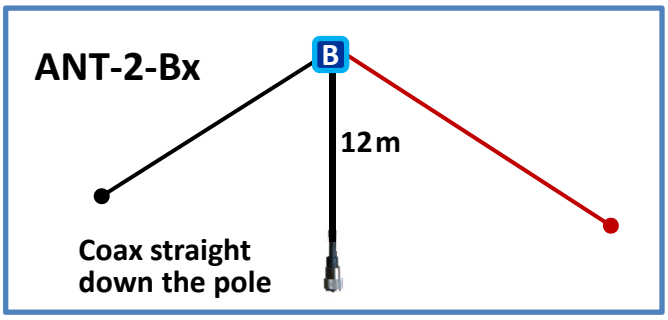
Single-Core Vs. Dual-Core 4:1 Guanella BALUN

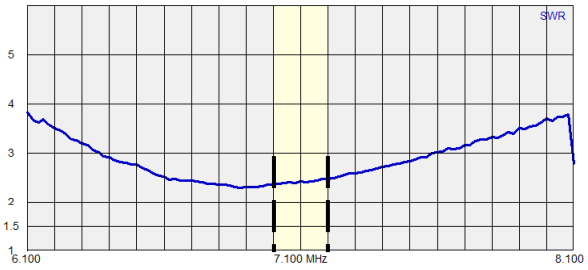
A direct comparison of a real life antenna.

The Antenna: 40m Off-Center-Fed Dipole (Inverted-V)

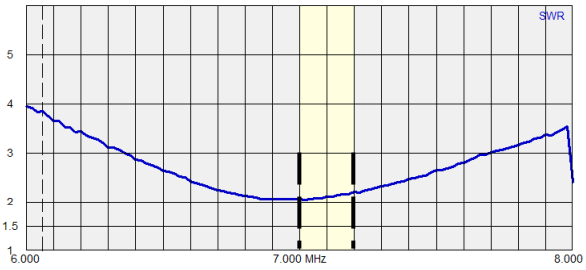
- 20.50m long
- Feedpoint Split: 43% / 57%
- Feedpoint Height: 10m
- Height of Ends: 4m
- Coax 12m Long and running straight down the pole.
- Analyzer: RigExpert AA-54
- **Not Grounded**



Single-Core BALUN (B5)



Dual-Core BALUN (B6)



21mA ⟵ **Measured Common Mode Current** ⟶ 7mA

Comments:

At this point, with just the antenna connected to the analyzer, you don't see much difference in the SWR curves. If you look closely at the curves, you will see that the dual-core balun has a slightly better SWR within the band (the yellow area is the [Region1] 40m ham band).

Problem: In attempting to measure this in the field with an antenna analyzer such as the MFJ-259B, you typically find it sensitive to the touch. When you touch the analyzer, the SWR and impedance change, sometimes dramatically. Many people blame the analyzer.

"Not Grounded" is not representative of how an antenna is used. Normally we ground the radio in the shack. Even if we forget to ground it, the rig is still grounded through the power supply.

It is obvious that we need to add a ground.

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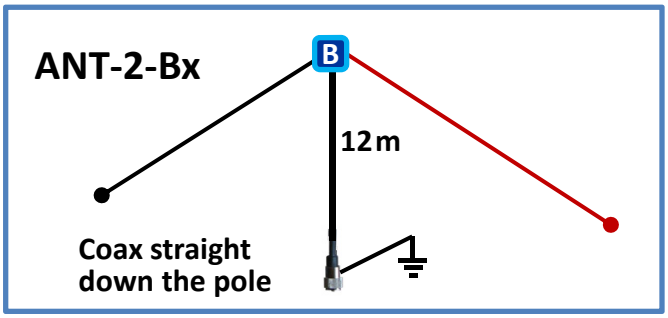
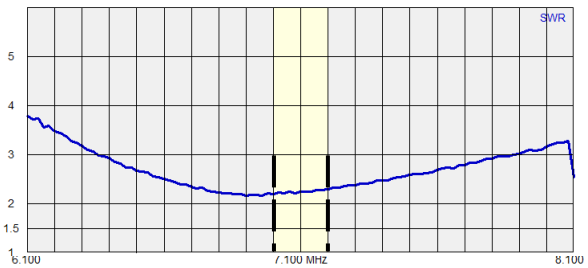
- Height of Ends: 4m
- Coax 12m Long and running straight down the pole.
- Analyzer: RigExpert AA-54
- **The Coax is Grounded at the Analyzer** (here with a 75cm stake in the ground)

