

## Product Summary

| $V_{(BR)DSS}$ | $R_{DS(on)TYP}$ | $I_D$ |
|---------------|-----------------|-------|
| 120V          | 3.5mΩ@10V       | 200A  |



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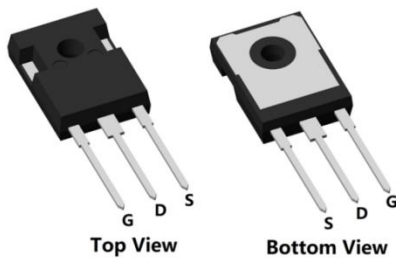
## Feature

- Fast Switching
- Low Gate Charge and Rdson
- Low Reverse transfer capacitances
- **100% UIS TESTED**

## Applications

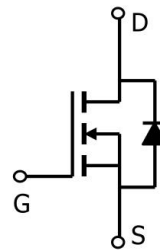
- High Speed Power switching
- DC-DC Converter
- Power Management

## Package

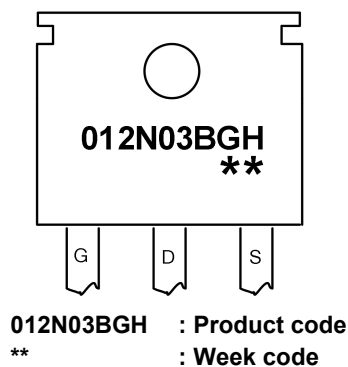


TO-247(1:G 2:D 3:S)

## Circuit diagram



## Marking



## Order Information

| Device        | Package | Unit/Tube |
|---------------|---------|-----------|
| SP012N03BGHTF | TO-247  | 30        |

**Absolute maximum ratings (Ta=25°C unless otherwise noted)**

| Parameter                                  | Symbol          | Rating     | Unit |
|--------------------------------------------|-----------------|------------|------|
| Drain-Source Voltage                       | $V_{DS}$        | 120        | V    |
| Gate-Source Voltage                        | $V_{GS}$        | $\pm 20$   | V    |
| Continuous Drain Current (Tc=25°C)         | $I_D$           | 200        | A    |
| Continuous Drain Current (Tc=100°C)        | $I_D$           | 133        | A    |
| Pulsed Drain Current                       | $I_{DM}$        | 800        | A    |
| Single Pulse Avalanche Energy <sup>1</sup> | $E_{AS}$        | 900        | mJ   |
| Power Dissipation (Tc=25°C)                | $P_D$           | 270        | W    |
| Power Dissipation (Tc=100°C)               | $P_D$           | 108        | W    |
| Thermal Resistance Junction-to-Case        | $R_{\theta JC}$ | 0.46       | °C/W |
| Storage Temperature Range                  | $T_{STG}$       | -55 to 150 | °C   |
| Operating Junction Temperature Range       | $T_J$           | -55 to 150 | °C   |

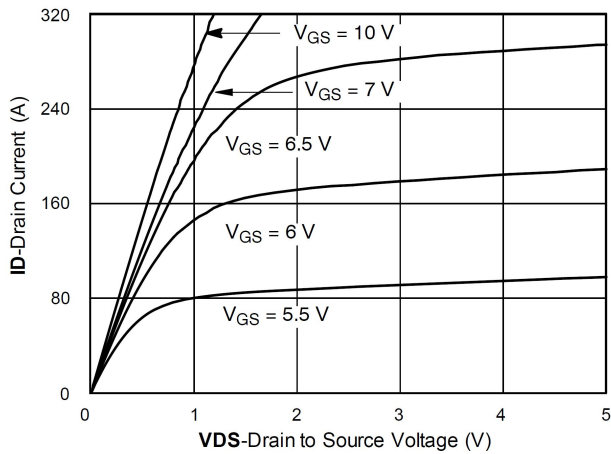
**Electrical characteristics (Ta=25°C, unless otherwise noted)**

