

# 120V, 145A, 3.2mΩ N-channel Power SGT MOSFET

## JMSH1204PC

### Features

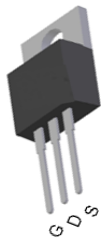
- Excellent  $R_{DS(ON)}$  and Low Gate Charge
- 100% UIS TESTED
- 100%  $\Delta V_{ds}$  TESTED
- Halogen-free; RoHS-compliant
- Pb-free plating

### Applications

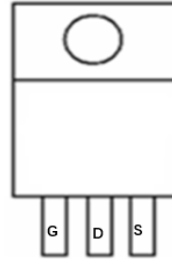
- Load Switch
- PWM Application
- Power Management

### Product Summary

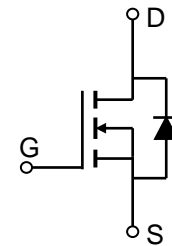
| Parameters                     | Value | Unit |
|--------------------------------|-------|------|
| $V_{DSS}$                      | 120   | V    |
| $V_{GS(th\_Typ)}$              | 2.9   | V    |
| $I_D(@V_{GS}=10V)$             | 145   | A    |
| $R_{DS(ON\_Typ)}(@V_{GS}=10V)$ | 3.2   | mΩ   |



TO-220-3L Top View



Pin Assignment



Schematic Diagram

### Ordering Information

| Device     | Marking    | MSL | Form | Package   | Reel&Tube(pcs) | Per Carton (pcs) |
|------------|------------|-----|------|-----------|----------------|------------------|
| JMSH1204PC | JMSH1204PC | N/A | Tube | TO-220-3L | 50             | 5000             |

### Absolute Maximum Ratings (@ $T_C = 25^\circ\text{C}$ unless otherwise specified)

| Symbol         | Parameter                                     | Value                     | Unit             |
|----------------|---|---------------------------|------------------|
| $V_{DS}$       | Drain-to-Source Voltage                       | 120                       | V                |
| $V_{GS}$       | Gate-to-Source Voltage                        | $\pm 20$                  | V                |
| $I_D$          | Continuous Drain Current                      | $T_C = 25^\circ\text{C}$  | 145              |
|                |   | $T_C = 100^\circ\text{C}$ | 103              |
| $I_{DM}$       | Pulsed Drain Current <sup>(1)</sup>           | Refer to Fig.4            | A                |
| $E_{AS}$       | Single Pulsed Avalanche Energy <sup>(2)</sup> | 1061                      | mJ               |
| $P_D$          | Power Dissipation                             | $T_C = 25^\circ\text{C}$  | 208              |
|                |   | $T_C = 100^\circ\text{C}$ | 83               |
| $T_J, T_{STG}$ | Junction & Storage Temperature Range          | -55 to 150                | $^\circ\text{C}$ |

### Thermal Characteristics

| Symbol          | Parameter  | Max | Unit               |
|-----------------|--|-----|--------------------|
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient <sup>(3)</sup> | 32  | $^\circ\text{C/W}$ |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case                   | 0.6 |                    |



**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                   | $I_D = 250\mu\text{A}$ , $V_{GS} = 0\text{V}$   | 120  | -    | -         | V             |
| $I_{DSS}$                         | Zero Gate Voltage Drain Current                  | $V_{DS} = 96\text{V}$ , $V_{GS} = 0\text{V}$  | -    | -    | 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                           | $V_{DS} = V_{GS}$ , $I_D = 250\mu\text{A}$  | 2.0  | 2.9  | 3.7       | V             |
| $R_{DS(ON)}$                      | Static Drain-Source ON-Resistance <sup>(4)</sup> | $V_{GS} = 10\text{V}$ , $I_D = 20\text{A}$  | -    | 3.2  | 4.1       | m $\Omega$    |
| <b>Dynamic Characteristics</b>    |  |   |      |      |           |               |
| $R_g$                             | Gate Resistance                                  | $f = 1\text{MHz}$   | -    | 3.1  | -         | $\Omega$      |
| $C_{iss}$                         | Input Capacitance                                | $V_{GS} = 0\text{V}$ , $V_{DS} = 60\text{V}$ ,<br>$f = 1\text{MHz}$                         | 4834 | 6768 | 9137      | pF            |
| $C_{oss}$                         | Output Capacitance                               |   | 542  | 759  | 1024      | pF            |
| $C_{rss}$                         | Reverse Transfer Capacitance                     |   | 17   | 24   | 33        | pF            |
| $Q_g$                             | Total Gate Charge                                | $V_{GS} = 0$ to $10\text{V}$<br>$V_{DS} = 60\text{V}$ , $I_D = 20\text{A}$                  | 74   | 104  | 140       | nC            |
| $Q_{gs}$                          | Gate Source Charge                               |   | 26   | 36   | 49        | nC            |
| $Q_{gd}$                          | Gate Drain ("Miller") Charge                     |   | 18   | 25   | 34        | nC            |
| <b>Switching Characteristics</b>  |  |   |      |      |           |               |
| $t_{d(on)}$                       | Turn-On DelayTime                                | $V_{GS} = 10\text{V}$ , $V_{DD} = 60\text{V}$<br>$I_D = 20\text{A}$ , $R_{GEN} = 6.2\Omega$ | -    | 33   | -         | ns            |
| $t_r$                             | Turn-On Rise Time                                |   | -    | 61   | -         | ns            |
| $t_{d(off)}$                      | Turn-Off DelayTime                               |   | -    | 92   | -         | ns            |
| $t_f$                             | Turn-Off Fall Time                               |   | -    | 59   | -         | ns            |
| <b>Body Diode Characteristics</b> |  |   |      |      |           |               |
| $I_S$                             | Maximum Continuous Body Diode Forward Current    |   | -    | -    | 145       | A             |
| $I_{SM}$                          | Maximum Pulsed Body Diode Forward Current        |   | -    | -    | 581       | 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                 | $I_F = 20\text{A}$ , $di/dt = 100\text{A}/\mu\text{s}$                                      | 80   | 112  | 151       | ns            |
| $Q_{rr}$                          | Body Diode Reverse Recovery Charge               |   | -    | 450  | -         | nC            |

