Homebrewing SSB Transceivers

Pete Juliano, N6QW

September 2020

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www.n6qw.com/GQRP.html

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Roll Your Own Rig!

No finer Joy than to be able to say to the Op at the other side of the QSO.

The Rig on this End is Homebrew!

A Bit of History!

- Early Rigs were separate Rx & Tx
- Enter the Transceiver
- Modular Approach
- Upgrades simplified

Technology has Served us Well!

- Arduino, RPi4, Si5351, Teensy 3.5 & 4.0
  = The Electronic LEGO Blocks.
- Technology Shift from Analog to Digital
- HDR > SDR

New Technology and the Realm of Possibilities

- The new hardware IS user friendly.
- The Modular Approach = Rapid Prototyping
- Test as You Go (ala Heathkit)
- BITE (Built in Test Equip.)
- New Test Instruments (Nano VNA, DSO's)

So, OK where is this Headed?

- Today is about Homebrewing a SSB Transceiver
- Details at www.n6qw.com/GQRP.html
- Focus is HDR; but Future is SDR

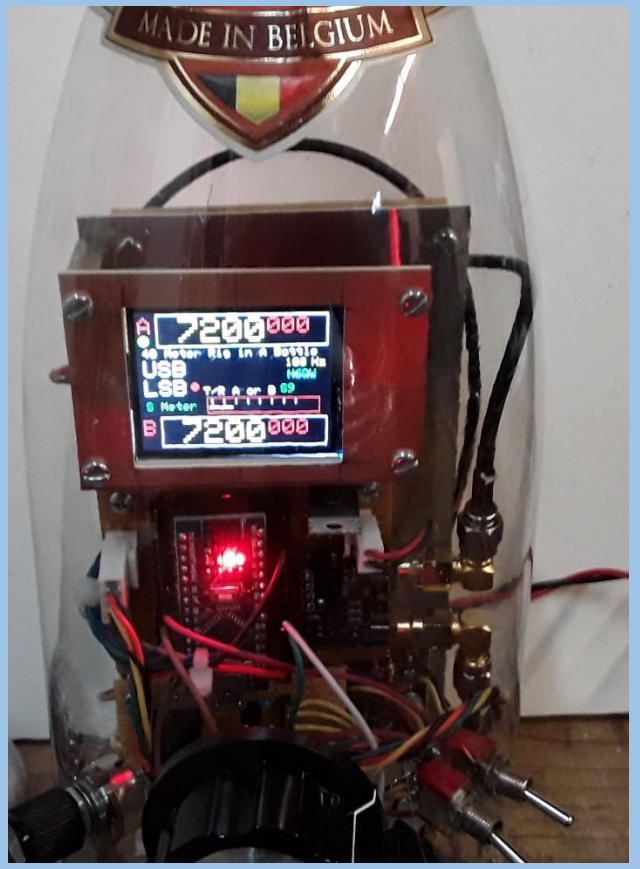
The Simple SSB ~ 9 Common Devices

www.n6qw.com/GQRP.html

Or Two NE602's Doing the Heavy Lifting

www.n6qw.com

Or Something in the Small Size



Or Something Bordering on The Bizarre!

Or Something Definitely Insane Like the KWM-4 !

Let us start by using the “Noodling Process”

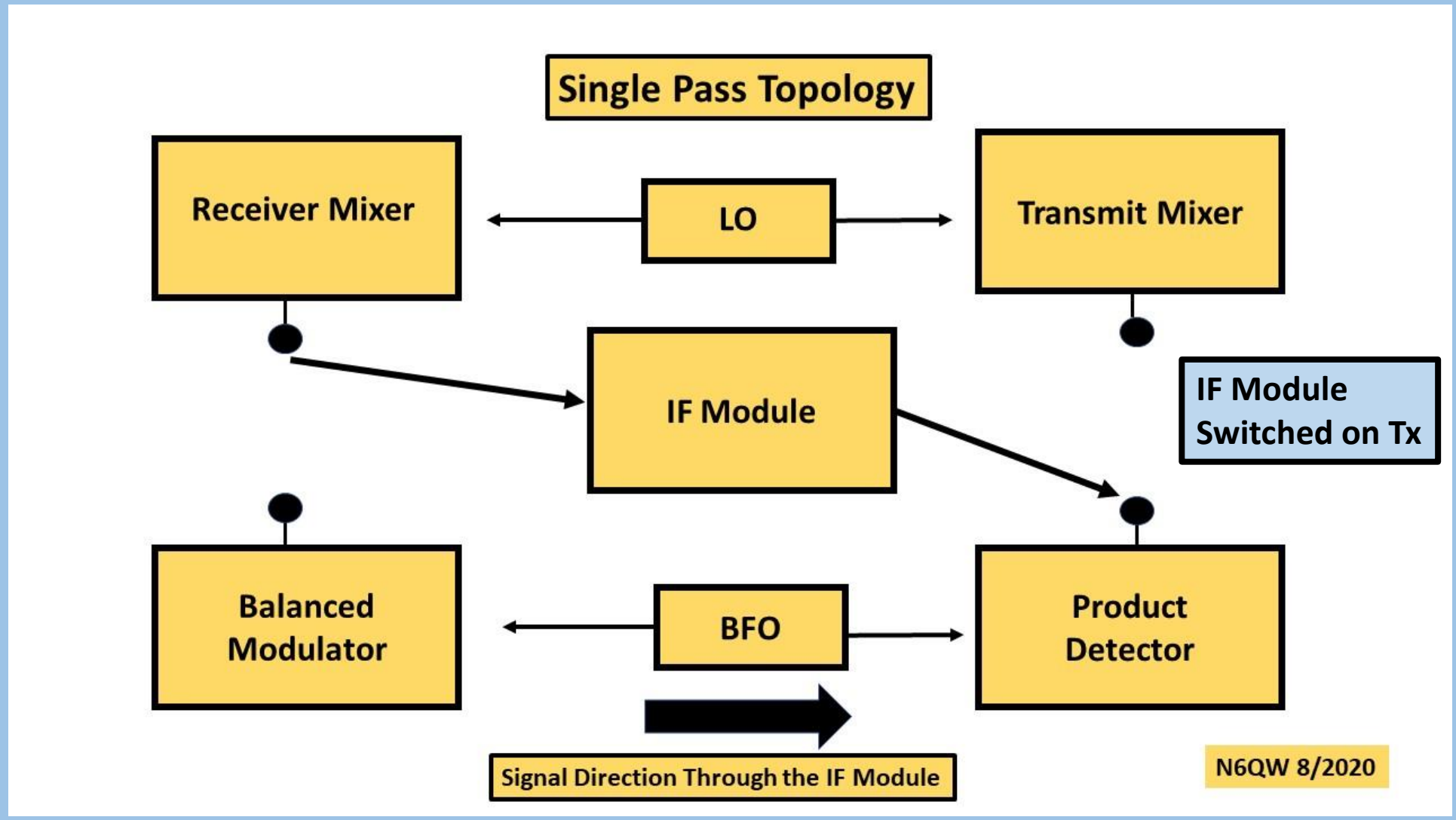
- What are the SSB Transceiver Topologies?
- What are the Modules in a Rx and Tx?
- What are the Common Elements?
- Common Elements used as a Transceiver?

