

# BALUNS

## And Designing Coiled Coax “Ugly” Baluns



# BALUN PRINCIPLES

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

## DESIGNING A COAX BALUN

What Will You  
Learn Today?



# Universal Balun Principles



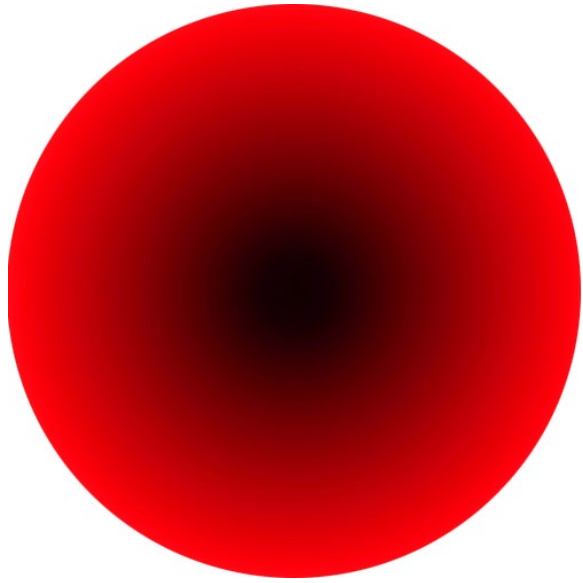
# Concept 1 - Purpose

**BALanced > UNbalanced**

***POOR --> BETTER***

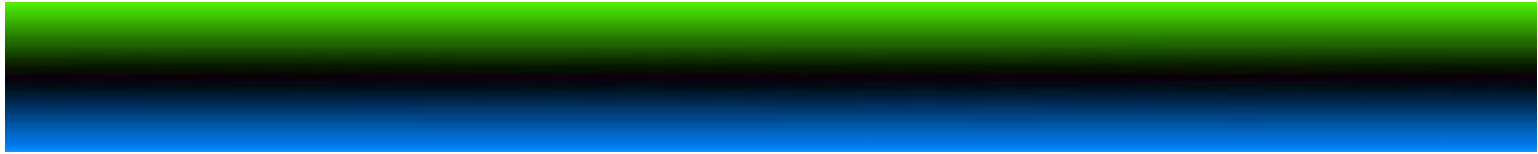
**Choke off Outside-Shield Current  
Common-mode**





