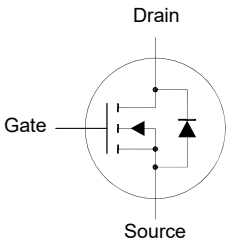
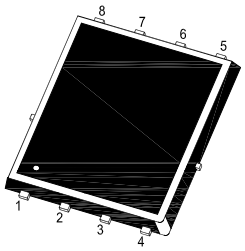
# WTM506N031L-HAF

## N-Channel Enhancement Mode MOSFET

### Features

- Optimized for synchronous rectification low Input capacitance
- Low switching charge
- Low miller capacitance
- Fully characterized capacitance and avalanche
- Halogen and Antimony Free(HAF), RoHS compliant




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

### Applications

- Battery powered circuits
- BLDC Motor drive applications
- Half-bridge and full-bridge topologies
- Synchronous rectifier applications
- Resonant mode power supplies

### Key Parameters

| Parameter | Value | Unit |
|---|---|---|
| $BV_{DSS}$ | 60 | V |
| $R_{DS(ON)}$ Max | 4 @ $V_{GS}$ = 10 V | mΩ |
| | 6 @ $V_{GS}$ = 4.5 V | mΩ |
| $V_{GS(th)}$ typ | 1.6 | V |
| $Q_g$ typ | 51.4 @ $V_{GS}$ = 10 V | nC |

### Absolute Maximum Ratings (at $T_a$ = 25℃ unless otherwise specified)

| Parameter | | Symbol | Value | Unit |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 60 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | V |
| Drain Current Continuous | $T_c$ = 25℃<br>$T_c$ = 100℃ | $I_D$ | 70<br>44 | A |
| Peak Drain Current, Pulsed [1] | | $I_{DM}$ | 300 | A |
| Power Dissipation | $T_c$ = 25℃ | $P_D$ | 34.7 | W |
| Avalanche Current, Single Pulse | | $I_{AS}$ | 45 | A |
| Avalanche Energy, Single Pulse [2] | | $E_{AS}$ | 101 | mJ |
| Operating Junction and Storage Temperature Range | | $T_j$, $T_{stg}$ | - 55 to + 150 | ℃ |

### Thermal Characteristics

| Parameter | Symbol | Max. | Unit |
|---|---|---|---|
| Thermal Resistance from Junction to Case | $R_{\theta JC}$ | 3.6 | ℃/W |
| Thermal Resistance from Junction to Ambient [3] | $R_{\theta JA}$ | 50 | ℃/W |

[1] Pulse Test: Pulse Width ≤ 100 μs, Duty Cycle ≤ 2%.

[2] Limited by $T_{J(MAX)}$, starting $T_J$ = 25 °C, L = 0.1 mH, $R_g$ = 25 Ω, $I_D$ = 45 A, $V_{GS}$ = 10 V.

[3] Device mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate in still air.