| Characteristics                         | Symbol            | Test Condition                       | Min | Typ  | Max  | Unit |
|-----------------------------------------|-------------------|--------------------------------------|-----|------|------|------|
| Static Characteristics                  |                   |                                      |     |      |      |      |
| Drain-Source Breakdown Voltage          | BV <sub>DSS</sub> | ID=250μA , VGS=0V                    | 120 | -    | -    | V    |
| Drain Cut-Off Current                   | IDSS              | VDS=96V , VGS=0V                     | -   | -    | 1    | μA   |
| Gate Leakage Current                    | IGSS              | VGS=±20V , VDS=0V                    | -   | -    | ±100 | nA   |
| Gate Threshold Voltage                  | VGS(th)           | VDS=VGS , ID=250μA                   | 2.8 | 3.2  | 3.8  | V    |
| Drain-Source ON Resistance              | RDS(ON)           | VGS=10V , ID=50A                     | -   | 3.5  | 4.6  | mΩ   |
| Gate Resistance                         | RG                | VDS=60V , VGS=0V , f=1MHz            | -   | 1.6  | -    | Ω    |
| Dynamic Characteristics                 |                   |                                      |     |      |      |      |
| Input Capacitance                       | Ciss              | VDS=60V , VGS=0V , f=1.0MHz          | -   | 5640 | -    | pF   |
| Output Capacitance                      | Coss              |                                      | -   | 1049 | -    |      |
| Reverse Transfer Capacitance            | Crss              |                                      | -   | 36   | -    |      |
| Total Gate Charge                       | Qg                | VDS=60V , VGS=10V , ID=75A           | -   | 104  | -    | nC   |
| Gate-Source Charge                      | Qgs               |                                      | -   | 26   | -    |      |
| Gate-Drain Charge                       | Qgd               |                                      | -   | 18   | -    |      |
| Gate Plateau Voltage                    | Vplateau          |                                      | -   | 4.6  | -    | V    |
| Switching Characteristics               |                   |                                      |     |      |      |      |
| Turn-On Delay Time                      | td(on)            | VGS=10V , VDS=50V , ID=75A , RG=1.6Ω | -   | 28   | -    | nS   |
| Rise Time                               | tr                |                                      | -   | 18   | -    |      |
| Turn-Off Delay Time                     | td(off)           |                                      | -   | 38   | -    |      |
| Fall Time                               | tr                |                                      | -   | 12   | -    |      |
| Drain-Source Body Diode Characteristics |                   |                                      |     |      |      |      |
| Source-Drain Diode Forward Voltage      | VSD               | IS=1A , VGS=0V , TJ=25℃              | -   | -    | 1.2  | V    |
| Maximum Body-Diode Continuous Current   | IS                |                                      | -   | -    | 200  | A    |
| Reverse Recovery Time                   | Trr               | IS=100A , di/dt=100A/us , TJ=25℃     | -   | 88   | -    | nS   |
| Reverse Recovery Charge                 | Qrr               |                                      | -   | 166  | -    | nC   |

