JJMICROELECTRONICS

# 40V, 223A, 1.4mΩ N-channel Power SGT MOSFET

## JMSH0401MGQ

### Features

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

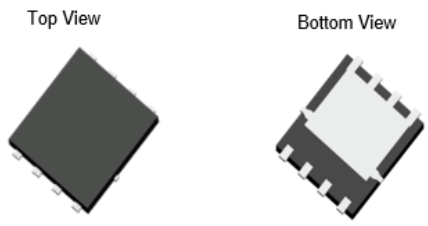
### Applications

- Load Switch
- PWM Application
- General Automtoive Application

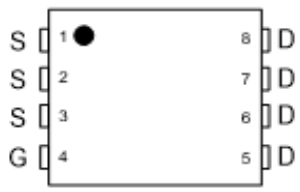
### Product Summary

| Parameters | Value | Unit |
|---|---|---|
| $V_{DSS}$ | 40 | V |
| $V_{GS(th)\_Typ}$ | 2.7 | V |
| $I_D$(@$V_{GS}$=10V) | 223 | A |
| $R_{DS(ON)\_Typ}$(@$V_{GS}$=10V | 1.4 | mΩ |

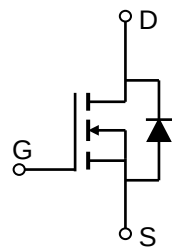
RoHS




PDFN5X6-8L




Pin Assignment




Schematic Diagram

### Ordering Information

| Device | Marking | MSL | Form | Package | Reel(pcs) | Per Carton (pcs) |
|---|---|---|---|---|---|---|
| JMSH0401MGQ-13 | SH0401MQ | 1 | Tape&Reel | PDFN5x6-8L | 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 | 223 | A |
| | | $T_C$ = 100°C | 158 | |
| $I_{DM}$ | Pulsed Drain Current (1) | | Refer to Fig.4 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy (2) | | 459 | mJ |
| $P_D$ | Power Dissipation | $T_C$ = 25°C | 157 | W |
| | | $T_C$ = 100°C | 78 | |
| $T_J$, $T_{STG}$ | 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 | 1.0 | |

## 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 | 1.9 | 2.7 | 3.5 | V |
| $R_{DS(ON)}$ | Static Drain-Source ON-Resistance(4) | $V_{GS}$ = 10V, $I_D$ = 20A | - | 1.4 | 1.7 | mΩ |
| **Dynamic Characteristics** | | | | | | |
| $R_g$ | Gate Resistance | f = 1MHz | - | 0.9 | - | Ω |
| $C_{iss}$ | Input Capacitance | $V_{GS}$ = 0V, $V_{DS}$ = 20V, f = 1MHz | 2589 | 3625 | 4893 | pF |
| $C_{oss}$ | Output Capacitance | | 1413 | 1979 | 2671 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | 113 | 158 | 213 | pF |
| $Q_g$ | Total Gate Charge | $V_{GS}$ = 0 to 10V $V_{DS}$ = 20V, $I_D$ = 20A | 42 | 59 | 80 | nC |
| $Q_{gs}$ | Gate Source Charge | | 11 | 15 | 21 | nC |
| $Q_{gd}$ | Gate Drain("Miller") Charge | | 12 | 16 | 22 | 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 | | - | 29 | - | ns |
| $t_{d(off)}$ | Turn-Off DelayTime | | - | 35 | - | ns |
| $t_f$ | Turn-Off Fall Time | | - | 13 | - | ns |
| **Body Diode Characteristics** | | | | | | |
| $I_S$ | Maximum Continuous Body Diode Forward Current | | - | - | 223 | A |
| $I_{SM}$ | Maximum Pulsed Body Diode Forward Current | | - | - | 891 | 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 | 37 | 52 | 70 | ns |
| Qrr | Body Diode Reverse Recovery Charge | | - | 66 | - | 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, $I_{AS}$=17.5A, $V_{DD}$=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%.