Dated: 28/09/2020 Rev: 01

**Characteristics at $T_a$ = 25℃ unless otherwise specified**

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| **STATIC PARAMETERS** | | | | | |
| Drain-Source Breakdown Voltage<br>at $I_D$ = 250 μA | $BV_{DSS}$ | 60 | - | - | V |
| Drain-Source Leakage Current<br>at $V_{DS}$ = 48 V | $I_{DSS}$ | - | - | 1 | μA |
| Gate-Source Leakage Current<br>at $V_{GS}$ = ± 20 V | $I_{GSS}$ | - | - | ±100 | nA |
| Gate-Source Threshold Voltage<br>at $V_{DS}$ = $V_{GS}$, $I_D$ = 250 μA | $V_{GS(th)}$ | 1.2 | - | 2.3 | V |
| Drain-Source On-State Resistance<br>at $V_{GS}$ = 10 V, $I_D$ = 20 A<br>at $V_{GS}$ = 4.5 V, $I_D$ = 15 A | $R_{DS(on)}$ | -<br>- | 3.1<br>- | 4<br>6 | mΩ |
| **DYNAMIC PARAMETERS** | | | | | |
| Gate Resistance<br>at $V_{GS}$ = 0 V, $V_{DS}$ = 0 V, f = 1MHz | $R_g$ | - | 0.9 | - | Ω |
| Forward Transconductance<br>at $V_{DS}$ = 5 V, $I_D$ = 20 A | $g_{fs}$ | - | 50 | - | S |
| Input Capacitance<br>at $V_{GS}$ = 0 V, $V_{DS}$ = 40 V, f = 1 MHz | $C_{iss}$ | - | 2571 | - | pF |
| Output Capacitance<br>at $V_{GS}$ = 0 V, $V_{DS}$ = 40 V, f = 1 MHz | $C_{oss}$ | - | 1031 | - | pF |
| Reverse Transfer Capacitance<br>at $V_{GS}$ = 0 V, $V_{DS}$ = 40 V, f = 1 MHz | $C_{rss}$ | - | 35 | - | pF |
| Total Gate Charge<br>at $V_{DS}$ = 30 V, $I_D$ = 20 A, $V_{GS}$ = 10 V<br>at $V_{DS}$ = 30 V, $I_D$ = 20 A, $V_{GS}$ = 4.5 V | $Q_g$ | -<br>- | 51.4<br>26.5 | -<br>- | nC |
| Gate Source Charge<br>at $V_{DS}$ = 30 V, $I_D$ = 20 A, $V_{GS}$ = 10 V | $Q_{gs}$ | - | 7.8 | - | nC |
| Gate Drain Charge<br>at $V_{DS}$ = 30 V, $I_D$ = 20 A, $V_{GS}$ = 10 V | $Q_{gd}$ | - | 12.8 | - | nC |
| Turn-On Delay Time<br>at $V_{DS}$ = 30 V, $V_{GS}$ = 10 V, $I_D$ = 20 A, $R_g$ = 3.3 Ω | $t_{d(on)}$ | - | 18 | - | nS |
| Turn-On Rise Time<br>at $V_{DS}$ = 30 V, $V_{GS}$ = 10 V, $I_D$ = 20 A, $R_g$ = 3.3 Ω | $t_r$ | - | 31 | - | nS |
| Turn-Off Delay Time<br>at $V_{DS}$ = 30 V, $V_{GS}$ = 10 V, $I_D$ = 20 A, $R_g$ = 3.3 Ω | $t_{d(off)}$ | - | 18 | - | nS |
| Turn-Off Fall Time<br>at $V_{DS}$ = 30 V, $V_{GS}$ = 10 V, $I_D$ = 20 A, $R_g$ = 3.3 Ω | $t_f$ | - | 5 | - | nS |
| **Body-Diode PARAMETERS** | | | | | |
| Drain-Source Diode Forward Voltage<br>at $I_S$ = 1 A, $V_{GS}$ = 0 V | $V_{SD}$ | - | - | 1.2 | V |
| Body-Diode Continuous Current | $I_S$ | - | - | 70 | A |
| Body-Diode Continuous Current, Pulsed | $I_{SM}$ | - | - | 300 | A |
| Body Diode Reverse Recovery Time<br>at $I_S$ = 20 A, di/dt = 100 A / μs | $t_{rr}$ | - | 46.5 | - | nS |
| Body Diode Reverse Recovery Charge<br>at $I_S$ = 20 A, di/dt = 100 A / μs | $Q_{rr}$ | - | 48.2 | - | nC |

