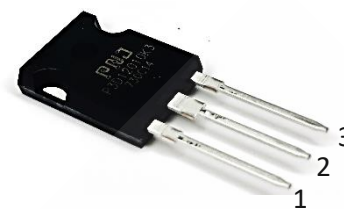


## SiC MOS P3M171K0K3

### N-Channel Enhancement Mode



#### Features

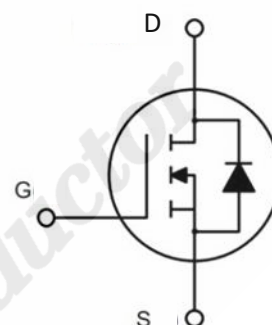
- High Blocking Voltage with Low On-Resistance
- High-Frequency Operation
- Ultra-Small  $Q_{gd}$
- 100% UIS tested

#### Benefits

- Improve System Efficiency
- Increase Power Density
- Reduce Heat Sink Requirements
- Reduction of System Cost

#### Applications

- Solar Inverters
- EV Battery Chargers
- High Voltage DC/DC Converters
- Switch Mode Power Supplies



TO-247-3

|        |   |
|--------|---|
| Gate   | 1 |
| Drain  | 2 |
| Source | 3 |



#### Order Information

| Part Number | Package  | Marking    |
|-------------|----------|------------|
| P3M171K0K3  | TO-247-3 | P3M171K0K3 |



## **Contents**

|  |          |
|--|----------|
| Features.....                          | 1        |
| Benefits.....                          | 1        |
| Applications.....                      | 1        |
| Order Information .....                | 1        |
| <b>Contents.....</b>                   | <b>2</b> |
| 1. Maximum Ratings.....                | 3        |
| 2. Electrical Characteristics .....    | 4        |
| 3. Reverse Diode Characteristics ..... | 6        |
| 4. Thermal Characteristics.....        | 6        |
| 5. Typical Performance .....           | 7        |
| 6. Definitions .....                   | 11       |
| 7. Package Outlines.....               | 12       |

PN Junction Semiconductor



## 1. Maximum Ratings

At  $T_J = 25^\circ\text{C}$ , unless specified otherwise

| Parameter                          | Symbol      | Value       | Unit             | Test Conditions                             |
|------------------------------------|-------------|-------------|------------------|---|
| Drain - Source Voltage             | $V_{DSmax}$ | 1700        | V                | $V_{GS} = 0V$<br>$I_D = 200\mu A$           |
| Gate - Source Voltage<br>(Dynamic) | $V_{GSmax}$ | -8 / +19    | V                | AC ( $f > 1\text{Hz}$ )                     |
| Gate - Source Voltage<br>(Static)  | $V_{GSop}$  | -3 / +15    | V                | Static                                      |
| Continuous Drain<br>Current        | $I_D$       | 6           | A                | $V_{GS} = 15V$<br>$T_C = 25^\circ\text{C}$  |
|                                    |             | 4           |                  | $V_{GS} = 15V$<br>$T_C = 100^\circ\text{C}$ |
| Power Dissipation                  | $P_D$       | 68          | W                |   |
| Operating Junction<br>Temperature  | $T_J$       | -55 To +175 | $^\circ\text{C}$ |   |
| Storage Temperature                | $T_{stg}$   | -55 To +175 | $^\circ\text{C}$ |   |
| Solder Temperature                 | $T_L$       | 260         | $^\circ\text{C}$ |   |
| Mounting Torque                    | $M_d$       | 1<br>8.8    | Nm<br>lbf-in     | M3 or 6-32 screw                            |



## 2. Electrical Characteristics

At  $T_J = 25^\circ\text{C}$ , unless specified otherwise

| Parameter                        | Symbol        | Value |      |      | Unit     | Test Conditions  |
|----------------------------------|---------------|-------|------|------|----------|--|
|                                  |               | Min.  | Typ. | Max. |          |  |
| Drain-Source Breakdown Voltage   | $V_{(BR)DSS}$ | 1700  | /    | /    | V        | $V_{GS} = 0V$<br>$I_D = 200\mu A$  |
| Gate Threshold Voltage           | $V_{GS(th)}$  | 1.8   | 2.2  | /    | V        | (tested after 30ms pulse at $V_{GS} = 15V$ )<br>$V_{DS} = V_{GS}$<br>$I_D = 2mA$<br>$T_J = 25^\circ\text{C}$ |
|                                  |               | /     | 1.45 | /    | V        | $V_{DS} = V_{GS}$<br>$I_D = 2mA$<br>$T_J = 175^\circ\text{C}$  |
| Zero Gate Voltage Drain Current  | $I_{DSS}$     | /     | 2.6  | 200  | $\mu A$  | $V_{GS} = 0V$<br>$V_{DS} = 1700V$  |
| Gate-Source Leakage Current      | $I_{GSS}$     | /     | 2    | 125  | nA       | $V_{GS} = 15V$<br>$V_{DS} = 0V$  |
| Drain-Source On-State Resistance | $R_{DS(on)}$  | /     | 1    | 1.4  | $\Omega$ | $V_{GS} = 15V$<br>$I_D = 2A$<br>$T_J = 25^\circ\text{C}$   |
|                                  |               | /     | 1.4  | /    |          | $V_{GS} = 15V$<br>$I_D = 2A$<br>$T_J = 125^\circ\text{C}$  |
|                                  |               | /     | 1.7  | /    |          | $V_{GS} = 15V$<br>$I_D = 2A$<br>$T_J = 175^\circ\text{C}$  |
| Transconductance                 | $g_{fs}$      | /     | 0.29 | /    | S        | $V_{DS} = 20V$<br>$I_{DS} = 2A$<br>$T_J = 25^\circ\text{C}$  |
|                                  |               | /     | 0.31 | /    |          | $V_{DS} = 20V$<br>$I_{DS} = 2A$<br>$T_J = 175^\circ\text{C}$   |



