

**NH2319**



**P-Channel Enhancement Mode Trench Power MOSFET**

**Voltage:** -40 Volts

**Current:** -5.0 Ampers

**Package:** SOT-23

**Features**

- NH'S Advanced Trench Technology
- Low Rds(on) For Low On-State Loss
- High EAS For High Reliability
- Excellent Qg\*Rds(on) Product(FOM)

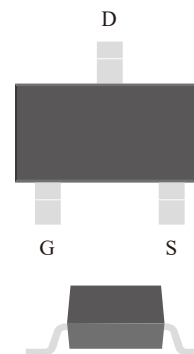
**Typical Applications**

- DC-DC Converter
- Battery Management System(BMS)
- Printed Circuit Board For Control Circuit
- Uninterruptible Power Supplies(UPS)

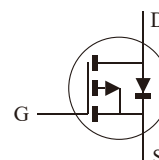
**Product Summary**

|                   |      |    |
|-------------------|------|----|
| VDS Min.@Tj       | -40  | V  |
| Id Min.@Ta        | -5.0 | A  |
| RDS(ON)(TYP)@-10V | 56   | mΩ |

**Diagram:**



**Polarity:**



**\*100% UIS TESTED**

**\*100% ΔVDS TESTED**

**Absolute Maximum Ratings (Ta=25℃ Unless Otherwise Specified )**

| Parameter                             | Test Conditions | Symbol          | Ratings | Unit |
|---------------------------------------|-----------------|-----------------|---------|------|
| Drain-Source Voltage                  |                 | V <sub>DS</sub> | -40     | V    |
| Gate-Source Voltage                   |                 | V <sub>GS</sub> | ±20     | V    |
| Continuous Drain Current (Note 1)     | Ta= 25 ℃        | I <sub>D</sub>  | -5.0    | A    |
|                                       | Ta= 100 ℃       |                 | -3.2    |      |
| Drain Current-Pulse (Note 1)          | Tj< 150 ℃       | I <sub>DM</sub> | -20     | A    |
| Maximum Power Dissipation Power       | Ta= 25 ℃        | P <sub>D</sub>  | 2.5     | W    |
| Dissipation Derating Factor Above 25℃ | Ta= 100 ℃       |                 | 1       |      |
| Derating Factor                       |                 | D <sub>F</sub>  | 0.02    | W/℃  |

**Thermal Characteristics (Ta=25℃ Unless Otherwise Specified)**

| Parameter                                                   | Test Conditions                      | Symbol           | Typ.       | Unit |
|-------------------------------------------------------------|--------------------------------------|------------------|------------|------|
| Junction Temperature                                        |                                      | T <sub>J</sub>   | -55 to 150 | ℃    |
| Storage Temperature Range                                   |                                      | T <sub>STD</sub> | -55 to 150 | ℃    |
| Thermal Resistance Junction To Ambient<br>With Steady-State | Still Air Environment<br>With Ta=25℃ | R <sub>θJA</sub> | 357        | ℃/W  |

Notes: 1.Pulse Width Limited By Max. Junction Temperature. (See Fig. 12).

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**P-Channel Enhancement Mode Trench Power MOSFET**
**Electrical Characteristics (Ta=25°C Unless Otherwise Specified )**

| Parameter                                                                                   | Test Conditions              | Symbol                              | Min. | Typ. | Max. | Unit |
|---------------------------------------------------------------------------------------------|------------------------------|-------------------------------------|------|------|------|------|
| Static Off Characteristics                                                                  |                              |                                     |      |      |      |      |
| Drain-Source Breakdown Voltage                                                              | VGS=0V,ID=-250uA             | BV <sub>DSS</sub>                   | -40  | --   | --   | V    |
| Bvdss Temperature Coefficient                                                               | ID=-250uA,Reference25℃       | ΔBV <sub>DSS</sub> /ΔT <sub>J</sub> | --   | 0.05 | --   | V/℃  |
| Drain-Source Leakage Current                                                                | VDS= -32 V,VGS=0V            | I <sub>DSS</sub>                    | --   | --   | -1   | uA   |
| Gate-Body Leakage Current                                                                   | VGS= <del>-20</del> V,VDS=0V | I <sub>GSS</sub>                    | --   | --   | ±100 | nA   |
| Static On Characteristics                                                                   |                              |                                     |      |      |      |      |
| Gate Threshold Voltage                                                                      | VGS= VDS ID=-250uA           | V <sub>GS(TH)</sub>                 | -1   | -1.6 | -2.5 | V    |
| Drain-Source On Resistance                                                                  | ID= -2.5 A,VGS= -10 V        | R <sub>DS(ON)</sub>                 | --   | 56   | 75   | mΩ   |
|                                                                                             | ID= -2.5 A,VGS= -4.5 V       |                                     | --   | 70   | 94   |      |
| Dynamic Characteristics                                                                     |                              |                                     |      |      |      |      |
| Input Capacitance                                                                           | VDS= -20 V                   | C <sub>iss</sub>                    | --   | 520  | --   | pF   |
| Output Capacitance                                                                          | VGS= 0 V                     | C <sub>oss</sub>                    | --   | 55   | --   | pF   |
| Reverse Transfer Capacitance                                                                | F= 1 MHZ                     | C <sub>rss</sub>                    | --   | 46   | --   | pF   |
| Switching Paramters (Test Circuit & Waveform See Fig.14)                                    |                              |                                     |      |      |      |      |
| Turn-On Delay Time                                                                          | VDS= -20 V                   | t <sub>d(on)</sub>                  | --   | 7    | --   | ns   |
| Turn-On Rise Time                                                                           | VGS= -10.0 V                 | t <sub>r</sub>                      | --   | 18   | --   | ns   |
| Turn-Off Delay Time                                                                         | RG= 10.0 Ω                   | t <sub>d(off)</sub>                 | --   | 15   | --   | ns   |
| Turn-Off Rise Time                                                                          |                              | t <sub>f</sub>                      | --   | 24   | --   | ns   |
| Gate Charge Paramters (Test Circuit & Waveform See Fig.15)                                  |                              |                                     |      |      |      |      |
| Total Gate Charge                                                                           | VDS= -20 V                   | Q <sub>g</sub>                      | --   | 10   | --   | nC   |
| Gate-Source Charge                                                                          | VGS= -10.0 V                 | Q <sub>gs</sub>                     | --   | 2    | --   | nC   |
| Gate-Drain Charge                                                                           | ID= -2.5 A                   | Q <sub>gd</sub>                     | --   | 1.5  | --   | nC   |
| Drain-Source Diode Characteristics And Maximum Ratings (Test Circuit & Waveform See Fig.17) |                              |                                     |      |      |      |      |
| Max. Diode Forward Cuurent                                                                  |                              | I <sub>s</sub>                      | --   | --   | -5.0 | A    |
| Max. Pulsed Forward Cuurent                                                                 |                              | I <sub>SM</sub>                     | --   | --   | -20  | A    |
| Diode Forward Voltage                                                                       | ID= -2.5 A,VGS=0V            | V <sub>SD</sub>                     | --   | -0.8 | -1.2 | V    |

