

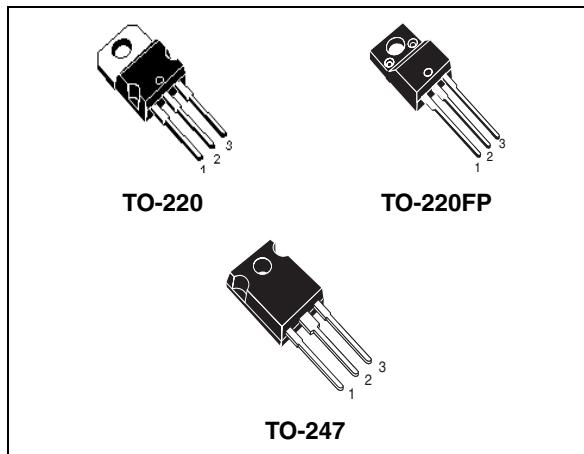
# **STP5NK100Z, STF5NK100Z STW5NK100Z**

N-channel 1000 V, 2.7  $\Omega$ , 3.5 A, TO-220, TO-220FP, TO-247  
SuperMESH3™ Power MOSFET

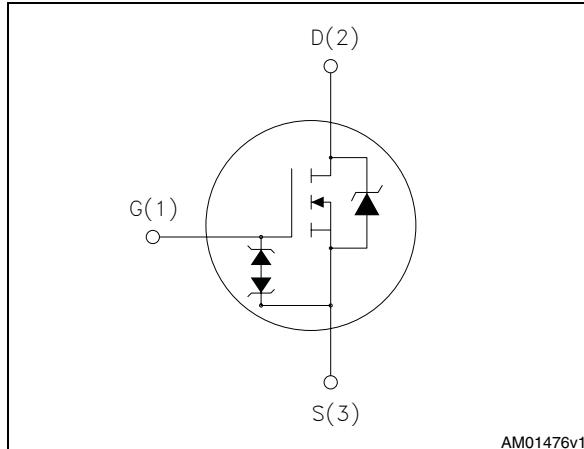
## Features

Type	$V_{DSS}$ (@ $T_{JMAX}$ )	$R_{DS(on)max}$	$I_D$
STF5NK100Z	1000 V	< 3.7 $\Omega$	3.5 A
STP5NK100Z	1000 V	< 3.7 $\Omega$	3.5 A
STW5NK100Z	1000 V	< 3.7 $\Omega$	3.5 A

- Extremely high dv/dt capability
- 100% avalanche tested
- Gate charge minimized
- Very low intrinsic capacitances
- Very good manufacturing repeatability



**Figure 1. Internal schematic diagram**



## Applications

- Switching application

## Description

The new SuperMESH™ series of Power MOSFETs is the result of further design improvements on ST's well-established strip-based PowerMESH™ layout. In addition to significantly lower on-resistance, the device offers superior dv/dt capability to ensure optimal performance even in the most demanding applications. The SuperMESH™ devices further complement an already broad range of innovative high voltage MOSFETs, which includes the revolutionary MDmesh™ products.

**Table 1. Device summary**

Order code	Marking	Package	Packaging
STF5NK100Z	F5NK100Z	TO-220FP	Tube
STP5NK100Z	P5NK100Z	TO-220	Tube
STW5NK100Z	W5NK100Z	TO-247	Tube

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220, TO-247	TO-220FP	
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	1000		V
$V_{GS}$	Gate-source voltage	$\pm 30$		V
$I_D$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	3.5	3.5 <sup>(1)</sup>	A
$I_D$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	2.2	2.2 <sup>(1)</sup>	A
$I_{DM}^{(2)}$	Drain current (pulsed)	14	14 <sup>(1)</sup>	A
$P_{TOT}$	Total dissipation at $T_C = 25^\circ\text{C}$	125	30	W
	Derating factor	1	0.24	W/ $^\circ\text{C}$
$V_{ESD(G-S)}$	Gate source ESD (HBM-C=100pF, R=1.5 k $\Omega$ )	4000		V
dv/dt <sup>(3)</sup>	Peak diode recovery voltage slope	4.5		V/ns
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t=1$ s; $T_c = 25^\circ\text{C}$ )		2500	V
$T_J$ $T_{stg}$	Operating junction temperature Storage temperature	-55 to 150		$^\circ\text{C}$

1. Limited only by maximum temperature allowed
2. Pulse width limited by safe operating area
3.  $I_{SD} \leq 3.5$  A,  $di/dt \leq 200$  A/ $\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_j \leq T_{JMAX}$ .

