

**NPS10N60R**

**N-Channel Enhancement Mode Power MOSFET**



**Voltage:** 600 Volts

**Current:** 10 Ampers

**Package:** TO-262

**Features**

- NH'S Advanced Planar DMOS Technology
- Low Rds(on) For Low On-State Loss
- High EAS For High Reliability
- Qualified According To JEDEC Criteria

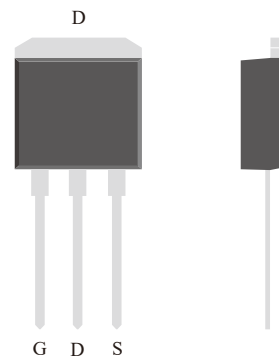
**Typical Applications**

- AC/DC Converter
- Adaptor And Charger
- PC Power
- LED Drives And LED Lighting

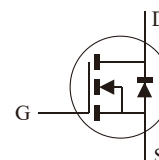
**Product Summary**

|                  |      |   |
|------------------|------|---|
| VDS Min.@Tj      | 600  | V |
| Id Min.@Ta       | 10   | A |
| RDS(ON)(TYP)@10V | 0.68 | Ω |

**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> | 600     | V    |
| Gate-Source Voltage                                                          |                                                                       | V <sub>GS</sub> | ±30     | V    |
| Continuous Drain Current (Note 1)                                            | Ta= 25 ℃                                                              | I <sub>D</sub>  | 10      | A    |
|                                                                              | Ta= 100 ℃                                                             |                 | 6.4     |      |
| Drain Current-Pulse (Note 1)                                                 | Tj< 150 ℃                                                             | I <sub>DM</sub> | 39      | A    |
| Maximum Power Dissipation Power<br>Dissipation Derating Factor Above 25℃     | Ta= 25 ℃                                                              | P <sub>D</sub>  | 139     | W    |
|                                                                              | Ta= 100 ℃                                                             |                 | 56      |      |
| Derating Factor                                                              |                                                                       | D <sub>F</sub>  | 1.11    | W/℃  |
| Avalanche Current,Single Pulse (Note 1)                                      | L= 10.0 mH                                                            | I <sub>AS</sub> | 10.8    | A    |
| Single Pulse Avalanche Energy (Note 1)<br>Test Circuit & Waveform See Fig.16 | L= 10.0 mH<br>IAS= 10.8 A, RG= 10.0 Ω<br>Starting Tj=25 ℃, VG= 10.0 V | E <sub>AS</sub> | 583     | mJ   |

**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> | 65         | ℃/W  |
| Thermal Resistance Junction-Case<br>With Steady-State       | Device Mounted On<br>75mm x 45mm x 2.5mm Alu. Heat. | R <sub>θJC</sub> | 0.9        |      |

