Check this option to output a link directive file in the link list file.

- Output Public Symbol List [-kp]

  Check this option to output a public symbol list in the link list file.

- Output Local Symbol List [-kl]

  Check this option to output a local symbol list in the link list file.

- Add Form Feed at End of List File [-lf]

  Check this option to add a form feed code (FF) to the link list file.

- Lines per Page [-ll]

  Specify the number of lines on one page of the link list file, in a range of 20 to 32767.

- Command Line Options

  This edit box is read-only. The currently set option character string is displayed.

<< Library >> Tab

- Library File [-b]

  Specify a file to be input as a library file by using the [Edit] button or directly inputting a path and file names.

- Library File Search Path [-i]

  Specify the path via which the library file is to be read, by using the [Edit] button or directly inputting a path and file name.

- Command Line Options

  This edit box is read-only. The currently set option character string is displayed.

<< Others >> Tab

- Directive File [-d]

  Specify the file to be input as a directive file by using the [Browse] button or directly inputting a path and file name.

- Temporary Directory [-t]

  Specify the file where a temporary file is to be created by using the [Browse] button or directly inputting a path and file name.

- Create Stack Symbol [-s]

  Check this option to allocate the maximum vacant area of the memory area as a stack area.

- Area Name

  Specify a memory area name defined by the user or the memory area name defined by default.

- Warning Level [-w]

  Specify the warning message output level.

  0 : Don’t output warning message.

  1 : Output normal warning message.

  2 : Output detailed warning message.

- Flash Start Address for the Product with Flash ROM [-zb]

  Specify the boot area start address for products with flash memory.

  Caution Do not specify this option for a device that does not have a flash memory area self-programming function.

- Use Command File

  Check this option to create a command file.

- Parameterfile [-f]

  Specify the file to be input as a user-defined parameter file by using the [Browse] button or directly inputting a file name.

- Other options

  To specify an option other than those that can be set in this dialog box, enter the option in the input box.

  Caution The help specification (--) option cannot be specified on PM plus.

- Reset

  Resets the input contents.

- Option data read

  Opens < Read Option Data > dialog box opens and the option data file is specified, that file is read.

- Option data save

  After the < Save Option Data > dialog box opens, save the option data file to the option data file with a name.

- Command Line Options

  This edit box is read-only. The currently set option character string is displayed.

6.7.3 Edit option dialog box

Items are edited in list format in the < Edit Option > dialog box.

The < Edit Option > dialog box is described below.

Figure 6-7 < Edit Option > Dialog Box

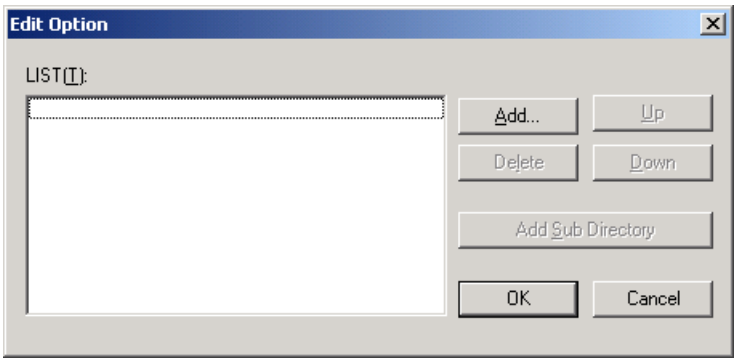
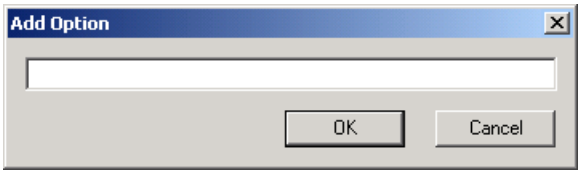


Figure 6-8 < Add Option > Dialog Box



- [Add] button

  Adds a list item.

  If the item to be added is a file or directory, the corresponding < Browse for Folder > dialog box opens.

  In all other cases, the < Add Option > dialog box opens. Specify details of the item to be added in this box.

- [Delete] button

  Deletes the selected list item.

- [Up] button

  Moves the selected list item up.

- [Down] button

  Moves the selected list item down.

- [Add Sub Directory] button

  A subdirectory can be added to the selected list item when the item is specified as Library File Search Path [-i] on the << Library >> Tab.

CHAPTER 7 OBJECT CONVERTER

The object converter inputs the load module file output by the RA78K0 linker (all reference address data must be determined at this point). It then converts this data into hexadecimal format and outputs it as an object module file.

The object converter also outputs the symbol data used for symbolic debugging as a symbol table file.

When an object converter error occurs, an error message appears on the display to clarify the cause of the error.

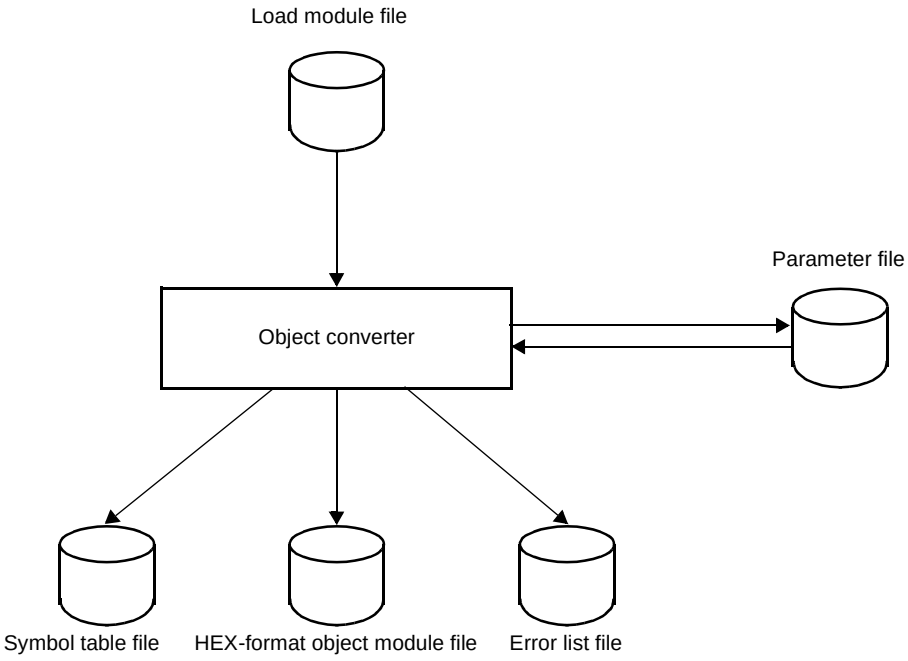
7.1 I/O Files of Object Converter

The I/O files of the object converter are as shown below.

Table 7-1 I/O Files of Object Converter

Type	File Name	Explanation	Default File Type
Input files	Load module files	- These are binary image files of the object codes output as a result of linking. - These files are output by the linker.	.lmf
	Parameter files	- These files contain the parameters for the executed programs. - These files are created by the user.	.poc
Output files	HEX format object module files	- These are files created by converting load module files into hexadecimal object format. - These files are used during mask ROM development and PROM program use.	.hex
	Symbol table files	- These files contain the symbol data included in each module of an input file.	.sym
	Error list files	- These files contain error data from the object conversion.	.eoc

Figure 7-1 I/O Files of Object Converter



7.2 Functions of Object Converter

7.2.1 How the object converter handles extended space

When a code is output to segments located in extended memory space, the object converter generates a separate HEX-format object module file for each space.

To output a separate HEX file to each space, specify the space for both memory and merge directives in the link directive file. For the link directive, refer to "6.4.1 Directive files".

The object converter also generates a symbol table file for each space in extended space when symbols having ADDRESS or BIT attributes are defined for segments located in extended space. All symbols having NUMBER attributes are output to symbol table file generated for normal space.

Table 7-2 shows the file types of the HEX-format object module files and symbol table files generated for extended space.

Table 7-2 Output File Types for Extended Space

File	Normal Spac	Extended Space							
	REGULAR	EX1	EX2	EX3	EX4	…	EX13	EX14	EX15
HEX	.hex	.H1	.H2	.H3	.H4	…	.H13	.H14	.H15
Symbol	.sym	.S1	.S2	.S3	.S4	…	.S13	.S14	.S15

7.2.2 Flash ROM self-rewriting mode support

The object converter can create separate HEX object module files in the boot area and flash area for the code located in the flash ROM when the self-rewriting mode of the flash ROM is used. To output separate HEX files, specify object converter option -ZF. The file type is as follows :

Table 7-3 File Type When -ZF Option Is Specified

File	File Type
Output file at boot area ROM program side	.hxb
Output file at program side other than boot area ROM	.hxf

7.2.3 HEX-format object module files

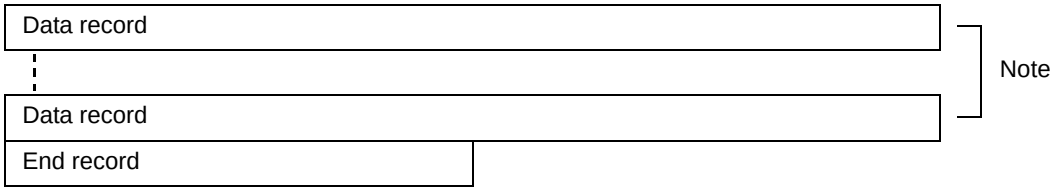
The HEX-format object module file output by the object converter can be input to a HEX loader such as a PROM programmer or a debugger.

The following is a HEX-format object module file of a sample program.

```
: 0200000080007E
: 1000800011201A1620FE9A93001421FE63958462B3
: 1000900095FAFE617131809AA40073617131809A82
: 0D00A000A40072AF4D8D020D070D30AFA8
: 00000001FF
```

[Intel standard HEX-format object module file format]

Figure 7-2 Intel Standard Format



Note The data record is repeated here.

(1) Data record

:	XX	XXXX	00	DD ... DD	SS
↑	↑	↑	↑	↑	↑
(i)	(ii)	(iii)	(iv)	(v)	(vi)

(i) Record mark

Indicates beginning of record.

(ii) Code number (2 digits)

Number of bytes in the code stored in the record. A maximum of 16 bytes can be stored.

(iii) Location address (offset)

The start address (offset) of the code displayed in the record is shown as a 4-digit hexadecimal.

(iv) Record type (2 digits)

Fixed at 00.

(v) Code (Max. 32 digits)

The object code is shown one byte at a time, with the upper 4 bits and lower 4 bits separated. A maximum of 16 bytes can be expressed in the code.

(vi) Check sum (2 digits)

A value is input subtracting in order from 0 which counts down the data from the code number to the code.

(2) End record

:	00	0000	01	FF
↑	↑	↑	↑	↑
(i)	(ii)	(iii)	(iv)	(v)

(i) Record mark

(ii) Code number, fixed at 00

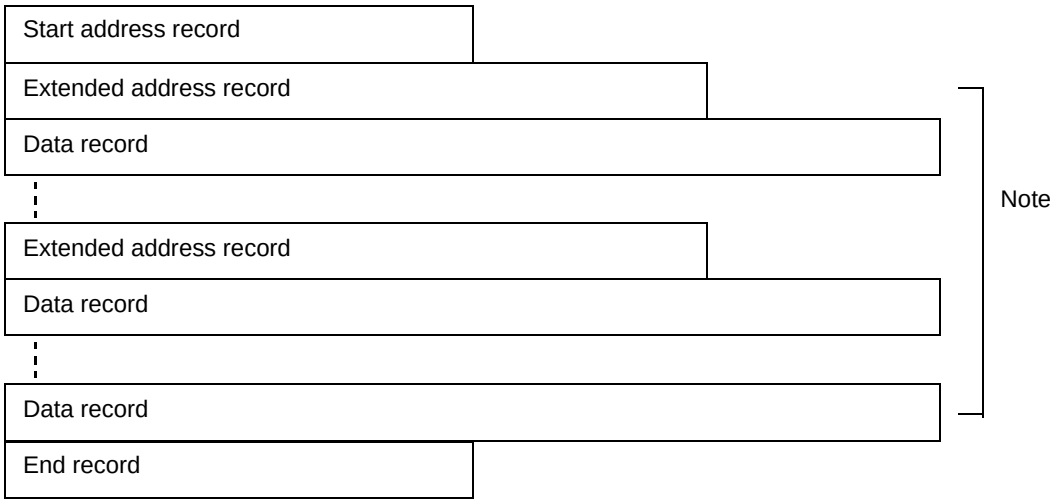
(iii) Fixed at 0000

(iv) Record type, fixed at 01

(v) Check sum, fixed at FF

[Intel extended HEX-format object module file format]

Figure 7-3 Intel Extended Format



Note The extended address record and data record are repeated here.

(1) Extended address record

:	02	0000	02	XXXX	SS
↑	↑	↑	↑	↑	↑
(i)	(ii)	(iii)	(iv)	(v)	(vi)

(i) Record mark

Indicates beginning of record.

(ii) Code number, fixed to 02

(iii) 0Fixed to 0000

(iv) Record type, fixed to 02

(v) The paragraph value of the segment

The paragraph value of the segment is shown as a 4-digit hexadecimal.

(vi) Check sum (2 digits)

A value is input subtracting in order from 0 which counts down the data from the code number to the higher 8-bit value of the address.

(2) Data record

:	XX	XXXX	00	DD ... DD	SS
↑	↑	↑	↑	↑	↑
(i)	(ii)	(iii)	(iv)	(v)	(vi)

(i) Record mark

Indicates beginning of record.

(ii) Code number (2 digits)

Number of bytes in the code stored in the record. A maximum of 16 bytes can be stored.

(iii) Location address (offset)

The start address (offset) of the code displayed in the record is shown as a 4-digit hexadecimal.

(iv) Record type (2 digits)

Fixed to 00H.

(v) Code (Max. 32 digits)

The object code is shown one byte at a time, with the higher 4 bits and lower 4 bits separated. A maximum of 16 bytes can be expressed in the code.

(vi) Check sum (2 digits)

A value is input subtracting in order from 0 which counts down the data from the code number to the code.

(3) Start address code

:	04	0000	03	0000	0000	F9
↑	↑	↑	↑	↑	↑	↑
(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)

(i) Record mark

(ii) Fixed to 04

(iii) Fixed to 0000

(iv) Fixed to 03

(v) Fixed to 0000

(vi) Fixed to 0000

(vii) Fixed to F9

(4) End record

:	00	0000	01	FF
↑	↑	↑	↑	↑
(i)	(ii)	(iii)	(iv)	(v)

(i) Record mark

(ii) Fixed to 00

(iii) Fixed to 0000

(iv) Fixed to 01

(v) Fixed to FF

[Extended tech HEX-format object module file format]

HEX files are composed of the following 3 types of block.

(i) Data block

(ii) Symbol block (This is an unused block. Symbol data uses the symbol table file.)

(iii) Termination block

Each block starts with a header field composed of a common 6 characters, and ends with the string end-ofline.

Maximum length of each block is 255, not including the start character % and end-of-line.

The format for the common header field is shown in Table 7-4.

Table 7-4 Extended Tech Header Field

Item	No. of ASCII Characters	Explanation
%	1	The percent symbol specifies that the block is in extended tech format.
Block length	2	This is a 2-digit hexadecimal which indicates the number of characters in the block. This number of characters does not include the start character % and end-of-line.
Block type	1	6 = Data block 3 = Symbol block 8 = Termination block
Check sum	2	This is a 2-digit hexadecimal which indicates the remainder produced when the total value of the characters in the block (except the start character %, the check sum, and end-of-line) is divided by 256. The total value of the characters is shown in Table 7-5.

Table 7-5 Character Values for Check Sum Evaluation

Character	Value (Decimal)
0-9 A-Z $ % . (period) _ (underscore) a-z	0-9 10-35 36 37 38 39 40-65

(1) Data block

The format for the data block is shown in Table 7-6.

Table 7-6 Data Block Format for Extended Tech

Field	No. of ASCII Characters	Explanation
Header	6	Standard header field Block type = 6

Table 7-6 Data Block Format for Extended Tech

Field	No. of ASCII Characters	Explanation
Load address	2-17	Address from which the object code is loaded. Number of characters is variable.
Object code	2n	Number of bytes n, displayed as a 2-digit hexadecimal

Caution In extended Tech, the number of characters in a specific field is variable within 2 to 17 (1 to 16 characters of actual data). The first character in this variable field is a hexadecimal which indicates the length of the field. The numerical zero indicates that a character line consists of 16 characters. The length of the character string is therefore 1 to 16 characters, and the length of the variable-length field including the character string length indicator is 2 to 17.

```
%    15   6    1C   3    100   020202020202
↑    ↑    ↑    ↑    ↑    ↑     ↑
(i)  (ii) (iii) (iv) (v)  (vi)  (vii)
```

(i) Header character

(ii) Block length : 15H = 21

(iii) Block type : 6

(iv) Check sum : 1CH

(v) Number of digits in load address

(vi) Load address : 100H

(vii) Object code : 6 bytes

(2) Termination block

The format for the termination block is shown in Table 7-7.

Table 7-7 Termination Block Format for Extended Tech

Field	No. of ASCII Characters	Explanation
Header	6	Standard header field Block type = 8
Load address	2-17	Start address for program execution. Number of characters is variable.

```
%    08   8    1A   2    80
↑    ↑    ↑    ↑    ↑    ↑
(i)  (ii) (iii) (iv) (v)  (vi)
```

(i) Header character

(ii) Block length : 8H

(iii) Block type : 8

(iv) Check sum : 1AH

(v) Number of digits in load address

(vi) Load address : 80H

(3) Symbol block (unused)

The extended Tech symbol block is data used for symbolic debugging. It may be assumed to have the following characteristics.

Symbol :	1 to 16 uppercase and lowercase alphabets, numerals, period and underscore. Numerals are not permitted for the start character.
Value :	Up to 64 bits (16 hexadecimal digits) possible.
Type :	Address or scalar (a scalar indicates any numerical value other than an address). Addresses are divided into code addresses (instruction addresses) and data addresses (addresses of data items).
Global/local specification :	Indicates whether a symbol is global (external reference enabled) or local.
Section membership :	A section may be considered a range to which a memory name is given. Each address in a program belongs to at least 1 section. A scalar does not belong to any section.

The format for the symbol block is shown in Table 7-8.

Table 7-8 Symbol Block Format for Extended Tech

Field	No. of ASCII Characters	Explanation
Header	6	Standard header field Block type = 3
Section name	2-17	Section name 2 to 17 Name of the section which includes the symbols defined in the block. Number of characters is variable.
Section definition	5-35	Each symbol block must have 1 of this type of field. This field may be placed before or after any number of symbol definition fields. This format is shown in Table 7-9.
Symbol definition	5 to 35 each	This is a symbol definition field greater than 0 as shown in Table 7-10.

The symbols contained in a program are transferred as a symbol block. Each symbol block includes a section name and a list of the symbols that belong to that section. If necessary, a scalar can also be included in any section.

A symbol in the same section can be placed in one or more blocks.

The formats for the section definition field and the symbol definition field in the symbol block are shown in

Table 7-9 and Table 7-10.

Table 7-9 Symbol Block Section Definition Fields for Extended

Field	No. of ASCII Characters	Explanation
0	1	0 specifies that the field is a section definition field.
Base address	2-17	This is a section start address. Number of characters is variable.
Length	2-17	Indicates the section length. Number of characters is variable and is calculated by the following 1 - (higher address ? base address)

Table 7-10 Symbol Block Symbol Definition Fields for Extended Tech

Field	No. of ASCII Characters	Explanation
Type	1	1-digit hexadecimal indicating global/local symbol specification and type of value displayed. 1 = Global address 2 = Global scalar 3 = Global code address 4 = Global data address 5 = Local address 6 = Local scalar 7 = Local code address 8 = Local data address
Symbol	2-17	Indicates the symbol length. Variable.
Numerical value	2-17	Value corresponding to a symbol. Number of characters is variable.

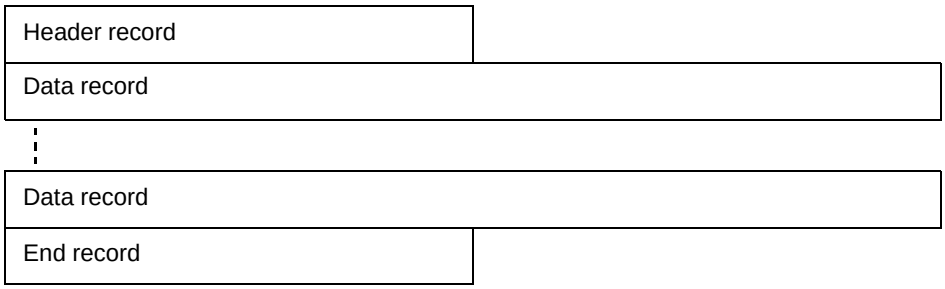
[Motorola S-type format]

Motorola S-type format files are converted from 5 records into 3 types. The composition of the entire file is shown in Figure 7-4. Types of records are shown in Table 7-11.

Table 7-11 Motorola HEX File Record Types

Item	Record Type
Header record (optional)	S0
Data record	S2 (Standard 24 bits) S3 (32 bits)
End record	S8 (Standard 24 bits) S7 (32 bits)

Figure 7-4 Motorola S-Type Format



Motorola HEX format files are divided into standard 24-bit addresses and 32-bit addresses. Standard addresses are composed of records S0, S2, and S8. The 32-bit addresses are composed of records S0, S3 and S7. Header record S0 is optional and is not output. A CR character is placed at the end of each S record.

The general formats and their meanings for each field in each record are shown in Table 7-12 and Table 7-13.

Table 7-12 General Format for Each Record

Record Type	General Format
S0	S0XXYY ... YYZZZZ
S2	S2XXWWWWWWDD ... DDZZ
S3	S3XXWWWWWWWWDD ... DDZZ
S7	S7XXWWWWWWWWZZ
S8	S8XXWWWWWWZZ

Table 7-13 Meanings of Fields

Field	Meaning
Sn	Record type
XX	Length of data record Number of bytes in the address, hexadecimal data and check sum
YY ... YY	File name ASCII code for the input file name expressed as a hexadecimal
WWWWWW [WW]	24th [32th] bit address
DD ... DD	Hexadecimal data 1 byte of data is expressed as a 2-digit hexadecimal.
ZZ	Check sum The lower 1 byte of complement 1 for the sum for each byte of the record length, address and the hexadecimal data, expressed as a 2-digit hexadecimal

```
S2      08      00FF11  D4520A20  A0
↑       ↑         ↑         ↑      ↑
(i)     (ii)      (iii)     (iv)   (v)
```

(i) Record type : S2

(ii) Record length : 8 bytes

(iii) Load addresses (24-bit address)

(iv) Hexadecimal data

(v) Check sum

(1) S0 record

```
S0      XX      YYYYYYYY      ZZ
↑       ↑         ↑           ↑
(i)     (ii)      (iii)       (iv)
```

(i) Record type

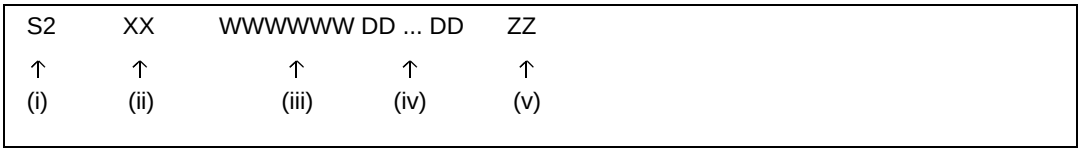
(ii) Record length

This is the number of bytes in (iii) plus the number of bytes in (iv).

(iii) File name

(iv) Check sum

(2) S2 record



(i) Record type

(ii) Record length

This is the number of bytes in (iii) plus the number of bytes in (iv) plus the number of bytes in (v).

(iii) Load address

This is the 24-bit load address of the data in (iv) within the range 0H to FFFFFFH.

(iv) Data

This is the loaded data itself.

(v) Check sum

(3) S3 record

(i) Record type

(ii) Record length

This is the number of bytes in (iii) plus the number of bytes in (iv) plus the number of bytes in (v).

(iii) Load address

This is the 24-bit load address of the data in (iv) within the range 0H to FFFFFFFH.

(iv) Data

This is the loaded data itself.

(v) Check sum

(4) S7 record

(i) Record type

(ii) Record length

This is the number of bytes in (iii) plus the number of bytes in (iv).

(iii) Entry address

This is the 32-bit entry address within the range 0H to FFFFFFFH.

(iv) Check sum

(5) S8 record

S7	XX	WWWWWWWW	ZZ
↑	↑	↑	↑
(i)	(ii)	(iii)	(iv)

(i) Record type

(ii) Record length

This is the number of bytes in (iii) plus the number of bytes in (iv).

(iii) Entry address

This is the 24-bit entry address within the range 0H to FFFFFFH.

(iv) Check sum

7.2.4 Symbol table file

The symbol table file output by the object converter is input to a debugger.

The following is the symbol table file of the sample program.

```
#04
; FF       PUBLIC
010097CONVAH
010000MAIN
010080START
00FE20_@STBEG
00FB00_@STEND
; FF       SAMPM
<02FE20HDTSA
02FE21STASC
; FF       SAMPS
<0100A8SASC
0100AESASC1
=
```

[Symbol Table File Formats]

Start of symbol table	#	0	C	LF			
Start of public symbol	;		4 blank spaces		PUBLI	C	LF
	Note 1 --	Symbol attributes	Symbol value		Public symbol name	C	LF
		:	:		:	:	:
	;	F	C		Module name 1	C	LF
Start of local symbol	<	Symbol attributes	Symbol value		Local symbol name	C	LF
		Symbol attributes	Symbol value		Local symbol name	C	LF
		:	:		:	:	:
	;	F	4 blank spaces		Module name 2	C	LF
Repeated in units of object modules.		:	:		:	:	:
Symbol table end mark	=	C	LF				

Public symbols

Local symbols for each module

Notes 1 Symbol attributes are the values shown in Table 7-14.

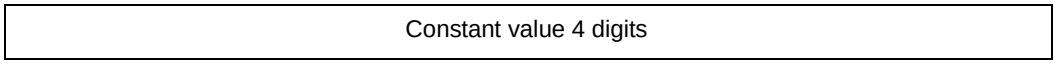
Notes 2 For symbol values, refer to Figure 7-5.

Table 7-14 Values of Symbol Attributes

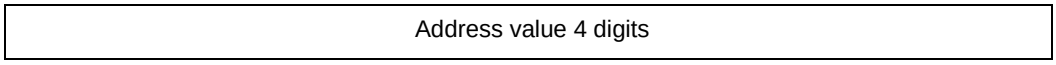
Value	Symbol Attribute
00	Constant defined by the EQU directive
01	Label within a code segment
02	Label within a data segment
03	Bit symbol for ABBIT attribute
04	Bit symbol for AWBIT attribute
05	Bit symbol for saddr.bit/bsaddr.bit3
06	Bit symbol for wsaddr.bit4
07	Bit symbol for sfr.bit/bsfr.bit3
08	Bit symbol for wsfr.bit4
09	Bit symbol for RBBIT attribute
10	Bit symbol for RWBIT attribute
11	Bit symbol for byte register.bit
FF	Module name

Figure 7-5 Symbol Value Formats

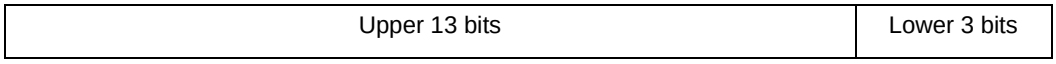
- When the symbol attribute is NUMBER



- When the symbol attribute is LABEL



- When the symbol attribute is a bit symbol



Upper 13 bits : The relative address from 0FE00H

Lower 3 bits : Bit position (0 to 7)

7.3 Object Converter Startup

7.3.1 Object converter startup

The following two methods can be used to start up the object converter.

(1) Startup from the command line

```
X>[ path-name ] oc78k0 [ Δ option] ... load-module-file-name[ Δ option ] ... [ Δ ]
  ↑      ↑        ↑      ↑                  ↑                      ↑
 (a)    (b)      (c)    (d)                (e)                    (d)
```

(a) Current drive name

(b) Current directory name

(c) Object converter command file name

(d) This contains detailed directions for the action of the object converter.
Enclose a path that includes a space in a pair of double quotation marks (" ").

(e) File name of the load module to be converted
Specify the file name of a path that includes a space by enclosing it in a pair of double quotation marks (" ").

Example C>oc78k0 k0.lmf -osample.hex

Caution If more than one object converter option is specified, separate the options with a space. For a detailed explanation of object converter options, refer to "7.4 Object Converter Options".

(2) Startup from a parameter file

Use the parameter file when the data required to start up the object converter will not fit on the command line, or when the same object converter option is specified repeatedly each time object conversion is performed. To start up the object converter from a parameter file, specify the specify parameter file option (-F) on the command line.

Start up the object converter from a parameter file as follows.

```
X>oc78k0 [ Δ load-module-file] Δ -f parameter-file-name
                                  ↑          ↑
                                 (a)        (b)
```

(a) Specify parameter file option

(b) A file which includes the data required to start up the object converter

Remark An editor is used to create the parameter file.

The rules for writing the contents of a parameter file are as follows.

```
[ [ [ Δ ] option [ Δ option] ... [ Δ ] Δ ] ] ...
```

Remarks 1 If the load module file name is omitted from the command line, only one load module file name can be specified in the parameter file.

Remarks 2 The load module file name can also be specified after the option.

Remarks 3 Write in the parameter file all object converter options and output file names that should be specified in the command line.

Example Create the parameter file (k0.poc) using an editor.

< Contents of k0.poc >

```
; parameter file
k0.lmf -osample.hex
-ssample.sym -r
```

Use parameter file k0.poc to start up the object converter.

```
C>oc78k0 -fk0.poc
```

7.3.2 Execution start and end messages

(1) Execution start message

When the object converter is started up, an execution startup message appears on the display.

```
78K/0 Series Object Converter Vx.xx [ xx xxx xx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx
```

(2) Execution end message

If it detects no object conversion errors resulting from the object conversion, the object converter outputs the following message to the display and returns control to the operating system.

```
 Target chip : uPD780xxx
 Device file : Vx.xx

Object Conversion Complete ,      0 error ( s ) and      0 warning ( s ) found.
```

If it detects an object conversion errors resulting from the object conversion, the object converter outputs the error number to the display and returns control to the operating system.

```
Target chip : uPD780xxx
 Device file : Vx.xx

Object Conversion Complete ,      3 error ( s ) and      0 warning ( s ) found.
```

If the object converter detects a fatal error during object conversion which makes it unable to continue link processing, the object converter outputs a message to the display, cancels object conversion and returns control to the operating system.

Example 1 A non-existent load module file name is specified.

```
C>oc78k0 sample.lmf

78K/0 Series Object Converter Vx.xx [ xx xxx xx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

RA78K0 error F4006 : File not found ' SAMPLE.LMF '
Program aborted.
```

In the above example, a non-existent load module file is specified. An error results and the object converter aborts the object conversion.

Example 2 A non-existent object converter option is specified.

```
C>oc78k0 k0.lmf -a

78K/0 Series Object Converter Vx.xx [ xx xxx xx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

RA78K0 error F4018 : Option is not recognized '-a'
Please enter ' OC78K0 -- ' , if you want help messages.
Program aborted.
```

In the above example, a nonexistent object converter option is specified. An error results and the object converter aborts the object conversion.
When an error message is displayed and object conversion is aborted, look for the cause in "CHAPTER 12 ERROR MESSAGES" and take action accordingly.

