2021 OCARC Presentation

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EndFed-HalfWave Antenna (EFHW)

by

Ken Konechy W6HHC

W6HHC@W6ZE.org

EndFed-HalfWave Antenna

What is an End Fed Half Wave antenna…

- EFHW is a simple multiband antenna
- EFHW Wire can be oriented as horz or vert or sloping
- Does NOT need 1/4-wave RADIALs
- Can use short "counterpoise" wires or Ground-rod
- The End-Fed impedance is around 2400 ohms,
  so requires 49:1 impedance transformer for 50Ω coax

EndFed-HalfWave Antenna

What is an End Fed Half Wave antenna…

End-Fed Half-Wave (EFHW) antennas are a multiband HF antenna-design.

They are simple and relatively low cost compared to commercial multiband beams and vertical antennas.

Hams can:

- **purchase assembled units**
- **build the EFHW from an antenna kit**
- **build the EFHW antenna from scratch w/ purchased components (for example: from DigiKey)**

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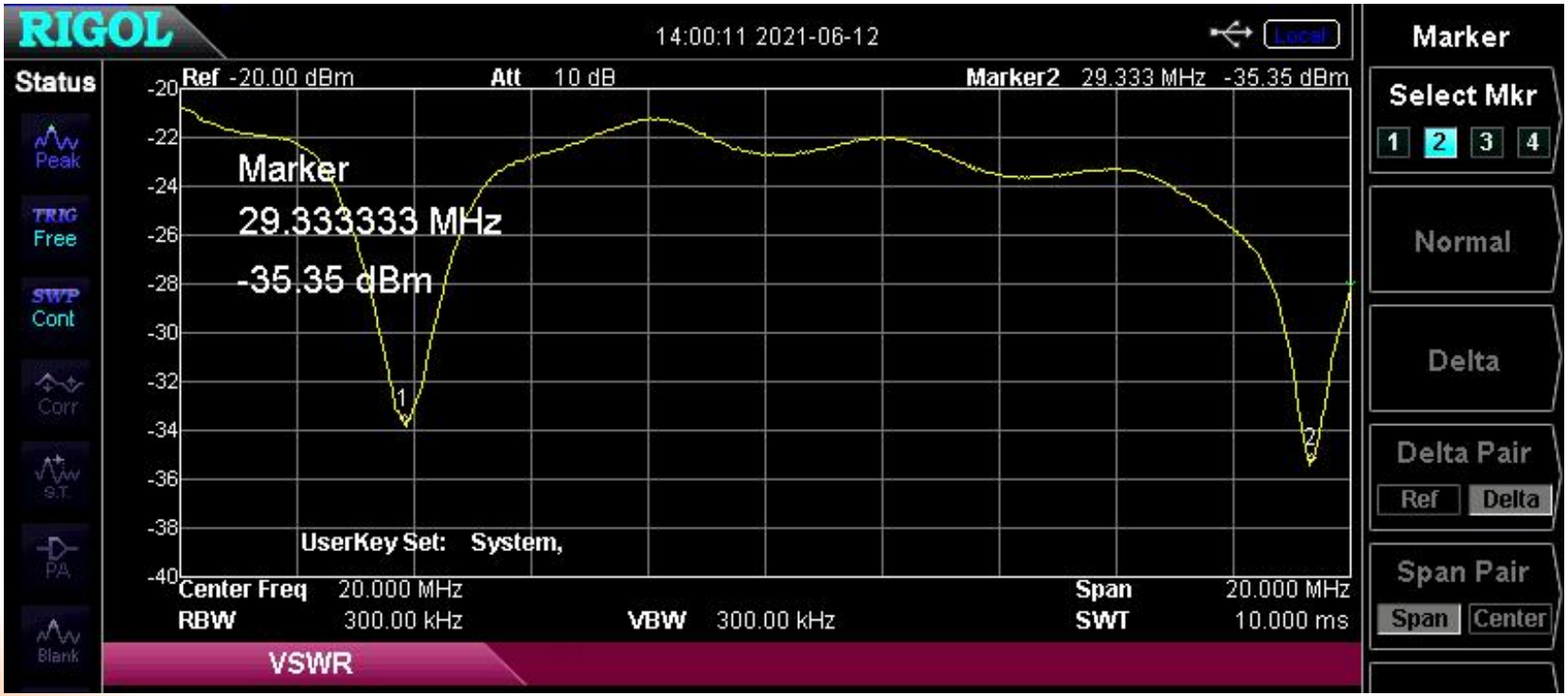
EFHW concepts



Typical 20M EFHW antenna SWR for 20M and 10M

(provided by W6HHC)

