# VBL1405/VBNC1405

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# N-Channel 45-V (D-S) MOSFET

| PRODUCT SUMMARY | | | |
|---|---|---|---|
| $V_{DS}$ (V) | $R_{DS(on)}$ ($\Omega$) | $I_D$ (A)[a, c] | $Q_g$ (Typ.) |
| 45 | 0.0057 at $V_{GS}$ = 10 V | 75 | 240 nC |
| | 0.0060 at $V_{GS}$ = 4.5 V | 70 | |

## FEATURES

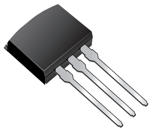
- TrenchFET® Power MOSFET
- 100 % $R_g$ and UIS Tested

RoHS
COMPLIANT

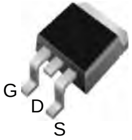
## APPLICATIONS

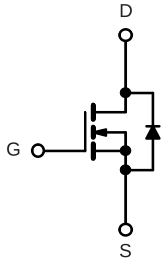
- Synchronous Rectification
- Power Supplies

I²PAK
(TO-262)



D²PAK
(TO-263)





N-Channel MOSFET

| ABSOLUTE MAXIMUM RATINGS $T_A$ = 25 °C, unless otherwise noted | | | | |
|---|---|---|---|---|
| Parameter | | Symbol | Limit | Unit |
| Drain-Source Voltage | | $V_{DS}$ | 45 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 25 | |
| Continuous Drain Current ($T_J$ = 175 °C) | $T_C$ = 25 °C | $I_D$ | 75 [a, c] | A |
| | $T_C$ = 70 °C | | 70 [c] | |
| | $T_A$ = 25 °C | | 29[b] | |
| | $T_A$ = 70 °C | | 23[b] | |
| Pulsed Drain Current | | $I_{DM}$ | 250 | |
| Avalanche Current Pulse | L = 0.1 mH | $I_{AS}$ | 80 | |
| Single Pulse Avalanche Energy | | $E_{AS}$ | 320 | V |
| Continuous Source-Drain Diode Current | $T_C$ = 25 °C | $I_S$ | 110[a, c] | A |
| | $T_A$ = 25 °C | | 2.6[b] | |
| Maximum Power Dissipation | $T_C$ = 25 °C | $P_D$ | 312[a] | W |
| | $T_C$ = 70 °C | | 200 | |
| | $T_A$ = 25 °C | | 3.13[b] | |
| | $T_A$ = 70 °C | | 2.0[b] | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to 150 | °C |

| THERMAL RESISTANCE RATINGS | | | | | |
|---|---|---|---|---|---|
| Parameter | | Symbol | Typical | Maximum | Unit |
| Maximum Junction-to-Ambient[b] | Steady State | $R_{thJA}$ | 32 | 40 | °C/W |
| Maximum Junction-to-Case | Steady State | $R_{thJC}$ | 0.33 | 0.4 | |

Notes:
a. Based on $T_C$ = 25 °C.
b. Surface Mounted on 1" x 1" FR4 board.
c. Calculated based on maximum junction temperature. Package limitation current is 110 A.

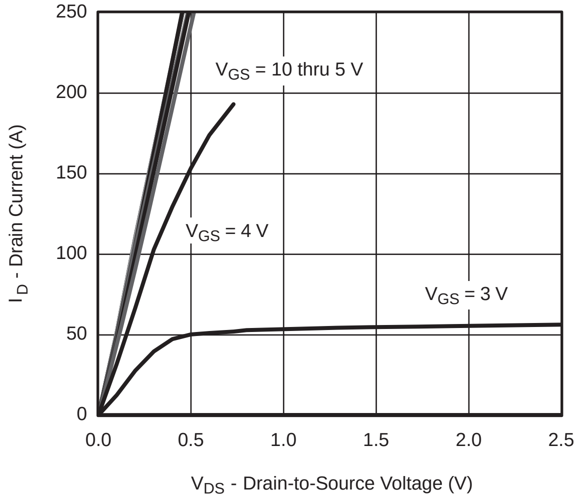
**SPECIFICATIONS** $T_J$ = 25 °C, unless otherwise noted

