



# STB22NM60N, STF22NM60N STP22NM60N, STW22NM60N

N-channel 600 V, 0.190  $\Omega$ , 16 A MDmesh™ II Power MOSFET  
in D<sup>2</sup>PAK, TO-220FP, TO-220 and TO-247

Preliminary data

## Features

Type	V <sub>DSS</sub> (@T <sub>jmax</sub> )	R <sub>DS(on)</sub> max	I <sub>D</sub>	P <sub>w</sub>
STB22NM60N	650 V	< 0.22 $\Omega$	16 A	125 W
STF22NM60N	650 V	< 0.22 $\Omega$	16 A	30 W
STP22NM60N	650 V	< 0.22 $\Omega$	16 A	125 W
STW22NM60N	650 V	< 0.22 $\Omega$	16 A	125 W

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

## Application

- Switching applications

## Description

This second generation of MDmesh™ technology, applies the benefits of the multiple drain process to STMicroelectronics' well-known PowerMESH™ horizontal layout structure. The resulting product offers improved on-resistance, low gate charge, high dv/dt capability and excellent avalanche characteristics.

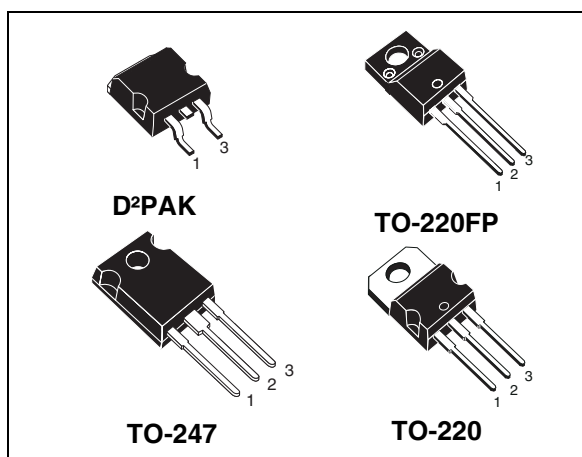


Figure 1. Internal schematic diagram

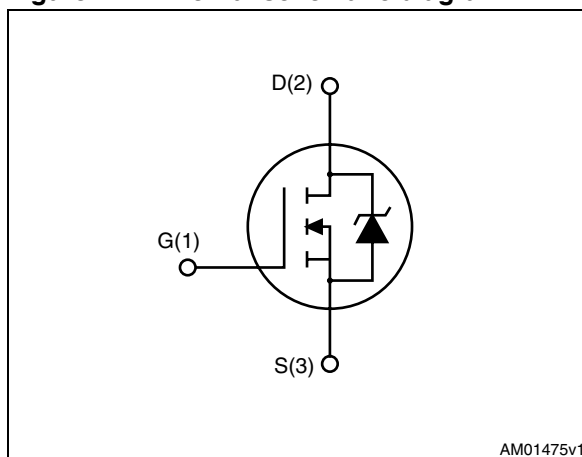


Table 1. Device summary

Order codes	Marking	Package	Packaging
STB22NM60N	22NM60N	D <sup>2</sup> PAK	Tape and reel
STF22NM60N	22NM60N	TO-220FP	Tube
STP22NM60N	22NM60N	TO-220	Tube
STW22NM60N	22NM60N	TO-247	Tube

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value			Unit
		D <sup>2</sup> PAK	TO-220 TO-247	TO-220FP	
V <sub>GS</sub>	Gate- source voltage	± 30			V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	16	16 <sup>(1)</sup>		A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	12.8	12.8 <sup>(1)</sup>		A
I <sub>DM</sub> <sup>(2)</sup>	Drain current (pulsed)	64	64 <sup>(1)</sup>		A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	125	30		W
I <sub>AR</sub>	Avalanche current, repetitive or not-repetitive (pulse width limited by T <sub>J</sub> max)	TBD			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)	TBD			mJ
dv/dt <sup>(3)</sup>	Peak diode recovery voltage slope	15			V/ns
V <sub>ISO</sub>	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s; T <sub>C</sub> =25 °C)			2500	V
T <sub>J</sub> T <sub>stg</sub>	Operating junction temperature Storage temperature	-55 to 150			°C

- Limited only by maximum temperature allowed
- Pulse width limited by safe operating area
- I<sub>SD</sub> ≤ 16 A, di/dt ≤ 100 A/μs, peak V<sub>DS</sub> ≤ V<sub>(BR)DSS</sub>

