STD9NM50N - STD9NM50N-1
STF9NM50N - STP9NM50N

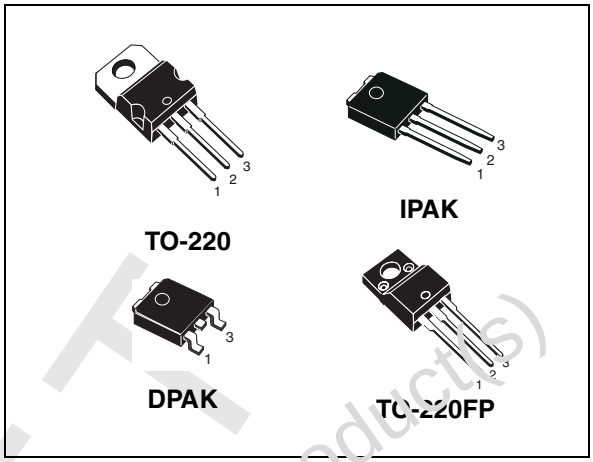
N-channel 500V - 0.47Ω - 7.5A - TO-220 - TO-220FP - IPAK - DPAK
Second generation MDmesh™ Power MOSFET

Features

Type	V_{DSS} (@Tjmax)	$R_{DS(on)}$	I_D
STD9NM50N	550V	<0.56Ω	7.5A
STD9NM50N-1	550V	<0.56Ω	7.5A
STP9NM50N	550V	<0.56Ω	7.5A
STF9NM50N	550V	<0.56Ω	7.5A(1)

1. Limited only by maximum temperature allowed

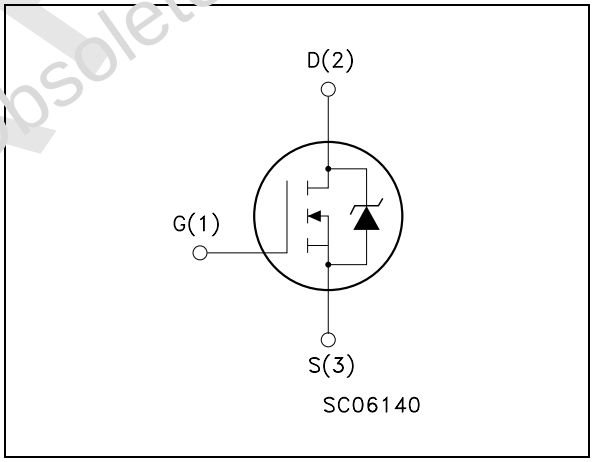
- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance



Description

This series of devices implements second generation 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.

Internal schematic diagram



Applications

- Switching application

Order codes

Part number	Marking	Package	Packaging
STD9NM50N-1	D9NM50N	IPAK	Tube
STD9NM50N	D9NM50N	DPAK	Tape & reel
STP9NM50N	P9NM50N	TO-220	Tube
STF9NM50N	F9NM50N	TO-220FP	Tube

Contents

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)	500		V
V_{GS}	Gate-source voltage	± 25		V
I_D	Drain current (continuous) at T_C = 25°C	7.5	7.5 (1)	A
I_D	Drain current (continuous) at T_C = 100°C	5	5 (1)	A
I_{DM} (2)	Drain current (pulsed)	30	30 (1)	A
P_{TOT}	Total dissipation at T_C = 25°C	70	25	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=1s;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} ≤7.5A, di/dt ≤400A/µs, V_{DD} =80% $V_{(BR)DSS}$

Table 2. Thermal data

Symbol	Parameter	TO-220 DPAK/IPAK	TO-220FP	Unit
Rthj-case	Thermal resistance junction-case max	1.78	5	°C/W
Rthj-amb	Thermal resistance junction-amb max	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)	3	A
E_{AS}	Single pulse avalanche energy (starting Tj=25°C, I_D=I_{AS}, V_{DD}= 50V)	150	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	500			V
dv/dt(1)	Drain-source voltage slope	Vdd= 400V, Id=7.5A, Vgs=10V		35		V/ns
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = Max rating, V_{DS} = Max rating,Tc = 125°C			1 100	µA µA
I_{GSS}	Gate body leakage current (V_{DS} = 0)	V_{GS} = ±20V			100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS}= V_{GS}, I_D = 250µA	2	3	4	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS}= 10V, I_D= 3.7A		0.47	0.56	Ω