# P3M171K0K3 SiC MOS

## N-Channel Enhancement Mode

| Parameter                    | Symbol       | Value |      |      | Unit     | Test Conditions   |
|------------------------------|--------------|-------|------|------|----------|---|
|                              |              | Min.  | Typ. | Max. |          |   |
| Input Capacitance            | $C_{iss}$    | /     | 235  | /    | pF       | $V_{GS} = 0V$<br>$V_{DS} = 1000V$<br>$f = 1MHz$<br>$V_{AC} = 25mV$                |
| Output Capacitance           | $C_{oss}$    | /     | 8.9  | /    |          |   |
| Reverse Transfer Capacitance | $C_{rss}$    | /     | 2.8  | /    |          |   |
| Coss Stored Energy           | $E_{oss}$    | /     | 9.4  | /    | $\mu$    |   |
| Turn-on Energy               | $E_{on}$     | /     | 95.7 | /    | $\mu$    |   |
| Turn-off Energy              | $E_{off}$    | /     | 16.9 | /    |          |   |
| Turn-On Delay Time           | $T_{d(on)}$  | /     | 15.5 | /    | nS       | $V_{DS} = 1200V$<br>$V_{GS} = -3/15V$<br>$I_{DS} = 3A$<br>$R_G = 1\Omega$         |
| Rise Time                    | $T_r$        | /     | 16.2 | /    |          |   |
| Turn-Off Delay Time          | $T_{d(off)}$ | /     | 15.7 | /    |          |   |
| Fall Time                    | $T_f$        | /     | 31.2 | /    |          |   |
| Internal Gate Resistance     | $R_{G(int)}$ | /     | 27   | /    | $\Omega$ | $f = 1MHz$<br>$V_{AC} = 25mV$   |
| Gate to Source Charge        | $Q_{gs}$     | /     | 2.2  | /    | nC       | $V_{DS} = 1200V$<br>$I_{DS} = 2A$<br>$V_{GS} = -3 \text{ to } 15V$<br>$I_G = 2mA$ |
| Gate to Drain Charge         | $Q_{gd}$     | /     | 2.5  | /    |          |   |
| Total Gate Charge            | $Q_g$        | /     | 7.4  | /    |          |   |

### 3. Reverse Diode Characteristics

At  $T_J=25\text{ }^\circ\text{C}$ , unless specified otherwise

| Parameter                        | Symbol    | Value |      | Unit | Test Conditions  |
|----------------------------------|-----------|-------|------|------|--|
|                                  |           | Typ.  | Max. |      |  |
| Diode Forward Voltage            | $V_{SD}$  | 5.1   | /    | V    | $V_{GS} = -3V$<br>$I_{SD} = 1A$<br>$T_J = 25^\circ\text{C}$  |
|                                  |           | 5.1   | /    | V    | $V_{GS} = -3V$<br>$I_{SD} = 1A$<br>$T_J = 175^\circ\text{C}$   |
| Continuous Diode Forward Current | $I_S$     | 5     | /    | A    | $V_{GS} = -3V$   |
| Reverse Recover Time             | $t_{rr}$  | 35.4  | /    | ns   | $V_{GS} = -3/15V$<br>$I_{SD} = 3A$<br>$V_R = 1200V$<br>$d_{if}/d_t = 650A/\mu s$<br>$T_J = 25^\circ\text{C}$ |
| Reverse Recovery Charge          | $Q_{rr}$  | 69.1  | /    | nC   |  |
| Peak Reverse Recovery Current    | $I_{rrm}$ | 4.2   | /    | A    |  |

### 4. Thermal Characteristics

| Parameter                                | Symbol          | Value | Unit               |
|--|-----------------|-------|--------------------|
| Thermal Resistance from Junction to Case | $R_{\theta JC}$ | 2.2   | $^\circ\text{C}/W$ |

