

## FEATURES

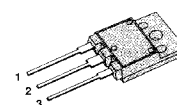
- Advanced New Design
- Avalanche Rugged Technology
- Rugged Gate Oxide Technology
- Very Low Intrinsic Capacitances
- Excellent Switching Characteristics
- Unrivalled Gate Charge: 70nC (Typ.)
- Extended Safe Operating Area
- Lower  $R_{DS(ON)}$ : 0.43Ω (Typ.)

$$BV_{DSS} = 700V$$

$$R_{DS(ON)} = 0.56\Omega$$

$$I_D = 9.5A$$

TO-3PF



1. Gate 2. Drain 3. Source

## ABSOLUTE MAXIMUM RATINGS

| Symbol         | Characteristics                                                         | Value       | Units     |
|----------------|-------------------------------------------------------------------------|-------------|-----------|
| $V_{DSS}$      | Drain-to-Source Voltage                                                 | 700         | V         |
| $I_D$          | Continuous Drain Current ( $T_C = 25^\circ C$ )                         | 9.5         | A         |
|                | Continuous Drain Current ( $T_C = 100^\circ C$ )                        | 6.0         |           |
| $I_{DM}$       | Drain Current-Pulsed ①                                                  | 38          | A         |
| $V_{GS}$       | Gate-to-Source Voltage                                                  | $\pm 30$    | V         |
| $E_{AS}$       | Single Pulsed Avalanche Energy ②                                        | 950         | mJ        |
| $I_{AR}$       | Avalanche Current ①                                                     | 9.5         | A         |
| $E_{AR}$       | Repetitive Avalanche Energy ①                                           | 12          | mJ        |
| dv/dt          | Peak Diode Recovery dv/dt ③                                             | 4.5         | V/ns      |
| $P_D$          | Total Power Dissipation ( $T_C = 25^\circ C$ )                          | 120         | W<br>W/°C |
|                | Linear Derating Factor                                                  | 0.96        |           |
| $T_J, T_{STG}$ | Operating Junction and Storage Temperature Range                        | -55 to +150 | °C        |
| $T_L$          | Maximum Lead Temp. for Soldering Purposes, 1/8" from case for 5-seconds | 300         |           |

## THERMAL RESISTANCE

| Symbol          | Characteristics     | Typ. | Max. | Units |
|-----------------|---------------------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case    | —    | 1.04 | °C/W  |
| $R_{\theta JA}$ | Junction-to-Ambient | —    | 40   |       |