## Electrical Characteristics Curves

Fig. 1 Typical Output Characteristic

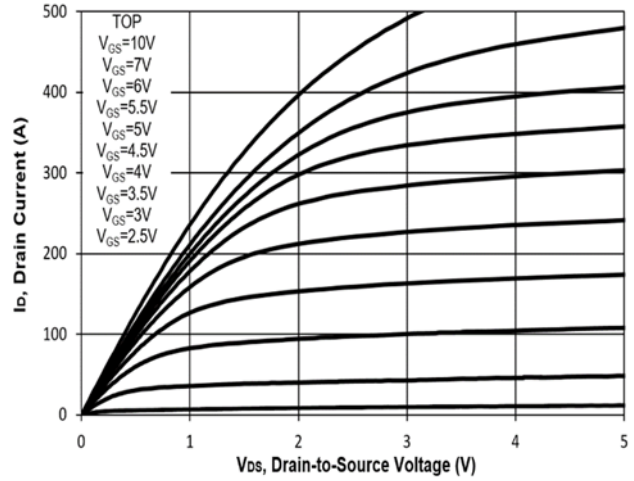



Fig. 2 Typical Transfer Characteristic

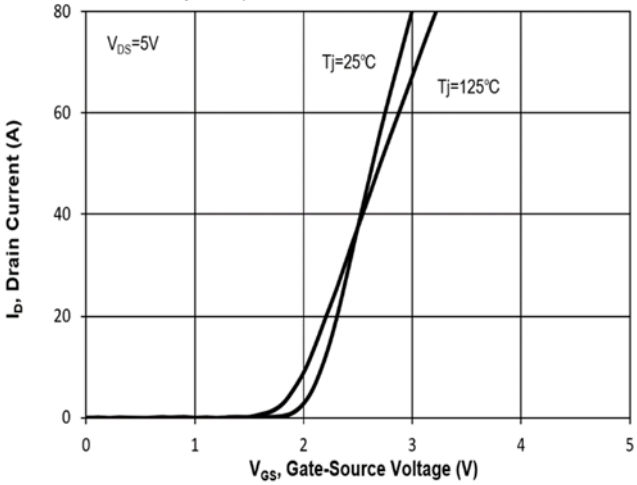



Fig. 3 On-Resistance vs. Drain Current

