

## Advanced Power MOSFET

## IRFM014A

### FEATURES

- Avalanche Rugged Technology
- Rugged Gate Oxide Technology
- Lower Input Capacitance
- Improved Gate Charge
- Extended Safe Operating Area
- Lower Leakage Current : 10  $\mu$ A (Max.) @  $V_{DS} = 60V$
- Lower  $R_{DS(ON)}$  : 0.097  $\Omega$  (Typ.)

$$BV_{DSS} = 60 V$$

$$R_{DS(on)} = 0.14 \Omega$$

$$I_D = 2.8 A$$

### SOT-223



1. Gate 2. Drain 3. Source

### Absolute Maximum Ratings

| Symbol         | Characteristic                                                          | Value        | Units         |
|----------------|-------------------------------------------------------------------------|--------------|---------------|
| $V_{DSS}$      | Drain-to-Source Voltage                                                 | 60           | V             |
| $I_D$          | Continuous Drain Current ( $T_A=25^\circ C$ )                           | 2.8          | A             |
|                | Continuous Drain Current ( $T_A=70^\circ C$ )                           | 2.25         |               |
| $I_{DM}$       | Drain Current-Pulsed ①                                                  | 22           | A             |
| $V_{GS}$       | Gate-to-Source Voltage                                                  | $\pm 20$     | V             |
| $E_{AS}$       | Single Pulsed Avalanche Energy ②                                        | 67           | mJ            |
| $I_{AR}$       | Avalanche Current ①                                                     | 2.8          | A             |
| $E_{AR}$       | Repetitive Avalanche Energy ①                                           | 0.21         | mJ            |
| $dv/dt$        | Peak Diode Recovery $dv/dt$ ③                                           | 5.5          | V/ns          |
| $P_D$          | Total Power Dissipation ( $T_A=25^\circ C$ ) *                          | 2.1          | W             |
|                | Linear Derating Factor *                                                | 0.017        | 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          | Characteristic        | Typ. | Max. | Units        |
|-----------------|-----------------------|------|------|--------------|
| $R_{\theta JA}$ | Junction-to-Ambient * | --   | 60   | $^\circ C/W$ |

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

### Electrical Characteristics ( $T_A=25^\circ\text{C}$ unless otherwise specified)

| Symbol                 | Characteristic                          | Min. | Typ.  | Max. | Units              | Test Condition                                                              |
|------------------------|-----------------------------------------|------|-------|------|--------------------|-----------------------------------------------------------------------------|
| $BV_{DSS}$             | Drain-Source Breakdown Voltage          | 60   | --    | --   | V                  | $V_{GS}=0V, I_D=250\ \mu A$                                                 |
| $\Delta BV/\Delta T_J$ | Breakdown Voltage Temp. Coeff.          | --   | 0.060 | --   | $V/^\circ\text{C}$ | $I_D=250\ \mu A$ <b>See Fig 7</b>                                           |
| $V_{GS(th)}$           | Gate Threshold Voltage                  | 2.0  | --    | 4.0  | V                  | $V_{DS}=5V, I_D=250\ \mu A$                                                 |
| $I_{GSS}$              | Gate-Source Leakage, Forward            | --   | --    | 100  | nA                 | $V_{GS}=20V$                                                                |
|                        | Gate-Source Leakage, Reverse            | --   | --    | -100 | nA                 | $V_{GS}=-20V$                                                               |
| $I_{DSS}$              | Drain-to-Source Leakage Current         | --   | --    | 10   | $\mu A$            | $V_{DS}=60V$                                                                |
|                        |                                         | --   | --    | 100  | $\mu A$            | $V_{DS}=48V, T_A=125^\circ\text{C}$                                         |
| $R_{DS(on)}$           | Static Drain-Source On-State Resistance | --   | --    | 0.14 | $\Omega$           | $V_{GS}=10V, I_D=1.4A$ ④                                                    |
| $g_{fs}$               | Forward Transconductance                | --   | 3.85  | --   | $\text{S}$         | $V_{DS}=30V, I_D=1.4A$ ④                                                    |
| $C_{iss}$              | Input Capacitance                       | --   | 280   | 360  | pF                 | $V_{GS}=0V, V_{DS}=25V, f=1\text{MHz}$<br><b>See Fig 5</b>                  |
| $C_{oss}$              | Output Capacitance                      | --   | 110   | 125  |                    |                                                                             |
| $C_{rss}$              | Reverse Transfer Capacitance            | --   | 40    | 46   |                    |                                                                             |
| $t_{d(on)}$            | Turn-On Delay Time                      | --   | 11    | 25   | ns                 | $V_{DD}=30V, I_D=10A,$<br>$R_G=24\ \Omega$<br><b>See Fig 13</b> ④ ⑤         |
| $t_r$                  | Rise Time                               | --   | 17    | 40   |                    |                                                                             |
| $t_{d(off)}$           | Turn-Off Delay Time                     | --   | 27    | 60   |                    |                                                                             |
| $t_f$                  | Fall Time                               | --   | 28    | 60   |                    |                                                                             |
| $Q_g$                  | Total Gate Charge                       | --   | 12    | 17   | nC                 | $V_{DS}=48V, V_{GS}=10V,$<br>$I_D=10A$<br><b>See Fig 6 &amp; Fig 12</b> ④ ⑤ |
| $Q_{gs}$               | Gate-Source Charge                      | --   | 2.4   | --   |                    |                                                                             |
| $Q_{gd}$               | Gate-Drain( " Miller " ) Charge         | --   | 5.4   | --   |                    |                                                                             |

