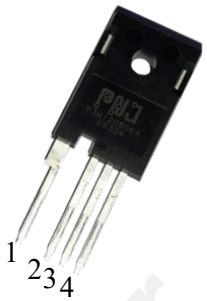
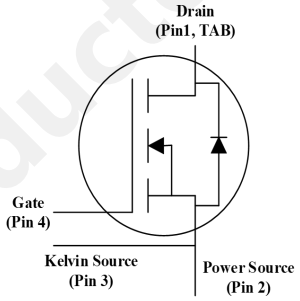
# SiC MOS P3M06035K4
# N-Channel Enhancement Mode




## Features

- Qualified to AEC-Q101
- 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

TO-247-4

| | |
|---|---|
| Drain | 1 |
| Power Source | 2 |
| Kelvin Source | 3 |
| Gate | 4 |

## Applications

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

RoHS

Halogen

## Order Information

| Part Number | Package | Marking |
|---|---|---|
| P3M06035K4 | TO-247-4 | P3M06035K4 |

## Contents

# 1. Maximum Ratings

At $T_J$= 25℃, unless specified otherwise

| Parameter | Symbol | Value | Unit | Test Conditions |
|---|---|---|---|---|
| Drain - Source Voltage | $V_{DSmax}$ | 650 | V | $V_{GS}$= 0V<br>$I_D$= 100μA |
| Gate - Source Voltage (dynamic) | $V_{GSmax}$ | -8 / +21 | V | AC (f>1 Hz) |
| Gate - Source Voltage(static)<br>turn-on gate voltage<br>turn-off gate voltage | $V_{GS,on}$<br>$V_{GS,off}$ | +15 / +18<br>-3 | V | Static |
| Continuous Drain Current | $I_D$ | 67 | A | $V_{GS}$= 18V<br>$T_C$= 25℃ |
| | | 47 | | $V_{GS}$= 18V<br>$T_C$= 100℃ |
| Pulsed Drain Current | $I_{D(pulse)}$ | 175 | A | PW≤ 10us，<br>Duty cycle ≤ 1% |
| Power Dissipation | $P_D$ | 254 | W | |
| Operating Junction | $T_J$ | -55 To +175 | ℃ | |
| Storage Temperature | $T_{stg}$ | -55 To +175 | ℃ | |
| Solder Temperature | $T_L$ | 260 | ℃ | |
| Mounting Torque | $M_d$ | 1<br>8.8 | Nm<br>lbf-in | M3 or 6-32 screw |

## 2. Electrical Characteristics

At $T_J$= 25℃, unless specified otherwise

| Parameter | Symbol | Value | | | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Drain-Source Breakdown Voltage | $V_{(BR)DSS}$ | 650 | / | / | V | $V_{GS}$= 0V<br>$I_D$= 1.2mA |
| Gate Threshold Voltage | $V_{GS(th)}$ | 1.8 | 2.3 | / | V | (tested after 30ms pulse at $V_{GS}$=18V)<br>$V_{DS}$= $V_{GS}$<br>$I_D$= 20mA<br>$T_J$ = 25℃ |
| | | / | 1.6 | / | V | $V_{DS}$= $V_{GS}$<br>$I_D$= 20mA<br>$T_J$ = 175℃ |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | / | 1 | 250 | μA | $V_{GS}$= 0V<br>$V_{DS}$= 650V |
| Gate-Source Leakage Current | $I_{GSS}$ | / | 0.5 | 250 | nA | $V_{GS}$= 18V<br>$V_{DS}$= 0V |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | / | 35 | 50 | mΩ | $V_{GS}$= 18V<br>$I_D$= 40A<br>$T_J$= 25℃ |
| | | / | 38 | / | | $V_{GS}$= 18V<br>$I_D$= 40A<br>$T_J$= 175℃ |
| | | / | 40 | / | | $V_{GS}$= 15V<br>$I_D$= 40A<br>$T_J$= 25℃ |
| | | / | 42 | / | | $V_{GS}$= 15V<br>$I_D$= 40A<br>$T_J$= 175℃ |
| Trans conductance | $g_{fs}$ | / | 17 | / | S | $V_{DS}$= 20V<br>$I_{DS}$= 40A<br>$T_J$= 25℃ |

