# N-Channel 40 V (D-S) MOSFET

| PRODUCT SUMMARY | | | |
|---|---|---|---|
| $V_{DS}$ (V) | $R_{DS(on)}$ (Ω) MAX. | $I_D$ (A) [d] | $Q_g$ (TYP.) |
| 40 | 0.0012 at $V_{GS}$ = 10 V | 300 | 430 |
| | 0.0016 at $V_{GS}$ = 7.5 V | 250 | |

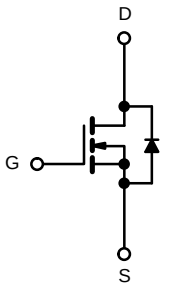
## FEATURES

- DT-Trench Power MOSFET
- Maximum 175 °C junction temperature
- $Q_{gd}/Q_{gs}$ ratio < 0.5
- Operable with logic-level gate drive
- 100 % $R_g$ and UIS tested

RoHS COMPLIANT

TO-220 Pin Configuration


Top View




N-Channel MOSFET

## APPLICATIONS

- Power supply
  - Secondary synchronous rectification
- DC/DC converter
- Power tools
- Motor drive switch
- DC/AC inverter
- Battery management

| ABSOLUTE MAXIMUM RATINGS ($T_C$ = 25 °C, unless otherwise noted) | | | | |
|---|---|---|---|---|
| PARAMETER | | SYMBOL | LIMIT | UNIT |
| Drain-Source Voltage | | $V_{DS}$ | 40 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current ($T_J$ = 150 °C) | $T_C$ = 25 °C | $I_D$ | 300[d] | A |
| | $T_C$ = 70 °C | | 240 [d] | |
| Pulsed Drain Current (t = 100 µs) | | $I_{DM}$ | 1200 | |
| Avalanche Current | L = 0.1 mH | $I_{AS}$ | 290 | |
| Single Avalanche Energy [a] | | $E_{AS}$ | 1550 | mJ |
| Maximum Power Dissipation [a] | $T_C$ = 25 °C | $P_D$ | 396 [b] | W |
| | $T_C$ = 125 °C | | 205 [b] | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | -55 to +175 | °C |

| THERMAL RESISTANCE RATINGS | | | |
|---|---|---|---|
| PARAMETER | SYMBOL | LIMIT | UNIT |
| Junction-to-Ambient (PCB Mount) [c] | $R_{thJA}$ | 25 | °C/W |
| Junction-to-Case (Drain) | $R_{thJC}$ | 0.2 | |

**Notes**

a. Duty cycle ≤ 1 %.
b. See SOA curve for voltage derating.
c. When mounted on 1" square PCB (FR4 material).
d. Package limited.

