



STD10NM60N, STF10NM60N STP10NM60N, STU10NM60N

N-channel 600 V, 0.53 Ω , 8 A, DPAK, TO-220, TO-220FP, IPAK
MDmesh™ II Power MOSFET

Features

Type	V _{DSS}	R _{DS(on)} max	I _D	P _w
STD10NM60N	600 V	< 0.55 Ω	8 A	70 W
STF10NM60N	600 V	< 0.55 Ω	8 A	25 W
STP10NM60N	600 V	< 0.55 Ω	8 A	70 W
STU10NM60N	600 V	< 0.55 Ω	8 A	70 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.

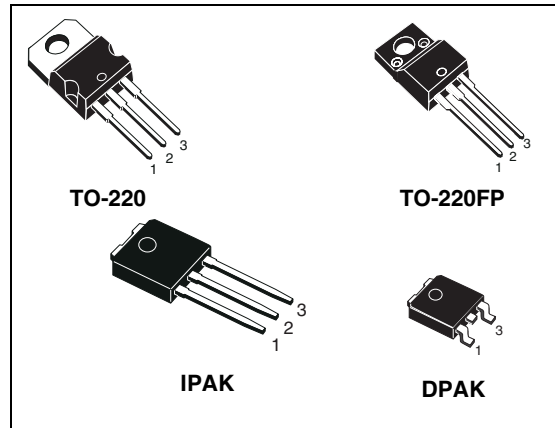
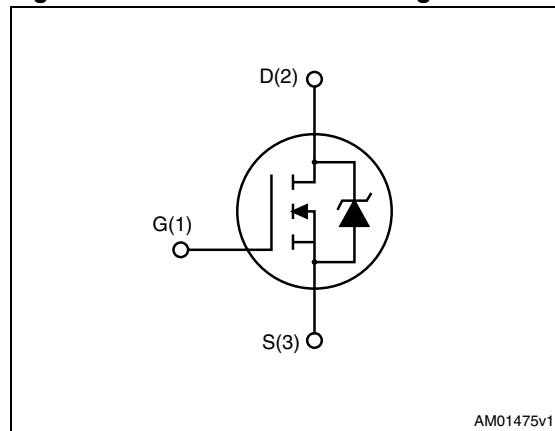


Figure 1. Internal schematic diagram



AM01475v1

Table 1. Device summary

Order code	Marking	Package	Packaging
STD10NM60N	10NM60N	DPAK	Tape and reel
STF10NM60N	10NM60N	TO-220FP	Tube
STP10NM60N	10NM60N	TO-220	Tube
STU10NM60N	10NM60N	IPAK	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value				Unit
		TO-220	TO-220FP	IPAK	DPAK	
V_{GS}	Gate- source voltage	± 25				V
I_D	Drain current (continuous) at $T_C = 25\text{ °C}$	8	8 ⁽¹⁾	8		A
I_D	Drain current (continuous) at $T_C = 100\text{ °C}$	5	5 ⁽¹⁾	5		A
$I_{DM}^{(2)}$	Drain current (pulsed)	32	32 ⁽¹⁾	32		A
P_{TOT}	Total dissipation at $T_C = 25\text{ °C}$	70	25	70		W
$dv/dt^{(3)}$	Peak diode recovery voltage slope	15				V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink ($t=1\text{ s}; T_C=25\text{ °C}$)		2500			V
T_J T_{stg}	Operating junction temperature Storage temperature	-55 to 150				°C

- Limited only by maximum temperature allowed
- Pulse width limited by safe operating area
- $I_{SD} \leq 8\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, peak $V_{DS} \leq V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value				Unit
		TO-220	TO-220FP	IPAK	DPAK	
$R_{thj-case}$	Thermal resistance junction-case max	1.79	5	1.79		°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient max	62.50		100		°C/W
$R_{thj-pcb}$	Thermal resistance junction-pcb max				50	°C/W
T_J	Maximum lead temperature for soldering purpose	300				°C/W

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_J Max)	4	A
E_{AS}	Single pulse avalanche energy (starting $T_J=25\text{ °C}$, $I_D=I_{AS}$, $V_{DD}=50\text{ V}$)	200	mJ

