

**NH3404**



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

**Voltage:** 30 Volts

**Current:** 5.8 Ampers

**Package:** SOT-23-3L

**Features**

- NH'S Advanced Trench Technology
- Low  $R_{ds(on)}$  For Low On-State Loss
- High EAS For High Reliability
- Excellent  $Q_g \cdot R_{ds(on)}$  Product(FOM)

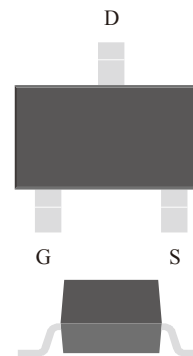
**Typical Applications**

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

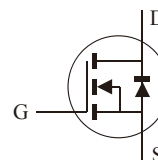
**Product Summary**

|                  |     |    |
|------------------|-----|----|
| VDS Min.@Tj      | 30  | V  |
| Id Min.@Ta       | 5.8 | A  |
| RDS(ON)(TYP)@10V | 19  | mΩ |

**Diagram:**



**Polarity:**



**\*100% UIS TESTED**

**\*100% ΔVDS TESTED**

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

| Parameter                              | Test Conditions | Symbol   | Ratings | Unit |
|----------------------------------------|-----------------|----------|---------|------|
| Drain-Source Voltage                   |                 | $V_{DS}$ | 30      | V    |
| Gate-Source Voltage                    |                 | $V_{GS}$ | ±20     | V    |
| Continuous Drain Current (Note 1)      | Ta= 25 °C       | $I_D$    | 5.8     | A    |
|                                        | Ta= 100 °C      |          | 4       |      |
| Drain Current-Pulse (Note 1)           | Tj< 150 °C      | $I_{DM}$ | 23      | A    |
| Maximum Power Dissipation Power        | Ta= 25 °C       | $P_D$    | 1.5     | W    |
| Dissipation Derating Factor Above 25°C | Ta= 100 °C      |          | 0.6     |      |
| Derating Factor                        |                 | $D_F$    | 0.01    | W/°C |

**Thermal Characteristics (Ta=25°C Unless Otherwise Specified)**

| Parameter                                                   | Test Conditions                       | Symbol    | Typ.       | Unit |
|-------------------------------------------------------------|---------------------------------------|-----------|------------|------|
| Junction Temperature                                        |                                       | $T_J$     | -55 to 150 | °C   |
| Storage Temperature Range                                   |                                       | $T_{STD}$ | -55 to 150 | °C   |
| Thermal Resistance Junction To Ambient<br>With Steady-State | Still Air Environment<br>With Ta=25°C | $R_{θJA}$ | 89.2       | °C/W |

Notes: 1.Pulse Width Limited By Max. Junction Temperature. (See Fig. 13).

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**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>                   | 30   | --   | --   | V    |
| Bvdss Temperature Coefficient                                                               | ID=250uA,Reference25℃ | ΔBV <sub>DSS</sub> /ΔT <sub>J</sub> | --   | 0.03 | --   | V/℃  |
| Drain-Source Leakage Current                                                                | VDS= 30 V,VGS=0V      | I <sub>DSS</sub>                    | --   | --   | 1    | uA   |
| Gate-Body Leakage Current                                                                   | VGS= ±20 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  | 2    | 3    | V    |
| Drain-Source On Resistance                                                                  | ID= 2.9 A,VGS= 10.0 V | R <sub>DS(ON)</sub>                 | --   | 19   | 30   | mΩ   |
|                                                                                             | ID= 2.9 A,VGS= 4.5 V  |                                     | --   | 24.7 | 45   |      |
| Dynamic Characteristics                                                                     |                       |                                     |      |      |      |      |
| Input Capacitance                                                                           | VDS= 15 V             | C <sub>iss</sub>                    | --   | 437  | --   | pF   |
| Output Capacitance                                                                          | VGS= 0 V              | C <sub>oss</sub>                    | --   | 68   | --   | pF   |
| Reverse Transfer Capacitance                                                                | F= 1 MHZ              | C <sub>rss</sub>                    | --   | 60   | --   | pF   |
| Switching Paramters (Test Circuit & Waveform See Fig.14)                                    |                       |                                     |      |      |      |      |
| Turn-On Delay Time                                                                          | VDS= 15 V             | t <sub>d(on)</sub>                  | --   | 3.3  | --   | ns   |
| Turn-On Rise Time                                                                           | VGS= 10.0 V           | t <sub>r</sub>                      | --   | 4.8  | --   | ns   |
| Turn-Off Delay Time                                                                         | RG= 10.0 Ω            | t <sub>d(off)</sub>                 | --   | 26   | --   | ns   |
| Turn-Off Rise Time                                                                          |                       | t <sub>f</sub>                      | --   | 4    | --   | ns   |
| Gate Charge Paramters (Test Circuit & Waveform See Fig.15)                                  |                       |                                     |      |      |      |      |
| Total Gate Charge                                                                           | VDS= 15 V             | Q <sub>g</sub>                      | --   | 9.7  | --   | nC   |
| Gate-Source Charge                                                                          | VGS= 10.0 V           | Q <sub>gs</sub>                     | --   | 1.6  | --   | nC   |
| Gate-Drain Charge                                                                           | ID= 2.9 A             | Q <sub>gd</sub>                     | --   | 3.1  | --   | nC   |
| Drain-Source Diode Characteristics And Maximum Ratings (Test Circuit & Waveform See Fig.17) |                       |                                     |      |      |      |      |
| Max. Diode Forward Cuurent                                                                  |                       | I <sub>S</sub>                      | --   | --   | 5.8  | A    |
| Max. Pulsed Forward Cuurent                                                                 |                       | I <sub>SM</sub>                     | --   | --   | 23.2 | A    |
| Diode Forward Voltage                                                                       | ID= 2.9 A,VGS=0V      | V <sub>SD</sub>                     | --   | 0.7  | 1.2  | V    |

