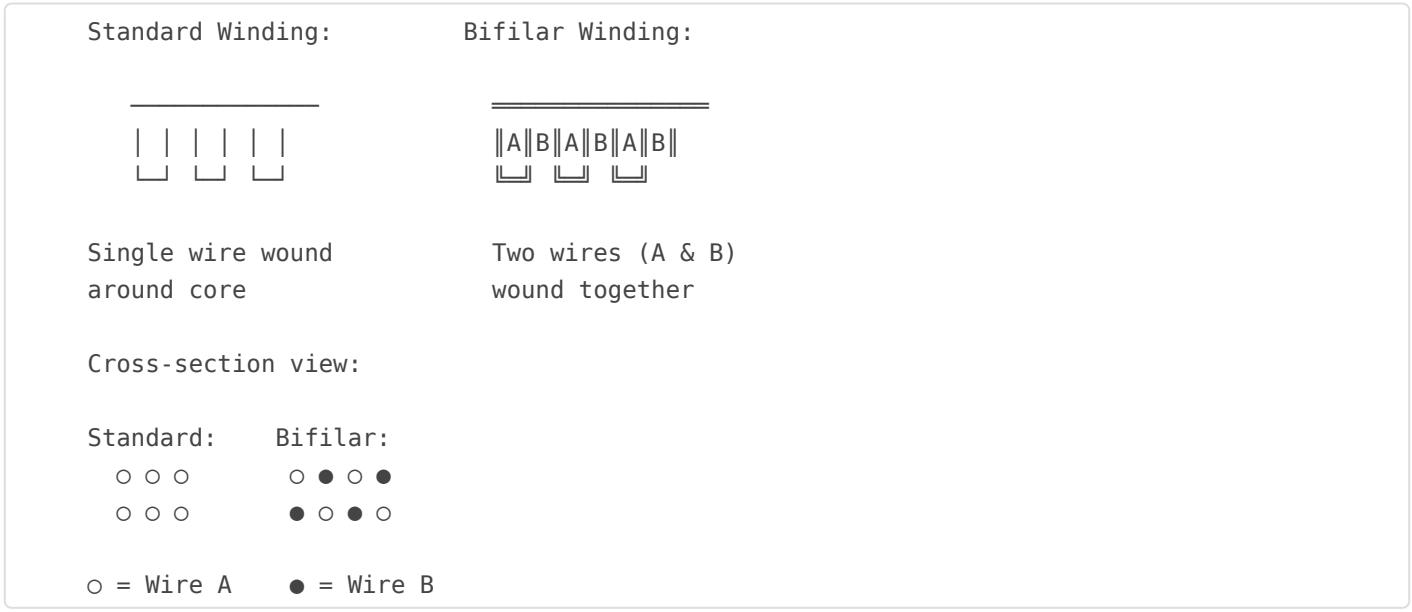
Bifilar Windings

Bifilar Winding Technique

Bifilar winding is a special technique where two wires are wound together in parallel on a core. This configuration creates unique electromagnetic properties that are particularly relevant to VIC designs, including inherent capacitance between windings and special transformer-like coupling.

What is Bifilar Winding?

In a bifilar winding, two conductors are wound side-by-side along the entire length of the coil:



Bifilar Winding Properties

Property	Effect	VIC Relevance
High inter-winding capacitance	Built-in C between A and B	May replace discrete capacitor
Near-unity coupling	k ≈ 1 between windings	Efficient energy transfer
Cancellation modes	Some flux cancellation possible	Affects net inductance

Property	Effect	VIC Relevance
Lower SRF	High $C_{parasitic}$ reduces SRF	Consider in frequency selection

Connection Configurations

1. Series Aiding (Same Direction):

End of A connects to start of B → Fluxes add

$L_{total} = L_A + L_B + 2M$? $4L$ (for $k=1$)

2. Series Opposing (Opposite Direction):

End of A connects to end of B → Fluxes subtract

$L_{total} = L_A + L_B - 2M$? 0 (for $k=1$)

3. Parallel Connection:

Starts connected, ends connected → Current splits

$L_{total} = L/2$ (for identical windings)

4. Transformer Mode:

A is primary, B is secondary → Voltage transformation

$V_B/V_A = N_B/N_A = 1$ (for bifilar)

Calculating Bifilar Capacitance

Approximate Inter-Winding Capacitance:

$C_{winding}$? $???_r \times (l_{wire} \times d_{wire}) / s$

Where:

- l_{wire} = length of each wire

- d_{wire} = wire diameter
- s = spacing between wires (≈ insulation thickness × 2)
- ε_r = dielectric constant of insulation

Typical Values:

For magnet wire on ferrite: 10-100 pF per meter of winding

Bifilar in VIC Context

Meyer's designs reportedly used bifilar chokes in several ways:

As Primary/Secondary Pair

L1 and L2 wound as bifilar on same core:

- Tight coupling between primary and secondary
- Built-in capacitance may serve as C1
- Simpler construction (single winding operation)

As Choke Sets

Matched pairs for symmetrical circuits:

- Identical L values guaranteed
- Common-mode rejection possible
- Push-pull drive configurations

Winding Techniques

Tips for Bifilar Winding:

1. **Keep wires parallel:** Twist them together before winding or use a jig
2. **Maintain tension:** Even tension prevents gaps and loose spots

3. **Mark the wires:** Use different colors or tag ends carefully
4. **Wind in layers:** Complete one layer before starting next
5. **Insulate between layers:** Add tape for voltage isolation

Measuring Bifilar Parameters

Measurement	Configuration	What It Tells You
L_A alone	Measure A, B open	Inductance of winding A
$L_{series-aid}$	A end to B start, measure	$L_A + L_B + 2M$
$L_{series-opp}$	A end to B end, measure	$L_A + L_B - 2M$
$C_{winding}$	Measure C between A and B	Inter-winding capacitance

Calculating Coupling Coefficient:

$M = (L_{series-aid} - L_{series-opp}) / 4$

$k = M / ?(L_A \times L_B)$

For true bifilar winding: k ≈ 0.95-0.99

Advantages and Disadvantages

Advantages:

- Built-in capacitance may simplify circuit
- Excellent magnetic coupling
- Matched characteristics between windings
- Compact construction

Disadvantages:

- Lower SRF due to high parasitic capacitance
- Difficult to adjust windings independently
- Insulation must handle full voltage difference
- More complex to wind correctly

VIC Matrix Calculator: The Choke Design section includes options for bifilar windings. It can calculate the expected inter-winding capacitance and adjust the SRF estimate accordingly. When designing bifilar chokes, the calculator helps ensure compatibility with your target resonant frequency.

Next: Parasitic Capacitance & SRF →

Revision #1
Created 2026-01-01 20:41:52 UTC by Chris Bake
Updated 2026-01-01 20:42:04 UTC by Chris Bake