W3USR Amateur Radio Station Equipment and Capabilities

University of Scranton Amateur Radio Station Location: Loyola Science Center, Room 596

Station Overview

W3USR is a fully-equipped amateur radio station capable of communications across multiple bands and modes, from HF worldwide communications to VHF/UHF satellite operations. The station features professional-grade equipment and antenna systems installed on the Loyola Science Center roof.

Antenna Systems

1. Satellite Antenna System

Location: Southwestern corner, western roof section of LSC

Capabilities: - VHF (2 meter) and UHF (70 centimeter) satellite operation - Terrestrial weak-signal communications when oriented at horizon - Full azimuth/elevation computer-controlled tracking

Equipment: - **VHF Antenna:** M2 2MCP22 circularly-polarized antenna (2m) - **UHF Antenna:** M2 436CP42UG circularly-polarized antenna (70cm) - **Rotator:** Yaesu G-5500DC azimuth/elevation rotator with fiberglass crossboom - **Controller:** Green Heron RT-21Aazel digital controller with computer interface - **Preamplifiers:** Low-noise DC-switched outdoor preamps (VHF and UHF) - **Mounting:** Non-penetrating roof mount with 2-3/8" x 12' mast and 850 lbs ballast

2. VHF/UHF Omnidirectional Antenna System

Location: Southeastern corner, western roof section of LSC

Capabilities: - 6 meter band (52 MHz) - 2 meter band (144-148 MHz) - 70 centimeter band (440-450 MHz) - 23 centimeter band (1.2 GHz) - GPS reception

Equipment: - **6m Antenna:** Kreco CP-40A (52 MHz, 2.1 dB gain) - **2m Antenna:** RFS BA1312 (144-148 MHz, 5.1 dBi gain) - **70cm Antenna:** Commander 1150-5N (440-450 MHz, 7.1 dBi gain) - **23cm Antenna:** Newtronics HS10-12430 (1.2 GHz, 14.1 dBi gain) - **GPS Antenna:** Abracon AEAGMK148060-S1575 multiband GPS antenna - **Mounting:** Non-penetrating frame with four 2-3/8" x 8' masts and 1,400 lbs ballast

3. HF Antenna System

Location: East-center and west-central sections of LSC roof

Capabilities: - 80 meter band - 40 meter band - 20 meter band - 15 meter band - 10 meter band

Equipment: - **Tower:** Custom 40' bracketed/self-supporting Rohn 45G tower - **Yagi Antenna:** DX Engineering DXE-3X10 (10m/15m/20m) on 20' chromoly 2" mast - **Rotator:** Yaesu G-1000DXA with top thrust bearing - **Wire Antenna:** Custom fan dipole for 40m/80m with rigging - **Support Masts:** Two 2-3/8" x 20' galvanized masts for dipole end supports

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Radio Equipment

HF Transceiver

- **Radio:** Icom IC-7610 HF all-mode transceiver
- **Radio Coverage:** 1.8-29.7 MHz (160m-10m amateur bands)
- **Station Antenna Coverage:** 3.5-29.7 MHz (80m-10m, limited by installed antennas)
- **Amplifier:** ACOM 1010 HF amplifier (~600W output)
- **Accessories:** SP-38 speaker, SM-50 microphone
- **Modes:** SSB, CW, AM, FM, RTTY, PSK31, and other digital modes

6m Transceiver

- **Radio:** Icom IC-7300 HF/6m all-mode transceiver (dedicated to 6m)
- **Radio Coverage:** 1.8-54 MHz (160m-6m amateur bands)
- **Station Configuration:** Dedicated to 6m operation (50-54 MHz)
- **Modes:** SSB, CW, AM, FM, RTTY, PSK31, and other digital modes

VHF/UHF/23cm Transceiver

- **Radio:** Icom IC-9700 2m/70cm/23cm all-mode transceiver
- **Accessories:** SP-41 speaker, SM-50 microphone
- **Modes:** SSB, CW, FM, digital modes, satellite operations
- **Coverage:** 144-148 MHz, 430-450 MHz, 1240-1300 MHz

VHF/UHF FM/Digital Voice

- **Radio:** Yaesu FTM-400XDR FM/C4FM transceiver
- **Modes:** FM analog voice, C4FM digital voice (System Fusion)
- **Coverage:** 2m/70cm
- **Accessories:** External speaker

UHF DMR Radio

- **Radio:** Motorola XPR-5550 70cm FM/DMR transceiver
- **Modes:** FM analog voice, DMR (Digital Mobile Radio)
- **Accessories:** Programming software, programming cable, external speaker
- **Coverage:** 70cm band

CW (Morse Code) Equipment

- **Iambic Paddles:** Vibroplex iambic paddles
- **Keyer:** microHAM Winkey CW keyer with cables
- **Straight Key:** Vibroplex straight key with cable

