

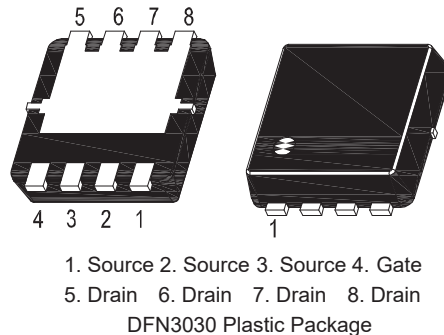
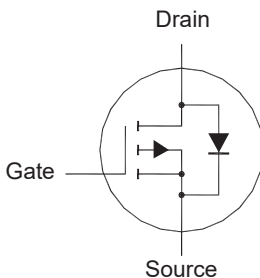
## P-Channel Enhancement Mode MOSFET

### Features

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

### Applications

- Motor Drive
- Synchronous Rectification in DC/DC and AC/DC Converters



### Key Parameters

| Parameter         | Value                  | Unit       |
|-------------------|------------------------|------------|
| $-BV_{DS}$        | 40                     | V          |
| $R_{DS(ON)}$ Max  | 19 @ $-V_{GS} = 10$ V  | m $\Omega$ |
|                   | 29 @ $-V_{GS} = 4.5$ V |            |
| $-V_{GS(th)}$ typ | 1.5                    | V          |
| $Q_g$ typ         | 42 @ $-V_{GS} = 10$ V  | nC         |

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

| Parameter                                        | Symbol         | Value         | Unit             |
|--------------------------------------------------|----------------|---------------|------------------|
| Drain-Source Voltage                             | $-V_{DS}$      | 40            | V                |
| Gate-Source Voltage                              | $V_{GS}$       | $\pm 20$      | V                |
| Drain Current                                    | $-I_D$         | 30            | A                |
|                                                  |                | 19            |                  |
| Peak Drain Current, Pulsed <sup>1)</sup>         | $-I_{DM}$      | 120           | A                |
| Single-Pulse Avalanche Current                   | $-I_{AS}$      | 29            | A                |
| Single-Pulse Avalanche Energy <sup>2)</sup>      | $E_{AS}$       | 42            | mJ               |
| Power Dissipation                                | $P_D$          | 30            | 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                  | $R_{\theta JC}$ | 5    | $^\circ\text{C/W}$ |
| Thermal Resistance from Junction to Ambient <sup>3)</sup> | $R_{\theta JA}$ | 50   | $^\circ\text{C/W}$ |

