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# MOSFET – Power, N-Channel, SUPERFET® III 800 V, 450 mΩ, 11 A

## NTPF450N80S3Z

### 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.  $R_{DS(on)} = 380 \text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 19.3 \text{ nC}$ )
- Low Stored Energy in Output Capacitance ( $E_{oss} = 2.2 \text{ }\mu\text{J @ 400 V}$ )
- 100% Avalanche Tested
- ESD Improved Capability with Zener Diode
- RoHS Compliant

### Applications

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

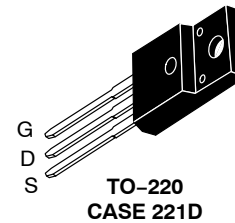
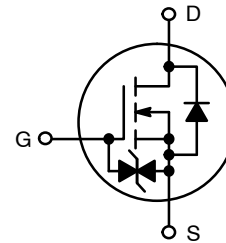


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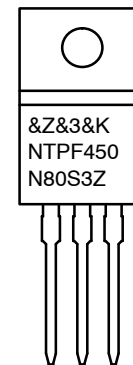
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$V_{(BR)DSS}$	$R_{DS(ON)} \text{ MAX}$	$I_D \text{ MAX}$
800 V	450 mΩ @ $V_{GS} = 10 \text{ V}$	11 A

### N-CHANNEL MOSFET



### MARKING DIAGRAM



- &Z = Assembly Plant Code
- &3 = Data Code (Year & Week)
- &K = Lot
- NTPF450N80S3Z = Specific Device Code

### ORDERING INFORMATION

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

# NTPF450N80S3Z

## MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise noted)

Symbol	Parameter		Value	Unit
V <sub>DSS</sub>	Drain-to-Source Voltage		800	V
V <sub>GS</sub>	Gate-to-Source Voltage	DC	±20	V
		AC (f > 1 Hz)	±30	V
I <sub>D</sub>	Drain Current	Continuous (T <sub>C</sub> = 25°C)	11*	A
		Continuous (T <sub>C</sub> = 100°C)	7*	A
I <sub>DM</sub>	Drain Current	Pulsed (Note 1)	25*	A
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)		32	mJ
I <sub>AS</sub>	Avalanche Current (Note 2)		1.55	A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)		0.295	mJ
dv/dt	MOSFET dv/dt		100	V/ns
	Peak Diode Recovery dv/dt (Note 3)		10	V/ns
P <sub>D</sub>	Power Dissipation	T <sub>C</sub> = 25°C	29.5	W
		Derate above 25°C	0.236	W/°C
T <sub>J</sub> , T <sub>stg</sub>	Operating Junction and Storage Temperature Range		-55 to +150	°C
T <sub>L</sub>	Lead Temperature for Soldering Purposes (1/8" from Case for 10 seconds)		260	°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<sub>AS</sub> = 1.55 A, R<sub>G</sub> = 25 Ω, starting T<sub>J</sub> = 25°C.
3. I<sub>SD</sub> ≤ 2.75 A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ 400 V, starting T<sub>J</sub> = 25°C.

## THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case, Max.	4.23	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient, Max.	62.5	

## PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
NTPF450N80S3Z	NTPF450N80S3Z	TO-220F	Tube	N/A	N/A	50 Units

# NTPF450N80S3Z

## ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 25°C	800	-	-	V
		V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 150°C	900	-	-	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Drain-to-Source Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 1 mA, Reference to 25°C	-	1.1	-	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 800 V, V <sub>GS</sub> = 0 V	-	-	1	μA
		V <sub>DS</sub> = 640 V, T <sub>C</sub> = 125°C	-	0.8	-	
I <sub>GSS</sub>	Gate-to-Source Leakage Current	V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V	-	-	±1	μA

### ON CHARACTERISTICS

V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 0.24 mA	2.2	-	3.8	V
R <sub>DS(on)</sub>	Static Drain-to-Source On Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 5.5 A	-	380	450	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 5.5 A	-	11.8	-	S