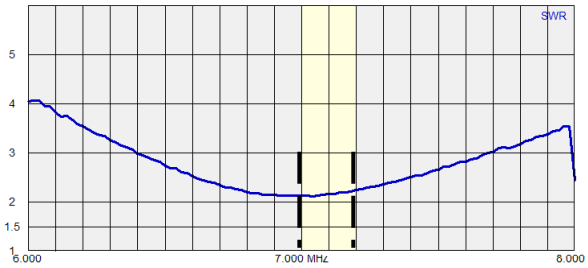


Single-Core BALUN (B5)



GND

Dual-Core BALUN (B6)



237mA ⟵ **Measured Common Mode Current** ⟶ 84mA

Comments:

"Grounded", with just the antenna connected to the analyzer, you still don't see much difference In the SWR curves. If you look real close at the curve, you will see that the dual-core balun still has A slightly better SWR within the ham band but now the difference is insignificant.
In fact, it is fair say one see's no apparent difference between a single and dual core balun.

However, look at the difference in Common Mode Current! Without a clear path to ground, the CMC's only path to ground is through capacitive coupling. As a result, you don't measure a lot of CMC on the feedline. As soon as you ground the feedline, which is a more realistic indication of real-life conditions, the CMC rises considerably.

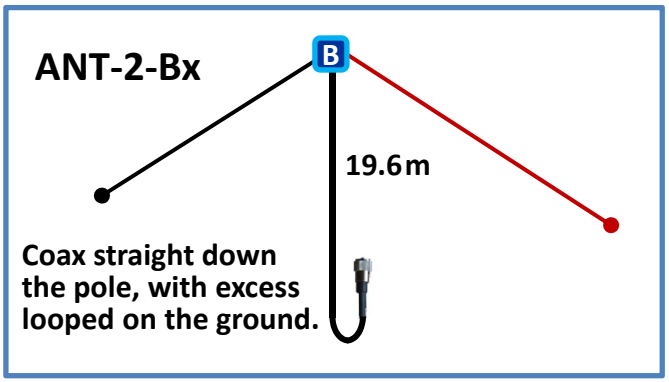
Let's not stop here. Let's continue to look at other examples.

Single-Core Vs. Dual-Core 4:1 Guanella BALUN

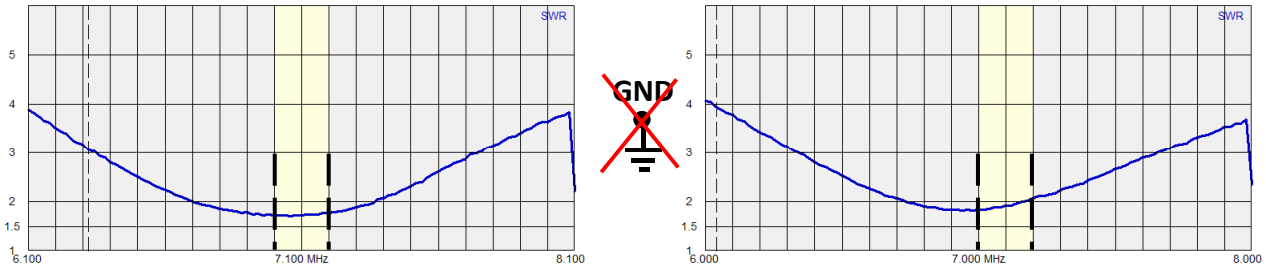
A direct comparison of a real life antenna.

