# ASC60N650MT3

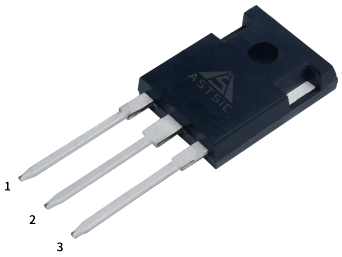
650V, 60A, 30mΩ, N-Channel, Silicon Carbide MOSFET

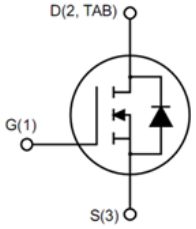
Product Data Sheet ASTC-3T04-15A A/2

爱仕特科技
AST TECHNOLOGY

## General Description

The AST-MT3 series SiC MOSFET in TO-247-3L package ensures stable high-temperature operation for power-dense and energy-critical systems, enabling compact designs with reduced EMI.




## Features

- 3rd Generation SiC MOSFET Technology
- High-Speed Switching with Low Capacitances
- High Blocking Voltage with Low $R_{DS(on)}$
- Easy to parallel and Simple to Drive
- RoHS Compliant, Halogen Free

## Applications

- EV Charging
- DC/DC Converters
- Switch Mode Power Supplies
- Power Factor Correction Modules
- Solar PV Inverters

## Ordering Informations

| Order Number / Marking | ASC60N650MT3 |
|---|---|
| Package Type | TO-247-3L |
| Packing Method | Tube |

## Key Parameters

| Symbol | Parameter | Values | | | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| **Absolute maximum rating** | | | | | | |
| $V_{DS}$ | Drain-Source Voltage | | 650 | | V | $T_C$=25°C |
| $I_D$ | Drain Current (Continuous) | | 60 | | A | $T_C$=25°C |
| $P_D$ | Power Dissipation | | 395 | | W | $T_C$=25°C |
| $T_J$ | Junction Temperature | | 175 | | °C | |
| **Symbol** | **Parameter** | **Min.** | **Typ.** | **Max.** | **Unit** | **Test Conditions** |
| **Static characteristics** | | | | | | |
| $R_{DS(on)}$ | Static Drain-Source on Resistance | - | 30 | 38 | mΩ | $V_{GS}$=18V; $I_D$=30A; $T_J$=25°C |
| | | - | 42 | - | | $V_{GS}$=18V; $I_D$=30A; $T_J$=175°C |
| **Dynamic characteristics** | | | | | | |
| $Q_G$ | Total Gate Charge | - | 128 | - | nC | $V_{DS}$=400V; $V_{GS}$=-5/+18V; $I_D$=30A; $T_J$=25°C |
| $Q_{GD}$ | Gate-Drain Charge | - | 24 | - | | |
| **Source-drain diode** | | | | | | |
| $Q_{rr}$ | Reverse Recovery Charge | - | 160 | - | nC | $V_{GS}$=-5V; $I_F$=15A; $V_R$=400V; di/dt=2400A/μs; $T_J$=175°C |

## Absolute Maximum Ratings (at $T_C$=25°C unless otherwise specified)

| Symbol | Parameter | Values | Unit |
|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage | 650 | V |
| $I_D$ | Drain Current (Continuous; $T_C$=25°C) | 60 | A |
| | Drain Current (Continuous; $T_C$=100°C) | 48 | |
| $I_{DM}$ | Drain Current (Pulsed) | 135 | A |
| $V_{GS}$ | Gate-Source Voltage | -10/+22 | V |
| $P_D$ | Power Dissipation | 395 | W |
| $T_J$; $T_{stg}$ | Junction and Storage Temperature Range | -55 to +175 | °C |