1. Characteristics value at turn off on inductive load

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
g_{fs}(1)	Forward transconductance	V_{DS} =15V, I_D= 3.7A		5		S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V_{DS} = 50V, f=1MHz, V_{GS}=0		570 46 6		pF pF pF
$C_{oss\ eq.}$(2)	Equivalent output characteristics	V_{GS}=0, V_{DS} = 0V to 400V		94		pF
Rg	Gate input resistance	f=1MHz Gate DC Bias=0 Test signal level=20mV Open drain		6		Ω
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD}= 400V, I_D = 7.5A V_{GS} =10V *(see Figure 16)*		20 4 10		nC nC nC

1. Pulsed: pulse duration = 300µs, duty cycle 1.5%
2. $C_{oss\ eq.}$ 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}

Table 6. 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}=250V, I_D=3.7A, R_G=4.7Ω, V_{GS}=10V *(see Figure 15)*		11 16 45 19		ns ns ns ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
I_{SD} I_{SDM}(1)	Source-drain current Source-drain current (pulsed)				7.5 30	A A
V_{SD}(2)	Forward on voltage	I_{SD}=7.5A, V_{GS}=0			1.2	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD}=7.5A, di/dt=100A/µs, V_{DD}=100V, Tj=150°C *(see Figure 17)*		420 3 14		ns µC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD}=7.5A, di/dt=100A/µs, V_{DD}=100V, Tj= 25°C *(see Figure 17)*		280 2 14		ns µC A

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

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area for TO-220 / DPAK / IPAK

