

60V N-Channel MOSFET

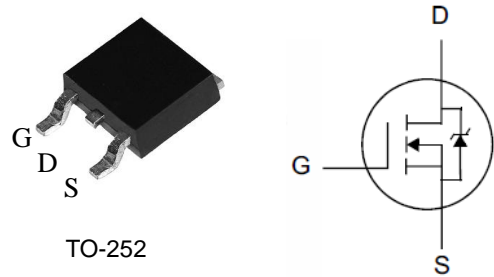
General Features

- Proprietary New Trench Technology
- $R_{DS(ON),typ.}=13.5\text{ m}\Omega@V_{GS}=10\text{V}$
- Low Gate Charge Minimize Switching Loss
- Fast Recovery Body Diode

Applications

- Automotive
- DC Motor Control
- Class D Amplifier

| | | |
|------------|-------------------|-------|
| BV_{DSS} | $R_{DS(ON),typ.}$ | I_D |
| 60V | 13.5m Ω | 55A |



TO-252

Package No to Scale

Absolute Maximum Ratings

$T_C=25^\circ\text{C}$ unless otherwise specified

| Symbol | Parameter | SK 50N06A | Unit |
|--------------------|--|------------|---------------------|
| V_{DSS} | Drain-to-Source Voltage ^[1] | 60 | V |
| V_{GSS} | Gate-to-Source Voltage | ± 20 | |
| I_D | Continuous Drain Current | 55 | A |
| | Continuous Drain Current at $T_C=100^\circ\text{C}$ | 35 | |
| I_{DM} | Pulsed Drain Current at $V_{GS}=10\text{V}^{[2]}$ | 200 | |
| E_{AS} | Single Pulse Avalanche Energy | 300 | mJ |
| P_D | Power Dissipation | 85 | W |
| | Derating Factor above 25°C | 0.57 | W/ $^\circ\text{C}$ |
| T_L T_{PAK} | Maximum Temperature for Soldering Leads at 0.063in (1.6mm) from Case for 10 seconds, Package Body for 10 seconds | 300 260 | $^\circ\text{C}$ |
| T_J & T_{STG} | Operating and Storage Temperature Range | -55 to 175 | |

Caution: Stresses greater than those listed in the "Absolute Maximum Ratings" may cause permanent damage to the device.

Thermal Characteristics

| Symbol | Parameter | SK 50N06A | Unit |
|-----------------|---|-----------|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | 1.76 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 75 | |

Electrical Characteristics

OFF Characteristics $T_J = 25^\circ\text{C}$ unless otherwise specified

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions |
|------------|-----------------------------------|------|------|------|---------|---|
| BV_{DSS} | Drain-to-Source Breakdown Voltage | 60 | -- | -- | V | $V_{GS}=0V, I_D=250\mu A$ |
| I_{DSS} | Drain-to-Source Leakage Current | -- | -- | 1 | μA | $V_{DS}=60V, V_{GS}=0V$ |
| | | -- | -- | 100 | | $V_{DS}=48V, V_{GS}=0V,$ $T_J=125^\circ\text{C}$ |
| I_{GSS} | Gate-to-Source Leakage Current | -- | -- | +1.0 | μA | $V_{GS}=+20V, V_{DS}=0V$ |
| | | -- | -- | -1.0 | | $V_{GS}=-20V, V_{DS}=0V$ |

ON Characteristics

 $T_J = 25^\circ\text{C}$ unless otherwise specified

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions |
|--------------|--------------------------------------|------|------|------|------------|-------------------------------|
| $R_{DS(ON)}$ | Static Drain-to-Source On-Resistance | -- | 13.5 | 17 | m Ω | $V_{GS}=10V, I_D=20A^{[3]}$ |
| $V_{GS(TH)}$ | Gate Threshold Voltage | 1.0 | -- | 3.0 | V | $V_{DS}=V_{GS}, I_D=250\mu A$ |
| gFS | Forward Transconductance | 18 | -- | -- | S | $V_{DS}=5V, I_D=20A$ |

