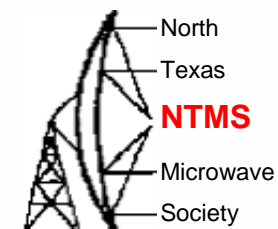
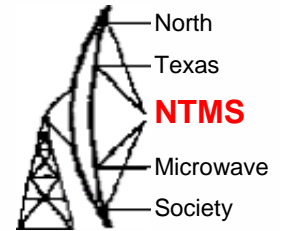


W5HN



Backyard Microwave EME What they didn't tell me

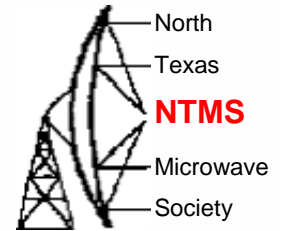
Dave Robinson, WW2R
NTMS, Denton, Feb 2007



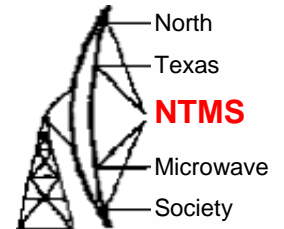
Been Inspired for a long time by the KD5RO article in MUD Proceedings 1989 “Microwave EME using a Ten Foot TVRO antenna”

Searched for a dish for a long time with no success, then one day N5PYK announced he was moving to College Station....

N5PYK Dish Location



Transportation

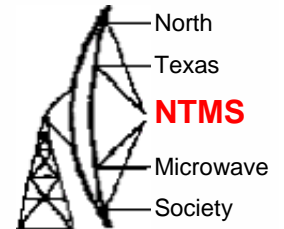


“You can have it if you help take it down”

Luckily the dish came apart in 4 pieces. Tied to the roof of my Blazer and moved the 3 miles home.

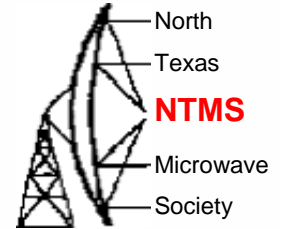
Joe said he had a heavy duty “polar” mount which I could have. Wouldn’t fit in Blazer so we dropped the tailgate and strapped it in place using the rear seat belts. Joe followed me home in case it fell off!

Commissioning



- Visited the hardware store and obtained stainless steel bolts to replace all those holding dish together. Assembled dish. Got 24" Actuator
- Jan 2005: Got metalwork kit from G4HUP for OK1DFC 1296 Feed. Spent many weekends trying to get it to match. Failed. All those who I spoke to about feed said "Built it and it worked" Gave up!
- Aug 2005: Learnt VE1ALQ was making a batch of VE4MA feeds. Ordered one. Match and circularity excellent

Feed mount



Inspired by G4NNS description of his cage mount at Martlesham RT.

Wanted design to allow either 23/13/9cm feed to be mounted in Cage

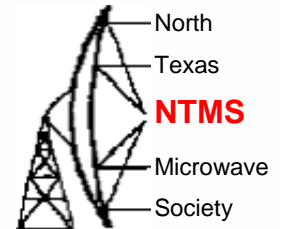
Version 1: Mount interfered with feed flange

Version 2: worked OK but All aluminum construction too flimsy

Version 3 (final): Ali / steel construction fine (shown below)

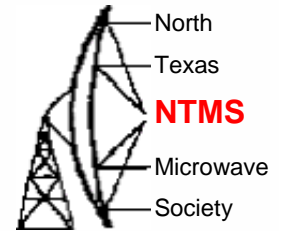


Tracking



- Use polar mount (no need to dig hole and fill with concrete; less property invasive)
- Linear actuator to move dish. Count pulses to track position
- Initially used Houston Tracker IV C band unit but an IC failed
- Built my own version using IC7216A pulse counter chip (from G3AUA IC collection), surplus 24V PSU (from AI) and LARGE LED readouts
- B/W camera mounted on edge of dish for visual tracking

Tracker/Sequencer/Z3801



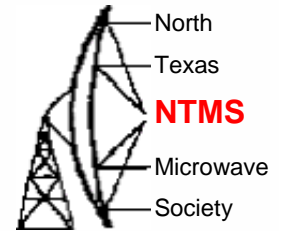
Dish Camera

Z3801A

Dish Positioner

Sequencer

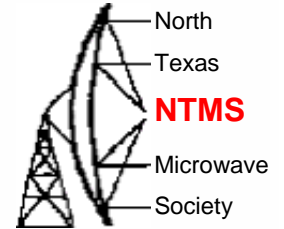
Dish Stability



WRONG!

Need concrete blocks
on Mount legs

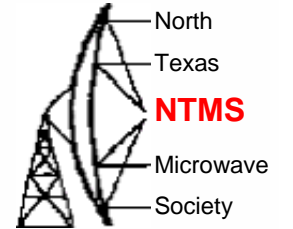
Initial Equipment 23cm



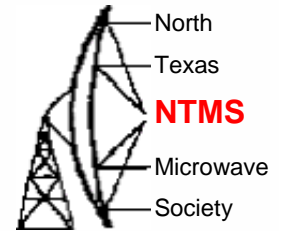
- WD5AGO preamp on G4DDK PCB. 0.33dB NF
- 20 year old 2x2C39A EME Electronics PA 200W
- 70' LDF4 TX feeder
- DEMI Xverter (2 IF outputs)
- M57762 Predriver (7W)
- IC706
- PIC Sequencer