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

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

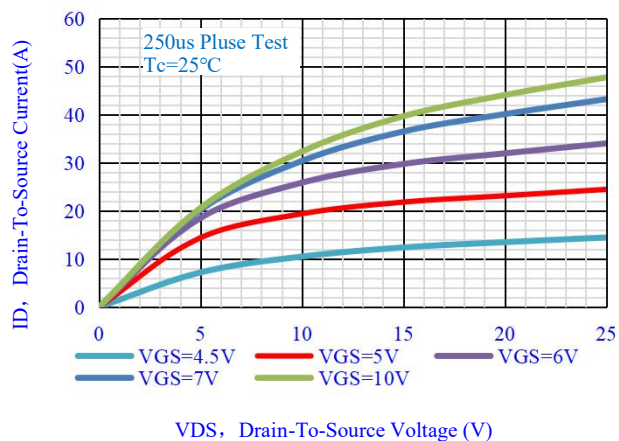
| Parameter                                                                                   | Test Conditions           | Symbol                              | Min. | Typ. | Max. | Unit |
|---------------------------------------------------------------------------------------------|---------------------------|-------------------------------------|------|------|------|------|
| Static Off Characteristics                                                                  |                           |                                     |      |      |      |      |
| Drain-Source Breakdown Voltage                                                              | VGS=0V,ID=250uA           | BV <sub>DSS</sub>                   | 600  | --   | --   | V    |
| Bvdss Temperature Coefficient                                                               | ID=250uA,Reference25℃     | ΔBV <sub>DSS</sub> /ΔT <sub>J</sub> | --   | 0.71 | --   | V/℃  |
| Drain-Source Leakage Current                                                                | VDS= 600 V,VGS=0V         | I <sub>DSS</sub>                    | --   | --   | 1    | uA   |
| Gate-Body Leakage Current                                                                   | VGS= ±30 V,VDS=0V         | I <sub>GSS</sub>                    | --   | --   | ±100 | nA   |
| Forward Transconductance                                                                    | ID= 5.0 A,VDS= 15 V       | g <sub>fs</sub>                     | --   | 9.5  | --   | S    |
| Static On Characteristics                                                                   |                           |                                     |      |      |      |      |
| Gate Threshold Voltage                                                                      | VGS= VDS ID=250uA         | V <sub>GS(TH)</sub>                 | 2.0  | 3.0  | 4.0  | V    |
| Drain-Source On Resistance                                                                  | ID= 5.0 A,VGS= 10.0 V     | R <sub>DS(ON)</sub>                 | --   | 0.68 | 0.9  | Ω    |
|                                                                                             | ID= 5.0 A,VGS= 4.5 V      |                                     | --   | 0.9  | 1.4  |      |
| Dynamic Characteristics                                                                     |                           |                                     |      |      |      |      |
| Input Capacitance                                                                           | VDS= 50 V                 | C <sub>iss</sub>                    | --   | 1609 | --   | pF   |
| Output Capacitance                                                                          | VGS= 0 V                  | C <sub>oss</sub>                    | --   | 1306 | --   | pF   |
| Reverse Transfer Capacitance                                                                | F= 1 MHZ                  | C <sub>rss</sub>                    | --   | 8    | --   | pF   |
| Switching Paramters (Test Circuit & Waveform See Fig.14)                                    |                           |                                     |      |      |      |      |
| Turn-On Delay Time                                                                          | VDS= 300 V                | t <sub>d(on)</sub>                  | --   | 26   | --   | ns   |
| Turn-On Rise Time                                                                           | VGS= 10.0 V               | t <sub>r</sub>                      | --   | 23   | --   | ns   |
| Turn-Off Delay Time                                                                         | RG= 10.0 Ω                | t <sub>d(off)</sub>                 | --   | 49   | --   | ns   |
| Turn-Off Rise Time                                                                          |                           | t <sub>f</sub>                      | --   | 27   | --   | ns   |
| Gate Charge Paramters (Test Circuit & Waveform See Fig.15)                                  |                           |                                     |      |      |      |      |
| Total Gate Charge                                                                           | VDS= 300 V                | Q <sub>g</sub>                      | --   | 32   | --   | nC   |
| Gate-Source Charge                                                                          | VGS= 10.0 V               | Q <sub>gs</sub>                     | --   | 8    | --   | nC   |
| Gate-Drain Charge                                                                           | ID= 5.0 A                 | Q <sub>gd</sub>                     | --   | 12   | --   | nC   |
| Drain-Source Diode Characteristics And Maximum Ratings (Test Circuit & Waveform See Fig.17) |                           |                                     |      |      |      |      |
| Max. Diode Forward Cuurent                                                                  |                           | I <sub>s</sub>                      | --   | --   | 10   | A    |
| Max. Pulsed Forward Cuurent                                                                 |                           | I <sub>SM</sub>                     | --   | --   | 40   | A    |
| Diode Forward Voltage                                                                       | ID= 5.0 A,VGS=0V          | V <sub>SD</sub>                     | --   | 0.90 | 1.4  | V    |
| Reverse Recovery Time                                                                       | ID= 5.0 A,di/dt= 100 A/us | t <sub>rr</sub>                     | --   | 499  | --   | ns   |
| Reverse Recovery Charge                                                                     | VGS= 10.0 V,VDD= 300 V    | Q <sub>rr</sub>                     | --   | 2940 | --   | nC   |

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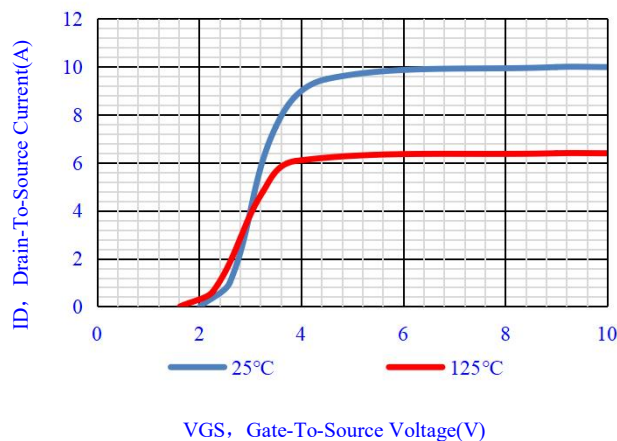
**N-Channel Enhancement Mode Power MOSFET**