7.4 Object Converter Options

7.4.1 Types of object converter options

The object converter options are detailed instructions for the operation of the object converter. Object converter options are classified into 10 types.

The classifications of the object converter options and explanations of each type are shown below.

Table 7-15 Object Converter Options

Classification	Option	Explanation
HEX format object module file output specification	-O	Specifies the output of a HEX-format object module file.
	-NO	
Symbol table file output specification	-S	Specifies output of a symbol table file.
	-NS	
Specification of sort by object address order	-R	Sorts HEX-format objects in the order of their addresses.
	-NR	
Object complement specification	-U	Outputs a specified complement value as an object code for an address area to which no HEX-format object is output.
	-NU	
Error list file output specification	-E	Outputs an error list file.
	-NE	
Parameter file specification	-F	Inputs an input file name and options from a specified file.
HEX format specification	-KI	Intel standard HEX format
	-KIE	Intel extended HEX format
	-KT	Extended Tech format
	-KM	Motorola S-type format (24-bit standard address)
	-KME	Motorola S-type format (32-bit address)
Device file search path specification	-Y	Reads a device file from a specified path.
File separate output specification for flash ROM model	-ZF	- Adds an option that outputs the boot area and other areas to separate HEX-format files when linking of the boot area ROM program of a flash ROM model is specified. - If the -ZF option is specified, the output file type at the boot area ROM program side is "HXB", and the output file type at the side of the other programs is "HXF".
Help specification	--	Displays a help message on the display.

7.4.2 Explanation of object converter options

This section contains detailed explanations of each object converter option.

(1) HEX format object module file output specification

HEX format object module file output specification (-O/-NO)

[Syntax]

```
-O [ output-file-name ]
-NO
```

- Default assumption

  -O input-file-name.HEX

  (The file type for extended space is '.H1' to '.H15'.)

[Function]

- Option -O specifies the output of a HEX-format object module file. Option -O also specifies the output destination and output file name.
- Option -NO specifies that no HEX-format object module file is output.

[Application]

- Specify the option -O to change the output destination and output file name of the HEX-format object module file.
- Specify option -NO when performing an object conversion only to output a symbol table file. This will shorten object conversion time.

[Explanation]

- Specify a disk type file name for the "output-file-name".'
  If a device-type file name is specified, an abort error will result.
- If the "output-file-name" is omitted when option -O is specified, the HEX-format object module file "input-file-name.hex" will be output to the current directory.
- If only the path name is specified in "output-file-name", "input-file-name.hex" will be output to the specified path.
- If both options -O and -NO are specified at the same time, the option specified last takes precedence.
- When -ZF option is specified, the file type is as follows :

Table 7-16 File Type When -ZF Option Is Specified

File	File Type
Output file at boot area ROM program side	.hxb
Output file at program side other than boot area ROM	.hxf

When a code is output to a segment located in extended space, the object converter generates a separate HEX-format object module file for each space.

The file types of HEX-format object module files generated for extended space are as follows.

Table 7-17 Type of HEX Format Object Module File for Extended Space

File	Normal Spac	Extended Space								
	REGULAR	EX1	EX2	EX3	EX4	EX5	…	EX13	EX14	EX15
HEX	.hex	.H1	.H2	.H3	.H4	.H5	…	.H13	.H14	.H15

[Example of use]

- Output a HEX-format object module file (sample.hex).

```
C>oc78k0 k0.lmf -osample.hex
```

(2) Symbol table file output specification

Symbol table file output specification (-S/-NS)

[Syntax]

```
-S [ output-file-name ]
-NS
```

- Default assumption

  -S input-file-name.sym

  (The file type for extended space is '.S1' to '.S15'.)

[Function]

- Option -S specifies the output of a symbol table file. Option -S also specifies the output destination and output file name.
- Option -NS specifies that no symbol table file is output.

[Application]

- Specify option -S to change the output destination and output file name of the symbol table file.
- Specify option -NS when performing an object conversion only to output a HEX-format object module file. This will shorten object conversion time.

[Explanation]

- Specify a disk type file name for the "output-file-name".
  If a device-type file name is specified, an abort error will result.
- If the "output-file-name" is omitted when option -S is specified, the symbol table file "input-file-name.sym" will be output to the current directory.
- If only the path name is specified in "output-file-name", "input-file-name.sym" will be output to the specified path.
- If both options -S and -NS are specified at the same time, the option specified last takes precedence.

When a symbol having an ADDRESS or BIT attribute is defined for a segment located in extended space, the object converter generates a separate symbol table file for each space.

All symbols which have NUMBER attribute are output to a symbol table file in normal space.

The file types of symbol table files generated for extended space are as follows.

Table 7-18 Type of Symbol Table File for Extended Space

File	Normal Space	Extended Space								
	REGULAR	EX1	EX2	EX3	EX4	EX5	…	EX13	EX14	EX15
HEX	.hex	.S1	.S2	.S3	.S4	.S5	…	.S13	.S14	.S15

[Example of use]

- Output a symbol table file (sample.sym).

```
C>oc78k0 k0.lmf -ssample.sym
```

(3) Specification of sort by object address order

Specification of sort by object address order (-R/-NR)

[Syntax]

```
-R
-NR
```

- Default assumption

  -R

[Function]

- Option -R outputs sorting of HEX-format objects in order of address.
- Option -NR outputs HEX-format objects in the order in which they were stored in the load module file.

[Application]

- Specify the -NR option if the HEX-format objects do not have to be sorted in address order.

[Explanation]

- If both options -R and -NR are specified at the same time, the option specified last takes precedence.
- If option -NO is specified, option -R/-NR becomes unavailable.

[Example of use]

- Sort HEX-format objects in order of address.

```
C>oc78k0 k0.lmf -r
```

(4) Object complement specification

Object complement specification (-U/-NU)

[Syntax]

```
-U complement-value [ , [ start ] , size ]
-NU
```

- Default assumption

  -U0FFH (filled with 0FFH)

[Function]

- Option -U outputs a specified complement value as an object code for an address area to which no HEX-format object has been output.
- Option -NU makes option -U unavailable.

[Application]

- Address areas to which no HEX-format object has been output may become written with unnecessary code. When such addresses are accessed by the program for any reason, their action may be unpredictable. By specifying option -U, code can be written in advance to address areas to which no HEX-format object has been output.

[Explanation]

- The range of values that can be specified as complement values is as follows.

  0H ≤ complement value ≤ 0FFH

  Complement values can be specified in binary, octal, decimal or hexadecimal numbers. If a value outside the range or a value other than a numerical value is specified, an abort error occurs.
- "Start" specifies the start address area for complement to be performed.

  The range of values that can be specified for start is as follows.

  0H ≤ start ≤ Largest address in program space other than SFR area

  Start can be specified in binary, octal, decimal or hexadecimal numbers. If a value outside the range or a value other than a numerical value is specified, an abort error occurs. If start is omitted, 0 is assumed to be specified.
- "Size" specifies the size of the address area for complement to be performed. The range of values that can be specified for size is as follows.

  1H ≤ size ≤ Largest address in program space other than SFR area

  Size can be specified in binary, octal, decimal or hexadecimal numbers. If a value outside the range or a value other than a numerical value is specified, an abort error occurs. When start has been specified, size cannot be omitted.
- If neither a start address nor size is specified, the object converter performs processing assuming that the range of the internal ROM is specified.

- If both the -U and -NU options are specified at the same time, the one specified later takes precedence.
- If the -NO option is specified, the -U/-NU option is invalid.
- Two or more address ranges cannot be specified by using the -U option.
- Specification formats for start and size in option -U and their interpretation are as follows.

  (a) -U Complement value

  If the target device for assembly contains internal ROM, the internal ROM range

  (b) -U Complement value, , size

  From address 0 to the size - 1 address

  (c) -U Complement value, start, size

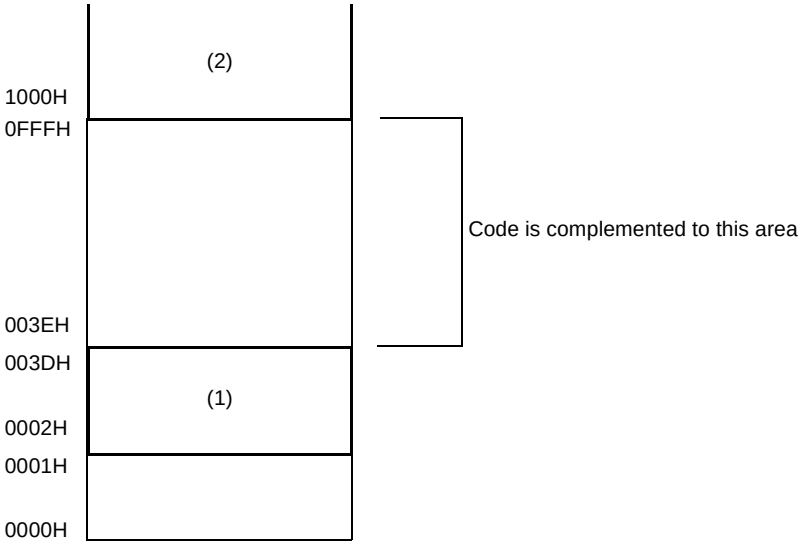
  From start address to start address + size - 1 address

[Example of use]

- Complement an address area to which a HEX-format object has not been output with code.

  In the following example, it is supposed that a HEX-format object module file exists. In this case, code cannot be written to the address area 003EH to 0FFFH.

```
: 020000000200FC
: 100002002B41000BFC80FE2B40000944F7083A20EC        ; (1)
: 100012001A6720FE2822006521FED350D25014FE1A        ; (1)
: 10002200B900059F2835002431B900059F28350005        ; (1)
: 0C003200242156AF0A8302A807A830560C
: 01000003B5D0d0026A3…                              ; (2)
: 1010100024A5F622B667…                             ; (2)
   :
: 00000001FF
```



00H is complemented to the address area 003EH to 0FFFH.

```
C>oc78k0 k0.lmf -u00h , 003eh , 0fc2h
```

(5) Error list file output specification

Error list file output specification (-E/-NE)

[Syntax]

```
-E [ output-file-name ]
-NE
```

- Default assumption

  -NE

[Function]

- Option -E specifies the output of an error list file. Option -E also specifies the output destination and output file name.
- Option -NE makes option -E unavailable.

[Application]

- Specify option -E to change the output destination and output file name of the error list file.

[Explanation]

- The file name of the error list file can be specified as a disk-type file name or as a device-type file name. However, if the device-type file name CLOCK is specified, an abort error will occur.
- When option -E is specified and the output file name is omitted, the error list file name will be "input-file-name.eoc".
- When option -E is specified and the drive name is omitted, the error list file will be output to the current drive.
- If both options -E and -NE are specified at the same time, the option specified last takes precedence.

[Example of use]

- Create an error list file (k0.eoc).

```
C>oc78k0 k0.lmf -ek0.eoc
```

(6) Parameter file specification

Parameter file specification (-F)

[Syntax]

-F file-name

- Default assumption

  With no input file.

[Function]

- Option -F specifies input of options and input file names from a specified file.

[Application]

- Specify option -F when the data required to start up the object converter will not fit on the command line.
- Specify option -F to repeatedly specify the same options each time object conversion is performed and to save those options to a parameter file.

[Explanation]

- Only a disk-type file name can be specified as "file-name". If a device-type file name is specified, an abort error will occur.
- If the file name is omitted, an abort error will occur.
- Nesting of parameter files is not permitted. If option -F is specified within a parameter file, an abort error will occur.
- The number of characters that can be written within a parameter file is unlimited.
- Separate options or input file names with a blank space, a tab or a line feed code (LF).
- Options and input file names written in a parameter file will be expanded at the position specified for the parameter file on the command line.
- The expanded options specified last will take precedence.
- All characters entered after ";" or "#" and before a line feed code (LF) or "EOF" will be interpreted as comments.
- If option -F is specified two or more times, an abort error will occur.

[Example of use]

- Perform object conversion using a parameter file.

< Set the contents of parameter file 78k0.poc as follows >.

```
; parameter file
k0.lmf -osample.hex
-ssample.sym -r
```

Enter the following on the command line.

```
C>oc78k0 k0.lmf -f78k0.poc
```

(7) HEX format specification

HEX format specification (-KI/-KIE/-KT/-KM/-KME)

[Syntax]

-KI -KIE -KT -KM -KME

- Default assumption

  -KIE

[Function]

- Specifies format of a HEX-format object module file to be output.

[Application]

- Use these options to specify the format of a HEX-format object module file to be output from among [Intel standard HEX format], [Intel extended HEX format], [Extended Tech format], [Motorola S-type format (standard address)] and [Motorola S-type format (32-bit address)].

[Explanation]

- The address ranges specified by each of these options are as follows.

  -KI : Intel standard HEX format

  0H to FFFFH (up to 64 KB)

  -KIE : Intel extended HEX format

  0H to FFFFFH (up to 1 MB)

  -KT : Extended Tech format

  0H to FFFFFFFFH (up to 4 GB)

  -KM : Motorola S-type format (standard address)

  0H to FFFFFFH (up to 16 MB)

  -KME : Motorola S-type format (32-bit address)

  0H to FFFFFFFFH (up to 4 GB)

[Example of use]

- Specify a Motorola S-type format (standard address) object.

```
C>oc78k0 k0.lmf -km
```

(8) Device file search path specification

Device file search path specification (-Y)

[Syntax]

-Y path-name

- Default assumption

  Device files will be read from the path determined in the following order.

  (i) <..\dev> (for the oc78k0.exe startup path)

  (ii) Path by which OC78K0 was started up

  (iii) Current directory

  (iv) The environmental variable PATH

[Function]

- Reads a device file from the specified path.

[Application]

- Specify a path where a device file exists.

[Explanation]

- If anything other than a path name is specified after option -Y, an abort error occurs.
- If the path name is omitted after option -Y, an abort error occurs.
- The path from which the device file is read in the order determined as follows.

  (i) Path specified by option -Y

  (ii) <..\dev> (for the oc78k0.exe startup path)

  (iii) Path by which OC78K0 was started up

  (iv) Current directory

  (v) The environmental variable PATH

[Example of use]

- Specify the path for the device file as directory c:\78k0\dev

```
C>oc78k0 k0.lmf -yc:\78k0\dev
```

(9) File separate output specification for flash ROM model

File separate output specification for flash ROM model (-ZF)

[Syntax]

-ZF

- Default assumption

  Not separately output.

[Function]

- Specifies the first address of the flash ROM area.

[Explanation]

- Adds an option that outputs the boot area and other areas to separate HEX-format files when linking the boot area ROM program of a flash ROM model is specified.
- If the -ZF option is specified, the output file type at the boot area ROM program side is "HXB", and the output file type at the side of the other programs is "HXF".

  Caution Do not specify this option for a device that does not have a flash memory area self-programming function.

[Example of use]

```
C>oc78k0 k0.lmf -zf
```

(10) Help specification

Help specification (--)

[Syntax]

```
--
```

- Default assumption

  No display

[Function]

- Option -- displays a help message on the display.

[Application]

- The help message is a list of explanations of the object converter options. Refer to these when executing the object converter.

[Explanation]

- When option -- is specified, all other options are unavailable.

  Caution This option cannot be specified from PM plus.
  To reference PM plus help, click the [Help] button in the < Object Converter Options > dialog box.

[Example of use]

- When option -- is specified, a help message is output on the display.

```
C>oc78k0 --

78K/0 Series Object Converter Vx.xx [ xx xxx xx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

usage : oc78k0 [ option [ ... ] ] input-file [ option [ ... ] ]
The option is as follows ( [ ] means omissible ).
-ffile              : Input option or input-file name from specified file.
-o [ file ] / -no   : Create HEX module file [ with specified name ] / Not.
-s [ file ] / -ns   : Create symbol table file [ with specified name ] / Not.
-r/-nr              : Sort HEX object by address / Not.
-uvalue [ , [ start ] , size]/-nu :Fill up HEX object with specified value / Not.
-kkind              : Select hex format.I ; intel format IE ; intel extend format T ; tex format M
                      ; s format ME ; s-32bit format
-ydirectory         : Set device file search path.
-zf                 : Create boot hex module file ( HXB ) , and flash hex module file ( HXF ).
--                  : Show this message.
DEFAULT ASSIGNMENT : -o -s -r -u0ffh
```

7.5 Option Settings in PM plus

This section describes the method for setting object converter options from PM plus.

7.5.1 Option setting method

The < Object Converter Options > dialog box is opened if [Object Converter Options] is selected from the [Tools] menu of PM plus or if the [OC] button on the toolbar is pressed.

Object converter options can be set by inputting the required options in this dialog box.

Figure 7-6 < Object Converter Options > Dialog Box (When << Output1 >> Tab Is Selected)

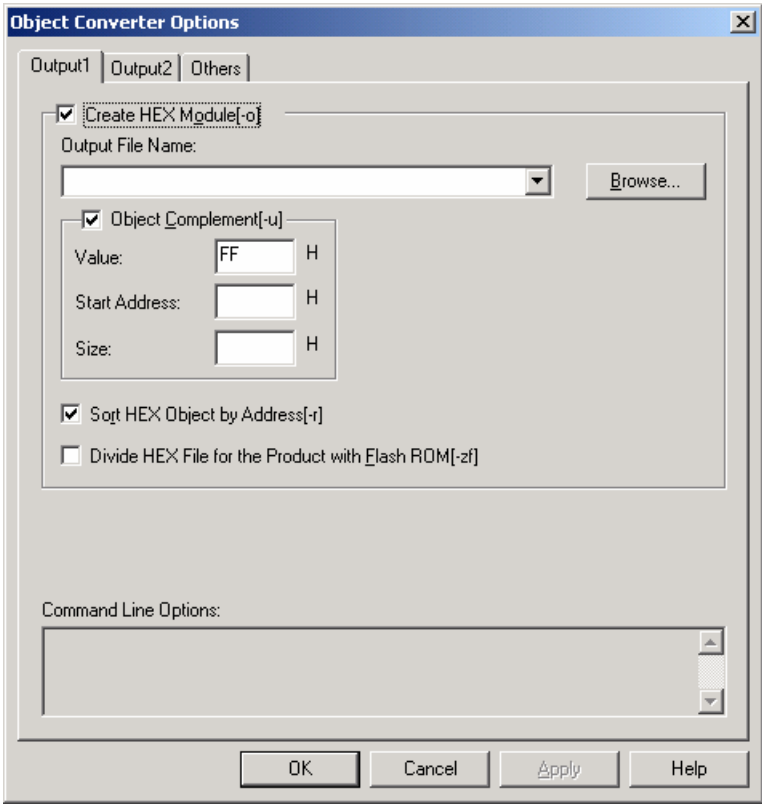


Figure 7-7 < Object Converter Options > Dialog Box (When << Output2 >> Tab Is Selected)

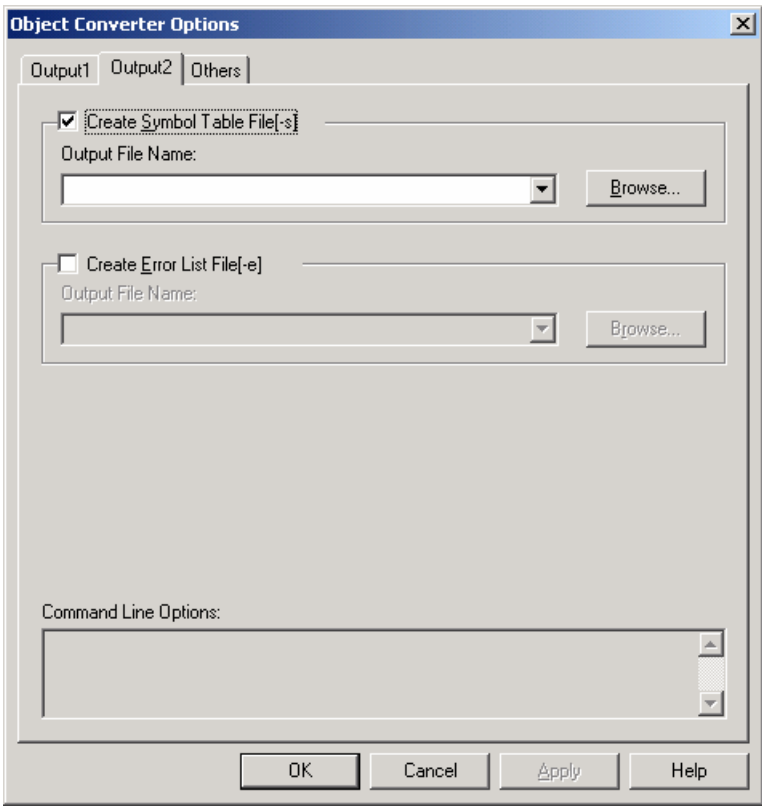
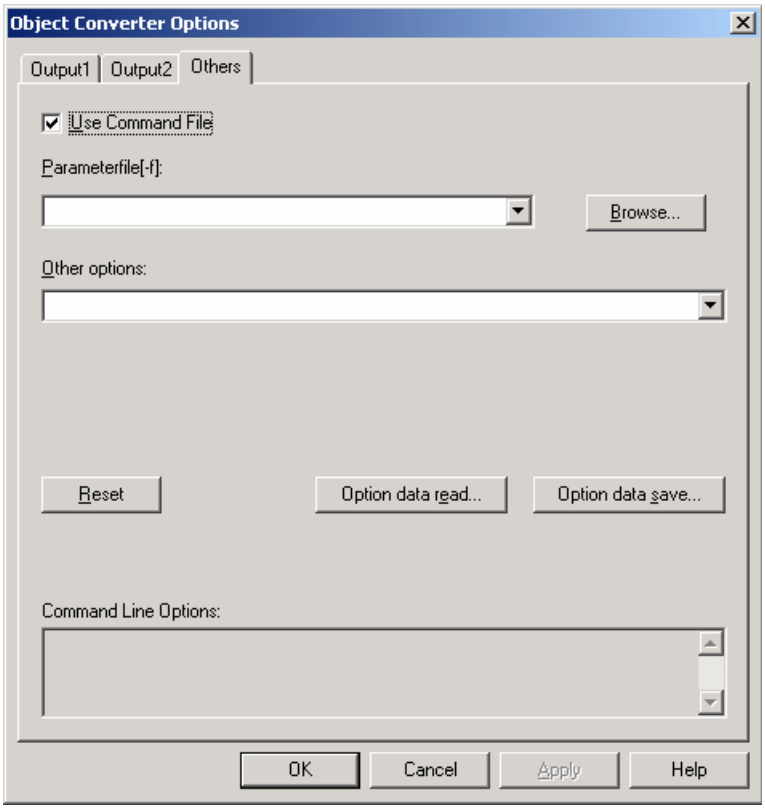


Figure 7-8 < Object Converter Options > Dialog Box (When << Others >> Tab Is Selected)



7.5.2 Option settings

The various options in the < Object Converter Options > dialog box are described below.

<< Output1 >> Tab

- Create HEX Module [-o]

  Check this option to output a HEX-format object module file.

  Output File Name

  Specify the path and file name of the object module file by using the [Browse] button or directly inputting a path and file name.

- Object Complement [-u]

  Specify this object to write a code in advance to addresses to which a HEX-format object is not output, to prevent unwanted codes from being written to those addresses and the program from hanging up.

- Sort HEX Object by Address [-r]

  Check this option if the HEX-format objects must be sorted in address order.

- Divide HEX Files for the Product with Flash ROM [-zf]

  Check this option to output the boot area and other areas of a product that contains flash memory to separate HEX-format files.

  Caution Do not specify this option for a device that does not have a flash memory area self-programming function.

- Command Line Options

  This edit box is read-only. The currently set option character string is displayed.

<< Output2 >> Tab

- Create Symbol Table File [-s]

  Check this option to output a symbol table file.

  Output File Name

  Specify the path and file name of a symbol table file by using the [Browse] button or directly inputting a path and file name.

- Create Error List File [-e]

  Check this option to output an error list file.

  Output File Name

  Specify the path and file name of the error list file by using the [Browse] button or directly inputting a path and file name.

- Command Line Options

  This edit box is read-only. The currently set option character string is displayed.

<< Others >> Tab

- Use Command File

  Check this option to create a command file.

- Parameterfile [-f]

  Specify the file to be input as a user-defined parameter file, by using the [Browse] button or directly inputting a file name.

- Other options

  To specify an option other than those that can be set in this dialog box, enter the option in the input box.

  Caution The help specification (--) option cannot be specified on PM plus.

- Reset

  Resets the input contents.

- Option data read

  Opens the < Read Option Data > dialog box and after the option data file has been specified, reads this file.

- Option data save

  Opens the < Save Option Data > dialog box and save the option data to the option data file with a name.

- Command Line Options

  This edit box is read-only. The currently set option character string is displayed.

CHAPTER 8 LIBRARIAN

The librarian edits RA78K0 object module files and library files in units of 1 module.

The librarian also outputs a list file.

If a librarian error occurs, an error message is output to the display indicating the cause of the error.

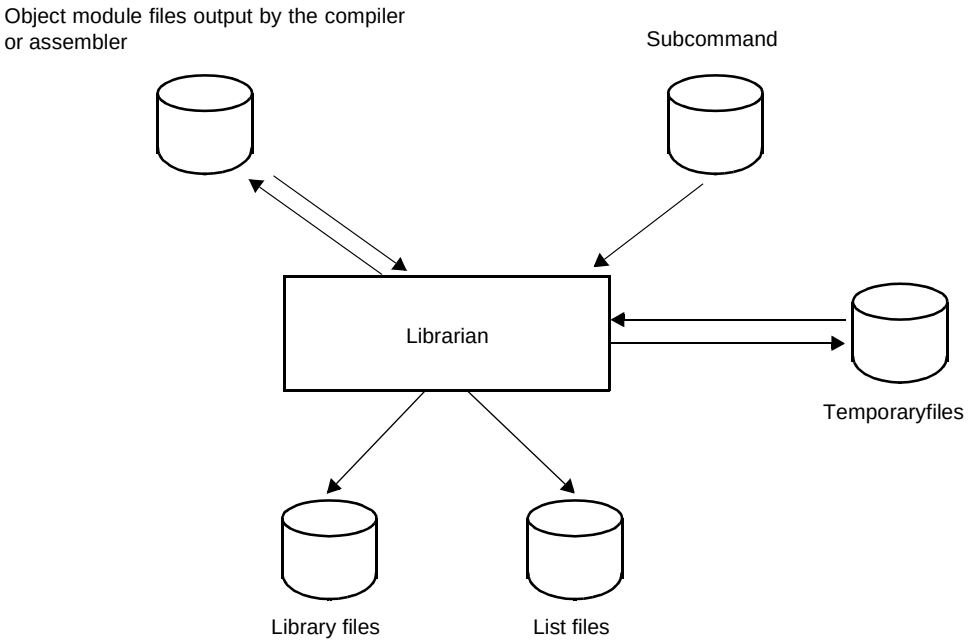
8.1 I/O Files of Librarian

The I/O files of the librarian are as follows.

Table 8-1 I/O Files of Librarian

Type	File Name	Explanation	Default File Type
Input files	Subcommand files	- These files contain the execute program command and the parameters. - These files are created by the user.	None
Output files	List files	- These files are the result of output of library data.	.lst
I/O files	Object module files	- These are object module files output by the assembler or compiler.	.rel
	Library files	- These files input the library files output by the librarian and update the contents.	.lib
	Temporary files	- These files are automatically generated by the librarian when forming a library. They are deleted when execution of the librarian is complete.	Lbxxxxxx.$$y (y = 1-6)

Figure 8-1 I/O Files of Librarian



8.2 Functions of Librarian

(1) Formation of a library of modules

The assembler and linker create 1 file for every module they output.

This means that if a large number of modules are created, the number of files also grows. The RA78K0 therefore includes a function for collecting a number of object modules in a single file. This function is called module library formation, and a file which is organized as a library is called a library file.

A library file can be input to the linker. By creating a library file consisting of modules common to many programs, users can make file management and operation efficient and easy when performing modular programming.

(2) Editing of library files

The librarian incorporates the following editing functions for library files.

(a) Addition of modules to library files

(b) Deletion of modules from library files

(c) Replacement of modules in library files

(d) Retrieval of modules from library files

For detailed explanations of these functions, refer to "8.5 Subcommands".

(3) Output of library file data

The librarian incorporates functions for the editing and output of the following items of data stored in library files.

(a) Module names

(b) Created programs

(c) Date of registration

(d) Date of update

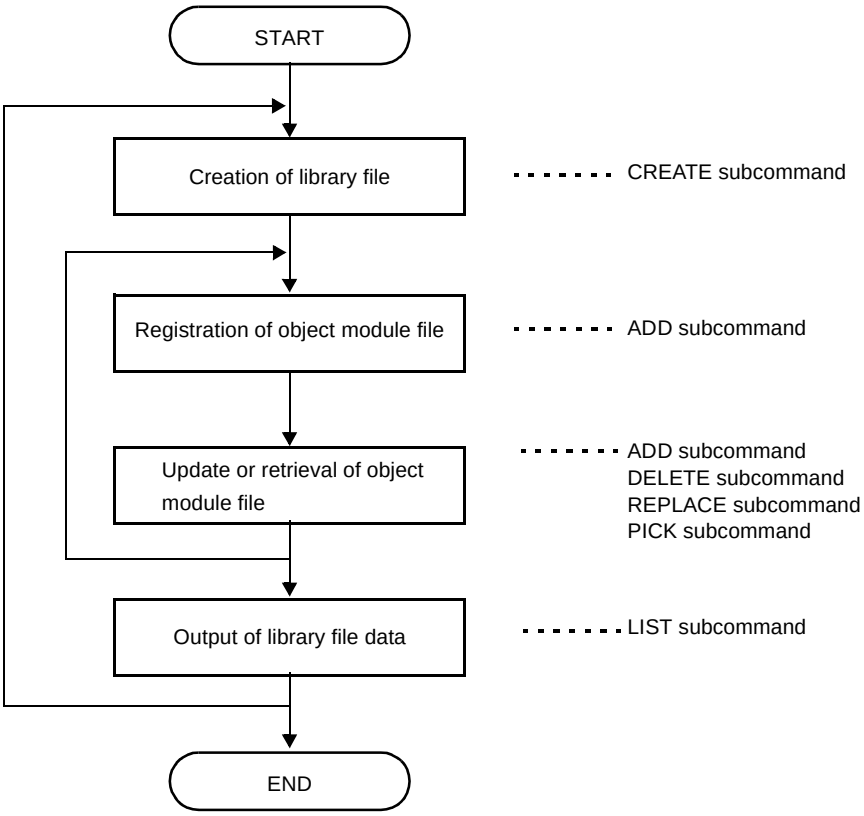
(e) PUBLIC symbol data

Caution The librarian performs functions (2) and (3) explained above using subcommands. The librarian determines each subcommand in order while performing processing. For an explanation of the operation of subcommands, refer to "8.5 Subcommands".

(4) Procedure for creating a library file

The general procedure for creating library files is as follows.

Figure 8-2 Procedure for Creating Library File



8.3 Librarian Startup

8.3.1 Librarian startup

The following two methods can be used to start up the librarian.