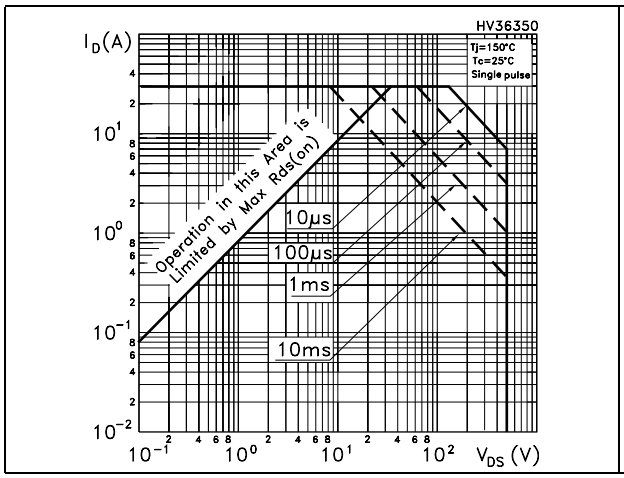


Figure 2. Thermal impedance for TO-220 / DPAK / IPAK

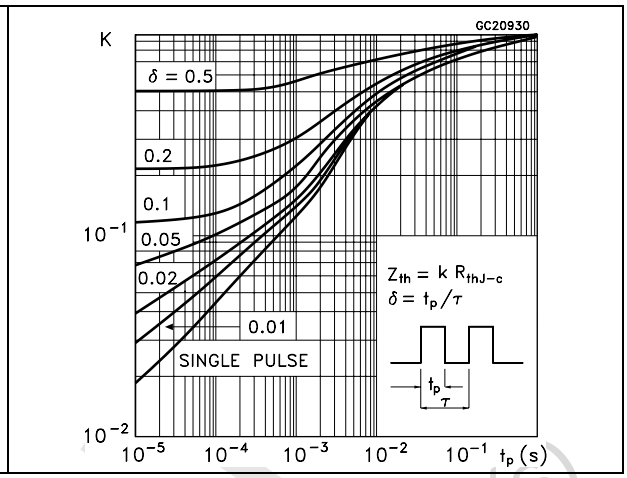


Figure 3. Safe operating area for TO-220FP

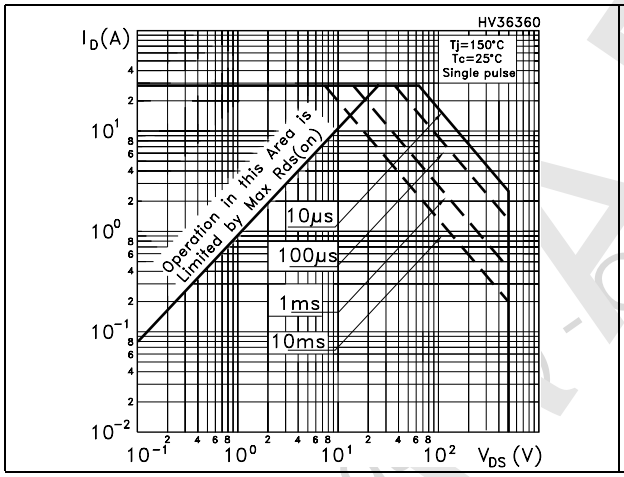


Figure 4. Thermal impedance for TO-220FP

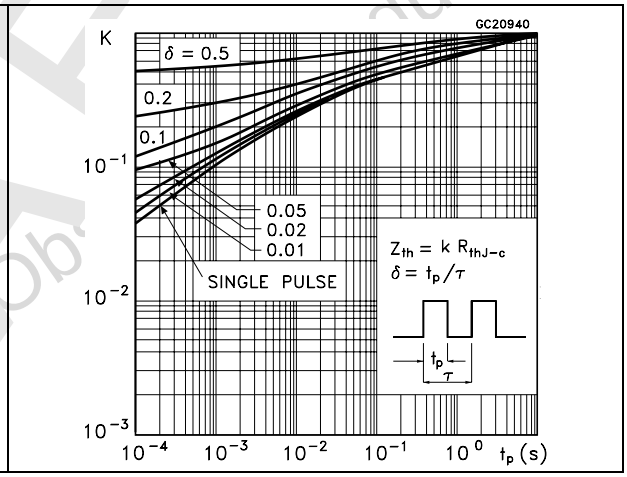


Figure 5. Output characteristics

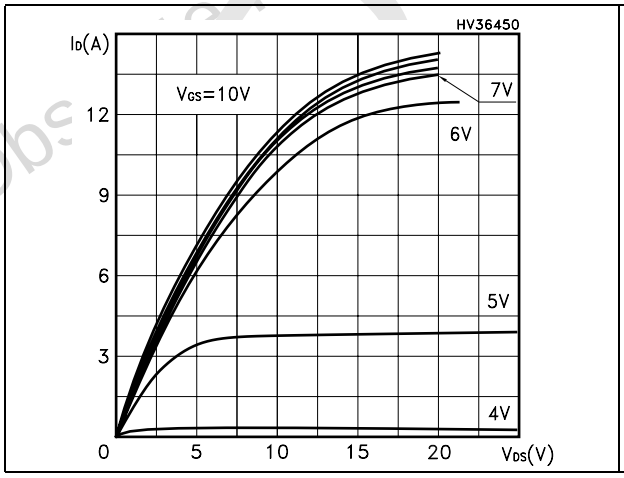