# Typical Performance Characteristics

Figure 1: Power De-rating

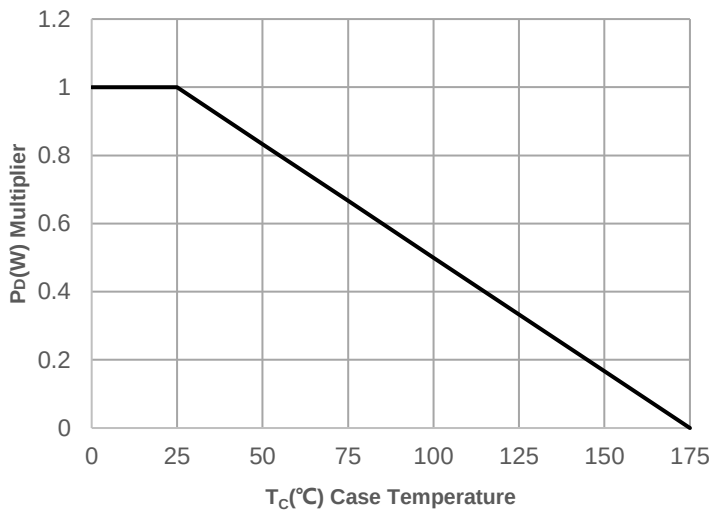



Figure 2: Current De-rating

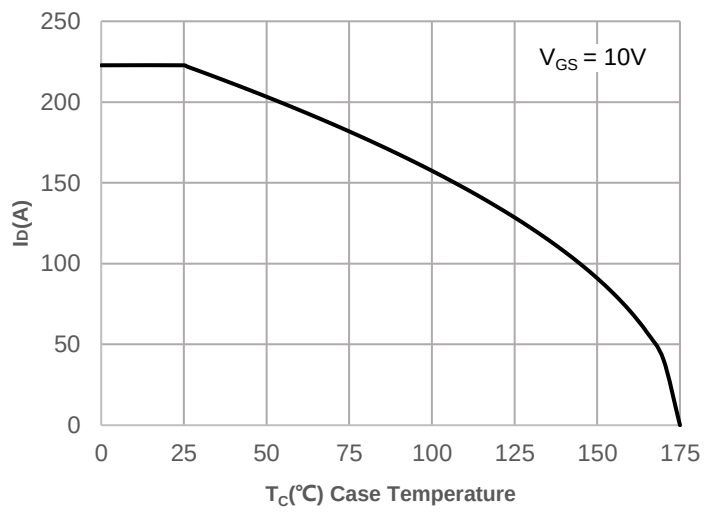



