## Description

### 45V N-CHANNEL ENHANCEMENT MODE POWER MOSFET

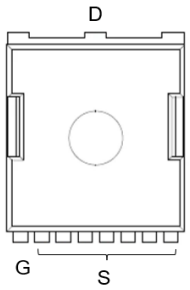
**Features**

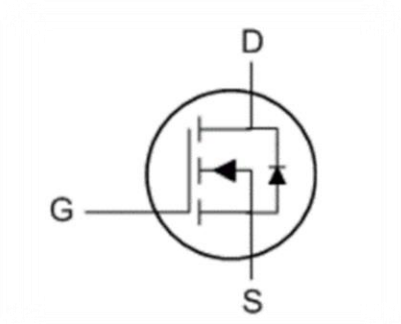
- Device Rating $V_{DS}$ = 45V, $I_D$ = 225A
- $R_{DS(ON)}$ =1.5mΩ (typ.) @ $V_{GS}$ = 10V, $I_D$ = 20A
- $R_{DS(ON)}$ =2.0mΩ (typ.) @ $V_{GS}$ = 4.5V, $I_D$ = 20A
- Proprietary High Density Trench Technology
- RoHS Compliant & Halogen-Free

**Application**

- BMS
- ESS
- PD charger
- E-tool

**Package**




**TOLL**
**JFG225N45Q**

## Absolute Maximum Ratings $T_C$=25℃ unless otherwise specified

| Symbol | Parameter | | Max. | Units |
|---|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage | | 45 | V |
| $V_{GS}$ | Gate-Source Voltage | | ± 20 | V |
| $I_D$ | Continuous Drain Current, VGS @ 10V note1 | $T_C$ = 25℃ | 225 | A |
| | | $T_C$ = 100℃ | 142 | A |
| $I_{DM}$ | Pulsed Drain Current note2 | | 900 | A |
| $P_D$ | Power Dissipation note4 | $T_C$ = 25℃ | 138 | W |
| | Power Dissipation | $T_A$ = 25℃ | 3.12 | W |
| $E_{AS}$ | Single Pulsed Avalanche Energy note3 | | 415 | mJ |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case note1 | | 0.9 | ℃/W |
| $R_{\theta JA}$ | Junction to Ambient (mounted on 1 inch square PCB) | | 40 | ℃/W |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | | -55 to +150 | ℃ |

## Electrical Characteristics $T_C$=25℃ unless otherwise specified

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **Off Characteristic** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0V, $I_D$ = 250μA | 45 | - | - | V |
| $I_{DSS}$ | Drain-Source Leakage Current | $V_{DS}$ = 45V, $V_{GS}$ = 0V, $T_C$ = 25℃ | - | - | 1 | μA |
| | | $V_{DS}$ = 45V, $V_{GS}$ = 0V, $T_C$ = 55℃ | - | - | 10 | μA |
| $I_{GSS}$ | Gate-Source Leakage Current | $V_{DS}$ = 0V, $V_{GS}$ = ±20V | -100 | - | 100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA | 1.0 | - | 2.5 | V |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance note2 | $V_{GS}$ = 10V, $I_D$ =20A | - | 1.5 | 1.8 | mΩ |
| | | $V_{GS}$ = 4.5V, $I_D$ =20A | - | 2.0 | 2.4 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 10V, $I_D$ =20A | | 88 | - | S |
| **Dynamic Characteristics** | | | | | | |
| $R_g$ | Gate Resistance | | - | 1.43 | - | Ω |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 20V, $V_{GS}$ = 0V, f = 1MHz | - | 7410 | - | pF |
| $C_{oss}$ | Output Capacitance | | - | 1110 | - | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 1070 | - | pF |
| $Q_g$ | Total Gate Charge | $V_{DS}$ =20V, $I_D$ = 20A, $V_{GS}$ = 10V | - | 173 | - | nC |
| $Q_{gs}$ | Gate-Source Charge | | - | 17.7 | - | nC |
| $Q_{gd}$ | Gate-Drain(“Miller”) Charge | | - | 58 | - | nC |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 20V, $I_D$ = 20A, $R_G$ = 1Ω, $V_{GS}$ = 10V | - | 40 | - | ns |
| $t_r$ | Turn-On Rise Time | | - | 90 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 180 | - | ns |
| $t_f$ | Turn-Off Fall Time | | - | 114 | - | ns |
| **Source-Drain Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Diode Forward Current note1,5 | | - | - | 115 | A |
| $I_{SM}$ | Maximum Pulsed Diode Forward Current note2,5 | | - | - | 900 | A |
| $t_{rr}$ | Reverse Recovery Time | $T_J$ = 25°C, $I_S$ = 20A, $V_{GS}$ = 0V | - | 80 | - | ns |
| $Q_{rr}$ | Reverse Recovery Charge | $T_J$ = 25°C, $I_S$ = 20A, di/dt = 100A/μs | | 128 | | nC |
| $V_{SD}$ note2 | Source to Drain Diode Forward Voltage | $T_J$ = 25°C, $I_S$ = 20A, $V_{GS}$ = 0V | - | 0.75 | - | V |

