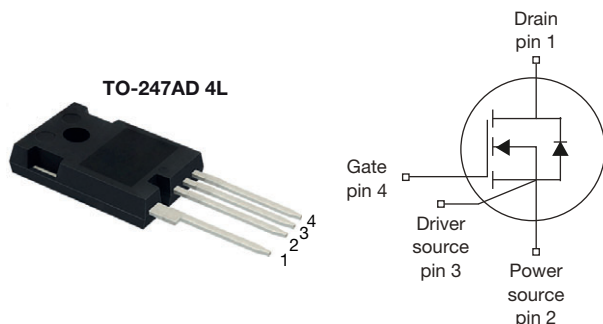


## E Series Power MOSFET



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

### 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)

### 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.              | 700             |       |
| $R_{DS(on)}$ typ. ( $\Omega$ ) at 25 °C | $V_{GS} = 10$ V | 0.035 |
| $Q_g$ max. (nC)                         | 138             |       |
| $Q_{gs}$ (nC)                           | 36              |       |
| $Q_{gd}$ (nC)                           | 27              |       |
| Configuration                           | Single          |       |

| ORDERING INFORMATION            |                 |
|---------------------------------|-----------------|
| Package                         | TO-247AD 4L     |
| Lead (Pb)-free and halogen-free | SiHL040N65E-GE3 |

| ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted) |                         |                         |                                   |             |      |
|---------------------------------------------------------------------------|-------------------------|-------------------------|-----------------------------------|-------------|------|
| PARAMETER                                                                 |                         |                         | SYMBOL                            | LIMIT       | UNIT |
| Drain-source voltage                                                      |                         |                         | V <sub>DS</sub>                   | 650         | V    |
| Gate-source voltage                                                       |                         |                         | V <sub>GS</sub>                   | ± 30        |      |
| Continuous drain current (T <sub>J</sub> = 150 °C)                        | V <sub>GS</sub> at 10 V | T <sub>C</sub> = 25 °C  | I <sub>D</sub>                    | 65          | A    |
|                                                                           |                         | T <sub>C</sub> = 100 °C |                                   | 41          |      |
| Pulsed drain current <sup>a</sup>                                         |                         |                         | I <sub>DM</sub>                   | 203         |      |
| Linear derating factor                                                    |                         |                         |                                   | 3.1         | W/°C |
| Single pulse avalanche energy <sup>b</sup>                                |                         |                         | E <sub>AS</sub>                   | 542         | mJ   |
| Maximum power dissipation                                                 |                         |                         | P <sub>D</sub>                    | 391         | W    |
| Operating junction and storage temperature range                          |                         |                         | T <sub>J</sub> , T <sub>stg</sub> | -55 to +150 | °C   |
| Drain-source voltage slope                                                |                         |                         | dv/dt                             | 90          | V/ns |
| Reverse diode dv/dt <sup>d</sup>                                          |                         |                         |                                   | 100         |      |
| Soldering recommendations (peak temperature) <sup>c</sup>                 |                         | For 10 s                |                                   | 260         | °C   |

