

# MOSFET – Power, N-Channel, SUPERFET® III 800 V, 360 mΩ, 13 A

## NTPF360N80S3Z

### 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.  $R_{DS(on)}$  = 300 mΩ
- Ultra Low Gate Charge (Typ.  $Q_g$  = 25.3 nC)
- Low Stored Energy in Output Capacitance ( $E_{oss}$  = 2.72 μJ @ 400 V)
- 100% Avalanche Tested
- ESD Improved Capability with Zener Diode
- RoHS Compliant

### Applications

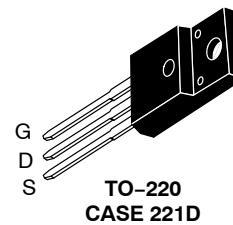
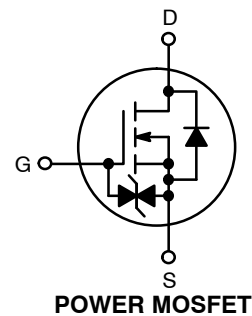
- Adapters / Chargers
- LED Lighting
- AUX Power
- Audio
- Industrial Power



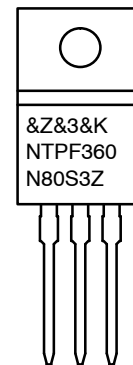
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$V_{(BR)DSS}$	$R_{DS(ON)}$ MAX	$I_D$ MAX
800 V	360 mΩ	13 A



### MARKING DIAGRAM



&Z = Assembly Plant Code  
 &3 = Data Code (Year & Week)  
 &K = Lot  
 NTPF360N80S3Z = Specific Device Code

### ORDERING INFORMATION

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

# NTPF360N80S3Z

## ABSOLUTE 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
		AC (f > 1 Hz)	±30
I <sub>D</sub>	Drain Current	Continuous (T <sub>C</sub> = 25°C)	13*
		Continuous (T <sub>C</sub> = 100°C)	8.2*
I <sub>DM</sub>	Drain Current	Pulsed (Note 1)	32.5*
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	40	mJ
I <sub>AS</sub>	Avalanche Current (Note 2)	2.0	A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	0.31	mJ
dv/dt	MOSFET dv/dt	100	V/ns
	Peak Diode Recovery dv/dt (Note 3)	10	
P <sub>D</sub>	Power Dissipation	(T <sub>C</sub> = 25°C)	31
		Derate Above 25°C	0.168
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range	-55 to +150	°C
T <sub>L</sub>	Lead Temperature Soldering Reflow 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> = 2.0 A, R<sub>G</sub> = 25 Ω, starting T<sub>J</sub> = 25°C.
3. I<sub>SD</sub> ≤ 3.25 A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ 400 V, starting T<sub>J</sub> = 25°C.

## THERMAL RESISTANCE RATINGS

Symbol	Parameter	Value	Unit
R <sub>θJC</sub>	Junction-to-Case - Steady State	4.04	°C/W
R <sub>θJA</sub>	Junction-to-Ambient - Steady State	62.5	

## PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
NTPF360N80S3Z	NTPF360N80S3Z	TO-220F	Tube	N/A	N/A	50 Units

# NTPF360N80S3Z

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

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>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 1 mA, Referenced 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-Body 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> = 0.3 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> = 6.5 A		300	360	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 6.5 A		13.8		S

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V, f = 250 kHz		1143		pF
C <sub>oss</sub>	Output Capacitance				18.1	
C <sub>oss(eff.)</sub>	Effective Output Capacitance	V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V		236.4		pF
C <sub>oss(er.)</sub>	Energy Related Output Capacitance	V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V		34		pF
Q <sub>g(tot)</sub>	Total Gate Charge at 10 V	V <sub>DS</sub> = 400 V, I <sub>D</sub> = 6.5 A, V <sub>GS</sub> = 10 V (Note 4)		25.3		nC
Q <sub>gs</sub>	Gate-to-Source Gate Charge			5.3		nC
Q <sub>gd</sub>	Gate-to-Drain "Miller" Charge			8.3		nC
ESR	Equivalent Series Resistance	f = 1 MHz		4		Ω