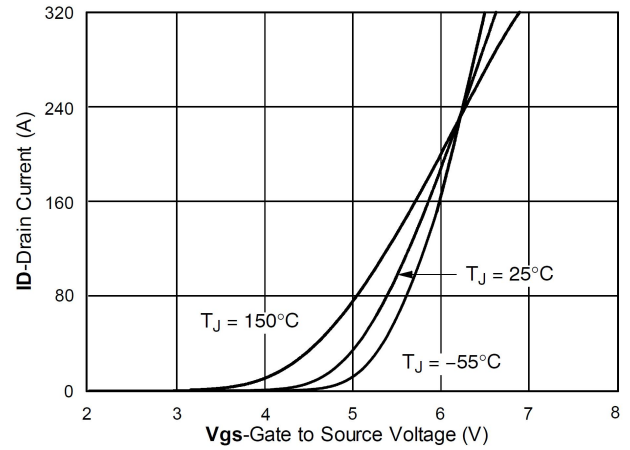
**Note :**

1. The test condition is  $V_{DD}=50V$ ,  $V_{GS}=10V$ ,  $L=0.5mH$ ,  $R_G=25\Omega$ ;

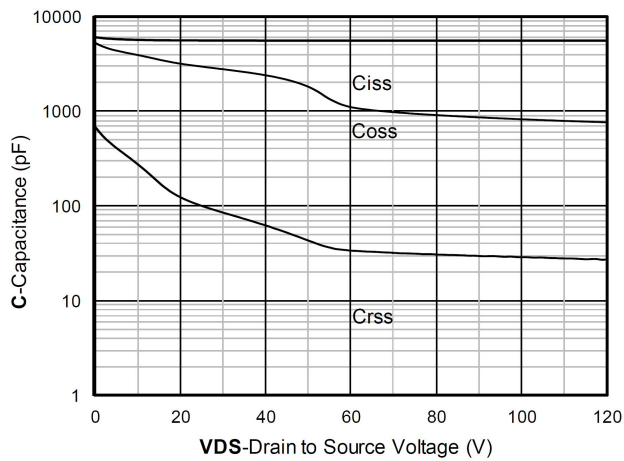
## Typical Characteristics



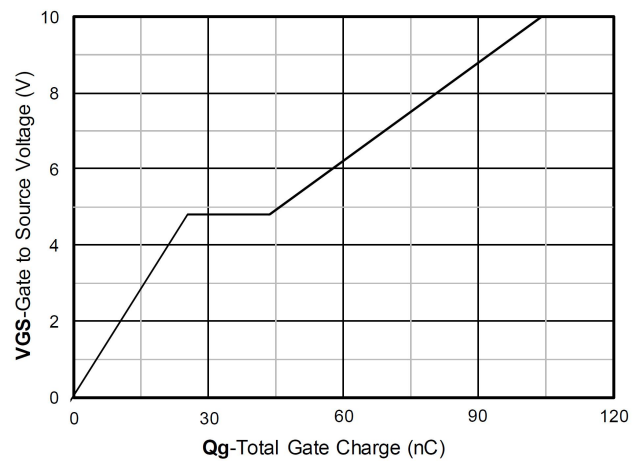
Output Characteristics



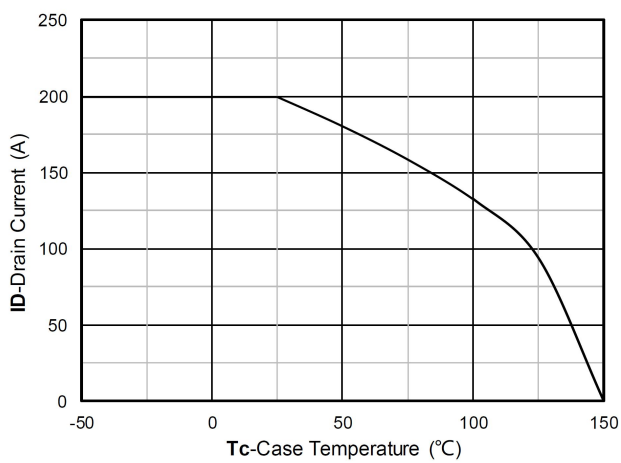
Transfer Characteristics



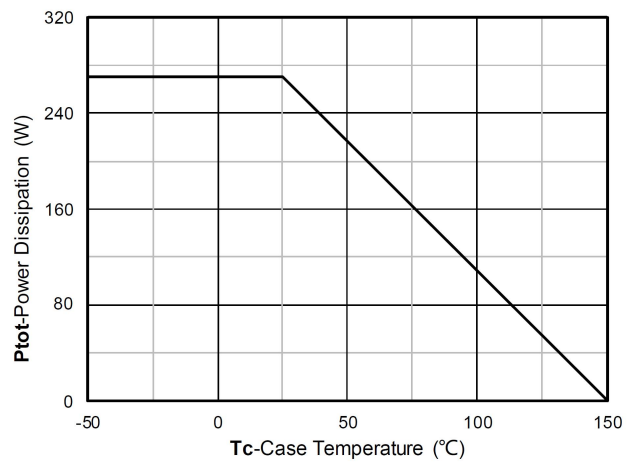
