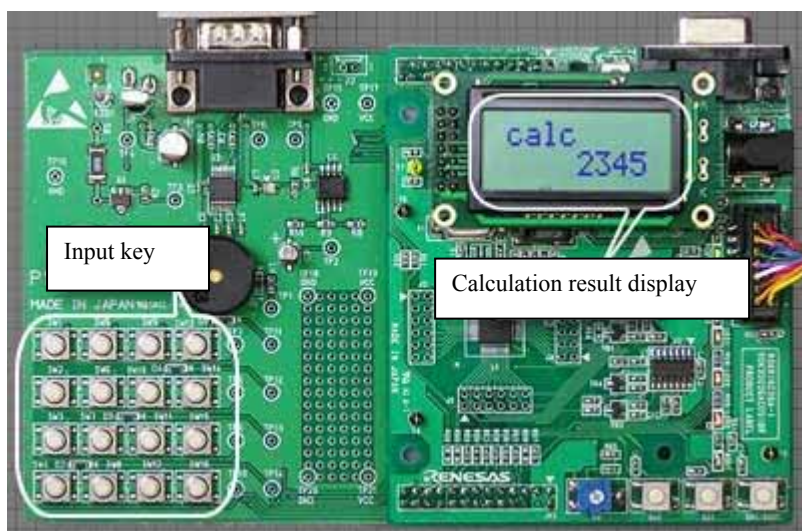


M16C/26A Group

Sample Program (Electronic Desktop Calculator)

1. Summary

This sample program provides the functionality of an electronic desktop calculator 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

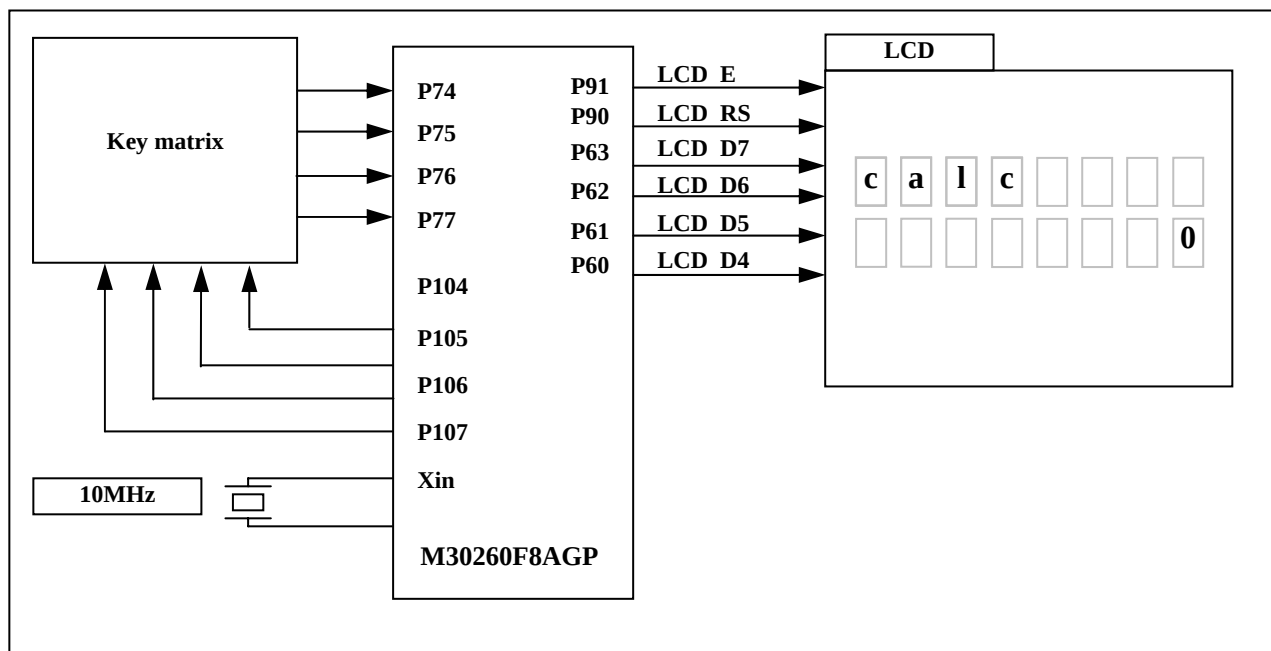
This sample program runs on the Renesas Starter Kit for M16C/26A (R0K33026AS000BE).

Prepare an extension board available for the Renesas Starter Kit or create a circuit similar to the one shown in the circuit diagram on page 15 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 key matrix and the buzzer are the facilities mounted on an extension board for the Renesas Starter Kit. To use these facilities, connect an extension board to the Starter Kit.