The Antenna: 40m Off-Center-Fed Dipole (Inverted-V)

- 20.50m long
- Feedpoint Split: 43% / 57%
- Feedpoint Height: 10m
- Height of Ends: 4m
- Coax 19.6m Long and running straight down the pole.
- Analyzer: RigExpert AA-54
- **Coax is Grounded at Analyzer: No/Yes**

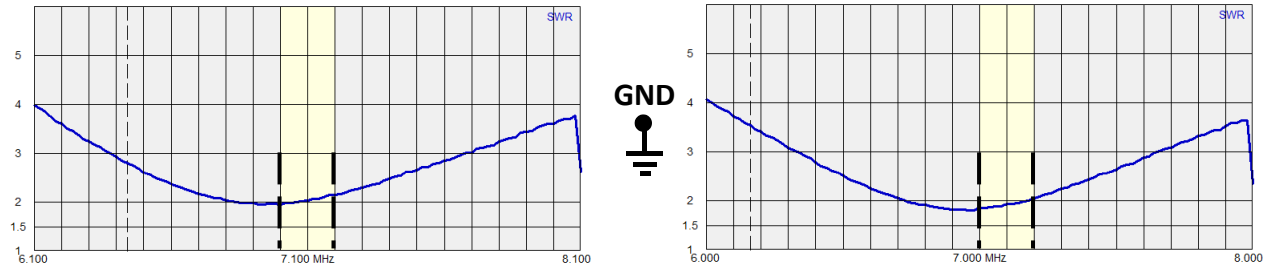


Single-Core BALUN (B5) | **Dual-Core BALUN (B6)**



54mA ⟵ **Measured Common Mode Current** ⟶ 12mA

Again **"not grounded",** with just the antenna connected to the analyzer, now you begin to see a difference in the SWR curves in favor of the single-core balun. The curve is better centered across the band and the SWR is generally better. But is this the true picture? Is it really better? I don't think so. What we are seeing here is a gentle distortion of the truth. **Now let's ground it:**



120mA ⟵ **Measured Common Mode Current** ⟶ 36mA

When **"grounded",** the picture changes – at least on the left, the side with the single-core balun. Note that the side with the dual-core balun shows no apparent change at all. Note the difference in CMC here. **Large amounts of CMC skew the curve significantly. Small amounts do not.**

Ever wonder why your analyzer shows a different value when touching it than it does when not touching it? This is a clear indication of CMC problems with your antenna… which is probably due to using an inferior balun (i.e. , in this case, a single-core Guanella balun).

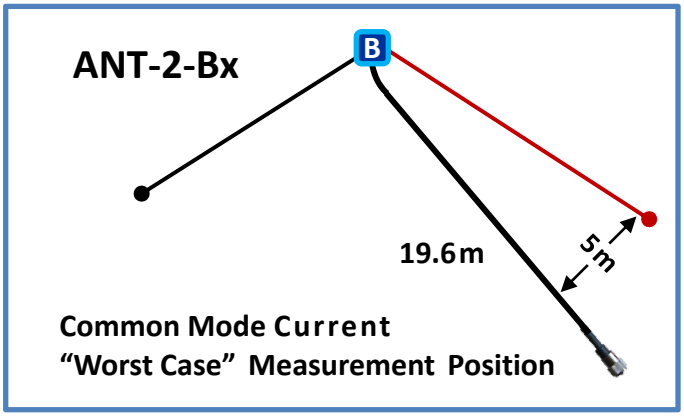
But wait! The worst is yet to come!

Single-Core Vs. Dual-Core 4:1 Guanella BALUN

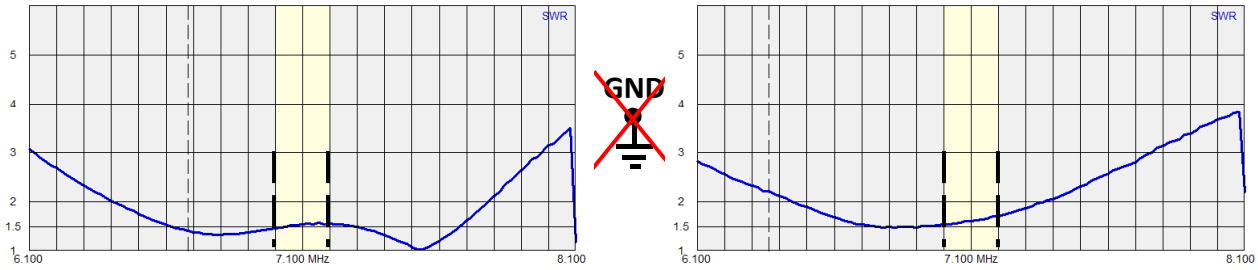
A direct comparison of a real life antenna.