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Typical Characteristics Curves

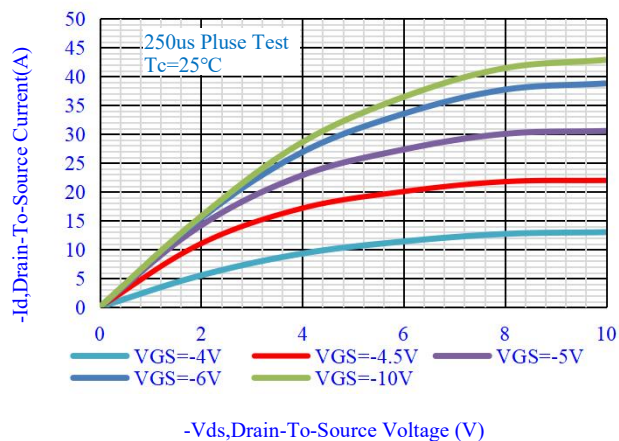


Fig.1-Output Characteristics

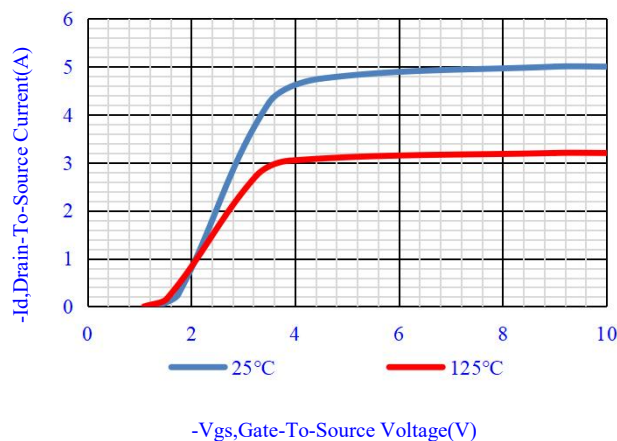


Fig.2-Transfer Characteristics

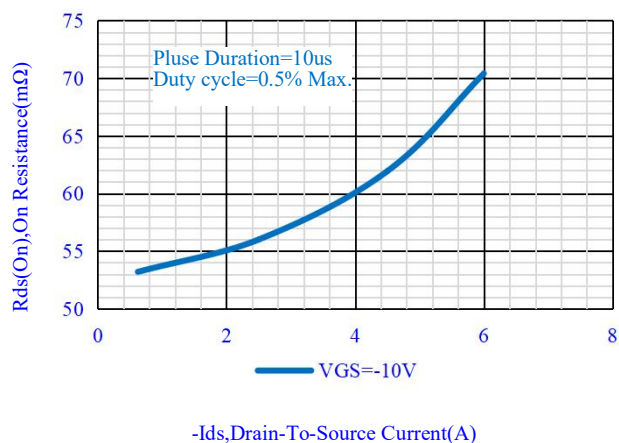


Fig.3-On Resistance Vs. Drain Current

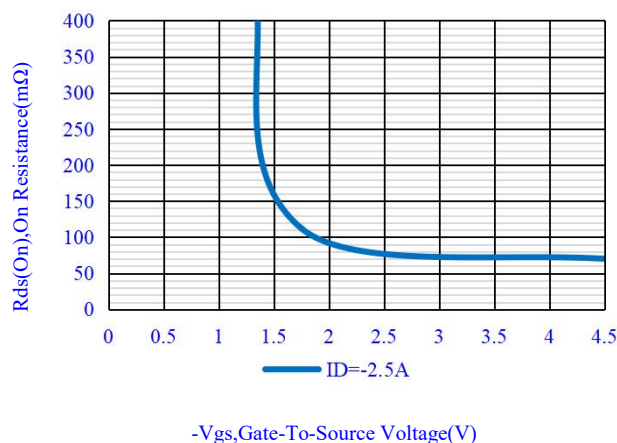


Fig.4-On Resistance Vs. Gate Source Voltage

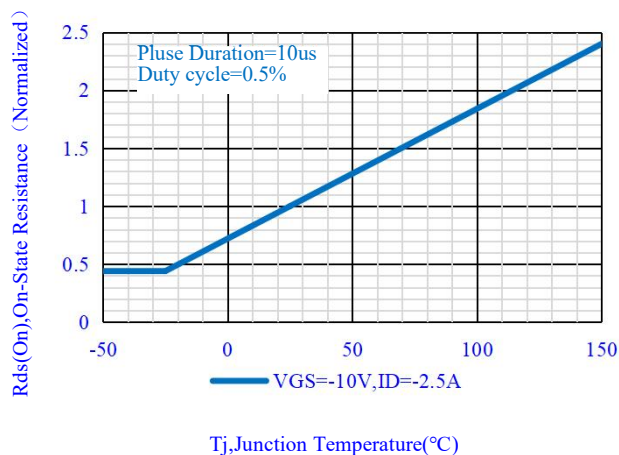


Fig.5-On Resistance Vs. Junction Temperature

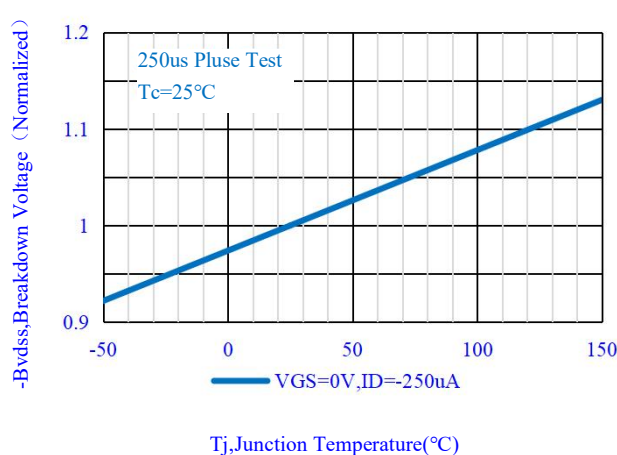


Fig.6-Breakdown Voltage Vs. Junction Temperature

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Typical Characteristics Curves

