

## SCT4090KRHR-VB Datasheet

### N-Channel 1200 V (D-S) SiC Power MOSFET

| PRODUCT SUMMARY                    |                 |       |
|------------------------------------|-----------------|-------|
| $V_{DS}$ (V)                       | 1200            |       |
| $R_{DS(on)}$ at 25 °C ( $\Omega$ ) | $V_{GS} = 18$ V | 0.080 |
| $Q_g$ (nC)                         | 108             |       |

#### FEATURES

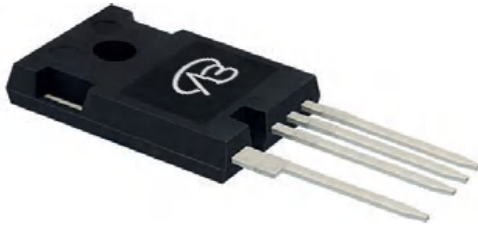
- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low input capacitance ( $C_{iss}$ )
- Reduced switching and conduction losses
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)



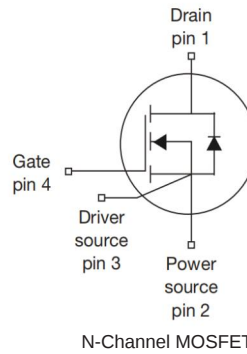
#### APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- DC/DC converter

TO-247-4L



- Pin1 D - Drain
- Pin2 S - Source(Power)
- Pin3 S - Source(Driver)
- Pin4 G - Gate



| ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted) |                         |                         |                                   |             |      |
|---------------------------------------------------------------------------|-------------------------|-------------------------|-----------------------------------|-------------|------|
| PARAMETER                                                                 |                         |                         | SYMBOL                            | LIMIT       | UNIT |
| Drain-Source Voltage                                                      |                         |                         | V <sub>DS</sub>                   | 1200        | V    |
| Gate-Source Voltage                                                       |                         |                         | V <sub>GS</sub>                   | -10 / +22   |      |
| Continuous Drain Current (T <sub>J</sub> = 150 °C)                        | V <sub>GS</sub> at 18 V | T <sub>C</sub> = 25 °C  | I <sub>D</sub>                    | 30          | A    |
|                                                                           |                         | T <sub>C</sub> = 100 °C |                                   | 21          |      |
| Pulsed Drain Current <sup>a</sup>                                         |                         |                         | I <sub>DM</sub>                   | 90          |      |
| Linear Derating Factor                                                    |                         |                         |                                   | 2.1         | W/°C |
| Single Pulse Avalanche Energy <sup>b</sup>                                |                         |                         | E <sub>AS</sub>                   | 1200        | mJ   |
| Maximum Power Dissipation                                                 |                         |                         | P <sub>D</sub>                    | 320         | W    |
| Operating Junction and Storage Temperature Range                          |                         |                         | T <sub>J</sub> , T <sub>stg</sub> | -55 to +175 | °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,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 9$  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      | $R_{thJA}$ | -    | 40   | °C/W |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | -    | 0.47 |      |

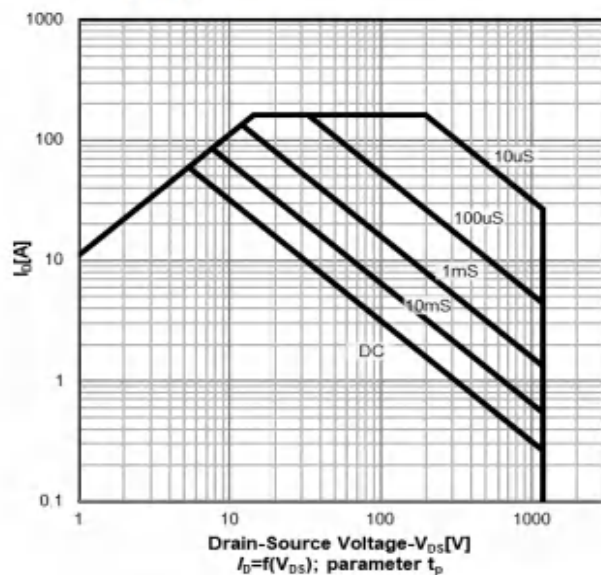
**SPECIFICATIONS** ( $T_J = 25\text{ °C}$ , unless otherwise noted)

