AWQuSam Engineering

Autonomous Water Quality Sampler (AWQuSam)

Final Design Review

Sponsor: Florida State University Department of Oceanography

April 11, 2012

Agenda

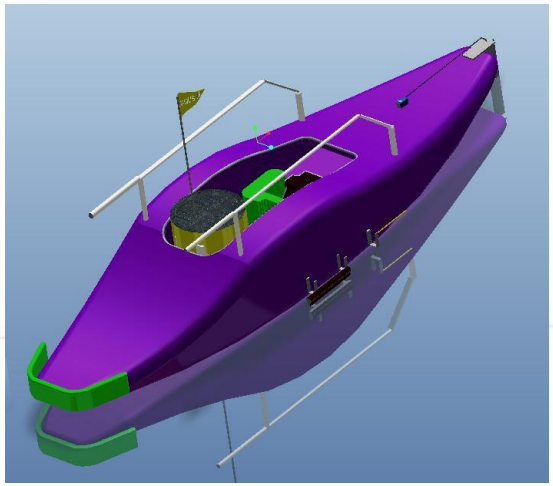
Thursday, April 11, 2012

- Project Overview
- Data Acquisition
- Data Logging
- Data Transmission
- Navigation
- Propulsion
- Steering
- Mechanical Housings
- Testing Results

Project Overview

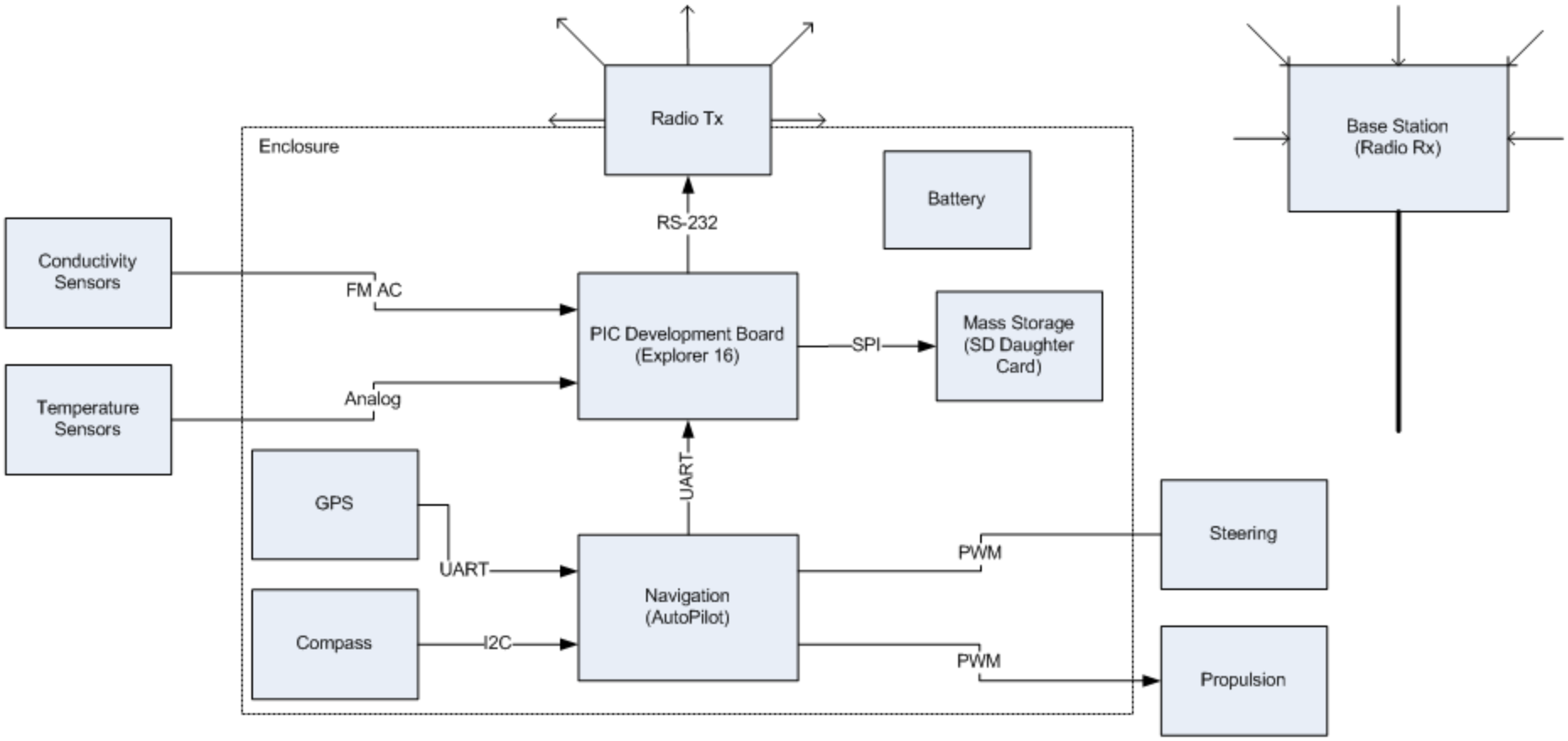
Brad Wells

Problem Description



- Gather Water Quality / Hydrographic Data
- Florida Shelf
  - Shallow Environment

