

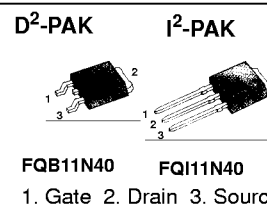
## FEATURES

- Advanced New Design
- Avalanche Rugged Technology
- Rugged Gate Oxide Technology
- Very Low Intrinsic Capacitances
- Excellent Switching Characteristics
- Unrivalled Gate Charge: 27nC (Typ.)
- Extended Safe Operating Area
- Lower  $R_{DS(ON)}$ : 0.38 $\Omega$  (Typ.)

$$BV_{DSS} = 400V$$

$$R_{DS(ON)} = 0.48\Omega$$

$$I_D = 11.4A$$



## ABSOLUTE MAXIMUM RATINGS

| Symbol         | Characteristics                                                          | Value       | Units              |
|----------------|--------------------------------------------------------------------------|-------------|--------------------|
| $V_{DSS}$      | Drain-to-Source Voltage                                                  | 400         | V                  |
| $I_D$          | Continuous Drain Current ( $T_C = 25^\circ C$ )                          | 11.4        | A                  |
|                | Continuous Drain Current ( $T_C = 100^\circ C$ )                         | 7.2         |                    |
| $I_{DM}$       | Drain Current-Pulsed ①                                                   | 46          | A                  |
| $V_{GS}$       | Gate-to-Source Voltage                                                   | $\pm 30$    | V                  |
| $E_{AS}$       | Single Pulsed Avalanche Energy ②                                         | 520         | mJ                 |
| $I_{AR}$       | Avalanche Current ①                                                      | 11.4        | A                  |
| $E_{AR}$       | Repetitive Avalanche Energy ①                                            | 14.7        | mJ                 |
| dv/dt          | Peak Diode Recovery dv/dt ③                                              | 4.5         | V/ns               |
| $P_D$          | Total Power Dissipation ( $T_A = 25^\circ C$ )                           | 3.1         | W                  |
|                | Total Power Dissipation ( $T_C = 25^\circ C$ )<br>Linear Derating Factor | 147<br>1.18 | W<br>W/ $^\circ C$ |
| $T_J, T_{STG}$ | Operating Junction and Storage Temperature Range                         | -55 to +150 | $^\circ C$         |
| $T_L$          | 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      | —    | 0.85 | $^\circ C/W$ |
| $R_{\theta JA}$ | Junction-to-Ambient * | —    | 40   |              |
| $R_{\theta JA}$ | Junction-to-Ambient   | —    | 62.5 |              |

\* When mounted on the minimum pad size recommended (PCB Mount)

**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          | 400  | —    | —    | V                   | $V_{GS}=0V$ , $I_D=250\mu A$                                                     |
| $\Delta BV/\Delta T_J$ | Breakdown Voltage Temp. Coeff.          | —    | 0.42 | —    | 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         | —    | —    | 1    | $\mu A$             | $V_{DS}=400V$                                                                    |
|                        |                                         | —    | —    | 10   |                     | $V_{DS}=320V$ , $T_C=125^\circ\text{C}$                                          |
| $R_{DS(on)}$           | Static Drain-Source On-State Resistance | —    | 0.38 | 0.48 | $\Omega$            | $V_{GS}=10V$ , $I_D=5.7A$ ④                                                      |
| $g_{fs}$               | Forward Transconductance                | —    | 7.6  | —    | S                   | $V_{DS}=50V$ , $I_D=5.7A$ ④                                                      |
| $C_{iss}$              | Input Capacitance                       | —    | 1080 | 1400 | pF                  | $V_{GS}=0V$ , $V_{DS}=25V$<br>$f=1\text{MHz}$<br><b>See Fig 5</b>                |
| $C_{oss}$              | Output Capacitance                      | —    | 180  | 240  |                     |                                                                                  |
| $C_{rss}$              | Reverse Transfer Capacitance            | —    | 20   | 30   |                     |                                                                                  |
| $t_{d(on)}$            | Turn-On Delay Time                      | —    | 30   | 70   | ns                  | $V_{DD}=200V$ , $I_D=11.4A$<br>$R_G=50\Omega$<br><b>See Fig 13</b> ④ ⑤           |
| $t_r$                  | Rise Time                               | —    | 105  | 220  |                     |                                                                                  |
| $t_{d(off)}$           | Turn-Off Delay Time                     | —    | 60   | 130  |                     |                                                                                  |
| $t_f$                  | Fall Time                               | —    | 60   | 130  |                     |                                                                                  |
| $Q_g$                  | Total Gate Charge                       | —    | 27   | 35   | nC                  | $V_{DS}=320V$ , $V_{GS}=10V$<br>$I_D=11.4A$<br><b>See Fig 6 &amp; Fig 12</b> ④ ⑤ |
| $Q_{gs}$               | Gate-Source Charge                      | —    | 7.3  | —    |                     |                                                                                  |
| $Q_{gd}$               | Gate-Drain (Miller) Charge              | —    | 12.3 | —    |                     |                                                                                  |

**SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS**

| Symbol   | Characteristics           | Min. | Typ. | Max. | Units   | Test Conditions                                                                |
|----------|---------------------------|------|------|------|---------|--------------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current | —    | —    | 11.4 | A       | Integral reverse pn-diode in the MOSFET                                        |
| $I_{SM}$ | Pulsed-Source Current ①   | —    | —    | 46   |         |                                                                                |
| $V_{SD}$ | Diode Forward Voltage ④   | —    | —    | 1.5  | V       | $T_J=25^\circ\text{C}$ , $I_S=11.4A$ , $V_{GS}=0V$                             |
| $t_{rr}$ | Reverse Recovery Time     | —    | 240  | —    | ns      | $T_J=25^\circ\text{C}$ , $I_F=11.4A$ , $V_{DD}=320V$<br>$di_F/dt=100A/\mu s$ ④ |
| $Q_{rr}$ | Reverse Recovery Charge   | —    | 1.8  | —    | $\mu C$ |                                                                                |

**Notes:**

- ① Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature  
 ②  $L=7\text{mH}$ ,  $I_{AS}=11.4A$ ,  $V_{DD}=50V$ ,  $R_G=25\Omega$ , Starting  $T_J=25^\circ\text{C}$   
 ③  $I_{SD} \leq 11.4A$ ,  $di/dt \leq 200A/\mu s$ ,  $V_{DD} \leq BV_{DSS}$ , 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