| Parameter | Symbol | Value | | | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| | | / | 16 | / | | $V_{DS}$= 20V<br>$I_{DS}$= 40A<br>$T_J$= 175℃ |
| Input Capacitance | $C_{iss}$ | / | 3550 | / | pF | $V_{GS}$= 0V<br>$V_{DS}$= 400V<br>f= 1MHz<br>$V_{AC}$= 25mV |
| Output Capacitance | $C_{oss}$ | / | 250 | / | | |
| Reverse Transfer Capacitance | $C_{rss}$ | / | 5 | / | | |
| Coss Stored Energy | $E_{oss}$ | / | 23.7 | / | μJ | |
| Turn-on Energy | $E_{on}$ | / | 172 | / | μJ | $V_{DS}$= 400V<br>$V_{GS}$= -3/15V<br>$I_D$= 40A<br>$R_G$= 1Ω |
| Turn-off Energy | $E_{off}$ | / | 30 | / | | |
| Turn-on Energy | $E_{on}$ | / | 100 | / | μJ | $V_{DS}$= 400V<br>$V_{GS}$= -3/18V<br>$I_D$= 40A<br>$R_G$= 1Ω |
| Turn-off Energy | $E_{off}$ | / | 29 | / | | |
| Turn-On Delay Time | $t_{d(on)}$ | / | 16.4 | / | ns | $V_{DS}$= 400V<br>$V_{GS}$= -3/18V<br>$I_D$= 40A<br>$R_G$= 1Ω |
| Rise Time | $t_r$ | / | 19.5 | / | | |
| Turn-Off Delay Time | $t_{d(off)}$ | / | 29.6 | / | | |
| Fall Time | $t_f$ | / | 5.6 | / | | |
| Internal Gate Resistance | $R_{G(int)}$ | / | 1.3 | / | Ω | f= 1MHz<br>$V_{AC}$= 25mV |
| Gate to Source Charge | $Q_{gs}$ | / | 46 | / | nC | $V_{DS}$= 400V<br>$I_{DS}$= 40A<br>$V_{GS}$= -3 to 18V<br>$I_G$= 20mA |
| Gate to Drain Charge | $Q_{gd}$ | / | 35.8 | / | | |
| Total Gate Charge | $Q_g$ | / | 119 | / | | |

## 3. Reverse Diode Characteristics

At $T_J$= 25℃, unless specified otherwise

| Parameter | Symbol | Value | | Unit | Test Conditions |
|---|---|---|---|---|---|
| | | Typ. | Max. | | |
| Diode Forward Voltage | $V_{SD}$ | 5.3 | / | V | $V_{GS}$= -3V<br>$I_{SD}$= 20A<br>$T_J$= 25℃ |
| | | 4.6 | / | V | $V_{GS}$= -3V<br>$I_{SD}$= 20A<br>$T_J$= 175℃ |
| Continuous Diode Forward Current | $I_S$ | 40.6 | / | A | $V_{GS}$= -3V |
| Reverse Recover Time | $t_{rr}$ | 17 | / | ns | $V_{GS}$= -3V/18V<br>$I_{SD}$= 40A<br>$V_R$= 400V<br>$di_f/dt$= 3600A/μs<br>$T_J$= 25℃ |
| Reverse Recovery Charge | $Q_{rr}$ | 376 | / | nC | |
| Peak Reverse Recovery Current | $I_{rrm}$ | 38 | / | A | |
| Reverse Recover Time | $t_{rr}$ | 16 | / | ns | $V_{GS}$= -3V/18V<br>$I_{SD}$= 40A<br>$V_R$= 400V<br>$di_f/dt$= 4200A/μs<br>$T_J$= 25℃ |
| Reverse Recovery Charge | $Q_{rr}$ | 433 | / | nC | |
| Peak Reverse Recovery Current | $I_{rrm}$ | 45 | / | A | |

## 4. Thermal Characteristics

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Thermal Resistance from Junction to Case | $R_{\theta JC}$ | 0.56 | ℃/W |

