

The HAARP Facility



Briefing to

HAARP/Resonance Meeting

University of Maryland, College Park

November 8, 2011

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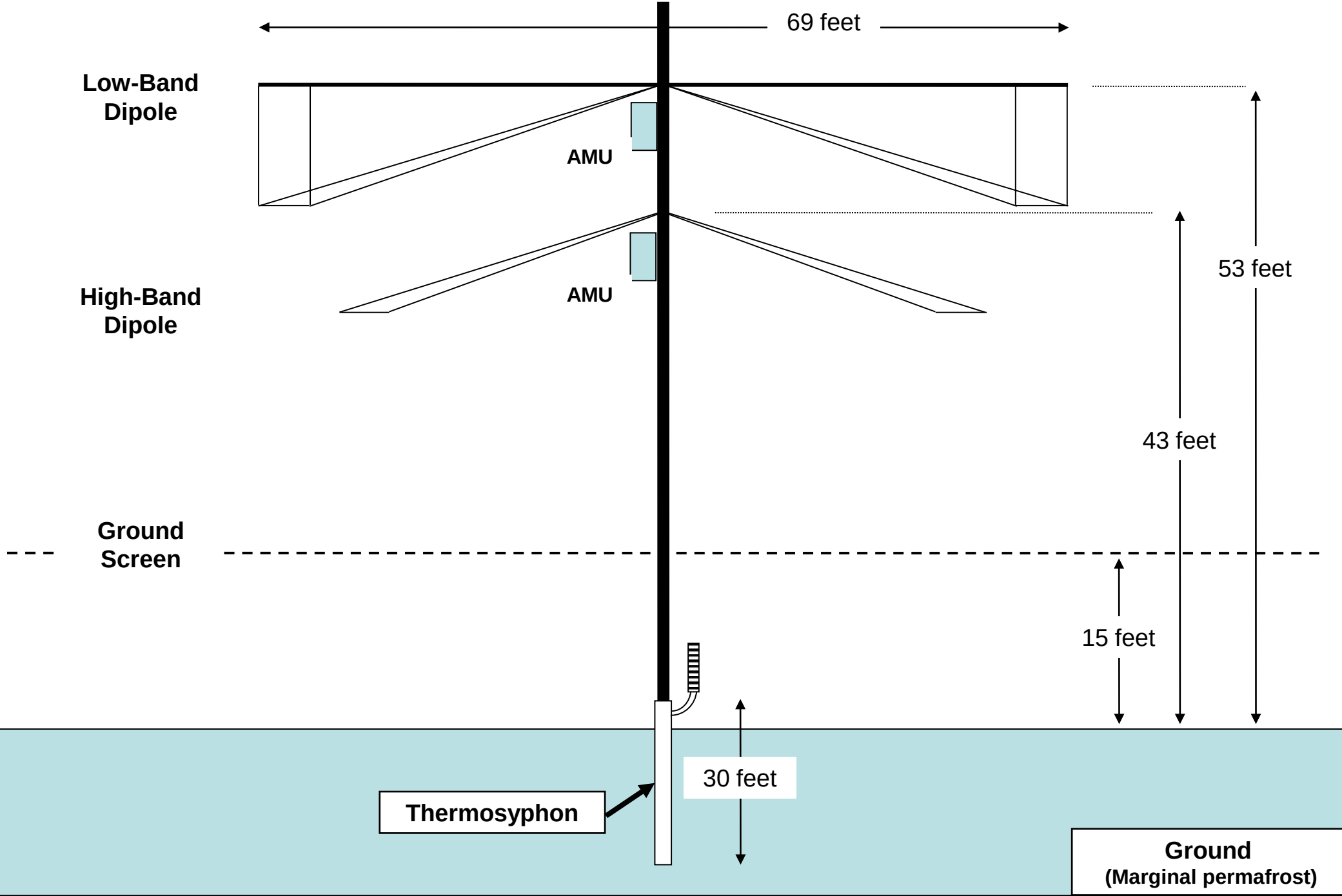
Marsh Creek LLC, Washington DC

The HAARP Array Specification

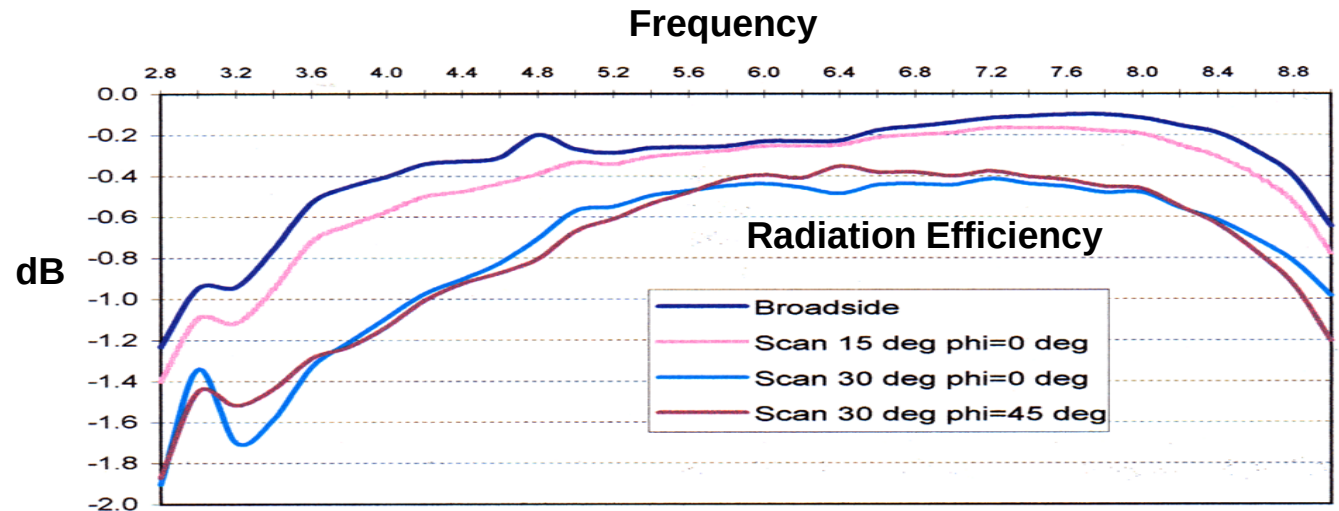
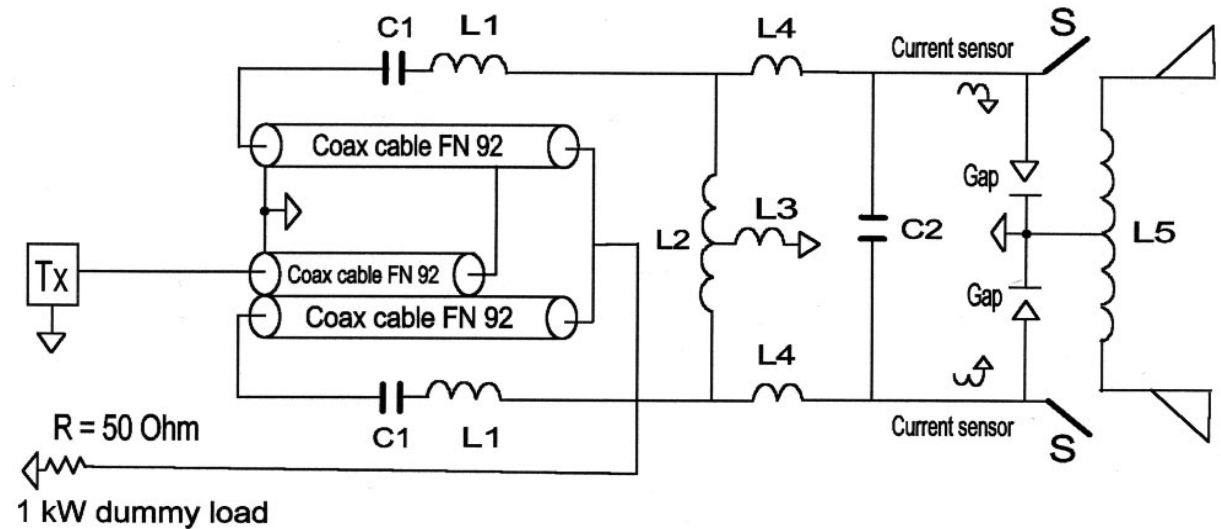
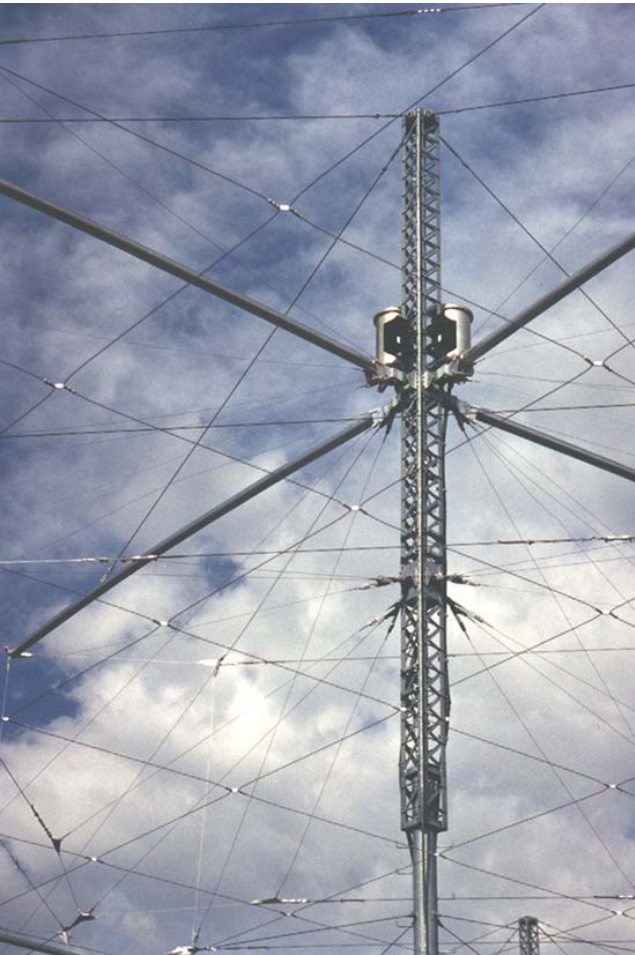


