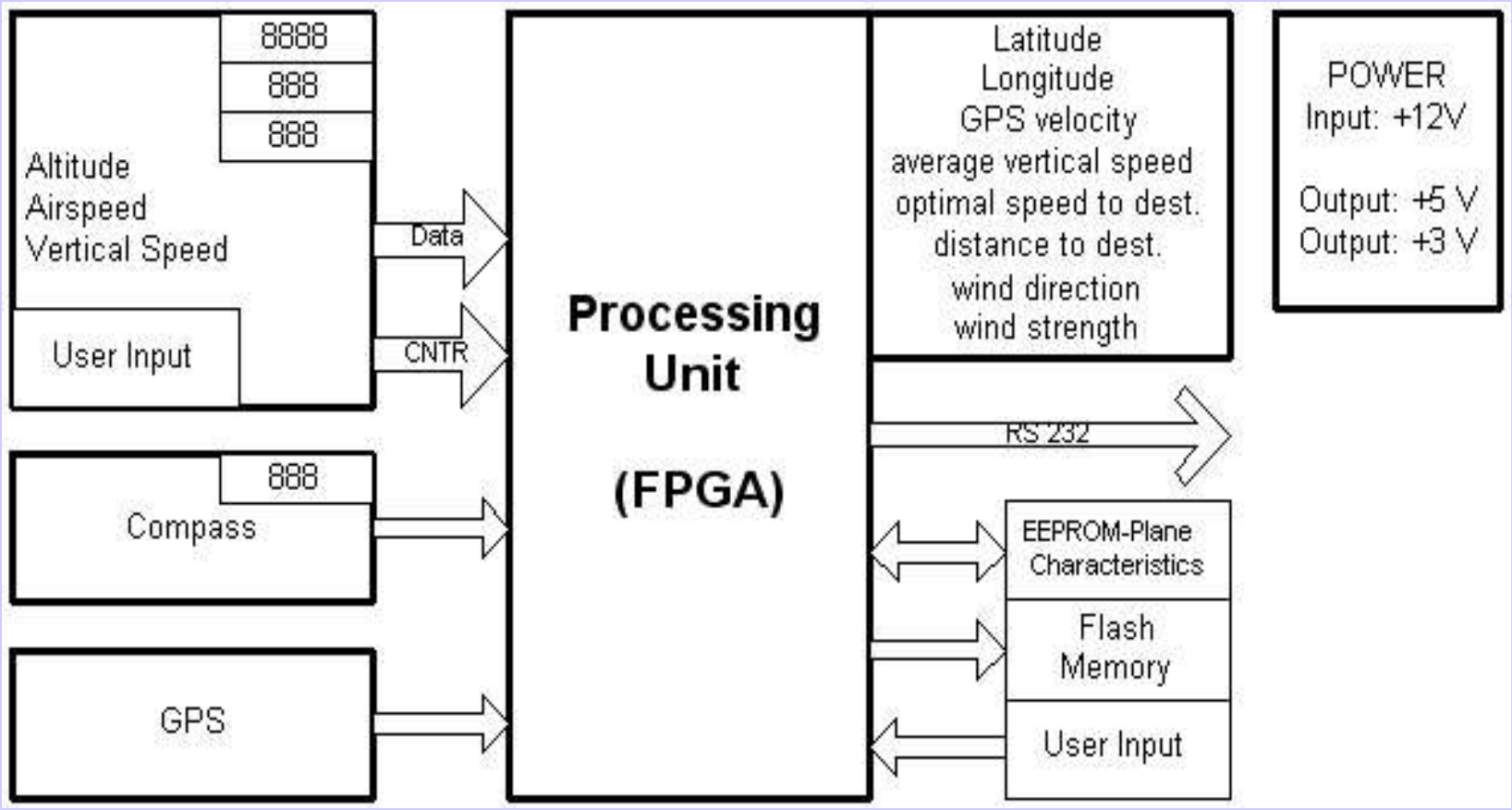
Glider Avionics Package

(Final Presentation)

