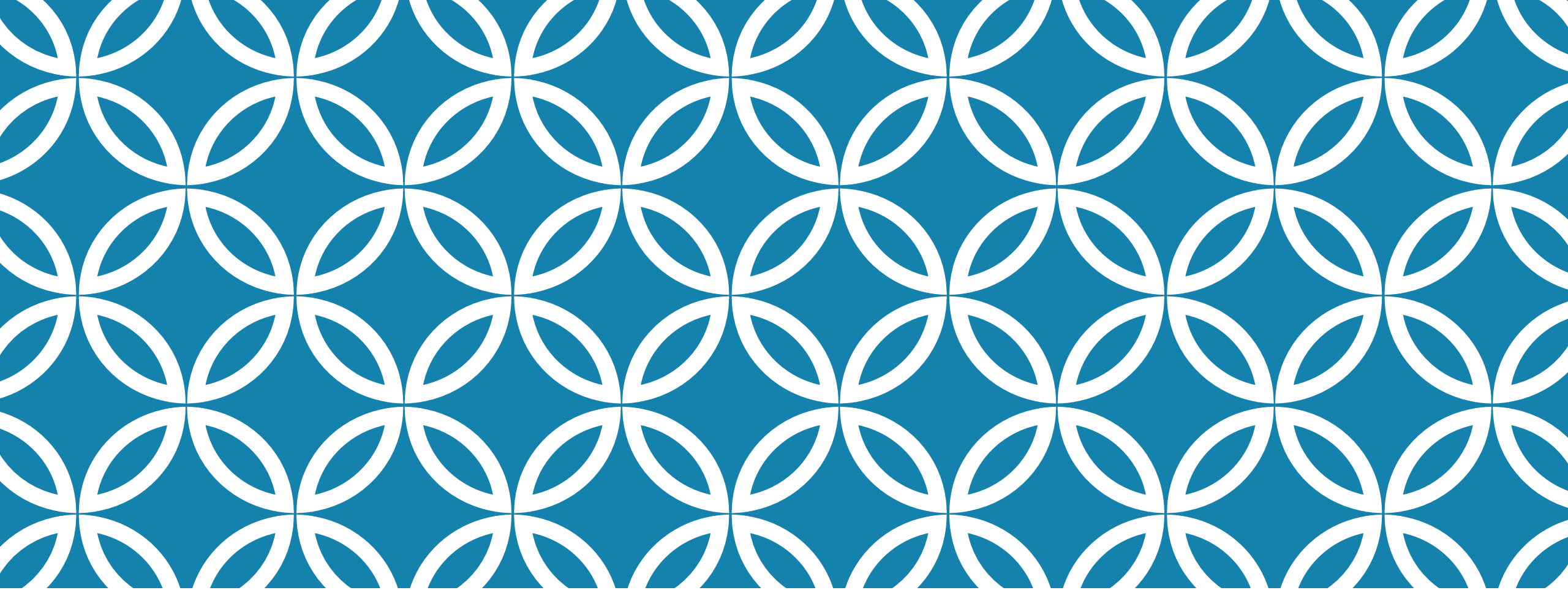


A VERY BASIC INTRODUCTION TO MICROWAVE COMMUNICATIONS

RVHFG Net mini-Topic for 2/20/17

WHAT ARE MICROWAVES?

In amateur radio, microwave frequencies are generally those above 902 MHz. However in a more general sense, anything from 300MHz – 300 GHz might be called microwaves

Common Frequencies

- 902 MHz
- 1.2 GHz (Most common microwave band)
- 2.3 GHz
- 3.4 GHz
- 5.8 GHz
- 10 GHz
- 24 GHz

K2DH and KF2MR operate during the 10GHz contest in John Boyd Thatcher park in FN22

WHY DO WE USE MICROWAVE BANDS

There are three common reasons why amateur radio operators use microwave bands

1. Availability of high bandwidths for data transmission (rare)

2. Providing a relatively private communications path between two stations (ever rarer)

3. Challenge and Learning (The primary topic of this presentation and most popular)

“Amateur radio interests in microwaves have mostly been for the challenge of working with such esoteric frequencies that require specialized techniques in design, fabrication and testing. Furthermore, in order to reach beyond LOS (line-of-sight) amateurs have spent countless hours carefully measuring propagation phenomena.” – WA1MBA

