



**THE DATASHEET OF
STQ1NC45R-AP**





STD2NC45-1 STQ1NC45R-AP

N-channel 450V - 4.1Ω - 1.5A - IPAK - TO-92
SuperMESH™ Power MOSFET

General features

Type	V _{DSS}	R _{DS(on)}	I _D	P _w
STD2NC45-1	450V	<4.5Ω	1.5A	30W
STQ1NC45R-AP	450V	<4.5Ω	0.5A	3.1W

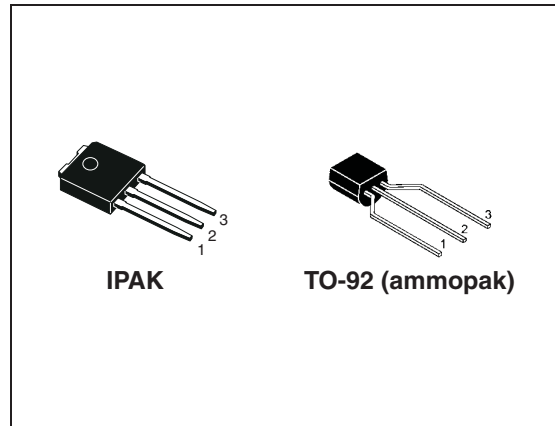
- Extremely high dv/dt capability
- 100% avalanche tested
- Gate charge minimized
- New high voltage benchmark

Description

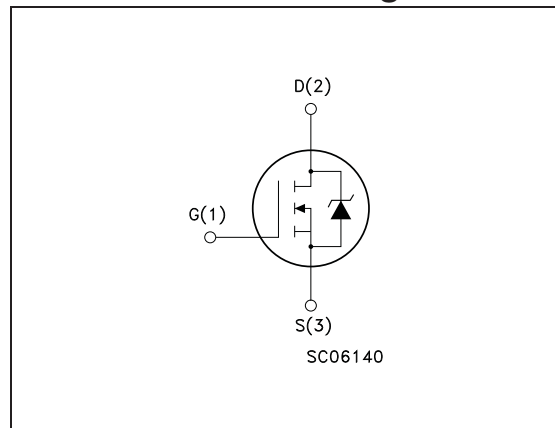
The SuperMESH™ series is obtained through an extreme optimization of ST's well established strip-based PowerMESH™ layout. In addition to pushing on-resistance significantly down, special care is taken to ensure a very good dv/dt capability for the most demanding applications. Such series complements ST full range of high voltage Power MOSFETs including revolutionary MDmesh™ products.

Applications

- Switching application
 - Switch mode low power supplies (SMPS)
 - Low power, low cost CFL (compact fluorescent lamps)
 - Low power battery chargers



Internal schematic diagram



Order codes

Part number	Marking	Package	Packaging
STD2NC45-1	D2NC45	IPAK	Tube
STQ1NC45R-AP	Q1NC45R	TO-92	Ammopak

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1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		IPAK	TO-92	
V_{DS}	Drain-source voltage ($V_{GS} = 0$)	450		V
V_{GS}	Gate- source voltage	± 30		V
I_D	Drain current (continuous) at $T_C = 25^\circ\text{C}$	1.5	0.5	A
I_D	Drain current (continuous) at $T_C = 100^\circ\text{C}$	0.95	0.315	A
$I_{DM}^{(1)}$	Drain current (pulsed)	6	2	A
P_{TOT}	Total dissipation at $T_C = 25^\circ\text{C}$	30	3.1	W
	Derating factor	0.24	0.025	W/ $^\circ\text{C}$
$dv/dt^{(2)}$	Peak diode recovery voltage slope	3		V/ns
T_{stg}	Storage temperature	-65 to 150		$^\circ\text{C}$
T_j	Max. operating junction temperature			$^\circ\text{C}$

1. Pulse width limited by safe operating area

2. $I_{SD} \leq 0.5\text{A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$, $V_{DD} = 80\% V_{(BR)DSS}$