## 5. Typical Performance

At  $T_J = 25^\circ\text{C}$ , unless specified otherwise

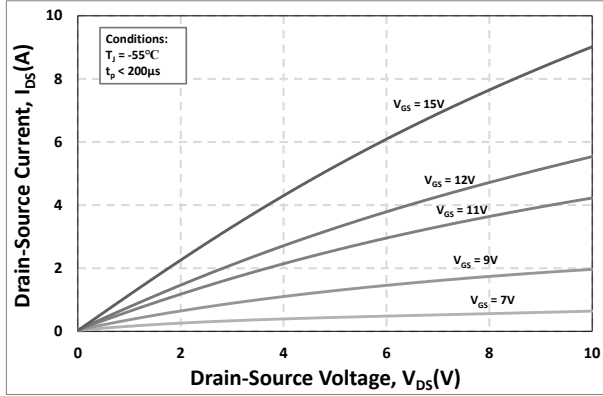


Figure 1. Output Characteristics  $T_J = -55^\circ\text{C}$

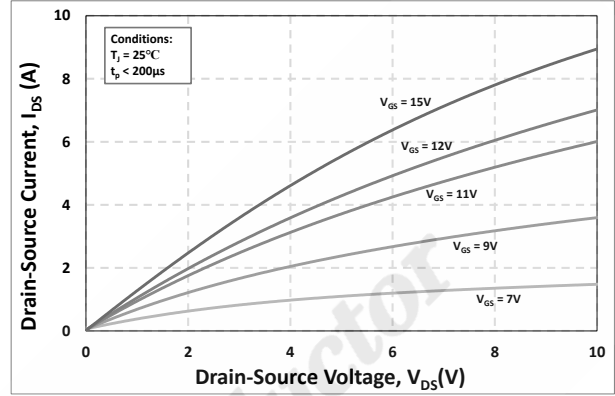


Figure 2. Output Characteristics  $T_J = 25^\circ\text{C}$

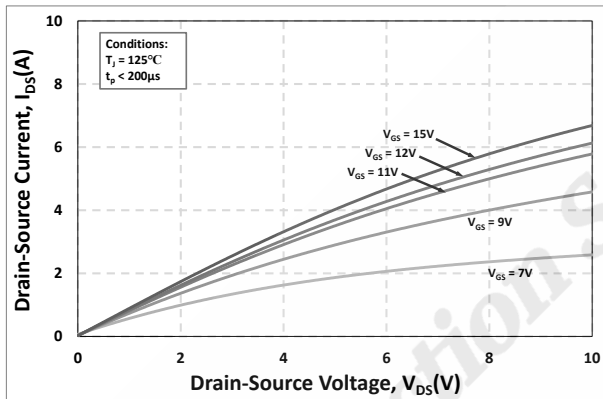


Figure 3. Output Characteristics  $T_J = 125^\circ\text{C}$

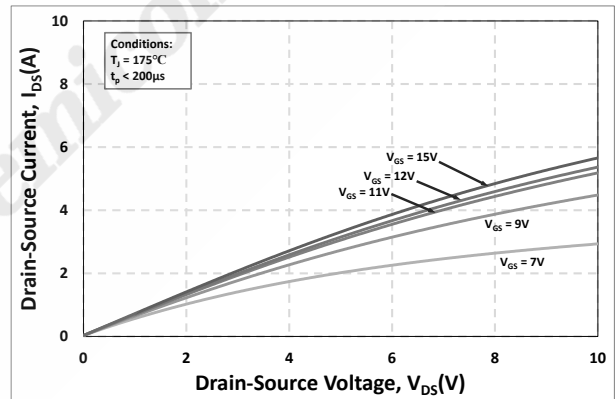


Figure 4. Output Characteristics  $T_J = 175^\circ\text{C}$

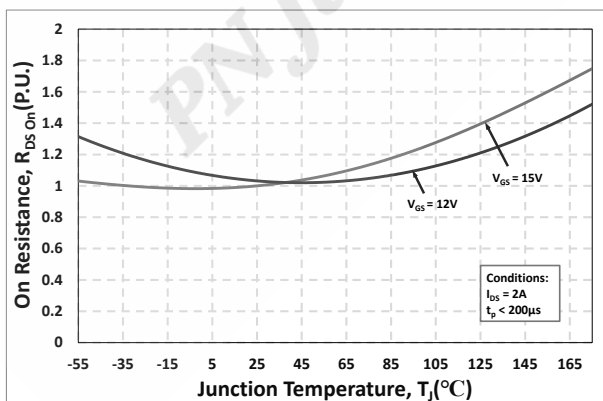