WHAT DOES IT TAKE TO GET STARTED

There is some limited commercial equipment available for 1.2GHz all mode communications (FM, SSB, CW)

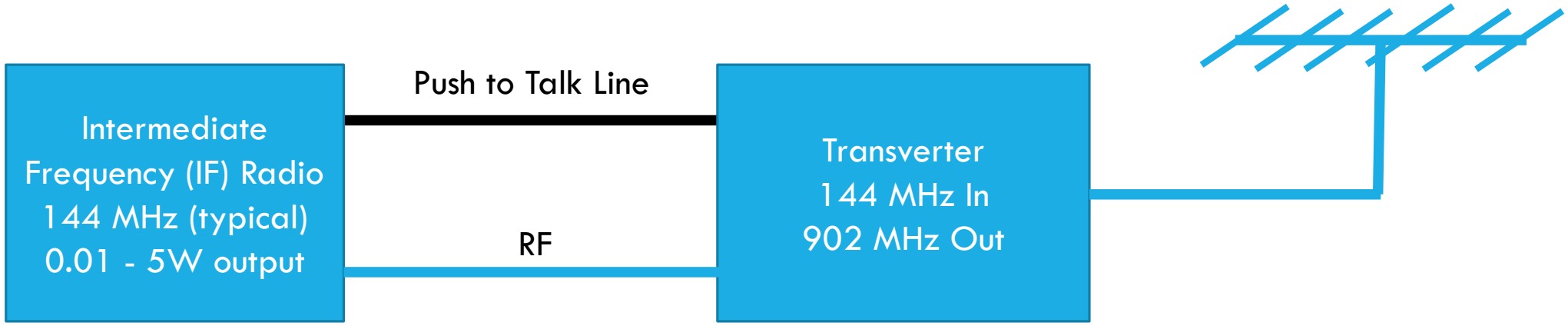
- Kenwood TS-2000X
- IC-9100 with optional module
- Older FT-736R radios have a 1.2GHz module option

To get the most out of it, you should have an all mode radio and transverter.

- SG-Labs (Ukraine)
- Down East Microwave (Florida)
- Kuhne Electronics (Germany)

Having a mentor to show you the "ropes" is very helpful. Often mentors will have spare equipment and parts to help you get started

BASIC MICROWAVE TRANSVERTER SYSTEM



The Push-to-Talk (PTT) line is a cable purchased or made. It connects to the accessory port of the radio and the PTT port of the transverter. This is needed to switch the transverter between transmit and receive. The RF line is coax. This could also be called the IF line.

A transverter works by mixing the frequency from the IF radio with a local oscillator built into the transverter.

It is critically important to ensure that the IF radio does not exceed the input power requirements of the transverter.

FT-817 & ELECRAFT 222 MHZ TRANSVERTER KIT

Before getting into microwave bands most hams get their first taste of transverter systems using the 222 MHz band. Most of the same concepts used for 222 transverters are applicable to microwave bands.

BASIC SYSTEMS – SG-LABS (UKRAINE)

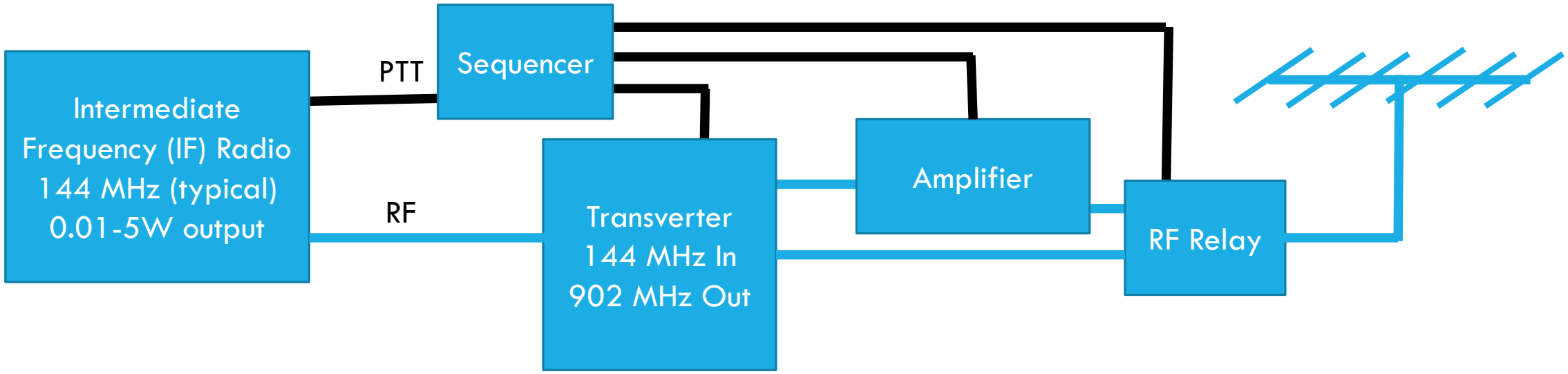
- Fairly new on the market and simple to use.
- Available for 902, 1296, and 2304
- Approximately $200-$225 each
- About 2W output
- Internal SWR detector
- Internal TX/RX switching
- TX and RX can be split later with some minor soldering if you would like to add a power amplifier or pre-amp.