**Table 3. Thermal data**

Symbol	Parameter	Value		Unit
		TO-220, TO-247	TO-220FP	
$R_{thj-case}$	Thermal resistance junction-case max	1	4.2	$^\circ\text{C/W}$
$R_{thj-a}$	Thermal resistance junction-ambient max	62.5		$^\circ\text{C/W}$
$T_I$	Maximum lead temperature for soldering purpose	300		$^\circ\text{C}$

**Table 4. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_{JMAX}$ )	3.5	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25^\circ\text{C}$ , $I_d = I_{AR}$ , $V_{dd} = 50$ V)	250	mJ

## 2 Electrical characteristics

( $T_{CASE}=25^\circ\text{C}$  unless otherwise specified)

**Table 5. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1 \text{ mA}, V_{GS} = 0$	1000			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating}$ , $V_{DS} = \text{Max rating}$ , $T_c = 125^\circ\text{C}$			1 50	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate body leakage current ( $V_{GS} = 0$ )	$V_{GS} = \pm 20 \text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(\text{th})}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 100 \mu\text{A}$	3	3.75	4.5	V
$R_{DS(\text{on})}$	Static drain-source on resistance	$V_{GS} = 10 \text{ V}, I_D = 1.75 \text{ A}$		2.7	3.7	$\Omega$

**Table 6. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15 \text{ V}, I_D = 1.75 \text{ A}$	-	4		S
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25 \text{ V}, f = 1 \text{ MHz}$ , $V_{GS} = 0$	-	1154 106 21.3		pF pF pF
$C_{osseq}^{(2)}$	Equivalent output capacitance	$V_{GS} = 0, V_{DS} = 0 \text{ V to } 800 \text{ V}$	-	46.8		pF
$t_{d(on)}$ $t_r$ $t_{d(off)}$ $t_f$	Turn-on delay time Rise time Off-voltage rise time Fall time	$V_{DD} = 500 \text{ V}, I_D = 1.75 \text{ A}$ , $R_G = 4.7 \Omega, V_{GS} = 10 \text{ V}$	-	22.5 7.7 51.5 19		ns ns ns ns
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 800 \text{ V}, I_D = 3.5 \text{ A}$ $V_{GS} = 10 \text{ V}$	-	42 7.3 21.7	59	nC nC nC

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

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

**Table 7. Source drain diode**

<b>Symbol</b>	<b>Parameter</b>	<b>Test conditions</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
$I_{SD}$	Source-drain current		-		3.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		14	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}=3.5\text{ A}, V_{GS}=0$	-		1.6	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD}=3.5\text{ A},$ $di/dt=100\text{ A}/\mu\text{s},$ $V_{DD}=30\text{ V}$	-	605 3.09 10.5		ns $\mu\text{C}$ A
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD}=3.5\text{ A},$ $di/dt=100\text{ A}/\mu\text{s},$ $V_{DD}=35\text{ V}, T_j=150\text{ }^\circ\text{C}$	-	742 4.2 11.2		ns $\mu\text{C}$ A

1. Pulse width limited by safe operating area
2. Pulsed: pulse duration=300  $\mu\text{s}$ , duty cycle 1.5%

**Table 8. Gate-source Zener diode**

<b>Symbol</b>	<b>Parameter</b>	<b>Test conditions</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>
$BV_{GSO}$	Gate-source breakdown voltage	$I_{GS}=\pm 1\text{ mA}$ (open drain)	30			V

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.