**Table 3. Thermal data**

Symbol	Parameter	Value				Unit
		D <sup>2</sup> PAK	TO-220	TO-247	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				°C/W
R <sub>thj-pcb</sub>	Thermal resistance junction-pcb max	30				°C/W
T <sub>J</sub>	Maximum lead temperature for soldering purpose	300				°C/W

## 2 Electrical characteristics

(T<sub>case</sub> = 25°C unless otherwise specified)

**Table 4. On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source breakdown voltage	I <sub>D</sub> = 1 mA, V <sub>GS</sub> = 0	600			V
I <sub>DSS</sub>	Zero gate voltage drain current (V <sub>GS</sub> = 0)	V <sub>DS</sub> = Max rating V <sub>DS</sub> = Max rating, T <sub>C</sub> = 125 °C			1 10	μA μA
I <sub>GSS</sub>	Gate-body leakage current (V <sub>DS</sub> = 0)	V <sub>GS</sub> = ± 25 V			0.1	nA
V <sub>GS(th)</sub>	Gate threshold voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 100 μA	2	3	4	V
R <sub>DS(on)</sub>	Static drain-source on resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 6 A		0.190	0.220	Ω

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C <sub>iss</sub>	Input capacitance	V <sub>DS</sub> = 50 V, f = 1 MHz, V <sub>GS</sub> = 0	-	1300	-	pF
C <sub>oss</sub>	Output capacitance			90		
C <sub>rss</sub>	Reverse transfer capacitance			3		
C <sub>o(tr)</sub> <sup>(1)</sup>	Equivalent capacitance time related	V <sub>DS</sub> = 0 to 480 V, V <sub>GS</sub> = 0	-	TBD	-	pF
C <sub>o(er)</sub> <sup>(2)</sup>	Equivalent capacitance energy related	V <sub>DS</sub> = 0 to 480 V, V <sub>GS</sub> = 0	-	TBD	-	pF
R <sub>g</sub>	Gate input resistance	f = 1 MHz open drain	-	4	-	Ω
Q <sub>g</sub>	Total gate charge	V <sub>DD</sub> = 480 V, I <sub>D</sub> = 12 A, V <sub>GS</sub> = 10 V (see Figure 3)	-	35	-	nC
Q <sub>gs</sub>	Gate-source charge			TBD		
Q <sub>gd</sub>	Gate-drain charge			TBD		

1. C<sub>oss eq</sub> time related is defined as a constant equivalent capacitance giving the same charging time as C<sub>oss</sub> when V<sub>DS</sub> increases from 0 to 80% V<sub>DSS</sub>
2. C<sub>oss eq</sub> energy related is defined as a constant equivalent capacitance giving the same stored energy as C<sub>oss</sub> when V<sub>DS</sub> increases from 0 to 80% V<sub>DSS</sub>

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$ , $I_D = 12\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 2)	-	TBD	-	ns
$t_r$	Rise time			TBD		ns
$t_{d(off)}$	Turn-off-delay time			TBD		ns
$t_f$	Fall time			TBD		ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$I_{SD}$	Source-drain current		-		16	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				64	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 12\text{ A}$ , $V_{GS} = 0$	-		TBD	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 12\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 4)	-	TBD		ns
$Q_{rr}$	Reverse recovery charge			TBD		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			TBD		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 12\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ $T_J = 150\text{ }^\circ\text{C}$ (see Figure 4)	-	TBD		ns
$Q_{rr}$	Reverse recovery charge			TBD		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			TBD		A

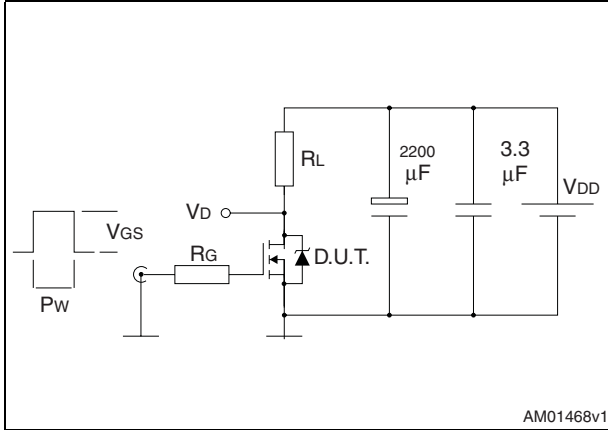
1. Pulse width limited by safe operating area

