

# **Voice Telemetry System**

## **System Description and Results of the First Flight Test**

Launched April 14, 2013, Kentland Farms

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June 13, 2013

# Voice Telemetry System (VTS)

## System Overview

### Purpose

- Eliminate manual decoding of altimeter beeps
- Increase safety by automating ejection arming
- Increase reliability with continual pre-launch system status checking
- Provide real-time flight data via radio link
- Use voice reporting for ease of reception and understanding

### Current Functions

- Report comprehensive pre-launch system status
- Report flight progress: altitude, apogee, recovery events
- Control power to altimeters and transmitter
- Provide radio location signal after landing

### Planned Enhancements

- Tracking using GPS
- Improved power efficiency/redundancy
- Improved transmitter - higher power, cleaner signal
- Improved voice quality

# Voice Telemetry System (VTS)

## Flight Test Overview

### Goals

- Flight stress survivability
- Successful altimeter controlled dual-deploy recovery
- Accurate altitude and ejection event reporting
- Transmitter effectiveness

### Results summary

- Successful launch to 1328 feet AGL
- System survived intact
- Dual deploy performed flawlessly
- Small error in apogee altitude report
- Premature report of primary main ejection
- Strong transmitter signal throughout flight

### Test Rocket

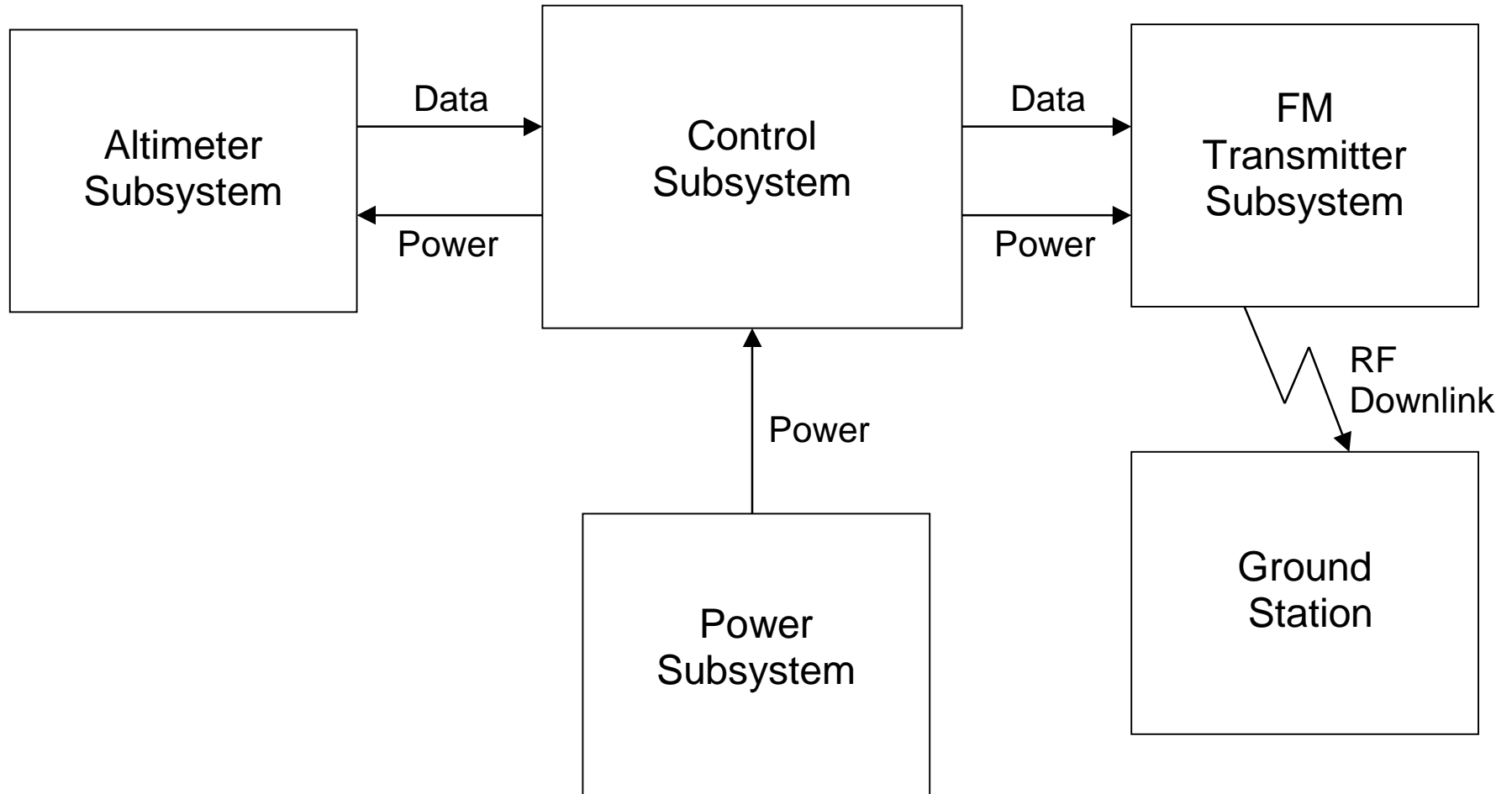
Length: 6' 5", Diameter: 4", Weight: 7 pounds

