OKI

MASK167 Mask Option Generator

User's Manual

MSM64167 Program Development Support Tool

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Chapter 1

Introduction

This chapter explains what to do first after receiving the MASK167 Mask Option generator.

1. Symbols

This manual uses the following symbols for convenient explanation.

■Note■	This explains information in the manual that must be given attention.
■Reference■	The numbers of chapters or commands under this symbol refer the reader to information in the manual.
Note X	In this manual, this symbol marks a word to show that a supplemental explanation is included to emphasize special caution. X is the number. Explanations are written after ■Note X■.
■Note X■	Supplemental explanations are written for a word marked by Note X. A number substituted for X corresponds to X of Note X.
↵	Indicates carriage return key.
[ESC]	Indicates escape key.
[SCROLL UP]	Indicates scroll-up key.
[SCROLL DOWN]	Indicates scroll-down key.
[↑],[↓],[←],[→]	Indicates cursor keys.
[f • n]	Indicates function keys (n = 1~0)

2. Configuration of This Manual

This manual describes the handling of the MASK167 Mask Option generator, provided for use with Oki Electric's CMOS 4-bit microcontroller MSM64167. The manual consists of Chapters 1~4 and an Appendix. An outline of each chapter follows.

Chapter 1 Introduction

This chapter describes the first step to perform when a user receives the MASK167 Mask Option generator. Be certain to read this chapter.

Chapter 2 Overview

This chapter describes matters that should be known before using the MASK167 Mask Option generator, such as system configuration and the environment required for start-up.

Chapter 3 Operation Method of MASK167

This chapter describes the start-up method and the operation method of the MASK167 Mask Option generator.

Chapter 4 Files Generated by MASK167

This chapter describes the files generated by the MASK167 Mask Option generator.

Appendix

The Appendix consists of an error message list, print examples, and the content of Mask Option files of the MASK167 Mask Option generator. Refer to the Appendix as necessary in reading this manual.

The following manuals are related to this manual.

Name: **The MSM64167 User's Manual**

- Description of terminals
- Description of CPU architecture
- Description of various functions
- Description of addressing modes
- Description of instruction set

Name: **The EASE64165/167 User's Manual**

- Description of the EASE64165/167 system
- Description of the EASE64165/167 start-up method
- Description of the EASE64165/167 emulator commands

Name: **The ASM64K Cross Assembler User's Manual**

- Description of the ASM64K cross assembler operation
- Description of the ASM64K assembly language
- Description of DCL files

Name: **Macroprocessor MP User's Manual**

- Description of MP (Macroprocessor) operation
- Description of Macroprocessor language

3. Check Floppy Disks

When you receive the MASK167 Mask Option generator, check that the labels on the floppies are the same as those illustrated below.

Floppy labels indicate either MS-DOS (for the NEC PC9801) or PC-DOS (for the IBM PC/AT). Check that the labeled floppy is for your host computer model.

Prior to shipment Oki Electric pays close attention that a product is not damaged or an incomplete set is not shipped. However, if the product is damaged, if the model is incorrect, or if any other problems have occurred, immediately contact the sales department close to your place.

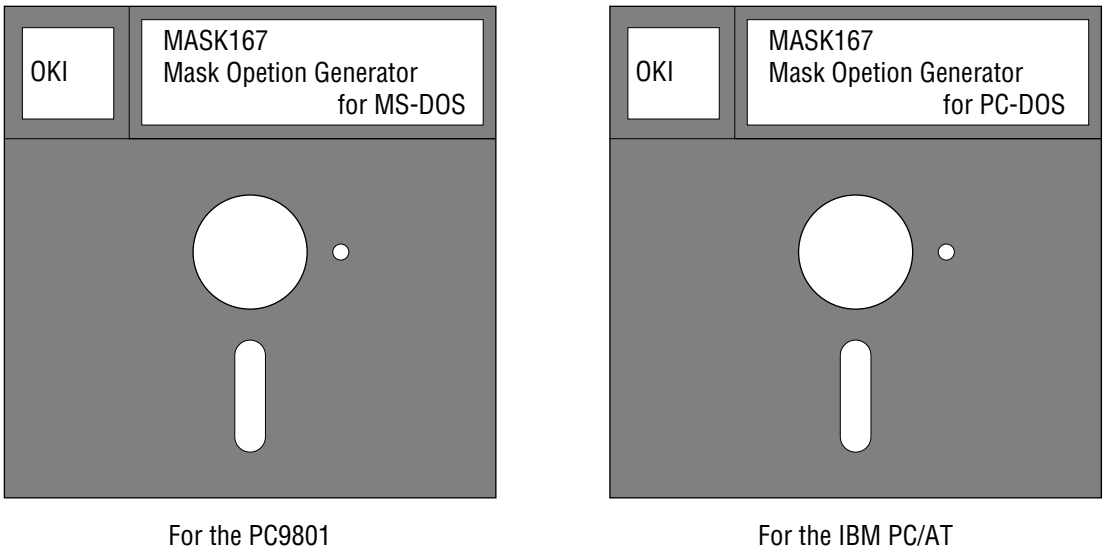


Figure 1-1: External view of the MASK167 floppy disks (in the case of 5 1/4 inch 2HD)

■Note■

Type of Floppy Disks

- MS-DOS Format (For the NEC PC9801)
  - (a) 3.5 inch 2 HD (1.21 Mb)
  - (b) 5 1/4 inch 2 HD (1.21 Mb)

- PC-DOS Format (For the IBM PC/AT)
  - (a) 3.5 inch 2 HD (1.44 Mb)
  - (b) 5 1/4 inch 2 HD (1.232 Mb)

Chapter 2

Overview

This chapter describes matters that should be known before using the MASK167 Mask Option generator, such as system configuration and the environment required for start-up.

1. What is the MASK167?

The Oki Electric CMOS 4-bit microcontroller MSM64167 has 31 internal LCD drivers. Either the common driver or segment driver of each LCD driver is selected by Mask Option. The assignment of each bit of a display register to the segment driver can be freely specified by Mask Option. 8 LCD drivers, L0~L7, can be specified to an output port by Mask Option. The MSM64167 can also specify built-in/ external of capacitors for the oscillation (CG.) of a crystal oscillator by Mask Option.

The LCD drivers of the MSM64167 have 4 segments of the internal registers for a segment driver[Note1]. By assigning these registers of the segment driver to each bit of a display register, the data of each bit of a display register can be output to each segment terminal. Therefore, software can display an LCD merely by writing display data to a display register. See the MSM64167 User's Manual for more details.

The MASK167 Mask Option generator is a program that generates an Intel HEX Format Mask Option (Mask Option file) merely by a simple operation that assigns the same unique name to the internal register segment driver of the MSM64167, and to each bit of the display register.

The MASK167 can set the following Mask Options.

(a) Assignments to segment terminal, common terminal and port terminal of LCD driver terminal.

(b) Assignments to segment driver of display register.

(c) Setting duty of LCD.

(d) Setting of capacitor for oscillation (CG.) of a crystal oscillator.

■Note 1■

If the LCD duty is 1/4, 4 segments of a register can be used, but if the duty is 1/3, only 3 segments can be used. And, if the duty is 1/2, only 2 segments of a register can be used.

This Mask Option file is used to create Mask data required to manufacture the MSM64167, and to debug the application program by the EASE64165/167 in-circuit emulator.

Figure 2-1 shows a series of operations that concern the Mask Option file.

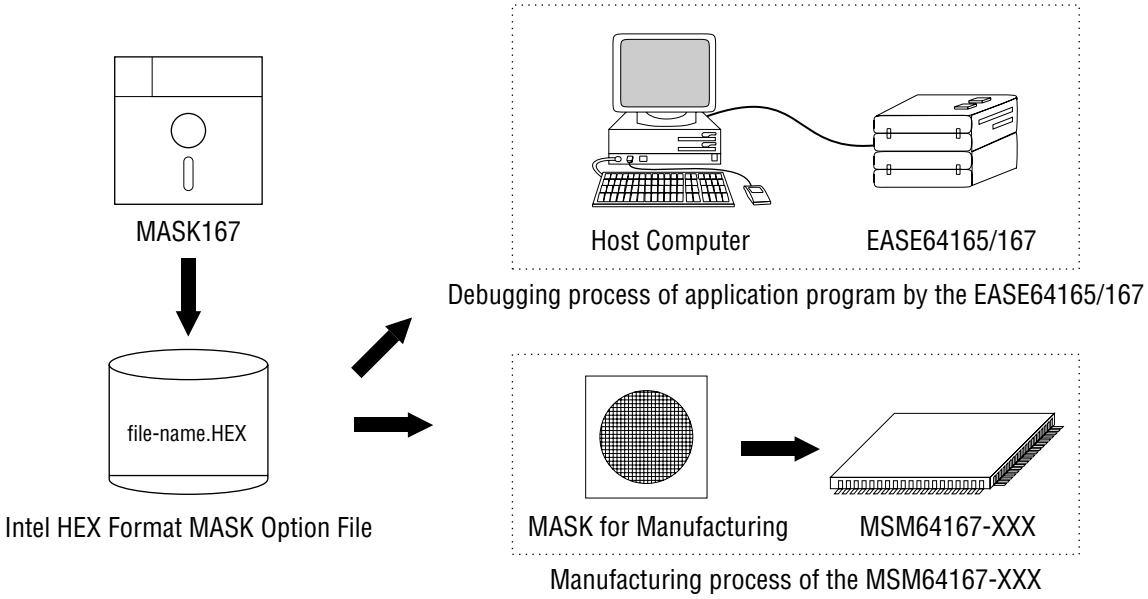


Figure 2-1: Application of mask option file

If a Mask Option file is used with the EASE64165/167, refer to the EASE64165/167 User's Manual.

■Note■

If an MSM64167 application program is debugged using the EASE64165/167, use assignment information to the segment terminal, common terminal and port terminal of each LCD driver terminal, information on the LCD duty, and assignment information to the segment driver of the display register. This information is included in an Intel HEX Format Mask Option file generated by the MASK167.

Built-in/External information of the capacitor for the oscillation (CG.) of a crystal oscillator cannot be verified in debugging an application program by the EASE64165/167.

2. Operation Environment of the MASK167

If a MASK167 Mask Option generator is used, use a host computer that meets the following conditions.

- Use a host computer running on MS-DOS Ver. 3.1 or PC-DOS Ver. 3.3 or later.
- Since the resident part of the MASK167 program consumes about 134 Kb of memory, secure at least 134 Kb of memory area.

3. Mask Option File Creation Process

The MASK167 Mask Option generator consists of the following edit screens. In each edit screen, various works required to create a Mask Option file can be performed, for example, the creation, printing and generation of various files.

