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# E8 Emulator

Additional Document for User's Manual

R0E000080KCE00EP21

Renesas Microcomputer Development  
Environment System  
M16C Family / M16C/60 Series  
Notes on Connecting the M16C/6S

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This user's manual is applicable to the E8 emulator software V.2.10 Release 00 or later.



## Section 1 Inside the E8 Emulator User's Manual

The E8 emulator manual consists of two documents: the E8 User's Manual and the E8 Additional Document for User's Manual (this document). Be sure to read BOTH documents before using the E8 emulator.

(1) E8 Emulator User's Manual

The E8 Emulator User's Manual describes the hardware specifications and how to use the emulator debugger.

- E8 emulator hardware specifications
- Connecting the E8 emulator to the host computer or user system
- Operating the E8 emulator debugger
- Tutorial: From starting up the E8 emulator debugger to debugging

(2) E8 Additional Document for User's Manual

The E8 Additional Document for User's Manual describes content dependent on the MCUs and precautionary notes.

- MCU resources used by the E8 emulator
- Example of the E8 emulator connection or interface circuit necessary for designing hardware
- Notes on using the E8 emulator
- Setting the E8 emulator debugger during startup





## Section 2 E8 Emulator Specifications

Table 2.1 shows the E8 emulator specifications for the M16C/6S Group.

Table 2.1 E8 Emulator Specifications for the M16C/6S Group

Target MCUs	M16C Family M16C/60 Series M16C/6S Group
Available operating modes	Single-chip mode
Break functions	- Address match break, 8 points - PC break points (maximum 255 points) - Forced break
Trace functions	None
Flash memory programming function	Available
User interface	Clock-synchronized serial (communication via P64/P65/P66/P67)
MCU resources to be used	- ROM size: 2 KB (variable assigned address) - RAM size: 128 bytes (variable assigned address) - Stack 14 bytes - UART1 function and P64/P65/P66/P67 - Pin P15 - Address match interrupt
Emulator power supply	Unnecessary (USB bus powered, power supplied from the PC)
Interface with host machine	USB (USB 1.1, full speed) * Also connectable to host computers that support USB 2.0
Power supply function	Can supply 3.3 V or 5.0 V to the user system (maximum 300 mA)
Power voltage	M16C/6S      3.0 - 3.6 V

Table 2.2 shows the operating environment of the E8 emulator.

Table 2.2 Operating Environment

Temperatures	Active	: 10°C to 35°C
	Inactive	: -10°C to 50°C
Humidity	Active	: 35% RH to 80% RH, no condensation
	Inactive	: 35% RH to 80% RH, no condensation
Vibrations	Active	: maximum 2.45 m/s <sup>2</sup>
	Inactive	: maximum 4.9 m/s <sup>2</sup>
	Transportation	: maximum 14.7 m/s <sup>2</sup>
Ambient gases	No corrosive gases	



## Section 3 Connecting the E8 Emulator to the User System

Before connecting the E8 emulator to the user system, a connector must be installed in the user system so a user system interface cable can be connected. When designing the user system, refer to Figure 4.1 “E8 Connecting Connector Pin Assignments” and Figure 5.1 “Example of an E8 Connection”.

Before designing the user system, be sure to read the E8 Emulator User’s Manual and related device hardware manuals.

Table 3.1 shows the recommended connector for the emulator.

Table 3.1 Recommended Connector

	Type Number	Manufacturer	Specification
14-pin connector	2514-6002	3M Limited	14-pin straight type

Connect E8 connecting connector pins 2, 6, 10, 12 and 14 firmly to the GND on the user system board. These pins are used as an electric GND and monitor the connection of the user system connector. Note the pin assignments for the user system connector.

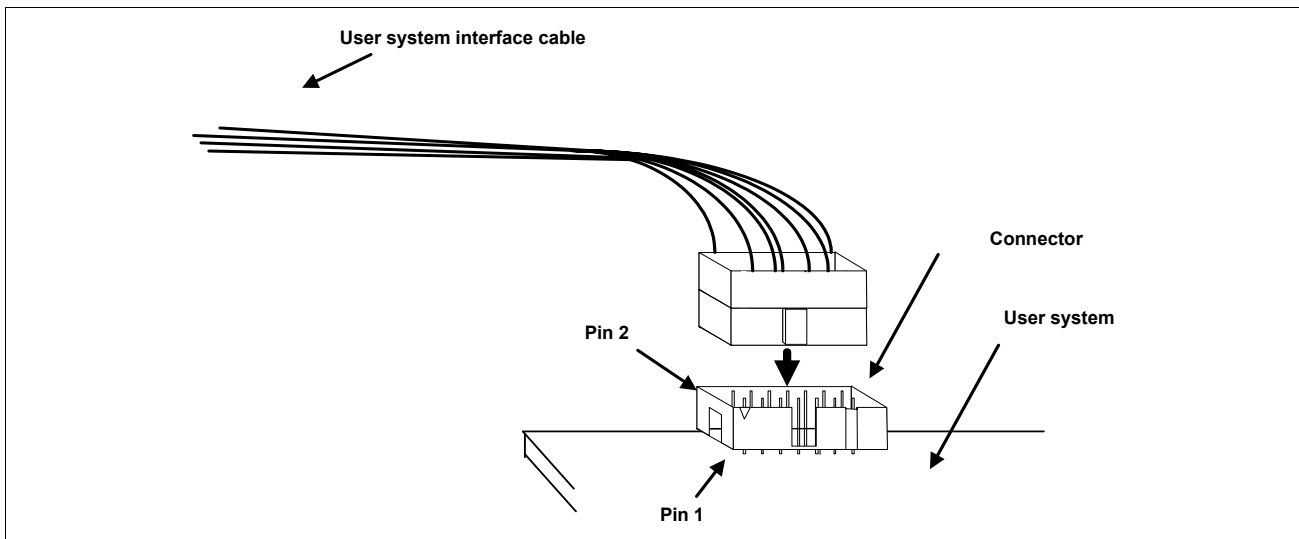


Figure 3.1 Connecting the User System Interface Cable with an E8 Connecting Connector

Notes:

1. Do not place any components within 3 mm area of the connector.
2. When using the E8 emulator as a programmer, connect it to the user system in the same way.



## Section 4 E8 Connecting Connector Pin Assignments

Figure 4.1 shows the pin assignments for the E8 connecting connector.