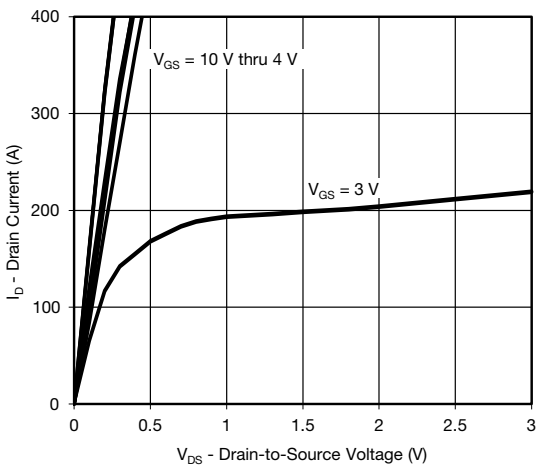
| **SPECIFICATIONS** ($T_J$ = 25 °C, unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 µA | 40 | - | - | V |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 1.0 | - | 3.0 | |
| Gate-Body Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | - | - | ± 250 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 40 V, $V_{GS}$ = 0 V | - | - | 1 | µA |
| | | $V_{DS}$ = 40 V, $V_{GS}$ = 0 V, $T_J$ = 125 °C | - | - | 150 | |
| | | $V_{DS}$ = 40 V, $V_{GS}$ = 0 V, $T_J$ = 175 °C | - | - | 5 | mA |
| On-State Drain Current [a] | $I_{D(on)}$ | $V_{DS}$ ≥ 10 V, $V_{GS}$ = 10 V | 300 | - | - | A |
| Drain-Source On-State Resistance [a] | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 30 A | - | 0.0012 | 0.0015 | Ω |
| | | $V_{GS}$ = 7.5 V, $I_D$ = 20 A | - | 0.0016 | 0.0018 | |
| Forward Transconductance [a] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 30 A | - | 261 | - | S |
| **Dynamic [b]** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 30 V, f = 1 MHz | - | 12100 | - | pF |
| Output Capacitance | $C_{oss}$ | | - | 2410 | - | |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 890 | - | |
| Total Gate Charge [c] | $Q_g$ | $V_{DS}$ = 20 V, $V_{GS}$ = 10 V, $I_D$ = 20 A | - | 430 | - | nC |
| Gate-Source Charge [c] | $Q_{gs}$ | | - | 57 | - | |
| Gate-Drain Charge [c] | $Q_{gd}$ | | - | 19 | - | |
| Gate Resistance | $R_g$ | f = 1 MHz | 0.46 | 2.7 | 3.9 | Ω |
| Turn-On Delay Time [c] | $t_{d(on)}$ | $V_{DD}$ = 20 V, $R_L$ = 5 Ω<br>$I_D$ ≅ 10 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | - | 26 | - | ns |
| Rise Time [c] | $t_r$ | | - | 32 | - | |
| Turn-Off Delay Time [c] | $t_{d(off)}$ | | - | 73 | - | |
| Fall Time [c] | $t_f$ | | - | 32 | - | |
| **Drain-Source Body Diode Ratings and Characteristics [b]** ($T_C$ = 25 °C) | | | | | | |
| Pulsed Current (t = 100 µs) | $I_{SM}$ | | - | - | 1200 | A |
| Forward Voltage [a] | $V_{SD}$ | $I_F$ = 10 A, $V_{GS}$ = 0 V | - | 0.7 | 1.2 | V |
| Reverse Recovery Time | $t_{rr}$ | $I_F$ = 41 A, di/dt = 100 A/µs | - | 237 | - | ns |
| Peak Reverse Recovery Charge | $I_{RM(REC)}$ | | - | 39 | - | A |
| Reverse Recovery Charge | $Q_{rr}$ | | - | 0.54 | - | µC |

**Notes**

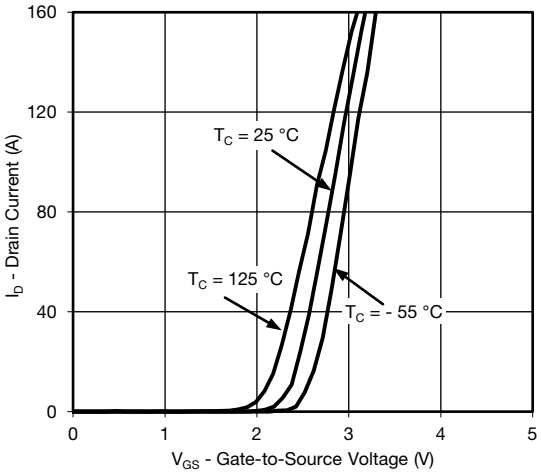
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

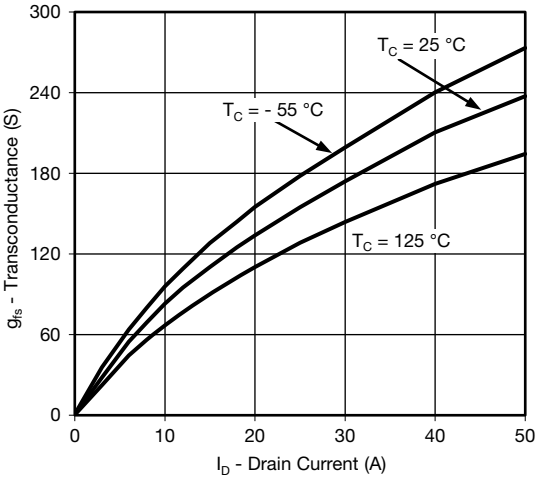
**TYPICAL CHARACTERISTICS** ($T_A$ = 25 °C, unless otherwise noted)



