



SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)



COIMBATORE-35

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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai**

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME: 19EEB303 / Microcontroller and its Applications

III YEAR / VI SEMESTER

Unit II – PIC MICROCONTROLLER

Topic: Synchronous and Asynchronous serial ports



Synchronous and Asynchronous serial ports

Synchronous/Asynchronous communication. USART is a two-wire communication system in which the data flow serially. USART is also a full-duplex communication, which means you can send and receive data at the same time which can be used to communicate with peripheral devices, such as CRT terminals and personal computers. The **USART** can be configured in the following modes:

- Asynchronous (full-duplex)
- Synchronous – Master (half-duplex)
- Synchronous – Slave (half-duplex)



Synchronous and Asynchronous serial ports

Registers used for Serial Communication

- TXSTA (Transmit Status And Control Register)
- RCSTA (Receive Status And Control Register)
- SPBRG (USART Baud Rate Generator)
- TXREG (USART Transmit Register)
- RCREG (USART Receiver Register)

TXSTA (Transmit Status And Control Register)

This register is used to configure the Serial communication for TX.

TXSTA: TRANSMIT STATUS AND CONTROL REGISTER

R/W-0	R/W-0	R/W-0	R/W-0	U-0	R/W-0	R-1	R/W-0
CSRC	TX9	TXEN	SYNC	—	BRGH	TRMT	TX9D
bit 7							bit 0



Synchronous and Asynchronous serial ports

RCSTA (Receive Status And Control Register)

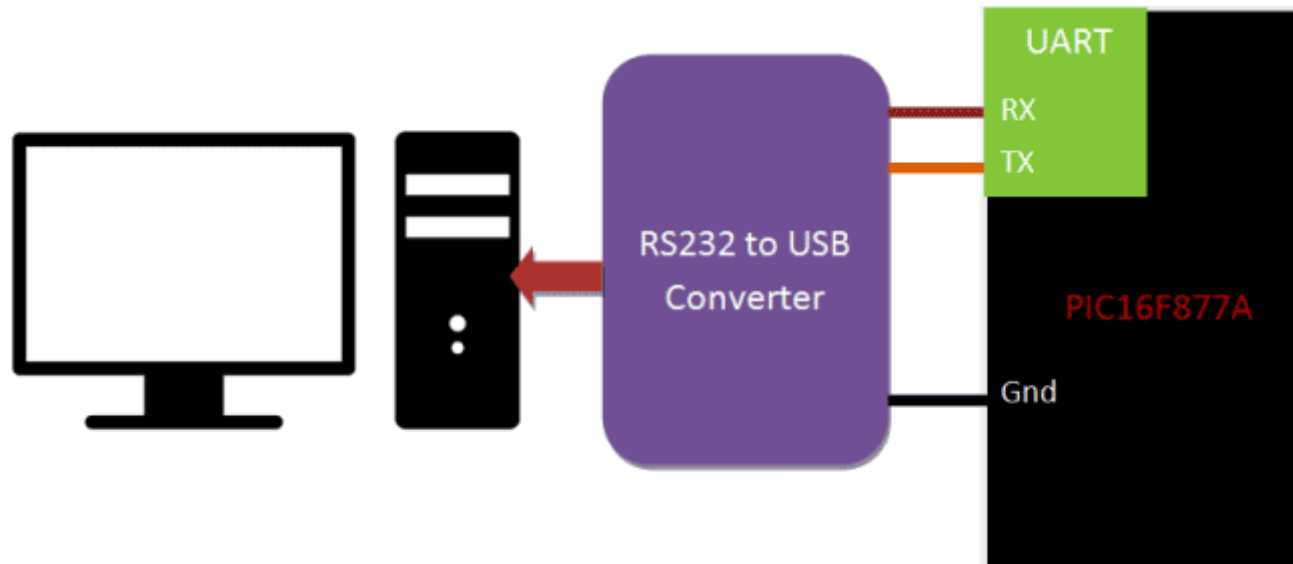
This register is used to configure the Serial communication for RX.

