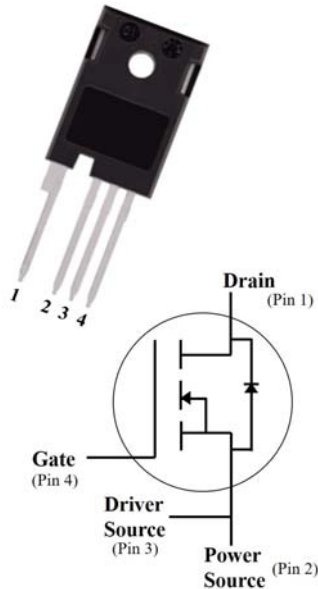


## Silicon Carbide Power MOSFET (N-Channel Enhancement)

|              |       |
|--------------|-------|
| $V_{DS}$     | 1200V |
| $I_D$ (25°C) | 80A   |
| $R_{DS(on)}$ | 25mΩ  |



### Features

- High speed switching
- Essentially no switching losses
- Reduction of heat sink requirements
- Maximum working temperature at 175 °C
- High blocking voltage
- Fast Intrinsic diode with low recovery current
- High-frequency operation
- Halogen free, RoHS compliant

### Typical Applications

Typical applications are in power factor correction(PFC), solar inverter, uninterruptible power supply, motor drives, photovoltaic inverter, electric car and charger.

### Mechanical Data

- **Package:** TO-247-4L
- **Terminals:** Tin plated leads
- **Polarity:** As marked

### ■Maximum Ratings (T<sub>c</sub>=25°C Unless otherwise specified)

| PARAMETER                                        | SYMBOL          | UNIT | VALUE         | TEST CONDITIONS                                 | NOTE   |
|--------------------------------------------------|-----------------|------|---------------|-------------------------------------------------|--------|
| Device marking code                              |                 |      | D212025NCFYG3 |                                                 |        |
| Drain source voltage @ T <sub>j</sub> =25°C      | $V_{DS,max}$    | V    | 1200          | $V_{GS}=0V, I_D=100\mu A$                       |        |
| Gate source voltage @ T <sub>j</sub> =25°C       | $V_{GS,max}$    | V    | -8/+22        | Absolute maximum values                         |        |
| Gate source voltage @ T <sub>j</sub> =25°C       | $V_{GS,op}$     | V    | -4/+18        | Recommended operational values                  |        |
| Continuous drain current @ T <sub>c</sub> =25°C  | $I_D$           | A    | 80            | $V_{GS}=18V, T_c=25^\circ C$                    | Fig.17 |
| Continuous drain current @ T <sub>c</sub> =100°C |                 |      | 55            | $V_{GS}=18V, T_c=100^\circ C$                   |        |
| Pulsed drain current                             | $I_{D(pulsed)}$ | A    | 178           | Pulse width $t_p$ limited by T <sub>j,max</sub> | Fig.22 |
| Avalanche energy,Single pulse                    | $E_{AS}$        | J    | 1.1           | $V_{DD}=75V, L=30mH$                            |        |
| Power Dissipation                                | $P_{TOT}$       | W    | 365           | $T_c=25^\circ C, T_j = 175^\circ C$             | Fig.16 |
| Power Dissipation                                |                 |      | 182           | $T_c=100^\circ C, T_j = 175^\circ C$            |        |
| Operating junction and Storage temperature range | $T_j, T_{stg}$  | °C   | -55 to +175   |                                                 |        |
| Soldering temperature                            | $T_L$           | °C   | 260           | 1.6mm (0.063") from case for 10s                |        |
| Mounting torque                                  | $T_M$           | Nm   | 0.6           | M3 screw Maximum of mounting process: 3         |        |



## ■Static Electrical Characteristics (Tc=25°C unless otherwise specified)

| PARAMETER                                | SYMBOL        | UNIT | Min. | Typ. | Max. | Test Conditions                                  | Note        |
|------------------------------------------|---------------|------|------|------|------|--------------------------------------------------|-------------|
| Gate threshold voltage                   | $V_{GS(th)}$  | V    | 2.0  | 2.7  | 4.0  | $V_{DS}=V_{GS}$ , $I_D=15mA$                     | Fig.4, 11   |
|                                          |               |      |      | 2.0  |      | $V_{DS}=V_{GS}$ , $I_D=15mA$ , $T_j=175^\circ C$ |             |
| Drain source breakdown voltage           | $V_{(BR)DSS}$ | V    | 1200 |      |      | $V_{GS}=0V$ , $I_D=100\mu A$                     |             |
| Gate source leakage current              | $I_{GSS}$     | nA   |      | 10   | 100  | $V_{GS}=18V$ , $V_{DS}=0V$                       |             |
| Current drain source on-state resistance | $R_{DS(on)}$  | mΩ   |      | 25   | 40   | $V_{GS}=18V$ , $I_D=40A$                         | Fig.5, 6, 7 |
|                                          |               |      |      | 46   |      | $V_{GS}=18V$ , $I_D=40A$ , $T_j=175^\circ C$     |             |
| Transconductance                         | $g_f$         | S    |      | 28   |      | $V_{DS}=20V$ , $I_D=40A$                         | Fig.4       |
|                                          |               |      |      | 26   |      | $V_{DS}=20V$ , $I_D=40A$ , $T_j=175^\circ C$     |             |

