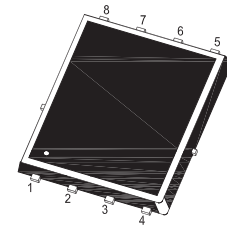
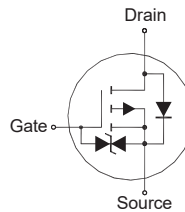


## P-Channel Enhancement Mode MOSFET

### Features

- Low  $R_{DS(ON)}$
- Surface-mounted package
- Built-in G-S Protection Diode
- Halogen and Antimony Free(HAF), RoHS compliant
- Typical ESD Protection HBM Class 2



1.Source 2.Source 3.Source 4.Gate  
5.Drain 6.Drain 7.Drain 8.Drain  
DFN5060 Plastic Package

| Classification | Voltage Range(V) |
|----------------|------------------|
| 0A             | < 125            |
| 0B             | 125 to < 250     |
| 1A             | 250 to < 500     |
| 1B             | 500 to < 1000    |
| 1C             | 1000 to < 2000   |
| 2              | 2000 to < 4000   |
| 3A             | 4000 to < 8000   |
| 3B             | ≥ 8000           |

### Key Parameters

| Parameter         | Value                    | Unit |
|-------------------|--------------------------|------|
| $-BV_{DS}$        | 30                       | V    |
| $R_{DS(ON)}$ Max  | 17.5 @ $-V_{GS} = 10$ V  | mΩ   |
|                   | 22.5 @ $-V_{GS} = 4.5$ V |      |
| $-V_{GS(th)}$ typ | 1.4                      | V    |
| $Q_g$ typ         | 22.9 @ $-V_{GS} = 10$ V  | nC   |

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

| Parameter                                        | Symbol         | Value         | Unit |
|--------------------------------------------------|----------------|---------------|------|
| Drain-Source Voltage                             | $-V_{DS}$      | 30            | V    |
| Gate-Source Voltage                              | $V_{GS}$       | ± 20          | V    |
| Drain Current                                    | $-I_D$         | 32            | A    |
| $T_c = 25^\circ\text{C}$                         |                | 20            |      |
| $T_c = 100^\circ\text{C}$                        |                |               |      |
| Peak Drain Current, Pulsed <sup>1)</sup>         | $-I_{DM}$      | 110           | A    |
| Single-Pulse Avalanche Current                   | $-I_{AS}$      | 23.8          | A    |
| Single-Pulse Avalanche Energy <sup>2)</sup>      | $E_{AS}$       | 28.3          | mJ   |
| Total Power Dissipation                          | $P_{tot}$      | 22.7          | W    |
| $T_c = 25^\circ\text{C}$                         |                |               |      |
| Operating Junction and Storage Temperature Range | $T_J, T_{stg}$ | - 55 to + 150 | °C   |

### Thermal Characteristics

| Parameter                                                 | Symbol          | Max. | Unit |
|-----------------------------------------------------------|-----------------|------|------|
| Thermal Resistance from Junction to Case                  | $R_{\theta JC}$ | 5.5  | °C/W |
| Thermal Resistance from Junction to Ambient <sup>3)</sup> | $R_{\theta JA}$ | 55   | °C/W |

<sup>1)</sup> Pulse Test: Pulse Width ≤ 100 μs, Duty Cycle ≤ 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  $T_J = 25^\circ\text{C}$ ,  $L = 0.1$  mH,  $R_g = 25$  Ω,  $I_{AS} = 23.8$  A,  $V_{GS} = 10$  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  $T_a = 25^\circ\text{C}$  unless otherwise specified

