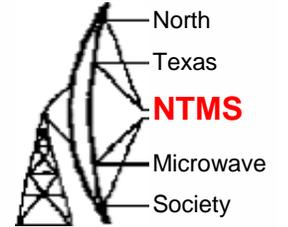


W5HN

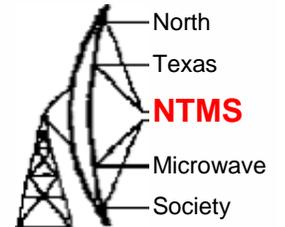


# Rover Challenges

*There's nothing that can't be done  
with Velcro and microprocessors*

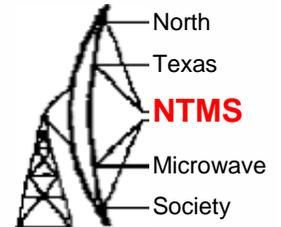
Stephen Hicks — N5AC, AFA4SH

# Agenda



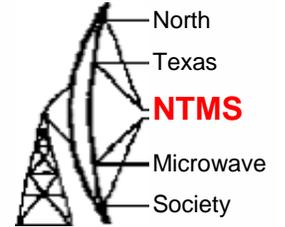
- Radio Equipment
- Power
- Antennas & Feedline Egress
- Interactions & Power
- Controlling Everything
- Logging, Navigation
- Future Plans

# Mobile Challenges



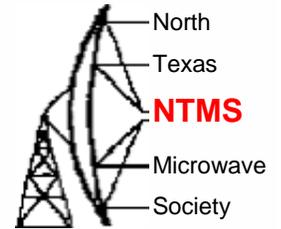
- How many radios?
- Where to put everything
- Mounting, Securing
- Height worries
- Antenna Interactions
- Controlling everything while driving
- Roles: driving, navigating, logging, operating

# Radio Equipment



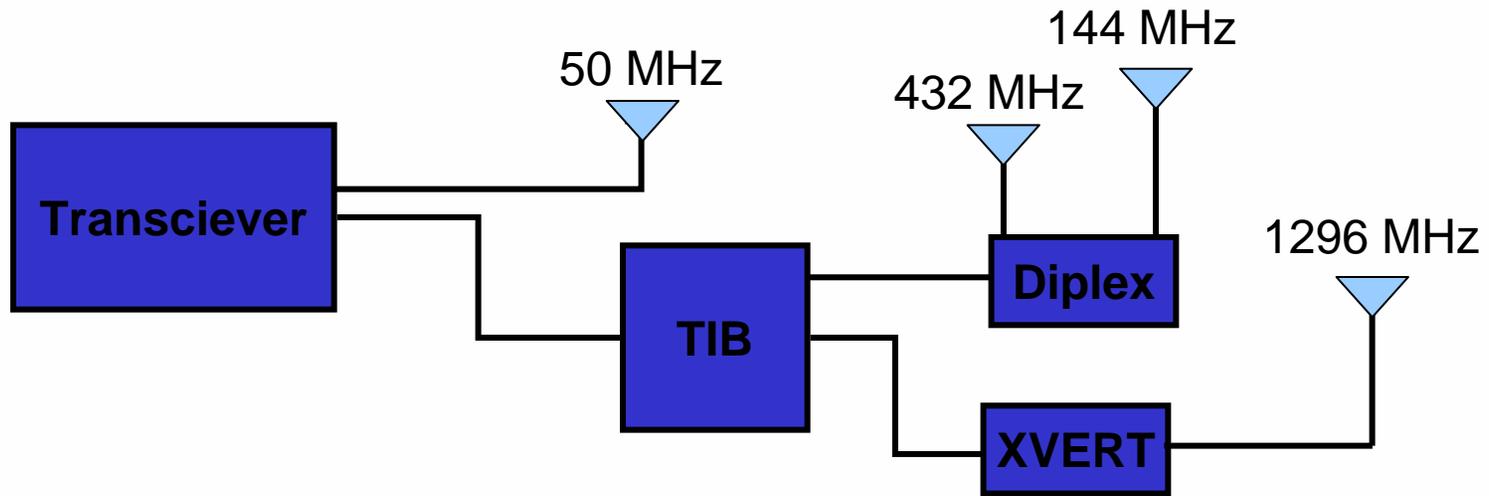
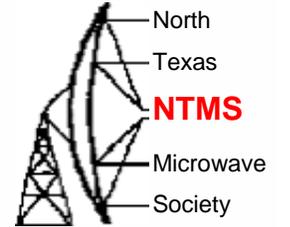
- Like a shack, you must worry about mounting
  - Easy removal for repair
  - Interconnect simplicity
  - Space is a premium in a vehicle
  - Some equipment must be kept out of elements
    - Water
    - Oscillator temperature