| 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 |
| $V_{DS}$ Temperature Coefficient | $\Delta V_{DS}/T_J$ | $I_D$ = 250 µA | | 41 | | mV/°C |
| $V_{GS(th)}$ Temperature Coefficient | $\Delta V_{GS(th)}/T_J$ | | | - 8 | | |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}$, $I_D$ = 250 µA | 1.2 | | 2.5 | V |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | | ± 100 | 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, $T_J$ = 55 °C | | | 10 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{DS} \geq 5$ V, $V_{GS}$ = 10 V | 120 | | | A |
| Drain-Source On-State Resistance[a] | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 30 A | | 0.0057 | | Ω |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 20 A | | 0.0060 | | |
| Forward Transconductance[a] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 30 A | | 180 | | S |
| **Dynamic[b]** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ = 20 V, $V_{GS}$ = 0 V, f = 1 MHz | | 18800 | | pF |
| Output Capacitance | $C_{oss}$ | | | 1550 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 850 | | |
| Total Gate Charge | $Q_g$ | $V_{DS}$ = 20 V, $V_{GS}$ = 10 V, $I_D$ = 20 A | | 240 | 360 | nC |
| Gate-Source Charge | $Q_{gs}$ | | | 40 | | |
| Gate-Drain Charge | $Q_{gd}$ | | | 22 | | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 0.85 | 1.3 | Ω |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD}$ = 20 V, $R_L$ = 1.0 Ω<br>$I_D \cong 20$ A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | | 20 | 30 | ns |
| Rise Time | $t_r$ | | | 11 | 17 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 77 | 115 | |
| Fall Time | $t_f$ | | | 10 | 15 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD}$ = 20 V, $R_L$ = 1.0 Ω<br>$I_D \cong 20$ A, $V_{GEN}$ = 4.5 V, $R_g$ = 1 Ω | | 102 | 155 | |
| Rise Time | $t_r$ | | | 62 | 95 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 180 | 270 | |
| Fall Time | $t_f$ | | | 60 | 90 | |
| **Drain-Source Body Diode Characteristics** | | | | | | |
| Continuous Source-Drain Diode Current | $I_S$ | $T_C$ = 25 °C | | | 110 | A |
| Pulse Diode Forward Current[a] | $I_{SM}$ | | | | 200 | |
| Body Diode Voltage | $V_{SD}$ | $I_S$ = 20 A | | 0.8 | 1.2 | V |
| Body Diode Reverse Recovery Time | $t_{rr}$ | $I_F$ = 20 A, di/dt = 100 A/µs, $T_J$ = 25 °C | | 50 | 75 | ns |
| Body Diode Reverse Recovery Charge | $Q_{rr}$ | | | 70 | 105 | nC |
| Reverse Recovery Fall Time | $t_a$ | | | 30 | | ns |
| Reverse Recovery Rise Time | $t_b$ | | | 20 | | |

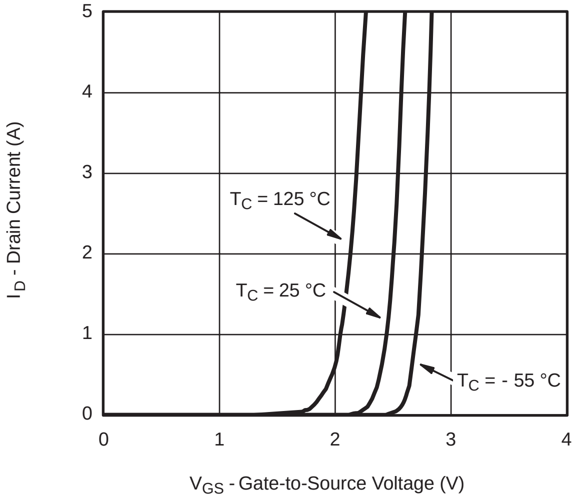
Notes:
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.