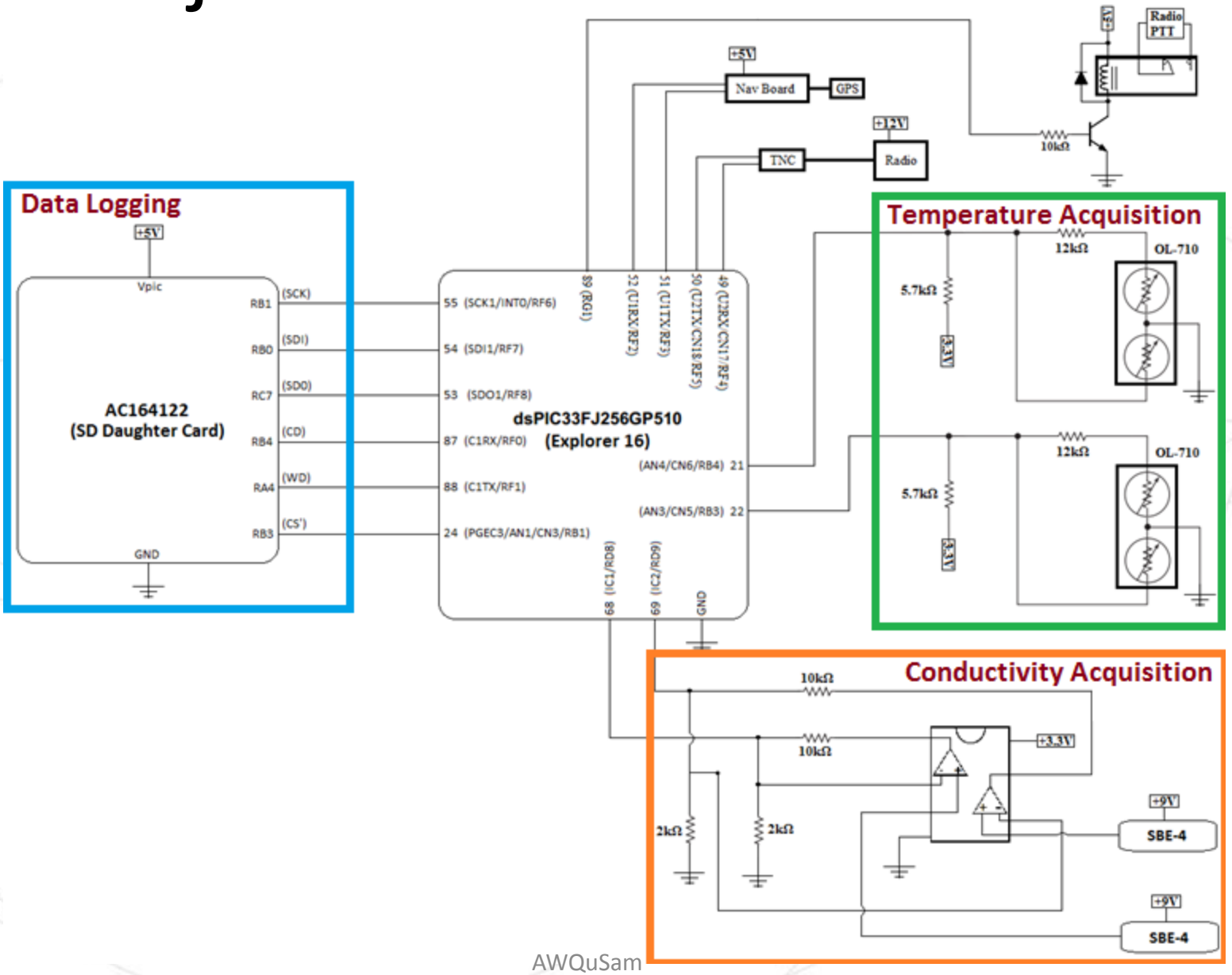
Design Solution



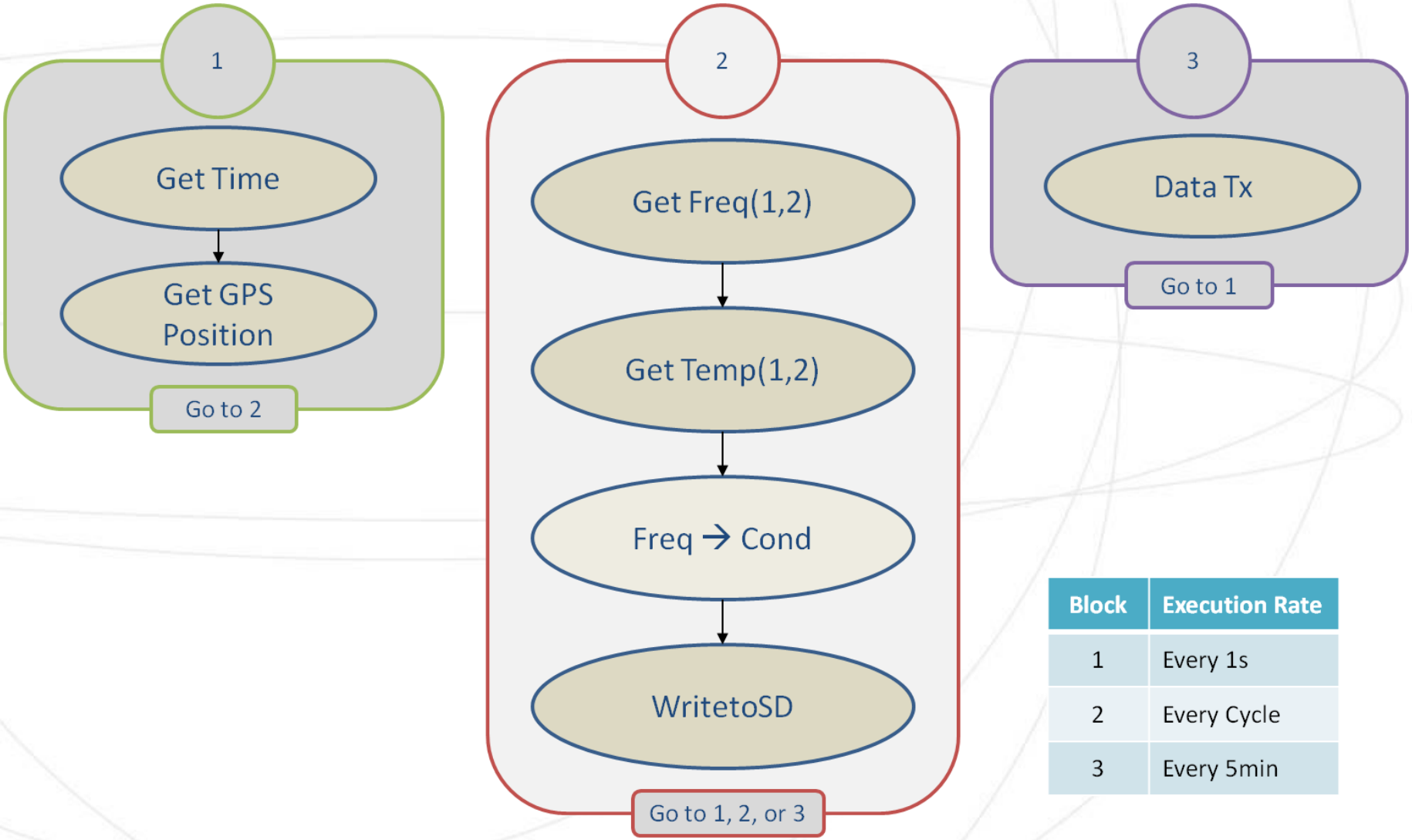
Data Acquisition

Brad Wells

Project Schematic Overview



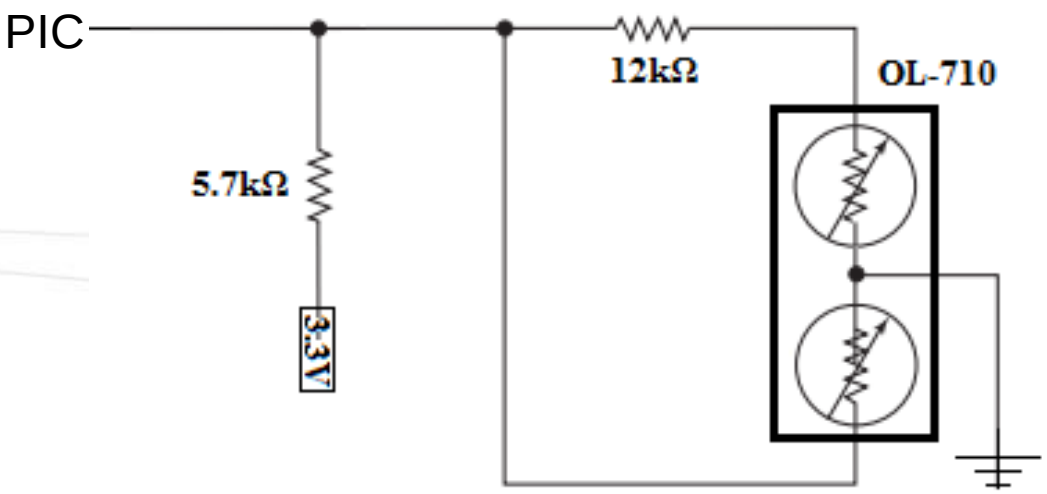
Explorer16 Development Board



Block	Execution Rate
1	Every 1s
2	Every Cycle
3	Every 5min

Temperature Sensors

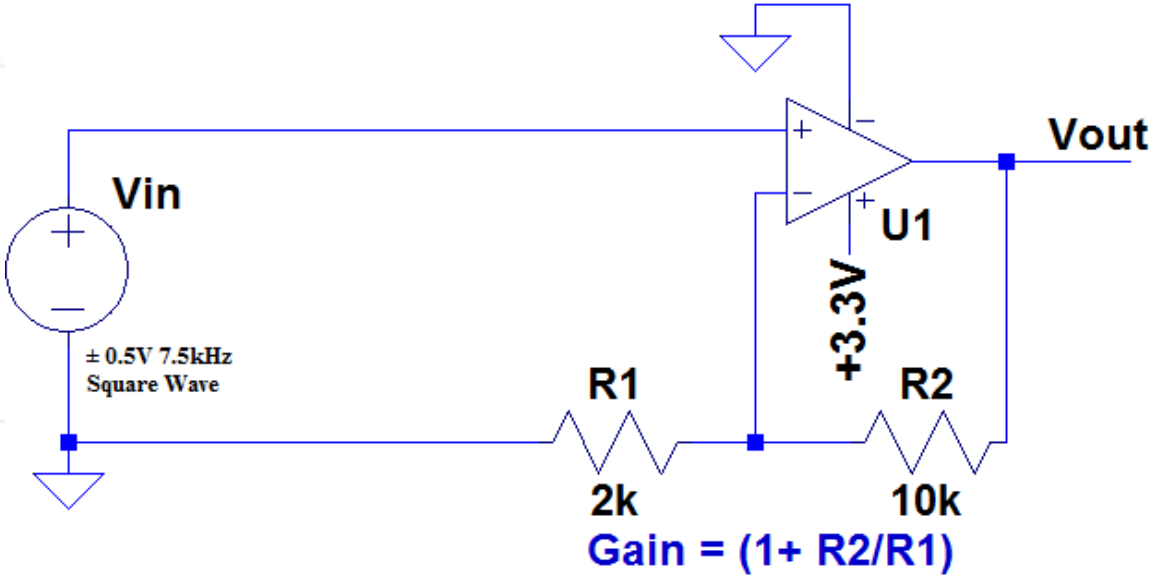
$$T = \frac{.805858 \cdot V_{in} - V_{out}}{.0056846 \cdot V_{in}}$$

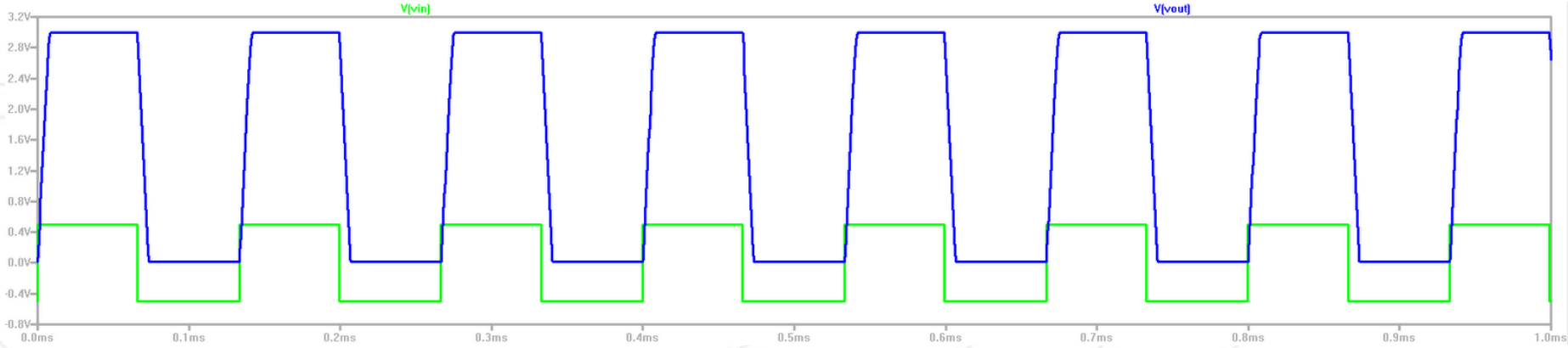


Omega OL-710
Fast Response Thermistor

Conductivity Sensors

Seabird SBE-4





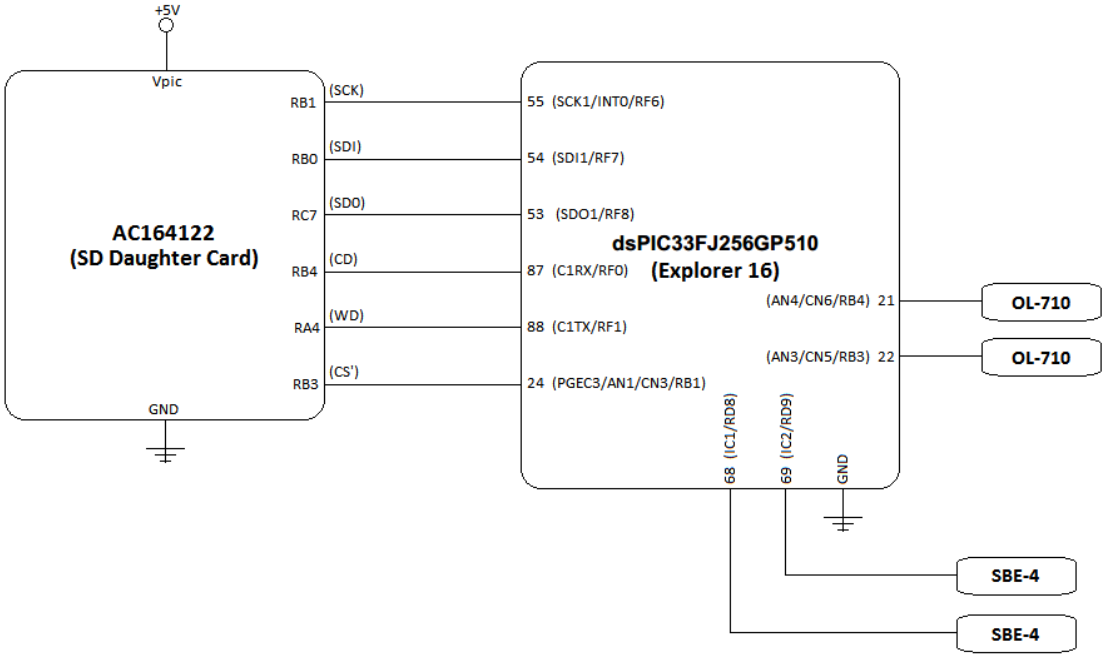
$$\text{Conductivity} = \frac{(g + hf^2 + if^3 + jf^4)}{10(1 + \delta t + \varepsilon p)} \quad \text{Siemens/meter}$$

Data Logging and Handling

Brad Wells

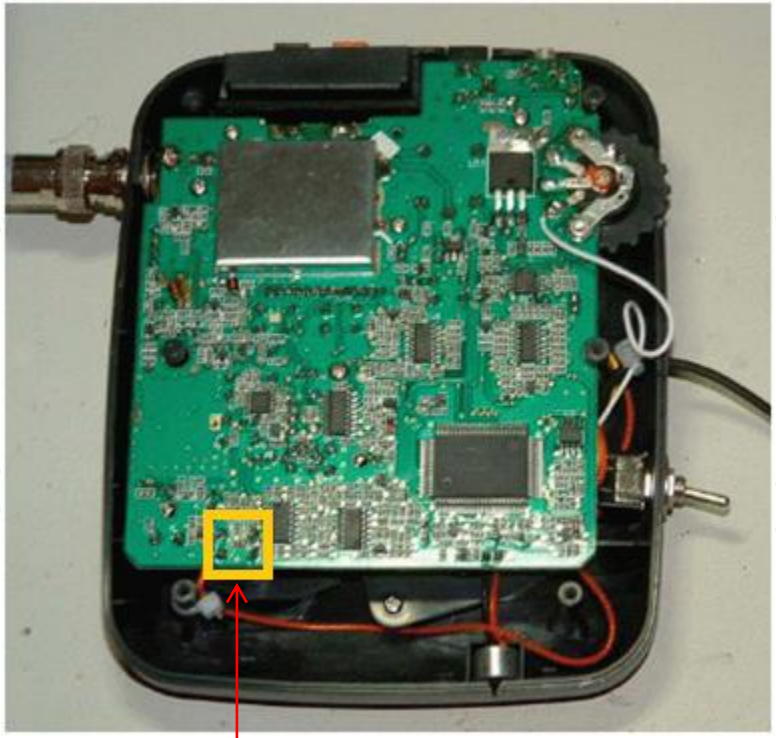
Data Logging

- **Format**
  - Text File
  - Tab Delimited Values
- **Memory**
  - Memory needed = 10.36 GB
  - SD daughter card = 16 GB
- **Procedure**
  - Initialize card
  - Open/create File
  - Write to card
    - Function with data as Parameters
  - Close SD when complete

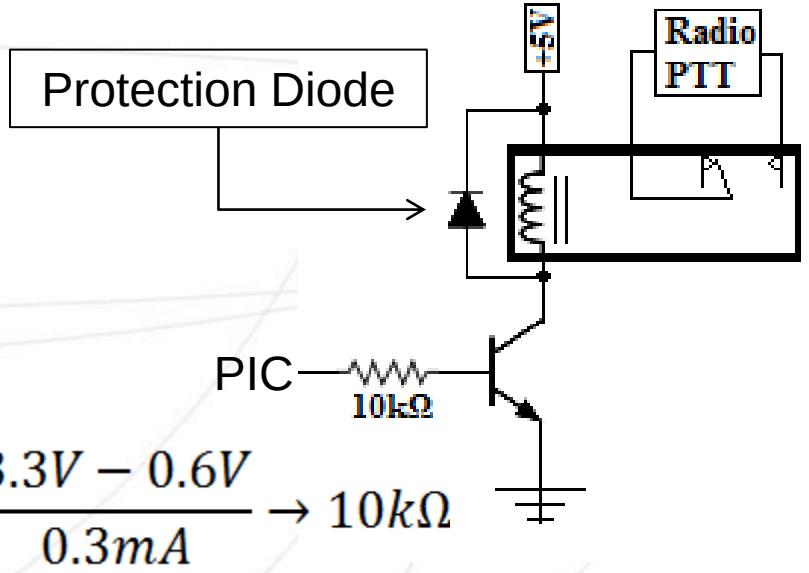


t=0s	Time, Latitude, Longitude, Conductivity1, Conductivity2, Temperature1, Temperature2
	, , , Conductivity1, Conductivity2, Temperature1, Temperature2
	, , , Conductivity1, Conductivity2, Temperature1, Temperature2
	, , , Conductivity1, Conductivity2, Temperature1, Temperature2
	, , , Conductivity1, Conductivity2, Temperature1, Temperature2
	, , , Conductivity1, Conductivity2, Temperature1, Temperature2
	, , , Conductivity1, Conductivity2, Temperature1, Temperature2
	, , , Conductivity1, Conductivity2, Temperature1, Temperature2
t=1s	Time, Latitude, Longitude, Conductivity1, Conductivity2, Temperature1, Temperature2
	, , , Conductivity1, Conductivity2, Temperature1, Temperature2

