JEDEC STANDARD

Commutating Diode Safe Operating Area Test Procedure for Measuring DV/DT During Reverse Recovery of Power Transistors

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COMMUTATING DIODE SAFE OPERATING AREA TEST PROCEDURE FOR MEASURING dv/dt DURING REVERSE RECOVERY OF POWER TRANSISTORS

(From Council Ballot JCB-91-50 formulated under the cognizance of JC-25 Committee on Transistors)

1. PURPOSE

To define a method for verifying the diode recovery stress capability of power transistors. The focus is on simplicity and practicability.

2. SCOPE

This method covers all power transistors which have an internal diode capable of commutating current generated during reverse recovery.

3. DEFINITIONS

R_g	Gate drive impedance
R_{DUT}	Gate to source circuit resistance at DUT
T_J	Semiconductor junction temperature
V_{GEN}	Gate generator voltage (volts) for drive transistors
V_{DD}	Supply voltage
I_{FM}	A device is used in the lower portion of an H bridge (Refer to Figure 1) and is equivalent to the DUT.
$L_{(LOAD)}$	Load inductor. Shall be of a large enough value such that the decay of current during the forward conduction of the DUT is less than 5% of I_{FM}.
t_{rv}	Drain voltage rise time. Measured between 10% of V_{DD} and 90% of V_{DD}. The voltage waveform limits shall be recorded during the test and a typical value shall be contained in the detail specification.
t_{rr}	Reverse recovery time

V_{DS}	Drain - source voltage
$V_{(BR)DSS}$	Breakdown voltage drain - source
I_{GSS}	Reverse gate current, drain shorted to source
$R_{DS(on)}$	Static drain - source on state or resistance

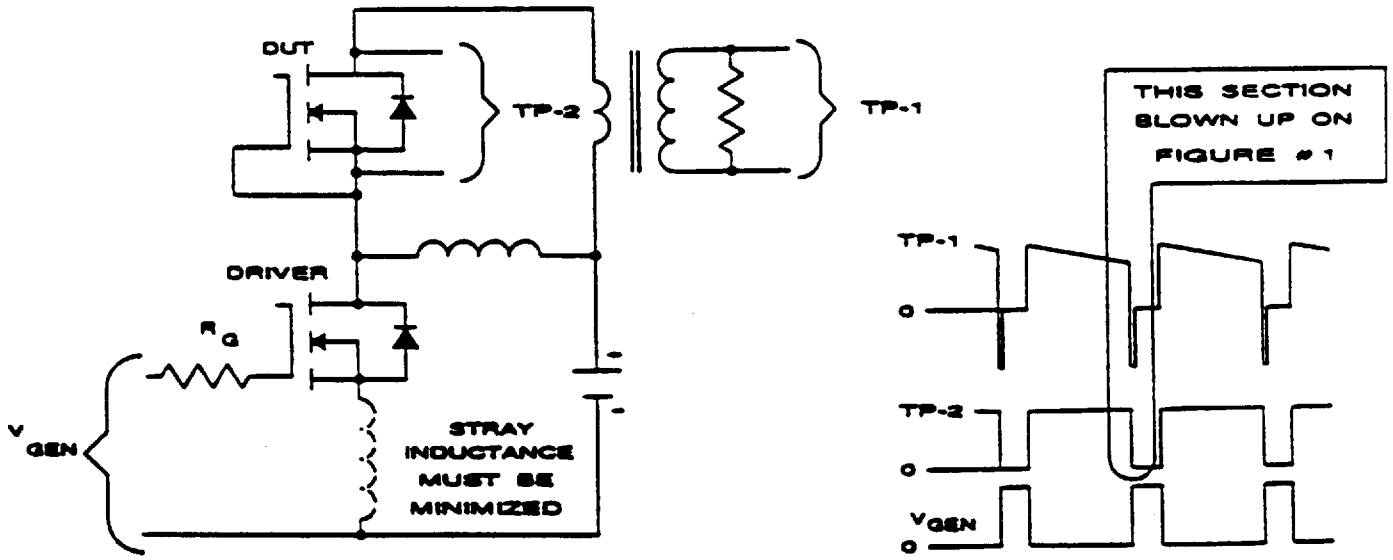

Figure 1
Body Diode Test Circuit

4. CIRCUIT

Basic circuity for testing this parameter is shown in Figure 1. Idealized waveforms are shown in Figure 2. Snubbers may not be used. Stray capacitance and inductance, especially in the source of the drive transistor, must be minimized.