## ■Dynamic Electrical Characteristics (Tc=25°C unless otherwise specified)

| PARAMETER                | SYMBOL    | UNIT | Min. | Typ. | Max. | Test Conditions                                                                | Note       |
|--------------------------|-----------|------|------|------|------|--------------------------------------------------------------------------------|------------|
| Input capacitance        | $C_{iss}$ | pF   |      | 4710 |      | $V_{DS}=800V$ , $V_{GS}=0V$ , $T_j=25^\circ C$ ,<br>$f=100kHz$ , $V_{AC}=25mV$ | Fig.13, 14 |
| Output capacitance       | $C_{oss}$ |      |      | 160  |      |                                                                                |            |
| Reverse capacitance      | $C_{rss}$ |      |      | 6.8  |      |                                                                                |            |
| Coss stored energy       | $E_{oss}$ | uJ   |      | 84   |      |                                                                                | Fig.15     |
| Gate source charge       | $Q_{gs}$  | nC   |      | 40   |      | $V_{DS}=800V$ , $V_{GS}=-4/18V$ , $I_D=40A$                                    | Fig.12     |
| Gate drain charge        | $Q_{gd}$  |      |      | 61   |      |                                                                                |            |
| Gate charge              | $Q_g$     |      |      | 152  |      |                                                                                |            |
| Internal gate resistance | $R_g$     | Ω    |      | 2    |      | $f=1MHz$                                                                       |            |

## ■Switching Characteristics (Tc=25°C unless otherwise specified)

| PARAMETER                 | SYMBOL       | UNIT | Min. | Typ. | Max. | Test Conditions                                                                  | Note       |
|---------------------------|--------------|------|------|------|------|----------------------------------------------------------------------------------|------------|
| Turn on switching energy  | $E_{on}$     | uJ   |      | 580  |      | $V_{DD}=800V$ , $V_{GS}=-4/+18V$ , $I_D=40A$ ,<br>$R_g=2.4\Omega$ , $L=100\mu H$ | Fig.19, 20 |
| Turn off switching energy | $E_{off}$    |      |      | 249  |      |                                                                                  |            |
| Turn on delay time        | $t_{d(on)}$  | ns   |      | 19   |      | $V_{DD}=800V$ , $V_{GS}=-4/+18V$ , $I_D=40A$ ,<br>$R_g=2.4\Omega$ , $L=100\mu H$ | Fig.21     |
| Rise time                 | $t_r$        |      |      | 37.5 |      |                                                                                  |            |
| Turn off delay time       | $t_{d(off)}$ | ns   |      | 25   |      |                                                                                  |            |
| Fall time                 | $t_f$        |      |      | 14   |      |                                                                                  |            |

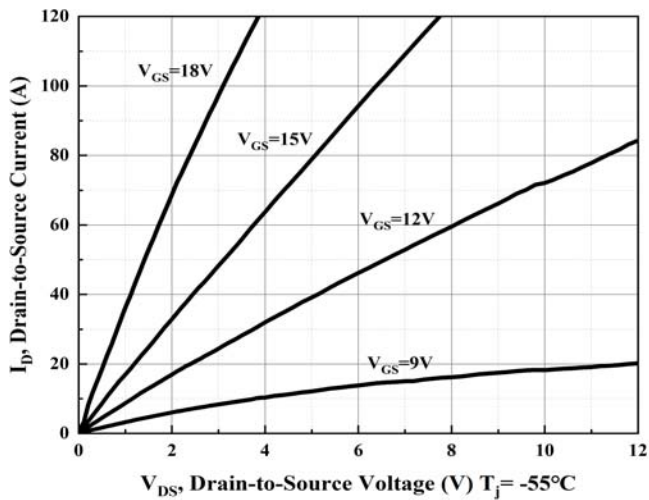
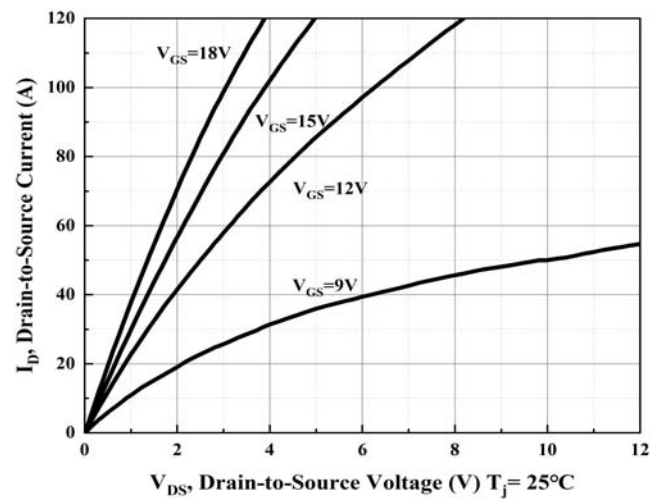
■Body diode characteristics (T<sub>c</sub>=25°C unless otherwise specified )

