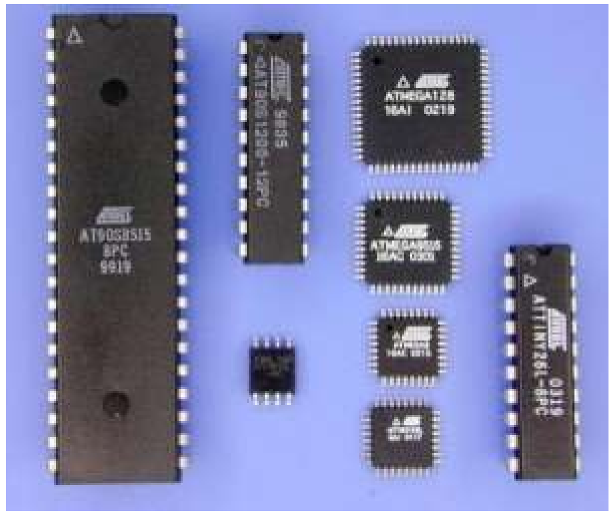
AVR Microcontroller (Atmel 8) Serial Communication USART Configuration

Microcontroller is a control device that contains a number of peripherals like RAM, ROM data communication, etc., which are required to perform some pre-defined tasks. Nowa type of microcontrollers are used in a wide variety of applications as per their capability a perform some desired tasks and these controllers include 8051, AVR and PIC microc article, we are going to learn about advanced AVR family microcontroller and its programmi

AVR Microcontroller

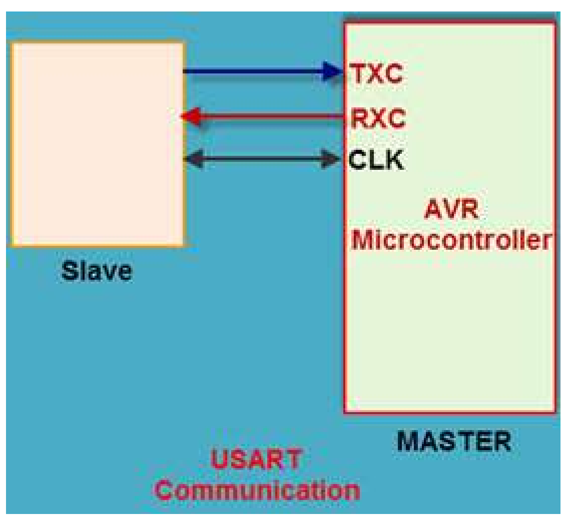
The AVR is a type of controlling device manufactured by the Atmel Corporation in 1996. Th stand for anything, it is just a name. The AVR microcontrollers consist of the Harvard a therefore, the device run very fast with a reduced number of machine level instructions (R microcontrollers consist of special features compared with other microcontroller such as inbuilt ADC, internal oscillator and serial data communication, etc. The AVR microcontrolle in different configurations of 8-bit, 16-bit, and 32-bit to perform various operations.



AVR Microcontroller

USART Serial Data Communication in AVR Microcontroller

The USART stands for universal synchronous and asynchronous receiver and transmitt communication of two protocols. This protocol is used for transmitting and receiving the da respect to clock pulses on a single wire. The AVR microcontroller has two pins: TXD and specially used for transmitting and receiving the data serially. Any AVR microcontroller con protocol with its own features.



USART Communication in AVR Microcontroller

The Main Features of AVR USART

- The USART protocol supports the full-duplex protocol.
- It generates high resolution baud rate.
- It supports transmitting serial data bits from 5 to 9 and it consists of two stop bits.

USART Pin Configuration

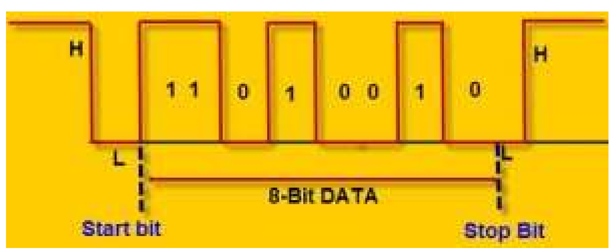
The USART of AVR consists of three Pins:

- RXD: USART receiver pin (ATMega8 PIN 2; ATMega16/32 Pin 14)
- TXD: USART transmitter pin (ATMega8 PIN 3; ATMega16/32 Pin 15)
- XCK: USART clock pin (ATMega8 PIN 6; ATMega16/32 Pin 1)

Modes of Operation

The AVR microcontroller of USART protocol operates in three modes which are:

- Asynchronous Normal Mode
- Asynchronous Double Speed Mode
- Synchronous Mode



Modes of Operation

Asynchronous Normal Mode

In this mode of communication, the data is transmitted and received bit by bit without cloc predefined baud rate set by the UBBR register.

Asynchronous Double Speed Mode

In this mode of communication, the data transferred at double the baud rate is set by the and set U2X bits in the UCSRA register. This is a high-speed mode for synchronous cor transmitting and receiving the data quickly. This system is used where accurate baud ra system clock are required.

Synchronous Mode

In this system, transmitting and receiving the data with respect to clock pulse is set U UCSRC register.

USART Configuration In AVR microcontroller

USART can be configured using five registers such as three control registers, one data reg rate-selection register, such as UDR, UCSRA, UCSRB, UCSRC and UBRR.

7 Steps for Composing the Program

Step1: Calculate and Set the Baud Rate

The baud rate of USART/UART is set by the UBRR registrar. This register is used to ge transmission at the specific speed. The UBRR is a 16-bit register. Since the AVR is a 8-bit and its any register size is 8-bit. Hence, here the 16-bit UBRR register is composed of tw such as UBRR (H), UBRR(L).

