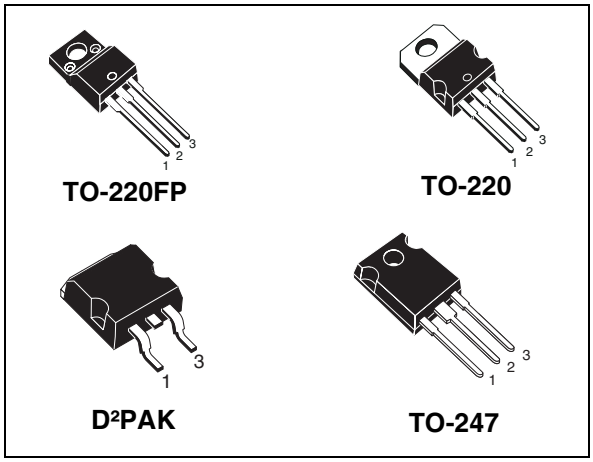
STB28NM50N, STF28NM50N STP28NM50N, STW28NM50N

N-channel 500 V, 0.135 Ω, 21 A D²PAK, TO-220, TO-220FP, TO-247
MDmesh™ II Power MOSFET

Features

Type	V_{DSS} (@Tjmax)	$R_{DS(on)}$ max	I_D
STB28NM50N	550 V	< 0.158 Ω	21 A
STF28NM50N			
STP28NM50N			
STW28NM50N			

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



Application

Switching applications

Description

These devices are made using the second generation of MDmesh™ technology. This revolutionary Power 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.

Figure 1. Internal schematic diagram

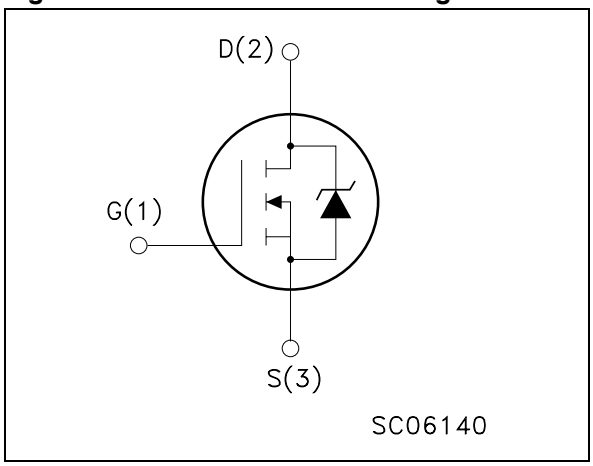


Table 1. Device summary

Order codes	Marking	Package	Packaging
STB28NM50N	28NM50N	D²PAK	Tape and reel
STF28NM50N		TO-220FP	Tube
STP28NM50N		TO-220	
STW28NM50N		TO-247	

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value				Unit
		TO-220	D²PAK	TO-220FP	TO-247	
V_{DS}	Drain-source voltage (V_{GS} = 0)	500				V
V_{GS}	Gate- source voltage	± 25				V
I_D	Drain current (continuous) at T_C = 25 °C	21		21 (1)	21	A
I_D	Drain current (continuous) at T_C = 100 °C	13		13 (1)	13	A
I_{DM} (2)	Drain current (pulsed)	84		84 (1)	84	A
P_{TOT}	Total dissipation at T_C = 25 °C	90		25	150	W
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s;T_C=25 °C)			2500		V
dv/dt (3)	Peak diode recovery voltage slope	21				V/ns
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. $I_{SD} \leq 21$ A, di/dt ≤ 400 A/µs, V_{DD} = 80% $V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value				Unit
		TO-220	D²PAK	TO-247	TO-220FP	
$R_{thj\text{-}case}$	Thermal resistance junction-case max	1.39		0.83	5	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max	62.5		50	62.5	°C/W
$R_{thj\text{-}pcb}$ (1)	Thermal resistance junction-pcb max		30			°C/W
T_l	Maximum lead temperature for soldering purpose	300		300		°C

1. When mounted on 1inch² FR-4 board, 2 oz Cu

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by Tj Max)	8.5	A
E_{AS}	Single pulse avalanche energy (starting Tj = 25 °C, $I_D = I_{AR}$, V_{DD} = 50 V)	430	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	500			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0) V_{DS} = max rating V_{DS} = max rating, @125 °C				1 10	µA µA
I_{GSS}	Gate-body leakage current (V_{DS} = 0)	V_{GS} = ± 20 V			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 = 10.5 A		0.135	0.158	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} = 25 V, f = 1 MHz, V_{GS} = 0	-	1735 122 4.3	-	pF pF pF
$C_{oss(tr)}$(1)	Equivalent output capacitance time related	V_{GS} = 0, V_{DS} = 0 to 50 V	-	122	-	pF
$C_{oss(er)}$(2)	Equivalent output capacitance energy related		-	86	-	
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD} = 400 V, I_D = 21 A, V_{GS} = 10 V, *(see Figure 18)*	-	50 9.5 25	-	nC nC nC
R_g	Gate input resistance	f=1 MHz Gate DC Bias=0 Test signal level=20 mV open drain	-	2.7	-	Ω

1. $C_{oss(tr)}$ is a constant capacitance value that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.
2. $C_{oss(er)}$ is a constant capacitance value that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

