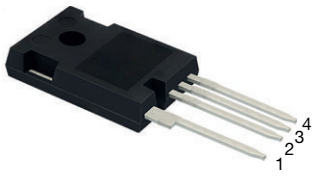
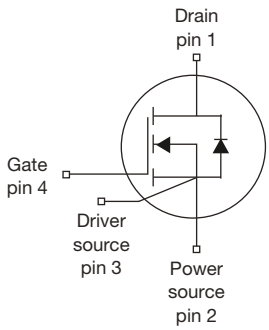
# MaxSiC™ 1200 V N-Channel SiC MOSFET

TO-247AD 4L






**Marking Code:** 120A250FL

## FEATURES

- Fast switching speed
- Short circuit withstand time 3 µs
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT
HALOGEN FREE

## APPLICATIONS

- Charger
- Industrial UPS
- Boost inverter
- DC/DC converter

| PRODUCT SUMMARY | | |
|---|---|---|
| $V_{DS}$ (V) at $T_J$ max. | 1200 | |
| $R_{DS(on)}$ typ. (mΩ) at 25 °C | $V_{GS}$ = 20 V | 250 |
| $Q_g$ typ. (nC) | 20 | |
| $I_D$ (A) | 10.5 | |
| $C_{oss}$ (pF) | 21.2 | |
| $P_D$ (W) | 56 | |
| Configuration | Single | |

| ORDERING INFORMATION | |
|---|---|
| Package | TO-247AD 4L |
| Lead (Pb)-free and halogen-free | MXP120A250FL-GE3 |

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

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Drain-source voltage [a] | | $V_{DS}$ | 1200 | V |
| Gate-source voltage | | $V_{GS}$ | -10 / +22 | |
| Recommended operation voltage of gate-source | | $V_{GSOP}$ | -5 / +20 | |
| Continuous drain current | $T_C$ = 25 °C | $I_D$ | 10.5 | A |
| | $T_C$ = 100 °C | $I_D$ | 6.7 | |
| Pulsed drain current [b] | | $I_{DM}$ | 21 | |
| Short-circuit withstand time [c] | | $T_{SC}$ | 3 | µs |
| Maximum power dissipation | $T_C$ = 25 °C | $P_D$ | 56 | W |
| | $T_C$ = 100 °C | $P_D$ | 22 | |
| Operating junction and storage temperature range | | $T_J$, $T_{stg}$ | -55 to +150 | °C |
| Soldering recommendations (peak temperature) | For 10 s | | 260 | °C |

**Notes**

a. $T_J$ = 25 °C to 150 °C
b. Repetitive rating; pulse width limited by maximum junction temperature
c. Verified by the design / characterization

*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.*

| THERMAL RESISTANCE RATINGS | | | | |
|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TYP.** | **MAX.** | **UNIT** |
| Maximum junction-to-ambient | $R_{thJA}$ | - | 40 | °C/W |
| Maximum junction-to-case (drain) | $R_{thJC}$ | - | 2.24 | |

