

N-channel 600 V, 0.150 Ω , 19.5 A, FDmesh™ II Power MOSFET
(with fast diode) D²PAK, I²PAK, TO-220, TO-220FP, TO-247

Features

Type	V_{DSS} (@ T_{jmax})	$R_{DS(on)}$ max.	I_D
STx23NM60ND	650 V	< 0.180 Ω	19.5 A

- The worldwide best $R_{DS(on)}$ * area amongst the fast recovery diode devices
- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance
- High dv/dt and avalanche capabilities

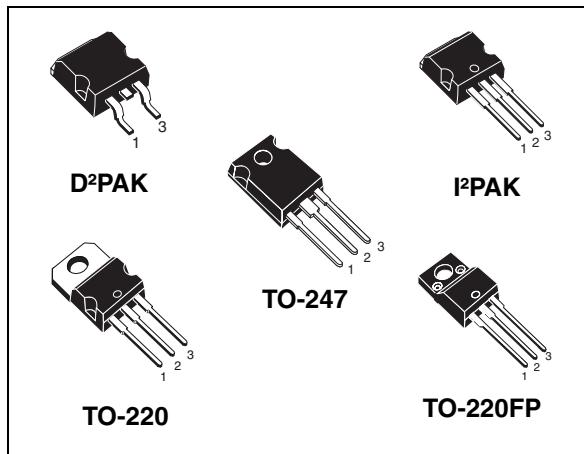


Figure 1. Internal schematic diagram

AM01475v1

Application

Switching applications

Description

The device is an N-channel FDmesh™ II Power MOSFET that belongs to the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a new vertical structure to the company's strip layout and associates all advantages of reduced on-resistance and fast switching with a n intrinsic fast-recovery body diode. It is therefore strongly recommended for bridge topologies, in particular ZVS phase-shift converters.

Table 1. Device summary

Part number	Marking	Package	Packaging
STB23NM60ND	23NM60ND	D ² PAK	Tape and reel
STI23NM60ND	23NM60ND	I ² PAK	Tube
STF23NM60ND	23NM60ND	TO-220FP	Tube
STP23NM60ND	23NM60ND	TO-220	Tube
STW23NM60ND	23NM60ND	TO-247	Tube

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D ² PAK, I ² PAK TO-220, TO-247	TO-220FP	
V _{DS}	Drain-source voltage (V _{GS} =0)	600		V
V _{GS}	Gate-source voltage	± 25		V
I _D	Drain current (continuous) at T _C = 25 °C	19.5	19.5 ⁽¹⁾	A
I _D	Drain current (continuous) at T _C = 100 °C	11.7	11.7 ⁽¹⁾	A
I _{DM} ⁽²⁾	Drain current (pulsed)	78	78 ⁽¹⁾	A
P _{TOT}	Total dissipation at T _C = 25 °C	150	35	W
dv/dt ⁽³⁾	Peak diode recovery voltage slope	40		V/ns
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T _C = 25 °C)		2500	V
T _{stg}	Storage temperature	-55 to 150		°C
T _j	Max. operating junction temperature	150		°C

1. Limited only by maximum temperature allowed
2. Pulse width limited by safe operating area
3. I_{SD} ≤ 19.5 A, di/dt ≤ 600 A/μs, V_{DD} = 80% V_{(BR)DSS}

Table 3. Thermal data

Symbol	Parameter	D ² PAK	I ² PAK	TO-220	TO-247	TO-220FP	Unit
R _{thj-case}	Thermal resistance junction-case max		0.83			3.6	°C/W
R _{thj-amb}	Thermal resistance junction-amb max		62.5	50	62.5		°C/W
T _I	Maximum lead temperature for soldering purposes		300				°C