RCSTA: RECEIVE STATUS AND CONTROL REGISTER

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R-0	R-0	R-x
SPEN	RX9	SREN	CREN	ADDEN	FERR	OERR	RX9D
bit 7				bit 0			

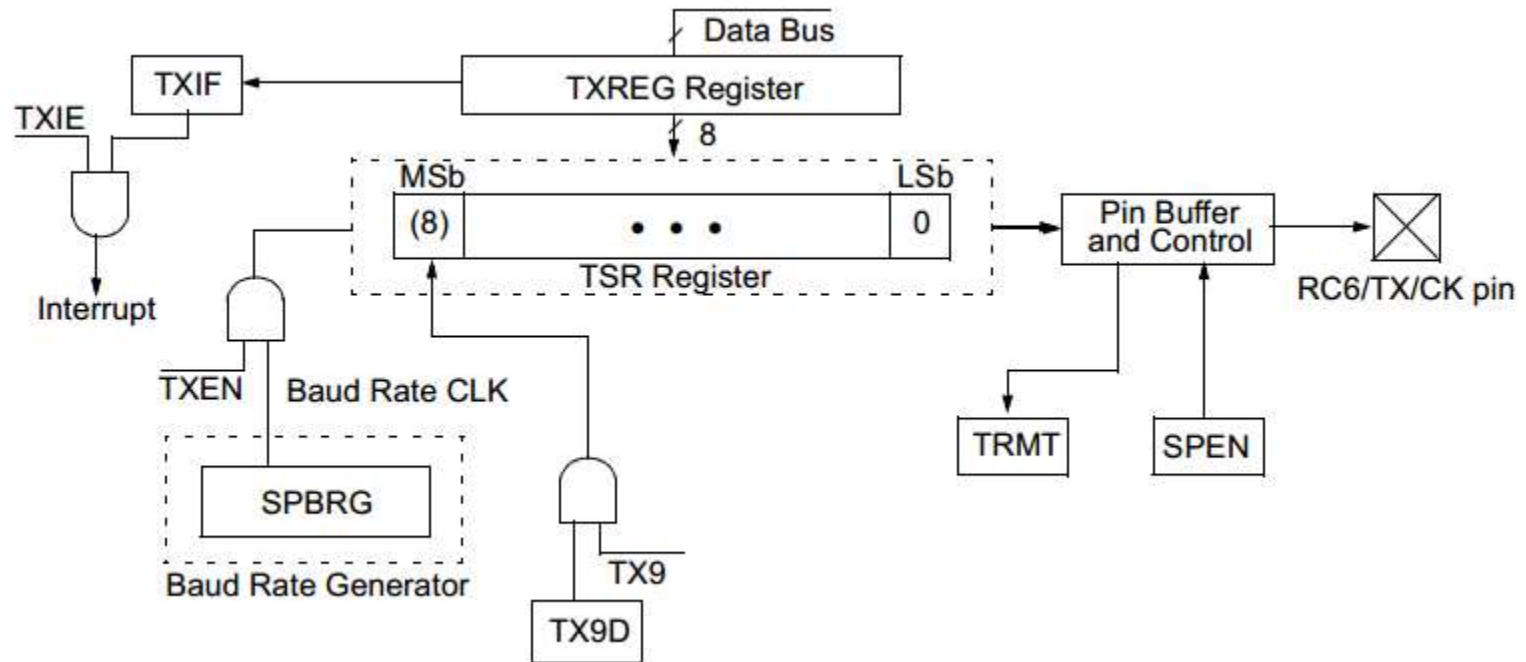


Synchronous and Asynchronous serial ports UART





UART transmitter



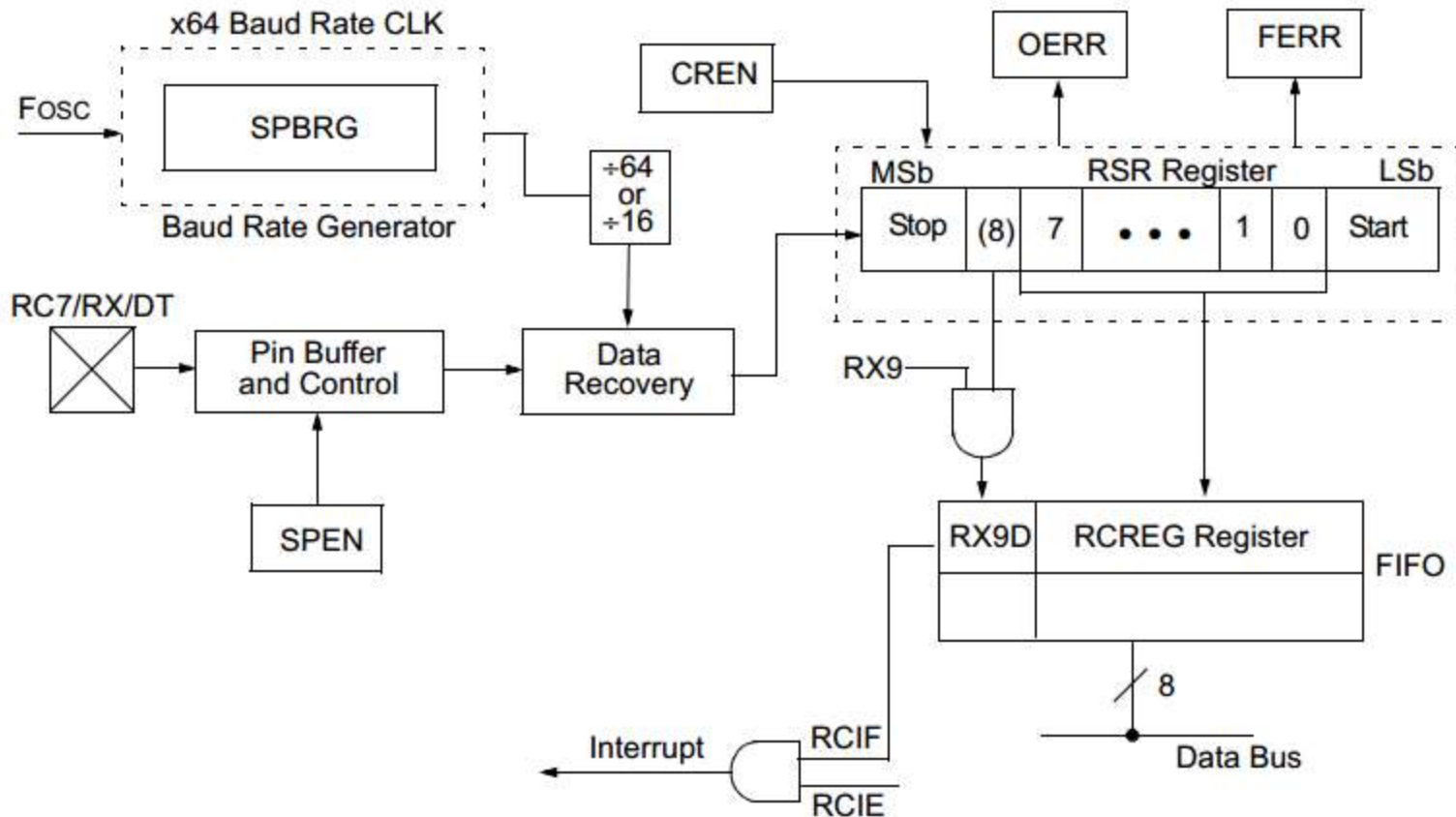


UART transmitter

In UART transmitter mode, a byte of data is written to the 8-Bit **TXREG** register. Then it's latched to the **TSR** transmitter shift register combined with the 9th bit (if used). The data is shifted out through the **TX/RC6** physical pin at a rate specified by the **BRG** baud rate generator. The baud rate is pre-determined and pre-configured by us (the programmers) in order to match the design specifications. Setting the baud rate to be generated is as easy as writing a byte-value to the **SPBRG** register.



UART Receiver





UART Receiver

UART Receiving Process

The data is received on the **RX/C7** physical pin and drives the data recovery block. The data recovery block is actually a high-speed shifter, operating at x16 times the baud rate. Whereas the main receiver serial shifter operates at the bit rate or at F_{OSC} .