**SPECIFICATIONS** ($T_J$ = 25 °C, unless otherwise noted)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| **Static** | | | | | | |
| Drain-source breakdown voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 1 mA | 1200 | - | - | V |
| Gate-source threshold voltage (N) | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 10 mA | - | 3.1 | - | V |
| | | $V_{DS}$ = $V_{GS}$, $I_D$ = 10 mA, $T_J$ = 150 °C | - | 2.3 | - | V |
| Gate-source leakage | $I_{GSS}$ | $V_{GS}$ = +22 V, $V_{DS}$ = 0 V | - | - | 100 | nA |
| | | $V_{GS}$ = -10 V, $V_{DS}$ = 0 V | - | - | -100 | |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$ = 960 V, $V_{GS}$ = 0 V | - | - | 10 | µA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}$ = 20 V, $I_D$ = 4 A | - | 250 | 313 | mΩ |
| | | $V_{GS}$ = 20 V, $I_D$ = 4 A, $T_J$ = 150 °C | - | 383 | 479 | |
| | | $V_{GS}$ = 18 V, $I_D$ = 4 A | - | 280 | 350 | |
| | | $V_{GS}$ = 18 V, $I_D$ = 4 A, $T_J$ = 150 °C | - | 400 | 500 | |
| **Dynamic** | | | | | | |
| Input capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 800 V, f = 1 MHz | - | 447 | - | pF |
| Output capacitance | $C_{oss}$ | | - | 21.2 | - | |
| Reverse transfer capacitance | $C_{rss}$ | | - | 3.2 | - | |
| Cross stored energy | $E_{oss}$ | | - | 8.7 | - | µJ |
| Total gate charge | $Q_g$ | $V_{GS}$ = 18 V, $I_D$ = 4 A, $V_{DS}$ = 800 V | - | 20.3 | - | nC |
| Gate-source charge | $Q_{gs}$ | | - | 5.5 | - | |
| Gate-drain charge | $Q_{gd}$ | | - | 7.9 | - | |
| Gate Resistance | $R_g$ | $V_{DS}$ = 0 V, f = 1 MHz | - | 34 | - | Ω |
| **Switching Characteristics** | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $V_{GS}$ = -5 V ~ 18 V, $I_D$ = 4 A, $V_{DS}$ = 800 V, $R_{g(ext)}$ = 4.4 Ω | - | 8.5 | - | ns |
| Rise time | $t_r$ | | - | 11.5 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 8.5 | - | |
| Fall time | $t_f$ | | - | 14.5 | - | |
| Turn-on switching energy | $E_{on}$ | | - | 67 | - | µJ |
| Turn-off switching energy | $E_{off}$ | | - | 5 | - | |
| **Body Diode Ratings and Characteristic** | | | | | | |
| Forward diode voltage | $V_{SD}$ | $V_{GS}$ = -5 V, $I_{SD}$ = 2 A, $T_J$ = 25 °C | - | 4.6 | - | V |
| Continuous diode forward current | $I_{SD}$ | $V_{GS}$ = -5 V, $T_J$ = 25 °C | - | - | 7 | A |
| Pulsed diode forward current | $I_{SDM}$ | | - | - | 21 | |
| Reverse recovery time | $t_{rr}$ | $V_{GS}$ = -5 V, $I_{SD}$ = 4 A, $V_R$ = 800 V, di/dt = 1000 A/µs | - | 7.5 | - | ns |
| Reverse recovery charge | $Q_{rr}$ | | - | 12 | - | nC |
| Reverse recovery current | $I_{rrm}$ | | - | 2.8 | - | A |

