

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

### PRODUCT SUMMARY

| V <sub>DS</sub> (V) | R <sub>DS(on)</sub> (Ω)            | I <sub>D</sub> (A) <sup>d</sup> | Q <sub>g</sub> (Typ) |
|---------------------|------------------------------------|---------------------------------|----------------------|
| - 60                | 0.060 at V <sub>GS</sub> = - 10 V  | - 19                            | 26                   |
|                     | 0.077 at V <sub>GS</sub> = - 4.5 V | - 16.8                          |                      |

### FEATURES

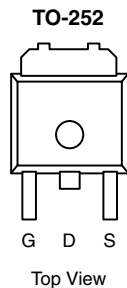
- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET<sup>®</sup> Power MOSFET
- 100 % UIS Tested
- Compliant to RoHS Directive 2002/95/EC



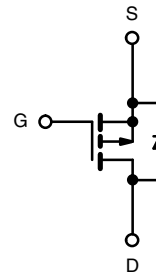
RoHS  
COMPLIANT  
HALOGEN  
**FREE**  
Available

### APPLICATIONS

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



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<sub>A</sub> = 25 °C, unless otherwise note)

| Parameter  | Symbol                            | Limit                   | Unit                |
|--|-----------------------------------|-------------------------|---------------------|
| Drain-Source Voltage                                   | V <sub>DS</sub>                   | - 60                    | V                   |
| Gate-Source Voltage                                    | V <sub>GS</sub>                   | ± 20                    |                     |
| Continuous Drain Current (T <sub>J</sub> = 150 °C)     | I <sub>D</sub>                    | T <sub>C</sub> = 25 °C  | - 18.3              |
|  |                                   | T <sub>C</sub> = 125 °C | - 8.19              |
| Pulsed Drain Current                                   | I <sub>DM</sub>                   | - 30                    | A                   |
| Avalanche Current, Single Pulse                        | I <sub>AS</sub>                   | - 22                    |                     |
| Repetitive Avalanche Energy, Single Pulse <sup>a</sup> | E <sub>AS</sub>                   | 24.2                    | mJ                  |
| Power Dissipation                                      | P <sub>D</sub>                    | T <sub>C</sub> = 25 °C  | 38.5 <sup>c</sup>   |
|  |                                   | T <sub>A</sub> = 25 °C  | 2.3 <sup>b, c</sup> |
| Operating Junction and Storage Temperature Range       | T <sub>J</sub> , T <sub>stg</sub> | - 55 to 150             | °C                  |

### THERMAL RESISTANCE RATINGS

| Parameter                                | Symbol            | Typical      | Maximum | Unit |
|--|-------------------|--------------|---------|------|
| Maximum Junction-to-Ambient <sup>b</sup> | R <sub>thJA</sub> | t ≤ 10 s     | 17      | 21   |
|  |                   | Steady State | 45      | 55   |
| Maximum Junction-to-Case                 | R <sub>thJC</sub> | 2.7          | 3.25    | °C/W |

Notes:

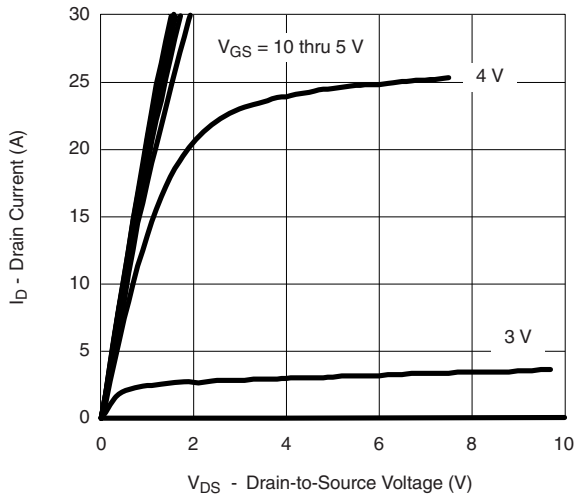
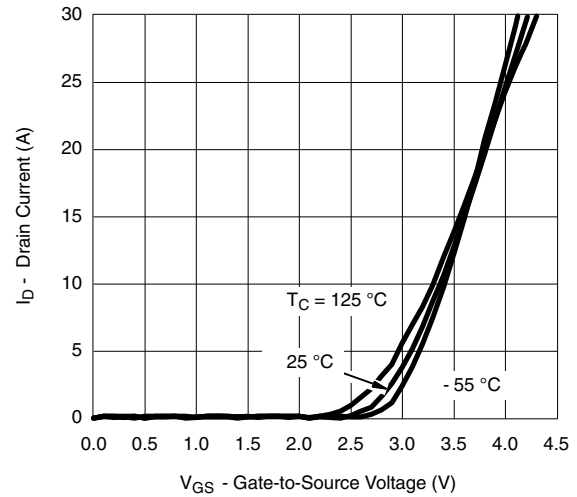
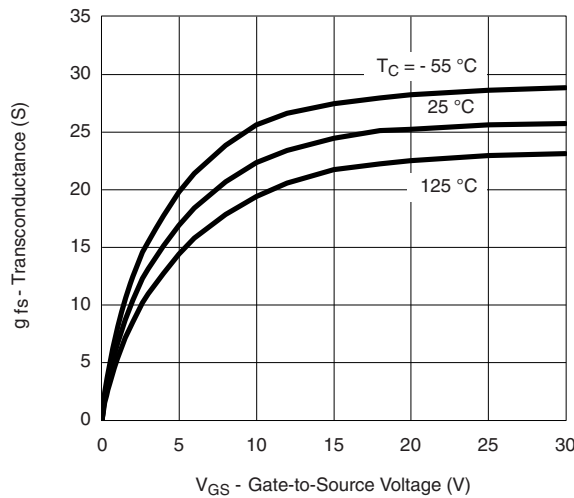
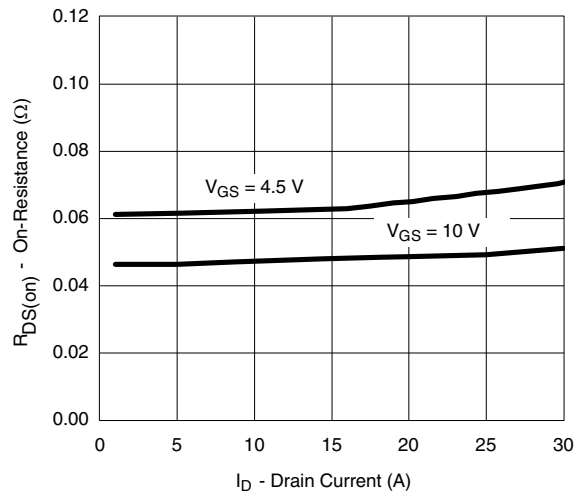
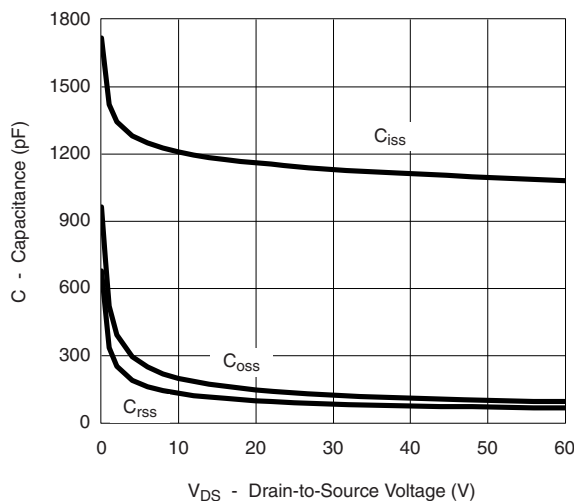
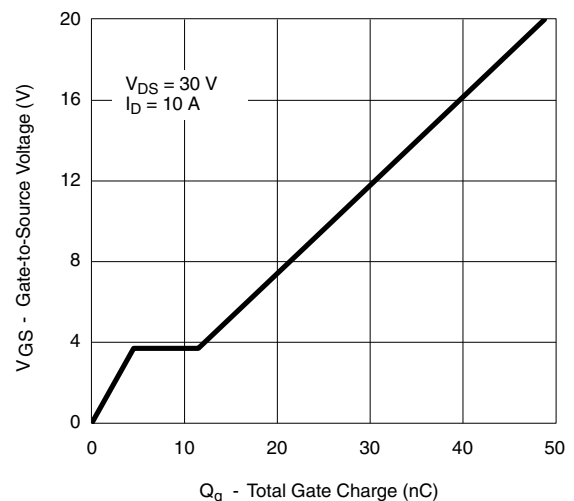
- Duty cycle ≤ 1 %.
- When mounted on 1" square PCB (FR-4 material).
- See SOA curve for voltage derating.
- Based up on T<sub>C</sub> = 25 °C.

