

## Silicon Carbide Power Mosfet

### 1. Product Information

#### Features

- 1200V, 59A
- $R_{DS(ON)} < 54m\Omega$  @  $V_{GS} = 18V$ , TYP=40M $\Omega$
- Low on-resistance
- Fast switching speed with low capacitances
- Fast intrinsic diode with low reverse recovery ( $Q_{RR}$ )
- Halogen-free, RoHS compliant

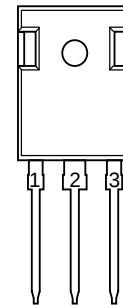
#### Applications

- DC/DC Converters
- Motor Drives
- Switch Mode Power Supply
- Solar Inverters

#### Pin Description

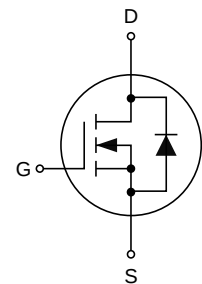
| Pin | Description |
|-----|-------------|
| 1   | Gate(G)     |
| 2   | Drain(D)    |
| 3   | Source(S)   |

#### Simplified Outline



Top View  
TO-247-3L

#### Symbol



#### Package Marking and Ordering Information

| Product Name | Package   | Marking    | Form | Quantity |
|--------------|-----------|------------|------|----------|
| KJC40C120P   | TO-247-3L | KJC40C120P | Tube | 450      |

### 2. Absolute Maximum Ratings (T<sub>A</sub>=25°C unless otherwise noted)

| Symbol           | Parameter                                            | Values  | Unit |
|------------------|------------------------------------------------------|---------|------|
| V <sub>DS</sub>  | Drain-Source Voltage                                 | 1200    | V    |
| V <sub>GS</sub>  | Gate-Source Voltage(dynamic)                         | -10/+22 | V    |
| V <sub>GS</sub>  | Gate-Source Voltage(static)                          | -6/+18  | V    |
| I <sub>D</sub>   | Continuous Drain Current(T <sub>A</sub> =25°C) ①     | 59      | A    |
| I <sub>D</sub>   | Continuous Drain Current(T <sub>A</sub> =100°C) ①    | 45      | A    |
| I <sub>DM</sub>  | Pulsed Drain Current ②                               | 100     | A    |
| P <sub>D</sub>   | Power Dissipation                                    | 300     | W    |
| R <sub>θJA</sub> | Thermal Resistance-Junction to Ambient, Steady-State | 40      | °C/W |
| R <sub>θJC</sub> | Thermal Resistance-Junction to Case, Steady-State    | 0.5     | °C/W |
| T <sub>J</sub>   | Junction Temperature                                 | 175     | °C   |
| T <sub>STG</sub> | Storage Temperature Range                            | -55~175 | °C   |

