8CLJQ045 8A 45V Schottky Rectifier

1.0 Scope

This document contains a description of the SPICE models and test circuits for the International Rectifier 8CLJQ045 90V – 8A 45V Schottky Rectifier.

Analysis:	**Solid State Relay**
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SPICE File	**IR_Semi.LIB**

2.0 Functional Description

The 8CLJQ045 is an 8A, 45V Schottky rectifier. The device's low forward voltage drop and reverse leakage current are optimized for typical high frequency switching power supplies and resonant converters.

3.0 Assumptions

1. Diode V-I characteristics vs. temperature, and reverse leakage vs. temperature are not optimized in the basic SPICE diode model representation of the 8CLJQ045; however, the SPICE diode model will track temperature performance to a significant degree.

2. International Rectifier does not characterize its Schottky diodes at low currents. There is no data available below 1A. Therefore some estimation was made in order to obtain a proper fit for the data that is available.
3. The SPICE model parameters EG and XTI were set to 0.69 and 3, respectively, for the Schottky diodes. This will allow the performance over temperature to be more accurate.
4. No Monte Carlo or other statistical data was provided by the manufacturer.
5. Package parasitics were not included in the SPICE diode model.
6. Package parasitics except for series inductance package parasitics were not included in the subcircuit model.

3.0 Model Description

Two SPICE representations were created for the 8CLJQ045 diode. One uses the built-in SPICE diode. The second uses a subcircuit topology to better model the forward recovery and reverse leakage vs. reverse voltage over temperature. The built-in SPICE diode model is sufficient for most simulations and will run faster than the subcircuit model.

The power Schottky rectifier subcircuit model is based on a subcircuit described in [1]-[4]. Schottky diodes can normally be modeled using the built-in SPICE diode as is the case with the remainder of the Schottky rectifier's model here. However, in the case of power Schottky rectifiers, two effects must be accounted for that are not included in the built-in SPICE model. The first is the conductivity modulation in the forward conductance and the second is the reverse leakage current which is an exponential function of both temperature and reverse voltage. PSpice contains the functions necessary to construct a reasonable power Schottky model that adds these enhancements.

Table 4-2 shows the subcircuit netlist for the 8CLJQ045. The diode, DIO, accounts for most of the traditional Schottky behavior. A Schottky diode is a majority carrier device whose reverse recovery time is zero. However, its larger junction capacitance, CJO, will produce a similar effect. Therefore, the minority carrier storage time parameter, TT, is left at its default value of 0. The emission coefficient, N, is normally set close to 1. The saturation current value, IS, is typically much higher (two orders of magnitude) than for p-n diodes. The values for saturation current temperature exponent, XTI =2-3, and energy gap, EG=0.6-0.69, are set based on the values expected for Schottky barrier diodes.

The voltage sensitive effects are produced by GBDIO, an exponential nonlinear current source. Such a source would have been considerably more difficult to construct with SPICE 2 based programs. With the in-line equation features available in current SPICE programs, this function is simple to implement. The forward recovery of the diode is modeled by the time constant of RFR and CFR.

Table 4.2: PSpice model of the 8CLJQ045.

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*PSpice Subcircuit model

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Both model representations include the following functionality and features:

- VI Characteristics
- Capacitance vs. reverse voltage
- Reverse current vs. reverse voltage

4.0 Model Verification

Each model was simulated and the results were compared to data sheet and data supplied by International Rectifier. Shown in the figures below are the simulated characteristic curves (VI, reverse recovery, capacitance, and reverse breakdown) for the diode models. In order to test the model, a simple test circuit to derive DC and transient characteristics was constructed.