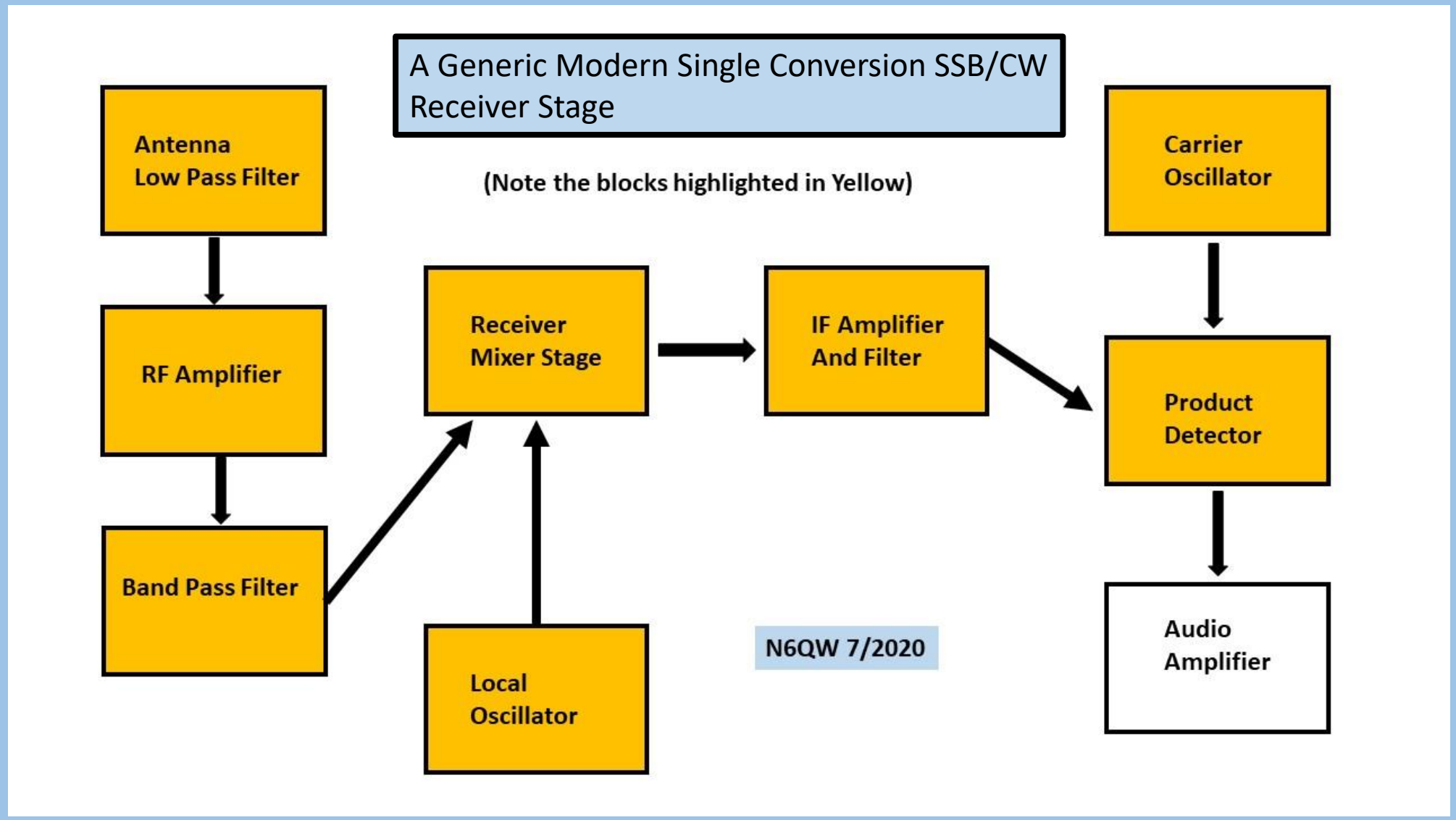
SSB Transceiver Topologies

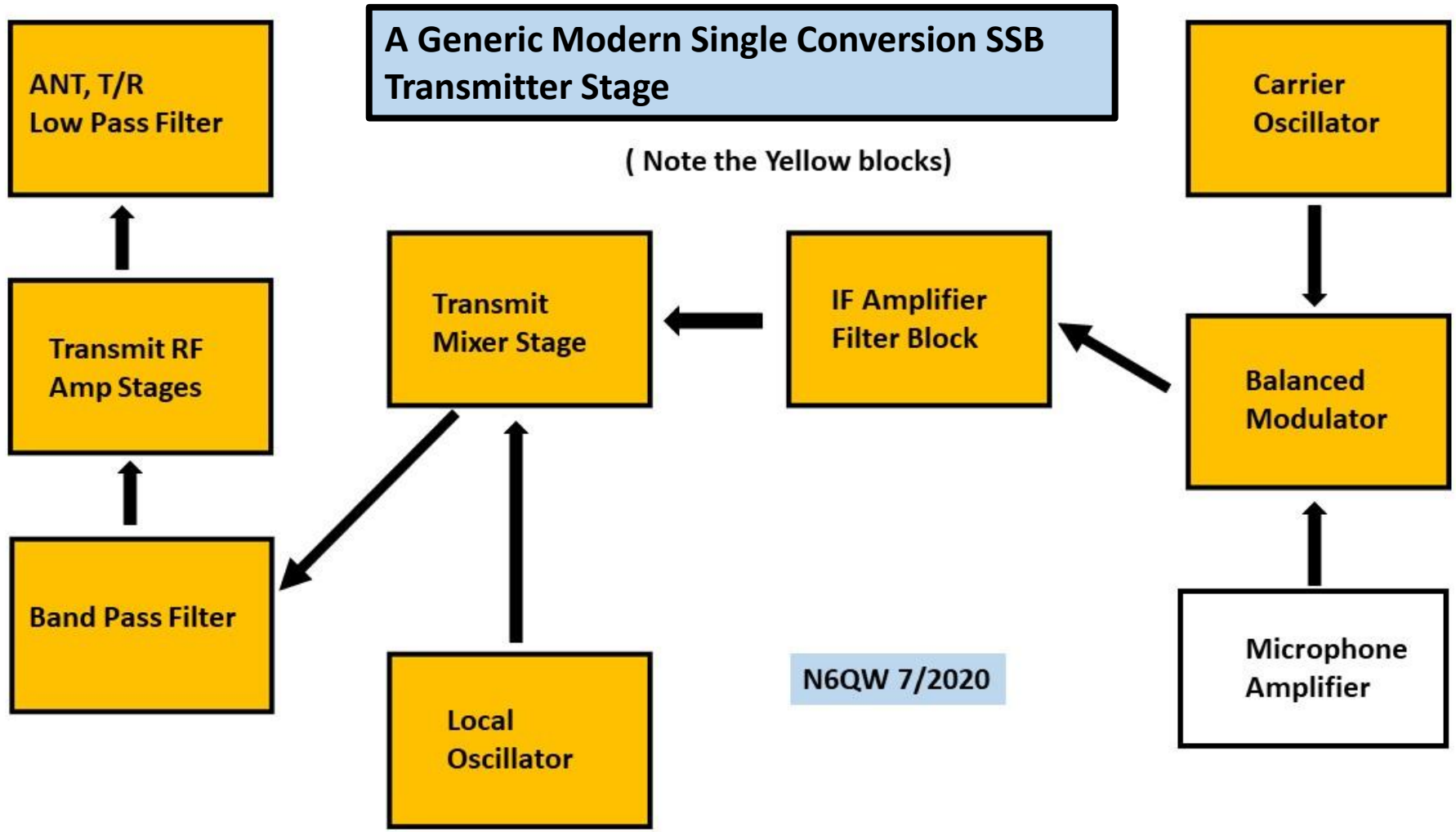
- Single Pass
- Bi-Lateral
- Switched Filter

Selection involves signal routing, minimum part count and of course cost.

I have built all three approaches.