## 3. Electrical Characteristics (T<sub>A</sub>=25°C, unless otherwise noted)

| Symbol                    | Parameter                        | Test Conditions                                                                                                                                     | Min  | Type | Max  | Unit |
|---------------------------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| Static Characteristics    |                                  |                                                                                                                                                     |      |      |      |      |
| BV <sub>DSS</sub>         | Drain-Source Breakdown Voltage   | V <sub>GS</sub> =0V, I <sub>D</sub> =100μA                                                                                                          | 1200 | -    | -    | V    |
| I <sub>DSS</sub>          | Zero Gate Voltage Drain Current  | V <sub>DS</sub> =1200V, V <sub>GS</sub> =0V                                                                                                         | -    | 5    | 50   | μA   |
| I <sub>GSS</sub>          | Gate-Body Leakage Current        | V <sub>GS</sub> =+18V, V <sub>DS</sub> =0V                                                                                                          | -    | -    | 100  | nA   |
|                           |                                  | V <sub>GS</sub> =-6V, V <sub>DS</sub> =0V                                                                                                           | -    | -    | -100 | nA   |
| V <sub>GS(th)</sub>       | Gate Threshold Voltage           | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =9.5mA                                                                                            | 2.2  | 3.2  | 4.5  | V    |
|                           |                                  | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =9.5mA, T <sub>J</sub> =175°C                                                                     | -    | 2.2  | -    | V    |
| R <sub>DS(ON)</sub>       | Drain-Source On-State Resistance | V <sub>GS</sub> =18V, I <sub>D</sub> =33A                                                                                                           | -    | 40   | 54   | mΩ   |
|                           |                                  | V <sub>GS</sub> =18V, I <sub>D</sub> =33A, T <sub>J</sub> =175°C                                                                                    | -    | 64   | -    | mΩ   |
| G <sub>FS</sub>           | Forward Transconductance         | V <sub>GS</sub> =20V, I <sub>D</sub> =33A                                                                                                           | -    | 16   | -    | S    |
|                           |                                  | V <sub>GS</sub> =20V, I <sub>D</sub> =33A, T <sub>J</sub> =175°C                                                                                    | -    | 17   | -    | S    |
| Dynamic Characteristics   |                                  |                                                                                                                                                     |      |      |      |      |
| C <sub>iss</sub>          | Input Capacitance                | V <sub>DS</sub> =800V, V <sub>GS</sub> =0V,<br>F=100kHz, V <sub>AC</sub> =25mV                                                                      | -    | 2360 | -    | pF   |
| C <sub>oss</sub>          | Output Capacitance               |                                                                                                                                                     | -    | 108  | -    | pF   |
| C <sub>rss</sub>          | Reverse Transfer Capacitance     |                                                                                                                                                     | -    | 13   | -    | pF   |
| E <sub>OSS</sub>          | C <sub>OSS</sub> Stored Energy   |                                                                                                                                                     | -    | 43   | -    | μJ   |
| R <sub>G</sub>            | Gate Resistance                  | F=1MHz, V <sub>AC</sub> =25mV                                                                                                                       | -    | 3.3  | -    | Ω    |
| Q <sub>g</sub>            | Total Gate Charge                | V <sub>DD</sub> =800V, I <sub>D</sub> =33A,<br>V <sub>GS</sub> =-5/+18V                                                                             | -    | 128  | -    | nC   |
| Q <sub>gs</sub>           | Gate-Source Charge               |                                                                                                                                                     | -    | 38   | -    | nC   |
| Q <sub>gd</sub>           | Gate-Drain Charge                |                                                                                                                                                     | -    | 58   | -    | nC   |
| Switching Characteristics |                                  |                                                                                                                                                     |      |      |      |      |
| t <sub>d(on)</sub>        | Turn-on Delay Time               | V <sub>DD</sub> =800V, I <sub>D</sub> =33A,<br>V <sub>GS</sub> =-5/+18V, R <sub>G</sub> =5Ω,<br>L=99μH,<br>Diode: Body Diode @V <sub>GS</sub> =-5V  | -    | 19   | -    | ns   |
| t <sub>r</sub>            | Turn-on Rise Time                |                                                                                                                                                     | -    | 22   | -    | ns   |
| t <sub>d(off)</sub>       | Turn-off Delay Time              |                                                                                                                                                     | -    | 33   | -    | ns   |
| t <sub>f</sub>            | Turn-off Fall Time               |                                                                                                                                                     | -    | 22   | -    | ns   |
| E <sub>ON</sub>           | Turn-on Energy                   |                                                                                                                                                     | -    | 1227 | -    | μJ   |
| E <sub>OFF</sub>          | Turn-off Fall Time Energy        |                                                                                                                                                     | -    | 160  | -    | μJ   |
| t <sub>d(on)</sub>        | Turn-on Delay Time               | V <sub>DD</sub> =800V, I <sub>D</sub> =33A,<br>V <sub>GS</sub> =-5/+18V, R <sub>G</sub> =20Ω,<br>L=99μH,<br>Diode: Body Diode @V <sub>GS</sub> =-5V | -    | 30   | -    | ns   |
| t <sub>r</sub>            | Turn-on Rise Time                |                                                                                                                                                     | -    | 45   | -    | ns   |
| t <sub>d(off)</sub>       | Turn-off Delay Time              |                                                                                                                                                     | -    | 88   | -    | ns   |
| t <sub>f</sub>            | Turn-off Fall Time               |                                                                                                                                                     | -    | 53   | -    | ns   |
| E <sub>ON</sub>           | Turn-on Energy                   |                                                                                                                                                     | -    | 1970 | -    | μJ   |
| E <sub>OFF</sub>          | Turn-off Fall Time Energy        |                                                                                                                                                     | -    | 580  | -    | μJ   |

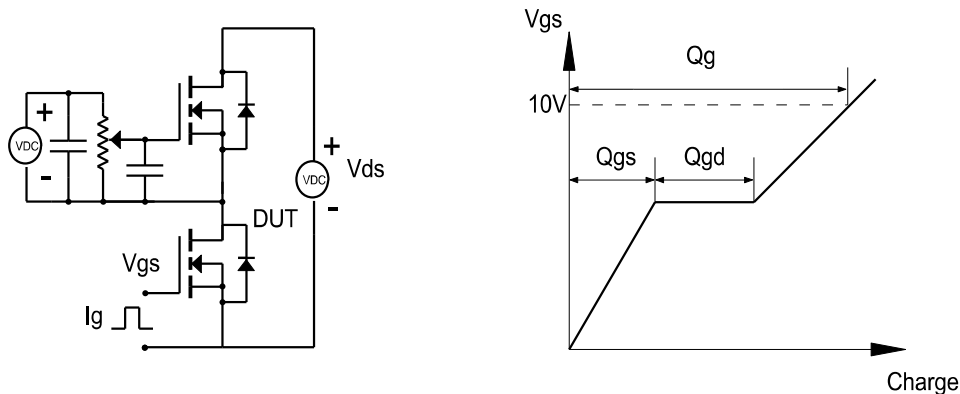
| Source-Drain Diode Characteristics |                                          |                                                                                                  |   |     |   |    |
|------------------------------------|------------------------------------------|--------------------------------------------------------------------------------------------------|---|-----|---|----|
| V <sub>SD</sub>                    | Diode Forward Voltage                    | V <sub>GS</sub> =-4V, I <sub>S</sub> =20A                                                        | - | 4.5 | - | V  |
|                                    |                                          | V <sub>GS</sub> =-4V, I <sub>S</sub> =20A, T <sub>J</sub> =175°C                                 | - | 4   | - | V  |
| I <sub>S</sub>                     | Maximum Continuous Diode Forward Current |                                                                                                  | - | 59  | - | A  |
| I <sub>SM</sub>                    | Maximum Pulsed Diode Forward Current     |                                                                                                  | - | 100 | - | A  |
| I <sub>RM</sub>                    | Peak Reverse Recovery Current            | V <sub>GS</sub> =-4V, I <sub>SD</sub> =33A,<br>V <sub>R</sub> =800V, di <sub>F</sub> /dt=650A/μs | - | 7.5 | - | A  |
| T <sub>RR</sub>                    | Reverse Recovery Time                    |                                                                                                  | - | 22  | - | ns |
| Q <sub>r</sub>                     | Reverse Recovery Charge                  |                                                                                                  | - | 92  | - | nC |

