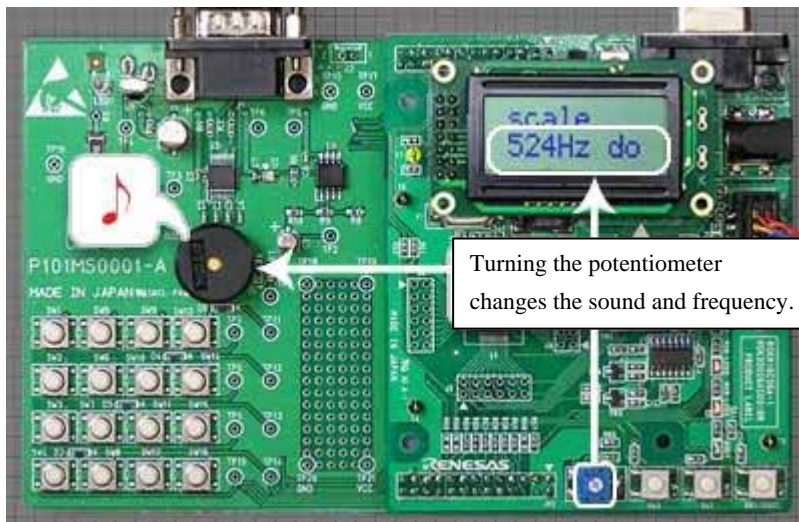


## M16C/26A Group

### Sample Program (Musical Scale)

#### 1. Summary

This sample program provides the functionality of musical scale output by using the Renesas Starter Kit for M16C/26A (R0K33026AS000BE) and an extension board.



The extension board used here is a product from PI System Co., Ltd.

#### 2. Introduction

The example described in this document applies to the microcomputers listed below:

Microcomputers: M16C26A

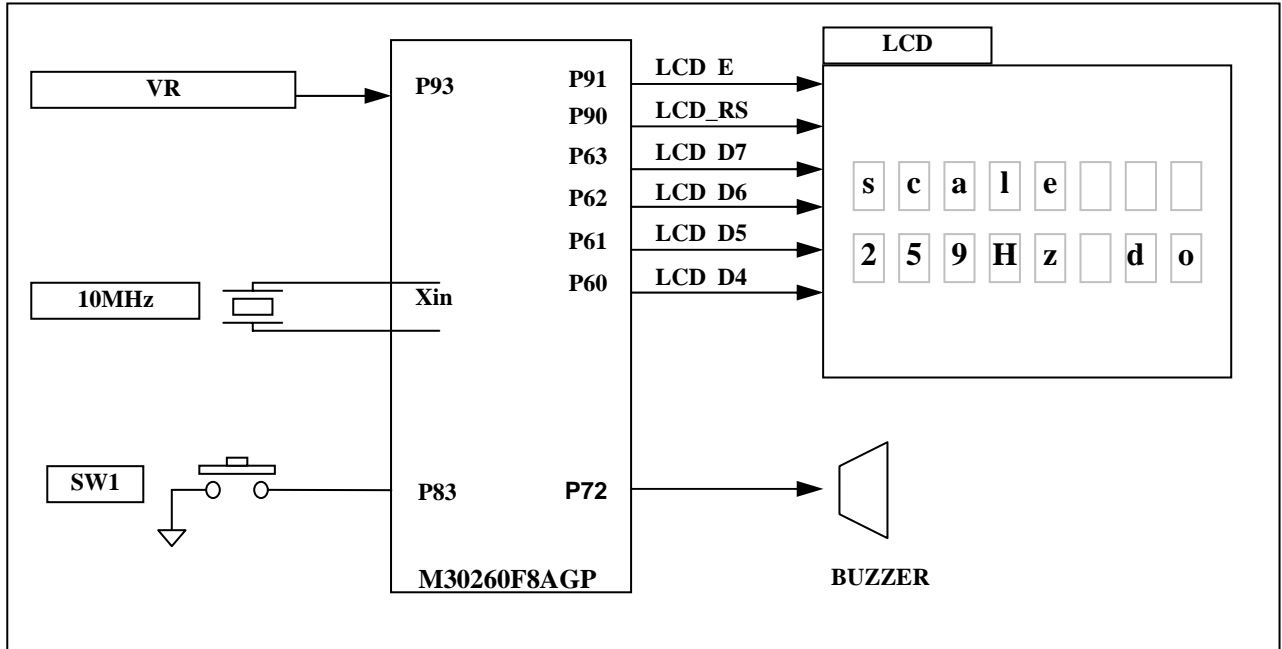
This sample program runs on the Renesas Starter Kit for M16C/26A (R0K33026AS000BE).

Prepare an extension board available for the Renesas Starter Kit or create a circuit similar to the one shown in the example circuit on page 14 and then connect it to the Starter Kit.