Figure 3: Normalized Maximum Transient Thermal Impedance

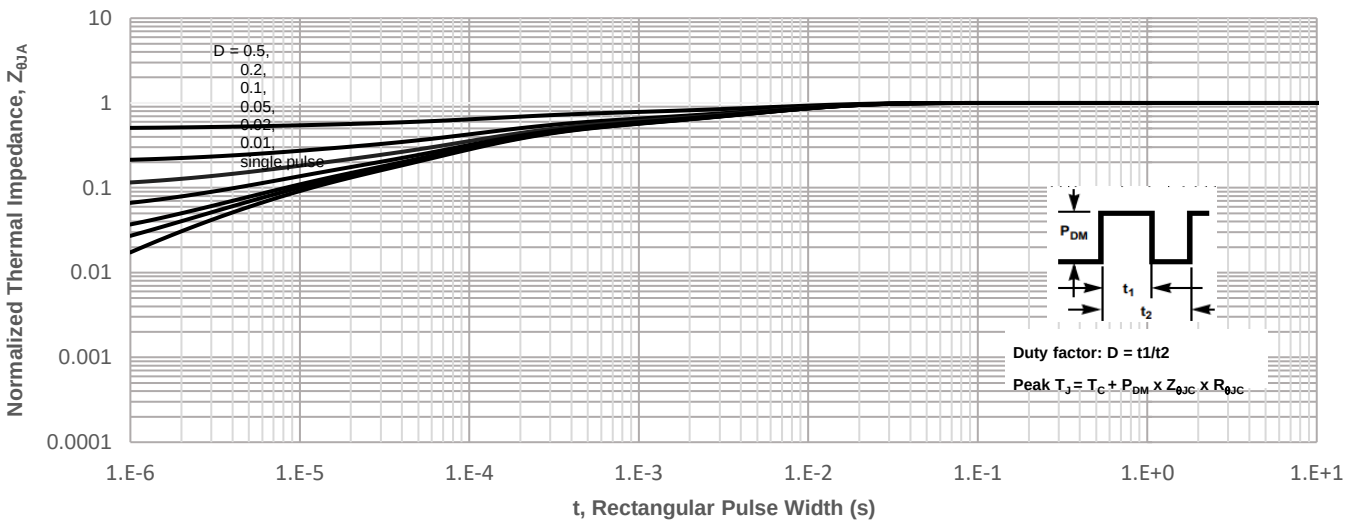
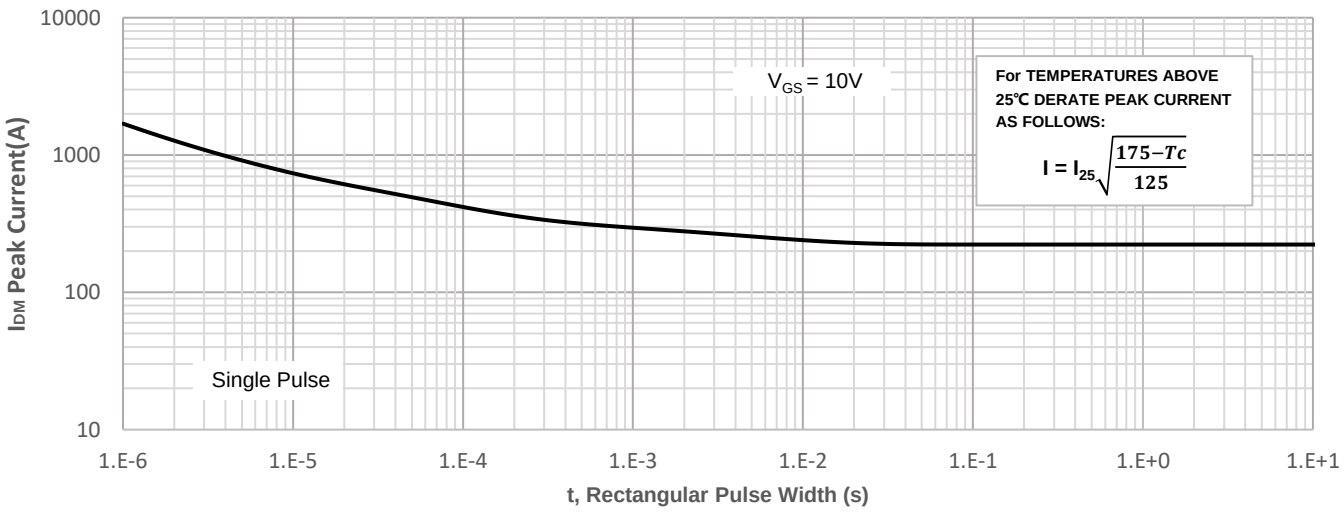