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

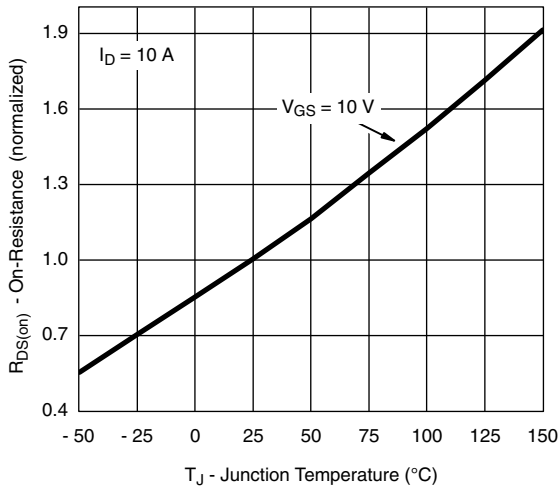
## Notes:

- Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .
- Guaranteed by design, not subject to production testing.
- Independent of operating temperature.

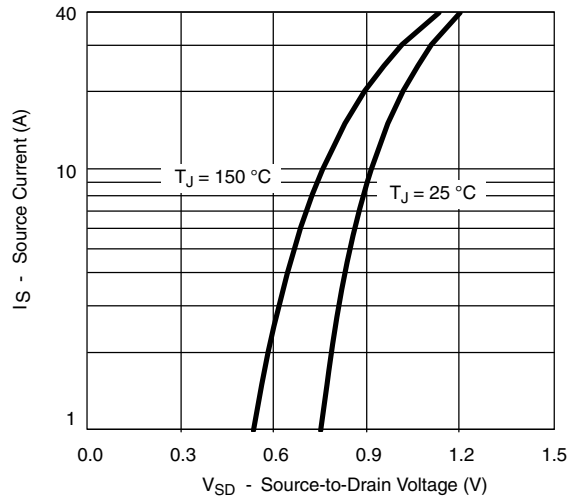
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

