EPSON

CMOS 4-BIT SINGLE CHIP MICROCOMPUTER **E0C6008**

DEVELOPMENT TOOL MANUAL

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E0C6008 Development Tool Manual

PREFACE

This manual mainly explains the outline of the development support tool for the 4-bit Single Chip Micro-computer E0C6008.

Refer to the "E0C62 Family Development Tool Reference Manual" for the details (common to all models) of each development support tool. Manuals for hardware development tools are separate, so you should also refer to the below manuals.

Development tools	☞	E0C62 Family Development Tool Reference Manual
		EVA6008 Manual
		ICE62R (ICE6200) Hardware Manual
Development procedure	☞	E0C62 Family Technical Guide
Device (E0C6008)	☞	E0C6008 Technical Manual
Instructions	☞	E0C6200/6200A Core CPU Manual

CONTENTS

1 COMPOSITION OF DEVELOPMENT SUPPORT TOOL

Here we will explain the composition of the software for the development support tools, developmental envilonment and how to generate the execution disk.

1.1 Configuration of DEV6008

The below software are included in the product of the E0C6008 development support tool DEV6008.

1. Cross Assembler ASM6008 .... Cross assembler for program preparation
2. Function Option Generator FOG6008 .... Function option data preparation program
3. Segment Option Generator SOG6008 .... Segment option data preparation program
4. ICE Control Software ICS6008 .... ICE control program
5. Mask Data Checker MDC6008 .... Mask data preparation program

1.2 Developmental Environment

The software product of the development support tool DEV6008 operates on the following host systems:

- IBM PC/AT (at least PC-DOS Ver. 2.0)
- NEC PC-9801 Series (at least MS-DOS Ver. 3.1)

When developing the E0C6008, the above-mentioned host computer, editor, P-ROM writer, printer, etc. must be prepared by the user in addition to the development tool which is normally supported by Seiko Epson.
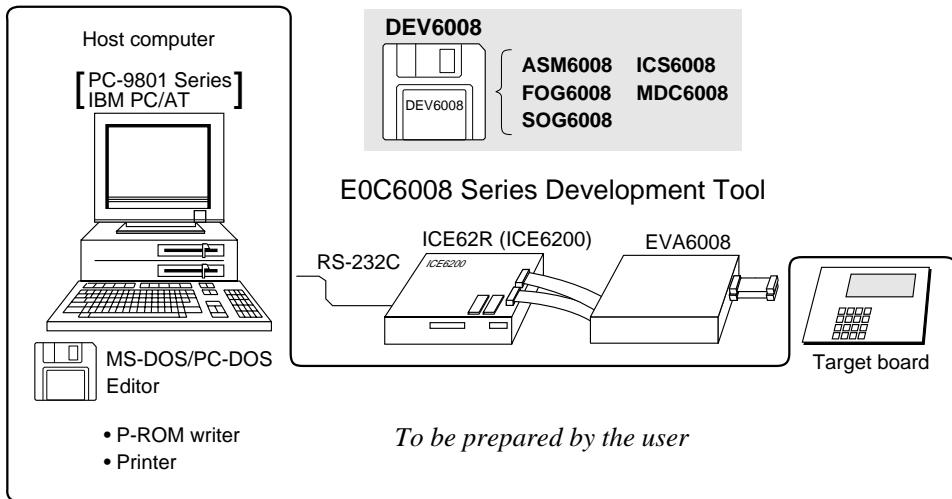
Fig. 1.2.1 System configuration

Note   The DEV6008 system requires a host computer with a RAM capacity of about 140K bytes.
        Since the ICE62R (ICE6200) is connected to the host computer with a RS-232C serial interface,
        adapter board for asynchronous communication will be required depending on the host computer
        used.

1.3 Development Flow

Figure 1.3.1 shows the development flow through the DEV6008.
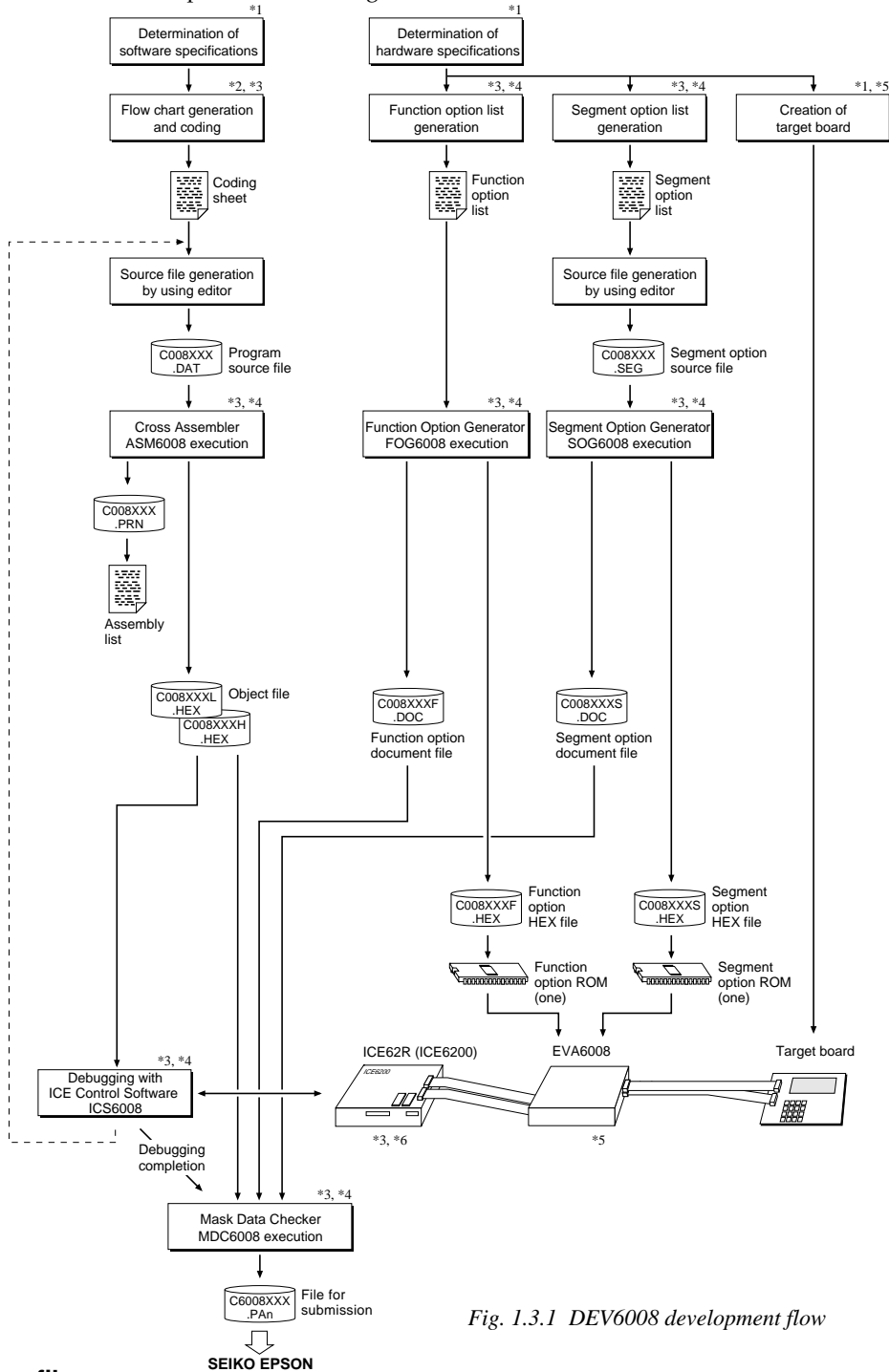
Fig. 1.3.1 DEV6008 development flow

Concerning file names

All the input-output file name for the each development support tool commonly use "C008XXX". In principle each file should be produced in this manner. Seiko Epson will designate the "XXX" for each customer.

☞ Reference Manual

*1 E0C6008 Technical Hardware Manual	*4 E0C6008 Development Tool Manual (this manual)
*2 E0C6200/6200A Core CPU Manual	*5 EVA6008 Manual
*3 E0C62 Family Development Tool Reference Manual	*6 ICE62R (ICE6200) Hardware Manual

1.4   Production of Execution Disk

Execution files for each software development support tool and batch and parameter files for the ICE62R (ICE6200) are recorded in the DEV6008 floppy disk.
The content of the files contained in the DEV6008 floppy disk are shown below.

PC-DOS version	MS-DOS version	Contents
ASM6008.EXE	ASM6008.EXE	Cross Assembler execution file
FOG6008.EXE	FOG6008.EXE	Function Option Generator execution file
ICS6008.BAT	ICS6008.BAT	ICE Control Software batch file
ICS6008W.EXE	ICS6008J.EXE	ICE Control Software execution file
ICS6008P.PAR	ICS6008P.PAR	ICE Control Software parameter file
MDC6008.EXE	MDC6008.EXE	Mask Data Checker execution file
SOG6008.EXE	SOG6008.EXE	Segment Option Generator execution file

■ First copy the entire content of this disk using commands such as DISKCOPY then make the execution disk. Carefully conserve the original floppy disk for storage purposes.
When copying into a hard disk, make a sub-directory with an appropriate name (DEV6008, etc.) then copy the content of the floppy disk into that subdirectory using the COPY command.

■ Next make a CONFIG.SYS file using Editor or the like.
When a CONFIG.SYS has previously been made using a hard disk system, check the setting of the FILES within it. (If there is none add it.) Set the number of files to be described in CONFIG.SYS at 10 or more, so that the Mask Data Checker MDC6008 will handle many files.

Note   *The driver for the RS-232C must be included in CONFIG.SYS by the host computer.*

■ In "ICS6008.BAT" the batch process is indicated such that the ICS6008J(W).EXE is executed after the execution of the command for the setting of the RS-232C communication parameters.
The SPEED (MS-DOS) or MODE (PC-DOS) command is used for setting the RS-232C, so you should copy these commands into the disk to be executed or specify a disk or directory with the command using the PATH command.

Example:
   Copying into a floppy disk
   Insert the original disk into the A drive and the formatted disk to be copied into B drive, then execute the DISKCOPY command.

   A>DISKCOPY A: B: ⏎

   Copying into a hard disk (C drive)
   Make a subdirectory (DEV6008), then insert the original disk into the A drive and execute the COPY command.

   C\>MD DEV6008 ⏎
   C\>CD DEV6008 ⏎
   C\DEV6008\>COPY A:*.* ⏎

Example:
   Setting of FILES (CONFIG.SYS)
   C\>TYPE CONFIG.SYS ⏎
         :
   FILES=20
         :

RS-232C Setting (PC-DOS version)
   MODE COM1: 9600, n, 8, 1, p

RS-232C Setting (MS-DOS version)
   SPEED R0 9600 B8 PN S1

2 CROSS ASSEMBLER ASM6008

2.1 ASM6008 Outline

The ASM6008 cross assembler is an assembler program for generating the machine code used by the E0C6008 4-bit, single-chip microcomputers. The Cross Assembler ASM6008 will assemble the program source files which have been input by the user's editor and will generate an object file in Intel-Hex format and assembly list file. In this assembler, program modularization has been made possible through macro definition functions and programming independent of the ROM page structure has been made possible through the auto page set function. In addition, consideration has also been given to precise error checks for program capacity (ROM capacity) overflows, undefined codes and the like, and for debugging of such things as label tables for assembly list files and cross reference table supplements.

```
A>EDLIN C008XXX.DAT
Create the source file
        ↓
   C008XXX
    .DAT
        ↓
A>ASM6008 C008XXX
Execute the cross assembler
```

Error message → Error message

C008XXX .PRN — Assembly listing file

C008XXXL .HEX   C008XXXH .HEX — Object file
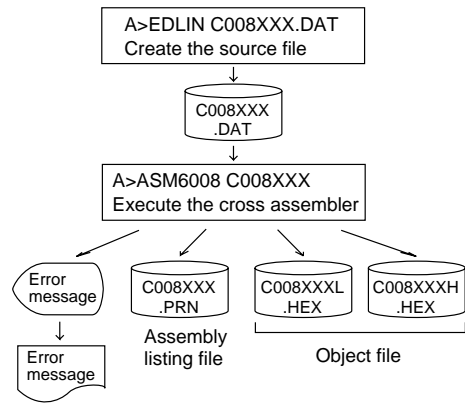
Fig. 2.1.1 ASM6008 execution flow

☞ *The format of the source file and its operating method are same as for the E0C62 Family. Refer to the "E0C62 Family Development Tool Reference Manual" for details.*

2.2 E0C6008 Restrictions

Note the following when generating a program by the E0C6008:

■ ROM area

The capacity of the E0C6008 ROM is 4k steps (0000H to 0FFFH).
Therefore, the specification range of the memory setting pseudo-instructions and PSET instruction is restricted.

Memory configuration:
  Bank: Only bank 0, Page: 16 pages (0 to 0FH), each 256 steps

Significant specification range:

ORG	pseudo-instruction:	0000H to 0FFFH
PAGE	pseudo-instruction:	00H to 0FH
BANK	pseudo-instruction:	Only 0H
PSET	instruction:	00H to 0FH

■ RAM area

The capacity of the E0C6008 RAM is 832 words (000H to 3FFH, 4 bits/word).
However, note the following points when programming.

(1) When 040H–06FH has been specified as the segment data memory through the mask option, 240H–2CFH and 2D1H–2DFH become unused areas. Memory access is invalid when this unused area is specified.

(2) When 240H–26FH has been specified as the segment data memory through the mask option, 270H–2CFH and 2D1H–2DFH become unused areas. Memory access is invalid when this unused area is specified.

(3) Since RAM is set for up to 4 pages, only the subordinate 2 bits of the page section of the index register which specifies address are effective. (The 2 superordinate bits are ignored.)

Example:
```
LD   A,04H
LD   XP,A
LD   X,9FH
```
49FH is loaded into the IX register, but an unused area has been specified so that the memory accessible with the IX register (MX) is invalid.

■ Undefined codes

The SLP instruction has not been defined in the E0C6008 instruction sets.

2.3   ASM6008 Quick Reference

■ Starting command and input/output files

_ indicates a blank.

⏎ indicates the Return key.
A parameter enclosed by [ ] can be omitted.

Execution file:	ASM6008.EXE	
Starting command:	**ASM6008_ [drive-name:] source-file-name [.shp]_ [-N]⏎**	
Option:	.shp	Specifies the file I/O drives.
	s	Specifies the drive from which the source file is to be input. (A–P, @)
	h	Specifies the drive to which the object file is to be output. (A–P, @, Z)
	p	Specifies the drive to which the assembly listing file is to be output. (A–P, @, Z)
		@: Current drive, Z: File is not generated
	-N	The code (FFH) in the undefined area of program memory is not created.
Input file:	C008XXX.DAT	(Source file)
Output file:	C008XXXL.HEX	(Object file, low-order)
	C008XXXH.HEX	(Object file, high-order)
	C008XXX.PRN	(Assembly listing file)

■ Display example

```
       *** E0C6008 CROSS ASSEMBLER. --- Ver 1.00 ***

EEEEEEEEE    PPPPPPPP      SSSSSSS    OOOOOOO    NNN      NNN
EEEEEEEEE    PPPPPPPPPP   SSS  SSSS   OOO   OOO  NNNN     NNN
EEE          PPP    PPP   SSS   SSS   OOO   OOO  NNNNN    NNN
EEE          PPP    PPP   SSS         OOO   OOO  NNNNNN   NNN
EEEEEEEEE    PPPPPPPPPP    SSSSSS     OOO   OOO  NNN NNN  NNN
EEEEEEEEE    PPPPPPPP        SSSS     OOO   OOO  NNN  NNNNNNN
EEE          PPP             SSS      OOO   OOO  NNN   NNNNN
EEE          PPP         SSS   SSS    OOO   OOO  NNN    NNNN
EEEEEEEEE    PPP         SSSS  SSS    OOO   OOO  NNN     NNN
EEEEEEEEE    PPP          SSSSSSS     OOOOOOO    NNN      NN

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     SOURCE FILE NAME IS " C008XXX.DAT "

     THIS SOFTWARE MAKES NEXT FILES.

         C008XXXH.HEX  ...  HIGH BYTE OBJECT FILE.
         C008XXXL.HEX  ...  LOW BYTE OBJECT FILE.
         C008XXX .PRN  ...  ASSEMBLY LIST FILE.

DO YOU NEED AUTO PAGE SET? (Y/N) Y                    ...(1)

DO YOU NEED CROSS REFERENCE TABLE? (Y/N) Y            ...(2)
```

When ASM6008 is started, the start-up message is displayed.
At (1), select whether or not the auto-page-set function will be used.