- **180 Element (12x15) Phased Array**
- **360 Nested Crossed Dipoles**
 - Low Band Dipole - 2.8 to 8.4 MHz
 - High Band Dipole - 7 MHz to 10 MHz
- **3.6 MW Radiated from 360 10kW Transmitters**
- **Instantaneous Bandwidth**
 - 200 kHz (2.8 MHz) 500 kHz (10 MHz)
- **ERP of 84 to 95 dBW**
- **Beam width**
 - 20°x16° (2.8 MHz) 5.7°x4.5° (10 MHz)
- **Beam can be Slued 30° off Zenith in any Azimuth 2.8 to 8 MHz (decreasing to 15° at 10 MHz)**
- **Rapid Scanning of +/- 15° Around Pointing Direction**
- **FM, AM and Pulse Modulation from DC to 30 kHz**
- **Dual Frequency Operation (Split Array)**
- **Linear, Left or Right Circular Polarization**
- **Transmitter Power Generated on Site 16.25 MVA at 12.5 kV**
- **System Operation from -40° F to + 90° F**

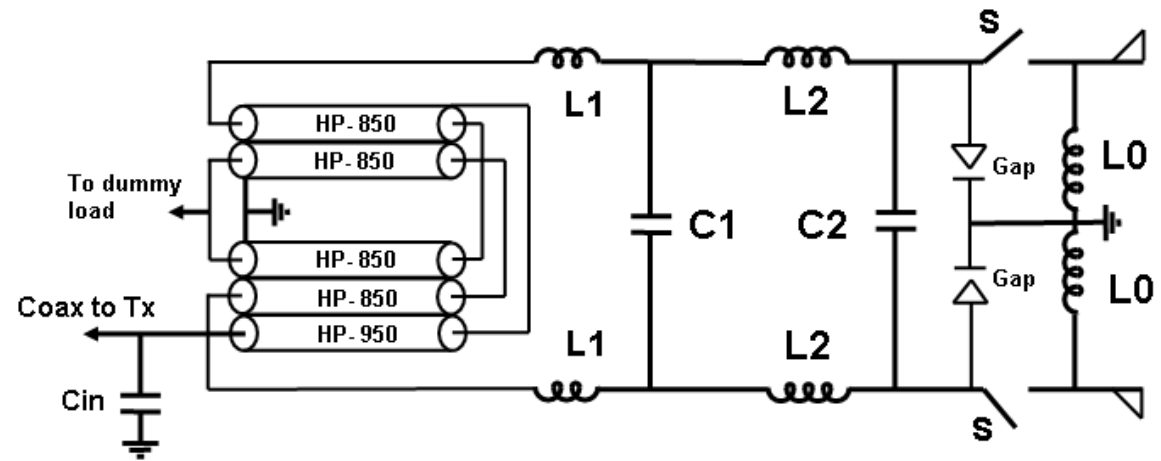
Antenna Element Components



