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10 GHz Transverter Update

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August 6, 2022

Introduction

- Re-do 10 G transverter from ~2 years ago
  - Old set up was heavy, difficult to mount
  - Improved IF Rig available (Icom-9700)
- Haven’t actually built anything at this point
  - Thinking options over many times
  - Helped to write it up, welcome group feedback
- Goals
- Options
- Plan

Goals

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- Split into Base Unit and Remote Unit
  - Decrease weight at antenna
  - Enable remote unit to be higher up
  - Allow operation from inside rover vehicle or house
- Continue with connectorized parts – flexible but..
  - Drawbacks on size, weight and power compared to microstripline
  - Drawacks on reliability – last time had 64 SMA connectors
- Bonus goals
  - Panadapter function (IF rig does this now)
  - Signal monitoring
  - Addition of multiple bands (6cm, 9cm, 13cm)

Options – IF Rig vs Pluto+

- Rig choice
  - Traditional IF-rig (Icom-9700) transverter
  - Pluto+ SDR / Raspberry PI system
- Tried several SDR programs with Pluto+/Raspberry PI
  - Heavyweight programs, lots of graphics, had some difficulty
    - Might be able to tune sample rates to reduce CPU load
  - Langstone approach with simple display is a good direction
    - https://github.com/g4eml/Langstone
    - One solution might be just do a Langstone with a transverter for 10 G
  - Tried a few GNU Radio flowgraphs – started to see how high the learning curve is
  - Pluto+ communications seem more stable on powered external USB strip
  - Believe I observed 10 GHz response at 3.456G as others have
    - https://twitter.com/ea4eoz/status/1101552567774007297
- Key to using Pi may be limiting bandwidth or eye candy to fit processing power
  - Which is ok for microwave hams as we are usually interested in 3 Khz out of 1 GHz
- Pluto+ has potential but it seems like a longer term project for me
- Not trivial to replace capability in a full featured modern transceiver
- Use IF Rig this time but keep learning Pluto+/SDR for future projects

Options – Shared or Independent RX/TX Paths

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- Some designs share a switched filter/mixer between TX and RX
- Shared path - one cable base to remote unit
- Independent path – two cables
- Key benefit of independent paths is ability to monitor output signal from leakage in T/R relay at antenna
  - Benchtop end-to-end check on signal quality
  - Avoid wasting people's contest time if rig malfunctions
- If using shared path people tend to make two transverters for testing
  - Shared path doesn't really save parts
- Independent path more compatible with Pluto SDRs configuration
- Allows using simple SDR dongle to monitor TX at IF
- Independent Paths for RX and TX

Option – Base/Remote Unit

- Learned lesson - Keith WB5ZDP, Paul W1GHZ
  - Losses are ok if you compensate with gain
  - Gain can be cheaper/easier than low-loss perfect components
- Put compensating gain ahead of lossy cables
  - And use reasonable quality cable LMR-240
  - LMR-240 attenuation at 10 G – 15 db for 50 feet
- Goal is to get 25 feet+
- Lessons learned from last time
  - Right-size power supplies and heat sinks
  - Put them where weight isn't critical (in the base unit)
- Base/Remote Unit split is ok with gain ahead of cable

Option – Multiband Expansion

- Some components multi or wide band
  - Relays DC-18G, six/two way SMA relays
  - Mixers Several GHz
  - PLL 0-13G
- Amplifiers – tend to be mono-band
- Splitter – mono-band unless lossy resistive
- Pipe cap filters – effective and DIY – relatively easy to provide per band
- Prefer to keep other bands working if one is taken down for maintenance
  - Loosely coupled transverters without shared components easier to maintain
  - Elecraft has separate transverters that only share T/R and signals
  - Connectorized components easier to work on than integrated PCB
- Assume won't need multiple bands monitored at the same time due to microwave contacts frequently being coordinated/spotted rather than random
- One band at a time allows sharing base/remote unit cables among bands
- 10G is the priority but configure things with multiple band expansion in mind