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} = 250 V, I_D = 10.5 A R_G = 4.7 Ω V_{GS} = 10 V *(see Figure 17)*	-	13.6 19 62 52	-	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)		-		21 84	A A
V_{SD} (2)	Forward on voltage	I_{SD} = 21 A, V_{GS} = 0	-		1.5	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 21 A, di/dt = 100 A/µs V_{DD} = 400 V *(see Figure 22)*	-	326 5 30		ns µC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 21 A, di/dt = 100 A/µs V_{DD} = 400 V, T_j = 150 °C *(see Figure 22)*	-	376 6.2 33.2		ns µC 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

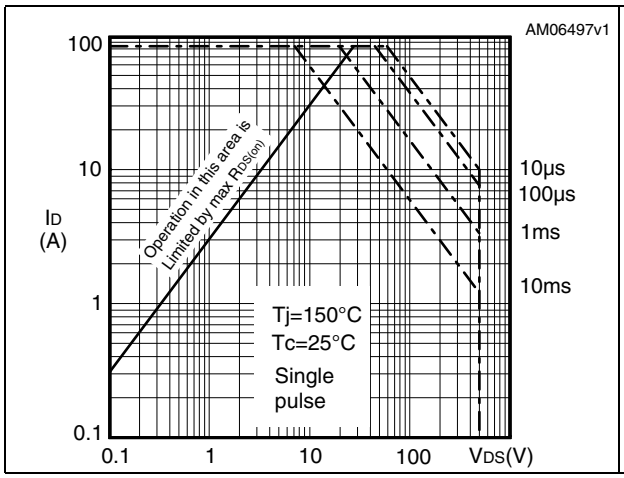


Figure 3. Thermal impedance for TO-220, D²PAK

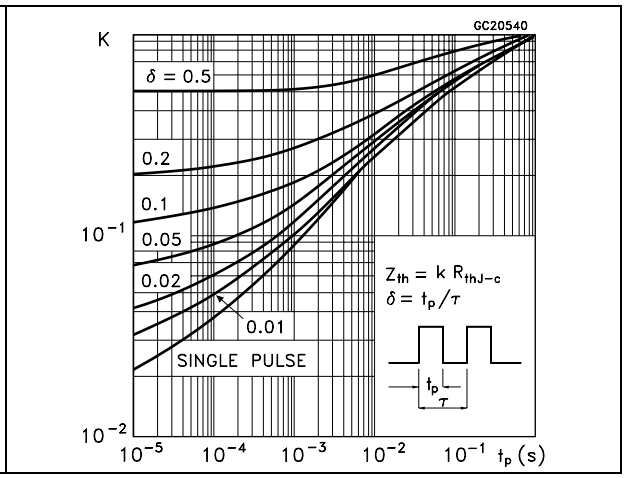


Figure 4. Safe operating area for TO-220FP

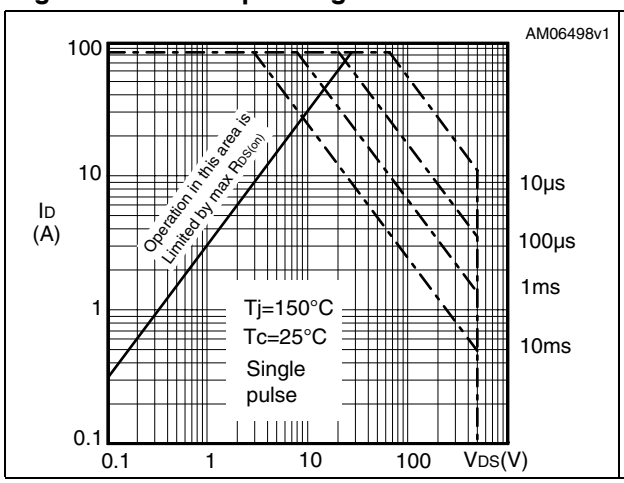


Figure 5. Thermal impedance for TO-220FP

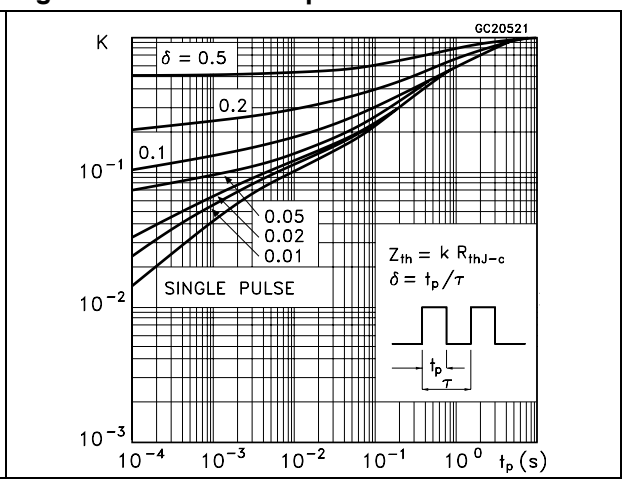


Figure 6. Safe operating area for TO-247

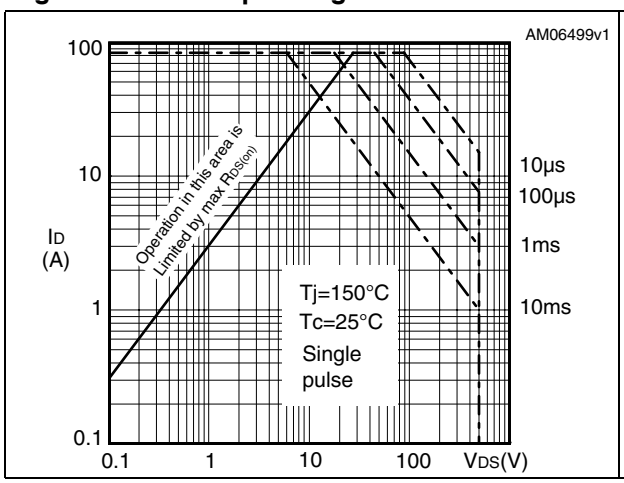


Figure 7. Thermal impedance for TO-247

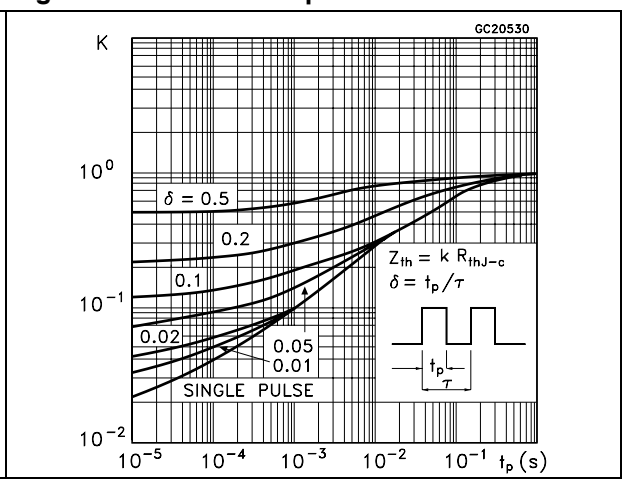


Figure 8. Output characteristics

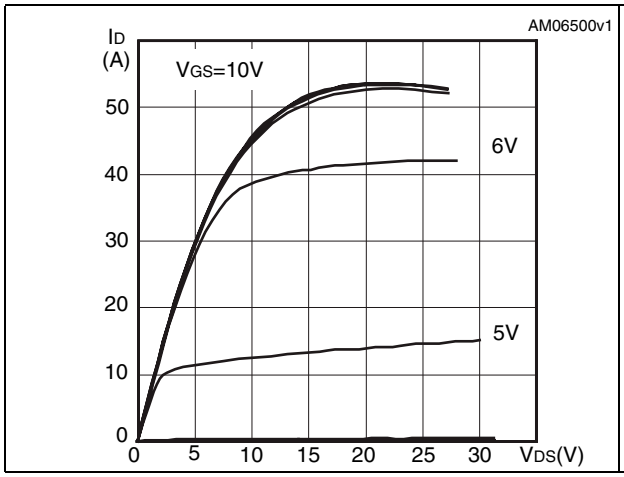


Figure 9. Transfer characteristics

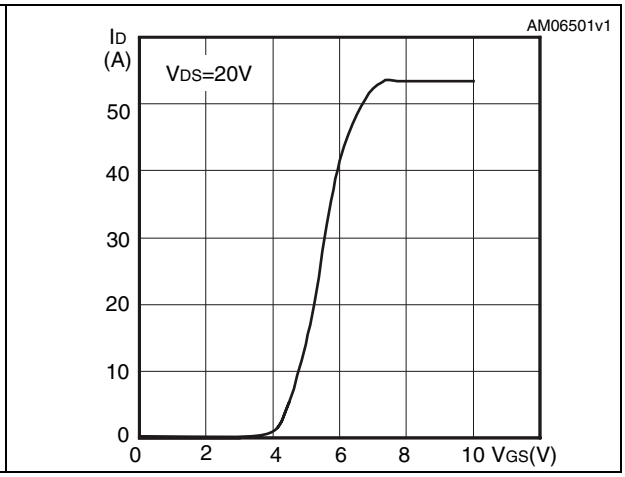


