

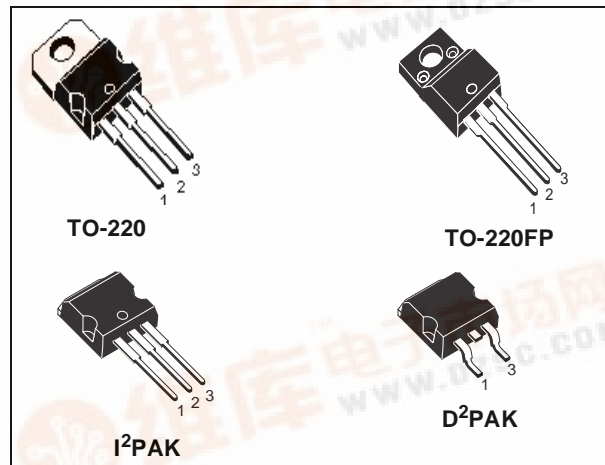


# STP7NK80Z - STP7NK80ZFP STB7NK80Z - STB7NK80Z-1

N-CHANNEL 800V-1.5Ω - 5.2A TO-220/TO-220FP/I<sup>2</sup>PAK/D<sup>2</sup>PAK  
Zener-Protected SuperMESH™ Power MOSFET

TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>	P <sub>w</sub>
STP7NK80Z	800 V	< 1.8 Ω	5.2 A	125 W
STP7NK80ZFP	800 V	< 1.8 Ω	5.2 A	30 W
STB7NK80Z	800 V	< 1.8 Ω	5.2 A	125 W
STB7NK80Z-1	800 V	< 1.8 Ω	5.2 A	125 W

- TYPICAL R<sub>DS(on)</sub> = 1.5 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- GATE CHARGE MINIMIZED
- VERY LOW INTRINSIC CAPACITANCES
- VERY GOOD MANUFACTURING REPEATIBILITY



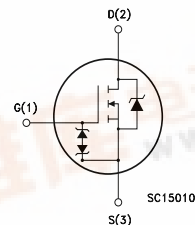
## DESCRIPTION

The SuperMESH™ series is obtained through an extreme optimization of ST's well established strip-based PowerMESH™ layout. In addition to pushing on-resistance significantly down, special care is taken to ensure a very good dv/dt capability for the most demanding applications. Such series complements ST full range of high voltage MOSFETs including revolutionary MDmesh™ products.

## APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- SMPS FOR INDUSTRIAL APPLICATION.
- LIGHTING (PREHEATING)

## INTERNAL SCHEMATIC DIAGRAM



## ORDERING INFORMATION

SALES TYPE	MARKING	PACKAGE	PACKAGING
STP7NK80Z	P7NK80Z	TO-220	TUBE
STP7NK80ZFP	P7NK80ZFP	TO-220FP	TUBE
STB7NK80ZT4	B7NK80Z	D <sup>2</sup> PAK	TAPE & REEL
STB7NK80Z	B7NK80Z	D <sup>2</sup> PAK	TUBE (ONLY UNDER REQUEST)
STB7NK80Z-1	B7NK80Z	I <sup>2</sup> PAK	TUBE

**STP7NK80Z - STP7NK80ZFP - STB7NK80Z - STB7NK80Z-1**

**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value		Unit
		STP7NK80Z STB7NK80Z STB7NK80Z-1	STP7NK80ZFP	
V <sub>DS</sub>	Drain-source Voltage (V <sub>GS</sub> = 0)	800		V
V <sub>DGR</sub>	Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)	800		V
V <sub>GS</sub>	Gate- source Voltage	± 30		V
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 25°C	5.2	5.2 (*)	A
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 100°C	3.3	3.3 (*)	A
I <sub>DM</sub> (•)	Drain Current (pulsed)	20.8	20.8 (*)	A
P <sub>TOT</sub>	Total Dissipation at T <sub>C</sub> = 25°C	125	30	W
	Derating Factor	1	0.24	W/°C
V <sub>ESD(G-S)</sub>	Gate source ESD(HBM-C=100pF, R=1.5KΩ)	4000		V
dv/dt (1)	Peak Diode Recovery voltage slope	4.5		V/ns
V <sub>ISO</sub>	Insulation Withstand Voltage (DC)	-	2500	V
T <sub>j</sub>	Operating Junction Temperature	-55 to 150		°C
T <sub>stg</sub>	Storage Temperature	-55 to 150		°C

(•) Pulse width limited by safe operating area  
 (1) I<sub>SD</sub> ≤ 5.2A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>.  
 (\*) Limited only by maximum temperature allowed

**THERMAL DATA**

		TO-220 D <sup>2</sup> PAK I <sup>2</sup> PAK	TO-220FP	
R <sub>thj-case</sub>	Thermal Resistance Junction-case Max	1	4.2	°C/W
R <sub>thj-amb</sub>	Thermal Resistance Junction-ambient Max	62.5	50	°C/W
T <sub>I</sub>	Maximum Lead Temperature For Soldering Purpose	300		°C

**AVALANCHE CHARACTERISTICS**

Symbol	Parameter	Max Value	Unit
I <sub>AR</sub>	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T <sub>j</sub> max)	5.2	A
E <sub>AS</sub>	Single Pulse Avalanche Energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V)	210	mJ

**GATE-SOURCE ZENER DIODE**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
BV <sub>GSO</sub>	Gate-Source Breakdown Voltage	I <sub>gs</sub> =± 1mA (Open Drain)	30			V

**PROTECTION FEATURES OF GATE-TO-SOURCE ZENER DIODES**

The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.