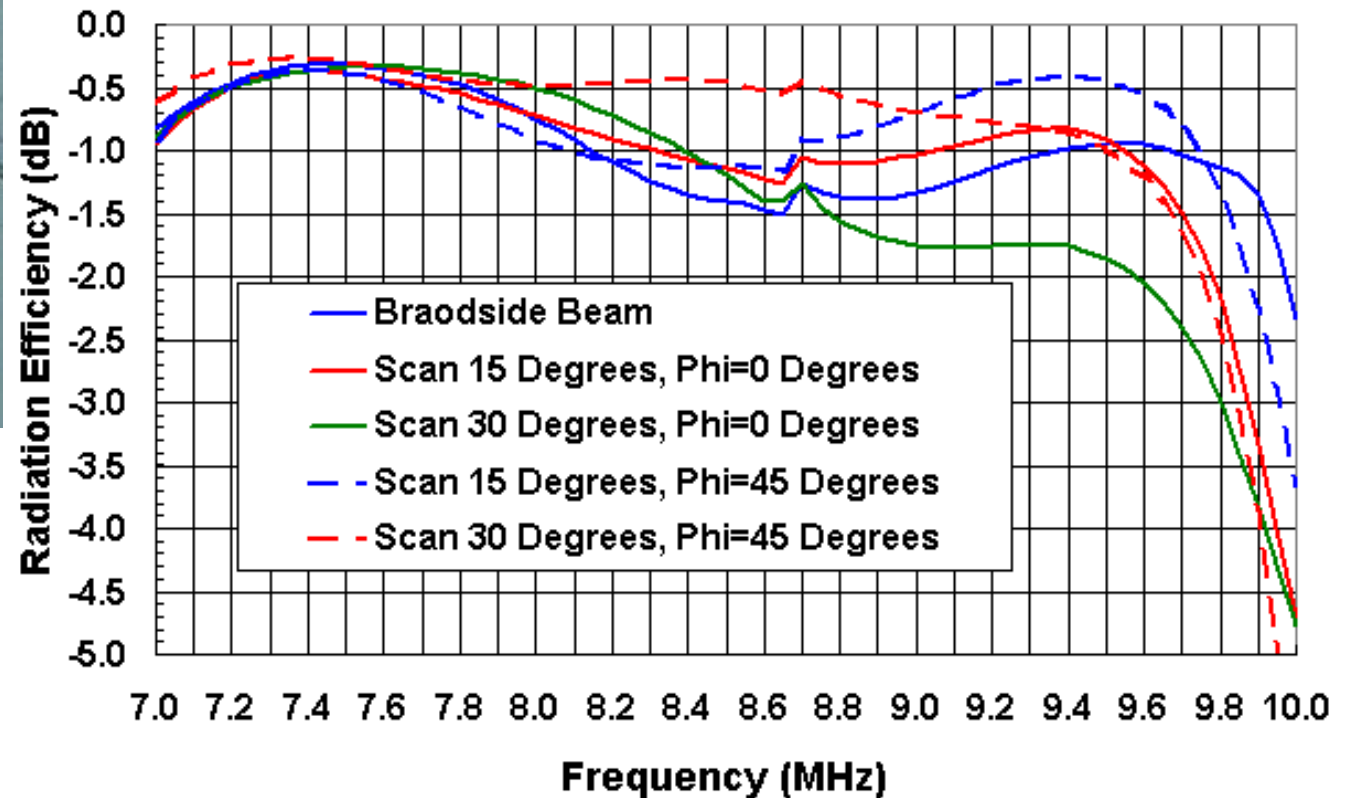
Low Band Balanced AMU & Hybrid



High Band Balanced AMU & Hybrid



Radiation Efficiency of HB HAARP Array

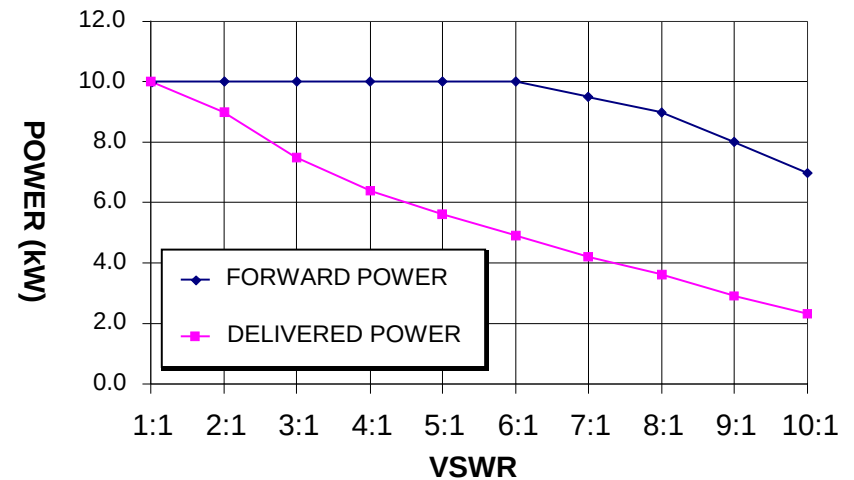
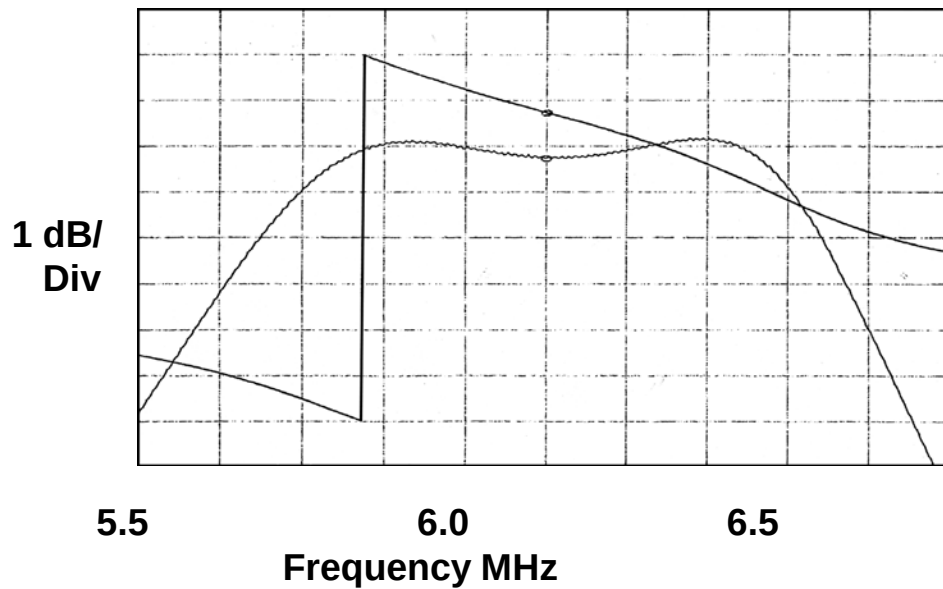
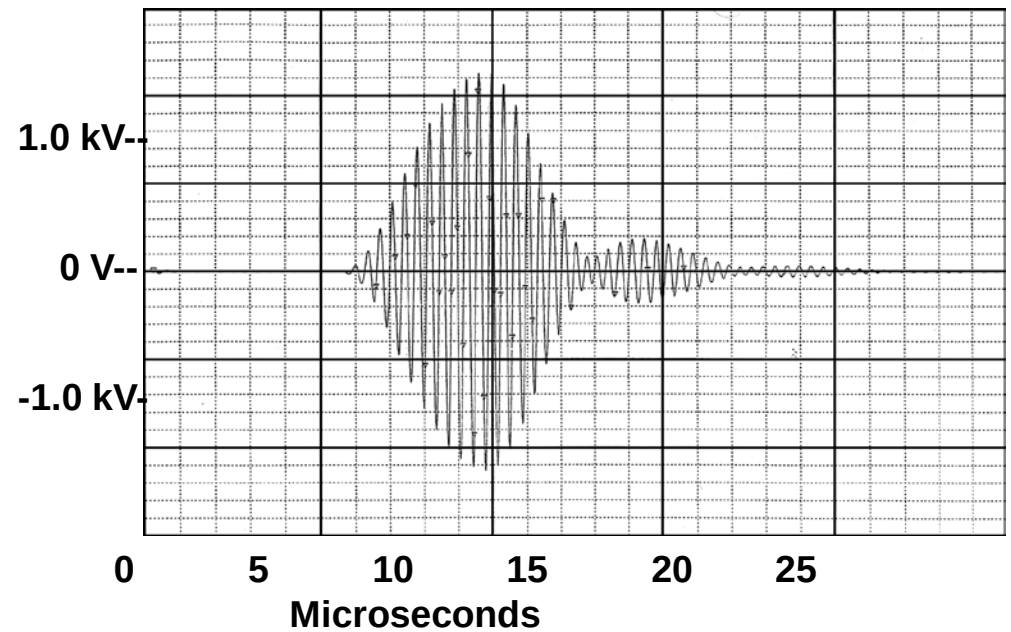
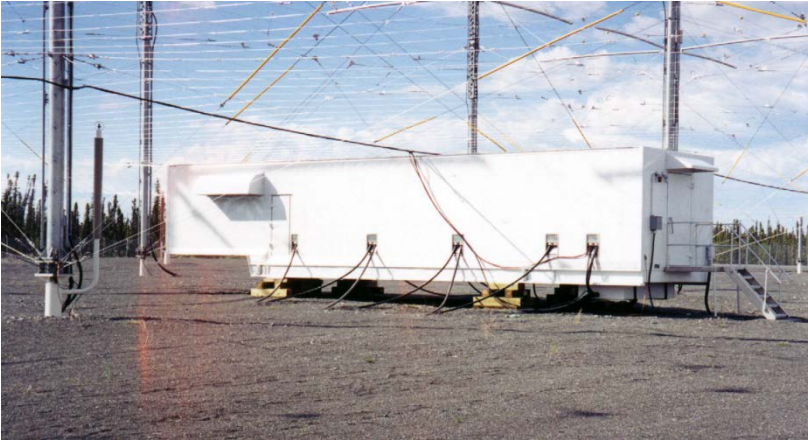


The HAARP Transmitters

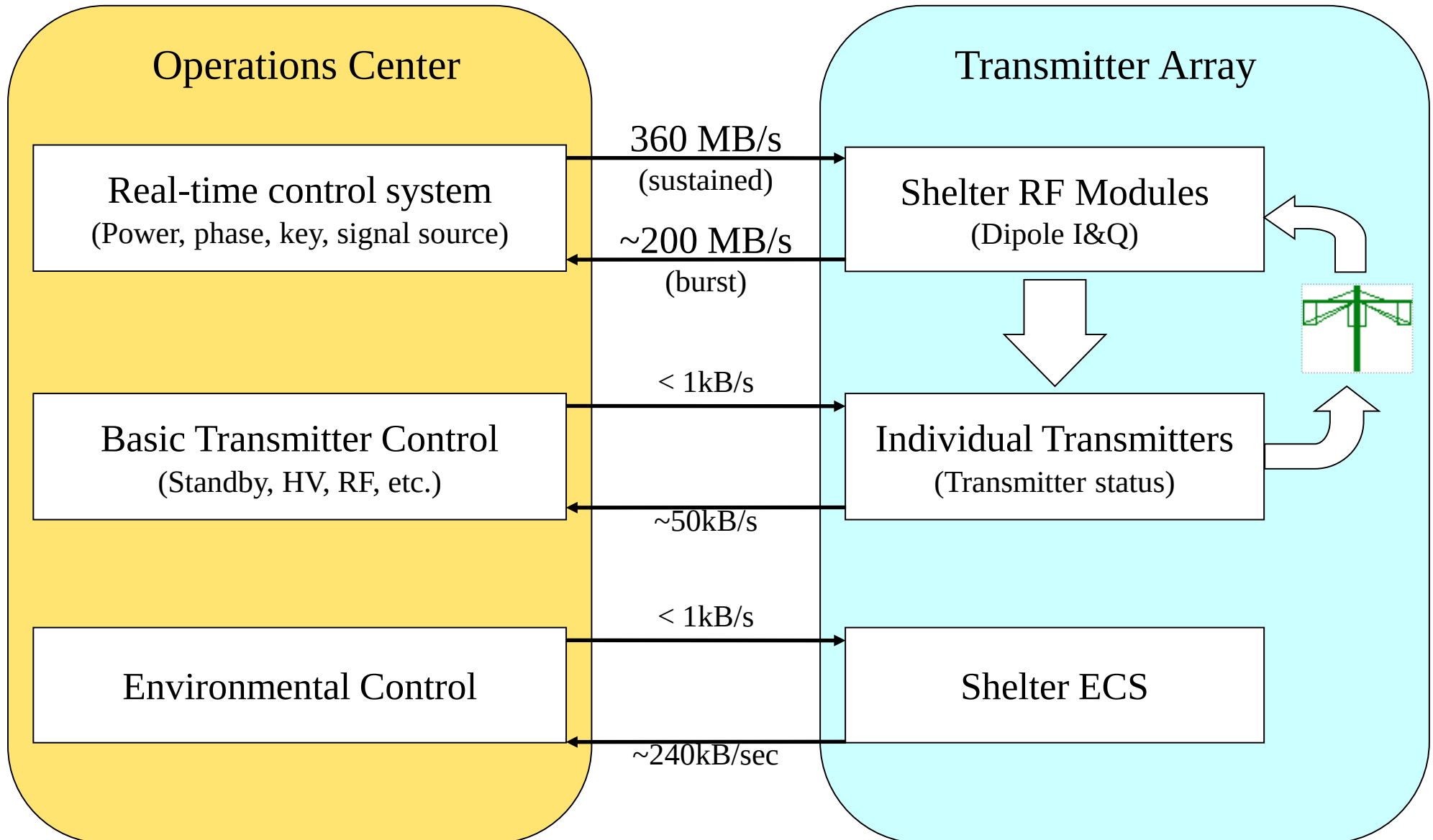


- 2.8 MHz to 10 MHz - Continuous Tuning
- Dual Independent Outputs - 10 kW Each Side
- Automatic Antenna Tuning to VSWR < 6:1
- Graceful Degradation for VSWR > 6:1
- Linear Amplifier 200 kHz Bandwidth (2.8 MHz),
500 kHz (10 MHz)
- Harmonic and Spurious Output
< -80 dBc (in band)
< -120 dBc (out of band)
< -150 dBc (from 88 to 200 MHz)
- Modes of Operation - CW, AM, FM, Pulse
- 6 Dual Units Mounted in each Shelter