Motor: Cesaroni Pro38 3-grain 411-I175-14A

Recovery: Dual redundant, dual deploy

-Drogue chute: Primary-Altimeter 1 (apogee)	Backup-Motor ejection
-Main chute: Primary-Altimeter 1 (700')	Backup-Altimeter 2 (500')

# Voice Telemetry System (VTS)



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## Subsystem Component Highlights

### Altimeter Subsystem

Two PerfectFlite Stratologger SL100 Dual-deploy Altimeters  
100,000 foot MSL altitude rating, audio (beep) and telemetry (altitude) ports  
20 altitude samples/second

### Control Subsystem (CS)

Microchip 16-bit PIC24FJ64GA002 running a C program  
Signal conditioning & power control circuitry  
RC Systems V-Stamp Voice Synthesizer Module, software controllable

### Transmitter Subsystem

Amateur VHF FM, 2-meter band, 147.025 MHz  
Currently: low-power prototype (~10 mW)  
Future: enhanced, higher-power version (~50 mW)

### Power Subsystem

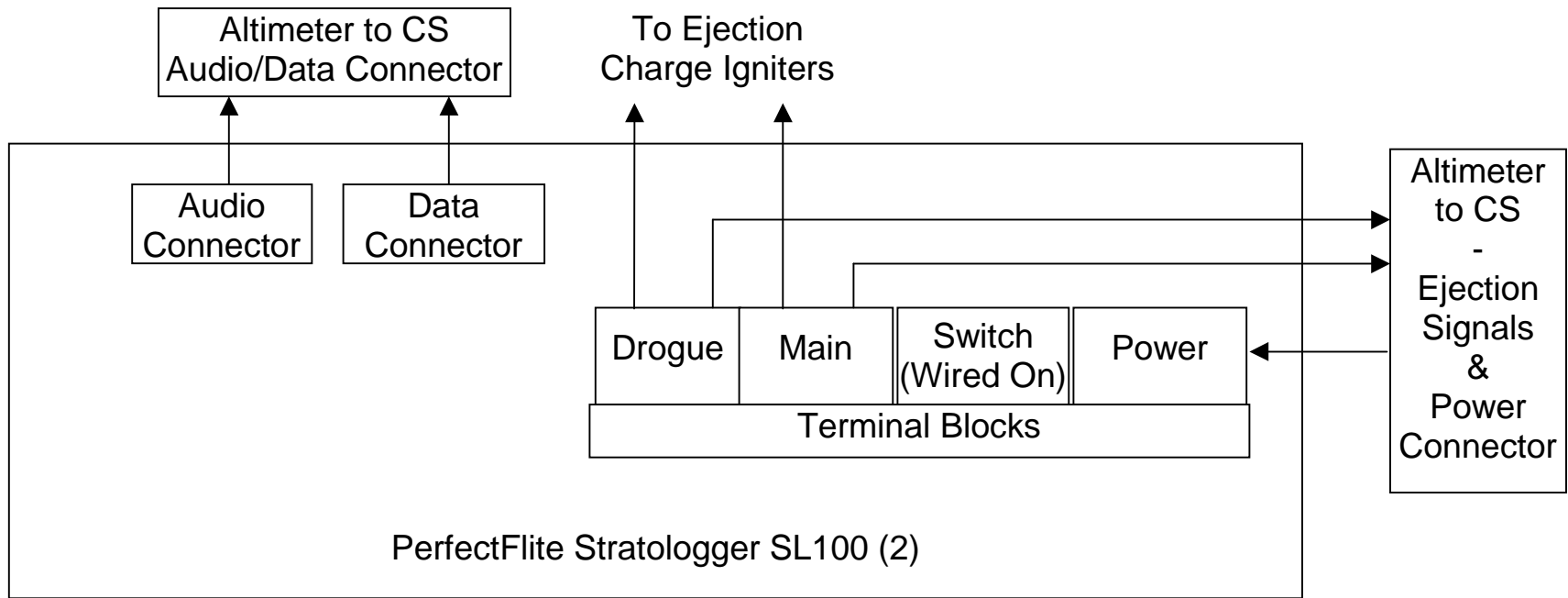
4-battery (9V) power supply, key switch

### Ground Station

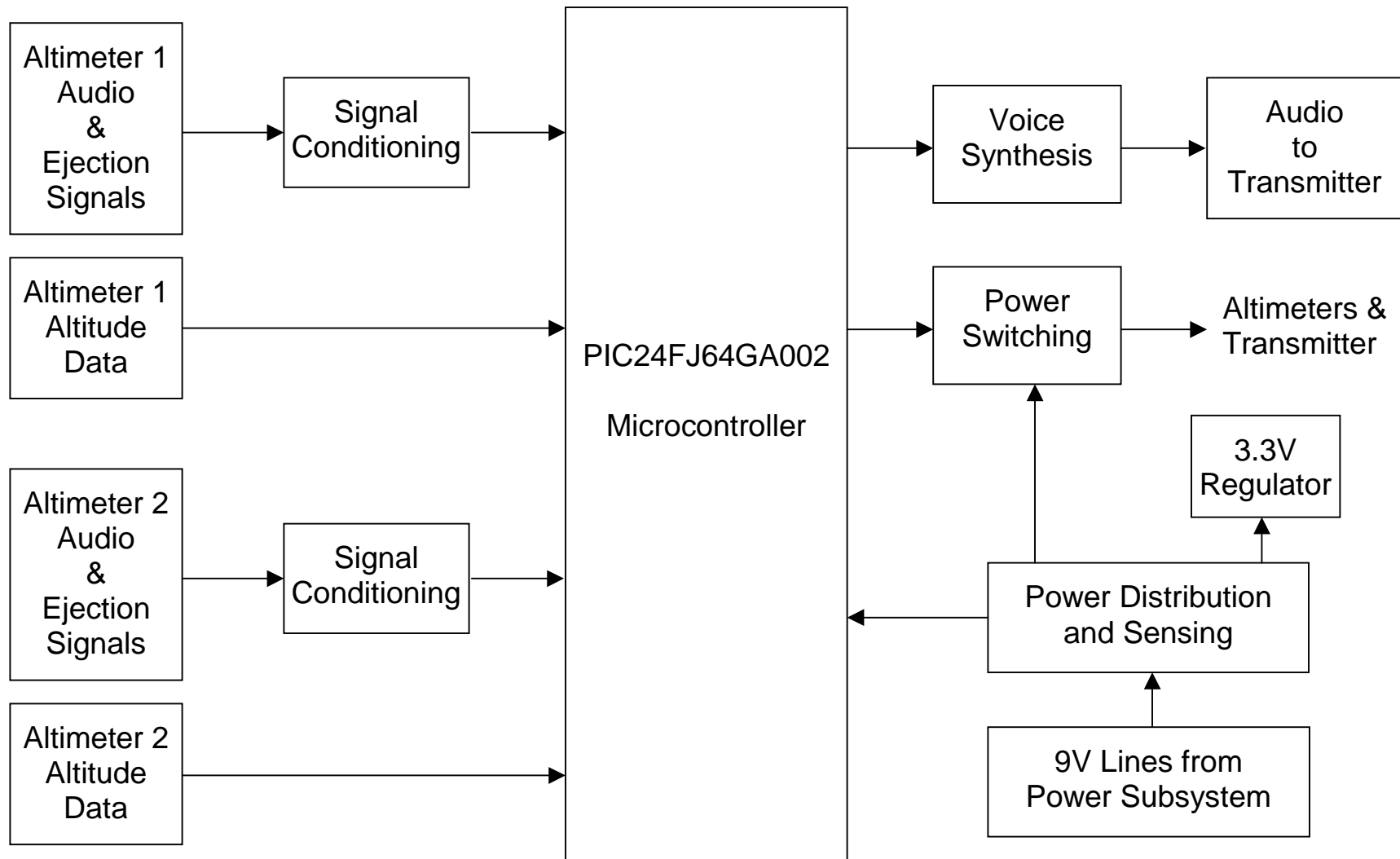
Arrow II Satellite antenna feeding a 2-meter preamp  
Kenwood Dual-band TH-G71 HT, 2-meter VHF receiver  
Audio recorder and amplifier/speaker