Data Transmission
Push to Talk

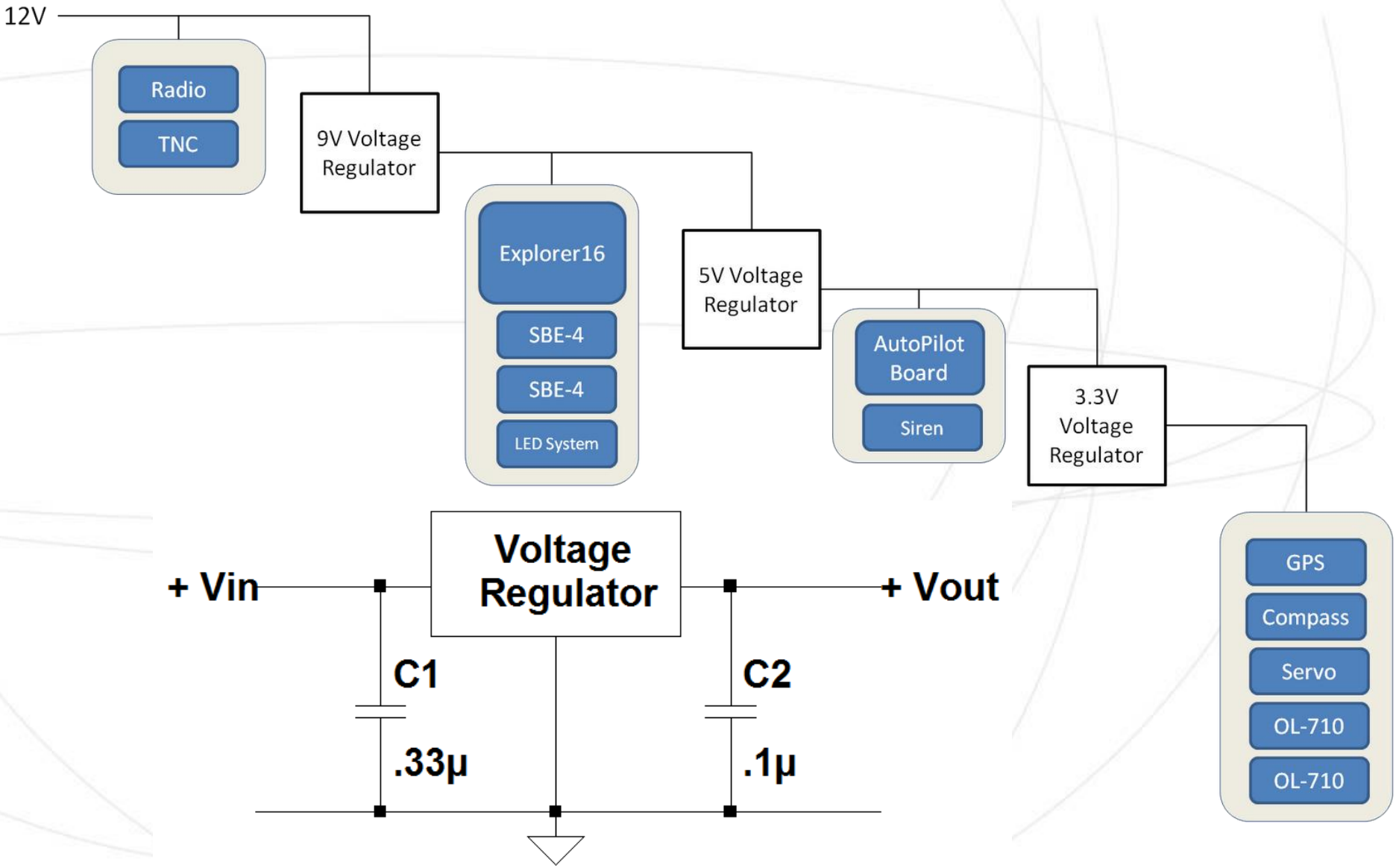


- Relay switches w/ 30mA through coil
- Must use BJT to amplify current

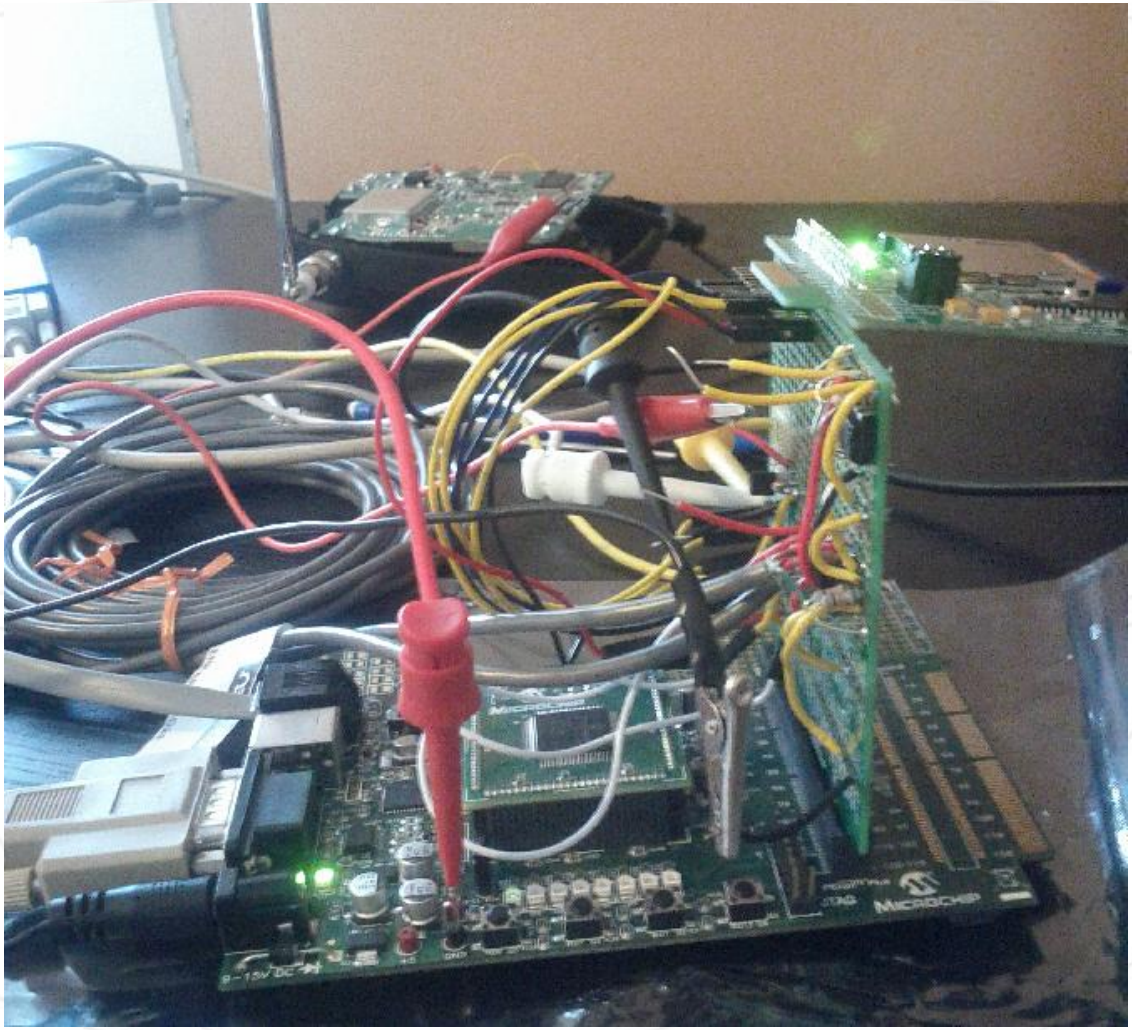


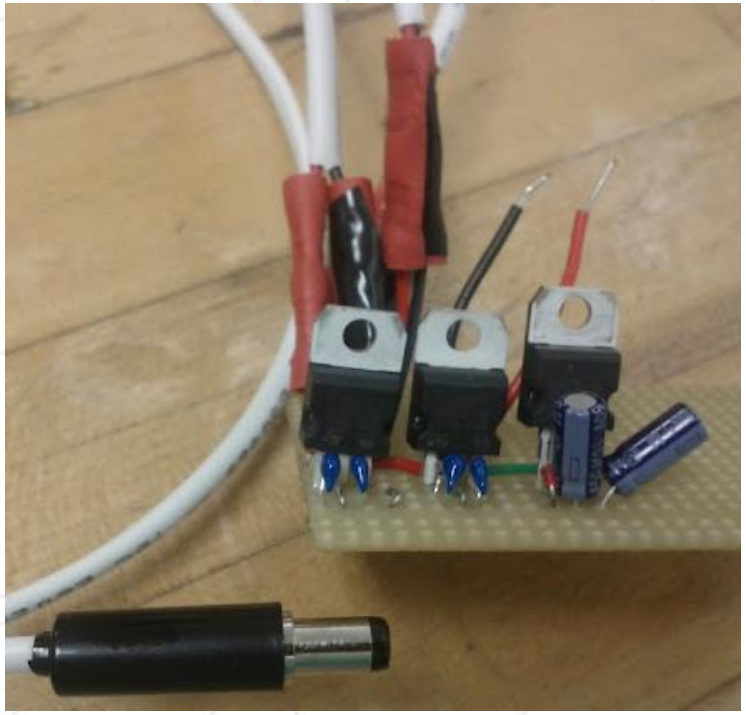
$$\frac{3.3V - 0.6V}{0.3mA} \rightarrow 10k\Omega$$