Figure 6. Transfer characteristics

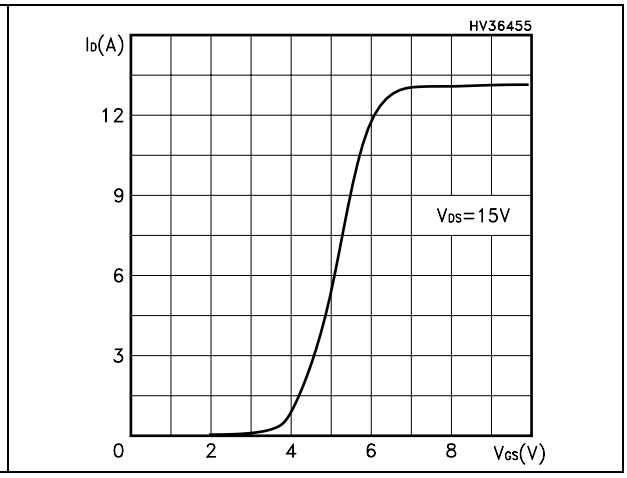


Figure 7. Transconductance

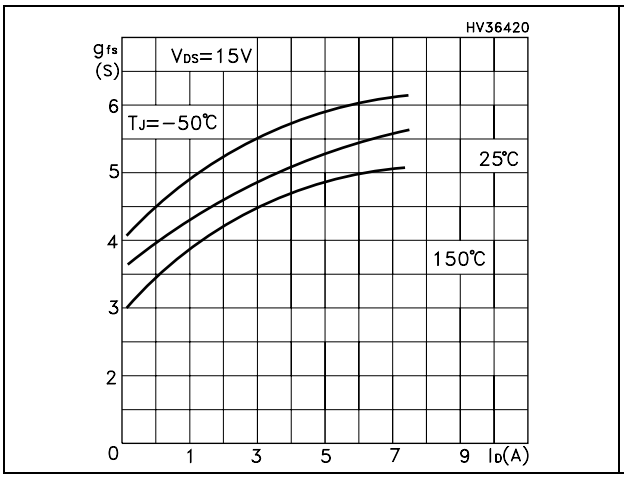


Figure 8. Static drain-source on resistance

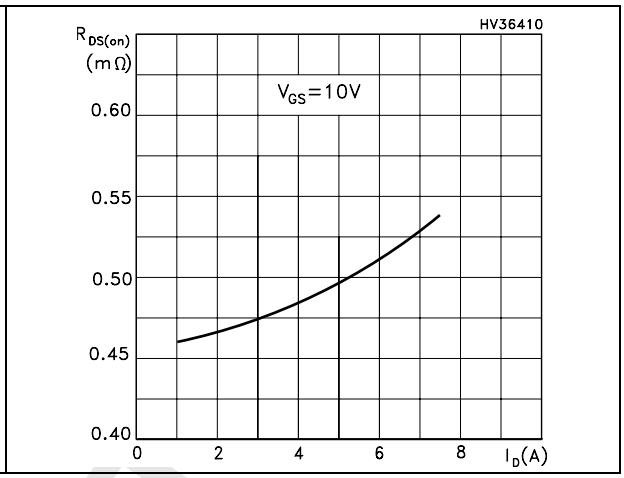


Figure 9. Gate charge vs. gate-source voltage

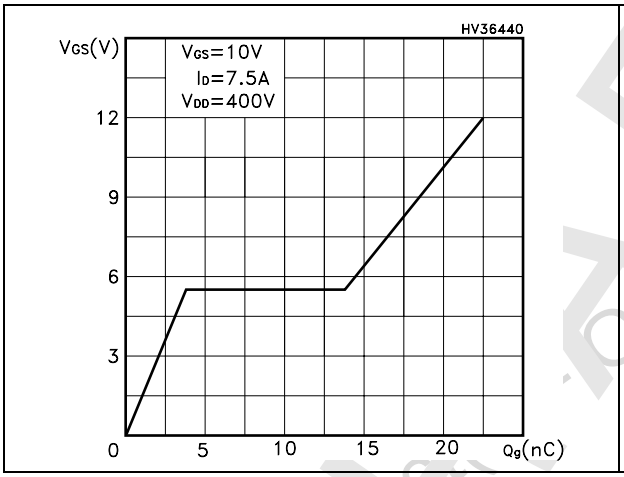


Figure 10. Capacitance variations