Use .... Y⏎
Not use .... N⏎

If the assembly listing file output is specified, message (2) is displayed. At this stage, cross-reference table generation may be selected.

Generating .... Y⏎
Not generating ...... N⏎

When the above operation is completed, ASM6008 assembles the source file.
To suspend execution, press the "CTRL" and "C" keys together at stage (1) or (2).

■ Operators

Arithmetic operators		Logical operators	
+a	Monadic positive	a_AND_b	Logical product
-a	Monadic negative	a_OR_b	Logical sum
a+b	Addition	a_XOR_b	Exclusive logical sum
a-b	Subtraction	NOT_a	Logical negation
a*b	Multiplication	**Relational operators**	
a/b	Division	a_EQ_b	True when a is equal to b
a_MOD_b	Remainder of a/b	a_NE_b	True when a is not equal to b
a_SHL_b	Shifts a b bits to the left	a_LT_b	True when a is less than b
a_SHR_b	Shifts a b bits to the right	a_LE_b	True when a is less than or equal to b
HIGH_a	Separates the high-order eight bits from a	a_GT_b	True when a is greater than b
LOW_a	Separates the low-order eight bits from a	a_GE_b	True when a is greater than or equal to b

■ Pseudo-instructions

Pseudo-instruction		Meaning	Example of Use		
EQU	(Equation)	To allocate data to label	ABC	EQU	9
			BCD	EQU	ABC+1
SET	(Set)	To allocate data to label (data can be changed)	ABC	SET	0001H
			ABC	SET	0002H
DW	(Define Word)	To define ROM data	ABC	DW	'AB'
			BCD	DW	0FFBH
ORG	(Origin)	To define location counter		ORG	100H
				ORG	256
PAGE	(Page)	To define boundary of page		PAGE	1H
				PAGE	3
SECTION	(Section)	To define boundary of section		SECTION	
END	(End)	To terminate assembly		END	
MACRO	(Macro)	To define macro	CHECK	MACRO	DATA
			LOCAL	LOOP	
LOCAL	(Local)	To make local specification of label during macro definition	LOOP	CP	MX,DATA
				JP	NZ,LOOP
				ENDM	
ENDM	(End Macro)	To end macro definition		CHECK	1

■ Error messages

Error message		Explanation
S	(Syntax Error)	An unrecoverable syntax error was encountered.
U	(Undefined Error)	The label or symbol of the operand has not been defined.
M	(Missing Label)	The label field has been omitted.
O	(Operand Error)	A syntax error was encountered in the operand, or the operand could not be evaluated.
P	(Phase Error)	The same label or symbol was defined more than once.
R	(Range Error)	• The location counter value exceeded the upper limit of the program memory, or a location exceeding the upper limit was specified. • A value greater than that which the number of significant digits of the operand will accommodate was specified.
!	(Warning)	• Memory areas overlapped because of a "PAGE" or "ORG" pseudo-instruction or both.
FILE NAME ERROR		The source file name was longer than 8 characters.
FILE NOT PRESENT		The specified source file was not found.
DIRECTORY FULL		No space was left in the directory of the specified disk.
FATAL DISK WRITE ERROR		The file could not be written to the disk.
LABEL TABLE OVERFLOW		The number of defined labels and symbols exceeded the label table capacity (4000).
CROSS REFERENCE TABLE OVERFLOW		The label/symbol reference count exceeded the cross-reference table capacity (only when the cross-reference table is generated).

3   *FUNCTION OPTION GENERATOR FOG6008*

3.1   *FOG6008 Outline*

With the 4-bit single-chip E0C6008 microcomputers, the customer may select 19 hardware options. By modifying the mask patterns of the E0C6008 according to the selected options, the system can be customized to meet the specifications of the target system.

The Function Option Generator FOG6008 is a software tool for generating data files used to generate mask patterns. It enables the customer to interactively select and specify pertinent items for each hardware option. From the data file created with FOG6008, the E0C6008 mask pattern is automatically generated by a general purpose computer. The HEX file for the evaluation board (EVA6008) hardware option ROM is simultaneously generated with the data file.

☞   *The operating method is same as for the E0C62 Family. Refer to the "E0C62 Family Development Tool Reference Manual" for details.*
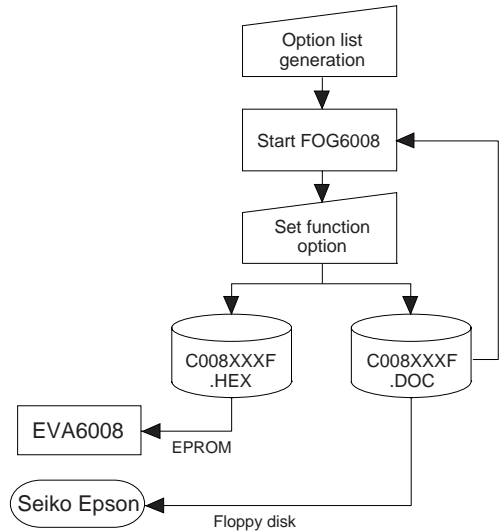
Fig. 3.1.1 FOG6008 execution flow

Note: When creating option files, please make a function option file (C008xxxF.DOC) before making a segment option file (C008xxxS.DOC).

3.2   *E0C6008 Option List*

Multiple specifications are available in each option item as indicated in the Option List. Using "3.3 Option Specifications and Selection Message" as reference, select the specifications that meet the target system. Be sure to record the specifications for unused ports too, according to the instructions provided.

1. DEVICE TYPE
- DEVICE TYPE .... ☐ 1. E0C6008   (Normal Type)
  ☐ 2. E0C60L08   (Low Power Type)
  ☐ 3. E0C60A08   (Twin Clock Type)
- CLOCK TYPE (for EVA) .... ☐ 1. 32 kHz   ☐ 2. 38 kHz

2. OSC3 SYSTEM CLOCK (only for E0C60A08)
  ☐ 1. CR   ☐ 2. Ceramic

3. MULTIPLE KEY ENTRY RESET
- COMBINATION .... ☐ 1. Not Use
  ☐ 2. Use K00, K01
  ☐ 3. Use K00, K01, K02
  ☐ 4. Use K00, K01, K02, K03
- TIME AUTHORIZE .... ☐ 1. Use   ☐ 2. Not Use

4. WATCHDOG TIMER
  ☐ 1. Use   ☐ 2. Not Use

5. INPUT INTERRUPT NOISE REJECTOR
- K00–K03 .... ☐ 1. Use   ☐ 2. Not Use
- K10 .... ☐ 1. Use   ☐ 2. Not Use
- K20–K23 .... ☐ 1. Use   ☐ 2. Not Use

6. INPUT PORT PULL DOWN RESISTOR
- K00 .... ☐ 1. With Resistor   ☐ 2. Gate Direct
- K01 .... ☐ 1. With Resistor   ☐ 2. Gate Direct
- K02 .... ☐ 1. With Resistor   ☐ 2. Gate Direct
- K03 .... ☐ 1. With Resistor   ☐ 2. Gate Direct
- K10 .... ☐ 1. With Resistor   ☐ 2. Gate Direct
- K20 .... ☐ 1. With Resistor   ☐ 2. Gate Direct
- K21 .... ☐ 1. With Resistor   ☐ 2. Gate Direct
- K22 .... ☐ 1. With Resistor   ☐ 2. Gate Direct
- K23 .... ☐ 1. With Resistor   ☐ 2. Gate Direct

7. OUTPUT PORT SPECIFICATION (R00–R03)
- R00 .... ☐ 1. Complementary   ☐ 2. Pch-OpenDrain
- R01 .... ☐ 1. Complementary   ☐ 2. Pch-OpenDrain
- R02 .... ☐ 1. Complementary   ☐ 2. Pch-OpenDrain
- R03 .... ☐ 1. Complementary   ☐ 2. Pch-OpenDrain

8. R10 SPECIFICATION
- OUTPUT SPECIFICATION .... ☐ 1. Complementary   ☐ 2. Pch-OpenDrain
- OUTPUT TYPE .... ☐ 1. DC Output   ☐ 2. Buzzer Output

9. R11 SPECIFICATION
- OUTPUT SPECIFICATION .... ☐ 1. Complementary   ☐ 2. Pch-OpenDrain
- OUTPUT TYPE .... ☐ 1. DC Output   ☐ 2. SIO Flag

10. R12 SPECIFICATION
- OUTPUT SPECIFICATION .... ☐ 1. Complementary   ☐ 2. Pch-OpenDrain
- OUTPUT TYPE .... ☐ 1. DC Output
  ☐ 2. FOUT   32768 or 38400 [Hz]
  ☐ 3. FOUT   16384 or 19200 [Hz]
  ☐ 4. FOUT   8192 or 9600 [Hz]
  ☐ 5. FOUT   4096 or 4800 [Hz]
  ☐ 6. FOUT   2048 or 2400 [Hz]
  ☐ 7. FOUT   1024 or 1200 [Hz]
  ☐ 8. FOUT   512 or 600 [Hz]
  ☐ 9. FOUT   256 or 300 [Hz]

11. R13 SPECIFICATION
- OUTPUT SPECIFICATION .... ☐ 1. Complementary   ☐ 2. Pch-OpenDrain
- OUTPUT TYPE .... ☐ 1. DC Output
  ☐ 2. Buzzer Inverted Output (R13 Control)
  ☐ 3. Buzzer Inverted Output (R10 Control)

12. I/O PORT SPECIFICATION
- P00 .... ☐ 1. Complementary   ☐ 2. Pch-OpenDrain
- P01 .... ☐ 1. Complementary   ☐ 2. Pch-OpenDrain
- P02 .... ☐ 1. Complementary   ☐ 2. Pch-OpenDrain
- P03 .... ☐ 1. Complementary   ☐ 2. Pch-OpenDrain
- P10 .... ☐ 1. Complementary   ☐ 2. Pch-OpenDrain
- P11 .... ☐ 1. Complementary   ☐ 2. Pch-OpenDrain
- P12 .... ☐ 1. Complementary   ☐ 2. Pch-OpenDrain
- P13 .... ☐ 1. Complementary   ☐ 2. Pch-OpenDrain

13. SIN PULL DOWN RESISTOR
☐ 1. With Resistor   ☐ 2. Gate Direct

14. SOUT SPECIFICATION
☐ 1. Complementary   ☐ 2. Pch-OpenDrain

15. SCLK SPECIFICATION
- PULL DOWN RESISTOR .... ☐ 1. With Resistor ☐ 2. Gate Direct
- OUTPUT SPECIFICATION .... ☐ 1. Complementary ☐ 2. Pch-OpenDrain
- LOGIC .... ☐ 1. Positive ☐ 2. Negative

16. SIO DATA PERMUTATION
☐ 1. MSB First ☐ 2. LSB First

17. EVENT COUNTER NOISE REJECTOR
☐ 1. 2048 or 2400 [Hz] ☐ 2. 256 or 300 [Hz]

18. LCD SPECIFICATION
- BIAS SELECTION

  E0C6008 .... ☐ 1. 1/3 Bias, Regulator Used, LCD 3 V
  ☐ 2. 1/3 Bias, Regulator Not Used, LCD 3 V
  ☐ 3. 1/2 Bias, Regulator Not Used, LCD 3 V
  ☐ 4. 1/3 Bias, Regulator Not Used, LCD 4.5 V

  E0C60L08 .... ☐ 1. 1/3 Bias, Regulator Used, LCD 3 V
  ☐ 2. 1/2 Bias, Regulator Not Used, LCD 3 V
  ☐ 3. 1/3 Bias, Regulator Not Used, LCD 4.5 V

  E0C60A08 .... ☐ 1. 1/3 Bias, Regulator Used, LCD 3 V
  ☐ 2. 1/3 Bias, Regulator Not Used, LCD 3 V
  ☐ 3. 1/2 Bias, Regulator Not Used, LCD 3 V
  ☐ 4. 1/3 Bias, Regulator Not Used, LCD 4.5 V

- DUTY SELECTION .... ☐ 1. 1/4 Duty
  ☐ 2. 1/3 Duty
  ☐ 3. 1/2 Duty

19. SEGMENT MEMORY ADDRESS
☐ 1. 0 Page (040–06F)
☐ 2. 2 Page (240–26F)

3.3 Option Specifications and Selection Message

Screen that can be selected as function options set on the E0C6008 are shown below, and their specifications are also described.

1 Device type

```
*** OPTION   NO.1 ***
--- DEVICE TYPE ---
      DEVICE TYPE
                    1. E0C6008
                    2. E0C60L08
                    3. E0C60A08

PLEASE SELECT NO.(1) ? 3↵

      DEVICE TYPE    3. E0C60A08 SELECTED
```

Select the chip specification.
E0C6008, E0C60L08 and E0C60A08 denote 3 V power source voltage specification, LOW POWER specification for 1.5 V power source voltage, and TWIN CLOCK specification, respectively.
When E0C6008 or E0C60L08 is selected, OSC3 oscillation circuit is fixed at CR oscillation. However, it can not be used.

Crystal selection for EVA6008

```
--- CLOCK TYPE ---
      CLOCK TYPE
                    1. 32KHZ
                    2. 38KHZ

PLEASE SELECT NO.(1) ? 1↵

      CLOCK TYPE     1. 32KHZ  SELECTED
```

Select the OSC1 clock frequency (crystal) for the EVA6008.
Either 32.768 kHz or 38.4 kHz can be selected.

2 OSC3 system clock

```
*** OPTION   NO.2 ***
--- OSC3 SYSTEM CLOCK ---
      OSC3 SYSTEM CLOCK
                    1. CR
                    2. CERAMIC

PLEASE SELECT NO.(1) ? 1↵

 OSC3 SYSTEM CLOCK    1. CR  SELECTED
```

* The above selection is only possible with 60A08.

Select an oscillator type for the OSC3 oscillation circuit.
To minimize external components, CR oscillation circuit would be suitable; to obtain a stable oscillation frequency, ceramic oscillation circuit would be suitable. When CR oscillation circuit is selected, only a resistor is needed as a external component since a capacitor is built-in.
On the other hand, when ceramic oscillation circuit is selected, a ceramic oscillator, a gate capacitor and a drain capacitor are needed as external components. When ceramic oscillation circuit is selected, the oscillation frequency is fixed at 500 kHz; when CR oscillation circuit is selected, it may be adjusted to a certain extent depending on the external resistor.

3 Multiple key entry reset

```
*** OPTION   NO.3 ***
--- MULTIPLE KEY ENTRY RESET ---
      COMBINATION
                    1. NOT USE
                    2. USE K00,K01
                    3. USE K00,K01,K02
                    4. USE K00,K01,K02,K03

PLEASE SELECT NO.(1) ? 2↵

      TIME AUTHORIZE
                    1. USE
                    2. NOT USE

PLEASE SELECT NO.(1) ? 1↵

      COMBINATION    2. USE K00,K01  SELECTED
      AUTHORIZE      1. USE  SELECTED
```

The reset function when K00 through K03 are entered and the time authorize circuit are configured.
When "NOT USE" is set for the combination, the reset function is not activated even if K00 through K03 are entered. When "USE K00, K01" is set, the system is reset immediately the K00 and K01 inputs go high at the same time. Similarly, the system is reset as soon as the K00 through K02 inputs or the K00 through K03 inputs go high.
When "USE" is set for the time authorize circuit, a simultaneous high input time is authorized. The system is reset when a signal is input for more than 1 to 3 sec.
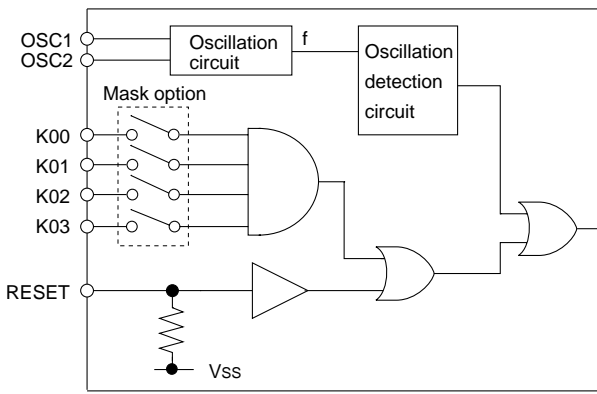
If the time authorize circuit is not used, the system is reset when a high signal is input for more than 6 msec.