### Notes

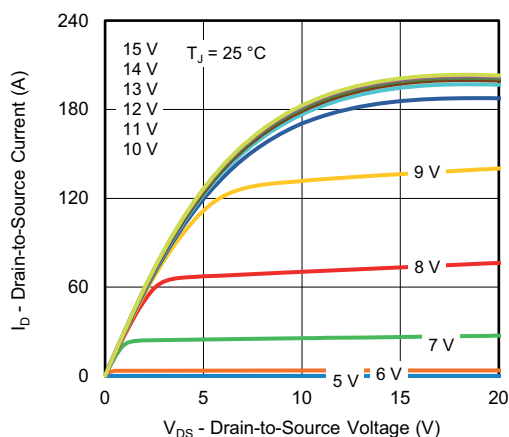
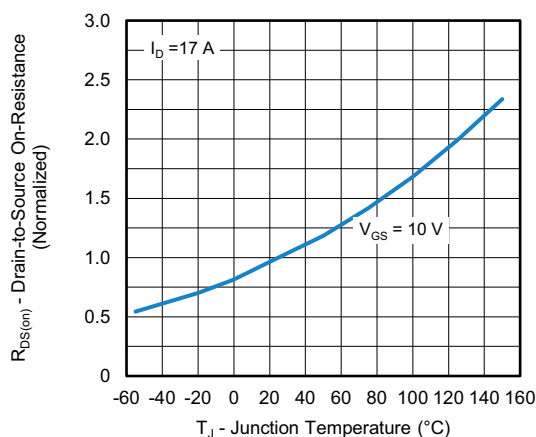
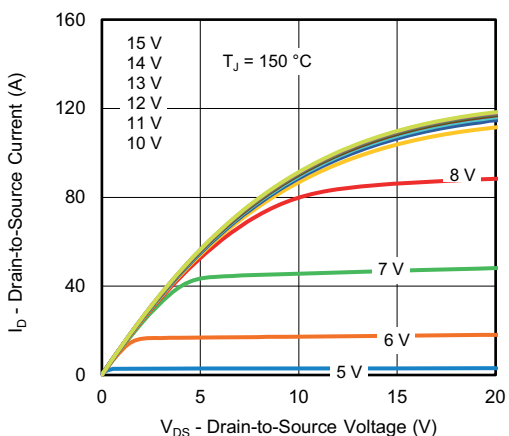
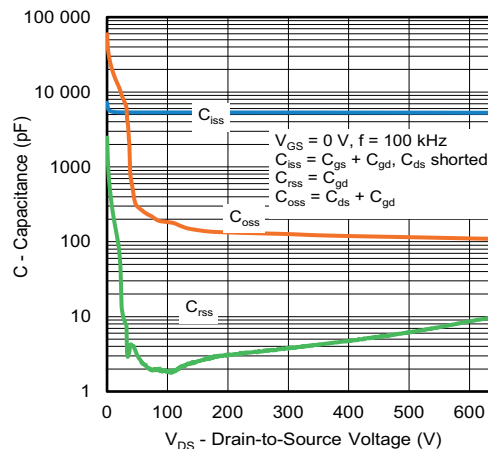
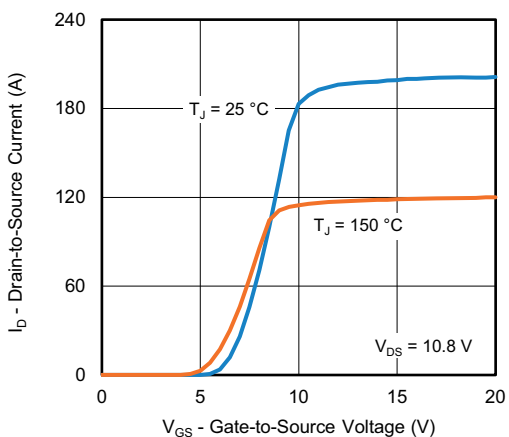
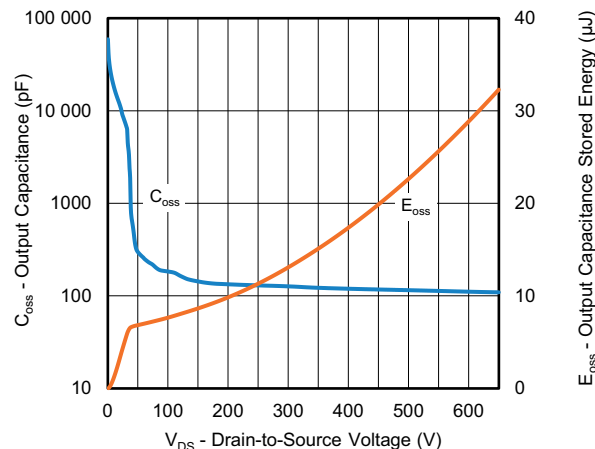
- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{DD} = 120$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 6.2$  A
- 1.6 mm from case
- $I_{SD} \leq I_D$ , di/dt = 200 A/ $\mu$ s, starting  $T_J = 25$  °C

