

# MOSFET – Power, N-Channel, SUPERFET® III 800 V, 600 mΩ, 8 A

## NTD600N80S3Z

### Description

800 V SUPERFET III MOSFET is ON Semiconductor's high performance MOSFET family offering 800 V breakdown voltage.

New 800 V SUPERFET III MOSFET which is optimized for primary switch of flyback converter, enables lower switching losses and case temperature without sacrificing EMI performance thanks to its optimized design. In addition, internal Zener Diode significantly improves ESD capability.

This new family of 800 V SUPERFET III MOSFET enables to make more efficient, compact, cooler and more robust applications because of its remarkable performance in switching power applications such as Laptop adapter, Audio, Lighting, ATX power and industrial power supplies.

### Features

- Typ.  $R_{DS(on)}$  = 550 mΩ
- Ultra Low Gate Charge (Typ.  $Q_g$  = 15.5 nC)
- Low Stored Energy in Output Capacitance ( $E_{oss}$  = 1.74 μJ @ 400 V)
- 100% Avalanche Tested
- ESD Improved Capability with Zener Diode
- RoHS Compliant

### Applications

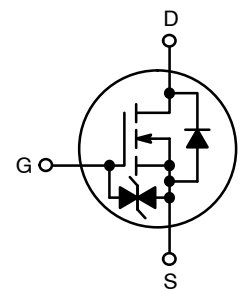
- Adapters / Chargers
- LED Lighting
- AUX Power
- Audio
- Industrial Power



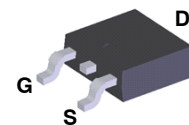
ON Semiconductor®

[www.onsemi.com](http://www.onsemi.com)

| $V_{(BR)DSS}$ | $R_{DS(on)}$ MAX | $I_D$ MAX |
|---------------|------------------|-----------|
| 800 V         | 600 mΩ           | 8 A       |

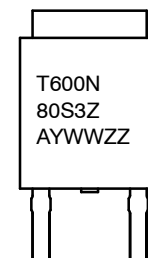


POWER MOSFET



D-PAK  
TO-252  
CASE 369AS

### MARKING DIAGRAM



|            |                        |
|------------|------------------------|
| T600N80S3Z | = Specific Device Code |
| A          | = Assembly Location    |
| Y          | = Year                 |
| WW         | = Work Week            |
| ZZ         | = Lot Code             |

### ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

# NTD600N80S3Z

## ABSOLUTE MAXIMUM RATINGS ( $T_J = 25^{\circ}\text{C}$ , unless otherwise noted)

| Symbol         | Parameter                                                                                   |                                            | Value       | Unit                  |
|----------------|---------------------------------------------------------------------------------------------|--------------------------------------------|-------------|-----------------------|
| $V_{DSS}$      | Drain-to-Source Voltage                                                                     |                                            | 800         | V                     |
| $V_{GS}$       | Gate-to-Source Voltage                                                                      | DC                                         | $\pm 20$    | V                     |
|                |                                                                                             | AC ( $f > 1\text{ Hz}$ )                   | $\pm 30$    |                       |
| $I_D$          | Drain Current                                                                               | Continuous ( $T_C = 25^{\circ}\text{C}$ )  | 8*          | A                     |
|                |                                                                                             | Continuous ( $T_C = 100^{\circ}\text{C}$ ) | 5*          |                       |
| $I_{DM}$       | Drain Current                                                                               | Pulsed (Note 1)                            | 21*         | A                     |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 2)                                                     |                                            | 24          | mJ                    |
| $I_{AS}$       | Avalanche Current (Note 2)                                                                  |                                            | 1.2         | A                     |
| $E_{AR}$       | Repetitive Avalanche Energy (Note 1)                                                        |                                            | 0.6         | mJ                    |
| dv/dt          | MOSFET dv/dt                                                                                |                                            | 100         | V/ns                  |
|                | Peak Diode Recovery dv/dt (Note 3)                                                          |                                            | 10          |                       |
| $P_D$          | Power Dissipation                                                                           | ( $T_C = 25^{\circ}\text{C}$ )             | 60          | W                     |
|                |                                                                                             | Derate Above $25^{\circ}\text{C}$          | 0.48        | W/ $^{\circ}\text{C}$ |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range                                                     |                                            | -55 to +150 | $^{\circ}\text{C}$    |
| $T_L$          | Lead Temperature Soldering Reflow for Soldering Purposes<br>(1/8" from Case for 10 seconds) |                                            | 260         | $^{\circ}\text{C}$    |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

\*Drain current limited by maximum junction temperature.