The Antenna: 40m Off-Center-Fed Dipole (Inverted-V)

- 20.50m long
- Feedpoint Split: 43% / 57%
- Feedpoint Height: 10m
- Height of Ends: 4m
- Coax 19.6m Long and running diagonal to the antenna, through the air at about the same height as the antenna.
- Analyzer: RigExpert AA-54
- **Coax is Grounded at Analyzer: No/Yes**

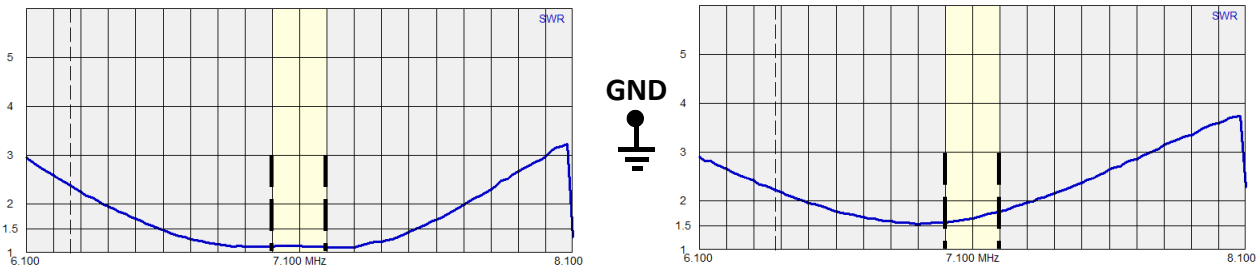


Single-Core BALUN (B5) | **Dual-Core BALUN (B6)**



340mA ⟵ **Measured Common Mode Current** ⟶ 105mA

Here **"not grounded",** is a totally distorted pattern. Not only do you see a double-dip, the second dip is lower than the first dip. Neither dip reflects the reality. Even the dual-core balun's results are distorted, though nowhere nearly as bad as those of the single-core balun. **Let's ground it:**



300mA ⟵ **Measured Common Mode Current** ⟶ 156mA

When **"grounded",** the picture changes on both sides. The curve on the left is what we all dream of at night. But then we wake up. The curve on the right has returned to its original shape, but is still showing a lower SWR than the antenna really has. That was one small step in the right direction

BUT WHAT DO WE DO NOW? (!)

First of all, we should never have gotten into this situation. NEVER run your coax like this!
The coax should always exit the antenna at 90 degrees and run as far as possible in that direction.
But for the sake of this test, let's say "we had to". **What <u>do</u> we do now?**

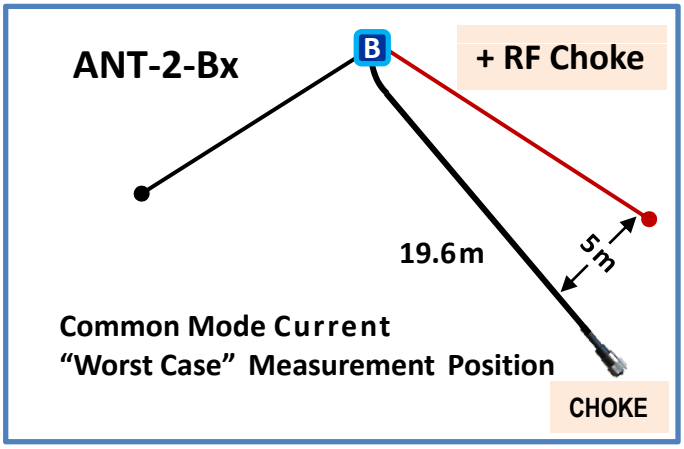
HINT: 

Single-Core Vs. Dual-Core 4:1 Guanella BALUN

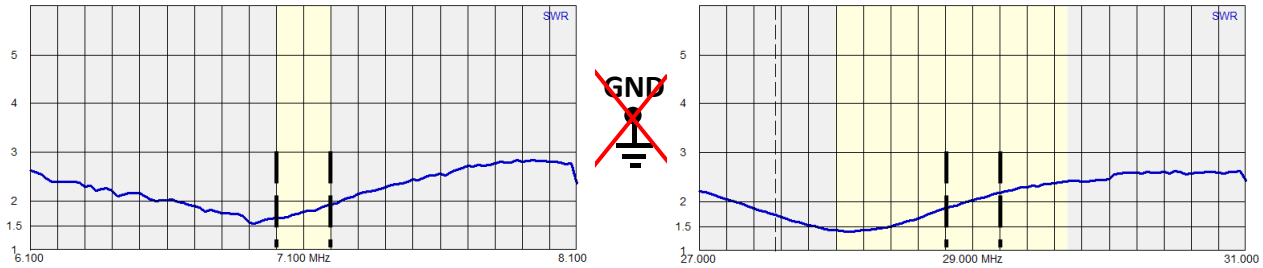
A direct comparison of a real life antenna.