# AC/RF flows on surface

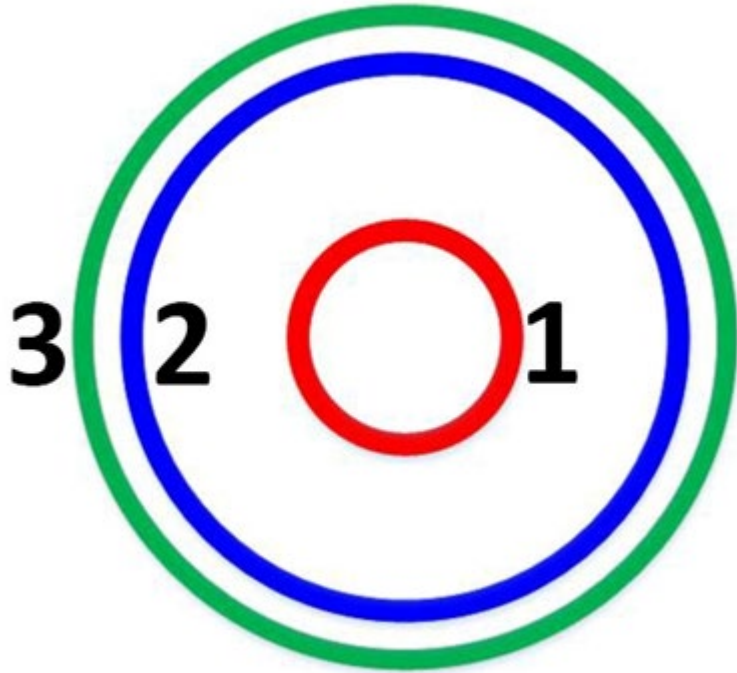
*Shield divides into  
two conductors*



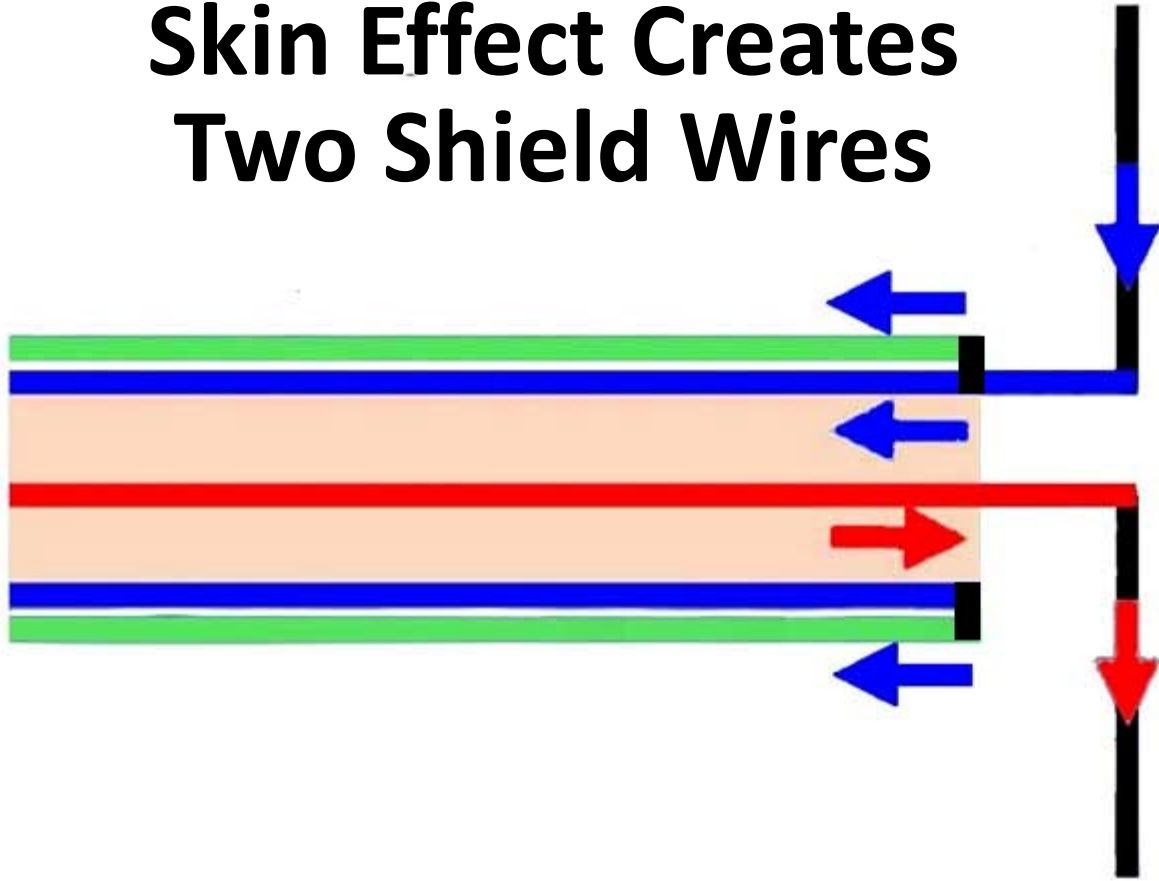
# *Skin Effect*

*causes:*