1. Repetitive rating: pulse-width limited by maximum junction temperature.

2.  $I_{AS} = 1.2\text{ A}$ ,  $R_G = 25\ \Omega$ , starting  $T_J = 25^{\circ}\text{C}$ .

3.  $I_{SD} \leq 2\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq 400\text{ V}$ , starting  $T_J = 25^{\circ}\text{C}$ .

## THERMAL RESISTANCE RATINGS

| Symbol          | Parameter                          | Value | Unit                        |
|-----------------|------------------------------------|-------|-----------------------------|
| $R_{\theta JC}$ | Junction-to-Case – Steady State    | 2.08  | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Junction-to-Ambient – Steady State | 62.5  |                             |

## PACKAGE MARKING AND ORDERING INFORMATION

| Part Number  | Top Marking  | Package | Reel Size | Tape Width | Quantity   |
|--------------|--------------|---------|-----------|------------|------------|
| NTD600N80S3Z | NTD600N80S3Z | TO-252  | 330 mm    | 16 mm      | 2500 Units |

# NTD600N80S3Z

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|--------|-----------|-----------------|-----|-----|-----|------|
|--------|-----------|-----------------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                |                                                           |                                                                   |     |     |   |                     |
|--------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------|-----|-----|---|---------------------|
| $BV_{DSS}$                     | Drain-to-Source Breakdown Voltage                         | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 25^\circ\text{C}$  | 800 |     |   | V                   |
|                                |                                                           | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 150^\circ\text{C}$ | 900 |     |   | V                   |
| $\Delta BV_{DSS} / \Delta T_J$ | Drain-to-Source Breakdown Voltage Temperature Coefficient | $I_D = 1\text{ mA}$ , Referenced to $25^\circ\text{C}$            |     | 1.1 |   | V/ $^\circ\text{C}$ |
| $I_{DSS}$                      | Zero Gate Voltage Drain Current                           | $V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}$                      |     |     | 1 | $\mu\text{A}$       |
|                                |                                                           | $V_{DS} = 640\text{ V}, T_C = 125^\circ\text{C}$                  |     | 0.8 |   |                     |
| $I_{GSS}$                      | Gate-to-Body Leakage Current                              | $V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$                   |     |     | 1 | $\mu\text{A}$       |

### ON CHARACTERISTICS

|              |                                      |                                          |     |     |     |                  |
|--------------|--------------------------------------|------------------------------------------|-----|-----|-----|------------------|
| $V_{GS(th)}$ | Gate Threshold Voltage               | $V_{GS} = V_{DS}, I_D = 0.18\text{ mA}$  | 2.2 |     | 3.8 | V                |
| $R_{DS(on)}$ | Static Drain-to-Source On Resistance | $V_{GS} = 10\text{ V}, I_D = 4\text{ A}$ |     | 550 | 600 | $\text{m}\Omega$ |
| $g_{FS}$     | Forward Transconductance             | $V_{DS} = 20\text{ V}, I_D = 4\text{ A}$ |     | 9.4 |     | S                |

### DYNAMIC CHARACTERISTICS

|                 |                                   |                                                                             |  |      |  |          |
|-----------------|-----------------------------------|-----------------------------------------------------------------------------|--|------|--|----------|
| $C_{iss}$       | Input Capacitance                 | $V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, f = 250\text{ kHz}$            |  | 725  |  | pF       |
| $C_{oss}$       | Output Capacitance                |                                                                             |  | 12   |  | pF       |
| $C_{oss(eff.)}$ | Effective Output Capacitance      | $V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$                 |  | 139  |  | pF       |
| $C_{oss(er.)}$  | Energy Related Output Capacitance | $V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$                 |  | 21   |  | pF       |
| $Q_{g(tot)}$    | Total Gate Charge at 10 V         | $V_{DD} = 400\text{ V}, I_D = 4\text{ A}, V_{GS} = 10\text{ V}$<br>(Note 4) |  | 15.5 |  | nC       |
| $Q_{gs}$        | Gate-to-Source Gate Charge        |                                                                             |  | 3.1  |  | nC       |
| $Q_{gd}$        | Gate-to-Drain "Miller" Charge     |                                                                             |  | 5.1  |  | nC       |
| ESR             | Equivalent Series Resistance      | $f = 1\text{ MHz}$                                                          |  | 3.5  |  | $\Omega$ |

