

**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%  $\Delta V_{ds}$  Tested
- Halogen-free; RoHS-compliant
- AEC-Q101 Qualified

**Applications**

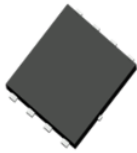
- Load Switch
- PWM Application
- General Automotive Application

**Product Summary**

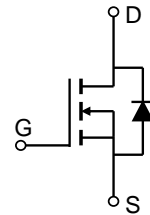
| Parameters                     | Value | Unit |
|--------------------------------|-------|------|
| $V_{DSS}$                      | 40    | V    |
| $V_{GS(th\_Typ)}$              | 2.7   | V    |
| $I_D(@V_{GS}=10V)$             | 223   | A    |
| $R_{DS(ON\_Typ)}(@V_{GS}=10V)$ | 1.4   | mΩ   |



Top View


**PDFN5X6-8L**

Bottom View


**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** (@  $T_C = 25^\circ\text{C}$  unless otherwise specified)

| Symbol         | Parameter                                     | Value                     | Unit             |
|----------------|---|---------------------------|------------------|
| $V_{DS}$       | Drain-to-Source Voltage                       | 40                        | V                |
| $V_{GS}$       | Gate-to-Source Voltage                        | $\pm 20$                  | V                |
| $I_D$          | Continuous Drain Current                      | $T_C = 25^\circ\text{C}$  | 223              |
|                |   | $T_C = 100^\circ\text{C}$ | 158              |
| $I_{DM}$       | Pulsed Drain Current <sup>(1)</sup>           | Refer to Fig.4            | A                |
| $E_{AS}$       | Single Pulsed Avalanche Energy <sup>(2)</sup> | 459                       | mJ               |
| $P_D$          | Power Dissipation                             | $T_C = 25^\circ\text{C}$  | 157              |
|                |   | $T_C = 100^\circ\text{C}$ | 78               |
| $T_J, T_{STG}$ | Junction & Storage Temperature Range          | -55 to 175                | $^\circ\text{C}$ |

**Thermal Characteristics**

| Symbol          | Parameter  | Max | Unit                      |
|-----------------|--|-----|---------------------------|
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient <sup>(3)</sup> | 42  | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case                   | 1.0 |                           |

**Electrical Characteristics** ( $T_J = 25^\circ\text{C}$  unless otherwise specified)

| Symbol                            | Parameter  | Conditions  | Min. | Typ. | Max.      | Unit          |
|-----------------------------------|--|---|------|------|-----------|---------------|
| <b>Off Characteristics</b>        |  |   |      |      |           |               |
| $V_{(BR)DSS}$                     | Drain-Source Breakdown Voltage                   | $I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$  | 40   | -    | -         | V             |
| $I_{DSS}$                         | Zero Gate Voltage Drain Current                  | $V_{DS} = 32\text{V}, V_{GS} = 0\text{V}$   | -    | -    | 1.0       | $\mu\text{A}$ |
| $I_{GSS}$                         | Gate-Body Leakage Current                        | $V_{DS} = 0\text{V}, V_{GS} = \pm 20\text{V}$                                       | -    | -    | $\pm 100$ | nA            |
| <b>On Characteristics</b>         |  |   |      |      |           |               |
| $V_{GS(th)}$                      | Gate Threshold Voltage                           | $V_{DS} = V_{GS}, I_D = 250\mu\text{A}$   | 1.9  | 2.7  | 3.5       | V             |
| $R_{DS(ON)}$                      | Static Drain-Source ON-Resistance <sup>(4)</sup> | $V_{GS} = 10\text{V}, I_D = 20\text{A}$   | -    | 1.4  | 1.7       | m $\Omega$    |
| <b>Dynamic Characteristics</b>    |  |   |      |      |           |               |
| $R_g$                             | Gate Resistance                                  | $f = 1\text{MHz}$   | -    | 0.9  | -         | $\Omega$      |
| $C_{iss}$                         | Input Capacitance                                | $V_{GS} = 0\text{V}, V_{DS} = 20\text{V}, f = 1\text{MHz}$                          | 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                                | $V_{GS} = 0 \text{ to } 10\text{V}$<br>$V_{DS} = 20\text{V}, I_D = 20\text{A}$      | 42   | 59   | 80        | nC            |
| $Q_{gs}$                          | Gate Source Charge                               |   | 11   | 15   | 21        | nC            |
| $Q_{gd}$                          | Gate Drain ("Miller") Charge                     |   | 12   | 16   | 22        | nC            |
| <b>Switching Characteristics</b>  |  |   |      |      |           |               |
| $t_{d(on)}$                       | Turn-On Delay Time                               | $V_{GS} = 10\text{V}, V_{DD} = 20\text{V}$<br>$I_D = 20\text{A}, R_{GEN} = 3\Omega$ | -    | 16   | -         | ns            |
| $t_r$                             | Turn-On Rise Time                                |   | -    | 29   | -         | ns            |
| $t_{d(off)}$                      | Turn-Off Delay Time                              |   | -    | 35   | -         | ns            |
| $t_f$                             | Turn-Off Fall Time                               |   | -    | 13   | -         | ns            |
| <b>Body Diode Characteristics</b> |  |   |      |      |           |               |
| $I_S$                             | Maximum Continuous Body Diode Forward Current    |   | -    | -    | 223       | A             |
| $I_{SM}$                          | Maximum Pulsed Body Diode Forward Current        |   | -    | -    | 891       | A             |
| $V_{SD}$                          | Body Diode Forward Voltage                       | $V_{GS} = 0\text{V}, I_S = 20\text{A}$  | -    | -    | 1.2       | V             |
| $t_{rr}$                          | Body Diode Reverse Recovery Time                 | $I_F = 20\text{A}, di/dt = 100\text{A}/\mu\text{s}$                                 | 37   | 52   | 70        | ns            |
| $Q_{rr}$                          | Body Diode Reverse Recovery Charge               |   | -    | 66   | -         | nC            |