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

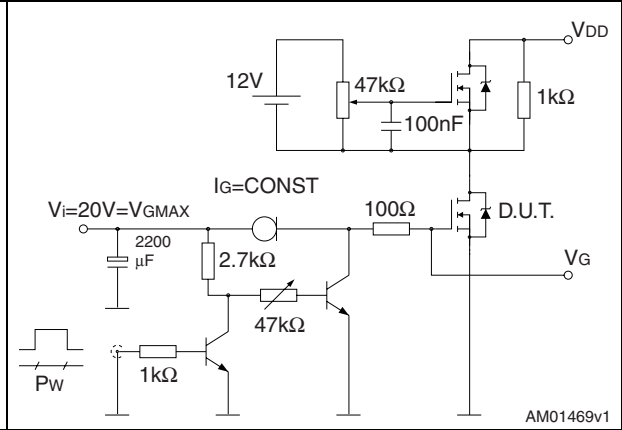
Test circuits

### 3 Test circuits

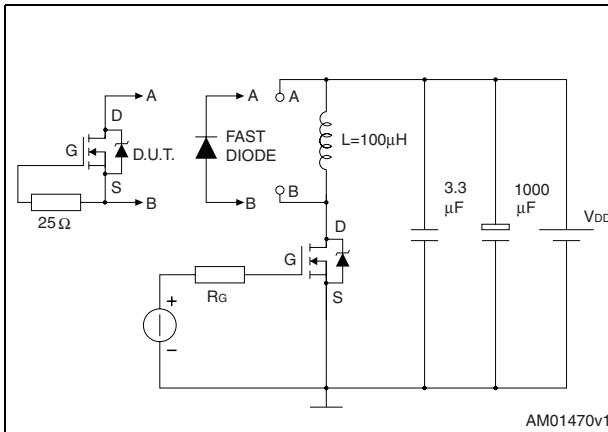
**Figure 2. Switching times test circuit for resistive load**



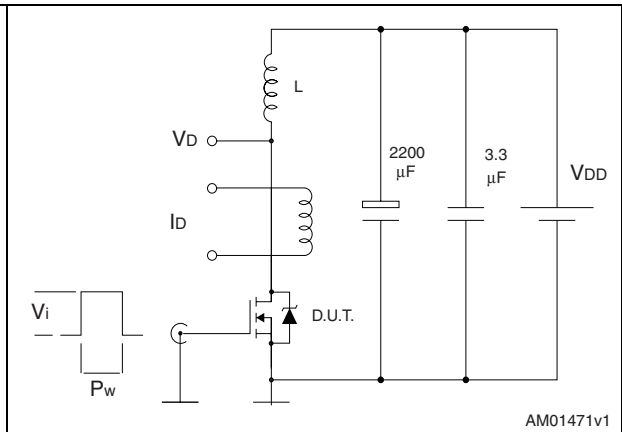
**Figure 3. Gate charge test circuit**



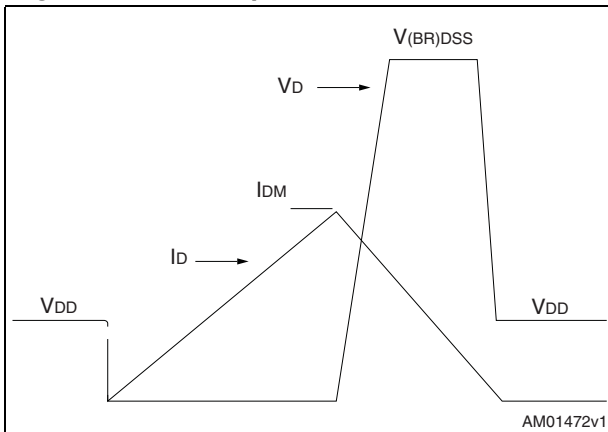
**Figure 4. Test circuit for inductive load switching and diode recovery times**



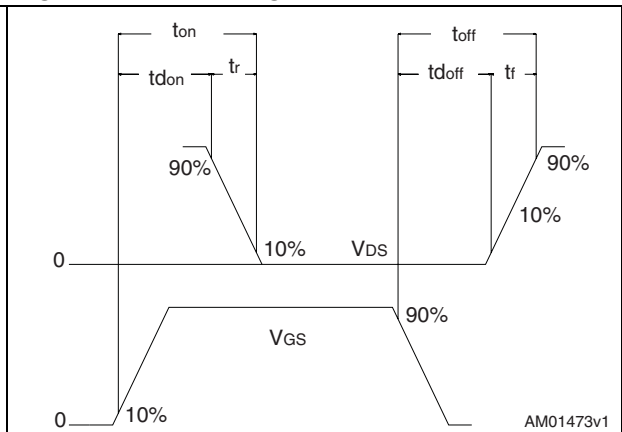
**Figure 5. Unclamped inductive load test circuit**