Note :

1.The data tested by surface mounted on one $inch^2$ FR-4 board with 2OZ copper.

2.The data tested by pulsed, pulse width ≦ 300us, duty cycle ≦ 2%.

3.The EAS data shows Max. rating. The test condition is L=0.1mH, $I_{AS}$= 91.1 A.

4.The power dissipation is limited by 150℃ junction temperature.

5.The data is theoretically the same as $I_D$ and $I_{DM}$, in real applications, should be limited by total power dissipation.

## Typical Performance Characteristics

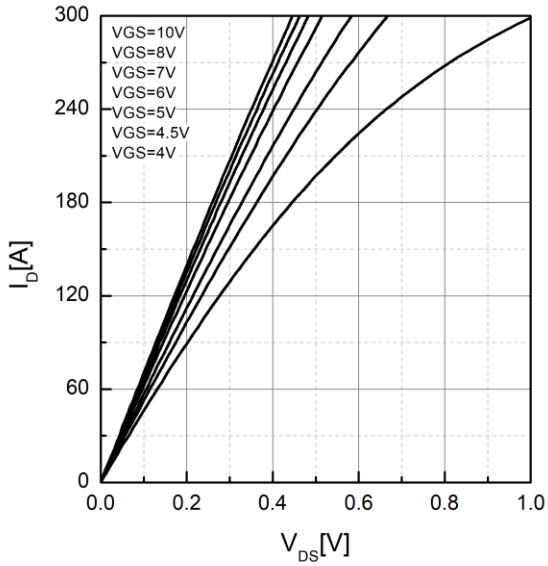



Figure 1. Output Characteristics, TJ=25℃

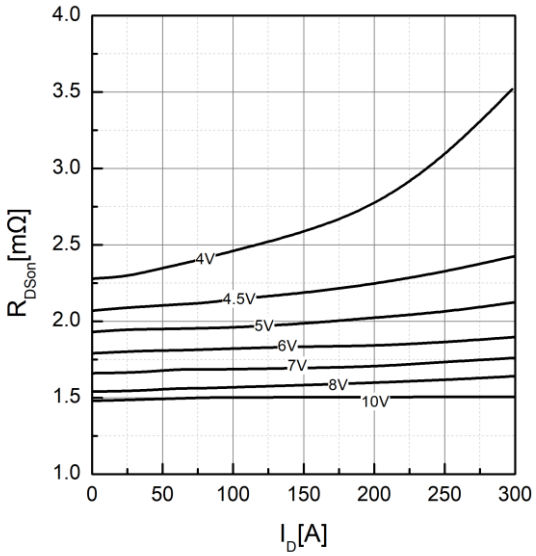



Figure 2. Drain-source on resistance , TJ=25℃

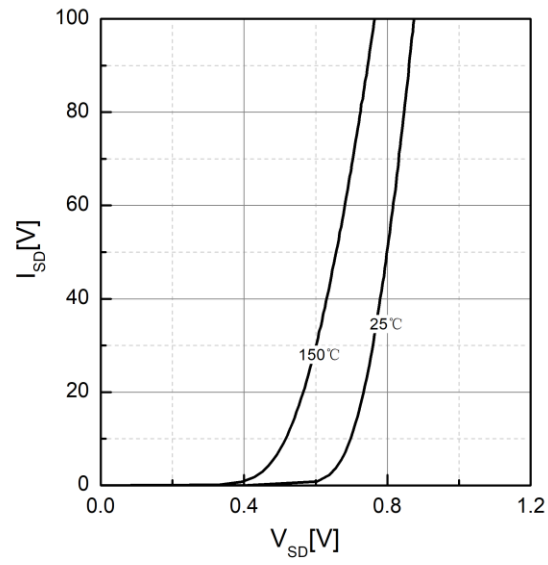



