

## P3M12040K3-VB Datasheet

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

| PRODUCT SUMMARY                    |                |       |
|------------------------------------|----------------|-------|
| $V_{DS}$ (V)                       | 1200           |       |
| $R_{DS(on)}$ at 25 °C ( $\Omega$ ) | $V_{GS} = 18V$ | 0.040 |
| $Q_g$ (nC)                         | 101            |       |

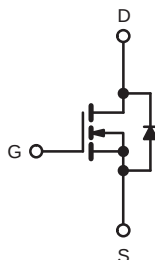
#### FEATURES

- 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)


**RoHS**

#### APPLICATIONS

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

**TO-247**

**N-Channel MOSFET**

| 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 18V  | T <sub>C</sub> = 25 °C  | I <sub>D</sub>                    | 60          | A    |
|                                                                           |                         | T <sub>C</sub> = 100 °C |                                   | 42          |      |
| Pulsed Drain Current <sup>a</sup>                                         |                         |                         | I <sub>DM</sub>                   | 160         |      |
| 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.
- $V_{DD} = 100\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 30\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 9\text{ A}$ .
- 1.6 mm from case.
- $I_{SD} \leq I_D$ ,  $dI/dt = 100\text{ A}/\mu\text{s}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ .

**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 |      |

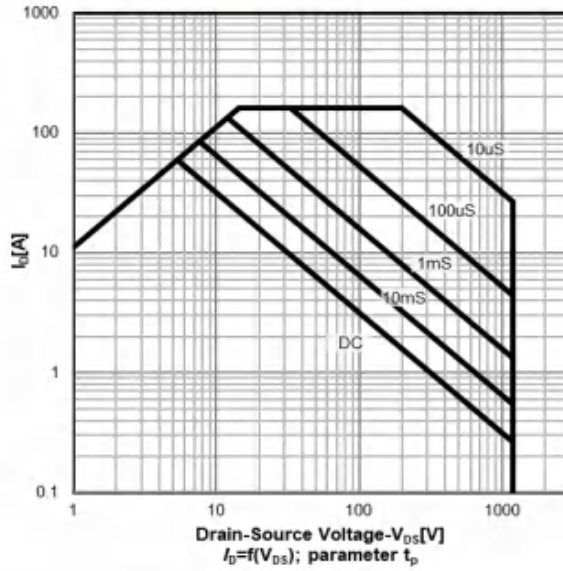
**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

| 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 $25\text{ }^{\circ}\text{C}$ , $I_D = 1\text{ mA}$                                                                                          | -    | 0.70  | -    | V/ $^{\circ}\text{C}$ |
| 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  | $\mu\text{A}$         |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$           | $V_{DS} = 1200\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                                         | -    | 10    | -    | $\mu\text{A}$         |
|                                                           |                     | $V_{DS} = 1200\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^{\circ}\text{C}$                                                                   | -    | -     | 100  |                       |
| Drain-Source On-State Resistance                          | $R_{DS(on)}$        | $V_{GS} = 18\text{ V}$ , $I_D = 30\text{ A}$                                                                                                             | -    | 0.040 | -    | $\Omega$              |
| 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>$f = 1\text{ MHz}$                                                                               | -    | 2200  | -    | 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   | -    | pF                    |
| Effective Output Capacitance, Time Related <sup>b</sup>   | $C_{o(tr)}$         |                                                                                                                                                          | -    | 268   | -    |                       |
| Total Gate Charge                                         | $Q_g$               | $V_{GS} = -5/18\text{ V}$ ,<br>$I_D = 20\text{ A}$ , $V_{DS} = 800\text{ V}$                                                                             | -    | 101   | -    | 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>$V_{GS} = -5/18\text{ V}$ , $R_g = 2\text{ }\Omega$                                                   | -    | 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   | -    | $\Omega$              |
| <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> | -    | -     | 60   | A                     |
| Pulsed Diode Forward Current                              | $I_{SM}$            |                                                                                                                                                          | -    | -     | 160  |                       |
| Diode Forward Voltage                                     | $V_{SD}$            | $T_J = 25\text{ }^{\circ}\text{C}$ , $I_S = 30\text{ A}$ , $V_{GS} = 0$                                                                                  | -    | -     | 4.1  | V                     |
| Reverse Recovery Time                                     | $t_{rr}$            | $T_J = 25\text{ }^{\circ}\text{C}$ , $I_F = I_S = 30\text{ A}$ ,<br>$di/dt = 1000\text{ A}/\mu\text{s}$ , $V_R = 800\text{ V}$                           | -    | 47    | -    | ns                    |
| Reverse Recovery Charge                                   | $Q_{rr}$            |                                                                                                                                                          | -    | 220   | -    | $\mu\text{C}$         |
| Reverse Recovery Current                                  | $I_{RRM}$           |                                                                                                                                                          | -    | 60    | -    | A                     |

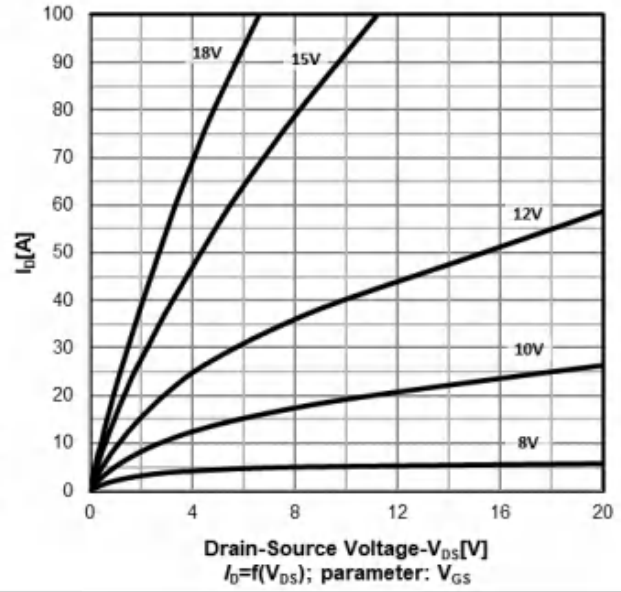
**Notes**

- 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 %  $V_{DSS}$ .