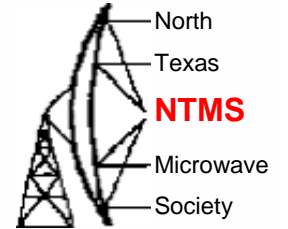
Original 23cm Configuration



1296 Dish Configuration

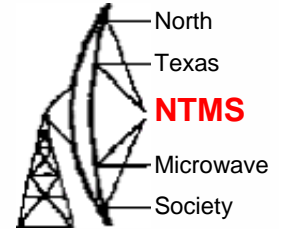


First Weekend 1296MHz



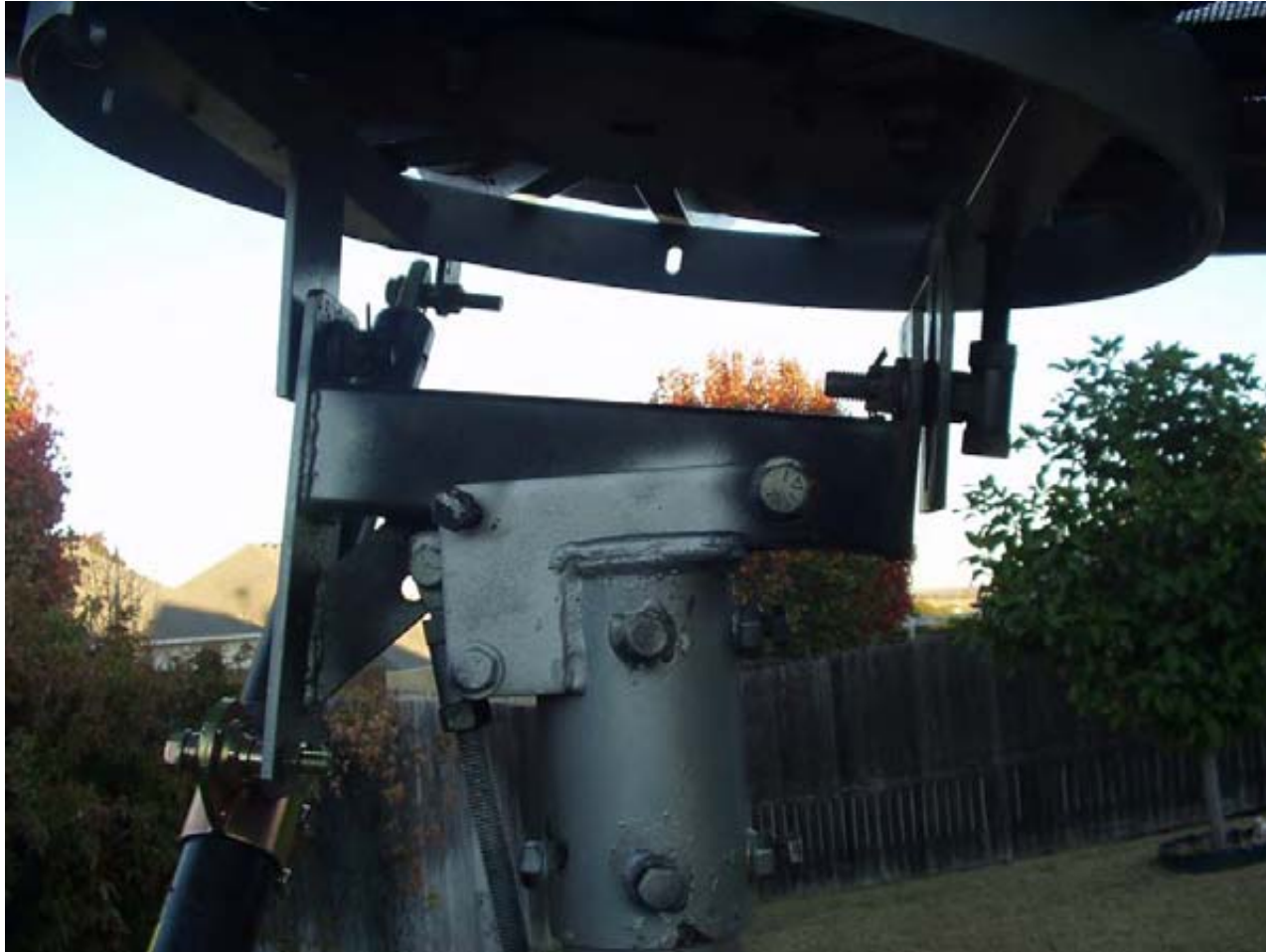
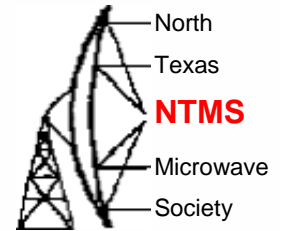
- 11-Dec-05 G4CCH IO93
- 11-Dec-05 K5SO DM66
- 11-Dec-05 VE6TA DO33
- 11-Dec-05 K9SLQ EN70
- 12-Dec-05 G3LTF IO91
- 12-Dec-05 K5JL EM15
- 12-Feb-05 F2TU JN38