Audio Equipment

- **Headset:** Heil ProSet PS-IC with footswitch

Power Supplies

- **Two Astron RM-50M power supplies** with fused DC distribution panels

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Computer Systems

Station Computers

- **Two Windows 11 workstations** with:
  - Monitor
  - Speakers
  - Keyboard and mouse
  - Ham Radio Deluxe (HRD) software licenses

Capabilities: - Digital mode operations (RTTY, PSK31, FT8, WSPR, etc.) - Satellite tracking software - Logging and contest software - Radio control and remote operation

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Infrastructure

Station Grounding

- R56-compliant professional grounding system
- Copper bus bar with bond to building steel
- Coaxial cable ground kits on all antenna transmission lines
- #6 green THHN grounding conductor to equipment

Patch Panel System

Radio Station (LSC 596): - 40-port rack-mount patch panel in Middle Atlantic MMR-1220 rack - 16 ports for antennas (4 UHF, 12 Type N) - 16 ports for radio equipment (4 UHF, 12 Type N) - 8 ports for intramural cables to research room - Custom-length coaxial cables to equipment - UHF and Type N patch cables

Research Room: - 8-port wall-mount rack panel (2 UHF, 6 Type N) - Intramural cabling (LMR400) from radio station

Surge Protection

- Coaxial cable arrestors on all antenna feedlines
- Rotator cable arrestors
- Professional R56 grounding and lightning protection

Cable Infrastructure

- Professional LMR-type low-loss coaxial cables

- 3” rigid conduit risers through roof with weatherheads
- Proper cable management with hangers, strut, and raceways
- All roof penetrations sealed by certified contractor

Operating Capabilities

Communication Modes

1. **Voice:**
   - SSB (Single Sideband) - HF and VHF/UHF
   - FM (Frequency Modulation) - VHF/UHF
   - AM (Amplitude Modulation) - HF
2. **Digital Voice:**
   - C4FM (System Fusion)
   - DMR (Digital Mobile Radio)
3. **CW (Morse Code):**
   - Traditional straight key
   - Electronic iambic paddles with computer keyer
4. **Digital Data Modes:**
   - RTTY (Radioteletype)
   - PSK31, PSK63
   - FT8, FT4, WSPR
   - APRS (Automatic Packet Reporting System)
   - Other experimental modes

Operating Scenarios

1. **Local Communications:**
   - VHF/UHF FM repeater operations (2m, 70cm)
   - Simplex communications
   - Digital voice networks (DMR, System Fusion)
2. **Weak-Signal VHF/UHF:**
   - SSB communications on 2m, 70cm, 23cm
   - CW operations
   - Digital modes (FT8, MSK144, etc.)
   - Tropo, meteor scatter, and sporadic-E propagation
3. **Satellite Communications:**
   - FM voice satellites
   - Linear transponder satellites (SSB/CW)
   - Digital satellites
   - Computer-controlled antenna tracking
4. **HF Worldwide Communications:**
   - DX (long distance) on 80m, 40m, 20m, 15m, 10m
   - SSB voice, CW, and digital modes
   - Propagation studies across different bands and times
   - Contests and special event operations
5. **Experimental and Research:**

- Propagation studies
- Antenna pattern analysis
- Digital mode development and testing
- GPS timing applications
- Software-defined radio experiments

Educational Applications

The W3USR station provides hands-on learning opportunities in:

- **Electromagnetic wave propagation** (HF, VHF, UHF, microwave)
- **Antenna theory and design** (dipoles, yagis, vertical antennas, circular polarization)
- **Modulation techniques** (AM, FM, SSB, digital modulation)
- **Radio frequency transmission lines** and impedance matching
- **Signal processing** (analog and digital)
- **Satellite communications** and orbital mechanics
- **Computer-controlled systems** (rotator control, satellite tracking)
- **Receiver design concepts** (superheterodyne, direct conversion)
- **Spectrum management** and frequency coordination
- **Propagation phenomena** (ionospheric, tropospheric, line-of-sight)

Technical Specifications Summary

Parameter	Specification
Frequency Coverage	3.5 MHz - 1.3 GHz (80m through microwave, antenna-limited)
Transmit Power	Up to 600W on HF (with amplifier), 100W on VHF/UHF
Antenna Gain	2.1 dB (6m) to 14.1 dBi (23cm)
Rotator Control	Computer-controlled Az/El and azimuth-only
Operating Modes	SSB, CW, FM, AM, C4FM, DMR, and digital data
Computer Integration	Full logging, digital modes, satellite tracking
Grounding	Professional R56 standard

Document created from equipment proposal dated 01 Aug 2022 All proposed equipment assumed installed and operational