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F²MC-8FX Family
8-BIT MICROCONTROLLER
MB95260H series

LCD Module control

Example of connection to SC1602BS

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Revision History

Revision	Date	Description
1.0	Sep 9,2010	Initial release

Subject

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1 Introduction

This application note explains the method of controlling the LCD display module SC1602BS by external Fujitsu 8-bit MCU F²MC-8FX family. MB95F260H series is used in the explanation of control methods.

2 About LCD module of SC1602BS

The SC1602BS is popular LCD module of offered commercially. The SC1602BS has LCD driver controller for LCD display. These LCD minimum controls required are 4bit parallel command line and 2bit control line.

		Higher 4-bit (D4 to D7) of Character Code (Hexadecimal)															
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Lower 4-bit (D0 to D3) of Character Code (Hexadecimal)	0 CG RAM (1)			0	a	P	'	P					-	9	E	o	p
	1 CG RAM (2)		:	1	R	O	a	a					n	7	4	a	a
	2 CG RAM (3)		"	2	R	R	b	r					"	7	4	x	p
	3 CG RAM (4)		#	3	O	S	c	c					j	7	7	E	s
	4 CG RAM (5)		\$	4	O	T	e	t					\	7	7	4	e
	5 CG RAM (6)		%	5	E	U	e	v					"	7	7	1	S
	6 CG RAM (7)		&	6	F	U	r	v					7	7	2	3	p
	7 CG RAM (8)		'	7	G	U	e	v					7	7	7	7	g
	8 CG RAM (1)		(8	H	X	h	x					4	7	7	7	X
	9 CG RAM (2))	9	I	V	i	v					6	7	7	7	y
	A CG RAM (3)		*	#	J	Z	j	z					x	7	7	7	7
	B CG RAM (4)		+	#	K	K	k	k					x	7	7	7	7
	C CG RAM (5)		,	<	L	X	l						x	7	7	7	7
	D CG RAM (6)		-	=	M	n	n						x	7	7	7	7
	E CG RAM (7)		.	>	N	n	n						x	7	7	7	7
	F CG RAM (8)		/	?	O	L	o						x	7	7	7	7

Figur 2-1

2.1 Control signal of LCD module

Shown below the LCD module signals.

No	Symbol	Function	No	Symbol	Function
1	VDD	5V	9	DB2	Data bit2
2	VSS	GND	10	DB3	Data bit3
3	Vo	Contrast ADJ.	11	DB4	Data bit4
4	RS	REGISTER SELECT	12	DB5	Data bit5
5	R/W	READ/WRITE	13	DB6	Data bit6
6	E	ENABLE SIGNAL	14	DB7	Data bit7
7	DB0	Data bit0			
8	DB1	Data bit1			

Chart 2-1

VDD : Supply Voltage 5V

VSS : GND

Vo : LCD contrast voltage

RS : Register select

High : Character data input mode

Low : Instruction command input mode

R/W : Read/Write Data bus selector

High : Data bus read mode

Low : Data bus write mode

E : Data enable

Data valid is high to low.

DBn : From DB7 to DB0 are Data bus line.

2.2 How to control the SC1602BS LCD module.

The LCD module of SC1602BS has two kind of controlling.

One is read/write from instruction command or character data use on 8bit bus from DB7 to DB0.

Other one is 4bit bus from DB7 to DB4 use. In this case user need read/write to bus access twice.

