

# ARISS GROUND STATION RECOMMENDATION

This document describes the recommended ground station equipment and control methods for conducting a direct ARISS contact. A station such as this is likely to overcome the technical challenges of communicating with ISS and result in a successful contact. Variations are possible, but must be discussed with your mentor. Valuable improvements, in order of preference, are a better antenna, lower-loss coax, and increased output power. If you can manage a better station, give preference to improving reception.

## PRIMARY STATION

The recommended primary station consists of:

- Transceiver with 50–100 W output, 1-kHz tuning steps, and 21 memories capable of storing split frequencies
- Low-loss coax (such as 9913 or LMR-400)
- Mast-mounted receive pre-amplifier
- 14-element yagi antenna with switched circular polarity
- Antenna rotators for azimuth (0–360°) and elevation (0–180°), with interface for computer control
- Computer running tracking software for antenna control (including flip mode operation)

## REASONING

**Transmitter power:** The ISS radio uses a small antenna that is occasionally obscured by parts of the ISS structure. A strong signal from the ground station reduces the effect of signal blockage and helps overcome any interference on the frequency, making it easier for the astronaut to understand the student's questions.

**1 kHz tuning:** Staying close to the Doppler-shifted uplink and downlink frequencies helps keep the signal within the bandpass of the receivers (especially the narrow bandpass of the Ericsson radio). This produces better audio throughout the contact and allows a usable signal closer to acquisition and loss of signal (which means a longer contact and more questions answered). Larger tuning steps (such as 5 kHz) are not adequate.

**Radio memories:** Doppler correction of uplink and downlink frequencies is required. Computer control is possible, but using manually switched radio memories is recommended because of easier setup and reduced risk of failure.

**Coax and pre-amplifier:** For safety and interference reasons, the ISS radio has limited power output (5 watts for the Ericsson radio). Low-loss coax and a pre-amp help to get the best possible signal to the receiver, making the astronaut's answers easier to understand and increasing contact duration.

**Antenna:** Signals from the ISS quarter-wave vertical antenna become circularly polarized while passing through the ionosphere. An antenna with switched circular polarization captures a stronger signal and can eliminate (or greatly reduce) polarization-induced signal dropouts, improving the quality of the contact.

**Rotators and computer control:** Elevation capability of 180° with flip-mode operation prevents a signal dropout (one minute or more) if the ISS crosses the azimuth rotator's dead spot. Computer control (with an accurate time setting and the latest TLEs) gives accurate tracking for maximum signal capture.

## BACKUP STATION

The backup station allows a minimal contact in case the primary station fails during the contact. It consists of:

- Transceiver with 50–100 W output, 1-kHz tuning steps, and 21 memories capable of storing split frequencies
- Power amplifier with 100–200 W output (optional)
- Low-loss coax
- Mast-mounted receive pre-amplifier
- Omnidirectional antenna, either vertical (preferred) or eggbeater style
- Uninterruptable power source (UPS or battery)

# Recommended Station for Direct Contacts