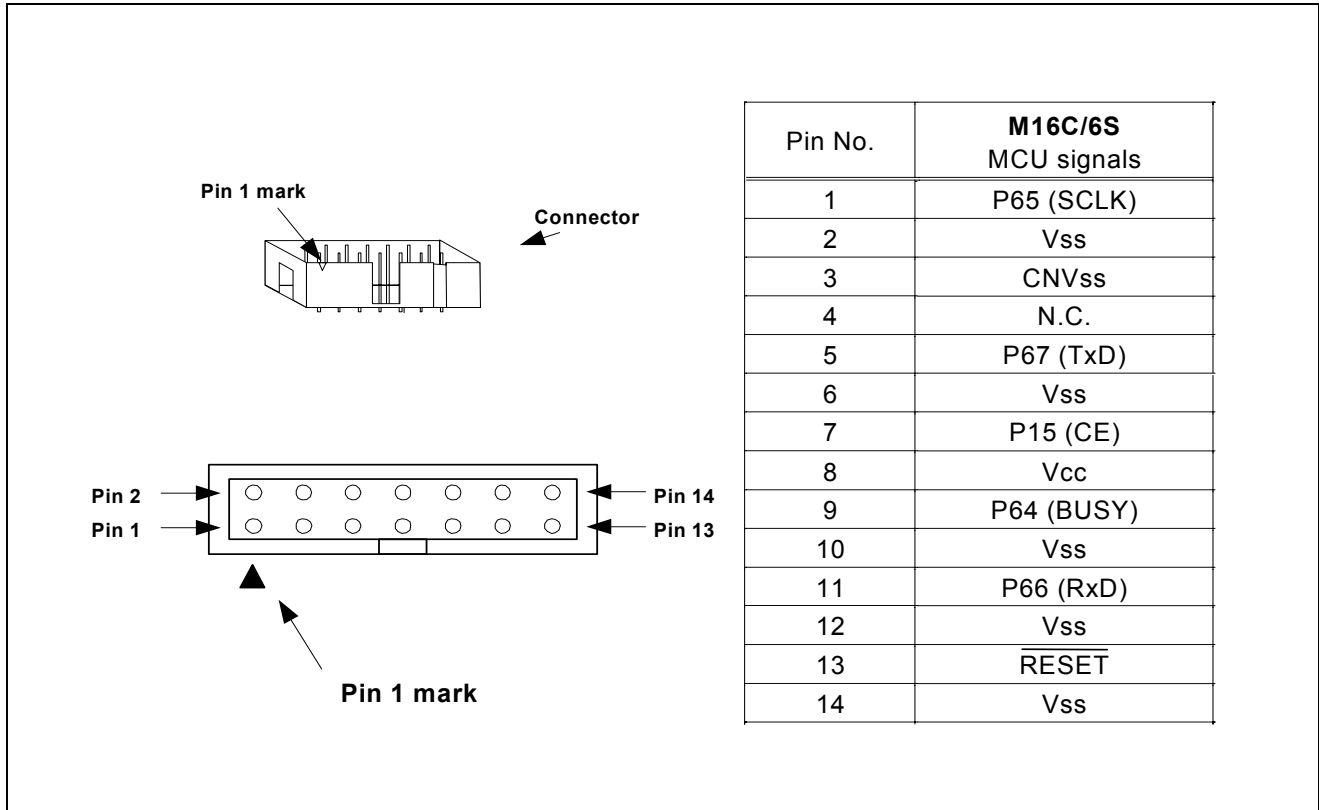


Figure 4.1 E8 Connecting Connector Pin Assignments

Note:

Pin 14 is used for checking the connection between the E8 and the user system, and is not directly connected to the Vss inside the E8. Make sure pins 2, 6, 10, 12 and 14 are all connected to the Vss.



## Section 5 Examples of E8 Connections

Figure 5.1 shows a connection example. When using the emulator as a programmer, the connection specification between the E8 and the MCUs is the same as shown in Figure 5.1.

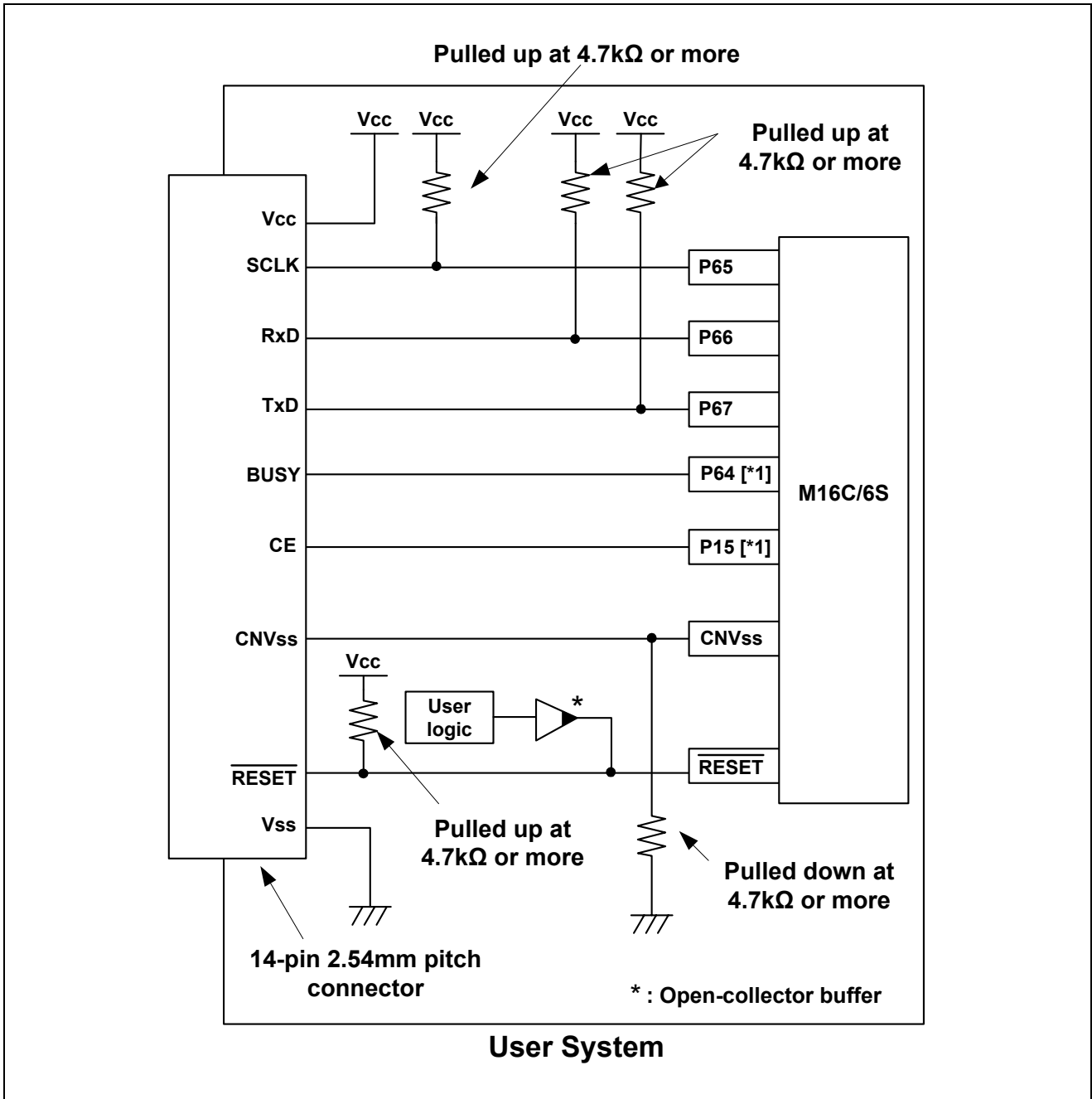


Figure 5.1 Example of an E8 Connection

Note:

1. For details on setting pins P15 and P64, refer to numbers 1 and 2 of “Points to Remember” on page 10.



Points to Remember

1. Pins P64, P65, P66 and P67 are used exclusively by the E8 emulator. Connect the E8 emulator to the MCU pins. Connect pins P65, P66 and P67 to the E8 emulator after pulling up the MCU pins. Pull up or down on P64 according to the MCU pin state after disconnecting the E8 emulator. P64 may be in a Hiz state while the E8 emulator is active. Therefore, set the pin resistance value so the voltage cannot be at the midpoint potential, depending on the voltage dividing of the resistance inside the E8 emulator (Figure 5.6).

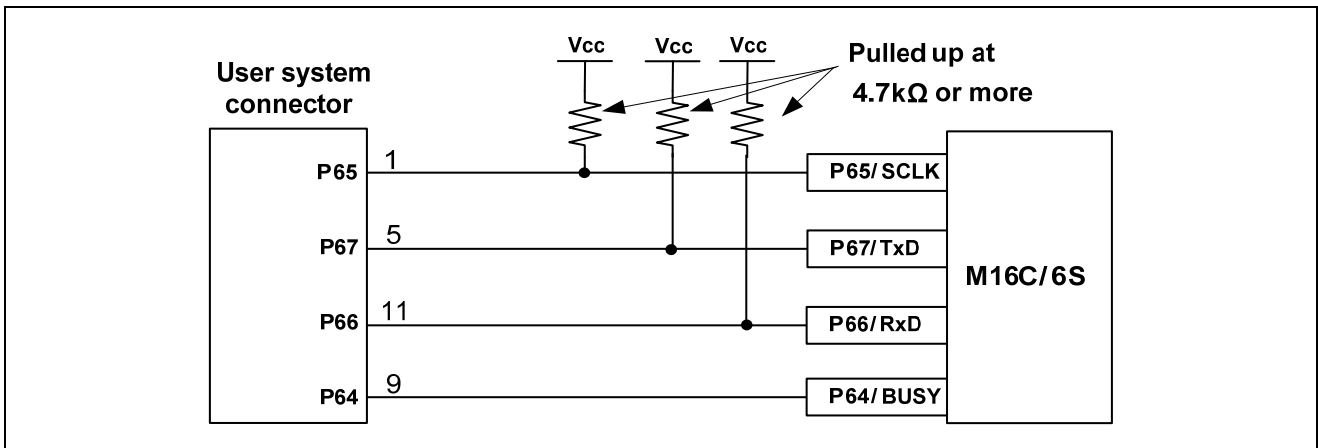


Figure 5.2 E8 Emulator and MCU Connection

2. P15 is used by the E8 emulator for MCU control. Connect the E8 emulator to the MCU pins.

P15 may be in a Hiz state while the E8 emulator is active. Therefore, set the pin resistance value so the voltage cannot be at the midpoint potential, depending on the voltage dividing of the resistance inside the E8 emulator (Figure 5.6).

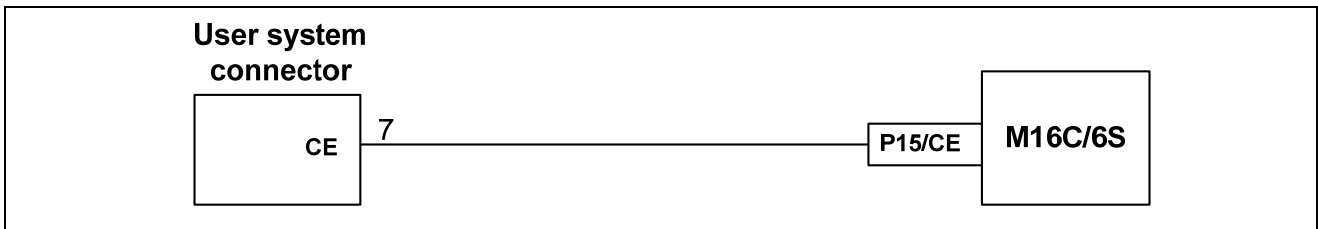


Figure 5.3 Connection of E8 Emulator and Pin P15

3. The E8 emulator uses the CNVss pin for MCU control. Pull down the E8 emulator and MCU pins and connect the E8 emulator.

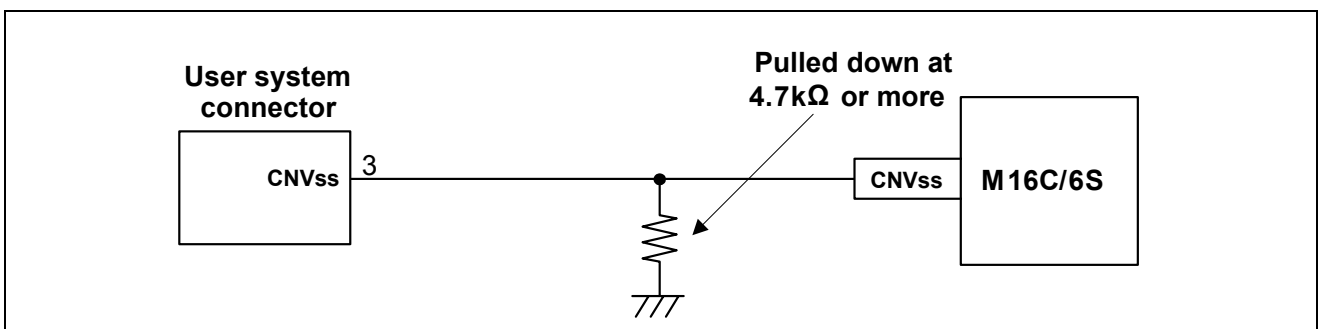


Figure 5.4 E8 Emulator and CNVss Pin Connection



4. The  $\overline{\text{RESET}}$  pin is used by the E8 emulator. Therefore, use an open-collector output buffer or a CR reset circuit as the reset circuit for the user system. The recommended pull-up value is 4.7 k $\Omega$  or more. The MCU can be reset by outputting “L” from the E8 emulator. However, if the reset IC output is “H”, the user system reset circuit cannot be set to “L”. As such, the E8 emulator will not operate normally.