### SWITCHING CHARACTERISTICS

|              |                     |                                                                                                           |  |      |  |    |
|--------------|---------------------|-----------------------------------------------------------------------------------------------------------|--|------|--|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = 400\text{ V}, I_D = 4\text{ A}, V_{GS} = 10\text{ V},$<br>$R_g = 4.7\text{ }\Omega$<br>(Note 4) |  | 12.3 |  | ns |
| $t_r$        | Turn-On Rise Time   |                                                                                                           |  | 5.9  |  | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |                                                                                                           |  | 39.5 |  | ns |
| $t_f$        | Turn-Off Fall Time  |                                                                                                           |  | 8.2  |  | ns |

### SOURCE-TO-DRAIN DIODE CHARACTERISTICS

|          |                                                          |                                                                                     |  |      |               |
|----------|----------------------------------------------------------|-------------------------------------------------------------------------------------|--|------|---------------|
| $I_S$    | Maximum Continuous Source-to-Drain Diode Forward Current |                                                                                     |  | 8    | A             |
| $I_{SM}$ | Maximum Pulsed Source-to-Drain Diode Forward Current     |                                                                                     |  | 21   | A             |
| $V_{SD}$ | Source-to-Drain Diode Forward Voltage                    | $V_{GS} = 0\text{ V}, I_{SD} = 4\text{ A}$                                          |  | 1.2  | V             |
| $t_{rr}$ | Reverse Recovery Time                                    | $V_{GS} = 0\text{ V}, I_{SD} = 2\text{ A},$<br>$di_F/dt = 100\text{ A}/\mu\text{s}$ |  | 137  | ns            |
| $Q_{rr}$ | Reverse Recovery Charge                                  |                                                                                     |  | 0.91 | $\mu\text{C}$ |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. Essentially independent of operating temperature typical characteristics.

