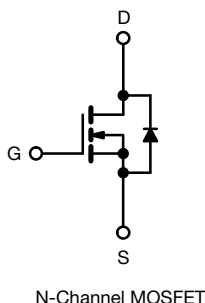


## E Series Power MOSFET



### 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 | 0.60 |
| $Q_g$ max. (nC)                         | 12              |      |
| $Q_{gs}$ (nC)                           | 3               |      |
| $Q_{gd}$ (nC)                           | 3               |      |
| Configuration                           | Single          |      |

### ORDERING INFORMATION

|                                 |                 |
|---------------------------------|-----------------|
| Package                         | DPAK (TO-252)   |
| Lead (Pb)-free and halogen-free | SiHD690N60E-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)                | $I_D$          | $T_C = 25$ °C  | A    |
|                                                           |                | $T_C = 100$ °C |      |
| Pulsed drain current <sup>a</sup>                         | $I_{DM}$       | 11             | W/°C |
| Linear derating factor                                    |                | 0.5            |      |
| Single pulse avalanche energy <sup>b</sup>                | $E_{AS}$       | 9              | mJ   |
| Maximum power dissipation                                 | $P_D$          | 62.5           | 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 | V/ns |
| Reverse diode $dv/dt$ <sup>d</sup>                        |                |                |      |
| 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,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 0.8$  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**

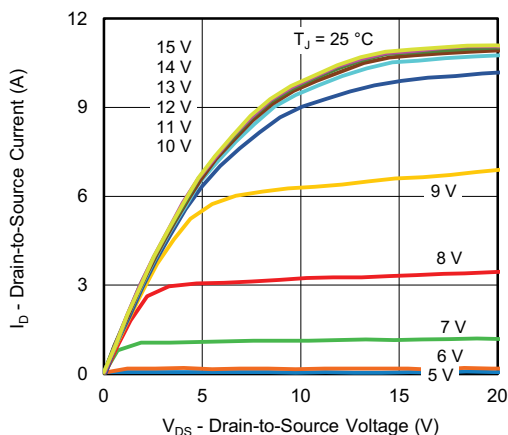
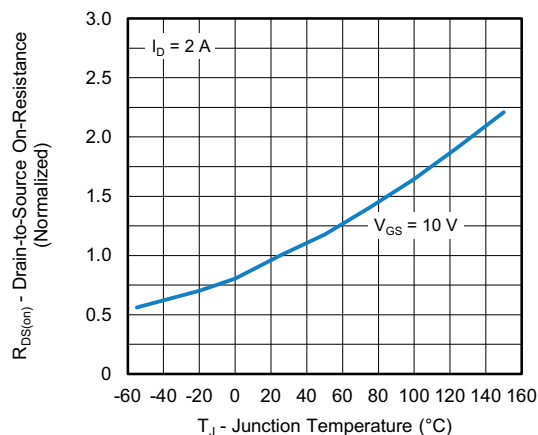
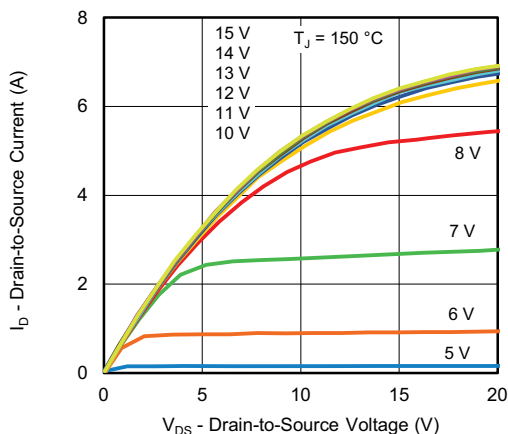
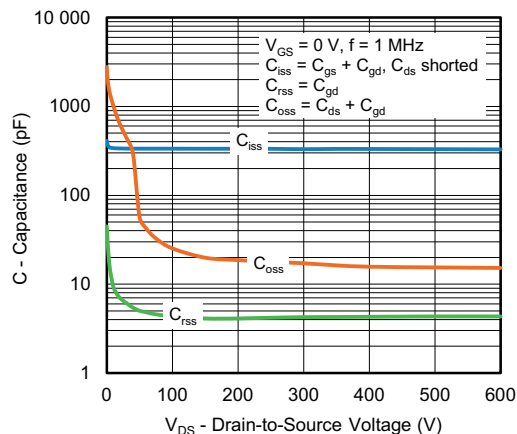
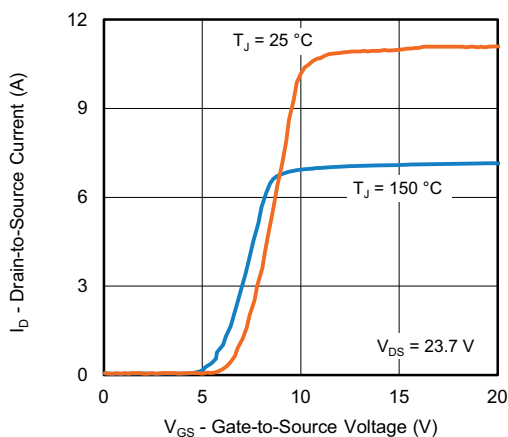
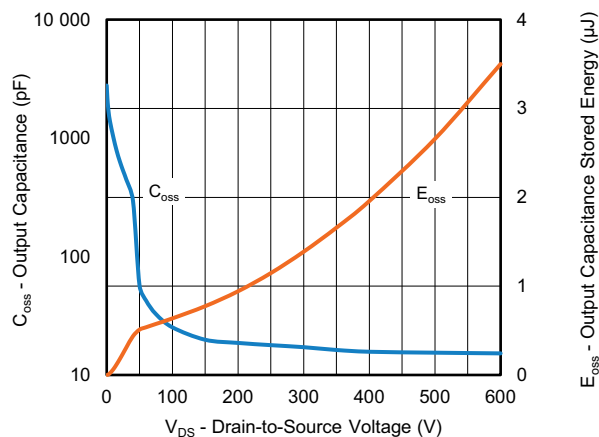
| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum junction-to-ambient      | $R_{thJA}$ | -    | 62   | °C/W |
| Maximum junction-to-case (drain) | $R_{thJC}$ | -    | 2.0  |      |