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

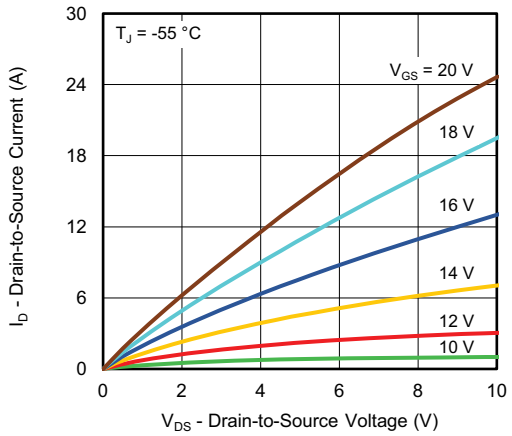



**Fig. 1 - Typical Output Characteristics**

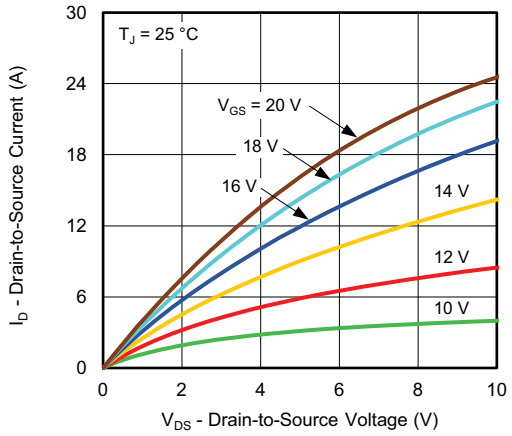



**Fig. 2 - Typical Output Characteristics**

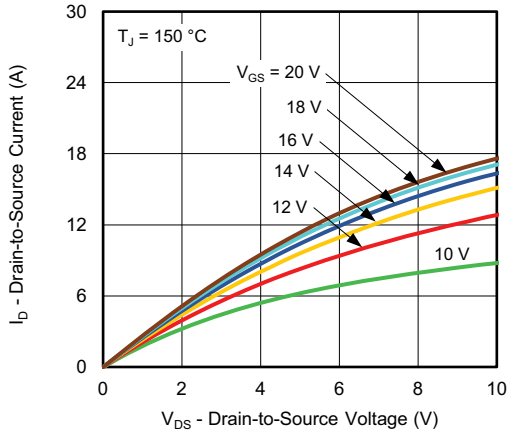



**Fig. 3 - Typical Output Characteristics**

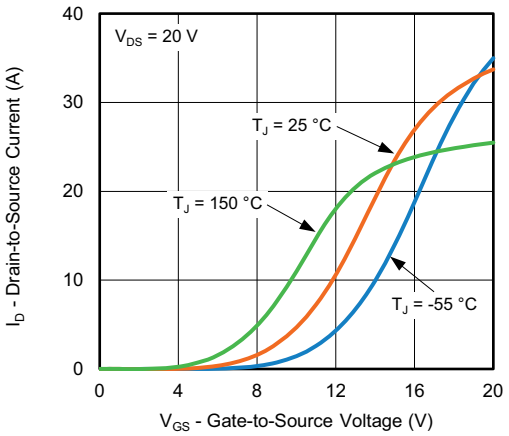



**Fig. 4 - Typical Transfer Characteristics**

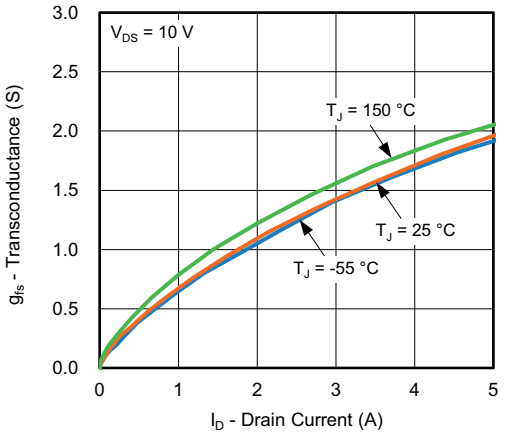