This program uses RSK\_LIB. For details about RSK\_LIB, see the RSK\_LIB reference manual. (RSK\_LIB is the library software provided for use with the Renesas Starter Kit for M16C/26A.)

### 3. Port Arrangement

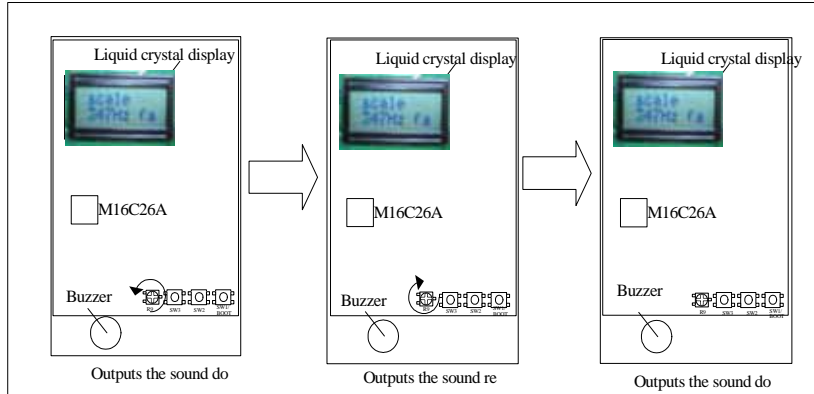
The buzzer shown here is the facility mounted on an extension board for the Renesas Starter Kit. To use this facility, connect an extension board to the Starter Kit.



## 4. Operational Outline

The variable resistor (R9) mounted on the board is used to adjust the musical scale and sound a buzzer. Scales and frequencies are displayed as adjusted with the variable resistor (R9).

Turning the variable resistor (R9) clockwise lowers the sound, and turning it counterclockwise raises the sound. When SW1 is pressed while a scale is sounded, the sound stops and a string “mute” is displayed on liquid crystal display.



The operation described above is accomplished using the following microcomputer facilities:

- Timer A0 (timer mode, main 2 ms cycle)

This timer counts 2 milliseconds using the main clock of the microcomputer as the count source.

It is used as the basic timer of RSK\_LIB.

Time management, LCD display management and AD input are performed using this timer.

- AD24 (single-shot mode, AD value measurement)

Analog voltages are converted to digital data using the main clock of the microcomputer as a conversion clock.

More specifically, the analog voltages output from the variable resistor (R9) are A/D converted.

- Timer A1 (pulse modulation mode, buzzer output)

This timer outputs a waveform with different high and low pulse widths using the main clock of the microcomputer as the count source.

The high-level width of the output pulse is changed to alter the frequency, by which the buzzer tone is varied.

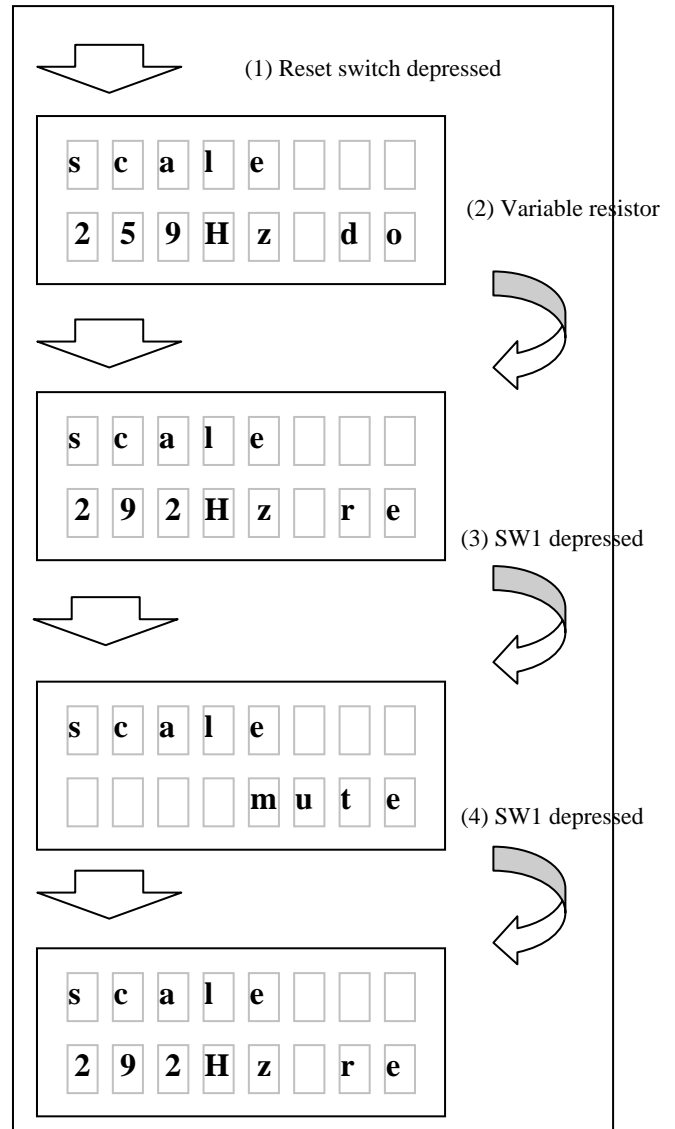
## 5. Operational Specification

- (1) Immediately after the reset switch is depressed, the scale corresponding to a variable resistor position is output.
- (2) Scale output and display are changed using the variable resistor (R9).
- (3) Scale output is turned on or off by pressing SW1.  
When scale output is turned off, a string "mute" is displayed.