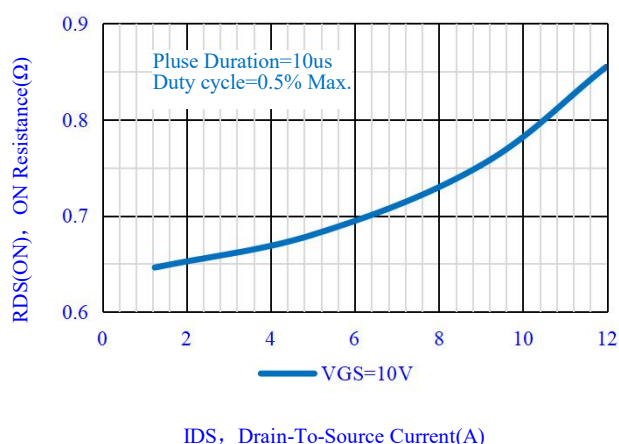
**Typical Characteristics Curves**



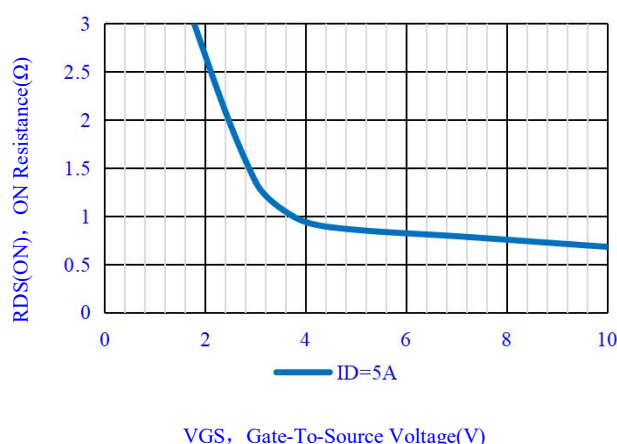
**Fig.1-Output Characteristics**



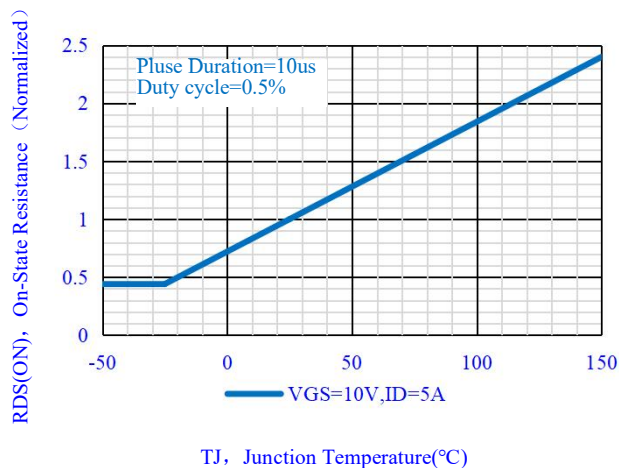
**Fig.2- Transfer Characteristics**



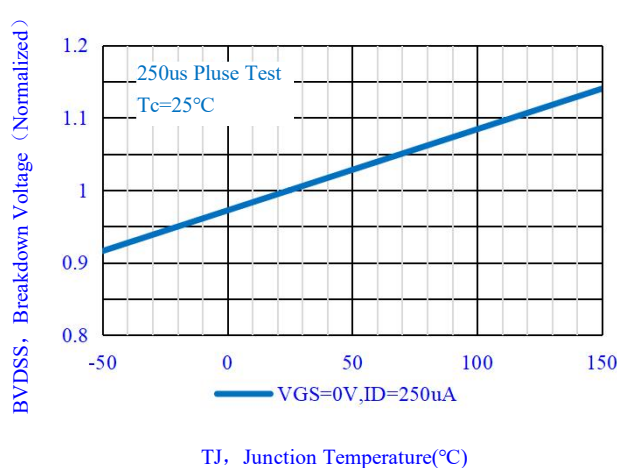
**Fig.3- On Resistance vs. Drain Current**



