1. **Power Consumption Calculation of Key Components in the Communication System**

| Subsystem Components | power | Description |
| --- | --- | --- |
| RFM98PW LoRa Module（433 MHz）[[1]](#footnote-1) | Tx: 3.25~4.5 W  Sleep: 25  Rx: 65~75 mW | Transmit current: 650mA~900mA(@5V)  sleep current: 5~12(@5V)  Receive current: 13~15mA(@5V) |
| RP2040 MCU[[2]](#footnote-2) | 1. Popcorn: 94.9mW~137mW 2. ﻿﻿BOOTSEL\_mode\_Active: 22.2mW~41.8mW 3. ﻿BOOTSEL\_mode\_Idle:   15.8mW~34.35mW  ﻿4. Dormant: 0.2mW~5mW  ﻿5. Sleep:0.47mW~5.4mW | User case |
| RV-3028-C7 Real-Timeclock (RTC)[[3]](#footnote-3) | ignore | Low power design，typical current only 45 nA |
| VL6180 LiDAR[[4]](#footnote-4) | Distance Measurement Mode：~ 5mW | Hardware standby (GPIO0 = 0): < 1 uA  Software standby: < 1uA  Ranging: 1.7 mA (typical average)  Operating voltage: 2.6~3.0V |

There is no clear choice for the type of Micro SD card reader, so a 200mW design margin is left for redundancy.

**Total Power of Different Modes in Communication System**

Below is an analysis of the power consumption of several key components in different operating modes:

1. **Transmit Mode (Tx) Power Consumption**  
   When the satellite is communicating, the LoRa module’s transmission power consumption ranges from 3.25W to 4.5W. The RP2040 MCU consumes approximately 94.9mW to 137mW in Popcorn mode, and the VL6180 LiDAR consumes around 5mW in ranging mode. Combining the power consumption of these components, the total power consumption in transmit mode is approximately 3.34W to 4.64W.
2. **Sleep Mode Power Consumption**  
   When the system is in sleep mode, the LoRa module’s power consumption drops to 25μW. The RP2040 MCU consumes around 0.47mW to 5.4mW in Sleep mode, while the LiDAR consumes nearly no power in standby mode. Overall, the total power consumption in sleep mode is approximately 0.49mW to 5.4mW.
3. **Receive Mode (Rx) Power Consumption**  
   When the satellite is receiving data, the LoRa module’s reception power consumption ranges from 65mW to 75mW. The RP2040 MCU consumes approximately 22.2mW to 41.8mW in BOOTSEL active mode, and the LiDAR consumes 5mW in ranging mode. Combining the power consumption of these components, the total power consumption in receive mode is approximately 92.2mW to 121.8mW.
4. **Power Consumption Calculation of Key Components in Power System**
5. **Load Power**

we use the ELP-USBFHD06H-L180 camera[[5]](#footnote-5) module as example, which is a 2MP low-illumination USB camera equipped with a fisheye lens. According to its specifications, the module operates at a supply voltage of 5V, with a working current ranging from 140mA to 190mA depending on usage conditions (e.g., standby vs. active video transmission).

Minimum Power Consumption:

=5V×0.14A=0.7W

Maximum Power Consumption:​

=5V×0.19A=0.95W

Therefore, the camera’s power consumption ranges from 0.7W to 0.95W, depending on the operational mode. For design purposes, allocate at least 1W of power budget to this camera module to ensure stable operation under peak load.

1. RFM98PW LoRa Module datasheet: <https://www.hoperf.com/modules/lora/RFM98PW.html>
2. RP2040 MCU datasheet: <https://datasheets.raspberrypi.com/rp2040/rp2040-datasheet.pdf>
3. RV-3028-C7 RTC datasheet: <https://www.microcrystal.com/fileadmin/Media/Products/RTC/Datasheet/RV-3028-C7.pdf>
4. VL6180 LiDAR datasheet: <https://www.st.com/resource/en/datasheet/vl6180.pdf>
5. ELP-USBFHD06H-L180 data: <https://www.elpcctv.com/elp-2mp-full-hd-1080p-uvc-free-driver-low-light-imx322-usb-camera-wide-angle-for-android-p-333.html>
6. <https://www.st.com/resource/en/user_manual/um2206-stm32-nucleo64p-boards-mb1319-stmicroelectronics.pdf>
7. STM32 Nucleo MB1319C datasheet

1. 1. RFM98PW LoRa Module datasheet: <https://www.hoperf.com/modules/lora/RFM98PW.html>

   [↑](#footnote-ref-1)
2. 1. RP2040 MCU datasheet: <https://datasheets.raspberrypi.com/rp2040/rp2040-datasheet.pdf>

   [↑](#footnote-ref-2)
3. 1. RV-3028-C7 RTC datasheet: <https://www.microcrystal.com/fileadmin/Media/Products/RTC/Datasheet/RV-3028-C7.pdf>

   [↑](#footnote-ref-3)
4. 1. VL6180 LiDAR datasheet: <https://www.st.com/resource/en/datasheet/vl6180.pdf>

   [↑](#footnote-ref-4)
5. 1. ELP-USBFHD06H-L180 data: <https://www.elpcctv.com/elp-2mp-full-hd-1080p-uvc-free-driver-low-light-imx322-usb-camera-wide-angle-for-android-p-333.html>

   [↑](#footnote-ref-5)