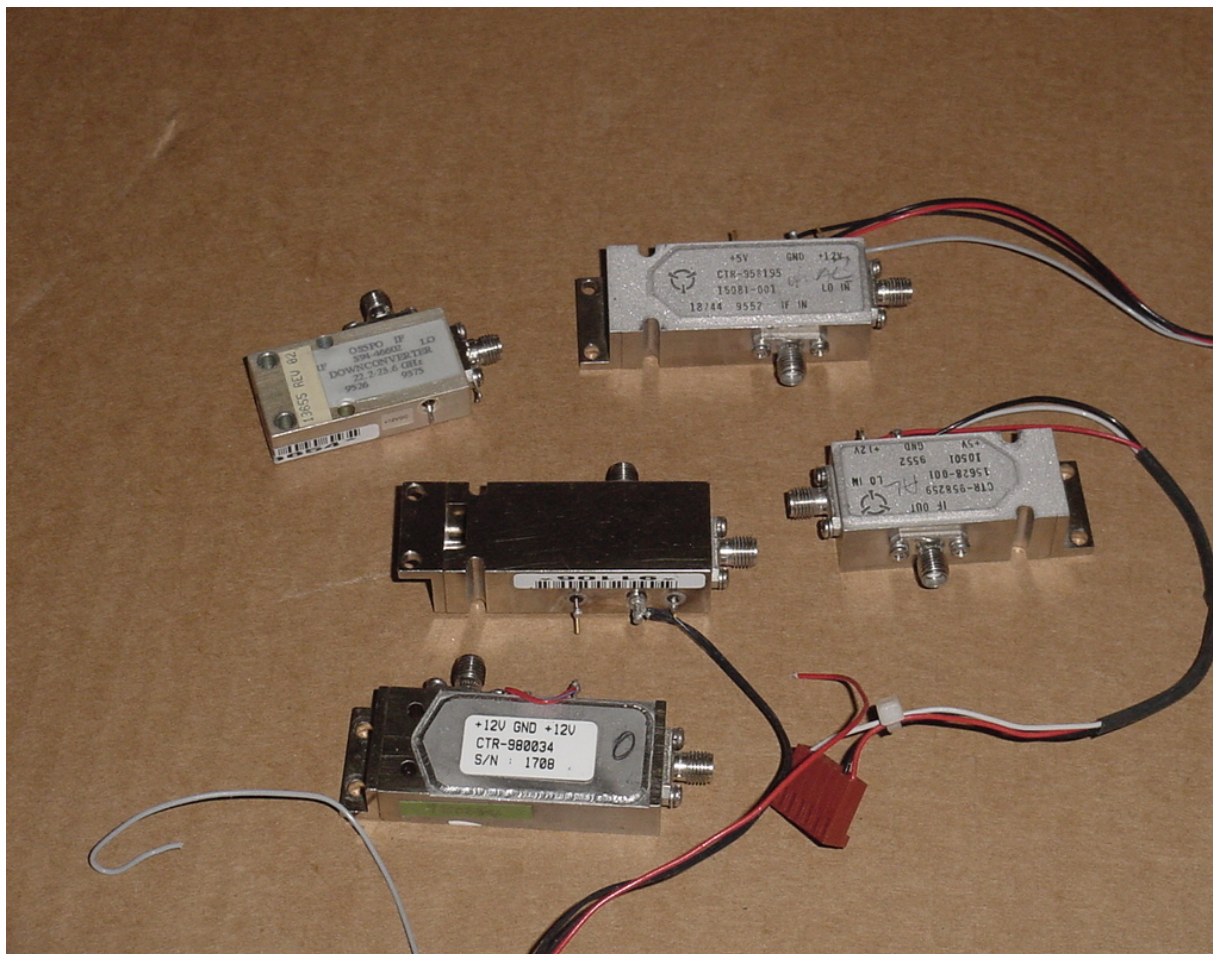
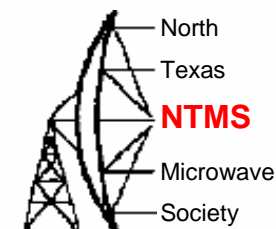