The HAARP Transmitters and Shelters

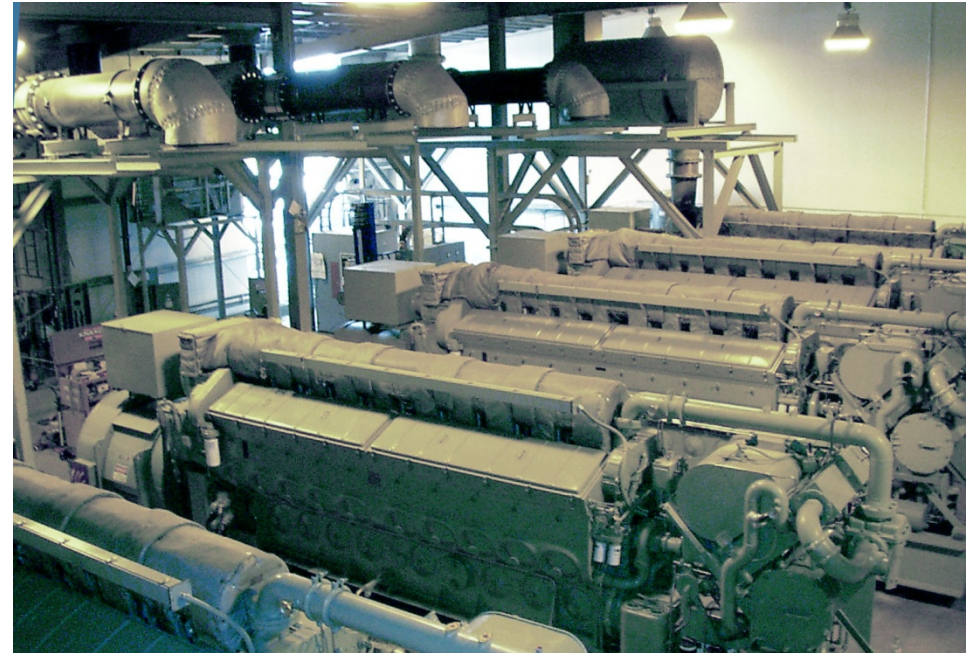


Typical Data Rates

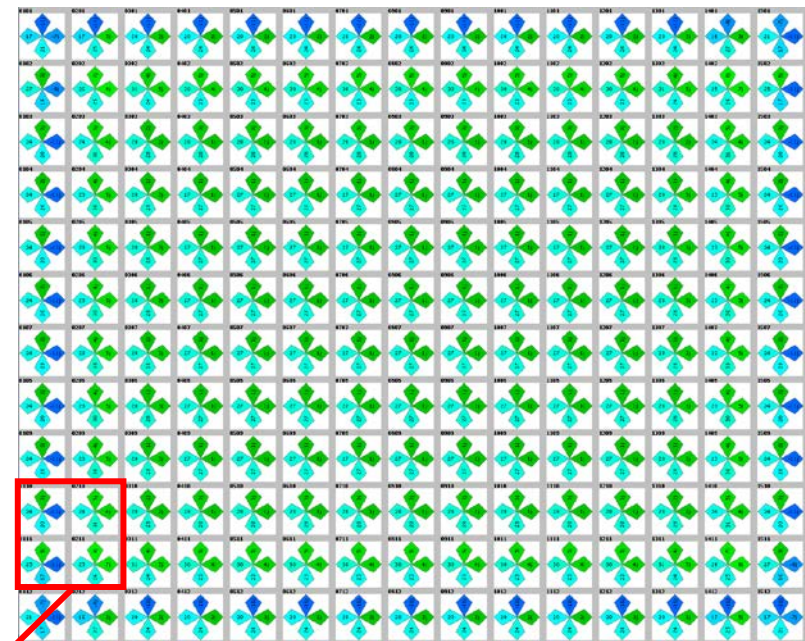
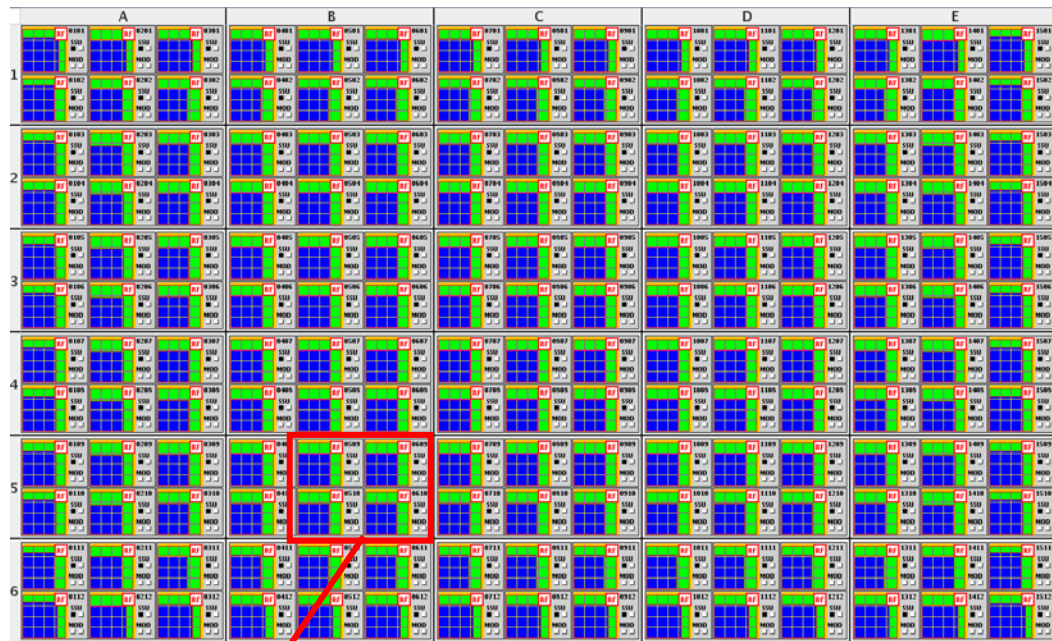


Facility Power Plant

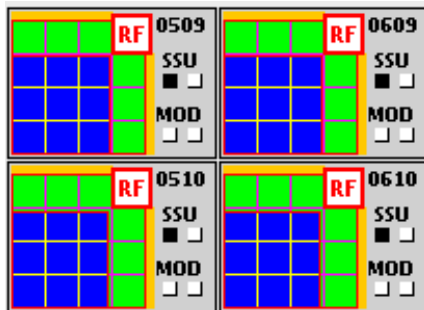
- The Power Plant uses 5 EMD diesel engines, each of which is rated at 3,600 HP.
 - The total power capability is 16.25 MVA (13MW, Pf 0.8)
 - To operate the Array at full power requires 4 generators (9.6 MW).
 - Fuel consumption at full array power will be approximately 565 gal per hour
- 1.2 MVA of commercial power available for housekeeping function