| Parameter                                                                                                                                                                            | Symbol        | Min.   | Typ.       | Max.         | Unit             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|------------|--------------|------------------|
| <b>STATIC PARAMETERS</b>                                                                                                                                                             |               |        |            |              |                  |
| Drain-Source Breakdown Voltage<br>at $-I_D = 250\ \mu\text{A}$                                                                                                                       | $-BV_{DS}$    | 30     | -          | -            | V                |
| Drain-Source Leakage Current<br>at $-V_{DS} = 24\ \text{V}$                                                                                                                          | $-I_{DSS}$    | -      | -          | 1            | $\mu\text{A}$    |
| Gate Leakage Current<br>at $V_{GS} = \pm 16\ \text{V}$                                                                                                                               | $I_{GSS}$     | -      | -          | $\pm 10$     | $\mu\text{A}$    |
| 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 $-V_{GS} = 10\ \text{V}$ , $-I_D = 6\ \text{A}$<br>at $-V_{GS} = 4.5\ \text{V}$ , $-I_D = 5\ \text{A}$                                        | $R_{DS(on)}$  | -<br>- | 11.7<br>-  | 17.5<br>22.5 | $\text{m}\Omega$ |
| <b>DYNAMIC PARAMETERS</b>                                                                                                                                                            |               |        |            |              |                  |
| Forward Transconductance<br>at $-V_{DS} = 5\ \text{V}$ , $-I_D = 5\ \text{A}$                                                                                                        | $g_{FS}$      | -      | 14         | -            | S                |
| Gate Resistance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                          | $R_g$         | -      | 7.6        | -            | $\Omega$         |
| Input Capacitance<br>at $-V_{DS} = 15\ \text{V}$ , $V_{GS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                      | $C_{iss}$     | -      | 1287       | -            | pF               |
| Output Capacitance<br>at $-V_{DS} = 15\ \text{V}$ , $V_{GS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                     | $C_{oss}$     | -      | 138        | -            | pF               |
| Reverse Transfer Capacitance<br>at $-V_{DS} = 15\ \text{V}$ , $V_{GS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                           | $C_{rss}$     | -      | 93         | -            | pF               |
| Total Gate Charge<br>at $-V_{GS} = 10\ \text{V}$ , $-V_{DS} = 15\ \text{V}$ , $-I_D = 6\ \text{A}$<br>at $-V_{GS} = 4.5\ \text{V}$ , $-V_{DS} = 15\ \text{V}$ , $-I_D = 6\ \text{A}$ | $Q_g$         | -<br>- | 22.9<br>11 | -<br>-       | nC               |
| Gate-Source Charge<br>at $-V_{GS} = 10\ \text{V}$ , $-V_{DS} = 15\ \text{V}$ , $-I_D = 6\ \text{A}$                                                                                  | $Q_{gs}$      | -      | 3.6        | -            | nC               |
| Gate-Drain Charge<br>at $-V_{GS} = 10\ \text{V}$ , $-V_{DS} = 15\ \text{V}$ , $-I_D = 6\ \text{A}$                                                                                   | $Q_{gd}$      | -      | 4.2        | -            | nC               |
| Turn-On Delay Time<br>at $-V_{GS} = 10\ \text{V}$ , $-V_{DS} = 15\ \text{V}$ , $-I_D = 6\ \text{A}$ , $R_g = 3.3\ \Omega$                                                            | $t_{d(on)}$   | -      | 8.5        | -            | ns               |
| Turn-On Rise Time<br>at $-V_{GS} = 10\ \text{V}$ , $-V_{DS} = 15\ \text{V}$ , $-I_D = 6\ \text{A}$ , $R_g = 3.3\ \Omega$                                                             | $t_r$         | -      | 21         | -            | ns               |
| Turn-Off Delay Time<br>at $-V_{GS} = 10\ \text{V}$ , $-V_{DS} = 15\ \text{V}$ , $-I_D = 6\ \text{A}$ , $R_g = 3.3\ \Omega$                                                           | $t_{d(off)}$  | -      | 18         | -            | ns               |
| Turn-Off Fall Time<br>at $-V_{GS} = 10\ \text{V}$ , $-V_{DS} = 15\ \text{V}$ , $-I_D = 6\ \text{A}$ , $R_g = 3.3\ \Omega$                                                            | $t_f$         | -      | 3.5        | -            | 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                                                                                                                                                        | $-I_S$        | -      | -          | 32           | A                |
| Body-Diode Continuous Current, Pulsed                                                                                                                                                | $-I_{SM}$     | -      | -          | 110          | A                |
| Body Diode Reverse Recovery Time<br>at $-I_S = 6\ \text{A}$ , $di/dt = 100\ \text{A}/\mu\text{s}$                                                                                    | $t_{rr}$      | -      | 9.1        | -            | ns               |
| Body Diode Reverse Recovery Charge<br>at $-I_S = 6\ \text{A}$ , $di/dt = 100\ \text{A}/\mu\text{s}$                                                                                  | $Q_{rr}$      | -      | 2.5        | -            | nC               |

