JJMICROELECTRONICS

# 40V, 160A, 2.2mΩ N-channel Power SGT MOSFET

## JMSH04025K3LQ

### Features

- Ultra-low ON-resistance, $R_{DS(ON)}$
- Low Gate Charge
- 100% UIS Tested
- 100% ΔVds Tested
- Halogen-free; RoHS-compliant
- AEC-Q101 Qualified

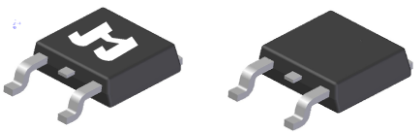
### Applications

- Load Switch
- PWM Application
- General Automotive Application

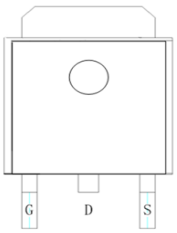
### Product Summary

| Parameters | Value | Unit |
|---|---|---|
| $V_{DSS}$ | 40 | V |
| $V_{GS(th)_Typ}$ | 2.8 | V |
| $I_D$(@$V_{GS}$=10V) | 160 | A |
| $R_{DS(ON)_Typ}$(@$V_{GS}$=10V) | 2.2 | mΩ |

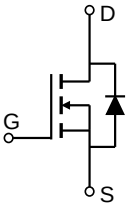
RoHS



TO-252-3L




Pin Assignment




Schematic Diagram

### Ordering Information

| Device | Marking | MSL | Form | Package | Reel(pcs) | Per Carton (pcs) |
|---|---|---|---|---|---|---|
| JMSH04025K3LQ-13 | SH040253LQ | 1 | Tape&Reel | TO-252-3L | 5000 | 50000 |

### Absolute Maximum Ratings (@ $T_C$ = 25°C unless otherwise specified)

| Symbol | Parameter | | Value | Unit |
|---|---|---|---|---|
| $V_{DS}$ | Drain-to-Source Voltage | | 40 | V |
| $V_{GS}$ | Gate-to-Source Voltage | | ±20 | V |
| $I_D$ | Continuous Drain Current | $T_C$ = 25°C | 160 | A |
| | | $T_C$ = 100°C | 113 | |
| $I_{DM}$ | Pulsed Drain Current (1) | | Refer to Fig.4 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy (2) | | 536 | mJ |
| $P_D$ | Power Dissipation | $T_C$ = 25°C | 115 | W |
| | | $T_C$ = 100°C | 58 | |
| $T_J$, $T_{STG}$ | Junction & Storage Temperature Range | | -55 to 175 | °C |

### Thermal Characteristics

| Symbol | Parameter | Max | Unit |
|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient(3) | 42 | °C/W |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | 1.3 | |


