STD9NM60N - STD9NM60N-1
STP9NM60N - STF9NM60N

N-CHANNEL 600V - 0.51Ω - 9A - TO220/TO-220FP/DPAK/IPAK
SECOND GENERATION MDmesh™ MOSFET

Target Specification

General features

Type	V_{DSS} (@Tjmax)	$R_{DS(on)}$	I_D
STD9NM60N	650 V	<0.56 Ω	9 A
STD9NM60N-1	650 V	<0.56 Ω	9 A
STF9NM60N	650 V	<0.56 Ω	9 A *Note* 3
STP9NM60N	650 V	<0.56 Ω	9 A

- 100% AVALANCHE TESTED
- LOW INPUT CAPACITANCE AND GATE CHARGE
- LOW GATE INPUT RESISTANCE

Description

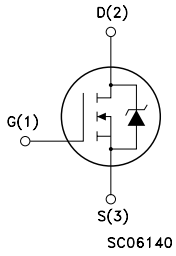
The STP9NM60N is realized with the second generation of MDmesh Technology. This revolutionary MOSFET associates a new vertical structure to the Company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

Applications

- HIGHER EFFICIENCIES

Package

Internal schematic diagram



Order codes

Sales Type	Marking	Package	Packaging
STD9NM60N-1	D9NM60N-1	DPAK	TAPE & REEL
STD9NM60N	D9NM60N	IPAK	TUBE
STF9NM60N	P9NM60N	TO-220	TUBE
STF9NM60N	F9NM60N	TO-220FP	TUBE

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220/DPAK/IPAK	TO-220FP	
V_{DS}	Drain-source Voltage (V_{GS}=0)	600		V
V_{DGR}	Drain-gate Voltage (R_{GS}=20kΩ)	600		V
V_{GS}	Gate-Source Voltage	± 25		V
I_D	Drain Current (continuous) at T_C = 25°C	9	9 (*Note* 3)	A
I_D	Drain Current (continuous) at T_C = 100°C	6	6 (*Note* 3)	A
I_{DM} *Note* 2	Drain Current (pulsed)	35	35 (*Note* 3)	A
P_{TOT}	Total Dissipation at T_C = 25°C	100	25	W
	Derating Factor	0.8	0.2	W/°C
dv/dt *Note* 1	Peak Diode Recovery voltage slope	TBD		V/ns
V_{ISO}	Insulation Withstand Volatge (DC)	--	2500	V
T_j T_{stg}	Operating Junction Temperature Storage Temperature	-55 to 150		°C

Table 2. Thermal data

		TO-220	DPAK/IPAK	TO-220FP	Unit
Rthj-case	Thermal Resistance Junction-case Max	1.25		5	°C/W
Rthj-amb	Thermal Resistance Junction-amb Max	62.5	100	62.5	°C/W
T_l	Maximum Lead Temperature For Soldering Purpose	300			°C

Table 3. Avalanche characteristics

Symbol	Parameter	Max Value	Unit
I_{AS}	Avalanche Current, repetitive or Not-Repetitive (pulse width limited by Tj max)	TBD	A
E_{AS}	Single Pulse Avalanche Energy (starting Tj=25°C, I_D=I_{AS}, V_{DD}= 50V)	TBD	mJ

2 Electrical characteristics

(T_{CASE} = 25 °C unless otherwise specified)

Table 4. On/off states

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	I_D = 1mA, V_{GS}= 0	600			V
dv/dt *Note* 4	Drain-Source Voltage Slope	Vdd=TBD,Id=TBD,Vgs=TBD		TBD		V/ns
I_{DSS}	Zero Gate Voltage Drain Current (V_{GS} = 0)	V_{DS} = Max Rating, V_{DS} = Max Rating,Tc = 125°C			1 10	µA µA
I_{GSS}	Gate Body Leakage Current (V_{DS} = 0)	V_{GS} = ±25V			±100	µA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}= V_{GS}, I_D = 250 µA	2	3	4	V
$R_{DS(on)}$	Static Drain-Source On Resistance	V_{GS}= 10 V, I_D= 4.5 A		0.51	0.56	Ω