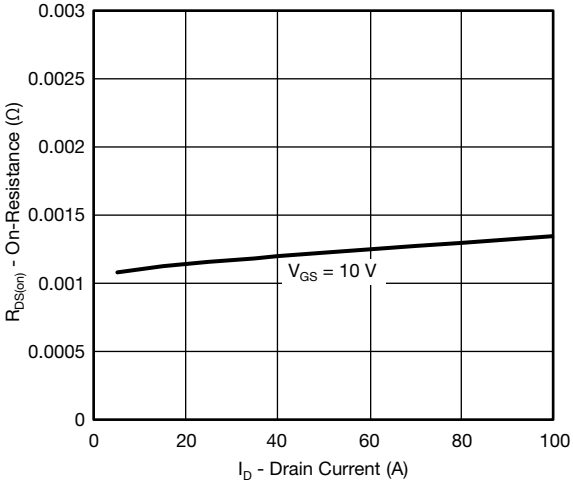

**Output Characteristics**



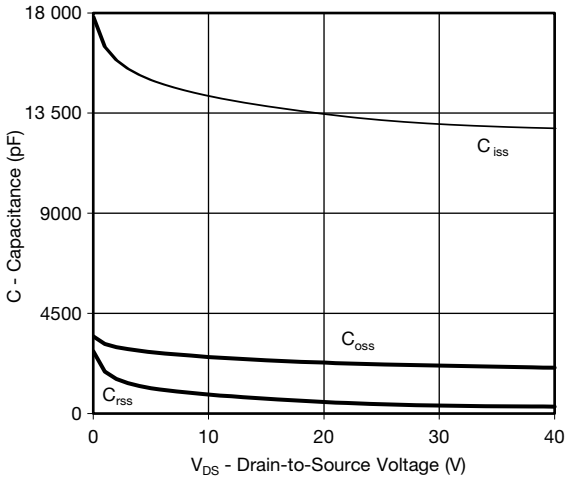

**Transfer Characteristics**



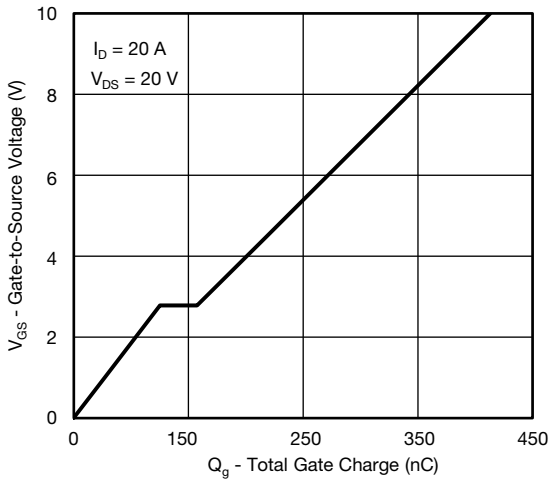

**Transconductance**




**On-Resistance vs. Drain Current**

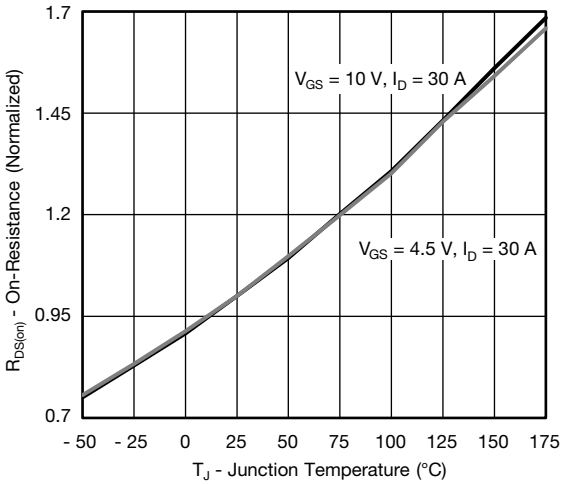



**Capacitance**

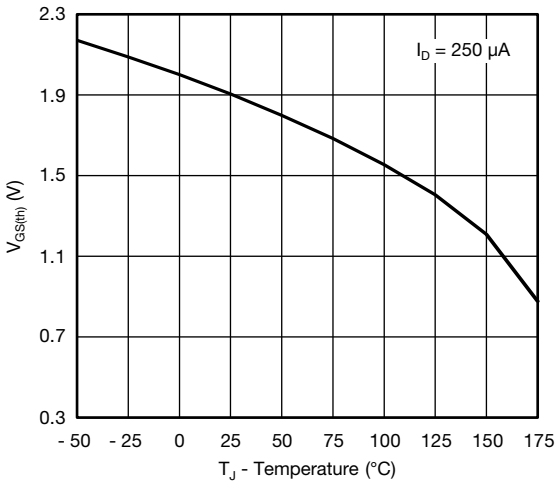



**Gate Charge**

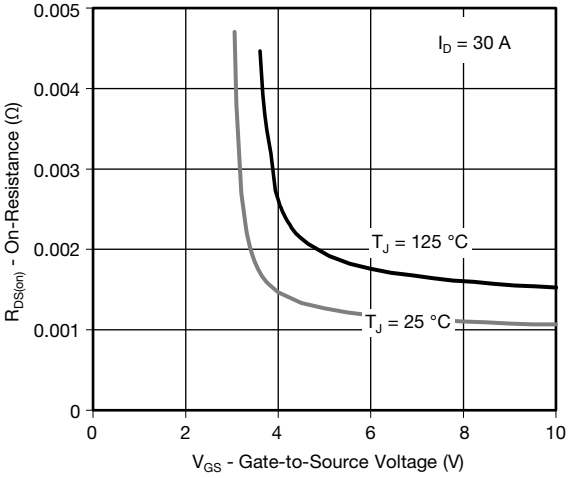
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