**ELECTRICAL CHARACTERISTICS** ( $T_C = 25^\circ\text{C}$  unless otherwise specified)

| Symbol                 | Characteristics                         | Min. | Typ. | Max. | Units               | Test Conditions                                                                |
|------------------------|-----------------------------------------|------|------|------|---------------------|--------------------------------------------------------------------------------|
| $BV_{DSS}$             | Drain-Source Breakdown Voltage          | 700  | —    | —    | V                   | $V_{GS}=0V$ , $I_D=250\mu A$                                                   |
| $\Delta BV/\Delta T_J$ | Breakdown Voltage Temp. Coeff.          | —    | 0.68 | —    | V/ $^\circ\text{C}$ | $I_D=250\mu A$ , <b>See Fig 7</b>                                              |
| $V_{GS(th)}$           | Gate Threshold Voltage                  | 3.0  | —    | 5.0  | V                   | $V_{DS}=5V$ , $I_D=250\mu A$                                                   |
| $I_{GSS}$              | Gate-Source Leakage, Forward            | —    | —    | 100  | nA                  | $V_{GS}=30V$                                                                   |
|                        | Gate-Source Leakage, Reverse            | —    | —    | –100 |                     | $V_{GS}= -30V$                                                                 |
| $I_{DSS}$              | Drain-to-Source Leakage Current         | —    | —    | 10   | $\mu A$             | $V_{DS}=700V$                                                                  |
|                        |                                         | —    | —    | 100  |                     | $V_{DS}=560V$ , $T_C=125^\circ\text{C}$                                        |
| $R_{DS(on)}$           | Static Drain-Source On-State Resistance | —    | 0.43 | 0.56 | $\Omega$            | $V_{GS}=10V$ , $I_D=4.8A$ ④                                                    |
| $g_{fs}$               | Forward Transconductance                | —    | 12   | —    | S                   | $V_{DS}=50V$ , $I_D=4.8A$ ④                                                    |
| $C_{iss}$              | Input Capacitance                       | —    | 2790 | 3630 | pF                  | $V_{GS}=0V$ , $V_{DS}=25V$<br>$f=1\text{MHz}$<br><b>See Fig 5</b>              |
| $C_{oss}$              | Output Capacitance                      | —    | 300  | 390  |                     |                                                                                |
| $C_{rss}$              | Reverse Transfer Capacitance            | —    | 27   | 35   |                     |                                                                                |
| $t_{d(on)}$            | Turn-On Delay Time                      | —    | 70   | 150  | ns                  | $V_{DD}=350V$ , $I_D=15A$<br>$R_G=50\Omega$<br><b>See Fig 13</b> ④ ⑤           |
| $t_r$                  | Rise Time                               | —    | 180  | 370  |                     |                                                                                |
| $t_{d(off)}$           | Turn-Off Delay Time                     | —    | 160  | 330  |                     |                                                                                |
| $t_f$                  | Fall Time                               | —    | 120  | 250  |                     |                                                                                |
| $Q_g$                  | Total Gate Charge                       | —    | 70   | 90   | nC                  | $V_{DS}=560V$ , $V_{GS}=10V$<br>$I_D=15A$<br><b>See Fig 6 &amp; Fig 12</b> ④ ⑤ |
| $Q_{gs}$               | Gate-Source Charge                      | —    | 17   | —    |                     |                                                                                |
| $Q_{gd}$               | Gate-Drain (Miller) Charge              | —    | 33   | —    |                     |                                                                                |

**SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS**

| Symbol   | Characteristics           | Min. | Typ. | Max. | Units   | Test Conditions                                                              |
|----------|---------------------------|------|------|------|---------|------------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current | —    | —    | 9.5  | A       | Integral reverse pn-diode in the MOSFET                                      |
| $I_{SM}$ | Pulsed-Source Current ①   | —    | —    | 38   |         |                                                                              |
| $V_{SD}$ | Diode Forward Voltage ④   | —    | —    | 1.4  | V       | $T_J=25^\circ\text{C}$ , $I_S=9.5A$ , $V_{GS}=0V$                            |
| $t_{rr}$ | Reverse Recovery Time     | —    | 460  | —    | ns      | $T_J=25^\circ\text{C}$ , $I_F=15A$ , $V_{DD}=560V$<br>$di_F/dt=100A/\mu s$ ④ |
| $Q_{rr}$ | Reverse Recovery Charge   | —    | 5.7  | —    | $\mu C$ |                                                                              |

**Notes:**

- ① Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature  
 ②  $L=19.5\text{mH}$ ,  $I_{AS}=9.5A$ ,  $V_{DD}=50V$ ,  $R_G=25\Omega$ , Starting  $T_J=25^\circ\text{C}$   
 ③  $I_{SD} \leq 15A$ ,  $di/dt \leq 200A/\mu s$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J=25^\circ\text{C}$   
 ④ Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$   
 ⑤ Essentially Independent of Operating Temperature

