

VHF/UHF/Microwave Radio Topics

+ W6QI's 47 GHz Adventure
in the Sierras!

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W6QI



Outline

- VHF/UHF/Microwave Bands
- Propagation Modes
- Operating Activities
- Equipment
- Photos
- Resources
- W6QI 47 GHz Sierra Adventure

Amateur VHF/UHF Bands

- 50 – 54 MHz
 - Terrestrial SSB/CW, FM
- 144 – 148 MHz
 - Terrestrial SSB/CW, FM
 - EME
 - Satellite
- 222 – 225 MHz
 - Terrestrial SSB/CW, FM
 - Novice privileges
- 420 – 450 MHz
 - Terrestrial SSB/CW, FM
 - Satellite
- 902 – 928 MHz
 - Terrestrial SSB/CW, FM

- *All modes for all license classes except novice*

Amateur Microwave Bands

- 1,240 – 1,300 MHz
 - Terrestrial SSB/CW, FM
 - EME
 - Satellite
- 2,300 – 2,310 MHz
 - Terrestrial SSB/CW, FM
 - EME
 - Satellite
- 2,390 – 2,450 MHz
 - 802.11b Experimental
- 3,300 – 3,500 MHz
 - Terrestrial SSB/CW
- 5,650 – 5,925 MHz
 - Terrestrial SSB/CW
- 10.0 – 10.5 GHz
 - Terrestrial SSB/CW
- 24.0 – 24.25 GHz
 - Terrestrial SSB/CW
 - Satellite

- 22 GHz of Spectrum above 1 GHz!!
- *All* modes for *all* license classes except novice

Amateur Millimeter-Wave Bands

- 47.0 – 47.2 GHz
 - Terrestrial CW
- 77.0 – 81.0 GHz
 - Terrestrial CW
- 119.98 – 120.02 GHz
 - Terrestrial CW
- 142 – 149 GHz
 - Terrestrial CW
- 241 – 250 GHz
 - Terrestrial CW
- 300+ GHz
 - Terrestrial CW

Propagation Modes

- Refractive
 - Mountain to Mountain
 - 800 km on 10 GHz
 - Mountain to Rover
 - 400 km on 10 GHz
 - Home to Home
 - 100 – 200 km
- Ducting
 - SF to LA on VHF/UHF and above
 - 4,000 km CA to HI, all bands up to 5.7 GHz!!!
- Diffraction
 - 1100 km+ on 10 GHz (Valley-Mt. Frazier-Mexico)
- Rain Scatter
 - 10 GHz and up contest 2004, N5XSA to N9JIM and AD6A 229 km from Santa Clara to Central Valley
- Bounce
 - Water tower, mountain, etc.
 - 200 km on 10 GHz
- E-Skip
 - 50 MHz, 144 MHz
 - 1,000+ km QSOs
- Aurora
 - 1,000+ km QSOs
 - 28 MHz, 50 MHz, 144 MHz

Activity - Ragchewing

- Random QSOs (lower bands)
- Weekly SSB nets (See WSWSS web page)
 - Sundays & Tuesdays, 8:00 pm, 144.250 MHz
 - Mondays, 8:00 pm, 430.100 MHz
 - Tuesdays, 7:30 pm, 1,296.110 MHz, SSB
 - Check-ins: local, central valley, LA when conditions good
- Weekly FM net
 - Mondays, 10 pm, ~10,369.180 MHz, -600 kHz
 - Can use Echolink to check in as well

Activity - Contests

- June, September, January ARRL VHF contest
 - 50 MHz and up bands
 - Lots of activity in June on all bands
- 10 GHz and up Cumulative contest
 - BIG contest for local microwave group
 - 2 weekends each year in August and September
 - Main appeal: Get outside with your rig
 - Rove around central valley like mad
 - Sit on an accessible mountain, get some sun
 - 4x4in' fun!
 - 10 GHz just like 20 meters!
 - Random QSOs
 - Pileups
 - QRM
- 2 GHz and up contest, SBMS
 - New this year, end of April
- Various Spring Sprints, or activity days