- Notes:
1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
  2.  $E_{AS}$  condition: Starting  $T_J = 25^\circ\text{C}$ ,  $V_{DD} = 60\text{V}$ ,  $V_G = 10\text{V}$ ,  $R_G = 25\text{ohm}$ ,  $L = 3\text{mH}$ ,  $I_{AS} = 26.6\text{A}$ ,  $V_{DD} = 0\text{V}$  during time in avalanche.
  3.  $R_{\theta JA}$  is measured with the device mounted on a  $1\text{inch}^2$  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

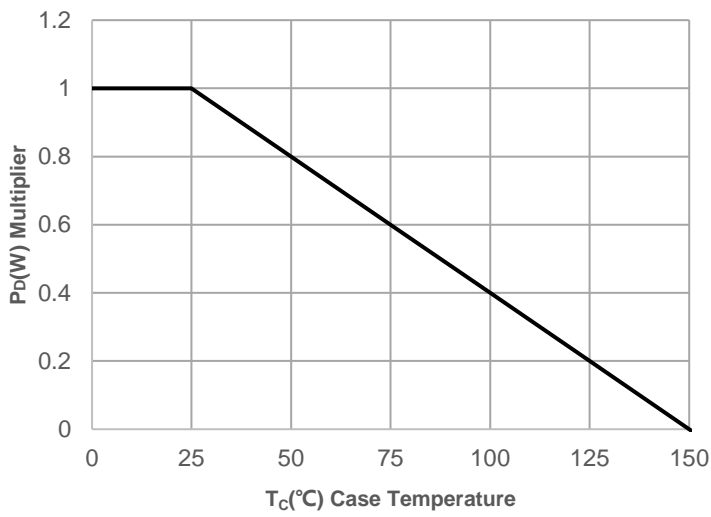


Figure 2: Current De-rating

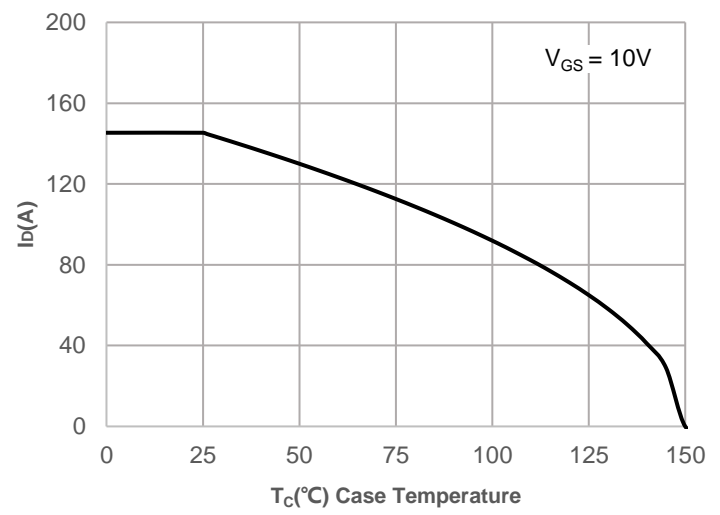


Figure 3: Normalized Maximum Transient Thermal Impedance

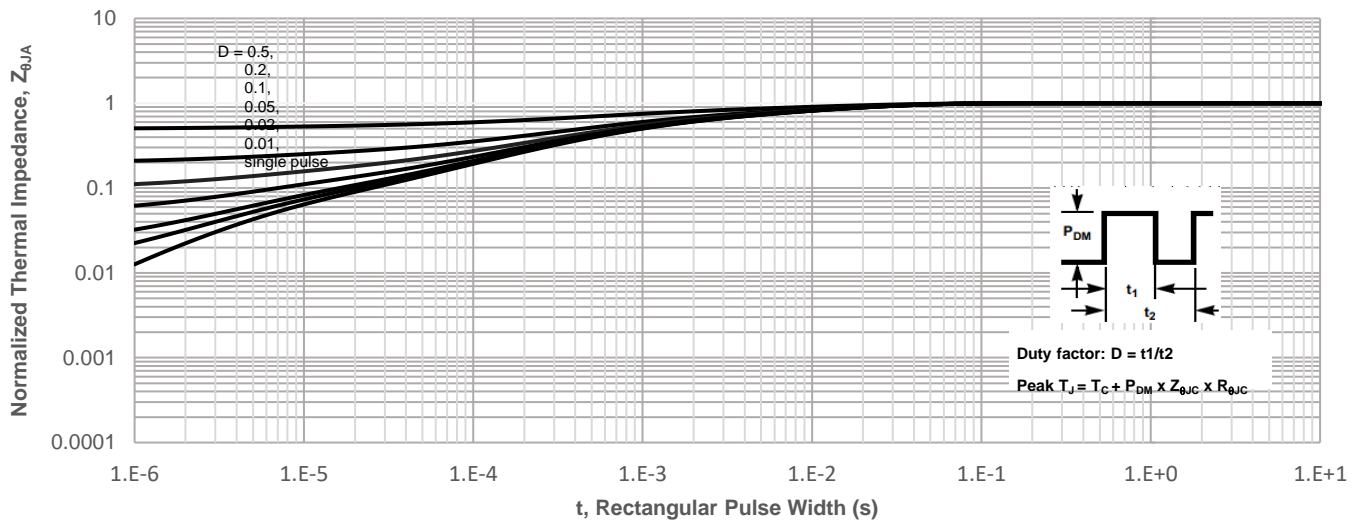
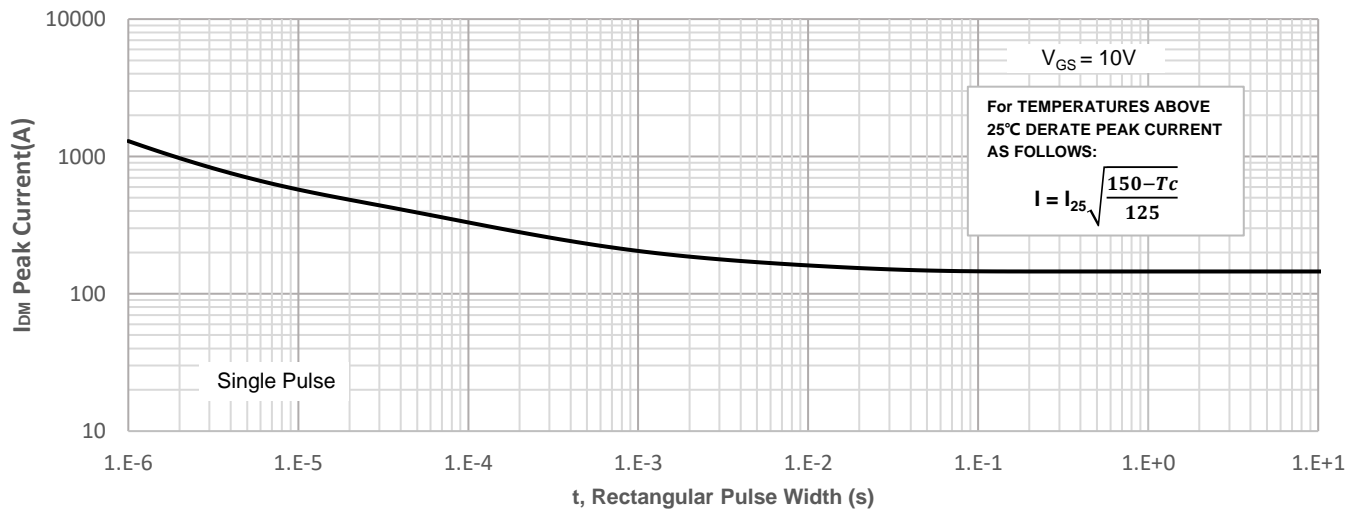