**Coax to  
have 3  
Conductors**



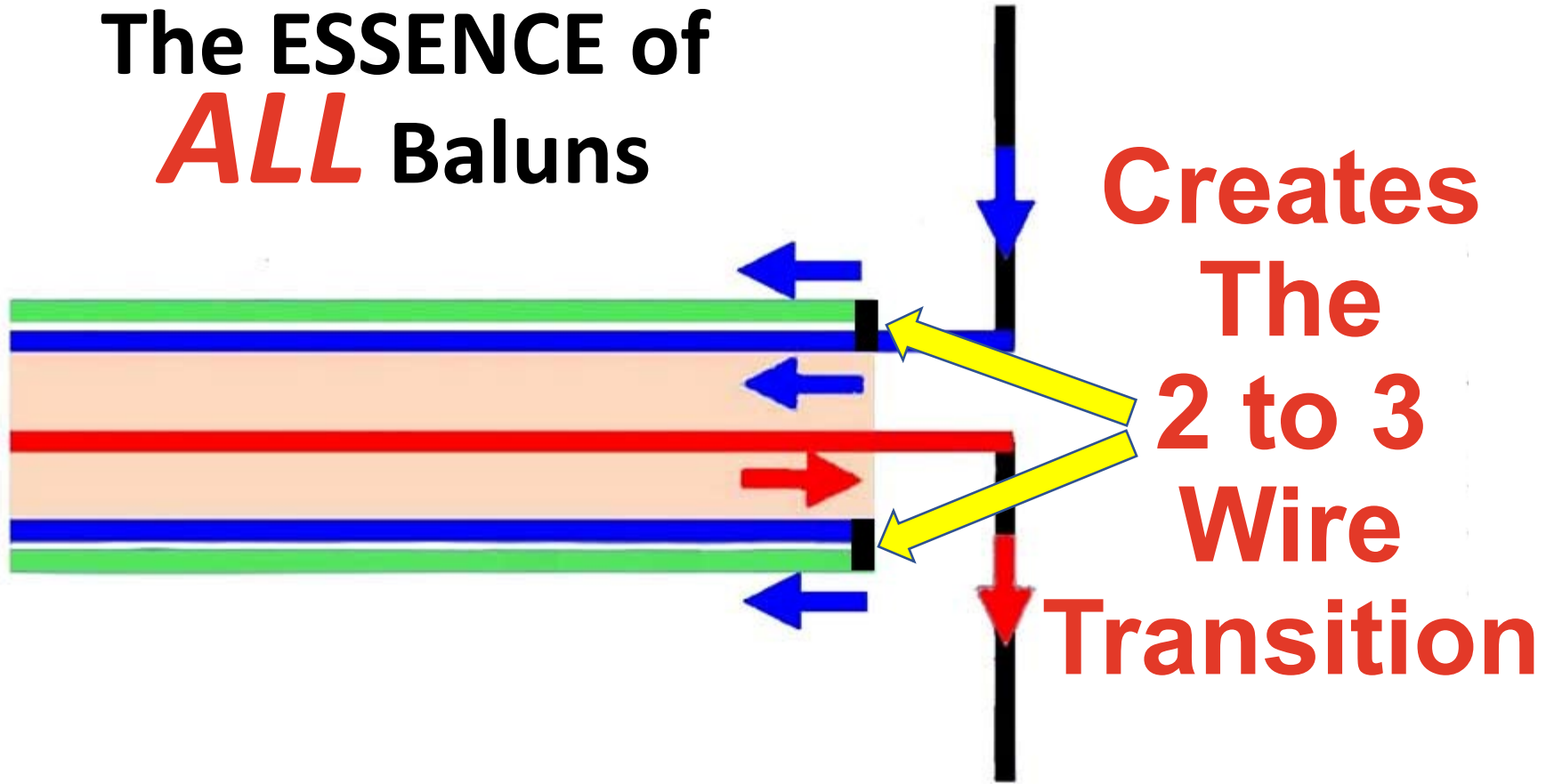
# Skin Effect Creates Two Shield Wires



**AND** it  
connects  
them at  