Table 5. Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} *Note* 5	Forward Transconductance	V_{DS} =15V, I_D= 4.5 A I_D = 10A		5		S
C_{iss} C_{oss} C_{rss}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V_{DS} =25V, f=1 MHz, V_{GS}=0		880 205 26		pF pF pF
$C_{oss\ eq.}$ *Note* 6	Equivalent Ouput Capacitance	V_{GS}=0, V_{DS} =0V to 480V		TBD		pF
Rg	Gate Input Resistance	f=1MHz Gate DC Bias=0 Test Signal Level=20mV Open Drain		1.6		Ω
Q_g Q_{gs} Q_{gd}	Total Gate Charge Gate-Source Charge Gate-Drain Charge	V_{DD}=480V, I_D = 4.5A V_{GS} =10V (see Figure 2)		32 TBD TBD		nC nC nC

Table 6. Switching times

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r	Turn-on Delay Time Rise Time	V_{DD}=300 V, I_D=4.5A, R_G=4.7Ω, V_{GS}=10V (see Figure 3)		TBD TBD		ns ns
$t_{d(off)}$ t_f	Off voltage Rise Time FallTime	V_{DD}=300 V, I_D=4.5A, R_G=4.7Ω, V_{GS}=10V (see Figure 3)		TBD TBD		
$t_{r(Voff)}$ t_f t_c	Off-voltage Rise Time Fall Time Cross-over Time	V_{DD}=480 V, I_D=4.5A, R_G=4.7Ω, V_{GS}=10V (see Figure 3)		TBD TBD TBD		ns ns ns

Table 7. Source drain diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD} I_{SDM}	Source-drain Current Source-drain Current (pulsed)				9 35	A A
V_{SD}*Note* 5	Forward on Voltage	I_{SD}=9A, V_{GS}=0			1.3	V
t_{rr} Q_{rr} I_{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	I_{SD}=9A, di/dt = 100A/µs, V_{DD}=100 V, Tj=25°C		TBD TBD TBD		ns µC A
t_{rr} Q_{rr} I_{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	I_{SD}=9A, di/dt = 100A/µs, V_{DD}=100 V, Tj=150°C		TBD TBD TBD		ns µC A

