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!
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Transistors CK722</td>
<td>KWM-1 KWM-2/2A</td>
<td>Heathkit AT1</td>
<td>Collins KWM-380</td>
<td>Digital VFO</td>
<td>Microcontrollers</td>
<td>SDR Offshore Reigns</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bought Receivers</td>
<td>Drake TR-7</td>
<td>Microprocessors</td>
<td>Digital Integration</td>
<td>Rig from China</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collins</td>
<td>Ten Tec Triton IV</td>
<td>Digital Display</td>
<td>Computer Interface</td>
<td>Cheap Technology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drake TR-3</td>
<td>Ten Tec Triton IV</td>
<td>Computer Control</td>
<td>Ten Tec Omni VII</td>
<td>Computer Inside</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eico 753</td>
<td>Drake TR-4</td>
<td>Hi Power S5 Amps</td>
<td>/Orion</td>
<td>HDR Shrinking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yaesu FT-101</td>
<td>Atlas 180/210X</td>
<td>Kachina 505</td>
<td>Yaesu FT2000</td>
<td>ICOM 7850</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Homebrew</td>
<td>Yaesu TS820</td>
<td>Ten Tec Pegasus</td>
<td>Kenwood TS2000</td>
<td>Yaesu FTdx5000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CW/SSB</td>
<td>TS520</td>
<td>Omni VI Plus</td>
<td>Kenwood TS950</td>
<td>Kenwood TS890</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ICOM IC730/745</td>
<td>ICOM IC755</td>
<td>FLEX Radio</td>
<td>Apache ANON</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yaesu FT-102</td>
<td>Kenwood TS950</td>
<td>Bitx20</td>
<td>ubitx</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Atlas 350-XL</td>
<td>Yaesu FT900 CAT</td>
<td>GONE! Drake</td>
<td>Homebrew Rigs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Less Homebrew</td>
<td>Trinket Homebrew</td>
<td>Collins</td>
<td>On the Rise</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>National</td>
<td>Impact of .io</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hallicrafters</td>
<td>Groups and user</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hammarlund</td>
<td>Groups.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Heathkit</td>
<td>Podcasts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Some Homebrew</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Some Homebrew</td>
<td></td>
</tr>
</tbody>
</table>

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

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
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.

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!

The Old Days!
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
A Basic Transmitter!

L1 / L2 tank coil

<table>
<thead>
<tr>
<th></th>
<th>L1 (primary/collector windings)</th>
<th>L2 (secondary/antenna windings)</th>
</tr>
</thead>
<tbody>
<tr>
<td>160 meters</td>
<td>60 turns, tapped at 20</td>
<td>8 turns</td>
</tr>
<tr>
<td>80 meters</td>
<td>45 turns, tapped at 15</td>
<td>6 turns</td>
</tr>
<tr>
<td>40 meters</td>
<td>21 turns, tapped at 7</td>
<td>4 turns</td>
</tr>
<tr>
<td>30 meters</td>
<td>15 turns, tapped at 6</td>
<td>4 turns</td>
</tr>
</tbody>
</table>

7030 kHz

Michigan Mighty Mite ~ 100 mw*

* On a clear day, if you squint!

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

W3NQN LPF from QST
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
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)

I/Q SDR Block Schematic

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

Notes:
* Bare Bones SDR has Few Parts
* I and Q Reversal on Tx via DPDT
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
Thank You for the invitation to speak to your club! 73’s Pete N6QW