The formula of the baud rate is

BAUD= Fosc/(16*(UBBR+1))

The formula of the UBRR register is

UBRR= Fosc/(16*(BAUD-1))

The frequency of the AVR microcontroller is 16MHz=16000000; Let us assume the 19200Bps, then

UBRR= 16000000/(16*(19200-1))

UBRR= 16000000/(16*(19200-1))

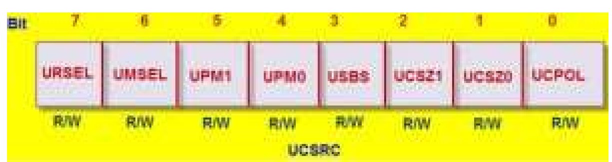
UBRR= 51.099

Eventually find the baud rate

BAUD= 16000000/(16*(51+1))
UBRR= 19230bps

Step2: Data Mode Selection

The data transmission mode, start bit and stop bit and the character size is set by the co register UCSRC.



Data Mode Selection

Step3: Data Transmission Mode Selection

The synchronous and asynchronous mode is selected by the UMSEL bit of the control statu give UMSEL=0, then the USART operates in asynchronous mode, otherwise operates mode.

UMSEL	Mode
0	Asyncronous
1	Syncronous

Data Transmission Mode Selection

Step4: Start Bit and Stop Bit

The start bit and stop bits are a way for sending and receiving the data serially. Generally consists of one stat bit and one stop bit, but the AVR microcontroller has one start bit and t processing the data. The extra stop bit can be useful for adding a little extra receive proce especially useful for high data transfer rates, whereas the data transfer speed is very high, proper data. Thus, we can increase the processing time by using two stop bits to get the pro

USBS	Stop Bits
0	1-Bit
1	2-Bit

Start Bit and Stop Bit

The number of stop bits is selected by the USBS bit of UCSRC – the control status registe for one stop bit, and USBS=1, for two stop bits.

Step5: Set the Character Size

As in case with the basic microcontrollers sending and receiving the byte of data(8-bits) at in a AVR microcontroller, we can choose a data frame format in each frame by the UCSZ bi register.

UCSZ2	UCSZ1	UCSZ0	Charector size
0	0	0	5-bit
0	0	1	6-bit
0	1	0	7-bit
0	1	1	8-bit
1	0	0	Reserved
1	0	1	Reserved
1	1	0	Reserved
1	1	1	9-bit

Data Frame Format

Step6: Store the Received Data

The AVR microcontroller consists of a UDR buffer register for transmitting and receiving da a 16-bit buffer register wherein 8-bits are used for receiving (RXB) the data and other bi transmitting the data (TXB). Transmitting data buffer register will be the destination to UDR written data on its location. Receiving data buffer register will be returning the content of the

Step7: Transmitter and Receiver Enabling

The transmitted and received data will be allowed by the RXC and TXC pins of the micro are set by the UCSRA register of the microcontroller. This flag bit set by the microcontrolle completed by receiving and transmitting (TXC=RXC=1).

Double the Baud Rate

We can double the transfer rate of the USART communication of the AVR microcontroller fr bits effectively by the U2X –bit in the UCSRA register. This bit effects only on asynchronc we can set this bit (U2X=1), it will reduce the baud rate from 16-bit to 8-bit effectively doub rate for synchronous communication.

This is an advanced feature of the AVR microcontroller for speedy processing of the data.

USART Program

USART Program

```
#include<avr/io.h>

#define USART_BAUDRATE 9600

#define BAUD_PRESCALE (((fosc/(16*BAUDRATE)))-1)

int main(void)

{

UCSRB = (1 << RXEN) | (1 << TXEN);   // Turn on the transmission and reception//
UCSRC = (1 << URSEL) | (1 << UCSZ0) | (1 << UCSZ1); // Use 8-bit character
sizes//
UBRRH = (BAUD_PRESCALE >> 8); // Load upper 8-bits//
UBRRL = BAUD_PRESCALE; // Load lower 8-bits of the //
for(;;) // continuous loop//

{
   while ((UCSRA & (1 << RXC)) == 0) {}; // Do nothing until data have been
received and is ready to be read from the UDR
  ReceivedByte = UDR; // Fetch the received byte value into the variable
"ByteReceived"
while ((UCSRA & (1 << UDRE)) == 0) {}; // Do nothing until UDR is ready for
more data to be written to it
  UDR = ReceivedByte; // Echo back the received byte back to the computer
  }

}
```

Every microcontroller is predefined with a specific IDE, and based on this IDE, micro programmed with embedded C or assembly language. The AVR microcontroller p developed by the AVR studio. Furthermore, If you want additional information about the microcontroller based projects, or detailed information on this topic, you can contact us below.

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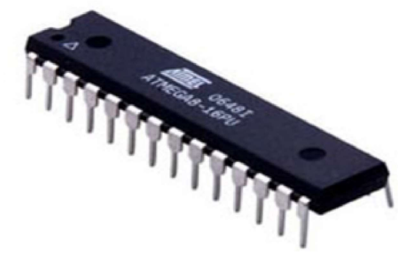

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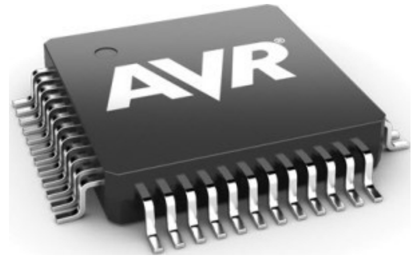
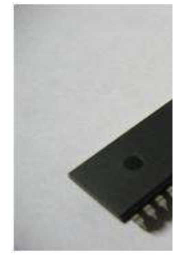
Stepper Motor Control Using AVR (Atmega) Microcontroller



AVR Microcontroller Projects for Engineering Students



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