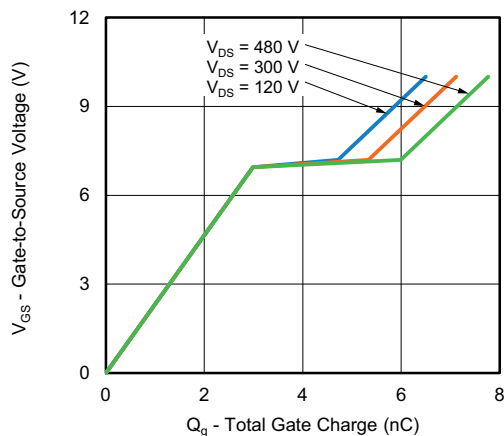
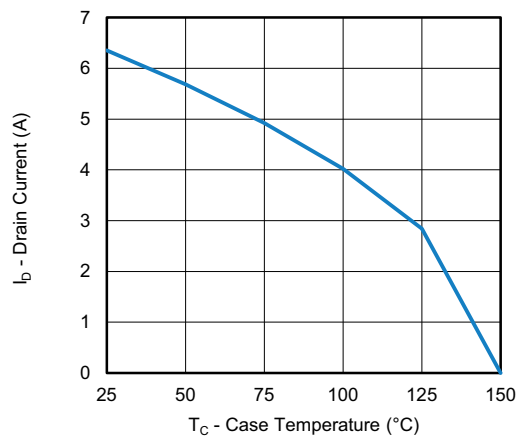
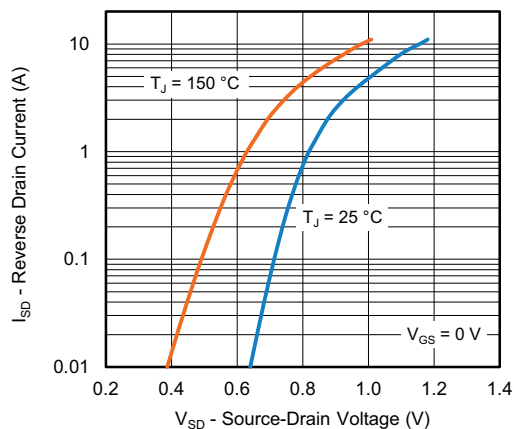
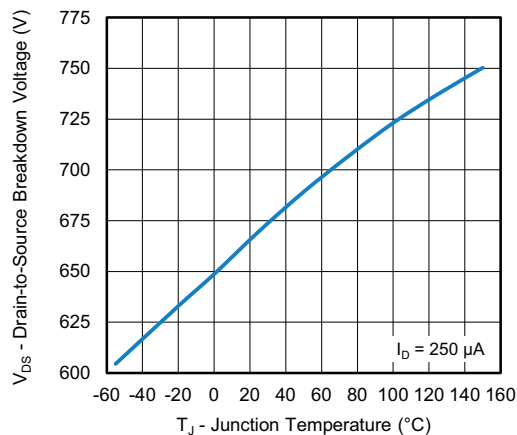
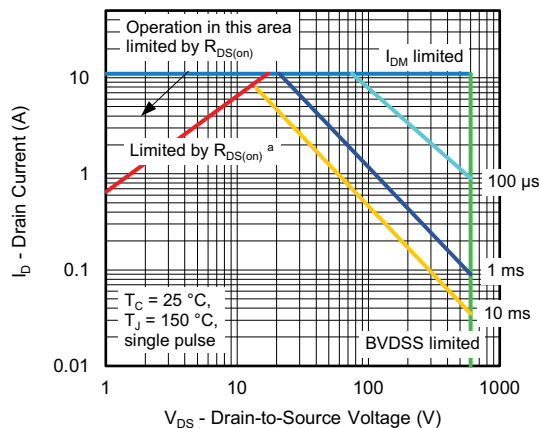
**SPECIFICATIONS** ( $T_J = 25\text{ °C}$ , unless otherwise noted)