**Fig. 5 - Forward Transconductance vs. Drain Current**

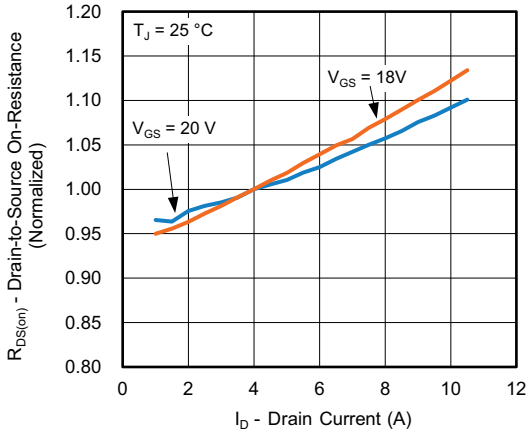



**Fig. 6 - Normalized On-Resistance vs. Drain Current**

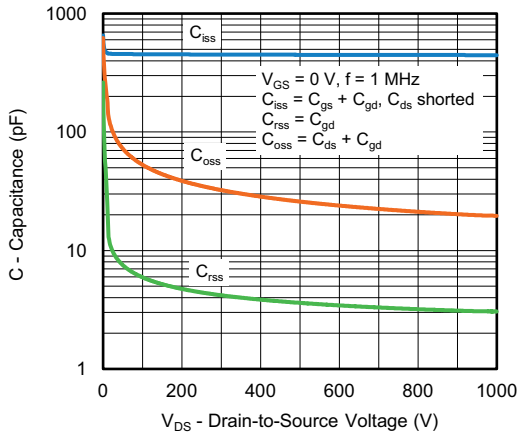



**Fig. 7 - Typical Capacitance vs. Drain-to-Source Voltage**

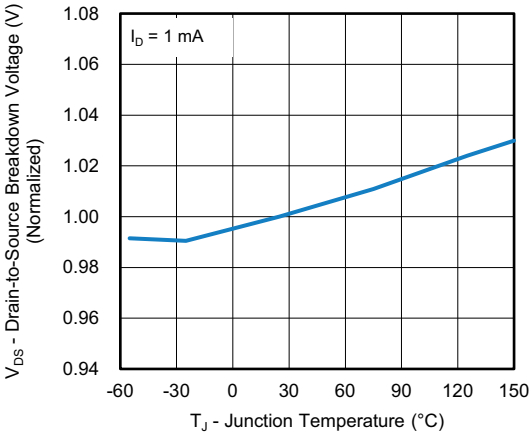



**Fig. 10 - Drain-to-Source Voltage vs. Temperature**

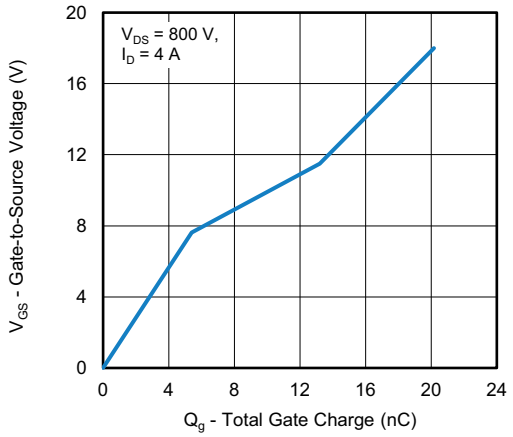



**Fig. 8 - Typical Gate Charge vs. Gate-to-Source Voltage**

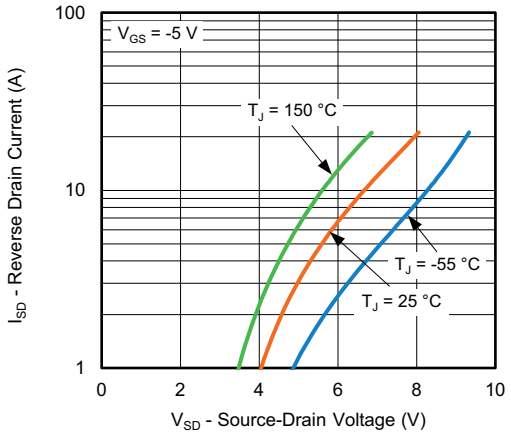