the Ends

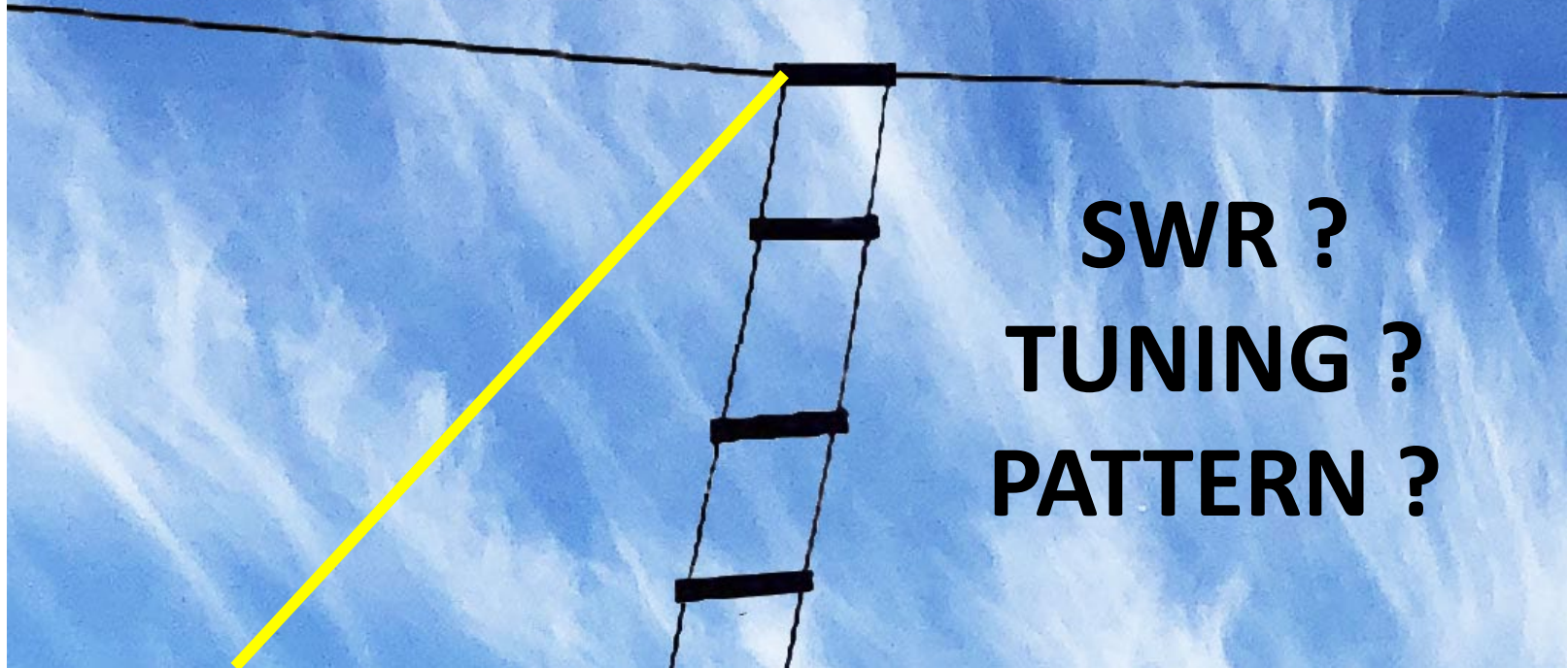


# The ESSENCE of *ALL* Baluns

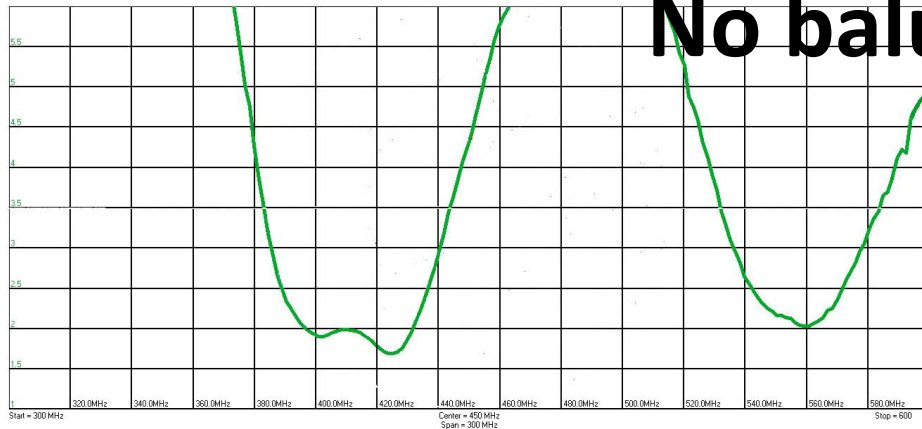




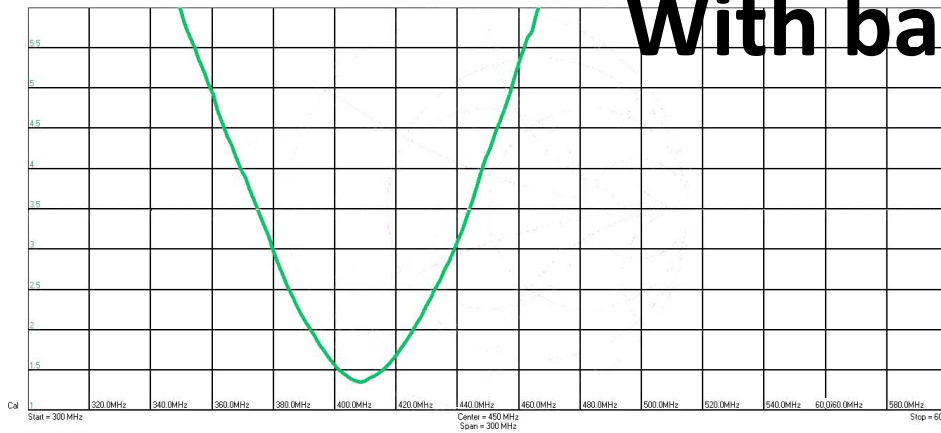