The basic principle of the circuit may not be altered, that is, the lower H bridge device must be equivalent to the DUT. The circuit may operate "repetitively", or "single shot", as long as the required test conditions are achieved. Gate drive to the driver may be any Thevenin equivalent of that specified.

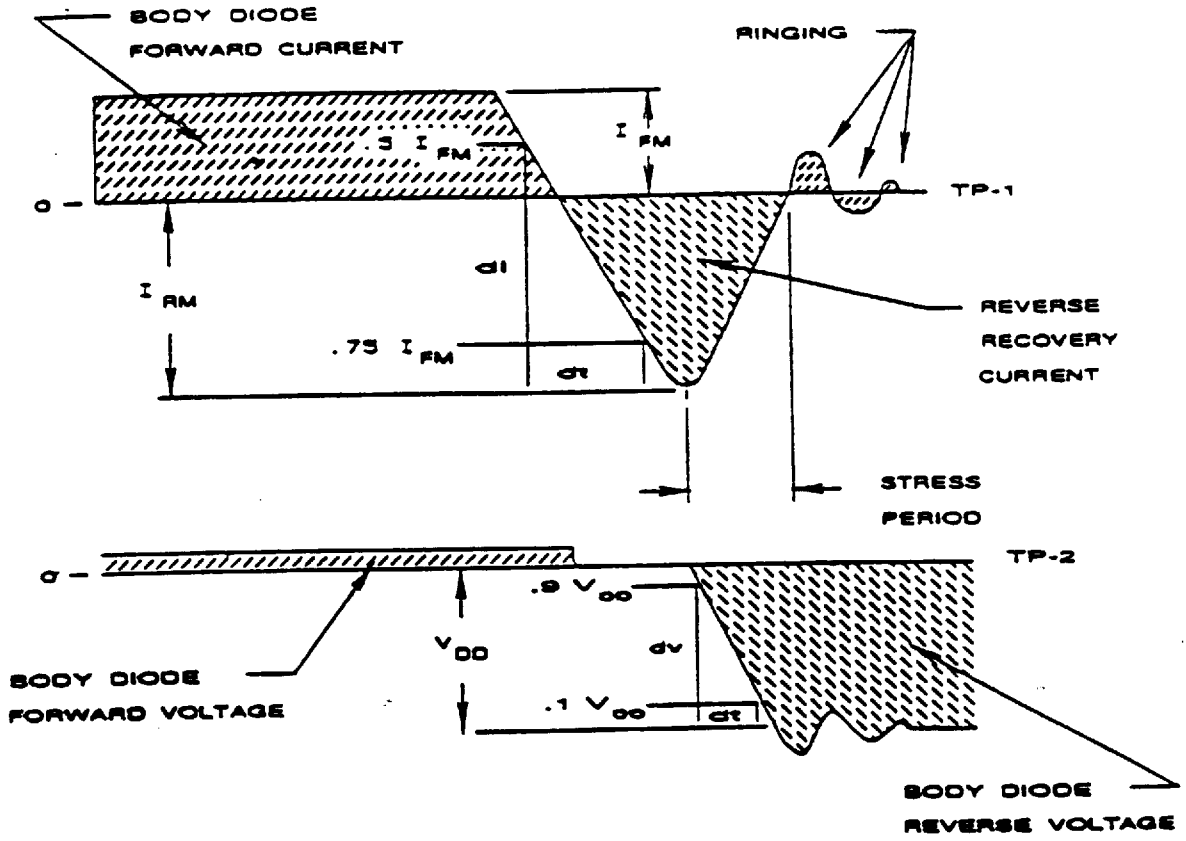

Figure 2
Body Diode Waveforms

To test "continuously" or "single shot", the electrical sequence is almost the same:

1) Drive is turn on until current in $L_{(LOAD)}$ is higher than I_{FM}.