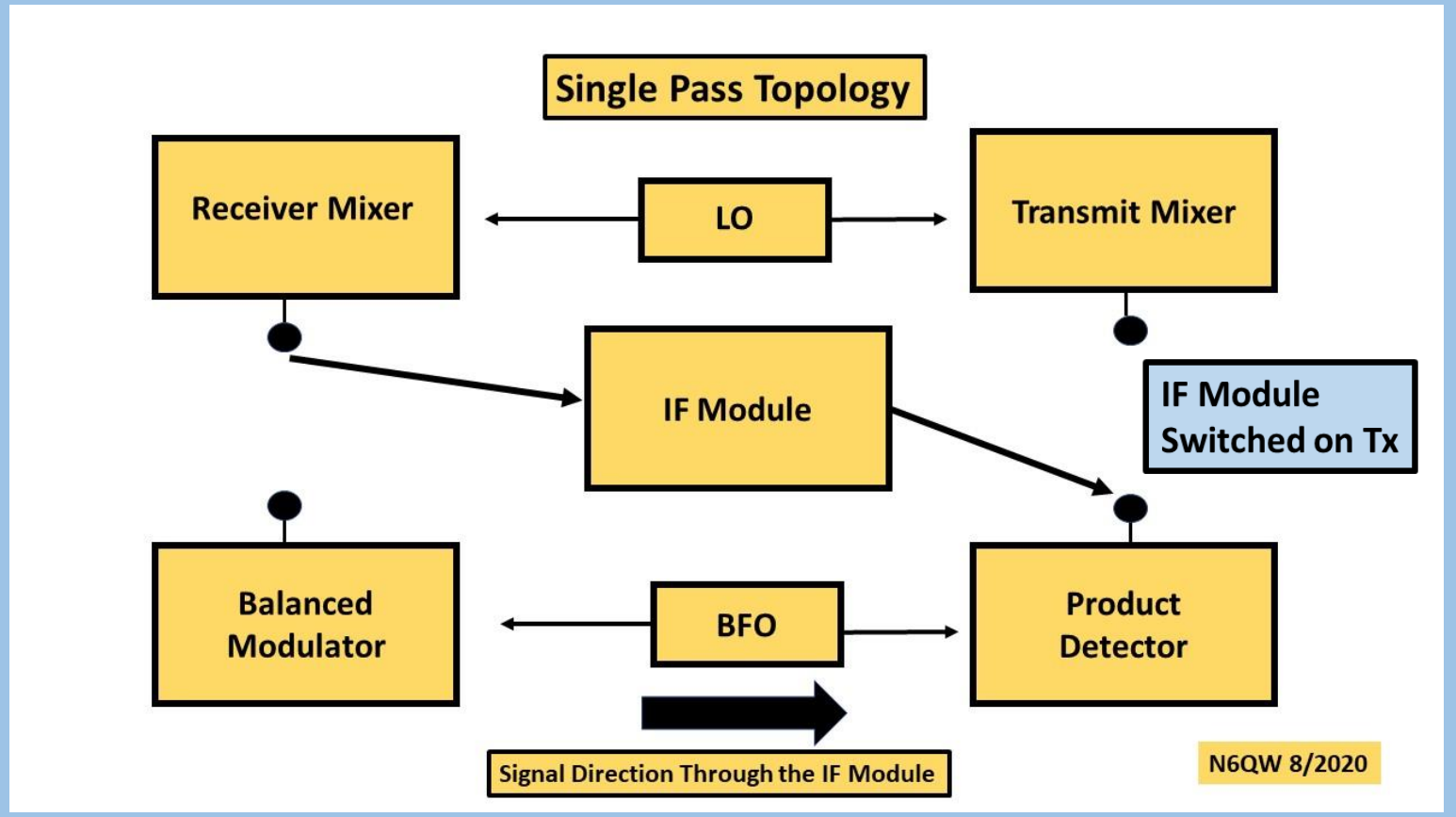




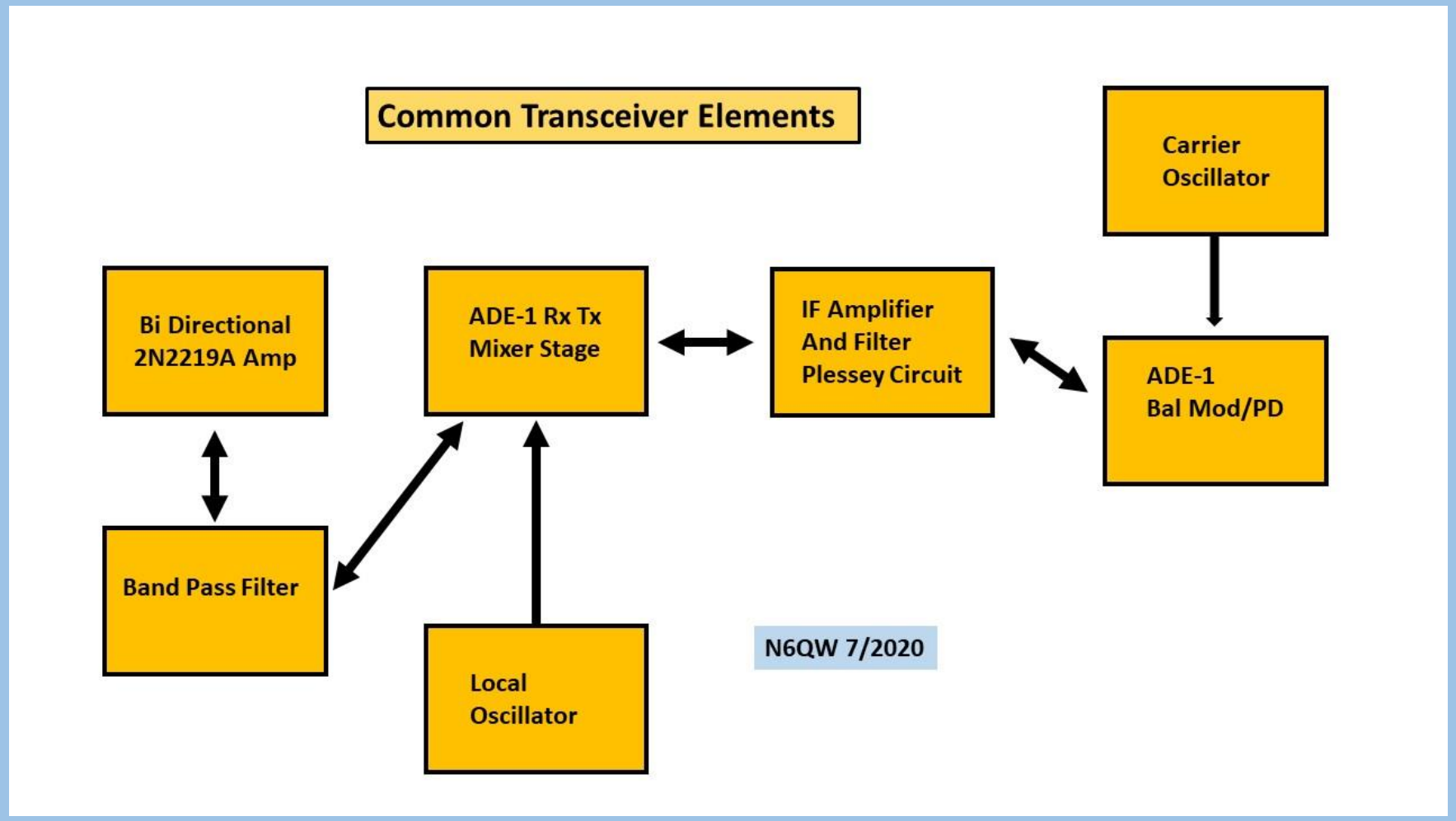


The Common Elements

- DBM's can be used as Transmit and Receive Mixers, Balanced Modulators and Product Detector --- Two Devices, Four Jobs. (ADE-1, SBL-1, TUF-1)
- IF Module can be 4 Transistors and Bilateral
- The LO and BFO are NOT Switched!
- Double Duty Modules (Amps & Filter Networks)



Remember our Single Pass Topology ~ Possibilities for Improvement!
Suppose we Combine Modules using Electronic Tricks such as DBM's?

