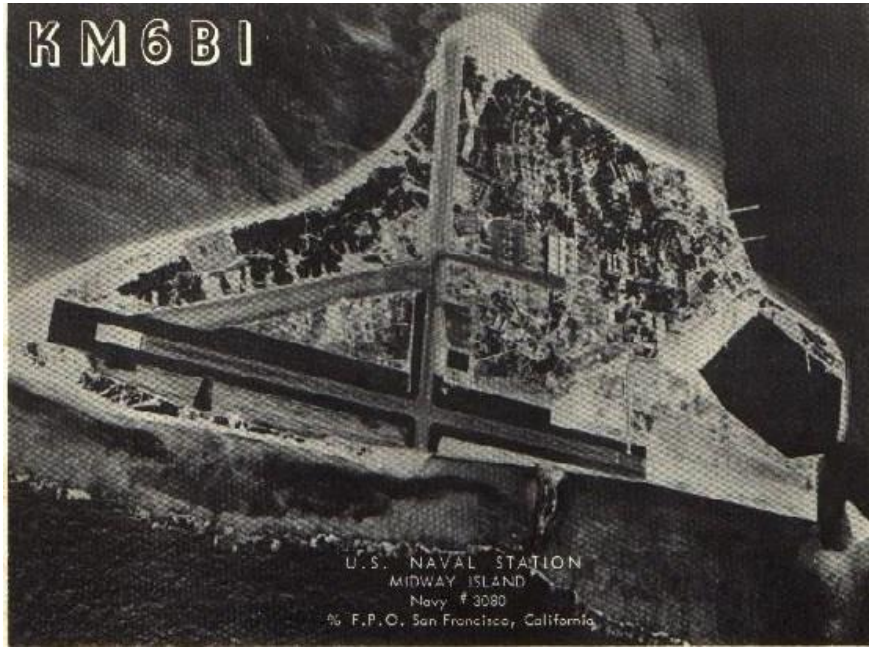
It all started with that Italian CW Guy -- Marconi!

Something about Pete, N6QW…

1. Originally licensed in 1959 as KN3IXU/K3IXU
2. Operated DX on Midway Island as KM6DD
3. Degreed EE working in Aerospace
4. Homebrew Enthusiast mostly SSB Rigs (50)
5. Three CW Transceivers published in QRP Quarterly
6. Operate very little CW (disclaimer)

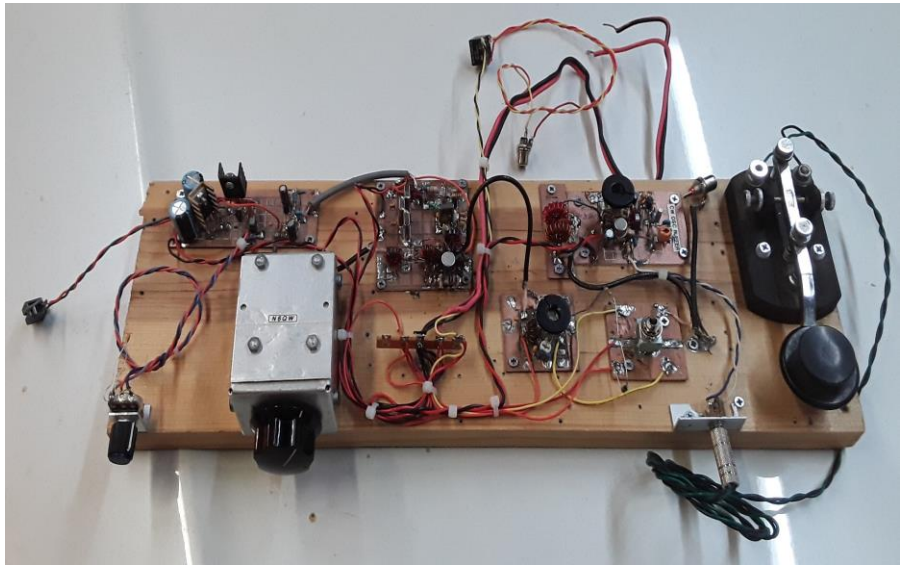
Midway Island formerly KM6 Prefix now KH4
Original Inhabitants: 6 Cable Station Employees Circa 1906. Critical Role in the Battle of Midway June 1942.

