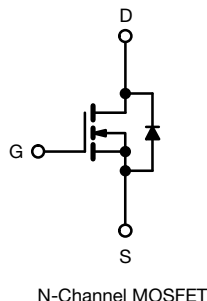


# MaxSiC™ 1200 V N-Channel SiC MOSFET



N-Channel MOSFET

**Marking Code:** 120A080FW

## FEATURES

- Fast switching speed
- Short circuit withstand time 3  $\mu$ s
- Material categorization:  
for definitions of compliance please see  
[www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


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

## APPLICATIONS

- Charger
- Auxiliary motor drive
- DC/DC converter

## PRODUCT SUMMARY

|                                          |                 |    |
|------------------------------------------|-----------------|----|
| $V_{DS}$ (V) at $T_J$ max.               | 1200            |    |
| $R_{DS(on)}$ typ. ( $m\Omega$ ) at 25 °C | $V_{GS} = 20$ V | 80 |
| $Q_g$ typ. (nC)                          | 47.3            |    |
| $I_D$ (A)                                | 29              |    |
| $C_{oss}$ typ. (pF)                      | 50              |    |
| $P_D$ (W)                                | 139             |    |
| Configuration                            | Single          |    |

## ORDERING INFORMATION

|                                 |                  |
|---------------------------------|------------------|
| Package                         | TO-247AD 3L      |
| Lead (Pb)-free and halogen-free | MXP120A080FW-GE3 |

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

| PARAMETER                                        |                         | SYMBOL                            | LIMIT       | UNIT |
|--------------------------------------------------|-------------------------|-----------------------------------|-------------|------|
| Drain-source voltage <sup>a</sup>                |                         | V <sub>DS</sub>                   | 1200        | V    |
| Gate-source voltage                              |                         | V <sub>GS</sub>                   | -10 / +22   |      |
| Recommended operation voltage of gate-source     |                         | V <sub>GSOP</sub>                 | -5 / +20    |      |
| Continuous drain current                         | T <sub>C</sub> = 25 °C  | I <sub>D</sub>                    | 29          | A    |
|                                                  | T <sub>C</sub> = 100 °C | I <sub>D</sub>                    | 18          |      |
| Pulsed drain current <sup>b</sup>                |                         | I <sub>DM</sub>                   | 58          |      |
| Short-circuit withstand time <sup>c</sup>        |                         | T <sub>SC</sub>                   | 3           | μs   |
| Maximum power dissipation                        | T <sub>C</sub> = 25 °C  | P <sub>D</sub>                    | 139         | W    |
|                                                  | T <sub>C</sub> = 100 °C | P <sub>D</sub>                    | 56          |      |
| Operating junction and storage temperature range |                         | T <sub>J</sub> , T <sub>stg</sub> | -55 to +150 | °C   |
| Soldering recommendations (peak temperature)     | For 10 s                |                                   | 260         | °C   |