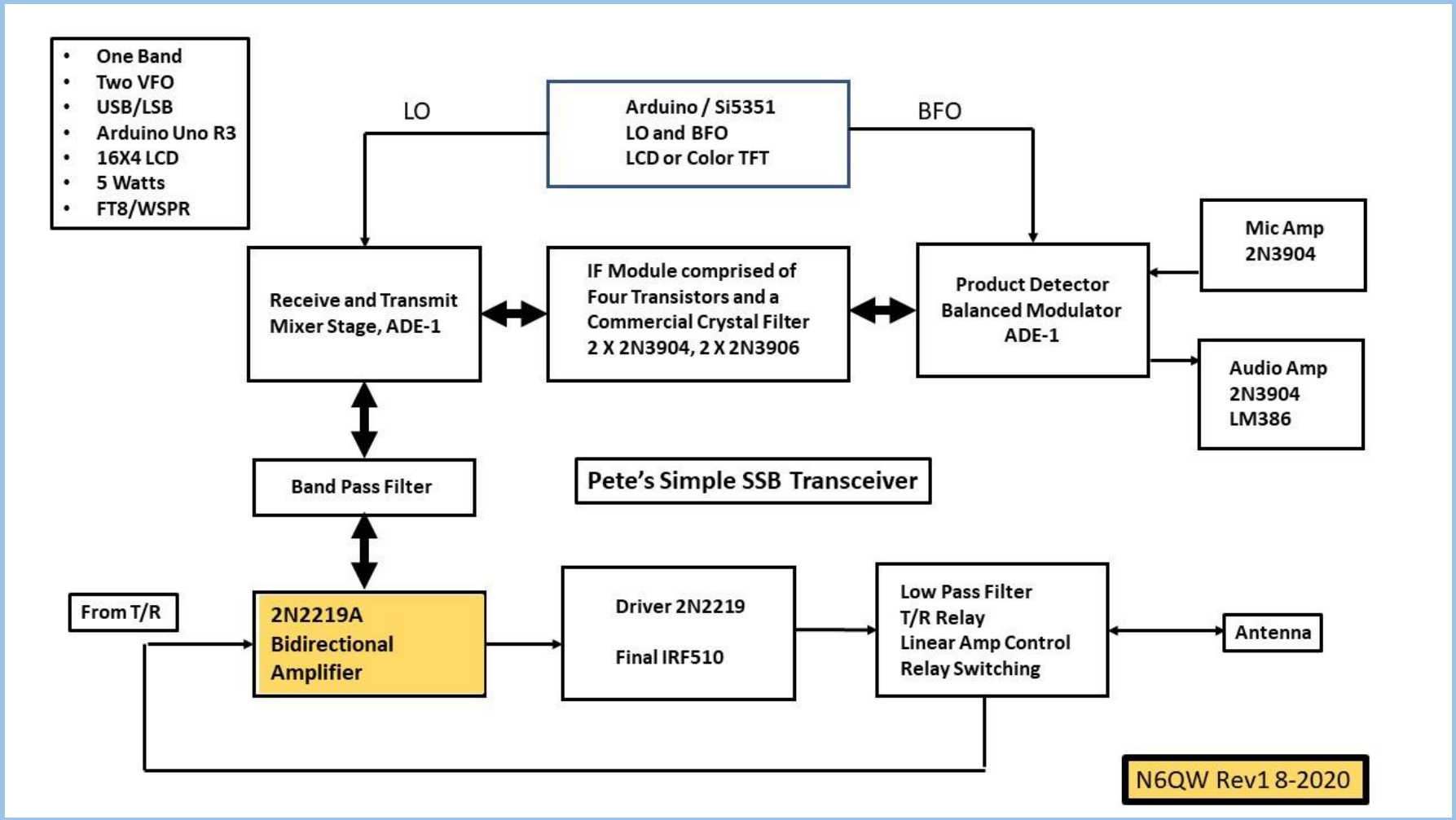


The Result: Bi-Lateral Circuitry

What are the Benefits?

- Reduced Part Count > Lower Cost & Compact Size
- LO/BFO NOT Hot Switched
- Circuits designed for Zin/out = 50 Ohms
- Stage Gains Optimized & Physical Isolation
- Fabrication Processes minimized