# How many radios?

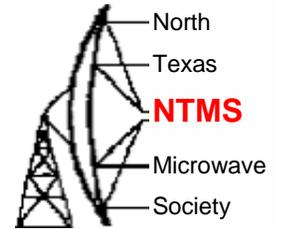


- Single radio
  - Low confusion, less space required
  - Inability to liaison for uW contacts
  - Marginally lower power consumption
- Two radios
  - Mild confusion
  - Liaison abilities
- Multiple radios
  - High confusion
  - Tremendous flexibility

# Single Radio

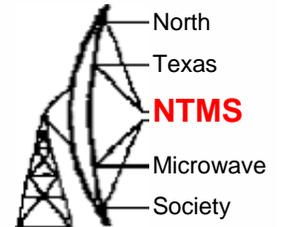


# Multiple Radio Considerations



- How many microphones will you have?
- How do you move the CW Key between radios
- All the usual where to mount, where to put speakers

# Number of Radios



- I prefer a dedicated radio for 2m & 432, all others can be on one radio
- Last contest (1/06) I had 4: a 2m, 432, 6m and IF radio
  - Escalating white noise
- Which microphone? Where's the key?



• 6m

• IF

• 2m

• 432



6m / 2m

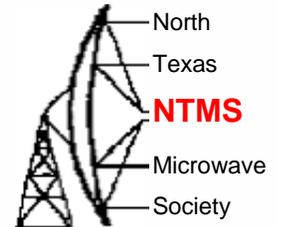
1296, 432

2m Squelo  
446.0 TA

iOpenNav

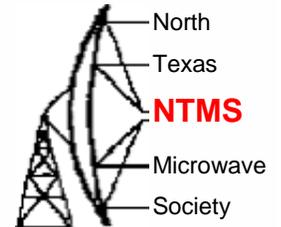
Straight key?

# Power: Batteries



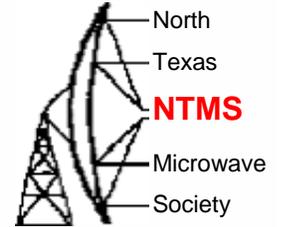
- Batteries
  - Clean power
  - Only 12.5v
  - Can be as high as 14v if connected to auto electrical, but often sags
  - Must secure lead acid
  - I have an 8D 400 Ah battery in Avalanche
  - My max current requirement is 65A continuous
  - 28v is harder
  - Potential for alternator noise

# Power: Generator

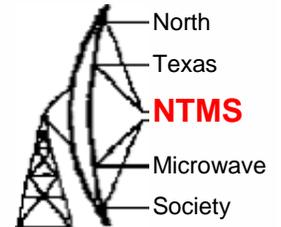


- Generator
  - I was initially skeptical, but I ran a Honda EU2000i for the entire VHF SS 06
  - Lots of current – my Honda provides 20A @ 110 and ran a 70A 12v Astron and 50A 28v supply
  - Not terribly practical for non contest use
  - Need to have external vents, etc
  - I bought 2” hitch basket from Tractor Supply for ~\$100
  - 28v is easier

