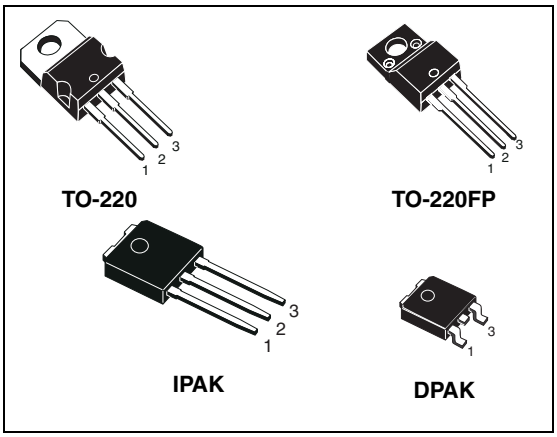
STD10NM60N, STF10NM60N
STP10NM60N, STU10NM60N

N-channel 600 V, 0.53 Ω, 10 A, DPAK, TO-220, TO-220FP, IPAK
MDmesh™ II Power MOSFET

Features

Order codes	V_{DSS} @$T_J$max	$R_{DS(on)}$ max.	I_D	P_w
STD10NM60N	650 V	< 0.55 Ω	10 A	70 W
STF10NM60N				25 W
STP10NM60N				70 W
STU10NM60N				

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



Application

Switching applications

Description

These devices are N-channel 600 V Power MOSFET realized using the second generation of MDmesh™ technology. It 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

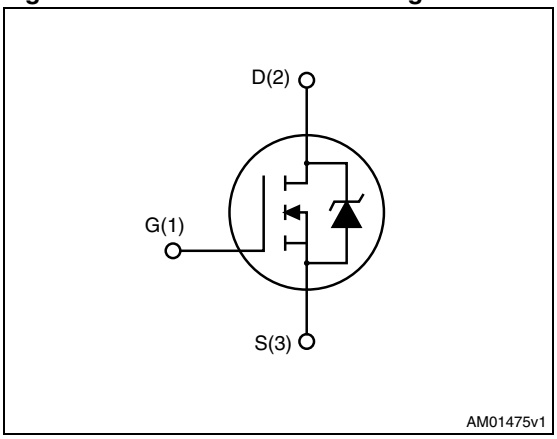


Table 1. Device summary

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

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Contents

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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 °C	10	10 (1)	10		A
I_D	Drain current (continuous) at T_C = 100 °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 °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 s;T_C=25 °C)		2500			V
T_J T_{stg}	Operating junction temperature Storage temperature	- 55 to 150				°C

1. Limited only by maximum temperature allowed.
2. Pulse width limited by safe operating area.
3. I_{SD} ≤10 A, di/dt ≤400 A/µs, V_{DS} peak ≤$V_{(BR)DSS}$, V_{DD} = 80% $V_{(BR)DSS}$.

Table 3. Thermal data

Symbol	Parameter	Value				Unit
		TO-220	TO-220FP	IPAK	DPAK	
$R_{thj\text{-}case}$	Thermal resistance junction-case max	1.79	5	1.79		°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max	62.50		100		°C/W
$R_{thj\text{-}pcb}$	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 Tj Max)	4	A
E_{AS}	Single pulse avalanche energy (starting T_J=25 °C, I_D=I_{AS}, V_{DD}=50 V)	200	mJ

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2 Electrical characteristics

(Tcase =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				1 100	µA µA
I_{GSS}	Gate-body leakage current (V_{DS} = 0)	V_{GS} = ± 25 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} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V_{DS} = 50 V, f = 1 MHz, V_{GS} = 0	-	540 44 1.2	-	pF pF pF
$C_{oss\ eq}$ (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 Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD} = 480 V, I_D = 8 A, V_{GS} = 10 V *(see Figure 17)*	-	19 3 10	-	nC nC 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}

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Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on delay time Rise time Turn-off-delay time Fall time	V_{DD} = 300 V, I_D = 4 A, R_G = 4.7 Ω, V_{GS} = 10 V *(see Figure 16)*	-	10 12 32 15	-	ns ns ns ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
I_{SD} I_{SDM} (1)	Source-drain current Source-drain current (pulsed)		-		8 32	A A
V_{SD} (2)	Forward on voltage	I_{SD} = 8 A, V_{GS} = 0	-		1.3	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 8 A, di/dt = 100 A/µs V_{DD}= 60 V *(see Figure 18)*	-	250 2.12 17		ns µC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 8 A, di/dt = 100 A/µs V_{DD}= 60 V T_J = 150 °C *(see Figure 18)*	-	315 2.6 16.5		ns µC A

