# Heat Sink Thermal Resistance Required for a Semiconductor

Heat-sink-to-air thermal resistance needed to keep a semiconductor junction below its limit, from power, ambient, junction-to-case and interface resistances.

**Method:** Series thermal resistance network for semiconductors

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Power dissipated | 15.000 | W |
| Maximum junction temperature (with margin) | 125.00 | °C |
| Ambient (air inside the enclosure) | 50.000 | °C |
| Junction-to-case thermal resistance (K/W) | 1.5000 | |
| Case-to-sink (interface) thermal resistance (K/W) | 0.50000 | |
| Junction-to-ambient without a heat sink (K/W) | 62.000 | |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Required heat sink to air resistance (K/W) | 3.0000 | |
| Case temperature at the limit | 102.50 | °C |
| Heat sink temperature at the limit | 95.000 | °C |
| Junction temperature with no heat sink | 980.00 | °C |
| Maximum power with no heat sink | 1.2097 | W |

### Notes for this case

- Series thermal path T_j = T_a + P(R_θJC + R_θCS + R_θSA). Choose a heat sink with R_θSA below the result at the expected airflow.

## Formula and method

$$R_{\theta SA} = \frac{T_{j,max} - T_a}{P} - R_{\theta JC} - R_{\theta CS}, \quad T_j = T_a + P(R_{\theta JC} + R_{\theta CS} + R_{\theta SA})$$

### Variables

| | | |
|---|---|---|
| $P$ | Power dissipated | W |
| $T_{j,max}$ | Maximum junction temperature (with margin) | K |
| $T_a$ | Ambient (air inside the enclosure) | K |
| $R_{\theta JC}$ | Junction-to-case thermal resistance (K/W) | - |
| $R_{\theta CS}$ | Case-to-sink (interface) thermal resistance (K/W) | - |
| $R_{\theta JA}$ | Junction-to-ambient without a heat sink (K/W) | - |
| $R_{\theta SA}$ | Required heat sink to air resistance (K/W) | - |
| $T_c$ | Case temperature at the limit | K |
| $T_s$ | Heat sink temperature at the limit | K |
| $T_{j,bare}$ | Junction temperature with no heat sink | K |
| $P_{max,bare}$ | Maximum power with no heat sink | W |

### Method and standards

Thermal resistance network.

### Assumptions and limits

- Steady state, one-dimensional series heat path.

### References

Series thermal resistance network for semiconductors

## Report details

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|---|---|
| Report reference | FCC-DBVH-DRVJ (the same inputs always give the same reference) |
| Generated | 23 November 2026, 17:34 UTC |
| Calculator | Heat Sink Thermal Resistance Required for a Semiconductor |
| Method last reviewed | 17 November 2026 |
| Software release | FireCAD Calc, release of 22 November 2026 |
| Release checks | 3 reference cases of this calculator, computed independently, are checked on every release |

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

### This calculator online

https://calc.firecad.com/electrical/electronics/heat-sink-thermal-resistance

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.