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Introduction to Amateur Microwave Radio

By Matt, W5ZCA

NTMS Vice President

Outline

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- Who Am I?
- Microwave propagation
- Transverters systems
- Roving (POTA on Steroids)

Who am I?

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- Originally from Farwell, Texas (DM84).
- Been licensed since 2013.
- Graduated college in 2023 with Bachelors in E.E.T.
- Published research paper using Machine Learning to design antennas.

Grid Expeditions pt. 1

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- Recently, I have been exploring the VHF bands (6M, 2M, 70CM, and 1.2GHz).
- I have also started roving to different Grid squares and helping folks on there journey to FFMA.

Grid Expeditions pt. 2

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Grid Expeditions pt. 3

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Microwave Propagation

Line Of Sight

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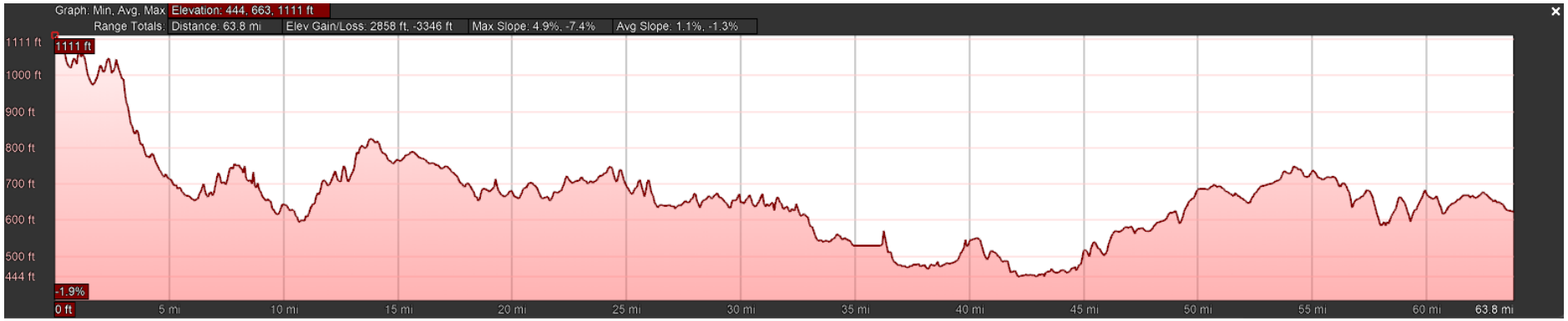
- RF travels in a straight line and require an unobstructed path between the transmitting and receiving antennas
- The practical range is limited by the Earth's curvature
- Hills, buildings, or even trees block 10 GHz signals



^Path profile between Weatherford and W5LUA

Tropospheric Ducting

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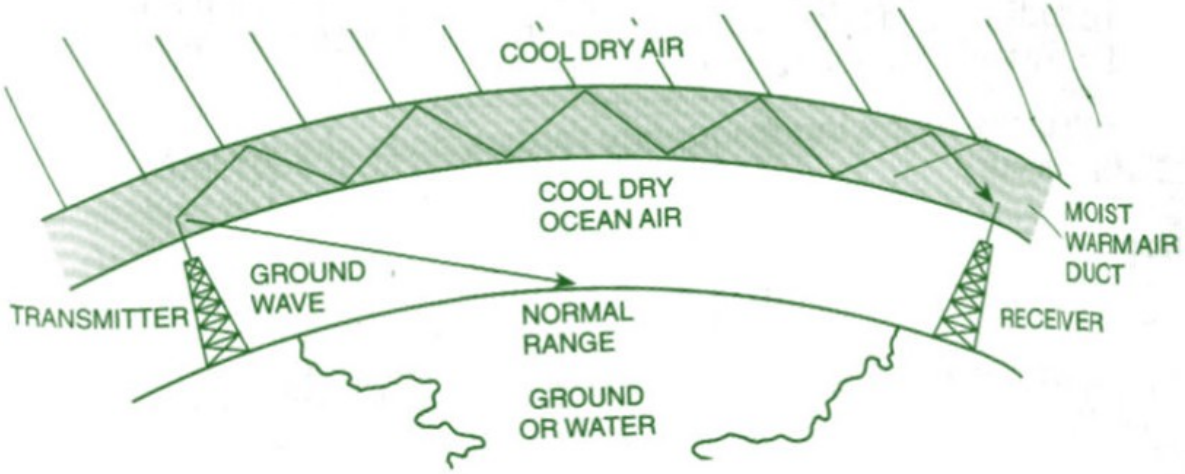
- Weather-driven phenomenon where RF get trapped in a “duct” of air (Common Volume) between layers of different temperature and humidity.
- Common over water (ex. coastal areas, Great Lakes) or during stable high-pressure systems in summer