**Note:**

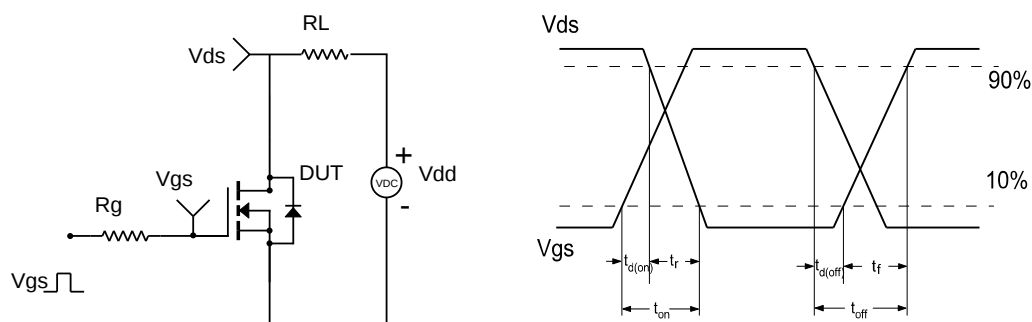
①. Repetitive Rating: Pulse width limited by maximum junction temperature.

## 4. Test Circuits

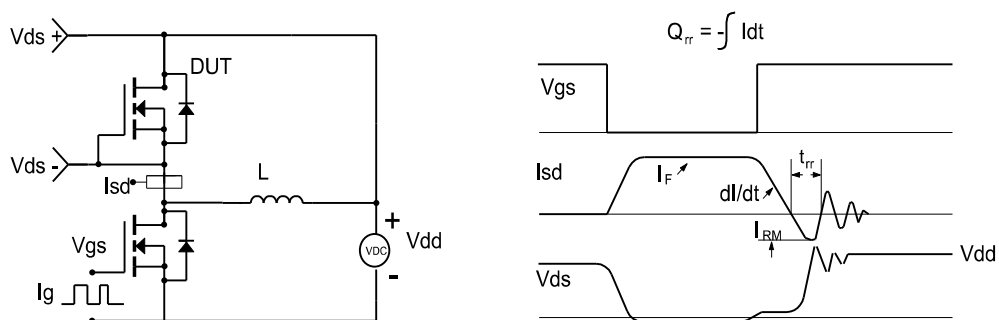
**Gate Charge test circuit and Waveform**



**Switching Time test circuit and Waveform**



**Diode Recovery Test Circuit and Waveform**



## 5. Typical Characteristics

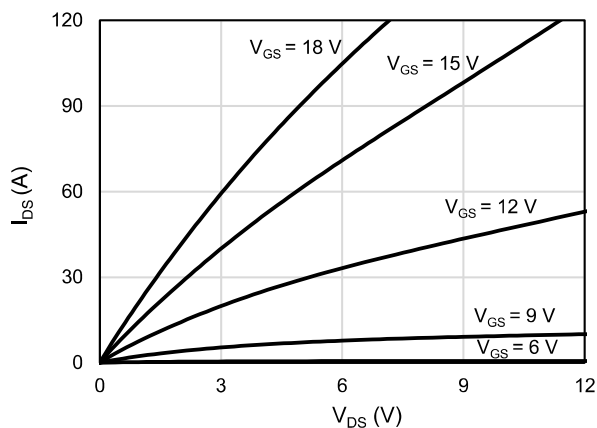


Figure 1. Output Characteristics ( $T_J = -40^\circ\text{C}$ )

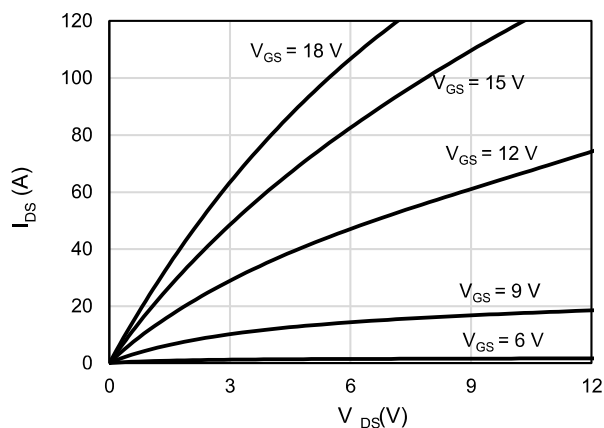


Figure 2. Output Characteristics ( $T_J = 25^\circ\text{C}$ )