(1) Startup from the command line

```
X>[ path-name ] lb78k0 [ Δ option ] ...
 ↑      ↑        ↑       ↑
(a)    (b)      (c)     (d)
```

(a) Current drive name

(b) Current directory name

(c) Librarian command file name

(d) This contains detailed directions for the action of the librarian

Enclose a path that includes a space in a pair of double quotation marks (" ").

Example C>lb78k0 -ll20 -lw80

Caution If more than one librarian option is specified, separate the options with a space. For a detailed explanation of librarian options, refer to "8.4 Librarian Options".

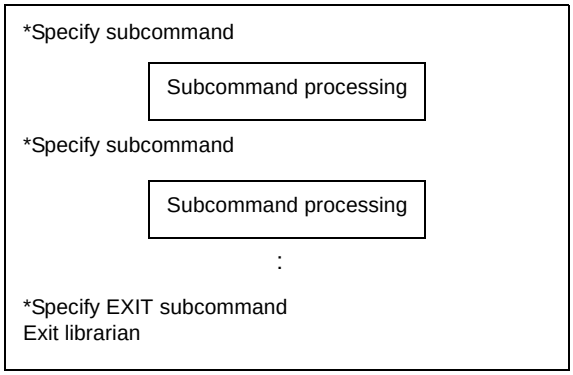
When the librarian is started up, the following startup message appears on the display.

```
78K/0 Series Librarian Vx.xx [ xx xxx xx ]
  Copyright (C) NEC Electronics Corporation xxxx , xxxx
*
```

After an asterisk (*), specify a librarian subcommand.

```
*create k0.lib
*add k0.lib k0main.rel k0sub.rel
*exit
```

When input of subcommands is finished, processing of each subcommand begins. When processing of one subcommand is complete, "*" appears again on the screen and the librarian waits for the next subcommand to be entered. The librarian repeats this operation until the EXIT subcommand is entered.



Up to 128 characters can be specified in 1 line.

If all the required operand data will not fit on 1 line, use "&" to continue specification on the next line.

Specification can be continued up to 15 lines.

(2) Startup from a subcommand file

A subcommand file is a file in which librarian subcommands are stored.

If a subcommand file is not specified when the librarian is started up, multiple subcommands must be specified after the "*" appears. By creating a subcommand file, these multiple subcommand files can all be processed at once.

A subcommand file can also be used when the same subcommand is specified repeatedly each time library formation is performed.

When using a subcommand file, describe "<" before the file name.

Start up the librarian from a subcommand file as follows.

```
X>lb78k0 Δ  < subcommand-file-name   [ Δ option ] ...
          ↑              ↑
         (i)            (ii)
```

(i) Be sure to add this when specifying a subcommand file

(ii) File in which subcommands are stored

(a) Use an editor to create the subcommand file.

(b) The rules for writing the content of a subcommand file are as follows.

```
Subcommand name   operand data
Subcommand name   operand data
  :
EXIT
```

(c) When repeating one subcommand, describe "&" at the end of each line to indicate continuation.

(d) Everything described from a semicolon (";") to the end of the line will be assumed to be a comment, and will not be interpreted by the librarian command.

(e) If the last subcommand in a subcommand file is not the EXIT subcommand, the librarian will automatically interpret an EXIT subcommand.

(f) The librarian reads subcommands from the subcommand file and processes them. The librarian quits after it completes processing of all subcommands in the subcommand file.

Example Create the subcommand file (k0.slb) using an editor.

< Contents of k0.slb >

```
; library creation command
create k0.lib
add k0.lib k0main.rel &
k0sub.rel
;
exit
```

Use subcommand file k0.slb to start up the librarian.

```
C>lb78k0 <k0.slb
```

8.3.2 Execution start and end messages

(1) Execution start message

When the librarian is started up, an execution startup message appears on the display.

```
78K/0 Series Librarian Vx.xx [ xx xxx xx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx
*
```

(2) Execution end message

The librarian does not output an execution end message. When the user enters the EXIT subcommand after all processing is complete, the librarian returns control to the operating system.

```
*create k0.lib
*add k0.lib k0main.rel k0sub.rel
*exit
```

If the librarian detects a fatal error which makes it unable to continue librarian processing, the librarian outputs a message to the display and returns control to the operating system.

Example A non-existent librarian option is specified.

```
C>lb78k0 -a

78K/0 Series Librarian Vx.xx [ xx xxx xx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx
RA78K0 error F5018 : Option is not recognized ' -z '
Usage : LB78K0 [ options ]
```

In the above example, a non-existent librarian option is specified. An error results and the librarian aborts librarian execution.

When an error message is displayed and library formation is aborted, look for the cause in "CHAPTER 12 ERROR MESSAGES" and take action accordingly.

8.4 Librarian Options

8.4.1 Types of librarian options

The librarian options are used to specify the format of list files and the file creation path for temporary files. Librarian options are classified into 4 types.

Table 8-2 Librarian Options

Classification	Option	Explanation
List file format specification	-LW	Changes the number of characters that can be printed in 1 line in a list file.
	-LL	Changes the number of lines that can be printed in 1 page in a list file.
	-LF	Inserts a page feed code at the end of a list file.
	-NLF	
Specification of path for temporary file creation	-T	Creates a temporary file in a specified path.
Device file search path specification	-Y	Reads a device file from a specified path.
Help specification	--	Displays a help message on the display.

8.4.2 Explanation of librarian options

The following is a detailed explanation of the library options.

(1) List file format specification

List file format specification (-LW, -LL, -LF/-NLF)

(a) -LW

[Syntax]

-LW [number-of-characters]

- Default assumption

  -LW132 (80 characters in the case of display output)

[Function]

- Option -LW changes the number of characters that can be printed in 1 line in a list file.

[Application]

- Specify option -LW to change the number of characters that can be printed in 1 line in a list file.

[Explanation]

- The range of number of characters that can be specified with option -LW is shown below.
  (In the case of display output, this number is 80)
- 72 ≤ number of characters printed on 1 line ≤ 260
- If a numerical value outside this range, or something other than a numerical value, is specified, an abort error occurs.
- If the number of characters is omitted, 132 will be specified. If the list file is output to the display, 80 is specified.
- The specified number of characters does not include the terminator (CR, LF).
- If the LIST subcommand is not specified, option -LW is ignored.
- If option -LW is specified 2 or more times, the last specified item will take precedence.

[Example of use]

- Specify 80 as the number of characters per line in a list file.

```
C>lb78k0 -lw80
```

(b) -LL

[Syntax]

-LL [number-of-lines]

- Default assumption

  -LL66 (No page breaks in the case of display output)

[Function]

- Option -LL specifies the number of lines that can be printed in 1 page in a list file.

[Application]

- Specify option -LL to change the number of lines that can be printed in 1 page in a list file.

[Explanation]

- The range of number of lines that can be specified with option -LL is shown below.
  20 ≤ number of lines printed on 1 page ≤ 32767
- If a numerical value outside this range, or something other than a numerical value, is specified, an abort error occurs.
- If the number of lines is omitted, 66 will be specified.
- If the number of lines specified is 0, no page breaks will be made.
- If the LIST subcommand is not specified, option -LL is ignored.
- If option -LL is specified 2 or more times, the last specified item will take precedence.

[Example of use]

- Specify 20 as the number of lines per page in a list file.

```
C>lb78k0 -ll20
```

(c) -LF/-NLF

[Syntax]

```
-LF
-NLF
```

- Default assumption

  -NLF

[Function]

- Option -LF inserts a form feed (FF) code at the end of a list file.
- The -NLF option makes the -LF option unavailable.

[Application]

- If you wish to add a page break after the contents of a list file are printed, specify option -LF to add a form feed code.

[Explanation]

- If the LIST subcommand is not specified, option -LF is ignored.
- If both options -LF and -NLF are specified at the same time, the option specified last takes precedence.

[Example of use]

- Add a page feed code to a list file.

```
C>lb78k0 -lf
```

(2) Specification of path for temporary file creation

Specification of path for temporary file creation (-T)

[Syntax]

```
-T path-name
```

- Default assumption

  Created in the path specified by the environmental variable TMP.

  If no path is specified, the temporary file is created in the current path.

[Function]

- Option -T creates a temporary file in a specified path.

[Application]

- Use option -T to specify the location for creation of a temporary file.

[Explanation]

- Only a path can be specified as a path name.
- The path name cannot be omitted.
- Even if a previously created temporary file exists, if the file is not protected it will be overwritten.
- As long as the required memory size is available, the temporary file will be expanded in memory. If not enough memory is available, the contents of the temporary file being created will be written to disk.

  Such temporary files may be accessed later through the saved disk file.
- Temporary files are deleted when library formation is finished. They are also deleted when library formation is aborted by pressing (CTRL-C).
- The path in which the temporary file is to be created is determined according to the following order.

  (i) The path specified by option -T

  (ii) The path specified by environmental variable TMP (when option -T is omitted)

  (iii) The current path (when TMP is not set)

  When (i) or (ii) is specified, if the temporary file cannot be created in the specified path an abort error occurs.

[Example of use]

- Specify output of a temporary file to directory c:\tmp.

```
C>lb78k0 -tc:\tmp
```

(3) Device file search path specification

Device file search path specification (-Y)

[Syntax]

-Y path-name

- Default assumption

  Device files will be read from the path determined in the following order.

  (i) <..\dev> (for the lb78k0.exe startup path)

  (ii) Path by which LB78K0 was started up

  (iii) Current directory

  (iv) The environmental variable PATH

[Function]

- Reads a device file from the specified path.

[Application]

- Specify a path where a device file exists.

[Explanation]

- If anything other than a path name is specified after option -Y, an abort error occurs.
- If the path name is omitted after option -Y, an abort error occurs.
- The path from which the device file is read in the order determined as follows.

  (i) Path specified by option -Y

  (ii) <..\dev> (for the lb78k0.exe startup path)

  (iii) Path by which LB78K0 was started up

  (iv) Current directory

  (v) The environmental variable PATH

[Example of use]

- Specify the path for the device file as directory c:\78k0\dev

```
C>lb78k0 -yc:\78k0\dev
```

(4) Help specification

Help specification (--)

[Syntax]

```
--
```

- Default assumption

  No display

[Function]

- Option -- displays a help message on the display.

[Application]

- The help message is a list of explanations of the subcommands. Refer to these when executing the librarian.

[Explanation]

- When option -- is specified, all other options are unavailable.

  Caution This option cannot be specified from PM plus.

  To reference PM plus help, click the [Help] button in the < Library File Name > dialog box.

[Example of use]

- When option -- is specified, a help message is output on the display.

```
C>lb78k0 --

78K/0 Series Librarian Vx.xx [ xx xxx xx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx
+-------------------------------------------------------------------------------------------------------+
|  Subcommands : create , add , delete , replace , pick , list , help , exit                            |
|                                                                                                       |
|    Usage : subcommand [ option ] masterLBF [ option ] transaction [ option ]                          |
|                                                                                                       |
|                    transaction : ==                        OMFname                                    |
|                                                  LBFname [ ( modulename [ , ... ] ) ]                 |
|                                                                                                       |
|    <create      > :      create masterLBF [ transaction ]                                             |
|    <add         > :      add masterLBF transaction                                                    |
|    <delete      > :      delete masterLBF ( modulename [ , ... ] )                                    |
|    <replace     > :      replace masterLBF transaction                                                |
|    <pick        > :      pick masterLBF ( modulename [ , ... ] )                                      |
|    <list        > :      list [ option ] masterLBF [ ( modulename [ , ... ] )                         |
|                          option :  -p                = output public symbol                           |
|                                    -np               = no output public symbol                        |
|                                    -o filename = specify output file name                             |
|    <help        > : help                                                                              |
|    <exit        > : exit                                                                              |
+-------------------------------------------------------------------------------------------------------+
```

8.5 Subcommands

8.5.1 Types of subcommands

The subcommands provide detailed directions for the operation of the librarian. Subcommands are classified into eight types.

Table 8-3 Subcommands

Subcommand Name	Abbrev.	Explanation
CREATE	C	Creates a new library file.
ADD	A	Adds a module to a library file.
DELETE	D	Deletes a module from a library file.
REPLACE	R	Replaces module in a library file with other modules.
PICK	P	Retrieves a module from a library file.
LIST	L	Outputs data on modules in a library file.
HELP	H	Displays a help message on the display.
EXIT	E	Exits librarian.

8.5.2 Explanation of subcommands

The following is a detailed explanation of the function and operation of each subcommand.

[General format of command files]

```
*Subcommand [ Δ option] Δ library-file-name [ Δ option] transaction [ Δ option]
                        ↑                          ↑
                       (a)                        (b)
```

(a) The library file name specified immediately before can be replaced with '.'.

(b) Transaction = Δ object-module-file-name Δ library-file-name [Δ (Δ module-name [Δ , ...])]

(1) CREATE

CREATE

[Syntax]

CREATE Δ library-file-name [Δ transaction]

- Default assumption

  C

[Function]

- The CREATE subcommand creates a new library file.

[Explanation]

- The size of the created library file becomes 0.
- When a transaction is specified, a module is registered at the same time as the library file is created.
- Library file name : If a file with the same name already exists, it will be overwritten.
- Transaction : An object module file carrying the same public symbol as the public symbol in the library file cannot be registered.

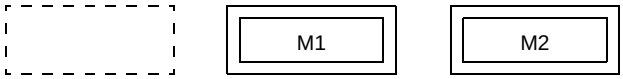
  A module with the same name as a module in the library file cannot be registered.
- If an error occurs, processing is interrupted and the library file cannot be created.

[Example of use]

- Register modules M1 and M2 at the same time as a library file is created.

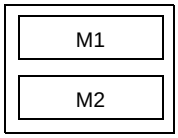
  *create k0.lib m1.rel m2.rel

  < Before file creation >



  < After file creation >

  k0.lib



(2) ADD

ADD

[Syntax]

ADD Δ library-file-name Δ transaction

- Default assumption

  A

[Function]

- The ADD subcommand adds a module to a library file.

[Explanation]

- A module can be added to a library file even if no modules are currently stored in the library.
- If a module with the same name as the module to be added already exists in the library file, an error occurs.
- If the module to be added carries the same public symbol as the public symbol in the library file, an error occurs.

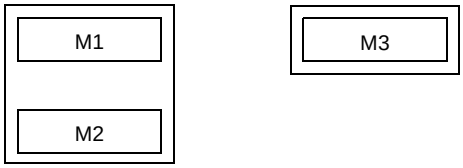
[Example of use]

- Add a module (M3) to a library file (k0.lib).

  *add k0.lib m3.rel

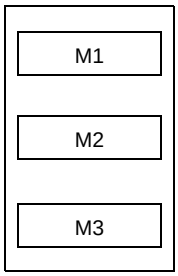
  < Before addition >

  k0.lib



  < After addition >

  k0.lib



(3) DELETE

DELETE

[Syntax]

DELETE Δ library-file-name Δ (Δ module-name [Δ , ...] Δ)

- Default assumption

  D

[Function]

- The DELETE subcommand deletes a module from a library file.

[Explanation]

- If the specified module does not exist in the library file, an error occurs.
- If an error occurs, processing is interrupted and the condition of the library file will not be changed.

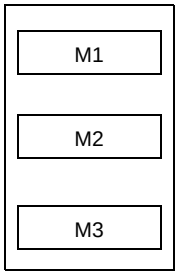
[Example of use]

- Delete modules (M1, M3) from a library file (k0.lib).

  *delete k0.lib (m1.rel , m3.rel)

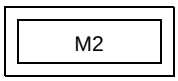
  < Before deletion >

  k0.lib



  < After deletion >

  k0.lib



(4) REPLACE

REPLACE

[Syntax]

REPLACE Δ library-file-name Δ transaction

- Default assumption

  R

[Function]

- The REPLACE subcommand replaces module in a library file with the module in other object module files.

[Explanation]

- If no module in the library file has the same name as the replacement module, an error will result.
- If a public symbol contained in the replacement module is the same as a public symbol in the library file, an error will occur.
- The file name of the replacement object module must be the same as the file name used in registration.
- If an error occurs, processing is interrupted and the condition of the library file will not be changed.

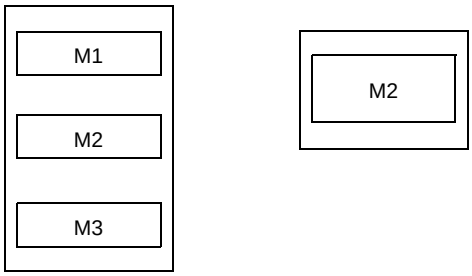
[Example of use]

- Replace a module (M2) in a library file (k0.lib).

*replace k0.lib m2.rel

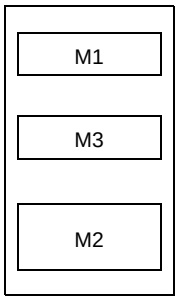
< Before replacement >

k0.lib



< After replacement >

k0.lib



Because the new module (M2) is registered after the module (M2) in the library file is deleted, M2 is last in order in the library file.

(5) PICK

PICK

[Syntax]

PICK Δ library-file-name Δ (Δ module-name [Δ , ...] Δ)

- Default assumption

  P

[Function]

- The PICK subcommand retrieves a specified module from an existing library file.

[Explanation]

- The retrieved module becomes an object module file with the file name under which it was registered in the library file.
- If the specified module name does not exist in the library file, an error will result.
- If an error occurs, processing is interrupted. However, if an error occurs when two or more modules are specified, the modules retrieved before the module which caused the error become available and are saved onto disk.

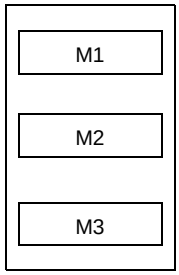
[Example of use]

- Retrieve a module (M2) from a library file (k0.lib).

  *pick k0.lib (m2.rel)

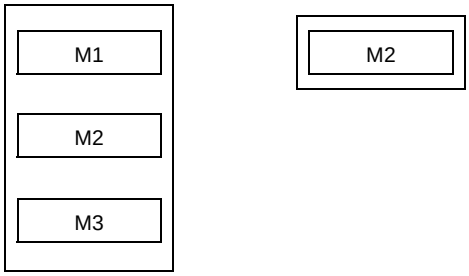
  < Before pickup >

  k0.lib



  < After pickup >

  k0.lib



(6) LIST

LIST

[Syntax]

```
LIST [ Δ option] Δ library-file-name [ Δ ( Δ module-name [ Δ , ... ] Δ )]
                Option :    -PUBLIC/-NOPUBLIC
                     :      - O Δ file-name
```

- Default assumption

  L

[Function]

- The LIST subcommand outputs data on modules in a library file.

[Explanation]

- Multiple options may be specified.
- -O :

  A device-type file name can be specified as the output file name.

  If the output file name is omitted, an error occurs.

  If the file type is omitted, the librarian assumes that "input-file-name.LST" is entered.
- -PUBLIC/-NOPUBLIC :

  This option can be selected by specifying only the underlined characters.

  -PUBLIC specifies output of public symbol data.

  -NOPUBLIC makes -PUBLIC unavailable.

  If -PUBLIC and -NOPUBLIC are specified at the same time, the last specified option takes precedence.

[Example of use]

- Output a module data in a library file (k0.lib) to a list file (k0.lst). Specify option -P so that public symbol ata will be output.

  *list -p -ok0.lst k0.lib

List file (k0.lst) is referenced.

```
78K/0 Series librarian Vx.xx    DATE : xx xxx xx PAGE   1

LIB-FILE NAME : K0.LIB    ( xx xxx xx )

0001  M1.REL                ( xx xxx xx )

   sym1  sym2  sym3

   NUMBER OF PUBLIC SYMBOLS :   3

0002  M3.REL                ( xx xxx xx )

   NUMBER OF PUBLIC SYMBOLS :   0

0003  M2.REL                ( xx xxx xx )

   bit1  bit2

   NUMBER OF PUBLIC SYMBOLS :   2
```

(7) HELP

HELP

[Syntax]

```
HELP
```

- Default assumption

  H

[Function]

- The HELP command displays a help message on the display.

[Explanation]

- The help message is a list of the subcommands and explanations for each. Specify the HELP command or option -- to refer to this message during librarian execution.

[Example of use]

- Specify the HELP command to output the HELP message.

  *help

```
+-------------------------------------------------------------------------------------------------------------------+
| Subcommands : create , add , delete , replace , pick , list , help , exit                                         |
|                                                                                                                   |
|    Usage : subcommand [ option ] masterLBF [ option ] transaction [ option ]                                      |
|                                                                                                                   |
|                    transaction : ==          OMFname                                                              |
|                                              LBFname [ ( modulename [ , ... ] ) ]                                 |
|                                                                                                                   |
|    <create      > :     create masterLBF [ transaction ]                                                          |
|    <add         > :     add masterLBF transaction                                                                 |
|    <delete      > :     delete masterLBF ( modulename [ , ... ] )                                                 |
|    <replace     > :     replace masterLBF transaction                                                             |
|    <pick        > :     pick masterLBF ( modulename [ , ... ] )                                                   |
|    <list        > :     list [ option ] masterLBF [ ( modulename [ , ... ] )                                      |
|                                  option :          -p       = output public symbol                              |
|                                                    -np      = no output public symbol                           |
|                                                    -o filename = specify output file name                       |
|    <help        > :     help                                                                                      |
|    <exit        > :     exit                                                                                      |
+-------------------------------------------------------------------------------------------------------------------+
```

(8) EXIT

EXIT

[Syntax]

```
EXIT
```

- Default assumption

  E

[Function]

- The EXIT subcommand exits the librarian.

[Explanation]

- Use this subcommand to exit the librarian.

[Example of use]

- Exit the librarian.

```
*exit
```

8.6 Option Settings in PM plus

This section describes the method for specifying library flies from PM plus.

8.6.1 Option setting method

Select [Librarian Options] from the [Tools] menu of PM plus or the [LB] button on the toolbar is pressed to display the < Librarian Options > dialog box. After specifying the path and the file name, press [Next] to display the < Subcommand > dialog box.

The various librarian options can be set by inputting the required option in this dialog box.

Figure 8-3 < Librarian Options > Dialog Box (When << Output >> Tab Is Selected)

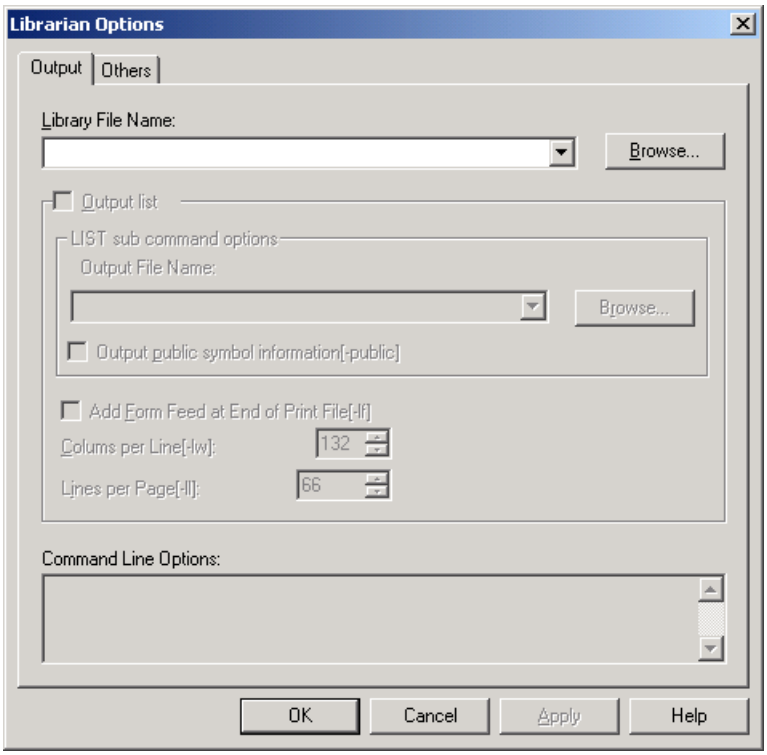
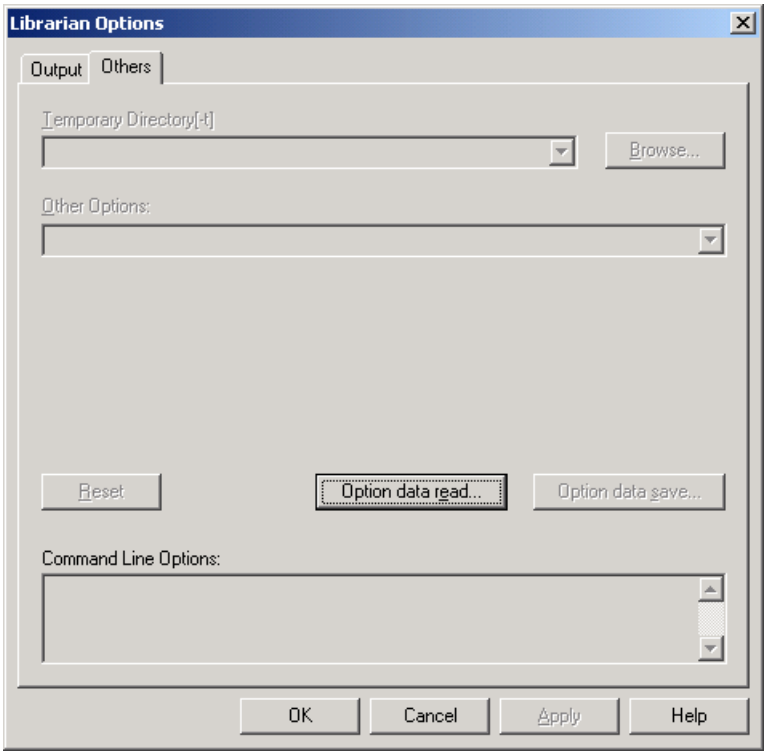


Figure 8-4 < Librarian Options > Dialog Box (When << Others >> Tab Is Selected)



8.6.2 Option settings

The various options in the < Librarian > dialog box are described below.

<< Output >> Tab

- Library File Name

  Specify the name of the library file by using the [Browse] button or by directly inputting the file name.

- LIST sub command options

  Check this box to output a list file.

- Output File Name

  Specify the name and path of the list file by using the [Browse] button or by directly inputting the file name.

- Output public symbol information[-publc]

  Check this box to add public symbol information to the list file to be output.

- Add Form Feed at End of Print File[-lf]

  Check this box to add a page feed code (FF) to the end of a library file.

- Colums per Line[-lw]

  Specify the number of characters on one line of a library file. Between 72 and 260 characters can be specified.

- Lines per Page[-ll]

  Specify the number of lines on one page of a library file. Between 20 and 32767 lines can be specified.

- Command Line Options

  This edit box is read-only. The currently set option character string is displayed.

<< Others >> Tab

- Temporary directory [-t]

  Specify the path where a temporary file is to be created, by using the [Browse] button or directly inputting a path name.

- Other Options

  To specify an option other than those that can be set in the dialog box, enter it in the input box.

  Caution The help specification (--) option cannot be specified on PM plus.

- Reset

  Resets the input contents.

- Option data read

  Opens the < Read Option Data > dialog box and after the option file has been specified, reads this file.

- Option data save

  Opens the < Save Option Data > dialog box and saves the option file under the specified name.

- Command Line Options

  This edit box is read-only. The currently set option character string is displayed.

8.7 Method for Manipulating Library Files from PM plus

This section describes the method for manipulating library files from PM plus.The < Edit Option > dialog box is described below.

8.7.1 Method for manipulating

Register the execution format for starting LB in standalone mode by selecting [Register Ex-tool] from the [Tools] menu of PM plus.

Selecting the registered icon then opens the < Library File Name > dialog box.

After specifying the path and the file name, press [Next] to display the < Subcommand > dialog box.

Figure 8-5 < Library File Name > Dialog Box

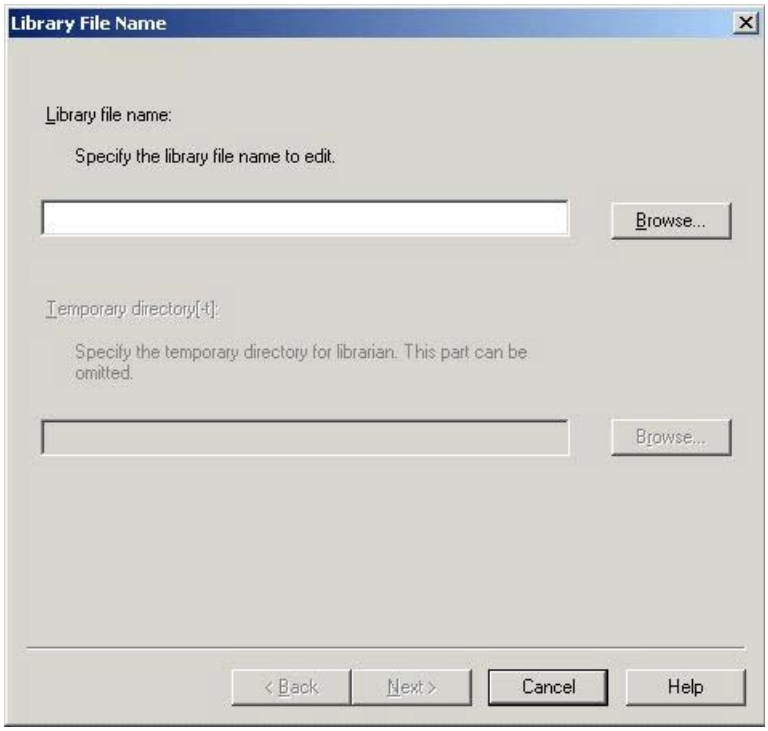
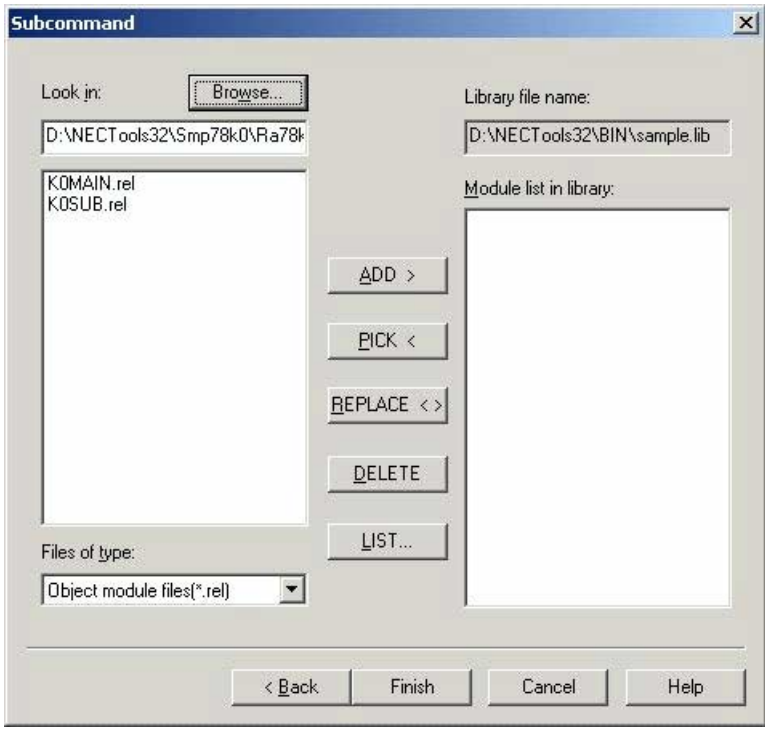


Figure 8-6 < Subcommand > Dialog Box



8.7.2 Item settings

The various items in the < Subcommand > dialog box are described below.