(1) I_{SD} ≤9A, di/dt ≤400A/µs, V_{DD} =80% $V_{(BR)DSS}$

(2) Pulse width limited by safe operating area

(3) Limited only by maximum temperature allowed

(4) Characteristics value at turn off on inductive load

(5) Pulsed: pulse duration = 300µs, duty cycle 1.5%

(6) $C_{oss\ eq.}$ 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}

3 Test circuits

Figure 1. Switching Times Test Circuit For Resistive Load

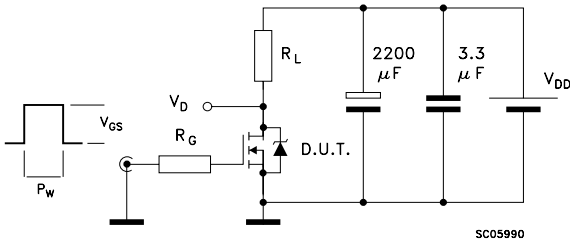


Figure 2. Gate Charge Test Circuit

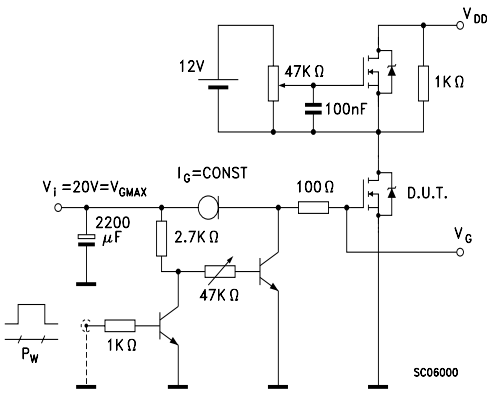


Figure 3. Test Circuit For Indictive Load Switching and Diode Recovery Times

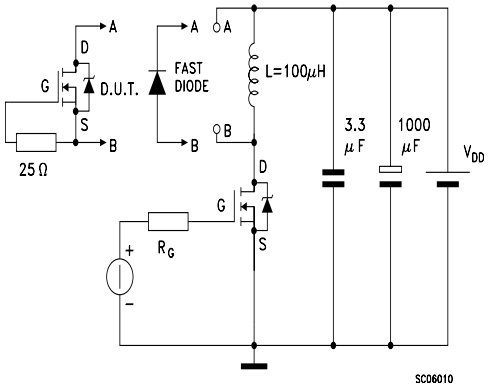


Figure 5. Unclamped Inductive Load Test Circuit

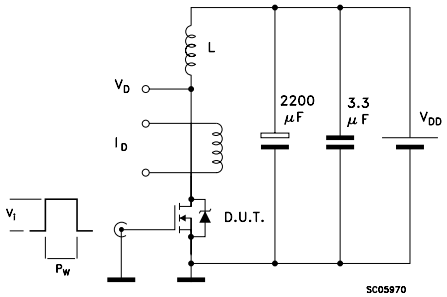
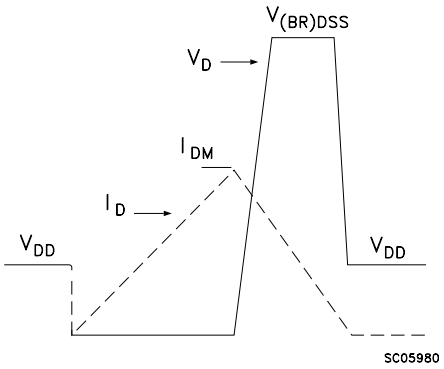


Figure 4. Unclamped Inductive Waveform

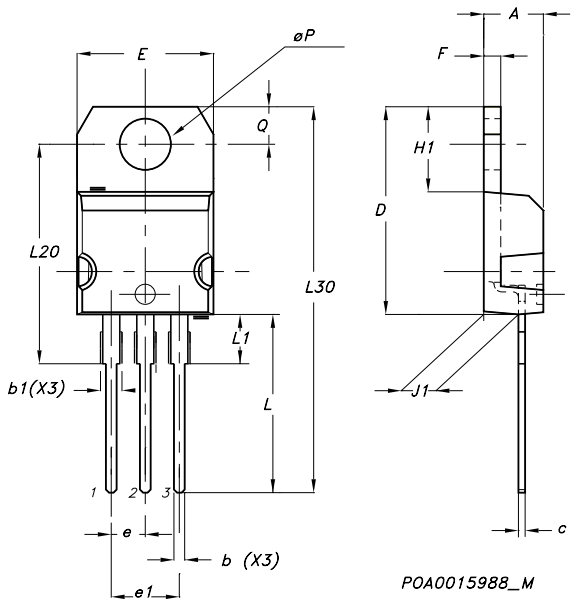


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com

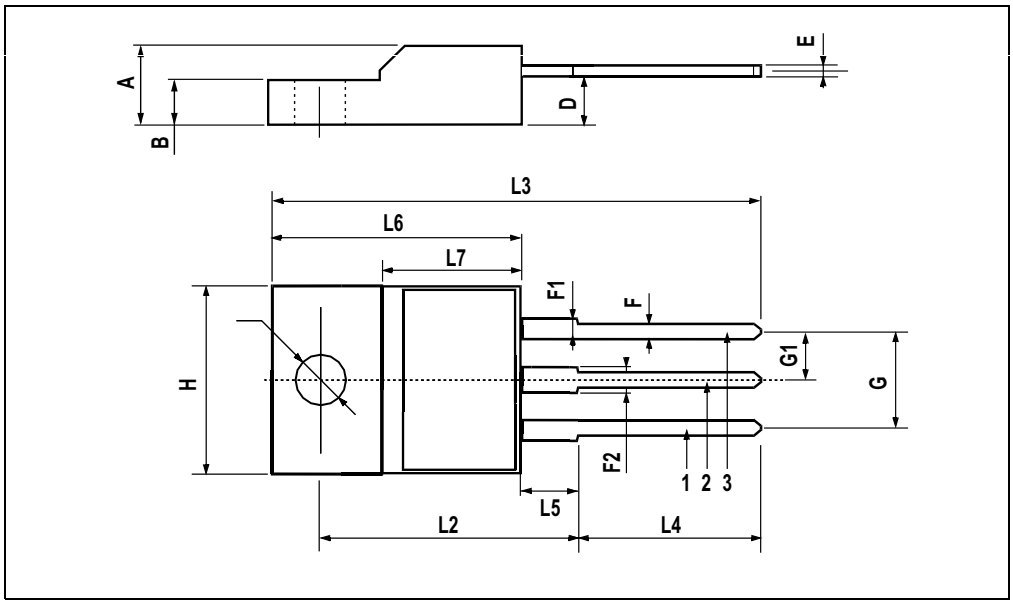
TO-220 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.052
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
øP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



