

HF ANTENNA

Tilted Terminated Folded Dipole

The wideband 3–30 MHz wire antenna — build, deploy, operate

T2FD / TTFD / W3HH

What is a T2FD?

A broadband, non-resonant HF wire antenna

Origin: Developed by the U.S. Navy in the late 1940s at San Diego for shipboard HF use.

Introduced to hams: Capt. G.L. Countryman published the design in QST, June 1949.

Also known as: TTFD, BTFD, W3HH antenna — a folded dipole closed in a loop, terminated by a resistor opposite the feedpoint.



Why Hams Use It

Trade peak gain for band agility and simplicity



- **Single feedline, no tuner**
Usable SWR across roughly 3–30 MHz
- **No traps, no switching**
One antenna covers every HF band
- **Modest footprint**
Smaller than a full 80 m dipole
- **Quiet RX noise floor**
Popular for SWL and digital modes
- **Forgiving install**
Works at low heights, in attics, inverted-V

How It Works

Traveling-wave behavior, not resonance

01 Folded loop

Two parallel conductors form a closed loop. The loop's characteristic impedance is high — a few hundred ohms — and stays nearly constant with frequency.

02 Resistive termination

A non-inductive resistor opposite the feed absorbs energy that would otherwise reflect, killing the standing wave that makes resonant antennas band-specific.

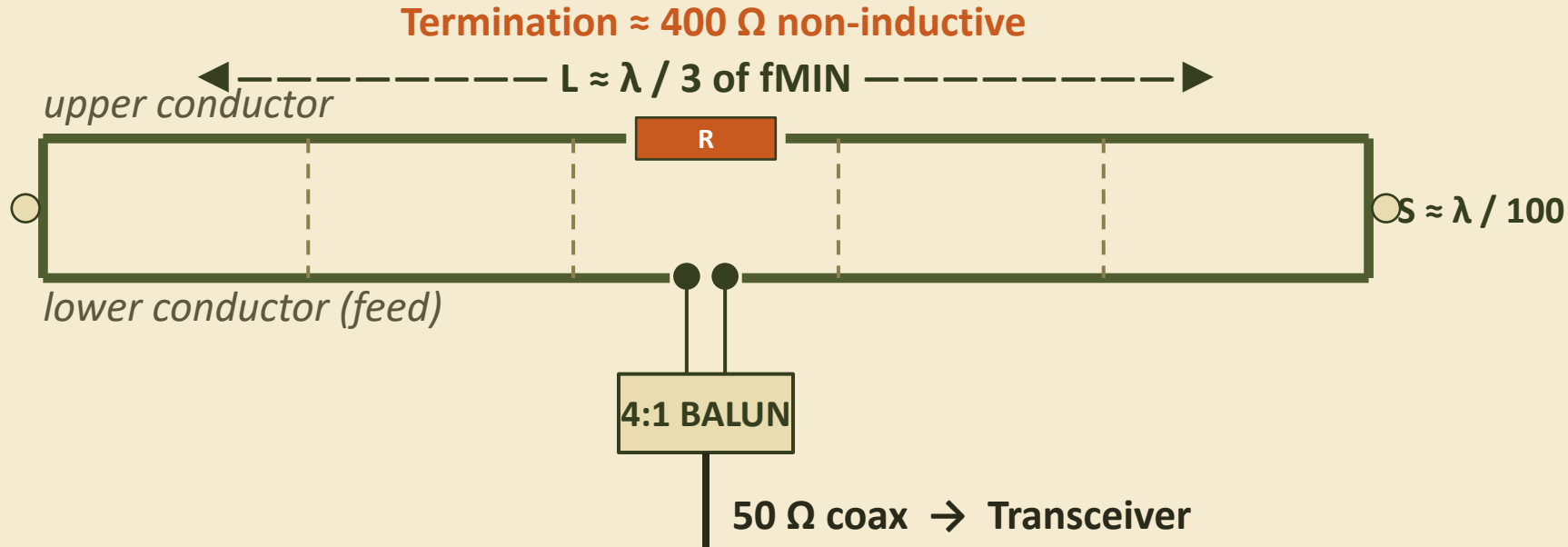
03 Broadband match

Because the load is mostly resistive across the design range, SWR stays low (typically 1.5:1–3:1) over a 6:1 or wider frequency span — no tuner needed.

Trade-off: 30%+ of transmit power is dissipated as heat in the termination resistor at low frequencies.

Antenna Geometry

Schematic of the folded loop — termination opposite feed



In the field, the whole assembly is sloped at 20° – 40° between a high and low support to broaden the radiation pattern.