< Library File Name > Dialog Box

- Library file name

  Specify the name of the library file by using the [Browse] button or by directly inputting the file name.

- Temporary directory [-t]

  Specify the path where a temporary file is to be created, by using the [Browse] button or directly inputting a path name.

< Subcommand > Dialog Box

- Look in

  Specify the path where the object module file to be used as a library exists by using the [Browse] button or directly inputting a path.

  If a path is specified, a file list is displayed.

- Files of type

  Specify the type of the file to be displayed on the list of files.

- Library file name

  This edit box is read-only. It displays the file name of the library currently specified.

- Module list in library

  A list of the object module files in the library currently specified is displayed.

- ADD >

  Add a module to an existing library file.

- PICK <

  Retrieve the specified module from an existing library file.

- REPLACE < >

  Replace an existing library file module with the module of another object module file.

- DELETE

  Delete a module from an existing library file.

- LIST

  Outputs data on modules in a library file.

CHAPTER 9 LIST CONVERTER

The list converter inputs assemble list files and object module files output by the assembler and load module files output by the linker.

The list converter then embeds actual addresses in the relocatable addresses and symbols in the input file and outputs an absolute assembly list. This eliminates the troublesome task of looking at an assemble list while referring to a link map.

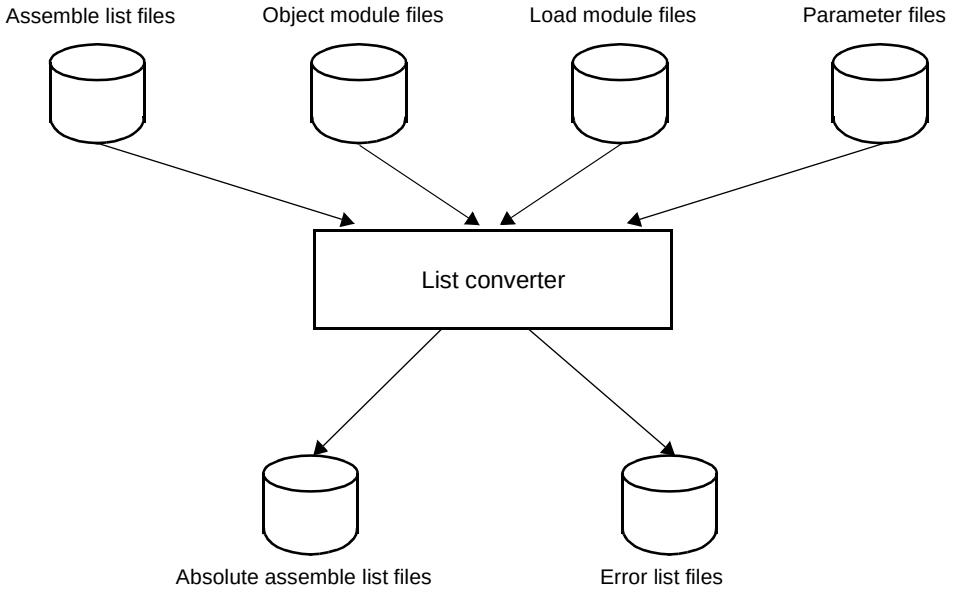
9.1 I/O Files of List Converter

The I/O files of the list converter are as shown below.

Table 9-1 I/O Files of List Converter

Type	File Name	Explanation	Default File Type
Input files	Object module files	- These are binary files including relocation data and symbol data regarding machine language data and machine language location addresses.	.rel
	Assemble list files	- These are files containing assembly data such as assemble lists and cross-reference lists.	.prn
	Load module files	- These are binary image files which contain object code as a result of linking.	.lmf
	Parameter files	- These files contain the parameters for the executed program. - These files are created by the user.	.plv
Output files	Absolute assemble list files	- This is a list file which embeds actual addresses in relocatable addresses and symbols in the input file.	.p
	Error list files	- These are files containing error data generated during list conversion.	.elv

Figure 9-1 I/O Files of List Converter



9.2 Functions of List Converter

The following is a comparison of the advantages and disadvantages of relocatable assemblers with respect to absolute assemblers.

[Advantages]

(1) Relocatable assemblers can be developed by a team of several personnel.
(2) Relocatable assemblers can be divided into modules for easy development and storage.
(3) Relocatable assemblers support library management.
(4) Relocatable assemblers are appropriate for development of large-scale programs.

[Disadvantages]

(1) The addresses in the assemble lists of relocatable assemblers do not agree with their actual, physical addresses.
(2) The values of external symbols become 0 in the assemble lists of relocatable assemblers. To find out the actual values of external symbols, a link map must be referred to.
(3) Relocatable values in assemble lists are different from actual values.

The above disadvantages particularly reduce productivity in the areas of debugging and storage because of the considerable documentation they require. The list converter offers a solution to these disadvantages of relocatable assembler packages.

(1) The absolute assemble list output by the list converter agrees completely with the addresses used in actual program operation.
(2) The actual values of external symbols are embedded in the list.
(3) Relocatable values are embedded in the list as actual values.
(4) For the symbol values in symbol tables or cross-reference lists, the actual values are embedded in the list.

Example 1 Relocation embedding

< Assemble list >

```
21  2   ----                    CSEG
22  22  0000            START :
23  23
24  24                          ; chip initialize
25  25
26  26  0000    11201A          MOV     HDTSA , #1AH
27  27  0003    1620FE          MOVW    HL , #HDTSA     ; set hex 2-code data in HL registor
28  28
29  29  0006 R9A0000           CALL    !CONVAH         ; convert ASCII <- HEX
30  30                                                  ; output BC-register <- ASCII code
31  31  0009    1421FE          MOVW    DE , #STASC     ; set DE <- store ASCII code table
32  32  000C    63              MOV     A , B
33  33  000D    95              MOV     [ DE ] , A
34  34  000E    84              INCW    DE
35  35  000F    62              MOV     A , C
36  36  0010    95              MOV     [ DE ] , A
37  37
38  38  0011    FAFE            BR      $$
39  39
40  40                          END
```

< Absolute assemble list >

```
21  21  ----                    CSEG
22  22  0080            START :
23  23
24  24                          ; chip initialize
25  25
26  26  0080    11201A          MOV     HDTSA , #1AH
27  27  0083    1620FE          MOVW    HL , #HDTSA     ; set hex 2-code data in HL registor
28  28
29  29  0086 R9A9300           CALL    !CONVAH         ; convert ASCII<- HEX
30  30                                                  ; output BC-register <- ASCII code
31  31  0089    1421FE          MOVW    DE , #STASC     ; set DE <- store ASCII code table
32  32  008C    63              MOV     A , B
33  33  008D    95              MOV     [ DE ] , A
34  34  008E    84              INCW    DE
35  35  008F    62              MOV     A , C
36  36  0090    95              MOV     [ DE ] , A
37  37
38  38  0091    FAFE            BR      $$
39  39
40  40                          END
```

Example 2 Embedding of object codes

< Assemble list >

```
21  21   ----                    CSEG
22  22   0000          START :
23  23
24  24                           ; chip initialize
25  25
26  26   0000   11201A          MOV    HDTSA , #1AH
27  27   0003   1620FE          MOVW   HL , #HDTSA     ; set hex 2-code data in HL registor
28  28
29  29   0006 R9A0000           CALL   !CONVAH         ; convert ASCII <- HEX
30  30                                                  ; output BC-register <- ASCII code
31  31   0009   1421FE          MOVW   DE , #STASC     ; set DE <- store ASCII code table
32  32   000C   63              MOV    A , B
33  33   000D   95              MOV    [ DE ] , A
34  34   000E   84              INCW   DE
35  35   000F   62              MOV    A , C
36  36   0010   95              MOV    [ DE ] , A
37  37
38  38   0011   FAFE            BR     $$
39  39
40  40                           END
```

< Absolute assemble list >

```
21  21   ----                                CSEG
22  22   0080          START :
23  23
24  24                                                  ; chip initialize
25  25
26  26   0080   11201A          MOV    HDTSA , #1AH
27  27   0083   1620FE          MOVW   HL , #HDTSA     ; set hex 2-code data in HL registor
28  28
29  29   0086 R9A9300           CALL   !CONVAH         ; convert ASCII <- HEX
30  30                                                  ; output BC-register <- ASCII code
31  31   0089   1421FE          MOVW   DE , #STASC     ; set DE <- store ASCII code table
32  32   008C   63              MOV    A , B
33  33   008D   95              MOV    [ DE ] , A
34  34   008E   84              INCW   DE
35  35   008F   62              MOV    A , C
36  36   0090   95              MOV    [ DE ] , A
37  37
38  38   0091   FAFE            BR     $$
39  39
40  40                           END
```

9.3 List Converter Startup

9.3.1 List converter startup

The following two methods can be used to start up the list converter.

(1) Command-line startup

```
X>lcnv78k0 [ Δ option ] ... input-file-name [ Δ option ] ... [ Δ ]
↑    ↑        ↑              ↑              ↑
(a)  (b)      (c)            (d)            (c)
```

(a) Current drive name

(b) Command file name of the list converter

(c) Enter detailed instructions for the operation of the list converter.
Enclose a path that includes a space in a pair of double quotation marks (" ").

(d) Primary name of assemble list
Specify the file name of a path that includes a space by enclosing it in a pair of double quotation marks (" ").

Example C>lcnv78k0 k0main -lk0.lmf

Cautions 1. In (c) above, when specifying two or more list converter options, separate the list converter options with a blank space. For a detailed explanation of list converter options, refer to "9.4 List Converter Options".

Cautions 2. Use the extension .prn for (d) above.

Cautions 3. In (d) above, if only the primary name of the assemble list is specified in the command line, the primary names of the object module file and load module file must be identical to the primary name of the assemble list file.
The file types must also be as shown below.

Table 9-2 Type of Specification File When List Converter Is Started

File Name	Type
Object module type	.rel
Load module file	.lmf

Use an option when specifying a file which is different in the primary name.

(2) Startup from a parameter file

Use the parameter file when the data required to start up the list converter will not fit on the command line, or when the same list converter option is specified repeatedly each time list conversion is performed.

To start up the list converter from a parameter file, specify the specify parameter file option (-F) on the

command line.

Start up the list converter from a parameter file as follows.

```
C>lcnv78k0 [ Δ input-file-name] Δ -f parameter-file-name
                                  ↑          ↑
                                 (a)        (b)
```

(a) Specify a parameter file option

(b) A file which includes the data required to start up the list converter

Remark Create the parameter file using an editor.

The rules for writing the contents of a parameter file are as follows.

```
[ [ [ Δ ] option [ Δ option ]  ...  [ Δ ] Δ ] ] ...
```

- If the input file name is omitted from the command line, only 1 input file name can be specified in the parameter file.
- The input file name can also be written after the option.
- Write in the parameter file all list converter options and output file names that should be specified in the command line.

Example Create the parameter file (k0.plv) using an editor.

< Contents of k0.plv >

```
; parameter file
k0main -lk0.lmf
-ek0.elv
```

Use parameter file (k0.plv) to start up the list converter.

```
C>lcnv78k0 -fk0.plv
```

9.3.2 Execution start and end messages

(1) Execution start message

When the list converter is started up, an execution startup message appears on the display.

```
List Conversion Program for RA78K/0 Vx.xx [ xx xxx xx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

Pass1 : start ...
Pass2 : start ...
```

(2) Execution end message

If it detects no list conversion errors resulting from the list conversion, the list converter outputs the following message to the display and returns control to the operating system.

```
Conversion complete.
```

If the list converter detects a fatal error during list conversion which makes it unable to continue list conversion processing, the list converter outputs a message to the display, cancels list conversion and returns control to the operating system.

Example A non-existent list converter option is specified.

```
C>lcnv78k0 k0main.prn -a

List Conversion Program for RA78K/0 Vx.xx [ xx xxx xx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

RA78K0 error F6018 : Option is not recognized ' -a '
Program aborted.
```

When the list converter outputs an error message and aborts list conversion, look for the cause in "CHAPTER 12 ERROR MESSAGES" and take action accordingly.

9.4 List Converter Options

9.4.1 Types of list converter options

The list converter options are detailed instructions for the operation of the list converter. List converter options are classified into 6 types.

Table 9-3 List Converter Options

Classification	Option	Explanation
Object module file input specification	-R	Inputs an object module file.
Load module file input specification	-L	Inputs a load module file.
Absolute assemble list file output specification	-O	Specifies output of an absolute assemble list file.
Error list file output specification	-E	Outputs an error list file.
Parameter file specification	-F	Inputs the input file name and options from a specified file.
Help specification	--	Displays a help message on the display.

9.4.2 Explanation of list converter options

Each list converter option is described in detail on the following pages.

(1) Object module file input specification

Object module file input specification (-R)

[Syntax]

```
-R [ input-file-name ]
```

- Default assumption

  -R assemble-list-file-name.rel

[Function]

- Option -R specifies the input of an object module file.

[Application]

- When the primary name of an object module file is different from the primary name in the assemble list file, or if its file type is not ".rel", specify option -R.

[Explanation]

- If a fatal error occurs, the absolute assemble list file cannot be output.
- If only the primary name of the input file name is specified, the list converter will assign the file type ".rel" and input the file.

[Example of use]

- Assemble list file name is k0main.prn, the object module file name is sample.rel, and the load module file name is k0.lmf.

  C>lcnv78k0 k0main.prn -rsample.rel -lk0.lmf

(2) Load module file input specification

Load module file input specification (-L)

[Syntax]

```
-L [ input-file-name ]
```

- Default assumption

  -L assemble-list-file-name.lmf

[Function]

- Option -L specifies the input of a load module file.

[Application]

- When the primary name of a load module file is different from the primary name in the assemble list file, or if its file type is not ".lmf", specify option -L.

[Explanation]

- If a fatal error occurs, the absolute assemble list file cannot be output.
- If only the primary name of the input file name is specified, the list converter will assign the file type ".lmf" and input the file.

[Example of use]

- Assemble list file name is k0main.prn and the load module file name is sample.rel.

  C>lcnv78k0 k0main.prn -lsample.lmf

(3) Absolute assemble list file output specification

Absolute assemble list file output specification (-O)

[Syntax]

-O [output-file-name]

- Default assumption

  -O assemble-list-file-name.p

[Function]

- Option -O specifies the output of an absolute assemble list file. Option -O also specifies the output destination and output file name.

[Application]

- Use option -O to change the output destination and output file name of the absolute assemble list file.

[Explanation]

- A file name can be specified as a disk-type file name or as a device-type file name. However, only CON, PRN, NUL, and AUX can be specified as device-type file names. If CLOCK is specified, an abort error will occur.
- If the same device is specified for the file name as for the error file, an abort error will occur.
- If the output file name is omitted when option -O is specified, the absolute assemble list file name will become "assemble-list-file-name.p".
- If only the primary name of the output file name is specified, the list converter will assign the file type ".p" and output the file.
- If the drive name is omitted when option -O is specified, the absolute assemble list file will be output to the current drive.

[Example of use]

- Create an absolute assemble list file (sample.p).

```
C>lcnv78k0 k0main.prn -osample.p -lk0.lmf
```

(4) Error list file output specification

Error list file output specification (-E/-NE)

[Syntax]

```
-E [ output-file-name ]
-NE
```

- Default assumption

  -NE

[Function]

- Specify option -E to specify the output of an error list file. This option also specifies the output destination and output file name.
- Option -NE makes option -E unavailable.

[Application]

- Specify option -E to save error messages in a file.

[Explanation]

- The file name of the error list file can be specified as a disk-type file name or as a device-type file name. However, if the device-type file name CLOCK is specified, an abort error will occur.
- If the device specified in the file name is the same as that specified in the absolute assemble list file, an abort error will occur.
- If option -E is specified and the output file name is omitted, the error list file name will be "assemble-list-file-name.elv".
- If only the primary name of the output file name is specified, the list converter will assign the file type ".elv" and output the file.
- If the drive name is omitted when option -E is specified, the error list file will be output to the current drive.
- If both options -E and -NE are specified at the same time, the option specified last takes precedence.

[Example of use]

- Create an error list file (sample.elv).

  C>lcnv78k0 k0main.prn -esample.elv

  The error list file (sample.elv) is referenced.

```
RA78K0 warning W6701: Load module file is older than object module file 'K0MAIN.LMF , K0MAIN.REL'
Pass1: start
RA78K0 error F6105: Segment name is not found is load module file 'DATA'
```

(5) Parameter file specification

Parameter file specification (-F)

[Syntax]

-F file-name

- Default assumption

  With no input file

[Function]

- Option -F specifies input of options and the input file name from a specified file.

[Application]

- Specify option -F when the data required to start up the list converter will not fit on the command line.
- When you wish to repeatedly specify the same options each time list conversion is performed, describe those options in a parameter file and specify option -F.

[Explanation]

- Only a disk-type file name can be specified as "file-name". If a device-type file name is specified, an abort error will occur.
- If the file name is omitted, an abort error will occur.
- If only the primary name of the file name is specified, the list converter will assign the file type ".plv" and open the file.
- Nesting of parameter files is not permitted. If option -F is specified within a parameter file, an abort error will occur.
- The number of characters that can be written within a parameter file is unlimited.
- Separate options or input file names with a blank space, a tab or a line feed code (LF).
- Options and input file names written in a parameter file will be expanded at the position specified for the parameter file on the command line.
- The expanded options specified last will take precedence.
- If option -F is specified two or more times, an abort error will occur.
- All characters entered after ";" or "#" and before a line feed code (LF) or "EOF" will be interpreted as comments.

[Example of use]

- Start up list converter using a parameter file.

  The contents of the parameter file (k0.plv) are as follows.

```
: parameter file
k0main -lk0.lmf
-ek0.elv
```

Enter the following on the command line.

```
C>lcnv78k0 -fk0.plv
```

(6) Help specification

Help specification (--)

[Syntax]

```
--
```

- Default assumption

  No display

[Function]

- Option -- displays a help message on the display.

[Application]

- The help message is a list of explanations of the list converter options. Refer to these when executing the list converter.

[Explanation]

- When option -- is specified, all other options are unavailable.

  Caution This option cannot be specified on PM plus.

  To reference PM plus help, click the [Help] button in the < List Converter Options > dialog box.

[Example of use]

- When option -- is specified, a help message is output on the display.

```
C>lcnv78k0 --

List Conversion Program for RA78K/0 Vx.xx [ xx xxx xx ]
  Copyright ( C ) NEC Electronics Corporation xxxx , xxxx

usage : LCNV78K0 [ option [ ... ] ] input-file [ option [ ... ] ]
The option is as follows ( [ ] means omissible ).
-R [ file ] : Specify object module file.
-L [ file ] : Specify load module file.
-O [ file ] : Specify output list file ( absolute assemble list file ).
-Ffile      : Input option or input-file name from specified file.
-E [ file ] : Create error list file.
--          : Show this message.
```

9.5 Option Settings in PM plus

This section describes the method for setting list converter options from PM plus.

9.5.1 Option setting method

The < List Converter Options > dialog box is opened if [List converter Options] is selected from the [Tools] menu of PM plus or if the [LC] button on the toolbar is pressed.

List converter options can be set by inputting the required options in this dialog box.

Figure 9-2 < List Converter Options > Dialog Box (When << Output >> Tab Is Selected)

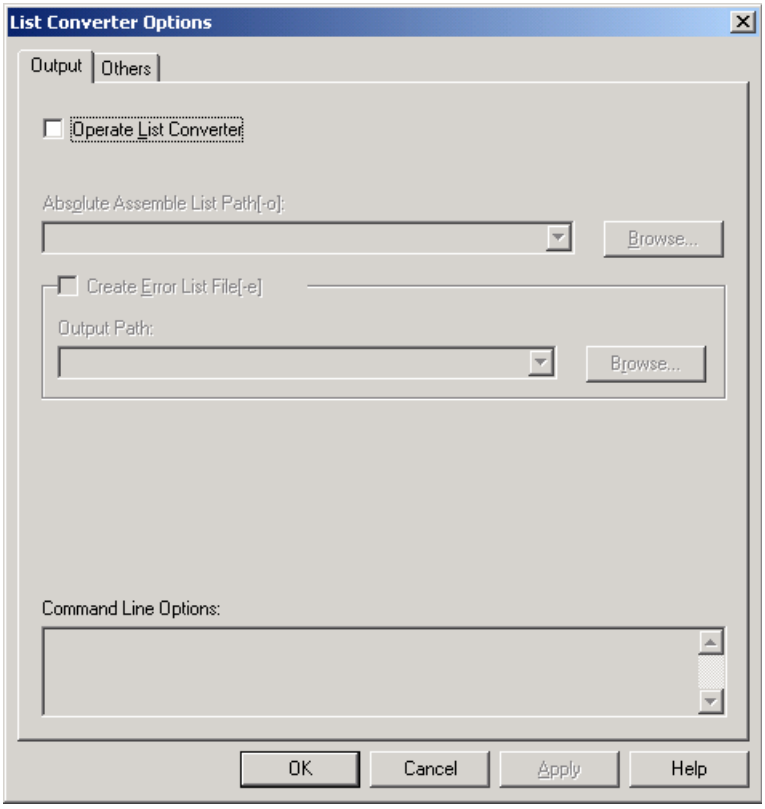
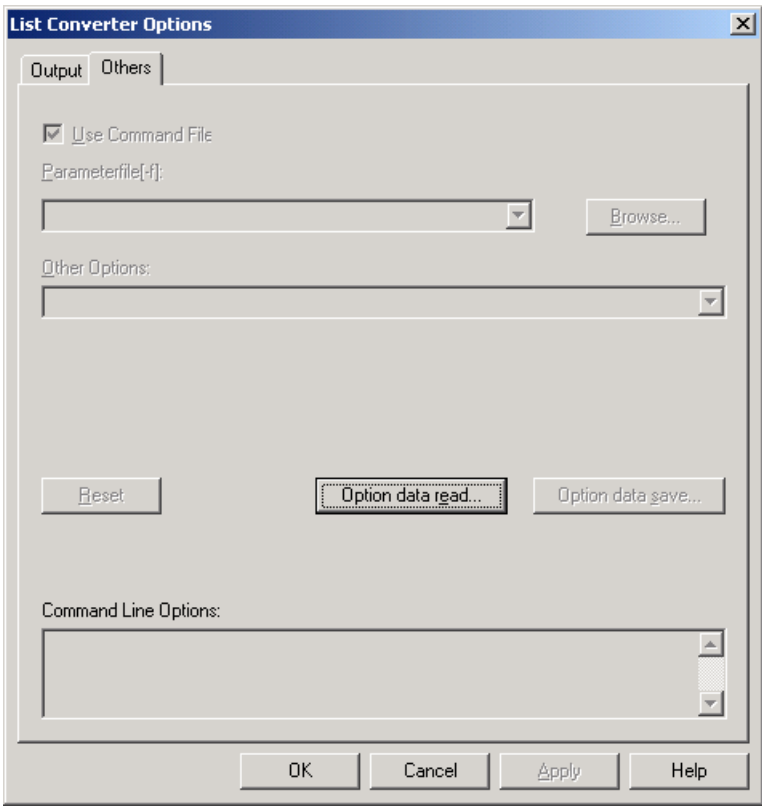


Figure 9-3 < List Converter Options > Dialog Box (When << Others >> Tab Is Selected)



9.5.2 Option settings

The various options in the < List Converter Options > dialog box are described below.

<< Output >> Tab

- Operate List Converter

  Check this option to start the list converter.

- Absolute Assemble List Path [-o]

  Specify the path of the absolute assemble list by using the [Browse] button or directly inputting a path.

- Create Error List File [-e]

  Check this option to output an error list file.

- Output Path

  Specify the path of the error list file by using the [Browse] button or directly inputting a path.

- Command Line Options

  This edit box is read-only. The currently set option character string is displayed.

<< Others >> Tab

- Use Command File

  Check this option to create a command file.

- Parameterfile [-f]

  Specify the file to be input as a user-defined parameter file by using the [Browse] button or directly inputting a file name.

- Other Options

  To specify an option other than those that can be set in this dialog box, enter the option in the input box.

  Caution The help specification (--) option cannot be specified on PM plus.

- Reset

  Resets the input contents.

- Option data read

  Opens the < Read Option Data > dialog box and after the option data file has been specified, reads this file.

- Option data save

  Opens the < Save Option Data > dialog box and save the option data to the option data file with a name.

- Command Line Options

  This edit box is read-only. The currently set option character string is displayed.

CHAPTER 10 PROGRAM OUTPUT LIST

The following is an explanation of the formats and other information for the lists output by each program.

- Lists Output by Structured Assembler Preprocessor
  Error list
- Lists Output by Assembler
  Assemble list file header
  Assemble list
  Symbol list
  Cross-reference list
  Error list
- Lists Output by Linker
  Link list file header
  Map list
  Public symbol list
  Local symbol list
  Error list
- List Output by Object Converter
  Error list
- List Output by Librarian
  Library data output list
- Lists Output by List Converter
  Absolute assemble list
  Error list

10.1 Lists Output by Structured Assembler Preprocessor

The structured assembler preprocessor outputs the following lists.

Table 10-1 Lists Output by Structured Assembler Preprocessor

Output List File Name	Output List Name
Error list file	Error list

10.1.1 Error list

An error list stores the error messages output when the structured assembler preprocessor is started up.

[Output format]

Start

(1) TTT.S((2) 4) : RA78K0 (3) error (4) E1221: (5) Missing ENDIF

[Explanation of output items]

Table 10-2 Explanation of Error List Output Items (when the structured assembler preprocessor is started up)

Item	Details
(1)	Name of source module file in which error occurred
(2)	Line on which error occurred
(3)	Type of error
(4)	Error no.
(5)	Error message

Caution The file name and the line where the error occurred may not be displayed.

10.2 Lists Output by Assembler

The assembler outputs the following lists.

Table 10-3 Lists Output by Assembler

Output List File Name	Output List Name
Assemble list file	Assemble list
	Symbol list
	Cross-reference list
Error list file	Error list

10.2.1 Assemble list file headers

The header is always output at the beginning of an assemble list file.

[Output format]

```
78K/0 Series Assembler (1) Vx.xx (2)          Date: (3) xx xxx xxxx Page: (4)    1
(5)
Command: (6) k0main.asm -c054
Para-file: (7)
In-fine:   (8)   K0MAIN.ASM
Obj-file:  (9)   K0MAIN.REL
Prn-file:  (10) K0MAIN.PRN
```

[Explanation of output items]

Table 10-4 Explanation of Assemble List File Headers Output Items

Item	Details
(1)	Assembler version no.
(2)	Title character string Character string specified by option -LH or TITLE control instruction
(3)	Date of assemble list creation
(4)	Page no.
(5)	Subtitle character string Character string specified by SUBTITLE control instruction
(6)	Command-line image
(7)	Contents of parameter file
(8)	Input source module file name
(9)	Output object module file name
(10)	Assemble list file name

10.2.2 Assemble list

The assemble list outputs the results of the assemble with error messages (if errors occur).

[Output format]

```
          Assemble list

ALNO   STNO   ADRS    OBJECT (3) M   (4) I    SOURCE STATEMENT
(1) 1  (2) 1
(2) 2  (2) 2                          (5)      NAME    SAMPM
:
28     28
29     29     (6) 0006 (8) R220000 (5)        CALL !CONVAH          ; convert ASCII <- HEX
30     30                            (5)                            ; output BC-register <-
                                                                      ASCII code
31     31     (6) 0009  00000000              MOV      DE , #STASC   ; set DE <- store
                                                                      ASCII code table
(7) **   ERROR E2202 , STNO      31 ( 0 ) Illegal operand
                (6) 000D              00
32     32     (6) 000E (8) 0A27       (5)     MOV      A , B
33     33     (6) 0010 (8) EB         (5)     MOV      [ DE ] , A
:
Segment informations :

ADRS   LEN     NAME

(9) FE20 (10) 0003H (11) DATA
(9) 0000 (10) 0002H (11) CODE
(9) 0000 (10) 0017H (11) ?CSEG

 Target chip : (12) uPD78xxx
 Device file : (13) Vx. xx
 Assembly complete ,  (14) 1 error ( s ) and  (15) 0 warning ( s ) found. ( (16) 31 )
```

[Explanation of output items]

Table 10-5 Explanation of Assemble list Output Items

Item	Details
(1)	Line no. of source module image
(2)	Line no. (including expansion of INCLUDE files and macros)
(3)	Macro display M : This is a macro definition line. #n : This is a macro expansion line. n is the nest level. Blank : This is not a macro definition or expansion line.

Table 10-5 Explanation of Assemble list Output Items

Item	Details
(4)	INCLUDE display In : Within an INCLUDE file. n is the nest level. Blank : INCLUDE file is not used.
(5)	Source program statement
(6)	Location counter value (4 or 5 digits)
(7)	Error occurrence line
(8)	Relocation data R : Object code or symbol value is changed by the linker. Blank : Object code or symbol value is not changed by the linker.
(9)	Segment address (4 or 5 digits)
(10)	Segment size (4 or 5 digits)
(11)	Segment name
(12)	RA78K0 target device
(13)	Device file version no.
(14)	Number of fatal errors
(15)	Number of warnings
(16)	Final error line

10.2.3 Symbol list

A symbol list outputs the symbols (including local symbols) defined in a source module.

[Output format]

Symbol Table List

VALUE	ATTR	RTYP	NAME	VALUE	ATTR	RTYP	NAME
	(2) CSEG		(4) ?CSEG		(2) CSEG		(4) CODE
(1) ----H		(3) EXT	(4) CONVAH		(2) DSEG		(4) DATA
(1) FE20H	ADDR		(4) HDTSA	(1) 0H	(2) ADDR	(3) PUB	(4) MAIN
	MOD		(4) SAMPM	(1) 0H	(2) ADDR	(3) PUB	(4) START
(1) FE21H	ADDR		(4) STASC				

[Explanation of output items]

Table 10-6 Explanation of Symbol list Output Items

Item	Details
(1)	Symbol value (4 or 5 digits)
(2)	Symbol attributes CSEG : Code segment name DSEG : Data segment name BSEG : Bit segment name MAC : Macro name MOD : Module name SET : Symbol defined by SET directive NUM : NUMBER attribute symbol ADDR : ADDRESS attribute symbol BIT : BIT attribute symbol (addr.bit) SABIT : BIT attribute symbol (saddr.bit) SFBIT : BIT attribute symbol (sfr.bit) RBIT : BIT attribute symbol (A.bit, X.bit, PSW.bit) Blank : External reference symbol declared by EXTRN or EXTBIT ***** : Undefined symbol
(3)	Symbol reference format EXT : External reference symbol declared by EXTRN (SADDR attribute) EXTB : External reference symbol declared by EXTBIT (saddr.bit) PUB : External reference symbol declared by PUBLIC Blank : Local symbol, segment name, macro name, module name ***** : Undefined symbol
(4)	Defined symbol name

10.2.4 Cross-reference list

A cross-reference list outputs data indicating where (on what line) symbols are defined in a source module.