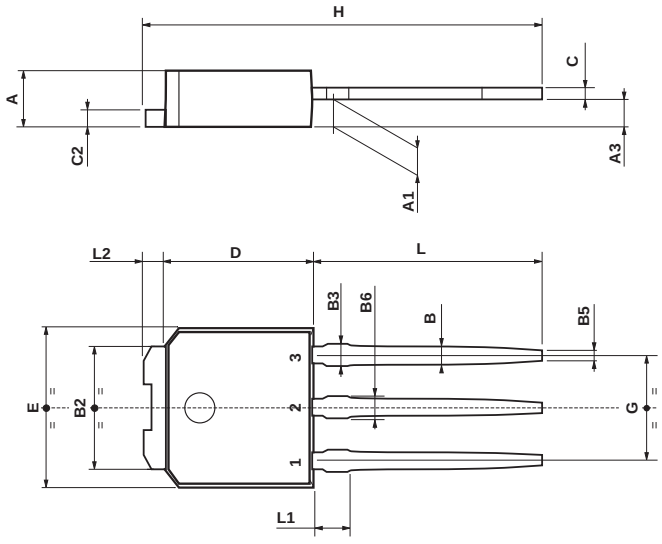
TO-220FP MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.7	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
H	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	.0385		0.417
L5	2.9		3.6	0.114		0.141
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
Ø	3		3.2	0.118		0.126



TO-251 (IPAK) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A3	0.7		1.3	0.027		0.051
B	0.64		0.9	0.025		0.031
B2	5.2		5.4	0.204		0.212
B3			0.85			0.033
B5		0.3			0.012	
B6			0.95			0.037
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
E	6.4		6.6	0.252		0.260
G	4.4		4.6	0.173		0.181
H	15.9		16.3	0.626		0.641
L	9		9.4	0.354		0.370
L1	0.8		1.2	0.031		0.047
L2		0.8	1		0.031	0.039



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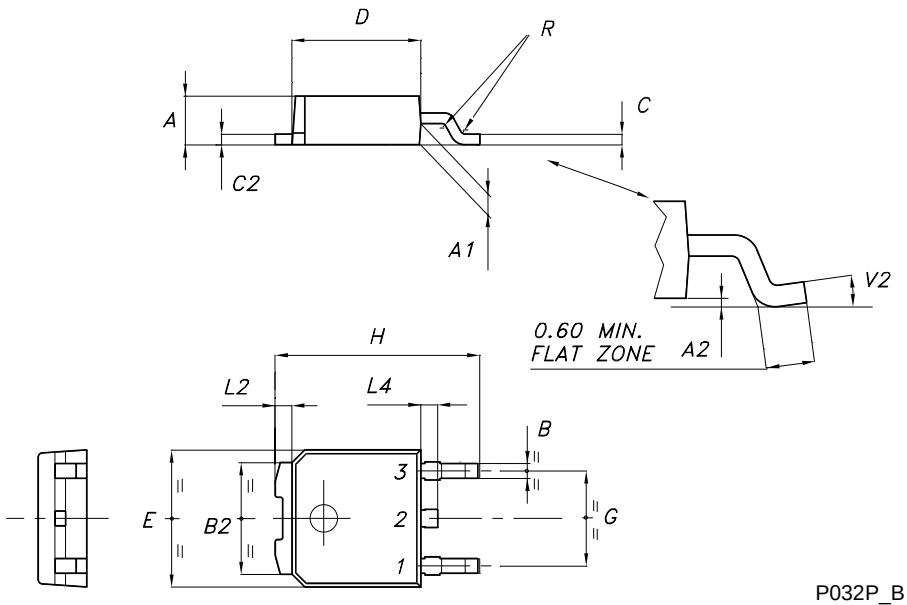
TO-252 (DPAK) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.20		2.40	0.087		0.094
A1	0.90		1.10	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.90	0.025		0.035
B2	5.20		5.40	0.204		0.213
C	0.45		0.60	0.018		0.024
C2	0.48		0.60	0.019		0.024
D	6.00		6.20	0.236		0.244
E	6.40		6.60	0.252		0.260
G	4.40		4.60	0.173		0.181
H	9.35		10.10	0.368		0.398
L2		0.8			0.031	
L4	0.60		1.00	0.024		0.039
V2	0^o		8^o	0^o		0^o



