

Designing & Building Ugly or Coax Baluns

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BALUN PRINCIPLES

- **Primary Purpose of a Balun**
Are you sure you know?
- **Where to Put a Balun**
- **How Many Baluns do you Need?**
- **How Much Balun do you Need?**

DESIGNING A COAX BALUN

What Will You
Learn Today?



Universal Balun Principles



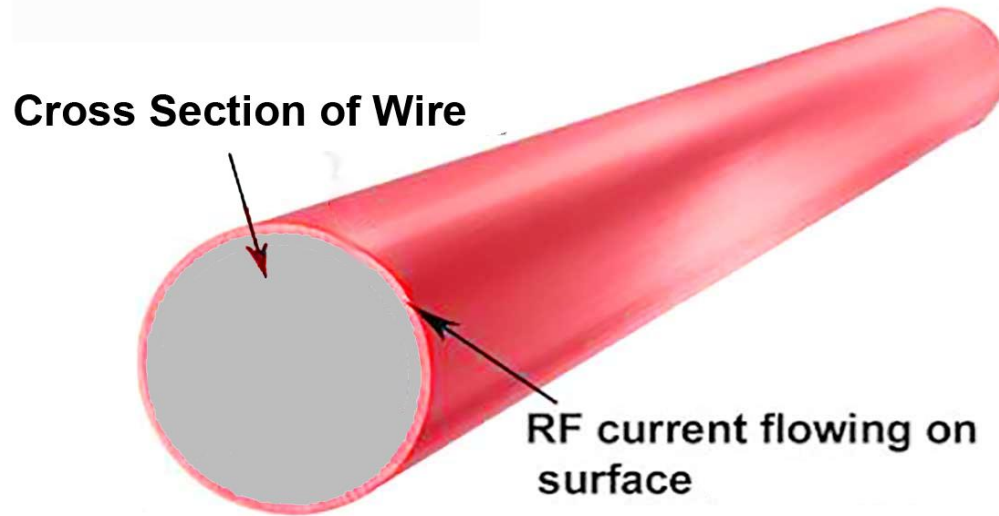
Concept 1 - Purpose

BAlanced > UNbalanced

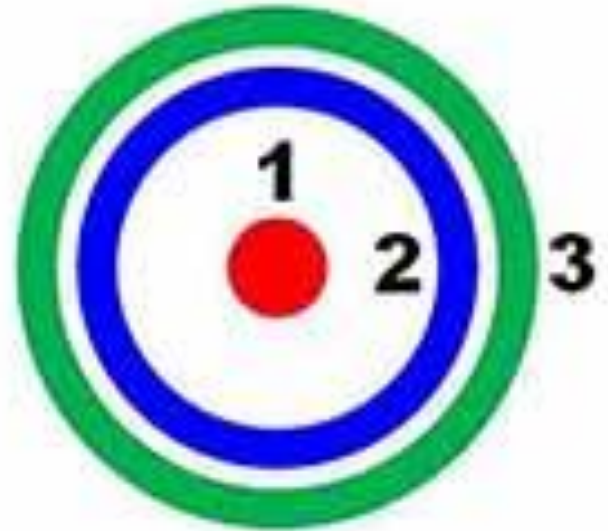
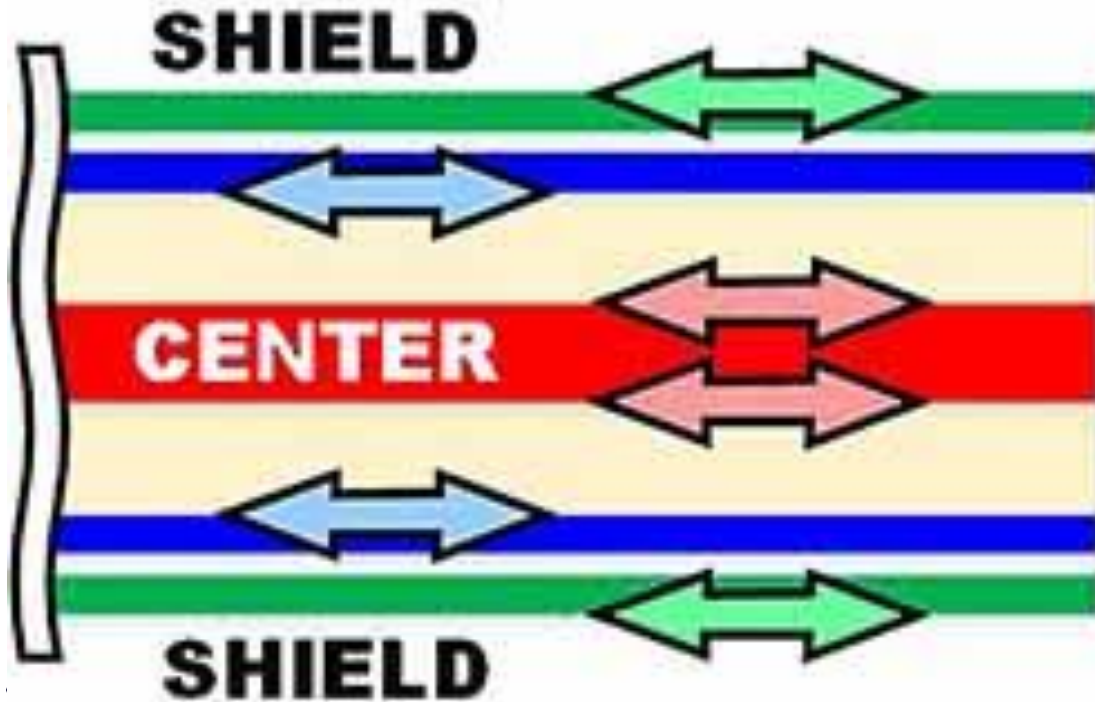
POOR --> BETTER