Issues from 1st activities

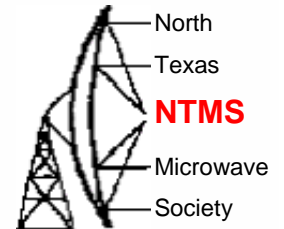


- Tracking
- Feed skewing on dish
- Frequency Stability/Setting

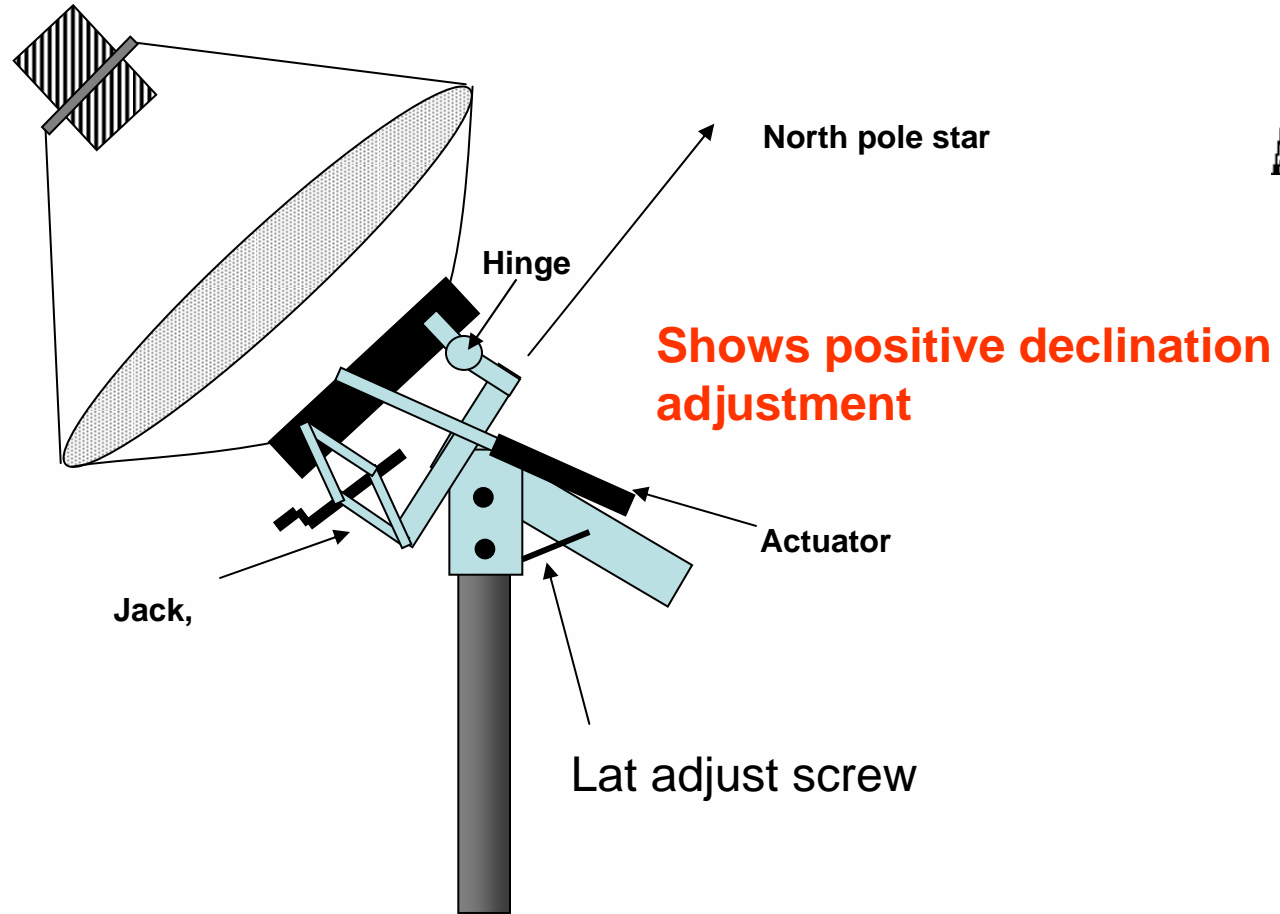
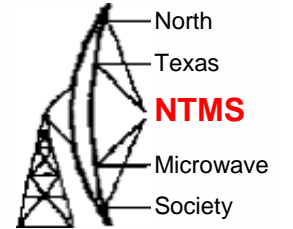
Original Mount



Tracking

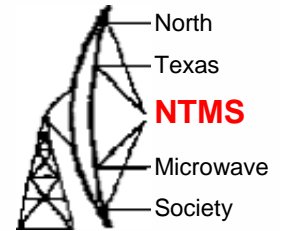


- Initially pointed dish due south and adjusted threaded (latitude) rod until elevation of dish matched predictions
- Quickly discovered that something was very wrong with this. To track the moon the mount basically used as a manually controlled az el mount
- In a long conversation with G4DDK he said I had discovered in a month what had taken him 2 years to discover. **Satellite dish mounts are not close to Polar mounts, they have to be modified.**
- Found W4OP Paper from SEVHFS conference 2002 **“POLAR MOUNTS FOR EME DISHES “** which explained problem pictorially

