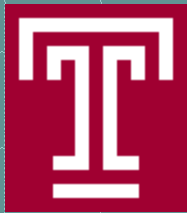
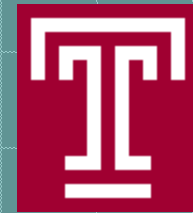


Digital Wireless Data Communications With a Semi-Autonomous Rover



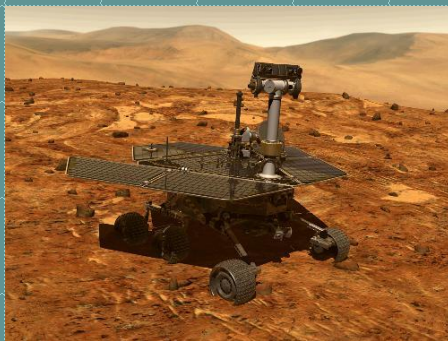
www.temple.edu/k3tu



Steven D. Herman • John P. Falcone, KB3KDM • John F. Dessino
Technical Advisor: Dr. Dennis A. Silage, K3DS

Introduction

Sojourner - NASA



Spirit and Opportunity - NASA

Andros - Remotec



Project Overview



Base Station

- ◆ Command
- ◆ Control



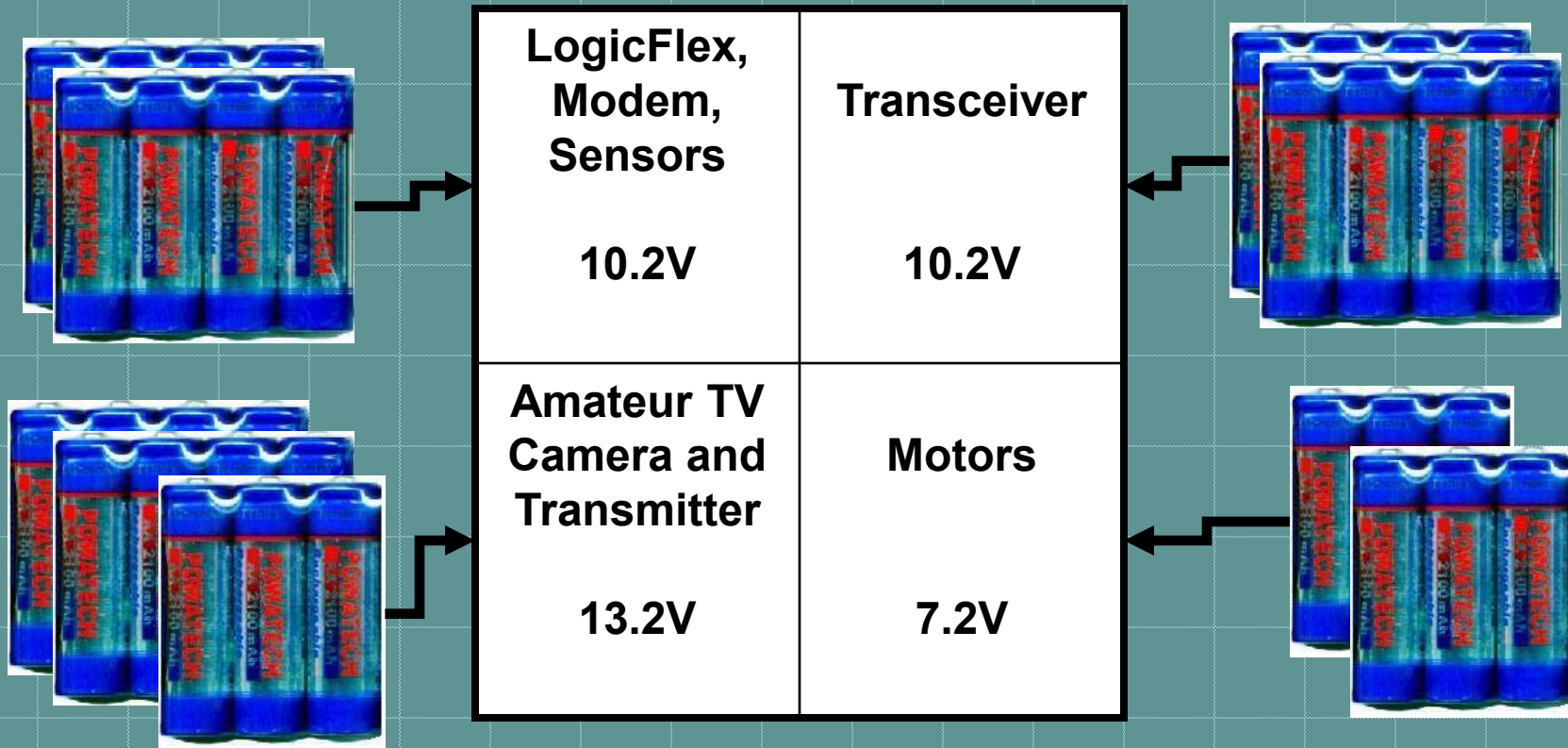
Rover

- ◆ Data gathering
- ◆ Surveillance
- ◆ Exploration

Communication protocols

Rover Power Supply

Thirty-Three 1.2V NiMh Cells



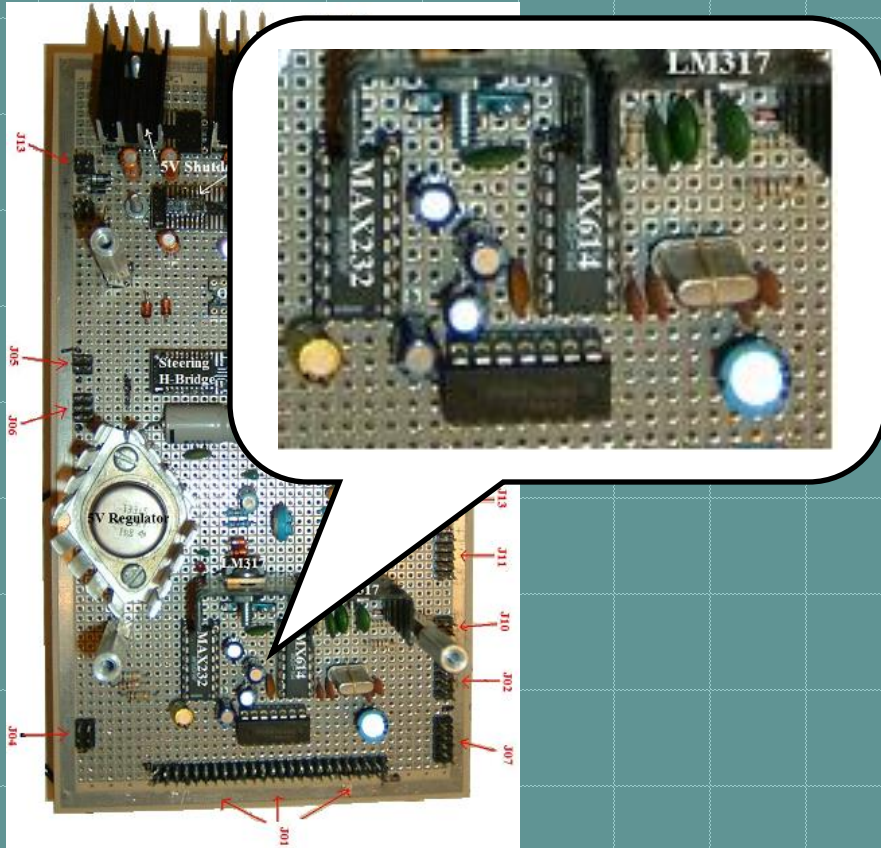
Base Station Hardware



- ◆ PC – mouse, keyboard
- ◆ Joystick
- ◆ Baseband modem
- ◆ Kenwood TM721A
146.58 MHz Simplex
- ◆ Monopole antenna
- ◆ ATV down converter
426.25 MHz
- ◆ TV monitor

