FMKS Series Diodes with Temperature Detection

By Maxx Yoshida
Sanken Electric Co., Ltd.

Summary

In the FMKS series, a Schottky barrier diode is formed on the same die as the fast-recovery diode that is used as the secondary-side rectifier diode, making temperature-change detection in real-time possible, as well as reducing part count and design time.

Circuit Operation

For switched mode power supplies in applications such as audio systems and adaptors, by using thermistor characteristics, overloaded state is detected through the temperature of the rectifier diode at the secondary side of the switched mode power supply.

Figure 1 is a typical application circuit using a thermistor for thermal detection of the rectifier diode. In this circuit, when the temperature of D1 goes up, the resistance value of the thermistor (which is thermally connected to D1) will be reduced; see Figure 2 for general characteristics of thermistors. When the temperature of D1 rises and the resistance value of the thermistor drops, the base voltage of Tr1 reaches the threshold and Tr1 turns on. Then current flows through the photocoupler, and by the signal sent back to the primary side through the photocoupler, the supply of electric power will be limited.

By using this method, the destruction of switched mode power supplies in the overloaded state can be avoided.

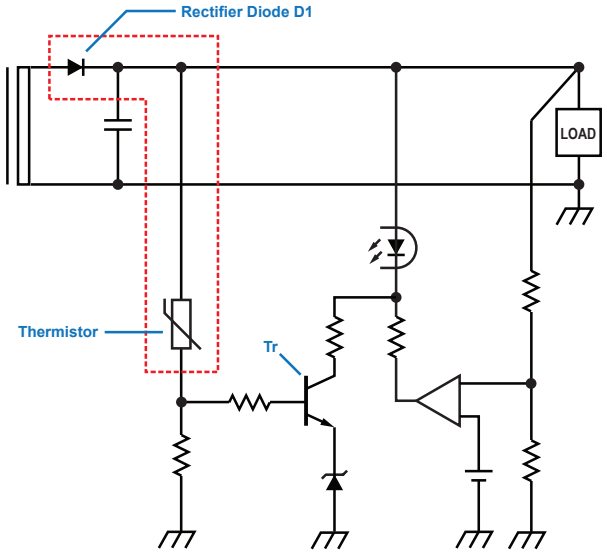

Figure 1: Secondary Side of Switched Mode Power Supply using Thermistor

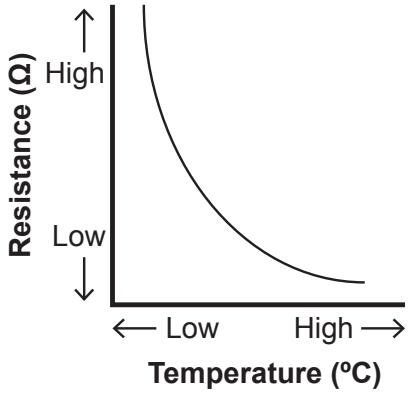

Figure 2: General Thermistor Temperature Characteristics
Increasing thermistor temperature reduces thermistor resistance.

Figure 3 is an application circuit using a Schottky barrier diode instead of a thermistor. Schottky barrier diodes have characteristics that I_R (leakage current) increases when temperature rises (see Figure 4).

When D1 temperature rises, the leakage current from the Schottky barrier diode (which is thermally connected to D1) will increase. Due to the increase of this leakage current, when Tr1 base current reaches the threshold, Tr1 will turn on. Then, in the same way as the case when using a thermistor, the current flows through the photocoupler, and by the signal sent back to the primary side through the photocoupler, the supply of electric power will be limited.

By using this method, the destruction of switched mode power supplies in the overloaded state can be avoided.

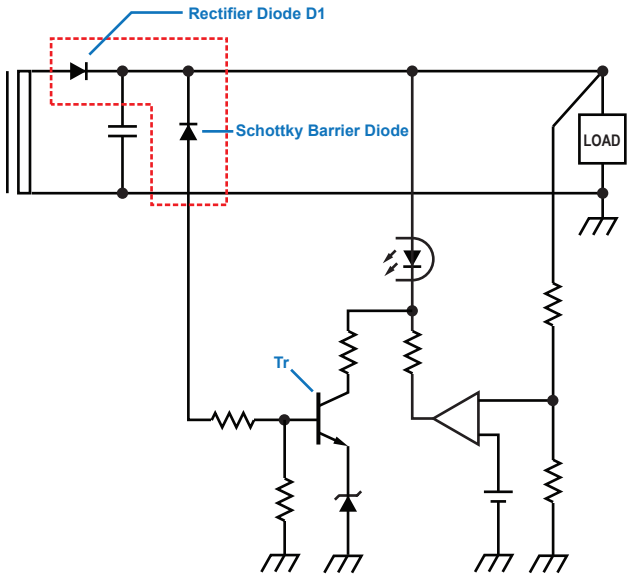

Figure 3: Secondary Side of Switched Mode Power Supply using Schottky Barrier Diode