## 5. Typical Performance

At $T_J$= 25℃, unless specified otherwise

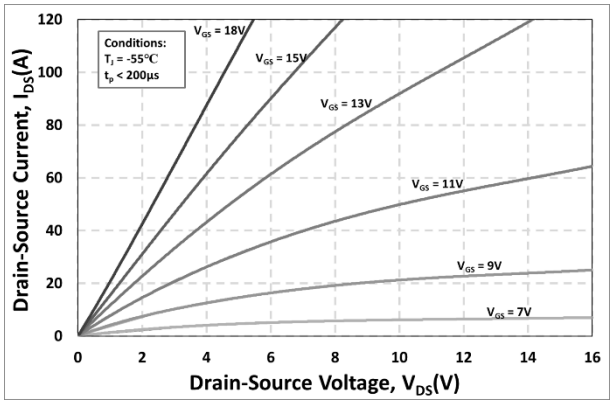



Figure 1. Output Characteristics $T_J$ = -55℃

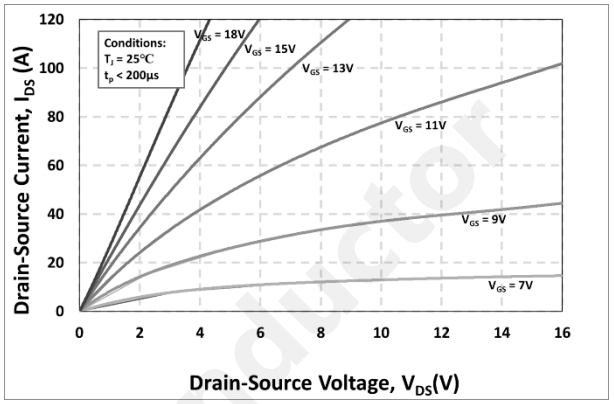



Figure 2. Output Characteristics $T_J$ = 25℃

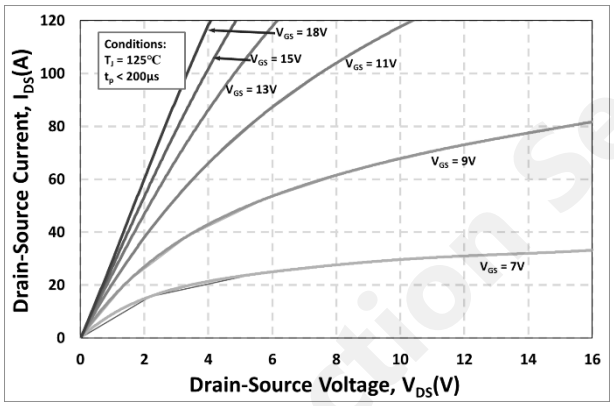



Figure 3. Output Characteristics $T_J$ = 125℃

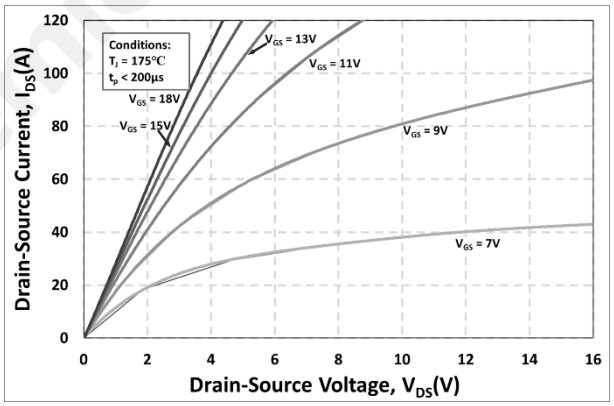



Figure 4. Output Characteristics $T_J$ = 175ºC

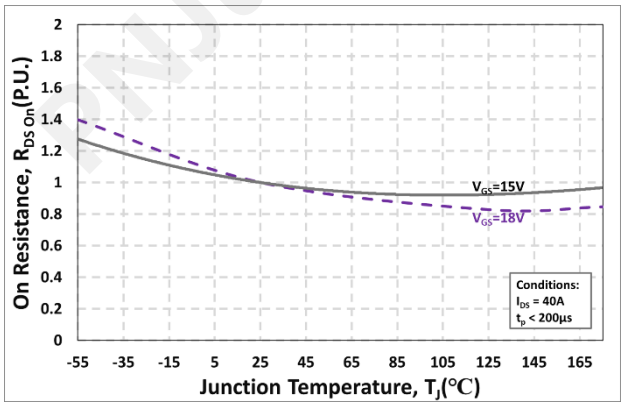



Figure 5. Normalized On-Resistance vs. Temperature

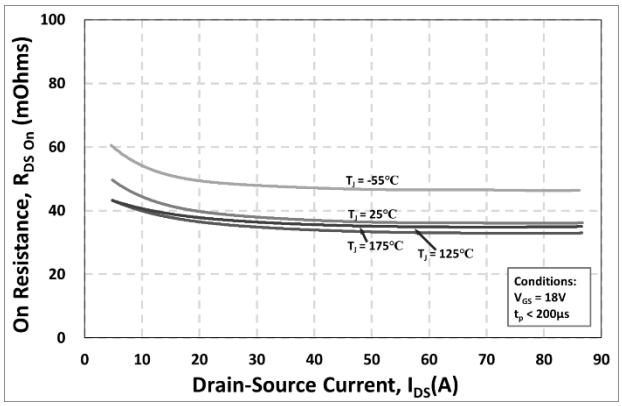



Figure 6. On-Resistance vs. Drain Current Various Temperatures