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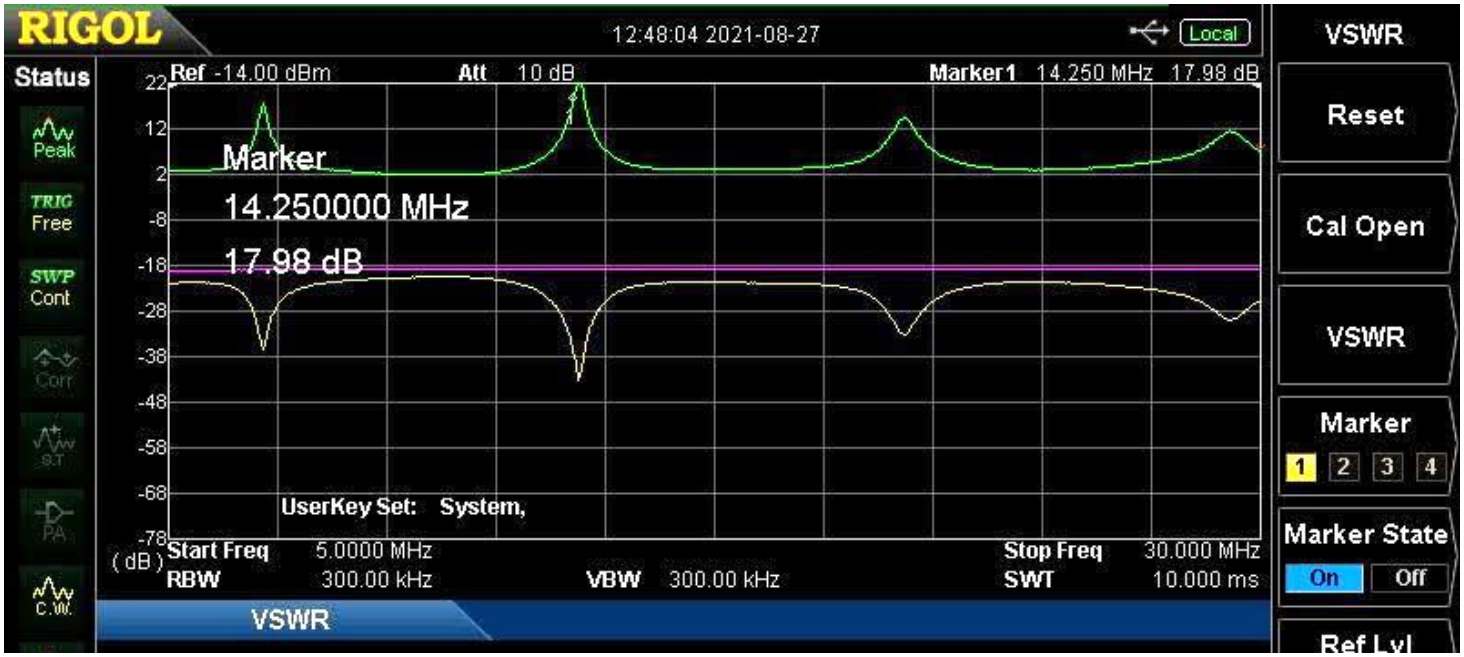
EFHW concepts



Typical 40M EFHW antenna SWR for 40M 20M 15M and 10M

(courtesy of John KE6SPO)

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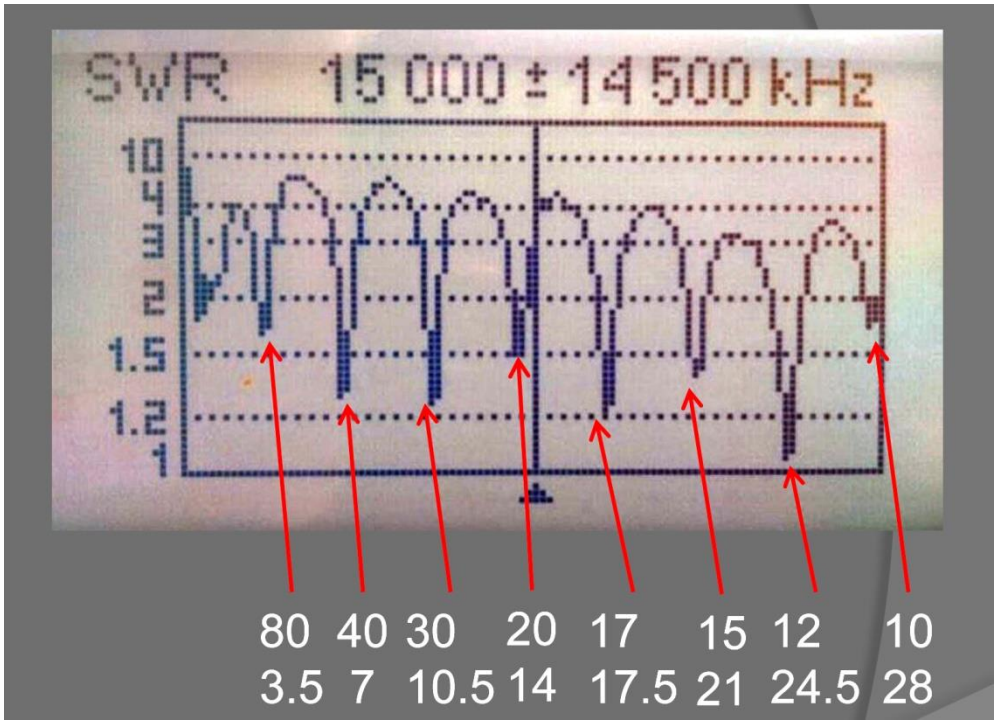
EFHW concepts