## MOSFET Characteristics

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| **Static characteristics (at $T_J$=25°C unless otherwise specified)** | | | | | | |
| $BV_{DS}$ | Drain-Source Breakdown Voltage | 650 | - | - | V | $I_D$=250μA; $V_{GS}$=0V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | - | 5 | 100 | μA | $V_{DS}$=650V; $V_{GS}$=0V |
| $I_{GSS}$ | Gate-Body Leakage Current | - | 10 | 100 | nA | $V_{GS}$=-10 to 20V; $V_{DS}$=0V |
| $V_{GS(th)}$ | Gate Threshold Voltage | 2 | 3 | 4 | V | $V_{DS}$=$V_{GS}$; $I_D$=10mA |
| $V_{GS(on)}$ | Recommended Turn-on Voltage | - | 18 | - | V | Static |
| $V_{GS(off)}$ | Recommended Turn-off Voltage | - | -5 | - | | |
| $R_{DS(on)}$ | Static Drain-Source on Resistance | - | 30 | 38 | mΩ | $V_{GS}$=18V; $I_D$=30A; $T_J$=25°C |
| | | - | 42 | - | | $V_{GS}$=18V; $I_D$=30A; $T_J$=175°C |
| **Dynamic characteristics (at $T_J$=25°C unless otherwise specified)** | | | | | | |
| $C_{iss}$ | Input Capacitance | - | 2112 | - | pF | $V_{DS}$=600V; f=1MHz; $V_{AC}$=25mV |
| $C_{oss}$ | Output Capacitance | - | 212 | - | | |
| $C_{rss}$ | Reverse Transfer Capacitance | - | 5 | - | | |
| $g_{fs}$ | Transconductance | - | 23 | - | S | $V_{DS}$=20V; $I_D$=30A |
| $E_{oss}$ | $C_{oss}$ Stored Energy | - | 12 | - | μJ | $V_{DS}$=400V; f=1MHz |
| $E_{on}$ | Turn-on Energy (Body Diode) | - | 220 | - | μJ | $V_{DS}$=400V; $V_{GS}$=-5/+18V; $I_D$=30A; L=100μH; $R_{G(ext)}$=2.5Ω; $T_J$=175°C |
| $E_{off}$ | Turn-off Energy (Body Diode) | - | 45 | - | | |
| $Q_G$ | Total Gate Charge | - | 128 | - | nC | $V_{DS}$=400V; $V_{GS}$=-5/+18V; $I_D$=30A |
| $Q_{GS}$ | Gate-Source Charge | - | 33 | - | | |
| $Q_{GD}$ | Gate-Drain Charge | - | 24 | - | | |
| $R_{G(int)}$ | Internal Gate Resistance | - | 4.1 | - | Ω | f=1MHz; $V_{AC}$=25mV |
| $t_{d(on)}$ | Turn-on Delay Time | - | 12 | - | ns | $V_{DS}$=400V; $V_{GS}$=-5/+18V; $I_D$=30A; $R_{G(ext)}$=2.5Ω; Load=100μH |
| $t_r$ | Rise Time | - | 35 | - | | |
| $t_{d(off)}$ | Turn-off Delay Time | - | 22 | - | | |
| $t_f$ | Fall Time | - | 9 | - | | |

## Body Diode Characteristics (at $T_J$=25°C unless otherwise specified)

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| $V_{SD}$ | Diode Forward Voltage | - | 3.5 | 6 | V | $V_{GS}$=0V; $I_F$=20A; $T_J$=25°C |
| | | - | 3.0 | 6 | | $V_{GS}$=0V; $I_F$=20A; $T_J$=175°C |
| $I_S$ | Continuous Diode Forward Current | - | 55 | - | A | $V_{GS}$=0V; $T_C$=25°C |
| $t_{rr}$ | Reverse Recovery Time | - | 18 | - | ns | $V_{GS}$=-5V; $I_F$=15A; $V_R$=400V; di/dt=2400A/μs; $T_J$=175°C |
| $Q_{rr}$ | Reverse Recovery Charge | - | 160 | - | nC | |
| $I_{rrm}$ | Peak Reverse Recovery Current | - | 8.5 | - | A | |

## Thermal Characteristics

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | 0.38 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 40 | °C/W |

The values are based on Junction-to-Case Thermal Impedance measured with the device mounted to a large heat sink, assuming a maximum junction temperature of $T_{J(max)}$=175°C.