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Typical Characteristics Curves

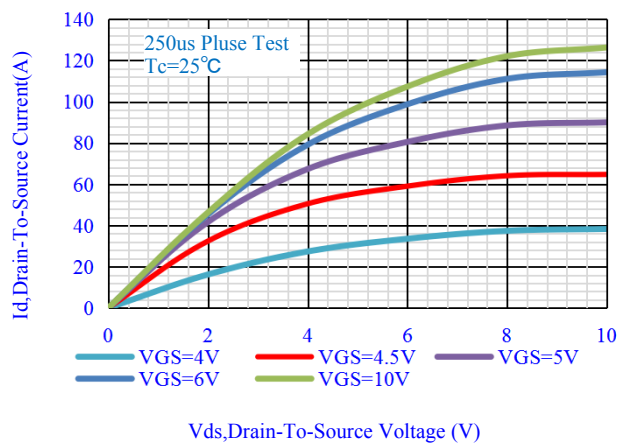


Fig.1-Output Characteristics

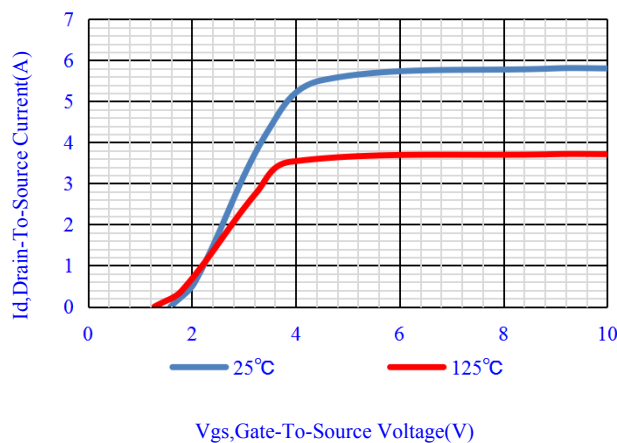


Fig.2-Transfer Characteristics

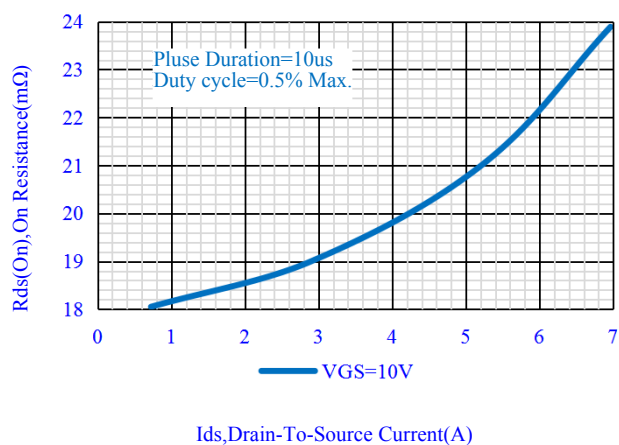


Fig.3-On Resistance Vs. Drain Current

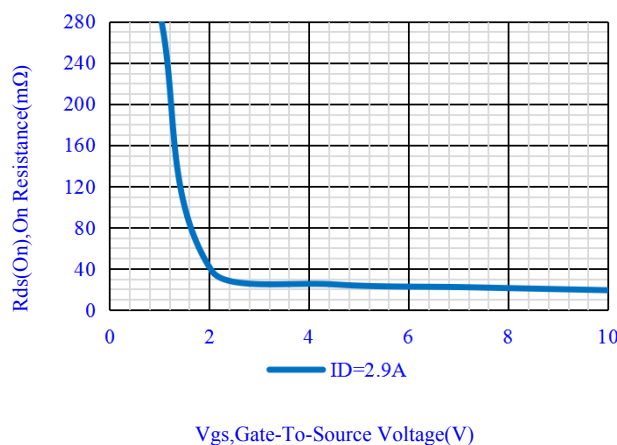


Fig.4-On Resistance Vs. Gate Source Voltage

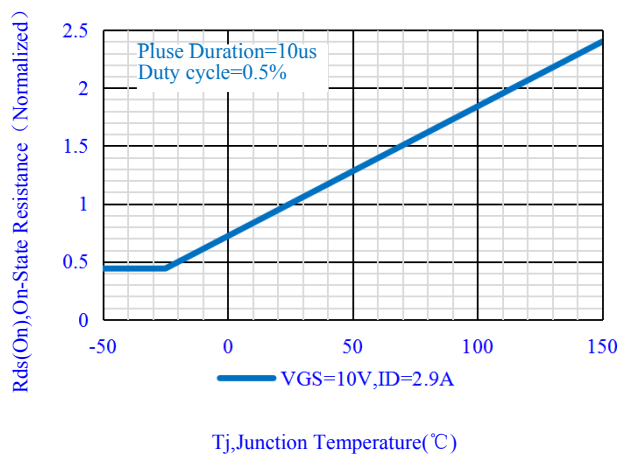


Fig.5-On Resistance Vs. Junction Temperature

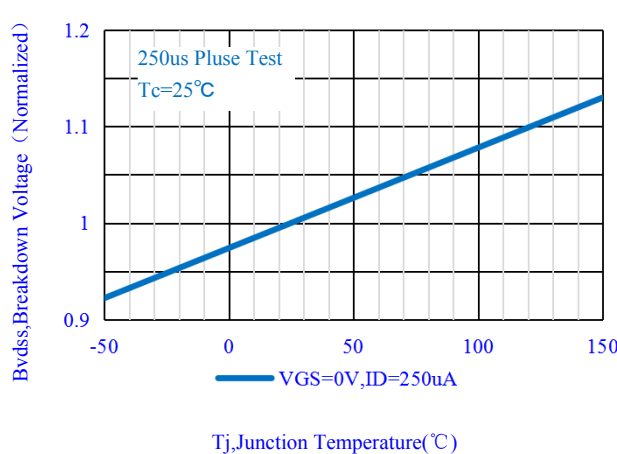


Fig.6-Breakdown Voltage Vs. Junction Temperature

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Typical Characteristics Curves