*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.*

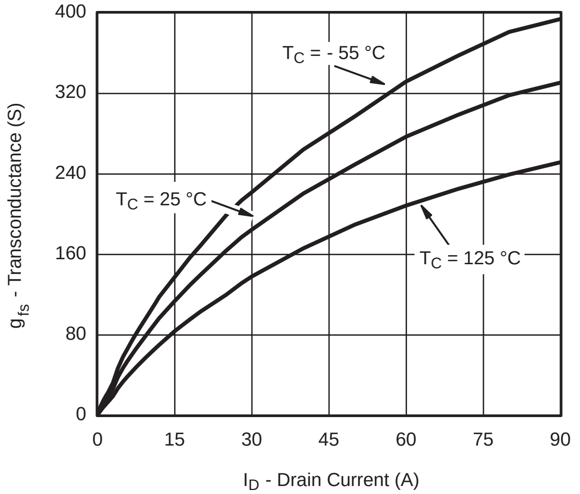
## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



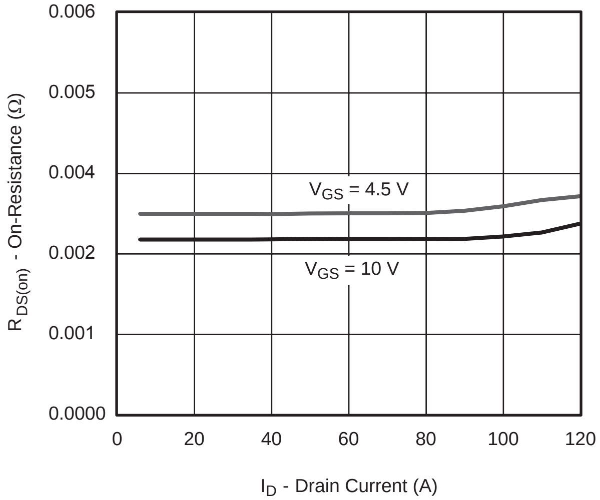
**Output Characteristics**



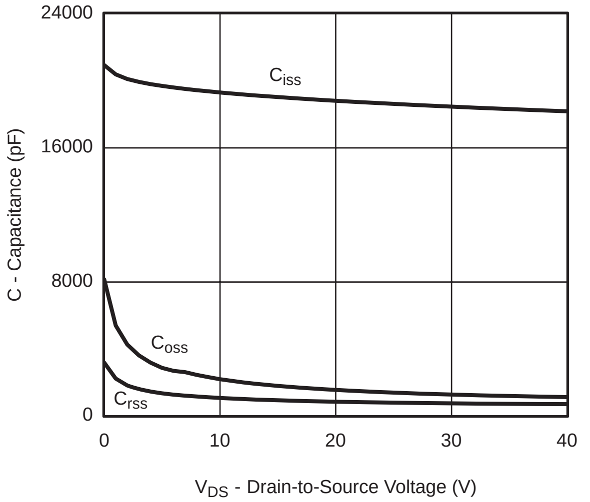
**Transfer Characteristics**



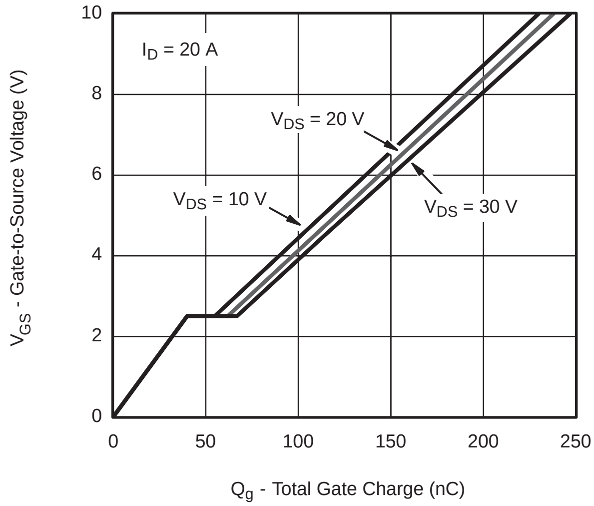