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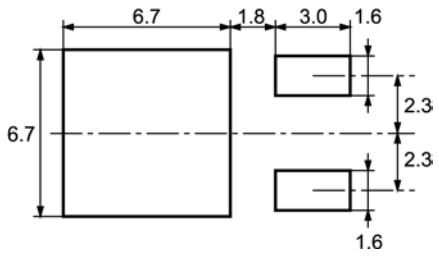
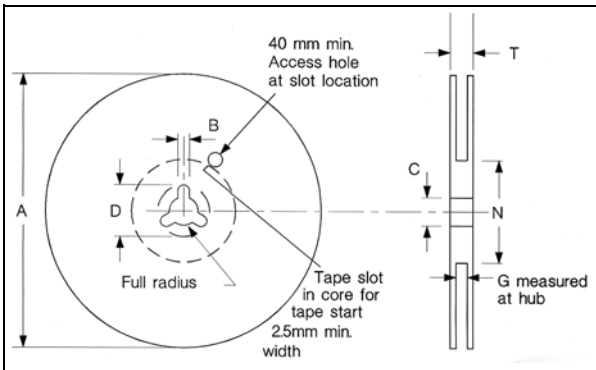
5 Packing mechanical data

DPAK FOOTPRINT



All dimensions are in millimeters

TAPE AND REEL SHIPMENT



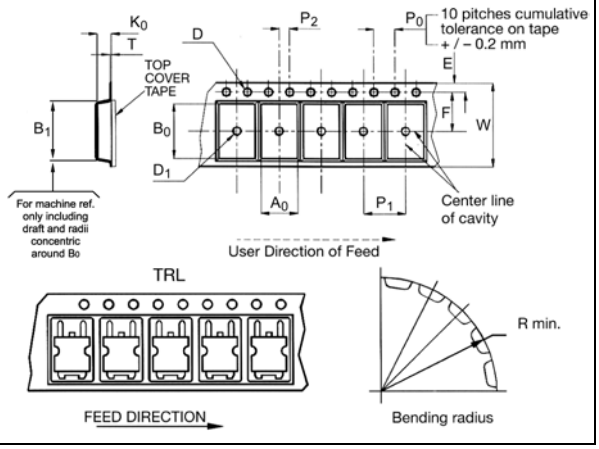
REEL MECHANICAL DATA

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	16.4	18.4	0.645	0.724
N	50		1.968	
T		22.4		0.881

BASE QTY	BULK QTY
2500	2500

TAPE MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	6.8	7	0.267	0.275
B0	10.4	10.6	0.409	0.417
B1		12.1		0.476
D	1.5	1.6	0.059	0.063
D1	1.5		0.059	
E	1.65	1.85	0.065	0.073
F	7.4	7.6	0.291	0.299
K0	2.55	2.75	0.100	0.108
P0	3.9	4.1	0.153	0.161
P1	7.9	8.1	0.311	0.319
P2	1.9	2.1	0.075	0.082
R	40		1.574	
W	15.7	16.3	0.618	0.641



6 Revision History

Date	Revision	Changes
05-Oct-2005	1	First release