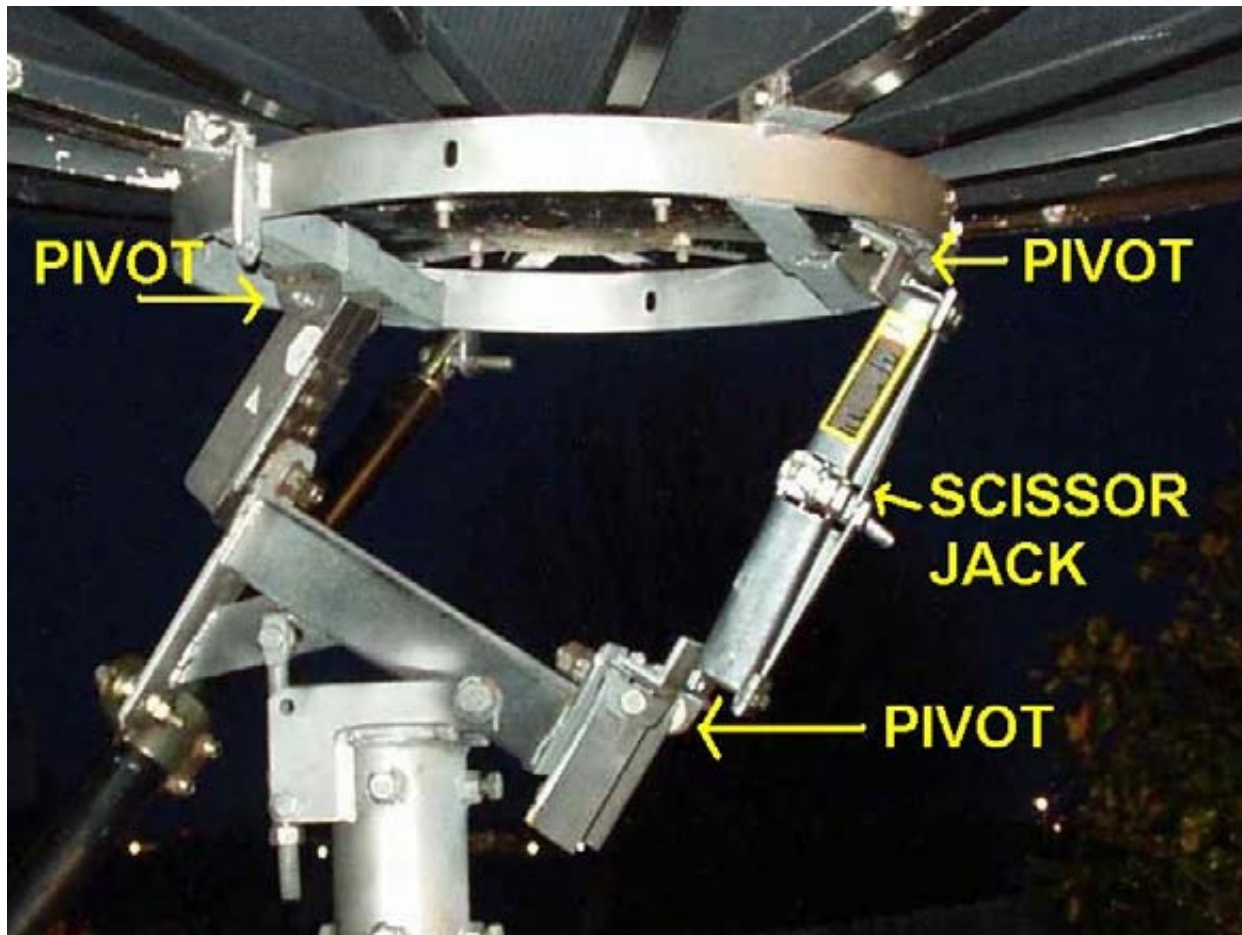
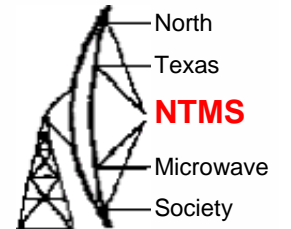


Mount modified with saw and angle grinder using lots of stainless steel hardware and a scissor Jack

Digital Inclinometer

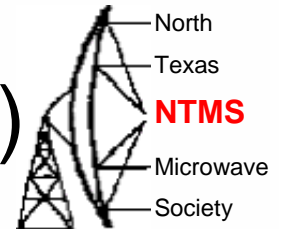


Modified Mount



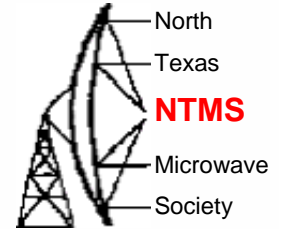
Use Scissor Jack allows -12 to +33 degrees declination coverage.

Where the moon?: WW2R process (1)



- Obtain digital Inclinometer. “Smart level” (\$90)
- With digital inclinometer on dish saddle set latitude screw for a reading of the latitude of station (33.2)
- From predictions ascertain Declination (ex: 30degrees).
- Calculate latitude – declination ($33.2 - 30 = 3.2$ degrees)
- With digital inclinometer across dish ring adjust scissor Jack to obtain 3.2 degree reading
- Dish will now describe an arc that will track moon for a few hours
- Where on that arc is the moon?