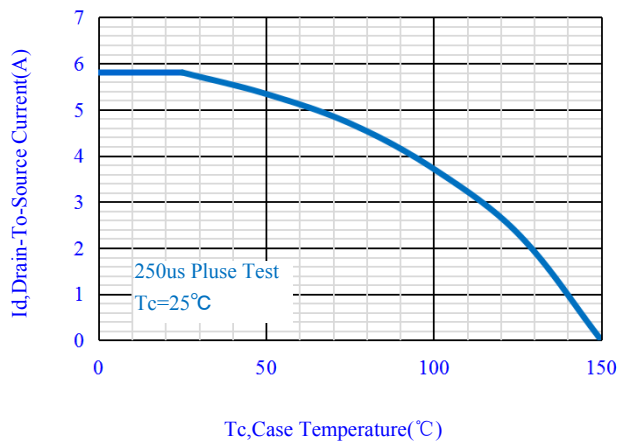


Fig.7-Maximum Continuous Drain Current Vs. Case Temperature

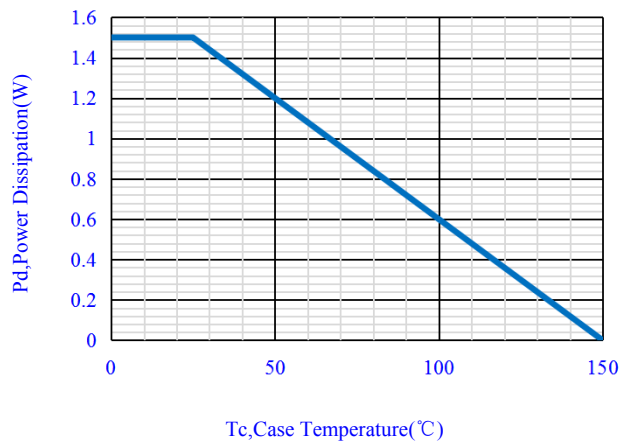


Fig.8-Maximum Power Dissipation Vs. Case Temperature

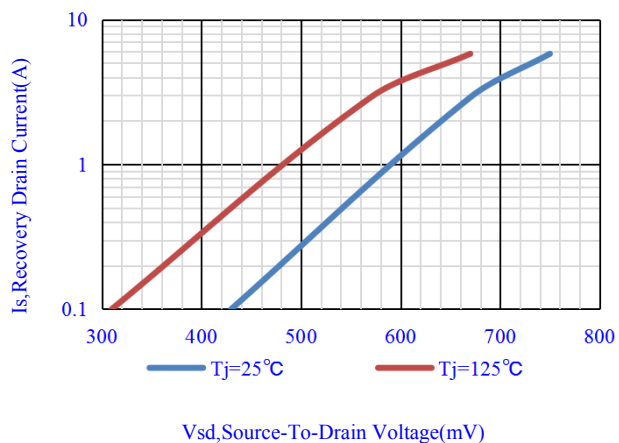


Fig.9-Source-To-Drain Diode Forward Voltage