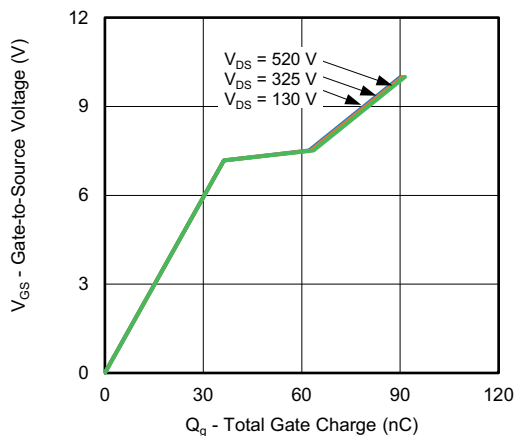
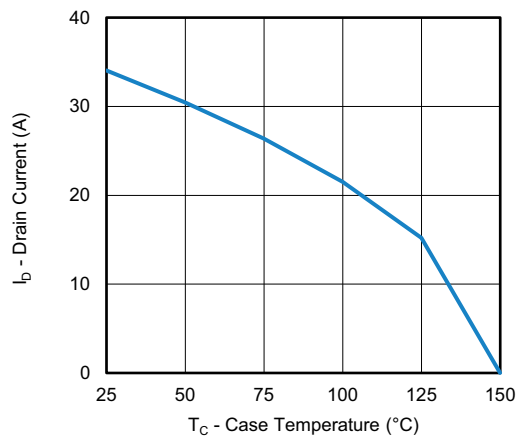
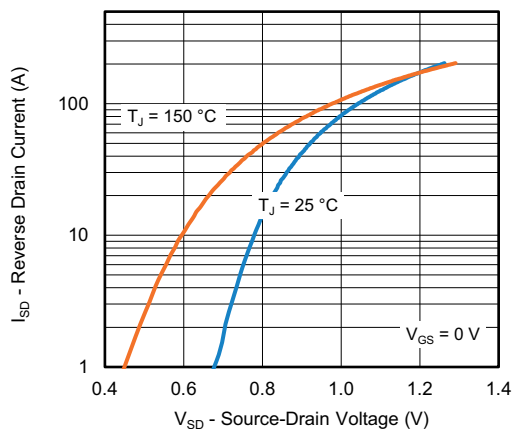
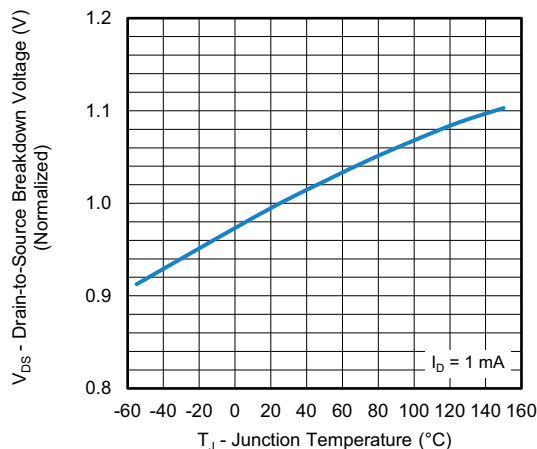
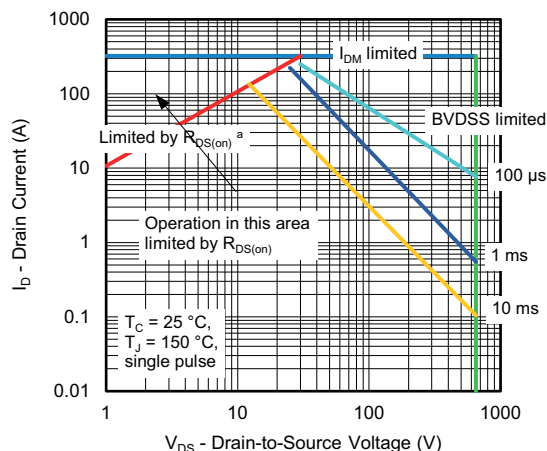
**THERMAL RESISTANCE RATINGS**

| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum junction-to-ambient      | $R_{thJA}$ | -    | 40   | °C/W |
| Maximum junction-to-case (drain) | $R_{thJC}$ | -    | 0.32 |      |

