BUILD A LOOP

John Payton – N7GHZ Amateur Extra Class Feb. 2020

FULLWAVE HORIZONTAL or SKYWAVE ANTENNA

- WHY?
 - Simple Answer I have hearing loss & tinnitus which makes picking out voices from background noise difficult! (You may have noticed)
 - My station has a hearing problem too; i.e. QRM!
 - Research led me to the Fullwave Loop

FULLWAVE HORIZONTAL LOOP

- CLASSIC OLD DESIGN USED SINCE THE 1920s
- SELF-RESONANT
- CAN BE ANY SHAPE SQUARE, TRIANGLE, ROUND
- BEST SHAPE IS WHAT ENCOMPASES MAX AREA! (CIRCLE [difficult to build, too many supports], SQUARE works best)

CLASSIC DESIGN



The Loop is erected horizontal to the earth.

THE MATH! DON'T PANIC, IT'S EASY!

One basic formula – L=1005/F
 L(ength of wire) = 1005/Frequency in MHz.

 1005/18.1= 55.52 feet ---I added about 6 inches to accommodate the mechanical connection to the Balun Box & to allow for trimming if needed... it wasn't!

The 'Magical' floating Balun box...



SWR for my example = 1.38 to 1; after 4:1 Balun as tested on 2 separate Antenna analyzers.

The Oracle State Park outing experience – Nov. 2019

- Due to computer glitch (never update Windows!), was not able to use FT8;
- however, hooked up antenna to Elecraft radio donated to OVARC club (thanks Bob!)
- ... and on receive recorded a 2 S-unit drop in noise levels and clearer copy of SSB signals!
- Was asked by our senior Elmer, Tom W8TK to reinstall at my home QTH and run more tests and present a 'Handyman Corner' presentation

Goals for testing

- To determine a real world comparison of a Full-wave Horizontal Skywave Loop Antenna vs. a 80-10 Meter Off-Center-Fed Dipole.
- The later a proven antenna that works well on SSB and Shortwave Listening. Ham contacts to Perth, Australia, and South Africa, 10,022 miles away (according to QRZ).

Goals

Comparisons of:

- No signal noise levels
- Noise levels in background of RX signals
- Readability of signals in various modes SSB, FT8, CW...
- ... and types Amateur, Broadcast, 'Reference' signals
- ... and across the bands! Longwave, AM broadcast, SWL broadcast and of course, HF Amateur radio 80-10
- Transmission responses Reverse Beacon CW, FT8 ability, SSB contacts & PSK reporter with maps

Environment at QTH

Lot size is 112.5 feet East-West by 165 feet North-South ~ .43 Ac.

 LOTS – of QRM (man-made noise)
 Due to 50+ year old utility infrastructure & Near business 'district' (Auto Shops, Restaurants, Retail Stores)
 Some 'questionable' Chinesium signage!* * That Violates Part 15 of FCC rules!

Equipment

- 17 Meter Full wave Horz. Skywave Loop
- 80-10 Meter OCF Dipole
- Kenwood TS-440SAT
- SignaLink USB Audio Interface
- CW Auto-Keyer (supplied by Tom-W8TK)
- Later borrowed W8TK Kenwood TS-590S & P.S. for TX testing (simpler switching & better/faster Auto-Ant. Tuning)

Terminology note...

- Technically speaking, a full wave loop antenna has no more gain than a dipole.
- And I was corrected on my improperly using the term, "well the loop appears to have higher GAIN".
- HOWEVER, I should note that I now use the term

 "relative gain"; for as the signal levels are the same, the noise floor is lowered, making for more signal to work with in the receiver.

Results

 IMMEDIATELY apparent difference in noise levels and ability to comprehend weak signals, easier on ears, and signals pulled out of nowhere on Loop antenna!



IMPULSE NOISE - ELIMINATED



No Signal NOISE

Results - Longwave

- Aviation beacon station on 338 kHz, not there at all on dipole, completely blanked out by ORM!!!
- Switching to Loop presented no noise and the ongoing CW ID of the beacon! NOTE HOW THE NOISE LEVEL ALSO DROPS ON THE METER!
- DIPOLE IS 'ANT 1', LOOP IS 'ANT 2'



Results – AM & SWL Broadcast

- Barely able to hear at all, again mostly covered over by noise on dipole.
- Able to hear on Loop



30 M - SWL Broadcast

Another 30 M - SWL BC

AM Broadcast Band

Results – Shortwave Listening & Reference Stations (WWV & CHU)

• same results, stations apparently not present on dipole, just spring out the cloud of noise!



WWV IMPULSE NOISE

WWV out of thin air!

CHU too!