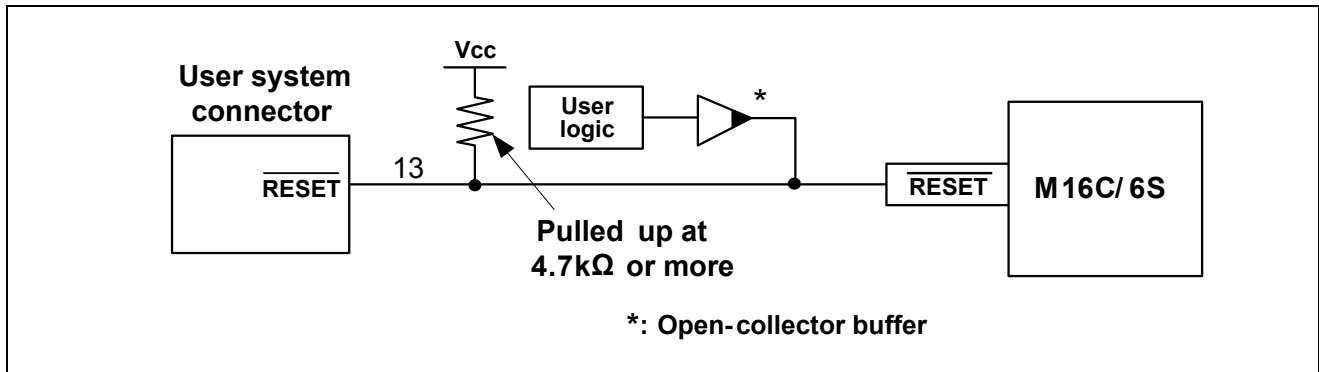


Figure 5.5 Example of a Reset Circuit

5. Connect Vss and Vcc to the Vss and Vcc of the MCU, respectively.
6. Do not connect anything to the N.C. pin.
7. The amount of voltage input to Vcc must be within the specified range of the MCU.
8. Pin 14 is used for checking the connection between the E8 and the user system, and is not directly connected to the Vss inside the E8. Make sure that pins 2, 6, 10, 12 and 14 are all connected to the Vss.

9. Figure 5.6 shows the interface circuit in the E8 emulator. Use this figure as a reference when determining the pull-up resistance value.

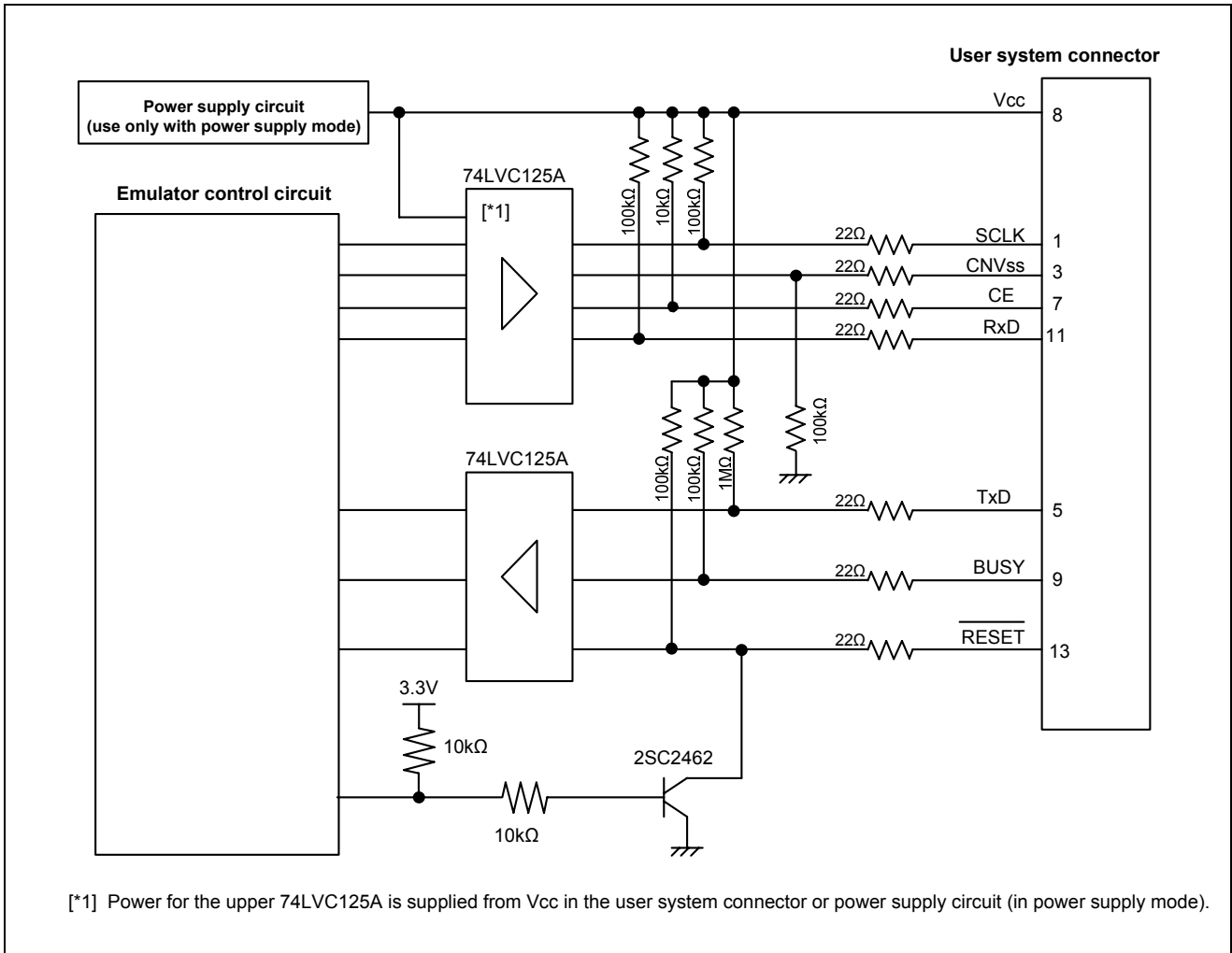


Figure 5.6 Interface Circuit Inside the E8 Emulator (For Reference)

## Section 6 Notes on Using the E8 Emulator

### 1. Program area for the E8 emulator

Table 6.1 lists the program areas allotted for the E8 emulator. Do not change this area allocation, otherwise the E8 emulator will not control the MCU. If settings were changed, disconnect the debugger and then reconnect it.

Table 6.1 Program Area for the E8 Emulator

Group	Part No.	ROM Size		RAM Size	Program Area for E8 Emulator		
		Programming Area	Data Area		Vector Area	ROM Area	RAM Area
M16C/6S	M306S0FAGP M306S0FA -XXXGP	96 KB	-	24 KB	FFFE4h - FFFE7h, FFFE8h - FFEbBh, FFFECh - FFEFh, FFFF4h - FFFF7h, FFFFCh - FFFFh	2 KB of the programming area [*1]	128 bytes [*1]

Note:

- When starting the debugger, the [Emulator Setting] dialog box shown in Figure 6.1 is displayed. Specify the area which will not be used in the user system. The data area cannot be specified.

