

# STW28NM60ND-VB Datasheet

## N-Channel 600V (D-S) Super Junction Power MOSFET

**PRODUCT SUMMARY**

|                                    |                 |       |
|------------------------------------|-----------------|-------|
| $V_{DS}$ (V) at $T_J$ max.         | 600             |       |
| $R_{DS(on)}$ at 25 °C ( $\Omega$ ) | $V_{GS} = 10$ V | 0.160 |

**FEATURES**

- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low input capacitance ( $C_{iss}$ )
- Reduced switching and conduction losses
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)

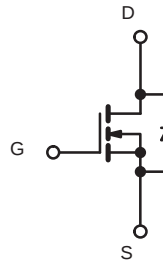
**APPLICATIONS**

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting

TO-247



Top View



N-Channel MOSFET

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

| PARAMETER                                                 |                         |                         | SYMBOL                            | LIMIT       | UNIT |
|-----------------------------------------------------------|-------------------------|-------------------------|-----------------------------------|-------------|------|
| Drain-Source Voltage                                      |                         |                         | V <sub>DS</sub>                   | 600         | 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>                    | 20          | A    |
|                                                           |                         | T <sub>C</sub> = 100 °C |                                   | 12          |      |
| Pulsed Drain Current <sup>a</sup>                         |                         |                         | I <sub>DM</sub>                   | 60          |      |
| Linear Derating Factor                                    |                         |                         |                                   | 1.67        | W/°C |
| Single Pulse Avalanche Energy <sup>b</sup>                |                         |                         | E <sub>AS</sub>                   | 1000        | mJ   |
| Maximum Power Dissipation                                 |                         |                         | P <sub>D</sub>                    | 160         | W    |
| Operating Junction and Storage Temperature Range          |                         |                         | T <sub>J</sub> , T <sub>stg</sub> | -55 to +150 | °C   |
| Drain-Source Voltage Slope                                | T <sub>J</sub> = 125 °C |                         | dV/dt                             | 50          | V/ns |
| Reverse Diode dV/dt <sup>d</sup>                          |                         | 15                      |                                   |             |      |
| Soldering Recommendations (Peak Temperature) <sup>c</sup> | for 10 s                |                         |                                   | 260         | °C   |

**Notes**

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 100$  V, starting  $T_J = 25$  °C,  $L = 30$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 13$  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) | $R_{thJC}$ | -    | 0.38 |      |

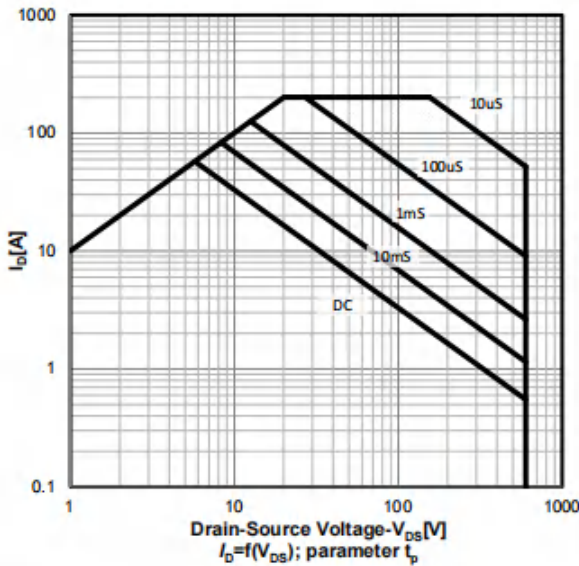
**SPECIFICATIONS** ( $T_J = 25\text{ °C}$ , unless otherwise noted)

