ECE3073 Computer Systems

Practice Questions

Computer Interfaces

i) Describe in detail the voltage level changes that would be observed on an RS232 line carrying asynchronous serial data when one character is transmitted.

For RS232 data a logic '1' signal is indicated by a negative voltage of about -10V and a logic '0' signal by a positive voltage of about +10V.

Before a data frame is transmitted carrying information about the character the serial line is held 'marking' at logic 1.

The start of a data frame is signaled by a start bit which is a logic '0' for one bit time.

Data bits are then transmitted starting from the least significant bit to the most significant bit.

The data is followed by an optional parity bit (either odd parity or even parity).

The data frame is finished with either one or two stop bits which are logic '1'.

One and a half stop bits indicates that the UART will transmit 2 stop bits but will receive 1 stop bit.

ii) For an asynchronous serial communications link carrying data from a UART set up as follows: 8-bit data with parity and 1 and 1/2 stop bits what is the maximum permissible percentage error between transmit and receive clocks? Clearly explain how you arrived at your answer.

Transmission is synchronized on the falling edge of the start bit.

The value of each bit is sampled in the middle of each bit time.
Therefore, the clocks must not vary by more than 0.5 bit time between synchronization and sampling of the stop bit. This time is:

0.5 bit time between falling edge of the start bit and the center of the start bit +
8 bit times to the center of the last data bit +
1 bit time to the centre of the parity bit +
2 bit time to the center of the last stop bit
= 11.5 bit times

Note that 1½ stop bits means that a transmitted frame will have 2 stop bits while a received frame may have a single stop bit. The worst case (which we must consider) is 2 stop bits.

Therefore, the maximum percentage error between transmitter and receiver clocks is (0.5/11.5)*100% = 4.34%

iii) In terms of asynchronous serial communications explain the meaning of the following terms:

     a) parity error,

The number of 1's in the data and parity bit are added and even parity indicates that this sum is even and for odd parity the sum is odd. If no error occurs in transmission then the parity of the transmitted frame will be the same as the received frame. However, if one bit in the data + parity bit is corrupted (1 changed to 0 or 0 changed to 1) the parity will not be the same and this indicates an error. Two or any even number of errors will not be detected.

     b) framing error,

The stop bits of a data frame are always logic '1'. If the receiving end detects a stop bit as logic '0' then this is a framing error. Framing errors could be caused by noise or by transmitted and received baud rates not matching.
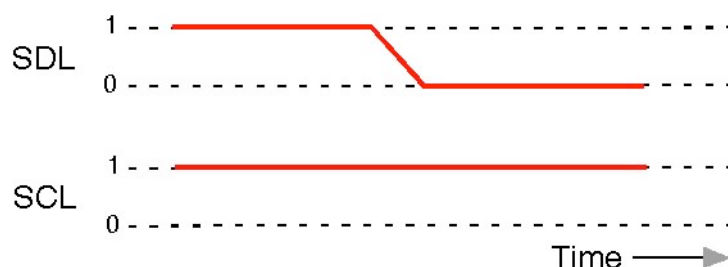
     c) overrun error, and

A new data frame is received by the receiver but the receiver data buffer has not been read. The new data is loaded into the receive buffer overwriting the previous data and the previous data is lost. This is an overrun error.
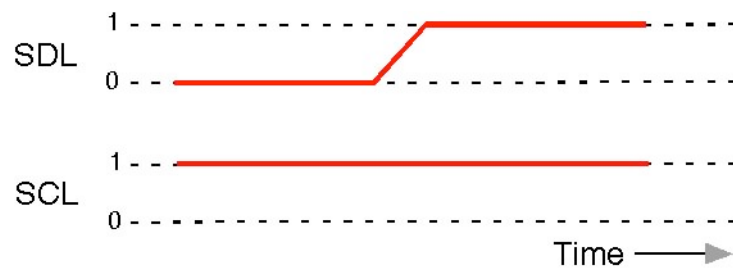
     d) baud rate.

For an RS232 communication link, the Baud rate is the reciprocal of the bit time (the time to send one bit).

iv) For an I²C bus system complete the following timing diagrams to show how start, stop, a '1' data bit and a '0' data bit are transmitted:
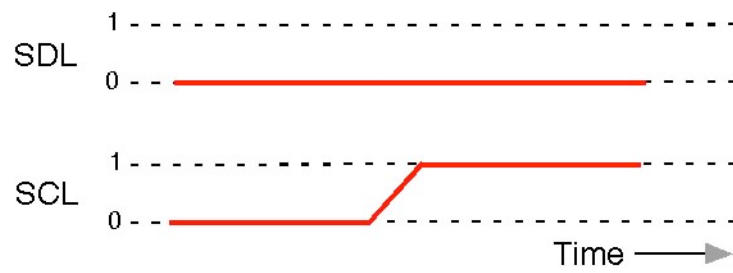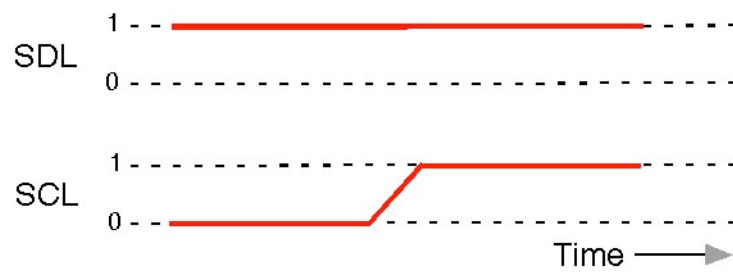
START

STOP

SDL

SCL

Time ⟶

DATA '0'

SDL

SCL

Time ⟶

DATA '1'

SDL

SCL

Time ⟶

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