**Transconductance**



**On-Resistance vs. Drain Current**

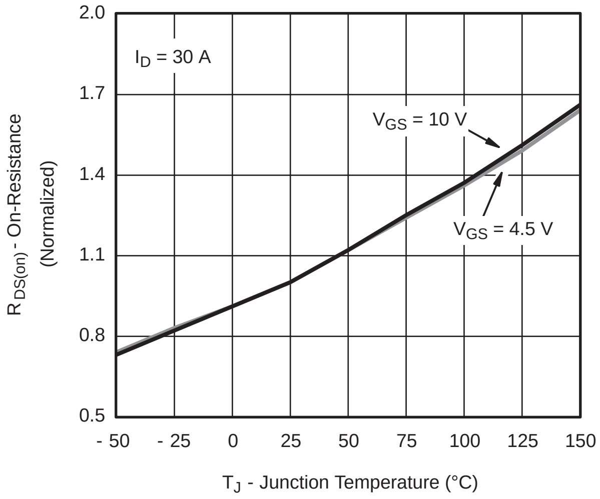


**Capacitance**

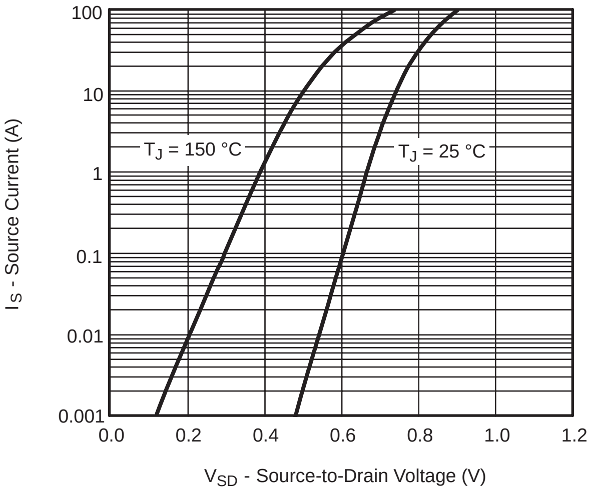


**Gate Charge**

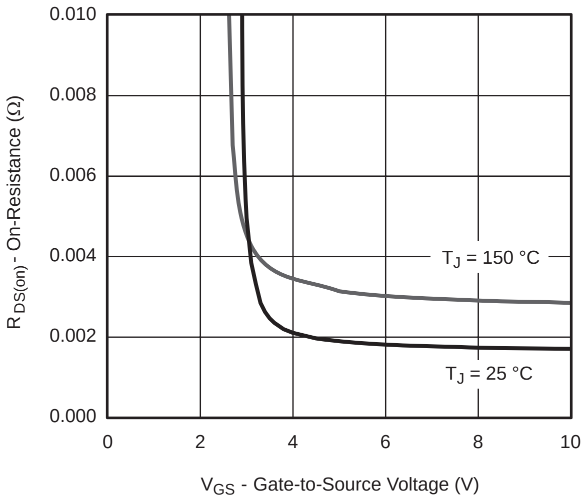
## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



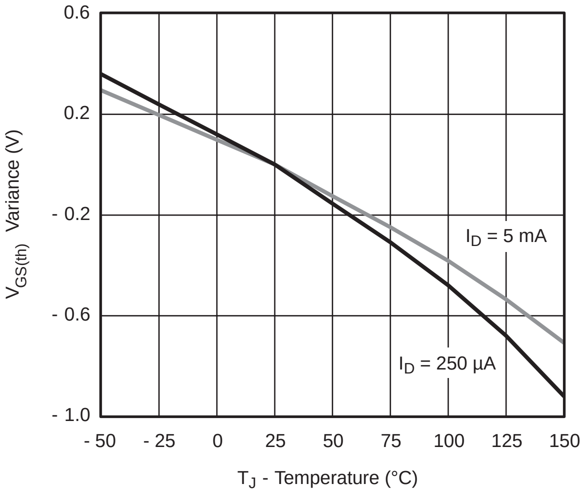
**On-Resistance vs. Junction Temperature**