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**Electrical Characteristics** ($T_J$ = 25°C unless otherwise specified)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $V_{(BR)DSS}$ | Drain-Source Breakdown Voltage | $I_D$ = 250μA, $V_{GS}$ = 0V | 40 | - | - | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 32V, $V_{GS}$ = 0V | - | - | 1.0 | μA |
| $I_{GSS}$ | Gate-Body Leakage Current | $V_{DS}$ = 0V, $V_{GS}$ = ±20V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA | 2.0 | 2.8 | 4.0 | V |
| $R_{DS(ON)}$ | Static Drain-Source ON-Resistance(4) | $V_{GS}$ = 10V, $I_D$ = 20A | - | 2.2 | 2.5 | mΩ |
| **Dynamic Characteristics** | | | | | | |
| $R_g$ | Gate Resistance | f = 1MHz | - | 1.9 | - | Ω |
| $C_{iss}$ | Input Capacitance | $V_{GS}$ = 0V, $V_{DS}$ = 20V, f = 1MHz | - | 3690 | 5000 | pF |
| $C_{oss}$ | Output Capacitance | | - | 1022 | 1400 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 43 | 100 | pF |
| $Q_g$ | Total Gate Charge | $V_{GS}$ = 0 to 10V $V_{DS}$ = 20V, $I_D$ = 20A | - | 51 | - | nC |
| $Q_{gs}$ | Gate Source Charge | | - | 18 | - | nC |
| $Q_{gd}$ | Gate Drain("Miller") Charge | | - | 7 | - | nC |
| | | | | | | |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On DelayTime | $V_{GS}$ = 10V, $V_{DD}$ = 20V $I_D$= 20A, $R_{GEN}$ = 3Ω | - | 16 | - | ns |
| $t_r$ | Turn-On Rise Time | | - | 32 | - | ns |
| $t_{d(off)}$ | Turn-Off DelayTime | | - | 36 | - | ns |
| $t_f$ | Turn-Off Fall Time | | - | 11 | - | ns |
| **Body Diode Characteristics** | | | | | | |
| $I_S$ | Maximum Continuous Body Diode Forward Current | | - | - | 160 | A |
| $I_{SM}$ | Maximum Pulsed Body Diode Forward Current | | - | - | 640 | A |
| $V_{SD}$ | Body Diode Forward Voltage | $V_{GS}$ = 0V, $I_S$ = 20A | - | | 1.2 | V |
| trr | Body Diode Reverse Recovery Time | $I_F$ = 20A, di/dt = 100A/us | 21 | 42 | 62 | ns |
| Qrr | Body Diode Reverse Recovery Charge | | - | 43 | - | nC |

Notes:

1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
2. $E_{AS}$ condition: Starting $T_J$=25C, $V_{DD}$=20V, $V_{GS}$=10V, $R_G$=25ohm, L=3mH, $I_{AS}$=18.9A, $V_{DD}$=0V during time in avalanche.
3. $R_{\theta JA}$ is measured with the device mounted on a 1inch$^2$ pad of 2oz copper FR4 PCB.
4. Pulse Test: Pulse Width≤300μs, Duty Cycle≤0.5%.


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## Typical Performance Characteristics