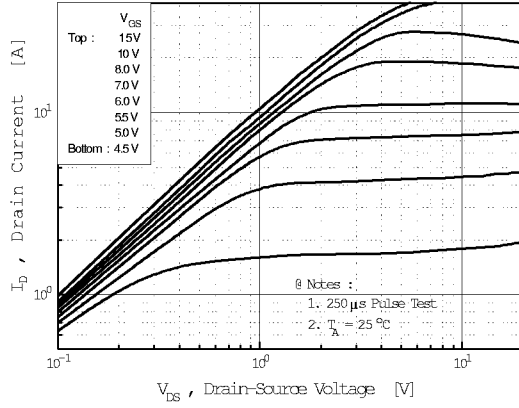
### Source-Drain Diode Ratings and Characteristics

| Symbol   | Characteristic            | Min. | Typ. | Max. | Units   | Test Condition                              |
|----------|---------------------------|------|------|------|---------|---------------------------------------------|
| $I_S$    | Continuous Source Current | --   | --   | 2.8  | A       | Integral reverse pn-diode in the MOSFET     |
| $I_{SM}$ | Pulsed-Source Current ①   | --   | --   | 22   |         |                                             |
| $V_{SD}$ | Diode Forward Voltage ④   | --   | --   | 1.5  | V       | $T_J=25^\circ\text{C}, I_S=2.8A, V_{GS}=0V$ |
| $t_{rr}$ | Reverse Recovery Time     | --   | 55   | --   | ns      | $T_J=25^\circ\text{C}, I_F=10A$             |
| $Q_{rr}$ | Reverse Recovery Charge   | --   | 0.11 | --   | $\mu C$ | $di_F/dt=100A/\mu s$ ④                      |

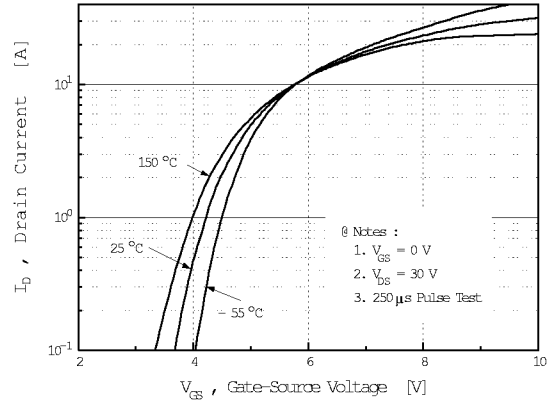
#### Notes ;

- ① Repetitive Rating : Pulse Width Limited by Maximum Junction Temperature
- ②  $L=10\text{mH}, I_{AS}=2.8A, V_{DD}=25V, R_G=27\ \Omega$ , Starting  $T_J=25^\circ\text{C}$
- ③  $I_{SD} \leq 10A, di/dt \leq 200A/\mu s, V_{DD} \leq BV_{DSS}$ , Starting  $T_J=25^\circ\text{C}$
- ④ Pulse Test : Pulse Width = 250  $\mu s$ , Duty Cycle  $\leq 2\%$
- ⑤ Essentially Independent of Operating Temperature