Power System



Integration Testing

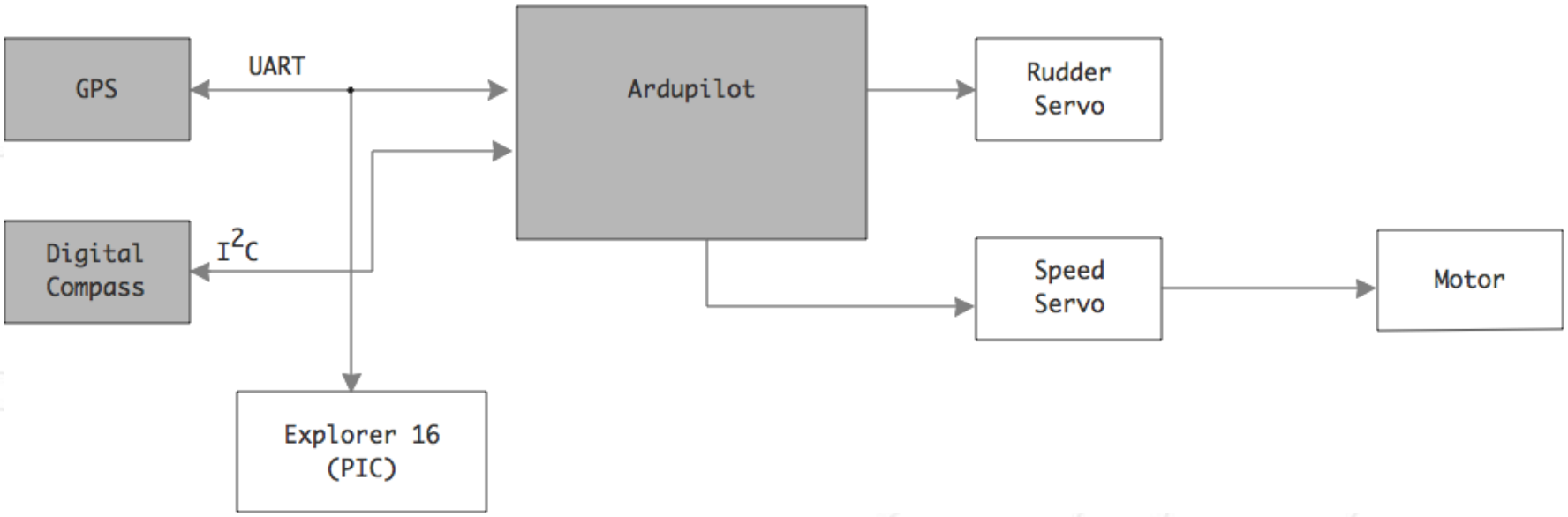




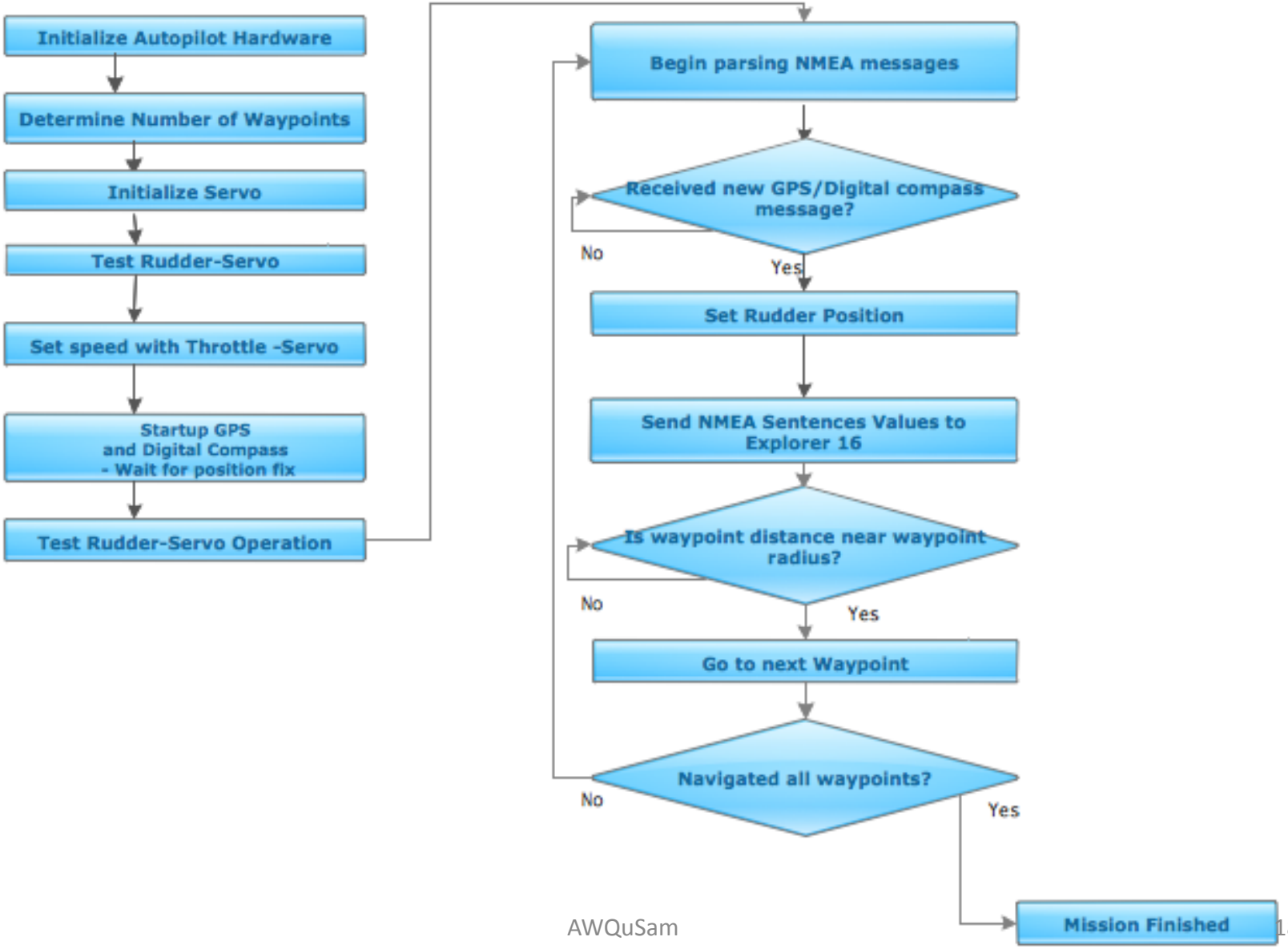
Navigation

Triesha Fagan

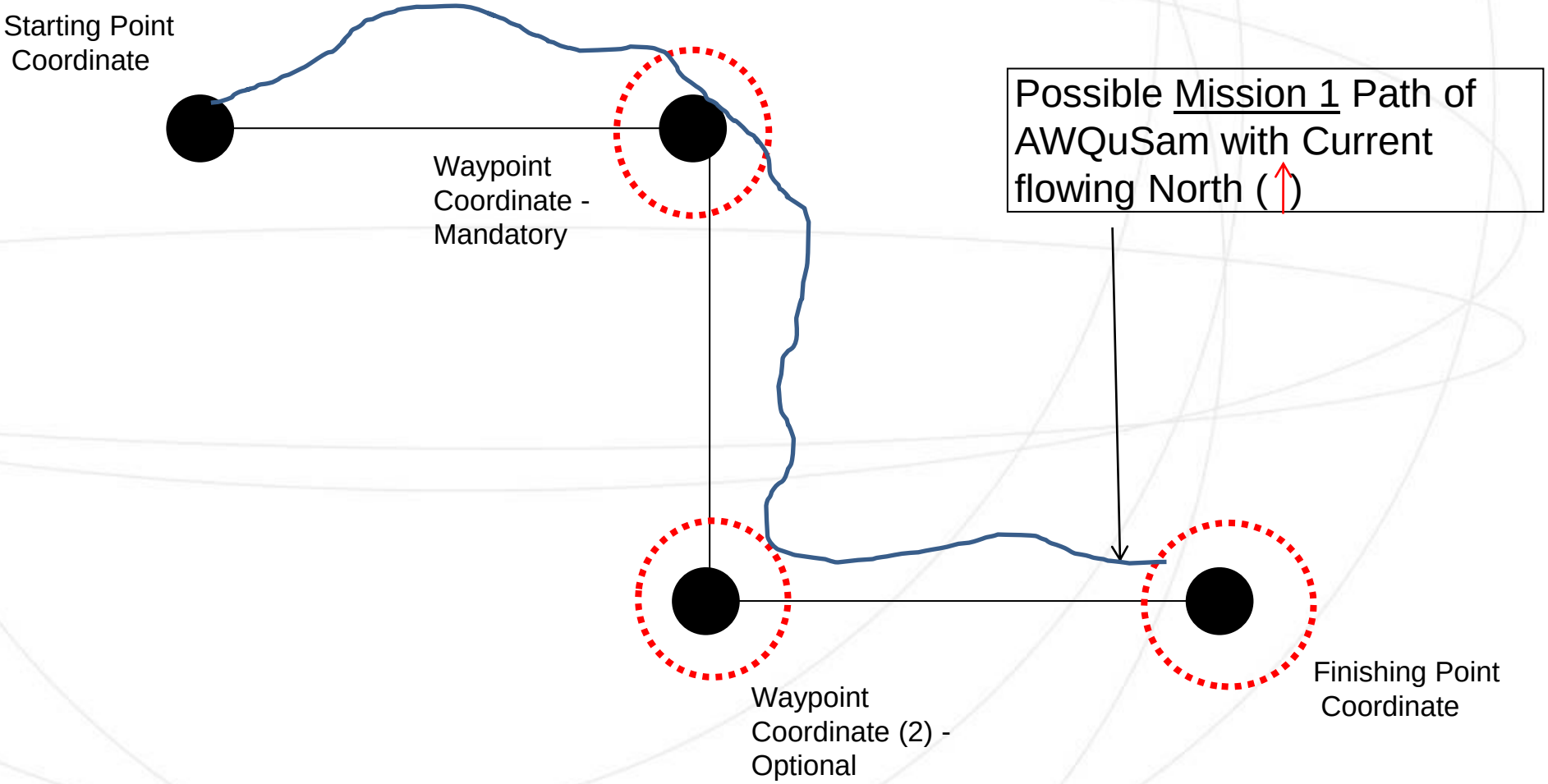
Top-level Architecture of Navigation System



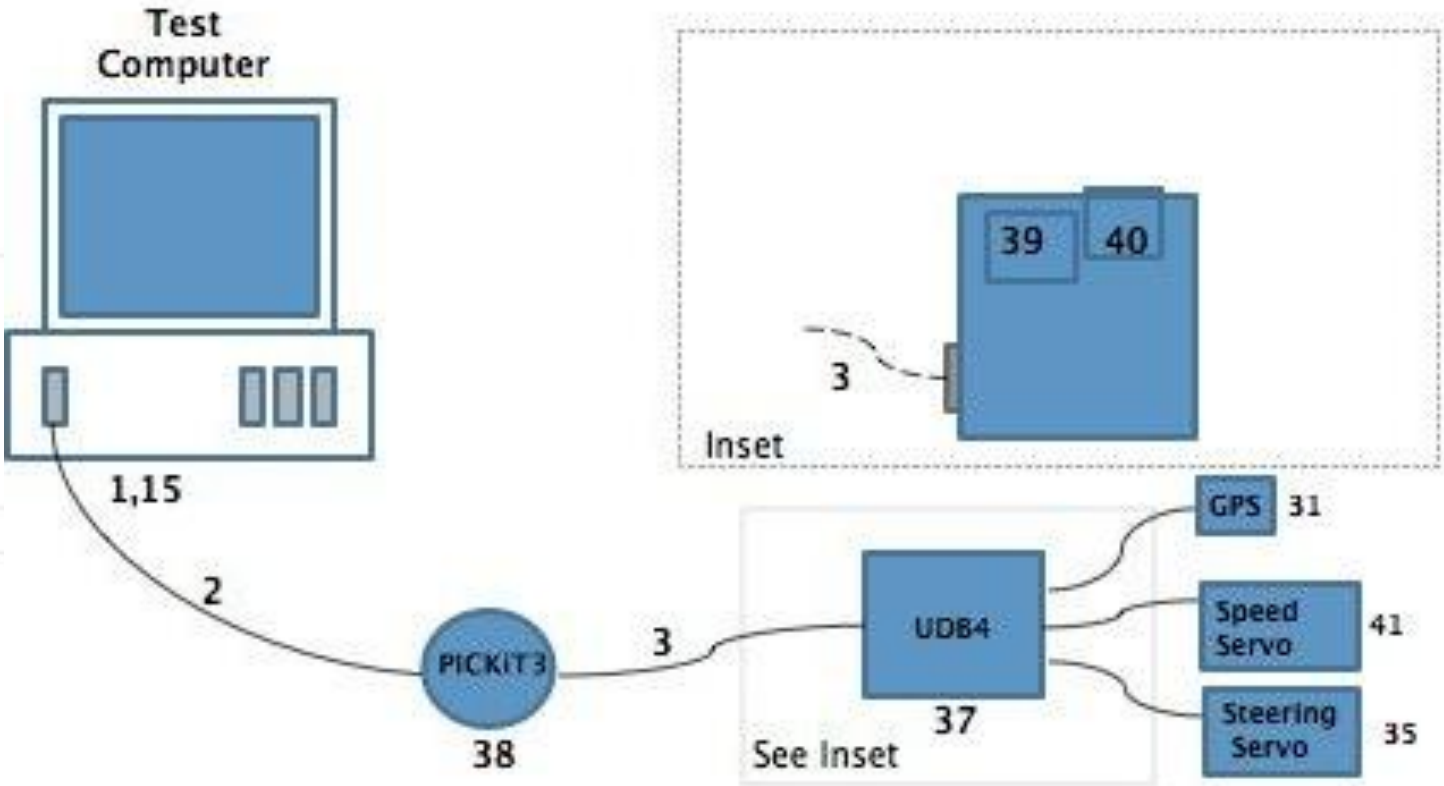
Flowchart: Operation of Navigation System



Motion Planning



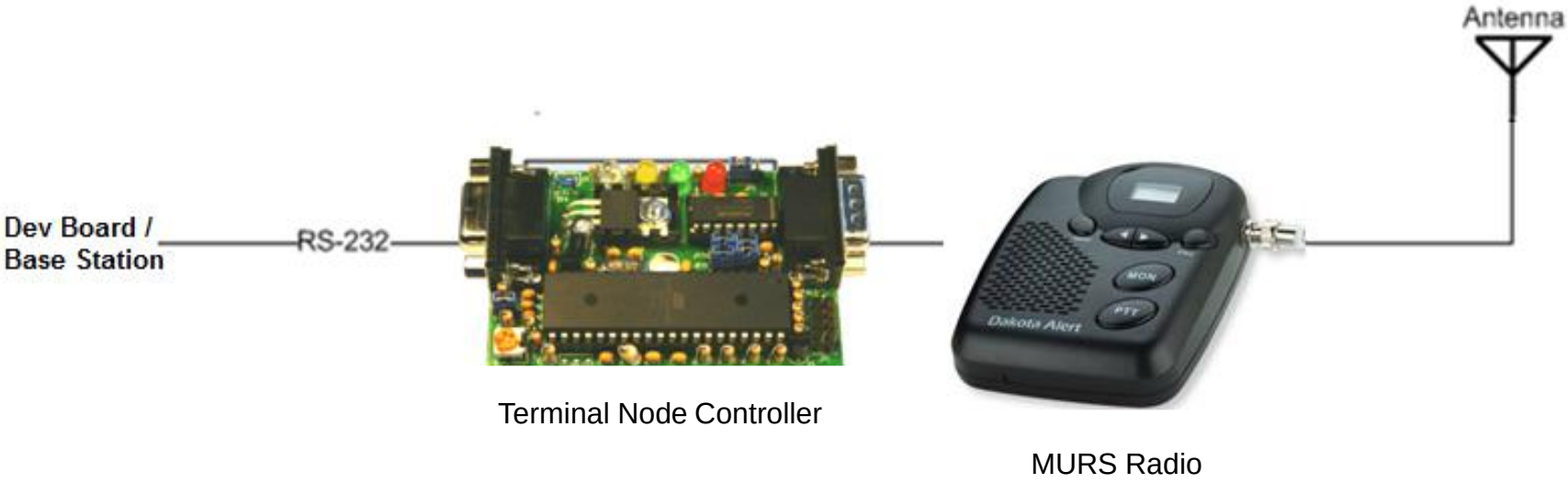
Test Configuration



Data Transmission

Steven Golemme

Data Transmission



Terminal Node Controller

MURS Radio

System Requirements

- Transmit Real-time data every 5 minutes
- Transmit longitude, latitude, time, conductivity, and temperature
- Maximum distance of 5km