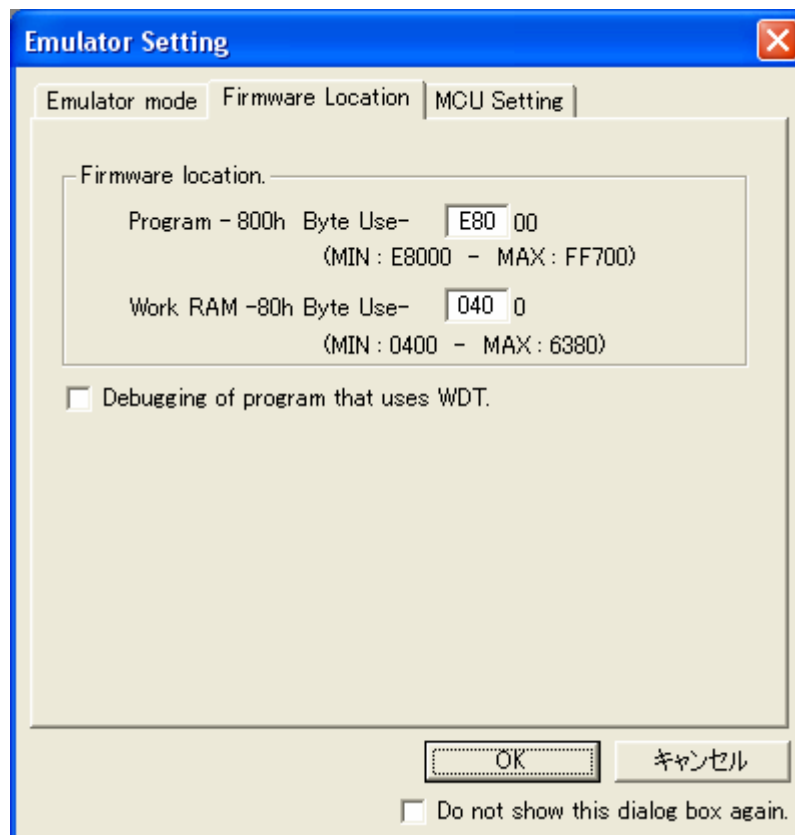


Figure 6.1 [Firmware Location] Tab of the [Emulator Setting] Dialog Box

2. When the system is launched, the E8 emulator initializes the general registers and some of the flag registers as shown in Table 6.2.

Table 6.2 E8 Emulator Register Initial Values

Status	Register	Initial Value
E8 Emulator Activation	PC	Reset vector value in the vector address table
	R0 to R3 (bank 0, 1)	0000h
	A0, A1 (bank 0, 1)	0000h
	FB (bank 0, 1)	0000h
	INTB	0000h
	USP	0000h
	ISP	Work RAM Address for the E8 emulator + 80h [*1]
	SB	0000h
	FLG	0000h

Note:

- The Work RAM address for the E8 emulator is specified in the [Firmware Location] tab of the [Emulator Setting] dialog box.
- The E8 emulator controls the MCUs by using the P64, P65, P66, P67,  $\overline{\text{RESET}}$  and CNVss, and P15 pin.
- The E8 emulator uses up to 14 bytes of the stack pointer during a user program break. Therefore, set aside 14 bytes for the stack area.
- SFRs used by the E8 emulator program  
As the SFRs listed in Table 6.3 are used by the E8 emulator program, do not change any of these values. If these values are changed, the E8 emulator cannot control the MCU. Note that UART1 transmit interrupt control register SITIC and UART1 receive interrupt control register SIRIC always read out values used by the emulator. These registers are not initialized by selecting [Debug] -> [Reset CPU] or by using the RESET command. If register contents are referred to, a value that has been set in the E8 emulator program will be read out.

Table 6.3 SFRs Used by the E8 Emulator Program

Address	Register	Symbol	Bit	Notes on using the E8 emulator
0009h	Address match interrupt enable register	AIER	All bits	[*1]
0010h - 0012h	Address match interrupt register 0	RMAD0	All bits	[*1]
0014h - 0016h	Address match interrupt register 1	RMAD1	All bits	[*1]
01B8h - 01BAh	Address match interrupt register 2	RMAD2	All bits	[*1]
01BBh	Address match interrupt enable register 2	AIER2	All bits	[*1]
01BCh - 01BEh	Address match interrupt register 3	RMAD3	All bits	[*1]
03A8h	UART1 transmit/receive mode register	U1MR	All bits	[*1]
03AAh, 03ABh	UART1 transmit buffer register	U1TB	All bits	[*1]
03ACh	UART1 transmit/receive control register 0	U1C0	All bits	[*1]
03ADh	UART1 transmit/receive control register 1	U1C1	All bits	[*1]
03AEh, 03AFh	UART1 receive buffer register	U1RB	All bits	[*1]
03B0h	UART transmit/receive control register 2	UCON	Bits 1, 3, 4, 5 and 6	[*2]
03ECh	Port P6 register	P6	Bits 4, 5, 6 and 7	[*2]
03EEh	Port P6 direction register	PD6	Bits 4, 5, 6 and 7	[*2]

Notes:

- Do not change this register value.
- Do not change the value of the bits listed in the column to the left. When operating this register, make changes using the bit operation instructions to avoid changing the bit values.

#### 6. Interrupts used by the E8 emulator program

The BRK instruction interrupt, address match interrupt, single-step interrupt and DBC interrupt are used by the E8 emulator program. Therefore, make sure the user program does not use any of these interrupts. The E8 emulator changes these interrupt vector values to the values to be used by the emulator. No problems occur if the interrupt vector values are written in the user program.

#### 7. Debugging using the watchdog timer

When debugging the user program using the watchdog timer, click the [Debugging of program that uses WDT.] check box in the [Firmware Location] tab of the [Emulator Setting] dialog box.

By clicking this box, the E8 emulator program refreshes the watchdog timer during program operation. If memory access is executed through memory reference or modification, the watchdog timer will be refreshed by the E8 emulator program.

When using the actual MCU, the watchdog timer starts operating by writing to the watchdog timer start register. However, when using this emulator, the watchdog timer starts after initiating the user program because the E8 emulator program refreshes the watchdog timer even if a user program halts. Note that this timing will differ from the actual operational timing.

