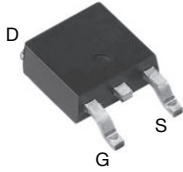


## E Series Power MOSFET

**DKPAK (TO-252)**


N-Channel MOSFET

### FEATURES

- 4<sup>th</sup> generation E series technology
- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low effective capacitance ( $C_{o(er)}$ )
- Reduced switching and conduction losses
- Avalanche energy rated (UIS)
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
 COMPLIANT  
 HALOGEN  
**FREE**

### APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Industrial
  - Welding
  - Induction heating
  - Motor drives
  - Battery chargers
  - Solar (PV inverters)

### PRODUCT SUMMARY

|   |                 |       |
|---|-----------------|-------|
| $V_{DS}$ (V) at $T_J$ max.              | 650             |       |
| $R_{DS(on)}$ typ. ( $\Omega$ ) at 25 °C | $V_{GS} = 10$ V | 0.208 |
| $Q_g$ max. (nC)                         | 23              |       |
| $Q_{gs}$ (nC)                           | 4               |       |
| $Q_{gd}$ (nC)                           | 6               |       |
| Configuration                           | Single          |       |

### ORDERING INFORMATION

|                                 |                    |
|---------------------------------|--------------------|
| Package                         | DPAK (TO-252)      |
| Lead (Pb)-free and halogen-free | SiHD240N60E-GE3    |
|                                 | SiHD240N60E-T1-GE3 |
|                                 | SiHD240N60E-T4-GE3 |
|                                 | SiHD240N60E-T5-GE3 |


### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)

| PARAMETER   | SYMBOL           | LIMIT          | UNIT |      |
|---|------------------|----------------|------|------|
| Drain-source voltage                                      | $V_{DS}$         | 600            | V    |      |
| Gate-source voltage                                       | $V_{GS}$         | $\pm 30$       |      |      |
| Continuous drain current ( $T_J = 150$ °C)                | $V_{GS}$ at 10 V | $T_C = 25$ °C  | 12   | A    |
|   |                  | $T_C = 100$ °C | 7    |      |
| Pulsed drain current <sup>a</sup>                         | $I_{DM}$         | 30             |      |      |
| Linear derating factor                                    |                  | 0.63           | W/°C |      |
| Single pulse avalanche energy <sup>b</sup>                | $E_{AS}$         | 81             | mJ   |      |
| Maximum power dissipation                                 | $P_D$            | 78             | W    |      |
| Operating junction and storage temperature range          | $T_J, T_{stg}$   | -55 to +150    | °C   |      |
| Drain-source voltage slope                                | $dv/dt$          | $T_J = 125$ °C | 100  | V/ns |
| Reverse diode $dv/dt$ <sup>d</sup>                        |                  | 28             |      |      |
| Soldering recommendations (peak temperature) <sup>c</sup> | For 10 s         | 260            | °C   |      |

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{DD} = 120$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 2.4$  A
- 1.6 mm from case
- $I_{SD} \leq I_D$ ,  $di/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C

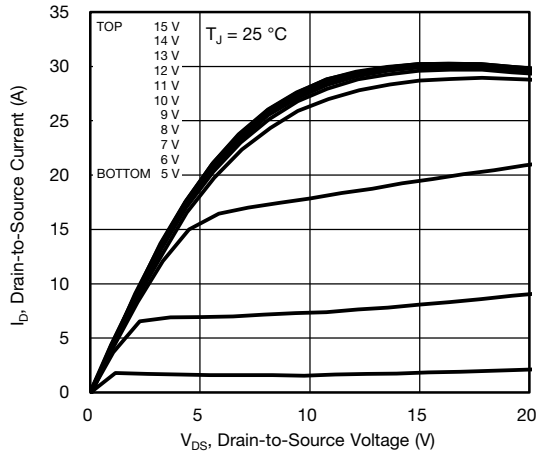
| THERMAL RESISTANCE RATINGS       |            |      |      |      |
|----------------------------------|------------|------|------|------|
| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
| Maximum junction-to-ambient      | $R_{thJA}$ | -    | 62   | °C/W |
| Maximum junction-to-case (drain) | $R_{thJC}$ | -    | 1.6  |      |

| SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted) |                     |   |   |      |       |           |               |
|---|---------------------|---|---|------|-------|-----------|---------------|
| PARAMETER   | SYMBOL              | TEST CONDITIONS   |   | MIN. | TYP.  | MAX.      | UNIT          |
| <b>Static</b>   |                     |   |   |      |       |           |               |
| Drain-source breakdown voltage  | $V_{DS}$            | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$   |   | 600  | -     | -         | V             |
| $V_{DS}$ temperature coefficient  | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$   |   | -    | 0.63  | -         | V/°C          |
| Gate-source threshold voltage (N)   | $V_{GS(th)}$        | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$   |   | 3.0  | -     | 5.0       | V             |
| Gate-source leakage   | $I_{GSS}$           | $V_{GS} = \pm 20\text{ V}$  |   | -    | -     | $\pm 100$ | nA            |
|   |                     | $V_{GS} = \pm 30\text{ V}$  |   | -    | -     | $\pm 1$   | $\mu\text{A}$ |
| Zero gate voltage drain current   | $I_{DSS}$           | $V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$  |   | -    | -     | 1         | $\mu\text{A}$ |
|   |                     | $V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$   |   | -    | -     | 10        |               |
| Drain-source on-state resistance  | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$  | $I_D = 5.5\text{ A}$                        | -    | 0.208 | 0.240     | $\Omega$      |
| Forward transconductance <sup>a</sup>                                       | $g_{fs}$            | $V_{DS} = 20\text{ V}, I_D = 5.5\text{ A}$  |   | -    | 4     | -         | S             |
| <b>Dynamic</b>  |                     |   |   |      |       |           |               |
| Input capacitance   | $C_{iss}$           | $V_{GS} = 0\text{ V},$<br>$V_{DS} = 100\text{ V},$<br>$f = 1\text{ MHz}$  |   | -    | 783   | -         | pF            |
| Output capacitance  | $C_{oss}$           |   |   | -    | 50    | -         |               |
| Reverse transfer capacitance  | $C_{rss}$           |   |   | -    | 5     | -         |               |
| Effective output capacitance, energy related <sup>a</sup>                   | $C_{o(er)}$         | $V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$   |   | -    | 32    | -         | pF            |
| Effective output capacitance, time related <sup>b</sup>                     | $C_{o(tr)}$         |   |   | -    | 187   | -         |               |
| Total gate charge   | $Q_g$               | $V_{GS} = 10\text{ V}$  | $I_D = 5.5\text{ A}, V_{DS} = 480\text{ V}$ | -    | 15    | 23        | nC            |
| Gate-source charge  | $Q_{gs}$            |   |   | -    | 4     | -         |               |
| Gate-drain charge   | $Q_{gd}$            |   |   | -    | 6     | -         |               |
| Turn-on delay time  | $t_{d(on)}$         | $V_{DD} = 480\text{ V}, I_D = 5.5\text{ A},$<br>$V_{GS} = 10\text{ V}, R_g = 9.1\text{ }\Omega$   |   | -    | 15    | 30        | ns            |
| Rise time   | $t_r$               |   |   | -    | 14    | 28        |               |
| Turn-off delay time   | $t_{d(off)}$        |   |   | -    | 26    | 52        |               |
| Fall time   | $t_f$               |   |   | -    | 14    | 28        |               |
| Gate input resistance   | $R_g$               | $f = 1\text{ MHz}, \text{ open drain}$  |   | 0.8  | 1.5   | 3.0       | $\Omega$      |
| <b>Drain-Source Body Diode Characteristics</b>                              |                     |   |   |      |       |           |               |
| Continuous source-drain diode current                                       | $I_S$               | MOSFET symbol showing the integral reverse p-n junction diode  |   | -    | -     | 12        | A             |
| Pulsed diode forward current  | $I_{SM}$            |   |   | -    | -     | 30        |               |
| Diode forward voltage   | $V_{SD}$            | $T_J = 25\text{ }^\circ\text{C}, I_S = 5.5\text{ A}, V_{GS} = 0\text{ V}$   |   | -    | -     | 1.2       | V             |
| Reverse recovery time   | $t_{rr}$            | $T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 5.5\text{ A},$<br>$di/dt = 100\text{ A}/\mu\text{s}, V_R = 25\text{ V}$                                |   | -    | 209   | 418       | ns            |
| Reverse recovery charge   | $Q_{rr}$            |   |   | -    | 2.1   | 4.2       | $\mu\text{C}$ |
| Reverse recovery current  | $I_{RRM}$           |   |   | -    | 18    | -         | A             |