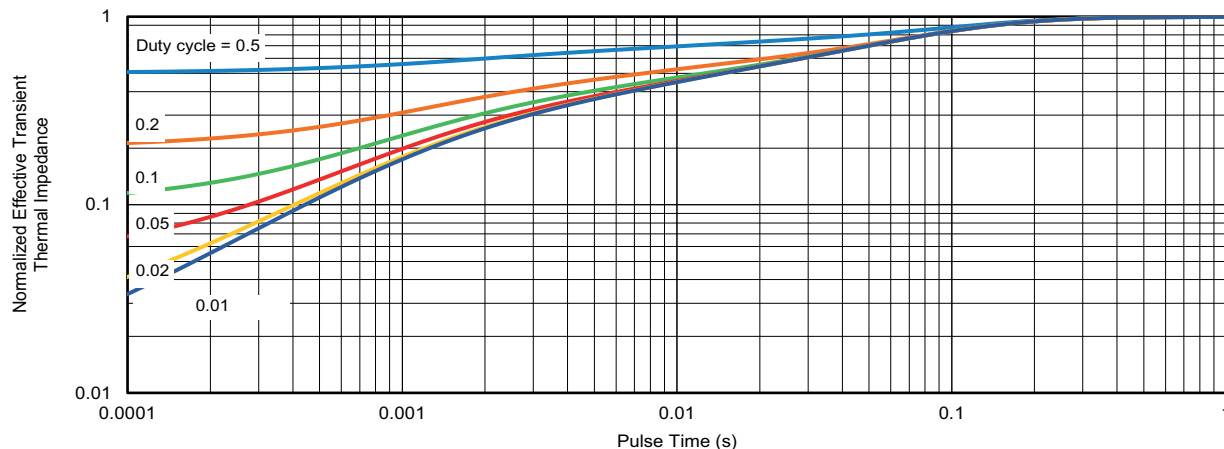
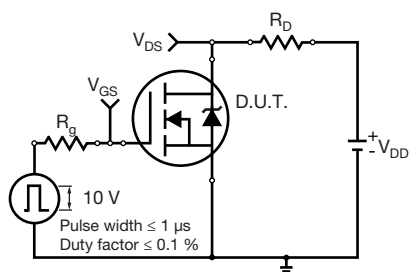
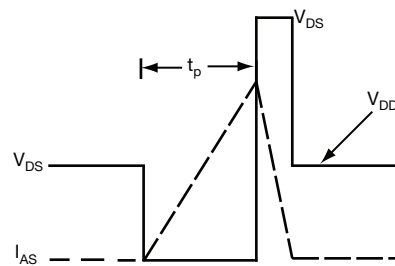
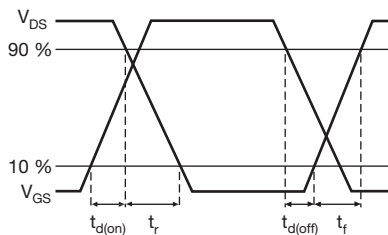
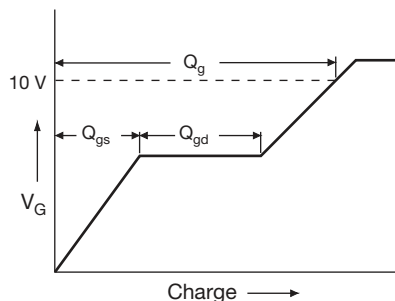
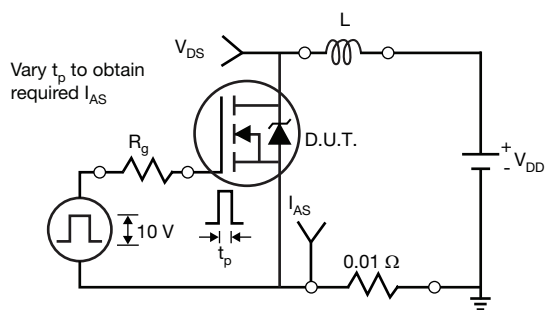
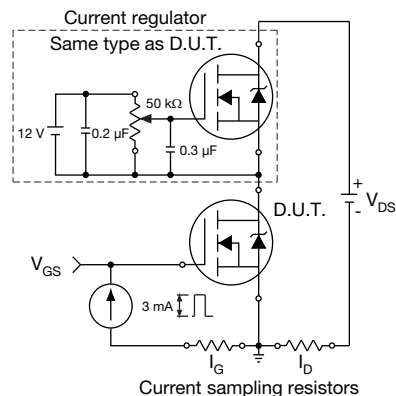
**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