Figure 1: Power De-rating

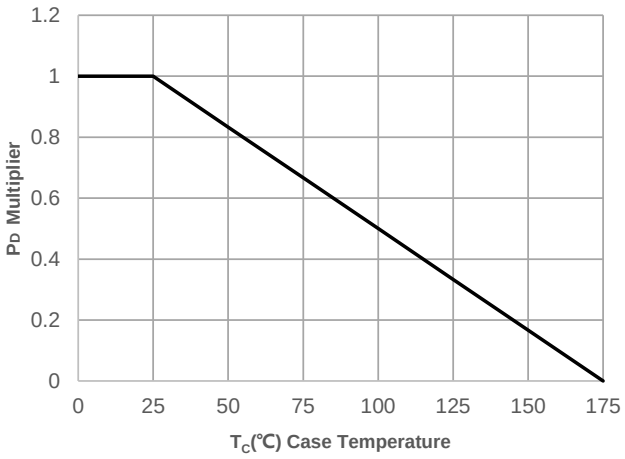



Figure 2: Current De-rating

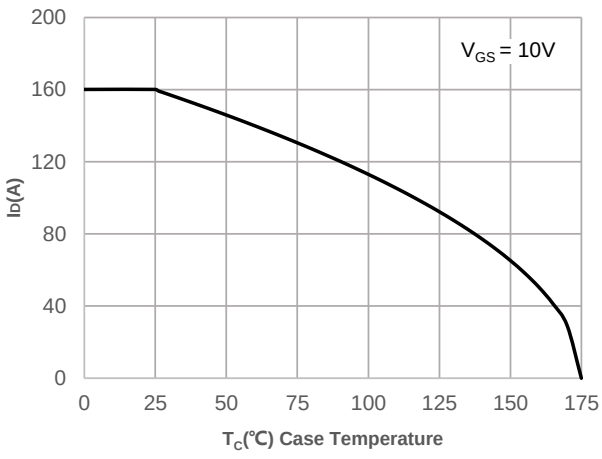



Figure 3: Normalized Maximum Transient Thermal Impedance

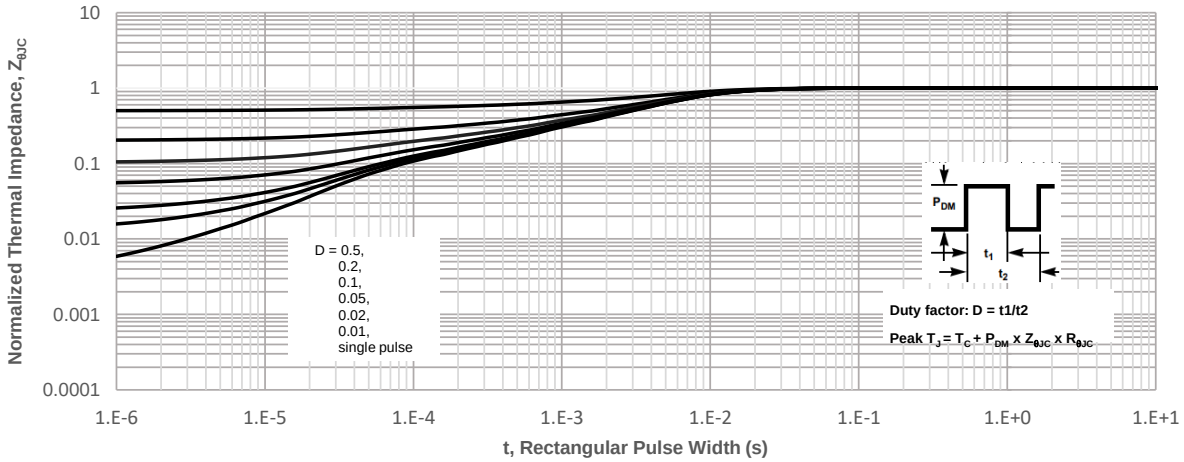
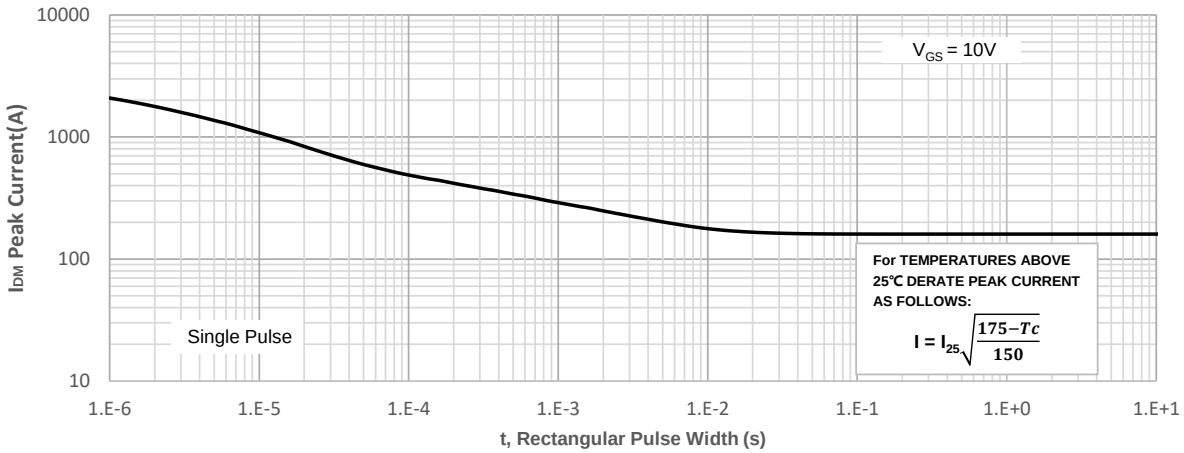



Figure 4: Peak Current Capacity





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## Typical Performance Characteristics