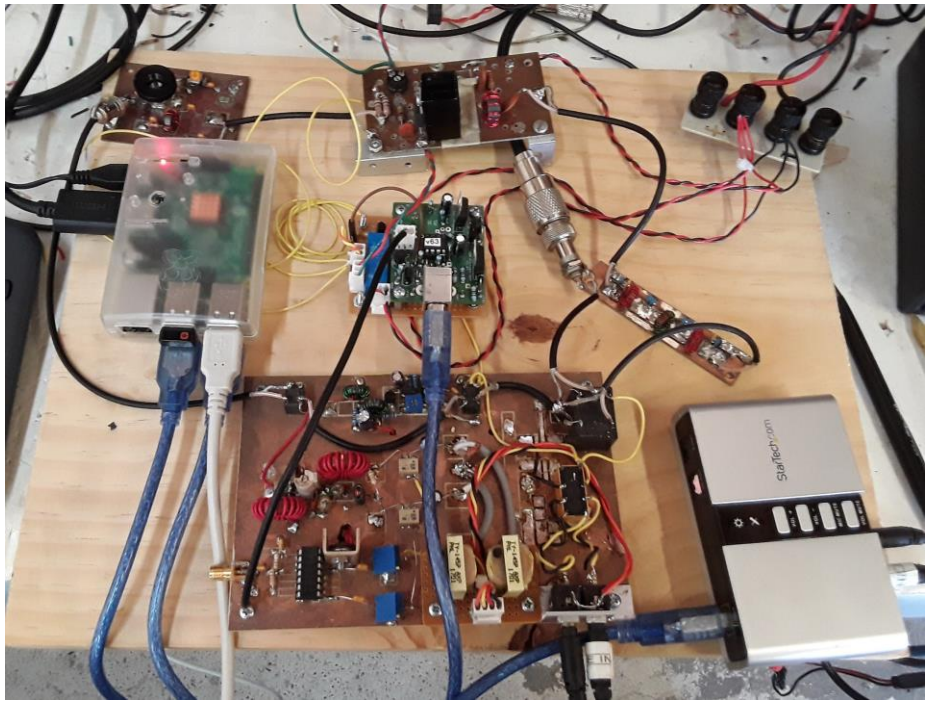


Long Island CW Club Presentation ~ N6QW 3/13/2021

From a Simple 1 W CW Transceiver

To a Slick 5 Watt SDR Transceiver





Unlike the Fan Dancer – We Do See Everything!

1950's	1960's	1970's	1980's	1990's	2000's	2010-2020's
Transistors CK722 KWM-1 KWM-2/2A begin.ssb(); Simple CW Homebrew Heathkit AT1 Bought Receivers Collins Hallicrafters National Hammarlund Heathkit Eldico Eico Knight Kit Drake	Swan 100 Series 240/350/500 SBE 33/34 National NCX-3 Hallicrafters SR-150/160 SR-5400/500 Heathkit Drake TR-3 Collins KWM-2/2A Eico 753 Yaesu FTdx100 Some Homebrew CW/SSB	Heathkit Hot Water Rigs ICOM IC701 Ten Tec Triton II Drake TR-4 Atlas 180/210X Yaesu FT-101 Trio (Kenwood) TS-520 Homebrew SSB LM373 Hallicrafters FPM300	Collins KWM-380 Drake TR-7 Ten Tec Triton IV Omni C Corsair Kenwood TS820 TS520 TS180 ICOM IC730/745 Yaesu FT-102 Atlas 350-XL Less Homebrew	Digital VFO Microprocessors Digital Display Computer Control Hi Power SS Amps Kachina 505 Ten Tec Pegasus Omni VI Plus ICOM IC 755 Kenwood TS950 Yaesu FT900 CAT Trinket Homebrew	Microcontrollers Digital Integration Computer Interface Ten Tec Omni VII /Orion Yaesu FT2000 Kenwood TSS2000 ICOM IC706 FLEX Radio Bitx20 GONE! Drake Collins National Hallicrafters Hammarlund Heathkit Some Homebrew	SDR Offshore Reigns Rigs from China Cheap Technology Computer Inside HDR Shrinking ICOM 7850 Yaesu FTdx5000 Kenwood TS890 FLEX 6700 Apache ANON uBitx Homebrew Rigs On the Rise Impact of .io Groups and user Groups. Podcasts

Touring Ham Radio Over the Past 70 Years ~ Dramatic Changes!

Homebrew Examples from N6QW

Four MC1496 IC's are the heart of this Rig

"KWM-4" SS Version of a Collins KWM-2

Two NE602's Are the Guts of this Rig

Rig in a Bottle

Some CW Rigs

DIY Ham Stations

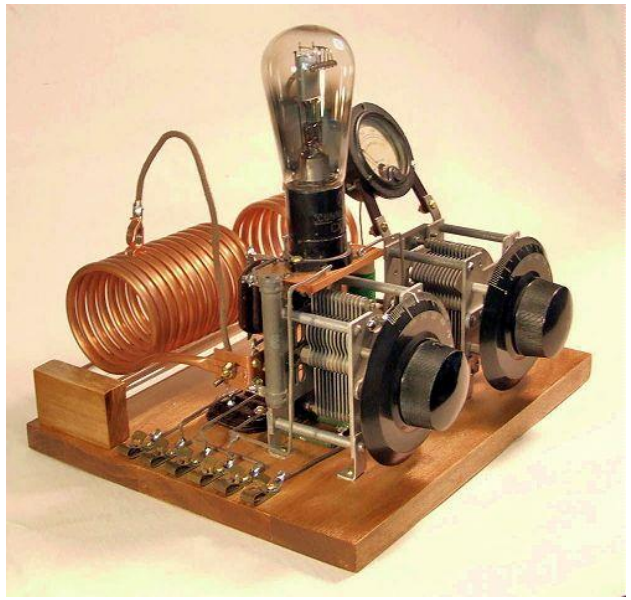
1. My Goal is to discuss Hardware
2. Many Kits and many *expensive* Appliance Boxes available.
3. But Suppose you Rolled Your Own?
4. Key Point – know how deep the water is before diving in!
5. Range of Options: Simple CW Rigs to SDR Radios
6. Cheap Available Technology is Driving a Homebrew Resurgence