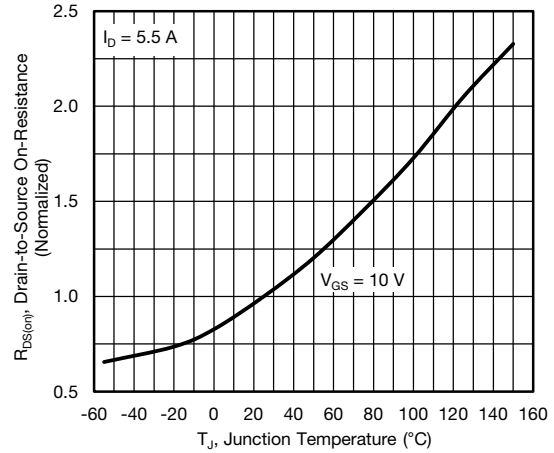
**Notes**

- a.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$   
 b.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$

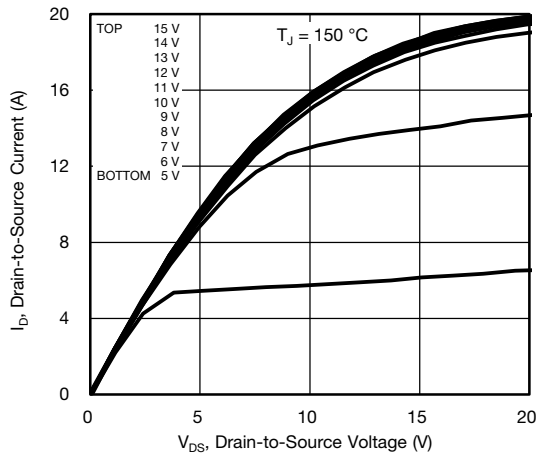
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



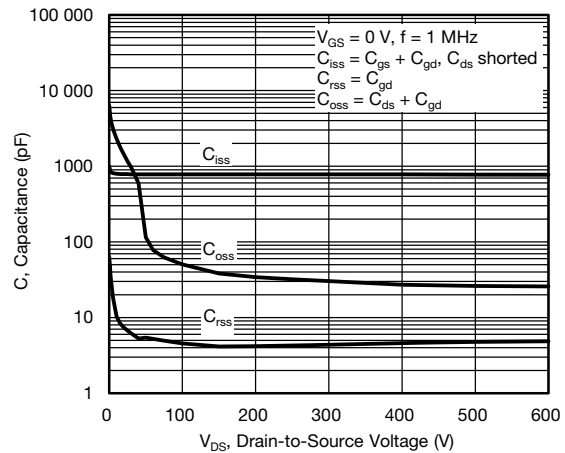
**Fig. 1 - Typical Output Characteristics**



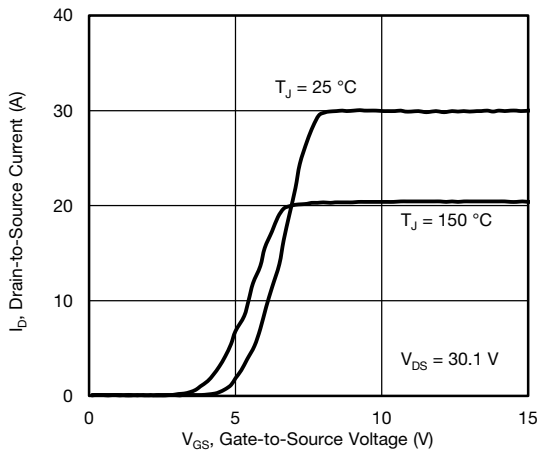
**Fig. 4 - Normalized On-Resistance vs. Temperature**