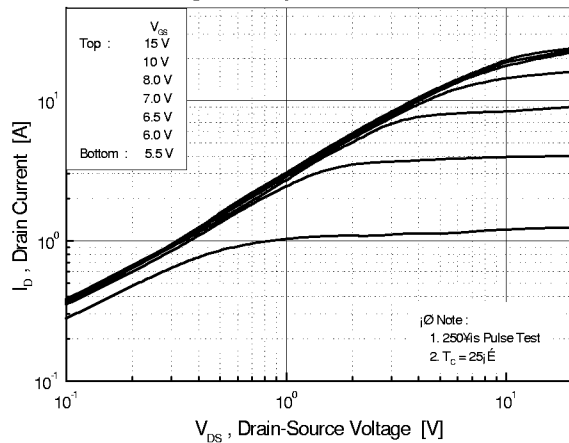


Fig 2. Transfer Characteristics

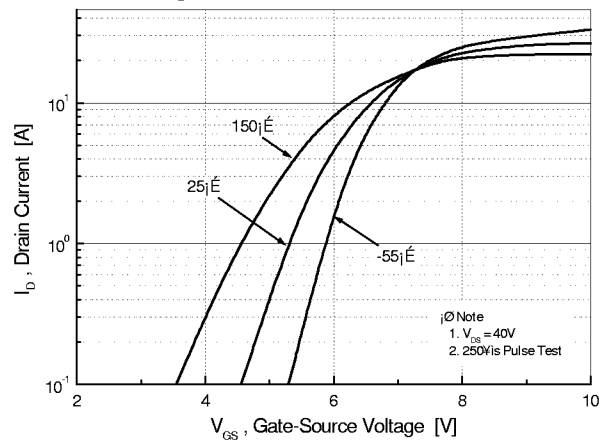


Fig 3. On-Resistance vs. Drain Current

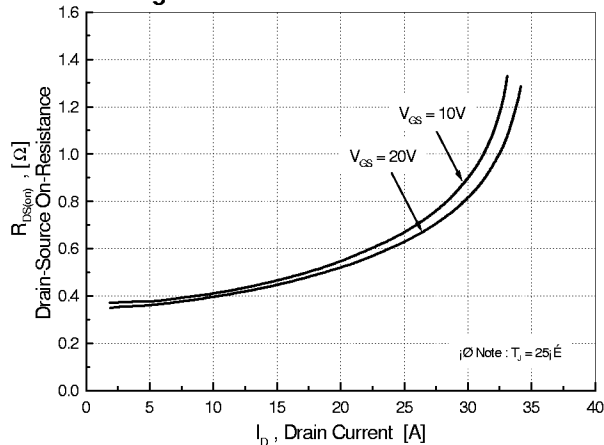


Fig 4. Source-Drain Diode Forward Voltage

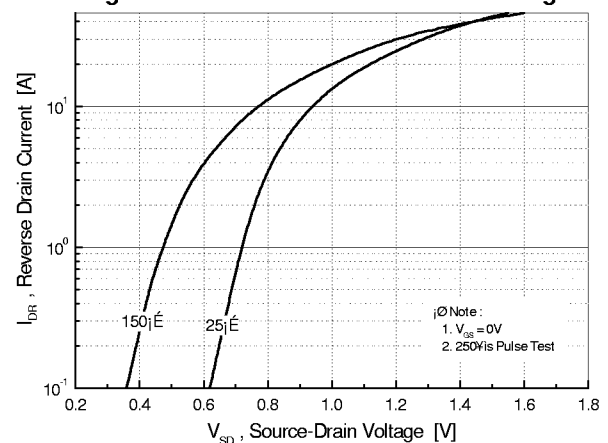