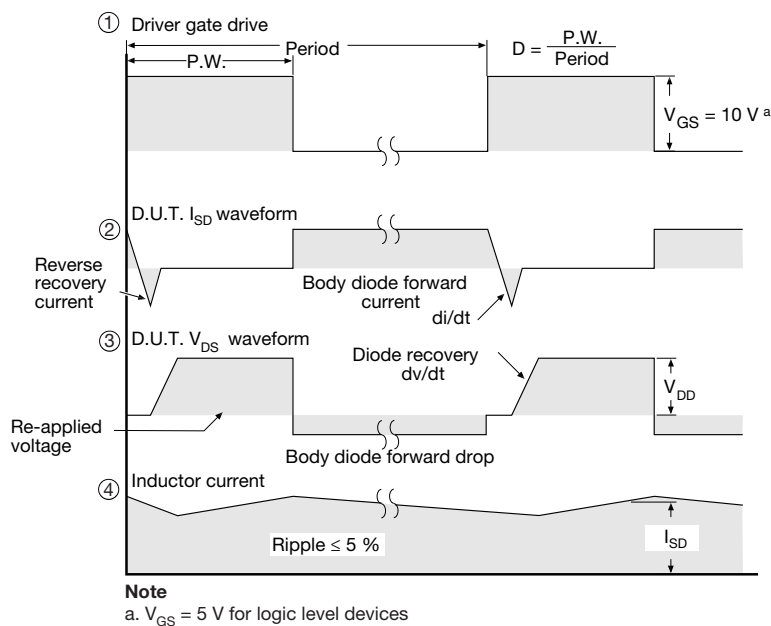
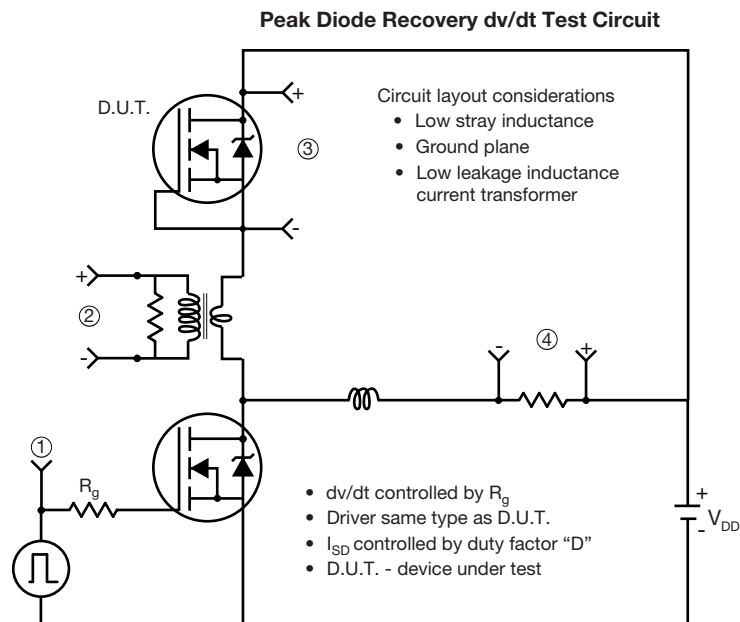
| PARAMETER                                    | SYMBOL              | TEST CONDITIONS                                                                                                                                          |                                               | MIN. | TYP.  | MAX.      | UNIT                  |
|----------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------|-------|-----------|-----------------------|
| Static                                       |                     |                                                                                                                                                          |                                               |      |       |           |                       |
| Drain-source breakdown voltage               | $V_{DS}$            | $V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$                                                                                                   |                                               | 650  | -     | -         | V                     |
| $V_{DS}$ temperature coefficient             | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^{\circ}\text{C}$ , $I_D = 1\text{ mA}$                                                                                          |                                               | -    | 0.61  | -         | V/ $^{\circ}\text{C}$ |
| 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              | $I_{DSS}$           | $V_{DS} = 650\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                                          |                                               | -    | -     | 1         | $\mu\text{A}$         |
|                                              |                     | $V_{DS} = 520\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^{\circ}\text{C}$                                                                    |                                               | -    | -     | 10        |                       |
| Drain-source on-state resistance             | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$                                                                                                                                   | $I_D = 17\text{ A}$                           | -    | 0.035 | 0.040     | $\Omega$              |
| Forward transconductance                     | $g_{fs}$            | $V_{DS} = 10\text{ V}$ , $I_D = 17\text{ A}$                                                                                                             |                                               | -    | 20    | -         | S                     |
| Dynamic                                      |                     |                                                                                                                                                          |                                               |      |       |           |                       |
| Input capacitance                            | $C_{iss}$           | $V_{GS} = 0\text{ V}$ ,<br>$V_{DS} = 100\text{ V}$ ,<br>$f = 100\text{ KHz}$                                                                             |                                               | -    | 5344  | -         | pF                    |
| Output capacitance                           | $C_{oss}$           |                                                                                                                                                          |                                               | -    | 207   | -         |                       |
| Reverse transfer capacitance                 | $C_{rss}$           |                                                                                                                                                          |                                               | -    | 3     | -         |                       |
| Effective output capacitance, energy related | $C_{o(er)}$         | $V_{DS} = 0\text{ V to } 400\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                           |                                               | -    | 1510  | -         | pF                    |
| Effective output capacitance, time related   | $C_{o(tr)}$         |                                                                                                                                                          |                                               | -    | 217   | -         |                       |
| Total gate charge                            | $Q_g$               | $V_{GS} = 10\text{ V}$                                                                                                                                   | $I_D = 17\text{ A}$ , $V_{DS} = 520\text{ V}$ | -    | 92    | 138       | nC                    |
| Gate-source charge                           | $Q_{gs}$            |                                                                                                                                                          |                                               | -    | 36    | -         |                       |
| Gate-drain charge                            | $Q_{gd}$            |                                                                                                                                                          |                                               | -    | 27    | -         |                       |
| Turn-on delay time                           | $t_{d(on)}$         | $V_{DD} = 520\text{ V}$ , $I_D = 17\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ , $R_g = 10.1\text{ }\Omega$                                                   |                                               | -    | 50    | 100       | ns                    |
| Rise time                                    | $t_r$               |                                                                                                                                                          |                                               | -    | 36    | 72        |                       |
| Turn-off delay time                          | $t_{d(off)}$        |                                                                                                                                                          |                                               | -    | 105   | 158       |                       |
| Fall time                                    | $t_f$               |                                                                                                                                                          |                                               | -    | 9     | 18        |                       |
| Gate input resistance                        | $R_g$               | $f = 1\text{ MHz}$ , open drain                                                                                                                          |                                               | 0.4  | 0.8   | 1.6       | $\Omega$              |
| Drain-Source Body Diode Characteristics      |                     |                                                                                                                                                          |                                               |      |       |           |                       |
| Continuous source-drain diode current        | $I_S$               | MOSFET symbol showing the integral reverse p - n junction diode<br> |                                               | -    | -     | 65        | A                     |
| Pulsed diode forward current                 | $I_{SM}$            |                                                                                                                                                          |                                               | -    | -     | 203       |                       |
| Diode forward voltage                        | $V_{SD}$            | $T_J = 25\text{ }^{\circ}\text{C}$ , $I_S = 17\text{ A}$ , $V_{GS} = 0\text{ V}$                                                                         |                                               | -    | -     | 1.2       | V                     |
| Reverse recovery time                        | $t_{rr}$            | $T_J = 25\text{ }^{\circ}\text{C}$ , $I_F = I_S = 17\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 25\text{ V}$                             |                                               | -    | 428   | 856       | ns                    |
| Reverse recovery charge                      | $Q_{rr}$            |                                                                                                                                                          |                                               | -    | 8     | 16        | $\mu\text{C}$         |
| Reverse recovery current                     | $I_{RRM}$           |                                                                                                                                                          |                                               | -    | 31    | -         | A                     |

