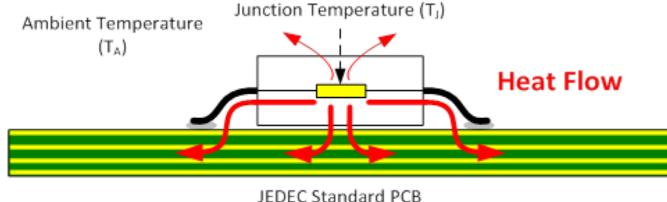
Application and Definition of Thermal Resistances

1. θ_{JA} Thermal Resistances

The thermal resistance θ_{JA} (Theta-JA) is the chip junction-to-ambient air thermal resistance measured in the convection environments described in JESD51-2. The value can be used to compare the thermal performance of different packages if all the test conditions listed in Table 1 are similar.
The following formula can be used to define the value of θ_{JA} :

$$\theta_{JA} = \frac{T_J - T_A}{P}$$

Where P is the "Total" power (heat) dissipated in the chip. TJ is the junction temperature after thermal balance. T_A is the ambient temperature. The unit of θ_{JA} is in °C/W.

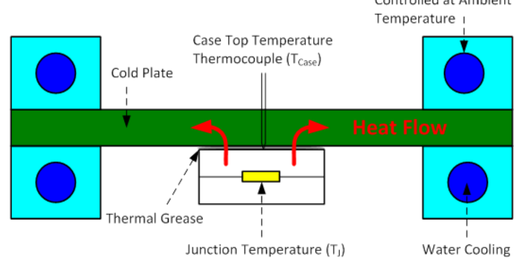


2. θ_{JCx} Thermal Resistances

The conduction thermal resistance θ_{JCx} (Theta-JCx) is measured with nearly all of the component power dissipation flowing through either the top or the bottom of the package. The "x" indicates the case surface where T_{Case} is measured and through which all the heat is forced to flow during the θ_{JCx} measurement, "top" for the top surface or "bot" for the bottom surface. The values may be useful for comparing packages but the test conditions don't generally match the user's application. An exception is an application where nearly all of the component heat is flowing through the top of the package to a heat sink (i.e. via a metal mounting tab). $\theta_{JC(Top)}$ is representative of this application.
The following formula can be used to define the value of θ_{JCx} :

$$\theta_{JCx} = \frac{T_J - T_{Case}}{P}$$

Where P is the "Part" of the chip power (heat) that flows from the junction to the "x" case surface. Ideally, during θ_{JCx} measurement, close to 100% of the power flows from the junction to the "x" case surface. T_J is the junction temperature after thermal balance. The unit of θ_{JCx} is in ^{o}C/W.



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3. Thermal considerations

The power dissipation is defined as

$P_D = I_{OUT} \times (V_{IN} - V_{OUT})$

The maximum power dissipation depends on the thermal resistance of IC package, PCB layout, the rate of surrounding airflow and temperature difference between junction and ambient.
The maximum power dissipation can be calculated by the following formula：

$$P_{D(MAX)} = \frac{(T_J - T_A)}{\theta_{JA}}$$

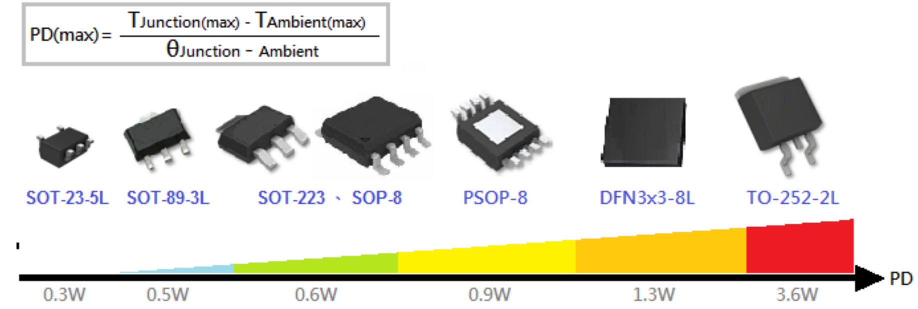
Package	SOT-363	SOT-23-5L	SOT-89-3L	DFN5x6-8L	TO-252-2L
Diagram					
P_D	**0.25W**	**0.3W**	**0.5W**	**2.7W**	**3.6W**

$P_D = (V_{IN} - V_{OUT}) \times I_{OUT} < P_{D(max)}$

And the case temperature, T_C, can be calculated as follows：

$T_J = T_C + (P_D \times \theta J_C)$

For this operating condition, T_J is lower than the absolute maximum operating junction Temperature (≤125℃).



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