TYPICAL CHARACTERISTICS

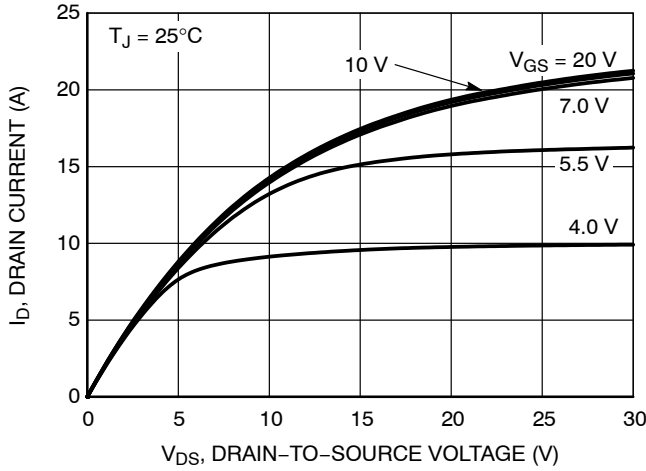


Figure 1. On-Region Characteristics

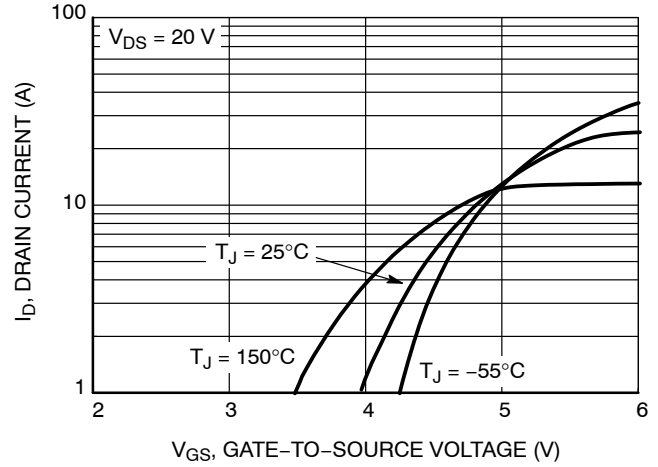


Figure 2. Transfer Characteristics

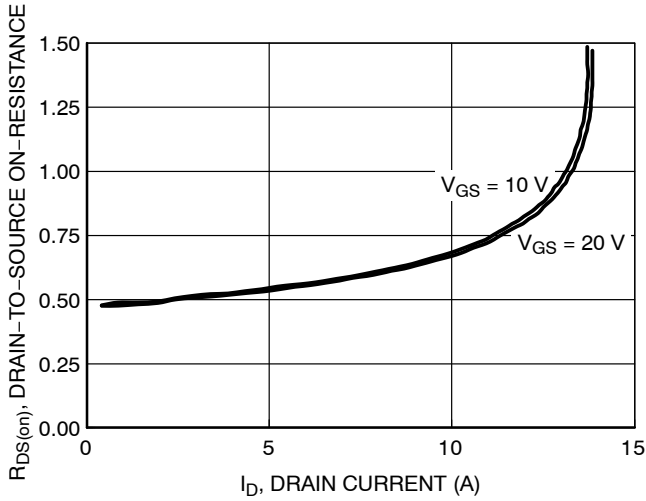


Figure 3. On Resistance vs. Drain Current

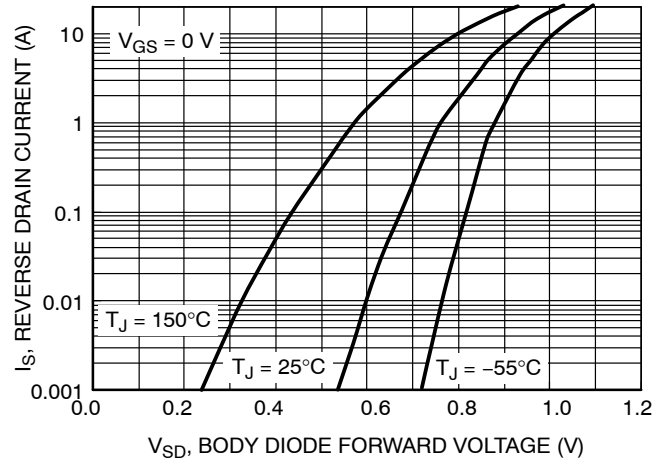


