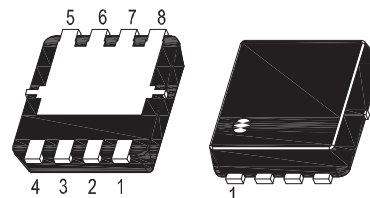
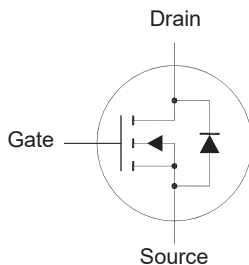


## N-Channel Enhancement Mode MOSFET

### Features

- AEC-Q101 Qualified
- Surface-mounted package
- Low Gate-Source Threshold Voltage
- Halogen and Antimony Free(HAF)  
RoHS compliant



1. Source 2. Source 3. Source 4. Gate  
5. Drain 6. Drain 7. Drain 8. Drain  
DFN3030 Plastic Package

### Key Parameters

| Parameter        | Value                        | Unit      |
|------------------|------------------------------|-----------|
| $BV_{DSS}$       | 40                           | V         |
| $R_{DS(ON)}$ Max | 16 @ $V_{GS} = 10\text{ V}$  | $m\Omega$ |
|                  | 20 @ $V_{GS} = 4.5\text{ V}$ |           |
| $V_{GS(th)}$ typ | 1.6                          | V         |
| $Q_g$ typ        | 22 @ $V_{GS} = 10\text{ V}$  | 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                |
| Drain Current - Continuous                       | $I_D$          | 29                        | A                |
|                                                  |                | 18                        |                  |
|                                                  |                | $T_c = 25^\circ\text{C}$  |                  |
|                                                  |                | $T_c = 100^\circ\text{C}$ |                  |
| Drain Current Pulsed <sup>1)</sup>               | $I_{DM}$       | 100                       | A                |
| Avalanche Current                                | $I_{AS}$       | 9.8                       | A                |
| Single Pulse Avalanche Energy <sup>2)</sup>      | $E_{AS}$       | 24                        | mJ               |
| Power Dissipation                                | $P_D$          | 23.3                      | W                |
|                                                  |                | $T_c = 25^\circ\text{C}$  |                  |
| Operating Junction and Storage Temperature Range | $T_j, T_{stg}$ | - 55 to + 150             | $^\circ\text{C}$ |

### Thermal Characteristics

| Parameter                                                 | Symbol          | Max. | Unit               |
|-----------------------------------------------------------|-----------------|------|--------------------|
| Thermal Resistance from Junction to Case                  | $R_{\theta JC}$ | 5.3  | $^\circ\text{C/W}$ |
| Thermal Resistance from Junction to Ambient <sup>3)</sup> | $R_{\theta JA}$ | 60   | $^\circ\text{C/W}$ |

<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  $T_{J(MAX)} = 150^\circ\text{C}$ .

<sup>2)</sup> Limited by  $T_{J(MAX)}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.5\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 9.8\text{ A}$ ,  $V_{GS} = 10\text{ V}$ .