**Fig. 11 - Typical Source-Drain Diode Forward Voltage**

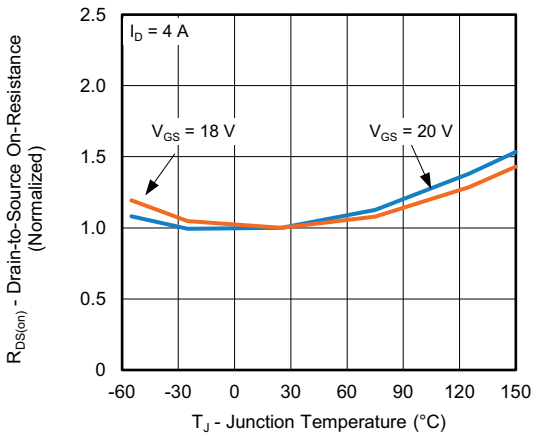



**Fig. 9 - Normalized On-Resistance vs. Temperature**

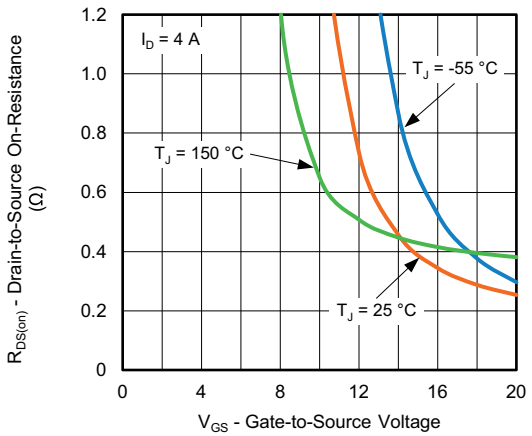



**Fig. 12 - On-Resistance vs. Gate-to-Source Voltage**

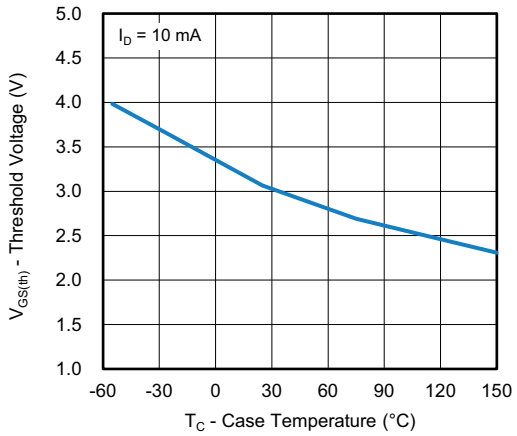



**Fig. 13 - Threshold Voltage vs. Case Temperature**

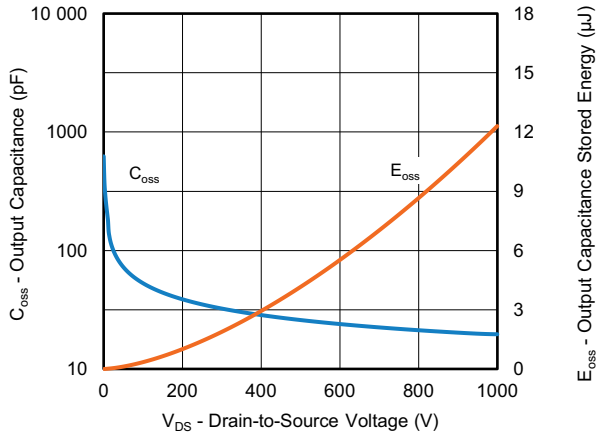



**Fig. 15 - Output Capacitance and its Stored Energy vs. Drain-to-Source Voltage**

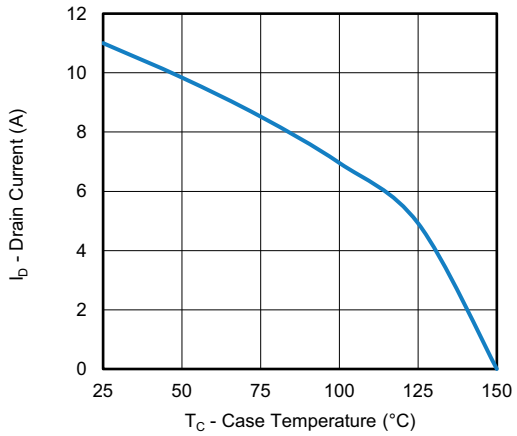