## STP7NK80Z - STP7NK80ZFP - STB7NK80Z - STB7NK80Z-1

### ELECTRICAL CHARACTERISTICS (TCASE =25°C UNLESS OTHERWISE SPECIFIED) ON/OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	$I_D = 1 \text{ mA}, V_{GS} = 0$	800			V
$I_{DSS}$	Zero Gate Voltage Drain Current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max Rating}$ $V_{DS} = \text{Max Rating}, T_C = 125 \text{ }^\circ\text{C}$			1 50	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body Leakage Current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 100\mu\text{A}$	3	3.75	4.5	V
$R_{DS(on)}$	Static Drain-source On Resistance	$V_{GS} = 10\text{V}, I_D = 2.6 \text{ A}$		1.5	1.8	$\Omega$

### DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{fs} (1)$	Forward Transconductance	$V_{DS} = 15 \text{ V}, I_D = 2.6 \text{ A}$		5		S
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{DS} = 25\text{V}, f = 1 \text{ MHz}, V_{GS} = 0$		1138 122 25		pF pF pF
$C_{oss \text{ eq.}} (3)$	Equivalent Output Capacitance	$V_{GS} = 0\text{V}, V_{DS} = 0\text{V to } 640\text{V}$		50		pF

### SWITCHING ON

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on Delay Time Rise Time	$V_{DD} = 400 \text{ V}, I_D = 2.6 \text{ A}$ $R_G = 4.7\Omega, V_{GS} = 10 \text{ V}$ (Resistive Load see, Figure 3)		20 12		ns ns
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total Gate Charge Gate-Source Charge Gate-Drain Charge	$V_{DD} = 640\text{V}, I_D = 5.2 \text{ A},$ $V_{GS} = 10\text{V}$		40 7 21	56	nC nC nC

### SWITCHING OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$ $t_f$	Turn-off Delay Time Fall Time	$V_{DD} = 400 \text{ V}, I_D = 2.6 \text{ A}$ $R_G = 4.7\Omega, V_{GS} = 10 \text{ V}$ (Resistive Load see, Figure 3)		45 22		ns ns
$t_r(V_{off})$ $t_f$ $t_c$	Off-voltage Rise Time Fall Time Cross-over Time	$V_{DD} = 640\text{V}, I_D = 5.2 \text{ A},$ $R_G = 4.7\Omega, V_{GS} = 10\text{V}$ (Inductive Load see, Figure 5)		12 10 20		ns ns ns

### SOURCE DRAIN DIODE

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM} (2)$	Source-drain Current Source-drain Current (pulsed)				5.2 20.8	A A
$V_{SD} (1)$	Forward On Voltage	$I_{SD} = 5.2 \text{ A}, V_{GS} = 0$			1.6	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD} = 5.2 \text{ A}, di/dt = 100\text{A}/\mu\text{s}$ $V_{DD} = 50\text{V}, T_j = 150^\circ\text{C}$ (see test circuit, Figure 5)		530 3.31 12.5		ns $\mu\text{C}$ A

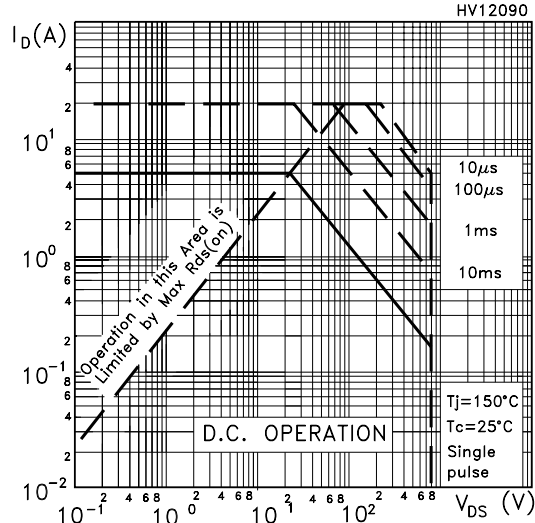
Note: 1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.

2. Pulse width limited by safe operating area.

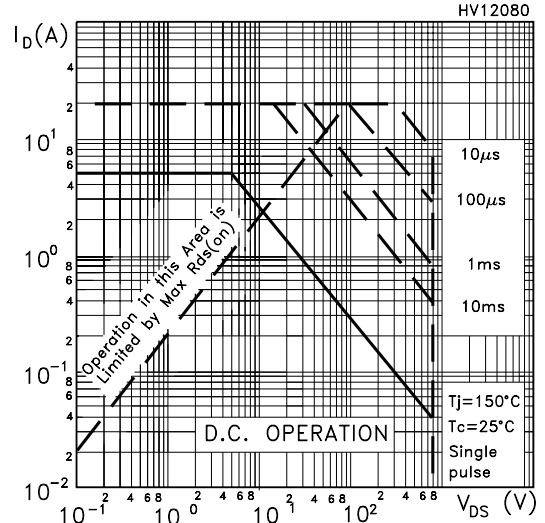
3.  $C_{oss \text{ eq.}}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$ .

