Hardware Design Engineer for Payload Electronics Development  
Duration to complete the assignment from date of receiving: 7 days  
Screening of the candidates for the panel interview round will be based on the acceptance  
of the solution provided by the candidate. Successful candidates will have the opportunity  
to design and develop electronics along with our external partners and in-house. These  
electronics operating in space will be powering and controlling a state-of-the-art earth  
observation payload.

Problem Statement: Design of a high-accuracy actuator control electronics for an EO  
payload.  
You are tasked with designing the electronics hardware to control a high-accuracy piezo  
actuator that will be used to precisely actuate a mirror in three axes for an imaging payload  
intended for use on a satellite. The mirror's motion requirements include dynamic movement in two axes. The piezo actuator operates at a high voltage, and your circuit design should  
incorporate a low-power amplifier for driving the actuator efficiently. Your goal is to create a  
robust and reliable control electronics system that meets the following specifications:

Piezo Actuator: You have access to a high-quality piezo actuator with specifications  
regarding voltage and displacement, and frequency response, as below. The actuator can  
move the optical component in multiple dimensions (e.g., pitch and yaw).

Functional Specs:

|  |  |
| --- | --- |
| Full stroke length of the actuator  Tip/tilt angle  Precision of the actuation | : 400 micrometer : 1 degree : 100 nanometer |

Electrical Specs and constraints:

|  |  |
| --- | --- |
| Actuator’s Drive Voltage Range  Load Impedance | : -20 V to +150 V : 15 pf |
| Peak power | : <5 W |
| Supply voltage | : 5 V DC |
| DAC resolution | : 12 bit |
| Linearity error | : <0.01% |

Multi-Axis Control: Ensure that the control system can independently control both pitch and  
yaw axes for precise optical stabilisation.

Integration: Ensure that the control system can be integrated into the larger EO payload  
electronics, including interfaces with other subsystems and communication with a central  
control unit.

It can be assumed that this electronic system receives a command from a digital processor  
on a serial interface as an unsigned integer digital count value.

All other necessary assumptions may be made for this electronic system design.  
Mandatory Questions: These are absolutely essential!

1)High Voltage Power Supply: Design a high-voltage power supply circuit capable of  
providing a stable and precise DC supply to the piezo actuator.  
2) Position Feedback: Implement a high-resolution position feedback system to  
continuously monitor the position of the optical component in both pitch and yaw  
axes. This feedback should be accurate down to nanometer-level precision.  
3)Closed-Loop Control: Design a control algorithm and hardware that uses the  
position feedback to control the piezo actuator. The control system should  
compensate for satellite onboard vibrations and thermal effects to maintain the  
optical component's line of sight with exceptional stability.  
4) Low-Power Amplifier: Develop a low-power amplifier circuit that can efficiently drive  
the piezo actuator while minimizing power consumption. Ensure the amplifier can  
handle the voltage and current requirements of the actuator.  
5)Filtering and Noise Reduction: Implement filtering and noise reduction techniques to  
ensure that the control system operates with minimal noise and jitter.

**Bonus Questions**: Can you go beyond the basic requirement?!  
1) Safety Features: Include safety mechanisms to prevent damage to the piezo  
actuator and optical component in the event of system failures or external  
disturbances.  
2) Testing and Verification: Develop a testing strategy to verify the precision, accuracy,  
and reliability of the closed-loop stabilisation system. This may involve calibrating  
the system and conducting extensive testing under various conditions.  
3)Space Environmental Considerations: Account for the harsh space environment,  
including radiation, vacuum, and extreme temperatures, when selecting  
components and designing for reliability