MF640-02

EPSON

CMOS 4-BIT SINGLE CHIP MICROCOMPUTER

E0C6233 DEVELOPMENT TOOL MANUAL

ENERGY SAVING EPSON

SEIKO EPSON CORPORATION

E0C6233 Development Tool Manual

PREFACE

This manual mainly explains the outline of the development support tool for the 4-bit Single Chip Microcomputer E0C6233.

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 EVA6233 Manual ICE6200 Hardware Manual
Development procedure	☞ E0C62 Family Technical Guide
Device (E0C6233)	☞ E0C6233 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 DEV6233

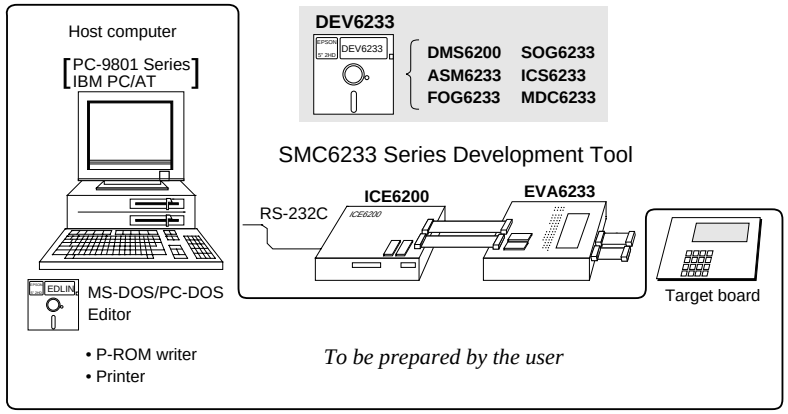
The below software are included in the product of the E0C6233 development support tool DEV6233.

1. Development Tool Management System DMS6200 ..... Menu selection for each software / start-up software
2. Cross Assembler ASM6233 ..... Cross assembler for program preparation
3. Function Option Generator FOG6233 ..... Function option data preparation program
4. Segment Option Generator SOG6233 ..... Segment option data preparation program
5. ICE Control Software ICS6233 ..... ICE control program
6. Mask Data Checker MDC6233 ..... Mask data preparation program

1.2 Developmental Environment

The software product of the development support tool DEV6233 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 E0C6233, 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 DEV6233 system requires a host computer with a RAM capacity of about 140K bytes. Since the 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 DEV6233.

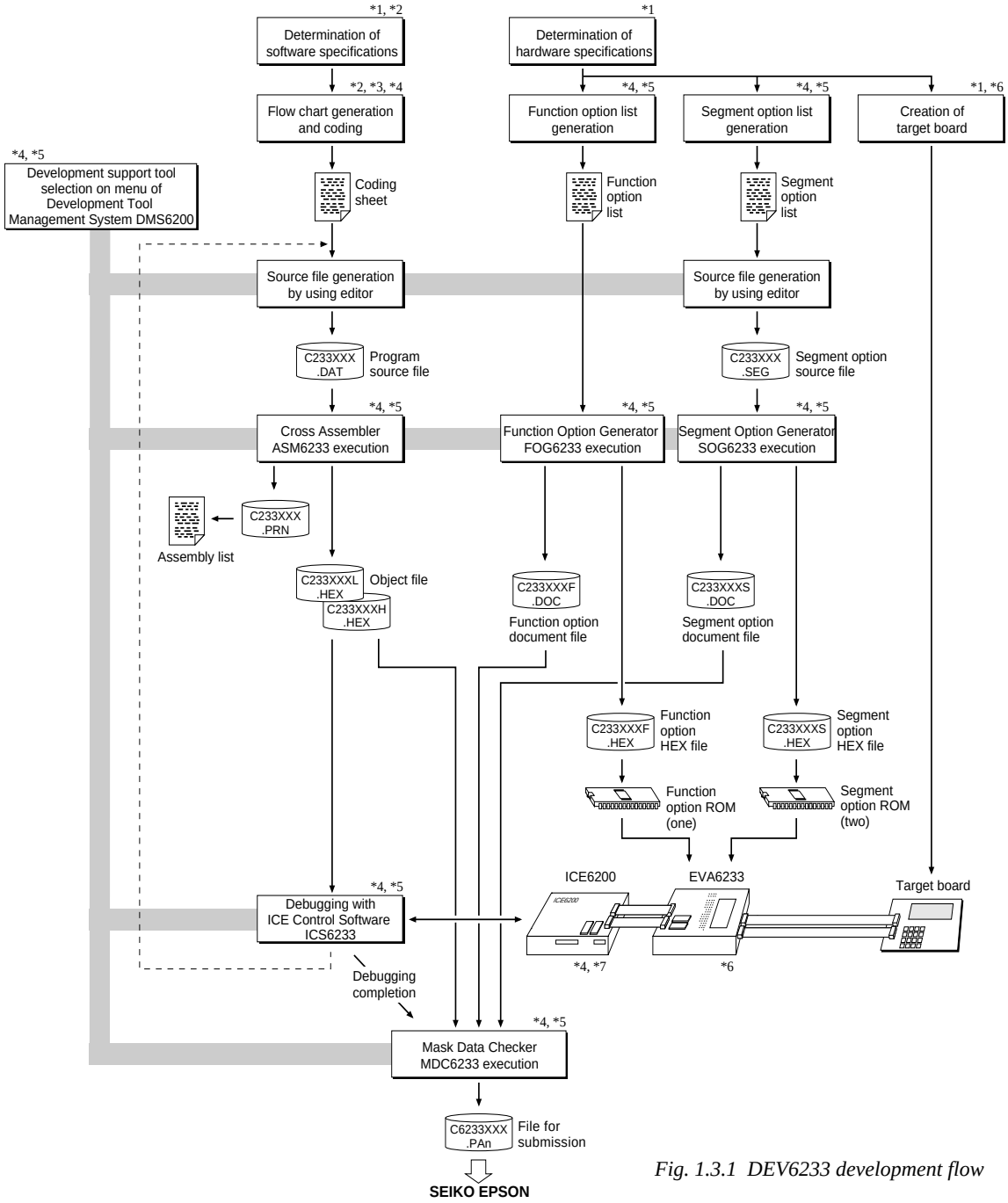


Fig. 1.3.1 DEV6233 development flow

Concerning file names

All the input-output file name for the each development support tool commonly use "C233XXX". In principle each file should be produced in this manner. Seiko Epson will designate the "XXX" for each customer.

☞ Reference Manual

*1 E0C6233 Technical Hardware Manual
*2 E0C6233 Technical Software Manual
*3 E0C6200/6200A Core CPU Manual
*4 E0C62 Family Development Tool Reference Manual
*5 E0C6233 Development Tool Manual (this manual)
*6 EVA6233 Manual
*7 ICE6200 Hardware Manual

1.4 Production of Execution Disk

Execution files for each software development support tool and batch and parameter files for the ICE6200 are recorded in the DEV6233 floppy disk.
The content of the files contained in the DEV6233 floppy disk are shown below.

PC-DOS version	MS-DOS version	Contents
ASM6233.EXE	ASM6233.EXE	Cross Assembler execution file
DMS6200.EXE	DMS6200.EXE	Development Tool Management System execution file
FOG6233.EXE	FOG6233.EXE	Function Option Generator execution file
ICS6233B.BAT	ICS6233.BAT	ICE Control Software batch file
ICS6233W.EXE	ICS6233J.EXE	ICE Control Software execution file
ICS6233P.PAR	ICS6233P.PAR	ICE Control Software parameter file
MDC6233.EXE	MDC6233.EXE	Mask Data Checker execution file
SOG6233.EXE	SOG6233.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 (DEV6233, etc.) then copy the content of the floppy disk into that subdirectory using the COPY 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 (DEV6233), then insert the original disk into the A drive and execute the COPY command.

```
C\>MD DEV6233↵
C\>CD DEV6233↵
C\DEV6233\>COPY A:*.*↵
```

■ 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 MDC6233 will handle many files.

Example:

Setting of FILES (CONFIG.SYS)

```
C\>TYPE  CONFIG.SYS↵
     :
FILES=20
     :
```

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

■ It is a good idea to copy the editor into the disk to be copied and the subdirectory so you can also select the editor from the DMS6200 menu.

■ In "ICS6233(B).BAT" the batch process is indicated such that the ICS6233J(W).EXE is executed after the execution of the command for the setting of the RS-232C communication parameters. When first executing the ICE Control Software after resetting the host computer, select then activate this batch file from the DMS6200 menu.
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.

RS-232C Setting (PC-DOS version)

```
MODE  COM1:  4800, n, 8, 1, p
```

RS-232C Setting (MS-DOS version)

```
SPEED  R0  9600  B8  PN  S1
```

Note The DMS6200 prepares a menu from files that are in the current directory. Consequently, be sure to arrange the above mentioned files in the same disk or the same directory.

2 DEVELOPMENT TOOL MANAGEMENT SYSTEM DMS6200

2.1 DMS6200 Outline

The DMS6200 (Development Tool Management System) is a software which selects the DEV6233 software development support tool and the program such as an editor in menu form and starts it.
In this way the various software frequently executed during debugging can be effectively activated.

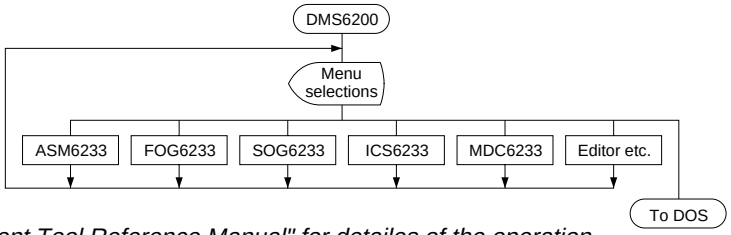


Fig. 2.1.1 DMS6200 execution flow

Refer to the "E0C62 Family Development Tool Reference Manual" for detailes of the operation.