**Figure 6. Unclamped inductive waveform**



**Figure 7. Switching time waveform**

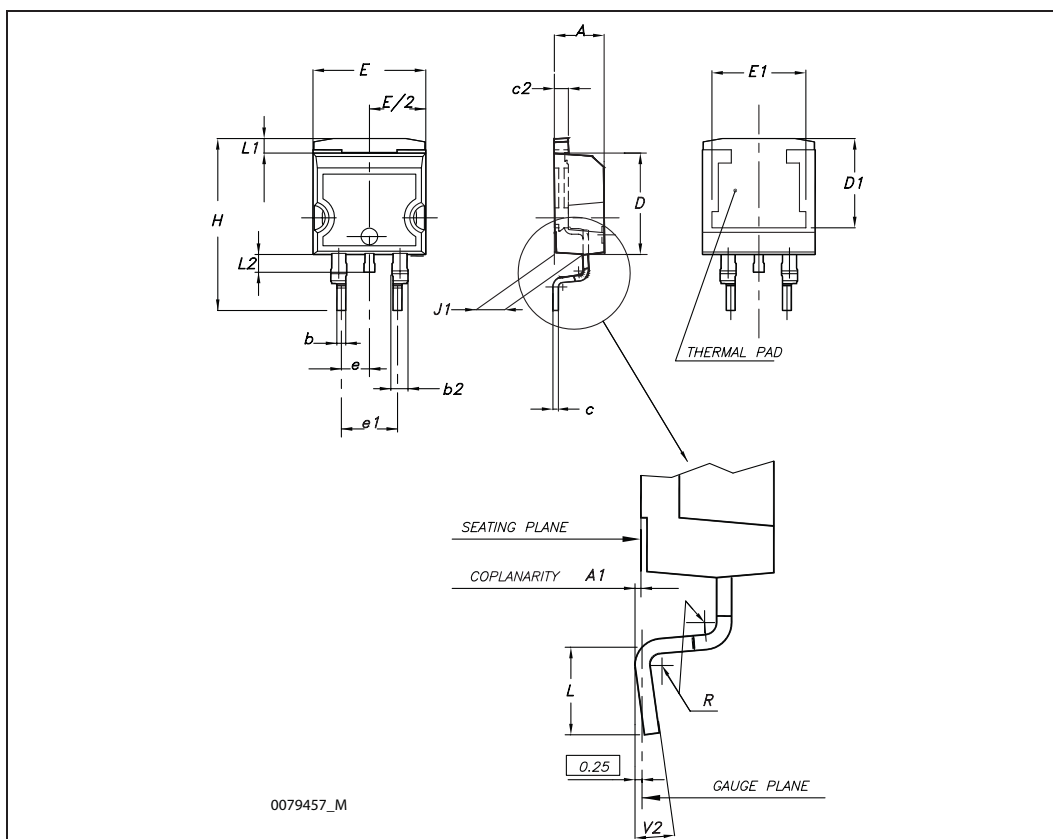


## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

D<sup>2</sup>PAK (TO-263) mechanical data

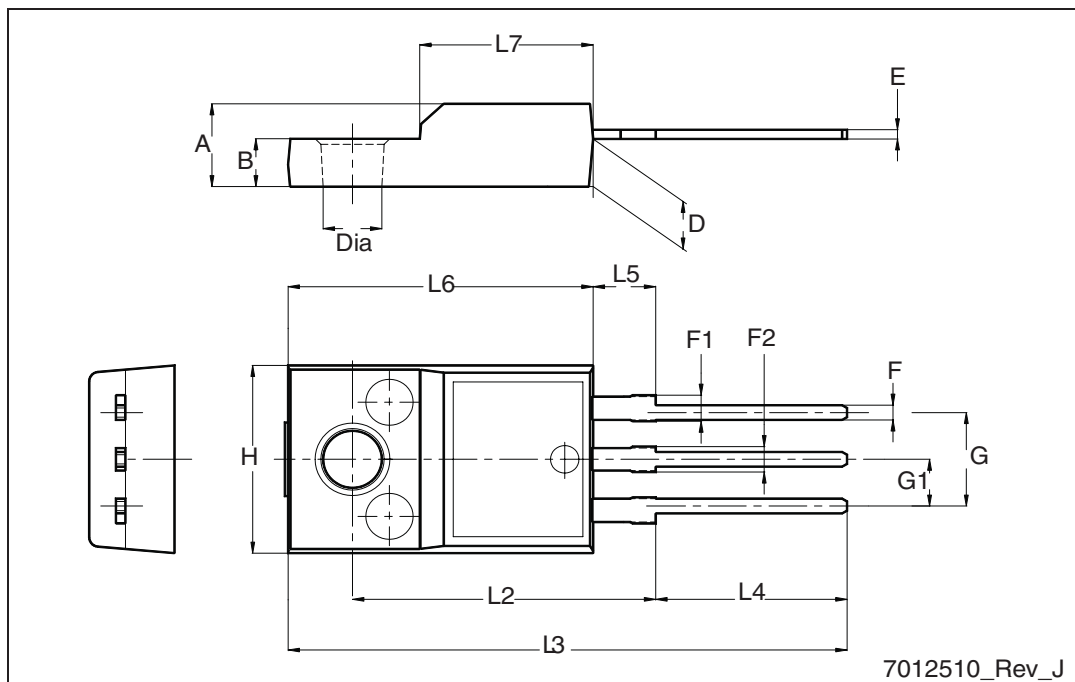
Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
A1	0.03		0.23	0.001		0.009
b	0.70		0.93	0.027		0.037
b2	1.14		1.70	0.045		0.067
c	0.45		0.60	0.017		0.024