2) Driver is turned off until current in DUT reaches I_{FM}. The minimum time for DUT forward conduction is 5 microseconds, or 10 times the rated maximum t_{rr}, whichever is greater.

3) If testing "repetitively" then go back to Step 1. Else, driver is turned on for the reverse recovery period of the device plus a minimum additional 1 microsecond. The DUT shall be monitored for V_{DS} collapse during this additional time period, and gate drive to the driver transistor may be removed at any time a failure is encountered.

If the device operates with a low repetition rate, the device may not be exposed to sufficient energy to cause a catastrophic failure. The circuit must be equipped to either cause catastrophic failure or generate a failure signal in the event of a collapse of V_{DS} during voltage recovery.

5. SPECIFICATION DETAILS

The specification may take the form of a single point tabular specification, a graphical representation, or both. Ideally, a device will have both. This will allow for easy comparison of devices with the tabular specification, but still have the detail of the graph available to the designer.

A tabular specification will define a single point of operation. The following must be specified in the detail specification.

R_G	ohms
V_{GEN}	volts
I_{FM}	amperes
V_{DD}	volts
T_J	°C
dv/dt	v/ns minimum

A graphical representation could take several different forms, for example R_G vs. I_{FM}, di/dt vs. dv/dt or I_{FM} vs. V_{DS}. An example of R_g vs. I_{FM} is shown in Figure 3.

6. ACCEPTANCE CRITERIA

If a specification requires that this test be performed for verification of a maximum limit, then device V_{DS} must not collapse during or after reverse recovery and in addition must pass any specified parametric limits, as a minimum $V_{(BR)DSS}$, I_{GSS}, and $R_{DS(on)}$.

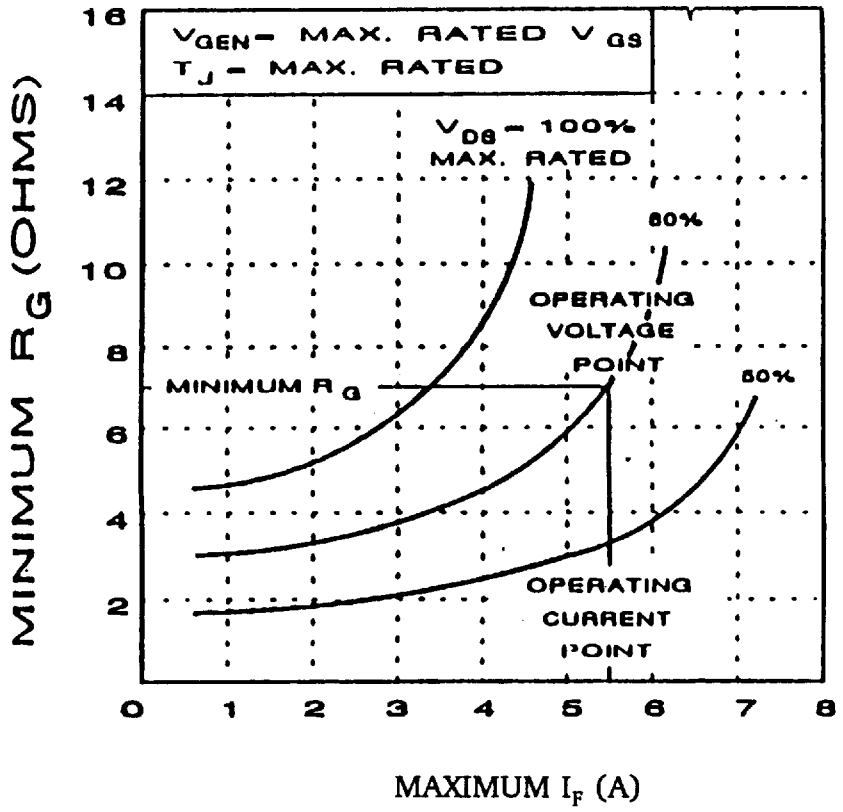

Figure 3


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