MF882-02

EPSON

CMOS 4-BIT SINGLE CHIP MICROCOMPUTER

E0C6S27 DEVELOPMENT TOOL MANUAL

ENERGY SAVING EPSON

SEIKO EPSON CORPORATION

E0C6S27 Development Tool Manual

PREFACE

This manual mainly explains the outline of the development support tool for the 4-bit Single Chip Microcomputer E0C6S27.

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 EVA6S27 Manual ICE6200 Hardware Manual
Development procedure	☞ E0C62 Family Technical Guide
Device (E0C6S27)	☞ E0C6S27 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 DEV6S27

The below software are included in the product of the E0C6S27 development support tool DEV6S27.

1. Development Tool Management System DMS6200 ..... Menu selection for each software / start-up software
2. Cross Assembler ASM6S27 ..... Cross assembler for program preparation
3. Function Option Generator FOG6S27 ..... Function option data preparation program
4. Segment Option Generator SOG6S27 ..... Segment option data preparation program
5. ICE Control Software ICS6S27 ..... ICE control program
6. Mask Data Checker MDC6S27 ..... Mask data preparation program

1.2 Developmental Environment

The software product of the development support tool DEV6S27 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 E0C6S27, 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.

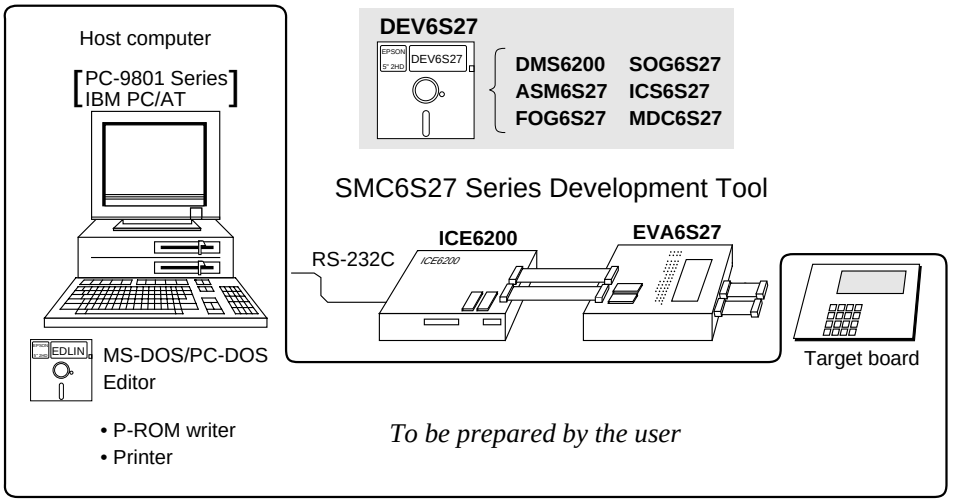


Fig. 1.2.1 System configuration

Note The DEV6S27 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 DEV6S27.

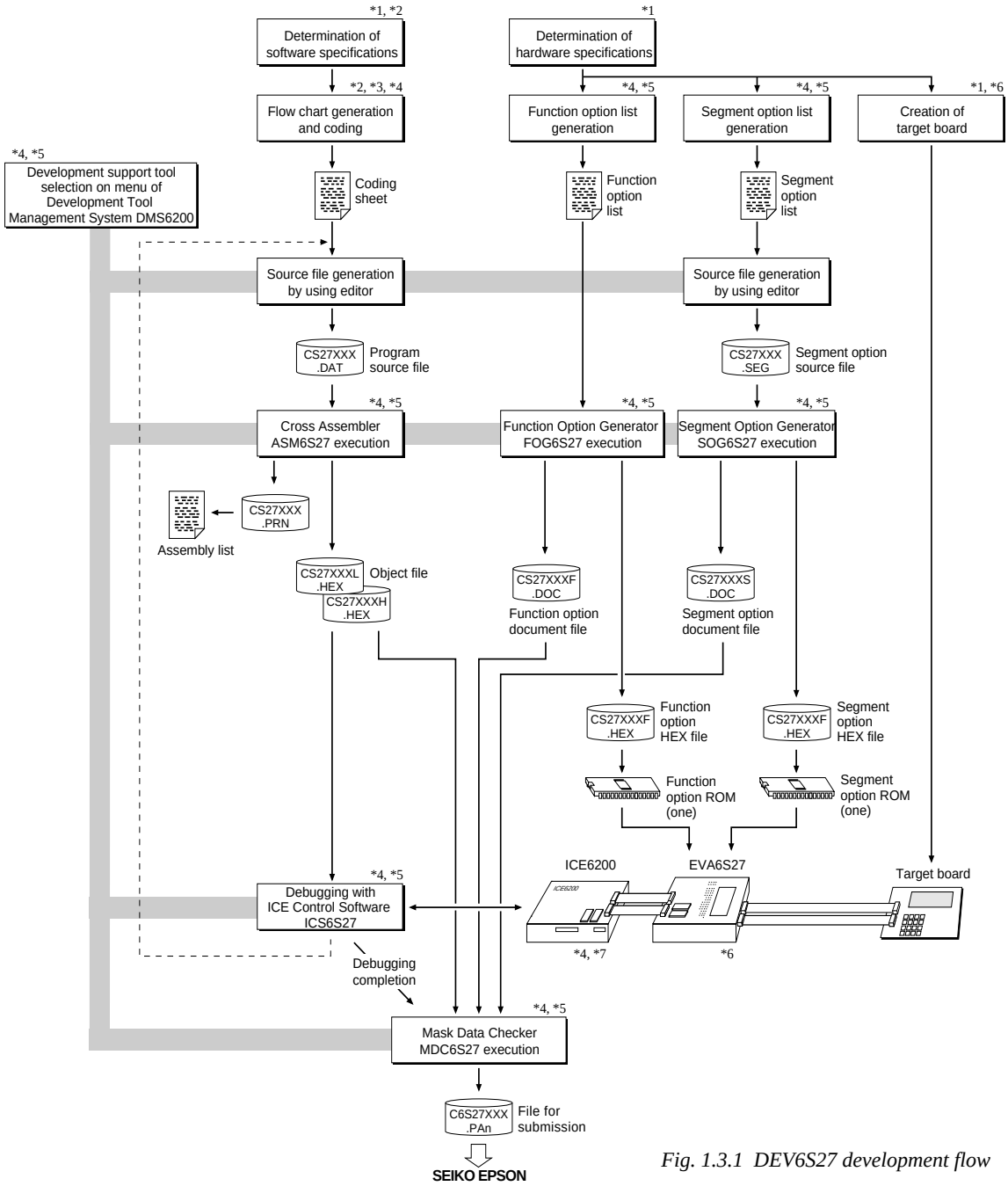


Fig. 1.3.1 DEV6S27 development flow

Concerning file names

All the input-output file name for the each development support tool commonly use "CS27XXX". In principle each file should be produced in this manner. Seiko Epson will designate the "XXX" for each customer.

☞ Reference Manual

*1 E0C6S27 Technical Hardware Manual
*2 E0C6S27 Technical Software Manual
*3 E0C6200/6200A Core CPU Manual
*4 E0C62 Family Development Tool Reference Manual
*5 E0C6S27 Development Tool Manual (this manual)
*6 EVA6S27 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 DEV6S27 floppy disk.
The content of the files contained in the DEV6S27 floppy disk are shown below.

PC-DOS version	MS-DOS version	Contents
ASM6S27.EXE	ASM6S27.EXE	Cross Assembler execution file
DMS6200.EXE	DMS6200.EXE	Development Tool Management System execution file
FOG6S27.EXE	FOG6S27.EXE	Function Option Generator execution file
ICS6S27B.BAT	ICS6S27.BAT	ICE Control Software batch file
ICS6S27W.EXE	ICS6S27J.EXE	ICE Control Software execution file
ICS6S27P.PAR	ICS6S27P.PAR	ICE Control Software parameter file
MDC6S27.EXE	MDC6S27.EXE	Mask Data Checker execution file
SOG6S27.EXE	SOG6S27.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 (DEV6S27, 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 (DEV6S27), then insert the original disk into the A drive and execute the COPY command.

```
C\>MD DEV6S27↵
C\>CD DEV6S27↵
C\DEV6S27\>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 MDC6S27 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 "ICS6S27(B).BAT" the batch process is indicated such that the ICS6S27J(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 DEV6S27 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.

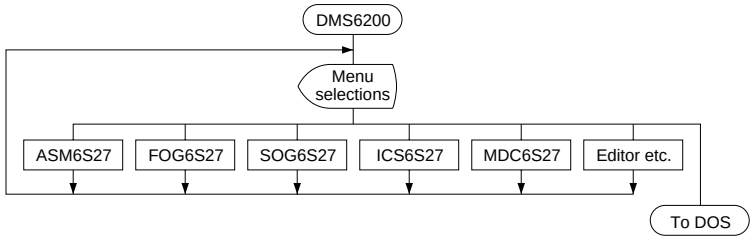


Fig. 2.1.1 DMS6200 execution flow

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 1990 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. 1990.

1) ASM6S27 .EXE
2) FOG6S27 .EXE
3) ICS6S27B.BAT
4) ICS6S27W.EXE
5) MDC6S27 .EXE
6) SOG6S27 .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. 1990.

 1) CS27XXX .DAT
 2) CS27XXX .PRN
 3) CS27XXX .SEG
 :     :
10) C6S27XXX.PA0

 Input Number ? [1  ]

   Edit > [ASM6S27 CS27XXX                                        ]
```

Source file selection screen
To starting ASM6S27, 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 ASM6S27

3.1 ASM6S27 Outline

The ASM6S27 cross assembler is an assembler program for generating the machine code used by the E0C6S27 4-bit, single-chip microcomputers. The Cross Assembler ASM6S27 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.*

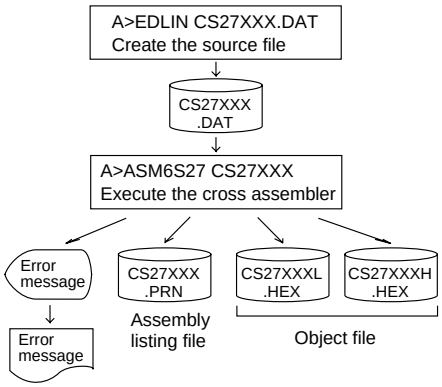


Fig. 3.1.1 ASM6S27 execution flow

3.2 E0C6S27 Restrictions

Note the following when generating a program by the E0C6S27:

■ ROM area

The capacity of the E0C6S27 ROM is 1,536 steps (0000H to 05FFH).
Therefore, the specification range of the memory setting pseudo-instructions and PSET instruction is restricted.