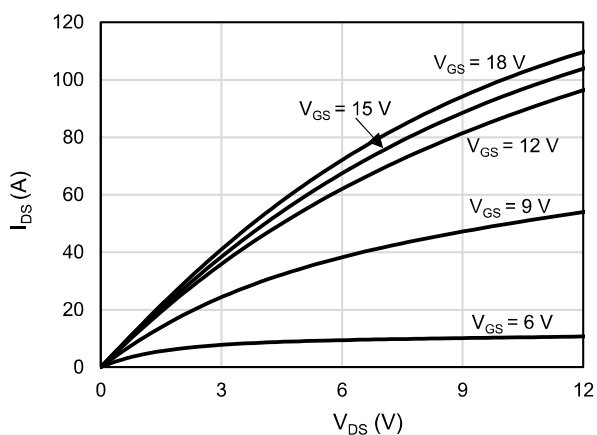


Figure 3. Output Characteristics ( $T_J = 175^\circ\text{C}$ )

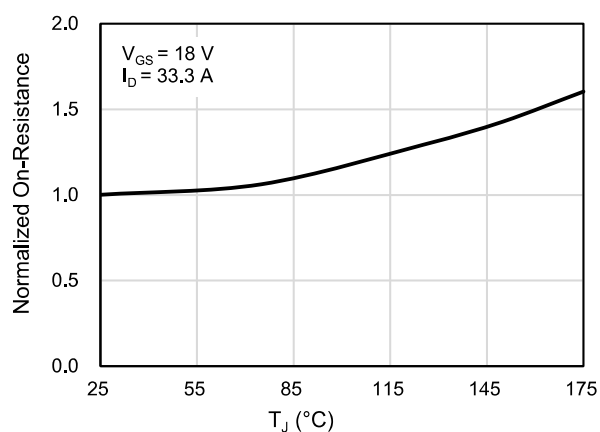


Figure 4. Normalized On-Resistance vs. Temperature

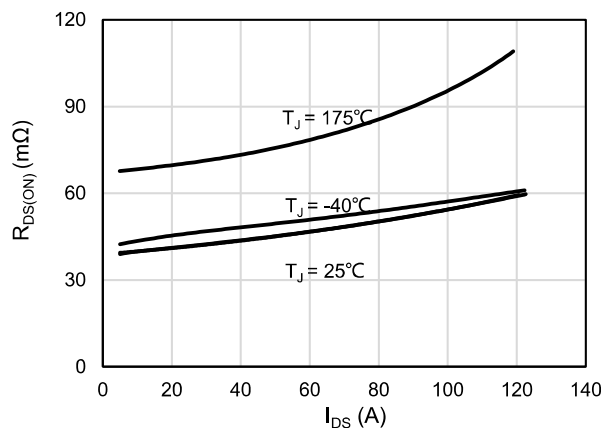


Figure 5. On-Resistance vs. Drain Current For Various Temperature

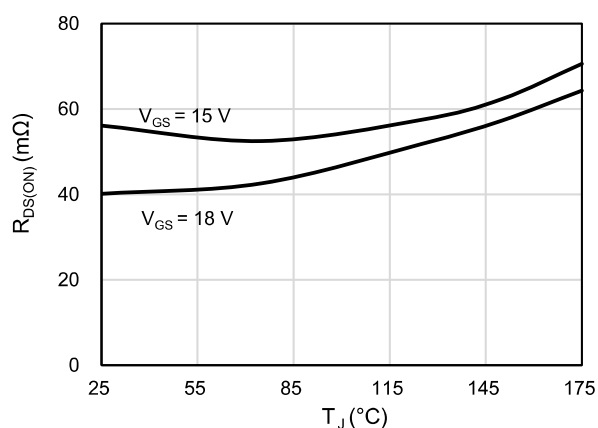


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

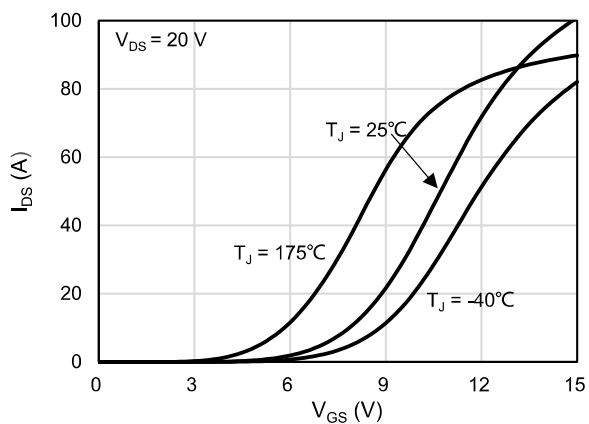


Figure 7. Transfer Characteristics For Various Junction Temperature

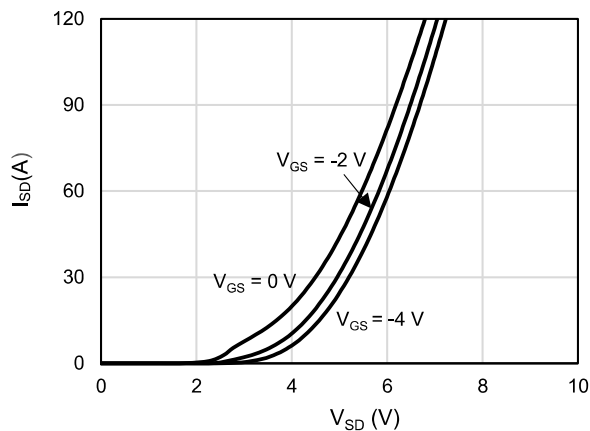


Figure 8. Body Diode Characteristics ( $T_J = -40^{\circ}\text{C}$ )