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	V <sub>D</sub> = 400 V, V <sub>GS</sub> = 0 V, f = 250 kHz	-	885	-	pF
C <sub>oss</sub>	Output Capacitance		-	15	-	
C <sub>oss(eff.)</sub>	Effective Output Capacitance	V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V	-	188	-	
C <sub>oss(er.)</sub>	Energy Related Output Capacitance		-	27	-	
Q <sub>g(tot)</sub>	Total Gate Charge at 10 V	V <sub>DS</sub> = 400 V, I <sub>D</sub> = 5.5 A, V <sub>GS</sub> = 10 V (Note 4)	-	19.3	-	nC
Q <sub>gs</sub>	Gate-to-Source Charge		-	4.2	-	
Q <sub>gd</sub>	Gate-to-Drain "Miller" Charge		-	6.6	-	
ESR	Equivalent Series Resistance	f = 1 MHz	-	4.0	-	Ω

### SWITCHING CHARACTERISTICS

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 400 V, I <sub>D</sub> = 5.5 A, V <sub>GS</sub> = 10 V, R <sub>G</sub> = 4.7 Ω (Note 4)	-	13.3	-	ns
t <sub>r</sub>	Turn-On Rise Time		-	6.7	-	
t <sub>d(off)</sub>	Turn-Off Delay Time		-	44.3	-	
t <sub>f</sub>	Turn-Off Fall Time		-	4.6	-	

### SOURCE-TO-DRAIN DIODE CHARACTERISTICS

I <sub>S</sub>	Maximum Continuous Source-to-Drain Diode Forward Current		-	-	11	A
I <sub>SM</sub>	Maximum Pulsed Source-to-Drain Diode Forward Current		-	-	25	A
V <sub>SD</sub>	Source-to-Drain Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 5.5 A	-	-	1.2	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 2.75 A, di <sub>F</sub> /dt = 100 A/μs	-	170	-	ns
Q <sub>rr</sub>	Reverse Recovery Charge		-	1.5	-	μC

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.