[Output format]

Cross-Reference List

NAME	VALUE	R	ATTR	RTYP	SEGNAME	XREFS		
(1) ?CSEG			(4) CSEG		(6) ?CSEG	(7) 21#		
(1) CODE			(4) CSEG		(6) CODE	(7) 18#		
(1) CONVAH	(2) ----H	(3) E		(5) EXT		(7) 12	29	
(1) DATA			(4) DSEG		(6) DATA	(7) 14#		
(1) HDTSA	(2) FE20H		(4) ADDR		(6) DATA	(7) 15#	26	
(1) MAIN	(2) 0H		(4) ADDR	(5) PUB	(6) CODE	(7) 11@	19#	
(1) SAMPM			(4) MOD			(7) 2#		
(1) START	(2) 0H	(3) R	(4) ADDR	(5) PUB	(6) ?CSEG	(7) 11@	19	22#
(1) STASC	(2) FE21H		(4) ADDR		(6) DATA	(7) 16#	31	

[Explanation of output items]

Table 10-7 Explanation of Cross-reference Output Items

Item	Details
(1)	Defined symbol name
(2)	Symbol value (4 or 5 digits)
(3)	Relocation attributes R : Relocatable symbol E : External symbol Blank : Absolute symbol * : Undefined symbol
(4)	Symbol attributes CSEG : Code segment name DSEG : Data segment name BSEG : Bit segment name MAC : Macro name MOD : Module name SET : Symbol defined by SET directive NUM : NUMBER attribute symbol ADDR : ADDRESS attribute symbol BIT : BIT attribute symbol (addr.bit) SABIT : BIT attribute symbol (saddr.bit) SFBIT : BIT attribute symbol (sfr.bit) RBIT : BIT attribute symbol (A.bit, X.bit, PSW.bit) Blank : External reference symbol declared by EXTRN or EXTBIT ***** : Undefined symbol
(5)	Symbol reference format EXT : External reference symbol declared by EXTRN (SADDR attribute) EXTB : External reference symbol declared by EXTBIT (saddr.bit) PUB : External reference symbol declared by PUBLIC Blank : Local symbol, segment name, macro name, module name ***** : v
(6)	Defined symbol name

Table 10-7 Explanation of Cross-reference Output Items

Item	Details
(7)	Definition/reference line no. Definition line : XXXXX# Reference line : XXXXX Δ (Δ = 1 blank) EXTRN declaration, EXTBIT declaration, PUBLIC declaration : xxxxx@

10.2.5 Error list

An error list stores the error messages output when the assembler is started up.

[Output format]

```
  Pass1 Start
(1) ERROR.ASM ( (2) 26 ) : RA78K0 (3) error (4) E2202 :      (5) Illegal operand
(1) ERROR.ASM ( (2) 32 ) : RA78K0 (3) error (4) E2202 :      (5) Illegal operand
  Pass2 Start
(1) ERROR.ASM ( (2) 26 ) : RA78K0 (3) error (4) E2202 :      (5) Illegal operand
(1) ERROR.ASM ( (2) 29 ) : RA78K0 (3) error (4) E2407 :      (5) Undefined symbol reference ' DTSA '
(1) ERROR.ASM ( (2) 29 ) : RA78K0 (3) error (4) E2303 :      (5) Illegal expression
(1) ERROR.ASM ( (2) 32 ) : RA78K0 (3) error (4) E2202 :      (5) Illegal operand
(1) ERROR.ASM ( (2) 37 ) : RA78K0 (3) error (4) E2407 :      (5) Undefined symbol reference ' F '
(1) ERROR.ASM ( (2) 37 ) : RA78K0 (3) error (4) E2303 :      (5) Illegal expression
```

[Explanation of output items]

Table 10-8 Explanation of Error List Output Items (when the assembler is started up)

Item	Details
(1)	Name of source module file in which error occurred
(2)	Line on which error occurred
(3)	Type of error
(4)	Error no.
(5)	Error message

Caution The file name and the line where the error occurred may not be displayed.

10.3 Lists Output by Linker

The linker outputs the following lists.

Table 10-9 Lists Output by Linker

Output List File Name	Output List Name
Link list file	Map list
	Public symbol list
	Local symbol list

10.3.1 Link list file headers

The header is always output at the beginning of a link list file.

[Output format]

```
78K/0 Series Linker (1) Vx.xx                    Date : (2) xx xxx xxxx Page : (3) 1

Command :       (4) k0main.rel k0sub.rel -ok0.map -dk0.dr
Para-file :     (5)
Out-file :      (6) K0.MAP
Map-File :      (7) K0MAIN.MAP
Direc-File :    (8)
Directive :     (9)

*** Link information ***
(10) 3 output segment ( s )
(11) 37H byte ( s ) real data
(12) 23 symbol ( s ) defined
```

[Explanation of output items]

Table 10-10 Explanation of Link List File Header Output Items

Item	Details
(1)	Linker version no.
(2)	Date of link list file creation
(3)	Page no. (4 or 5 digits)
(4)	Command-line image (4 or 5 digits)
(5)	Contents of parameter file
(6)	Output load module file name
(7)	Link list file name
(8)	Directive file name

Table 10-10 Explanation of Link List File Header Output Items

Item	Details
(9)	Directive file contents (4 or 5 digits)
(10)	Number of segments output to load module file (4 or 5 digits)
(11)	Size of data output to load module file
(12)	Number of symbols output to load module file

10.3.2 Map list

The map list outputs data on the location of segments.

[Output format]

```
   *** Memory map ***

(1) SPACE = REGULAR

 MEMORY = (2) ROM
 BASE ADDRESS = (3) 0000H          SIZE = (4) 2000H
        OUTPUT      INPUT      INPUT      BASE       SIZE
        SEGMENT     SEGMENT    MODULE     ADDRESS
        (6) CODE                          (9) 0000H  (10) 0002H
                                                     (11) CSEG AT
                    (7) CODE   (8) SAMPM   (9) 0000H  (10) 0002H
(5) *gap *                                (9) 0002H  (10) 007EH
        (6) ?CSEG                         (9) 0080H  (10) 0035H
                                                     (11) CSEG
                    (7) ?CSEG  (8) SAMPM   (9) 0080H  (10) 0015H
                    (7) ?CSEG  (8) SAMPS   (9) 0095H  (10) 0020H
(5) *gap *                                (9) 00B5H  (10) 1F4BH

    MEMORY = RAM
    BASE ADDRESS = (3) FE00H      SIZE = (4) 0200H
        OUTPUT      INPUT      INPUT      BASE       SIZE
        SEGMENT     SEGMENT    MODULE     ADDRESS
(5) * gap *                               (9) FE00H  (10) 0020H
        (6) DATA                          (9) FE20H  (10) 0003H
                                                     (11) DSEG AT
                    (7) DATA   (8) SAMPM   (9) FE20H  (10) 0003H
(5) *gap *                                (9) FE23H  (10) 00DDH
(5) *gap ( Not Free Area ) *              (9) FE00H  (10) 0100H

   Target chip : (12) uPD78xxx
   Device File : (13) Vx.xx
```

[Explanation of output items]

Table 10-11 Explanation of Map List Output Items

Item	Details
(1)	Memory space name
(2)	Memory area name
(3)	Memory area start address (4 or 5 digits)
(4)	Memory area size (4 or 5 digits)

Table 10-11 Explanation of Map List Output Items

Item	Details
(5)	Output group Displays "gap" for areas where nothing is located.
(6)	Segment names output to load module file
(7)	Segment names read from object module file
(8)	Input module name
(9)	Segment start address (4 or 5 digits)
(10)	Output/input segment size (4 or 5 digits)
(11)	Segment type and reallocation attributes
(12)	Target device for this assemble
(13)	Device file version no.

10.3.3 Public symbol list

A public symbol list outputs data on public symbols defined in an input module.

[Output format]

```
*** Public symbol list ***

MODULE          ATTR          VALUE          NAME

(1) SAMPM       (2) ADDR      (3) 0000H      (4) MAIN
(1) SAMPM       (2) ADDR      (3) 0080H      (4) START
(1) SAMPS       (2) ADDR      (3) 0095H      (4) CONVAH
```

[Explanation of output items]

Table 10-12 Explanation of Public Symbol List Output Items

Item	Details
(1)	Name of module in which public symbols are defined
(2)	Symbol attributes CSEG : Code segment name DSEG : Data segment name BSEG : Bit segment name MAC : Macro name MOD : Module name SET : Symbol defined by SET directive NUM : NUMBER attribute symbol ADDR : ADDRESS attribute symbol BIT : BIT attribute symbol (addr.bit) SABIT : BIT attribute symbol (saddr.bit) SFBIT : BIT attribute symbol (sfr.bit) RBIT : BIT attribute symbol (A.bit, X.bit PSW.bit) Blank : External reference symbol declared by EXTRN or EXTBIT ***** : Undefined symbol
(3)	Symbol value (4 or 5 digits)
(4)	Public symbol name

10.3.4 Local symbol list

A local symbol list outputs data on local symbols defined in an input module.

[Output format]

*** Local symbol list ***

MODULE	ATTR	VALUE	NAME
(1) SAMPM	(2) MOD		(4) SAMPM
(1) SAMPM	(2) DSEG		(4) DATA
(1) SAMPM	(2) ADDR	(3) FE20H	(4) HDTSA
(1) SAMPM	(2) ADDR	(3) FE21H	(4) STASC
(1) SAMPM	(2) CSEG		(4) CODE
(1) SAMPM	(2) CSEG		(4) ?CSEG
(1) SAMPS	(2) MOD		(4) SAMPS
(1) SAMPS	(2) CSEG		(4) ?CSEG
(1) SAMPS	(2) ADDR	(3) 00ACH	(4) SASC
(1) SAMPS	(2) ADDR	(3) 00B2H	(4) SASC1

[Explanation of output items]

Table 10-13 Explanation of Local Symbol List Output Items

Item	Details	
(1)	Name of module in which local symbols are defined	
(2)	Symbol attributes CSEG : Code segment name DSEG : Data segment name BSEG : Bit segment name MAC : Macro name MOD : Module name SET : Symbol defined by SET directive NUM : NUMBER attribute symbol	ADDR : ADDRESS attribute symbol BIT : BIT attribute symbol (addr.bit) SABIT : BIT attribute symbol (saddr.bit) SFBIT : BIT attribute symbol (sfr.bit) RBIT : BIT attribute symbol (A.bit, X.bit, PSW.bit) Blank : External reference symbol declared by EXTRN or EXTBIT ***** : Undefined symbol
(3)	Symbol value (4 or 5 digits)	
(4)	Local symbol name	

10.3.5 Error list

An error list stores the error messages output when the linker is started up.

[Output format]

```
RA78K0 (1) error          (2) E3405 :          (3) Undefined symbol ' CONVAH ' in file ' K0MAIN.REL '
```

[Explanation of output items]

Table 10-14 Explanation of Error List Output Items(when the linker is started up)

Item	Details
(1)	Type of error
(2)	Error no.
(3)	Error message

10.4 List Output by Object Converter

The object converter outputs the following list.

Table 10-15 Explanation of Object Converter Output Items

Output List File Name	Output List Name
Error list file	Error list

10.4.1 Error list

Error messages output when the object converter is started up are stored in an error list.

[Output format]

Same as error list output by the linker.

10.5 List Output by Librarian

The librarian outputs the following list.

Table 10-16 List Output by Librarian

Output List File Name	Output List Name
List file	Library data output list

10.5.1 Library data output list

The library data output list outputs data on the modules in a library file.

[Output format]

```
78K/0 Series librarian (1) Vx.xx      DATE : (2) xx xxx xx                PAGE (3) 1
 LIB-FILE NAME : (4) K0.LIB            ( (5) xx xxx xx )
(6) 0001   (7) K0MAIN.REL              ( (8) xx xxx xx )
   (9) MAIN                                    (9) START
   NUMBER OF PUBLIC SYMBOLS :   (10) 2
(6) 0002   (7) K0SUB.REL               ( (8) xx xxx xx )
   (9) CONVAH
   NUMBER OF PUBLIC SYMBOLS :   (10) 1
```

[Explanation of output items]

Table 10-17 Explanation of Library Data Output List Output Items

Item	Details
(1)	Librarian version no.
(2)	Date of list creation
(3)	Number of pages
(4)	Library file name
(5)	Date of library file creation
(6)	Module serial no. (beginning from 0001)
(7)	Module name
(8)	Date of module creation
(9)	Public symbol name
(10)	Number of public symbols defined in module

10.6 Lists Output by List Converter

The list converter outputs the following lists.

Table 10-18 Lists Output by List Converter

Output List File Name	Output List Name
Absolute assemble list file	Absolute assemble list
Error list file	Error list

10.6.1 Absolute assemble list

The absolute assemble list embeds absolute values in the assemble list and outputs the list.

[Output format]

Same as for the assemble list output by the assembler.

10.6.2 Error list

Error messages output when the list converter is started up are stored in an error list.

[Output format]

Same as for the error list output by the assembler.

CHAPTER 11 EFFICIENT USE OF RA78K0

This chapter introduces some methods that will help you to use the RA78K0 efficiently.

11.1 Improving Operating Efficiency (EXIT Status Function)

When any of the programs of the RA78K0 finishes processing, the program stores the maximum level of errors occurring during processing as the "EXIT status," and returns control to the operating system.

The EXIT statuses are as follows :

- Normal operation : 0
- WARNING occurs : 0
- FATAL ERROR occurs : 1
- ABORT : 2

The exit status can be used to create a batch file, making operation more efficient.

[Example of use]

< Contents of the batch file (ra.bat) >

```
ra78K0 -c014 k0main.-g -e
echo off
IF ERRORLEVEL 1 GOTO ERR
echo\
echo on
ra78K0 -c014 k0sub.asm -g -e
echo off
IF ERRORLEVEL 1 GOTO ERR
echo\
echo on
lk78K0 k0main.rel k0sub.rel -ok0.lmf -g
echo off
IF ERRORLEVEL 1 GOTO ERR
echo\
echo on
oc78K0 k0.lmf
echo off
IF ERRORLEVEL 1 GOTO ERR
GOTO EXIT
: ERR
echo  Error occurred
: EXIT
```

Perform processing using batch file (ra.bat).

```
C>ra.bat
```

11.2 Preparing Development Environment (Environmental Variables)

The RA78K0 supports the following environmental variables for preparing the software development environment.

PATH :	Search path for execution format
INC78K0 :	Search path for include file (structured assembler preprocessor and assembler)
LIB78K0 :	Search path for library file (linker only)
TMP :	Path for creating temporary files
LANG78K :	Kanji (2-byte character) type specification

[Example of use]

< Contents of autoexec.bat >

```
; AUTOEXEC.BAT
Verify on
break on
PATH c:\bin ; c:\bat ; c:\ra78k0 ;          <-- (1)
SET INC78K0 = c:\ra78k0\include             <-- (2)
SET LIB78K0 = c:\ra78k0\lib                 <-- (3)
SET TMP = c:\tmp                            <-- (4)
SET LANG78K = SJIS                          <-- (5)
```

(1) Because this path is specified, execution format files are retrieved from directories in the order c:\bin, c:\bat, c:\ra78k0.

(2) The assembler retrieves include files from the directory c:\ra78k0\include.

(3) The linker retrieves library files from c:\ra78k0\lib.

(4) Each program creates a temporary file in c:\tmp.

(5) Kanji in the comment statement is interpreted as shift JIS code.

Caution If the assembler package has been installed using the Windows installer, the necessary environmental variables are automatically set.

11.3 Interrupting Program Execution

Execution of each program can be interrupted by entering CTRL-C from the keyboard.

If "break on" is specified during execution of a batch file, control is returned to the operating system regardless of the timing of the key input. When "break off" is specified, control is only returned to the operating system during screen display. In this case, all open temporary files and output files are deleted.

11.4 Making Assemble List Easy to Read

Display a title in the header of an assemble list using option -LH or the TITLE control instruction. By displaying a title that briefly indicates the contents of the assemble list, the contents of the assemble list can be made easy to see at a glance.

When the SUBTITLE control instruction is used, a subtitle can also be displayed. For information on control instructions, refer to RA78K0 Assembler Package Language User's Manual.

[Example of use]

Print a title in the header of an assemble list file.

```
C>ra78K0 -c054 k0main.asm -lhRA78K0_MAINROUTINE
```

This references k0main.prn.

```
78K/0 Series Assembler Ex.xx RA78K0_MAINROUTINE          Date : xx xxx xxxx Page :   1
                                        |
                                        Title

Command : -c054 k0main.asm -IhRA78K0_MAINROUTINE
Para-file :
In-file :   K0MAIN.ASM
Obj-file : K0MAIN.REL
Prn-file : K0MAIN.PRN

    Assemble list

 ALNO   STNO    ADRS    OBJECT          M I SOURCE STATEMENT

    1    1
    2    2                                      NAME SAMPM
    3    3                                  ; ************************************************
    4    4                                  ; *                                              *
    5    5                                  ; *  HEX -> ASCII Conversion Program             *
    6    6                                  ; *                                              *
    7    7                                  ; *          main-routine                        *
      :
```

11.5 Reducing Program Startup Time

11.5.1 Specifying control instruction in the source program

Control instructions which have the same functions as the options normally specified in assembler startup can be specified in advance in the source program. This eliminates the need to specify options every time the assembler is started up.

[Example of use]

```
$ PROCESSOR ( 054 )              ; Control instructions
$ XREF                           ; Control instructions

   NAME          SAMPM
; ************************************************
; *                                              *
; *  HEX -> ASCII Conversion Program             *
; *                                              *
; *          main-routine                        *
; *                                              *
; ************************************************
    :
```

11.5.2 Using PM plus

The options of each program of the RA78K0 are automatically saved to the project file (.PRJ) in PM plus. The saved options will be used for subsequent builds (MAKE). It is not therefore necessary to specify the options each time.

11.5.3 Creating parameter files and subcommand files

When executing any of the RA78K0's programs (structured assembler preprocessor, assembler, linker, object converter and list converter), if all the necessary data will not fit on the command line, or if the same options are specified every time the program is executed, create a parameter file.

Also, subcommands can be registered in a subcommand file in the librarian. This makes object module library formation easy.

[Example of use 1]

Create a parameter file and perform assembly.

< Contents of parameter file k0main.pra >

```
; parameter file
k0main.asm -osample.rel -g
-psample.prn
```

Enter the following on the command line.

```
C>ra78k0 -fk0main.pra
```

[Example of use 2]

Create a parameter file and perform assembly.

< Contents of parameter file k0.slb >

```
;
; library creation command
;
create k0.lib
;
add k0.lib k0main.rel &
k0sub.rel
;
exit
```

Enter the following on the command line.

```
C>lb78k0 <k0.slb
```

11.6 Object Module Library Formation

The assembler and linker create 1 file for every 1 output module. When there are many object modules, therefore, the number of files also increases. The RA78K0 incorporates a function for collecting a number of object modules in a single file. This function is called module library formation. A file which forms such a library is called a library file.

Library files can be input to the linker. Therefore, when performing modular programming, library files containing common modules can be created, enabling efficient file management and operation.

CHAPTER 12 ERROR MESSAGES

This chapter explains the causes of error messages output by the RA78K0's programs (structured assembler preprocessor, assembler, linker, object converter and librarian), and the action to be taken by the user.

12.1 Overview of Error Messages

Error messages output by the RA78K0 are divided into the following 4 levels.

(1) Abort error (Fxxxx)

An error has occurred which makes the program unable to continue processing. The program quits (interrupts) immediately.

If the abort error is found on the command line, processing ends when another command line error is found.

(2) Fatal error (Exxxx)

An execution error has occurred. When another error is found, the program quits (interrupts) without generating an output object.

When a fatal error occurs, to clarify that an output object is not generated, if an object with the same name exists, that object is deleted.

(3) Internal error (Cxxxx)

Processing is immediately terminated (aborted) because an internal error has occurred.

(4) Warning (Wxxxx)

An output object is generated which may not be the result the user intended.

Remark In a program executed in conversational format, the execution ends normally unless an abort error occurs.

The error messages of the assembler package are classified as follows.

- Fn0xx --- Command line analysis error - Fn9xx --- File or system error - Fn1xx --- Other abort error - Cnxxx --- Internal error - En2xx --- Statement specification error - En3xx --- Expression error - En4xx --- Symbol error - En5xx --- Segment error - En6xx --- Control instruction or macro error - Wnxxx --- Any type of warning	n = 1 to 6 - 1 --- Structured Assembler Preprocessor - 2 --- Assembler - 3 --- Linker - 4 --- Object Converter - 5 --- Librarian - 6 --- List Converter

12.2 Structured Assembler Preprocessor Error Messages

Table 12-1 Structured Assembler Preprocessor Error Messages

Error Number	Error Message	
F1001	Message	Missing input file
	Cause	An input file has not been specified.
	Action by user	Specify an input file.
F1002	Message	Too many input files
	Cause	Two or more input files have been specified.
	Action by user	Specify only one input file.
F1004	Message	Illegal file name ‘file name’
	Cause	Either there are illegal characters in the file name, or the number of characters exceeds the limit.
	Action by user	Input a file name that has legal characters and is within the character number limit.
F1005	Message	Illegal file specification ‘file name’
	Cause	An illegal file has been specified.
	Action by user	Specify a legal file.
F1006	Message	File not found ‘file name’
	Cause	The specified file does not exist.
	Action by user	Specify an existent file.
F1008	Message	File specification conflicted ‘file name’
	Cause	An I/O file name has been specified in duplicate.
	Action by user	Specify different I/O file names.
F1009	Message	Unable to make file ‘file name’
	Cause	The specified file is write-protected.
	Action by user	Release the write protection on the specified file.
F1010	Message	Directory not found ‘file name’
	Cause	A non-existent drive and/or directory has been included in the output file name.
	Action by user	Specify an existent drive and/or directory.
F1011	Message	Illegal path 'option'
	Cause	Other than a path name has been specified in the option that specifies the path for the parameter.
	Action by user	Specify a correct path name.
F1012	Message	Missing parameter 'option'
	Cause	A necessary parameter has not been specified.
	Action by user	Specify the parameter.

Table 12-1 Structured Assembler Preprocessor Error Messages

Error Number	Error Message	
F1013	Message	Parameter not needed ‘option’
	Cause	An unnecessary parameter has been specified.
	Action by user	Delete the unnecessary parameter.
F1014	Message	Out of range 'option'
	Cause	The specified numerical value is outside the range.
	Action by user	Specify a correct numerical value.
F1015	Message	Parameter is too long 'option'
	Cause	The number of characters in the parameter exceeds the limit.
	Action by user	Specify a parameter whose character number is within the limit.
F1016	Message	Illegal parameter 'option'
	Cause	The syntax of the parameter is incorrect.
	Action by user	Specify a correct parameter.
F1017	Message	Too many parameters 'option'
	Cause	The total number of parameters exceeds the limit.
	Action by user	Specify parameters within the number limit.
F1018	Message	Option is not recognized 'option'
	Cause	The option name is incorrect.
	Action by user	Specify a correct option name.
F1019	Message	Parameter file nested
	Cause	The -F option has been specified inside a parameter file.
	Action by user	Do not specify the -F option inside a parameter file.
F1020	Message	Parameter file read error 'file name'
	Cause	The parameter file cannot be read.
	Action by user	Specify a correct parameter file.
F1021	Message	Memory allocation failed
	Cause	There is insufficient memory.
	Action by user	Secure the necessary memory.
F1100	Message	Can’t set Control-C
	Cause	Control-C to stop execution of the structured assembler preprocessor cannot be set.
	Action by user	Execute the structured assembler preprocessor once again.
F1101	Message	Open/read/write/close error on 'file name'
	Cause	Due to a file I/O error, the file cannot be opened, read written to, or closed normally.
	Action by user	Specify a correct file name.

Table 12-1 Structured Assembler Preprocessor Error Messages

Error Number	Error Message	
F1102	Message	Can't find 'file name'
F1103	Message	Illegal include file 'file name'
	Cause	An illegal name has been specified for an include file.
	Action by user	Specify a correct file.
F1104	Message	Illegal (-sc) character
	Cause	A character that cannot be used as a symbol has been specified in the -SC option.
	Action by user	Specify a correct character.
F1105	Message	Can't define the reserved symbol
	Cause	A reserved word has been specified in the -D option.
	Action by user	Do not specify a reserved word in the -D option.
F1106	Message	Duplicate PROCESSOR control
	Cause	The PROCESSOR control instruction has been specified more than once in the source file. A product type different to that of the -C option has been specified.
	Action by user	Specify the PROCESSOR control instruction once only. Correct the product type name.
F1107	Message	No processor specified
	Cause	The device type has not been specified.
	Action by user	Specify the device type.
F1108	Message	Illegal processor type specified
	Cause	The device type specification is incorrect in the PROCESSOR control instruction in the source file.
	Action by user	Specify a correct device type.
F1109	Message	Illegal processor type specified -C
	Cause	The device type specification is incorrect in the -C option.
	Action by user	Specify a correct device type.
F1110	Message	Can't use this control outside module header
	Cause	An instruction that should have been written in the source module header has been written in a normal source line.
	Action by user	Write the instruction in the source module header.
F1111	Message	Syntax error in module header
	Cause	The syntax of the instruction written in the source module header is incorrect.
	Action by user	Write the instruction using the correct syntax.

Table 12-1 Structured Assembler Preprocessor Error Messages

Error Number	Error Message	
C1112	Message	Structured assembler preprocessor internal error
	Cause	An error has occurred inside the structured assembler preprocessor.
	Action by user	Contact NEC Electronics or an NEC Electronics distributor.
E1201	Message	Illegal #ELSE/#ENDIF
	Cause	#ELSE and #ENDIF statements have been written in an incorrect place.
	Action by user	Write the #ELSE and #ENDIF statements in the correct place.
E1202	Message	Illegal #ENDCALLT
	Cause	An #ENDCALLT statement has been written in an incorrect place.
	Action by user	Write the #ENDCALLT statement in the correct place.
E1203	Message	Missing #ENDIF
	Cause	The #ENDIF statement is missing.
	Action by user	Write the #ENDIF statement in the correct place.
E1204	Message	Missing #ENDCALLT
	Cause	The #ENDCALLT statement is missing.
	Action by user	Write the #ENDCALLT statement in the correct place.
E1205	Message	Too many #DEFCALLT definition
	Cause	The registered number of callt instruction conversion patterns exceeds the limit.
	Action by user	Reduce the number of registered #defcallt instructions.
E1206	Message	Too many CALL instruction
	Cause	There are too many instructions to be defined by #DEFCALLT to #ENDCALLT.
	Action by user	Specify only one instruction to be defined by #DEFCALLT to #ENDCALLT.
E1207	Message	Duplicate definition
	Cause	The same conversion pattern has been defined a second time.
	Action by user	Correct the #DEFCALLT registration.
E1208	Message	Symbol table overflow
	Cause	The number of symbols exceeds the limit.
	Action by user	Reduce the number of symbols.
E1209	Message	Syntax error
	Cause	The syntax of the written statement is incorrect.
	Action by user	Use correct syntax.
E1210	Message	Nest level error
	Cause	There is an error in the nesting (overflow, nesting level, etc.)
	Action by user	Use a correct control statement.

Table 12-1 Structured Assembler Preprocessor Error Messages

Error Number	Error Message	
E1211	Message	Too many characters in a line
	Cause	The length of one line has been exceeded.
	Action by user	Specify 2046 or fewer characters on one line.
E1212	Message	Too many include files
	Cause	There is an include quasi-directive in the include file.
	Action by user	Do not specify an include quasi-directive in the include file.
E1214	Message	Illegal BREAK
	Cause	A BREAK statement has been written in an incorrect place.
	Action by user	Write the BREAK statement in the correct place.
E1215	Message	Illegal CONTINUE
	Cause	A CONTINUE statement has been written in an incorrect place.
	Action by user	Write the CONTINUE statement in the correct place.
E1216	Message	Illegal CASE/DEFAULT/ENDS
	Cause	A CASE/DEFAULT/ENDS statement has been written in an incorrect place.
	Action by user	Write the CASE/DEFAULT/ENDS statement in the correct place.
E1217	Message	Illegal ELSEIF/ELSE/ENDIF
	Cause	An ELSEIF/ELSE/ENDIF statement has been written in an incorrect place.
	Action by user	Write the ELSEIF/ELSE/ENDIF statement in the correct place.
E1218	Message	Illegal NEXT
	Cause	A NEXT statement has been written in an incorrect place.
	Action by user	Write the NEXT statement in the correct place.
E1219	Message	Illegal ENDW
	Cause	An ENDW statement has been written in an incorrect place.
	Action by user	Write the ENDW statement in the correct place.
E1220	Message	Illegal UNTIL/UNTIL_BIT
	Cause	UNTIL and UNTIL_BIT statements have been written in an incorrect place.
	Action by user	Write the UNTIL and UNTIL_BIT statements in the correct place.
E1221	Message	Missing ENDIF
	Cause	The ENDIF statement is missing.
	Action by user	Write the ENDIF statement in the correct place.
E1222	Message	Missing ENDS
	Cause	The ENDS statement is missing.
	Action by user	Write the ENDS statement in the correct place.

Table 12-1 Structured Assembler Preprocessor Error Messages

Error Number	Error Message	
E1223	Message	Missing ENDW
	Cause	The ENDW statement is missing.
	Action by user	Write the ENDW statement in the correct place.
E1224	Message	Missing NEXT
	Cause	The NEXT statement is missing.
	Action by user	Write the NEXT statement in the correct place.
E1225	Message	Missing UNTIL/UNTIL_BIT
	Cause	The UNTIL and UNTIL_BIT statements are missing.
	Action by user	Write the UNTIL and UNTIL_BIT statements in the correct place.
E1226	Message	Illegal character in a line
	Cause	An incorrect character has been written in the source line.
	Action by user	Delete the incorrect character written in the source line.
E1227	Message	Illegal operand in a line
	Cause	The data size of the substitution and comparative condition formats is incorrect.
	Action by user	Specify the correct data size.
E1228	Message	Illegal SFR access in operand
	Cause	An sfr symbol that is unable to access the substitution format has been written.
	Action by user	Check the access status of the sfr symbols and write a correct sfr symbol.
E1229	Message	This symbol is reserved ‘symbol name’
	Cause	The symbol used is a reserved word.
	Action by user	Change the symbol name.
E1230	Message	Out source line overflow
	Cause	The number of characters on the source line has exceeded the limit.
	Action by user	Delete unnecessary descriptions on the source line.
W1301	Message	Symbol redefinition
	Cause	The symbol has been defined more than once by the #define statement.
	Program action	The most recently defined symbol is valid.
	Action by user	To validate the symbol first defined, correct the syntax.
W1302	Message	Duplicate PROCESSOR option and control
	Cause	The device type specified in the -C option is different to that specified in the $PROCESSOR control instruction.
	Program action	The device type specified in the -C option is valid, and the device type specified in the $PROCESSOR control instruction is ignored.
	Action by user	Check that the device type specified in the -C option is correct.