Figure 5: Output Characteristics

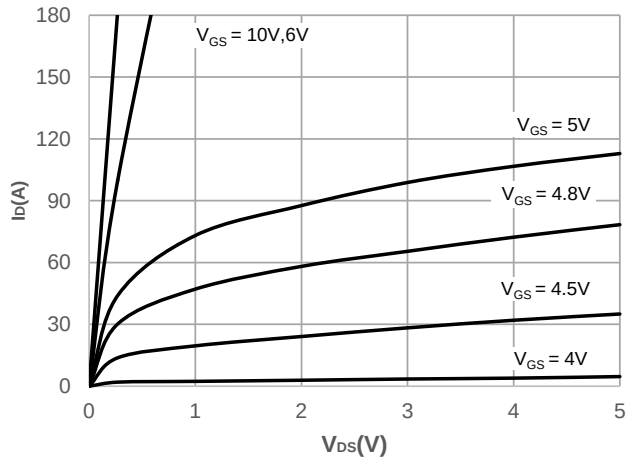



Figure 6: Typical Transfer Characteristics

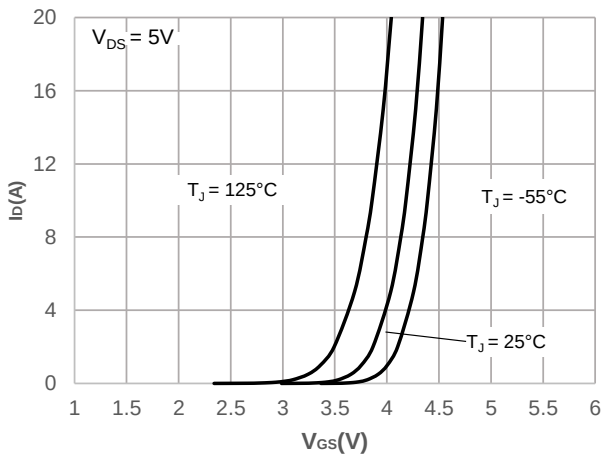



Figure 7: On-resistance vs. Drain Current

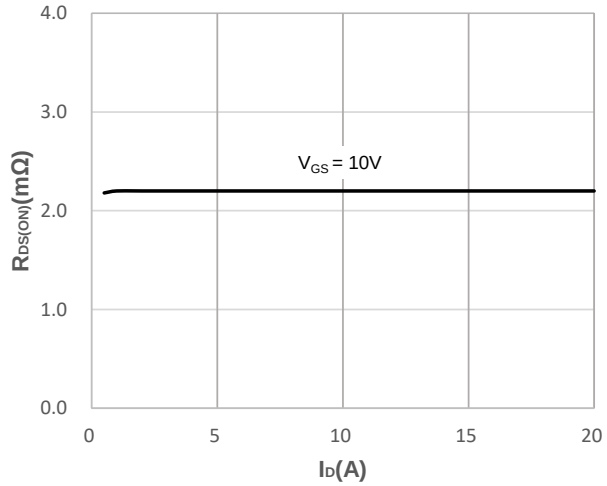



Figure 8: Body Diode Characteristics