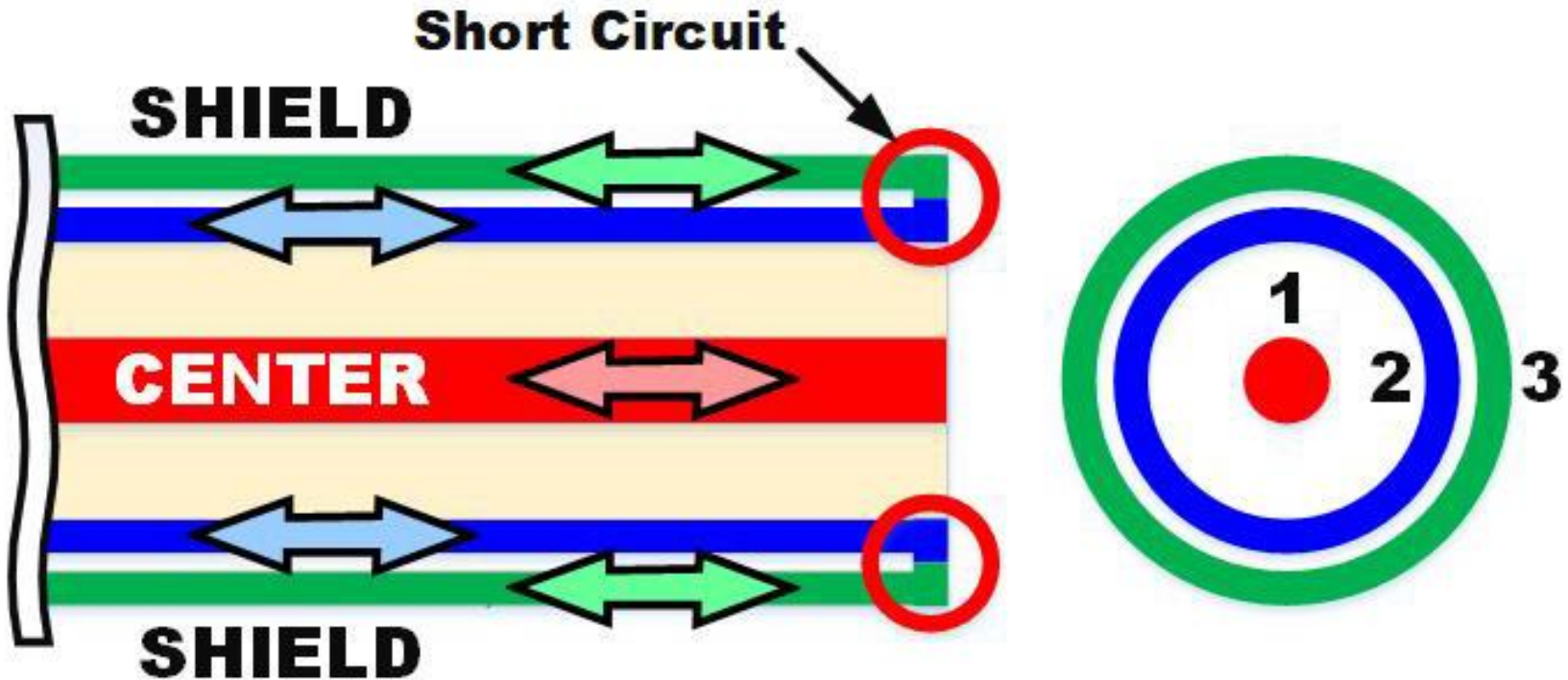
Baluns are the Consequence of **Skin Effect**



