Power Management Design

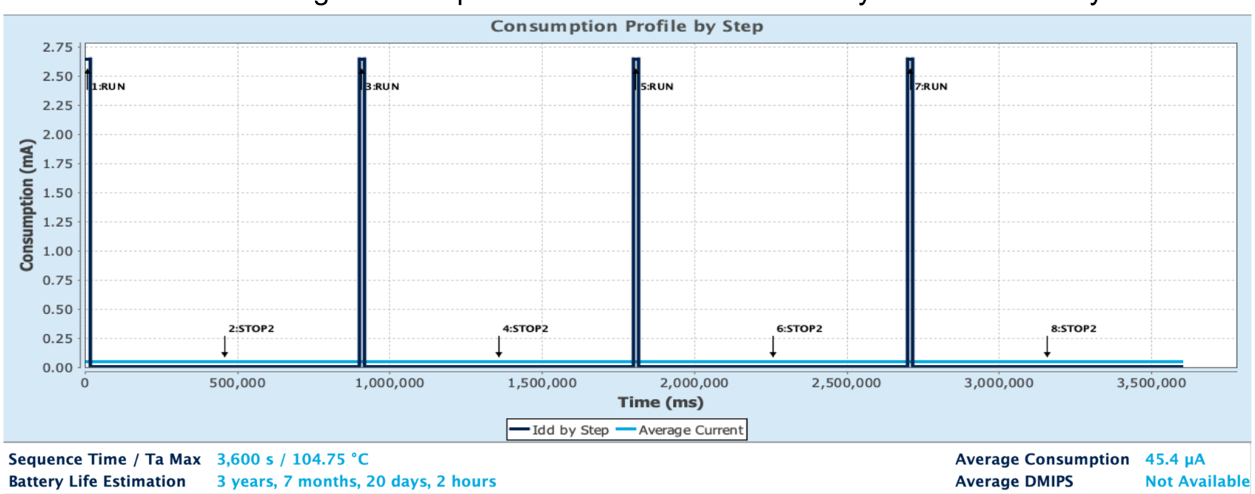
Background

The battery we tested the power consumption with has a capacity of 1500.0 mAh, self discharge of 0.08% per month, nominal voltage of 3.6 V, and a maximum current of 10.0 mA. We do not come close to the maximum current. The capacity of 1500.0 mAh is larger than the capacity of the small batteries we were given (180 mAh), but we thought a higher quality battery would be used in the field so we tested with such. The larger capacity battery will give a longer estimated battery lifetime, but the average consumption (mA) should not be affected by differing capacities.

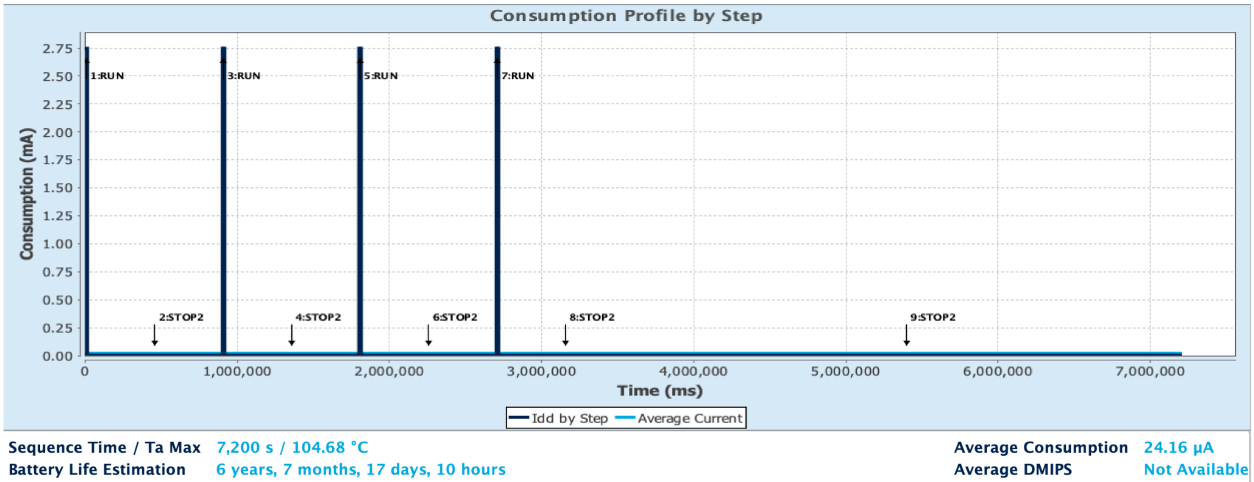
In testing, the light sensor was accounted for by adding 2 mA of additional consumption in the 15 second run steps. The other peripherals turned on in the run steps are ADC, GPIOA, GPIOB, GPIOC, RTC, TIM2, and USART2. Stop steps happen for 985 seconds between runs and there is a 12 hour stop step once a day. During stops, the only peripheral turned on is RTC because we need to know the time when we wake back up and because an RTC alarm will switch back to running when it is time to run again. The CPU frequency is 4 MHz while running and 0 MHz while sleeping.

Analysis

RUN (Range2) and STOP 2 - one hour of switching between running 15 seconds and waiting 885 seconds. The average consumption would be the same for any number of this cycle.



RUN (Range1) and STOP 2 - one hour switching between running and waiting then 1 hour of just waiting. This calculates the average consumption for a whole day that would include 12 hours of switching and 12 hours of waiting.



Results using the steps shown above to calculate the average consumption for a full day.

Running Mode	Low Power Mode	Average Consumption (µA)
Run Range1	STOP2	24.16
Run Range2	STOP2	23.71
LPRUN (2 MHz CPU)	STOP2	20.66
RUN (Range1)	SLEEP	136.96
RUN (Range1)	STOP0	136.96
RUN (Range1)	STOP1	27.38
RUN (Range1)	STOP2	24.16
RUN (Range1)	STANDBY + SRAM	23.46
RUN (Range1)	STANDBY	23.38

Conclusion

Run (Range1) is the best option for running. Run (Range2) is not desirable because the flash memory is clocked off, but we need flash memory to be powered and clocked for collecting data. LPRUN's max CPU frequency is only 2 MHz, but 4MHz is desirable so the CPU can have a comfortably higher frequency than the light sensor.

Stop2 is the best option for the low power mode because it clocks off everything other than RTC, and all we need to use while in low power mode is RTC. Stop1 and Stop0 keep unnecessary peripherals on and Sleep mode and STOP0 keep SRAM on so there is wasted current with each of those options. STANDBY stops powering SRAM and Flash so the board would basically reset each time it comes out of low power mode. STANDBY + SRAM keeps some SRAM clocked off but still powered. STANDBY + SRAM would have the same problems as STANDBY, but maybe the code could be refactored to store its state in the SRAM that's maintained when it goes into low power mode.