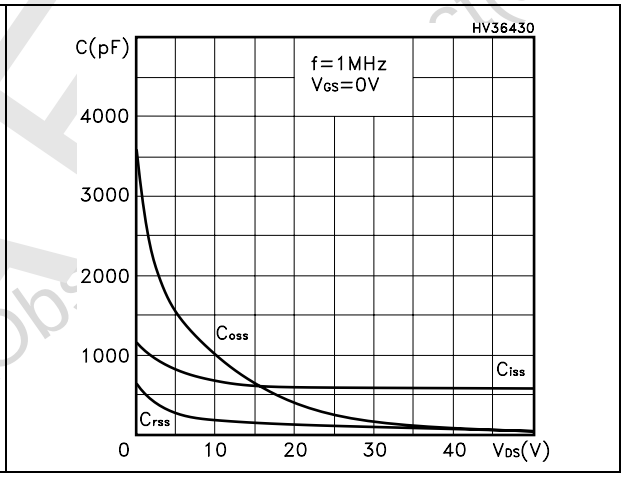


Figure 11. Normalized gate threshold voltage vs. temperature

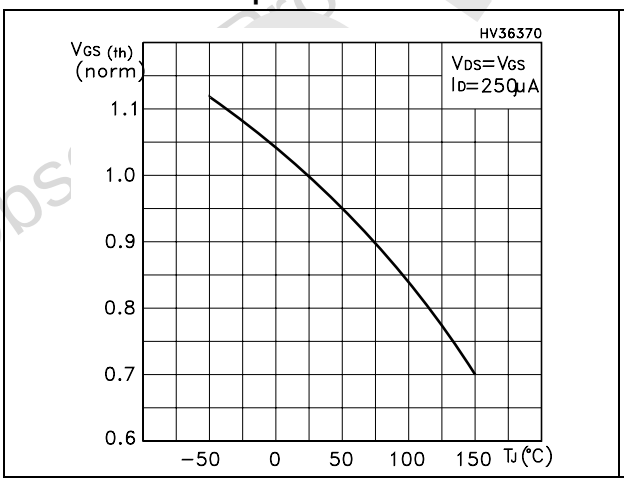


Figure 12. Normalized on resistance vs. temperature

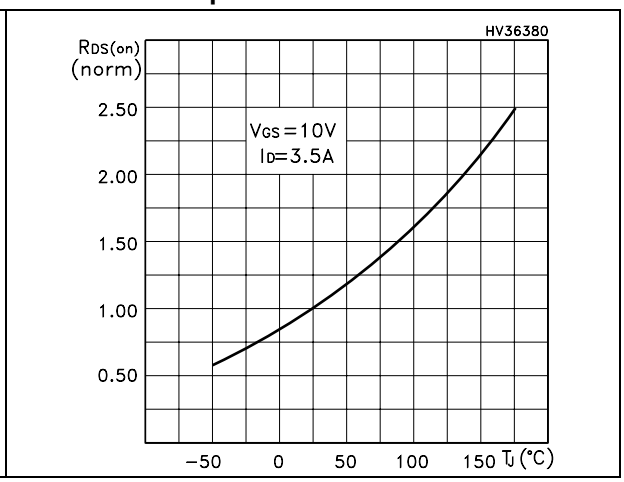


Figure 13. Source-drain diode forward characteristics

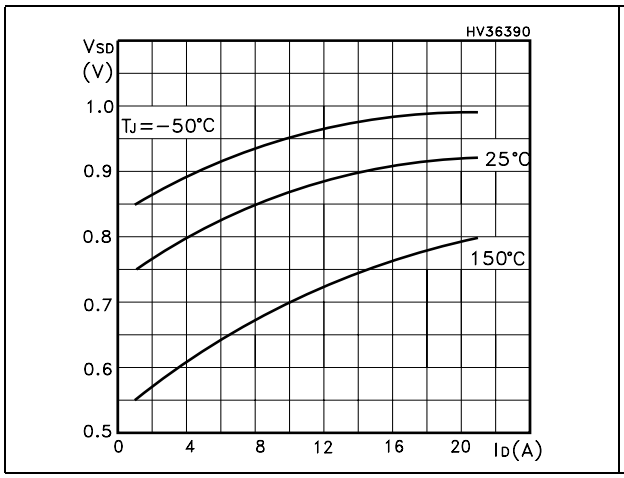
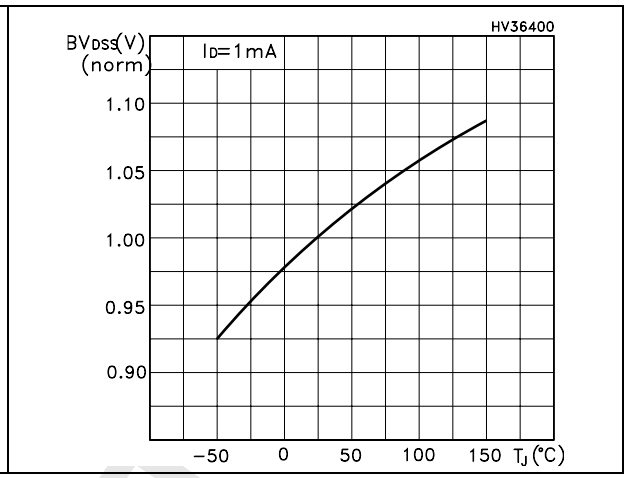