Tropospheric Ducting

Rain Scatter

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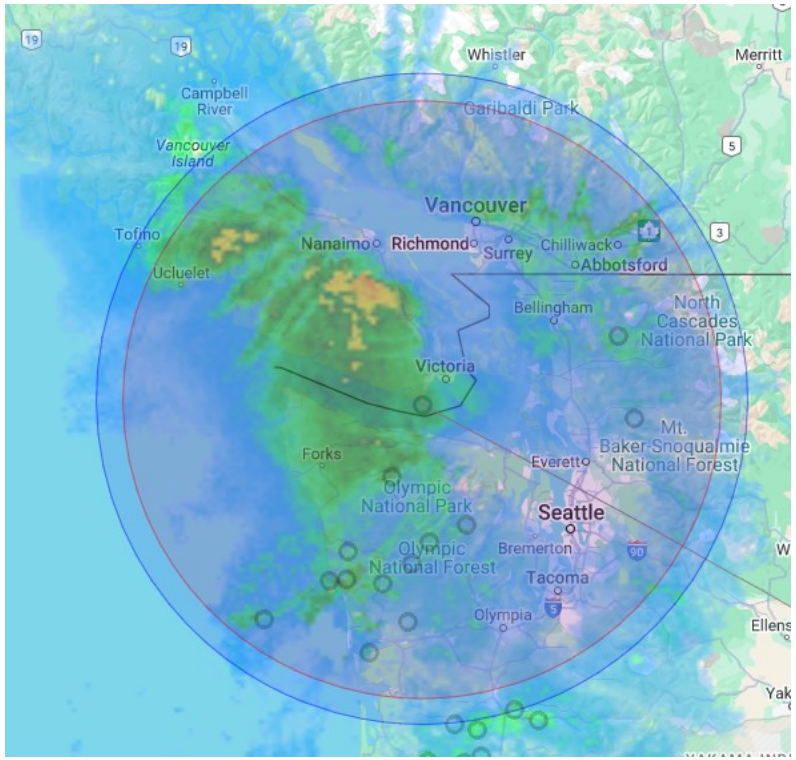
- Propagation mode where 10 GHz microwaves bounce off raindrops or other precipitation (like hail or wet snow)
- The 3 cm wavelength at 10 GHz is close to the size of raindrops (typically 1–5 mm)
- rainscatter.com is the best place to find rain scatter information



