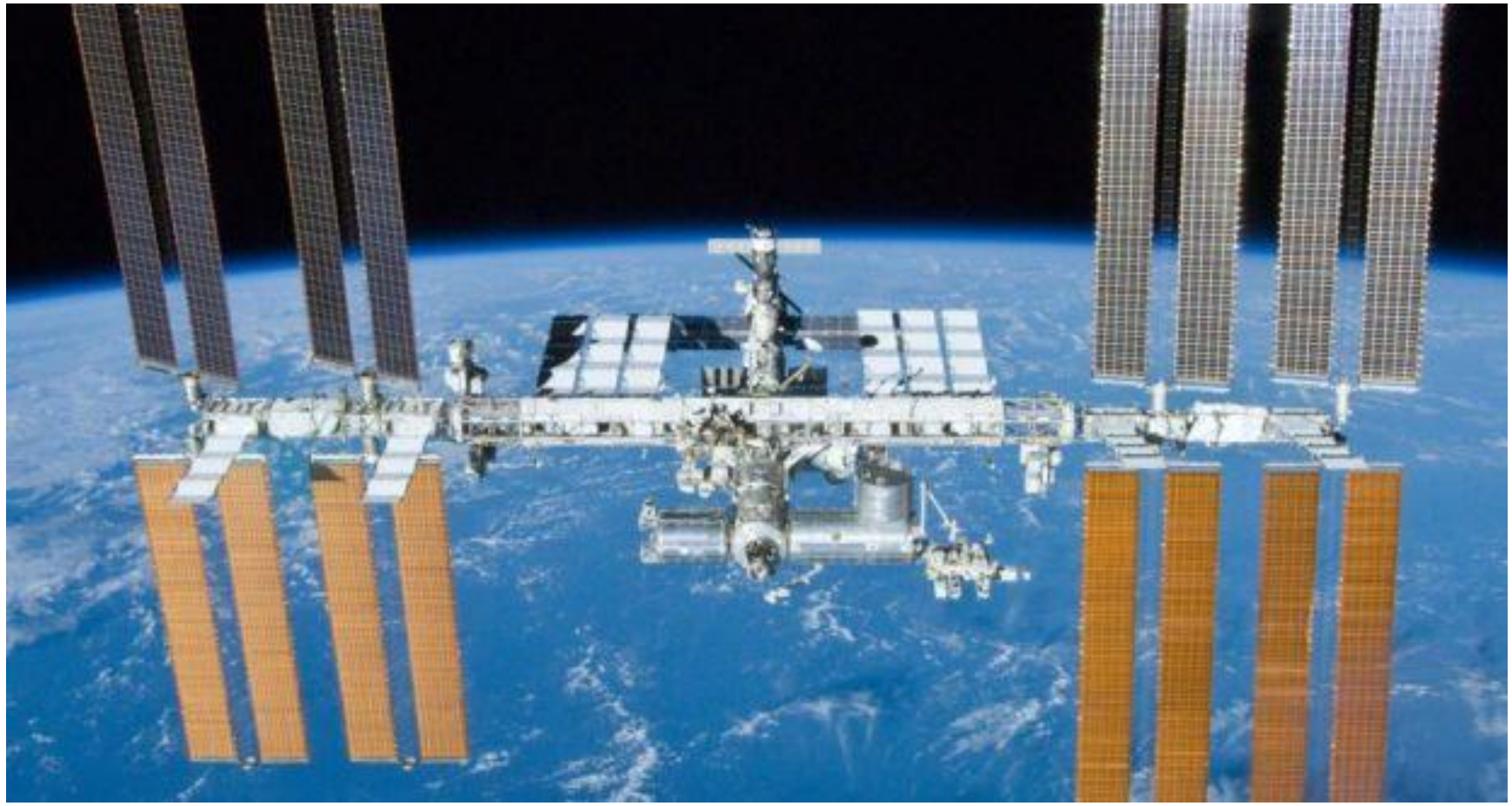
Amateur Radio And The International Space Station



Making Contact

- ISS crew members make random, unscheduled, amateur radio voice contacts with earth-bound radio amateurs.
- They can make radio contacts during their breaks, pre-sleep time and before and after mealtime.
- Astronauts have contacted thousands of hams around the world.
- ISS crew work schedules dictate when they are able to operate the radios.
- The most common times to find a crew member making casual contacts are about one hour after waking (07:30) and before sleeping 11:30 (UTC). They're usually free most of the weekend, as well.