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

**Characteristics at  $T_a = 25^\circ\text{C}$  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-Source Leakage Current<br>at $V_{GS} = \pm 20\ \text{V}$                                                                                                                    | $I_{GSS}$    | -      | -         | $\pm 100$ | nA            |
| Gate-Source Threshold Voltage<br>at $V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$                                                                                                 | $V_{GS(th)}$ | 1      | -         | 2.5       | V             |
| Drain-Source On-State Resistance<br>at $V_{GS} = 10\ \text{V}$ , $I_D = 10\ \text{A}$<br>at $V_{GS} = 4.5\ \text{V}$ , $I_D = 5\ \text{A}$                                       | $R_{DS(on)}$ | -<br>- | 12.7<br>- | 16<br>20  | m $\Omega$    |
| <b>DYNAMIC PARAMETERS</b>                                                                                                                                                        |              |        |           |           |               |
| Forward Transconductance<br>at $V_{DS} = 5\ \text{V}$ , $I_D = 5\ \text{A}$                                                                                                      | $g_{fs}$     | -      | 11.3      | -         | S             |
| Gate resistance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                      | $R_g$        | -      | 1.2       | -         | $\Omega$      |
| Input Capacitance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 20\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                   | $C_{iss}$    | -      | 1038      | -         | pF            |
| Output Capacitance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 20\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                  | $C_{oss}$    | -      | 83        | -         | pF            |
| Reverse Transfer Capacitance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 20\ \text{V}$ , $f = 1\ \text{MHz}$                                                                        | $C_{rss}$    | -      | 52        | -         | pF            |
| Gate charge total<br>at $V_{DS} = 20\ \text{V}$ , $I_D = 10\ \text{A}$ , $V_{GS} = 10\ \text{V}$<br>at $V_{DS} = 20\ \text{V}$ , $I_D = 10\ \text{A}$ , $V_{GS} = 4.5\ \text{V}$ | $Q_g$        | -<br>- | 22<br>10  | -<br>-    | nC            |
| Gate to Source Charge<br>at $V_{DS} = 20\ \text{V}$ , $I_D = 10\ \text{A}$ , $V_{GS} = 10\ \text{V}$                                                                             | $Q_{gs}$     | -      | 4         | -         | nC            |
| Gate to Drain Charge<br>at $V_{DS} = 20\ \text{V}$ , $I_D = 10\ \text{A}$ , $V_{GS} = 10\ \text{V}$                                                                              | $Q_{gd}$     | -      | 4         | -         | nC            |
| Turn-On Delay Time<br>at $V_{DS} = 20\ \text{V}$ , $I_D = 10\ \text{A}$ , $V_{GS} = 10\ \text{V}$ , $R_g = 3.3\ \Omega$                                                          | $t_{d(on)}$  | -      | 10        | -         | ns            |
| Turn-On Rise Time<br>at $V_{DS} = 20\ \text{V}$ , $I_D = 10\ \text{A}$ , $V_{GS} = 10\ \text{V}$ , $R_g = 3.3\ \Omega$                                                           | $t_r$        | -      | 21        | -         | ns            |
| Turn-Off Delay Time<br>at $V_{DS} = 20\ \text{V}$ , $I_D = 10\ \text{A}$ , $V_{GS} = 10\ \text{V}$ , $R_g = 3.3\ \Omega$                                                         | $t_{d(off)}$ | -      | 10        | -         | ns            |
| Turn-Off Fall Time<br>at $V_{DS} = 20\ \text{V}$ , $I_D = 10\ \text{A}$ , $V_{GS} = 10\ \text{V}$ , $R_g = 3.3\ \Omega$                                                          | $t_f$        | -      | 1.6       | -         | 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                                                                                                                                                    | $I_S$        | -      | -         | 29        | A             |
| Body-Diode Continuous Current, Pulsed                                                                                                                                            | $I_{SM}$     | -      | -         | 100       | A             |
| Body Diode Reverse Recovery Time<br>at $I_S = 10\ \text{A}$ , $di/dt = 100\ \text{A} / \mu\text{s}$                                                                              | $t_{rr}$     | -      | 9         | -         | ns            |
| Body Diode Reverse Recovery Charge<br>at $I_S = 10\ \text{A}$ , $di/dt = 100\ \text{A} / \mu\text{s}$                                                                            | $Q_{rr}$     | -      | 4         | -         | nC            |