MURS Radio (**M**ulti-**U**se-**R**adio-**S**ervice)

Radio Specifications

- Dakota Alert MURS base station model M538 – BS
- Federal Communications Commissions (FCC) approved unlicensed band
- Frequency range 151.8 – 154.6 MHz

Antenna Specifications

- Firestik MURS45 Antenna
- 5/8 wave antenna
- Propagates better in the horizontal plane
- Isotropic gain of 6db
- 45 inches

TinyTrak4 (Terminal Node Controller)

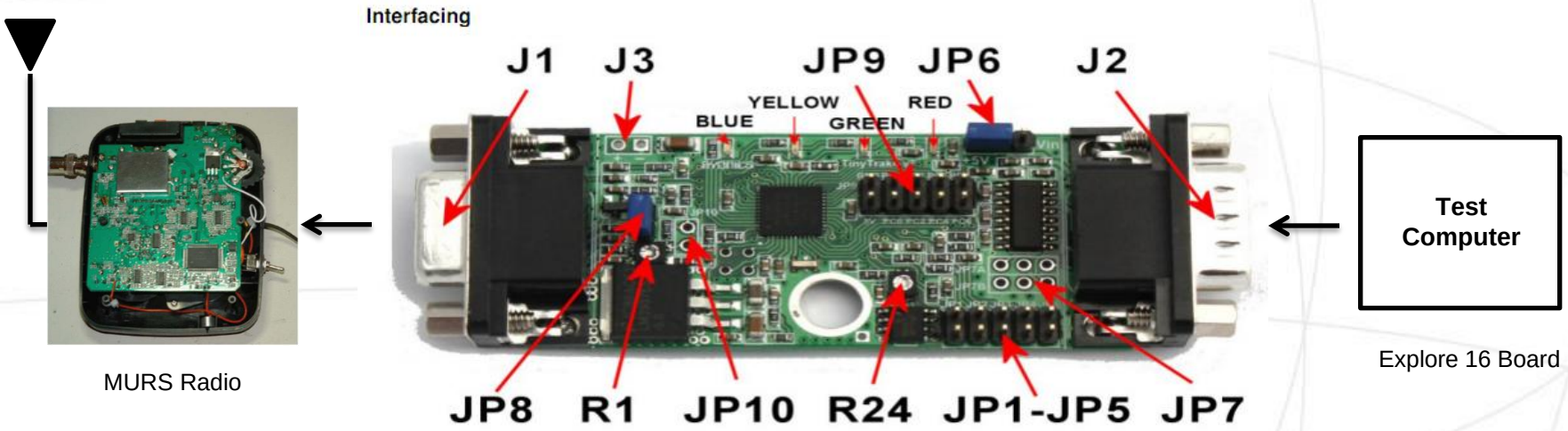


Figure 3.8.1.1: TinyTrak4 Terminal Node Controller

J1 - Radio

Pin	Function	Description
1	Audio out	Generated packet or other audio tones to be transmitted via the radio microphone jack.
2	Carrier Detect	Digital carrier detect state from radio. Can either be active high or active low.
3	PTT Out	This line is grounded when the radio should transmit. Connect to radio PTT input.
4	JP1	Optional J1 interface to the JP1 line. Can be an analog or digital input, or output, depending on firmware.
5	Audio in	Audio received from the radio via the earphone or speaker jack.
6	Ground	Ground return for power, audio, PTT and all other signals.
7	Power In	Power input to the TinyTrak4. Can be 6V to 18V.
8	PTT In	State of optional external microphone PTT switch. Grounded during transmit.
9	No connection	May be end-user wired for custom features.

Testing Data Transmission

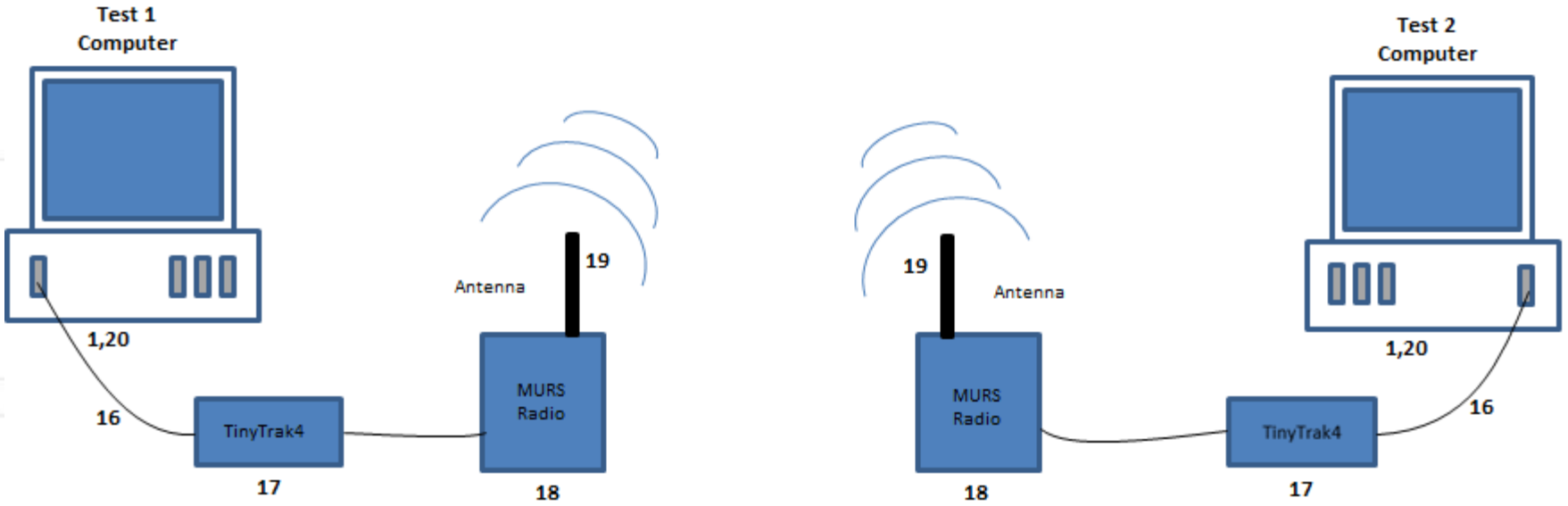
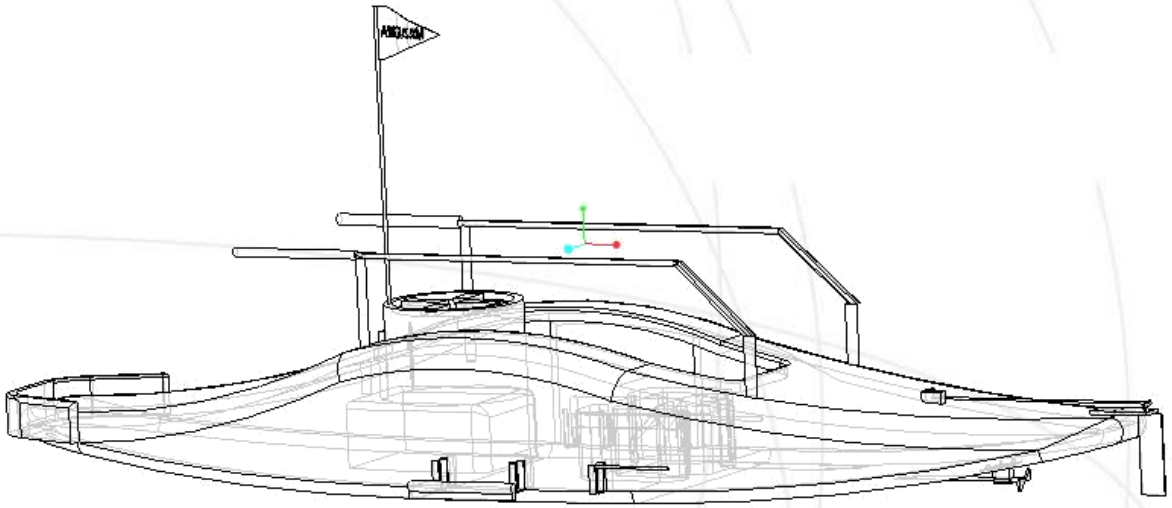


Figure 4.2.5: Test Configuration for Data Transmission

Mechanical Housing Safety Features Cooling System

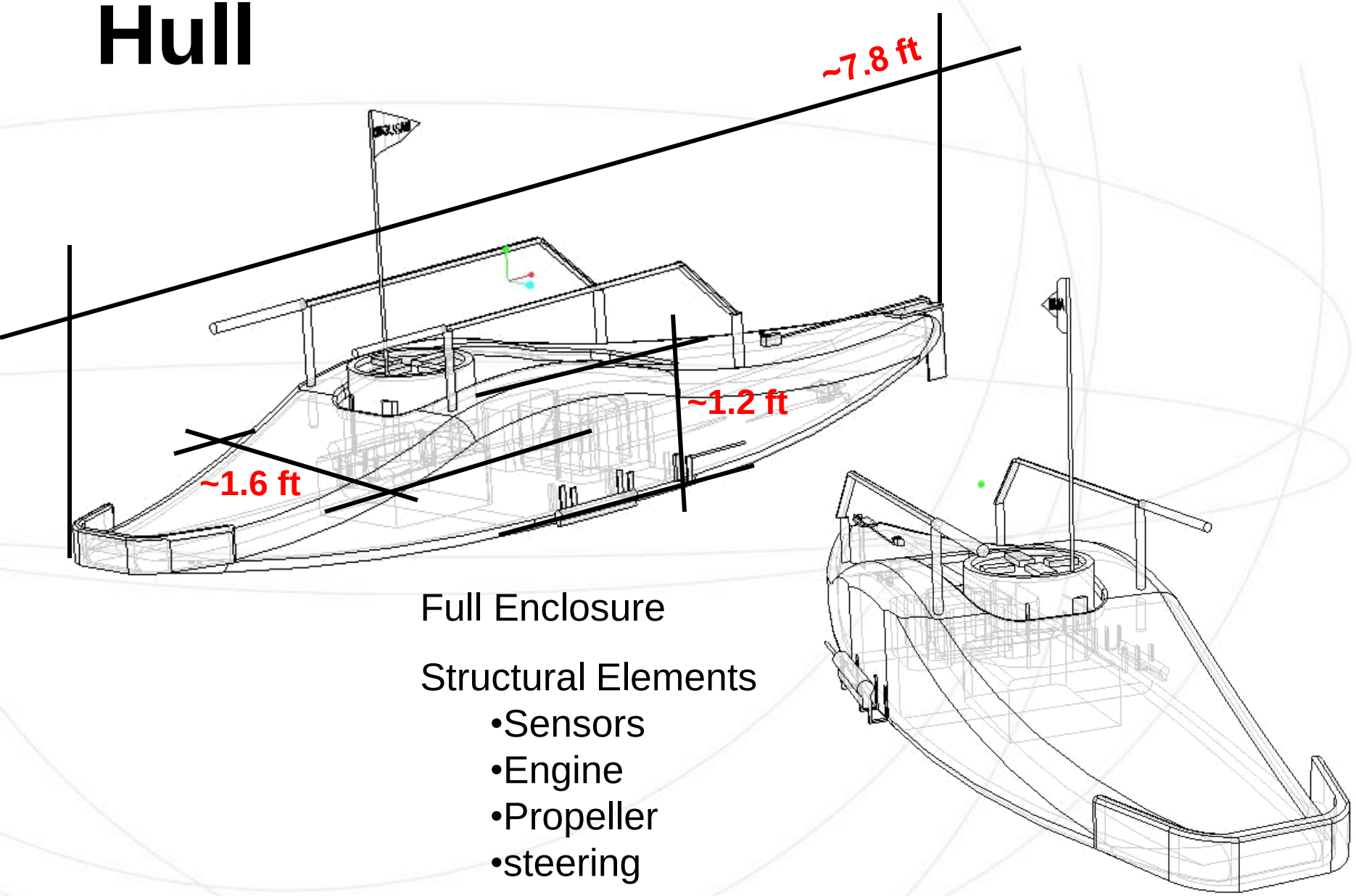
Juan Garcia de Paredes

Hull



- Riot Trickster Kayak.
- Cheaper, most durable, hydrodynamic.
- Required a Mounting Structure