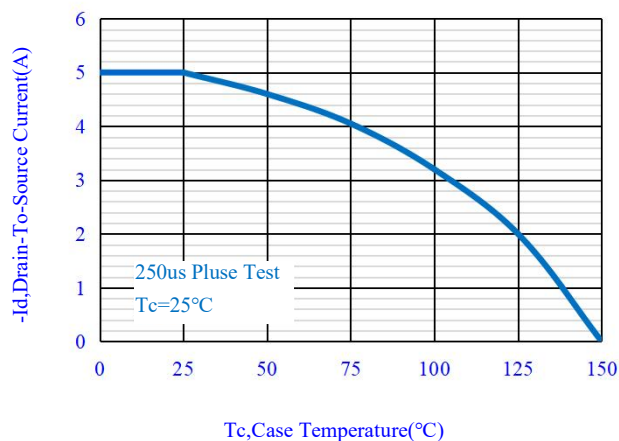


Fig.7-Maximum Continuous Drain Current Vs. Case Temperature

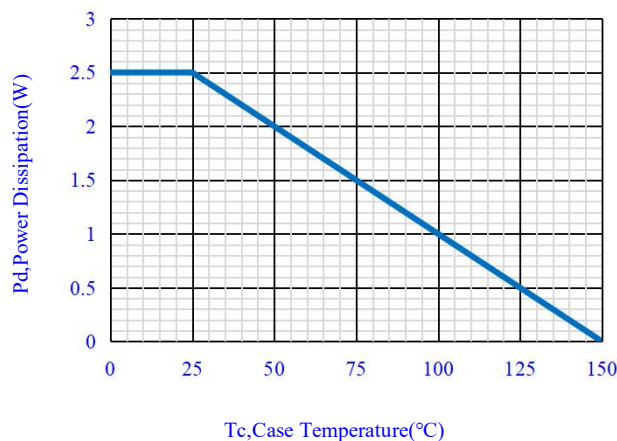


Fig.8-Maximum Power Dissipation Vs. Case Temperature

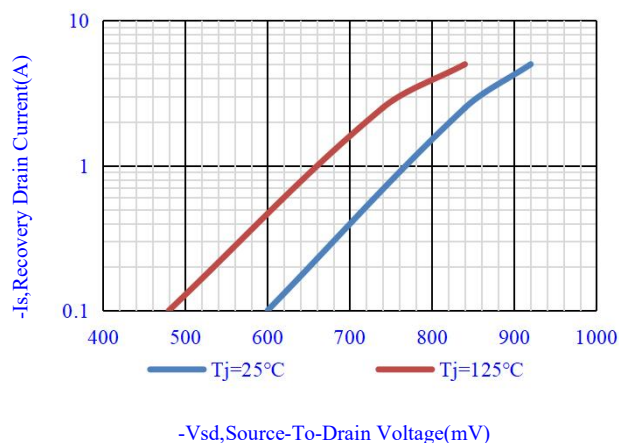


Fig.9-Source-To-Drain Diode Forward Voltage

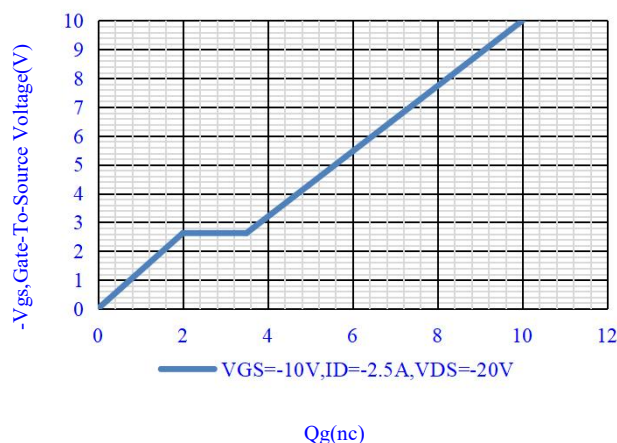


Fig.10-Gate Charge Waveform

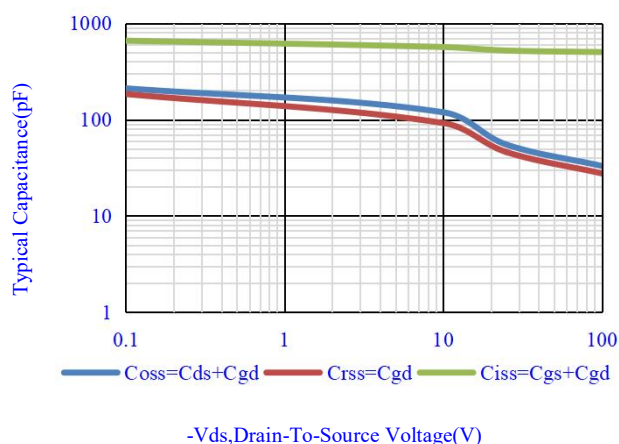


Fig.11-Typical Capacitance Vs. Drain-To-Source Voltage

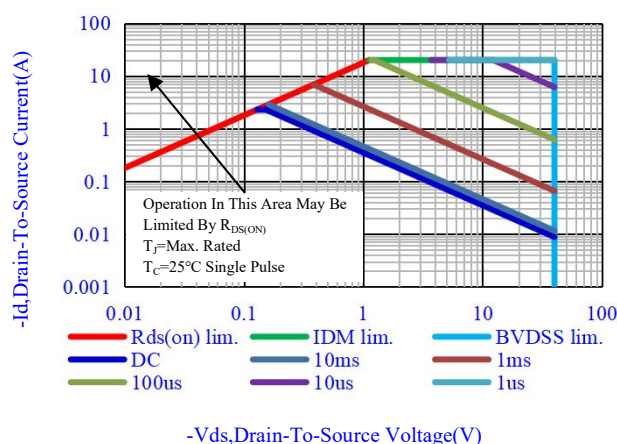


Fig.12-Maximum Safe Operating Area(SOA)

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Typical Characteristics Curves