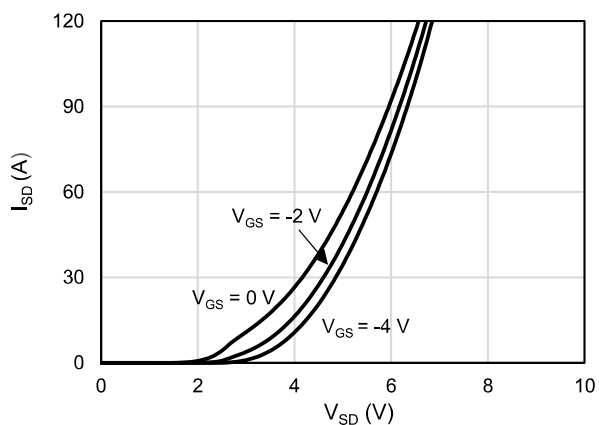


Figure 9. Body Diode Characteristics ( $T_J = 25^{\circ}\text{C}$ )

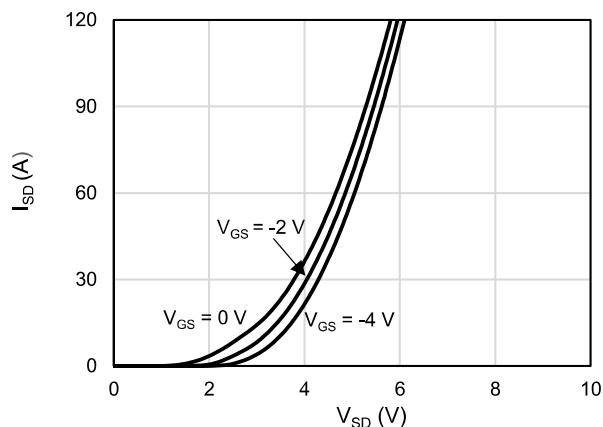


Figure 8. Body Diode Characteristics ( $T_J = 175^{\circ}\text{C}$ )

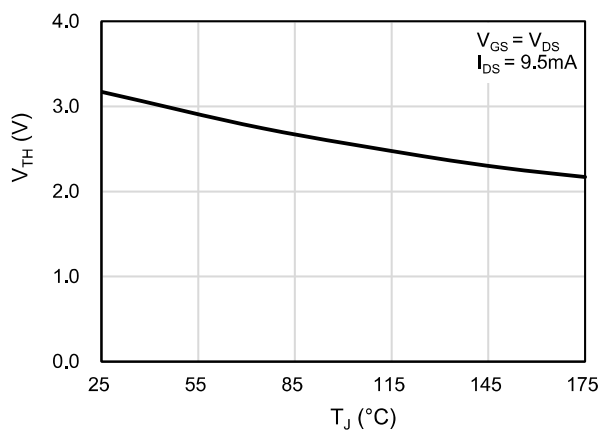


Figure 11. Threshold Voltage vs. Temperature

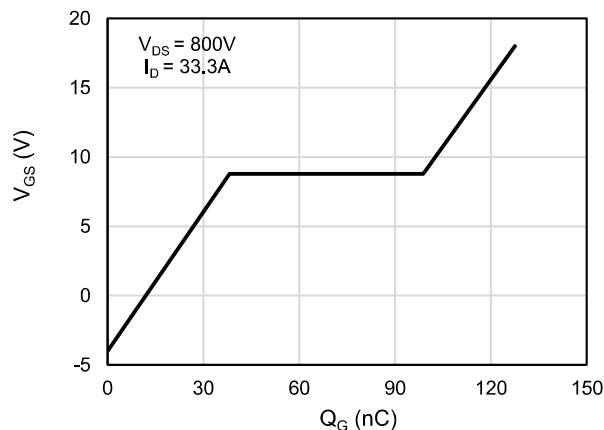


Figure 4. Gate-Charge Characteristics

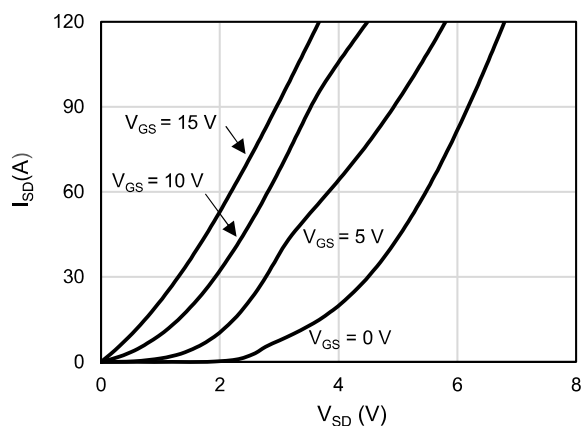


Figure 13. 3rd Quadrant Characteristics ( $T_J = -40^\circ\text{C}$ )