Memory configuration:
Bank: Only bank 0, Page: 6 pages (0 to 5H), each 256 steps

Significant specification range:

ORG	pseudo-instruction:	0000H to 05FFH
PAGE	pseudo-instruction:	00H to 05H
BANK	pseudo-instruction:	Only 0H
PSET	instruction:	00H to 05H

■ RAM area

The capacity of the E0C6S27 RAM is 132 words (000H to 0FFH, 4 bits/word). The following memory access is invalid when the unused area of the index register is specified.

- 050H–08FH, 0B0H–0DFH, 0E1H, 0E5H–0E7H, 0F0H–0F2H, 0F4H, 0F5H, 0F7H, 0F8H, 0FFH

Example:

```
LD   X,050H
```
50H 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.

```
LD   Y,0C7H
```
C7H is loaded into the IY register, but an unused area has been specified so that the memory accessible with the IY register (MY) is invalid.

■ Undefined codes

The following instructions have not been defined in the E0C6S27 instruction sets.

```
SLP
PUSH  XP      PUSH  YP
POP   XP      POP   YP
LD    XP,r    LD    YP,r
LD    r,XP    LD    r,YP
```

3.3 ASM6S27 Quick Reference

■ Starting command and input/output files

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

Execution file: ASM6S27.EXE

Starting command: **ASM6S27_ [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: CS27XXX.DAT (Source file)

Output file: CS27XXXL.HEX (Object file, low-order)
CS27XXXH.HEX (Object file, high-order)
CS27XXX.PRN (Assembly listing file)

■ Display example

```
          *** E0C6S27 CROSS ASSEMBLER. --- 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 1988 SEIKO EPSON CORP.

          SOURCE FILE NAME IS " CS27XXX.DAT "

          THIS SOFTWARE MAKES NEXT FILES.

             CS27XXXH.HEX  ...  HIGH BYTE OBJECT FILE.
             CS27XXXL.HEX  ...  LOW BYTE OBJECT FILE.
             CS27XXX .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 ASM6S27 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, ASM6S27 assembles the source file.
To suspend execution, press the "CTRL" and "C" keys together at stage (1) or (2).

■ Operators

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

■ Pseudo-instructions

Pseudo-instruction	Meaning	Example of Use
EQU (Equation)	To allocate data to label	`ABC EQU 9` `BCD EQU ABC+1`
SET (Set)	To allocate data to label (data can be changed)	`ABC SET 0001H` `ABC SET 0002H`
DW (Define Word)	To define ROM data	`ABC DW 'AB'` `BCD DW 0FFBH`
ORG (Origin)	To define location counter	`ORG 100H` `ORG 256`
PAGE (Page)	To define boundary of page	`PAGE 1H` `PAGE 3`
SECTION (Section)	To define boundary of section	`SECTION`
END (End)	To terminate assembly	`END`

MACRO (Macro)	To define macro	`CHECK MACRO DATA`
		`LOCAL LOOP`
		`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)	• 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 FOG6S27

4.1 FOG6S27 Outline

With the 4-bit single-chip E0C6S27 microcomputers, the customer may select 11 hardware options. By modifying the mask patterns of the E0C6S27 according to the selected options, the system can be customized to meet the specifications of the target system.
The Function Option Generator FOG6S27 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 FOG6S27, the E0C6S27 mask pattern is automatically generated by a general purpose computer. The HEX file for the evaluation board (EVA6S27) 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.*

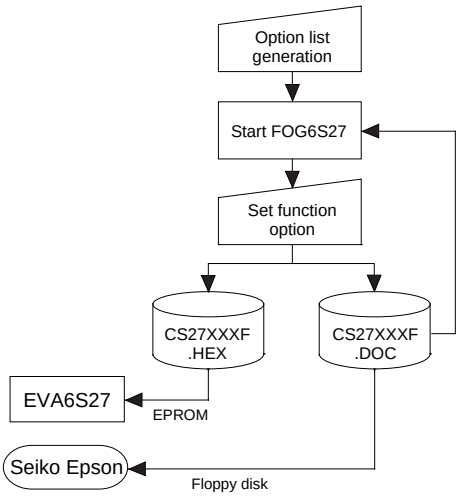


Fig. 4.1.1 FOG6S27 execution flow

4.2 E0C6S27 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, LCD VOLTAGE REGULATOR AND LCD VOLTAGE

☐ 1. E0C6S27	(Normal Type)	LCD Voltage Regurator	Use	LCD 3 V
☐ 2. E0C6S27	(Normal Type)	LCD Voltage Regurator	Not Use	LCD 3 V
☐ 3. E0C6SA27	(High Speed Type)	LCD Voltage Regurator	Use	LCD 3 V
☐ 4. E0C6SA27	(High Speed Type)	LCD Voltage Regurator	Not Use	LCD 3 V
☐ 5. E0C6SA27	(High Speed Type)	LCD Voltage Regurator	Not Use	LCD 4.5 V
☐ 6. E0C6SB27	(Wide Range Type)	LCD Voltage Regurator	Use	LCD 3 V
☐ 7. E0C6SL27	(Low Power Type)	LCD Voltage Regurator	Use	LCD 3 V
☐ 8. E0C6SL27	(Low Power Type)	LCD Voltage Regurator	Not Use	LCD 3 V

2. MULTIPLE KEY ENTRY RESET

- KEY COMBINATION ..... ☐ 1. Not Use
  ☐ 2. Use K00, K01
  ☐ 3. Use K00, K01, K02
  ☐ 4. Use K00, K01, K02, K03
- INPUT TIME ..... ☐ 1. 4 [sec]
  ..... ☐ 2. 2 [sec]
  ..... ☐ 3. 62.5 [msec]
  ..... ☐ 4. 250 [msec]

3. INTERRUPT NOISE REJECTOR

- K00–K03 ..... ☐ 1. Use ☐ 2. Not Use

4. 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

5. R00 SPECIFICATION

- OUTPUT TYPE ..... ☐ 1. DC Output
  ☐ 2. Buzzer Inverted Output (R00 Control)
  ☐ 3. Buzzer Inverted Output (R01 Control)
  ☐ 4. FOUT Output
- FOUT OUTPUT SPACIFICATION

F1	☐ 1.	256[Hz]	F3	☐ 1.	1,024[Hz]
	☐ 2.	512[Hz]		☐ 2.	2,048[Hz]
	☐ 3.	1,024[Hz]		☐ 3.	4,096[Hz]
	☐ 4.	2,048[Hz]		☐ 4.	8,192[Hz]
	☐ 5.	4,096[Hz]		☐ 5.	16,384[Hz]
F2	☐ 1.	512[Hz]	F4	☐ 1.	2,048[Hz]
	☐ 2.	1,024[Hz]		☐ 2.	4,096[Hz]
	☐ 3.	2,048[Hz]		☐ 3.	8,192[Hz]
	☐ 4.	4,096[Hz]		☐ 4.	16,384[Hz]
	☐ 5.	8,192[Hz]		☐ 5.	32,768[Hz]

- OUTPUT SPECIFICATION ..... ☐ 1. Complementary ☐ 2. Pch-Open Drain

6. R01 SPECIFICATION

- OUTPUT TYPE ..... ☐ 1. DC Output ☐ 2. Buzzer Output
- OUTPUT SPECIFICATION ..... ☐ 1. Complementary ☐ 2. Pch-Open Drain

7. OUTPUT SPECIFICATION (R02, R03)

- R02 ..... ☐ 1. Complementary ☐ 2. Pch-Open Drain
- R03 ..... ☐ 1. Complementary ☐ 2. Pch-Open Drain

8. I/O PORT SPECIFICATION

- P00 ..... ☐ 1. Complementary ☐ 2. Pch-Open Drain
- P01 ..... ☐ 1. Complementary ☐ 2. Pch-Open Drain
- P02 ..... ☐ 1. Complementary ☐ 2. Pch-Open Drain
- P03 ..... ☐ 1. Complementary ☐ 2. Pch-Open Drain

9. LCD COMMON DUTY AND BIAS

☐ 1. 1/4 Duty 1/3 Bias
☐ 2. 1/3 Duty 1/3 Bias
☐ 3. 1/2 Duty 1/3 Bias
☐ 4. 1/4 Duty 1/2 Bias
☐ 5. 1/3 Duty 1/2 Bias
☐ 6. 1/2 Duty 1/2 Bias

10. OSC1 SYSTEM CLOCK

☐ 1. Crystal
☐ 2. CR

11. STEPPING MOTOR PF PULSE WIDTH

☐ 1.	1.46[msec]	☐ 13.	4.39[msec]
☐ 2.	1.71[msec]	☐ 14.	4.64[msec]
☐ 3.	1.95[msec]	☐ 15.	4.88[msec]
☐ 4.	2.20[msec]	☐ 16.	5.13[msec]
☐ 5.	2.44[msec]	☐ 17.	5.37[msec]
☐ 6.	2.69[msec]	☐ 18.	5.61[msec]
☐ 7.	2.93[msec]	☐ 19.	5.86[msec]
☐ 8.	3.17[msec]	☐ 20.	6.10[msec]
☐ 9.	3.42[msec]	☐ 21.	6.35[msec]
☐ 10.	3.66[msec]	☐ 22.	6.59[msec]
☐ 11.	3.91[msec]	☐ 23.	6.83[msec]
☐ 12.	4.15[msec]	☐ 24.	7.08[msec]

4.3 Option Specifications and Selection Message

Screen that can be selected as function options set on the E0C6S27 are shown below, and their specifications are also described.

1 Device type, LCD voltage regulator and LCD voltage

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

--- DEVICE TYPE & LCD POWER VREG ---

                    1. E0C6S27  VREG USE     LCD 3V
                    2. E0C6S27  VREG NOT USE LCD 3V
                    3. E0C6SA27 VREG USE     LCD 3V
                    4. E0C6SA27 VREG NOT USE LCD 3V
                    5. E0C6SA27 VREG NOT USE LCD 4.5V
                    6. E0C6SB27 VREG USE     LCD 3V
                    7. E0C6SL27 VREG USE     LCD 3V
                    8. E0C6SL27 VREG NOT USE LCD 3V

PLEASE SELECT NO.(1) ? 2↵

                    2. E0C6S27  VREG NOT USE LCD 3V   SELECTED
```