OTHER BASIC SYSTEMS – JUST ADD RF RELAY

Down East Microwave (Florida)

Kuhne Electronics (Germany)

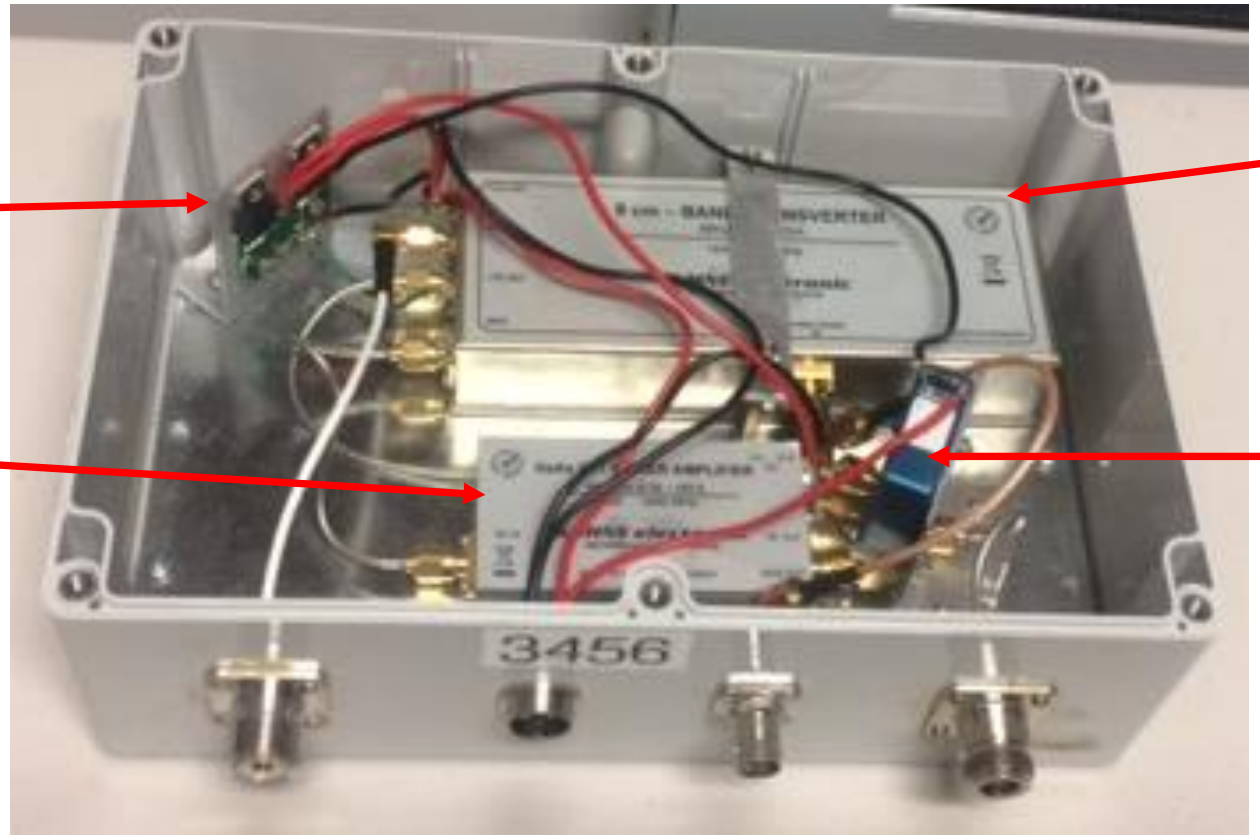
INTERMEDIATE MICROWAVE TRANSVERTER SYSTEM



Sequencers ensure that the RF relay is NOT switching with RF power on the contacts. There are many sequencer designs. Some use the mechanical delay of a regular relay while others using electronic switching with exact delay characteristics.