Fig 1. Output Characteristics

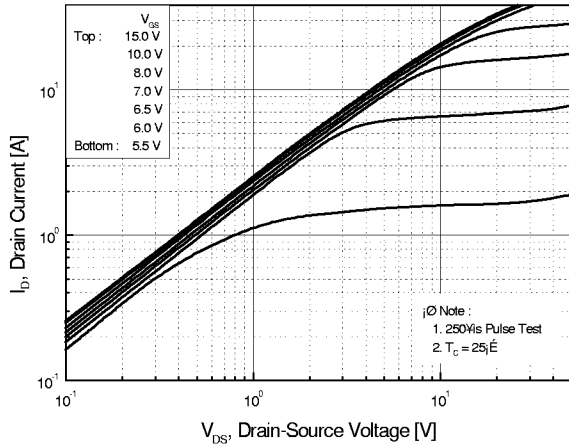


Fig 2. Transfer Characteristics

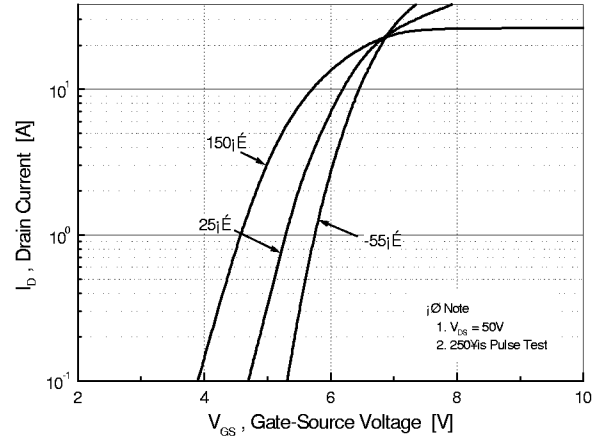


Fig 3. On-Resistance vs. Drain Current

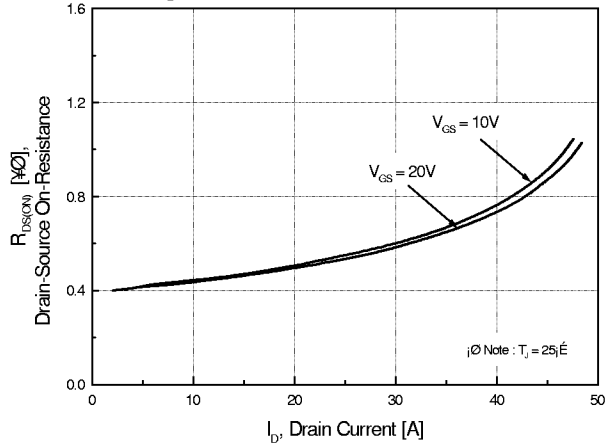