| 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 $25\text{ °C}$ , $I_D = 1\text{ mA}$                                                                                                     | -    | 0.73 | -         | 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         | $\mu\text{A}$ |
|                                                           |                     | $V_{DS} = 480\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ °C}$                                                                               | -    | -    | 10        |               |
| Drain-source on-state resistance                          | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$ , $I_D = 2.0\text{ A}$                                                                                                         | -    | 0.60 | 0.70      | $\Omega$      |
| Forward transconductance <sup>a</sup>                     | $g_{fs}$            | $V_{DS} = 20\text{ V}$ , $I_D = 2.0\text{ A}$                                                                                                         | -    | 1.2  | -         | S             |
| <b>Dynamic</b>                                            |                     |                                                                                                                                                       |      |      |           |               |
| Input capacitance                                         | $C_{iss}$           | $V_{GS} = 0\text{ V}$ ,<br>$V_{DS} = 100\text{ V}$ ,<br>$f = 1\text{ MHz}$                                                                            | -    | 347  | -         | pF            |
| Output capacitance                                        | $C_{oss}$           |                                                                                                                                                       | -    | 24   | -         |               |
| Reverse transfer capacitance                              | $C_{rss}$           |                                                                                                                                                       | -    | 4    | -         |               |
| Effective output capacitance, energy related <sup>a</sup> | $C_{o(er)}$         | $V_{DS} = 0\text{ V to } 480\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                        | -    | 17   | -         |               |
| Effective output capacitance, time related <sup>b</sup>   | $C_{o(tr)}$         |                                                                                                                                                       | -    | 86   | -         |               |
| Total gate charge                                         | $Q_g$               | $V_{GS} = 10\text{ V}$ , $I_D = 2.0\text{ A}$ , $V_{DS} = 480\text{ V}$                                                                               | -    | 8    | 12        | nC            |
| Gate-source charge                                        | $Q_{gs}$            |                                                                                                                                                       | -    | 3    | -         |               |
| Gate-drain charge                                         | $Q_{gd}$            |                                                                                                                                                       | -    | 3    | -         |               |
| Turn-on delay time                                        | $t_{d(on)}$         | $V_{DD} = 480\text{ V}$ , $I_D = 2.0\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ , $R_g = 9.1\text{ }\Omega$                                                | -    | 12   | 24        | ns            |
| Rise time                                                 | $t_r$               |                                                                                                                                                       | -    | 9    | 18        |               |
| Turn-off delay time                                       | $t_{d(off)}$        |                                                                                                                                                       | -    | 19   | 38        |               |
| Fall time                                                 | $t_f$               |                                                                                                                                                       | -    | 22   | 44        |               |
| Gate input resistance                                     | $R_g$               | $f = 1\text{ MHz}$ , open drain                                                                                                                       | 1.1  | 2.3  | 4.6       | $\Omega$      |
| <b>Drain-Source Body Diode Characteristics</b>            |                     |                                                                                                                                                       |      |      |           |               |
| Continuous source-drain diode current                     | $I_S$               | MOSFET symbol showing the integral reverse p - n junction diode  | -    | -    | 6.4       | A             |
| Pulsed diode forward current                              | $I_{SM}$            |                                                                                                                                                       | -    | -    | 11        |               |
| Diode forward voltage                                     | $V_{SD}$            | $T_J = 25\text{ °C}$ , $I_S = 2.0\text{ A}$ , $V_{GS} = 0\text{ V}$                                                                                   | -    | -    | 1.2       | V             |
| Reverse recovery time                                     | $t_{rr}$            | $T_J = 25\text{ °C}$ , $I_F = I_S = 2.0\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 25\text{ V}$                                       | -    | 146  | 292       | ns            |
| Reverse recovery charge                                   | $Q_{rr}$            |                                                                                                                                                       | -    | 1.0  | 2.0       | $\mu\text{C}$ |
| Reverse recovery current                                  | $I_{RRM}$           |                                                                                                                                                       | -    | 13   | -         | A             |