# Generators

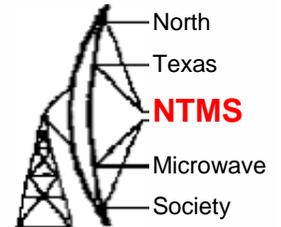


# 28v Mobile



- RF switches and some amplifiers require 28v
- Options
  - 28v supply on an inverter
  - Adding batteries (battery doubler)
  - Floating switcher such as MFJ-4545
- I've had luck with 28v on generator and battery doubler, haven't tried floating switcher yet.
- Relays with capacitor (next page)

# Resistive Losses



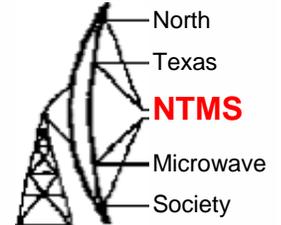
- Generally doesn't matter, but can cost power output in PA's
- In my truck, I'm able to get only 350W or so from TE Amp
- With the Generator and 70A supply 2' from Amp, I get 400W (0.6 dB)
- Again, no big deal, but good to keep in mind
- I run 4 gauge wire around in the truck for master power connections
- Tanner's carries power connection blocks and cable for decent prices

# Antennas

- Omni or Directional
  - Omni helps with operation en route, < gain
  - Little reason for omni on higher bands (2G+)
- I like to run omni and directional on 2m & 432
  - Coupling can be an issue

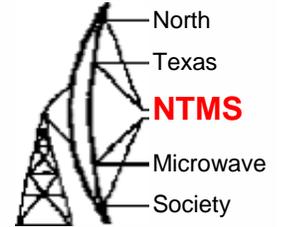


# Antennas



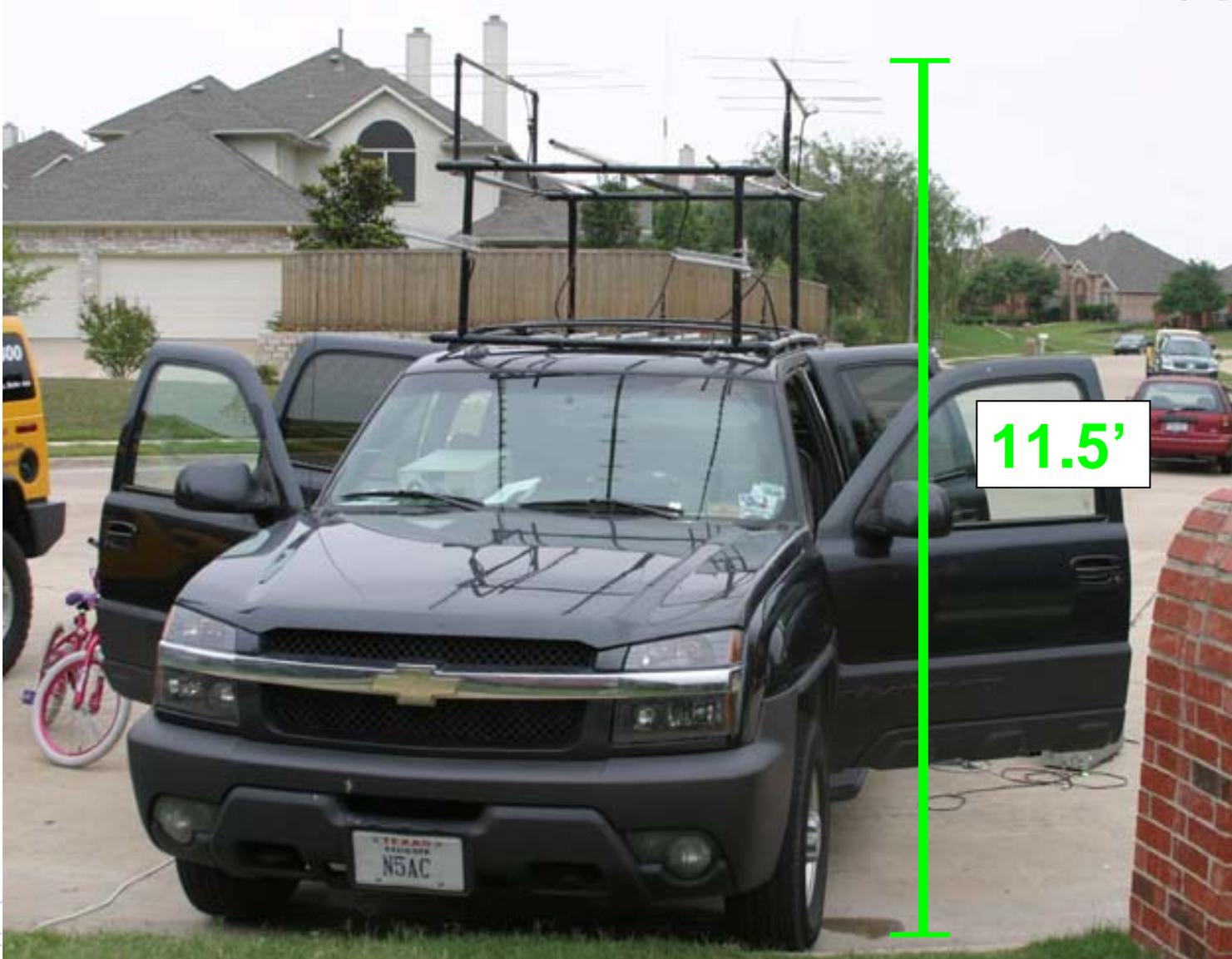
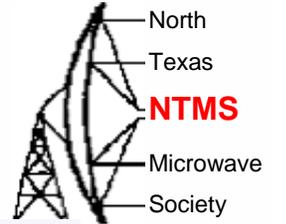
- Spacing Issues
  - Avoid coupling
    - Interband and Intraband
  - Performance – I try to put lower bands on top which creates inverse pyramid
  - Height restrictions (14') – I shoot for 13.5' max
    - East Texas trees
    - Drive through woes
  - Wind Load – some may care ... I really don't
    - 12,000 mi, 12 to 10 mpg = \$500 / year!
  - Safety – Stay attached!