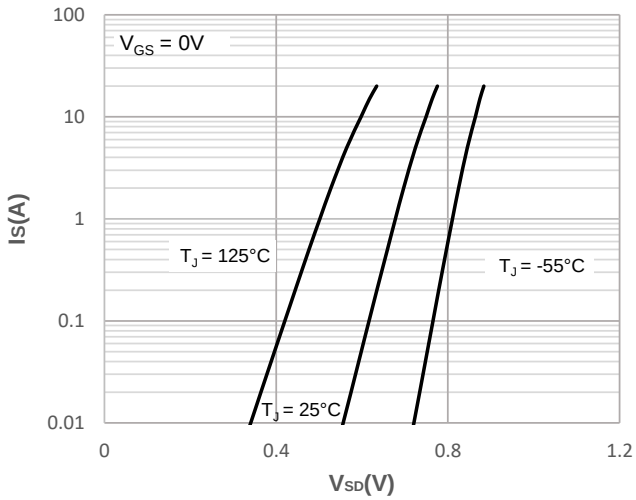



Figure 9: Gate Charge Characteristics

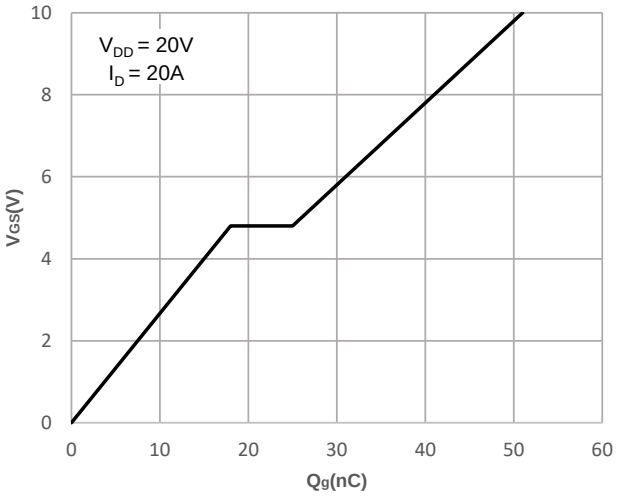
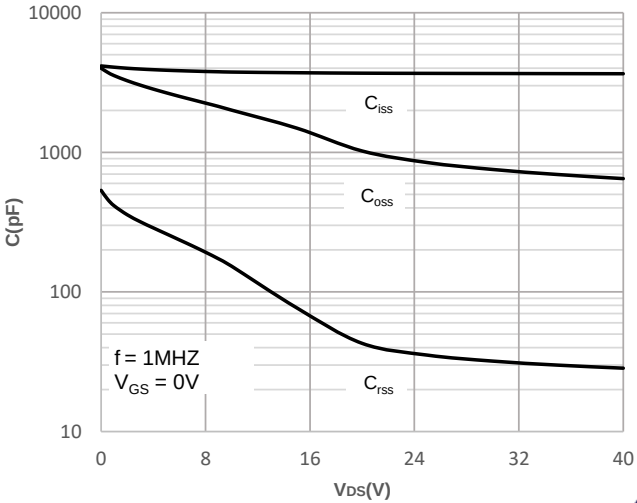



Figure 10: Capacitance Characteristics





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# Typical Performance Characteristics