# Like Adding a 3<sup>rd</sup> Wire



# No balun



# With balun



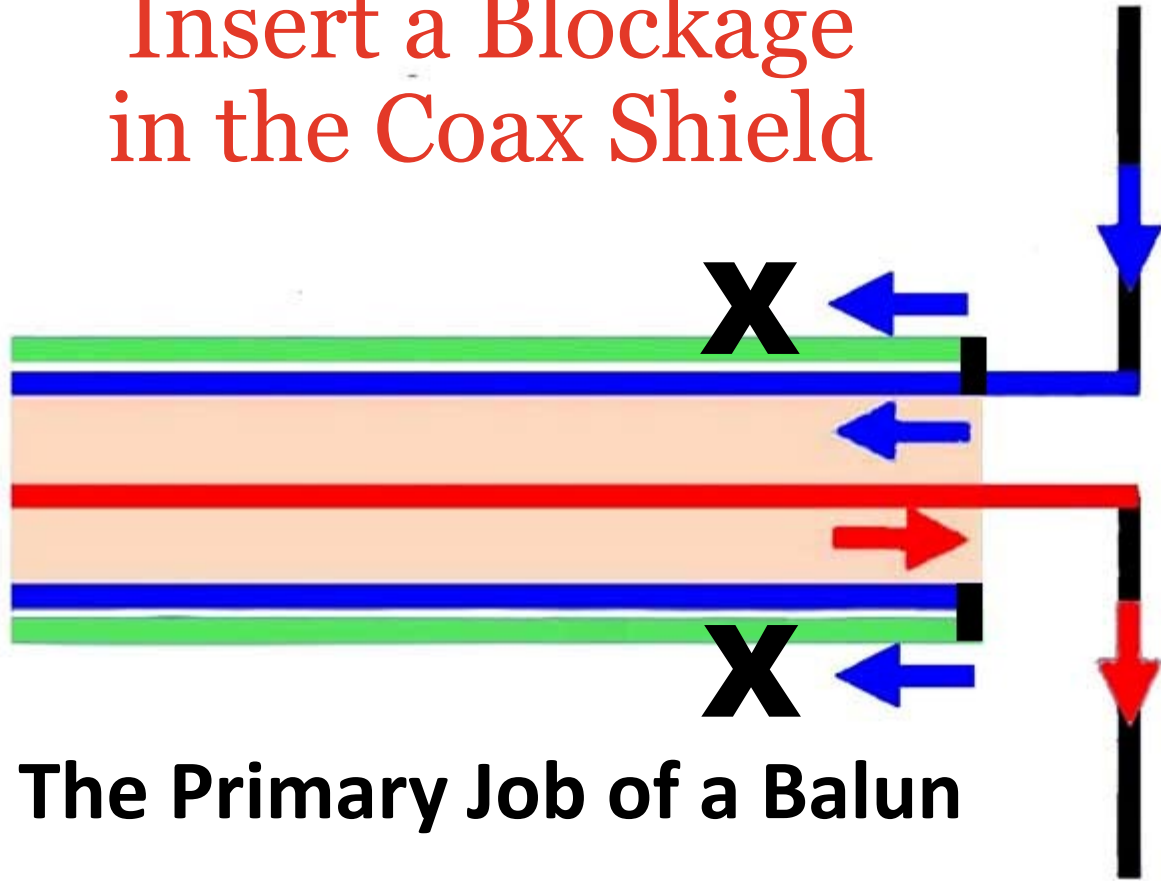
# A Painful Lesson with a 70cm Rocket Antenna