Activity - Experimental

- 802.11 Experimentation
 - Laptops have built-in 2.4 & 5.7 GHz transceivers!
 - Need wireless adapter with antenna port
 - Use “adhoc” network mode
 - Can do full duplex audio/video
 - Fully legal under part 97 rules for 100 mW wireless adapters
 - N5XSA and N9JIM completed part 97 link between Mt. Diablo and Canada College – 60 km!
 - 18” and 30” dishes used with SMC 200 mW 802.11b card
 - 1 Mbps, ad-hoc
 - Some QSB – link would come up for 10 minutes, then go down
- Call upon the microwave group members to test out your rig, dish, measure sun noise, etc.
 - Can run to nearby mountaintop to do experiments

Favorite Local Mountaintops

- Stanford Foothills
- Canada College
- Mt. Helena
- Mt. Vaca
- Mt. Tamalpais
- Mt. Diablo
- Mt. Hamilton
- Loma Prieta
- Mt. Leeson
- Mt. Frazier
- Mt. Benito
- Southern Sierras
- Mt. Bullychoop
- Mt. Lassen
- Anywhere in the central valley floor!
- Various parking garages (e.g., NSC)

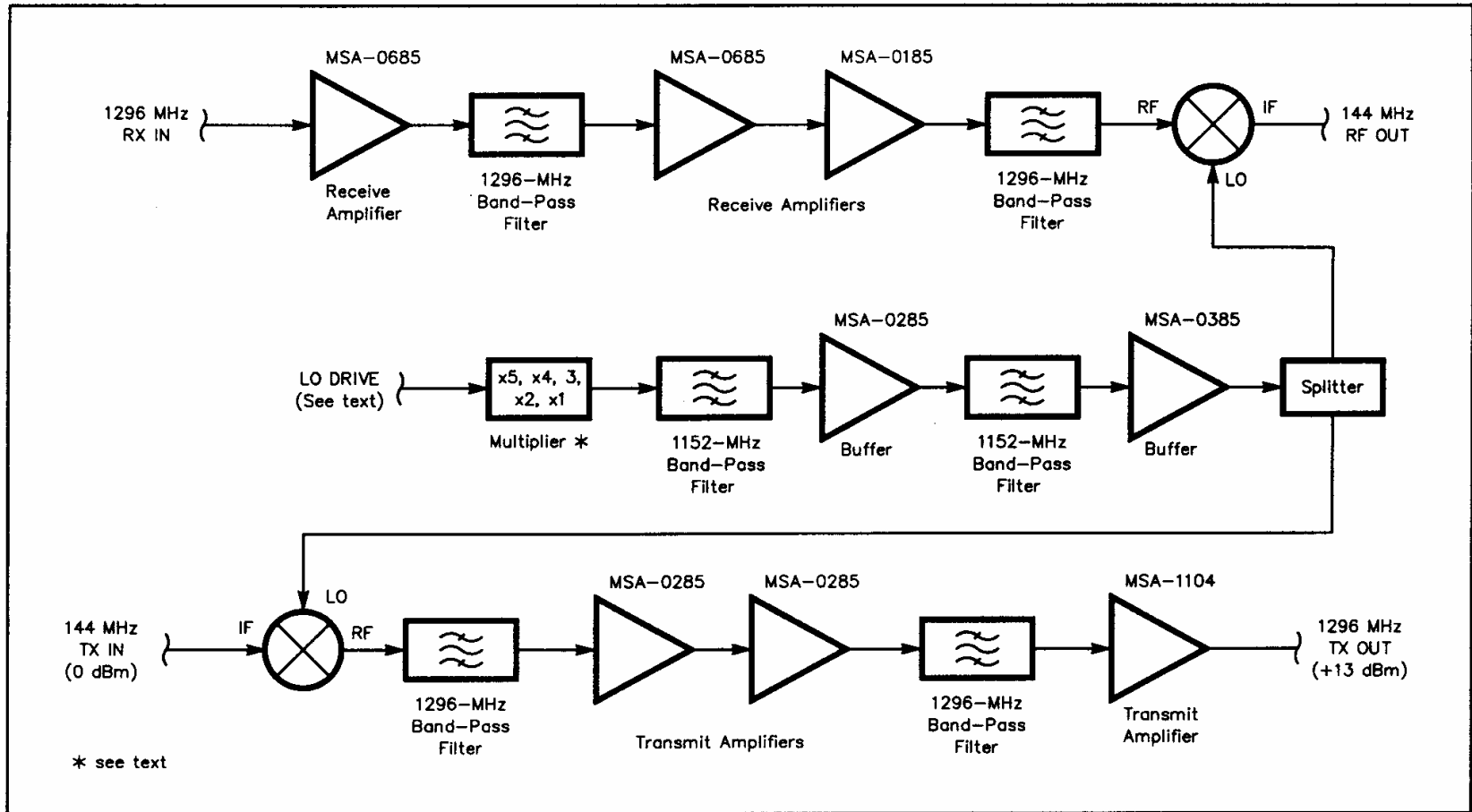
Current World Records

- 144 MHz through 5,760 MHz (P) – Chip N6CA and Paul KH6KME hold 4,000 km record from LA to Hawaii
 - Continental (C) & rainscatter records are distinguished separately
 - 4,800 km on 144 MHz, to a maritime mobile station