<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,  $R_g = 25$   $\Omega$ ,  $-I_{AS} = 29$  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 $-I_D = 250\ \mu\text{A}$                                                                                                                         | $-BV_{DS}$    | 40     | -        | -         | V             |
| Drain-Source Leakage Current<br>at $-V_{DS} = 32\ \text{V}$                                                                                                                            | $-I_{DSS}$    | -      | -        | 1         | $\mu\text{A}$ |
| Gate Leakage Current<br>at $V_{GS} = \pm 20\ \text{V}$                                                                                                                                 | $I_{GSS}$     | -      | -        | $\pm 100$ | 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 $-V_{GS} = 10\ \text{V}$ , $-I_D = 10\ \text{A}$<br>at $-V_{GS} = 4.5\ \text{V}$ , $-I_D = 8\ \text{A}$                                         | $R_{DS(on)}$  | -<br>- | 15<br>-  | 19<br>29  | m $\Omega$    |
| <b>DYNAMIC PARAMETERS</b>                                                                                                                                                              |               |        |          |           |               |
| Forward Transconductance<br>at $-V_{DS} = 5\ \text{V}$ , $-I_D = 5\ \text{A}$                                                                                                          | $g_{fs}$      | -      | 15       | -         | S             |
| Gate resistance<br>at $V_{DS} = 0\ \text{V}$ , $V_{GS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                            | $R_g$         | -      | 5.1      | -         | $\Omega$      |
| Input Capacitance<br>at $-V_{DS} = 20\ \text{V}$ , $V_{GS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                        | $C_{iss}$     | -      | 2573     | -         | pF            |
| Output Capacitance<br>at $-V_{DS} = 20\ \text{V}$ , $V_{GS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                       | $C_{oss}$     | -      | 174      | -         | pF            |
| Reverse Transfer Capacitance<br>at $-V_{DS} = 20\ \text{V}$ , $V_{GS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                             | $C_{rss}$     | -      | 111      | -         | pF            |
| Total Gate Charge<br>at $-V_{GS} = 10\ \text{V}$ , $-V_{DS} = 20\ \text{V}$ , $-I_D = 10\ \text{A}$<br>at $-V_{GS} = 4.5\ \text{V}$ , $-V_{DS} = 20\ \text{V}$ , $-I_D = 10\ \text{A}$ | $Q_g$         | -<br>- | 42<br>19 | -<br>-    | nC            |
| Gate-Source Charge<br>at $-V_{GS} = 10\ \text{V}$ , $-V_{DS} = 20\ \text{V}$ , $-I_D = 10\ \text{A}$                                                                                   | $Q_{gs}$      | -      | 8.5      | -         | nC            |
| Gate-Drain Charge<br>at $-V_{GS} = 10\ \text{V}$ , $-V_{DS} = 20\ \text{V}$ , $-I_D = 10\ \text{A}$                                                                                    | $Q_{gd}$      | -      | 5.5      | -         | nC            |
| Turn-On Delay Time<br>at $-V_{DD} = 20\ \text{V}$ , $-V_{GS} = 10\ \text{V}$ , $-I_D = 10\ \text{A}$ , $R_g = 3.3\ \Omega$                                                             | $t_{d(on)}$   | -      | 14       | -         | ns            |
| Turn-On Rise Time<br>at $-V_{DD} = 20\ \text{V}$ , $-V_{GS} = 10\ \text{V}$ , $-I_D = 10\ \text{A}$ , $R_g = 3.3\ \Omega$                                                              | $t_r$         | -      | 26       | -         | ns            |
| Turn-Off Delay Time<br>at $-V_{DD} = 20\ \text{V}$ , $-V_{GS} = 10\ \text{V}$ , $-I_D = 10\ \text{A}$ , $R_g = 3.3\ \Omega$                                                            | $t_{d(off)}$  | -      | 27       | -         | ns            |
| Turn-Off Fall Time<br>at $-V_{DD} = 20\ \text{V}$ , $-V_{GS} = 10\ \text{V}$ , $-I_D = 10\ \text{A}$ , $R_g = 3.3\ \Omega$                                                             | $t_f$         | -      | 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                                                                                                                                                          | $-I_S$        | -      | -        | 30        | A             |
| Body-Diode Continuous Current, Pulsed                                                                                                                                                  | $-I_{SM}$     | -      | -        | 120       | A             |
| Body Diode Reverse Recovery Time<br>at $-I_S = 10\ \text{A}$ , $di/dt = 100\ \text{A} / \mu\text{s}$                                                                                   | $t_{rr}$      | -      | 14.4     | -         | ns            |
| Body Diode Reverse Recovery Charge<br>at $-I_S = 10\ \text{A}$ , $di/dt = 100\ \text{A} / \mu\text{s}$                                                                                 | $Q_{rr}$      | -      | 9.4      | -         | nC            |