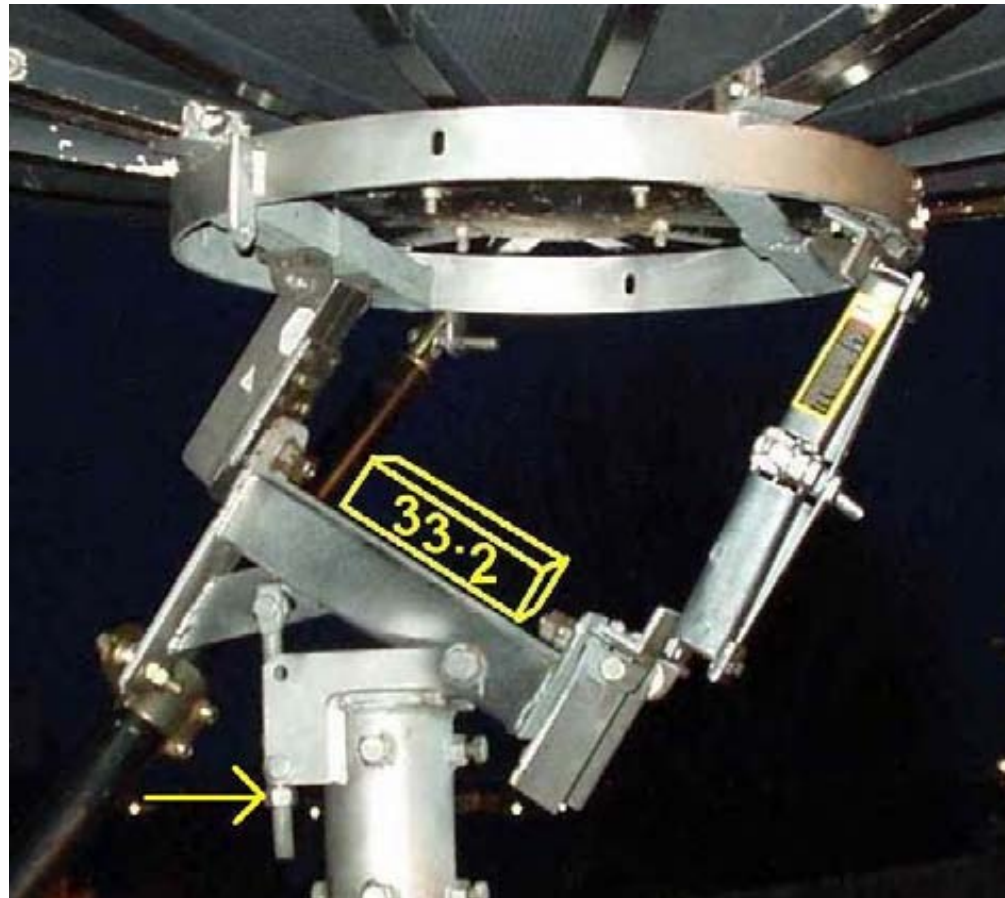
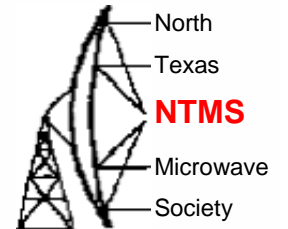
Where the moon?: WW2R Process (2)



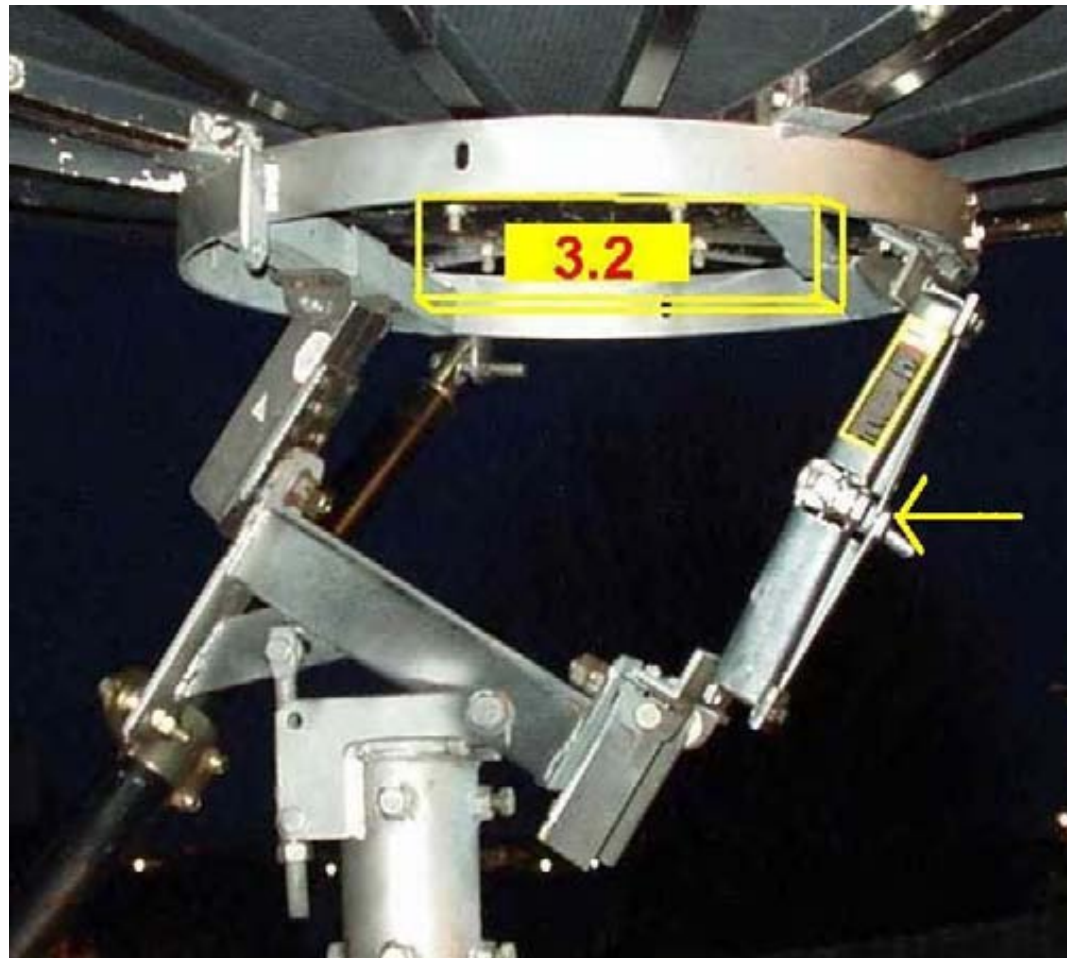
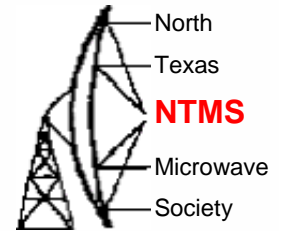
- From predictions one can ascertain the elevation of the moon at any time
- Put digital inclinometer on edge of ring and adjust actuator to match predicted elevation