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

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2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220

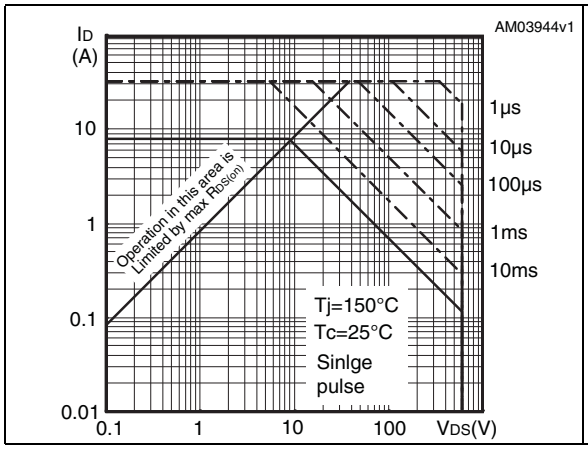

Figure 3. Thermal impedance for TO-220

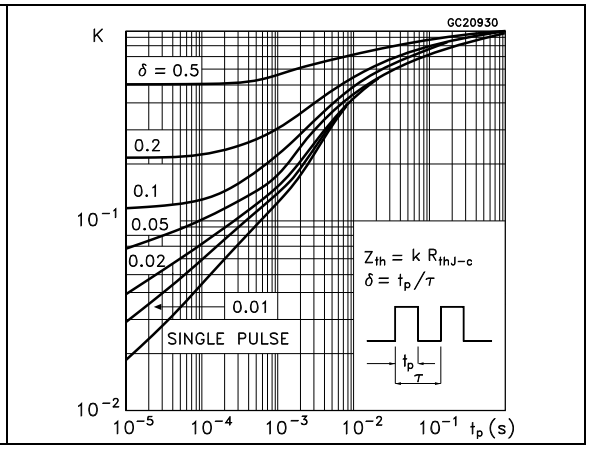

Figure 4. Safe operating area for TO-220FP

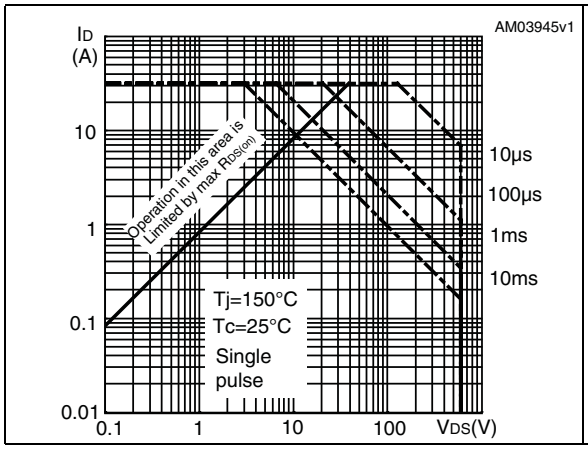

Figure 5. Thermal impedance for TO-220FP

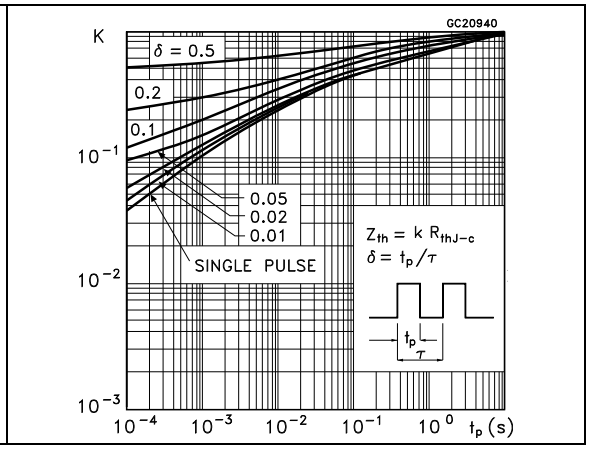

Figure 6. Safe operating area for DPAK, IPAK

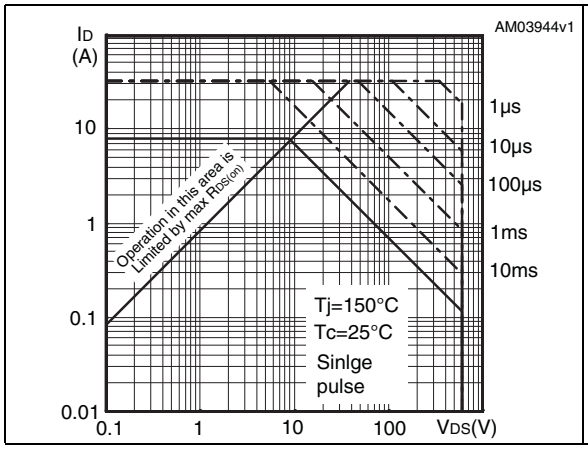

Figure 7. Thermal impedance for DPAK, IPAK

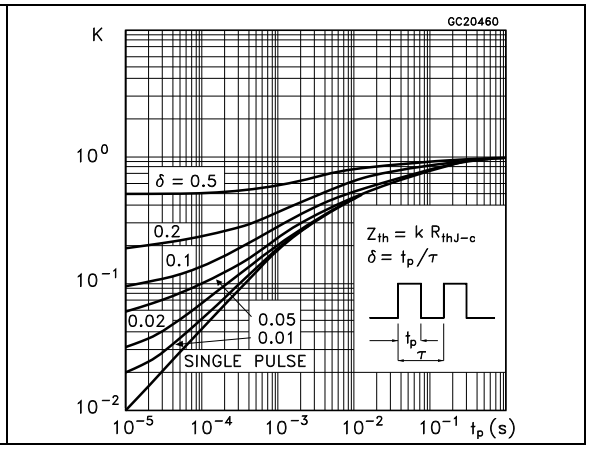

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Figure 8. Output characteristics