Fig. 1 Typical Output Characteristics

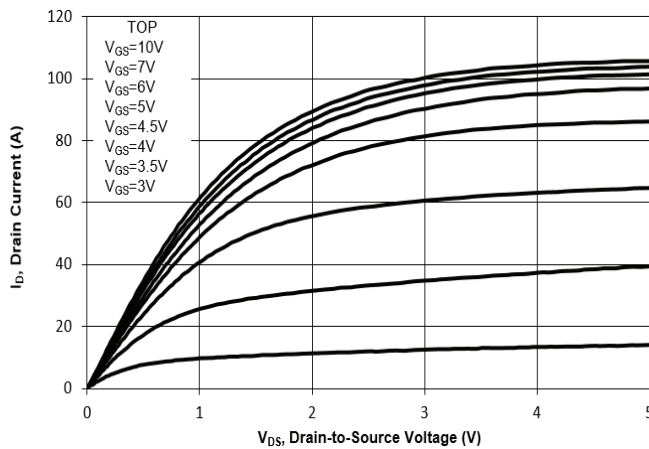


Fig. 2 Typical Transfer Characteristics

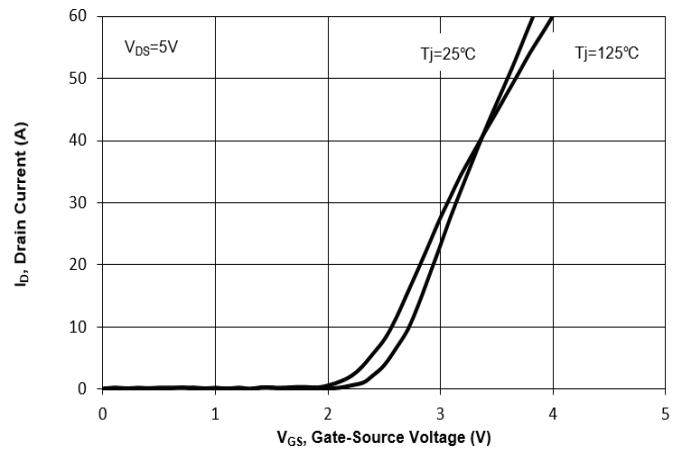


Fig. 3 On-Resistance vs. Drain Current

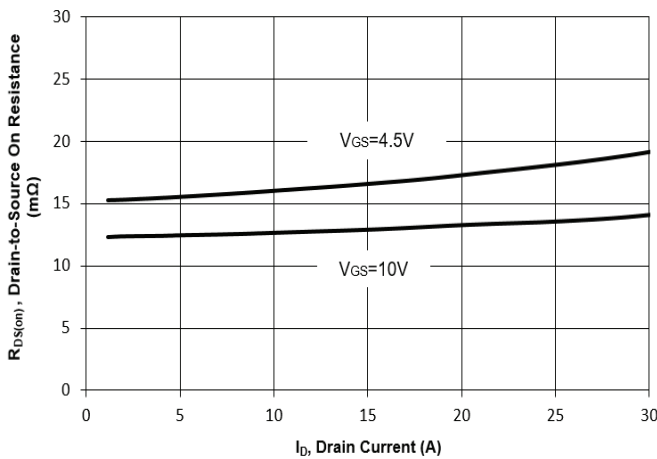