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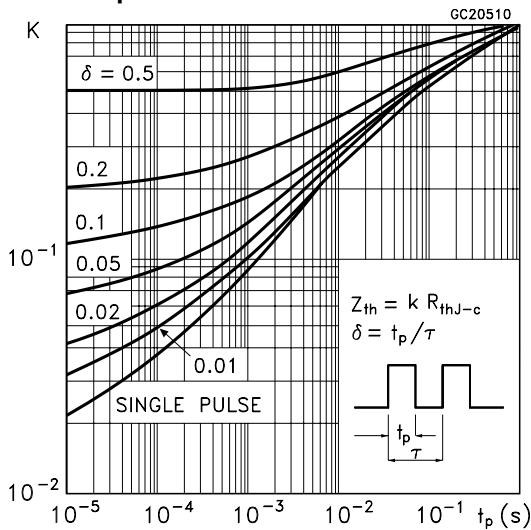
**Safe Operating Area For TO-220/D2PAK/I2PAK**



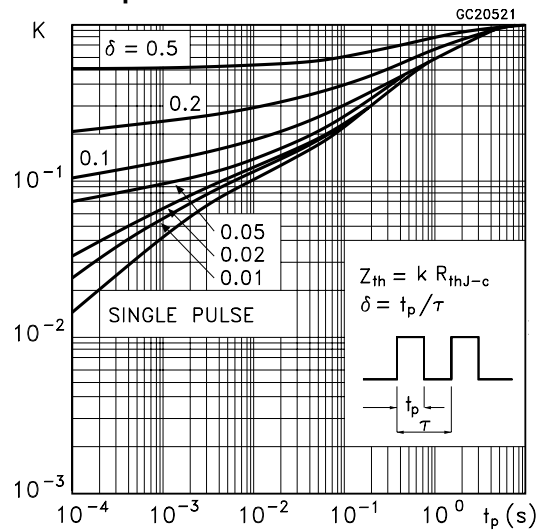
**Safe Operating Area For TO-220FP**



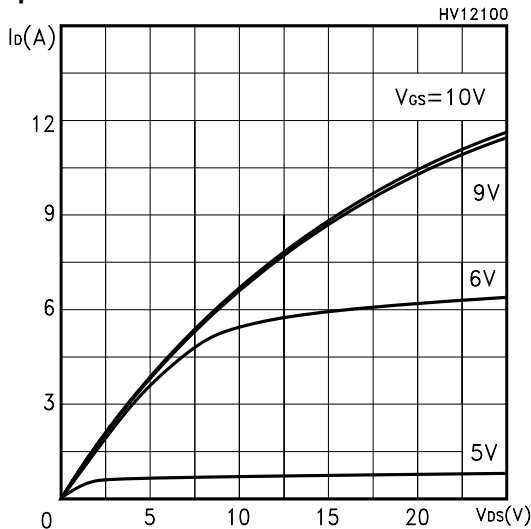
**Thermal Impedance For TO-220/D2PAK/I2PAK**