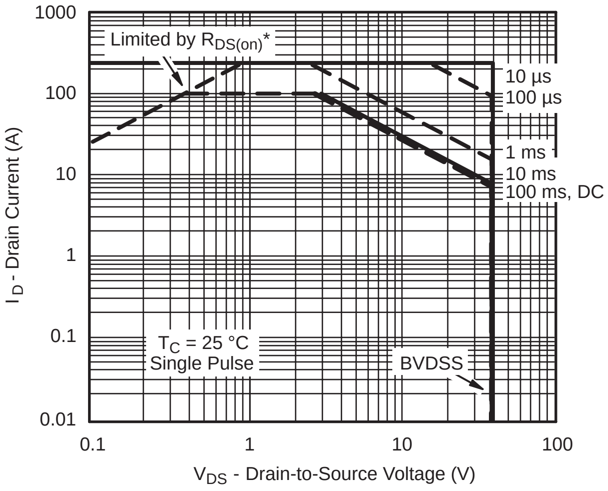
**Forward Diode Voltage vs. Temperature**



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



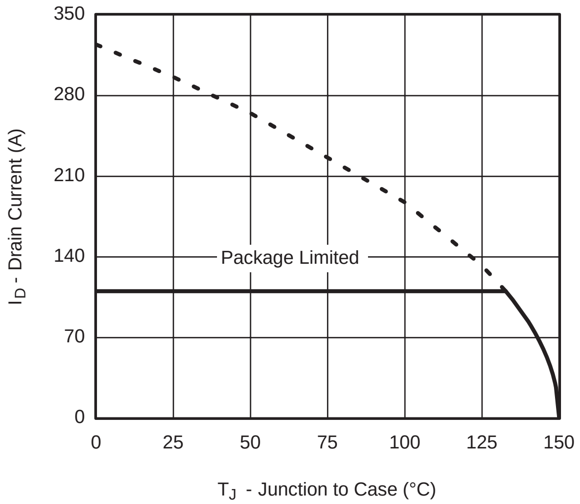
**Threshold Voltage**



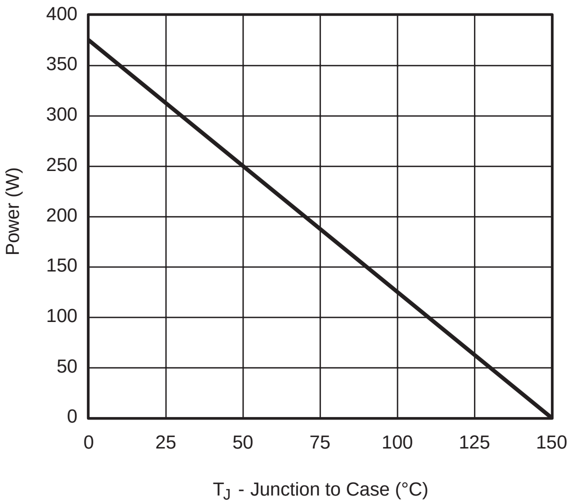
* $V_{GS}$ > minimum $V_{GS}$ at which $R_{DS(on)}$ is specified

