



## STD2NC45-1

N-channel 450 V, 4.1  $\Omega$ , 1.5 A, IPAK  
SuperMESH™ Power MOSFET

### Features

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

### Application

- Switching applications

### 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.

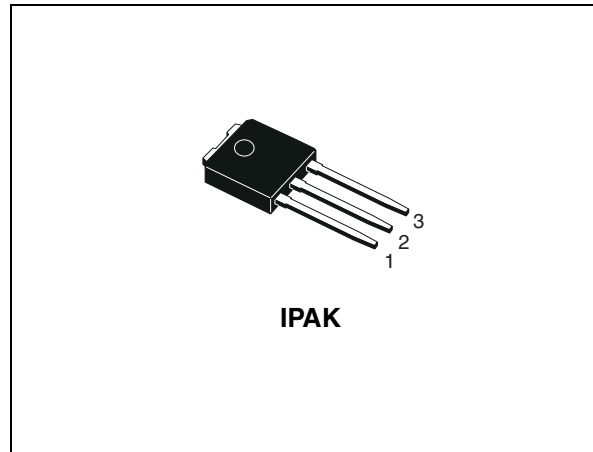


Figure 1. Internal schematic diagram

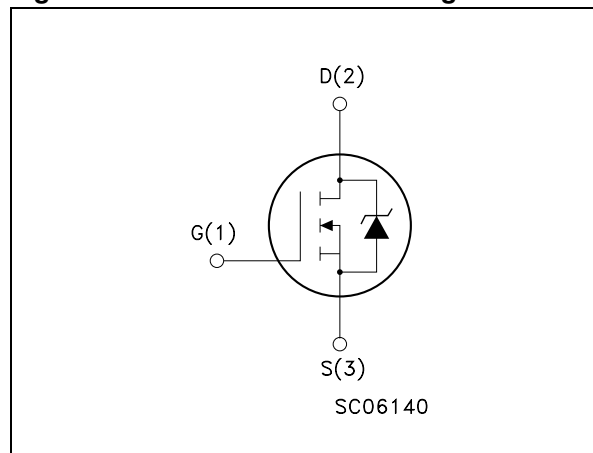


Table 1. Device summary

Order code	Marking	Package	Packaging
STD2NC45-1	D2NC45	IPAK	Tube

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	450	V
$V_{GS}$	Gate- source voltage	$\pm 30$	V
$I_D$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	1.5	A
$I_D$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	0.95	A
$I_{DM}^{(1)}$	Drain current (pulsed)	6	A
$P_{TOT}$	Total dissipation at $T_C = 25^\circ\text{C}$	30	W
	Derating factor	0.24	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 3. Thermal data**

Symbol	Parameter	Value	Unit
Rthj-case	Thermal resistance junction-case max	4.1	$^\circ\text{C}/\text{W}$
Rthj-amb	Thermal resistance junction-ambient max	100	$^\circ\text{C}/\text{W}$
$T_l$	Maximum lead temperature for soldering purpose	275	$^\circ\text{C}$

**Table 4. 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 5. 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	$\mu A$ $\mu A$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 30V$			$\pm 100$	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	$\Omega$

**Table 6. 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 17)	-	7 1.3 3.2	10	nC nC nC

1. Pulsed: pulse duration = 300  $\mu s$ , duty cycle 1.5 %

**Table 7. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on delay time Rise time	$V_{DD} = 225V, I_D = 0.5A$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see Figure 16)	-	6.7 4	-	ns ns
$t_{r(Voff)}$ $t_f$ $t_c$	Off-voltage rise time Fall time Cross-over time	$V_{DD} = 360V, I_D = 1.5A,$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see Figure 16)	-	8.5 12 18	-	ns ns ns

**Table 8. 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	$I_{SD} = 1.5A, di/dt = 100A/\mu s$ $V_{DD} = 100V, T_j = 150^\circ C$ <i>(see Figure 21)</i>	-	225		ns
$Q_{rr}$	Reverse recovery charge			530		$\mu C$
$I_{RRM}$	Reverse recovery current			4.7		A

