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AN204728

F²MC-8FX Family MB95310/370 Series 8-Bit Microcontroller I²C Source Code API

Associated Part Family: MB95310/370 Series

This document introduces API for I²C code.

Contents

1 Introduction

This document introduces API for I²C code.

In MB95F310 MCU there is an I²C module which can transfer data to other I²C device synchronously. In following chapters we should describes the MB95F310 registers and codes in C and the compilation.

2 MB95F310 I²C Register

This chapter describes MB95F310 I²C register

There are six registers in MB95F310. Those registers are bus control register IBCR00, bus control register IBCR10, bus status register IBSR0, I²C data register IDDR0, I²C address register IAAR0, and clock control register ICCR0.

In following sections, these registers are described in detail.

2.1 IBCR00 and IBCR10 (I²C Bus Control Register)

The two registers are mainly used to select the operating mode and to enable or disable interrupts, acknowledgment, general call acknowledgment, and MCU standby wakeup function.

Figure 1 describes register IBCR00

Figure 1. IBCR00 Register

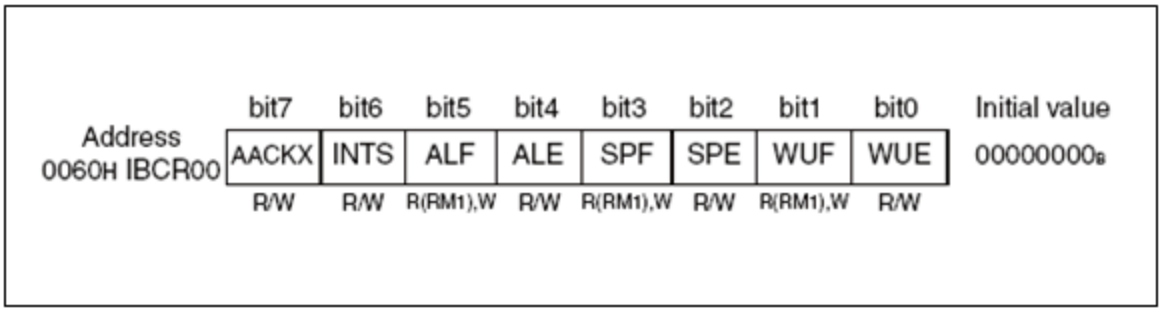


Table 1 describes every bit of IBCR00

Table 1. IBCR00 Register Description

Register	Description	
AACKX	In slave mode, it sends “1” when received first data as acknowledge.	
INTS	Set transfer finish interrupt at ninth SCL cycle or eighth SCL cycle	0: interrupt in ninth SCL cycle
		1: interrupt in eighth SCL cycle
ALF	When “1” is read, Arbitration lost is detected. Writing “0” will clear lost interrupt	
ALE	When “1” is written, it will enable Arbitration interrupt	
SPF	When “1” is read, stop condition is detected. Write “0” will clear stop interrupt	
SPE	When “1” is written, stop interrupt is enabled	
WUF	When “1” is read, start condition detected. Writing “0” will clear start interrupt.	
WUE	Writing “1” is enable and writing “0” is disable the function to wake up from standby mode	