Figure 4: Peak Current Capacity



# Typical Performance Characteristics

Figure 5: Output Characteristics

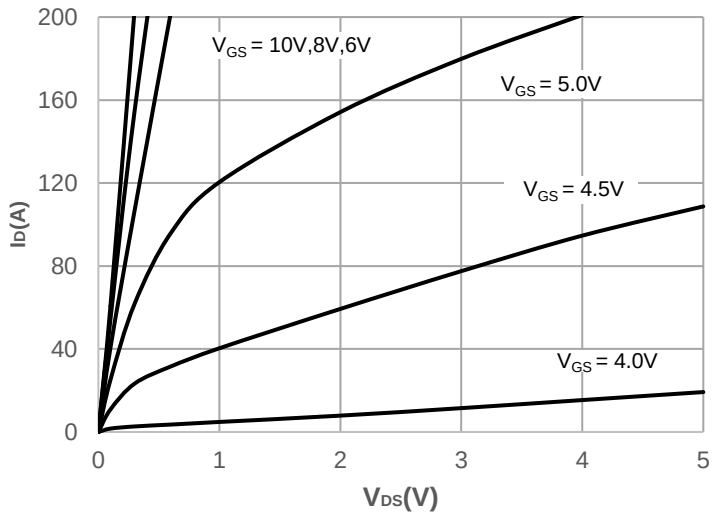



Figure 6: Typical Transfer Characteristics

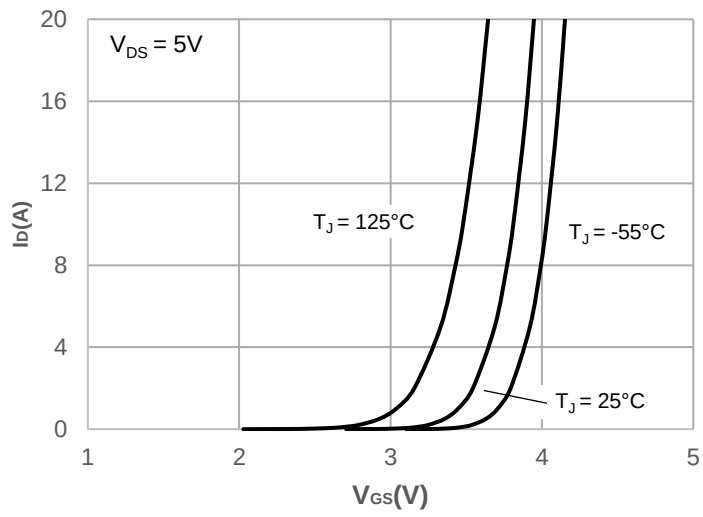



Figure 7: On-resistance vs. Drain Current