2 Electrical characteristics

(T_{case} = 25 °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 mA, V _{GS} = 0	600			V
I _{DSS}	Zero gate voltage drain current (V _{GS} = 0)	V _{DS} = max rating V _{DS} = max rating, T _C = 125 °C			1 10	μA μA
I _{GSS}	Gate-body leakage current (V _{DS} = 0)	V _{GS} = ± 20 V; V _{DS} = 0			100	nA
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 A		0.53	0.55	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C _{iss}	Input capacitance	V _{DS} = 50 V, f = 1 MHz, V _{GS} = 0	-	540	-	pF
C _{oss}	Output capacitance			44		pF
C _{rss}	Reverse transfer capacitance			1.2		pF
C _{o(tr)} ⁽¹⁾	Equivalent capacitance time related	V _{DS} = 0 to 480 V, V _{GS} = 0	-	110	-	pF
R _g	Gate input resistance	f = 1 MHz open drain	-	6	-	Ω
Q _g	Total gate charge	V _{DD} = 480 V, I _D = 8 A, V _{GS} = 10 V (see Figure 18)	-	19	-	nC
Q _{gs}	Gate-source charge			3		nC
Q _{gd}	Gate-drain charge			10		nC

1. C_{oss eq.} time related 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	$V_{DD} = 300\text{ V}$, $I_D = 4\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 17)	-	10	-	ns
t_r	Rise time			12		ns
$t_{d(off)}$	Turn-off-delay time			32		ns
t_f	Fall time			15		ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
I_{SD}	Source-drain current		-		8	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				32	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 8\text{ A}$, $V_{GS} = 0$	-		1.3	V
t_{rr}	Reverse recovery time	$I_{SD} = 8\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 19)	-	250		ns
Q_{rr}	Reverse recovery charge			2.12		μC
I_{RRM}	Reverse recovery current			17		A
t_{rr}	Reverse recovery time	$I_{SD} = 8\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ $T_J = 150\text{ }^\circ\text{C}$ (see Figure 19)	-	315		ns
Q_{rr}	Reverse recovery charge			2.6		μC
I_{RRM}	Reverse recovery current			16.5		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