**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

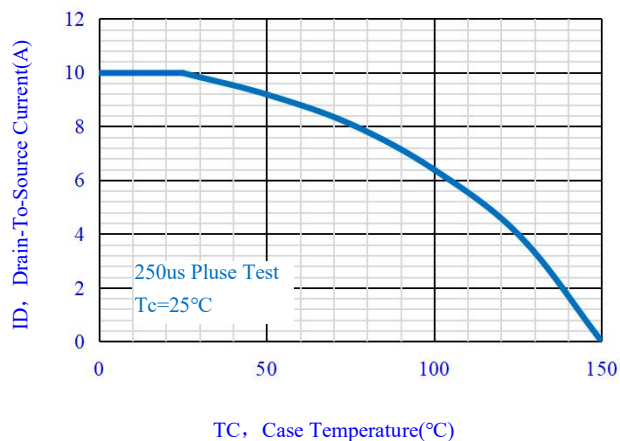


Fig.7-Maximum Continuous Drain Current vs. Case Temperature

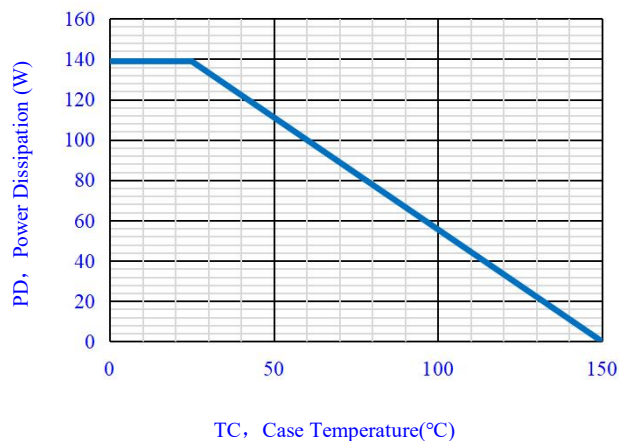


Fig.8-Maximum Power Dissipation vs. Case Temperature

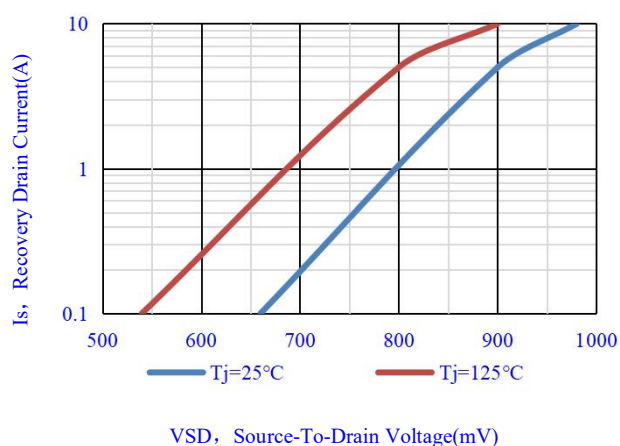


Fig.9- Source-To-Drain Diode Forward Voltage

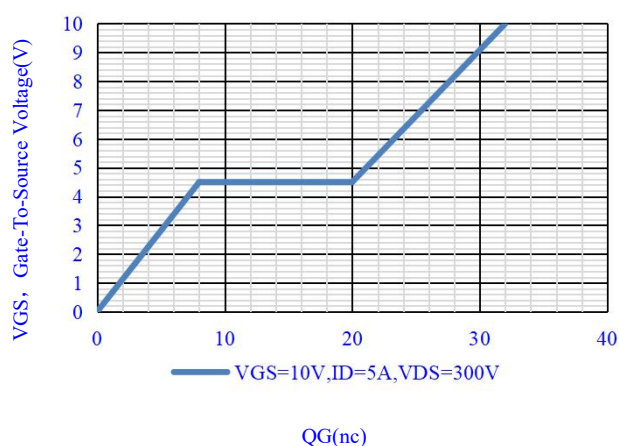


Fig.10-Gate Charge Waveform

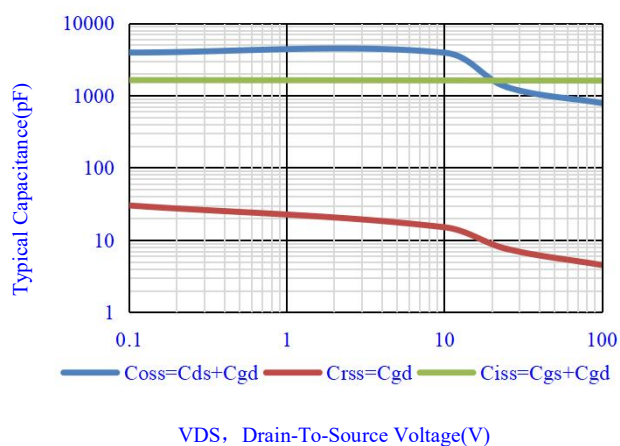


Fig.11-Typical Capacitance vs. Drain-To-Source Voltage

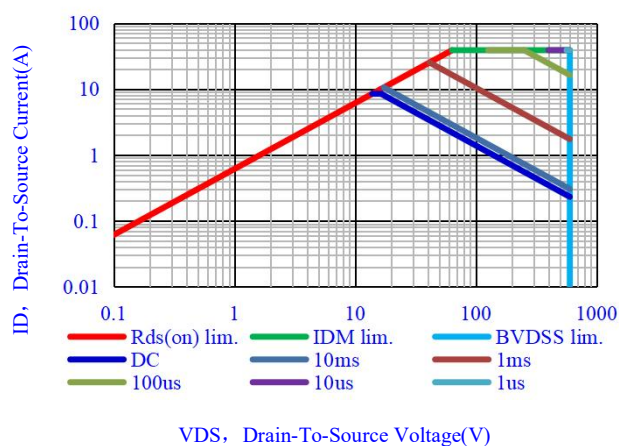


Fig.12-Maximum Safe Operating Area(SOA)

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Typical Characteristics Curves