Relationship between VR Input (Input Voltage) and Scale Output

Input voltage		Frequency
0 -0.625V	<i>do</i>	259Hz
0.625 - 1.25V	<i>re</i>	292Hz
1.25 - 1.875V	<i>mi</i>	327Hz
1.875 - 2.5V	<i>fa</i>	347Hz
2.5 - 3.125V	<i>so</i>	393Hz
3.125 - 3.75V	<i>la</i>	441Hz
3.75 - 4.375V	<i>si</i>	498Hz
4.375 - 5V	<i>do</i>	524Hz

\* The AD values are set by calling the common function "AD average" (RL\_AdVeraging). Within the function, a value is sampled 6 times, and the sampled values except the maximum and minimum values are averaged, the result of which is returned. This average value is acquired 8 times, the average of which is made a fixed value.



## 6. Definition of the RSK Functionality and the RSK\_LIB APIs and Common Functions Used by Musical Scale

### 6.1 Definition of the RSK Functionality

RSKdefine.h file

In this application, the following functionalities (those shown in red) are set

```

/*****
    The boot information on CPU is defined
    Usually, this mode is used
    *****/
#define _CPU_M16C26A_NORMAL_MOD
/* Use in low power mode can be performed. */
//#define _CPU_M16C26A_32KHZ_MOD
/* Use of access of a flash can be performed. */
//#define _CPU_M16C26A_DATAFLASF_USE
/*****

    The hardware function which RSK supports is chosen
    *****/
#define _USE_KEY
#define _USE_BUZZER
#define _OPTION_USE_AD
//#define _OPTION_USE_COM_RX
//#define _OPTION_USE_COM_TX
//#define _OPTION_USE_INFRAEDRX
//#define _OPTION_USE_INFRAEDTX
#define _OPTION_USE_SW
//#define _OPTION_USE_LED
//#define _OPTION_USE_IO
    
```

Individual definition of each selected functionality

```

#if defined _OPTION_USE_AD
    /* Define Illumimeter Adc */
    //#define _OPTION_USE_AD0
    /* Define Vr Adc */
    #define _OPTION_USE_AD24
#endif

#if defined _OPTION_USE_SW
    #define _OPTION_USE_PUSHSW1
    //#define _OPTION_USE_PUSHSW2
    //#define _OPTION_USE_PUSHSW3
#endif
    
```

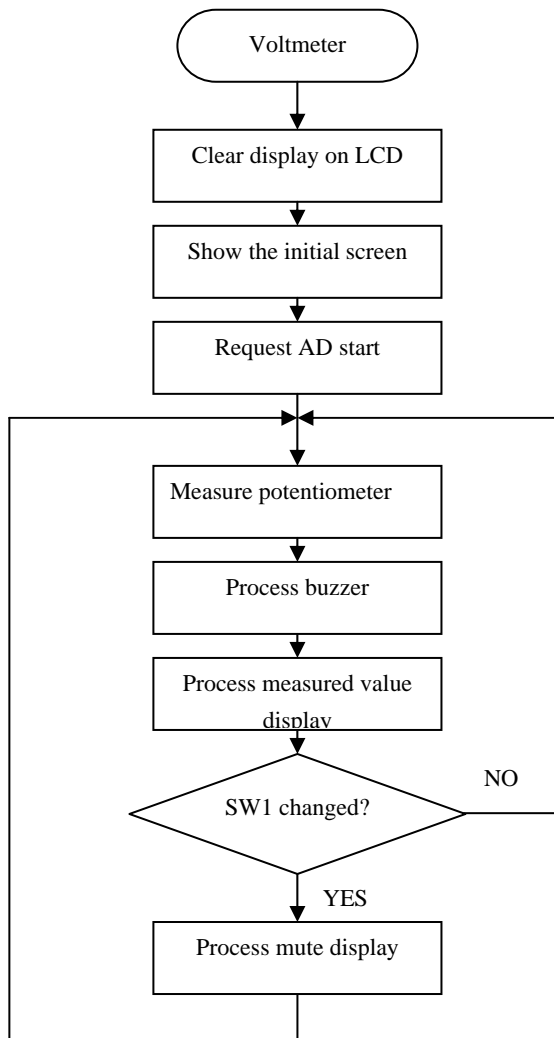
## 6.2 APIs and Common Functions Used

```
ApiStatusType RL_SefTimerReq( unsigned int TimerValue, char TimerMode, int *TimerNo, int *ERcode );  
ApiStatusType RL_StartTimer( int TimerNo, int *ERcode );  
ApiStatusType RL_CheckTimer( int TimerNo, int *ERcode );  
ApiStatusType RL_Putc_Lcd( char Ylocation, char outc, int *ERcode );  
ApiStatusType RL_Puts_LcdLoc( char Xlocation, char Ylocation, char RvTime, const char far* outc, int  
                             *ERcode );
```

```
ApiStatusType RL_Start_Buzzer( char freqNo, int *ERcode );  
ApiStatusType RL_Stop_Buzzer( int *ERcode );  
ApiStatusType RL_Start_Adc( int AdIdentfier, int *ERcode );  
int RL_AdAveraging( int AdLogicalNo, int *AdAverage, int *ERcode );  
ApiStatusType RL_GetSwPort( char PortNo, char *Indata, int *ERcode );  
void RL_ErrorHook( int FuncNo, int ErrorNo );
```