Figure 11: Normalized Breakdown Voltage vs. Junction Temperature

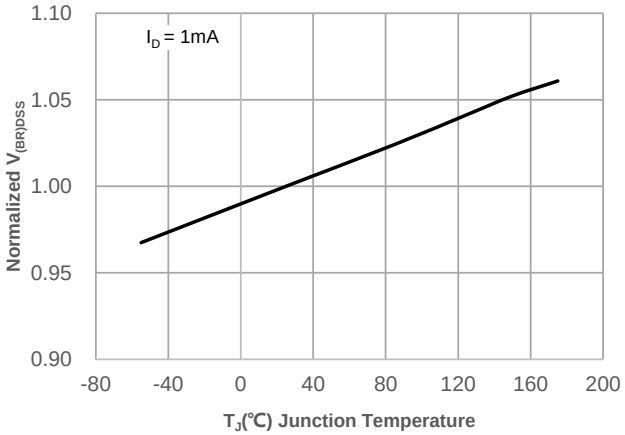



Figure 12: Normalized on Resistance vs. Junction Temperature

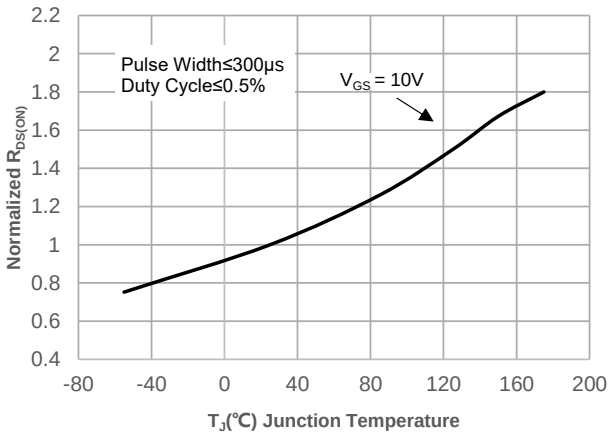



Figure 13: Normalized Threshold Voltage vs. Junction Temperature

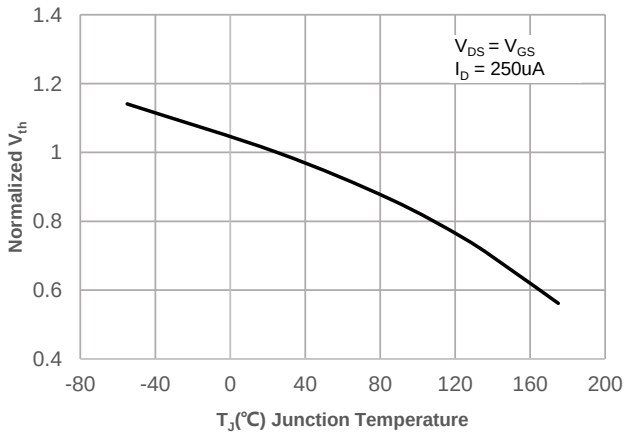



Figure 14: $R_{DS(ON)}$ vs. $V_{GS}$

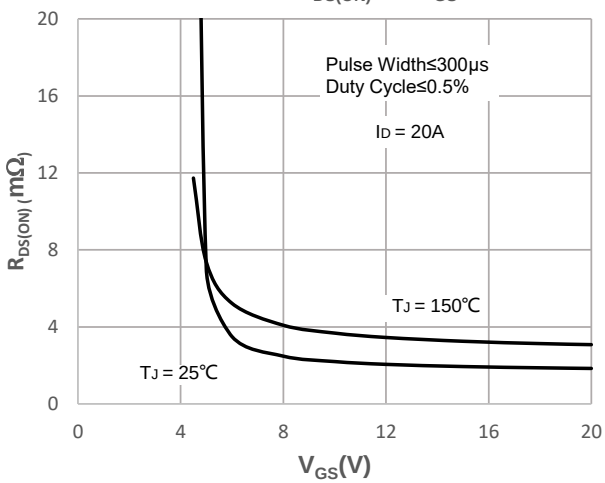
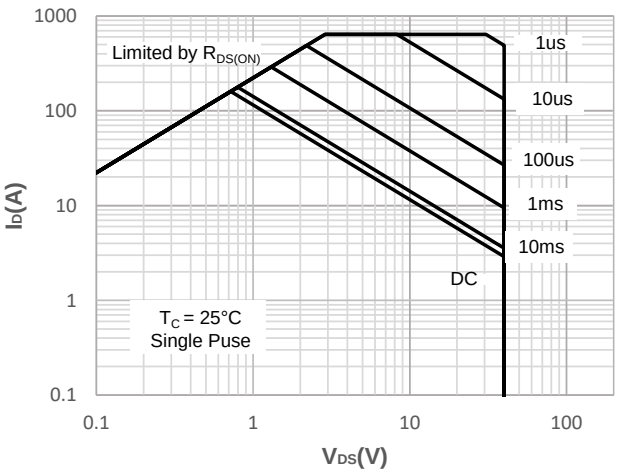