- Notes:
1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
  2.  $E_{AS}$  condition: Starting  $T_J = 25^\circ\text{C}$ ,  $V_{DD} = 20\text{V}$ ,  $V_{GS} = 10\text{V}$ ,  $R_G = 25\text{ohm}$ ,  $L = 3\text{mH}$ ,  $I_{AS} = 17.5\text{A}$ ,  $V_{DD} = 0\text{V}$  during time in avalanche.
  3.  $R_{\theta JA}$  is measured with the device mounted on a 1inch<sup>2</sup> pad of 2oz copper FR4 PCB.
  4. Pulse Test: Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 0.5\%$ .

## Typical Performance Characteristics

Figure 1: Power De-rating

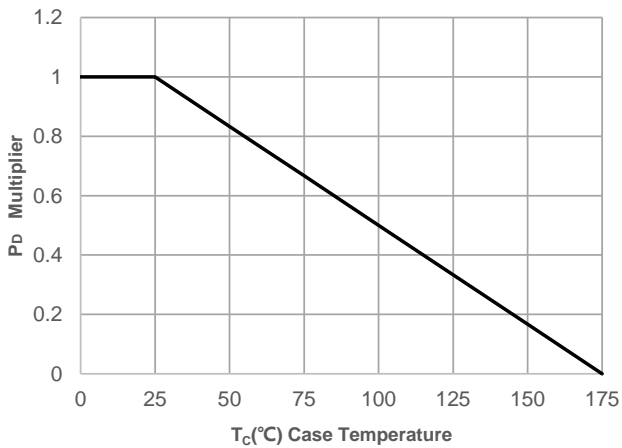


Figure 2: Current De-rating

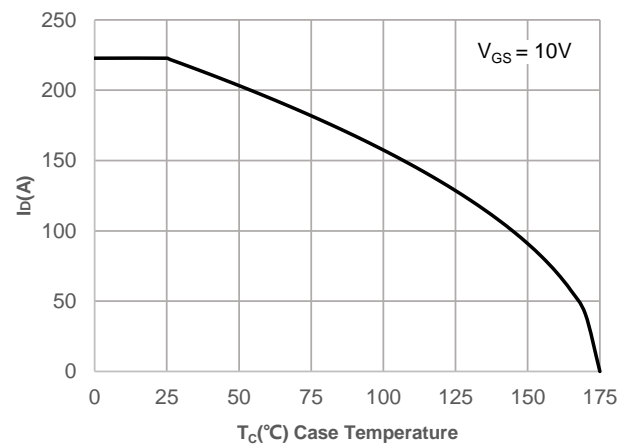


Figure 3: Normalized Maximum Transient Thermal Impedance