Fig 4. Source-Drain Diode Forward Voltage

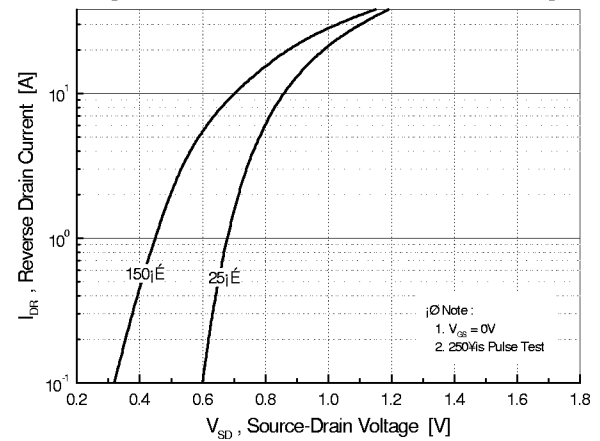


Fig 5. Capacitance vs. Drain-Source Voltage

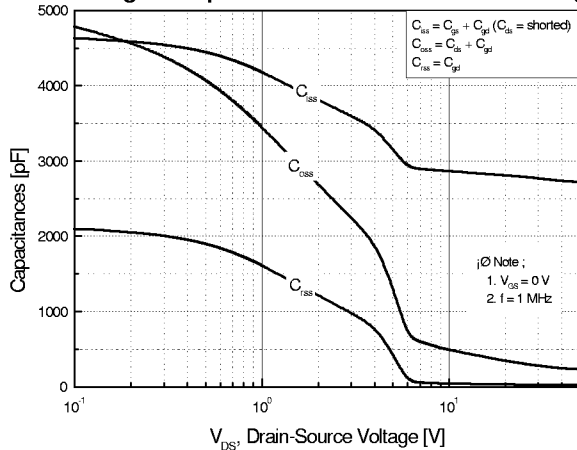


Fig 6. Gate Charge vs. Gate-Source Voltage

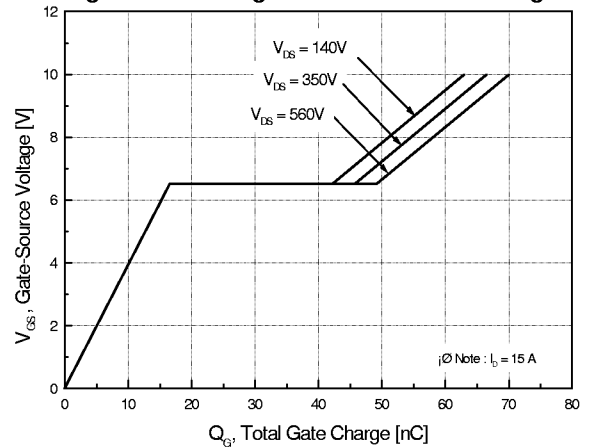