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		IPAK	TO-92	
$R_{thj-case}$	Thermal resistance junction-case max	4.1	--	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	100	120	$^\circ\text{C}/\text{W}$
$R_{thj-lead}$	Thermal resistance junction-lead max	--	40	$^\circ\text{C}/\text{W}$
T_l	Maximum lead temperature for soldering purpose	275	260	$^\circ\text{C}$

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j Max)	1.5	A
E_{AS}	Single pulse avalanche energy (starting $T_j=25^\circ\text{C}$, $I_D=I_{AS}$, $V_{DD}=50\text{V}$)	25	mJ

2 Electrical characteristics

($T_{CASE} = 25^{\circ}C$ unless otherwise specified)

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250\mu A, V_{GS} = 0$	450			V
I_{DSS}	Zero gate voltage Drain current ($V_{GS} = 0$)	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}, T_C = 125^{\circ}C$			1 50	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 30V$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	2.3	3	3.7	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10V, I_D = 0.5A$		4.1	4.5	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} > I_{D(on)} \times R_{DS(on)max},$ $I_D = 0.5A$		1.1		S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25V, f = 1 \text{ MHz}, V_{GS} = 0$		160 27.5 4.7		pF pF pF
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 360V, I_D = 1.5A,$ $V_{GS} = 10V, R_G = 4.7\Omega$ (see Figure 18)		7 1.3 3.2	10	nC nC nC

1. Pulsed: pulse duration = 300 μs , duty cycle 1.5 %

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 225V, I_D = 0.5A$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see Figure 17)		6.7		ns
t_r	Rise time			4		ns
$t_{r(voff)}$	Off-voltage rise time	$V_{DD} = 360V, I_D = 1.5A,$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see Figure 17)		8.5		ns
t_f	Fall time			12		ns
t_c	Cross-over time			18		ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
I_{SD}	Source-drain current				1.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				6.0	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 1.5A, V_{GS} = 0$			1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 1.5A, di/dt = 100A/\mu s$ $V_{DD} = 100V, T_j = 150^\circ C$ (see Figure 22)		225		ns
Q_{rr}	Reverse recovery charge			530		μC
I_{RRM}	Reverse recovery current			4.7		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 1. Safe operating area for IPAK

Figure 2. Thermal impedance for IPAK

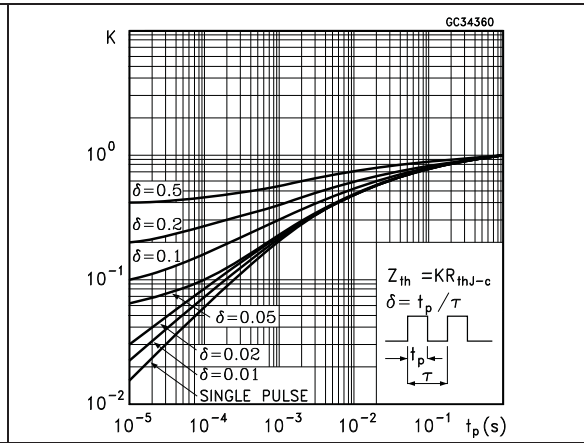
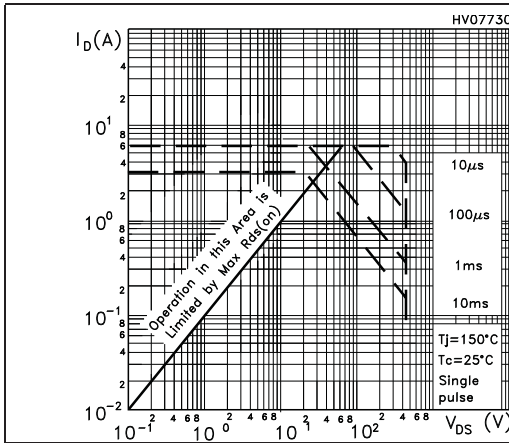