Select the chip specification.
There are four models: E0C6S27 (3 V supply voltage), E0C6SA27 (3 V supply voltage, high speed specification), E0C6SL27 (1.5 V supply voltage, low-power specification) and E0C6SB27 (0.9 to 3.6 V supply voltage, wide range specification).
The other specifications of the E0C6SB27 are same as the E0C6S27.
In the E0C6S27, the E0C6SA27 and the E0C6SL27, select either "Use" or "Not use" for the LCD system voltage regulator. The E0C6SB27 always uses the LCD system voltage regulator.
When the LCD system voltage regulator is not used in the E0C6S27, the E0C6SA27 or the E0C6SL27, the external capacitors can be minimized. However, the display quality of the LCD panel when the supply voltage drops is inferior to when the LCD system voltage regulator is used.
Moreover, when the LCD system voltage regulator is not used in the E0C6S27, the E0C6SA27 or the E0C6SL27, select the LCD drive voltage (3 V or 4.5 V) according to the LCD panel to be used. When the LCD system voltage regulator is used, the LCD drive voltage is fixed at 3 V.
Figure 4.3.1 shows the external elements when the LCD system voltage regulator is used.
Figure 4.3.2 shows the external elements when the LCD system voltage regulator is not used.

SMC6S27, SMC6SA27, SMC6SL27, SMC6SB27

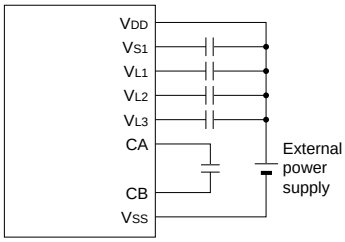
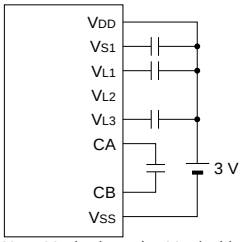


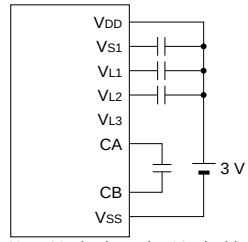
Fig. 4.3.1 External elements when LCD system voltage regulator is used

SMC6SA27
4.5 V LCD panel
1/4, 1/3, 1/2 duty, 1/3 bias



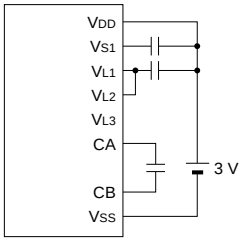
Note: V_{L2} is shorted to V_{SS} inside the IC.

SMC6S27, SMC6SA27
3 V LCD panel
1/4, 1/3, 1/2 duty, 1/3 bias



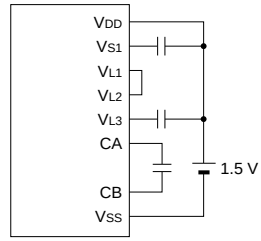
Note: V_{L3} is shorted to V_{SS} inside the IC.

SMC6S27, SMC6SA27
3 V LCD panel
1/4, 1/3, 1/2 duty, 1/2 bias



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

SMC6SL27
3 V LCD panel
1/4, 1/3, 1/2 duty, 1/2 bias



Note: V_{L1} is shorted to V_{SS} inside the IC.

Fig. 4.3.2 External elements when LCD system voltage regulator is not used

2 Multiple key entry reset

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

--- K00-K03 MULTIPLE KEY ENTRY RESET ---

       KEY COMBINATION   1. NOT USE
                         2. USE  K00,K01
                         3. USE  K00,K01,K02
                         4. USE  K00,K01,K02,K03

PLEASE SELECT  NO.(1) ? 2↵

       INPUT TIME        1. INPUT 4   [SEC]
                         2. INPUT 2   [SEC]
                         3. INPUT 62.5[MSEC]
                         4. INPUT 250 [MSEC]

PLEASE SELECT  NO.(1) ? 1↵

       KEY COMBINATION   2. USE  K00,K01   SELECTED
       INPUT TIME        1. INPUT 4 [SEC]   SELECTED
```

The reset function is set when K00 through K03 are entered.
When "NOT USE" is selected, the reset function is not activated even if K00 through K03 are entered.
When "USE K00, K01" is selected, 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 items 2, 3 or 4 are selected for KEY COMBINATION, the simultaneous high input time for system reset can be selected from 4 sec, 2 sec, 62.5 msec and 250 msec.
The system reset circuit is shown in Figure 4.3.3.

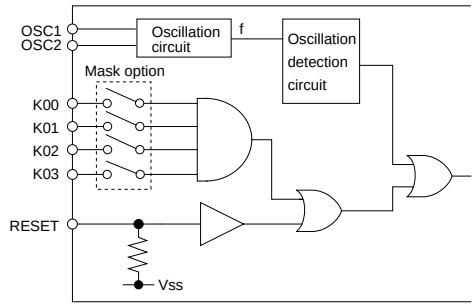


Fig. 4.3.3
System reset circuit

3 Interrupt noise rejector

```
*** OPTION  NO.3 ***

--- INTERRUPT NOISE REJECTOR ---

        K00-K03          1. USE
                         2. NOT USE

PLEASE SELECT NO.(1) ? 1↵

        K00-K03          1. USE   SELECTED
```

Select whether noise rejector will be supplemented to the input interrupter of K00–K03. 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.

4 Input ports pull down resistor

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

--- 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↵

        K00              1. WITH RESISTOR   SELECTED
        K01              1. WITH RESISTOR   SELECTED
        K02              1. WITH RESISTOR   SELECTED
        K03              1. WITH RESISTOR   SELECTED
```

Select whether input ports (K00–K03) 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 "H" level (V_{DD}) to "L" level (V_{SS}) with pull down resistors, a delay of approximately 1 msec in waveform fall 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 4.3.4.

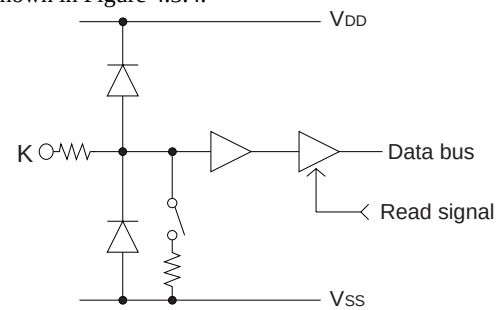


Fig. 4.3.4
Configuration of pull down resistor

5 R00 specification

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

--- R00 SPECIFICATION ---

        OUTPUT TYPE             1. D.C.
                                2. /BZ R00
                                3. /BZ R01
                                4. FOUT

PLEASE SELECT NO.(4) ? 4↵

        F1                      1.   256 [HZ]
                                2.   512 [HZ]
                                3.  1024 [HZ]
                                4.  2048 [HZ]
                                5.  4096 [HZ]

PLEASE SELECT NO.(4) ? 4↵

        F2                      1.   512 [HZ]
                                2.  1024 [HZ]
                                3.  2048 [HZ]
                                4.  4096 [HZ]
                                5.  8192 [HZ]

PLEASE SELECT NO.(4) ? 4↵

        F3                      1.  1024 [HZ]
                                2.  2048 [HZ]
                                3.  4096 [HZ]
                                4.  8192 [HZ]
                                5. 16384 [HZ]

PLEASE SELECT NO.(4) ? 4↵

        F4                      1.  2048 [HZ]
                                2.  4096 [HZ]
                                3.  8192 [HZ]
                                4. 16384 [HZ]
                                5. 32768 [HZ]

