CREE

# C3M0075120J

## Silicon Carbide Power MOSFET
## C3M™ MOSFET Technology

N-Channel Enhancement Mode

| | |
|---|---|
| $V_{DS}$ | 1200 V |
| $I_{D\ @\ 25^{\circ}C}$ | 30 A |
| $R_{DS(on)}$ | 75 mΩ |

### Features

- 3rd generation SiC MOSFET technology
- Low impedance package with driver source pin
- 7mm of creepage distance between drain and source
- High blocking voltage with low on-resistance
- High-speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery ($Q_{rr}$)
- Halogen free, RoHS compliant

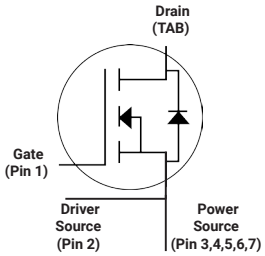
### Package


Halogen-Free

RoHS

### Benefits

- Reduce switching losses and minimize gate ringing
- Higher system efficiency
- Reduce cooling requirements
- Increase power density
- Increase system switching frequency




### Applications

- Renewable energy
- EV battery chargers
- High voltage DC/DC converters
- Switch Mode Power Supplies

| Part Number | Package | Marking |
|---|---|---|
| C3M0075120J | TO-263-7 | C3M0075120J |

### Maximum Ratings ($T_C$ = 25 ˚C unless otherwise specified)

| Symbol | Parameter | Value | Unit | Test Conditions | Note |
|---|---|---|---|---|---|
| $V_{DSmax}$ | Drain - Source Voltage | 1200 | V | $V_{GS}$ = 0 V, $I_D$ = 100 µA | |
| $V_{GSmax}$ | Gate - Source Voltage (dynamic) | -8/+19 | V | AC (f >1 Hz) | Note: 1 |
| $V_{GSop}$ | Gate - Source Voltage (static) | -4/+15 | V | Static | Note: 2 |
| $I_D$ | Continuous Drain Current | 30 | A | $V_{GS}$ = 15 V, $T_C$ = 25˚C | Fig. 19 |
| | | 19.7 | | $V_{GS}$ = 15 V, $T_C$ = 100˚C | |
| $I_{D(pulse)}$ | Pulsed Drain Current | 80 | A | Pulse width $t_P$ limited by $T_{jmax}$ | Fig. 22 |
| $P_D$ | Power Dissipation | 113.6 | W | $T_C$=25˚C, $T_J$ = 150 ˚C | Fig. 20 |
| $T_J$ , $T_{stg}$ | Operating Junction and Storage Temperature | -55 to +150 | ˚C | | |
| $T_L$ | Solder Temperature | 260 | ˚C | 1.6mm (0.063”) from case for 10s | |

Note (1): When using MOSFET Body Diode $V_{GSmax}$ = -4V/+19V
Note (2): MOSFET can also safely operate at 0/+15 V

## Electrical Characteristics ($T_C$ = 25˚C unless otherwise specified)

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions | Note |
|---|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-Source Breakdown Voltage | 1200 | | | V | $V_{GS}$ = 0 V, $I_D$ = 100 µA | |
| $V_{GS(th)}$ | Gate Threshold Voltage | 1.8 | 2.5 | 3.6 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 5 mA | Fig. 11 |
| | | | 2.2 | | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 5 mA, $T_J$ = 150°C | |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | | 1 | 50 | µA | $V_{DS}$ = 1200 V, $V_{GS}$ = 0 V | |
| $I_{GSS}$ | Gate-Source Leakage Current | | 10 | 250 | nA | $V_{GS}$ = 15 V, $V_{DS}$ = 0 V | |
| $R_{DS(on)}$ | Drain-Source On-State Resistance | | 75 | 90 | mΩ | $V_{GS}$ = 15 V, $I_D$ = 20 A | Fig. 4, 5, 6 |
| | | | 100 | | | $V_{GS}$ = 15 V, $I_D$ = 20A, $T_J$ = 150°C | |
| $g_{fs}$ | Transconductance | | 12 | | S | $V_{DS}$= 20 V, $I_{DS}$= 20 A | Fig. 7 |
| | | | 13 | | | $V_{DS}$= 20 V, $I_{DS}$= 20 A, $T_J$ = 150°C | |
| $C_{iss}$ | Input Capacitance | | 1390 | | pF | $V_{GS}$ = 0 V, $V_{DS}$ = 1000 V<br>f = 1 MHz<br>$V_{AC}$ = 25 mV | Fig. 17, 18 |
| $C_{oss}$ | Output Capacitance | | 58 | | | | |
| $C_{rss}$ | Reverse Transfer Capacitance | | 2 | | | | |
| $E_{oss}$ | $C_{oss}$ Stored Energy | | 33 | | µJ | | Fig. 16 |
| $E_{ON}$ | Turn-On Switching Energy (Body Diode FWD) | | 200 | | µJ | $V_{DS}$ = 800 V, $V_{GS}$ = -4 V/15 V, $I_D$ = 20A,<br>$R_{G(ext)}$ = 0 Ω, L= 156 µH, $T_J$ = 150°C | Fig. 26, 29 |
| $E_{OFF}$ | Turn-Off Switching Energy (Body Diode FWD) | | 90 | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | | 7 | | ns | $V_{DD}$ = 800 V, $V_{GS}$ = -4 V/15 V<br>$I_D$ = 20 A, $R_{G(ext)}$ = 0 Ω,<br>Timing relative to $V_{DS}$<br>Inductive load | Fig. 27, 28, 29 |
| $t_r$ | Rise Time | | 15 | | | | |
| $t_{d(off)}$ | Turn-Off Delay Time | | 24 | | | | |
| $t_f$ | Fall Time | | 8 | | | | |
| $R_{G(int)}$ | Internal Gate Resistance | | 9 | | Ω | f = 1 MHz, $V_{AC}$ = 25 mV | |
| $Q_{gs}$ | Gate to Source Charge | | 18 | | nC | $V_{DS}$ = 800 V, $V_{GS}$ = -4 V/15 V<br>$I_D$ = 20 A<br>Per IEC60747-8-4 pg 21 | Fig. 12 |
| $Q_{gd}$ | Gate to Drain Charge | | 12 | | | | |
| $Q_g$ | Total Gate Charge | | 48 | | | | |