Typical 80M EFHW antenna SWR for 80M 40M 30M 20M 15M and 10M

(courtesy of K1RT)

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Block Diagram of EFHW concept

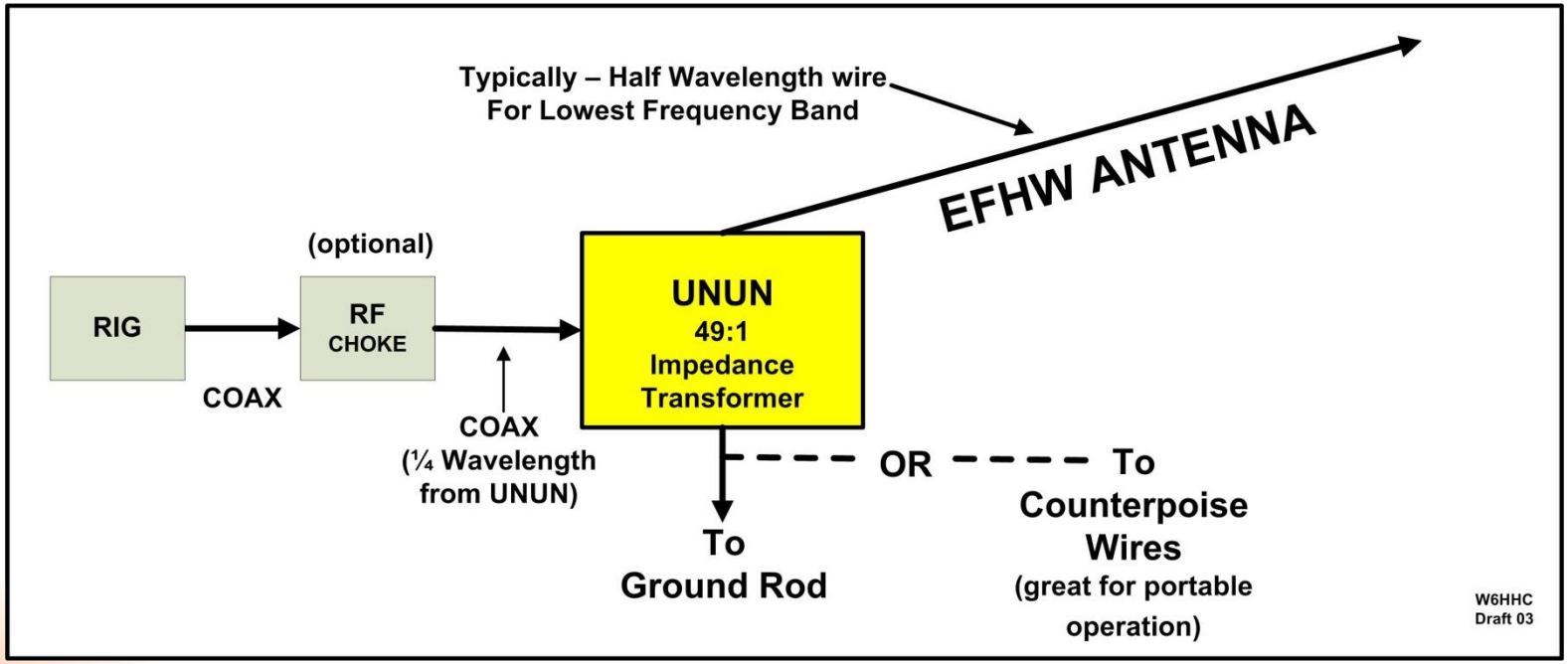

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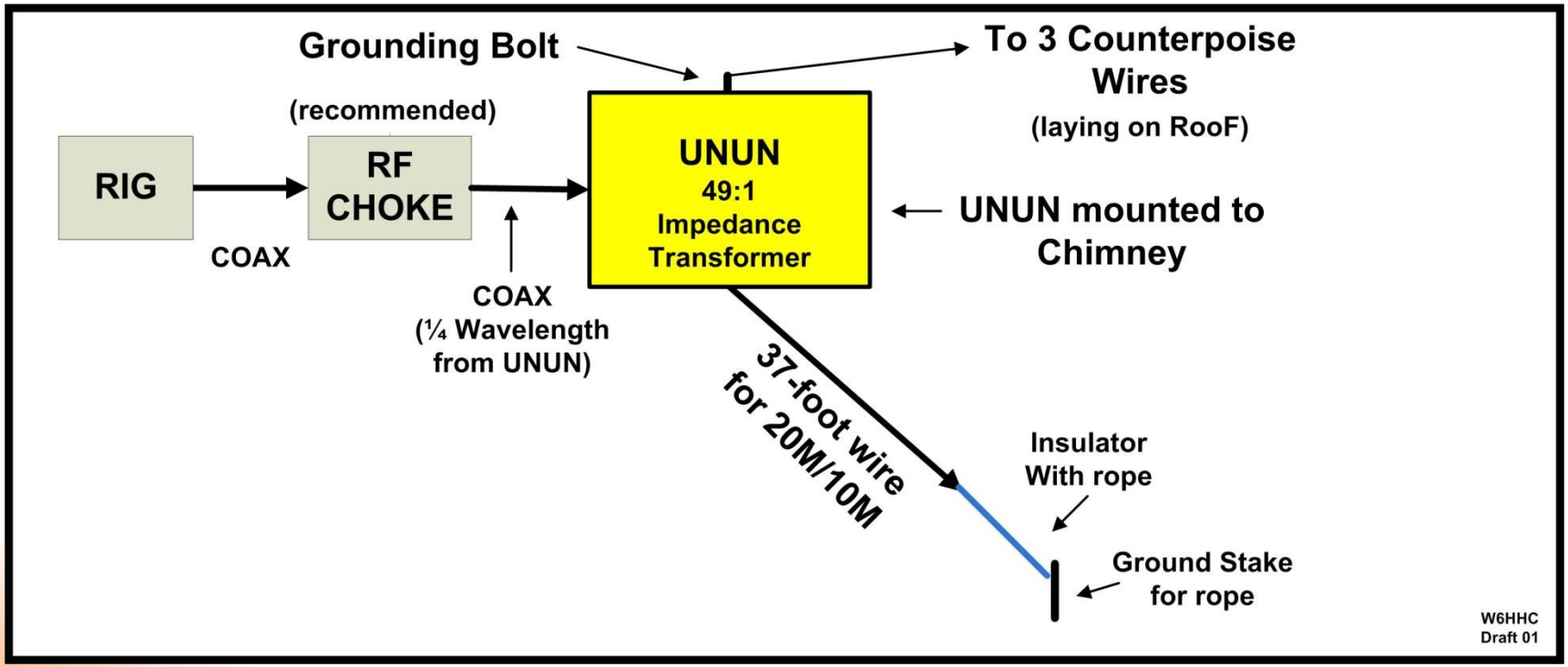
Diagram with UNUN mounted on Chimney