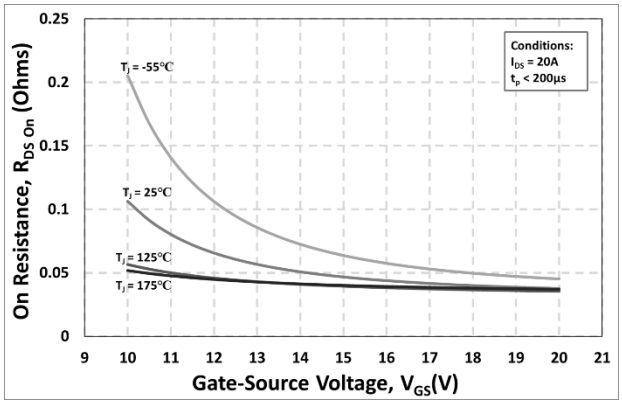



Figure 7. On-Resistance vs. Gate-Source Voltage

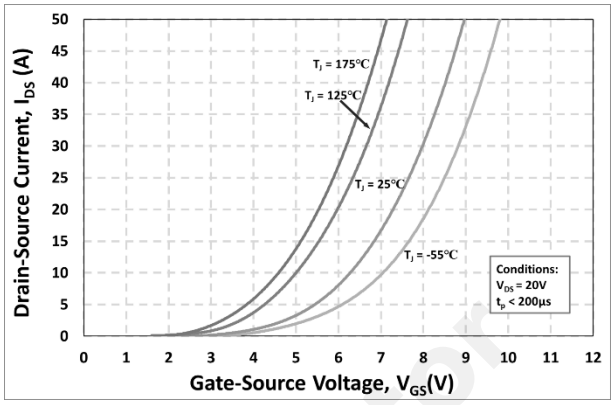



Figure 8. Transfer Characteristic for Various Junction Temperatures

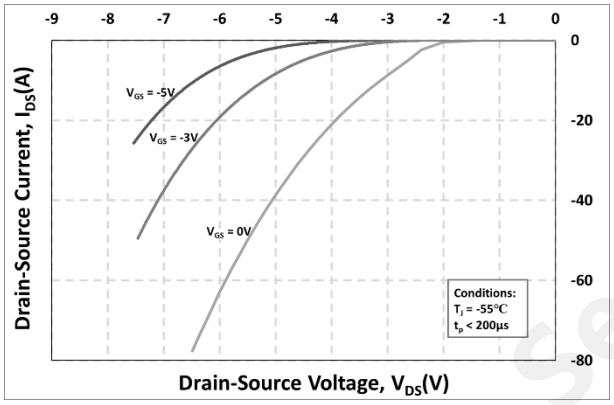



Figure 9. Body Diode Characteristic at -55°C

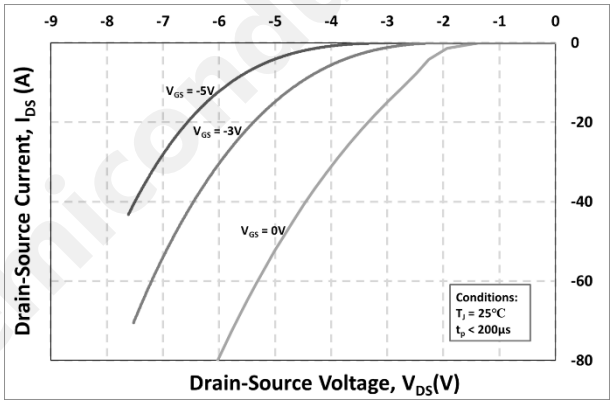



Figure 10. Body Diode Characteristic at 25°C

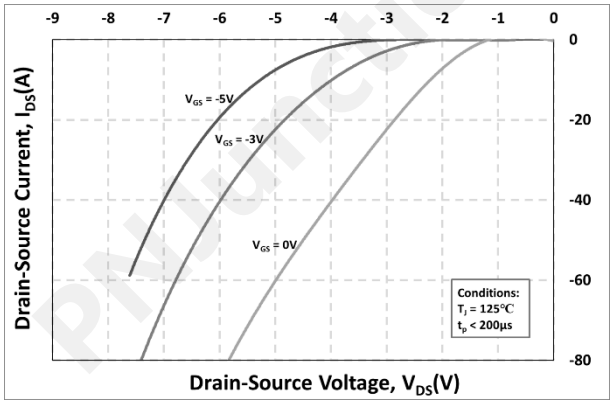



Figure 11. Body Diode Characteristic at 125°C

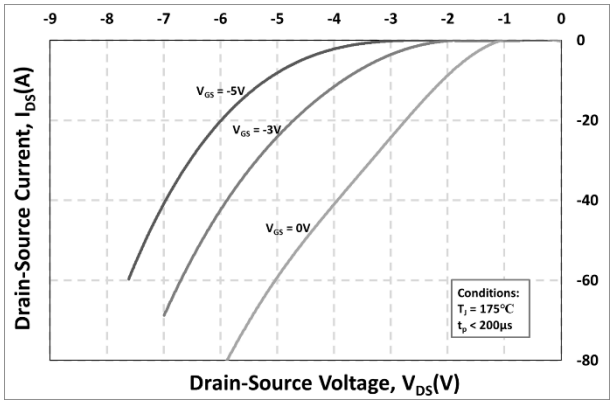



Figure 12. Body Diode Characteristic at 175°C

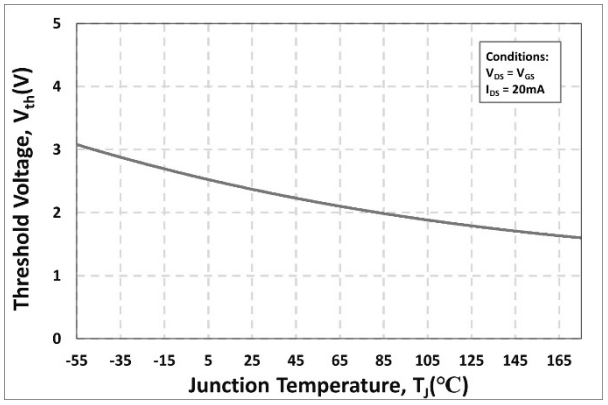