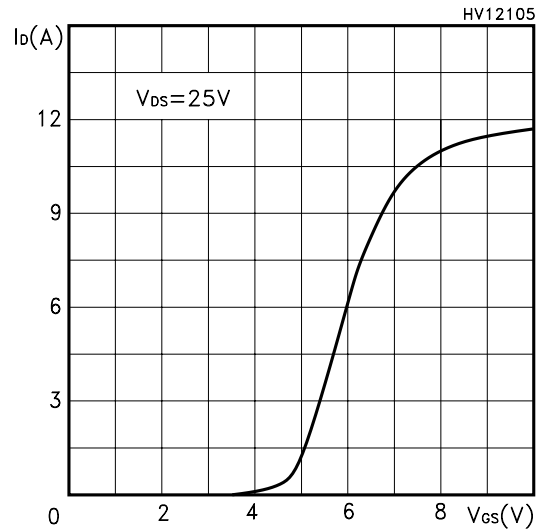
**Thermal Impedance For TO-220FP**



**Output Characteristics**

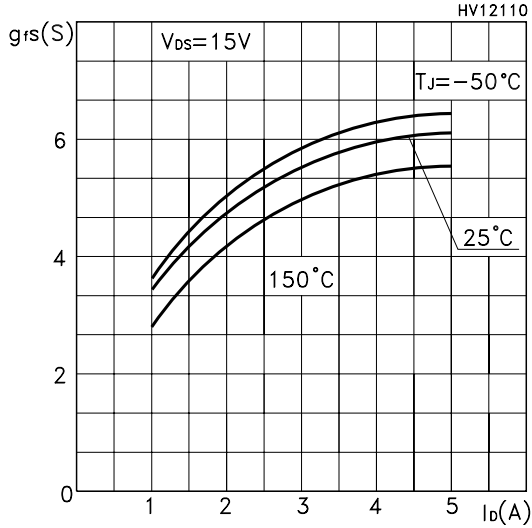


**Transfer Characteristics**

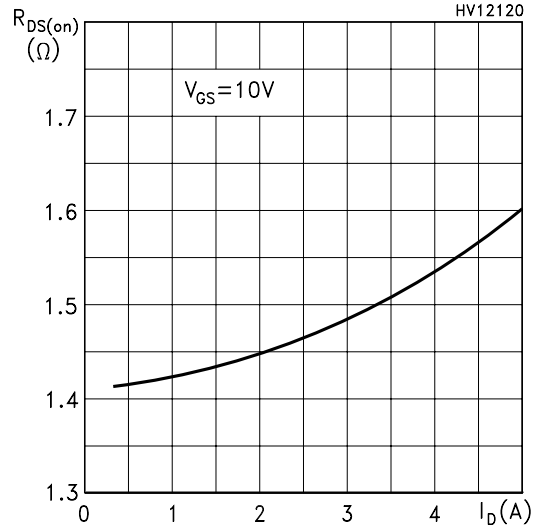


**STP7NK80Z - STP7NK80ZFP - STB7NK80Z - STB7NK80Z-1**

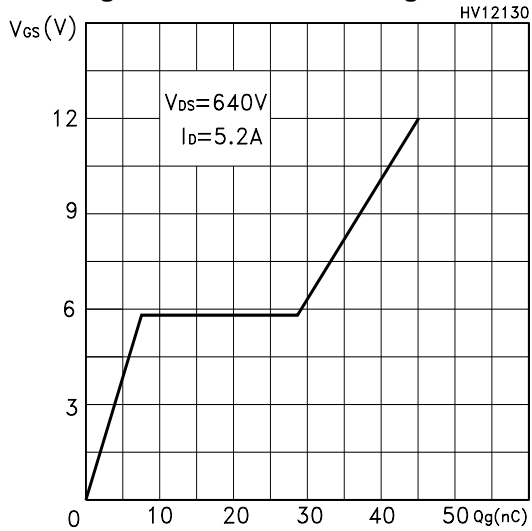
**Transconductance**



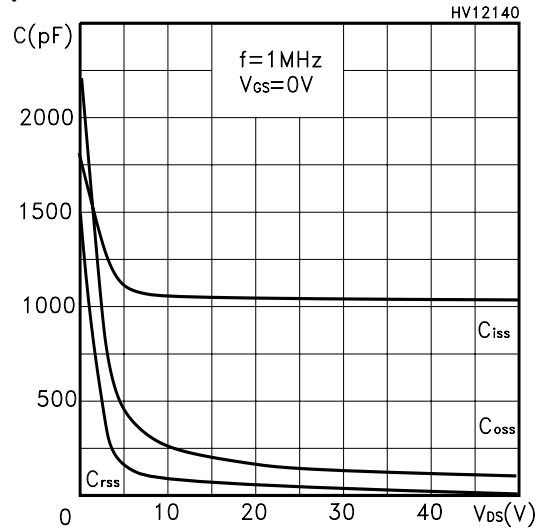
**Static Drain-source On Resistance**



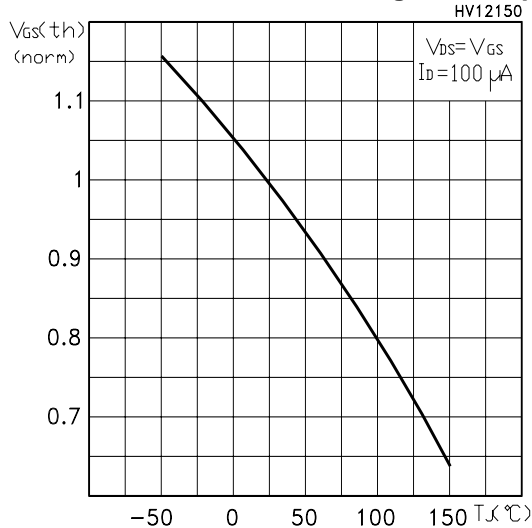
