

THERMAL DESIGN BASICS

Circuit

7805 regulator supplied by a 12V battery (allow for 14V MAX during charging)

Max voltage drop across the regulator = $14 - 5 = 7$ Volts

For a design load current of .5 Amp

Max regulator dissipation = $7V \times .5A =$

3.5 Watts

Regulator Specs

Case 221A

Thermal Resistance, Junction-to-Ambient R_{qJA} 65 °C/W

Thermal Resistance, Junction-to-Case R_{qJC} 5.0 °C/W

Max Operating Junction Temperature T_J 150 °C

Thermal Design

What is the max current with no heatsink?

With no heatsink, $R_{qJA} = 65C/W$

Assuming a 50C ambient temperature, max allowable temp rise = $(T_J - T_a) = (150 - 50) =$
100C Then max power = $100C / (65C/W) = 1.538W$

Max current without a heatsink = $1.538W / 7V = .22A = 220mA$

For the nominated .5A, 3.5W load and an ambient temperature of 50C

We a heatsink and an overall R_{qJA} of $(150 - 50)C / 3.5W = 28.6 C/W$

$R_{qJC} = 5C/W$ so we need a (case-ambient) $R_{qCA} = (28.6 - 5) = 23.6C/W$

Jacar \$1 HH-8502 (19x19x9.5mm) 20C/W will marginally do

{ alternatively, the Jaycar \$1.45 HH-8504 12C/W is much better }

The junction temperature will be $(20 + 5)C/W \times 3.5W = 87.5C$ above ambient [$T_J = 137.5C$]

{ or with the 12C/W heatsink $(12 + 5)C/W \times 3.5W = 59.5C$ above ambient [$T_J = 109.5C$] }

For the 12C/W heatsink, the case temperature will be $109.5C - 5C/W \times 3.5W = 109.5C - 17.5C = 92C$