## Typical Performance

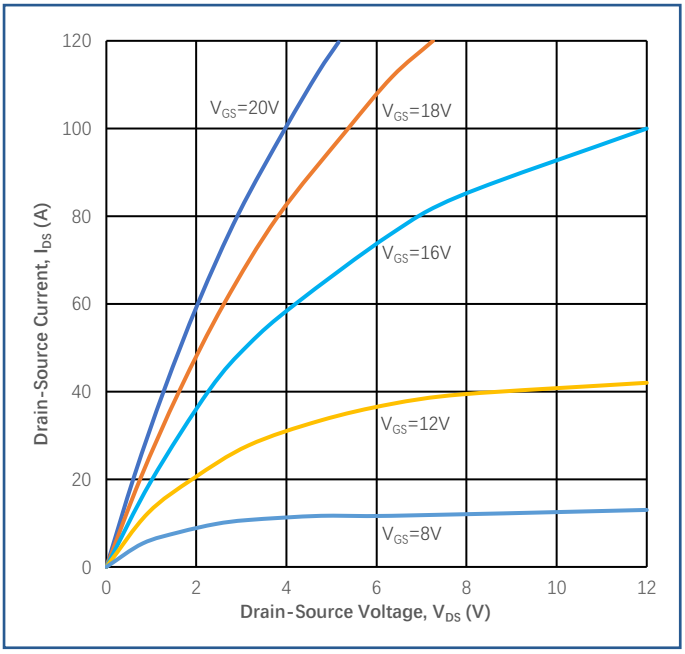



**Figure 1**
Output Characteristics ($T_J$=25 °C)

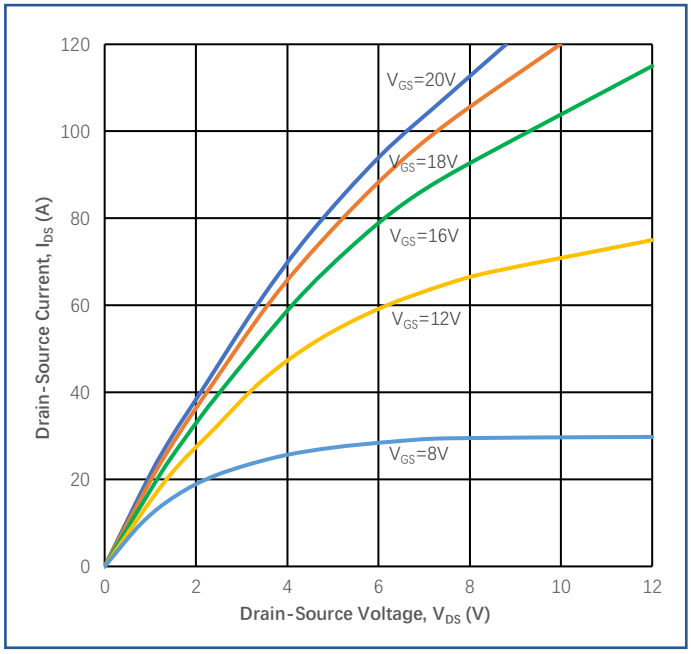



**Figure 2**
Output Characteristics ($T_J$=175°C)

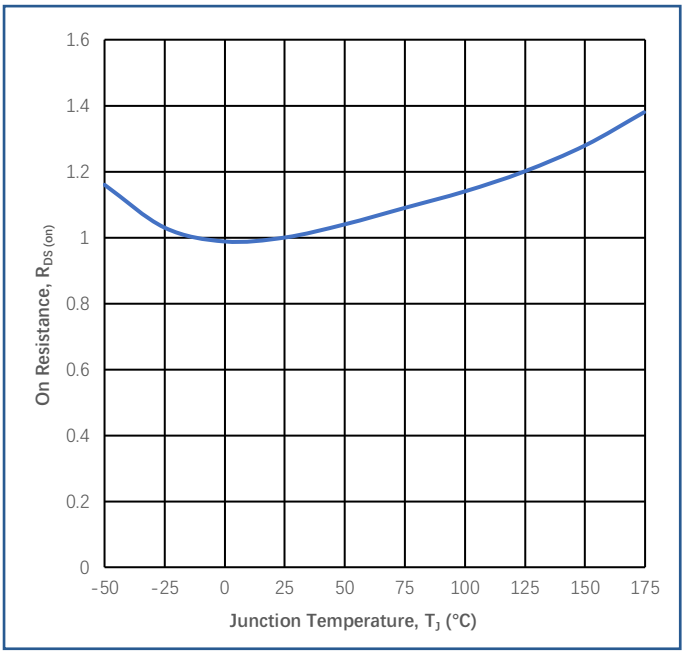



**Figure 3**
Normalized On-Resistance vs. Temperature

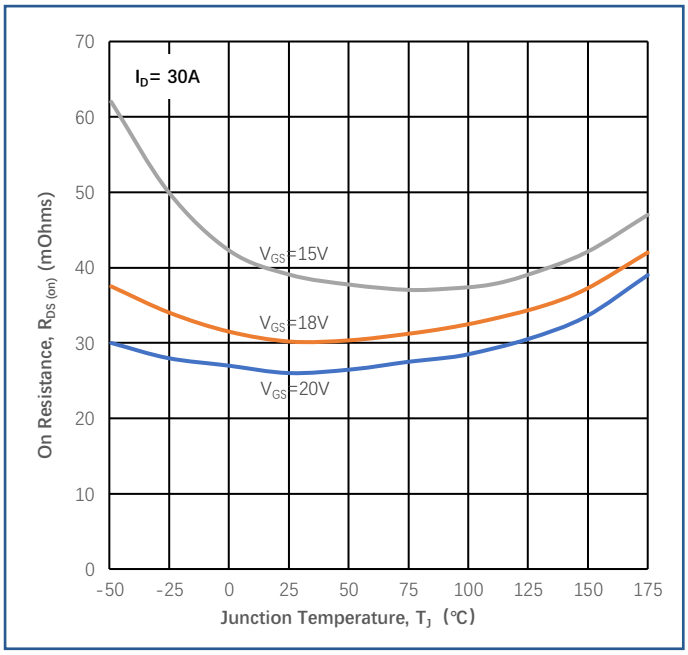



**Figure 4**
On-Resistance vs. Temperature

## Typical Performance

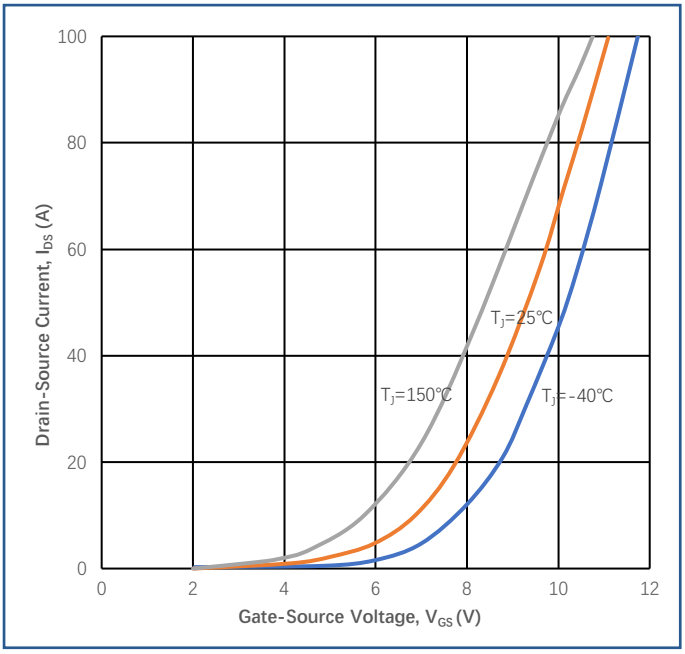



**Figure 5**
Transfer Characteristic

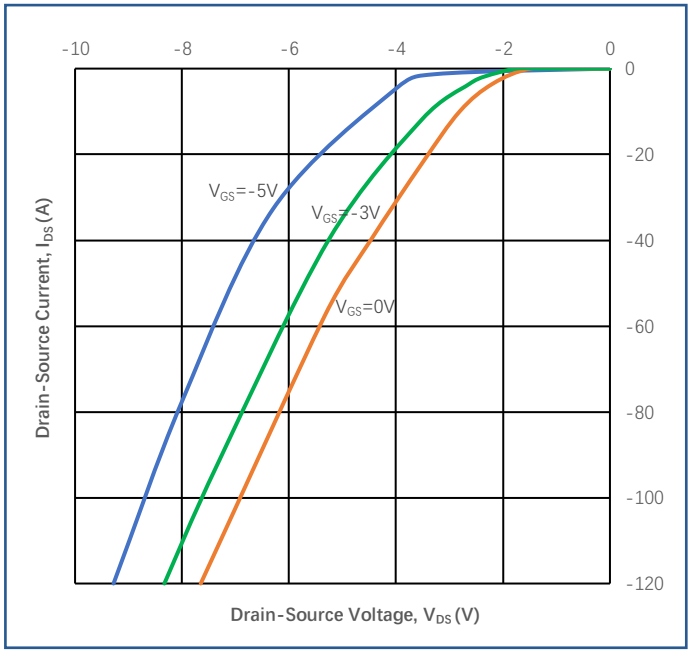



