

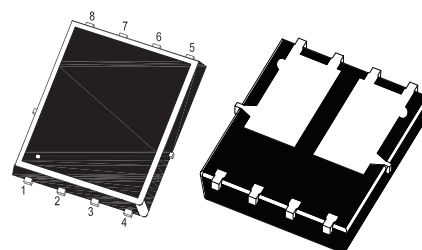
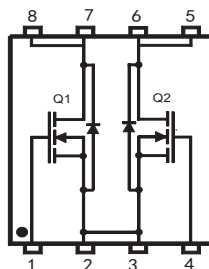
## Dual N-Channel Enhancement Mode MOSFET

### Features

- Low  $R_{DS(ON)}$
- Fully Characterized Capacitance and Avalanche
- Halogen and Antimony Free(HAF), RoHS compliant

### Application

- Synchronous Rectification
- BLDC Motor drive applications
- Battery powered circuits



Q1: 1.Gate 2. Source 7.Drain 8.Drain  
Q2: 3.Source 4.Gate 5.Drain 6.Drain  
DFN5060 Plastic Package

### Key Parameters(Q1/Q2)

| Parameter        | Value                 | Unit       |
|------------------|-----------------------|------------|
| $BV_{DSS}$       | 100                   | V          |
| $R_{DS(ON)}$ Max | 22 @ $V_{GS} = 10$ V  | m $\Omega$ |
|                  | 26 @ $V_{GS} = 4.5$ V |            |
| $V_{GS(th)}$ typ | 1.9                   | V          |
| $Q_g$ typ        | 22 @ $V_{GS} = 10$ V  | nC         |

### Absolute Maximum Ratings (at $T_a = 25^\circ\text{C}$ unless otherwise specified)(Q1\Q2)

| Parameter                                        | Symbol         | Value         | Unit             |
|--------------------------------------------------|----------------|---------------|------------------|
| Drain-Source Voltage                             | $V_{DS}$       | 100           | V                |
| Gate-Source Voltage                              | $V_{GS}$       | $\pm 20$      | V                |
| Continuous Drain Current                         | $I_D$          | 34            | A                |
|                                                  |                | 24            |                  |
| Peak Drain Current, Pulsed <sup>1)</sup>         | $I_{DM}$       | 120           | A                |
| Avalanche Current                                | $I_{AS}$       | 17.4          | A                |
| Single Pulse Avalanche Energy <sup>2)</sup>      | $E_{AS}$       | 15            | mJ               |
| Total Power Dissipation                          | $P_{tot}$      | 79            | W                |
| Operating Junction and Storage Temperature Range | $T_J, T_{stg}$ | - 55 to + 175 | $^\circ\text{C}$ |

### Thermal Characteristics(Q1\Q2)

| Parameter                                                 | Symbol          | Max. | Unit               |
|-----------------------------------------------------------|-----------------|------|--------------------|
| Thermal Resistance from Junction to Case $t \leq 10$ ms   | $R_{\theta JC}$ | 1.9  | $^\circ\text{C/W}$ |
| Thermal Resistance from Junction to Case                  | $R_{\theta JC}$ | 3.8  | $^\circ\text{C/W}$ |
| Thermal Resistance from Junction to Ambient <sup>3)</sup> | $R_{\theta JA}$ | 80   | $^\circ\text{C/W}$ |

<sup>1)</sup> Pulse Test: Pulse Width  $\leq 100$   $\mu\text{s}$ , 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  $T_J = 25^\circ\text{C}$ ,  $L = 0.1$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 17.4$  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(Q1\Q2)**