Figure 10. Gate charge vs gate-source voltage

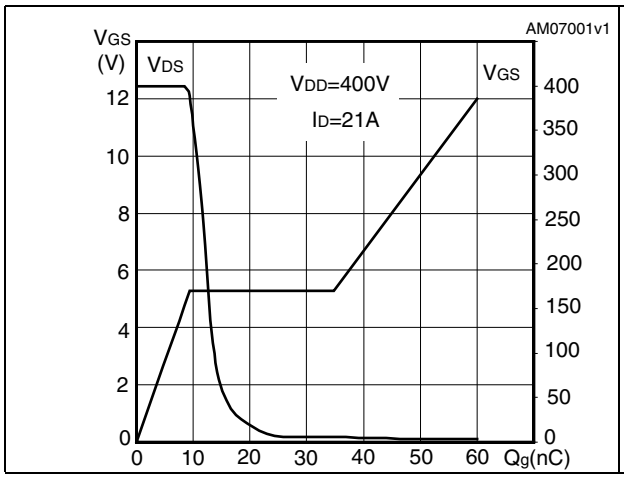


Figure 11. Static drain-source on resistance

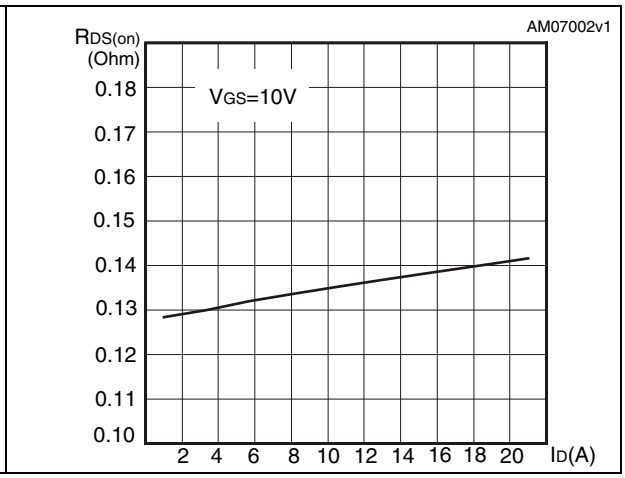


Figure 12. Capacitance variations

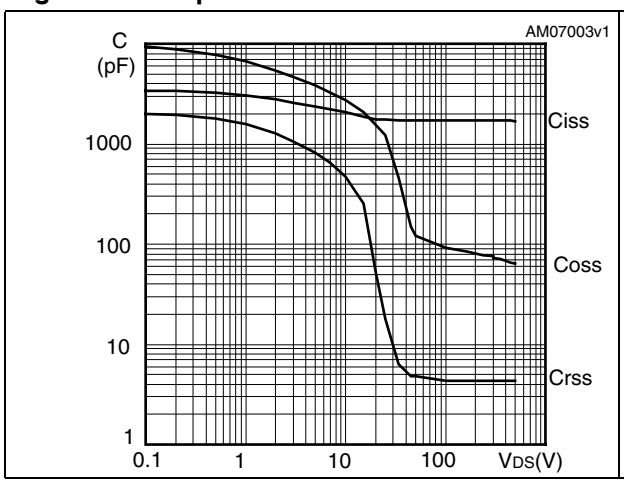


Figure 13. Output capacitance stored energy

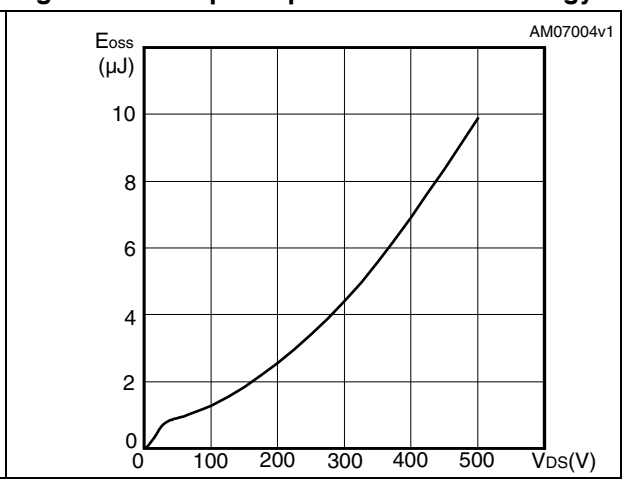


Figure 14. Normalized gate threshold voltage vs temperature

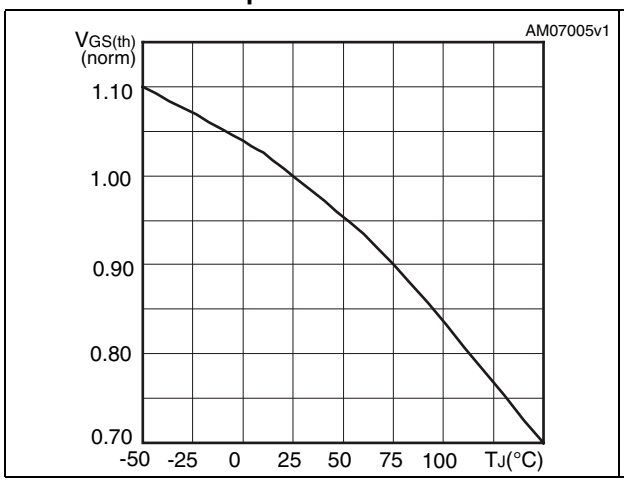


Figure 15. Normalized on resistance vs temperature

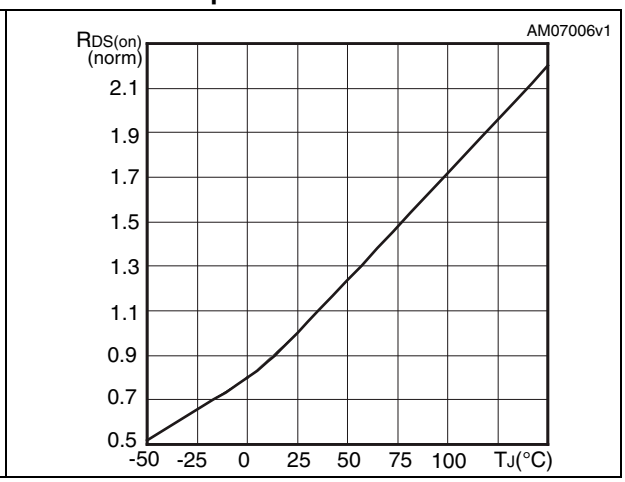
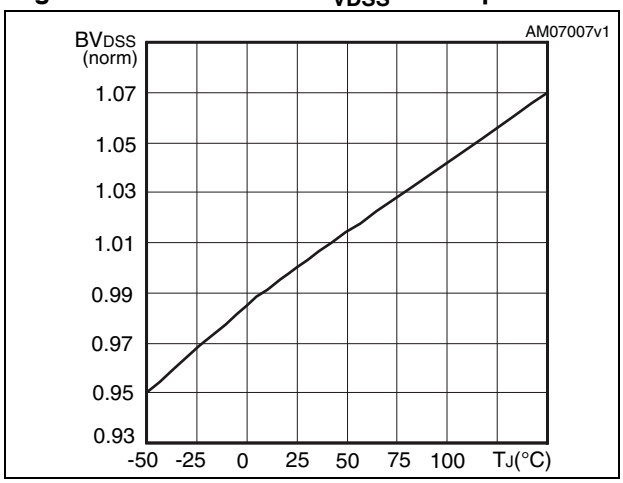