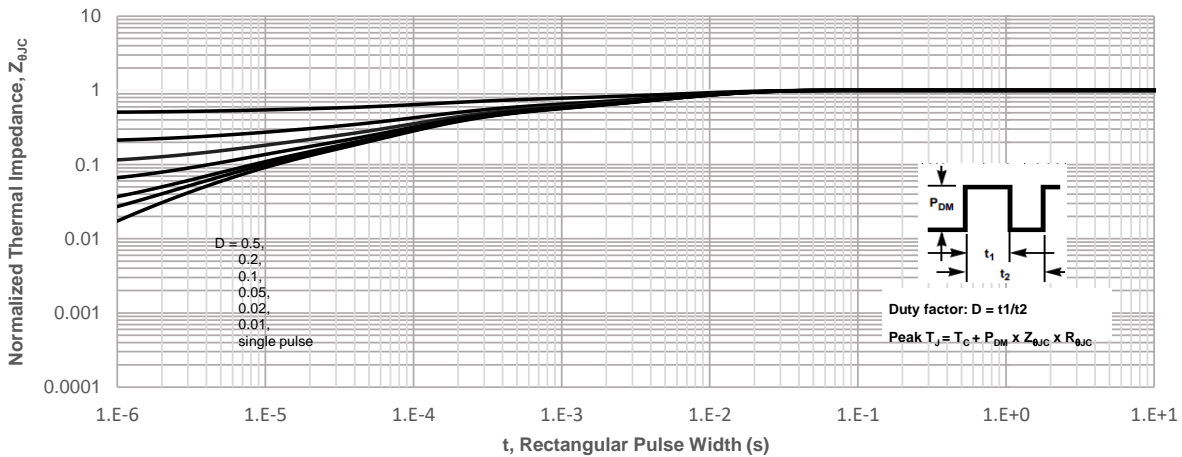
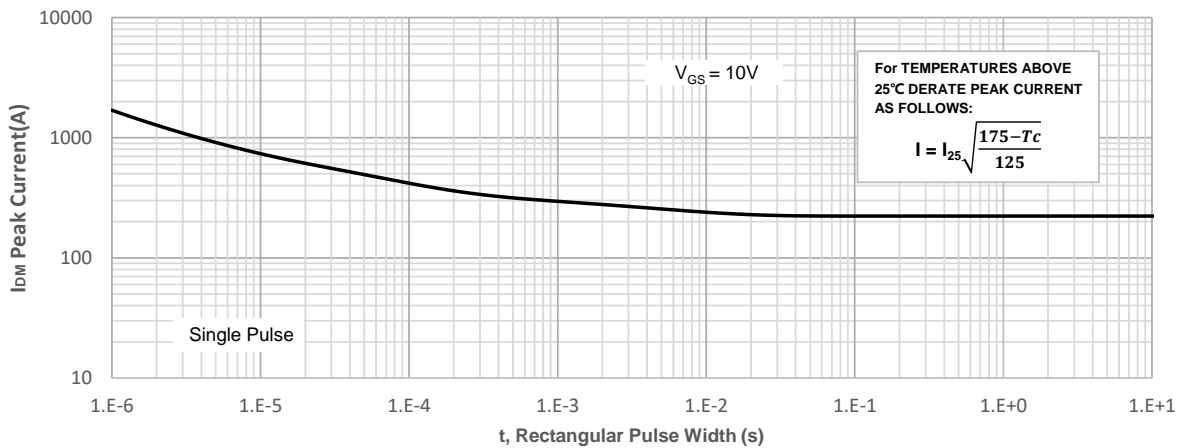
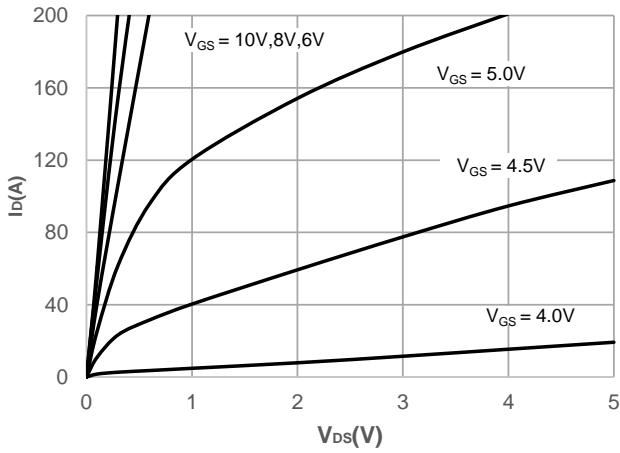
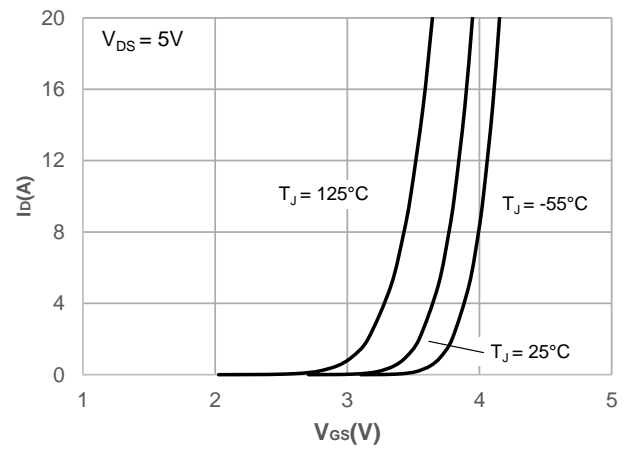
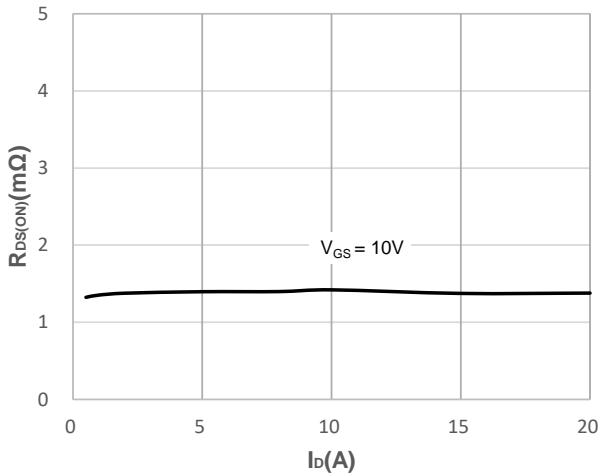
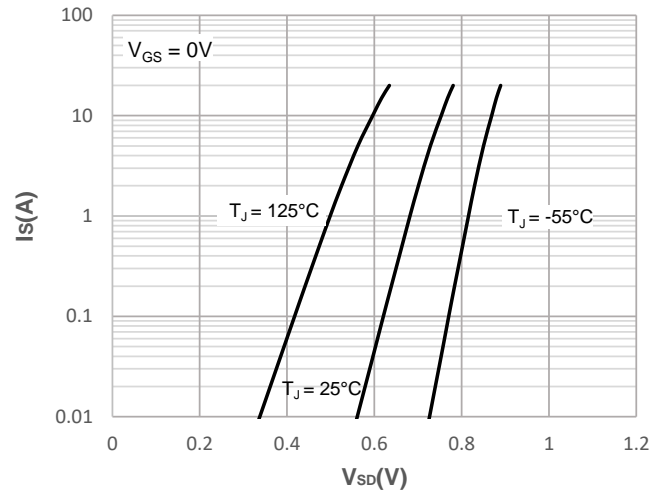
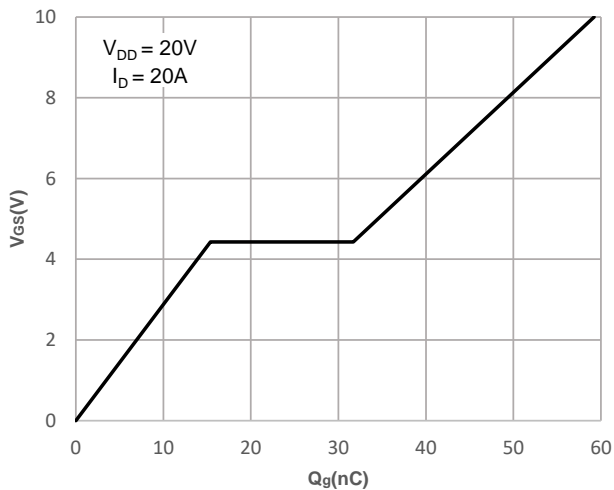
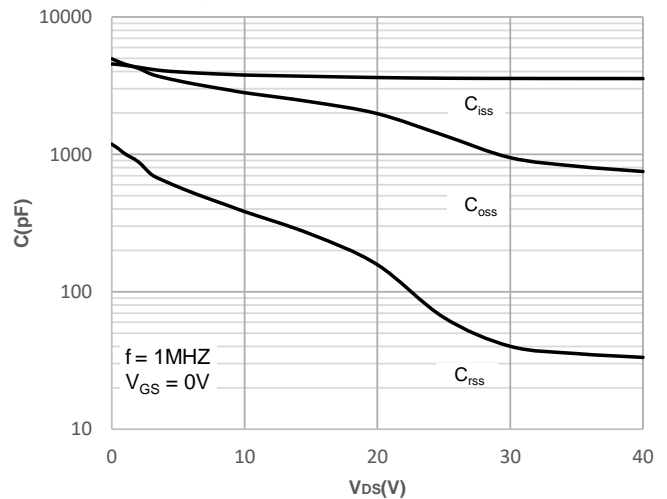