# Height Worries

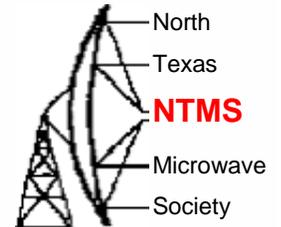


- Main problem is trees in residential areas
- Occasional concerns about overpasses (Hwy 5 North between Fairview / McKinney)
- H2 was about  $7' + 5.5' = 12.5'$
- Avalanche is about  $6' + 5.5' = 11.5'$
- Main consideration is getting 2m off the deck (more later)

# Height Worries

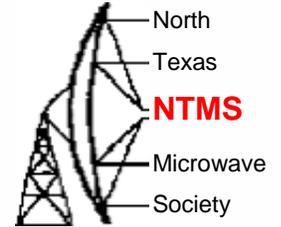


# Height Worries



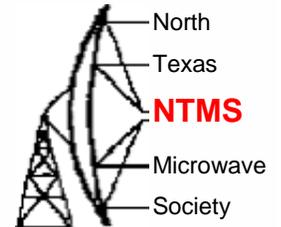
- Constantly look at foliage on road
- Drive-thru food always a challenge
  - Often drive once around restaurant to check it out before entering the line
- Gas stations never a challenge
- Significant wind load at high speeds
  - 70 MPH gas mileage went down from ~11.5 to 10

# Antenna Mounting



- I like PVC for its versatility and price
  - Few tools required
    - Hacksaw or PVC cutter (best)
    - PVC Primer and adhesive
  - Can be strengthened w/dowel (\$\$)
  - Moved between vehicles easily
    - Hummer – 1' = Avalanche – 1' = Trailblazer
- I've seen aluminum in pictures