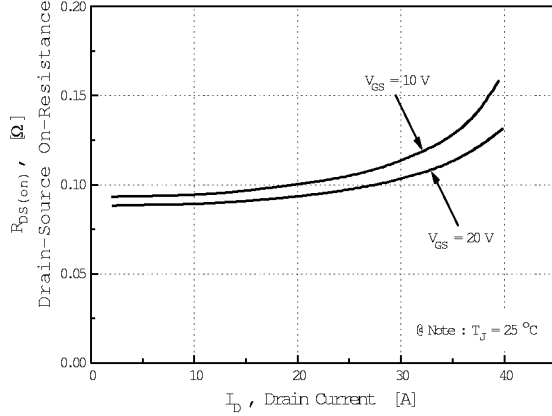
**Fig 1. Output Characteristics**



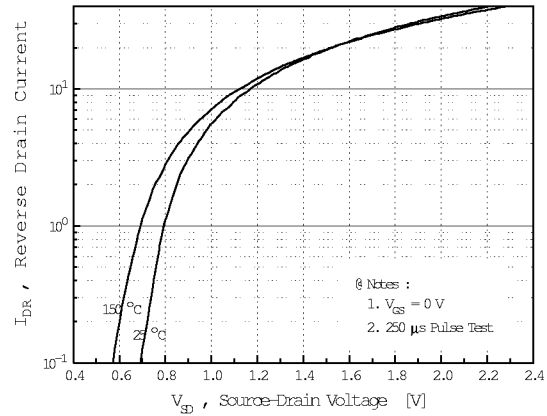
**Fig 2. Transfer Characteristics**



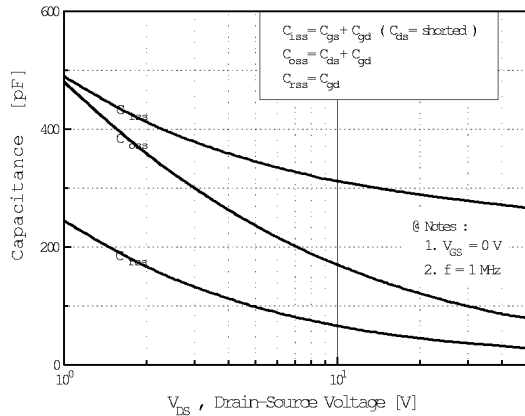
**Fig 3. On-Resistance vs. Drain Current**



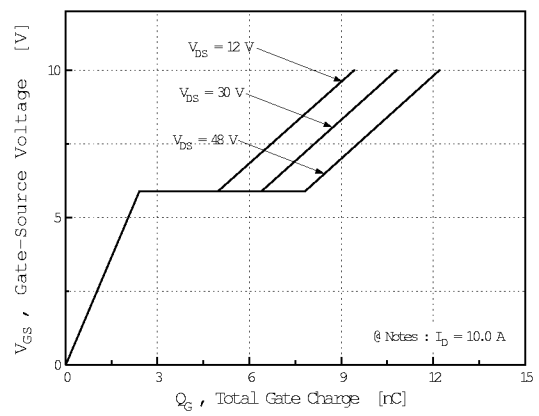
**Fig 4. Source-Drain Diode Forward Voltage**