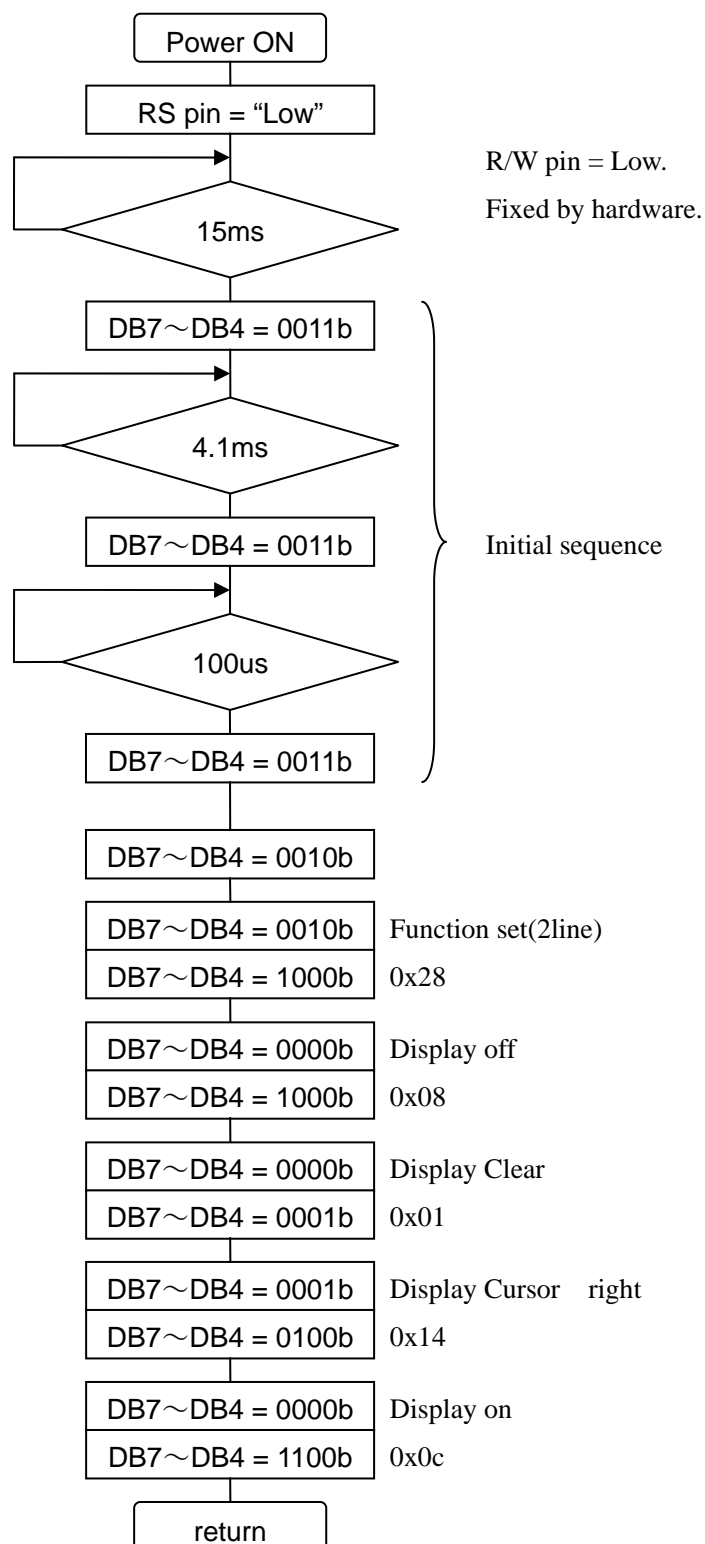
This application manual used 4bit bus access mode which will be able to save the microcontroller pin.

The SC1602BS will be able to use BUSY signal but, this application manual is using software wait time instead of the BUSY signal.

2.3 Initialization of the SC1602BS

The SC1602BS need initialization to LCD control module when startup.

Showing below are flowchart of initialization sequence and sample program.