*   If "NOT USE" is set for the combination, the time authorize selection is required.

The system reset circuit is shown in Figure 3.3.1.

Fig. 3.3.1 System reset circuit

4 Watchdog timer

```
*** OPTION  NO.4 ***
--- WATCHDOG TIMER ---
        WATCHDOG TIMER
                        1. USE
                        2. NOT USE

PLEASE SELECT NO.(1) ? 1↵

        WATCHDOG TIMER   1. USE  SELECTED
```

Select whether the watchdog timer built-in to detect CPU runaways will be used or not.
When the watchdog timer is not reset by the program within 3 to 4 second cycles, the CPU is initially reset.

5 Input interrupt noise rejector

```
*** OPTION  NO.5 ***
--- I/P INTERRUPUT NOISE REJECTOR ---
        K00-K03
                        1. USE
                        2. NOT USE

PLEASE SELECT NO.(1) ? 1↵

        K10
                        1. USE
                        2. NOT USE

PLEASE SELECT NO.(1) ? 1↵

        K20-K23
                        1. USE
                        2. NOT USE

PLEASE SELECT NO.(1) ? 1↵

        K00-K03   1. USE  SELECTED
        K10       1. USE  SELECTED
        K20-K23   1. USE  SELECTED
```

Select whether noise rejector will be supplemented to the input interruptor of K00–K03, K10 and K20–K23.
When "USE" is selected, the entry signal will pass the noise rejector, and occurrence of interrupt errors due to noise or chattering can be avoided. Note, however, that because the noise rejector performs entry signal sampling at 4 kHz, "NOT USE" should be selected when high speed response is required.

6 Input port pull down resistor

```
*** OPTION  NO.6 ***
--- I/P PORT PULL DOWN RESISTOR ---
        K00
                        1. WITH RESISTOR
                        2. GATE DIRECT

PLEASE SELECT NO.(1) ? 1⏎

                      :
            (Selection for K01–K03 and K10)
                      :

PLEASE SELECT NO.(1) ? 1⏎

        K20
                        1. WITH RESISTOR
                        2. GATE DIRECT

PLEASE SELECT NO.(1) ? 2⏎

                      :
              (Selection for K21–K23)
                      :

PLEASE SELECT NO.(1) ? 2⏎

        K00   1. WITH RESISTOR  SELECTED
        K01   1. WITH RESISTOR  SELECTED
        K02   1. WITH RESISTOR  SELECTED
        K03   1. WITH RESISTOR  SELECTED
        K10   1. WITH RESISTOR  SELECTED
        K20   2. GATE DIRECT  SELECTED
        K21   2. GATE DIRECT  SELECTED
        K22   2. GATE DIRECT  SELECTED
        K23   2. GATE DIRECT  SELECTED
```

Select whether input ports (K00–K03, K10 and K20–K23) will each be supplemented with pull down resistors or not. When "GATE DIRECT" is selected, see to it that entry floating state does not occur. Select "WITH RESISTOR" pull down resistor for unused ports.

Moreover, the input port status is changed from high level (VDD) to low (VSS) with pull down resistors, a delay of approximately 1 msec in waveform rise time will occur depending on the pull down resistor and entry load time constant. Because of this, when input reading is to be conducted, ensure the appropriate wait time with the program.

The configuration of the pull down resistor circuit is shown in Figure 3.3.2.
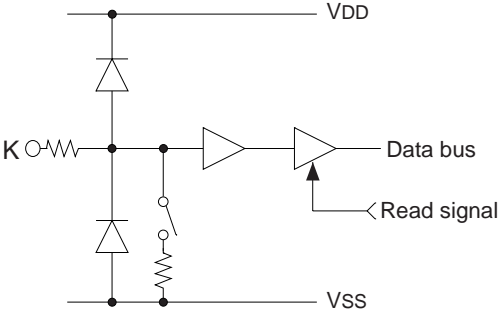

Fig. 3.3.2 Configuration of pull down resistor

7 Output port output specification (R00–R03)

```
*** OPTION  NO.7 ***
--- O/P OUTPUT SPEC. (R00-R03) ---
        R00
                        1. COMPLEMENTARY
                        2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 1⏎

        R01
                        1. COMPLEMENTARY
                        2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 1⏎

        R02
                        1. COMPLEMENTARY
                        2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 2⏎

        R03
                        1. COMPLEMENTARY
                        2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 2⏎

        R00   1. COMPLEMENTARY  SELECTED
        R01   1. COMPLEMENTARY  SELECTED
        R02   2. P-CH OPEN DRAIN  SELECTED
        R03   2. P-CH OPEN DRAIN  SELECTED
```

Select the output specification for the output ports (R00–R03).

Either complementary output or Pch open drain output may be selected.

When output port is to be used on key matrix configuration, select Pch open drain output.

For unused output ports, select complementary output.

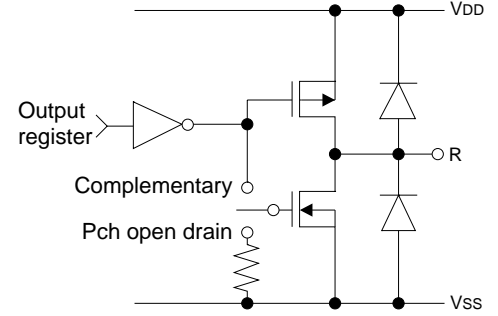The output circuit configuration is shown in Figure 3.3.3.

Fig. 3.3.3 Configuration of output circuit

8 R10 specification

```
*** OPTION  NO.8 ***
--- R10 SPECIFICATION ---
       OUTPUT SPECIFICATION
                        1. COMPLEMENTARY
                        2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 1⏎

       OUTPUT TYPE
                        1. DC OUTPUT
                        2. BUZZER OUTPUT

PLEASE SELECT NO.(1) ? 2⏎

OUTPUT SPECIFICATION 1. COMPLEMENTARY  SELECTED
OUTPUT TYPE          2. BUZZER  SELECTED
```

Select the output specification for the R10 terminal.
Either complementary output or Pch open drain output may be selected.
When DC output is selected, R10 becomes a regular output port. When buzzer output is selected, by writing "1" to the R10 register, buzzer drive (oscillation output) signal is output from the R10 terminal.

*   When DC output is selected, the R13 terminal output type (see Option 11, "R13 specification") selection is limited to DC output only.

The circuit configuration is the same as those of the output ports R00–R03 (Figure 3.3.3).
Refer to Figure 3.3.6 for the buzzer output waveform.

9 R11 specification

```
*** OPTION  NO.9 ***
--- R11 SPECIFICATION ---
       OUTPUT SPECIFICATION
                        1. COMPLEMENTARY
                        2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 1⏎

       OUTPUT TYPE
                        1. DC OUTPUT
                        2. SIO FLAG

PLEASE SELECT NO.(1) ? 2⏎

OUTPUT SPECIFICATION 1. COMPLEMENTARY  SELECTED
OUTPUT TYPE          2. SIO FLAG  SELECTED
```

Select the output specification for the R11 terminal.
Either complementary output or Pch open drain output may be selected.
When DC output is selected, R11 becomes a regular output port. When SIO flag is selected, a signal indicating the SIO operation status (RUN/STOP) is generated from the R11 terminal.
The circuit configuration is the same as those of the output ports R00–R03 (Figure 3.3.3).

10 R12 specification

```
*** OPTION  NO.10 ***
--- R12 SPECIFICATION ---
       OUTPUT SPECIFICATION
                        1. COMPLEMENTARY
                        2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 1⏎

       OUTPUT TYPE
                        1. DC OUTPUT
                        2. FOUT 32768 OR 38400 HZ
                        3. FOUT 16384 OR 19200 HZ
                        4. FOUT  8192 OR  9600 HZ
                        5. FOUT  4096 OR  4800 HZ
                        6. FOUT  2048 OR  2400 HZ
                        7. FOUT  1024 OR  1200 HZ
                        8. FOUT   512 OR   600 HZ
                        9. FOUT   256 OR   300 HZ

PLEASE SELECT NO.(1) ? 2⏎

OUTPUT SPECIFICATION 1. COMPLEMENTARY  SELECTED
OUTPUT TYPE          2. FOUT 32768 OR 38400 HZ  SELECTED
```

Select the output specification for the R12 terminal.
Either complementary output or Pch open drain output may be selected.
When DC output is selected, R12 becomes a regular output port. When FOUT is selected, clock with frequency selected from the R12 terminal is generated by writing "1" to the R12 register.

*   When DC output is selected
    When the R12 register is set to "1", the R12 terminal output goes high (V_{DD}), and goes low (V_{SS}) when set to "0".
    Output waveform is shown in Figure 3.3.4.

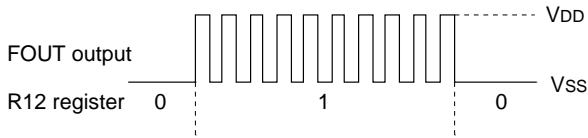
Fig. 3.3.4 Output waveform at DC output selection

Fig. 3.3.5 Output waveform at R12 FOUT output selection

• When FOUT output is selected
  When FOUT bit (R12 register) is set to "1", 50% duty and V_{DD}–V_{SS} amplitude square wave is generated at the specified frequency. When set to "0", the FOUT terminal goes low (V_{SS}).
  A FOUT frequency may be selected from among 8 types, ranging from 256 or 300 Hz to 32,768 or 38,400 Hz.
  FOUT output is normally utilized to provide clock to other devices but since hazard occurs at the square wave breaks, great caution must be observed when using it. Output waveform is shown in Figure 3.3.5.

11 R13 specification

```
*** OPTION  NO.11 ***
--- R13 SPECIFICATION ---
      OUTPUT SPECIFICATION
                      1. COMPLEMENTARY
                      2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 1↵

      OUTPUT TYPE
                      1. DC OUTPUT
                      2. BUZZER INVERTED O/P(R13)
                      3. BUZZER INVERTED O/P(R10)

PLEASE SELECT NO.(1) ? 2↵

OUTPUT SPECIFICATION 1. COMPLEMENTARY  SELECTED
OUTPUT TYPE          2. BUZZER INVERTED O/P(R13)  SELECTED
```

Select the output specification for the R13 terminal.
Either complementary output or Pch open drain output may be selected.
When DC output is selected, R13 becomes a regular output port. When "BUZZER INVERTED OUTPUT" is selected, inverted waveform of the R10 buzzer output is generated from the R13 terminal. The R13 and R10 control bits become buzzer inverted output when "1" is written to the R13 and R10 registers, respectively.

∗   The buzzer inverted output may not be selected when the R10 output type (see Option 8, "R10 specification") is not set to buzzer. Moreover, at this point, when the R10 output type is reselected after selecting buzzer inverted output, the R10 output type is fixed at buzzer output.
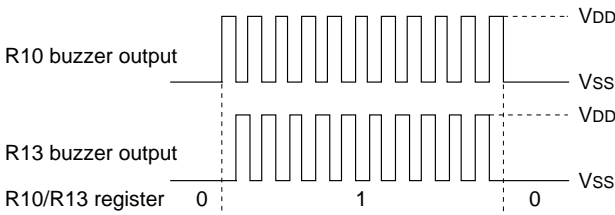
Buzzer output waveform is shown in Figure 3.3.6.

Fig. 3.3.6 Buzzer output waveform

12 I/O port specification

```
*** OPTION  NO.12 ***
--- I/O PORT SPECIFICATION ---
        P00
                        1. COMPLEMENTARY
                        2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 1↵

        P01
                        1. COMPLEMENTARY
                        2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 1↵

        P02
                        1. COMPLEMENTARY
                        2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 2↵

        P03
                        1. COMPLEMENTARY
                        2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 1↵

        P10
                        1. COMPLEMENTARY
                        2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 2↵

        P11
                        1. COMPLEMENTARY
                        2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 2↵

        P12
                        1. COMPLEMENTARY
                        2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 2↵

        P13
                        1. COMPLEMENTARY
                        2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 2↵

        P00   1. COMPLEMENTARY   SELECTED
        P01   1. COMPLEMENTARY   SELECTED
        P02   1. COMPLEMENTARY   SELECTED
        P03   1. COMPLEMENTARY   SELECTED
        P10   2. P-CH OPEN DRAIN   SELECTED
        P11   2. P-CH OPEN DRAIN   SELECTED
        P12   2. P-CH OPEN DRAIN   SELECTED
        P13   2. P-CH OPEN DRAIN   SELECTED
```

Select the output specification when the I/O ports (P00–P03 and P10–P13) are in output mode. Either complementary output or Pch open drain output may be selected.
The circuit configuration of the output driver is the same as those of the output ports R00–R03 (Figure 3.3.3).
Select complementary output for unused ports.

The I/O ports can control the input/output direction according to the IOC bit (2EEH•D0 and 2FEH•D0); at "1" and "0" settings, it is set to output port and input port, respectively.

The pull down resistor of this port is turned on by the read signal and is normally turned off to minimize leak current.
Because of this, when the port is set for input, take care that a floating state does not occur in the terminal.
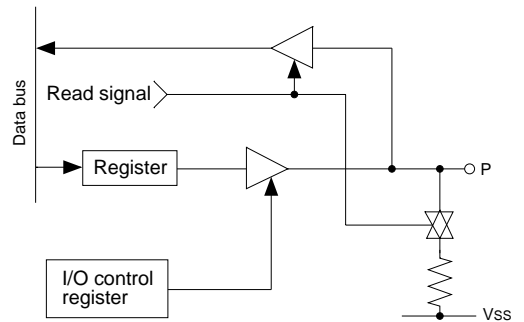The I/O port circuit configuration is shown in Figure 3.3.7.

Fig. 3.3.7 Circuit configuration of I/O port

13 SIN pull down resistor

```
*** OPTION  NO.13 ***
--- SIN PULL DOWN RESISTOR ---
        SIN PULL DOWN RESISTOR
                        1. WITH RESISTOR
                        2. GATE DIRECT

PLEASE SELECT NO.(1) ? 1↵

SIN PULL DOWN RESISTOR  1. WITH RESISTOR  SELECTED
```

Select whether pull down resistor will be supplemented to the SIN terminal (SIO data input terminal). When "GATE DIRECT" is selected, take care that input floating state does not occur. Select "WITH RESISTOR" if the SIN terminal will not be used.

14 SOUT specification

```
*** OPTION  NO.14 ***
--- SOUT SPECIFICATION ---
      SOUT SPECIFICATION
                    1. COMPLEMENTARY
                    2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 1⏎

SOUT SPECIFICATION     1. COMPLEMENTARY  SELECTED
```

Select the output specification for the SOUT terminal.
Either complementary output or Pch open drain output may be selected.
Select complementary output if the SOUT terminal will not be used.

15 SCLK specification

```
*** OPTION  NO.15 ***
--- SCLK SPECIFICATION ---
      SCLK PULL DOWN RESISTOR
                    1. WITH RESISTOR
                    2. GATE DIRECT

PLEASE SELECT NO.(1) ? 1⏎

      OUTPUT SPECIFICATION
                    1. COMPLEMENTARY
                    2. P-CH OPEN DRAIN

PLEASE SELECT NO.(1) ? 1⏎

      LOGIC
                    1. POSITIVE
                    2. NEGATIVE

PLEASE SELECT NO.(1) ? 1⏎

SCLK PULL DOWN RESISTOR  1. WITH RESISTOR  SELECTED
OUTPUT SPECIFICATION     1. COMPLEMENTARY  SELECTED
LOGIC                    1. POSITIVE  SELECTED
```

Select the pull down resistor, output specification and logic for the SCLK terminal (input/output terminal of the SIO synchronous clock).
Pull down resistor is only available when the clock mode is set at external clock mode.
Select with pull down resistor, complementary output, and positive logic it the SCLK terminal will not be used.
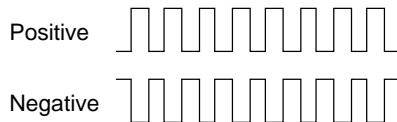The SCLK timing chart is shown in Figure 3.3.8.