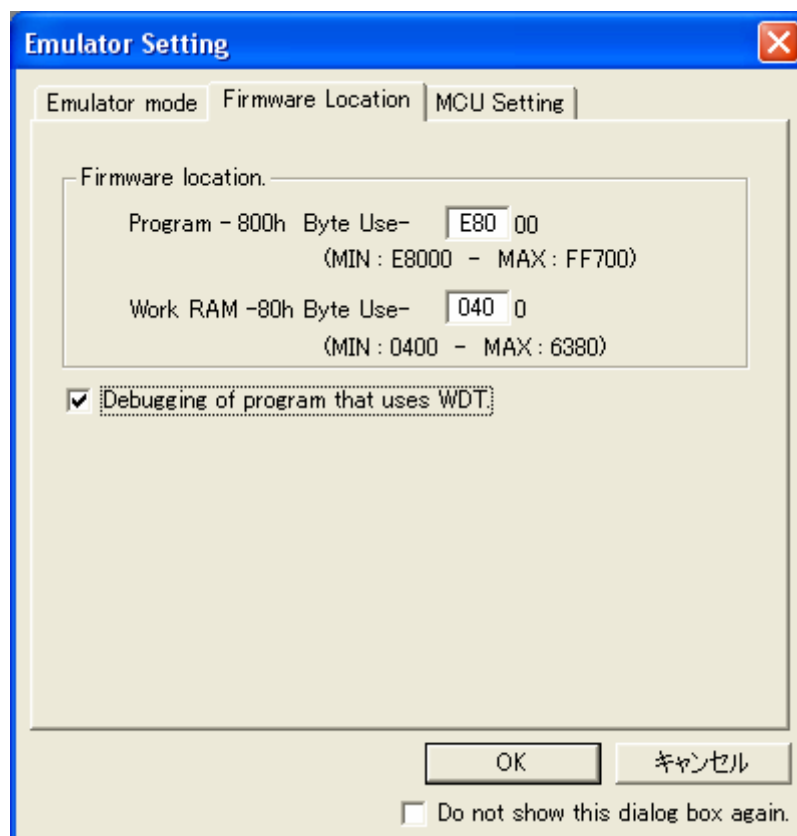


Figure 6.2 [Firmware Location] Tab of the [Emulator Setting] Dialog Box

## 8. Flash memory ID code

This MCU function prevents the Flash memory from being read out by anyone other than the user. The ID code in Table 6.4 written to the flash memory of the MCU must match the ID code displayed in the Figure 6.3 [ID Code verification] dialog box at debugger startup, otherwise the debugger cannot be launched. Note that when the ID code is FFh, FFh, FFh, FFh, FFh, FFh, FFh, the ID code is regarded as undefined. In this case, the ID code is automatically authenticated and the [ID Code verification] dialog box is not displayed.

In ‘Program Flash’ mode, the contents of the user program are input into the ID code area. When debugging in other modes, FFh, FFh, FFh, FFh, FFh, FFh, FFh is written into the ID code area regardless of the contents of the downloaded user program.

Table 6.4 ID Code Storage Area of M16C/6S

Address	Description
FFFDh	First byte of ID code
FFFE3h	Second byte of ID code
FFFEb	Third byte of ID code
FFFEFh	Fourth byte of ID code
FFFF3h	Fifth byte of ID code
FFFF7h	Sixth byte of ID code
FFFFBh	Seventh byte of ID code

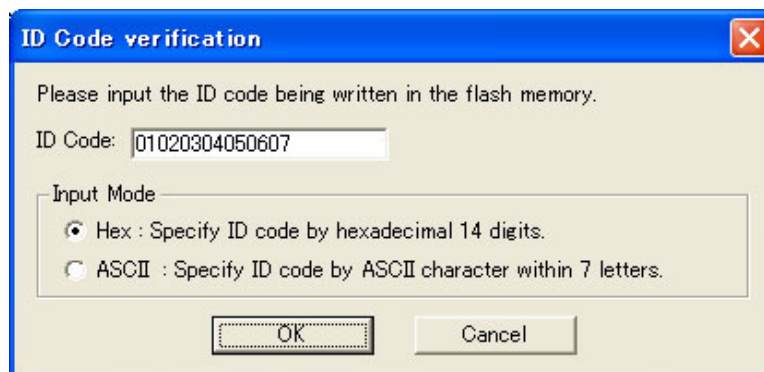


Figure 6.3 [ID Code verification] Dialog Box

Note on ‘Program Flash’ mode:

When the ID code is specified by the -ID option of the lmc30, download the MOT file or HEX file. When the X30 file is downloaded, the ID code is not valid. When downloading the X30 file, specify the ID code using an assembler directive command such as “.BYTE”. The file to which the ID code specified by the assembler directive command “.ID” is output varies depending on the version of the assembler. For details, refer to the Assembler User’s Manual.

## 9. Operation clock during a user program halt

While the user program halts, the E8 emulator program changes the main clock divide-by-N value to operate.

## 10. Reset

The reset vector is used by the E8 emulator program. If the MCU is reset while executing the user program, control is transferred to the E8 emulator program and the user program is forced to stop. Do not use the software reset, watchdog timer reset and oscillation stop detection reset, otherwise the E8 emulator will not operate normally.

11. Memory access during emulation execution

When referring to or modifying the memory contents, the user program is temporarily halted. For this reason, a real-time emulation cannot be performed. When a real-time emulation is necessary during a program execution, disable the automatic update in the watch window or fix the display in the memory window before running the program so that memory accesses do not occur during an execution.

12. When the E8 emulator does not supply power to the user system, it consumes the power voltage of the user system from several mA to more than 10 mA. This is because the user power supply drives one 74LVC125A to make the communication signal level match the user system power supply voltage.

13. When debugging, the Flash memory is frequently rewritten by the E8 emulator. Therefore, do not use an MCU that has been used for debugging in products. Also, as the E8 emulator program is written to the MCU while debugging, do not save the contents of the MCU Flash memory which were used for debugging nor use them as the ROM data for products.

14. Reserved area

The addresses not specified in the Hardware Manual for M16C/6S Group are reserved area. Do not change the contents. Otherwise, the E8 emulator cannot control the MCU.

15. Debugging in stop mode or wait mode

When in stop mode or wait mode, the program cannot be stopped by the E8 emulator. If you attempt to stop the program in stop or wait mode, the emulator will not control the MCU. Do not operate windows until the program stops at the breakpoint by setting the breakpoint at the line of the program where the stop mode or the wait mode is cancelled. When using stop mode or wait mode in the user program, disable the automatic update in the watch window or fix the display in the memory window before running the program so memory accesses do not occur during an execution.

16. Peripheral I/Os during a halt

During a user program halt, interrupts are not accepted although peripheral I/Os continue to run. For example, a timer interrupt is not accepted although the timer continues to count when a user program is stopped by a break after the timer started.

## 17. Exceptional step execution

## a) Software interrupt instruction

Step execution cannot be performed in the internal processing of instructions (undefined, overflow, BRK and INT) which generate a software interrupt continuously in the program.

Example: INT instruction

```

NOP
NOP
INT #3
NOP
JMP MAIN

```

← Passes through if the STEP execution is carried out.

```

INT_3:
NOP
NOP
NOP
REIT

```

← Program should be stopped at this address.