2.2 DMS6200 Quick Reference

■ Starting command

Execution file: **DMS6200.EXE** ***Starting command:*** **DMS6200**↵ ↵ *indicates the Return key.*

■ Display examples

```
   *** E0C6200 Development tool Management System. --- Ver 1.0 ***

EEEEEEEEEE   PPPPPPPP        SSSSSSS       OOOOOOOO     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      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       OOOOOOOO     NNN      NN

               (C) Copyright 1991 SEIKO EPSON CORP.

                          STRIKE ANY KEY.
```

Start message
When DMS6200 is started, the following 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.

```
      DMS6200 Version 1.0     Copyright(C) SEIKO EPSON CORP. 1991.

1) ASM6233 .EXE
2) FOG6233 .EXE
3) ICS6233B.BAT
4) ICS6233W.EXE
5) MDC6233 .EXE
6) SOG6233 .EXE

Input Number ? [1  ]
```

Menu screen (PC-DOS Version)
A list of all executable files will appear on this menu screen.
Input the number of the development support tool you wish to start and then press the "RETURN" key. To return to DOS at this point, press the "ESC" key.

```
      DMS6200 Version 1.0     Copyright(C) SEIKO EPSON CORP. 1991.

 1) C233XXX .DAT
 2) C233XXX .PRN
 3) C233XXX .SEG
 :     :
10) C6233XXX.PA0

 Input Number ? [1  ]

   Edit > [ASM6233 C233XXX                                        ]
```

Source file selection screen
To starting ASM6233, select the source file on this screen. When the source file is selected by number, the edit line enclosed in [ ] will appear; enter the option parameter if necessary. Press the "RETURN" key when input is completed.When starting, press the "RETURN" key twice particularly for the support tools which do not require source files. To return to DOS at this point, press the "ESC" key.

3 CROSS ASSEMBLER ASM6233

3.1 ASM6233 Outline

The ASM6233 cross assembler is an assembler program for generating the machine code used by the E0C6233 4-bit, single-chip microcomputers. The Cross Assembler ASM6233 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.

☞ *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.*

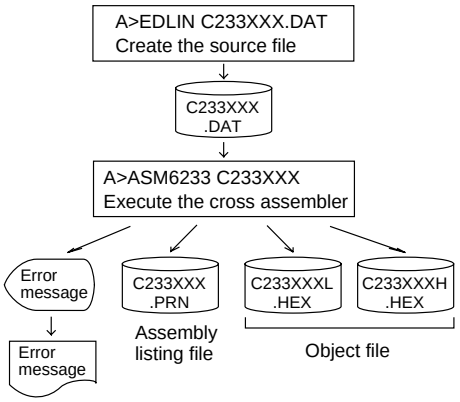


Fig. 3.1.1 ASM6233 execution flow

3.2 E0C6233 Restrictions

Note the following when generating a program by the E0C6233:

■ ROM area

The capacity of the E0C6233 ROM is 3K steps (0000H to 0BFFH).
Therefore, the specification range of the memory setting pseudo-instructions and PSET instruction is restricted.

Memory configuration:

Bank: Only bank 0, Page: 12 pages (0 to 0BH), each 256 steps

Significant specification range:

ORG	pseudo-instruction:	0000H to 0BFFH
PAGE	pseudo-instruction:	00H to 0BH
BANK	pseudo-instruction:	Only 0H
PSET	instruction:	00H to 0BH

■ RAM area

The capacity of the E0C6233 RAM is 320 words (000H to 1FEH, 4 bits/word).
However, note the following points when programming.

(1) The following addresses become unused area. Memory access is invalid when the unused area is specified.
0A0H–0BFH, (0C0H–0EFH), 0F4H, 0F5H, 0FAH, 0FBH, 180H–1EFH, 1F4H, 1F5H, 1FAH, 1FBH

(2) When 0C0H–0EFH has been specified as the segment data memory through the mask option, that area becomes write-only.

(3) Since RAM is set for up to 1 page, only the subordinate 1 bit of the page section of the index register which specifies address is effective. (The 3 superordinate bits are ignored.)

Example:

```
LD    A,2
LD    XP,A
LD    X,0F5H
```

0F5H 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 E0C6233 instruction sets.

3.3 ASM6233 Quick Reference

■ Starting command and input/output files

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

Execution file: ASM6233.EXE

Starting command: **ASM6233_ [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: C233XXX.DAT (Source file)

Output file:
C233XXXL.HEX (Object file, low-order)
C233XXXH.HEX (Object file, high-order)
C233XXX.PRN (Assembly listing file)

■ Display example

```
          *** E0C6233 CROSS ASSEMBLER. --- Ver 2.00 ***

EEEEEEEEEE   PPPPPPPP        SSSSSSS       00000000     NNN     NNN
EEEEEEEEEE   PPPPPPPPPP     SSS   SSSS    000    000    NNNN    NNN
EEE          PPP     PPP   SSS     SSS   000      000   NNNNN   NNN
EEE          PPP     PPP    SSS          000      000   NNNNNN  NNN
EEEEEEEEEE   PPPPPPPPPP      SSSSSS      000      000   NNN NNN NNN
EEEEEEEEEE   PPPPPPPP           SSSS     000      000   NNN  NNNNNN
EEE          PPP                 SSS    000      000   NNN   NNNNN
EEE          PPP           SSS     SSS   000    000    NNN    NNNN
EEEEEEEEEE   PPP           SSSS   SSS     000    000    NNN     NNN
EEEEEEEEEE   PPP            SSSSSSS       00000000     NNN      NN

             (C) COPYRIGHT 1991 SEIKO EPSON CORP.

          SOURCE FILE NAME IS " C233XXX.DAT "

          THIS SOFTWARE MAKES NEXT FILES.

             C233XXXH.HEX  ...  HIGH BYTE OBJECT FILE.
             C233XXXL.HEX  ...  LOW BYTE OBJECT FILE.
             C233XXX .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 ASM6233 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, ASM6233 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 11`
SECTION (Section)	To define boundary of section	`SECTION`
END (End)	To terminate assembly	`END`

MACRO (Macro)	To define macro	`CHECK MACRO DATA`
		`LOCAL LOOP`
		`LOOP CP MX,DATA`
		`JP NZ,LOOP`
		`ENDM`
		
		`CHECK 1`

LOCAL (Local)	To make local specification of label during macro definition	
ENDM (End Macro)	To end macro definition	

■ 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)	• A statement exceeded a page boundary although its location was not specified. • 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).

4 FUNCTION OPTION GENERATOR FOG6233

4.1 FOG6233 Outline

With the 4-bit single-chip E0C6233 microcomputers, the customer may select 19 hardware options. By modifying the mask patterns of the E0C6233 according to the selected options, the system can be customized to meet the specifications of the target system.
The Function Option Generator FOG6233 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 FOG6233, the E0C6233 mask pattern is automatically generated by a general purpose computer.
The HEX file for the evaluation board (EVA6233) 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.*

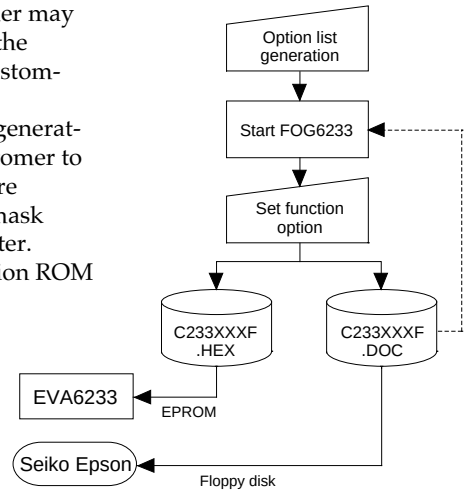


Fig. 4.1.1 FOG6233 execution flow

4.2 E0C6233 Option List

Multiple specifications are available in each option item as indicated in the Option List. Using "4.3 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

☐ 1. E0C6233 (Normal Type)
☐ 2. E0C62L33 (Low Power Type)
☐ 3. E0C62A33 (Twin Clock Type)

2. OSC1 SYSTEM CLOCK (only for E0C62A33)

☐ 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. WATCH DOG TIMER

☐ 1. Use ☐ 2. Not Use

5. INTERRUPT NOISE REJECTOR

• K00–K03 ..... ☐ 1. Use ☐ 2. Not Use
• K10 ..... ☐ 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

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

10. R12 SPECIFICATION

- OUTPUT SPECIFICATION ..... ☐ 1. Complementary ☐ 2. Pch-OpenDrain
- OUTPUT TYPE ..... ☐ 1. DC Output
  - ☐ 2. FOUT 32768 [Hz]
  - ☐ 3. FOUT 16384 [Hz]
  - ☐ 4. FOUT 8192 [Hz]
  - ☐ 5. FOUT 4096 [Hz]
  - ☐ 6. FOUT 2048 [Hz]
  - ☐ 7. FOUT 1024 [Hz]
  - ☐ 8. FOUT 512 [Hz]
  - ☐ 9. FOUT 256 [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. EVENT COUNTER NOISE REJECTOR

☐ 1. 2048 [Hz] ☐ 2. 256 [Hz]

14. LCD COMMON DUTY

☐ 1. 1/4 Duty ☐ 2. 1/3 Duty

15. SEGMENT MEMORY ADDRESS

☐ 1. 4*–6* (R/W) ☐ 2. C*–E* (W)

16. SIN PULL DOWN RESISTOR

☐ 1. With Resistor ☐ 2. Gate Direct

17. SOUT OUTPUT SPECIFICATION

☐ 1. Complementary ☐ 2. Pch-OpenDrain

18. SCLK SPECIFICATION

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

19. SIO DATA PERMUTATION

☐ 1. MSB First ☐ 2. LSB First

4.3 Option Specifications and Selection Message

Screen that can be selected as function options set on the E0C6233 are shown below, and their specifications are also described.

1 Device type

```
*** OPTION  NO.1 ***

--- DEVICE TYPE ---

            1. E0C6233  ( NORMAL TYPE )
            2. E0C62L33 ( LOW POWER TYPE )
            3. E0C62A33 ( TWIN CLOCK TYPE )

PLEASE SELECT NO.(1) ? 3↵

            3. E0C62A33 ( TWIN CLOCK TYPE )  SELECTED
```

Select the chip specification.
E0C6233, E0C62L33, and E0C62A33 denote 3 V power source voltage specification, LOW POWER specification for 1.5 V power source voltage, and TWIN CLOCK specification, respectively.
When 6233 and 62L33 are selected, oscillation circuit OSC3 is fixed at CR oscillation. However, it can not be used.

2 OSC3 system clock

Select oscillation circuit that uses OSC3 and OSC4.