**Fig. 14 - Drain Current vs. Case Temperature**

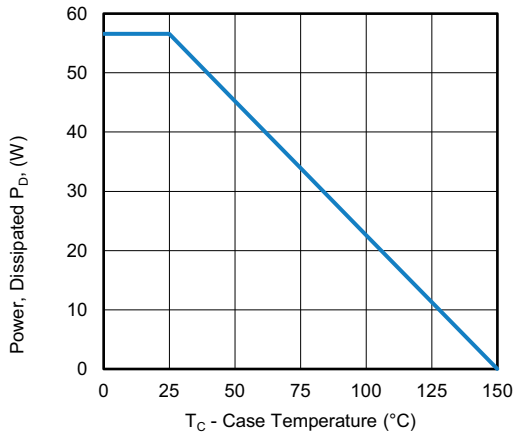



**Fig. 16 - Power, Dissipated $P_D$ vs. Case Temperature**

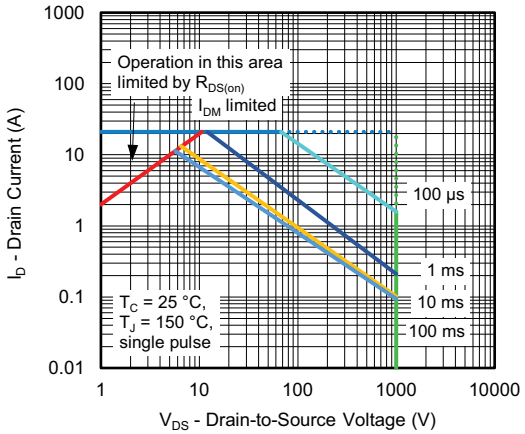



**Fig. 17 - Safe Operating Area**

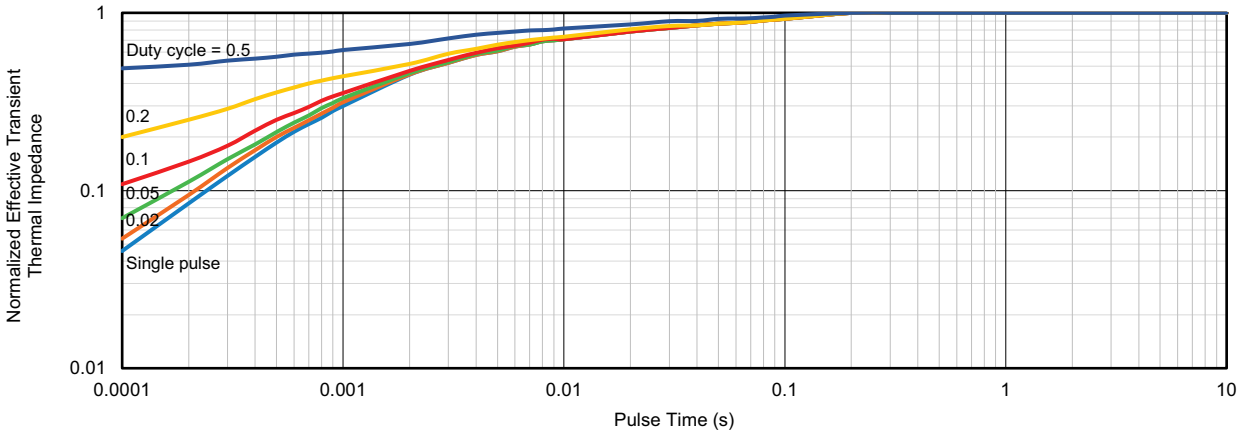



**Fig. 18 - Normalized Effective Transient Thermal Impedance**

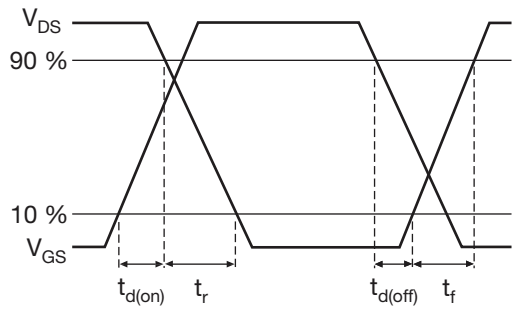



**Fig. 19 - Waveforms of Switching Time**

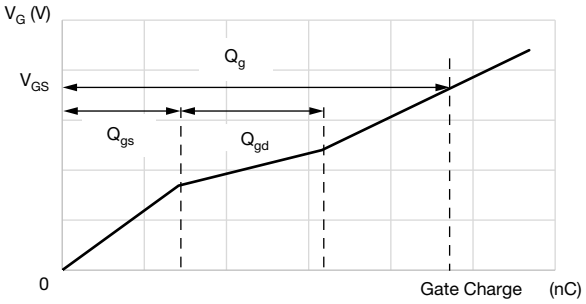