**TYPICAL CHARACTERISTICS** (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)

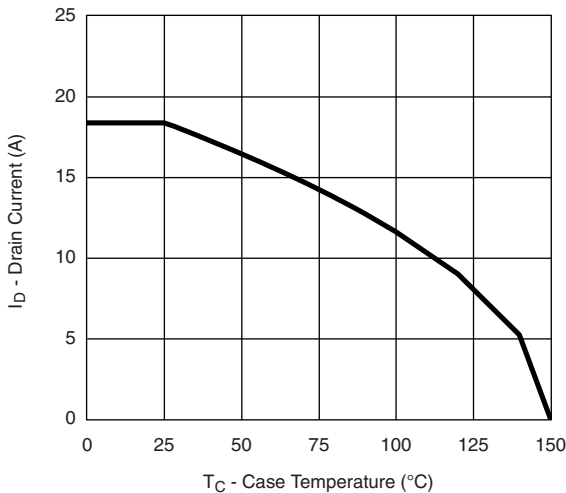


On-Resistance vs. Junction Temperature

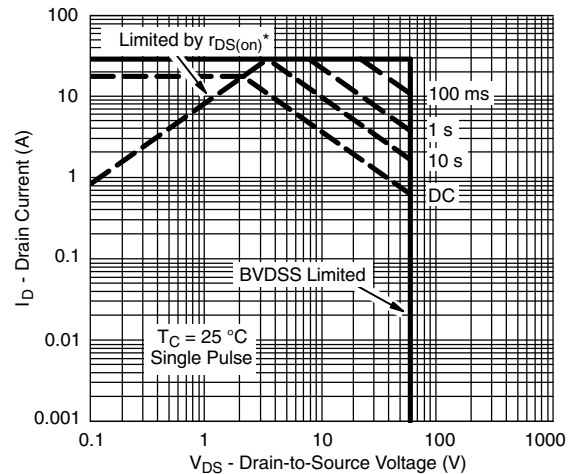


Source-Drain Diode Forward Voltage

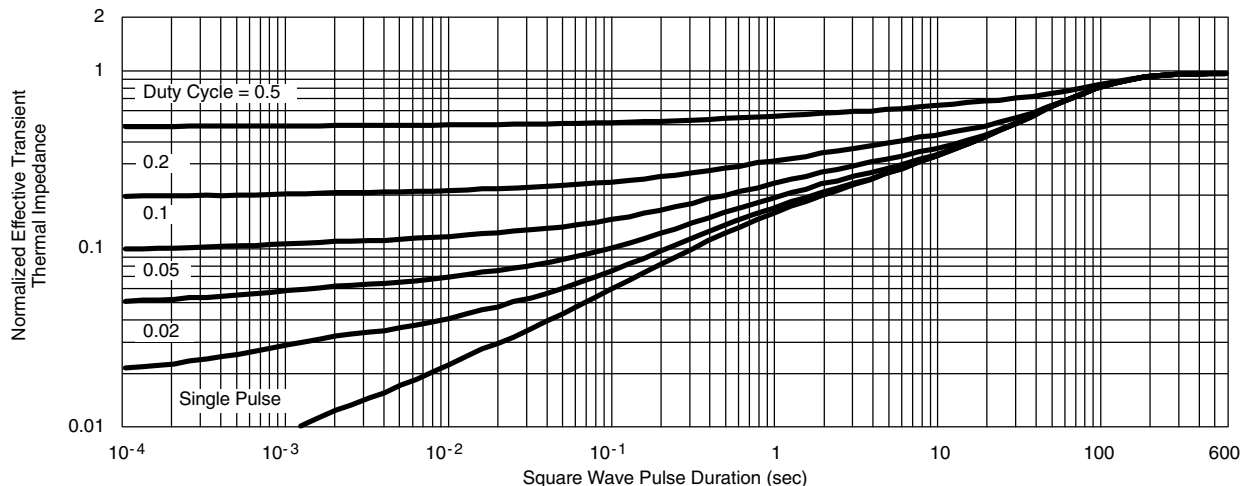
### THERMAL RATINGS



Maximum Drain Current vs. Case Temperature

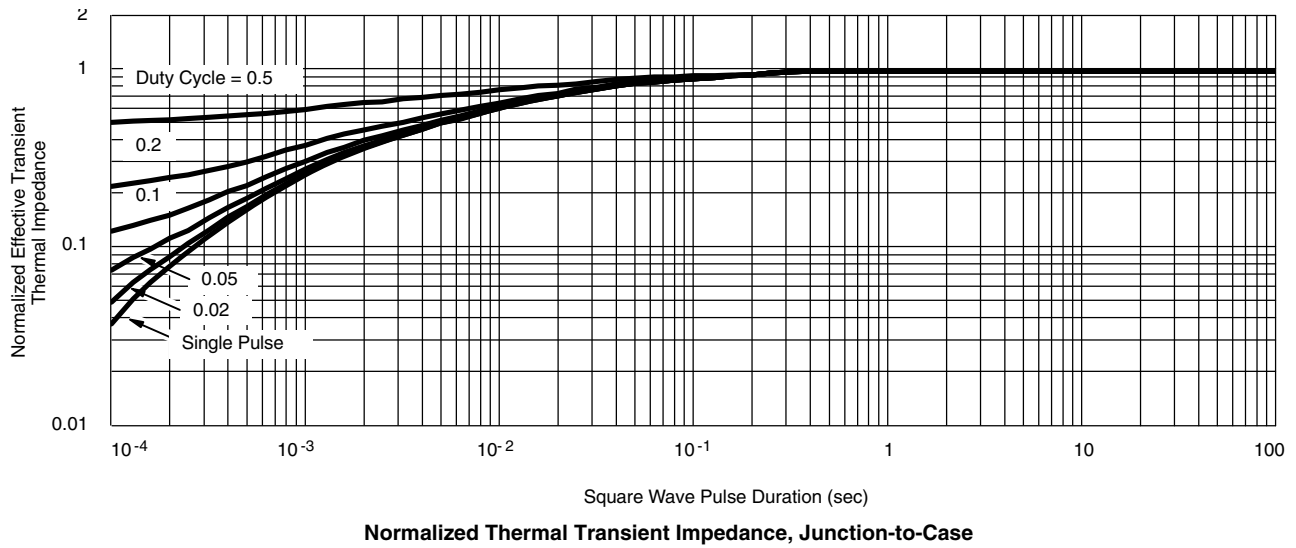


\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $r_{DS(on)}$  is specified  
Safe Operating Area



Normalized Thermal Transient Impedance, Junction-to-Ambient

**THERMAL RATINGS**



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# TO-252AA Case Outline

## VERSION 1: FACILITY CODE = Y



| DIM. | MILLIMETERS |       |
|------|-------------|-------|
|      | 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



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: E19-0649-Rev. Q, 16-Dec-2019  
DWG: 5347

## RECOMMENDED MINIMUM PADS FOR DPAK (TO-252)



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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