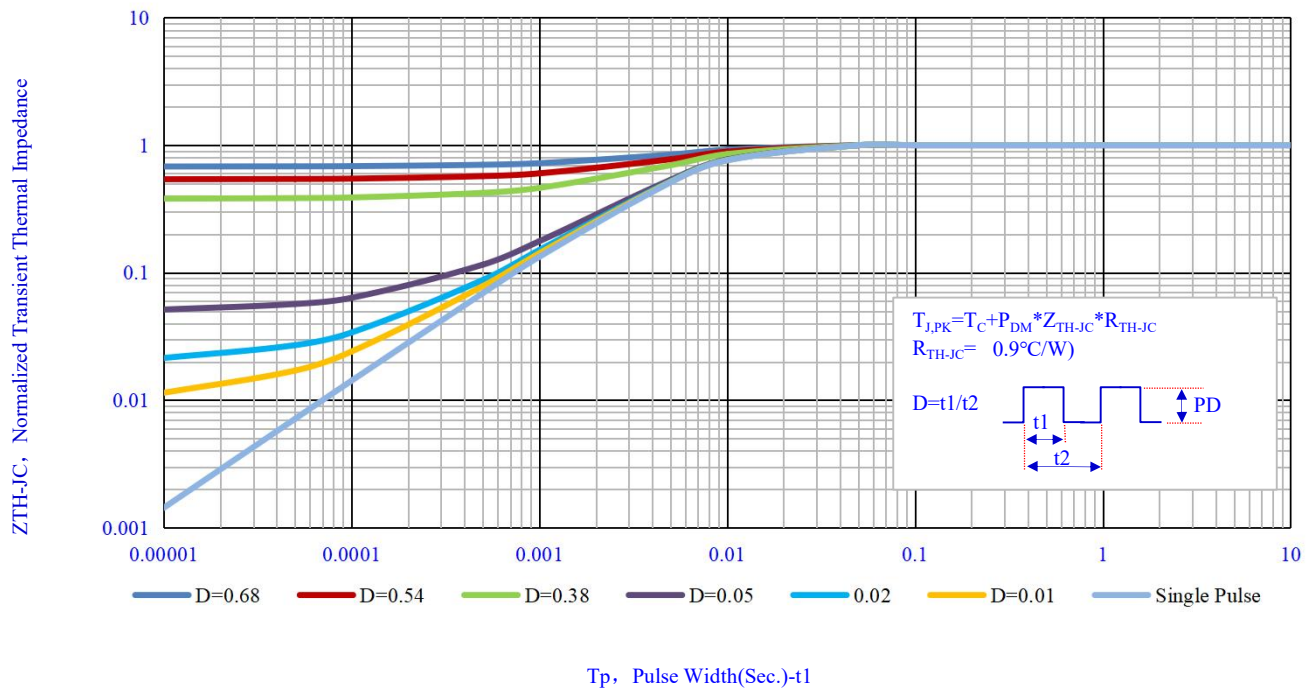


Fig.13- Normalized Maximum Transient Thermal Impedance vs.Pulse Width

Test Circuit & Waveform

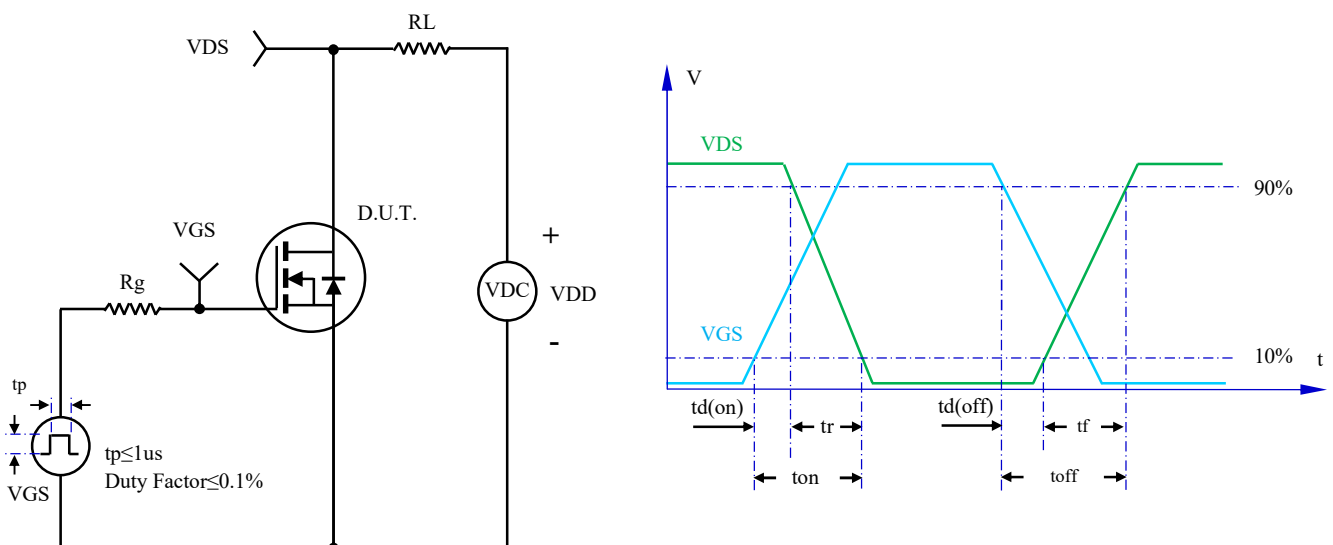


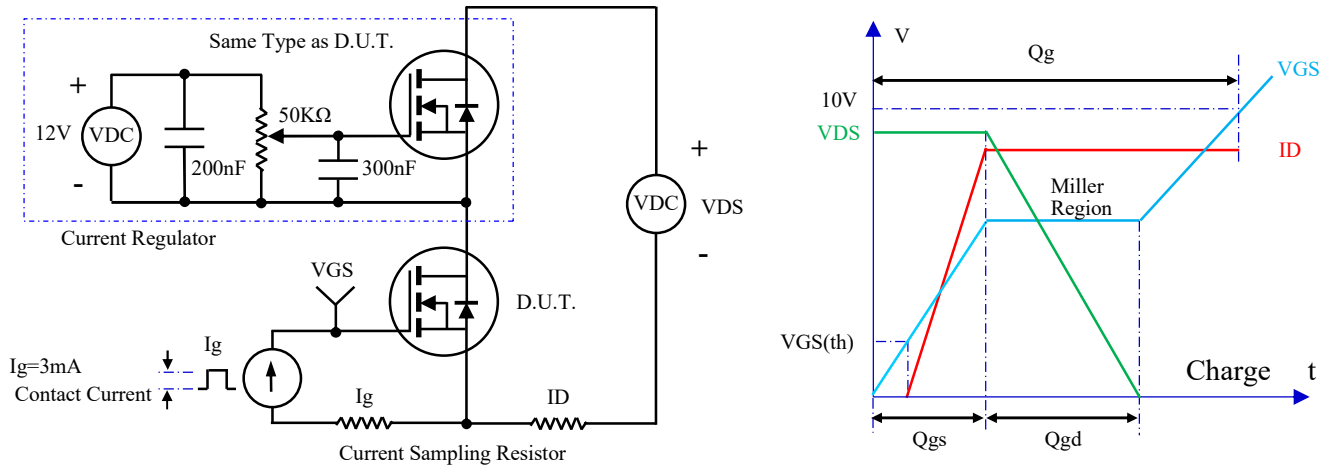