| Parameter                                                                                                                                                                        | Symbol       | Min.   | Typ.       | Max.      | Unit          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------|------------|-----------|---------------|
| <b>STATIC PARAMETERS</b>                                                                                                                                                         |              |        |            |           |               |
| Drain-Source Breakdown Voltage<br>at $I_D = 250\ \mu\text{A}$                                                                                                                    | $BV_{DSS}$   | 100    | -          | -         | V             |
| Drain-Source Leakage Current<br>at $V_{DS} = 80\ \text{V}$                                                                                                                       | $I_{DSS}$    | -      | -          | 1         | $\mu\text{A}$ |
| Gate 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    | -          | 2.5       | V             |
| Drain-Source On-State Resistance<br>at $V_{GS} = 10\ \text{V}$ , $I_D = 7\ \text{A}$<br>at $V_{GS} = 4.5\ \text{V}$ , $I_D = 5\ \text{A}$                                        | $R_{DS(on)}$ | -<br>- | -<br>-     | 22<br>26  | m $\Omega$    |
| <b>DYNAMIC PARAMETERS</b>                                                                                                                                                        |              |        |            |           |               |
| Forward Transconductance<br>at $V_{DS} = 5\ \text{V}$ , $I_D = 7\ \text{A}$                                                                                                      | $g_{fs}$     | -      | 15.8       | -         | S             |
| Gate resistance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                      | $R_g$        | -      | 0.6        | -         | $\Omega$      |
| Input Capacitance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 25\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                   | $C_{iss}$    | -      | 1054       | -         | pF            |
| Output Capacitance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 25\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                  | $C_{oss}$    | -      | 446        | -         | pF            |
| Reverse Transfer Capacitance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 25\ \text{V}$ , $f = 1\ \text{MHz}$                                                                        | $C_{rss}$    | -      | 36         | -         | pF            |
| Gate charge total<br>at $V_{DS} = 50\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 20\ \text{A}$<br>at $V_{DS} = 50\ \text{V}$ , $V_{GS} = 4.5\ \text{V}$ , $I_D = 20\ \text{A}$ | $Q_g$        | -<br>- | 22<br>11.5 | -<br>-    | nC            |
| Gate to Source Charge<br>at $V_{DS} = 50\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 20\ \text{A}$                                                                             | $Q_{gs}$     | -      | 4.6        | -         | nC            |
| Gate to Drain Charge<br>at $V_{DS} = 50\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 20\ \text{A}$                                                                              | $Q_{gd}$     | -      | 6.3        | -         | nC            |
| Turn-On Delay Time<br>at $V_{DS} = 50\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 20\ \text{A}$ , $R_g = 3\ \Omega$                                                            | $t_{d(on)}$  | -      | 11         | -         | ns            |
| Turn-On Rise Time<br>at $V_{DS} = 50\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 20\ \text{A}$ , $R_g = 3\ \Omega$                                                             | $t_r$        | -      | 17         | -         | ns            |
| Turn-Off Delay Time<br>at $V_{DS} = 50\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 20\ \text{A}$ , $R_g = 3\ \Omega$                                                           | $t_{d(off)}$ | -      | 10         | -         | ns            |
| Turn-Off Fall Time<br>at $V_{DS} = 50\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 20\ \text{A}$ , $R_g = 3\ \Omega$                                                            | $t_f$        | -      | 2          | -         | 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                                                                                                                                                    | $I_S$        | -      | -          | 34        | A             |
| Body-Diode Continuous Current, Pulsed                                                                                                                                            | $I_{SM}$     | -      | -          | 120       | A             |
| Body Diode Reverse Recovery Time<br>at $I_S = 7\ \text{A}$ , $di/dt = 100\ \text{A} / \mu\text{s}$                                                                               | $t_{rr}$     | -      | 40         | -         | ns            |
| Body Diode Reverse Recovery Charge<br>at $I_S = 7\ \text{A}$ , $di/dt = 100\ \text{A} / \mu\text{s}$                                                                             | $Q_{rr}$     | -      | 30         | -         | nC            |