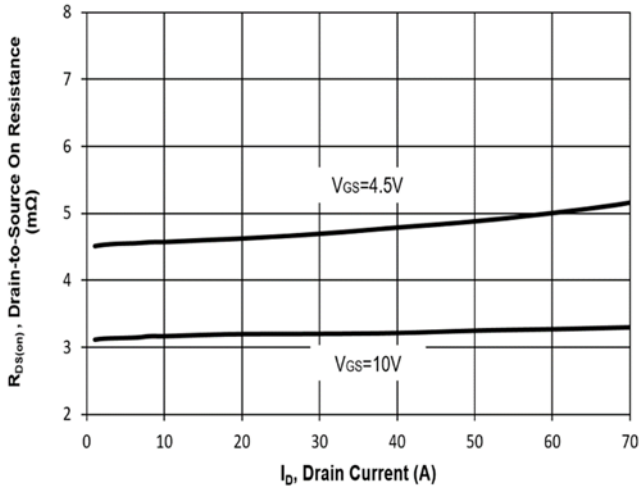



Fig. 4 On-Resistance vs. Gate Voltage

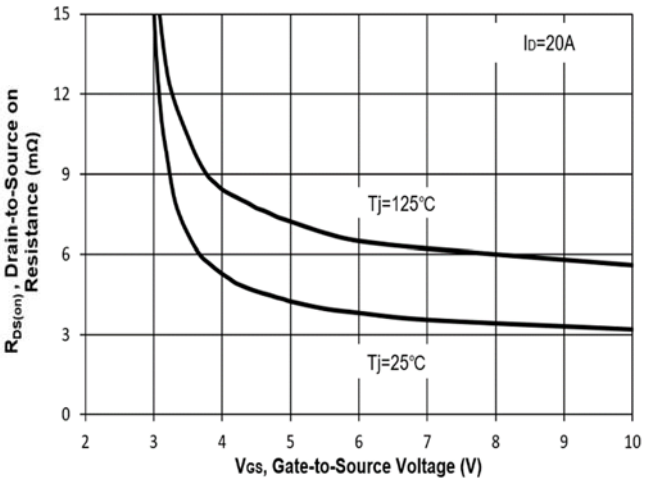



Fig. 5 On-Resistance vs.$T_j$

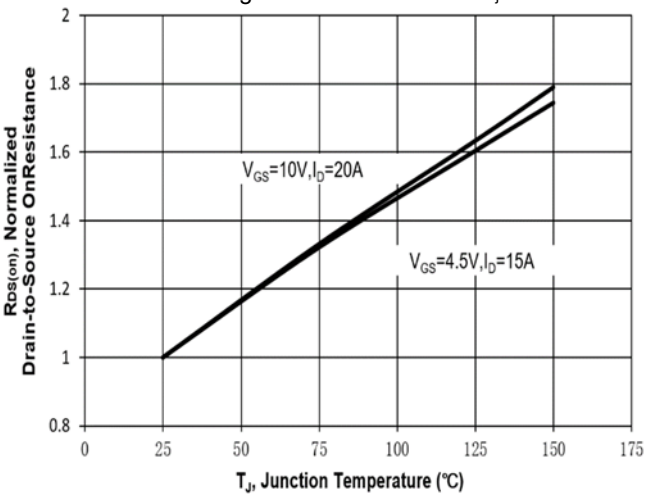
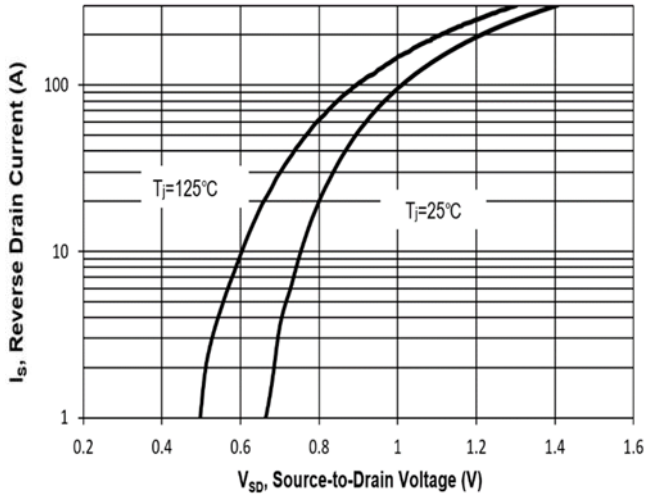



