

NTS220N15S



N-Channel Enhancement Mode Trench Power MOSFET

**Voltage:** 150 Volts

**Current:** 10 Amperes

**Package:** TO-252

**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)

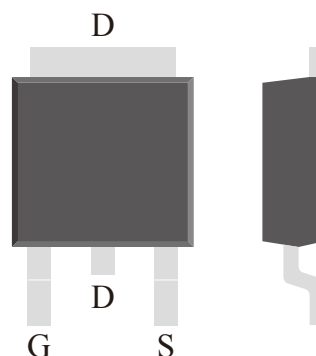
**Typical Applications**

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

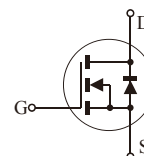
**Product Summary**

|                                     |     |    |
|-------------------------------------|-----|----|
| V <sub>DS</sub> Min.@T <sub>j</sub> | 150 | V  |
| I <sub>D</sub> Min.@T <sub>a</sub>  | 10  | A  |
| R <sub>DS(ON)</sub> (TYP)@10V       | 216 | mΩ |

**Diagram:**



**Polarity:**



**\*100% UIS TESTED**

**\*100% ΔV<sub>DS</sub> TESTED**

**Absolute Maximum Ratings (T<sub>a</sub>=25℃ Unless Otherwise Specified)**

| Parameter                                                                    | Test Conditions                                                                                                     | Symbol          | Ratings | Unit |
|------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-----------------|---------|------|
| Drain-Source Voltage                                                         |                                                                                                                     | V <sub>DS</sub> | 150     | V    |
| Gate-Source Voltage                                                          |                                                                                                                     | V <sub>GS</sub> | ±20     | V    |
| Continuous Drain Current (Note 1)                                            | T <sub>a</sub> = 25 ℃                                                                                               | I <sub>D</sub>  | 10      | A    |
|                                                                              | T <sub>a</sub> = 100 ℃                                                                                              |                 | 6       |      |
| Drain Current-Pulse (Note 1)                                                 | T <sub>j</sub> < 150 ℃                                                                                              | I <sub>DM</sub> | 40      | A    |
| Maximum Power Dissipation Power<br>Dissipation Derating Factor Above 25℃     | T <sub>a</sub> = 25 ℃                                                                                               | P <sub>D</sub>  | 60      | W    |
|                                                                              | T <sub>a</sub> = 100 ℃                                                                                              |                 | 24      |      |
| Derating Factor                                                              |                                                                                                                     | D <sub>F</sub>  | 0.48    | W/℃  |
| Avalanche Current,Single Pulse (Note 1)                                      | L= 0.5 mH                                                                                                           | I <sub>AS</sub> | 6       | A    |
| Single Pulse Avalanche Energy (Note 1)<br>Test Circuit & Waveform See Fig.17 | L= 0.5 mH<br>I <sub>AS</sub> = 6 A,R <sub>G</sub> = 10.0 Ω<br>Starting T <sub>j</sub> =25 ℃,V <sub>G</sub> = 10.0 V | E <sub>AS</sub> | 9       | mJ   |

**Thermal Characteristics (T<sub>a</sub>=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 T <sub>a</sub> =25℃      | R <sub>θJA</sub> | 100        | ℃/W  |
| Thermal Resistance Junction-Case<br>With Steady-State       | Device Mounted On<br>1 in2 FR-4 Board With 2oz. Copper | R <sub>θJC</sub> | 2.1        |      |

Notes: 1.Pulse Width Limited By Max. Junction Temperature. (See Fig.14)