The Block Diagram

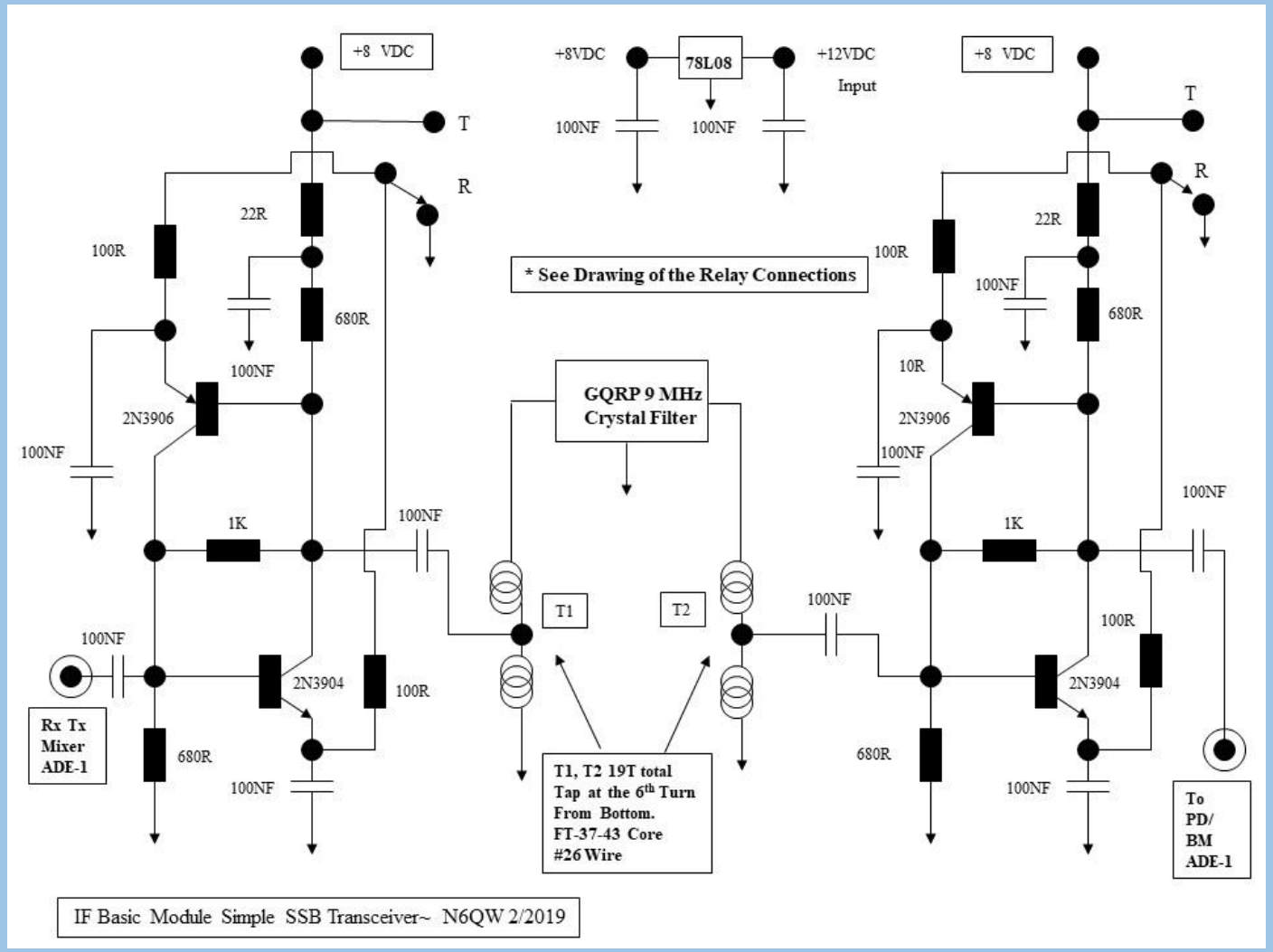


A Detailed Look at the Modules

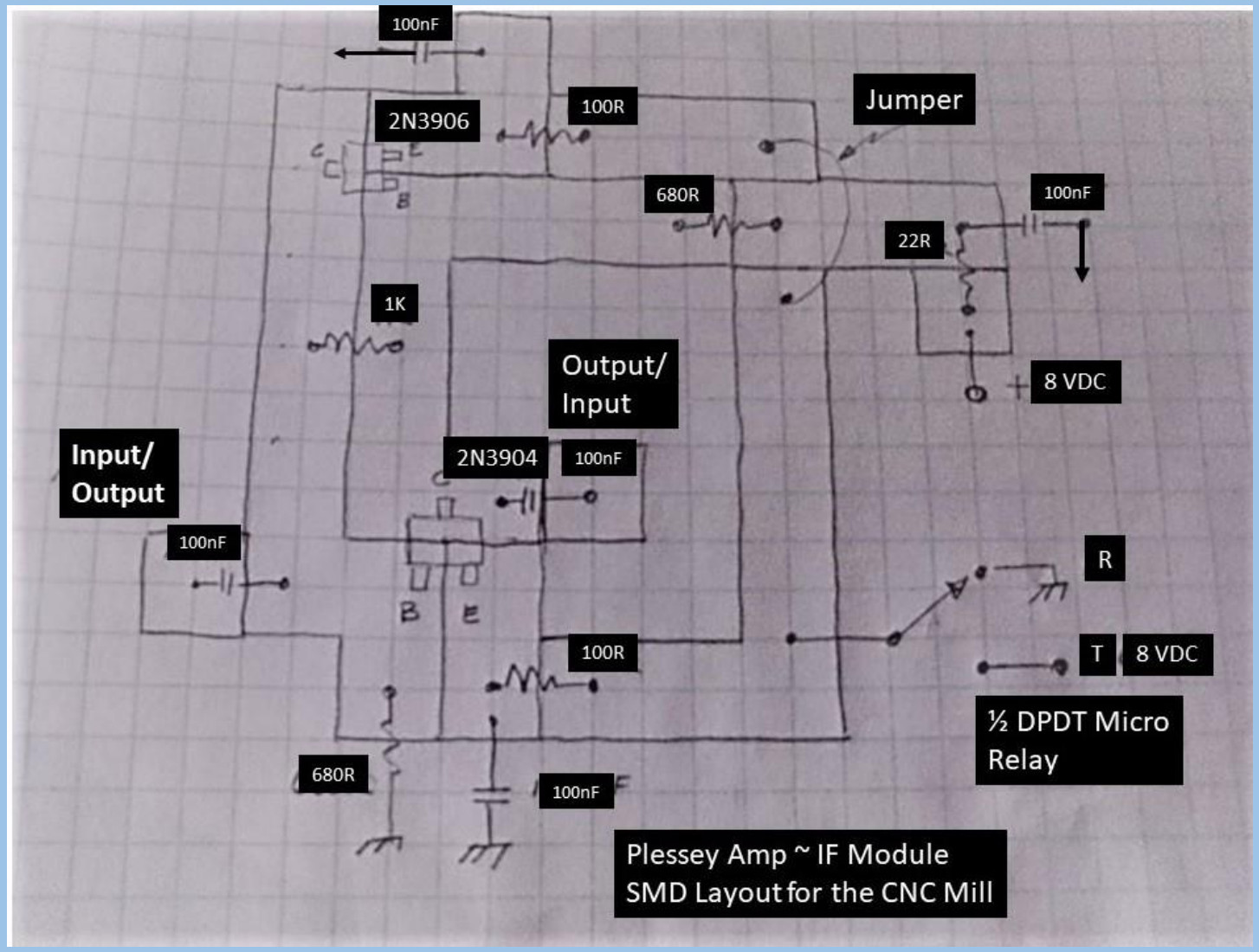
The Heart of Simple SSB Transceiver is the Bilateral IF Module ~ Thank You Plessey!

- **Four Low Cost Transistors**
- **Wideband, Moderate Gain @ 8 VDC**
- **Literally Bullet Proof**
- **EMRFD Fig 6.110 > Passes the “Smell Test”**

The Bilateral IF Module



½ the Bilateral IF Module

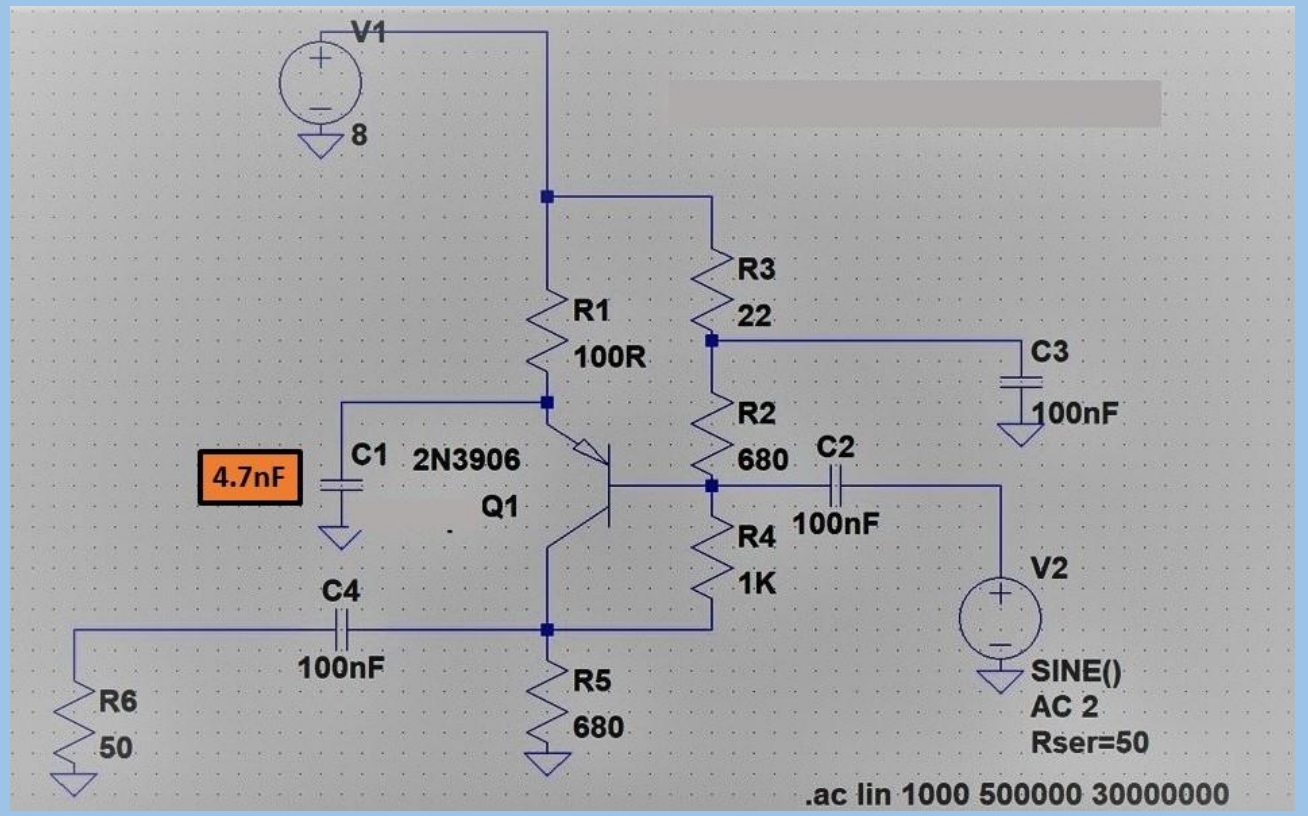


Using Available Tools!

- LT SPICE = Circuit Simulation, Saves the Soldering Iron
- Antuino and Nano VNA to check Networks & Filters
- 100 MHz DSO with FFT Analysis
- Homebrew RF Signal Generator (AD9850)