**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. 9 - Maximum Drain Current vs. Case Temperature**

**Fig. 8 - Typical Source-Drain Diode Forward Voltage**

**Fig. 10 - Temperature vs. Drain-to-Source Voltage**

**Fig. 11 - 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**

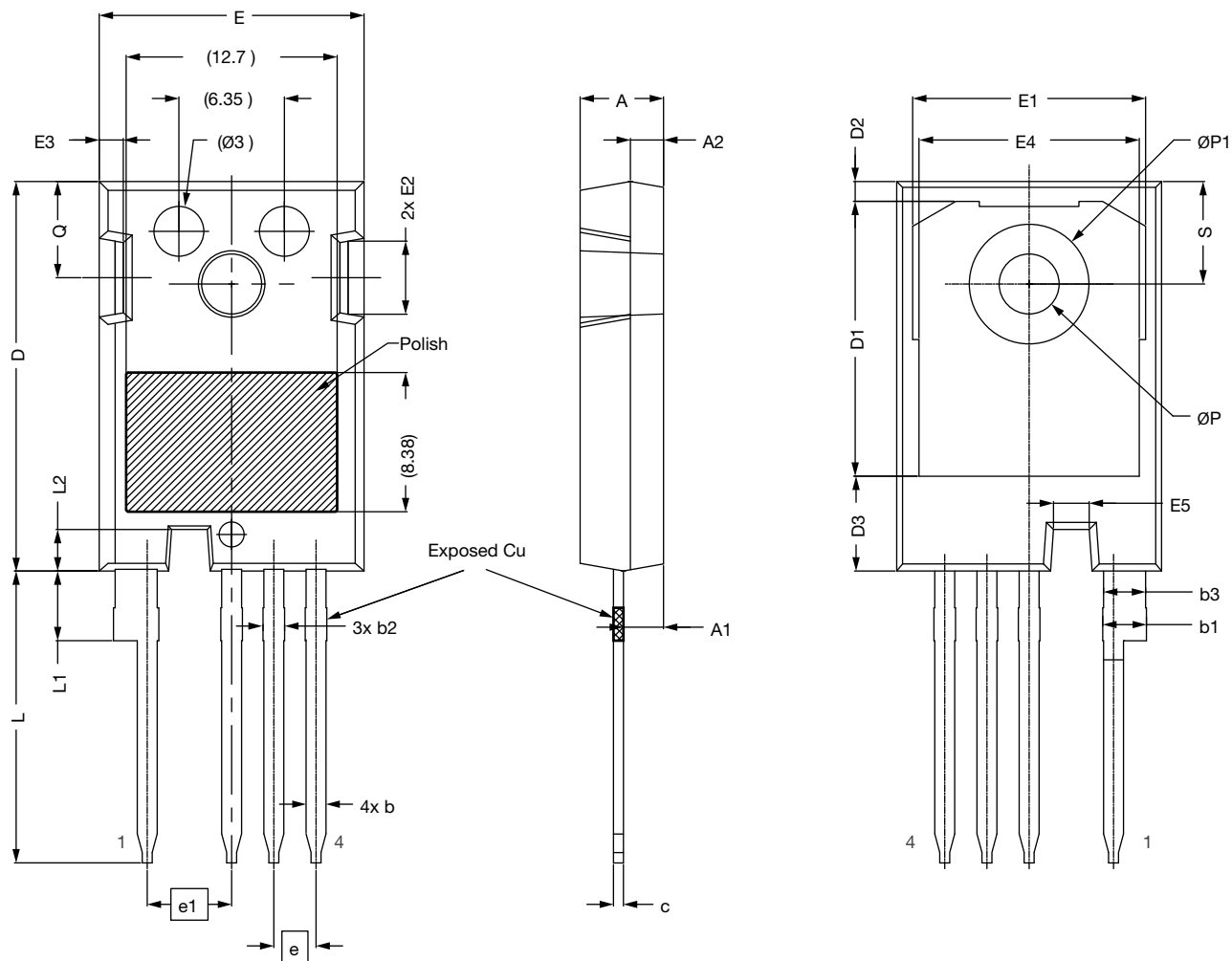

**Fig. 19 - For N-Channel**

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## Case Outline for TO-247AD 4L Package