**Gate Charge vs Gate-source Voltage**



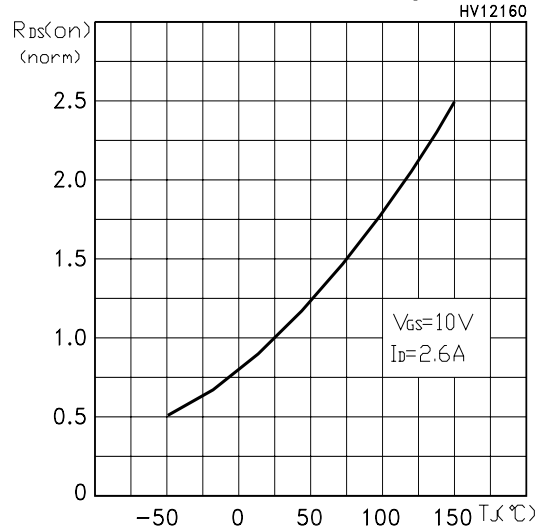
**Capacitance Variations**



**Normalized Gate Threshold Voltage vs Temp.**

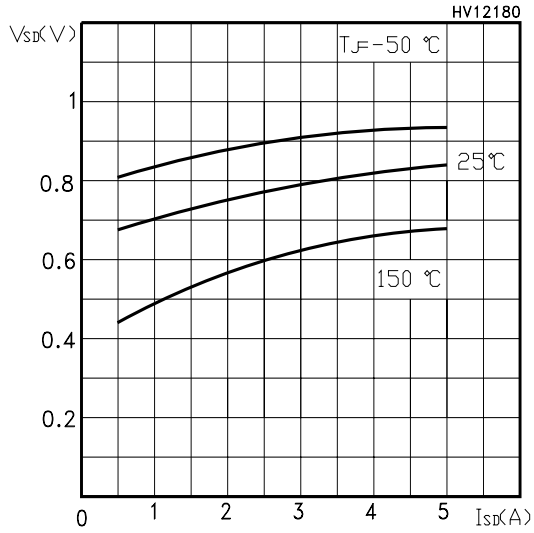


**Normalized On Resistance vs Temperature**

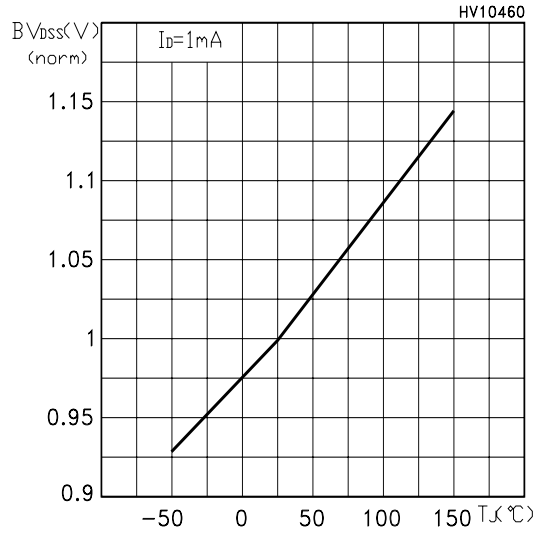


**STP7NK80Z - STP7NK80ZFP - STB7NK80Z - STB7NK80Z-1**

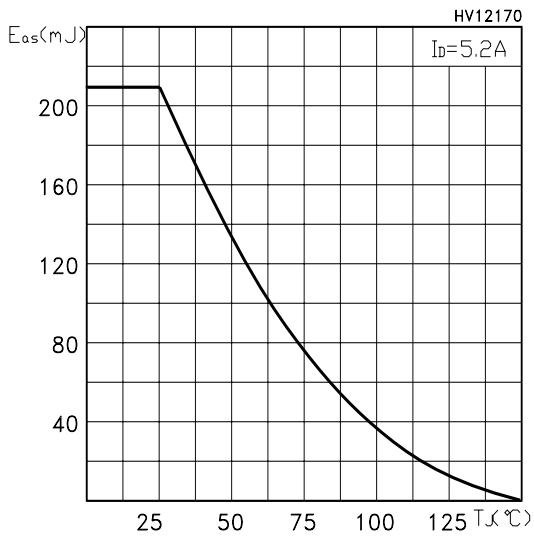
**Source-drain Diode Forward Characteristics**