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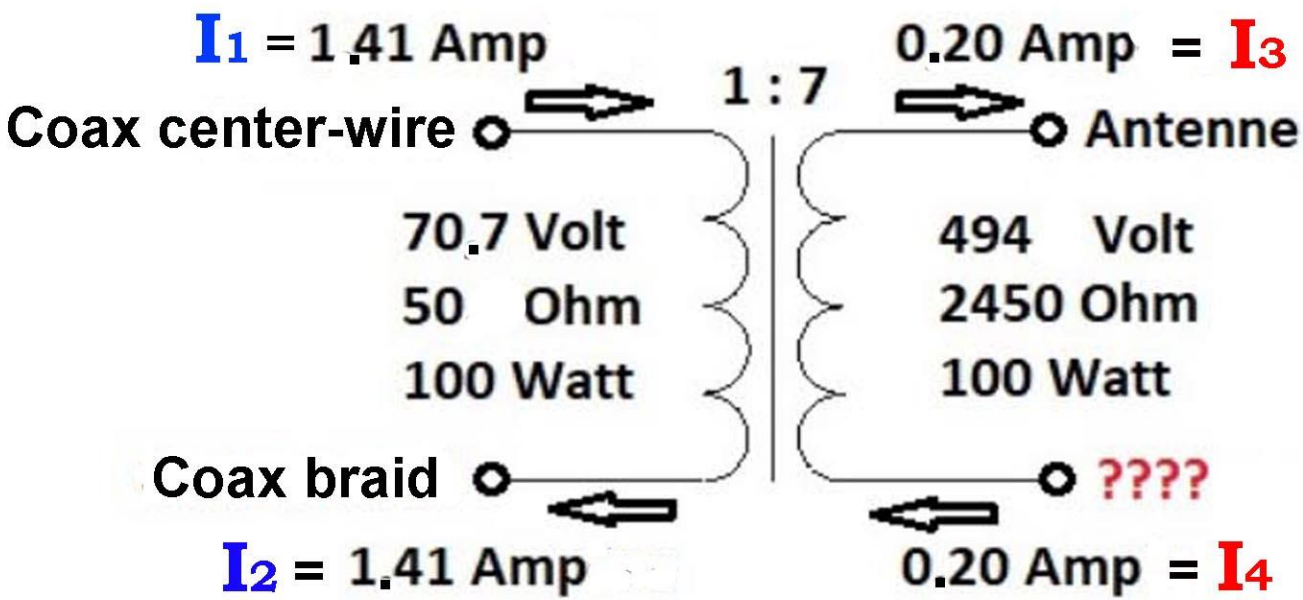
Discussion on “Counterpoise” wires

Where does UNUN current I_4 flow to - in diagram below



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Discussion on “Counterpoise” wires

Kirchhoff’s Law defines

$$I_1 + I_2 + I_3 + I_4 = 0$$

So where does I_4 flow to?