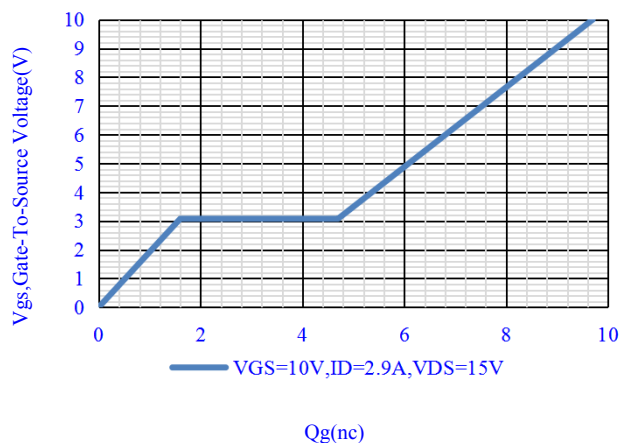


Fig.10-Gate Charge Waveform

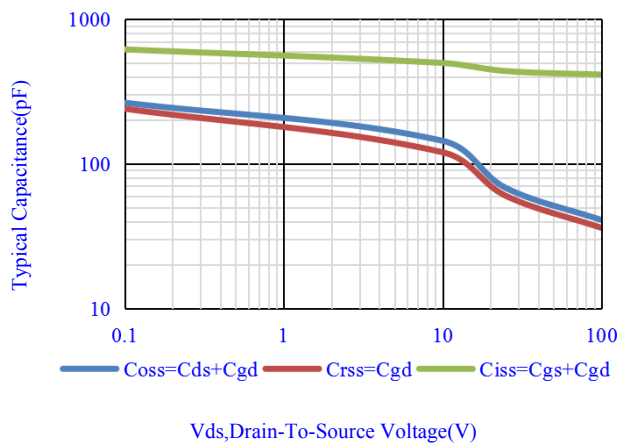


Fig.11-Typical Capacitance Vs. Drain-To-Source Voltage

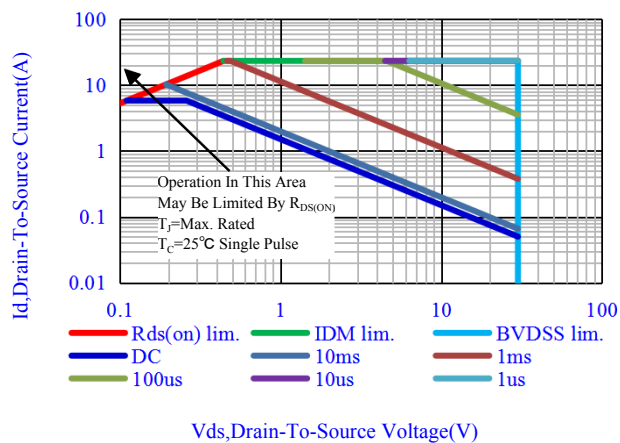


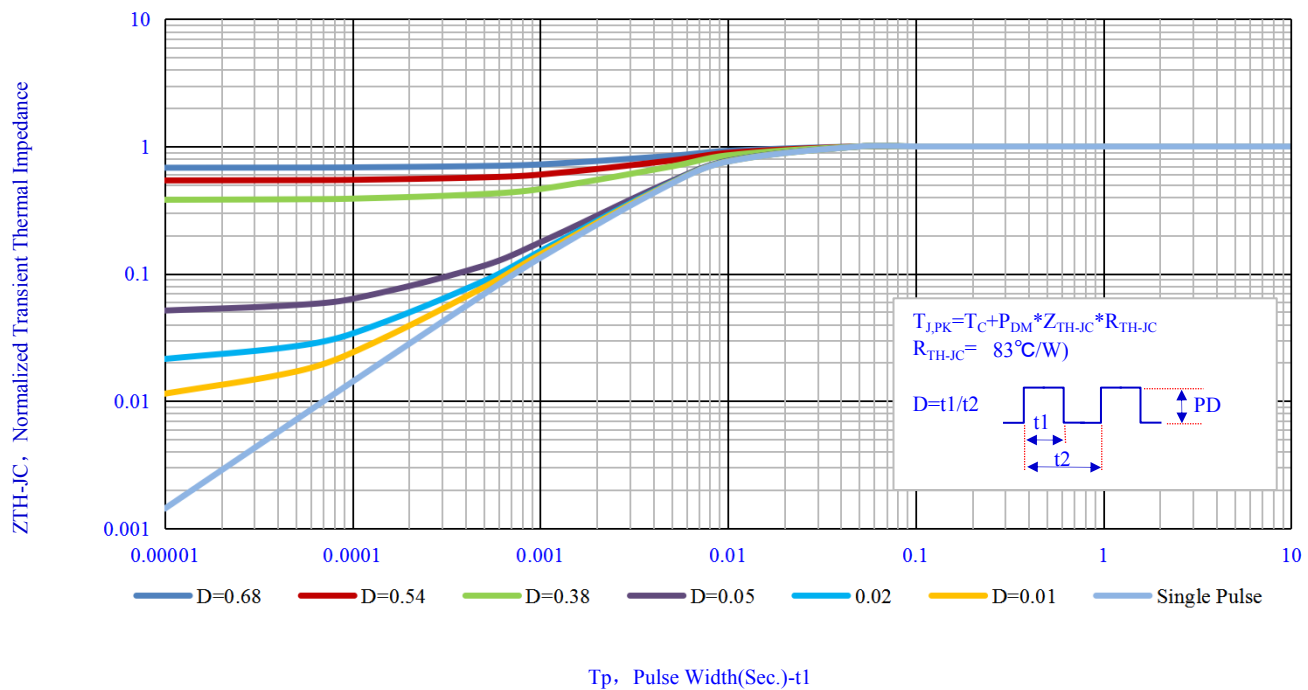
Fig.12-Maximum Safe Operating Area(SOA)