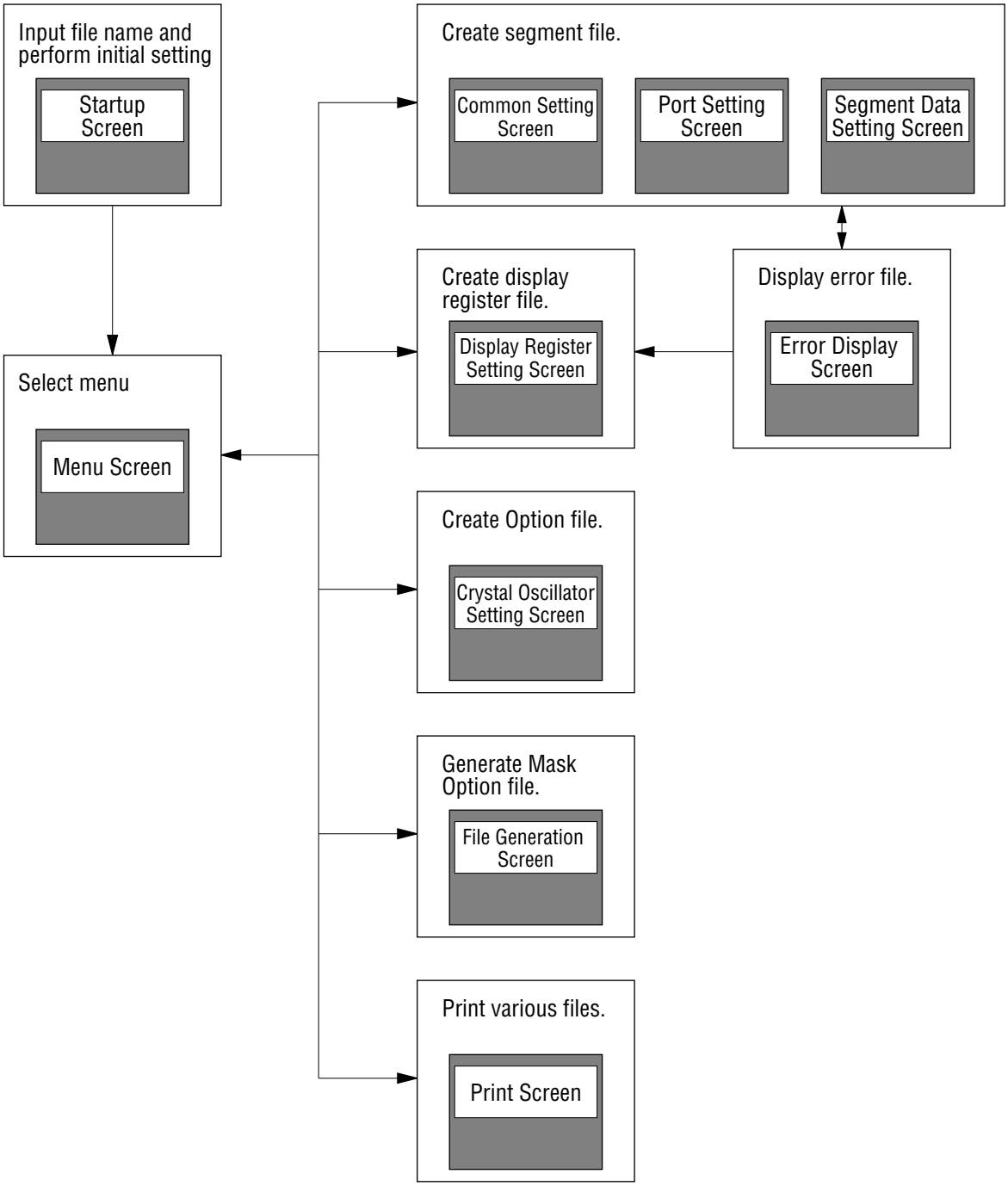


Figure 2-2: Various edit screens of the MASK167

Create an Intel HEX Format Mask Option file using the MASK167 if a Mask Option is specified, such as wiring between a liquid crystal screen and each segment terminal, assignments to a segment terminal, common terminal and port terminal of an LCD driver terminal, assignments to a segment driver of a display register, and if specifying built-in/external of a capacitor (CG.) of a crystal oscillator.

The general creation procedure of a Mask Option file follows.

(1) File Name Input • Initial Setting

Start-up the MASK167, and input the Mask Option file name to the startup screen. Then, set the LCD duty.

(2) Creating Segment File

Enter the common setting screen from the menu screen, and assign one, from L0 to L30, to the common terminal. Then, enter the port setting screen and assign the LCD driver terminal, from L0 to L7, to either a port terminal or a segment terminal. Next, enter the segment data setting screen and assign a unique name to each segment terminal. A segment file is created in this manner.

(3) Creating Display Register File

Enter the display register screen from the menu screen, and assign a unique name during segment file creation to each bit of the display register in the same manner as assigning to a segment terminal of the display register. A Display Register file is created in this manner.

(4) Creating Option File

Enter the crystal oscillator setting screen from the menu screen, and set built-in/external of the capacitor for the oscillation (CG.) of a crystal oscillator, and create an Option file. Data on the LCD duty set in (1) is also stored into the Option file.

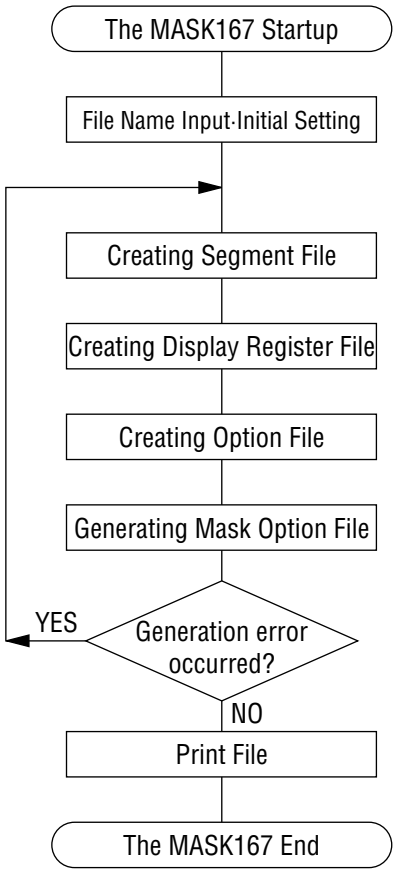


Figure 2-3: Mask Option File Creation Flow

(5) Mask Option File Generation

If a segment file, Display Register file and Option file are created, the program displays a file generation screen to generate a Mask Option file. If a generation error occurs, a Mask Option file and Print file are not generated, and an Error file is generated. Operations (2)~(5) continue until the error is corrected.

If a generation error does not occur, a Print file and Mask Option file are generated.

(6) File Printing

If a generation error does not occur when the file generation screen is displayed, and if a Mask Option file and Print file are generated normally, a Print file, Display Register file and Option file are printed, and the MASK167 operation ends.

■Note■

The work flow and terms described in this section are general in nature, and may be different from those which appear in other manuals.

Chapter 3

Operation Method of the MASK167

This chapter describes the start-up method and operation method of the MASK167 Mask Option generator.

1. Start-up the MASK167 Mask Option Generator

The start-up procedure of the MASK167 Mask Option generator follows.

[1] Turn the power supply of the host computer on and startup MS-DOS (PC-DOS).

Run the host computer with either the MS-DOS Ver. 3.1 or the PC-DOS Ver. 3.3 or later as OS. Also, secure at least 134Kbytes of memory area.

[2] Start-up the MASK167 Mask Option generator.

There are two start-up methods: starting up from the directory where the MASK167 extension file (MASK167. EXE) exists, or starting up from another directory.

(a) Starting up from where directory the MASK167.EXE exists.

Input the start-up command after the DOS prompt as follows.

```
A> MASK167 ↵
```

(b) Starting up from where the directory of the MASK167.EXE does not exist.

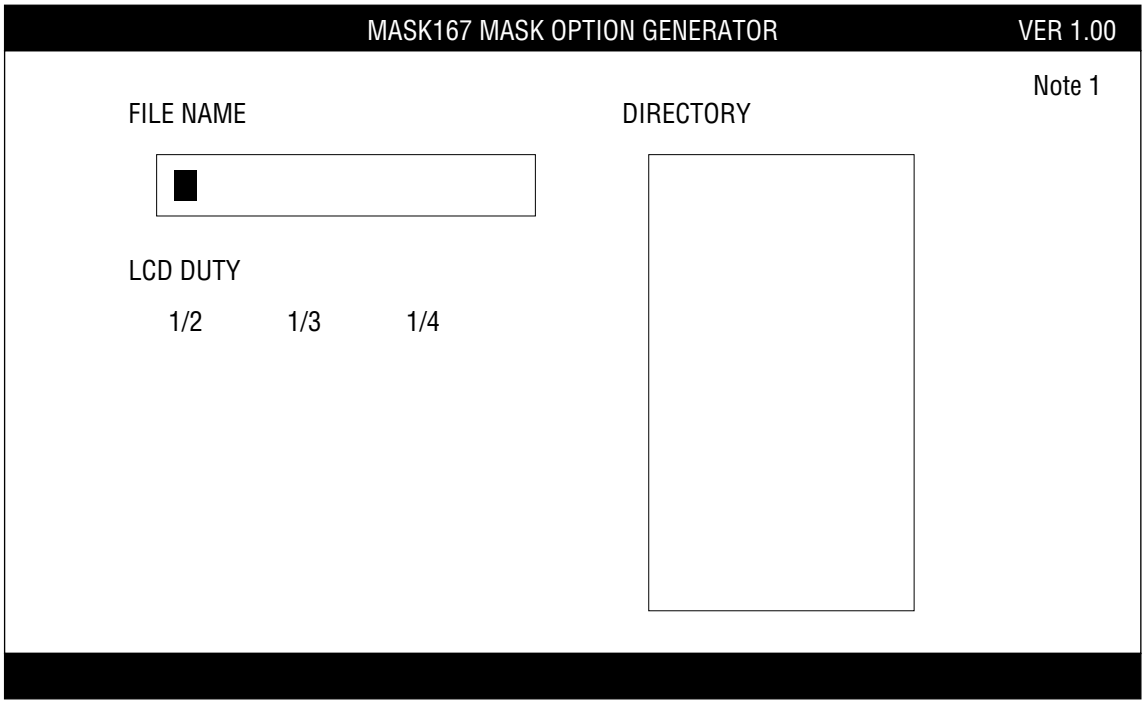
If an environment variable path includes a directory where the MASK167.EXE exists, startup the MASK167 in the same manner as in (a) above. If the path is not specified, input the *path-name* of the directory where the MASK167.EXE exists, and input the start-up command after the DOS prompt as follows, and start-up the MASK167.

```
A> path-name ¥ MASK167 ↵
```

All the files created by the MASK167 Mask Option generator are stored to the current directory during start-up. Therefore, start-up the MASK167 from the directory where each file created by the MASK167 is stored.

[3] Input file name to start-up screen.

If the MASK167 is started up, the start-up screen is displayed, prompting file name input.



Input the file name according to the following procedure.

(a) When inputting file name directly.

If the file name is input directly, for example, when a new Mask Option file is created, follow the procedure below.

(1) Input the file name using alphabetic and numeric keys. 8 alphanumerics can be used for a file name.

(2) Input [↵]. If this is a new file name, create a new Mask Option file. If the file name already exists, read the current Mask Option file.

■Note■

Indicates the version of the MASK167 Mask Option generator.

(b) When inputting file name after displaying current Mask Option file at the DIRECTORY area.

All Mask Option files existing in the current directory at the DIRECTORY area are displayed without extension code.

If a current Mask Option file is to be changed, or if file names are systematically managed, it is convenient to display the current Mask Option files at the DIRECTORY area.

Read a Mask Option file displayed at the DIRECTORY area according to the following procedure.

(1) Input [↑] or [↓] at the FILE NAME area. All current Mask Option files are displayed at the DIRECTORY area.

(2) Input [↑] or [↓] and select the file to be changed.

(3) Input [↵]. The file name of the selected Mask Option file is displayed at the FILE NAME area.

(4) If the file name displayed at the FILE NAME area is correct, input [↵]. The Mask Option file is read.

(5) If the file name displayed at the FILE NAME area is not correct, retry the procedure from (1) to (3).

■Note■

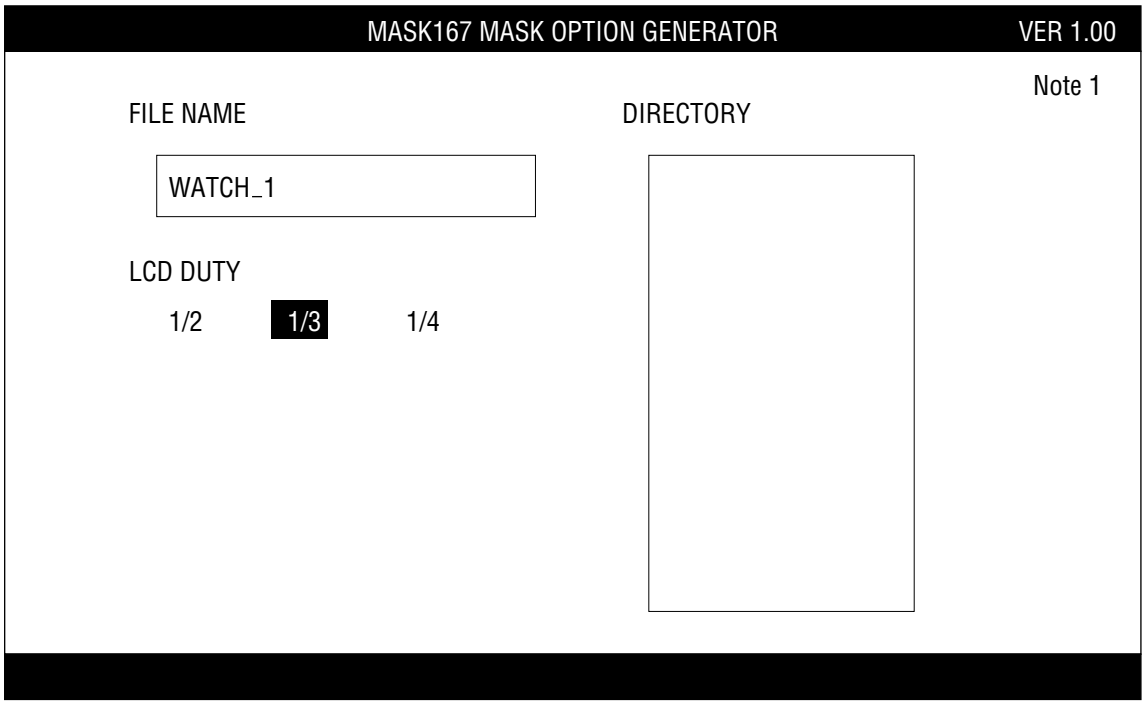
If [ESC] is input when in file name input status, the MASK167 edit stops, and the program returns to the DOS screen.