Fig. 3.3.8 SCLK timing chart

16 SIO data permutation

```
*** OPTION  NO.16 ***
--- SIO DATA PERMUTATION ---
      SIO DATA PERMUTATION
                    1. MSB FIRST
                    2. LSB FIRST

PLEASE SELECT NO.(1) ? 1⏎

SIO DATA PERMUTATION    1. MSB FIRST  SELECTED
```

Select whether the SIO input/output (SIN or SOUT) data bit permutation will be MSB first or LSB first.
Select one suitable for your programming needs.
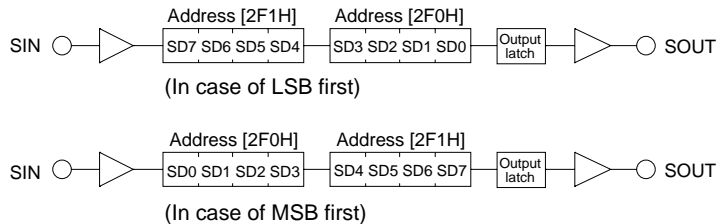Input/output data permutation is shown in Figure 3.3.9.

Fig. 3.3.9 Input/output data permutation

17 Event counter noise rejector

```
*** OPTION  NO.17 ***
--- EVENT COUNTER NOISE REJECTOR ---
      EVENT COUNTER NOISE REJECTOR
                    1. 2048 OR 2400 HZ
                    2. 256 OR 300 HZ

PLEASE SELECT NO.(1) ? 1⏎

EVENT COUNTER NOISE REJECTOR 1. 2048 OR 2400 HZ  SELECTED
```

The system is equipment with built-in noise rejector to prevent operational errors by the event counter caused by noise and chattering in the K02 and K03 terminals.
Either 2,048 (or 2,400) Hz or 256 (or 300) Hz may be selected as the sampling frequency.
Select one suitable for the input signal.

18 LCD specification

```
*** OPTION  NO.18 ***
--- LCD SPECIFICATION ---
       BIAS SELECTION
                    1. 1/3 B USE REGUL. LCD 3V
                    2. 1/3 B NOT USE REGUL. LCD 3V
                    3. 1/2 B NOT USE REGUL. LCD 3V
                    4. 1/3 B NOT USE REGUL. LCD 4.5V

PLEASE SELECT NO.(1) ? 1↵


       DUTY SELECTION
                    1. 1/4 DUTY
                    2. 1/3 DUTY
                    3. 1/2 DUTY

PLEASE SELECT NO.(1) ? 1↵

BIAS SELECTION    1. 1/3 B USE REGUL. LCD 3V   SELECTED
DUTY SELECTION    1. 1/4 DUTY  SELECTED
```
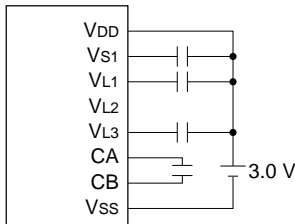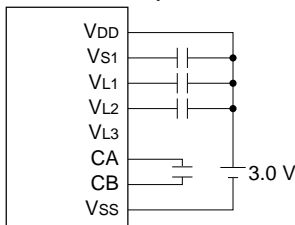
Select the common duty and bias.
When "1/3 B USE REGULATOR LCD 3V" is selected, the internal regulator is used. The internal regulator will generate V_{L1} (-1.05 V).
When "1/3 B NOT USE REGULATOR LCD 3V" is selected, the internal regulator is not used.
For the LCD drive bias, either 1/3 bias or 1/2 bias can be selected.
See Figure 3.3.10 for the external elements according to the bias to be selected.
When 1/2 duty is selected, up to 96 segments of LCD panel can be driven with 2 COM terminals and 48 SEG terminals. When 1/3 duty is selected, up to 144 segments can be driven with 3 COM terminals, and when 1/4 duty is selected, up to 192 segments with 4 COM terminals.
When 1/2 duty is selected, the COM0 and COM1 terminals are effective for COM output and the COM2 and COM3 terminals always output an off signal. When 1/3 duty is selected, the COM0 to COM2 terminals are effective and the COM3 terminal always outputs an off signal.
For drive duty selection, refer to Table 3.3.1.
Figures 3.3.11 and 3.3.12 show the drive wave-forms of 1/3 bias driving and 1/2 bias driving, respectively.

Table 3.3.1 Common duty selection standard

Number of segments	Common duty
1–96	1/2
97–144	1/3
145–192	1/4

4.5 V LCD panel
1/4, 1/3 or 1/2 duty, 1/3 bias

Note: V_{L2} is shorded to V_{SS} inside the IC

3 V LCD panel
1/4, 1/3 or 1/2 duty, 1/3 bias

3 V LCD panel
1/4, 1/3 or 1/2 duty, 1/2 bias

Note: V_{L3} is shorded to V_{SS} inside the IC

4.5 V LCD panel
1/4, 1/3 or 1/2 duty, 1/3 bias

3 V LCD panel
1/4, 1/3 or 1/2 duty, 1/2 bias
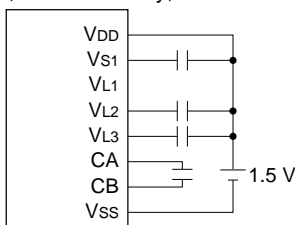
Note: V_{L1} is shorded to V_{SS} inside the IC
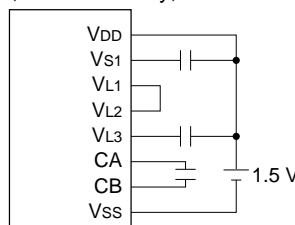
Fig. 3.3.10
External elements for LCD power supply circuit
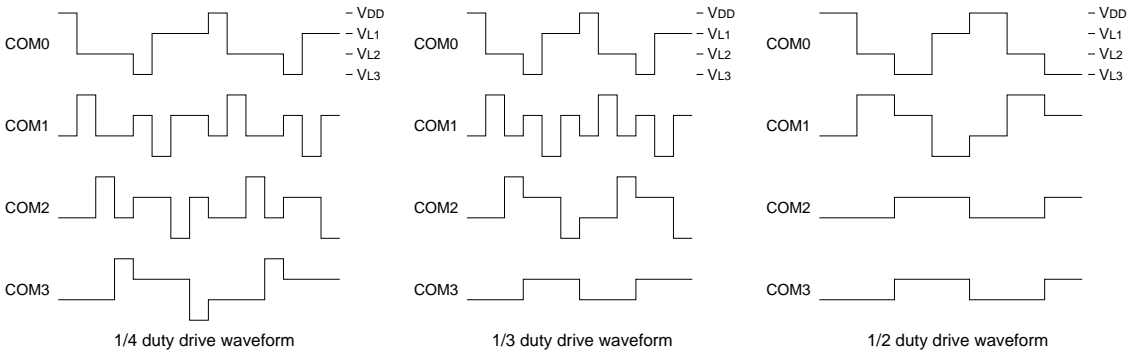
Fig. 3.3.11 Drive waveform of COM terminals (1/3 bias)
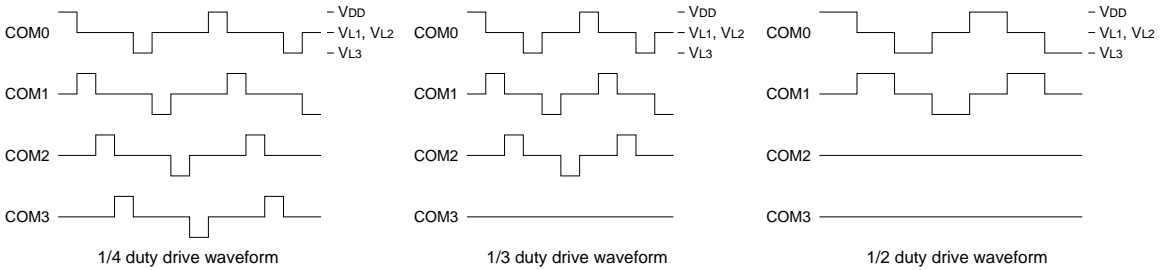
Fig. 3.3.12 Drive waveform of COM terminals (1/2 bias)

19 Segment memory address

```
*** OPTION  NO.19 ***
--- SEGMENT MEMORY ADDRESS ---
       SEGMENT MEMORY ADDRESS
                         1. 0 PAGE(040-06F)
                         2. 2 PAGE(240-26F)

PLEASE SELECT NO.(1) ? 1↵

SEGMENT MEMORY ADDRESS   1. 0 PAGE(040-06F)   SELECTED
```

Select the segment memory area.
When "0 PAGE" is selected, the segment memory area is allocated to "040H–06FH" and R/W access utilizing this RAM area becomes available.
When "2 PAGE" is selected, the segment memory area is allocated to "0C0H–0EFH" and becomes a write-only area.

3.4 FOG6008 Quick Reference

■ Starting command and input/output files

Execution file: FOG6008.EXE

Starting command: **FOG6008**⏎   ⏎ *indicates the Return key.*

Input file: C008XXXF.DOC (Function option document file, when modifying)

Output file: C008XXXF.DOC (Function option document file)
                        C008XXXF.HEX (Function option HEX file)

■ Display example

```
       ***  E0C6008 FUNCTION OPTION GENERATOR. --- Ver 2.20  ***

EEEEEEEEEE   PPPPPPPP      SSSSSSS     OOOOOOO     NNN    NNN
EEEEEEEEEE   PPPPPPPPP    SSS   SSSS  OOO   OOO   NNNN    NNN
EEE          PPP    PPP  SSS    SSS  OOO     OOO  NNNNN   NNN
EEE          PPP    PPP  SSS        OOO      OOO  NNNNNN  NNN
EEEEEEEEEE   PPPPPPPPPP   SSSSSS    OOO      OOO  NNN NNN NNN
EEEEEEEEEE   PPPPPPPP       SSSS    OOO      OOO  NNN  NNNNNN
EEE          PPP             SSS    OOO      OOO  NNN   NNNNN
EEE          PPP         SSS    SSS  OOO     OOO  NNN    NNNN
EEEEEEEEEE   PPP         SSSS   SSS   OOO   OOO   NNN     NNN
EEEEEEEEEE   PPP          SSSSSSS      OOOOOOO    NNN      NN

             (C) COPYRIGHT 1997 SEIKO EPSON CORP.

        THIS SOFTWARE MAKES NEXT FILES.

           C008XXXF.HEX  ...   FUNCTION OPTION HEX FILE.
           C008XXXF.DOC  ...   FUNCTION OPTION DOCUMENT FILE.

                    STRIKE ANY KEY.
```

Start-up message
When FOG6008 is started, the start-up message is displayed.
For "STRIKE ANY KEY.", press any key to advance the program execution.

To suspend execution, press the "CTRL" and "C" keys together: the sequence returns to the DOS command level.

```
*** E0C6008 USER'S OPTION SETTING. --- Ver 2.20 ***

CURRENT DATE IS  99/03/01
PLEASE INPUT NEW DATE  :  ⏎
```

Date input
Enter the 2-digit year, month, and day of the month by delimiting them with a slash ("/"). When not modifying the date, press the RETURN key "⏎" to continue.

```
*** OPERATION SELECT MENU ***

        1. INPUT NEW FILE
        2. EDIT FILE
        3. RETURN TO DOS

PLEASE SELECT NO.?
```

Operation selection menu
Enter a number from 1 to 3 to select a subsequent operation.
1. To set new function options.
2. To modify the document file.
3. To terminate FOG6008.

```
*** OPERATION SELECT MENU ***

        1. INPUT NEW FILE
        2. EDIT FILE
        3. RETURN TO DOS

PLEASE SELECT NO.? 1⏎
PLEASE INPUT FILE NAME? C0080A0⏎                        ..(1)
PLEASE INPUT USER'S NAME? SEIKO EPSON CORP. ⏎           ..(2)
PLEASE INPUT ANY COMMENT
(ONE LINE IS 50 CHR)? FUJIMI PLANT⏎                     ..(3)
                    ? 281 FUJIMI SUWA-GUN NAGANO-KEN 399-0293 JAPAN⏎
                    ? TEL 0266-61-1211⏎
                    ? FAX 0266-61-1273⏎
                    ? ⏎
```

Setting new function options
Select "1" on the operation selection menu.
(1) Enter the file name.
(2) Enter the customer's company name.
(3) Enter any comment.
    (Within 50 characters x 10 lines)
Next, start function option setting from option No. 1.

```
PLEASE INPUT FILE NAME? C0080A0⏎
EXISTS OVERWRITE(Y/N)? N⏎
PLEASE INPUT FILE NAME? C0080B0⏎
PLEASE INPUT USER'S NAME?
```

In case a function option document file with the same name as the file name specified in the current drive exists, the user is asked whether overwrition is desired. Enter "Y" or "N" accordingly.

```
*** OPERATION SELECT MENU ***

        1. INPUT NEW FILE
        2. EDIT FILE
        3. RETURN TO DOS

PLEASE SELECT NO.? 2↵

*** SOURCE FILE(S) ***

C0080A0        C0080B0        C0080C0              ..(1)

PLEASE INPUT FILE NAME? C0080A0↵                  ..(2)
PLEASE INPUT USER'S NAME? ↵                       ..(3)
PLEASE INPUT ANY COMMENT
(ONE LINE IS 50 CHR)? ↵                           ..(4)
PLEASE INPUT EDIT NO.? 4↵                         ..(5)
            :
(Modifying function option settings)
            :
PLEASE INPUT EDIT NO.? E↵
```

In step (1), if no modifiable source exists, the following message is displayed and the sequence returns to the operation selection menu.

```
*** SOURCE FILE(S) ***

FUNCTION OPTION DOCUMENT FILE IS NOT FOUND.
```

In step (2), if the function option document file is not in the current drive, the following message is displayed, prompting entry of other file name.

```
PLEASE INPUT FILE NAME? C0080N0↵
FUNCTION OPTION DOCUMENT FILE IS NOT FOUND.
PLEASE INPUT FILE NAME?
```

```
*** OPTION  NO.2 ***
--- OSC3 SYSTEM CLOCK ---
     OSC3 SYSTEM CLOCK
                    1. CR
                    2. CERAMIC

PLEASE SELECT NO.(1) ? 1↵

OSC3 SYSTEM CLOCK    1. CR  SELECTED
```

```
END OF OPTION SETTING.
DO YOU MAKE HEX FILE (Y/N) ? Y↵                   ..(1)

*** OPTION EPROM SELECT MENU ***

        1. 27C64
        2. 27C128
        3. 27C256
        4. 27C512

PLEASE SELECT NO.? 2↵                             ..(2)

        2. 27C128    SELECTED

MAKING FILE(S) IS COMPLETED.

*** OPERATION SELECT MENU ***

        1. INPUT NEW FILE
        2. EDIT FILE
        3. RETURN TO DOS

PLEASE SELECT NO.?
```

Modifying function option settings

Select "2" on the operation selection menu.
(1) Will display the files on the current drive.
(2) Enter the file name.
(3) Enter the customer's company name.
(4) Enter any comment.
   Previously entered data can be used by pressing the RETURN key "↵" at (3) and (4).
(5) Enter the number of the function option to be modified. When selection of one option is complete, the system prompts entry of another function option number. Repeat selection until all options to be modified are selected.
   Enter "E↵" to end option setting. Then, move to the confirmation procedure for HEX file generation.

Option selection

The selections for each option correspond one to one to the option list. Enter the selection number. The value in parentheses ( ) indicates the default value, and is set when only the RETURN key "↵" is pressed.
In return, the confirmation is displayed.
When you wish to modify previously set function options in the new setting process, enter "B↵" to return 1 step back to the previous function option setting operation.