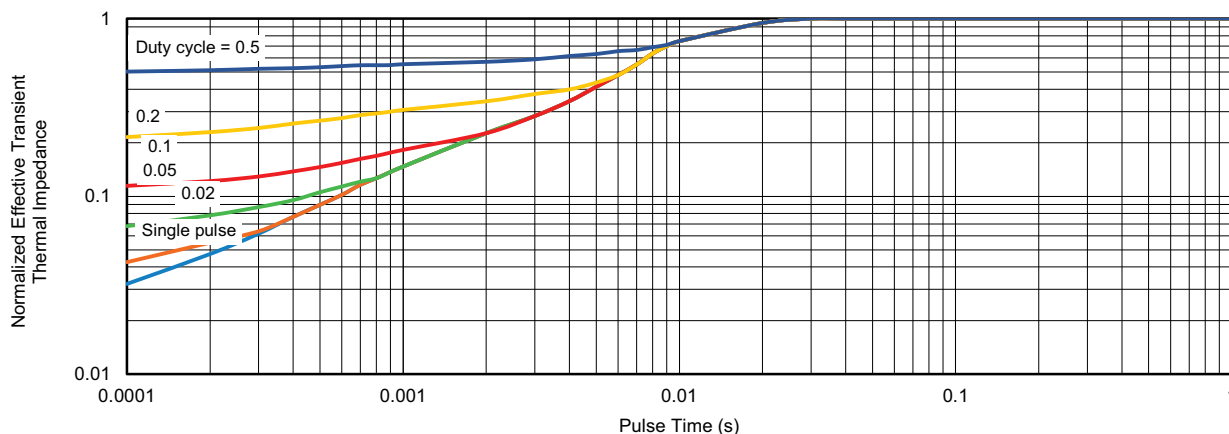
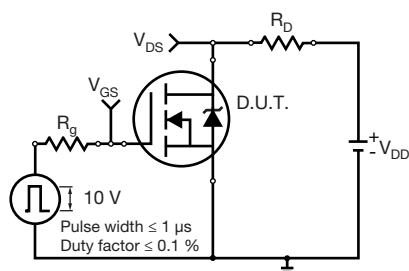
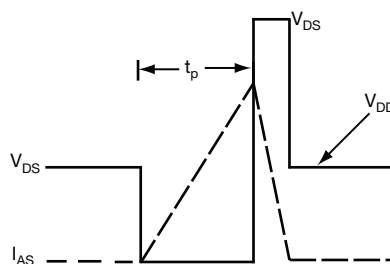
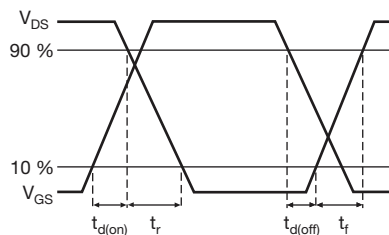
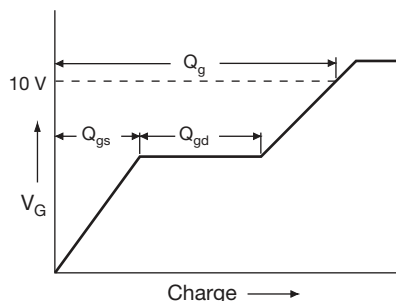
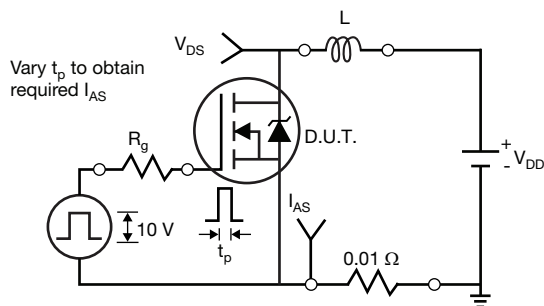
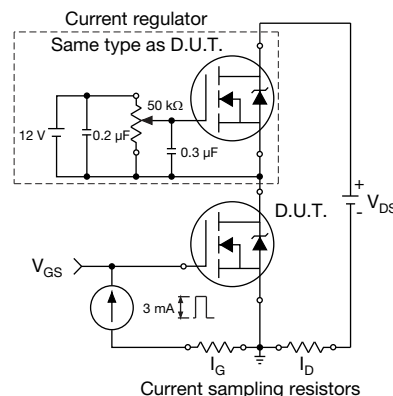
**Notes**