### SWITCHING CHARACTERISTICS

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 400 V, I <sub>D</sub> = 6.5 A, V <sub>GS</sub> = 10 V, R <sub>g</sub> = 25 Ω (Note 4)		21.2		ns
t <sub>r</sub>	Turn-On Rise Time			18.5		ns
t <sub>d(off)</sub>	Turn-Off Delay Time			110		ns
t <sub>f</sub>	Turn-Off Fall Time			17.7		ns

### SOURCE-DRAIN DIODE CHARACTERISTICS

I <sub>S</sub>	Maximum Continuous Source-to-Drain Diode Forward Current			13		A
I <sub>SM</sub>	Maximum Pulsed Source-to-Drain Diode Forward Current			32.5		A
V <sub>SD</sub>	Source-to-Drain Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 6.5 A		1.2		V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 3.25 A, dI <sub>F</sub> /dt = 100 A/μs		370		ns
Q <sub>rr</sub>	Reverse Recovery Charge			3.0		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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# NTPF360N80S3Z

## TYPICAL CHARACTERISTICS

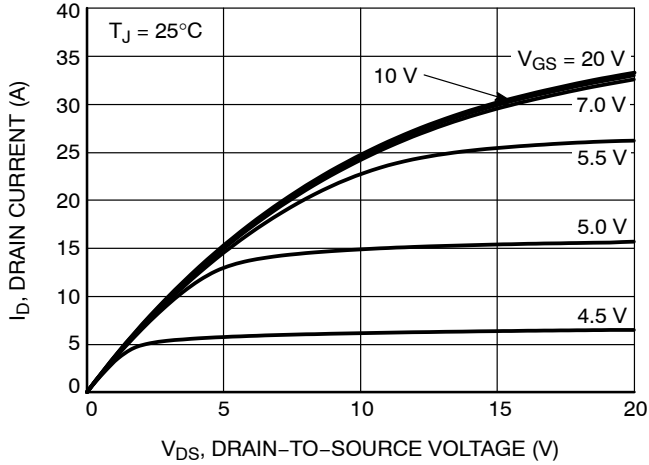


Figure 1. On-Region Characteristics