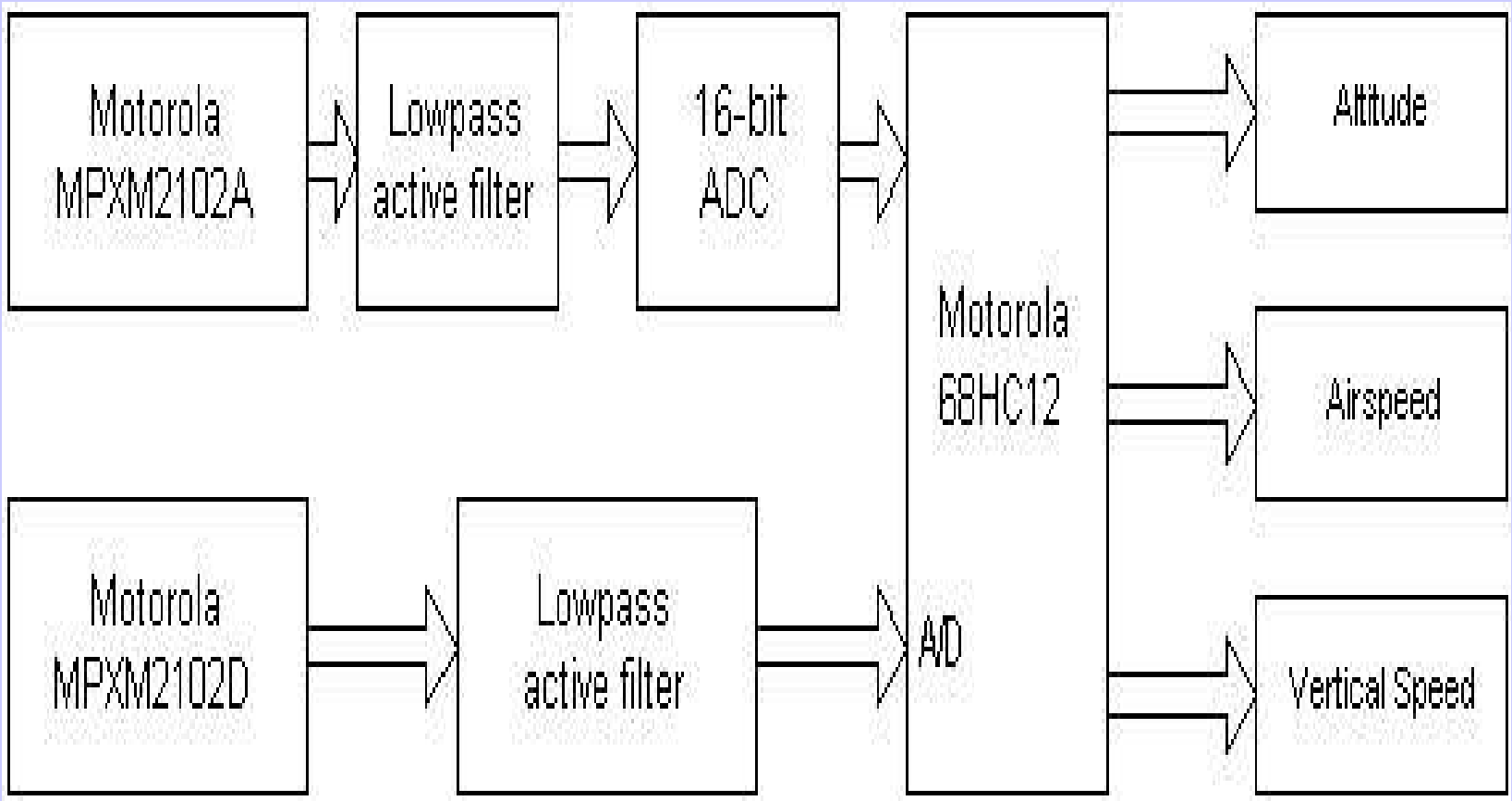
Proposed Features

- 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

