

General Inputs

$anchorSamplePeriod := 64 \cdot min$ $sleepEnergy := 2 \cdot J$ $sleepVolts := 28.0 \cdot V$ $wakeFromSleepEnergy := 2 \cdot J$

Science instrument joules per sample

$isusSampleEnergy := 3.62 \cdot J$ $sbe41SampleEnergy := 3.04 \cdot J$ $pHSampleEnergy := 0.16 \cdot J$

$FLBBSampleEnergy := 0.1 \cdot J$ $optodeSampleEnergy := 0.5 \cdot J$ $OCRSampleEnergy := 1 \cdot J$

Profile parameters

$profileDepth := 200 \cdot m$ $numProfiles := 100$ $samplesPerProfile := 20$ $descendSpeed := 0.2 \cdot \frac{m}{sec}$

$ascendSpeed := 0.1 \cdot \frac{m}{sec}$ $numAnchorSamples := 4$ $descendEnergy := 100 \cdot J$ $anchorEnergy := 100 \cdot J$

$deanchorEnergy := 500 \cdot J$ $ascendEnergy := 100 \cdot J$ $surfaceOpsEnergy := 1000 \cdot J$ $PVMaintainEnergy := 10 \cdot \frac{J}{m}$

$anchorTime := 1 \cdot min$ $deAnchorTime := 4 \cdot min$ $surfaceOpsTime := 15 \cdot min$

Battery pack parameters

$numBatteries := 32$ $batteryVolts := 28 \cdot V$ $batteryCharge := 3.3 \cdot amp \cdot hr$ $selfDischarge := \frac{0.03}{yr} = (9.507 \cdot 10^{-10}) \frac{1}{s}$

$sampleEnergy := isusSampleEnergy + sbe41SampleEnergy + pHSampleEnergy$
 $\quad + FLBBSampleEnergy + optodeSampleEnergy + OCRSampleEnergy$

$sampleEnergy = 8.42 J$

$$\text{sleepAmps} := \frac{\text{sleepEnergy}}{\text{anchorSamplePeriod} \cdot \text{sleepVolts}} = (1.86 \cdot 10^{-5}) \text{ A}$$

$$\text{totalAnchorTime} := (\text{numAnchorSamples} - 1) \cdot \text{anchorSamplePeriod} + \text{anchorTime} + \text{deAnchorTime} = (1.182 \cdot 10^4) \text{ s}$$

$$\begin{aligned} \text{totalAnchorEnergy} := & \text{anchorEnergy} + ((\text{numAnchorSamples} - 1) \cdot \text{wakeFromSleepEnergy}) \downarrow \\ & + (\text{numAnchorSamples} \cdot \text{sampleEnergy}) \downarrow \\ & + (\text{numAnchorSamples} - 1) \cdot (\text{anchorSamplePeriod} \cdot \text{sleepVolts} \cdot \text{sleepAmps}) \end{aligned}$$

$$\text{totalAnchorEnergy} = 145.68 \text{ J}$$

$$\text{profileMaintainEnergy} := \text{PVMaintainEnergy} \cdot \text{profileDepth} = (2 \cdot 10^3) \text{ J}$$

$$\text{totalSampleEnergy} := \text{samplesPerProfile} \cdot \text{sampleEnergy} = 168.4 \text{ J}$$

$$\begin{aligned} \text{profileEnergy} := & \text{descendEnergy} + (2 \cdot \text{profileMaintainEnergy}) + \text{anchorEnergy} + \text{deanchorEnergy} \downarrow \\ & + \text{ascendEnergy} + \text{surfaceOpsEnergy} + \text{totalSampleEnergy} \end{aligned}$$

$$\text{profileEnergy} = (5.968 \cdot 10^3) \text{ J}$$

$$\text{missionEnergy} := \text{numProfiles} \cdot (\text{profileEnergy} + \text{totalAnchorEnergy}) = (6.114 \cdot 10^5) \text{ J}$$

$$\begin{aligned} \text{profileTime} := & \frac{\text{profileDepth}}{\text{descendSpeed}} + \frac{\text{profileDepth}}{\text{ascendSpeed}} + (\text{numAnchorSamples} - 1) \cdot \text{anchorSamplePeriod} \downarrow \\ & + \text{anchorTime} + \text{deAnchorTime} + \text{surfaceOpsTime} \end{aligned}$$

$$profileTime = 4.367 \text{ hr}$$

$$totalMissionTime := numProfiles \cdot (profileTime + totalAnchorTime) = 31.875 \text{ day}$$

$$batteryEnergy := batteryVolts \cdot batteryCharge = (3.326 \cdot 10^5) \text{ J}$$

$$packEnergy := numBatteries \cdot batteryEnergy = (1.064 \cdot 10^7) \text{ J}$$

$$missionSelfDischarge := selfDischarge \cdot totalMissionTime = 0.003$$

$$packEnergy := packEnergy \cdot (1 - missionSelfDischarge) = (1.062 \cdot 10^7) \text{ J}$$

$$packUsage := \frac{missionEnergy}{packEnergy} = 5.8\%$$