Figure 3. Forward characteristics of body diode

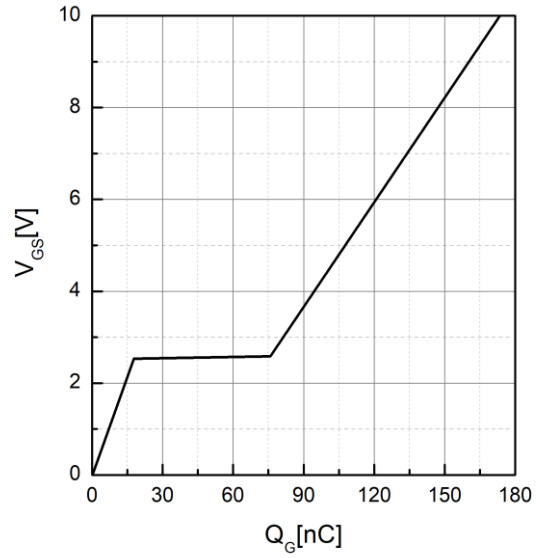



Figure 4. Gate Charge Characteristics

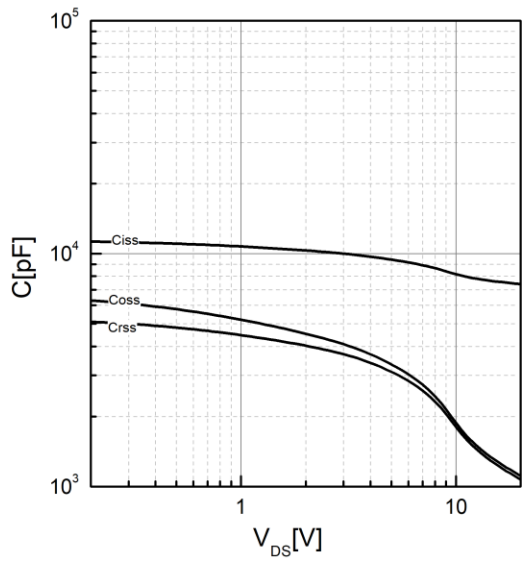



Figure 5. Capacitance Characteristics

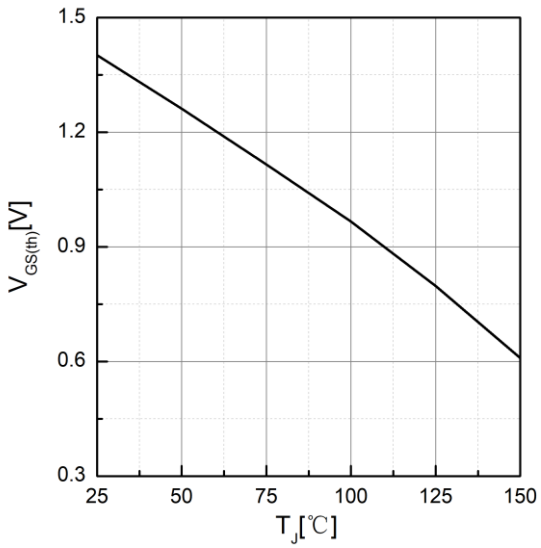



Figure 6. Threshold Voltage Vs. Temperature