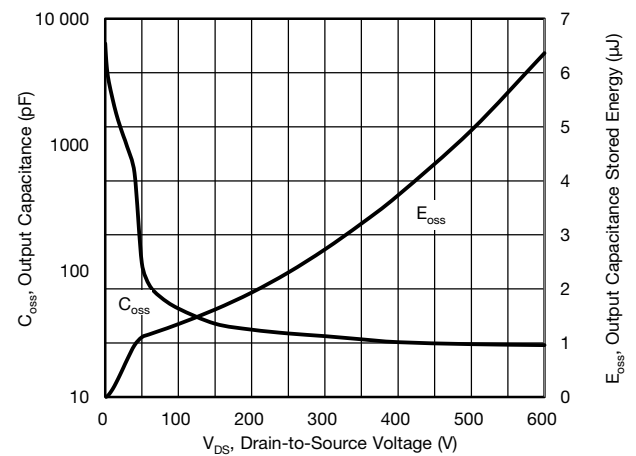
**Fig. 2 - Typical Output Characteristics**



**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**



**Fig. 3 - Typical Transfer Characteristics**



**Fig. 6 -  $C_{oss}$  and  $E_{oss}$  vs.  $V_{DS}$**

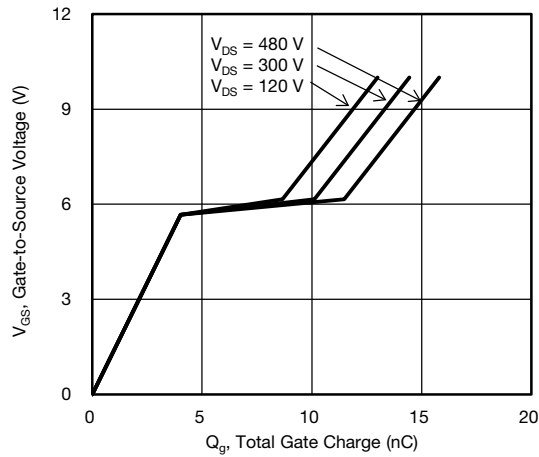


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

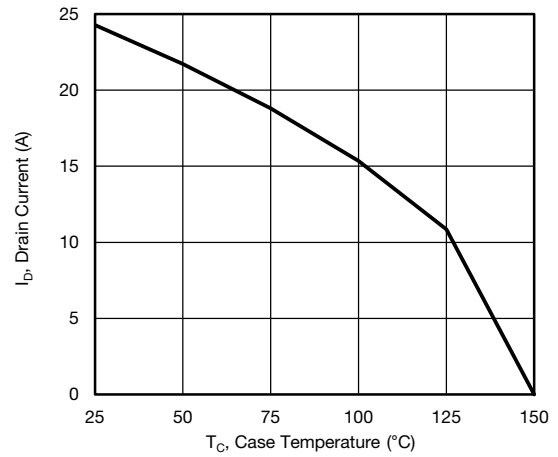


Fig. 10 - Maximum Drain Current vs. Case Temperature

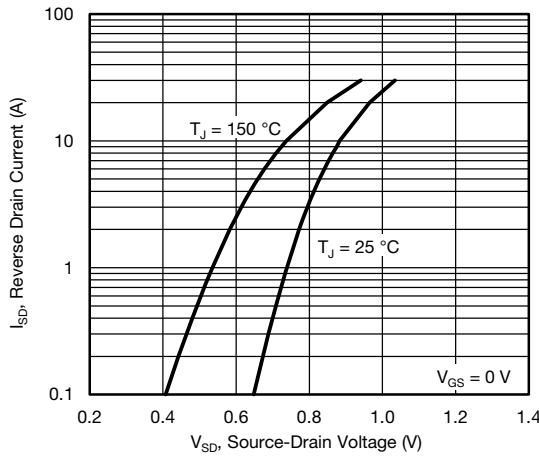


Fig. 8 - Typical Source-Drain Diode Forward Voltage

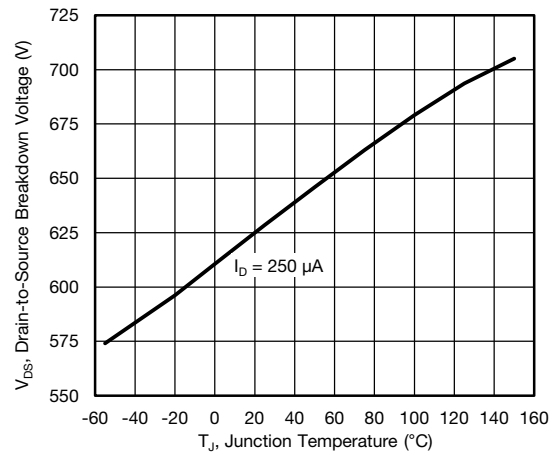


Fig. 11 - Temperature vs. Drain-to-Source Voltage

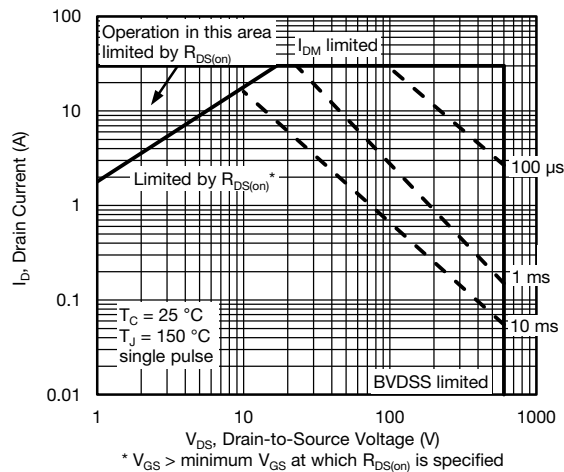


Fig. 9 - Maximum Safe Operating Area

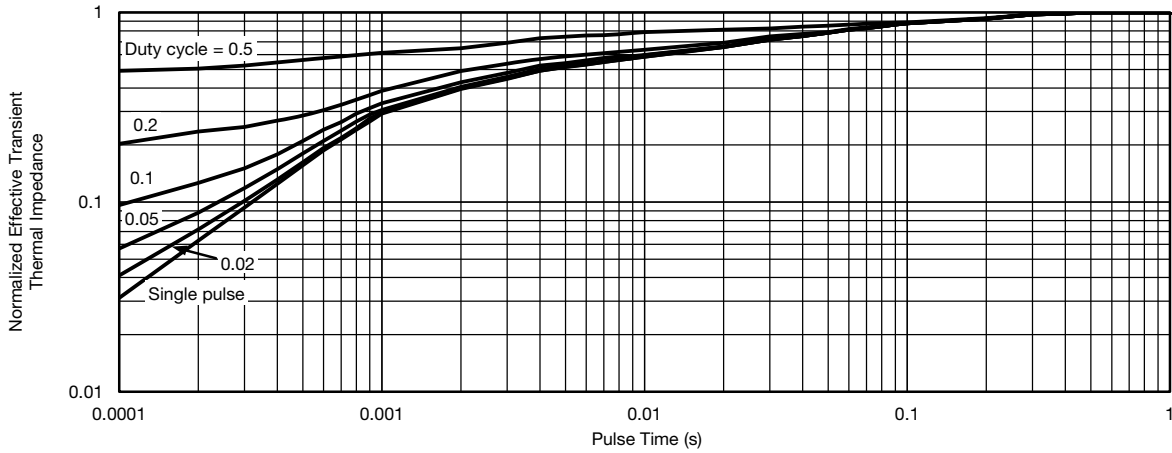