Dynamic Characteristics

Essentially independent of operating temperature

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions |
|-----------|-------------------------------|------|------|------|------|--|
| C_{iss} | Input Capacitance | -- | 2.05 | -- | nF | $V_{GS}=0V,$ $V_{DS}=30V,$ $f=1.0\text{MHz}$ |
| C_{rSS} | Reverse Transfer Capacitance | -- | 0.12 | -- | | |
| C_{oss} | Output Capacitance | -- | 0.16 | -- | | |
| Q_g | Total Gate Charge | -- | 50 | -- | nC | $V_{DD}=30V,$ $I_D=20A, V_{GS}=0$ to 10V |
| Q_{gs} | Gate-to-Source Charge | -- | 6.0 | -- | | |
| Q_{gd} | Gate-to-Drain (Miller) Charge | -- | 15 | -- | | |

Resistive Switching Characteristics

Essentially independent of operating temperature

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions |
|--------------|---------------------|------|------|------|------|--|
| $t_{d(ON)}$ | Turn-on Delay Time | -- | 7.5 | -- | nS | $V_{DD}=30V,$ $I_D=20A,$ $V_{GS}=10V$ $R_G=3.0\Omega$ |
| t_{rise} | Rise Time | -- | 5.0 | -- | | |
| $t_{d(OFF)}$ | Turn-Off Delay Time | -- | 28 | -- | | |
| t_{fall} | Fall Time | -- | 5.5 | -- | | |

Source- Drain Body Diode Characteristics T_J=25°C unless otherwise specified

| Symbol | Parameter | Min | Typ. | Max. | Unit | Test Conditions |
|-----------------|--|-----|------|------|------|--|
| I _{SD} | Continuous Source Current ^[2] | -- | -- | 55 | A | Integral PN-diode in MOSFET |
| I _{SM} | Pulsed Source Current ^[2] | -- | -- | 200 | | |
| V _{SD} | Diode Forward Voltage | -- | -- | 1.5 | V | I _S =55A ^[3] , V _{GS} =0V |
| t _{rr} | Reverse recovery time | -- | 30 | -- | ns | V _{GS} =0V, I _F =20A, di _F /dt=100A/μs |
| Q _{rr} | Reverse recovery charge | -- | 40 | -- | nC | |

Note:

[1] T_J=+25°C to +175°C .

[2] Repetitive rating; pulse width limited by maximum junction temperature.

[3] Pulse width≤380μs; duty cycle≤2%.

Typical Characteristics

Typical Electrical and Thermal Characteristics (Curves)