PLEASE SELECT NO.(4) ? 4↵

        OUTPUT SPECIFICATION    1. COMPLEMENTARY
                                2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

        OUTPUT TYPE             4. FOUT   SELECTED
        F1                      4.  2048 [HZ]   SELECTED
        F2                      4.  4096 [HZ]   SELECTED
        F3                      4.  8192 [HZ]   SELECTED
        F4                      4. 16384 [HZ]   SELECTED
        OUTPUT SPECIFICATION    1. COMPLEMENTARY   SELECTED
```

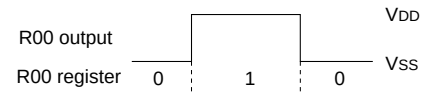


Fig. 4.3.5 Output waveform at DC output selection

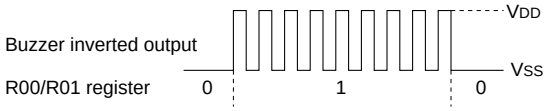


Fig. 4.3.6 Output waveform at buzzer inverted output selection

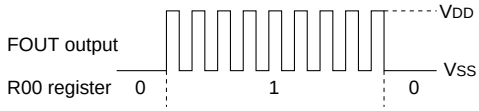


Fig. 4.3.7 Output waveform at FOUT output selection

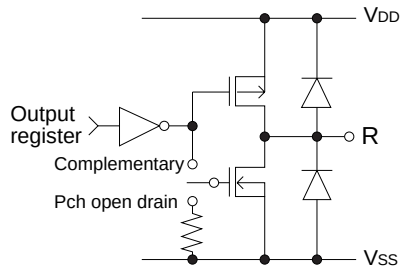


Fig. 4.3.8 Configuration of output circuit

Select the output specification for the R00 terminal. Either complementary output or Pch open drain output may be selected.
When "D.C." (DC output) is selected, R00 becomes a regular output port.
When "/BZ R00" (buzzer inverted output, R00 control) is selected, by writing "1" to the R00 register, clock with frequency specified through the software is generated from the R00 terminal. When "/BZ R01" (buzzer inverted output, R01 control) is selected, by writing "1" to the R01 register, clock with frequency specified through the software is generated from the R00 terminal.
When FOUT is selected, clock with frequency selected from the R10 terminal is generated by writing "1" to the R10 register.
When the DC output or buzzer inverted output is selected as the output type, the FOUT frequencies cannot be selected.

- When DC output is selected
  When the R00 register is set to "1", the R00 terminal output goes high (V_{DD}), and goes low (V_{SS}) when set to "0".
  Output waveform is shown in Figure 4.3.5.
- When buzzer inverted output (R00 control) is selected
  When the R00 register is set to "1", 50% duty and V_{DD}–V_{SS} amplitude square wave is generated at the specified frequency by the software. When set to "0", the R00 terminal goes low (V_{SS}). The clock phase when buzzer drive signal is output from R00 terminal is antiphase to that of the R01 terminal.
  Output waveform is shown in Figure 4.3.6.
- When buzzer inverted output (R01 control) is selected
  When the R01 register is set to "1", 50% duty and V_{DD}–V_{SS} amplitude square wave is generated at the specified frequency by the software. When set to "0", the R00 terminal goes low (V_{SS}). The clock phase when buzzer drive signal is output from the R00 terminal is antiphase to that of the R01 terminal. Output waveform is shown in Figure 4.3.6.
- When FOUT output is selected
  When the R00 register is set to "1", 50% duty and V_{DD}–V_{SS} amplitude square wave is generated at the specified frequency. When set to "0", the FOUT terminal goes low (V_{SS}).
  The F1 to F4 FOUT frequencies are set by mask option. One of them is used by the software.
  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 4.3.7.

The output circuit configuration is shown in Figure 4.3.8.

6 R01 specification

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

--- R01 SPECIFICATION ---

        OUTPUT TYPE             1. D.C.
                                2. BZ OUTPUT

PLEASE SELECT NO.(1) ? 2↵

        OUTPUT SPECIFICATION    1. COMPLEMENTARY
                                2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 1↵

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

Select the output specification for the R01 terminal. Either complementary output or Pch open drain output may be selected.
When "D.C." (DC output) is selected, R01 becomes a regular output port.
When "BZ OUTPUT" (buzzer output) is selected, by writing "1" to the R01 register, clock with frequency specified through the software is generated from the R01 terminal.

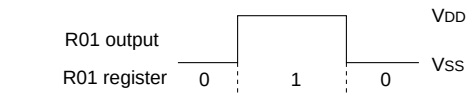


Fig. 4.3.9 Output waveform at DC output selection

- When DC output is selected
  When the R01 register is set to "1", the R01 terminal output goes high (V_{DD}), and goes low (V_{SS}) when set to "0".
  Output waveform is shown in Figure 4.3.9.

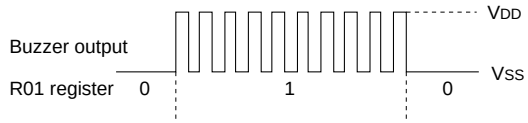


Fig. 4.3.10 Output waveform at buzzer output selection

- When buzzer output is selected
  When the R01 register is set to "1", 50% duty and V_{DD}–V_{SS} amplitude square wave is generated at the specified frequency by the software. When set to "0", the R01 terminal goes low (V_{SS}). The clock phase when buzzer drive signal is output from the R01 terminal is antiphase to that of the R00 terminal.
  Output waveform is shown in Figure 4.3.10.

7 Output port output specification (R02, R03)

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

--- OUTPUT PORT SPECIFICATION ---

        R02                     1. COMPLEMENTARY
                                2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 2↵

        R03                     1. COMPLEMENTARY
                                2. PCH-OPENDRAIN

PLEASE SELECT NO.(1) ? 2↵

        R02                     1. PCH-OPENDRAIN   SELECTED
        R03                     2. PCH-OPENDRAIN   SELECTED
```

Select the output specification for the R02 and R03 output ports.
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 circuit configuration is the same as that of output ports (R00 shown in Figure 4.3.8).

8 I/O port specification

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

--- 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↵

        P00             1. COMPLEMENTARY   SELECTED
        P01             1. COMPLEMENTARY   SELECTED
        P02             1. COMPLEMENTARY   SELECTED
        P03             1. COMPLEMENTARY   SELECTED
```

Select the output specification to be used during I/O ports (P00–P03) 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 shown in Figure 4.3.8).
Select complementary output for unused ports.
The I/O ports can control the input/output direction according to the IOC bit (FC address, 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 circuit configuration of the I/O port. is shown in Figure 4.3.11.

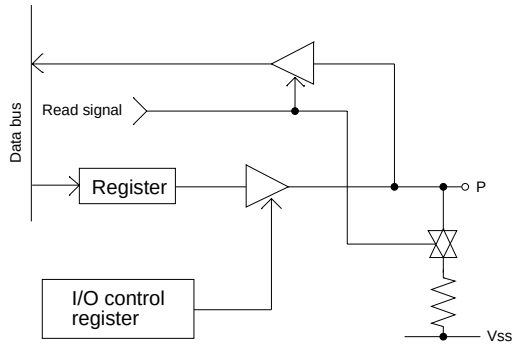


Fig. 4.3.11
Configuration of I/O port

9 LCD common duty and bias

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

--- LCD COMMON DUTY & BIAS ---

                      1. 1/4 DUTY 1/3 BIAS
                      2. 1/3 DUTY 1/3 BIAS
                      3. 1/2 DUTY 1/3 BIAS
                      4. 1/4 DUTY 1/2 BIAS
                      5. 1/3 DUTY 1/2 BIAS
                      6. 1/2 DUTY 1/2 BIAS

PLEASE SELECT NO.(1) ? 1↵

                      1. 1/4 DUTY 1/3 BIAS   SELECTED
```

Select the common (drive) duty and bias.
When 1/2 duty is selected, up to 52 segments of LCD panel can be driven with 2 COM terminals and 26 SEG terminals. When 1/3 duty is selected, up to 78 segments can be driven with 3 COM terminals, and when 1/4 duty is selected, up to 104 segments with 4 COM terminals.
When 1/2 duty is selected, the COM0 and COM1 terminals are effective for COM output and the COM2 and COM3 terminals always output an off signal. When 1/3 duty is selected, the COM0 to COM2 terminals are effective and the COM3 terminal always outputs an off signal.
Refer to Table 4.3.1 for common duty selection.

Table 4.3.1 Common duty selection standard

Number of segments	Common duty
1–52	1/2
53–78	1/3
79–104	1/4

For the LCD drive bias, either 1/3 bias (drives LCD with 4 levels, V_{DD}, V_{L1}, V_{L2} and V_{L3}) or 1/2 bias (drives LCD with 3 levels, V_{DD}, V_{L1}=V_{L2} and V_{L3}) can be selected.

By selecting 1/2 bias, external elements can be minimized (see Figure 4.3.2). However, it is limited when the LCD system voltage regulator is not used. Furthermore, when 1/2 bias is selected, be sure to short between the V_{L1} terminal and the V_{L2} terminal outside the IC.
Figures 4.3.12 and 4.3.13 show the drive waveforms of 1/3 bias driving and 1/2 bias driving, respectively.