- 10 GHz (C): 1,212 km, east coast stations!
- 24 GHz (C): 543 km, Texas
- 47 GHz (C): 290 km, W6QI/AD6FP
- 80 GHz (C): 177 km, AD6FP/KF6KVG
- 120 GHz (C): 30 km, WA1ZMS
- 122 GHz (C): 114 km, WA1ZMS
- 140 GHz (C): 79.7 km, WA1ZMS
- 241 GHz (C): 79.7 km, WA1ZMS
- 300 GHz+ (C):
 - 322 GHz: 1.4 km, WA1ZMS
 - 403 GHz: 1.42 km, WA1ZMS
- Light (C):
 - 474 THz: 192.6 km, AZ stations
 - 678 THz: 248 km, AZ stations

Equipment

- Problem: Cannot purchase a radio for bands above 1,296 MHz!
- Solution(?): Just homebrew a microwave transceiver
 - Want to have all the bells and whistles of your FT-1000
 - So imagine building a Yaesu FT-1000, with a 10 GHz front end!!??
- Solution(!): Build a 10 GHz front end only
 - Use your FT-1000 (or favorite HF/VHF/UHF rig) as the “IF”
 - The “Transverter”

The Microwave Transverter



DEMI 1,296 MHz Transverter



Equipment

- You can purchase transverter kits (or assembled) and antennas from vendors such as Down East Microwave and DB6NT
- You can design build your own
 - Amazing parts are available for bands through 10 GHz (e.g., Hittite, Eudyna (Fujitsu), Mini-Circuits)
 - PCB designs work up to 10 GHz
 - Use Rogers 5880 Duroid or 4350B above 2 GHz