## Notes

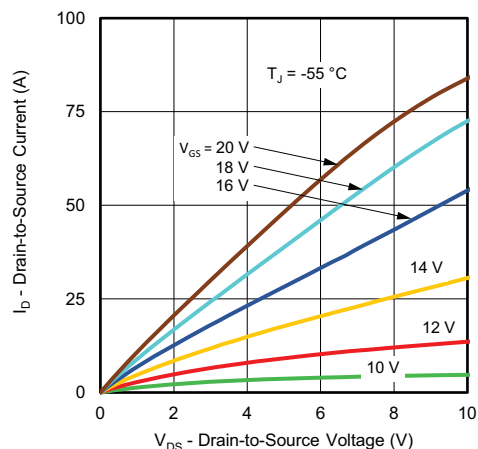
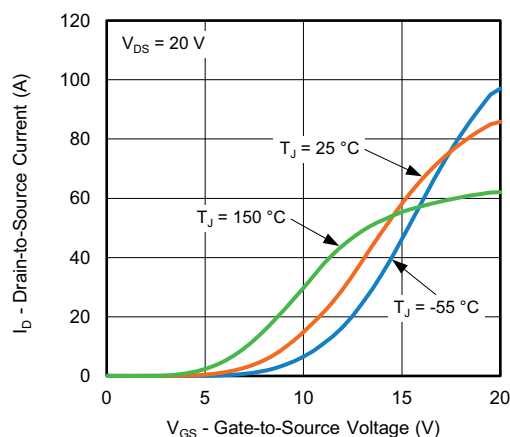
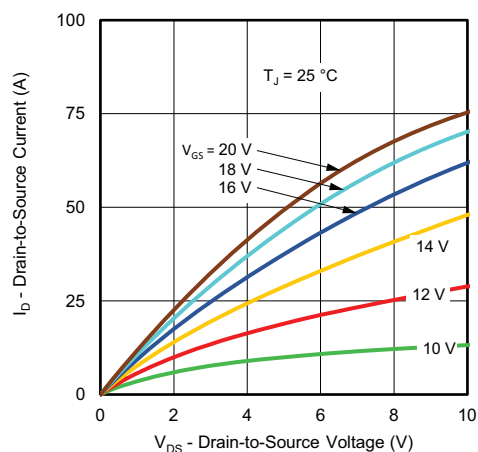
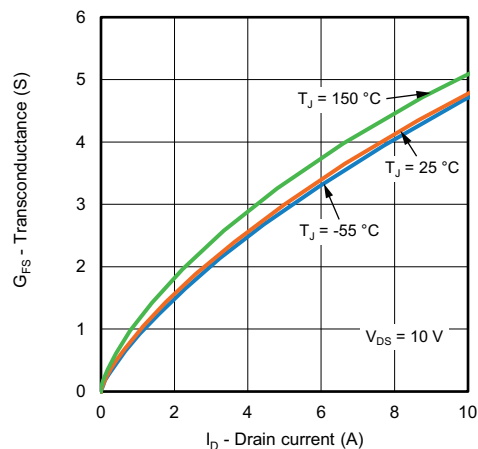
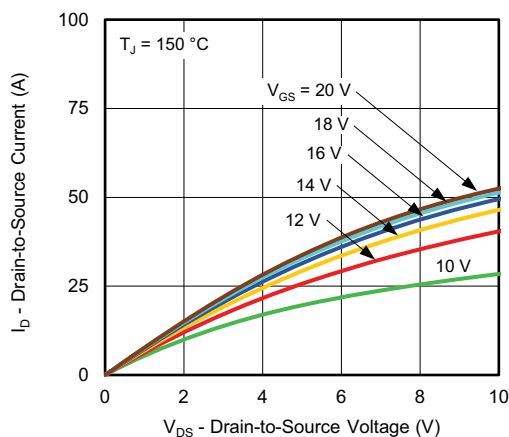
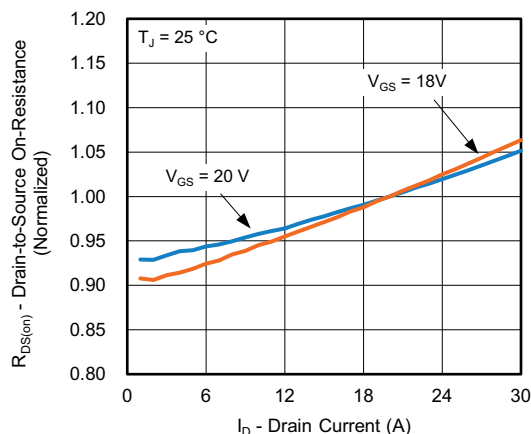
- a.  $T_J = 25$  °C to 150 °C  
b. Repetitive rating; pulse width limited by maximum junction temperature  
c. Verified by the design / characterization