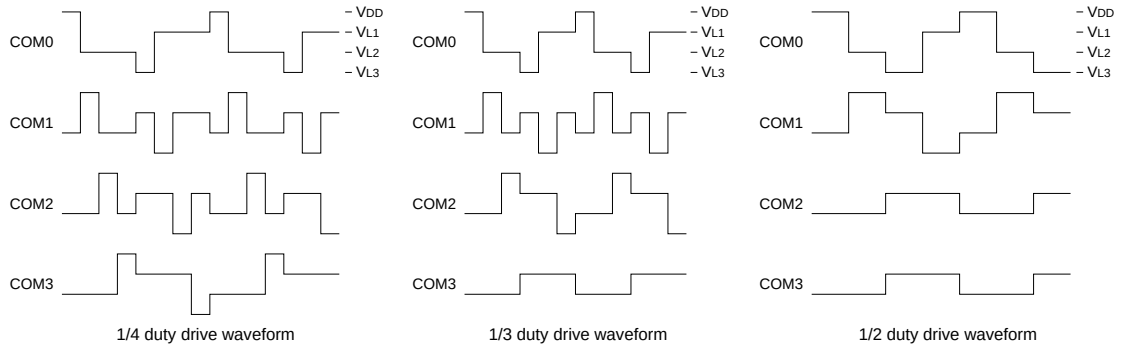


Fig. 4.3.12 Drive waveform from COM terminals (1/3 bias)

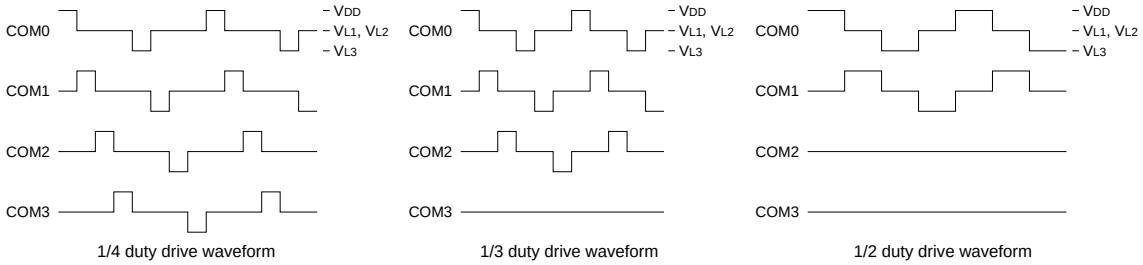


Fig. 4.3.13 Drive waveform from COM terminals (1/2 bias)

10 OSC1 system clock

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

--- OSC1 SYSTEM CLOCK ---

                        1. CRYSTAL
                        2. CR

PLEASE SELECT NO.(1) ? 1↵

                        1. CRYSTAL   SELECTED
```

Select oscillation circuit that uses OSC1 and OSC2. To minimize external components, CR oscillation circuit would be suitable; to obtain a stable oscillation frequency, crystal 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 crystal oscillation circuit is selected, crystal oscillator and trimmer capacitor are needed as external components. Although when crystal oscillation circuit is selected, it is fixed at 32.768 kHz, when CR oscillation circuit is selected, frequency may be modified to a certain extent depending on the resistance of external components.

11 Stepping motor PF pulse width

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

--- PF PULSE WIDTH ---

                        1.  1.46 [MSEC]
                        2.  1.71 [MSEC]
                        3.  1.95 [MSEC]
                        4.  2.20 [MSEC]
                        5.  2.44 [MSEC]
                        6.  2.69 [MSEC]
                        7.  2.93 [MSEC]
                        8.  3.17 [MSEC]
                        9.  3.42 [MSEC]
                        10. 3.66 [MSEC]
                        11. 3.91 [MSEC]
                        12. 4.15 [MSEC]
                        13. 4.39 [MSEC]
                        14. 4.64 [MSEC]
                        15. 4.88 [MSEC]
                        16. 5.13 [MSEC]
                        17. 5.37 [MSEC]
                        18. 5.61 [MSEC]
                        19. 5.86 [MSEC]
                        20. 6.10 [MSEC]
                        21. 6.35 [MSEC]
                        22. 6.59 [MSEC]
                        23. 6.83 [MSEC]
                        24. 7.08 [MSEC]

PLEASE SELECT NO.(1) ? 15↵

                        15. 4.88 [MSEC]   SELECTED
```

Selects a drive pulse width of the sutepping motor for PF pulse.
When the FTRG register (0FEH•D1)is set to "1", either the A01 or the A02 terminal outputs a drive pulse and an interrupt occurs after the output sequence has finished. Next by writing "1" to the register outputs a drive pulse from the other terminal. By repeating this sequence using the interrupt, drive pulses are alternately output from the A01 and A02 terminals.
At the first writing of "1" to the register after system reset, the A01 terminal outputs a drive pulse.

4.4 FOG6S27 Quick Reference

■ Starting command and input/output files

Execution file: FOG6S27.EXE

Starting command: **FOG6S27↵** ↵ *indicates the Return key.*

Input file: CS27XXXF.DOC (Function option document file, when modifying)

Output file: CS27XXXF.DOC (Function option document file)
CS27XXXF.HEX (Function option HEX file)

■ Display example

```
     ***  E0C6S27 FUNCTION OPTION GENERATOR. --- Ver 3.14  ***

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 1995  SEIKO EPSON CORP.

         THIS SOFTWARE MAKES NEXT FILES.

            CS27XXXF.HEX  ...  FUNCTION OPTION HEX FILE.
            CS27XXXF.DOC  ...  FUNCTION OPTION DOCUMENT FILE.

                        STRIKE ANY KEY.
```

Start-up message
When FOG6S27 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.

```
*** E0C6S27 USER'S OPTION SETTING. --- Ver 3.14 ***

CURRENT DATE IS  95/12/26
PLEASE INPUT NEW DATE  :   95/12/28↵
```

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 FOG6S27.

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

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

PLEASE SELECT NO.? 1↵
PLEASE INPUT FILE NAME? CS270A0↵                              ..(1)
PLEASE INPUT USER'S NAME? SEIKO EPSON CORP.↵                  ..(2)
PLEASE INPUT ANY COMMENT
(ONE LINE IS 50 CHR)? FUJIMI PLANT↵                           ..(3)
                    ? 281 FUJIMI SUWA-GUN NAGANO-KEN 399-02 JAPAN↵
                    ? TEL 0266-61-1211↵
                    ? FAX 0266-61-1273↵
                    ? ↵
```

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

```
PLEASE INPUT FILE NAME? CS270A0↵
EXISTS OVERWRITE(Y/N)? N↵
PLEASE INPUT FILE NAME? CS270B0↵
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) ***

CS270A0         CS270B0         CS270C0                 ..(1)

PLEASE INPUT FILE NAME? CS270A0↵                        ..(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? CS270N0↵
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.2 ***

--- K00-K03 MULTIPLE KEY ENTRY RESET ---

       KEY COMBINATION   1. NOT USE
                         2. USE  K00,K01
                         3. USE  K00,K01,K02
                         4. USE  K00,K01,K02,K03

PLEASE SELECT  NO.(1) ? 2↵

       INPUT TIME        1. INPUT 4   [SEC]
                         2. INPUT 2   [SEC]
                         3. INPUT 62.5[MSEC]
                         4. INPUT 250 [MSEC]