Surprise – Coax has 3 wires



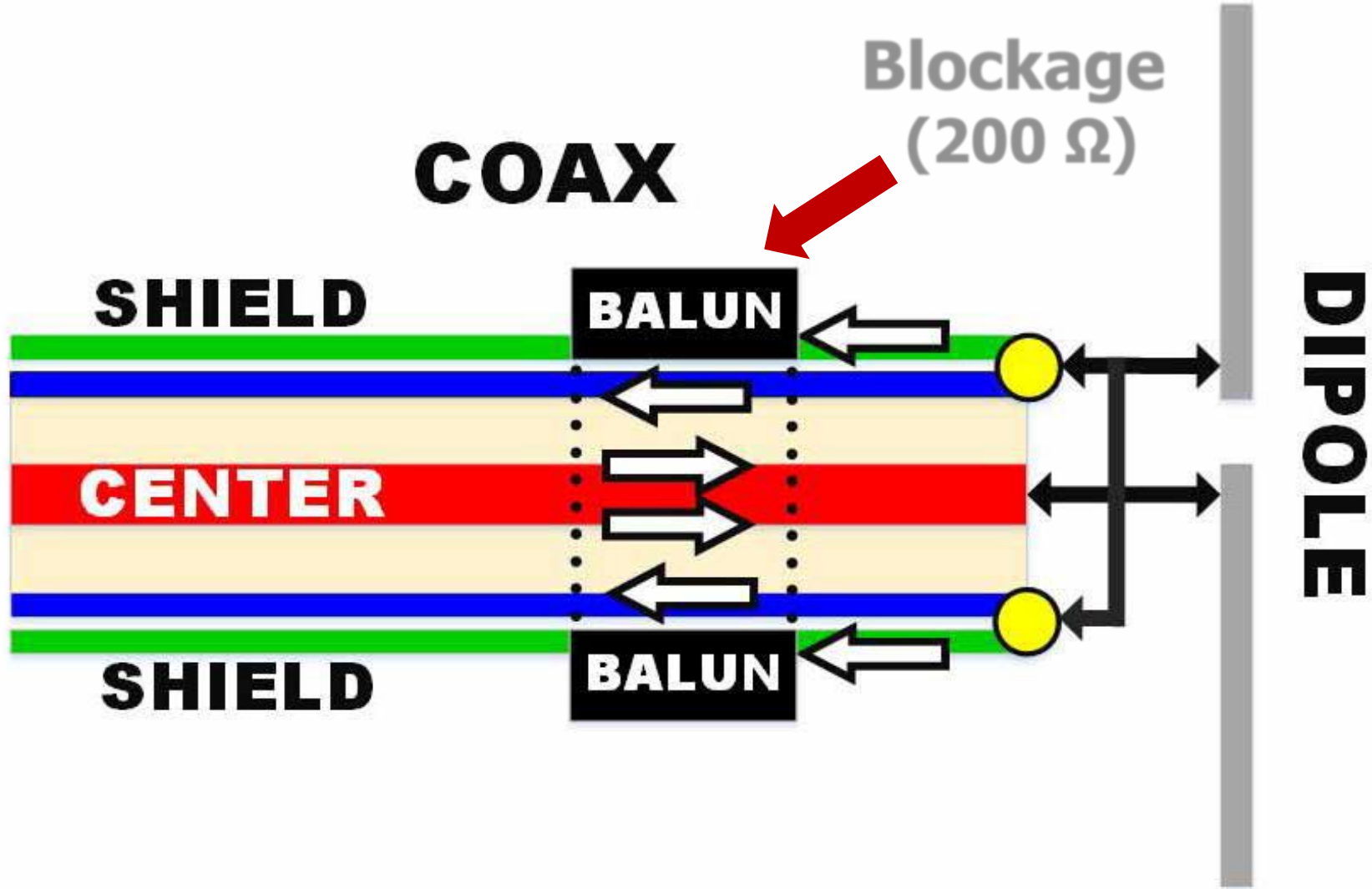
Surprise – The Ends are Shorted



Consequences at the Antenna



TRANSMITTER



**The PRIMARY job of
all baluns is to choke