**FACILITY CODE: 9**



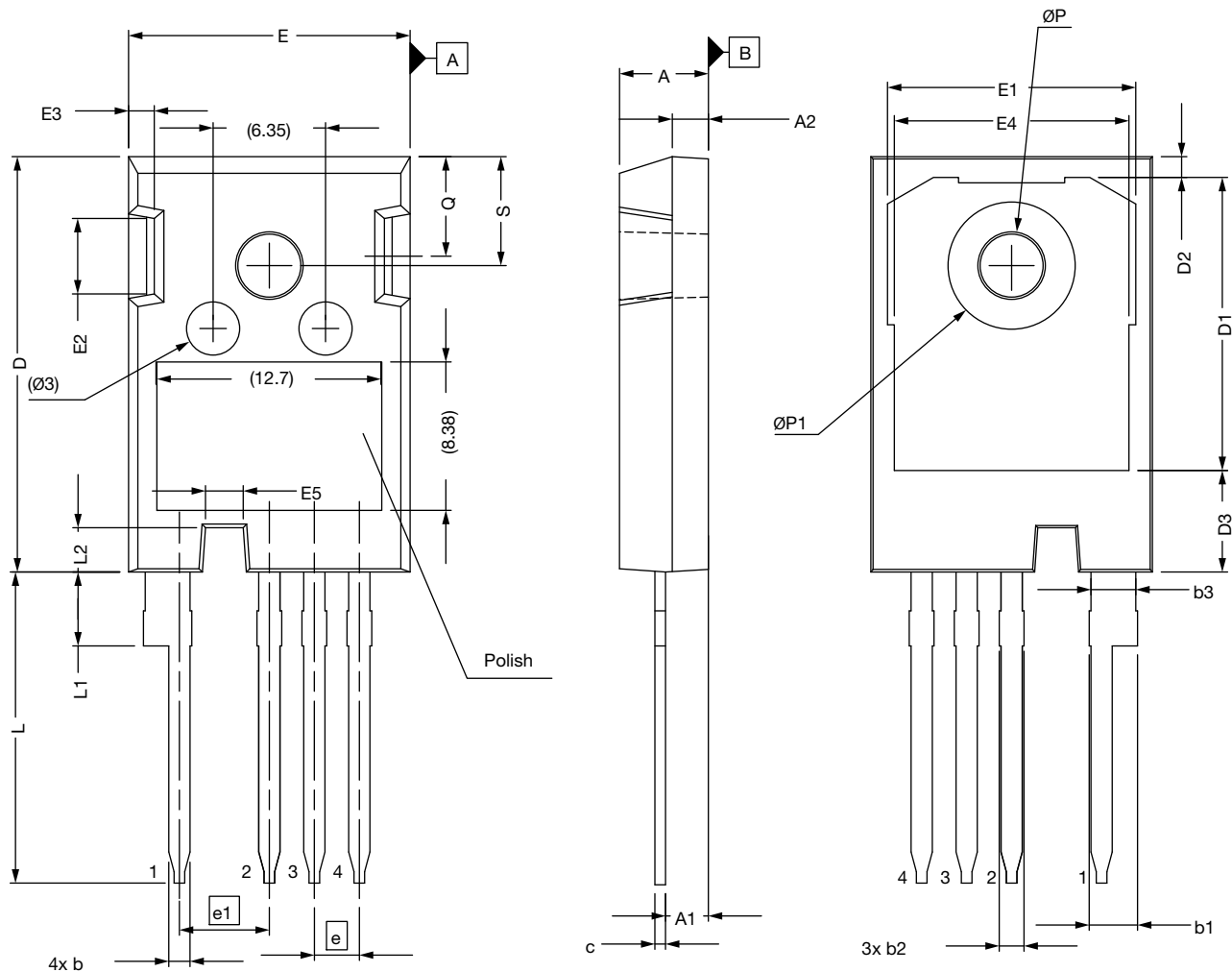


| DIM. | MILLIMETERS |       |
|------|-------------|-------|
|      | MIN.        | MAX.  |
| A    | 4.83        | 5.21  |
| A1   | 2.29        | 2.54  |
| A2   | 1.91        | 2.16  |
| b    | 1.07        | 1.33  |
| b1   | 2.39        | 2.94  |
| b3   | 1.07        | 1.60  |
| c    | 0.55        | 0.68  |
| D    | 23.30       | 23.60 |
| D1   | 16.25       | 17.65 |
| D2   | 0.95        | 1.25  |
| E    | 15.75       | 16.13 |
| E1   | 13.10       | 14.15 |
| E2   | 3.68        | 5.10  |
| E3   | 1.00        | 1.90  |
| E4   | 12.38       | 13.43 |
| E5   | 1.95        | 2.35  |
| e    | 2.54 BSC.   |       |
| e1   | 5.08 BSC.   |       |
| L    | 17.31       | 17.82 |
| L1   | 3.97        | 4.37  |
| L2   | 2.35        | 2.65  |
| ØP   | 3.51        | 3.65  |
| Q    | 5.49        | 6.00  |
| S    | 6.04        | 6.30  |

**Notes**

- All dimensions are in mm. Angles are in degrees
- Dimension D and E do not include mold flash
- All metal surfaces: tin plated, except area of cut
- Dimensioning and tolerancing confirm to ASME Y14.5M-1994
- Creepage 1 is 8.58 mm (ref.) which is the distance alongside the surface between drain (pin 1) and trough the notch towards source (pin 2).  
Creepage 2 is 7.95 mm (ref.) which is the distance from end of the copper slug on the backside of the package to either pin 2, pin 3 or pin 4



**FACILITY CODE: N**



| DIM.                              | MILLIMETERS |       |       |
|-----------------------------------|-------------|-------|-------|
|                                   | MIN.        | NOM.  | MAX.  |
| A                                 | 4.83        | 5.02  | 5.21  |
| A1                                | 2.29        | 2.41  | 2.54  |
| A2                                | 1.91        | 2.00  | 2.16  |
| b                                 | 1.07        | 1.20  | 1.33  |
| b1                                | 2.39        | 2.67  | 2.94  |
| b2                                | 1.07        | 1.30  | 1.60  |