Using Inexpensive Surplus Modules to Build a 24 GHz Transverter

By
Al Ward W5LUA
April 1, 2006

Celeretek and P-Com 23 GHz Up and Down Converter Modules

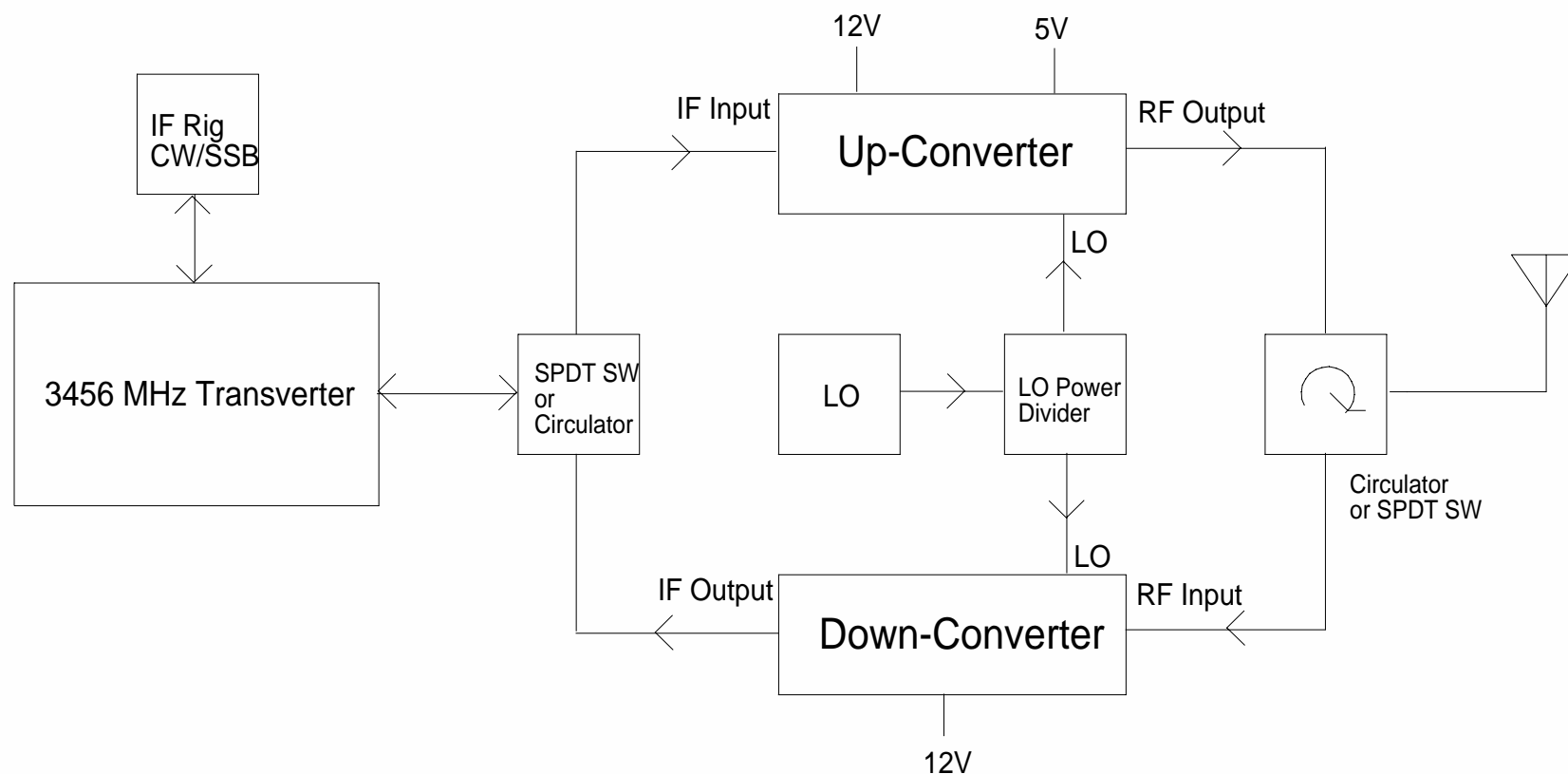
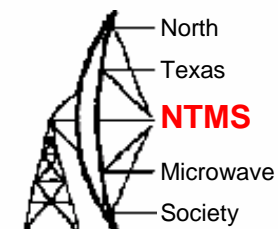


WR-42 or WR-28 for
RF port and SMA for
IF and LO ports

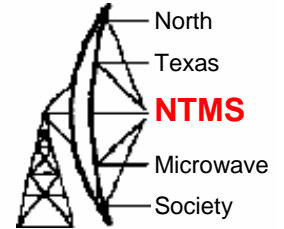
Most require +12V and
some +8V

Cost is normally \$30 to
\$50 each

Block diagram showing a typical 24192 MHz transverter using the surplus modules

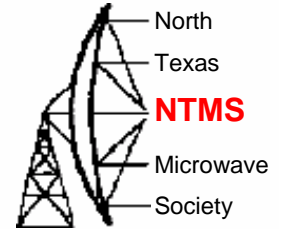


Celeretek & PCOM 23 GHz Modules



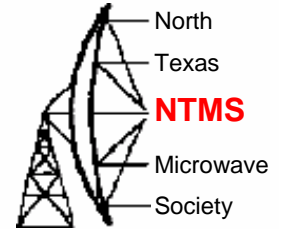
- The PCOM units come in a variety of “flavors” in terms of performance for our 24 GHz amateur band. Not all PCOM units are great performers at 24 GHz.
- They do offer the advantage of being able to be driven at half LO frequency
$$LO = (RF - IF) / 2$$
- IFs can be from 144 MHz through 3456 MHz
- Varying degrees of NF, Gc, image rejection and optimum IF frequency – Most provide good image rejection only with 2304 and 3456 MHz IFs – more recent “discoveries” work well at lower IF frequencies.
- Original Microwave Update 2000 article covers typical performance at various IFs in both up and down converting applications at 24 GHz

Waveguide at 24 GHz

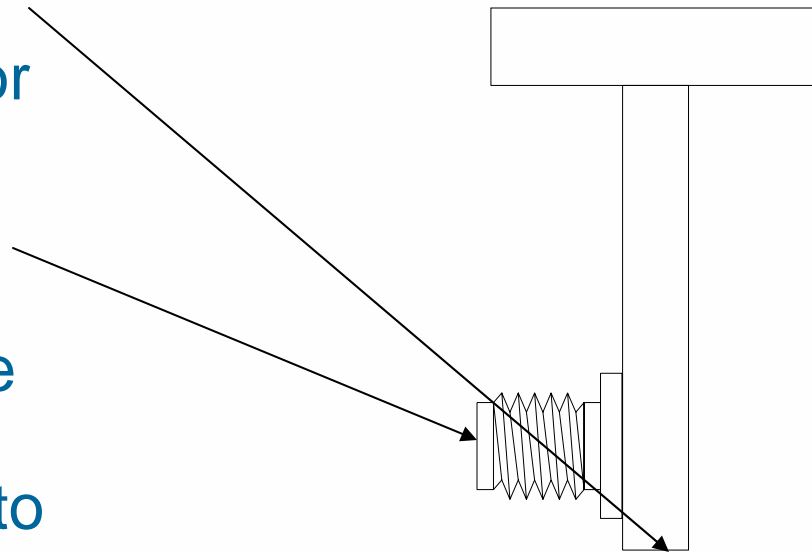


- WR-42 is the normal desired waveguide spec'ed normally for 18 to 26.5 GHz
- However WR-28 is more plentiful and actually has a low frequency cut-off of 21.081 GHz making it a fine candidate for 24 GHz