The Antenna: 40m Off-Center-Fed Dipole (Inverted-V)

- 20.50m long
- Feedpoint Split: 43% / 57%
- Feedpoint Height: 10m
- Height of Ends: 4m
- Coax 19.6m Long and running diagonal to the antenna, through the air at about the same height as the antenna.
- Analyzer: RigExpert AA-54
- **Coax is Grounded at Analyzer: No/Yes**
- **RF Choke inserted at the TX**

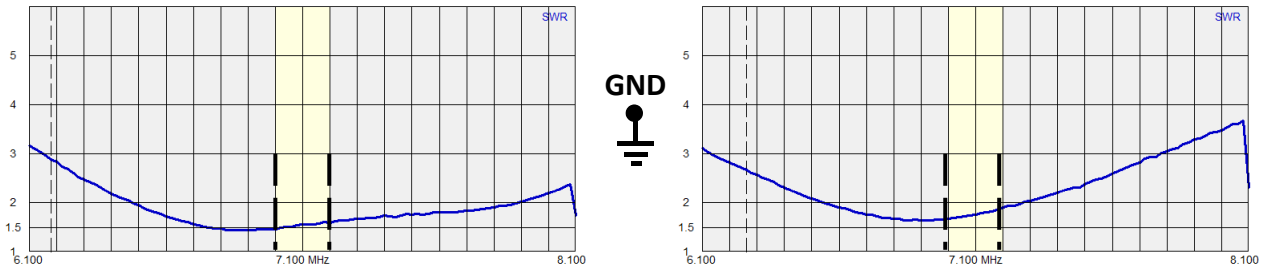


Single-Core BALUN (B5) **+ C1** **Dual-Core BALUN (B6)**



105mA ⟵ **Measured Common Mode Current** ⟶ 30mA

Looking better with a choke (no ground), but when the ground is added:

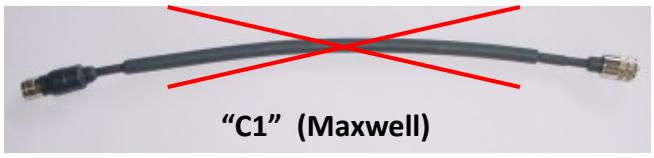


105mA ⟵ **Measured Common Mode Current** ⟶ 39mA

Holy Cow! It's WORSE!

(The CMC on the right is worse, the SWR on the left is still very distorted and the CMC is still too high.)

The problem here is the choke. The first choke chosen was simply not good enough for the job!



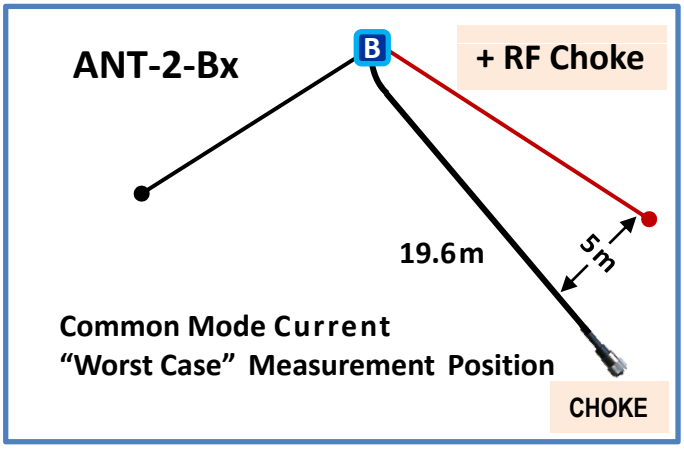
"C1" (Maxwell)