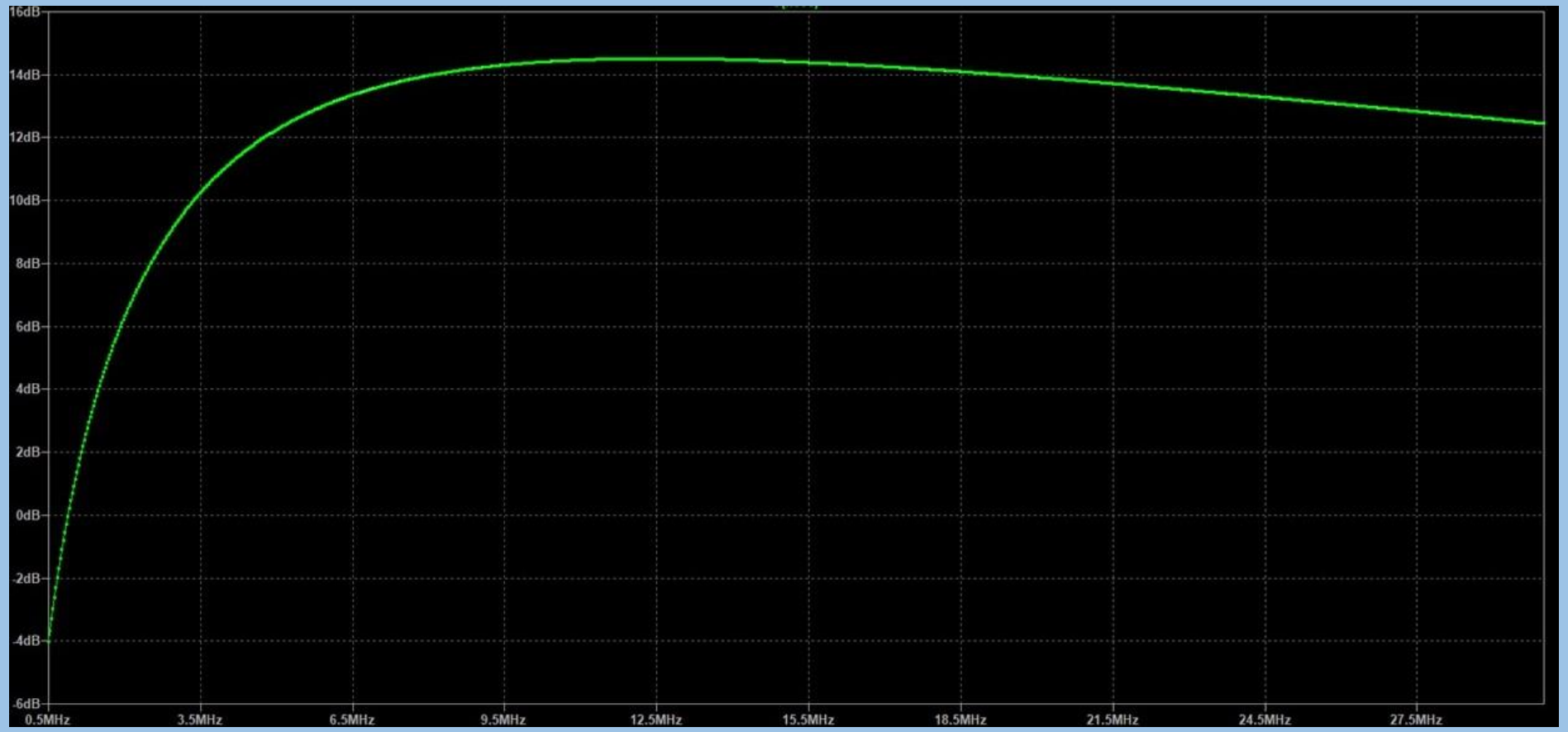
The Last Thing You Do Is Turn On The Soldering Iron

PNP Portion of Bilateral Amp



Using the LT Spice Tool For Evaluation

PNP Portion of the Bilateral Amp Revised

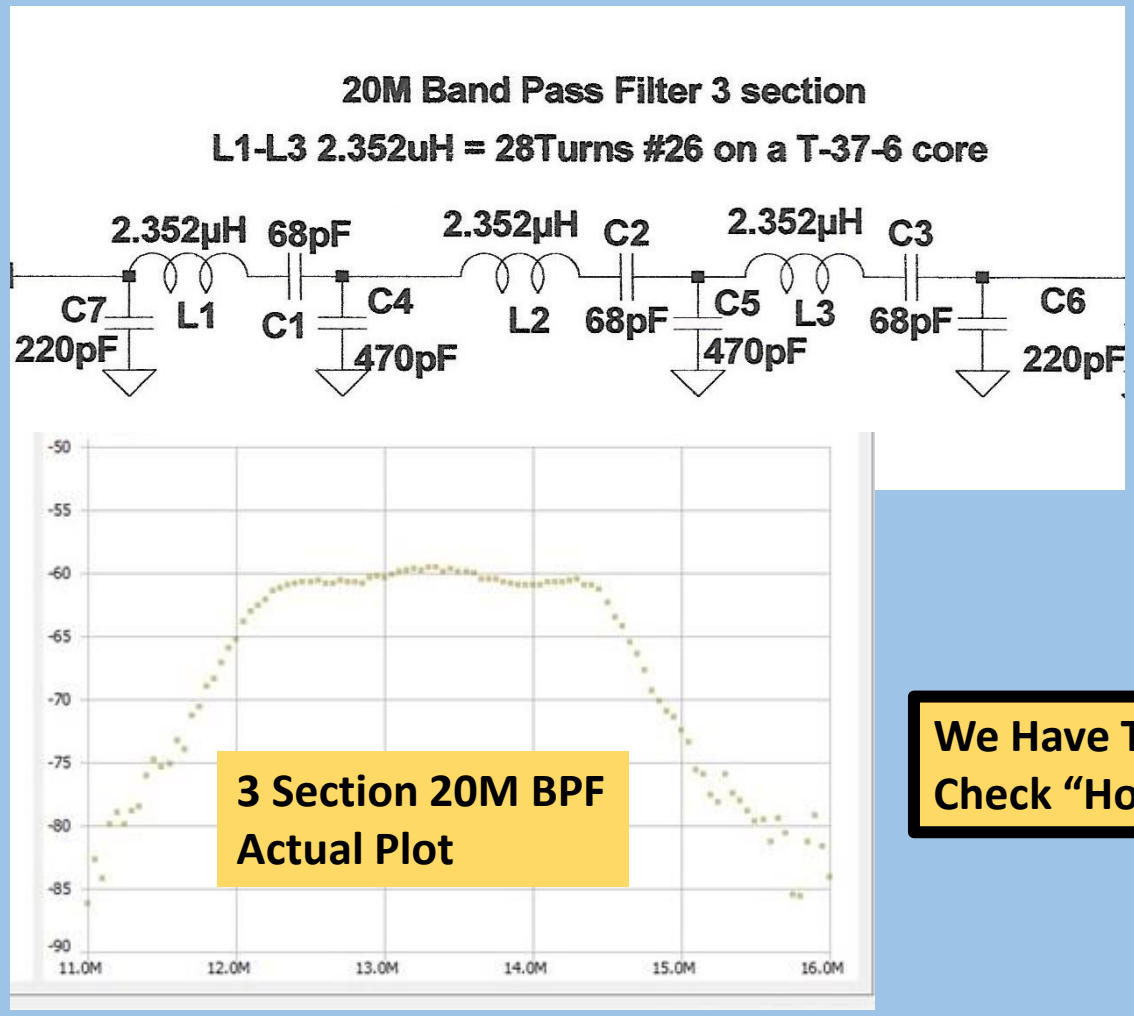


Evaluate Gain over 2 to 30 MHz

What Else Do We Need?

- We have the IF Module
- Critical Modules use DBM's
- Band Pass Filter: USE QUALITY PARTS (COG, SM)!
- Bi-Directional Amp & Tx Driver = Same Circuit
- Final Amplifier IRF-510
- Low Pass Filter: USE QUALITY PARTS (COG, SM)!
- Arduino, Si5351 and a Display, Encoder and PB Switches
- Misc. TR Relays and Voltage Regulators