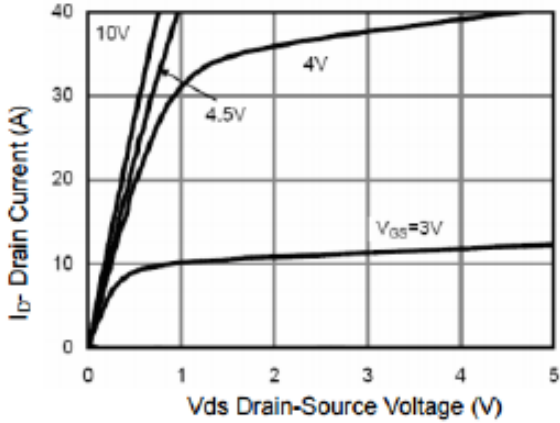


Figure 1 Output Characteristics

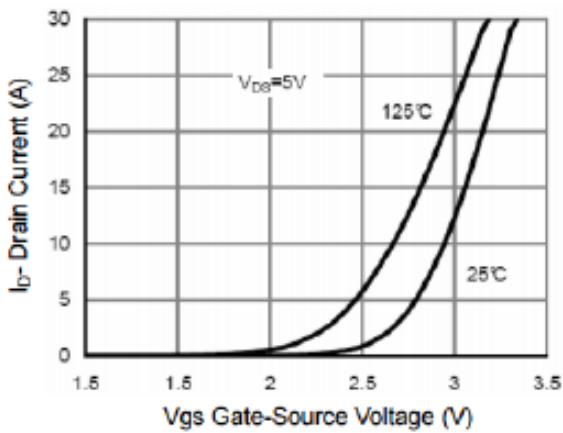


Figure 2 Transfer Characteristics

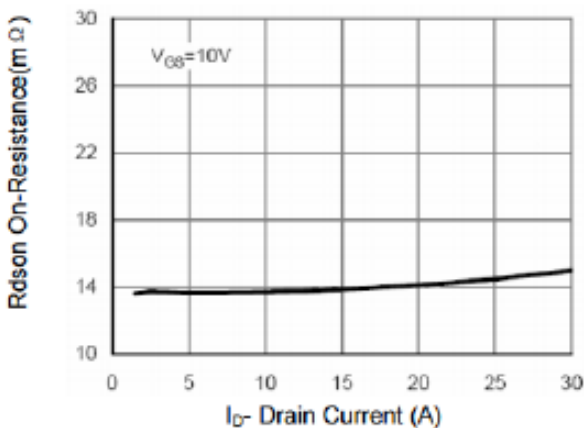


Figure 3 Rdson- Drain Current

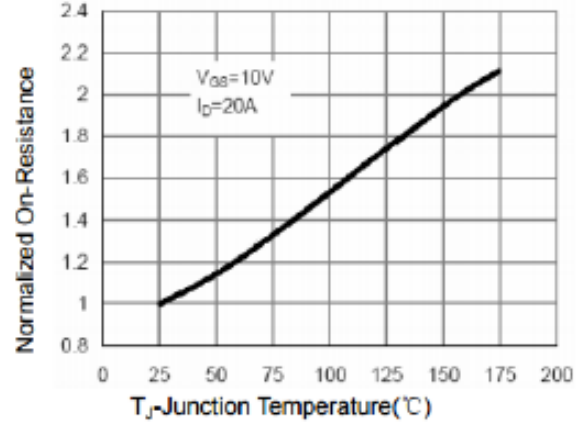


Figure 4 Rdson-Junction Temperature

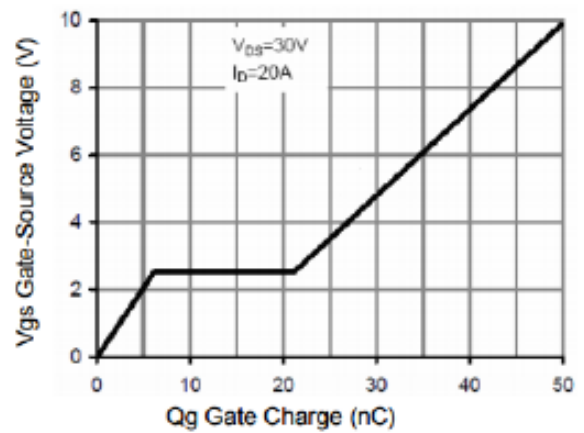


Figure 5 Gate Charge

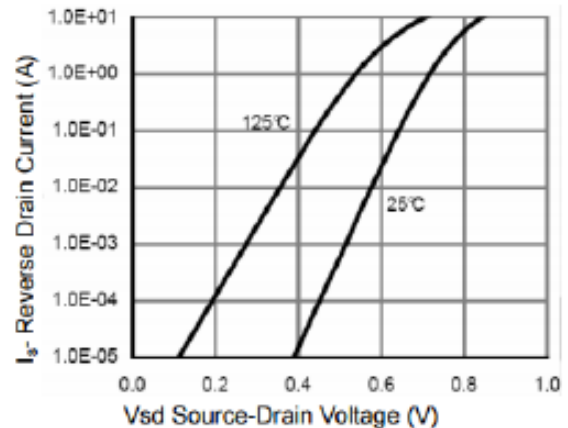


Figure 6 Source- Drain Diode Forward

Typical Characteristics(Cont.)