Capacitance Characteristics



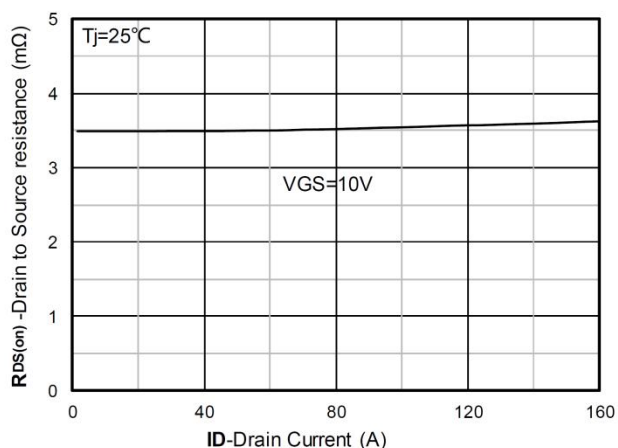
Gate Charge



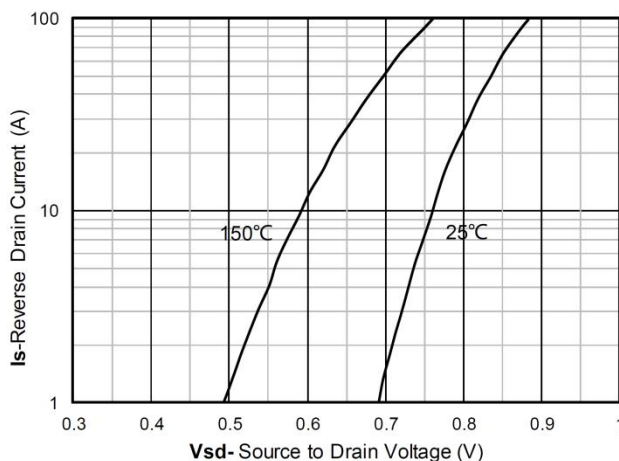
Current dissipation



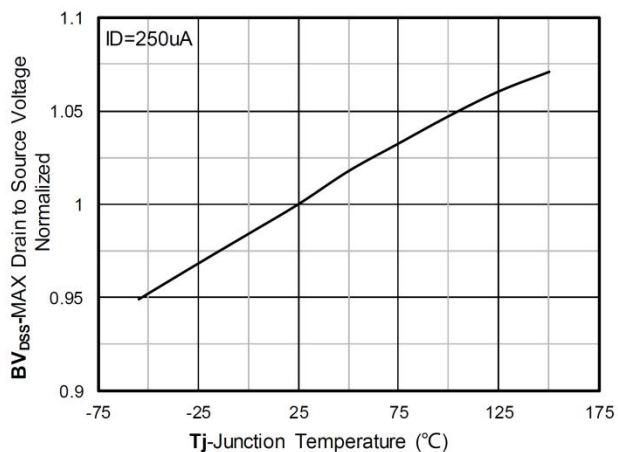
Power dissipation



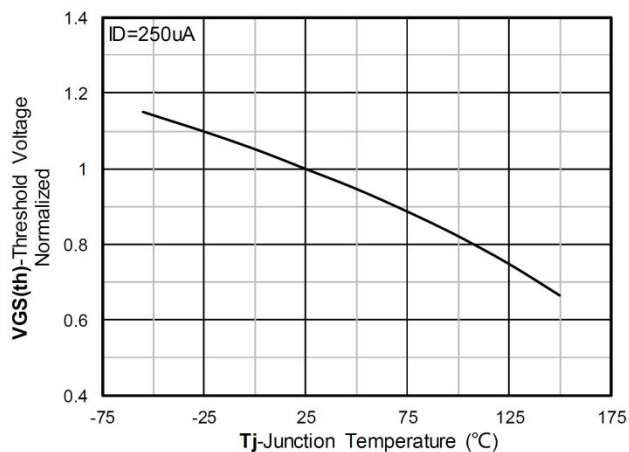
$R_{DS(on)}$  VS Drain Current



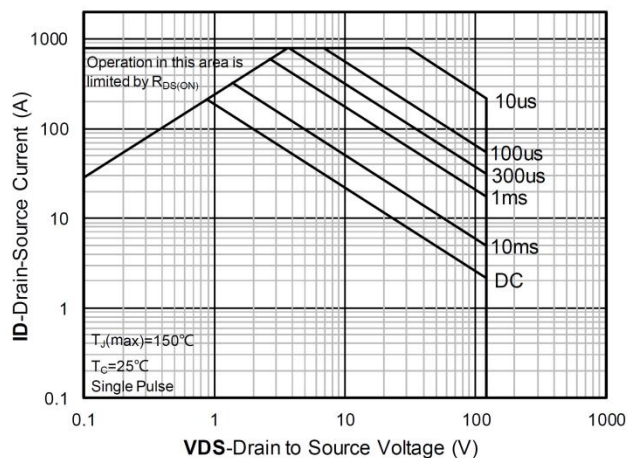
Forward characteristics of reverse diode