Fig 5. Capacitance vs. Drain-Source Voltage

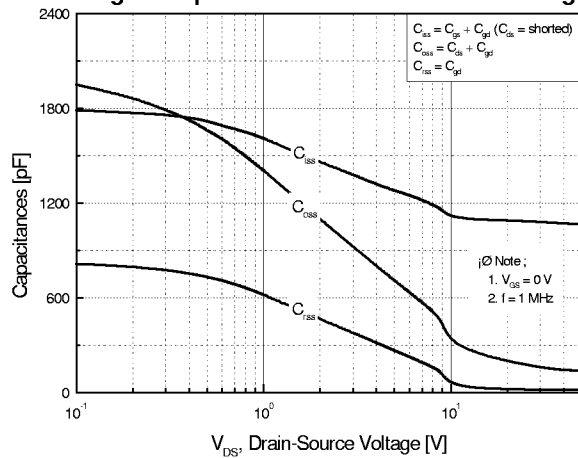


Fig 6. Gate Charge vs. Gate-Source Voltage

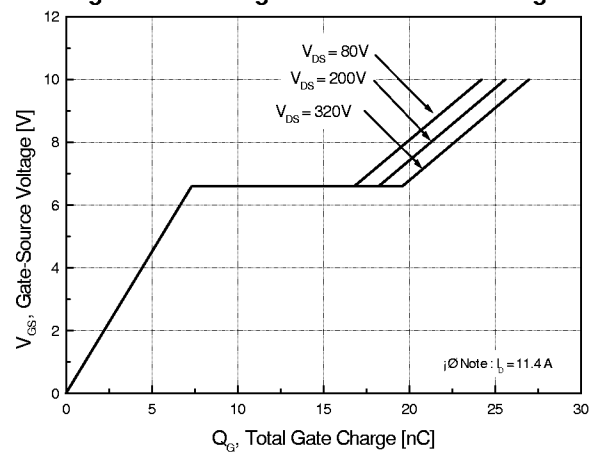


Fig 7. Breakdown Voltage vs. Temperature

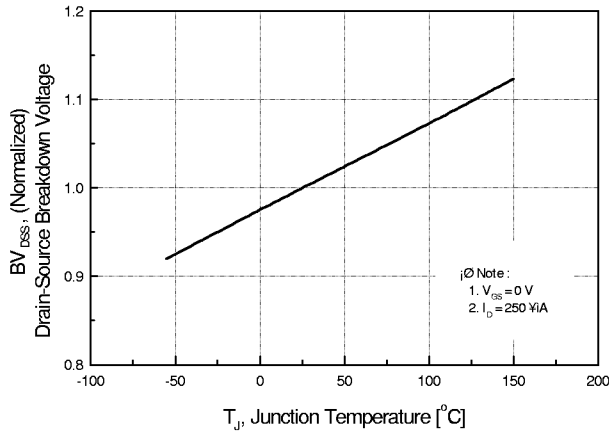


Fig 8. On-Resistance vs. Temperature