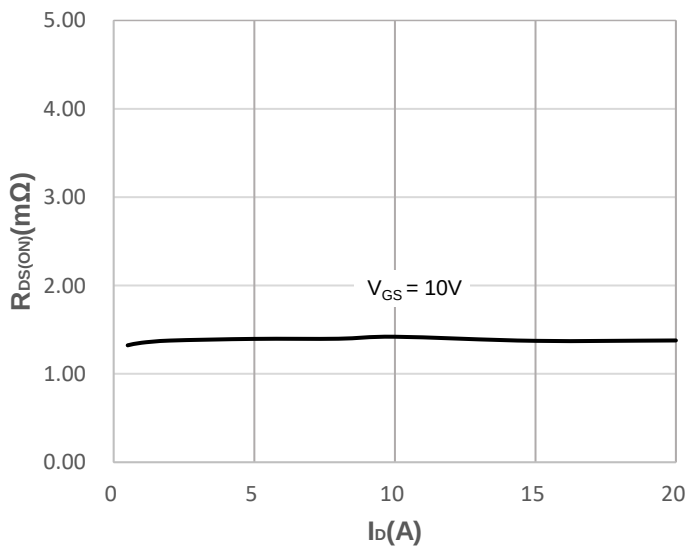



Figure 8: Body Diode Characteristics

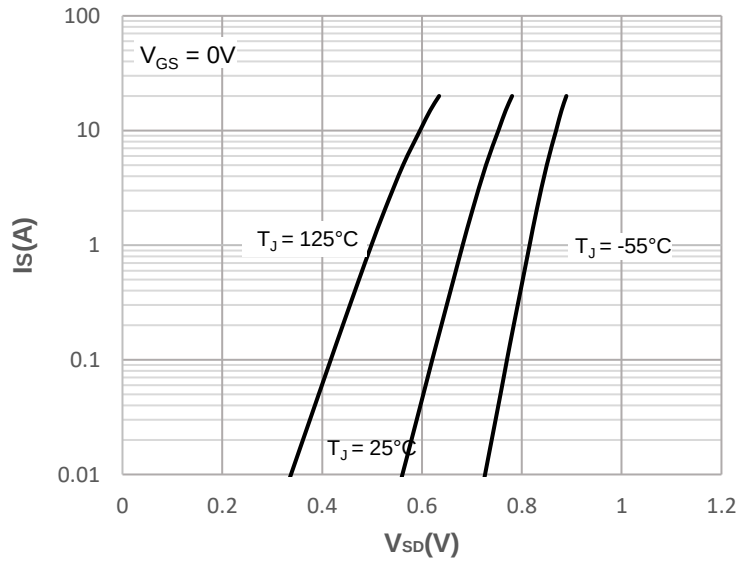



Figure 9: Gate Charge Characteristics

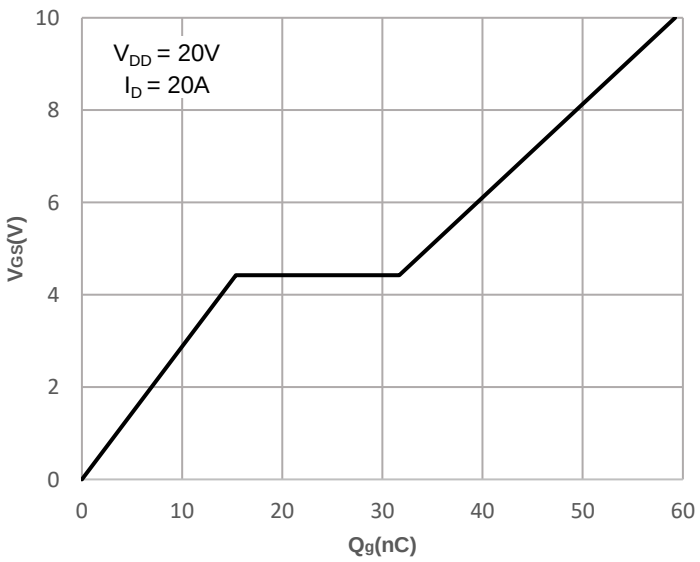
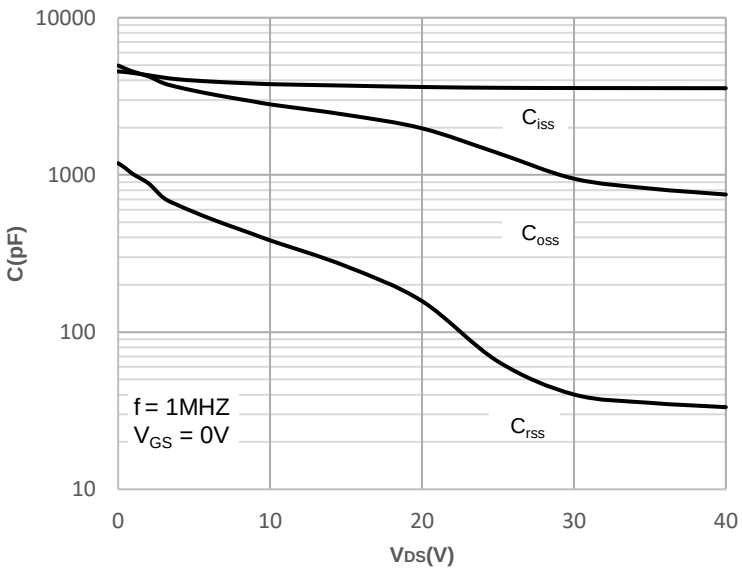