Fig.14- Resistive Switching Test Circuit & Waveform

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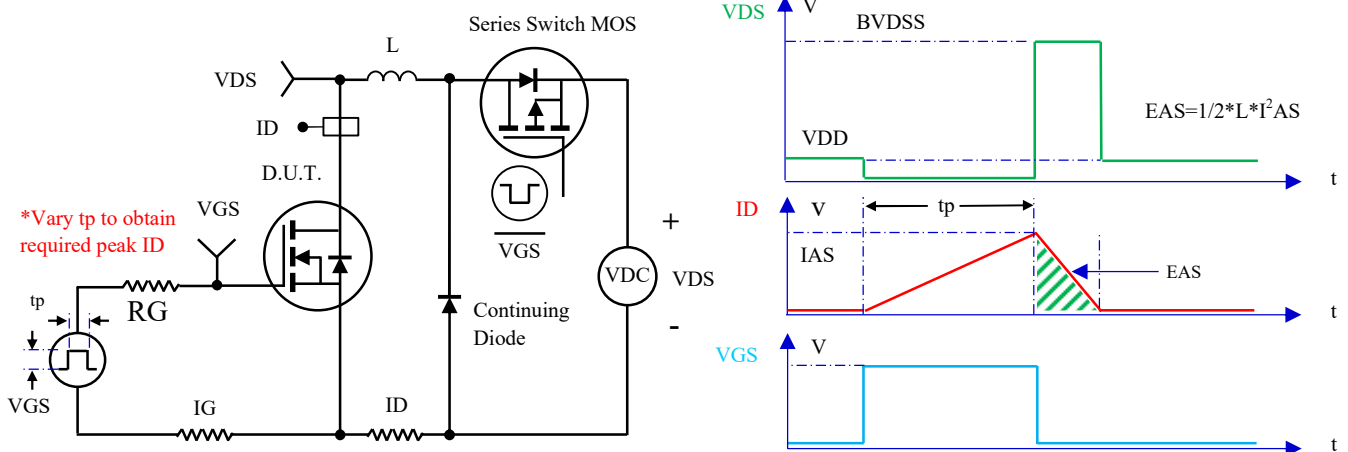
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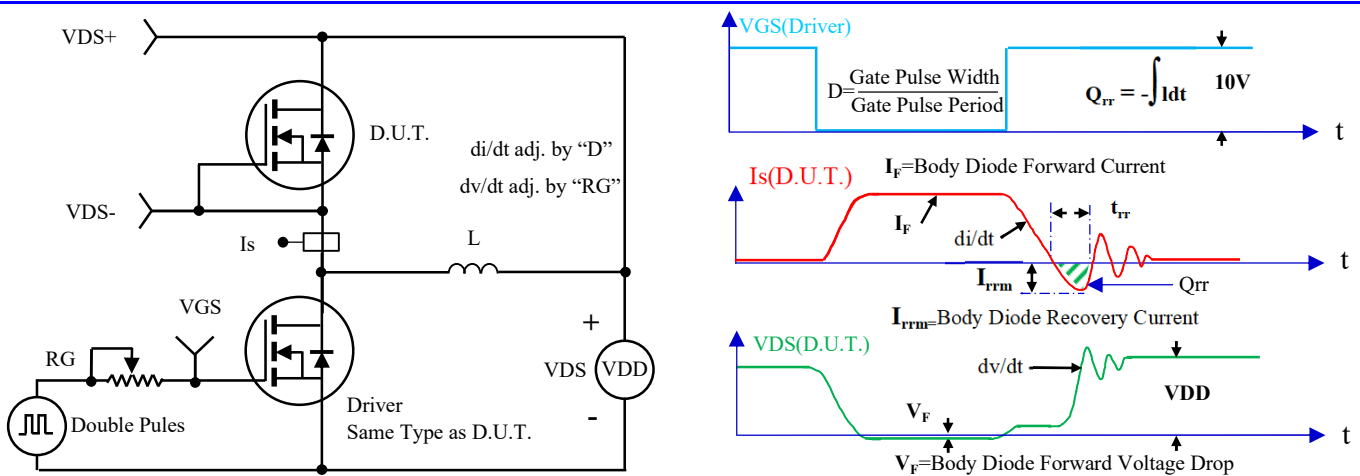
**Test Circuit & Waveform**