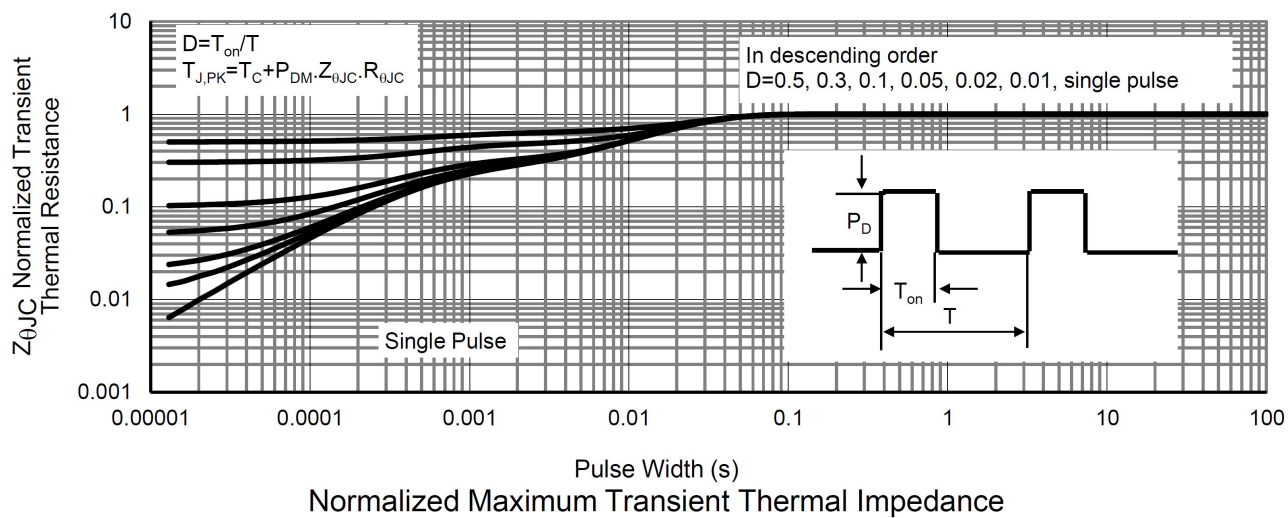
Normalized breakdown voltage



Normalized Threshold voltage

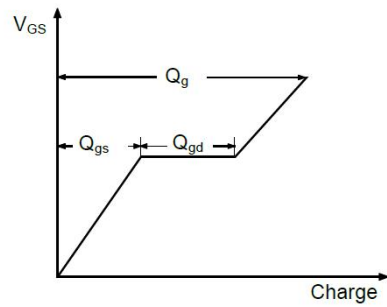
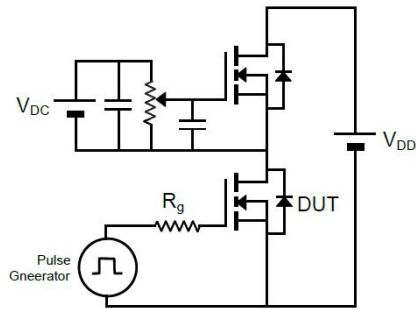


Safe Operation Area

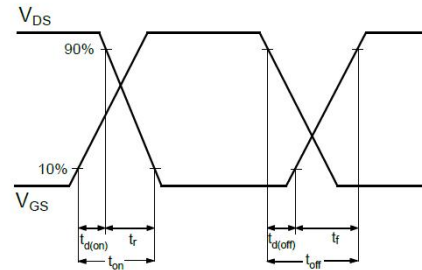
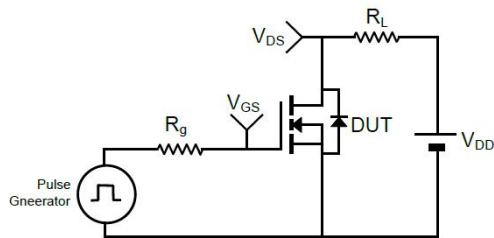