Figure 16. Normalized B_{VDSS} vs temperature



3 Test circuits

Figure 17. Switching times test circuit for resistive load

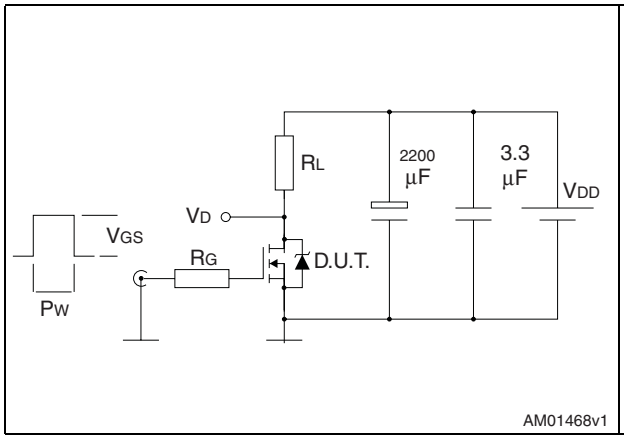


Figure 18. Gate charge test circuit

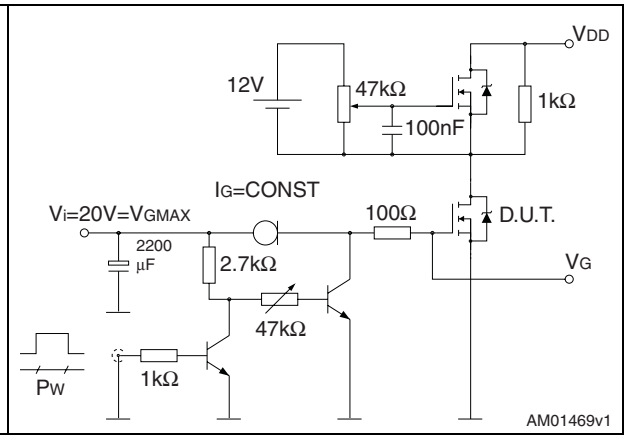


Figure 19. Test circuit for inductive load switching and diode recovery times

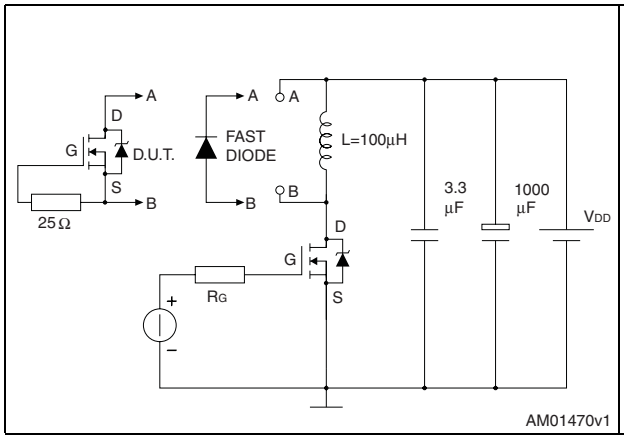


