

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

$$E_r = E_{r0} J'_m \left(\frac{V_{mn}}{R} r \right) \cos(m\varphi) \cos(-hz - \frac{\pi}{2});$$

$$E_z = E_{z0} J_m \left(\frac{V_{mn}}{R} r \right) \cos(m\varphi) \cos(-hz);$$

$$E_\varphi = E_{\varphi0} J_m \left(\frac{V_{mn}}{R} r \right) \sin(m\varphi) \cos(-hz + \frac{\pi}{2});$$

$$H_r = H_{r0} J_m \left(\frac{V_{mn}}{R} r \right) \sin(m\varphi) \cos(-hz - \frac{\pi}{2});$$

$$H_\varphi = H_{\varphi0} J'_m \left(\frac{V_{mn}}{R} r \right) \cos(m\varphi) \cos(-hz - \frac{\pi}{2});$$

$$H_z = 0;$$

$$h = \frac{2\pi}{\lambda_w}; \quad \lambda_w = \frac{\lambda}{\sqrt{1 - \left(\frac{\lambda}{\lambda_{cutoff}} \right)^2}}; \quad \lambda = \frac{c}{f}; \quad \lambda_{cutoff} = \frac{2\pi a}{V_{mn}}.$$

E_{mn} cutoff frequency and wavelength in circular waveguide, $R=10\text{mm}$.

| m | n | f_{cutoff} , GHz | λ_{cutoff} , mm |
|---|---|--------------------|-------------------------|
| 0 | 1 | 11,48 | 26,14 |
| 1 | 1 | 18,29 | 16,40 |
| 2 | 1 | 24,52 | 12,24 |
| 0 | 2 | 26,36 | 11,38 |
| 3 | 1 | 30,46 | 9,85 |
| 1 | 2 | 33,49 | 8,96 |
| 4 | 1 | 36,23 | 8,28 |
| 2 | 2 | 40,19 | 7,46 |
| 0 | 3 | 41,32 | 7,26 |
| 5 | 1 | 41,88 | 7,16 |

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

$$H_r = H_{r0} J'_m \left(\frac{\mu_{mn}}{R} r \right) \cos(m\varphi) \cos(-hz - \frac{\pi}{2})$$

$$H_z = H_{z0} J_m \left(\frac{\mu_{mn}}{R} r \right) \cos(m\varphi) \cos(-hz);$$

$$H_\varphi = H_{\varphi0} J_m \left(\frac{\mu_{mn}}{R} r \right) \sin(m\varphi) \cos(-hz + \frac{\pi}{2});$$

$$E_r = E_{r0} J_m \left(\frac{\mu_{mn}}{R} r \right) \sin(m\varphi) \cos(-hz + \frac{\pi}{2});$$

$$E_{\varphi} = E_{\varphi 0} J'_m \left(\frac{\mu_{mn}}{R} r \right) \cos(m\varphi) \cos\left(-hz + \frac{\pi}{2}\right);$$

$$E_z = 0;$$

$$h = \frac{2\pi}{\lambda_w}; \quad \lambda_w = \frac{\lambda}{\sqrt{1 - \left(\frac{\lambda}{\lambda_{\text{cutoff}}}\right)^2}}; \quad \lambda = \frac{c}{f}; \quad \lambda_{\text{cutoff}} = \frac{2\pi a}{\mu_{mn}}.$$

H_{mn} cutoff frequency and wavelength in circular waveguide, R=10mm.

| m | n | f _{cutoff} , GHz | λ _{cutoff} , mm |
|---|---|---------------------------|--------------------------|
| 1 | 1 | 8,79 | 34,15 |
| 2 | 1 | 14,58 | 20,58 |
| 0 | 1 | 18,29 | 16,40 |
| 3 | 1 | 20,05 | 14,96 |
| 4 | 1 | 25,39 | 11,82 |
| 1 | 2 | 25,45 | 11,79 |
| 5 | 1 | 30,63 | 9,79 |
| 2 | 2 | 32,01 | 9,37 |
| 0 | 2 | 33,49 | 8,96 |
| 6 | 1 | 35,81 | 8,38 |