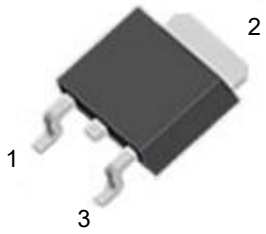
# N-Channel Enhancement Mode MOSFET

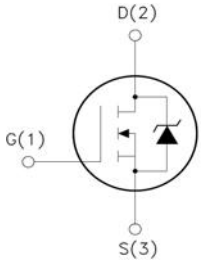
400V N-Channel MOSFET

## Features

- ☐ Low Intrinsic Capacitances.
- ☐ Excellent Switching Characteristics.
- ☐ Extended Safe Operating Area.
- ☐ Unrivalled Gate Charge :Qg=16nC (Typ.).
- ☐ BVDSS=400V,$I_D$=7 A
- ☐ $R_{DS}$(on) : 1.1 Ω (Max) @$V_G$=10V
- ☐ 100% Avalanche Tested

TO-252




1.Gate (G)
2.Drain (D)
3.Source (S)

## Absolute Maximum Ratings (Ta=25℃ unless otherwise noted)

| Symbol | Parameter | | Value | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | 400 | V |
| $I_D$ | Drain Current | $T_C$=25℃ | 7 | A |
| | | $T_C$=100℃ | 3.8 | |
| $V_{GSS}$ | Gate-Source Voltage | | ±30 | V |
| $E_{AS}$ | Single Pulse Avalanche Energy (note1) | | 260 | mJ |
| $I_{AR}$ | Avalanche Current (note2) | | 7 | A |
| $P_D$ | Power Dissipation (Tc=25℃) | | 75 | W |
| $T_j$ | Junction Temperature(Max) | | 150 | ℃ |
| $T_{stg}$ | Storage Temperature | | -55~+150 | |
| TL | Maximum lead temperature for soldering purpose,1/8" from case for 5 seconds | | 300 | |

## Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Unit |
|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | - | 1.67 | ℃/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | - | 100 | |
| $R_{\theta CS}$ | Thermal Resistance, Case to Sink | 0.5 | - | |

## Electrical Characteristics (Ta=25℃ unless otherwise noted)

| Symbol | Parameter | Test Condition | Min. | yp. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $I_D$=250μA，$V_{GS}$=0 | 400 | - | - | V |
| △BVDSS/△TJ | Breakdown Voltage Temperature Coefficient | $I_D$=250μA ,Reference to 25℃ | - | 0.5 | - | V/ |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=400V, $V_{GS}$=0V | - | - | 1 | μA |
| | | $V_{DS}$=320V, Tc=125℃ | | | 10 | |
| $I_{GSSF}$ | Gate-body leakage Current, Forward | $V_{GS}$=+30V, $V_{DS}$=0V | - | - | 100 | nA |
| $I_{GSSR}$ | Gate-body leakage Current, Reverse | $V_{GS}$=-30V, $V_{DS}$=0V | - | - | -100 | |
| **On Characteristics** | | | | | | |
| $V_{GS(TH)}$ | Gate Threshold Voltage | $I_D$=250μA,$V_{DS}$=$V_{GS}$ | 2 | - | 4 | V |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $I_D$=2.0A,$V_{GS}$=10V | - | 0.95 | 1.1 | Ω |
| **Dynamic Characteristics** | | | | | | |
| Ciss | In Capacitance | $V_{DS}$=25V，$V_{GS}$=0，f=1.0MHz | - | 583 | - | pF |
| Coss | Out Capacitance | | - | 71 | - | |
| Crss | Reverse Transfer Capacitance | | - | 5.1 | - | |
| **Switching Characteristics** | | | | | | |
| Td(on) | Turn-On Delay Time | $V_{DD}$=200V，$I_D$=7A $R_G$=10Ω (Note 3,4) | - | 1 | - | ns |
| Tr | Turn-On Rise Time | | - | 20 | - | |
| Td(off) | urn-Off Delay Time | | - | 3 | - | |
| Tf | Turn-Off Rise Time | | - | 12 | - | |
| Qg | Total Gate Charge | $V_{DS}$=320V,$V_{GS}$=10V，$I_D$=7 A (Note 3,4) | - | 1 | - | nC |
| Qgs | Gate-Source Charge | | - | 7.0 | - | |
| Qgd | Gate-Drain Charge | | - | 7. | - | |
| **Drain-Source Diode Characteristics and Maximum Ratings** | | | | | | |
| Is | Max. Diode Forward Current | - | - | - | 7 | A |
| $I_{SM}$ | Max. Pulsed Forward Current | - | - | - | 36 | |
| $V_{SD}$ | Diode Forward Voltage | $I_D$=7 A | - | - | 1.5 | V |
| Trr | Reverse Recovery Time | $I_S$=7 A,$V_{GS}$ =0V diF/dt=100A/μs (Note3) | - | 24 | - | nS |
| Qrr | Reverse Recovery Charge | | - | 1.8 | - | μC |