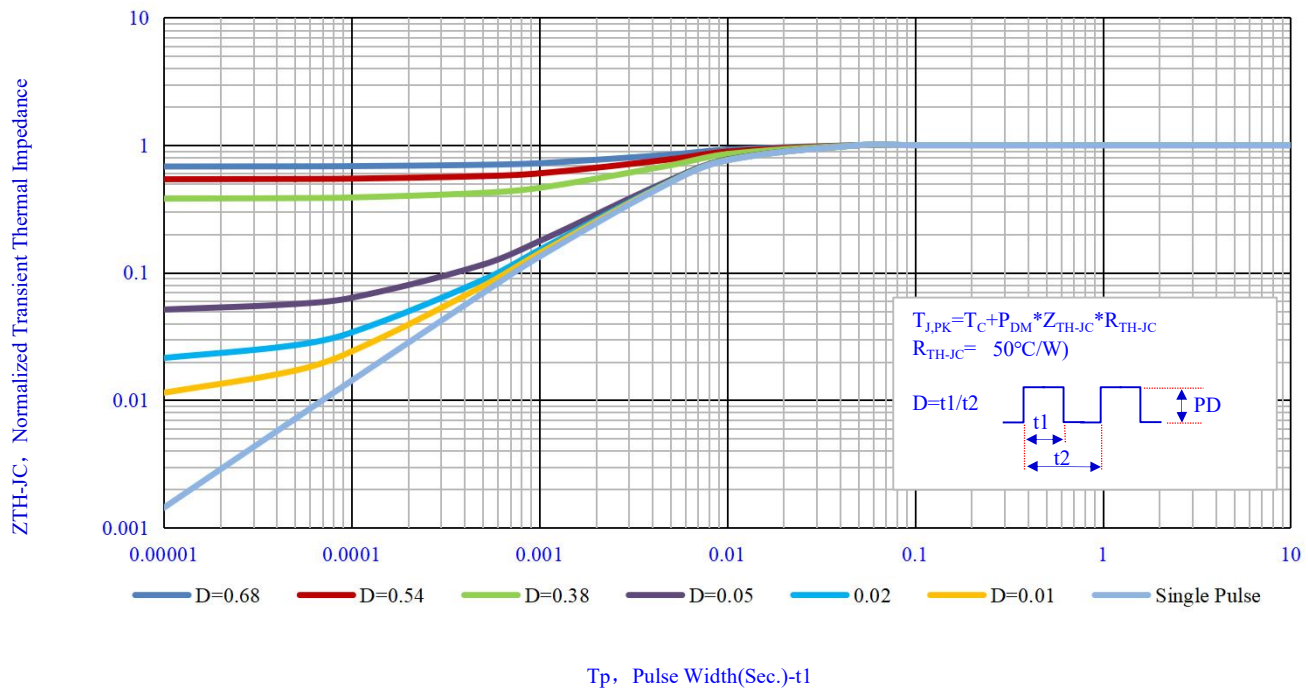


Fig.12- Normalized Maximum Transient Thermal Impedance Vs.Pulse Width

Test Circuit & Waveform

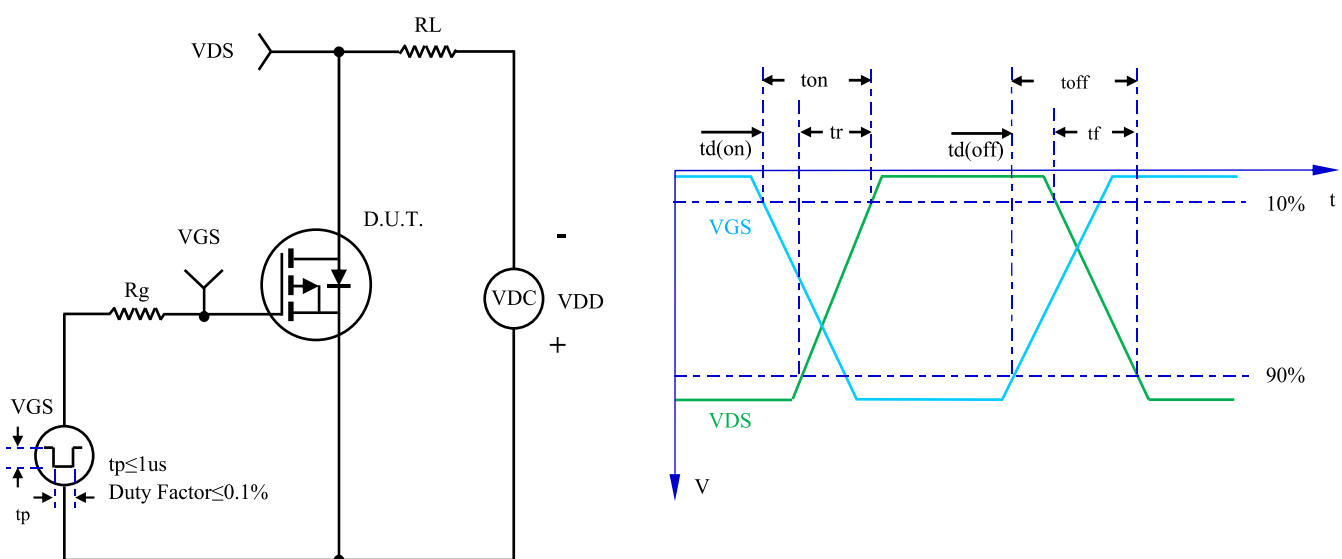


Fig.13- Resistive Switching Test Circuit & Waveform

