10GHz Wideband Amateur Radio Using Tellurometers

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For West Carleton Amateur Radio Club

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Tellurometer History

- Invented 1957 by Dr. T.L. Wadley, of the S.African National Institute for Telecommunications Research
- First Electronic Data Measuring Instrument (i.e. survey device) using microwaves
- Much less expensive than electro-optical instruments but slightly less accurate.
- Early instruction, "if anything goes wrong, kick the power pack." The vibrator in the power supply sometimes stuck, so kicking the power pack worked.

Tellurometer Specs - Electrical

- Model: MRA3 Mk II
- Frequency: 10.025GHz – 10.450GHz
- Power: 20-50mw (ERP is abt 12.8w)
- Beam Width: 9 deg @ 3dB point
- Mod Bandwidth: 100KHz
- IF: 33MHz
- Full Duplex only
- Completely solid state except Klystron
- 12vdc
- Amateur Band is 10.0GHz – 10.5GHz

Frequency & Wavelength - IEEE Radar Band designation

- 1-2 GHz 30-15 cm .....L Band
- 2-4 GHz 15-7.5 cm .....S Band
- 4-8 GHz 7.5-3.75 cm .....C Band
- 8-12 GHz 3.75-2.50 cm.....X Band
- 12-18 GHz 2.5-1.67 cm .....Ku Band
- 18-27 GHz 1.67-1.11 cm .....K Band
- 27-40 GHz 1.11 cm-7.5 mm ..Ka Band
- 40-300 GHz 7.5-1.0 mm mm

Tellurometer Specs - Mechanical

- Waterproof case
- Radome protects dish antenna
- Highly modular
- Weight is 30lbs w/o battery

Tellurometer Specs - Instrument

- Measures minimum of 100m line and maximum of over 50km
- Error: 1.5cm +/- 3ppm of the length, so for a 100m line, error is approx 1.5cm

How it Works as an Instrument

- Main frequency is determined from the tuning of the Klystron Cavity
- A continuous wave in the range of 10,000-10,500MHz is radiated from MASTER unit
- The wave is fm modulated by pattern freq of 7.5MHz or 10MHz
- Wave received at REMOTE is re-radiated to MASTER
- Phase difference of received modulation is a measure of the transit TIME of wave over the path
- Changing frequencies a measured amount, increases the accuracy
- With a pattern freq of 7.492377MHz, one phase rotation represents 40m of the 2 way path or 20m between units
- Distance = velocity factor X one way transit time
- Transit time is computed by the instrument
- Accurate velocity factor comes from 299792.5/refractive index = km/s
- Refractive Index is about 1.000325 but depends on temperature and humidity

OK so what?

- For Amateur Radio, we do not use the measurement portion of the instrument
- We only use the main unit without the fm frequency superimposed
- Old X-Band radar detectors make a good indicator of 10GHz RF