Results – Amateur Radio (RX)

- Once again, buried signals or weak signals just pop out and become readable.
- S-units of difference in background noise whether off-signal or with a signal. This is true of AM, SSB or CW.
- Marked difference in FT8 signal strength, & station decoding ability.



Barely There...

Best example...

FT8

Amateur Radio (RX) - 2



17 Meters



20 Meters



17M CW – Huge difference!



40 M – other guy lost is noise

Results – Transmitting Amateur

- CW Reverse Beacon Network reporting Using the provided CW auto-keyer, with programmed in "CQ N7GHZ", I was able to conduct tests over several days over most of the bands.
- Reverse Beacon signals are shown generally as greater but mixed on the Loop vs. the Dipole 17 Meters.

Results - TX

- FT8 While few Europe stations were decoded & worked on the dipole, quite a few more worked on the Loop. – 17 & 15 Meters
- Worked Norfolk, Is. (VK9), Osewega Is., South Africa, etc.
- Worked stations in Tucson area, Phoenix, CA, east coast, and mostly all over the world on Loop.
- Difficulty still with certain EU or SA countries (Catalina Mtn's.!)(issues with anything from about 115 to 145 degrees), but I own the Pacific!
- Have WORKED ALL STATES & ALL CONTINENTS Yes, including Antarctica – either on 17M fully on loop, or 80-20 using loop as RX antenna.

Results in graphics – 17 Meters







Loop Disadvantages

- Need 4 good, tall supports (I have 3- 40 foot trees, & 1- 22 foot tree).
- In crowded area with interfering objects (houses, poles, tree limbs, other antennas...) – you need several people to raise antenna.
- I needed 5 people in total in order to bring up my ant. @ QTH
 In a controlled fashion.
- In an open area without obstacles and poles, 1 person could install it.
- Lightning/Static electricity build-up. –
 Needless to say, lightning protection devices are an absolute requirement for permanent installations!
- Concerning static build up; there should be no issue here, as the wire is insulated, therefore the wind/snow should not be able to create a static build-up. However, that is the suppressor's job too.

Loop Disadvantages -2

- On TX, a loop is usually considered a single-band antenna!
- ... But Wait!!!
- In fact, if you build a larger loop for 40 or 80 meters, you can use a tuner (automatic or manual) in order to tune the higher frequency bands! ...and I did!
- The tuner in the TS-590SG is so very good, I started with very low power and found that the 17 Meter loop was able to tune 15, 12, 10 and 6 meters! And I was able to get signal reports from the Reverse Beacon Network! In each comparison, the loop almost always had a higher db report than the dipole.
- More importantly, in receiver's that have multiple antenna inputs, and especially those with an RX ANT IN Connector, you can transmit on a dipole that is not suited to YOUR loop (like mine that won't TX on 20, 30, 40, 60, 80, & 160M), yet still get the RX advantages of lesser noise!

Construction Details

- While simple to construct, some thought and planning must be exerted to ensure a working antenna. By using the math, my project returned a perfectly acceptable SWR of 1.38:1 with no further trimming needed!!!
- Wire used is simple, black 14 AWG solid insulated THHN wire used in homes and commercial electrical construction! Black insulation is UV stable!
- Lines used to hold up antenna are the same tar-coated heavy duty twine used by Tom for our Field Day antenna mast center guy ropes. Very strong. However, for long term use, would probably want to use synthetic line. Lines are tied off using same rope cleats as used on boats or flag pole lines. 3 lines tied to wire bent at 90 degree angle, and taped with electrical tape to prevent slippage.

Construction Details - 2

- Wind A couple of very gusty wind days, with no significant movement of lines or 'mid-air' balun. The balun and coax being the only significant 'catchers' of wind. The wire will never break before the twine! With synthetic lines, the tree branches would break in the wind before the wire or lines!
- Balun is a 4 to 1 commercial unit, though a well built and weather-proof box DIY unit would work as well.
- Lines are mechanically looped through eye-bolts, then connected to input bolts (same eye-bolts) with crimp-on spade-lugs. For permanent installation, those lugs should have silicon caulking to prevent corrosion. At top of Balun box, is another eye-bolt tied to support string.

Construction Details - 3

- Coax cable connected to bottom of Balun box and wrapped with electrical tape to protect from water intrusion. Cable has 8 ferrite beads and tape covered to prevent stray R.F.I. & currents on shield of wire. Fed to lightning suppression at outdoor station ground rod.
- Coax Cable Strain Relief In order to keep weight off of the PL-259 connection, I took another piece of that twine and installed it between the upper support eyebolt and circled the bottom around the base of the last tape covered ferrite bead. This allows all of the weight of the coax to be supported by the string, and not by the coax connector!