PROCESS PICTORIALLY:-

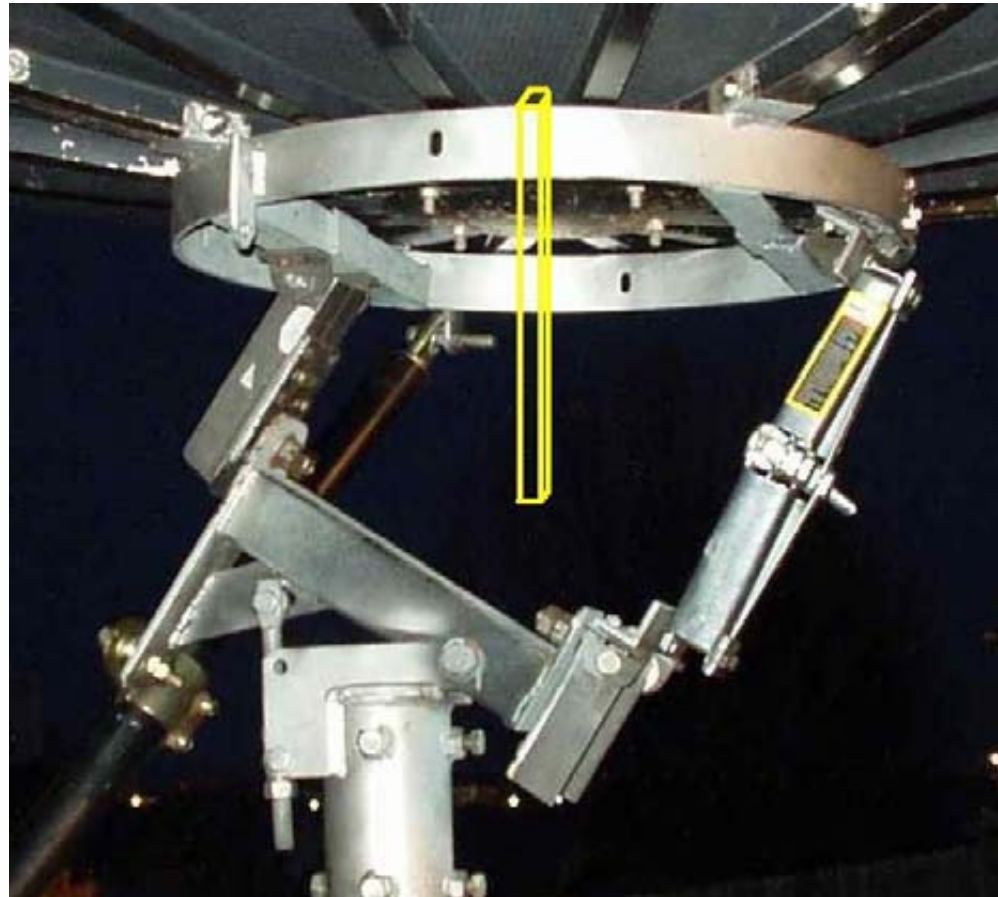
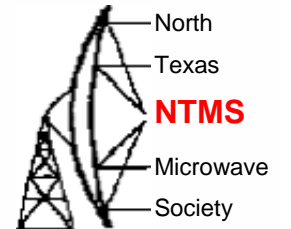
With inclinometer on saddle, set latitude screw for reading of 33.2 degrees.
“Once set:leave alone”



With inclinometer across dish ring adjust scissor Jack to obtain 3.2 degree reading



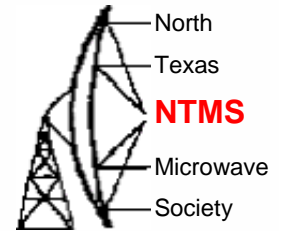
With inclinometer on edge of dish ring adjust actuator for calculated elevation reading



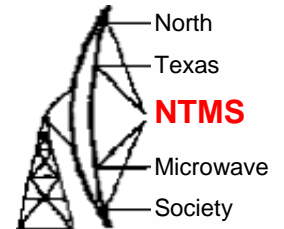
I adjust on 1296 about ever 15 minutes if moon not visible

Window limitations

- Actuator cannot track horizon to horizon
- Dish normally set up for moonrise (EU)
- After request by VK7MO for sked, found that by moving actuator to other side of mount can do moonset (VK, JA)
- First time took 30 minutes in dark, now takes just 10mins



Feed skewing on dish

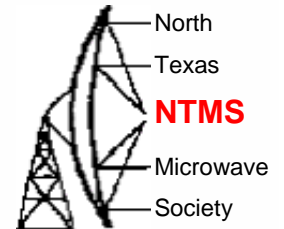


- Noticed that feed didn't always point at the centre of the dish
- Was going to get sturdier metal for tripod mount from K5GW when he mentioned WA5WCP had similar problem
- Issue resolved by mounting each arm to the feed mount with 2 not 1 screws



System Performance Improvements

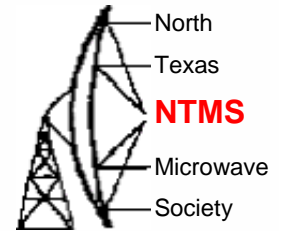
RX



- Measured overall NF of protection relay/ connectors/Preamp
- Initial QSOs with Transco N relay & adaptors 0.78dB
- Transco SMA relay, fewer adaptors 0.57dB
- Transco SMA relay, even fewer adaptors 0.45dB

With small system every tenth of a dB helps!