EPROM selection

When setting function options setting is completed, the following message is output to ask the operator whether to generate the HEX file.
(1) When debugging the program with EVA6008, HEX file is needed, so enter "Y↵". If "N↵" is entered, no HEX file is generated and only document file is generated.
(2) For the option ROM selection menu displayed when "Y↵" is entered in Step (1), select the EPROM to be used for setting EVA6008 options.

When a series of operations are complete, the sequence returns to the operation selection menu.

3.5 *Sample File*

```
* E0C6008 FUNCTION OPTION DOCUMENT  V 2.20
*
* FILE NAME    C0080A0F.DOC
* USER'S NAME  SEIKO EPSON CORP.
* INPUT DATE   1998/10/26
*
* COMMENT      ETT PLANT
*              NO.287 NANKING E.ROAD, SEC.3, TAIPEI, TAIWAN, R.O.C.
*              TEL 2717-7360
*              FAX 2717-7377
*
*
* OPTION NO.1
* < DEVICE TYPE >
*      DEVICE TYPE            E0C60A08 ---------------------- SELECTED
 OPT0101 03
*
* < CLOCK TYPE >
*      CLOCK TYPE             32KHZ ------------------------- SELECTED
 OPT0102 01
*
* OPTION NO.2
* < OSC3 SYSTEM CLOCK >
*      OSC3 SYSTEM CLOCK      CERAMIC ---------------------- SELECTED
 OPT0201 02
*
* OPTION NO.3
* < MULTIPLE KEY ENTRY RESET >
*      COMBINATION            USE K00,K01,K02,K03 ----------- SELECTED
*      AUTHORIZE              USE -------------------------- SELECTED
 OPT0301 04
 OPT0302 01
*
* OPTION NO.4
* < WATCHDOG TIMER >
*      WATCHDOG TIMER         USE -------------------------- SELECTED
 OPT0401 01
*
* OPTION NO.5
* < I/P INTERRUPT NOISE REJECTOR >
*      K00-K03               USE -------------------------- SELECTED
*      K10                   USE -------------------------- SELECTED
*      K20-K23               USE -------------------------- SELECTED
 OPT0501 01
 OPT0502 01
 OPT0503 01
*
* OPTION NO.6
* < I/P PORT PULL DOWN RESISTOR >
*      K00                   WITH RESISTOR ---------------- SELECTED
*      K01                   WITH RESISTOR ---------------- SELECTED
*      K02                   WITH RESISTOR ---------------- SELECTED
*      K03                   WITH RESISTOR ---------------- SELECTED
*      K10                   WITH RESISTOR ---------------- SELECTED
*      K20                   WITH RESISTOR ---------------- SELECTED
*      K21                   WITH RESISTOR ---------------- SELECTED
*      K22                   WITH RESISTOR ---------------- SELECTED
*      K23                   WITH RESISTOR ---------------- SELECTED
 OPT0601 01
 OPT0602 01
 OPT0603 01
 OPT0604 01
 OPT0605 01
 OPT0606 01
 OPT0607 01
 OPT0608 01
 OPT0609 01
*
* OPTION NO.7
```

```
* < O/P PORT SPEC. (R00-R03) >
*     R00                     COMPLEMENTARY ----------------- SELECTED
*     R01                     COMPLEMENTARY ----------------- SELECTED
*     R02                     COMPLEMENTARY ----------------- SELECTED
*     R03                     COMPLEMENTARY ----------------- SELECTED
 OPT0701 01
 OPT0702 01
 OPT0703 01
 OPT0704 01
*
* OPTION NO.8
* < R10 SPECIFICATION >
*     OUTPUT SPECIFICATION    COMPLEMENTARY ----------------- SELECTED
*     OUTPUT TYPE             DC OUTPUT --------------------- SELECTED
 OPT0801 01
 OPT0802 01
*
* OPTION NO.9
* < R11 SPECIFICATION >
*     OUTPUT SPECIFICATION    COMPLEMENTARY ----------------- SELECTED
*     OUTPUT TYPE             DC OUTPUT --------------------- SELECTED
 OPT0901 01
 OPT0902 01
*
* OPTION NO.10
* < R12 SPECIFICATION >
*     OUTPUT SPECIFICATION    COMPLEMENTARY ----------------- SELECTED
*     OUTPUT TYPE             DC OUTPUT --------------------- SELECTED
 OPT1001 01
 OPT1002 01
*
* OPTION NO.11
* < R13 SPECIFICATION >
*     OUTPUT SPECIFICATION    COMPLEMENTARY ----------------- SELECTED
*     OUTPUT TYPE             DC OUTPUT --------------------- SELECTED
 OPT1101 01
 OPT1102 01
*
* OPTION NO.12
* < I/O PORT SPECIFICATION >
*     P00                     COMPLEMENTARY ----------------- SELECTED
*     P01                     COMPLEMENTARY ----------------- SELECTED
*     P02                     COMPLEMENTARY ----------------- SELECTED
*     P03                     COMPLEMENTARY ----------------- SELECTED
*     P10                     COMPLEMENTARY ----------------- SELECTED
*     P11                     COMPLEMENTARY ----------------- SELECTED
*     P12                     COMPLEMENTARY ----------------- SELECTED
*     P13                     COMPLEMENTARY ----------------- SELECTED
 OPT1201 01
 OPT1202 01
 OPT1203 01
 OPT1204 01
 OPT1205 01
 OPT1206 01
 OPT1207 01
 OPT1208 01
*
* OPTION NO.13
* < SIN PULL DOWN RESISTOR >
*     SIN PULL DOWN RESISTOR WITH RESISTOR ----------------- SELECTED
 OPT1301 01
*
* OPTION NO.14
* < SOUT SPECIFICATION >
*     SOUT SPECIFICATION      COMPLEMENTARY ----------------- SELECTED
 OPT1401 01
*
* OPTION NO.15
* < SCLK SPECIFICATION >
*     SCLK PULL DOWN RESISTORWITH RESISTOR ----------------- SELECTED
*     OUTPUT SPECIFICATION    COMPLEMENTARY ----------------- SELECTED
*     LOGIC                   POSITIVE --------------------- SELECTED
```

```
 OPT1501 01
 OPT1502 01
 OPT1503 01
*
* OPTION NO.16
* < SIO DATA PERMUTATION >
*     SIO DATA PERMUTATION   MSB FIRST  --------------------  SELECTED
 OPT1601 01
*
* OPTION NO.17
* < EVENT COUNTER NOISE REJECTOR >
*     EVENT COUNTER NOISE REJECTOR2048 OR 2400 HZ  ----------  SELECTED
 OPT1701 01
*
* OPTION NO.18
* < LCD SPECIFICATION >
*     BIAS SELECTION          1/3 B USE REGULATOR LCD 3V  ----  SELECTED
*     DUTY SELECTION          1/4 DUTY  --------------------  SELECTED
 OPT1801 08
 OPT1802 01
*
* OPTION NO.19
* < SEGMENT MEMORY ADDRESS >
*     SEGMENT MEMORY ADDRESS 2 PAGE (240-26F)  -------------  SELECTED
 OPT1901 02
*
*
*
* SEIKO EPSON'S AREA
*
*
*
* OPTION NO.20
 OPT2001 01
*
* OPTION NO.21
 OPT2101 01
*
* OPTION NO.22
 OPT2201 01
 OPT2202 01
 OPT2203 01
 OPT2204 01
 OPT2205 01
 OPT2206 01
 OPT2207 01
 OPT2208 01
*
* OPTION NO.23
 OPT2301 01
 OPT2302 01
 OPT2303 01
 OPT2304 01
 OPT2305 01
 OPT2306 01
 OPT2307 01
 OPT2308 01
*
* OPTION NO.24
 OPT2401 01
*
* OPTION NO.25
 OPT2501 01
*
* OPTION NO.26
 OPT2601 01
*
* OPTION NO.27
 OPT2701 01
 OPT2702 01
\\END
```

Note   End mark "¥¥END" may be used instead of "\\END" depending on the PC used. (The code of \ and ¥ is 5CH.)

---

4 *SEGMENT OPTION GENERATOR SOG6008*

4.1 *SOG6008 Outline*

With the 4-bit single-chip E0C6008 microcomputers, the customer may select the LCD segment options. By modifying the mask patterns of the E0C6008 according to the selected options, the system can be customized to meet the specifications of the target system.

The Segment Option Generator SOG6008 is a software tool for generating data file used to generate mask patterns. From the data file created with SOG6008, the E0C6008 mask pattern is automatically generated by a general purpose computer. The HEX file for the evaluation board (EVA6008) segment option ROM is simultaneously generated with the data file.

```
  ┌─────────────────────────────────┐
  │ A>EDLIN C008XXX.SEG             │
  │ Segment source file generation  │
  └─────────────────────────────────┘
              │
           ╭───────╮
           │ C008XXX │
           │  .SEG   │
           ╰───────╯
              │
  ┌─────────────────────────────────┐
  │ A>SOG6008                       │
  │ Execute the segment option generator │
  └─────────────────────────────────┘
       ↙        ↓          ↘
   ╭───────╮ ╭───────╮ ╭───────╮
   │ Error │ │C008XXXS│ │C008XXXS│
   │message│ │ .HEX  │ │ .DOC  │
   ╰───────╯ ╰───────╯ ╰───────╯
      ↓      Segment option  Segment option
  ┌───────┐  HEX file       document file
  │ Error │
  │message│      └── for EVA6008 use ──┘
  └───────┘
```
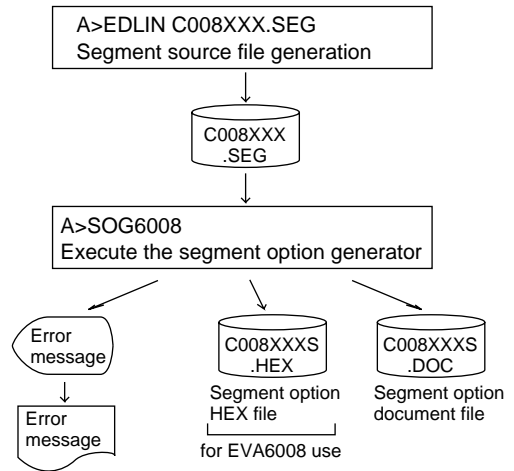
Fig. 4.1.1 SOG6008 execution flow

☞ *The operating method is same as for the E0C62 Family. Refer to the "E0C62 Family Development Tool Reference Manual" for details.*

4.2   Option List

TERMINAL NAME	ADDRESS												OUTPUT SPECIFICATION		
	COM0			COM1			COM2			COM3					
	H	L	D	H	L	D	H	L	D	H	L	D			
SEG0													SEG output		
SEG1													DC output	☐ C	☐ P
SEG2													SEG output		
SEG3													DC output	☐ C	☐ P
SEG4													SEG output		
SEG5													DC output	☐ C	☐ P
SEG6													SEG output		
SEG7													DC output	☐ C	☐ P
SEG8													SEG output		
SEG9													DC output	☐ C	☐ P
SEG10													SEG output		
SEG11													DC output	☐ C	☐ P
SEG12													SEG output		
SEG13													DC output	☐ C	☐ P
SEG14													SEG output		
SEG15													DC output	☐ C	☐ P
SEG16													SEG output		
SEG17													DC output	☐ C	☐ P
SEG18													SEG output		
SEG19													DC output	☐ C	☐ P
SEG20													SEG output		
SEG21													DC output	☐ C	☐ P
SEG22													SEG output		
SEG23													DC output	☐ C	☐ P
SEG24													SEG output		
SEG25													DC output	☐ C	☐ P
SEG26													SEG output		
SEG27													DC output	☐ C	☐ P
SEG28													SEG output		
SEG29													DC output	☐ C	☐ P
SEG30													SEG output		
SEG31													DC output	☐ C	☐ P
SEG32													SEG output		
SEG33													DC output	☐ C	☐ P
SEG34													SEG output		
SEG35													DC output	☐ C	☐ P
SEG36													SEG output		
SEG37													DC output	☐ C	☐ P
SEG38													SEG output		
SEG39													DC output	☐ C	☐ P
SEG40													SEG output		
SEG41													DC output	☐ C	☐ P
SEG42													SEG output		
SEG43													DC output	☐ C	☐ P
SEG44													SEG output		
SEG45													DC output	☐ C	☐ P
SEG46													SEG output		
SEG47													DC output	☐ C	☐ P

Legend: <ADDRESS>
　　　　H: High order address (4–6)
　　　　L: Low order address (0–F)
　　　　D: Data bit (0–3)

<OUTPUT SPECIFICATION>
　　C: Complementary output
　　P: Pch open drain output

Note: 1. Even if there are unused areas, set "---" (hyphens) such that there are no blank columns.
　　　2. When DC output is selected, the display memory of the COM0 column becomes effective.

4.3 Segment Ports Output Specifications

For the output specification of the segment output ports SEG0–SEG47 segment output and DC output can be selected in units of two terminals. When used for liquid crystal panel drives, select segment output; when used as regular output port, select DC output. When DC output is selected, either complementary output or Pch open drain output may further be selected.

However, for segment output ports that will not be used, select segment output.

Refer to the "E0C62 Family Development Tool Reference Manual (Segment Option Generator)" for the segment option source file creation.

■ When segment output is selected

The segment output port has a segment decoder built-in, and the data bit of the optional address in the segment memory area (040H–06FH or 240H–26FH) can be allocated to the optional segment. With this, up to 192 segments (144 segments when 1/3 duty is selected or 96 segments when 1/2 duty is selected) of liquid crystal panel could be driven.

The segment memory may be allocated only one segment and multiple setting is not possible.

The allocated segment displays when the bit for this segment memory is set to "1", and goes out when bit is set to "0".

Segment allocation is set to H for high address (4–6), to L for low address (0–F), and to D for data bit (0–3) and are recorded in their respective column in the option list. For segment ports that will not be used, write "---" (hyphen) in the H, L, and D columns of COM0–COM3.

Examples
• When 1/4 duty is selected
```
0   601   600   632   603   S
1   612   611   610   623   S
```

• When 1/3 duty is selected
```
0   601   600   632   ---   S
1   612   611   610   ---   S
```

• When 1/2 duty is selected
```
0   601   600   ---   ---   S
1   612   611   ---   ---   S
```

■ When DC output is selected

The DC output can be selected in units of two terminals and up to 48 terminals may be allocated for DC output. Also, either complementary output or Pch open drain output is likewise selected in units of two terminals. When the bit for the selected segment memory is set to "1", the segment output port goes high (V_{DD}), and goes low (V_{SS}) when set to "0". Segment allocation is the same as when segment output is selected but for the while the segment memory allocated to COM1–COM3 becomes ineffective. Write three hyphens ("---") in the COM1–COM3 columns in the option list.

Example
• When complementary output is set to SEG16 and SEG17, and Pch open drain output is set to SEG18 and SEG19.
```
16   6E0   ---   ---   ---   C
17   6F0   ---   ---   ---   C
18   6E1   ---   ---   ---   P
19   6F1   ---   ---   ---   P
```

Refer to the SOG section of the "E0C62 Family Development Tool Reference Manual" for details of segment option source file.

Note: *If you select "1/3 bias, internal regulator used, LCD 3 V" in LCD specification, do not select "DC output" in the SOG file, because it is not allowance.*

4.4   SOG6008 Quick Reference

■ Starting command and input/output files

Execution file:	SOG6008.EXE
Starting command:	**SOG6008_ [-H]**↵
Option:	-H: Specifies the segment option document file for input file of SOG6008.
Input file:	C008XXX.SEG (Segment option source file)
	C008XXXS.DOC (Segment option document file, when -H option use)
Output file:	C008XXXS.DOC (Segment option document file)
	C008XXXS.HEX (Segment option HEX file)

_ indicates a blank.
↵ indicates the Return key.
A parameter enclosed by [ ] can be omitted.