Fig 7. Breakdown Voltage vs. Temperature

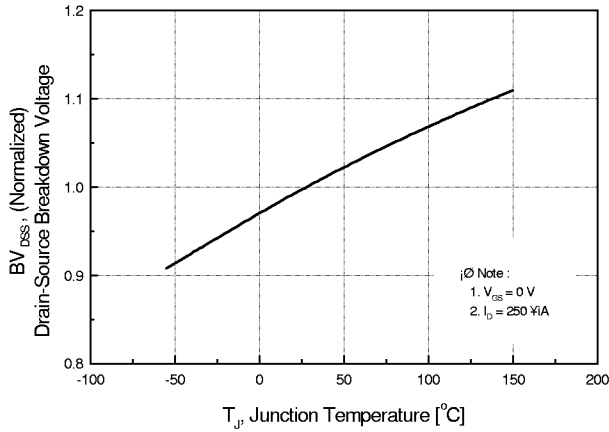


Fig 8. On-Resistance vs. Temperature

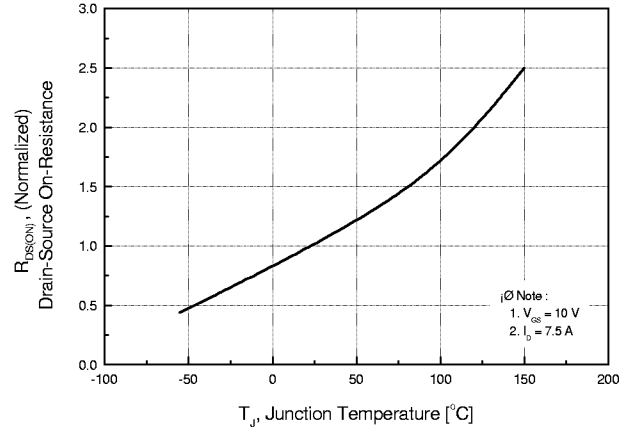


Fig 9. Max. Safe Operating Area

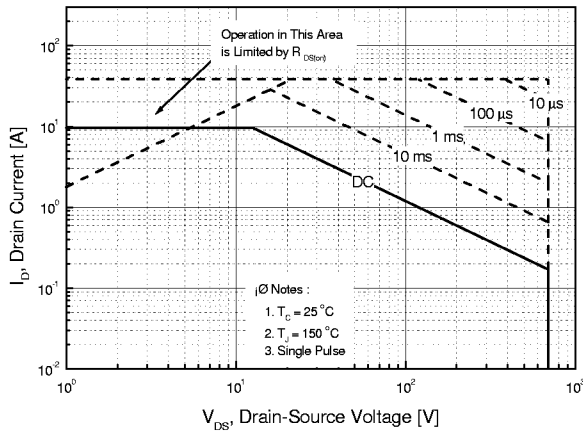