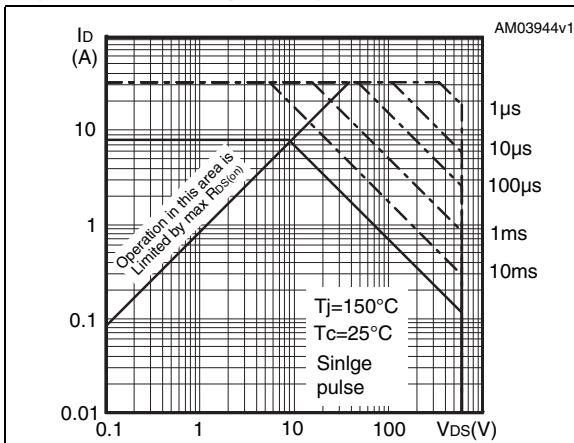


Figure 3. Thermal impedance for TO-220

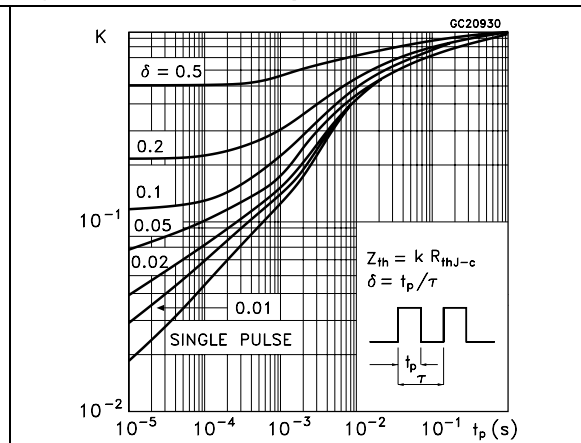


Figure 4. Safe operating area for TO-220FP

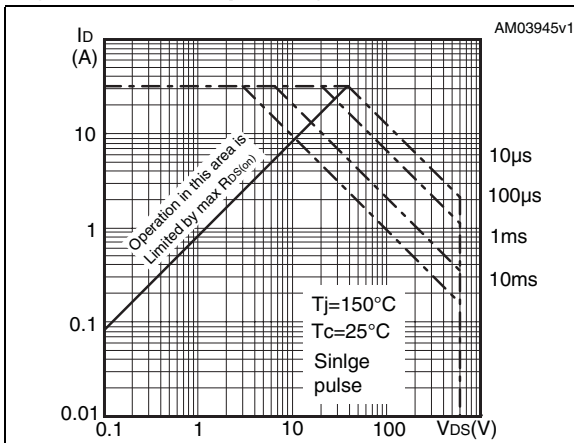


Figure 5. Thermal impedance for TO-220FP

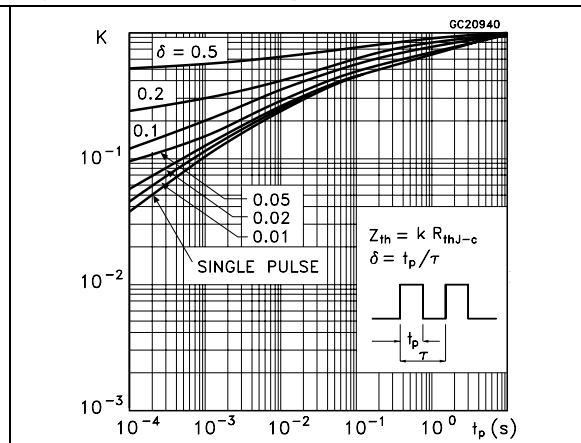


Figure 6. Safe operating area for DPAK, IPAK

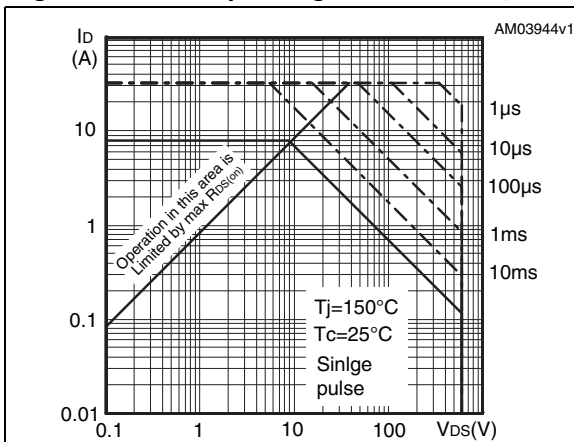


Figure 7. Thermal impedance for DPAK, IPAK

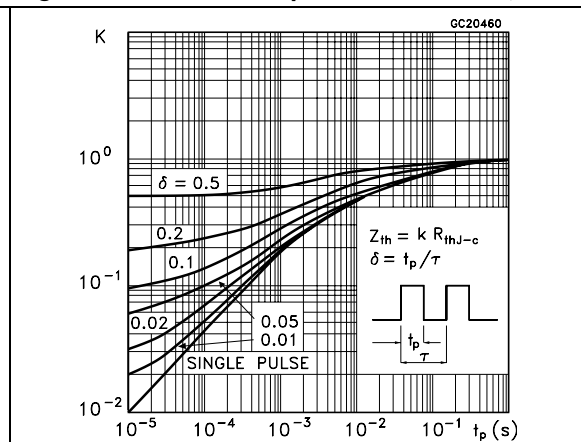


Figure 8. Output characteristics

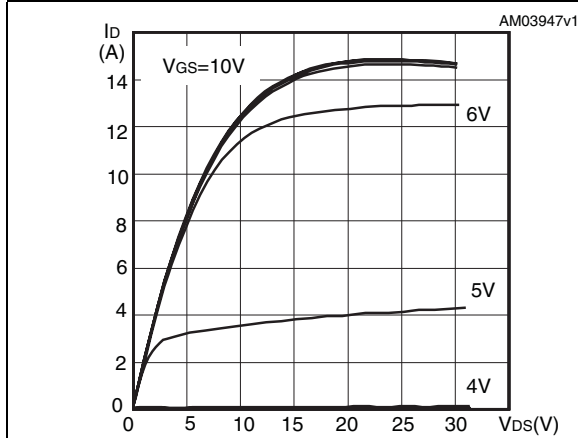