Figure 4: Peak Current Capacity



## 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

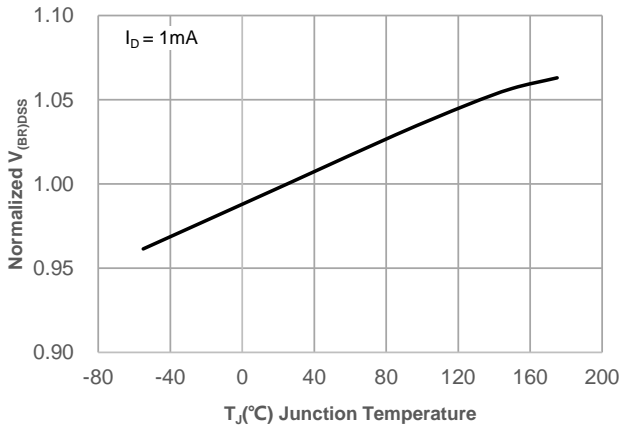


Figure 12: Normalized on Resistance vs. Junction Temperature

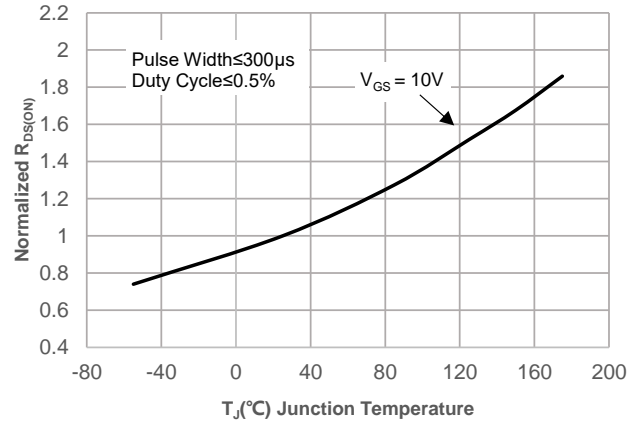


Figure 13: Normalized Threshold Voltage vs. Junction Temperature

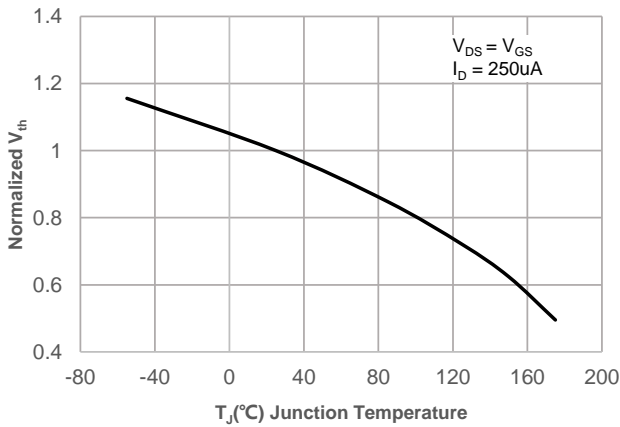


Figure 14:  $R_{DS(ON)}$  vs.  $V_{GS}$

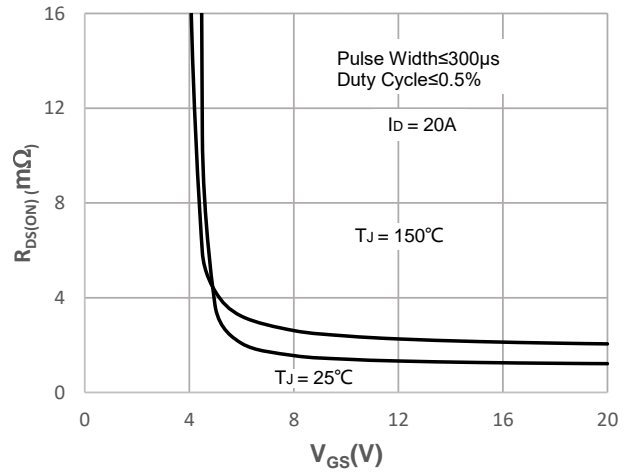
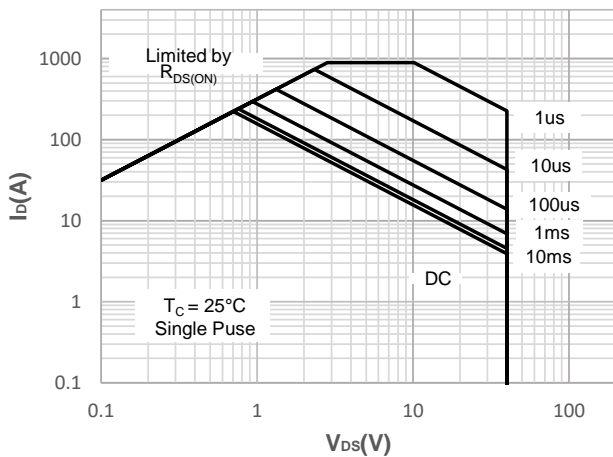