[4] Set LCD duty.

Input [←] or [→] to select the LCD duty, and input [↵]. LCD duty is set. If [ESC] is input, LCD duty returns to the previous status to setting, and the cursor moves to the input area of the file name.

In the start-up screen, the cursor flashes and the set status is highlighted.

A display example of a start-up screen is shown below.



All explanations in Chapter 3 are based on the assumption that the start-up screen has been set as above.

[5] Exit edit in start-up screen and enter the menu screen.

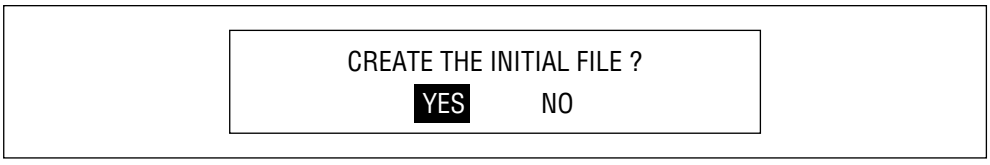
If LCD duty is set, edit in the start-up screen ends.

(a) When no change was made in the start-up screen:

the program enters the menu screen.

(b) When a change was made in the start-up screen:

the following comment is displayed on screen.



To update the start-up screen, input [←] to select YES, followed by [↵]. This updates the start-up screen and enters the menu screen.

If the start-up screen is not to be updated, input [→] to select NO, followed by [↵]. The program returns to [3] for file name input.

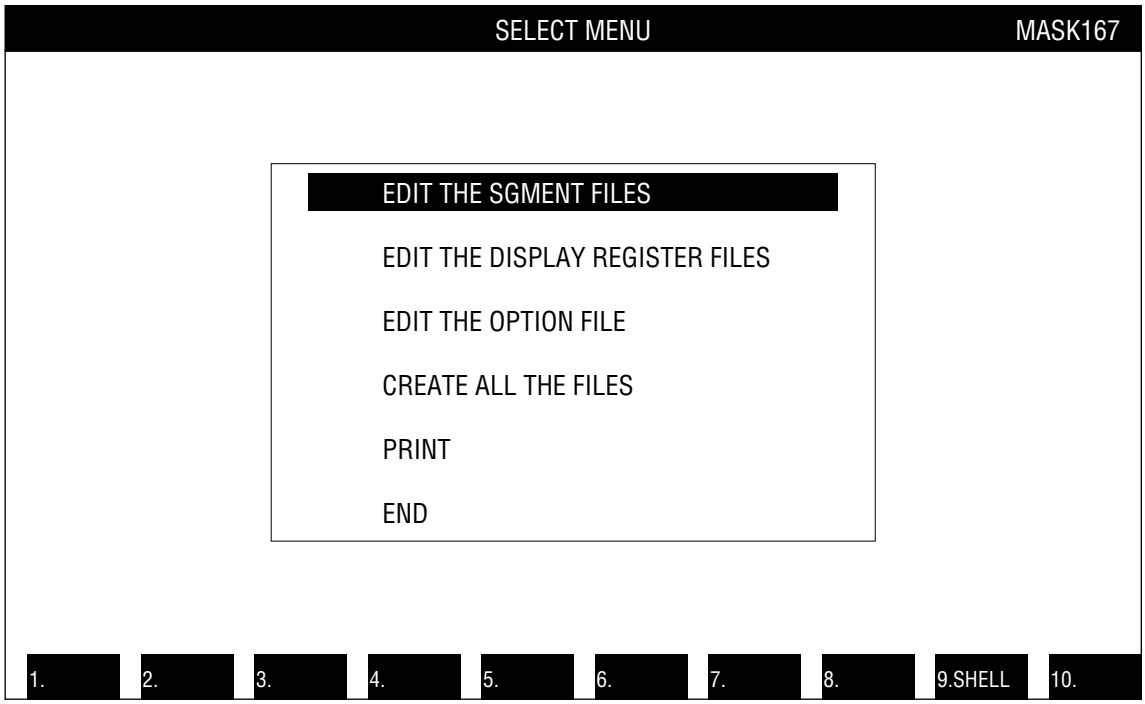
2. Selection of Menu

The menu screen is used to select the work to be performed next.

The operation method of the menu screen is shown below.

[1] Enter menu screen.

When edit of the start-up screen of the MASK167 Mask Option generator ends, the program enters menu screen.



[2] Select menu.

Select the menu by inputting [↑] or [↓] followed by [↵]. Each menu edit screen is displayed.

Each menu consists of the following edit screens. An outline of the functions of each edit screen follows.

(a) EDIT THE SEGMENT FILES

Common setting screen: sets LCD driver terminals, from L0 to L30, to common terminal.

Port setting screen: sets LCD driver terminals, from L0 to L7, to port terminal or segment terminal.

Segment data setting screen: assigns unique name to each segment terminal.

(b) EDIT THE DISPLAY REGISTER FILES

Display register setting screen: assigns unique name to display register.

(c) EDIT THE OPTION FILE

Crystal oscillator setting screen: sets built-in/external of capacitor for oscillation (CG.) of crystal oscillator.

(d) CREATE ALL THE FILES

File generation screen: generates Print file and Intel HEX Format Mask Option file. If error occurs when a file generates, an Error file is generated.

(e) PRINT

Printer output screen: outputs Print file, Display Register file, Option file, and Error file to printer.

(f) END

Ends edit of the MASK167 Mask Option generator.

■Reference■

[f • 9] SHELL: Chapter 3, 9.3 Shell Function.

3. Creation of Segment File

A segment file is created in the common setting screen, port setting screen, and segment data setting screen. In the common setting screen, each LCD driver terminal of a common terminal is assigned according to LCD duty. In the port setting screen, the LCD driver terminal of a port terminal is assigned. In the segment data setting screen, a unique name is assigned to each segment terminal.

A configuration of a segment file is shown below.

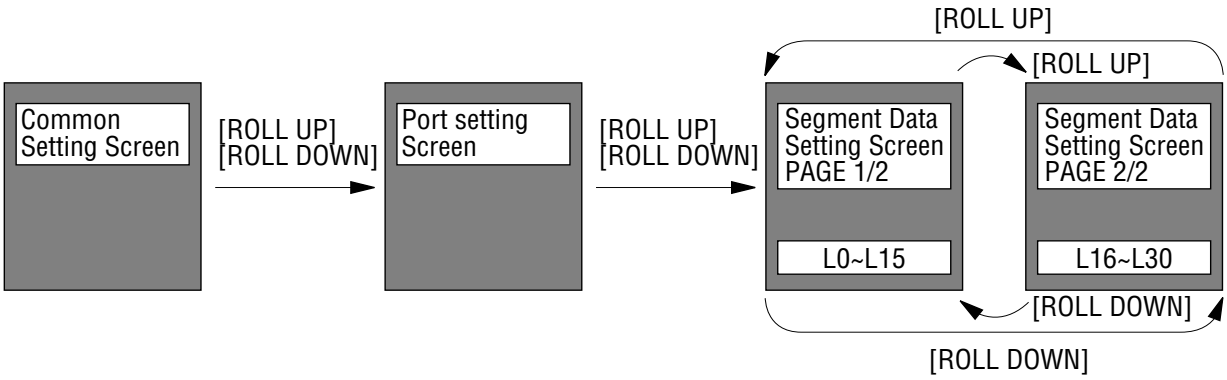


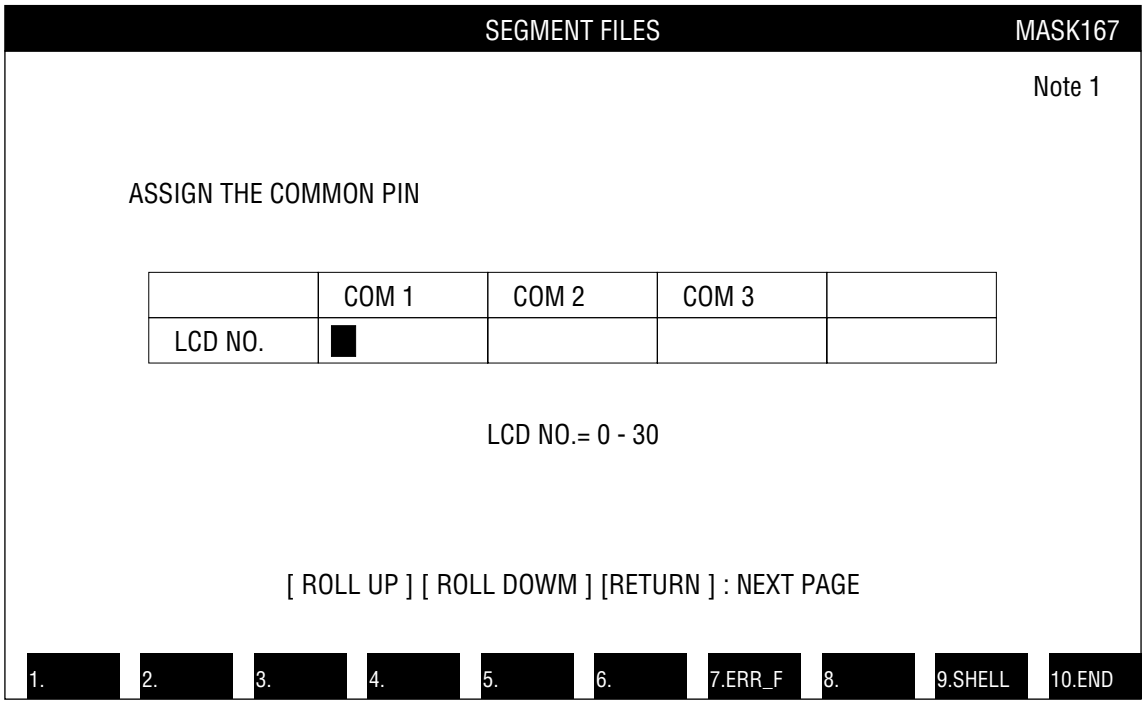
Figure 3-1: Configuration of segment file

Input [SCROLL UP] or [SCROLL DOWN] to enter each screen. Note, however, that it is impossible to enter the common setting screen from the port setting screen, or to enter the common setting screen or the port setting screen from the segment data setting screen.

The creation method of a segment file is shown below.

[1] Enter the common setting screen.

Select EDIT THE SEGMENT FILES in menu select to enter the common setting screen.



The number of common terminals is determined by the LCD duty set to the start-up screen. In the example above the LCD duty is set to 1/3.

■Note 1■

LCD No. indicates the number of L0~L30 segment terminals.

[2] Assign a common terminal to an LCD driver terminal.

Follow the procedure below to set a common terminal.

(1) Input [↵], [←] or [→] to move the cursor to the common terminal for setting.

(2) Input the number of the LCD driver terminal to set to the common terminal using numeric keys.

The following functions are assigned to each key.

(a) [↵]: moves cursor to the right area.

(b) [→]: moves cursor to the right numerical character. If numerical character has not been input, moves cursor to the right area.

(c) [←]: moves cursor to the left numerical character. If numerical character has not been input, moves cursor to the left area.

(d) [BS]: deletes left numeric character.

(e) [DEL]: deletes numerical character at cursor.

(f) [ESC]: moves cursor to the beginning of an area.

Set the common terminal within the range of LCD numbers without overlapping. If a common terminal was set outside the range of LCD driver terminals, or if a setting overlapped, or if the common terminal was not set, an error occurs while generating a Mask Option file. If an error occurs, an Error file is generated, not a Mask Option file.

A display example of a common setting screen is shown below.