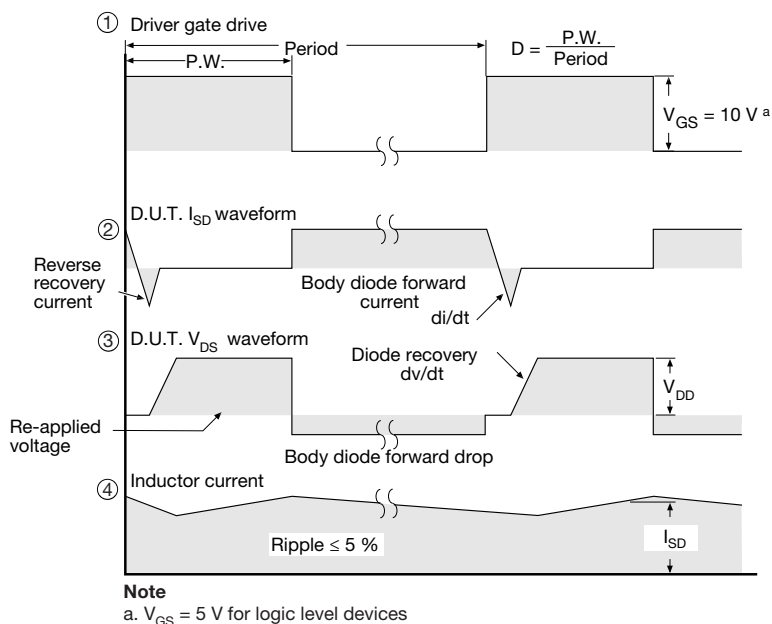
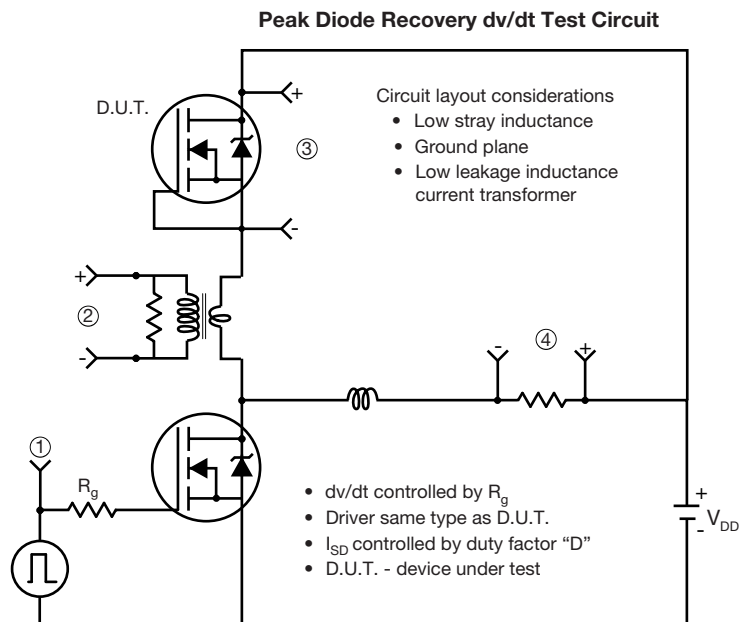
- a.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$   
b.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$