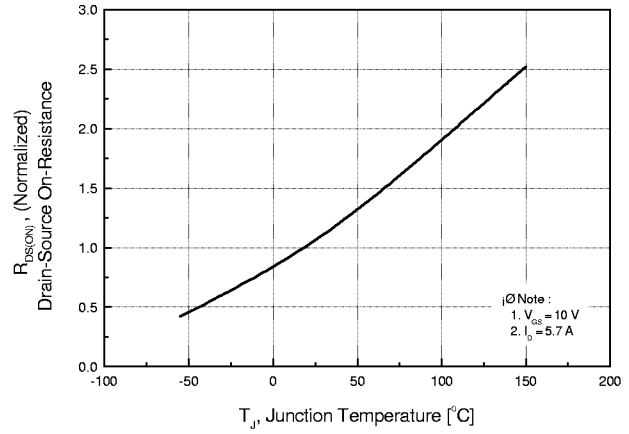


Fig 9. Max. Safe Operating Area

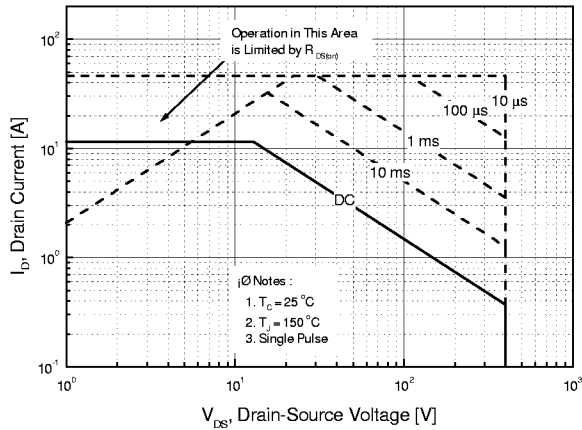


Fig 10. Max. Drain Current vs. Case Temperature

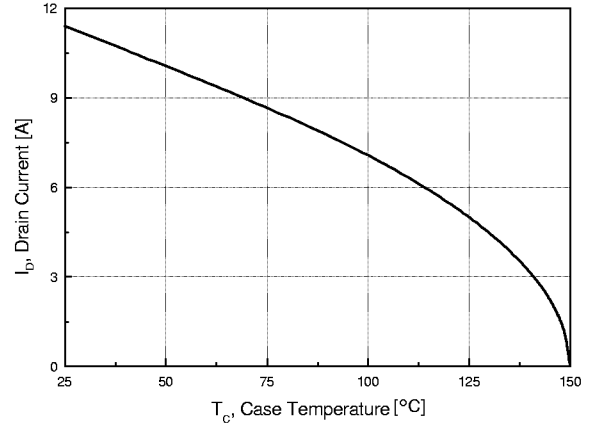


Fig 11. Thermal Response

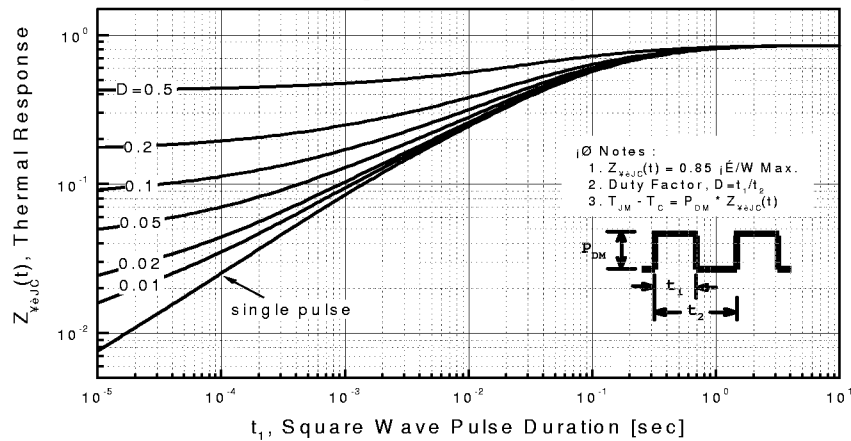


Fig 12. Gate Charge Test Circuit &amp; Waveform