## Electrical Characteristics Curves(Q1/Q2)

Fig. 1 Typical Output Characteristics

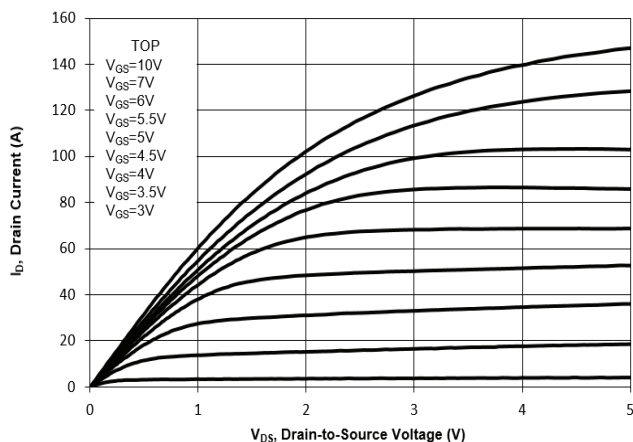


Fig. 2 Typical Transfer Characteristics

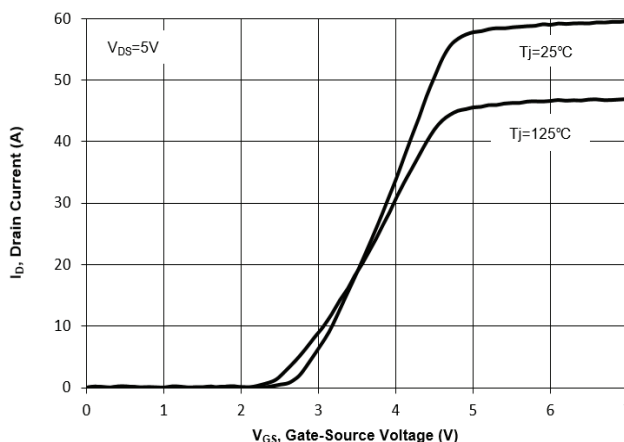


Fig. 3 On-Resistance vs. Drain Current

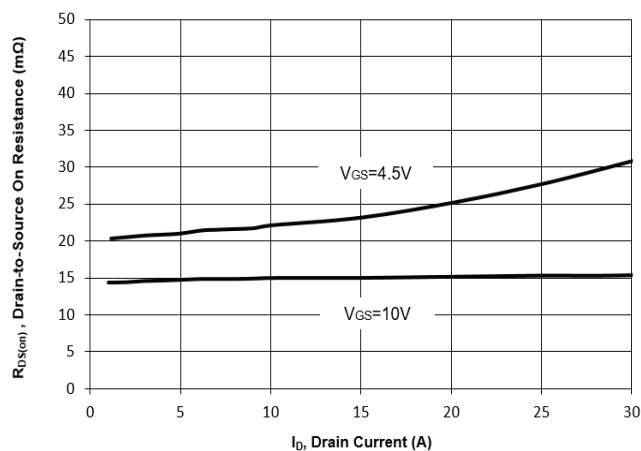


Fig. 4 On-Resistance vs. Gate to Source Voltage

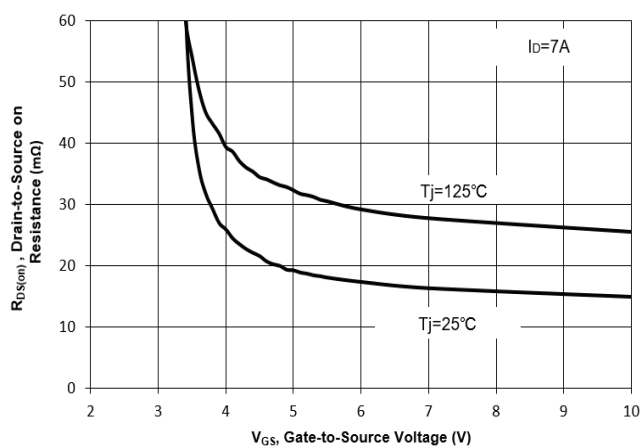