1. **To a nearby connected Ground Rod**
2. **To the “counterpoise wires”**
3. **Onto the Coax Braid as common-mode current (on coax I_4 is NOT differential)**

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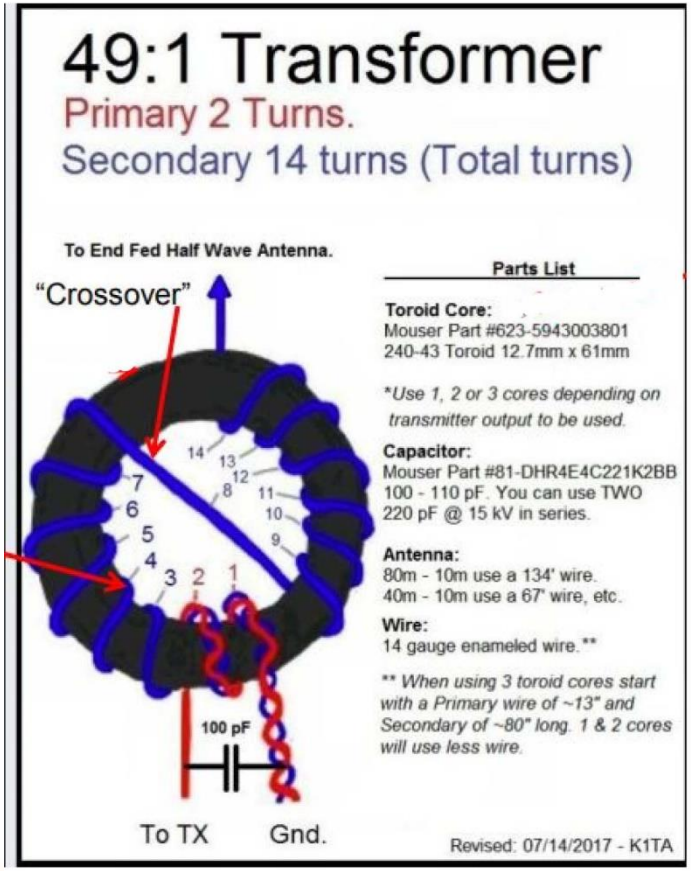
Winding the UNUN Transformer toroid



(Courtesy of K1TA)

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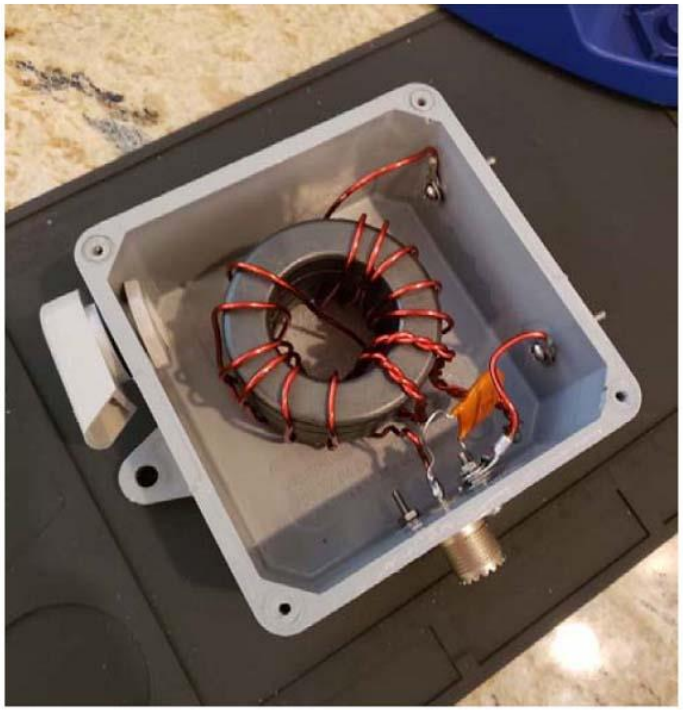
Typical Construction of Impedance XFormer



AI6ZV used two toroid cores in his impedance xfmr for better efficiency and to lower heat for 100W rig. Heat is lost power that never reaches the antenna.

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XFMR Construction using 1, 2, or 3 Toroids

- More than 1 toroid generally reduces wasted RF
- A single FT240-43 toroid with 2T/14T winding is 66.5% efficient on 80M.
- A double FT240-43 toroid with 2T/14T winding is 83.25% efficient and dissipates 7.4W on CW for a 100W rig
- Type 52 ferrite toroids (a few dollars more) are more efficient, and are good for 40M – to 10M – such as FT240-52

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My First EFHW Installation at my QTH

- Considerations for locating the UNUN
  - **My new wife had never dealt with HF antennas before**
  - **She is skilled Interior Designer… so appearance of coax is BIG**
  - **She had grave concerns about coax running over sidewalk … or from second floor to side yard (above sidewalk).**
- I mounted UNUN Transformer on Chimney
  - **The EFHW is for 20M…should also resonate on 10M**
  - **The wire slopes down to a ground stake with insulator & rope**
  - **My primary 20M interest is 14.076 MHz (FT-8 digital)**
  - **My primary 10M interest is 28.375 MHz (OCARC 10M SSB Net)**
  - **I expected the sloping wire (N-S) to give radiation in most directions…although there is a hill rising to the NE.**
  - **Counterpoise is 3 X 10-ft wires that lay on roof or nailed to eaves**

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My First EFHW Installation at my QTH

- **Checking out my 20M/10M EFHW**
  - **Checked out SWR using my RIGOL spectrum analyzer with VSWR adapter**
  - **SWR acted as expected on 20M and 10M**
  - **Added FT-8 (SignaLink-USB to my ICOM 756-PRO3)**
  - **ON-Air tests immediately found four BIG problems !!!**