**Figure 6**
Body Diode Characteristic at 25°C

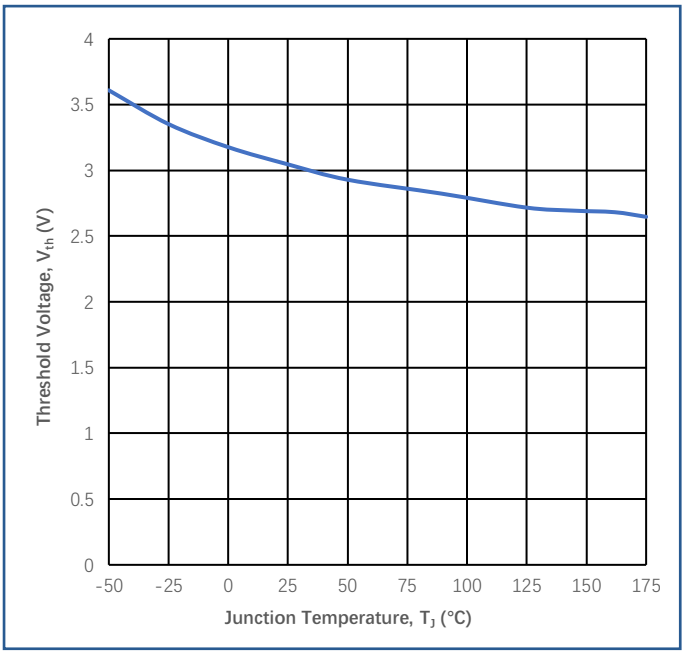



**Figure 7**
Threshold Voltage vs. Temperature

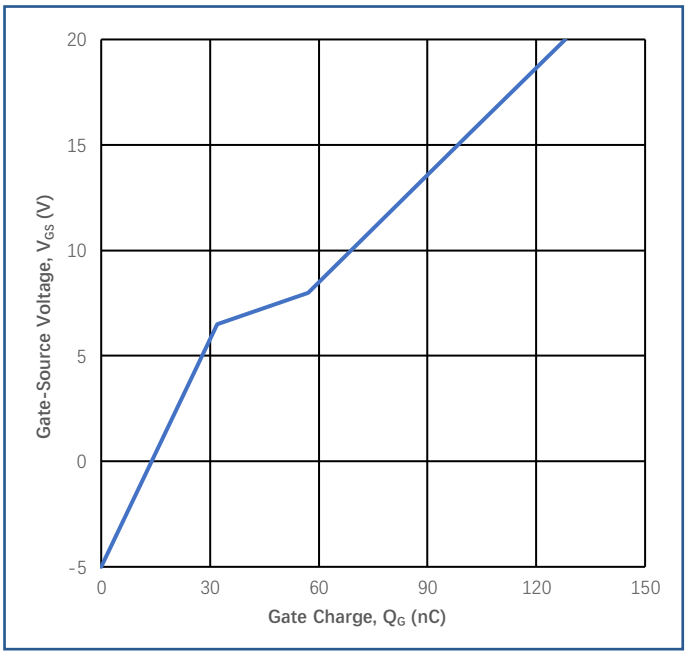



**Figure 8**
Gate Charge Characteristics

## Typical Performance

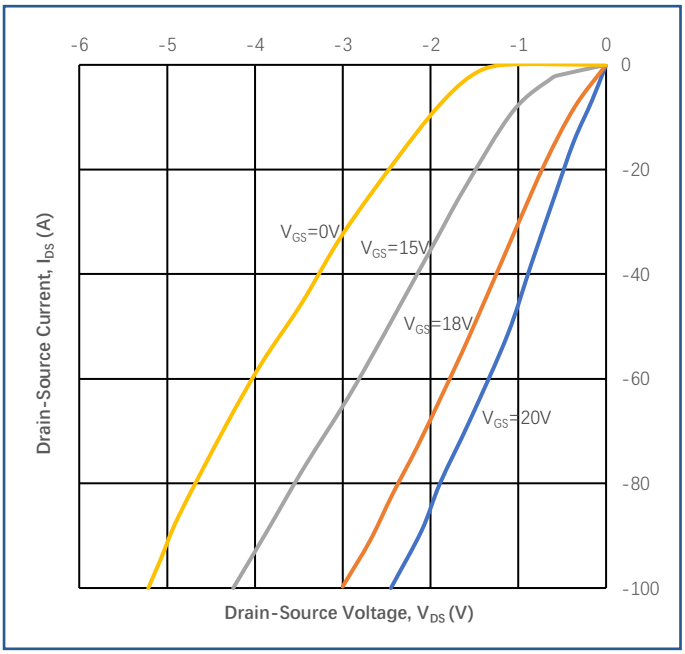



**Figure 9**

3rd Quadrant Characteristic at 25°C

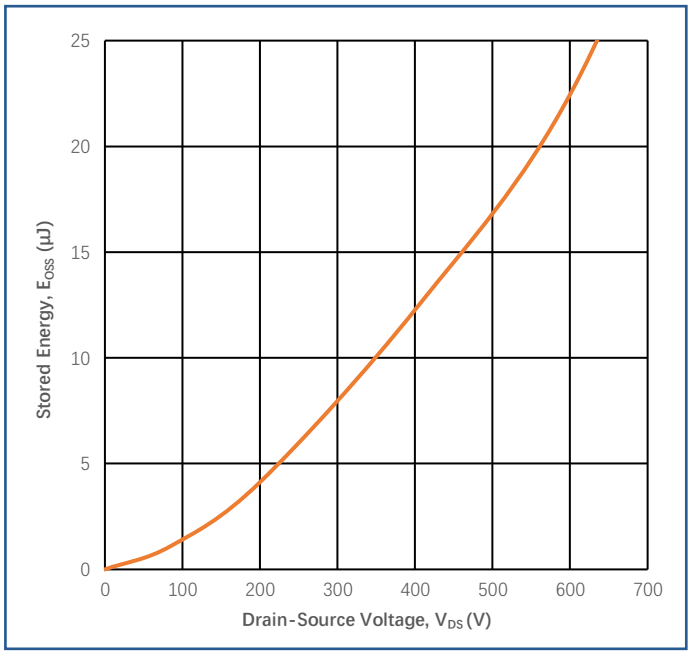



**Figure 10**

Output Capacitor Stored Energy

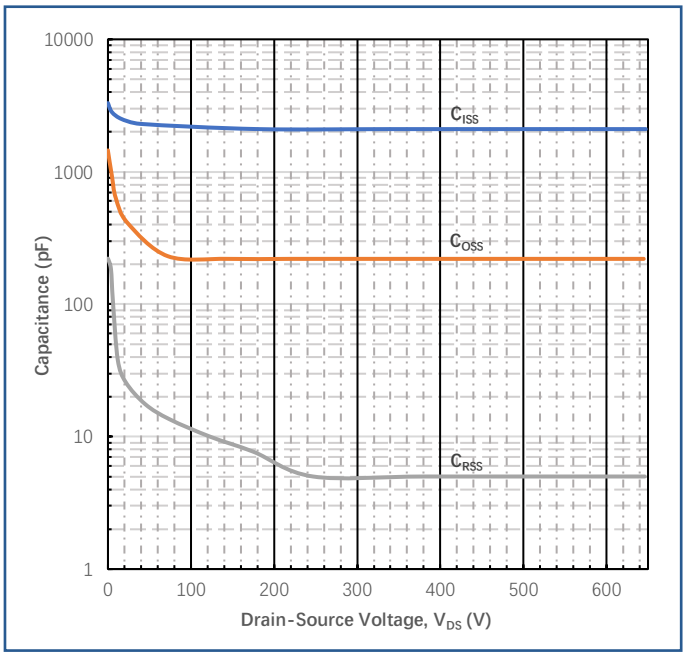



**Figure 11**

Capacitances vs. Drain-Source