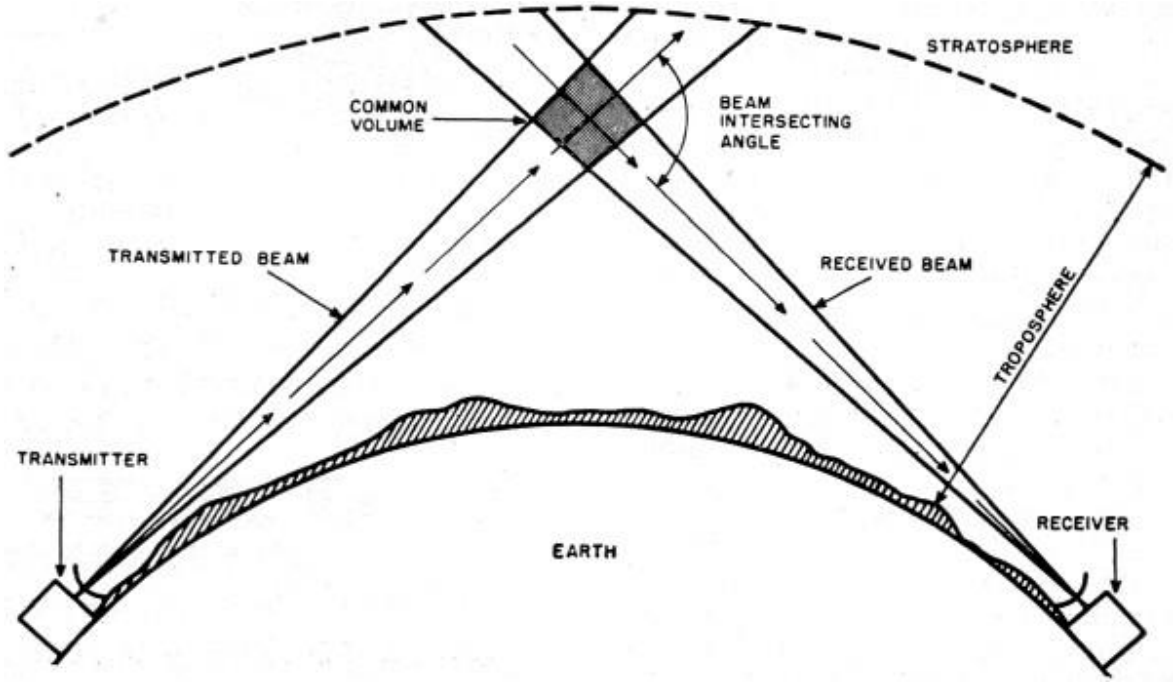
This is just one example of how an intermediate level system is configured. Hams with more technical ability can design their own transverter interface boards and circuitry to optimize performance.

