Chapter 10

Programming in C

Lesson 10

C Programming Examples for Serial Port

SCON and SBUF at 0x98 and 0x99 respectively for serial port communication

- Write into the SBUF transmits the bits serially
- A read from SBUF receives the bits serially
- SCON controls the transmission and receiving actions at the serial port
- SCON also holds the status its for TI and RI
- REN control bit means receiver enable serial bits

TI status bit

- = 1 means transmitter interrupt has occurred and new byte can be written into SBUF for transmitting next character
- TI has to be set in the interrupt function
- Not auto reset on start of its interrupt function.

RI status bit

- = 1 means receiver interrupt has occurred and new byte has been received in SBUF
- RI has to be set in the interrupt function
- Not auto reset on start of its interrupt function.

SCON mode bits

- SM0, SM1 and SM2 to specify the mode

SCON bit TB8

- TB8 specifies the 8th bit for transmission after bits 0 to 7 for serial transmission from SBUF in case of mode 2 or 3

TB8 use in multiple ways

- Specify the parity (odd or even) of the preceding 8 bits
- Used to specify the purpose of the preceding 8 bits, whether they specify the destination address or data for the destination, whether specifying destination address or data for the destination or command or control word for the destination or data

SCON bit RB8

- Specifies the 8th bit received after bits 0 to 7 for serial receive at SBUF in case of mode 2 or 3
- Interrupt function saves the RB8 and the appropriate use of the received 8 bits is done at the receiving device or MCU

Programming a serial port

- Programming the SCON bits and SBUF unsigned character

C statement to write 0x75 into the SBUF 8-bits for transmission

- SBUF = 0x75; /* Assign the SBUF transmitter = 0x75*/

C Program to set the baud rate = 9600 in mode 3

- Use serial transmission using T1 mode 2
- Set the baud rate = 9600 in mode 3 for serial transmission using T1 mode 2 in 8051 for specifying baud rate
- Assume 11.0592 MHz Xtal
- Reset SMOD bit = 0

C Program

- #include <reg51.h> /* Include header file for the registers and SFRs of 8051. */
- void main (void)
- {
- SMOD =0; /*SMOD in PCON = 0 */
- /* Calculate TH1 = 256 – [(2) SMOD × Xtal frequency/(32 × 12 × Baud rate)] = 256 –[1 × 11.0592 × 1000000 /(32 × 12 × 9600)] = 253 = 0xFD = – 3. */

C Program continued

- TH1= – 3; /* Baud rate =9600 */
- TMOD = 0x20; /*Assign TMOD upper four bits = 0010, means internal timer T1 auto-reload mode 2 as 8bit timer, no external start-stop control or internal count inputs.* /
- TR1 = 1; /* Start timer T1*/
- /* remaining codes of main function*/
- }

C program for 10 characters A, B, …. to J at baud 9600 mode 3

- Set the baud rate = 9600 in mode 3 for serial transmission using T1 mode 2 in 8051 for specifying baud rate
- *Assume 11.0592 MHz Xtal*. Reset SMOD bit = 0 and set TB8 =1
- Send 10 characters

C Statements for Preprocessor Directives

```
#include <reg51.h> /* Include header file for the registers and SFRs of 8051. */
```

C Statements for Main

```
void main (void)
 {unsigned char setChar [255]; /* Declare array of 255
   characters */
int numChar; /* Variable numChar.  It is for number of
   characters to be transmitted or received */
unsigned character i; /* Temporary variable i. It can be
   between 0 and 255*/
IE = 0x00; /* Disable all interrupts*/
SMOD =0;  = 0x9F; /*SMOD = 0 */
```

C Statements for T1 auto-reload mode 2 as 8-bit timer

- /* Calculate TH1 = 256 – [(2) SMOD × Xtal frequency/(32 × 12 × Baud rate)] = 256 –[1 × 11.0592 × 1000000 /(32 × 12 × 9600)] = 253 = 0xFD = – 3. */
- TH1= – 3; /* Baud rate =9600 */
- TMOD = 0x20; /*Assign TMOD upper four bits = 0010, means internal timer T1 auto-reload mode 2 as 8bit timer, no external start-stop control or internal count inputs.*

C Statements for Serial Mode 3 Set

- SM0 =1; /* SCON bit 7 = 0 for mode 3 serial variable baud rate 11T */
- SM1= 1; /* SCON bit 6 = 1 for mode 2*/
- SM2 = 0; /* SCON bit 5 = 0 for mode 2*/

C Statements for Receiver Enable and TB8

- REN = 1; /* SCON bit 4 for Enable receiver */
- TB8 =1 ; /* SCON bit 3 for 8th bit after 0th to 7th serial transmitted bits for the character. */

C Statements for Reset TI and RI

- TI = 0; /* SCON bit 1 for reset transmitter interrupt flag. */
- RI =0; /* SCON bit 0 for reset receiver interrupt flag. */ EA = 1; /*Enable interrupt service functions.*/

C Statements for 10 characters

- numChar = 10; /* assume 10 characters to be transmitted. */
- for (i = 0; i<10; i++) {setChar [i] = 97 + i]; /* Assign array of 10 characters as A, B, C, D, E, F, G, H, I and J. ASCII code of A is 97. */
- i = 0; /* Reassign the temporary variable */
- SBUF = setChar [i];; /* Write the character into SBUF for transmission */

- ES = 1; /*Enable interrupt function for serial transmission and receiver. */
-     TR1 = 1; /* Start timer T1*/
- .   /* remaining codes of main function*/
- }

Interrupt Function

```
 if ( i < numChar) {i++;
TI = 0; SBUF = setChar [i];} /* reset SCON bit 1
   for resetting the transmitter interrupt flag. This
   enables next serial interrupt after sending the
   second character. */
else {i = 0; TR1 =0; ES =0; } /* Reset array
   variable, stop Timer T1, Disable serial port
   interrupts*/
} /* End of interrupt function */
```

Summary

We learnt

- Serial bit baud rate setting program
- SMOD Program
- SCON Program
- Main and Interrupt functions for mode 3 serial UART communication

End of Lesson 10 on

C Programming Examples for Serial Port