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# NTPF450N80S3Z

## TYPICAL CHARACTERISTICS

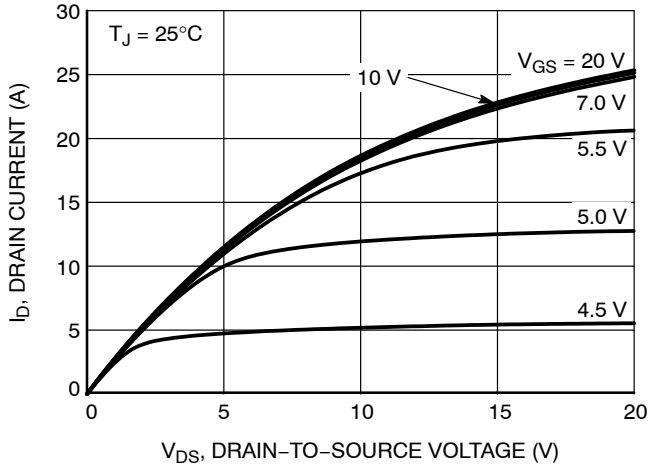


Figure 1. On-Region Characteristics

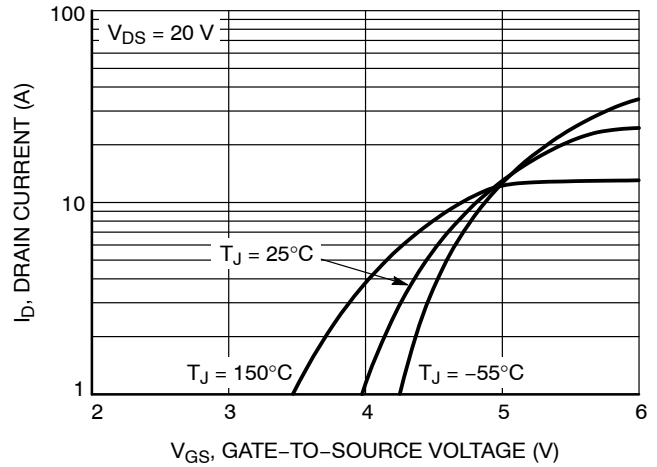


Figure 2. Transfer Characteristics

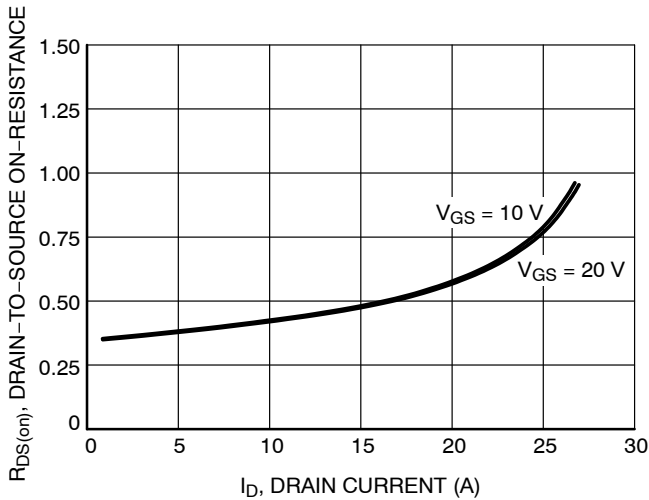


Figure 3. On Resistance vs. Drain Current

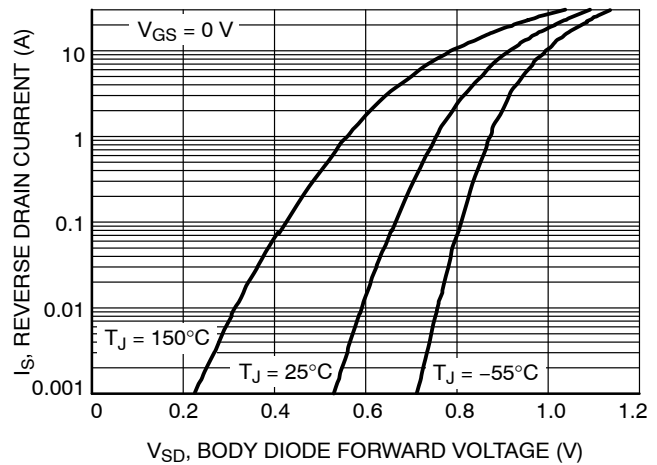