For details about the APIs and common functions used by the sample program (musical scale), see the Renesas Starter Kit Library V.1.00 Reference Manual.

7. Flowchart

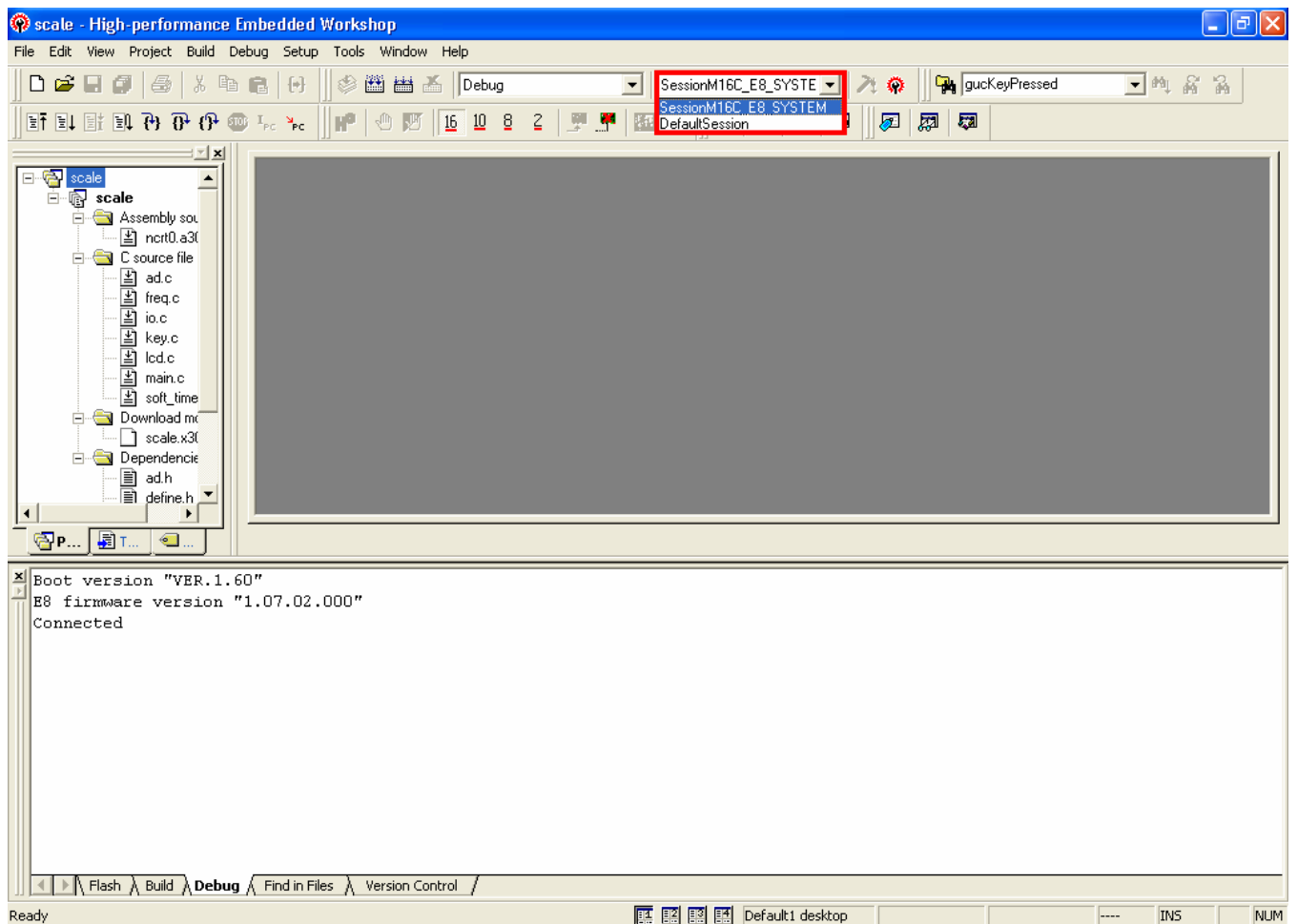


## 8. Tutorial

- 1 Launch the HEW by double-clicking its icon.