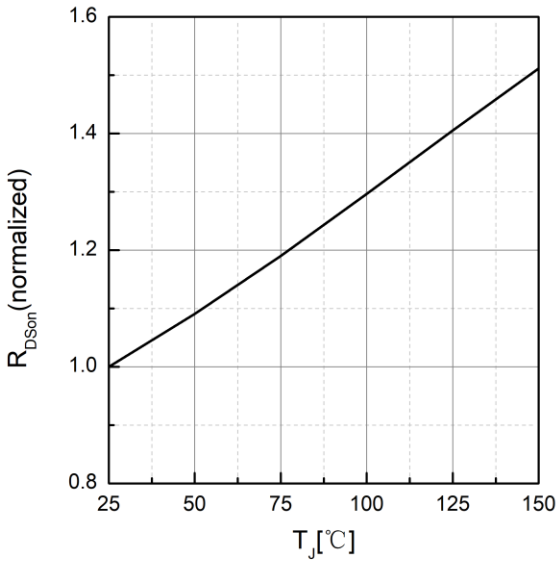



Figure 7. Drain-source on-state resistance

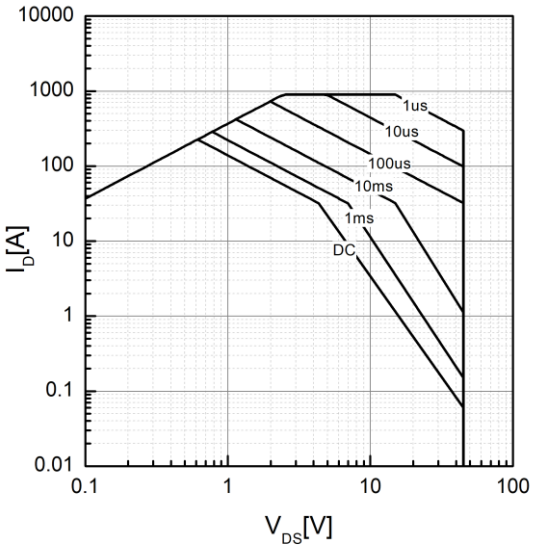



Figure 8. Maximum Safe Operating Area

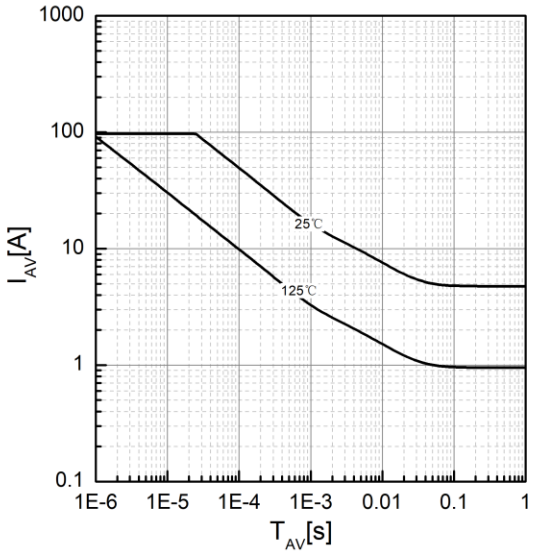



Figure 9. Avalanche characteristics

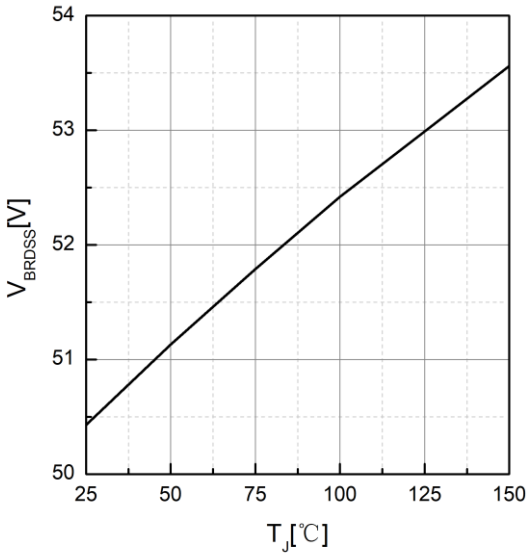



Figure 10. Drain-source breakdown voltage

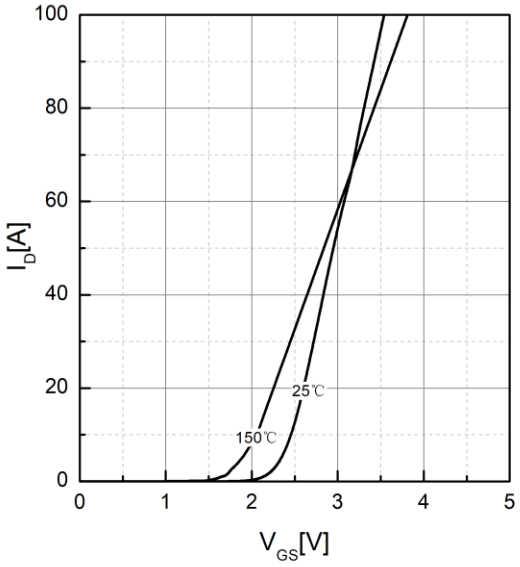