Sample code of Initialization to SC1602BS.

```

/*****
NAME:          LCD_Initial()
FUNCTION:      SC1602 Initialization
*****/
void LCD_Initial(void) {
// Port direction
    LCD_Control_DDR &= 0xf0;          /* Lower 4bit output */
    LCD_Enable    = 0;
    LCD_Register_sel = 0;

    mDelay(15);                      /* delay time */
    SC1602LCD_4bit(LCD_DL_8BIT >> 4);
    mDelay(5);                      /* delay time */
    SC1602LCD_4bit(LCD_DL_8BIT >> 4);
    mDelay(1);                      /* delay time */
    SC1602LCD_4bit(LCD_DL_8BIT >> 4);

    SC1602LCD_4bit(LCD_DL_4BIT >> 4);
    SC1602LCD_Control(LCD_DL_4BIT |
                      LCD_N_2LINE |
                      LCD_DH_NORMAL);
    SC1602LCD_Control(LCD_DISP_OFF);
    SC1602LCD_Control(LCD_DISP_CLEAR_HOME);

    mDelay(2);                      /* delay time */
    SC1602LCD_Control(LCD_CURSOR_RIGHT);
    SC1602LCD_Control(LCD_DISP_ON);

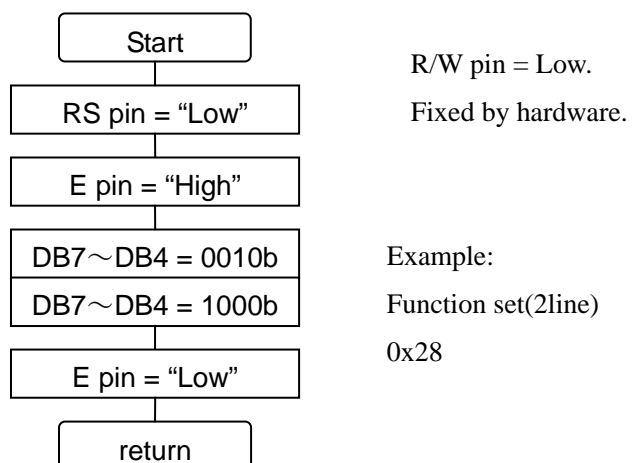
    return;
}

```

2.4 Example of writing instruction command to SC1602BS.

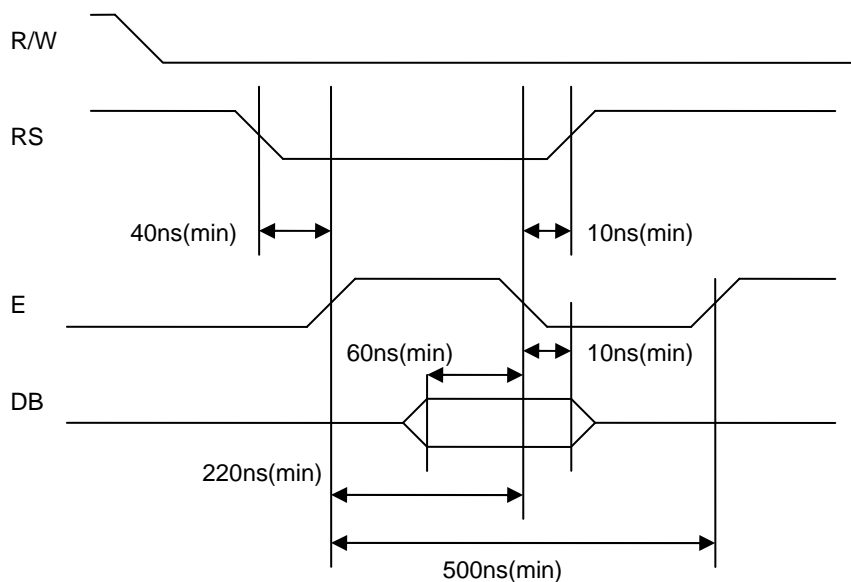
Writing an instruction command to LCD module of SC1602BS.

Showing below are flow chart of sequence.



Control of Writing:

Below is example of hardware timing chart.