Figure 5. Normalized On-Resistance vs. Temperature

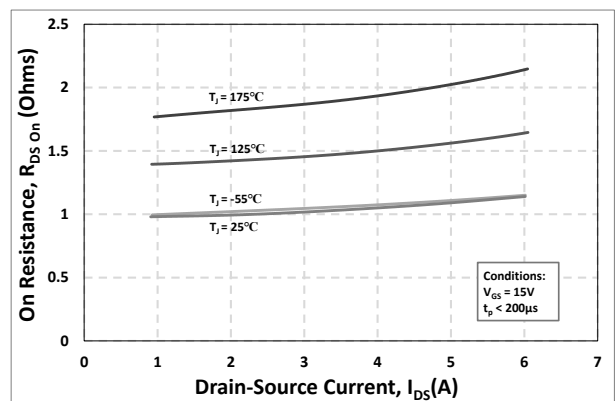


Figure 6. On-Resistance vs. Drain Current Various Temperatures



# P3M171K0K3 SiC MOS N-Channel Enhancement Mode

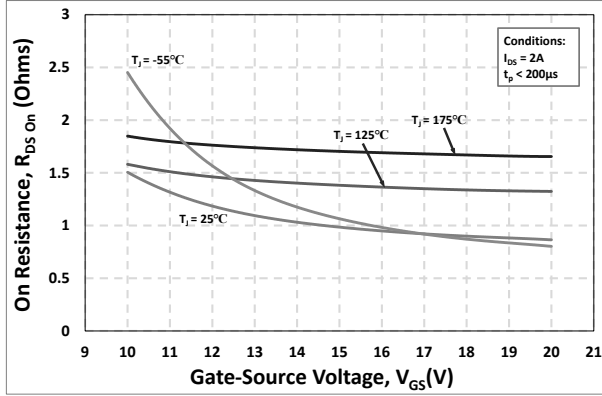


Figure 7. On-Resistance vs. Gate-Source Voltage

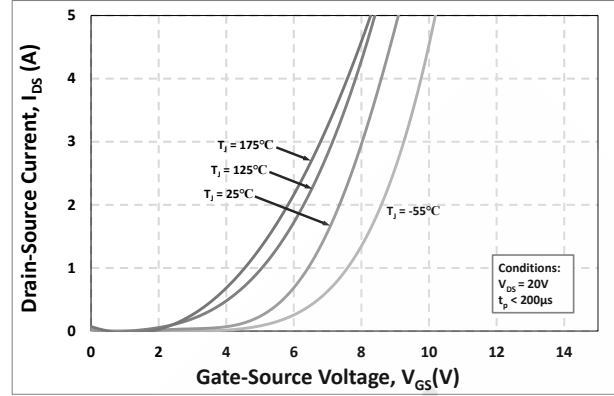


Figure 8. Transfer Characteristic for Various Junction Temperatures

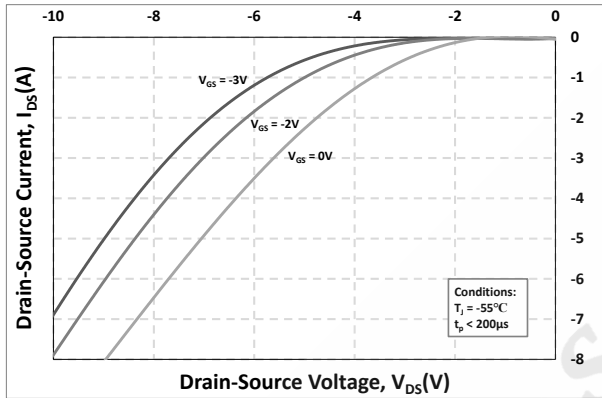


Figure 9. Body Diode Characteristic at -55°C

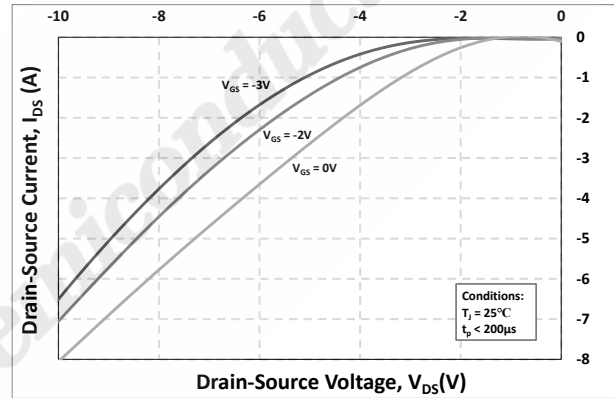