| 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                                                                                                             |                                                | 600  | -     | -     | V    |
| V <sub>DS</sub> Temperature Coefficient                   | ΔV <sub>DS</sub> /T <sub>J</sub> | Reference to 25 °C, I <sub>D</sub> = 1 mA                                                                                                                |                                                | -    | 0.70  | -     | V/°C |
| Gate-Source Threshold Voltage (N)                         | V <sub>GS(th)</sub>              | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                                                                                              |                                                | 2.5  | -     | 4.5   | V    |
| Gate-Source Leakage                                       | I <sub>GSS</sub>                 | V <sub>GS</sub> = ± 20 V                                                                                                                                 |                                                | -    | -     | ± 100 | nA   |
|                                                           |                                  | V <sub>GS</sub> = ± 30 V                                                                                                                                 |                                                | -    | -     | ± 1   | μA   |
| Zero Gate Voltage Drain Current                           | I <sub>DSS</sub>                 | V <sub>DS</sub> = 600V, V <sub>GS</sub> = 0 V                                                                                                            |                                                | -    | -     | 1     | μA   |
|                                                           |                                  | V <sub>DS</sub> = 480 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C                                                                                  |                                                | -    | -     | 100   |      |
| Drain-Source On-State Resistance                          | R <sub>DS(on)</sub>              | V <sub>GS</sub> = 10 V                                                                                                                                   | I <sub>D</sub> = 7A                            | -    | 0.160 | -     | Ω    |
| Forward Transconductance                                  | g <sub>fs</sub>                  | V <sub>DS</sub> = 30 V, I <sub>D</sub> = 7A                                                                                                              |                                                | -    | 5.6   | -     | S    |
| Dynamic                                                   |                                  |                                                                                                                                                          |                                                |      |       |       |      |
| Input Capacitance                                         | C <sub>iss</sub>                 | V <sub>GS</sub> = 0 V,<br>V <sub>DS</sub> = 100 V,<br>f = 1 MHz                                                                                          |                                                | -    | 2300  | -     | pF   |
| Output Capacitance                                        | C <sub>oss</sub>                 |                                                                                                                                                          |                                                | -    | 330   | -     |      |
| Reverse Transfer Capacitance                              | C <sub>rss</sub>                 |                                                                                                                                                          |                                                | -    | 4     | -     |      |
| Effective Output Capacitance, Energy Related <sup>a</sup> | C <sub>o(er)</sub>               | V <sub>DS</sub> = 0 V to 520 V, V <sub>GS</sub> = 0 V                                                                                                    |                                                | -    | 63    | -     | pF   |
| Effective Output Capacitance, Time Related <sup>b</sup>   | C <sub>o(tr)</sub>               |                                                                                                                                                          |                                                | -    | 213   | -     |      |
| Total Gate Charge                                         | Q <sub>g</sub>                   | V <sub>GS</sub> = 10 V                                                                                                                                   | I <sub>D</sub> = 20 A, V <sub>DS</sub> = 520 V | -    | 62    | -     | nC   |
| Gate-Source Charge                                        | Q <sub>gs</sub>                  |                                                                                                                                                          |                                                | -    | 39    | -     |      |
| Gate-Drain Charge                                         | Q <sub>gd</sub>                  |                                                                                                                                                          |                                                | -    | 4.7   | -     |      |
| Turn-On Delay Time                                        | t <sub>d(on)</sub>               | V <sub>DD</sub> = 520 V, I <sub>D</sub> = 20A,<br>V <sub>GS</sub> = 10 V, R <sub>g</sub> = 9.1 Ω                                                         |                                                | -    | 18    | 25    | ns   |
| Rise Time                                                 | t <sub>r</sub>                   |                                                                                                                                                          |                                                | -    | 24    | 55    |      |
| Turn-Off Delay Time                                       | t <sub>d(off)</sub>              |                                                                                                                                                          |                                                | -    | 8.0   | -     |      |
| Fall Time                                                 | t <sub>f</sub>                   |                                                                                                                                                          |                                                | -    | 1.2   | -     |      |
| Gate Input Resistance                                     | R <sub>g</sub>                   | f = 1 MHz, open drain                                                                                                                                    |                                                | -    | 0.8   | -     | Ω    |
| Drain-Source Body Diode Characteristics                   |                                  |                                                                                                                                                          |                                                |      |       |       |      |
| Continuous Source-Drain Diode Current                     | I <sub>S</sub>                   | MOSFET symbol showing the integral reverse p - n junction diode<br> |                                                | -    | -     | 20    | A    |
| Pulsed Diode Forward Current                              | I <sub>SM</sub>                  |                                                                                                                                                          |                                                | -    | -     | 60    |      |
| Diode Forward Voltage                                     | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = 8 A, V <sub>GS</sub> = 0 V                                                                                      |                                                | -    | -     | 1.5   | V    |
| Reverse Recovery Time                                     | t <sub>rr</sub>                  | T <sub>J</sub> = 25 °C, I <sub>F</sub> = I <sub>S</sub> = 8 A,<br>dI/dt = 100 A/μs, V <sub>R</sub> = 400 V                                               |                                                | -    | 520   | -     | ns   |
| Reverse Recovery Charge                                   | Q <sub>rr</sub>                  |                                                                                                                                                          |                                                | -    | 5.8   | -     | μC   |
| Reverse Recovery Current                                  | I <sub>RRM</sub>                 |                                                                                                                                                          |                                                | -    | 4.5   | -     | A    |

