

# 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 straightforward

# 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

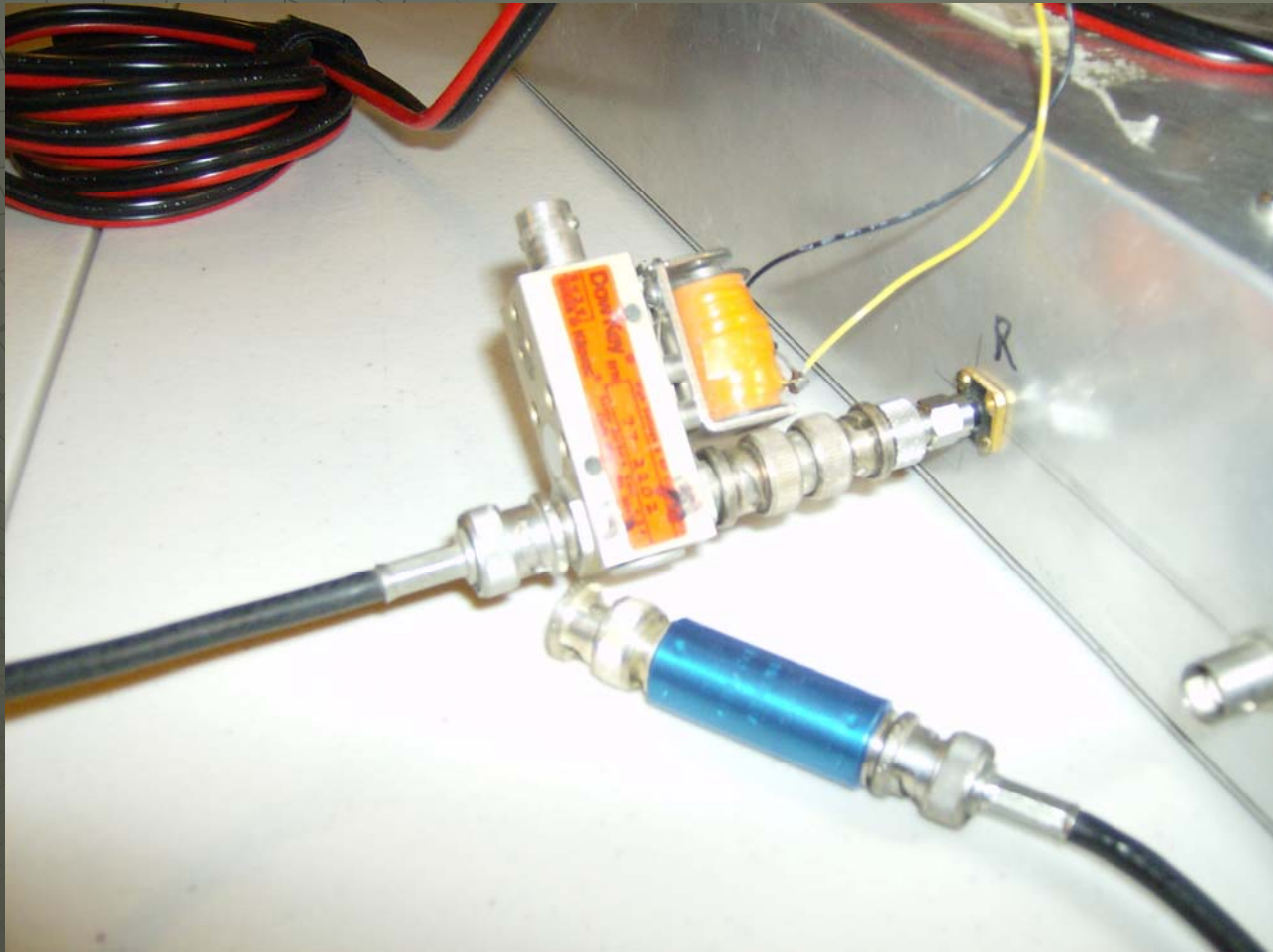
- ◆ Similar to superheterodyne radios
  - Signal from local oscillator (LO) is mixed with incoming radio signal
  - Detector picks up generated intermediate frequency (IF) and converts the IF to audio
  - Example: a 1296 MHz transverter might have a LO at 1152 MHz. If the IF is 144.100 MHz, we receive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