Notes : 1, L=2.26mH, IAS=7 A, VDD=50V, RG=25Ω, St artingTJ =25°C
2, Repetitive Rating : Pulse width limited by maximum junction temperature
3, Pulse Test : Pulse Width ≤ 300μs, Duty Cycle ≤ 2%
4, Essentially Independent of Operating Temperature

## Typical Characteristics

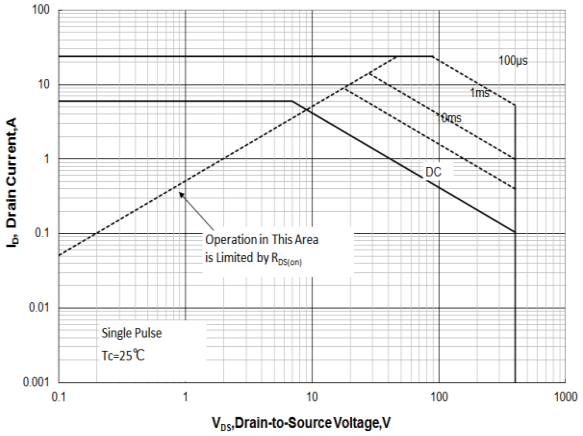



Figure 1 Maximum Forward Bias Safe Operating Area

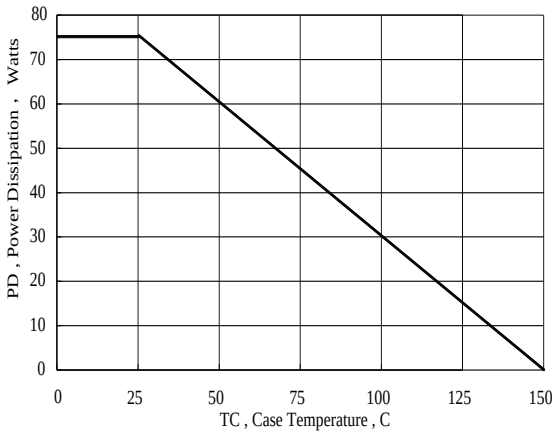



Figure 2 Maximum Power dissipation vs Case Temperature

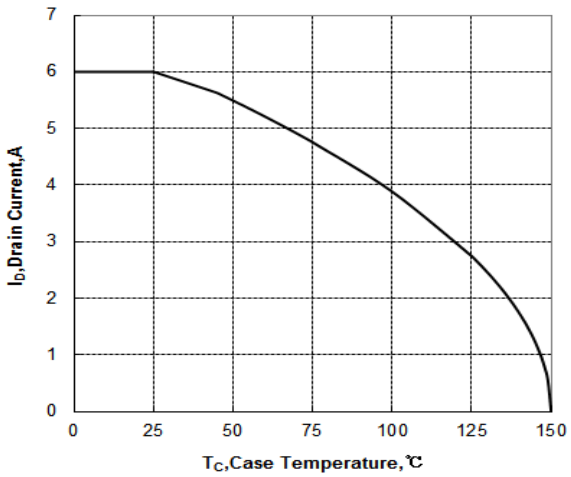



Figure 3 Maximum Continuous Drain Current vs Case Temperature

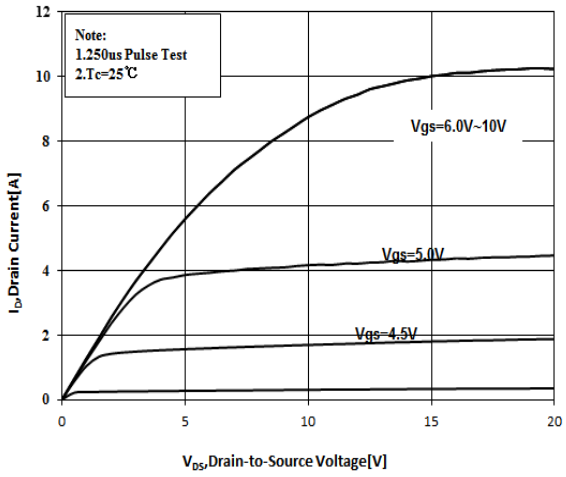