Figure 3. Safe operating area for TO-92

Figure 4. Thermal impedance for TO-92

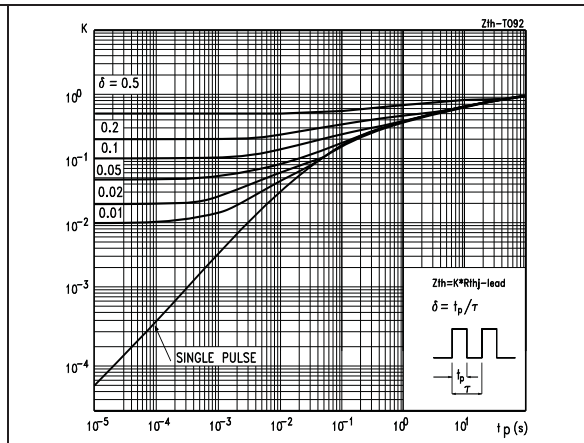
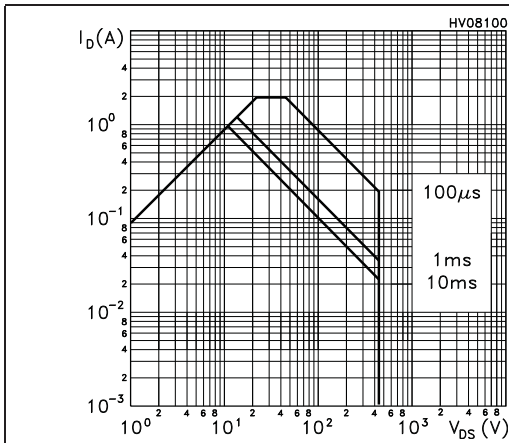


Figure 5. Output characteristics

Figure 6. Transfer characteristics

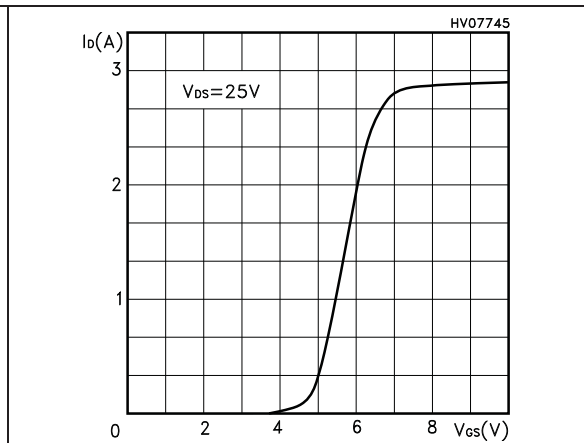
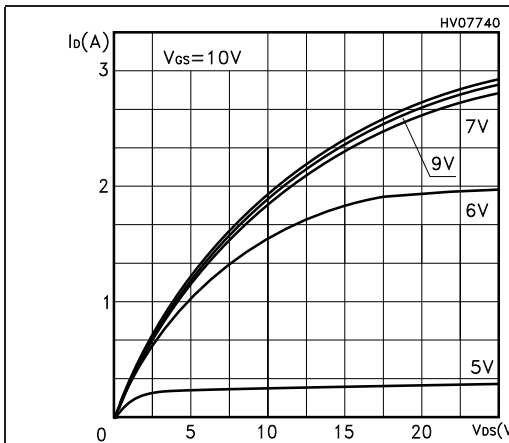