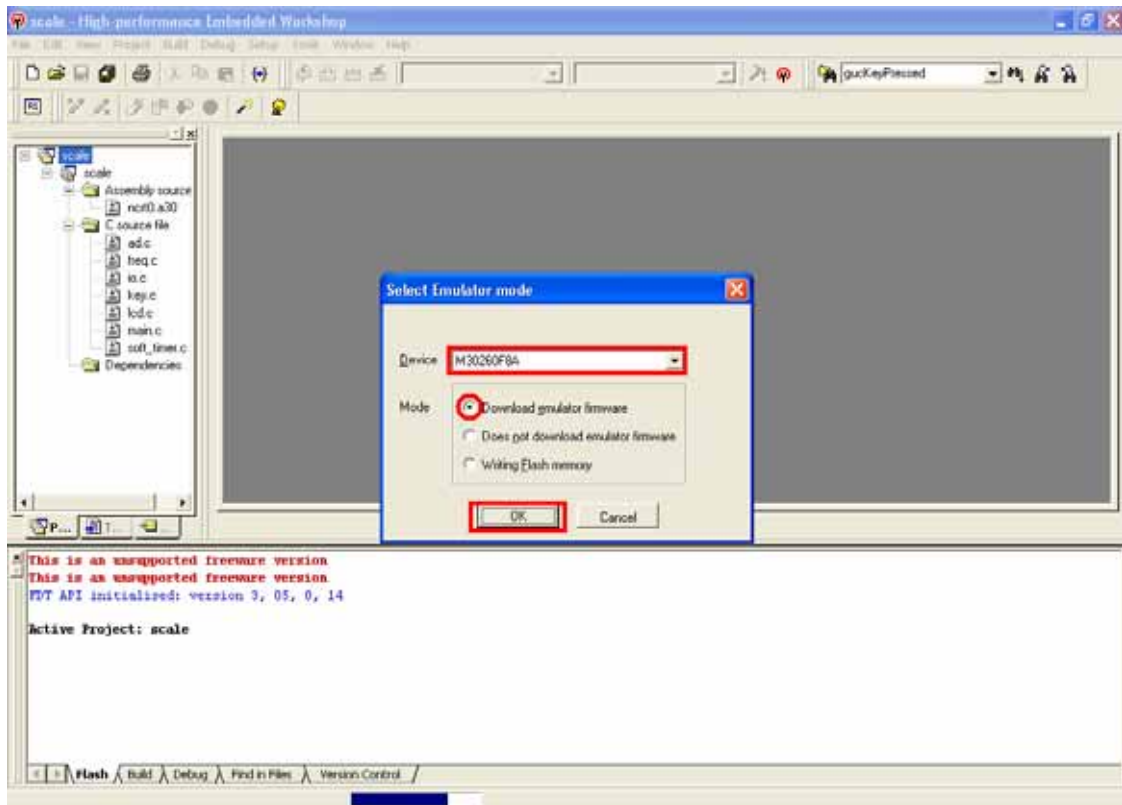


- 2 Change the session name from “default Session” to “SessionM16C\_E8\_System.”