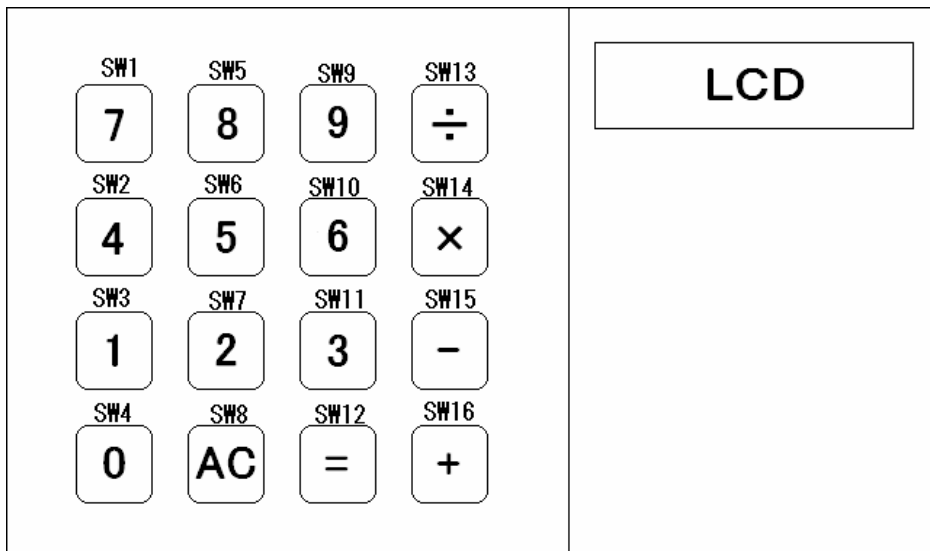


4. Operational Outline

Calculation results are shown on liquid crystal display.

The display shows the result of operation when calculation results are within 7 digits (from -9999999 to 9999999) or "E" when calculation results are equal to or more than 8 digits. For example, when you enter "1234 5678 =", the display will show "6912." Or when you enter "1234567 8901234," the display will show "E."

When a key is depressed, the buzzer sounds.



Note: In this program, pressing two or more switches at the same time has no effect (i.e., ignored).

This function is materialized 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, key scan, and LCD display management are performed using this timer.

- Timer A1 (pulse modulation mode, buzzer output)

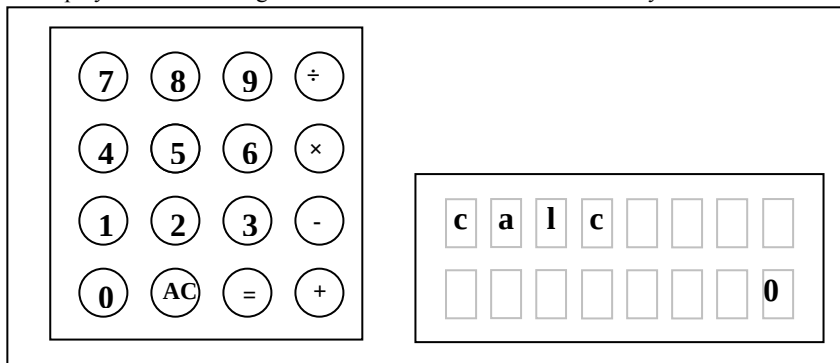
This timer outputs a waveform with different high and low pulse widths using the main clock of the microcomputer as the count source.

It is used to sound a buzzer each time a key is touched.

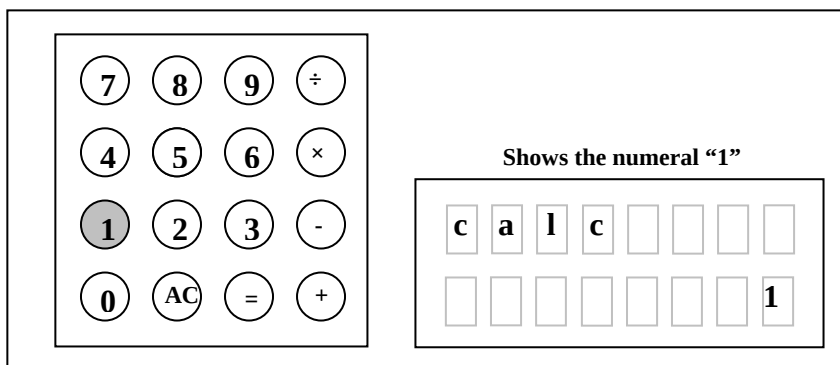
5. Operational Specification

Example for $1 \times 20 = 20$

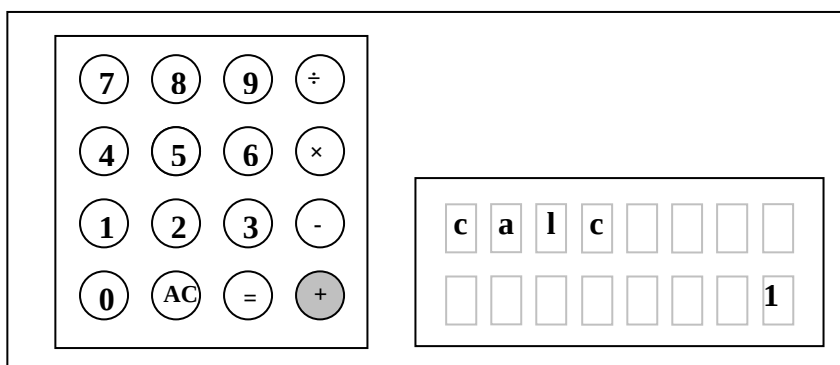
- (1) The display shows the string "calc" and the numeral "0" immediately after the reset switch is pressed.