- The following frequencies are currently used for Amateur Radio ISS contacts:

  Voice and SSTV Downlink: 145.80 (Worldwide)
  Voice Uplink: 144.49 for ITU Regions 2 and 3
  Voice Uplink: 145.20 for ITU Region 1 (Europe, Russia and Africa)
  VHF Packet Uplink and Downlink: 145.825 (Worldwide)
  UHF Packet Uplink and Downlink: 437.550
  UHF/VHF Repeater Uplink: 437.80
  UHF/VHF Repeater Downlink: C

- Most ARISS operations are split-frequency (each station uses separate receive and transmit frequencies).
- The downlink is the earth station's receiving frequency. The uplink is the earth station's transmitting frequency.
- Earth stations can listen to the downlink frequency and transmit on the uplink frequency when the ISS is in range and crew members are on the air. **Please do not transmit on the ISS downlink frequency**.

The following call signs are available for use on the ISS:

- Russian: RS0ISS
- USA: NA1SS
- European: DP0ISS, OR4ISS, IR0ISS
  Packet Station Mailbox: RS0ISS-11 and RS0ISS-1

Commercial and public domain software is available to help track when the ISS (and other satellites) will be in range of your station, and where to point your antenna.

You'll find one such Pass Prediction Tool on the AMSAT website at http://www.amsat.org/track/ . Use the drop-down menu to select the "ISS" as the satellite you want to track and enter your longitude and latitude information. Click on the link provided on that page to view the current location of the ISS. You'll find this and other tools for satellite tracking on the AMSAT web site.

AMSAT™
10605 Concord St, #304
Kensington, MD 20895
1-888-322-6728

AMSAT Online Satellite Pass Predictions

AMSAT Online Satellite Pass Predictions

NOTICE:Fox 1B is now AO-91

Please select a satellite and provide your latitude, longitude and elevation or calculate them from your grid square. If you choose we will save your position information in a cookie on your system for future predictions.