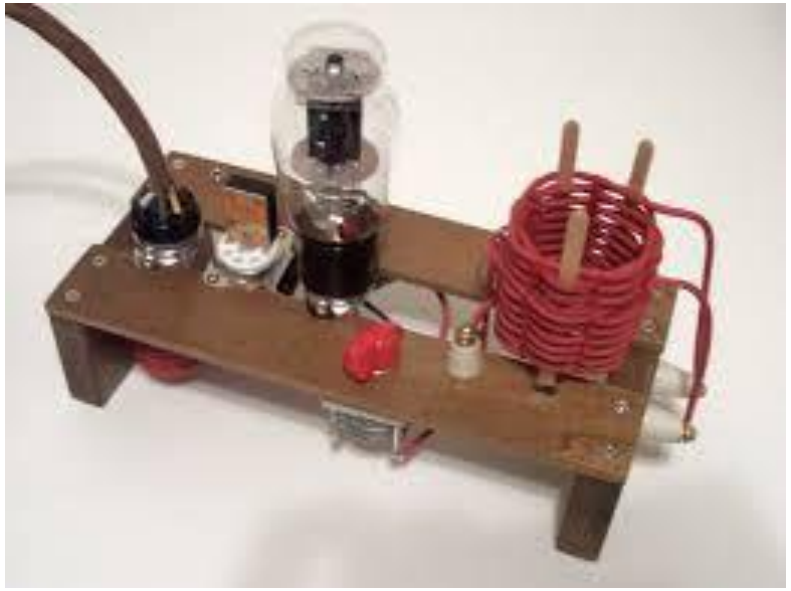
In the Old Days… (Dating Back to the 1930's)

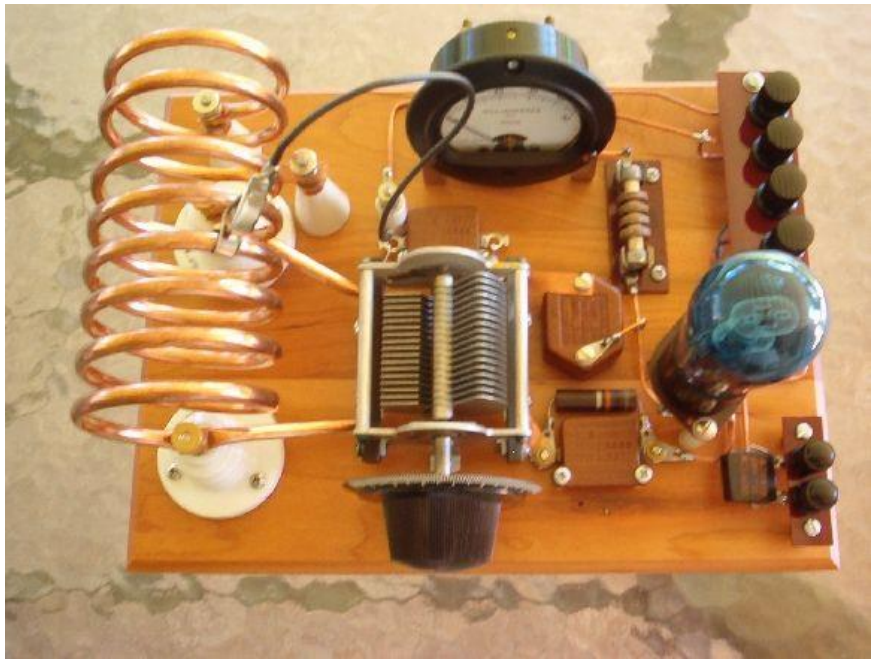
1. **Many Stations were a simple one or two tube Transmitters ditto for the Rx.**
2. **Part of the allure was "part scrounging" and "home construction" No eBay!**
3. **Rigs often were "Works of Art".**
4. **It was part technical skill to fabricate a station and part skill to operate.**
5. **Speed was the goal – 65 WPM copying in your head while multi-tasking!**
6. **Self Excited Hartley Oscillators required a taught antenna!**
7. **Key Clicks and Frequency Drift were simply accepted as was TVI.**

But Today, with Cheap, Readily Available Technology – Limitless

Think of a GPS Linked Digital VFO accurate to less than 1 Hz!







My 1st Rig was a 6V6 ~ 3709 kHz.

The Old Days!

Self-Excited Hartley Oscillators Ruled the Roost
Ability to QSY. Often about 10 watts with tube's
Such a 45, 27, 2A3 and even some 810's or 845's
Open Construction ~ Definitely a Safety Hazard!

Roll Your Own ~ Where to Start?