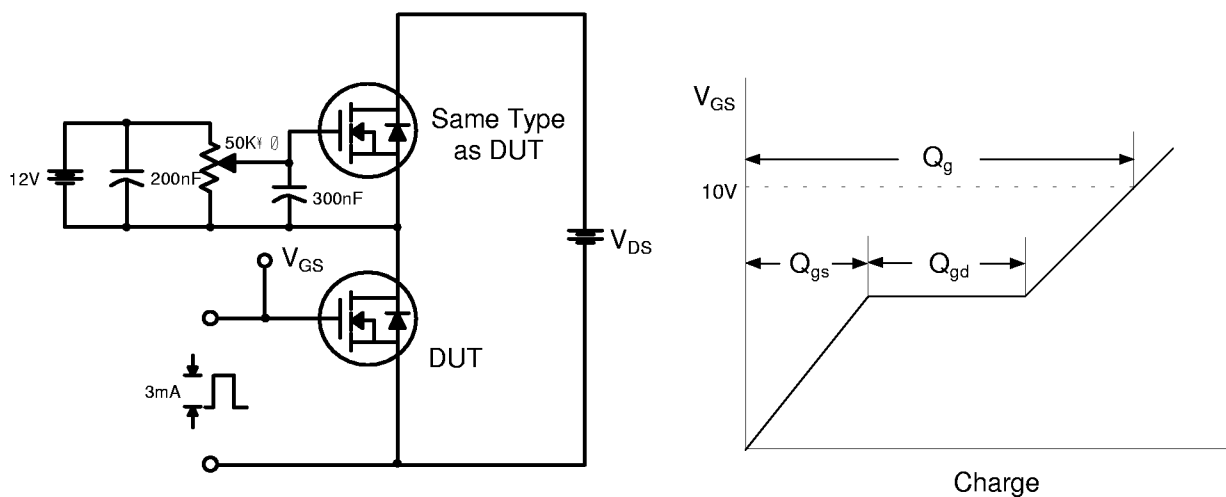


Fig 13. Resistive Switching Test Circuit &amp; Waveforms

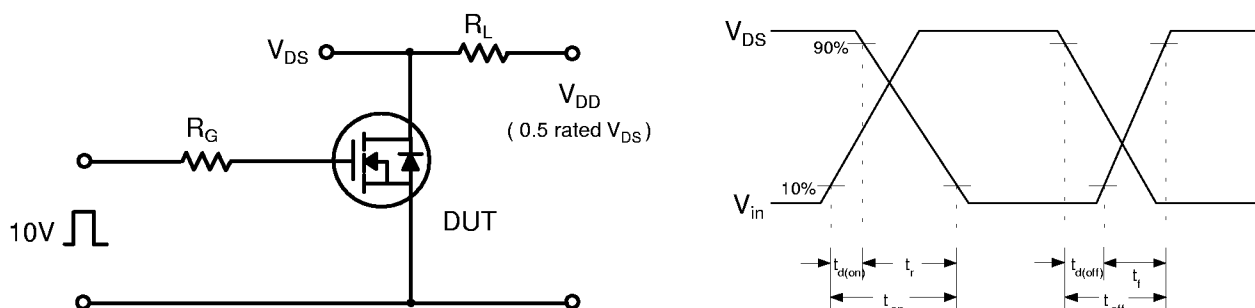


Fig 14. Unclamped Inductive Switching Test Circuit &amp; Waveforms

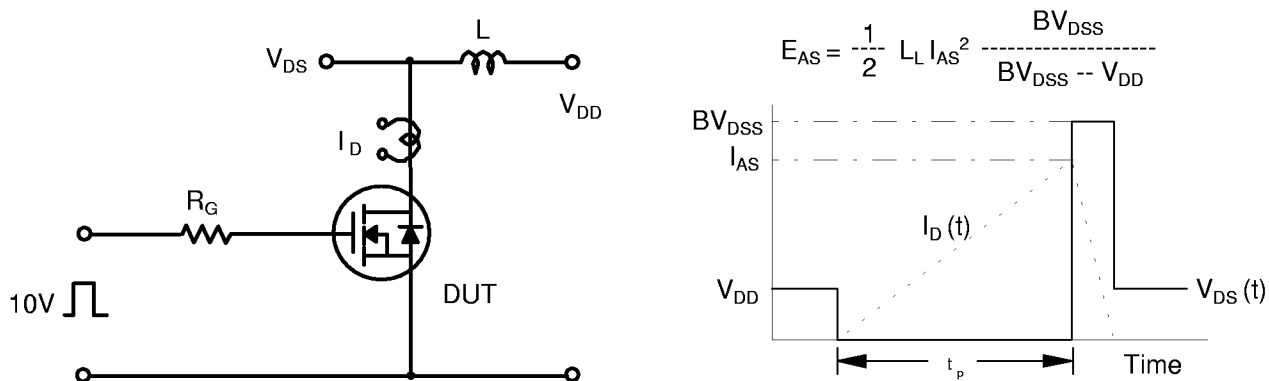
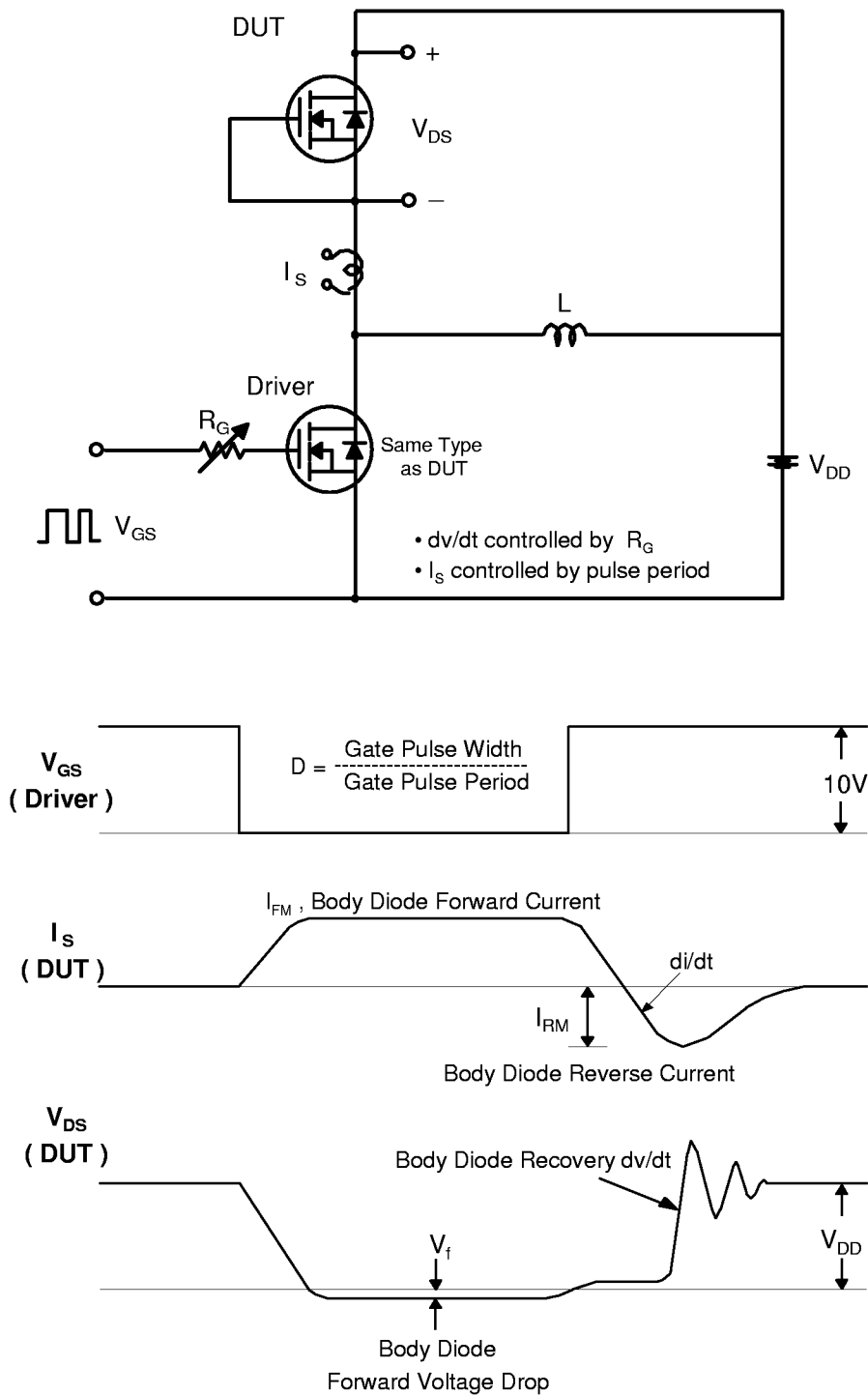