Figure 4. Diode Forward Voltage vs. Current

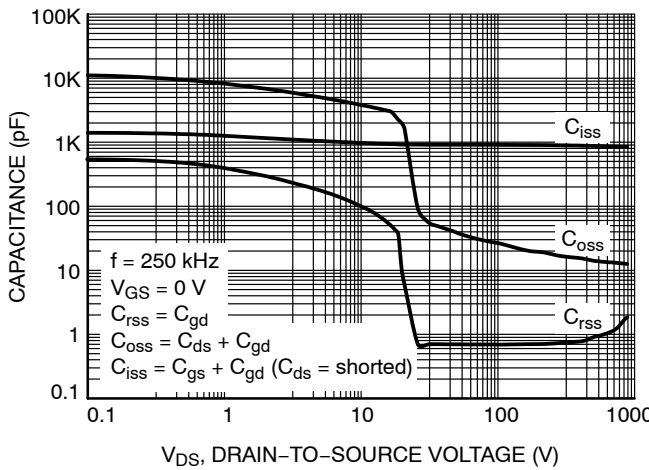


Figure 5. Capacitance Characteristics

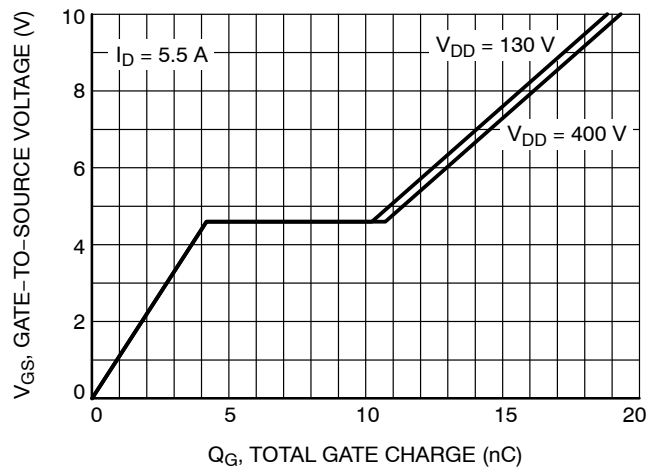


Figure 6. Gate Charge Characteristics

TYPICAL CHARACTERISTICS

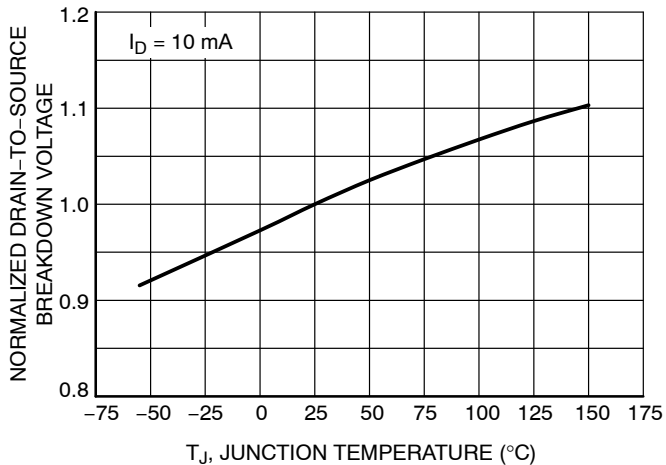


Figure 7. Normalized  $BV_{DSS}$  vs. Temperature

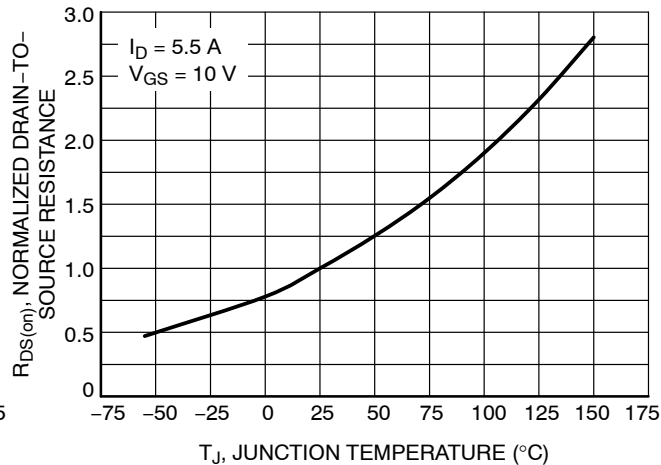