Block Diagram

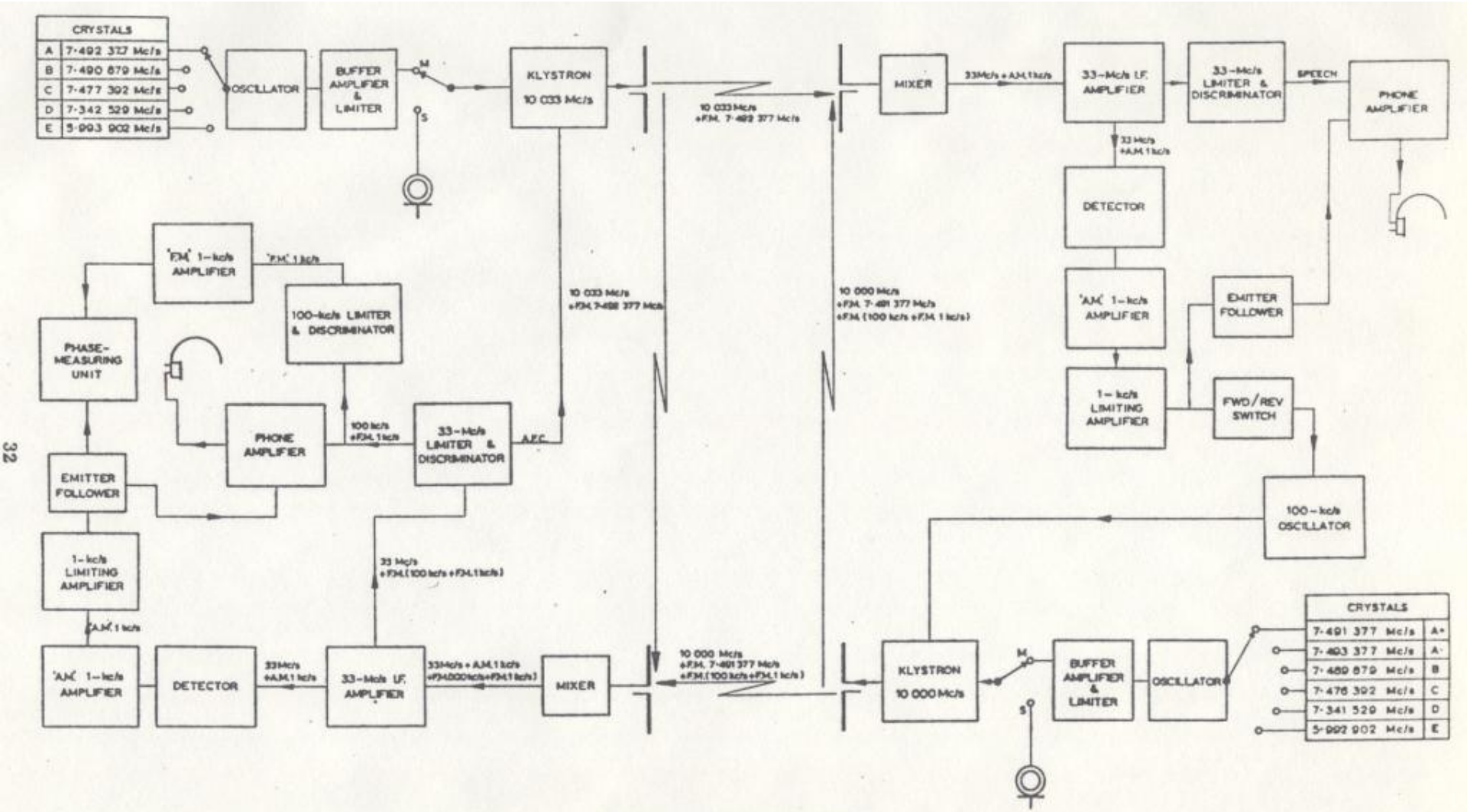

Figure 6. Block Diagram

Caution

- Microwaves can be hazardous to your health. Avoid brain and eye proximity to concentrated RF. The Tellurometer is very low power.
- Be careful with spectators
- The Tellurometer employs a dish antenna and energy levels at 10GHz, close to the device, may be harmful to humans.
- Old X-Band radar detectors make a good indicator of 10GHz RF

Results

- Contacts of 100km or more are realistic
- You can only talk to another tellurometer
- You'll need a clear path and a dry day
- Height is an asset
- Audio quality is not great
- No CW capability
- But it works

Where do I get one?

- Flea Markets
- Garage Sales
- Surplus stores
- Contact VE3FN, VE3BBM, VE2JWH, VE3CVG to buy or borrow
- Expect to spend $25 - $100 ea for a working unit
- Make sure that you get a model that is on the same frequency as your other one.
- Buy in working pairs if possible.
- Get handset, cables and connectors or be ready to do some mods.

Modifications

- If yours came with a handset, the rest is easy
- If no handset, use an old telephone handset with carbon mic element
- Requires 12vdc - use existing battery box with gelcell or build something outboard
- Oven and lights are fairly tough on batteries but are not needed and can be disabled
- Car booster batteries work well.
- Manual available frm VE3CVG for copying

Conclusion

- Tellurometers are an inexpensive way to get on 10GHz
- Tellurometers require minimal effort to get operational
- There are other forms of wideband 10GHz
- All microwave work requires an enthusiastic buddy and a tolerant wife
- If you have the $$$ to spend, narrowband 10GHz will give you more contacts