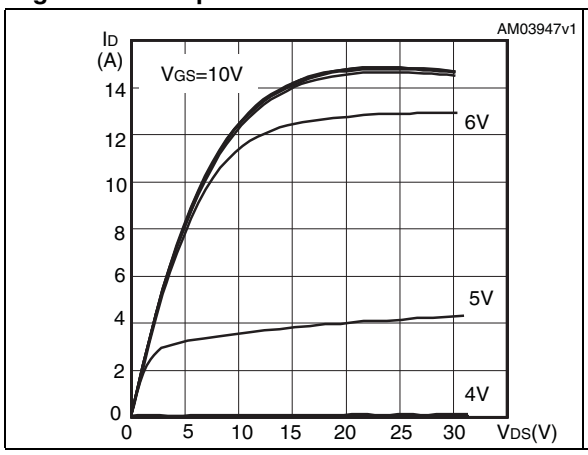

Figure 9. Transfer characteristics

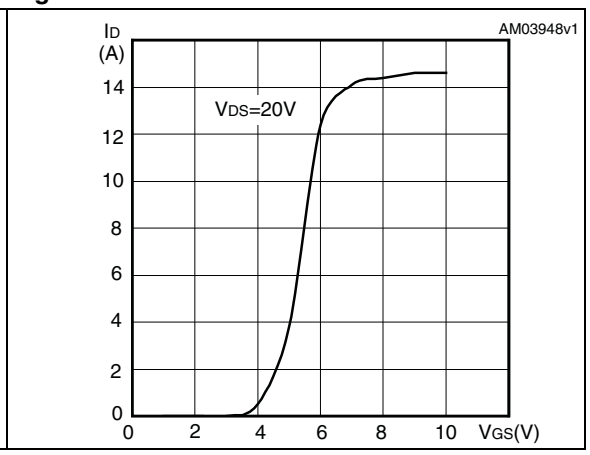

Figure 10. Normalized BV_{DSS} vs temperature

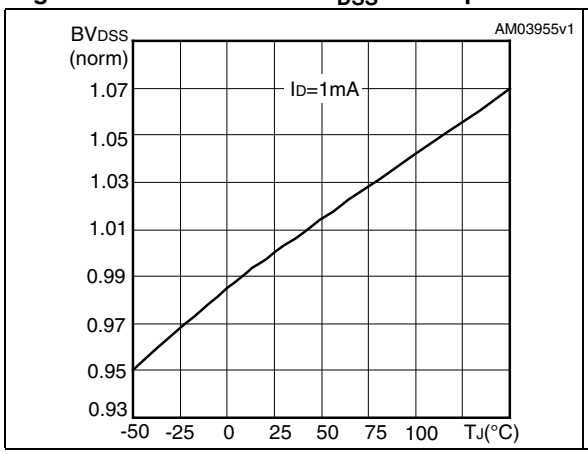

Figure 11. Static drain-source on resistance

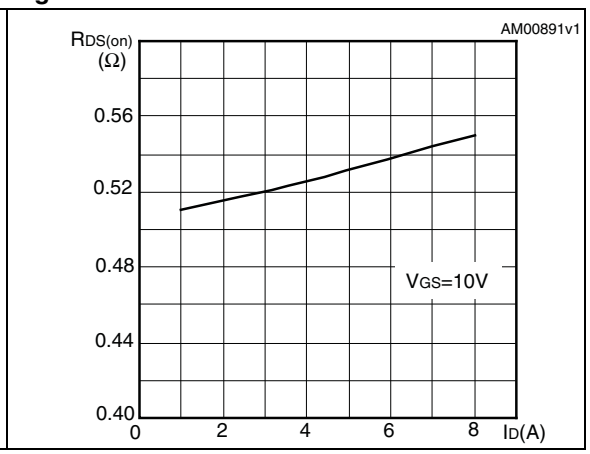

Figure 12. Gate charge vs gate-source voltage

