SGS-THOMSON MICROELECTRONICS

APPLICATION NOTE

Tj MAX LIMIT OF SCHOTTKY DIODES

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INTRODUCTION

This application note is about the limit of Tj max given in the datasheet of SCHOTTKY rectifiers.

It explains the real meaning of this parameter and why in some applications, the component can operate with a junction temperature higher than Tj max.

Table fig.1 shows the Tj max specified in the datasheet for the different families of SCHOTTKY diodes.

Fig.1 : Tj max versus SCHOTTKY family

SCHOTTKY FAMILY	V_{RRM} (V)	Tj Max (°C)
STPSxxL10	10	100
STPSxxL25	25	125
STPSxx45	45	150
STPSxx100	100	125

For a classical ultra fast rectifier, this limit is equal to 150°C. For a SCHOTTKY diode this limit is lower (for instance 125°C for a STPSxxL25). This lower limit of Tj max is only due to thermal runaway phenomenon linked to the leakage current.

This phenomenon is explained in the application note : "THERMAL RUNAWAY IN RECTIFIER".

This application note describes the rules for the calculation of the limit before thermal instability is reached . This limit depends on the characteristics of the diodes (leakage current : I_R, junction to case thermal resistance Rth(j-c) ...) and application parameters (reapplied voltage across the diodes : V_R, duty cycle of the blocking of the diode : (1 - δ), thermal resistance of the heatsink : Rth(c-a) ...).

The following two examples show that for the same diode (STPS10L25D) different conditions lead to different limits for Tj max.

First example :

Application parameters :

$(1-\delta) = 0.5$

$V_R = 15V$

$Rth(c-a) = 8.5°C/W$

Diode parameters : (STPS10L25D) :

I_R max (15V, 125°C) = 210mA

$Rth(j-c) = 1.6°C/W$

The limit of the reverse current at V_R and Tj max before reaching thermal runaway is given by :

$$I_R(15V, Tjmax) = \frac{1}{V_R(1-\delta)\, cR\, th\,(j-a)}$$

Where c is a thermal coefficient $c \approx 0.055$

$Rth(j-a) = Rth(j-c) + Rth(c-a)$

We have : I_R (15V, Tj max) = 242mA

Tj max is given by :

$$Tjmax = 125 + \frac{1}{c}\, In \frac{I_R(15V, Tjmax)}{I_R \max(15V, 125°C)}$$

Tj max = 127°C

Second example :

Application parameters :

$(1-\delta) = 0.5$

$V_R = 5V$

$Rth(c-a) = 18.5°C/W$

Diode parameters (STPS10L25D) :

I_R max (5V, 125°C) = 125mA

$Rth(c-a=) = 1.6°C/W$

We have I_R (5V, Tj max) = 363mA

and **Tj max = 144°C**

CONCLUSIONS :

This application note shows that the maximum limit of Tj of the SCHOTTKY diodes given in the datasheet is mainly due to the thermal runaway phenomenon. This limit doesn't only depend on diode parameters but also application parameters. In the first example corresponding to a typical application we will find Tj max given in the datasheet. The second example shows that in some applications SCHOTTKY diodes can be used with a junction temperature higher than the Tj max given in the datasheet.