off outside shield
current**

**A SECONDARY job of
only some
baluns is to also be
an impedance
transformer 4:1, 9:1**

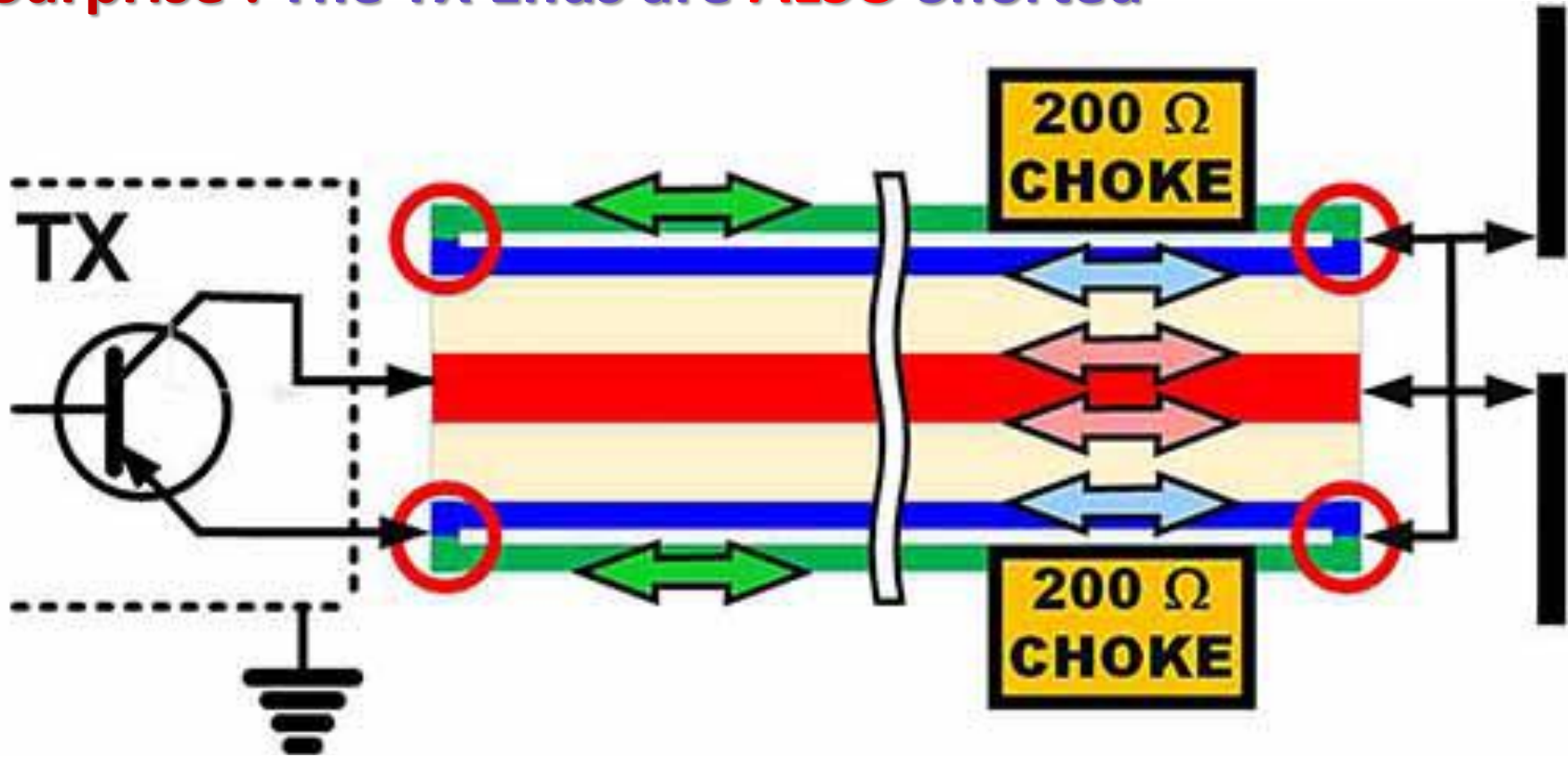
The effect of a 3rd wire (the outside of the shield)