Figure 7. Transconductance

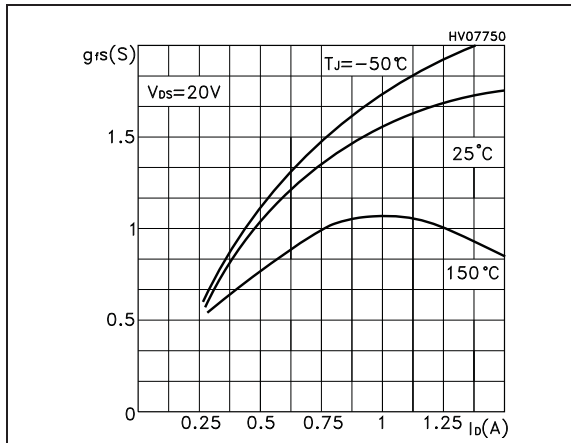


Figure 8. Static drain-source on resistance

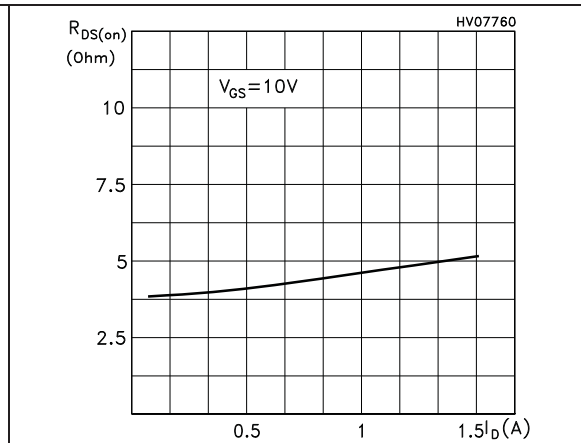


Figure 9. Gate charge vs gate-source voltage Figure 10. Capacitance variations

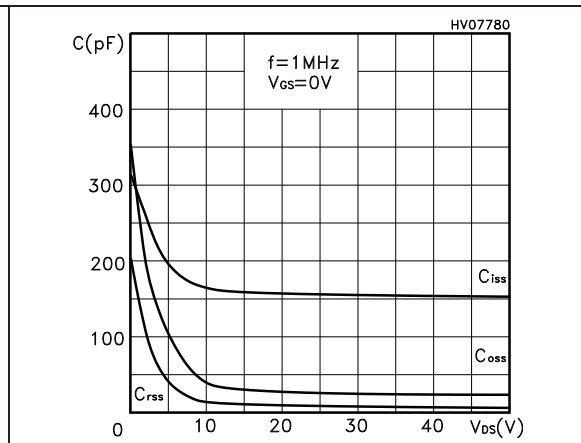
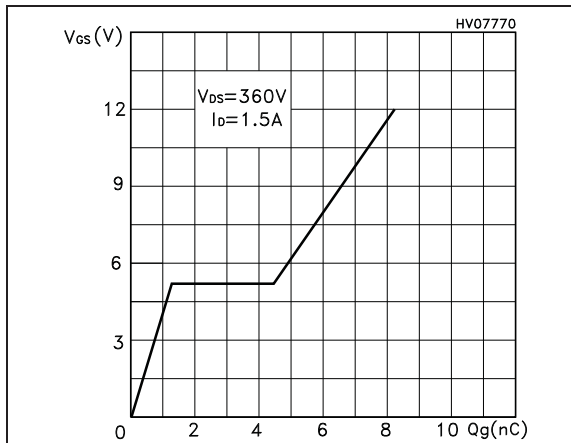