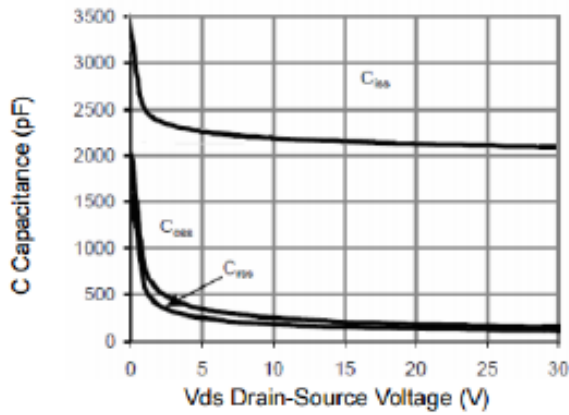


Figure 7 Capacitance vs Vds

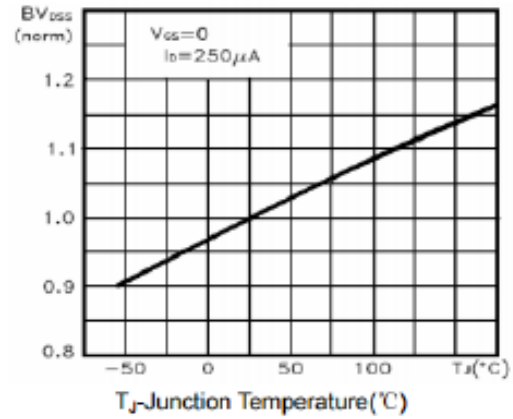


Figure 9 BV_{OSS} vs Junction Temperature

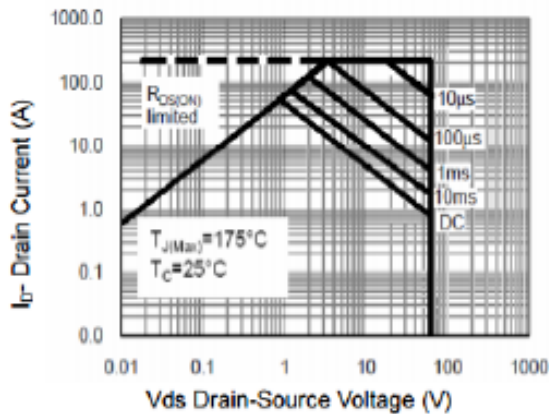


Figure 8 Safe Operation Area