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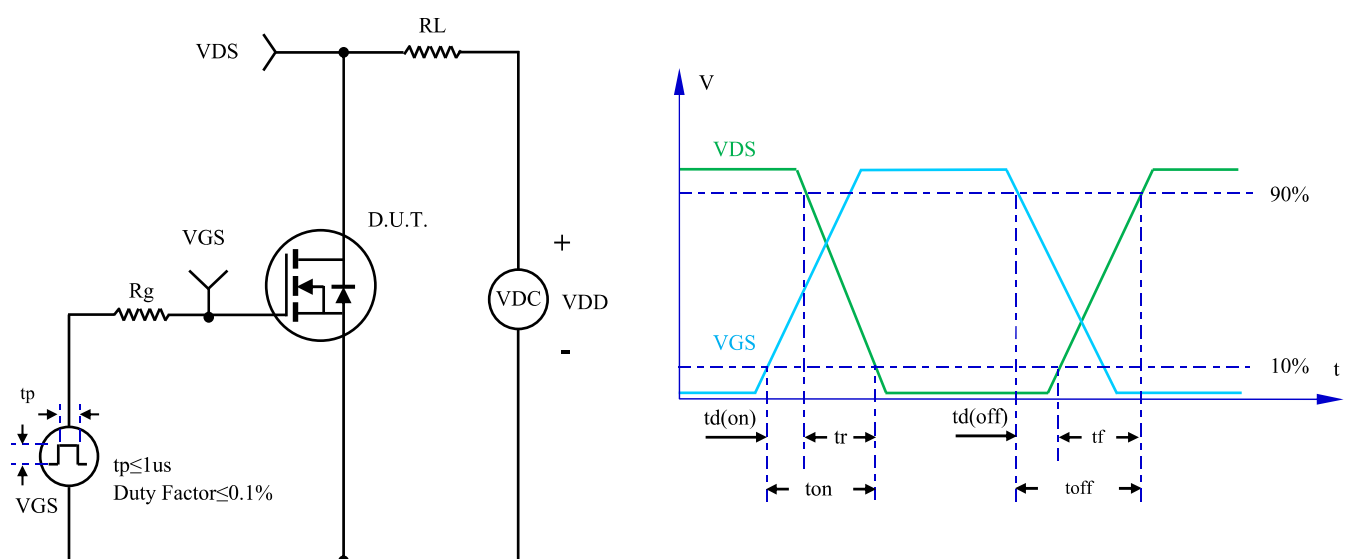