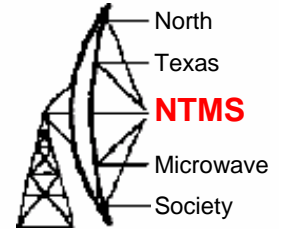
WR-42 to SMA Transition



- Use standard copper WR-42 and use a thin copper or brass plate for the backshort.
- I use EF Johnson 142-0701-881 Gold plated connectors and snip the PCB ground fingers off and trim the center pin to .160" and then insert it into the waveguide at a distance .15" from the inside of the backshort

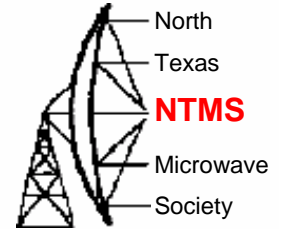


Using an SMA Transfer Relay as a T/R Relay at 24 GHz



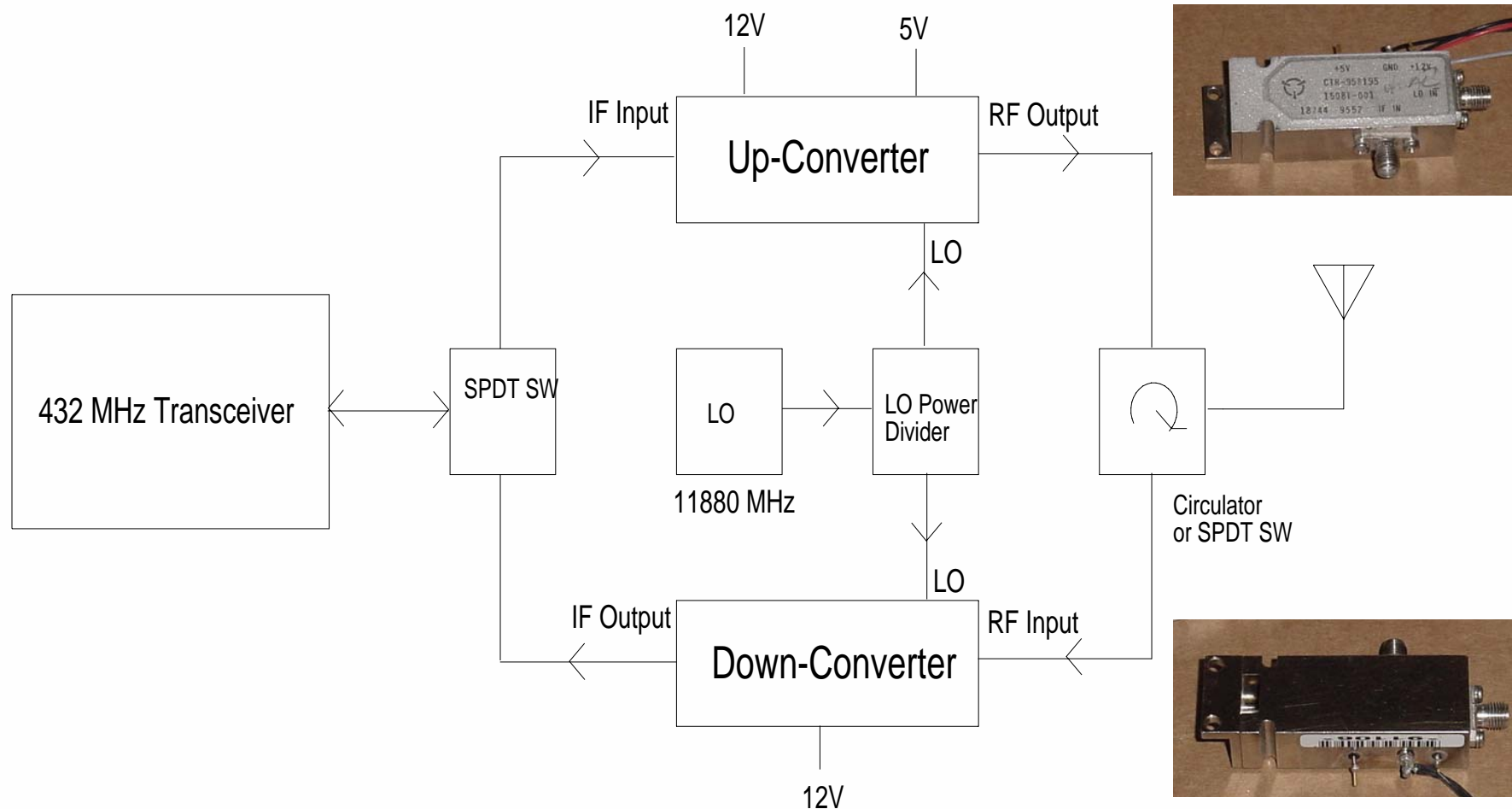
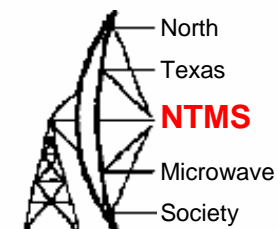
- An SMA type transfer relay can quite often provide less than 1.5 dB of loss and greater than 50 dB of isolation at 24 GHz.
- Normal SPDT SMA relays only provide about 30 dB of isolation and slightly greater loss than the transfer relay.
- Transfer relays can also be used to provide a means of reversing the direction of an amplifier so that it can provide low noise amplification on receive and on transmit the amplifier can provide some gain and power after a mixer.