## Electrical Characteristics Curves

Fig. 1 Typical Output Characteristics

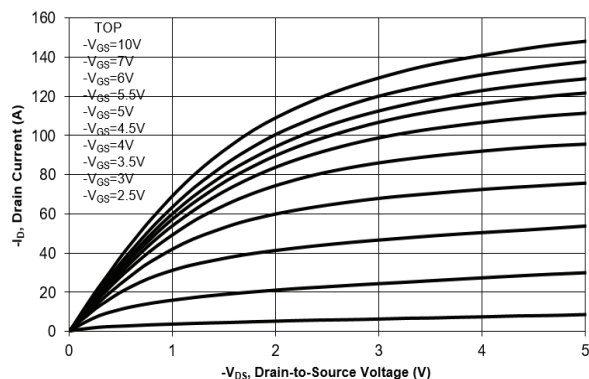


Fig. 2 Typical Transfer Characteristics

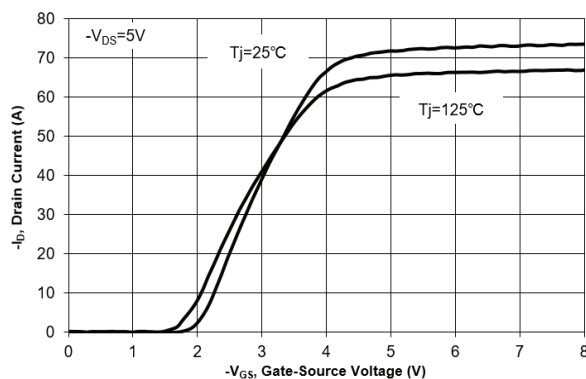


Fig. 3 on-Resistance vs. Drain Current

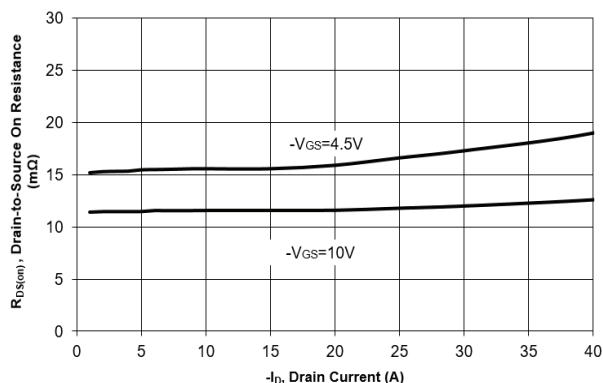


Fig. 4 on-Resistance vs. Gate to Source Voltage

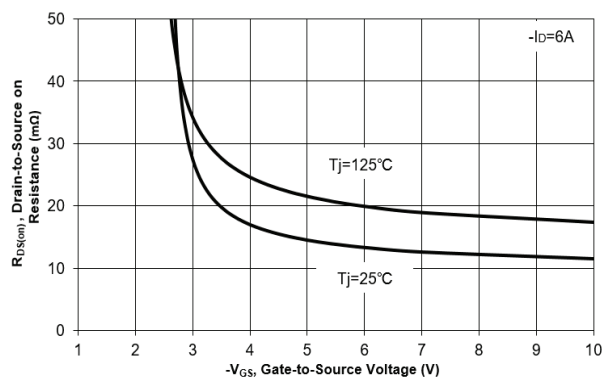


Fig. 5 on-Resistance vs. T<sub>J</sub>

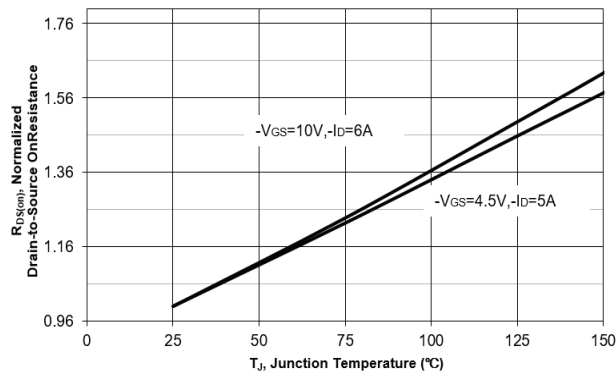
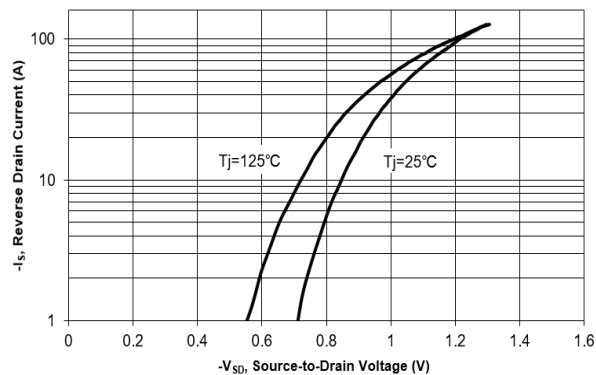