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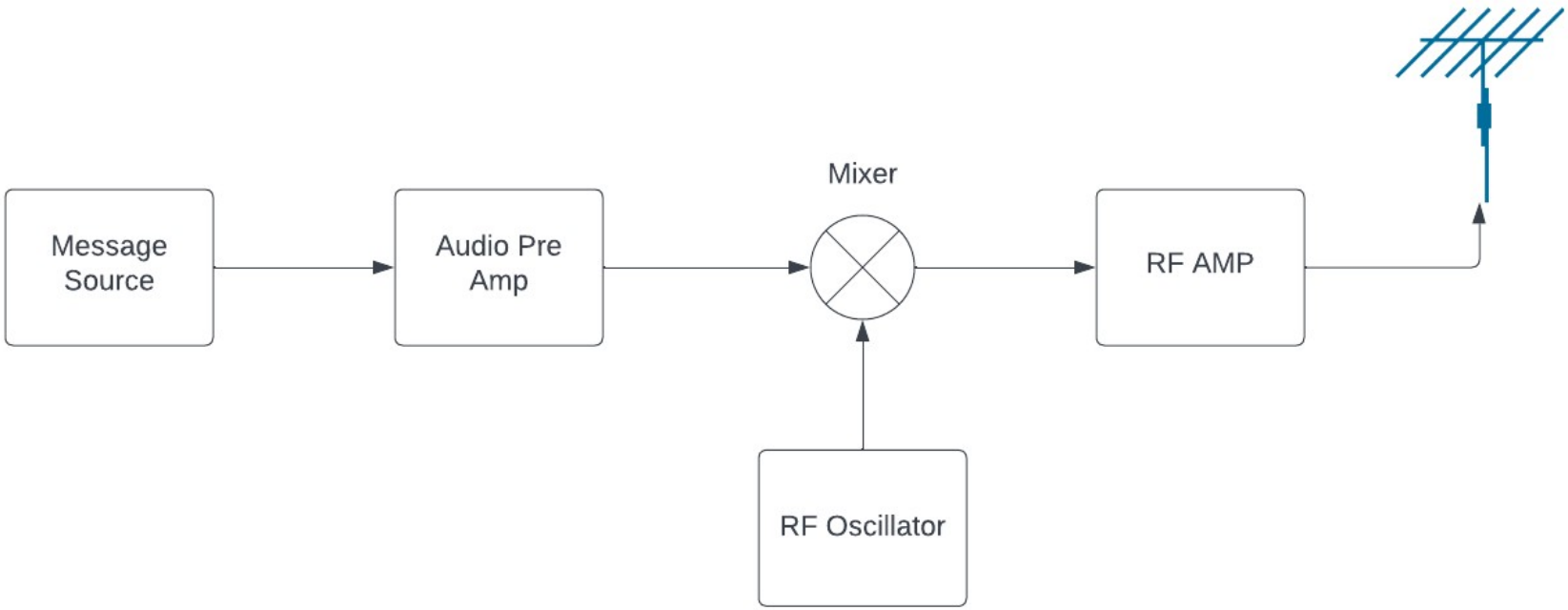
Transverters

Commonly used terms

- LO: Local Oscillator
- IF: Intermediate Frequency
- X-Verter: Transverter
- LNA: Low Noise Amplifier
- PA: Power Amplifier
- Feed Horn: Microwave Antenna

Simple FM Transmitter



Simple Transverter

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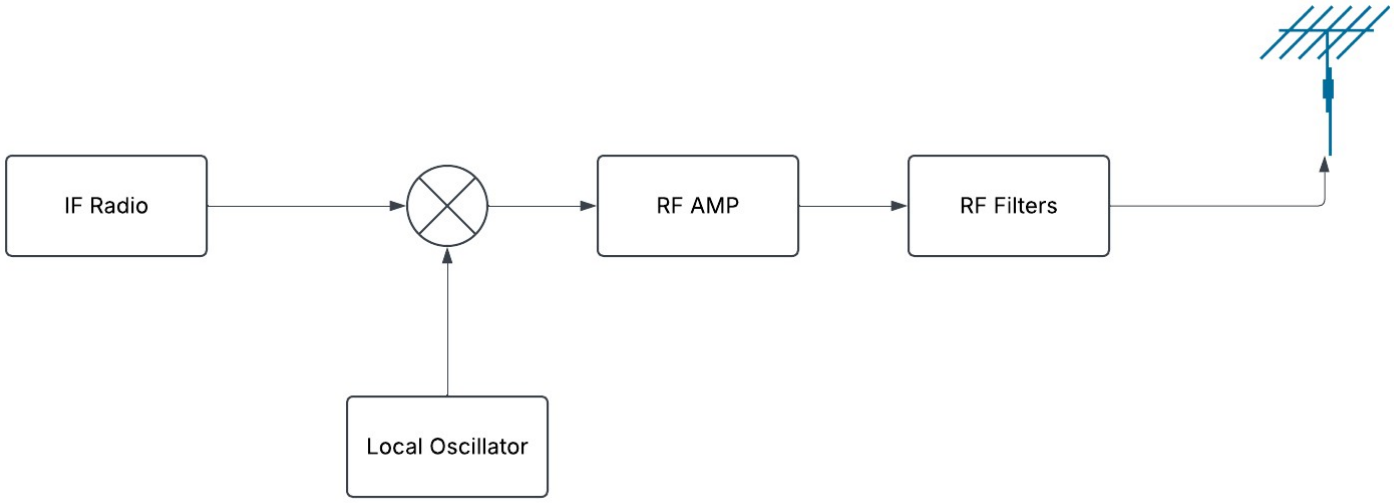
- Common IF Frequencies are 28MHz and 144MHz.
- LO Frequences depend on the output of the frequency the transverter.
- EX: To achieve an output of 1.2 GHz or 1296 with an IF frequency of 144MHz:

1296-144= 1152



Typical 10GHz Rig

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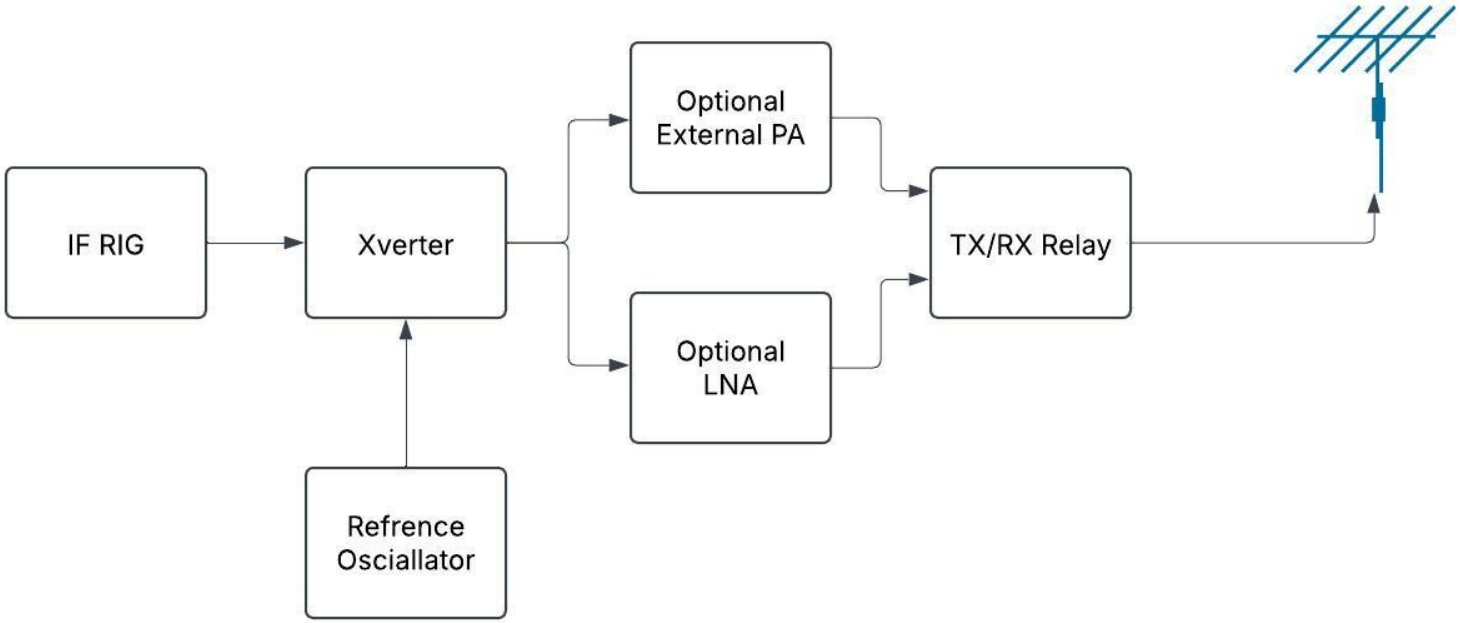