Fig. 4 On-Resistance vs. Gate to Source Voltage

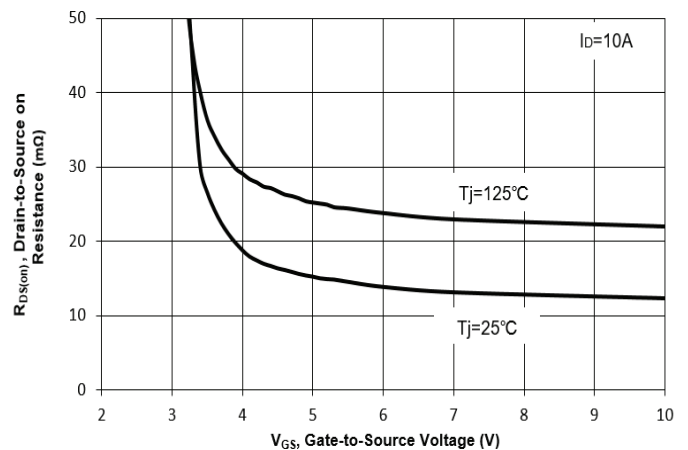


Fig. 5 On-Resistance vs.  $T_J$

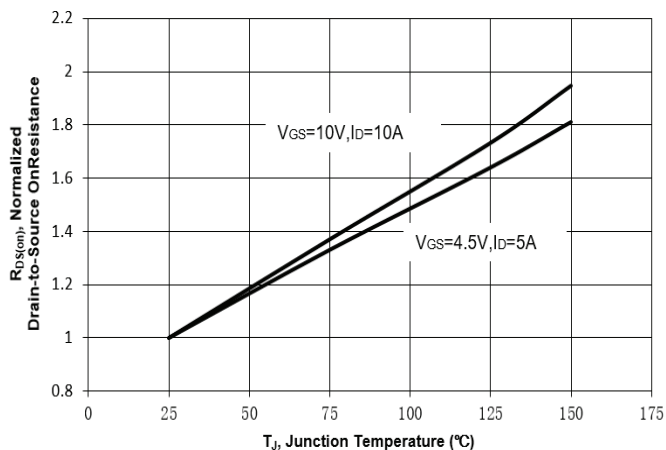
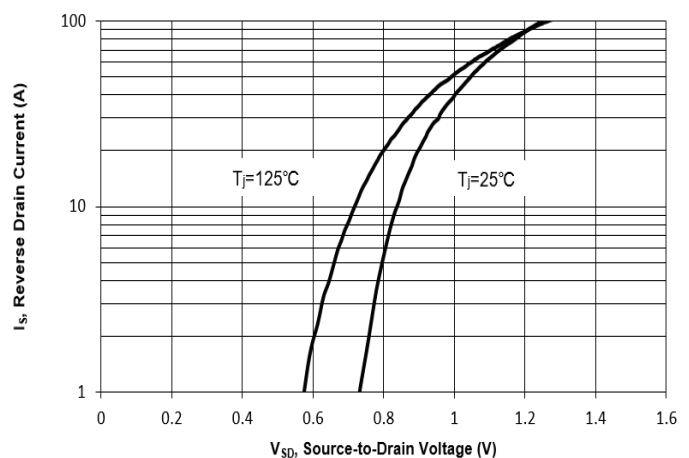