PLEASE SELECT  NO.(1) ? 1↵

       KEY COMBINATION   2. USE  K00,K01   SELECTED
       INPUT TIME        1. INPUT 4 [SEC]   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 EVA6S27, 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 EVA6S27 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

```
* E0C6S27 FUNCTION OPTION DOCUMENT  V 3.14
*
* FILE NAME    CS270A0F.DOC
* USER'S NAME  SEIKO EPSON CORP.
* INPUT DATE   1995/08/28
*
* COMMENT      FUJIMI PLANT
*              281 FUJIMI SUWA-GUN NAGANO-KEN 399-02 JAPAN
*              TEL 0266-61-1211
*              FAX 0266-61-1273
*
*
* OPTION NO.1
* < DEVICE TYPE & LCD POWER VREG >
*                           E0C6SL27 VREG NOT USE LCD 3V  --  SELECTED
 OPT0101 02
*
* OPTION NO.2
* < K00-K03 MULTIPLE KEY ENTRY RESET >
*     KEY COMBINATION       USE K00,K01  ------------------  SELECTED
*     INPUT TIME            INPUT 4 (SEC)  ----------------  SELECTED
 OPT0201 02
 OPT0202 01
*
* OPTION NO.3
* < INTERRUPT NOISE REJECTOR >
*     K00-K03               USE  --------------------------  SELECTED
 OPT0301 01
*
* OPTION NO.4
* < INPUT PORT PULL DOWN RESISTOR >
*     K00                   WITH RESISTOR  ----------------  SELECTED
*     K01                   WITH RESISTOR  ----------------  SELECTED
*     K02                   WITH RESISTOR  ----------------  SELECTED
*     K03                   WITH RESISTOR  ----------------  SELECTED
 OPT0401 01
 OPT0402 01
 OPT0403 01
 OPT0404 01
*
* OPTION NO.5
* < R00 SPECIFICATION >
*     OUTPUT TYPE           FOUT  -------------------------  SELECTED
*     FOUT FREQUENCY (F1)   2048 (HZ)  --------------------  SELECTED
*     FOUT FREQUENCY (F2)   4096 (HZ)  --------------------  SELECTED
*     FOUT FREQUENCY (F3)   8192 (HZ)  --------------------  SELECTED
*     FOUT FREQUENCY (F4)   16384 (HZ)  -------------------  SELECTED
*     OUTPUT SPECIFICATION  COMPLEMENTARY  ----------------  SELECTED
 OPT0501 04
 OPT0502 04
 OPT0503 04
 OPT0504 04
 OPT0505 04
 OPT0506 01
*
* OPTION NO.6
* < R01 SPECIFICATION >
*     OUTPUT TYPE           BZ OUTPUT  --------------------  SELECTED
*     OUTPUT SPECIFICATION  COMPLEMENTARY  ----------------  SELECTED
 OPT0601 02
 OPT0602 01
*
* OPTION NO.7
* < R02,R03 OUTPUT PSPECIFICATION >
*     R02                   P-CH OPEN DRAIN  --------------  SELECTED
*     R03                   P-CH OPEN DRAIN  --------------  SELECTED
 OPT0701 02
```

```
 OPT0702 02
*
* OPTION NO.8
* < I/O PORT OUTPUT SPECIFICATION(P00–P03) >
*     P00                    COMPLEMENTARY  -----------------  SELECTED
*     P01                    COMPLEMENTARY  -----------------  SELECTED
*     P02                    COMPLEMENTARY  -----------------  SELECTED
*     P03                    COMPLEMENTARY  -----------------  SELECTED
 OPT0801 01
 OPT0802 01
 OPT0803 01
 OPT0804 01
*
* OPTION NO.9
* < LCD COMMON DUTY & BIAS >
*                            1/4 DUTY 1/3 BIAS  -------------  SELECTED
 OPT0901 01
*
* OPTION NO.10
* < OSC1 SYSTEM CLOCK >
*                            CRYSTAL  -----------------------  SELECTED
 OPT1001 01
*
* OPTION NO.11
* < PF PULSE WIDTH >
*                            4.88 (MSEC)  -------------------  SELECTED
 OPT1101 15
*
*
*
* SEIKO EPSON'S AREA
*
*
*
* OPTION NO.12
 OPT1201 01
*
* OPTION NO.13
 OPT1301 01
*
* OPTION NO.14
 OPT1401 01
*
* OPTION NO.15
 OPT1501 01
 OPT1502 01
 OPT1503 01
 OPT1504 01
*
* OPTION NO.16
 OPT1601 01
 OPT1602 01
 OPT1603 01
 OPT1604 01
*
* OPTION NO.17
 OPT1701 01
 OPT1702 01
*
* OPTION NO.18
 OPT1801 01
 OPT1802 01
*
* OPTION NO.19
 OPT1901 02
*
* OPTION NO.20
 OPT2001 01
*
* OPTION NO.21
 OPT2101
\\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 SOG6S27

5.1 SOG6S27 Outline

With the 4-bit single-chip E0C6S27 microcomputers, the customer may select the LCD segment options. By modifying the mask patterns of the E0C6S27 according to the selected options, the system can be customized to meet the specifications of the target system.
The Segment Option Generator SOG6S27 is a software tool for generating data file used to generate mask patterns. From the data file created with SOG6S27, the E0C6S27 mask pattern is automatically generated by a general purpose computer.
The HEX file for the evaluation board (EVA6S27) 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.*

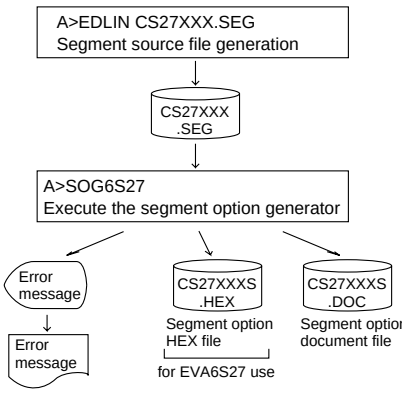


Fig. 5.1.1 SOG6S27 execution flow

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

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

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

5.3 Segment Ports Output Specifications

For the output specification of the segment output ports SEG0–SEG25, 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 (090H–0AFH) can be allocated to the optional segment. With this, up to 104 segments (78 segments when 1/3 duty is selected or 52 segments when 1/2 duty is selected) of liquid crystal panel could be driven.
The segment memory may be allocated only one segment and multiple setting is not possible.
The allocated segment displays when the bit for this segment memory is set to "1", and goes out when bit is set to "0".
Segment allocation is set to H for high address (9–A), 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  900  901  902  903  S
1  910  911  912  913  S
```

• When 1/3 duty is selected

```
0  900  901  902  ---  S
1  910  911  912  ---  S
```

• When 1/2 duty is selected

```
0  900  901  ---  ---  S
1  910  911  ---  ---  S
```

■ When DC output is selected

The DC output can be selected in units of two terminals and up to 26 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 SEG22 and SEG23, and Pch open drain output is set to SEG24 and SEG25.

```
22  A00  ---  ---  ---  C
23  A10  ---  ---  ---  C
24  A21  ---  ---  ---  P
25  A31  ---  ---  ---  P
```

5.4 SOG6S27 Quick Reference

■ Starting command and input/output files

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

Execution file: SOG6S27.EXE

Starting command: **SOG6S27_ [-H]↵**

Option: -H: Specifies the segment option document file for input file of SOG6S27.

Input file: CS27XXX.SEG (Segment option source file)
CS27XXXS.DOC (Segment option document file, when -H option use)

Output file: CS27XXXS.DOC (Segment option document file)
CS27XXXS.HEX (Segment option HEX file)

■ Display example

```
     ***  E0C6S27 SEGMENT OPTION GENERATOR. --- Ver 3.00  ***

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 1994  SEIKO EPSON CORP.

         SEGMENT OPTION SOURCE FILE NAME IS " CS27XXX.SEG "

         THIS SOFTWARE MAKES NEXT FILES.

            CS27XXXS.HEX  ...  SEGMENT OPTION HEX FILE.
            CS27XXXS.DOC  ...  SEGMENT OPTION DOCUMENT FILE.

                        STRIKE ANY KEY.
```

Start-up message
When SOG6S27 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.

```
*** E0C6S27 USER'S OPTION SETTING. --- Ver 3.00 ***

CURRENT DATE IS  95/12/26
PLEASE INPUT NEW DATE  :   95/12/28↵
```

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) ***

CS270A0         CS270B0         CS270C0                          . . (1)

PLEASE INPUT SEGMENT OPTION FILE NAME? CS270A0↵                  . . (2)
PLEASE INPUT USER'S NAME? SEIKO EPSON CORP.↵                     . . (3)
PLEASE INPUT ANY COMMENT
(ONE LINE IS 50 CHR)? FUJIMI PLANT↵                              . . (4)
                    ? 281 FUJIMI SUWA-GUN NAGANO-KEN 399-02 JAPAN↵
                    ? TEL 0266-61-1211↵
                    ? FAX 0266-61-1273↵
                    ? ↵
```

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

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

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

*** SOURCE FILE(S) ***

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

In step (1), if no modifiable source exists, an error message (5) or (6) will be displayed and the program will be terminated.

```
PLEASE INPUT SEGMENT OPTION SOURCE FILE NAME? CS270N0↵
SEGMENT OPTION SOURCE FILE IS NOT FOUND.        . . (7)  -H option not use

PLEASE INPUT SEGMENT OPTION DOCUMENT FILE NAME? CS270N0↵
SEGMENT OPTION DOCUMENT FILE IS NOT FOUND.      . . (8)  -H option use
```

In step (2), if the specified file name is not found in the current drive, an error message (7) or (8) is displayed, prompting entry of other file name.

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

*** OPTION EPROM SELECT MENU ***

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

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

        2. 27C128   SELECTED

MAKING FILE IS COMPLETED.
```

EPROM selection

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

(1) When debugging the program with EVA6S27, 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 EVA6S27 options.

When a series of operations are complete, the SOG6S27 generates files. If no error is committed while setting segment options, "MAKING FILE IS COMPLETED" will be displayed and the SOG6S27 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

```
; CS270A0.SEG, VER.3.00
; EVA6S27 LCD SEGMENT DECODE TABLE
;
 0    901  900  932  AE0 S       ;1st DIGIT
 1    912  911  910  923 S
 2    913  920  921  922 S
 3    AC0  902  930  931 S
 4    941  940  972  AE1 S       ;2nd DIGIT
 5    952  951  950  963 S
 6    953  960  961  962 S
 7    AC1  942  970  971 S
 8    981  980  9B2  AE2 S       ;3rd DIGIT
 9    992  991  990  9A3 S
10    993  9A0  9A1  9A2 S
11    AC2  982  9B0  9B1 S
12    9C1  9C0  9F2  AE3 S       ;4th DIGIT
13    9D2  9D1  9D0  9E3 S
14    9D3  9E0  9E1  9E2 S
15    AC3  9C2  9F0  9F1 S
16    A01  A00  A32  AF0 S       ;5th DIGIT
17    A12  A11  A10  A23 S
18    A13  A20  A21  A22 S
19    AD0  A02  A30  A31 S
20    A41  A40  A72  AF1 S       ;6th DIGIT
21    A52  A51  A50  A63 S
22    A53  A60  A61  A62 S
23    AD1  A42  A70  A71 S
24    AD3  ---  ---  --- C       ;DC OUTPUT
25    AF3  ---  ---  --- C
```