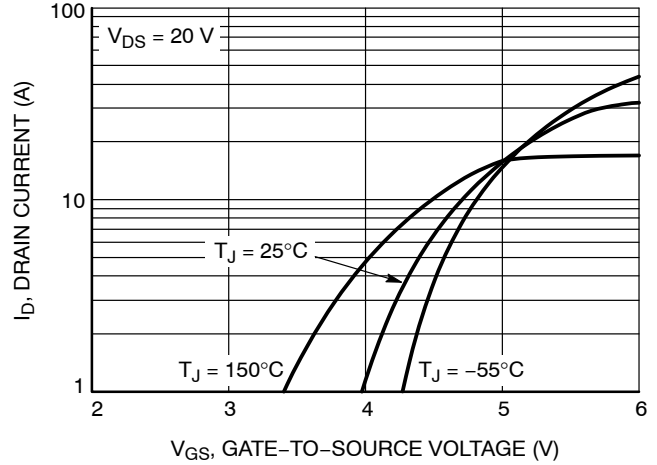


Figure 2. Transfer Characteristics

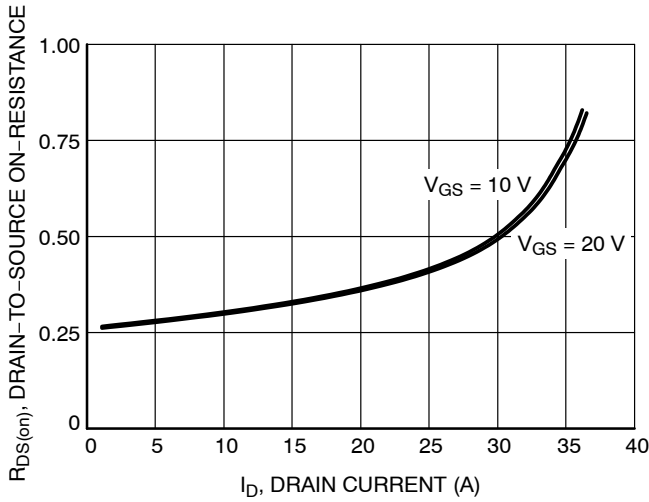


Figure 3. On Resistance vs. Drain Current

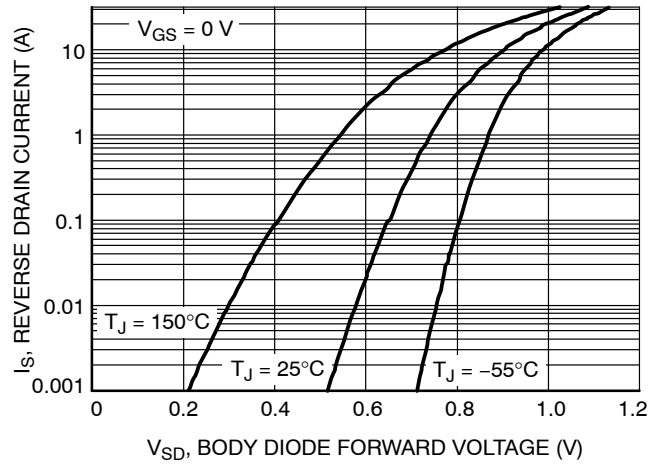


Figure 4. Diode Forward Voltage vs. Current

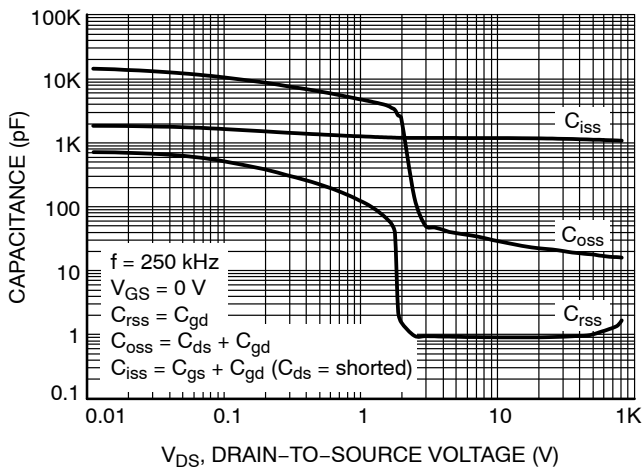


Figure 5. Capacitance Characteristics

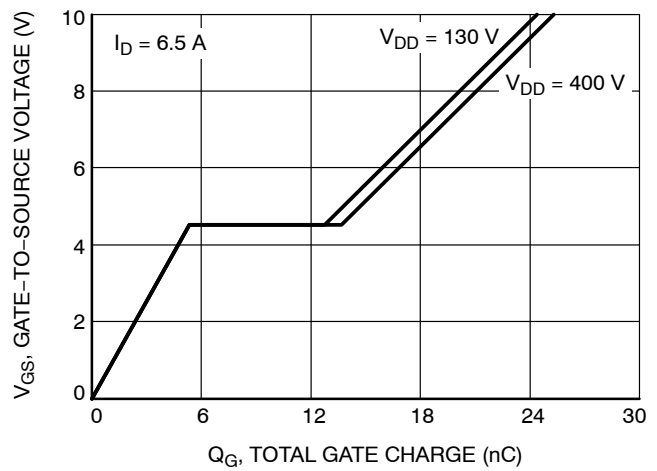


Figure 6. Gate Charge Characteristics

# NTPF360N80S3Z

## TYPICAL CHARACTERISTICS

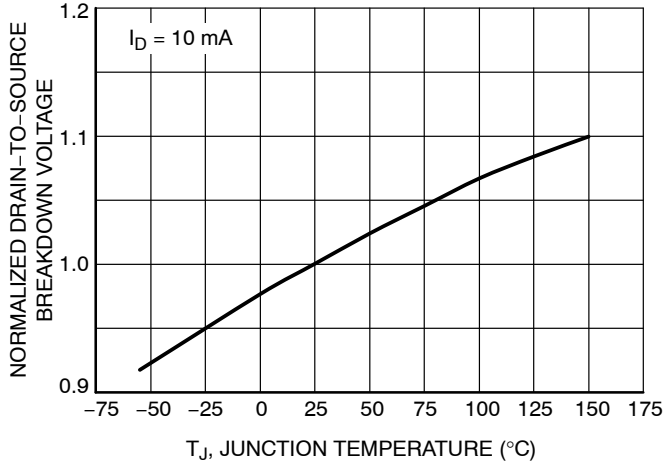