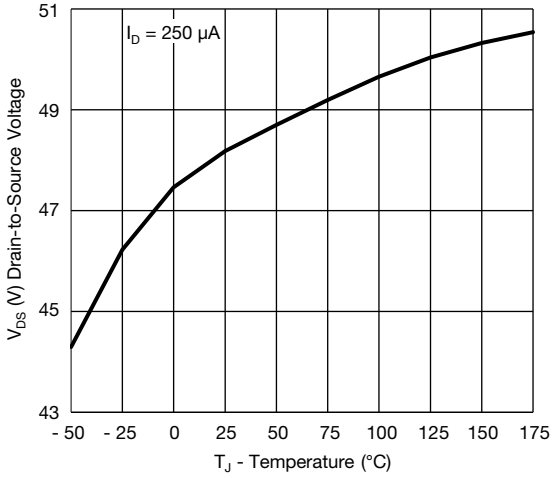

**On-Resistance vs. Junction Temperature**



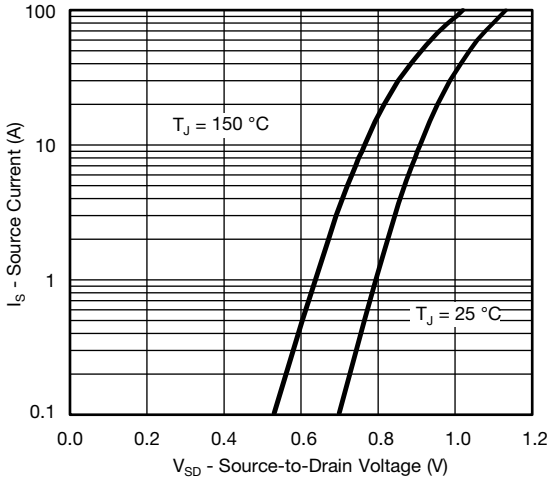

**Threshold Voltage**



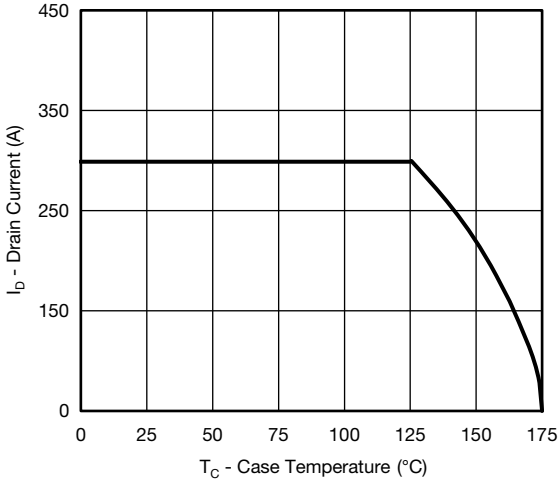

**On-Resistance vs. Gate-to-Source Voltage**




**Drain Source Breakdown vs. Junction Temperature**

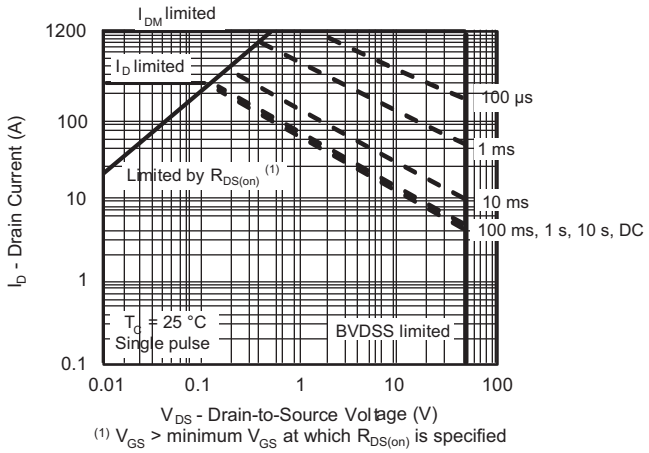



