# P-Channel 60 V (D-S) MOSFET

| PRODUCT SUMMARY | | | |
|---|---|---|---|
| $V_{DS}$ (V) | $R_{DS(on)}$ (Ω) | $I_D$ (A)[d] | $Q_g$ (Typ) |
| - 60 | 0.060 at $V_{GS}$ = - 10 V | - 19 | 26 |
| | 0.077 at $V_{GS}$ = - 4.5 V | - 16.8 | |

## FEATURES

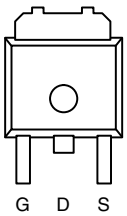
- **Halogen-free According to IEC 61249-2-21 Definition**
- TrenchFET® Power MOSFET
- 100 % UIS Tested
- Compliant to RoHS Directive 2002/95/EC

RoHS COMPLIANT
HALOGEN FREE Available

## APPLICATIONS

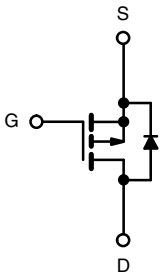
- High Side Switch for Full Bridge Converter
- DC/DC Converter for LCD Display

**TO-252**




Top View

Drain Connected to Tab




P-Channel MOSFET

**Ordering Information:** SUD19P06-60-E3 (Lead (Pb)-free)
SUD19P06-60-GE3 (Lead (Pb)-free and Halogen free)

| ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25 °C, unless otherwise note) | | | | |
|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Limit** | **Unit** |
| Drain-Source Voltage | | $V_{DS}$ | - 60 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current ($T_J$ = 150 °C) | $T_C$ = 25 °C | $I_D$ | - 18.3 | A |
| | $T_C$ = 125 °C | | - 8.19 | |
| Pulsed Drain Current | | $I_{DM}$ | - 30 | |
| Avalanche Current, Single Pulse | L = 0.1 mH | $I_{AS}$ | - 22 | |
| Repetitive Avalanche Energy, Single Pulse[a] | | $E_{AS}$ | 24.2 | mJ |
| Power Dissipation | $T_C$ = 25 °C | $P_D$ | 38.5[c] | W |
| | $T_A$ = 25 °C | | 2.3[b, c] | |
| 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] | t ≤ 10 s | $R_{thJA}$ | 17 | 21 | °C/W |
| | Steady State | | 45 | 55 | |
| Maximum Junction-to-Case | | $R_{thJC}$ | 2.7 | 3.25 | |

Notes:
a. Duty cycle ≤ 1 %.
b. When mounted on 1" square PCB (FR-4 material).
c. See SOA curve for voltage derating.
d. Based up on $T_C$ = 25 °C.


