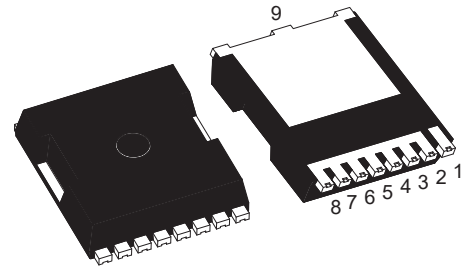
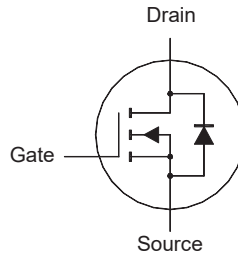


## N-Channel Enhancement Mode MOSFET

### Features

- Ultra Low  $R_{DS(ON)}$
- Surface-mounted package
- Halogen and Antimony Free(HAF), RoHS compliant



1.Gate 2~8.Source 9.Drain  
TOLL Plastic Package

### Key Parameters

| Parameter        | Value                                                         | Unit       |
|------------------|---------------------------------------------------------------|------------|
| $BV_{DSS}$       | 40                                                            | V          |
| $R_{DS(ON)}$ Max | 0.7 @ $V_{GS} = 10\text{ V}$<br>1.1 @ $V_{GS} = 4.5\text{ V}$ | m $\Omega$ |
| $V_{GS(th)}$ typ | 1.4                                                           | V          |
| $Q_g$ typ        | 588 @ $V_{GS} = 10\text{ V}$                                  | nC         |

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

| Parameter                                        | Symbol         | Value         | Unit             |
|--------------------------------------------------|----------------|---------------|------------------|
| Drain-Source Voltage                             | $V_{DS}$       | 40            | V                |
| Gate-Source Voltage                              | $V_{GS}$       | $\pm 20$      | V                |
| Continuous Drain Current                         | $I_D$          | 400<br>280    | A                |
| Peak Drain Current, Pulsed <sup>1)</sup>         | $I_{DM}$       | 1600          | A                |
| Single Pulse Avalanche Current                   | $I_{AS}$       | 126           | A                |
| Single Pulse Avalanche Energy <sup>2)</sup>      | $E_{AS}$       | 793.8         | mJ               |
| Total Power Dissipation                          | $P_{tot}$      | 250           | W                |
| Operating Junction and Storage Temperature Range | $T_J, T_{stg}$ | - 55 to + 175 | $^\circ\text{C}$ |

### Thermal Characteristics

| Parameter                                                 | Symbol          | Max. | Unit               |
|-----------------------------------------------------------|-----------------|------|--------------------|
| Thermal Resistance from Junction to Case                  | $R_{\theta JC}$ | 0.6  | $^\circ\text{C/W}$ |
| Thermal Resistance from Junction to Ambient <sup>3)</sup> | $R_{\theta JA}$ | 35   | $^\circ\text{C/W}$ |

<sup>1)</sup> Pulse Test: Pulse Width  $\leq 100\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ , Repetitive rating, pulse width limited by junction temperature  $T_{J(MAX)} = 175^\circ\text{C}$ .

<sup>2)</sup> Limited by  $T_{J(MAX)}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.1\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 126\text{ A}$ ,  $V_{GS} = 10\text{ V}$ .

<sup>3)</sup> Device mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate in still air.