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220FP

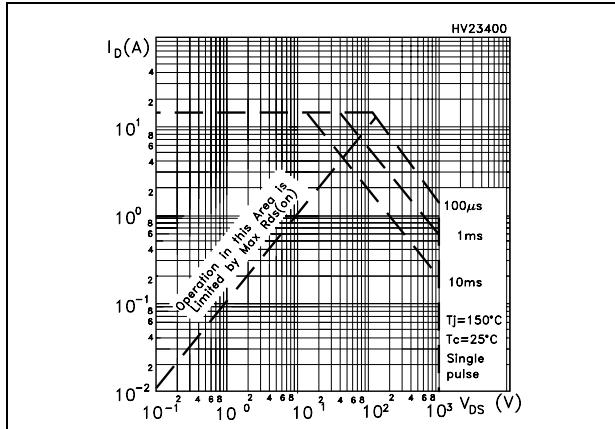


Figure 3. Thermal impedance for TO-220FP

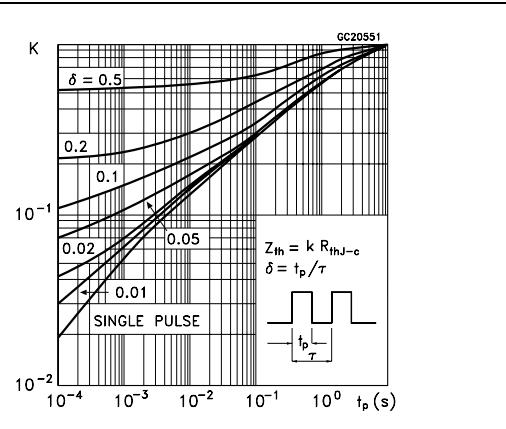


Figure 4. Safe operating area for TO-220

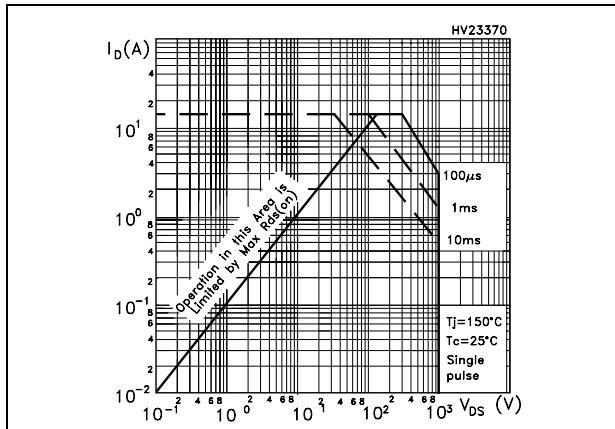


Figure 5. Thermal impedance for TO-220

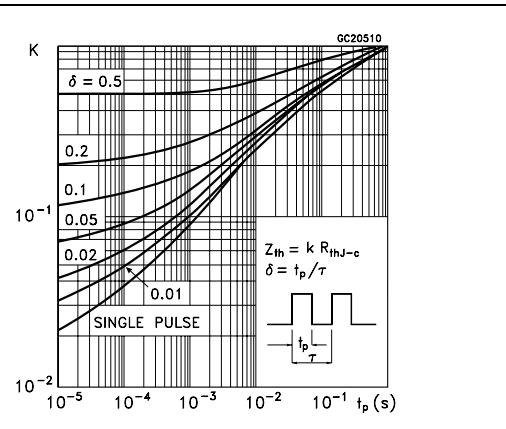


Figure 6. Safe operating area for TO-247

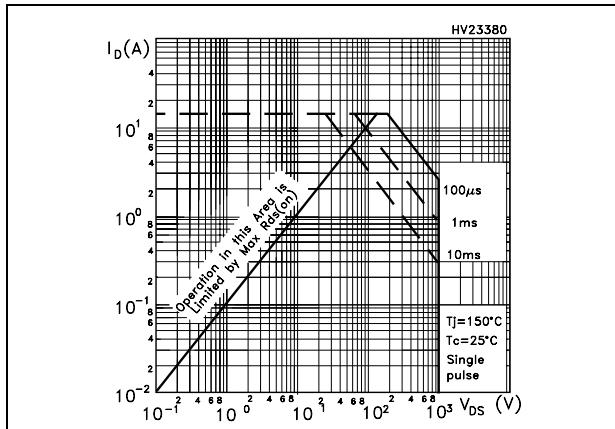


Figure 7. Thermal impedance for TO-247