## Electrical Characteristics Curves

Fig. 1 Typical Output Characteristics

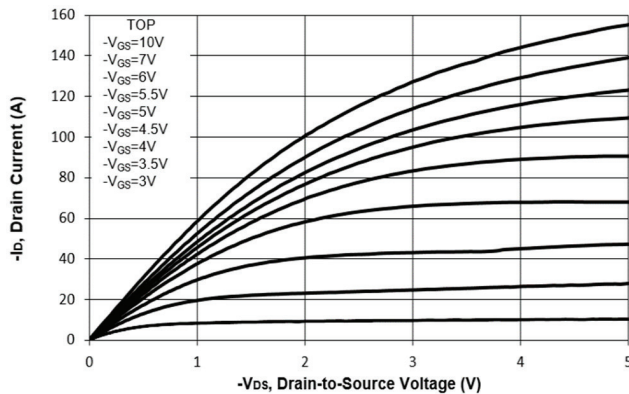


Fig. 2 Typical Transfer Characteristics

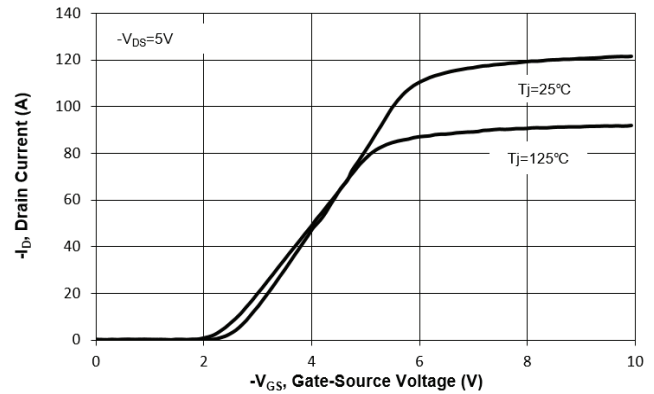


Fig. 3 on-Resistance vs Drain Current

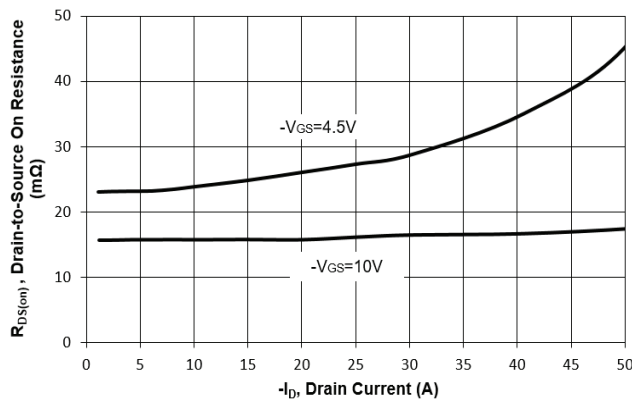


Fig. 4 on-Resistance vs. Gate to Source Voltage

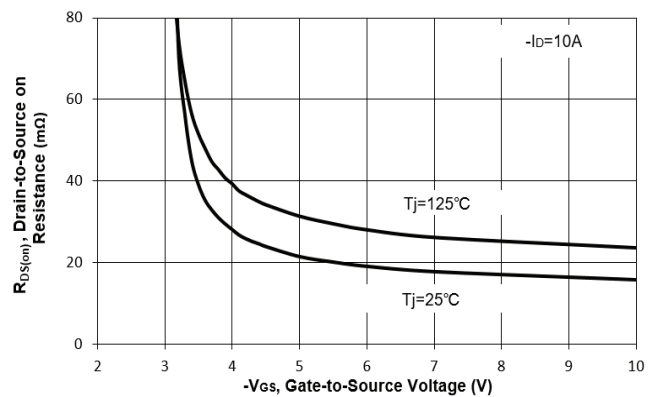


Fig. 5 on-Resistance vs. Tj

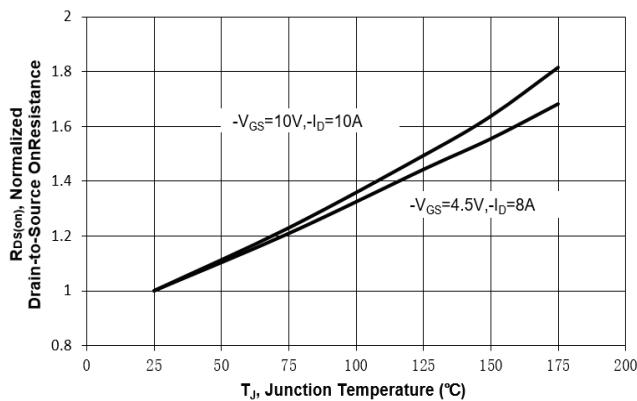
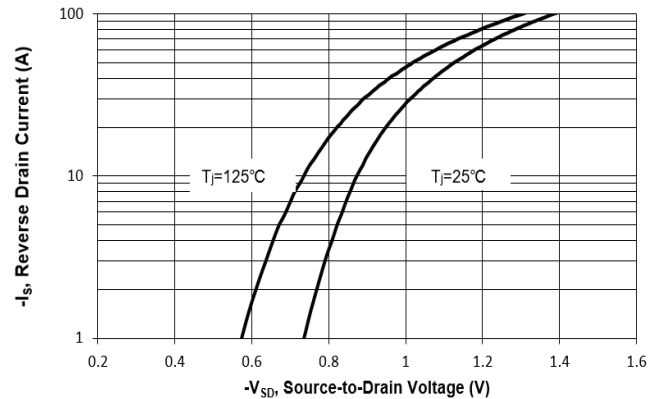