Figure 11. Transfer characteristics

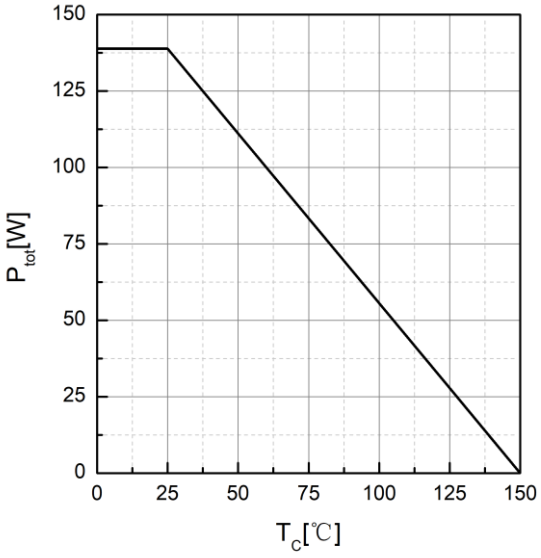



Figure 12. Power dissipation

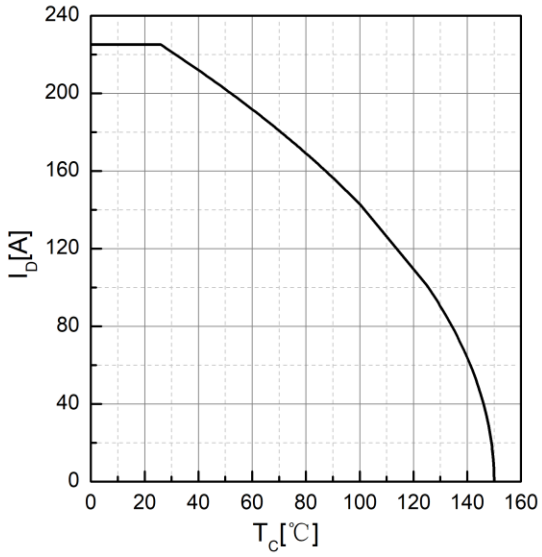



Figure 13. Drain current

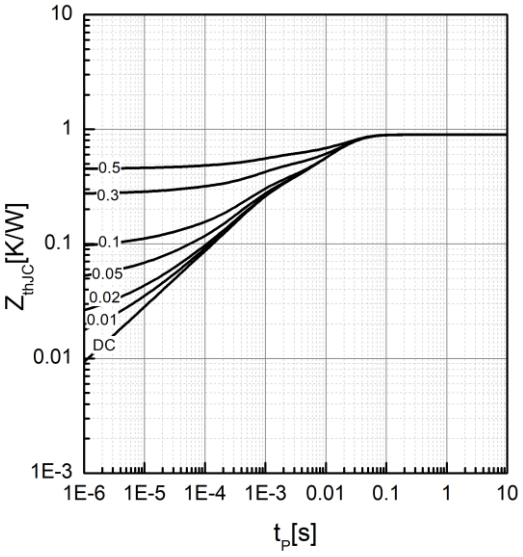



Figure 14. Effective Transient Thermal Impedance

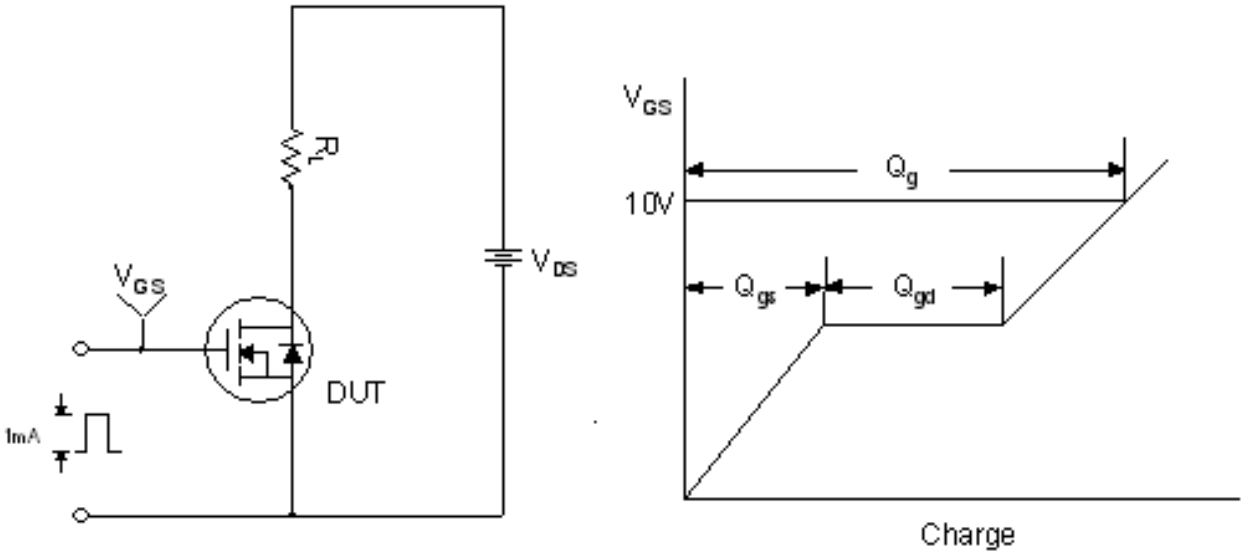