ASSIGN THE COMMON PIN

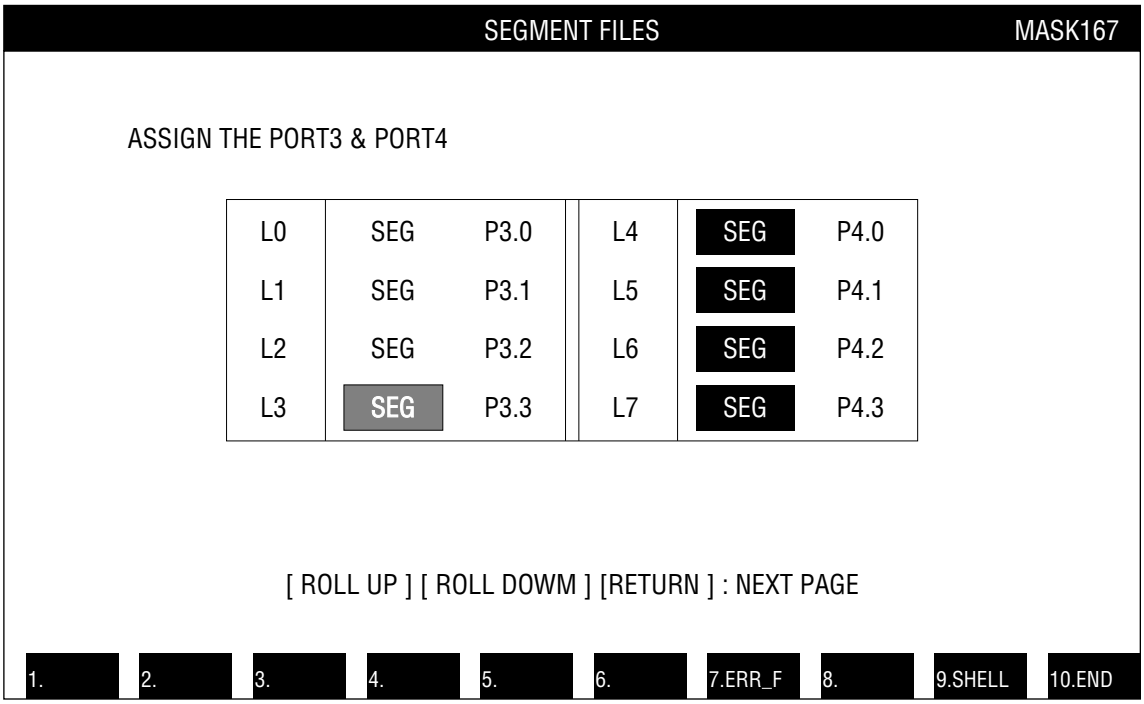
	COM 1	COM 2	COM 3	
LCD NO.	0	1	2	

LCD NO.= 0 - 30

The file open function can be used in the common setting screen. For details on use, see Chapter 3, 9. Other Operation Methods.

[3] Exit the common setting screen and enter the port setting screen.

Input [ROLL UP] or [ROLL DOWN] in the common setting screen, or input [↵] in the area farthest right. The common setting screen ends and the program enters the port setting screen.



On the port setting screen the cursor flashes and the setting status is highlighted.

The LCD driver terminal set to a common terminal cannot be set to a port terminal. In the above example, L0, L1 and L2 are set to a common terminal, unaccessible by cursor.

■Note■

It is not possible to enter the common setting screen from the port setting screen. If common terminals are changed, exit the port setting screen and perform [1] of Chapter 3, 3. Creation of Segment File.

[4] Assign an output port to the LCD driver terminals L0~L7.

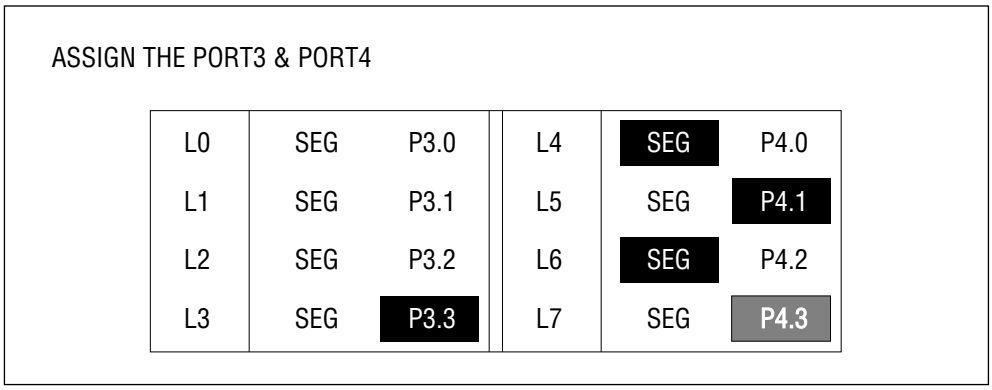
Follow the procedure below when an output port is assigned to LCD driver terminals L0~L7.

(1) Input [↑] or [↓] to move the cursor to an LCD driver terminal for setting.

(2) Input [←] or [→] to select either a segment terminal or a port terminal.

(3) Input [↵]. The item selected in (2) is assigned to LCD driver terminals L0~L7.

A display example of a port setting screen is shown below.



In this example, L0~L2 are set to a common terminal, L4 and L6 are set to a segment terminal, and L3, L5 and L7 are set to a port terminal.

The file open function can be used in the port setting screen. For details on use, see Chapter 3, 9 Other Operation Methods.

[5] Exit the port setting screen and enter the segment data setting screen.

Input [ROLL UP] or [ROLL DOWN] to the port setting screen, or input [↵] to the area farthest right. This exits the port setting screen, and the program enters the segment data setting screen.

SEGMENT FILES MASK167

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LCD	COM 1	COM 2	COM 3	
L0	COM 1			
L1		COM 2		
L2			COM3	
L3	P3.3			
L4				
L5	P4.1			
L6				
L7	P4.3			

LCD	COM 1	COM 2	COM 3	
L8				
L9				
L10				
L11				
L12				
L13				
L14				
L15				

COPY DATA [ ]

1.AREA_C 2.LINE_C 3.PASTE 4. 5. 6.DISP_F 7.ERR_F 8. 9.SHELL 10.END

In the above example, a 1/3 duty is selected. Since this duty value is selected, COM 4 is not displayed. If 1/2 duty is selected, COM 3 and COM 4 will not be displayed. COM 1~4 displayed in the segment data setting screen correspond to the common output of each segment terminal. To assign a unique name, assign a unique name corresponding to the common output of each segment terminal in COM 1~4.

If an LCD driver terminal is set to a port terminal in the port setting screen, that port terminal name is not displayed on screen. The LCD driver terminal set to the common terminal, port terminal or common terminal row not displayed on screen cannot be accessed by the cursor.

■Note■

The common setting screen and port setting screen cannot be entered from the segment data setting screen. To change the common terminal and port terminal, exit the segment data setting screen first, then perform [1]~[4] of Chapter 3, 3. Creation of Segment File.

[6] Assign a unique name to a segment terminal.

Follow the procedure below when a unique name is assigned to a segment terminal.

(1) Input [↵], [←], [→], [↑] or [↓] to move the cursor to the segment terminal where a unique name is to be assigned.

(2) Input the unique name to the segment terminal using alphabetic keys and numeric keys. 6 alphanumerics can be used for the unique name. Upper and lower case are regarded as the same.

The following functions are assigned to each key.

(a) [↵]: moves cursor to the right area.

(b) [→]: moves cursor to the right character. If character is not input, moves cursor to the right area.

(c) [←]: moves cursor to the left character. If character is not input, moves cursor to the left area.

(d) [↑]: moves cursor to the area above.

(e) [↓]: moves cursor to the area below.

(f) [BS[: deletes left character.

(g) [DEL]: deletes character at cursor

(h) [ESC]: moves cursor to the beginning of an area.

The MASK167 supports multiple assignments to assign the same unique name to a segment terminal. Even if the same unique name is assigned to a segment terminal, an error does not occur when generating a Mask Option file. A Mask Option file and Print file are generated normally.

A display example of the segment data setting screen is shown below.

SEGMENT FILES MASK167

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LCD	COM 1	COM 2	COM 3	
L0	COM 1			
L1		COM 2		
L2			COM3	
L3	P3.3			
L4	1B	1C	m1	
L5	P4.1			
L6	1A	1G	1D	
L7	P4.3			

LCD	COM 1	COM 2	COM 3	
L8	1F	1E		
L9	2b	2c	a2	
L10	2a	2g	2b	
L11	2f	2e	p2	
L12	3B	3C		
L13	3A	3G	3D	
L14	3F	3E		
L15	4B	4C		

COPY DATA [ ]

1.AREA_C 2.LINE_C 3.PASTE 4. 5. 6.DISP_F 7.ERR_F 8. 9.SHELL 10.END

The copy & paste function and the file open function can be used in the segment data setting screen. For details see Chapter 3, 9. Other Operation Methods.

[7] Enter the next screen of the current editing screen.

The segment data setting screen consists of multiple screens. Enter the next screen according to the following procedure, and assign a unique name to the segment terminal.

(a) [ROLL UP]: immediately enters the next screen.

(b) [ROLL DOWN]: immediately enters the previous screen.

(c) [↓]: moves cursor to the lowest line of the segment data setting screen. Inputting [↓] enters the next screen.

(d) [↑]: moves cursor to the highest line of the segment data setting screen. Inputting [↑] enters the previous screen.

[8] End the creation of a segment file and enter the menu screen.

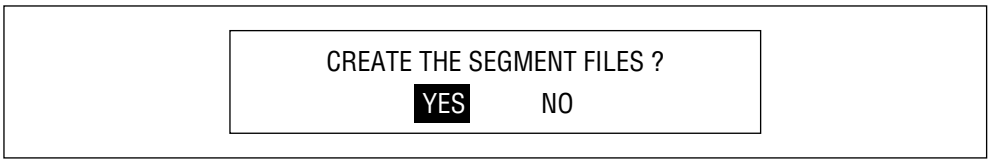
If [f • 10] END is input to the common setting screen, port setting screen or to the segment data setting screen, the creation of a segment file ends.

(a) When a segment file is not created:

If [f • 10] END is input, the creation of a segment file ends immediately, and the program enters the menu screen.

(b) When a segment file is created:

If [f • 10] END is input, the following comment is displayed on screen.



If a segment file is to be updated, select YES by inputting [←] followed by [↵]. The segment file is updated and the program enters the menu screen.

If a segment file is not to be updated, select NO by inputting [→] followed by [↵]. The segment file is not updated and the program enters the menu screen.

■Reference■

[f • 1] AREA_C: Chapter 3, 9.1 Copy & Paste Function

[f • 2] LINE_C: Chapter 3, 9.1 Copy & Paste Function

[f • 3] PASTE: Chapter 3, 9.1 Copy & Paste Function

[f • 6] DISP_F: Chapter 3, 9.2 File Open Function

[f • 7] ERR_F: Chapter 3, 9.2 File Open Function

[f • 9] SHELL: Chapter 3, 9.3 Shell Function

4. Creation of Display Register File

A Display Register file is created in the display register setting screen. A unique name is assigned to a display register in this screen.

The configuration of a Display Register file is shown below.

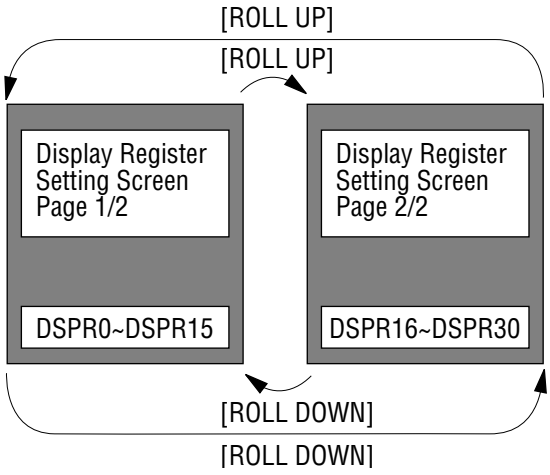


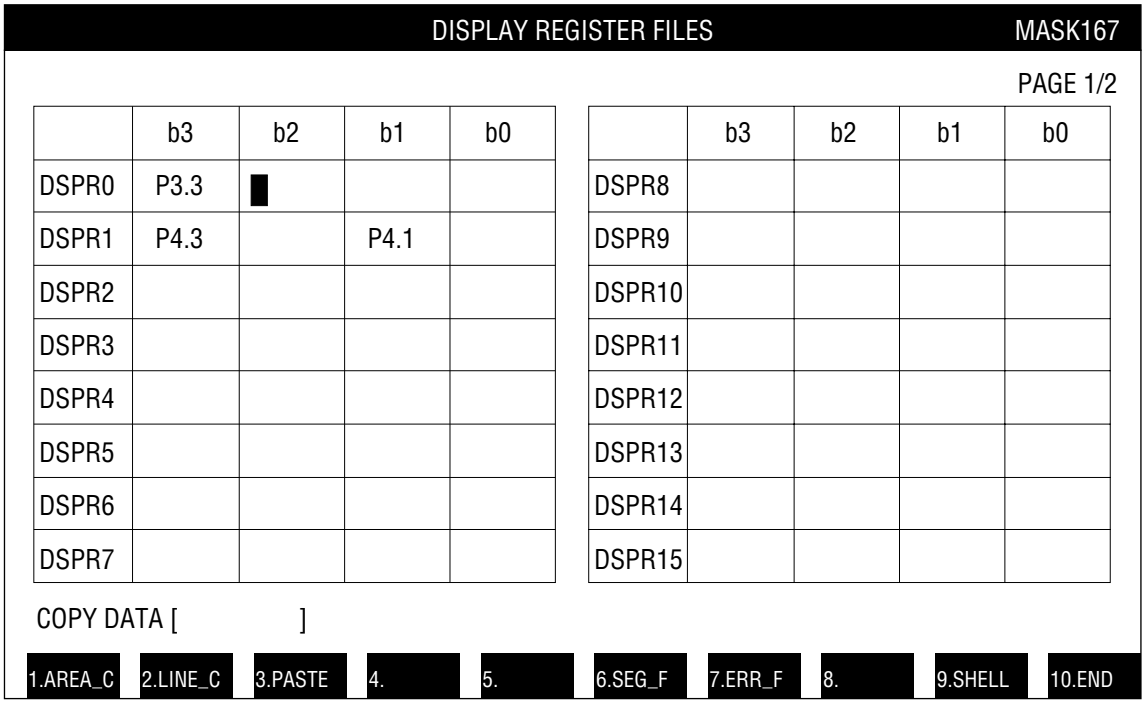
Figure 3-2: Configuration of display register file

Screens can be entered by inputting either [ROLL UP] or [ROLL DOWN].