```
*** OPTION  NO.2 ***

--- OSC3 OSCILLATOR ---

                        1. CR
                        2. CERAMIC

PLEASE SELECT NO.(1) ? 1↵

                        1. CR  SELECTED
```

* The above selection is only possible with 62A33.

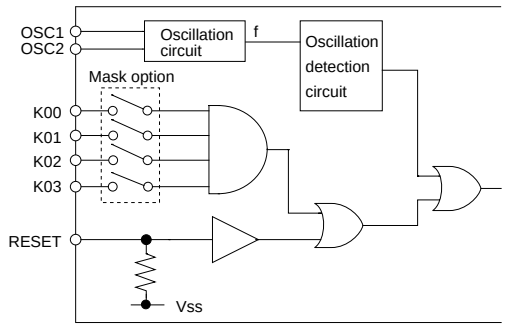
To minimize external components, CR oscillation circuit would be suitable; to obtain a stable oscillation frequency, ceramic oscillation circuit would be suitable. When CR oscillation circuit is selected, only resistors are needed as external components since capacities are built-in.
On the other hand, when ceramic oscillation circuit is selected, ceramic oscillator, gate capacity and drain capacity are needed as external components. Although when ceramic oscillation circuit is selected, it is fixed at 455 kHz, when CR oscillation circuit is selected, frequency may be modified to a certain extent depending on the resistance of external components.
The reset function and time authorize circuit are set

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) ? 1↵

       TIME AUTHORIZE    1. USE
                         2. NOT USE

PLEASE SELECT NO.(1) ? 1↵

       COMBINATION       1. NOT USE  SELECTED
       TIME AUTHORIZE    1. USE  SELECTED
```

when K00 through K03 are entered.
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 4.3.1.
Fig. 4.3.1 System reset circuit

4 Watchdog timer

```
*** OPTION  NO.4 ***

--- WATCH DOG TIMER ---

                         1. USE
                         2. NOT USE

PLEASE SELECT NO.(1) ? 1↵

                         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.
Select whether noise rejector will be supplemented

5 Input interrupt noise rejector

```
*** OPTION  NO.5 ***

--- INTERRUPT 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↵

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

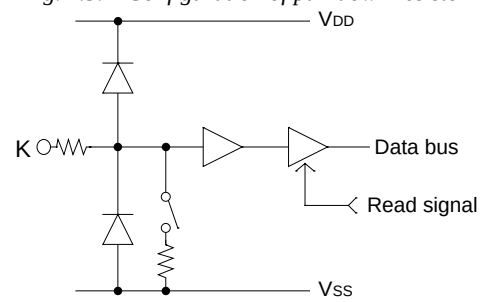
to the input interruptor of K00–K03 and K10.
When "Use" is selected, the entry signal will pass the noise rejector, and occurrence of interrupt errors due to noise or chattering can be avoided. Note, however, that because the noise rejector performs entry signal sampling at 4 kHz, "Not Use" should be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

6 Input port pull down resistor

```
*** OPTION  NO.6 ***

--- INPUT PORT PULL DOWN RESISTOR ---

        K00             1. WITH RESISTOR
                        2. GATE DIRECT

PLEASE SELECT NO.(1) ? 1↵

        K01             1. WITH RESISTOR
                        2. GATE DIRECT

PLEASE SELECT NO.(1) ? 1↵

        K02             1. WITH RESISTOR
                        2. GATE DIRECT

PLEASE SELECT NO.(1) ? 1↵

        K03             1. WITH RESISTOR
                        2. GATE DIRECT

PLEASE SELECT NO.(1) ? 1↵

        K10             1. WITH RESISTOR
                        2. GATE DIRECT

PLEASE SELECT NO.(1) ? 1↵

        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
```

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 (V_{DD}) to low (V_{SS}) 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 4.3.2.

Fig. 4.3.2 Configuration of pull down resistor



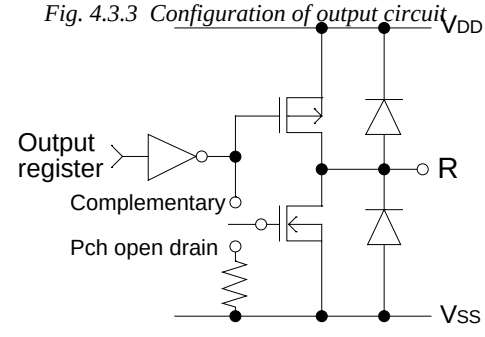
Select the output specification for the output ports

7 Output port output specification (R00–R03)

```
*** OPTION  NO.7 ***

--- OUTPUT PORT SPECIFICATION (R00-R03) ---

        R00             1. COMPLEMENTARY
                        2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

        R01             1. COMPLEMENTARY
                        2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

        R02             1. COMPLEMENTARY
                        2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

        R03             1. COMPLEMENTARY
                        2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

        R00             1. COMPLEMENTARY  SELECTED
        R01             1. COMPLEMENTARY  SELECTED
        R02             1. COMPLEMENTARY  SELECTED
        R03             1. COMPLEMENTARY  SELECTED
```

(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 4.3.3.

Fig. 4.3.3 Configuration of output circuit



Select the output specification for R10 terminal.

8 R10 specification

```
*** OPTION  NO.8 ***

--- R10 SPECIFICATION ---

    OUTPUT SPECIFICATION 1. COMPLEMENTARY
                         2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

    OUTPUT TYPE          1. D.C.
                         2. BUZZER

PLEASE SELECT NO.(1) ? 2↵

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

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

The circuit configuration is the same as that of output ports (R00–R03 shown in Figure 4.3.3).
Refer to Figure 4.3.6 for buzzer output waveform.
Select the output specification for R11 terminal.

9 R11 specification

```
*** OPTION  NO.9 ***

--- R11 SPECIFICATION ---

    OUTPUT SPECIFICATION 1. COMPLEMENTARY
                         2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

    OUTPUT SPECIFICATION 1. COMPLEMENTARY  SELECTED
```

Either complementary output or Pch open drain output may be selected.
The circuit configuration is the same as that of output ports (R00–R03 shown in Figure 4.3.3).
Select the output specification for R12 terminal.

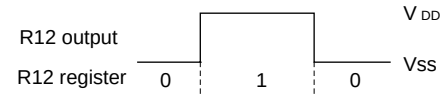
10 R12 specification

```
*** OPTION  NO.10 ***

--- R12 SPECIFICATION ---

    OUTPUT SPECIFICATION 1. COMPLEMENTARY
                         2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

    OUTPUT TYPE          1. D.C.
                         2. FOUT 32768 [HZ]
                         3. FOUT 16384 [HZ]
                         4. FOUT  8192 [HZ]
                         5. FOUT  4096 [HZ]
                         6. FOUT  2048 [HZ]
                         7. FOUT  1024 [HZ]
                         8. FOUT   512 [HZ]
                         9. FOUT   256 [HZ]

PLEASE SELECT NO.(1) ? 1↵

    OUTPUT SPECIFICATION 1. COMPLEMENTARY  SELECTED
    OUTPUT TYPE          1. D.C.  SELECTED
```

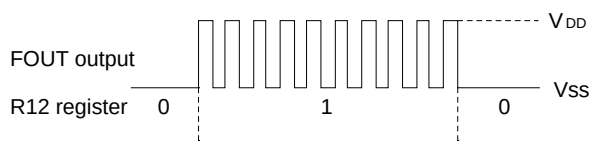
Either complementary output or Pch open drain output may be selected.
When DC output is selected, R12 becomes a regular output port. When FOUT is selected, clock with frequency selected from R12 terminal is generated by writing "1" to the R12 register.

– When DC output is selected
When 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 4.3.4.

Fig. 4.3.4 Output waveform at DC output selection



– When FOUT output is selected



selection

When FOUT bit (R12 register) is set to "1", 50% duty and VDD–VSS amplitude square wave is generated at the specified frequency. When set to "0", the FOUT terminal goes low (VSS). A FOUT frequency may be selected from among 8 types, ranging from 256 Hz to 32,768 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 4.3.5.

Fig. 4.3.5 Output waveform at R12 FOUT output

11 R13 specification

```
*** OPTION  NO.11 ***

--- R13 SPECIFICATION ---

    OUTPUT SPECIFICATION 1. COMPLEMENTARY
                         2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

    OUTPUT TYPE          1. D.C.
                         2. BUZZER OUTPUT R13
                         3. BUZZER OUTPUT R10

PLEASE SELECT NO.(1) ? 1↵

    OUTPUT SPECIFICATION 1. COMPLEMENTARY  SELECTED
    OUTPUT TYPE          1. D.C.  SELECTED
```

Select the output specification for 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 R10 buzzer output is generated from R13 terminal. R13 and R10 control bits become buzzer inverted output when "1" is written to R13 and R10 registers, respectively.

* The buzzer inverted output may not be selected when the output type R10 terminal (see Option 8, "R10 specification") is not set to buzzer. Moreover, at this point, when the output type of R10 terminal is reselected after selecting buzzer inverted output, the output type of R10 is fixed at buzzer output.

Buzzer output waveform is shown in Figure 4.3.6.

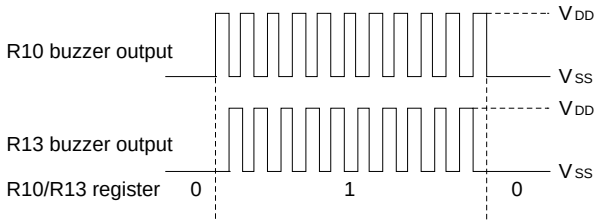


Fig. 4.3.6 Buzzer output waveform

12 I/O port specification

