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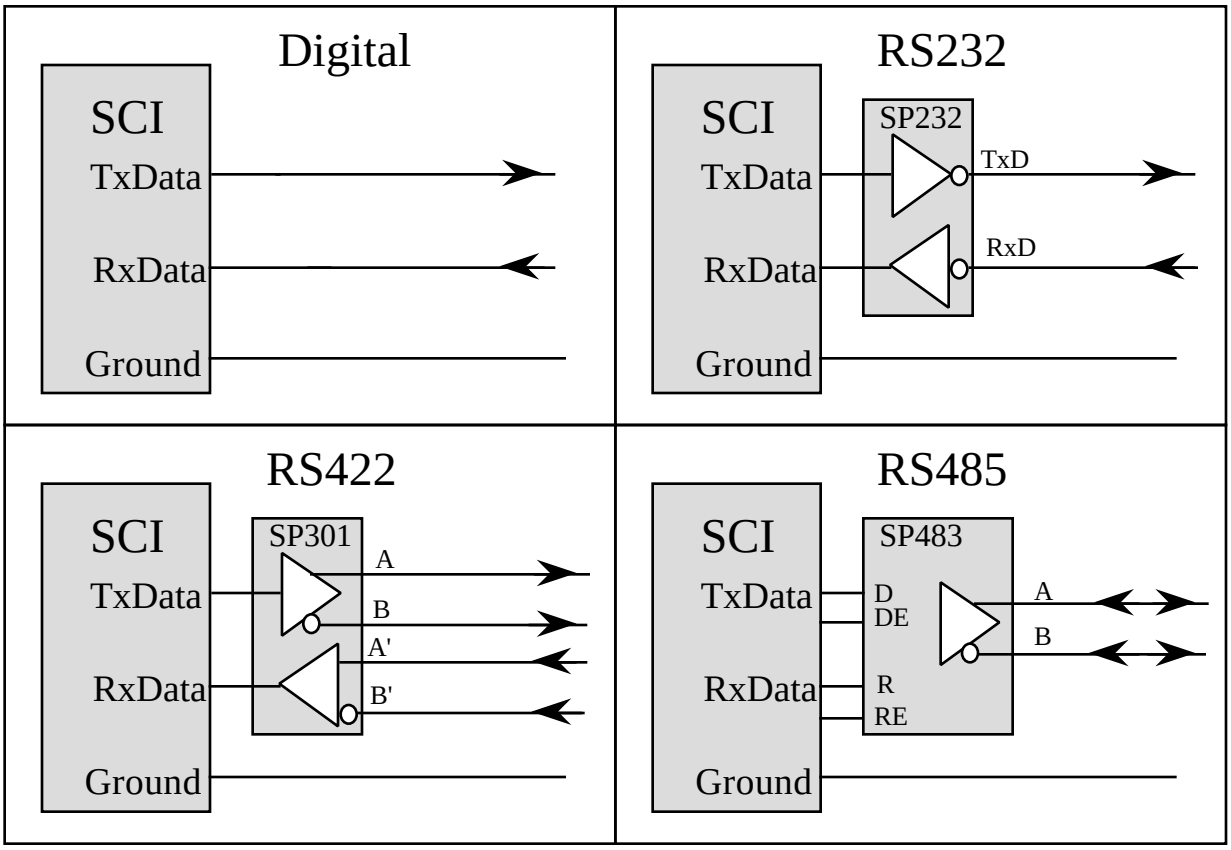
April 5, 2000, 11:00am-11:50am

This is an open book, open notes exam. You must put your answers on these pages only, you can use the back. You have 50 minutes, so please allocate your time accordingly. ***Please read the entire quiz before starting.***

(20) Question 1. For each situation, choose the best interface protocol to implement a serial channel. In particular, for each part simply write in your selection from the available choices (i.e., digital, RS232, RS422, or RS485). You may use the same protocol more than once, or not at all.



Baud rate	Distance	Duplex	Noise	Your choice
9600	30 ft	half duplex	very high	
9600	30 ft	full duplex	very high	
9600	3000 ft	full duplex	low	
500,000	30 ft	full duplex	medium	
500,000	3 in	full duplex	low	

(20) Question 2. The overall objective of this problem is to convert this gadfly SCI example to generate and receive even parity frames. Redesign the system so that even parity is generated on each 11-bit transmit frame that is output (1 start, 8 data, even parity, and 1 stop). You should also check for parity errors on each 11-bit receive frame that is input. There is a protected global variable, which you will initialize to zero, and increment on every input frame that is received in error.

```
unsigned short ParErr;  // number of parity errors detected by InChar()
```

The following are the ritual, input, and output functions from SCI12.C. Please make the necessary changes.

```
void InitSCI(void){

    SC0BDH=0;

    SC0BDL=13;

    SC0CR1=0;

    SC0CR2=0x0C;

    };


char InChar(void){

   while ((SC0SR1 & RDRF) == 0){};

   return(SC0DRL);}


void OutChar(char data){

   while ((SC0SR1 & TDRE) == 0){};

   SC0DRL = data;

   if(data==CR){   /* if CR add LF */

        while((SC0SR1 & TDRE) == 0){};

        SC0DRL = LF;}

   else if(data==LF){ /* if LF add CR */

        while((SC0SR1 & TDRE) == 0);

        SC0DRL = CR;}

}
```

(60) Question 3. The overall objective of this problem is to record songs, which a musician plays on an 8-key piano. The keys are labeled 0 through 7. Each of the 8 piano keys is a simple switch, which is closed (0Ω) when the key is touched, and is open when the key is released. There is 100 μs of bounce. You will design the hardware interface to the piano and write the song-recording software. The main program, which you do not write, will call your ritual then perform unrelated operations. I.e., the song recording will occur in the background using interrupt synchronization. Time will be expressed as a 16-bit unsigned decimal fixed-point number, with a resolution of 0.01 seconds. Time will vary from 0 to 655.35 seconds. Your system will measure the time when a key is pressed, and when it is released. The data structure used to store the song is as follows:

```
struct Event{
      unsigned char KeyCode;  // key number, 0 through 7
      unsigned char What;     // 0 means touch, 1 means release
      unsigned short When;}   // Time in 0.01 sec units
typedef struct Event EventType;
EventType Song[200];          // a song consists of up to 200 events
```

If the musician touches keys 1,3,5 at time 1.2345 sec, and releases them all at 9.8765 sec, the six entries would be

Song[0]={1,0,124}	means key 1 is touched at 1.24 sec
Song[1]={3,0,124}	means key 3 is touched at 1.24 sec
Song[2]={5,0,124}	means key 5 is touched at 1.24 sec
Song[3]={1,1,987}	means key 1 is released at 9.88 sec
Song[4]={3,1,987}	means key 3 is released at 9.88 sec
Song[5]={5,1,987}	means key 5 is released at 9.88 sec

(10) Part a) All eight keys will be interfaced to a single I/O port. Which port would you use? Justify?

(10) Part b) Show the hardware interface between the piano and the 6812. Since each of the piano keys, numbered 0 to 7, is separate and identical, you need only show the connection between Key0 and bit 0 of the port you selected in part a. Decide whether to debounce in hardware or software. Select the best approach (direct, scanned, or multiplexed.)

(5) Part c) Show any additional global data structures required.

(15) Part d) Show the ritual that initializes the I/O port and data structures. You are free to use any of the available interrupt mechanisms. Arm and enable interrupts.

(15) Part e) Show the ISR(s), which record the song. Stop recording (disarm) after 200 events are recorded or after 655.35 seconds, whichever occurs first.

(5) Part f) Show the C code that establishes the necessary interrupt vector(s).