Modems

- Custom-built
- Baseband FSK
- MX 614
- MAX 232



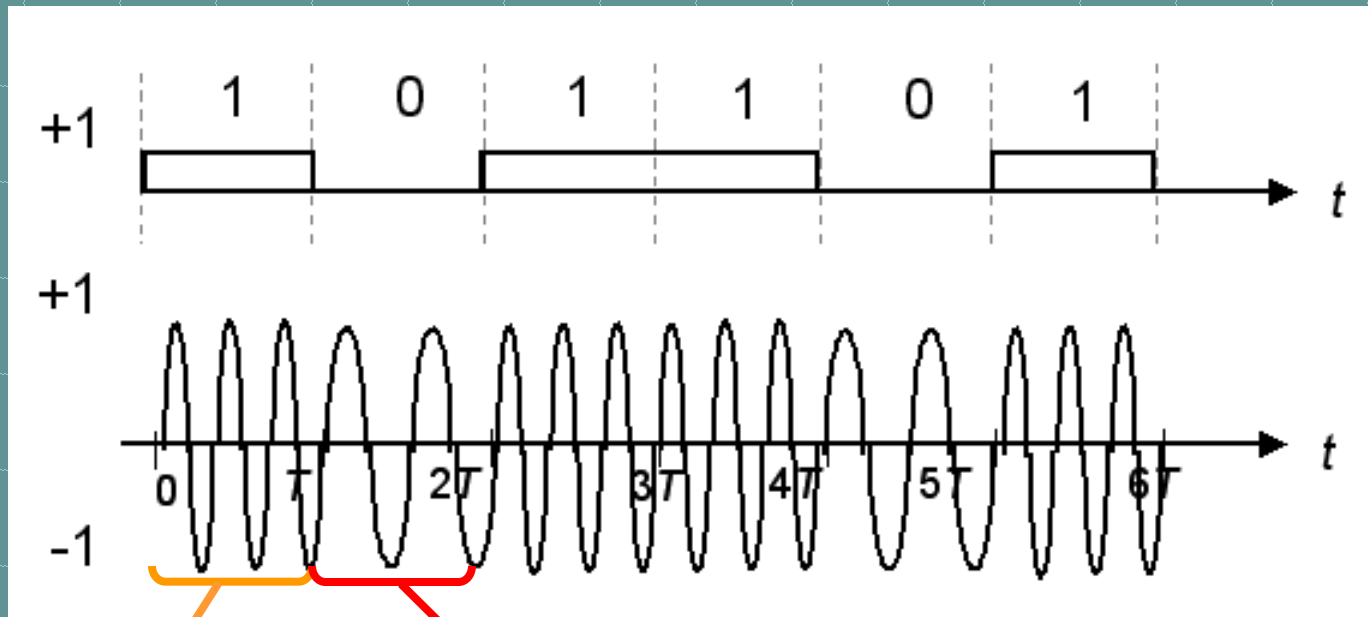
Rover



Base Station

MX 614

Frequency Shift Keying – baseband modulation

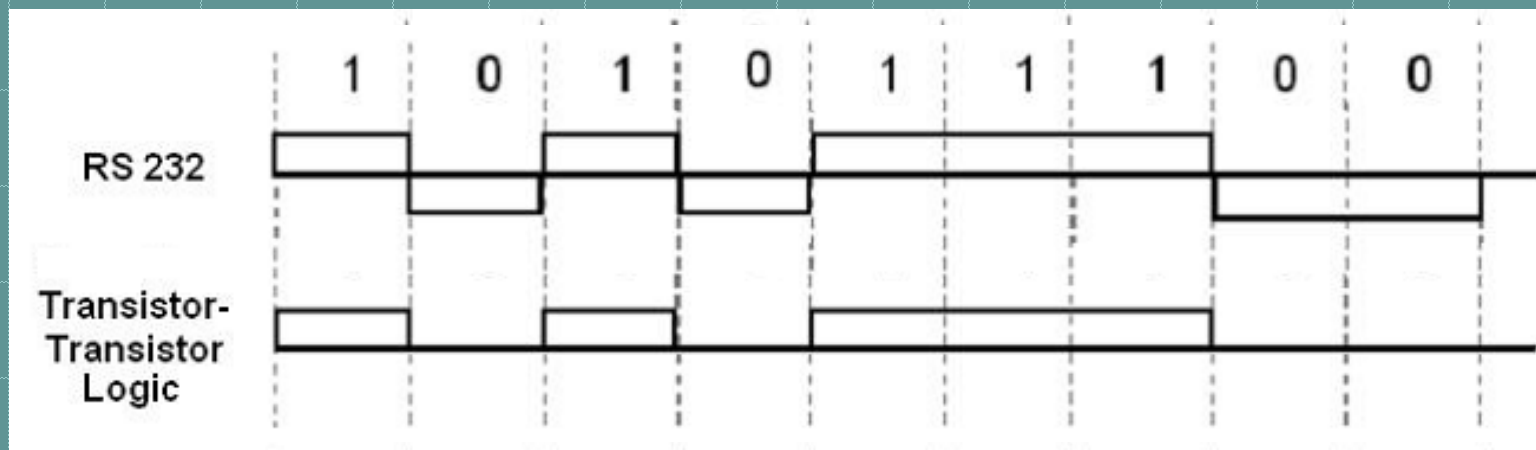


2200 Hz

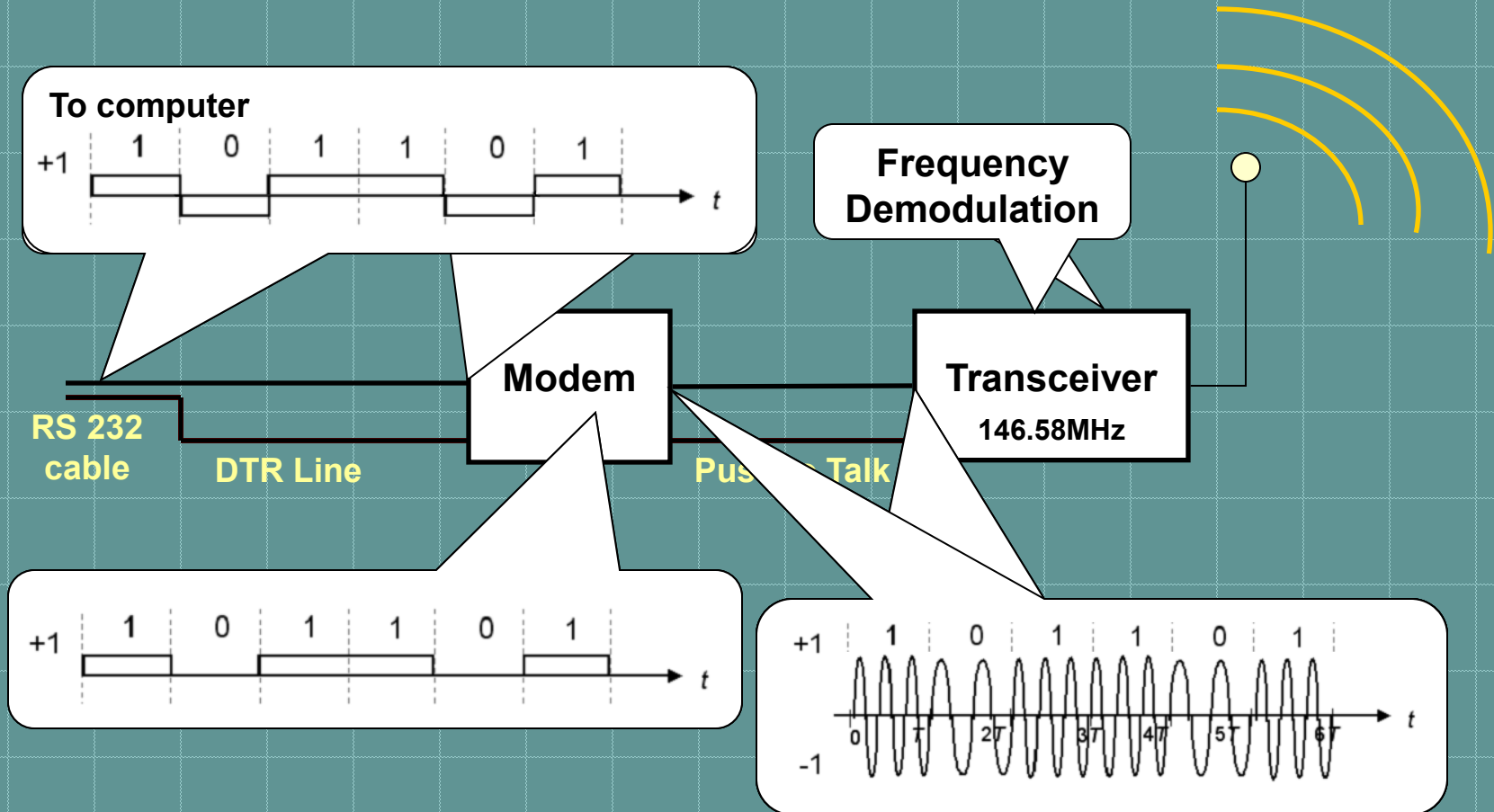
1200 Hz

MAX 232

Bipolar-Bipolar



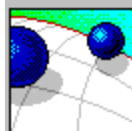
Communication Sequence