W0EOM Modules for 432 MHz IF

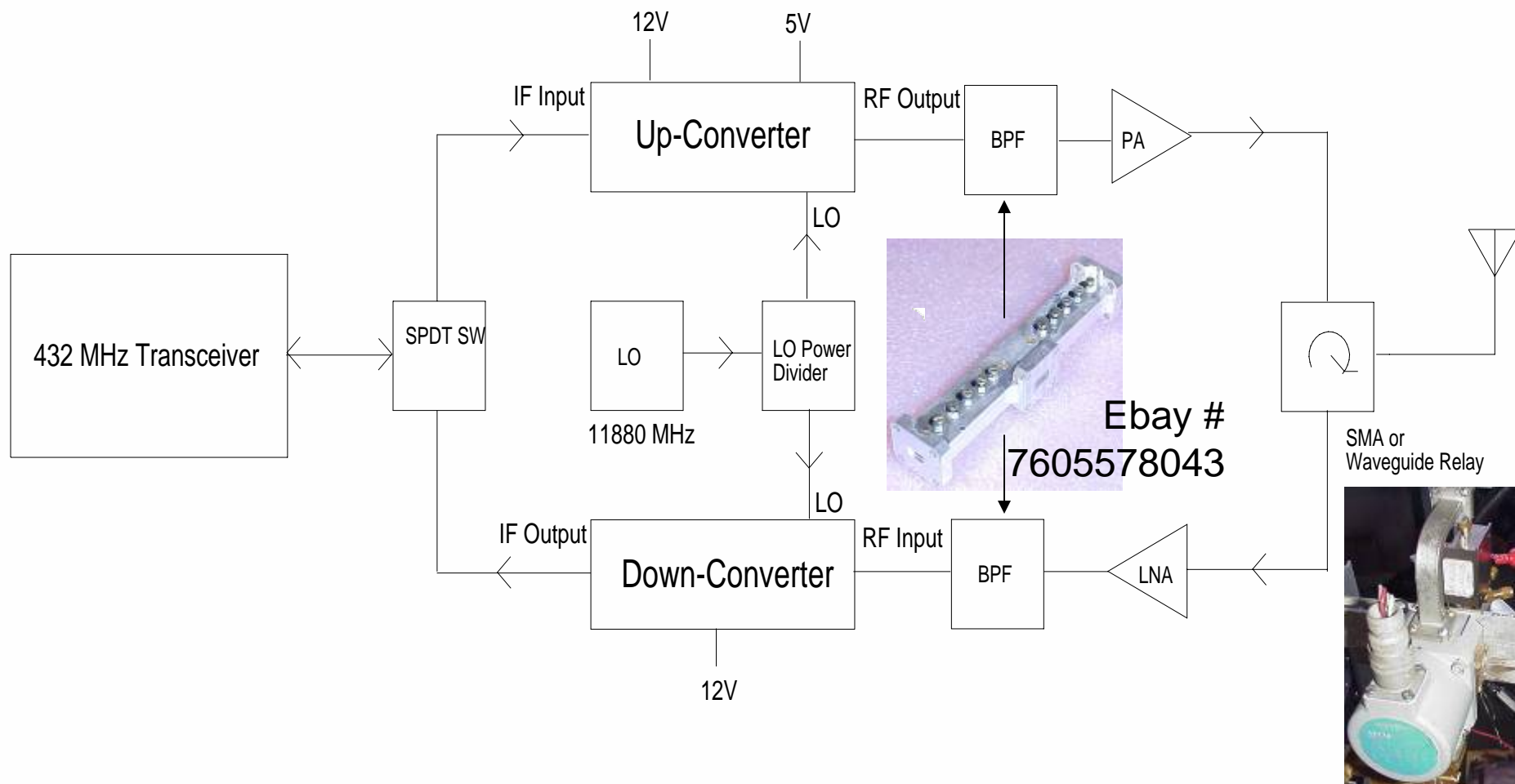
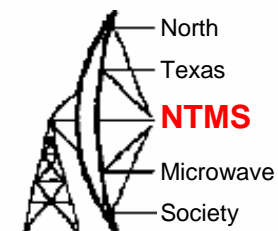


- Part Number S97-48034
- 24192 MHz downconverters LO = 11880 MHz at +16 dBm with 432 IF
- NF about 4 dB with Conversion Gain around 21 dB
- A few more available – contact W0EOM

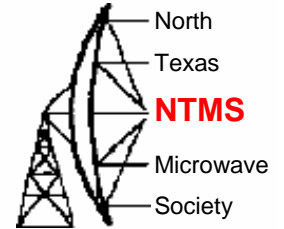
Basic 24 GHz Transverter with 432 MHz IF



Hi Performance 24 GHz Transverter



DMC Units



- The DMC units are very nice looking and very nice performing modules , however, they do require the LO frequency be at RF – IF and not the LO/2 that the PCOM units use.
- SMA connectors on all ports
- Upconverter is a diode mixer feeding an external BPF and then re-enter module to drive amplifier
- An inexpensive X2 multiplier from W0EOM takes care of the problem.

Block Diagram of a 24192 MHz Transverter Using a Transfer Relay and 1 or 2 Amplifiers