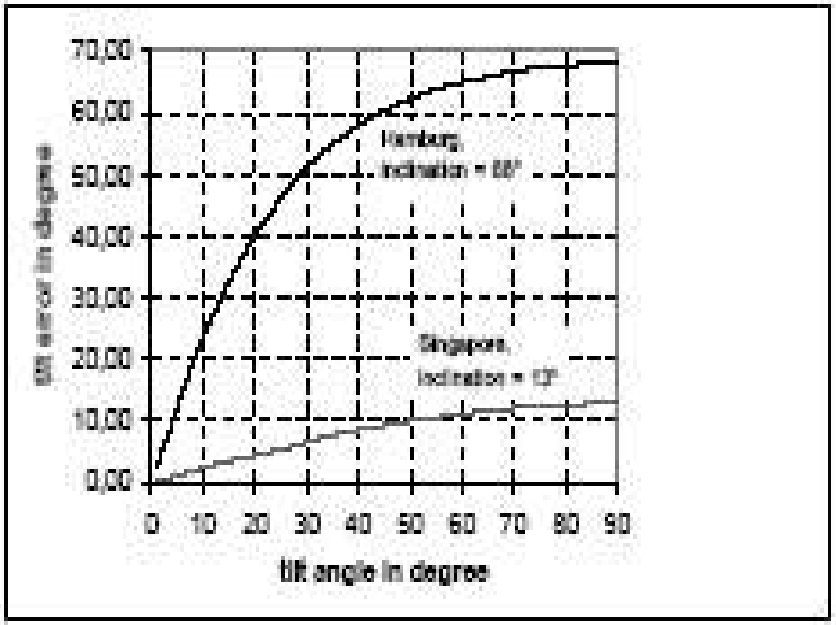
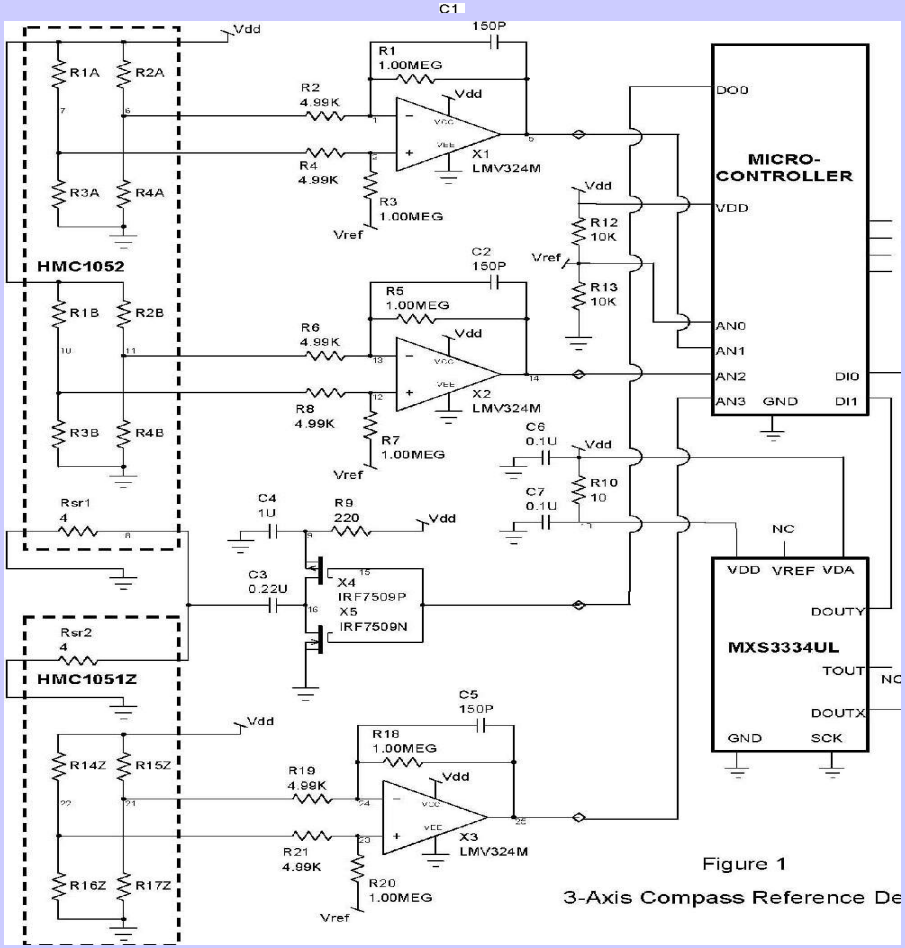