**Source Drain Diode Forward Voltage**

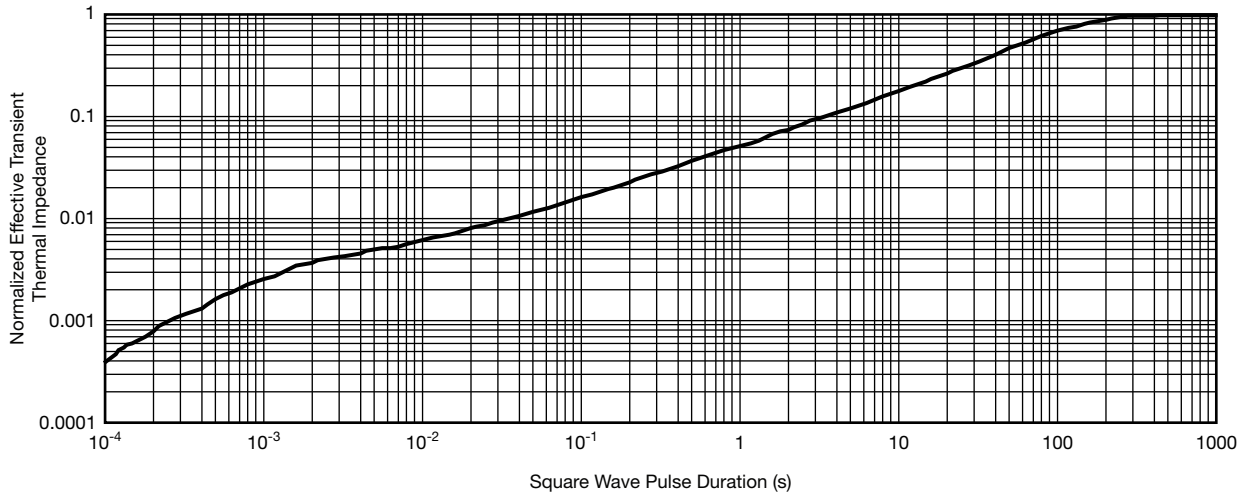



**Current De-rating**

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)

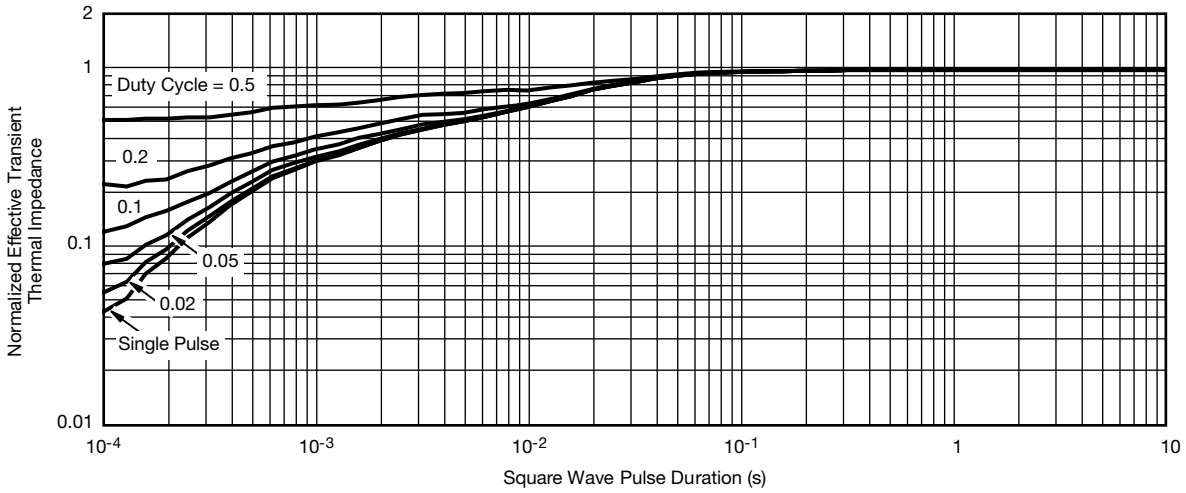



**Safe Operating Area**




**Normalized Thermal Transient Impedance, Junction-to-Ambient**

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)



