

# Counterpoise

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## Abstract

This article presents a discussion of the meaning of the term “Counterpoise” which is so often found in discussions about antenna systems.

### 1. What does it mean

Readers of VK1OD on the 'net may have noticed that the term counterpoise does not appear much, not even once in the few hundred odd articles extant at the time of writing of this article.

Counterpoise means all things to all hams, because of its lack of clear and unique meaning, wise authors avoid its use.

Let's explore a rational meaning based on the roots of the word. It has two roots, counter and poise:

- counter means in the opposite direction; and
- poise means in a state of balance.

So the use in a quarter wave ground plane antenna of a system of pairs of opposing radial conductors carrying equal currents in opposite directions such that effect of the currents on the far field balance out and the radial system make no contribution to far field strength could be rationally described as a counterpoise.

In contrast, consider a ground plane antenna with all radials but one removed. The remaining radial carries current which contributes to the far field, the effect of its current is not balanced out by some other current in an opposite direction.

A ground plane antenna with many pairs of opposed radials produces nearly perfect cancellation of the effects of radial current, the more pairs the more perfect the cancellation in three dimensional space. Nevertheless, the cancellation is quite good down to just three symmetric radials, and in all these cases, use of the term counterpoise seems quite justifiable.

Sloping the radials down on a ground plane antenna does reduce the cancellation in the far field, the lower the radials, the poorer the cancellation, and use of the term counterpoise is less justifiable.

The case of the L (ground plane with all but one radial removed) discussed earlier is probably a worst case for

balance, and use of the term counterpoise is quite misleading.

The term counterpoise is widely used with inconsistent meaning, most often by people who don't really understand what they mean by it.

The test in my mind of rational use of the term counterpoise is:

*does the structure provide a path  
for currents such that the radiation  
effects of those currents  
substantially balance out in the far  
field in three dimensional space?*

### 2. ARRL

The ARRL Handbook (Straw 2003) defines counterpoise as "A wire or group of wires mounted close to ground, but insulated from ground, to form a low impedance, high-capacitance path to ground. Used at MF and HF to provide an RF ground for an antenna." I would argue that whether the counterpoise is in the ground, close to the ground or well above ground is irrelevant to whether it can perform the function I mention, nor does it need to have a low impedance high capacitance path to ground.

Elsewhere in the same handbook:

- "A counterpoise is most commonly a system of elevated radials...;"
- "Detailed modeling indicates that a sufficiently large mass of metal (that is, a large, “Plumber’s Delight” Yagi) connected to the top of the” tower acts like enough of a “top counterpoise”...”
- "The tower is obviously not contributing much in this setup, since the mass of the large 20-meter Yagi is acting like an elevated counterpoise all by itself."
- "He reported that the uninsulated guy wires act as an effective counterpoise for the sloping wire."

So, you can see that a counterpoise is all things to all people, none of these comply with the definition in the appendix of the handbook quoted above!

It is interesting to note that the term counterpoise is hardly mentioned in the ARRL Antenna Handbook and certainly not defined, reinforcing the thought that people who know more about antennas are less likely to use the term.

### 3. ON4UN's low-band DXing

(Devoldere 2005) uses the term counterpoise several times through the book, but gives only one definition, a parenthetical "(a 0- $\Omega$  connection point high above ground)".

### 4. US Federal Standard 1037C - Telecommunications: Glossary of Telecommunications Terms

The US Federal Standard 1037C (National Communications Systems Technology and Standards Division 1996) gives the definition of counterpoise as "A conductor or system of conductors used as a substitute for earth or ground in an antenna system. [From Weik '89]". The reference to Weik '89 is to Communications Standard Dictionary, 2nd ed., Dr. M. Weik, 1989.

The question that arises is in what ways must a system of conductors be a substitute for earth or ground to satisfy the requirement. If it is simply that it is a path for current, then is one side of a coax centre fed dipole a counterpoise?

### 5. IEEE standard definition of terms for antennas - IEEE Std 145-1993

(IEEE 1993) has a simple, but narrow definition:

*2.86 A system of conductors elevated above and insulated from ground, forming a lower system of conductors for an antenna.*

By that definition, a single radial used with a vertical monopole would constitute a counterpoise, but not if the radial was at ground level. Is a trapped vertical mounted on a tin shed mounted on a counterpoise? If the tin shed is not insulated from ground, no. It is a pretty narrow definition, and excludes some structures that might behave very similarly to ones that are counterpoises under the definition.

### 6. Conclusions

The term counterpoise applied to antenna systems means all things to all people. It is used inconsistently, it is

jargon often used in dialogue by people who don't really understand what they mean when asked. If you want clarity, you must define what you mean with each use.

Since the term does not have a widely accepted clear meaning, much less a standardised meaning, it is in the writer's view best avoided.

### 7. Links / References

- Devoldere, John. 2005. ON4UN's low-band DXing. 4th ed. Newington: ARRL.
  - IEEE. 1993. IEEE standard definition of terms for antennas - IEEE Std 145-1993. New York: IEEE.
  - National Communications Systems Technology and Standards Division. 1996. Telecommunications: glossary of telecommunications terms - FED-STD-1037C. General Services Administration Information Technology Service.
  - Straw, Dean, ed. 2003. The ARRL Antenna Book. 20th ed. Newington: ARRL. 27.25 -27.32.
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