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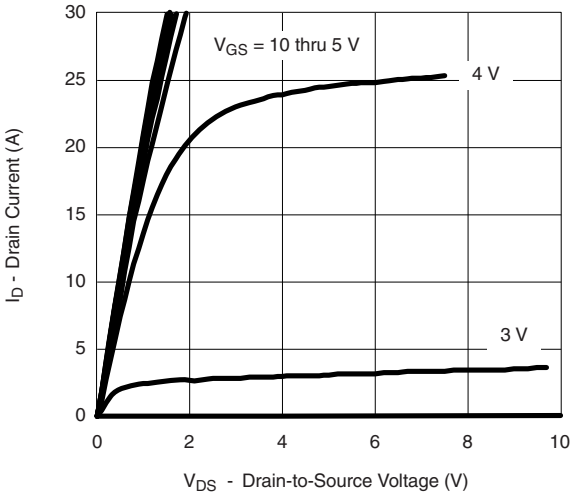
| **SPECIFICATIONS** ($T_J$ = 25 °C, unless otherwise note) | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Test Conditions** | **Min .** | **Typ.** | **Max.** | **Unit** |
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = - 250 µA | - 60 | | | V |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = - 250 µA | - 1 | | - 3 | V |
| Gate-Body Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = - 60 V, $V_{GS}$ = 0 V | | | - 1 | µA |
| | | $V_{DS}$ = - 60 V, $V_{GS}$ = 0 V, $T_J$ = 125 °C | | | - 50 | |
| | | $V_{DS}$ = - 60 V, $V_{GS}$ = 0 V, $T_J$ = 150 ° C | | | - 125 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{DS}$ = - 5 V, $V_{GS}$ = - 10 V | - 30 | | | A |
| Drain-Source On-State Resistance[a] | $R_{DS(on)}$ | $V_{GS}$ = - 10 V, $I_D$ = - 10 A | | 0.048 | 0.060 | Ω |
| | | $V_{GS}$ = - 10 V, $I_D$ = - 10 A, $T_J$ = 125 °C | | | 0.102 | |
| | | $V_{GS}$ = - 10 V, $I_D$ = - 10 A, $T_J$ = 150 °C | | | 0.120 | |
| | | $V_{GS}$ = - 4.5 V, $I_D$ = - 5 A | | 0.061 | 0.077 | |
| Forward Transconductance[a] | $g_{fs}$ | $V_{DS}$ = - 15 V, $I_D$ = - 10 A | | 22 | | S |
| **Dynamic[b]** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = - 25 V, f = 1 MHz | | 1140 | 1710 | pF |
| Output Capacitance | $C_{oss}$ | | | 130 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 90 | | |
| Total Gate Charge[c] | $Q_g$ | $V_{DS}$ = - 30 V, $V_{GS}$ = - 10 V, $I_D$ = - 10 A | | 26 | 40 | nC |
| Gate-Source Charge[c] | $Q_{gs}$ | | | 4.5 | | |
| Gate-Drain Charge[c] | $Q_{gd}$ | | | 7 | | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 7 | | Ω |
| Turn-On Delay Time[c] | $t_{d(on)}$ | $V_{DD}$ = - 30 V, $R_L$ = 3 Ω<br>$I_D \cong$ - 19 A, $V_{GEN}$ = - 10 V, $R_g$ = 2.5 Ω | | 8 | 15 | ns |
| Rise Time[c] | $t_r$ | | | 9 | 15 | |
| Turn-Off Delay Time[c] | $t_{d(off)}$ | | | 65 | 100 | |
| Fall Time[c] | $t_f$ | | | 30 | 45 | |
| **Drain-Source Body Diode and Characteristics** ($T_C$ = 25 °C)[b] | | | | | | |
| Continuous Current | $I_S$ | | | | - 30 | A |
| Pulsed Current | $I_{SM}$ | | | | - 30 | |
| Forward Voltage[a] | $V_{SD}$ | $I_F$ = - 19 A, $V_{GS}$ = 0 V | | - 1 | - 1.5 | V |
| Reverse Recovery Time | $t_{rr}$ | $I_F$ = - 19 A, di/dt = 100 A/µs | | 41 | 61 | ns |

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.

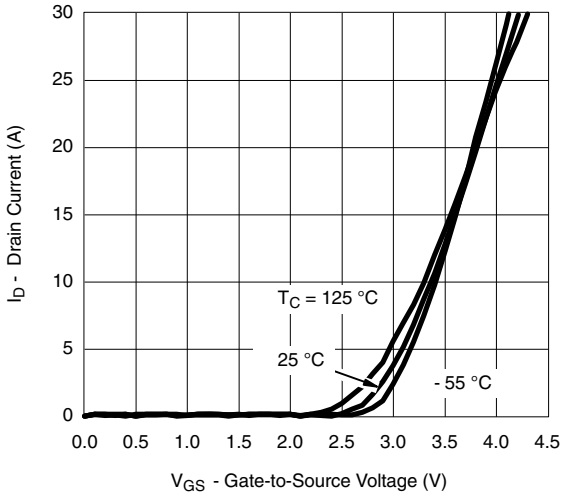
*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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