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

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for IPAK

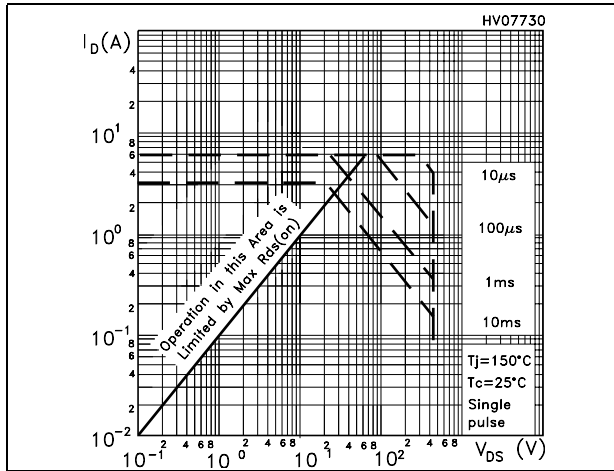


Figure 3. Thermal impedance for IPAK

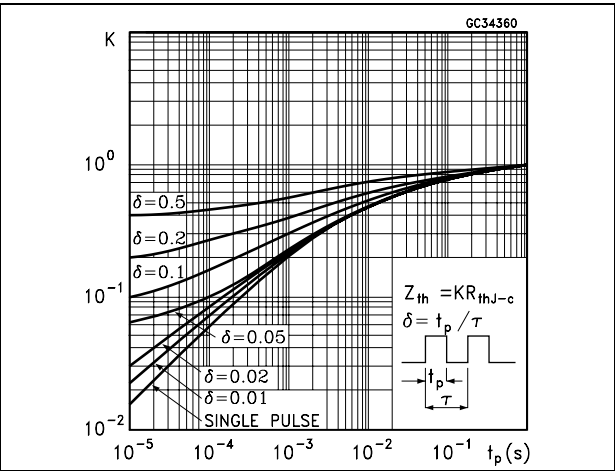


Figure 4. Output characteristics

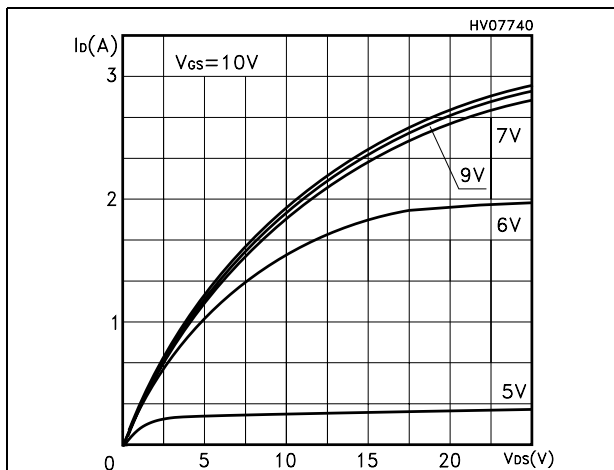