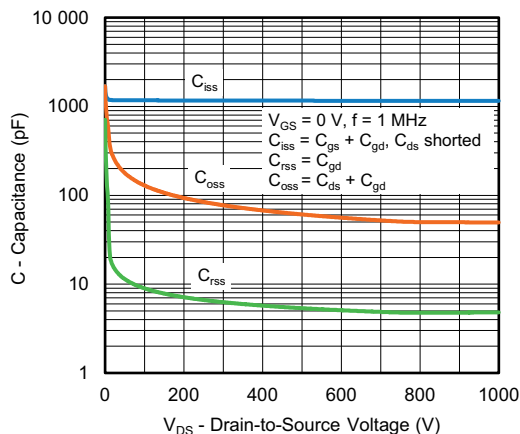
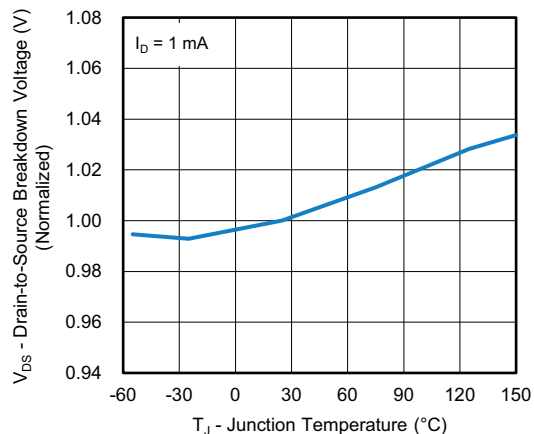
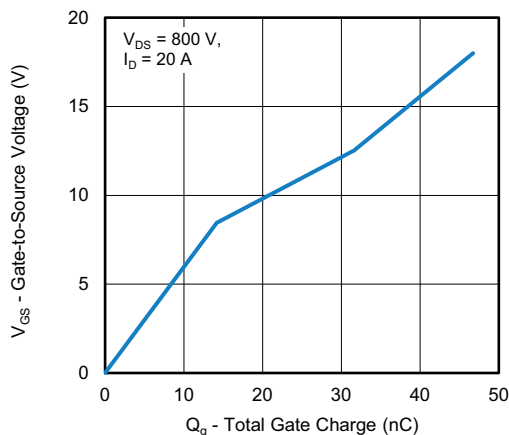
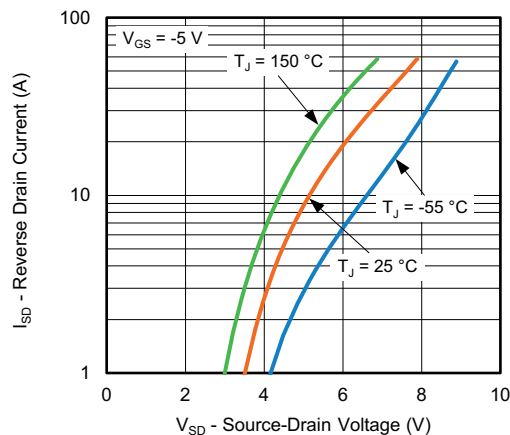
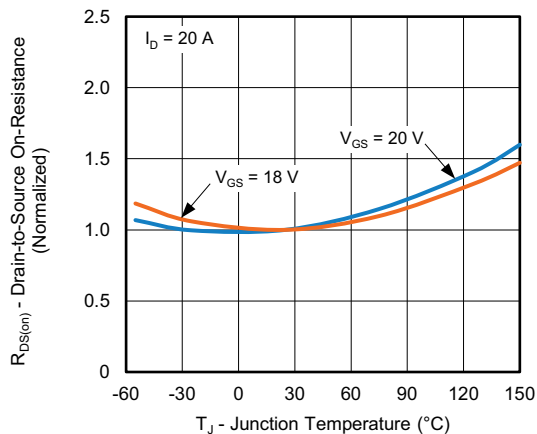
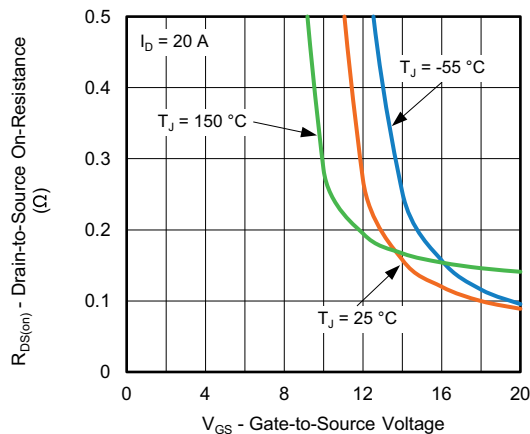
**THERMAL RESISTANCE RATINGS**