The creation method of a Display Register file is shown below.

[1] Enter the display register setting screen.

If EDIT THE DISPLAY REGISTER FILES is selected from the menu, the program enters the display register setting screen.



When LCD driver terminals L0~L7 are set to a port terminal, display registers DSPR0 and DSPR1 are used as writing registers of that port terminal. At this time the output port name is displayed at the write register of the port terminal. Each bit of display registers DSPR0 and DSPR1 that are not set to the port terminal can be used as normal display registers.

The above example shows the case where LCD driver terminals L3, L5 and L7 are set to port terminals P3.3, P4.1 and P4.3. b0, b1 and b2 of DSPR0 and b0 and b2 of DSPR1 can be used as display registers, but b3 of DSPR0 and b1 and b3 of DSPR1 cannot. Use b3 of DSPR0 and b1 and b3 of DSPR1 as the write registers of port terminals P3.3, P4.1 and P4.3.

The correspondence between output ports and display registers are shown below.

Table 3-1: Correspondence between output ports and display registers

	b3	b2	b1	b0
DSPR0	P3.3	P3.2	P3.1	P3.0
DSPR1	P4.3	P4.2	P4.1	P4.0

[2] Assign a unique name to display register.

Follow the procedure below when a unique name is assigned to a display register.

(1) Input [↵], [←], [→], [↑] or [↓] to move the cursor to the display register when a unique name is to be assigned.

(2) Input the unique name to the display register using alphabetic keys and numeric keys. 6 alphanumeric characters can be used for a unique name. Upper/lower case are regarded as the same.

The following functions are assigned to each key.

(a) [↵]: moves cursor to the right area.

(b) [→]: moves cursor to the right character. If character is not input, moves cursor to the right area.

(c) [←]: moves cursor to the left character. If character is not input, moves cursor to the left area.

(d) [↑]: moves cursor to the area above.

(e) [↓]: moves cursor to the area below.

(f) [BS]: deletes character at left.

(g) [DEL]: deletes character at cursor.

(h) [ESC]: moves cursor to the beginning of an area.

The MASK167 disables multiple assignments that assign the same unique name to a display register. If the same character is assigned to a display register, an error occurs when generating a Mask Option file. A Mask Option file and Print file are not generated.

A display example of the display register screen is shown below.

DISPLAY REGISTER FILES MASK167

PAGE 1/2

	b3	b2	b1	b0
DSPR0	P3.3	a1		p1
DSPR1	P4.3	a2	P4.1	p2
DSPR2	1E	1F	1G	
DSPR3	1A	1B	1C	1D
DSPR4	2E	2F	2G	
DSPR5	2A	2B	2C	2D
DSPR6	3E	3F	3G	
DSPR7	3A	3B	3C	3D

	b3	b2	b1	b0
DSPR8	4E	4F	4G	
DSPR9	4A	4B	4C	4D
DSPR10	5E	5F	5G	
DSPR11	5A	5B	5C	5D
DSPR12	mode01	mode02	mode03	mode04
DSPR13	mode05	mdoe06		
DSPR14	min	sec	m1	
DSPR15	24h			

COPY DATA [ ]

1.AREA_C 2.LINE_C 3.PASTE 4. 5. 6.SEG_F 7.ERR_F 8. 9.SHELL 10.END

The copy & paste function and the file open function are used in the display register setting screen. For details, see Chapter 3, 9. Other Operation Methods.

[3] Enter the next screen of the current editing screen.

The display register setting screen consists of multiple screens. Enter the next screen according to the following procedure, and assign a unique name to the display register.

(a) [ROLL UP]: immediately enters the next screen.

(b) [ROLL DOWN]: immediately enters the previous screen

(c) [↓]: moves cursor to the lowest line of the segment data setting screen. Inputting [↓] enters the next screen.

(d) [↑]: moves cursor to the highest line of the segment data setting screen. Inputting [↑] enters the previous screen.

[4] End the creation of a Display Register file and enter the menu screen.

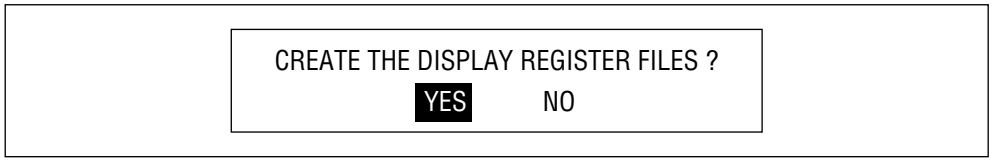
If [f • 10] END is input to the display register setting screen, the creation of a Display Register file ends.

(a) When a Display Register file is not created:

If [f • 10] END is input, the creation of a Display Register file ends immediately, and the program enters the menu screen.

(b) When a Display Register file is created:

If [f • 10] END is input, the following comment is displayed on screen.



If a Display Register file is updated, select YES by inputting [←] followed by [↵]. That Display Register file is updated and the program enters the menu screen.

If a Display Register file is not to be updated, select NO by inputting [→] followed by [↵]. That Display Register file is not updated and the program enters the menu screen.

■Reference■

[f • 1] AREA_C: Chapter 3, 9.1 Copy & Paste Function

[f • 2] LINE_C: Chapter 3, 9.1 Copy & Paste Function

[f • 3] PASTE: Chapter 3, 9.1 Copy & Paste Function

[f • 6] DISP_F: Chapter 3, 9.2 File Open Function

[f • 7] ERR_F: Chapter 3, 9.2 File Open Function

[f • 9] SHELL: Chapter 3, 9.3 Shell Function

5. Creation of Option File

An Option file is created in the crystal oscillator setting screen. In this screen, the capacitor for oscillation (CG.) is assigned to a crystal oscillator.

Configuration of an Option file is shown below.

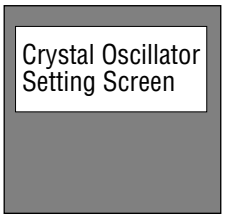
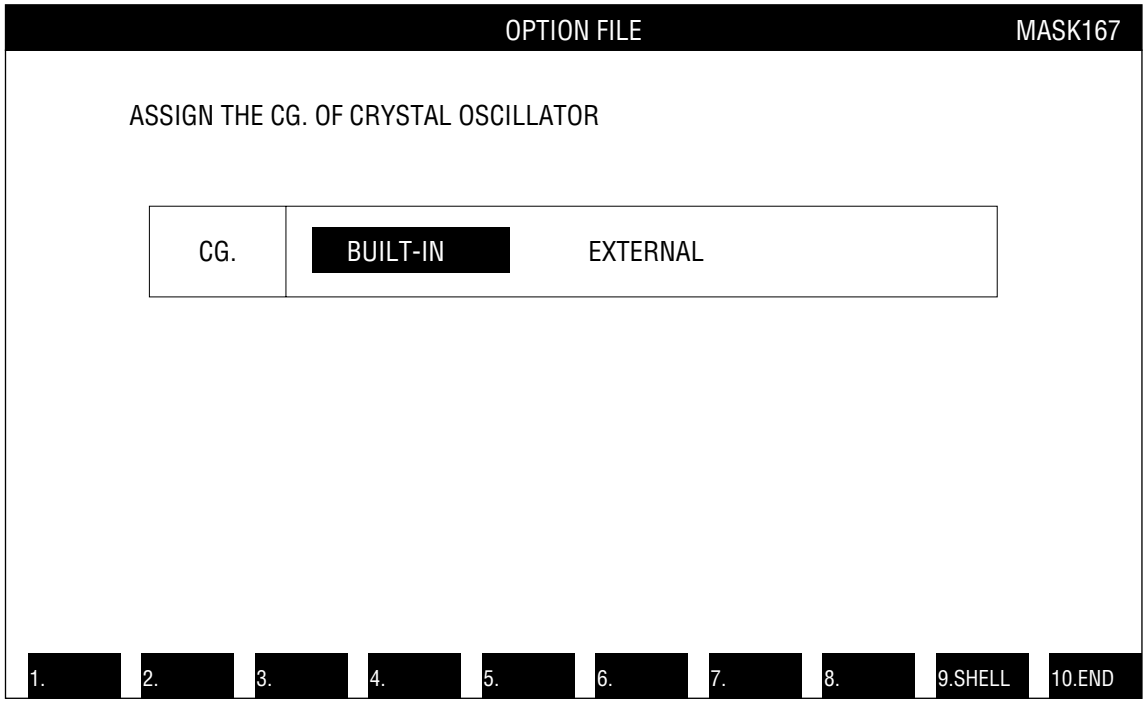


Figure 3-3: Configuration of option file

The creation method of an Option file is shown below.

[1] Enter the crystal oscillator setting screen.

If EDIT THE OPTION FILE is selected from menu selection, the program enters the crystal oscillator setting screen.



In the crystal oscillator setting screen, the cursor flashes and the setting status is highlighted.

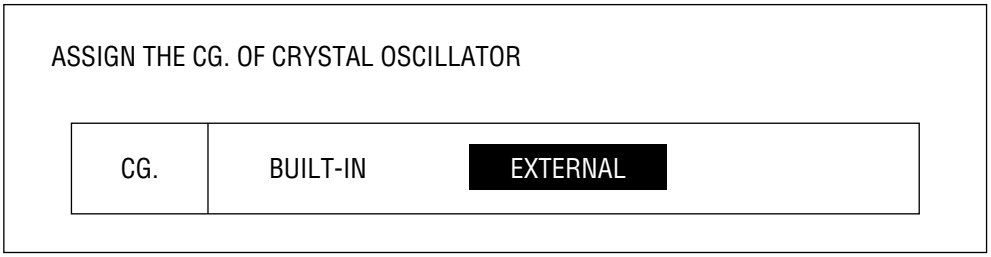
[2] Assign the capacitor for oscillation (CG.) to the crystal oscillator.

Assign the capacitor for oscillation (CG.) to the crystal oscillator according to the following procedure.

(1) Input [←] or [→] to select built-in/external of the capacitor for oscillation (CG.) of a crystal oscillator.

(2) Input [↵]. The content selected in (1) is set to the crystal oscillator.

An entry example to the crystal oscillator setting screen is shown below.



In this example, the crystal oscillator is set to external of the capacitor of oscillation (CG.).

[3] End the creation of an Option file and enter the menu screen.

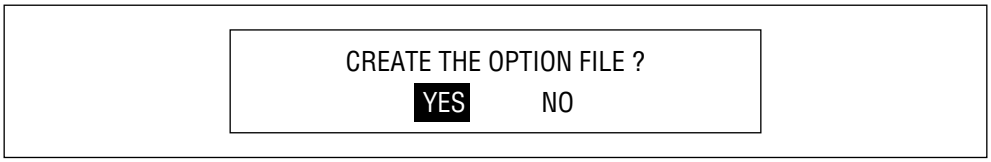
If [f • 10] END is input to the crystal oscillator setting screen, the creation of an Option file ends.