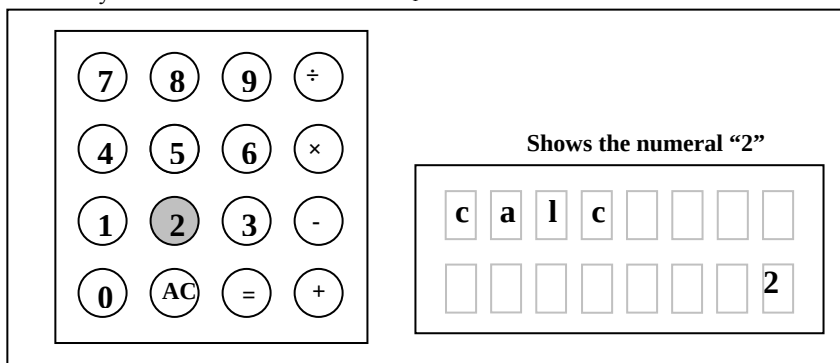
- (2) The "1" key is entered.

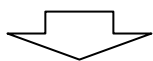


- (3) The "." key is entered.

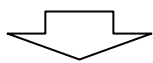
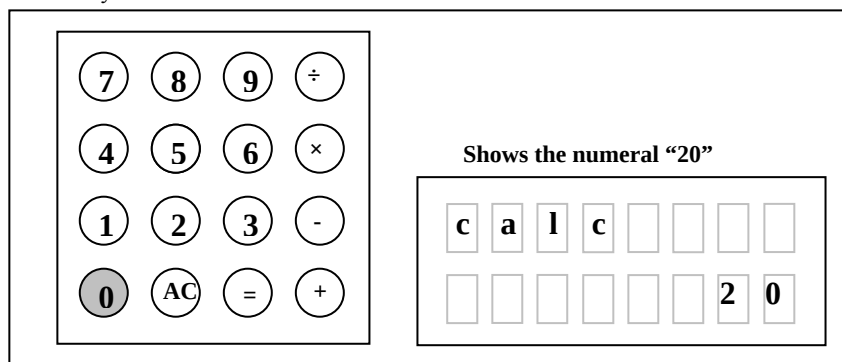


- (4) The "2" key is entered.

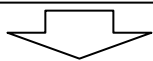
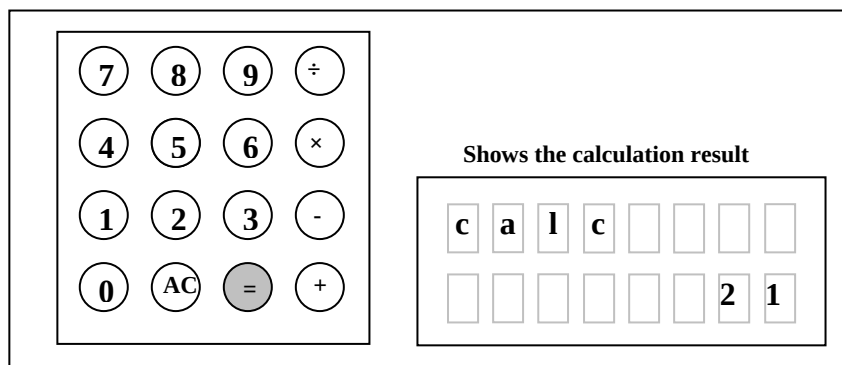




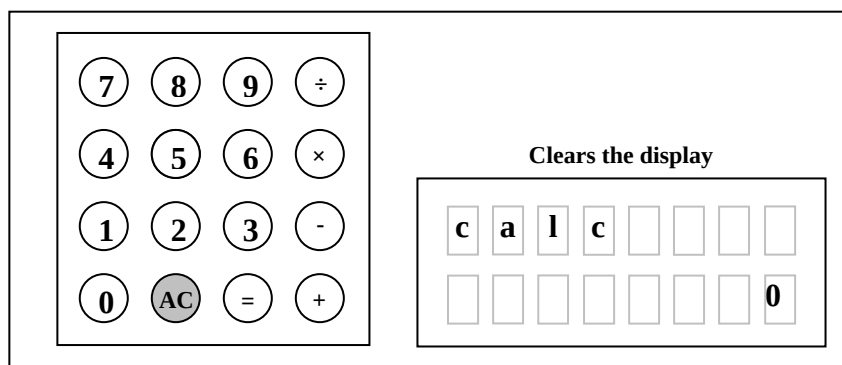
(5) The “0” key is entered.



(6) The “=” key is entered.



(7) The “AC” key is entered.



