The accelerometer outputs a raw signal ranging from 700 mV to 2.2 V (with a 1.5 V swing). To output a 0 V – 5 V signal, the LM6144 Quad Op-Amp in an inverting configuration is used to amplify and center the signal on 2.5 V using a reference voltage. We see that a 3.3 gain is necessary. We will use the following equation to solve for the reference voltage.

$$V\_{out}= (V\_{ref}-V\_{in})\*((R\_{f}/(R\_{i})+ V\_{ref}$$

From the gain calculation we choose the following resistor values

$$R\_{f}= 3.3 K $$

$$R\_{i}=1 K$$

We now fill in the equation with Vout as 5 V and Vin as .700 V

$$5= (V\_{ref}-.7)\*(3.3K/1K)+ V\_{ref}$$

$$V\_{ref}= 1.7 V$$

The same calculation can be done with a Vout of 0 and Vin of 2.2

$$0= (V\_{ref}-2.2)\*(3.3K/1K)+ V\_{ref}$$

$$V\_{ref}= 1.7 V$$

We now can use a voltage divider to obtain the reference voltage.

$$V\_{out}=V\_{in}\*(R\_{2}/(R\_{1}+R\_{2}))$$

The flex sensor used for the throttle outputs a raw signal ranging from 1.36 V to 2.42 V (with a 1.06 V swing). To output a 0 V – 5 V signal, the LM6144 Quad Op-Amp in an inverting configuration is used to amplify and center the signal on 2.5 V using a reference voltage. We see that a 4.7 gain is necessary. We will use the following equation to solve for the reference voltage.

$$V\_{out}= (V\_{ref}-V\_{in})\*((R\_{f}/(R\_{i})+ V\_{ref}$$

From the gain calculation we choose the following resistor values

$$R\_{f}= 47 K $$

$$R\_{i}=10 K$$

We now fill in the equation with Vout as 5 V and Vin as .700 V

$$5= (V\_{ref}-1.36)\*(47K/10K)+ V\_{ref}$$

$$V\_{ref}= 2.2 V$$

The same calculation can be done with a Vout of 0 and Vin of 2.2

$$0= (V\_{ref}-2.42)\*(47K/10K)+ V\_{ref}$$

$$V\_{ref}= 2.2 V$$

We now can use a voltage divider to obtain the reference voltage.

$$V\_{out}=V\_{in}\*(R\_{2}/(R\_{1}+R\_{2}))$$

Current Calculations

|  |  |
| --- | --- |
| **Component / Device**  | **Max Current Draw** |
| XBee | 100 mA |
| Accelerometer | 600 uA |
| Flex Sensor | 250 uA |
| OpAmp | 880 uA |
| Hall Switch | 1.20 mA |
| MOSFET+ LED chain | 300 mA |
| L7805 Quiescent Current  | 6 mA |
| **Total**  | **409 mA** |

Total battery capacity for NiCad batteries is 1500mA-h.

If all the subsystems run continuously, we need 3 batteries in parallel to meet the 8-hour control running time. Three batteries give us the capacity to run the controller for 11 hours. We are not running all the subsystems continuously. (The LEDs are off approximately ¼ of the time dropping our current consumption significantly.) Thus, 2 batteries are sufficient for 8 hours of running time.