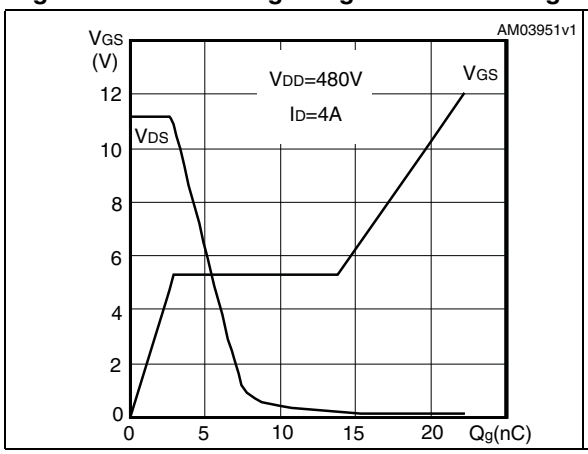

Figure 13. Capacitance variations

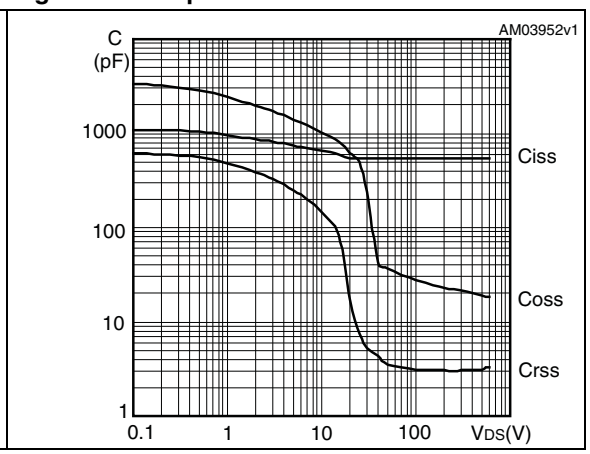

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Figure 14. Normalized gate threshold voltage vs temperature

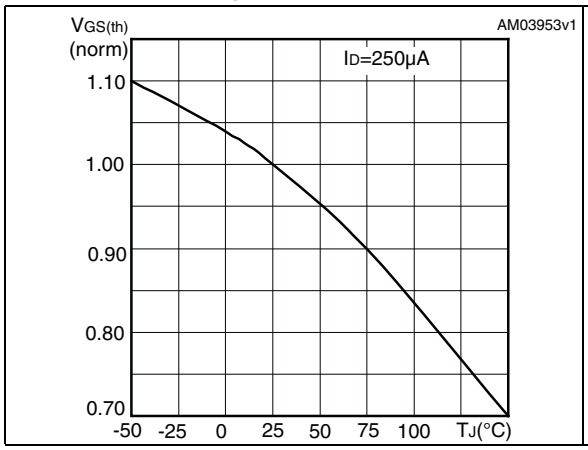
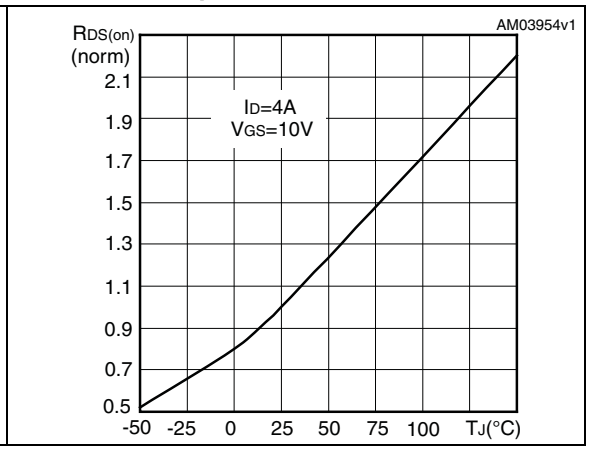