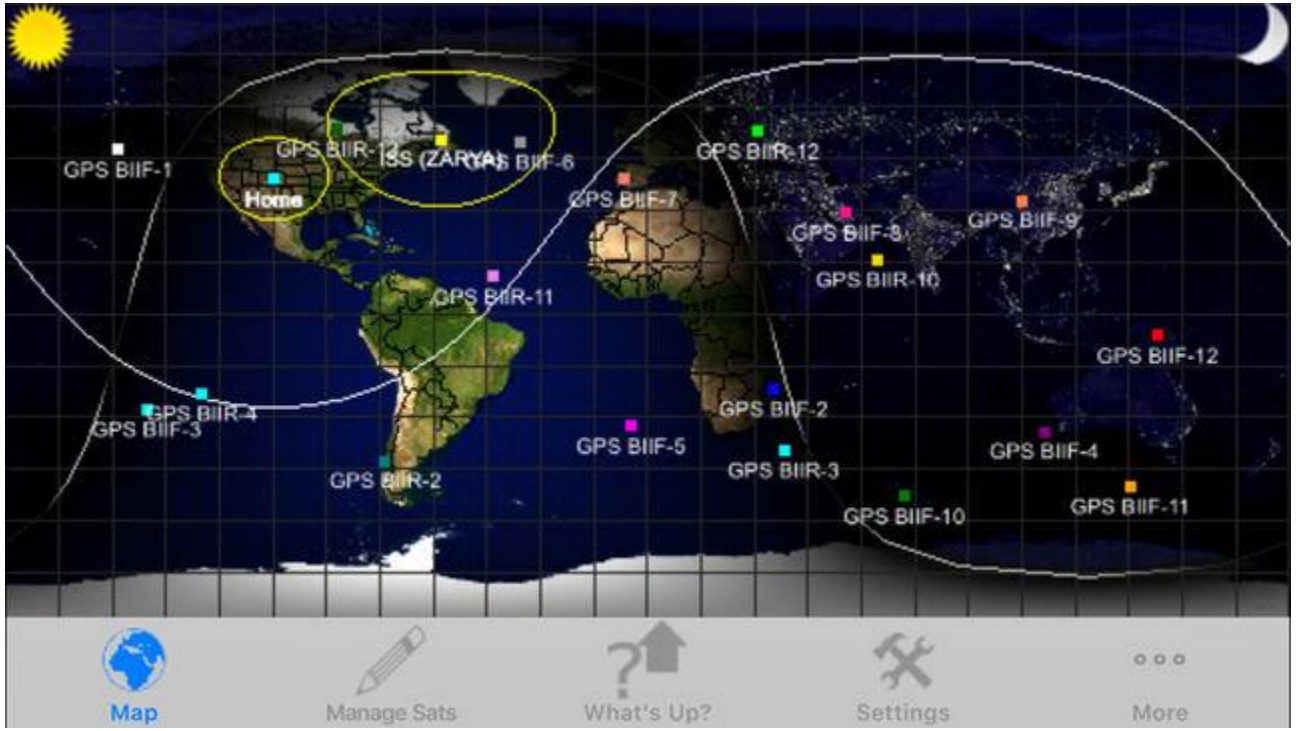
Show Predictions for: ISS **for Next** 10 **Passes**	
Calculate Latitude and Longitude from Gridsquare:	Calculate Position
Or	
Enter Decimal Latitude:*	North
Enter Decimal Longitude:*	West
Elevation in meters AMSL:	
Predict	
Save my location for later use	

For the best in full featured tracking software visit The AMSAT Store

Finding the space station in the sky

- The space station flies at an average altitude of 248 miles above Earth. It circles the globe every 90 minutes at a speed of about 17,500 mph.
- The space station can rival the brilliant planet Venus in brightness and appears as a bright light moving across the night sky. It can be seen from Earth without the use of a telescope by night sky observers who know when and where to look
- Commercial and public domain software is available to help track when the ISS will be in range of your station, and where to point your antenna. Various online programs allow you to follow the path of satellites, including the ISS.

Track Satellites on your I-Pad



Satellite Tracker - (ProSat) 4+

Craig Vosburgh

•$9.99

Radios on Board The ISSS:

Two hand-held Ericsson transceivers are on board in the ISS Columbus module: a VHF radio that receives and transmits FM voice or packet radio signals in the 2-meter Band, and a UHF radio that receives and transmits FM voice or packet radio signals in the 70 centimeter Amateur Band. Both radios are commercial grade radios with up to 5 Watts of output power available on any one of 64 possible channels.

JVC Kenwood D710GA Transciever

The Kenwood TM-D700 radio. located in the ISS FGB Service Module (Zarya), supports 2 meter (144-146 MHz) and 70 cm (435-438 MHz) operation. This radio provides a higher output power capability (restricted to a maximum of 25 Watts in ISS operation) supporting FM and packet operations. *The higher power capability allows nearly horizon-to-horizon signal reception using simple hand-held radios or scanners.* A set of 5 default options, or Programmable Memories, are embedded in the D700 to support ISS operations.

Radios on Board The ISSS:

- Two hand-held Ericsson transceivers are on board in the ISS Columbus module that receive and transmit FM voice or packet radio signals in the 2-meter Band, and a UHF radio that receives and transmits FM voice or packet radio signals in the 70 centimeter Amateur Band.
- The Kenwood TM-D700 radio. located in the ISS FGB Service Module (Zarya), supports 2 meter (144-146 MHz) and 70 cm (435-438 MHz) operation providig a higher output power capability (restricted to a maximum of 25 Watts in ISS operation). operations.
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Radios on Board The ISSS:

- There are numerous channels programmed in the radios. Two of these channels on the 2 meter radio band support voice operations (**145.80 down/144.49 up for ITU Regions 2 &3** & 145.80 down/145.20 up for ITU Region 1). It is necessary to use two uplink frequencies to operate in accordance with region-to-region IARU band plan differences.