Hull

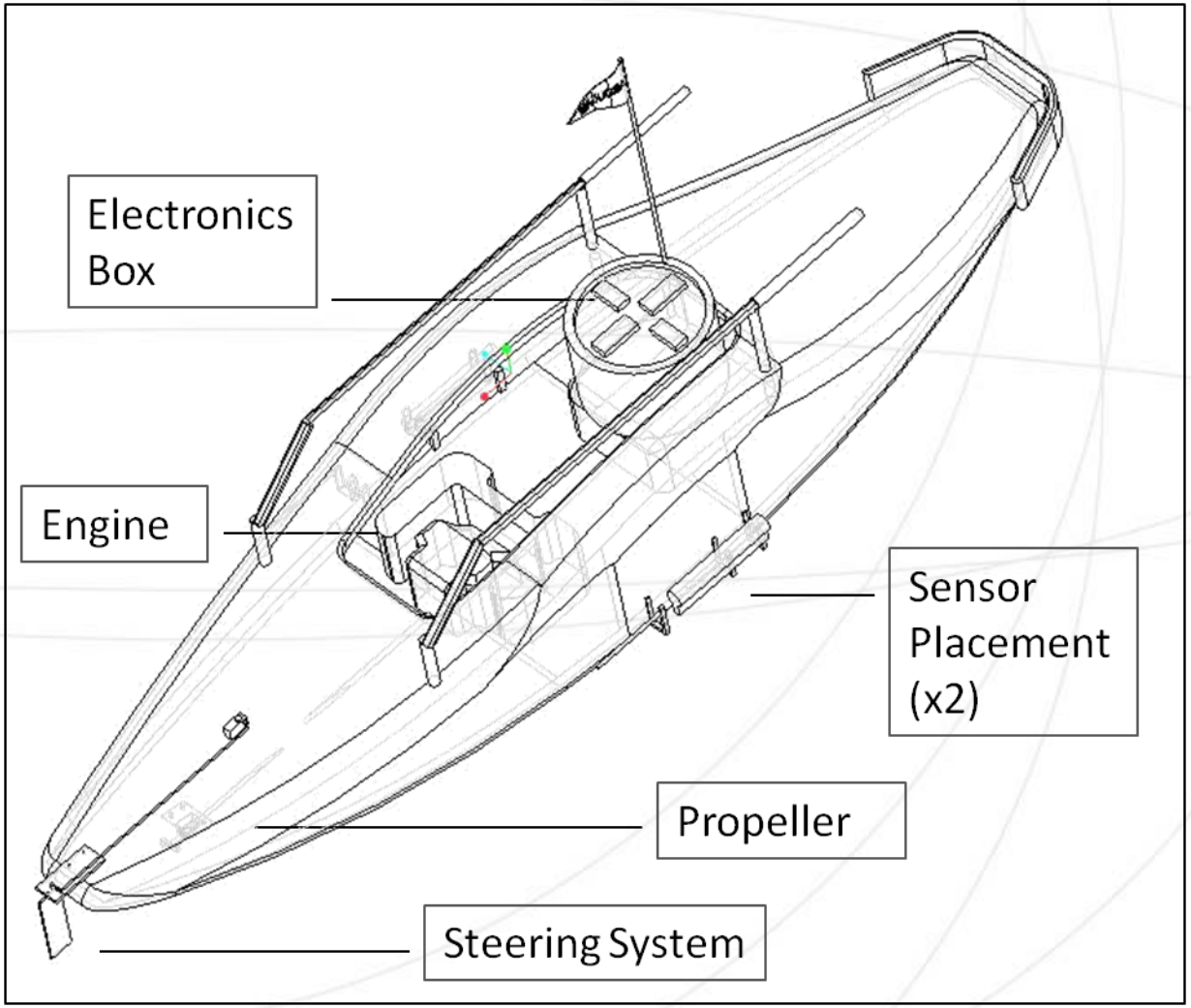


Full Enclosure

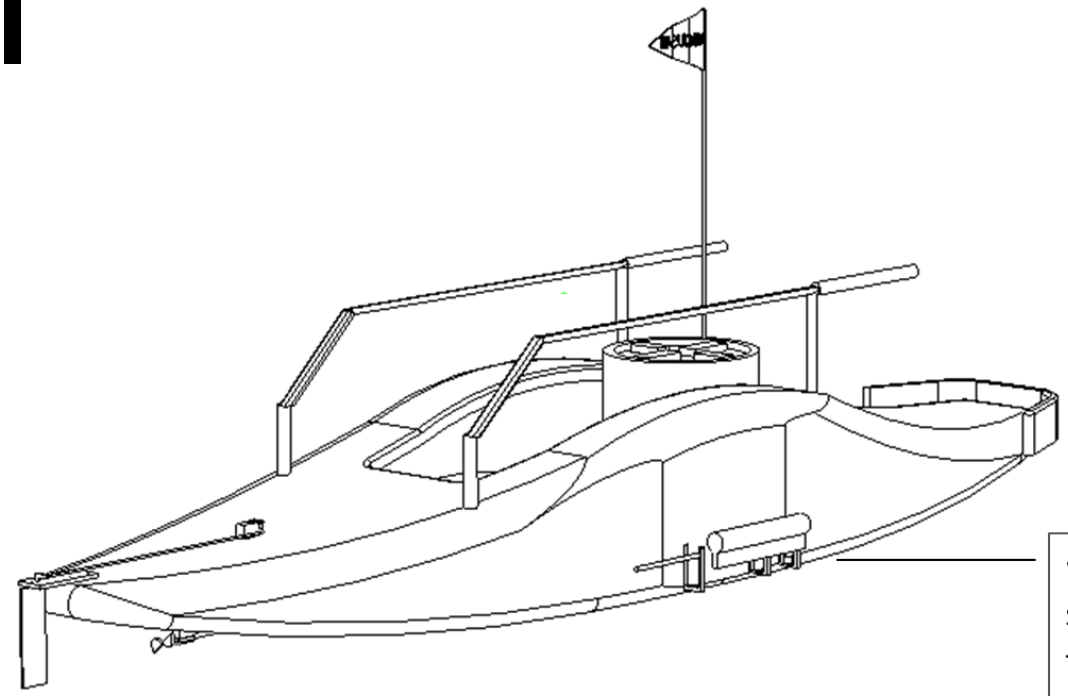
Structural Elements

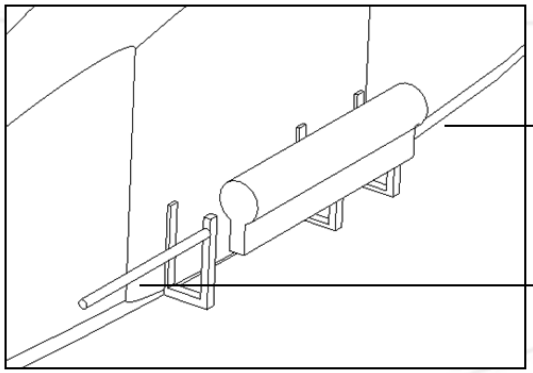
- Sensors
- Engine
- Propeller
- steering

Major Components



Hull





Salinity sensor

Temperature sensor

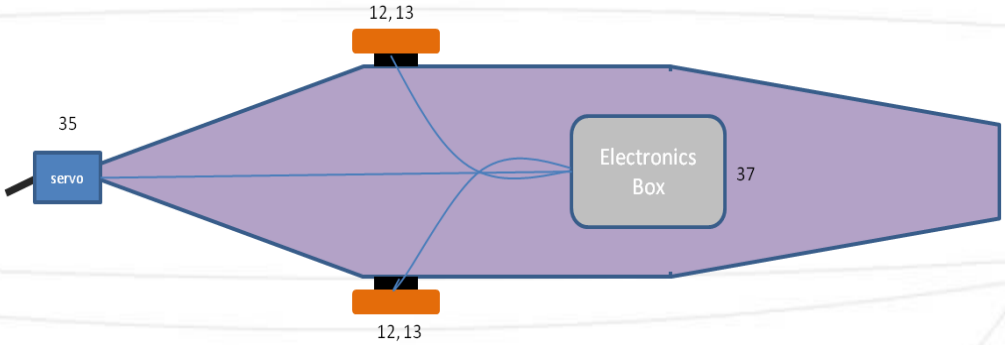
- Temperature and salinity sensors are fixed on both sides of the craft by steel plates and bolts.
- They can be fixed into different depth position by simply attaching it to prescribed increments that are 1 in. apart.

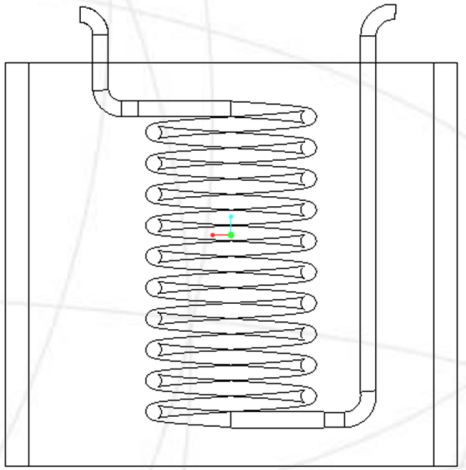
Hull

- Cover from rain
- Engine Placement
- Electronics Box fixed by 3M velcro

Electronic Housing

- Water Tightness
- Overheating Prevention





Safety System

- Public Safety
- Easy Detection
- LED nighttime system
- Brightly Colored
- Loud Siren
- Foam Bumber
- Obstacle Avoidance

Propulsions System
Steering System

Carlos Sanchez

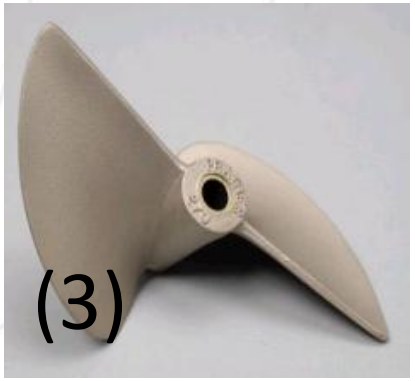
Propulsion System.

Will Consist on three major parts:

- (1) the engine;
- (2) the connecting shaft assembly;
- (3) the propeller

(1)


(2)

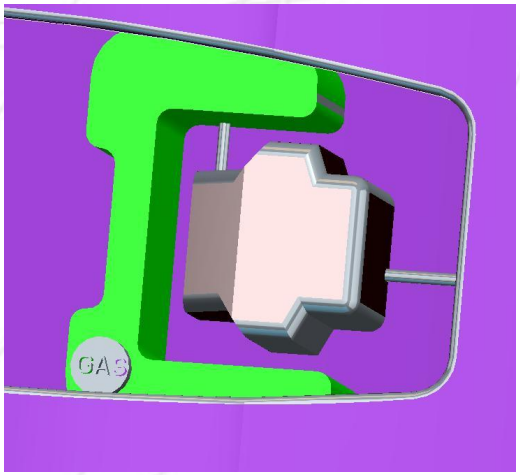

(3)

The Engine

- 4 stroke gasoline engine.
- A pull-cord for cranking.
- Only 3.33 kg.
- 2- 2.5 gallons of fuel
- 12 hour mission.

It needs:

- An external fuel tank

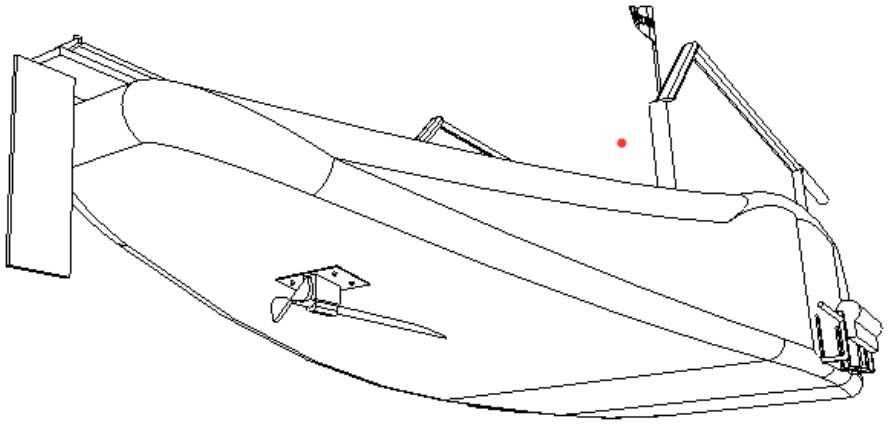


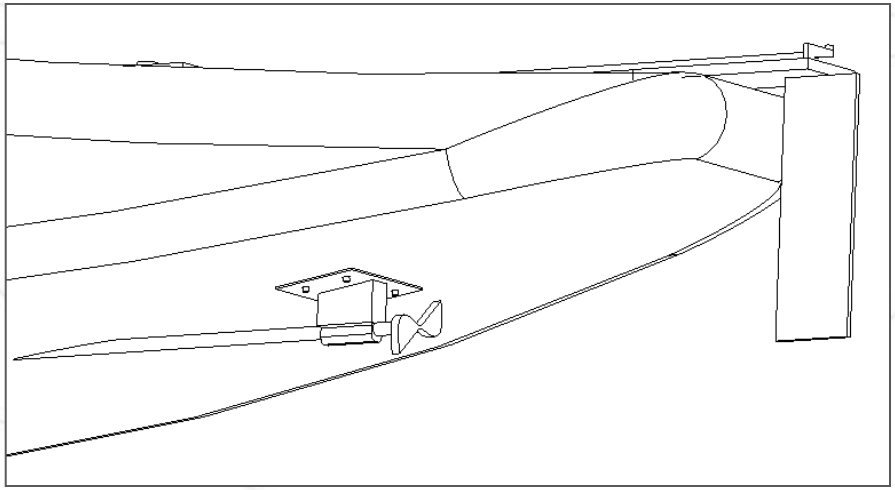
The Shaft Assembly

Torque Transmission

Consists on:

1. The aluminum strut
2. A flexible dark metal shaft
3. A thin hollow Teflon tube





The Propeller

Used “*prop algorithm*” developed in the United Kingdom

Counterclockwise 2.8 inch diameter, 4.5 inch pitch and about 30-40 % mean area.