6. Definition of the RSK Functionality and the RSK_LIB APIs and Common Functions Used by the Calculator

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 _USE_KEY
/* A key matrix continues pushing and existence is defined.*/
/* When not using -USE_KEY_CONTINU is made a comment. */
// #define _USE_KEY_CONTINU
#if defined _USE_KEY_CONTINU

#else
#define _CONTINU_SW1 _KEY_CONTEINU_OFF
#define _CONTINU_SW2 _KEY_CONTEINU_OFF
#define _CONTINU_SW3 _KEY_CONTEINU_OFF
#define _CONTINU_SW4 _KEY_CONTEINU_OFF
#define _CONTINU_SW5 _KEY_CONTEINU_OFF
#define _CONTINU_SW6 _KEY_CONTEINU_OFF
#define _CONTINU_SW7 _KEY_CONTEINU_OFF
#define _CONTINU_SW8 _KEY_CONTEINU_OFF
#define _CONTINU_SW9 _KEY_CONTEINU_OFF
#define _CONTINU_SW10 _KEY_CONTEINU_OFF
#define _CONTINU_SW11 _KEY_CONTEINU_OFF
#define _CONTINU_SW12 _KEY_CONTEINU_OFF
#define _CONTINU_SW13 _KEY_CONTEINU_OFF
#define _CONTINU_SW14 _KEY_CONTEINU_OFF
#define _CONTINU_SW15 _KEY_CONTEINU_OFF
#define _CONTINU_SW16 _KEY_CONTEINU_OFF
#endif
    
```

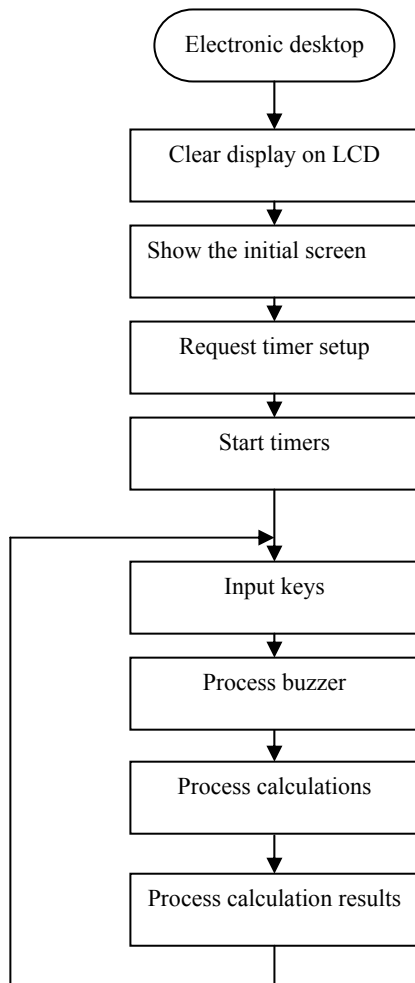
Continuous key depression is not used in this application.

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_Get_Key( int *Inkey, int *ERcode );
ApiStatusType RL_Start_Buzzer( char freqNo, int *ERcode );
ApiStatusType RL_Stop_Buzzer( 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 );
void RL_LengthCpy( char *Dest, char far *Strm, char Len );
void RL_ErrorHook( int FuncNo, int ErrorNo );
```

