

## 4:1 Hybrid Balun Kit Instructions

### Bill of Materials:

Part	Qty	Assembly
FT-240-43	1	4:1 Transformer
18AWG Wire	5	
FT-240-31	1	1:1 Choke
RG400 Coax	4	
150pF Cap	1	Loading Capacitor Assembly
180pF Cap	1	
2.7M Res	1	
#8-32 - 5/8"	2	
#8-32 locknut	2	
Enclosure	1	Enclosure, Bracket, Insulators
HDPE Mount	1	
HDPE Insulator	3	
#6-32 - 3/4"	2	
#6-32 locknut	2	
#6 washer	2	
#10-32 - 1"	2	Antenna Wire Mounting
#10-32 nut	4	
#10 washer	6	
#10 split washer	4	
SO-239	1	SO-239 Mounting
#4-40 - 1/2"	2	
#4 locknut	2	
#4 star washer	2	
#4 washer	2	
small wire tie	8	Wire Ties
medium wire tie	4	
wire tie mount	4	

## Step #1 – 1:1 Choke

- Secure one end of the 4-foot section of RG400 coax to the Type 31 toroid using 2 small wire ties (one wrapped around the toroid and the other passing under the first wire tie to secure the coax). Leave about 3 inches of coax at the starting point.
- Wind 13 turns (80M Dipole) or 12 turns (40M Dipole) depending on what size dipole you intend to build. Use a crossover for turn #7 so that the coax extends from opposite sides of the toroid when the winding is complete. Windings should be as tight to the toroid as possible.
- Secure the loose end with 2 more small wire ties.
- **Pro Tip:** Use Needle Nose Pliers to get the wire ties VERY tight.



## Step #2 – 4:1 Transformer

- Secure one end of a 30-inch section of #18AWG zip cord to the Type 43 toroid using a small wire tie. Leave about 3 inches of zip cord wire at the starting point.
- Wind 10 turns tightly around the toroid placing each winding tightly against the last. This should fill one half of the toroid.
- Secure the loose end with a small wire tie.
- Starting in the same location as the first winding, secure one end of a 30-inch section of zip cord on the opposite face of the toroid. Arrange the wire such that that colors alternate (red next to black, not red next to red).
- Wind 10 turns tightly around the toroid placing each winding tightly against the last. This should fill the remaining half of the toroid.
- Secure the loose end with a small wire tie.
- At the winding starting point separate both sets of wires and strip all four ends ( $\frac{1}{4}$ " ).
- Twist the red ends together. Repeat for the black ends. These connections will be wired to the 1:1 Choke.
- At the winding end point separate both sets of wires. Cut the adjacent set of red and black wires such that about  $\frac{1}{2}$ " extends beyond the toroid. Strip the ends, twist together and solder.
- The remaining long wires will be used for the antenna connections.



### Step #3 – Enclosure Prep

- Drill two 3/16" holes on each side of the enclosure about 3" from the top for the two #10-32 antenna connection bolts.
- Drill a 5/8" hole centered on the bottom face of the enclosure for the SO-239 connector.
- Insert the SO-239 into the 5/8" hole and mark 2 mounting points. Drill a 1/8" hole at each mounting point.
- Mount the SO-239 using the following sequence (leave bolt with ring terminal loose for connection to the 1:1 choke):
  - #4-40 Bolt
  - Washer
  - Enclosure
  - SO-239
  - Ring Terminal (for coax shield connection)
  - Star Washer
  - Locknut

### Step #4 – 1:1 Choke Prep

- Pick one end of 1:1 choke for connection to the SO-239.
- Strip outer insulation off coax about 1/4" from toroid.
- Separate center conductor and braid.
- **Pro Tip:** Split the coax braid on the "side" opposite of the connection point to the SO-239 so that all the braid naturally gathers on the side that you want.
- Trim and strip the center conductor such that the center conductor and shield braid align properly with the SO-239 (the coax shield will be longer than the center conductor).
- Strip outer insulation off the other end of the coax about 1/4" from toroid.
- Separate center conductor and braid.