Figure 2 describes register IBCR10

Figure 2. IBCR10 Register

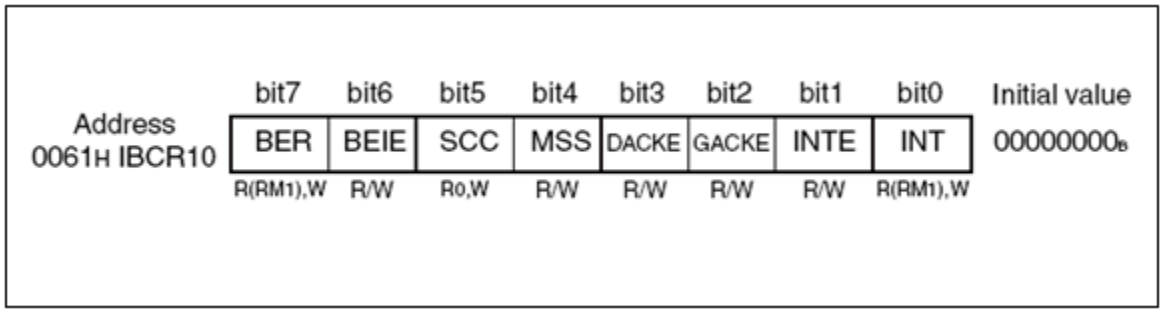


Table 2 describes every bit of IBCR10

Table 2. Description of IBCR10 Register

Register	Description
BER	When “1” is read, bus error is detected. Writing “0” will clear flag
BEIE	When writing “1” to it, bus error interrupt is enabled
SCC	When “1” is written, start signal generated again
MSS	When “1” is written, becoming as master mode, generating start condition and starting address data transfer
	When “0” is written, generating stop condition and being transfer to slave mode
DACKE	When “1” is written, data acknowledge is enabled
GACKE	When “1” is written, call address acknowledge enabled
INTE	When “1” is written, data transfer completed interrupt is enabled
INT	Write “1” is read, 0ne-byte data transfer completed

2.2 IBSR0 (I²C Bus Status Register)

This is a read only register. It is used to feedback the status of I²C bus.

Figure 3 describes register IBSR0

Figure 3. IBSR0 Register

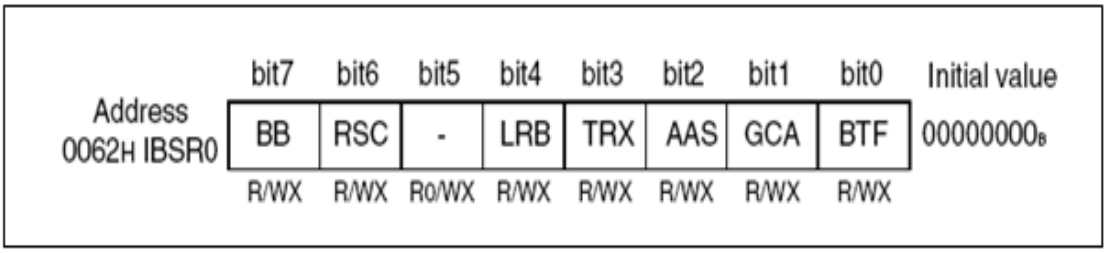


Table 3 describes every bit of IBSR0

Table 3. Description of IBSR0 Register

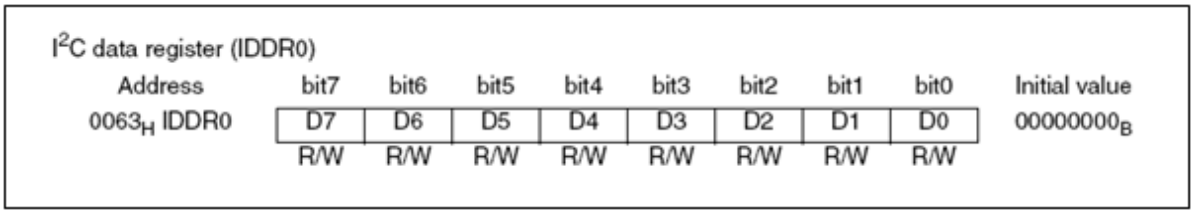
Register	Description	
BB	When “1” is read, bus is busy or else bus is idle	
RSC	When “1” is read, repeated start condition detected	
-	Not used	
LRB	When “1” is read, there is no acknowledge from slave chip	
	When “0” is read, acknowledge is detected or a start or a stop condition is detected	
TRX	It is decided by the last bit of written address, and will reverse the value for read detect	When “0” is read, it is receive mode
		When “1” is read, it is transmit mode
AAS	When “1” is read, MCU has addressed in slave mode	
	When “0” is read, a start or stop condition is detected	
GCA	When “1” is read, the general call address is received in slave mode	
FBT	When “1” is read, received data is the first address data	

2.3 IDDR0 (I²C Data Register)

The IDDR0 register is used to set the data or address to send and to hold the data or address received.

Figure 4 describes register IDDR0.