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

7. Flowchart



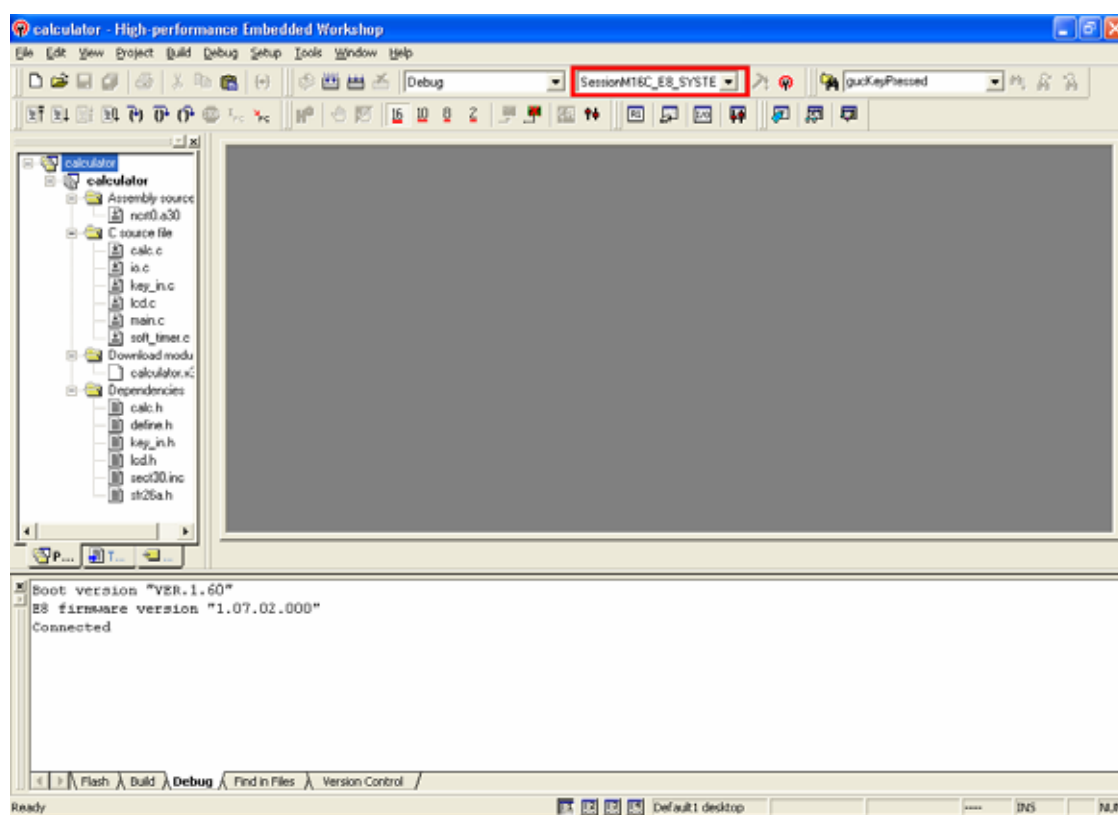
8. Tutorial

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

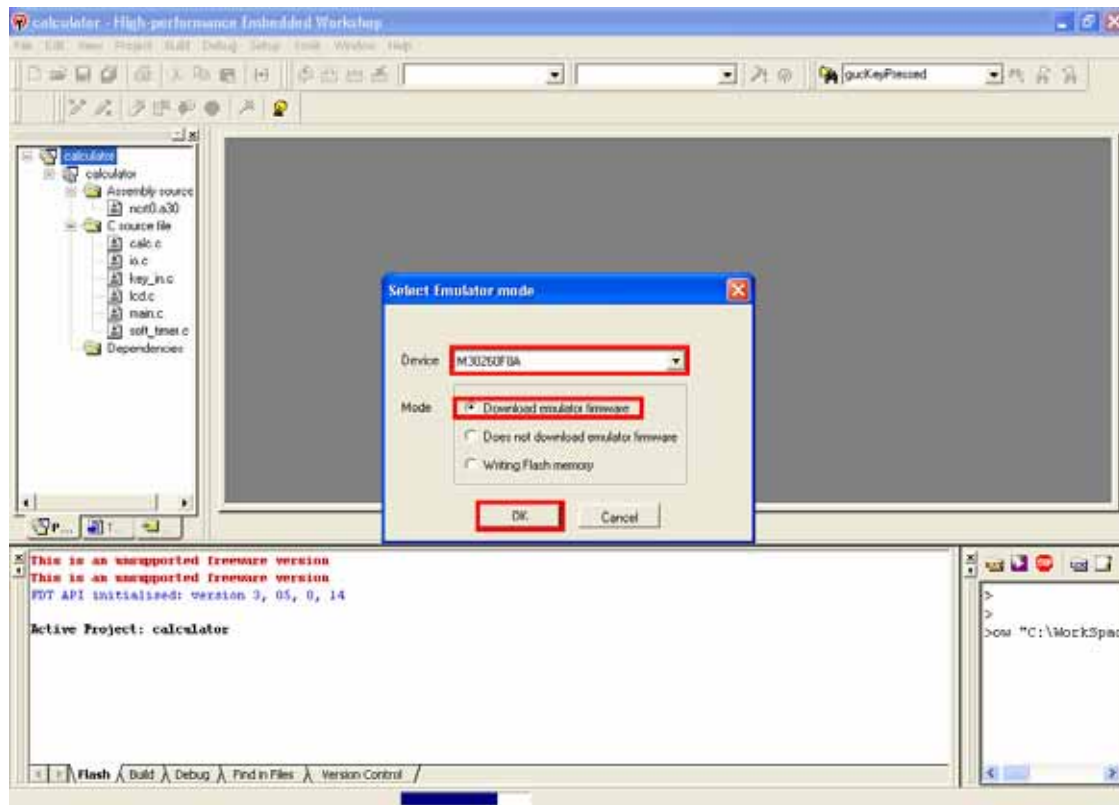


Calculator.hws