Software Applications



Rover Operations Application



Borland® C++

Version 4.52
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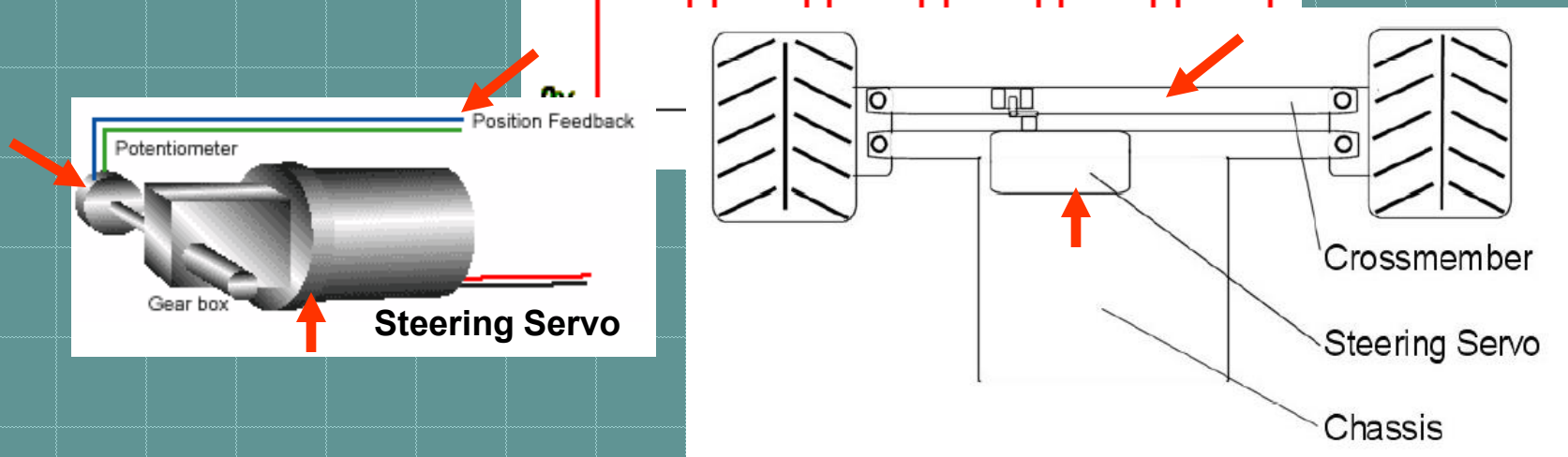
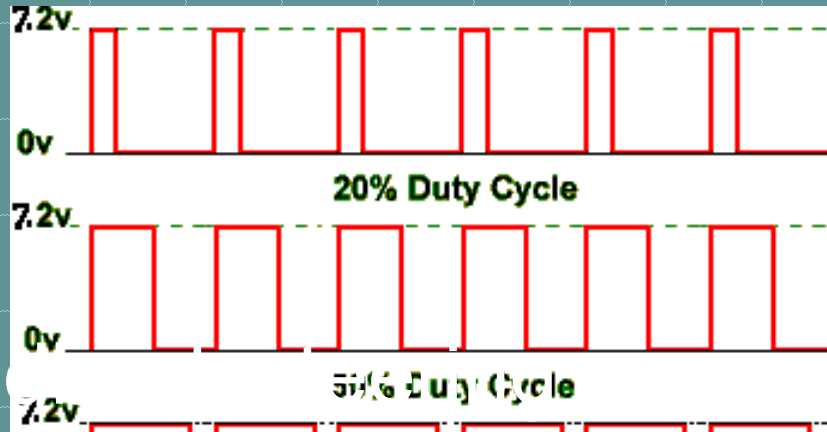
Rover Interface Application



Rover Mobility

◆ PWM

◆ Position feedback



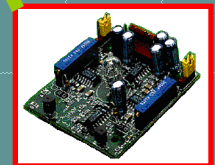