Single-Core Vs. Dual-Core 4:1 Guanella BALUN

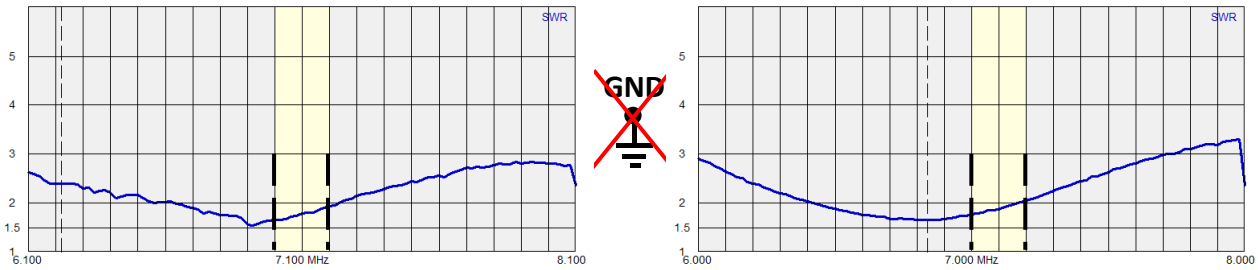
A direct comparison of a real life antenna.

The Antenna: 40m Off-Center-Fed Dipole (Inverted-V)

- 20.50m long
- Feedpoint Split: 43% / 57%
- Feedpoint Height: 10m
- Height of Ends: 4m
- Coax 19.6m Long and running diagonal to the antenna, through the air at about the same height as the antenna.
- Analyzer: RigExpert AA-54
- **Coax is Grounded at Analyzer: No/Yes**
- **DIFFERENT RF Chokes inserted at the TX**

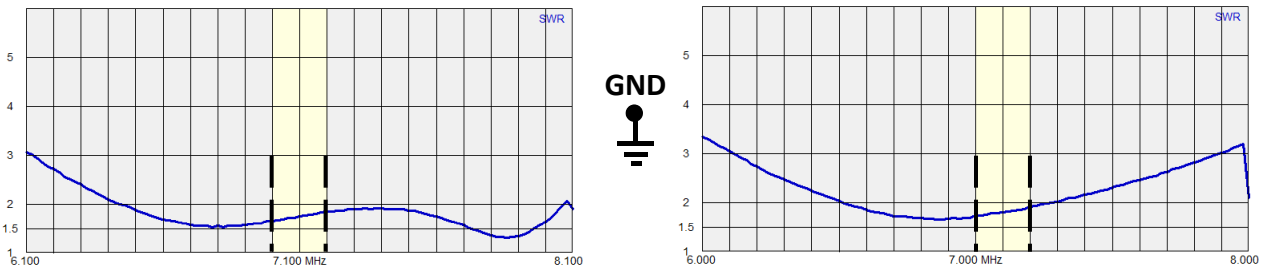


Single-Core BALUN (B5) **+ C2** **Dual-Core BALUN (B6)**



66mA ⟵ **Measured Common Mode Current** ⟶ 30mA

Looking a little better with this choke (no ground), but when the ground is added:



51mA ⟵ **Measured Common Mode Current** ⟶ 21mA

There is still a distorted pattern with the single-core balun! The dual core balun looks much better; much like it should look. This choke is good enough for working with the dual-core balun, but it does not manage to remove the CMC from the antenna with the single-core balun.

Note: CMC less than 30mA seems to be an acceptable value.

Let's try another choke . . .

Single-Core Vs. Dual-Core 4:1 Guanella BALUN

A direct comparison of a real life antenna.