# Antenna Mounting con't



- Some things that don't look secure, really are:
  - My 2304 and 3456 and end mounted loop yagis
  - They bounce
    - Doesn't affect contacts while mobile, really
    - Minimal mechanical issues
    - Avoids PVC reactivity

N5AC



# N5AC VHF SS '06

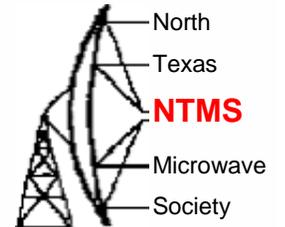
Vehicle courtesy Chevrolet



WDØACD & K5FOG



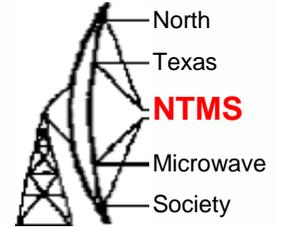
# What's Wrong?



- Counter on 902 feedline at radio end (other end on antenna)
- 2m 400W PA keyed on FM
- **21.5 dBm = 140 mW**

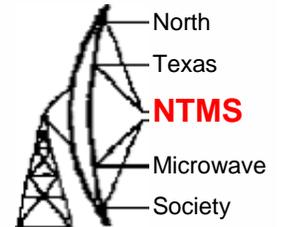


# Antenna Coupling



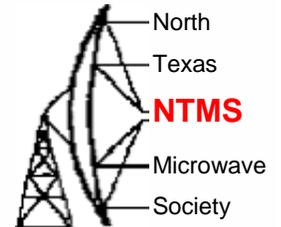
RX \ TX	144, +56 dBm	220, +51 dBm
902	+22 dBm	+8 dBm
1296	-10 dBm	-17 dBm
2304*	-6 dBm	-15 dBm
3456*	-31 dBm	< -35 dBm

# Interactions & Power



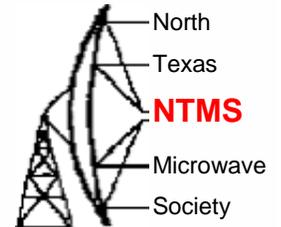
- It's hard to get away from power in a vehicle
- Casualties
  - 3456 Front End
  - 902 Front End
  - Custom Control Head
- Keying relay chatter when voltage appears on relay control lines
- Microprocessor reset
- Vehicle Computer Issues w/500W on 4-7 MHz

# Coupling Solutions



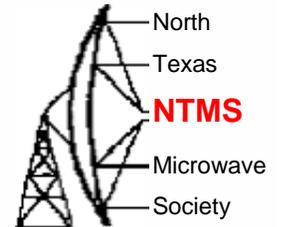
- Alter antenna placement and remeasure
  - Not always practical
- Filter
  - Put a band pass filter on the front of all receivers
  - I have one on 9EFG(H) with IL from 0.35-2.0 dB
- Energize to Receive (K5QE)
  - TriState logic on switching
- For electronics, bypass often
- Use shielded cable for control or enclose control hardware in a shielded box

# “Energize to Receive”



- TriState Logic
  - BAND OFF: T/R → Transmit
  - BAND ON, RX: T/R → Receive
  - BAND ON, TX: T/R → Transmit
- Keeps out-of-band RF out of receiver when band not in use
- Only works when you use a common IF for multiple bands
- Implemented via AUX port on sequencer

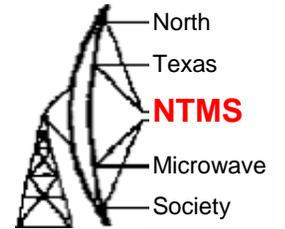
# 10 GHz Omni



- Design from Harold K5SXX
- Milled by Craig KA5BOU
- Welding, etc. N5AC
- Gain appx 12 dBd
- 36 mi no problem  
Lone Oak

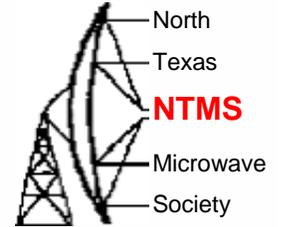


# Feedline Egress

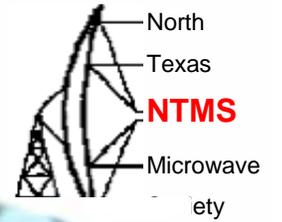


- How to get coax out of vehicle and
  - Keep water out of vehicle
  - Make it look neat
  - Keep from pinching it
  - Is opening a door important?