**Characteristics at  $T_c = 25^\circ\text{C}$  unless otherwise specified**

| Parameter                                                                                                                                                                        | Symbol       | Min.   | Typ.       | Max.       | Unit             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------|------------|------------|------------------|
| <b>STATIC PARAMETERS</b>                                                                                                                                                         |              |        |            |            |                  |
| Drain-Source Breakdown Voltage<br>at $I_D = 250\ \mu\text{A}$                                                                                                                    | $BV_{DSS}$   | 40     | -          | -          | V                |
| Drain-Source Leakage Current<br>at $V_{DS} = 32\ \text{V}$                                                                                                                       | $I_{DSS}$    | -      | -          | 1          | $\mu\text{A}$    |
| Gate Leakage Current<br>at $V_{GS} = \pm 16\ \text{V}$                                                                                                                           | $I_{GSS}$    | -      | -          | $\pm 100$  | nA               |
| Gate-Source Threshold Voltage<br>at $V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$                                                                                                 | $V_{GS(th)}$ | 1      | -          | 2          | V                |
| Drain-Source On-State Resistance<br>at $V_{GS} = 10\ \text{V}$ , $I_D = 20\ \text{A}$<br>at $V_{GS} = 4.5\ \text{V}$ , $I_D = 20\ \text{A}$                                      | $R_{DS(on)}$ | -<br>- | 0.5<br>-   | 0.7<br>1.1 | $\text{m}\Omega$ |
| <b>DYNAMIC PARAMETERS</b>                                                                                                                                                        |              |        |            |            |                  |
| Forward Transconductance<br>at $V_{DS} = 5\ \text{V}$ , $I_D = 20\ \text{A}$                                                                                                     | $g_{fs}$     | -      | 112        | -          | S                |
| Gate resistance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                      | $R_g$        | -      | 2          | -          | $\Omega$         |
| Input Capacitance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 20\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                   | $C_{iss}$    | -      | 57756      | -          | pF               |
| Output Capacitance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 20\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                  | $C_{oss}$    | -      | 2440       | -          | pF               |
| Reverse Transfer Capacitance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 20\ \text{V}$ , $f = 1\ \text{MHz}$                                                                        | $C_{rss}$    | -      | 1811       | -          | pF               |
| Gate charge total<br>at $V_{DS} = 20\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 20\ \text{A}$<br>at $V_{DS} = 20\ \text{V}$ , $V_{GS} = 4.5\ \text{V}$ , $I_D = 20\ \text{A}$ | $Q_g$        | -<br>- | 588<br>278 | -<br>-     | nC               |
| Gate to Source Charge<br>at $V_{DS} = 20\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 20\ \text{A}$                                                                             | $Q_{gs}$     | -      | 103        | -          | nC               |
| Gate to Drain Charge<br>at $V_{DS} = 20\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 20\ \text{A}$                                                                              | $Q_{gd}$     | -      | 80         | -          | nC               |
| Turn-On Delay Time<br>at $V_{DS} = 20\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 20\ \text{A}$ , $R_g = 3.3\ \Omega$                                                          | $t_{d(on)}$  | -      | 173        | -          | ns               |
| Turn-On Rise Time<br>at $V_{DS} = 20\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 20\ \text{A}$ , $R_g = 3.3\ \Omega$                                                           | $t_r$        | -      | 83         | -          | ns               |
| Turn-Off Delay Time<br>at $V_{DS} = 20\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 20\ \text{A}$ , $R_g = 3.3\ \Omega$                                                         | $t_{d(off)}$ | -      | 184        | -          | ns               |
| Turn-Off Fall Time<br>at $V_{DS} = 20\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 20\ \text{A}$ , $R_g = 3.3\ \Omega$                                                          | $t_f$        | -      | 34         | -          | ns               |
| <b>Body-Diode PARAMETERS</b>                                                                                                                                                     |              |        |            |            |                  |
| Drain-Source Diode Forward Voltage<br>at $I_S = 1\ \text{A}$ , $V_{GS} = 0\ \text{V}$                                                                                            | $V_{SD}$     | -      | -          | 1.2        | V                |
| Body-Diode Continuous Current                                                                                                                                                    | $I_S$        | -      | -          | 400        | A                |
| Body-Diode Continuous Current, Pulsed                                                                                                                                            | $I_{SM}$     | -      | -          | 1600       | A                |
| Body Diode Reverse Recovery Time<br>at $I_S = 20\ \text{A}$ , $di/dt = 100\ \text{A} / \mu\text{s}$                                                                              | $t_{rr}$     | -      | 58         | -          | ns               |
| Body Diode Reverse Recovery Charge<br>at $I_S = 20\ \text{A}$ , $di/dt = 100\ \text{A} / \mu\text{s}$                                                                            | $Q_{rr}$     | -      | 103        | -          | nC               |