(a) When an Option file is not created:

If [f • 10] END is input, the creation of an Option file ends immediately, and the program enters the menu screen.

(b) When an Option file is created:

If [f • 10] END is input, the following comment is displayed on screen.



If an Option file is to be updated, select YES by inputting [←] followed by [↵]. That Option file is updated and the program enters the menu screen.

If an Option file is not to be updated, select NO by inputting [→] followed by [↵]. That Option file is not updated and the program enters the menu screen.

■Note■

If a Mask Option file is generated without creating an Option file, the crystal oscillator is set to built-in for the capacitor for oscillation (CG.).

■Reference■

[f • 9] SHELL: Chapter 3, 9.3 Shell Function

6. Generation of Mask Option File

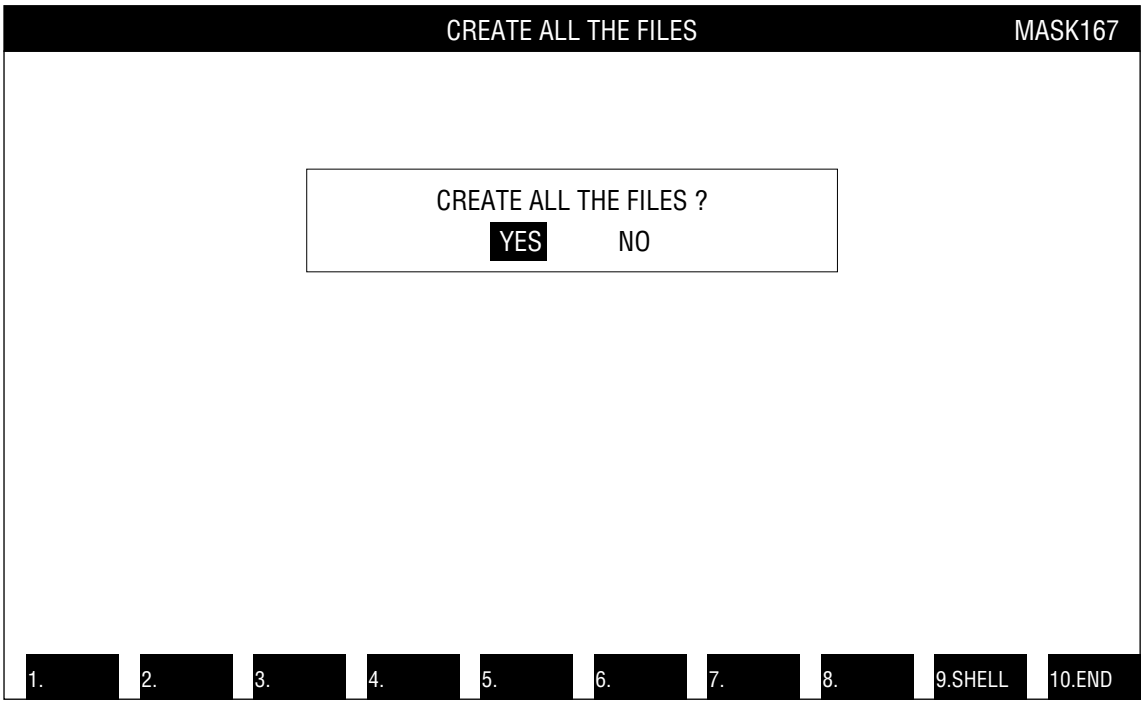
An Intel HEX Format Mask Option file, Print file used to check the assignment of segments, and an Error file are generated in the file generation screen.

Print files to be generated in the file generation screen are segment files and files generated from the Display Register file. A 3rd party can check segment assignments from the contents of a Print file and a Display Register file.

The operation method of a file generation screen is shown below.

[1] Enter the file generation screen.

If CREATE ALL THE FILES is selected from the menu, the program enters the file generation screen.

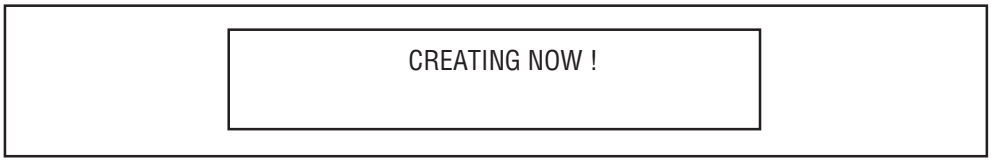


[2] Generate a Mask Option file.

When a Mask Option file is generated, select YES by inputting [←] followed by [↵]. This starts the generation of a Mask Option file, a Print file and an Error file.

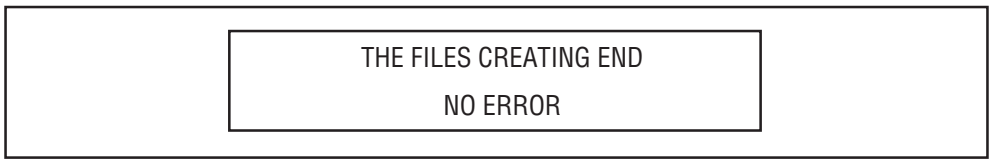
(1) During file generation:

During file generation the following comment is displayed on the file generation screen.



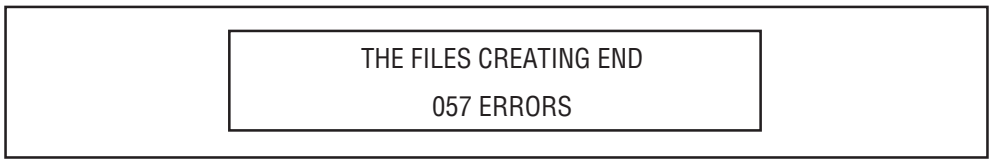
(2) File Generation Normal End

If file generation ended normally, the following comment is displayed on the file generation screen, and a Mask Option file and a Print file are generated.



(3) File Generation Abnormal End

If an error is detected during file generation, the following comment is displayed on the file generation screen, and an Error file generated.



The above example indicates that 57 errors occurred.

If an Error file is used, see Chapter 3, 9.2 File Open Functions. If a Print file or an Error file is printed, see Chapter 3, 7. Output to Printer.

[3] Stop generation of a Mask Option file.

If a Mask Option file is not to be generated, select NO by inputting [→] followed by [↵]. That Mask Option file is not generated and the program enters the menu screen.

[4] End generation of a Mask Option file and enter the menu screen.

Input [f • 10] END when Mask Option file generation ends. The program exits the file generation screen and enters the menu screen.

■Reference■

[f • 9] SHELL: Chapter 3, 9.3 Shell Function

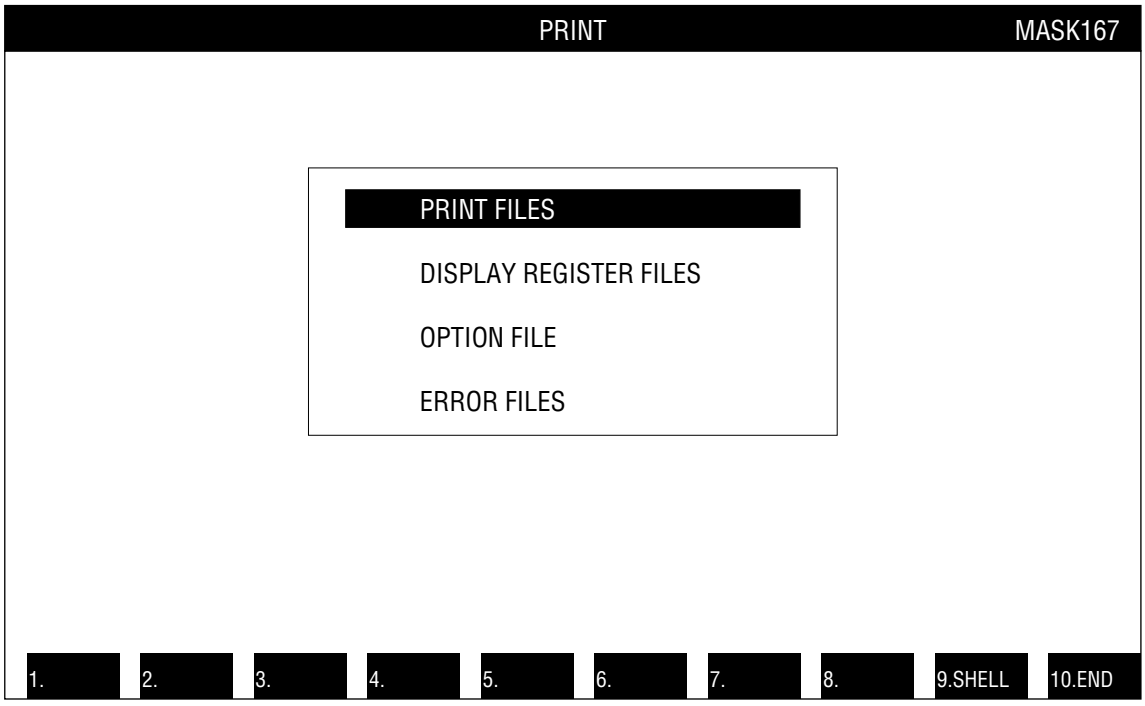
7. Output to Printer

Print files, Display Register files, Option files and Error files created thus far are printed to the print screen.

The operation method of the print screen is shown below.

[1] Enter the print screen.

Select PRINT from the menu select to enter the print screen.



[2] Print each file.

Follow the procedure below to print each file.

(1) Before printing, check that the printer is ready for operation.

(2) If the printer is ready, select the file to print by inputting either [↑] or [↓] followed by [↵]. The printing of each file then starts.

(3) If the printer is not ready, set it up so that it can print and begin by referring to Chapter 3, 1. Start-up the MASK167 Mask Option Generator [1].

[3] Stop printing.

The following comment is displayed on screen when file data is output to a printer. If any key is input during this status, file data output to printer stops.

```
PRINT OUT NOW!
PRESS ANY KEYS, THEN STOP
```

[4] End printing of files and enter the menu screen.

If [f • 10] END is input to the printing screen, printing of files ends and the program enters the menu screen. For printing results see Appendix B, Print Example.

■Reference■

[f • 9] SHELL: Chapter 3, 9.3 Shell Function

8. End of the MASK167 Mask Option Generator

Select END by inputting either [↑] or [↓] to the menu screen followed by [↵]. The MASK167 Mask Option generator program then ends.

9. Other Operation Methods

9.1 Copy & Paste Function

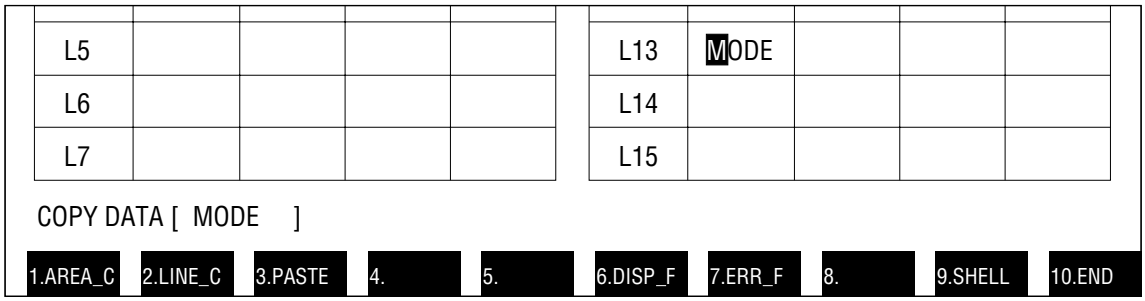
The MASK167 supports the function to copy a character string by using function keys. There are two types of copy functions: area copy and line copy. Both can be used in the segment data setting screen and display register setting screen.

(a) Area Copy

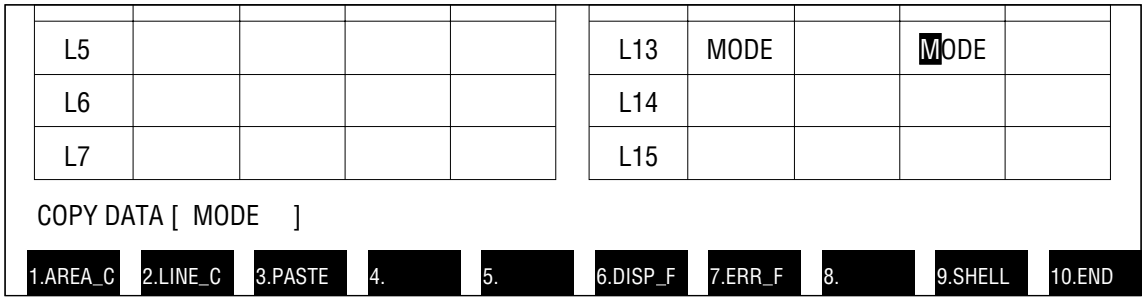
The area copy function copies 6 characters in an area. This function can be used in the segment data setting screen and display register setting screen, or to copy characters between the segment data setting screen and display register setting screen.