Figure 4: Peak Current Capacity



## Typical Performance Characteristics

Figure 5: Output Characteristics

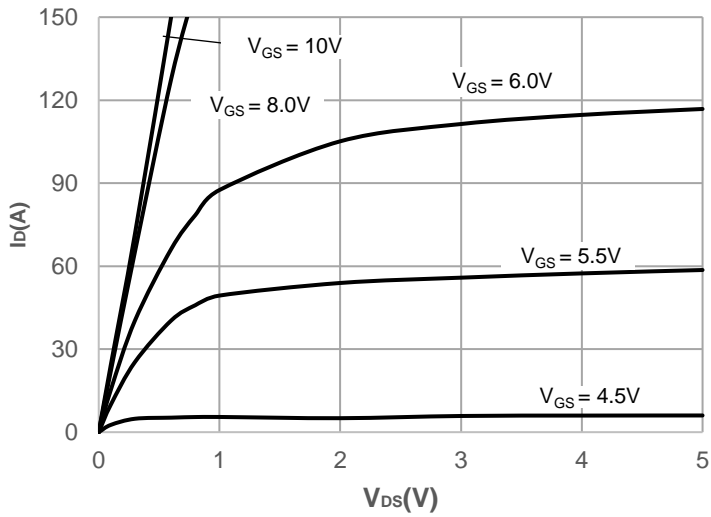


Figure 6: Typical Transfer Characteristics

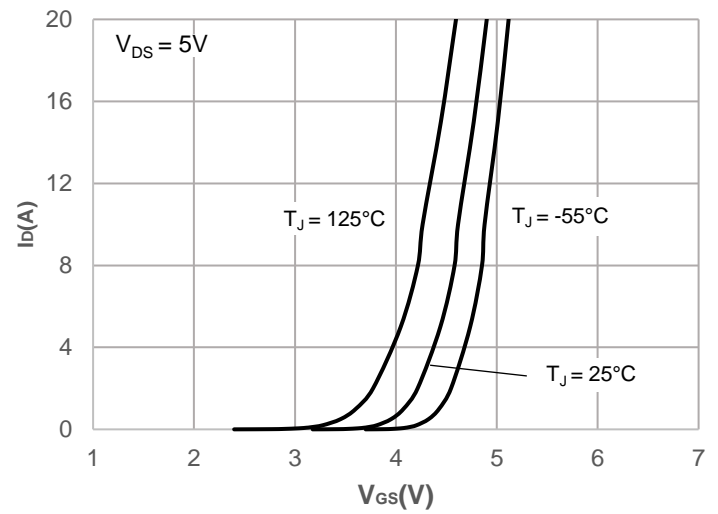


Figure 7: On-resistance vs. Drain Current