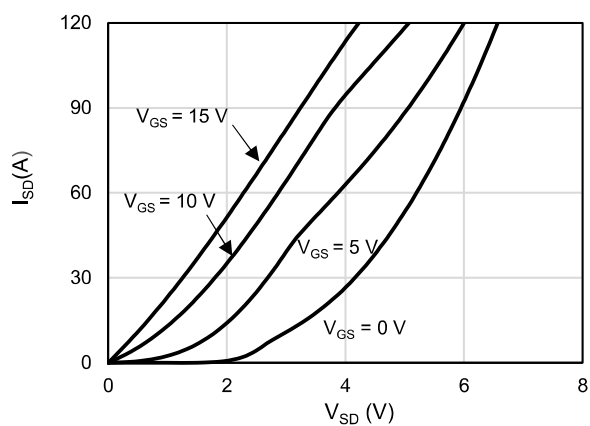


Figure 14. 3rd Quadrant Characteristics ( $T_J = 25^\circ\text{C}$ )

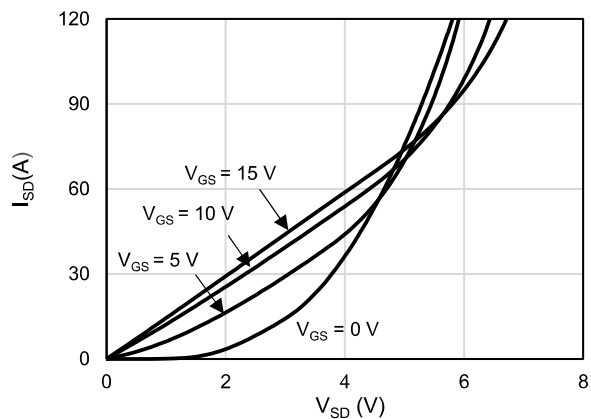


Figure 15. 3rd Quadrant Characteristics ( $T_J = 175^\circ\text{C}$ )

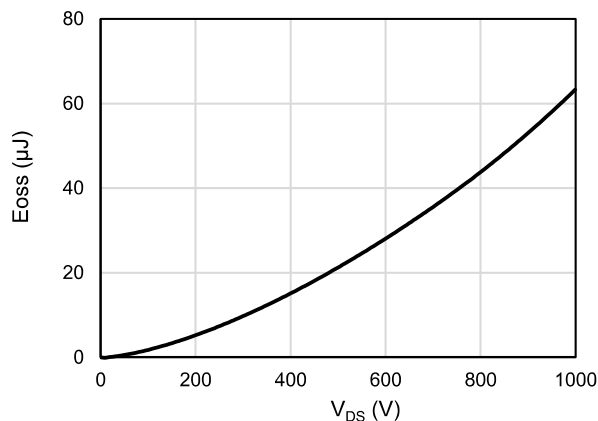


Figure 16. Output Capacitor Stord Energy

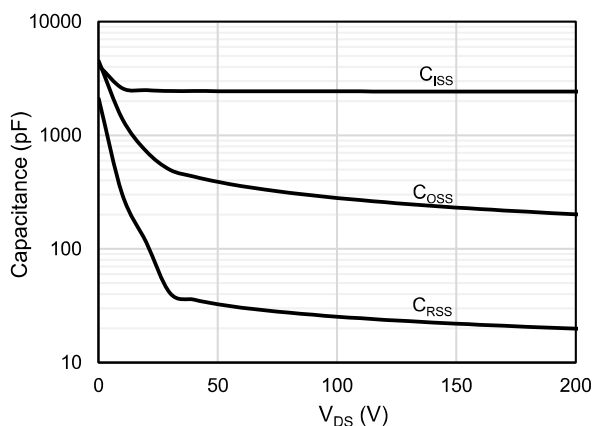


Figure 17. Capacitance Characteristics(0-200V)

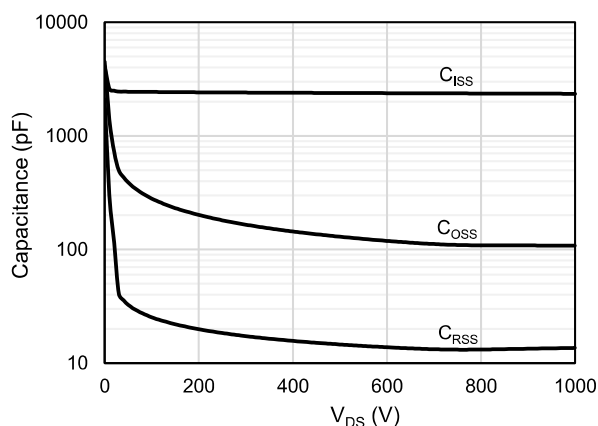


Figure 18. Capacitance Characteristics(0-1000V)