Figure 9. Transfer characteristics

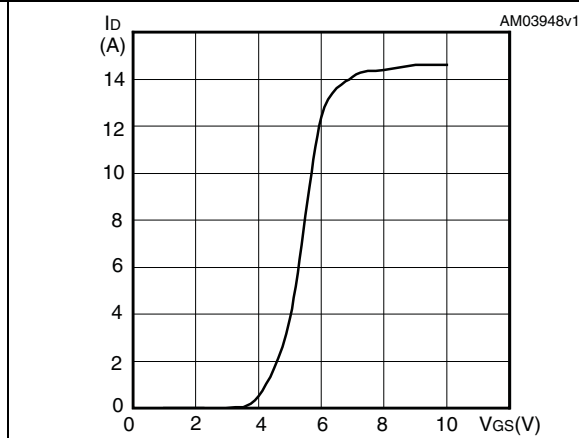


Figure 10. Normalized BV_{DSS} vs temperature

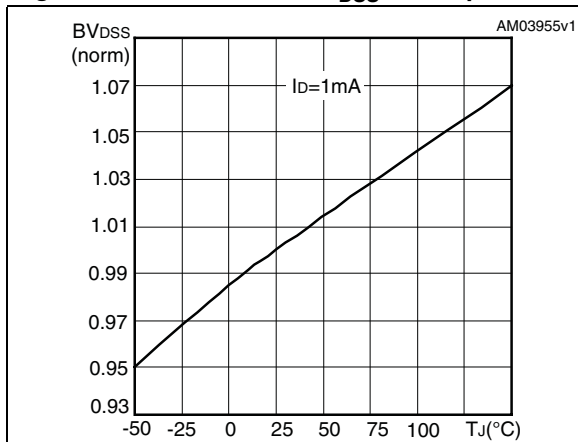


Figure 11. Static drain-source on resistance

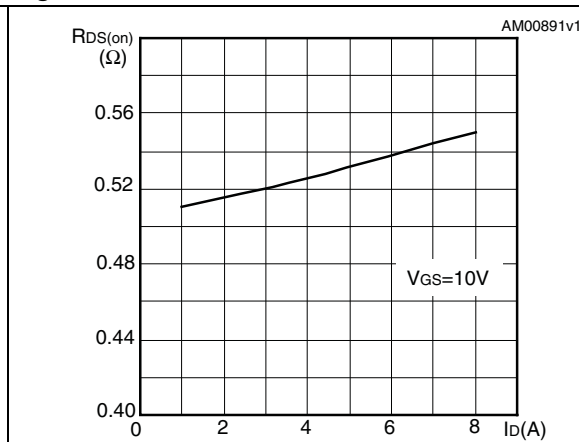


Figure 12. Gate charge vs gate-source voltage

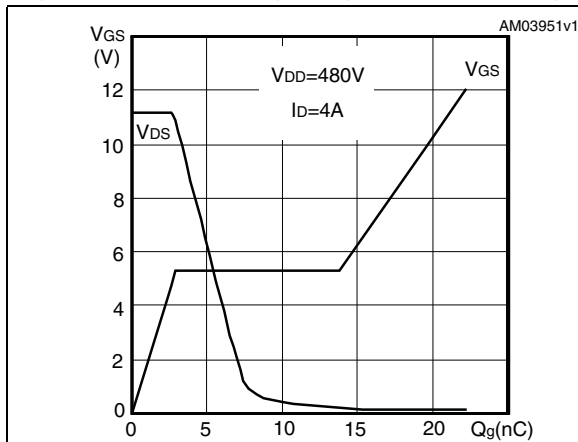


Figure 13. Capacitance variations

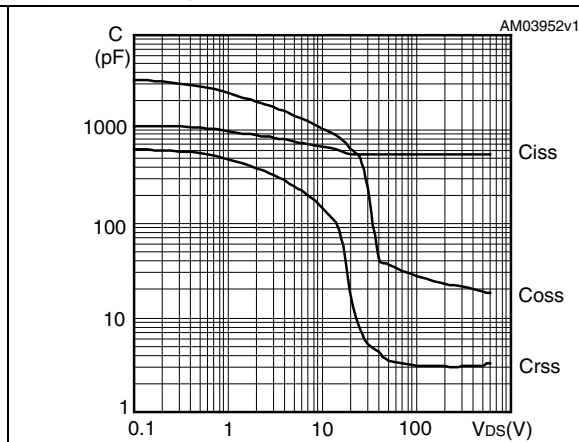


Figure 14. Normalized gate threshold voltage vs temperature Figure 15. Normalized on resistance vs temperature