```
*** OPTION  NO.12 ***

--- I/O PORT OUTPUT SPECIFICATION ---

        P00             1. COMPLEMENTARY
                        2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

        P01             1. COMPLEMENTARY
                        2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

        P02             1. COMPLEMENTARY
                        2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

        P03             1. COMPLEMENTARY
                        2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

        P10             1. COMPLEMENTARY
                        2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

        P11             1. COMPLEMENTARY
                        2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

        P12             1. COMPLEMENTARY
                        2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

        P13             1. COMPLEMENTARY
                        2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

        P00             1. COMPLEMENTARY  SELECTED
        P01             1. COMPLEMENTARY  SELECTED
        P02             1. COMPLEMENTARY  SELECTED
        P03             1. COMPLEMENTARY  SELECTED
        P10             1. COMPLEMENTARY  SELECTED
        P11             1. COMPLEMENTARY  SELECTED
        P12             1. COMPLEMENTARY  SELECTED
        P13             1. COMPLEMENTARY  SELECTED
```

Select the output specification to be used during I/O ports (P00–P03 and P10–P13) output mode selection.
Either complementary output or Pch open drain output may be selected.
The circuit configuration of the output driver is the same as that of output ports (R00–R03 shown in Figure 4.3.3).
Select complementary output for unused ports.

The I/O ports can control the input/output direction according to the IOC bit (7E address, D0 bit, and FE, D0 bit); 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 4.3.7.

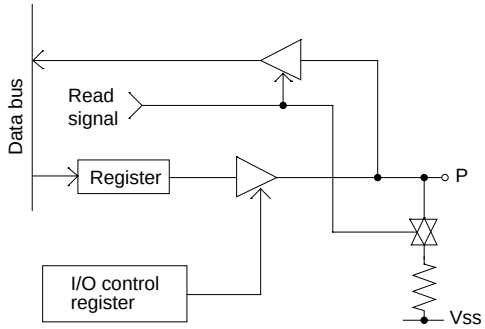


Fig. 4.3.7 Circuit configuration of I/O port

13 Event counter noise rejector

```
*** OPTION  NO.13 ***

--- EVENT COUNTER NOISE REJECTOR ---

                        1. 2048 [HZ]
                        2.  256 [HZ]

PLEASE SELECT NO.(1) ? 1↵

                        1. 2048 [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 2048 Hz or 256 Hz may be selected as the sampling frequency.
Select the one suitable for the input signal.

14 LCD common duty

```
*** OPTION  NO.14 ***

--- LCD COMMON DUTY ---

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

PLEASE SELECT NO.(1) ? 1↵

                        1. 1/4 DUTY  SELECTED
```

Select the common (drive) duty for the LCD segment.
When 1/3 duty is selected, with 3 COM terminals and 40 SEG terminals, i.e., up to 120 segments may be driven; when 1/4 duty is selected, with 4 COM terminals and 40 SEG terminals, up to 160 segment drives will be possible.
When 1/3 duty is selected, COM terminals COM0–COM2 become effective and COM3 will always generate OFF signals.
For drive duty selection, please refer to Table 4.3.1.

Table 4.3.1 Common duty selection standard

Number of LCD segment drives	Common duty
1 – 120	1/3
121 – 160	1/4

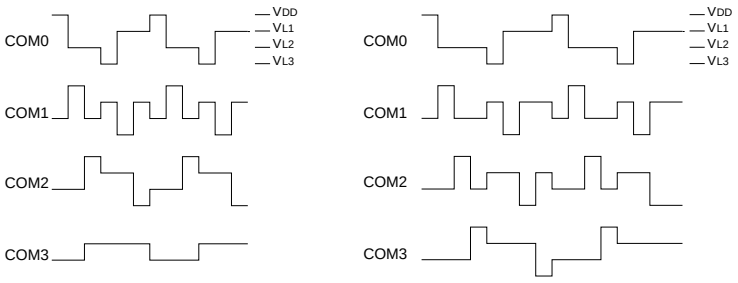


Fig. 4.3.8
Drive waveform of COM terminals

1/3 Duty *1/4 Duty*

15 Segment memory address

```
*** OPTION  NO.15 ***

--- SEGMENT MEMORY ADDRESS ---

                        1. 4* - 6* (R/W)
                        2. C* - E* (W)

PLEASE SELECT NO.(1) ? 1↵

                        1. 4* - 6* (R/W)  SELECTED
```

Select the segment memory area.
When "4* – 6*" is selected, the segment memory area is allocated "040H–06FH" and R/W access utilizing this RAM area becomes available.
When "C* – E*" is selected, the segment memory area is allocated "0C0H–0EFH" and becomes a write-only area.

16 SIN pull down resistor

```
*** OPTION  NO.16 ***

--- SIN PULL DOWN RESISTOR ---

                        1. WITH RESISTOR
                        2. GATE DIRECT

PLEASE SELECT NO.(1) ? 1↵

                        1. WITH RESISTOR  SELECTED
```

Select whether pull down resistor will be supplemented to SIN terminal (SIO data input terminal).
When "Gate Direct" is selected, take care that input floating state does not occur. Select "With Resistor" for SIN terminal that will not be used.

17 SOUT specification

```
*** OPTION  NO.17 ***

--- SOUT OUTPUT SPECIFICATION ---

                         1. COMPLEMENTARY
                         2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

                         1. COMPLEMENTARY  SELECTED
```

Select the output specification for SOUT terminal. Either complementary output or Pch open drain output may be selected.
Select complementary output for unused SOUT terminal.

18 SCLK specification

```
*** OPTION  NO.18 ***

--- SCLK SPECIFICATION ---

    PULL DOWN RESISTOR   1. WITH RESISTOR
                         2. GATE DIRECT

PLEASE SELECT NO.(1) ? 1↵

    OUTPUT SPECIFICATION 1. COMPLEMENTARY
                         2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

    LOGIC                1. POSITIVE
                         2. NEGATIVE

PLEASE SELECT NO.(1) ? 1↵

    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 SCLK terminal (input/output terminal of the SIO synchronous clock).
Pull down resistor is only valid when the clock mode is set at external clock mode.
Set unused SCLK terminal to with pull down resistor, complementary output, and positive logic.
The SCLK timing chart is shown in Figure 4.3.9.

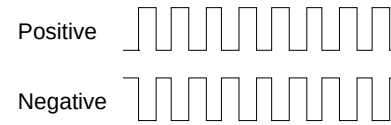


Fig. 4.3.9 SCLK timing chart

19 SIO data permutation

```
*** OPTION  NO.19 ***

--- SIO DATA PERMUTATION ---

                         1. MSB FIRST
                         2. LSB FIRST

PLEASE SELECT NO.(1) ? 1↵

                         1. MSB FIRST  SELECTED
```

Select whether the SIO input/output (SIN or SOUT) data bit permutation will be MSB first or LSB first.
Select the one suitable to your programming needs.
Input/output data permutation is shown in Figure 4.3.10.

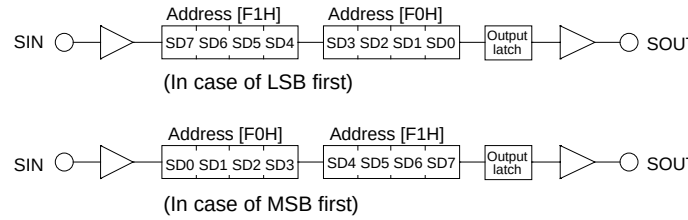


Fig. 4.3.10
Input/output data permutation

4.4 FOG6233 Quick Reference

■ Starting command and input/output files

Execution file: FOG6233.EXE

Starting command: **FOG6233**↵ ↵ *indicates the Return key.*

Input file: C233XXXF.DOC (Function option document file, when modifying)

Output file: C233XXXF.DOC (Function option document file)
C233XXXF.HEX (Function option HEX file)

■ Display example

```
     ***  E0C6233 FUNCTION OPTION GENERATOR. --- Ver 3.10  ***

EEEEEEEEEE   PPPPPPPP         SSSSSSS       OOOOOOOO     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      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       OOOOOOOO     NNN      NN

              (C) COPYRIGHT 1991  SEIKO EPSON CORP.

         THIS SOFTWARE MAKES NEXT FILES.

            C233XXXF.HEX  ...  FUNCTION OPTION HEX FILE.
            C233XXXF.DOC  ...  FUNCTION OPTION DOCUMENT FILE.

                         STRIKE ANY KEY.
```

Start-up message
When FOG6233 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.

```
*** E0C6233 USER'S OPTION SETTING. --- Ver 3.10 ***

CURRENT DATE IS  91/10/14
PLEASE INPUT NEW DATE  :   91/10/14↵
```

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 FOG6233.

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

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

PLEASE SELECT NO.? 1↵
PLEASE INPUT FILE NAME? C2330A0↵                          ..(1)
PLEASE INPUT USER'S NAME? SEIKO EPSON CORP.↵              ..(2)
PLEASE INPUT ANY COMMENT
(ONE LINE IS 50 CHR)? TOKYO DESIGN CENTER↵                ..(3)
                    ? 421-8 HINO HINO-SHI TOKYO 191 JAPAN↵
                    ? TEL 0425-84-2551↵
                    ? FAX 0425-84-8512↵
                    ? ↵
```

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? C2330A0↵
EXISTS OVERWRITE(Y/N)? N↵
PLEASE INPUT FILE NAME? C2330B0↵
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) ***

C2330A0          C2330B0          C2330C0                 ..(1)

PLEASE INPUT FILE NAME? C2330A0↵                          ..(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? C2330N0↵
FUNCTION OPTION DOCUMENT FILE IS NOT FOUND.
PLEASE INPUT FILE NAME?
```

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  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↵

     COMBINATION       2. Use  K00,K01  SELECTED
```

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.

```
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.?
```

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 EVA6233, 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 EVA6233 options.