## Electrical Characteristics Curves

Fig. 1 Typical Output Characteristics

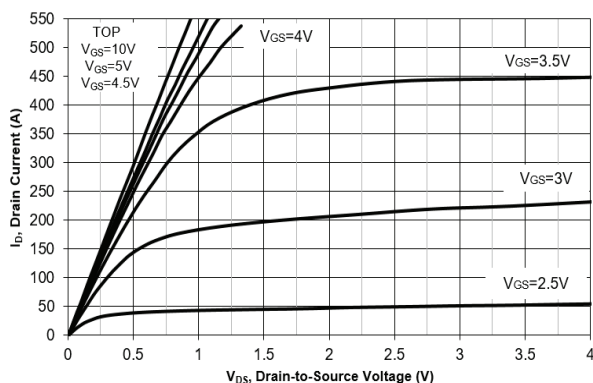


Fig. 2 Typical Transfer Characteristics

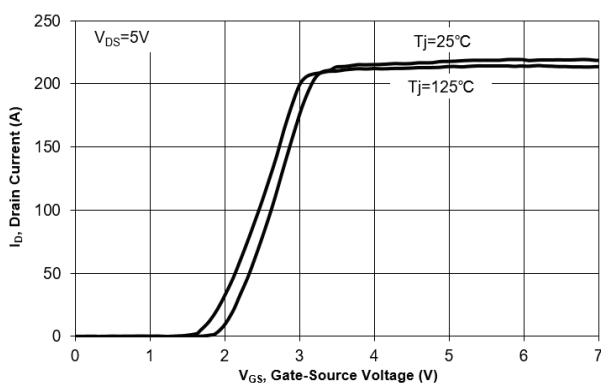


Fig. 3 on-Resistance vs. Drain Current

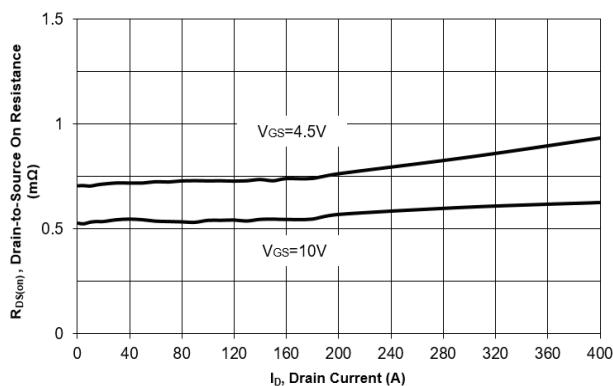


Fig. 4 on-Resistance vs. Gate to Source Voltage

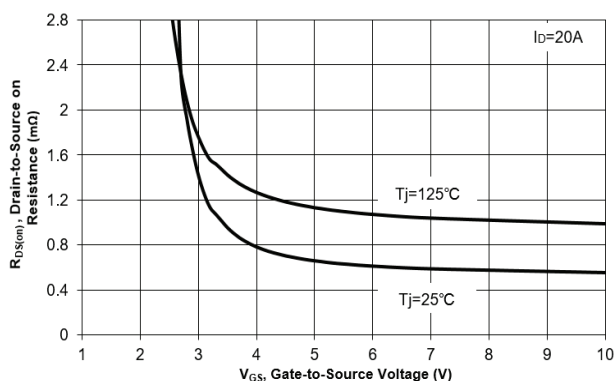