Figure 10. Body Diode Characteristic at 25°C

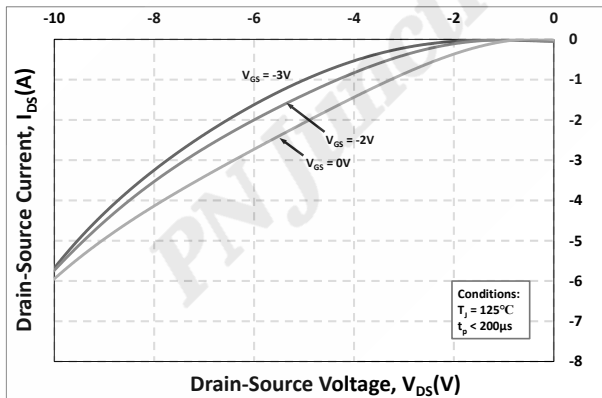


Figure 11. Body Diode Characteristic at 125°C

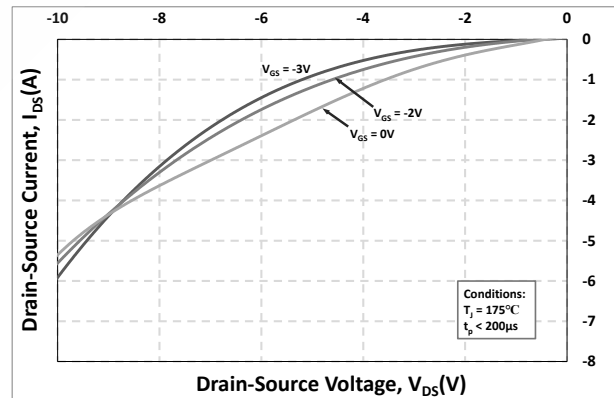


Figure 12. Body Diode Characteristic at 175°C



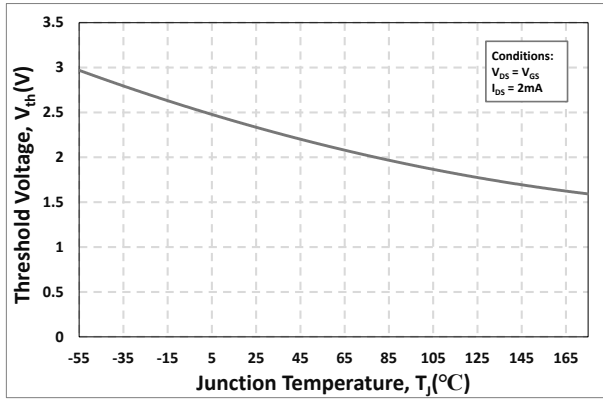


Figure 13. Threshold Voltage vs. Temperatures

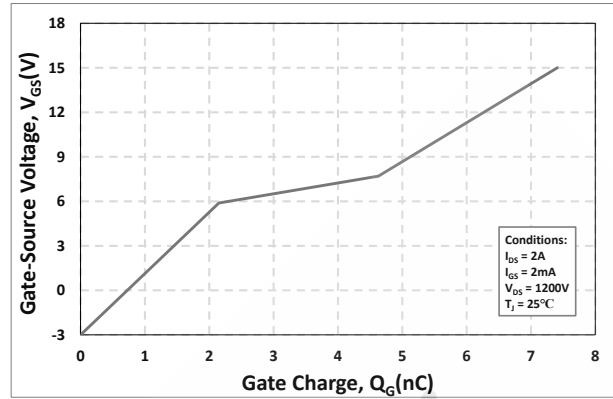


Figure 14. Gate Charge Characteristics

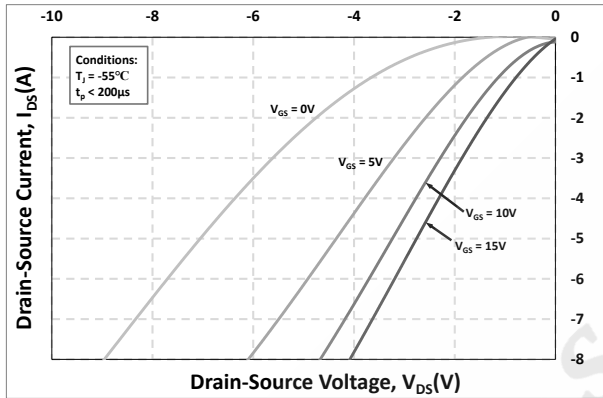


Figure 15. 3rd Quadrant Characteristic at -55°C

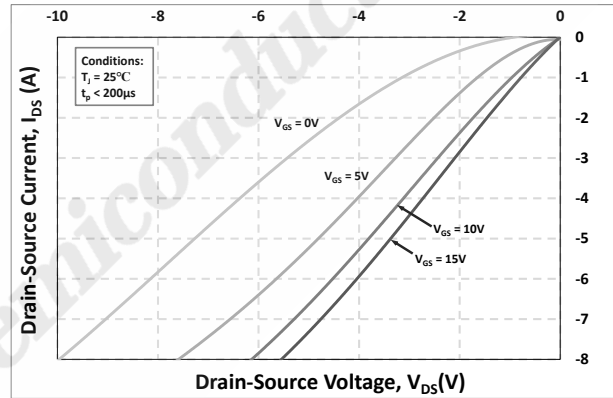