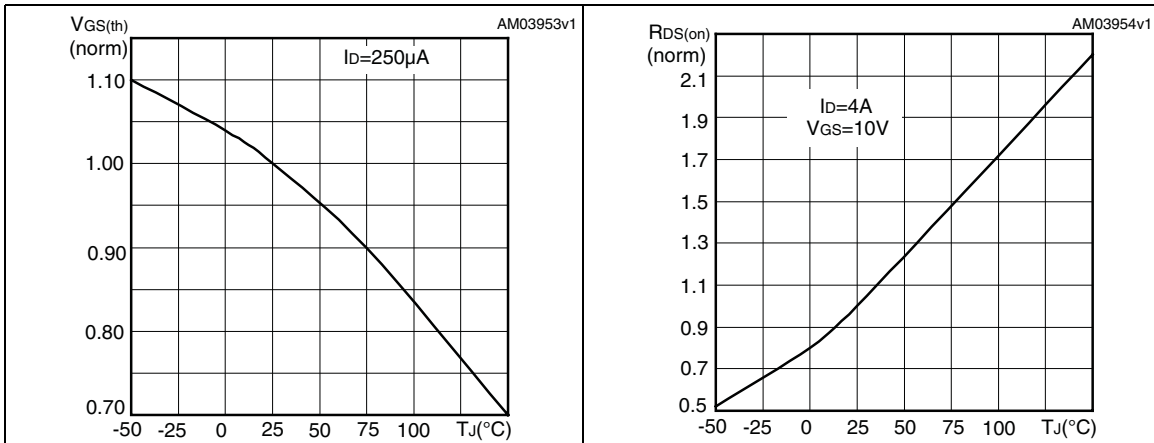
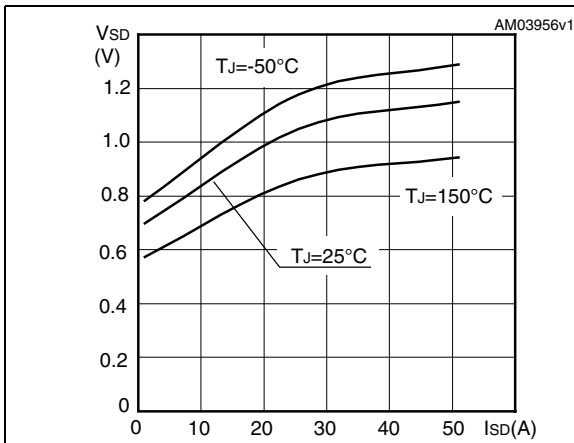