## Test Circuit

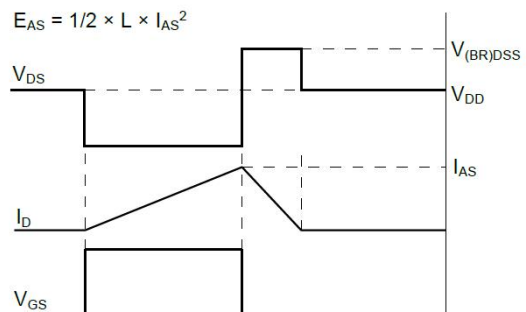
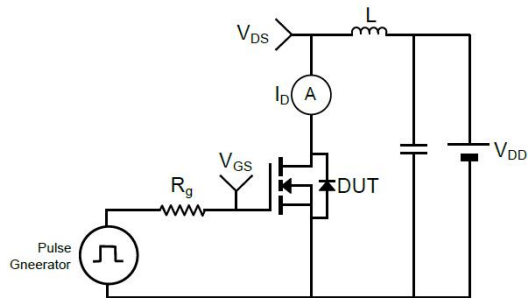
### Gate Charge



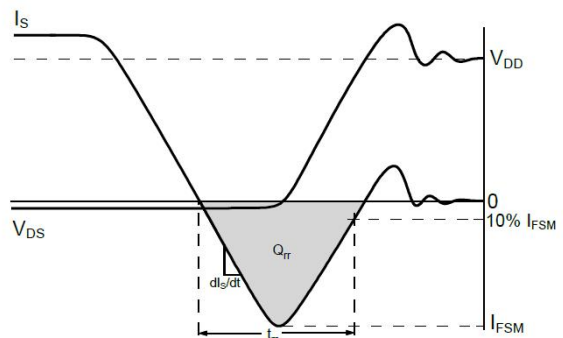
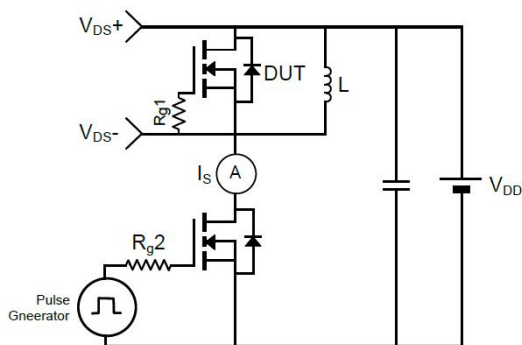
### Resistive Load Switching Time