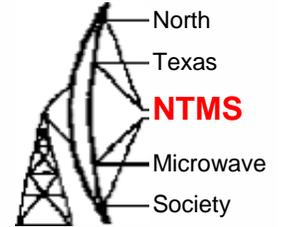
# No rain, No Duct Tape!



# Window, Duct Tape & Bag



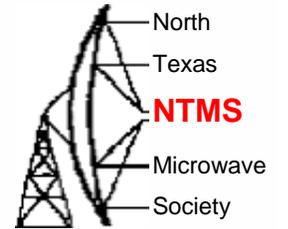
# Through Avalanche Cover



W5HN

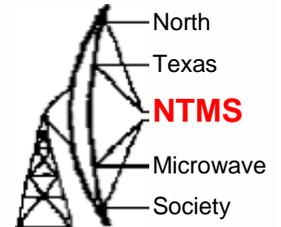
# Through Suburban Hatch

## WDØACD



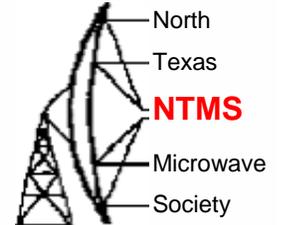


# Controlling Everything



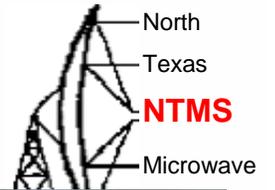
- What you need depends on ...
  - How many transverters do you have?
    - Probably don't need "controller" if you have 6m, 2m, 440 and 1296
    - If you have five transverters, probably need some help
  - Do you have multiple antennas per band?
    - Omni / Directional
  - Do you make mistakes easily?
  - Will you be in a hurry during a contest?

# What could be controlled?



- What needs to be controlled?
  - PTT to transverters
  - IF switching to transverters
  - TIB if you have one
  - Change bands/frequency on IF radio
  - Move key to different radio
  - Switch antennas where more than one per band is used
  - Switch microphone between bands
  - Use or not use PA on a given band
  - Sequencing

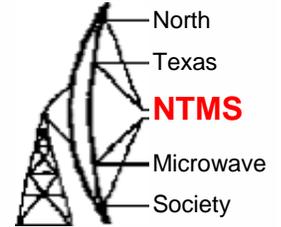
# Simple but effective



- Rotary Switch
  - Simple and easy to understand
  - Can be fixed in the field, generally
  - Mine had three poles – 3P11T
    - Connect PTT to transverter
    - Switch IF to transverter (drive 1P6T coax relay)
    - Enable/ Disable TIB
  - Use multi-conductor cable to go from control box to everything

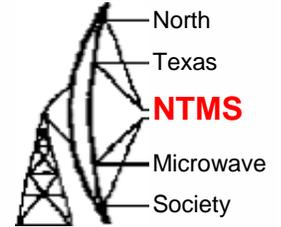


# Microprocessor Control



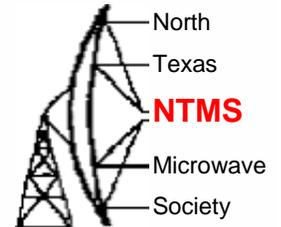
- More complex to design and build
- Can handle complex tasks such as sequencing
- Can keep you from doing silly things
- Can alter sequencing by band – maybe you only have a preamp on some bands
- Can lock-out TX in unsafe situations
- Can enable entire power systems based on band (28v supply)
- Logic and High RF don't mix