Figure 4. IDDR0 Register

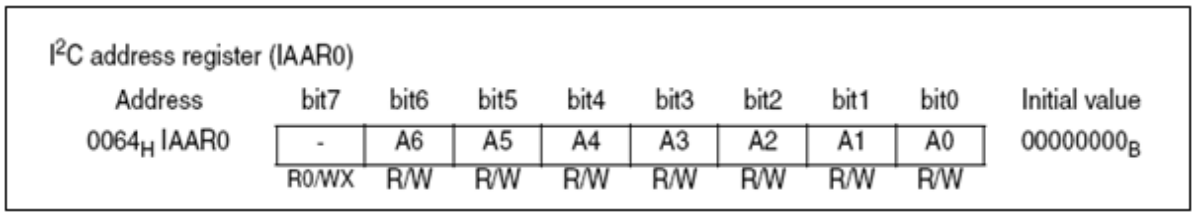


2.4 IAAR0 (I²C Address Register)

The IAAR0 register is used to set the slave address. The received address is compared with it when in slave mode.

Figure 5 describes register IAAR0

Figure 5. IAAR0 Register



2.5 ICCR0 (I²C Clock Control Register)

The ICCR0 register is used to enable I²C operation and select the shift clock frequency.

Figure 6 describes register ICCR0

Figure 6. ICCR0 Register

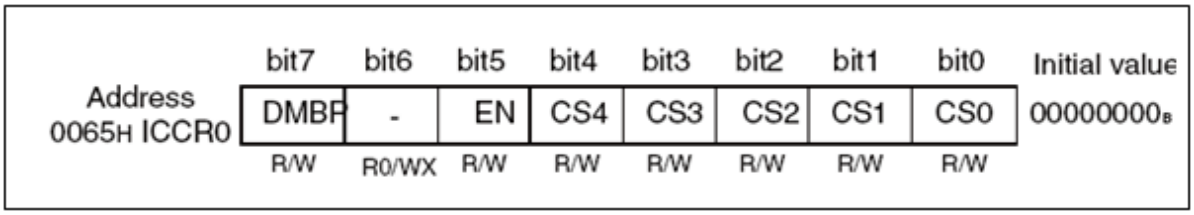


Table 4 describes each bit of ICCR0

Table 4. Description of ICCR0 Register

Register	Description
DMBP	When “1” is written, divider m will be bypassed
EN	When “1” is written, I2C operation be enabled
CS4	Divider m, reference Table 4 - 5
CS3	Divider m, reference Table 4 - 5
CS2	Divider n, reference Table 4 - 6
CS1	Divider n, reference Table 4 - 6
CS0	Divider n, reference Table 4 - 6

Table 5 describes divider m

Table 5. Description of Divider m

CS4	CS3	Divider m
0	0	5
0	1	6
1	0	7
1	1	8

Table 6 describes divider n

Table 6. Description of Divider n

CS2	CS1	CS0	Divider n
0	0	0	4
0	0	1	8
0	1	0	22
0	1	1	38
1	0	0	98
1	0	1	128
1	1	0	256
1	1	1	512

3 Steps of Realizing I²C in Software

This chapter describes steps of how to realize I²C.

About I²C register they are divided to initialization register, status register and data register.

Following items will describe how to use these registers to realize I²C function.

- Step one is initializing I²C:
  IBCR00 register sets interrupt type
  IBCR10 register sets I²C mode and acknowledge generate condition
  ICCR0 register enables I²C and sets the shift frequency
- Step two is generating start signal
  IBSR0 register feeds back the I²C status
  IDDR0 register sends out the address of slave device, when set to master mode the data send out
- Step three is write data to slave device
  IBCR10 register sets condition to which I²C can set data
  IDDR0 register saves the data and sends out
- Step four is setting read condition to read data
  IBCR10 register feeds back the status which data is received
  IDDR0 register saves the data received
- Step five is setting condition to detect acknowledge
  IBSR0 register detects whether bus has received acknowledge
- Step fix is generating stop signal
  IBCR10 register sets the mode to stop
  IBSR0 register detects whether bus is released

4 I²C Sample Code

This chapter describes MB95F310 I²C C code.

Figure 7 describes the initial function.