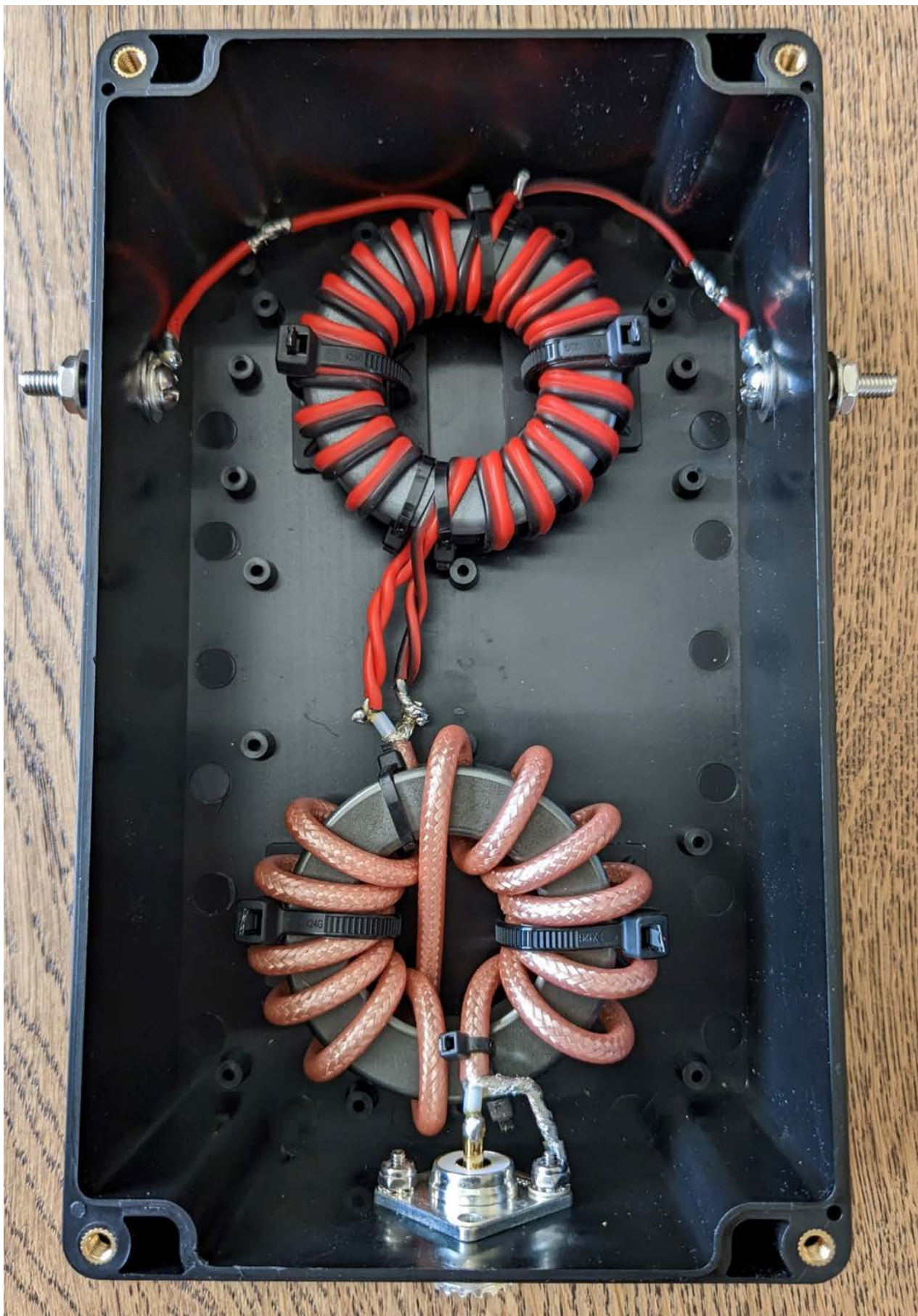
## Step #5 – 4:1 Transformer Prep

- Dry assemble the hybrid balun in the enclosure. The 4:1 transformer should be located as high as possible toward the top and the choke should be reasonably close to the SO-239 at the bottom to maximize separation between the two toroids.
- **Pro Tip:** When assembling the hybrid balun arrange the 1:1 choke such that the connection to the SO-239 faces up and the connection to the 4:1 transformer faces down. This will make final assembly easier and make your wire connections shorter.
- Trim the coax / 4:1 transformer leads to limit excess wire.