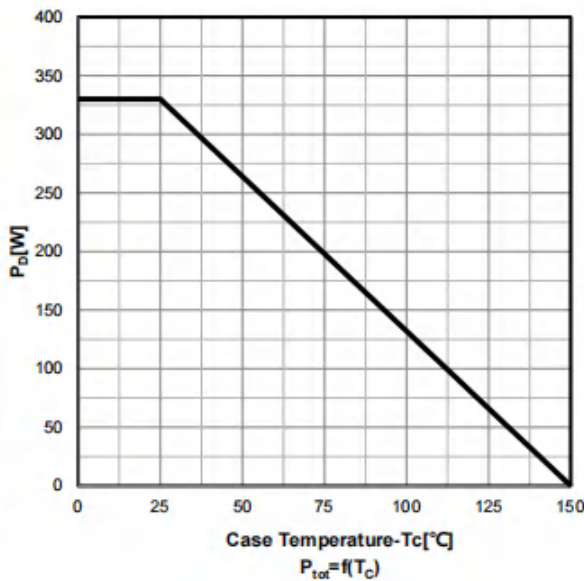
**Notes**

- 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 %  $V_{DSS}$ .

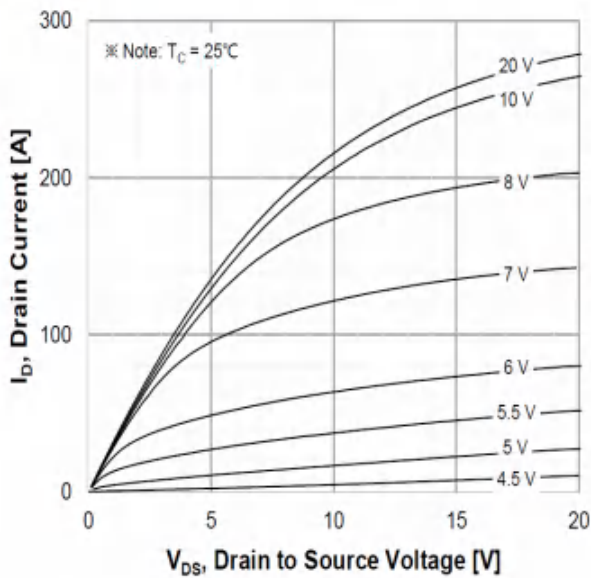
Safe operating area TC=25 °C  
TO-247



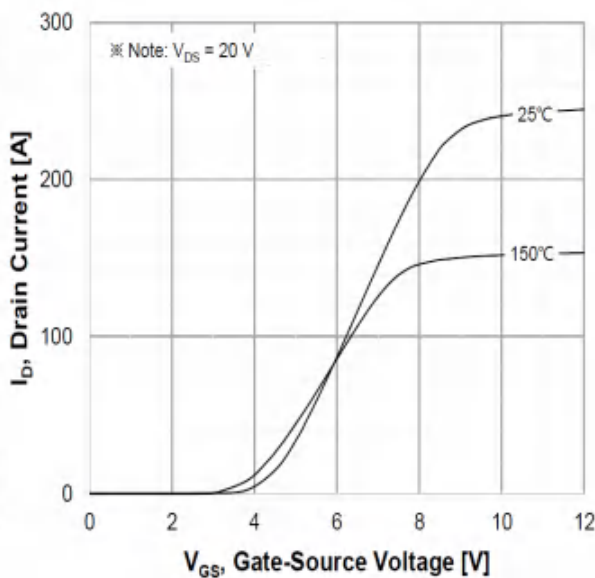
Power dissipation



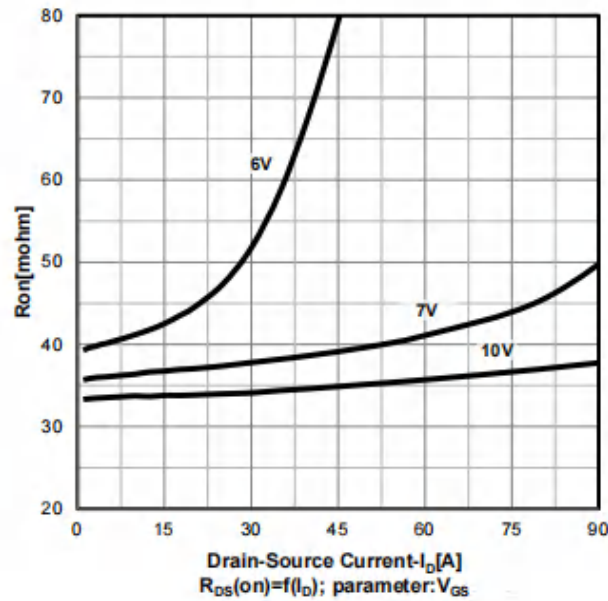
Typ. output characteristics  $T_J=25\text{ }^{\circ}\text{C}$