**Normalized BVDSS vs Temperature**



**Maximum Avalanche Energy vs Temperature**



STP7NK80Z - STP7NK80ZFP - STB7NK80Z - STB7NK80Z-1

Fig. 1: Unclamped Inductive Load Test Circuit

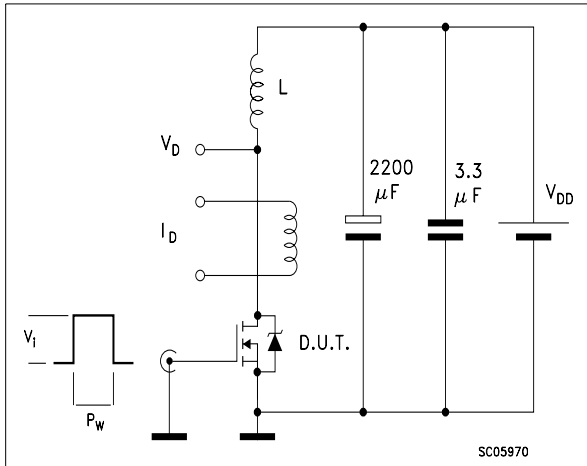


Fig. 2: Unclamped Inductive Waveform

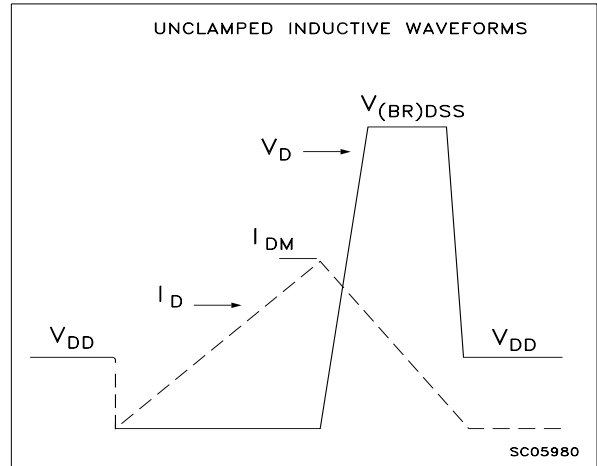


Fig. 3: Switching Times Test Circuit For Resistive Load

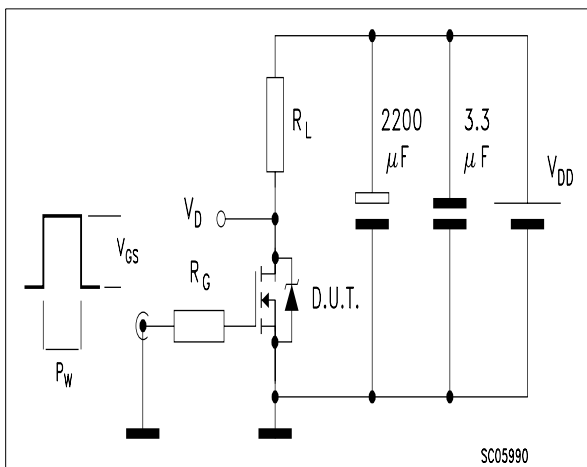


Fig. 4: Gate Charge test Circuit

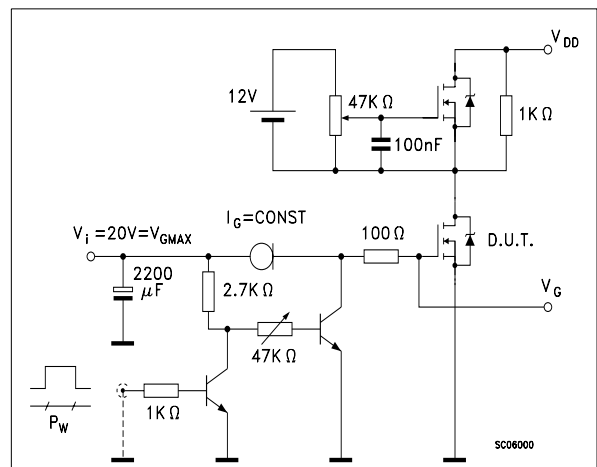
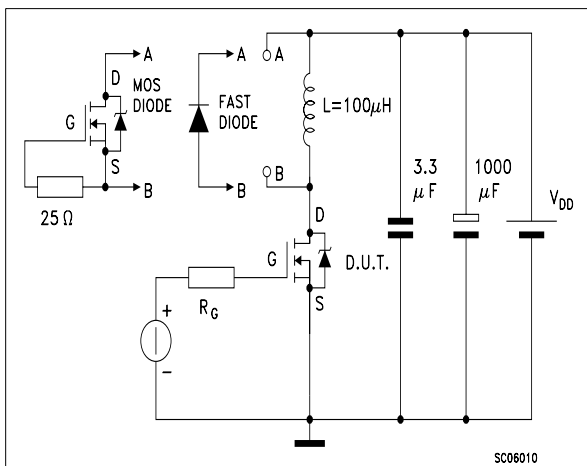


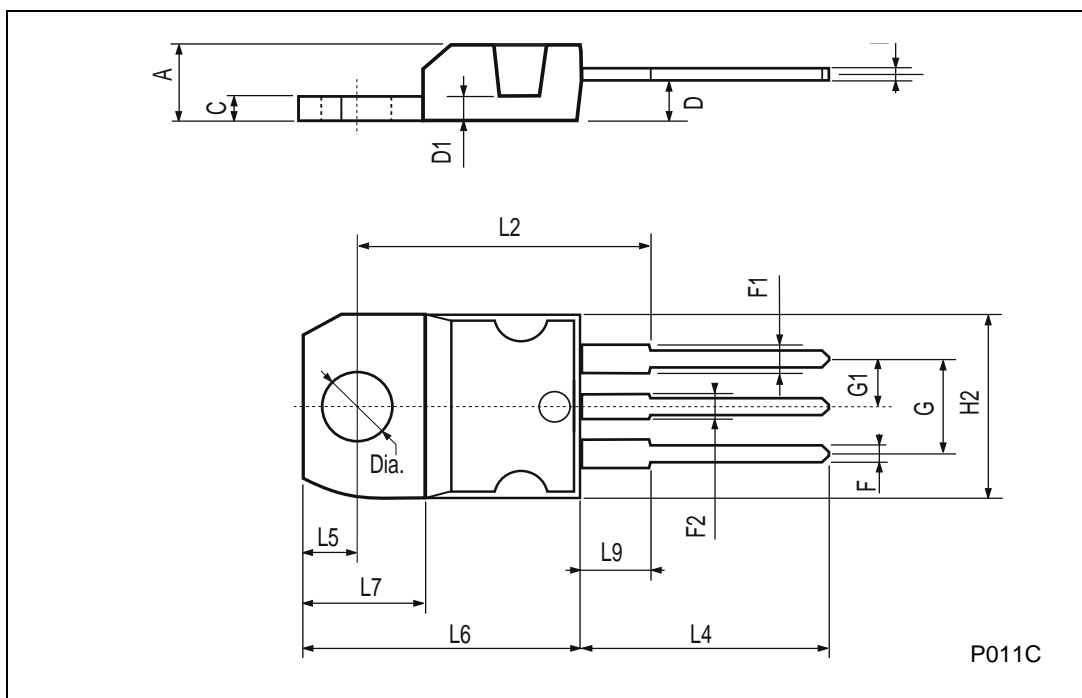
Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