Fig. 6 Typical Forward Characteristic



## Electrical Characteristics Curves

Fig. 7 Typical Junction Capacitance

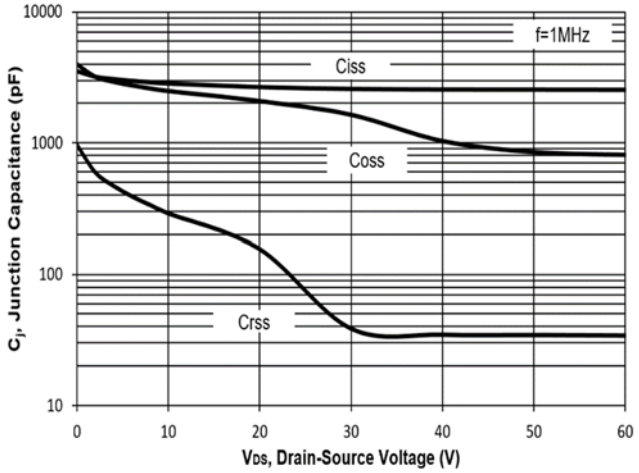



Fig. 8 Drain-Source Leakage Current vs. $T_j$

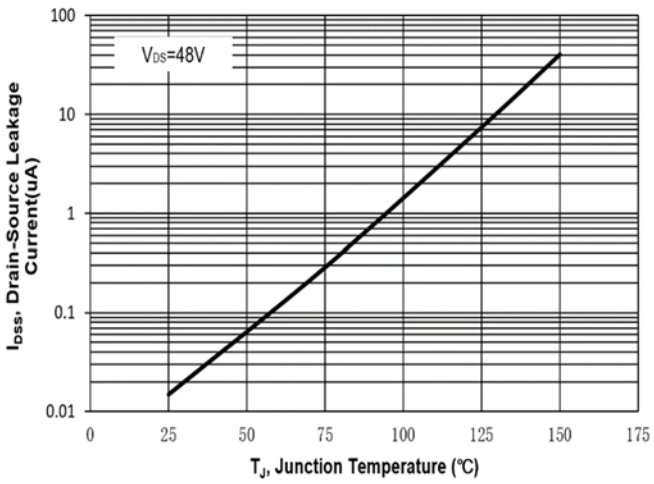



Fig. 9 $V_{(BR)DSS}$ vs. Junction Temperature

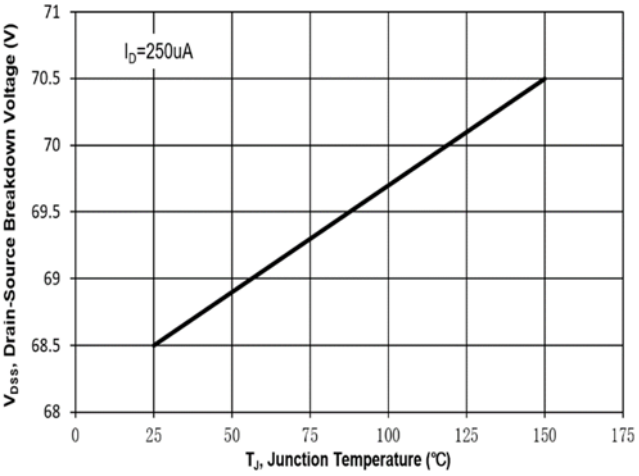



Fig. 10 Gate Threshold Variation vs. $T_j$

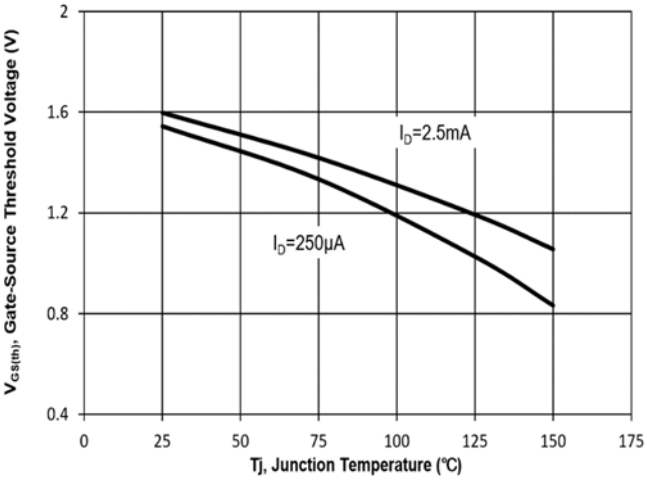



Fig. 11 Gate Charge

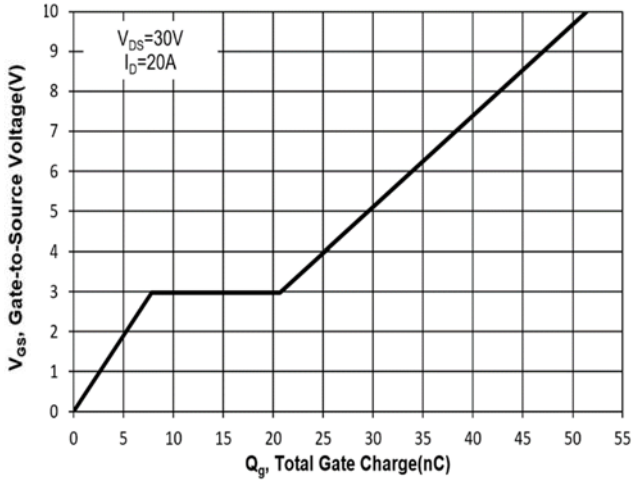
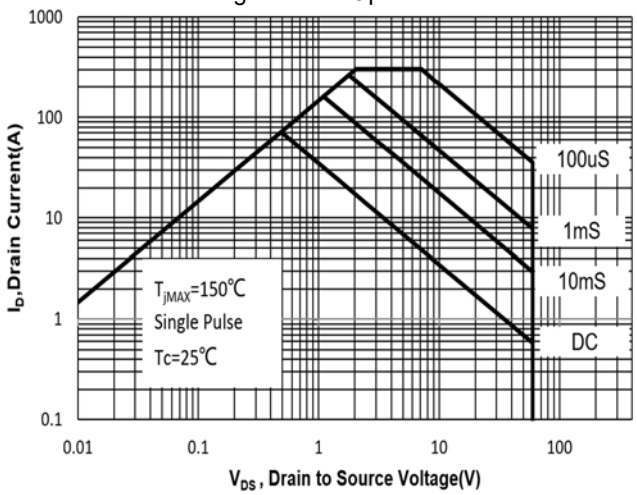