| PARAMETER                                                 | SYMBOL              | TEST CONDITIONS                                                                                                                                          | MIN. | TYP.  | MAX. | UNIT |
|-----------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|------|------|
| <b>Static</b>                                             |                     |                                                                                                                                                          |      |       |      |      |
| Drain-Source Breakdown Voltage                            | $V_{DS}$            | $V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$                                                                                                              | 1200 | -     | -    | V    |
| $V_{DS}$ Temperature Coefficient                          | $\Delta V_{DS}/T_J$ | Reference to $25\text{ °C}$ , $I_D = 1\text{ mA}$                                                                                                        | -    | 0.70  | -    | V/°C |
| Gate-Source Threshold Voltage (N)                         | $V_{GS(th)}$        | $V_{DS} = V_{GS}$ , $I_D = 10\text{ mA}$                                                                                                                 | 2.5  | -     | 4.5  | V    |
| Gate-Source Leakage                                       | $I_{GSS}$           | $V_{GS} = +22\text{ V}$                                                                                                                                  | -    | -     | 100  | nA   |
|                                                           |                     | $V_{GS} = -10\text{ V}$                                                                                                                                  | -    | -     | 100  | μA   |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$           | $V_{DS} = 1200\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                                         | -    | 10    | -    | μA   |
|                                                           |                     | $V_{DS} = 1200\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ °C}$                                                                                 | -    | -     | 100  |      |
| Drain-Source On-State Resistance                          | $R_{DS(on)}$        | $V_{GS} = 18\text{ V}$ , $I_D = 30\text{ A}$                                                                                                             | -    | 0.080 | -    | Ω    |
| Forward Transconductance                                  | $g_{fs}$            | $V_{DS} = 0\text{ V}$ , $I_D = 30\text{ A}$                                                                                                              | -    | 16    | -    | S    |
| <b>Dynamic</b>                                            |                     |                                                                                                                                                          |      |       |      |      |
| Input Capacitance                                         | $C_{iss}$           | $V_{GS} = 0\text{ V}$ ,<br>$V_{DS} = 800\text{ V}$ ,<br>$f = 1\text{ MHz}$                                                                               | -    | 2800  | -    | pF   |
| Output Capacitance                                        | $C_{oss}$           |                                                                                                                                                          | -    | 123   | -    |      |
| Reverse Transfer Capacitance                              | $C_{rss}$           |                                                                                                                                                          | -    | 10    | -    |      |
| Effective Output Capacitance, Energy Related <sup>a</sup> | $C_{o(er)}$         | $V_{DS} = 0\text{ V to } 800\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                           | -    | 156   | -    |      |
| Effective Output Capacitance, Time Related <sup>b</sup>   | $C_{o(tr)}$         |                                                                                                                                                          | -    | 268   | -    |      |
| Total Gate Charge                                         | $Q_g$               | $V_{GS} = -5/18\text{ V}$ ,<br>$I_D = 20\text{ A}$ , $V_{DS} = 800\text{ V}$                                                                             | -    | 108   | -    | nC   |
| Gate-Source Charge                                        | $Q_{gs}$            |                                                                                                                                                          | -    | 29    | -    |      |
| Gate-Drain Charge                                         | $Q_{gd}$            |                                                                                                                                                          | -    | 33    | -    |      |
| Turn-On Delay Time                                        | $t_{d(on)}$         | $V_{DD} = 800\text{ V}$ , $I_D = 20\text{ A}$ ,<br>$V_{GS} = -5/18\text{ V}$ , $R_g = 2\text{ Ω}$                                                        | -    | 18    | 25   | ns   |
| Rise Time                                                 | $t_r$               |                                                                                                                                                          | -    | 24    | 55   |      |
| Turn-Off Delay Time                                       | $t_{d(off)}$        |                                                                                                                                                          | -    | 80    | -    |      |
| Fall Time                                                 | $t_f$               |                                                                                                                                                          | -    | 12    | -    |      |
| Gate Input Resistance                                     | $R_g$               | $f = 1\text{ MHz}$ , open drain                                                                                                                          | -    | 3.2   | -    | Ω    |
| <b>Drain-Source Body Diode Characteristics</b>            |                     |                                                                                                                                                          |      |       |      |      |
| Continuous Source-Drain Diode Current                     | $I_S$               | MOSFET symbol showing the integral reverse p - n junction diode<br> | -    | -     | 30   | A    |
| Pulsed Diode Forward Current                              | $I_{SM}$            |                                                                                                                                                          | -    | -     | 90   |      |
| Diode Forward Voltage                                     | $V_{SD}$            | $T_J = 25\text{ °C}$ , $I_S = 30\text{ A}$ , $V_{GS} = 0$                                                                                                | -    | -     | 4.1  | V    |
| Reverse Recovery Time                                     | $t_{rr}$            | $T_J = 25\text{ °C}$ , $I_F = I_S = 30\text{ A}$ ,<br>$di/dt = 1000\text{ A/μs}$ , $V_R = 800\text{ V}$                                                  | -    | 70    | -    | ns   |
| Reverse Recovery Charge                                   | $Q_{rr}$            |                                                                                                                                                          | -    | 220   | -    | μC   |
| Reverse Recovery Current                                  | $I_{RRM}$           |                                                                                                                                                          | -    | 60    | -    | A    |