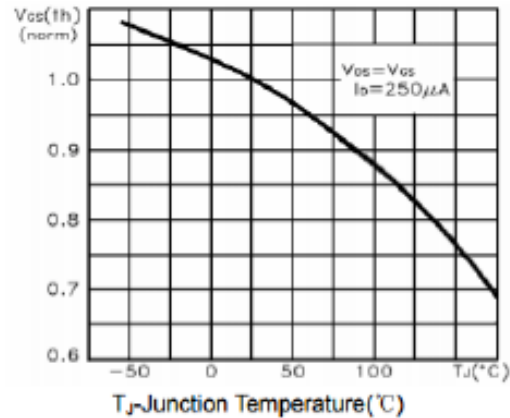


Figure 10 $V_{GS(th)}$ vs Junction Temperature

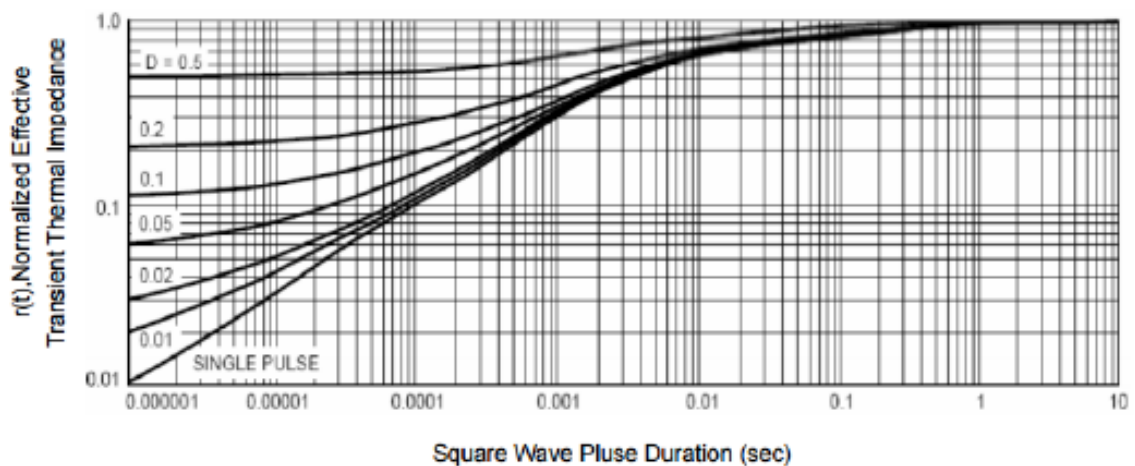


Figure 11 Normalized Maximum Transient Thermal Impedance

Test Circuits and Waveforms

