

## Space Hardware Experiment Design

ASEN 5519  
**Homework #4**

Name: \_\_\_\_\_  
Unique Identifier \_\_\_\_\_

Date: \_\_\_\_\_  
due 12/04(09)/03

*Note: You may have to make assumptions (and properly state those) to solve the problems (that's life). Not all required information may be given. If in doubt, simplify with real life assumptions. This test is meant to be easy. Don't hesitate to ask questions (303) 492-5875 or email (hoehn@spot.colorado.edu) if you get stuck.*

### **Question 1 - Electrical Power:**

You have to power a microprocessor-based controller and its periphery at a nominal 5VDC (4.5 – 5.5 V max. allowed range).

- Your DC-DC converter is regulated and adjusted to 5.0 V, but can be trimmed +/- 10% from its nominal 5VDC. It is regulated over its entire power range, i.e., the output voltage is independent of the load.
- You have 3 ft of wire between the regulated power supply and the microprocessor, and a solid state relay with 0.05 Ohm 'on resistance' (see below).
- The microprocessor and its periphery (video cameras, switches, electronics) draw up to 2.0 Amps.

#### **Wire Data**

18 AWG	6.385 Ohm / 1000 feet
20 AWG	10.5 Ohm / 1000 feet
22 AWG	16.8 Ohm / 1000 feet
24 AWG	27.3 Ohm / 1000 feet

#### **Switch Data**

<b>Solid state relay: NAIS AZQ102</b>	On-resistance
I max. = 4.0 Amp.	R typ. : 0.050 $\Omega$
I peak < 9 Amp	R max: 0.090 $\Omega$

[http://ctlgserv.mew.co.jp/acg/e\\_nais/e\\_menseki/e\\_pdf/aqz10\\_pdf](http://ctlgserv.mew.co.jp/acg/e_nais/e_menseki/e_pdf/aqz10_pdf)

- a) What is the voltage drop across the solid state relay at the maximum current of 2.0 Amp.
- b) At 3 ft length, and using either 18 AWG, 20 AWG, 22 AWG or 24 AWG wire, what is the resulting total voltage drop across the wire (note: 3 feet distance = 6 feet from/to length).
- c) What minimum wire size do you need to ensure that the DIFFERENTIAL voltage at the microprocessor is > 4.5 V ?

Wire	Ohm/feet	length	Amps	Switch Drop [V]	Wire Drop [V]	Final Volt. if regulated 5V
18 AWG	6.385	6	2			
20 AWG	10.5	6	2			
22 AWG	16.8	6	2			
24 AWG	27.3	6	2			

- d) What else, other than thicker wire, could you do to ensure that there is enough differential voltage available at the user:

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**Question 2 - Video:**

You want to digitize video on your computer as well as download video images using the Orbiter data transfer system.

- your video camera has a CCD with 640x480 pixels. Assuming that for each pixel you store a 16 bit number representing the intensity seen at that pixel location, what is the approximate file size for the image file (8 bit = 1 byte).
- How many gray scales can you display at 16 bit black and white and how many colors at 16 bit color resolution ?
- How long to download the file using a typical Orbiter data transfer rate of 500 bits per second. How much from your home if you use your 33 kbits/second modem.
- How many images can you store on a 80 Mbyte (1 byte = 8 bits) disk without compression using your 640\*480 pixel image ?
- If you have a CCD camera with 640x480 pixels TOTAL, and you can choose between a color or black and white camera, which one has the better resolution ? Remember: a CCD can only measure intensity. Color is measured using color filters in front of individual pixels, deriving intensities at certain wavelength, then calculating a color.

<b>Answers:</b>	16 bit black and white 640*480 pixel B&W CCD	16 bit color 640*480 pixel color CCD
file size at 640x480 pix.		
# of colors / gray scales		
file size at 640x480 pix.		
Time to download at 500 <b>bits</b> per second		
Time to download at 33 <b>kbits</b> /second		
Images per 80 <b>Mbyte</b> disk		
Better resolution ? B/W vs. Color, which and why ?		