Fig. 6 Typical Body-Diode Forward Characteristics



## Electrical Characteristics Curves

Fig. 7 Typical Junction Capacitance

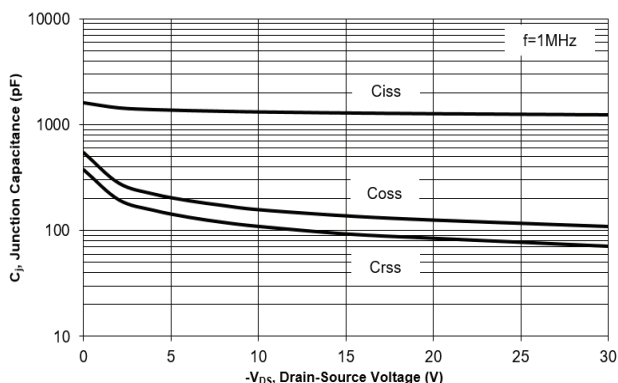


Fig. 8 Drain-Source Leakage Current vs.  $T_J$

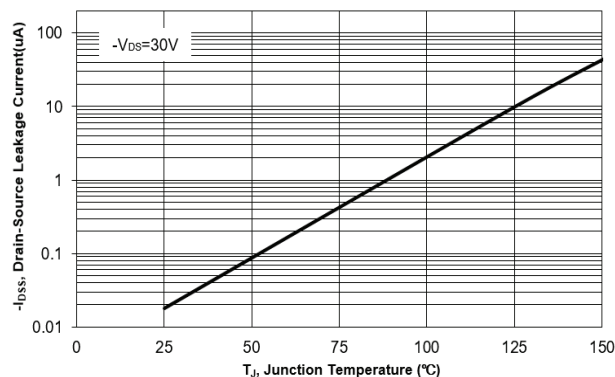


Fig. 9  $V_{(BR)DSS}$  vs. Junction Temperature

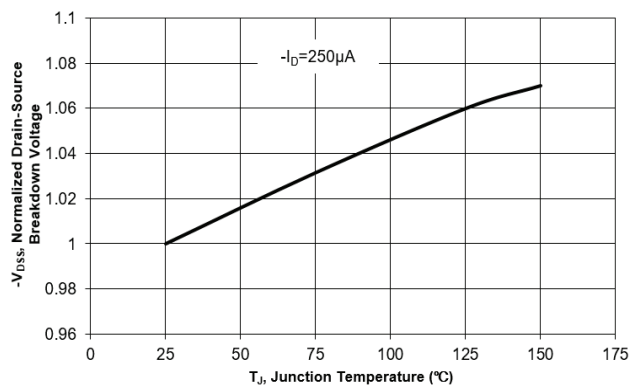