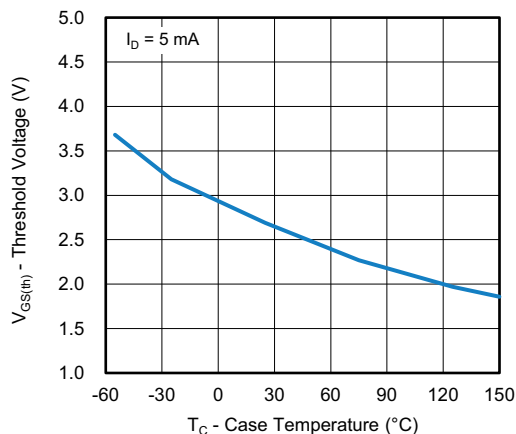
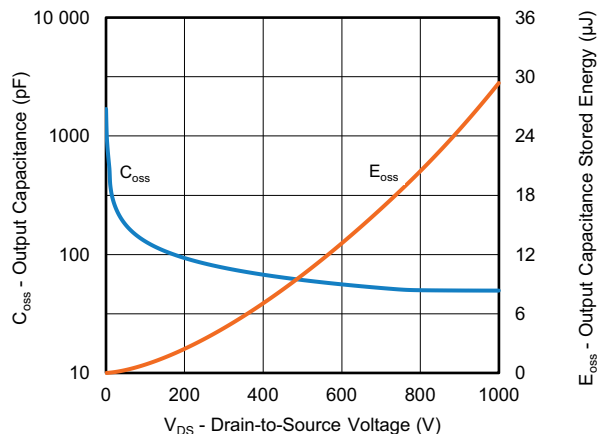
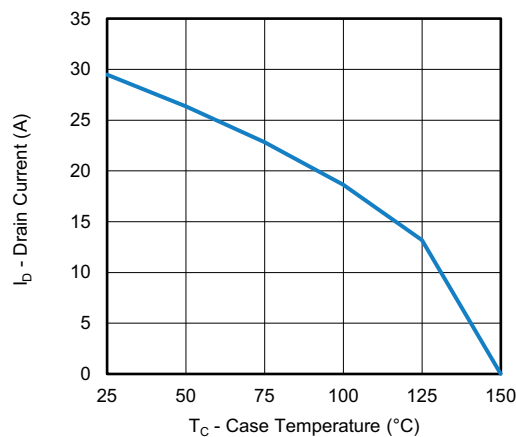
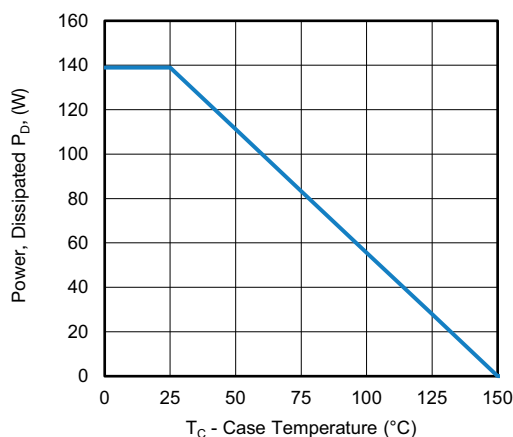
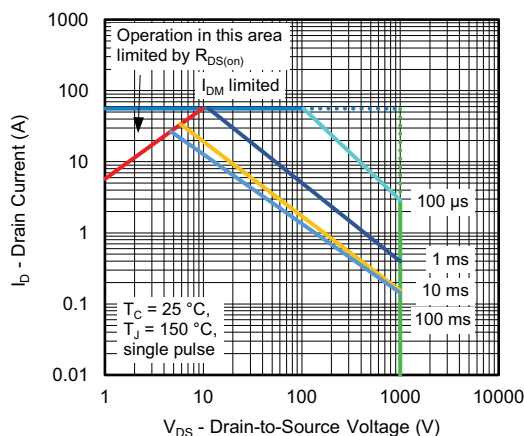
| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum junction-to-ambient      | $R_{thJA}$ | -    | 40   | °C/W |
| Maximum junction-to-case (drain) | $R_{thJC}$ | -    | 0.9  |      |

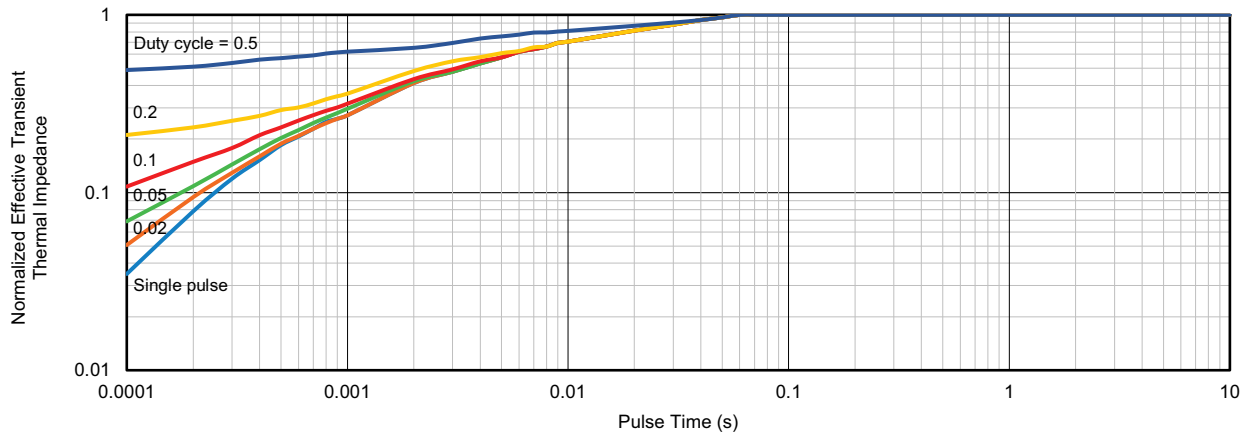
**SPECIFICATIONS** ( $T_J = 25\text{ °C}$ , unless otherwise noted)