System Performance Improvements TX

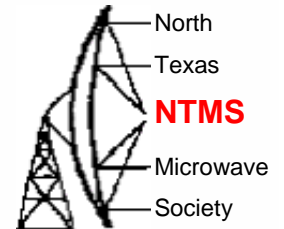


- 70' LDF4 + 20' FSJ4 on dish 2.6dB Loss
- 70' LDF5 + 20' FSJ4 on dish 1.8dB Loss
- 50' LDF5 + 14' FSJ4 on dish 1.1dB Loss
- Increased power at dish from 110 to 155W...41% more power

With small system every tenth of a dB helps!

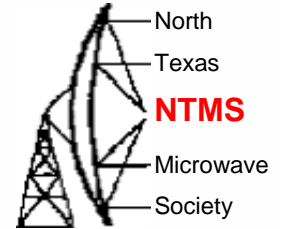
K5JL:” NO PLACE FOR SUPERFLEX ON A DISH”

Frequency stability

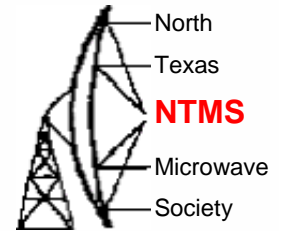


- Changed from IC706 to DSP10 which was GPS locked...no I.F. drift
- But DEMI Xverter drifted 3-5kHz during moon pass, even with xtal heater
- Initially measured carrier frequency using EIP548 counter with GPS locked 10MHz reference
- Then had discussion with G4DDK and WA1ZMS. Need to lock 1152MHz LO.
- Now use DFS9096 previously described

New LO Locked Transverter

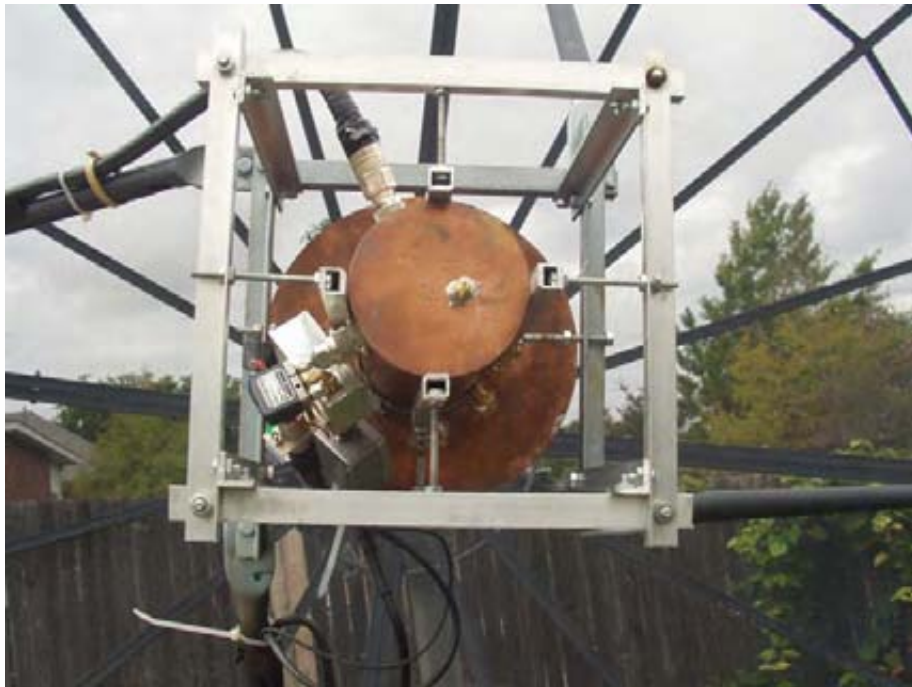
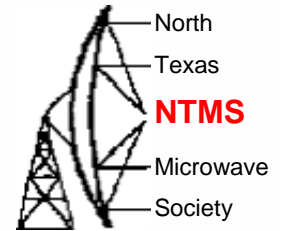


Equipment 13cm

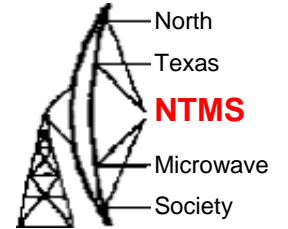


- WD5AGO preamp 0.46dB NF
- Spectrian Amplifier mounted at dish (200W).
48V Supply
- Homemade VE4MA Superfeed using copper tube mailed by PA3CSG. Tuned for “reasonable” return loss
- 2304: DB6NT Xverter. IF: IC706 (now FT847)
- 2320: Softrock V7/d44 soundcard displaying/decoding 80kHz of band via 160 & 28MHz IFs
- 2424MHz RX:ADC7133 AO40 down converter to IC706 IF at 168MHz

13cm Configuration

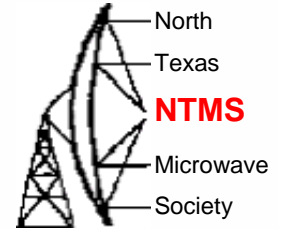


PA Housing!