Fig. 5 on-Resistance vs. Tj

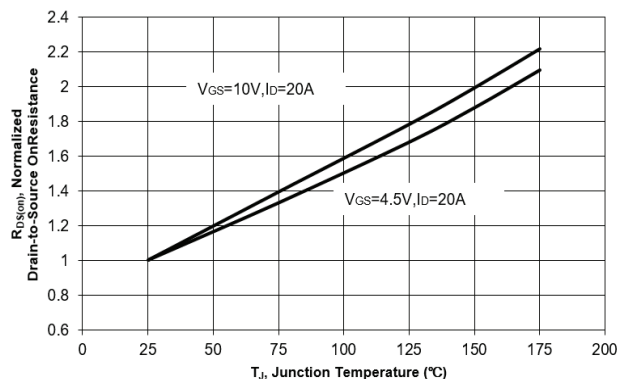
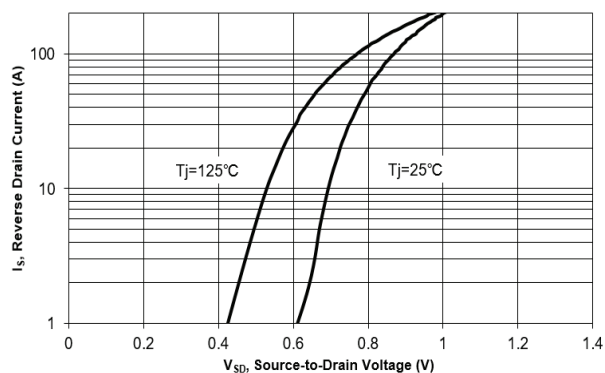


Fig. 6 Typical Body-Diode Forward Characteristics



## Electrical Characteristics Curves

Fig. 13 Normalized Maximum Transient Thermal Impedance( $Z_{\theta JC}$ )

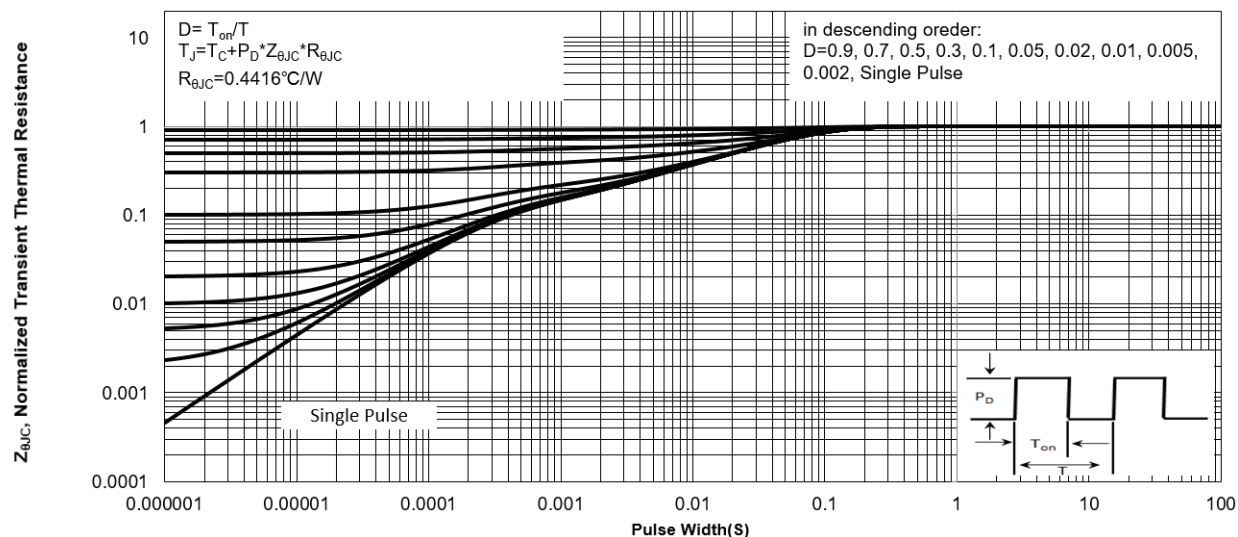


Fig. 14 Normalized Maximum Transient Thermal Impedance( $Z_{\theta JA}$ )