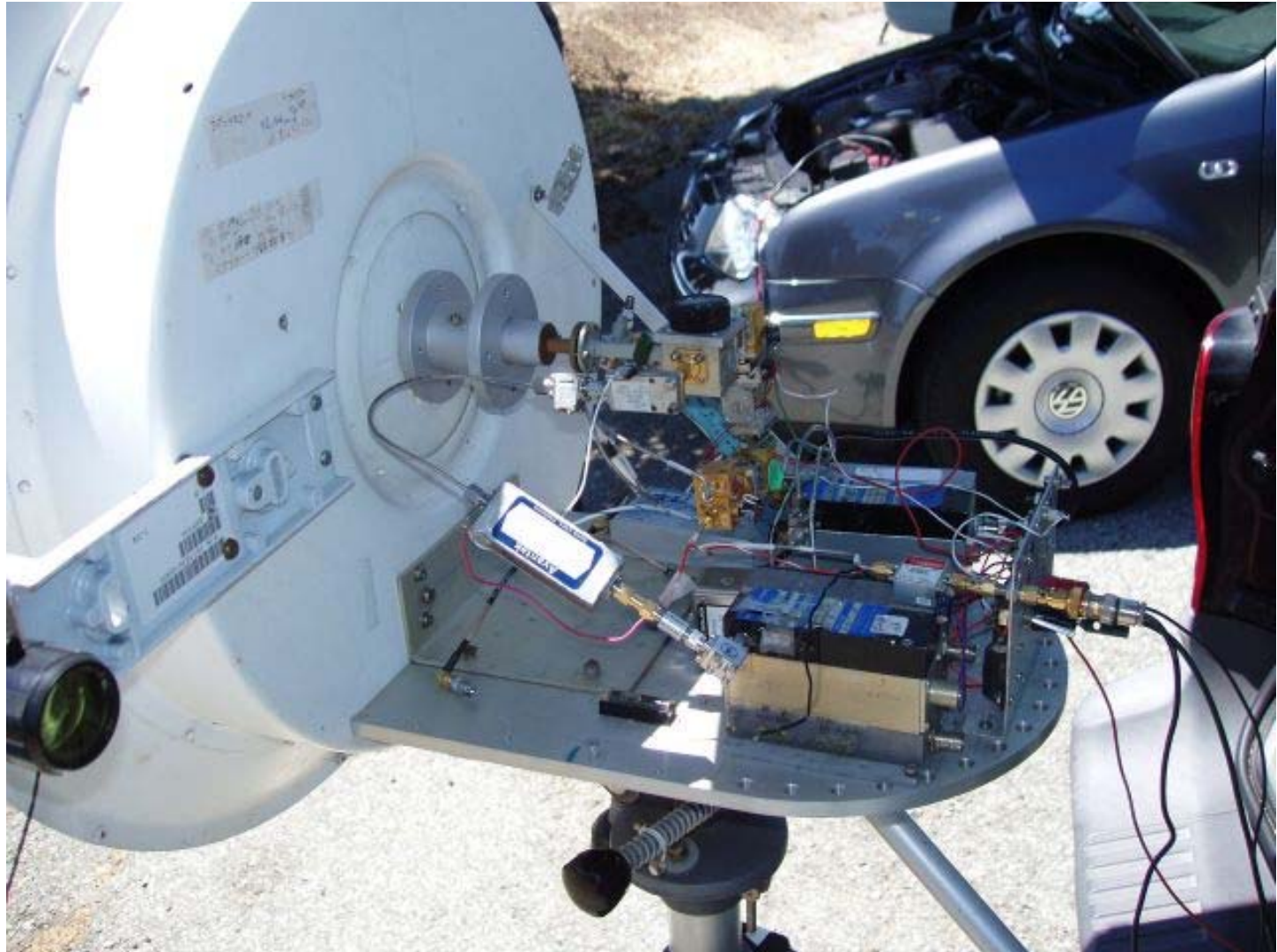
Antennas

- Antennas are fun and easy at microwave frequencies!!!
- 30 dB gain is easily achievable!
- Low bands
 - Loop Yagi
 - Large dish
- High bands
 - Parabolic reflector
 - Just get a DSS dish, put your own feed on it, and you are on the air!
 - Make the feed entirely out of hobby brass and one SMA connector

50 MHz and Up Tune-up Party Before August Contest



W0EOM 24 GHz Rig



N5XSA 10 GHz Rig



AD6IW 10 GHz Rig



W6QI 10/24 GHz Rig



Resources

- ARRL
 - 50 MHz and up web site
 - QST has a new section for microwaves
- Various VHF/UHF/Microwave publications from ARRL and RSGB
- Many informative websites
 - G3PHO, W1GHZ, WA1MBA, etc.

Resources - Clubs

- 50 MHz and Up Group of Northern California
 - Very technically astute group of 100 local and worldwide hams
 - Monthly meetings, 1st Thursday each month, 7:30 pm, NSC in Sunnyvale
 - Technical presentation, swap, ragchew
 - Outdoor operating activities
 - Yearly picnic
 - President: Jim Moss N9JIM
 - www.50mhzandup.org

2004 10 GHz Cumulative Contest - Log Summary

- First Weekend
 - 162 QSOs
 - 53 Calls
 - 36,825 Distance Points
- Second Weekend
 - 85 QSO
 - 3 New Calls
 - 15,942 Distance Points
- Total
 - 247 QSOs
 - 56 Calls
 - 58,366 Points
 - Best DX
 - 10 GHz – 882.5 km
 - 24 GHz – 295 km
 - 47 GHz – 290 km ☺
- W6QI won the 10 GHz and Up category in 2004! ☺