Would it
Disrupt ?
SWR
Frequency
Pattern

The Really **Big** Surprise



Surprise : The TX Ends are **ALSO** Shorted



**At any coax end, where
there's a source of power
(TX/ant), RF can get
out onto the shield
[not at barrels, switches]**

**Therefore, a BALUN
(shield current choke) is
just as necessary at the
TX as at the antenna.**

How to Make a Coiled Coax “Ugly” Balun to Choke off Outside Shield Current





Typical “Ugly” (Coax) Baluns



**How to
Design one?**

The Steps

- 1. Form of the Coil**
- 2. Coil Inductance**
- 3. Coil Turns, Length, Diameter**



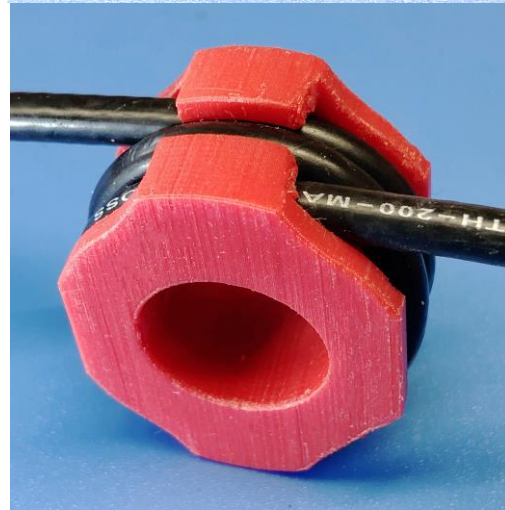
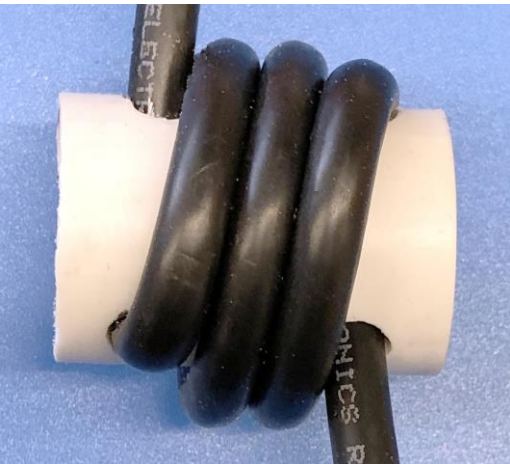
Forms (2m)