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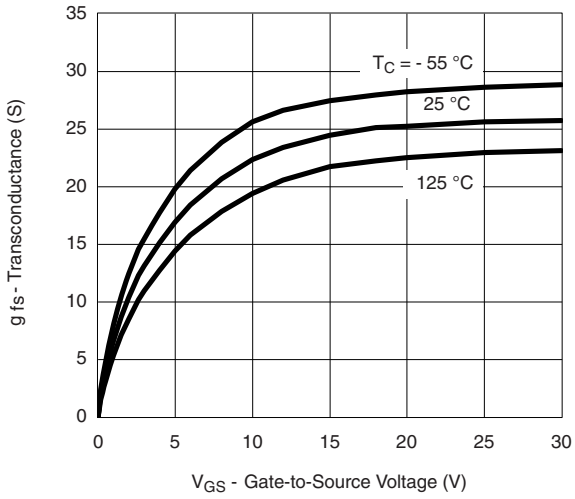
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



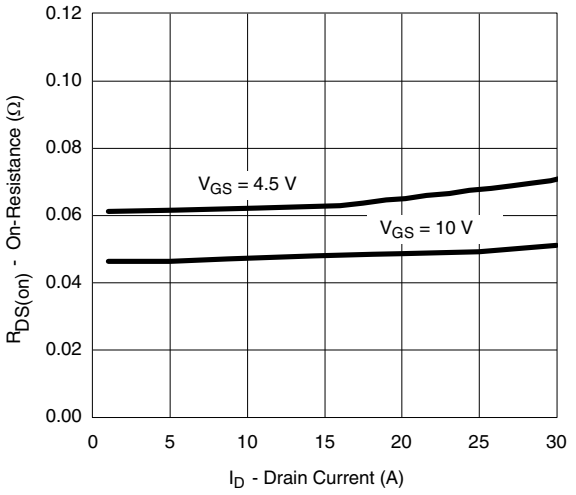

**Output Characteristics**



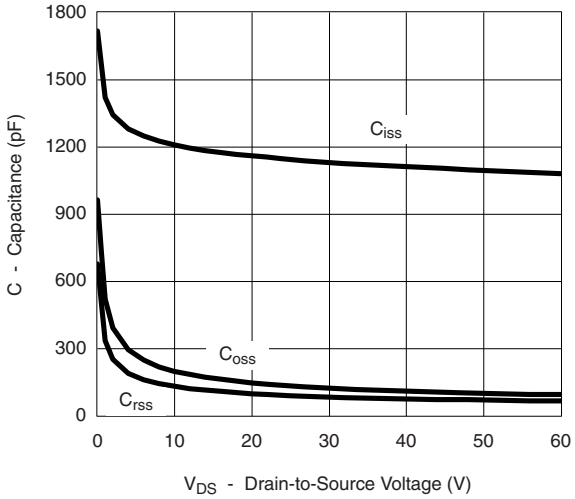

**Transfer Characteristics**



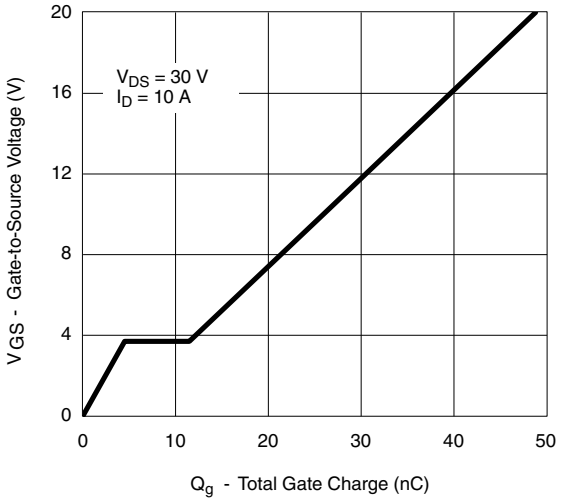

**Transconductance**




**On-Resistance vs. Drain Current**



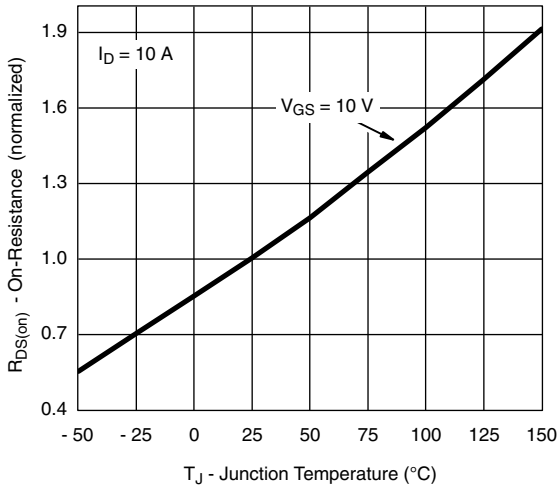