Fig. 6 Typical Body-Diode Forward Characteristics



## Electrical Characteristics Curves

Fig. 7 Typical Junction Capacitance

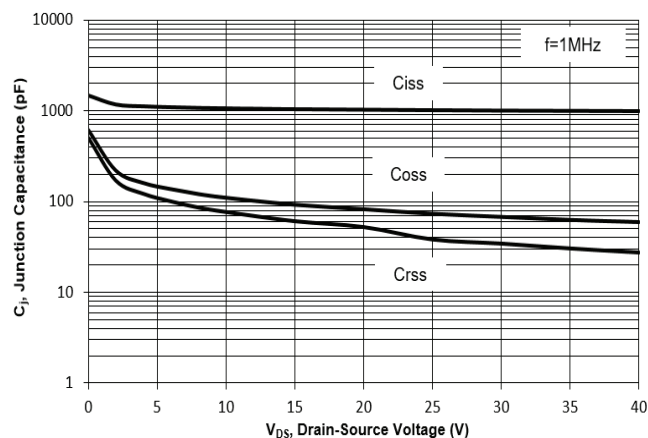


Fig. 8 Drain-Source Leakage Current vs. T<sub>J</sub>

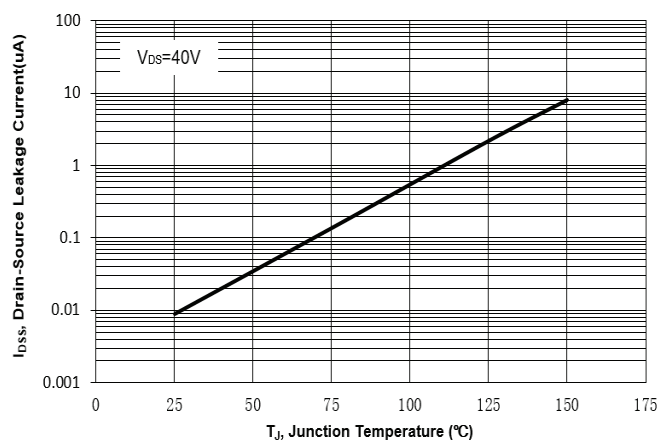


Fig. 9 V<sub>(BR)DSS</sub> vs. Junction Temperature

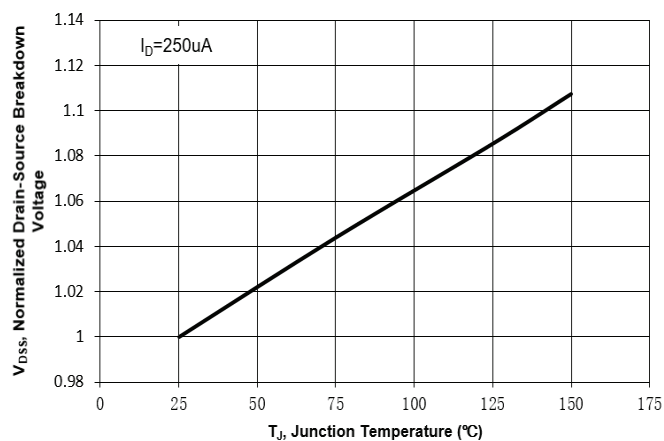


Fig. 10 Gate Threshold Variation vs. T<sub>J</sub>

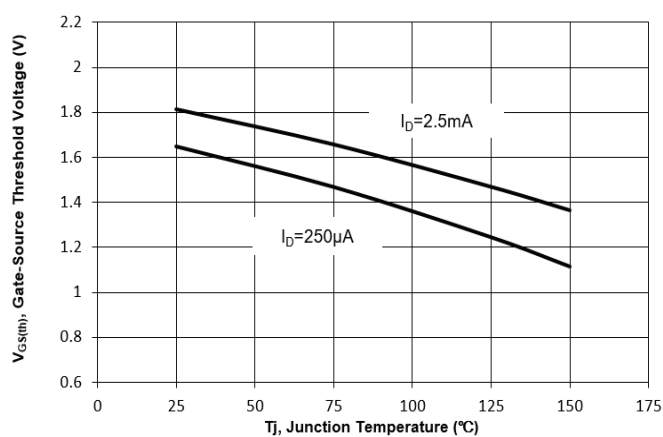


Fig. 11 Gate Charge

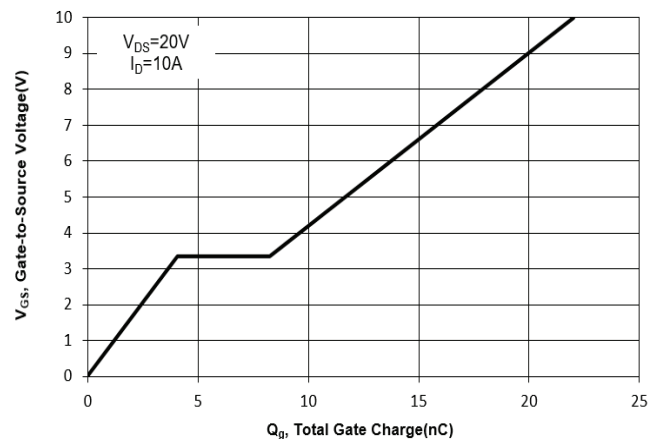
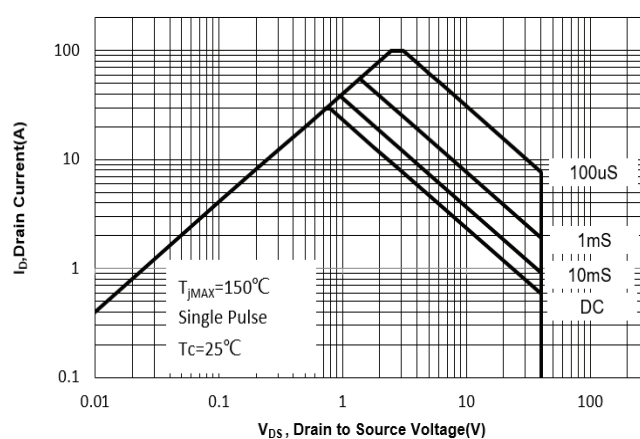


