

The top half of the slide features a dark background with several bright, white, curved light rays emanating from the right side, creating a sense of motion and depth.

Developing an Interorbital TubeSat at Morehead State University

7th Annual CubeSat Developer's Workshop

Project Members

Tyler Rose, Undergraduate Student

- Project Lead

Tyler Burba, Undergraduate Student

- Datalogger work
- Communications

Kelsey Koontz, Undergraduate Student

- Digital Thermometer work

Tyler Blair, Undergraduate Student

- GPS module work

Chris Bailey, Undergraduate Student

- Radios

Bob Twiggs, Professor

- Advisor

Morehead State University (MSU)

Located in Kentucky

Bachelor's Degree – Space Science

- 1 of 5 in the Nation

Active Participant in Kentucky Space

- Frontier 1 Launch – ADAMASat Successful
 - 1st equipment sent into space by Kentucky

MSU Space Science Center

45,000 ft²

\$15.6 Million

RF and electronics laboratories

Rooftop antenna test range

21-meter space antenna control center

Clean rooms

- Micro-nano lab
- Space systems development lab

Digital Star Theater

Student Labs

- Astrophysics Student Lab
- Astronautic System Lab

Interorbital Systems (IOS)

Established in Mojave, California in 1996

Current Projects:

- Orbital Expeditions
- Lunar Sample Return Mission
- **Neptune 30 Launch Vehicle**
- **TubeSat Personal Satellite (PS) Kit**

TubeSat PS Kit

Launch: Neptune 30 Rocket

- 32 TubeSat ejection cylinders
- Satellites are released in programmed timing sequence
- Orbital flight altitude of 310 km
- Launched at IOS Spaceport Tonga

TubeSat PS Kit

\$8,000 Cost

- Covers orbital launch and personal kit
 - Kit includes:
 - Structural Components
 - PCB Gerber Files
 - Electronic Components
 - Solar Cells
 - Batteries
 - Transceiver
 - Antennas
 - Microcomputer
 - Programming Tools

TubeSat PS Kit

TubeSat Project Goals at MSU:

- Develop our own payload to fit dimensions
- Increase students with launch experience
- Expand contacts and resources
- **Utilize simple, "Basic" hardware for students**
- **Test these "Basic" components**

Suborbital Test Flight : TubeSat Project at MSU

Working Mission Statement:

- In effort to substantiate the lessening cost of small-sat launches, Morehead State University's Space Science Center has purchased an Interorbital System's TubeSat Personal Satellite Launch aboard their Neptune 30 rocket with payload dedicated to environment and inertial measurements.
- These measurements will provide necessary experience and information to prepare for the orbital launch expected between late 2010 and early 2011.

TubeSat at MSU – Test Flight

Flight Details

- Common Propulsion Module Test Vehicle
- Altitude of expected apogee – 35,000 ft
- Retrievable first test flight
- Expected time to apogee – 44 seconds
- Expected time from apogee to ground – 141 seconds
- Spin rate – 20 rpm

TubeSat at MSU – Test Flight

Payload Overview

- Students at MSU have been working with Parallax Basic Stamps to familiarize with microcontrollers.
- Is it possible to use something as simple and cheap as a Basic Stamp Homework Board for a space mission?
 - Send it up on the first test flight!
- Stamps programmed in PBASIC – simple and effective for students
- Parallax offers many sensors we could test
 - Accelerometers
 - GPS modules
 - Digital Thermometers
 - Radios
 - USB Dataloggers
 - ...many more