**Capacitance**



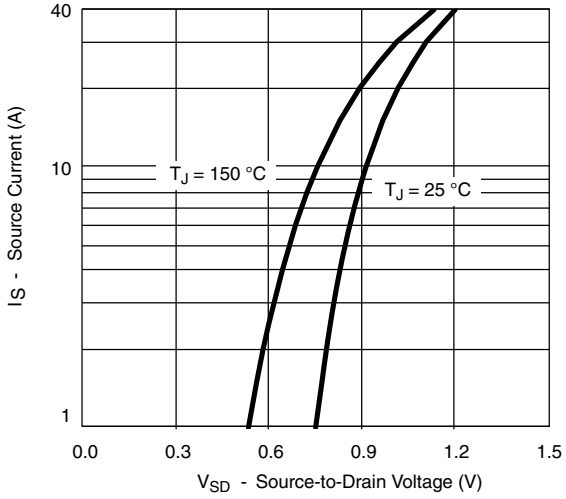

**Gate Charge**


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

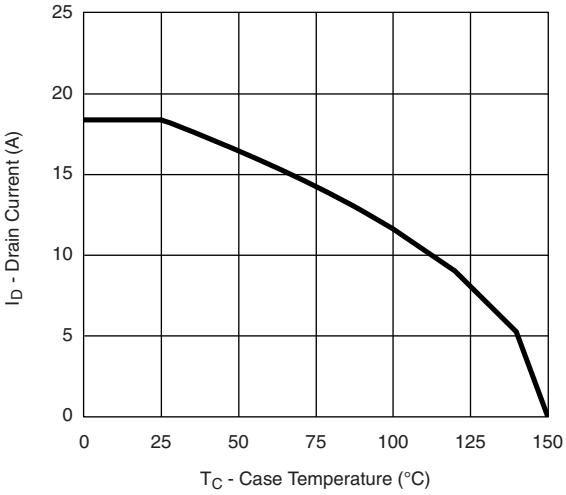



**On-Resistance vs. Junction Temperature**

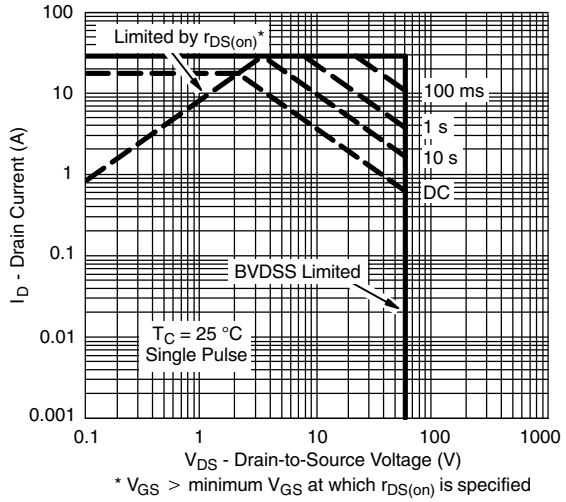



**Source-Drain Diode Forward Voltage**

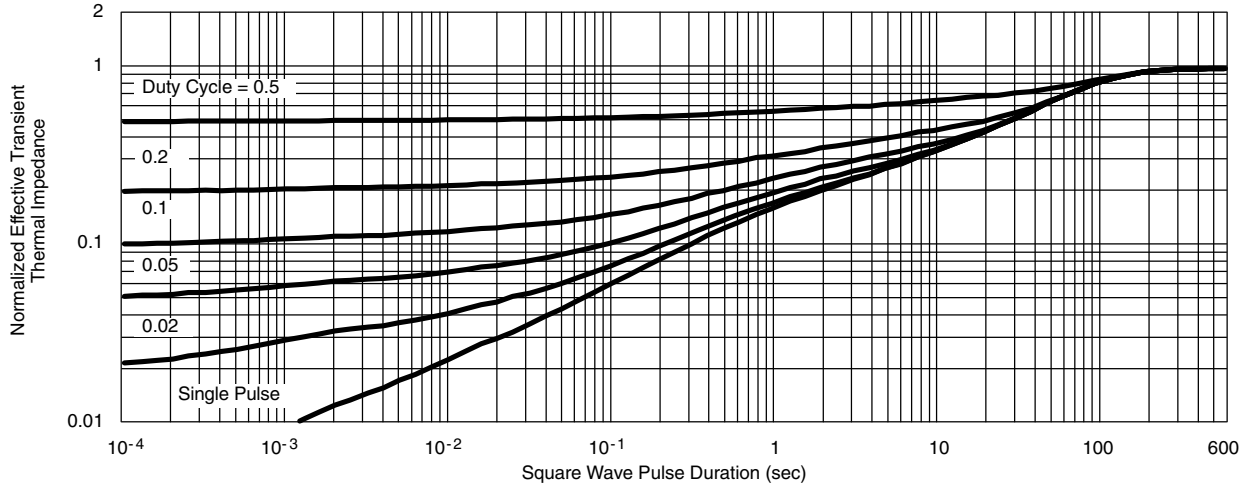