| PARAMETER                             | SYMBOL              | TEST CONDITIONS                                                                                               | MIN. | TYP. | MAX. | UNIT |
|---------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------|------|------|------|------|
| Static                                |                     |                                                                                                               |      |      |      |      |
| Drain-source breakdown voltage        | V <sub>DS</sub>     | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA                                                                  | 1200 | -    | -    | V    |
| Gate-source threshold voltage (N)     | V <sub>GS(th)</sub> | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 5 mA                                                     | -    | 2.69 | -    | V    |
|                                       |                     | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 5 mA, T <sub>J</sub> = 150 °C                            | -    | 1.86 | -    | V    |
| Gate-source leakage                   | I <sub>GSS</sub>    | V <sub>GS</sub> = +22 V, V <sub>DS</sub> = 0 V                                                                | -    | -    | 100  | nA   |
|                                       |                     | V <sub>GS</sub> = -10 V, V <sub>DS</sub> = 0 V                                                                | -    | -    | -100 |      |
| Zero gate voltage drain current       | I <sub>DSS</sub>    | V <sub>DS</sub> = 960 V, V <sub>GS</sub> = 0 V                                                                | -    | -    | 10   | μA   |
| Drain-source on-state resistance      | R <sub>DS(on)</sub> | V <sub>GS</sub> = 20 V, I <sub>D</sub> = 20 A                                                                 | -    | 80   | 100  | mΩ   |
|                                       |                     | V <sub>GS</sub> = 20 V, I <sub>D</sub> = 20 A, T <sub>J</sub> = 150 °C                                        | -    | 128  | 160  |      |
|                                       |                     | V <sub>GS</sub> = 18 V, I <sub>D</sub> = 20 A                                                                 | -    | 95   | 119  |      |
|                                       |                     | V <sub>GS</sub> = 18 V, I <sub>D</sub> = 20 A, T <sub>J</sub> = 150 °C                                        | -    | 140  | 175  |      |
| Dynamic                               |                     |                                                                                                               |      |      |      |      |
| Input capacitance                     | C <sub>iss</sub>    | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 800 V, f = 1 MHz                                                     | -    | 1156 | -    | pF   |
| Output capacitance                    | C <sub>oss</sub>    |                                                                                                               | -    | 50   | -    |      |
| Reverse transfer capacitance          | C <sub>rss</sub>    |                                                                                                               | -    | 5    | -    |      |
| Coss Stored Energy                    | E <sub>oss</sub>    |                                                                                                               | -    | 20   | -    | μJ   |
| Total gate charge                     | Q <sub>g</sub>      | V <sub>GS</sub> = 18 V, I <sub>D</sub> = 20 A, V <sub>DS</sub> = 800 V                                        | -    | 47.3 | -    | nC   |
| Gate-source charge                    | Q <sub>gs</sub>     |                                                                                                               | -    | 14.2 | -    |      |
| Gate-drain charge                     | Q <sub>gd</sub>     |                                                                                                               | -    | 17.8 | -    |      |
| Gate Resistance                       | R <sub>g</sub>      | V <sub>DS</sub> = 0 V, f = 1 MHz                                                                              | -    | 9.8  | -    | Ω    |
| Switching Characteristics             |                     |                                                                                                               |      |      |      |      |
| Turn-on delay time                    | t <sub>d(on)</sub>  | V <sub>GS</sub> = -5 V ~ 18 V, I <sub>D</sub> = 20 A,<br>V <sub>DS</sub> = 800 V, R <sub>g(ext)</sub> = 4.4 Ω | -    | 25.6 | -    | ns   |
| Rise time                             | t <sub>r</sub>      |                                                                                                               | -    | 15.6 | -    |      |
| Turn-off delay time                   | t <sub>d(off)</sub> |                                                                                                               | -    | 16   | -    |      |
| Fall time                             | t <sub>f</sub>      |                                                                                                               | -    | 9    | -    |      |
| Turn-on switching energy              | E <sub>on</sub>     |                                                                                                               | -    | 386  | -    | μJ   |
| Turn-off switching energy             | E <sub>off</sub>    |                                                                                                               | -    | 37   | -    |      |
| Body Diode Ratings and Characteristic |                     |                                                                                                               |      |      |      |      |
| Forward diode voltage                 | V <sub>SD</sub>     | V <sub>GS</sub> = -5 V, I <sub>SD</sub> = 10 A, T <sub>J</sub> = 25 °C                                        | -    | 5.1  | -    | V    |
| Continuous diode forward current      | I <sub>SD</sub>     | V <sub>GS</sub> = -5 V, T <sub>J</sub> = 25 °C                                                                | -    | -    | 21   | A    |
| Pulsed diode forward current          | I <sub>SDM</sub>    |                                                                                                               | -    | -    | 58   |      |
| Reverse recovery time                 | t <sub>rr</sub>     | V <sub>GS</sub> = -5 V, I <sub>SD</sub> = 20 A,<br>V <sub>R</sub> = 800 V, di/dt = 1000 A/μs                  | -    | 14   | -    | ns   |
| Reverse recovery charge               | Q <sub>rr</sub>     |                                                                                                               | -    | 35   | -    | nC   |
| Reverse recovery current              | I <sub>rrm</sub>    |                                                                                                               | -    | 4.5  | -    | A    |