## Step #6 – Hybrid Balun Assembly

- Using the hybrid balun dry assembly as reference mount the 4 double-stick cable tie mounts to the back of the enclosure (2 per toroid).
- Reassemble the hybrid balun with the toroids placed on the cable tie mounts.
- Solder the 1:1 choke to the SO-239.
- Secure the toroids to the cable tie mounts using 4 medium cable ties.
- Solder the 1:1 choke to the 4:1 transformer (one twisted wire pair to the center conductor, the other twisted pair to the shield).
- Strip the 4:1 transformer's antenna connection wires ( $\frac{1}{4}$ ").
- Crimp and solder ring terminals to antenna connection wires.
- Install the antenna connection bolts using the following sequence:
  - #10-32 Bolt
  - Ring Terminal
  - Washer
  - Enclosure
  - Washer
  - Split Washer
  - Nut
- Mount Hybrid Balun to bracket using the following sequence:
  - #6-32 Bolt
  - HDPE Center Bracket
  - Enclosure
  - Washer
  - Locknut







## Step #7 – Loading Capacitor Strain Relief

- Wrap the leads of the 180pF capacitor around the leads of the 2.7Mohm resistor. Repeat with the 150pF capacitor.
- Trim each wrapped lead such that the loading capacitor assembly fits in the load capacitor enclosure.
- Strip one end of each 6" connection wire (1/4") and insert it through the hole on each side of the load capacitor enclosure.
- Solder one side of the load capacitor assembly to each 6" connection wire.
- Mount the load capacitor assembly to HDPE insulator using #8-32 hardware.

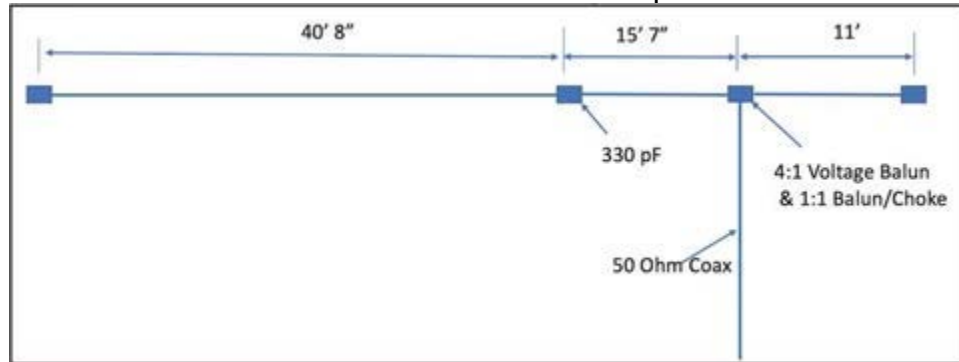


- When assembling the antenna, make sure that the insulator bears all of the wire load and no strain is placed on the connection wires to the load capacitors.
- After assembling and testing the antenna for proper operation, pot the load capacitor enclosure using non-corrosive "sensor safe" RTV silicone or equivalent potting compound. Opaque silicone is recommended to prevent exposure to UV light.