## THERMAL RATINGS




**Maximum Drain Current vs. Case Temperature**




**Safe Operating Area**

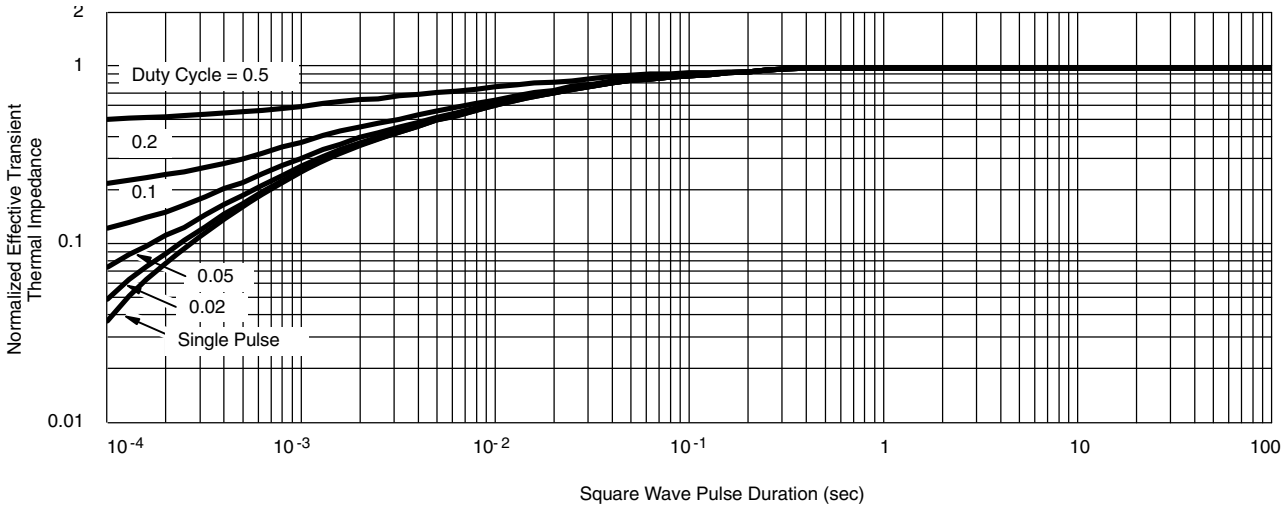



**Normalized Thermal Transient Impedance, Junction-to-Ambient**




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## THERMAL RATINGS



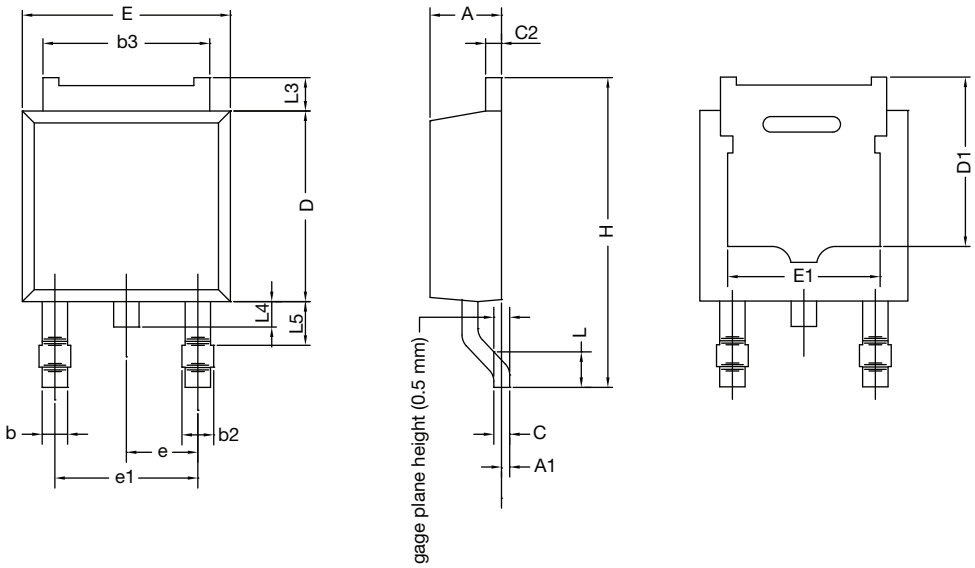

**Normalized Thermal Transient Impedance, Junction-to-Case**

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# TO-252AA Case Outline

## VERSION 1: FACILITY CODE = Y




| | MILLIMETERS | |
|---|---|---|
| DIM. | MIN. | MAX. |
| A | 2.18 | 2.38 |
| A1 | - | 0.127 |
| b | 0.64 | 0.88 |
| b2 | 0.76 | 1.14 |
| b3 | 4.95 | 5.46 |
| C | 0.46 | 0.61 |
| C2 | 0.46 | 0.89 |
| D | 5.97 | 6.22 |
| D1 | 4.10 | - |
| E | 6.35 | 6.73 |
| E1 | 4.32 | - |
| H | 9.40 | 10.41 |
| e | 2.28 BSC | |
| e1 | 4.56 BSC | |
| L | 1.40 | 1.78 |
| L3 | 0.89 | 1.27 |
| L4 | - | 1.02 |
| L5 | 1.01 | 1.52 |