Figure 11. Normalized gate threshold voltage vs temperature

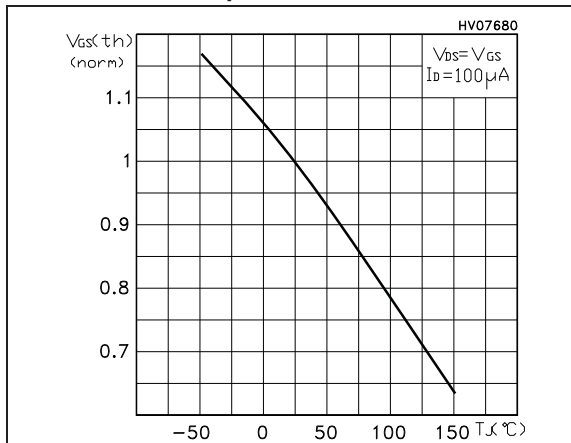


Figure 12. Normalized on resistance vs temperature

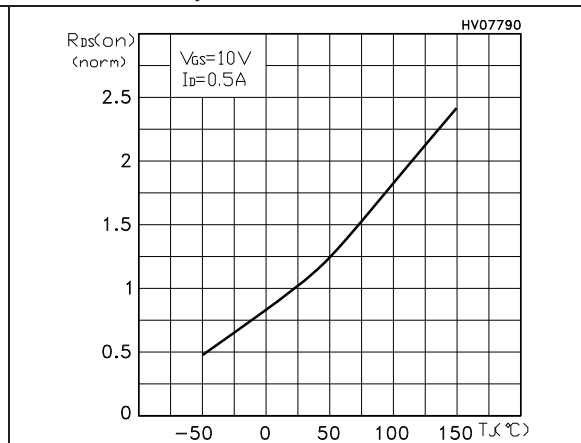


Figure 13. Source-drain diode forward characteristics

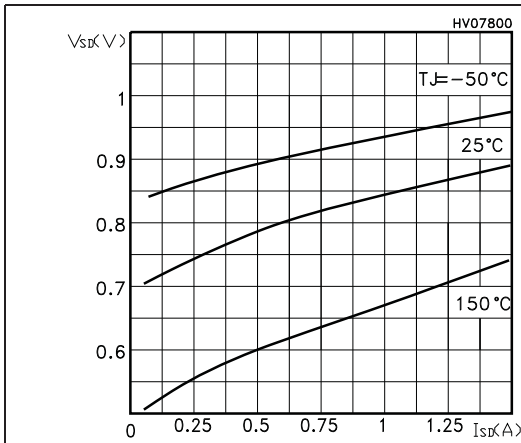


Figure 14. Normalized B_{VDSS} vs temperature

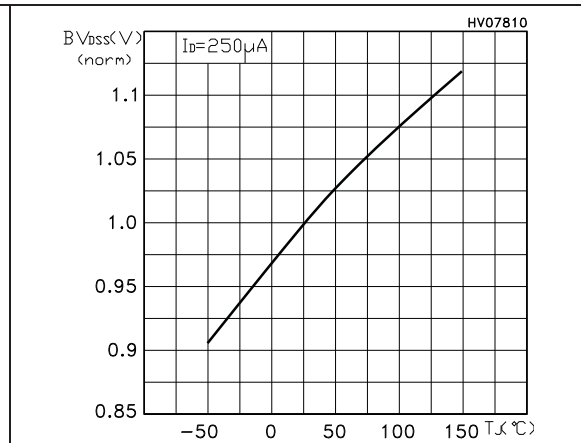


Figure 15. Max Id current vs Temperature

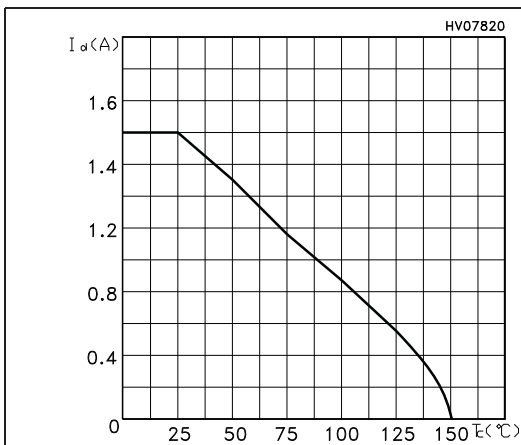
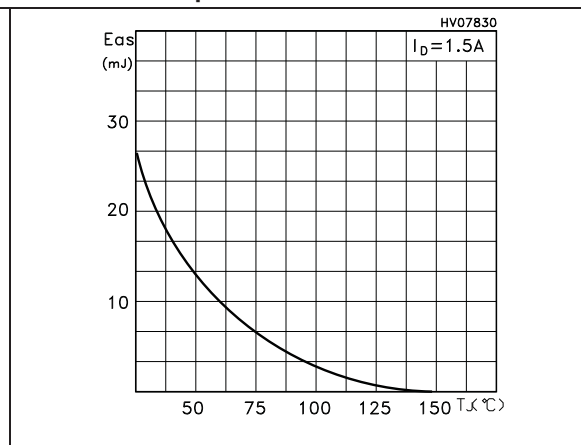