Fig 10. Max. Drain Current vs. Case Temperature

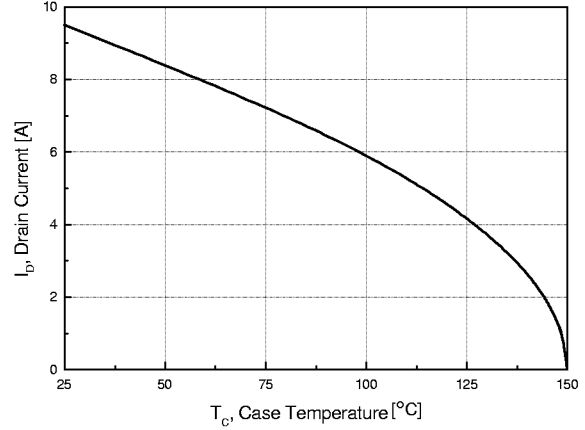


Fig 11. Thermal Response

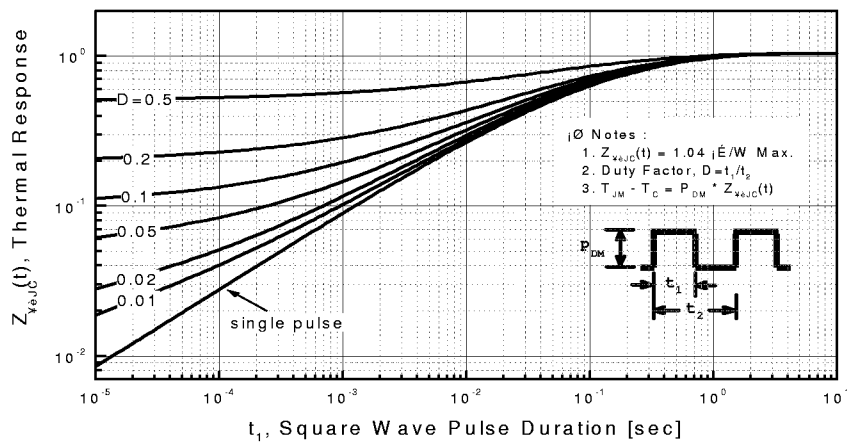


Fig 12. Gate Charge Test Circuit & Waveform