To perform area copy, follow the procedure below.

(1) Move the cursor to the area to perform area copy, and input [f • 1] AREA_C. Characters in that area are stored to COPY DATA.



(2) Move the cursor to the area to paste to, and input [f • 3] PASTE. Characters stored to COPY DATA are pasted.



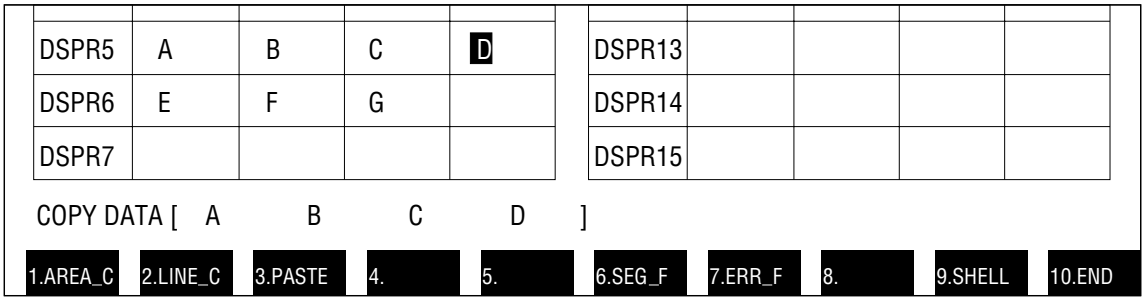
(3) Continue operation (2) to copy the same characters to multiple areas.

(b) Line Copy

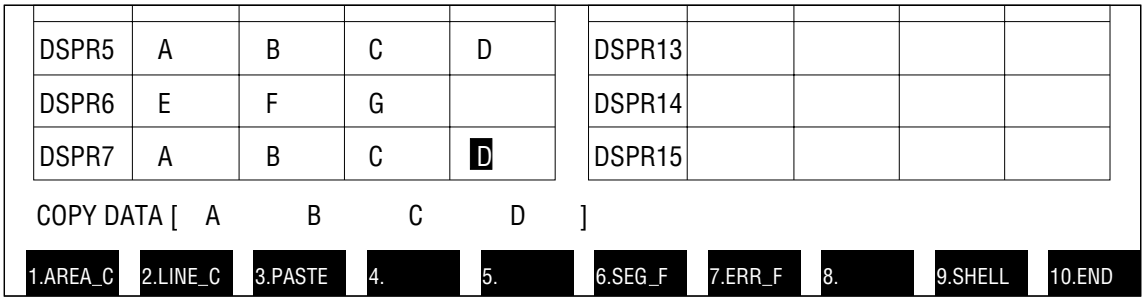
The line copy function copies a 1-line character string. This function cannot be used to copy a character string between the segment data setting screen and display register setting screen. Use this function only in the segment data setting screen, or only in the display register setting screen.

Follow the procedure below when using the line copy function.

(1) Move the cursor to the line to be copied, and input [f • 2] LINE_C. A 1-line character string is stored to COPY DATA.



(2) Move the cursor to the line where the stored string will be pasted and input [f • 3] PASTE.



(3) Continue (2) operation if the same character string is to be copied to multiple lines.

■Note■

If the area copy function is executed, the character string stored to COPY DATA by line copy is cleared.
If the line copy function is executed, the characters stored to COPY DATA by area copy is cleared.

9.2 File Open Function

The MASK167 supports the file open function, which allows a Display Register file or an Error file to be referred to while creating a segment file or allows a file to be changed during creation.

The file open function can be used for the common setting screen, port setting screen, segment data setting screen and the display register setting screen.

A screen transition diagram while the file open function is used is shown below.

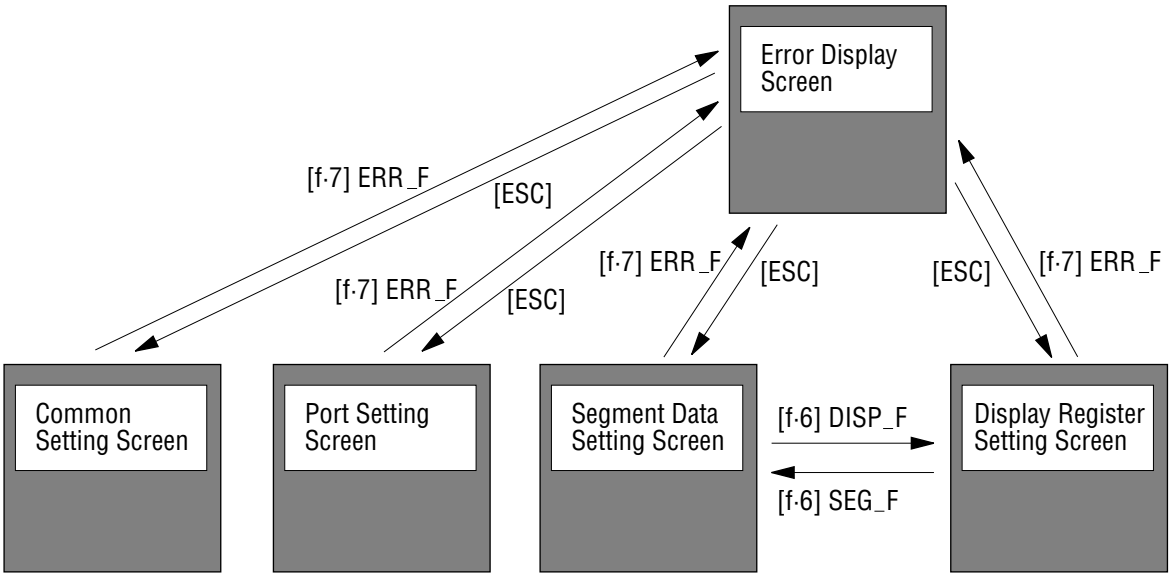


Figure 3-4: Screen transition by file open function

(a) Referring to Error Display Screen

By using the file open function, the common setting screen, port setting screen, segment data setting screen and display register setting screen can be edited while referring to the error display screen. However, if a Mask Option file is not generated, the error display screen cannot be referred to.

Follow the procedure below when the error display screen is referred to.

(1) Input [f • 7] ERR_F to each edit screen. The program enters the error display screen.

(2) Input [ESC] to the error display screen. The program returns to each edit screen.

(3) Input [ROLL UP] or [ROLL DOWN] to scroll the error display screen. If [ROLL UP] is input, the screen scrolls to the next screen, and if [ROLL DOWN] is input, the screen scrolls to the previous screen.

(b) Enter the display register setting screen from the segment data setting screen.

If the file open function is used, the segment data setting screen can be edited by referring to the display register setting screen, or data can be edited by entering the display register setting screen from the segment data setting screen, or vice versa. It is not possible to enter the display register setting screen from the common setting screen or port setting screen.

Follow the procedure below to change edit screens.

(1) Input [f • 6] DISP_F to the segment data setting screen. The program enters the display register setting screen.

(2) Input [f • 6] SEG_F to the display register setting screen. The program enters the segment data setting screen.

■Note■

If the segment data setting screen and the display register setting screen are changed by using the file open function, the character string stored to COPY DATA by using the line copy function, explained in 9.1 Copy & Paste Function, is deleted.

9.3 Shell Function

By using function keys, the MASK167 can use shell functions in all edit screens except the start-up screen. Follow the procedure below to use shell functions.

(1) Input [f • 9] SHELL. The command processor for DOS, COMMAND.COM starts up.

(2) When exiting COMMAND.COM, COMMAND.COM exits and the program returns to each edit screen of the MASK167.

```
A> EXIT ↵
```

■Note■

To use shell functions, it is necessary to secure a free memory area large enough to start-up the MASK167 program and COMMAND.COM.

The resident part of MASK167.EXE consumes about 134Kbytes of memory. If shell functions are used, secure a memory area of 134Kbytes plus sufficient area for COMMAND.COM and capacity for program start-up under SHELL.

Chapter 4

Files Generated by the MASK167

This chapter describes the files generated by the MASK167 Mask Option generator.

1. Contents of Each Generation File

The MASK167 Mask Option generator generates the following 6 data files. “file-name” indicates the file name input to the startup screen.

(a) Segment File <file-name.SEG>

A segment file stores the unique name assigned to each segment terminal. It is used to generate Mask Option files, Print files and Error files.

(b) Display Register File <file-name.DSP>

A Display Register file stores the unique name assigned to a display register. It is used to generate Mask Option files, Error files and to print Display Register files.

(c) Option File <file-name.OPF>

An Option file stores data on LCD duty and the built-in/external of the capacitor for oscillation (CG.) of a crystal oscillator. It is used to generate Mask Option files and to print Option files.

(d) Mask Option File <file-name.HEX>

A Mask Option file stores Intel HEX Format Mask Option Data. It is used to create the Mask data required to manufacture the MSM64167 and to debug application programs by the EASE64165/167, an in-circuit emulator.

(e) Print File <file-name.PRN>

A Print file stores the unique name assigned to a segment file, and assignment data to a display register. It is used to output Print files.

(f) Error File <file-name.ERR>

An Error file stores error data that occurred during Mask Option file generation. It is used to refer to an Error file by the file open function, and to print Error files.

■Reference■

For more details on the data configuration of a Mask Option file see Appendix C, Content of Mask Option

Appendix

- Appendix A Error Message List
- Appendix B Print Example
- Appendix C Content of Mask Option File

Appendix A Error Message List

When a file generation error occurs, the following error message is output to an Error file.

(a) is already defined to the disp. file

2 or more of the same unique name are assigned to a Display Register file.

(b) isn't assigned to the segment file

Unique name in Display Register file is not assigned to a segment file.

(c) isn't assigned to the disp. file

Unique name in segment file is not assigned to a Display Register file.

(d) isn't assigned to the segment file

Common terminal is not assigned.

(e) is double-assigned with another common pin

Common terminal is assigned twice.

■Note■

If the same unique name exists in a segment file, it is regarded as a double assignment, and an error message is not output.

Appendix B Print Example

(a) Print File

FILE NAME:A:¥USR¥WATCH_1.PRN

DEVICE TYPE:MSM64167 LCD DUTY:1/3

PRINT FILES PAGE1/2

LCD	SIGNAL				C/S/P	COM1		COM2		COM3	
						DATA	DSPR	DATA	DSPR	DATA	DSPR
L0	COM1	/.	/.	/.	C	.	00	.	00	.	00
L1	.	/COM2	/.	/.	C	.	00	.	00	.	00
L2	.	/.	/COM3	/.	C	.	00	.	00	.	00
L3	P3.3	/.	/.	/.	P	d	00	.	00	.	00
L4	1B	/1C	/m1	/.	S	c	03	b	03	b	15
L5	P4.1	/.	/.	/.	P	b	01	.	00	.	00
L6	1A	1G	/1D	/.	S	d	03	b	02	a	03
L7	P4.3	/.	/.	/.	P	d	01	.	00	.	00
L8	1F	/1E	/.	/.	S	c	02	d	02	.	00
L9	2b	/2c	/a2	/.	S	c	05	b	05	c	01
L10	2a	/2g	/2d	/.	S	d	05	b	04	a	05
L11	2f	/2e	/p2	/.	S	c	04	d	04	a	01
L12	3B	/3C	/.	/.	S	c	07	b	07	.	00
L13	3A	/3G	/3D	/.	S	d	07	b	06	a	07
L14	3F	/3E	/.	/.	S	c	06	d	06	.	00
L15	4b	/4c	/.	/.	S	c	09	b	09	.	00

LCD	SIGNAL				C/S/P	COM1		COM2		COM3	
						DATA	DSPR	DATA	DSPR	DATA	DSPR
L16	4a	/4g	/4d	/.	S	d	09	b	08	a	09
L17	4f	/4e	/.	/.	S	c	08	d	08	.	00
L18	MODE01	/MODE02	/MODE03	/.	S	d	17	c	17	b	17
L19	24H	/.	/.	/.	S	d	16	.	00	.	00
L20	min	/sec	/.	/.	S	d	15	c	15	.	00
L21	5B	/5C	/.	/.	S	c	11	b	11	.	00
L22	5ADEG	/.	/.	/.	S	d	11	.	00	.	00
L23	.	/.	/.	/.	S	.	00	.	00	.	00
L24	6B	/6C	/.	/.	S	c	13	b	13	.	00
L25	6A	6G	/6D	/.	S	d	13	b	12	a	13
L26	6F	/6E	/.	/.	S	c	12	d	12	.	00
L27	6H	/6I	/6J	/.	S	d	14	c	14	b	14
L28	6K	/.	/.	/.	S	a	14	.	00	.	00
L29	MODE04	/MODE05	/MODE06	/.	S	a	17	d	18	c	18
L30	.	/.	/.	/.	S	.	00	.	00	.	00

■Note■

- The number data of a display register is printed to the DSPR string of a Print file. Number data of a display register is data that indicates the display register where the unique name of a segment terminal corresponding to each common output COM 1~4 is assigned.
- Bit data of a display register is printed to the DATA string of a Print file. Bit data of a display register is data that indicates the bit of a display register where the unique name of a segment terminal corresponding to each common output COM 1~4 is assigned. a, b, c and d printed to a DATA string in the print example corresponds to b0, b1, b2 and b3 of a display register.