Figure 16. Maximum avalanche energy vs temperature



3 Test circuit

Figure 17. Switching times test circuit for resistive load

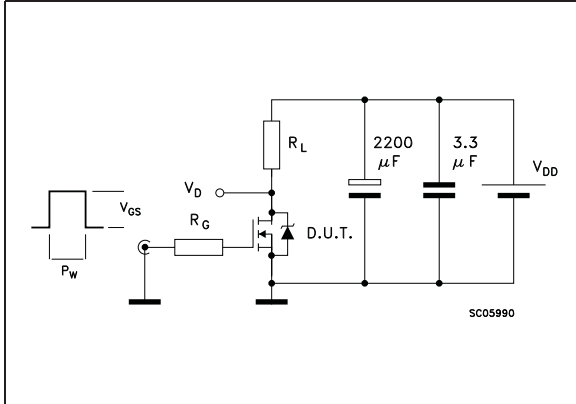


Figure 18. Gate charge test circuit

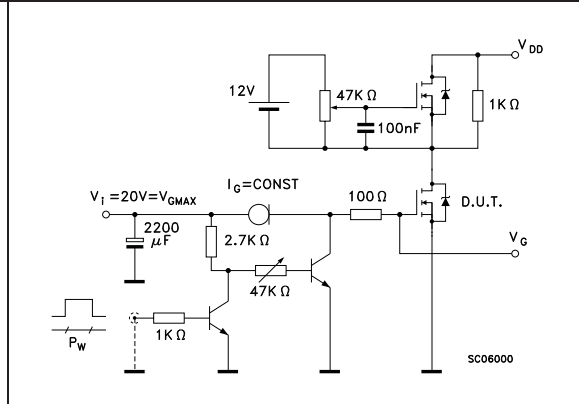


Figure 19. Test circuit for inductive load switching and diode recovery times

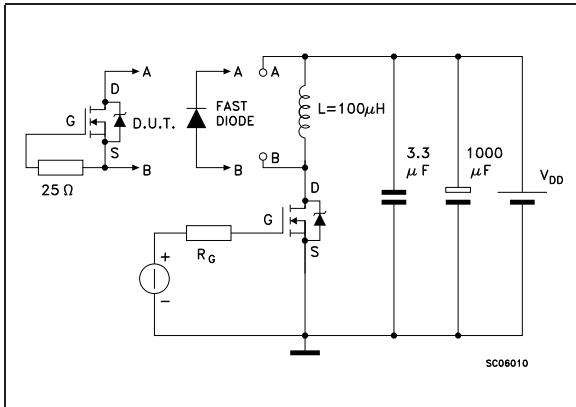


Figure 20. Unclamped Inductive load test circuit

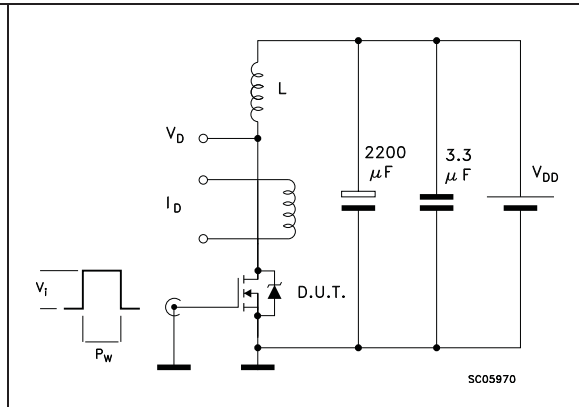
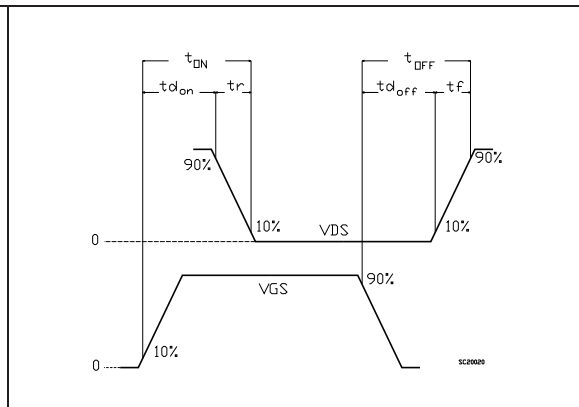
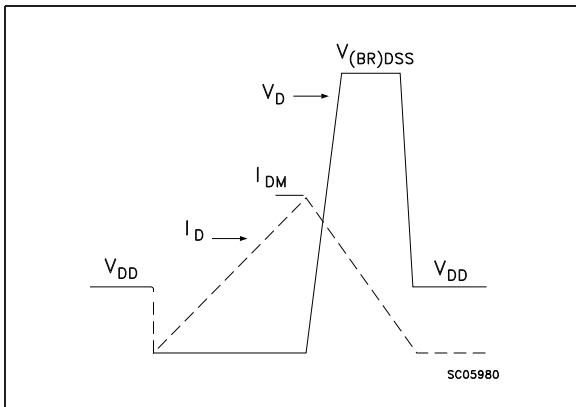