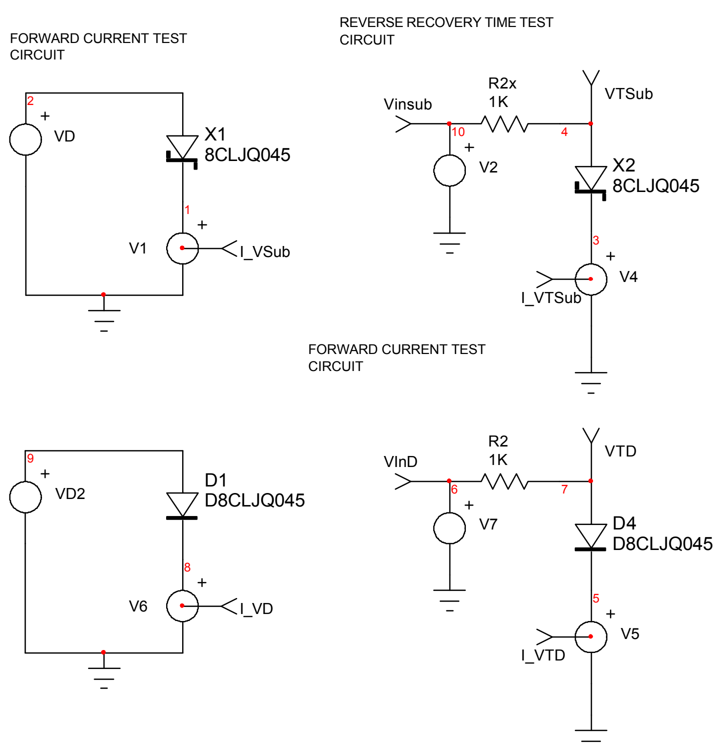

Figure 4-1: Simple test circuits for the DC and transient characteristics of the Schottky diodes.

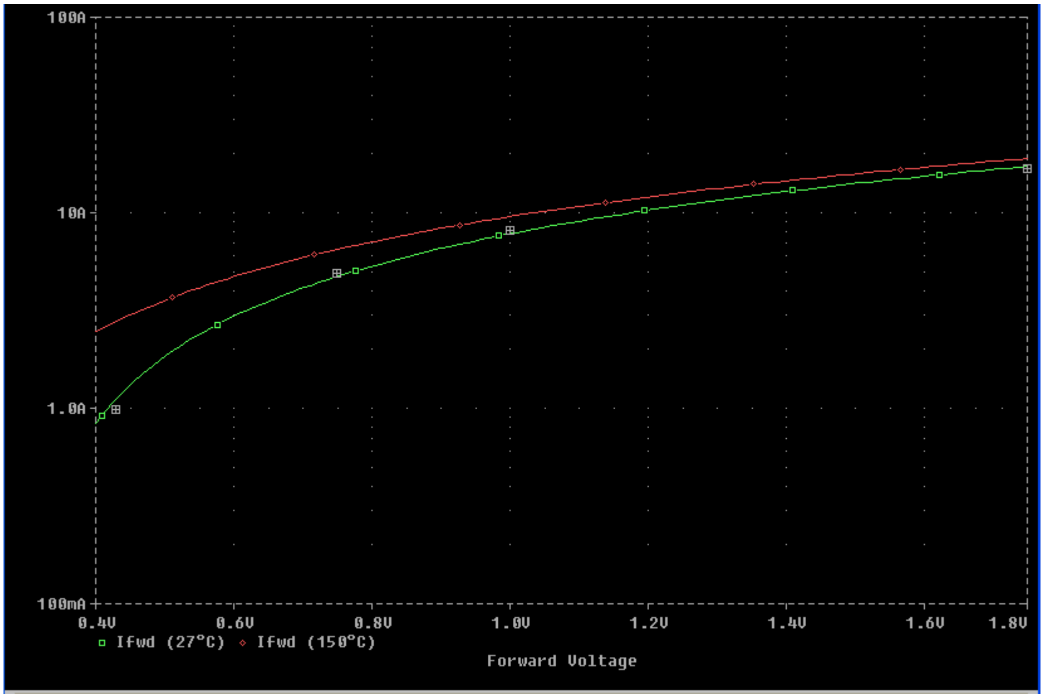

Figure 4.2 Forward voltage-current characteristic curves for the 8CLJQ045 (Top 150C, Bottom 27C).