Tilt 20° – 40°

Dimensions & Formulas

Sizing the wire for your lowest band

KEY FORMULAS

Span (length):

$$L \text{ (ft)} \approx 328 / f_{\text{MIN}}(\text{MHz})$$

$$L \text{ (m)} \approx 100 / f_{\text{MIN}}(\text{MHz})$$

Spacing between conductors:

$$S \approx \lambda_{\text{MIN}} / 100 \text{ (~}0.5\text{--}1 \text{ m)}$$

Bandwidth:

$$\approx 6:1 \text{ from } f_{\text{MIN}} \text{ to } f_{\text{MAX}}$$

fMIN	Top wire	Bottom wire	Spacing
3 MHz	33 m / 108 ft	32 m / 105 ft	0.9 m / 3 ft
5 MHz	20 m / 66 ft	19 m / 63 ft	0.6 m / 2 ft
7 MHz	14 m / 47 ft	14 m / 45 ft	0.4 m / 1.5 ft
10 MHz	10 m / 33 ft	9.5 m / 31 ft	0.3 m / 1 ft

Bottom wire is slightly shorter than the top — the two ends meet at insulating spreaders.

Termination Resistor & Balun

The two parts that make T2FD broadband

Termination resistor

- **Value:** 300–900 Ω , non-inductive (typically 390–470 Ω with a 9:1 balun, 800 Ω with 16:1)
- **Type:** carbon composition or thick-film — never wire-wound
- **Power rating:** at least 1/3 of TX PEP (50 W resistor for a 100 W rig)

Balun (impedance transformer)

- **Ratio:** classic 4:1 voltage balun \rightarrow 75 Ω coax; modern builds use 9:1 or 16:1 \rightarrow 50 Ω
- **Location:** feedpoint = middle of the bottom (lower) conductor
- **Choke:** add a 1:1 current balun or coax choke below to keep RF off the feedline



Bill of Materials

Everything you need for a backyard T2FD

Wire

#14 or #16 insulated stranded copper; two equal-length runs

End insulators

Ceramic or polycarbonate dogbones at each end

Balun

4:1 (traditional), 9:1 or 16:1 (modern) current balun in weatherproof box

Supports

Two trees, masts, or push-up poles 30–50 ft tall

Spreaders

PVC pipe or fiberglass rod, 0.5–1 m long, 4–6 along the span

Termination resistor

Non-inductive, 300–900 Ω , 25–100 W rated for the chosen power

Feedline

50 Ω coax (RG-8X / LMR-240 typical) with PL-259 or N connectors

Rope

Dacron / paracord (UV-resistant), pulleys optional

Deployment & Tilt Angle

Putting it up between two supports



- **Tilt 20°–40°**
Slope from one high anchor to a lower one.
Roughly omnidirectional, fills nulls.
- **Height**
Get the high end as high as possible ($\geq \frac{1}{4} \lambda$ at mid-band ideal, but 15 ft still works).
- **Straight run**
Keep wire taut; sag detunes the design and stresses spreaders.
- **Horizontal OK**
Flat-top works too if you can't tilt; performance is similar at HF.
- **Inverted-V**
Acceptable variant — apex at the feedpoint, ends sloping down at $\sim 30^\circ$.

Performance Expectations

What to actually see on the SWR meter

3–30 MHz

Typical coverage range

1.5 – 3 : 1

*SWR across HF,
no tuner*

~ -3 dB

Gain vs. resonant dipole

6 : 1

*Frequency span
(f_{MAX} / f_{MIN})*

Practical notes

- At least 30% of TX power is lost as heat in the resistor — lowest at high frequencies, worst near f_{MIN} .
- Radiation pattern stays similar across bands — no deep nulls or dead spots.
- Excellent for digital modes, ALE, EmComm, and shortwave listening; less ideal for chasing weak DX on a single band.
- Receive noise floor is often noticeably quieter than an end-fed or random wire in suburban locations.

Pros, Cons & When to Build One

The honest summary

PROS

- Wideband 3–30 MHz with one feedline
- No tuner needed for most rigs
- Simple, cheap materials
- Quiet on receive; consistent pattern
- Works at modest heights
- Great for digital, EmComm, SWL

CONS

- 30%+ of TX power lost in the resistor
- Lower gain than a resonant monobander
- Needs a true non-inductive resistor
- Length: ~33 m / 108 ft for 3 MHz coverage
- Not the antenna for weak-signal DX contests

Build one when band agility, simplicity, and a quiet receive matter more than peak gain.

Deployment & Tilt Angle