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Test Circuit & Waveform

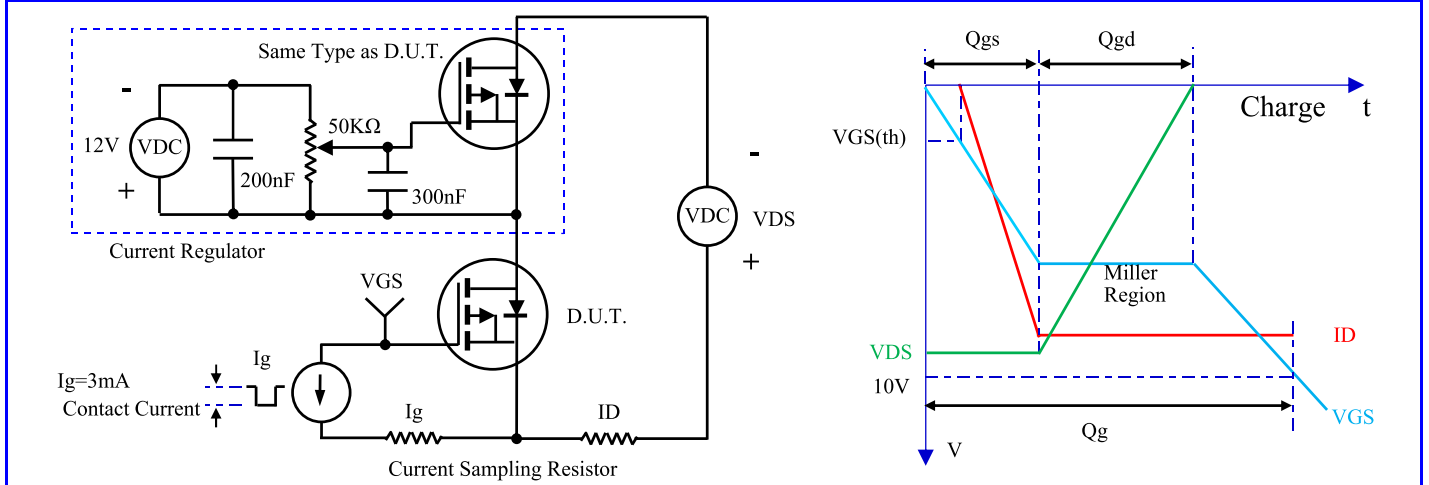


Fig.14-Gate Charge Test Circuit & Waveform

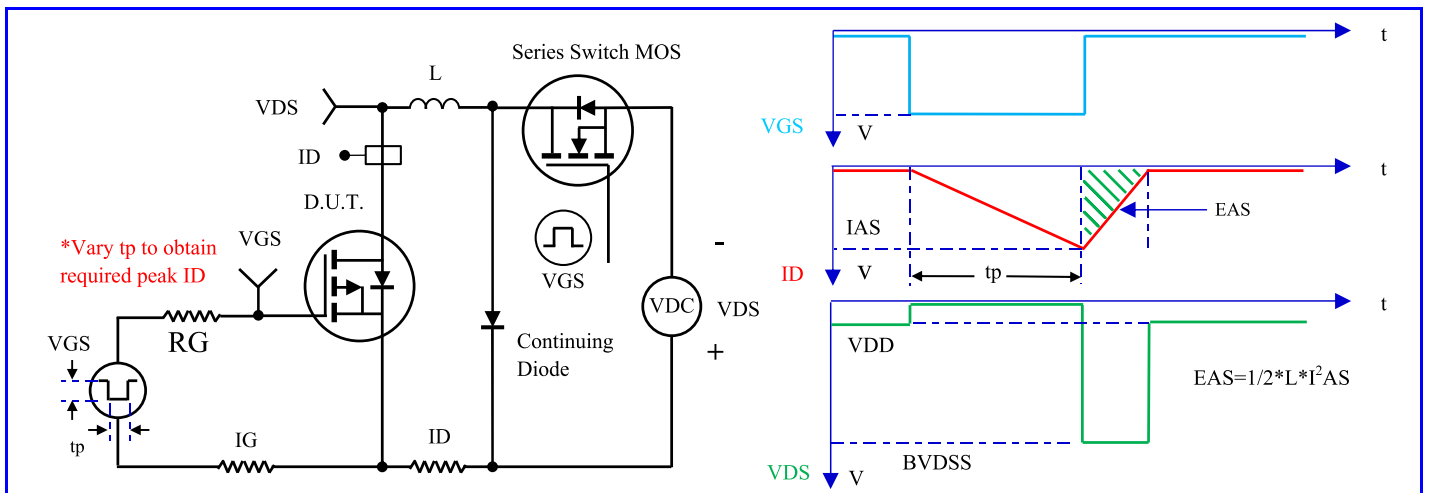