Figure 15. Gate Charge Test Circuit & Waveform

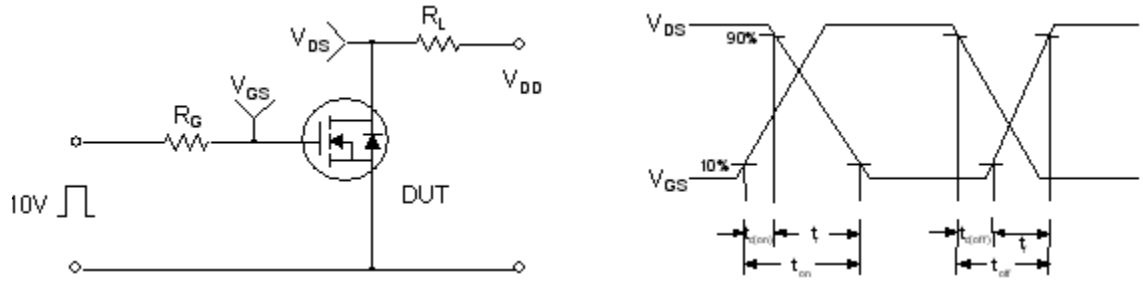


Figure 16. Resistive Switching Test Circuit & Waveforms

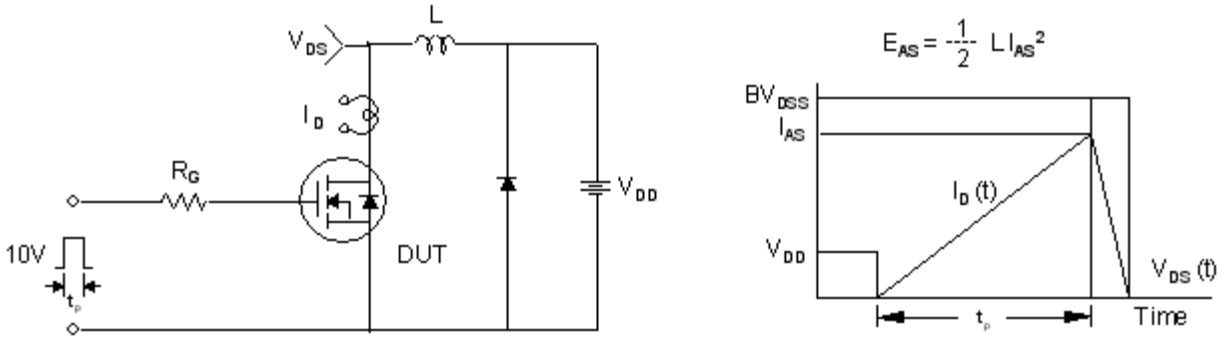



Figure 17. Unclamped Inductive Switching Test Circuit & Waveforms

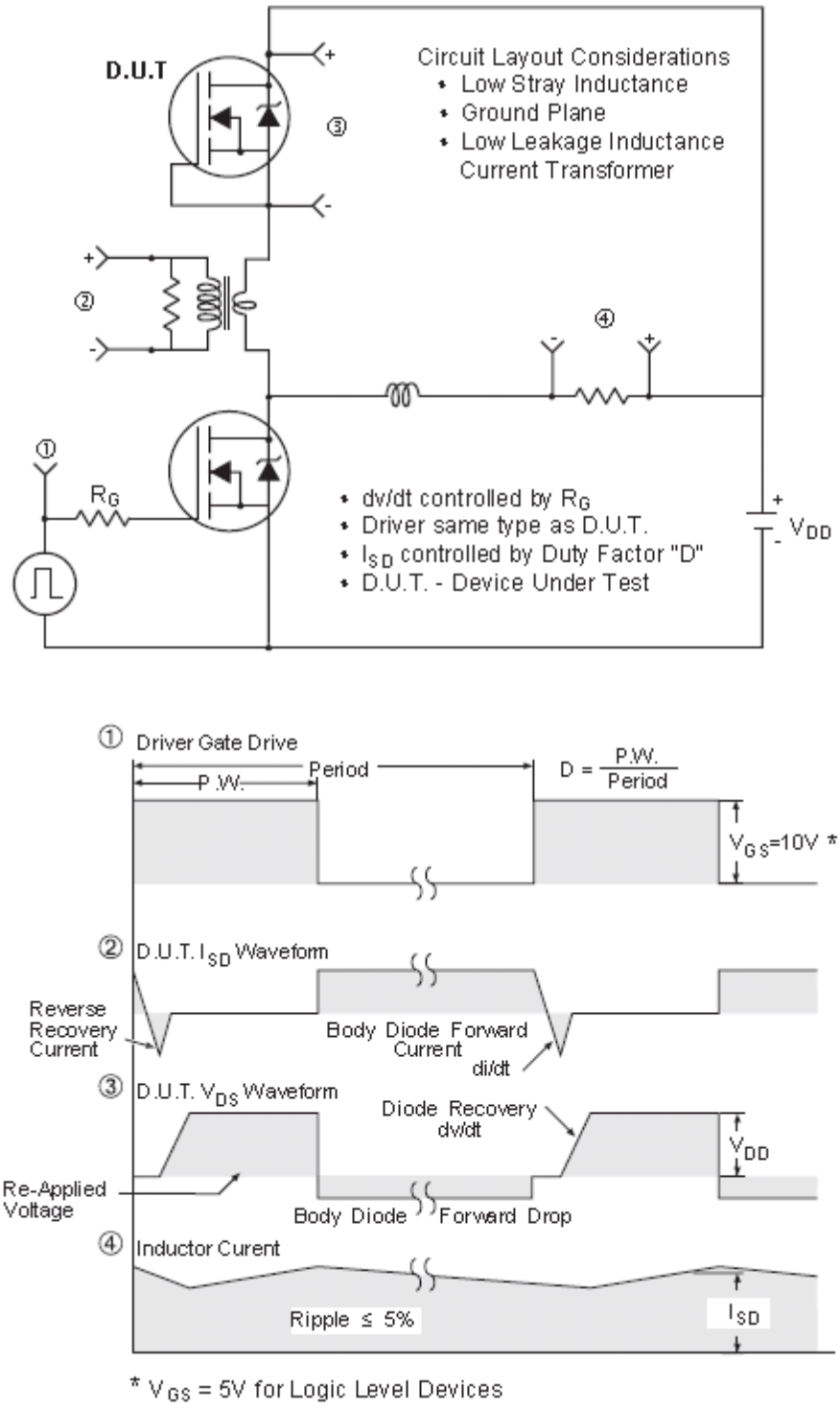
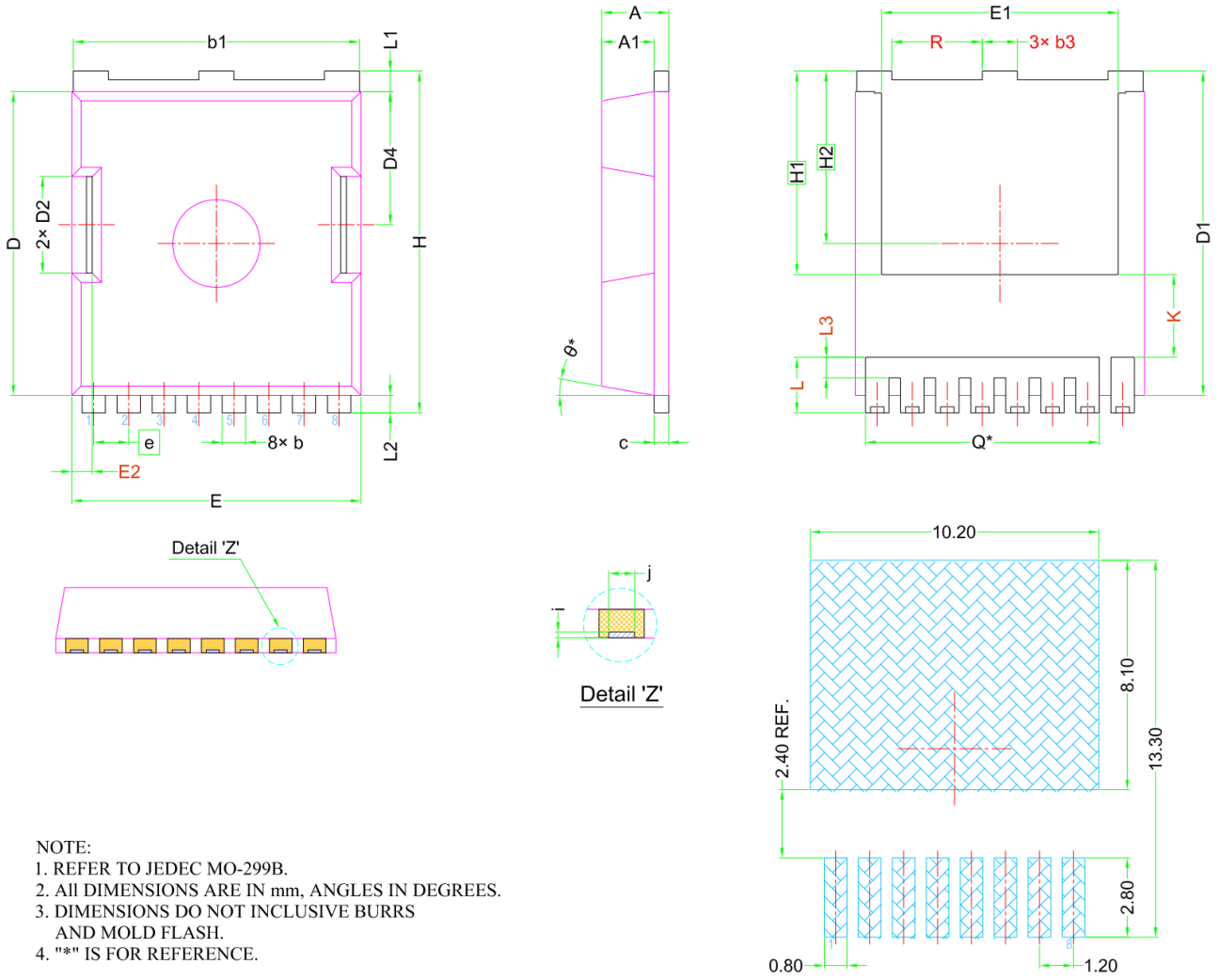