Fig. 6 Typical Body Diode Forward Characteristics



## Electrical Characteristics Curves

Fig. 7 Typical Junction Capacitance

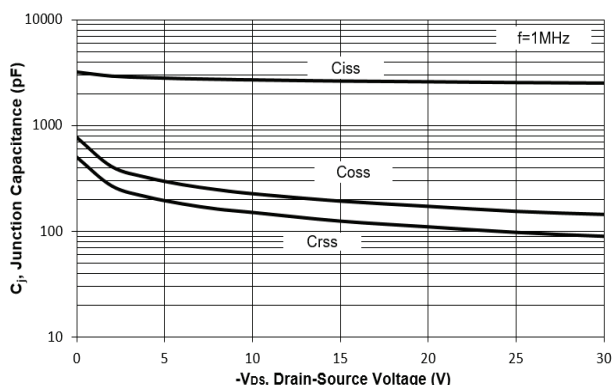


Fig. 8 Drain-Source Leakage Current vs. T<sub>J</sub>

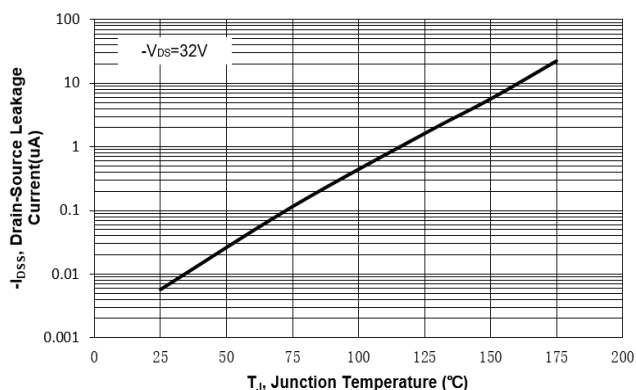


Fig. 9 V<sub>(BR)DSS</sub> vs. Junction Temperature

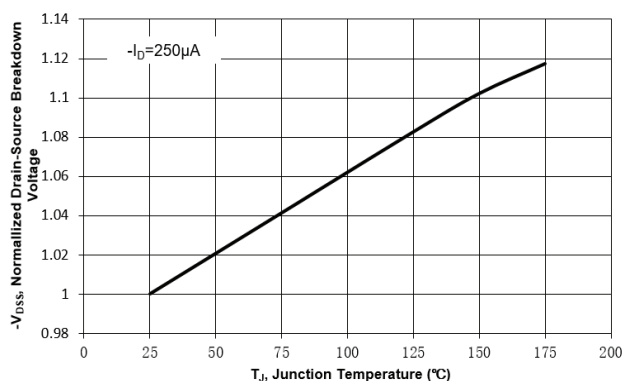