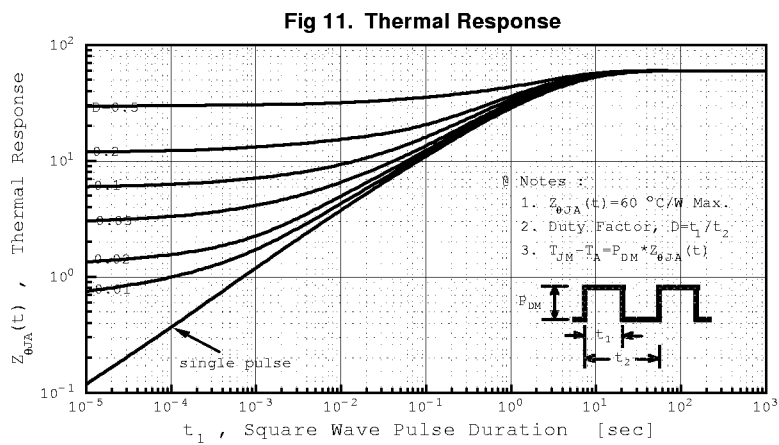
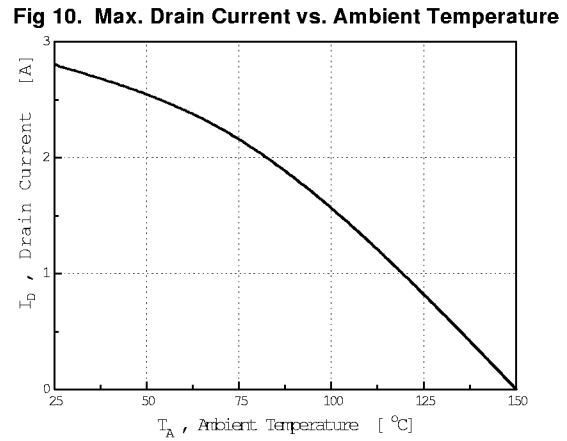
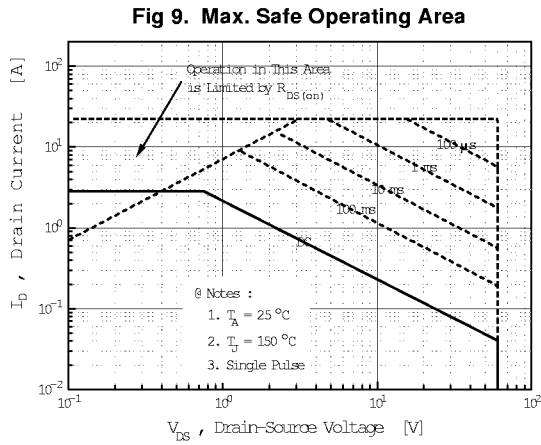
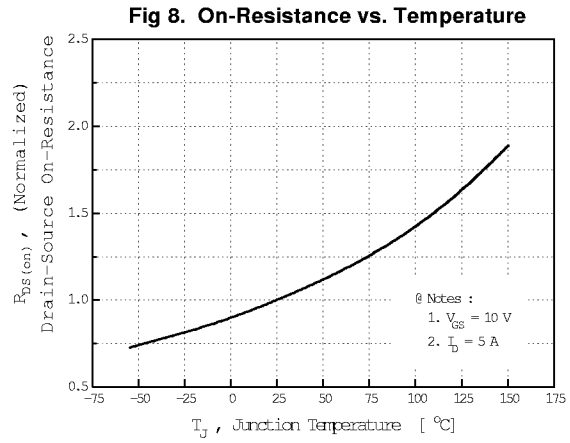
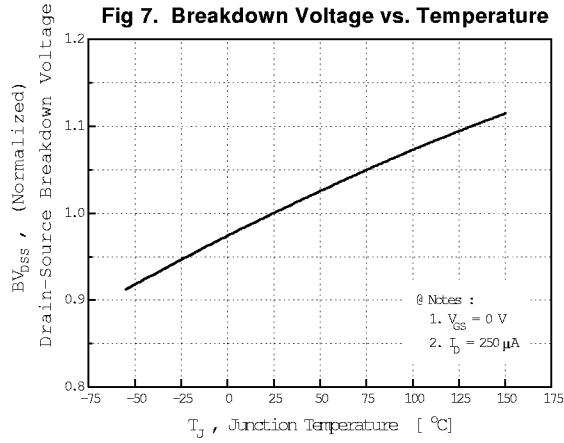