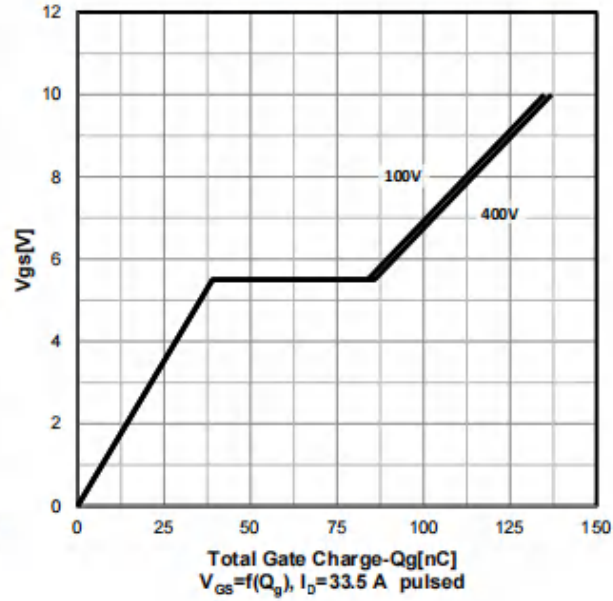
Transfer characteristics



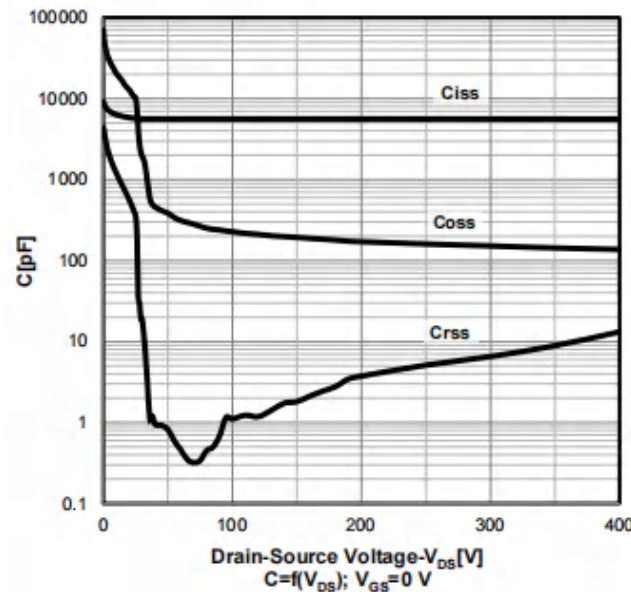
Typ. drain-source on-state resistance



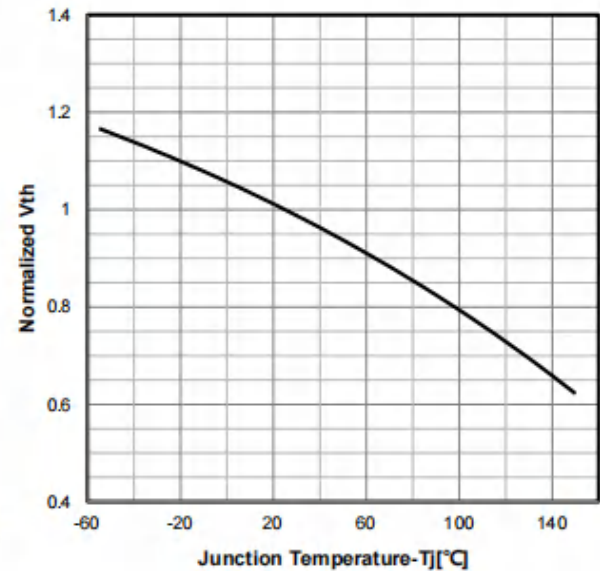