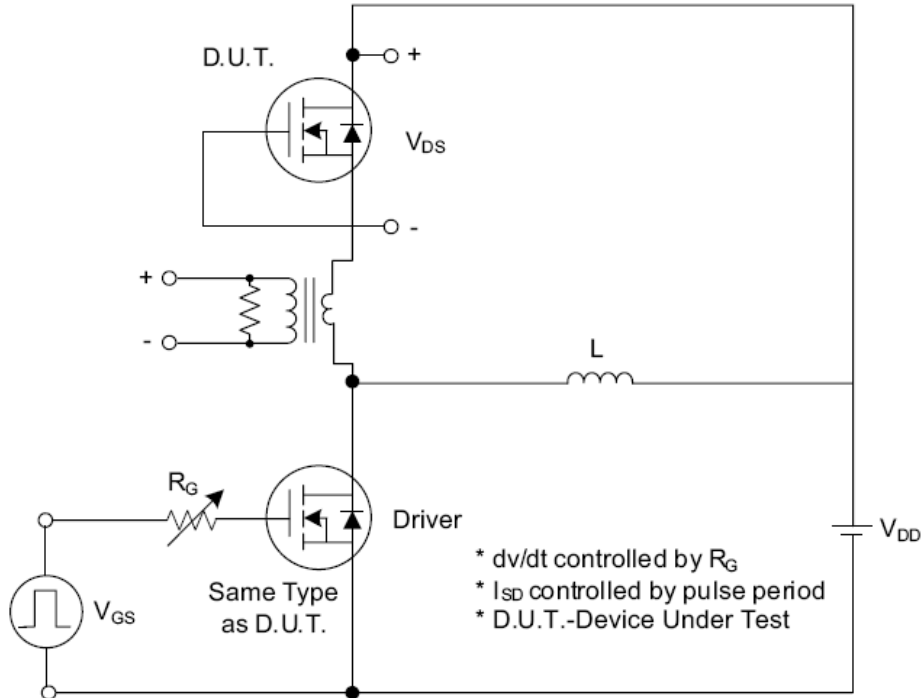


Fig. 1.1 Peak Diode Recovery dv/dt Test Circuit

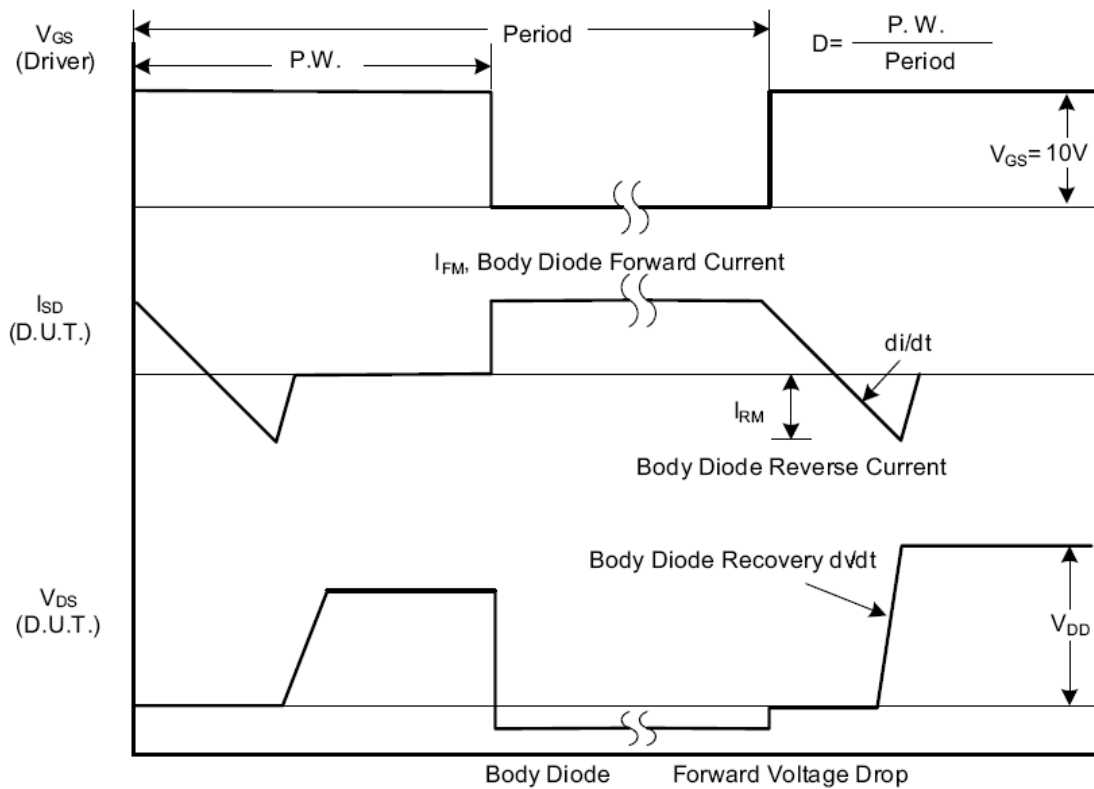


Fig. 1.2 Peak Diode Recovery dv/dt Waveforms

Test Circuits and Waveforms (Cont.)

