The Why and How of Microwave Transverters

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Introduction

- Why use transverters
- How to hook up transverters
- Attenuators
- Antennas and feedlines
- Amplifiers and Pre-Amps
- Does my rig work?
- Microwaves on a budget

Highlights

- Not necessary to open or modify your “IF” HF or VHF radio to work with transverters
- Second-hand transverters are available and economical
- With a little basic knowledge, hooking up transverters is straight-forward

Why Use Transverters?

- Popular new all-mode radios available only for the lower bands (50, 144, and 432 MHz)
- Some high-end radios cover 1296 MHz
- Few 222 MHz all-mode radios are available, especially new
- Why? cost, complexity, low demand

Why Transverters? (con't)

- Using transverters allows amateurs to re-use that all-mode radio that they already have and know how to operate
- Transverters allow one to "run the bands" during contests from a single radio, increasing contesting efficiency

Transverter Band Switch



photo courtesy of Rick Rosen K1DS

Transverter Band Switch Back

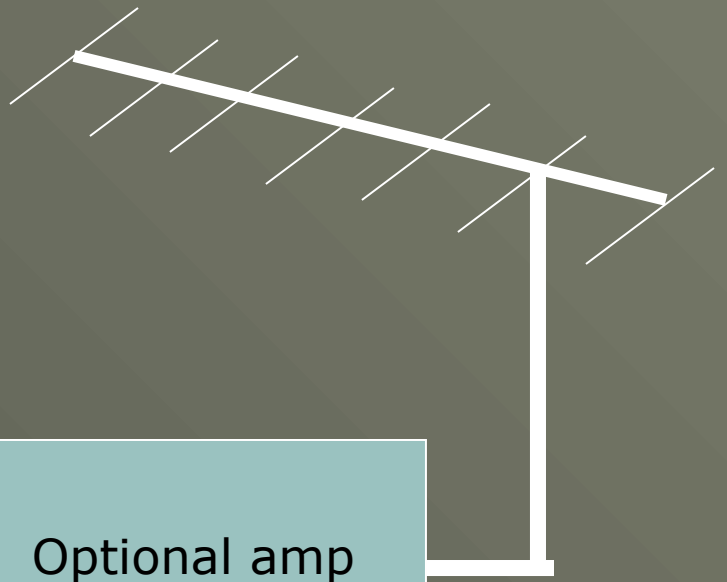


photo courtesy of Rick Rosen K1DS

How Transverters Work

- Similar to superheterodyne radios
  - Signal from local oscillator (LO) is mixed with incoming radio signal
  - Detector picks up generated intermediate frequency (IF) and converts the IF to audio
  - Example: a 1296 MHz transverter might have a LO at 1152 MHz. If the IF is 144.100 MHz, we receive 1296.100 MHz (1152 + 144.1 = 1296.1)