Fig. 12 Safe Operation Area



## Electrical Characteristics Curves

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

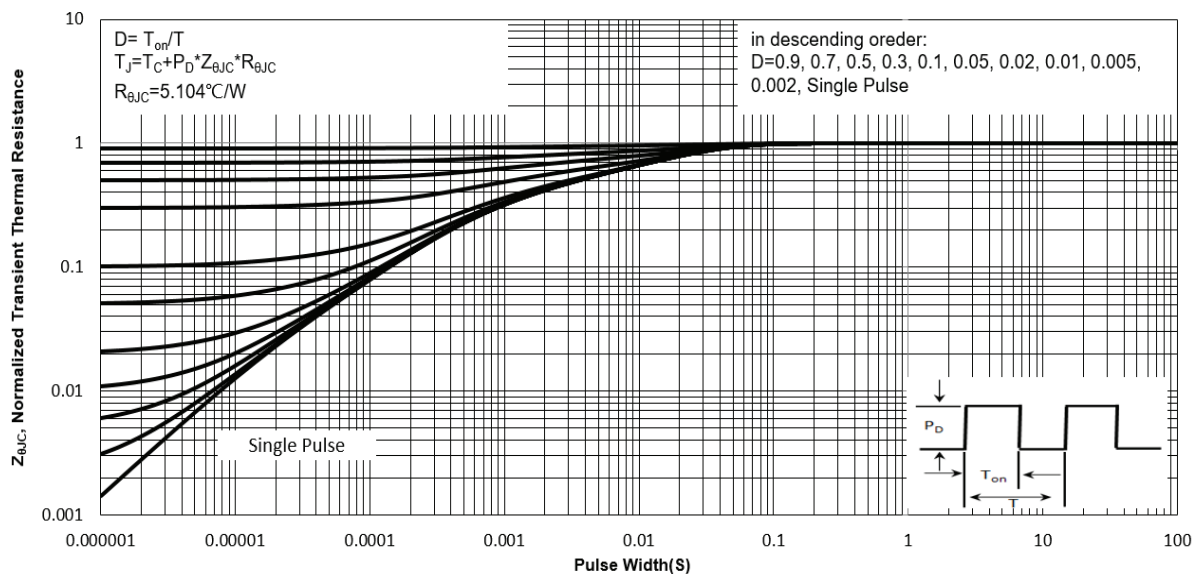
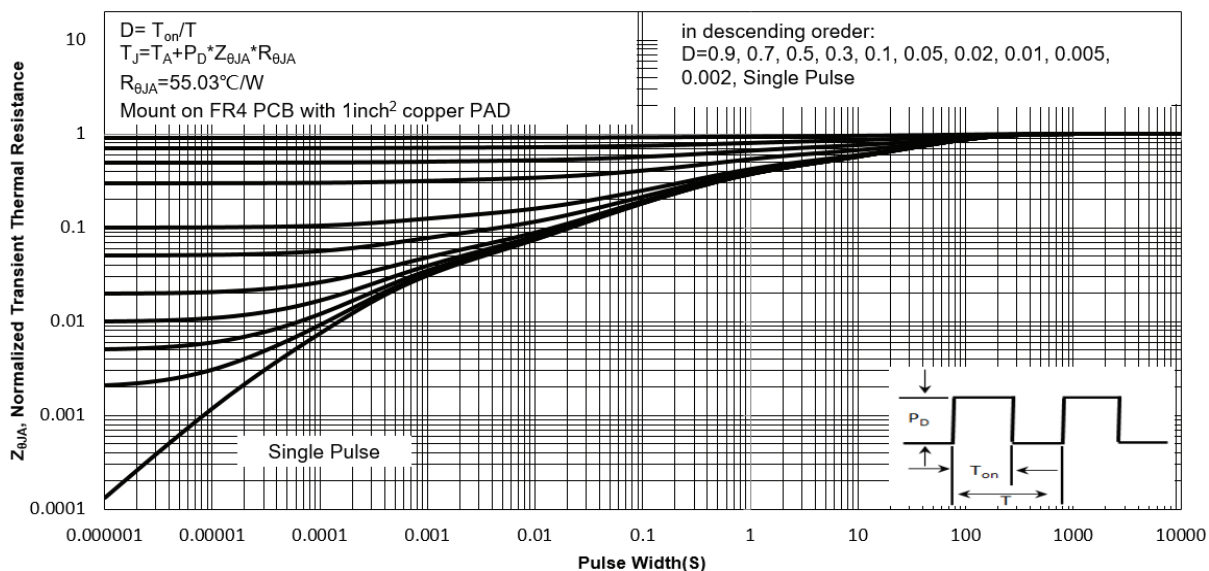