Fig. 5 On-Resistance vs.  $T_J$

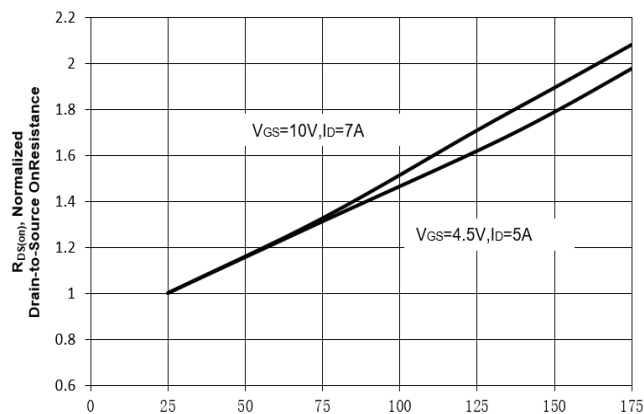
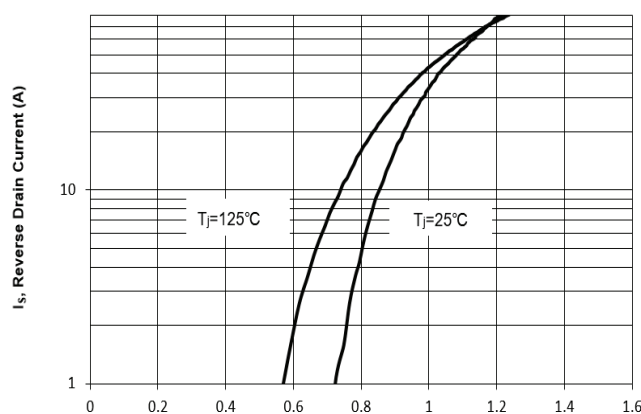


Fig. 6 Typical Body-Diode Forward Characteristics



# Electrical Characteristics Curves(Q1/Q2)

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

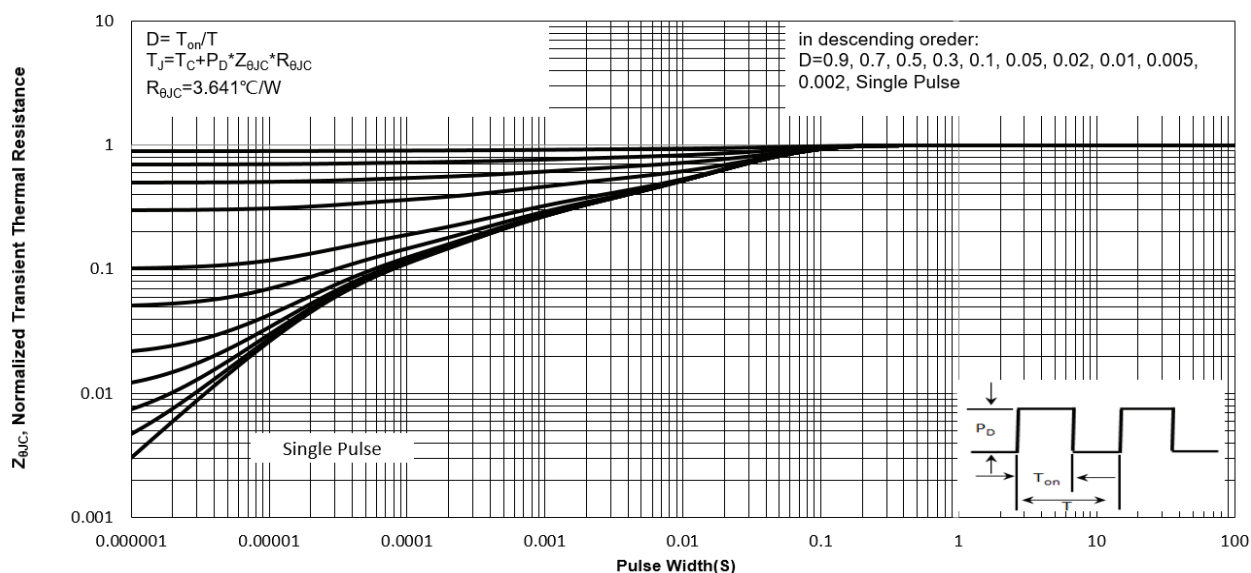


Fig. 14 Normalized Maximum Transient Thermal Impedance( $Z_{\theta JA}$ )