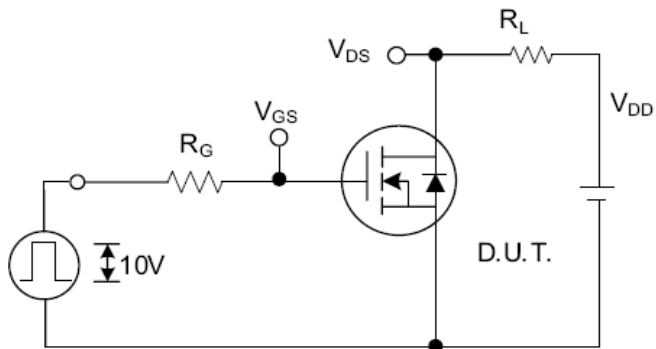


Fig. 2.1 Switching Test Circuit

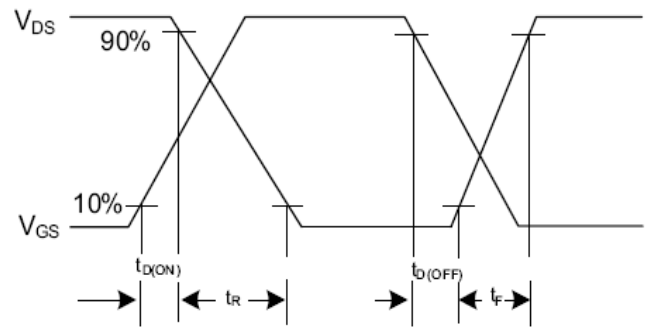


Fig. 2.2 Switching Waveforms

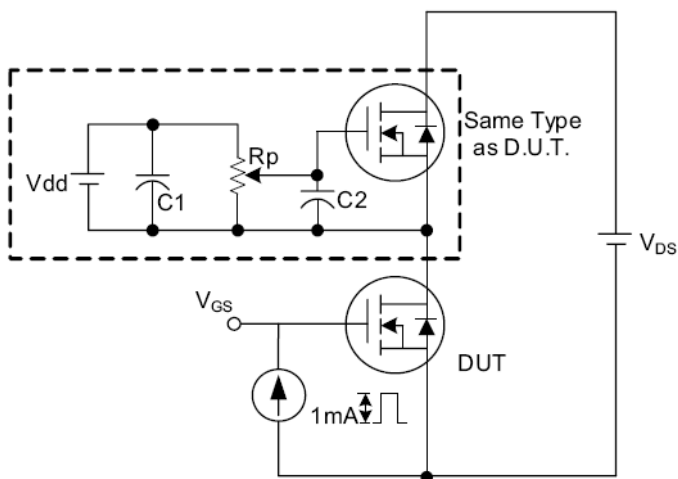


Fig. 3.1 Gate Charge Test Circuit

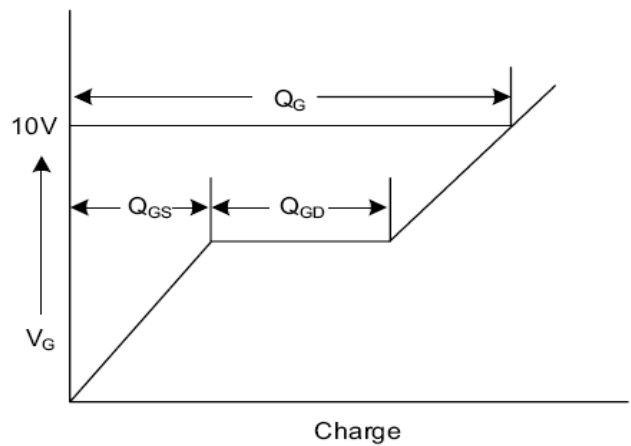


Fig. 3.2 Gate Charge Waveform

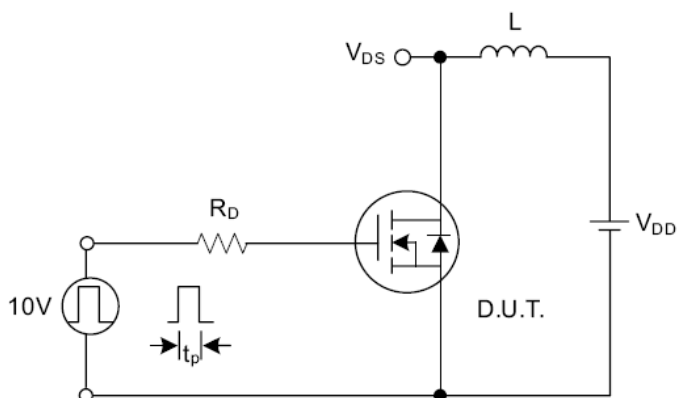


Fig. 4.1 Unclamped Inductive Switching Test Circuit

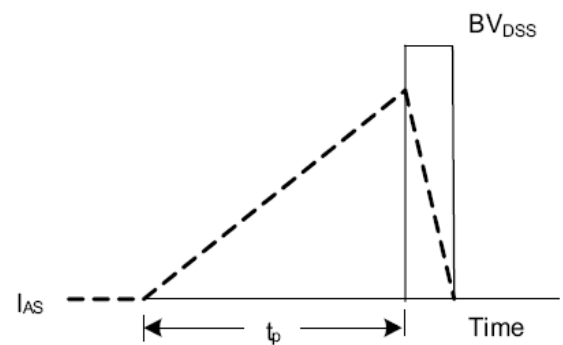
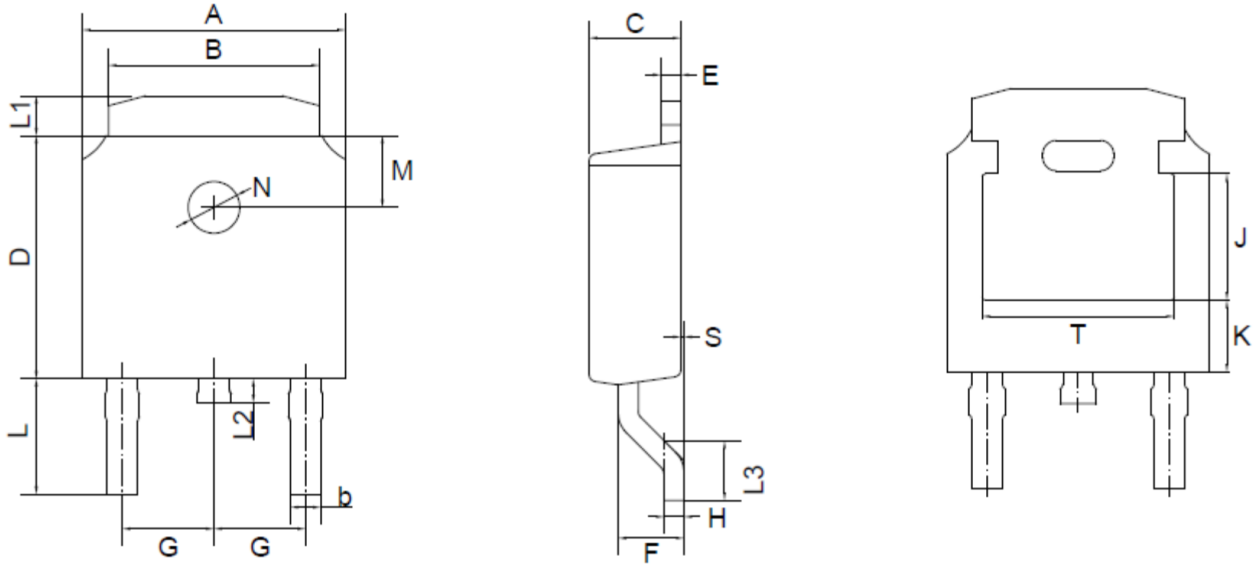


Fig. 4.2 Unclamped Inductive Switching Waveforms

PACKAGE OUTLINE

TO-252(D-PAK)



TO-252(D-PAK) mechanical data

| UNIT | A | B | b | C | D | E | F | G | H | L | L1 | L2 | L3 | S | M | N | J | K | T | |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----------------|------|-----|-----|-----|------|-----|----------------|----------------|--------------|--------------|--------------|
| mm | max | 6.7 | 5.5 | 0.8 | 2.5 | 6.3 | 0.6 | 1.8 | 2.29 TYPICAL | 0.55 | 3.1 | 1.2 | 1.0 | 1.75 | 0.1 | 1.8 TYPICAL | 1.3 TYPICAL | 3.16 ref. | 1.80 ref. | 4.83 ref. |
| | min | 6.3 | 5.1 | 0.3 | 2.1 | 5.9 | 0.4 | 1.3 | | 0.45 | 2.7 | 0.8 | 0.6 | 1.40 | 0.0 | | | | | |
| mil | max | 264 | 217 | 31 | 98 | 248 | 24 | 71 | 90 TYPICAL | 22 | 122 | 47 | 39 | 69 | 4 | 71 TYPICAL | 51 TYPICAL | 124 ref. | 71 ref. | 190 ref. |
| | min | 248 | 201 | 12 | 83 | 232 | 16 | 51 | | 18 | 106 | 31 | 24 | 55 | 0 | | | | | |