The Eye of HAARP

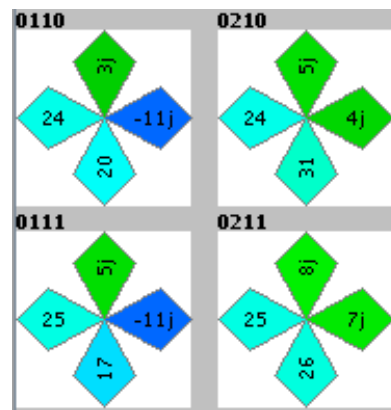


4.50 MHz

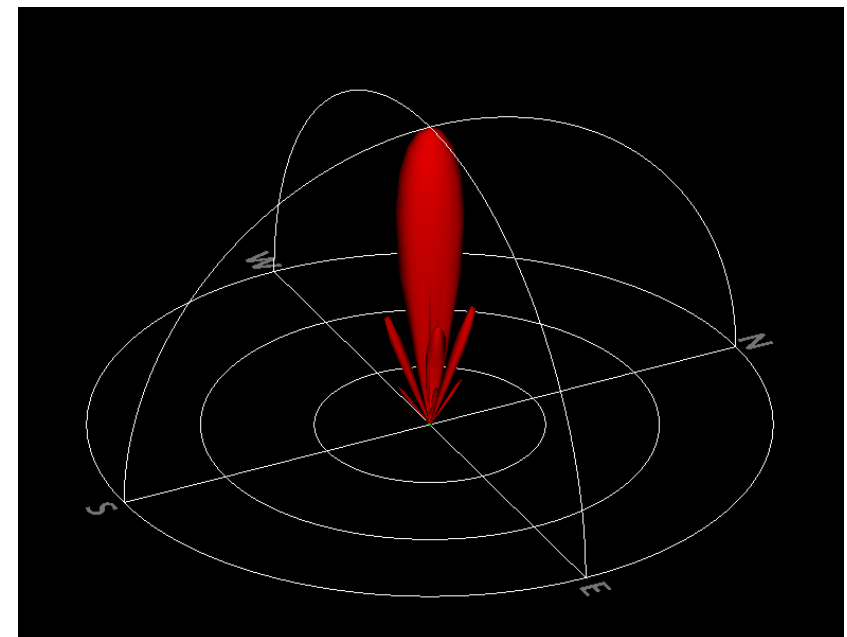


10 dB

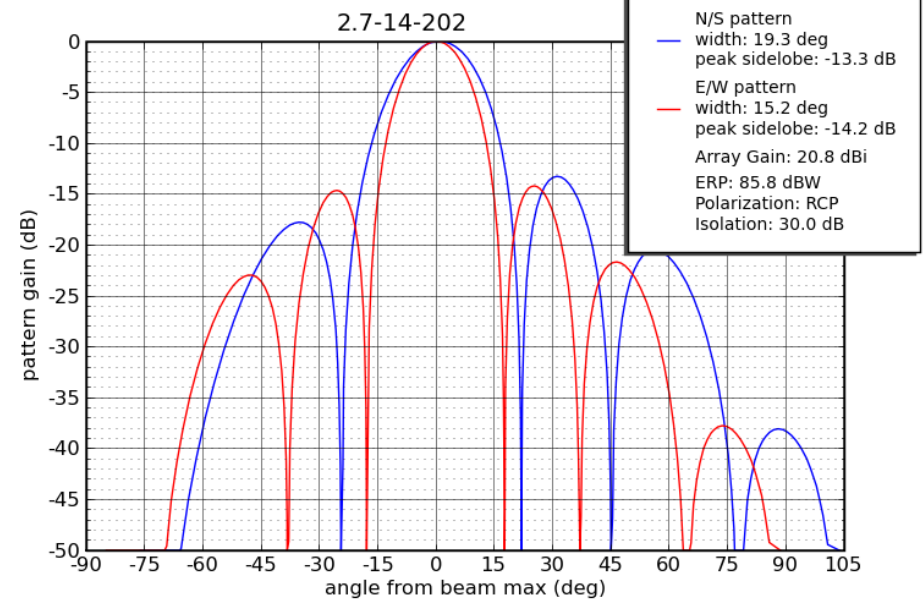
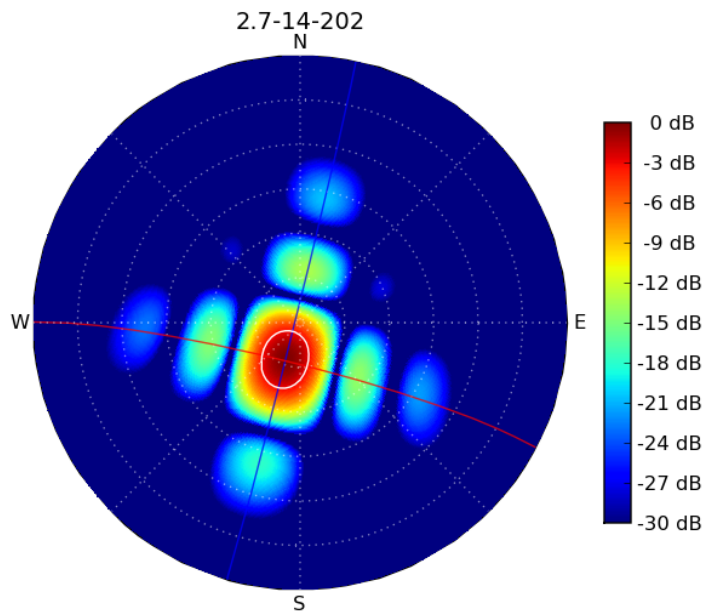
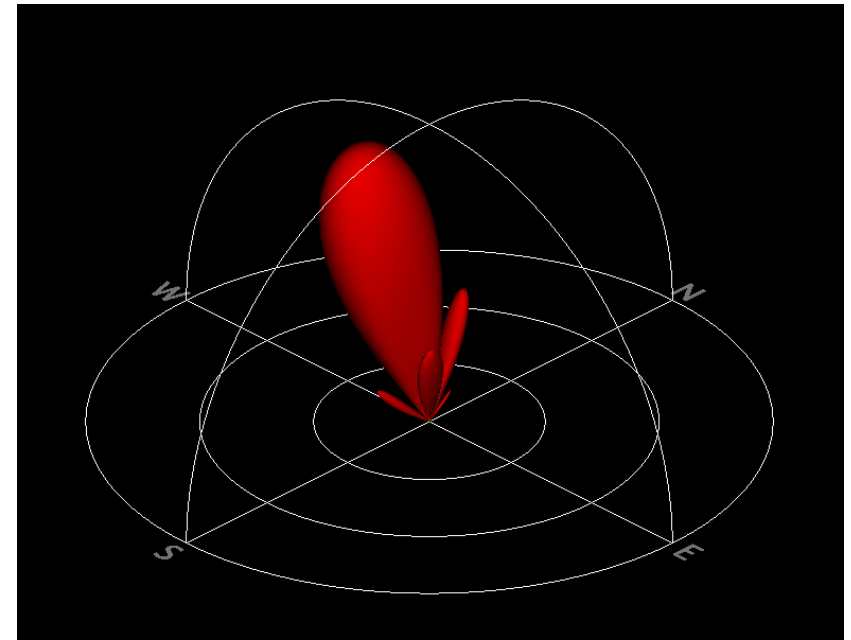
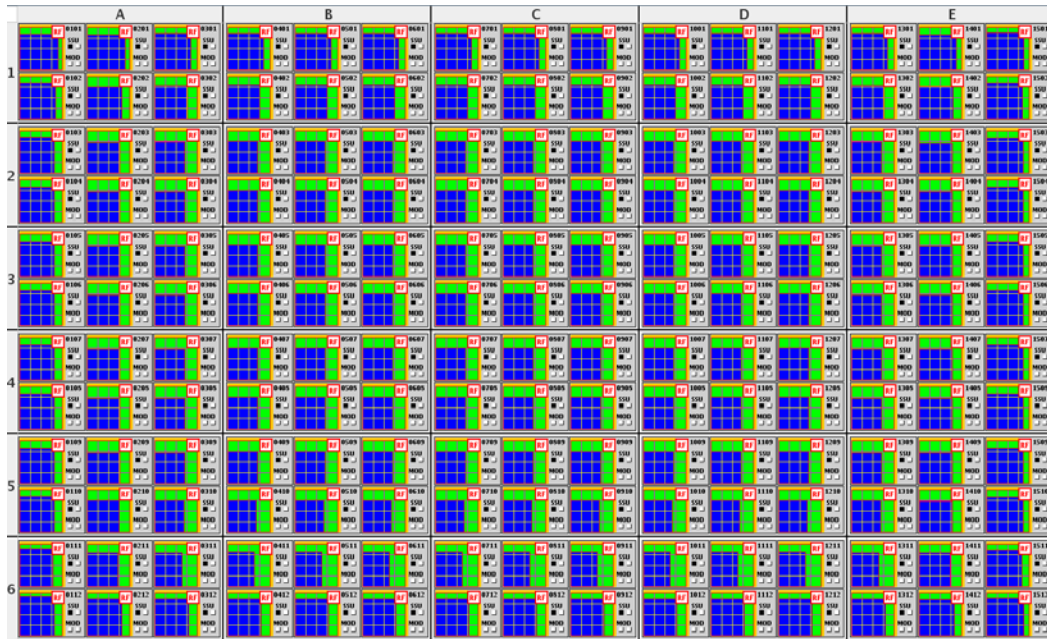
Forward/Reflected Power