**STP7NK80Z - STP7NK80ZFP - STB7NK80Z - STB7NK80Z-1**

**TO-220 MECHANICAL DATA**

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
D1		1.27			0.050	
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.4		2.7	0.094		0.106
H2	10.0		10.40	0.393		0.409
L2		16.4			0.645	
L4	13.0		14.0	0.511		0.551
L5	2.65		2.95	0.104		0.116
L6	15.25		15.75	0.600		0.620
L7	6.2		6.6	0.244		0.260
L9	3.5		3.93	0.137		0.154
DIA.	3.75		3.85	0.147		0.151



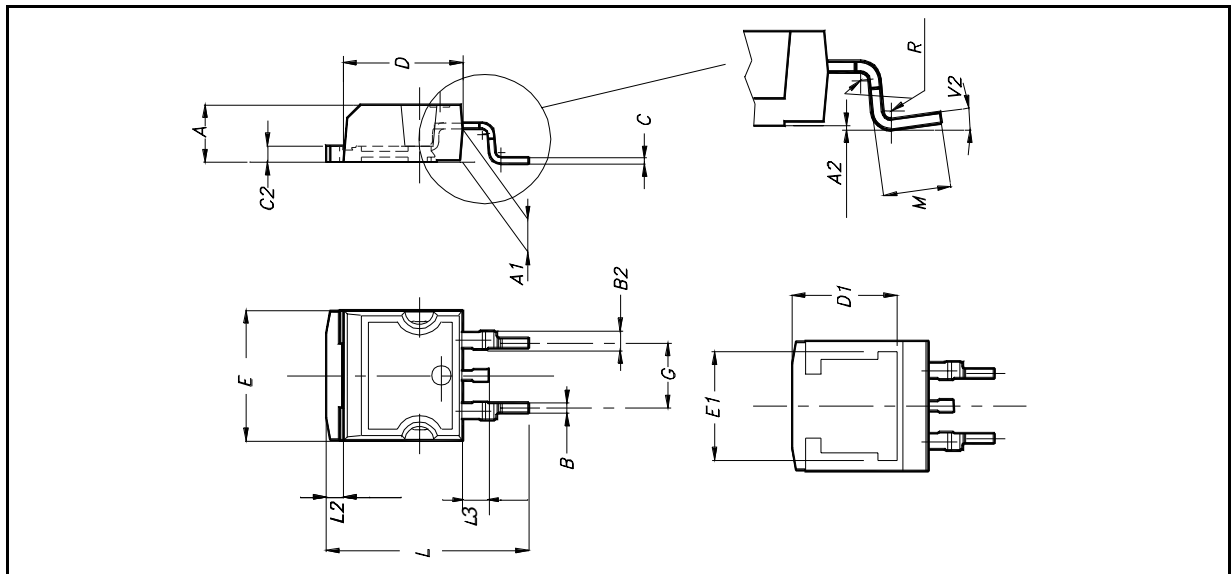




**STP7NK80Z - STP7NK80ZFP - STB7NK80Z - STB7NK80Z-1**

**D<sup>2</sup>PAK MECHANICAL DATA**

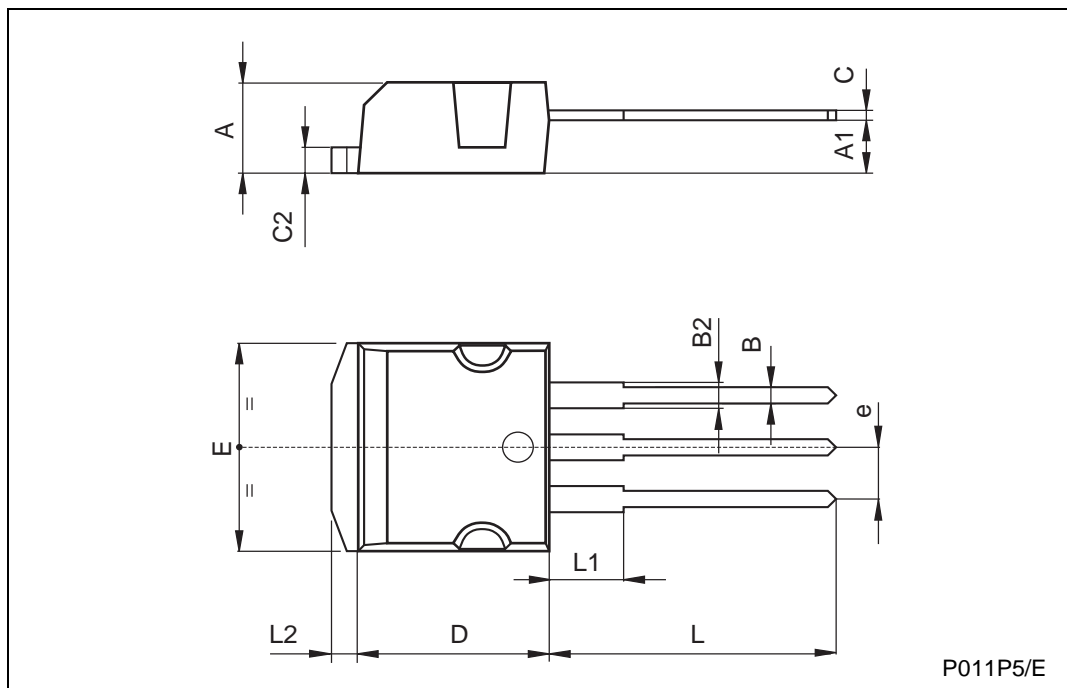
DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.393		
E1		8.5			0.334	
G	4.88		5.28	0.192		0.208
L	15		15.85	0.590		0.625
L2	1.27		1.4	0.050		0.055
L3	1.4		1.75	0.055		0.068
M	2.4		3.2	0.094		0.126
R		0.4			0.015	
V2	0°		4°			



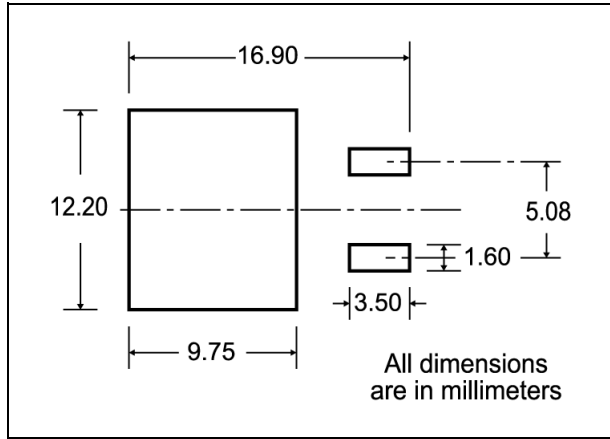
**STP7NK80Z - STP7NK80ZFP - STB7NK80Z - STB7NK80Z-1**

**TO-262 (I<sup>2</sup>PAK) MECHANICAL DATA**

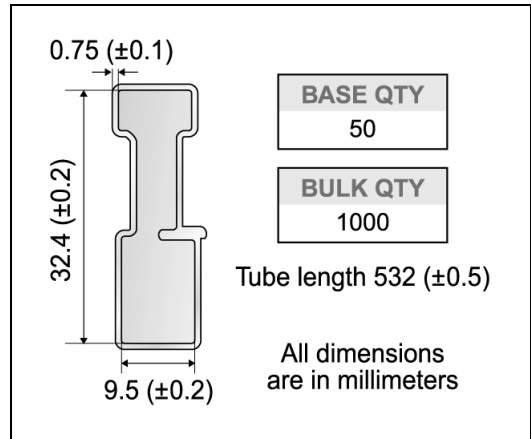
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
e	2.4		2.7	0.094		0.106
E	10		10.4	0.393		0.409
L	13.1		13.6	0.515		0.531
L1	3.48		3.78	0.137		0.149
L2	1.27		1.4	0.050		0.055