## Reverse Diode Characteristics ($T_C$ = 25˚C unless otherwise specified)

| Symbol | Parameter | Typ. | Max. | Unit | Test Conditions | Note |
|---|---|---|---|---|---|---|
| $V_{SD}$ | Diode Forward Voltage | 4.5 | | V | $V_{GS}$ = -4 V, $I_{SD}$ = 10 A | Fig. 8, 9, 10 |
| | | 4.0 | | V | $V_{GS}$ = -4 V, $I_{SD}$ = 10 A, $T_J$ = 150 °C | |
| $I_S$ | Continuous Diode Forward Current | | 22.4 | A | $V_{GS}$ = -4 V | Note 1 |
| $I_{S, pulse}$ | Diode pulse Current | 80 | | A | $V_{GS}$ = -4 V, pulse width $t_P$ limited by $T_{jmax}$ | Note 1 |
| $t_{rr}$ | Reverse Recover time | 25 | | ns | $V_{GS}$ = -4 V, $I_{SD}$ = 20 A, $V_R$ = 800 V<br>dif/dt = 1925 A/µs, $T_J$ = 25 °C | Note 1, Fig. 29 |
| $Q_{rr}$ | Reverse Recovery Charge | 109 | | nC | | |
| $I_{rrm}$ | Peak Reverse Recovery Current | 11 | | A | | |

## Thermal Characteristics

| Symbol | Parameter | Max. | Unit | Test Conditions | Note |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance from Junction to Case | 1.1 | °C/W | | Fig. 21 |
| $R_{\theta JA}$ | Thermal Resistance From Junction to Ambient | 40 | | | |