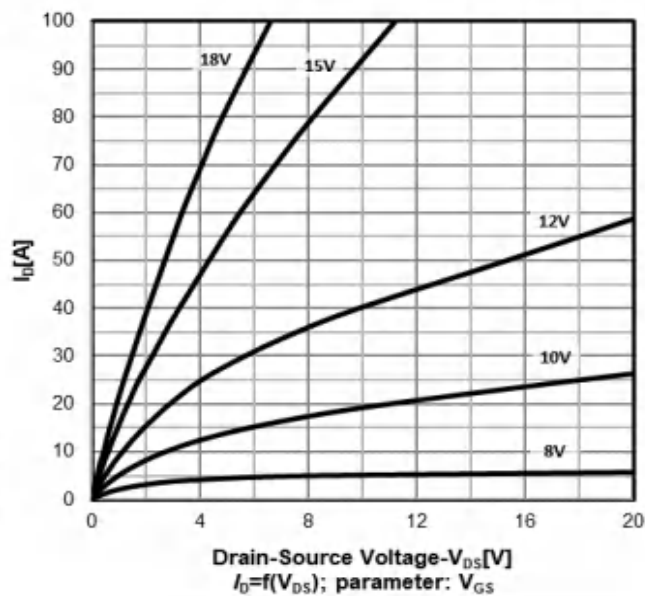
**Notes**

- 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 %  $V_{DSS}$ .

