

Expressions for the field components of the E_{mn} waves in a rectangular waveguide.

$$\begin{aligned}E_x &= E_{x0} \cos\left(\frac{m\pi}{a} x\right) \sin\left(\frac{n\pi}{b} y\right) \cos\left(-hz - \frac{\pi}{2}\right); \\E_y &= E_{y0} \sin\left(\frac{m\pi}{a} x\right) \cos\left(\frac{n\pi}{b} y\right) \cos\left(-hz - \frac{\pi}{2}\right); \\E_z &= E_{z0} \sin\left(\frac{m\pi}{a} x\right) \sin\left(\frac{n\pi}{b} y\right) \cos(-hz); \\H_x &= H_{x0} \sin\left(\frac{m\pi}{a} x\right) \cos\left(\frac{n\pi}{b} y\right) \cos\left(-hz + \frac{\pi}{2}\right); \\H_y &= H_{y0} \cos\left(\frac{m\pi}{a} x\right) \sin\left(\frac{n\pi}{b} y\right) \cos\left(-hz - \frac{\pi}{2}\right); \\H_z &= 0;\end{aligned}$$

Expressions for the field components of the H_{mn} waves in a rectangular waveguide.

$$\begin{aligned}H_x &= H_{x0} \sin\left(\frac{m\pi}{a} x\right) \cos\left(\frac{n\pi}{b} y\right) \cos\left(-hz + \frac{\pi}{2}\right); \\H_y &= H_{y0} \cos\left(\frac{m\pi}{a} x\right) \sin\left(\frac{n\pi}{b} y\right) \cos\left(-hz + \frac{\pi}{2}\right); \\H_z &= H_{z0} \cos\left(\frac{m\pi}{a} x\right) \cos\left(\frac{n\pi}{b} y\right) \cos(-hz); \\E_x &= E_{x0} \cos\left(\frac{m\pi}{a} x\right) \sin\left(\frac{n\pi}{b} y\right) \cos\left(-hz + \frac{\pi}{2}\right); \\E_y &= E_{y0} \sin\left(\frac{m\pi}{a} x\right) \cos\left(\frac{n\pi}{b} y\right) \cos\left(-hz - \frac{\pi}{2}\right); \\E_z &= 0;\end{aligned}$$

$$h = \sqrt{k_0^2 - k_1^2};$$

$$k_0 = \frac{2\pi f}{c};$$

$$k_1 = \sqrt{\left(\frac{m\pi}{a}\right)^2 + \left(\frac{n\pi}{b}\right)^2};$$

$$\lambda_{\text{cutoff}} = 2 / \sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2}.$$

Cutoff wavelength and frequency of H_{mn} modes.

m	n	f_{cutoff} , GHz	λ_{cutoff} , mm
1	0	6,52	46,00
2	0	13,04	23,00
0	1	15,00	20,00
1	1	16,36	18,34
3	0	19,57	15,33
2	1	19,88	15,09
3	1	24,65	12,17
4	0	26,09	11,50
0	2	30,00	10,00
4	1	30,09	9,97

Cutoff wavelength and frequency of E_{mn} modes.

m	n	f_{cutoff} , GHz	λ_{cutoff} , mm
1	1	16,36	18,34
2	1	19,88	15,09
3	1	24,65	12,17
4	1	30,09	9,97
1	2	30,70	9,77
2	2	32,71	9,17
3	2	35,82	8,38
5	1	35,89	8,36
4	2	39,76	7,55
6	1	41,91	7,16

Cutoff wavelength expressions of H and E modes

Modes	H₁₀	H₂₀	H₀₁	H₁₁	E₁₁
λ_{mn}	$2a$	a	$2b$	$2ab/\sqrt{a^2 + b^2}$	$2ab/\sqrt{a^2 + b^2}$
Modes	H₃₀	H₂₁	E₂₁	H₃₁	E₃₁
λ_{mn}	$2a/3$	$2ab/\sqrt{a^2 + 4b^2}$	$2ab/\sqrt{a^2 + 4b^2}$	$2ab/\sqrt{a^2 + 9b^2}$	$2ab/\sqrt{a^2 + 9b^2}$
Modes	H₄₀	H₀₂	H₄₁	E₄₁	E₁₂
λ_{mn}	$a/2$	b	$2ab/\sqrt{a^2 + 16b^2}$	$2ab/\sqrt{a^2 + 16b^2}$	$2ab/\sqrt{2a^2 + b^2}$
Modes	E₂₂	E₃₂	E₅₁	E₄₂	E₆₁
λ_{mn}	$ab/\sqrt{a^2 + b^2}$	$2ab/\sqrt{4a^2 + 9b^2}$	$2ab/\sqrt{a^2 + 25b^2}$	$ab/\sqrt{a^2 + 4b^2}$	$2ab/\sqrt{a^2 + 36b^2}$