## Typical Performance

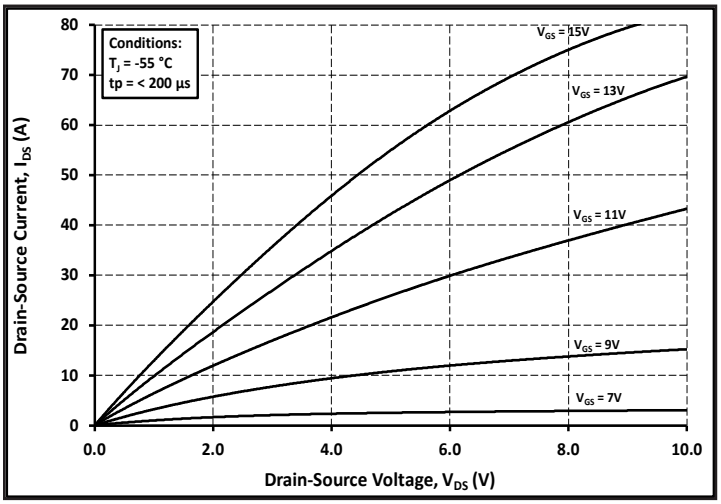



Figure 1. Output Characteristics $T_J$ = -55 °C

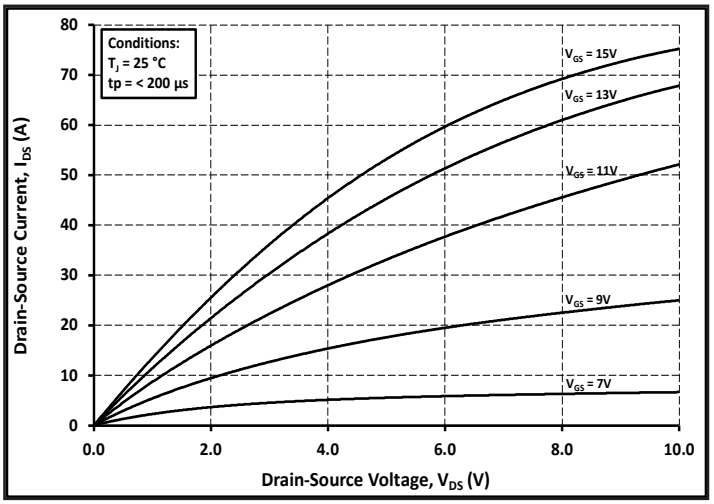



Figure 2. Output Characteristics $T_J$ = 25 °C

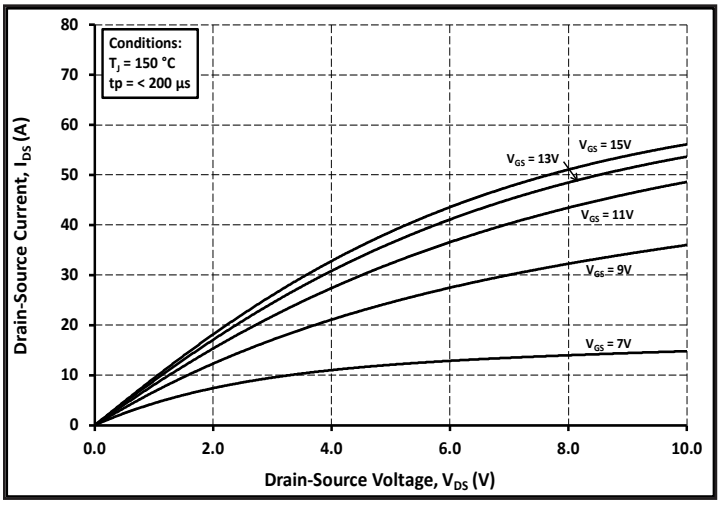



Figure 3. Output Characteristics $T_J$ = 150 °C

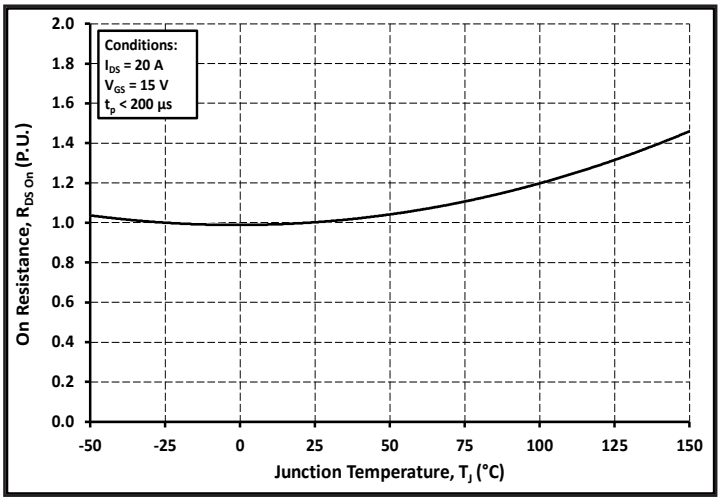



Figure 4. Normalized On-Resistance vs. Temperature

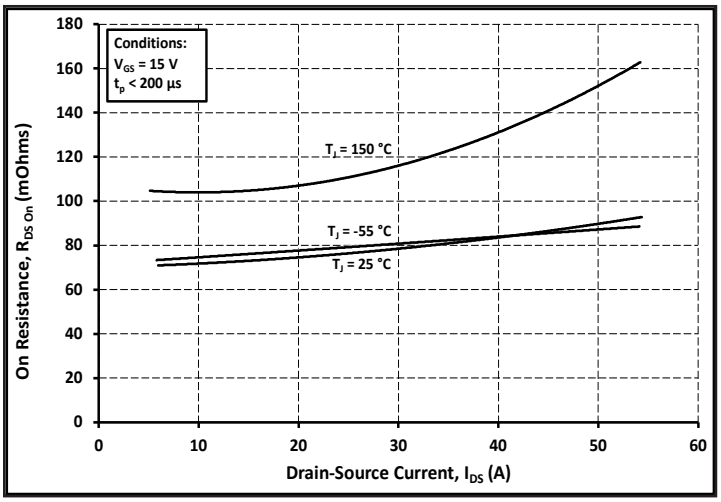



Figure 5. On-Resistance vs. Drain Current
For Various Temperatures

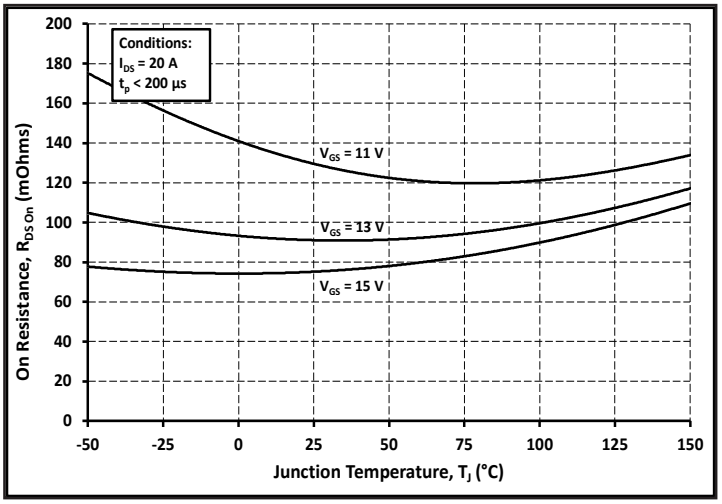