Sample code of writing instruction to SC1602BS.

```

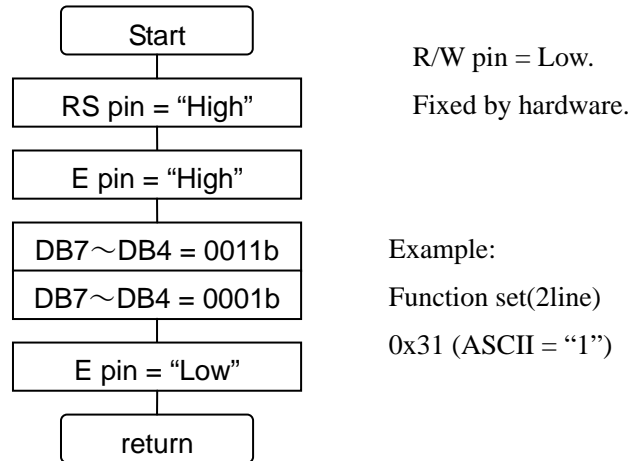
/*****
NAME:          SC1602LCD_Control()
FUNCTION:      Instruction input
*****/
void SC1602LCD_Control(unsigned char cmd) {
    LCD_Register_sel = 0;           // Control
    SC1602LCD_4bit(cmd >> 4);
    SC1602LCD_4bit(cmd);
    vDelay(32);                     //delay time
    return;
}

```

2.5 Example of writing data to LCD module of SC1602BS.

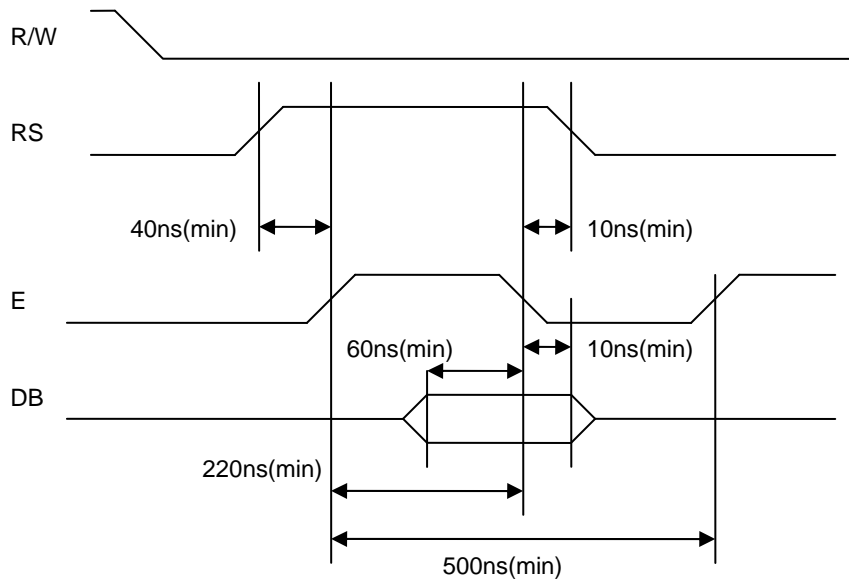
Writing data to LCD module of SC1602BS.

Showing below are flow chart of sequence.



Control of Writing:

Below is example of hardware timing chart.



Sample code of writing data to SC1602BS.

```

/*****
NAME:          LCD_WriteData()
FUNCTION:      Data set to SC1602
*****/
void LCD_WriteData(unsigned char data) {
    LCD_Register_sel = 1;                /* Data mode */
    SC1602LCD_4bit(data >> 4);
    SC1602LCD_4bit(data);
    vDelay(32);                          /* delay time */
    return;
}

```

```

/*****
NAME:          SC1602LCD_4bit()
FUNCTION:      Data set and Enable latch to SC1602
*****/
void SC1602LCD_4bit(unsigned char c)
{
    LCD_Enable = 1;                      /* Enable signal = High */
    LCD_Control_port = (LCD_Control_port & 0x0f) | (c << 4);
    vDelay(1);                           /* delay time */
    LCD_Enable = 0;                      /* Enable signal = Low */
    return;
}