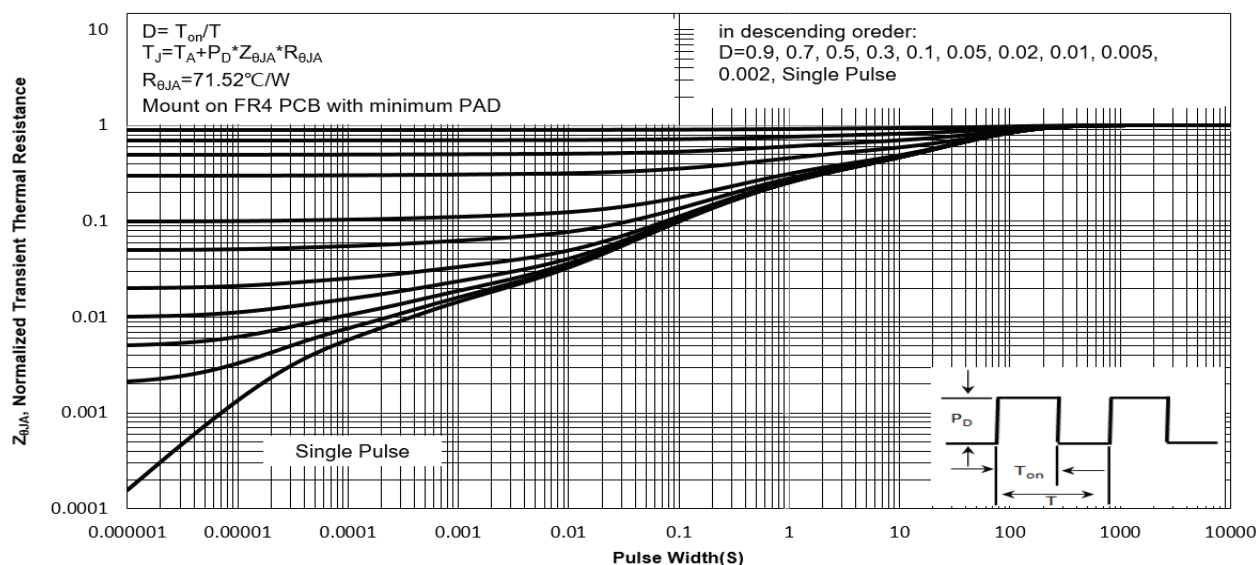


Fig. 7 Typical Junction Capacitance

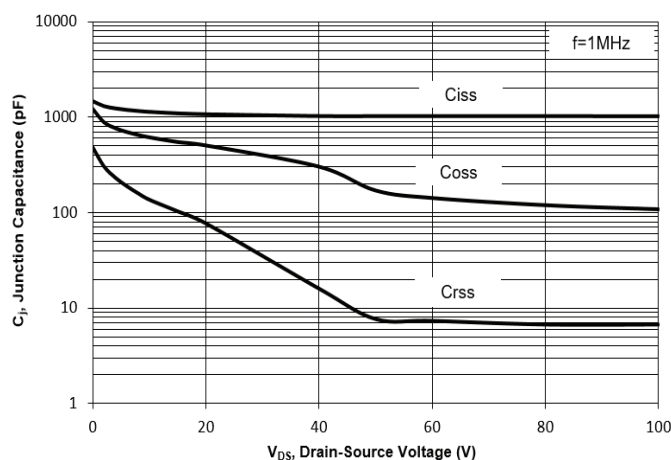


Fig. 8 Drain-Source Leakage Current vs.  $T_j$

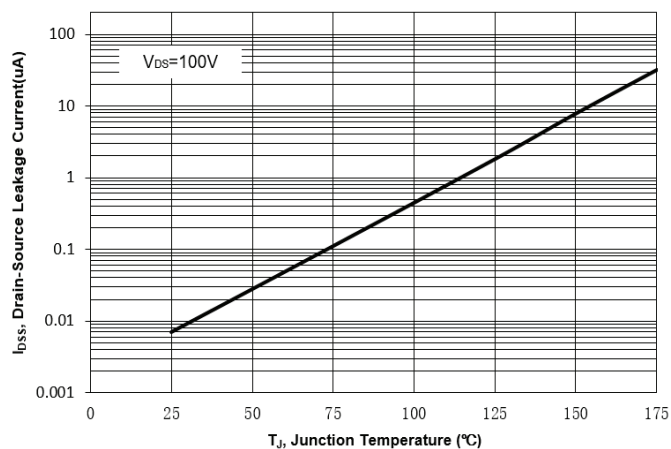


Fig. 9  $V_{(BR)DSS}$  vs. Junction Temperature