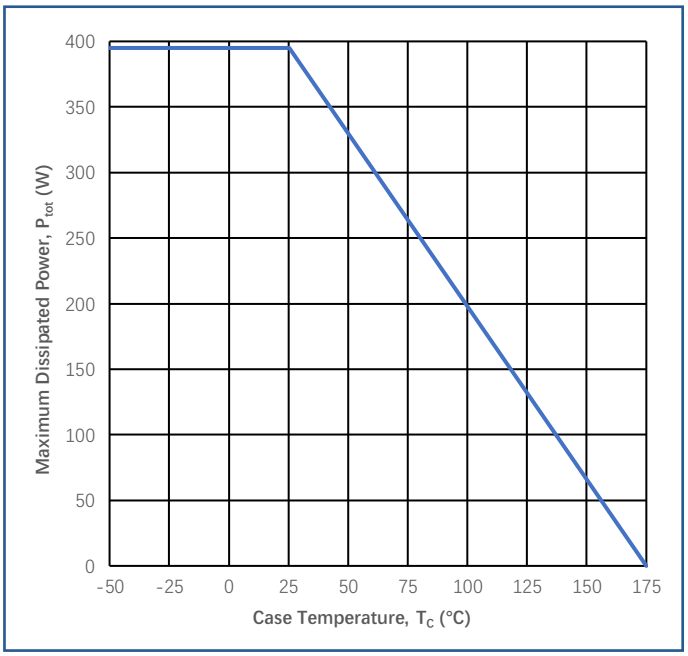



**Figure 12**

Max Power Dissipation Derating vs $T_C$

## Typical Performance

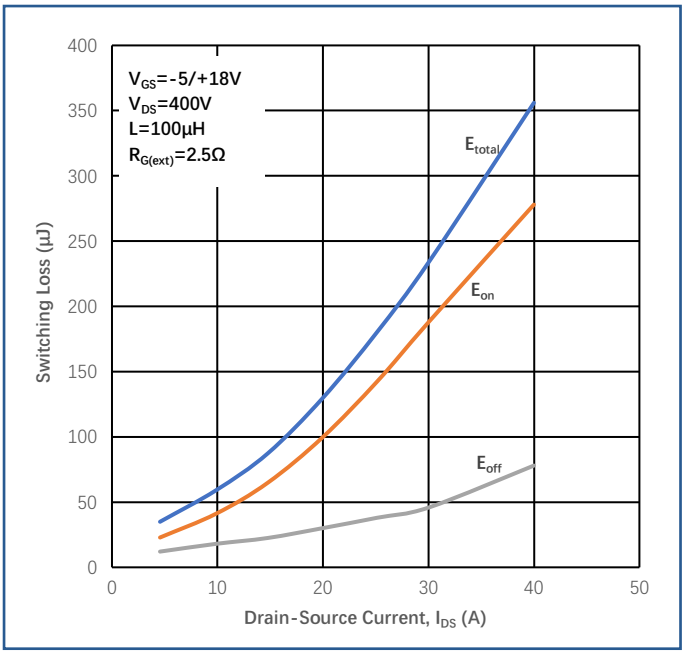



**Figure 13**
Switching Energy vs. Drain Current

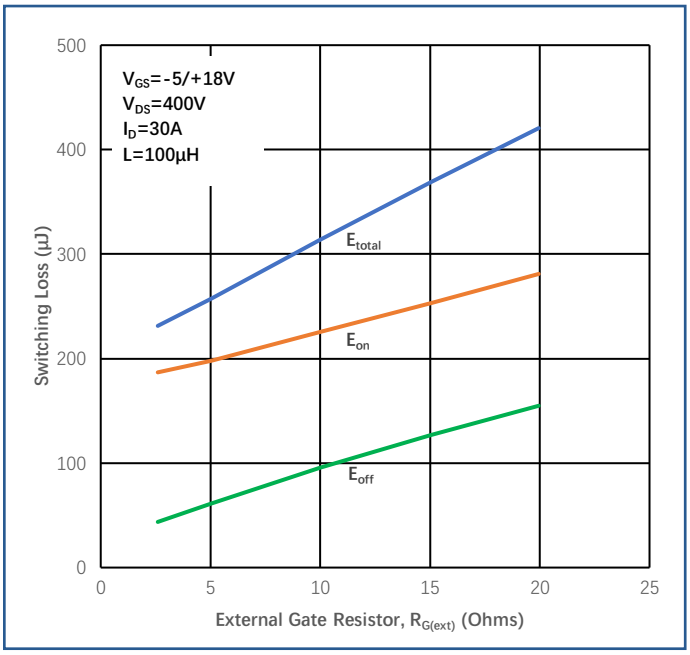



**Figure 14**
Switching Energy vs. $R_{G(ext)}$

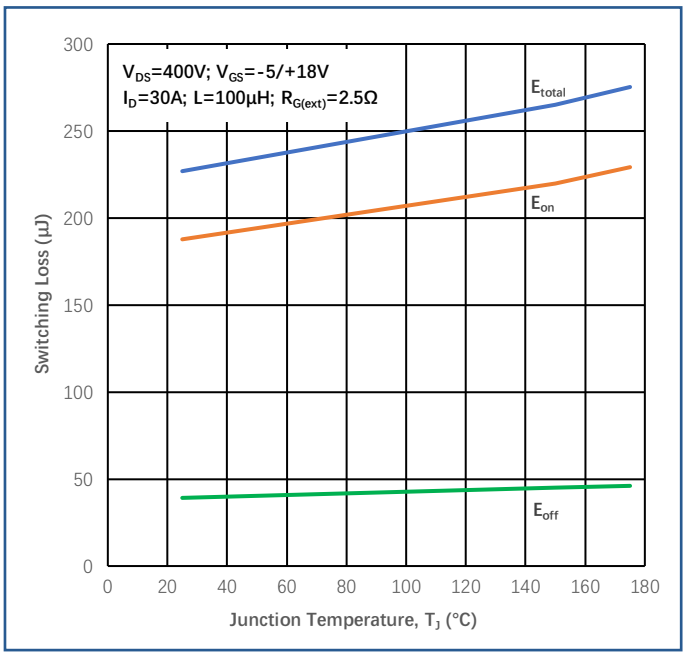



**Figure 15**
Switching Energy vs. Temperature

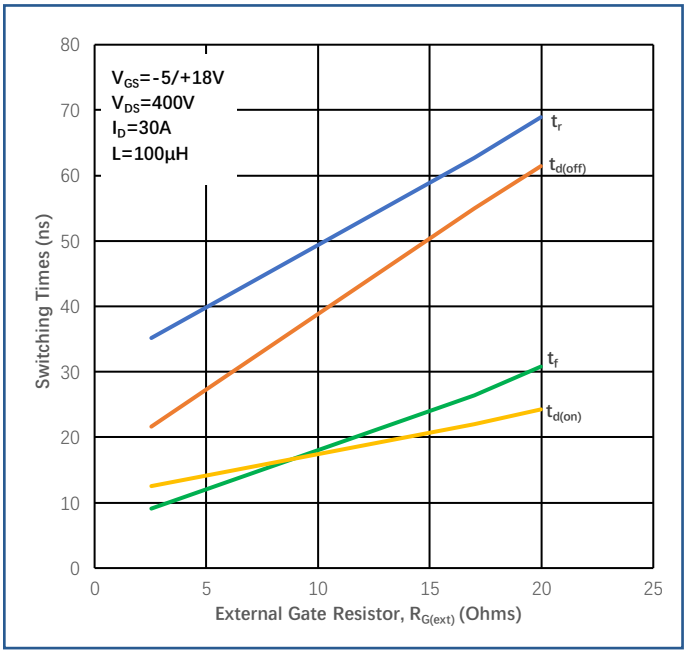



**Figure 16**
Switching Times vs. $R_{G(ext)}$