**Note**

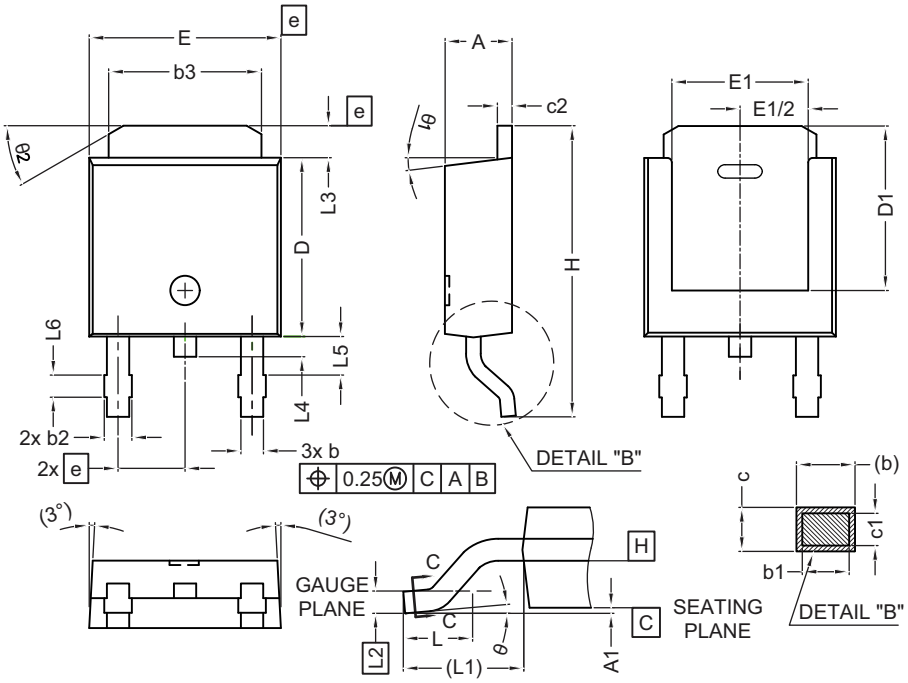
- Dimension L3 is for reference only



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## VERSION 2: FACILITY CODE = N




| | MILLIMETERS | |
|---|---|---|
| DIM. | MIN. | MAX. |
| A | 2.18 | 2.39 |
| A1 | - | 0.13 |
| b | 0.65 | 0.89 |
| b1 | 0.64 | 0.79 |
| b2 | 0.76 | 1.13 |
| b3 | 4.95 | 5.46 |
| c | 0.46 | 0.61 |
| c1 | 0.41 | 0.56 |
| c2 | 0.46 | 0.60 |
| D | 5.97 | 6.22 |
| D1 | 5.21 | - |
| E | 6.35 | 6.73 |
| E1 | 4.32 | - |
| e | 2.29 BSC | |
| H | 9.94 | 10.34 |

| | MILLIMETERS | |
|---|---|---|
| DIM. | MIN. | MAX. |
| L | 1.50 | 1.78 |
| L1 | 2.74 ref. | |
| L2 | 0.51 BSC | |
| L3 | 0.89 | 1.27 |
| L4 | - | 1.02 |
| L5 | 1.14 | 1.49 |
| L6 | 0.65 | 0.85 |
| θ | 0° | 10° |
| θ1 | 0° | 15° |
| θ2 | 25° | 35° |

**Notes**

- Dimensioning and tolerance confirm to ASME Y14.5M-1994
- All dimensions are in millimeters. Angles are in degrees
- Heat sink side flash is max. 0.8 mm
- Radius on terminal is optional

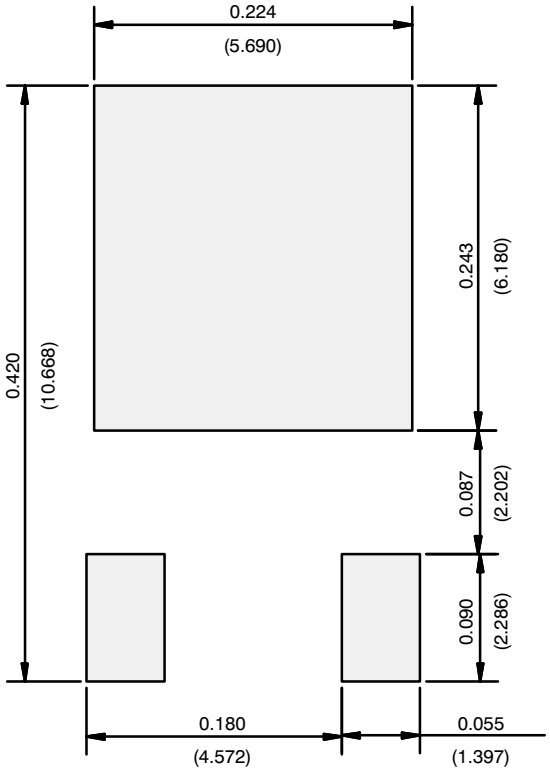
ECN: E22-0399-Rev. R, 03-Oct-2022
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## RECOMMENDED MINIMUM PADS FOR DPAK (TO-252)




Recommended Minimum Pads
Dimensions in Inches/(mm)

Return to Index

APPLICATION NOTE

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