Figure 10: Capacitance Characteristics



# Typical Performance Characteristics

Figure 11: Normalized Breakdown voltage vs. Junction Temperature

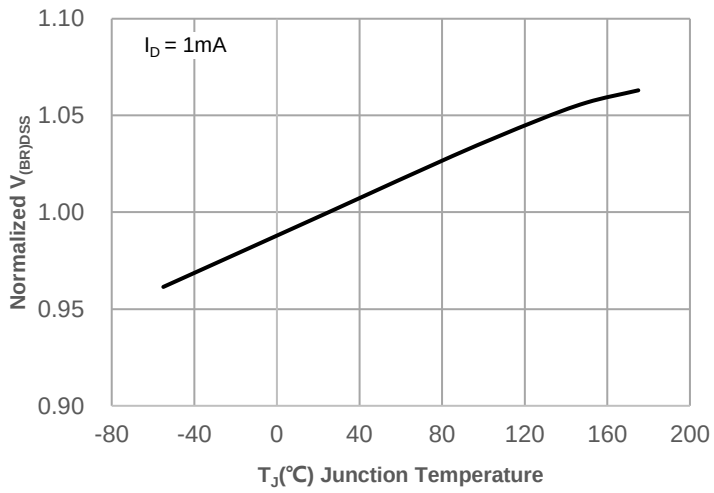



Figure 12: Normalized on Resistance vs. Junction Temperature

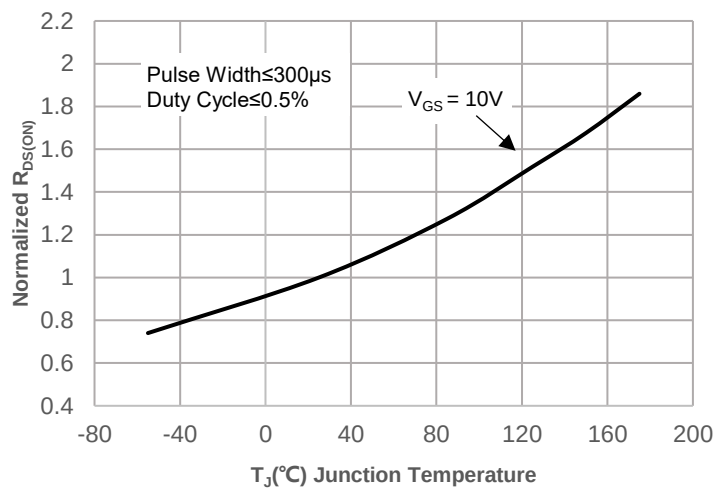



Figure 13: Normalized Threshold Voltage vs. Junction Temperature

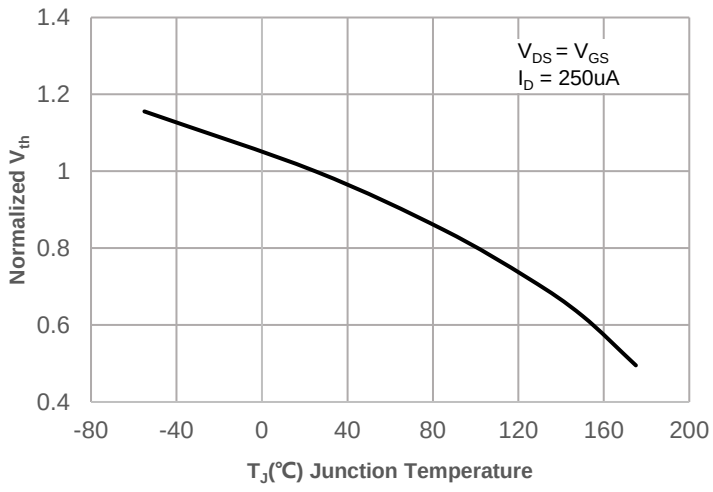



Figure 14: $R_{DS(ON)}$ vs. $V_{GS}$

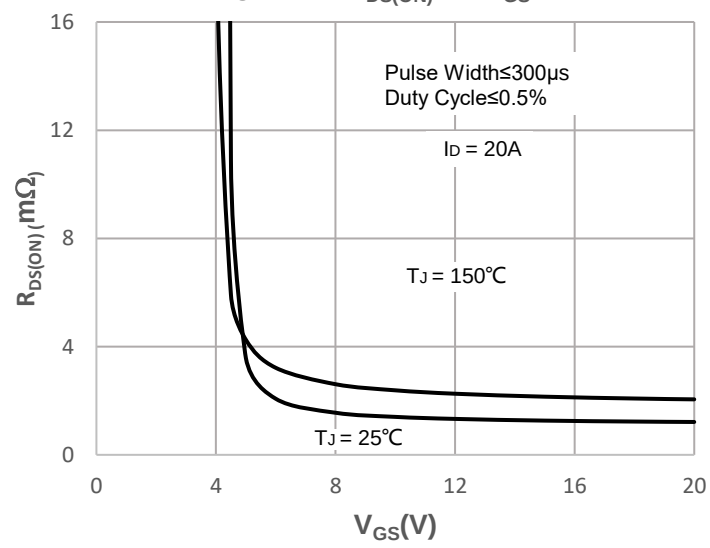
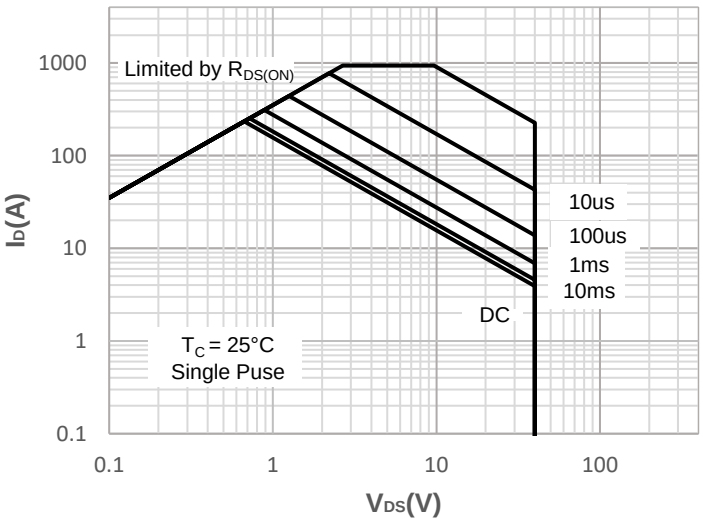