Figure 4 Typical Output Characteristics

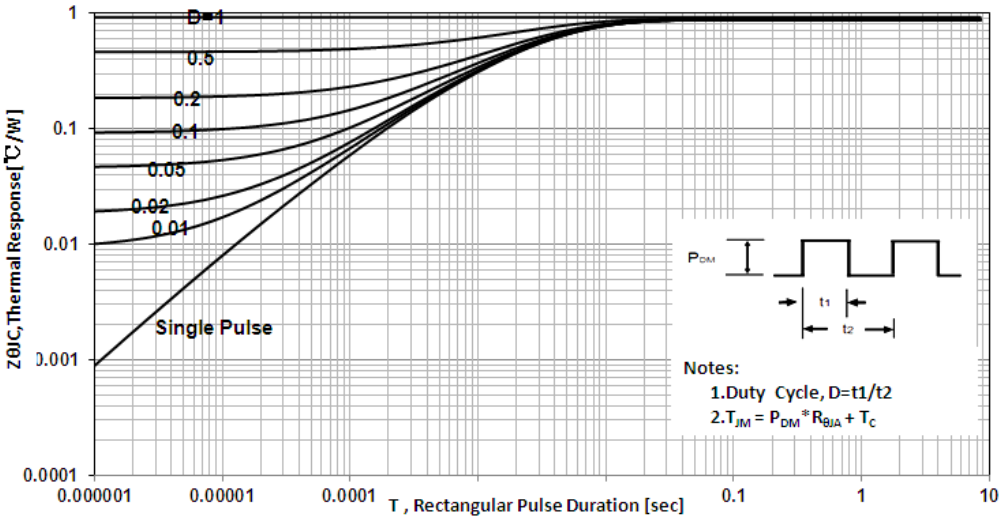



Figure 5 Maximum Effective Thermal Impedance , Junction to Case

## Typical Characteristics (Continued)

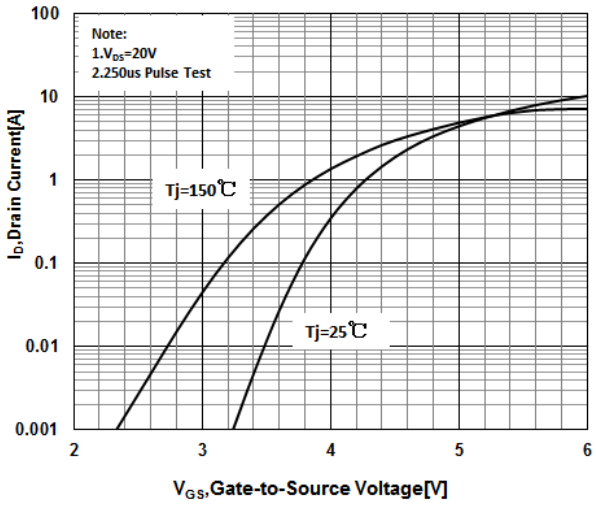



Figure 6 Typical Transfer Characteristics

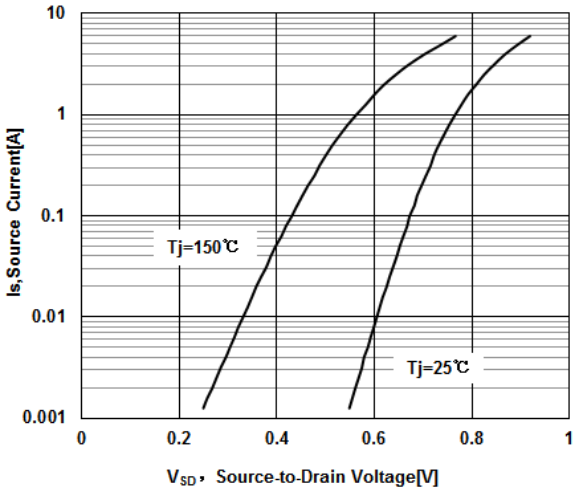