Figure 20. Unclamped inductive load test circuit

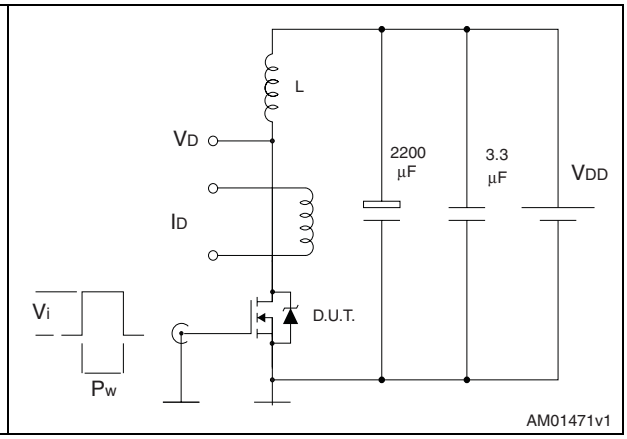


Figure 21. Unclamped inductive waveform

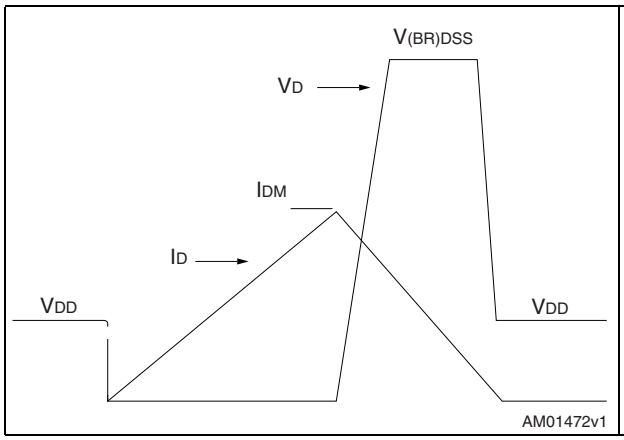
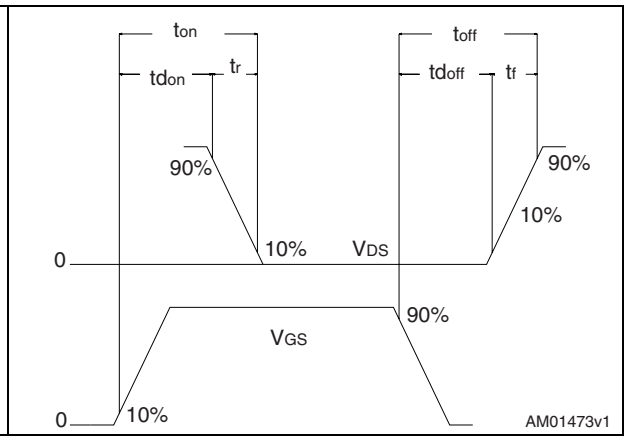


Figure 22. Switching time waveform



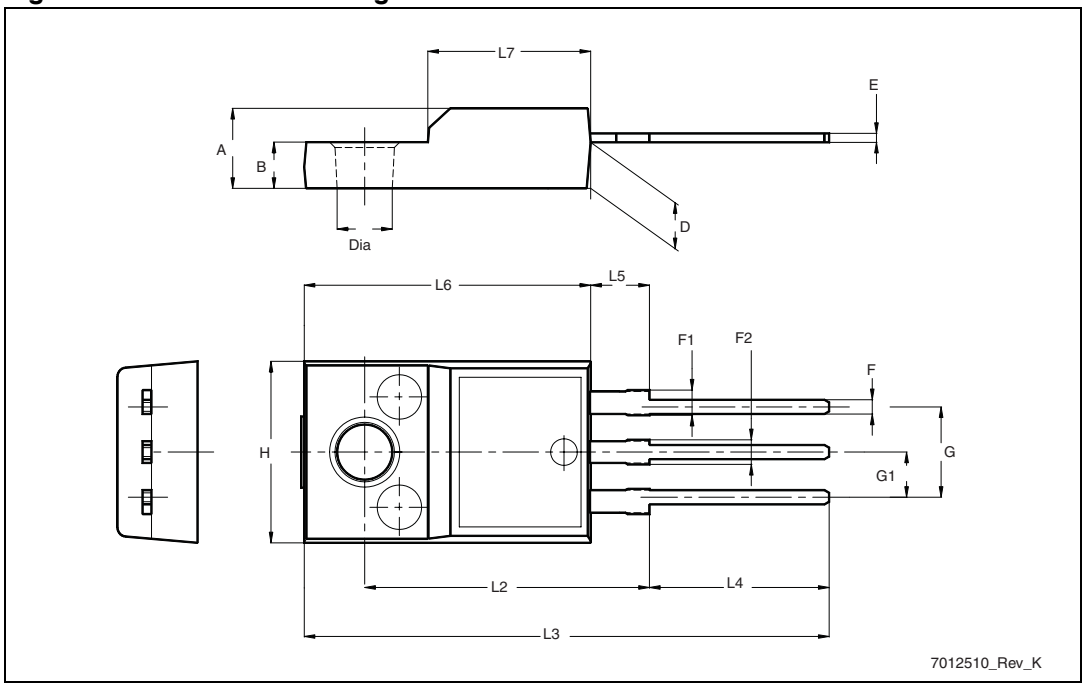
4 Package mechanical data

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.