Figure 6. On-Resistance vs. Temperature
For Various Gate Voltage

## Typical Performance

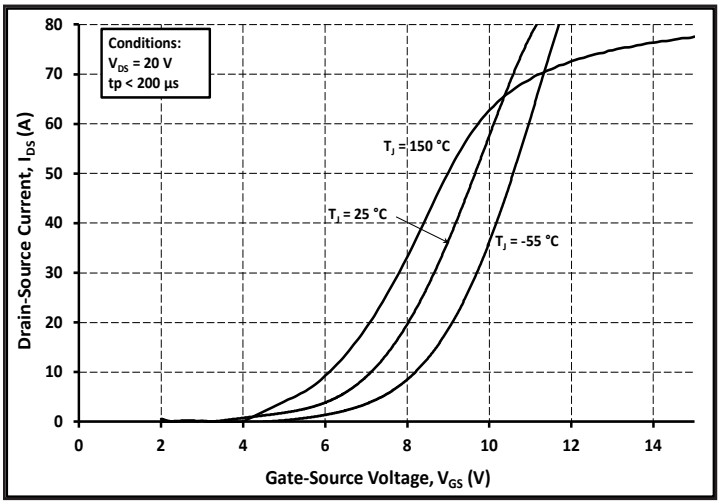



Figure 7. Transfer Characteristic for Various Junction Temperatures

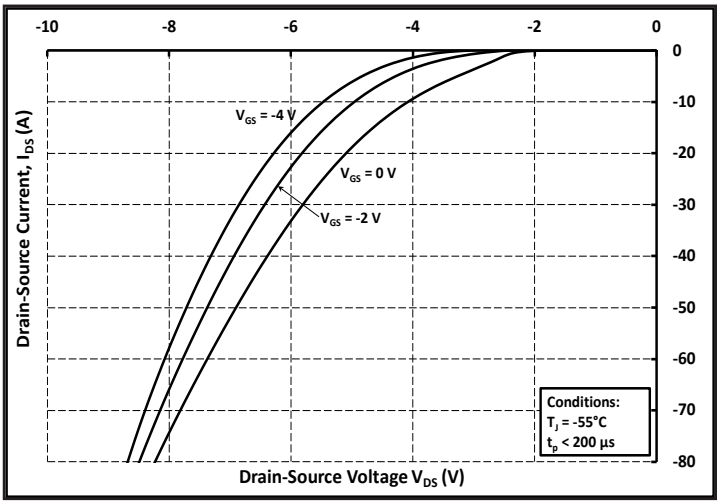



Figure 8. Body Diode Characteristic at -55 ºC

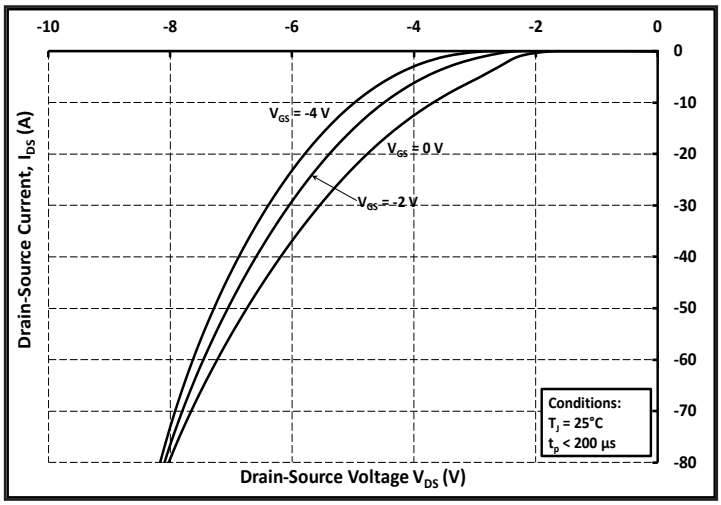



Figure 9. Body Diode Characteristic at 25 ºC

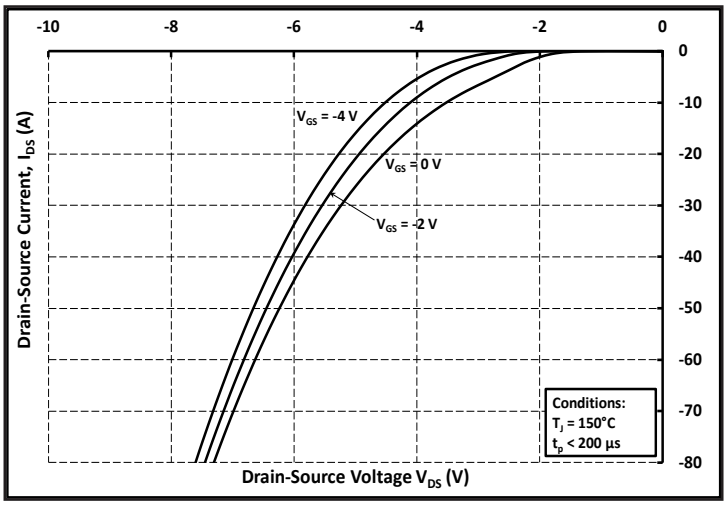



Figure 10. Body Diode Characteristic at 150 ºC

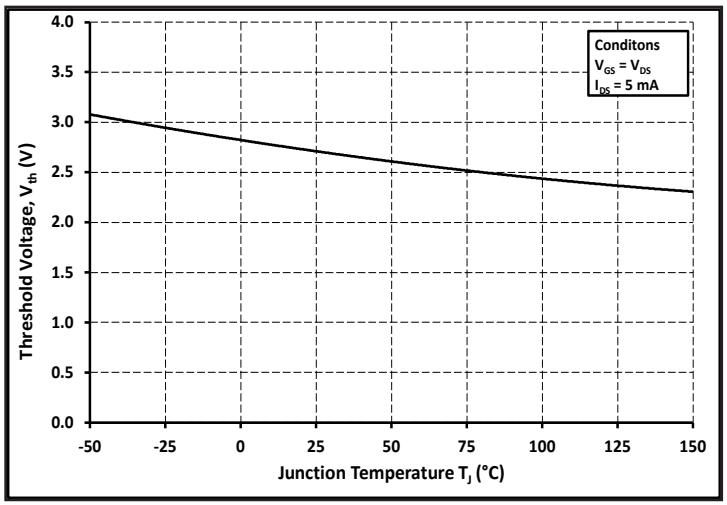