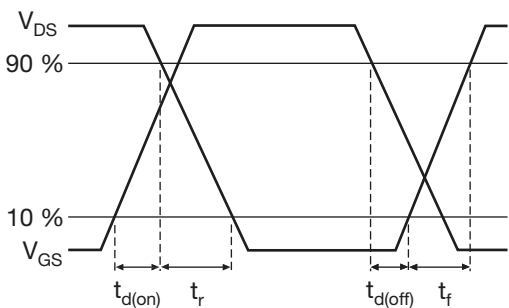
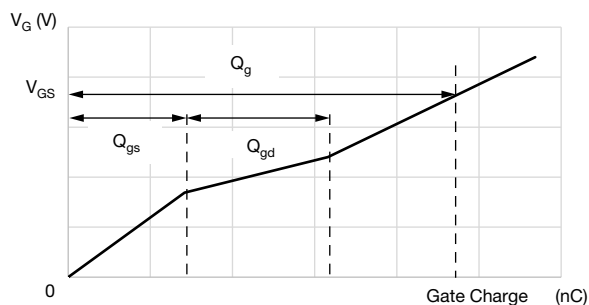
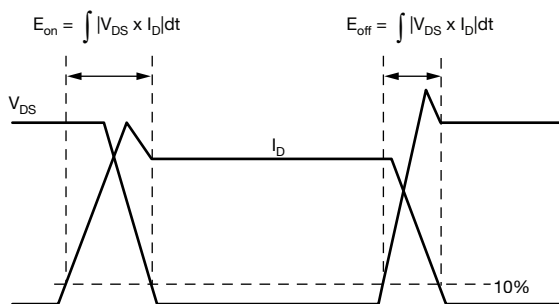
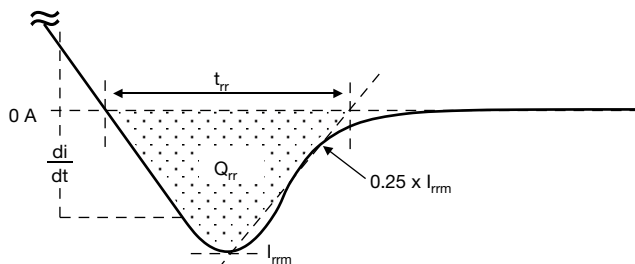
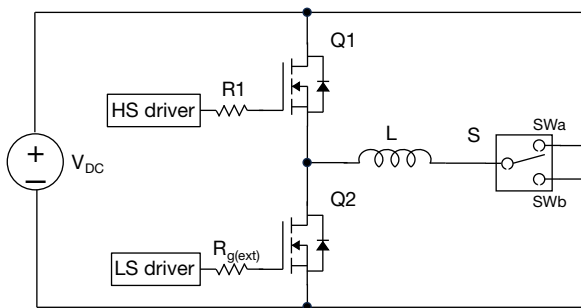
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Fig. 1 - Typical Output Characteristics**

**Fig. 4 - Typical Transfer Characteristics**

**Fig. 2 - Typical Output Characteristics**

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

**Fig. 3 - Typical Output Characteristics**

**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 Capacitances 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**