Figure 15: Maximum Safe Operating Area





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## Test Circuit

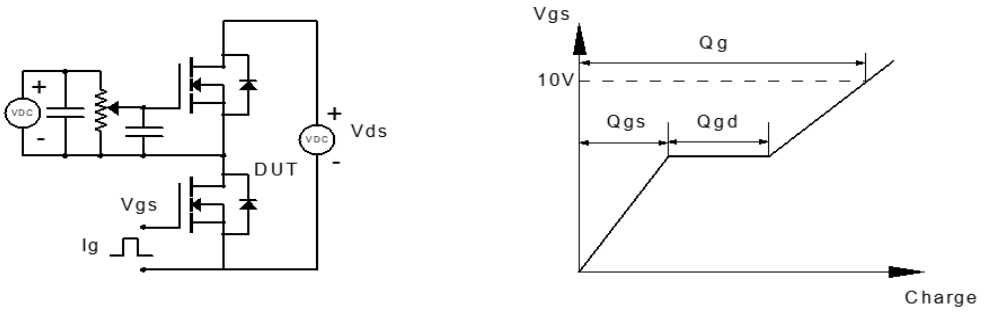



**Figure 1: Gate Charge Test Circuit & Waveform**

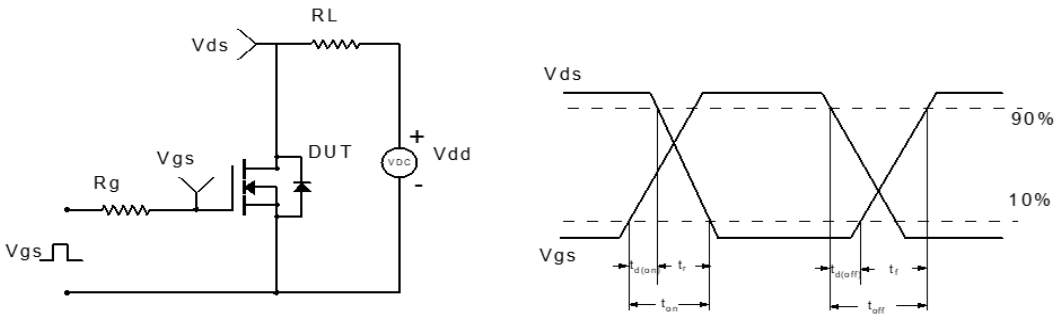



**Figure 2: Resistive Switching Test Circuit & Waveform**

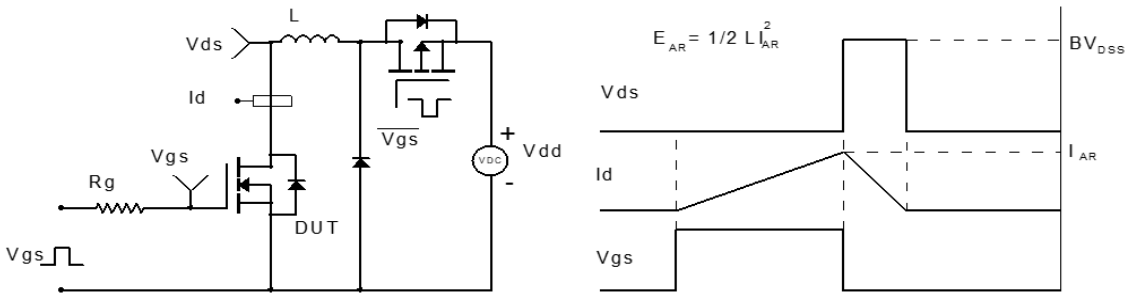



**Figure 3: Unclamped Inductive Switching Test Circuit& Waveform**

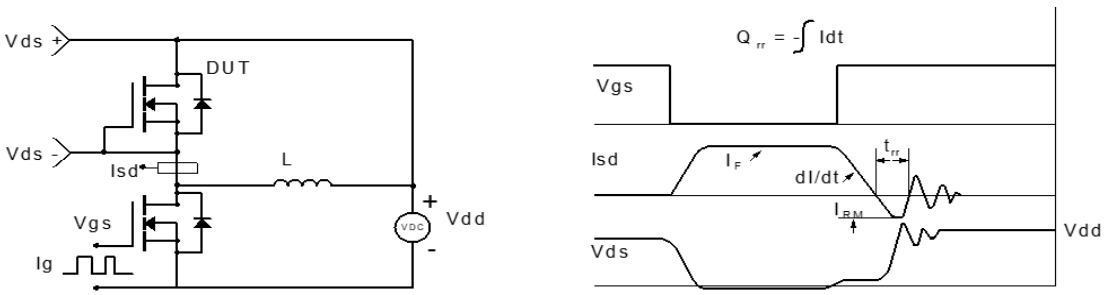
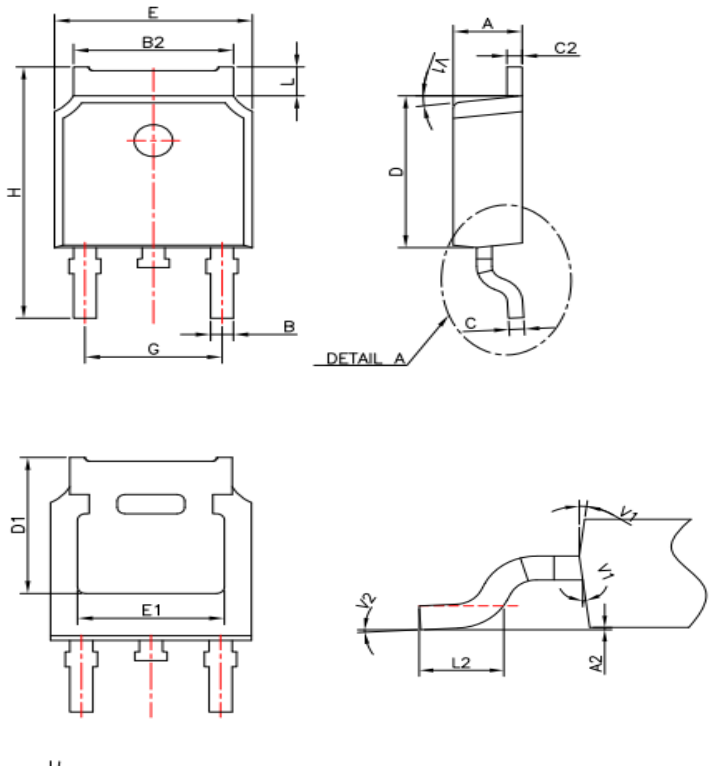



**Figure 4: Diode Recovery Test Circuit & Waveform**


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## Package Mechanical Data(TO-252-3L)




| Ref. | Dimensions | | | | | |
|---|---|---|---|---|---|---|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 2.10 | 2.30 | 2.50 | 0.083 | 0.091 | 0.098 |