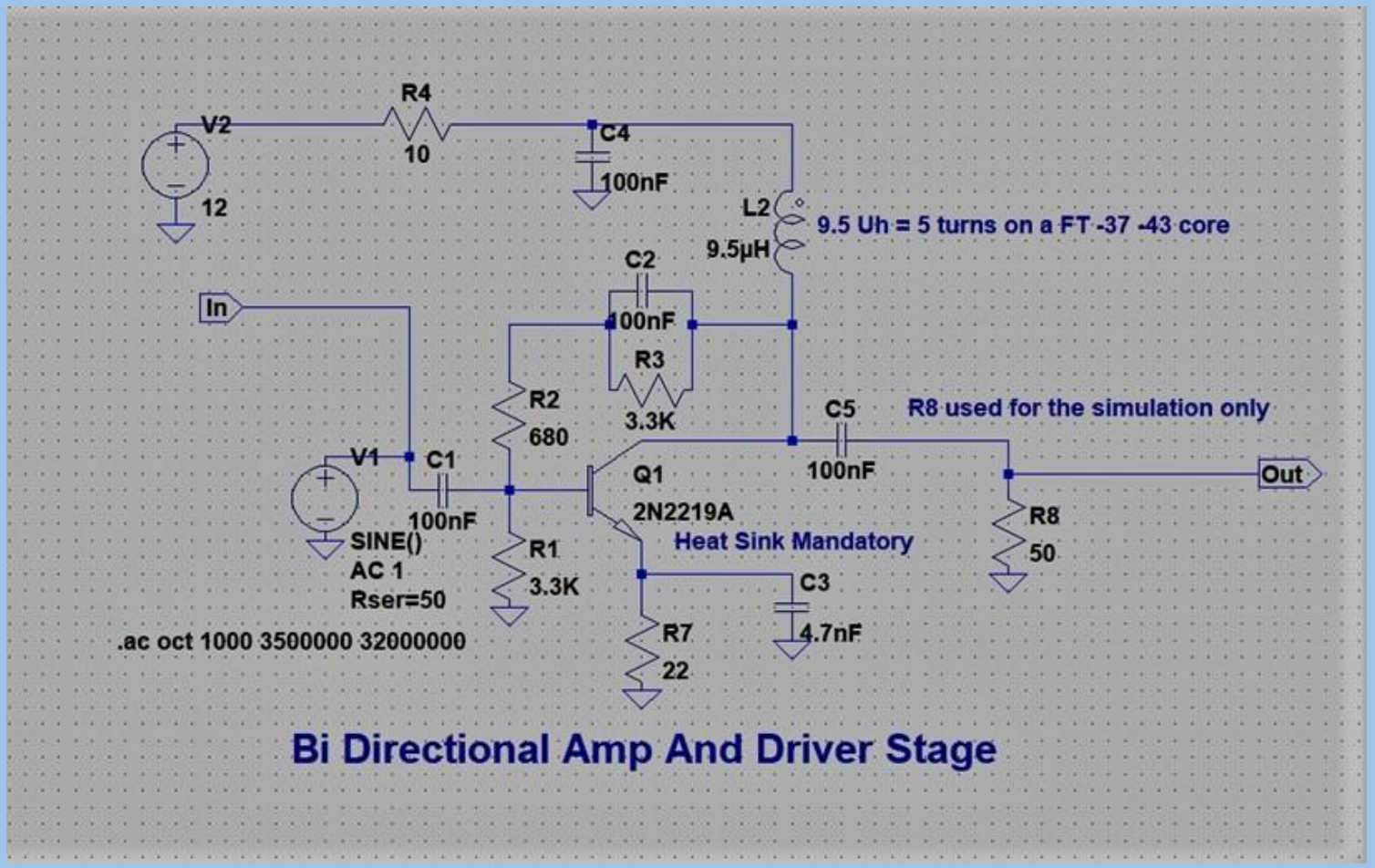
A Three Section Band Pass Filter



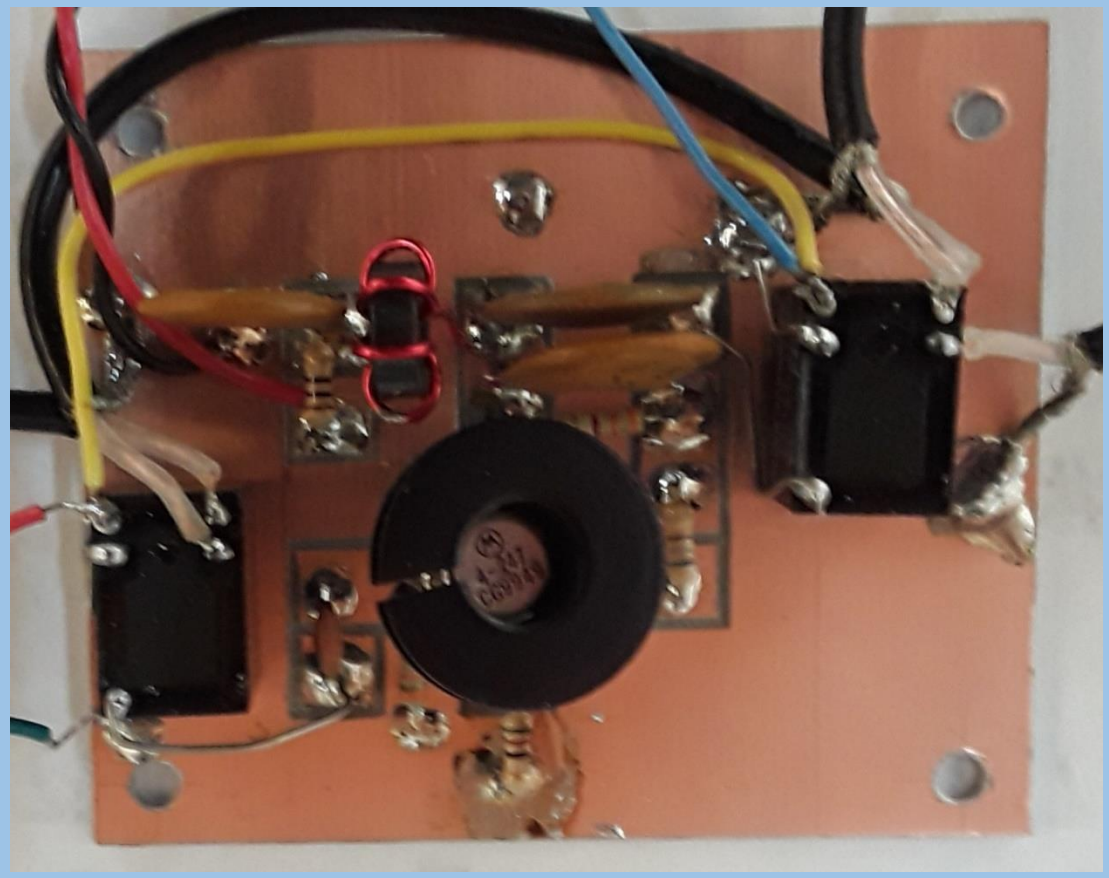
3 Section 20M BPF Actual Plot

We Have Tools Like The Nano VNA to Check "How Good are the Filters"