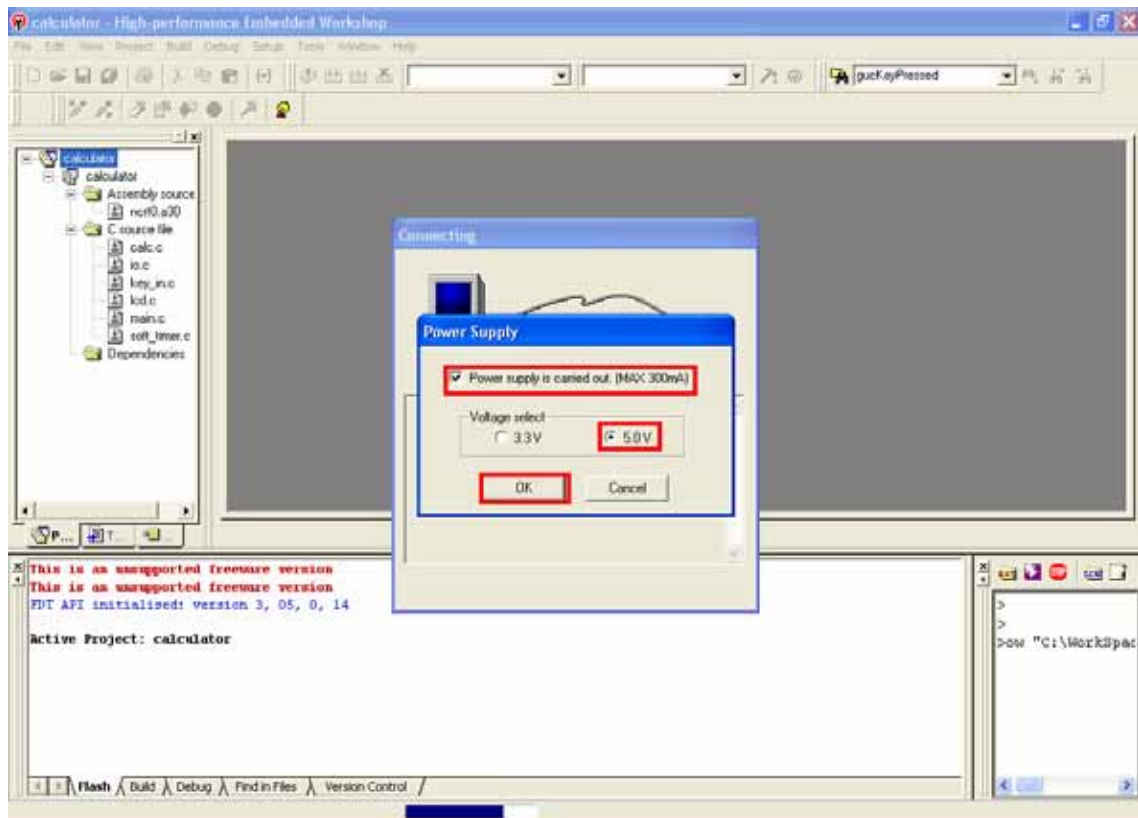
- 2 Change the session name from “default Session” to “SessionM16C_E8_System.”



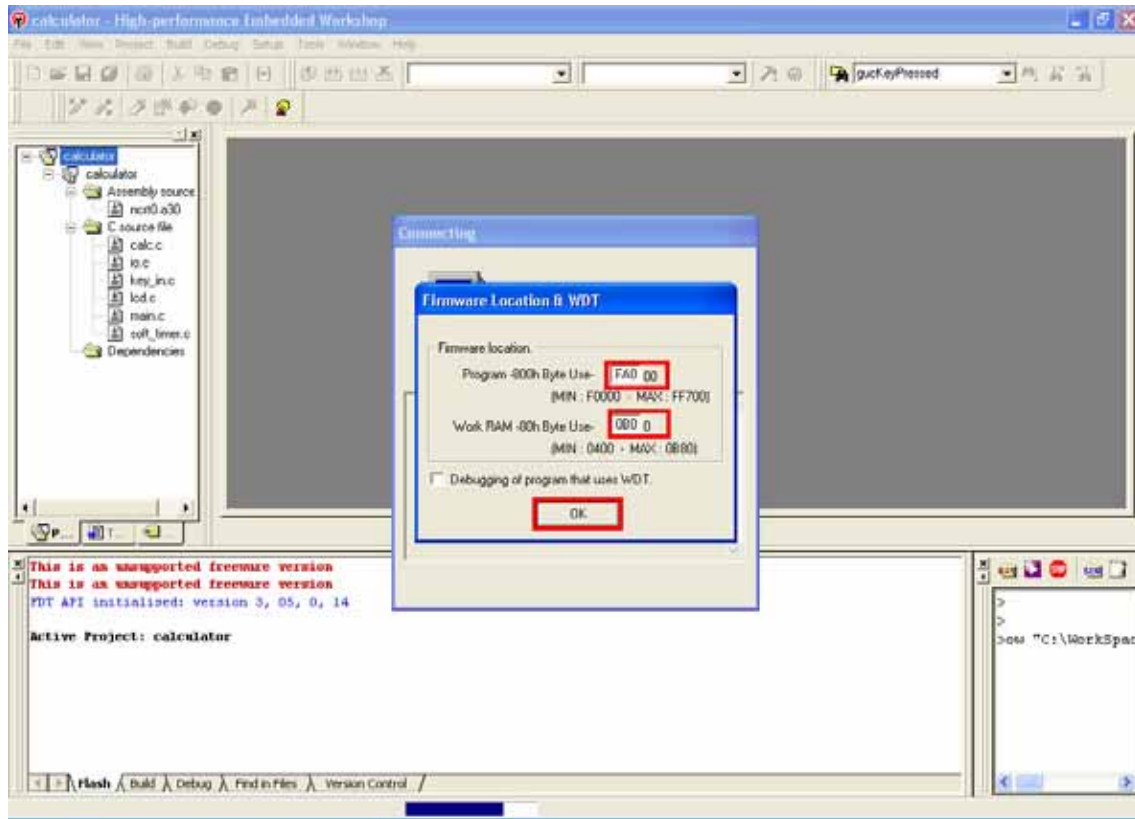
- 3 Select "M30260F8A" for Device.
Select "Download emulator firmware" for Mode.