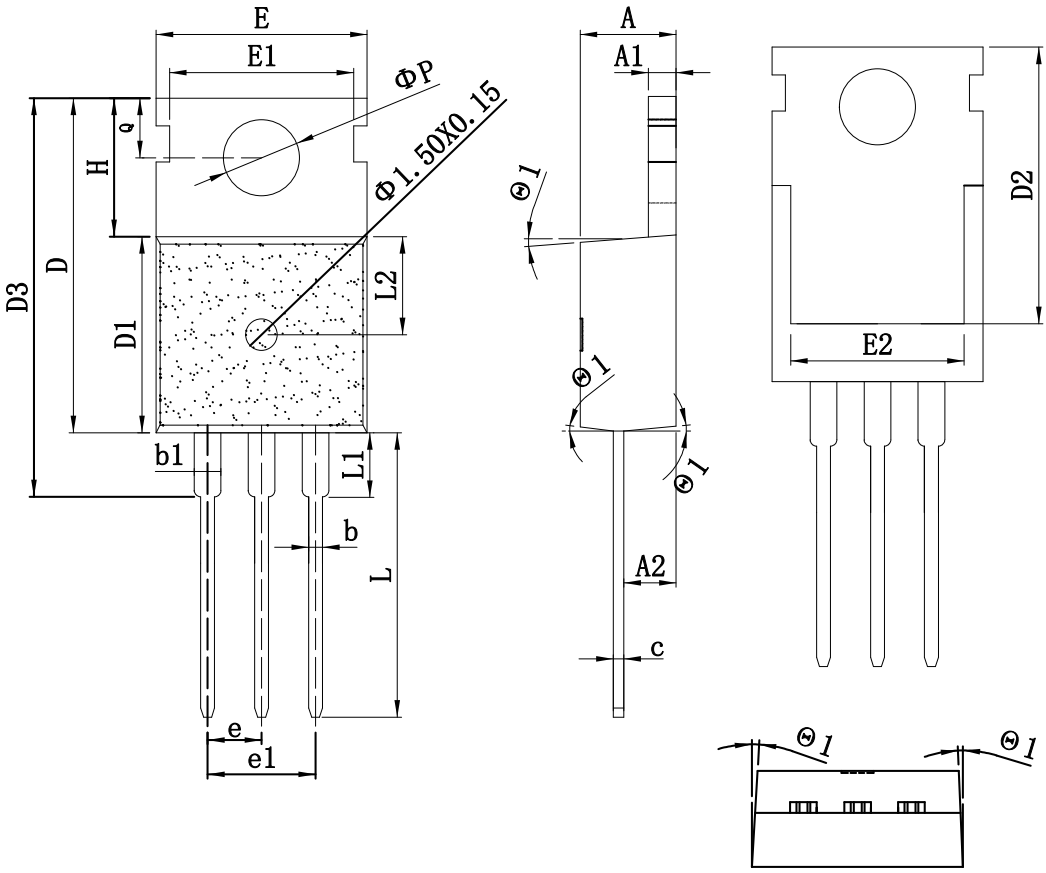

**Normalized Thermal Transient Impedance, Junction-to-Case**

**Note**

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction to Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction to Case (25 °C)