Figure 15. Normalized on resistance vs temperature



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3 Test circuits

Figure 16. Switching times test circuit for resistive load

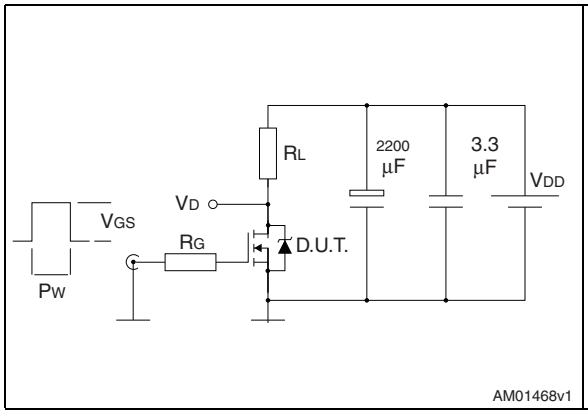


Figure 17. Gate charge test circuit

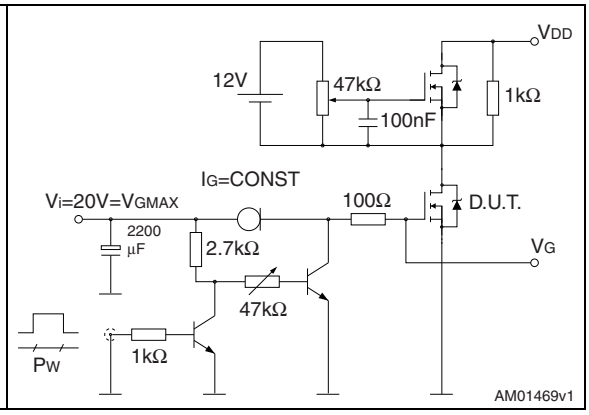


Figure 18. Test circuit for inductive load switching and diode recovery times

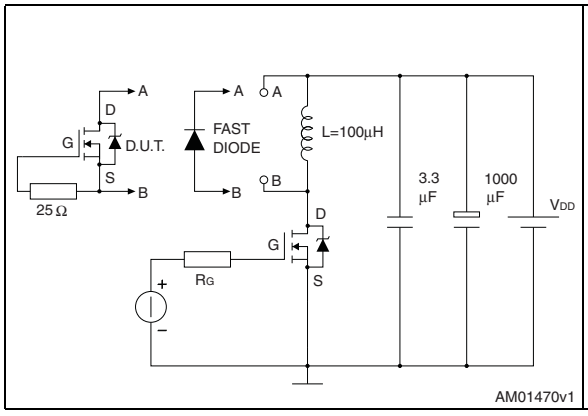


Figure 19. Unclamped inductive load test circuit

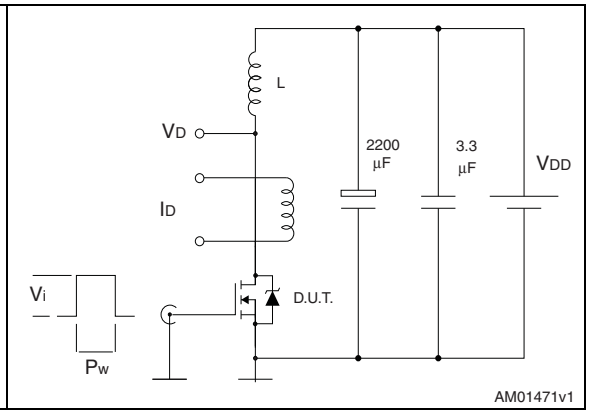