Table 4. Avalanche characteristics

Symbol	Parameter	Max value	Unit
I _{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by T _j max)	9	A
E _{AS}	Single pulse avalanche energy (starting T _j = 25 °C, I _D = I _{AS} , V _{DD} = 50 V)	700	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	$I_D = 1 \text{ mA}, V_{GS} = 0$	600			V
$dv/dt^{(1)}$	Drain-source voltage slope	$V_{DD} = 480 \text{ V}, I_D = 19.5 \text{ A}, V_{GS} = 10 \text{ V}$		30		V/ns
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = \text{Max rating}, V_{DS} = \text{Max rating, } @ 125^\circ\text{C}$			1 100	μA μA
I_{GSS}	Gate body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20 \text{ V}$			100	nA
$V_{GS(\text{th})}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250 \mu\text{A}$	3	4	5	V
$R_{DS(\text{on})}$	Static drain-source on resistance	$V_{GS} = 10 \text{ V}, I_D = 10 \text{ A}$		0.150	0.180	Ω

- Characteristic value at turn off on inductive load

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15 \text{ V}, I_D = 10 \text{ A}$	-	17	-	S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 50 \text{ V}, f = 1 \text{ MHz}, V_{GS} = 0$	-	2050 80 8	-	pF pF pF
$C_{oss \text{ eq.}}^{(2)}$	Equivalent output capacitance	$V_{GS} = 0, V_{DS} = 0 \text{ to } 480 \text{ V}$	-	318	-	pF
R_g	Gate input resistance	f=1 MHz Gate DC Bias=0 Test signal level=20 mV open drain	-	4	-	Ω
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 480 \text{ V}, I_D = 19.5 \text{ A}$ $V_{GS} = 10 \text{ V}$	-	70 10 30	-	nC nC nC

- Pulsed: pulse duration = 300 μs , duty cycle 1.5%

- $C_{oss \text{ eq.}}$ 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. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300 \text{ V}, I_D = 10 \text{ A}, R_G = 4.7 \Omega, V_{GS} = 10 \text{ V}$	-	25		ns
t_r	Rise time			45	-	ns
$t_{d(off)}$	Turn-off delay time			90		ns
t_f	Fall time			40		ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD} $I_{SDM}^{(1)}$	Source-drain current		-		19.5	A
	Source-drain current (pulsed)				78	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 19.5 \text{ A}, V_{GS}=0$	-		1.3	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time	$I_{SD} = 19.5 \text{ A}, dI/dt = 100 \text{ A}/\mu\text{s}, V_{DD} = 100 \text{ V}$	-	190		ns
	Reverse recovery charge			1.2		μC
	Reverse recovery current			13		A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time	$V_{DD} = 100 \text{ V}$ $dI/dt = 100 \text{ A}/\mu\text{s}, I_{SD} = 19.5 \text{ A}$ $T_j = 150^\circ\text{C}$	-	260		ns
	Reverse recovery charge			2.0		μC
	Reverse recovery current			15		A

1. Pulse width limited by safe operating area
2. Pulsed: pulse duration = 300 μs , duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220, D²PAK, I²PAK