Once the Asynchronous mode is selected, reception is enabled by setting bit **CREN**. The heart of the receiver is the Receive Serial Shift Register **RSR**. After sampling the Stop bit, the received data frame in the RSR is transferred to the **RCREG** register (if it is empty). If the transfer is complete, the flag bit, **RCIF**, is set. The actual interrupt can be enabled/disabled by setting/clearing the enable bit, **RCIE**. Flag bit RCIF is a read-only bit which is cleared by the hardware. It is cleared when the RCREG register has been read and is empty. The RCREG is a double-buffered register which means it's a two-level deep FIFO.



RS-232 UART

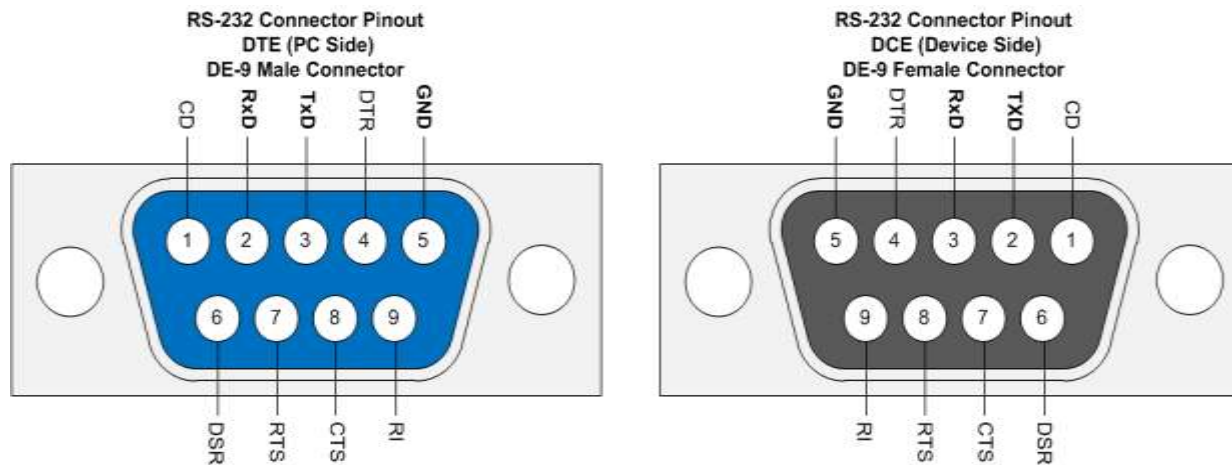
RS-232 UART

RS-232 (Recommended Standard 232) is a standard for serial binary data signals connecting between a Data Terminal Equipment (DTE) and a Data Communication Equipment (DCE). It is commonly used in computers' old-school serial ports. The major differences between TTL level UART and RS-232 include the voltage-level. The digital signals in RS-232 are ± 3 to ± 15 V, and signals near 0V aren't detected anyway.



RS-232 UART

The RS-232 also has a few more pins than the TTL-level UARTs, specifically designed for the communication between PCs and Modems in the past. The pinout of the DB-9 and their functions are shown down below.





RS-232 UART

Pin	SIG.	Signal Name	DTE (PC)
1	DCD	Data Carrier Detect	in
2	RXD	Receive Data	in
3	TXD	Transmit Data	out
4	DTR	Data Terminal Ready	out
5	GND	Signal Ground	-
6	DSR	Data Set Ready	in
7	RTS	Request to Send	out
8	CTS	Clear to Send	in
9	RI	Ring Indicator	in



Advantages Of UART Serial Communication

- Only two wires are required for a full-duplex data transmission (excluding the power lines).
- The structure of the data packet can be changed with coordination between both ends.
- No need for a serial clock signal (in asynchronous mode).
- Parity bit provides a hardware-level error detection.
- Well-documented and widely-used protocol.
- Relatively easy to set-up and run.



Disadvantages Of UART Serial Communication

- Speed for data transfer is less compared to parallel communication or even USARTs.
- The baud rates of each UART must be the same within a limited small error margin.
- The size of the data frame is limited to a maximum value of 9-Bits.
- Doesn't support multiple slaves or multiple masters capability.