# How do we Eliminate the 2 to 3 Wire Transition?



# Insert a Blockage in the Coax Shield



**Coil the  
Shield**

**Add  
Ferrites**

**The Primary Job of a Balun**



# Concept #2

## Locating a Balun





- 
- Which one needs a balun?
  - Do both need a balun?
  - Where do you put it?

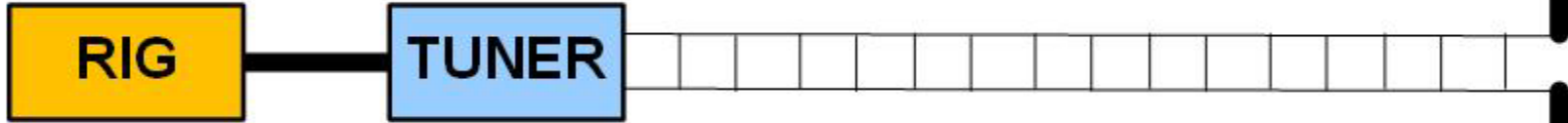




**Many Ham's believe.**  
**Two ways to use a tuner**







**SIMPLE: At the 3-wire transition**  
**With the only one possible solution?**



# The Coiled Coax “Ugly” Balun



# Aware of Coax “Ugly” Baluns



**Don't Know How  
To Design one**

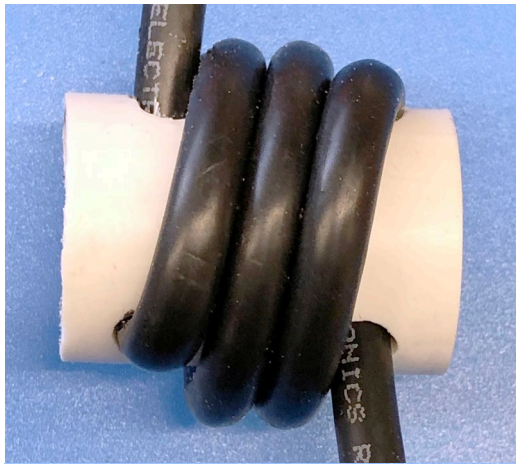


# How to Select

- **Coil Form**
- **Number of Turns**
- **Diameter of Coil**
- **Length of Coil**