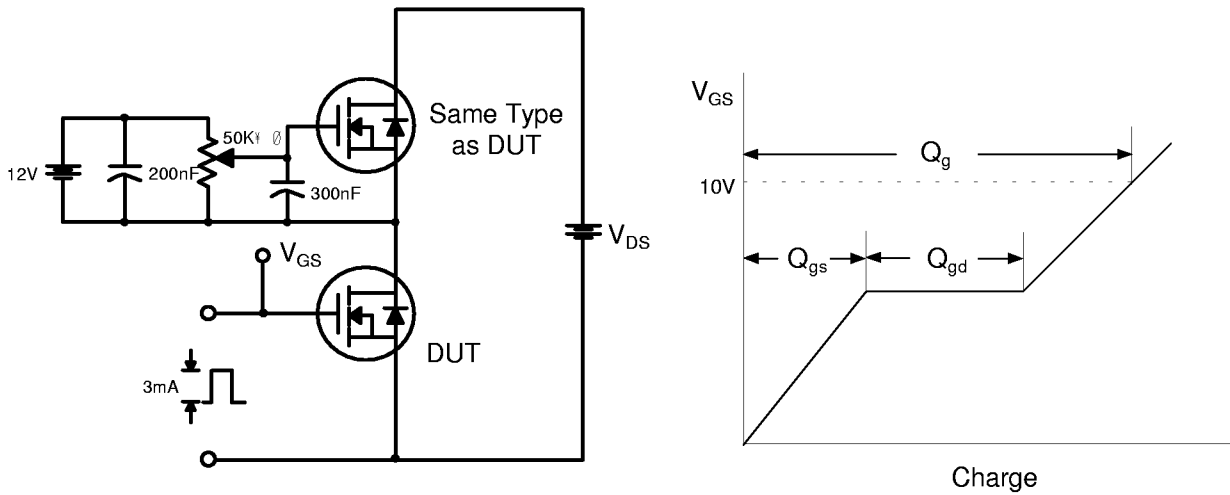


Fig 13. Resistive Switching Test Circuit & Waveforms

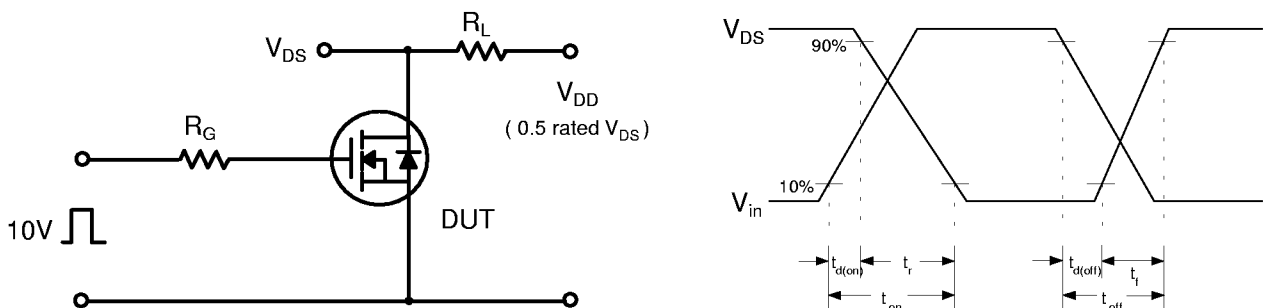


Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms

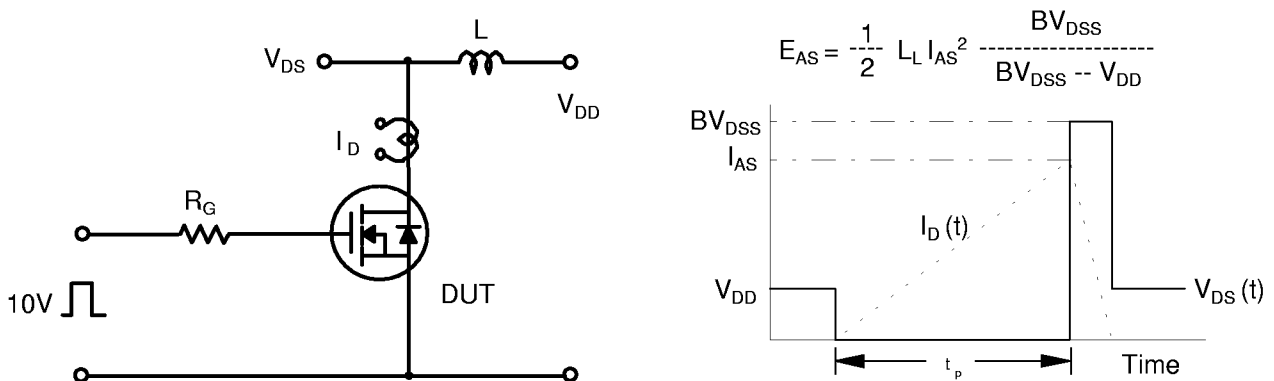