## Typical Performance

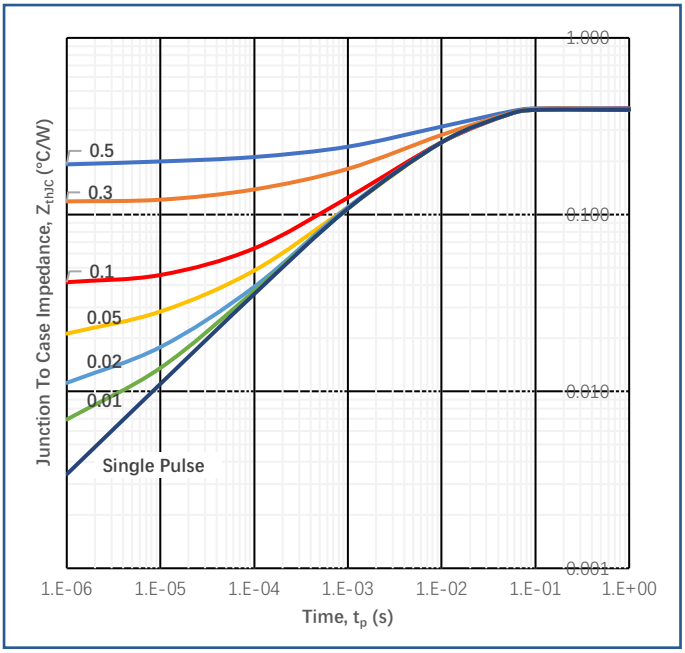



**Figure 17**
Transient Thermal Impedance

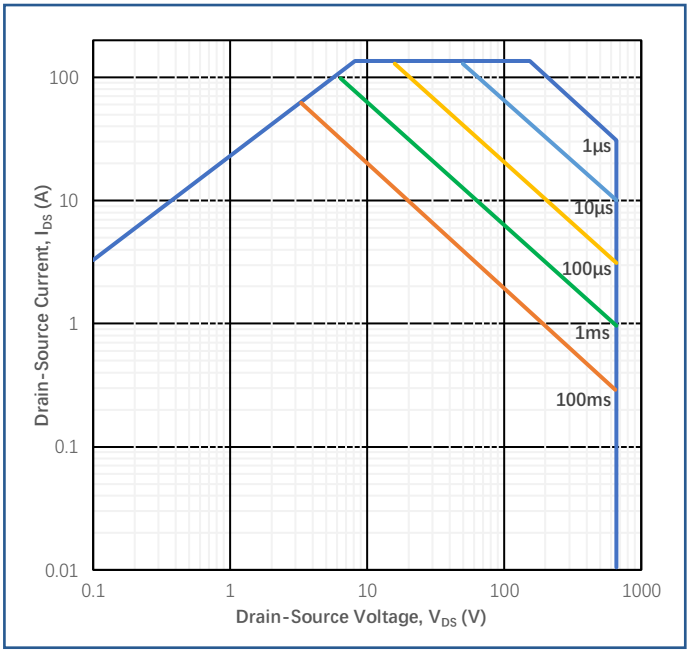
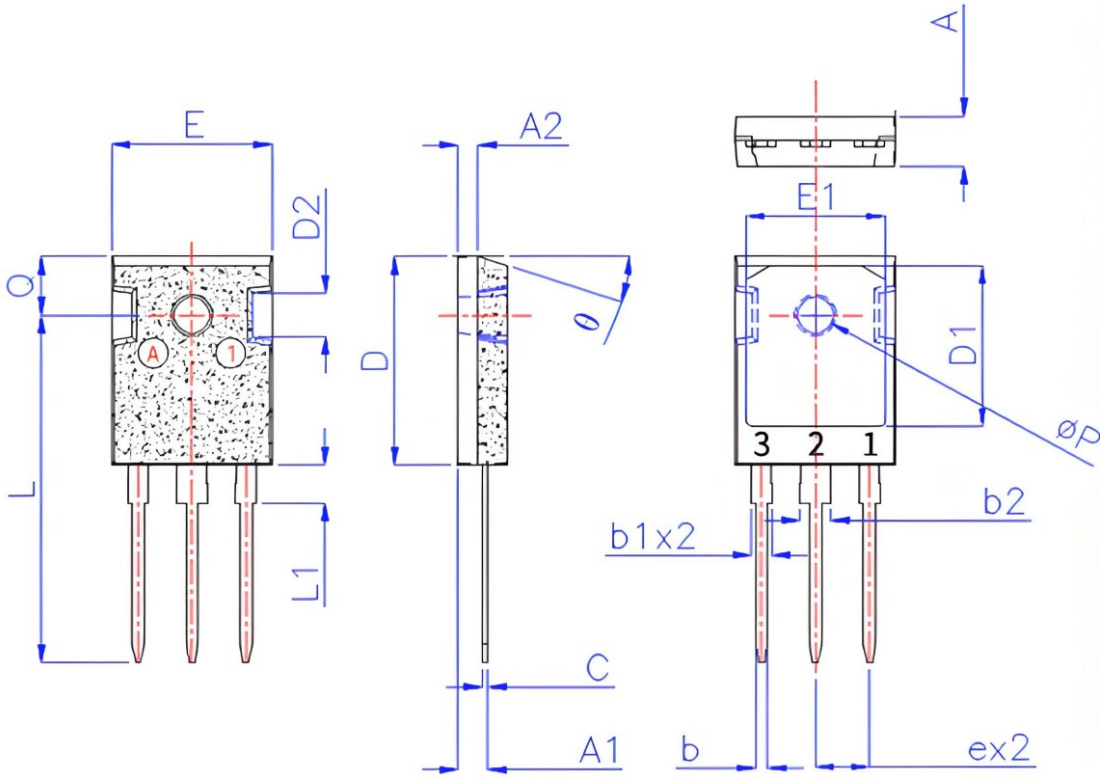



**Figure 18**
Safe Operating Area

## Package Dimensions (mm)

### Package Type: TO-247-3L




| Symbol | Millimeters | | | Inches | | |
|---|---|---|---|---|---|---|
| | Min. | Type. | Max. | Min. | Type. | Max. |
| A | 4.80 | 5.00 | 5.20 | 0.189 | 0.197 | 0.205 |
| A1 | 2.85 | 3.00 | 3.15 | 0.112 | 0.118 | 0.124 |
| b | 1.16 | 1.22 | 1.27 | 0.046 | 0.048 | 0.050 |