Figure 20. Unclamped inductive waveform

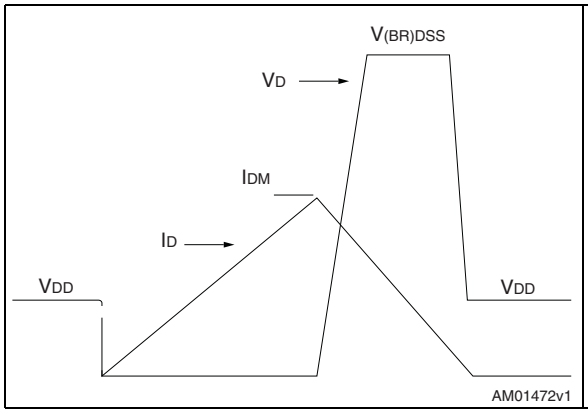
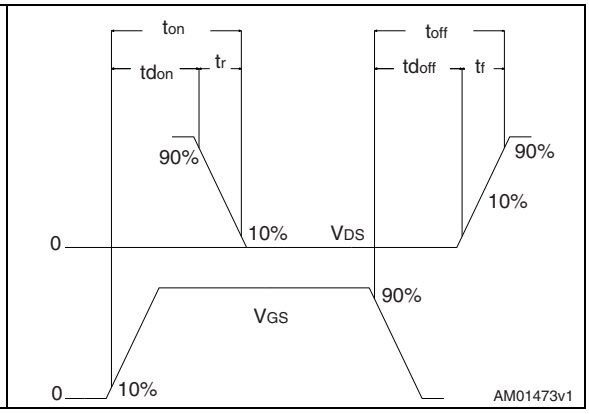


Figure 21. Switching time waveform



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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.

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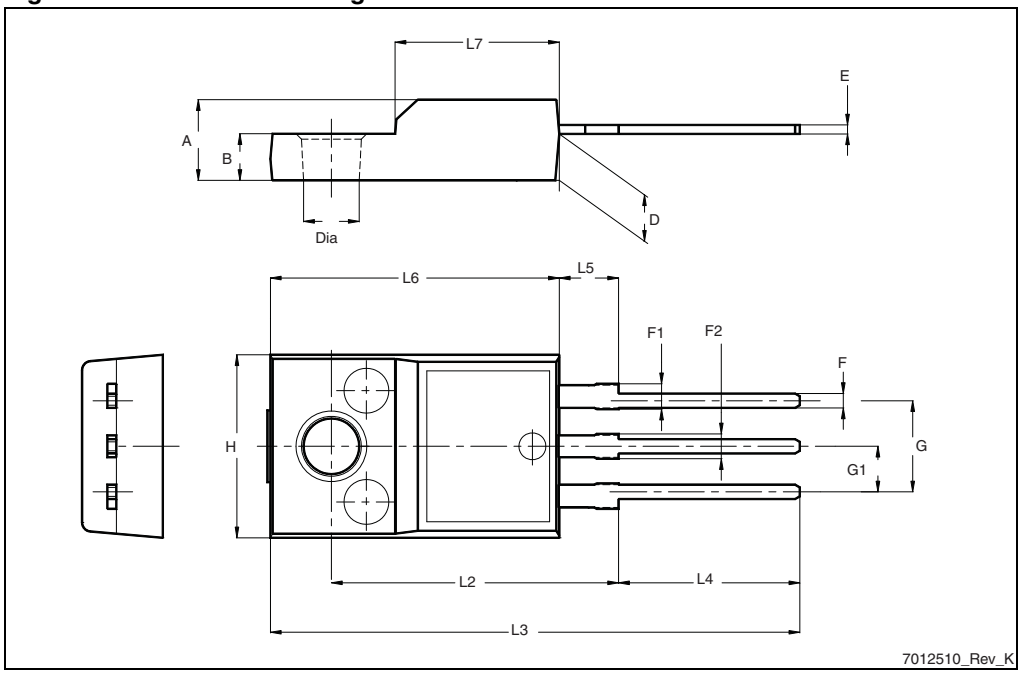
Table 9. TO-220FP mechanical data

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		1.70
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