Table 9. TO-220FP mechanical data

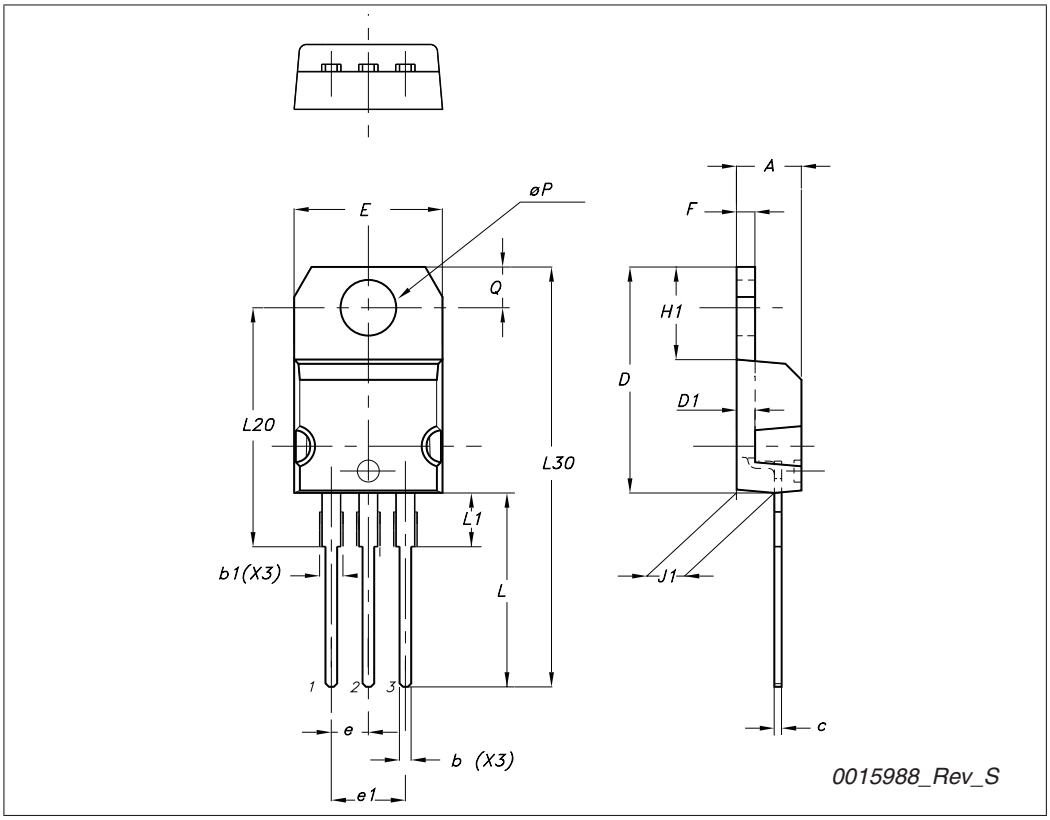
Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