| PARAMETER                        | SYMBOL           | UNIT | Min. | Typ. | Max. | Test Conditions                                                                    | Note  |
|----------------------------------|------------------|------|------|------|------|------------------------------------------------------------------------------------|-------|
| Diode forward voltage            | V <sub>SD</sub>  | V    |      | 4.8  |      | V <sub>GS</sub> =-4V, I <sub>SD</sub> =20A                                         | Fig.8 |
|                                  |                  |      |      | 3    |      | V <sub>GS</sub> =0V, I <sub>SD</sub> =20A, T <sub>j</sub> =175°C                   | Fig.9 |
| Continuous diode forward current | I <sub>S</sub>   | A    |      | 70   |      | T <sub>c</sub> =25°C                                                               |       |
| Reverse recovery time            | t <sub>rr</sub>  | nS   |      | 48   |      | V <sub>R</sub> =800V, V <sub>GS</sub> =-4V, I <sub>D</sub> =40A,<br>di/dt=2500A/uS |       |
| Reverse recovery charge          | Q <sub>rr</sub>  | nC   |      | 323  |      |                                                                                    |       |
| Peak reverse recovery current    | I <sub>rrm</sub> | A    |      | 11   |      |                                                                                    |       |

■Thermal Characteristics (T<sub>a</sub>=25°C Unless otherwise specified )

| PARAMETER          | SYMBOL            | UNIT | Typ. |
|--------------------|-------------------|------|------|
| Thermal resistance | R <sub>θJ-C</sub> | °C/W | 0.41 |

## ■Typical Characteristics

Figure 1. Output Characteristics T<sub>j</sub> = -55°CFigure2. Output Characteristics T<sub>j</sub> = 25°C