Fig.15- Unclamped Inductive Switching (UIS) Test Circuit & Waveform

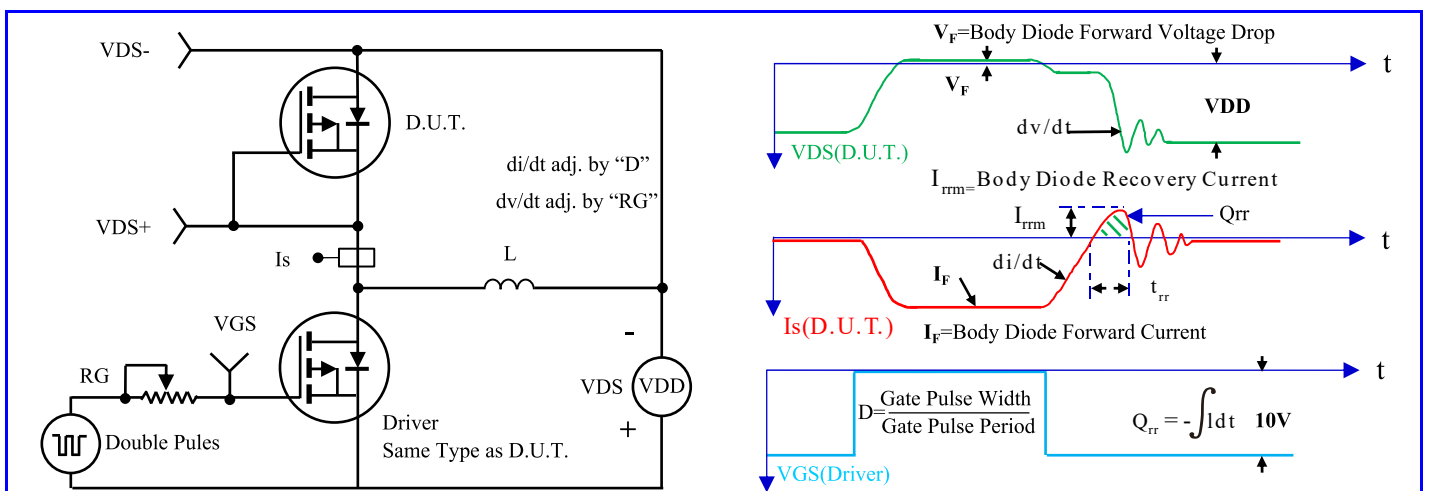


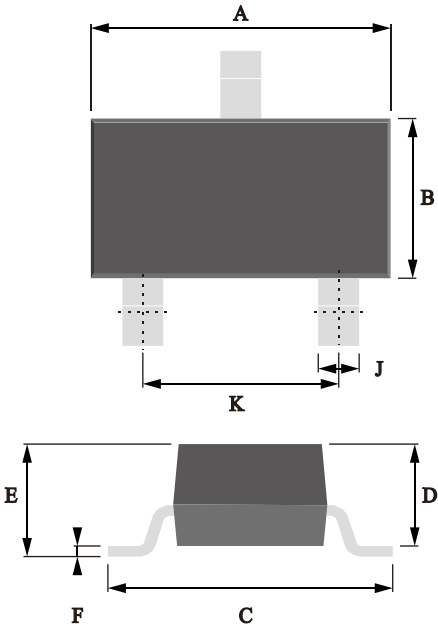
Fig.16- Diode Recovery Test Circuit & Waveform