| A2 | 0 | --- | 0.15 | 0 | --- | 0.006 |
| B | 0.66 | 0.76 | 0.86 | 0.026 | 0.030 | 0.034 |
| B2 | 5.18 | 5.33 | 5.48 | 0.202 | 0.210 | 0.216 |
| C | 0.40 | 0.508 | 0.60 | 0.016 | 0.020 | 0.024 |
| C2 | 0.44 | 0.508 | 0.58 | 0.017 | 0.020 | 0.023 |
| D | 5.90 | 6.10 | 6.30 | 0.232 | 0.240 | 0.248 |
| D1 | 5.30REF | | | 0.209REF | | |
| E | 6.40 | 6.60 | 6.80 | 0.252 | 0.260 | 0.268 |
| E1 | 4.826 REF | | | 0.19 REF | | |
| G | 4.47 | 4.57 | 4.67 | 0.176 | 0.180 | 0.184 |
| H | 9.50 | 10.10 | 10.70 | 0.374 | 0.398 | 0.421 |
| L | 0.95 | 1.16 | 1.30 | 0.037 | 0.046 | 0.051 |
| L2 | 1.35 | 1.50 | 1.65 | 0.053 | 0.059 | 0.065 |
| V1 | --- | 7° | --- | --- | 7° | --- |
| V2 | 0° | --- | 6° | 0° | --- | 6° |

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