**Fig. 22 - Waveforms for Gate Charge**

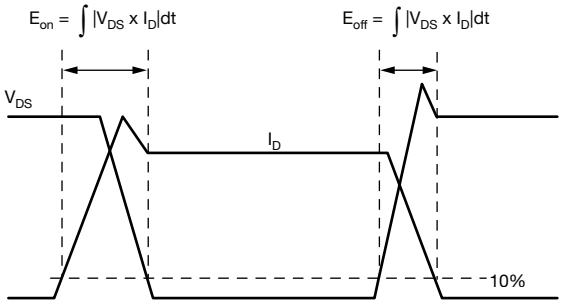



**Fig. 20 - Waveforms for Switching Energy**

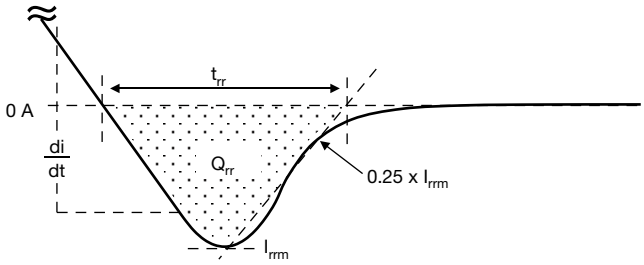



**Fig. 23 - Waveforms for Reverse Recovery**

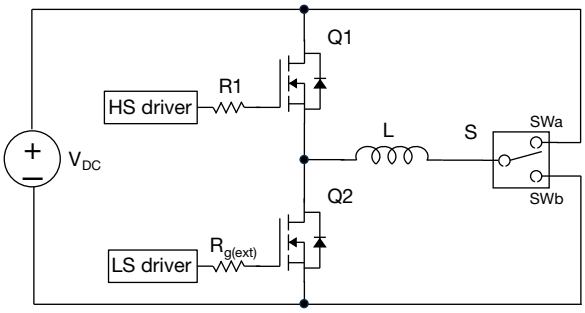



**Fig. 21 - Switching and Reverse Diode Characteristics Measurement Circuit**

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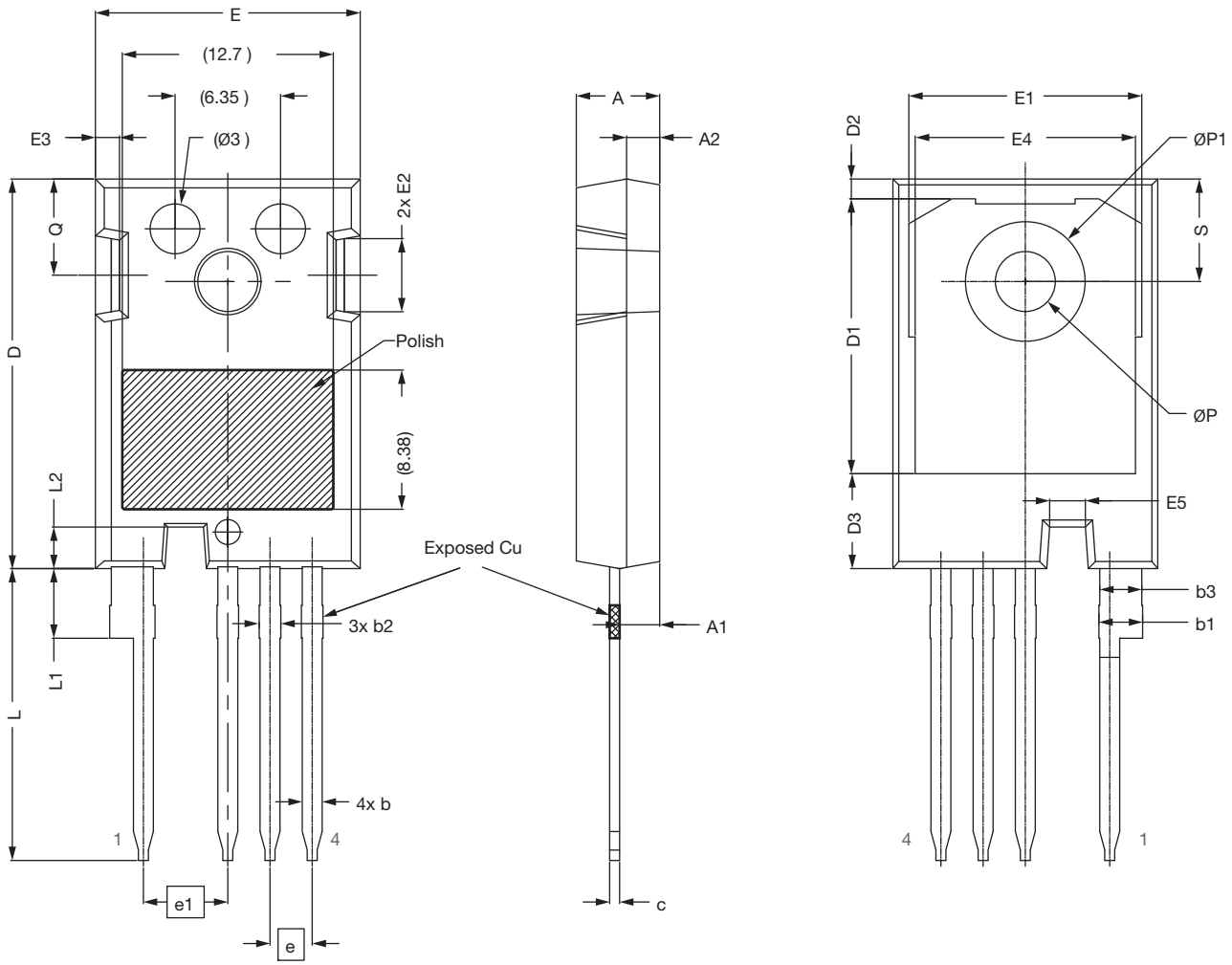
# Case Outline for TO-247AD 4L Package