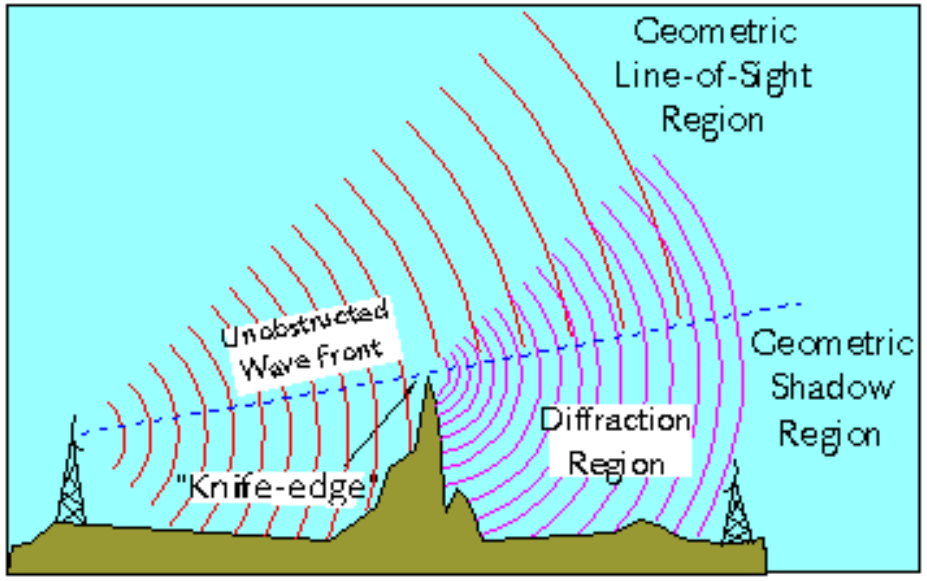
INTERMEDIATE SYSTEM – PORTABLE 3.4 GHZ



Cost of an intermediate level microwave system is $500- $1000
All parts are purchased separately and assembled by the user.
Some mechanical assembly skills are required as well as the ability to solder.
Can be built by an inexperienced ham in one weekend

LINE OF SIGHT IS NOT REQUIRED (OR DESIRED !)



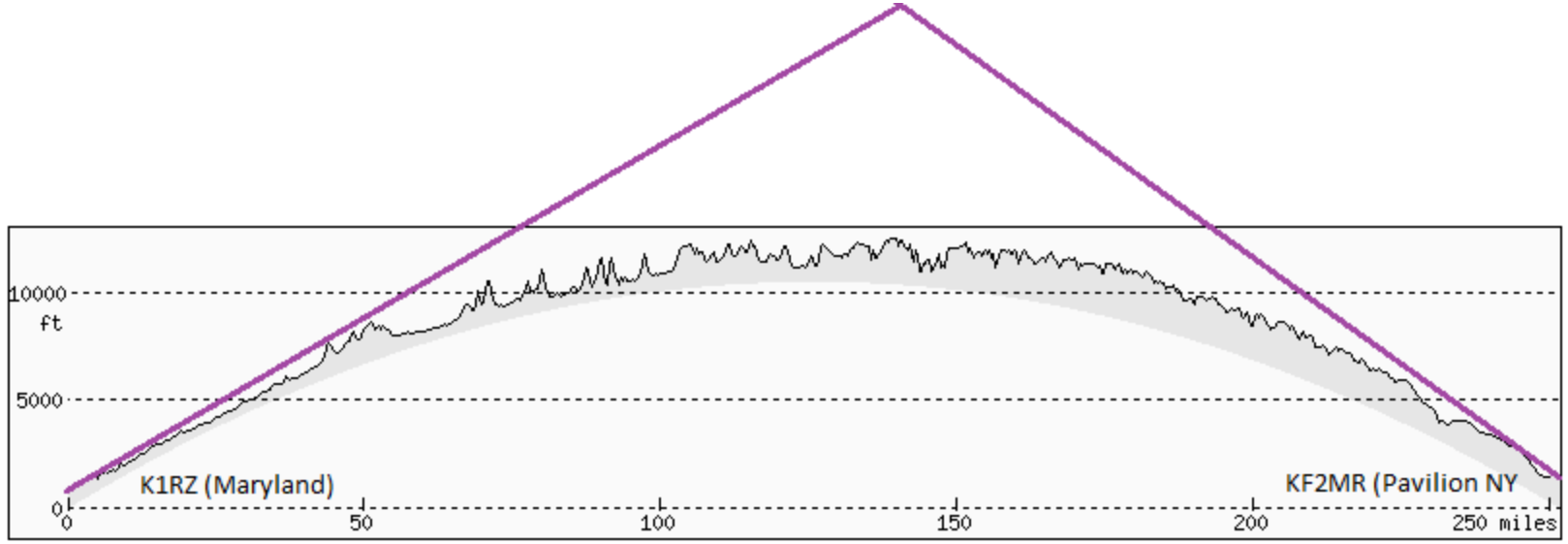


knife-edge effect

Tropospheric Scattering, Knife Edge Diffraction, Ducting, and other propagation enhancements are what makes “weak signal” communications interesting and fun above 432 MHz.