IF Rigs

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- An IF rig is a QRP radio that can TX on 28MHz and/or 144MHz.
- Not all rigs are able to be used with a Transverter.
- Common IF Rigs used: IC 705, FT-817,FT-290

Reference Oscillator

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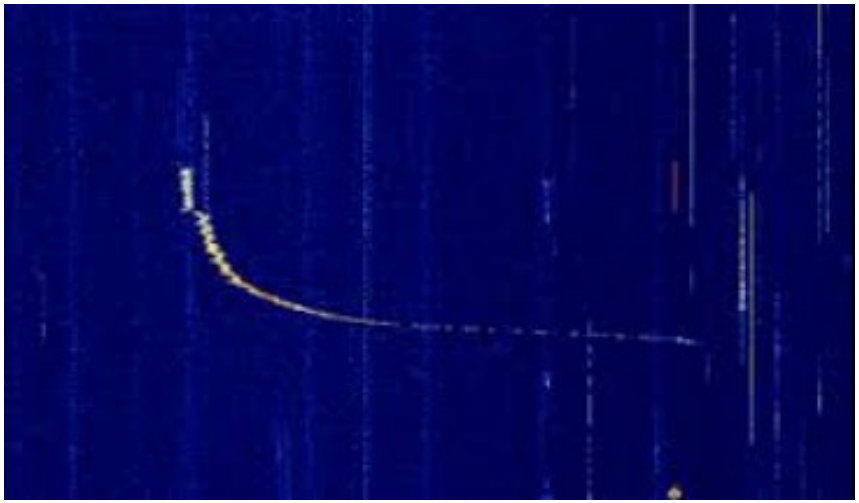
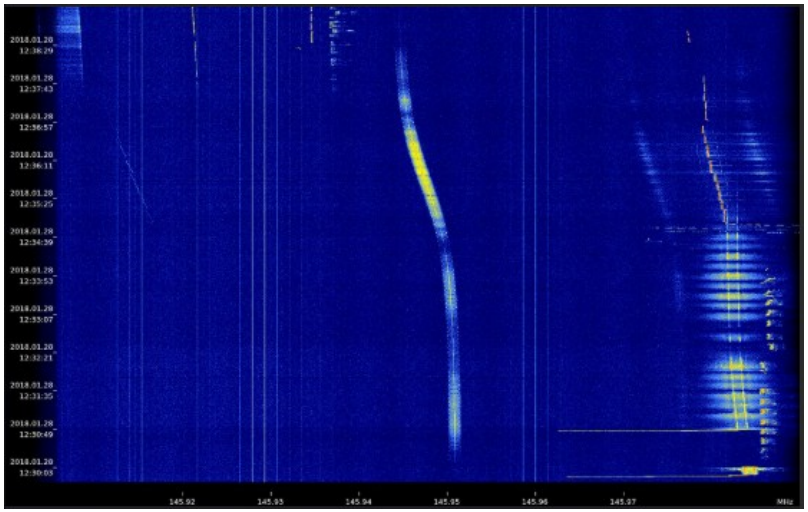
- Reference Oscillator keeps everything in rhythm.
- Tiny errors in frequency can cause problems in the resulting signal.