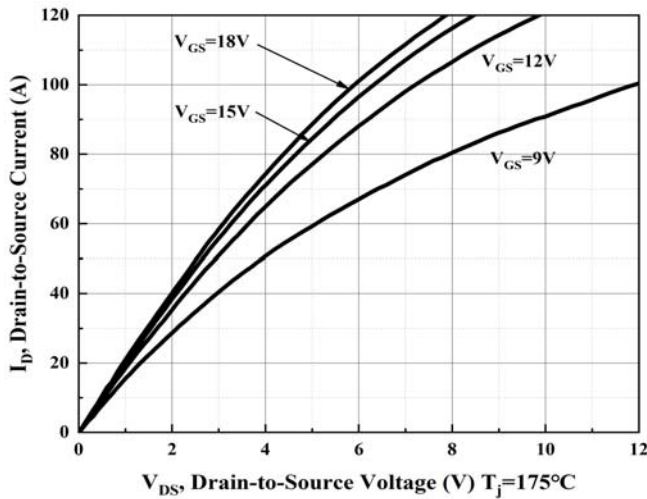


Figure 3. Output Characteristics  $T_j = 175^\circ\text{C}$

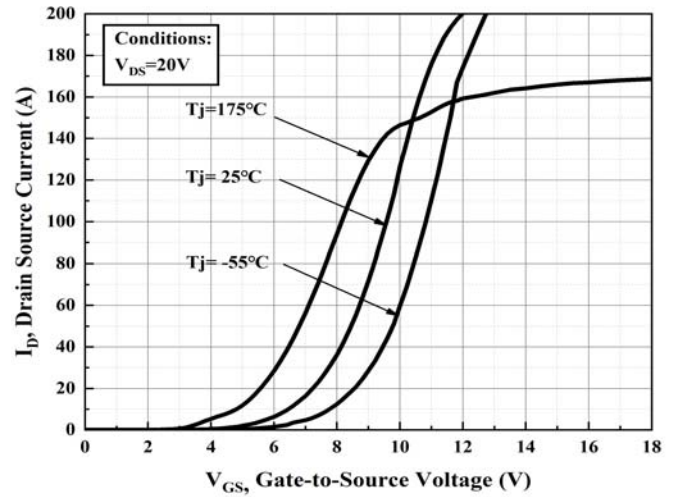


Figure 4. Transfer Characteristics for Various Junction Temperature

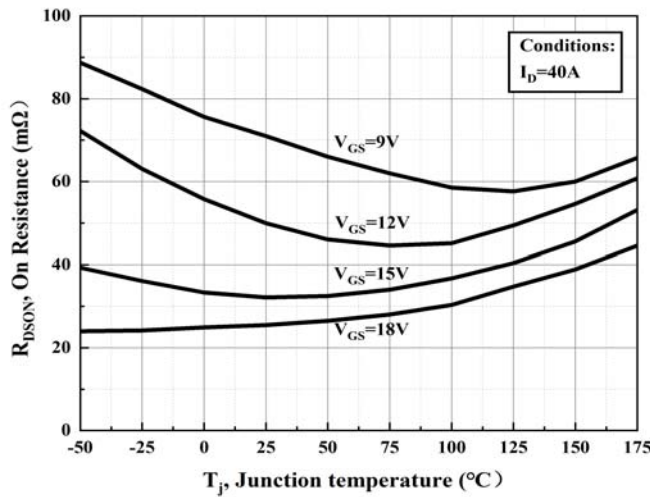


Figure 5. On-resistance vs. Temperature for Various Gate Voltage

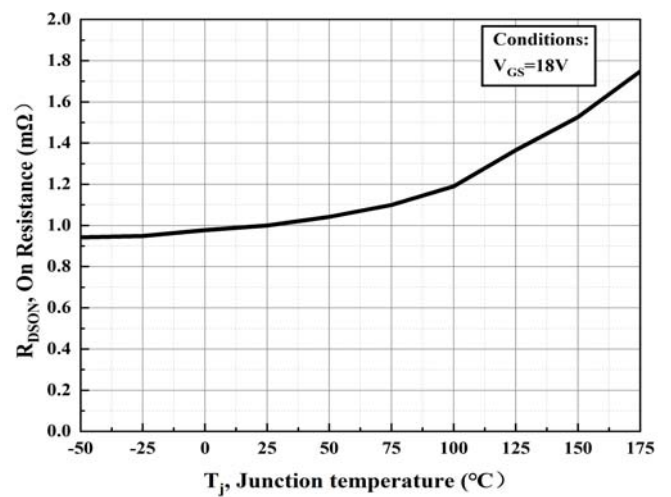


Figure 6. Normalized on-resistance vs. Temperature

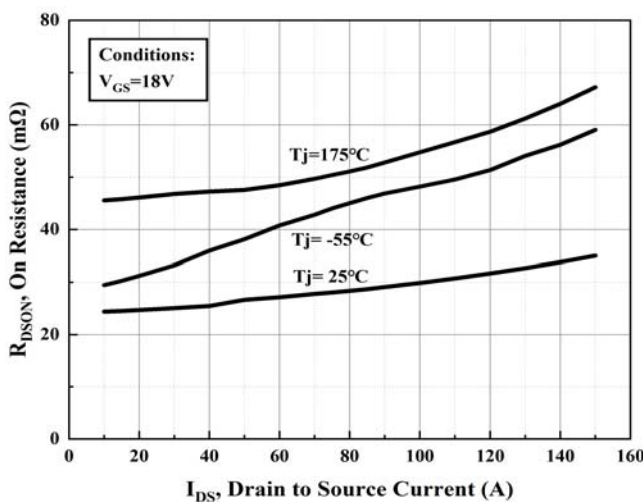


Figure 7. On-resistance vs. Drain Current

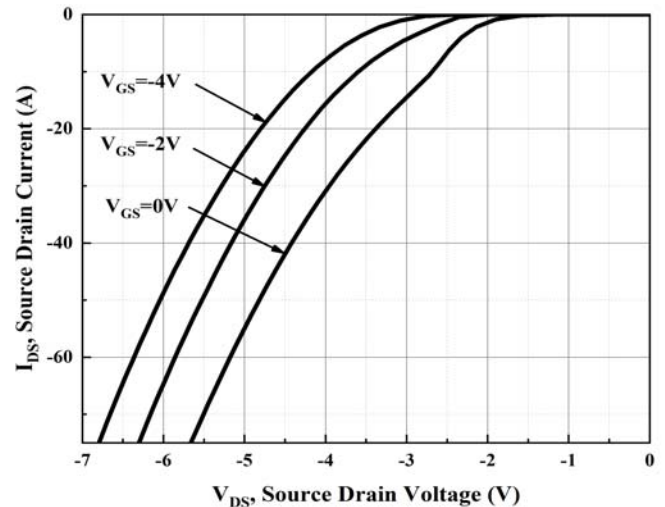


Figure 8. Body Diode Characteristic at  $T_j = 25^\circ\text{C}$