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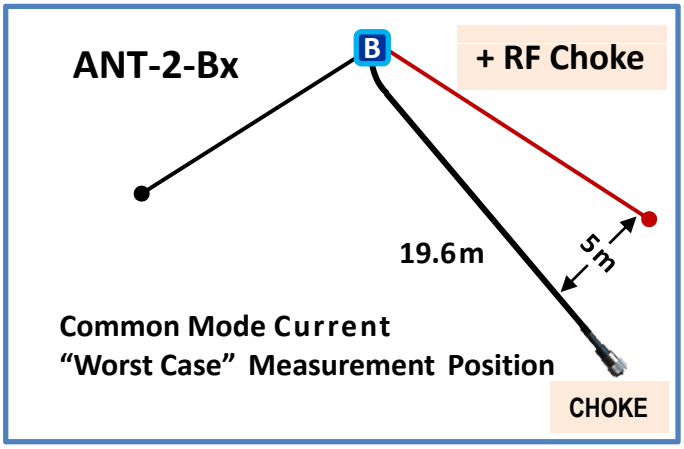
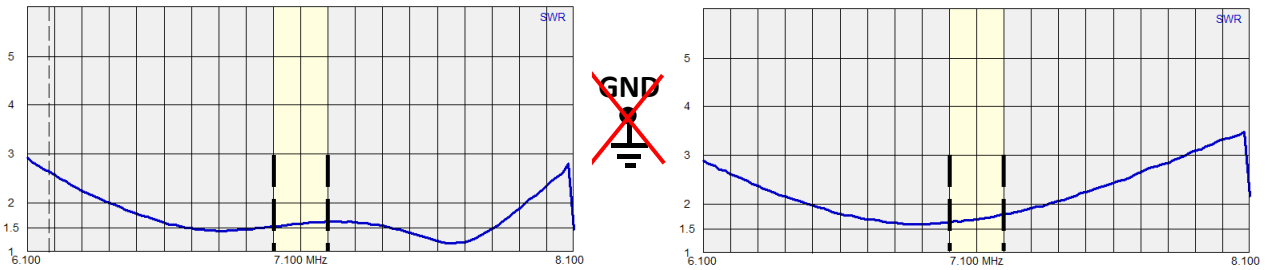
- 20.50m long
- Feedpoint Split: 43% / 57%
- Feedpoint Height: 10m
- Height of Ends: 4m
- Coax 19.6m Long and running diagonal to the antenna, through the air at about the same height as the antenna.
- Analyzer: RigExpert AA-54
- **Coax is Grounded at Analyzer: No/Yes**
- **DIFFERENT RF Chokes inserted at the TX**

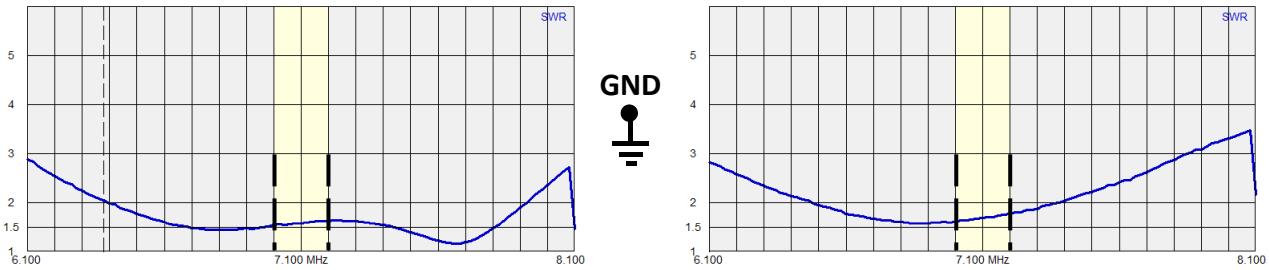


Single-Core BALUN (B5) **+ C3** **Dual-Core BALUN (B6)**



0mA ⟵ Measured Common Mode Current ⟶ 0mA

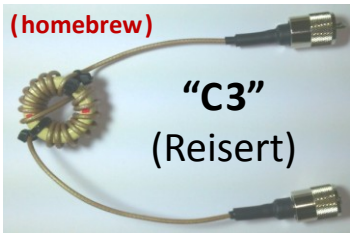
The CMC is gone in both, but the SWR curve on the left is still distorted! (The right is OK.)



0mA ⟵ Measured Common Mode Current ⟶ 0mA

Again with zero measurable CMC, the single-core balun has a distorted SWR curve. I am still searching for an explanation for this! With C3, regardless of whether it is grounded or not, the SWR curves of the dual-core balun look great; just like the coax coming straight down the pole.

This Choke Works!



But the single-core 4:1 Guanella balun fails miserably with the coax in this configuration.

Single-Core Vs. Dual-Core 4:1 Guanella BALUN

A direct comparison of a real life antenna.