Fig. 10 Gate Threshold Variation vs. T<sub>J</sub>

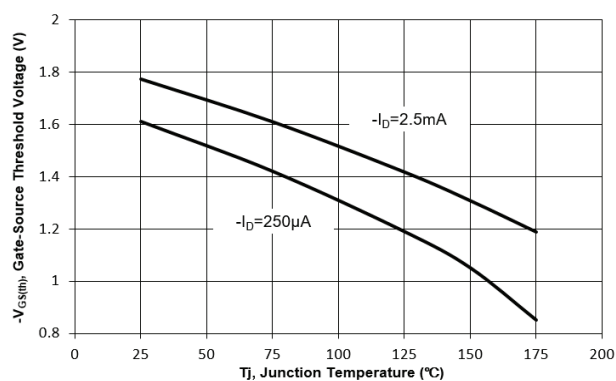


Fig. 11 Gate Charge

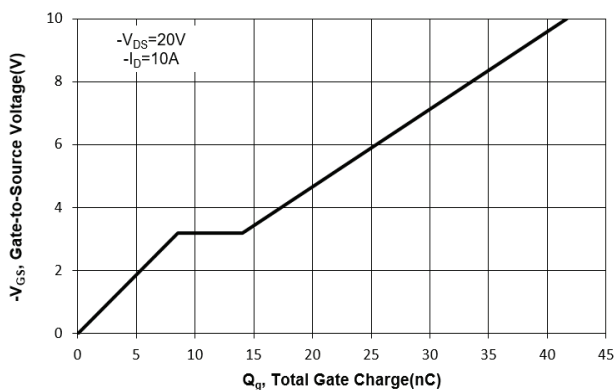
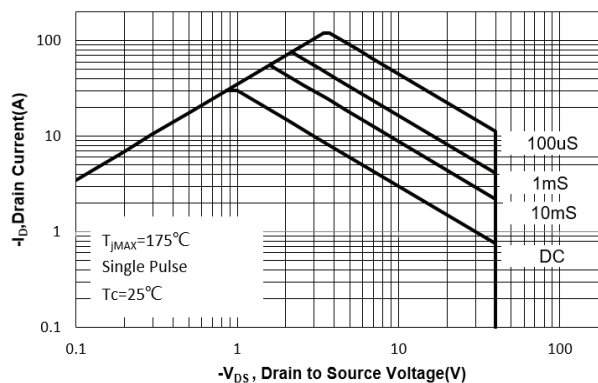


Fig. 12 Safe Operation Area



## Electrical Characteristics Curves

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

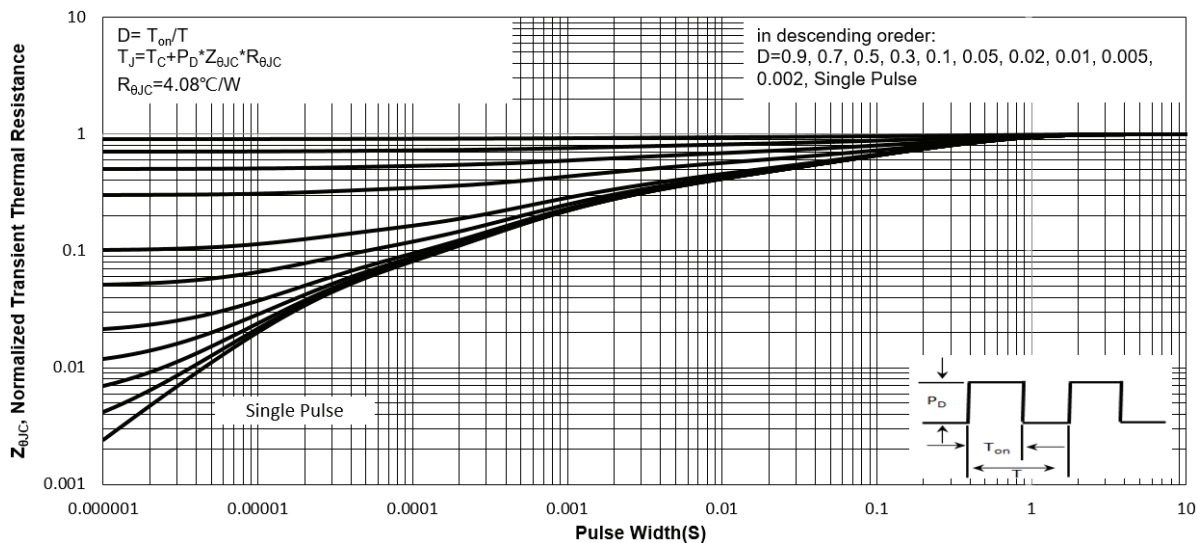
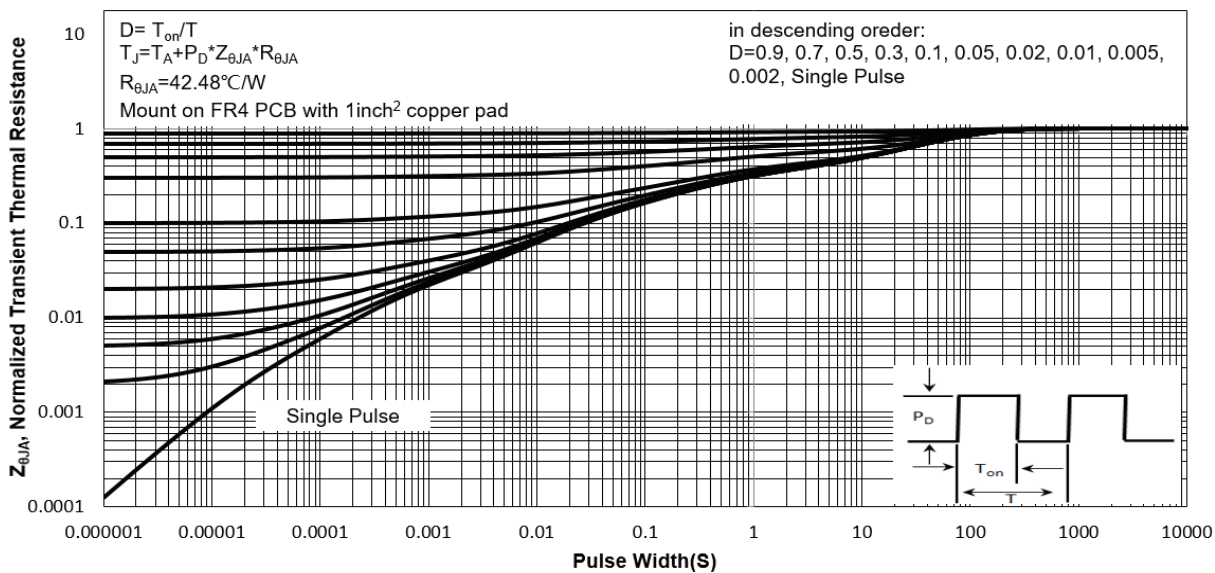