Packet Operations

There are two radios on the ISS that operate as packet digipeaters--at any time, you might hear one, both, or neither. The Kenwood D700 is 10W and uses the SSID RS0ISS-4 (or -3). The Ericsson HT is about 5W and uses RS0ISS. Both respond to the alias "ARISS". With the Ericsson, you'll have better luck using more power and, if you have it, FM Narrow mode.

For information about using the ISS packet system, check out this resource provided by JoAnne Maenpaa, K9JKM.

SSTV Operations

Slow Scan Television (SSTV) images can be transmitted from the International Space Station. An SSTV system is an integral part of one of the ARISS ham radio stations, NA1SS/ RS0ISS in the Service Module. It transmits and receives JPEG still images. This system utilizes the Kenwood D700 and D710 radios and the ARISS antennas mounted on the Service Module. The SSTV equipment also includes SpaceCam and MMSSTV software, a radio/computer interface module and data cables.

A Kenwood VC-H1 is also used to provide near real-time automatically transmitted images (usually earth views) once every 3 minutes, when active.

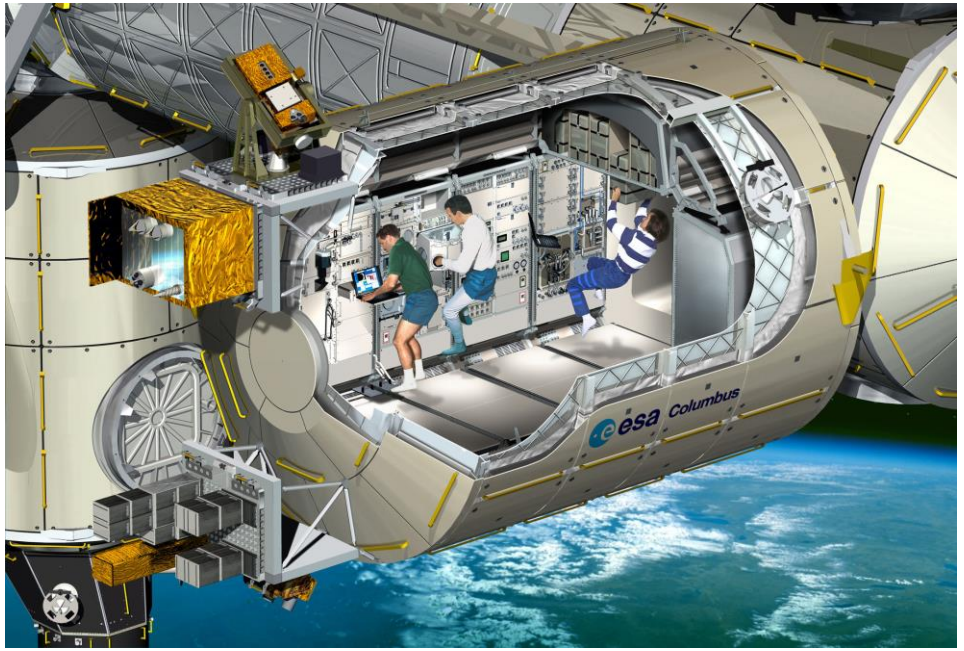
Antennas

- A set of four antenna systems are deployed in the ISS Service Module supporting the current installation of the Kenwood D700 and D710.
- Each of the four antennas can support amateur radio operations on multiple frequencies.
- Three of the four antennas are identical and each can support both transmit and receive operations on 2 meter and 70 cm. They also support reception for the station's Russian Glisser TV system, which is used during spacewalks.
- The fourth antenna has a 2.5-meter (8 foot) long vertical whip that can be used to support High Frequency operations, particularly on 10 meters. Currently, the HF antenna has no radio hardware available for use.