c2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1	7.50			0.295		
E	10		10.40	0.394		0.409
E1	8.50			0.334		
e		2.54			0.1	
e1	4.88		5.28	0.192		0.208
H	15		15.85	0.590		0.624
J1	2.49		2.69	0.099		0.106
L	2.29		2.79	0.090		0.110
L1	1.27		1.40	0.05		0.055
L2	1.30		1.75	0.051		0.069
R		0.4			0.016	
V2	0°		8°	0°		8°





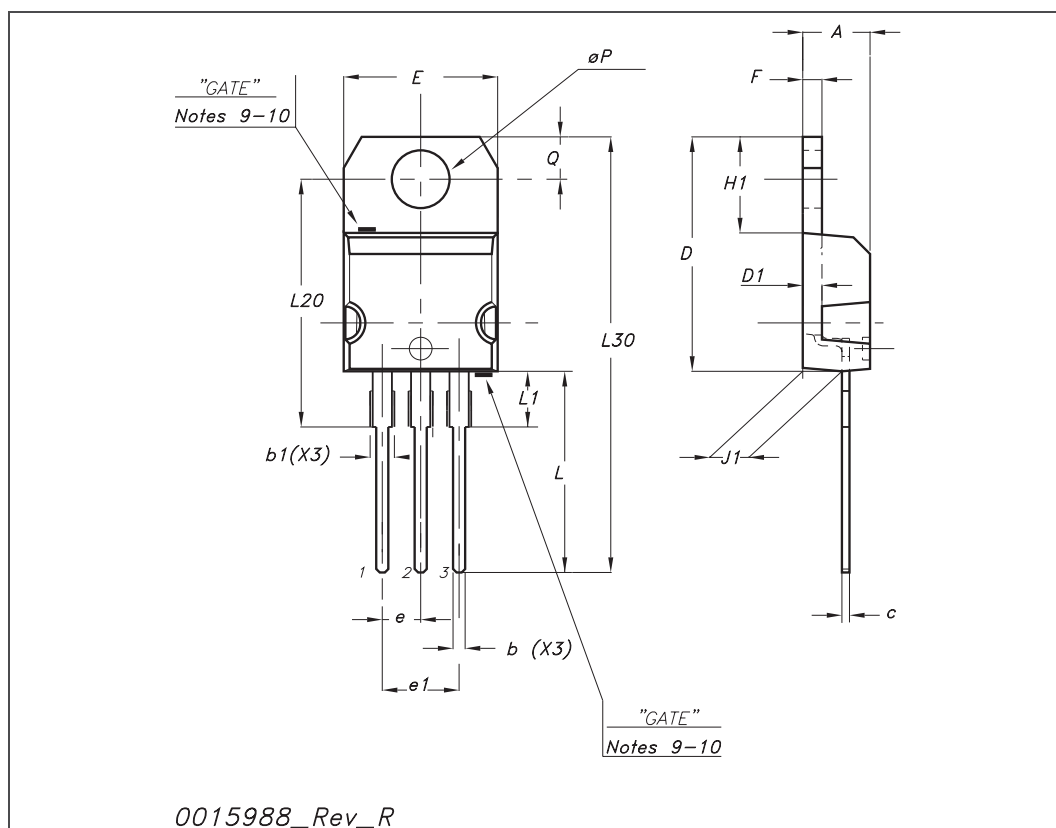
## TO-220FP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.5
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2