Figure 4. Diode Forward Voltage vs. Current

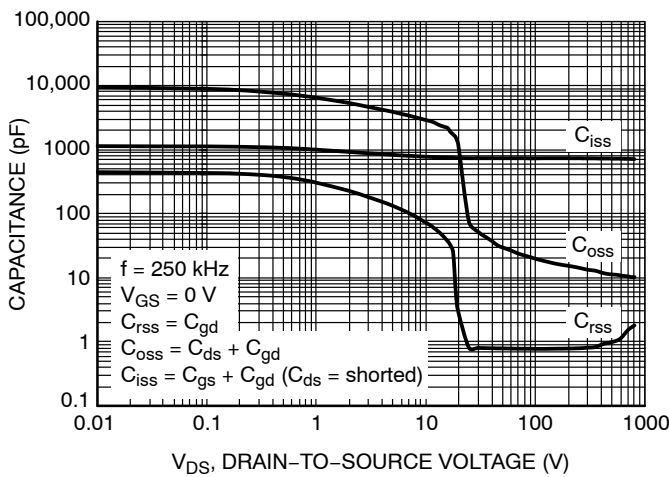


Figure 5. Capacitance Characteristics

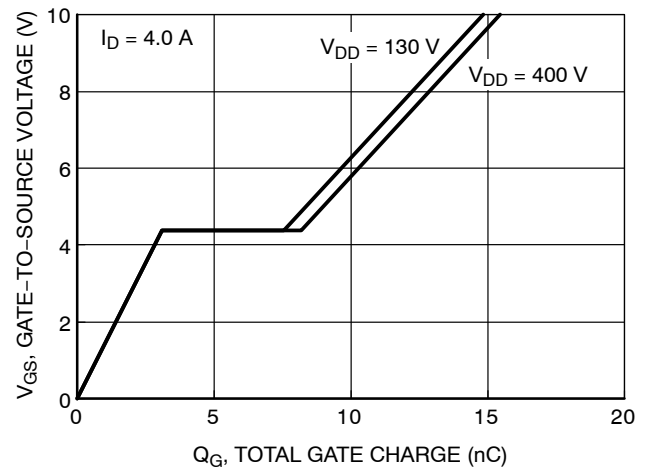


Figure 6. Gate Charge Characteristics

TYPICAL CHARACTERISTICS

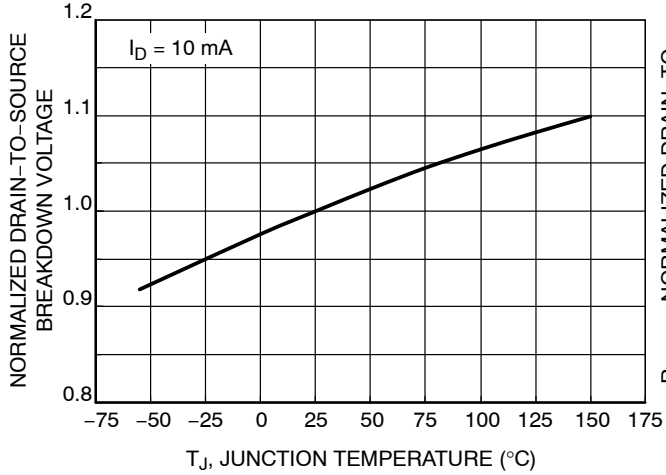


Figure 7. Normalized  $BV_{DSS}$  vs. Temperature