Bi-Directional Amplifier / Driver

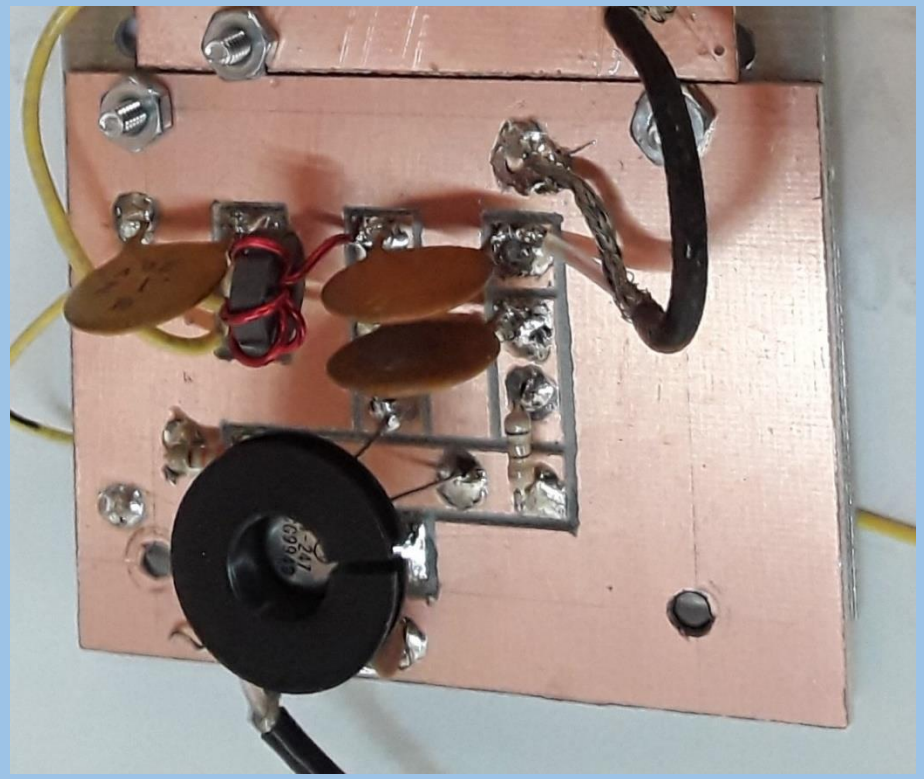


The Bi-Directional Board with Relay Steering



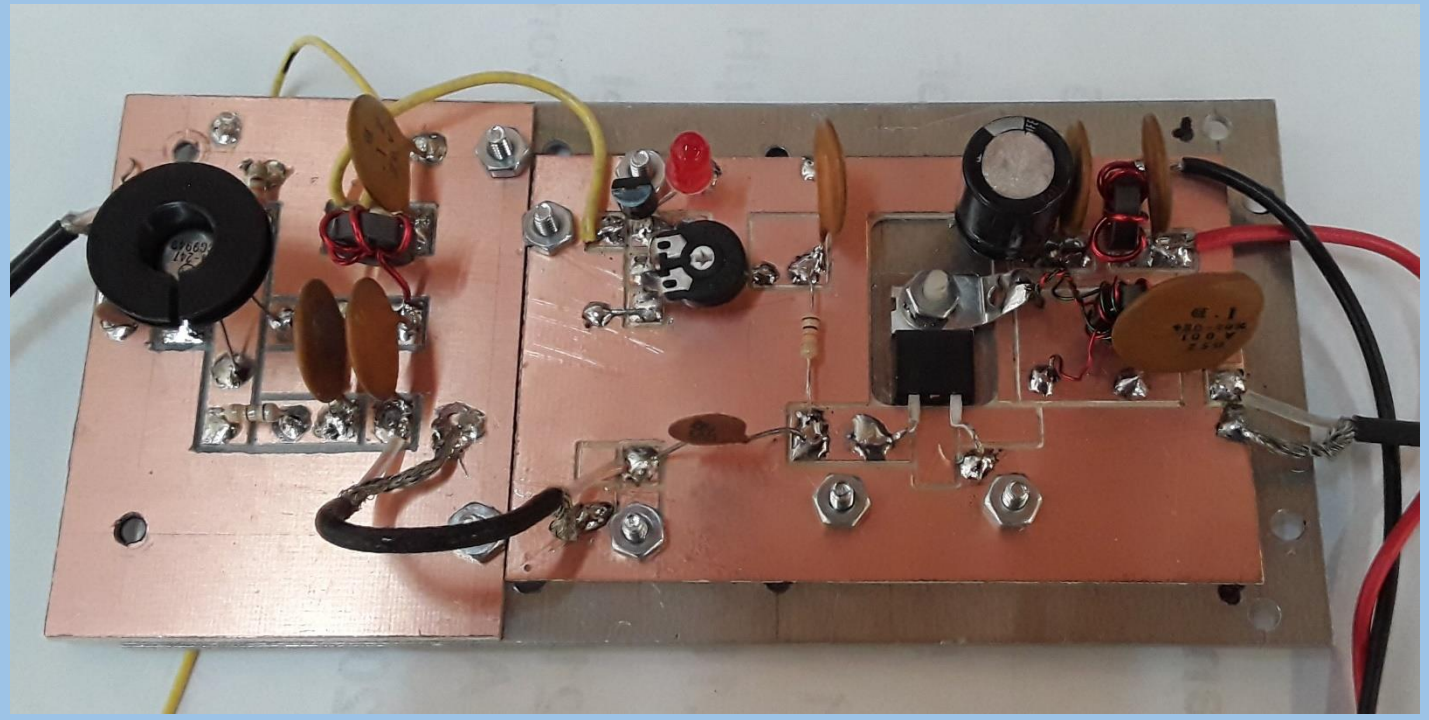
Receiver RF Amp and Transmit Pre-driver

Driver Stage



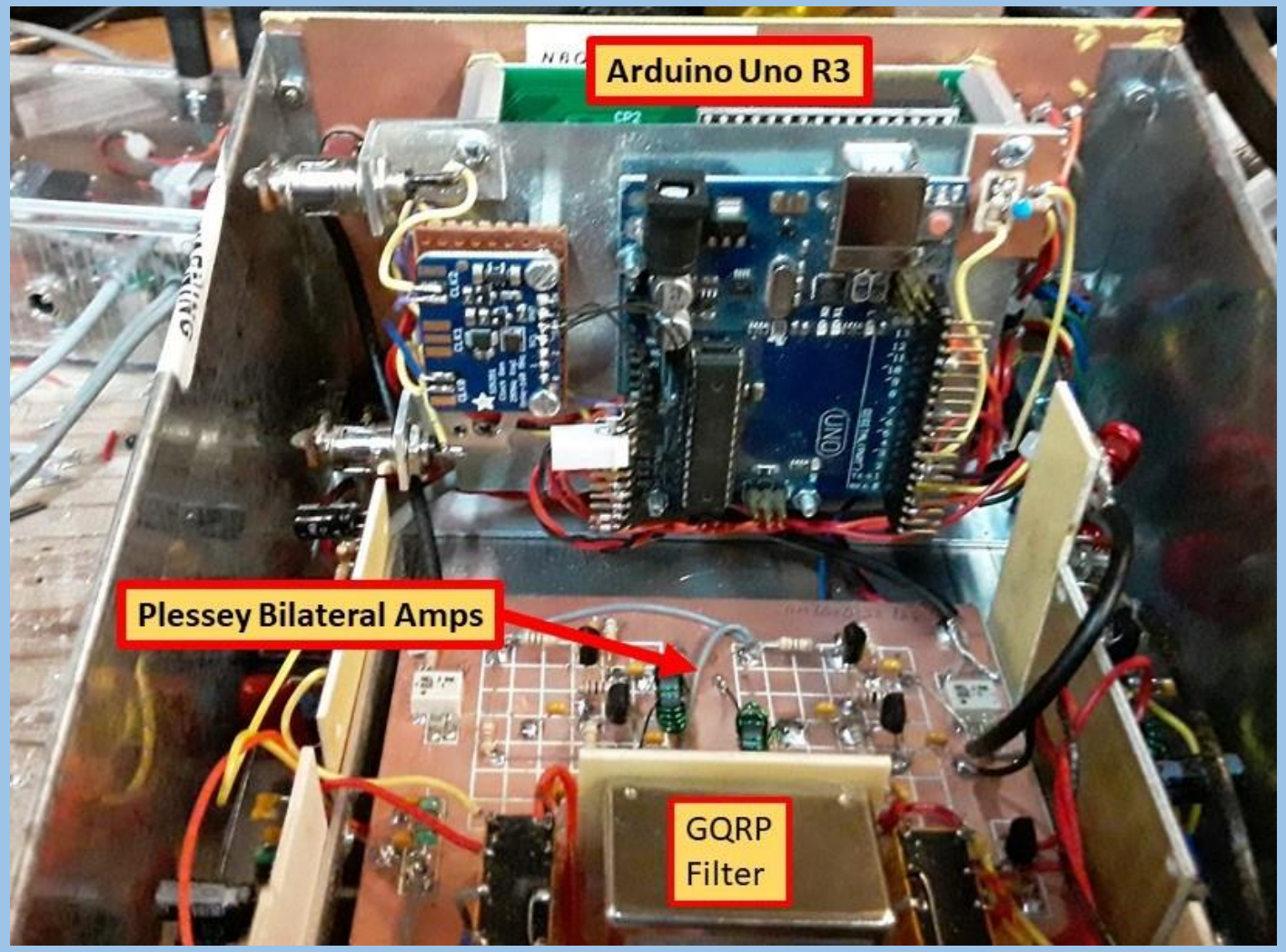
Same Circuit as the Bi-Directional Amplifier Circuit

IRF510 Stage (also RD06HHF1)



Driver to the Left and Final on the Right. The LED raises the Bias Voltage so Without any other changes either the IRF510 or RD06HHF1 can be used in the circuit. Caution the RD06HHF1 needs a more robust Heat Sink. Also a HUGE Caution: The Bias volts for a RD06HHF1 will SMOKE a IRF510!

The Arduino ~ Any Flavor



Final Integration

- Bits of wiring to assemble the Modules
- Test as you go of the Modules (Audio, LO/BFO)
- Start with the Rx – Get that working!
- Don’t be unhappy it only gets 5 Watts (Clean)
- http://www.n6qw.com/GQRP.html

Experimenter's Platform

- Modular Aspect Enables Experimentation
- A US Ham's build includes full CAT Control (Digital Modes), a Nextion Touch Screen, and Multi-Band Operation plus a future AGC add on.
- NOT a KIT but NOT a TOY.
- http://www.n6qw.com/GQRP.html

SDR Radio Transceivers

www.n6qwradiogenius.us

- I & Q Sound Card Based system
- Raspberry Pi3 Computer
- QUISK SDR Software
- 7 Inch HDMI = Portable!
- Minimum Hardware

Last Words!

Thank you for the opportunity to present today!

Build Detail at www.n6qw.com/GQRP.html

My other passion = COOKING (www.pastapete.com)

73's
Pete N6QW