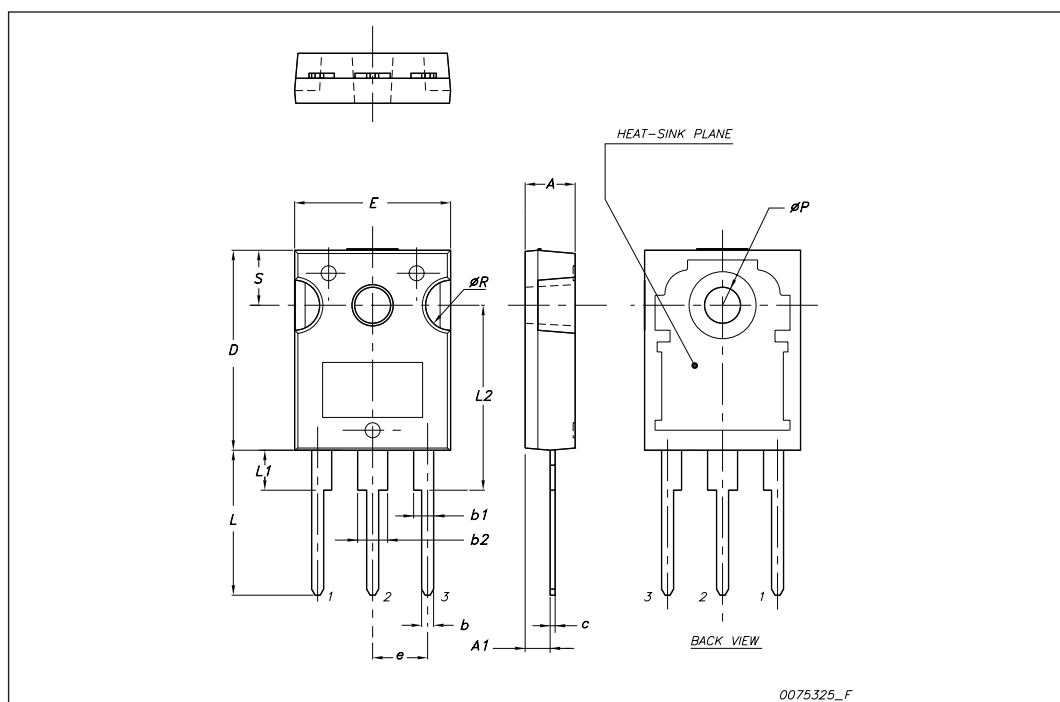
## TO-220 mechanical data

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	1.14		1.70	0.044		0.066
c	0.48		0.70	0.019		0.027
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
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		0.051
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	
∅P	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



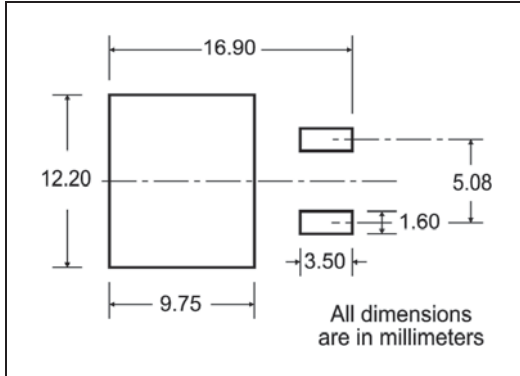
## TO-247 mechanical data

Dim.	mm.		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
øP	3.55		3.65
øR	4.50		5.50
S		5.50	



# 5 Packaging mechanical data

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



## TAPE AND REEL SHIPMENT

**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

**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

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

FEED DIRECTION

Bending radius R min.

## 6 Revision history

**Table 8. Document revision history**

Date	Revision	Changes
02-Jul-2009	1	First release

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