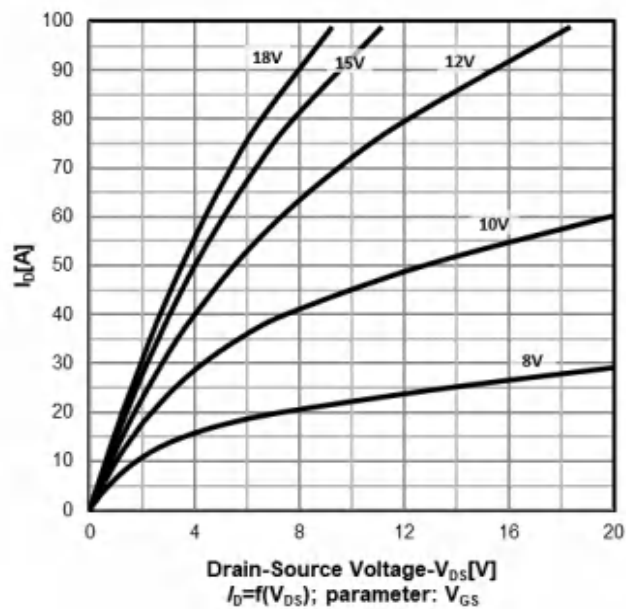
Safe operating area  $T_c=25^\circ\text{C}$   
TO-247



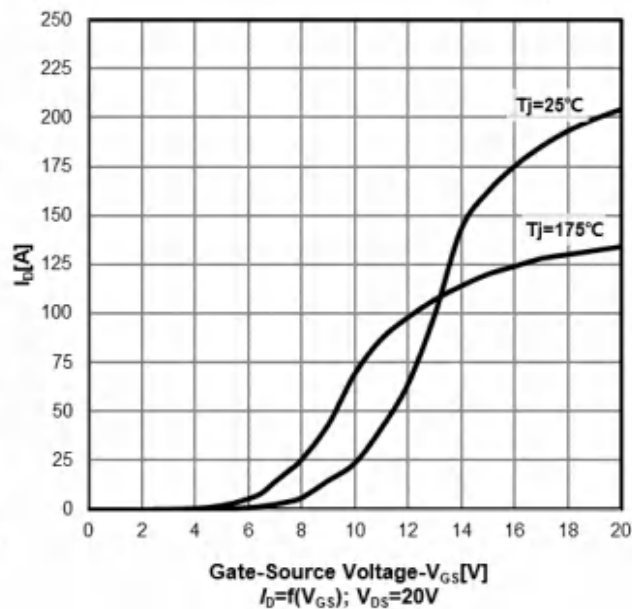
On-Region characteristics  $T_j=25^\circ\text{C}$



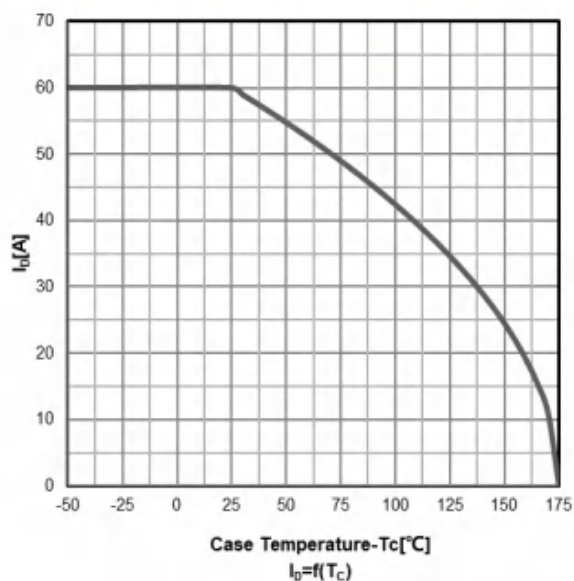
On-Region characteristics  $T_j=175^\circ\text{C}$



