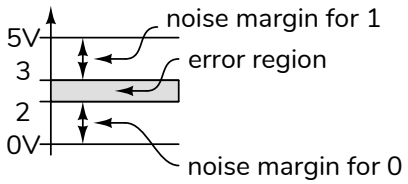
Solutions to Quiz 4

Question 1

A communication system uses voltage levels of +5 and 0 volts to transmit data. Voltages between 2 and 3 volts are considered unreliable and equivalent to an error. What is the noise margin of this system?

Answer

The noise margin is the noise level (voltage in this case) required to cause an error. If +5 is transmitted and a voltage is 3 volts or less is considered an error, then the noise margin is 2 V. Similarly if 0 V is transmitted and 2 V or more is considered an error then the noise margin is 2 V. This is shown below:



Question 2

A communication system uses differential signalling. You measure the voltages on each of the differential signals relative to ground.

On one signal the voltage switches between 1 volt (for 0) and 3 volts (for 1). On the other signal the voltage switches between 3 volts (for 0) and 1 volts (for 1).

(a) What is the common-mode voltage?

(a) What is the differential voltage?

Answer

For a 0 the differential voltage is $(1-3) = -2$ V and the common-mode voltage is $(1+3)/2 = 2$ V.

For a 1 the differential voltage is $3-1 = 2$ V and the common-mode voltage is $(3+1)/2 = 2$ V.

Question 3

A 10 kΩ pull-up resistor is used at one end of a 10 m transmission line that has a capacitance of 30 pF per meter.

What is the instantaneous slew rate when the voltage across the transmission line begins to be pulled up from 0 V to 10 V?

Hints:

- At the instant that the voltage on the line is 0V the voltage across the resistor is 10V.
- The current into a capacitor is equal to CdV/dt where dV/dt is the instantaneous rate of change of the voltage.

Answer

When the low-to-high transition begins the voltage across the pull-up resistor is 10 V so the current is $i = 10\text{ V}/10\text{ k}\Omega = 1\text{ mA} = CdV/dt$. Solving for the slew rate, $dV/dt = {}^{i}/_{C} = {}^{1\times10^{-3}}/_{10\times30\times10^{-12}} \approx 3.3\text{ V}/\mu\text{s}$.