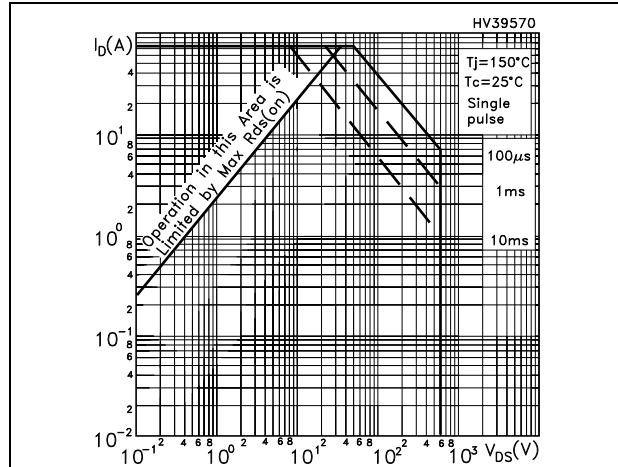


Figure 3. Thermal impedance for TO-220, D²PAK, I²PAK

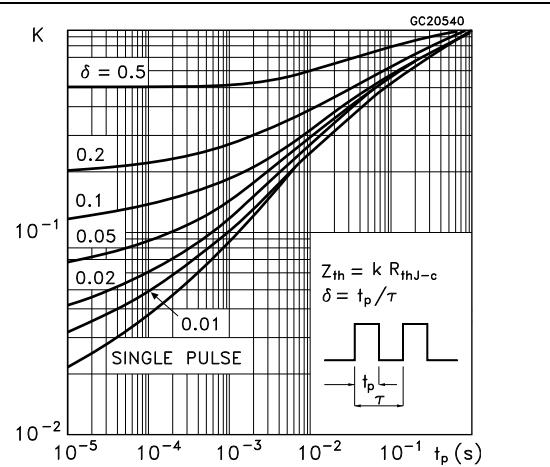


Figure 4. Safe operating area for TO-220FP

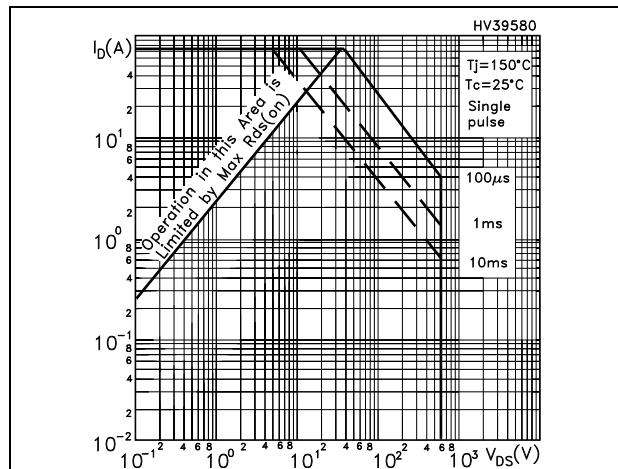


Figure 5. Thermal impedance for TO-220FP

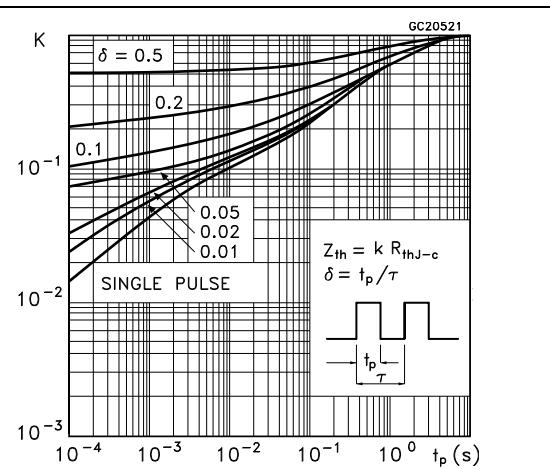


Figure 6. Safe operating area for TO-247

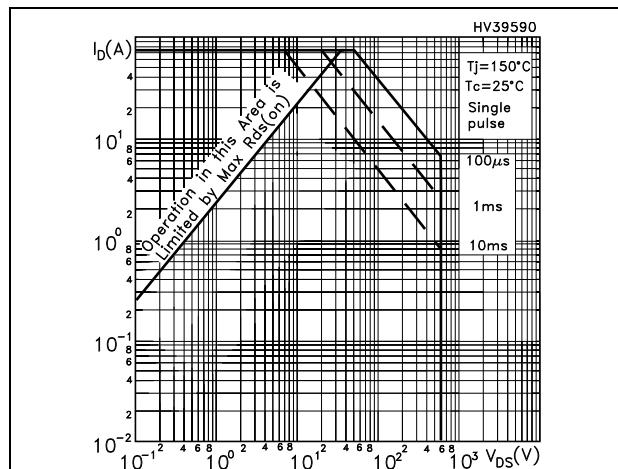


Figure 7. Thermal impedance for TO-247