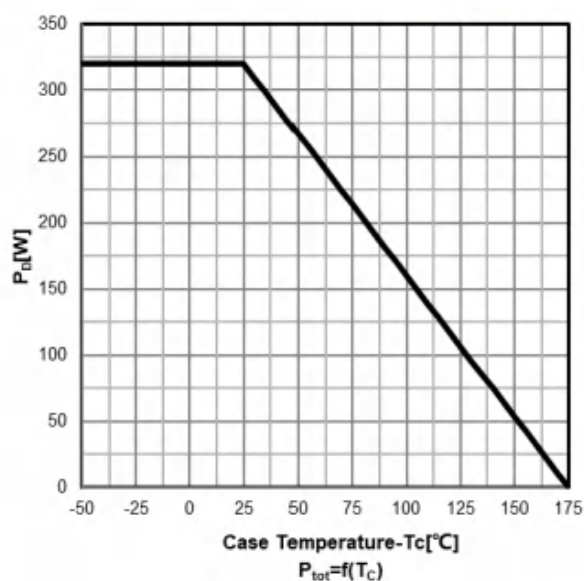
Transfer characteristics



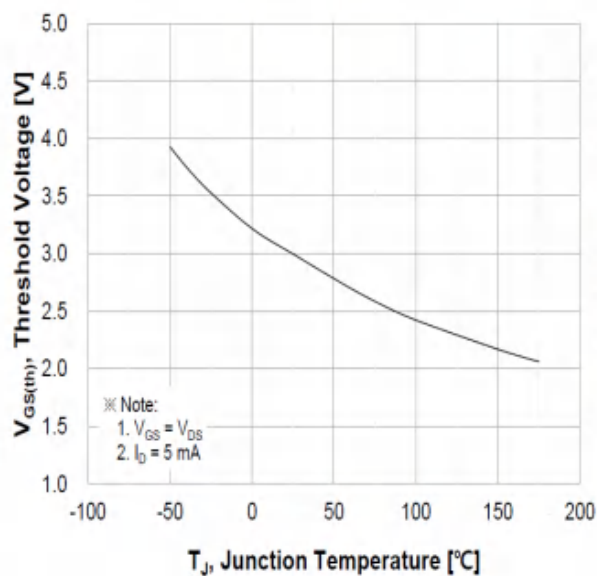
Drain current vs temperature



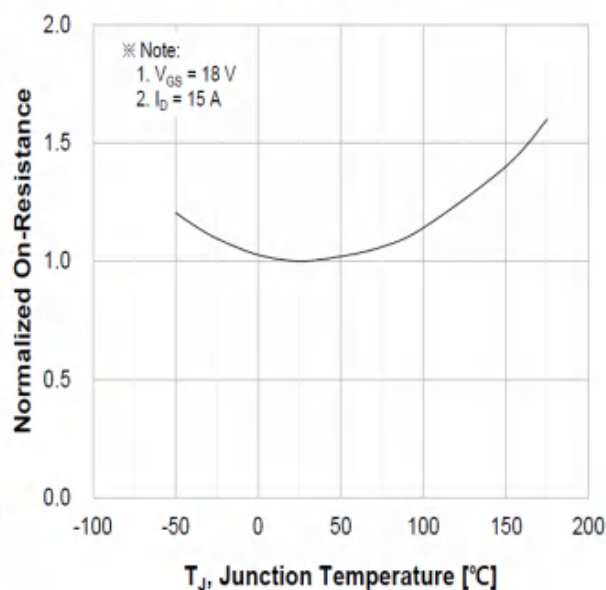
Power dissipation



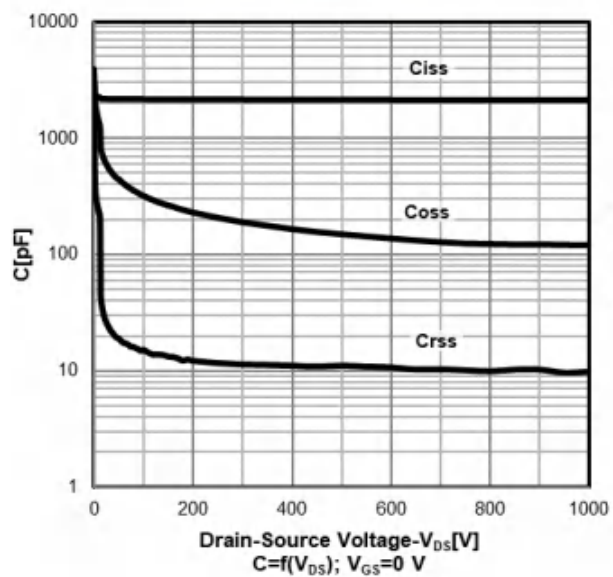