# Control Issues



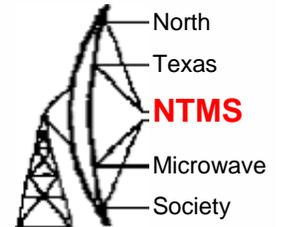
- Complexities are not obvious
  - Keyer transmits automatically, but may not key radio
  - May want to alter sequencing based on mode
  - Ramp-up of transmitter power can damage IF side of some transverters when switching to TX
  - 144.100 & 144.200: Let the confusion begin
  - 28.1 & 144.1 ... more confusion?

# Control System

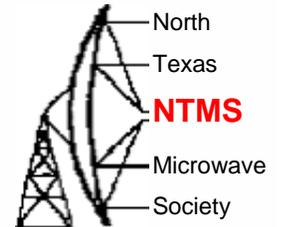


- Generally consists of two parts
  - Microprocessor and interface hardware
  - Control head
- Control Head Options
  - Series of buttons or switches
  - Something with a display such as a CRT or LCD
  - Computer (laptop)

# Touch Screen Control

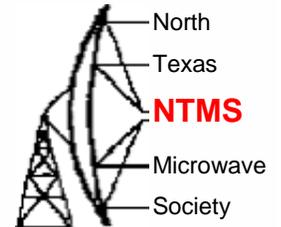


# Touch Screen Control

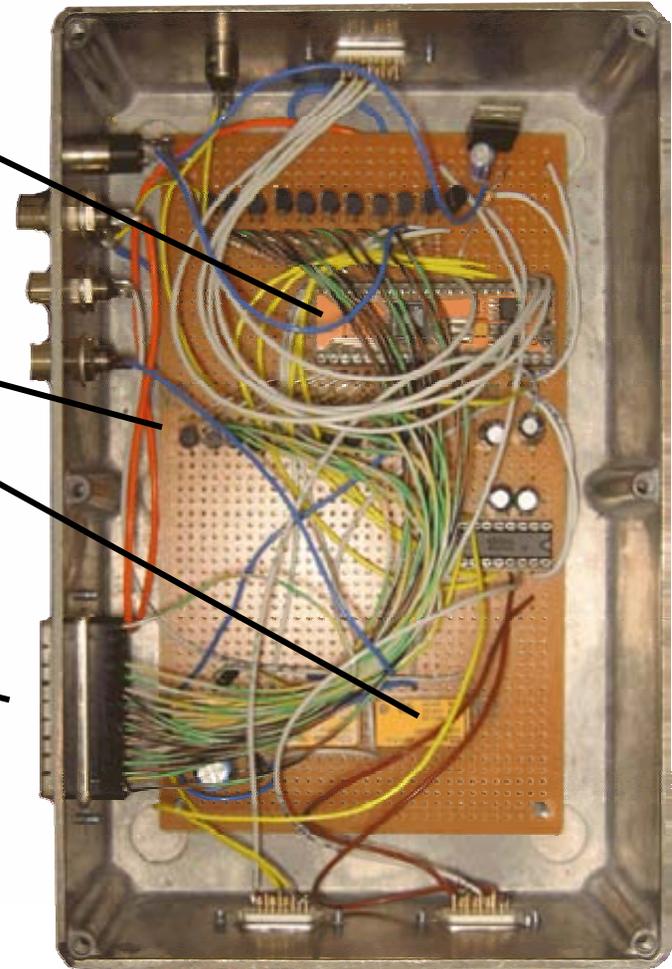


- Band switch with touch of a “button”
- Remembers last frequency used on each band
- Shows actual TX/RX frequency
- Controls TIB, Transverters, PTT of radio
- One touch to go to calling frequency on band