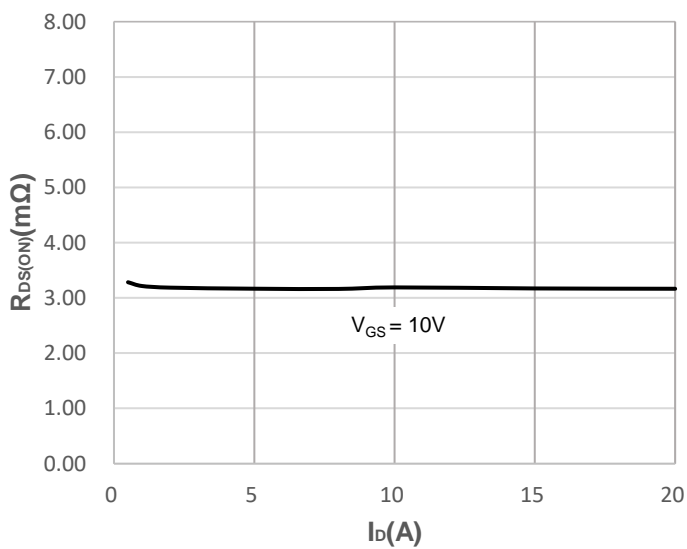


Figure 8: Body Diode Characteristics

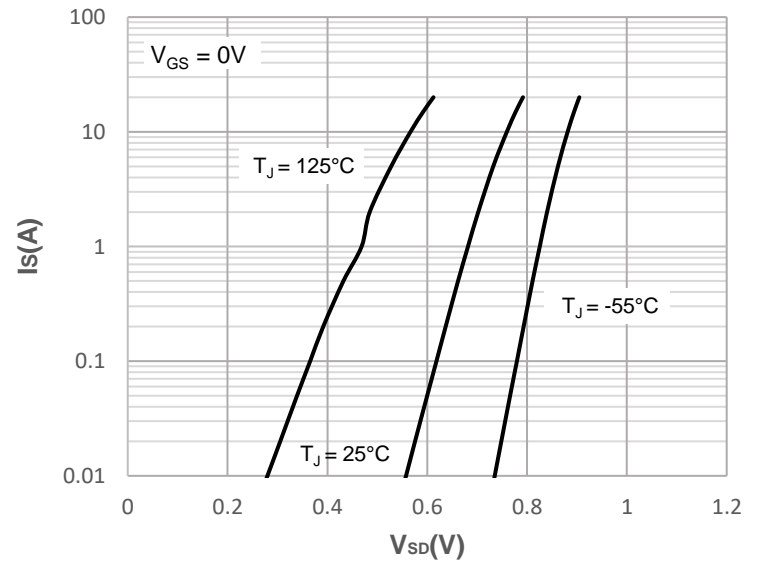


Figure 9: Gate Charge Characteristics

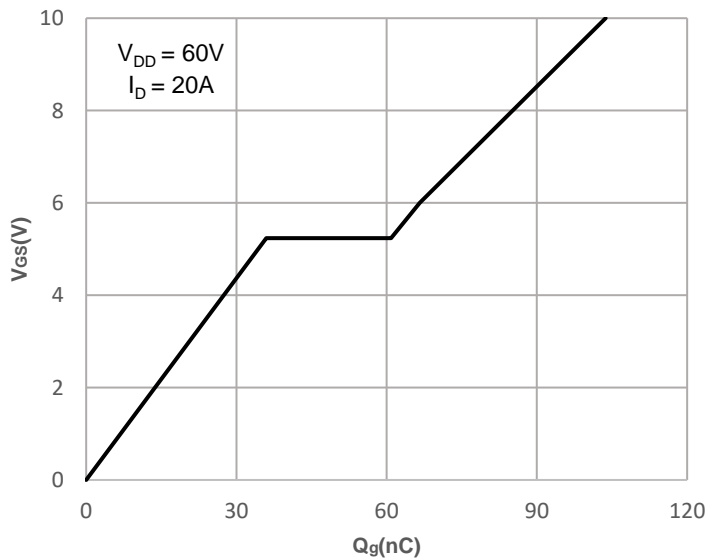
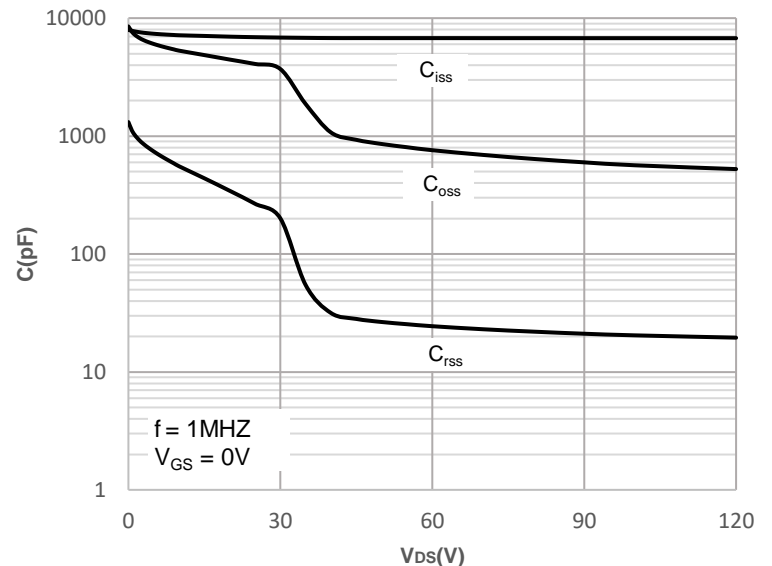


