

Waveguide Modes

Electrical Engineering

Why a hollow guide has a cutoff, which mode dominates, and the usable band.

A hollow waveguide carries TE and TM modes above a cutoff frequency, and nothing at all below it.

WR-90 WIDE WALL
22.86 mm

TE₁₀ CUTOFF
6.56 GHz

USABLE BAND
8.2 to 12.4 GHz

- No TEM mode: one conductor cannot support it
- TE₁₀ is the dominant rectangular-guide mode
- Cutoff for TE₁₀ is $c/2a$, set by the wide wall
- Below cutoff the field decays instead of travelling
- Guide wavelength exceeds the free-space value
- The usable band lies between two cutoffs

LOOK FOR IT

X-band radar uses WR-90 because its single-mode window covers 8.2 to 12.4 GHz.

Phase velocity inside a guide exceeds c while group velocity stays below it. Only the group velocity carries information.