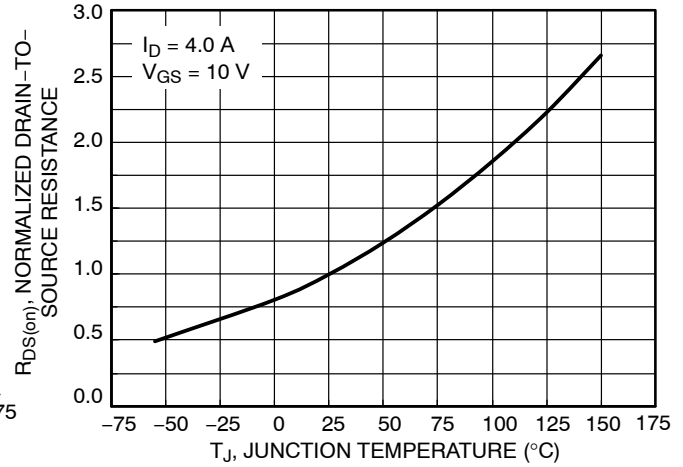


Figure 8. On-Resistance Variation vs. Temperature

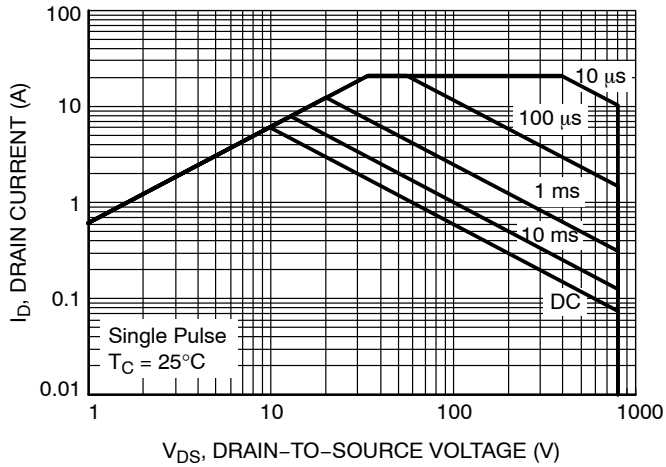


Figure 9. Safe Operating Area

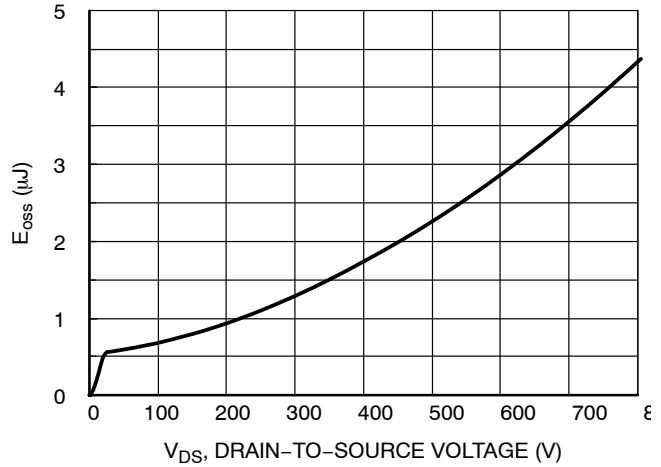


Figure 10.  $E_{OSS}$  vs. Drain-to-Source Voltage

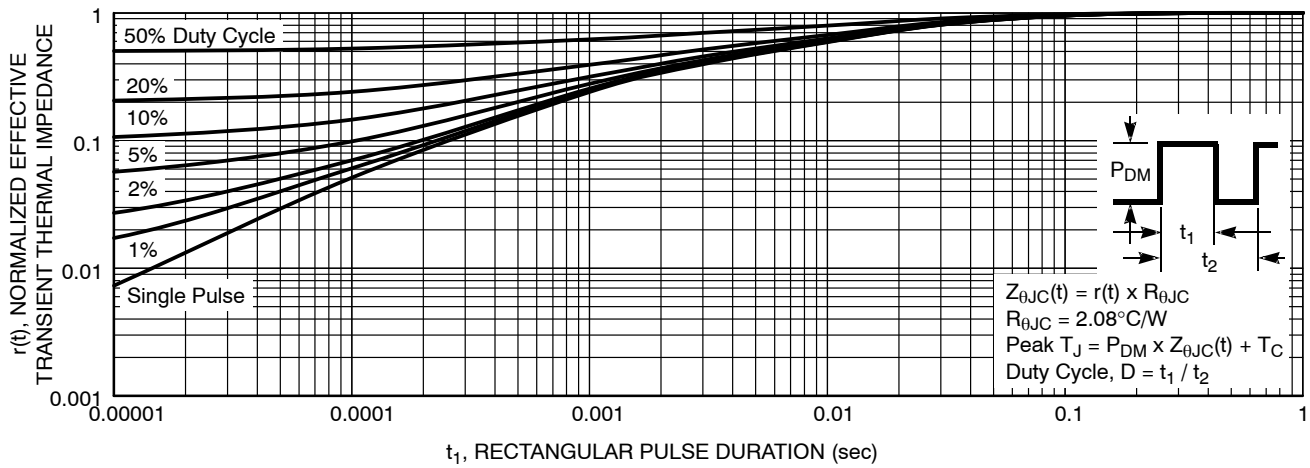


Figure 11. Transient Thermal Impedance