Figure 7 Typical Body Diode Transfer Characteristics

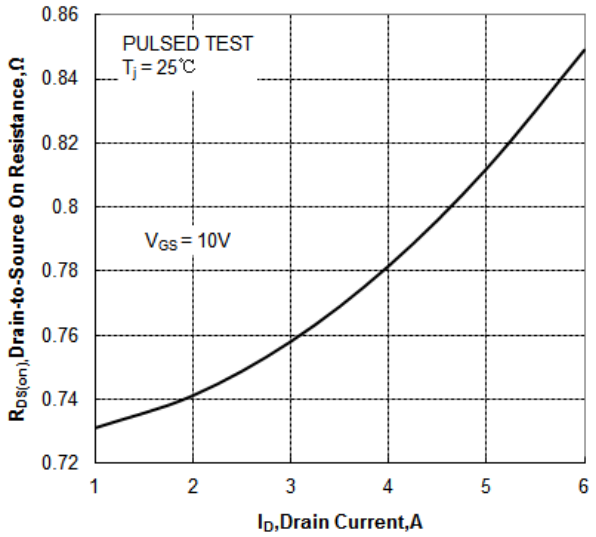



Figure 8 Typical Drain to Source ON Resistance vs Drain Current

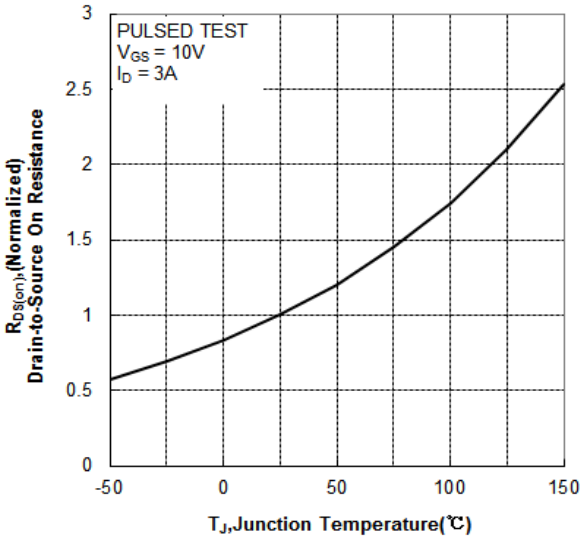
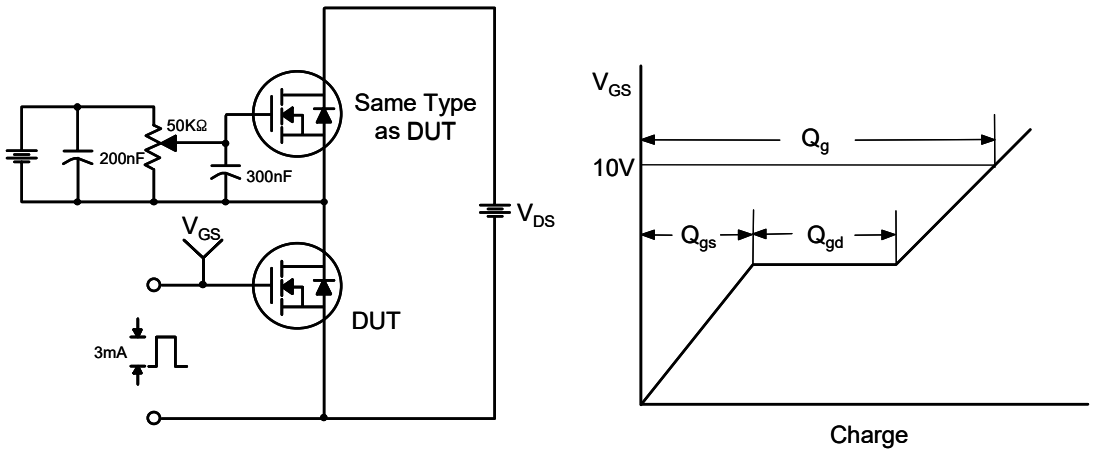
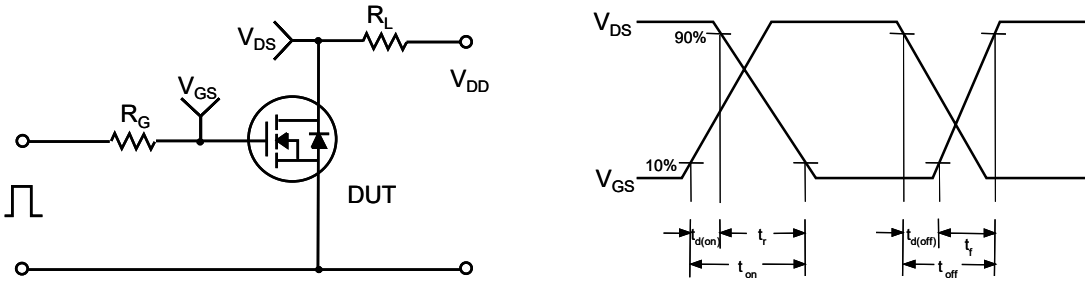