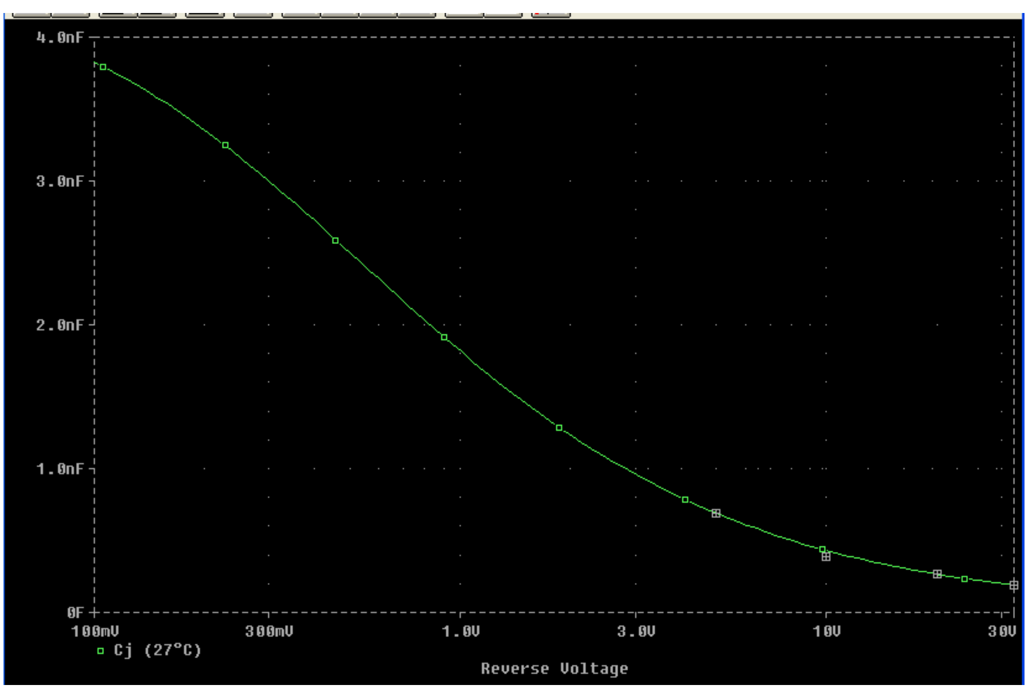

Figure 4.3 Capacitance vs. reverse voltage characteristic.

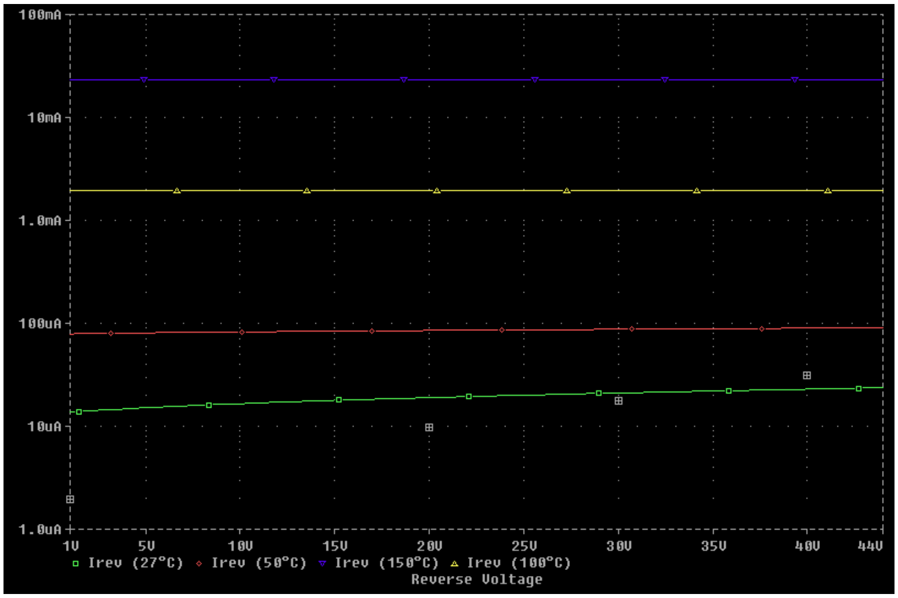

Figure 4.4 Typical reverse leakage current curves vs. temperature for the 8CLJQ045 built-in diode model.