■ Display example

```
    ***  E0C6008 SEGMENT OPTION GENERATOR. --- Ver 1.00  ***

EEEEEEEEE    PPPPPPPP      SSSSSSS     OOOOOOO    NNN     NNN
EEEEEEEEE    PPPPPPPPPP    SSS  SSSS  OOO   OOO   NNNN    NNN
EEE          PPP     PPP  SSS   SSS   OOO    OOO  NNNNN   NNN
EEE          PPP     PPP  SSS         OOO    OOO  NNNNNN  NNN
EEEEEEEEE    PPPPPPPPPP    SSSSSS     OOO    OOO  NNN NNN NNN
EEEEEEEEE    PPPPPPPP        SSSS     OOO    OOO  NNN  NNNNNN
EEE          PPP             SSS  OOO    OOO      NNN   NNNNN
EEE          PPP         SSS  SSS OOO    OOO      NNN    NNNN
EEEEEEEEE    PPP         SSSS SSS OOO   OOO       NNN     NNN
EEEEEEEEE    PPP           SSSSSSS OOOOOOO        NNN      NN

          (C) COPYRIGHT 1997 SEIKO EPSON CORP.

       SEGMENT OPTION SOURCE FILE NAME IS " C008XXX.SEG "

       THIS SOFTWARE MAKES NEXT FILES.

          C008XXXS.HEX  ...  SEGMENT OPTION HEX FILE.
          C008XXXS.DOC  ...  SEGMENT OPTION DOCUMENT FILE.

                 STRIKE ANY KEY.
```

Start-up message
When SOG6008 is started, the start-up message is displayed.
For "STRIKE ANY KEY.", press any key to advance the program execution.

To suspend execution, press the "CTRL" and "C" keys together: the sequence returns to the DOS command level.

```
*** E0C6008 USER'S OPTION SETTING. --- Ver 1.00 ***

CURRENT DATE IS  99/03/01
PLEASE INPUT NEW DATE  :  ↵
```

Date input
Enter the 2-digit year, month, and day of the month by delimiting them with a slash ("/"). When not modifying the date, press the RETURN key "↵" to continue.

```
*** SOURCE FILE(S) ***

C0080A0        C0080B0        C0080C0                    ..(1)

PLEASE INPUT SEGMENT OPTION FILE NAME? C0080A0↵         ..(2)
PLEASE INPUT USER'S NAME? SEIKO EPSON CORP.↵            ..(3)
PLEASE INPUT ANY COMMENT
(ONE LINE IS 50 CHR)? FUJIMI PLANT↵                     ..(4)
            ? 281 FUJIMI SUWA-GUN NAGANO-KEN 399-0293 JAPAN↵
            ? TEL 0266-61-1211↵
            ? FAX 0266-61-1273↵
            ? ↵
```

Input file selection
(1) Will display the files on the current drive.
(2) Enter the file name.
(3) Enter the customer's company name.
(4) Enter any comment.
      (Within 50 characters x 10 lines)
Then, move to the confirmation procedure for HEX file generation.

```
*** SOURCE FILE(S) ***

SEGMENT OPTION SOURCE FILE IS NOT FOUND.        ..(5) -H option not use

*** SOURCE FILE(S) ***

SEGMENT OPTION DOCUMENT FILE IS NOT FOUND.      ..(6) -H option use
```

In step (1), if no modifiable source exists, an error message (5) or (6) will be displayed and the program will be terminated. In step (2), if the specified file name is not found in the current drive, an error message (7) or (8) is displayed, prompting entry of other file name.

```
PLEASE INPUT SEGMENT OPTION SOURCE FILE NAME? C0080N0↵
SEGMENT OPTION SOURCE FILE IS NOT FOUND.        ..(7) -H option not use

PLEASE INPUT SEGMENT OPTION DOCUMENT FILE NAME? C0080N0↵
SEGMENT OPTION DOCUMENT FILE IS NOT FOUND.      ..(8) -H option use
```

Note: The SOG6008 refers C008xxxF.DOC files, so C008xxxF.DOC and C008xxx.SEG files (both "xxx" must be the same) must be prepared in the same directory befor invoking the SOG6008 without the -H option.

```
"USE LCD VOLTAGE REGULATOR" SELECTED OK(Y/N)?    ..(9)

"NO USE LCD VOLTAGE REGULATOR" SELECTED OK(Y/N)?..(10)
```

The SOG6008 displays an inquiring massage.
(9) is displayed if "USE REGULATOR" has been selected for Option 18 (LCD specification) in the C008xxxF.DOC.
(10) is displayed if "NOT USE REGULATOR" has been selected.
Enter "Y↵" to continue if it is correct.
If it is not correct, enter "N↵" to terminate the SOG6008 and then modify the C008xxxF.DOC using the FOG6008.

```
END OF OPTION SETTING.
DO YOU MAKE HEX FILE (Y/N) ? Y⏎                          ..(1)

*** OPTION EPROM SELECT MENU ***

        1. 27C64
        2. 27C128
        3. 27C256
        4. 27C512

PLEASE SELECT NO.? 2⏎                                    ..(2)

        2. 27C128    SELECTED

MAKING FILE IS COMPLETED.
```

EPROM selection

When selecting file is completed, the following message is output to ask the operator whether to generate the HEX file.

(1) When debugging the program with EVA6008, HEX file is needed, so enter "Y⏎". If "N⏎" is entered, no HEX file is generated and only document file is generated.

(2) For the option ROM selection menu displayed when "Y⏎" is entered in Step (1), select the EPROM to be used for setting EVA6008 options.

When a series of operations are complete, the SOG6008 generates files. If no error is committed while setting segment options, "MAKING FILE IS COMPLETED" will be displayed and the SOG6008 program will be terminated.

■ Error messages

Error message	Explanation
S (Syntax Error)	The data was written in an invalid format.
N (Segment No. Select Error)	The segment number outside the specificable range was specified.
R (RAM Address Select Error)	The segment memory address or data bit outside the specificable range was specified.
D (Duprication Error)	The same data (SEG port No., segment memory address, or data bit) was specified more then once.
Out Port Set Error	The output specifications were not set in units of two ports.

4.5   Sample File

■ Example of segment option source file

```
; EVA6008 LCD SEGMENT DECODE TABLE
0       680     681     690     691     S
1       692     693     6A0     6A2     S
2       6A3     6A1     682     683     S
3       6B0     6B1     6B2     6B3     S
4       640     641     650     651     S
5       652     653     660     662     S
6       663     661     642     643     S
7       670     671     672     673     S
8       600     601     610     611     S
9       612     613     620     622     S
10      623     621     602     603     S
11      630     631     632     633     S
12      5C0     5C1     5D0     5D1     S
13      5D2     5D3     5E0     5E2     S
14      5E3     5E1     5C2     5C3     S
15      5F0     5F1     5F2     5F3     S
16      580     581     590     591     S
17      592     593     5A0     5A2     S
18      5A3     5A1     582     583     S
19      5B0     5B1     5B2     5B3     S
20      540     541     550     551     S
21      552     553     560     562     S
22      563     561     542     543     S
23      570     571     572     573     S
24      500     501     510     511     S
25      512     513     520     522     S
26      523     521     502     503     S
27      530     531     532     533     S
28      4C0     4C1     4D0     4D1     S
29      4D2     4D3     4E0     4E2     S
30      4E3     4E1     4C2     4C3     S
31      4F0     4F1     4F2     4F3     S
32      480     481     490     491     S
33      492     493     4A0     4A2     S
34      4A3     4A1     482     483     S
35      4B0     4B1     4B2     4B3     S
36      440     441     450     451     S
37      452     453     460     462     S
38      463     461     442     443     S
39      470     471     472     473     S
40      400     401     410     411     S
41      412     413     420     422     S
42      423     421     402     403     S
43      430     431     432     433     S
44      6C0     6C1     6C2     6C3     S
45      6D0     6D1     6D2     6D3     S
46      6E0     ---     ---     ---     C
47      6E1     ---     ---     ---     C
```

5 ICE CONTROL SOFTWARE ICS6008

5.1 ICS6008 Outline

The In-circuit Emulator ICE62R (ICE6200) connects the target board produced by the user via the EVA6008 and performs real time target system evaluation and debugging by passing through the RS-232C from the host computer and controlling it. The operation on the host computer side and ICE62R (ICE6200) control is done through the ICE Control Software ICS6008.

The ICS6008 has a set of numerous and highly functional emulation commands which provide sophisticated break function, on-the-fly data display, history display, etc., and so perform a higher level of debugging.
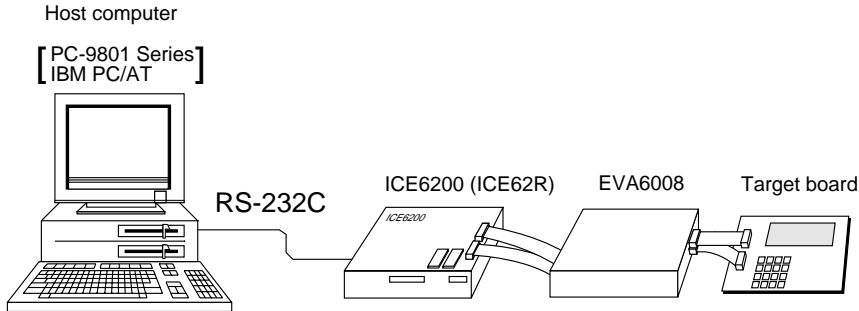

Fig. 5.1.1 Debugging system using ICE62R (ICE6200)

☞ *The functions of the ICE62R (ICE6200) and commands are same as for the E0C62 Family. Refer to the "E0C62 Family Development Tool Reference Manual" for details.*

5.2 ICS6008 Restrictions

Take the following precautions when using the ICS6008.

■ ROM Area

The ROM area is limited to a maximum address of 0FFFH. Assigning data above the 0FFFH address causes an error.

■ RAM Area

The RAM area is limited to a maximum address of 3FFH. However, as the following addresses are in the unused area, designation of this area with the ICE commands produces an error.

Unused area: 240H–2CFH and 2D1H–2DFH (when 040H–06FH has been specified as the segment data memory through the mask option)
270H–2CFH and 2D1H–2DFH (when 240H–26FH has been specified as the segment data memory through the mask option)

(Refer to the "E0C6008 Technical Manual" for details.)

■ Undefined Code

The SLP instruction is not specified for the E0C6008 and so cannot be used.

■ OPTLD Command

In the ICS6008, OPTLD command can be used.
This command is used to load HEX files (function option data and segment option data for LCD) in the EVA6008 memory with the ICE62R (ICE6200).

Load of function option data: `#OPTLD,1,C008XXX⏎`
Load of segment option data: `#OPTLD,2,C008XXX⏎`

OPTLD   *READ HEXA DATA FILE*

Format   #**OPTLD,1,**<*file name*>⏎   ...(1)
              #**OPTLD,2,**<*file name*>⏎   ...(2)

Function   (1) Load function option HEX file in the EVA6008 function option data memory.
                   It is HEX file output by the function option generator and has intel HEX format.

               (2) Load segment option HEX file in the EVA6008 segment option data memory.
                   It is HEX file output by the segment option generator and has intel HEX format.

Examples   #OPTLD,1,C008XXX⏎ ..... C008XXXF.HEX file is loaded in the function option data memory.

               #OPTLD,2,C008XXX⏎ ..... C008XXXS.HEX file is loaded in the segment option data memory.

5.3 ICS6008 Quick Reference

■ Starting command and input/output files

Execution file:	ICS6008.BAT	(ICS6008J.EXE)	. . . for MS-DOS
	ICS6008.BAT	(ICS6008W.EXE)	. . . for PC-DOS
Starting command:	**ICS6008 (ICS6008J)**⏎		. . . for MS-DOS
	ICS6008 (ICS6008W)⏎		. . . for PC-DOS
Input file:	C008XXXL.HEX	(Object file, low-order)	
	C008XXXH.HEX	(Object file, high-order)	
	C008XXXD.HEX	(Data RAM file)	
	C008XXXC.HEX	(Control file)	
Output file:	C008XXXL.HEX	(Object file, low-order)	
	C008XXXH.HEX	(Object file, high-order)	
	C008XXXD.HEX	(Data RAM file)	
	C008XXXC.HEX	(Control file)	

■ Display example

```
        *** E0C6008 ICE CONTROL SOFTWARE. --- Ver 3.01 ***

EEEEEEEEEE   PPPPPPPP      SSSSSSS      OOOOOOO     NNN      NNN
EEEEEEEEEE   PPPPPPPPPP   SSS   SSSS   OOO   OOO   NNNN     NNN
EEE          PPP    PPP   SSS    SSS   OOO    OOO  NNNNN    NNN
EEE          PPP    PPP   SSS          OOO    OOO  NNNNNN   NNN
EEEEEEEEEE   PPPPPPPPPP    SSSSSSS     OOO    OOO  NNN NNN  NNN
EEEEEEEEEE   PPPPPPPP         SSSS     OOO    OOO  NNN  NNNNNN
EEE          PPP              SSS      OOO    OOO  NNN   NNNNN
EEE          PPP         SSS   SSS     OOO    OOO  NNN    NNNN
EEEEEEEEEE   PPP         SSSS  SSS     OOO   OOO   NNN     NNN
EEEEEEEEEE   PPP          SSSSSSS      OOOOOOO     NNN      NN

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* ICE POWER ON RESET *
* DIAGNOSTIC TEST OK *
#
```

Start-up message
When ICS6008 is started, the start-up message is displayed, and a self-test is automatically performed. ICS6008 commands are awaited when the program is properly loaded and the # mark is displayed.
Debugging can be done by entering command after the # mark.
The ICS6008 program is terminated by entering the Q (Quit) command.

Note   Confirm that the cables con-nected properly, then operate the ICS6008.

■ Error messages

Error message	Meaning	Recover procedure
* COMMUNICATION ERROR OR ICE NOT READY *	ICE62R (ICE6200) is disconnected or power is OFF.	Switch OFF the host power supply, connect cable, and reapply power. Or switch ON power to ICE62R (ICE6200).
* TARGET DOWN (1) *	Evaluation board is disconnected. (Check at power ON)	Switch OFF power to ICE, and connect the evaluation board. Then, apply power to ICE62R (ICE6200).
* TARGET DOWN (2) *	Evaluation board is disconnected. (Check at command execution)	Switch OFF power to ICE, and connect the evaluation board. Then, apply power to ICE62R (ICE6200).
* UNDEFINED PROGRAM CODE EXIST *	Undefined code is detected in the program loaded from ROM or FD.	Convert ROM and FD data with the cross assembler, then restart the ICE62R (ICE6200).
* COMMAND ERROR *	A miss occurs by command input.	Reenter the proper command.
(No response after power on)	The ICE-to-HOST cable is disconnected on the host side.	Switch OFF the host power supply, connect cable, and reapply power.