**Typical Characteristics Curves**



**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

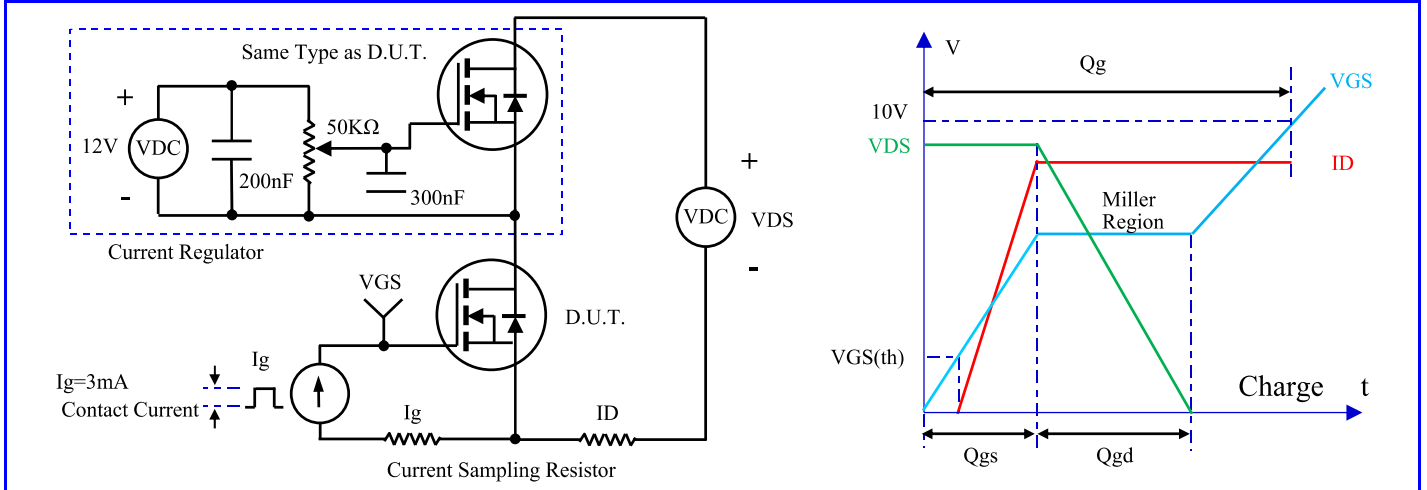


Fig.14-Gate Charge Test Circuit & Waveform

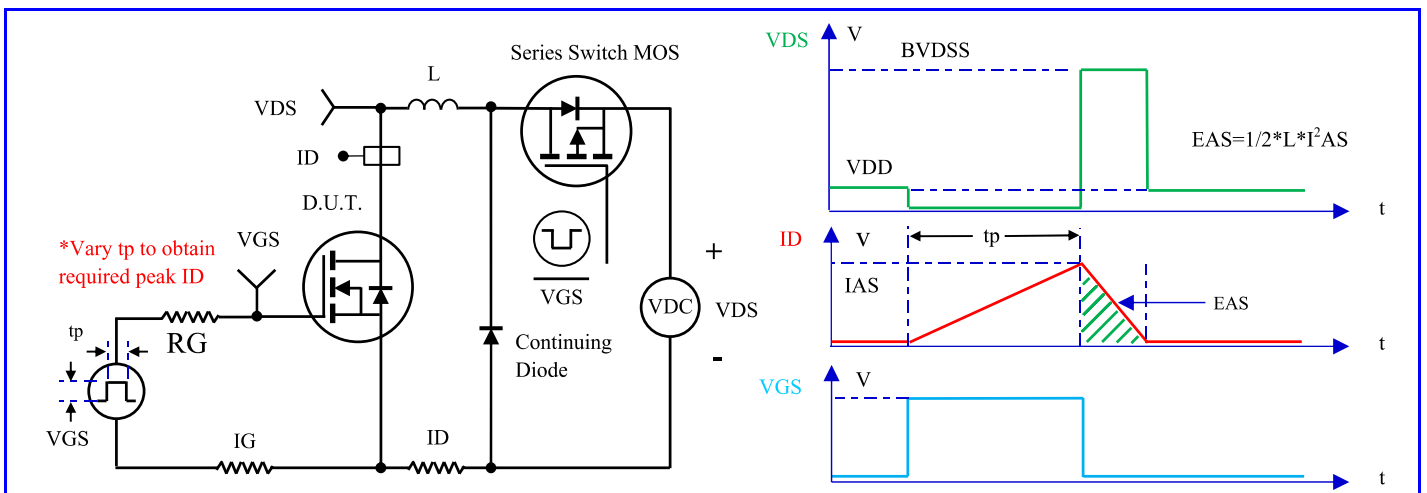


Fig.15- Unclamped Inductive Switching (UIS) Test Circuit & Waveform

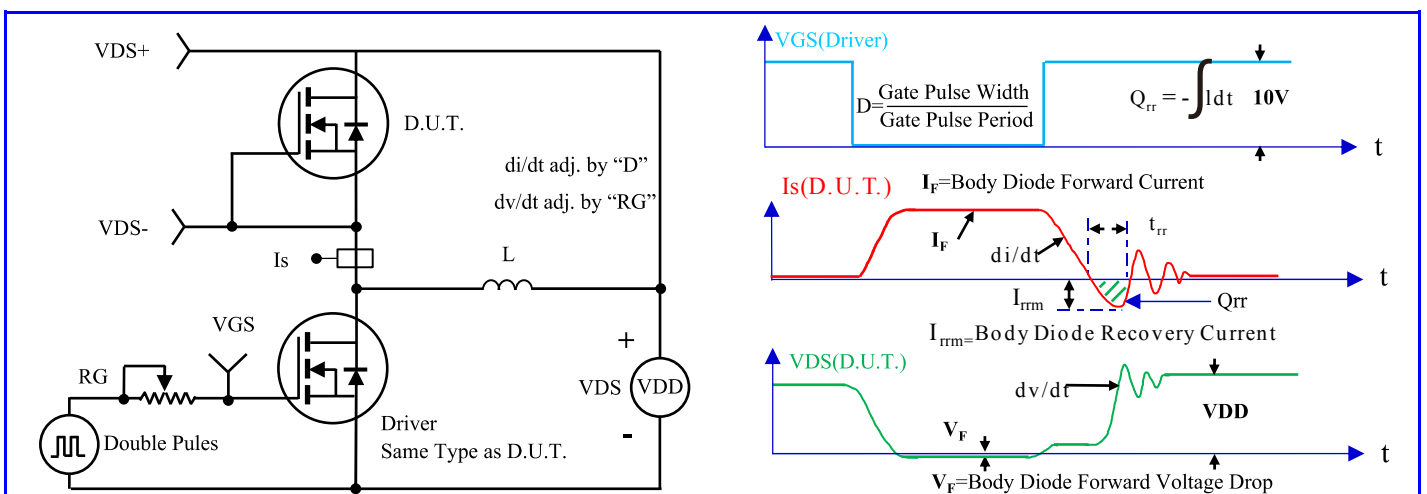


Fig.16- Diode Recovery Test Circuit & Waveform

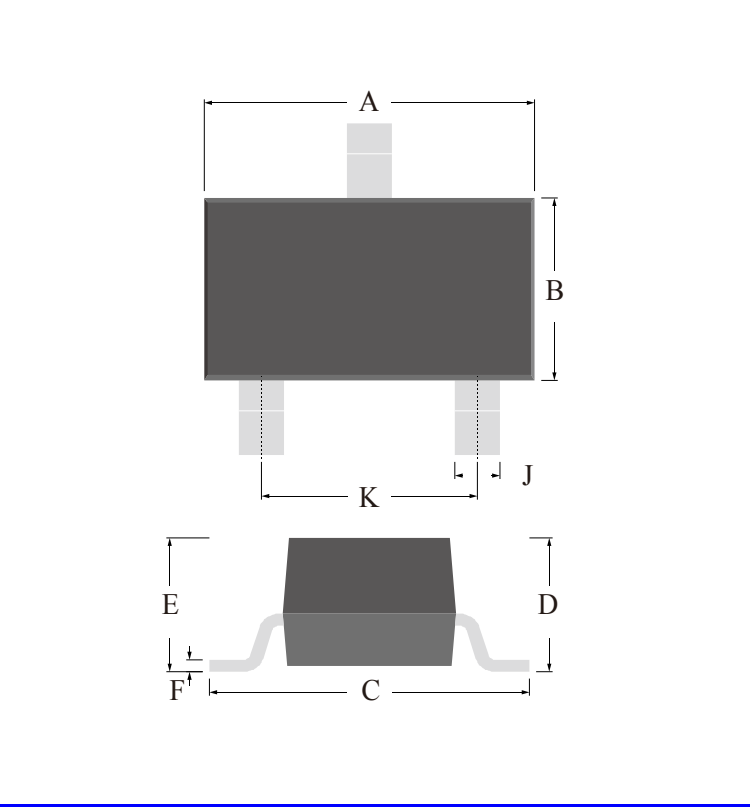
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OUTLINE DRAWINGS

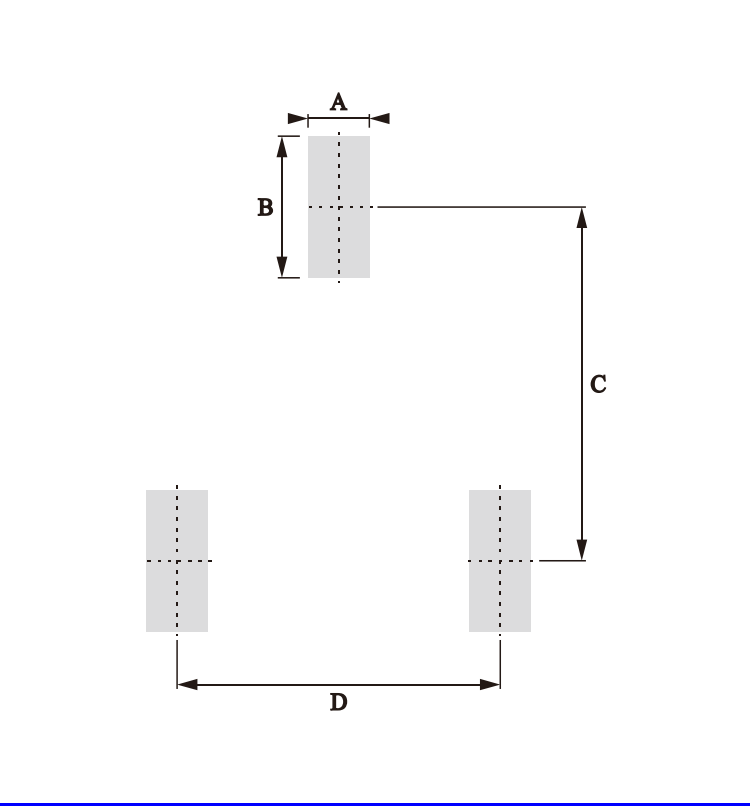
SOT-23-3L



| OUTLINE DIMENSIONS |            |      |      |        |      |        |
|--------------------|------------|------|------|--------|------|--------|
| Dim.               | Milimeters |      |      | Inches |      |        |
|                    | Min.       | Typ. | Max. | Min.   | Typ. | Max.   |
| A                  | 2.80       | -    | 3.20 | 0.1102 | -    | 0.1260 |
| B                  | 1.45       | -    | 1.75 | 0.0571 | -    | 0.0689 |
| C                  | 2.65       | -    | 3.05 | 0.1043 | -    | 0.1201 |
| D                  | 0.95       | -    | 1.25 | 0.0374 | -    | 0.0492 |
| E                  | 1.00       | -    | 1.30 | 0.0394 | -    | 0.0512 |
| 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-23-3L