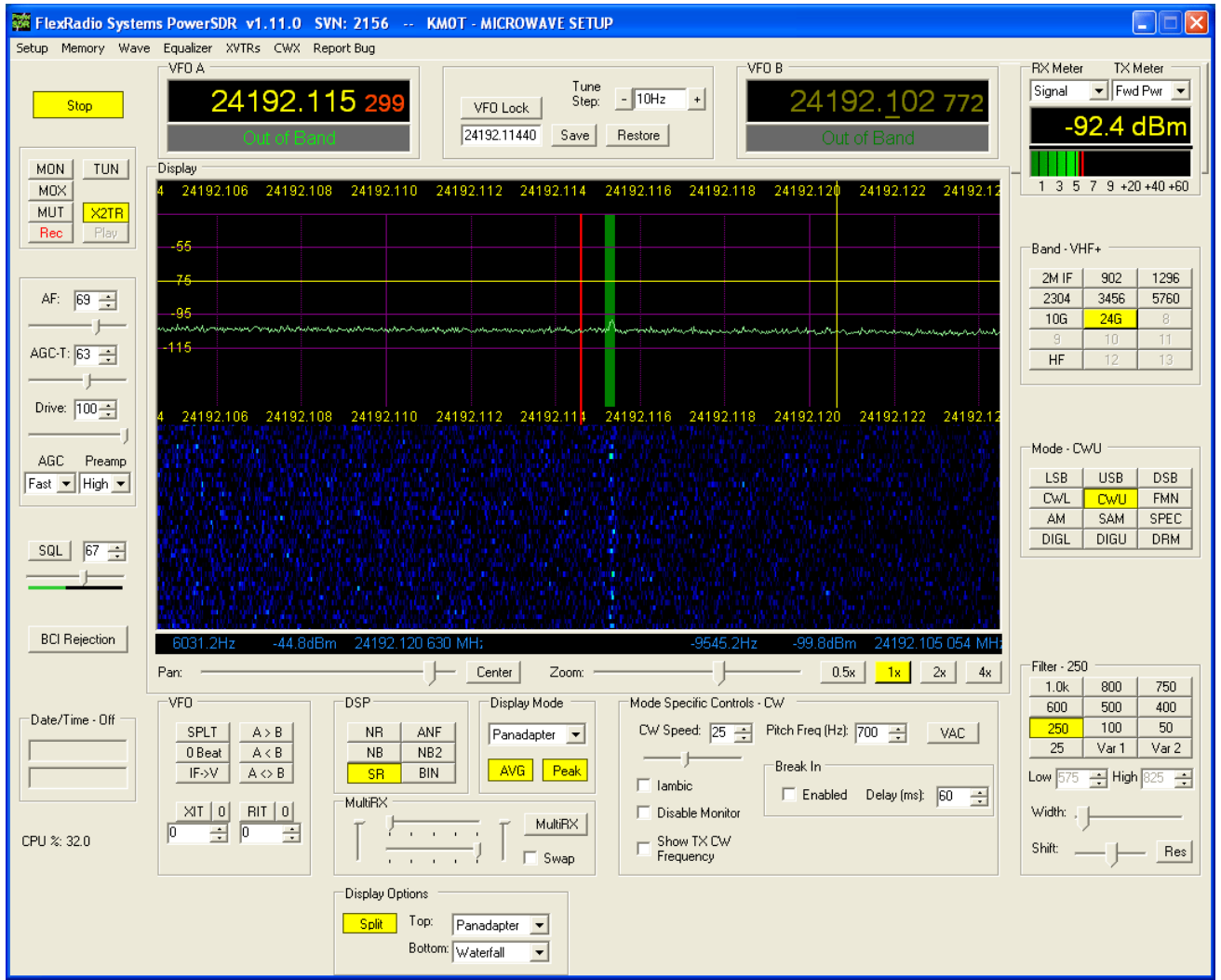
CW is an absolute must for communicating hundreds of miles on microwave bands

TROPOSPHERIC SCATTERING



This path is repeatable year round on 144 MHz – 1296 MHz
Under good tropospheric conditions, this path is achievable up to 10 GHz.