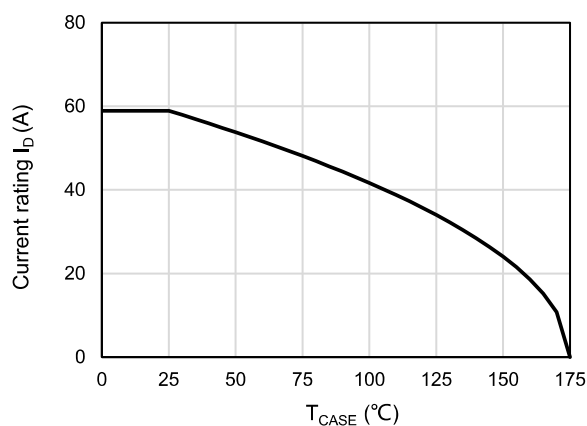


Figure 19. Current De-rating

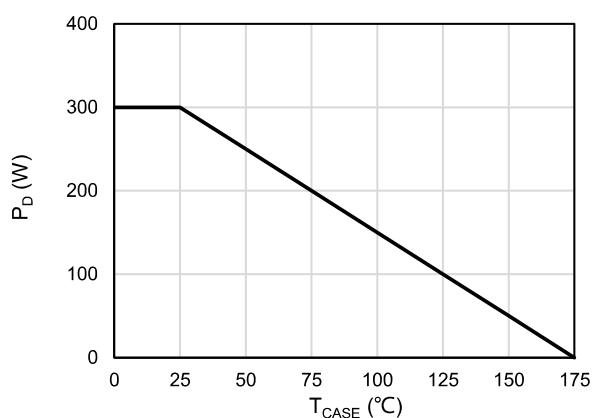


Figure 20. Maximum Power Dissipation De-rating vs. Case Temperature

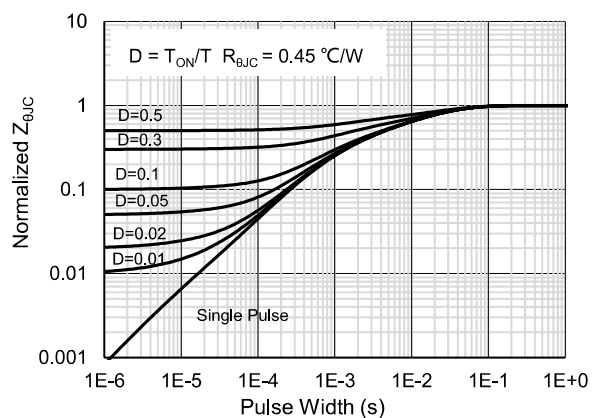


Figure 21. Normalized Maximum Transient Thermal Impedance

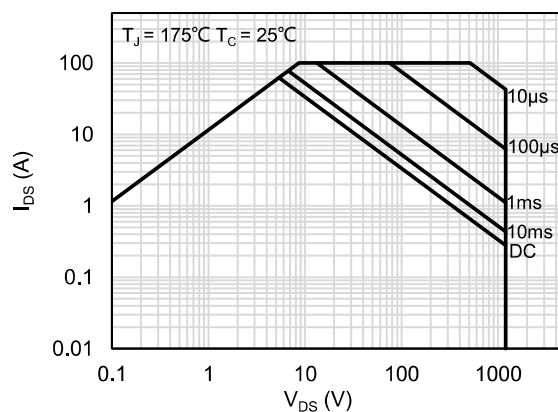


Figure 22. Maximum Forward Biased Safe Operating Area

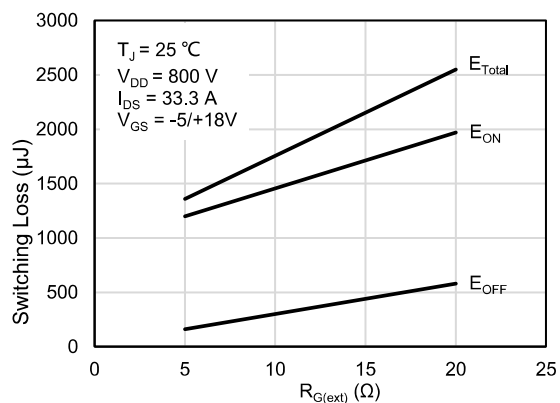


Figure 23. Clamped Inductive Switching Energy vs.  $R_{G(ext)}$

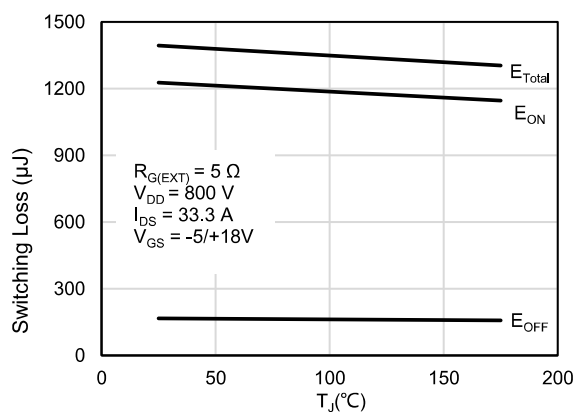


Figure 24. Clamped Inductive Switching Energy vs.  $T_J$

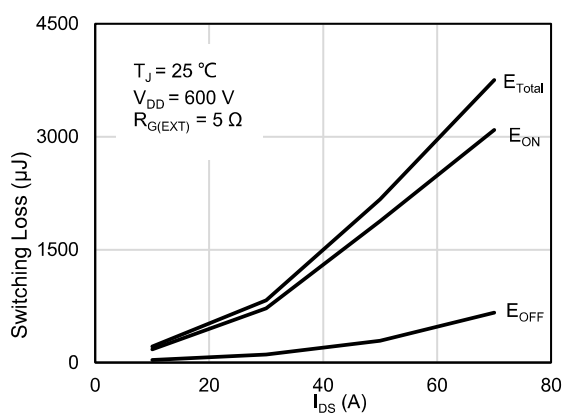


Figure 25. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD}=600V$ )