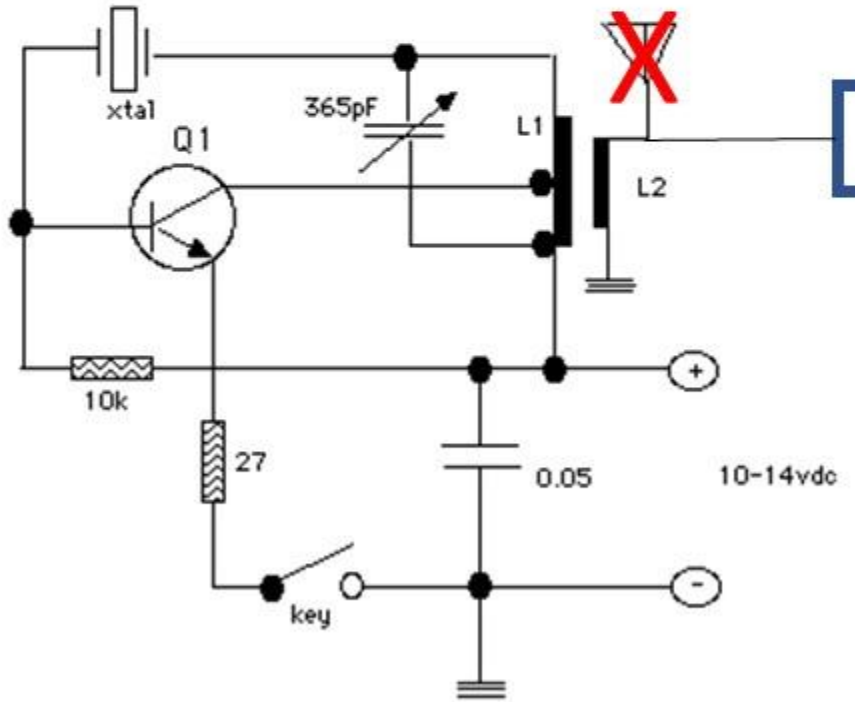
1. **Turn Off The Soldering Iron ~ “Noodling Phase”**
2. **Develop a Requirements Document.**
3. **Develop A Plan of Action:**

- **Start with a solid state transmitter (12 VDC is the highest Voltage)**
- **Start small with the Michigan Mighty Mite ~ 15 Parts**
- **Don’t just build things --- learn how they work**
- **Move to a more complex transmitter using two devices/more Pout**
- **Add in a Digital VFO w/readout**
- **Automatic T/R and multiband operation**
- **Build in Modules so you can add a Receiver Board > Transceiver**

L1 / L2 tank coil

	L1 (primary/collector windings)	L2 (secondary/antenna windings)
160 meters	60 turns, tapped at 20	8 turns
80 meters	45 turns, tapped at 15	6 turns
40 meters	21 turns, tapped at 7	4 turns
30 meters	15 turns, tapped at 6	4 turns

7030 kHz



W3NQN LPF from QST

A Basic Transmitter!

Michigan Mighty Mite ~ 100 mw*

Q1 = 2N3053, 2N2219A, 2N5109, 2N3866, 2N4427, 2N697

* On a clear day, if you squint!

General Considerations:

1. CW Transceivers are more difficult to build than an SSB Rig
2. Much Narrower Filters Required for CW on the Rx Side
3. Crystal Control while workable results in less contacts.
4. Topologies that provide an offset
5. Digital versus Analog VFO (Digital is Better!)
6. Power Level: 10 watts is better than 100 milliwatts.
7. Start with One Band (Multi-Band = Multi-Complexities)
8. Don’t Overlook a VXO Synthesizer
9. Insure adequate filtering (BPF’s LPF’s) 100 mw can be heard!

Offset Topologies ~ Leapfrogging & Zero Beat

1. **Tuned to the same frequency (zero beat) is a problem!**
2. **Enter the offset ~ 400 Hz, 600 Hz, 700 Hz, 1350 Hz (NO!)**
3. **Offset Methods: Keyed Tone, Separate BFO, Shift the VFO**
4. **The Transceiver versus the Trans-Receiver (sidetone signal)**
5. **CWU or CWL ~ I think the convention is CWU.**

https://www.youtube.com/watch?v=al6EzO-JQ3w

20M CW Trans- Receiver
9 MHz Homebrew Crystal Filter. NE602 Mixer on Tx & A Common 5 MHz LC VFO

Built by N6QW circa 2010.