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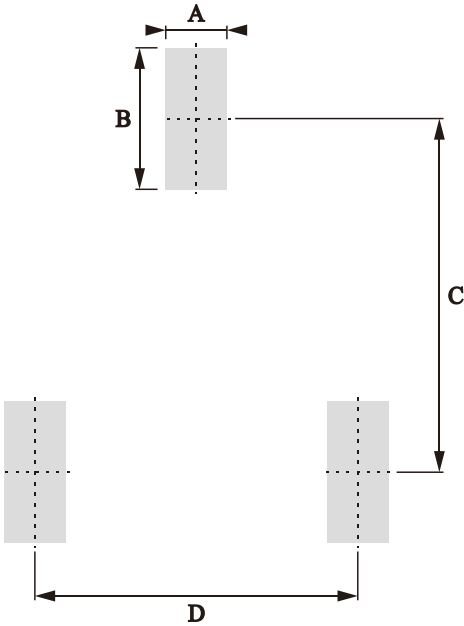
OUTLINE DRAWINGS



SOT-23

| OUTLINE DIMENSIONS |            |      |      |        |      |        |
|--------------------|------------|------|------|--------|------|--------|
| Dim.               | Milimeters |      |      | Inches |      |        |
|                    | Min.       | Typ. | Max. | Min.   | Typ. | Max.   |
| A                  | 2.80       | -    | 3.20 | 0.1102 | -    | 0.1260 |
| B                  | 1.15       | -    | 1.45 | 0.0453 | -    | 0.0571 |
| C                  | 2.25       | -    | 2.65 | 0.0886 | -    | 0.1043 |
| D                  | 0.85       | -    | 1.15 | 0.0335 | -    | 0.0453 |
| E                  | 0.90       | -    | 1.20 | 0.0354 | -    | 0.0472 |
| F                  | 0.08       | -    | 0.18 | 0.0031 | -    | 0.0071 |
| J                  | 0.30       | -    | 0.50 | 0.0118 | -    | 0.0197 |
| K                  | 1.70       | -    | 2.10 | 0.0669 | -    | 0.0827 |

RECOMMEDND LAYOUT DRAWINGS



SOT-23

| OUTLINE DIMENSIONS |            |      |      |        |        |      |
|--------------------|------------|------|------|--------|--------|------|
| Dim.               | Milimeters |      |      | Inches |        |      |
|                    | Min.       | Typ. | Max. | Min.   | Typ.   | Max. |
| A                  | -          | 0.60 | -    | -      | 0.0000 | -    |
| B                  | -          | 0.80 | -    | -      | 0.0315 | -    |
| C                  | -          | 2.00 | -    | -      | 0.0787 | -    |
| D                  | -          | 1.90 | -    | -      | 0.0748 | -    |

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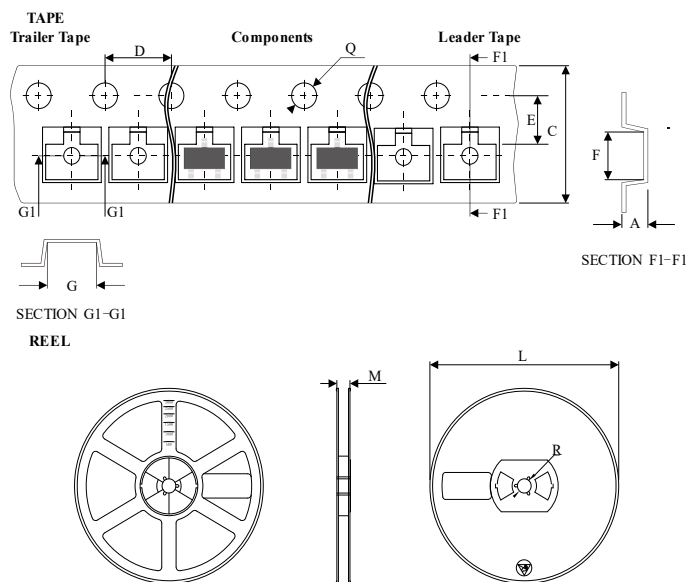
## MARKING INFORMATION