**Figure 18. Peak Diode Recovery dv/dt Test Circuit & Waveforms (For N-channel)**

## Package outline




NOTE:
1. REFER TO JEDEC MO-299B.
2. All DIMENSIONS ARE IN mm, ANGLES IN DEGREES.
3. DIMENSIONS DO NOT INCLUSIVE BURRS AND MOLD FLASH.
4. "*" IS FOR REFERENCE.

| SYMBOL | DIMENSIONS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | 2.20 | 2.30 | 2.40 |
| A1 | 1.70 | 1.80 | 1.90 |
| b | 0.70 | 0.80 | 0.90 |
| b1 | 9.70 | 9.80 | 9.90 |
| b3 | 1.10 | 1.20 | 1.30 |
| c | 0.40 | 0.50 | 0.60 |
| D | 10.28 | 10.38 | 10.48 |
| D1 | 10.98 | 11.08 | 11.18 |
| D2 | 3.20 | 3.30 | 3.40 |
| D4 | 4.45 | 4.55 | 4.65 |
| E | 9.80 | 9.90 | 1 0.00 |
| E1 | 8.00 | 8.10 | 8.20 |
| E2 | 0.60 | 0.70 | 0.80 |
| e | 1.20 BSC | | |

| SYMBOL | DIMENSIONS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| H | 11.58 | 11.68 | 11.78 |
| H1 | 6.95 BSC | | |
| H2 | 5.89 BSC | | |
| i | 0.10 REF. | | |
| j | 0.46 REF. | | |
| K | 2.80 REF. | | |
| L | 1.40 | 1.90 | 2.10 |
| L1 | 0.60 | 0.70 | 0.80 |
| L2 | 0.50 | 0.60 | 0.70 |
| L3 | 0.30 | 0.70 | 0.80 |
| N | 8 | | |
| Q | 8.00 REF. | | |
| R | 3.00 | 3.10 | 3.20 |
| θ | 10° REF. | | |

**Figure 19. TOLL Package outline**

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