Figure 10: Capacitance Characteristics



## Typical Performance Characteristics

Figure 11: Normalized Breakdown voltage vs. Junction Temperature

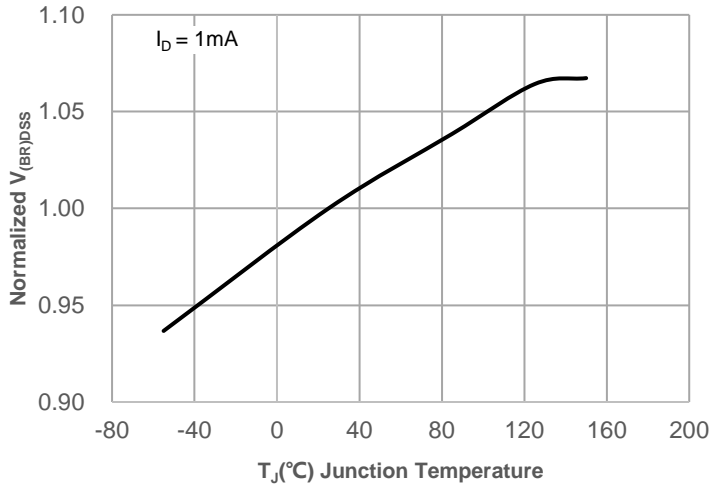


Figure 12: Normalized on Resistance vs. Junction Temperature

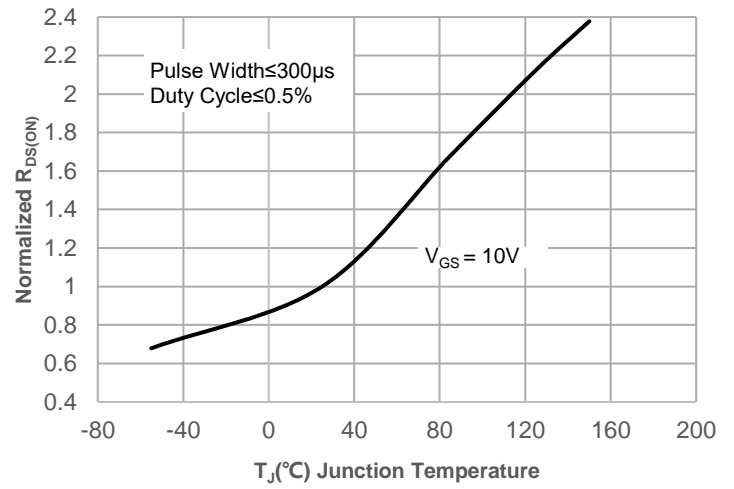


Figure 13: Normalized Threshold Voltage vs. Junction Temperature

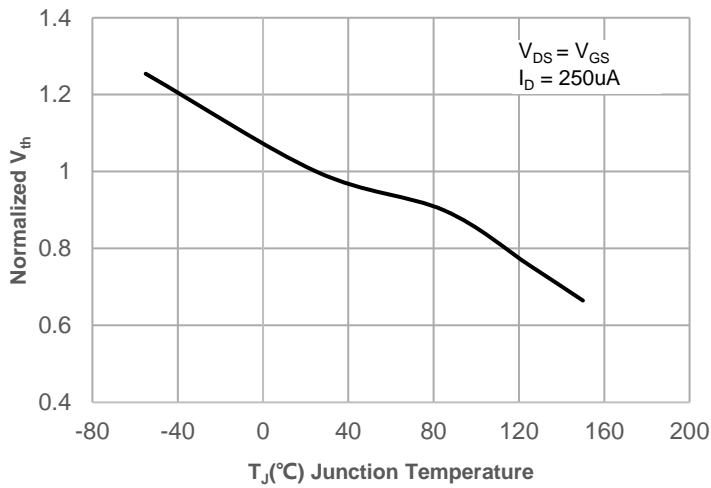


Figure 14:  $R_{DS(ON)}$  vs.  $V_{GS}$

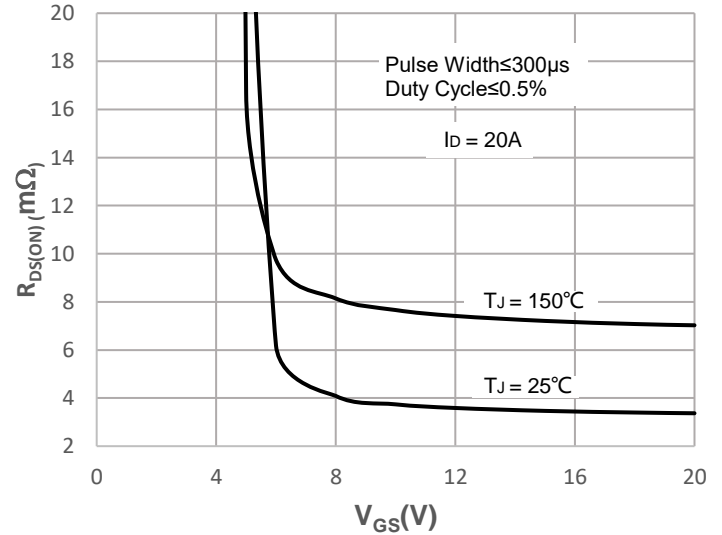
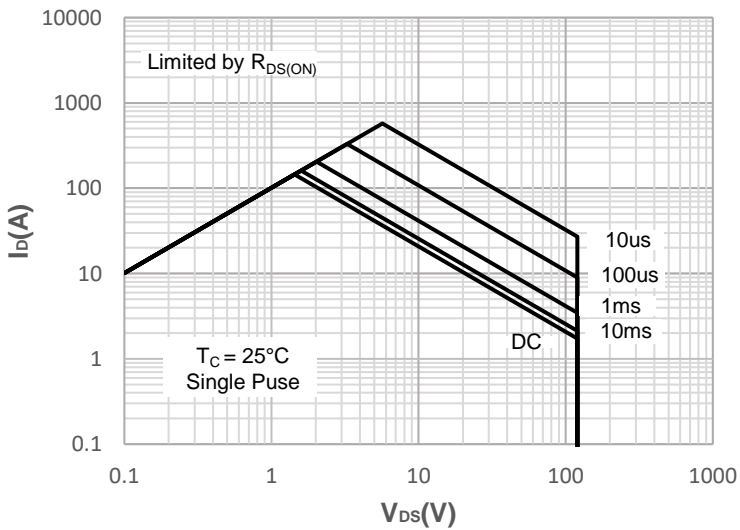


