

# TerraMICRO

## Mission Success Criteria and System Requirements

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### I. Introduction

TerraMICRO is a high altitude balloon (HAB) technology demonstration mission. The key objectives of this mission are to validate a new HAB avionics architecture called  $\mu$ HAB, experiment with core technologies which enable long duration flights, and collect high quality images from high altitudes.

As a technology demonstrator, TerraMICRO flight systems are intended to be used on future HAB systems. TerraMICRO systems are designed to be generic in order to support any future mission. TerraHAB has selected long duration flights as a target for future missions, and as such many of the systems beyond the core avionics are building blocks toward this goal.

This document shall list and describe all mission requirements and their criteria for success, all system requirements and their criteria for performance, and (when applicable) methods by which the aforementioned requirements shall be evaluated. The intent of this specification is to quantify and control the criteria by which mission success is defined, and to provide traceability to each subsystem's performance to ensure mission success is achieved by the vehicle's design.

### II. Mission Requirements

#### A. Key Design Requirements

Regardless of the mission objectives, the HAB system must meet several key design requirements in order to achieve mission success. These requirements serve as success criteria and also as constraints to the design trade space.

The flight vehicle **must**:

- Include multiple independent cut-down mechanisms.
- Include redundant tracking systems.
- Achieve 3 to 6 hours of powered flight time
- Have a total mass of no more than 2.72 kg (6 lbs.).

#### B. Engineering & Technology Objectives

The following objectives provide the basis for TerraHAB's criteria for success and drive all other mission requirements. These objectives steer the vision and end goals for the mission and every subsystem or feature in the end result should support at least one of these objectives.

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| <i>In-Flight Balloon Monitoring</i>          | A system will be able to monitor the temperature and pressure within a balloon and report that back to the HAB payload.  |
| <i><math>\mu</math>HAB Avionics Platform</i> | Flight test $\mu$ HAB as a flexible, expandable, and cost-effective platform to support many different mission profiles or payloads with all of the basics for a HAB launch included out of the box. |
| <i>Open-Loop Altitude Regulation</i>         | Limit maximum altitude and rate of ascent by the controlled release of helium during flight to prolong the mission duration. Maintain 75,000 feet altitude for at least 30 minutes.                  |
| <i>HD On-Board Video</i>                     | Horizon-looking full color video at 1080p30 fps or better (1080p60fps or 4K30fps preferred).   |
| <i>Video Capture of Balloon Burst</i>        | Capture the balloon burst event with minimum resolution of 720p60fps or better. (720p@120fps or 1080p@120fps preferred)  |

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| <i>“Remove Before Flight” Pins</i>      | Include externally accessible remove before flight pins to safe or disarm subsystems while on the ground, such as a power pin (included in $\mu$ HAB), startup sequence pin, launch pin, etc. |
| <i>Status Indicators &amp; Displays</i> | Include displays and self-test and status check codes to ensure that the balloon is stable and behaving nominally for flight.   |
| <i>Simple Balloon Filling</i>           | Simple and clear procedures during flight preparations, including a quick-disconnect from helium fill plumbing.   |
| <i>Vegetation Density Experiment</i>    | Use NDVI with a commercially available RGB (VNIR) camera to estimate vegetation density from images in real time during flight. Minimum video quality 480p30fps.                              |

### **C. Stretch Goals & Desired Features**

There are several design features that are specific requests from TerraHAB engineers. The flight system should meet these requests or provide justification for not including them. These features are not required for mission success as defined in subsection II.B, but it is expected that the TerraHAB team strives to accomplish these goals.

## **III. System Requirements**

All of the systems demonstrated by this mission shall be thoroughly tested on the ground prior to launch. Flight data and telemetry recorded during the flight should be consistent with behavior observed during testing.

### **A. Avionics & Telemetry**

### **B. Bus & Recovery**

### **C. Altitude Regulation**