Figure 11. Threshold Voltage vs. Temperature

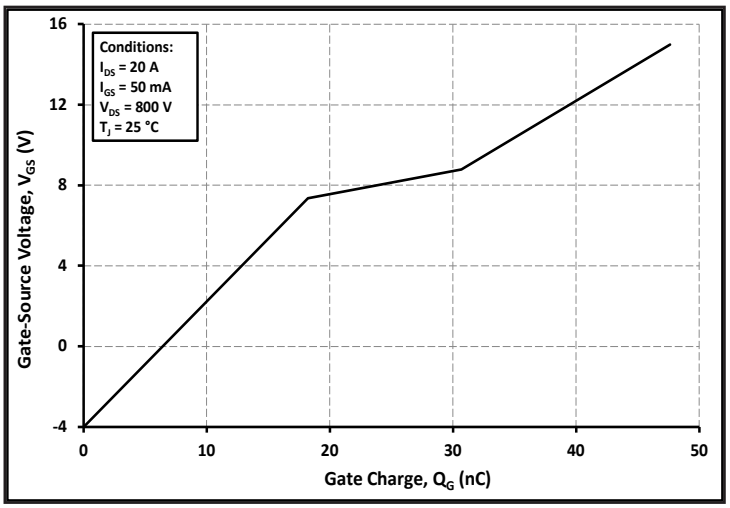



Figure 12. Gate Charge Characteristics

## Typical Performance

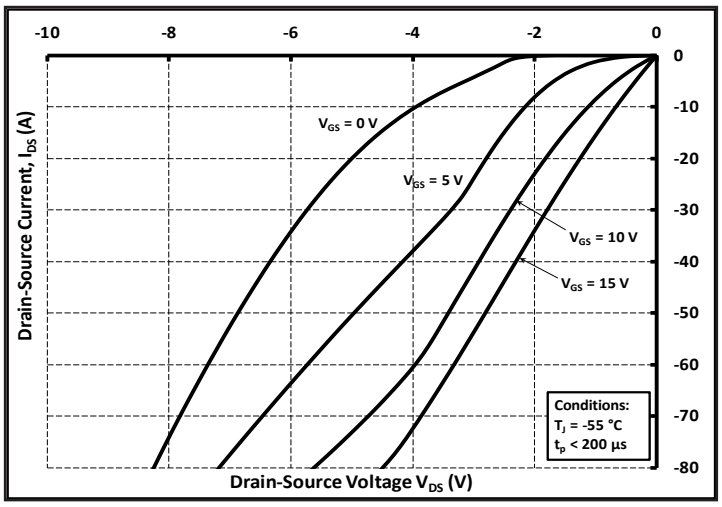



Figure 13. 3rd Quadrant Characteristic at -55 ºC

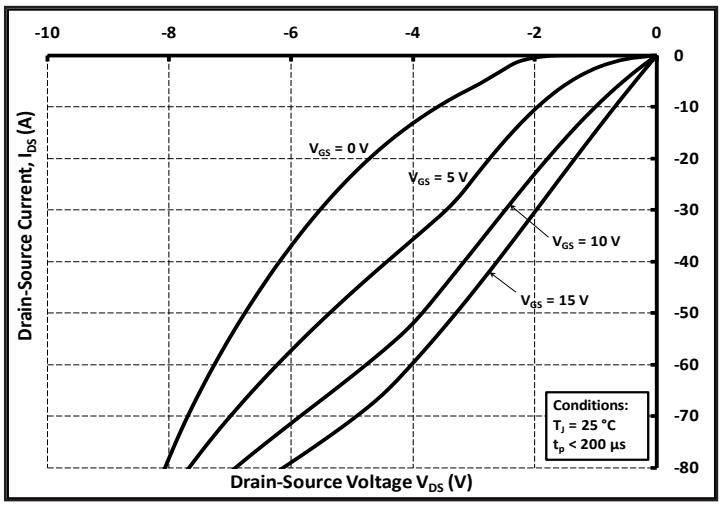



Figure 14. 3rd Quadrant Characteristic at 25 ºC

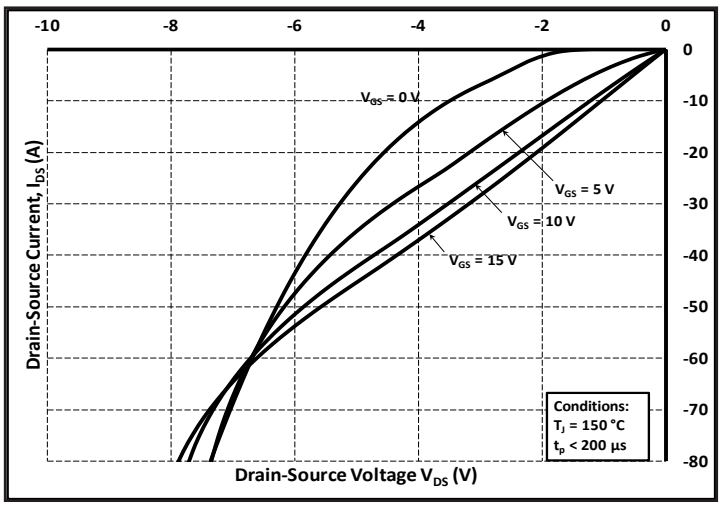



Figure 15. 3rd Quadrant Characteristic at 150 ºC

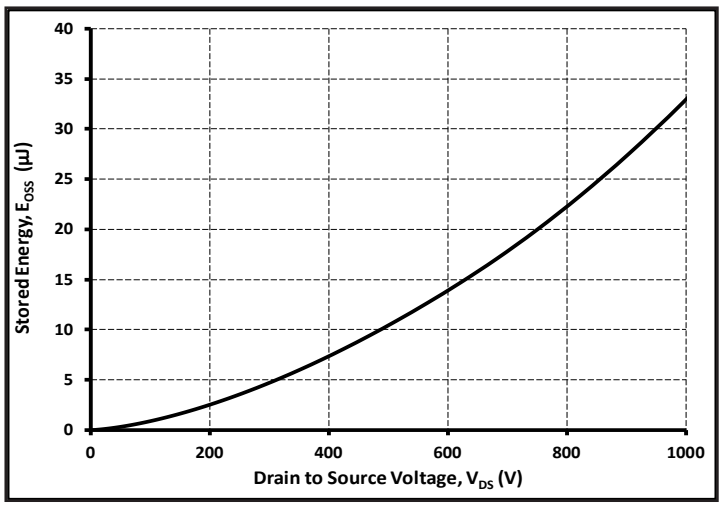



Figure 16. Output Capacitor Stored Energy