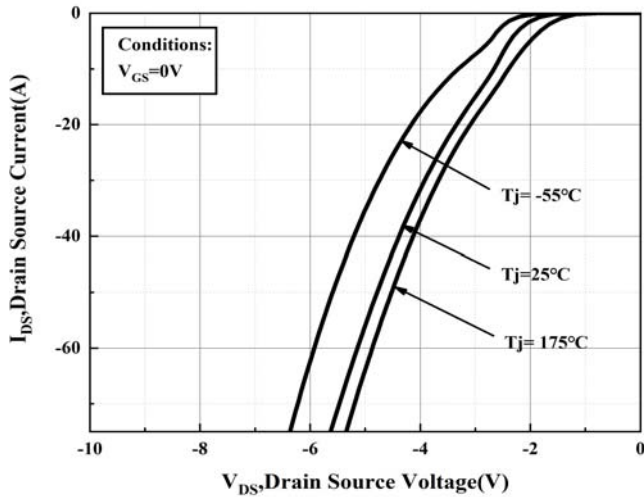


Figure 9. Body Diode Characteristic

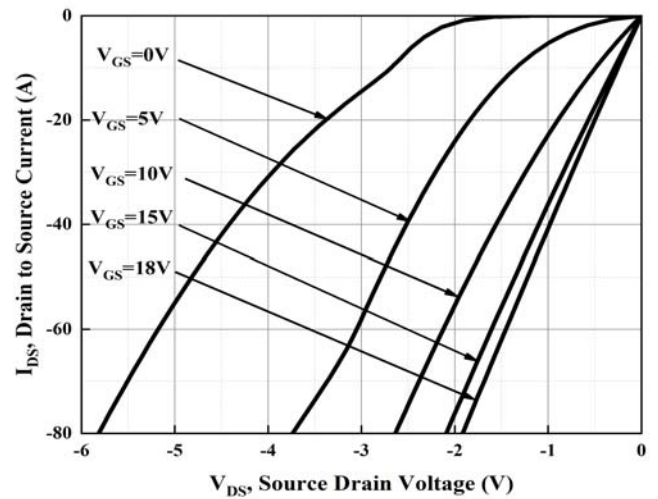
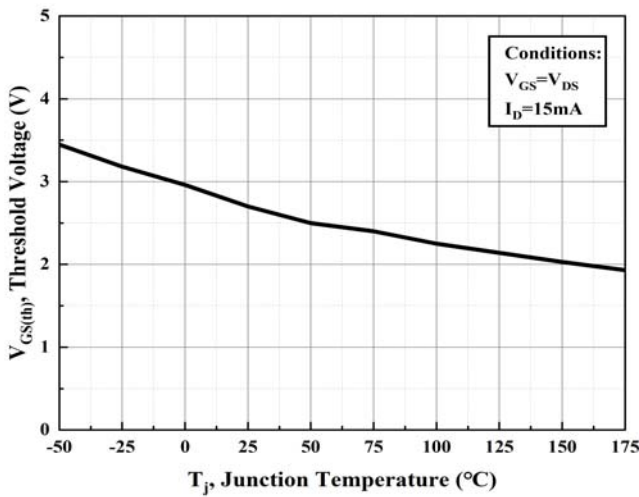

Figure 10. 3<sup>rd</sup> quadrant Characteristic at Tj= 25 °C


Figure 11. Threshold Voltage vs. Temperature

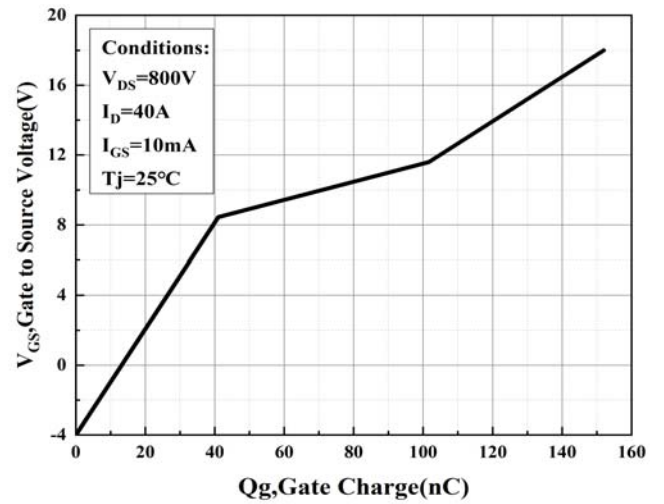


Figure 12. Gate Charge Characteristic

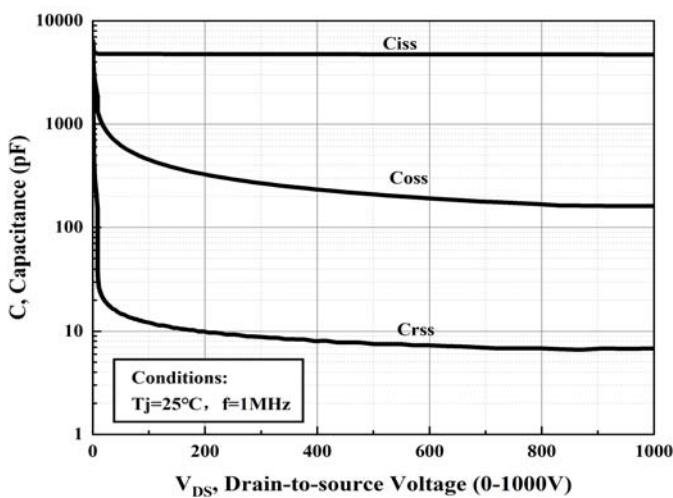


Figure 13. Capacitances vs. Drain Source Voltage (0-1000V)

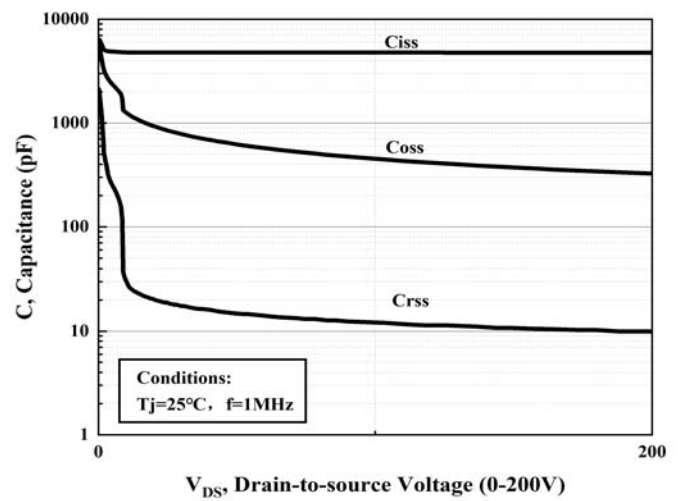


Figure 14. Capacitances vs. Drain Source Voltage (0-200V)