Figure 21. Unclamped inductive waveform

Figure 22. Switching time waveform

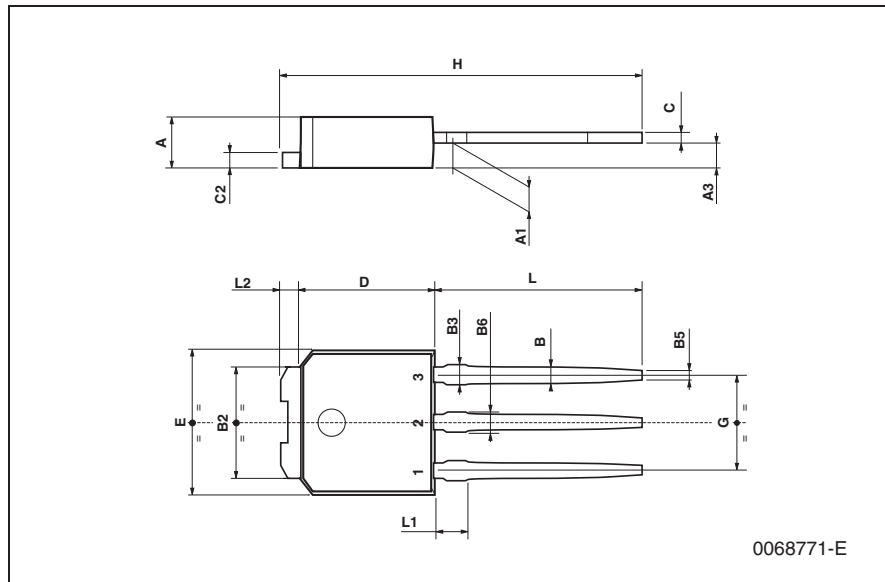


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in 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