**Safe Operating Area, Junction-to-Ambient**

## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

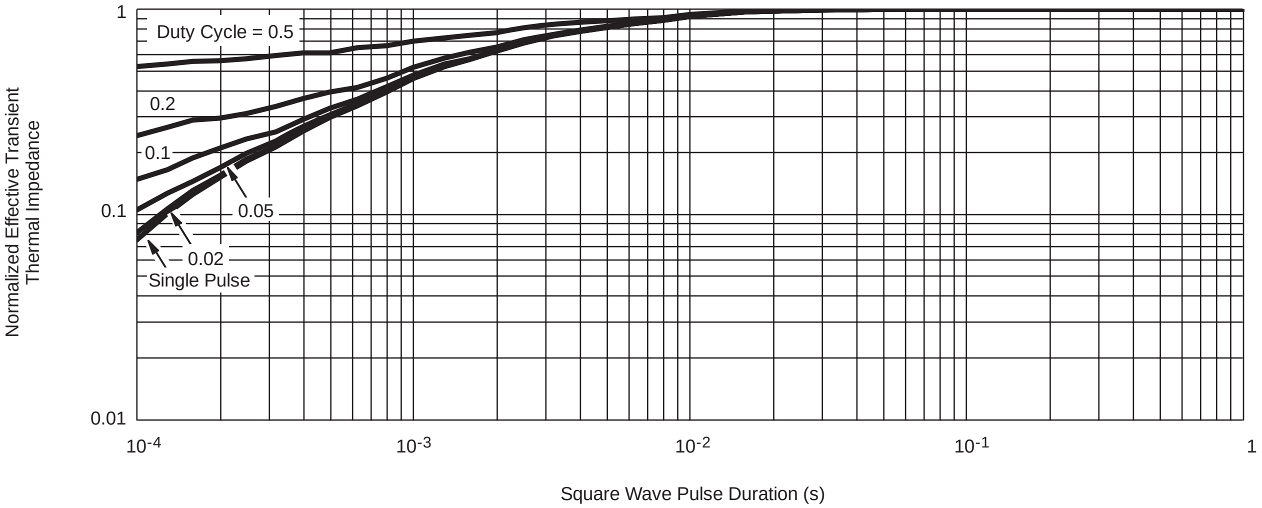


**Current Derating***



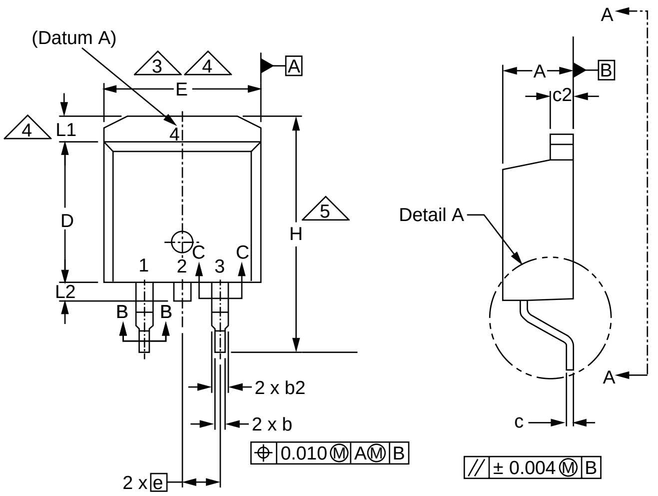
**Power Derating**

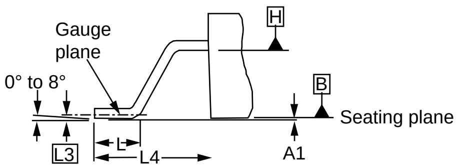
* The power dissipation $P_D$ is based on $T_{J(max)}$ = 150 °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.



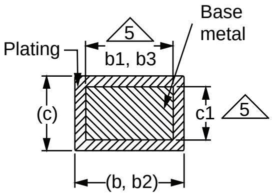
**Normalized Thermal Transient Impedance, Junction-to-Case**