## MARKING INSTRUCTIONS

2319=Mark

## PACKAGING



## SOT-23

| OUTLINE DIMENSIONS |             |      |        |        |      |        |
|--------------------|-------------|------|--------|--------|------|--------|
| Dim.               | Millimeters |      |        | Inches |      |        |
|                    | Min.        | Typ. | Max.   | Min.   | Typ. | Max.   |
| <b>TAPE</b>        |             |      |        |        |      |        |
| A                  | 1.12        | -    | 1.32   | 0.0441 | -    | 0.0520 |
| C                  | 7.90        | -    | 8.10   | 0.3110 | -    | 0.3189 |
| D                  | 3.70        | -    | 4.30   | 0.1457 | -    | 0.1693 |
| E                  | 3.40        | -    | 3.60   | 0.1339 | -    | 0.1417 |
| F                  | 2.67        | -    | 2.87   | 0.1051 | -    | 0.1130 |
| G                  | 3.05        | -    | 3.25   | 0.1201 | -    | 0.1280 |
| Q $\Phi$           | 1.40        | -    | 1.60   | 0.0551 | -    | 0.0630 |
| <b>REEL</b>        |             |      |        |        |      |        |
| L $\Phi$           | 176.00      | -    | 180.00 | 6.929  | -    | 7.087  |
| R                  | 12.00       | -    | 14.00  | 0.4724 | -    | 0.5512 |
| M                  | 11.00       | -    | 13.00  | 0.4331 | -    | 0.5118 |

## PACKING INFORMATION

| Package Type | Package Code | Product Weight Approx(g/Pcs) | Package Method | Quantity (Pcs/Min. Pack.) | Quantity (Pcs/Inner Box) | Quantity (Pcs/Carton) |
|--------------|--------------|------------------------------|----------------|---------------------------|--------------------------|-----------------------|
| SOT-23       | P1           | 0.008                        | 7" Reel        | 3000                      | 45000                    | 180000                |

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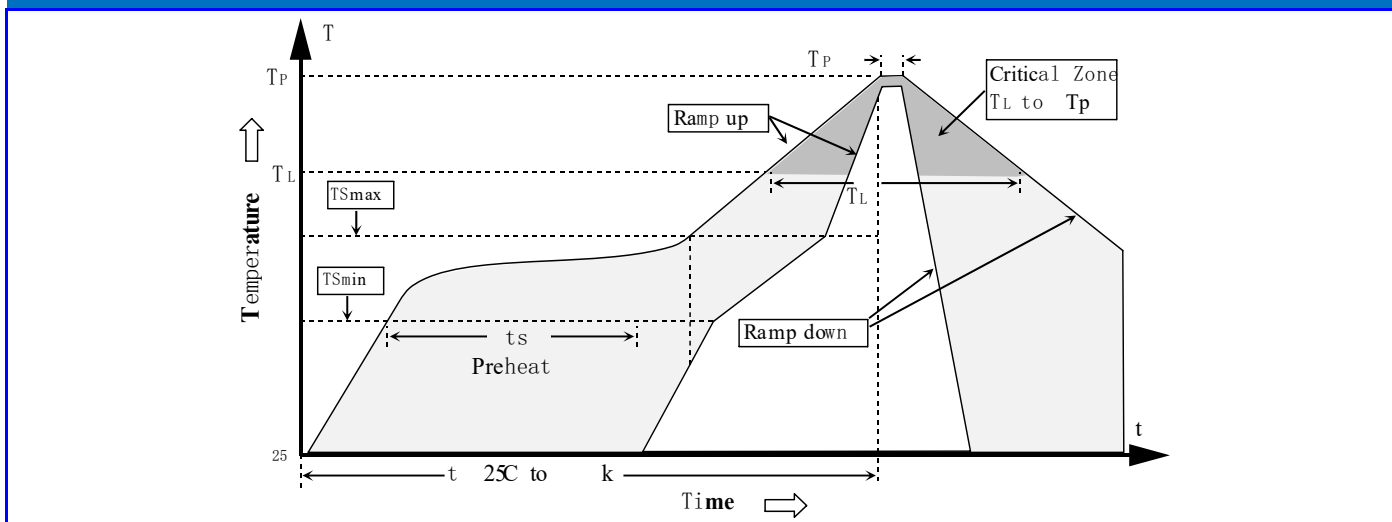
**P-Channel Enhancement Mode Trench Power MOSFET**



**Recommended wave soldering condition**

|                 |                  |                 |
|-----------------|------------------|-----------------|
| Product         | Peak Temperature | Soldering Time  |
| Pb-free devices | 260 +0/-5 °C     | 5 +1/-1 seconds |

**Recommended temperature profile for IR reflow**



| Profile feature                                                                            | Sn-Pb eutectic Assembly          | Pb-free Assembly                 |
|--------------------------------------------------------------------------------------------|----------------------------------|----------------------------------|
| Average ramp-up rate (Tsmx to Tp)                                                          | 3°C/second max.                  | 3°C/second max.                  |
| Preheat<br>-Temperature Min(TS min)<br>-Temperature Max(TS max)<br>-Time(ts min to ts max) | 100°C<br>150°C<br>60-120 seconds | 150°C<br>200°C<br>60-180 seconds |
| Time maintained above:<br>-Temperature (TL)<br>- Time (tL)                                 | 183°C<br>60-150 seconds          | 217°C<br>60-150 seconds          |
| Peak Temperature(TP)                                                                       | 240 +0/-5 °C                     | 260 +0/-5 °C                     |
| Time within 5°C of actual peak temperature(tp)                                             | 10-30 seconds                    | 20-40 seconds                    |
| Ramp down rate                                                                             | 6°C/second max.                  | 6°C/second max.                  |
| Time 25 °C to peak temperature                                                             | 6 minutes max.                   | 8 minutes max.                   |

Note : All temperatures refer to topside of the package, measured on the package body surface.

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