Lab 10
Serial Port Programming of PIC microcontroller using assembly & C language

Objective:

In this lab students will learn

- About the registers used for serial communication.
- How to program PIC for serial communication?

Theory

Serial communication (also called RS232 communication) enables a microcontroller to communicate with other devices using the serial RS232 communication protocol. For example, a microcontroller can be connected to another microcontroller or to a PC and exchange data using the serial communication protocol. Some microcontrollers have built-in hardware called universal synchronous-asynchronous receiver-transmitter (USART) to implement a serial communication interface. The baud rate and the data format can usually be selected by the user program. If serial I/O hardware is not provided, it is easy to develop software to implement the serial data communication using any I/O pin of a microcontroller. The PIC18F series of microcontrollers have built-in USART modules.

Why do we use MAX232 IC in serial communication for PIC?

PIC microcontroller has a built in UART for performing the asynchronous serial communication. Since PIC microcontroller operates on 5V while the computer's communication port works on RS232 standards according to which -25V to -3V produce logic 1 and +3v to +25v produce logic 0. The voltage level -3v to +3v is undefined.

In order to accommodate their voltage level, a level converter MAX232 IC is added in between them. MAX232 will convert TTL voltage level to RS232 levels and vice versa.

What are the RS232 handshaking signals?

Handshaking is the procedure for initiating the communication. In order to see all the communications equipment and the data terminal equipments are ready for the communication, handshaking is done.

PC and modems perform handshaking by using the signals DTR (Data Terminal Ready) and DSR (Data set ready). DTR is the output signal form the PC once it tests its communication port while DSR is the output signal that modem send to computer after going through the self test. They both are active low signals. Once both computer and modem have gone through self testing procedure, the computer generates a signal RTS (Request to send) to indicate the modem that it has some data

for transmission. Modem after checking its internal buffer either it has room for new data or not sends a signal to computer that is CTS (Clear to Send) and also it will ring if it establishes the connection to the modem at the receiving end.

How to determine the Baud rate?

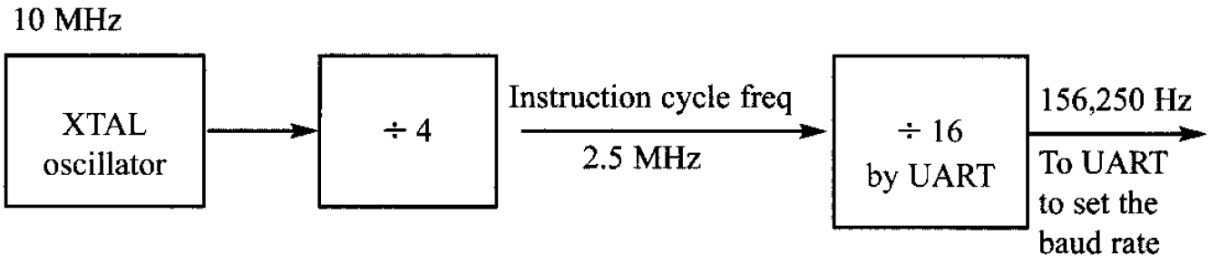
Desired Baud Rate = Fosc/(64X + 64) = Fosc/64(X + 1)

where X is the value we load into the SPBGR register. Assuming that Fosc = 10 MHz, we have the following:

Desired Baud Rate = Fosc/64(X + 1) = 10 MHz/64(X + 1) = 6250 Hz/(X + 1)

To get the X value for different baud rates we can solve the equation as follows:

X = (156250/Desired Baud Rate) – 1



b)

Baud Rate	SPBRG (Decimal Value)	SPBRG (Hex Value)
19200	2	2
9600	5	5
4800	12	0C
2400	25	19
1200	51	33

Lab Exercise

Mention all the PIC microcontroller registers that's are used for serial communication? [4]

What is the difference between simplex, half duplex and full duplex transmission? [3]

Briefly explain what are the RS232 standards? What is the role of MAX232? [4]

Make a block diagram for showing how PIC is connected to DB Port via MAX232? [4]

Write a program for PIC18 to transfer the letters your name serially at 9600 baud rate continuously, assuming XTAL=10MHz. Show the simulations results both on MPLAB and PROTEUS software using virtual PORT. [5]

Write a PIC18 C program to transfer serially the letter "P" continuously at the Baud Rate 1200. [5]

Program PIC18 to receive byte of data serially and put them on PORTB with baud rate 9600 1 start and stop bit. [5]

Implement the example 10.14 on Proteus and show its results. [5]