Figure 13. Threshold Voltage vs. Temperature

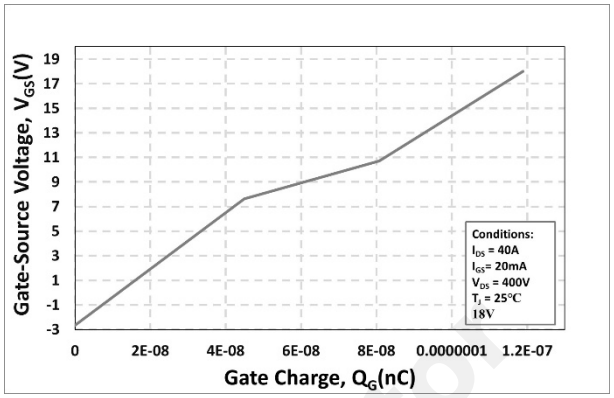



Figure 14. Gate Charge Characteristics

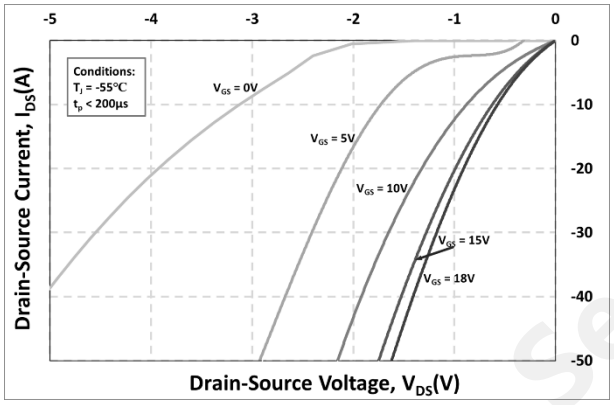



Figure 15. 3rd Quadrant Characteristic at -55°C

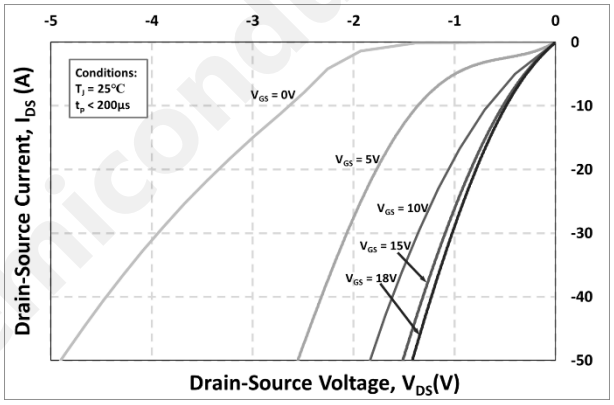



Figure 16. 3rd Quadrant Characteristic at 25°C

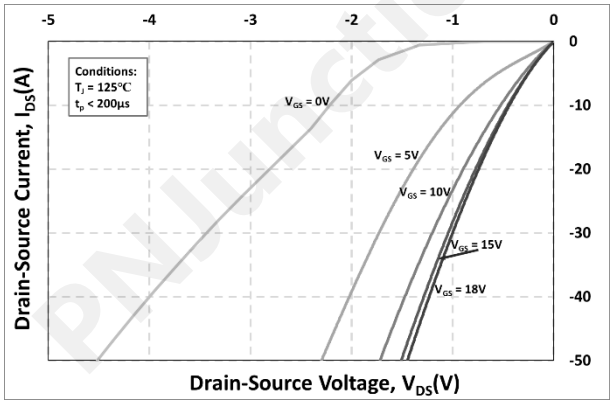



Figure 17. 3rd Quadrant Characteristic at 125°C

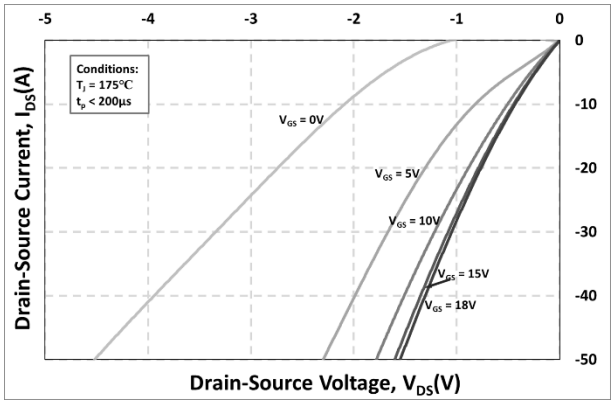



Figure 18. 3rd Quadrant Characteristic at 175°C

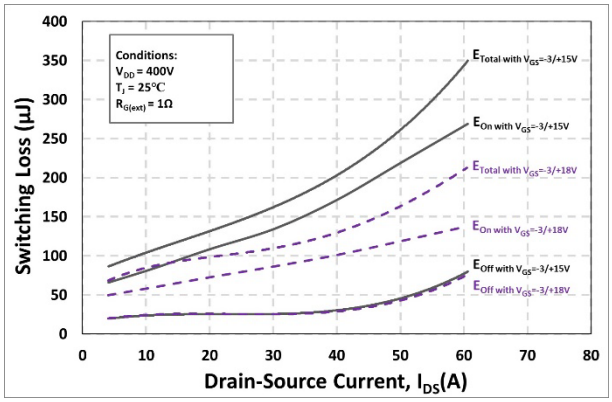



Figure 19. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD}$= 400V)