(b) Display Register File

FILE NAME:A:¥USR¥WATCH_1.DSP

DEVICE TYPE:MSM64167 LCD DUTY:1/3

DISPLAY REGISTER FILES PAGE1/1

	b3	b2	b1	b0		b3	b2	b1	b0
DSPR0	P3.3	a1		p1	DSPR16	24H			
DSPR1	P4.3	a2	P4.1	p2	DSPR17	mode01	mode02	mode03	mode04
DSPR2	1E	1F	1G		DSPR18	mode05	mode06		
DSPR3	1A	1B	1C	1D	DSPR19				
DSPR4	2E	2F	2G		DSPR20				
DSPR5	2A	2B	2C	2D	DSPR21				
DSPR6	3E	3F	3G		DSPR22				
DSPR7	3A	3B	3C	3D	DSPR23				
DSPR8	4E	4F	4G		DSPR24				
DSPR9	4A	4B	4C	4D	DSPR25				
DSPR10					DSPR26				
DSPR11	5ADEG	5B	5C		DSPR27				
DSPR12	6E	6F	6G		DSPR28				
DSPR13	6A	6B	6C	6D	DSPR29				
DSPR14	6H	6I	6J	6K	DSPR30				
DSPR15	min	sec	m1						

(c) Option File

FILE NAME:A:¥USR¥WATCH_1.OPF

DEVICE TYPE:MSM64167 LCD DUTY:1/3

OPTION FILE PAGE1/1

CG. OF CRYSTAL OSCILLATOR

CG.
BUILT - IN

(d) Error File

```
FILE NAME:A:¥USR¥WATCH 1.ERR
DEVICE TYPE:MSM64167  LCD DUTY:1/3
*ERROR FILES*                                                    PAGE1/1

ERROR 000       DSPR00.b "1B     " isn't assigned to the segment file
ERROR 001       DSPR00.c "1C     " isn't assigned to the segment file
ERROR 002       DSPR07.c "1B     " isn't assigned to the segment file
ERROR 003       DSPR08.b "MD     " is already defined to the disp. file
ERROR 004       LCD04.0  "1A     " isn't assigned to the disp. file
ERROR 005       LCD04.2  "1D     " isn't assigned to the disp. file
ERROR 006       "COM1 pin "      isn't assigned to the segment file
ERROR 007       "COM3 pin "      is double-assigned with another common pin
ERROR COUNT => 008
```

Appendix C Content of Mask Option File

(a) Stored Address Mask Option Data

Table C-1 shows the addresses of Intel HEX Format Mask Option files where each Mask Option Data is assigned.

Table C-1: Correspondence between each mask option data and addresses

Address	Stored Data
000h~01Eh	Stores number data of display register corresponding to COM 1 output segment terminals L0~L30.
100h~11Eh	Stores number data of display register corresponding to COM 2 output segment terminals L0~L30.
200h~21Eh	Stores number data of display register corresponding to COM 3 output segment terminals L0~L30.
300h~31Eh	Stores number data of display register corresponding to COM 4 output segment terminals L0~L30.
400h~41Eh	Stores bit data of display register corresponding to COM 1 output segment terminals L0~L30.
500h~51Eh	Stores bit data of display register corresponding to COM 2 output segment terminals L0~L30.
600h~61Eh	Stores bit data of display register corresponding to COM 3 output segment terminals L0~L30.
700h~71Eh	Stores bit data of display register corresponding to COM 4 output segment terminals L0~L30.
800h~81Eh	Stores attribute data 1 of LCD driver terminals L0~L30.
900h~91Eh	Stores high order 6 bits of attribute data 2 of LCD driver terminals L0~L30.
0A00h~0A1Eh	Stores low order 7 bits of attribute data 2 of LCD driver terminals L0~L30.
0B00h	Stores Option Data.

(b) Number Data of Display Register

Number data of the display register corresponding to each common output COM1~4 of segment terminals from L0 to L30 is stored to from 000h to 31Eh of a Mask Option file. Number data of a display register is data that indicates the display register where data corresponding to each common output of a segment driver is assigned.

Table C-2 shows a reference table to create number data of a display register.

Table C-2: Number data of display register table

	AD4	AD3	AD2	AD1	AD0		AD4	AD3	AD2	AD1	AD0
DSPR0	0	0	0	0	0	DSPR16	1	0	0	0	0
DSPR1	0	0	0	0	1	DSPR17	1	0	0	0	1
DSPR2	0	0	0	1	0	DSPR18	1	0	0	1	0
DSPR3	0	0	0	1	1	DSPR19	1	0	0	1	1
DSPR4	0	0	1	0	0	DSPR20	1	0	1	0	0
DSPR5	0	0	1	0	1	DSPR21	1	0	1	0	1
DSPR6	0	0	1	1	0	DSPR22	1	0	1	1	0
DSPR7	0	0	1	1	1	DSPR23	1	0	1	1	1
DSPR8	0	1	0	0	0	DSPR24	1	1	0	0	0
DSPR9	0	1	0	0	1	DSPR25	1	1	0	0	1
DSPR10	0	1	0	1	0	DSPR26	1	1	0	1	0
DSPR11	0	1	0	1	1	DSPR27	1	1	0	1	1
DSPR12	0	1	1	0	0	DSPR28	1	1	1	0	0
DSPR13	0	1	1	0	1	DSPR29	1	1	1	0	1
DSPR14	0	1	1	1	0	DSPR30	1	1	1	1	0
DSPR15	0	1	1	1	1						

Number data of a display register are stored to each address of a Mask Option file in the format shown in Figure C-1.

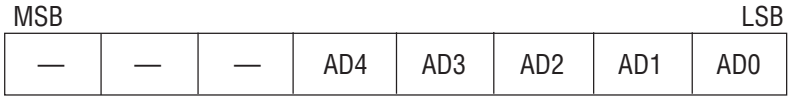


Figure C-1: Format in which number data of a display register is stored.

(c) Bit Data of Display Register

Bit data of the display register corresponding to each common output COM1~4 of segment terminals L0~L30 is stored to 400h~71Eh of a Mask Option file. Bit data of a display register is data that indicates the bits of a display register where data corresponding to each common output of a segment driver is assigned.

Table C-3 shows the reference table to create bit data of a display register.

Table C-3: Bit data of display register table

	DATA		D7	D6	D5	D4	D3	D2	D1	D0
DSPR Even Numbers	b0	a	0	0	0	0	0	0	0	1
	b1	b	0	0	0	0	0	0	1	0
	b2	c	0	0	0	0	0	1	0	0
	b3	d	0	0	0	0	1	0	0	0
DSPR Odd Numbers	b0	a	0	0	0	1	0	0	0	1
	b1	b	0	0	1	0	0	0	0	0
	b2	c	0	1	0	0	0	0	0	0
	b3	d	1	0	0	0	0	0	0	0

Bit data of a display register is stored to each address of a Mask Option file in the format shown in Figure C-2.

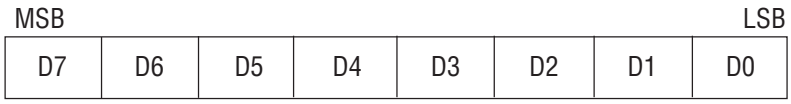


Figure C-2: Format in which bit data of a display register is stored.

(d) Attribute Data 1 of LCD Driver Terminal

Attribute data 1 of LCD driver terminals L0~L30 is stored to 800h~81Eh of a Mask Option file. Attribute data 1 is data that indicates whether an LCD driver terminal is used as either a common terminal, segment terminal, or port terminal.

Table C-4 shows the reference table to create attribute data 1 of an LCD driver terminal.

Table C-4: Table of attribute data 1

Attribute of Segment Terminal	S4	S4	S3	$\overline{S3}$	S2	$\overline{S2}$	S1	$\overline{S1}$
Used as COM 1	0	1	0	1	0	1	1	0
Used as COM 2	0	1	0	1	1	0	0	1
Used as COM 3	0	1	1	0	0	1	0	1
Used as COM 4	1	0	0	1	0	1	0	1
Used as 1/4 DUTY SEG	0	0	0	0	0	0	0	0
Used as 1/3 DUTY SEG	0	1	0	0	0	0	0	0
Used as 1/2 DUTY SEG	0	1	0	1	0	0	0	0
Used as PORT	0	1	0	1	0	1	0	0
Not Used	0	1	0	1	0	1	0	1

Attribute data 1 of LCD driver terminals is stored to a Mask Option file in the format shown in Figure C-3.

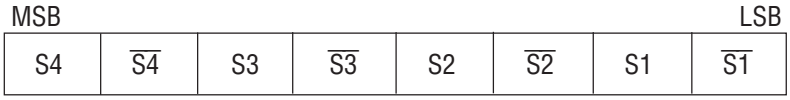


Figure C-3: Format in which attribute data 1 is stored.

(e) Attribute Data 2 of LCD Driver Terminal

Attribute data 2 of LCD driver terminals L0~L30 is stored to 900h~0A1Eh of a Mask Option file. Attribute data 2 is data that indicates whether an LCD driver terminal is used as either a common terminal, segment terminal, or port terminal, just as with attribute data 1.

Table C-5 shows a reference table to create attribute data 2 of LCD driver terminals.

Table C-5: Table of attribute data 2

C/S/P	VDD	VPC	VPS	VNC	VNS	VSS	CON	COF	POLS	POLC	TDC1	PON	POF
C	0	1	0	1	0	0	1	0	0	1	0	0	1
S	0	0	1	0	1	0	0	1	1	0	0	0	1
P	1	0	0	0	0	1	0	1	0	0	1	1	0
Not Used	0	1	0	1	0	0	1	0	0	1	0	0	1

The high order 6 bits of attribute data 2 of LCD driver terminals is stored to 900h~91Eh of a Mask Option file in the format shown in Figure C-4.

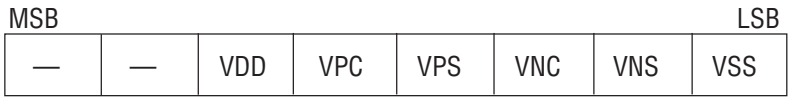


Figure C-4: Format in which high order 6 bits of attribute data 2 is stored.

The low order 7 bits of attribute data 2 of LCD driver terminals is stored to 0A00h~0A1Eh of a Mask Option file in the format shown in Figure C-5.

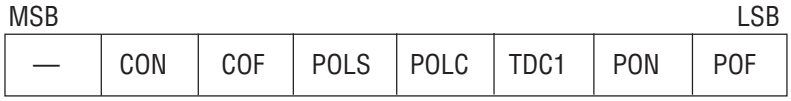


Figure C-5: Format in which low order 7 bits of attribute data 2 is stored.

(f) Option Data

Option Data is stored to 0B00h of a Mask Option file. Option Data is data that indicates the built-in/ external of a capacitor for oscillation (CG.) of a crystal oscillator.

Table C-6 shows the reference table to create Option Data.

Table C-6: Option Data table

Crystal Oscillator	CG.
Capacitor for Oscillation (CG.) External	0
Capacitor for Oscillation (CG.) Built-in	1

Option Data is stored to a Mask Option file in the format shown in Figure C-6.

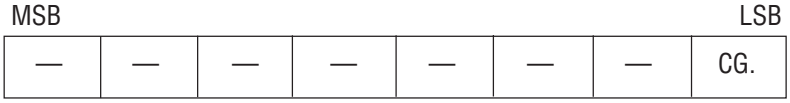


Figure C-6: Format in which Option Data is stored.