## b) INT instruction

To debug the user program with the INT instruction, set a PC break for the internal processing of the INT instruction and execute the program with the GO command.

Example:

```

NOP
INT #3
NOP
JMP MAIN

```

Execute using GO command.

```

INT_3:
NOP Break
NOP
REIT

```

## 18. "Go to cursor" function

The "Go to cursor" function is actualized using an address match break. Therefore, when you execute the "Go to cursor" command, all the address match breaks you set become invalid, while all the PC breaks remain valid.

## 19. Note on PC break point

When downloading a user program after modifying it, the set address of PC break may not be corrected normally depending on the modification. Therefore, break points other than the set PC breaks may shift. After downloading a user program, check the setting of PC breaks in the event point window and reset it.



#### 20. Note on debugging in CPU rewrite mode

When debugging in CPU rewrite mode, do not rewrite in CPU block 0 area (addresses FF000h - FFFFFh) and block containing the E8 emulator program. If these areas are rewritten, the E8 emulator will not control the MCU. Do not halt the user program while setting up the CPU rewrite mode and releasing it. If halted, the E8 emulator may not control the MCU. In addition, disable the automatic update in the watch window or fix the display in the memory window before running the program so memory accesses do not occur during an execution.

To check the data after executing the CPU rewrite mode, halt the program after releasing the CPU rewrite mode and refer to the memory window, etc.

#### 21. Notes on rewriting Flash memory

Do not reset the MCU when rewriting the Flash memory.

The Flash memory is rewritten when the “Flash memory write end” is displayed in the output window of the High-performance Embedded Workshop. If the MCU is reset when rewriting the Flash memory, the user program or the E8 emulator program may be disrupted.

Flash memory rewrite occurs:

- When downloading the user program
- After setting PC breaks in the Flash memory and executing the user program
- After canceling PC breaks in the Flash memory and executing the user program
- After rewriting the value of the Flash memory in the memory window and executing the user program

#### 22. Notes on the E8 emulator power supply

When writing a program with the E8 emulator for mass production processes, the program requires reliability, so do not use the E8 emulator power supply function. Supply power separately to the user system according to the allowable voltage for MCU writing. Voltage supplied from the E8 emulator depends on the quality of the USB power supply of the PC, and as such, precision is not guaranteed.

#### 23. Notes on the emulator setup switch

Use the emulator setup switch at the factory setting (upper side 1).



## Section 7 Debugger Setting

### 1. [Emulator Setting] dialog box

The [Emulator Setting] dialog box is provided for setting items that need to be set when the debugger is launched. The contents set from this dialog box (excluding [Power Supply] group box items) also become valid the next time the debugger is launched. When launching the debugger for the first time after creating a new project work space, the [Emulator Setting] dialog box is displayed with the Wizard.

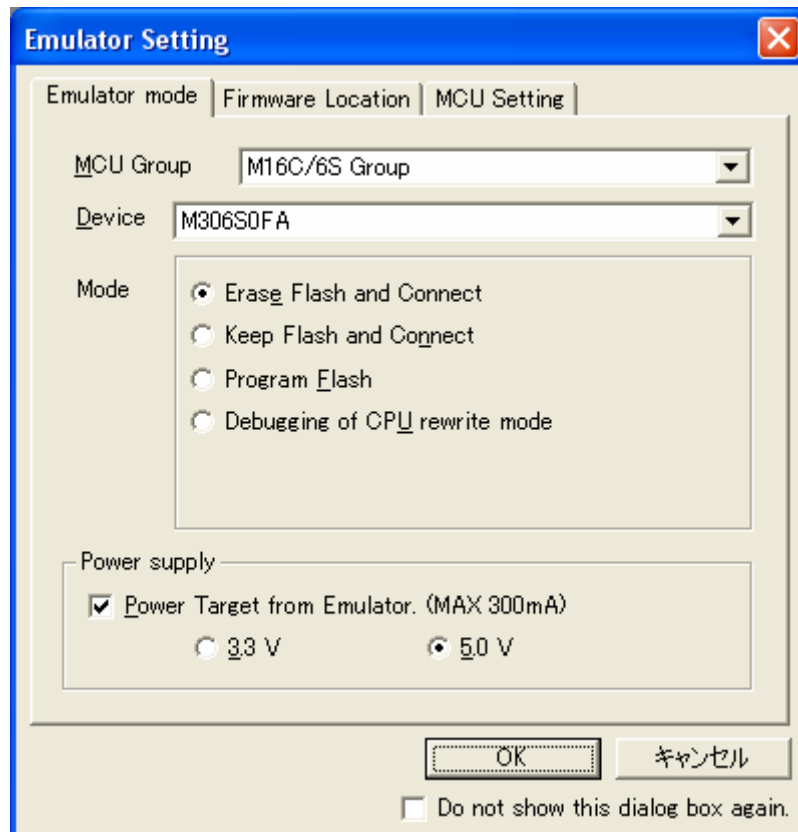


Figure 7.1 [Emulator Setting] Dialog Box

If you check “Do not show this dialog box again.” at the bottom of the [Emulator Setting] dialog box, the [Emulator Setting] dialog box will not be displayed the next time the debugger is launched. You can open the [Emulator Setting] dialog box using one of the following methods:

- After the debugger is launched, select Menu -> [Setup] -> [Emulator] -> [Emulator Setting...].
- Hold down the Ctrl key while launching the debugger.

When “Do not show this dialog box again.” is checked, the E8 does not supply power to the user system.

## 2. [Emulator mode] tab

Device selection, mode specification and power supply setting are made from the [Emulator mode] tab of the [Emulator Setting] dialog box.

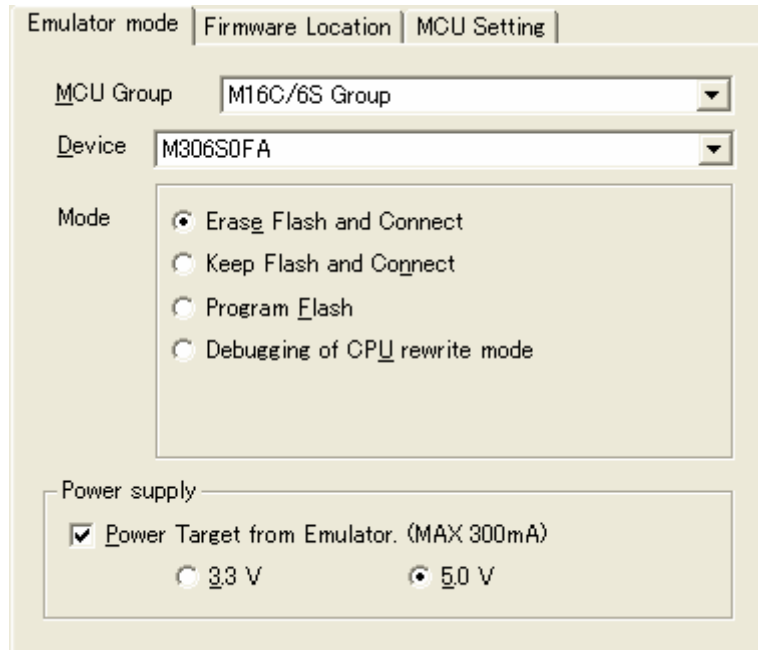


Figure 7.2 [Emulator mode] Tab

### [MCU Group]

Select the name of the MCU group to be used from the [MCU Group] drop-down list.