# VTS Altimeter Subsystem

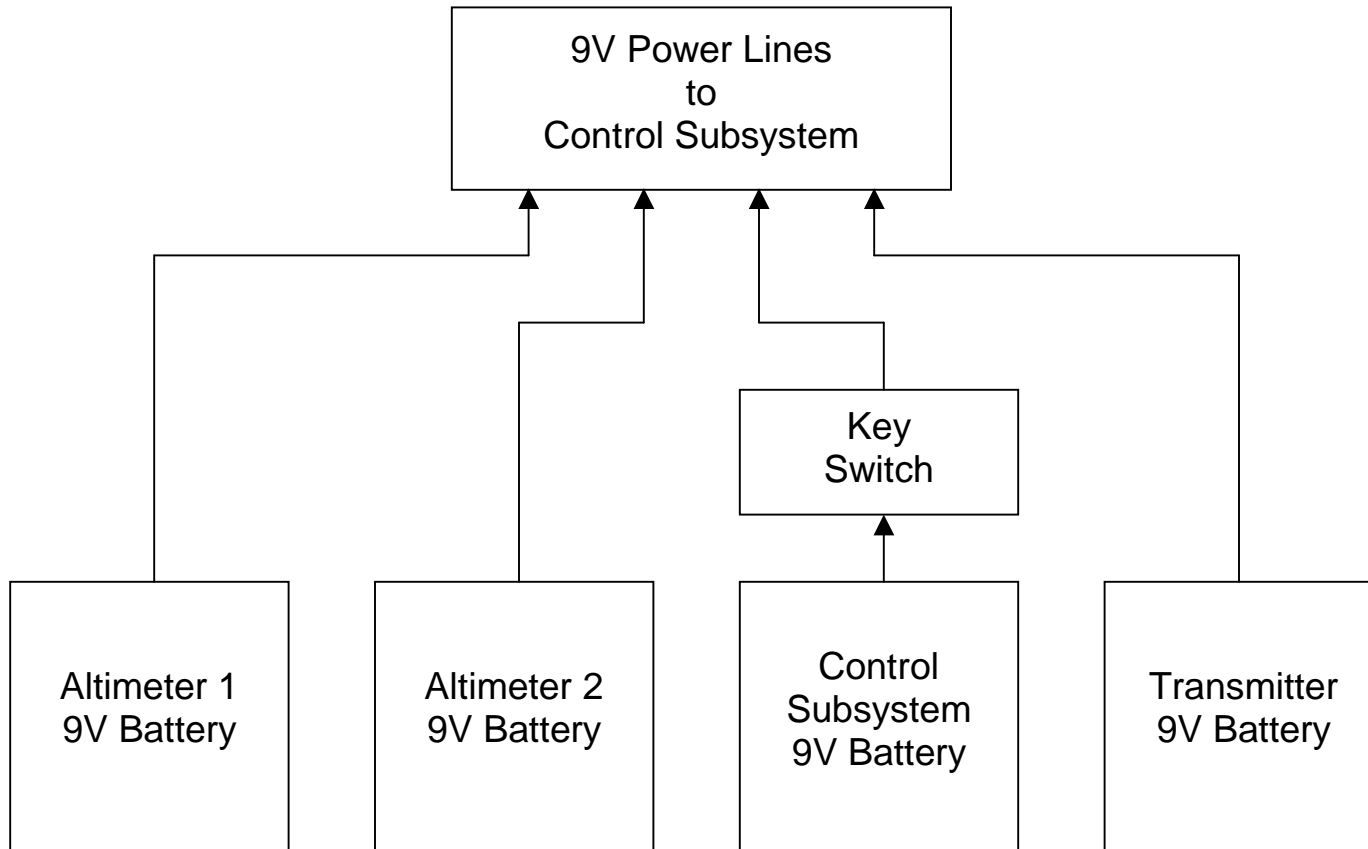
## Dual Redundant Altimeters



# VTS Control Subsystem

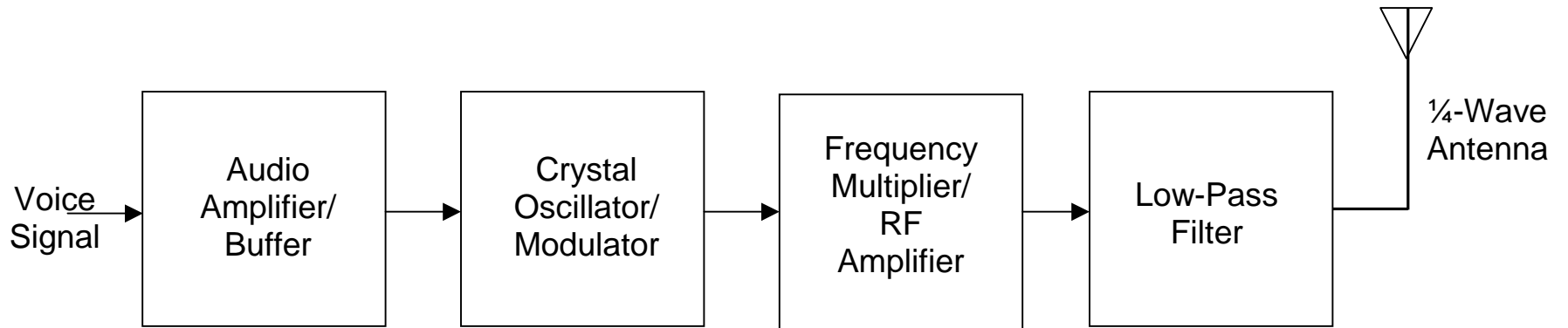


# VTS Power Subsystem

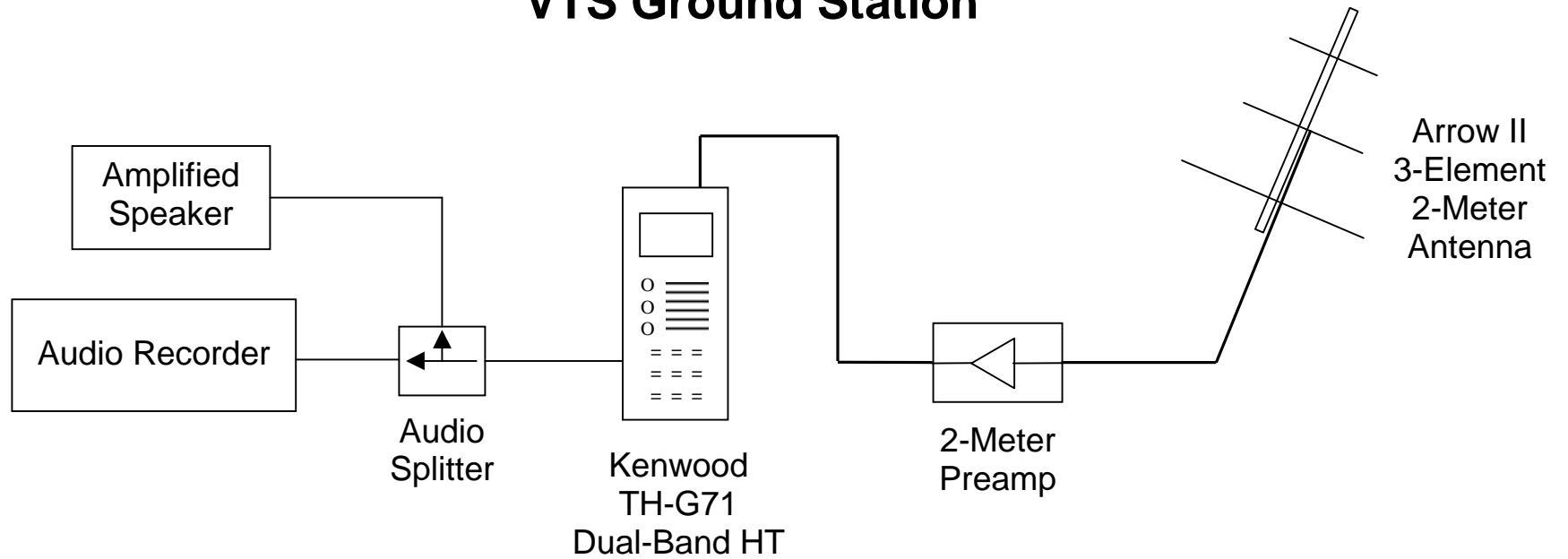




# VTS FM Transmitter Subsystem



# VTS Ground Station



# Voice Telemetry System (VTS)

## Design Errors Revealed by the Test Flight

### Error

### Explanation

### Possible Fixes

Incorrect apogee altitude report

Software problem: Around the time of drogue parachute ejection, rocket altitude can decrease and then increase again perhaps due to forces created (1) by the ejection charge and (2) by the released parachute. The VTS software responded too soon after detecting the first downward movement of the rocket.

1. Delay testing for altitude reduction until 1 second after drogue ejection occurs.
2. Wait until a larger altitude reduction occurs before reporting the maximum value.

Premature report of primary main parachute ejection

Hardware problem: The VTS detects parachute ejection by sensing the altimeter-controlled voltage drop on one side of the igniter circuit. However, a drop in battery voltage will also cause a drop in the igniter circuit voltage. Data downloaded from the primary altimeter post-flight showed that ejection charge igniter firing causes a brief but significant battery voltage drop. Therefore, the firing on one circuit can indirectly cause a voltage drop on the non-firing circuit. This effect was not seen during bench testing because low-power light bulbs, not actual igniters, were used to indicate ejection firing.

1. Adjust voltage level-shifting circuit thresholds.
2. Measure voltage relative to the battery voltage instead of sensing its absolute value.