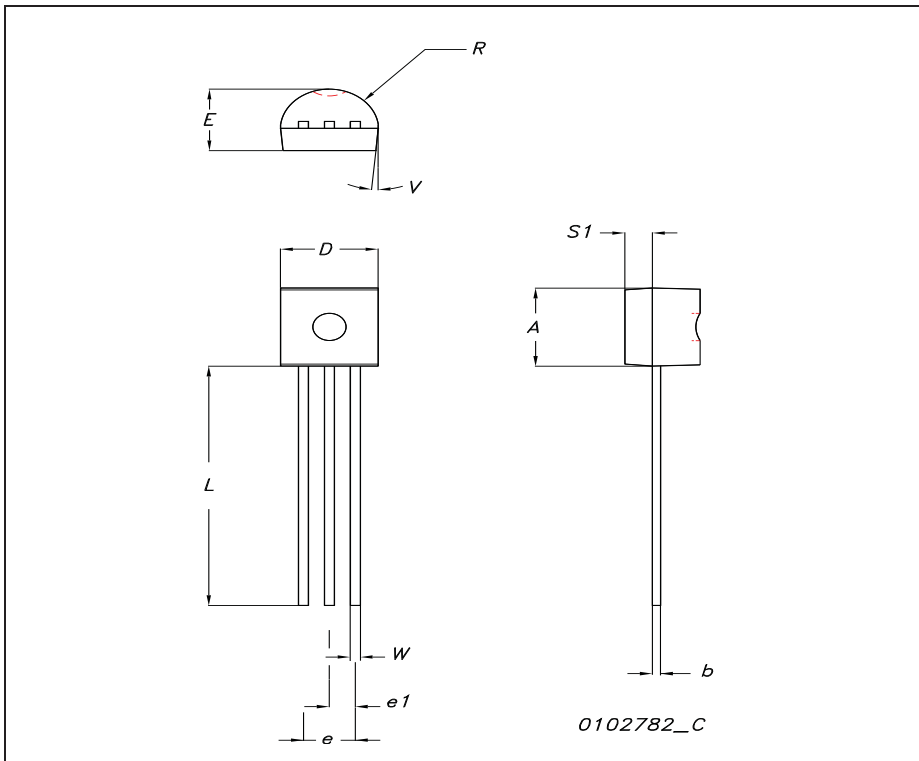
TO-251 (IPAK) MECHANICAL DATA

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



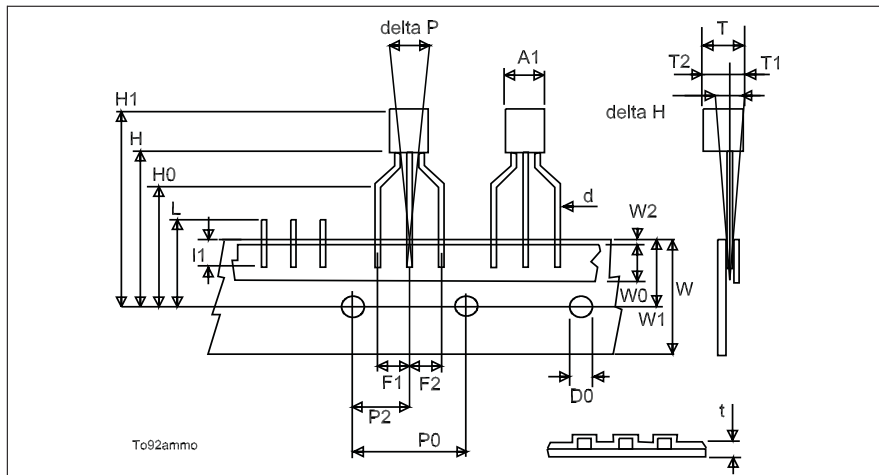
TO-92 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.32		4.95	0.170		0.194
b	0.36		0.51	0.014		0.020
D	4.45		4.95	0.175		0.194
E	3.30		3.94	0.130		0.155
e	2.41		2.67	0.094		0.105
e1	1.14		1.40	0.044		0.055
L	12.70		15.49	0.50		0.610
R	2.16		2.41	0.085		0.094
S1	0.92		1.52	0.036		0.060
W	0.41		0.56	0.016		0.022
V		5°			5°	



TO-92 AMMOPACK

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A1	4.45		4.95	0.170		0.194
T	3.30		3.94	0.130		0.155
T1			1.6			0.06
T2			2.3			0.09
d	0.41		0.56	0.016		0.022
P0	12.5	12.7	12.9	0.49	0.5	0.51
P2	5.65	6.35	7.05	0.22	0.25	0.27
F1, F2	2.44	2.54	2.94	0.09	0.1	0.11
delta H	-2		2	-0.08		0.08
W	17.5	18	19	0.69	0.71	0.74
W0	5.7	6	6.3	0.22	0.23	0.24
W1	8.5	9	9.25	0.33	0.35	0.36
W2			0.5			0.02
H	18.5		20.5	0.72		0.80
H0	15.5	16	16.5	0.61	0.63	0.65
H1			25			0.98
D0	3.8	4	4.2	0.15	0.157	0.16
t			0.9			0.035
L			11			0.43
l1	3			0.11		
delta P	-1		1	-0.04		0.04



5 Revision history

Table 8. Revision history

Date	Revision	Changes
21-Jun-2004	2	Complete version
12-Jul-2006	3	New template

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