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

4.5 Sample File

■ Example of function option document file

```
* E0C6233 FUNCTION OPTION DOCUMENT  V 3.10
*
* FILE NAME    C2330A0F.DOC
* USER'S NAME  SEIKO EPSON CORP.
* INPUT DATE   91/10/14
*
* COMMENT      TOKYO DESIGN CENTER
*              421-8 HINO HINO-SHI TOKYO 191 JAPAN
*              TEL 0425-84-2551
*              FAX 0425-84-8512
*
*
* OPTION NO.1
* < DEVICE TYPE >
*                            E0C62A33  ( TWIN CLOCK TYPE )  -  SELECTED
 OPT0101 05
 OPT0102 05
*
* OPTION NO.2
* < OSC3 OSCILLATOR >
*                            CR  ----------------------------  SELECTED
 OPT0201 02
*
* OPTION NO.3
* < MULTIPLE KEY ENTRY RESET >
*     COMBINATION            NOT USE  ----------------------  SELECTED
*     TIME AUTHORIZE         USE  --------------------------  SELECTED
 OPT0301 01
 OPT0302 01
*
* OPTION NO.4
* < WATCH DOG TIMER >
*                            USE  --------------------------  SELECTED
 OPT0401 01
*
* OPTION NO.5
* < INTERRUPT NOISE REJECTOR >
*     K00-K03                USE  --------------------------  SELECTED
*     K10                    USE  --------------------------  SELECTED
 OPT0501 01
 OPT0502 01
*
* OPTION NO.6
* < INPUT PORT PULL DOWN RESISTOR >
*     K00                    WITH RESISTOR  ----------------  SELECTED
*     K01                    WITH RESISTOR  ----------------  SELECTED
*     K02                    WITH RESISTOR  ----------------  SELECTED
*     K03                    WITH RESISTOR  ----------------  SELECTED
*     K10                    WITH RESISTOR  ----------------  SELECTED
 OPT0601 01
 OPT0602 01
 OPT0603 01
 OPT0604 01
 OPT0605 01
*
* OPTION NO.7
* < OUTPUT PORT SPECIFICATION (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            BUZZER  ----------------------  SELECTED
```

```
 OPT0801 01
 OPT0802 02
*
* OPTION NO.9
* < R11 SPECIFICATION >
*     OUTPUT SPECIFICATION   COMPLEMENTARY  ----------------  SELECTED
 OPT0901 01
*
* OPTION NO.10
* < R12 SPECIFICATION >
*     OUTPUT SPECIFICATION   COMPLEMENTARY  ----------------  SELECTED
*     OUTPUT TYPE            D.C.  -------------------------  SELECTED
 OPT1001 01
 OPT1002 01
 OPT1003 08
*
* OPTION NO.11
* < R13 SPECIFICATION >
*     OUTPUT SPECIFICATION   COMPLEMENTARY  ----------------  SELECTED
*     OUTPUT TYPE            D.C.  -------------------------  SELECTED
 OPT1101 01
 OPT1102 01
*
* OPTION NO.12
* < I/O PORT OUTPUT 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
* < EVENT COUNTER NOISE REJECTOR >
*                            2048 [HZ]  ---------------------  SELECTED
 OPT1301 01
*
* OPTION NO.14
* < LCD COMMON DUTY >
*                            1/4 DUTY  ----------------------  SELECTED
 OPT1401 01
*
* OPTION NO.15
* < SEGMENT MEMORY ADDRESS >
*                            4* - 6* (R/W)  -----------------  SELECTED
 OPT1501 01
*
* OPTION NO.16
* < SIN PULL DOWN RESISTOR >
*                            WITH RESISTOR  -----------------  SELECTED
 OPT1601 01
*
* OPTION NO.17
* < SOUT OUTPUT SPECIFICATION >
*                            COMPLEMENTARY  -----------------  SELECTED
 OPT1701 01
*
* OPTION NO.18
* < SCLK SPECIFICATION >
*     PULL DOWN RESISTOR     WITH RESISTOR  -----------------  SELECTED
*     OUTPUT SPECIFICATION   COMPLEMENTARY  ----------------  SELECTED
*     LOGIC                  POSITIVE  ----------------------  SELECTED
 OPT1801 01
 OPT1802 01
 OPT1803 01
*
```

```
* OPTION NO.19
* < SIO DATA PERMUTATION >
*                              MSB FIRST  ----------------------  SELECTED
 OPT1901 01
*
*
*
* SEIKO EPSON'S AREA
*
*
*
* OPTION NO.20
 OPT2001 01
 OPT2002 01
 OPT2003 01
 OPT2004 01
 OPT2005 01
 OPT2006 01
 OPT2007 01
 OPT2008 01
*
* OPTION NO.21
 OPT2101 01
 OPT2102 01
 OPT2103 01
 OPT2104 01
 OPT2105 01
 OPT2106 01
 OPT2107 01
 OPT2108 01
*
* OPTION NO.22
 OPT2201 01
*
* OPTION NO.23
 OPT2301 01
*
* OPTION NO.24
 OPT2401 01
 OPT2402 01
*
* OPTION NO.25
 OPT2501 01
 OPT2502 01
\\END
```

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

5 SEGMENT OPTION GENERATOR SOG6233

5.1 SOG6233 Outline

With the 4-bit single-chip E0C6233 microcomputers, the customer may select the LCD segment options. By modifying the mask patterns of the E0C6233 according to the selected options, the system can be customized to meet the specifications of the target system.
The Segment Option Generator SOG6233 is a software tool for generating data file used to generate mask patterns. From the data file created with SOG6233, the E0C6233 mask pattern is automatically generated by a general purpose computer.
The HEX file for the evaluation board (EVA6233) segment 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.*

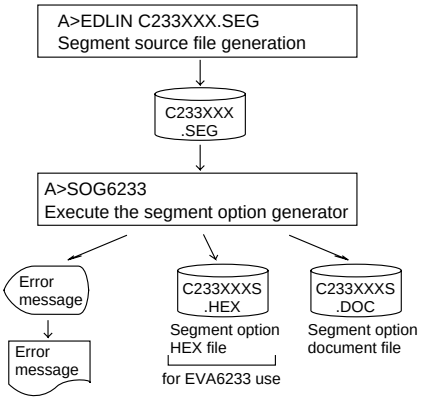


Fig. 5.1.1 SOG6233 execution flow

5.2 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

Legend: <ADDRESS>
H: High order address, L: Low order address
D: Data bit
<OUTPUT SPECIFICATION>
C: Complementary output
P: Pch open drain output

5.3 Segment Ports Output Specifications

For the output specification of the segment output ports SEG0–SEG39 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" 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 0C0H–0EFH) can be allocated to the optional segment. With this, up to 160 segments (120 segments when 1/3 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 or C–E), 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 DC output is selected

The DC output can be selected in units of two terminals and up to 40 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
```

Note *Only complementary output is enabled as the DC output of the SEG ports of EVA6233. Therefore, complementary output is enabled even if Pch open drain output is selected. Respond to it by adding external circuits as required.*

5.4 SOG6233 Quick Reference

■ Starting command and input/output files

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

Execution file: SOG6233.EXE

Starting command: **SOG6233_ [-H]↵**

Option: -H: Specifies the segment option document file for input file of SOG6233.

Input file: C233XXX.SEG (Segment option source file)
C233XXXS.DOC (Segment option document file, when -H option use)

Output file: C233XXXS.DOC (Segment option document file)
C233XXXS.HEX (Segment option HEX file)

■ Display example

```
     ***  E0C6233 SEGMENT OPTION GENERATOR. --- Ver 3.10  ***

EEEEEEEEEE   PPPPPPPP         SSSSSSS        OOOOOOOO      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      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       OOOOOOOO      NNN      NN

             (C) COPYRIGHT 1991  SEIKO EPSON CORP.

         SEGMENT OPTION SOURCE FILE NAME IS " C233XXX.SEG "

         THIS SOFTWARE MAKES NEXT FILES.

            C233XXXS.HEX  ...  SEGMENT OPTION HEX FILE.
            C233XXXS.DOC  ...  SEGMENT OPTION DOCUMENT FILE.

                        STRIKE ANY KEY.
```

Start-up message
When SOG6233 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.

```
*** E0C6233 USER'S OPTION SETTING. --- Ver 3.10 ***

CURRENT DATE IS  91/10/14
PLEASE INPUT NEW DATE  :   91/10/14↵
```

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) ***

C2330A0         C2330B0         C2330C0                          . . (1)
```

Input file selection
(1) Will display the files on the current drive.

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

SEGMENT OPTION FILE IS NOT FOUND.              . . (b) -H option use

FUNCTION OPTION FILE IS NOT FOUND.             . . (c)
```

If no modifiable source exists, an error message (a) or (b) will be displayed and the program will be terminated.
If no function option document file exists, an error message (c) will be displayed and the program will be terminated

```
PLEASE INPUT SEGMENT OPTION FILE NAME? C2330A0↵                . . (2)
```

(2) Enter the file name.

If the specified file name is not found in the current drive, an error message (d) or (e) is displayed, prompting entry of other file name.

```
PLEASE INPUT SEGMENT SOURCE FILE NAME? C2330N0↵
SEGMENT SOURCE FILE IS NOT FOUND.              . . (d) -H option not use

PLEASE INPUT SEGMENT OPTION DOCUMENT FILE NAME? C2330N0↵
SEGMENT OPTION DOCUMENT FILE IS NOT FOUND.     . . (e) -H option use
```

```
SEGMENT RAM ADDRESS 400-6F3 select OK(Y/N)? Y↵                    ..(3)
```

When C0–EF is selected for the segment RAM address by FOG6233, following message is displayed.