Figure 23 Tilt error magnitudes

Compass Design



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

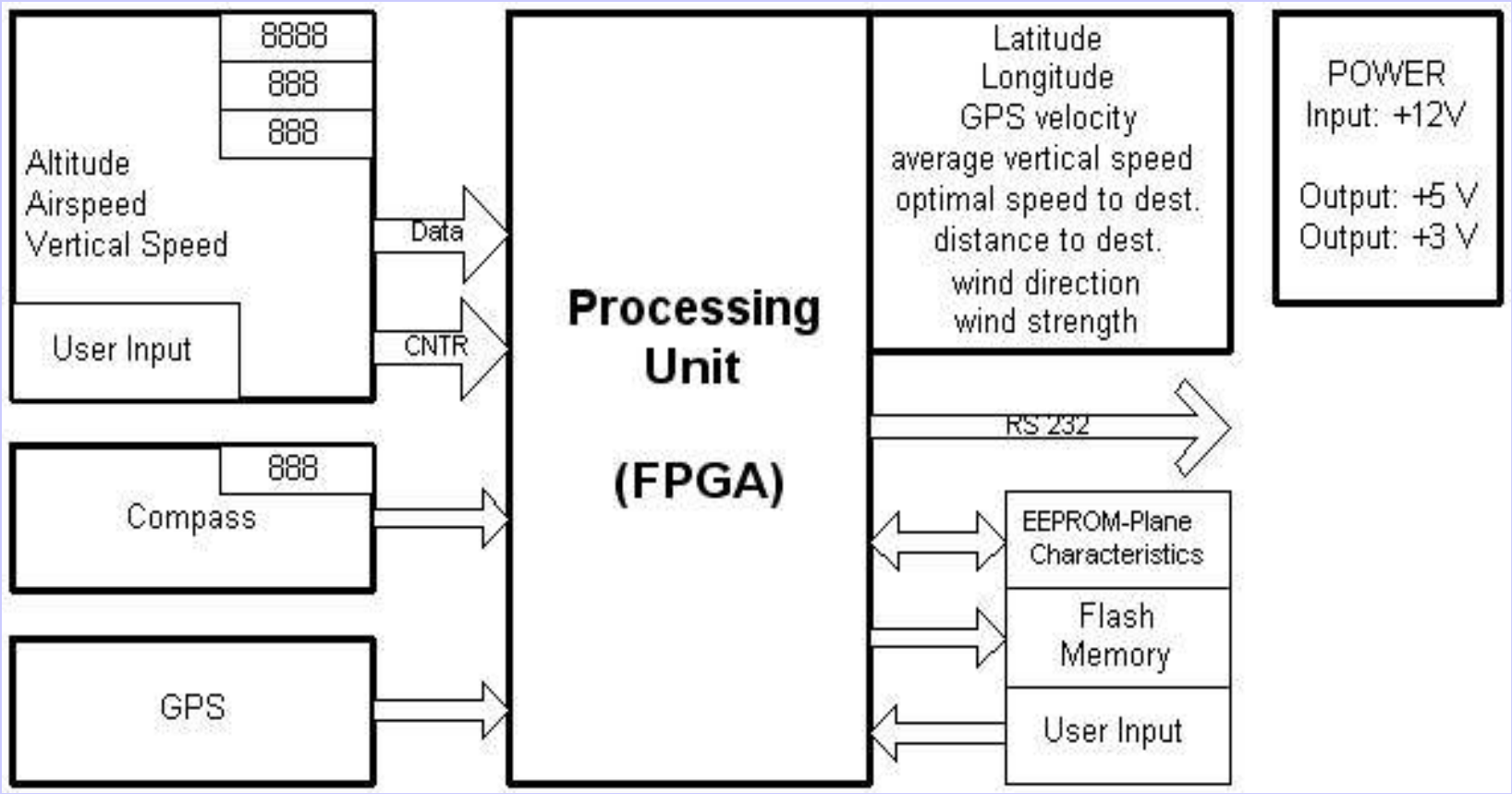
Debugging Process

- Algorithms for Motorola microcontrollers will be simulated
- Each module debugged independently
- Test drives

Bill of Materials

			part number	lead time	unit cost	quantity	total cost
	Part:	**Motorola MPXM2102A**					
	Prim. Dist.	Arrow	MPXM2102A	in stock	$5.76	1	$5.76
	Sec. Dist.	Digi-key	MPXM2102A-ND	in stock	$7.90	1	$7.90
	Part:	**Motorola MPXM2102D**					
	Prim. Dist.	Digi-key	MPXM2102D-ND	in stock	$7.90	1	$7.90
	Sec. Dist.	Arrow	MPXM2102D	12 weeks	$5.76	1	$5.76
	Part:	**Motorola 68HC912**					
	Prim. Dist.	Arrow	MC68HC912B32CFU8	in-stock	$15.99	2	$31.98
	Sec. Dist.	Digi-key	MC68HC912B32CFU8-N	in stock	$19.26	2	$38.52
	Part:	**Honeywell HMC1055**					
	Prim. Dist.	Digi-key	342-1036-ND	in stock	$60.00	1	$60.00
	Sec. Dist.	Honeywell	MHC1055	in-stock	$33.40	3	$100.20
	Part:	**Motorola M12+ Oncore**					
	Prim. Dist.	synergy-gps	P283T12N1x	in stock	$70.00	1	$70.00
	Part:	**Active GPS antenna**					
	Prim. Dist.	synergy-gps	GC3LP279CA	4-6 weeks	$30.00	1	$30.00
	Part:	**FPGA D2E**					
	Prim. Dist.	Digilent, Inc	D2E	in-stock	$109.00	1	$109.00
	Sec. Dist.	DSL lab		in stock	$0.00	1	$0.00
	Part:	**Lumex LCM-S02004DSF**					
	Prim. Dist.	Mouser	696-LCM-S02004DSF	in-stock	$31.50	1	$31.50
	Sec. Dist.	Digi-key	67-1763-ND	in stock	$31.50	1	$31.50
						Total:	$346.14

Questions?


8888
888
888
Altitude
Airspeed
Vertical Speed
User Input
Data
CNTR
888
Compass
GPS
Processing Unit
(FPGA)
Latitude
Longitude
GPS velocity
average vertical speed
optimal speed to dest.
distance to dest.
wind direction
wind strength
RS 232
EEPROM-Plane Characteristics
Flash Memory
User Input
POWER
Input: +12V
Output: +5 V
Output: +3 V