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.

$$\boldsymbol{V_{out} = (V_{ref} - V_{in}) * ((R_f/(R_i) + V_{ref}}$$

From the gain calculation we choose the following resistor values
$\boldsymbol{R_f = 3.3\ K}$
$\boldsymbol{R_i = 1\ K}$

We now fill in the equation with Vout as 5 V and Vin as .700 V
$\boldsymbol{5 = (V_{ref} - .7) * (3.3K/1K) + V_{ref}}$
$\boldsymbol{V_{ref} = 1.7\ V}$

The same calculation can be done with a Vout of 0 and Vin of 2.2
$\boldsymbol{0 = (V_{ref} - 2.2) * (3.3K/1K) + V_{ref}}$
$\boldsymbol{V_{ref} = 1.7\ V}$

We now can use a voltage divider to obtain the reference voltage.
$\boldsymbol{V_{out} = V_{in} * (R_2/(R_1 + R_2))}$

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.

$$\boldsymbol{V_{out} = (V_{ref} - V_{in}) * ((R_f/(R_i) + V_{ref}}$$

From the gain calculation we choose the following resistor values
$\boldsymbol{R_f = 47\ K}$
$\boldsymbol{R_i = 10\ K}$

We now fill in the equation with Vout as 5 V and Vin as .700 V
$\boldsymbol{5 = (V_{ref} - 1.36) * (47K/10K) + V_{ref}}$
$\boldsymbol{V_{ref} = 2.2\ V}$

The same calculation can be done with a Vout of 0 and Vin of 2.2
$\boldsymbol{0 = (V_{ref} - 2.42) * (47K/10K) + V_{ref}}$
$\boldsymbol{V_{ref} = 2.2\ V}$

We now can use a voltage divider to obtain the reference voltage.
$\boldsymbol{V_{out} = V_{in} * (R_2/(R_1 + R_2))}$

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.