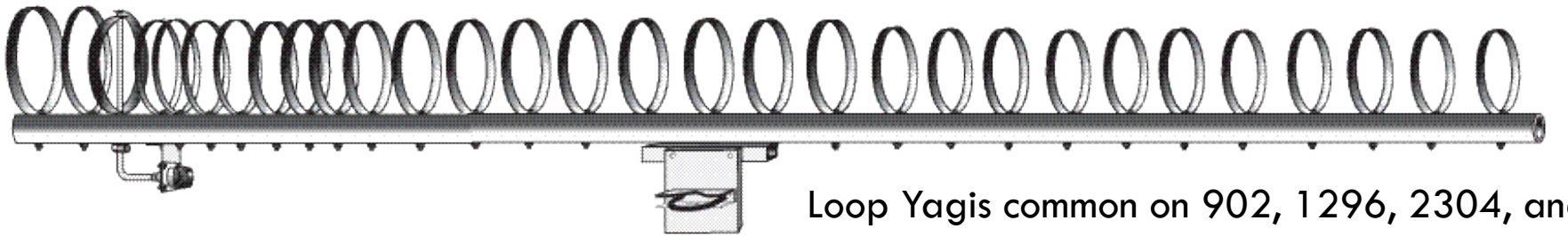
ADVANCED METHODS IN COMMUNICATIONS



Advanced enthusiasts use computers to “see” the signals by tapping the intermediate frequencies within the receiver. This is very helpful since frequencies of two different oscillators could be several hundred kHz different on both ends and will likely drift as the temperature changes.

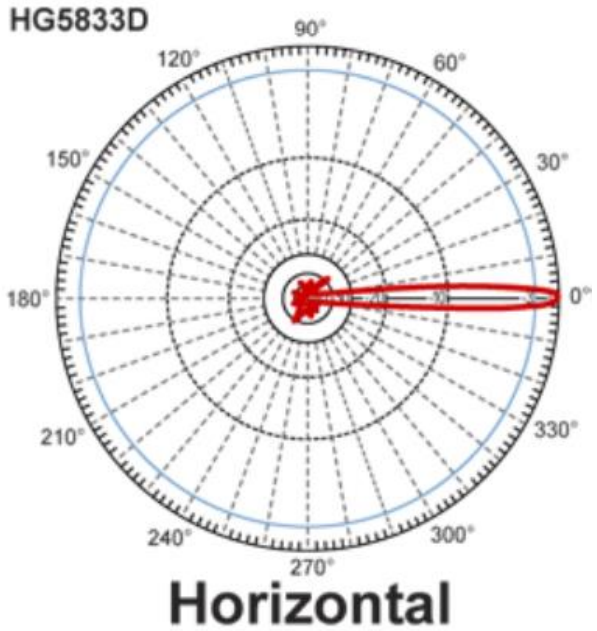
MICROWAVE ANTENNAS

High gain from a small package



Loop Yagis common on 902, 1296, 2304, and 3456 MHz- Directive Systems Engineering

Parabolic Dish – Good gain to size ratio above 2 GHz. Commonly used for 5.8, 10, and 24 GHz



Extreme directionality possible. Sometimes only a 3-6 degree beam width using a large dish.

Makes azimuth **and** elevation aiming important

WHY BOTHER WITH MICROWAVES?

Technical Challenge and Learning

- Most equipment requires assembly or construction
- A large portion of microwave operators get as much enjoyment out of building their equipment as they do using it. You don't need to be an engineer, just capable of using a soldering iron and a drill.

Thrill of doing it

- Making a contact over 250 miles on 1.2GHz using troposcatter can be exciting
- Just as exciting is a 50 mile contact on 10 GHz where the stations are relying on knife-edge diffraction to scatter the signal over a mountain.
- HF provides 10 bands while the world above 50 MHz provides another10+ bands to use. Why not give them all a try.

Pushing the Limits

- Puts CW to use. Sometimes the only way to make a contact. Just 5-13 wpm will do.
- Some contests offer a multiplier of x4 or x8 for microwave contacts

Community

- Microwave operators tend to be a niche group in the ham community. As a result, there are email reflectors, conferences, and websites dedicated just to microwave communications. The experienced members of this community tend to have a wealth of knowledge and are willing to help a newbie like me.

73 DE KF2MR

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