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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>                   | 150  | --   | --   | V    |
| Bvdss Temperature Coefficient                                                               | ID=250uA,Reference25℃                               | ΔBV <sub>DSS</sub> /ΔT <sub>J</sub> | --   | 0.17 | --   | V/℃  |
| Drain-Source Leakage Current                                                                | VDS= 150 V,VGS=0V                                   | I <sub>DSS</sub>                    | --   | --   | 1    | uA   |
| Gate-Body Leakage Current                                                                   | VGS= ±20 V,VDS=0V                                   | I <sub>GSS</sub>                    | --   | --   | ±100 | nA   |
| Forward Transconductance                                                                    | ID= 5.0 A,VDS= 5 V                                  | g <sub>fs</sub>                     | --   | 8    | --   | S    |
| Static On Characteristics                                                                   |                                                     |                                     |      |      |      |      |
| Gate Threshold Voltage                                                                      | VGS= VDS ID=250uA                                   | V <sub>GS(TH)</sub>                 | 1    | 2    | 3    | V    |
| Drain-Source On Resistance                                                                  | ID= 5.0 A,VGS= 10.0 V                               | R <sub>DS(ON)</sub>                 | --   | 216  | 259  | mΩ   |
|                                                                                             | ID= 5.0 A,VGS= 5.0 V                                |                                     | --   | 313  | 389  |      |
| Dynamic Characteristics                                                                     |                                                     |                                     |      |      |      |      |
| Gate Resistance                                                                             | VGS=0V,VDS=0V,<br>Freq.=1MHz                        | R <sub>g</sub>                      | --   | 1.4  | --   | Ω    |
| Input Capacitance                                                                           | VDS= 50 V<br>VGS= 0 V<br>F= 1 MHZ                   | C <sub>iss</sub>                    | --   | 733  | --   | pF   |
| Output Capacitance                                                                          |                                                     | C <sub>oss</sub>                    | --   | 13.5 | --   | pF   |
| Reverse Transfer Capacitance                                                                |                                                     | C <sub>rss</sub>                    | --   | 5    | --   | pF   |
| Switching Paramters With Inductive Load(Test Circuit & Waveform See Fig.15)                 |                                                     |                                     |      |      |      |      |
| Turn-On Delay Time                                                                          | VDS= 50 V<br>VGS= 10.0 V<br>RG= 10.0 Ω<br>L= 0.5 mH | t <sub>d(on)</sub>                  | --   | 9    | --   | ns   |
| Turn-On Rise Time                                                                           |                                                     | t <sub>r</sub>                      | --   | 11   | --   | ns   |
| Turn-Off Delay Time                                                                         |                                                     | t <sub>d(off)</sub>                 | --   | 24   | --   | ns   |
| Turn-Off Rise Time                                                                          |                                                     | t <sub>f</sub>                      | --   | 8    | --   | ns   |
| Gate Charge Paramters (Test Circuit & Waveform See Fig.16)                                  |                                                     |                                     |      |      |      |      |
| Total Gate Charge                                                                           | VDS= 50 V<br>VGS= 10.0 V<br>ID= 10.0 A              | Q <sub>g</sub>                      | --   | 16   | --   | nC   |
| Gate-Source Charge                                                                          |                                                     | Q <sub>gs</sub>                     | --   | 2.1  | --   | nC   |
| Gate-Drain Charge                                                                           |                                                     | Q <sub>gd</sub>                     | --   | 6.4  | --   | nC   |
| Drain-Source Diode Characteristics And Maximum Ratings (Test Circuit & Waveform See Fig.18) |                                                     |                                     |      |      |      |      |
| Max. Diode Forward Current                                                                  |                                                     | I <sub>S</sub>                      | --   | --   | 10.0 | A    |
| Max. Pulsed Forward Current                                                                 |                                                     | I <sub>SM</sub>                     | --   | --   | 40   | A    |
| Diode Forward Voltage                                                                       | ID= 5.0 A,VGS=0V                                    | V <sub>SD</sub>                     | --   | 0.7  | 1.2  | V    |

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Typical Characteristics Curves