Figure 7. Initial Code

```
void I2C_Init( void )
{
  ICCR0_EN  = 0;                  // clear I2C interface
  ICCR0_CS4 = 1;                  // set clock divider 'm' => 7
  ICCR0_CS3 = 0;
  ICCR0_CS2 = 1;                  // set clock divider 'n' => 98
  ICCR0_CS1 = 0;
  ICCR0_CS0 = 0;                  // Fsck = MCLK / (m * n +2) => 16MHz/(7*98 +2) = 16MHz/688 = 23kHz
  ICCR0_EN  = 1;                  // enable I2C interface
  IDDR0     = 000;          // clear data register
  IBCR00    = 0x04;         // enable address acknowledge bit,
  IBCR10    = 0x00;         // set to slave mode first, disable data acknowledge bit,
}
```

Figure 8 lists the start code.

Figure 8. Start Code

```
void I2C_Start( unsigned char slave_address )
{
 do
 {
  IBCR10_BER = 0;             // clear bus error interrupt flag
  IDDR0     = slave_address;   // slave_address is sent out with start condition
  IBCR10_MSS = 1;             // set to master mode now and send start condition
  IBCR10_INT = 0;            // clear transfer end interrupt flag
  while(IBCR10_INT == 0);       // look if transfer is in process
 }
 while (IBCR10_BER == 1 | IBCR00_ALF == 1);       // retry if Bus-Error detected or arbitration lost
 while(IBSR0_LRB == 1)          // no acknowledge means device not ready
 {                        // maybe last write cycle not ended yet
  IBCR10_SCC = 1;             // try restart (= continue)
  while (IBCR10_INT == 0);      // wait that transfer is finished
 }
}
```

Figure 9 lists the write code.

Figure 9. Write Code

```
void I2C_Write( unsigned char value )
{
 IDDR0  = value;              // load data or address in to register
 IBCR10_INT = 0;              // clear transfer end intrerupt flag
 while (IBCR10_INT == 0);     // look if transfer is in process
 I2C_Acknowlegde();           // wait for Acknowledge
}
```

Figure 10 lists the read code.

Figure 10. Read Code

```
unsigned char I2C_Read( void )
{
 IBCR10_DACKE = 1;            // acknowledge has to be send
 IBCR10_INT = 0;              // clear transfer end interrupt flag
 while (IBCR10_INT == 0);     // wait that transfer is finished
 return(IDDR0);               // read received data out
}
```

Figure 11 lists the acknowledge code.

Figure 11. Acknowledge Code

```
void I2C_Acknowlegde( void )
{
  while(IBSR0_LRB == 1);          // no anwser from slave, program stucks,
                    // here a timeout mechanism should be implemented
}
```

Figure 12 lists the stop code.

Figure 12. Stop Code

```
void I2C_Stop( void )
{
 while (IBCR10_INT == 0);     // wait that transfer is finished
 IBCR10_MSS = 0;              // change to slave and release stop condition
 IBCR10_INT = 0;              // clear transfer end interrupt flag
 while (IBSR0_BB);            // wait till bus free
}
```

Figure 13 describes the write function.

Figure 13. Write Function

```
Void Write_I2C_Proc(unsigned char MainAddr, unsigned char SubAddr, unsigned char I2Cdata)
{
        I2C_Init();
        I2C_Start(MainAddr);
        I2C_Acknowlegde();
        I2C_Write(SubAddr);
        I2C_Acknowlegde();
        I2C_Write(SubAddr);
        I2C_Acknowlegde();
        I2C_Stop();
}
```

Figure 14 describes the read function.

Figure 14. Read Function

```
unsigned char RD_I2C( unsigned char Main_Addr, unsigned char Sub_Addr )
{
        unsigned char Temp;

        I2C_Start( (Main_Addr ) | I2C_WRITE );
        I2C_Write( Sub_Addr );
        I2C_Continue( (Main_Addr ) | I2C_READ );
       Temp = I2C_Read();
        I2C_Stop();
        return (Temp);
}
```

5 Usage Demo

This chapter describes something we must pay attention to when we use register to realize I^2C.

5.1 Register Use Attention

- When beginning the I^2C, the I^2C bus must be free,
- If the master register IBSR0_LRB is “1” the slave device did not receive the address or data.
- The read address is 1 bigger than write address.

6 Additional Information

For more information about how to use MB95310 EV-board, BGM Adaptor and SOFTUNE, please refer to EV-Board MB2146-450-E User Manual, or visit website:

http://www.cypress.com/documentation/application-notes/mb95310370-mb2146-450-e-lcd-evb-user-manual

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**	-	HUAL	11/13/2009	Original version
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