Glider Avionics Package

(Final Presentation)
Proposed Features

• Flight Characteristics:
  - Altitude
  - Airspeed
  - Vertical Speed
  - Current Position
  - Compass

• Calculated Values:
  - Average Vertical Speed
  - Distance to Destination
  - Optimal Speed to Destination
  - Wind Direction and Strength
Device Block Diagram
Measuring altitude, airspeed and vertical speed:
Measuring altitude, airspeed and vertical speed:

• Issues & Risks:
  Changing temperature brings 4% error per 20 degrees F
  Noises in analog signals

• Solutions:
  Temperature compensated pressure sensors & neglecting
  Active filters
  Calculating average of 16 samples
Measuring altitude, airspeed and vertical speed:

- Why Motorola 68HC912?
  - 16-bit microcontroller
  - 10-bit ADC
  - Instruction set same as 68HC11 (CS3720)
  - Downloadable free simulator

- Purpose:
  - Calculating average values
  - Calculating vertical speed
  - Controlling 3 displays
Compass Design:

• Issues & Risks:
  Tilt error (next slide)
  Commercial products expensive
  Unavailable practical experiences with building 3-dimensional tilt compensated compass
  Trigonometric calculations to correct the error

• Solutions:
  Set of sensors made by Honeywell + schematics
  Start working in summer
Compass Design

Figure 23  Tilt error magnitudes
Compass Design

• Motorola 68HC912 again?
  Keep uniform development environment
  8-channel, 10-bit ADC (need 3)
  Same display-controlling routines
GPS Receiver

• Motorola M12+ Oncore
  Meets my needs
  Available with 10% discount
  Already on order
  Arriving in 4-6 weeks

• Specs:
  Communicates at 9600 bauds, Binary Motorola Protocol
  Message: Latitude, longitude, height, velocity, heading and time.
  Precision: 100 m
Processing Unit

- FPGA implementation
- Selected board: Digilab 2E board manufactured by Digilent, Inc
  - 200K-gate Xilinx Spartan 2E XC2S200E FPGA
  - 143 user I/Os
  - Full development software free of charge
Processing Unit

• Functions:
  Receive data from all other modules for analysis
  Display GPS values: latitude, longitude, GPS velocity
  Calculate and display:
    Average vertical speed
    Optimal speed to destination
    Distance to destination
    Direction of wind
    Strength of wind
Processing Unit

- Functions (cont’d)
  Need to display 8 values -> LCD display instead of LED (power issue)
    Selected LCD: Lumex LCM-S02004DSF
  LCD display control
  RS-232 communication
  Writing & reading Flash memory

- Implementation:
  Verilog
Power Supply

- 12-volt battery available in gliders
- Standard 7805 and LM317 regulators
- Output voltages: +5V & +3V
Debugging Process

- Algorithms for Motorola microcontrollers will be simulated
- Each module debugged independently
- Test drives
# Bill of Materials

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**Total:** $346.14
Questions?