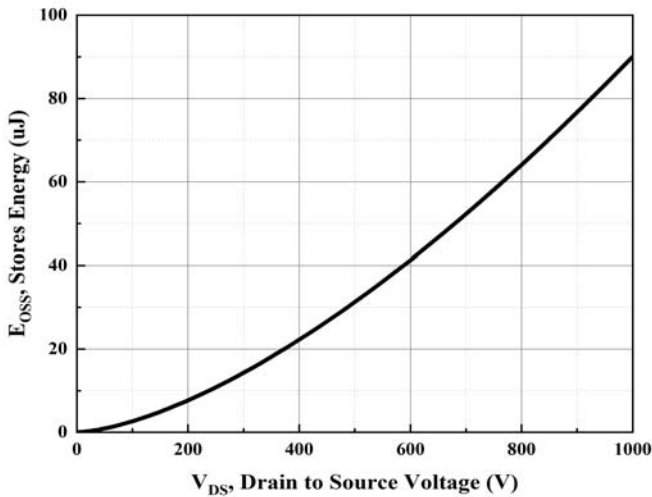


Figure 15. Output Capacitor Stored Energy

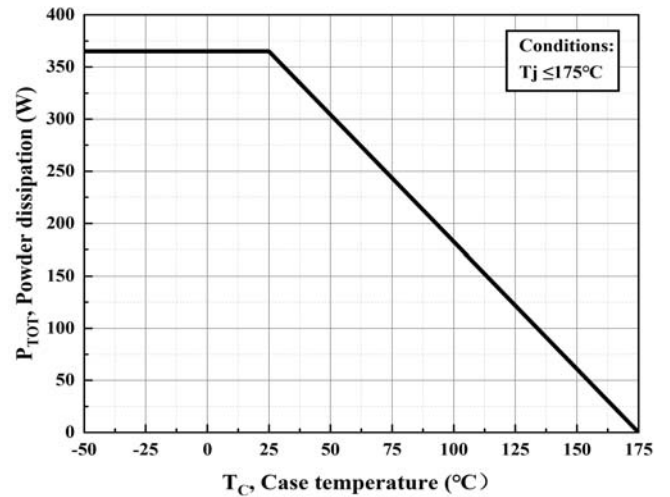


Figure 16. Maximum Power Dissipation Derating vs. Case Temperature

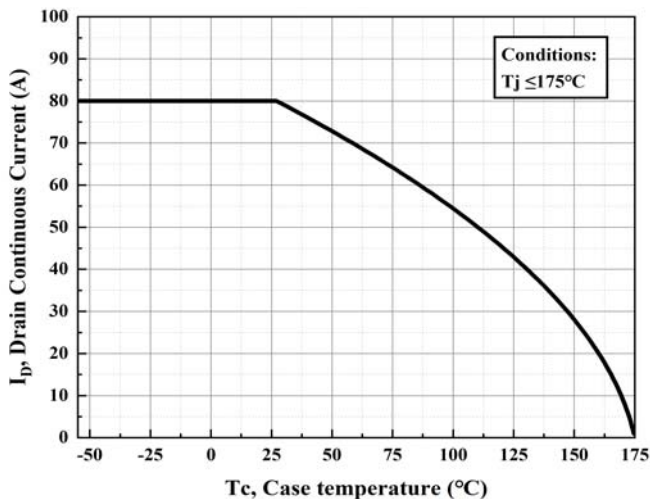


Figure 17. Continuous Drain Current Derating vs. Case Temperature

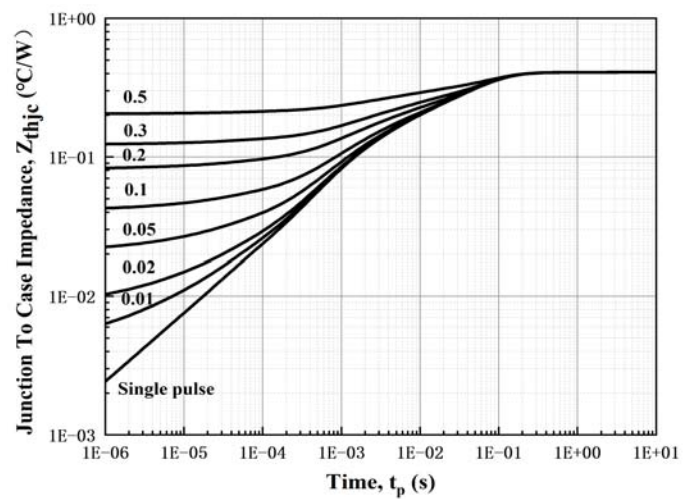


Figure 18 Transient Thermal Impedance (Junction - Case)