Figure 5. Transfer characteristics

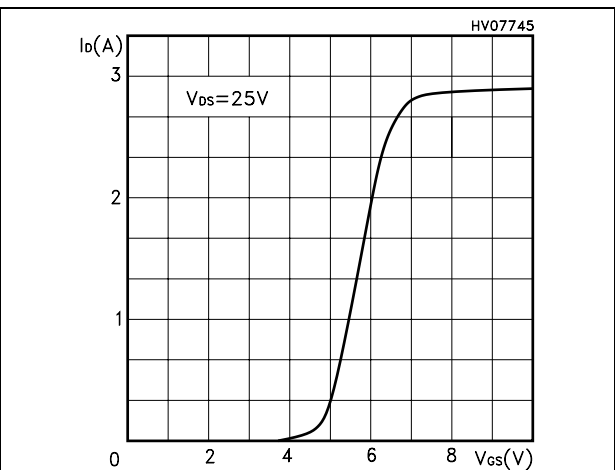


Figure 6. Transconductance

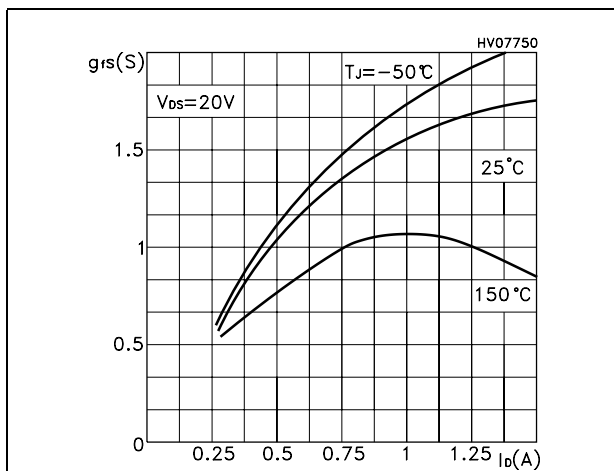


Figure 7. Static drain-source on resistance

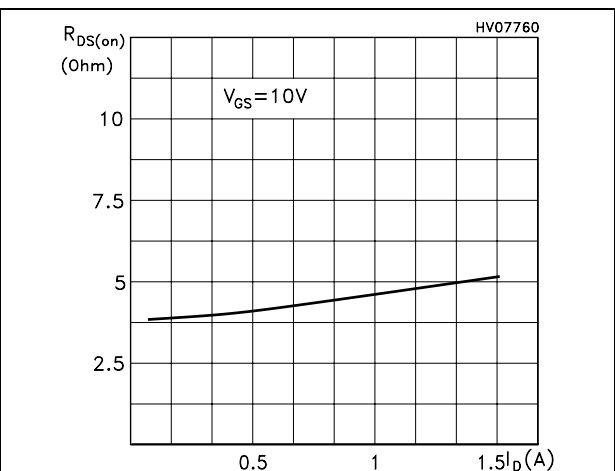


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