  are given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

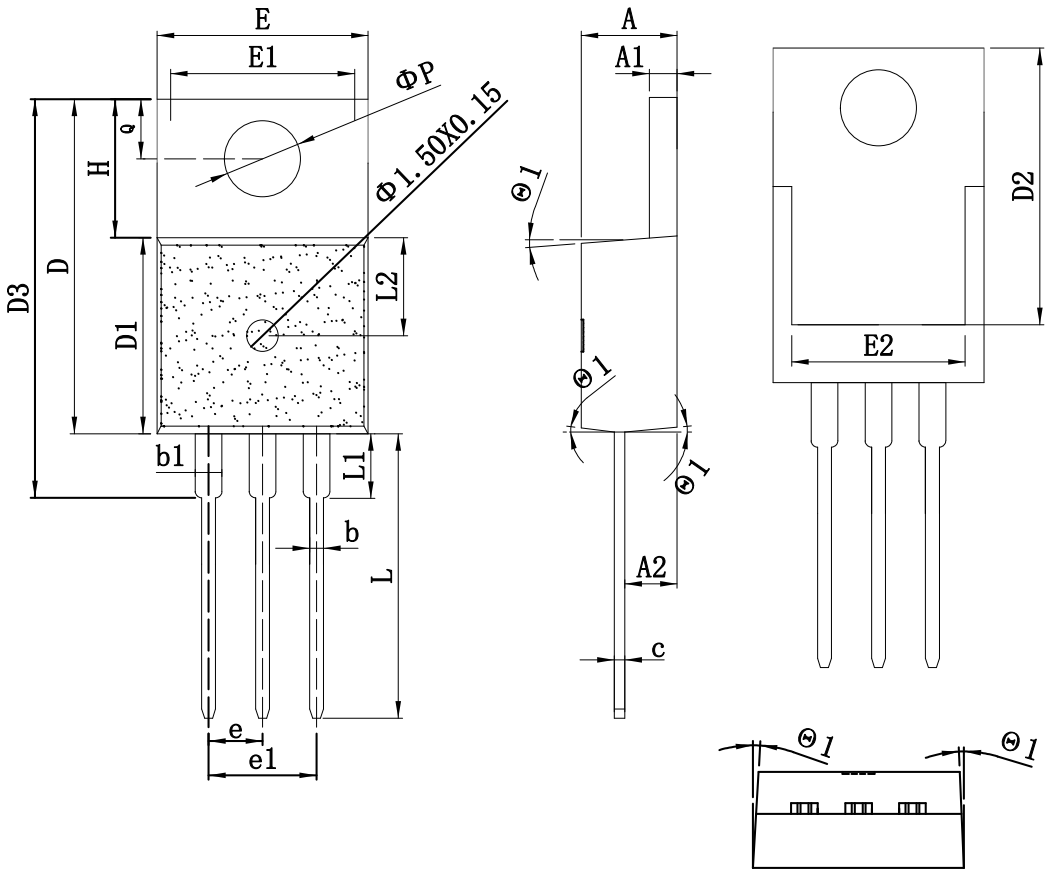
# TO-220_3L-A PACKAGE OUTLINE




COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

| SYMBOL | mm | | | SYMBOL | mm | | |
|---|---|---|---|---|---|---|---|
| | MIN | TYP | MAX | | MIN | TYP | MAX |
| A | 4.15 | 4.50 | 4.80 | E1 | 8.25 | 8.70 | 9.15 |
| A1 | 1.15 | 1.30 | 1.50 | E2 | 7.20 | 8.00 | 8.80 |
| A2 | 2.10 | 2.40 | 2.65 | e | 2.38 | 2.54 | 2.74 |
| b | 0.65 | 0.80 | 1.00 | e1 | 5.08REF | | |
| b1 | 1.10 | 1.33 | 1.80 | H | 6.20 | 6.50 | 6.90 |
| c | 0.35 | 0.50 | 0.65 | L | 12.75 | 13.28 | 13.70 |
| D | 14.25 | 15.75 | 16.15 | L1 | - | - | 3.50 |
| D1 | 8.70 | 9.20 | 9.60 | L2 | 2.30 | 4.65 | 7.00 |
| D2 | 12.30 | 13.10 | 13.85 | ϕP | 3.40 | 3.65 | 3.85 |
| D3 | 16.20 | 18.80 | 20.60 | Q | 2.50 | 2.80 | 3.00 |