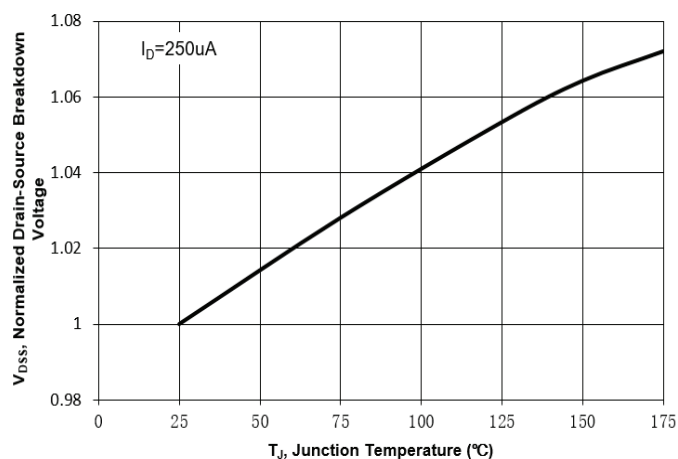


Fig. 10 Gate Threshold Variation vs.  $T_j$

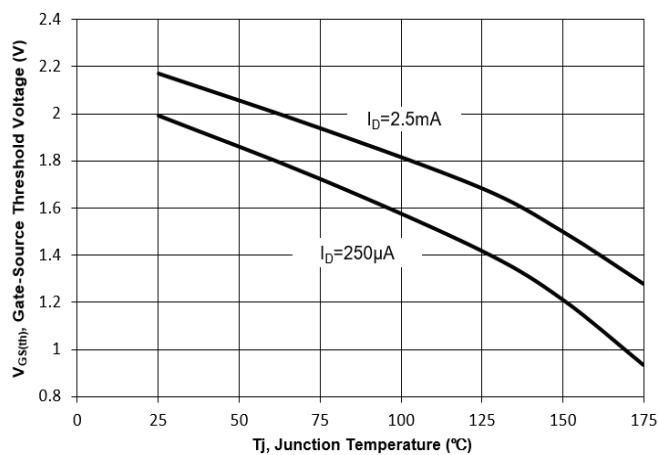


Fig. 11 Gate Charge

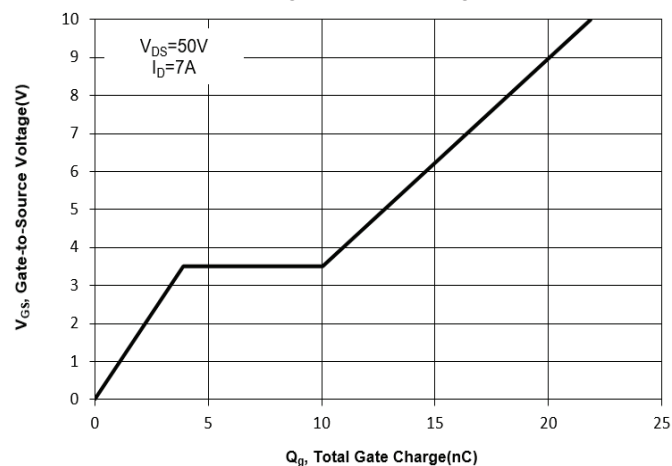
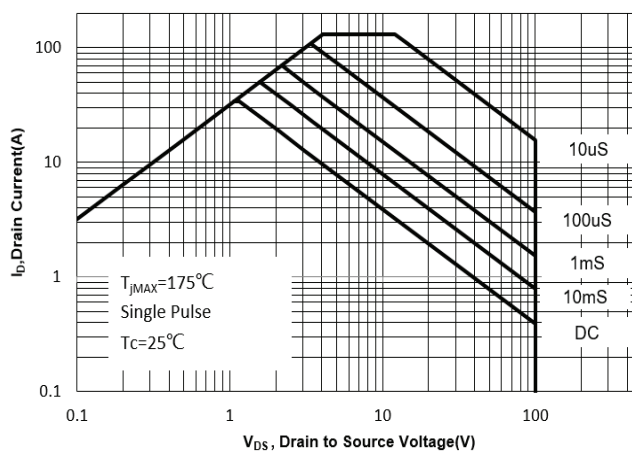