Typ. gate charge characteristics



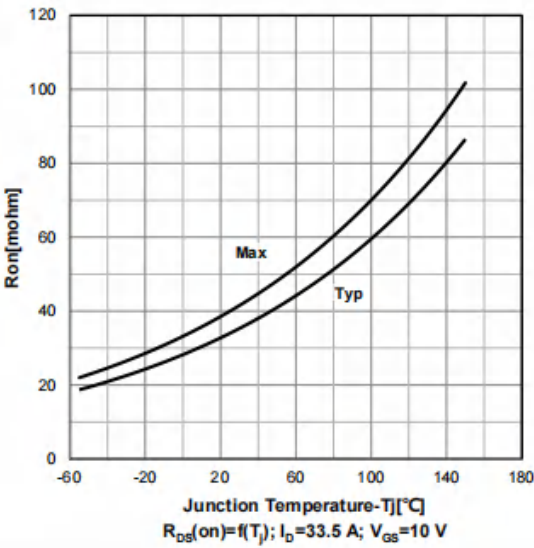
Typ. capacitances



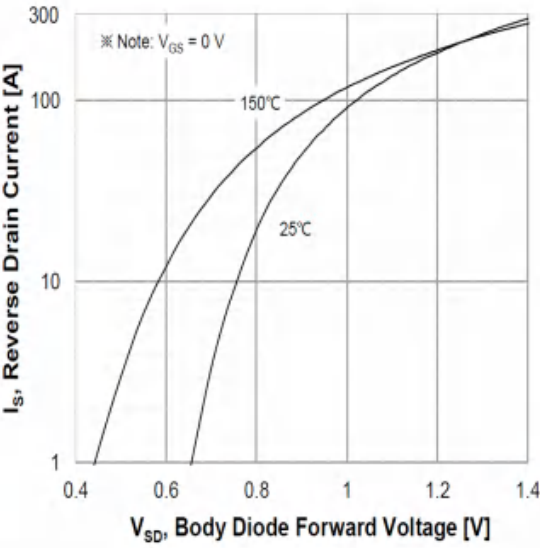
Normalized  $V_{GS(th)}$  characteristics