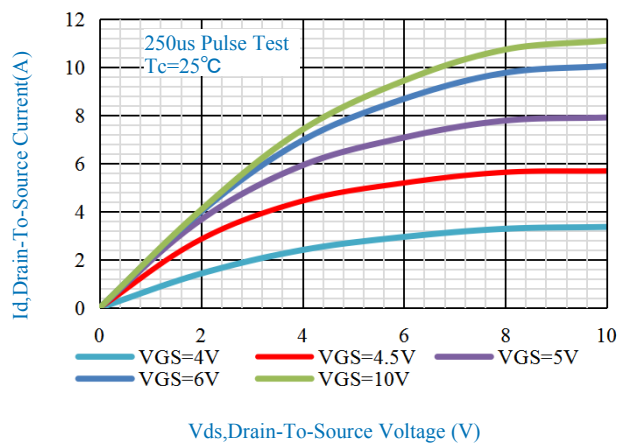


Fig.1-Output Characteristic

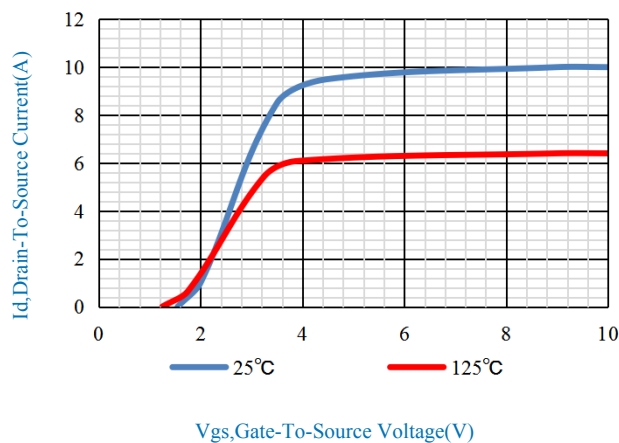


Fig.2-Transfer Characteristic

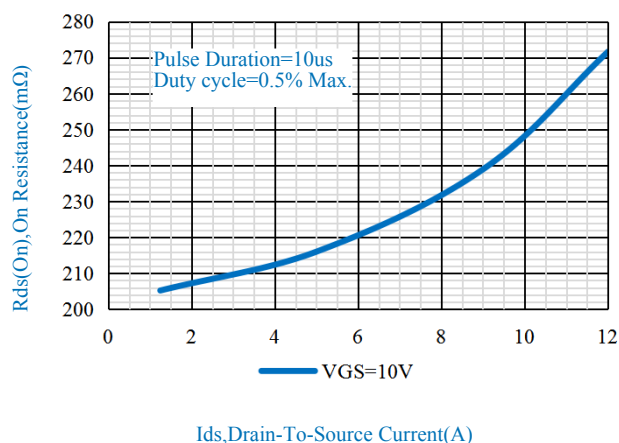


Fig.3-On Resistance Vs. Drain Current

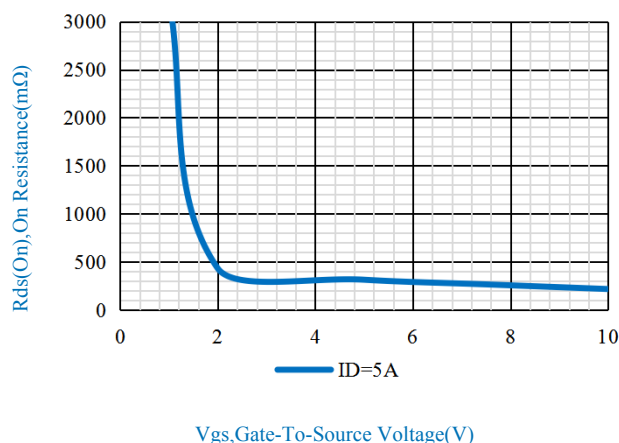


Fig.4-On Resistance Vs. Gate Source Voltage

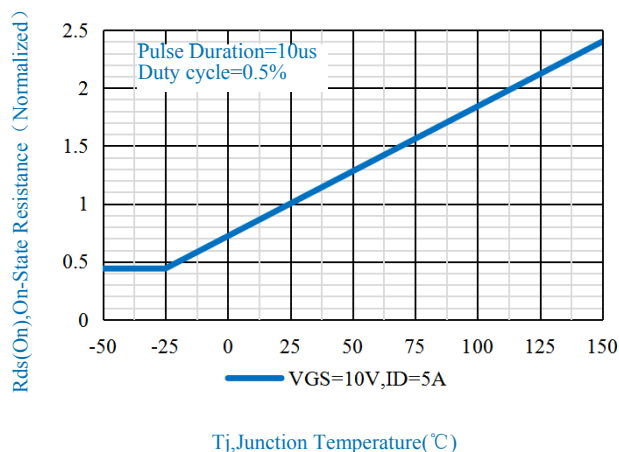


Fig.5-On Resistance Vs. Junction Temperature

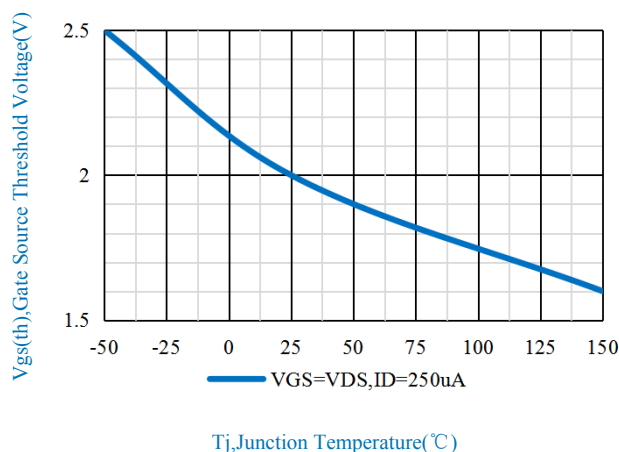


Fig.6-Gate Source Threshold Voltage Vs. Junction Temperature

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Typical Characteristics Curves