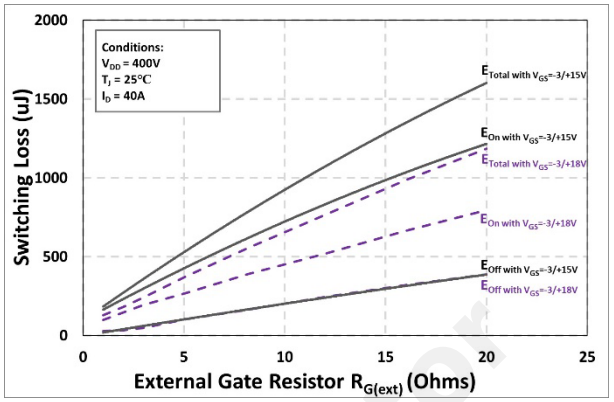



Figure 20. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

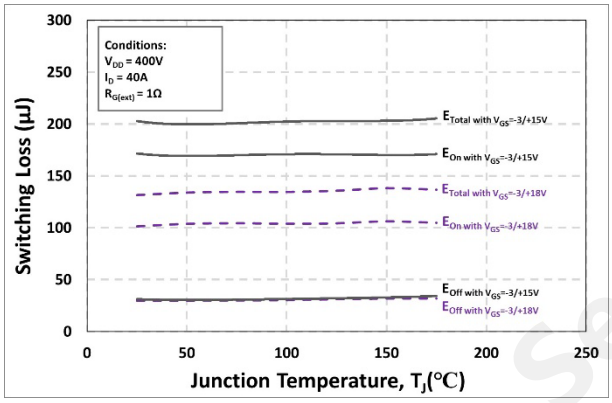



Figure 21. Clamped Inductive Switching Energy vs. Temperature

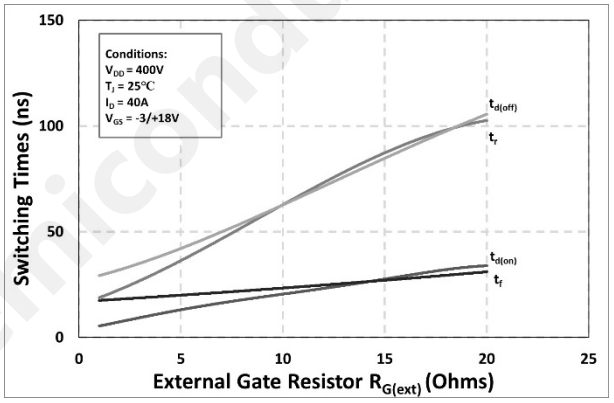



Figure 22. Switching Times vs. $R_{G(ext)}$

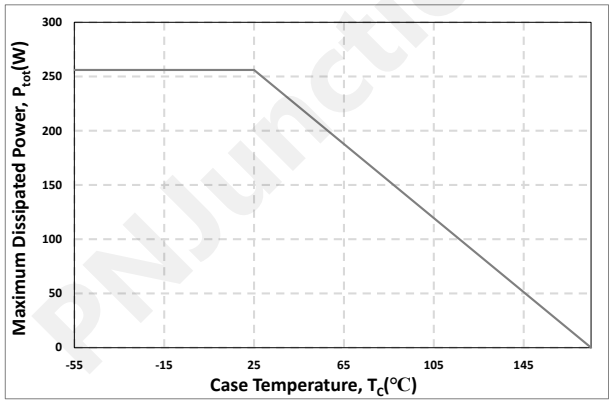



Figure 23. Maximum Power Dissipation Derating vs. Case Temperature

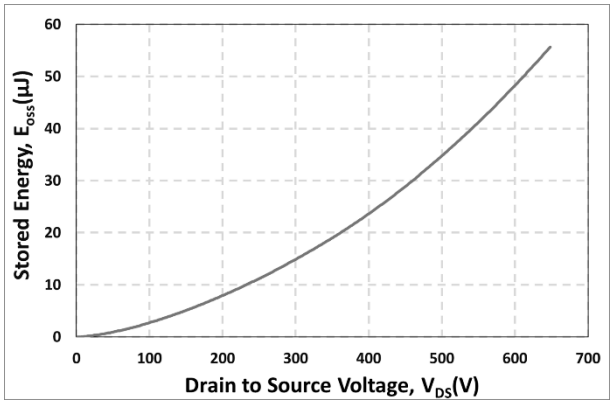



Figure 24. Output Capacitor Stored Energy

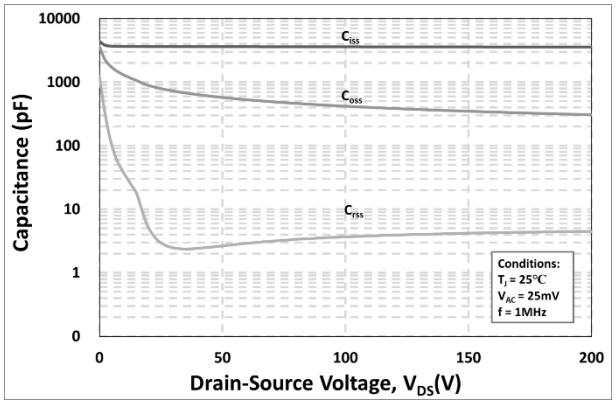



Figure 25. Capacitances vs. Drain-Source Voltage (0 - 200V)