Threshold voltage vs temperature



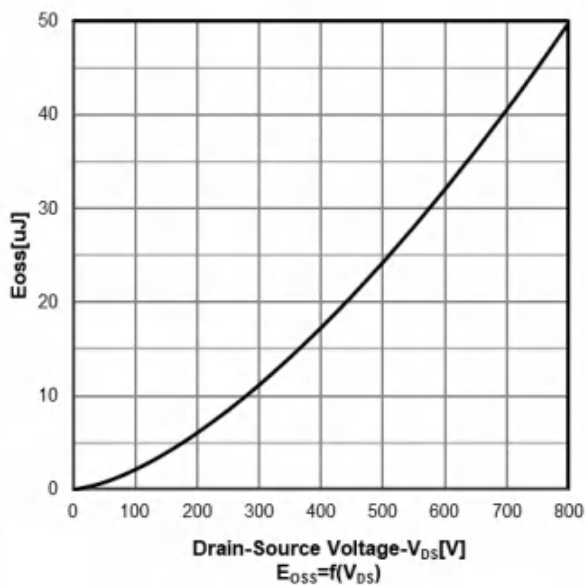
Normalized On-resistance vs temperature



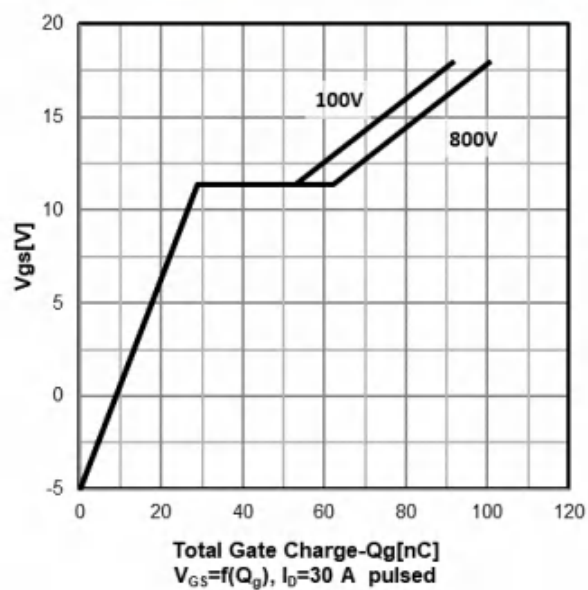
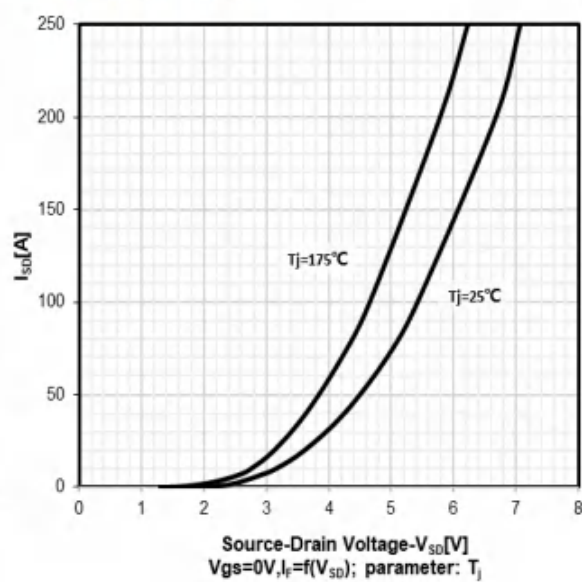
Typ. capacitances