■ Example of segment option source file

```
* E0C6S27 SEGMENT OPTION DOCUMENT  V 3.00
*
* FILE NAME    CS270A0S.DOC
* USER'S NAME  SEIKO EPSON CORP.
* INPUT DATE   95/12/26
* COMMENT      FUJIMI PLANT
*              281 FUJIMI SUWA-GUN NAGANO-KEN 399-02 JAPAN
*              TEL 0266-61-1211
*              FAX 0266-61-1273
*
*
* OPTION NO.22
*
* < LCD SEGMENT DECODE TABLE >
*
* SEG COM0 COM1 COM2 COM3 SPEC
*
   0  901  900  932  AE0  S
   1  912  911  910  923  S
   2  913  920  921  922  S
   3  AC0  902  930  931  S
   4  941  940  972  AE1  S
   5  952  951  950  963  S
   6  953  960  961  962  S
   7  AC1  942  970  971  S
   8  981  980  9B2  AE2  S
   9  992  991  990  9A3  S
  10  993  9A0  9A1  9A2  S
  11  AC2  982  9B0  9B1  S
  12  9C1  9C0  9F2  AE3  S
  13  9D2  9D1  9D0  9E3  S
  14  9D3  9E0  9E1  9E2  S
  15  AC3  9C2  9F0  9F1  S
  16  A01  A00  A32  AF0  S
  17  A12  A11  A10  A23  S
  18  A13  A20  A21  A22  S
  19  AD0  A02  A30  A31  S
  20  A41  A40  A72  AF1  S
  21  A52  A51  A50  A63  S
  22  A53  A60  A61  A62  S
  23  AD1  A42  A70  A71  S
  24  AD3  A80  AB2  AF2  C
  25  AF3  A91  A90  AA3  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 ICS6S27

6.1 ICS6S27 Outline

The In-circuit Emulator ICE6200 connects the target board produced by the user via the EVA6S27 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 ICS6S27.
The ICS6S27 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.

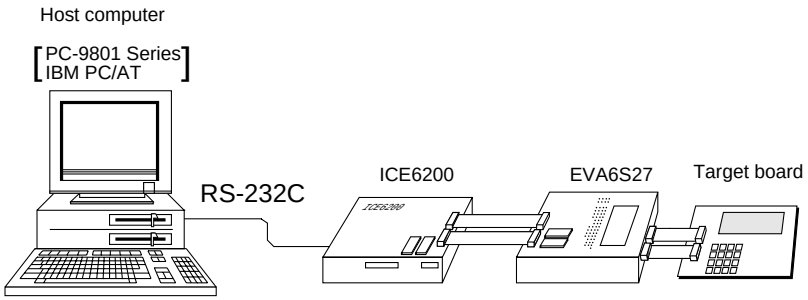


Fig. 6.1.1 Debugging system using ICE6200

☞ *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 ICS6S27 Restrictions

Take the following precautions when using the ICS6S27.

■ ROM Area

The ROM area is limited to a maximum address of 5FFH. Assigning data above the 5FFH address causes an error.

■ RAM Area

The RAM area is limited to a maximum address of 0FFH. However, as the following addresses are in the unused area, designation of this area with the ICE commands produces an error.

Unused area: 050H–08FH, 0B0H–0DFH, 0E1H, 0E5H–0E7H, 0F0H–0F2H, 0F4H, 0F5H, 0F7H, 0F8H, 0FFH

(Refer to the "E0C6S27 Technical Manual" for details.)

■ Undefined Code

The instructions below are not specified for the E0C6S27 and so cannot be used.

```
SLP
PUSH   XP      POP   XP      LD    XP,r      LD    r,XP
PUSH   YP      POP   YP      LD    YP,r      LD    r,YP
```

■ OPTLD Command

In the ICS6S27, OPTLD command can be used.
This command is used to load HEX files (function option and segment option data for LCD) in the EVA6S27 memory with the ICE6200.

Load of function option data: `#OPTLD,1,CS27XXX↵`
Load of segment option data: `#OPTLD,2,CS27XXX↵`

OPTLD *READ HEXA DATA FILE*

Format

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

Function

(1) Load function option HEX file in the EVA6S27 function option data memory.
It is HEX file output by the function option generator and has intel HEX format.

(2) Load segment option HEX file in the EVA6S27 segment option data memory.
It is HEX file output by the segment option generator and has intel HEX format.

Examples

`#OPTLD,1,CS27XXX`↵ ..... CS27XXXF.HEX file is loaded in the function option data memory.

`#OPTLD,2,CS27XXX`↵ ..... CS27XXXS.HEX file is loaded in the segment option data memory.

6.3 ICS6S27 Quick Reference

■ Starting command and input/output files

↵ *indicates the Return key.*

Execution file:
ICS6S27.BAT (ICS6S27J.EXE) . . . for MS-DOS
ICS6S27B.BAT (ICS6S27W.EXE) . . . for PC-DOS

Starting command:
ICS6S27 (ICS6S27J)↵ . . . for MS-DOS
ICS6S27B (ICS6S27W)↵ . . . for PC-DOS

Input file:
CS27XXXL.HEX (Object file, low-order)
CS27XXXH.HEX (Object file, high-order)
CS27XXXD.HEX (Data RAM file)
CS27XXXC.HEX (Control file)

Output file:
CS27XXXL.HEX (Object file, low-order)
CS27XXXH.HEX (Object file, high-order)
CS27XXXD.HEX (Data RAM file)
CS27XXXC.HEX (Control file)

■ Display example

```
          *** E0C6S27 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

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

Start-up message
When ICS6S27 is started, the start-up message is displayed, and a self-test is automatically performed. ICS6S27 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 ICS6S27 program is terminated by entering the Q (Quit) command.

Note *Confirm that the cables connected properly, then operate the ICS6S27.*

■ 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 ↵ #BAR,a ↵	Sets Break at program address "a" Breakpoint is canceled
		#BD ↵ #BDR ↵	Break condition is set for data RAM Breakpoint is canceled
		#BR ↵ #BRR ↵	Break condition is set for EVA6S27 CPU internal registers Breakpoint is canceled
		#BM ↵ #BMR ↵	Combined break conditions set for program data RAM address and registers 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 EVA6S27 CPU internal registers
		#SR ↵	Set EVA6S27 CPU internal registers
		#I ↵	Reset EVA6S27 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
		#OPTLD,1,file ↵ #OPTLD,2,file ↵	Load function option data from file Load segment option data from file
13	Coverage	#CVD ↵	Indicates coverage information
		#CVR ↵	Clears coverage information
14	ROM Access	#RP ↵	Move contents of ROM to program memory
		#VP ↵	Compare contents of ROM with contents of program memory
		#ROM ↵	Set ROM type
15	Terminate ICE	#Q ↵	Terminate ICE and return to operating system control
16	Command Display	#HELP ↵	Display ICE6200 instruction
17	Self Diagnosis	#CHK ↵	Report results of ICE6200 self diagnostic test

↵ means press the RETURN key.

7 MASK DATA CHECKER MDC6S27

7.1 MDC6S27 Outline

The Mask Data Checker MDC6S27 is a software tool which checks the program data (CS27XXXH.HEX and CS27XXXL.HEX) and option data (CS27XXXF.DOC and CS27XXXS.DOC) created by the user and creates the data file (C6S27XXX.PAn) for generating mask patterns. The user must send the file generated through this software tool to Seiko Epson.

Moreover, MDC6S27 has the capability to restore the generated data file (C6S27XXX.PA0) to the original file format.

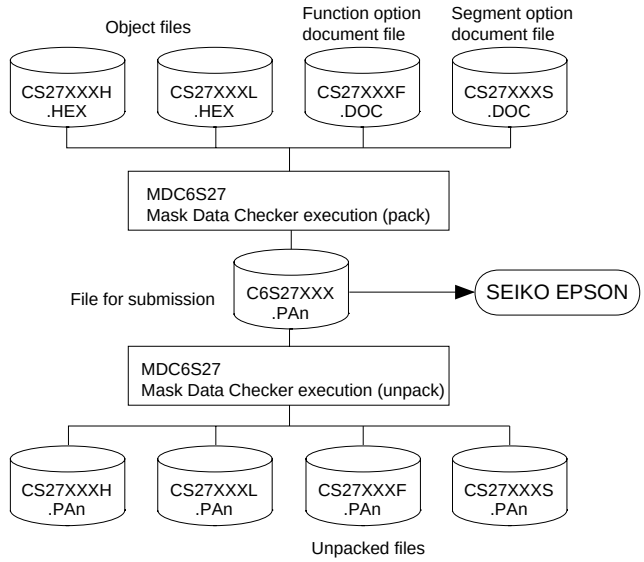

Fig. 7.1.1 MDC6S27 execution flow

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

7.2 MDC6S27 Quick Reference

■ Starting command and input/output files

Execution file: MDC6S27.EXE

Starting command: **MDC6S27**↵ ↵ *indicates the Return key.*

Input file:

CS27XXXL.HEX (Object file, low-order)	When packing
CS27XXXH.HEX (Object file, high-order)	
CS27XXXF.DOC (Function option document file)	
CS27XXXS.DOC (Segment option document file)	
C6S27XXX.PAn (Packed file)	When unpacking

Output file:

C6S27XXX.PAn (Packed file)	When packing
CS27XXXL.PAn (Object file, low-order)	When unpacking
CS27XXXH.PAn (Object file, high-order)	
CS27XXXF.PAn (Function option document file)	
CS27XXXS.PAn (Segment option document file)	

■ Display examples

```
          *** E0C6S27 PACK / UNPACK PROGRAM Ver 2.000 ***

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

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                    --- OPERATION MENU ---

                           1. PACK
                           2. UNPACK

                    PLEASE SELECT NO.?
```

Start-up message

When MDC6S27 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)

       CS27XXXH.HEX --------+
                            |
       CS27XXXL.HEX --------+
                            |-------- C6S27XXX.PAn (PACK FILE)
       CS27XXXF.DOC --------+
                            |
       CS27XXXS.DOC --------+

 PLEASE INPUT PACK FILE NAME (C6S27XXX.PAn) ?  C6S270A0.PA0↵   ...(2)

       CS270A0H.HEX --------+
                            |
       CS270A0L.HEX --------+
                            |-------- C6S270A0.PA0
       CS270A0F.DOC --------+
                            |
       CS270A0S.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 "C6S27XXX.PA0" has been submitted, the pack file name should be entered as "C6S27XXX.PA1".)