OXCO

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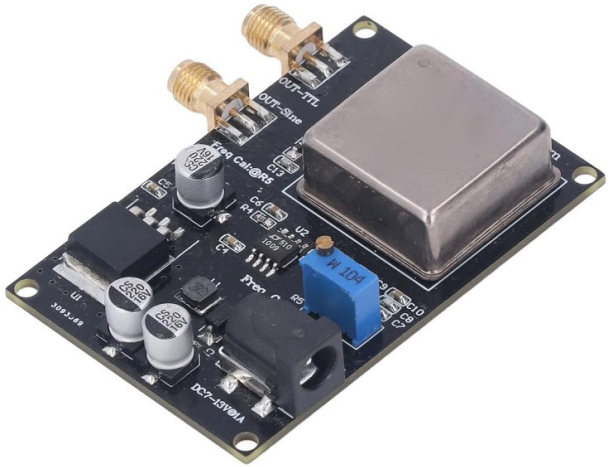
- Oven Controlled Crystal Oscillator
- These are typically rather low-cost oscillators that produce a refence signal at 10 MHz
- Typically found on Amazon or eBay for approx. $20



GPSDO

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- GPS Disciplined Oscillator (GPSDO) provides a highly accurate and stable frequency reference
- Accomplishes this by using signals from GPS satellites to "discipline" or control a LO, typically a quartz Crystal or rubidium oscillator.
- More Expensive option ($150 to $200) but provides the greatest stability. Found on Amazon or Leo Bodnar website.

TX/RX Relays

- TX/RX Relays are a protection device that is used to isolate RX side from the TX side.
- By running split RX/TX, it allows you to add in additional components such as a LNA or PA.
- TX/RX Relays can be found for less than $45 on eBay. Pyrojoseph has an amazing eBay store for secondhand microwave components.

Sequencers

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- Sequencers are a protection device that controls the order in which different parts of the Microwave system activate.
- Some transverters have a built in Sequencer.

Transverters options: DEMI

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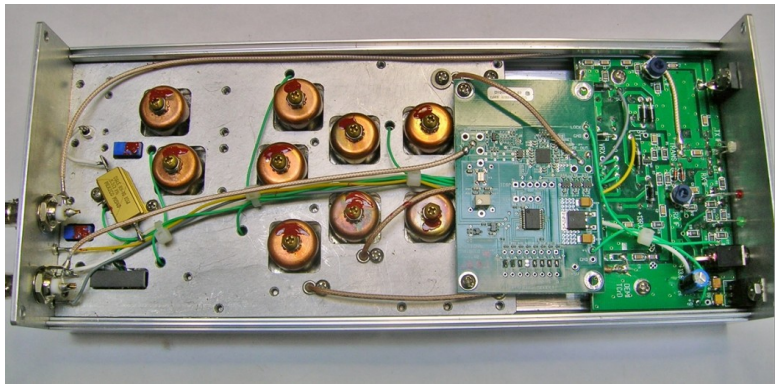
- Down East Microwave located in Florida provides affordable and reliable products for Microwave Amateurs
- Typical cost for a 3W 10GHz Demi X-Verter from DEMI is $775
- **DO NOT** buy a kit version unless you are very experienced with SMD components.



Transverters options: Khune

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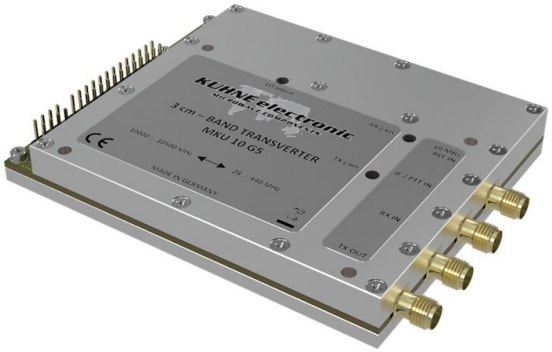
- Khune (DB6NT): Located in Germany provides high quality products for a premium price.
- Offers the ability of Flexible IF frequencies 28MHz to 440MHz
- DB6NT also requires that you use their LO Price: $687
- X-Verter Price: $780
- Total of $1476 not including international Shipping