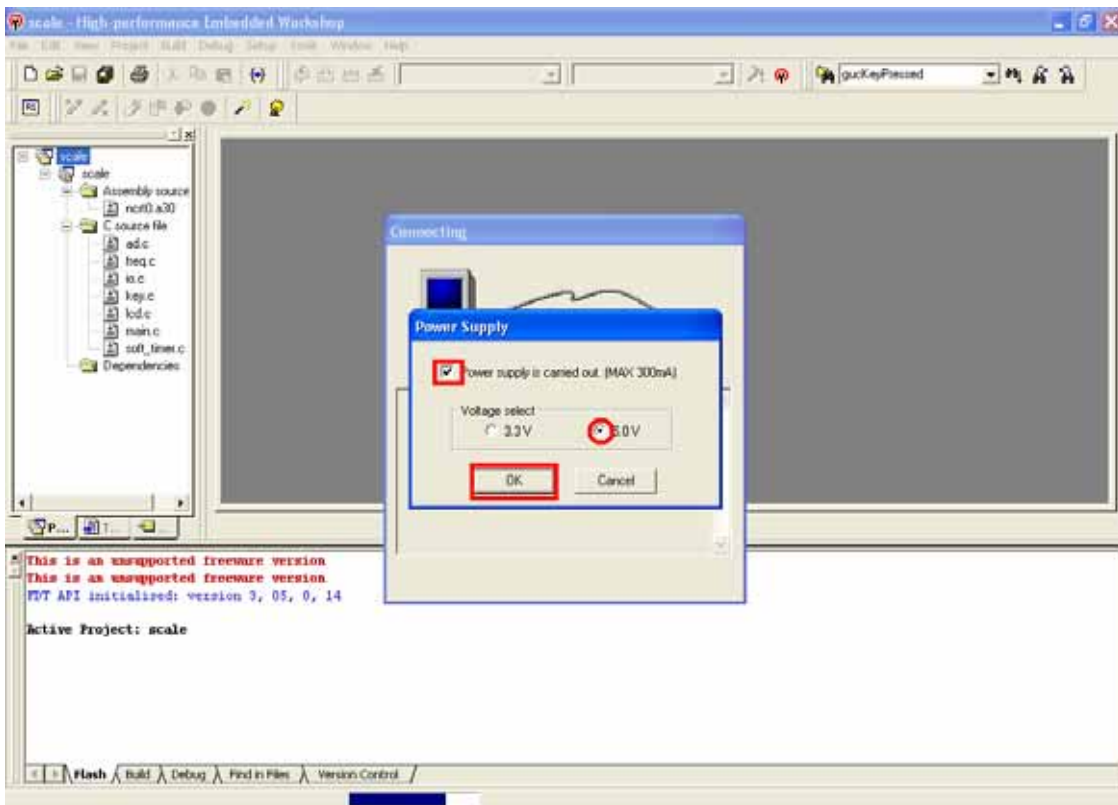




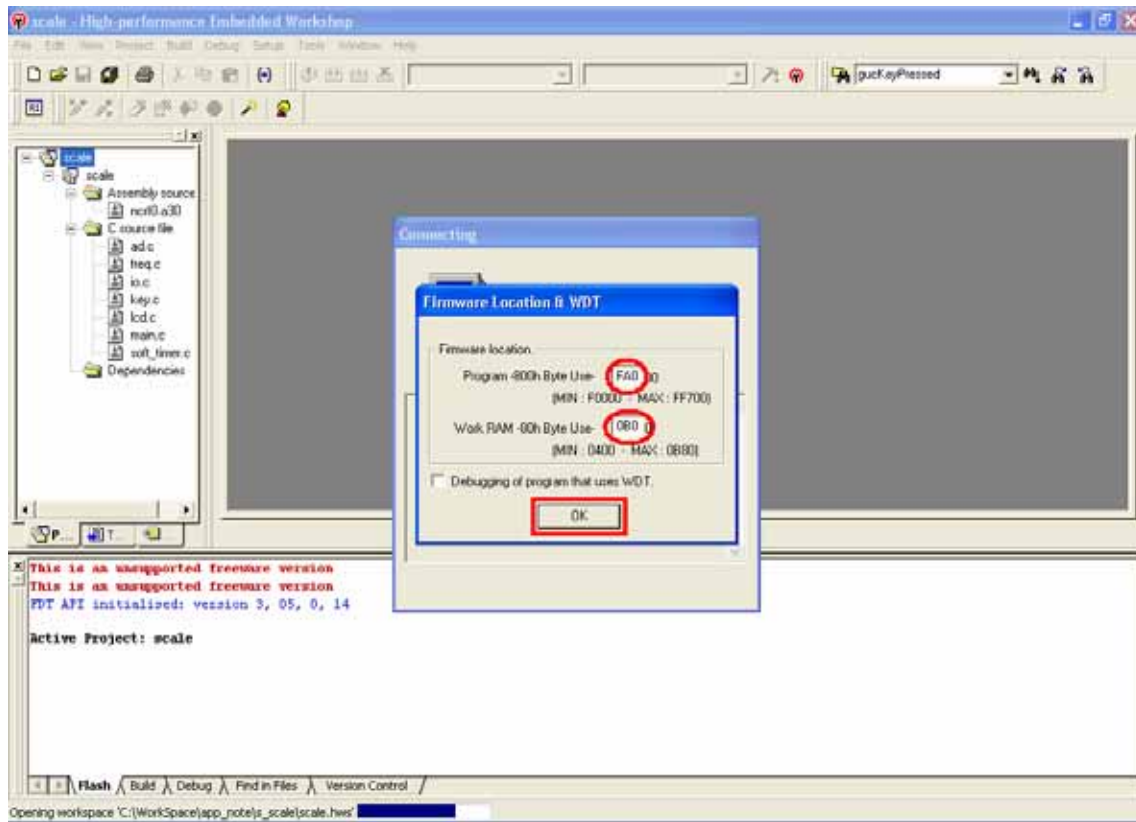
- 3 Select "M30260F8A" for Device.  
Select "Download emulator firmware" for Mode.



Check the box labeled “Power supply is carried out. (MAX 300mA)” and then select “5.0V.”

