

Calculation of power density



Note

The following calculation is based on the ANSI IEEE C95.1-1991 method, as that provides a worst case analysis. Details of the assessment to EN50383:2002 can be provided, if required.

Peak power density in the far field of a radio frequency point source is calculated as follows:

$$S = \frac{P.G}{4\pi d^2}$$

Where:

Is:

| | |
|---|--|
| S | power density in W/m ² |
| P | maximum average transmit power capability of the radio, in W |
| G | total Tx gain as a factor, converted from dB |
| d | distance from point source, in m |

Rearranging terms to solve for distance yields:

$$d = \sqrt{\frac{P.G}{4\pi.S}}$$

Calculated distances and power compliance margins

Table 84 shows calculated minimum separation distances, recommended distances and resulting margins for each frequency band and antenna combination. These are conservative distances that include compliance margins. At these and greater separation distances, the power density from the RF field is below generally accepted limits for the general population.

Explanation of terms used in **Table 84**:

Tx burst – maximum average transmit power in burst (Watt)

P – maximum average transmit power capability of the radio (Watt)

G – total transmit gain as a factor, converted from dB

S – power density (W/m²)

d – minimum distance from point source (meters)

R – recommended distances (meters)

C – compliance factor

Table 84 Power compliance margins, 5 GHz

| Band | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) | C |
|-------|-----------------------|----------|------|--------------------------|----------|----------|----|
| 5 GHz | Integrated, 13 dBi | 0.199 | 20 | 10 | 0.18 | .4 | 51 |
| 5 GHz | Connectorized, 15 dBi | 0.199 | 31.6 | 10 | 0.22 | .4 | 32 |

Table 85 Power compliance margins, 2.4 GHz, AP

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) | C |
|-----------|-------------------|------------------------------|----------|-------|--------------------------|----------|----------|------|
| PMP | 20 MHz | Connectorized, 8 dBi Omni | 0.631 | 6.3 | 10 | 0.18 | 0.4 | 50.5 |
| PMP | 40 MHz | Connectorized, 8 dBi Omni | 0.631 | 6.3 | 10 | 0.18 | 0.4 | 50.5 |
| PMP | 20 MHz | Connectorized, 17 dBi Sector | 0.079 | 50.1 | 10 | 0.18 | 0.4 | 50.5 |
| PMP | 40 MHz | Connectorized, 17 dBi Sector | 0.032 | 50.1 | 10 | 0.11 | 0.3 | 71.3 |
| PTP | 20 MHz | Connectorized, 25 dBi Dish | 0.003 | 316.2 | 10 | 0.08 | 0.2 | 63.2 |
| PTP | 40 MHz | Connectorized, 25 dBi Dish | 0.003 | 316.2 | 10 | 0.08 | 0.2 | 63.2 |

Table 86 Power compliance margins, 2.4 GHz, STA

| Conn Type | Channel Bandwidth | Antenna | P (W) | G | S (W/m ²) | d (m) | R (m) | C |
|-----------|-------------------|------------------------------|----------|-------|--------------------------|----------|----------|------|
| PMP | 20 MHz | Connectorized, 8 dBi Omni | 0.631 | 6.3 | 10 | 0.18 | 0.4 | 50.5 |
| PMP | 40 MHz | Integrated, 12 dBi Patch | 0.251 | 15.8 | 10 | 0.18 | 0.4 | 50.5 |
| PMP | 20 MHz | Connectorized, 17 dBi Sector | 0.079 | 50.1 | 10 | 0.18 | 0.4 | 50.5 |
| PMP | 40 MHz | Connectorized, 19 dBi Panel | 0.050 | 79.4 | 10 | 0.18 | 0.4 | 50.5 |
| PMP | 20 MHz | Connectorized, 25 dBi Dish | 0.010 | 316.2 | 10 | 0.16 | 0.4 | 63.5 |
| PMP | 40 MHz | Connectorized, 8 dBi Omni | 0.100 | 6.3 | 10 | 0.07 | 0.2 | 79.6 |
| PMP | 20 MHz | Integrated, 12 dBi Patch | 0.050 | 15.8 | 10 | 0.08 | 0.2 | 63.2 |
| PMP | 40 MHz | Connectorized, 17 dBi Sector | 0.025 | 50.1 | 10 | 0.10 | 0.2 | 39.9 |
| PMP | 20 MHz | Connectorized, 19 dBi Panel | 0.020 | 79.4 | 10 | 0.11 | 0.3 | 71.3 |
| PMP | 40 MHz | Connectorized, 25 dBi Dish | 0.006 | 316.2 | 10 | 0.13 | 0.3 | 56.7 |
| PTP | 20 MHz | Integrated, 12 dBi Patch | 0.398 | 15.8 | 10 | 0.22 | 0.4 | 31.9 |

| | | | | | | | | |
|-----|--------|------------------------------|-------|-------|----|------|-----|------|
| PTP | 40 MHz | Connectorized, 17 dBi Sector | 0.158 | 50.1 | 10 | 0.25 | 0.5 | 39.5 |
| PTP | 20 MHz | Connectorized, 19 dBi Panel | 0.050 | 79.4 | 10 | 0.18 | 0.4 | 50.5 |
| PTP | 40 MHz | Connectorized, 25 dBi Dish | 0.010 | 316.2 | 10 | 0.16 | 0.4 | 63.5 |
| PTP | 20 MHz | Integrated, 12 dBi Patch | 0.050 | 15.8 | 10 | 0.08 | 0.2 | 63.2 |
| PTP | 40 MHz | Connectorized, 17 dBi Sector | 0.025 | 50.1 | 10 | 0.10 | 0.2 | 39.9 |
| PTP | 20 MHz | Connectorized, 19 dBi Panel | 0.020 | 79.4 | 10 | 0.11 | 0.3 | 71.3 |
| PTP | 40 MHz | Connectorized, 25 dBi Dish | 0.006 | 316.2 | 10 | 0.13 | 0.3 | 56.7 |



Note

Gain of antenna in dBi = $10 \cdot \log(G)$.

The regulations require that the power used for the calculations is the maximum power in the transmit burst subject to allowance for source-based time-averaging.

At 2.4 GHz, 5.4 GHz and EU 5.8 GHz, the products are generally limited to a fixed EIRP which can be achieved with the Integrated Antenna. The calculations above assume that the maximum EIRP allowed by the regulations is being transmitted.



Note

If there are no EIRP limits in the country of deployment, use the distance calculations for FCC 5.8 GHz for all frequency bands.