Option – Power Monitoring

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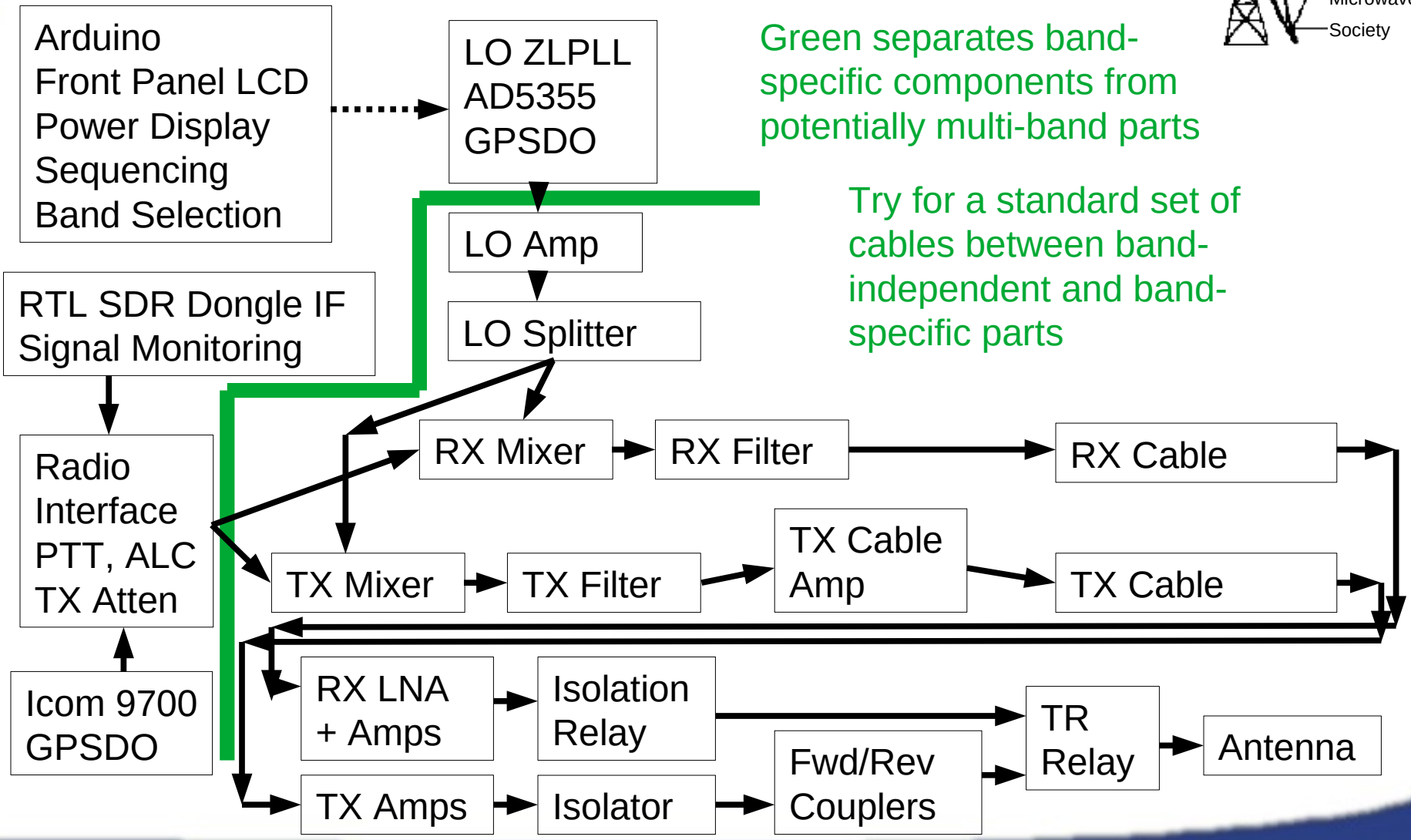
- Want to protect amplifier
- Nice to have measurement of forward power
- Seems easier to find surplus single directional couplers than dual
- Options for SWR/Power monitoring
  - (1) Measure SWR with two single couplers
  - (2) Measure reflected power with one single coupler and estimate SWR assuming max forward power
  - (3) Measure forward power and assume SWR is ok if forward power ok
- Looked at some examples
- Kuhne 3 cm 60W amplifier – take as a high quality example
  - https://shop.kuhne-electronic.com/kuhne/en/shop/power-amplifiers/MKU+PA+3CM60W+A+WG++Power+Amplifier/?card=1404#_tab_content1
  - Specs seem to say it only measures forward power and has a max SWR of 1.8:1.
  - So it has a tight SWR requirement but doesn't have a SWR fault mode
- Using an isolator is an alternative for protection but would still like to know if SWR changes suddenly
  - Isolator is a physical device and provides instantaneous protection
  - Rover/DIY setup more prone to SWR changes due to extra connections and bumps during travel
- Signal monitoring could detect change from normal forward power but not in an easy way to use for fault trip
- Given the DIY factor of the whole system and adverse conditions of rover operation…
- Thinking robust solution of isolator plus measuring both forward and reflected power

Plan Block Diagram



Green separates band-specific components from potentially multi-band parts

Try for a standard set of cables between band-independent and band-specific parts