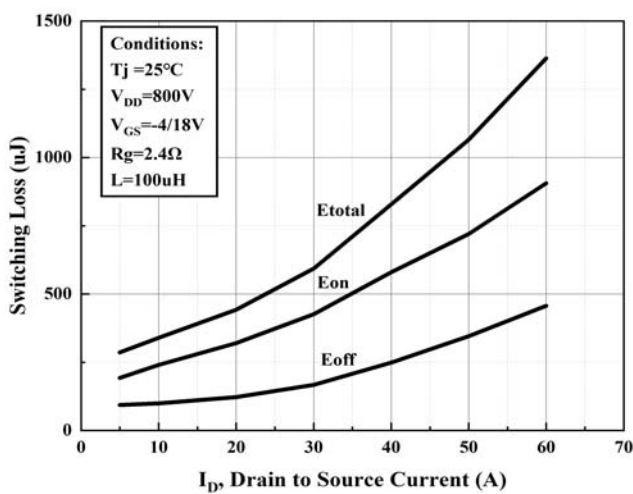


Figure 19. Clamped Inductive Switching Energy vs. Drain Current

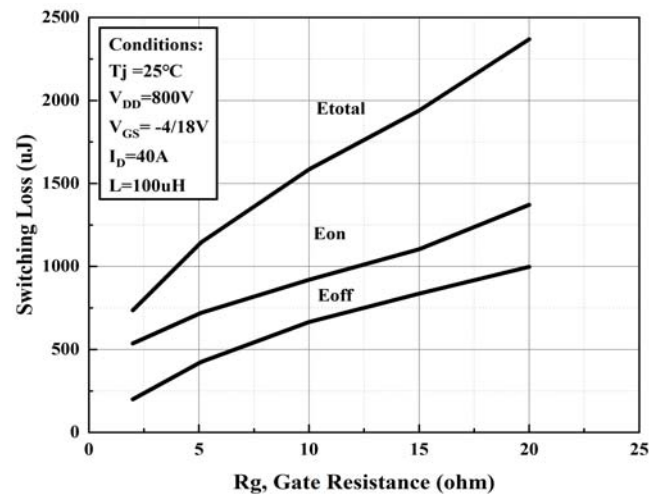


Figure 20. Clamped Inductive Switching Energy vs. Rg

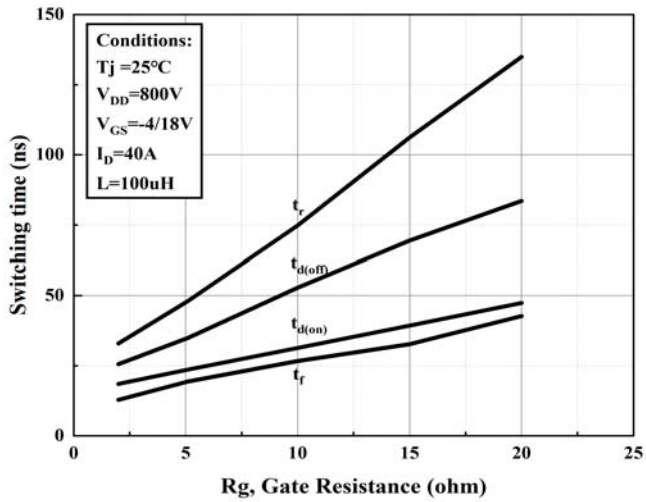


Figure 21. Switching Times vs.  $R_g$

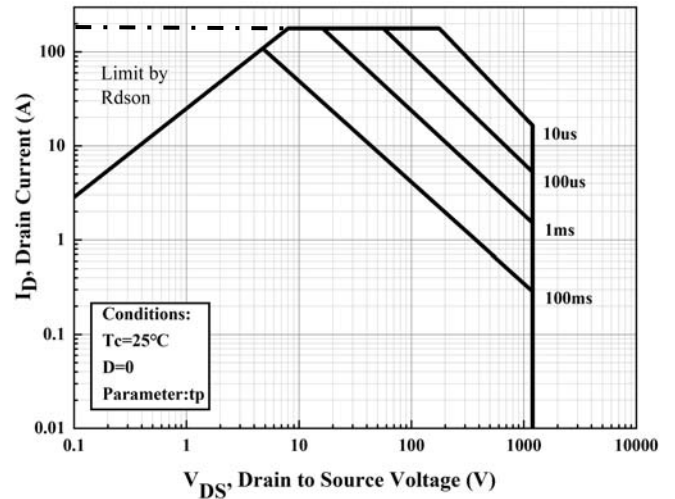


Figure 22. Safe Operating Area

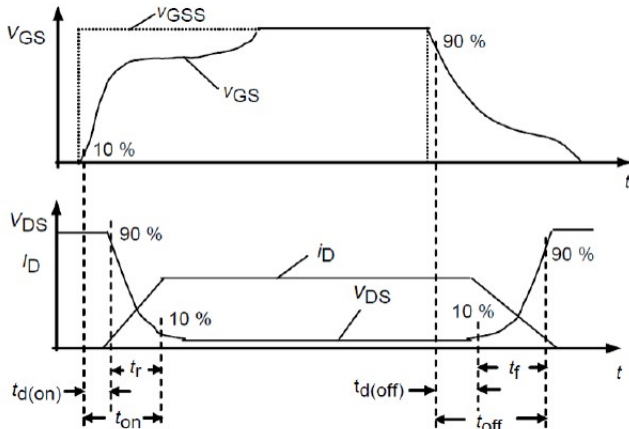


Figure 23. Switching Times Definition

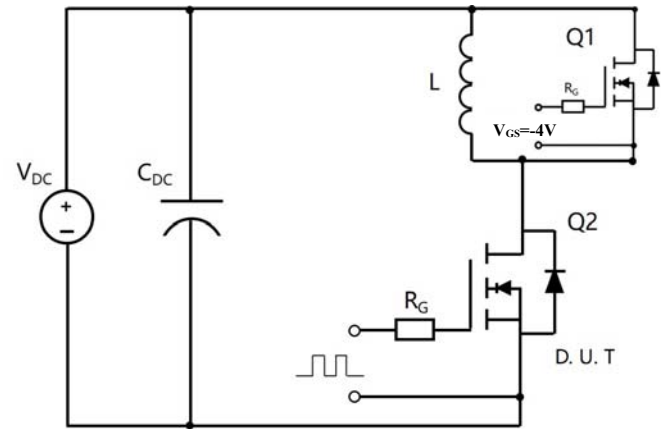
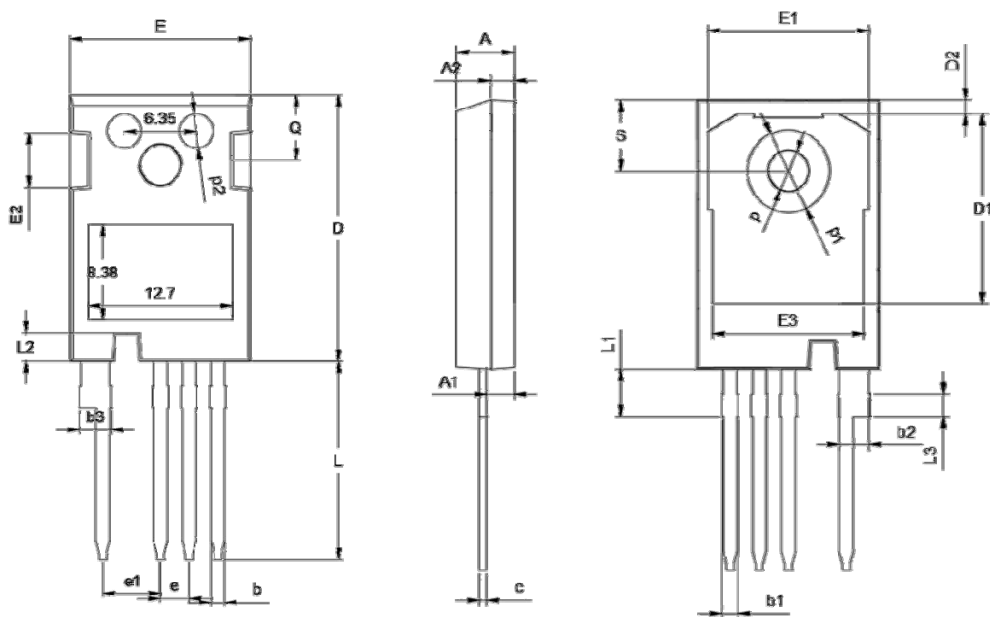


Figure 24. Clamped Inductive Switching Waveform Test Circuit

## ■Outline Dimensions



| TO247-4L |         |       |       |
|----------|---------|-------|-------|
| Dim      | Min     | Norm  | Max   |
| A        | 4.80    | 5.00  | 5.20  |
| A1       | 2.30    | 2.40  | 2.50  |
| A2       | 1.88    | 1.98  | 2.08  |
| b        | 1.10    | 1.20  | 1.30  |
| b1       | 1.20    | /     | 1.50  |
| b2       | 2.35    | 2.55  | 2.75  |
| b3       | 2.45    | /     | 2.85  |
| c        | 0.55    | 0.60  | 0.65  |
| D        | 23.3    | 23.45 | 23.6  |
| D1       | 16.25   | 16.55 | 16.85 |
| D2       | 1.00    | /     | 1.30  |
| e        | TYP2.54 |       |       |
| e1       | TYP5.06 |       |       |
| E        | 15.75   | 15.90 | 16.05 |
| E1       | 13.80   | /     | 14.20 |
| E2       | 4.40    | 4.75  | 5.10  |
| E3       | 13.00   | /     | 13.45 |
| L        | 17.34   | 17.49 | 17.64 |
| L1       | 4.00    | /     | 4.30  |
| L2       | 2.35    | /     | 2.65  |
| L3       | TYP1.98 |       |       |
| Q        | 5.60    | 5.80  | 6.00  |
| S        | 6.05    | /     | 6.30  |
| p        | TYP3.58 |       |       |
| p1       | TYP7.18 |       |       |
| p2       | TYP3.00 |       |       |



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