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My First EFHW Installation at my QTH

- **Four BIG "on-air" problems**
  1. Receiver noise on 10M SSB was constant S8
     (I could only understand stations that were S8 or better)
  2. Receiver noise on 20M SSB was S9+5db hard to hear FT-8
     (Decoding signals was harder…waterfall was almost useless)
  3. When I spoke into 10M mike…my desktop computer froze
  4. Resonance on 10M was above 29.3 MHz…I wanted 28.375 MHz
     (Lengthening wire helped 10M…but hurt 20M…down to 13 MHz)

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Prob #1) 20M SSB was constant S9 + 5dB

- Noise had peaks every 15 KHz across 20M
- My initial thoughts were neighbors' Plasma TV?
- Then I shut off house power – noise was still there?
- I remembered my Uninterruptable Power Supply (UPS) was still running.
- Turned House power ON – Turned UPS OFF
- Then 20M noise dropped to S4

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20M SSB had been constant S9 + 5dB

20M SSB dropped to S4 w/o UPS running

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Prob #2) 10M SSB was constant S8

- My Noise on 10M was a constant white noise at S8
- My initial thoughts where outdoor landscape lights SMPS
- Then I shut off house power – noise was still there?
- When I turned OFF UPS the 10M noise fell to S1

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10M SSB noise had been constant S8

10M SSB dropped to S1 w/o UPS running

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Prob #3) 10M SSB Freezes my Desktop PC

- When testing SSB … RFI was getting into my ham shack
- “Common Mode RF” was on the braid of my antenna coax
- The solution to common-mode RFI is to block it with ferrite toroids … where the current is at its peak.
- Member Frank W6NKU had a Minute-Man era torroid that was designed to detect common-mode RF current flowing
- Slide the detector along the coax looking for peak-current
- Place a torrid at the point of coax…for each band.

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Prob #3) 10M SSB Freezes my Desktop PC

- On 20M … the peak current was where the coax had come into shack from outside wall.
- On 10M … the peak current was about 8 ft further towards the rig from the 20M peak
- A “snap-on ferrite” core or a good toroid with several turns of coax did the job. The RFI current measurements basically disappeared.

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Prob #3) 10M SSB Freezes my Desktop PC

- LEFT – Common Mode RFI Current sniffer (surplus)
- RIGHT – Fair-rite Type 31 snap-on ferrite core from DigiKey

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Prob #4) Resonance on 10M was > 29 MHz

- On 10M …. My first resonance was above 29 MHz
- 20M halfwave was fine 14.0 MHz - but 10M was too high
- So I tried adding a separate 10M half-wave wire to EFHW
- The antenna worked better….10M was around 27.9 MHz and 20M was around 14.0 MHz
- Use tie-wraps to attach two wires together
- …black tape is terrible

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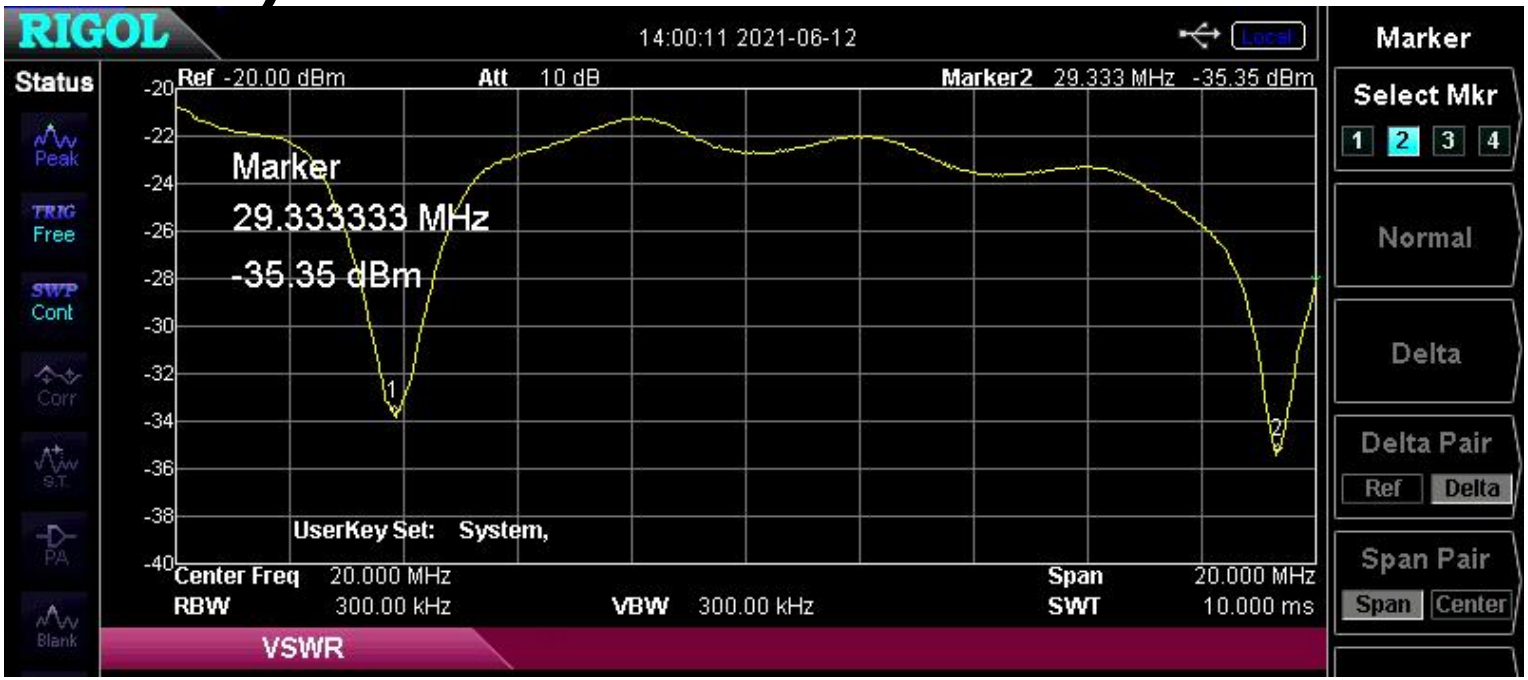
Prob #4) Resonance on 10M was > 29.3 MHz