| E | 8.68 | 10.02 | 11.00 | θ | 2° | - | 7° |

# TO-220_3L-B PACKAGE OUTLINE




COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

| SYMBOL | mm | | | SYMBOL | mm | | |
|---|---|---|---|---|---|---|---|
| | MIN | TYP | MAX | | MIN | TYP | MAX |
| A | 4.15 | 4.50 | 4.80 | E1 | 8.25 | 8.70 | 9.15 |
| A1 | 1.15 | 1.30 | 1.50 | E2 | 7.20 | 8.00 | 8.80 |
| A2 | 2.10 | 2.40 | 2.65 | e | 2.38 | 2.54 | 2.74 |
| b | 0.65 | 0.80 | 1.00 | e1 | 5.08REF | | |
| b1 | 1.10 | 1.33 | 1.80 | H | 6.20 | 6.50 | 6.90 |
| c | 0.35 | 0.50 | 0.65 | L | 12.75 | 13.28 | 13.70 |
| D | 14.25 | 15.75 | 16.15 | L1 | - | - | 3.50 |
| D1 | 8.70 | 9.20 | 9.60 | L2 | 2.30 | 4.65 | 7.00 |
| D2 | 12.30 | 13.10 | 13.85 | ϕP | 3.40 | 3.65 | 3.85 |
| D3 | 16.20 | 18.80 | 20.60 | Q | 2.50 | 2.80 | 3.00 |
| E | 8.68 | 10.02 | 11.00 | θ | 2° | - | 7° |

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