Block Diagram



All Mode IF rig
28 MHz

Transverter
28+404=432MHz

Local Oscillator
404MHz

Optional amp
and preamp



All Mode 2m rig
144MHz

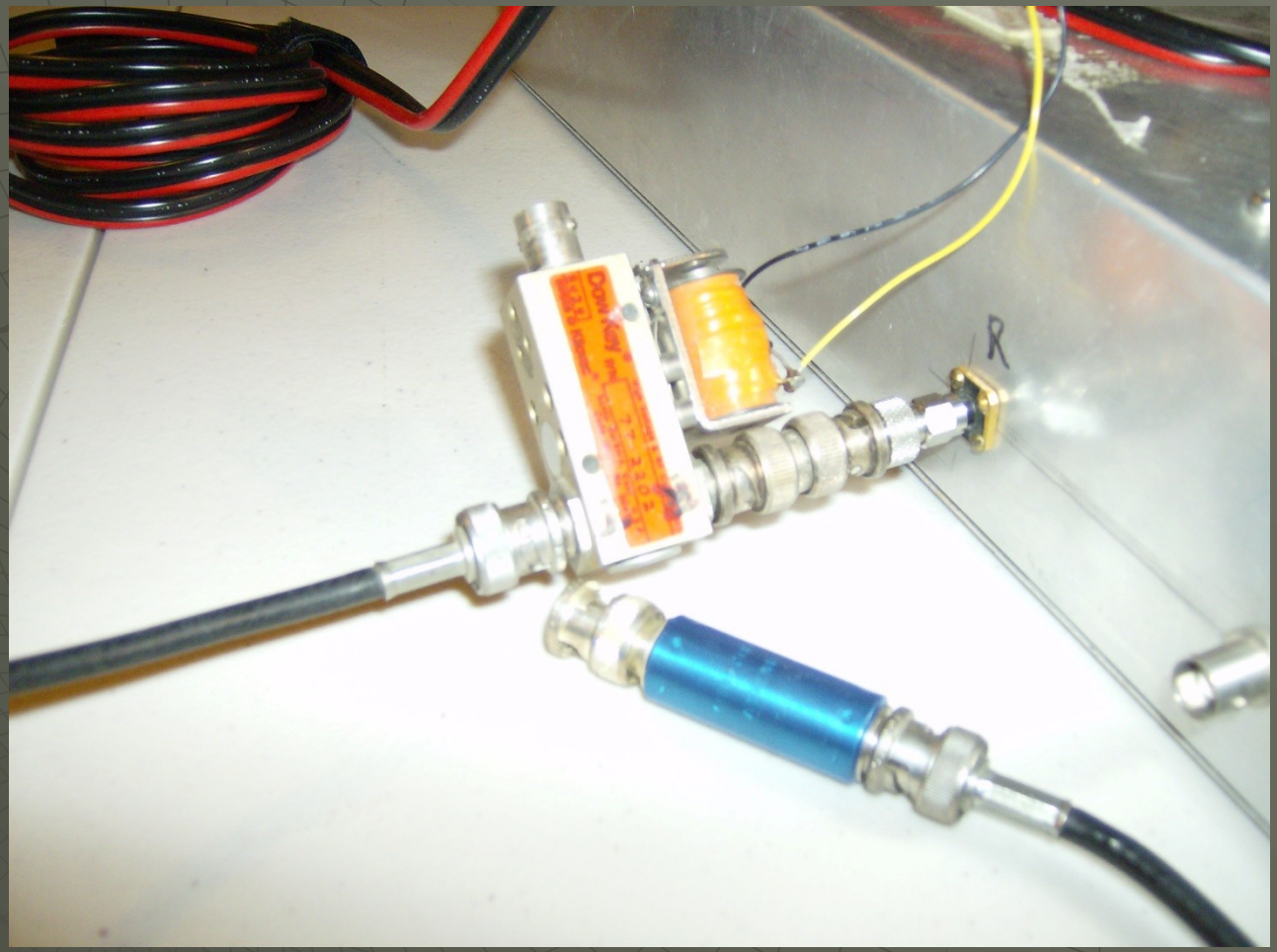
Transverter
144+1152=1296
LO 1152MHz

Optional amp
and preamp

How Transverters Work (con't)

- Transverters are organized internally into transmit and receive "chains"
  - Receive chain often contains a pre-amp that could be damaged by transmit RF if not switched out
  - Switching accomplished by a transmit/receive (T/R) relay
    - Mounted either internally or externally
    - RF terminals to the T/R relay are either SMA or BNC connectors