```
SEGMENT RAM ADDRESS C00-EF3 select OK(Y/N)? Y↵          ..(f)
```

```
PLEASE INPUT USER'S NAME? SEIKO EPSON CORP.↵                      ..(4)
PLEASE INPUT ANY COMMENT
(ONE LINE IS 50 CHR)? TOKYO DESIGN CENTER↵                        ..(5)
                    ? 421-8 HINO HINO-SHI TOKYO 191 JAPAN↵
                    ? TEL 0425-84-2551↵
                    ? FAX 0425-84-8512↵
                    ? ↵
```

```
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.
```

(3) Refer to the file name input in number (2) + the "F.DOC" file (in this case, C2330A0F.DOC) from the current directory and indicate whether 40–6F or C0–EF has been selected for the segment RAM address. (FOG6233, option No. 15)
If this address is OK, enter a "Y" and if not enter an "N", then reset the function option using FOG6233.

(4) Enter the customer's company name.

(5) Enter any comment.
(Within 50 characters x 10 lines)

Then, move to the confirmation procedure for HEX file generation.

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 EVA6233, 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 EVA6233 options.

When a series of operations are complete, the SOG6233 generates files. If no error is committed while setting segment options, "MAKING FILE IS COMPLETED" will be displayed and the SOG6233 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.

5.5 Sample Files

■ Example of segment option source file

```
; EVA6233 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      6E0     —       —       —       C
39      6E1     —       —       —       C
```

■ Example of segment option document file

```
* E0C6233 SEGMENT OPTION DOCUMENT  V 3.10
*
* FILE NAME    C2330A0S.DOC
* USER'S NAME  SEIKO EPSON CORP.
* INPUT DATE   91/10/14
* COMMENT      TOKYO DESIGN CENTER
*              421-8 HINO HINO-SHI TOKYO 191 JAPAN
*              TEL 0425-84-2551
*              FAX 0425-84-8512
*
*
* OPTION NO.20
*
* < LCD SEGMENT DECODE TABLE >
*
* SEG COM0 COM1 COM2 COM3 SPEC
*
   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  6E0  6E2  6E3  6F0  C
  39  6E1  6F1  6F2  6F3  C
\\END
```

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

6 ICE CONTROL SOFTWARE ICS6233

6.1 ICS6233 Outline

The In-circuit Emulator ICE6200 connects the target board produced by the user via the EVA6233 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 ICE6200 control is done through the ICE Control Software ICS6233.
The ICS6233 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.

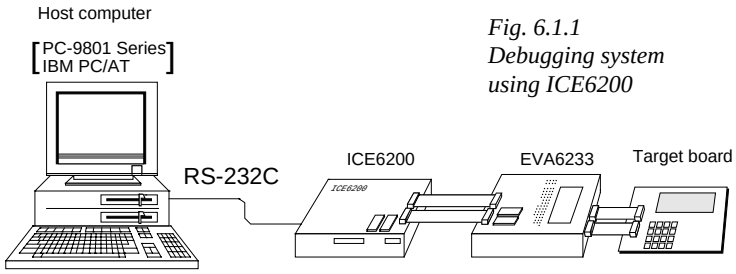


Fig. 6.1.1 Debugging system using ICE6200

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

6.2 ICS6233 Restrictions

Take the following precautions when using the ICS6233.

■ ROM Area

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

■ RAM Area

The RAM area is limited to a maximum address of 1FEH. However, as the following addresses are in the unused area, designation of this area with the ICE commands produces an error.

Unused area: 0A0H–0BFH,0C0H–0EFH (when 040H–06FH is selected for the display memory),
0F4H, 0F5H, 0FAH, 0FBH, 180H–1EFH, 1F4H, 1F5H, 1FAH, 1FBH

(Refer to the "E0C6233 Technical Manual" for details.)

■ Undefined Code

The SLP instruction is not specified for the E0C6233 and so cannot be used.

■ OPTLD Command

In the ICS6233, OPTLD command cannot be used.

6.3 ICS6233 Quick Reference

■ Starting command and input/output files

↵ *indicates the Return key.*

Execution file: ICS6233.BAT (ICS6233J.EXE) . . . for MS-DOS
ICS6233B.BAT (ICS6233W.EXE) . . . for PC-DOS

Starting command: **ICS6233 (ICS6233J)↵** . . . for MS-DOS
ICS6233B (ICS6233W)↵ . . . for PC-DOS

Input file: C233XXXL.HEX (Object file, low-order)
C233XXXH.HEX (Object file, high-order)
C233XXXD.HEX (Data RAM file)
C233XXXC.HEX (Control file)

Output file: C233XXXL.HEX (Object file, low-order)
C233XXXH.HEX (Object file, high-order)
C233XXXD.HEX (Data RAM file)
C233XXXC.HEX (Control file)

■ Display example

```
          *** E0C6233 ICE CONTROL SOFTWARE. --- Ver 3.01 ***

EEEEEEEEEE   PPPPPPPP        SSSSSSS       00000000     NNN     NNN
EEEEEEEEEE   PPPPPPPPPP     SSS   SSSS    000    000    NNNN    NNN
EEE          PPP     PPP   SSS     SSS   000      000   NNNNN   NNN
EEE          PPP     PPP    SSS          000      000   NNNNNN  NNN
EEEEEEEEEE   PPPPPPPPP      SSSSSS       000      000   NNN NNN NNN
EEEEEEEEEE   PPPPPPPP          SSSS      000      000   NNN  NNNNNN
EEE          PPP               SSS     000      000   NNN   NNNNN
EEE          PPP           SSS   SSS   000      000   NNN    NNNN
EEEEEEEEEE   PPP           SSSS   SSS    000    000    NNN     NNN
EEEEEEEEEE   PPP             SSSSSSS       00000000     NNN      NN

             (C) COPYRIGHT 1991 SEIKO EPSON CORP.

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

Start-up message
When ICS6233 is started, the start-up message is displayed, and a self-test is automatically performed. ICS6233 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 ICS6233 program is terminated by entering the Q (Quit) command.

Note *Confirm that the cables connected properly, then operate the ICS6233.*

■ Error messages

Error message	Meaning	Recover procedure
* COMMUNICATION ERROR OR ICE NOT READY *	ICE6200 is disconnected or power is OFF.	Switch OFF the host power supply, connect cable, and reapply power. Or switch ON power to 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 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 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 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.

■ 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 EVA6233 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 EVA6233 CPU internal registers
		#SR ↵	Set EVA6233 CPU internal registers
		#I ↵	Reset EVA6233 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 ICE6200 set condition from file
		#CS,file ↵	Save ICE6200 set condition to 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 ICE6200 instruction
17	Self Diagnosis	#CHK ↵	Report results of ICE6200 self diagnostic test

↵ means press the RETURN key.

7 MASK DATA CHECKER MDC6233

7.1 MDC6233 Outline

The Mask Data Checker MDC6233 is a software tool which checks the program data (C233XXXH.HEX and C233XXXL.HEX) and option data (C233XXXF.DOC and C233XXXS.DOC) created by the user and creates the data file (C6233XXX.PAn) for generating mask patterns. The user must send the file generated through this software tool to Seiko Epson.

Moreover, MDC6233 has the capability to restore the generated data file (C6233XXX.PA0) to the original file format .

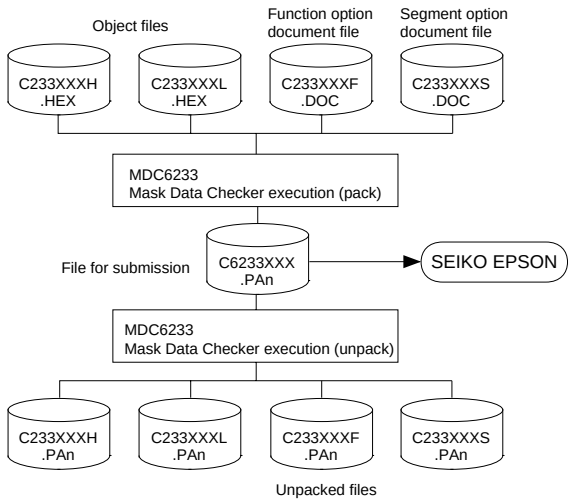


Fig. 7.1.1
MDC6233 execution flow

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

7.2 MDC6233 Quick Reference

■ Starting command and input/output files

Execution file: MDC6233.EXE

Starting command: **MDC6233**↵ ↵ *indicates the Return key.*

Input file:

C233XXXL.HEX	(Object file, low-order)	When packing
C233XXXH.HEX	(Object file, high-order)	
C233XXXF.DOC	(Function option document file)	
C233XXXS.DOC	(Segment option document file)	
C6233XXX.PAn	(Packed file)	When unpacking

Output file:

C6233XXX.PAn	(Packed file)	When packing
C233XXXL.PAn	(Object file, low-order)	When unpacking
C233XXXH.PAn	(Object file, high-order)	
C233XXXF.PAn	(Function option document file)	
C233XXXS.PAn	(Segment option document file)	

■ Display examples

```
          *** E0C6233 PACK / UNPACK PROGRAM Ver 2.00 ***

EEEEEEEEEE   PPPPPPPP         SSSSSSS       OOOOOOOO     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      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       OOOOOOOO     NNN      NN

             (C) COPYRIGHT 1991 SEIKO EPSON CORP.

                    --- OPERATION MENU ---

                           1. PACK
                           2. UNPACK

                    PLEASE SELECT NO.?
```

Start-up message

When MDC6233 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)

       C233XXXH.HEX --------+
                            |
       C233XXXL.HEX --------+
                            |-------- C233XXX.PAn (PACK FILE)
       C233XXXF.DOC --------+
                            |
       C233XXXS.DOC --------+

PLEASE INPUT PACK FILE NAME (C6233XXX.PAn) ?  C62330A0.PA0↵    ...(2)

       C2330A0H.HEX --------+
                            |
       C2330A0L.HEX --------+
                            |-------- C2330A0.PA0
       C2330A0F.DOC --------+
                            |
       C2330A0S.DOC --------+
```

Packing of data

(1) Select "1" 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 "C6233XXX.PA0" has been submitted, the pack file name should be entered as "C6233XXX.PA1".)

With this, the mask file (C6233XXX.PAn) is generated, and the MDC6233 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 (ASM6233) as program data. If the program data generated with the -N option of the Cross Assembler is packed, following message is displayed.*