| b1 | 2.03 | 2.06 | 2.10 | 0.080 | 0.081 | 0.083 |
| b2 | 3.03 | 3.06 | 3.10 | 0.119 | 0.120 | 0.122 |
| C | 0.55 | 0.60 | 0.65 | 0.022 | 0.024 | 0.026 |
| D | 20.80 | 21.00 | 21.20 | 0.819 | 0.827 | 0.835 |
| D1 | 15.94 | 16.24 | 16.54 | 0.628 | 0.639 | 0.651 |
| D2 | 4.30 BSC | | | 0.169 BSC | | |
| e | 5.44 BSC | | | 0.214 BSC | | |
| E | 15.95 | 16.15 | 16.35 | 0.628 | 0.636 | 0.644 |
| E1 | 13.82 | 14.02 | 14.26 | 0.544 | 0.552 | 0.561 |
| L | 34.65 | 35.05 | 35.45 | 1.364 | 1.380 | 1.396 |
| L1 | - | - | 3.86 | - | - | 0.152 |
| Q | 5.85 | 5.95 | 6.05 | 0.230 | 0.234 | 0.238 |
| øP | 3.45 | 3.60 | 3.75 | 0.136 | 0.142 | 0.148 |
| θ | 17.5° | | | 17.5° | | |

| Pin | Symbol | Description |
|---|---|---|
| 1 | G | Gate |
| 2 | D | Drain |
| 3 | S | Source |
| mb | D | mounting base; connected to drain |

**Note:**

1. All metal surfaces are Sn plated (matte), except area of cut.
2. Burr or mold flash size (0.5 mm) is not included in the dimensions.

## Notes & Disclaimer

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