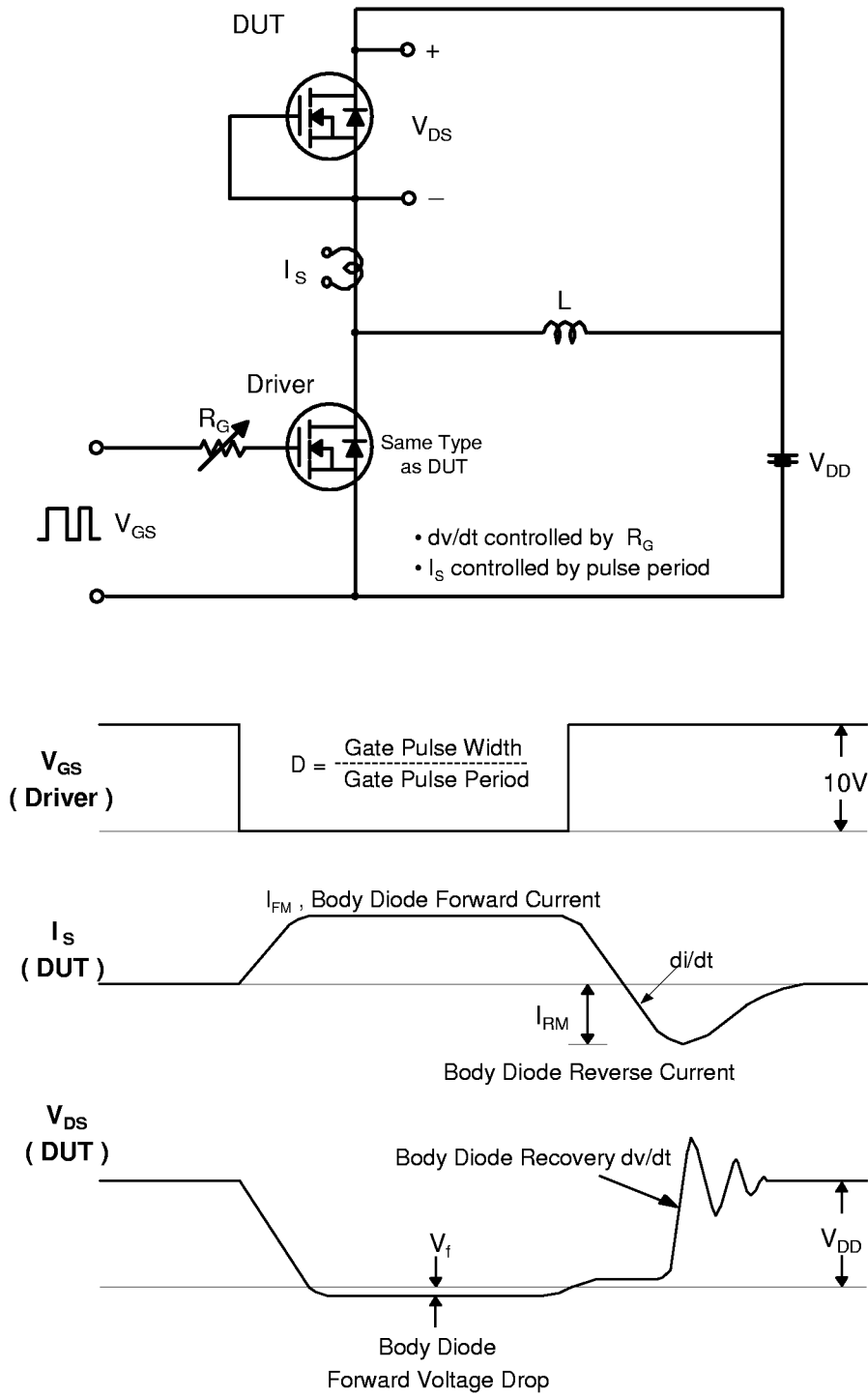
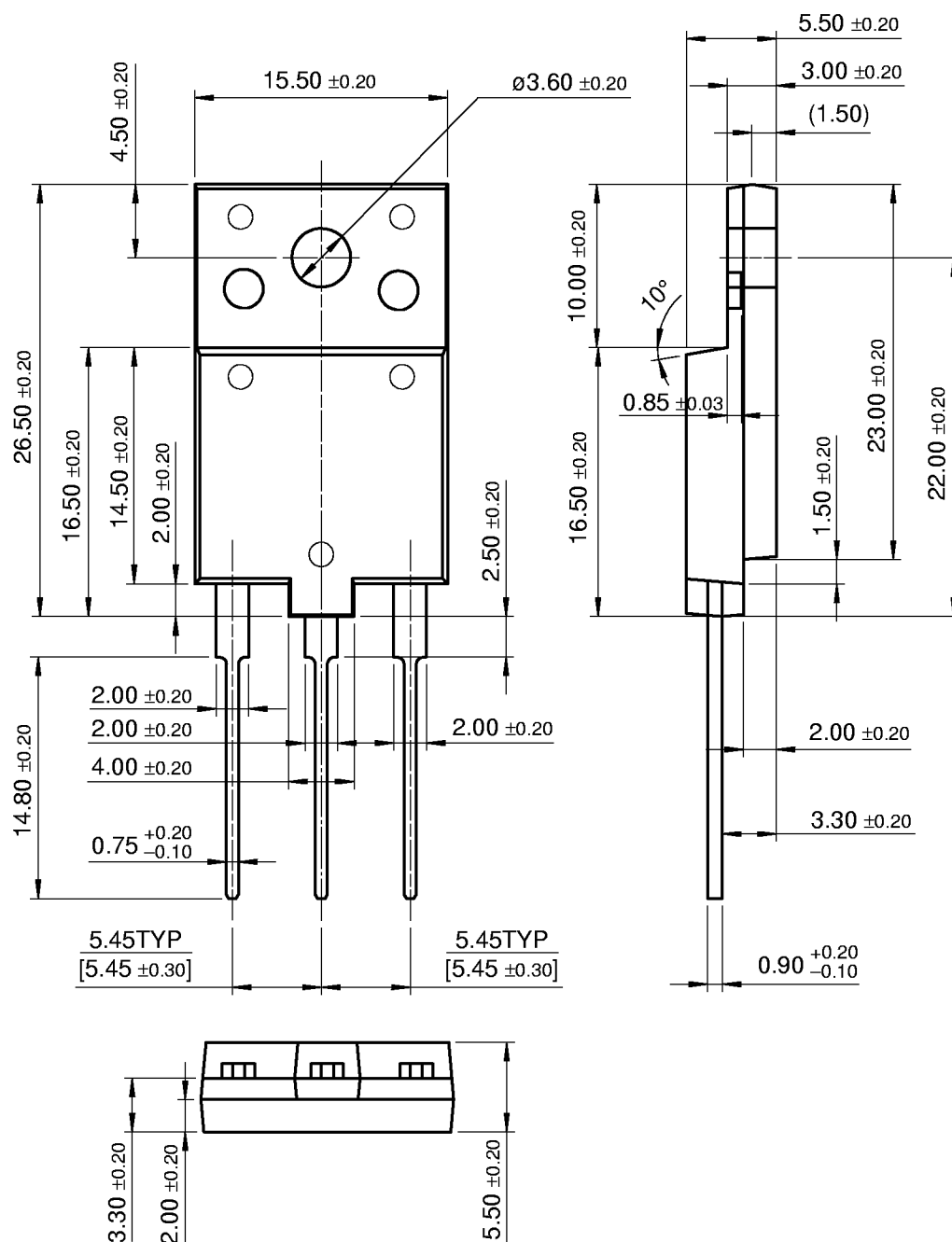


Fig 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



## TO-3PF Package Dimensions

## TO-3PF (FS PKG CODE AG)



Dimensions in Millimeters

September 1999, Rev B