A Wooden Box 20M CW Trans-Receiver @ 3 Watts. 100 kHz of 20M

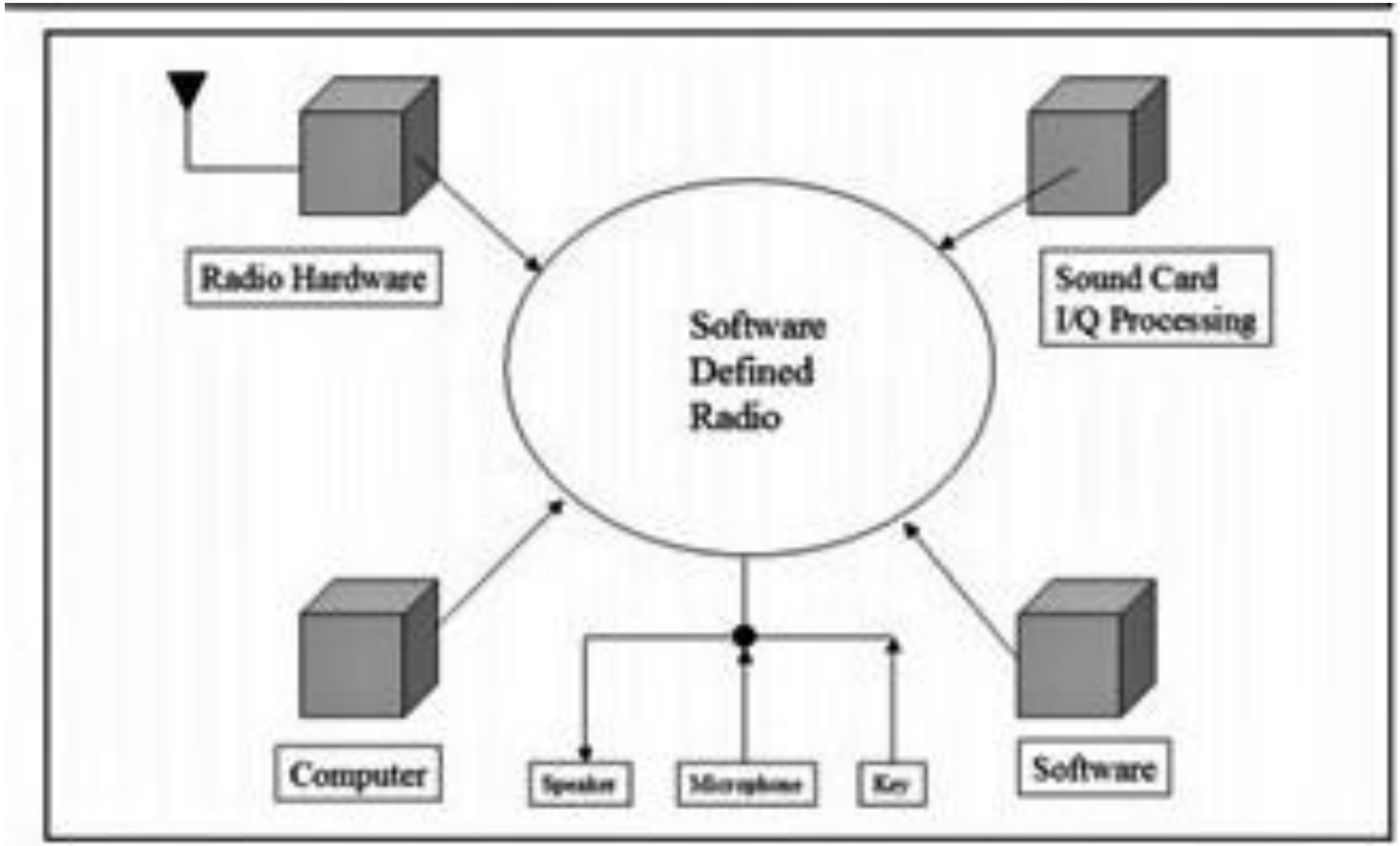


Figure 1—Software defined radio block diagram.

SDR – 4 Legs of the Stool

1. **Radio Hardware**
2. **Sound Card (I/Q)**
3. **Computer**
4. **Software**

RF Signals are translated to an **In Phase** and **Quadrature** Audio Baseband.

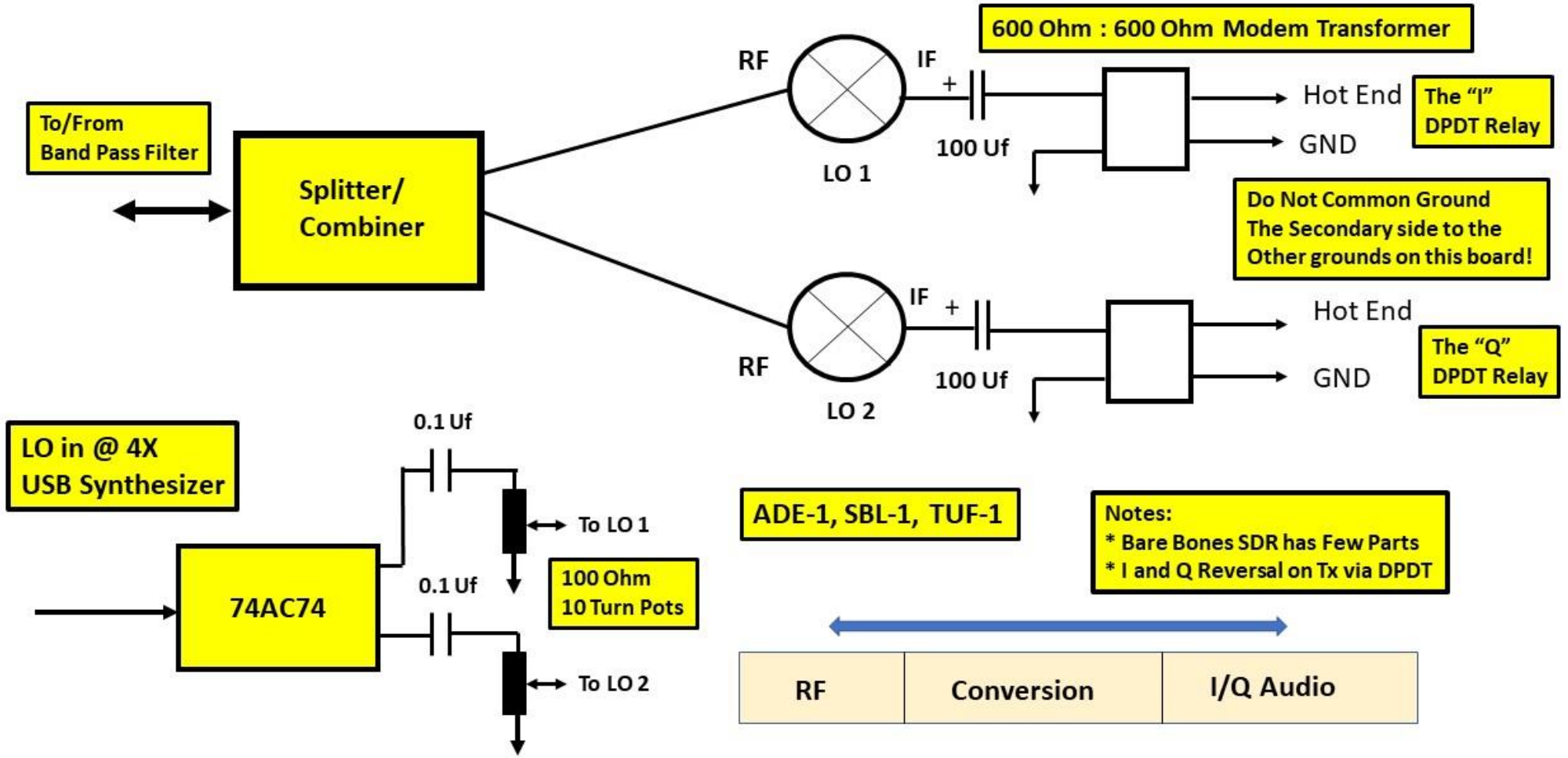
Advanced Fast Fourier and Hilbert Transforms are at the heart of DSP!