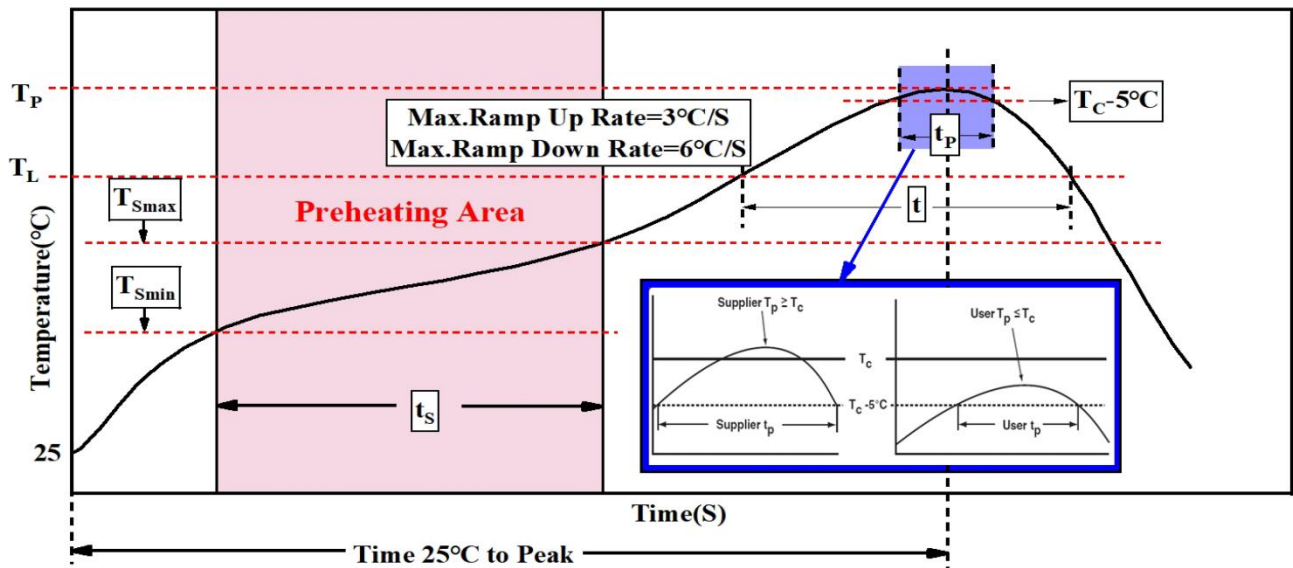
### Un-clamped Inductive Load Switching



### Drain-Source Body Diode Reverse Recovery



### Temperature Profile for IR Reflow Soldering(Pb-Free)



| Profile Feature                                                                                                                                                                                                                            | Sn-Pb Eutectic Assembly            | Pb-Free Assembly                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------------|
| <b>Preheat &amp; Soak</b>                                                                                                                                                                                                                  |                                    |                                    |
| Temperature min (T <sub>min</sub> )                                                                                                                                                                                                        | 100°C                              | 150°C                              |
| Temperature max (T <sub>max</sub> )                                                                                                                                                                                                        | 150°C                              | 200°C                              |
| Time (T <sub>min</sub> to T <sub>max</sub> ) (t <sub>s</sub> )                                                                                                                                                                             | 60-120 seconds                     | 60-120 seconds                     |
| Average ramp-up rate (T <sub>max</sub> to T <sub>p</sub> )                                                                                                                                                                                 | 3 °C/second max.                   | 3°C/second max.                    |
| Liquidous temperature (T <sub>L</sub> )                                                                                                                                                                                                    | 183 °C                             | 217°C                              |
| Time at liquidous (t <sub>L</sub> )                                                                                                                                                                                                        | 60-150 seconds                     | 60-150 seconds                     |
| Peak package body Temperature e (T <sub>p</sub> )*                                                                                                                                                                                         | See Classification Temp in table 1 | See Classification Temp in table 2 |
| Time (t <sub>p</sub> )** within 5°C of the specified classification temperature (T <sub>c</sub> )                                                                                                                                          | 20** seconds                       | 30** seconds                       |
| Average ramp-down rate (T <sub>p</sub> to T <sub>max</sub> )                                                                                                                                                                               | 6 °C/second max.                   | 6 °C/second max.                   |
| Time 25°C to peak temperature                                                                                                                                                                                                              | 6 minutes max.                     | 8 minutes max.                     |
| * Tolerance for peak profile Temperature (T <sub>p</sub> ) is defined as a supplier minimum and a user maximum.<br>** Tolerance for time at peak profile temperature (t <sub>p</sub> ) is defined as a supplier minimum and a user maximum |                                    |                                    |

Table 1. SnPb Eutectic Process – Classification Temperatures (T<sub>c</sub>)