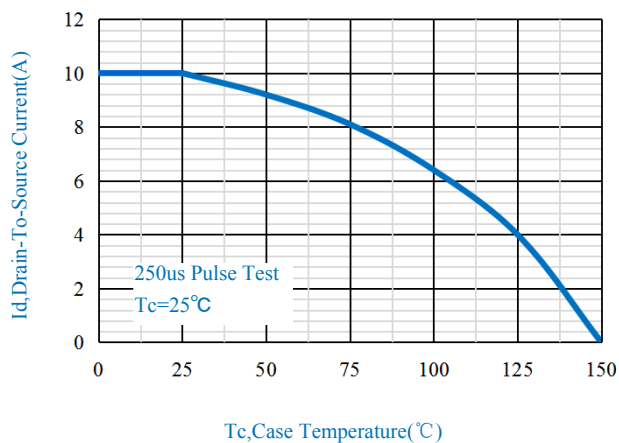


Fig.7-Maximum Continuous Drain Current Vs. Case Temperature

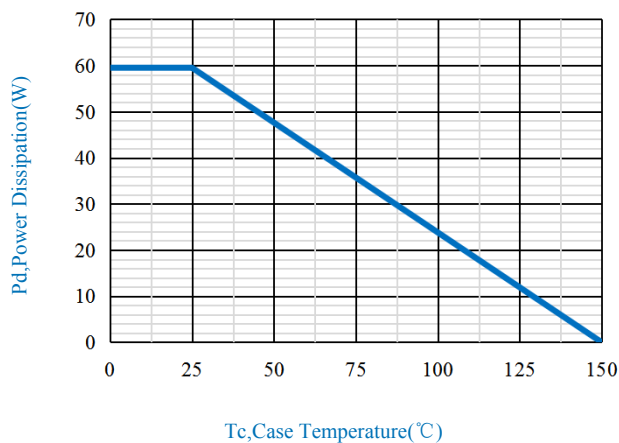


Fig.8-Maximum Power Dissipation Vs. Case Temperature

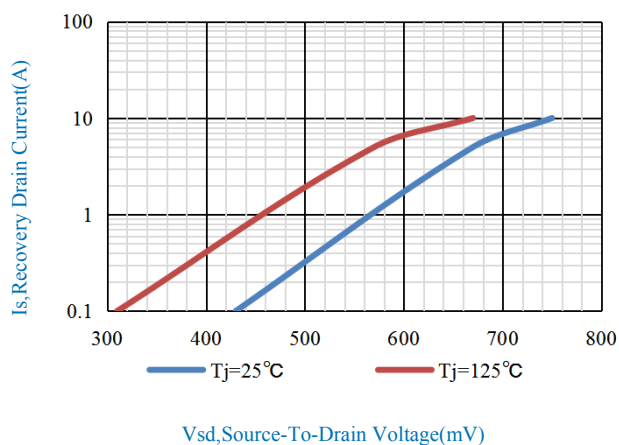


Fig.9-Source-To-Drain Diode Forward Voltage

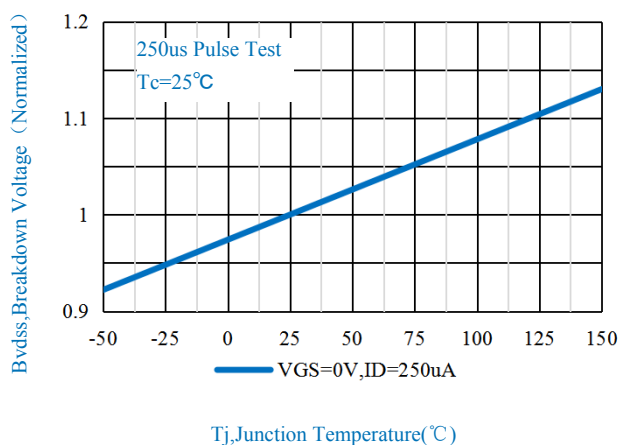


Fig.10-Breakdown Voltage Vs. Junction Temperature

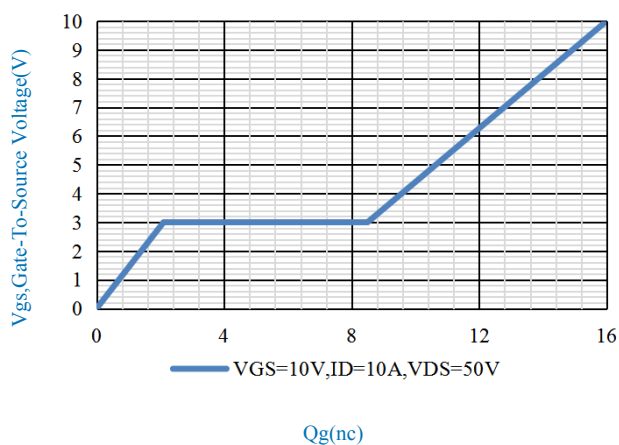


Fig.11-Gate Charge Waveform

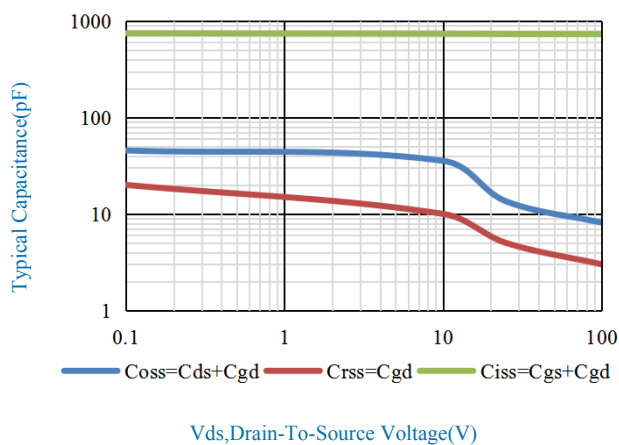


Fig.12-Typical Capacitance Vs. Drain-To-Source Voltage

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Typical Characteristics Curves