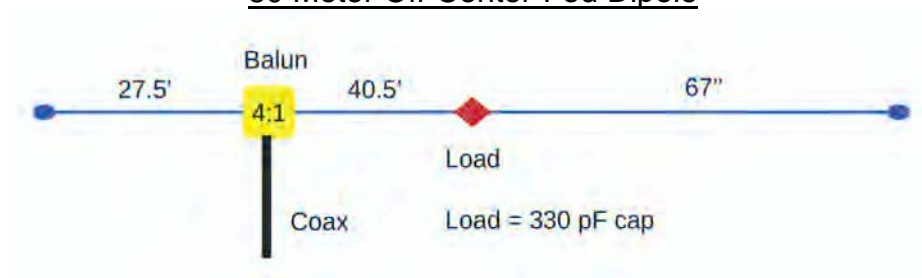


## Antenna Dimensions

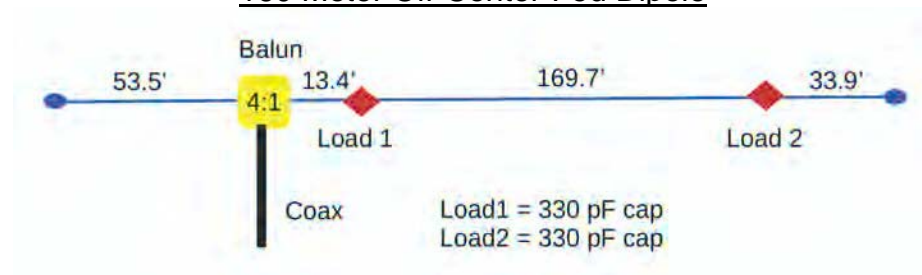
### 40 Meter Off-Center-Fed Dipole



### 80 Meter Off-Center-Fed Dipole



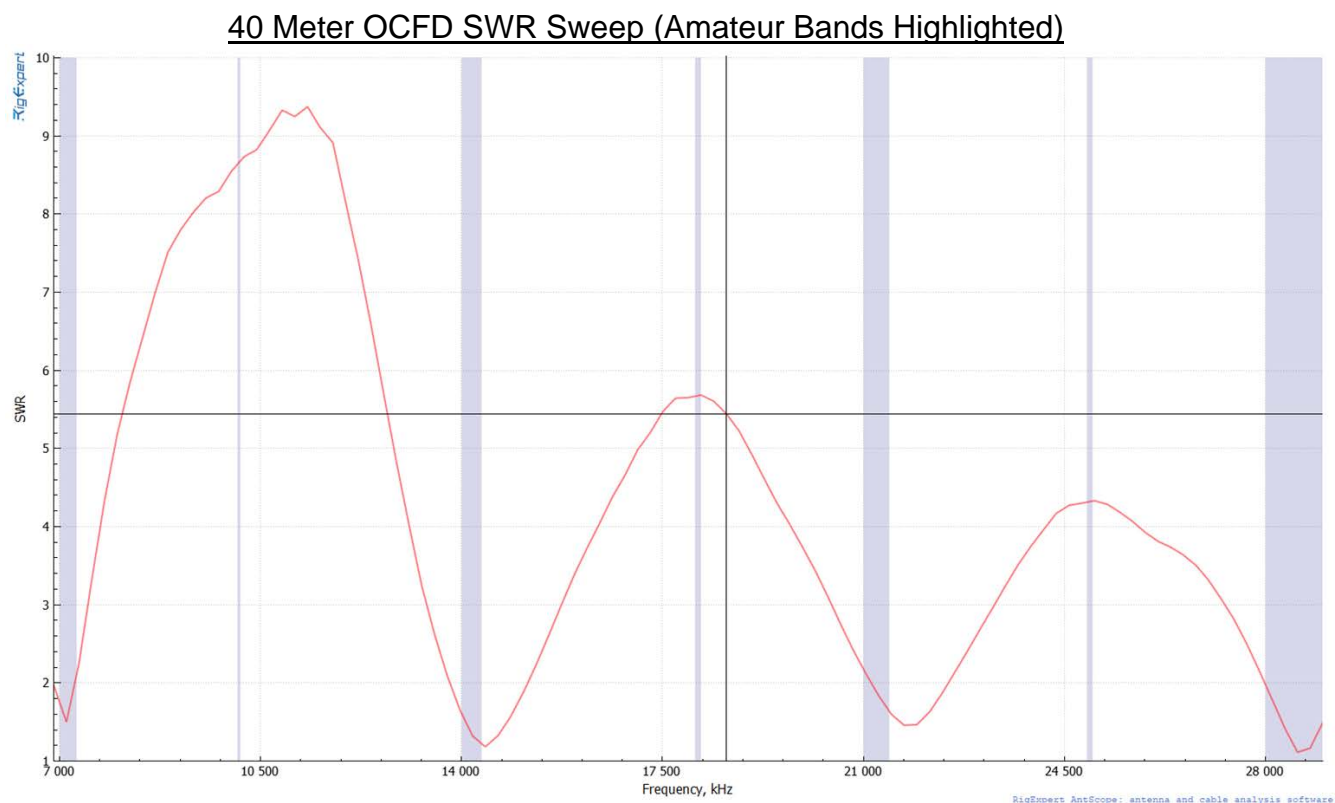
### 160 Meter Off-Center-Fed Dipole





## 40 Meter OCFD Trimming Tips

- Only shorten the wires at the ends.
- Shorten 1 inch on the short end for every 6 inches from the long end to preserve the feedpoint ratio.
- Do your shortening in small increments of no more than 3 inches on the long end and only change the short end when you have shortened the long end 6 inches.
- Placement of the capacitor is less critical, so you don't need to worry about changing its position.
- While trimming you may need to compromise the low SWR point on the higher bands with the low SWR point of the 40 meter band.
- With a 40 meter off-center-fed dipole you should have low SWR on the 40, 20, 15, and 10 meter bands. You may be able to operate the 12 meter band as well with a good antenna tuner.