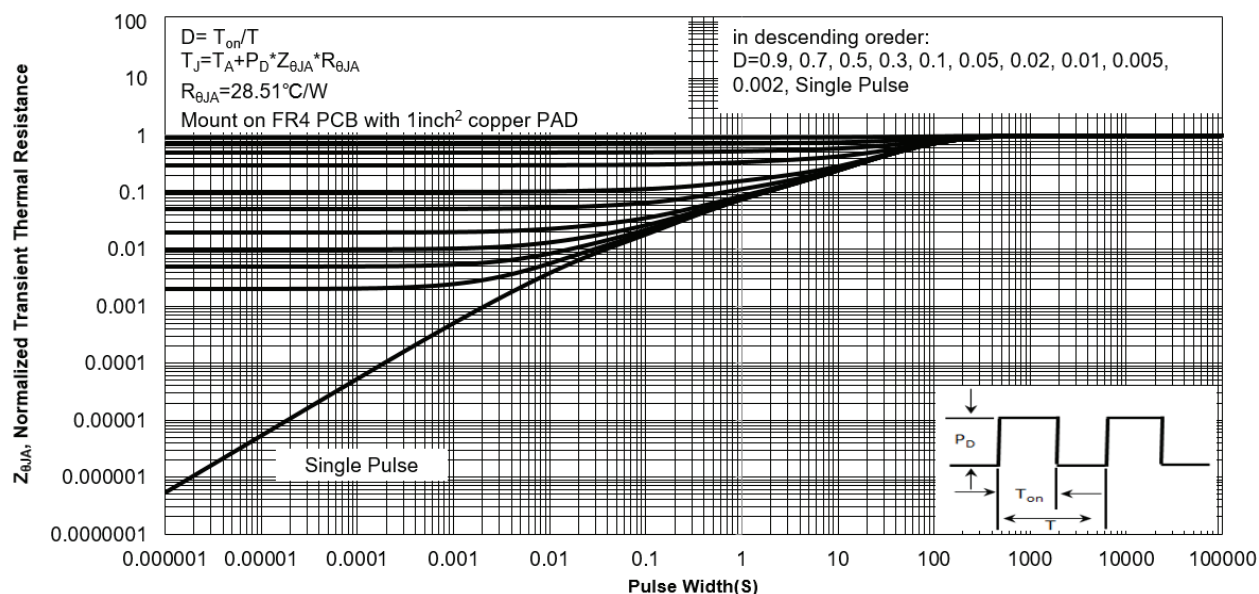


Fig. 7 Typical Junction Capacitance

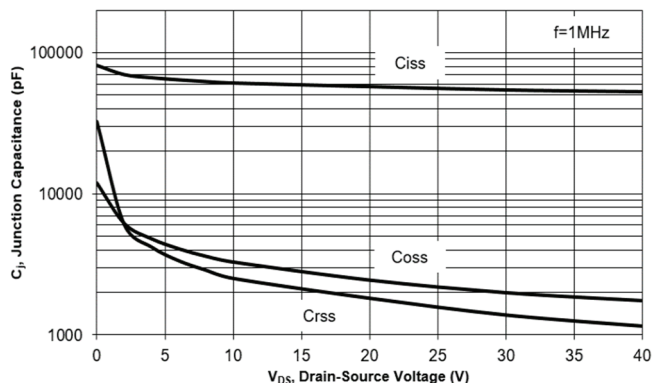


Fig. 8 Drain-Source Leakage Current vs.  $T_J$

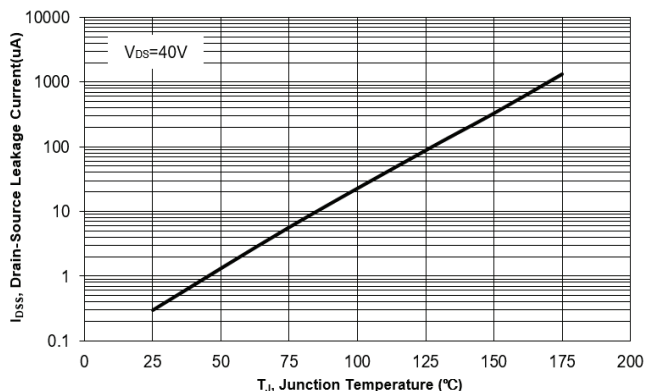


Fig. 9  $V_{(BR)DSS}$  vs. Junction Temperature