Figure 16. 3rd Quadrant Characteristic at 25°C

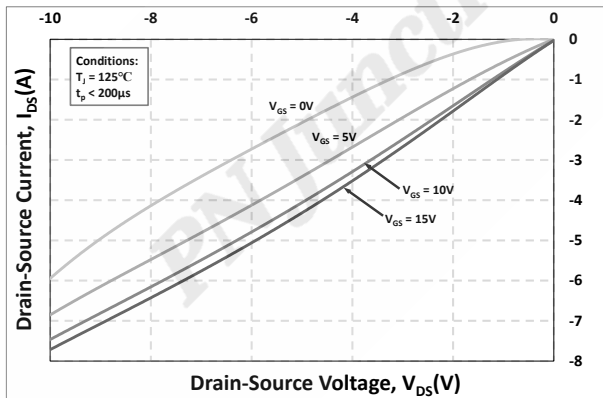


Figure 17. 3rd Quadrant Characteristic at 125°C

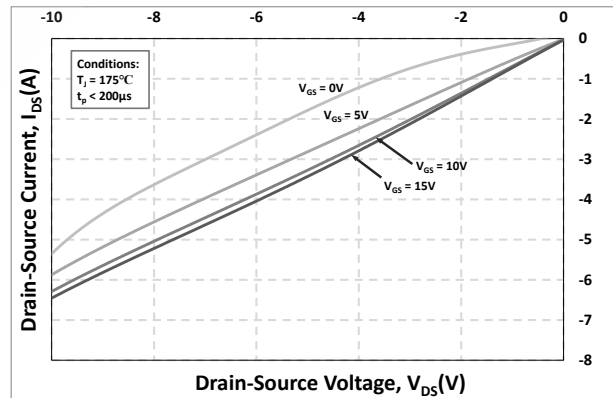


Figure 18. 3rd Quadrant Characteristic at 175°C

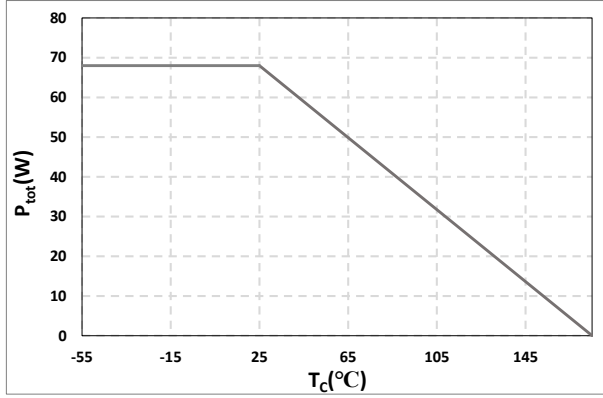


Figure 19. Maximum Power Dissipation Derating vs. Case Temperature

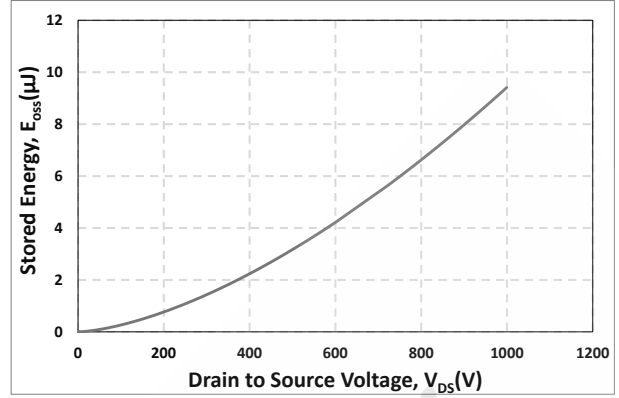


Figure 20. Output Capacitor Stored Energy

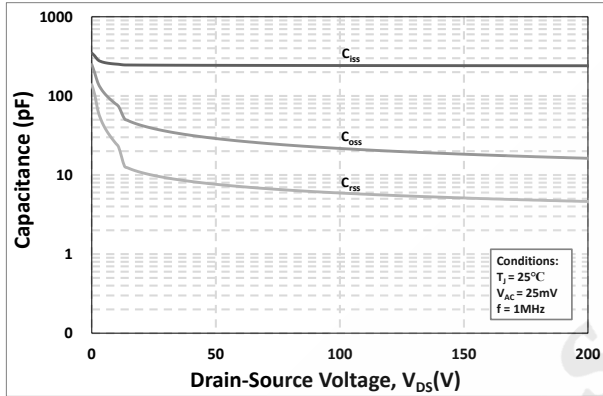


Figure 21. Capacitances vs. Drain-Source Voltage (0-200V)