12.3 Assembler Error Messages

Table 12-2 Assembler Error Messages

Error Number	Error Message	
F2001	Message	Missing input file
	Cause	An input file has not been specified.
	Action by user	Specify an input file.
F2002	Message	Too many input files
	Cause	Two or more input files have been specified.
	Action by user	Specify only one input file.
F2004	Message	Illegal file name ‘file name’
	Cause	Either there are illegal characters in the file name, or the number of characters exceeds the limit.
	Action by user	Input a file name that has legal characters and is within the character number limit.
F2005	Message	Illegal file specification 'file name'
	Cause	An illegal file has been specified.
	Action by user	Specify a legal file.
F2006	Message	File not found 'file name'
	Cause	The specified file does not exist.
	Action by user	Specify an existent file.
F2008	Message	File specification conflicted 'file name'
	Cause	An I/O file name has been specified in duplicate.
	Action by user	Specify different I/O file names.
F2009	Message	Unable to make file 'file name'
	Cause	The specified file is write-protected.
	Action by user	Release the write protection on the specified file.
F2010	Message	Directory not found 'file name'
	Cause	A non-existent drive and/or directory has been included in the output file name.
	Action by user	Specify an existent drive and/or directory.
F2011	Message	Illegal path 'option'
	Cause	Other than a path name has been specified in the option that specifies the path for the parameter.
	Action by user	Specify a correct path name.
F2012	Message	Missing parameter 'option'
	Cause	A necessary parameter has not been specified.
	Action by user	Specify the parameter.

Table 12-2 Assembler Error Messages

Error Number	Error Message	
F2013	Message	Parameter not needed 'option'
	Cause	An unnecessary parameter has been specified.
	Action by user	Delete the unnecessary parameter.
F2014	Message	Out of range 'option'
	Cause	The specified numerical value is outside the range.
	Action by user	Specify a correct numerical value.
F2015	Message	Parameter is too long 'option'
	Cause	The number of characters in the parameter exceeds the limit.
	Action by user	Specify a parameter whose character number is within the limit.
F2016	Message	Illegal parameter 'option'
	Cause	The syntax of the parameter is incorrect.
	Action by user	Specify a correct parameter.
F2017	Message	Too many parameters 'option'
	Cause	The total number of parameters exceeds the limit.
	Action by user	Specify parameters within the number limit.
F2018	Message	Option is not recognized 'option'
	Cause	The option name is incorrect.
	Action by user	Specify a correct option name.
F2019	Message	Parameter file nested
	Cause	The -F option has been specified inside a parameter file.
	Action by user	Do not specify the -F option inside a parameter file.
F2020	Message	Parameter file read error 'file name'
	Cause	The parameter file cannot be read.
	Action by user	Specify a correct parameter file.
F2021	Message	Memory allocation failed
	Cause	There is insufficient memory.
	Action by user	Secure the necessary memory.
F2101	Message	Source file size 0 'file-name'
	Cause	A source module with file size 0 has been input.
F2102	Message	Illegal processor type specified
	Cause	A mistake was made in the specification of the target device.
F2103	Message	Syntax error in module header
	Cause	A mistake was made in format for a control instruction that can be written in a source module header.

Table 12-2 Assembler Error Messages

Error Number	Error Message	
F2104	Message	Can’t use this control outside module header
	Cause	A control instruction for specification in a source module header is written in an ordinary source.
F2105	Message	Duplicate PROCESSOR control
	Cause	A PROCESSOR control instruction is written more than once in a source module header.
F2106	Message	Illegal source file name for module name
	Cause	Module name cannot be created because the primary name for the source file name has a character that is not a legal symbol structure character.
F2107	Message	Default segment ?CSEG is already used
	Cause	Attempted to define an undefined segment with a default segment.
F2108	Message	Symbol table overflow 'symbol name'
	Cause	The number of symbols exceeds the definable limit.
F2109	Message	Too many DS
	Cause	Too many gaps have opened between object codes in a segment because too many DS directives are used, so data cannot be output to the object file.
F2110	Message	String table overflow
	Cause	Limits of the string table are exceeded.
	Action by user	Reduce number of symbols to 9 characters or less.
F2111	Message	Object code more than 128 bytes
	Cause	Object code exceeds 128 bytes per line in a source statement.
F2112	Message	No processor specified
	Cause	Target device is not specified in the command line or in the source module file.
F2114	Message	Local symbol name of asm statement must begin with ‘?L’ in C source.
	Cause	A local symbol which begins with other than ‘?L’ is described in the #asm of the C source.
E2201	Message	Syntax error
	Cause	An incorrect statement format was used.
E2202	Message	Illegal operand
	Cause	The specified operand is illegal.
E2203	Message	Illegal register
	Cause	A register that cannot be specified was specified.
E2204	Message	Illegal character
	Cause	An illegal character is specified in the source module.
E2205	Message	Unexpected LF in string
	Cause	A carriage return code appears in a character string before the string is closed.

Table 12-2 Assembler Error Messages

Error Number	Error Message	
E2206	Message	Unexpected EOF in string
	Cause	An end-of-file code appears in a character string before the string is closed.
E2207	Message	Unexpected null code in string
	Cause	A null code (00H) is written in a character string.
E2209	Message	Too many line number
	Cause	The number of lines described in one file has exceeded the limit.
E2301	Message	Too complex expression
	Cause	Expression is too complex.
E2302	Message	Absolute expression expected
	Cause	A relocatable expression is specified.
E2303	Message	Illegal expression
	Cause	Incorrect format for expression is used.
E2304	Message	Illegal symbol in expression 'file name'
	Cause	An unusable symbol is used in an expression.
E2305	Message	Too long string as constant
	Cause	Limit on string constant length (4 characters) is exceeded.
E2306	Message	Illegal number
	Cause	Incorrect numerical value is specified.
E2307	Message	Division by zero
	Cause	A value is divided by zero.
E2308	Message	Too large integer
	Cause	The value of a constant exceeds 16 bits.
E2309	Message	Illegal bit value
	Cause	Incorrect bit value is specified.
E2310	Message	Bit value out of range
	Cause	Bit value exceeds the range 0 to 7.
E2311	Message	Operand out of range (n)
	Cause	Specified value exceeds the range n (0 to 7).
E2312	Message	Operand out of range (byte)
	Cause	Value of an operand exceeds the range (00H to FFH), or the value of the byte in an operand is outside the range (-128 to +127).
E2313	Message	Operand out of range (addr5)
	Cause	Operand is outside the specifiable range (40H to 7EH) for addr5.

Table 12-2 Assembler Error Messages

Error Number	Error Message	
E2314	Message	Operand out of range (addr11)
	Cause	Operand is outside the specifiable range (800H to FFFH) for addr11.
E2315	Message	Operand out of range (saddr)
	Cause	Operand is outside the specifiable range (0FE20H to 0FF1FH) for saddr.
E2316	Message	Operand out of range (addr16)
	Cause	Operand is outside the specifiable range (varies according to target device) for addr16.
E2317	Message	Even expression expected
	Cause	Odd-number address is specified for word access.
E2318	Message	Operand out of range (sfr)
	Cause	Operands for the SFR/SFRP directives are specified exceeding the limit, or an odd value is specified for the operand of the SFRP directive.
E2326	Message	Illegal SFR access in operand
	Cause	An SFR symbol that cannot access an operand is described.
E2327	Message	Illegal bank access in operand
	Cause	A symbol that cannot access an operand is described.
E2401	Message	Illegal symbol for PUBLIC 'symbol name'
	Cause	This symbol cannot be declared PUBLIC.
E2402	Message	Illegal symbol for EXTRN/EXBIT 'symbol name'
	Cause	This symbol cannot be declared EXTRN/EXTBIT.
E2403	Message	Can’t define PUBLIC symbol 'symbol name'
	Cause	This symbol already has a PUBLIC declaration and cannot be defined with a PUBLIC declaration.
	Action by user	A symbol defined with bit items other than saddr.bit cannot have a PUBLIC declaration. Cancel PUBLIC declaration or change EQU definition.
E2404	Message	Public symbol is undefined 'symbol name'
	Cause	A symbol with a PUBLIC declaration is undefined.
E2405	Message	Illegal bit symbol
	Cause	An illegal symbol is used as a forward-reference symbol or bit symbol for the bit symbol of an operand in a machine-language instruction.
	Action by user	Specify backward reference or EXTBIT declaration for the bit symbol.
E2406	Message	Can’t refer to forward bit symbol 'symbol name'
	Cause	Specification refers forward to a bit symbol or refers to a bit symbol in an expression.
E2407	Message	Undefined symbol reference 'symbol name'
	Cause	An undefined symbol is used.

Table 12-2 Assembler Error Messages

Error Number	Error Message	
E2408	Message	Multiple symbol definition 'symbol name'
	Cause	Symbol name is defined more than once.
E2409	Message	Too many symbols in operand
	Cause	The number of symbols written in an operand exceeds the number that can be described in 1 line.
E2410	Message	Phase error
	Cause	The value of the symbol changed during assemble (for example, an EQU symbol label changed by optimum processing of BR directive is defined in an operand).
E2411	Message	This symbol is reserved 'symbol name'
	Cause	The defined symbol is a reserved word.
E2502	Message	Illegal segment name
	Cause	Symbol is written with an illegal segment name.
E2503	Message	Different segment type 'segment name'
	Cause	Two or more segments are defined with the same name but types are different.
E2504	Message	Too many segment
	Cause	Number of segments defined exceeds limit (256).
E2505	Message	Current segment is not exist
	Cause	An ENDS directive was written before a segment was created, or before a subsequent segment was created after the previous segment had ended.
E2506	Message	Can’t describe DB, DW, DS, ORG, label in BSEG
	Cause	DB, DW, DS, ORG directives are defined in a bit segment.
E2507	Message	Can’t describe opcodes outside CSEG
	Cause	Machine language instruction or BR directive is defined in something other than a code segment.
E2508	Message	Can’t describe DBIT outside BSEG
	Cause	DBIT directive is defined in something other than a bit segment.
E2509	Message	Illegal address specified
	Cause	An address allocated to an absolute segment is outside the range for that segment.
E2510	Message	Location counter overflow
	Cause	Location counter is outside the range for a corresponding segment.
E2511	Message	Segment name expected
	Cause	Segment name is not specified for segment definition directive for reallocation attribute is AT.
E2512	Message	Segment size is odd numbers ‘segment name’
	Cause	Size of reallocation attribute callt0 segment is described in an odd number.

Table 12-2 Assembler Error Messages

Error Number	Error Message	
E2515	Message	Security ID is not supported for this device
	Cause	A security ID cannot be used with the specified device.
E2517	Message	Illegal bank number
	Cause	An illegal bank specification has been described.
E2601	Message	Nesting over of include
	Cause	Nesting of include file exceeds limit (2 levels).
E2602	Message	Must be specified switches
	Cause	Switch name not specified.
E2603	Message	Too many switches described
	Cause	Switch name exceeds limit (5 per module).
E2604	Message	Nesting over of IF-classes
	Cause	Nesting of IF/_IF clauses exceeds limit (8 levels).
E2605	Message	Needless ELSE statement exists
	Cause	An ELSE statement exists where it is not necessary.
E2606	Message	Needless ENDIF statement exists
	Cause	An ENDIF statement exists where it is not necessary.
E2608	Message	Missing ENDIF
	Cause	An ENDIF statement required by IF/_IF clause is missing.
E2609	Message	Illegal ELSEIF statement
	Cause	An ELSEIF or _ELSEIF statement is written after an ELSE statement.
E2610	Message	Multiple symbol definition (MACRO) 'symbol name'
	Cause	Symbol used to define a macro name is already defined.
E2611	Message	Illegal syntax of parameter
	Cause	Formal parameter of a macro is incorrect.
E2612	Message	Too many parameter
	Cause	Number of formal parameters for a macro definition exceeds limit (16).
E2613	Message	Same name parameter described 'symbol name'
	Cause	Symbol is specified with same name as a formal parameter for a macro definition.
E2614	Message	Can’t nest macro definition
	Cause	Macro definition cannot be nested in another macro definition.
E2615	Message	Illegal syntax of local symbol
	Cause	Specification of operand in a LOCAL directive is incorrect.
E2616	Message	Too many local symbols
	Cause	Number of local symbols that can be described in 1 macro body (64) is exceeded.

Table 12-2 Assembler Error Messages

Error Number	Error Message	
E2617	Message	Missing ENDM
	Cause	ENDM statement required by macro definition directive is missing.
E2618	Message	Illegal syntax of ENDM
	Cause	ENDM statement is incorrect.
E2619	Message	Illegal defined macro
	Cause	Referenced macro is incorrectly defined.
E2620	Message	Illegal syntax of actual parameter
	Cause	Specification of actual parameter of macro is incorrect.
E2621	Message	Nesting over of macro reference
	Cause	The limit on nesting in a macro reference (8 levels) is exceeded.
E2622	Message	Illegal syntax of EXITM
	Cause	EXITM statement is incorrect.
E2623	Message	Illegal operand of REPT
	Cause	An unpermitted expression is specified in the operand of a REPT directive.
E2624	Message	More than ??RAFFFF
	Cause	More than 65535 local symbols are replaced during macro development.
E2625	Message	Unexpected ENDM
	Cause	An unexpected ENDM is found.
E2626	Message	Can’t describe LOCAL outside macro definition
	Cause	LOCAL directive is specified in a normal source statement other than a macro body.
E2627	Message	More than two segments in this include / macro
	Cause	2 or more segments are found in an include file, macro body, rept-endm block, or irp-endm block.
W2701	Message	Too long source line
	Cause	Over 2048 characters are described on 1 line of a source statement.
	Program processing	2049th and subsequent characters are ignored.
W2702	Message	Duplicate PROCESSOR option and control
	Cause	Command-line specification option for target device (-C) and PROCESSOR directive in source header are both specified.
	Program processing	Command-line specification option for target device (-C) is available, and PROCESSOR directive in source header is ignored.

Table 12-2 Assembler Error Messages

Error Number	Error Message	
W2703	Message	Multiple defined module name
	Cause	NAME directive is defined 2 or more times.
	Program processing	NAME directive is unavailable and the already defined module name is available.
W2704	Message	Already declared EXTRN symbol 'symbol name'
	Cause	This symbol is already declared EXTRN.
	Action by user	Specify EXTRN declaration once in 1 module.
W2705	Message	Already declared EXTBIT symbol 'symbol name'
	Cause	This symbol is already declared EXTBIT.
	Action by user	Specify EXTBIT declaration once in 1 module.
W2706	Message	Missing END statement
	Cause	END statement is not written at end of source file.
	Program processing	Assumes that END statement is described at end of source file.
W2707	Message	Illegal statement after END directive
	Cause	Item other than comment, space, tab, or CR code is described after END statement.
	Program processing	Ignores everything after END statement.
W2708	Message	Already declared LOCAL symbol 'symbol name'
	Cause	This symbol is already declared LOCAL.
	Action by user	Declare 1 symbol LOCAL only once per macro.
W2709	Message	Few count of actual parameter
	Cause	Fewer actual parameters are set than formal parameters.
	Program processing	Formal parameters are handled as null strings where actual parameters are insufficient.
W2710	Message	Over count of actual parameter
	Cause	More actual parameters are set than formal parameters.
	Program processing	Surplus actual parameters are ignored.
W2711	Message	Too many errors to report
	Cause	Too many errors exist to report in a single line (i.e. 6 or more errors)
	Program processing	6th and subsequent error messages are not output but processing continues.

Table 12-2 Assembler Error Messages

Error Number	Error Message	
W2712	Message	Insufficient cross-reference work area
	Cause	Memory is insufficient to process output of cross-reference list.
	Program processing	Cross-reference list is not output but processing continues.
W2717	Message	Normal, callt and callf functions must be described together respectively.
	Cause	Debugging information may be illegal because normal, callt, and callf functions are not described together.
	Program processing	Describe normal and callt functions together.
E2801	Message	Illegal debug information
	Cause	The debug information in the source file is illegal.
	Action by user	Execute the compiler or structured assembler once again.
F2901	Message	Can't open source file 'file name'
	Cause	Source file cannot be opened.
F2902	Message	Can't open parameter file 'file name'
	Cause	Parameter file cannot be opened.
F2903	Message	Can't open include file 'file name'
	Cause	Include file cannot be opened.
F2904	Message	Illegal include file 'file name'
	Cause	A drive name only, path name only or a device-type file name is specified as an include file name.
F2905	Message	Can't open overlay file 'file name'
	Cause	Overlay file cannot be opened.
	Action by user	Make sure the overlay file is in the same directory as the assembler execution format.
F2906	Message	Illegal overlay file 'file name'
	Cause	Contents of overlay file are illegal.
F2907	Message	Can't open object file 'file name'
	Cause	Object file cannot be opened.
	Action by user	Use a disk with an open area in its directory.
F2908	Message	Can't open print file 'file name'
	Cause	Assemble list file cannot be opened.
	Action by user	Use a disk with an open area in its directory.
F2909	Message	Can't open error list file 'file name'
	Cause	Error list file cannot be opened.
	Action by user	Use a disk with an open area in its directory.

Table 12-2 Assembler Error Messages

Error Number	Error Message	
F2910	Message	Can't open temporary file 'file name'
	Cause	Temporary file cannot be opened.
	Action by user	Use a disk with an open area in its directory.
F2913	Message	Can't read source file 'file name'
	Cause	A file input/output error has occurred in the source file.
F2914	Message	Can't read parameter file 'file name'
	Cause	A file input/output error has occurred in the parameter file.
F2915	Message	Can't read include file 'file name'
	Cause	A file input/output error has occurred in the include file.
F2916	Message	Can't read overlay file 'file name'
	Cause	A file input/output error has occurred in the overlay file.
F2917	Message	Can’t write object file ‘file name’
	Cause	A file input/output error has occurred in the object file.
	Action by user	Output object file to another directory or create an open area in the specified disk.
F2918	Message	Can't write print file 'file name'
	Cause	A file input/output error has occurred in the assemble list file.
	Action by user	Output assemble list file to another directory or create an open area in the specified disk.
F2919	Message	Can’t write error list file 'file name'
	Cause	A file input/output error has occurred in the error list file.
	Action by user	Output error list file to another directory or create an open area in the specified disk.
F2920	Message	Can’t read / write temporary file 'file name'
	Cause	A file input/output error has occurred in the temporary file.
	Action by user	Output temporary file to another directory or create an open area in the specified disk.
C2921	Message	Assembler internal error
	Cause	An assembler-internal error has occurred.
	Action by user	If the error cannot be resolved, contact NEC Electronics or an NEC Electronics distributor.
F2922	Message	Insufficient memory in hostmachine
	Cause	System does not have sufficient memory to execute assembler.
F2923	Message	Insufficient memory for macro in hostmachine
	Cause	Memory for macro became insufficient in the middle of macro processing.
	Action by user	Reduce number of macros defined.

12.4 Linker Error Messages

Table 12-3 Linker Error Messages

Error Number	Error Message	
F3001	Message	Missing input file
	Cause	An input file has not been specified.
	Action by user	Specify an input file.
F3004	Message	Illegal file name ‘file name’
	Cause	Either there are illegal characters in the file name, or the number of characters exceeds the limit.
	Action by user	Input a file name that has legal characters and is within the character number limit.
F3005	Message	Illegal file specification 'file name'
	Cause	An illegal file has been specified.
	Action by user	Specify a legal file.
F3006	Message	File not found 'file name'
	Cause	The specified file does not exist.
	Action by user	Specify an existent file.
F3007	Message	Input file specification overlapped 'file name'
	Cause	The input file name has already been specified elsewhere.
	Action by user	Input a unique file name.
F3008	Message	File specification conflicted 'file name'
	Cause	An I/O file name has been specified in duplicate.
	Action by user	Specify different I/O file names.
F3009	Message	Unable to make file 'file name'
	Cause	The specified file is write-protected.
	Action by user	Release the write protection on the specified file.
F3010	Message	Directory not found 'file name'
	Cause	A non-existent drive and/or directory has been included in the output file name.
	Action by user	Specify an existent drive and/or directory.
F3011	Message	Illegal path 'option'
	Cause	Other than a path name has been specified in the option that specifies the path for the parameter.
	Action by user	Specify a correct path name.
F3012	Message	Missing parameter 'option'
	Cause	A necessary parameter has not been specified.
	Action by user	Specify the parameter.

Table 12-3 Linker Error Messages

Error Number	Error Message	
F3013	Message	Parameter not needed 'option'
	Cause	An unnecessary parameter has been specified.
	Action by user	Delete the unnecessary parameter.
F3014	Message	Out of range 'option'
	Cause	The specified numerical value is outside the range.
	Action by user	Specify a correct numerical value.
F3015	Message	Parameter is too long 'option'
	Cause	The number of characters in the parameter exceeds the limit.
	Action by user	Specify a parameter whose character number is within the limit.
F3016	Message	Illegal parameter 'option'
	Cause	The syntax of the parameter is incorrect.
	Action by user	Specify a correct parameter.
F3017	Message	Too many parameters 'option'
	Cause	The total number of parameters exceeds the limit.
	Action by user	Specify parameters within the number limit.
F3018	Message	Option is not recognized 'option'
	Cause	The option name is incorrect.
	Action by user	Specify a correct option name.
F3019	Message	Parameter file nested
	Cause	The -F option has been specified inside a parameter file.
	Action by user	Do not specify the -F option inside a parameter file.
F3020	Message	Parameter file read error 'file name'
	Cause	The parameter file cannot be read.
	Action by user	Specify a correct parameter file.
F3021	Message	Memory allocation failed
	Cause	There is insufficient memory.
	Action by user	Secure the necessary memory.
F3030	Message	On-chip debug is not supported for this device
	Cause	The on-chip debug function cannot be used with the specified device.
	Action by user	Do not specify the on-chip debug function.
F3031	Message	Security ID is not supported for this device
	Cause	A Security ID cannot be used with the specified device.
	Action by user	Do not specify a Security ID.

Table 12-3 Linker Error Messages

Error Number	Error Message	
F3101	Message	'File name' invalid input file (or made by different hostmachine)
	Cause	File other than object module file was input, or link was attempted with object module file created on an incompatible host machine.
E3102	Message	Directive syntax error
	Cause	Specification of directive is incorrect.
F3103	Message	'File name' Illegal processor type
	Cause	Target device of assemble or compile is not a target device of this linker.
	Action by user	Check to ensure that the object module file is correct. Check to ensure that the target device for the assemble or compile can be handled by the linker. Also check that the overlay file is the correct version. (The linker references part of the overlay file of the assembler to obtain characteristic data on the target device.)
F3104	Message	'File name' Different processor type from first input file 'first input file name'
	Cause	An object module file is input whose target device is different from that of the first input object module file.
W3105	Message	Library file 'file name' has no public symbol
	Cause	Library file has no public symbol. Therefore, an object module included in the library file cannot be linked.
F3106	Message	Can’t create temporary file 'file name'
	Cause	Cannot create temporary file.
E3107	Message	Name 'name' in directive already defined
	Cause	Attempted to define a reserved word or a previously defined name as the memory area of a directive. This name (reserved word, memory space name, memory area name) is already defined.
E3108	Message	Overlapped memory area 'Memory area 1' and 'Memory area 2'
	Cause	The memory area addresses defined in the memory directive are overlapped.
E3109	Message	Memory area 'Memory area name' too long name (up to 31 characters)
	Cause	The memory area name specified in the directive is too long. The memory area name specified in the directive is 32 characters or longer.
E3110	Message	Memory area 'Memory area name' already defined
	Cause	The memory area specified in the memory directive is already registered.
E3111	Message	Memory area 'Memory area name' redefinition out of range
	Cause	The range of the memory area specified in the memory directive is outside the redefinable range.
E3112	Message	Segment 'segment name' wrong allocation type
	Cause	Wrong allocation type is specified for the segment in the merge directive.

Table 12-3 Linker Error Messages

Error Number	Error Message	
C3113	Message	Linker internal error
	Cause	Internal error.
	Action by user	Contact NEC Electronics or an NEC Electronics distributor.
E3114	Message	Illegal number
	Cause	Specification of a numerical value in a directive is incorrect.
E3115	Message	Too large value (up to 1048575/0FFFFFH)
	Cause	A value greater than 1048575 (0FFFFFH) is described in the directive.
E3116	Message	Memory area ‘Memory area name’ definition out of range
	Cause	The sum of the start address and size of the memory area specified in the memory directive exceeds 1048575 (0FFFFFH).
E3117	Message	Can’t find target chip in all modules
	Cause	The target device cannot be identified because the series common object specification (-COMMON) option is specified for all the input object module files.
	Action by user	Remove the unnecessary series common object specification (-COMMON) options.
E3201	Message	Multiple segment definition 'segment name' in merge directive
	Cause	Segment specified in the merge directive is already registered (the same segment is attempted to specify allocation using multiple merge directives).
E3202	Message	Segment type mismatch 'segment 1' in file 'segment 2' -ignored
	Cause	A segment with the same name as this segment but having the reallocation attributes of a different segment type is found.
F3203	Message	Segment 'segment name' unknown segment type
	Cause	An error exists in the segment data of the input object module file (specification of link of output segments is incorrect).
E3204	Message	Memory area/space 'name' not defined
	Cause	Memory area/space name specified in merge directive is not defined.
E3205	Message	Name 'name' in directive has bad attribute
	Cause	An item that cannot be described in a segment name, memory area name or memory space name is described in the directive (for example, a memory space name is described where a memory area name is required).
E3206	Message	Segment 'segment name' can't allocate to memory - ignored
	Cause	Segment cannot be allocated to memory (not enough memory area exists to allocate segment).
E3207	Message	Segment 'segment name' has illegal segment type
	Cause	This segment type data is illegal.

Table 12-3 Linker Error Messages

Error Number	Error Message	
E3208	Message	Segment 'segment name' may not change attribute
	Cause	Attempted to change the link type in the directive for a segment created with the reallocation attribute 'AT xxxxH' specified during assemble, or created using the ORG directive.
E3209	Message	Segment 'segment name' may not change arrangement
	Cause	Attempted to change the allocation address in the directive for a segment created with the reallocation attribute 'AT xxxxxxH' specified during assemble, or created using the ORG directive.
	Action by user	Do not specify the allocation address in the assembler for a segment whose link type is to be specified during link.
E3210	Message	Segment 'segment name' is not exist - ignored
	Cause	Segment specified in the directive does not exist.
E3211	Message	Bank type mismatch 'symbol name' in file 'file name' - ignored
	Cause	A mismatch exists in the specified symbol bank number.
	Action by user	Confirm that the bank number of the symbol is correct.
E3301	Message	Relocatable object code address out of range (file 'file name', segment 'segment name', address xxxxH, type 'addressing type')
	Cause	Correction data of relocatable object code included in the input object module file is output to an address where no object code exists (relocation entry address is out of range of origin data).
	Action by user	Check that symbol reference is correct.
E3302	Message	Illegal symbol index in line number (file 'file name', segment 'segment name')
	Cause	Line number data for debugging included in the input object module file is incorrect, and does not correctly reference the symbol data. Line number index and symbol index do not correspond.
E3303	Message	Can't find symbol index in relocatable object code (file 'file name', segment 'segment name', address xxxxH, type 'addressing type')
	Cause	Correction data of relocatable code included in the input object module file is incorrect, and does not correctly reference the symbol data. Relocation entry and symbol index do not correspond.
	Action by user	Check that reference method of symbols and variables is correct.
E3304	Message	Operand out of range (segment 'segment name', address xxxxH, type 'addressing type')
	Cause	Operand value used in decision of relocatable object code is out of range for operand values corresponding to the instruction.
	Action by user	Describe the value for the operand in the source program that fits within the range determined for each addressing type.
E3305	Message	Even value expected (segment 'segment name', address xxxxH, type 'addressing type')
	Cause	The operand value used to determine the callt or saddrp addressing relocatable object code is an odd number (callt and saddrp addressing operands must be even numbers).

Table 12-3 Linker Error Messages

Error Number	Error Message	
E3306	Message	A multiple of 4 value expected (segment ‘segment name’, address xxxxH, type ‘addressing type’)
	Cause	The value of the operand used for resolving the relocatable object code for saddr addressing is not a multiple of 4.
F3401	Message	'File name' Bad symbol table
	Cause	Symbol data of input object module file is illegal. Symbol entry of input file does not begin with '.file'.
F3402	Message	File 'file name' has no string table for symbol
	Cause	Symbol data of input object module file is illegal.
	Action by user	Perform assemble or compile again. This may be avoidable by making the recognizable number of characters 8 for the assembler and 7 for the compiler.
E3403	Message	Symbol 'symbol name' unmatched type in file 'file name1'. First defined in file 'file name2'
	Cause	Externally defined/referenced symbol type with same name is different in file 1 and file 2.
E3404	Message	Multiple Symbol definition 'symbol name' in file 'file name1'. First defined in file 'file name2'
	Cause	Public symbol defined in object module file 1 is already declared PUBLIC in object module file 2.
E3405	Message	Undefined symbol 'symbol name' in file 'file name'
	Cause	Symbol declared EXTRN in the file is not declared PUBLIC in another file.
W3406	Message	Stack area less than 10 bytes
	Cause	Size of protected stack area is 10 bytes or less (size of stack area protected in memory area specified with -S option is 10 bytes or less).
W3407	Message	Can’t allocate stack area
	Cause	No free area is available in memory area in which stack area is protected (stack area cannot be protected in memory area specified with -S option).
E3410	Message	Multiple module name definition 'module name' in file 'file 1' First defined in file 'file 2'
	Cause	The module name of object module file 1 and the module name of object module file 2 are the same.
W3411	Message	Different REL type in 'file name'
	Cause	The type version of object module file is different.
	Action by user	Re-assemble or re-compile with the newest version.
E3415	Message	-QD/QF/etc. and Not -QD/QF/etc. REL are mixed
	Cause	An input object module file has a different specification for a compiler optimization option which must be the same for the entire program. Compile using the same value as in the rest of the program.

Table 12-3 Linker Error Messages

Error Number	Error Message	
W3416	Message	Multiple CAP/NOCAP are in file 'file name (option)' Defined first one in file 'file name (option)'
	Cause	CAP/NOCAP assemble or compile options are not identical for all input object module files.
W3417	Message	The version of tool name in file 'file name' are more than one. Used the first one in file 'file name'
	Cause	A discrepancy exists between each tool (CC78K0, ST78K0, RA78K0) used until the link stage for all input object module files and the device file version.
W3418	Message	File 'file name' is old. Can’t find TOOL information
	Cause	This is output when TOOL information is not found in input object module file. Normally, this is always output when link is performed with an old (DF-incompatible) object module file.
W3420	Message	File 'file name' has already had error(s)/warning(s) by 'tool name'
	Cause	An error message or warning message for each tool (CC78K0, ST78K0, RA78K0) used until the link stage is output.
E3424	Message	-ZF REL and no -ZF REL are mixed in file 'file name'
	Cause	When linking load module of the boot area ROM program of a flash ROM model with object module of the flash area program, some object module do not specify the -ZF option during compilation.
E3425	Message	There are different function ID in same name 'function name' (file 'file name')
	Cause	A function of the same name declared as EXT_FUNC by the compiler has a different ID value.
E3426	Message	Multiple input BOOT file 'file name'
	Cause	Two or more load module of the boot area ROM program are input when load module of the boot area ROM program of a flash ROM model is linked with object module of the flash area program.
E3427	Message	BOOT REL and -ZF REL are mixed in file 'file name'
	Cause	Object module specified by the -ZF option is input during compilation for linking with the -ZF option specified.
E3428	Message	FLASH start address larger than ROM max address
	Cause	The first address of the flash ROM area is greater than the ROM end address of the target device.
E3429	Message	BOOT segment 'segment name' are found in FLASH file 'file name'
	Cause	When load module of the boot area ROM program of a flash ROM model is linked with object module of the flash area ROM program, a segment with a location address less than the first address of the flash ROM area exists in the object module.
E3430	Message	Different FLASH address in file 'file name'
	Cause	All the first addresses of the flash ROM area of the input files are not the same.