# Forms (2m)



**PVC  
PIPE**

**TORUS  
KNOT**

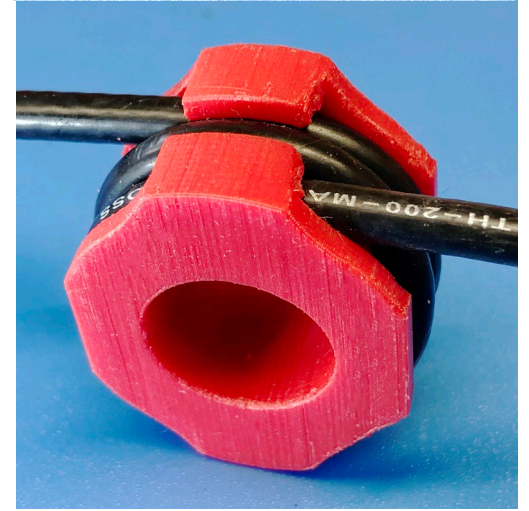


**SCRAMBLE**

**ZIP TIES**

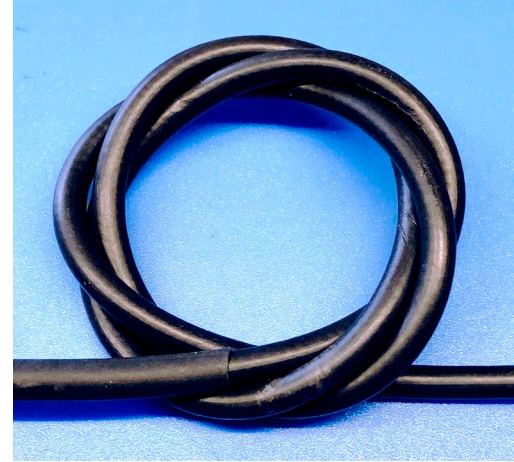
**3D**

**PRINTED**





# The Torus Knot



# Two Step Design Process For Ugly/Coax



# Step 1

## Starting Point

Coax Coil, minimum impedance  
(reactance  $X$ ) of 4 times  
system impedance  $Z = 200 \text{ Ohms}$





# Step 1

## The Math

$$(200\Omega) \quad X_L = 2\pi fL$$

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



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

**Lower band  
choke OK for higher**



# Step 2

## $L_{uH}$ → Coil Mechanics

1. # Turns
2. Length
3. Diameter



## Step 2

# The Math

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

L = Inductance, r = coil radius

t = coil turns, l = coil length



## Input

Required inductance

$L$   .. microhenry ( $\mu\text{H}$ )  $\vee$

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/](https://translatorscafe.com/unit-converter/en-US/calculator/coil-inductance/)



# Example

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

**Form diameter: 4.5 in.**

**Inductance: 17.7  $\mu\text{H}$**

**Dia. of wire, no insulation: .38 in.**

**Dia. of wire, with insulation: .403 in.**



### Input

Required inductance

$L$   microhenry ( $\mu\text{H}$ )

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

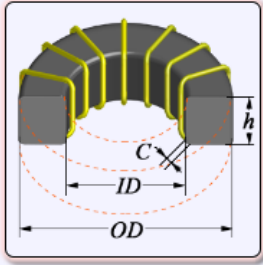
$l$   cm

Number of turns

$L$

**2.54 cm = 1 in.**





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

$\mu_r$  =  - Relative magnetic permeability

$d$  =   - Diameter of wire (AWG-20)

Calculate

RESULT:

$N$  =  - Number of turns

$A_L$  =  - inductance factor of the ring [nH/N<sup>2</sup>]

$L_w$  =   - Required length of wire\*

Clear all

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



# 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 Baluns





[w6nbc.com](http://w6nbc.com)



**DØGGY**



[jportune@aol.com](mailto:jportune@aol.com)

*"That's all Folks!"*

[w6nbcmail@gmail.com](mailto:w6nbcmail@gmail.com)