Antennas

Two antennas are installed in the Columbus module, currently serving the Ericsson radios deployed there. Frequencies available for transmission to and from Columbus are 2 meters, 70 centimeters, L-band and S-band. These antennas will also support the Ham TV DATV transmitter.

Astronaut Reid Wiseman, KF5LKT makes personal contacts with hams during the US Field Day exercise in June 2014.



- Schools and other educational organizations can schedule Amateur Radio contacts with crew on board the ISS through the ARISS (Amateur Radio International Space Station) program.
- **ARISS Educational Contacts Can Be Performed in One of Two Ways:**
  - a **DIRECT** radio link between an amateur radio station set up at a school and the amateur station on board the ISS
  - a **TELEBRIDGE**, where a dedicated ARISS amateur radio ground station, located somewhere in the world, establishes the radio link with the ISS. Voice communications between the students and the astronauts are then patched over regular telephone lines.

On May 23 five students from Moran Prairie Elementary School had an opportunity to communicate via Amateur Radio with Flight Engineer Jim Voss aboard the ISS as they passed over Spokane on May 23rd, 2001

Let's look at a video of an actual ISS contact made by local amateurs under the ARISS program for Moran Prairie Elementary School on the South Hill on May 23, 2001.

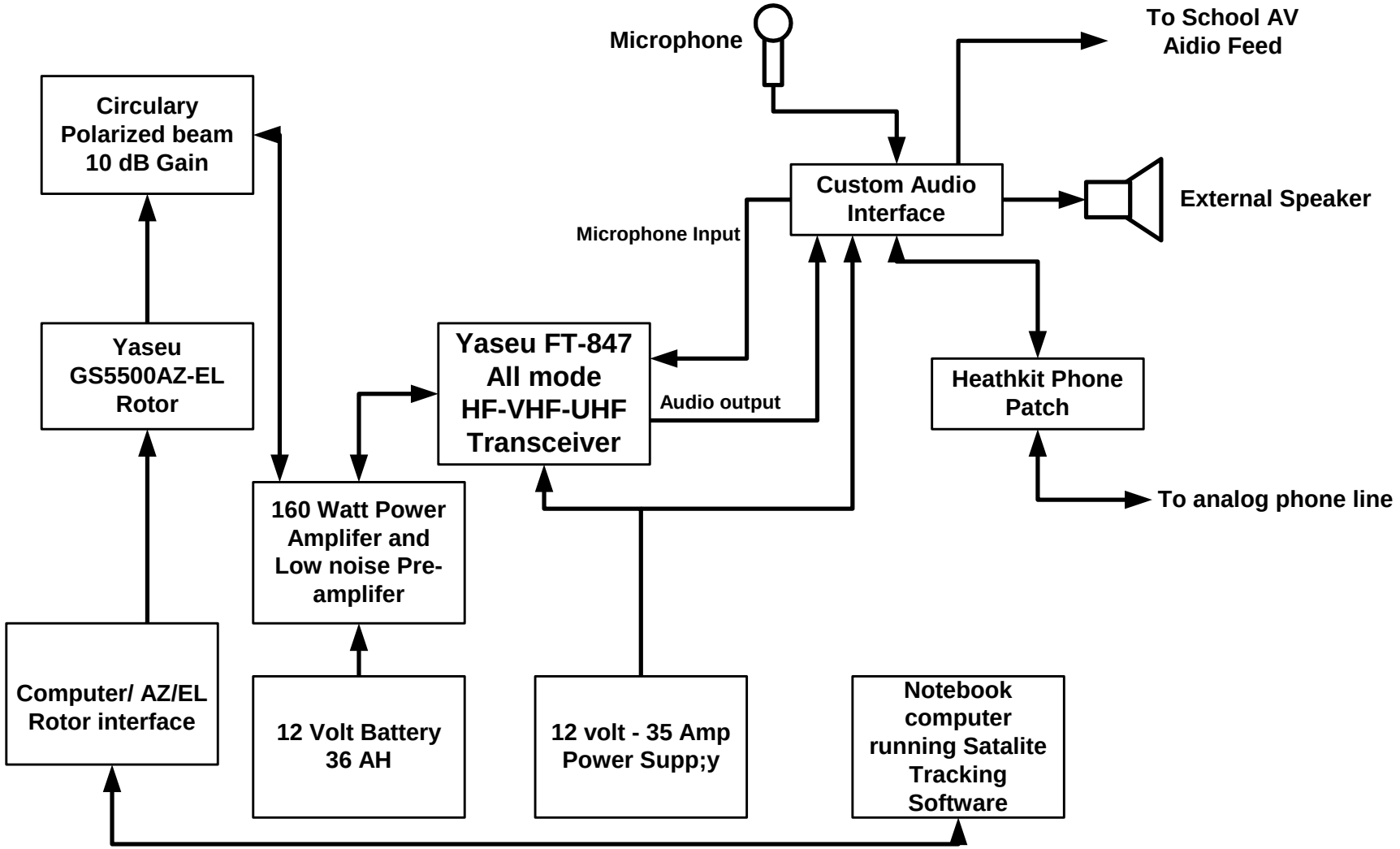
The ISS Station Challenge

- 3 – 4 Watt transmit output power from 5 watt Ericsson handheld radio system
- ISS receiver sensitivity (.15-.2 microvolts)
- Simple 1/4 wave vertical antenna on the exterior of the ISS
- No Doppler correction done on the ISS station a (+/- 4 kHz)
- At the beginning and end of the pass the ISS is ~1,600 miles away, ~233 miles when directly overhead
- Total pass time is 10-11 minutes or less