Figure 14. Normalized BV_{DSS} vs. temperature



3 Test circuit

Figure 15. Switching times test circuit for resistive load

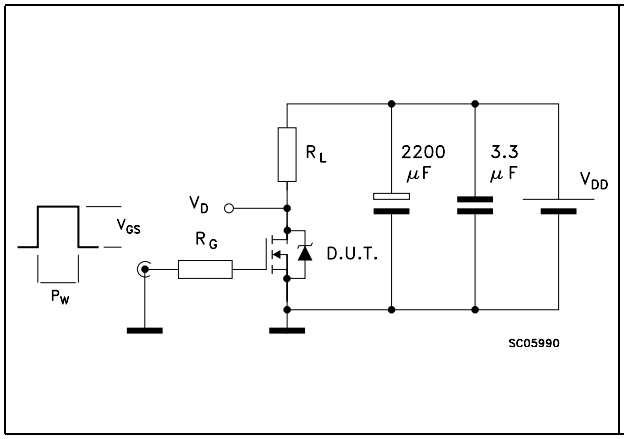


Figure 16. Gate charge test circuit

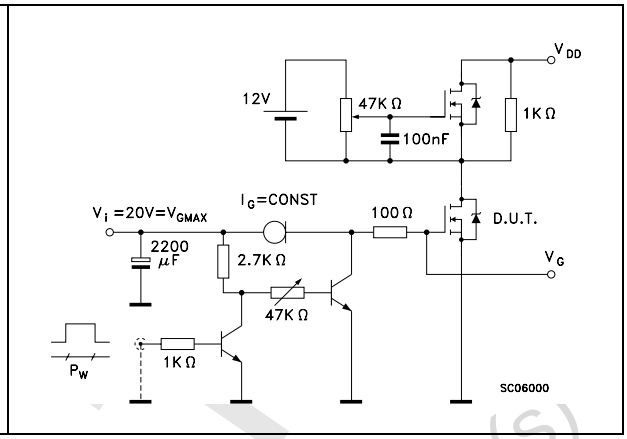


Figure 17. Test circuit for inductive load switching and diode recovery times

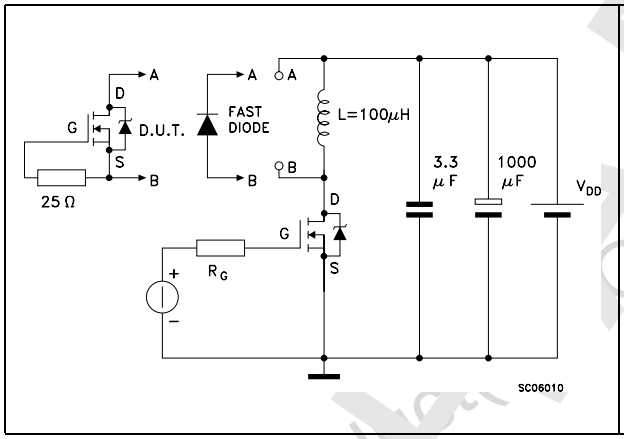


Figure 18. Unclamped inductive load test circuit

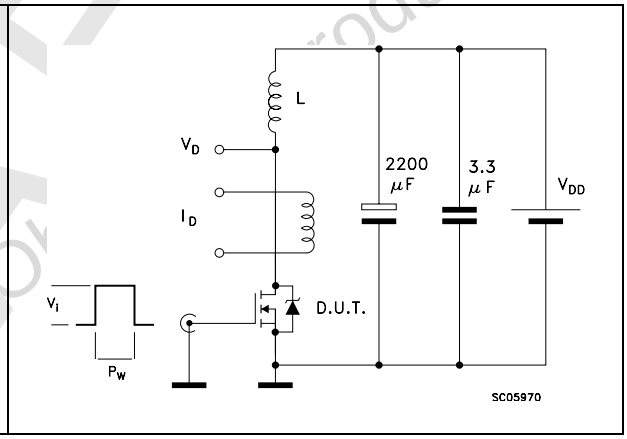


Figure 19. Unclamped inductive waveform

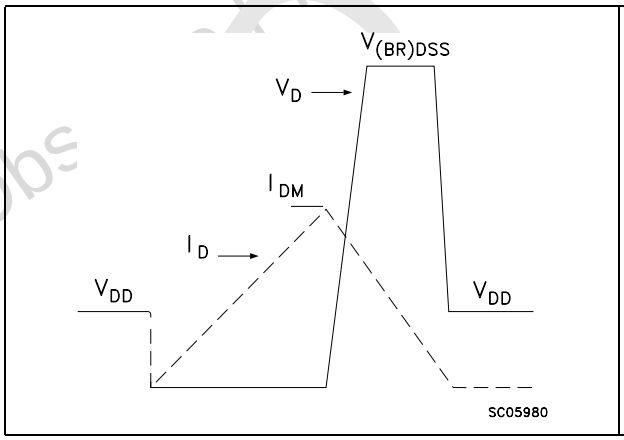
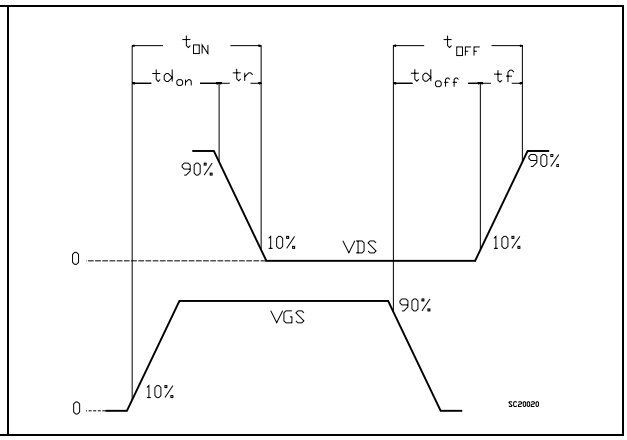