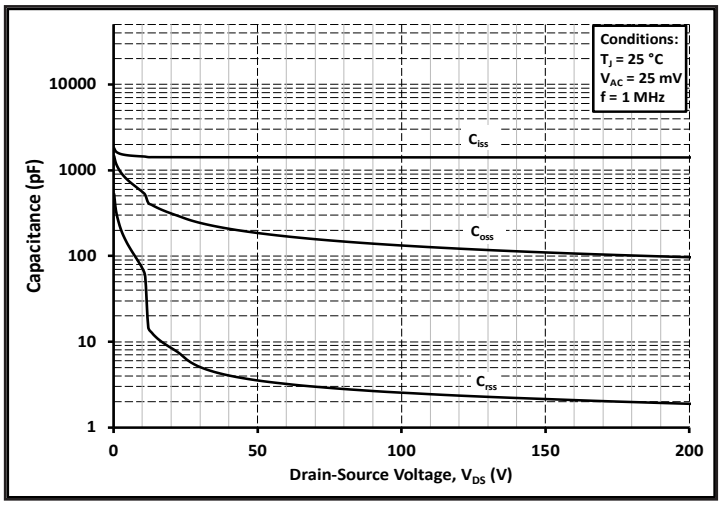



Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

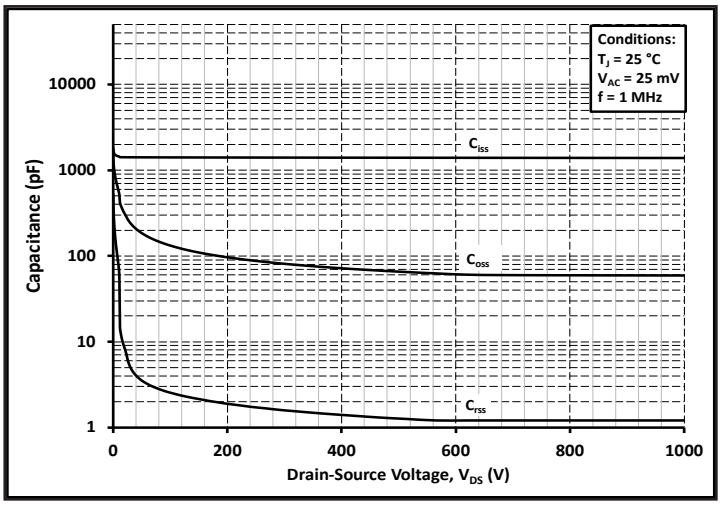



Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1000V)

## Typical Performance

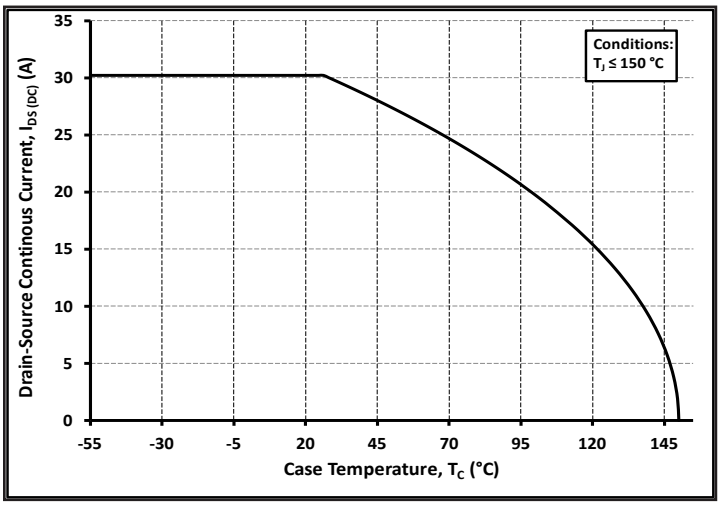



Figure 19. Continuous Drain Current Derating vs. Case Temperature

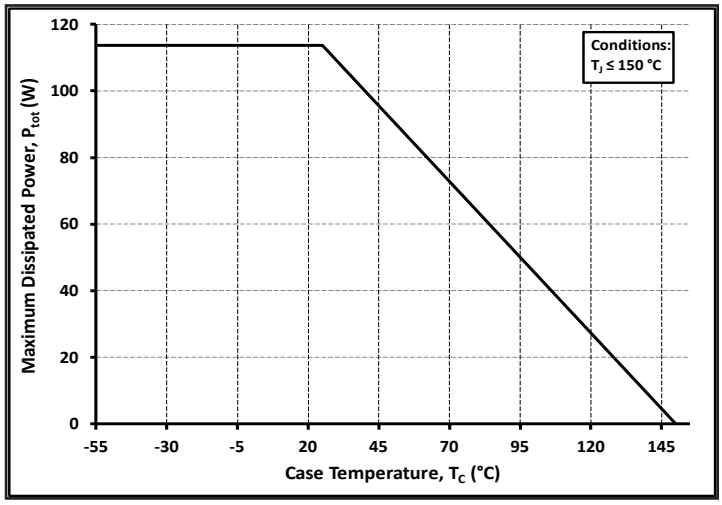



Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

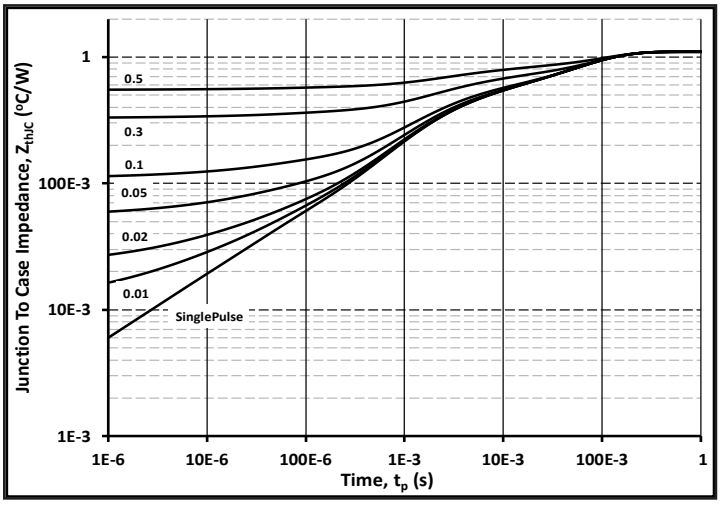



Figure 21. Transient Thermal Impedance (Junction - Case)