**Fig.15- Gate Charge Test Circuit & Waveform**



**Fig.16- Unclamped Inductive Switching (UIS) Test Circuit & Waveform**



**Fig.17- Diode Recovery Test Circuit & Waveform**

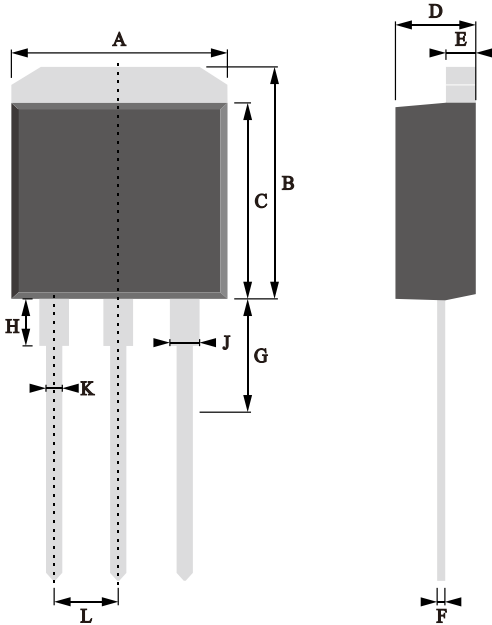
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OUTLINE DRAWINGS

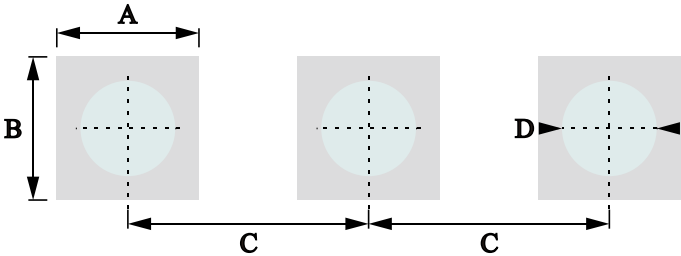
TO-262



| OUTLINE DIMENSIONS |            |      |       |        |      |        |
|--------------------|------------|------|-------|--------|------|--------|
| Dim.               | Milimeters |      |       | Inches |      |        |
|                    | Min.       | Typ. | Max.  | Min.   | Typ. | Max.   |
| A                  | 9.30       | -    | 10.50 | 0.3661 | -    | 0.4134 |
| B                  | 9.60       | -    | 11.60 | 0.3780 | -    | 0.4567 |
| C                  | 8.20       | -    | 9.50  | 0.3228 | -    | 0.3740 |
| D                  | 4.00       | -    | 5.00  | 0.1575 | -    | 0.1969 |
| E                  | 1.00       | -    | 1.70  | 0.0394 | -    | 0.0669 |
| F                  | 0.20       | -    | 0.70  | 0.0079 | -    | 0.0276 |
| G                  | 11.90      | -    | 14.40 | 0.4685 | -    | 0.5669 |
| H                  | 1.25       | -    | 1.85  | 0.0492 | -    | 0.0728 |
| J                  | 1.00       | -    | 1.60  | 0.0394 | -    | 0.0630 |
| K                  | 0.60       | -    | 1.00  | 0.0236 | -    | 0.0394 |
| L                  | 2.25       | -    | 2.80  | 0.0886 | -    | 0.1102 |