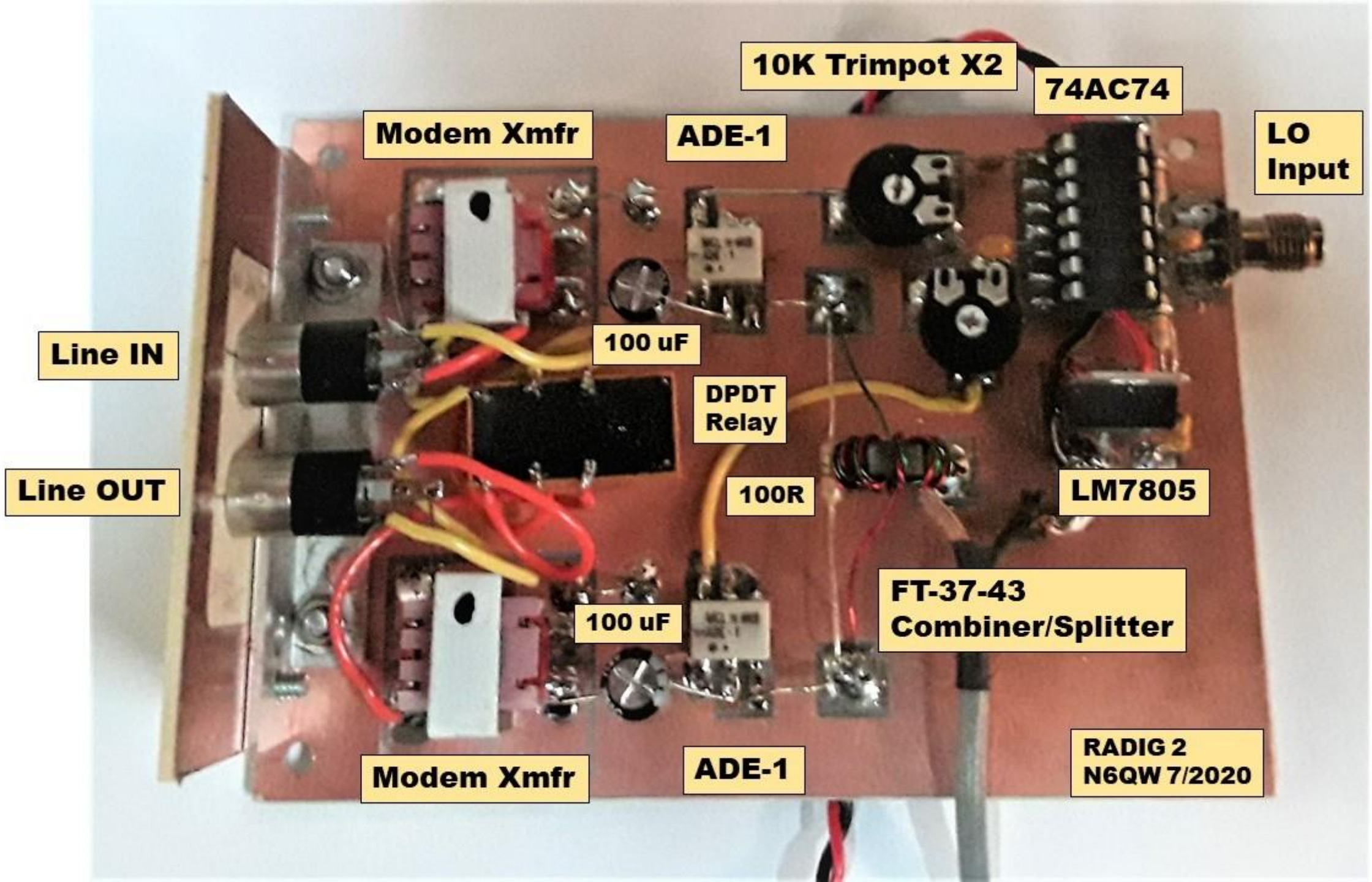
Today's Emphasis is Software Defined Radio (SDR)