### [Device]

Select the type of MCU to be used from the [Device] drop-down list.

**[Mode]**

- Erase Flash and Connect

When starting the debugger, the E8 emulator erases the Flash memory data for the MCUs and simultaneously writes the E8 emulator program.

- Keep Flash and Connect

When launching the debugger, the E8 emulator retains the Flash memory data for the MCUs. Note that the area for the E8 emulator program and the vector area used by the E8 emulator will change.

- Program Flash

The E8 emulator starts as a simple programmer. When downloaded, the E8 writes only the user program (E8 emulator program is not written). Therefore, the program cannot be debugged in this mode.

- Debugging of CPU rewrite mode

Select this setting when debugging the program which rewrites the CPU. In this mode, the following debug operation which rewrites the Flash memory cannot be executed.

- Setting the PC break points

- Changing the memory contents in the Flash memory area

In this mode, when starting the debugger, the E8 emulator erases the Flash memory data for the MCUs and simultaneously writes the E8 emulator program.

**[Power supply]**

When supplying power to the user system from the E8, click the [Power Target from Emulator. (MAX 300mA)] check box.

## 3. [Firmware Location] tab

For details, see “1. Program area for the E8 emulator” and “7. Debugging using the watchdog timer” in “Section 6. Notes on Using the E8 Emulator”.

## 4. [MCU Setting] Tab

There are no items to be setup for M16C/6S Group.

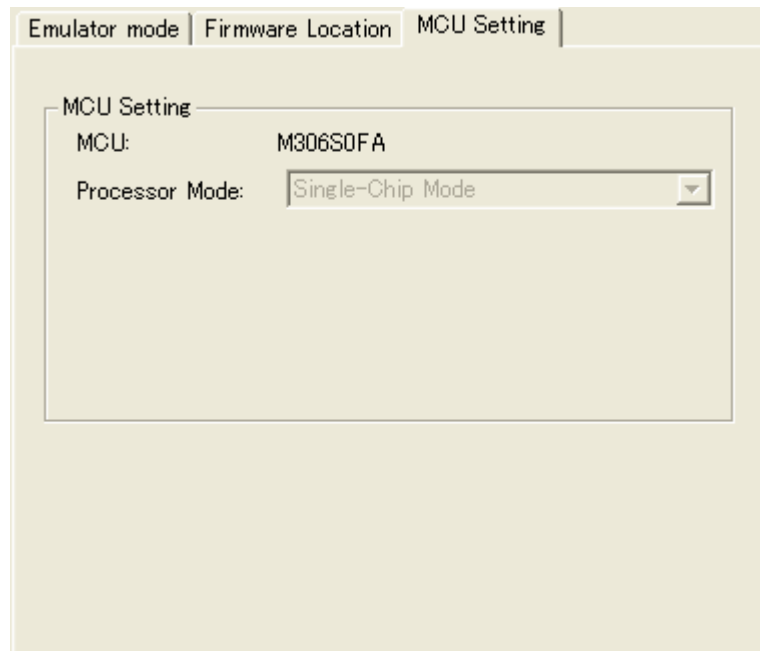


Figure 7.3 [MCU Setting] Tab

## Section 8 Applicable Tool Chain and Third-party Products

With the M16C/6S Group E8 emulator, you can debug modules created by the inhouse tool chain and third-party tools listed in Table 8.1 below.

Table 8.1 Applicable Tool Chain and Third-party Tools

Tool chain	M3T-NC30WA V.5.20 Release 01 or later
Third-party tools	TASKING M16C C/C++/EC++ Compiler V.2.3r1 or later IAR EWM16C V.2.12 or later

Notes on debugging the load modules created in ELF/DWARF2 format:

If the load module was created in ELF/DWARF2 format using TASKING M16C C/C++/EC++ compiler V3.0r1, the precautionary note described below must be observed when displaying member variables of the base class in the watch window.

Precautionary Note:

If any class object with a base class is defined, the following problems may occur:

Case 1: Member variables of the base class cannot be referenced directly from the class object (\*1).

Case 2: If the PC value resides in any member function of a derived class, member variables of the base class cannot be referenced directly (\*4).

Solution:

If member variables of the base class need to be referenced in the watch window, follow either method described below:

Case 1: Use indirect references from the class object to refer to member variables of the base class (\*2) (\*3).

Case 2: Use indirect references from “this” pointer to refer to member variables of the base class (\*5) (\*6).

<Example code>

```
////////////////////////////////////
```

```
*.h
class BaseClass
{
public:
    int m_iBase;
public:
    BaseClass() {
        m_iBase = 0;
    }
    void BaseFunc(void);
};

class DerivedClass : public BaseClass
{
public:
    int m_iDerive;
public:
    DerivedClass() {
        m_iDerive = 0;
    }
    void DerivedFunc(void);
};
```

```

*.cpp
main()
{
    class DerivedClass ClassObj;
    ClassObj.DerivedFunc();
    return;
}

void BaseClass::BaseFunc(void)
{
    m_iBase = 0x1234;
}

void DerivedClass::DerivedFunc(void)
{
    BaseFunc();
    m_iDerive = 0x1234;
}

```

////////////////////////////////////

< Watch window registration example >

////////////////////////////////////

Case 1: If the PC value resides in the main() function

- (1)"ClassObj.m\_iBase" : Cannot be referenced (\*1)
- (2)"ClassObj.\_\_b\_BaseClass.m\_iBase" : Can be referenced (\*2)
- (3)"ClassObj"
  - "\_\_b\_BaseClass"
  - "m\_iBase" : Can be referenced (\*3)
  - "m\_iDerive"

-: Expansion symbol

Case 2: If the PC value resides in the DerivedClass::DerivedFunc() function

- (1)"m\_iBase" : Cannot be referenced (\*4)
- (2)"this->\_\_b\_BaseClass.m\_iBase" : Can be referenced (\*5)
- (3)"\_\_b\_BaseClass.m\_iBase" : Can be referenced (\*5)
- (4)"this"
  - "\*"
    - "\_\_b\_BaseClass"
    - "m\_iBase" : Can be referenced (\*6)
    - "m\_iDerive"
- (5)"\_\_b\_BaseClass"
  - "m\_iBase" : Can be referenced (\*6)

////////////////////////////////////



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E8 Emulator  
Additional Document for User's Manual  
Notes on Connecting the M16C/6S

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