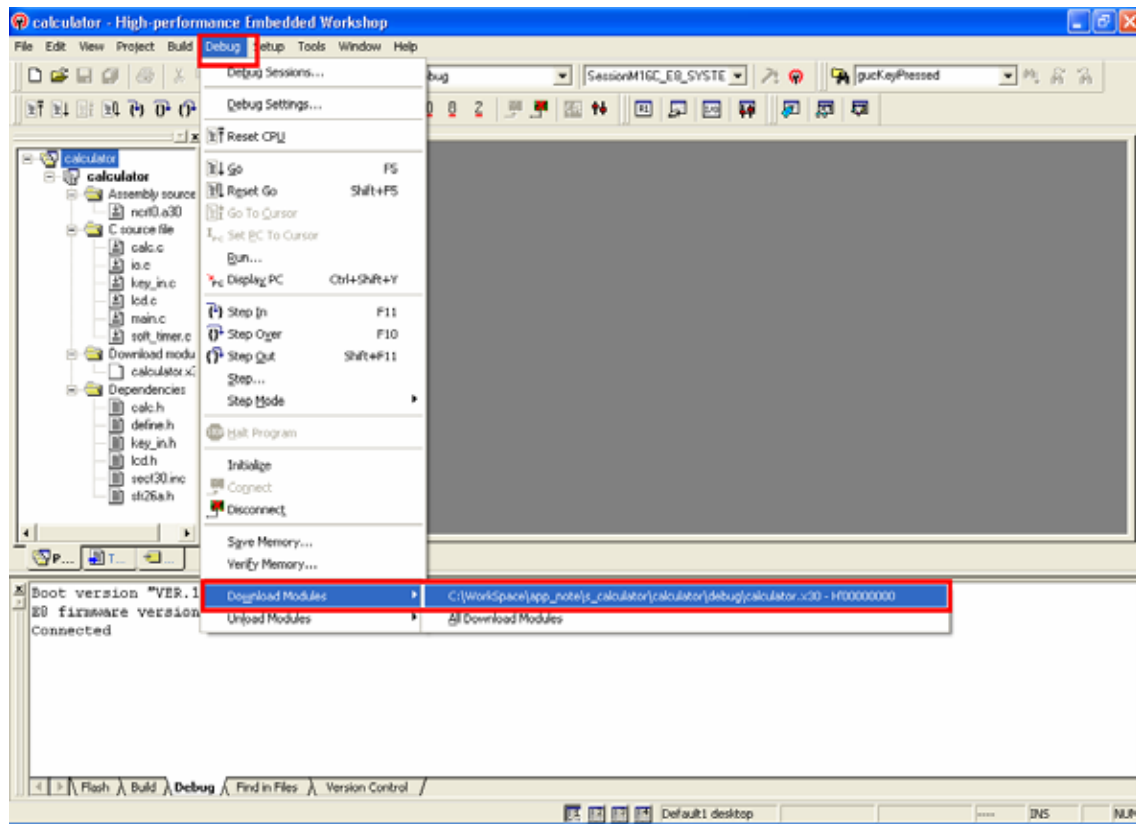
Check the box labeled “Power supply is carried out. (MAX 300mA)” and then select “5.0V.”



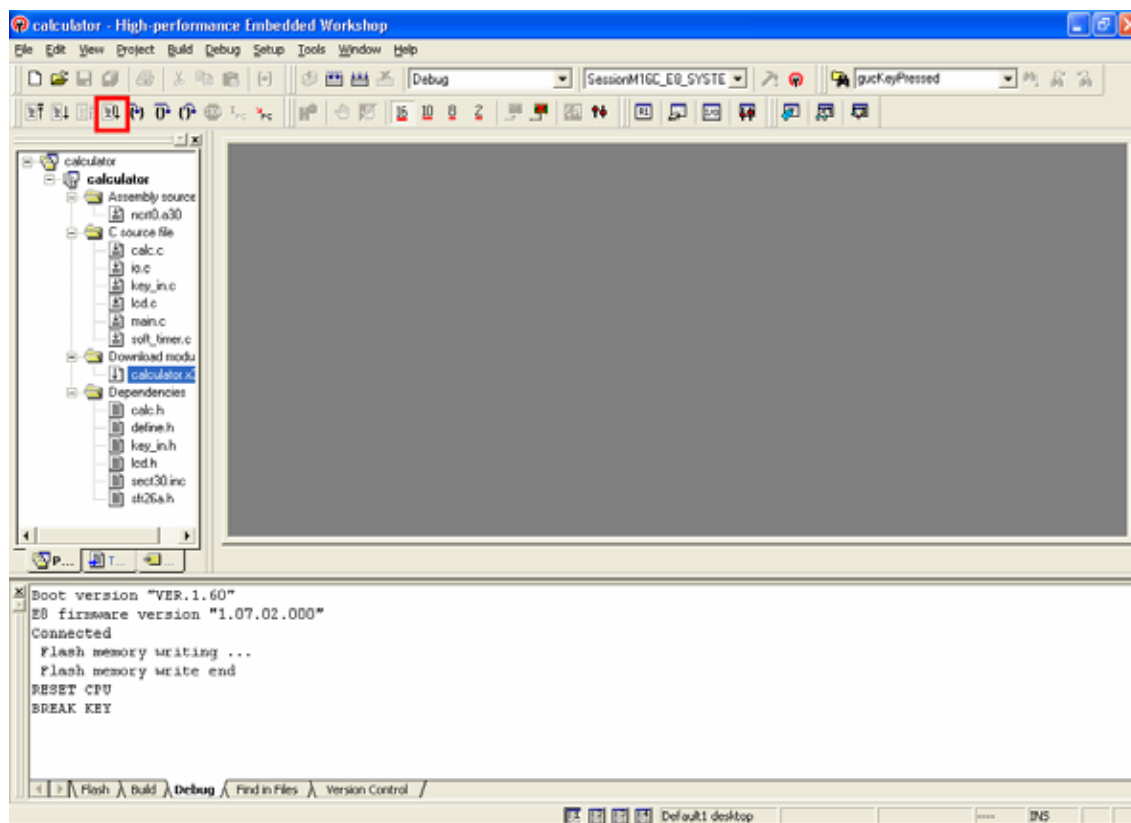
- 4 In the program and the work RAM text boxes of Firmware Location & WDT, enter “FA0” and “0B8” respectively. Leave the box labeled “Debug a program using the WDT” unchecked.