Figure 9 Typical Drian to Source on Resistance vs Junction Temperature

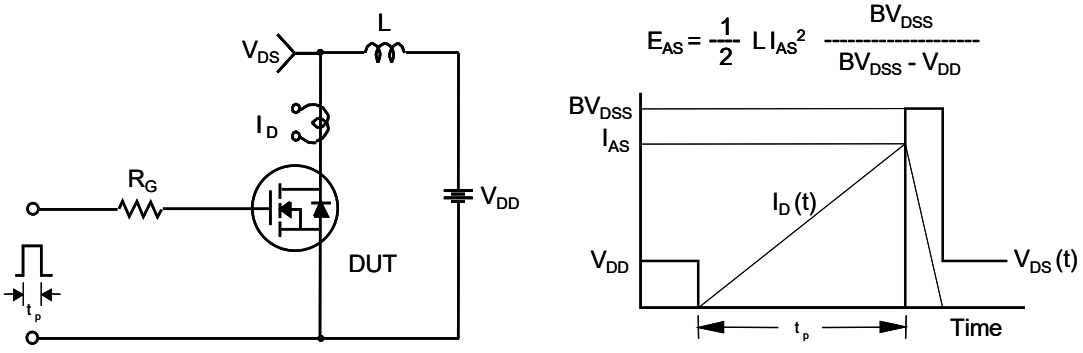
**Gate Charge Test Circuit & Waveform**

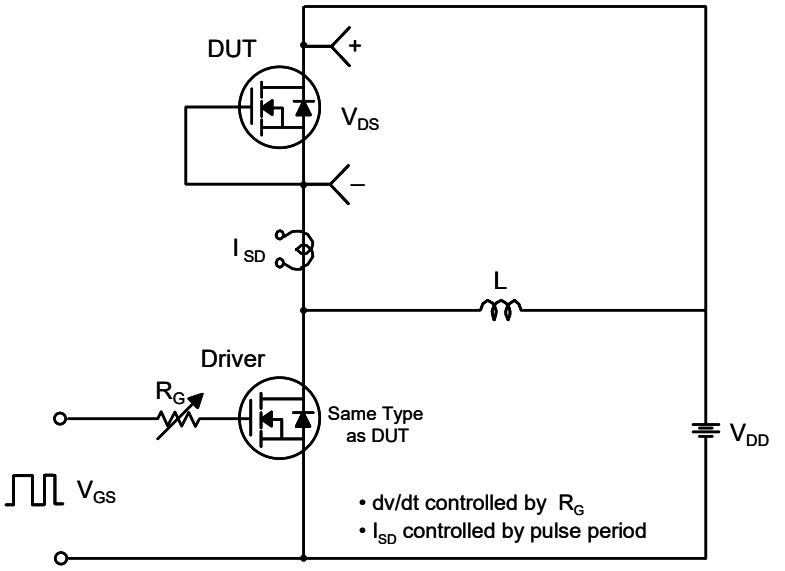


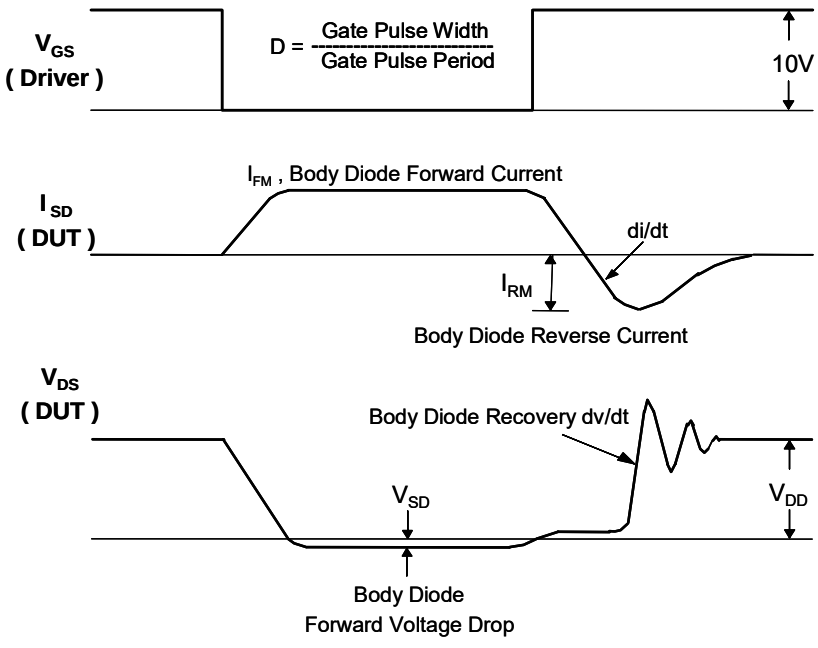

**Resistive Switching Test Circuit & Waveforms**




**Unclamped Inductive Switching Test Circuit & Waveforms**



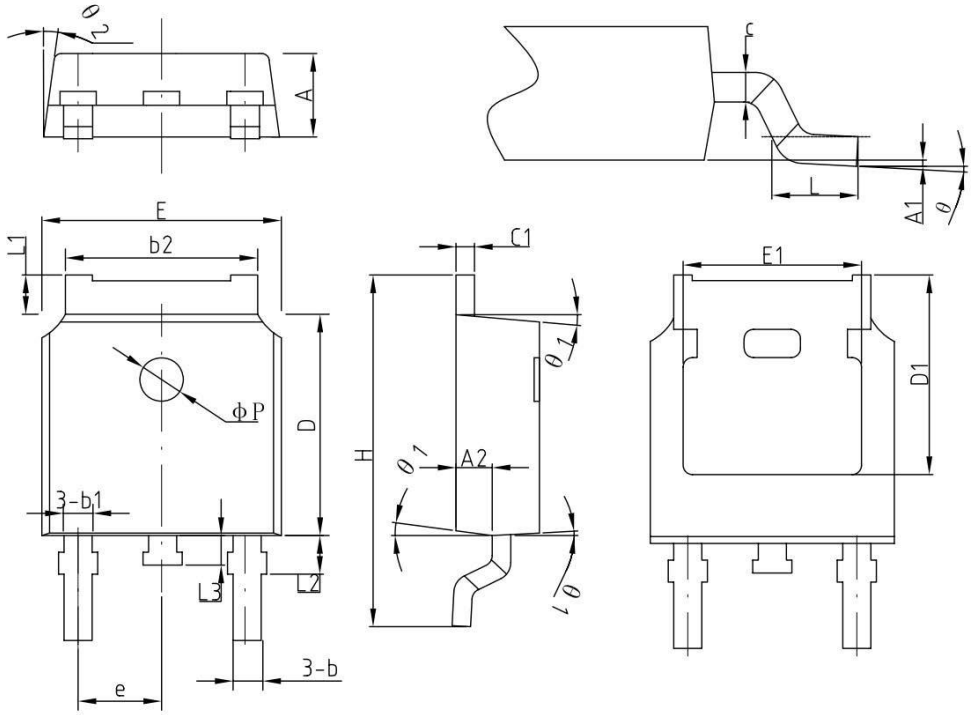

DUT
+
$V_{DS}$
–
$I_{SD}$
L
Driver
$R_G$
Same Type
as DUT
$V_{DD}$
$V_{GS}$
• dv/dt controlled by $R_G$
• $I_{SD}$ controlled by pulse period


$V_{GS}$
( Driver )
D = Gate Pulse Width / Gate Pulse Period
10V
$I_{FM}$ , Body Diode Forward Current
$I_{SD}$
( DUT )
di/dt
$I_{RM}$
Body Diode Reverse Current
$V_{DS}$
( DUT )