Figure 15: Maximum Safe Operating Area



### Test Circuit

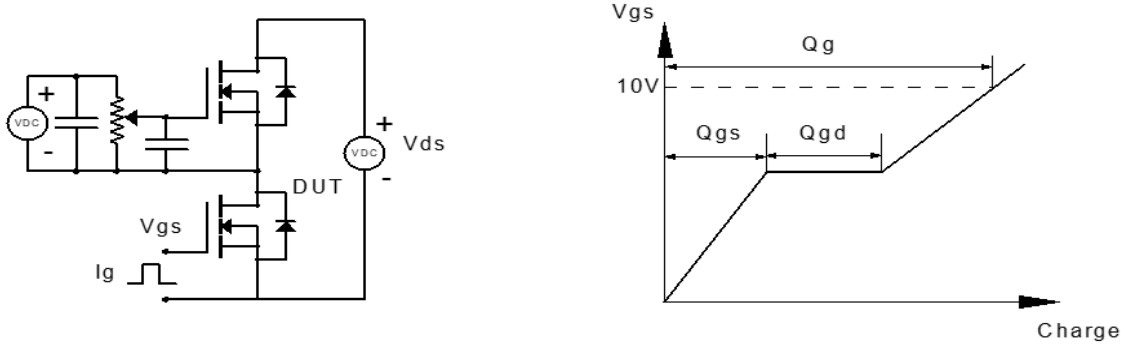


Figure 1: Gate Charge Test Circuit & Waveform

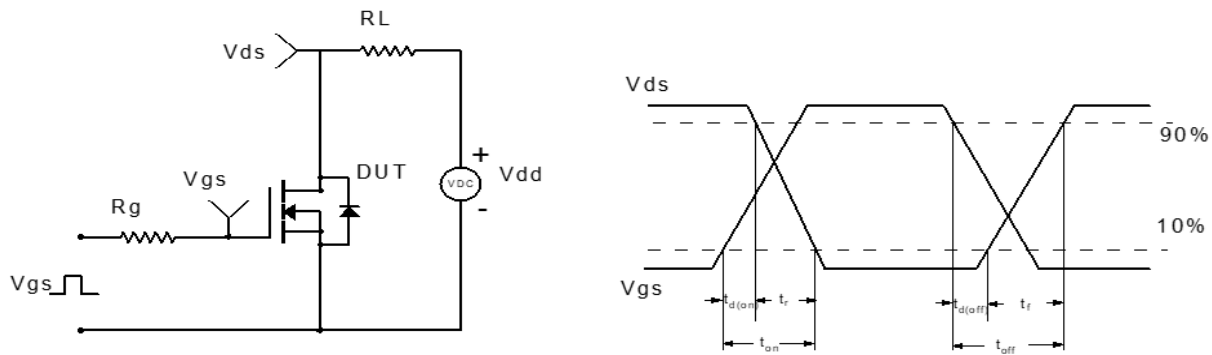


Figure 2: Resistive Switching Test Circuit & Waveform

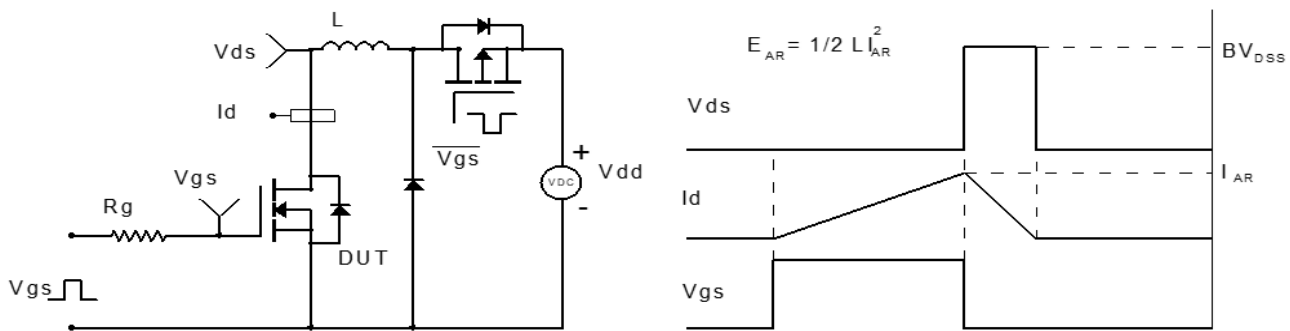


Figure 3: Unclamped Inductive Switching Test Circuit & Waveform

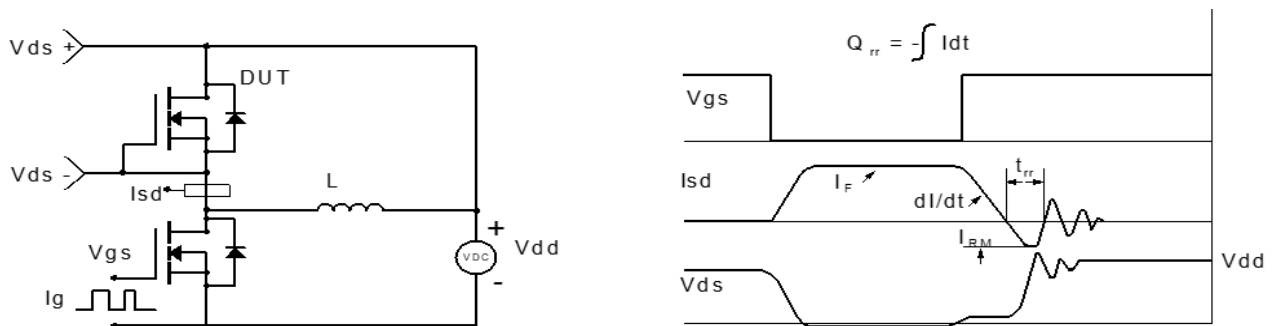
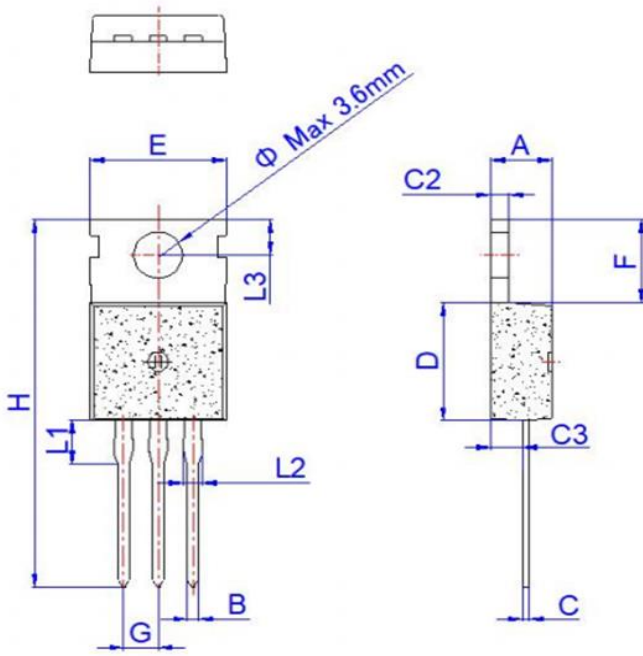


Figure 4: Diode Recovery Test Circuit & Waveform



**Package Mechanical Data(TO-220-3L)**


| Ref.   | Dimensions  |      |      |        |       |       |
|--------|-------------|------|------|--------|-------|-------|
|        | Millimeters |      |      | Inches |       |       |
|        | Min.        | Typ. | Max. | Min.   | Typ.  | Max.  |
| A      | 4.40        |      | 4.60 | 0.173  |       | 0.181 |
| B      | 0.70        |      | 0.90 | 0.028  |       | 0.035 |
| C      | 0.45        |      | 0.60 | 0.018  |       | 0.024 |
| C2     | 1.23        |      | 1.32 | 0.048  |       | 0.052 |
| C3     | 2.20        |      | 2.60 | 0.087  |       | 0.102 |
| D      | 8.90        |      | 9.90 | 0.350  |       | 0.390 |
| E      | 9.90        |      | 10.3 | 0.390  |       | 0.406 |
| F      | 6.30        |      | 6.90 | 0.248  |       | 0.272 |
| G      |             | 2.54 |      |        | 0.1   |       |
| H      | 28.0        |      | 29.8 | 1.102  |       | 1.173 |
| L1     |             | 3.39 |      |        | 0.133 |       |
| L2     | 1.14        |      | 1.70 | 0.045  |       | 0.067 |
| L3     | 2.65        |      | 2.95 | 0.104  |       | 0.116 |
| $\Phi$ |             | 3.6  |      |        | 0.142 |       |

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