Figure 7. Normalized  $BV_{DSS}$  vs. Temperature

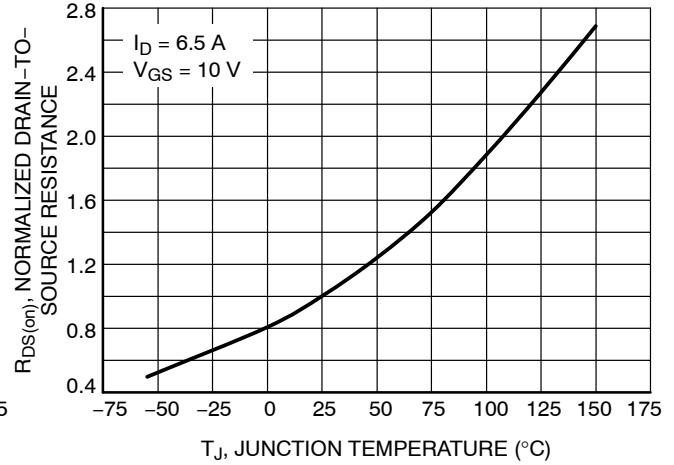


Figure 8. On-Resistance Variation vs. Temperature

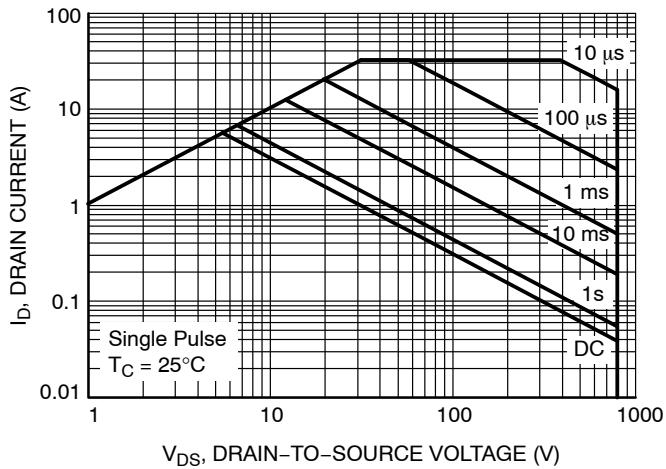


Figure 9. Safe Operating Area

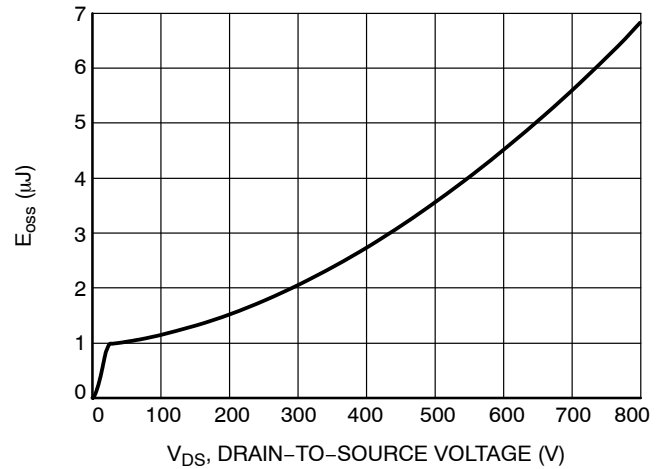


Figure 10.  $E_{oss}$  vs. Drain-to-Source Voltage

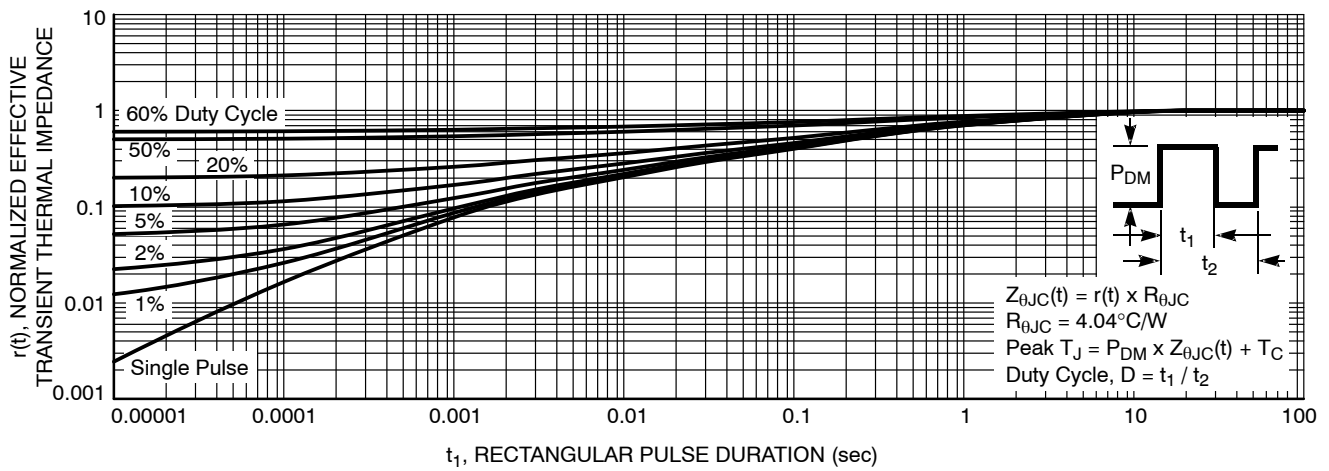


Figure 11. Transient Thermal Impedance

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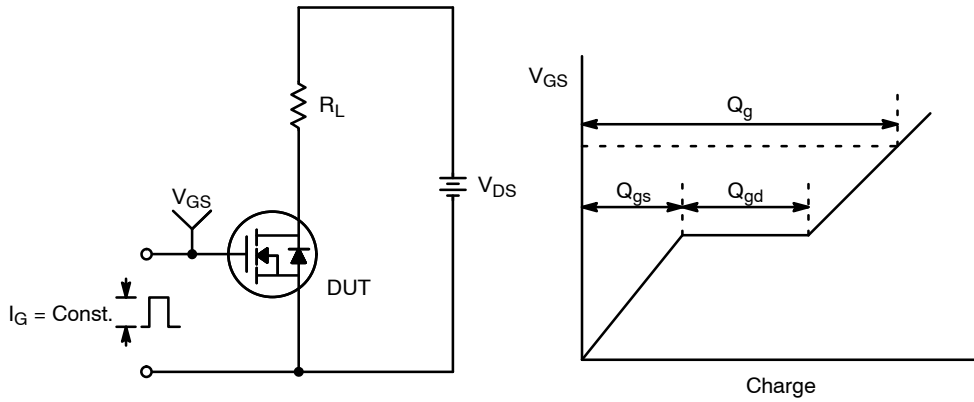


