

1. a) The transmission protocol is serial peripheral interface with two peripherals connections from

the master. SPI (serial peripheral interface) is a synchronous serial communication interface which is primarily used in embedded systems for short distance communication

b) SPI is a synchronous serial communication method of transmission and uses ~~master~~ a single master device acting as the controller and multiple slave devices on individual chips.

SPI bus has four specific logic signals.

c) SCLK Serial clock - clock output from master device.

MOSI Master Out Slave In - data output from master device.

MISO Master In Slave Out - data output from slave

CS 1+/CS 2 Slave select line 1 and Slave Select line 2 - active low pass filter output from master to slave data is sent to the slave. The SPI bus can operate with a single master devices and an unlimited number of slave devices.

2 a) Inverting operational amplifier configuration.

b) Gain of the operational amplifier (inverting)

$$= -\frac{R_f}{R_1}$$

c) Gain of the operational amplifier (inverting)

$$= -\frac{R_f}{24} = -4$$

d) 0.2 V pk-pk signal

$$A = 0.2V \quad V_{in} - V_{out} = \frac{R_1 + R_f}{R_f} \quad V_{in} = 0.2V$$

$$R_1 = 6k\Omega \quad R_f = 24k\Omega$$

$$V_{out} = -\frac{R_f}{R_1} \times V_{in} = -\frac{24}{6} \times 0.2 = -4 \times 0.2 = -0.8V$$

e) ~~-180° Output -180° between b~~
Output -180° behind input.

b) non inverting operational amplifier configuration.

b) Gain of the operational amplifier (non inverting)

$$= 1 + \frac{R_2}{R_1}$$

c) Gain of the operational amplifier (non inverting)

$$= 1 + \frac{24}{6} = 1 + 4 = 5$$

d) 0.11 V pk-pk signal $A = 0.11$ V $V_{in} = 0.11$ V

Gain of the operational amplifier (non inverting)

$$= 1 + \frac{R_2}{R_1} = \frac{V_{out}}{V_{in}}$$

$$5 = \frac{V_{out}}{0.11}$$

$$V_{out} = 0.55 \text{ V}$$

e) ~~in~~ out phase ~~180°~~ output 180° ahead of input

3 a) RS232 serial ~~trans~~ transmission protocol. RS232 transmission is the name of a serial interface for the interchange of serial binary data between two separate peripheral devices.

b) RS232 uses serial communication because one bit of data is sent along a single data line at time. RS232 is point-to-point. RS232 is a type of asynchronous communication

c) RS232 devices are often used to communicate to servers where there is no monitor or keyboard installed and in fact when the network connection is not possible as the operating system isn't running. A computer with an RS232 serial port can communicate with the serial port of embedded system like router which is an alternative to Ethernet cables.