A single 20M half wave wire resonates on 10 M

But on 10M the resonance is 29.3 MHz (too high)

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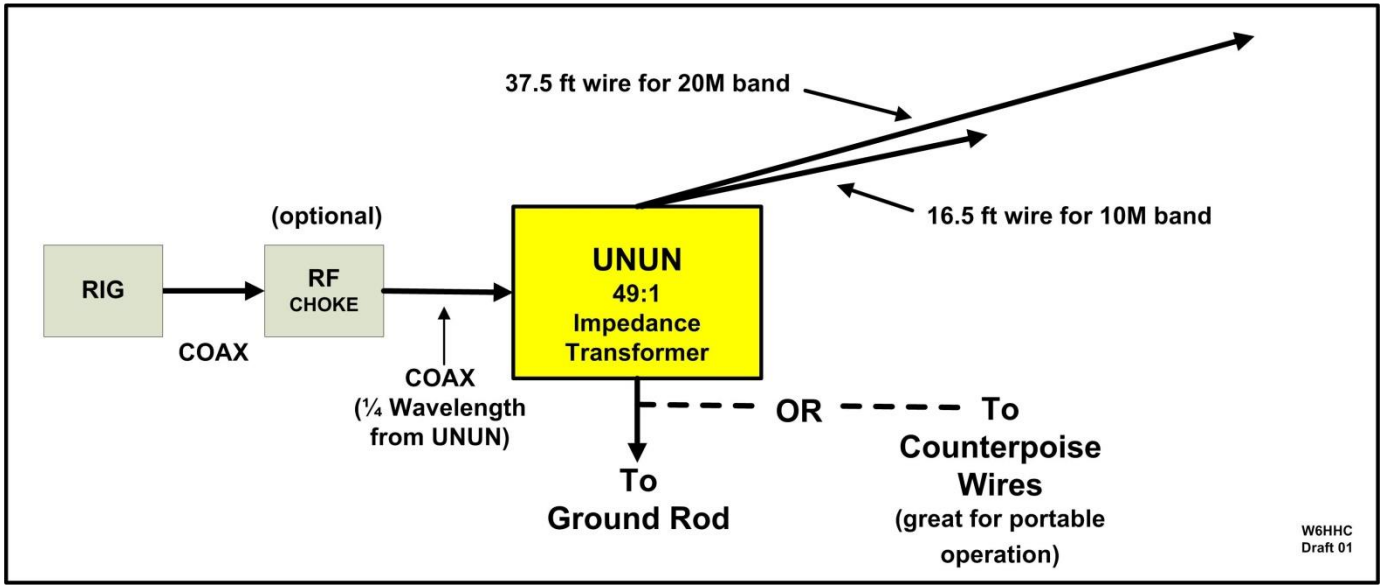
Prob #4) Resonance on 10M was > 29 MHz