Spaceball in Mountain View



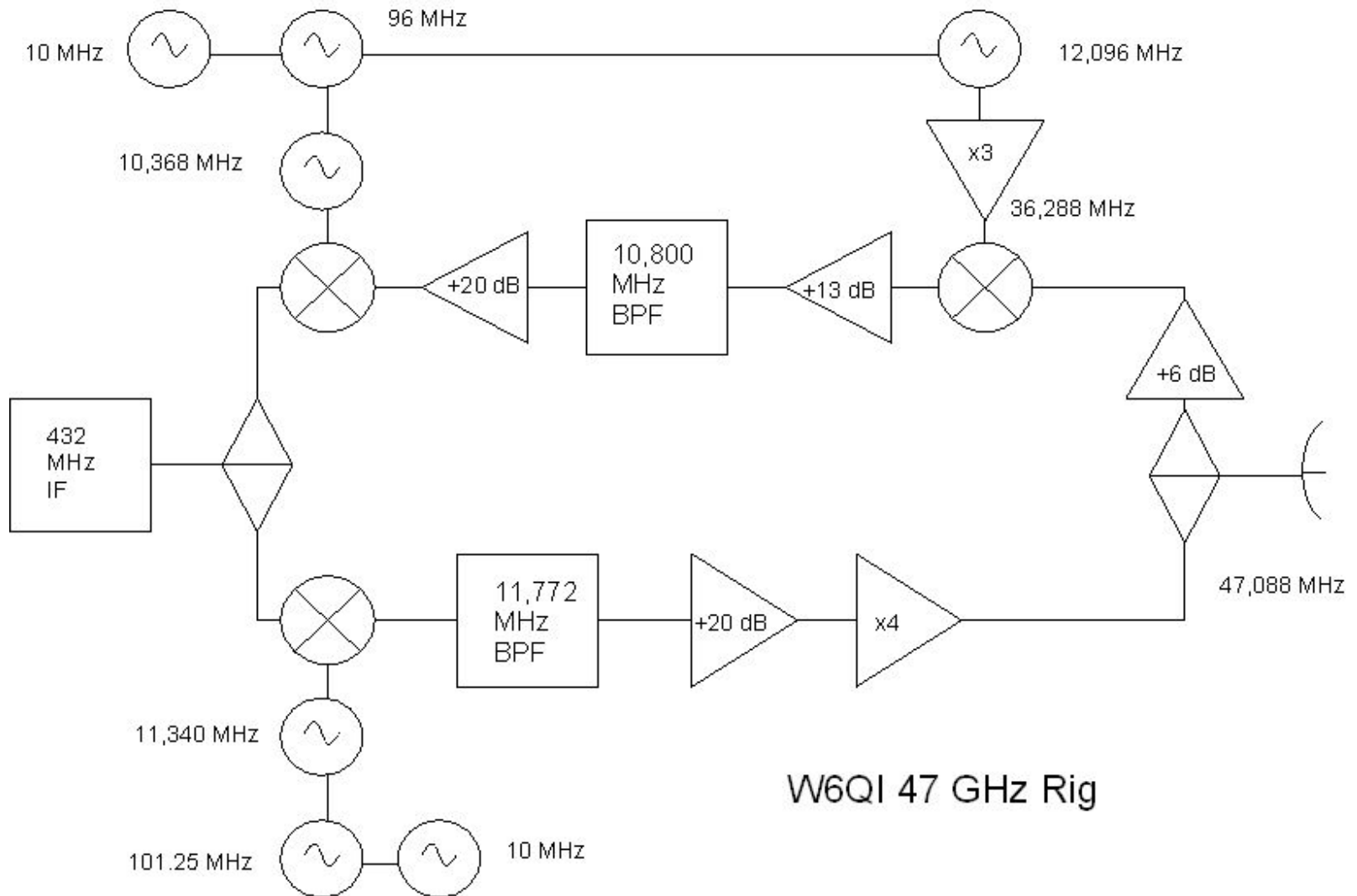
Spaceball Close-Up



Spaceball - Roving Central Valley



Two-Week 47 GHz Rig – Block Diagram



47 GHz Rig – Back View

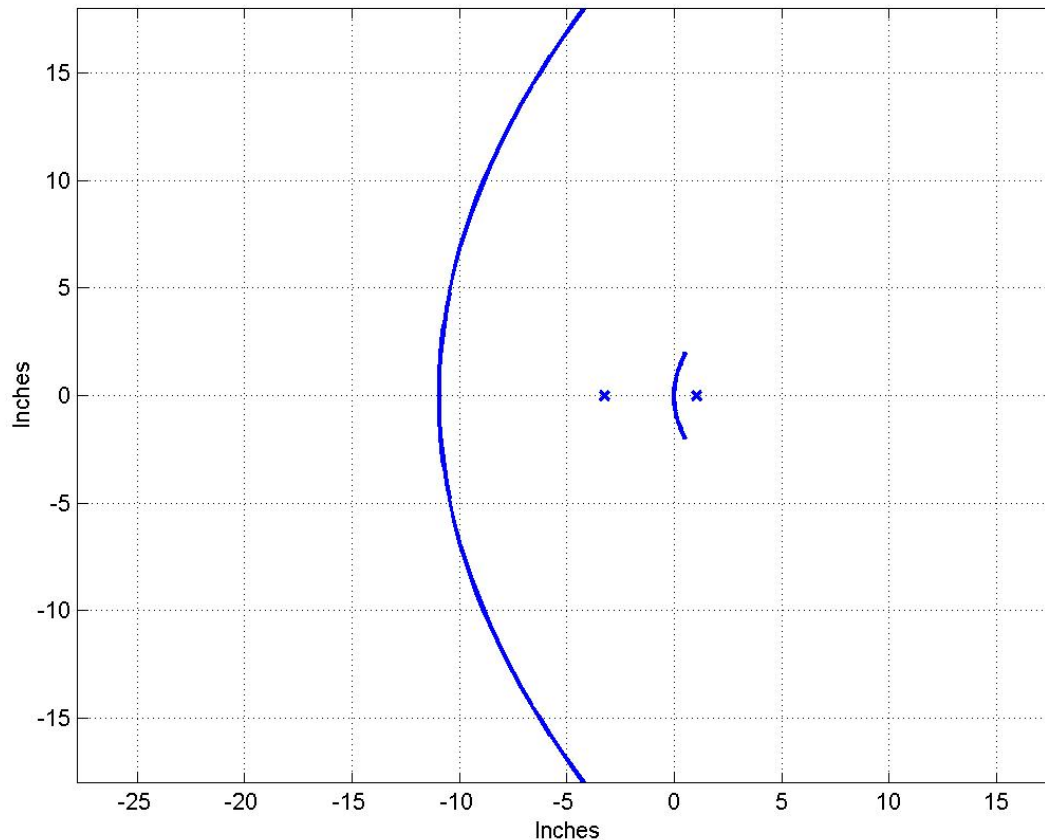


47 GHz Rig – High Frequency Electronics and Feed Arrangement



Subreflector Curve Fit With Foci

36" Cassegrain Reflector Antenna – 50 dB gain, 0.5° HPBW!



- Used Matlab to determine two foci of subreflector
- One focus (right) is placed at focus of main reflector
- Feed is placed at other focus (left)

47 GHz World Record

- September 19, 2004, Sunday Afternoon
- W6QI on Shuteye Peak in the Sierras, just south of Yosemite
- AD6FP on Mt. Frazier
- 290 km FM/CW QSO
- W6QI
 - 36" Cassegrain dish, +10 dBm TX Pwr, 8 dB system NF
- AD6FP
 - 12" splash plate dish, **+45 dBm TX Pwr**, 4 dB system NF

AD6FP on Mt. Frazier



10/24/47 GHz – Shuteye Peak



WX Getting Bad on Shuteye



Headin' Home



Pathfinder is Broken Free!



Dang!



Steep Descent



The End