Figure 22. TO-220FP drawing



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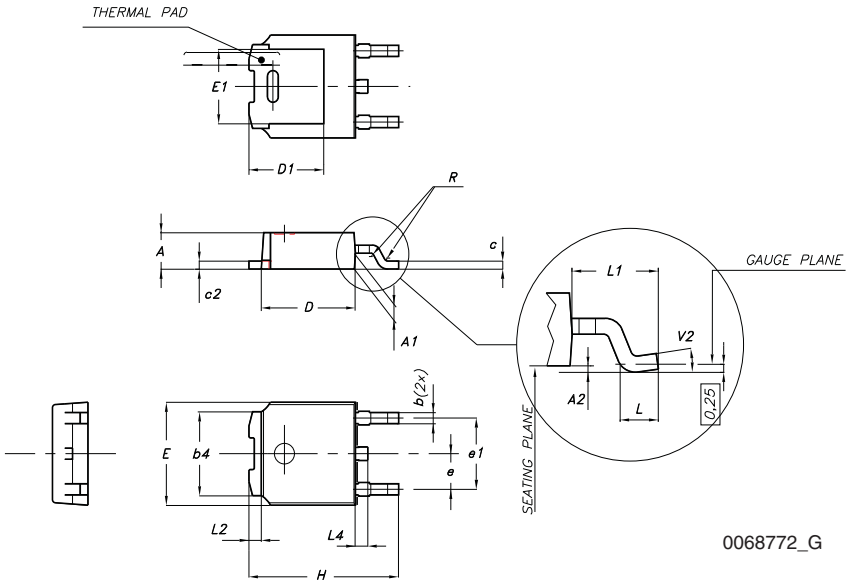
TO-252 (DPAK) mechanical data

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 °



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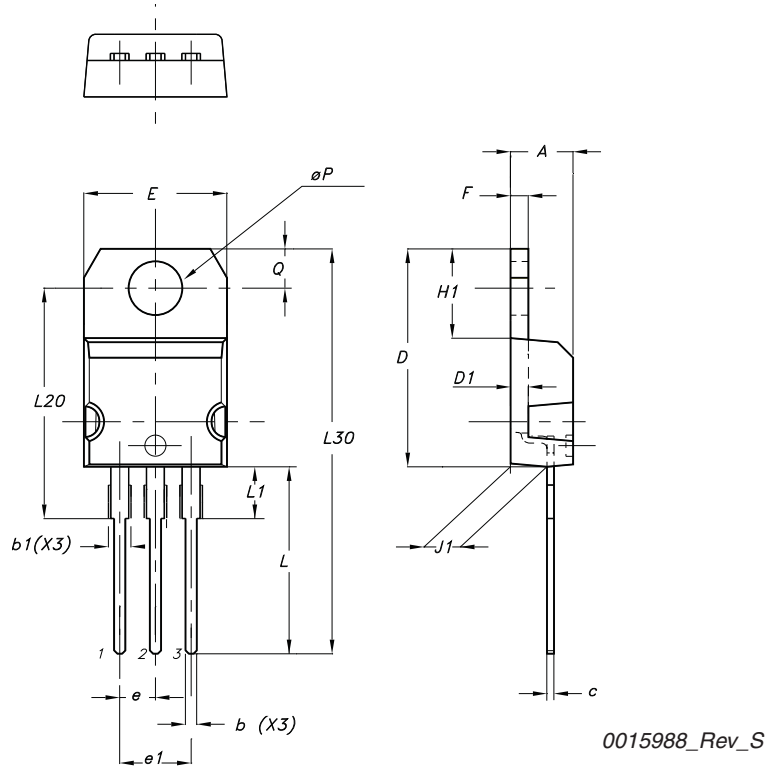
TO-220 type A mechanical data

Dim	mm		
	Min	Typ	Max
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
∅P	3.75		3.85
Q	2.65		2.95