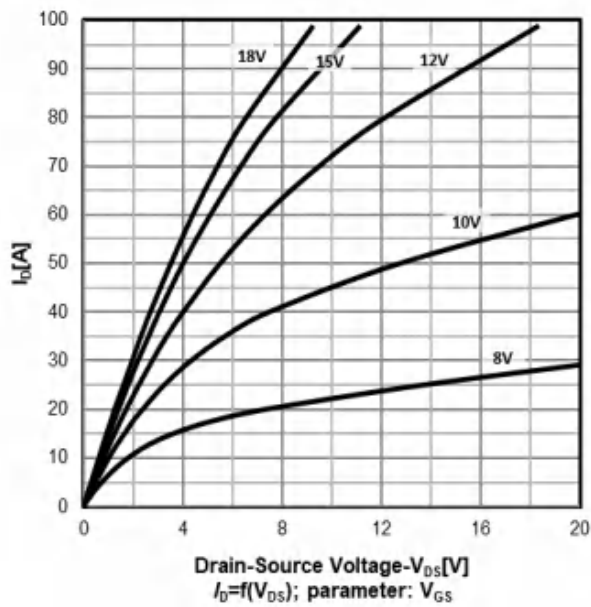
Safe operating area  $T_c=25^\circ\text{C}$   
TO-247



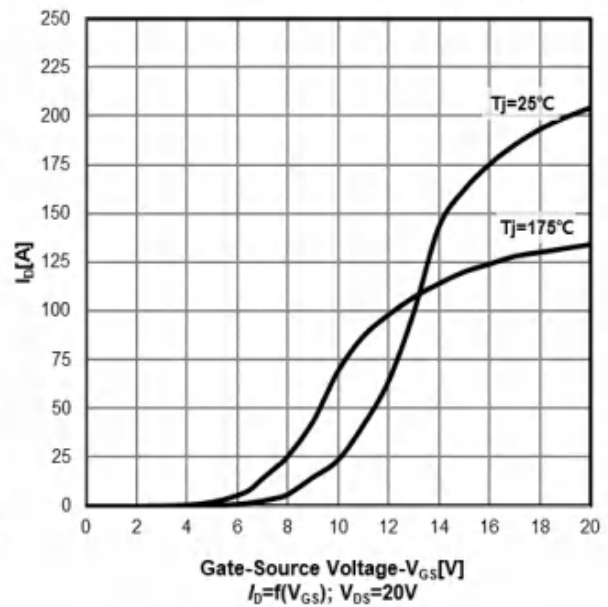
On-Region characteristics  $T_j=25^\circ\text{C}$



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



Transfer characteristics



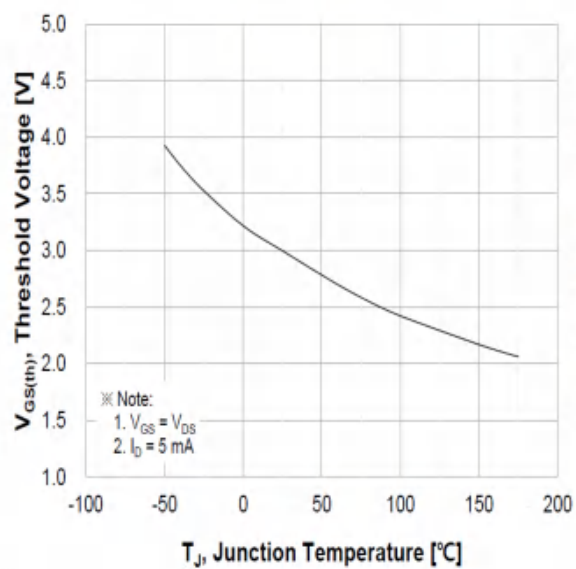
Drain current vs temperature



Power dissipation



Threshold voltage vs temperature



Normalized On-resistance vs temperature



Typ. capacitances



Coss stored energy



Typ. gate charge characteristics



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



# TO-247 PACKAGE OUTLINE DIMENSIONS



| SYMBOL | mm    |       |       |
|--------|-------|-------|-------|
|        | MIN   | NOM   | MAX   |
| *A     | 4.90  | 5.00  | 5.10  |
| *A1    | 2.31  | 2.41  | 2.51  |
| A2     | 1.90  | 2.00  | 2.10  |
| *b     | 1.15  | 1.20  | 1.25  |
| *b1    | 1.95  | 2.10  | 2.25  |
| *b2    | 2.95  | 3.10  | 3.25  |
| *c     | 0.55  | 0.60  | 0.65  |
| *D     | 20.90 | 21.00 | 21.10 |
| D1     | 16.35 | 16.55 | 16.75 |
| D2     | 1.05  | 1.20  | 1.35  |

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