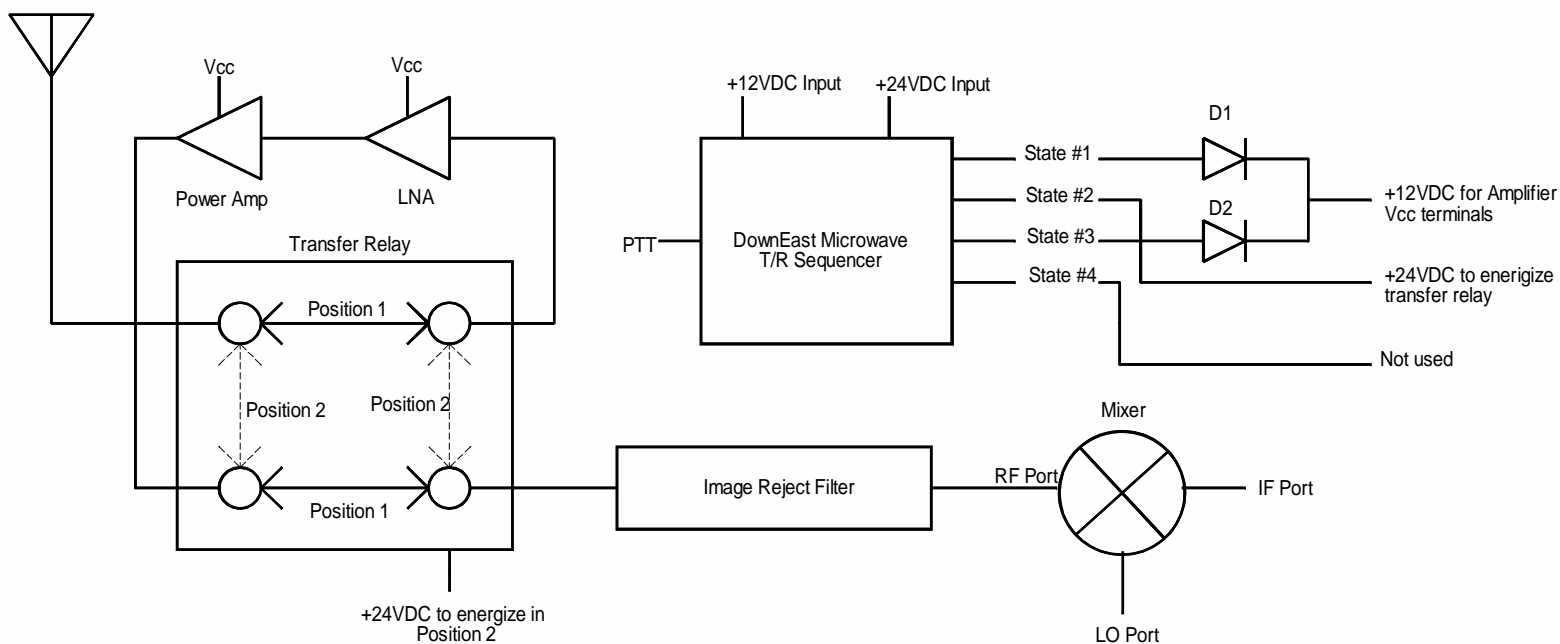
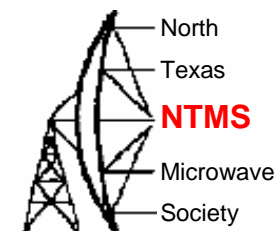
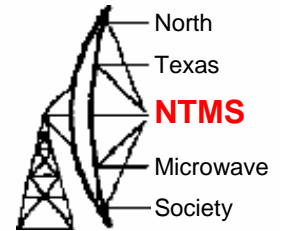


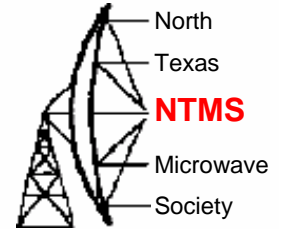
Figure 1 Transverter block diagram showing use of transfer relay to switch amplifier stages

LO Approaches



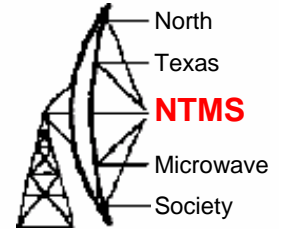
- Frequency West type “Brick” Approach
Internal reference oscillator
External reference oscillator
- Qualcomm LO
- KE5FX plus multiplier approach
- AD6IW plus multiplier approach

Frequency West Brick Oscillator



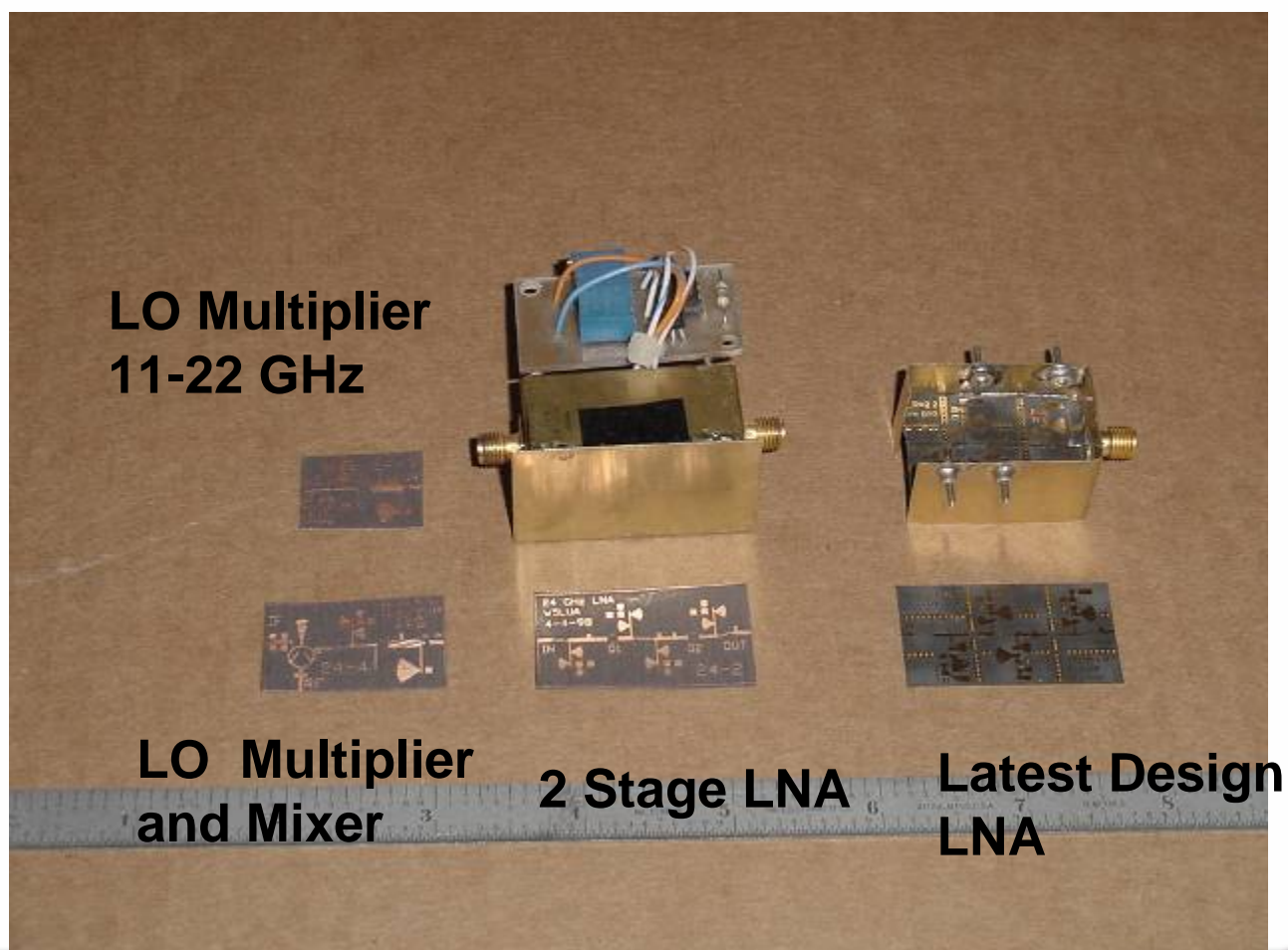
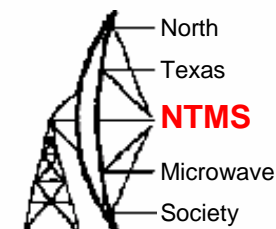
- Generally the Frequency West type of brick oscillators have an internal reference crystal oscillator in the 80 to 120 MHz frequency range
- Order based on Specs for a Frequency West MS-54XOL ($F_x = 80$ to 120 MHz)
- We can research a specific brick and multiplication factor for your application