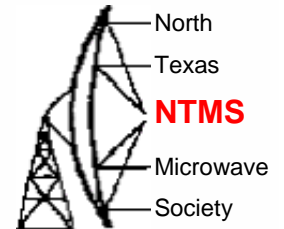
1. Electronics stood off bottom of kennel with briefcase...just in case water gets in.
2. Cable to feed should have droop loop...otherwise water channeled into PSU
3. Feed sample port through coax back to power meter in shack to see output

13cm Results so far (cw)



- 2-Apr-06 VE6TA DO33
- 8-Apr-06 OK1CA JO70
- 8-Apr-06 F2TU JN38
- 8-Apr-06 W5LUA EM13 16 QSOS
- 8-Apr-06 OK1KIR JN79 12 INITIALS
- 8-Apr-06 OZ4MM JO55 11 Grids
- 9-Apr-06 G3LTF IO91
- 11-Apr-06 OE9ERC JN47 (SSB) 9 DXCC
- 16-Sep-06 K5GW EM13 2 States
- 17-Sep-06 K2UYH FN20
- 17-Sep-06 PA3CSG JO21
- 17-Sep-06 RW1AW KO33

Results so far: 1296MHz CW



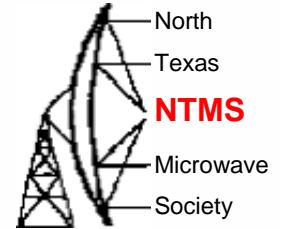
G4CCH K5SO VE6TA K9SLQ G3LTF K5JL F2TU
 K2UYH W5LUA K4QI OZ6OL OZ4MM ZS6AXT F6KHM
 LX1DB(SSB) LA8LF K5GW OK1CA RW1AW IK2MMB
 HB9Q OK1DFC JR4ZZS IW2FZR ES5PC PA3CSG
 SM3AKW OE9ERC CT3/DL1YMK KL6M VK3UM
 SM6CKU OK1KIR ON7UN DL1YMK K0YW WA6PY
 HB9BBD SM4DHN HB9SV LA9NEA K1RQG N2IQ N2UO
 K5PJR W7BBM NA4N WB2BYP GW3XYW ES6RQ

102 Qs 50 Inits 4 Continents 22 DXCC 45 Grids 13 States

11 CWNQ: W6IFE, DL0SHF, SM3LBN, WA5WCP/1, W9IIX, JA8IAD, JA6AHB, F6CGJ, W2DRZ, JA8ERE, LA8AV

4 Heard: G3LQR, VK4AFL, JH5LUZ, K9BCT

Still some left to work!

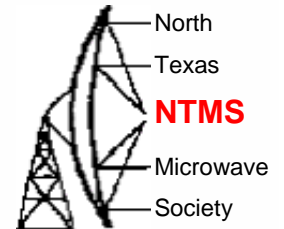


Results so far: 1296MHz JT65C

SM5LE VK7MO G4DDK RW3BP
G4DZU G4CCH OK1KIR VA7MM
OE9ERC PA0BAT OE9ERC ES5PC
K2UYH GW3XYW ES6RQ UR5LX
PA3FXB W5LUA

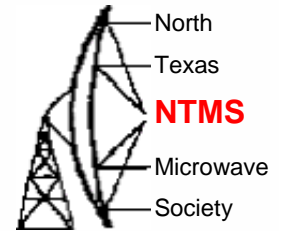
17 Initials 12 DXCC 16 Grids 2 States

Next Steps: 1296MHz



- Increase Power: TH338 Amp just needs sanitising. In last ditch attempt to get heard by WA5WCP/1 temporary lashup (unsafe!) gave 400W, drive restricted. (He still did not hear me!)

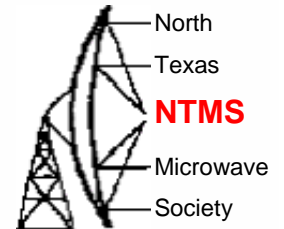
Next Steps: 2304MHz



- Replaced WD5AGO NE324 preamp with W5LUA AT36077 preamp on G4DDK PCB. (0.35dB NF measured)

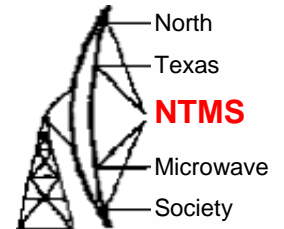


Next Steps: Other Bands



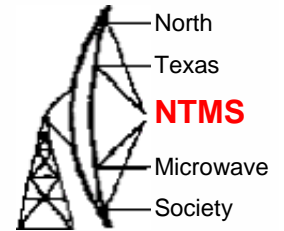
- 3456MHz: Two Toshiba amps combined for 105W o/p, need to work out how to mount/ it at feedpoint. Preamp built. Need to finish feed
- 5760MHz: Preamp built. TWT with 25W o/p. Need to build feed.

Other things learnt



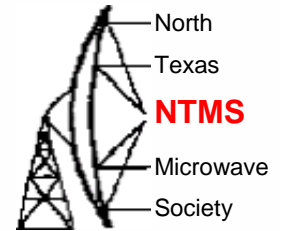
- Waterproof preamp etc with rugged plastic bag (soil bag)
- Make inline switch box so can move actuator when standing at the dish
- Not all N types are created equal. Some made for 2.4GHz WIFI don't even work as high as 2GHz (W5LUA same experience)

Acknowledgements

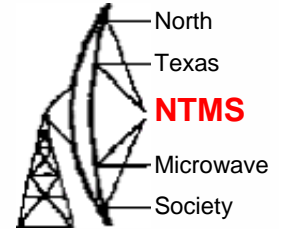


- To G4DDK, K5GW, W5LUA for advice and assistance
- To PA3CSG for *mailing* the 40mm copper tube for the 13cm feed
- To Meg for encouraging me to decorate the backyard with the oversize garden ornament
- Finally to N5PYK for moving and donating the dish

Feed protection bag



More information



- DFS9096: <http://g4fre.com/dfs9096.pdf>
- 1296MHz: <http://g4fre.com/1296eme.htm>
- 13cm: http://g4fre.com/13cm_eme.htm