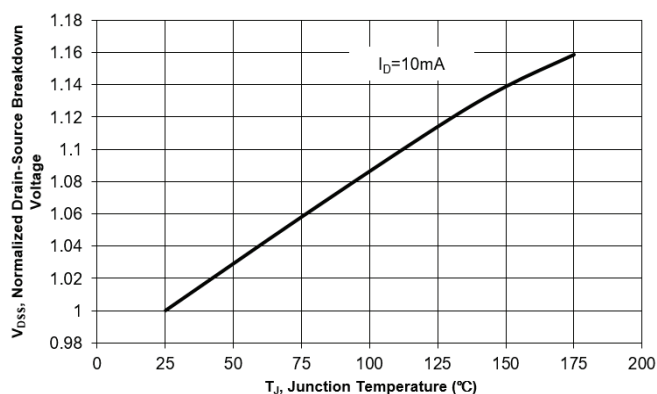


Fig. 10 Gate Threshold Variation vs.  $T_J$

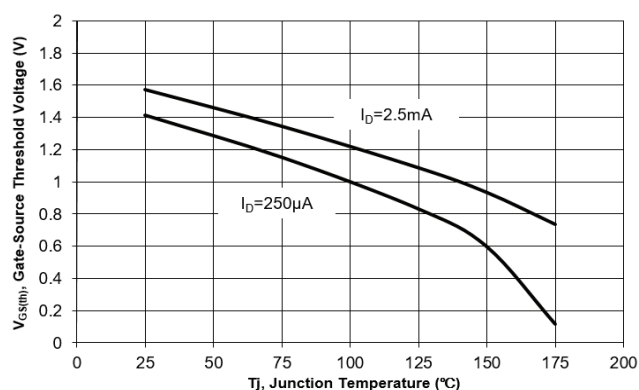


Fig. 11 Gate Charge

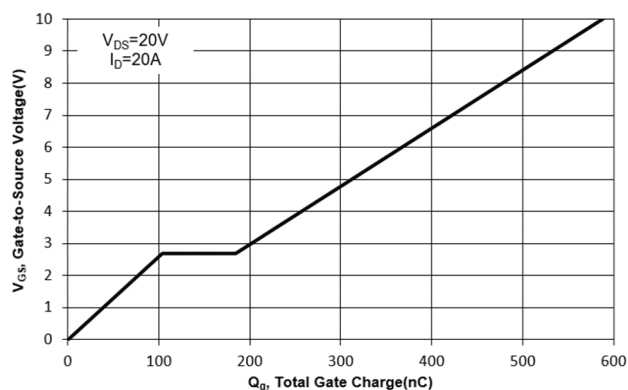
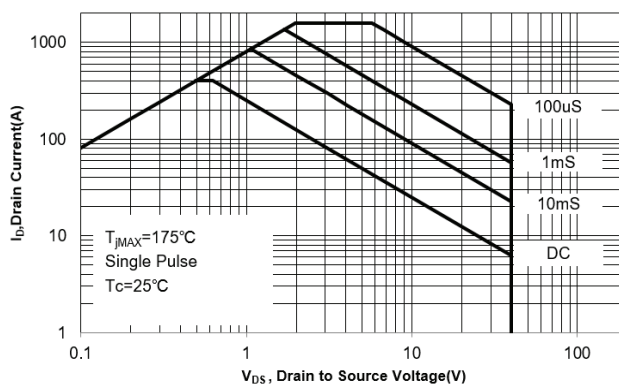