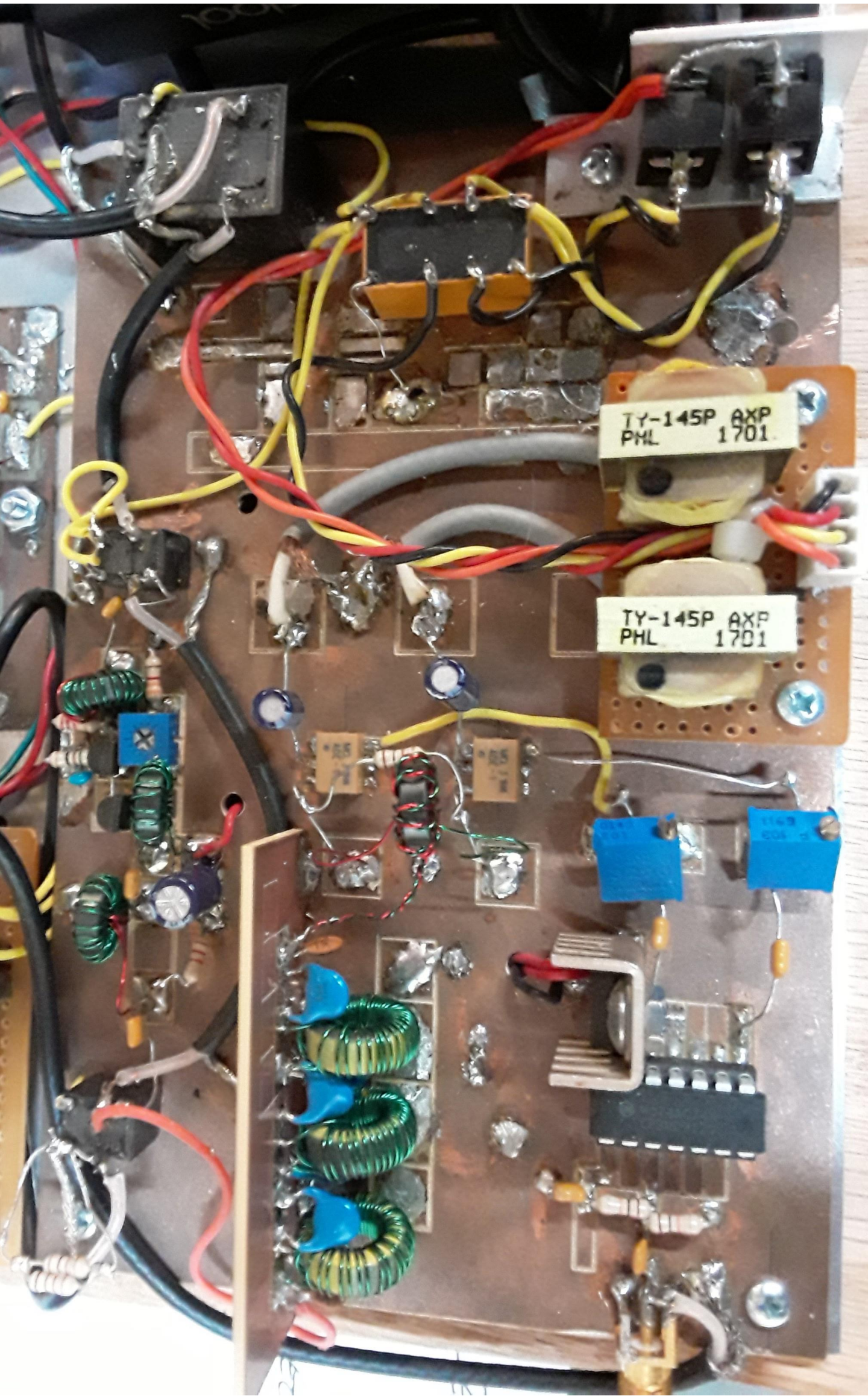
Fourier Transform

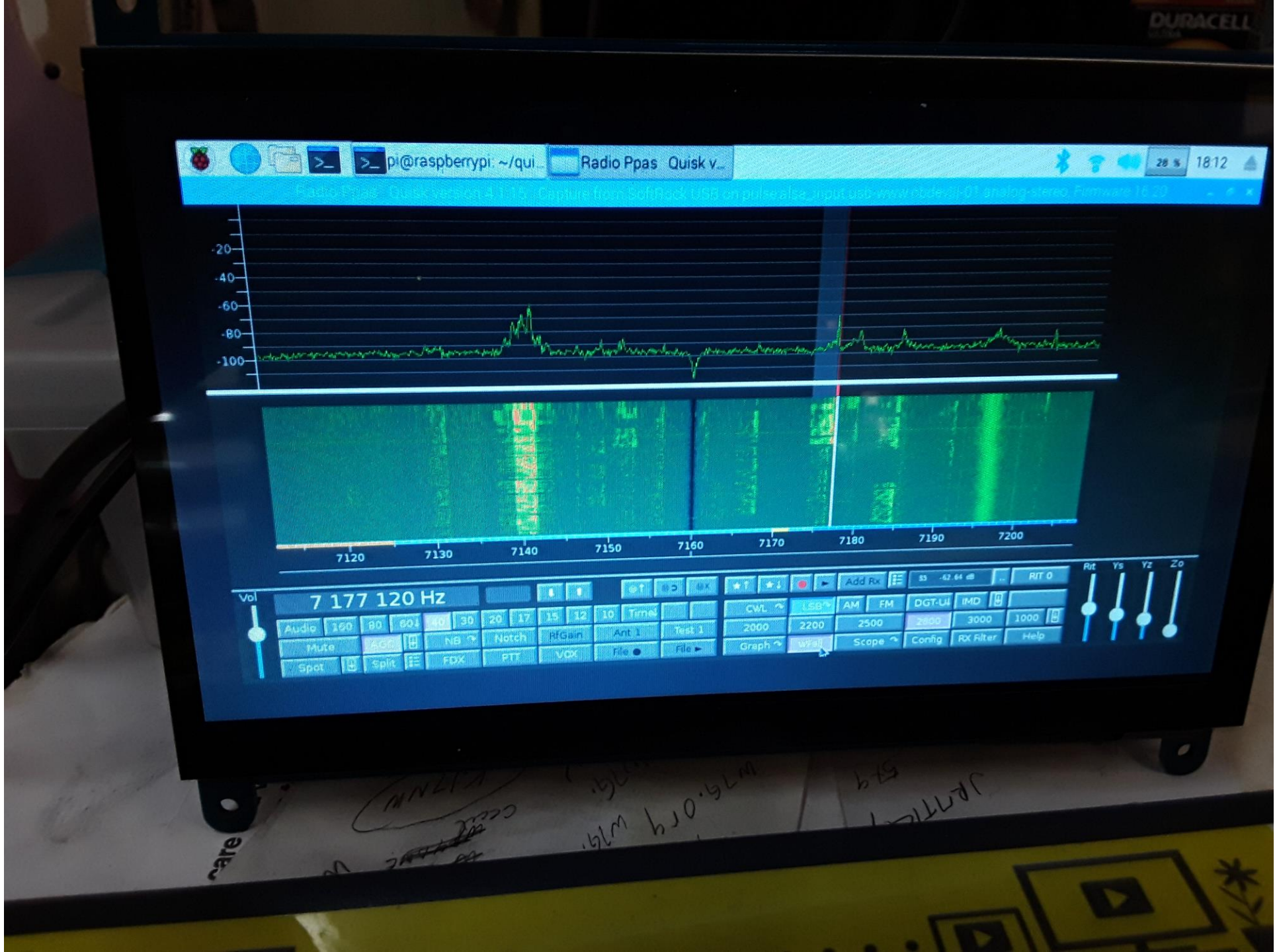
$$f(x) = a_0 + \sum_{n=1}^{\infty} \left(a_n \cos\frac{n\pi x}{L} + b_n \sin\frac{n\pi x}{L} \right)$$

I/Q SDR Block Schematic




10K Trimpot X2
74AC74
Modem Xmfr
ADE-1
LO Input
Line IN
100 uF
DPDT Relay
Line OUT
100R
LM7805
FT-37-43 Combiner/Splitter
100 uF
Modem Xmfr
ADE-1
RADIG 2 N6QW 7/2020


TY-145P AXP
PHL 1701
TY-145P AXP
PHL 1701


pi@raspberrypi: ~/qui
Radio Ppas Quisk v...
18:12
-20
-40
-60
-80
-100
7120
7130
7140
7150
7160
7170
7180
7190
7200
7 177 120 Hz
Vol
Audio
Mute
Spot
Split
FDX
PTT
VOX
Notch
RFGain
Ant 1
Test 1
Add Rx
RIT 0
CWL
LSB
AM
FM
DGT-UI
IMD
2000
2200
2500
3000
1000
Graph
Scope
Config
RX Filter
Help
Rit
Ys
Yz
Zo

N6QW Back Yard Field Day June 2020
Using a Homebrew SDR Transceiver

General Homebrew Tips:

1. Start with a small manageable project
2. Noodle First, Solder Last!
3. Learn the why – don’t just build!
4. Use simulation (LT Spice) [Validate Parts Subs]
5. Document the results, Organize the Information!
6. Build in Stages, Test as you go!
7. Before Applying Power Check! Check! Check!
8. Photo Documentation, Record Performance
9. Patience ~ This is not an “Appliance Box” (Few Menus)

Opportunity to Homebrew!

Cheap Technology ~ Readily Available
Resources: Internet, Forums, You Tube, Clubs
Test Instruments (VNA, DSO) and CNC/3-D Printers
Building Block Interfacing
Microcontrollers/Single Board Computers ~ The Brains
SDR Overtaking HDR ~ Simply Change the Software

Reference Links:

www.jessystems.com

www.n6qw.com

www.n6qwradiogenius.com

www.pastapete.com

n6qw.blogspot.com

Thank You for the invitation to speak to your club! 73's Pete N6QW