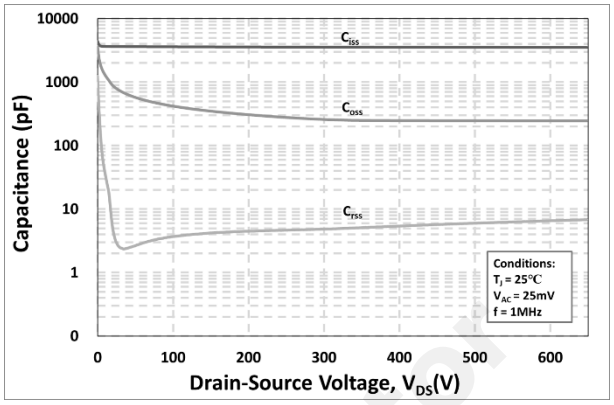



Figure 26. Capacitances vs. Drain-Source Voltage (0 - 650V)

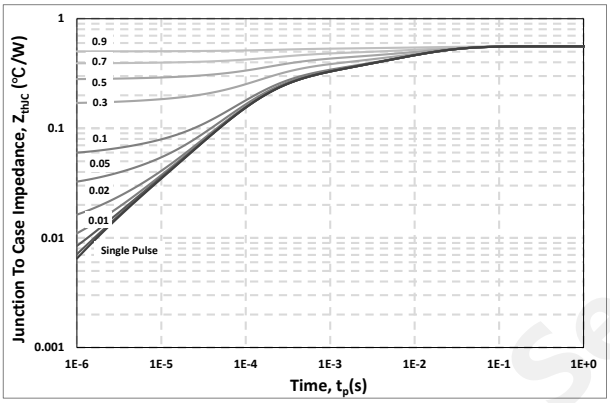



Figure 27. Transient Thermal Impedance (Junction - Case)