**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**
**Note**

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


**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**



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

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## TO-252AA Case Outline

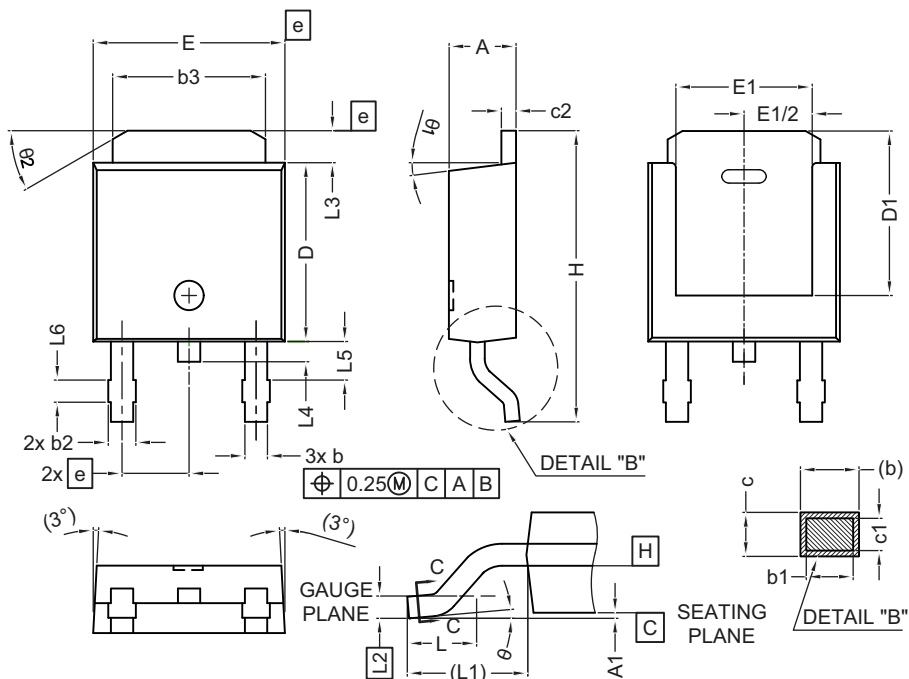
### VERSION 1: FACILITY CODE = Y



|      | 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

**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 |

|             | <b>MILLIMETERS</b> |             |
|-------------|--------------------|-------------|
| <b>DIM.</b> | <b>MIN.</b>        | <b>MAX.</b> |
| 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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