Figure 23. TO-220FP drawing



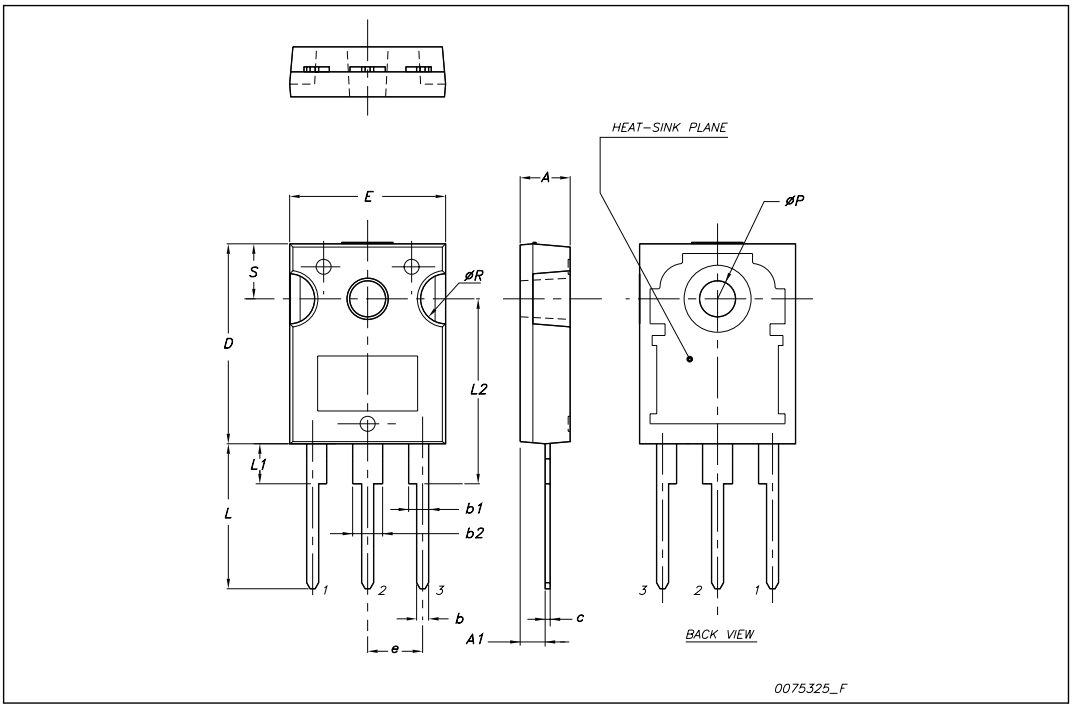
TO-220 type A mechanical data

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



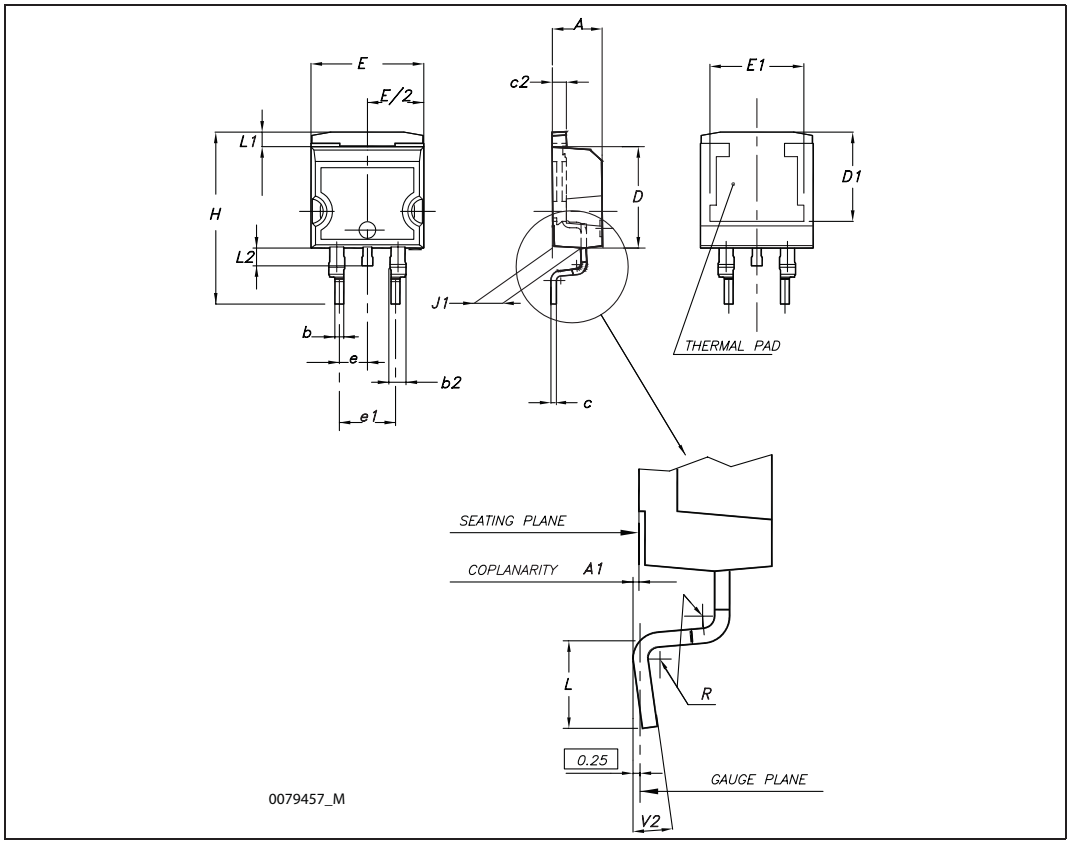
TO-247 mechanical data

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	



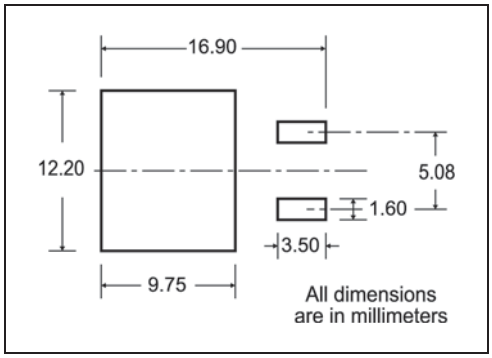
D²PAK (TO-263) mechanical data

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°

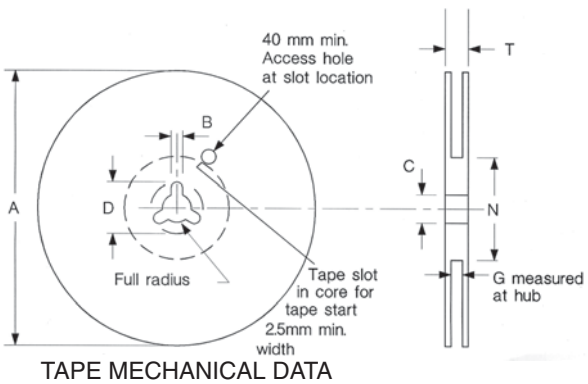


5 Packaging mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT



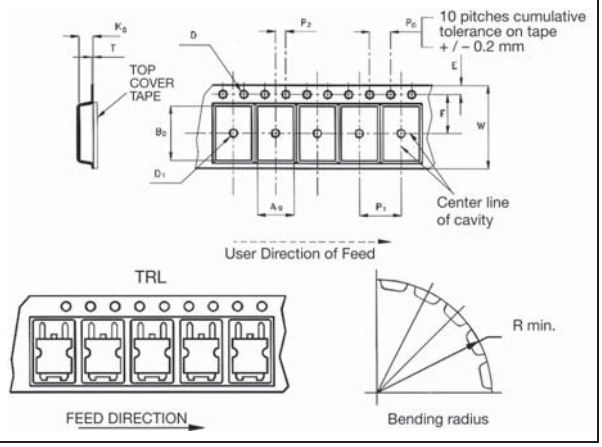
REEL MECHANICAL DATA

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		0795	
G	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

BASE QTY	BULK QTY
1000	1000

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



6 Revision history

Table 10. Document revision history

Date	Revision	Changes
19-Jul-2010	1	First release.

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