Fig. 14 Normalized Maximum Transient Thermal Impedance( $Z_{\theta JA}$ )





## Test Circuits

Fig.1-1 Switching times test circuit

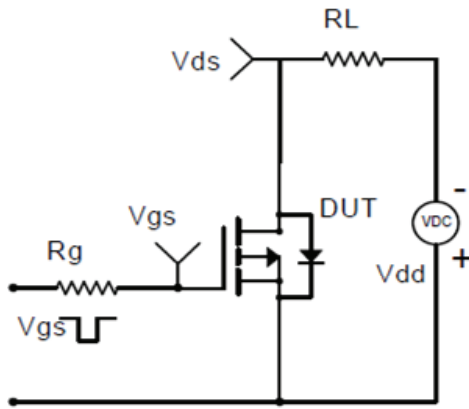


Fig.1-2 Switching Waveform

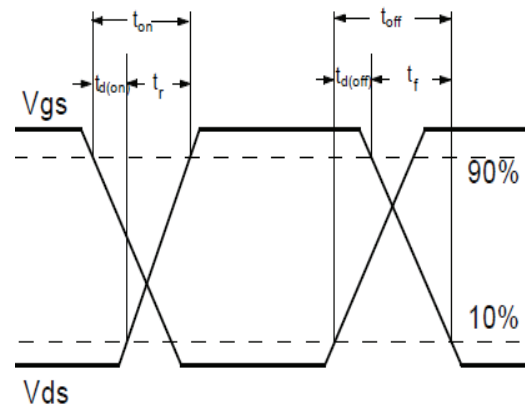


Fig.2-1 Gate charge test circuit

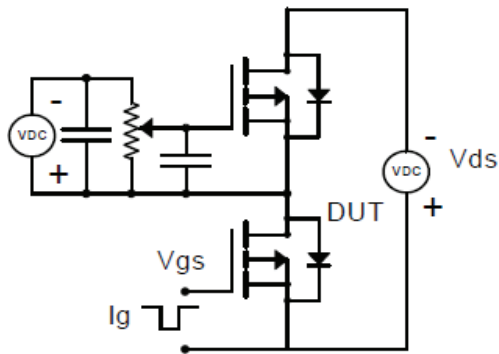


Fig.2-2 Gate charge waveform

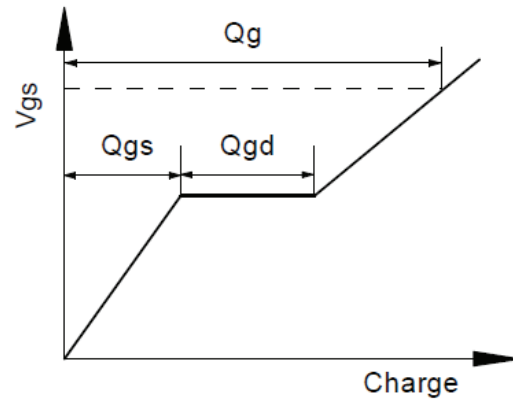


Fig.3-1 Avalanche test circuit

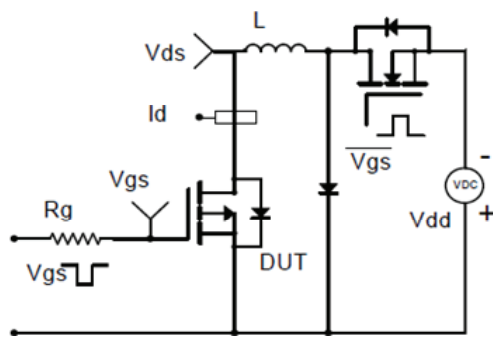
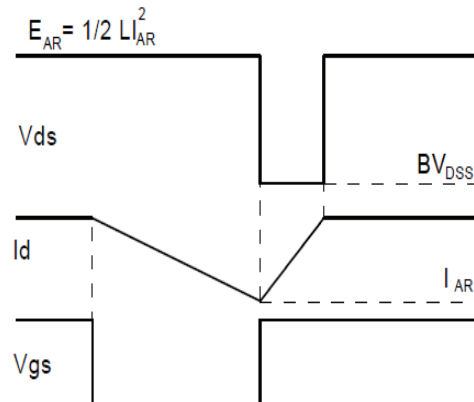
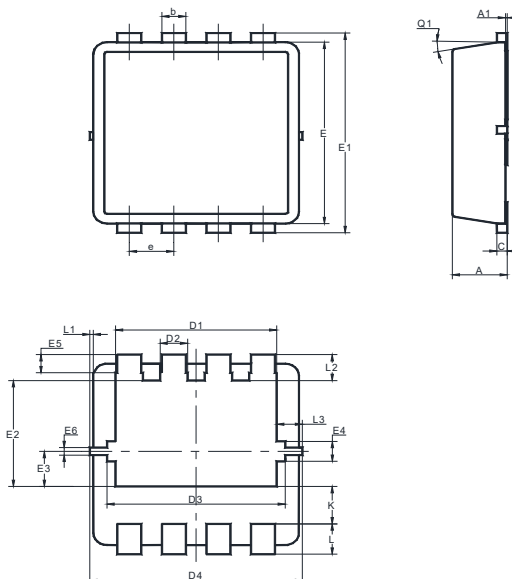


Fig.3-2 Avalanche waveform



Package Outline Dimensions (Units: mm)

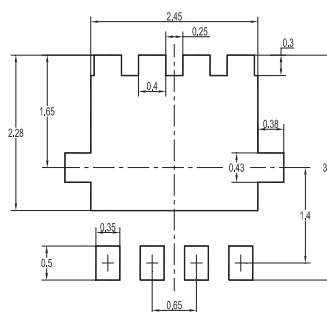
DFN3030



| 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

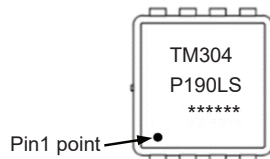
| Package | Tape Width (mm) | Pitch   |               | Reel Size |      | Per Reel Packing Quantity |
|---------|-----------------|---------|---------------|-----------|------|---------------------------|
|         |                 | mm      | inch          | mm        | inch |                    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

Marking information

" TM304P190LS " = Part No.

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

Font type: Arial



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