**FACILITY CODE: 9**

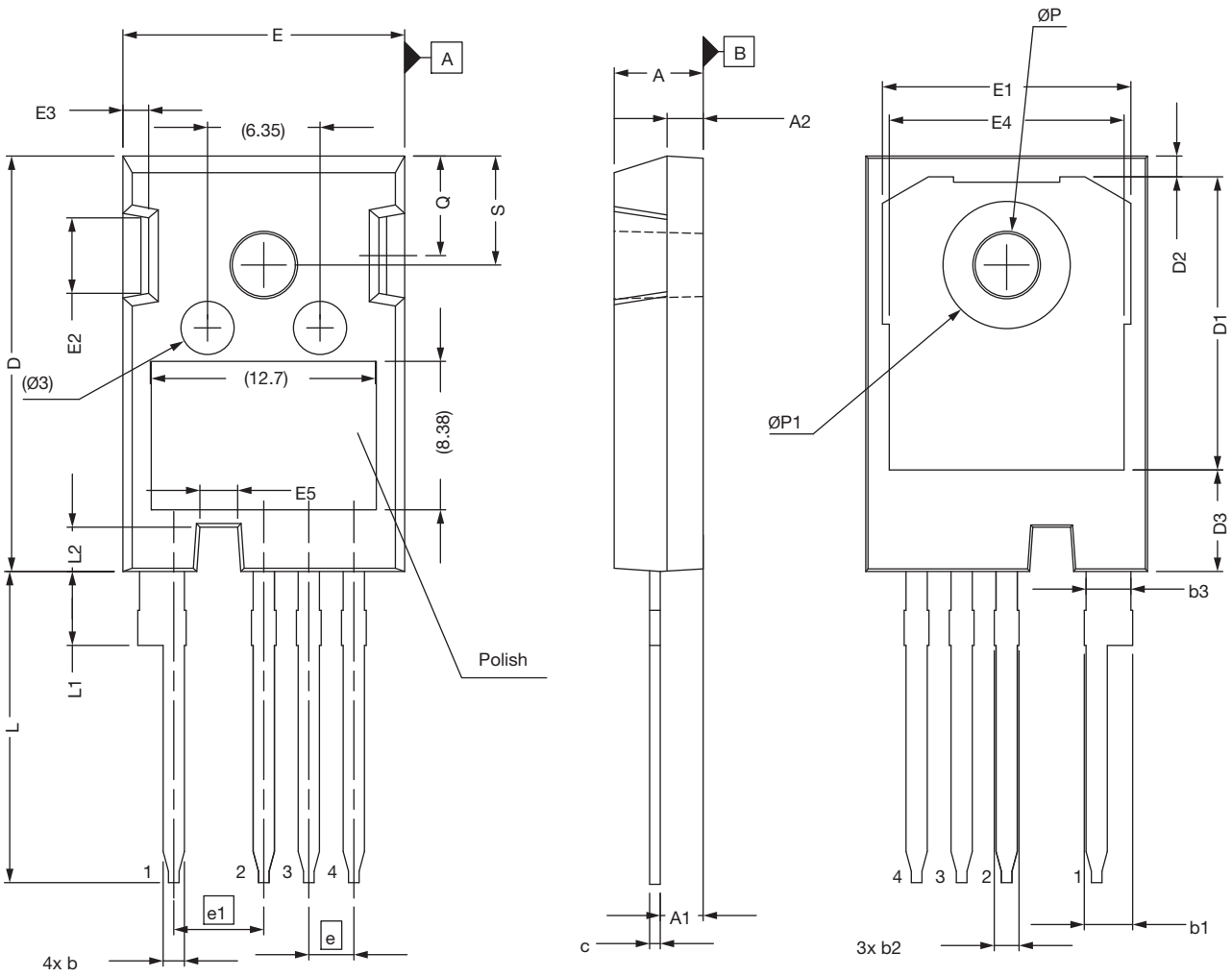


| DIM. | MILLIMETERS | |
|---|---|---|
| | MIN. | MAX. |
| A | 4.83 | 5.21 |
| A1 | 2.29 | 2.54 |
| A2 | 1.91 | 2.16 |
| b | 1.07 | 1.33 |
| b1 | 2.39 | 2.94 |
| b3 | 1.07 | 1.60 |
| c | 0.55 | 0.68 |
| D | 23.30 | 23.60 |
| D1 | 16.25 | 17.65 |
| D2 | 0.95 | 1.25 |
| E | 15.75 | 16.13 |
| E1 | 13.10 | 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 toleranceing 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: E24-0559-Rev. B, 11-Nov-2024<br>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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