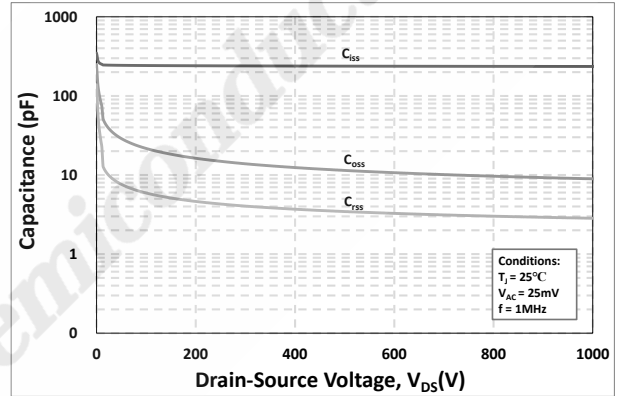


Figure 22. Capacitances vs. Drain-Source Voltage (0-1000V)

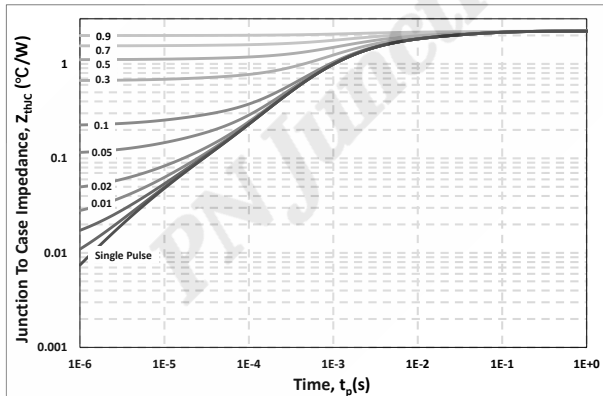


Figure 23. Transient Thermal Impedance (Junction - Case)