Fig. 12 Safe Operation Area



## Electrical Characteristics Curves

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

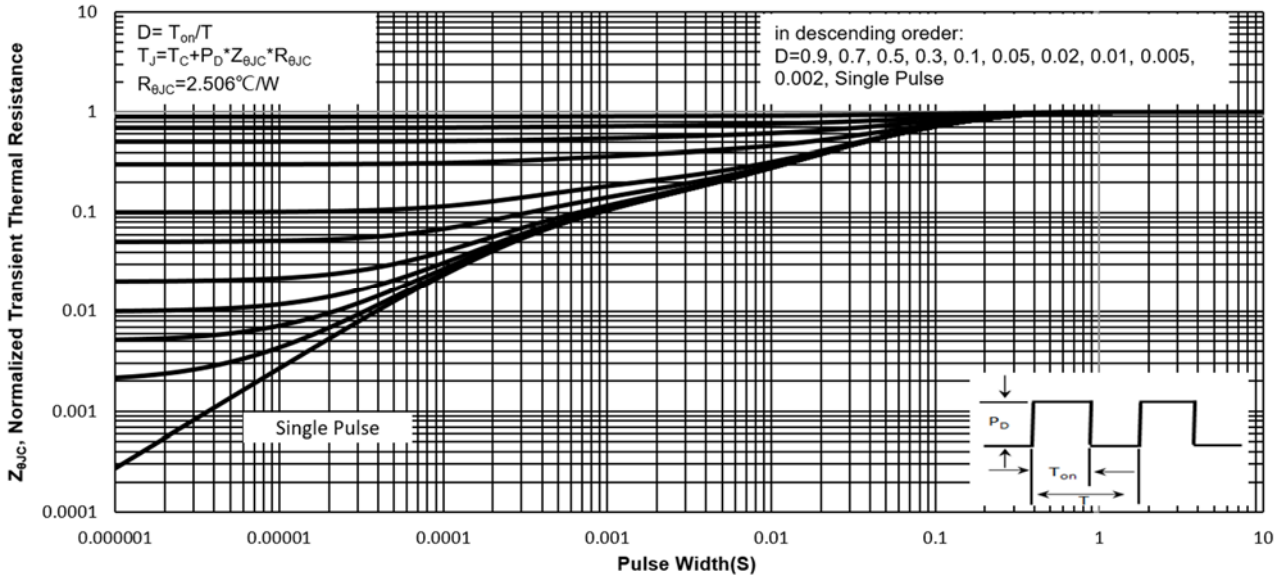
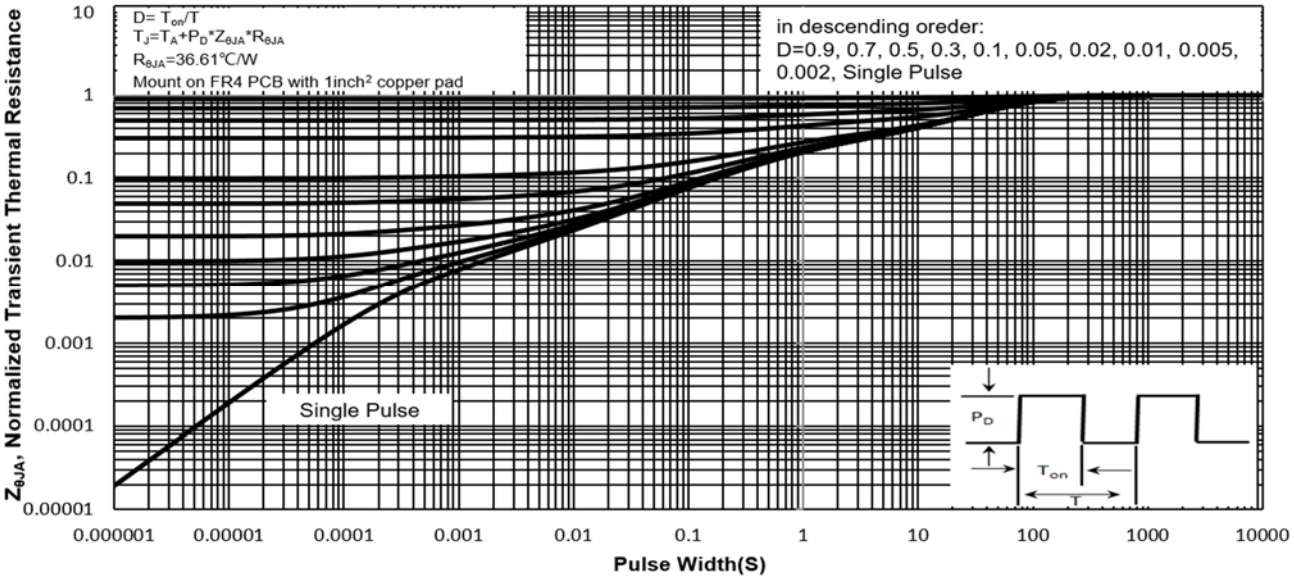