Electronic Systems - Parallax

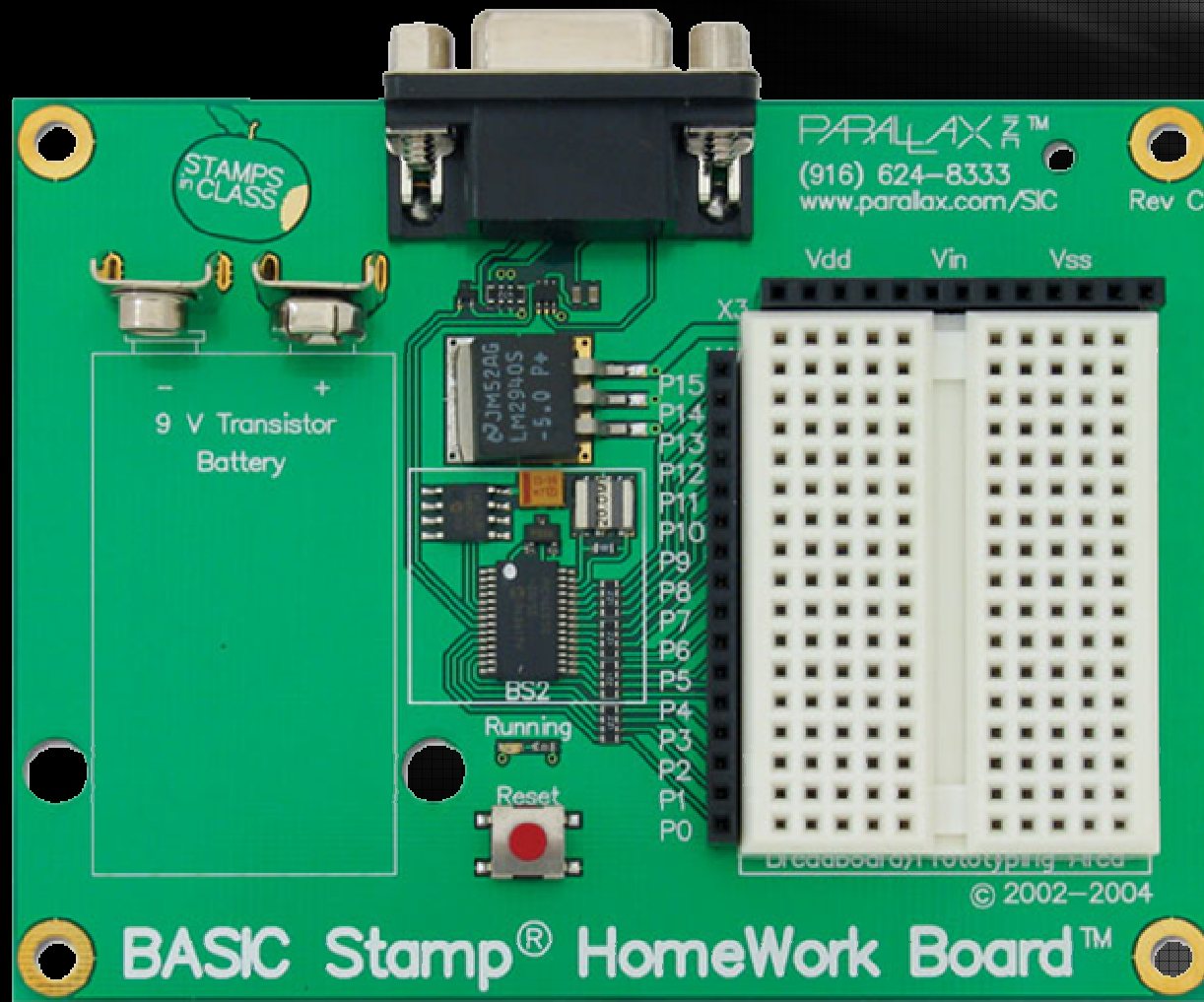
Microprocessors

- 2 BS2's – Basic Stamp 2 integrated into Homework Board

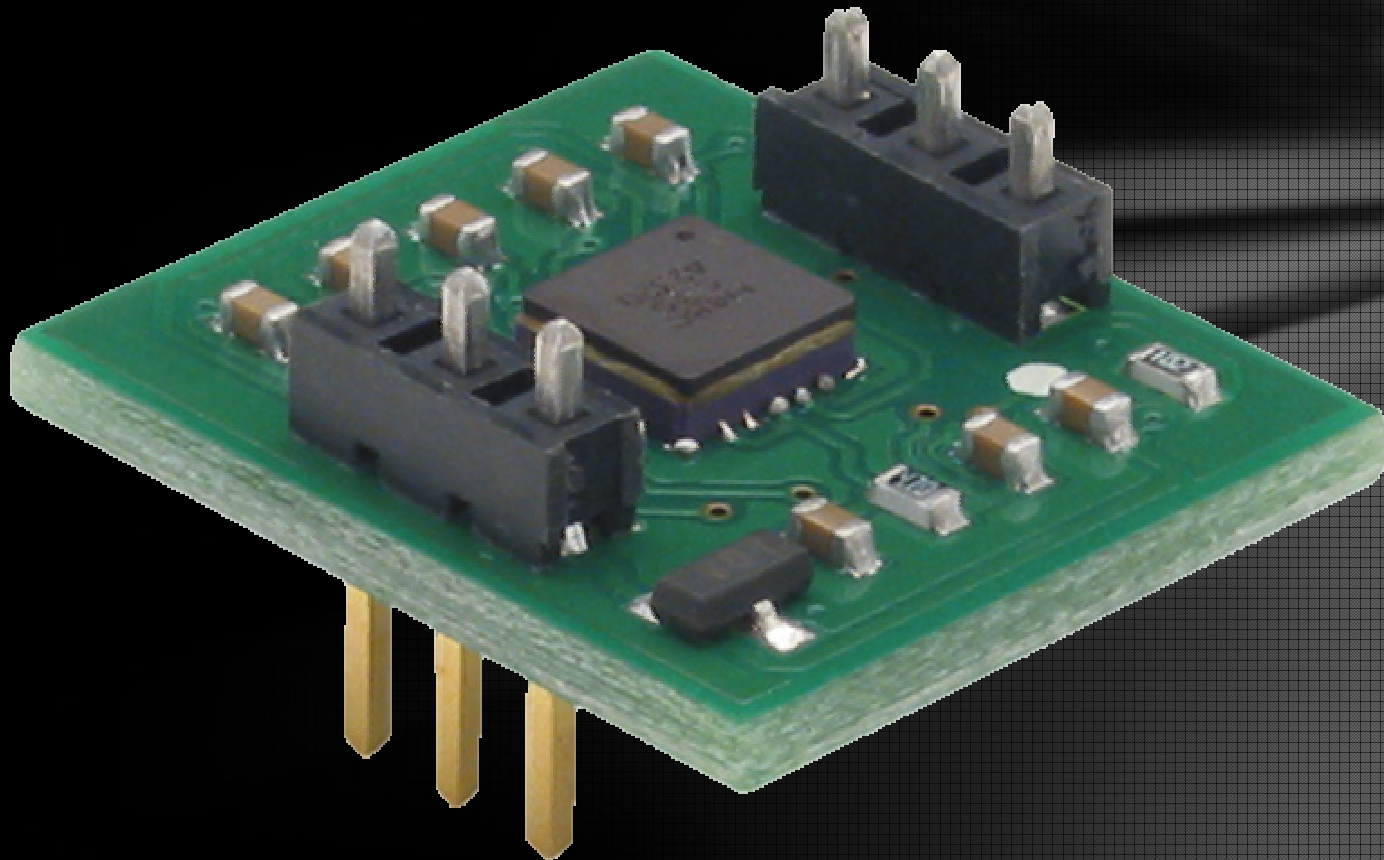
Components

- 2 Hitachi H48C Tri-Axis Accelerometers
- 2 Memory Stick Dataloggers
- 2 DS1620 Digital Thermometers
- 2 GPS Receiver Modules
- ... more depending on launch date?