Fig. 10 Gate Threshold Variation vs.  $T_J$

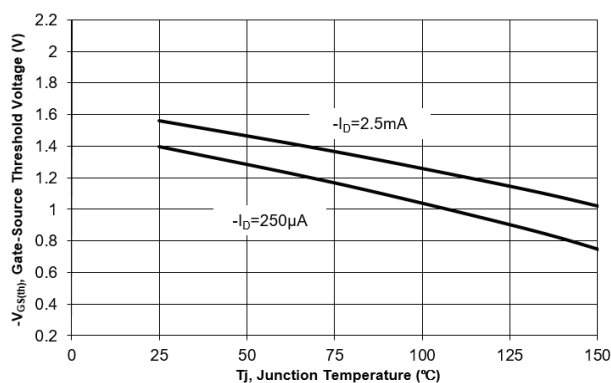


Fig. 11 Gate Charge

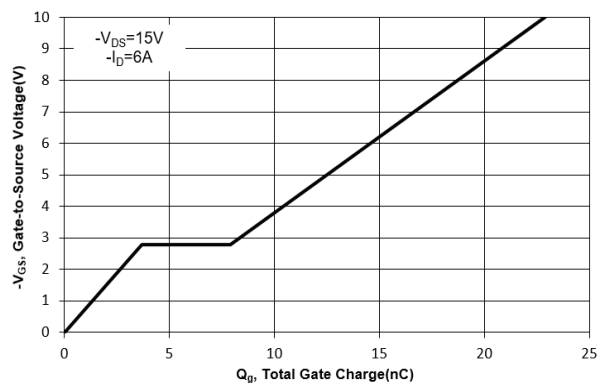


Fig. 12 Safe Operation Area

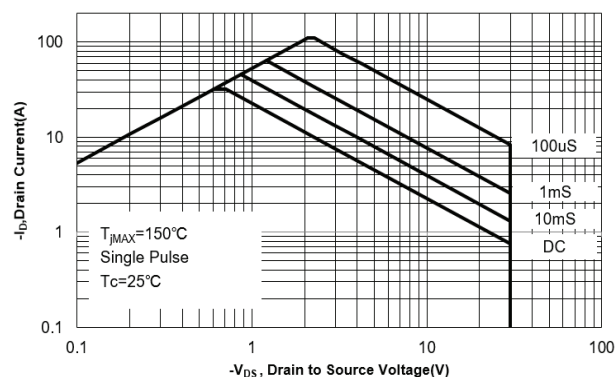


Fig. 13 Normalized Maximum Transient Thermal Impedance( $z_{\theta JC}$ )

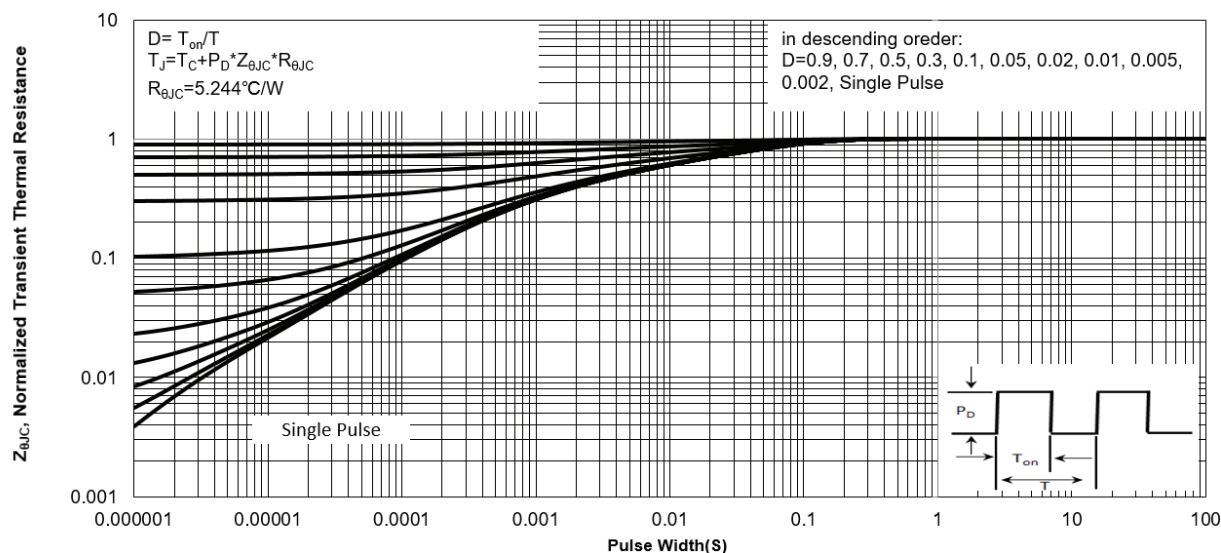
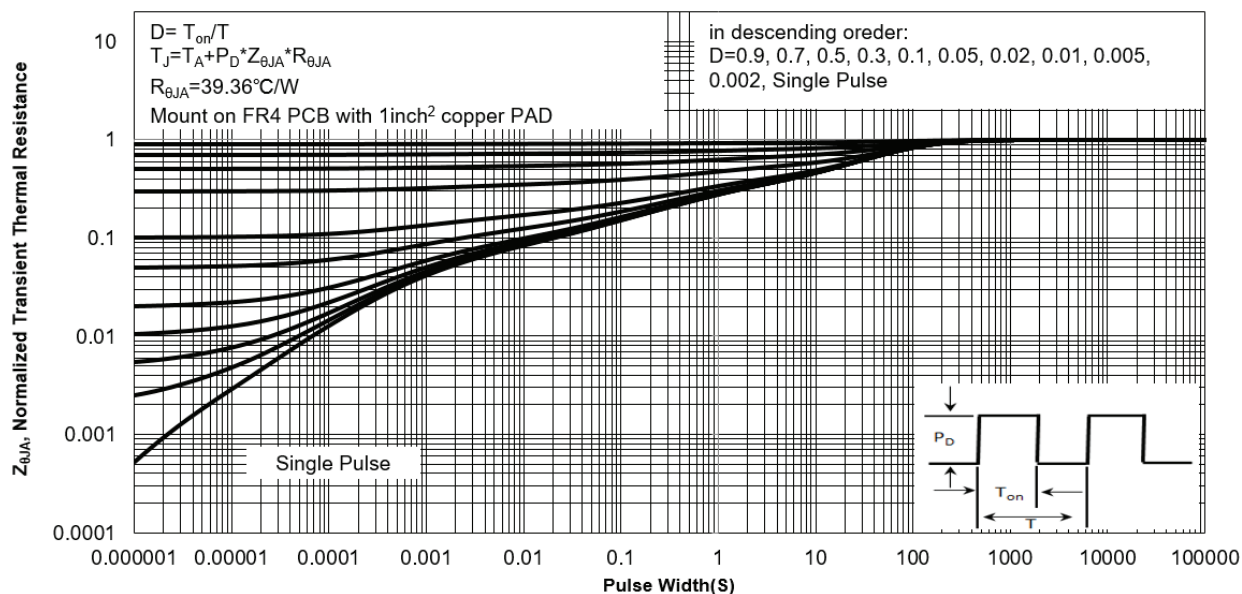