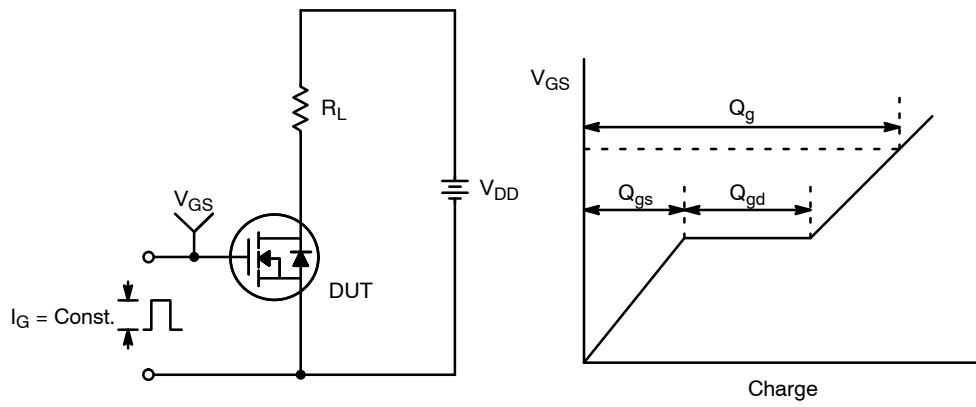


Figure 12. Gate Charge Test Circuit & Waveform

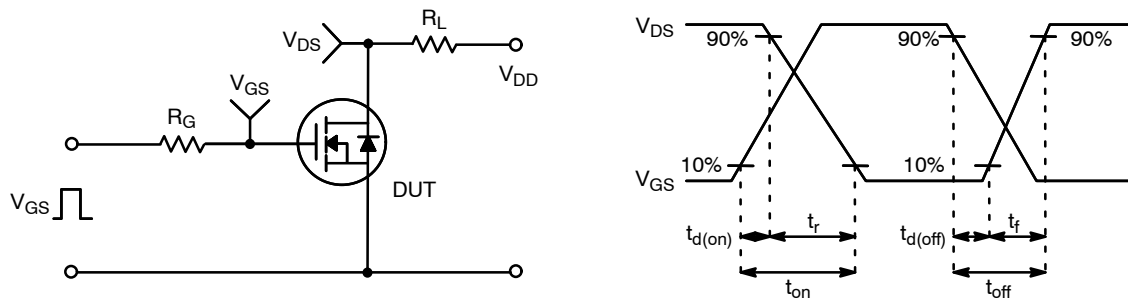


Figure 13. Resistive Switching Test Circuit & Waveforms

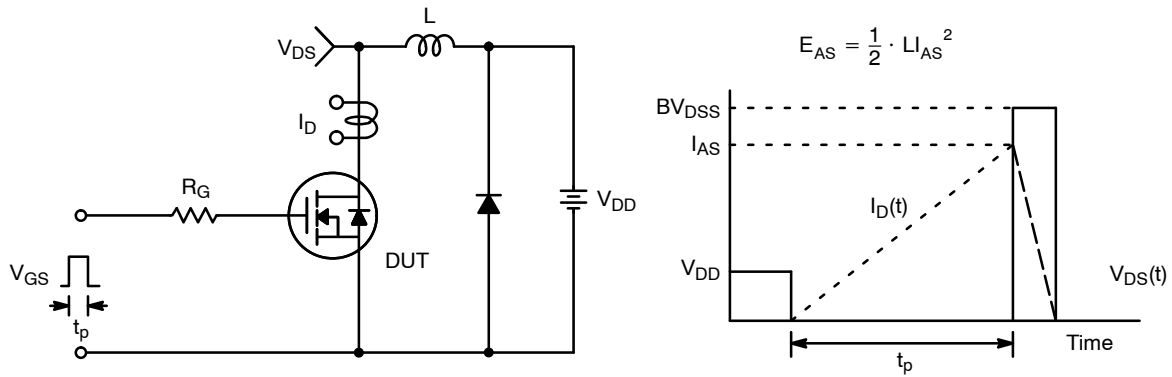
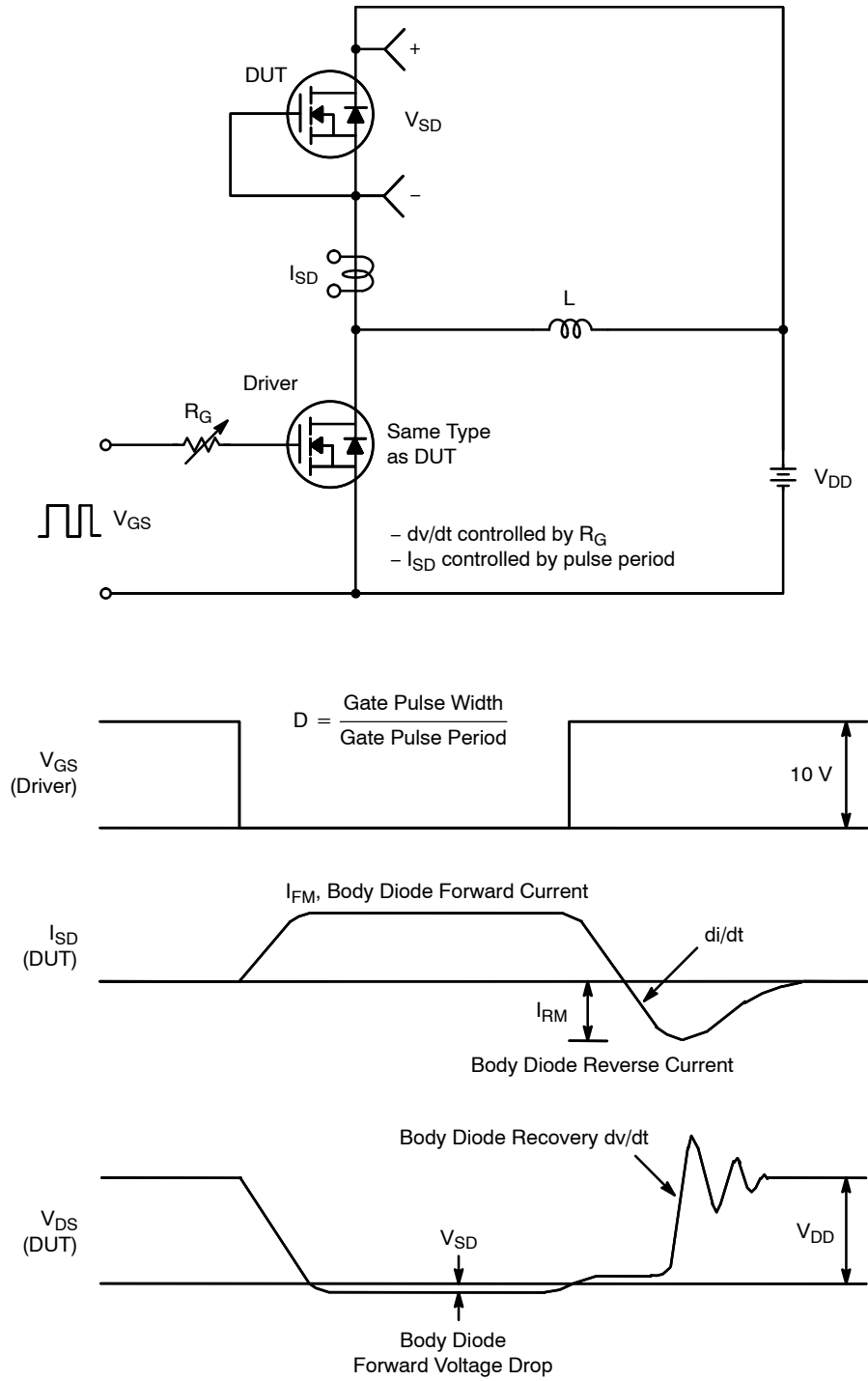
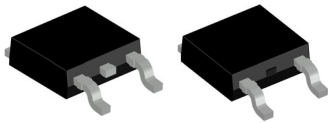