Fig. 12 Safe Operation Area



### Test Circuits(Q1/Q2)

Fig.1-1 Switching times test circuit

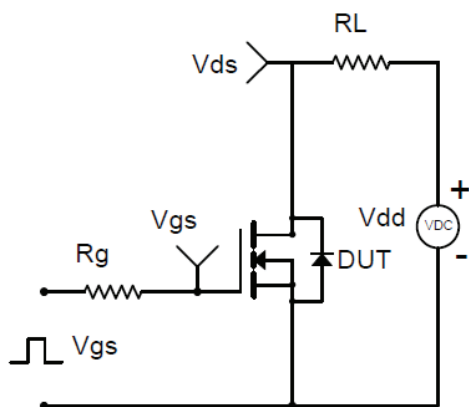


Fig.1-2 Switching Waveform

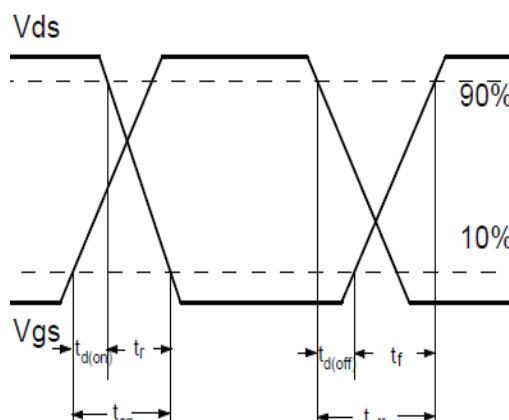


Fig.2-1 Gate charge test circuit

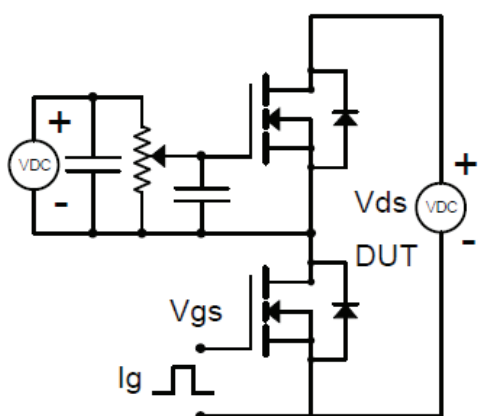


Fig.2-2 Gate charge waveform

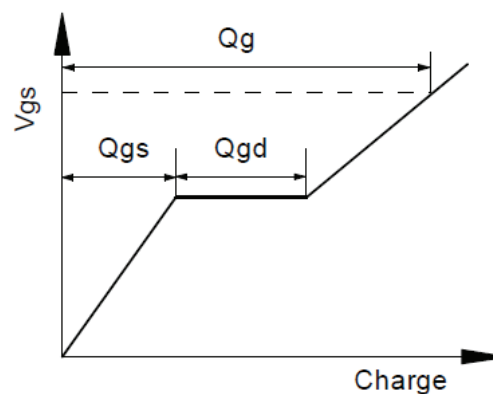


Fig.3-1 Avalanche test circuit

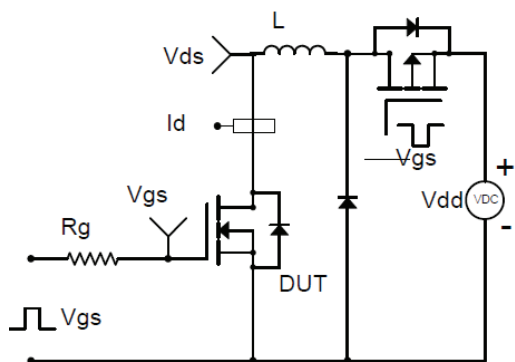
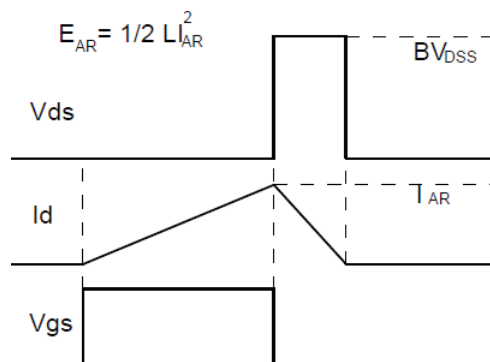
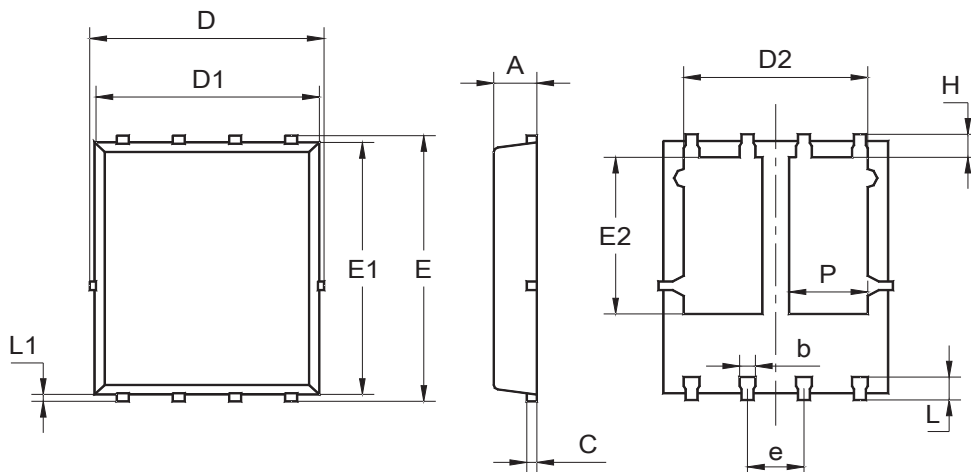


Fig.3-2 Avalanche waveform



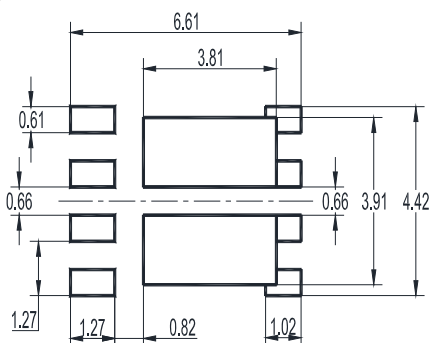
Package Outline Dimensions (Units: mm)

DFN5060



| Unit | A           | b            | C            | D           | D1         | D2          | E            | E1       | E2           | e            | L            | L1          | H            | P          |
|------|-------------|--------------|--------------|-------------|------------|-------------|--------------|----------|--------------|--------------|--------------|-------------|--------------|------------|
| mm   | 1.12<br>0.9 | 0.51<br>0.33 | 0.34<br>0.11 | 5.26<br>4.7 | 5.1<br>4.7 | 4.5<br>3.56 | 6.25<br>5.75 | 6<br>5.6 | 3.66<br>3.18 | 1.37<br>1.17 | 0.71<br>0.35 | 0.2<br>0.06 | 0.71<br>0.35 | 2.0<br>1.6 |

Recommended Soldering Footprint



Packing information

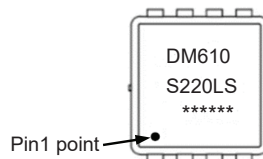
| Package | Tape Width (mm) | Pitch   |               | Reel Size |      | Per Reel Packing Quantity |
|---------|-----------------|---------|---------------|-----------|------|---------------------------|
|         |                 | mm      | inch          | mm        | inch |                    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

Marking information

" DM610S220LS " = Part No.

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

Font type: Arial



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