Fig. 14 Normalized Maximum Transient Thermal Impedance( $z_{\theta JA}$ )



## Test Circuits

Fig.1-1 Switching times test circuit

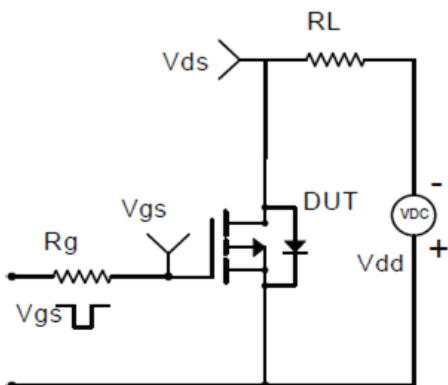


Fig.1-2 Switching Waveform

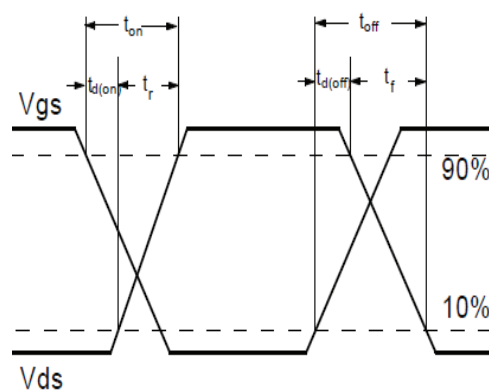


Fig.2-1 Gate charge test circuit

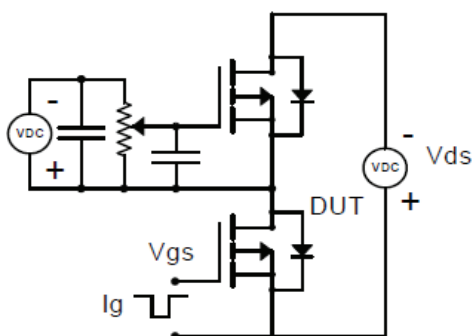


Fig.2-2 Gate charge waveform

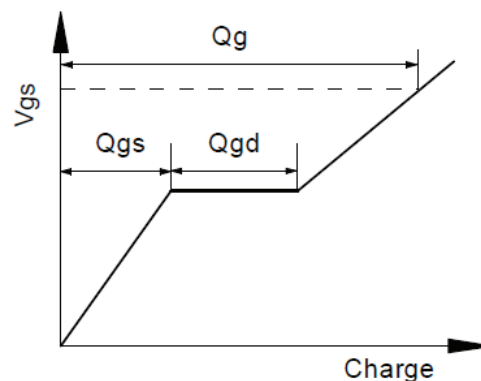


Fig.3-1 Avalanche test circuit

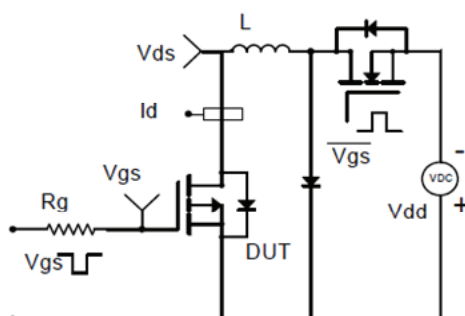
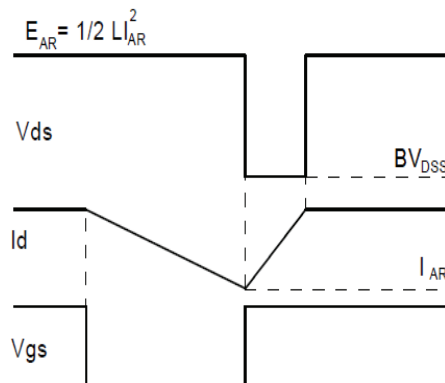
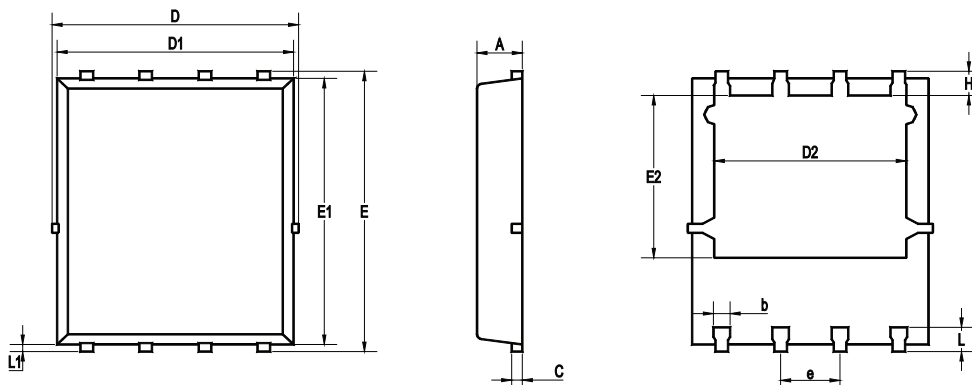


Fig.3-2 Avalanche waveform



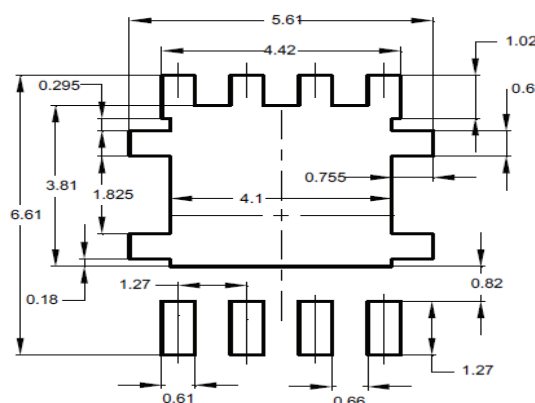
Package Outline Dimensions (Units: mm)

DFN5060



| UNIT | A    | b    | C    | D    | D1  | D2   | E    | E1  | E2   | e    | L    | L1   | H    |
|------|------|------|------|------|-----|------|------|-----|------|------|------|------|------|
| mm   | 1.12 | 0.51 | 0.34 | 5.26 | 5.1 | 4.5  | 6.25 | 6   | 3.66 | 1.37 | 0.71 | 0.2  | 0.71 |
|      | 0.9  | 0.33 | 0.11 | 4.7  | 4.7 | 3.56 | 5.75 | 5.6 | 3.18 | 1.17 | 0.35 | 0.06 | 0.35 |

Recommended Soldering Footprint



Packing information

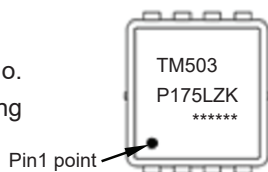
| Package | Tape Width (mm) | Pitch   |               | Reel Size |      | Per Reel Packing Quantity |
|---------|-----------------|---------|---------------|-----------|------|---------------------------|
|         |                 | mm      | inch          | mm        | inch |                           |
| DFN5060 | 12              | 8 ± 0.1 | 0.315 ± 0.004 | 330       | 13   | 5,000                     |

Marking information

" TM503P175LZK " = Part No.

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

Font type: Arial



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