Transverters options: W1GHZ

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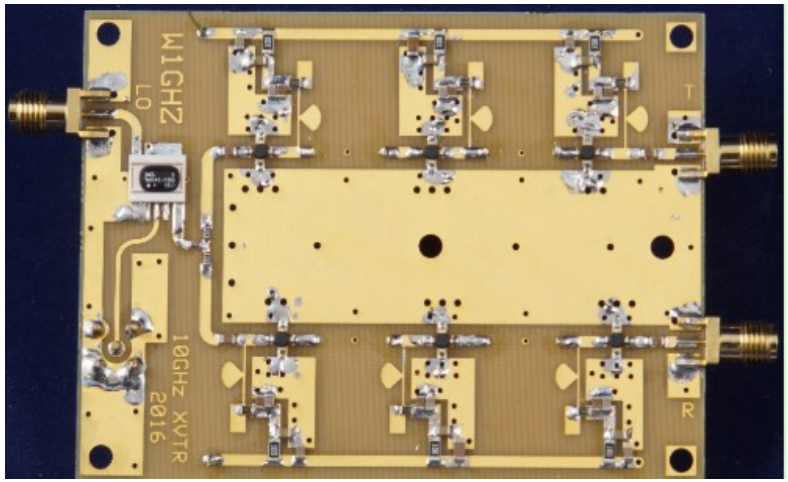
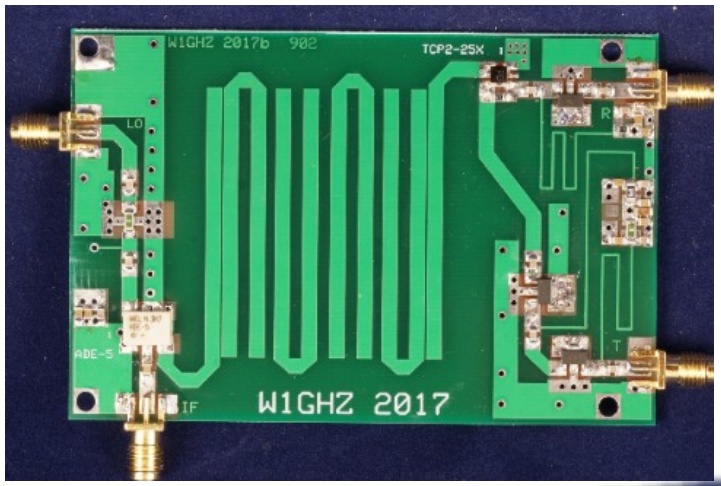
- W1GHZ offers many low cost DIY X-Verter PCB's. (222MHz-10GHz)
- Typically, the finished price tag on these boards range from $100-$150 but require considerable time and understanding of what you are building.





Transverters options: Other Sources

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- Some other sources of X-Verters include:
  - Q5 Signal (144MHz - 1296 MHZ)
  - SG Labs (902MHz - 2.4GHz)
  - Jim KM5PO Wavelab (24GHz X-Verter)
  - Transverter Store (Typically found secondhand)

Parabolic Dishes

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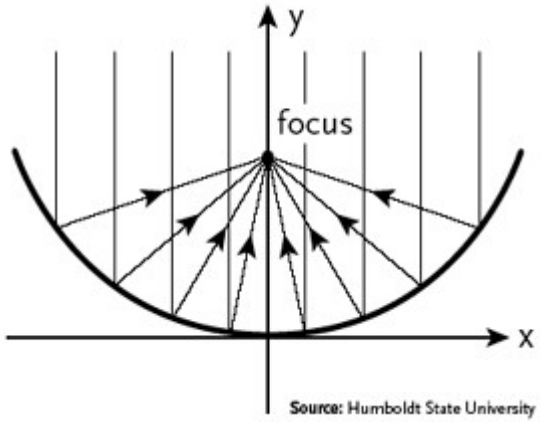
- Unlike Yagi's that are band specific Parabolic dishes can be used on multiple bands.
- Parabolic dishes, work by focusing RF using a reflective surface and a feed horn located at the focal point.
- The same dish can still function across a wide range if the feed horn is swapped or tuned for the desired frequency



Feed Horns

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- A feed horn is a small antenna used in parabolic dish systems to transmit or receive radio waves.
- It takes the signal from the system and radiates it toward the dish, which then reflects and focuses the waves into a narrow beam.