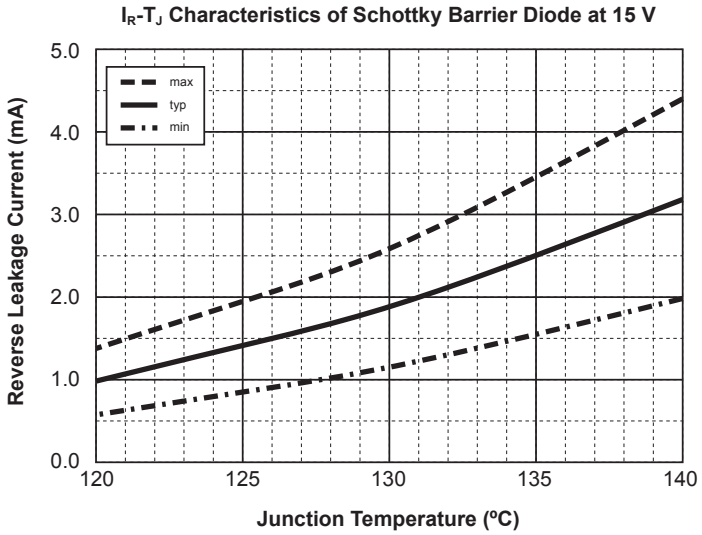

Figure 4: Schottky Barrier Diode I_R-T_J Characteristics

Sanken Electric Co., Ltd.
3-6-3 Kitano, Niiza-shi, Saitama-ken
352-8666, Japan
www.sanken-ele.co.jp

Issues When Using Thermistors or Schottky Barrier Diodes

In any case, since temperature differences occur between the thermistor or the Schottky barrier diode and the device detecting the temperature (the secondary rectifier diode D1 in the above mentioned cases), accurate temperature cannot be detected in real-time using thermistors or Schottky barrier diodes.

For this, it is necessary to consider the thermal connections of the device that detects temperature and the device of which temperature is detected.

It is ideal that the temperature-detecting device is formed on the same die as the device of which temperature is detected in order to detect changes in temperature in real-time.

In the FMKS series, a Schottky barrier diode is formed on the same die as the fast-recovery diode that is used as the secondary-side rectifier diode (see Figure 5). Thus, temperature change detection in real-time is made possible, and part count and design time is reduced.

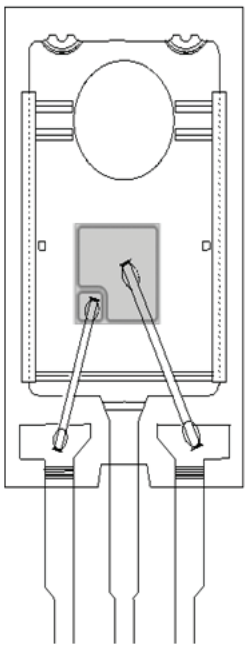

Figure 5: Internal Structure

Ultra-fast recovery diode (200 VRM(V)) and thermal-detect diode are incorporated into a TO-220F package.

Revision History

Revision	Revision Date	Description of Revision
–	November 3, 2015	Initial Release

The information contained in this document does not constitute any representation, warranty, assurance, guaranty, or inducement by Sanken to the customer with respect to the subject matter of this document. The information being provided does not guarantee that a process based on this information will be reliable, or that Sanken has explored all of the possible failure modes. It is the customer's responsibility to do sufficient qualification testing of the final product to insure that it is reliable and meets all design requirements.

The operation and circuit examples in this document are provided for reference purposes only. Sanken assumes no liability for violation of industrial property, intellectual property, or other rights of Sanken or third parties, that stem from these examples.

For the latest version of this document, visit our website:

www.sanken-ele.co.jp