Figure 16. Source-drain diode forward characteristics



3 Test circuits

Figure 17. Switching times test circuit for resistive load

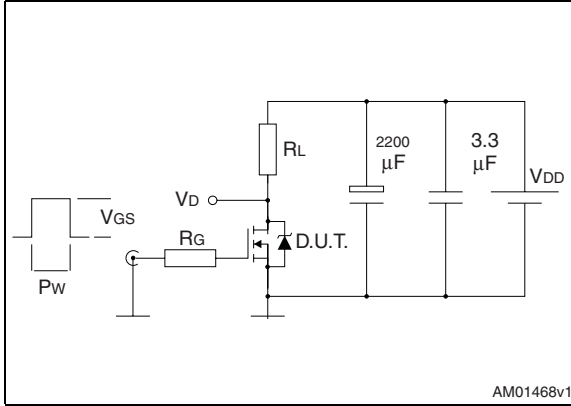


Figure 18. Gate charge test circuit

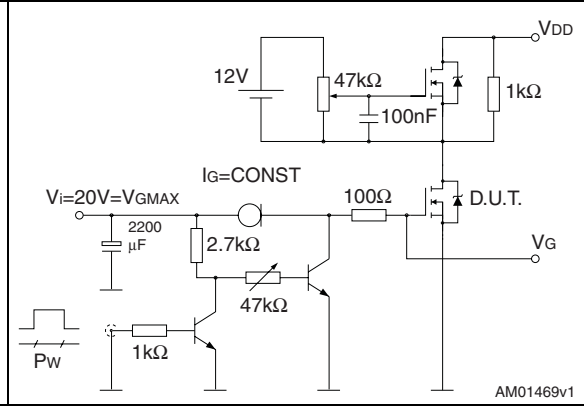


Figure 19. Test circuit for inductive load switching and diode recovery times

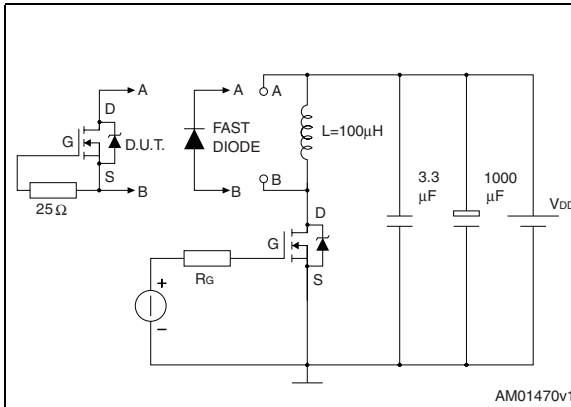


Figure 20. Unclamped inductive load test circuit

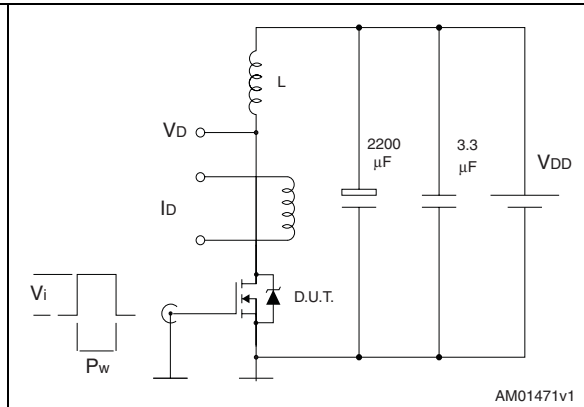


Figure 21. Unclamped inductive waveform

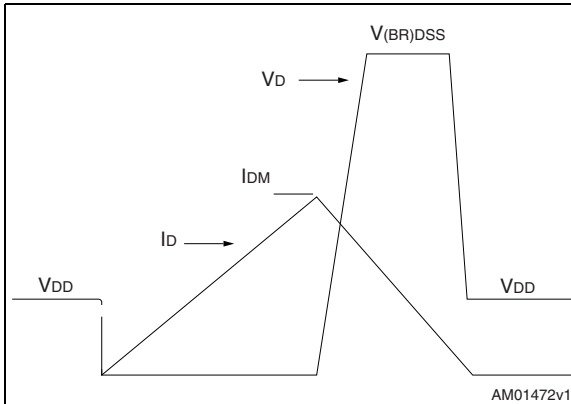
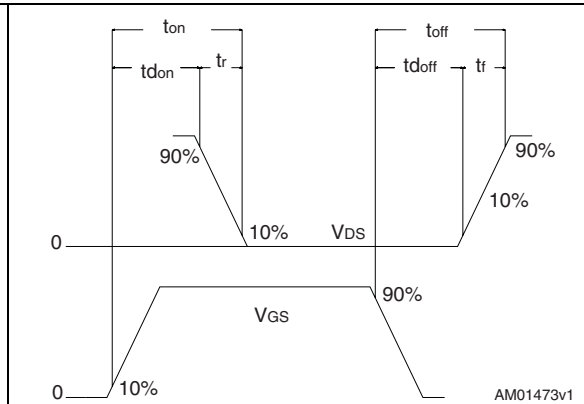


Figure 22. Switching time waveform

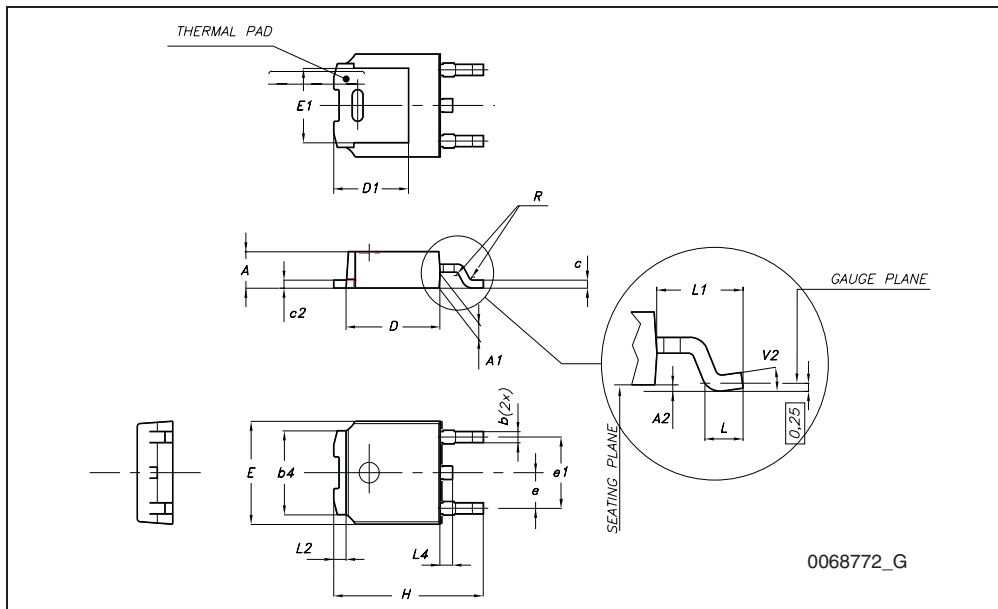


4 Package mechanical data

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. ECOPACK is an ST trademark.