```
HEX DATA ERROR : DATA (NO FFh)
```

```
                    --- OPERATION MENU ---

                           1. PACK
                           2. UNPACK

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

PLEASE INPUT PACKED FILE NAME (C6233XXX.PAn) ?  C62330A0.PA0↵  ...(2)

                             +-------- C2330A0H.PA0
                             |
                             +-------- C2330A0L.PA0
       C62330A0.PA0 --------|
                             +-------- C2330A0F.PA0
                             |
                             +-------- C2330A0S.PA0
```

Unpacking of data

(1) Select "1" in the operation menu.
(2) Enter the packed file name.

With this, the mask data file (C6233XXX.PAn) is restored to the original file format, and the MDC6233 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.
10. HEX DATA ERROR : DATA (NO FFh)	There is an undefined field in the HEX data.

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.
4. VERSION NUMBER ERROR : X.DOC	FOG6233, SOG6233 different from the version No. has been used.

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. E0C6233 INSTRUCTION SET

Classification	Mnemonic	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	*l*7	*l*6	*l*5	*l*4	*l*3	*l*2	*l*1	*l*0					12	PCSL ← M(SP), PCSH ← M(SP+1), PCP ← M(SP+2) SP ← SP+3, M(X) ← *l*3~*l*0, M(X+1) ← *l*7~*l*4, 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	Mnemonic	Operand	Operation Code												Flag				Clock	Operation
			B	A	9	8	7	6	5	4	3	2	1	0	I	D	Z	C		
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	*l*7	*l*6	*l*5	*l*4	*l*3	*l*2	*l*1	*l*0					5	M(X)←*l*3~*l*0, M(X+1)←*l*7~*l*4, 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	Mnemonic	Operand	Operation Code												Flag				Clock	Operation
			B	A	9	8	7	6	5	4	3	2	1	0	I	D	Z	C		
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← $\bar{r}$

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)
XP XP register
(high order four bits of index register IX)
YP YP register
(high order four bits of index register IY)
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 specified
r1	r0	q1	q0	
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. E0C6233 RAM MAP

PROGRAM NAME:

P	H \ L	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0 NAME																
	MSB																
	LSB																
	1 NAME																
	MSB																
	LSB																
	2 NAME																
	MSB																
	LSB																
	3 NAME																
	MSB																
	LSB																
	4 NAME																
	MSB																
	LSB																
	5 NAME																
	MSB																
	LSB																
	6 NAME																
	MSB																
	LSB																
	7 NAME																
	MSB	TM3	SWL3	SWH3	K03	DFK03	EIK03	HVLD	SCTRG	CSDC	–	IK1	R03	R13	P03	TMRST	WDRST
		TM2	SWL2	SWH2	K02	DFK02	EIK02	SVDDT	EIK10	ETI2	TI2	IK0	R02	R12	P02	SWRUN	WD2
		TM1	SWL1	SWH1	K01	DFK01	EIK01	EISWIT1	DFK10	ETI8	TI8	SWIT1	R01	R11	P01	SWRST	WD1
	LSB	TM0	SWL0	SWH0	K00	DFK00	EIK00	EISWIT0	K10	ETI32	TI32	SWIT0	R00	R10	P00	IOC0	WD0

PROGRAM NAME:

P	H \ L	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	8 NAME MSB																
	LSB																
	9 NAME MSB																
	LSB																
	C NAME MSB																
	LSB																
	D NAME MSB																
	LSB																
	E NAME MSB																
	LSB																
	F NAME MSB	SD3	SD7	SCS1	–	–	–	BZFQ	–	EV03	EV07	–	–	–	P13	–	–
		SD2	SD6	SCS0	–	–	–	–	–	EV02	EV06	–	–	EVRUN	P12	CLKCHG	–
		SD1	SD5	SE2	–	–	–	–	AMPDT	EV01	EV05	–	–	–	P11	OSCC	–
	LSB	SD0	SD4	EISIO	ISIO	–	–	–	AMPON	EV00	EV04	–	–	EVRST	P10	IOC1	–

PROGRAM NAME:																	
P	H \ L	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
1	0 NAME																
	MSB																
	LSB																
	1 NAME																
	MSB																
	LSB																
	2 NAME																
	MSB																
	LSB																
	3 NAME																
	MSB																
	LSB																
	4 NAME																
	MSB																
	LSB																
	5 NAME																
	MSB																
	LSB																
	6 NAME																
	MSB																
	LSB																
	7 NAME																
	MSB	TM3	SWL3	SWH3	K03	DFK03	EIK03	HVLD	SCTRG	CSDC	–	IK1	R03	R13	P03	TMRST	WDRST
		TM2	SWL2	SWH2	K02	DFK02	EIK02	SVDDT	EIK10	ETI2	TI2	IK0	R02	R12	P02	SWRUN	WD2
		TM1	SWL1	SWH1	K01	DFK01	EIK01	EISWIT1	DFK10	ETI8	TI8	SWIT1	R01	R11	P01	SWRST	WD1
	LSB	TM0	SWL0	SWH0	K00	DFK00	EIK00	EISWIT0	K10	ETI32	TI32	SWIT0	R00	R10	P00	IOC0	WD0
	F NAME																
	MSB	SD3	SD7	SCS1	–	–	–	BZFQ	–	EV03	EV07	–	–	–	P13	–	–
		SD2	SD6	SCS0	–	–	–	–	–	EV02	EV06	–	–	EVRUN	P12	CLKCHG	–
		SD1	SD5	SE2	–	–	–	–	AMPDT	EV01	EV05	–	–	–	P11	OSCC	–
	LSB	SD0	SD4	EISIO	ISIO	–	–	–	AMPON	EV00	EV04	–	–	EVRST	P10	IOC1	–

APPENDIX C. E0C6233 I/O MEMORY MAP

Address *7	Register D3	D2	D1	D0	Name	Init *1	1	0	Comment
70H	TM3	TM2	TM1	TM0	TM3	0			Timer data (clock timer 2 Hz)
					TM2	0			Timer data (clock timer 4 Hz)
	R				TM1	0			Timer data (clock timer 8 Hz)
					TM0	0			Timer data (clock timer 16 Hz)
71H	SWL3	SWL2	SWL1	SWL0	SWL3	0			MSB Stopwatch counter 1/100 sec (BCD)
					SWL2	0			
	R				SWL1	0			
					SWL0	0			LSB
72H	SWH3	SWH2	SWH1	SWH0	SWH3	0			MSB Stopwatch counter 1/10 sec (BCD)
					SWH2	0			
	R				SWH1	0			
					SWH0	0			LSB
73H	K03	K02	K01	K00	K03	*2	High	Low	Input port (K00–K03)
					K02	*2	High	Low	
	R				K01	*2	High	Low	
					K00	*2	High	Low	
74H	DFK03	DFK02	DFK01	DFK00	DFK03	0	Falling	Rising	Differential register (K00–K03)
					DFK02	0	Falling	Rising	
	R/W				DFK01	0	Falling	Rising	
					DFK00	0	Falling	Rising	
75H	EIK03	EIK02	EIK01	EIK00	EIK03	0	Enable	Mask	Interrupt mask register (K00–K03)
					EIK02	0	Enable	Mask	
	R/W				EIK01	0	Enable	Mask	
					EIK00	0	Enable	Mask	
76H	HVLD	SVDDT / SVDON	EISWIT1	EISWIT0	HVLD	0	Heavy load	Normal	Heavy load protection mode register
					SVDDT	0	Low voltage	Normal	SVD evaluation data (at read-out)
					SVDON	0	On	Off	SVD ON/OFF (at writing)
	R/W	R / W	R/W		EISWIT1	0	Enable	Mask	Interrupt mask register (stopwatch 1 Hz)
					EISWIT0	0	Enable	Mask	Interrupt mask register (stopwatch 10 Hz)
77H	SCTRG / SIOF	EIK10	DFK10	K10	SCTRG	–	Trigger	–	Serial interface clock trigger
					SIOF	0	Run	Stop	SIOF
	W / R	R/W		R	EIK10	0	Enable	Mask	Interrupt mask register (K10)
					DFK10	0	Falling	Rising	Differential register (K10)
					K10	*2	High	Low	Input port (K10)

Remarks

*1 Initial value following initial reset
*2 Not set in the circuit
*3 Undefined
*4 Reset (0) immediately after being read
*5 Always "0" when being read
*6 Refer to the "E0C6233 Technical Manual"
*7 Page switching in I/O memory is not necessary

Address *7	Register								Comment
	D3	D2	D1	D0	Name	Init *1	1	0	
78H	CSDC	ETI2	ETI8	ETI32	CSDC	0	Static	Dynamic	LCD drive switch
					ETI2	0	Enable	Mask	Interrupt mask register (clock timer 2 Hz)
	R/W				ETI8	0	Enable	Mask	Interrupt mask register (clock timer 8 Hz)
					ETI32	0	Enable	Mask	Interrupt mask register (clock timer 32 Hz)
79H	–	TI2	TI8	TI32	–	*2			Unused *5
					TI2	0	Yes	No	Interrupt factor flag (clock timer 2 Hz) *4
	R				TI8	0	Yes	No	Interrupt factor flag (clock timer 8 Hz) *4
					TI32	0	Yes	No	Interrupt factor flag (clock timer 32 Hz) *4
7AH	IK1	IK0	SWIT1	SWIT0	IK1	0	Yes	No	Interrupt factor flag (K10) *4
					IK0	0	Yes	No	Interrupt factor flag (K00–K03) *4
	R				SWIT1	0	Yes	No	Interrupt factor flag (stopwatch 1 Hz) *4