## TO-263AB (HIGH VOLTAGE)

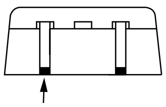




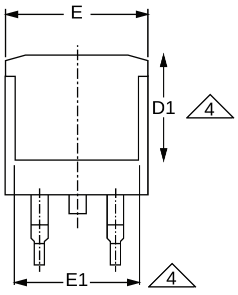
Detail “A”
Rotated 90° CW
scale 8:1



Section B - B and C - C
Scale: none



Lead tip



View A - A

| DIM. | MILLIMETERS MIN. | MILLIMETERS MAX. | INCHES MIN. | INCHES MAX. |
|---|---|---|---|---|
| A | 4.06 | 4.83 | 0.160 | 0.190 |
| A1 | 0.00 | 0.25 | 0.000 | 0.010 |
| b | 0.51 | 0.99 | 0.020 | 0.039 |
| b1 | 0.51 | 0.89 | 0.020 | 0.035 |
| b2 | 1.14 | 1.78 | 0.045 | 0.070 |
| b3 | 1.14 | 1.73 | 0.045 | 0.068 |
| c | 0.38 | 0.74 | 0.015 | 0.029 |
| c1 | 0.38 | 0.58 | 0.015 | 0.023 |
| c2 | 1.14 | 1.65 | 0.045 | 0.065 |
| D | 8.38 | 9.65 | 0.330 | 0.380 |

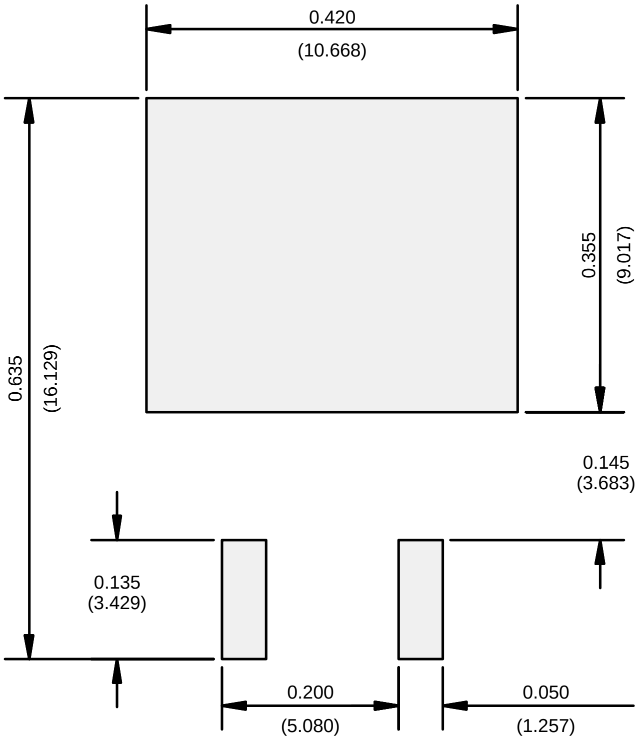
| DIM. | MILLIMETERS MIN. | MILLIMETERS MAX. | INCHES MIN. | INCHES MAX. |
|---|---|---|---|---|
| D1 | 6.86 | - | 0.270 | - |
| E | 9.65 | 10.67 | 0.380 | 0.420 |
| E1 | 6.22 | - | 0.245 | - |
| e | 2.54 BSC | | 0.100 BSC | |
| H | 14.61 | 15.88 | 0.575 | 0.625 |
| L | 1.78 | 2.79 | 0.070 | 0.110 |
| L1 | - | 1.65 | - | 0.066 |
| L2 | - | 1.78 | - | 0.070 |
| L3 | 0.25 BSC | | 0.010 BSC | |
| L4 | 4.78 | 5.28 | 0.188 | 0.208 |

ECN: S-82110-Rev. A, 15-Sep-08
DWG: 5970

**Notes**

1. Dimensioning and tolerancing per ASME Y14.5M-1994.
2. Dimensions are shown in millimeters (inches).
3. Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outmost extremes of the plastic body at datum A.
4. Thermal PAD contour optional within dimension E, L1, D1 and E1.
5. Dimension b1 and c1 apply to base metal only.
6. Datum A and B to be determined at datum plane H.
7. Outline conforms to JEDEC outline to TO-263AB.

## RECOMMENDED MINIMUM PADS FOR D$^2$PAK: 3-Lead



Recommended Minimum Pads
Dimensions in Inches/(mm)

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