With this, the mask file (C6S27XXX.PAn) is generated, and the MDC6S27 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 (ASM6S27) as program data. If the program data generated with the -N option of the Cross Assembler is packed, undefined program area is filled with FFH code. In this case, following message is displayed.*

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

```
                    --- OPERATION MENU ---

                           1. PACK
                           2. UNPACK

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

 PLEASE INPUT PACKED FILE NAME (C6S27XXX.PAn) ?  C6S270A0.PA0↵ ...(2)

                             +-------- CS270A0H.PA0
                             |
                             +-------- CS270A0L.PA0
       C6S270A0.PA0 --------|
                             +-------- CS270A0F.PA0
                             |
                             +-------- CS270A0S.PA0
```

Unpacking of data

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

With this, the mask data file (C6S27XXX.PAn) is restored to the original file format, and the MDC6S27 program will be terminated.

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

■ Error messages

Program data error

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

Function option data error

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

Segment option data error

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

File error

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

System error

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

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

APPENDIX A. E0C6S27 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
		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
		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, 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, 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
		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
		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
		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

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

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

Symbols associated with program counter

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

Symbols associated with flags

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

Associated with immediate data

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

Associated with arithmetic and other operations

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

APPENDIX B. E0C6S27 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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9 NAME	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MSB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LSB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	A NAME	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MSB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LSB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	E NAME	-	-	SWL3	SWH3	TM3	-	-	-	EIK03	-	-	-	-	-	-	-
	MSB	K03	-	SWL2	SWH2	TM2	-	-	-	EIK02	-	-	EIT2	-	-	-	IT2
		K02	-	SWL1	SWH1	TM1	-	-	-	EIK01	-	EISW1	EIT8	-	-	ISW1	IT8
	LSB	K01	-	SWL0	SWH0	TM0	-	P03	-	EIK00	EISMD	EISW0	EIT32	ISMD	IK0	ISW0	IT32
	F NAME	-	-	-	R03	-	-	P02	-	-	-	HLMOD	CSDC	-	XBZR	-	-
	MSB	-	-	-	R02	-	-	P01	-	-	TMRST	-	-	-	-	-	-
		-	-	-	R01	-	-	P00	-	-	SWRUN	SVDDT	-	-	XFOUT1	FRUN/FTRG	-
	LSB	-	-	-	R00	-	-	-	-	-	SWRST	SVDON	-	IOC	XFOUT0	-	-

APPENDIX C. E0C6S27 I/O MEMORY MAP

Address	Register								Comment
	D3	D2	D1	D0	Name	Init	1	0	
0E0H	K03	K02	K01	K00	K03	–	High	Low	Input port data K03
					K02	–	High	Low	Input port data K02
	R				K01	–	High	Low	Input port data K01
					K00	–	High	Low	Input port data K00
0E2H	SWL3	SWL2	SWL1	SWL0	SWL3	0			Stopwatch timer data 3 (1/100 sec) MSB
					SWL2	0			Stopwatch timer data 2 (1/100 sec)
	R				SWL1	0			Stopwatch timer data 1 (1/100 sec)
					SWL0	0			Stopwatch timer data 0 (1/100 sec) LSB
0E3H	SWH3	SWH2	SWH1	SWH0	SWH3	0			Stopwatch timer data 3 (1/10 sec) MSB
					SWH2	0			Stopwatch timer data 2 (1/10 sec)
	R				SWH1	0			Stopwatch timer data 1 (1/10 sec)
					SWH0	0			Stopwatch timer data 0 (1/10 sec) LSB
0E4H	TM3	TM2	TM1	TM0	TM3	–	High	Low	Clock timer data 2 Hz
					TM2	–	High	Low	Clock timer data 4 Hz
	R				TM1	–	High	Low	Clock timer data 8 Hz
					TM0	–	High	Low	Clock timer data 16 Hz
0E8H	EIK03	EIK02	EIK01	EIK00	EIK03	0	Enable	Mask	Interrupt mask register (K03)
					EIK02	0	Enable	Mask	Interrupt mask register (K02)
	R/W				EIK01	0	Enable	Mask	Interrupt mask register (K01)
					EIK00	0	Enable	Mask	Interrupt mask register (K00)
0E9H	0	0	0	EISMD	0				
					0				
	R			R/W	0				
					EISMD	0	Enable	Mask	Interrupt mask register (motor driver)
0EAH	0	0	EISW1	EISW0	0				
					0				
	R		R/W		EISW1	0	Enable	Mask	Interrupt mask register (stopwatch timer 1 Hz)
					EISW0	0	Enable	Mask	Interrupt mask register (stopwatch timer 10 Hz)
0EBH	0	EIT2	EIT8	EIT32	0				
					EIT2	0	Enable	Mask	Interrupt mask register (clock timer 2 Hz)
	R	R/W			EIT8	0	Enable	Mask	Interrupt mask register (clock timer 8 Hz)
					EIT32	0	Enable	Mask	Interrupt mask register (clock timer 32 Hz)
0ECH	0	0	0	ISMD	0				
					0				
	R				0				
					ISMD		Yes	No	Interrupt factor flag (motor driver)
0EDH	0	0	0	IK0	0				
					0				
	R				0				
					IK0	0	Yes	No	Interrupt factor flag (K00–K03)
0EEH	0	0	ISW1	ISW0	0				
					0				
	R				ISW1	0	Yes	No	Interrupt factor flag (stopwatch timer 1 Hz)
					ISW0	0	Yes	No	Interrupt factor flag (stopwatch timer 10 Hz)
0EFH	0	IT2	IT8	IT32	0				
					IT2	0	Yes	No	Interrupt factor flag (clock timer 2 Hz)
	R				IT8	0	Yes	No	Interrupt factor flag (clock timer 8 Hz)
					IT32	0	Yes	No	Interrupt factor flag (clock timer 32 Hz)

Address	Register								Comment
	D3	D2	D1	D0	Name	Init *1	1	0	
0F3H	R03	R02	R01	R00	R03	0	High	Low	Output port data R03
			BUZZER	FOUT	R02	0	High	Low	Output port data R02
					R01	0	High	Low	Output port data R01
					BUZZER	0	On	Off	Buzzer On/Off control register
	R/W				R00	0	High	Low	Output port data R00
					FOUT	0	On	Off	Frequency output control register
0F6H	P03	P02	P01	P00	P03	–	High	Low	I/O port data P03
					P02	–	High	Low	I/O port data P02
	R/W				P01	–	High	Low	I/O port data P01
					P00	–	High	Low	I/O port data P00
0F9H	0	TMRST	SWRUN	SWRST	0				
					TMRST	Reset	Reset	–	Clock timer reset
	R	W	R/W	W	SWRUN	0	Run	Stop	Stopwatch timer Run/Stop
					SWRST	Reset	Reset	–	Stopwatch timer reset
0FAH	HLMOD	0	SVDDT	SVDON	HLMOD	0	Heavy	Normal	Heavy load protection mode register
					0				
	R/W	R		R/W	SVDDT	0	Low	Normal	Supply voltage detection data
					SVDON	0	On	Off	Supply voltage detection circuit On/Off
0FBH	CSDC	0	0	0	CSDC	0	Static	Dynamic	LCD drive switch
					0				
	R/W	R			0				
					0				
0FCH	0	0	0	IOC	0				
					0				
	R			R/W	0				
					IOC	0	Out	In	I/O port I/O control register
0FDH	XBZR	0	XFOUT1	XFOUT0	XBZR	0	2 kHz	4 kHz	Buzzer frequency control
					0				
	R/W	R	R/W		XFOUT1	0			FOUT frequency control
					XFOUT0	0			FOUT frequency control
0FEH	0	0	FRUN	0	0				
			FTRG		0				
					FRUN	0	Run	Stop	Motor driver status (reading)
	R		R/W	R	FTRG	–	Start	–	Motor driver trigger (writing)
					0				

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 ICS6S27J.EXE PC-DOS ICS6S27W.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 EVA6S27 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 ICS6S27P.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.
SOG6S27	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
ASM6S27	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.
MDC6S27	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?
EVA6S27	The EVA6S27 does not work when it is used independently.	Check the following and remedy if necessary: • Has the EPROM for F.HEX and S.HEX been replaced by the EPROM for the target? • Is the EPROM for F.HEX and S.HEX installed correctly? • Is the appropriate voltage being supplied? (5V DC, 3A, or more) • Are the program ROMs (H and L) installed correctly? • Is data written from address 4000H? (When the 27C256 is used as the program ROM) • Is the EN/DIS switch on the EVA6S27 set to EN?
	Target segment does not light.	Check the following and remedy if necessary: • Is an EPROM with an access time of 250 ns or less being used for S.HEX. • Has the VADJ VR inside the EVA6S27 top cover been turned to a lower setting?

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Issue APRIL 1998 Printed in Japan Ⓜ A