### D<sup>2</sup>PAK FOOTPRINT



### TUBE SHIPMENT (no suffix)\*



### TAPE AND REEL SHIPMENT (suffix "T4")\*

Diagram showing the tape mechanical data. It includes a circular core with a diameter of 40 mm min. and an access hole at the slot location. The tape slot in the core has a width of 2.5 mm min. and a full radius. Dimensions A, B, C, D, G, and N are indicated. G is measured at the hub.

#### REEL MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0.795	
G	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

BASE QTY	BULK QTY
1000	1000

#### TAPE MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	10.5	10.7	0.413	0.421
B0	15.7	15.9	0.618	0.626
D	1.5	1.6	0.059	0.063
D1	1.59	1.61	0.062	0.063
E	1.65	1.85	0.065	0.073
F	11.4	11.6	0.449	0.456
K0	4.8	5.0	0.189	0.197
P0	3.9	4.1	0.153	0.161
P1	11.9	12.1	0.468	0.476
P2	1.9	2.1	0.075	0.082
R	50		1.574	
T	0.25	0.35	0.0098	0.0137
W	23.7	24.3	0.933	0.956

Diagram showing the tape and reel shipment details. It includes a top cover tape with dimensions K<sub>0</sub>, T, D, P<sub>2</sub>, P<sub>0</sub>, E, F, W, B<sub>0</sub>, D<sub>1</sub>, A<sub>0</sub>, P<sub>1</sub>. The center line of the cavity is shown. The user direction of feed is indicated. The bending radius is R min. The TRL (Tape Reel Length) is shown. The 10 pitches cumulative tolerance on tape is ±0.2 mm.

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