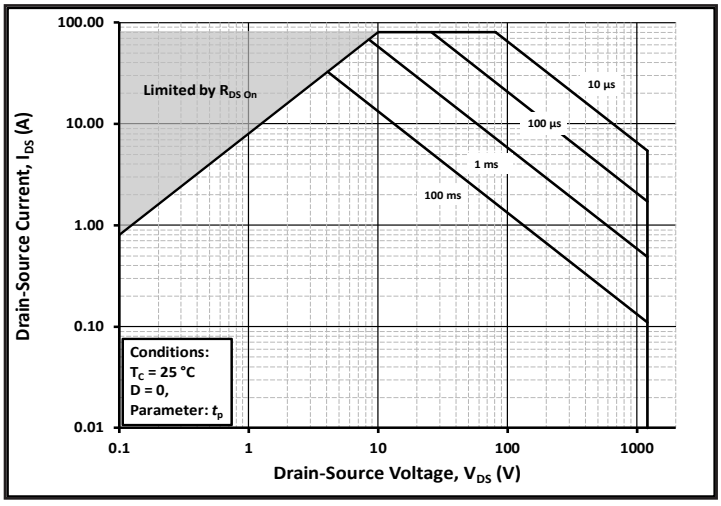



Figure 22. Safe Operating Area

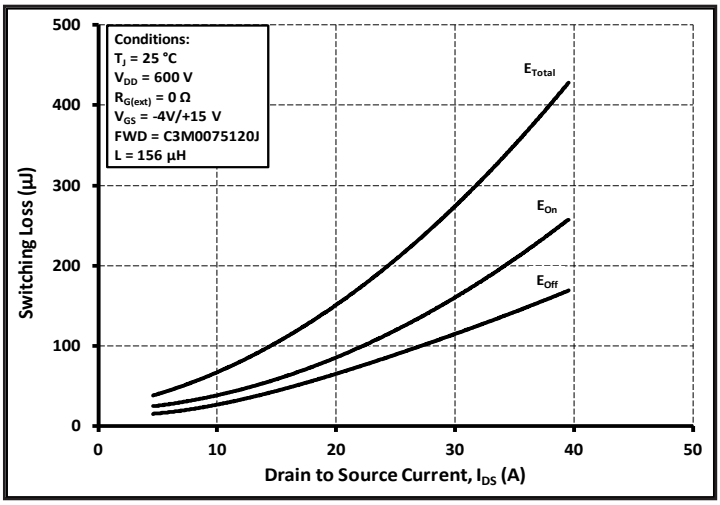



Figure 23. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD}$ = 600V)

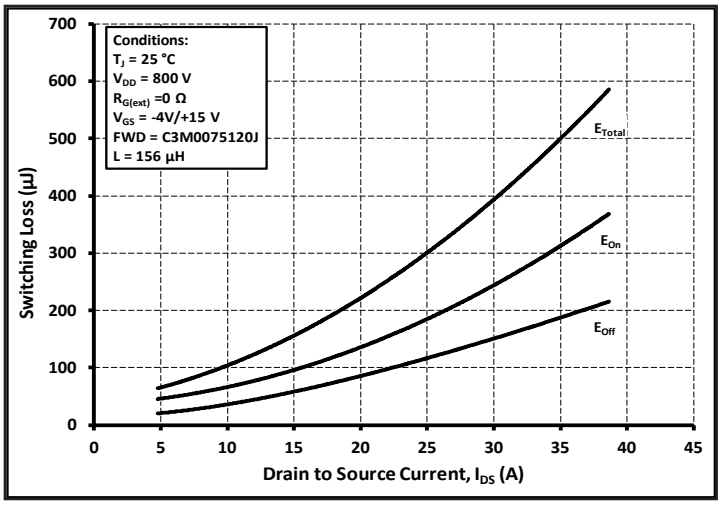



Figure 24. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD}$ = 800V)