Figure 8. On-Resistance Variation vs. Temperature

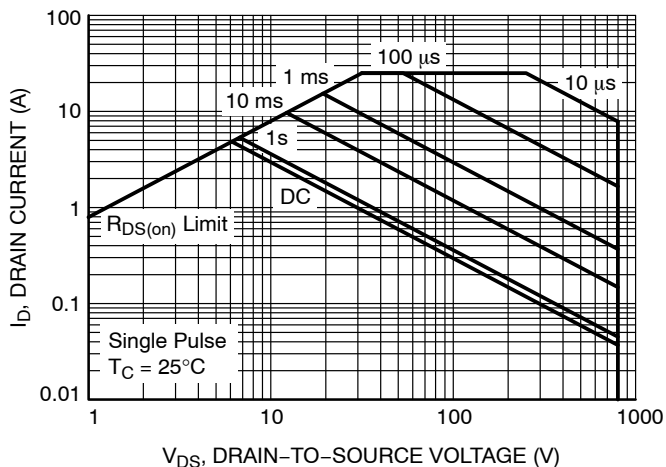


Figure 9. Safe Operating Area

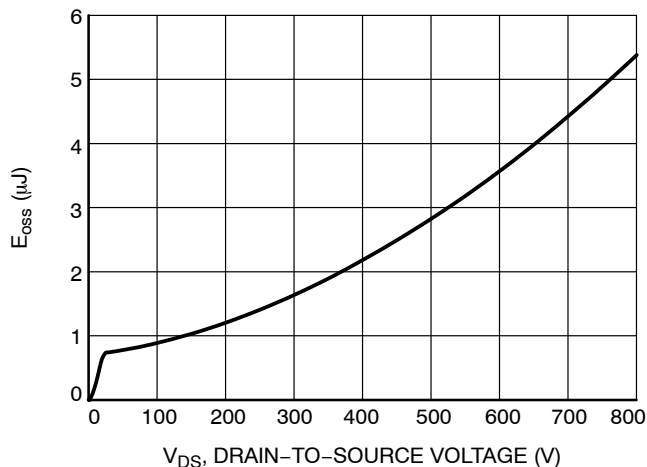


Figure 10.  $E_{oss}$  vs. Drain-to-Switching Voltage

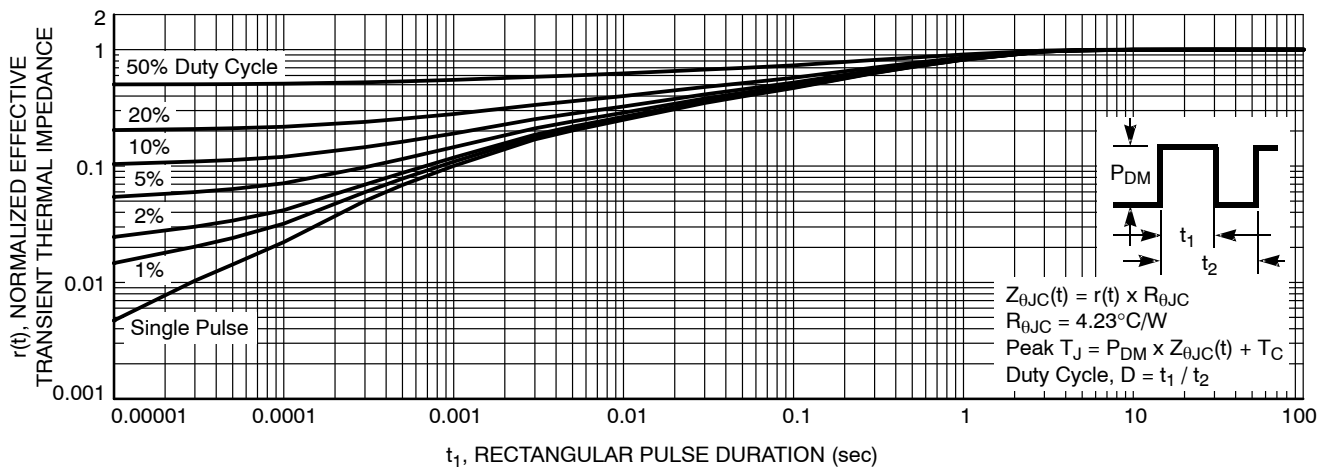


Figure 11. Transient Thermal Impedance

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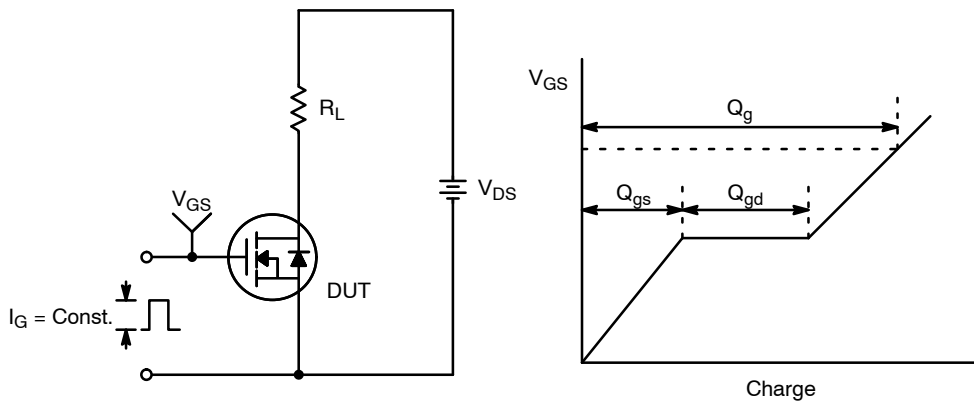