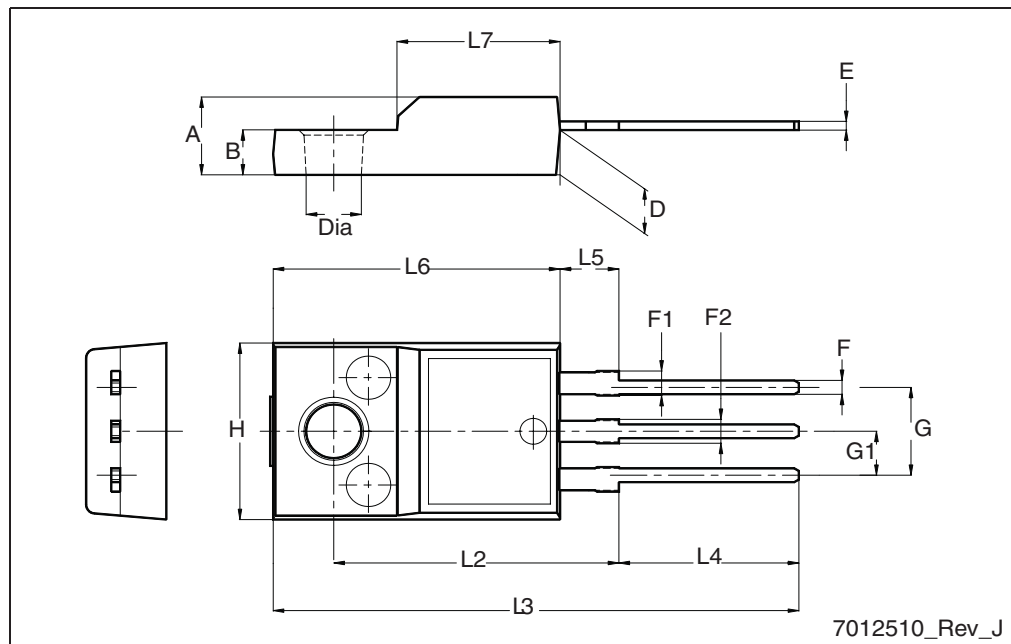
TO-252 (DPAK) mechanical data

DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1		
L1		2.80	
L2		0.80	
L4	0.60		1
R		0.20	
V2	0°		8°