## Typical Performance

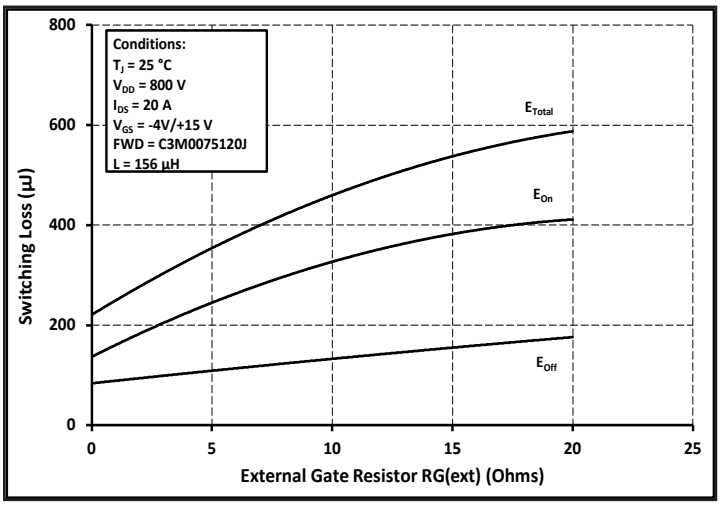



Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

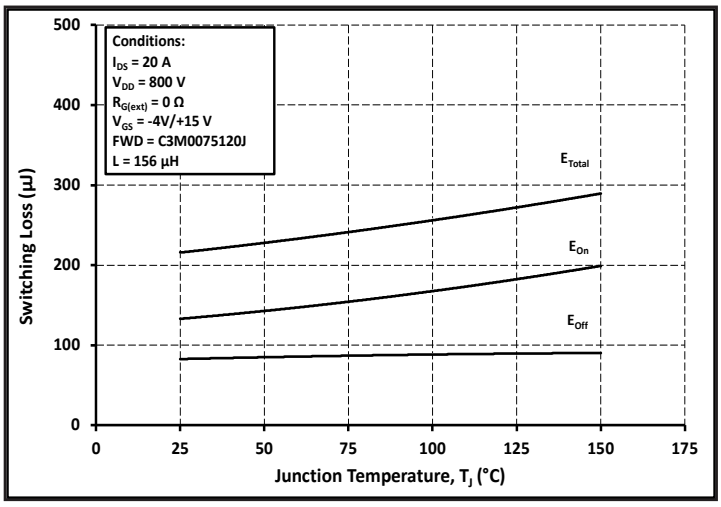



Figure 26. Clamped Inductive Switching Energy vs. Temperature

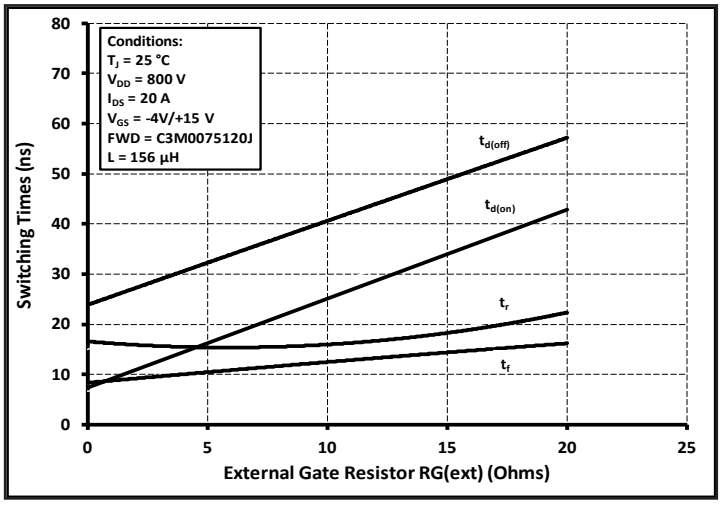



Figure 27. Switching Times vs. $R_{G(ext)}$

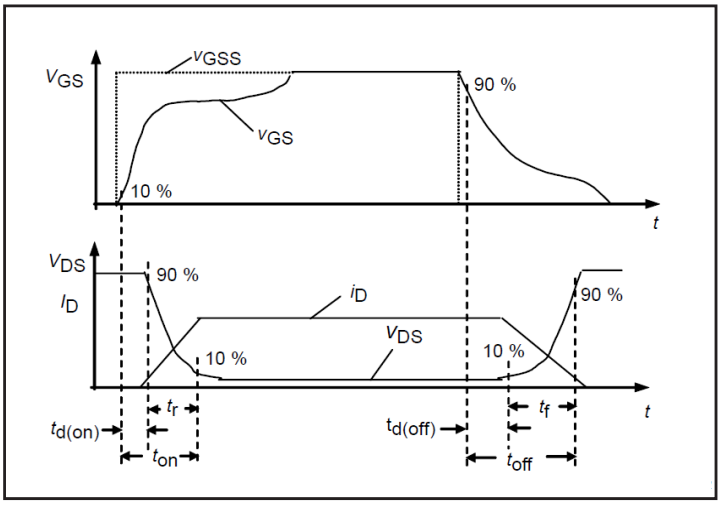



Figure 28. Switching Times Definition

## Test Circuit Schematic

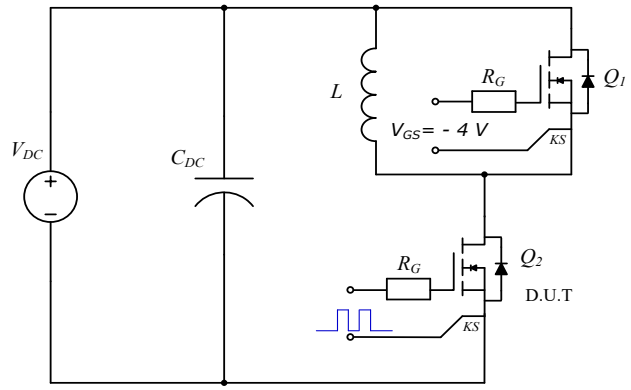
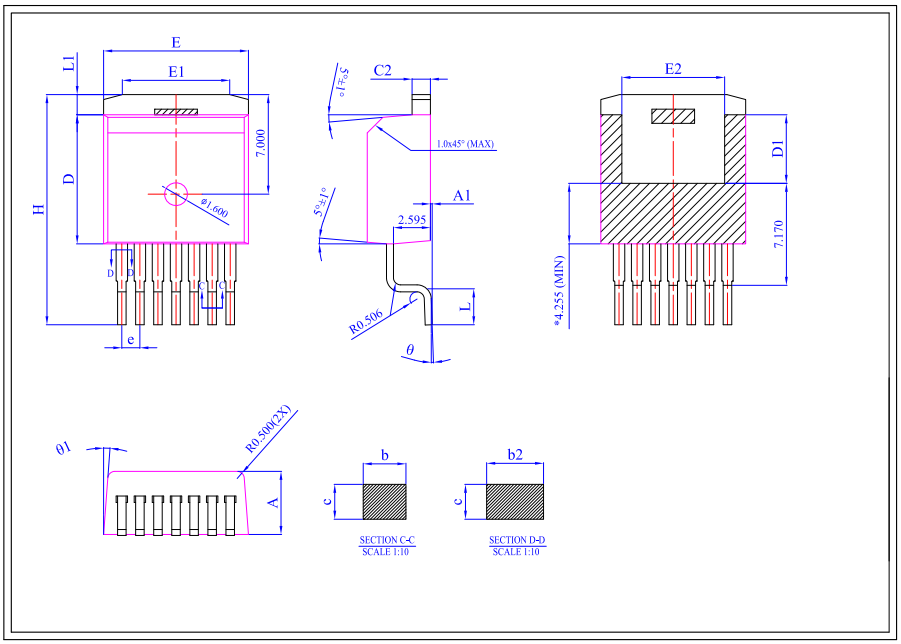



Figure 29. Clamped Inductive Switching Waveform Test Circuit

Note (3): Turn-off and Turn-on switching energy and timing values measured using SiC MOSFET Body Diode as shown above.

## Package Dimensions

Package 7L D2PAK




| Dim | All Dimensions in Millimeters | | |
|---|---|---|---|
| | Min | typ | Max |
| A | 4.300 | 4.435 | 4.570 |
| A1 | 0.00 | 0.125 | 0.25 |
| b | 0.500 | 0.600 | 0.700 |
| b2 | 0.600 | 0.800 | 1.000 |
| c | 0.330 | 0.490 | 0.650 |
| C2 | 1.170 | 1.285 | 1.400 |
| D | 9.025 | 9.075 | 9.125 |
| D1 | 4.700 | 4.800 | 4.900 |
| E | 10.130 | 10.180 | 10.230 |
| E1 | 6.500 | 7.550 | 8.600 |
| E2 | 6.778 | 7.223 | 7.665 |
| e | | 1.27 | |
| H | 15.043 | 16.178 | 17.313 |
| L | 2.324 | 2.512 | 2.700 |
| L1 | 0.968 | 1.418 | 1.868 |
| Ø | 0° | 4° | 8° |
| Ø1 | 4.5° | 5° | 5.5° |