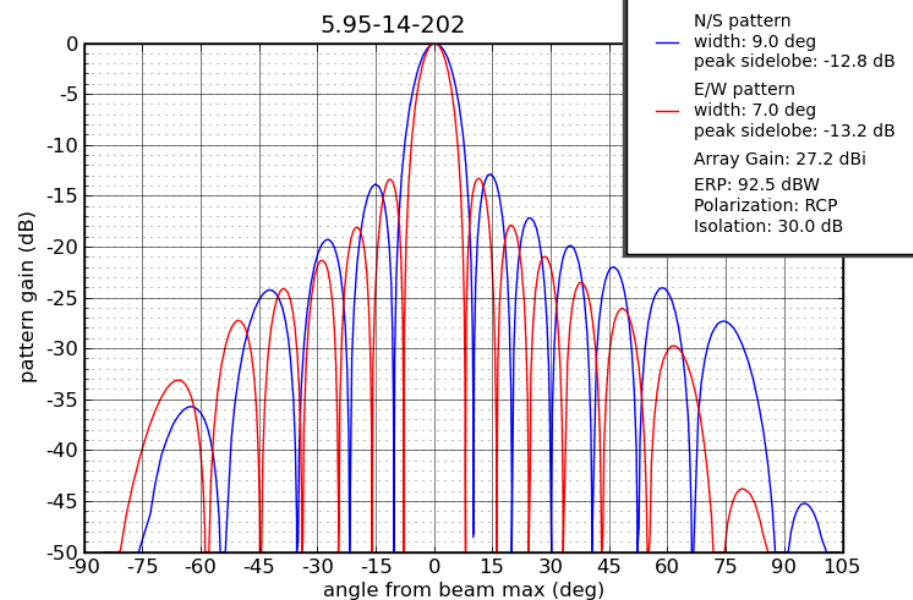
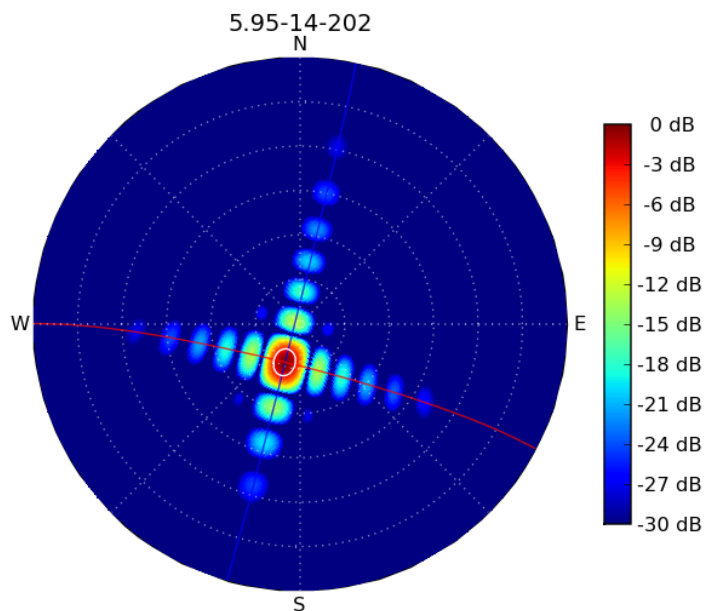
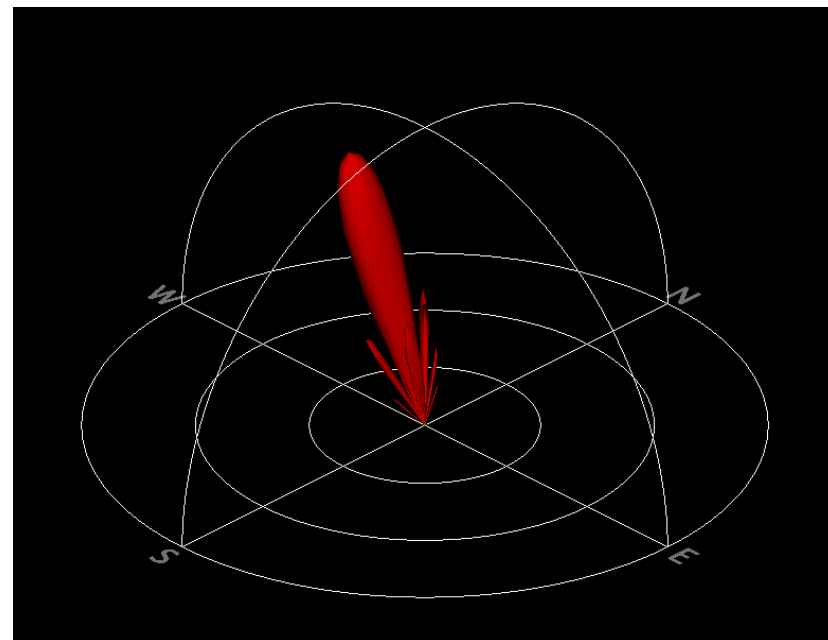
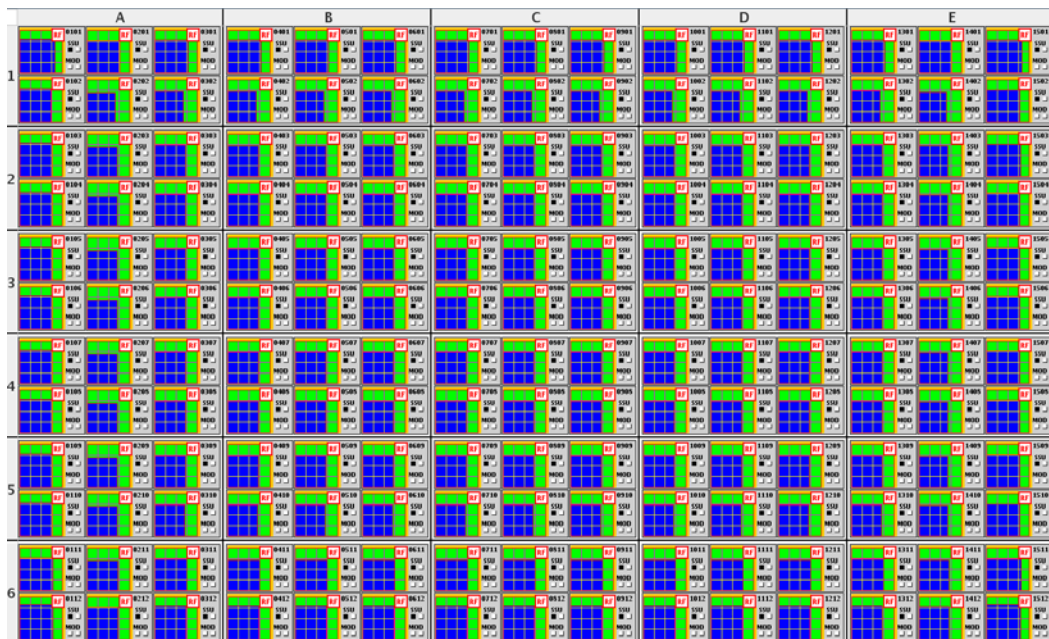
Dipole Impedance
(as seen by TX)



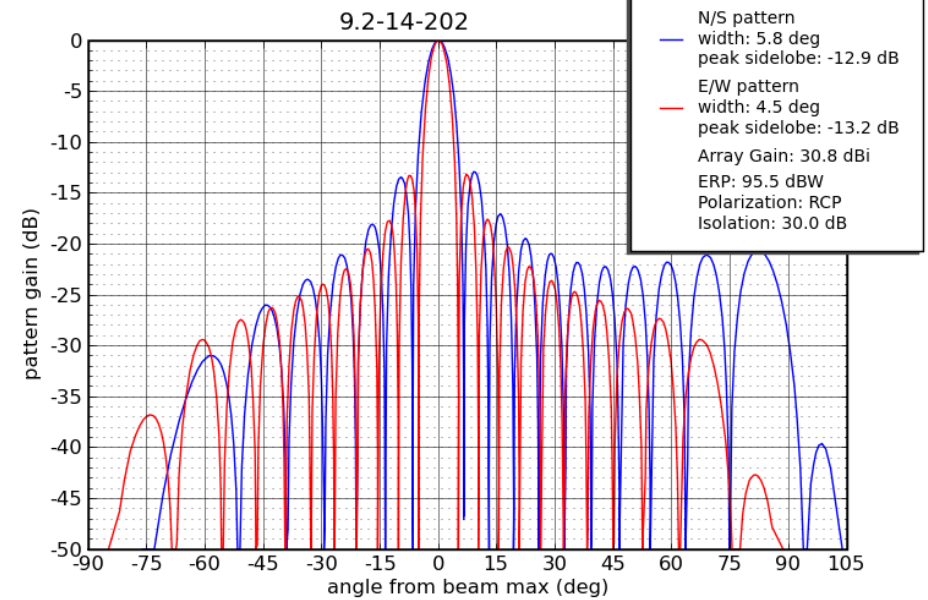
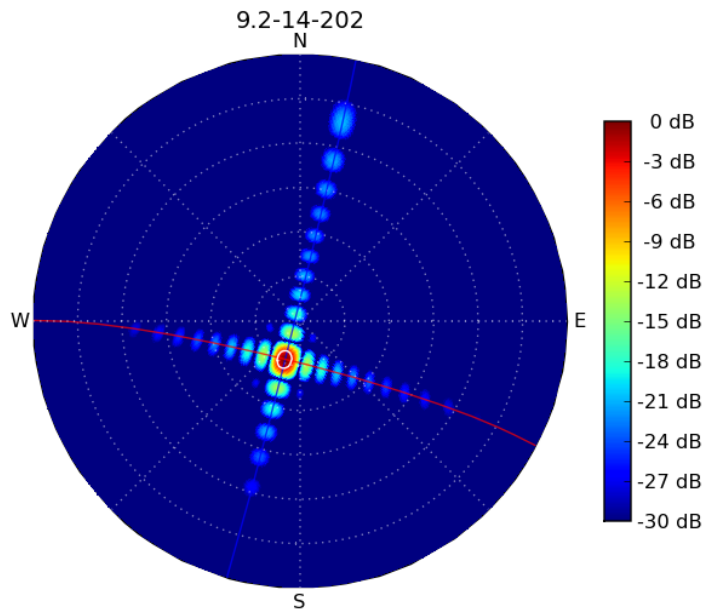
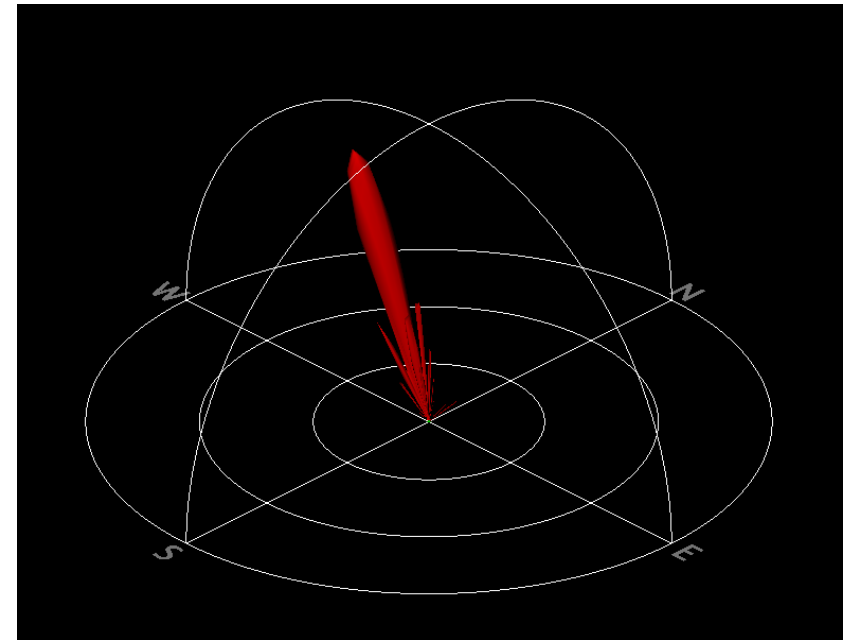
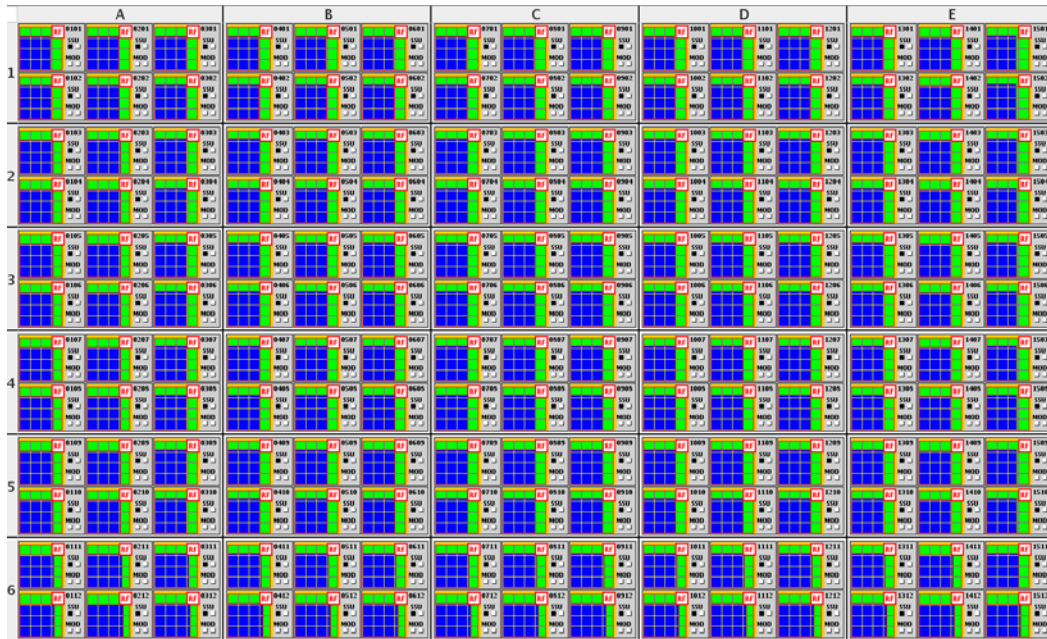
2.7 MHz Magnetic Zenith

