FAIRCHILD SEMICONDUCTOR™

Advanced Power Products

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Performance Restrictions Associated with 3.5 Watts SO-8 Power MOSFETs

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In applications requiring high current and small footprint electronic switches, a Power MOSFET packaged in an SO-8 is usually the best choice. This is because the combination offers low on-resistance and reasonable power handling. A second benefit is the numerous suppliers for this product. As a result, SO-8 Power MOSFETs are commonly found in applications such as notebook computer DC-DC converters, battery chargers, and disk drive motor controls.

SO-8 packaged Power MOSFETs handle about one Watt under "typical" conditions (Figure 1), regardless of the silicon size. The thermal capability of any semiconductor is strongly related to the operating conditions, however users often overlook the importance of such criteria. In addition, the lack of an industry standard means that MOSFET manufacturers may mislead the power handling of SO-8 Power MOSFETs by two to four times their typical thermal capability. Users should also remember that current handling is proportional to power handling. By simply manipulating the power rating conditions, MOSFET manufacturers can tailor any current rating to any "non-typical" condition.

Of particular concern is a claim circulating that 3.5 Watt SO-8 Power MOSFETs exist in the industry. This is another twist in addition to the existing ill-defined 2.5 Watt power rating. If users carefully read the fine print of the disclaimer on the datasheets, it reveals that 3.5 Watt power handling can only be achieved "when mounted on a 1 inch square copper board; t < 10 sec." Such conditions are not only unrealistic, but also pose a potential hazard for those who design parts with this information. As a result, it is not uncommon to see SO-8 Power MOSFETs being destroyed when they smoke during lab experiments.

The disclaimers are technically correct but unrealistic for two reasons. First, one square inch of board space is somewhat equivalent to the size of a typical CPU, (Figure 2). Realistically, no one can afford such precious space for a MOSFET switch in any portable electronics. Secondly, SO-8 Power MOSFETs reach thermal equilibrium in a few minutes. That means a 10 second operation is far from the worst case condition. As a general rule, SO-8 Power MOSFETs handle about one Watt under "typical" conditions (Figure 1).

In order to calculate power handling rather than rely on datasheet specifications, users should be familiar with the parameter $R_{\theta JA}$. Since $T_J - T_A = P_D * R_{\theta JA}$ (Equation 1), power handling can be calculated assuming the maximum allowable temperature, ambient temperature, and $R_{\theta JA}$ at a given condition are known. To facilitate users in proper thermal design, Fairchild Semiconductor publishes different $R_{\theta JA}$ specifications at various conditions.

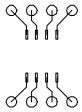

Figure 1. Typical Condition

$R_{\theta JA}$ = 125 ºC/W → P_D = 1 W

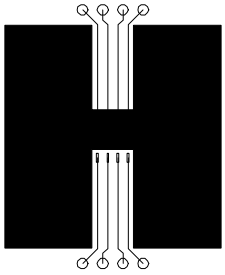

Figure 2. 1 in^2 2oz Copper PAD

$R_{\theta JA}$ (10sec) = 36 ºC/W → P_D(10sec) = 3.5 W
$R_{\theta JA}$ = 50 ºC/W → P_D = 2.5 W

Equation 1.

$T_J - T_A = P_D * R_{\theta JA}$

where:

T_J = Junction Temperature
T_A =Ambient Temperature
P_D =Power Dissipation

Be Aware That Under "Typical" Conditions, SO-8 Power MOSFETs Only Handle About One Watt.

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