11880 MHz Brick LO from “Pyro Joe”



- Eric NM5M discovered this LO from “Pyro Joe”
- 11880 MHz LO that is a X120 requiring an external reference frequency of 99 MHz
- The 99 MHz can be derived from a simple DEMI type Butler or Colpitts oscillator that could eventually be “ref-locked” or in the interim take a simpler approach and just use a “clock oscillator” from Tanner or Mouser
- Eric bought his reference oscillator from Mouser

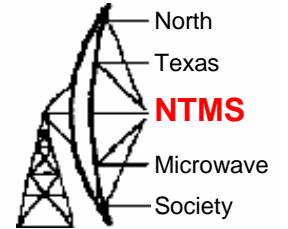
PCB Designs for 24 GHz



Ref:
Microwave Update
Proceedings 98

W5LUA
May 2001

Gem-Link 11.5 Inch 23 GHz Dish

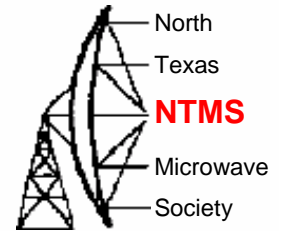


**16 dB Return
Loss @ 24.192
GHz**



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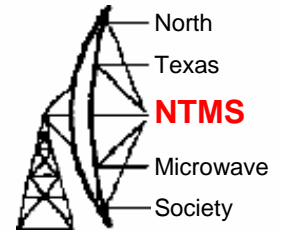
Cassegrain Fed Plastic dish for 24 GHz



**Feedhorn requires
some "tuning" for
24.192 GHz**

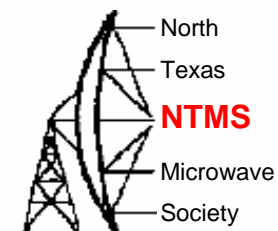
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May 2001

Feedhorns for 24 GHz



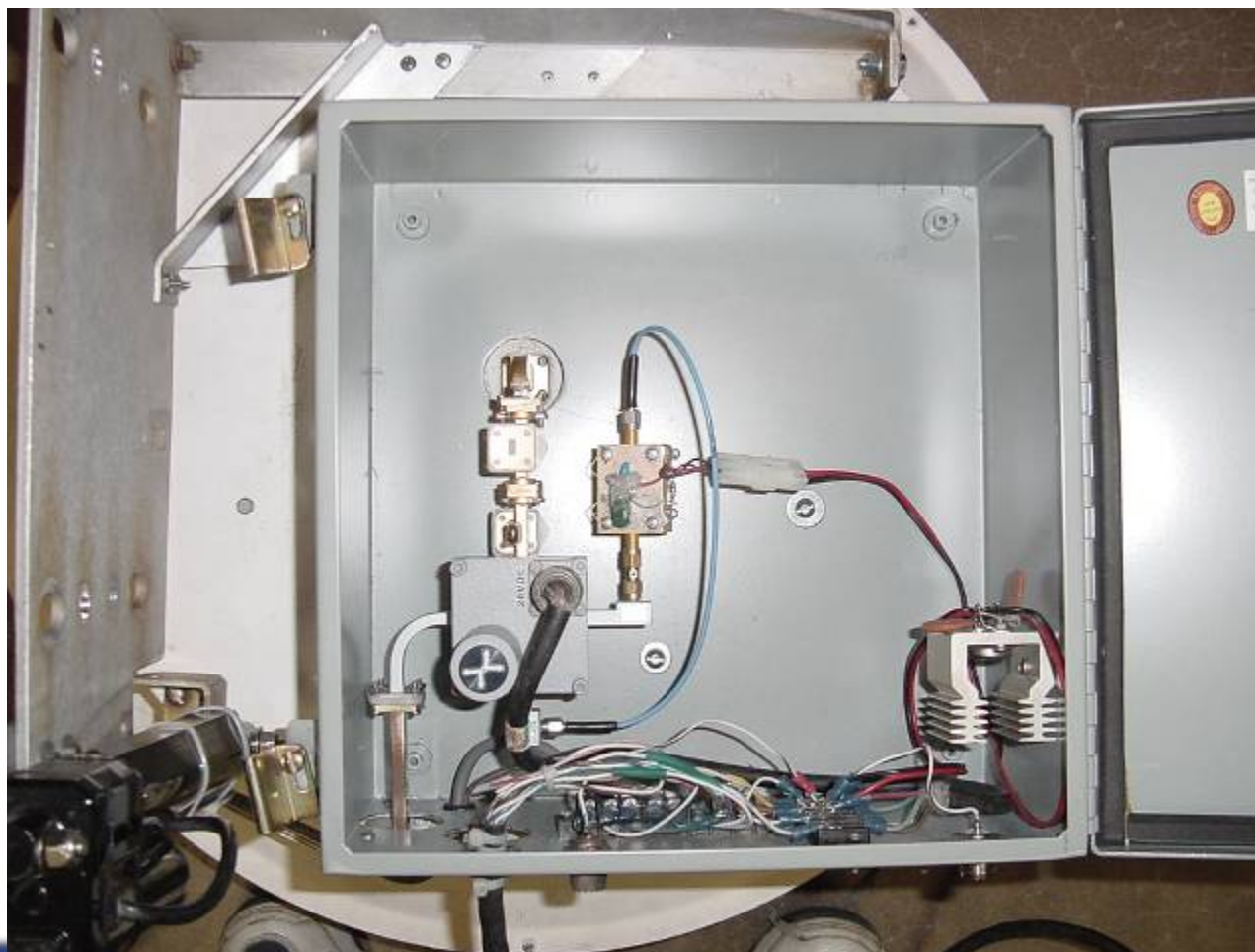
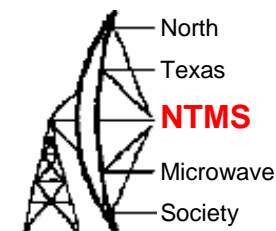
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24 Inch MA/COM Dish