Conclusions

- Without a doubt, increased performance in RX performance, across the bands and regardless of mode!
- While TX performance tests are not as impressive, there is certainly no lessening of performance.
- It should be noted also, that the broadband nature of the loop allows SSB & FT8 on same loop without retuning.
- Bottom line I'm gonna need a bigger loop!

Bigger Loop

- Need to cover All bands from 80-10 Meters. Not enough space for 160 M.
- Plan is to run an 80 Meter antenna; tuned for FT8, 3.573 MHz.
- Math time 1005/3.573 = 281 feet, 3 inches. Call it 282 ft. to allow trimming. 70 feet, 6 inches per side.*
- *3.573 (80 M) > 7.146 (40 M) > 14.292 (20 M) > 28.584 (10 M) Loops resonate on every harmonic, not third...
- With good tuner, should tune all ham bands.
- Will also vastly improve reception on all bands. Bigger is better!
- …"LIFT", ok now look, "LIFT" (a bit more), now look…
 "Ok, right there is good enough!"

BUILD A LOOP! Thanks!

- With great thanks to Tom W8TK, who asked for this presentation, and supplied several key components, and technical advice;
- As well as to George NU7A, who was also very supportive on the idea of picking up the mantle of the Fullwave LOOP antennas.
- …And… to Scott K7ADX, who's skills with PowerPoint were of absolute importance; as mine were so rusty!

KITTI - MA	MIN N7GHZ	18087.9	11	dB	22282 26 Jan
WZ71-PA	N7GHZ	18088.0	10	dB	2225z 26 Jan – 2 dB
K0788-2 -Mt. L	N7GHZ	18088.0	7	dB	2225z 26 Jan
K0788-Mt. L	N7GHZ	18088.0	7	dB	2225z 26 Jan
KITTT - MA	N7GHZ	18084.9	11	dB	2224z 26 Jan
WZ71-PA	N7GHZ	18085.0	12	dB	2224z 26 Jan
K0788-2 -Mt. L	N7GHZ	18085.0	7	dB	2224z 26 Jan
K0788-Mt. L	N7GHZ	18085.0	7	dB	2224z 26 Jan
K2DB -FL	N7GHZ	18088.2	8	dB	1659z 23 Jan - 1 dB
K0788-Mt. L	N7GHZ	18088.0	8	dB	1659z 23 Jan – 1 dB
K0788-2 -Mt. L	N7GHZ	18088.0	12	dB	1659z 23 Jan + 5 dB
WSOA -NC	N7GHZ	18088.0	29	dB	1658z 23 Jan + 8 dB
KITTT - MA	N7GHZ	18087.9	11	dB	1658z 23 Jan
WSOA -NC	N7GHZ	18085.0	21	dB	1657z 23 Jan
K2DB -FL	N7GHZ	18085.2	9	dB	1657z 23 Jan
K0788-2 -Mt. L	N7GHZ	18084.9	7	dB	1657z 23 Jan
K0788-Mt. L	N7GHZ	18085.0	9	dB	1657z 23 Jan
K0788-2 -Mt. L	N79HZ	24902.9	19	dB	1626z 23 Jan + 6 dB
K0788-2 -Mt. L	N7GHZ	24900.0	13	dB	1625z 23 Jan
K0788-2 -Mt. L	N79HZ	18088.0	10	dB	0134z 22 Jan + 2 dB
K0788-2 -Mt. L	N7GHZ	18085.0	8	dB	0132z 22 Jan
VE7CC -VacBC	N7GHZ	18088.0	6	dB	2136z 19 Jan - 11 dB
K0788-2 -Mt. L	N7GHZ	18088.0	12	dB	2135z 19 Jan + 8 dB
K0788-Mt. L	N7GHZ	18088.0	7	dB	2135z 19 Jan
KU7T -SooWA	N7GHZ	18085.0	1	dB	2135z 19 Jan
VE7CC -VacBC	N7GHZ	18085.0	17	dB	2134z 19 Jan
K0788-2 -Mt. L	N7GHZ	18085.0	4	dB	2134z 19 Jan
K0788-Mt. L	N7GHZ	18085.0	7	dB	2134z 19 Jan
K0788-Mt. L	N7GHZ	18088.0	8	dB	1635z 19 Jan 🚥
KITTT - MA	N7GHZ	18087.9	13	dB	1635z 19 Jan +4 dB
K0788-2 -Mt. L	N7GHZ	18085.0	5	dB	1634z 19 Jan
K0788-Mt. L	N7GHZ	18085.0	8	dB	1633z 19 Jan
KITTL - MA	N70HZ	18084.9	9	dB	1633z 19 Jan

More N7GHZ Results











336 out of 488 U.S. Grid Squares Worked!

By the way, & FYI U.S. Ham distribution