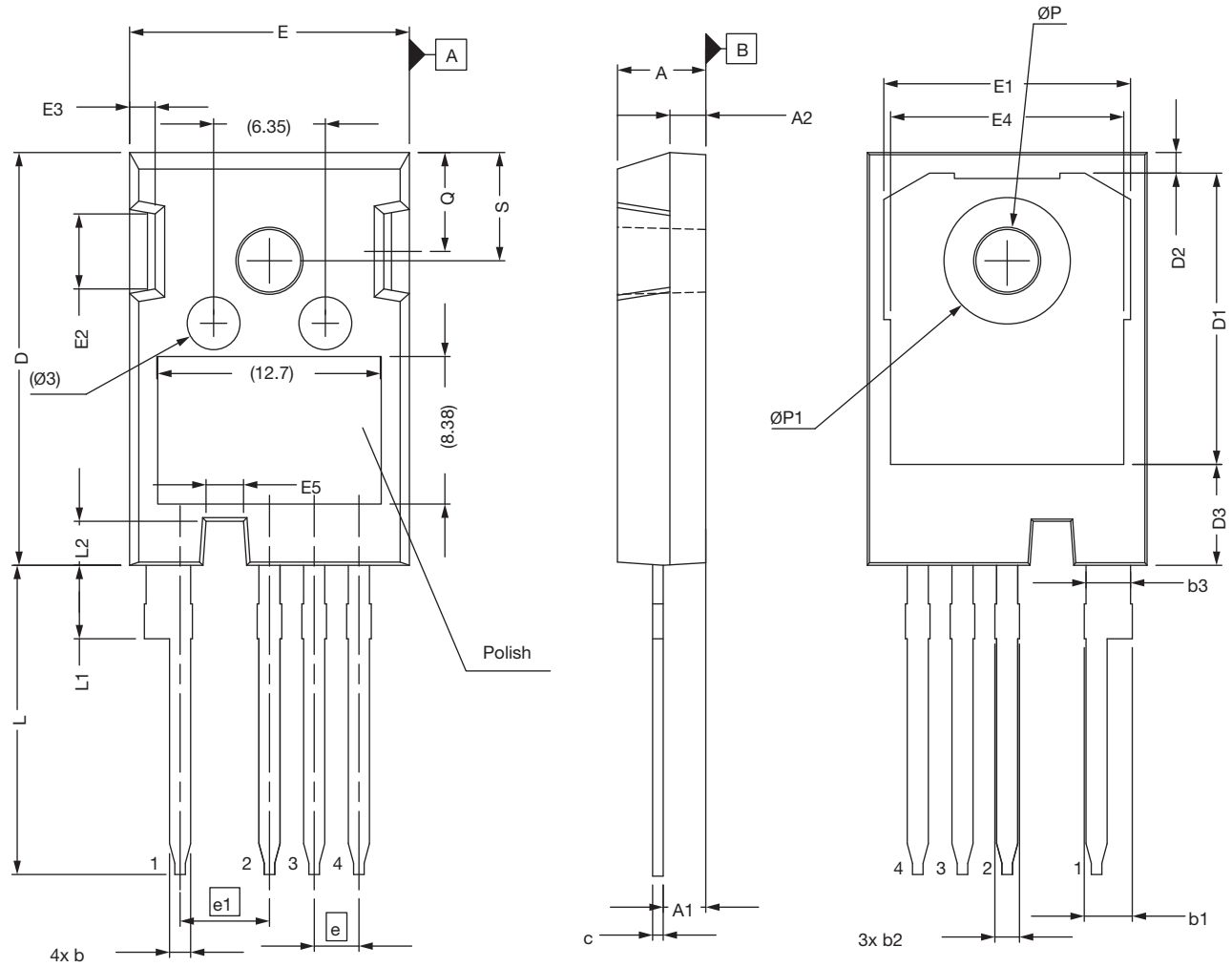
Coss stored energy



Typ. gate charge characteristics

Diode forward voltage characteristics  
 $T_j=25\text{ }^\circ\text{C}/175\text{ }^\circ\text{C}$ 

# TO-247-4L



| 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  |

**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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