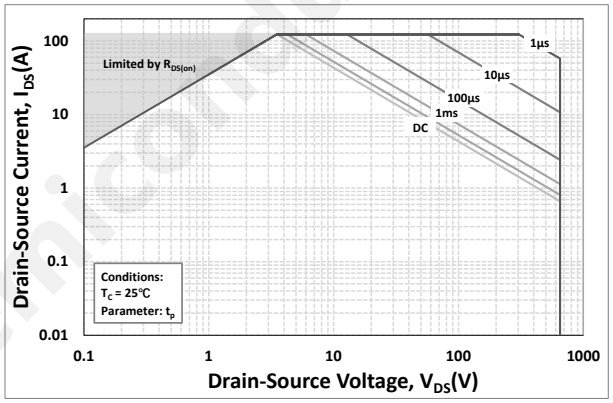



Figure 28. Safe Operating Area

## 6. Definitions

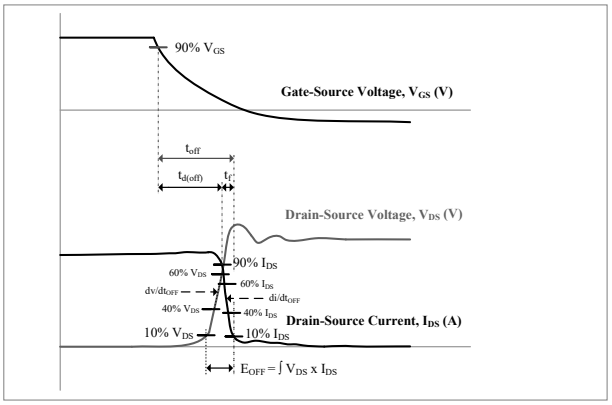



Figure 29. Turn-off Transient Definitions

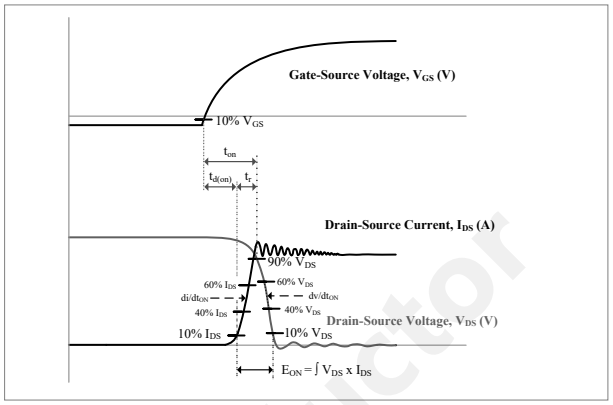



Figure 30. Turn-on Transient Definitions

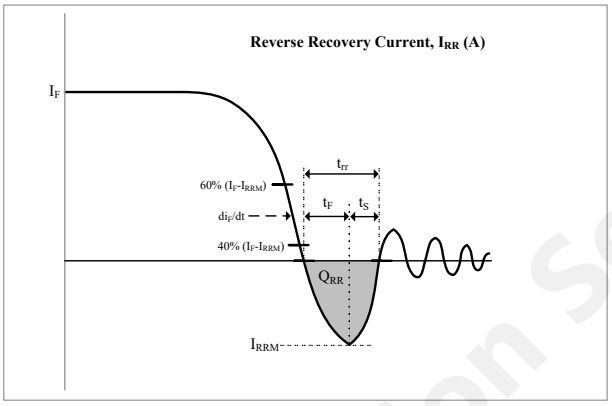



Figure 31. Reverse Recovery Definitions

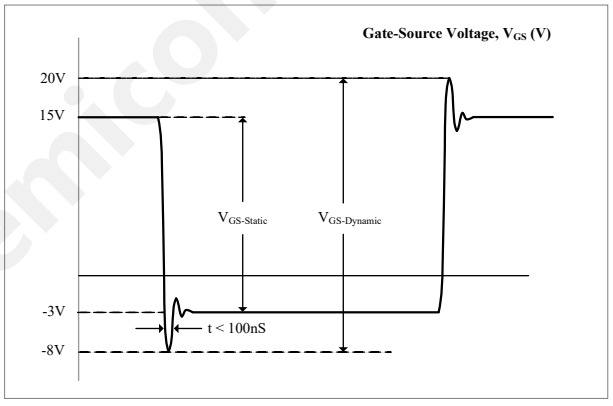
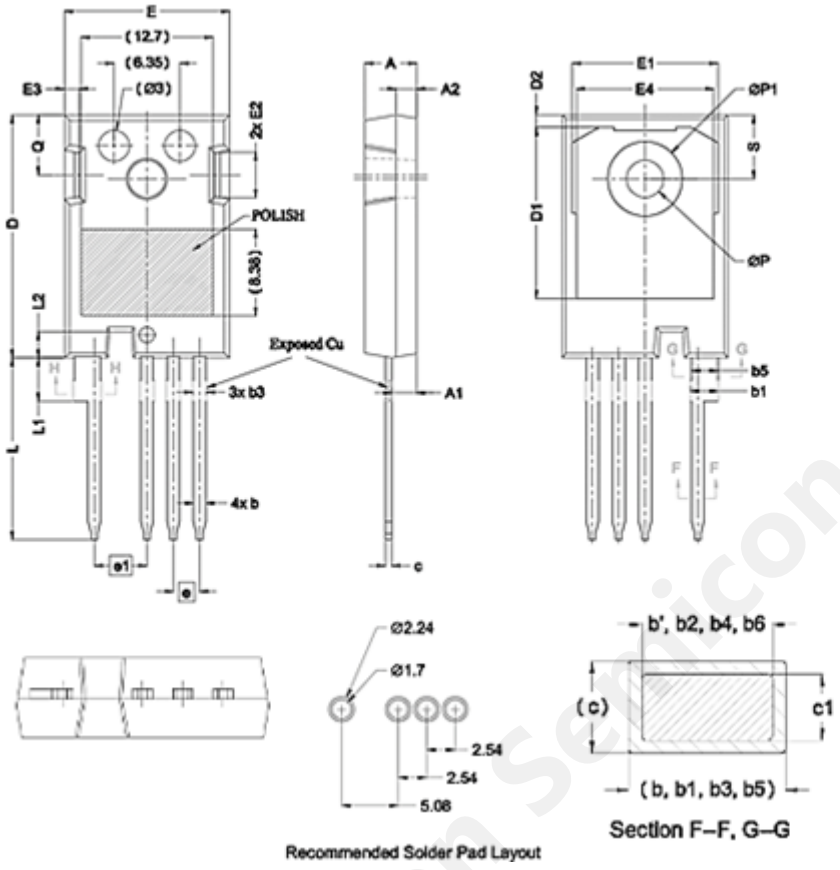



Figure 32. vgs Transient Definitions

## 7. Package Outlines




| SYMBOL | DIMENSIONS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | 4.83 | 5.02 | 5.21 |
| A1 | 2.28 | 2.41 | 2.54 |
| A2 | 1.91 | 2.00 | 2.16 |
| b' | 1.07 | 1.20 | 1.28 |
| b | 1.07 | 1.20 | 1.33 |
| b1 | 2.39 | 2.67 | 2.94 |
| b2 | 2.39 | 2.67 | 2.84 |
| b3 | 1.07 | 1.30 | 1.60 |
| b4 | 1.07 | 1.30 | 1.50 |
| b5 | 2.39 | 2.53 | 2.69 |
| b6 | 2.39 | 2.53 | 2.64 |
| c | 0.55 | 0.60 | 0.68 |
| c1 | 0.55 | 0.60 | 0.65 |
| D | 23.30 | 23.45 | 23.80 |
| D1 | 16.25 | 16.55 | 17.65 |
| D2 | 0.95 | 1.19 | 1.25 |
| E | 15.75 | 15.94 | 16.13 |
| E1 | 13.10 | 14.02 | 14.15 |
| E2 | 3.60 | 4.40 | 5.10 |
| E3 | 1.00 | 1.45 | 1.90 |
| E4 | 12.38 | 13.26 | 13.43 |
| ● | 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 |

Drawing and Dimensions

## Important Notice

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