Add a separate 10M half wave wire

Each wire sees half wavelength on its Freq

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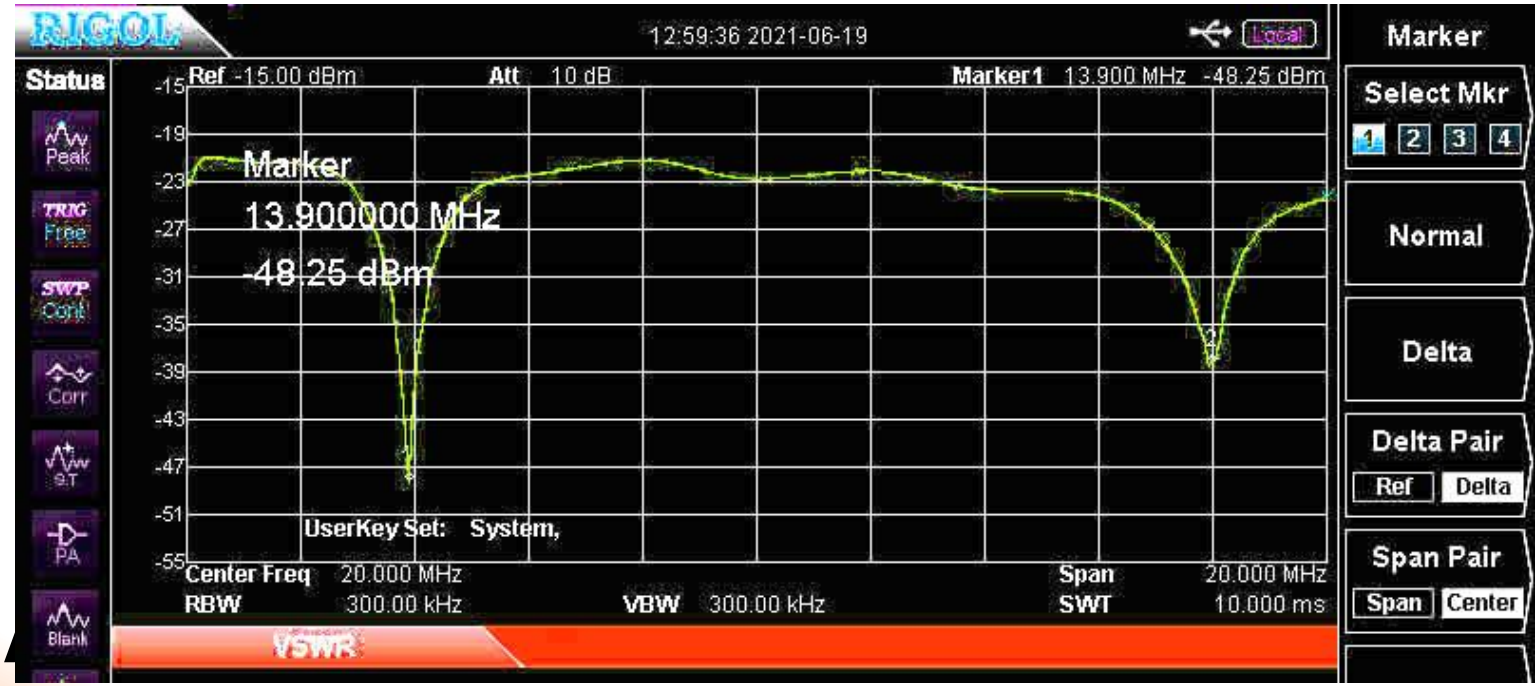
Prob #4) Resonance on 10M was > 29 MHz



Each wire sees half wavelength on its Freq

My first cut was 28.0 MHz

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Performance after EFHW Problems Fixed

10M OCARC Net Results

- Before the noise problem was fixed, I could only copy 3 stations (had to be S8)
- After noise was fixed, I can copy all 10M stations that NCS can copy.

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Performance after EFHW Problems Fixed

20M FT-8 Digital Results

- Before the noise problem was fixed, I could NOT copy any FT-8 stations
- After noise was fixed and with FT-8 help from Tim N6GP, I was able to make contacts on Seattle, Texas, VE7, and XE2 on the first night.

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Performance after EFHW Problems Fixed

20M FT-8 Digital Results

- **DX worked includes:**
  UA, JA, 9V, VK, XE, CO7, KP4, HK, LU, CE, & VE
- **PSKREPORTER.INFO is a wonderful website**
  One morning after few minutes of FT-8 calls on 20M
  I was logged in England, Switzerland, and Italy
- **Part-time on 2021 Field Day produced:**
  20 digital contacts using FT-8

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Where to Purchase EFHW assembled or Kits

40M – 10M Assembled (1 KW) – Vibroplex, LLC

- Google – PAR-EndFedz-EFHW-40-10-KW
- Sold through DX-Engineering ($160)

80M – 10M Assembled (1 KW) – MyAntennas.com

- Google - EFHW-60S-1K ($146)

40M – 10M Kit (200 W rating) - ARRL ($70)

40M – 10M "from Scratch parts"

- DigiKey is a good source (for ex: P/N 1934-1132-ND)
- Fair-Rite Type 52 toroid is P/N 5952003801 – ($14 each)

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Useful Web Sites

- EndFed HalfWave Antenna
  - Google - K1RF End-Fed Half-Wave antenna
- EFHW Antenna --- Building The Transformer
  - YouTube - Steve Ellington N4LQ
  - YouTube - EFHW MULTIBAND ANTENNA with 49:1 UNUN – OM0FT
- Weak Signal Joe Taylor (WSJT) Digital Modes
  - Google – WSJT-X User Guide
- Facebook group End Fed Half Wave Antennas >7000 members
- DigiMode Monitoring Stations - Propagation Reporter
  - Google – PSKReporter.INFO
- This OCARC EFHW Presentation by Ken W6HHC (PDF)
  - https://www.W6ZE.org/HR-related/OCARC_EFHW-antenna_W6HHC.pdf
- 49:1 Transformer End Fed Half Wave (EFHW) Antenna for W6ZE by AI6ZV
  - Select the May 2020 issue of OCARC RF Newsletter at
  - https://www.W6ZE.org/Newsletter/RF-Newsletter-2020-05.pdf