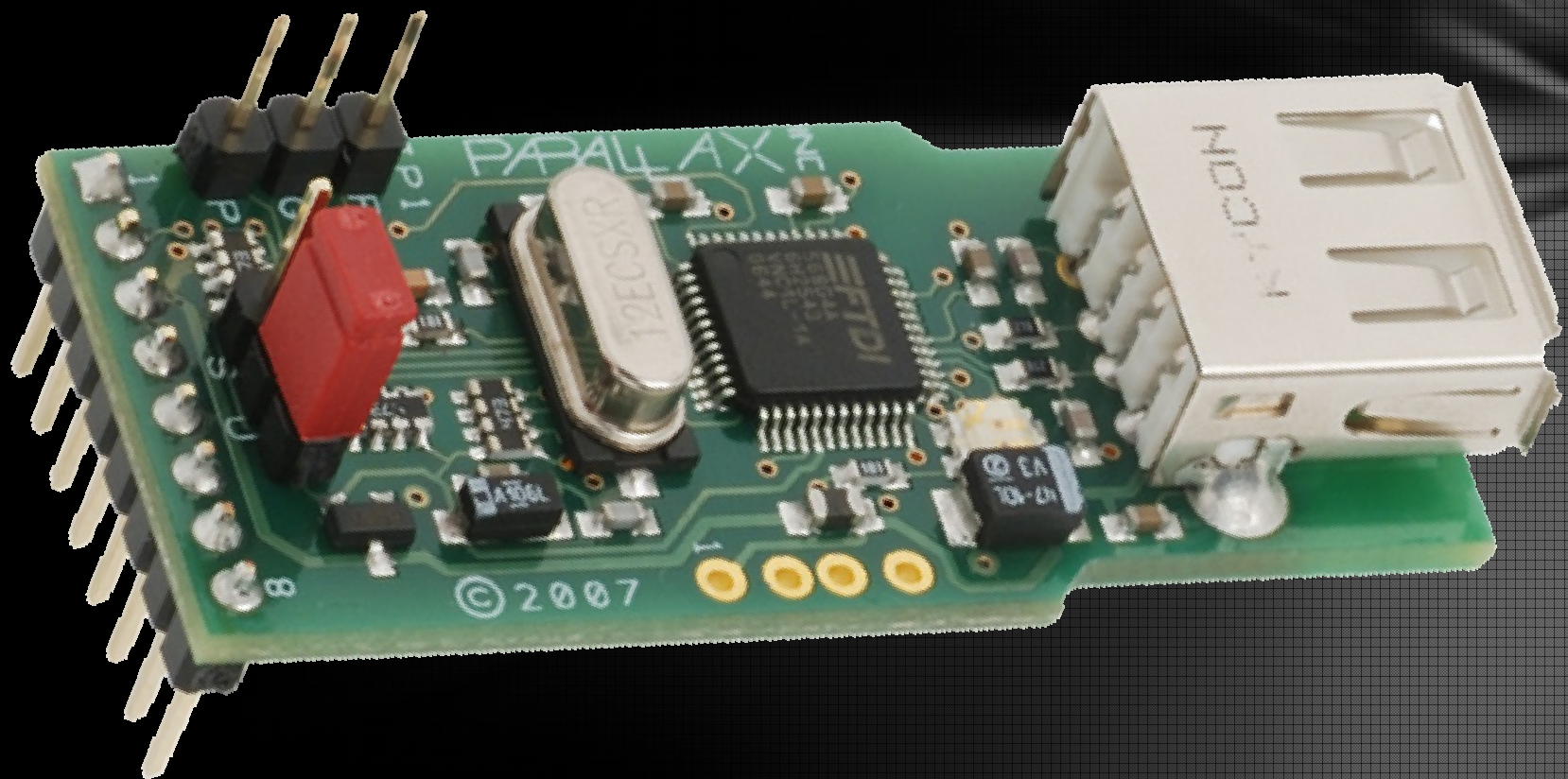
Parallax Basic Stamp Homework Board



Parallax Basic Stamp Sensors - Accelerometer



Parallax Basic Stamp Sensors - Datalogger



Parallax Basic Stamp Sensors – Digital Thermometer



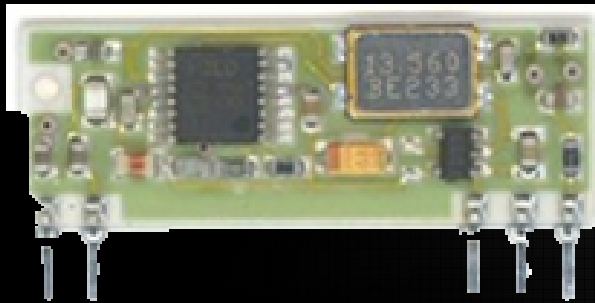
Communication Systems

Radios

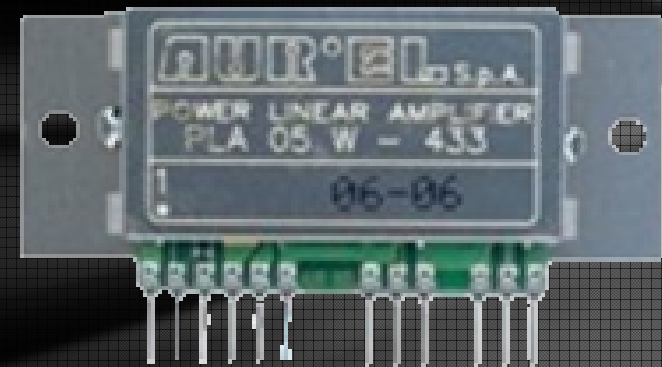
- 2 ABACOM Technologies RFTQ2-433 Transmitters
 - $-25^{\circ}\text{C} - 85^{\circ}\text{C}$
- 2 ABACOM Technologies PLA-05W-433 Amplifiers
 - Metal case and attached heat sink for heat dissipation
- 433 MHz Models – within Amateur Radio Band

Communication Systems

Transmitter



Amplifier



Suborbital TubeSat – Structural Specs

Dimensions:

- 6" diameter
- 7 1/2" length

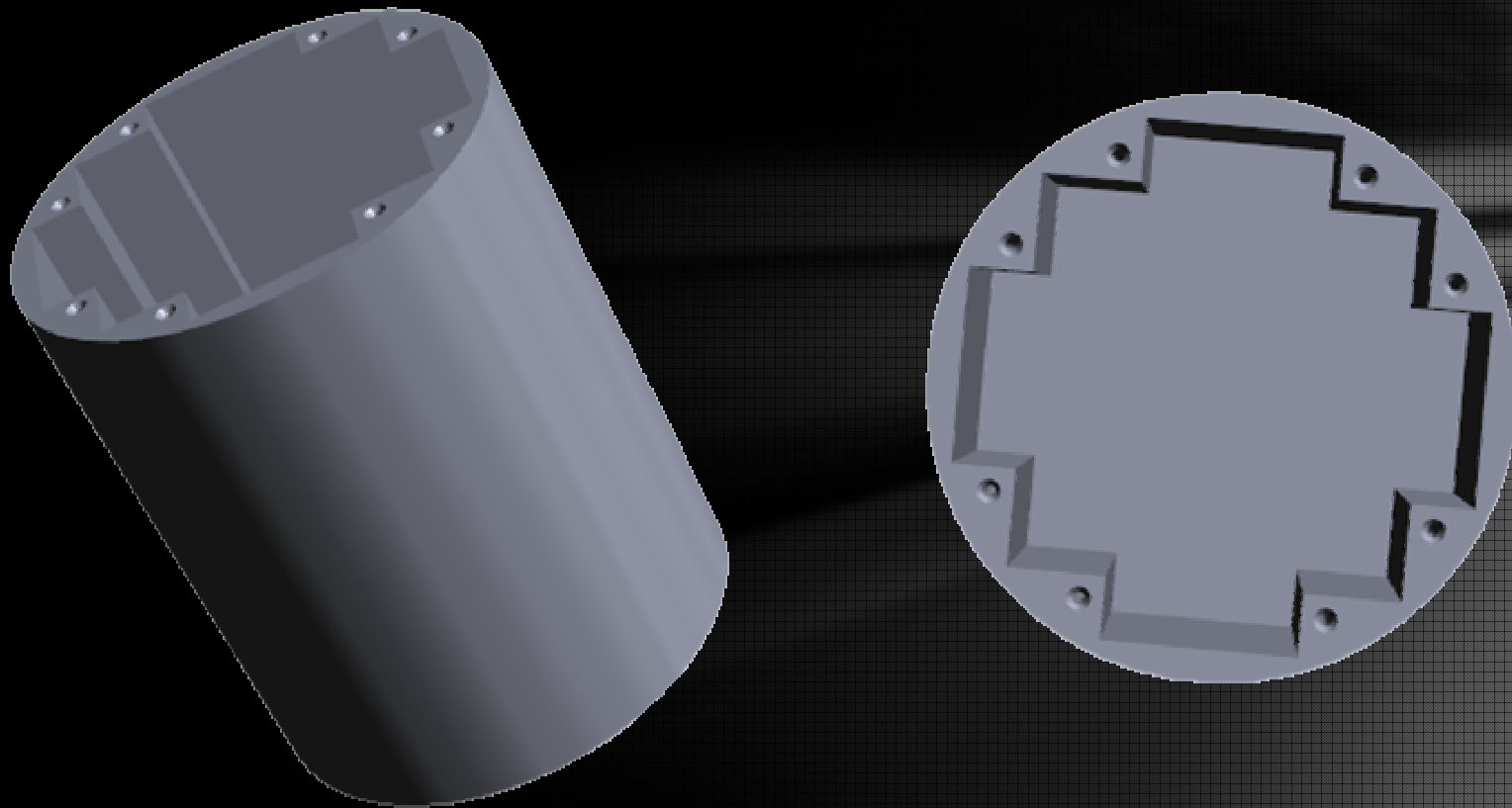
Weight Allocated:

- 1 – 2 kg

Locking mechanism:

- TubeSat slides in and is locked into place by a 5.9" diameter o-ring sealer
- Endcap of structure will be exterior of module

Suborbital TubeSat – Structure v.1



Suborbital TubeSat – Structure v.1

Dually accessible cylinder

- Duplicate payloads for redundancy
- Two end caps – take out payload after launch and be able to display at MSU
- Outer end cap will have objects mounted flush with surface (antenna(s), GPS(s), etc.)

Suborbital TubeSat – Structure v.1

(Picture of Structure)

(Picture of Structure)

Suborbital TubeSat - General

Powered by RC Car battery

Components soldered to PCB

PCB connected to stamp with ribbon cable