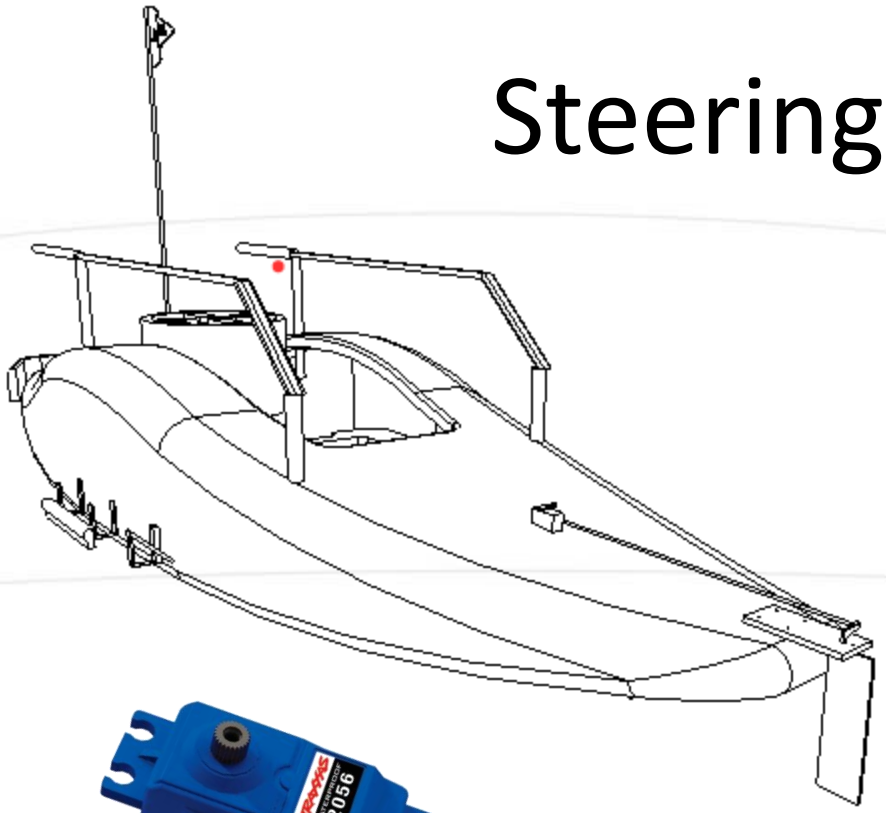
Numerous variables have to be taken into account :

rpm range, engine horsepower, outputted torque, hull displacement, gearbox

reduction if applicable, percentage of power loss due to bearings, speed length ratio,

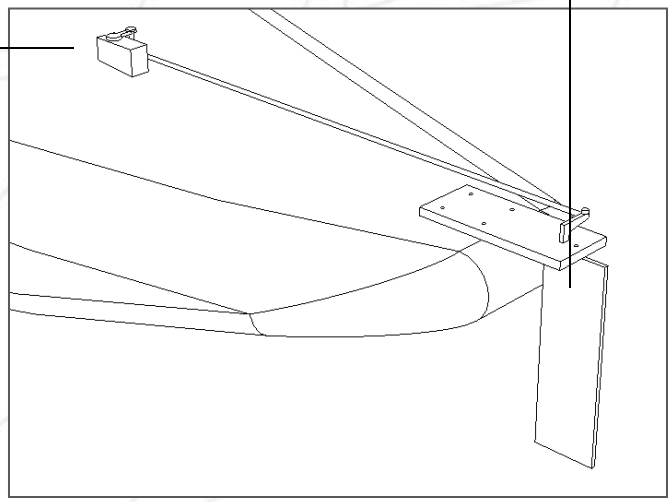
drag “C” value and more.

Steering System



Custom-made rudder

Waterproof high torque digital servo (80 oz/in)