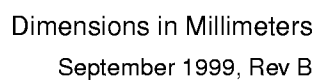
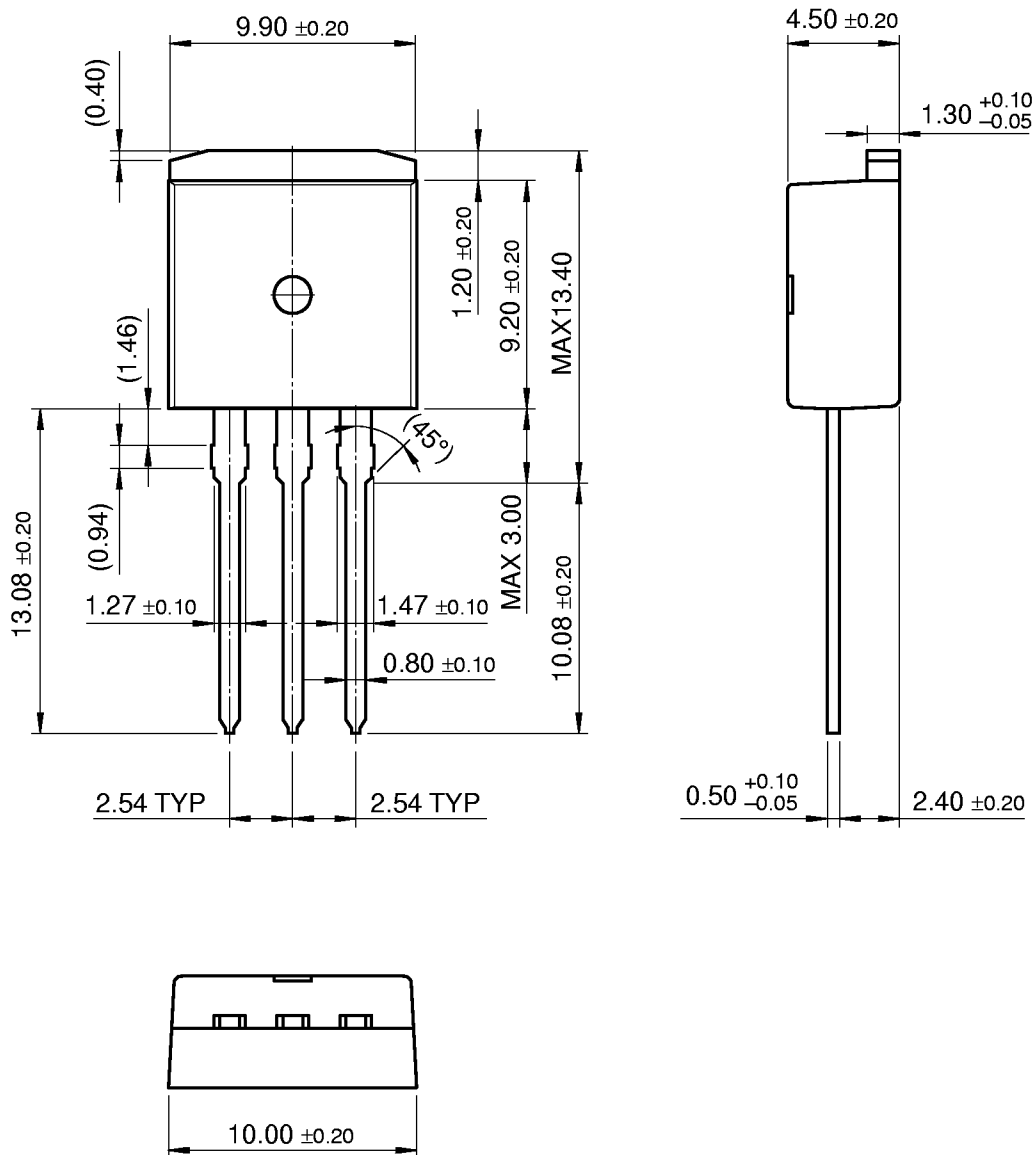


Fig 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



D<sup>2</sup>PAK/TO-263 (FS PKG CODE AB)

I<sup>2</sup>PAK Package DimensionsI<sup>2</sup>PAK (FS PKG CODE AO)

Dimensions in Millimeters

September 1999, Rev B