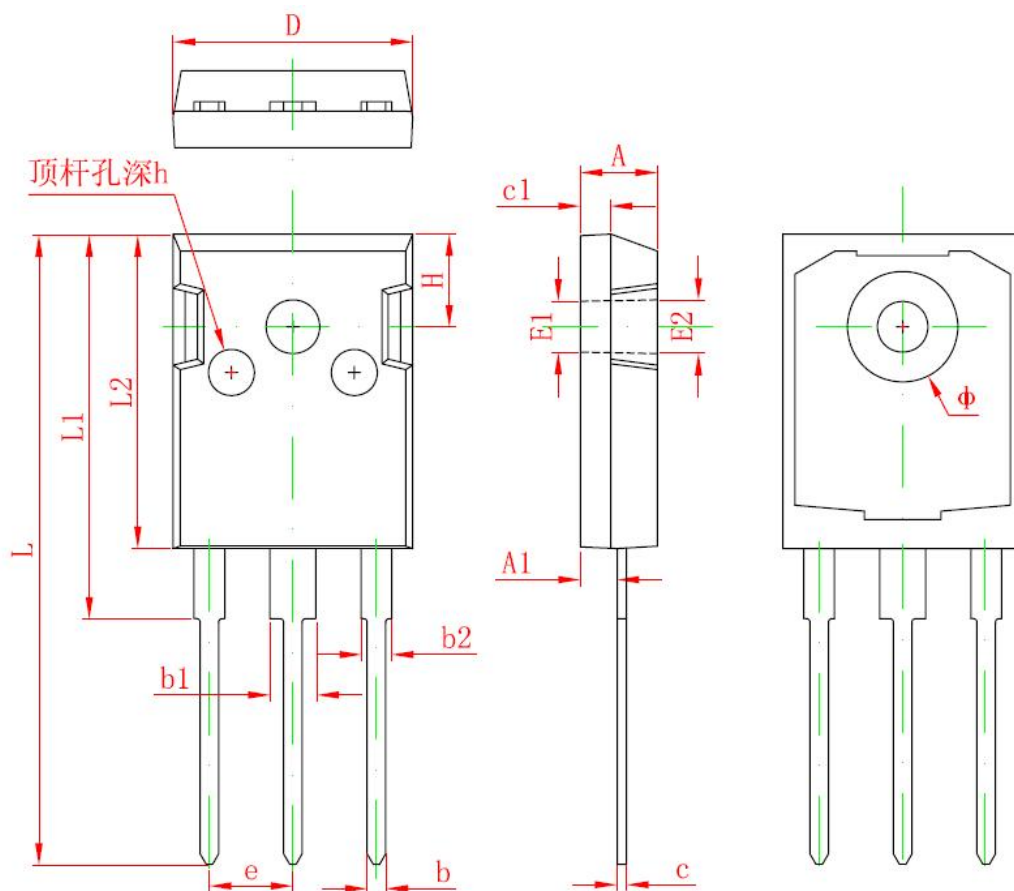
| Package Thickness | Volume mm <sup>3</sup><br><350 | Volume mm <sup>3</sup><br>≥350 |
|-------------------|--------------------------------|--------------------------------|
| <2.5 mm           | 235 °C                         | 220 °C                         |
| ≥2.5 mm           | 220 °C                         | 220 °C                         |

Table 2. Pb-free Process – Classification Temperatures (T<sub>c</sub>)

| Package Thickness | Volume mm <sup>3</sup><br><350 | Volume mm <sup>3</sup><br>350-2000 | Volume mm <sup>3</sup><br>>2000 |
|-------------------|--------------------------------|------------------------------------|---------------------------------|
| <1.6 mm           | 260 °C                         | 260 °C                             | 260 °C                          |
| 1.6 mm – 2.5 mm   | 260 °C                         | 250 °C                             | 245 °C                          |
| ≥2.5 mm           | 250 °C                         | 245 °C                             | 245 °C                          |



## TO-247 Package Information



| Symbol | Dimensions In Millimeters |        |
|--------|---------------------------|--------|
|        | Min.                      | Max.   |
| A      | 4.700                     | 5.300  |
| A1     | 2.100                     | 2.600  |
| b      | 1.000                     | 1.400  |
| b1     | 2.800                     | 3.200  |
| b2     | 1.800                     | 2.200  |
| c      | 0.500                     | 0.700  |
| c1     | 1.900                     | 2.500  |
| D      | 15.450                    | 16.200 |
| E1     | 3.500 REF.                |        |
| E2     | 3.600 REF.                |        |
| L      | 40.400                    | 41.600 |
| L1     | 24.750                    | 25.750 |
| L2     | 20.300                    | 21.300 |
| Φ      | 7.100                     | 7.300  |
| e      | 5.450 TYP.                |        |
| H      | 5.980 REF.                |        |
| h      | 0.000                     | 0.300  |