**Fig 5. Capacitance vs. Drain-Source Voltage**

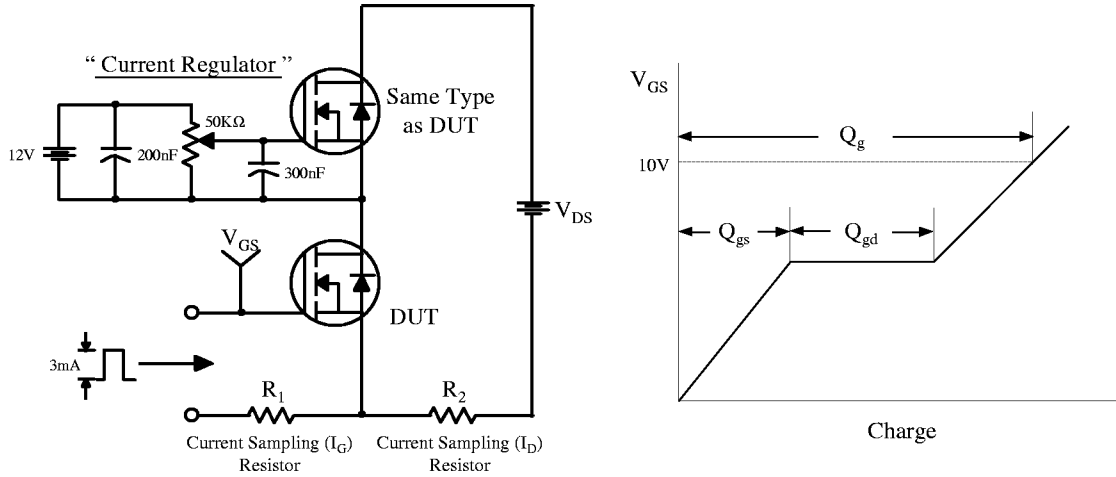


**Fig 6. Gate Charge vs. Gate-Source Voltage**

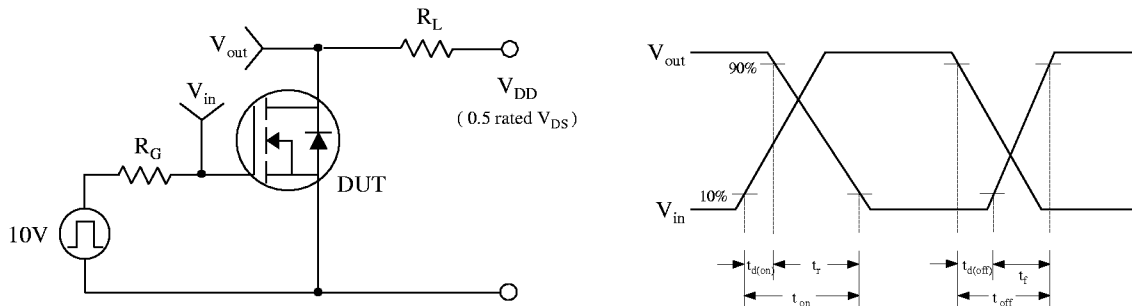




**Fig 12. Gate Charge Test Circuit & Waveform**



**Fig 13. Resistive Switching Test Circuit & Waveforms**



**Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms**

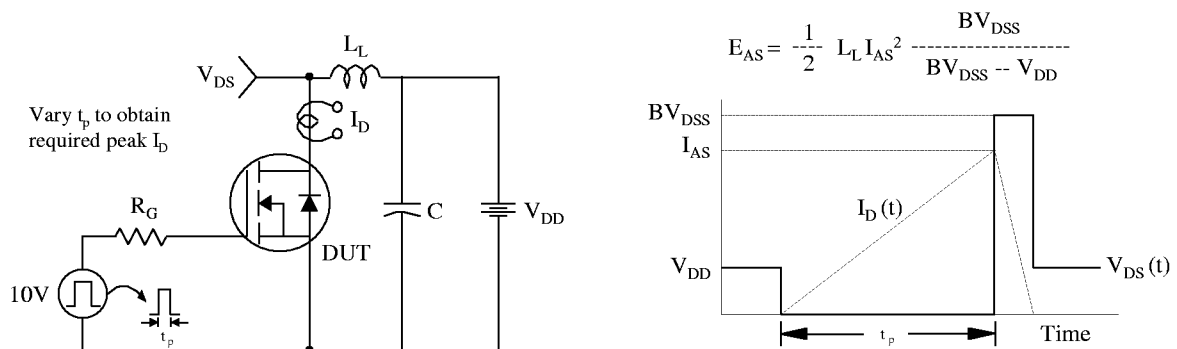
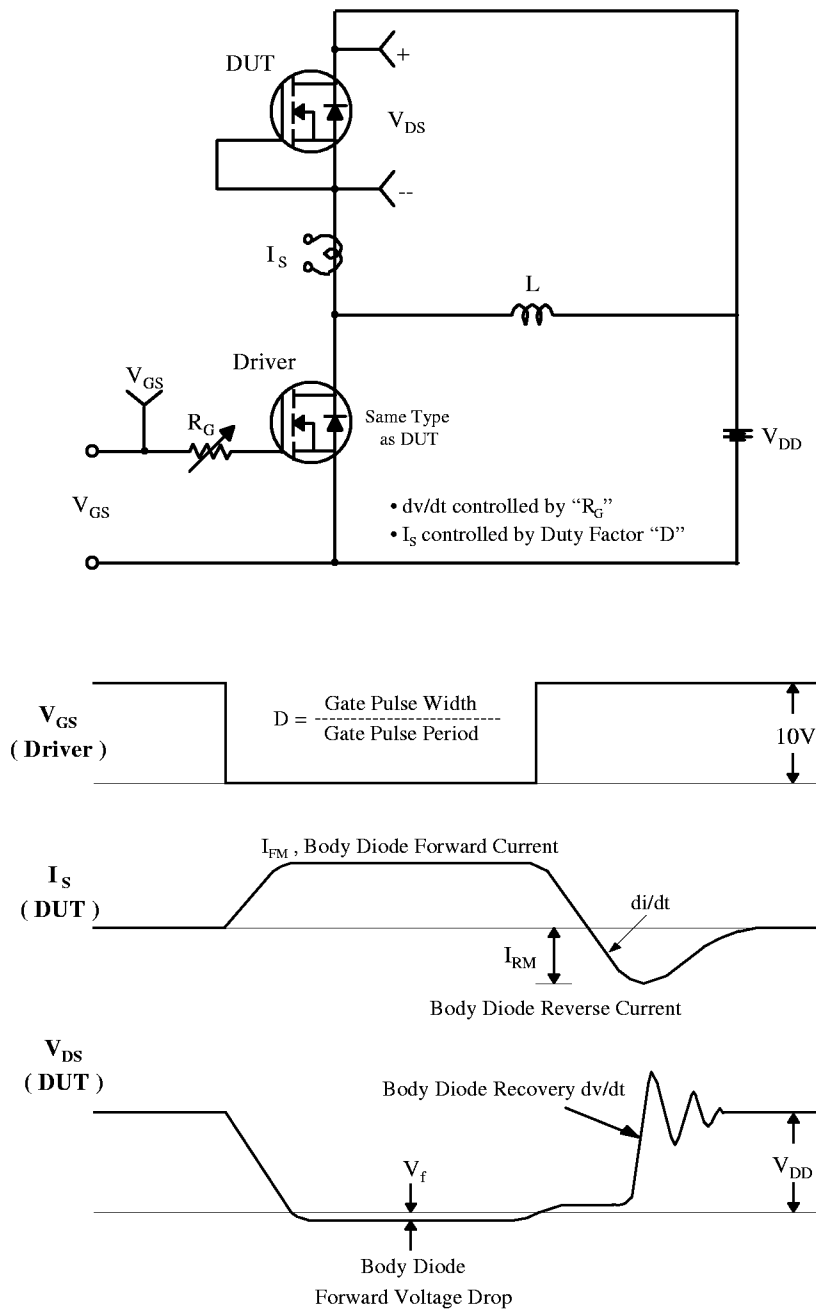
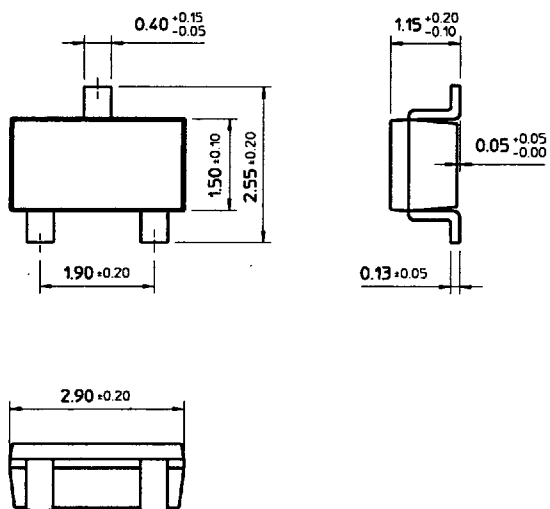


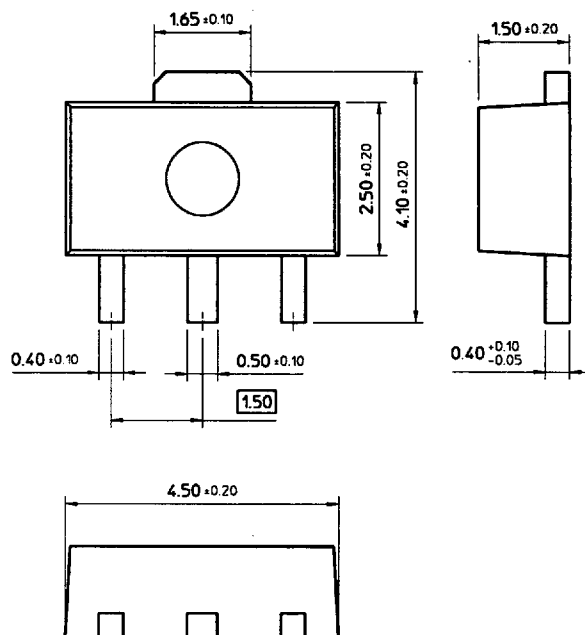
Fig 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



SOT-23



SOT-89



SOT-223