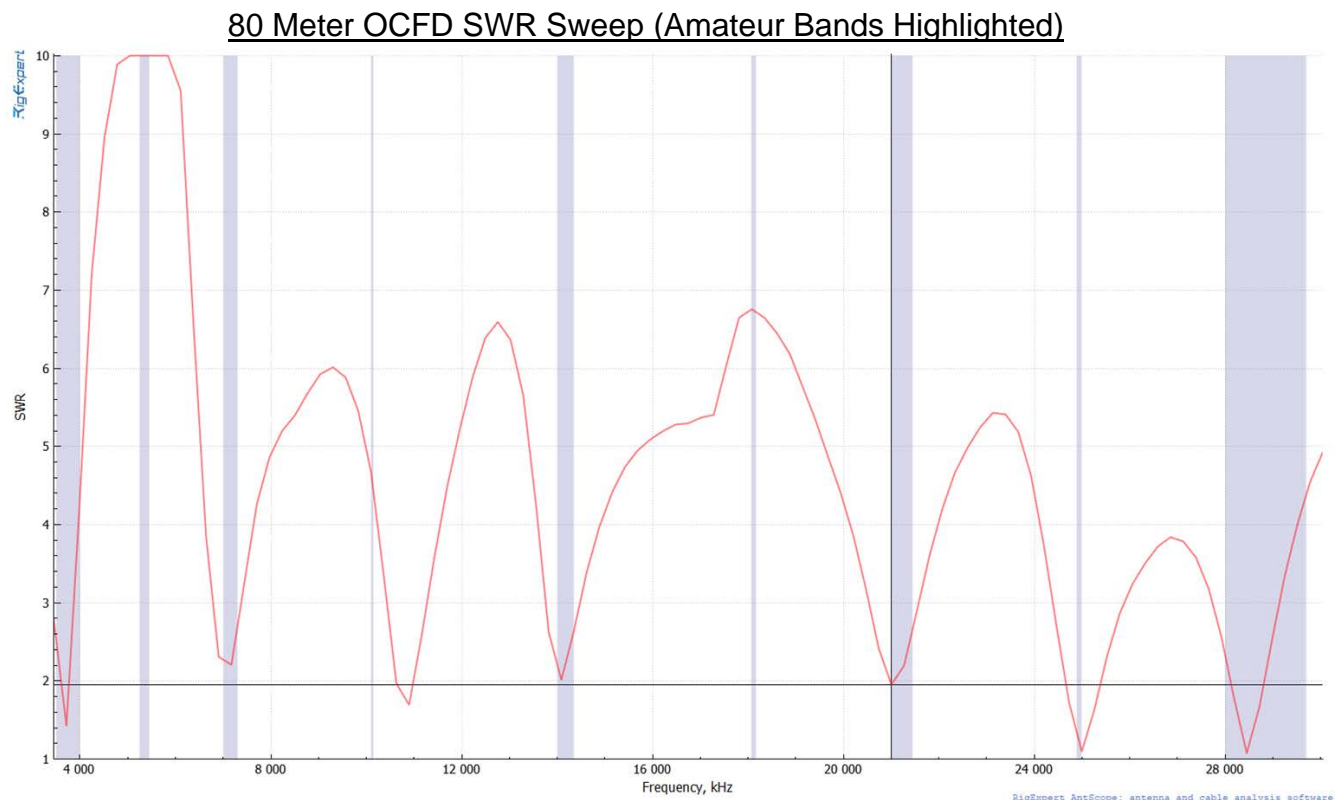


## 80 & 160 Meter OCFD Trimming Tips

- Leave the short end wire six inches longer, and the long end wire 2 feet longer, than specified.
- Tuning requires that the lengths remain in the 4:1 ratio of the 20% offset feed.
- Tuning the 80-meter OCF is best accomplished by adjusting the lengths at the ends to give minimum SWR on 40 meters at about 7.05 MHz.
- Tuning the 160-meter OCF requires adjusting the length for less than 3:1 SWR across most of the band, with a cross check on 15 meters, where the minimum SWR should be at about 21.35 MHz.

Note that there is no need to adjust the middle sections of either antenna; adjusting the ends is sufficient.