Offset Dish

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- Offset dishes are the typical dish antenna that is mounted on your roof.
- Offset dishes offer a clear signal path since the feed horn is positioned to the side.
- Very low cost and can be obtained easily.

Prime Focus Dish

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- The feed is directly in line with the dish's axis, unlike offset dishes.
- Prime focus dishes have a straightforward, symmetrical parabolic shape with the feed horn at the center.
- Typically, harder to find in smaller sizes.
- Better for lower frequencies.

Feed Horn Options pt.1

- Rochester VHF Group sells W1GHZ dual band feed for 10/24GHz current price is $250 for this feed.
- DX Engineering sells I0JXX mono band feeds for $189-$220 depending on the frequency

Feed Horn Options pt.2

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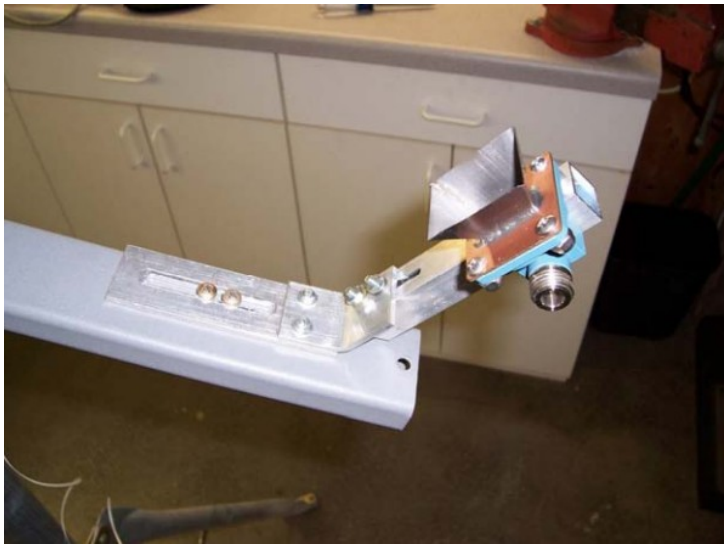
- NTMS hosts many presentations, in-person, or on our website that detail building feed horns of different styles.
- Simple materials which can be found at home depot can be used to construct feed horns.



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Roving
(POTA on Steroids)

NTMS Member Activities pt. 1

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- AL W5LUA: “BIG GUN” Station located in DFW area
- 40 years experience in RF and microwave circuit design and has written numerous technical articles in both professional and amateur radio journals.
- First to achieve Worked All States on 902MHz

NTMS Member Activities pt. 2

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- Jim KM5PO: Very active rover on 10GHz/24GHz/and 47GHz as well as 122GHz

NTMS Member Activities pt. 3

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- PAT W5VY: EM24or near Talihina, Rig is a DEMI 3W transverter, Icom IC705 IF rig and a 60cm prime focus dish

NTMS Member Activities pt. 4

- Scott AA5AM:IF rig Yaesu FT757GX (28 MHz) Intermediate IF DEMI (28 Mhz to 144 MHz)
  10 GHz transverter bare bones mixer with a Demi LO oscillator and a W1GHz multiplier chain to get to 10.224 GHz

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Conclusion

Conclusion

- Amateur Microwave radio is the ultimate D.I.Y. ham radio adventure.
- Microwave can be as expensive or cheap as you want.
- Propagation can provide challenging conditions and satisfying results.

NTMS Meetings

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- NTMS meets the second Saturday of the month at 1pm with Lunch starting at 11am.
- Lunch Location: Dickies BBQ, 801 South Denton tap road
- Location: Cozby Library, Coppell, TX or via Zoom

NTMS Activity Day

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NTMS Hosts a MW activity day which is the first Saturday of the month.

Ride alongs can be arranged.

Please contact me at:
W5ZCA2023@gmail.com

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Questions?