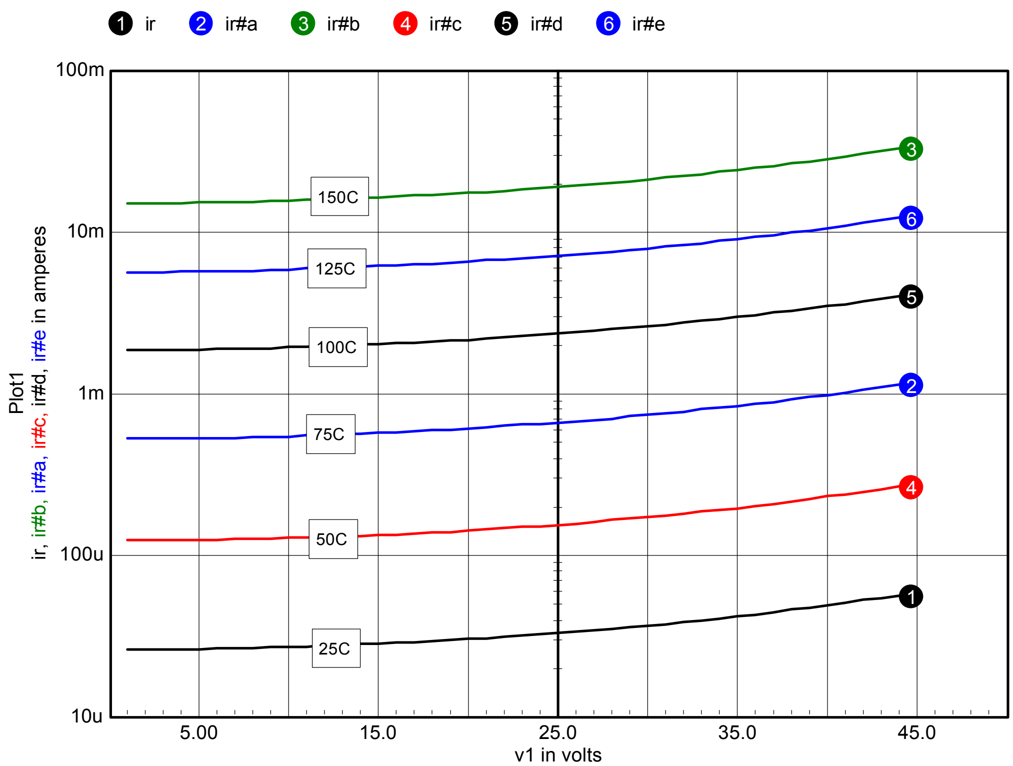

Figure 5.17 Typical reverse leakage current curves vs. temperature for the 8CLJQ045 subcircuit diode model.

5.0 Conclusions

The DC, transient and capacitive simulation results for the models provide excellent correlation with the manufacturer's electrical specifications and provided data. This data should be verified against actual hardware for further confirmation.

6.0 Conclusions

[1] Gerald Stanley, "A simple SPICE3 Model for Schottky Power Diodes", Crown International, 9-92, private correspondence

[2] Gerald Stanley, "SPICE32 Rect(n) Functions", Crown International, 9-92, private correspondence

[3] Y. Khersonsky, M. Robinson, D. Gutierrez, "The Hexfred Ultrafast Diode in Power Switching Circuits", AN-989, International Rectifier, 1992

[4] P. Antognetti and G. Massobrio, "Semiconductor Device Modeling with SPICE", 2nd Ed., McGraw-Hill, 1993