Figure 12. Gate Charge Test Circuit & Waveform

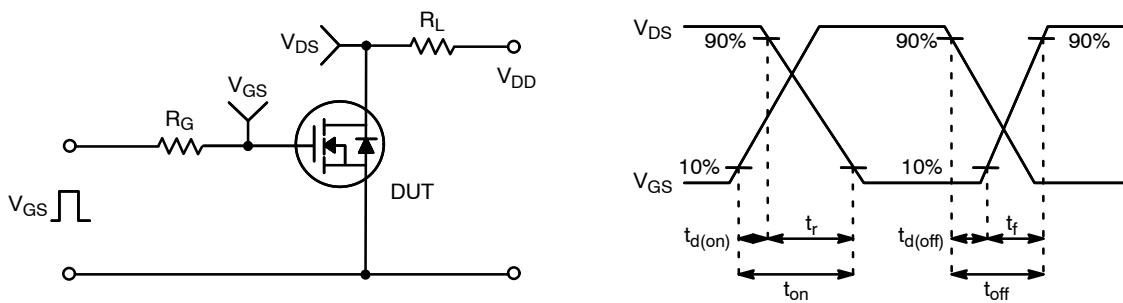


Figure 13. Resistive Switching Test Circuit & Waveforms

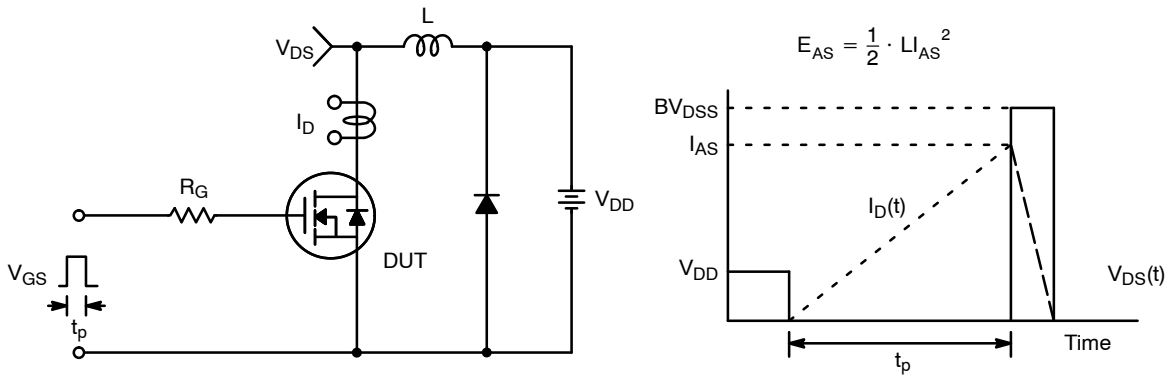
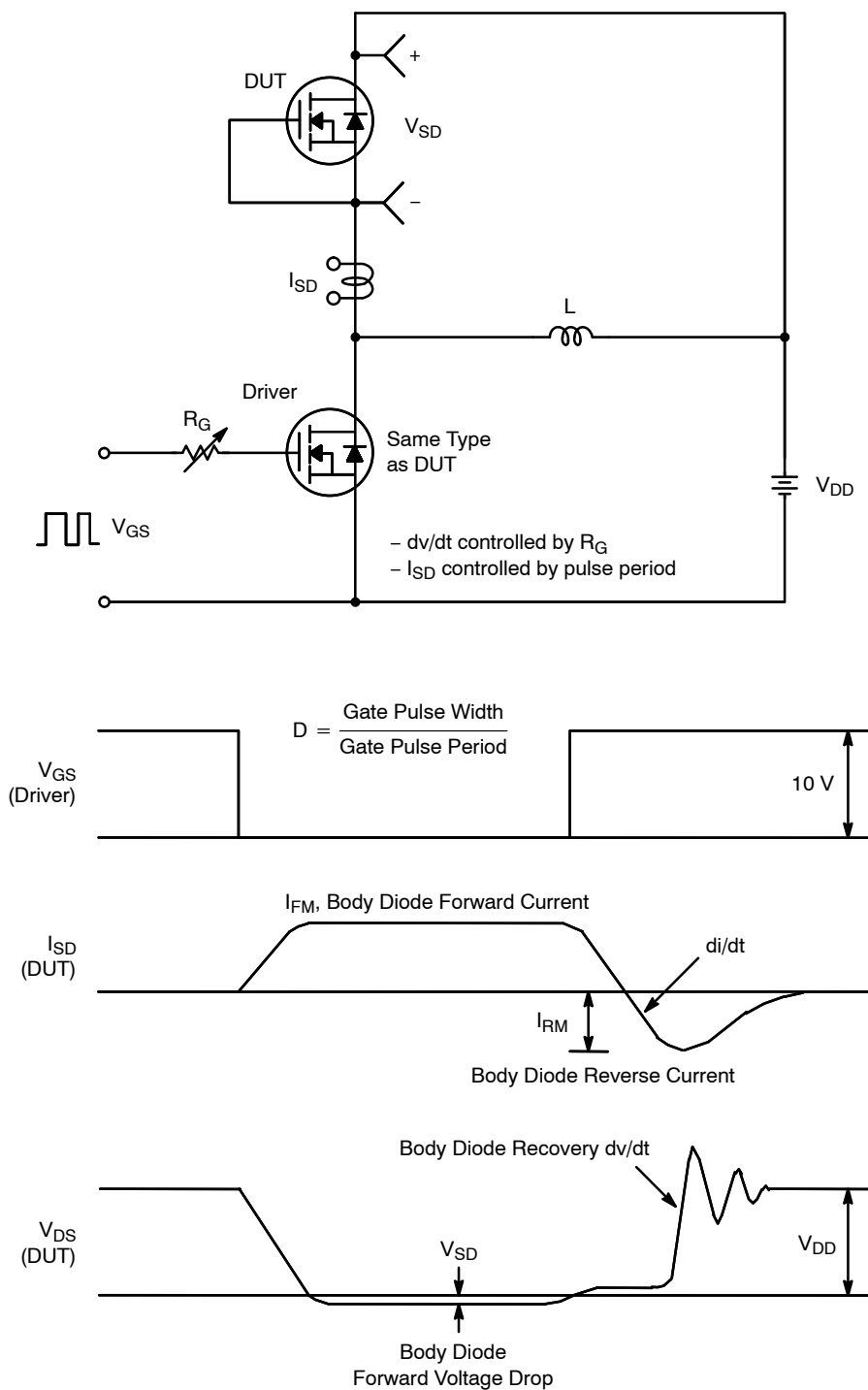