Figure 15: Maximum Safe Operating Area



### Test Circuit

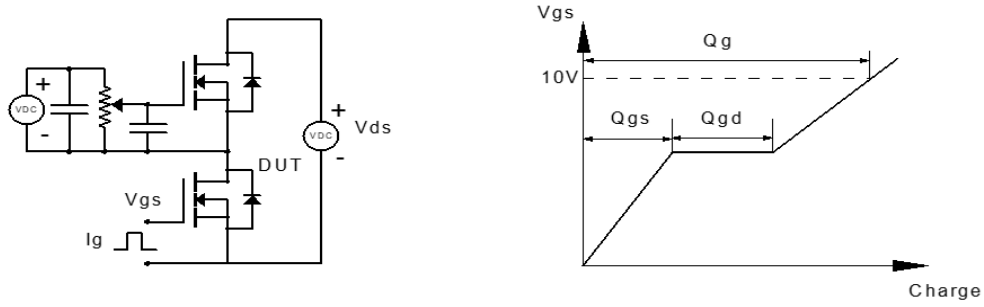


Figure 1: Gate Charge Test Circuit & Waveform

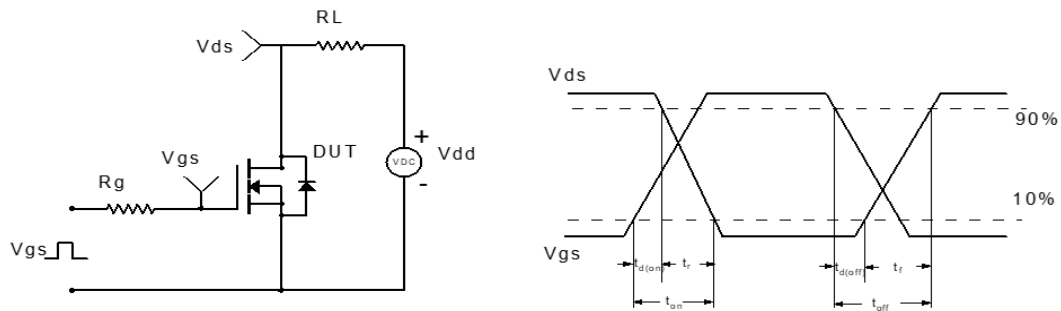


Figure 2: Resistive Switching Test Circuit & Waveform

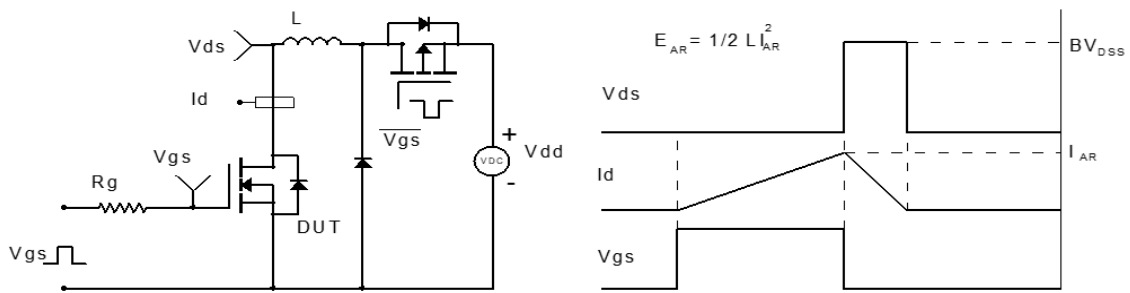


Figure 3: Unclamped Inductive Switching Test Circuit & Waveform

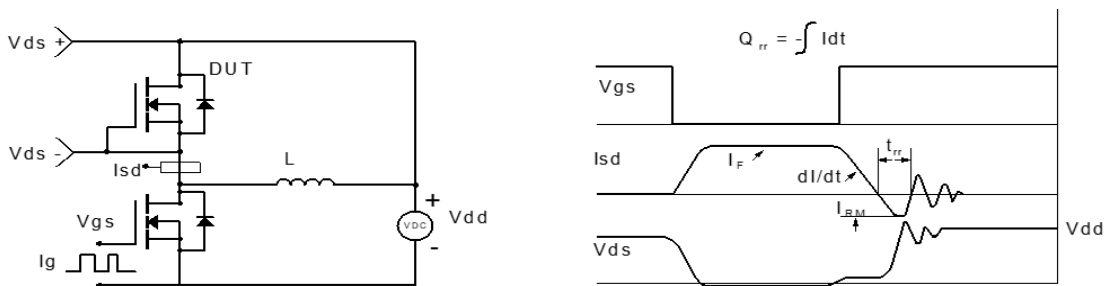