| b3                                | 2.39        | 2.53  | 2.69  |
| c                                 | 0.55        | 0.60  | 0.68  |
| D                                 | 23.30       | 23.45 | 23.60 |
| D1                                | 16.25       | 16.55 | 17.65 |
| D2                                | 0.95        | 1.19  | 1.25  |
| D3                                | 5.55        | 5.71  | 6.01  |
| E                                 | 15.75       | 15.94 | 16.13 |
| E1                                | 13.10       | 14.02 | 14.15 |
| E2                                | 3.68        | 4.40  | 5.10  |
| E3                                | 1.00        | 1.45  | 1.90  |
| E4                                | 12.38       | 13.26 | 13.43 |
| E5                                | 1.95        | 2.15  | 2.35  |
| e                                 | 2.54 BSC.   |       |       |
| e1                                | 5.08 BSC.   |       |       |
| L                                 | 17.31       | 17.57 | 17.82 |
| L1                                | 3.97        | 4.19  | 4.37  |
| L2                                | 2.35        | 2.50  | 2.65  |
| ØP                                | 3.51        | 3.61  | 3.65  |
| ØP1                               | 7.19 ref.   |       |       |
| Q                                 | 5.49        | 5.79  | 6.00  |
| S                                 | 6.04        | 6.17  | 6.30  |
| ECN: S25-0851-Rev. C, 18-Jul-2025 |             |       |       |
| DWG: 6121                         |             |       |       |

**Notes**

- All dimensions are in mm
- Dimension D and E do not include mold flash.
- Creepage 1 is 8.40 mm (ref.) which is the distance alongside the surface between drain (pin 1) and trough the notch towards source (pin 2).  
Creepage 2 is 7.70 mm (ref.) which is the distance from end of the copper slug on the backside of the package to either pin 2, pin 3 or pin 4



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