■ ICE62R (ICE6200) commands

Item No.	Function	Command Format	Outline of Operation
1	Assemble	#A,a ↵	Assemble command mnemonic code and store at address "a"
2	Disassemble	#L,a1,a2 ↵	Contents of addresses a1 to a2 are disassembled and displayed
3	Dump	#DP,a1,a2 ↵	Contents of program area a1 to a2 are displayed
		#DD,a1,a2 ↵	Content of data area a1 to a2 are displayed
4	Fill	#FP,a1,a2,d ↵	Data d is set in addresses a1 to a2 (program area)
		#FD,a1,a2,d ↵	Data d is set in addresses a1 to a2 (data area)
5	Set Run Mode	#G,a ↵	Program is executed from the "a" address
		#TIM ↵	Execution time and step counter selection
		#OTF ↵	On-the-fly display selection
6	Trace	#T,a,n ↵	Executes program while displaying results of step instruction from "a" address
		#U,a,n ↵	Displays only the final step of #T,a,n
7	Break	#BA,a ↵	Sets Break at program address "a"
		#BAR,a ↵	Breakpoint is canceled
		#BD ↵	Break condition is set for data RAM
		#BDR ↵	Breakpoint is canceled
		#BR ↵	Break condition is set for EVA6008 CPU internal registers
		#BRR ↵	Breakpoint is canceled
		#BM ↵	Combined break conditions set for program data RAM address and registers
		#BMR ↵	Cancel combined break conditions for program data ROM address and registers
		#BRES ↵	All break conditions canceled
		#BC ↵	Break condition displayed
		#BE ↵	Enter break enable mode
		#BSYN ↵	Enter break disable mode
		#BT ↵	Set break stop/trace modes
		#BRKSEL,REM ↵	Set BA condition clear/remain modes
8	Move	#MP,a1,a2,a3 ↵	Contents of program area addresses a1 to a2 are moved to addresses a3 and after
		#MD,a1,a2,a3 ↵	Contents of data area addresses a1 to a2 are moved to addresses a3 and after
9	Data Set	#SP,a ↵	Data from program area address "a" are written to memory
		#SD,a ↵	Data from data area address "a" are written to memory
10	Change CPU Internal Registers	#DR ↵	Display EVA6008 CPU internal registers
		#SR ↵	Set EVA6008 CPU internal registers
		#I ↵	Reset EVA6008 CPU
		#DXY ↵	Display X, Y, MX and MY
		#SXY ↵	Set data for X and Y display and MX, MY

Item No.	Function	Command Format	Outline of Operation
11	History	#H,p1,p2 ↵	Display history data for pointer 1 and pointer 2
		#HB ↵	Display upstream history data
		#HG ↵	Display 21 line history data
		#HP ↵	Display history pointer
		#HPS,a ↵	Set history pointer
		#HC,S/C/E ↵	Sets up the history information acquisition before (S), before/after (C) and after (E)
		#HA,a1,a2 ↵	Sets up the history information acquisition from program area a1 to a2
		#HAR,a1,a2 ↵	Sets up the prohibition of the history information acquisition from program area a1 to a2
		#HAD ↵	Indicates history acquisition program area
		#HS,a ↵	Retrieves and indicates the history information which executed a program address "a"
		#HSW,a ↵ #HSR,a ↵	Retrieves and indicates the history information which wrote or read the data area address "a"
12	File	#RF,file ↵	Move program file to memory
		#RFD,file ↵	Move data file to memory
		#VF,file ↵	Compare program file and contents of memory
		#VFD,file ↵	Compare data file and contents of memory
		#WF,file ↵	Save contents of memory to program file
		#WFD,file ↵	Save contents of memory to data file
		#CL,file ↵	Load ICE62R (ICE6200) set condition from file
		#CS,file ↵	Save ICE62R (ICE6200) set condition to file
		#OPTLD,1,file ↵	Load function option data from file
		#OPTLD,2,file ↵	Load segment option data from file
13	Coverage	#CVD ↵	Indicates coverage information
		#CVR ↵	Clears coverage information
14	ROM Access	#RP ↵	Move contents of ROM to program memory
		#VP ↵	Compare contents of ROM with contents of program memory
		#ROM ↵	Set ROM type
15	Terminate ICE	#Q ↵	Terminate ICE and return to operating system control
16	Command Display	#HELP ↵	Display ICE62R (ICE6200) instruction
17	Self Diagnosis	#CHK ↵	Report results of ICE62R (ICE6200) self diagnostic test

↵ means press the RETURN key.

6 *MASK DATA CHECKER MDC6008*

6.1 *MDC6008 Outline*

The Mask Data Checker MDC6008 is a software tool which checks the program data (C008XXXH.HEX and C008XXXL.HEX) and option data (C008XXXF.DOC and C008XXXS.DOC) created by the user and creates the data file (C6008XXX.PAn) for generating mask patterns. The user must send the file generated through this software tool to Seiko Epson.

Moreover, MDC6008 has the capability to restore the generated data file (C6008XXX.PA0) to the original file format.
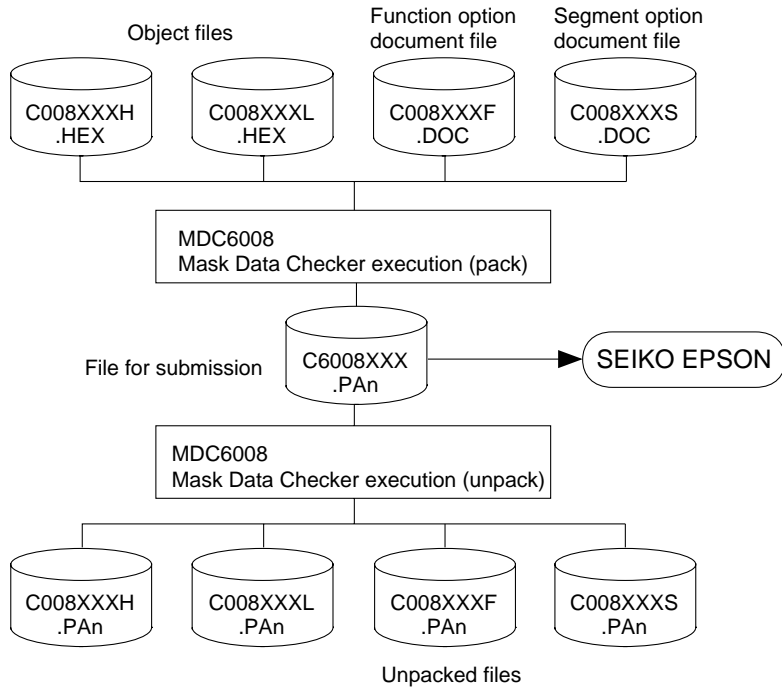

Fig. 6.1.1 MDC6008 execution flow

☞ *The operating method is same as for the E0C62 Family. Refer to the "E0C62 Family Development Tool Reference Manual" for details.*

6.2 *MDC6008 Quick Reference*

■ **Starting command and input/output files**

Execution file:	MDC6008.EXE	
Starting command:	**MDC6008**⏎	⏎ *indicates the Return key.*

Input file:	C008XXXL.HEX (Object file, low-order)	
	C008XXXH.HEX (Object file, high-order)	When packing
	C008XXXF.DOC (Function option document file)	
	C008XXXS.DOC (Segment option document file)	
	C6008XXX.PAn (Packed file)	When unpacking
Output file:	C6008XXX.PAn (Packed file)	When packing
	C008XXXL.PAn (Object file, low-order)	
	C008XXXH.PAn (Object file, high-order)	When unpacking
	C008XXXF.PAn (Function option document file)	
	C008XXXS.PAn (Segment option document file)	

■ Display examples

```
          *** E0C6008 PACK / UNPACK PROGRAM Ver 2.00 ***

EEEEEEEEE   PPPPPPPP      SSSSSSS      OOOOOOO      NNN      NNN
EEEEEEEEE   PPPPPPPPP    SSS  SSSS    OOO    OOO    NNNN     NNN
EEE         PPP    PPP   SSS    SSS   OOO    OOO    NNNNN    NNN
EEE         PPP    PPP   SSS          OOO    OOO    NNNNNN   NNN
EEEEEEEEE   PPPPPPPPPP     SSSSS      OOO    OOO    NNN NNN NNN
EEEEEEEEE   PPPPPPPP         SSSS     OOO    OOO    NNN  NNNNNN
EEE         PPP                SSS    OOO    OOO    NNN   NNNNN
EEE         PPP         SSS    SSS    OOO    OOO    NNN    NNNN
EEEEEEEEE   PPP         SSSS   SSS    OOO    OOO    NNN     NNN
EEEEEEEEE   PPP           SSSSSSS      OOOOOOO      NNN      NN

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                  --- OPERATION MENU ---

                       1. PACK
                       2. UNPACK

                  PLEASE SELECT NO.?
```

Start-up message
When MDC6008 is started, the start-up message and operation menu are displayed. Here, the user is prompted to select operation options.

```
                  --- OPERATION MENU ---

                       1. PACK
                       2. UNPACK

                  PLEASE SELECT NO.? 1↵                    ...(1)

      C008XXXH.HEX --------+
                           |
      C008XXXL.HEX --------+
                           |-------- C6008XXX.PAn (PACK FILE)
      C008XXXF.DOC --------+
                           |
      C008XXXS.DOC --------+

  PLEASE INPUT PACK FILE NAME (C6008XXX.PAn) ?  C60080A0.PA0↵   ...(2)

      C0080A0H.HEX --------+
                           |
      C0080A0L.HEX --------+
                           |-------- C60080A0.PA0
      C0080A0F.DOC --------+
                           |
      C0080A0S.DOC --------+
```

Packing of data
(1) Select "1.PACK" in the operation menu.
(2) Enter the file name.
    After submitting the data to Seiko Epson and there is a need to re-submit the data, increase the numeric value of "n" by one when the input is made.
    (Example: When re-submitting data after "C6008XXX.PA0" has been submitted, the pack file name should be entered as "C6008XXX.PA1".)

With this, the mask file (C6008XXX.PAn) is generated, and the MDC6008 program will be terminated.
Submit this file to Seiko Epson.

Note   Don't use the data generated with the -N option of the Cross Assembler (ASM6008) as program data. If the program data generated with the -N option of the Cross Assembler is packed, undefined program area is filled with FFH code. In this case, following message is displayed.

```
WARNING: FILLED <file_name> FILE WITH FFH.
```

```
                  --- OPERATION MENU ---

                       1. PACK
                       2. UNPACK

                  PLEASE SELECT NO.? 2↵                    ...(1)

  PLEASE INPUT PACKED FILE NAME (C6008XXX.PAn) ?  C60080A0.PA0↵ ...(2)

                           +-------- C0080A0H.PA0
                           |
                           +-------- C0080A0L.PA0
      C60080A0.PA0 --------|
                           +-------- C0080A0F.PA0
                           |
                           +-------- C0080A0S.PA0
```

Unpacking of data
(1) Select "2.UNPACK" in the operation menu.
(2) Enter the packed file name.

With this, the mask data file (C6008XXX.PAn) is restored to the original file format, and the MDC6008 program will be terminated.

Since the extension of the file name remains as "PAn", it must be renamed back to its original form ("HEX" and "DOC") in order to re-debug or modify the restored file.

■ Error messages

Program data error

Error Message	Explanation
1. HEX DATA ERROR : NOT COLON.	There is no colon.
2. HEX DATA ERROR : DATA LENGTH. (NOT 00-20h)	The data length of 1 line is not in the 00–20H range.
3. HEX DATA ERROR : ADDRESS.	The address is beyond the valid range of the program ROM.
4. HEX DATA ERROR : RECORD TYPE. (NOT 00)	The record type of 1 line is not 00.
5. HEX DATA ERROR : DATA. (NOT 00-FFh)	The data is not in the range between 00H and 0FFH.
6. HEX DATA ERROR : TOO MANY DATA IN ONE LINE.	There are too many data in 1 line.
7. HEX DATA ERROR : CHECK SUM.	The checksum is not correct.
8. HEX DATA ERROR : END MARK.	The end mark is not : 00000001FF.
9. HEX DATA ERROR : DUPLICATE.	There is duplicate definition of data in the same address.

Function option data error

Error Message	Explanation
1. OPTION DATA ERROR : START MARK.	The start mark is not "\OPTION". (during unpacking) *
2. OPTION DATA ERROR : OPTION NUMBER.	The option number is not correct.
3. OPTION DATA ERROR : SELECT NUMBER.	The option selection number is not correct.
4. OPTION DATA ERROR : END MARK.	The end mark is not "\\END" (packing) or "\END" (unpacking).*

Segment option data error

Error Message	Explanation
1. SEGMENT DATA ERROR : START MARK.	The start mark is not "\SEGMENT". (during unpacking) *
2. SEGMENT DATA ERROR : DATA.	The segment data is not correct.
3. SEGMENT DATA ERROR : SEGMENT NUMBER.	The SEG No. is not correct.
4. SEGMENT DATA ERROR : SPEC.	The output specification of the SEG terminal is not correct.
5. SEGMENT DATA ERROR : END MARK.	The end mark is not "\\END" (packing) or "\END" (unpacking).*

File error

Error Message	Explanation
1. <File_name> FILE IS NOT FOUND.	The file is not found or the file number set in CONFIG.SYS is less than 10.
2. PACK FILE NAME (File_name) ERROR.	The packed input format for the file name is wrong.
3. PACKED FILE NAME (File_name) ERROR.	The unpacked input format for the file name is wrong.

System error

Error Message	Explanation
1. DIRECTORY FULL.	The directory is full.
2. DISK WRITE ERROR.	Writing on the disk is failed.

\ sometimes appears as ¥, depending on the personal computer being used.

APPENDIX A. E0C6008 INSTRUCTION SET

Classification	Mne-monic	Operand	Operation Code													Flag				Clock	Operation
			B	A	9	8	7	6	5	4	3	2	1	0	I	D	Z	C		
Branch instructions	PSET	p	1	1	1	0	0	1	0	p4	p3	p2	p1	p0					5	NBP ←p4, NPP ←p3~p0
	JP	s	0	0	0	0	s7	s6	s5	s4	s3	s2	s1	s0					5	PCB ←NBP, PCP ←NPP, PCS ←s7~s0
		C, s	0	0	1	0	s7	s6	s5	s4	s3	s2	s1	s0					5	PCB ←NBP, PCP ←NPP, PCS ←s7~s0 if C=1
		NC, s	0	0	1	1	s7	s6	s5	s4	s3	s2	s1	s0					5	PCB ←NBP, PCP ←NPP, PCS ←s7~s0 if C=0
		Z, s	0	1	1	0	s7	s6	s5	s4	s3	s2	s1	s0					5	PCB ←NBP, PCP ←NPP, PCS ←s7~s0 if Z=1
		NZ, s	0	1	1	1	s7	s6	s5	s4	s3	s2	s1	s0					5	PCB ←NBP, PCP ←NPP, PCS ←s7~s0 if Z=0
	JPBA		1	1	1	1	1	1	1	0	1	0	0	0					5	PCB ←NBP, PCP ←NPP, PCSH ←B, PCSL ←A
	CALL	s	0	1	0	0	s7	s6	s5	s4	s3	s2	s1	s0					7	M(SP-1) ←PCP, M(SP-2) ←PCSH, M(SP-3) ←PCSL+1 SP ← SP-3, PCP ←NPP, PCS ←s7~s0
	CALZ	s	0	1	0	1	s7	s6	s5	s4	s3	s2	s1	s0					7	M(SP-1) ←PCP, M(SP-2) ←PCSH, M(SP-3) ←PCSL+1 SP ← SP-3, PCP ←0, PCS ←s7~s0
	RET		1	1	1	1	1	1	0	1	1	1	1	1					7	PCSL ←M(SP), PCSH ←M(SP+1), PCP ←M(SP+2) SP ←SP+3
	RETS		1	1	1	1	1	1	0	1	1	1	1	0					12	PCSL ←M(SP), PCSH ←M(SP+1), PCP ←M(SP+2) SP ←SP+3, PC ←PC+1
	RETD	l	0	0	0	1	l7	l6	l5	l4	l3	l2	l1	l0					12	PCSL ←M(SP), PCSH ←M(SP+1), PCP ←M(SP+2) SP ←SP+3, M(X) ←l3~l0, M(X+1) ←l7~l4, X ←X+2
System control instructions	NOP5		1	1	1	1	1	1	1	1	1	0	1	1					5	No operation (5 clock cycles)
	NOP7		1	1	1	1	1	1	1	1	1	1	1	1					7	No operation (7 clock cycles)
	HALT		1	1	1	1	1	1	1	1	1	0	0	0					5	Halt (stop clock)
Index operation instructions	INC	X	1	1	1	0	1	1	1	0	0	0	0	0					5	X ←X+1
		Y	1	1	1	0	1	1	1	1	0	0	0	0					5	Y ←Y+1
	LD	X, x	1	0	1	1	x7	x6	x5	x4	x3	x2	x1	x0					5	XH ←x7~x4, XL ←x3~x0
		Y, y	1	0	0	0	y7	y6	y5	y4	y3	y2	y1	y0					5	YH ←y7~y4, YL ←y3~y0
		XP, r	1	1	1	0	1	0	0	0	0	0	r1	r0					5	XP ←r
		XH, r	1	1	1	0	1	0	0	0	0	1	r1	r0					5	XH ←r
		XL, r	1	1	1	0	1	0	0	0	1	0	r1	r0					5	XL ←r
		YP, r	1	1	1	0	1	0	0	1	0	0	r1	r0					5	YP ←r
		YH, r	1	1	1	0	1	0	0	1	0	1	r1	r0					5	YH ←r
		YL, r	1	1	1	0	1	0	0	1	1	0	r1	r0					5	YL ←r
		r, XP	1	1	1	0	1	0	1	0	0	0	r1	r0					5	r ←XP
		r, XH	1	1	1	0	1	0	1	0	0	1	r1	r0					5	r ←XH
		r, XL	1	1	1	0	1	0	1	0	1	0	r1	r0					5	r ←XL
		r, YP	1	1	1	0	1	0	1	1	0	0	r1	r0					5	r ←YP
		r, YH	1	1	1	0	1	0	1	1	0	1	r1	r0					5	r ←YH
		r, YL	1	1	1	0	1	0	1	1	1	0	r1	r0					5	r ←YL
	ADC	XH, i	1	0	1	0	0	0	0	0	i3	i2	i1	i0			↕	↕	7	XH ←XH+i3~i0+C
		XL, i	1	0	1	0	0	0	0	1	i3	i2	i1	i0			↕	↕	7	XL ←XL+i3~i0+C
		YH, i	1	0	1	0	0	0	1	0	i3	i2	i1	i0			↕	↕	7	YH ←YH+i3~i0+C
		YL, i	1	0	1	0	0	0	1	1	i3	i2	i1	i0			↕	↕	7	YL ←YL+i3~i0+C