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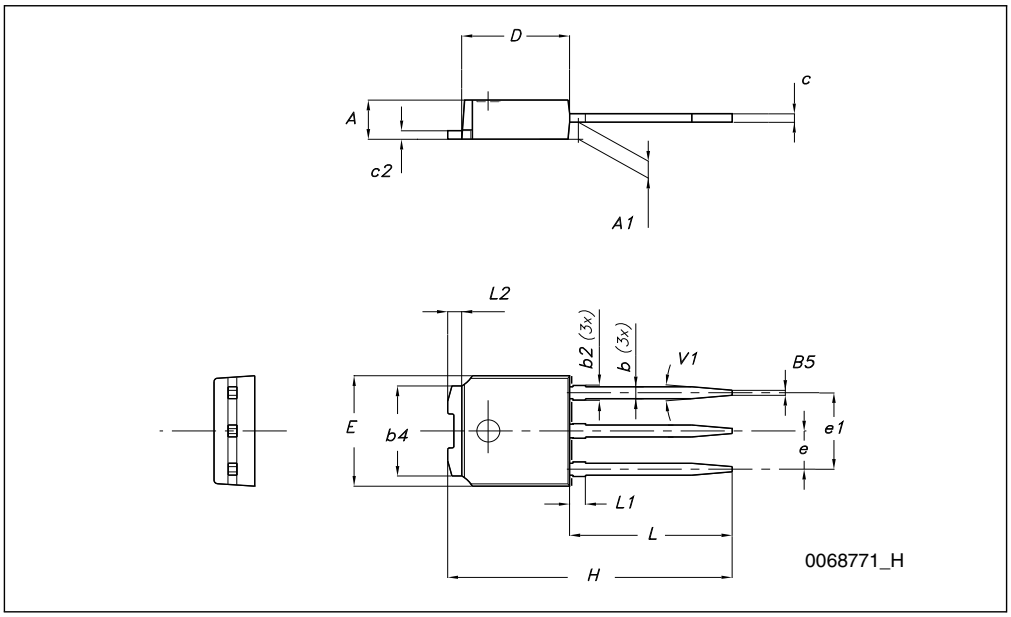
TO-251 (IPAK) mechanical data

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 °	



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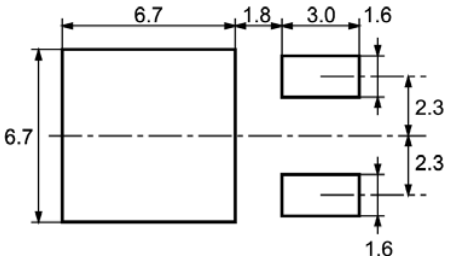
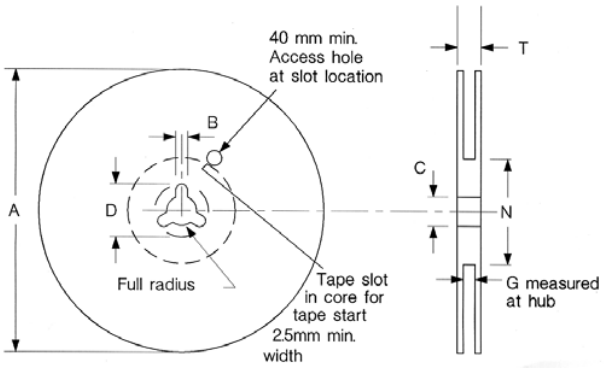
5 Packaging mechanical data

DPAK FOOTPRINT



All dimensions are in millimeters

TAPE AND REEL SHIPMENT



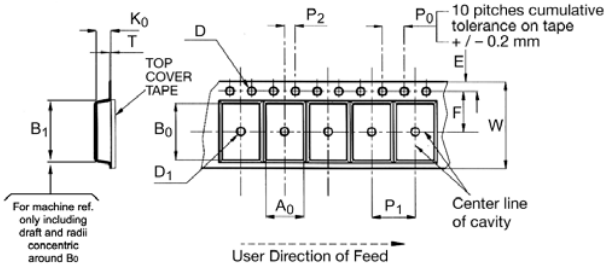
REEL MECHANICAL DATA

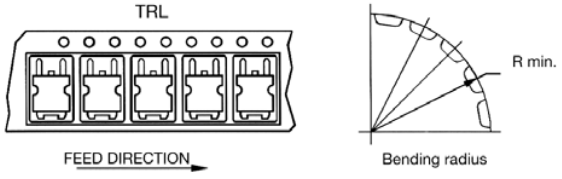
DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0.795	
G	16.4	18.4	0.645	0.724
N	50		1.968	
T		22.4		0.881

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





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6 Revision history

Table 10. Document revision history

Date	Revision	Changes
10-Jun-2009	1	First release
12-Jan-2010	2	*Figure 4: Safe operating area for TO-220FP* has been corrected
31-Mar-2010	3	*Features* have been corrected
17-Sep-2010	4	Content reworked to improve readability
24-Nov-2010	5	Corrected I_D value

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