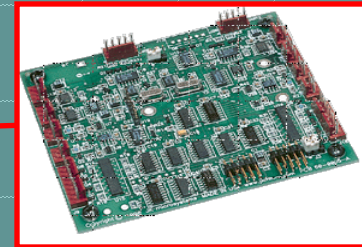
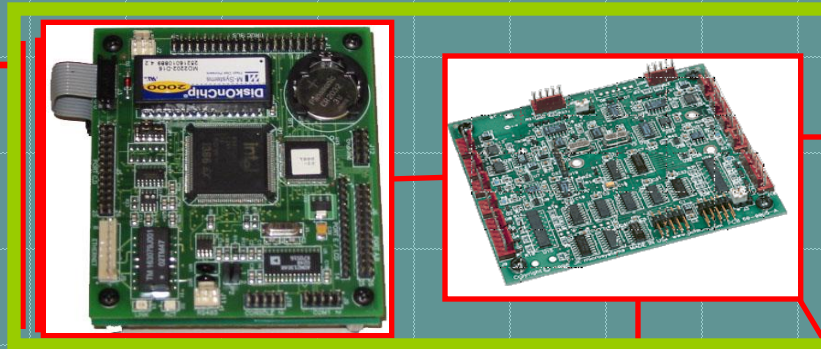
Autonomous Routines

- ◆ Autonomous station identification
 - ◆ Transmit call sign every ten minutes



- ◆ Quiet Mode
 - ◆ Shutdown sensors if no communication has been initiated for three minutes

Sensors



Inclinometer

Back ——— Front

Left ——— Right

Pitch Degrees

Roll Degrees

On

Off

Get Data

A diagram of an inclinometer showing pitch and roll axes. The pitch axis is labeled 'Back' and 'Front' with a horizontal line and a yellow circle. The roll axis is labeled 'Left' and 'Right' with a vertical line and a black circle. The pitch is set to -7 degrees and the roll is set to 9 degrees. There are 'On' and 'Off' buttons and a 'Get Data' button.