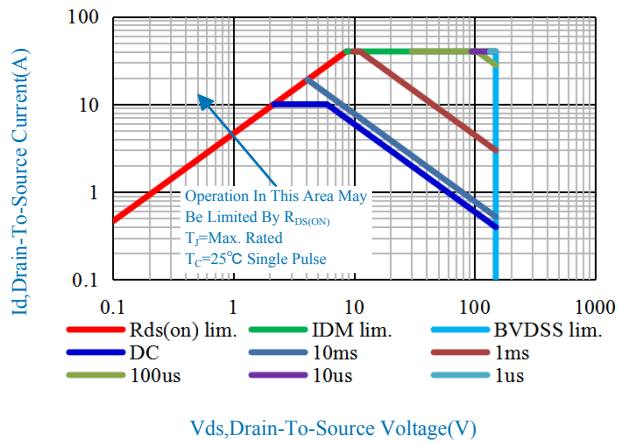


Fig.13-Maximum Safe Operating Area(SOA)

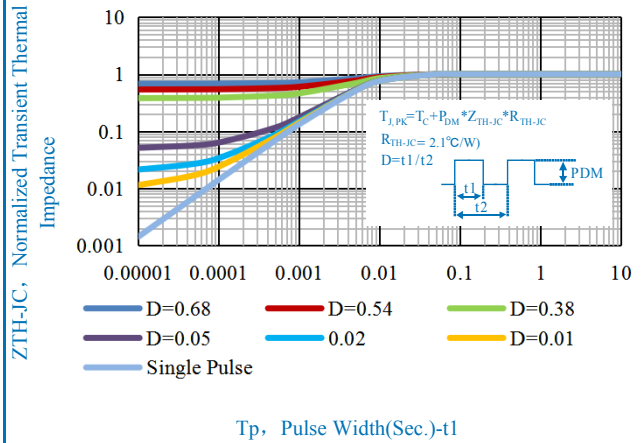


Fig.14- Normalized Maximum Transient Thermal Impedance Vs. Pulse Width

Inductive Load Test Circuit & Waveform

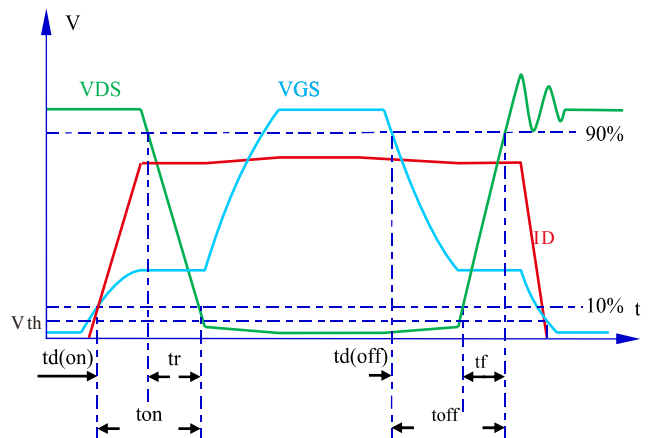
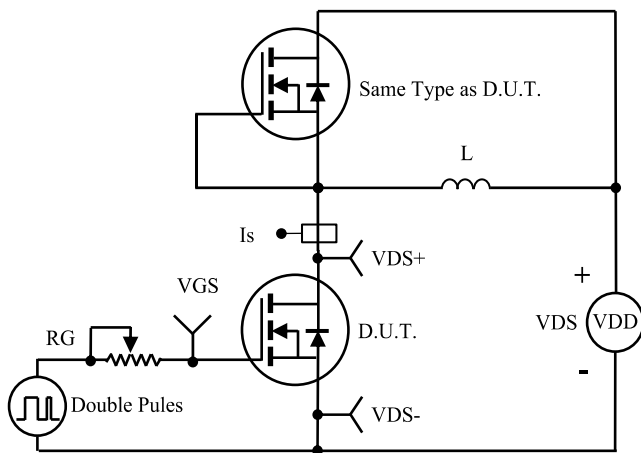