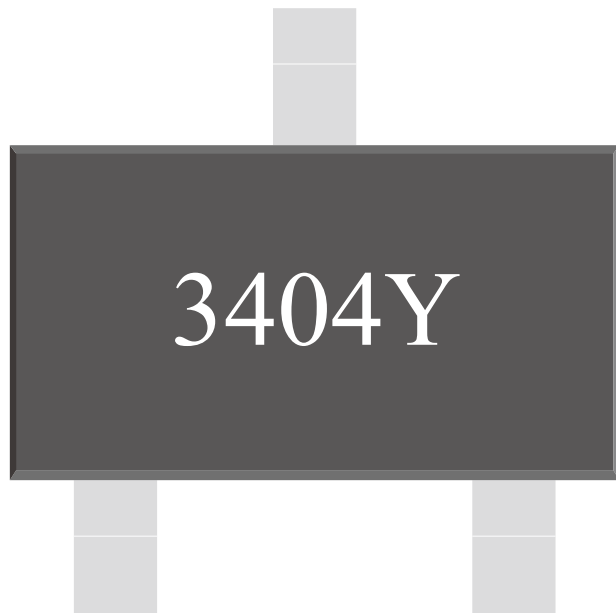
| OUTLINE DIMENSIONS |            |      |      |        |        |      |
|--------------------|------------|------|------|--------|--------|------|
| Dim.               | Milimeters |      |      | Inches |        |      |
|                    | Min.       | Typ. | Max. | Min.   | Typ.   | Max. |
| 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**

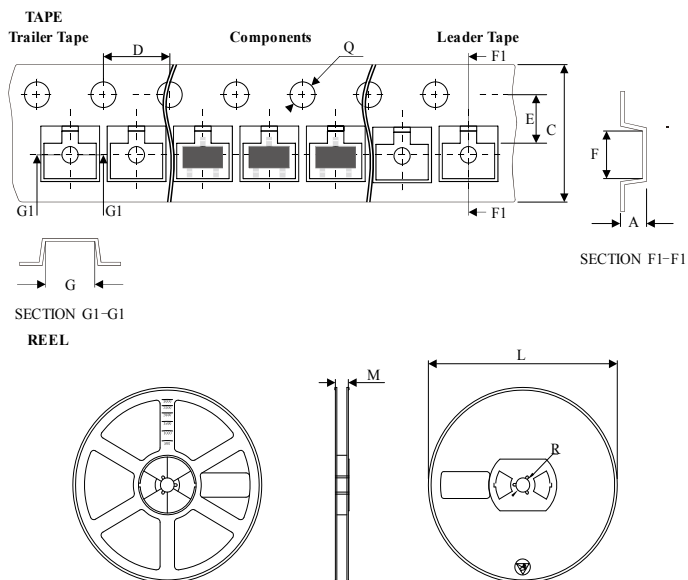


**MARKING INSTRUCTIONS**

3404Y=mark

**PACKAGING**

**SOT-23-3L**



| 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 Φ                | 1.40        | -    | 1.60   | 0.0551 | -    | 0.0630 |
| <b>REEL</b>        |             |      |        |        |      |        |
| L Φ                | 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-23-3L    | P1           | 0.014                        | 7" Reel        | 3000                      | 45000                    | 180000                |

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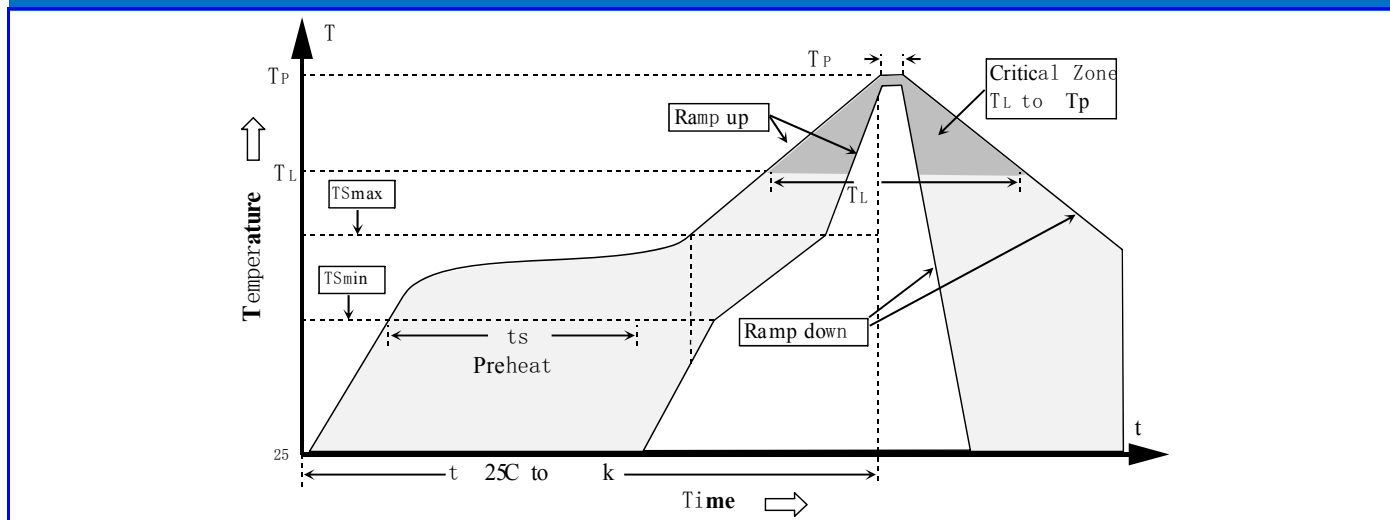


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**Recommended wave soldering condition**

| 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<br>(Tsmax 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<br>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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