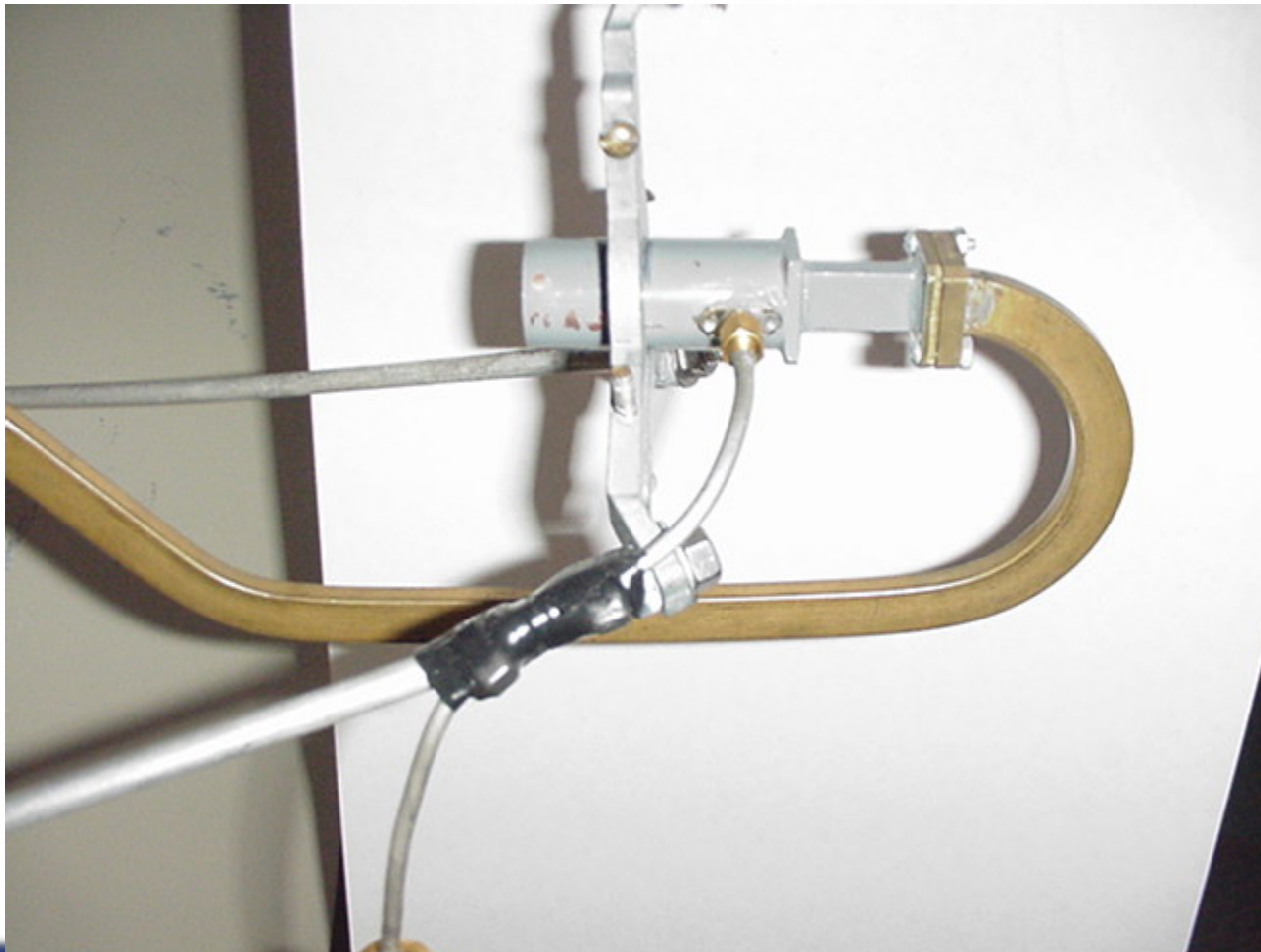
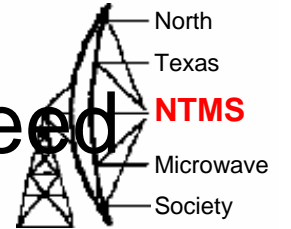
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MA/COM Dish with Preamplifier and Transfer Relay at W5LUA