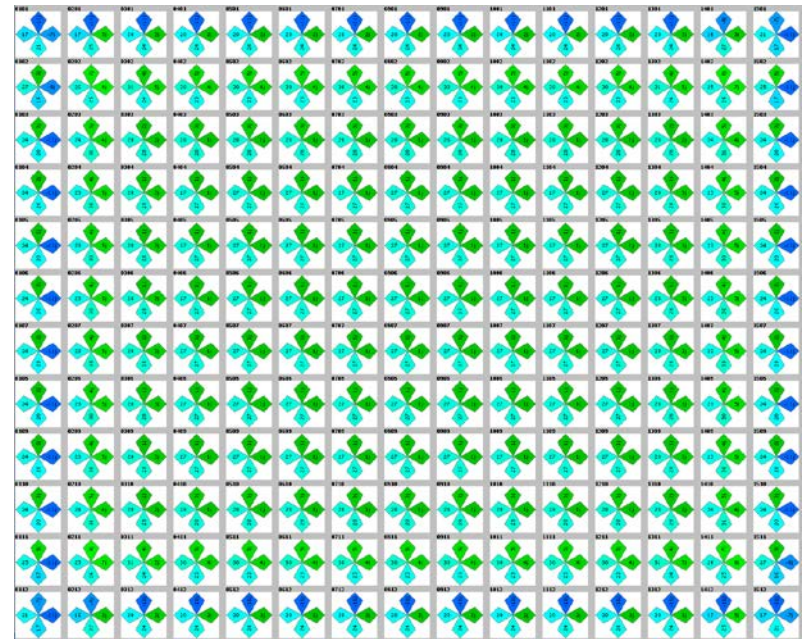
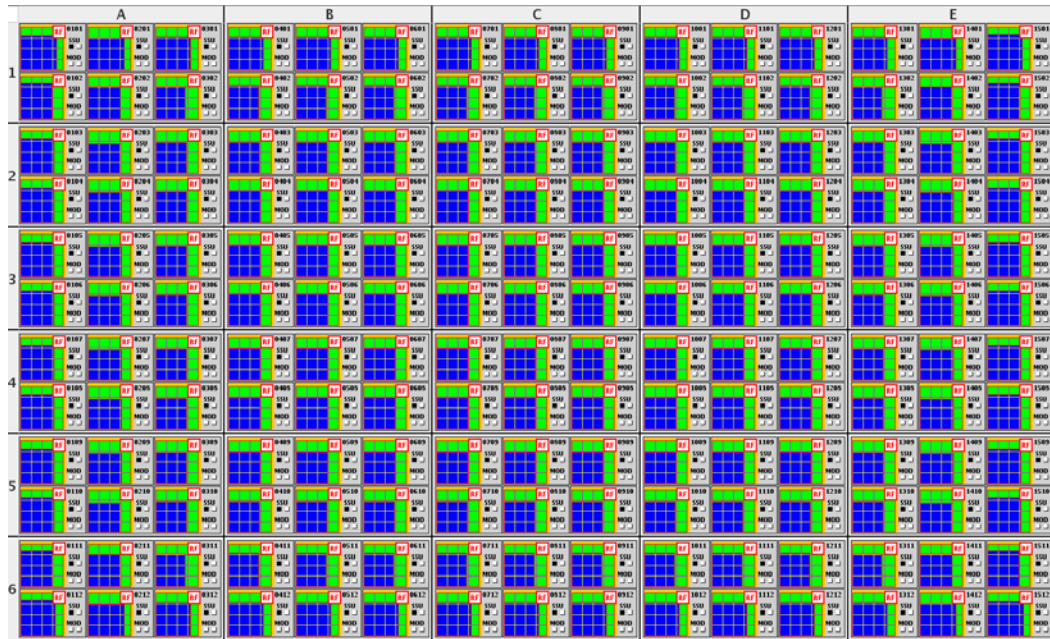


5.95 MHz Magnetic Zenith



9.2 MHz Magnetic Zenith

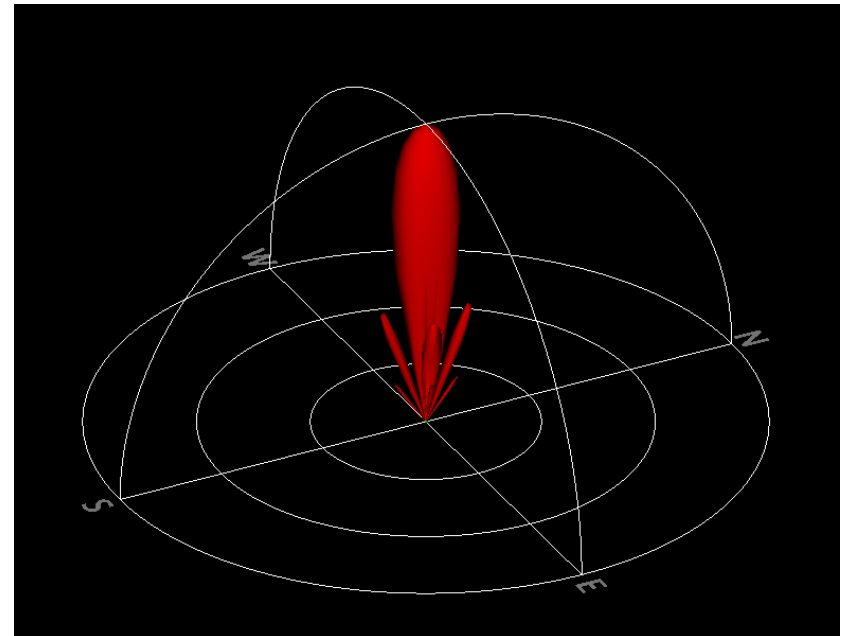
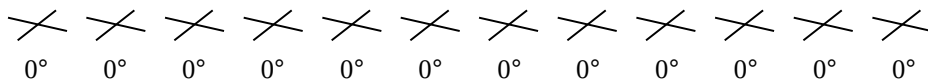