Figure 20. Switching time waveform

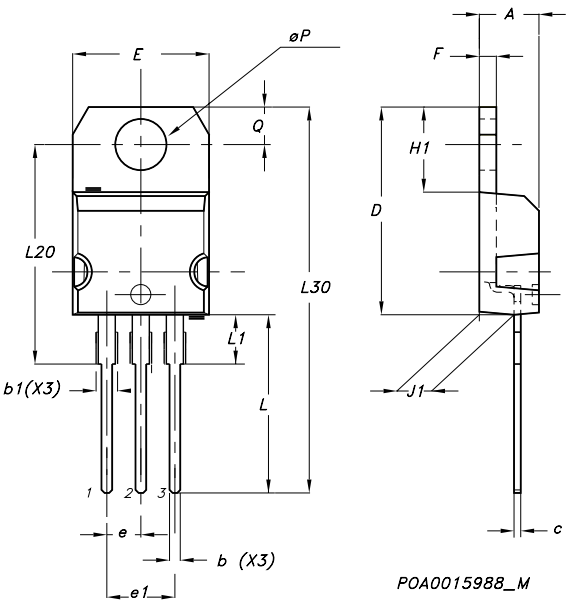


4 Package mechanical data

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*

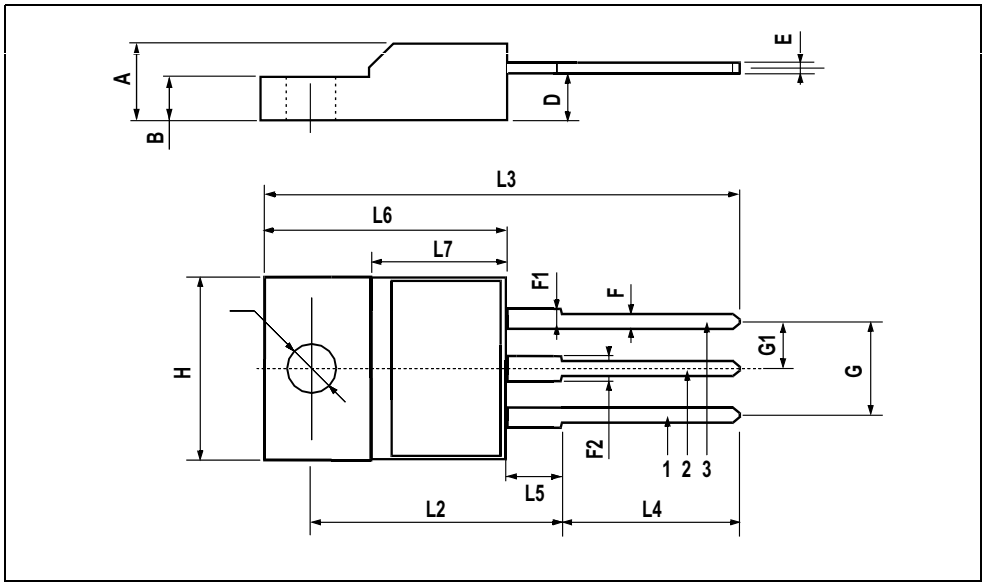
TO-220 MECHANICAL DATA

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



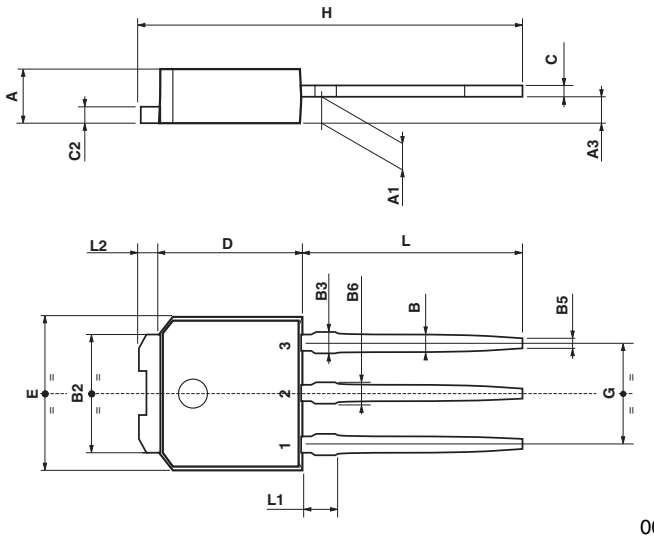
TO-220FP MECHANICAL DATA

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

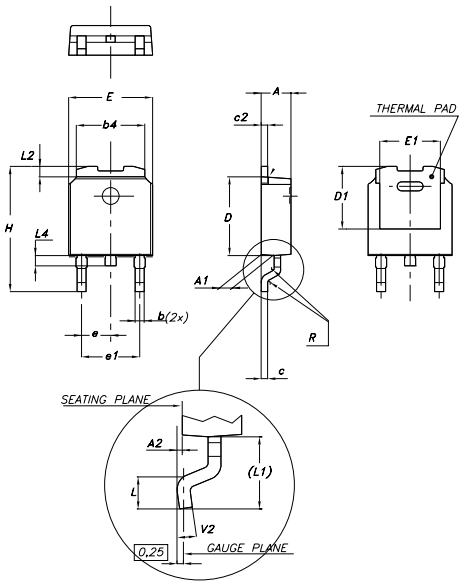
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A3	0.7		1.3	0.027		0.051
B	0.64		0.9	0.025		0.031
B2	5.2		5.4	0.204		0.212
B3			0.85			0.033
B5		0.3			0.012	
B6			0.95			0.037
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
E	6.4		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



0068771-E

DPAK MECHANICAL DATA

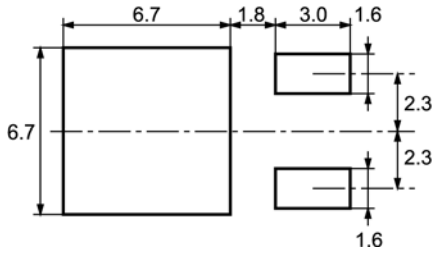