Table 12-3 Linker Error Messages

Error Number	Error Message	
E3431	Message	There are different function name in same ID (function name) (file 'file name')
	Cause	Two or more functions declared as EXT_FUNC by the compiler have the same ID value.
E3432	Message	Illegal allocation of an EXT_FUNC function 'function name' (file 'file name')
	Cause	The entity of the function declared as EXT_FUNC by the compiler exists when linking is performed with the -ZB option specified.
F3901	Message	Can’t open overlay file 'file name'
	Cause	Overlay file cannot be opened.
	Action by user	Make sure the overlay file is in the correct directory (a directory containing an execution program).
F3902	Message	File 'file name' not found
	Cause	The specified library file cannot be opened.
F3903	Message	Can't read input file 'file name'
	Cause	Object module file specified as an input file cannot be read.
F3904	Message	Can't open output file 'file name'
	Cause	Output file cannot be opened.
	Action by user	Check condition (open capacity, condition of media, etc.) of the disk used to create output file.
F3905	Message	Can’t create temporary file 'file name'
	Cause	Temporary file for symbol entry cannot be created.
	Action by user	Check condition (open capacity, condition of media, etc.) of the disk used to attempt to create temporary file.
F3906	Message	Can’t write map file 'file name'
	Cause	Data cannot be written to the link list file.
	Action by user	Check condition (open capacity, condition of media, etc.) of the disk used to attempt to create link list file.
F3907	Message	Can’t write output file 'file name'
	Cause	Data cannot be written to the load module file.
	Action by user	Check condition (open capacity, condition of media, etc.) of the disk used to attempt to create output file.
F3908	Message	Can’t access temporary file 'file name'
	Cause	Temporary file cannot be written.
	Action by user	Check condition (open capacity, condition of media, etc.) of the disk used to attempt to create temporary file.
F3909	Message	Can't read DEVICE_FILE file 'device file name'
	Cause	Device file corresponding to device specified by each tool (CC78K0, ST78K0, RA78K0) used until the link stage cannot be read.

Caution The address shown in 'address xxxxH' in the messages in E3301 to E3306 are absolute addresses after segment allocation.

12.5 Object Converter Error Messages

Table 12-4 Object Converter Error Messages

Error Number	Error Message	
F4001	Message	Missing input file
	Cause	An input file has not been specified.
	Action by user	Specify an input file.
F4002	Message	Too many input files
	Cause	Two or more input files have been specified.
	Action by user	Specify only one input file.
F4004	Message	Illegal file name ‘file name’
	Cause	Either there are illegal characters in the file name, or the number of characters exceeds the limit.
	Action by user	Input a file name that has legal characters and is within the character number limit.
F4005	Message	Illegal file specification 'file name'
	Cause	An illegal file has been specified.
	Action by user	Specify a legal file.
F4006	Message	File not found 'file name'
	Cause	The specified input file does not exist.
	Action by user	The file is output as "startup routine name.lmf" if the startup routine of the C compiler is linked. In this case, specify an output file name with a linker option, like "-o*.lmf".
F4008	Message	File specification conflicted 'file name'
	Cause	An I/O file name has been specified in duplicate.
	Action by user	Specify different I/O file names.
F4009	Message	Unable to make file 'file name'
	Cause	The specified file is write-protected.
	Action by user	Release the write protection on the specified file.
F4010	Message	Directory not found 'file name'
	Cause	A non-existent drive and/or directory has been included in the output file name.
	Action by user	Specify an existent drive and/or directory.
F4011	Message	Illegal path 'option'
	Cause	Other than a path name has been specified in the option that specifies the path for the parameter.
	Action by user	Specify a correct path name.

Table 12-4 Object Converter Error Messages

Error Number	Error Message	
F4012	Message	Missing parameter 'option'
	Cause	A necessary parameter has not been specified.
	Action by user	Specify the parameter.
F4013	Message	Parameter not needed 'option'
	Cause	An unnecessary parameter has been specified.
	Action by user	Delete the unnecessary parameter.
F4014	Message	Out of range 'option'
	Cause	The specified numerical value is outside the range.
	Action by user	Specify a correct numerical value.
F4015	Message	Parameter is too long 'option'
	Cause	The number of characters in the parameter exceeds the limit.
	Action by user	Specify a parameter whose character number is within the limit.
F4016	Message	Illegal parameter 'option'
	Cause	The syntax of the parameter is incorrect.
	Action by user	Specify a correct parameter.
F4017	Message	Too many parameters 'option'
	Cause	The total number of parameters exceeds the limit.
	Action by user	Specify parameters within the number limit.
F4018	Message	Option is not recognized 'option'
	Cause	The option name is incorrect.
	Action by user	Specify a correct option name.
F4019	Message	Parameter file nested
	Cause	The -F option has been specified inside a parameter file.
	Action by user	Do not specify the -F option inside a parameter file.
F4020	Message	Parameter file read error 'file name'
	Cause	The parameter file cannot be read.
	Action by user	Specify a correct parameter file.
F4021	Message	Memory allocation failed
	Cause	There is insufficient memory.
	Action by user	Secure the necessary memory.

Table 12-4 Object Converter Error Messages

Error Number	Error Message	
F4100	Message	'File name' Illegal processor type
	Cause	Target device of the assembler or compiler is different from the target device of this program.
	Action by user	Check whether the load module file is correct and check target device of the assemble or compile. Also, check whether the version of the device file is correct.
F4101	Message	'File name' invalid input file (or made by different hostmachine)
	Cause	Attempted to input a file other than a load module file, or to convert a load module file created on an incompatible host machine.
F4103	Message	Symbol 'symbol name' Illegal attribute
	Cause	A mistake exists in the symbol attribute of the input file.
F4104	Message	'File name' Illegal input file - not linked
	Cause	Attempted to input an object module file.
F4105	Message	Insufficient memory in hostmachine
	Cause	Memory is not sufficient to operate the program.
F4106	Message	Illegal symbol table
	Cause	A mistake exists in the symbol table of the input load module file.
	Action by user	If the source is written in C, make sure that the assembler code in the C source satisfies the following conditions : <Conditions> If a local symbol is used, use a symbol that starts with string ?L (such as ?L@01 or ?L@sym). However, keep this symbol to within 8 characters. Do not define this symbol externally (PUBLIC declaration).
F4107	Message	Can’t specify -U option for ROMless device
	Cause	The object complement specification (-U) option is specified for a model without internal ROM.
E4200	Message	Undefined symbol 'symbol name'
	Cause	A symbol whose address is undetermined has been found.
	Action by user	Define the symbol's value. This symbol is referenced as an external reference symbol. If it is not externally defined, specify an external definition outside the module in which the value of the symbol is defined.
E4201	Message	Out of address range
	Cause	The address of an object in a load module file is out of range.
W4300	Message	xxxxxxH - yyyyyyH overlapped
	Cause	Objects overlapped in the address from xxxxxxH to yyyyyyH are output.
W4301	Message	Can't initialize RAM area 'address' - 'address'
	Cause	Initial value data is output to the RAM area.
	Action by user	If DB/DW is described in DSEG of the assembly source, change it to DS or describe the DB/DW instruction in CSEG.

Table 12-4 Object Converter Error Messages

Error Number	Error Message	
F4900	Message	Can't open file 'file name'
	Cause	File cannot be opened.
F4901	Message	Can't close file 'file name'
	Cause	File cannot be closed.
F4902	Message	Can't read file 'file name'
	Cause	File cannot be correctly read.
F4903	Message	Can't access file 'file name'
	Cause	File cannot be correctly read or written to.
F4904	Message	Can't write file 'file name'
	Cause	Data cannot be correctly written to an output file.
F4905	Message	Can’t open overlay file 'file name'
	Cause	The overlay file cannot be opened.
	Action by user	Check if the overlay file is in the same directory as the execution format.
C4999	Message	Object Converter internal error
	Cause	This is an internal error.
	Action by user	Contact NEC Electronics or an NEC Electronics distributor.

12.6 Librarian Error Messages

Table 12-5 Librarian Error Messages

Error Number	Error Message	
F5001	Message	Missing input file
	Cause	Only options are specified. No input files are specified.
F5002	Message	Too many input files
	Cause	Total number of input files exceeds the limit.
F5003	Message	Unrecognized string '???'
	Cause	Something other than an option is specified on a conversational-format command line.
F5004	Message	Illegal file name 'file name'
	Cause	File name includes character(s) not permitted by the operating system, or exceeds the limit for number of characters.
F5005	Message	Illegal file specification 'file name'
	Cause	An illegal item is specified in the file name.
F5006	Message	File not found 'file name'
	Cause	Specified input file does not exist.
F5007	Message	Input file specification overlapped 'file name'
	Cause	Input file name specification is overlapped.
F5008	Message	File specification conflicted 'file name'
	Cause	Input or output file name specifications overlap.
F5009	Message	Unable to make file 'file name'
	Cause	Specified output file cannot be created.
F5010	Message	Directory not found 'file name'
	Cause	A drive or directory which does not exist is included in the output file name.
F5011	Message	Illegal path 'file name'
	Cause	An item other than a path name is specified in an option specifying the path name for a parameter.
F5012	Message	Missing parameter 'option'
	Cause	Required parameter is not specified.
F5013	Message	Parameter not needed 'option'
	Cause	An unnecessary parameter is specified.
F5014	Message	Out of range 'option'
	Cause	Specified value is out of range.
F5015	Message	Parameter is too long 'option'
	Cause	Number of characters specified in parameter exceeds limit.

Table 12-5 Librarian Error Messages

Error Number	Error Message	
F5016	Message	Illegal parameter 'option'
	Cause	A mistake exists in the syntax of the parameter.
F5017	Message	Too many parameters 'option'
	Cause	Total number of parameters exceeds limit.
F5018	Message	Option is not recognized 'option'
	Cause	An incorrect option is specified.
F5021	Message	Memory allocation failed
	Cause	Memory allocation has failed.
F5024	Message	Illegal character
	Cause	An illegal character or character string is found.
F5025	Message	Qualifier is not unique.
	Cause	The abbreviation type of the modifier is not unique.
F5026	Message	Umbigous input redirect.
	Cause	No file name is specified after '<', or '< D file name' is specified more than once.
C5100	Message	Internal error
	Cause	An internal error has occurred.
E5101	Message	Invalid sub command
	Cause	Subcommand name is incorrect.
E5102	Message	Invalid syntax
	Cause	Parameter specification in subcommand is incorrect.
E5103	Message	Illegal input file - different target chip (file: file name)
	Cause	Specification of target device in input object module file is incorrect.
E5104	Message	Illegal library file - different target chip (file: file name)
	Cause	Specification of target device in library file is incorrect.
E5105	Message	Module not found (module: file name)
	Cause	Specified module does not exist in library file.
E5106	Message	Module already exists (module: file name)
	Cause	A module of the same name already exists in the updated library file or another input file.
E5107	Message	Master library file is not specify
	Cause	Updated library file is not specified in a previous operation, but the library file name is replaced with '. '.

Table 12-5 Librarian Error Messages

Error Number	Error Message	
E5108	Message	Multiple transaction file (file: file name)
	Cause	Input object module files overlap.
E5109	Message	Public symbol already exists (symbol: symbol name)
	Cause	An externally defined symbol name already exists in an updated library file or other input file.
E5110	Message	File specification conflicted (file: file name)
	Cause	Specified input file name is same as output file name.
E5111	Message	Illegal file format (file: file name)
	Cause	Format of an updated library file or other input file is incorrect.
E5112	Message	Library file not found (file: file name)
	Cause	Specified library file is not found.
E5113	Message	Object module file not found (file: file name)
	Cause	Specified object module file is not found.
E5114	Message	No free space for temporary file
	Cause	Sufficient space does not exist in the disk to create a temporary file.
E5115	Message	Not enough memory
	Cause	Sufficient memory is not available to operate the program.
E5116	Message	Sub command Buffer full
	Cause	Limit for continuous line length in a subcommand (128 x 15 characters) is exceeded. Limit for length of 1 line in a subcommand (128 characters) is exceeded.
E5117	Message	Can not use device file
	Cause	A device-type file is specified in the input file. CLOCK is specified in the list command of an input or output file. PRN, CON, or CLOCK is specified in an output object module file or output library file.
E5118	Message	Illegal path (file: file name)
	Cause	Path name in the specified file is incorrect.
W5201	Message	Module not found (module: file name)
	Cause	The module for which REPLACE is specified is not in the library file.
F5901	Message	File open error (file: file name)
	Cause	File cannot be opened.
F5902	Message	File read error (file: file name)
	Cause	File cannot be correctly read.
F5903	Message	File write error (file: file name)
	Cause	Data cannot be correctly written to file.

Table 12-5 Librarian Error Messages

Error Number	Error Message	
F5904	Message	File seek error (file: file name)
	Cause	File seek error has occurred.
F5905	Message	File close error (file: file name)
	Cause	File cannot be closed.

12.7 List Converter Error Messages

Table 12-6 List Converter Error Messages

Error Number	Error Message	
F6001	Message	Missing input file
	Cause	An input file has not been specified.
	Action by user	Specify an input file.
F6002	Message	Too many input files
	Cause	Two or more input files have been specified.
	Action by user	Specify only one input file.
F6004	Message	Illegal file name ‘file name’
	Cause	Either there are illegal characters in the file name, or the number of characters exceeds the limit.
	Action by user	Input a file name that has legal characters and is within the character number limit.
F6005	Message	Illegal file specification 'file name'
	Cause	An illegal file has been specified.
	Action by user	Specify a legal file.
F6006	Message	File not found 'file name'
	Cause	The specified file does not exist.
	Action by user	Specify an existent file.
F6008	Message	File specification conflicted 'file name'
	Cause	An I/O file name has been specified in duplicate.
	Action by user	Specify different I/O file names.
F6009	Message	Unable to make file 'file name'
	Cause	The specified file is write-protected.
	Action by user	Release the write protection on the specified file.
F6010	Message	Directory not found 'file name'
	Cause	A non-existent drive and/or directory has been included in the output file name.
	Action by user	Specify an existent drive and/or directory.
F6011	Message	Illegal path 'option'
	Cause	Other than a path name has been specified in the option that specifies the path for the parameter.
	Action by user	Specify a correct path name.
F6012	Message	Missing parameter 'option'
	Cause	A necessary parameter has not been specified.
	Action by user	Specify the parameter.

Table 12-6 List Converter Error Messages

Error Number	Error Message	
F6013	Message	Parameter not needed 'option'
	Cause	An unnecessary parameter has been specified.
	Action by user	Delete the unnecessary parameter.
F6014	Message	Out of range 'option'
	Cause	The specified numerical value is outside the range.
	Action by user	Specify a correct numerical value.
F6015	Message	Parameter is too long 'option'
	Cause	The number of characters in the parameter exceeds the limit.
	Action by user	Specify a parameter whose character number is within the limit.
F6016	Message	Illegal parameter 'option'
	Cause	The syntax of the parameter is incorrect.
	Action by user	Specify a correct parameter.
F6017	Message	Too many parameters 'option'
	Cause	The total number of parameters exceeds the limit.
	Action by user	Specify parameters within the number limit.
F6018	Message	Option is not recognized 'option'
	Cause	The option name is incorrect.
	Action by user	Specify a correct option name.
F6019	Message	Parameter file nested
	Cause	The -F option has been specified inside a parameter file.
	Action by user	Do not specify the -F option inside a parameter file.
F6020	Message	Parameter file read error 'file name'
	Cause	The parameter file cannot be read.
	Action by user	Specify a correct parameter file.
F6021	Message	Memory allocation failed
	Cause	There is insufficient memory.
	Action by user	Secure the necessary memory.
F6101	Message	File is not 78K/0 'file name'
	Cause	Input file name is not a 78K/0 file name.
F6102	Message	Load module file is not executable 'file name'
	Cause	Attempted to input a file other than a load module file, or attempted to convert a load module file created on an incompatible host machine.
F6103	Message	Load module file has relocation data 'file name'
	Cause	Address of load module file is not determined.

Table 12-6 List Converter Error Messages

Error Number	Error Message	
F6104	Message	Object module file is executable 'file name'
	Cause	Object module file is in an executable format.
F6105	Message	Segment name is not found in module file 'segment name'
	Cause	Segment name of object module file is not found in load module file.
F6106	Message	Segment name is not found in object module file 'segment name'
	Cause	Segment name of assemble list file is not found in object module file.
F6107	Message	Not enough memory
	Cause	Memory is not sufficient for program operation.
F6108	Message	Load module file has no symbol data 'load module name'
	Cause	Option -NG is specified in linker, so symbol data in load module file cannot be output.
F6109	Message	Overlay file can not open 'path name'
	Cause	Assembler overlay file cannot be opened.
F6110	Message	Illegal assembler list file 'file name'
	Cause	Input assemble list is a file type other than an assemble list file.
W6701	Message	Load module file is older than object module file 'load module file name, object module file name'
	Cause	A load module file is specified which is older than the object module file.
W6702	Message	Load module file is older than assemble module file 'load module file name, assemble list file name'
	Cause	A load module file is specified which is older than the assemble list file.
W6703	Message	Assemble list has error statement 'file name'
	Cause	An error exists in the assemble list.
W6704	Message	Segment name is not found in assemble list file 'segment name'
	Cause	Segment name of object module file is not found in assemble list.
W6705	Message	Segment data length is different 'segment name'
	Cause	Length of segment data in assemble list file is different from length of segment data in object module file.
	Program processing	Surplus segment data is ignored and processing continues.
F6901	Message	File open error has occurred 'file name'
	Cause	File cannot be opened.
F6902	Message	File read error has occurred 'file name'
	Cause	File cannot be correctly read.

Table 12-6 List Converter Error Messages

Error Number	Error Message	
F6903	Message	File write error has occurred 'file name'
	Cause	Data cannot be correctly written to file.
F6904	Message	File seek error has occurred 'file name'
	Cause	File seek error has occurred.
C6999	Message	Internal error
	Cause	Program-internal error

12.8 PM plus Error Messages

This section explains error messages that are not contained in the online help of PM plus. For information on other PM plus error messages, please refer to PM plus Online Help.

12.8.1 Structured Assembler Preprocessor (ST78K0)

Table 12-7 Error Messages Displayed by the Structured Assembler Preprocessor (ST78K0) DLL

Error Type	Error Message	
x	Message	Cannot find ST78K0.EXE shown in environmental variable PATH.
	Cause	The ST78K0.EXE execution format is not in the specified directory.
	Action by user	Re-install the RA78K0 assembler package.
	Button	[OK] … Close the message box.
!	Message	Cannot find folder. Will you create?
	Cause	The specified folder does not exist.
	Action by user	Create a folder or select another folder.
	Button	[OK] … Creates a folder and closes the message box. [Cancel] … Close the message box.
!	Message	Not make folder.
	Cause	The specified folder could not be created.
	Action by user	Specify another folder.
	Button	[OK] … Close the message box.
!	Message	Invalid order size with TAB number.
	Cause	A value whose size relation is illegal has been specified as the number of tabs.
	Action by user	Specify a value within the usable range.
	Button	[OK] … Close the message box.
!	Message	Invalid value. The range of number of tabs until the instruction is from 0 to 97.
	Cause	A value outside the range is described as the number of tabs up to an instruction.
	Action by user	Specify a value within the usable range.
	Button	[OK] … Close the message box.
!	Message	Invalid value. The range of number of tabs until an operand is from 0 to 98.
	Cause	A value outside the range is described as the number of tabs up to an operand.
	Action by user	Specify a value in the usable range.
	Button	[OK] … Close the message box.

Table 12-7 Error Messages Displayed by the Structured Assembler Preprocessor (ST78K0) DLL

Error Type	Error Message	
!	Message	Invalid value. The range of number of tabs until a comment is from 0 to 99
	Cause	A value outside the range is specified as the number of tabs up to a comment
	Action by user	Specify a value in the usable range
	Button	[OK] … Close the message box
!	Message	Invalid word symbol character.
	Cause	A character that cannot be used as a symbol is specified.
	Action by user	Specify a usable character.
	Button	[OK] … Close the message box.
!	Message	Too many Include Search Path. Up to 64 can be specified for Include Search Path.
	Cause	Too many include file paths are specified.
	Action by user	Specify the number of include file paths in the usable range.
	Button	[OK] … Close the message box.
!	Message	Too many characters for Include Search Path.
	Cause	The length of the include file path is specified as a number of characters exceeding the input range.
	Action by user	Specify a number of characters in the input range.
	Button	[OK] … Close the message box.
!	Message	(Include file path) Multiple Include Search Path definition
	Cause	Include file paths are described in duplicate.
	Action by user	Delete the duplicate path(s) and retry.
	Button	[OK] … Close the message box.
!	Message	Too many symbols for Symbol Definition. Up to 30 symbols can be specified.
	Cause	A number of symbols exceeding the input range is described for the symbol definition.
	Action by user	Keep the number of symbols to within the usable range and retry.
	Button	[OK] … Close the message box.
!	Message	(symbol) Too many characters for Symbol Definition. Up to 31 characters can be described for symbol name.
	Cause	The length of the defined symbol is greater than the number of characters in the input range.
	Action by user	Keep the number of characters of the symbol to within the range and retry.
	Button	[OK] … Close the message box.

Table 12-7 Error Messages Displayed by the Structured Assembler Preprocessor (ST78K0) DLL

Error Type	Error Message	
!	Message	(symbol) Multiple symbol definition.
	Cause	A symbol is described in duplicate for the symbol definition.
	Action by user	Delete the duplicate symbol and retry.
	Button	[OK] … Close the message box.
!	Message	Can't set options to (source file name)
	Cause	If a common option is reflected on an individual option, specification of the individual option becomes illegal.
	Action by user	Check the specification of the individual option and retry.
	Button	[OK] … Close the message box.

12.8.2 Assembler (RA78K0)

Table 12-8 Error Messages Displayed by the Assembler (RA78K0) DLL

Error Type	Error Message	
x	Message	Cannot find RA78K0.EXE shown in environmental variable PATH.
	Cause	The RA78K0.EXE execution format is not in the specified directory.
	Action by user	Re-install the RA78K0 assembler package.
	Button	[OK] … Close the message box.
!	Message	Cannot find folder. Will you create?
	Cause	The specified folder does not exist.
	Action by user	Create a folder or select another folder.
	Button	[OK] …Creates a folder and close the message box. [Cancel] …Close the message box.
!	Message	Not make folder.
	Cause	The specified folder could not be created.
	Action by user	Specify another folder.
	Button	[OK] … Close the message box.
!	Message	Invalid value. The range of columns per line is from 72 to 2046.
	Cause	A value exceeding the limit range is specified as the number of characters on one line.
	Action by user	Specify a value within the range.
	Button	[OK] … Close the message box.
!	Message	Invalid value. The range of line per page is from 0, or 20 to 32767.
	Cause	A value outside the limit range is specified as the number of lines on one page.
	Action by user	Specify a value within the limit range.
	Button	[OK] … Close the message box.
!	Message	Invalid value. The range of TAB character is from 0 to 8.
	Cause	A value outside the input limit range is described as the number of tabs up to an operand.
	Action by user	Specify a value within the limit range.
	Button	[OK] … Close the message box.

Table 12-8 Error Messages Displayed by the Assembler (RA78K0) DLL

Error Type	Error Message	
!	Message	Too many Include Search Path. Up to 64 can be specified for Include Search Path.
	Cause	A number of include file paths outside the input limit range is specified.
	Action by user	Specify a number within the limit range.
	Button	[OK] … Close the message box.
!	Message	Too many characters for Include Search Path.
	Cause	The length of the include file path is specified as a number of characters exceeding the input range.
	Action by user	Specify a number of characters in the input range.
	Button	[OK] … Close the message box.
!	Message	(Include file path) Multiple Include Search Path definition
	Cause	Include file paths are described in duplicate.
	Action by user	Delete the duplicate path(s) and retry.
	Button	[OK] … Close the message box.
!	Message	Too many symbols for Symbol Definition. Up to 30 symbols can be specified.
	Cause	A number of symbols exceeding the input range is described for the symbol definition.
	Action by user	Keep the number of symbols to within the usable range and retry.
	Button	[OK] … Close the message box.
!	Message	(symbol) Too many characters for Symbol Definition. Up to 31 characters can be described for symbol name.
	Cause	The length of the defined symbol is greater than the number of characters in the input range.
	Action by user	Keep the number of characters of the symbol to within the range and retry.
	Button	[OK] … Close the message box.
!	Message	(symbol) Multiple symbol definition.
	Cause	A symbol is described in duplicate for the symbol definition.
	Action by user	Delete the duplicate symbol and retry.
	Button	[OK] … Close the message box.

Table 12-8 Error Messages Displayed by the Assembler (RA78K0) DLL

Error Type	Error Message	
!	Message	Can't set options to (source file name)
	Cause	If a common option is reflected on an individual option, specification of the individual option becomes illegal.
	Action by user	Check the specification of the individual option and retry.
	Button	[OK] … Close the message box.

12.8.3 Linker (LK78K0)

Table 12-9 Error Messages Displayed by the Linker (LK78K0) DLL

Error Type	Error Message	
x	Message	Cannot find LK78K0.EXE shown in environmental variable PATH.
	Cause	The LK78K0.EXE execution format is not in the specified directory.
	Action by user	Re-install the RA78K0 assembler package.
	Button	[OK] … Close the message box.
!	Message	Invalid value. The range of warning level is from 0 to 2.
	Cause	A value outside the limit input range is specified as the warning level.
	Action by user	Specify a value within the limit range.
	Button	[OK] … Close the message box.
!	Message	Invalid value. The range of flash start address is from 0h to 0ffffh.
	Cause	A value outside the input limit range is specified as the flash start address.
	Action by user	Specify a value within the limit range.
	Button	[OK] … Close the message box.
!	Message	Cannot find path or file. Make sure path or filename.
	Cause	The specified path or file cannot be found.
	Action by user	Specify a correct path or file name.
	Button	[OK] … Close the message box.
!	Message	Cannot find folder. Will you create?
	Cause	The specified folder does not exist.
	Action by user	Create a folder or select another folder.
	Button	[OK] … Creates a folder and close the message box. [Cancel] … Close the message box.
!	Message	Not make folder.
	Cause	The specified folder cannot be created.
	Action by user	Specify another folder.
	Button	[OK] … Close the message box.
!	Message	Invalid value. The range of Size for On-Chip Debug is from 256 to 1024.
	Cause	The size specified for on-chip debugging is outside the input limit range.
	Action by user	Specify a value within the limit range and retry.
	Button	[OK] … Close the message box.

Table 12-9 Error Messages Displayed by the Linker (LK78K0) DLL

Error Type	Error Message	
!	Message	Too many figures for Security ID. Up to 20 can be specified for Security ID.
	Cause	The specification format of the specified Security ID is incorrect.
	Action by user	Specify the Security ID in the correct format and retry.
	Button	[OK] … Close the message box.
!	Message	Invalid Security ID. Security ID is specified in hexadecimal numbers.
	Cause	The specified Security ID is not in the correct format.
	Action by user	Specify the Security ID in the correct format.
	Button	[OK] … Close the message box.
!	Message	Invalid Security ID. Missing parameter.
	Cause	A Security ID has not been input.
	Action by user	Input a Security ID.
	Button	[OK] … Close the message box.
!	Message	Too many files for Library File. Up to 10 can be specified for Library File.
	Cause	A number of library files outside the input limit range is specified.
	Action by user	Specify a number of library files within the limit range.
	Button	[OK] … Close the message box.
!	Message	(library file) Too long file name for Library File.
	Cause	The file name specified as a library file has a number of characters outside the limit range.
	Action by user	Retry with a number of characters within the limit range.
	Button	[OK] … Close the message box.
!	Message	(library file) Multiple Library File definition.
	Cause	Library files are described in duplicate.
	Action by user	Delete the duplicate library file(s) and retry.
	Button	[OK] … Close the message box.
!	Message	Too many path for Library File Search Path. Up to 64 can be specified.
	Cause	A number of paths for reading a library file is described outside the limit input range.
	Action by user	Specify a number of paths within the limit range and retry.
	Button	[OK] … Close the message box.

Table 12-9 Error Messages Displayed by the Linker (LK78K0) DLL

Error Type	Error Message	
!	Message	(library file read path) Too many characters for Library File Search Path.
	Cause	The library file read path is described with a number of characters outside the limit input range.
	Action by user	Specify the library file read path with a number of characters within the limit range.
	Button	[OK] … Close the message box.
!	Message	(library file read path) Multiple Library File Search Path definition.
	Cause	Library file read paths are described in duplicate.
	Action by user	Delete the duplicate path(s) and retry.
	Button	[OK] … Close the message box.

12.8.4 Object Converter (OC78K0)

Table 12-10 Error Messages Displayed by the Object Converter (OC78K0) DLL

Error Type	Error Message	
x	Message	Cannot find OC78K0.EXE shown in environmental variable PATH.
	Cause	The OC78K0.EXE execution format is not in the specified directory.
	Action by user	Re-install the RA78K0 assembler package.
	Button	[OK] … Close the message box.
!	Message	Invalid description format with object complement.
	Cause	The object filling value is specified in an illegal format.
	Action by user	Specify a format that can be described.
	Button	[OK] … Close the message box.
!	Message	Invalid value. The range of complement value is from 0h to 0ffh.
	Cause	A value outside the input limit range is specified as the filling value.
	Action by user	Specify a value within the limit range.
	Button	[OK] … Close the message box.
!	Message	Out of range. The range of start address is from 0h to (the maximum address of program area except sfr area).
	Cause	A value outside the input limit range is specified as the start address.
	Action by user	Specify a value within the limit range.
	Button	[OK] … Close the message box.
!	Message	Out of range. The range of size is from 1h to ((the maximum address of program area except sfr area) - (start address) + 1h).
	Cause	A value outside the limit input range is specified as the size.
	Action by user	Specify a value within the limit range.
	Button	[OK] … Close the message box.
!	Message	Cannot find folder. Will you create?
	Cause	The specified folder does not exist.
	Action by user	Create a folder or select another folder.
	Button	[OK] … Creates a folder and close the message box. [Cancel] … Close the message box.
!	Message	Not make folder.
	Cause	The specified folder could not be created.
	Action by user	Specify another folder.
	Button	[OK] … Close the message box.

12.8.5 Librarian (LB78K0)

Table 12-11 Error Messages Displayed by the Librarian (LB78K0) DLL

Error Type	Error Message	
x	Message	Cannot find LB78K0.EXE shown in environmental variable PATH.
	Cause	The LB78K0.EXE execution format is not in the specified directory.
	Action by user	Re-install the RA78K0 assembler package.
	Button	[OK] … Close the message box.
!	Message	Cannot find folder. Will you create?
	Cause	The specified folder does not exist.
	Action by user	Create a folder or select another folder.
	Button	[OK] … Creates a folder and close the message box. [Cancel] … Close the message box.
!	Message	Not make folder.
	Cause	The specified folder could not be created.
	Action by user	Specify another folder.
	Button	[OK] … Close the message box.