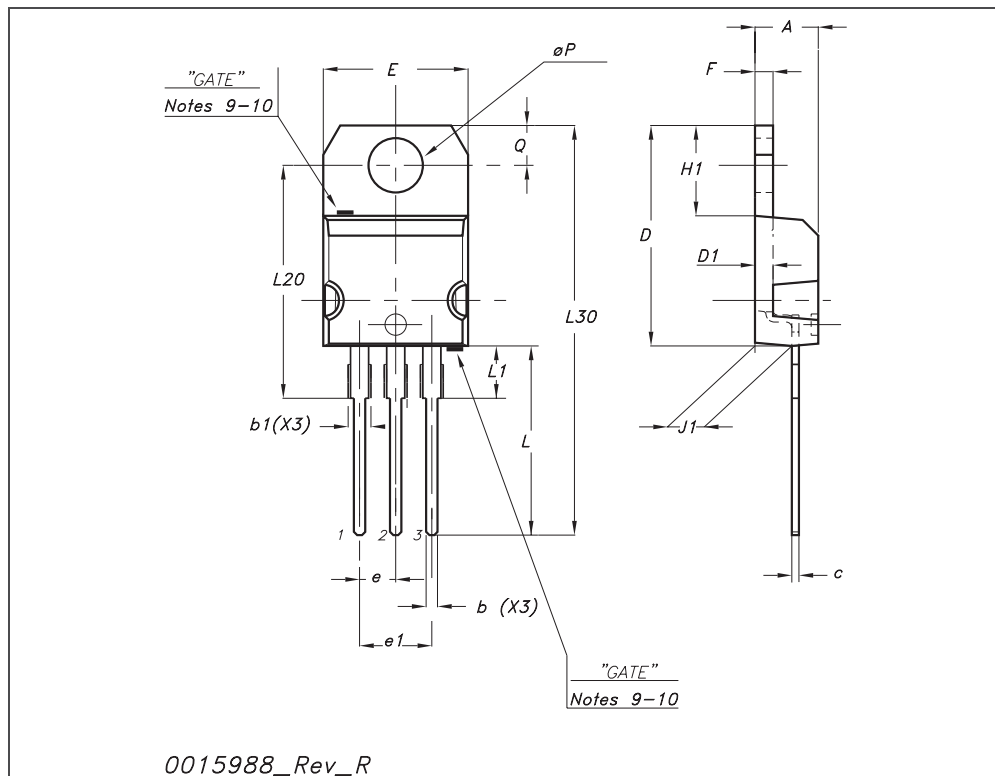
TO-220FP mechanical data

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



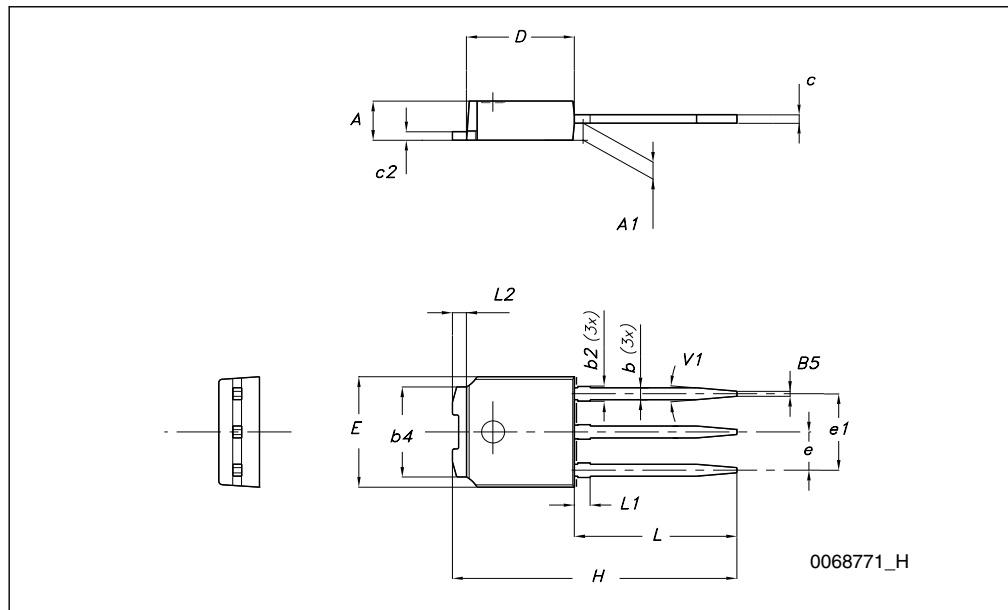
TO-220 mechanical data

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



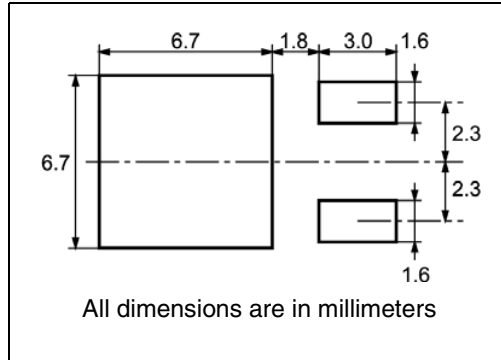
TO-251 (IPAK) mechanical data

DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.90		1.10
b	0.64		0.90
b2			0.95
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
E	6.40		6.60
e		2.28	
e1	4.40		4.60
H		16.10	
L	9.00		9.40
(L1)	0.80		1.20
L2		0.80	
V1		10°	



5 Packaging mechanical data

DPAK FOOTPRINT



TAPE AND REEL SHIPMENT

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 25mm min. width

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

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

BASE QTY

2500

BULK QTY

2500

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

For machine ref. only including draft and radii concentric around B0

FEED DIRECTION

Bending radius R min.

6 Revision history

Table 9. Document revision history

Date	Revision	Changes
10-Jun-2009	1	First release

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