- With an 80 meter off-center-fed dipole you should have usably low SWR on the 80 (majority of band under 3:1 SWR), 40, 20, 15, 12, and 10 meter bands. You may be able operate the 30 and 17 meter bands as well with a good antenna tuner.



## References

RF Choke Cookbook: <http://k9yc.com/2018Cookbook.pdf>

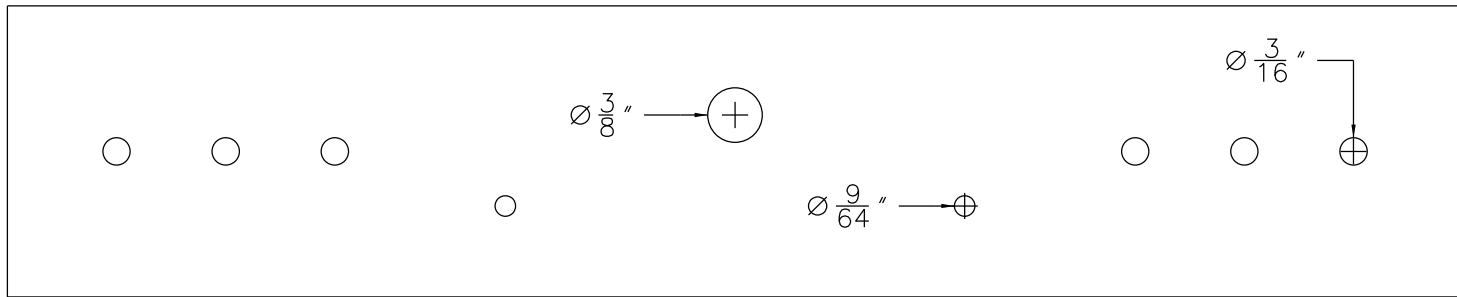
Multiband Off-Center-Fed Dipoles for 160 & 80 Meters:

<https://batteryeliminatorstore.com/blogs/ocf-masters-articles/multiband-off-center-fed-dipoles-for-160-80-meters>

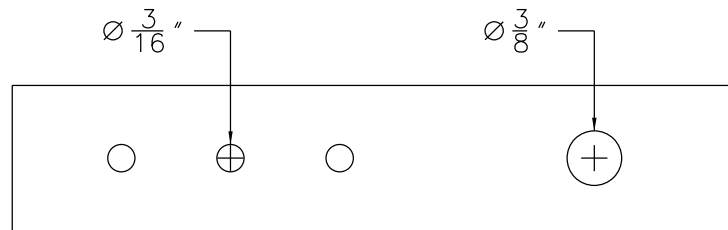
A New Design of a 40-6-Meter Off-Center-Fed Dipole:

<https://batteryeliminatorstore.com/blogs/ocf-masters-articles/a-new-design-of-a-40-6-meter-off-center-fed-dipole>

# Balun Bracket



End Insulator



Load Capacitor  
Strain Relief