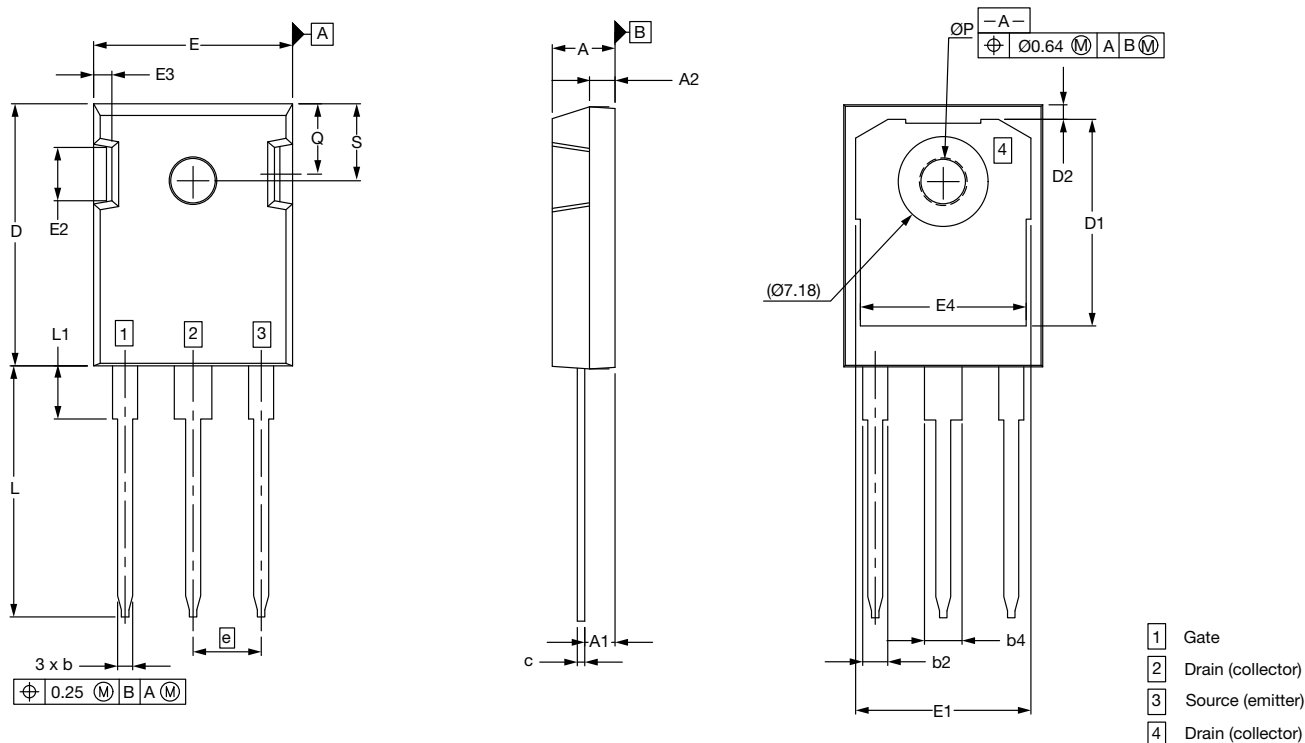
**Fig. 18 - Normalized Effective Transient Thermal Impedance**


**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 3L

**FACILITY CODE: N**


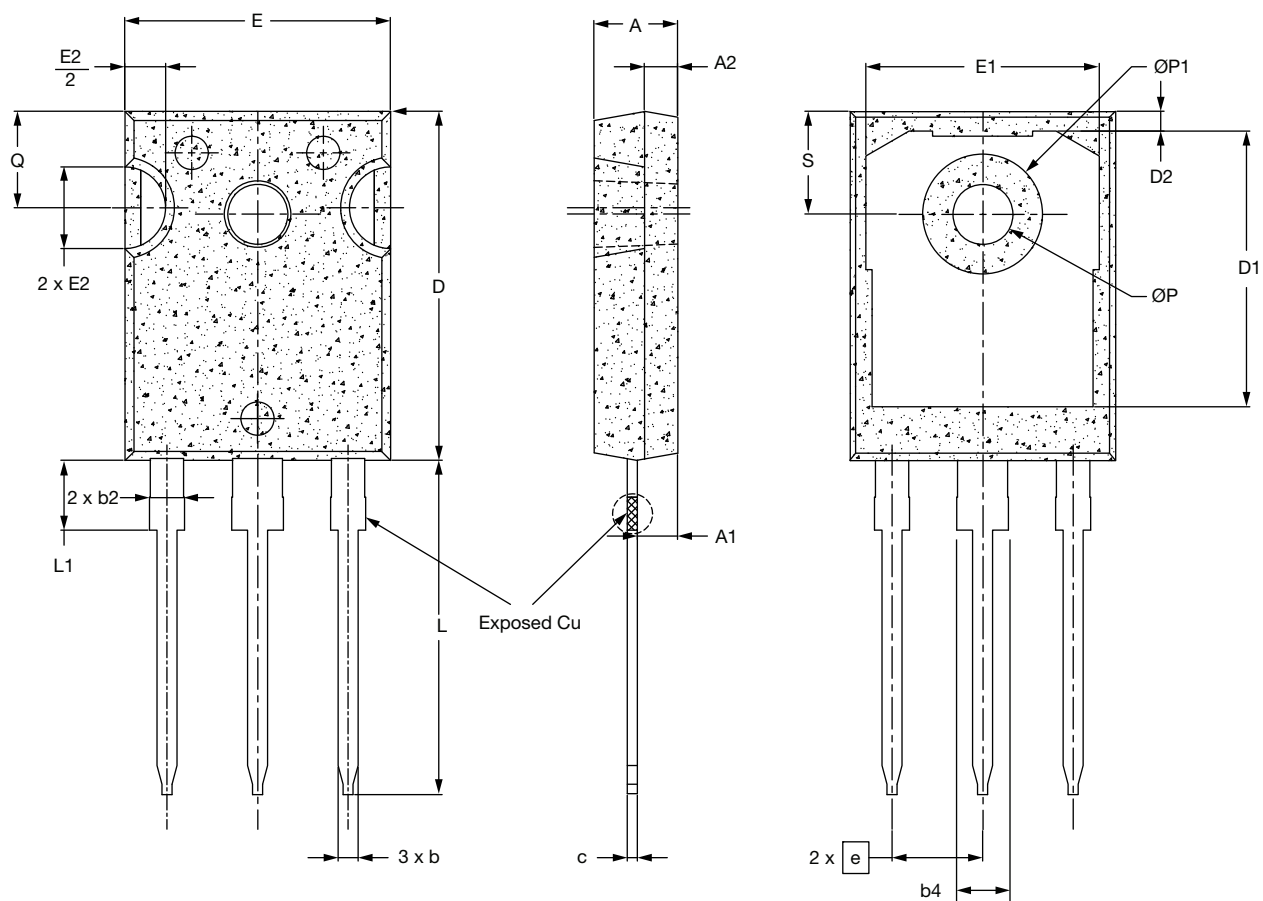
| DIM. | MILLIMETERS |       |
|------|-------------|-------|
|      | MIN.        | MAX.  |
| A    | 4.83        | 5.21  |
| A1   | 2.29        | 2.54  |
| A2   | 1.91        | 2.16  |
| b    | 1.07        | 1.33  |
| b2   | 1.91        | 2.41  |
| b4   | 2.87        | 3.38  |
| c    | 0.55        | 0.68  |
| D    | 20.80       | 21.10 |
| 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 |
| e    | 5.44 BSC.   |       |
| N    | 3           |       |
| L    | 19.81       | 20.32 |
| L1   | 4.10        | 4.40  |
| ØP   | 3.51        | 3.65  |
| Q    | 5.49        | 6.00  |
| S    | 6.04        | 6.30  |