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

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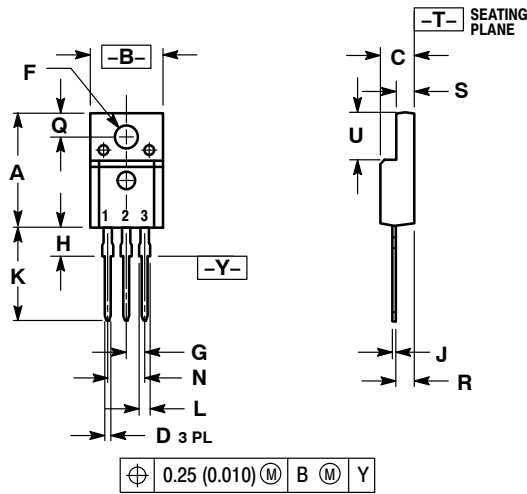
**Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms**



# NTPF450N80S3Z


## PACKAGE DIMENSIONS

### TO-220 FULLPAK CASE 221D-03 ISSUE K



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH
  3. 221D-01 THRU 221D-02 OBSOLETE, NEW STANDARD 221D-03.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.617	0.635	15.67	16.12
B	0.392	0.419	9.96	10.63
C	0.177	0.193	4.50	4.90
D	0.024	0.039	0.60	1.00
F	0.116	0.129	2.95	3.28
G	0.100 BSC		2.54 BSC	
H	0.118	0.135	3.00	3.43
J	0.018	0.025	0.45	0.63
K	0.503	0.541	12.78	13.73
L	0.048	0.058	1.23	1.47
N	0.200 BSC		5.08 BSC	
Q	0.122	0.138	3.10	3.50
R	0.099	0.117	2.51	2.96
S	0.092	0.113	2.34	2.87
U	0.239	0.271	6.06	6.88

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