Figure 12. Gate Charge Test Circuit & Waveform

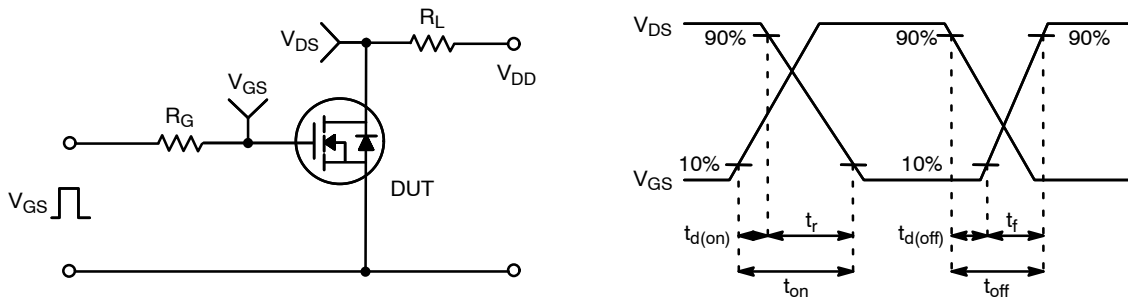


Figure 13. Resistive Switching Test Circuit & Waveforms

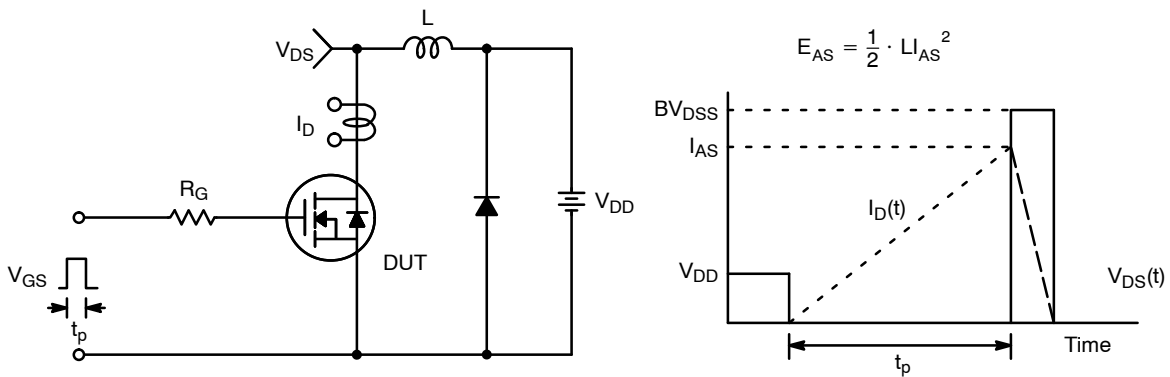
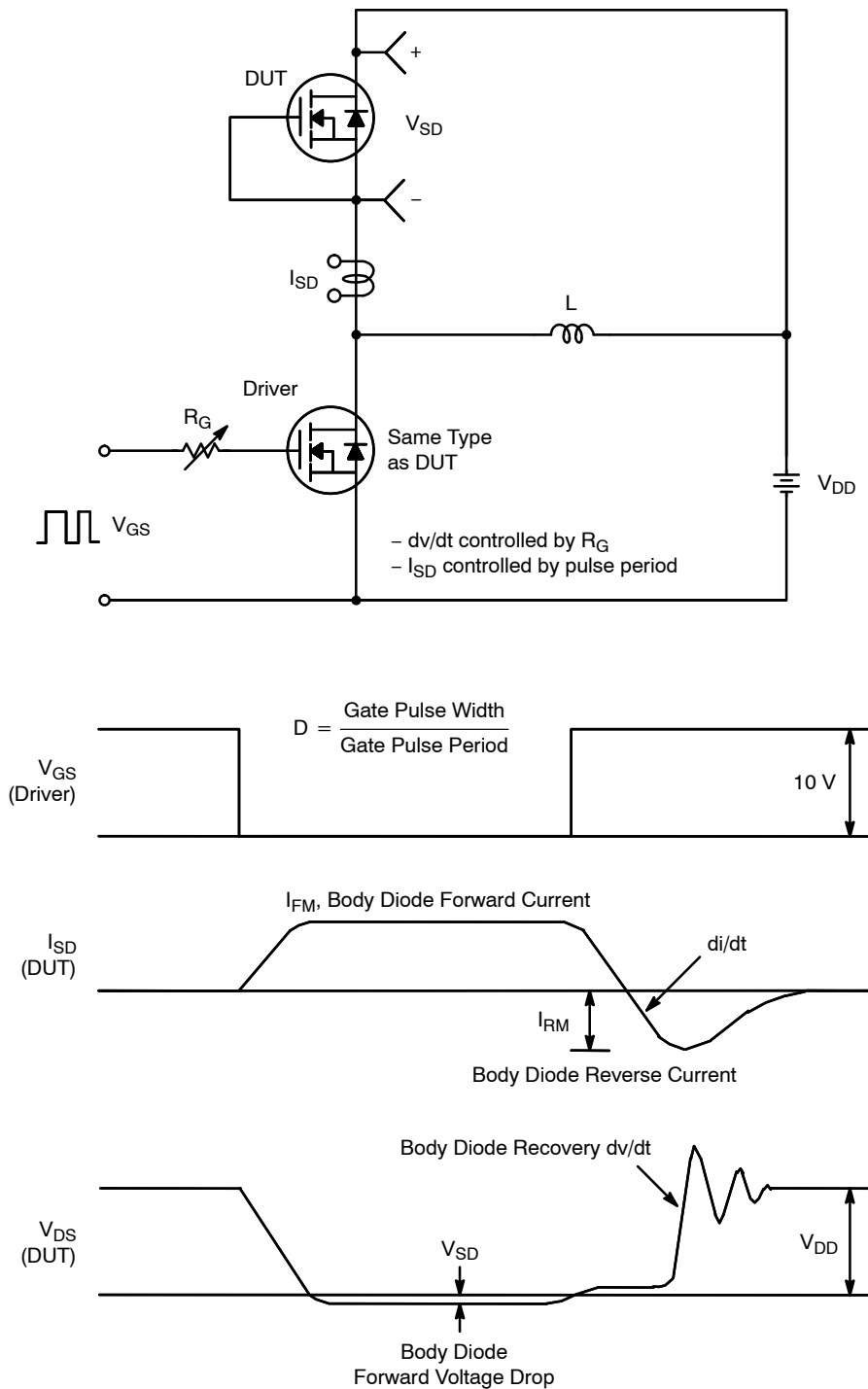