RECOMMEDND LAYOUT DRAWINGS

TO-262



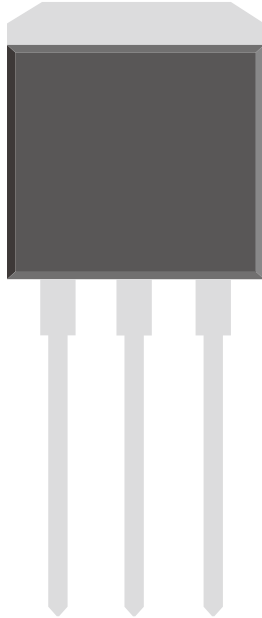
| OUTLINE DIMENSIONS |            |      |      |        |        |      |
|--------------------|------------|------|------|--------|--------|------|
| Dim.               | Milimeters |      |      | Inches |        |      |
|                    | Min.       | Typ. | Max. | Min.   | Typ.   | Max. |
| A                  | -          | 1.60 | -    | -      | 0.0630 | -    |
| B                  | -          | 1.60 | -    | -      | 0.0630 | -    |
| C                  | -          | 2.54 | -    | -      | 0.1000 | -    |
| D                  | -          | 1.00 | -    | -      | 0.0394 | -    |

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**MARKING INFORMATION**



**MARKING INSTRUCTIONS**

NH=Niuhan Trademark  
FF=Product Line Code,According To Actual Changes  
YWW=Date Code,According To Actual Changes  
LLWWF=Internal Code,According To Actual Changes  
NPS10N60R=Model

**PACKING INFORMATION**

| Package Type | Package Code | Product Weight<br>Approx(g/Pcs) | Package Method | Quantity<br>(Pcs/Min. Pack.) | Quantity<br>(Pcs/Inner Box) | Quantity<br>(Pcs/Carton) |
|--------------|--------------|---------------------------------|----------------|------------------------------|-----------------------------|--------------------------|
| TO-262       | P1           | 1.65                            | Tube           | 50                           | 1000                        | 5000                     |

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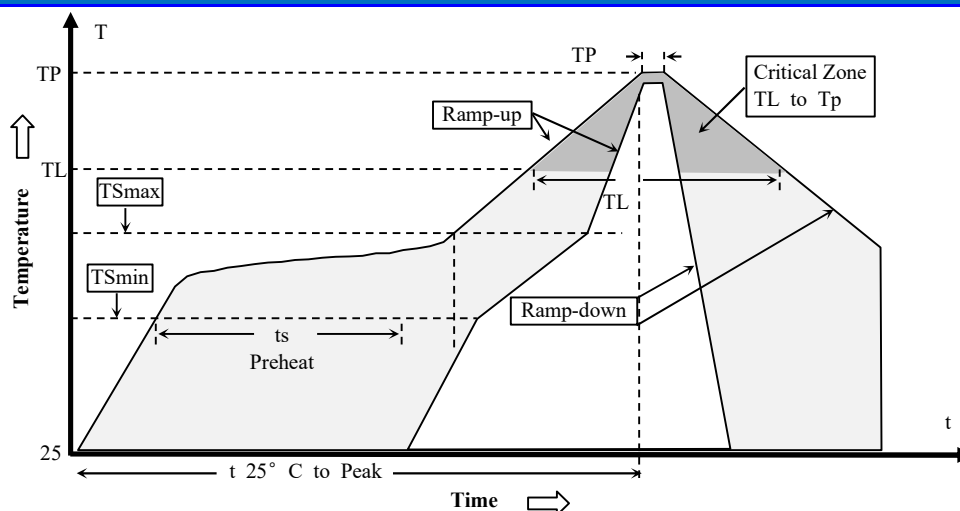
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**Recommended wave soldering condition**

| 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 (T <sub>smax</sub> to T <sub>p</sub> )                                                        | 3°C/second max.                  | 3°C/second max.                  |
| Preheat<br>-Temperature Min(T <sub>S</sub> min)<br>-Temperature Max(T <sub>S</sub> 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 (T <sub>L</sub> )<br>- Time (t <sub>L</sub> )                               | 183°C<br>60-150 seconds          | 217°C<br>60-150 seconds          |
| Peak Temperature(T <sub>P</sub> )                                                                                  | 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.