Fig.15- Inductive Switching Test Circuit & Waveform

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Test Circuit & Waveform

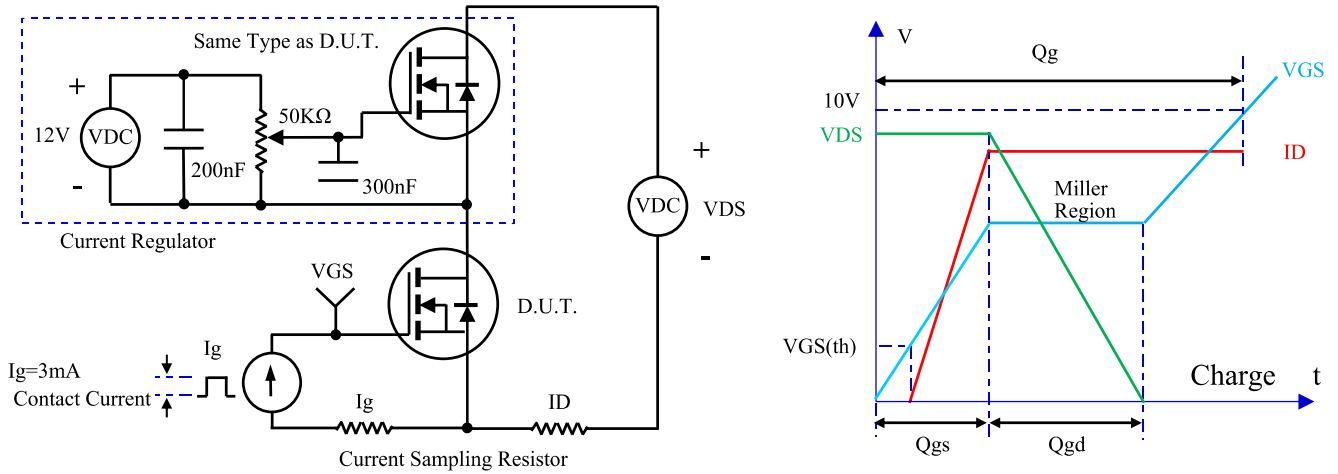


Fig.16- Gate Charge Test Circuit & Waveform

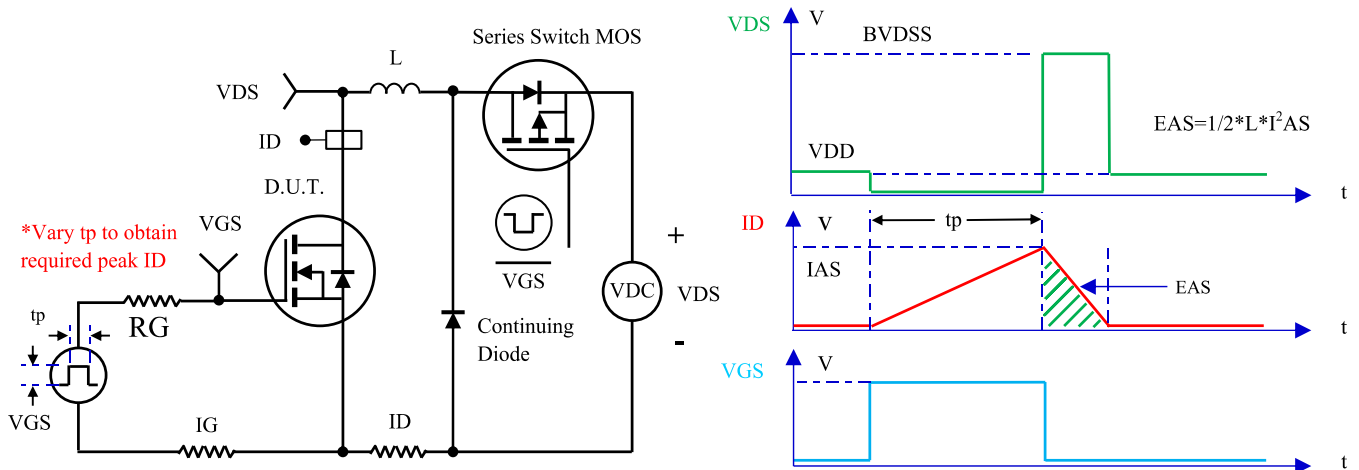


Fig.17- Unclamped Inductive Switching (UIS) Test Circuit & Waveform

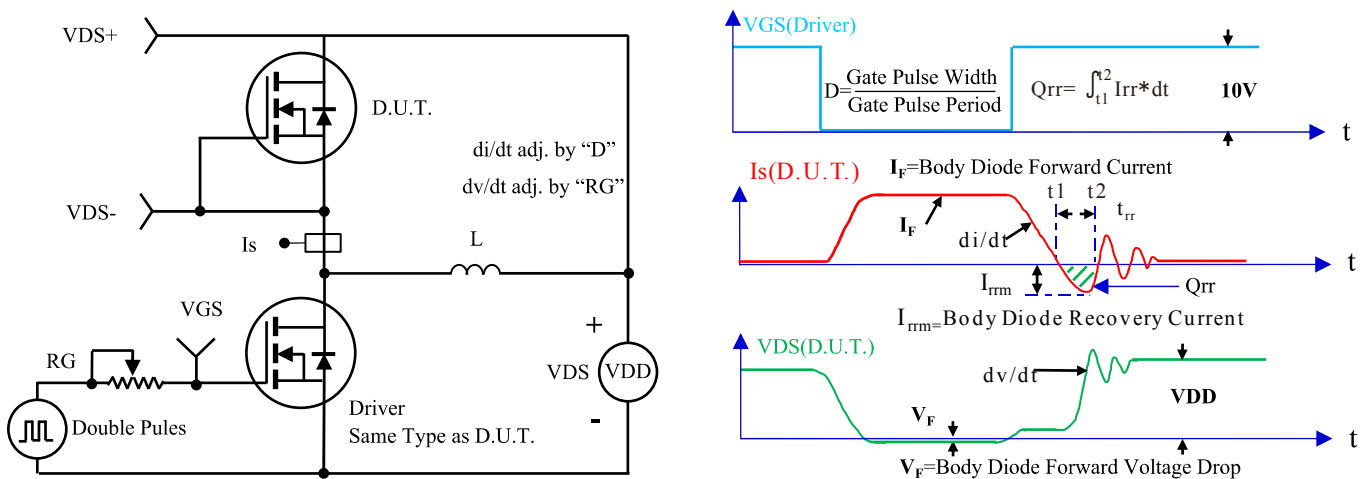


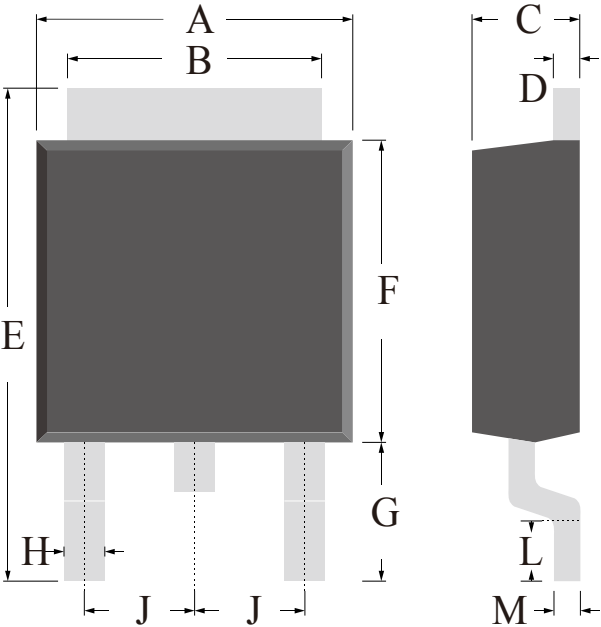
Fig.18- Diode Recovery Test Circuit & Waveform

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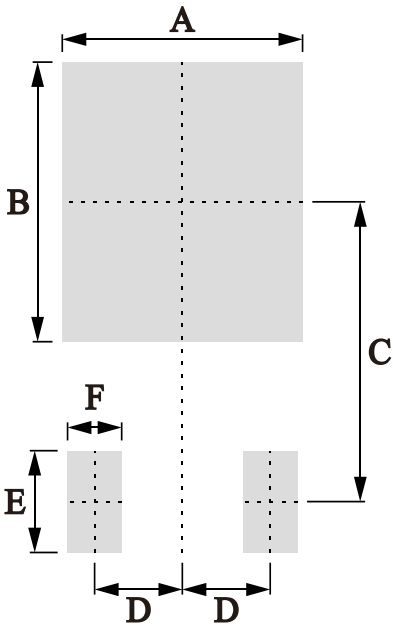
OUTLINE DRAWINGS



TO-252

| OUTLINE DIMENSIONS |            |      |       |        |      |        |
|--------------------|------------|------|-------|--------|------|--------|
| Dim.               | Milimeters |      |       | Inches |      |        |
|                    | Min.       | Typ. | Max.  | Min.   | Typ. | Max.   |
| A                  | 6.10       | -    | 7.10  | 0.2402 | -    | 0.2795 |
| B                  | 4.80       | -    | 5.80  | 0.1890 | -    | 0.2283 |
| C                  | 1.95       | -    | 2.55  | 0.0768 | -    | 0.1004 |
| D                  | 0.35       | -    | 0.75  | 0.0138 | -    | 0.0295 |
| E                  | 9.25       | -    | 10.75 | 0.3642 | -    | 0.4232 |
| F                  | 5.60       | -    | 6.60  | 0.2205 | -    | 0.2598 |
| G                  | 2.50       | -    | 3.10  | 0.0984 | -    | 0.1220 |
| H                  | 0.55       | -    | 0.85  | 0.0217 | -    | 0.0335 |
| J                  | 2.10       | -    | 2.50  | 0.0827 | -    | 0.0984 |
| L                  | 1.00       | -    | 1.40  | 0.0394 | -    | 0.0551 |
| M                  | 0.35       | -    | 0.75  | 0.0138 | -    | 0.0295 |