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

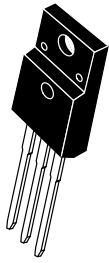
# NTPF360N80S3Z



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

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

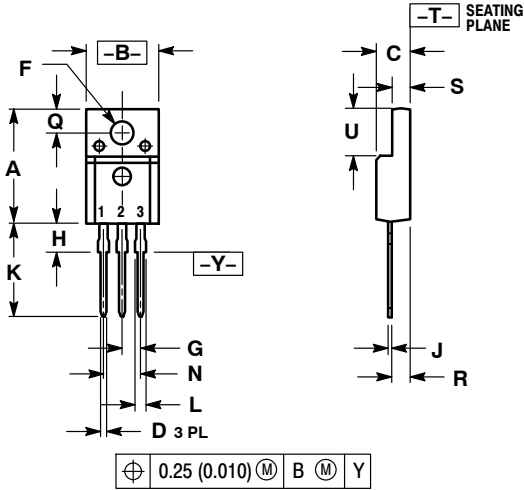
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SCALE 1:1

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

DATE 27 FEB 2009



- 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.

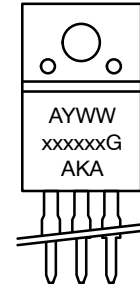
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.617	0.635	15.67	16.12
B	0.392	0.419	9.96	10.63
C	0.177	0.193	4.50	4.90
D	0.024	0.039	0.60	1.00
F	0.116	0.129	2.95	3.28
G	0.100 BSC		2.54 BSC	
H	0.118	0.135	3.00	3.43
J	0.018	0.025	0.45	0.63
K	0.503	0.541	12.78	13.73
L	0.048	0.058	1.23	1.47
N	0.200 BSC		5.08 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

### MARKING DIAGRAMS

- |  |   |  |
|--|---|--|
| STYLE 1:<br>PIN 1. GATE<br>2. DRAIN<br>3. SOURCE     | STYLE 2:<br>PIN 1. BASE<br>2. COLLECTOR<br>3. EMITTER | STYLE 3:<br>PIN 1. ANODE<br>2. CATHODE<br>3. ANODE |
| STYLE 4:<br>PIN 1. CATHODE<br>2. ANODE<br>3. CATHODE | STYLE 5:<br>PIN 1. CATHODE<br>2. ANODE<br>3. GATE     | STYLE 6:<br>PIN 1. MT 1<br>2. MT 2<br>3. GATE      |



**Bipolar**



**Rectifier**

- |                               |                           |
|-------------------------------|---------------------------|
| xxxxxx = Specific Device Code | A = Assembly Location     |
| G = Pb-Free Package           | Y = Year                  |
| A = Assembly Location         | WW = Work Week            |
| Y = Year                      | xxxxxx = Device Code      |
| WW = Work Week                | G = Pb-Free Package       |
|                               | AKA = Polarity Designator |

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