Fig.14 Normalized Maximum Transient Thermal Impedance( $Z_{\theta JA}$ )



## Test Circuits

Fig.1-1 Switching times test circuit

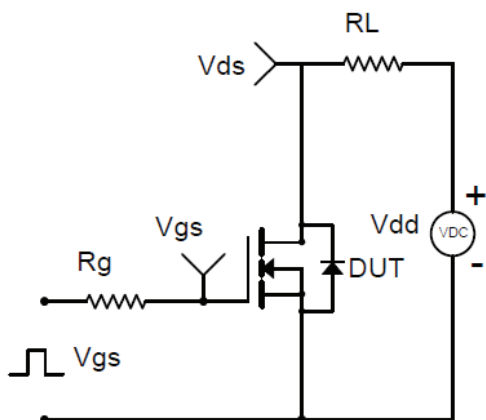


Fig.1-2 Switching Waveform

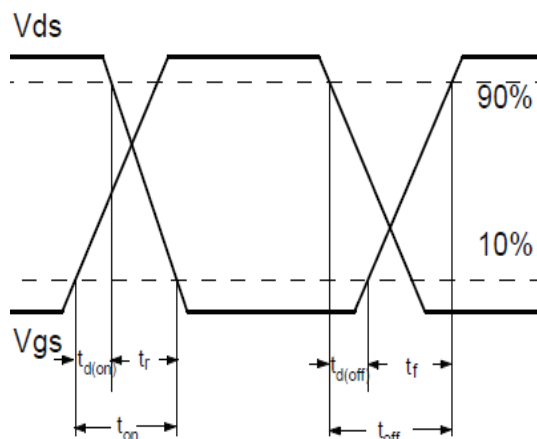


Fig.2-1 Gate charge test circuit

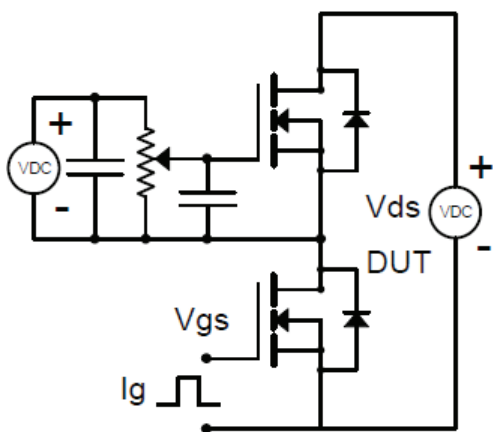


Fig.2-2 Gate charge waveform

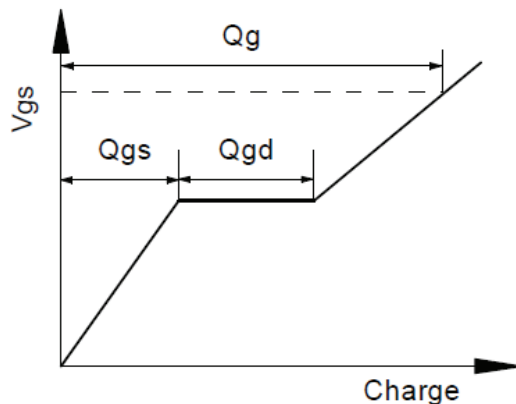


Fig.3-1 Avalanche test circuit

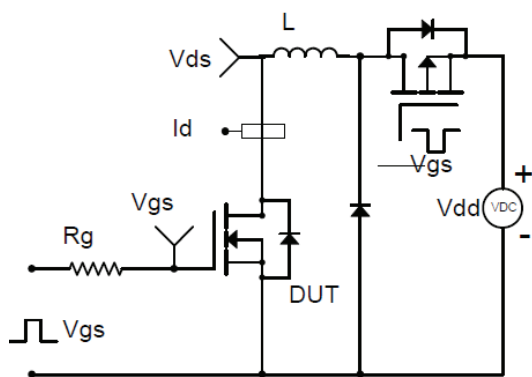
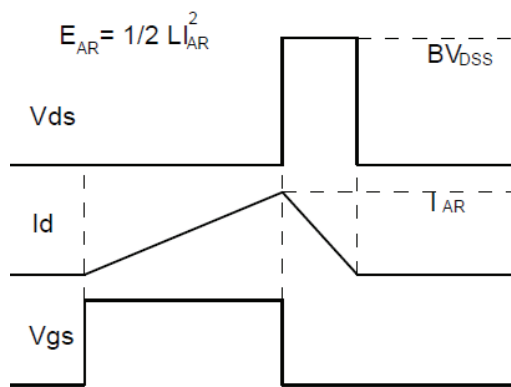
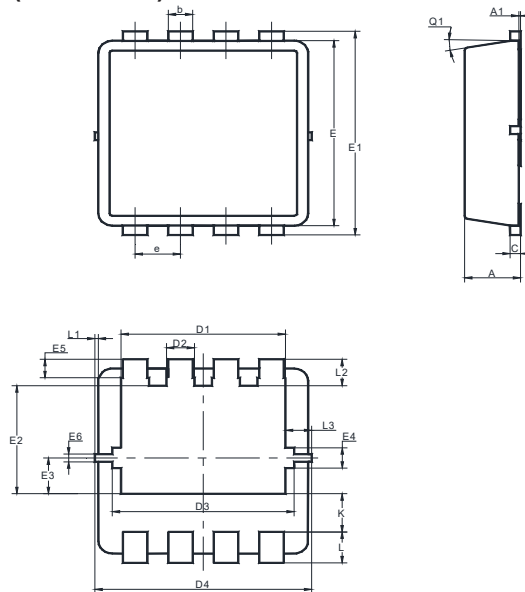


Fig.3-2 Avalanche waveform



Package Outline Dimensions (Units: mm)

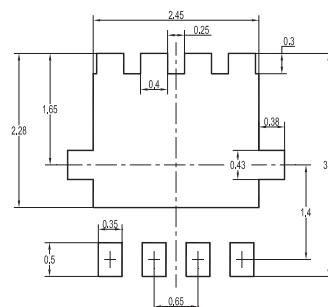
DFN3030



| UNIT | A   | A1   | b    | c    | D1  | D2  | D3  | D4  | E   | E1  | E2   | E3   | E4   |
|------|-----|------|------|------|-----|-----|-----|-----|-----|-----|------|------|------|
| mm   | 0.9 | 0.05 | 0.35 | 0.25 | 2.6 | 0.5 | 2.7 | 3.2 | 3.1 | 3.3 | 1.85 | 0.68 | 0.43 |
|      | 0.7 | 0    | 0.24 | 0.1  | 2.4 | 0.3 | 2.5 | 3   | 2.9 | 3.1 | 1.65 | 0.48 | 0.23 |

| UNIT | E5  | E6   | e   | K    | L   | L1  | L2   | L3    | θ1  |
|------|-----|------|-----|------|-----|-----|------|-------|-----|
| mm   | 0.4 | 0.25 | 0.7 | 0.72 | 0.5 | 0.1 | 0.53 | 0.475 | 12° |
|      | 0.2 | 0.15 | 0.6 | 0.52 | 0.3 | 0   | 0.33 | 0.275 | 0°  |

Recommended Soldering Footprint



Packing information

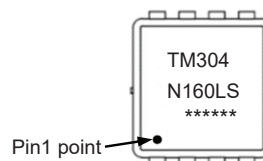
| Package | Tape Width (mm) | Pitch   |               | Reel Size |      | Per Reel Packing Quantity |
|---------|-----------------|---------|---------------|-----------|------|---------------------------|
|         |                 | mm      | inch          | mm        | inch |                           |
| DFN3030 | 12              | 8 ± 0.1 | 0.315 ± 0.004 | 330       | 13   | 5,000                     |

Marking information

" TM304N160LS " = Part No.

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

Font type: Arial



Disclaimer: Our company reserve the right to make modifications, enhancements, improvements, corrections or other changes to improve product design, functions and reliability, anytime without notice.