Fig. 12 - Normalized Transient Thermal Impedance, Junction-to-Case



Fig. 13 - Switching Time Test Circuit



Fig. 16 - Unclamped Inductive Waveforms

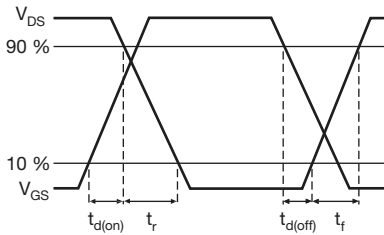


Fig. 14 - Switching Time Waveforms

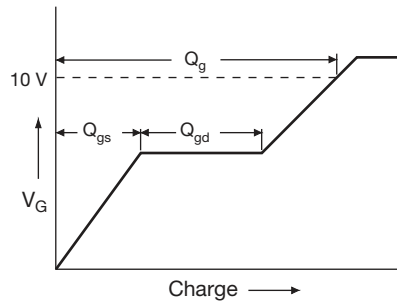


Fig. 17 - Basic Gate Charge Waveform



Fig. 15 - Unclamped Inductive Test Circuit



Fig. 18 - Gate Charge Test Circuit



**Note**

a.  $V_{GS} = 5\text{ V}$  for logic level devices

**Fig. 19 - For N-Channel**

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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: E22-0399-Rev. R, 03-Oct-2022  
 DWG: 5347



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



Recommended Minimum Pads  
Dimensions in Inches/(mm)

[Return to Index](#)



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