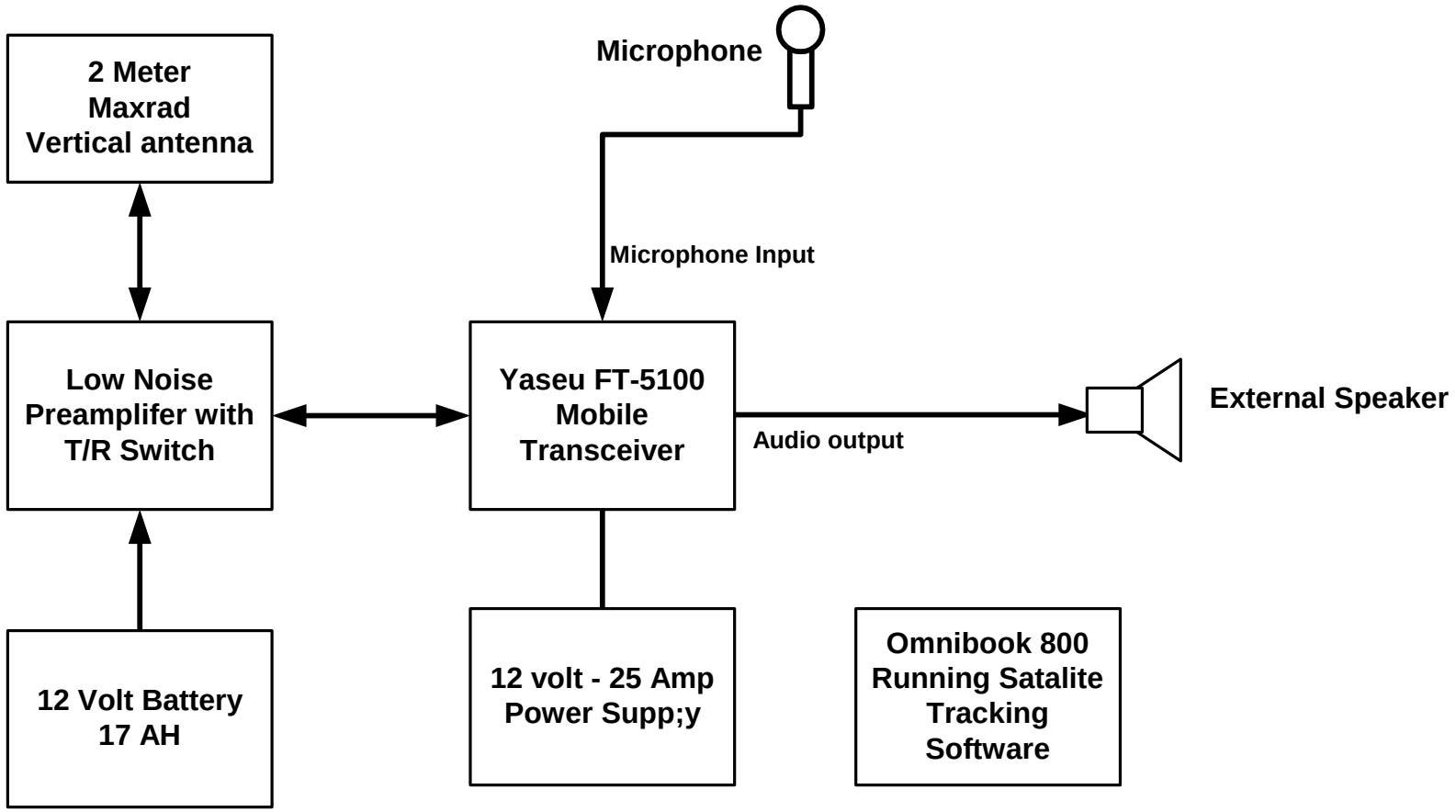
Our Teams Approach

- A LNA (1.3dB) to improve s/n on their 5 watt signal
- 10 dB gain beam circularly polarized antenna to help them hear us (1200 watt effective power with antenna gain)
- We did Doppler correction during he contact of +/- 4 kHz
- A tracking Azimuth Elevation antenna rotor for the bean antenna
- Computer software and interface to track the ISS and drive the Antenna AZ/EL rotor
- Computer clocks carefully time synchronized with NIST
- Back up station if we had a primary station failure

Primary Earth Station set-up



Back-up Earth Station set-up



The Time line

- In 1995 our school sponsor, Joe Bruce, submitted the original application for an amateur radio contact with the International space station for Moran Prairie Elementary School on the South Hill.
- Early November 2000 Joe is asked if the school could be ready for an ISS contact as early as January 2001.
- Through ARES (Amateur Radio Emergency Services) Gordon Grove, WA7LNC, was asked if someone in the amateur community could help the school with this opportunity
- Jack AD7FO and Tom W7TRF from Agilent agree to take on the challenge and assembled a team and "chartered the project" in mid November

The Time line

- An inventory of what equipment was available from within the team was developed.
- Early December 2000the Primary earth station and back up station were designed and missing items identified.
- Additional items needed were acquired by team members, and a few items acquired through donations from Agilent and Maxrad.
- We pulled together a dry run for the 2000 Christmas holiday at the school.