Classification	Mne-monic	Operand	B	A	9	8	7	6	5	4	3	2	1	0	I	D	Z	C	Clock	Operation
Index operation instructions	CP	XH, i	1	0	1	0	0	1	0	0	i3	i2	i1	i0			↕	↕	7	XH-i3~i0
		XL, i	1	0	1	0	0	1	0	1	i3	i2	i1	i0			↕	↕	7	XL-i3~i0
		YH, i	1	0	1	0	0	1	1	0	i3	i2	i1	i0			↕	↕	7	YH-i3~i0
		YL, i	1	0	1	0	0	1	1	1	i3	i2	i1	i0			↕	↕	7	YL-i3~i0
Data transfer instructions	LD	r, i	1	1	1	0	0	0	r1	r0	i3	i2	i1	i0					5	r←i3~i0
		r, q	1	1	1	0	1	1	0	0	r1	r0	q1	q0					5	r←q
		A, Mn	1	1	1	1	1	0	1	0	n3	n2	n1	n0					5	A←M(n3~n0)
		B, Mn	1	1	1	1	1	0	1	1	n3	n2	n1	n0					5	B←M(n3~n0)
		Mn, A	1	1	1	1	1	0	0	0	n3	n2	n1	n0					5	M(n3~n0)←A
		Mn, B	1	1	1	1	1	0	0	1	n3	n2	n1	n0					5	M(n3~n0)←B
	LDPX	MX, i	1	1	1	0	0	1	1	0	i3	i2	i1	i0					5	M(X)←i3~i0, X←X+1
		r, q	1	1	1	0	1	1	1	0	r1	r0	q1	q0					5	r←q, X←X+1
	LDPY	MY, i	1	1	1	0	0	1	1	1	i3	i2	i1	i0					5	M(Y)←i3~i0, Y←Y+1
		r, q	1	1	1	0	1	1	1	1	r1	r0	q1	q0					5	r←q, Y←Y+1
	LBPX	MX, l	1	0	0	1	l7	l6	l5	l4	l3	l2	l1	l0					5	M(X)←l3~l0, M(X+1)←l7~l4, X←X+2
Flag operation instructions	SET	F, i	1	1	1	1	0	1	0	0	i3	i2	i1	i0	↑	↑	↑	↑	7	F←F∨i3~i0
	RST	F, i	1	1	1	1	0	1	0	1	i3	i2	i1	i0	↓	↓	↓	↓	7	F←F∧i3~i0
	SCF		1	1	1	1	0	1	0	0	0	0	0	1				↑	7	C←1
	RCF		1	1	1	1	0	1	0	1	1	1	1	0				↓	7	C←0
	SZF		1	1	1	1	0	1	0	0	0	0	1	0			↑		7	Z←1
	RZF		1	1	1	1	0	1	0	1	1	1	0	1			↓		7	Z←0
	SDF		1	1	1	1	0	1	0	0	0	1	0	0		↑			7	D←1 (Decimal Adjuster ON)
	RDF		1	1	1	1	0	1	0	1	1	0	1	1		↓			7	D←0 (Decimal Adjuster OFF)
	EI		1	1	1	1	0	1	0	0	1	0	0	0	↑				7	I←1 (Enables Interrupt)
	DI		1	1	1	1	0	1	0	1	0	1	1	1	↓				7	I←0 (Disables Interrupt)
Stack operation instructions	INC	SP	1	1	1	1	1	1	0	1	1	0	1	1					5	SP←SP+1
	DEC	SP	1	1	1	1	1	1	0	0	1	0	1	1					5	SP←SP-1
	PUSH	r	1	1	1	1	1	1	0	0	0	0	r1	r0					5	SP←SP-1, M(SP)←r
		XP	1	1	1	1	1	1	0	0	0	1	0	0					5	SP←SP-1, M(SP)←XP
		XH	1	1	1	1	1	1	0	0	0	1	0	1					5	SP←SP-1, M(SP)←XH
		XL	1	1	1	1	1	1	0	0	0	1	1	0					5	SP←SP-1, M(SP)←XL
		YP	1	1	1	1	1	1	0	0	0	1	1	1					5	SP←SP-1, M(SP)←YP
		YH	1	1	1	1	1	1	0	0	1	0	0	0					5	SP←SP-1, M(SP)←YH
		YL	1	1	1	1	1	1	0	0	1	0	0	1					5	SP←SP-1, M(SP)←YL
		F	1	1	1	1	1	1	0	0	1	0	1	0					5	SP←SP-1, M(SP)←F
	POP	r	1	1	1	1	1	1	0	1	0	0	r1	r0					5	r←M(SP), SP←SP+1
		XP	1	1	1	1	1	1	0	1	0	1	0	0					5	XP←M(SP), SP←SP+1
		XH	1	1	1	1	1	1	0	1	0	1	0	1					5	XH←M(SP), SP←SP+1
		XL	1	1	1	1	1	1	0	1	0	1	1	0					5	XL←M(SP), SP←SP+1
		YP	1	1	1	1	1	1	0	1	0	1	1	1					5	YP←M(SP), SP←SP+1

Classification	Mne-monic	Operand	Operation Code B A 9 8	7 6 5 4	3 2 1 0	Flag I D Z C	Clock	Operation
Stack operation instructions	POP	YH	1 1 1 1	1 1 0 1	1 0 0 0		5	YH← M(SP), SP←SP+1
		YL	1 1 1 1	1 1 0 1	1 0 0 1		5	YL←M(SP), SP←SP+1
		F	1 1 1 1	1 1 0 1	1 0 1 0	↕ ↕ ↕ ↕	5	F←M(SP), SP←SP+1
	LD	SPH, r	1 1 1 1	1 1 1 0	0 0 r1 r0		5	SPH←r
		SPL, r	1 1 1 1	1 1 1 1	0 0 r1 r0		5	SPL←r
		r, SPH	1 1 1 1	1 1 1 0	0 1 r1 r0		5	r←SPH
		r, SPL	1 1 1 1	1 1 1 1	0 1 r1 r0		5	r←SPL
Arithmetic instructions	ADD	r, i	1 1 0 0	0 0 r1 r0	i3 i2 i1 i0	★ ↕ ↕	7	r←r+i3~i0
		r, q	1 0 1 0	1 0 0 0	r1 r0 q1 q0	★ ↕ ↕	7	r←r+q
	ADC	r, i	1 1 0 0	0 1 r1 r0	i3 i2 i1 i0	★ ↕ ↕	7	r←r+i3~i0+C
		r, q	1 0 1 0	1 0 0 1	r1 r0 q1 q0	★ ↕ ↕	7	r←r+q+C
	SUB	r, q	1 0 1 0	1 0 1 0	r1 r0 q1 q0	★ ↕ ↕	7	r←r-q
	SBC	r, i	1 1 0 1	0 1 r1 r0	i3 i2 i1 i0	★ ↕ ↕	7	r←r-i3~i0-C
		r, q	1 0 1 0	1 0 1 1	r1 r0 q1 q0	★ ↕ ↕	7	r←r-q-C
	AND	r, i	1 1 0 0	1 0 r1 r0	i3 i2 i1 i0	↕	7	r←r∧i3~i0
		r, q	1 0 1 0	1 1 0 0	r1 r0 q1 q0	↕	7	r←r∧q
	OR	r, i	1 1 0 0	1 1 r1 r0	i3 i2 i1 i0	↕	7	r←r∨i3~i0
		r, q	1 0 1 0	1 1 0 1	r1 r0 q1 q0	↕	7	r←r∨q
	XOR	r, i	1 1 0 1	0 0 r1 r0	i3 i2 i1 i0	↕	7	r←r∀i3~i0
		r, q	1 0 1 0	1 1 1 0	r1 r0 q1 q0	↕	7	r←r∀q
	CP	r, i	1 1 0 1	1 1 r1 r0	i3 i2 i1 i0	↕ ↕	7	r-i3~i0
		r, q	1 1 1 1	0 0 0 0	r1 r0 q1 q0	↕ ↕	7	r-q
	FAN	r, i	1 1 0 1	1 0 r1 r0	i3 i2 i1 i0	↕	7	r∧i3~i0
		r, q	1 1 1 1	0 0 0 1	r1 r0 q1 q0	↕	7	r∧q
	RLC	r	1 0 1 0	1 1 1 1	r1 r0 r1 r0	↕ ↕	7	d3←d2, d2←d1, d1←d0, d0←C, C←d3
	RRC	r	1 1 1 0	1 0 0 0	1 1 r1 r0	↕ ↕	5	d3←C, d2←d3, d1←d2, d0←d1, C←d0
	INC	Mn	1 1 1 1	0 1 1 0	n3 n2 n1 n0	↕ ↕	7	M(n3~n0)←M(n3~n0)+1
	DEC	Mn	1 1 1 1	0 1 1 1	n3 n2 n1 n0	↕ ↕	7	M(n3~n0)←M(n3~n0)-1
	ACPX	MX, r	1 1 1 1	0 0 1 0	1 0 r1 r0	★ ↕ ↕	7	M(X)←M(X)+r+C, X←X+1
	ACPY	MY, r	1 1 1 1	0 0 1 0	1 1 r1 r0	★ ↕ ↕	7	M(Y)←M(Y)+r+C, Y←Y+1
	SCPX	MX, r	1 1 1 1	0 0 1 1	1 0 r1 r0	★ ↕ ↕	7	M(X)←M(X)-r-C, X←X+1
	SCPY	MY, r	1 1 1 1	0 0 1 1	1 1 r1 r0	★ ↕ ↕	7	M(Y)←M(Y)-r-C, Y←Y+1
	NOT	r	1 1 0 1	0 0 r1 r0	1 1 1 1	↕	7	r←r̄

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Abbreviations used in the explanations have the following meanings.

Symbols associated with registers and memory

A	A register
B	B register
X	XHL register
	(low order eight bits of index register IX)
Y	YHL register
	(low order eight bits of index register IY)
XH	XH register
	(high order four bits of XHL register)
XL	XL register
	(low order four bits of XHL register)
YH	YH register
	(high order four bits of YHL register)
YL	YL register
	(low order four bits of YHL register)
SP	Stack pointer SP
SPH	High-order four bits of stack pointer SP
SPL	Low-order four bits of stack pointer SP
MX, M(X)	Data memory whose address is specified with index register IX
MY, M(Y)	Data memory whose address is specified with index register IY
Mn, M(n)	Data memory address 000H–00FH (address specified with immediate data n of 00H–0FH)
M(SP)	Data memory whose address is specified with stack pointer SP
r, q	Two-bit register code
	r, q is two-bit immediate data; according to the contents of these bits, they indicate registers A, B, and MX and MY (data memory whose addresses are specified with index registers IX and IY)

r		q		Register
r1	r0	q1	q0	specified
0	0	0	0	A
0	1	0	1	B
1	0	1	0	MX
1	1	1	1	MY

Symbols associated with program counter

NBP	New bank pointer
NPP	New page pointer
PCB	Program counter bank
PCP	Program counter page
PCS	Program counter step
PCSH	Four high order bits of PCS
PCSL	Four low order bits of PCS

Symbols associated with flags

F	Flag register (I, D, Z, C)
C	Carry flag
Z	Zero flag
D	Decimal flag
I	Interrupt flag
↓	Flag reset
↑	Flag set
↕	Flag set or reset

Associated with immediate data

p	Five-bit immediate data or label 00H–1FH
s	Eight-bit immediate data or label 00H–0FFH
l	Eight-bit immediate data 00H–0FFH
i	Four-bit immediate data 00H–0FH

Associated with arithmetic and other operations

+	Add
-	Subtract
∧	Logical AND
∨	Logical OR
∀	Exclusive-OR
★	Add-subtract instruction for decimal operation when the D flag is set

APPENDIX B. TROUBLESHOOTING

Tool	Problem	Remedy measures
ICE62R (ICE6200)	Nothing appears on the screen, or nothing works, after activation.	Check the following and remedy if necessary: • Is the RS-232C cable connected correctly? • Is the RS-232C driver installed? • Is SPEED.COM or MODE.COM on the disk? • Is the execution file correct? MS-DOS ICS6008J.EXE PC-DOS ICS6008W.EXE • Is the DOS version correct? MS-DOS Ver. 3.1 or later PC-DOS Ver. 2.1 or later • Is the DIP switches that set the baud rate of the main ICE62R (ICE6200) unit set correctly? • Is the breaker of the ICE62R (ICE6200) set to ON?
	The ICE6200 breaker tripped or the ICE62R fuse cut immediately after activation.	Check the following and remedy if necessary: • Are connectors F1 and F5 connected to the EVA6008 correctly? • Is the target board power short-circuiting?
	<ILLEGAL VERSION ICE6200> appears on the screen immediately after activation.	The wrong version of ICE is being used. Use the latest version.
	<ILLEGAL VERSION PARAMETER FILE> appears on the screen immediately after activation.	The wrong version of ICS6008P.PAR is being used. Use the latest version.
	Immediate values A (10) and B (11) cannot be entered correctly with the A command.	The A and B registers are reserved for the entry of A and B. Write 0A and 0B when entering A (10) and B (11). *Example:* LD A, B Data in the B register is loaded into the A register. LD B, 0A Immediate value A is loaded into the B register.
	<UNUSED AREA> is displayed by the SD command.	This message is output when the address following one in which data is written is unused. It does not indicates problem. Data is correctly set in areas other than the read-only area.
	You can not do a real-time run in break-trace mode.	Since the CPU stops temporarily when breaking conditions are met, executing in a real-time is not performed.
	Output from the EVA is impossible when data is written to the I/O memory for Buzzer and Fout output with the ICE command.	Output is possible only in the real-time run mode.
SOG6008	An R error occurs although the address is correctly set in the segment source file.	Check the following and remedy if necessary: • Does the address symbol use capital letters? • Are the output ports set for every two terminals?

Tool	Problem	Remedy measures
ASM6008	An R error occurs although the final page is passed.	The cross assembler is designed to output "R error" every time the page is changed. Use a pseudo-instruction to set the memory, such as ORG or PAGE, to change the page. See "Memory setting pseudo-instructions" in the cross assembler manual.
MDC6008	Activation is impossible.	Check the following and remedy if necessary: • Is the number of files set at ten or more in OS environment file CONFIG.SYS?
EVA6008	The EVA6008 does not work when it is used independently.	Check the following and remedy if necessary: • Has the EPROM for F.HEX and S.HEX been replaced by the EPROM for the target? • Is the EPROM for F.HEX and S.HEX installed correctly? • Is the appropriate voltage being supplied? (5V DC, 3A, or more) • Are the program ROMs (H and L) installed correctly? • Is data written from address 4000H? (When the 27C256 is used as the program ROM)
	Target segment does not light.	Check the following and remedy if necessary: • Is an EPROM with an access time of 250 ns or less being used for S.HEX.

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