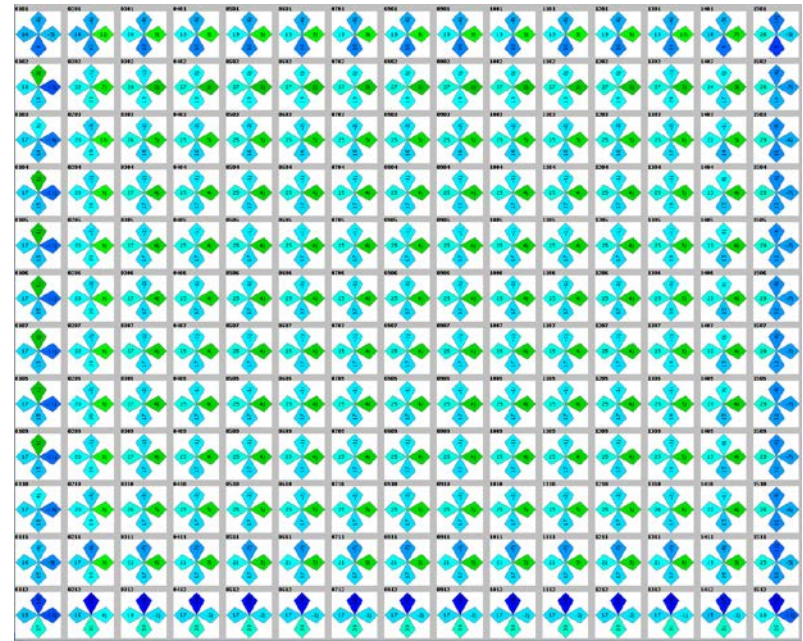
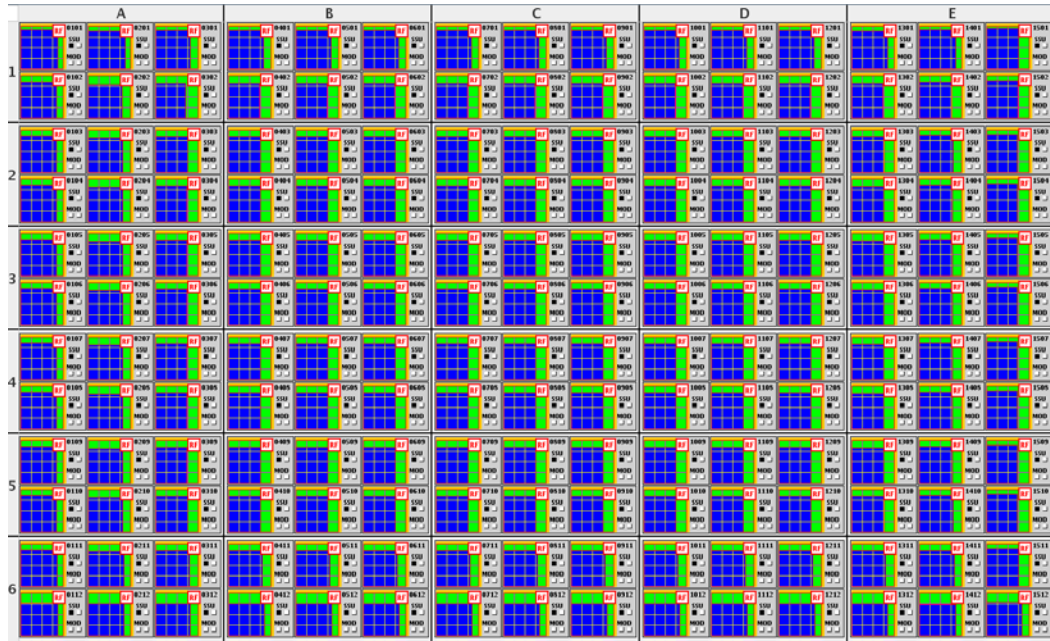


Impedance vs. Scan Angle

4.5 MHz

zenith=0°, azimuth=0°

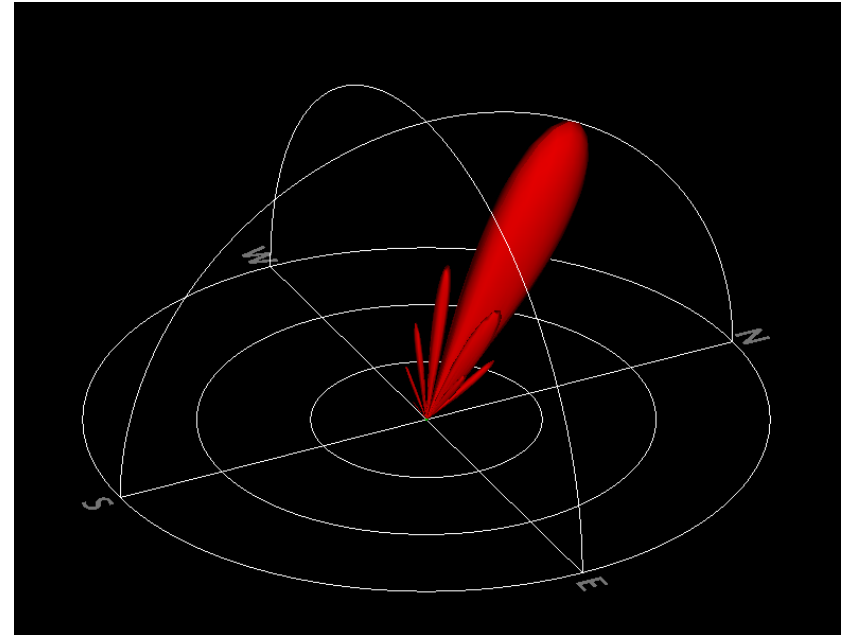
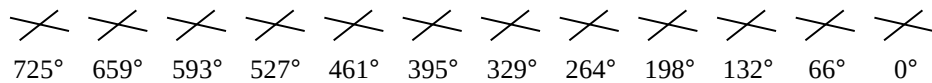


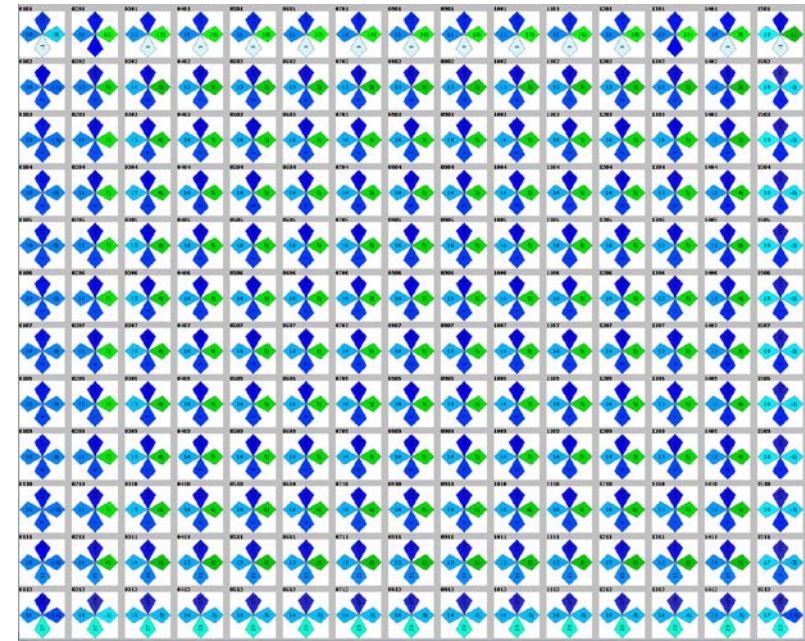
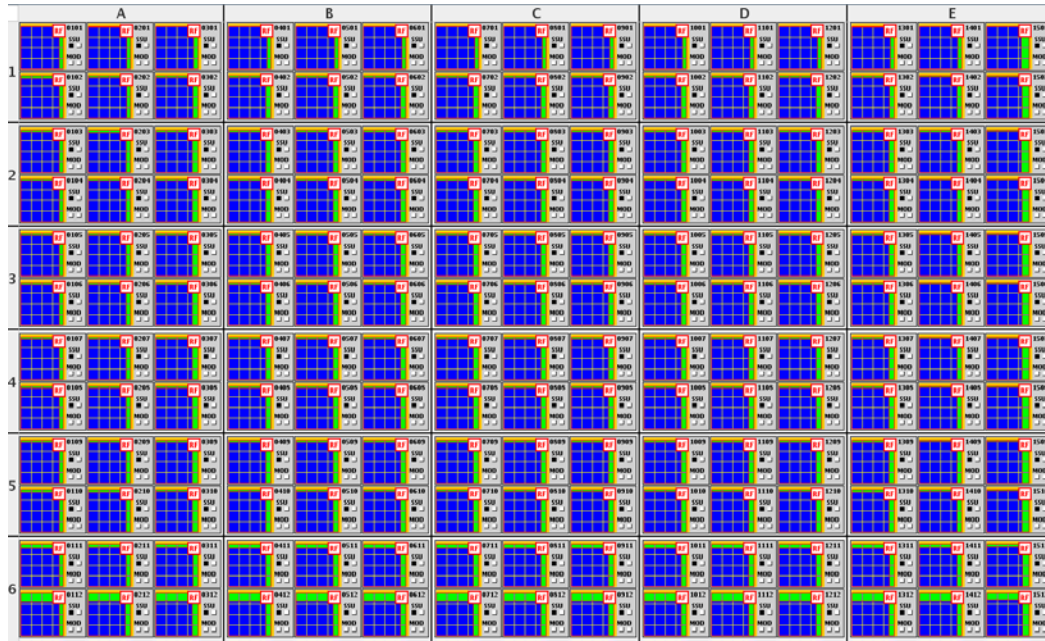


Impedance vs. Scan Angle

4.5 MHz

zenith=30°, azimuth=0°





Impedance vs. Scan Angle

4.5 MHz

zenith=60°, azimuth=0°