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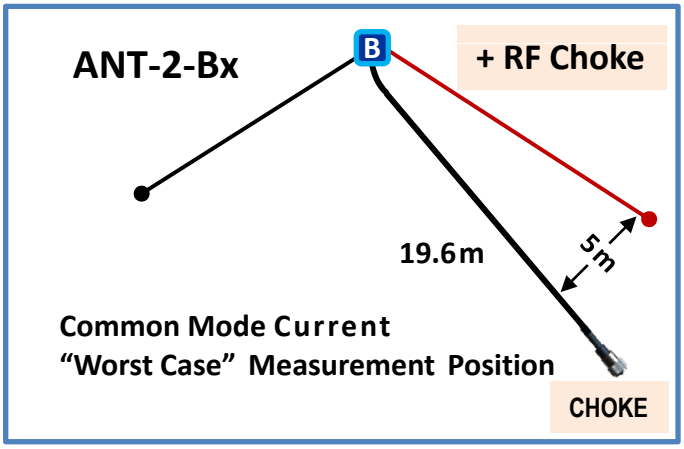
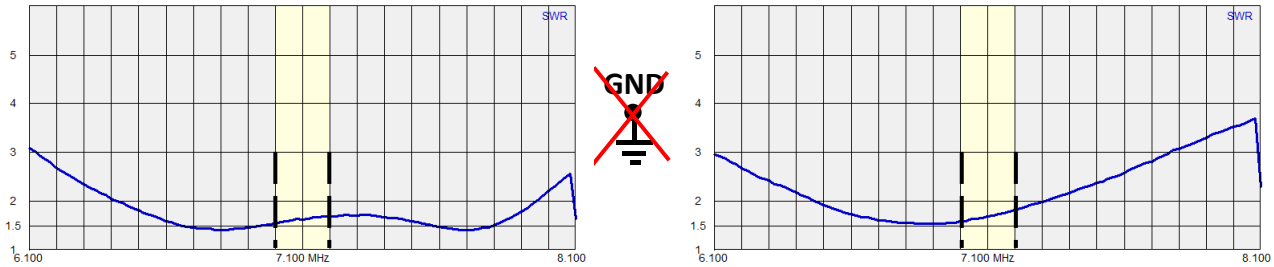
- 20.50m long
- Feedpoint Split: 43% / 57%
- Feedpoint Height: 10m
- Height of Ends: 4m
- Coax 19.6m Long and running diagonal to the antenna, through the air at about the same height as the antenna.
- Analyzer: RigExpert AA-54
- **Coax is Grounded at Analyzer: No/Yes**
- **DIFFERENT RF Chokes inserted at the TX**

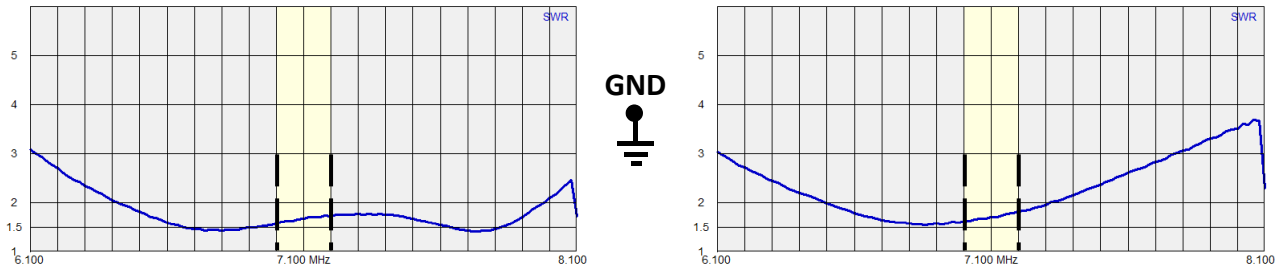


Single-Core BALUN (B5) **+ C4** **Dual-Core BALUN (B6)**



9mA ⟵ Measured Common Mode Current ⟶ 0mA

The CMC is gone in both, but the SWR curve on the left is still distorted! (The right is OK.)



15mA ⟵ Measured Common Mode Current ⟶ 0mA

With almost zero CMC, the single-core balun still has a distorted SWR curve. I am still searching for an explanation for this! With C4, regardless of whether it is grounded or not, the SWR curves of the dual-core balun look great; just like when the coax is running straight down the pole.

This Choke Works Too!

THE BOTTOM LINE:

THE SINGLE-CORE 4:1 GUANELLA BALUN DOES NOT WORK. IT FAILS MISERABLY AT ITS JOB OF IMPEDING COMMON MODE CURRENT, ESPECIALLY WHEN THE COAX IS RUN IN CLOSE PROXIMITY OF THE ANTENNA LEG.

*Original design by W2VJN