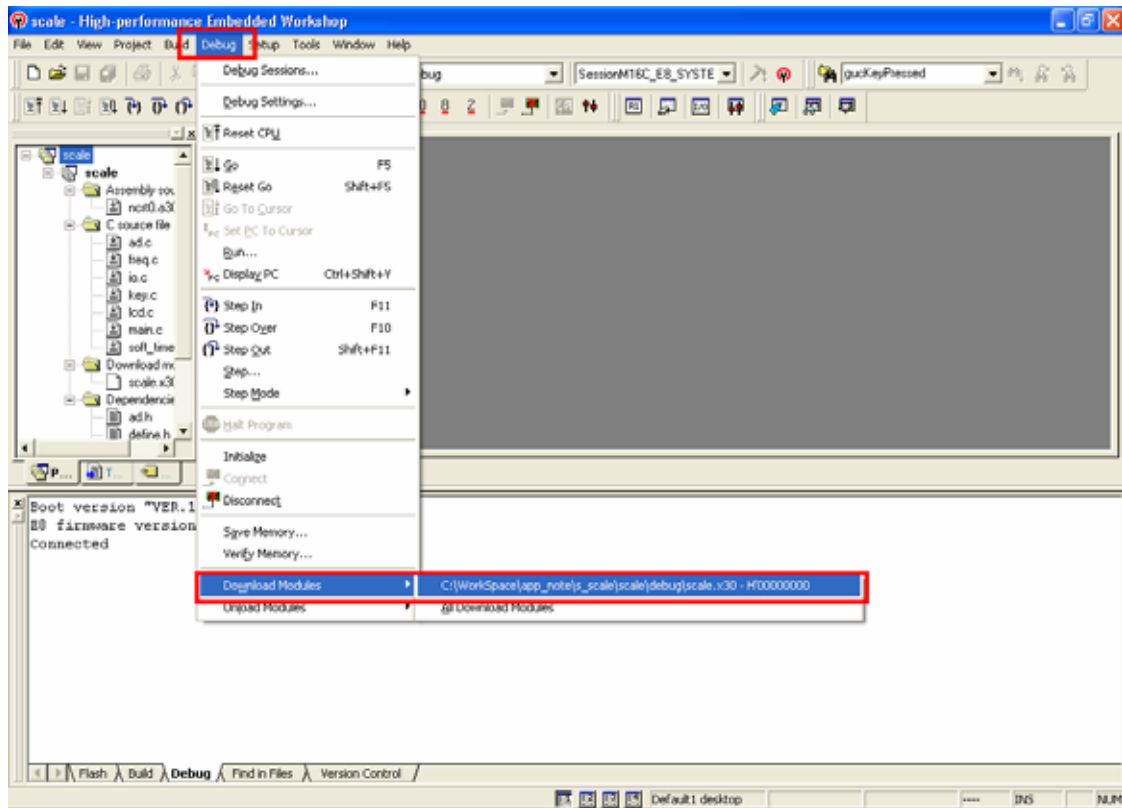


- In the program and the work RAM text boxes of Firmware Location Address, enter “FA0” and “0B8” respectively.  
Leave the box labeled “Debug a program using the WDT” unchecked.

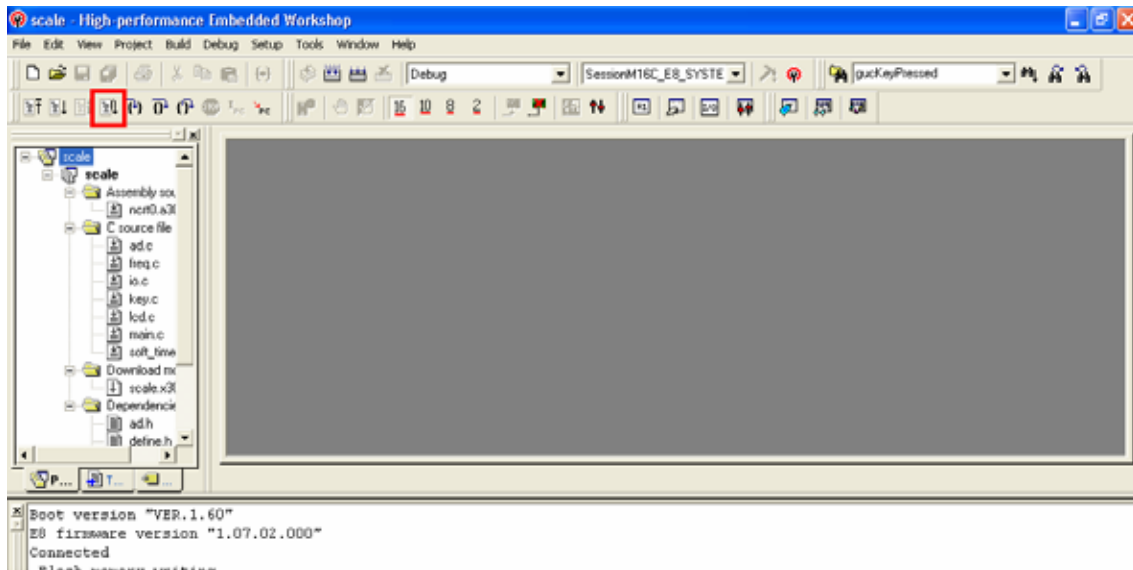


- 5 Choose Download from the Debug tab and download a module.