Fig. 12 Safe Operation Area



## Test Circuits

Fig.1-1 Switching times test circuit

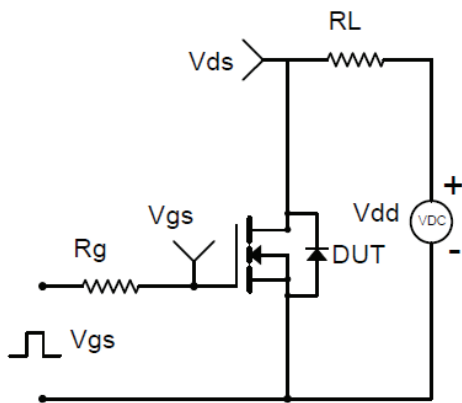


Fig.1-2 Switching Waveform

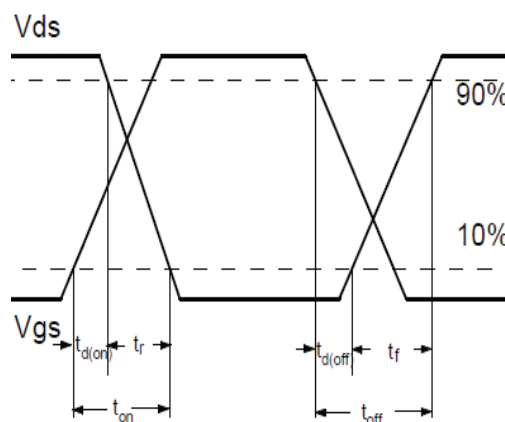


Fig.2-1 Gate charge test circuit

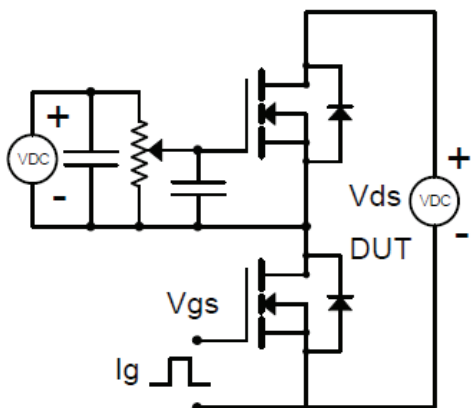


Fig.2-2 Gate charge waveform

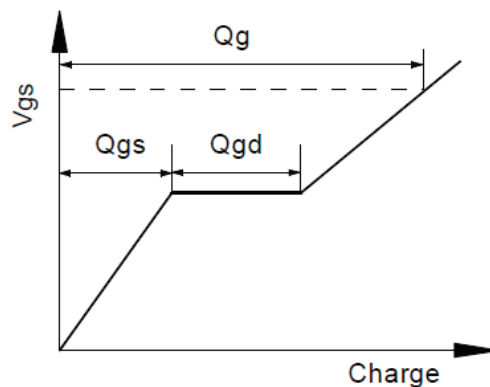


Fig.3-1 Avalanche test circuit

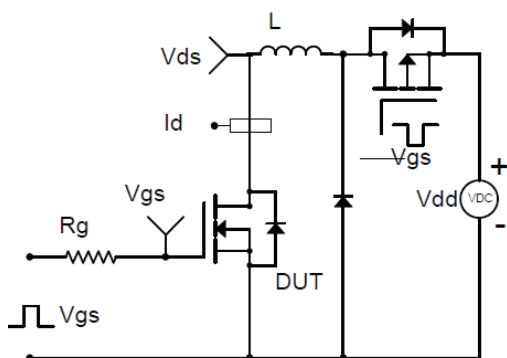
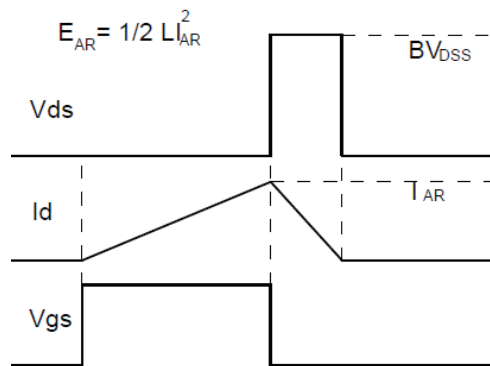
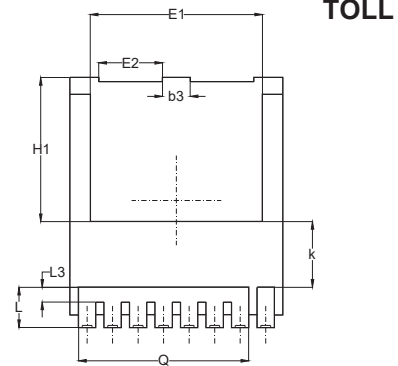
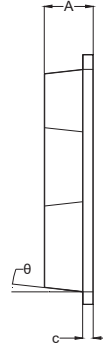
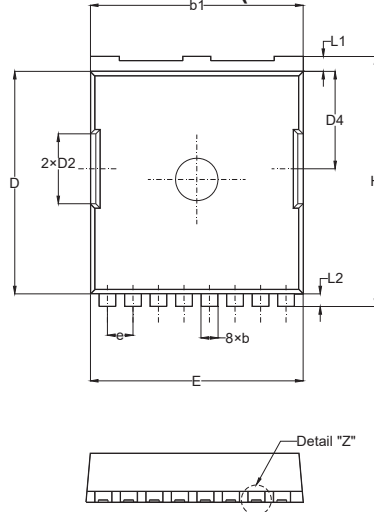


Fig.3-2 Avalanche waveform



Package Outline Dimensions (Units: mm)

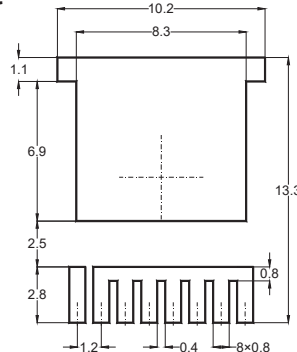


TOLL

| SYMBOL | A    | b    | b1   | b3   | c    | D     | D2   | D4   | E     | E1   | e    | H     | H1   | j    |
|--------|------|------|------|------|------|-------|------|------|-------|------|------|-------|------|------|
| MIN    | 2.20 | 0.65 | 9.70 | 1.15 | 0.40 | 10.28 | 3.20 | 4.45 | 9.80  | 7.90 | 1.20 | 11.48 | 6.95 | 0.35 |
| NOM    | 2.30 | 0.75 | 9.80 | 1.25 | 0.50 | 10.38 | 3.30 | 4.55 | 9.90  | 8.10 | BSC  | 11.68 | REF  | REF  |