RECOMMEDND LAYOUT DRAWINGS



TO-252

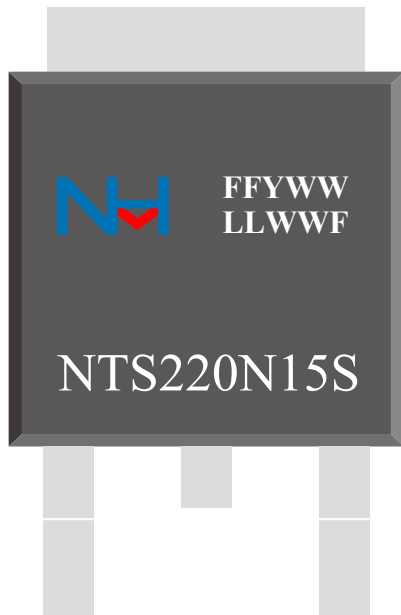
| OUTLINE DIMENSIONS |            |      |      |        |        |      |
|--------------------|------------|------|------|--------|--------|------|
| Dim.               | Milimeters |      |      | Inches |        |      |
|                    | Min.       | Typ. | Max. | Min.   | Typ.   | Max. |
| A                  | -          | 6.09 | -    | -      | 0.2398 | -    |
| B                  | -          | 7.57 | -    | -      | 0.2980 | -    |
| C                  | -          | 6.64 | -    | -      | 0.2614 | -    |
| D                  | -          | 2.30 | -    | -      | 0.0906 | -    |
| E                  | -          | 2.76 | -    | -      | 0.1087 | -    |
| F                  | -          | 1.42 | -    | -      | 0.0559 | -    |

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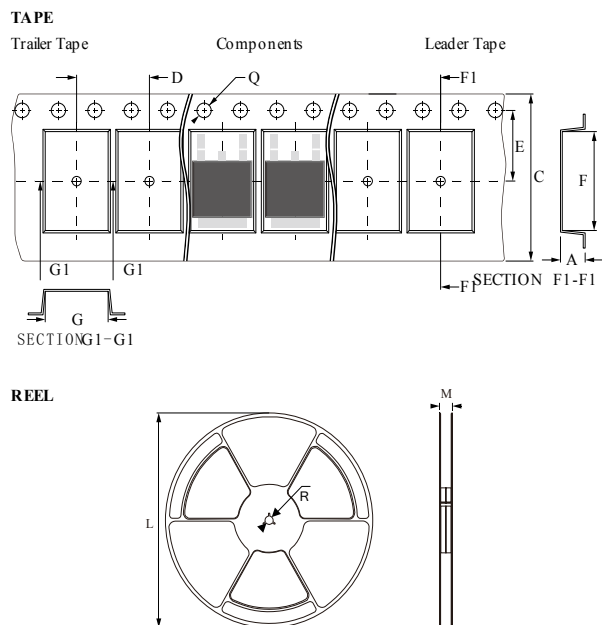
MARKING INFORMATION



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  
NTS220N15S=Model

PACKAGING



TO-252

| OUTLINE DIMENSIONS |             |      |        |        |      |        |
|--------------------|-------------|------|--------|--------|------|--------|
| Dim.               | Millimeters |      |        | Inches |      |        |
|                    | Min.        | Typ. | Max.   | Min.   | Typ. | Max.   |
| TAPE               |             |      |        |        |      |        |
| A                  | 2.60        | -    | 2.80   | 0.1024 | -    | 0.1102 |
| C                  | 15.60       | -    | 16.40  | 0.6142 | -    | 0.6457 |
| D                  | 7.70        | -    | 8.30   | 0.3031 | -    | 0.3268 |
| E                  | 7.30        | -    | 7.70   | 0.2874 | -    | 0.3031 |
| F                  | 10.20       | -    | 10.80  | 0.4016 | -    | 0.4252 |
| G                  | 6.70        | -    | 7.10   | 0.2638 | -    | 0.2795 |
| Q Φ                | 1.40        | -    | 1.60   | 0.0551 | -    | 0.0630 |
| REEL               |             |      |        |        |      |        |
| L                  | 328.00      | -    | 332.00 | 12.913 | -    | 13.071 |
| R                  | 12.00       | -    | 14.00  | 0.4724 | -    | 0.5512 |
| M                  | 19.40       | -    | 23.40  | 0.7638 | -    | 0.9213 |

PACKING INFORMATION

| Package Type | Package Code | Product Weight Approx(g/Pcs) | Package Method | Quantity (Pcs/Min. Pack.) | Quantity (Pcs/Inner Box) | Quantity (Pcs/Carton) |
|--------------|--------------|------------------------------|----------------|---------------------------|--------------------------|-----------------------|
| TO-252       | P1           | 0.321                        | 13" Reel       | 2500                      | 5000                     | 30000                 |
| TO-252       | P2           | 0.321                        | 13" Reel       | 2500                      | 2500                     | 25000                 |

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N-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 (T <sub>Smax</sub> to T <sub>P</sub> )                                                                              | 3°C/second max.                  | 3°C/second max.                  |
|  | Preheat-Temperature Min (T <sub>S</sub> min)<br>-Temperature Max (T <sub>S</sub> max)<br>-Time(t <sub>s</sub> min to t <sub>s</sub> 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 (t <sub>p</sub> )                                                                             | 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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- When the appearance of the product and chip size does not change, in order to product the customer. quality, change the internal structure and the production process Niuhang can not notify

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Specification Revision History

| Rev.        | Date       | Changed Items | Pre-Changed Content | Changed Content |
|-------------|------------|---------------|---------------------|-----------------|
| A/1         | 2014-10-20 | First Issue   |                     |                 |
| Blank Below |            |               |                     |                 |