Figure 15: Maximum Safe Operating Area



## Test Circuit

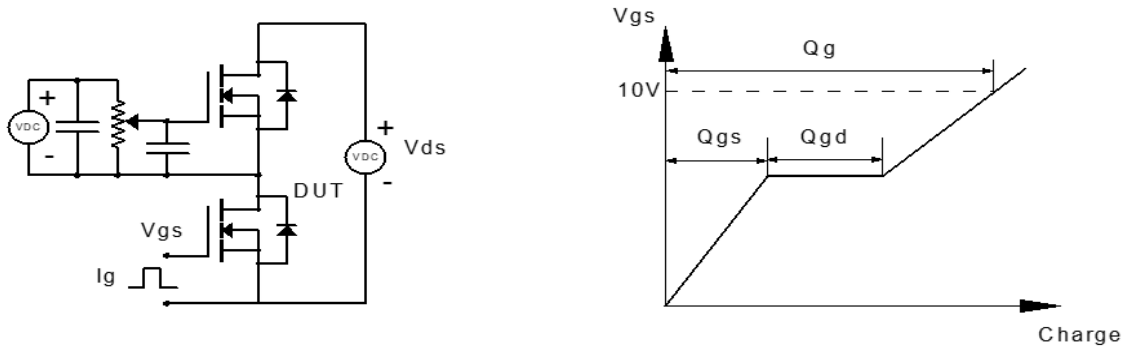



**Figure 1: Gate Charge Test Circuit & Waveform**

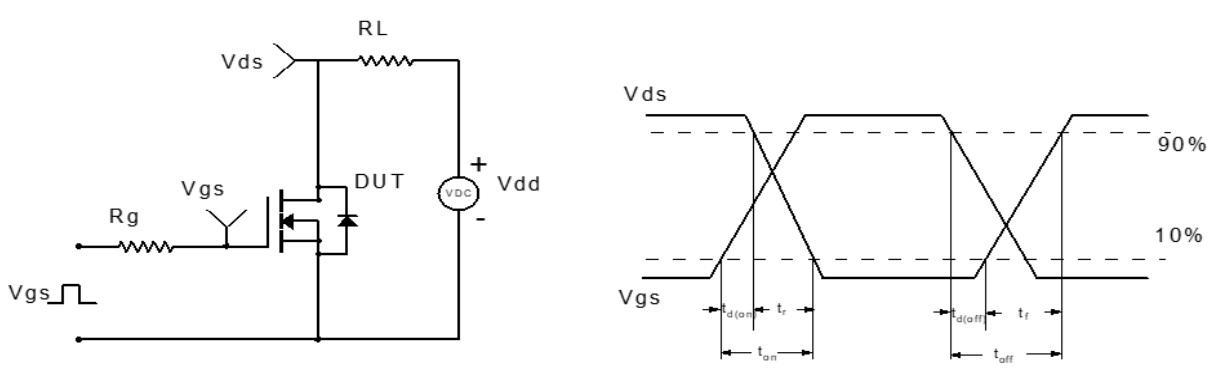



**Figure 2: Resistive Switching Test Circuit & Waveform**

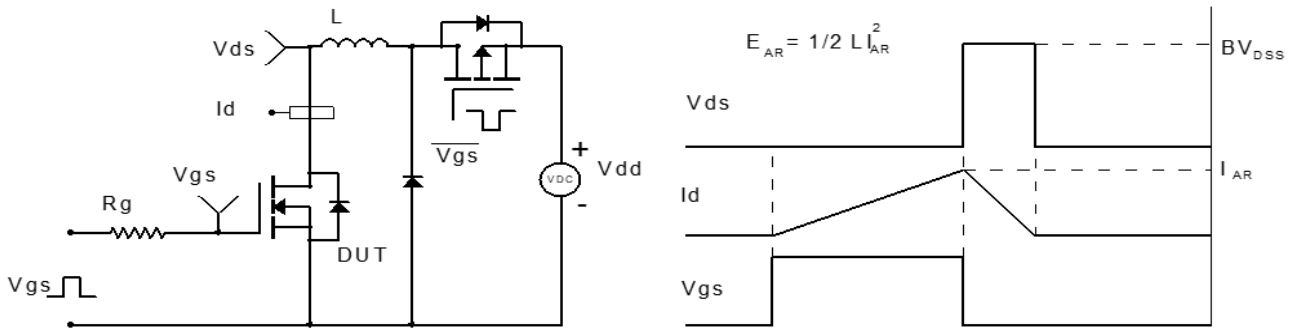



**Figure 3: Unclamped Inductive Switching Test Circuit& Waveform**

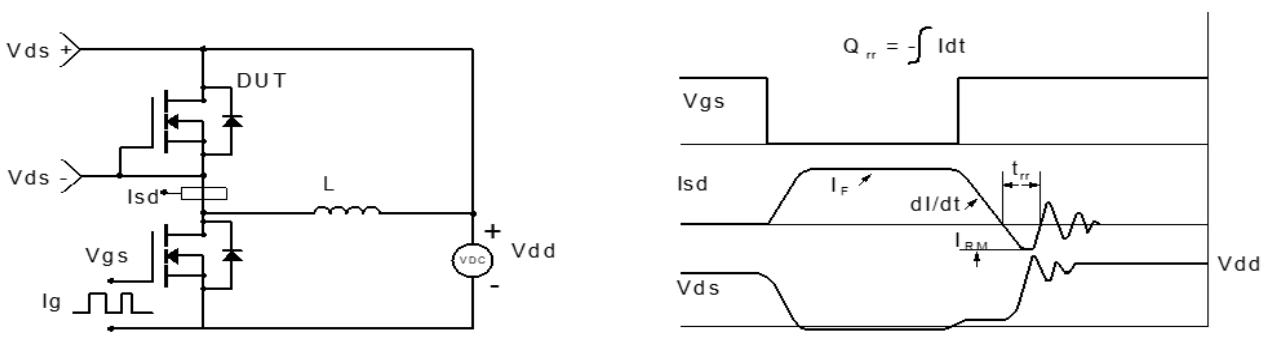
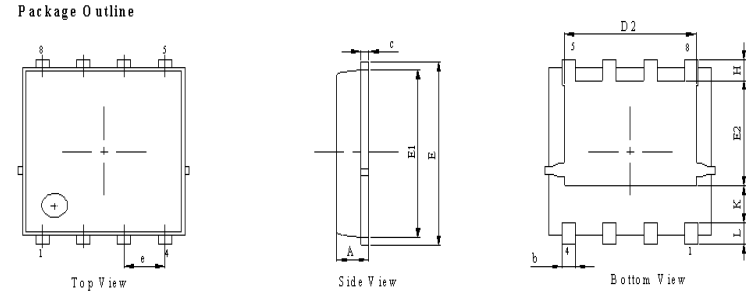



**Figure 4: Diode Recovery Test Circuit & Waveform**

# Package Mechanical Data(PDFN5X6-8L)

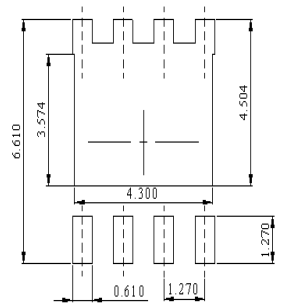
Package Outline




NOTES:
1. Dimension and tolerance per ASME Y14.5M, 1994.
2. All dimensions in millimeter (angle in degree).
3. Dimensions D1 and E1 do not include mold flash protrusions or gate burrs.

| DIM. | MILLIMETER | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | 0.9 | 1 | 1.15 |
| b | 0.31 | 0.41 | 0.51 |
| C | 0.24 | 0.32 | 0.4 |
| D | 5 | 5.2 | 5.4 |
| D1 | 4.95 | 5.05 | 5.15 |
| D2 | 4 | 4.1 | 4.2 |
| E | 6.05 | 6.15 | 6.25 |
| E1 | 5.5 | 5.6 | 5.7 |
| E2 | 3.42 | 3.53 | 3.63 |
| e | 1.27BSC | | |
| H | 0.6 | 0.7 | 0.8 |
| L | 0.5 | 0.7 | 0.8 |
| K | 1.23 REF | | |
| θ | | | 10 |

Recommended Soldering Footprint




DIMENSIONS:MILLIMETERS