Poll ADC
mV

Rover Interface Application

The screenshot displays the 'Rover Interface Application' window with a menu bar (File, View, Help) and several functional panels:

- Rover Command:** A large empty text area for entering commands.
- Compass:** A circular dial with cardinal directions (N, S, E, W) and a red needle. A 'Degrees' field shows '52'. It includes 'On', 'Off', and 'Get Data' buttons, with a green indicator light.
- Inclinometer:** A diagram showing pitch and roll levels. Pitch is '-7' degrees and Roll is '9' degrees. It includes 'On', 'Off', and 'Get Data' buttons, with a green indicator light.
- Accelerometer:** A 3D coordinate system with axes labeled 'Up Z', 'Forward X', and 'Right Y'. It shows acceleration in G's: X: 0.5, Y: 0.2, Z: 1.0. It includes 'On', 'Off', and 'Get Data' buttons, with a green indicator light.
- Status:** Contains an 'MSComm Report' field, a 'PTT' indicator (red light), 'Message String', 'Error String', and '# of errors corrected: 0'. It has a 'Ping Rover' button and a 'Sensor Report' field.
- Video:** Includes 'On', 'Off', and 'Get Data' buttons, a green indicator light, and a 'Calibrate Joystick' section with 'Joystick Position Data' and an 'Exit' button.

Red arrows point to the Rover Command area, the PTT indicator, the Pitch and Roll indicator lights, the Accelerometer indicator light, and the Sensor Report area.

Forward Error Correction

7-bit ASCII character



Encode

11-bit Hamming code

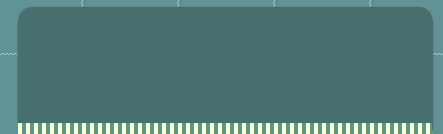


Decode

- Correct 1 bit error
- Detect 2 bit errors



7-bit ASCII character



Client/Server Relationship

Half-duplex channel



Client



Server

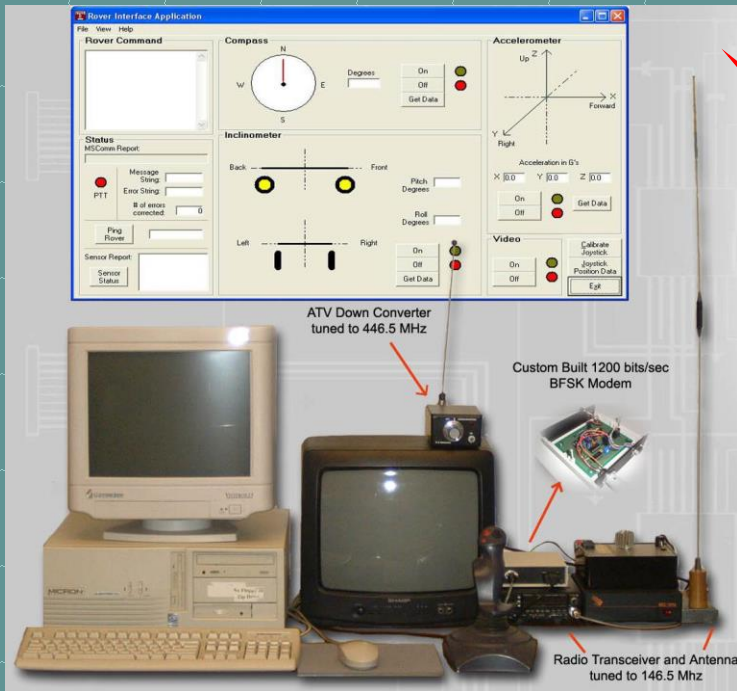
Video Demonstration



Video Demonstration



Conclusion



Base Station and its components

Rover and its components