**Notes**

- All metal surfaces: tin plated (MATTE), except area of cut
- Dimensioning and tolerancing confirm to ASME Y14.5M-1994
- All dimensions are in millimeters
- This drawing will meet all dimensions requirement of JEDEC outlines TO-247 AD
- Dimension b2 and b4 does not include dambar protrusion



**FACILITY CODE: 9**





| DIM.                                           | MILLIMETERS |       |       |
|------------------------------------------------|-------------|-------|-------|
|                                                | MIN.        | NOM.  | MAX.  |
| A                                              | 4.83        | 5.02  | 5.21  |
| A1                                             | 2.29        | 2.41  | 2.55  |
| A2                                             | 1.50        | 2.00  | 2.49  |
| b                                              | 1.12        | 1.20  | 1.33  |
| b2 <sup>(1)</sup>                              | 1.91        | 2.00  | 2.39  |
| b4 <sup>(1)</sup>                              | 2.87        | 3.00  | 3.22  |
| c                                              | 0.55        | 0.60  | 0.69  |
| D <sup>(2)</sup>                               | 20.80       | 20.95 | 21.10 |
| D1 <sup>(3)</sup>                              | 16.25       | 16.55 | 17.65 |
| D2                                             | 0.51        | 1.19  | 1.35  |
| E <sup>(2)</sup>                               | 15.75       | 15.94 | 16.13 |
| E1 <sup>(3)</sup>                              | 13.46       | 14.02 | 14.16 |
| E2                                             | 4.32        | 4.91  | 5.49  |
| e                                              | 5.44 BSC.   |       |       |
| L                                              | 19.81       | 20.07 | 20.32 |
| L1 <sup>(4)</sup>                              | 4.10        | 4.19  | 4.40  |
| ØP <sup>(5)</sup>                              | 3.56        | 3.61  | 3.65  |
| ØP1                                            | 7.19 ref.   |       |       |
| Q                                              | 5.39        | 5.79  | 6.20  |
| S                                              | 6.04        | 6.17  | 6.30  |
| ECN: E24-0303-Rev. B, 19-Aug-2024<br>DWG: 6118 |             |       |       |

**Notes**

- Package reference: JEDEC TO-247, variation AD
- All dimensions are in mm
- Slot required, notch may be rounded
- <sup>(1)</sup> Dimension b2 and b4 does not include dambar protrusion
- <sup>(2)</sup> Dimension D and E do not include mold flash
- <sup>(3)</sup> Thermal pad contour optional within dimension D1 and E1
- <sup>(4)</sup> Lead Finish Uncontrolled In L1
- <sup>(5)</sup> ØP to have a draft angle of 1.5 ° ref. to the top of the part with hole diameter of 3.91mm



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