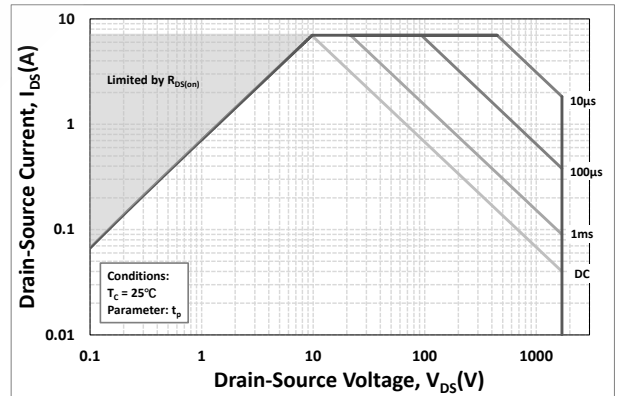


Figure 24. Safe Operating Area

## 6. Definitions

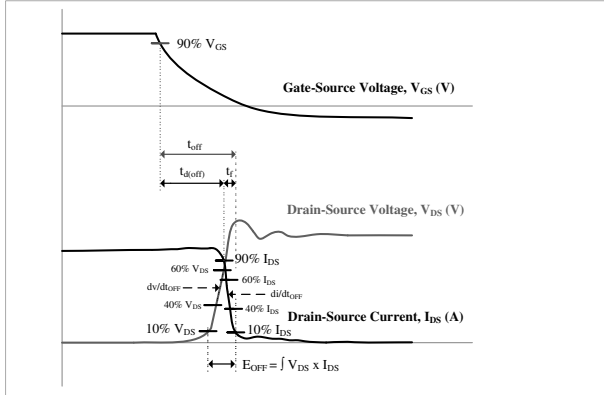


Figure 25. Turn-off Transient Definitions

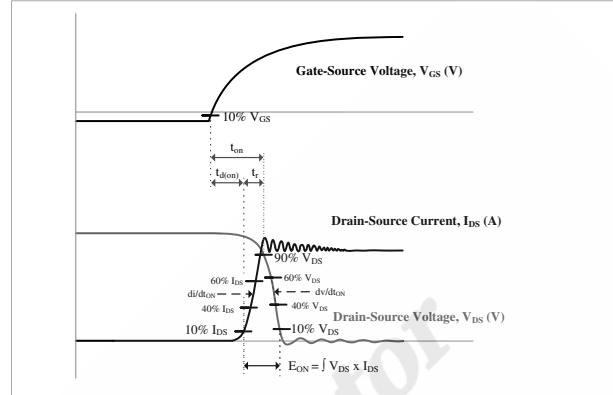


Figure 26. Turn-on Transient Definitions

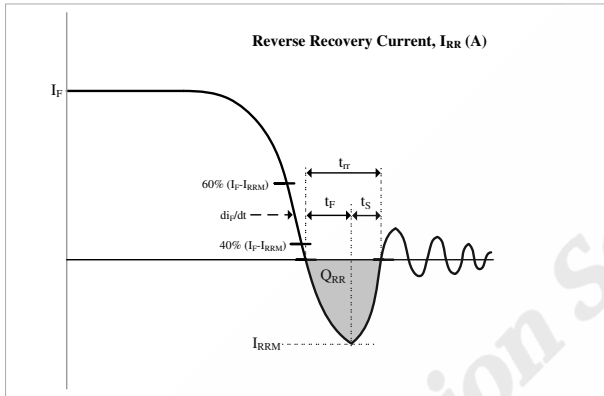


Figure 27. Reverse Recovery Definitions

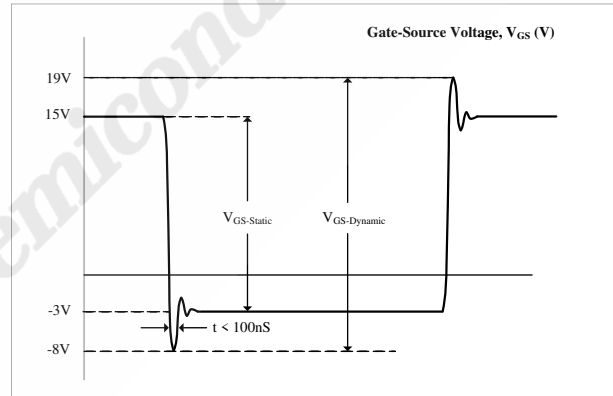
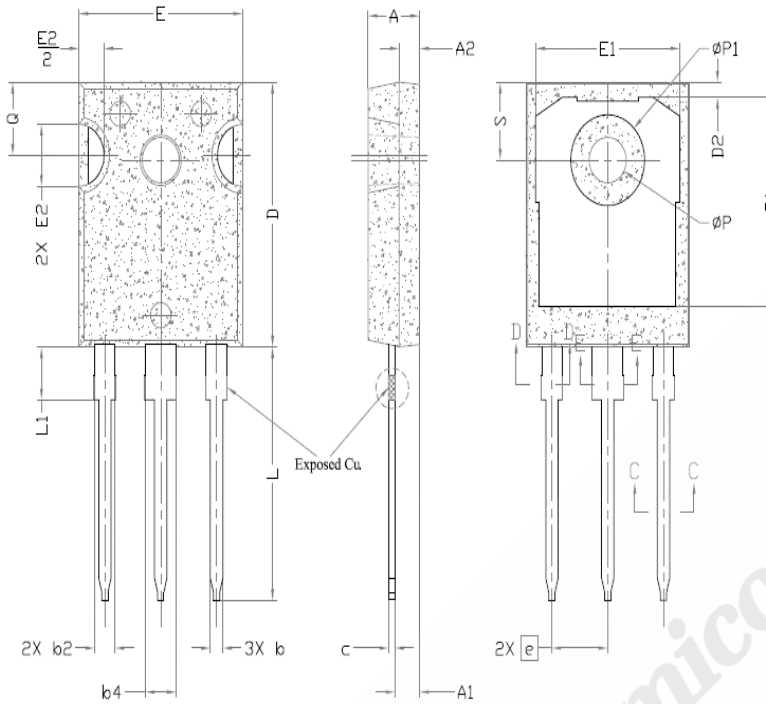


Figure 28. V<sub>GS</sub> Transient Definitions

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## 7. Package Outlines



| SYMBOL    | DIMENSIONS |       |       | NOTES |
|-----------|------------|-------|-------|-------|
|           | 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  |       |
| b1        | 1.12       | 1.20  | 1.28  |       |
| b2        | 1.91       | 2.00  | 2.39  | 6     |
| b3        | 1.91       | 2.00  | 2.34  |       |
| b4        | 2.87       | 3.00  | 3.22  | 6, 8  |
| b5        | 2.87       | 3.00  | 3.18  |       |
| c         | 0.55       | 0.60  | 0.69  | 6     |
| c1        | 0.55       | 0.60  | 0.65  |       |
| D         | 20.80      | 20.95 | 21.10 | 4     |
| D1        | 16.25      | 16.55 | 17.65 | 5     |
| D2        | 0.51       | 1.19  | 1.35  |       |
| E         | 15.75      | 15.94 | 16.13 | 4     |
| E1        | 13.46      | 14.02 | 14.16 | 5     |
| E2        | 4.32       | 4.91  | 5.49  | 3     |
| e         | 5.44BSC    |       |       |       |
| L         | 19.81      | 20.07 | 20.32 |       |
| L1        | 4.10       | 4.19  | 4.40  | 6     |
| $\phi P$  | 3.56       | 3.61  | 3.65  | 7     |
| $\phi P1$ | 7.19REF.   |       |       |       |
| Q         | 5.39       | 5.79  | 6.20  |       |
| S         | 6.04       | 6.17  | 6.30  |       |

Drawing and Dimensions

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## Important Notice

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