The upper-side choices for Download show the location from which a project was downloaded.

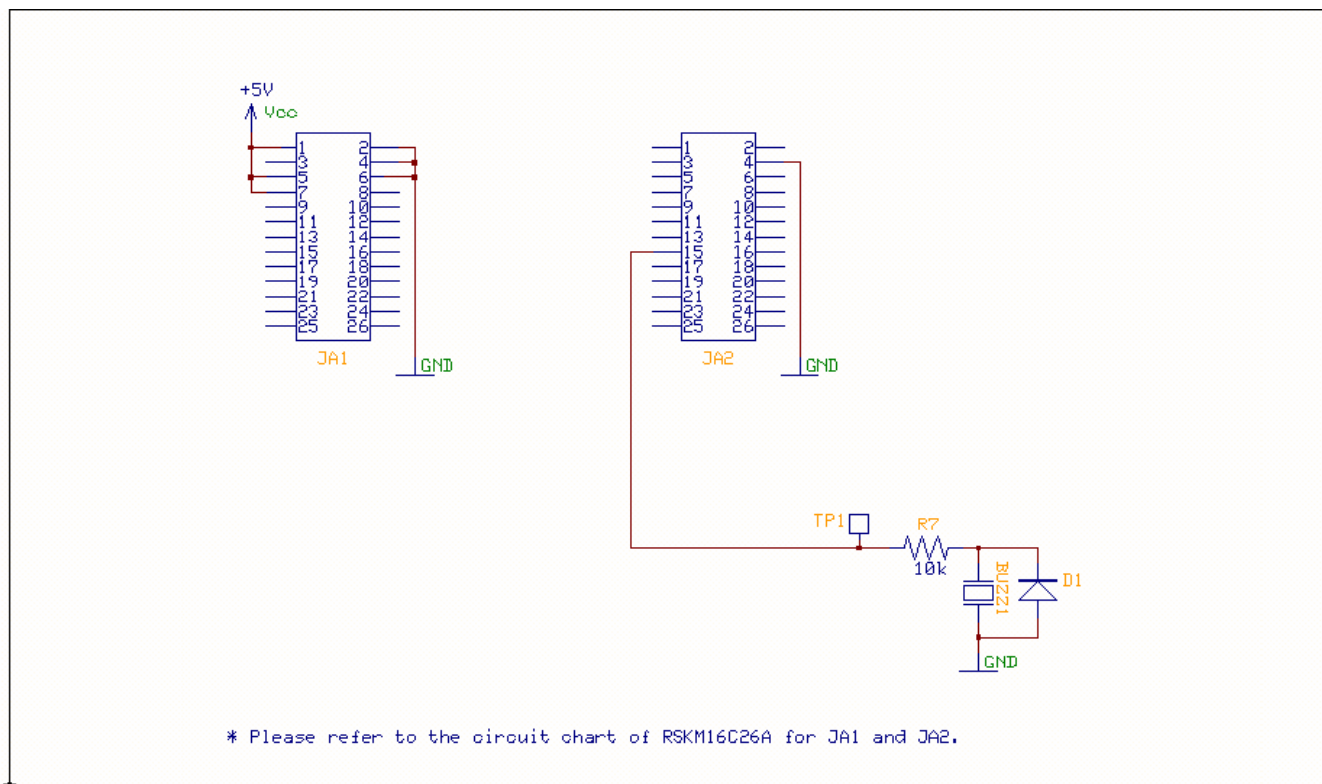


- 6 Click "Start after Reset" to start program execution.



- 7 Please do "Cancellation" when "The file is opened" window opens.

## 9. Example Circuit



## 10. Part List

Part name	Part No.	Q'ty	Manufacturer	Type number	Value	Remark
Buzzer	BUZZ1	1	CUI inc	CEP-1160		No-polarity, separately exited oscillation
Switching diode	D1	1	ROHM	1SS355TE-17		
Chip resistor	R7	1	ROHM	MCR10EZHF103	10k	1/8W, 5%
PCB header	JA1,JA2	2	Molex	10-88-1261	26pin	Male, 2-row, vertical type

11. Web Sitet

Renesas Technology Web site

<http://www.renesas.com/>

### Revision History

Rev.	Date of issue	Content of revision	
		Page	Points
1.00	2006.06.30	-	First revision issued
1.10	2007.12.03	-	Contents of presentation improved



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