Pulse Width Modulation Unit and UART

Pulse Width Modulation Unit

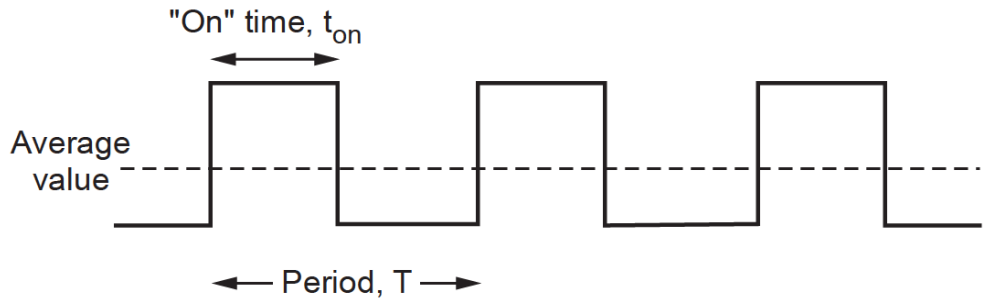
Pulse Width Modulation (PWM) is a simple method of using a rectangular digital waveform to control an analog variable

PWM control is used in a variety of applications, ranging from communications to automatic control.

The microcontrollers do everything with ones and zeros. That means microcontroller works with 3.3 V and 0 V as digital 1 & 0.

It can't produce for example 1 V or 2.5 V or any other value different than 0 V and 3.3 V. Here PWM feature allows us to generate any voltage level between 0 V and 3.3 V.

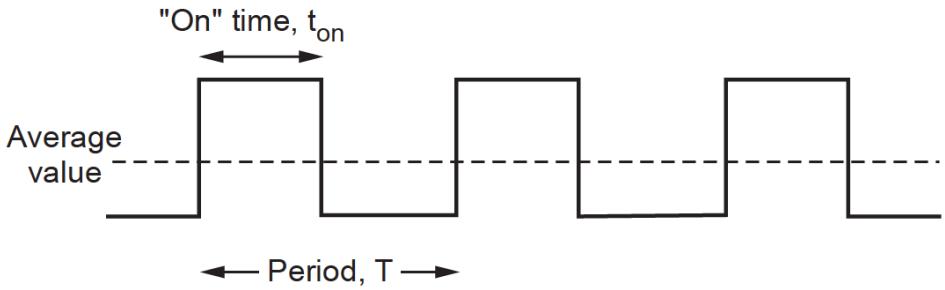
The period is normally kept constant, and the pulse width, or "on" time is varied. The duty cycle is the proportion of time that the pulse is 'on' or 'high', and is expressed as a percentage.



Duty cycle = 100 % X Pulse on time / Pulse period

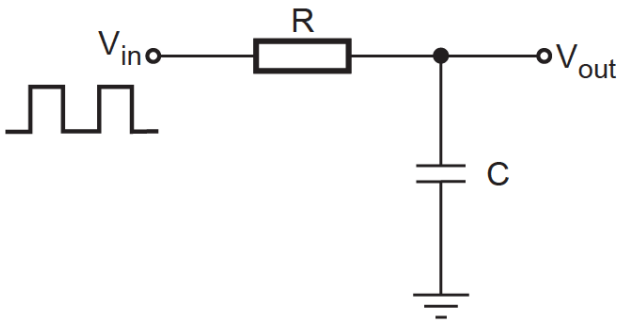
Whatever duty cycle a PWM stream has, there is an average value, as indicated by the dotted line.

If the on time is small, the average value is low; if the on time is large, the average value is high. By controlling the duty cycle, we control this average value.



The average value can be extracted from the PWM stream with a low-pass filter. In this case, and as long as PWM frequency and values of R and C are appropriately choosen, Vout becomes an analog output.

In practice, this sort of filtering is not always required; many physical systems have response characteristics which, in reality, act like low pass filter.



The PWM in LPC2148 is capable of producing six channels of single edge controlled PWM or three channel of dual edge controlled PWM.

UART

UART (Universal Asynchronous Receiver/Transmitter) is the microchip with programming that controls a computer's interface to its attached serial devices.

One of the most common interfaces used in embedded systems is the Universal Asynchronous Receiver/Transmitter (UART).

It provides the computer with RS-232C Data Terminal Equipment (DTE) interface so that it can "talk" to and "exchange" data with modems and other devices.

UART peripherals typically have several configurable parameters required to support different standards. There are five parameters which must be configured correctly to establish a basic serial connection :

1. **Baud rate** : Baud rate is the number of symbols or modulations per second.
2. Number of data bits : The number of data bits transmitted is typically between 5 and 8, with 7 and 8 being the most common since an ASCII character is 7 bits for the standard set and 8 bits for the extended.
3. **Parity** : The parity can be even, odd, mark or space.
4. **Stop bits** : The number of stop bits is most commonly configurable to either one or two.
5. **Endianess** : Some UART peripherals offer the option to send the data in either LSB (least significant bit) or MSB (most significant bit). Serial communication of ASCII characters is almost always LSB.

RS-232

RS-232 is a point-to-point signalling standard, meaning only two devices can be connected to each other.

The minimum connection required for bidirectional communication is three signals : Transmit (TX), receive (RX) and ground.

The separate RX and TX lines mean that data can flow in both directions at the same time. This is called full-duplex and it is the standard means for communicating over serial.

However, depending on the higher level protocols, there may be a need to block the transmitter while receiving. This is called half-duplex.

Hardware flow control can also be enabled in order to mitigate the flow of data. Two optional lines RTS and CTS are provided for this function.

Typically, RS-232 is used without hardware flow control and at full duplex.

- **RS-232 Error Conditions**

Errors in the RS-232 are : Framing error, over run errors and parity errors.

Framing error : This error arises when the receiver does not receive the stop bit. Stop bits may change its level because of noise or signal degradation.

Over run error : This error occurs when new character appears at the receiver before the previous character has been handled and disposed off completely.

Parity error : If the parity of the character is changed, then parity error will occur. It indicates that one or more data bits are in error.

- **Advantages of RS-232 :**
  1. It is low cost interface.
  2. RS 232C can provide good performance at low cost.
  3. Control and hand shake signals ensure the communication success.
  4. Easy to use because the IC is available for RS-232C.
  5. Voltage level reduces the interference due to noise
- **Disadvantages of RS-232 :**
  1. Distance covered by RS-232C cable is only 50 ft, which is not enough in many applications.
  2. Data transfer rate is slow. Baud rate is 20 k baud for less than 50 ft.
  3. Multiple user can not share single RS 232C cable.
  4. RS-232C interface is less flexible, since many interconnection arrangements are not possible.
  5. Voltage levels of RS-232C interface are not compatible with many digital electric circuit and device. Additional power supply is required to convert voltage levels.
  6. RS-232C interface uses single common ground for all the signals. Hence effect of noise is maximum