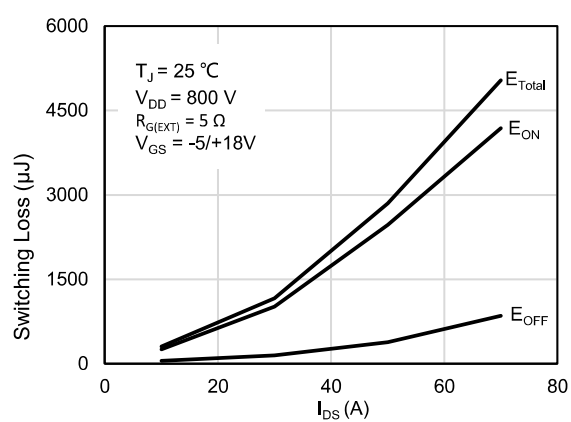
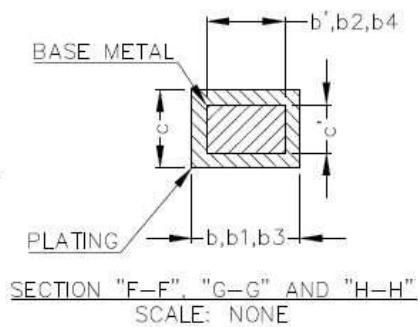
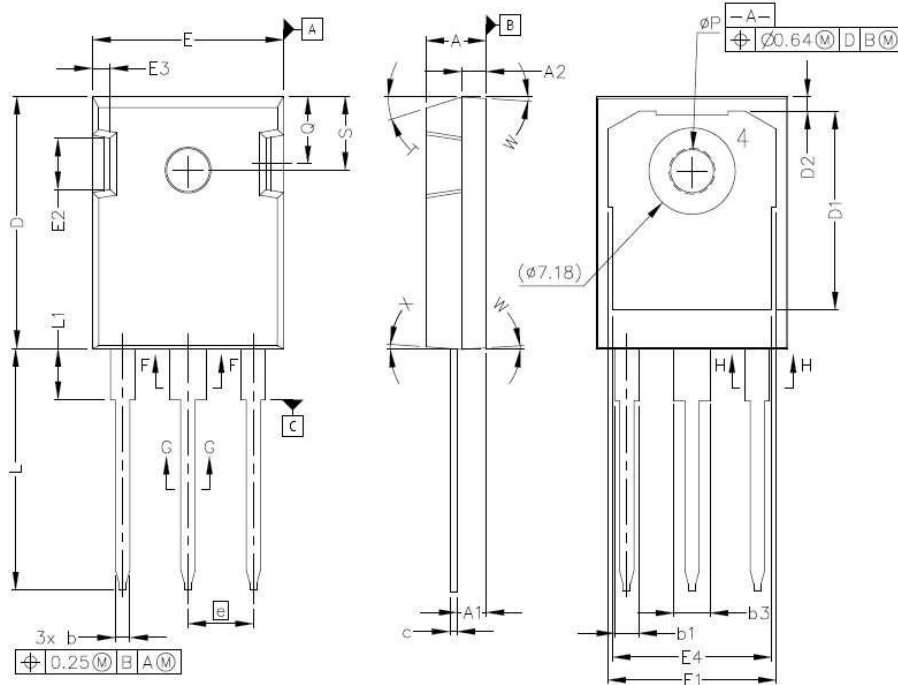


Figure 26. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD}=800V$ )

## 6. Package Mechanical Data

### TO-247-3L Package



| Symbol | MIN        | MAX   |
|--------|------------|-------|
| A      | 4.83       | 5.21  |
| A1     | 2.29       | 2.54  |
| A2     | 1.91       | 2.16  |
| b'     | 1.07       | 1.28  |
| b      | 1.07       | 1.33  |
| b1     | 1.91       | 2.41  |
| b2     | 1.91       | 2.16  |
| b3     | 2.87       | 3.38  |
| b4     | 2.87       | 3.13  |
| c'     | 0.55       | 0.65  |
| c      | 0.55       | 0.68  |
| D      | 20.80      | 21.10 |
| D1     | 16.25      | 17.65 |
| D2     | 0.95       | 1.25  |
| E      | 15.75      | 16.13 |
| E1     | 13.10      | 14.15 |
| E2     | 3.68       | 5.10  |
| E3     | 1.00       | 1.90  |
| E4     | 12.38      | 13.43 |
| e      | 5.44 BSC   |       |
| N      | 3          |       |
| L      | 19.81      | 20.32 |
| L1     | 4.10       | 4.40  |
| ΦP     | 3.51       | 3.65  |
| Q      | 5.49       | 6.00  |
| S      | 6.04       | 6.30  |
| T      | 17.5° REF. |       |
| W      | 3.5° REF.  |       |
| X      | 4° REF.    |       |