Dow T/R Relay



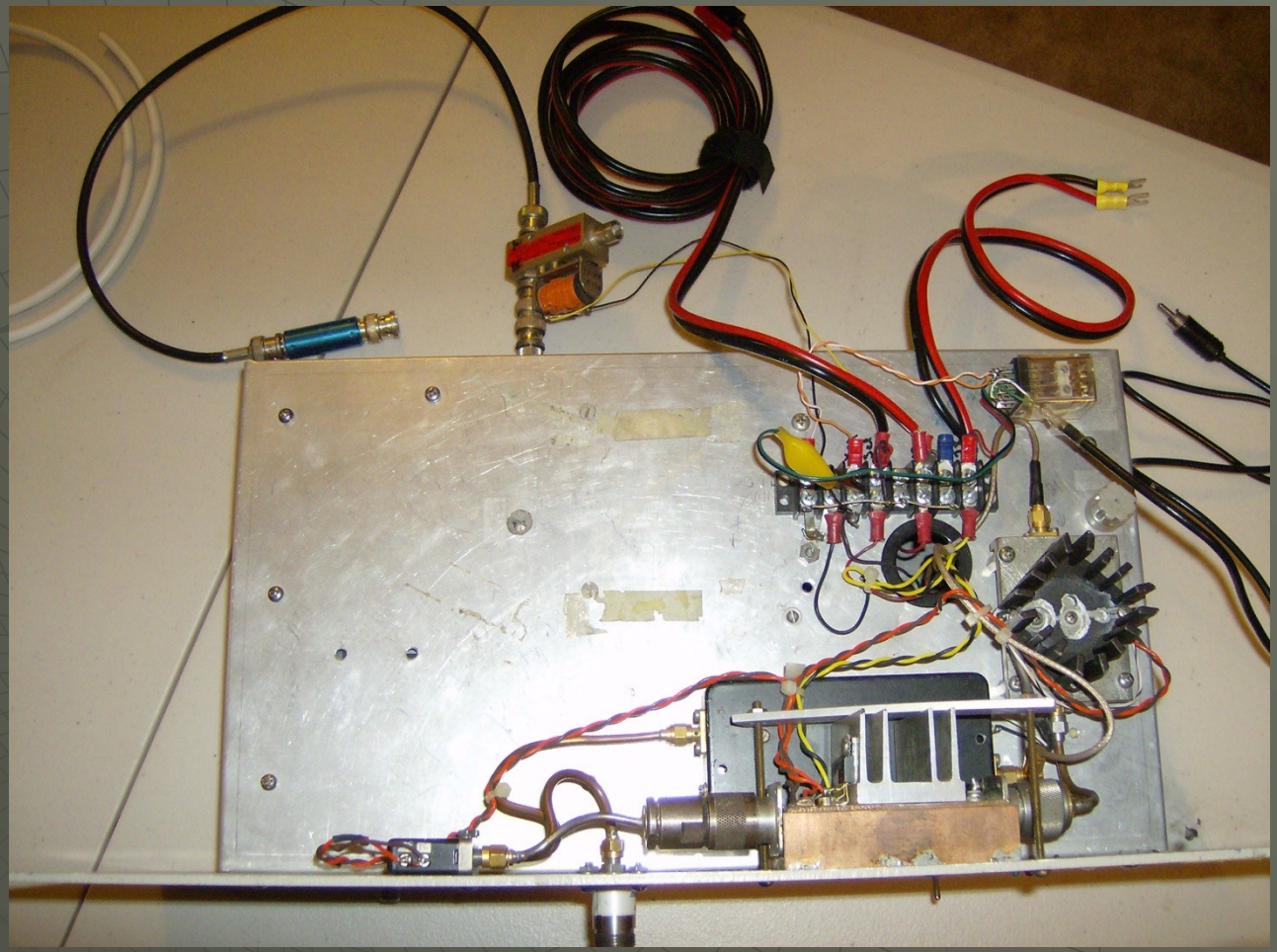
222 MHz DEMI Transverter



Hooking Up a Transverter

- Power:
  - 12-14 VDC for RF circuits
  - 24-28 VDC for relays, other components
- N connector goes to antenna
- BNC connector to T/R relay
  - Other end goes to SO-239 antenna connector on IF rig
- Phono connector to “key” T/R relay to transmit

1296 MHz Transverter



RF Connectors

- N connectors are better than PL-259 and SO-239 “UHF” connectors for connecting antenna feedlines at 432 MHz and higher frequencies
  - N connectors are also moisture-resistant
- BNC (“bayonet”) and SMA connectors are used where the RF current is only a few watts

N Connector



Next three pictures from NoCat.net

BNC Connector



BNC stands for Bayonet Neill-Concelmann

SMA Connector



SMA stands for Sub-Miniature A

Transmit “Key” Line

- On a commercial equipment, the connection will be an (RCA) phono jack
- IF rig often has an accessory jack to connected to the “Key” line
  - Home-brew alternative is to ground the “Key” line via a toggle switch
- Use a sequencer to insure that the pre-amp is disconnected before transmit power is applied

Attenuators

- Depending upon the IF rig, low power might be as little as 1 milliwatt or as much as 5 or 10 watts
- Some transverters can be damaged by RF levels above 10 microwatts
- Enlist a good watt meter and perhaps an Elmer to work out the required db loss

Attentuators (con't)

- Make sure that the attenuator is robust enough to dissipate the excess RF energy, which becomes heat
- Only attenuate the transmit chain!

Antennas

- Loop yagi antennas are used above 432 MHz because it is easier to fashion loops rather than dipoles at higher resonate frequencies
- Orient the antenna for horizontal polarization by placing the boom above or below the loops
- Horns and dishes are common for higher microwave frequencies

Loop Yagi



Photo courtesy of Steve Kerns N3FTI

Feedlines

- At microwave frequencies, feedline losses are more significant than at HF frequencies
- Use good quality coax (e.g. 9913, LMR400, LMR600)
- Use Heliax or hardline for long runs
- After routing the lines, shorten to minimize feedline losses

Pre-Amps

- An alternative strategy for compensating for received signal feedline loss is to incorporate mast-mounted pre-amps
- A mast-mounted pre-amp boosts signals *before* they become attenuated by the feedline
- Requires power to the mast

Linear Amplifiers

- A linear amplifier boosts transmitted signals, overcoming feedline loss at microwave frequencies
- Surplus commercial equipment can often be converted to amateur use
  - Packrats have recently converted surplus amps for 903 and 2304 MHz
- Use a 12 VDC relay to key amp and transverter simultaneously
  - Wire diode in series with each coil to prevent relays from hanging after keying to transmit

903 MHz Linear Amp



Is My Rig Working?

- Listen to the beacon
  - Packrat beacons at Grid Square FM29JW
  - Use beacons to check accuracy of frequency display and antenna aiming
- Use W3KM program to get heading
- Work with other hams
  - Start on 432 MHz
  - Pick a coordination frequency
  - Send a series of dashes

Do You Have to be Rich? No!

- New transverter kits run $200-$300
- Assembled ones go for $400-$600
- Check for used transverters
  - Club auctions, reflector postings, hamfests, and word-of-mouth
- Author's transverters (222, 903, 1296, and 2304 MHz) were all acquired used for under $500

Join a Club

- Author's used transverters were all obtained through radio club contacts
  - Let your fellow amateurs know what you need
- Fellow club members often have spare transverters and antennas for loan, especially during contest periods

Conclusion

- Working microwaves can take more effort than HF and FM repeaters but amateurs often need challenges to stay active in ham radio
- Show your fellow amateurs (and yourself) what you are capable of accomplishing
- Your fellow amateurs are eager for you to join them on microwaves

Contacts

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QUESTIONS?