12.8.6 List Converter (LCNV78K0)

Table 12-12 Error Messages Displayed by the List Converter (LCNV78K0) DLL

Error Type	Error Message	
x	Message	Cannot find LCNV78K0.EXE shown in environmental variable PATH.
	Cause	The LCNV78K0.EXE execution format is not in the specified directory.
	Action by user	Re-install the RA78K0 assembler package.
	Button	[OK] … Close the message box.
!	Message	Cannot find folder. Will you create?
	Cause	The specified folder does not exist.
	Action by user	Create a folder or select another folder.
	Button	[OK] … Creates a folder and close the message box. [Cancel] … Close the message box.
!	Message	Not make folder.
	Cause	The specified folder could not be created.
	Action by user	Specify another folder.
	Button	[OK] … Close the message box.

APPENDIX A SAMPLE PROGRAMS

This chapter is an introduction to the sample lists attached to the RA78K0.

A.1 k0main.asm

```
  NAME          SAMPM
; ********************************************
;
;     HEX -> ASCII Conversion Program
;
;          main-routine
;
; ********************************************

PUBLIC          MAIN , START
EXTRN           CONVAH
EXTRN           _@STBEG

DATA            DSEG    saddr
HDTSA :         DS  1
STASC :         DS  2

CODE            CSEG    AT 0H
MAIN :          DW      START

                CSEG
START :

        ; chip initialize
        MOVW    SP , #_@STBEG

        MOV     HDTSA , #1AH
        MOVW    HL , #HDTSA     ; set hex 2-code data in HL registor

        CALL    !CONVAH         ; convert ASCII <- HEX
                                ; output BC-register <- ASCII code
        MOVW    DE , #STASC     ; set DE <- store ASCII code table
        MOV     A , B
        MOV     [ DE ] , A
        INCW    DE
        MOV     A , C
        MOV     [ DE ] , A

        BR      $$

        END
```

A.2 k0sub.asm

```
   NAME          SAMPS
;*************************************************************
;
;       HEX -> ASCII Conversion Program
;             sub-routine
;
;  input condition : ( HL )          <- hex 2 code
;  output condition : BC-register    <- ASCII 2 code
;
;*************************************************************

PUBLIC          CONVAH

        CSEG
CONVAH :
        XOR     A , A
        ROL4    [ HL ]          ; hex upper code load
        CALL    !SASC
        MOV     B , A           ; store result

        XOR     A , A
        ROL4    [ HL ]          ; hex lower code load
        CALL    !SASC
        MOV     C , A           ; store result

        RET

;*************************************************************
;     subroutine   convert ASCII code
;
;   input   Acc ( lower 4bits ) <- hex code
;   output  Acc                 <- ASCII code
;*************************************************************

SASC :
        CMP     A , #0AH        ; check hex code > 9
        BC      $SASC1
        ADD     A , #07H        ; bias ( +7H )
SASC1 :
        ADD     A , #30H        ; bias ( +30H )
        RET

        END
```

A.3 test1.s

```
EXTRN           SEARCH , STABLE
EXTRN           _@STBEG
PUBLIC          MAIN , START
; ***********************************************
;     Searching data
; ***********************************************
SDATA :
        DB      04 , 12H , 34H , 56H , 78H
;
;
CODE    CSEG    AT 0H
START : DW      MAIN

MAIN :
        MOVW    SP , #_@STBEG
        DE = #STABLE
        HL = #SDATA
        CALL    !SEARCH
        if_bit ( !CY )
SLI :
                repeat
                until ( forever )
        else
SERR :
                repeat
                until ( forever )
        endif
        END
```

A.4 test2.s

```
#include        " testinc.s "

PUBLIC SEARCH

        CSEG
; ****************************************************************
; * Data search                                                   *
; *  input        HL      search data address        *
; *               DE      table top address          *
; *  output       CY = 1  not find                   *
; *               CY = 0  find ( DE <- table address ) *
; ****************************************************************

SEARCH :
        while ( [ DE ] !=  #0 ) ( A )
                BC = #0
                A = [ DE ]
                C = A
                PUSH    HL
                PUSH    DE
                while ( [ DE ] == [ HL ] ) ( A )
                        DE++
                        HL++
                        if ( C == #0 ) ( A )

                                POP     DE
                                POP     HL
                                CLR1    CY
                                RET
                        endif
                        C--
                endw
                POP      DE
                POP      HL
                A = [ DE ]
                E += A
                A = B
                ADDC    D , A
        endw
        SET1    CY
        RET
        END
```

A.5 testinc.s

```
PUBLIC          STABLE

; ************************************
;               Data table
; ************************************

        CSEG
STABLE :
        DB      03 , 12H , 34H, 78H
        DB      04 , 55H, 66H, 77H, 88H
        DB      05 , 12H, 34H, 56H, 78H, 10H
        DB      03 , 12H, 34H, 56H
        DB      04 , 12H, 34H, 0AH, 78H
        DB      04 , 12H, 34H, 56H, 70H
        DB      04 , 12H, 34H, 56H, 78H
        DB      01 , 0ABH
        DB      02 , 34H , 78H
        DB      00
```

A.6 st.bat

```
        echo off
        cls
        set         LEVEL = 0

        if " %1 " == "" goto ERR_BAT

        st78k0 -C%1 test1.s
        ra78k0 test1.asm
        if errorlevel 1 set LEVEL = 1
        st78k0 -C%1 test2.s
        ra78k0 test2.asm
        if errorlevel 1 set LEVEL = 1
        if %LEVEL% == 1 echo Assemble error !!
        if %LEVEL% == 1 goto END

        cls
        lk78k0 test1.rel test2.rel -s -otest.lmf -ptest.map
        if errorlevel 1 echo Link error !!
        if errorlevel 1 goto END

        cls
        oc78k0 test
        if errorlevel 1 echo Object conversion error !!
        if errorlevel 1 goto END

        cls
        set LEVEL = 0
        lcnv78k0 -ltest.lmf -rtest1.rel test1.prn
        if errorlevel 1 set LEVEL = 1
        lcnv78k0 -ltest.lmf -rtest2.rel test2.prn
        if errorlevel 1 set LEVEL = 1
        if %LEVEL% == 1 echo List conversion error !!
        if %LEVEL% == 1 goto END

        cls
        echo No error.
        goto END

: ERR_BAT

        echo Usage : st.bat chiptype

: END
        echo on
```

APPENDIX B NOTES ON USE

In this chapter, when using the RA78K0, note the following points :

(1) Notes on device file

A device file is required to execute the RA78K0. The device file is not included in the RA78K0 package, and must be obtained separately.

Download the relevant device file from NEC Electronics' Microcomputer home page.

(http://www.necel.com/micro/ods/eng/tool/DeviceFile/list.html -> Development tools download (ODS))

(2) Notes on Object Converter

Use the object converter by specifying the -R (address source of object) and -U (filling value specification) options.

These options are specified by default.

If a ROM code is ordered (work known as "across processing" or "tape out") when the addresses of the objects are not sorted, an error occurs. Therefore, be sure to specify -R (do not cancel the specification).

(3) Notes on memory initialization quasi directives

If memory initialization quasi directives DW and DB are described in a data segment (DSEG), object codes are output but the object converter outputs the warning message W4301. This is because a code exists at an address other than one in the ROM area (code area).

If a ROM code is ordered (work known as "across processing" or "tape out") in this status, an error occurs.

(4) Notes on manipulation specification of Object Converter

If starting is specified by the object converter option -U, filling is started from the start address or the address where the code is located, whichever is lower. The SFR area (FF00H to FFFFH) is not filled.

Description format : -U filling value [, [Start] , Size]

[ ] may be omitted.

(5) Notes on memory directives

The default memory area name of each device cannot be erased.

Set the size of the default memory area name not used to 0.

Some segments, however, are allocated to the default area. Bear this in mind when changing the area name.

For the default memory area name, refer to the User's Manual of the device to be used.

(6) Notes on debug option

If debug information is output by the C compiler/structured assembler preprocessor and the compiler/ structured assembler is executed, do not output the debug information when the output assemble source is assembled (specify this by using the -NGA option). If the debug information is output, debugging may not be executed at the C compiler/structured assembler source level.

(7) Notes related to CC78K0

Several points must be noted when C source level debugging is executed by assembling the assembler source output by the CC78K0.

For details, refer to the document supplied with the C compiler package (Notes on Use).

(8) Notes related to ID78K0/ID78K0-NS/ID78K0-QB and SM78K0

When debugging is executed with the ID78K0/ID78K0-NS/ID78K0-QB or SM78K0, keep the number of symbols and the number of source lines to within the limit of the ID78K0/ID78K0-NS/ID78K0-QB and SM78K0.

For details, refer to the document supplied with the debugger/simulator (Notes on Use).

(9) Notes on segment name

When describing a segment name, do not describe the same name as the primary name of the source file name. Otherwise, the abort error F2106 will occur as a result of assembly.

(10) Notes on description of macro definition in structured assembler source

Use an assembly language, instead of a structured assembly language, to describe a macro definition in the source of the structured assembler preprocessor. Otherwise, a duplicated label definition error may occur.

(11) Notes on EQU definition of SFR name

An SFR name may be specified as an operand of the EQU quasi directive. If the name of an SFR outside the saddr area is specified as PUBLIC, an assembly error occurs.

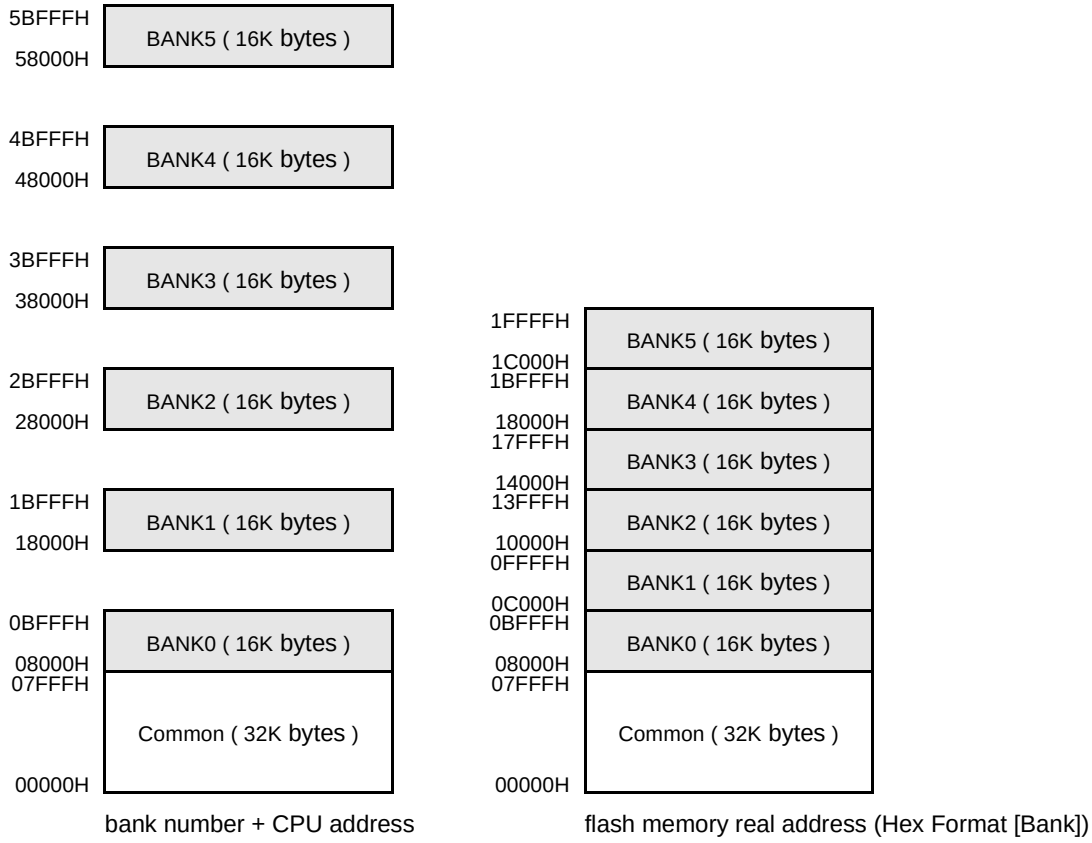
(12) Notes when using a network

If a directory where a temporary file is to be created is on a file system that is shared on a network, a file conflict may occur and an abnormal operation may be performed. Avoid this conflict by using options and environmental variables.

(13) HEX output modes in bank-supported products

In the bank-supported products, addresses are seen in two types of view: "bank number + CPU address", and the "flash memory real address (Hex Format [Bank])".

Figure B-1 Address View



The assembler references an address based on the "bank number + CPU address", so the user is conscious of this "bank number + CPU address".

When performing self-programming or on-board programming to the flash memory, however, programming must be performed based on the flash memory real address. Therefore, the object converter outputs the HEX-format object module file with the flash memory real address, thereby address translation (from "bank number + CPU address" to the flash memory real address) during self-programming or by the programmer is no longer required.

The HEX output based on the flash memory real address is supported in OC78K0 V3.80 or later. With the bank-supported products, codes are output in the "Intel extended HEX format" and "flash memory real address" by default, but other output formats can also be selected by specifying the -k option. With a 64 KB or larger flash memory, the code does not operate if it is output in the Intel standard format. In this case, be sure to specify the Intel extended format or the Motorola S-type 24-bit standard address or 32-bit address for output.

```
          Assemble list

ALNO    STNO    ADRS    OBJECT  M  I    SOURCE        STATEMENT
   1       1
   2       2    -----                   main_c        CSEG    AT 100H
   3       3
   4       4    00100   13F301                        MOV     BANK, #BANKNUM lab_bk1
   5       5    00103   R9A0080                       CALL    !lab_bk1
   7       7
   8       8    -----                                 CSEG    BANK  ; 18000->0C000H
   9       9    18000                   label_bk1 :
  10      10    18000   00                            NOP
  11      11    18001   00                            NOP
  12      12    18002   00                            NOP
  13      13    18003   AF                            RET
  14      14
  15      15
  16      16                            END
```

In the above program, lab_bk1 is allocated to address 18000H.

Table B-1 Example of output in Intel extended HEX format (flash memory real address)

```
:1000F000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF10
:020000020000FC
:0601000013F3019A0080D8
:020000020000FC
:10010600FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF9
:10011600FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFE9
:10012600FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFD9

          :
          :
          :

:10BFF000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF51
:02000002000FC
:04C000000000000AF8D
:020000020000FC
:10C00400FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF3C
:10C01400FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF2C
```

In the case of the flash memory real address, the code seen at address 18000H is described at address 0C000H, but the code part of 10th and subsequent byte does not change. The codes remain as is, and the address values are moved up. (At the same time, the checksum values of the last byte of each line are also changed.) The user is not required to make special allowances for this change.

Table B-2 Example of output in Intel extended HEX format (bank number + CPU address)

```
:1000F000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF10
:020000020000FC
:0601000013F3019A0080D8
:020000020000FC
:10010600FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF9
:10011600FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFE9
:10012600FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFD9

        :
        :
        :

:10BFF000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF51
:0200000210000EC
:0480000000000000AFCD
:020000021000EC
:10800400FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF7C
:10801400FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF6C
```

The code at address 18000H is described as is at address 18000H.

APPENDIX C LIST OF OPTIONS

In this chapter, the program options are summarized in table form.

Please refer to these when developing programs.

This list of options can also be used as an index.

C.1 Structured Assembler Options

Table C-1 Structured Assembler Options

Classification	Format	Function	Relation to Other Options	Interpretation When Omitted
Device type specification	-C device-type	Specifies the type of the target device.	Independent	Cannot be omitted.
Word symbol character specification	-SC character	Specifies the final character of a word symbol name.	Independent	-SCP
Symbol definition specification	-D symbol [= numerical-value] [, symbol-name [= numerical value] ...] ... (two or more path names can be specified)	Specifies the symbol given to the #IFDEF directive, etc.	Independent	None
Tab number specification	-WT numerical-value, numerical-value, numerical-value	Specifies the position of output of the converted instruction.	Independent	-WT2 , 3 , 4
Include file read path specification	-I path-name [, path-name] ... (two or more path names can be specified)	Specifies input of an include file from a specified path.	Independent	Path where the source file exists. Path specified by environment variable ‘INC78K0’.
Secondary source file specification	-O [file-name]	Specifies the secondary source.	Independent	-O input-file-name.asm
Error list file specification	-E [file-name]	Outputs the error list file.	Independent	-E input-file-name.est

Table C-1 Structured Assembler Options

Classification	Format	Function	Relation to Other Options	Interpretation When Omitted
Parameter file specification	-F file-name	Inputs the input file name and option from the specified file.	Independent	Options and input file names can only be input from the command line.
Debug data output specification	-GS	Specifies the output of structured assembler source level debug data.	If the options -GS and -NGS are both specified, the one specified later is valid.	-GS
	-NGS	Invalidates the option -GS.		
Secondary source file forcible output specification	-J	Forcibly outputs the secondary source file.	Independent	No forcible output
Kanji code (2-byte code) specification	-ZS	Kanji described in the comment is interpreted as shift JIS code.	If the -ZS, -ZE, and -ZN options are specified at the same time, the one specified later takes priority.	In Windows/ HP-UX: -ZS In SunOS, Solaris: -ZE
	-ZE	Kanji described in the comment is interpreted as EUC code.		
	-ZN	Characters described in the comment are not interpreted as kanji.		
Device file search path specification	-Y path-name	Reads the device file form the specified path.	Independent	<..\dev> for the path that activated the ST78K0.
Help specification	--	Outputs the help message to the display.	Invalidates all other options	Not displayed

C.2 Assembler Options

Table C-2 Assembler Options

Classification	Format	Function	Relation to Other Options	Interpretation When Omitted
Device type specification	-C device-type	Specifies the device type of the target device.	Independent	Cannot be omitted
Object module file output specification	-O [file-name]	Specifies the output of an object module file.	If both options -O and -NO are specified at the same time, the option specified last takes precedence.	-O input-file-name.rel
	-NO	Specifies that no object module file is output.		
Forced object module file output specification	-J	Specifies that the object module file can be output even if a fatal error occurs.	If both options -J and -NJ are specified at the same time, the option specified last takes precedence.	-NJ
	-NJ	Makes option -J unavailable.		
Debug data output specification	-G	Specifies that local symbol data is to be added to an object module file.	If both options -G and -NG are specified at the same time, the option specified last takes precedence.	-G
	-NG	Makes option -G unavailable.		
	-GA	Specifies that source debugging data is to be added to an object module file by the structured assembler.	If both options -GA and -NGA are specified at the same time, the option specified last takes precedence.	-GA
	-NGA	Makes option -GA unavailable.		
Include file read path specification	-I path-name [, path-name] ... (two or more path names can be specified)	Specifies input of an include file from a specified path.	Independent	Path where the source file exists. Path specified by the environmental variable (INC78K0)
Assemble list file output specification	-P [file-name]	Specifies output of an assemble list file. It also specifies the destination and file name of the output file.	If both options -P and -NP are specified at the same time, the option specified last takes precedence.	-P input-file-name.rel
	-NP	Makes option -P unavailable.		

Table C-2 Assembler Options

Classification	Format	Function	Relation to Other Options	Interpretation When Omitted
Assemble list file data specification	-KA	Outputs an assemble list into an assemble list file.	If -KS and _KX are specified at the same time, -KS is ignored. If both options -KA and -NKA, both options -KS and -NKS, or both options -KX and -NKX are specified at the same time, the option specified last takes precedence. If options -NKA, -NKS and -NKX are all specified, option -P is unavailable.	-KA
	-NKA	Makes option -KA unavailable.		
	-KS	Outputs an assemble list followed by a symbol list into an assemble list file.		-NKS
	-NKS	Makes option -KS unavailable.		
	-KX	Outputs an assemble list followed by a cross-reference list into an assemble list file.		-NKX
	-NKX	Makes option -KX unavailable.		
Assemble list file format specification	-LW [number-of-characters]	Changes the number of characters that can be printed in 1 line in a list file.	If option -NP is specified, option -LW is unavailable.	-LW132
	-LL [number-of-lines]	Changes the number of lines that can be printed in 1 page in an assemble list file.	If option -NP is specified, option -LL is unavailable.	-LL66
	-LH character-string	Specifies the character string printed in the title column of the header of an assemble list file.	If option -NP is specified, option -LH is unavailable.	None
	-LT [number-of-characters]	Specifies a number of characters to be developed in a tab.	If option -NP is specified, option -LT is unavailable.	-LT8
	-LF	Inserts a form feed (FF) code at the end of an assemble list file.	If both options -LF and -NLF are specified at the same time, the option specified last takes precedence. If option -NP is specified, option -LF is unavailable.	-NLF
	-NLF	Makes the option -LF unavailable.		
Error list file output specification	-E [file-name]	Outputs an error list file.	If both options -E and -NE are specified at the same time, the option specified last takes precedence.	-NE
	-NE	Makes the option -E unavailable.		

Table C-2 Assembler Options

Classification	Format	Function	Relation to Other Options	Interpretation When Omitted
Parameter file specification	-F file-name	Inputs assembler options and the input file name from a specified file.	Independent	Options and input file names can only be input from the command line.
Specification of path for temporary file creation	-T path-name	Creates a temporary file in a specified path.	Independent	Path specified by environmental variable 'TMP'
Kanji code specification	-ZS	Kanji described in the comment is interpreted as shift JIS code.	If the -ZS, -ZE, and -ZN options are specified at the same time, the one specified later takes priority.	In Windows/ HP-UX: -ZS In SunOS, Solaris: -ZE
	-ZE	Kanji described in the comment is interpreted as EUC code.		
	-ZN	Characters described in the comment are not interpreted as kanji.		
Device file search path specification	-Y path-name	Reads a device file from the specified path.	Independent	<..\dev> (for the RA78K0 startup path)
Symbol definition specification	-D symbol-name [= value] [, symbol-name [= value] …](two or more path names can be specified)	Defines a symbol.	Independent	None
Series common object specification	-COMMON	Specifies output of an object module file common to the 78K0 Series.	Independent	None
Self programming specification	-SELF	Specify when using self programming	Independent	None
Help specification	--	Displays a help message on the display.	When option -- is specified, all other options are unavailable.	No display

C.3 List of Linker Options

Table C-3 List of Linker Options

Classification	Format	Function	Relation to Other Options	Interpretation When Omitted
Load module file output specification	-O [file-name]	Outputs a load module file.	If both options -O and -NO are specified at the same time, the option specified last takes precedence.	-O input-file-name.lmf
	-NO	Does not output a load module file.		
Forced load module file output specification	-J	Forces output of a load module file.	If both options -J and -NJ are specified at the same time, the option specified last takes precedence.	-NJ
	-NJ	Makes option -J unavailable.		
Debug data output specification	-G	Outputs debugging data to a load module file.	If both options -G and -NG are specified at the same time, the option specified last takes precedence. When option -NG is specified, the public symbol list and local symbol list cannot be output regardless of specification of -KP or -KL.	-G
	-NG	Makes option -G unavailable.		
Generation of stack decision symbols specification	-S [area-name]	Automatically generates stack decision public symbols.	If both options -S and -NS are specified at the same time, the option specified last takes precedence.	-NS
	-NS	Makes option -S unavailable.		
Directive file specification	-D file-name	Specifies a particular file to be input as a directive file.	Independent	-
Link list file output specification	-P [file-name]	Specifies output of a link list file.	If both options -P and -NP are specified at the same time, the option specified last takes precedence.	-P file-name.map
	-NP	Makes option -P unavailable.		

Table C-3 List of Linker Options

Classification	Format	Function	Relation to Other Options	Interpretation When Omitted
Link list file data specification	-KM	Outputs a map list into a link list file.	If both options -KM and -NKM are specified at the same time, the option specified last takes precedence.	-KM
	-NKM	Makes option -KM unavailable.	If options -NKM, -NKP and -NKL are all specified, the link list file cannot be output even if option -P is specified.	
	-KD	Outputs a link directive file into a link list file.	If option -NKM is specified, option -KD becomes unavailable. If both options -KD and -NKD, both -KP and -NKP, or both -KL and -NKL are specified at the same time, the option specified last takes precedence. If option -NG is specified, the public symbol list and local symbol list cannot be output even if option -KP or -KL is specified.	-KD
	-NKD	Makes option -KD unavailable.		
	-KP	Outputs a public symbol list into a link list file.		-NKP
	-NKP	Makes option -KP unavailable.		
	-KL	Output a local symbol list into a link list file.		-NKL
	-NKL	Makes option -KL unavailable.		
Link list format specification	-LL [number-of-lines]	Specifies number of lines that can be printed in 1 page in a link list file.	If option -NP is specified, option -LL is unavailable.	-LL66
	-LF	Inserts a form feed (FF) code at the end of a link list file.	If both options -LF and -NLF are specified at the same time, the option specified last takes precedence. If option -NP is specified, the option specified last takes precedence.	-NLF
	-NLF	Makes the -LF option unavailable.		
Error list file output specification	-E [file-name]	Outputs error list file.	If both options -E and -NE are specified at the same time, the option specified last takes precedence.	-NE
	-NE	Default value: -NE Makes option -E unavailable.		
Library file specification	-B file-name	Inputs a specific file as a library file.	Independent	-

Table C-3 List of Linker Options

Classification	Format	Function	Relation to Other Options	Interpretation When Omitted
Library file read path specification	-I path-name [, path-name] ... (two or more path names can be specified)	Reads a library file from a specified path.	If a library file without a path name is specified by option -B, option -I is unavailable.	Path specified by environmental variable 'LIB78K0'
Parameter file specification	-F file-name	Inputs linker options and the input file name from a specified file.	Independent	Options and input file names can only be input from the command line.
Specification of path for temporary file creation	-T path-name	Creates a temporary file in a specified path.	Independent	Path specified by the environmental variable ‘TMP’.
Device file search path specification	-Y path-name	Reads a device file from the specified path.	Independent	Reads device files from <..\dev> (for the lk78k0.exe startup path)
Warning message output specification	-W [level]	Specifies whether or not a warning message is output to the console.	Independent	Outputs an ordinary error message
Link specification of boot area ROM program of flash ROM model	-ZB	Specifies the first address of the flash ROM area.	Independent	None
On-chip debug program size specification	-GO [size]	Specifies the on-chip debug program size.	Independent	None
Security ID specification	-GI Security ID	Specifies a Security ID.	Independent	None
Help specification	--	Displays a help message on the display.	All other options are unavailable.	No display

C.4 List of Object Converter Options

Table C-4 List of Object Converter Options

Classification	Format	Function	Relation to Other Options	Interpretation When Omitted
HEX format object module file output specification	-O [file-name]	Outputs a HEX format object module file.	If both options -O and -NO are specified at the same time, the option specified last takes precedence.	-O (input-file-name).hex (file type H1 to H15 for extended space)
	-NO	No HEX format object module file is output.		
Symbol table file output specification	-S [file-name]	Outputs a symbol table file.	If both options -S and -NS are specified at the same time, the option specified last takes precedence.	-S [input-file-name].sym (file type S1 to S15 for extended space)
	-NS	Does not output a symbol table file.		
Specification of sort by object address order	-R	Sorts HEX format objects in order of address.	If both options -S and -NS are specified at the same time, the option specified last takes precedence. If option -NO is specified, option -R becomes unavailable.	-R
	-NR	Makes option -R unavailable.		
Object complement specification	-U complement-value [, [start] , size]	Outputs a specified complement value as an object code for an address area to which no HEX format object has been output.	If -U and -NU are specified at the same time, the one specified later takes precedence. If option -NO is specified, -U becomes unavailable.	-U0FFH
	-NU			
Error list file output specification	-E [file-name]	Outputs an error list file.	If both options -E and -NE are specified at the same time, the option specified last takes precedence.	-NE
	-NE	Makes option -E unavailable.		
Parameter file specification	-F file-name	Inputs options and input file names from a specified file.	Independent	Options and input file names can only be input from the command line.
Device file search path specification	-Y path-name	Reads a device file from the specified path.	Independent	<..\dev> for path by which OC78K0 was started up

Table C-4 List of Object Converter Options

Classification	Format	Function	Relation to Other Options	Interpretation When Omitted
File separate output specification for flash ROM model	-ZF	Adds an option that separately outputs the boot area and other areas to separate HEX format files when linking of the boot area ROM program of a flash memory model is specified.	Independent	None
Help specification	--	Displays a help message on the display.	All other options are unavailable.	No display

C.5 List of Librarian Options

Table C-5 List of Librarian Options

Classification	Format	Function	Relation to Other Options	Interpretation When Omitted
List file format specification	-LW [number-of-characters]	Changes the number of characters that can be printed in 1 line in a list file.	Unavailable if the LIST subcommand is not specified.	-LW132
	-LL [number-of-lines]	Changes the number of lines that can be printed in 1 page in a list file.		-LL66
	-LF	Inserts a form feed (FF) code at the end of a list file.	If both options -LF and -NLF are specified at the same time, the option specified last takes precedence.	-NLF
	-NLF	Makes the option -LF unavailable.		
Specification of path for temporary file creation	-T path-name	Creates a temporary file in a specified path.	Independent	Created in the path specified by the environmental variable ‘TMP’.
Device file search path specification	-Y path-name	Reads a device file from the specified path.	Independent	<..\dev> (for the lb78k0 startup path)
Help specification	--	Displays a help message on the display.	All other options are unavailable.	No display

C.6 List of List Converter Options

Table C-6 List of List Converter Options

Classification	Format	Function	Relation to Other Options	Interpretation When Omitted
Object module file input specification	-R [file-name]	Specifies the input of an object module file.	Independent	-R assemble-list-file-name.rel
Load module file input specification	-L [file-name]	Inputs a load module file.	Independent	-L assemble-list-file-name.lnk
Absolute assemble list file output specification	-O [file-name]	Outputs an absolute assemble list file.	Independent	-O assemble-list-file-name.p
Error list file output specification	-E [file-name]	Outputs an error list file.	If both options -E and -NE are specified at the same time, the option specified last takes precedence.	-NE
	-NE	Makes option -E unavailable.		
Parameter file specification	-F file-name	Inputs options and input file name from a specified file.	Independent	Options and input file names can only be input from the command line.
Help specification	--	Displays a help message on the display (console).	All other options are unavailable.	No display

APPENDIX D LIST OF SUBCOMMANDS

This appendix is a summary of the subcommands in list form.

It will be helpful to refer to this list when developing software programs.

This list of subcommands can also serve as an index.

Table D-1 List of Subcommands

Classification	Format	Function	Abbrev. Format
CREATE	CREATE Δ library-file-name [Δ transaction]	Creates a new library file.	C
ADD	ADD Δ library-file-name Δ transaction	Adds a module to a library file.	A
DELETE	DELETE Δ library-file-name Δ (Δ module-name [Δ , ...] Δ)	Deletes a module from a library file.	D
REPLACE	REPLACE Δ library-file-name Δ transaction	Replaces one module with another in a library file.	R
PICK	PICK Δ library-file-name Δ (Δ module-name [Δ , ...] Δ)	Retrieves a specified module from an existing library file.	P
LIST	LIST[Δoption]library-file-name [Δ (Δ module-name [Δ , ...] Δ)]	Outputs data on modules in a library file.	L
HELP	HELP	Displays a help message on the display.	H
EXIT	EXIT	Exits the librarian.	E

APPENDIX E INDEX

W

Y

Z