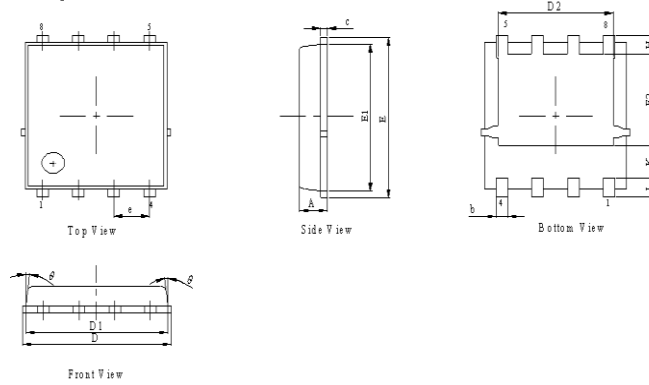


Figure 4: Diode Recovery Test Circuit & Waveform



## Package Mechanical Data(PDFN5X6-8L)

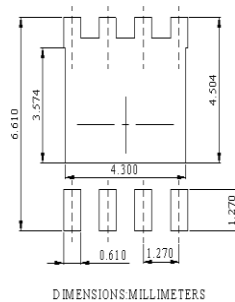
Package Outline


**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   |      |      |
| O    |            |      | 10   |

Recommended Soldering Footprint



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