Fig.14 Normalized Maximum Transient Thermal Impedance($z_{\Theta JA}$)



**Test Circuits**

Fig.1-1 Switching times test circuit

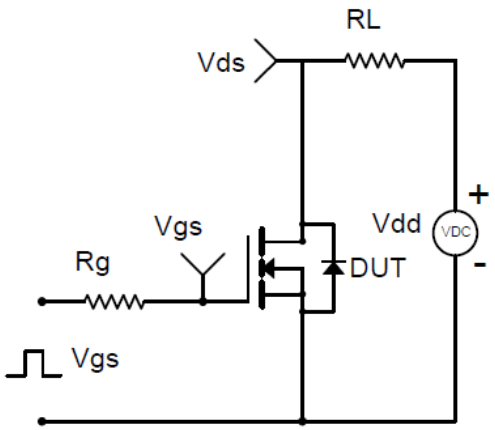



Fig.1-2 Switching Waveform

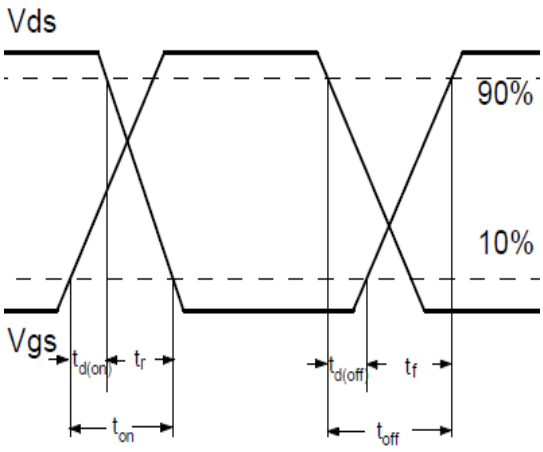



Fig.2-1 Gate charge test circuit

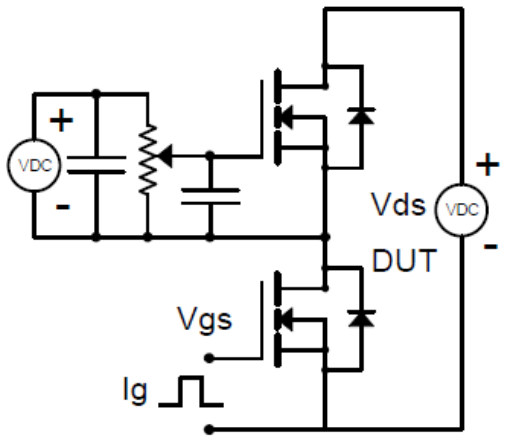



Fig.2-2 Gate charge waveform

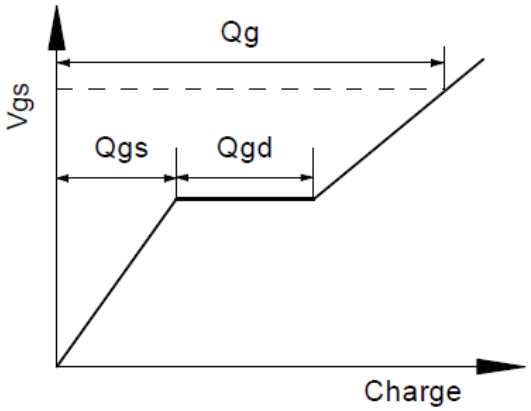



Fig.3-1 Avalanche test circuit

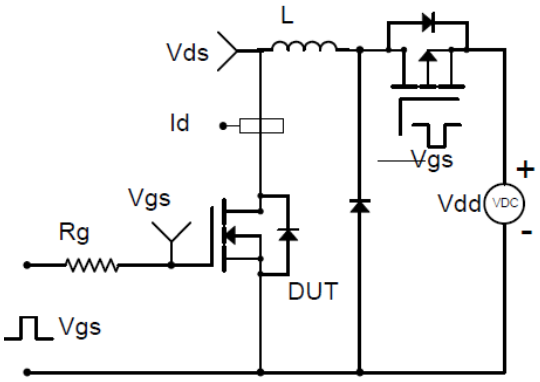
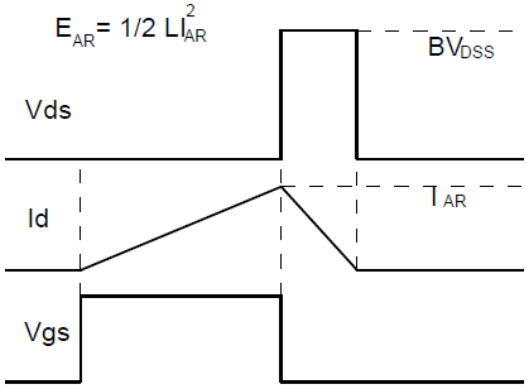
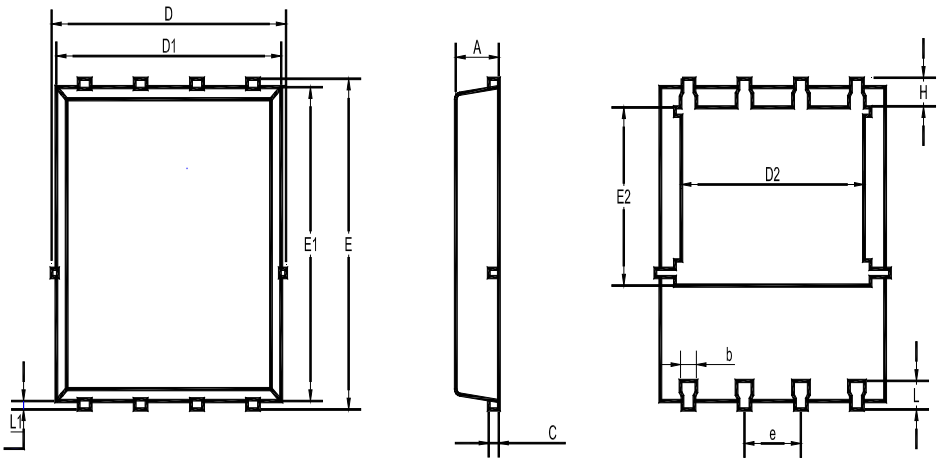



Fig.3-2 Avalanche waveform

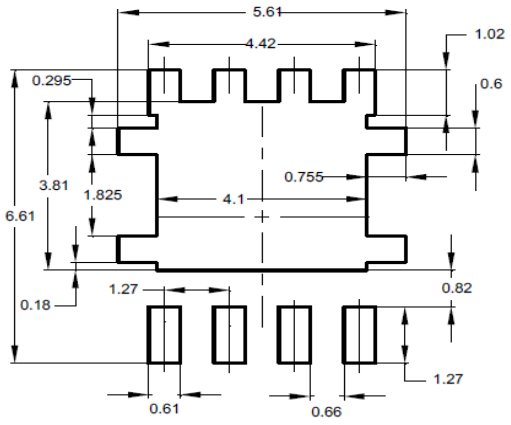


## Package Outline Dimensions (Units: mm) DFN5060




| UNIT | A | b | C | D | D1 | D2 | E | E1 | E2 | e | L | L1 | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |

## Recommended Soldering Footprint

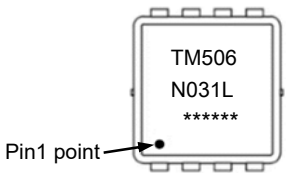



## Packing information

| 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 | 3,000 |

## Marking information

" TM506N031L " = Part No.
" ****** " = Date Code Marking
Font type: Arial



## IMPORTANT NOTICE

Our company and its subsidiaries reserve the right to make modifications, enhancements, improvements, corrections or other changes to improve product design, functions and reliability without further notice to this document and any product described herein.

Statements described herein regarding the reliability and suitability of products is for illustrative purposes only. Products specifically described herein are not authorized for use as critical components in life support devices, automobile, military, aviation or aerospace only with the written approval of our company.

The information contained herein is presented only as guidance for product use. No license to any intellectual property rights is granted under this document. No responsibility is assumed by our company for any infringement of patents or any other intellectual property rights of third party that may result from the use of the product.