Body Diode Recovery dv/dt
$V_{SD}$
$V_{DD}$
Body Diode
Forward Voltage Drop

## Package Dimension

# TO-252

Unit: mm




COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

| SYMBOL | MIN | NOM | MAX |
|---|---|---|---|
| A | 2.2 | 2.30 | 2.38 |
| A1 | 0 | – | 0.10 |
| A2 | 0.90 | 1.01 | 1.10 |
| b | 0.71 | 0.76 | 0.86 |
| b1 | | 0.76 | |
| b2 | 5.13 | 5.33 | 5.46 |
| c | 0.47 | 0.50 | 0.60 |
| c1 | 0.47 | 0.50 | 0.60 |
| D | 6.0 | 6.10 | 6.20 |
| D1 | – | 5.30 | – |
| E | 6.50 | 6.60 | 6.70 |
| E1 | – | 4.80 | – |
| e | | 2.286BSC | |
| H | 9.70 | 10.10 | 10.40 |
| L | 1.40 | 1.50 | 1.70 |
| L1 | 0.90 | – | 1.25 |
| L2 | | 1.05 | |
| L3 | | 0.8 | |
| ΦP | | 1.2 | |
| θ | 0° | – | 8° |
| θ1 | 5° | 7° | 9° |
| θ2 | 5° | 7° | 9° |