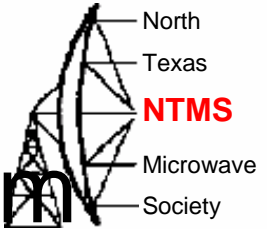
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W5ZN Dual Band 10 GHz / 24 GHz Feed

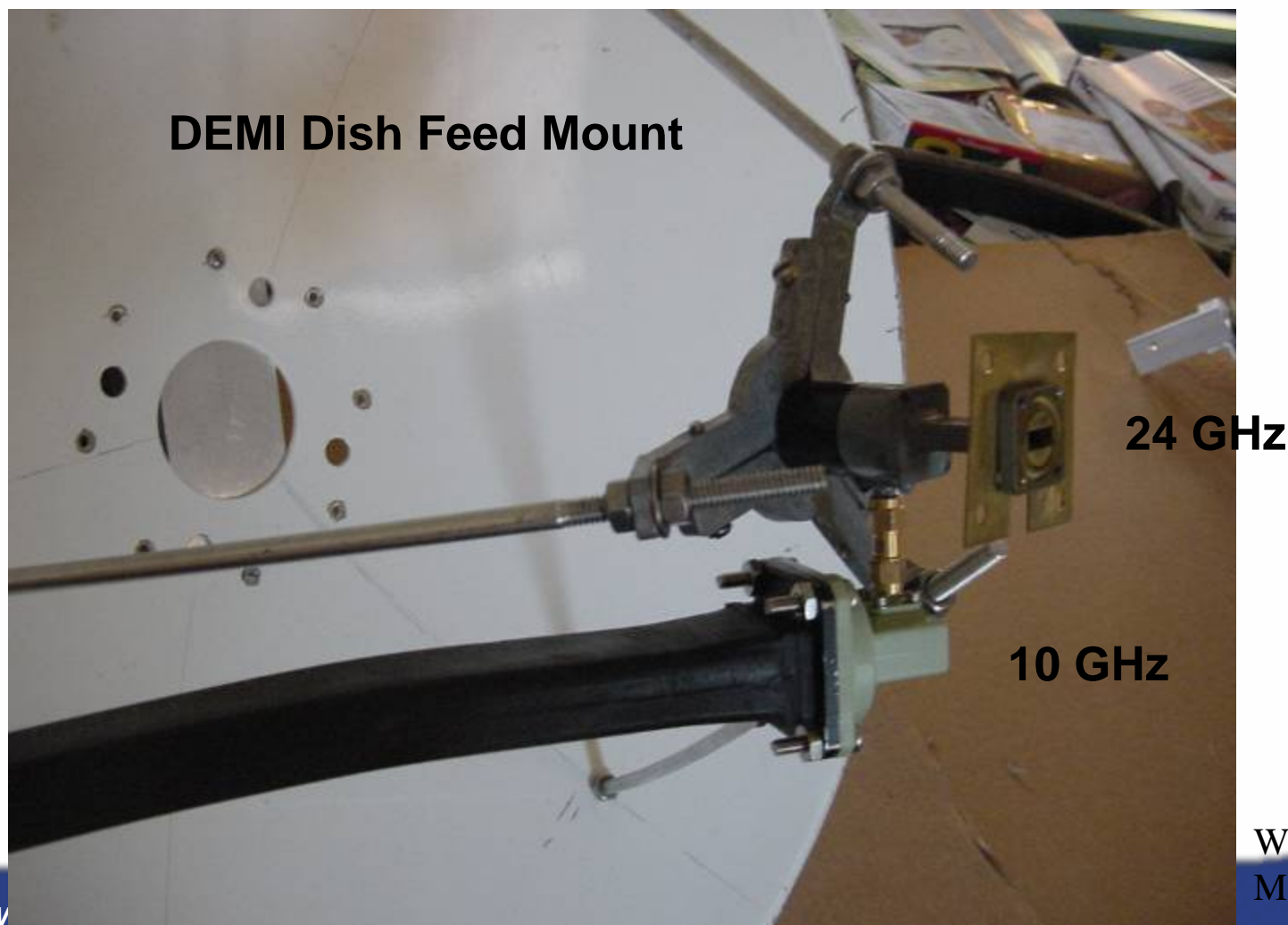
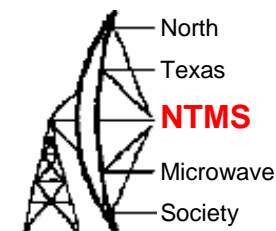


W5ZN

10 GHz / 24 GHz Antenna System

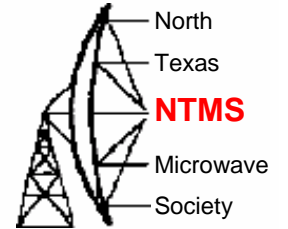


W5LUA 24 Inch Dish fed with W5ZN 10 and 24 GHz Dual- Band Feed

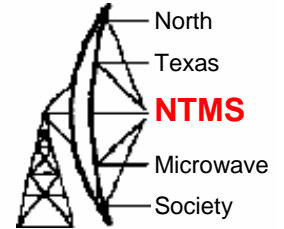


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May 2001

W5LUA roving for W5ZN on 10 and 24 GHz with dual-band dish



24 GHz Activity in the Texas Area



- Active W5LUA, WW2R & N4FRE, AA5C, WA5VJB
- Working towards being active WA5TKU, NM5M, N5AC, WA5YWC, W5DBY, KA5BOU, N5YC, N5TSP
- Recent interest K9MK
- Others got the bug?