```

Sample code of writing character data.

```

/*****
NAME:          LCD_Printf()
FUNCTION:      Character Data set to SC1602
*****/
void LCD_Printf(const char* str)
{
    while(*str)
    {
        LCD_WriteData(*str++);
    }
}

```

Sample code of writing ASCII code.

```

/*****
NAME:          LCD_Printf()
*****/
LCD_Printf("ABCD");           // LCD "ABCD" character //

```


Sample code of writing command code to SC1602BS.

```

/*****
NAME:          SC1602LCD_Control()
FUNCTION:      Instruction input
*****/
void SC1602LCD_Control(unsigned char cmd) {
    LCD_Register_sel = 0;          // Control
    SC1602LCD_4bit(cmd >> 4);
    SC1602LCD_4bit(cmd);
    vDelay(32);                    //delay time//
    __delay_us(40);
    return;
}

```

Example of cursor move by command code.

```

#define LCD_CURSOR_SH_RIGHT      0x14

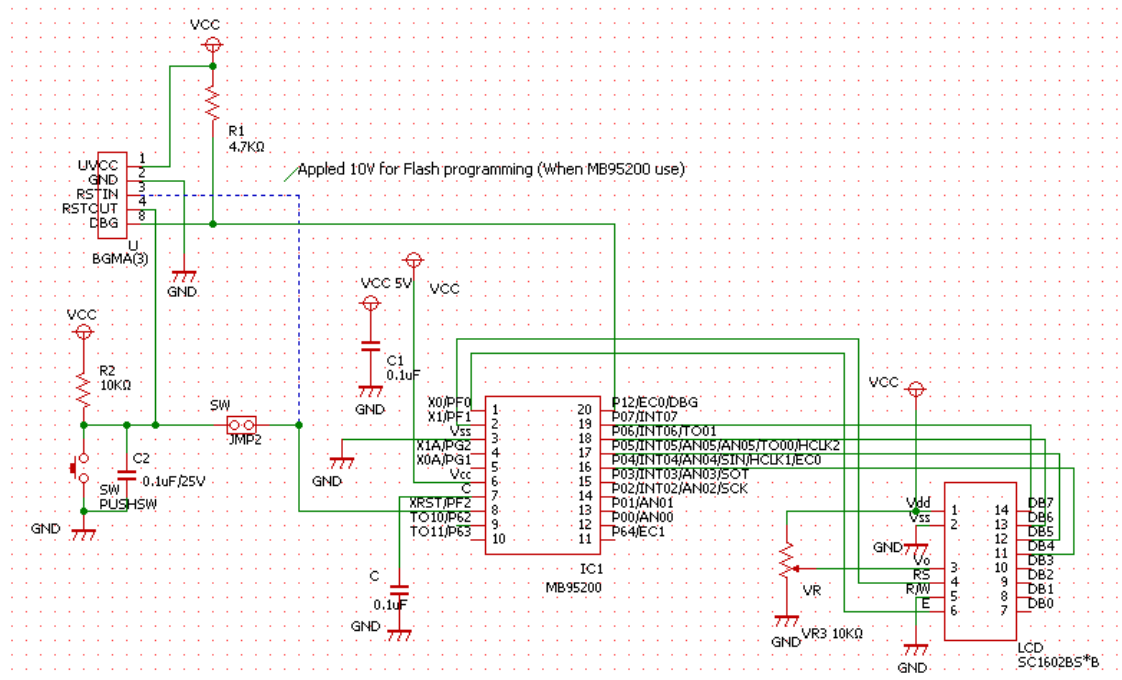
/*****
NAME:          LCD_Printf()
*****/
    SC1602LCD_Control(LCD_CURSOR_SH_RIGHT);

```

note : These code are excerpt from sample program.

Please get more detailed information from sample program.

3 Example of circuit diagram.



Figur 3-1example circuit diagram

Additional Information

For more information about how to use MB95260 series MCU, BGM adaptor and SOFTUNE,
please visit website

<http://jp.fujitsu.com/group/fsl/en/>