# 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

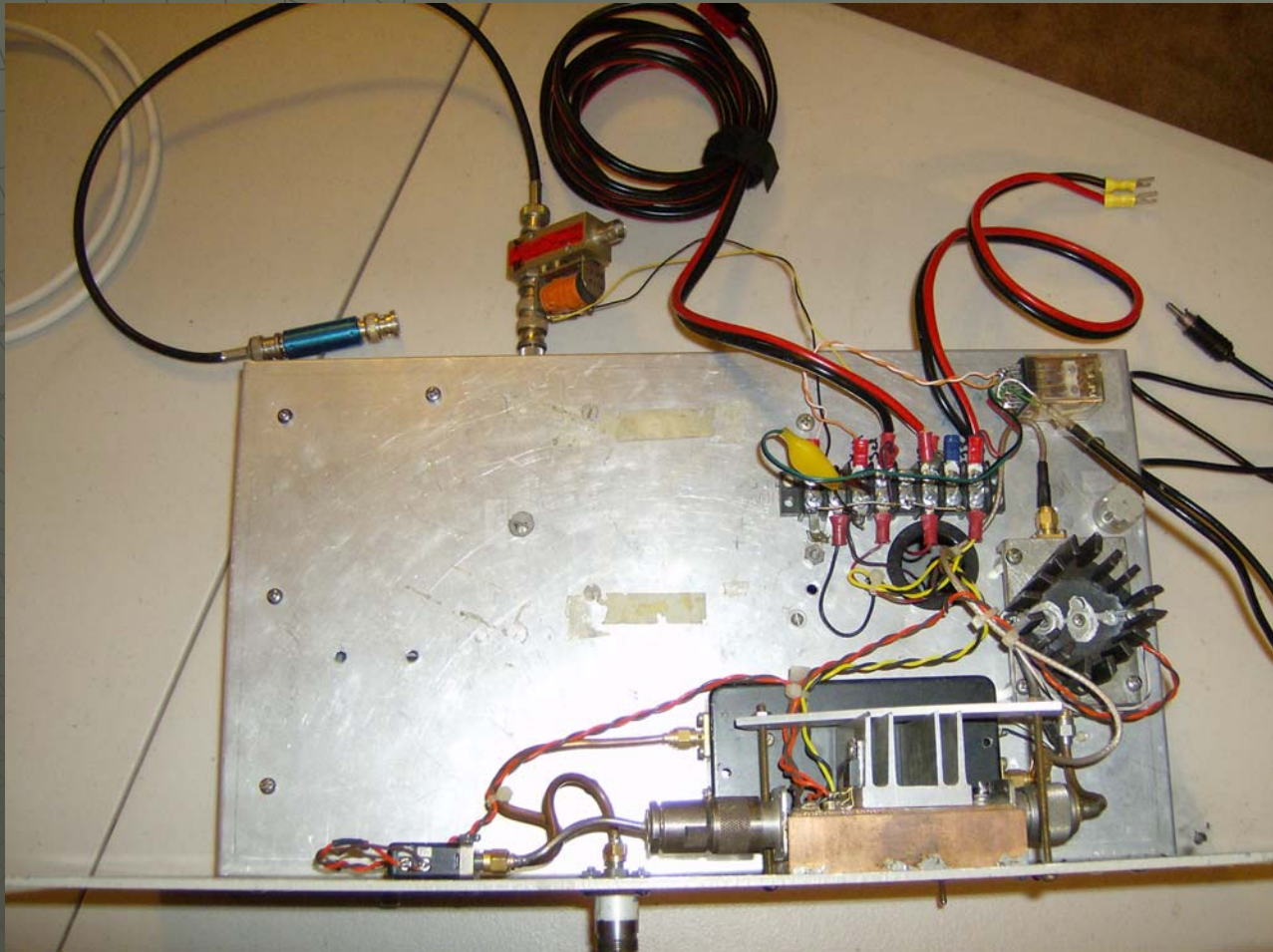


# Hooking Up a Transverter

- ◆ 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

# Attenuators (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 or LMR400)
- ◆ 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



# 2304 MHz Project



# 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



# Is My Rig Working ? (con't)

- ◆ Use a scanner receiver
  - Can you hear your dashes ?
  - If the scanner has an accurate display, use it to verify transmit frequency
- ◆ Remember that crystal oscillators drift as they warm up
  - Let transverter warm up for an hour
  - Solder thermistor to crystal case

# 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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