					SWIT0	0	Yes	No	Interrupt factor flag (stopwatch 10 Hz) *4
7BH	R03	R02	R01	R00	R03	0	High	Low	Output port (R00–R03)
					R02	0	High	Low	
	R/W				R01	0	High	Low	
					R00	0	High	Low	
7CH	R13	R12	R11	R10	R13	0	High	Low	Output port (R13, $\overline{BZ}$) *6
					R12	0	High	Low	Output port (R12, FOUT) *6
	R/W				R11	0	High	Low	Output port (R11)
					R10	0	High	Low	Output port (R10, BZ) *6
7DH	P03	P02	P01	P00	P03	*2	High	Low	I/O port (P00–P03) Output latch reset at time of initial reset
					P02	*2	High	Low	
	R/W				P01	*2	High	Low	
					P00	*2	High	Low	
7EH	TMRST	SWRUN	SWRST	IOC0	TMRST	Reset	Reset	–	Clock timer reset *5
					SWRUN	0	Run	Stop	Stopwatch counter RUN/STOP
	W	R/W	W	R/W	SWRST	Reset	Reset	–	Stopwatch counter reset *5
					IOC0	0	Output	Input	I/O control register 0 (P00–P03)
7FH	WDRST	WD2	WD1	WD0	WDRST	Reset	Reset	–	Watchdog timer reset *5
					WD2	0			Timer data (watchdog timer 1/4 Hz)
	W	R			WD1	0			Timer data (watchdog timer 1/2 Hz)
					WD0	0			Timer data (watchdog timer 1 Hz)

Address *7	Register D3	D2	D1	D0	Name	Init *1	1	0	Comment
F0H	SD3	SD2	SD1	SD0	SD3	*3			Serial interface data register Low order (SD0–SD3)
	R/W				SD2	*3			
					SD1	*3			
					SD0	*3			
F1H	SD7	SD6	SD5	SD4	SD7	*3			Serial interface data register High order (SD4–SD7)
	R/W				SD6	*3			
					SD5	*3			
					SD4	*3			
F2H	SCS1	SCS0	SE2	EISIO	SCS1	1	*6	*6	Clock edge selection register (SCS0, SCS1)
	R/W				SCS0	1	*6	*6	
					SE2	0	Rising	Falling	Clock edge selection register
					EISIO	0	Enable	Mask	Interrupt mask register (serial interface)
F3H	–	–	–	ISIO	–	*2			Unused *5
	R				–	*2			Unused *5
					–	*2			Unused *5
					ISIO	0	Yes	No	Interrupt factor flag (serial interface) *4
F6H	BZFQ	–	–	–	BZFQ	0	2 kHz	4 kHz	Buzzer frequency selection register
	R/W	R			–	*2			Unused *5
					–	*2			Unused *5
					–	*2			Unused *5
F7H	–	–	AMPDT	AMPON	–	*2			Unused *5
	R			R/W	–	*2			Unused *5
					AMPDT	1	+ > -	- > +	Analog comparator data
					AMPON	0	On	Off	Analog comparator ON/OFF
F8H	EV03	EV02	EV01	EV00	EV03	0			Event counter Low order (EV00–EV03)
	R				EV02	0			
					EV01	0			
					EV00	0			
F9H	EV07	EV06	EV05	EV04	EV07	0			Event counter High order (EV04–EV07)
	R				EV06	0			
					EV05	0			
					EV04	0			
FCH	–	EVRUN	–	EVRST	–	*2			Unused *5
	R	R/W	R	W	EVRUN	0	Run	Stop	Event counter RUN/STOP
					–	*2			Unused *5
					EVRST	Reset	Reset	–	Event counter reset *5
FDH	P13	P12	P11	P10	P13	*2	High	Low	I/O port (P10–P13) Output latch reset at time of initial reset
	R/W				P12	*2	High	Low	
					P11	*2	High	Low	
					P10	*2	High	Low	
FEH	–	CLKCHG	OSCC	IOC1	–	*2			Unused *5
	R	R/W			CLKCHG	0	OSC3	OSC1	CPU clock switch
					OSCC	0	On	Off	OSC3 oscillator ON/OFF
					IOC1	0	Output	Input	I/O control register 1 (P10–P13)

APPENDIX D. TROUBLESHOOTING

Tool	Problem	Remedy measures
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 ICS6233J.EXE PC-DOS ICS6233W.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 ICE6200 unit set correctly? • Is the breaker of the ICE6200 set to ON?
	The ICE6200 breaker tripped immediately after activation.	Check the following and remedy if necessary: • Are connectors F1 and F5 connected to the EVA6233 correctly? • Is the target board power short-circuiting?
	<ILLEGAL VERSION ICE6200> appears on the screen immediately after activation.	The wrong version of ICE6200 is being used. Use the latest version.
	<ILLEGAL VERSION PARAMETER FILE> appears on the screen immediately after activation.	The wrong version of ICS6233P.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.
SOG6233	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
ASM6233	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.
MDC6233	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?
EVA6233	The EVA6233 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, 33, 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) • Is the EN/DIS switch on the EVA6233 set to EN?
	Target segment does not light.	Check the following and remedy if necessary: • Is an EPROM with an access time of 170 ns or less being used for S.HEX. • Has the VADJ VR inside the EVA6233 top cover been turned to a lower setting?

EPSON International Sales Operations

AMERICA

S-MOS SYSTEMS, INC.
150 River Oaks Parkway
San Jose, CA 95134, U.S.A.
Phone: +1-408-922-0200 Fax: +1-408-922-0238
Telex: 176079 SMOS SNJUD

S-MOS SYSTEMS, INC.
EASTERN AREA SALES AND TECHNOLOGY CENTER
301 Edgewater Place, Suite 120
Wakefield, MA 01880, U.S.A.
Phone: +1-617-246-3600 Fax: +1-617-246-5443

S-MOS SYSTEMS, INC.
SOUTH EASTERN AREA SALES AND TECHNOLOGY CENTER
4300 Six Forks Road, Suite 430
Raleigh, NC 27609, U.S.A.
Phone: +1-919-781-7667 Fax: +1-919-781-6778

S-MOS SYSTEMS, INC.
CENTRAL AREA SALES AND TECHNOLOGY CENTER
1450 E.American Lane, Suite 1550
Schaumburg, IL 60173, U.S.A.
Phone: +1-847-517-7667 Fax: +1-847-517-7601

EUROPE

- HEADQUARTERS -
EPSON EUROPE ELECTRONICS GmbH
Riesstrasse 15
80992 Muenchen, GERMANY
Phone : +49-(0)89-14005-0 Fax : +49-(0)89-14005-110

- GERMANY -
EPSON EUROPE ELECTRONICS GmbH
SALES OFFICE
Breidenbachstrasse 46
D-51373 Leverkusen, GERMANY
Phone : +49-(0)214-83070-0 Fax : +49-(0)214-83070-10

- UNITED KINGDOM -
EPSON EUROPE ELECTRONICS GmbH
UK BRANCH OFFICE
G6 Doncastle House, Doncastle Road
Bracknell, Berkshire RG12 8PE, ENGLAND
Phone: +44-(0)1344-381700 Fax: +44-(0)1344-381701

- FRANCE -
EPSON EUROPE ELECTRONICS GmbH
FRENCH BRANCH OFFICE
1 Avenue de l' Atlantique, LP 915 Les Conquerants
Z.A. de Courtaboeuf 2, F-91976 Les Ulis Cedex, FRANCE
Phone: +33-(0)1-64862350 Fax: +33-(0)1-64862355

ASIA

- HONG KONG, CHINA -
EPSON HONG KONG LTD.
20/F., Harbour Centre, 25 Harbour Road
Wanchai, HONG KONG
Phone: +852-2585-4600 Fax: +852-2827-4346
Telex: 65542 EPSCO HX

- CHINA -
SHANGHAI EPSON ELECTRONICS CO., LTD.
4F, Bldg., 27, No. 69, Gui Jing Road
Caohejing, Shanghai, CHINA
Phone: 21-6485-5552 Fax: 21-6485-0775

- TAIWAN, R.O.C. -
EPSON TAIWAN TECHNOLOGY & TRADING LTD.
10F, No. 287,Nanking East Road, Sec. 3
Taipei, TAIWAN, R.O.C.
Phone: 02-2717-7360 Fax: 02-2712-9164
Telex: 24444 EPSONTB

EPSON TAIWAN TECHNOLOGY & TRADING LTD.
HSINCHU OFFICE
13F-3,No.295,Kuang-Fu Road,Sec.2
HsinChu 300,TAIWAN,R.O.C.
Phone: 03-573-9900 Fax: 03-573-9169

- SINGAPORE -
EPSON SINGAPORE PTE., LTD.
No. 1 Temasek Avenue, #36-00
Millenia Tower, SINGAPORE 039192
Phone: +65-337-7911 Fax: +65-334-2716

- KOREA -
SEIKO EPSON CORPORATION
KOREA OFFICE
10F, KLI 63 Bldg., 60 Yoido-Dong
Youngdeungpo-Ku, Seoul, 150-010, KOREA
Phone: 02-784-6027 Fax: 02-767-3677

- JAPAN -
SEIKO EPSON CORPORATION
ELECTRONIC DEVICES MARKETING DIVISION

Electronic Device Marketing Department
IC Marketing & Engineering Group
421-8, Hino, Hino-shi, Tokyo 191-8501, JAPAN
Phone: +81-(0)42-587-5816 Fax: +81-(0)42-587-5624

ED International Marketing Department I
(Europe & U.S.A.)
421-8, Hino, Hino-shi, Tokyo 191-8501, JAPAN
Phone: +81-(0)42-587-5812 Fax: +81-(0)42-587-5564

ED International Marketing Department II (Asia)
421-8, Hino, Hino-shi, Tokyo 191-8501, JAPAN
Phone: +81-(0)42-587-5814 Fax: +81-(0)42-587-5110

In pursuit of **“Saving” Technology**, Epson electronic devices.
Our lineup of semiconductors, liquid crystal displays and quartz devices
assists in creating the products of our customers’ dreams.
Epson IS energy savings.

EPSON

SEIKO EPSON CORPORATION
ELECTRONIC DEVICES MARKETING DIVISION

■ Electronic devices information on the Epson WWW server

http://www.epson.co.jp

Issue APRIL 1998 Printed in Japan Ⓜ A