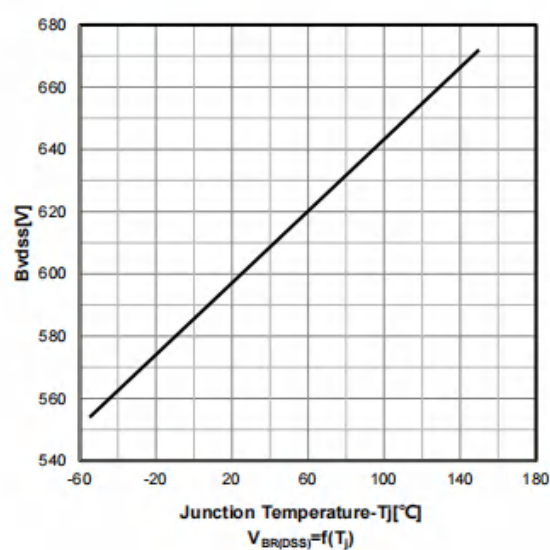
On-resistance vs temperature



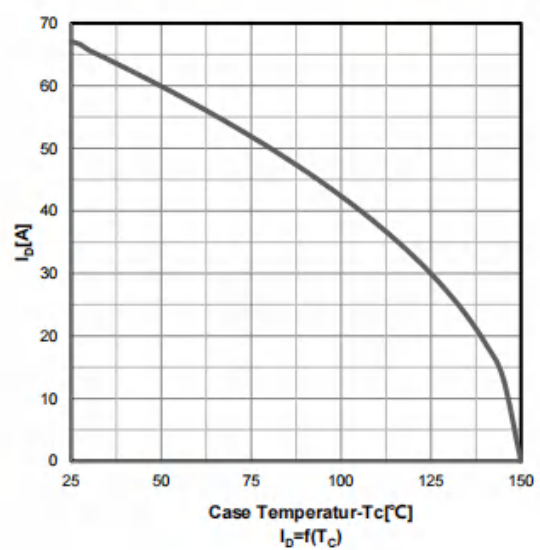
Forward characteristics of reverse diode



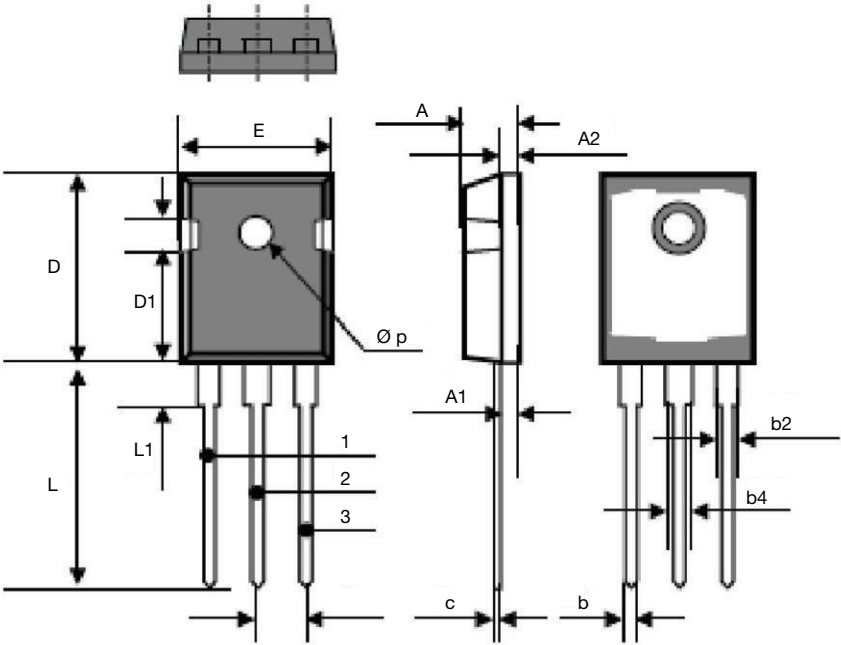
Drain-source breakdown voltage



Drain current vs temperature



TO-247



| DIM. | MILLIMETERS |       | INCHES    |       |
|------|-------------|-------|-----------|-------|
|      | MIN.        | MAX.  | MIN.      | MAX.  |
| A    | 4.70        | 5.31  | 0.185     | 0.209 |
| A1   | 2.21        | 2.59  | 0.087     | 0.102 |
| A2   | 1.50        | 2.49  | 0.059     | 0.098 |
| b    | 0.99        | 1.40  | 0.039     | 0.055 |
| b2   | 1.65        | 2.41  | 0.065     | 0.095 |
| b4   | 2.59        | 3.43  | 0.102     | 0.135 |
| c    | 0.61 BSC    |       | 0.024 BSC |       |
| D    | 20.80       | 21.46 | 0.819     | 0.845 |
| D1   | 3.68        | 5.49  | 0.145     | 0.216 |
| (e)  | 5.46 BSC    |       | 0.215 BSC |       |
| E    | 15.49       | 16.26 | 0.610     | 0.640 |
| L    | 19.81       | 20.32 | 0.780     | 0.800 |
| L1   | 4.06        | 4.50  | 0.160     | 0.177 |
| Ø p  | 3.51        | 3.66  | 0.138     | 0.144 |

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