| MAX    | 2.40 | 0.90 | 9.90 | 1.35 | 0.60 | 10.48 | 3.40 | 4.65 | 10.00 | 8.30 |      | 11.88 |      |      |

| SYMBOL | k   | L    | L1   | L2   | L3   | N | Q   | E2  | Θ   |
|--------|-----|------|------|------|------|---|-----|-----|-----|
| MIN    | 3.0 | 1.35 | 0.50 | 0.50 | 0.25 | 8 | 8   | 2.8 | 10° |
| NOM    | REF | 1.55 | 0.70 | 0.60 | 0.45 |   | REF | 3.0 | REF |
| MAX    |     | 1.75 | 0.90 | 0.70 | 0.65 |   |     | 3.2 |     |

Recommended Soldering Footprint



Packing information

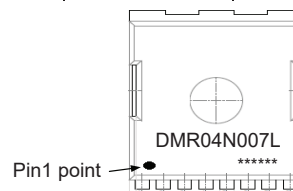
| Package | Tape Width (mm) | Pitch    |               | Reel Size |      | Per Reel Packing Quantity |
|---------|-----------------|----------|---------------|-----------|------|---------------------------|
|         |                 | mm       | inch          | mm        | inch |                           |
| TOLL    | 24              | 12 ± 0.1 | 0.472 ± 0.004 | 330       | 13   | 2,000                     |

Marking information

" DMR04N007L " = Part No.

" \*\*\*\*\* " = Date Code Marking

Font type: Arial



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