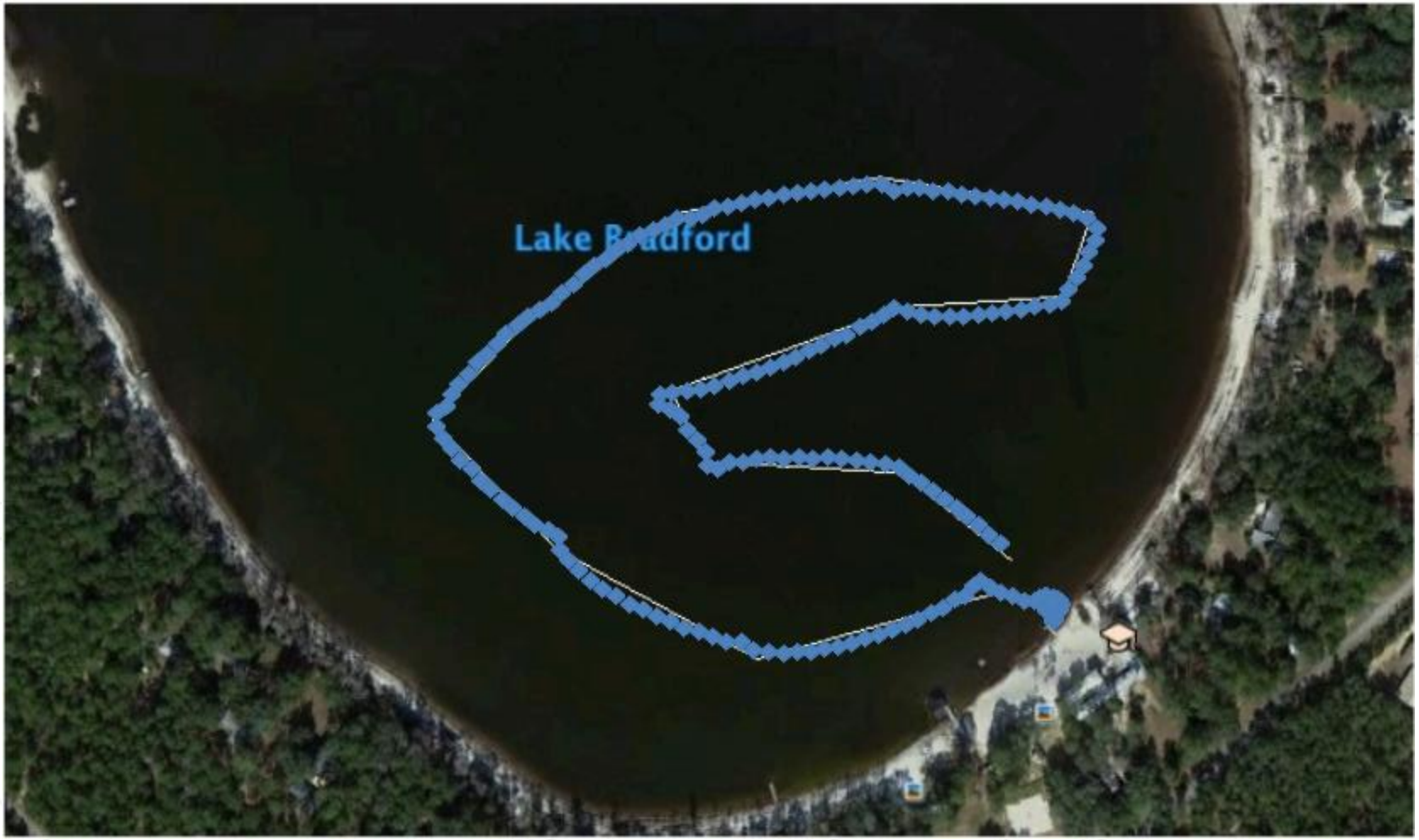


Verification Testing

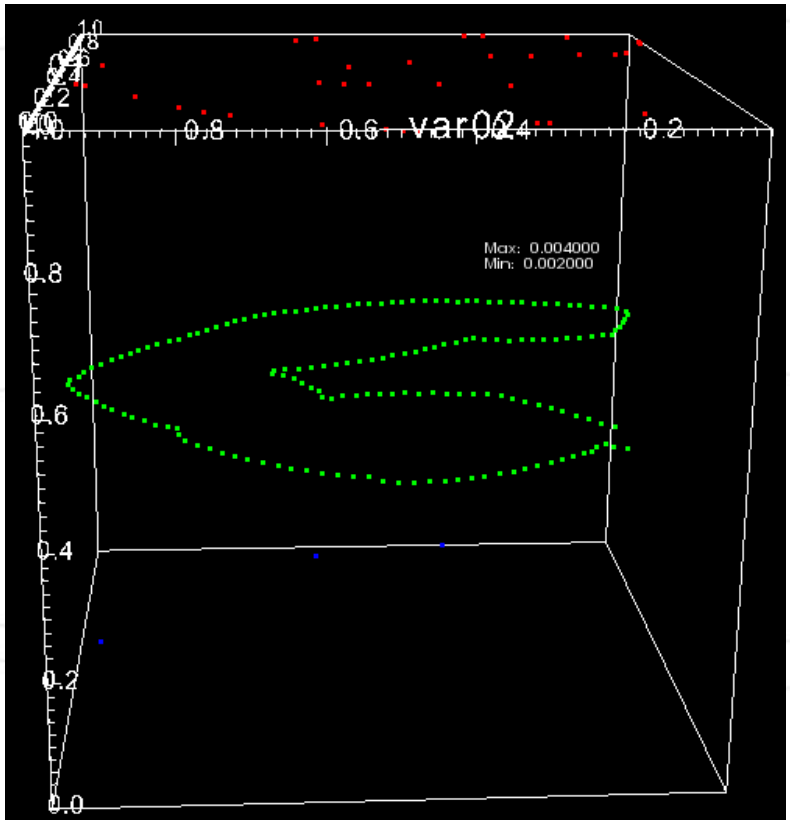
Brad Wells

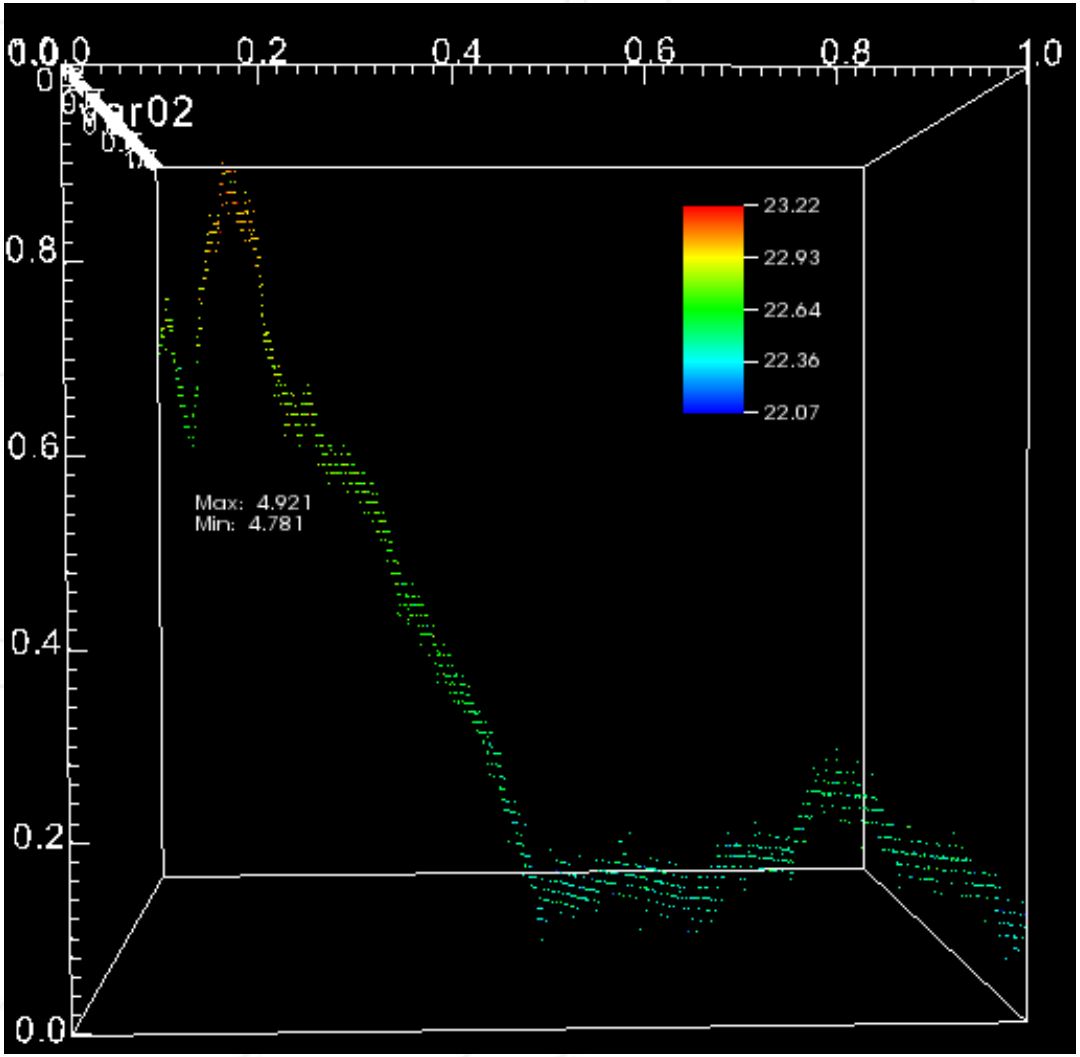
Verification Testing

Verification Testing



Data Visualization



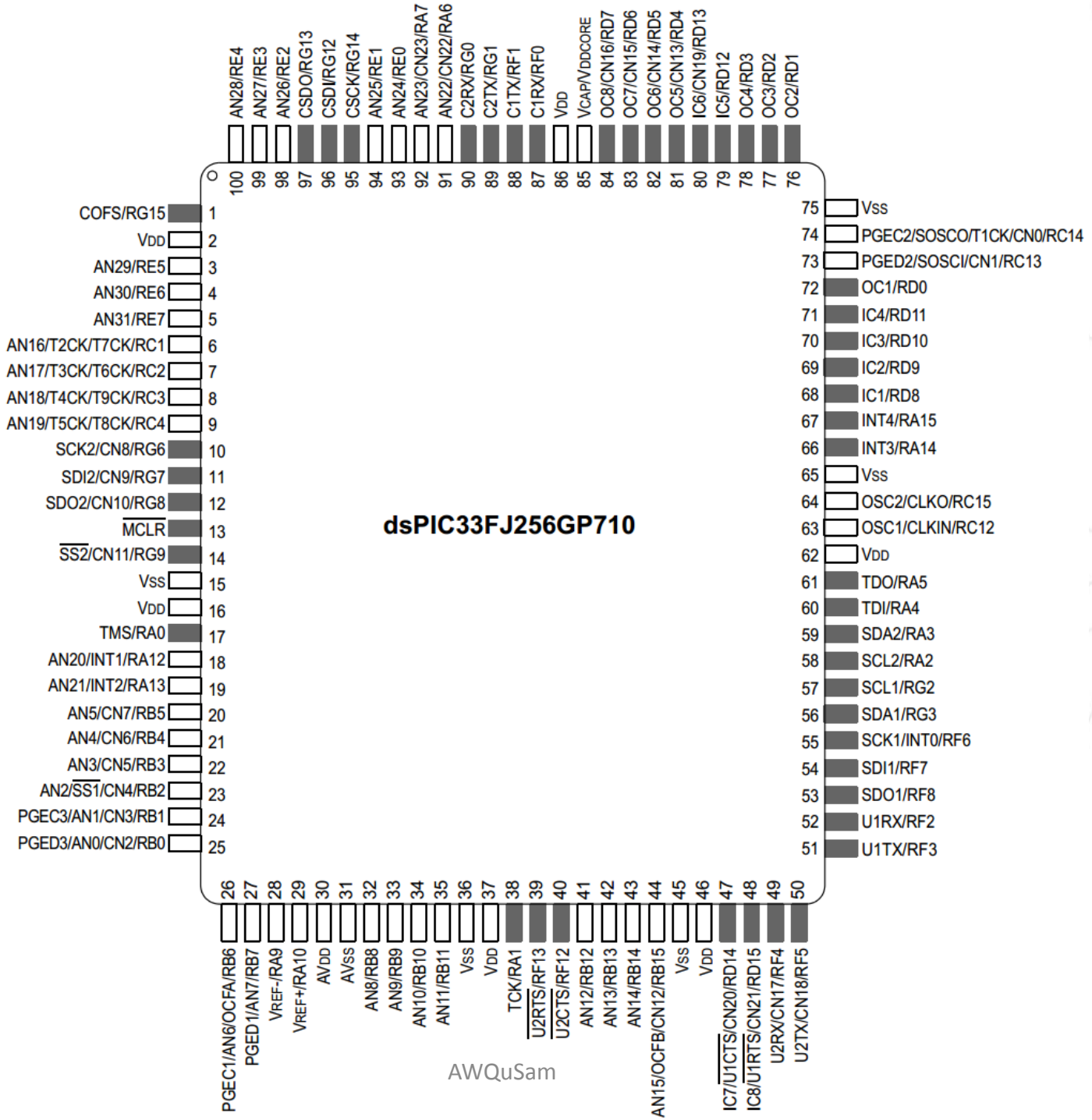


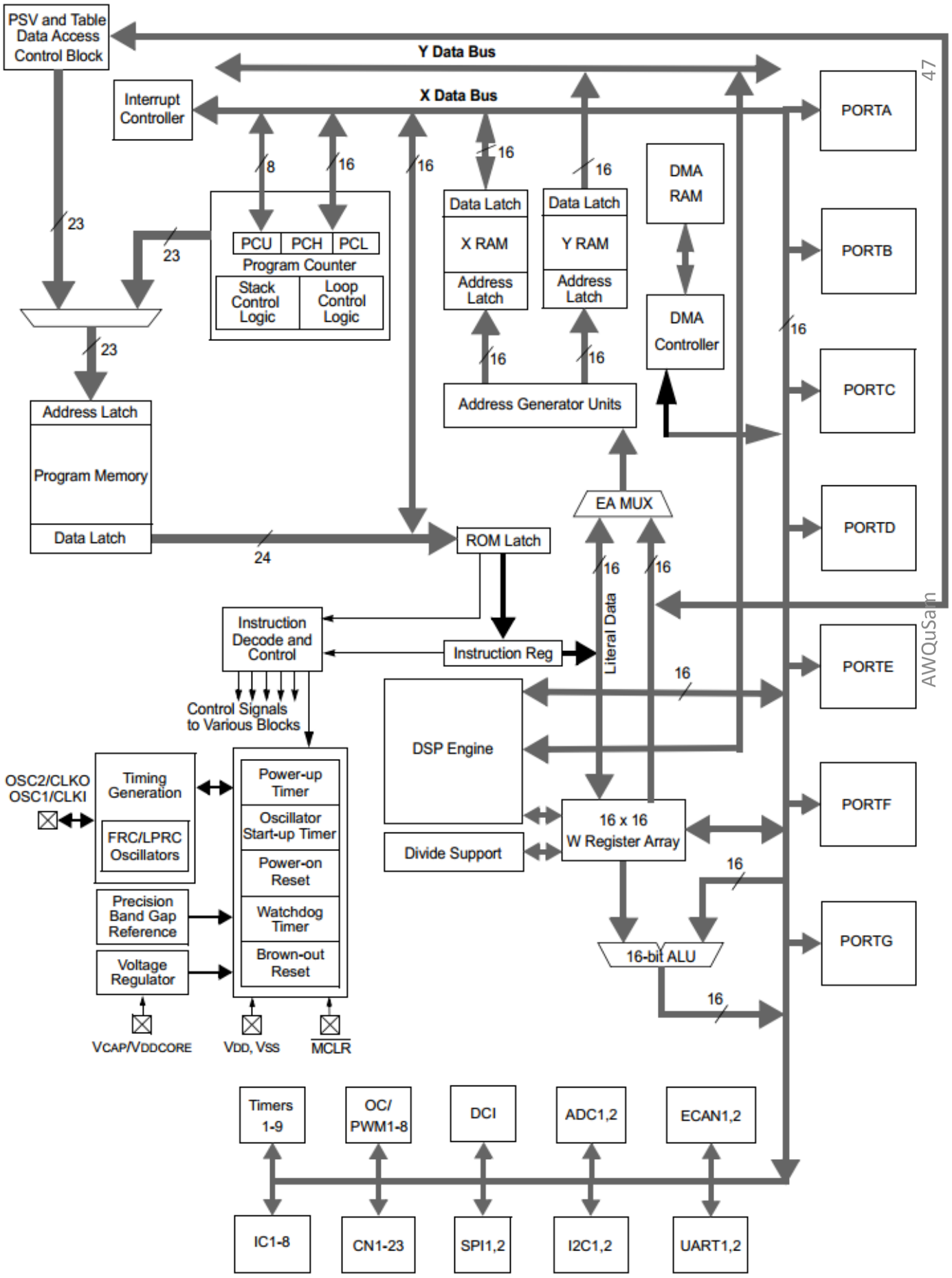
Questions?

AWQuSam Engineering

Thanks Each of You

Additional Slides


dsPIC33FJ256GP710
1 COFS/RG15
2 VDD
3 AN29/RE5
4 AN30/RE6
5 AN31/RE7
6 AN16/T2CK/T7CK/RC1
7 AN17/T3CK/T6CK/RC2
8 AN18/T4CK/T9CK/RC3
9 AN19/T5CK/T8CK/RC4
10 SCK2/CN8/RG6
11 SDI2/CN9/RG7
12 SDO2/CN10/RG8
13 MCLR
14 SS2/CN11/RG9
15 VSS
16 VDD
17 TMS/RA0
18 AN20/INT1/RA12
19 AN21/INT2/RA13
20 AN5/CN7/RB5
21 AN4/CN6/RB4
22 AN3/CN5/RB3
23 AN2/SS1/CN4/RB2
24 PGEC3/AN1/CN3/RB1
25 PGED3/AN0/CN2/RB0
26 PGEC1/AN6/OCFA/RB6
27 PGED1/AN7/RB7
28 VREF-/RA9
29 VREF+/RA10
30 AVDD
31 AVSS
32 AN8/RB8
33 AN9/RB9
34 AN10/RB10
35 AN11/RB11
36 VSS
37 VDD
38 TCK/RA1
39 U2RTS/RF13
40 U2CTS/RF12
41 AN12/RB12
42 AN13/RB13
43 AN14/RB14
44 AN15/OCFB/CN12/RB15
45 VSS
46 VDD
47 IC7/U1CTS/CN20/RD14
48 IC8/U1RTS/CN21/RD15
49 U2RX/CN17/RF4
50 U2TX/CN18/RF5
51 U1TX/RF3
52 U1RX/RF2
53 SDO1/RF8
54 SDI1/RF7
55 SCK1/INT0/RF6
56 SDA1/RG3
57 SCL1/RG2
58 SCL2/RA2
59 SDA2/RA3
60 TDI/RA4
61 TDO/RA5
62 VDD
63 OSC1/CLKIN/RC12
64 OSC2/CLKO/RC15
65 VSS
66 INT3/RA14
67 INT4/RA15
68 IC1/RD8
69 IC2/RD9
70 IC3/RD10
71 IC4/RD11
72 OC1/RD0
73 PGED2/SOSCI/CN1/RC13
74 PGEC2/SOSCO/T1CK/CN0/RC14
75 VSS
76 OC2/RD1
77 OC3/RD2
78 OC4/RD3
79 IC5/RD12
80 IC6/CN19/RD13
81 OC5/CN13/RD4
82 OC6/CN14/RD5
83 OC7/CN15/RD6
84 OC8/CN16/RD7
85 VCAP/VDDCORE
86 VDD
87 C1RX/RF0
88 C1TX/RF1
89 C2TX/RG1
90 C2RX/RG0
91 AN22/CN22/RA6
92 AN23/CN23/RA7
93 AN24/RE0
94 AN25/RE1
95 CSCK/RG14
96 CSDI/RG12
97 CSDO/RG13
98 AN26/RE2
99 AN27/RE3
100 AN28/RE4


PSV and Table Data Access Control Block
Y Data Bus
X Data Bus
Interrupt Controller
PORTA
PORTB
PORTC
PORTD
PORTE
PORTF
PORTG
DMA RAM
DMA Controller
PCU
PCH
PCL
Program Counter
Stack Control Logic
Loop Control Logic
Data Latch
X RAM
Address Latch
Data Latch
Y RAM
Address Latch
Address Generator Units
Address Latch
Program Memory
Data Latch
ROM Latch
EA MUX
Literal Data
Instruction Decode and Control
Instruction Reg
Control Signals to Various Blocks
DSP Engine
Divide Support
16 x 16 W Register Array
16-bit ALU
OSC2/CLKO
OSC1/CLKI
Timing Generation
FRC/LPRC Oscillators
Power-up Timer
Oscillator Start-up Timer
Power-on Reset
Watchdog Timer
Brown-out Reset
Precision Band Gap Reference
Voltage Regulator
VCAP/VDDCORE
VDD, VSS
MCLR
Timers 1-9
OC/ PWM1-8
DCI
ADC1,2
ECAN1,2
IC1-8
CN1-23
SPI1,2
I2C1,2
UART1,2
47
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