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

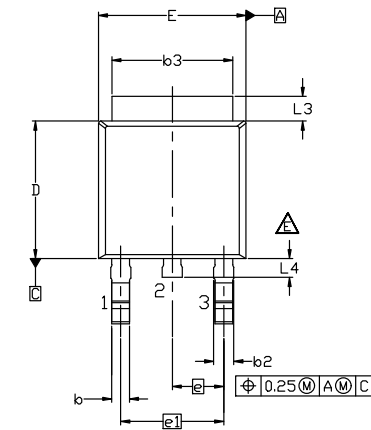
# NTD600N80S3Z



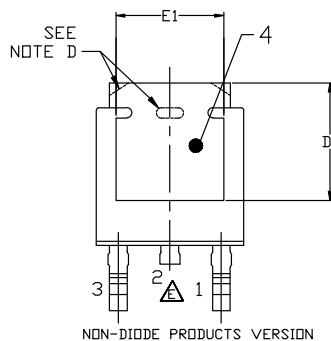
**Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms**


**DPAK3 6.10x6.54x2.29, 4.57P**  
**CASE 369AS**  
**ISSUE B**

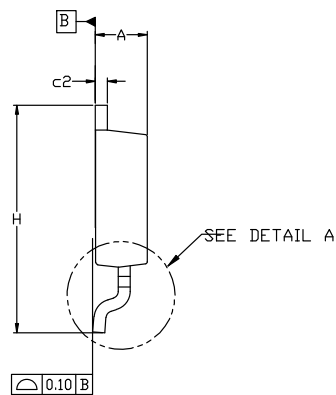
DATE 20 DEC 2023



NON-DIODE PRODUCTS VERSION



NON-DIODE PRODUCTS VERSION



NOTES: UNLESS OTHERWISE SPECIFIED

A) THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE F, VARIATION AA.

B) ALL DIMENSIONS ARE IN MILLIMETERS.

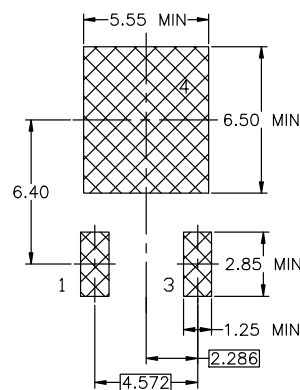
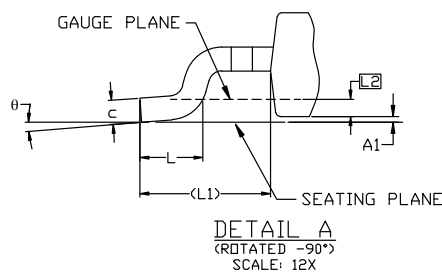
C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2018.

D) SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED CORNERS OR EDGE PROTRUSION.

E) FOR DIODE PRODUCTS, L4 IS 0.25 MM MAX PLASTIC BODY STUB WITHOUT CENTER LEAD.

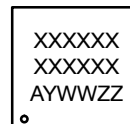
F) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.

G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TD228P991X239-3N.


**LAND PATTERN RECOMMENDATION**

\*FOR ADDITIONAL INFORMATION ON OUR Pb-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERM/D.

| DIM | MILLIMETERS |      |       |
|-----|-------------|------|-------|
|     | MIN.        | NDM. | MAX.  |
| A   | 2.18        | 2.29 | 2.39  |
| A1  | 0.00        | -    | 0.127 |
| b   | 0.64        | 0.77 | 0.89  |
| b2  | 0.76        | 0.95 | 1.14  |
| b3  | 5.21        | 5.34 | 5.46  |
| c   | 0.45        | 0.53 | 0.61  |
| c2  | 0.45        | 0.52 | 0.58  |
| D   | 5.97        | 6.10 | 6.22  |
| D1  | 5.21        | ---  | ---   |
| E   | 6.35        | 6.54 | 6.73  |
| E1  | 4.32        | ---  | ---   |
| e   | 2.286 BSC   |      |       |
| e1  | 4.572 BSC   |      |       |
| H   | 9.40        | 9.91 | 10.41 |
| L   | 1.40        | 1.59 | 1.78  |
| L1  | 2.90 REF    |      |       |
| L2  | 0.51 BSC    |      |       |
| L3  | 0.89        | 1.08 | 1.27  |
| L4  | ---         | ---  | 1.02  |
| θ   | 0°          | ---  | 10°   |

**GENERIC MARKING DIAGRAM\***


\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

XXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
ZZ = Assembly Lot Code

|                         |                                    |                                                                                                                                                                                  |
|-------------------------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| <b>DESCRIPTION:</b>     | <b>DPAK3 6.10x6.54x2.29, 4.57P</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                               |

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