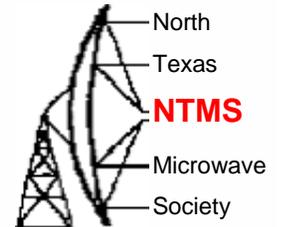
# Control System



- BASIC stamp 2P40
- 2N2222 to control all PTTs and relays
- 28V impulse for relays
- Serial to radio & display
- DB25 to all PTTs, relays
- A few kLOC of PBASIC



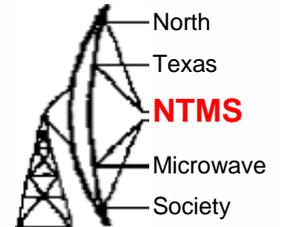
# Logging



- Three ideas
  - Use computer software
  - Use paper
  - Use a tape recorder
- I prefer computer software, but this is a personal preference
- Several packages available – N3FJP, RoverLog, etc.
- Interfacing your logging software to your control system!



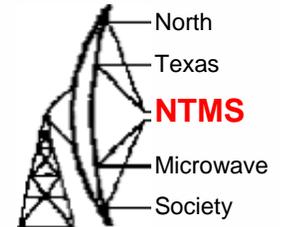
# Navigation



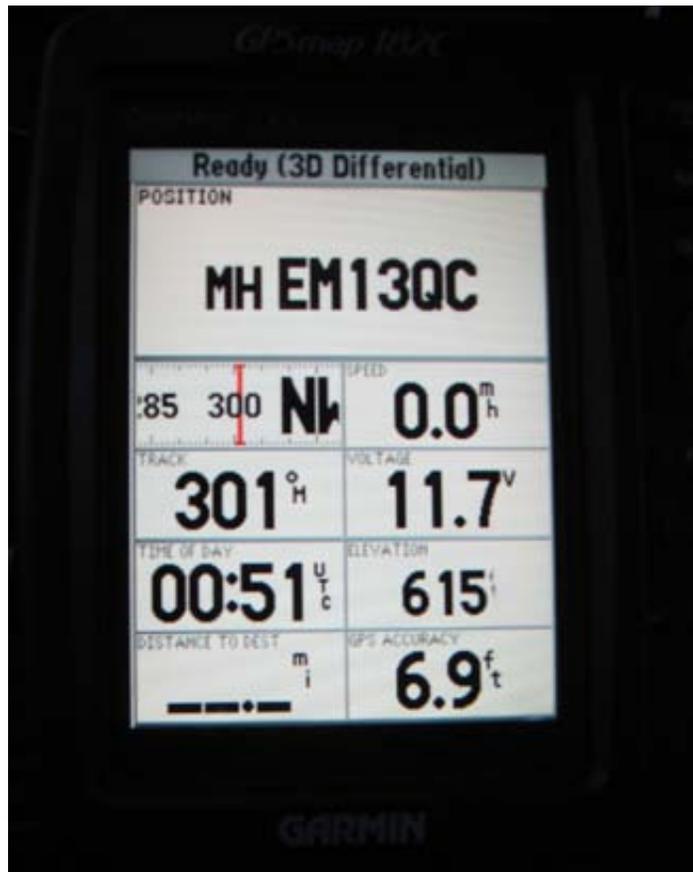
- 2 GPS Units (GPS 182C for position, GPS 376C for navigation, trip calculation, real-time NEXRAD, satellite weather)
- Street Atlas USA on computer for trip calculation
- TopoUSA to locate high points in new areas



# Navigation Con't



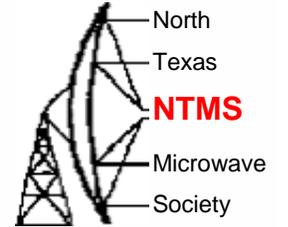
## GPS 182C

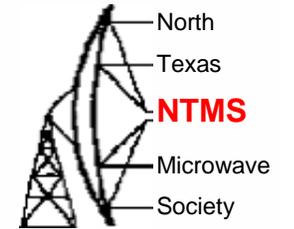


## Street Atlas USA



# Navigation - Topographic





# Questions?