PVC
PIPE

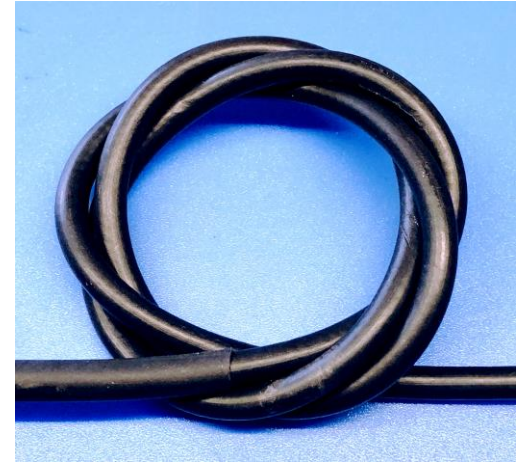
TORUS
KNOT

SCRAMBLE
ZIP TIES

3D
PRINTED



The Torus Knot



Step One: Choking Inductance

Minimum impedance of the Coax Coil
An RF resistance (reactance X_L)
of 4 times
system impedance $Z = 200 \text{ Ohms}$



The Simple Math

$$(200\Omega) \quad X_L = 2\pi f_{\text{Hz}} L_H$$


$$L_{\mu\text{H}} = 31.8 / f_{\text{MHz}}$$

Freq. MHz	Band m	LuH
1.8	160	17.7
3.5	80	9.1
5	60	6.4
7	40	4.5
10	30	3.2
14	20	2.3
18	17	1.8
25	12	1.3
28	10	1.1



Minimum Choke Inductance

More OK

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Step Two

Inductance → Coil Details

1. # Turns
2. Length
3. Diameter



The Math

$$t^2 = L_{uH}(9r + 10l) / r^2$$

L = Inductance, r = coil radius

t = coil turns, l = coil length





DON'T PANIC

You don't
have to do
the math

Free Internet Ugly Balun Calculator



Input

Required inductance

L .. microhenry (μH) $\vee$

Coil former diameter

D inch (in) $\vee$

Diameter of wire without insulation

d inch (in) $\vee$

Diameter of insulated wire

d_i inch (in) $\vee$

Calculate

Reset

Share

Output

Winding length

l cm

Number of turns

L

translatorscafe.com/unit-converter/en-US/calculator/coil-inductance/



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Coax Dimensions

RG-8, RG-213

Jacket diameter .403 in., shield .38 in

RG-mini 8

Jacket diameter .25 in., shield .2 in.



An Example

A 160m RG-8 balun on 4 in. PVC pipe

Form diameter: 4.5 in.

Inductance: 17.7 μH (160-meters)

Wire diameter, no insulation: .38 in.

Wire diameter, with insulation: .403 in.



Input

Required inductance

L microhenry (μH)

Coil former diameter

D inch (in)

Diameter of wire without insulation

d inch (in)

Diameter of insulated wire

d_i inch (in)

Calculate

Reset

[Share](#)

Output

Winding length

l cm

Number of turns

L

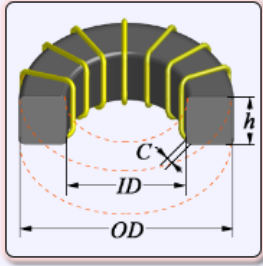
$2.54 \text{ cm} = 1 \text{ in.}$

6.7 in.

16.7 T

RESULTS





ENTER THE INPUT DATA:

Select units: AWG → SWG →

L = - Required inductance

OD = - Outer diameter of ring

ID = - Inner diameter of ring

h = - Height of ring

C = - Chamfer

μ_r = - Relative magnetic permeability

d = - Diameter of wire (AWG-20)

Calculate

RESULT:

N = - Number of turns

A_L = - Inductance factor of the ring [nH/N²]

L_w = - Required length of wire*

Clear all

<https://coil32.net/online-calculators/ferrite-torroid-calculator.html>

Ferrite baluns have more bandwidth

Toroid Coil Winding Calculator



Material Type:

Iron Powder ☐

Ferrite ☒

Inductance

mH

Core Size

▼

Material Number

▼

Calculate



<https://66pacific.com/calculators/toroid-coil-winding-calculator.aspx>





With Ugly/Coax Baluns



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DØGGY

"That's all Folks!"



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