- 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.

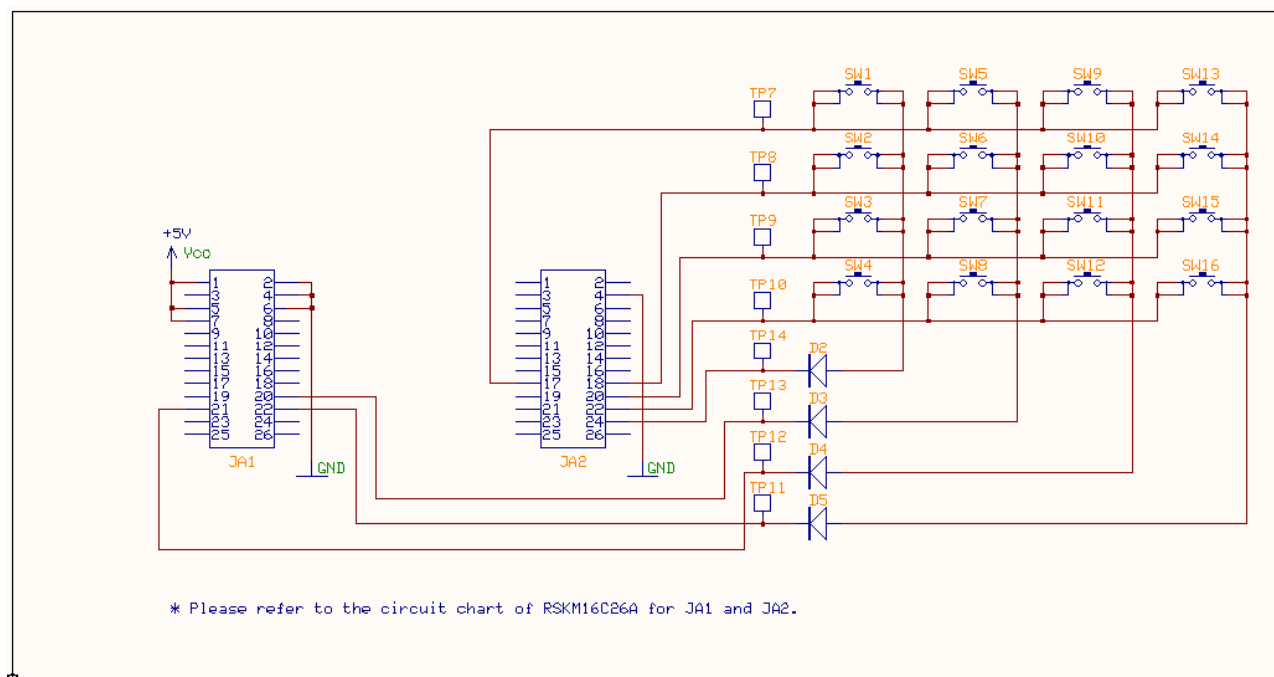


- 6 Click "Start after Reset" to start program execution.



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

9. Circuit Diagram



10. Part List

Part name	Part No.	Q'ty	Manufacturer	Type number	Value	Remark
Tact switch	SW1 -SW16	16	OMRON	B3FS-1000P		
Switching diode	D2 - D5	4	ROHM	1SS355TE-17		
PCB header	JA1,JA2	2	Molex	10-88-1261	26-pin	Male, 2-row, vertical type

11. Web Site

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	2007.07.12	-	Contents of presentation improved
1.20	2007.11.29	-	RSK_LIB APIs supported

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