- We reviewed the dry run, assembled check lists, and refined our skills by communicating through other Amateur Radio satellites

The Time line

- We practiced and waited, practiced and waited and practiced and waited with the students
- In early May we were told they would scheduled a contact by in the next few weeks but no later than the end of the school year in June.
- we were tenitively scheduled the weeks of May 14th or 21st , 2001.
- We prepared in earnest reassembling our equipment and getting ready for deployment to the school
- We were told that we were scheduled for the 21st of May,2001 and were at the school trying to contact the ISS (with full press coverage). Due to some last minute re-tasking, which we found out about just after our attempt that the crew was not available for the contact and would be available on the 23rd.

The Time line

- On May 23rd we set up for another try and this time we were successful.
- The contact started when the ISS was coming up over Alaska and ended somewhere in the Midwest.

Try It Yourself

- Determine when the ISS will be overhead with a tracking application.
- Listen on the down link on 145.800 During the ISS waking hours. Leaving a old scanner in the shack tuned to this frequency will alert you if there is activity.
- If you hear activity from NA1SS try contacting them on the 144.490 uplink frequency. Try contacting them from 3 minutes before the ISS is scheduled to be directly overhead.
- A directional antenna could be helpful
- The strongest signal and shortest path will be when the ISS is near directly overhead.
- Keep the contact short to allow others to make contact. This should not be a long conversation contact.


THE END