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.9	0.025		0.035
b4	5.2		5.4	0.204		0.212
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
D1		5.1			0.200	
E	6.4		6.6	0.252		0.260
E1		4.7			0.185	
e		2.28			0.090	
e1	4.4		4.6	0.173		0.181
H	9.35		10.1	0.368		0.397
L	1			0.039		
(L1)		2.8			0.110	
L2		0.8			0.031	
L4	0.6		1	0.023		0.039
R		0.2			0.008	
V2	0°		8°	0°		8°



0068772-F

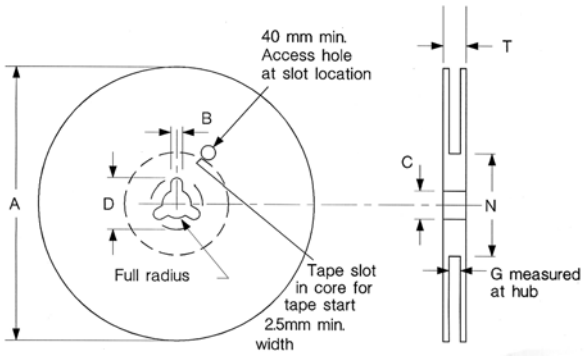
5 Packaging mechanical data

DPAK FOOTPRINT



All dimensions are in millimeters

TAPE AND REEL SHIPMENT



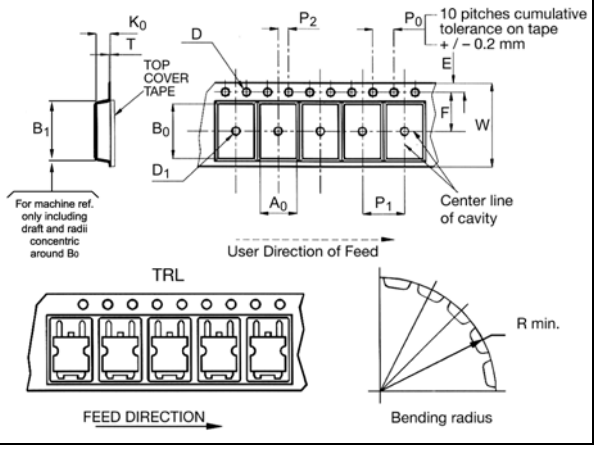
REEL MECHANICAL DATA

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



6 Revision history

Table 8. Revision history

Date	Revision	Changes
10-Apr-2007	1	First release

Please Read Carefully:

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