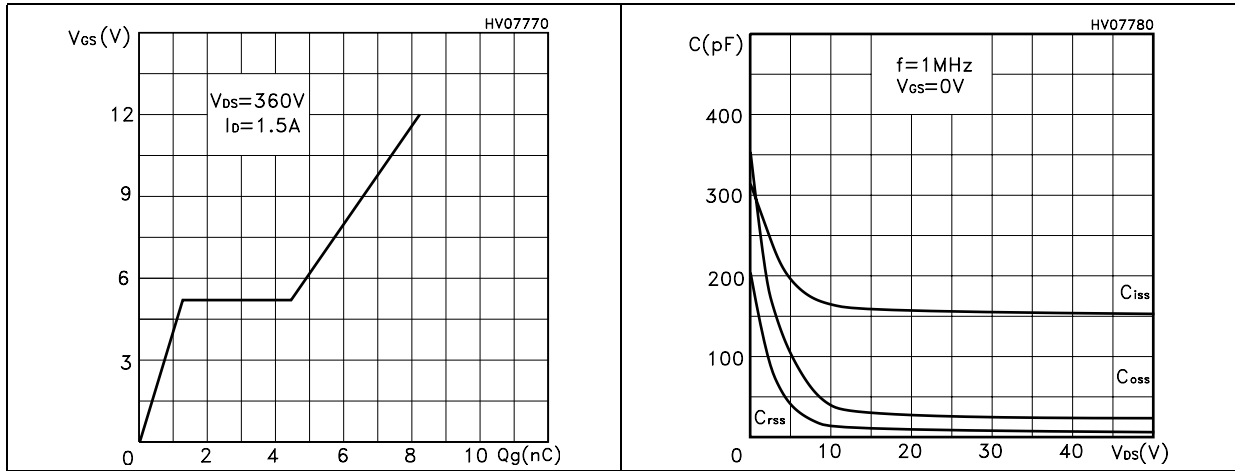


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

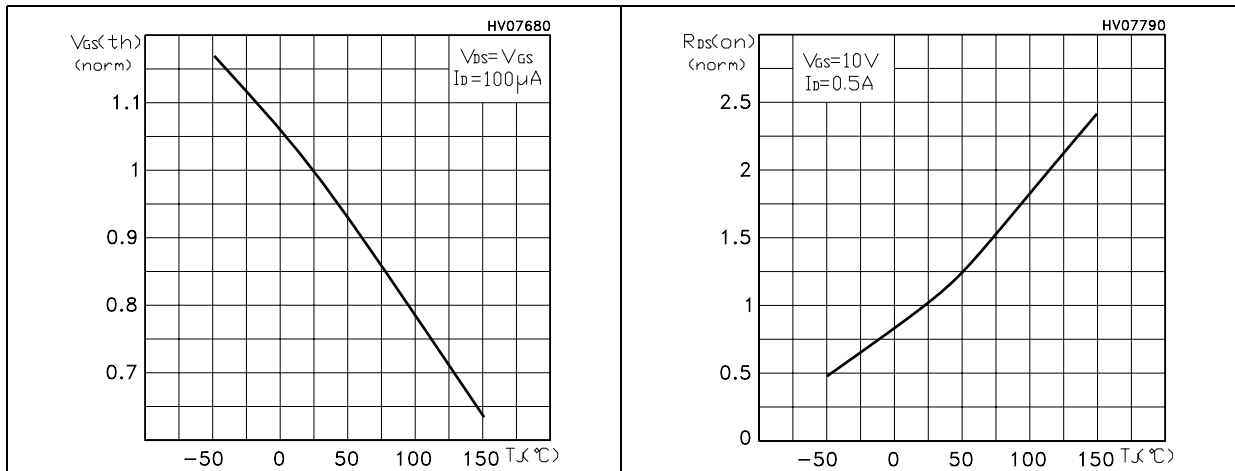


Figure 12. Source-drain diode forward characteristics Figure 13. Normalized  $B_{V_{DS}}$  vs temperature

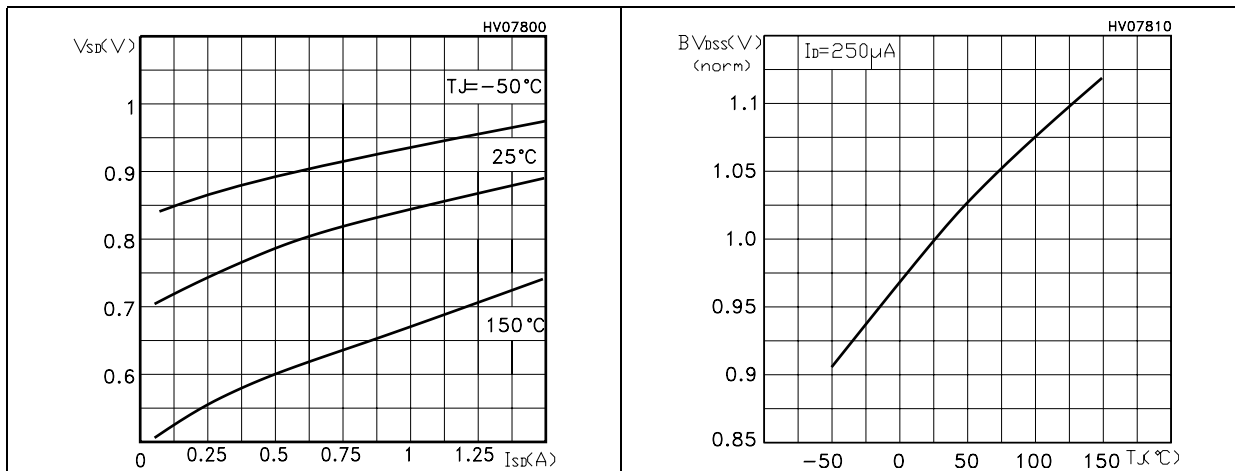


Figure 14. Max Id current vs Temperature

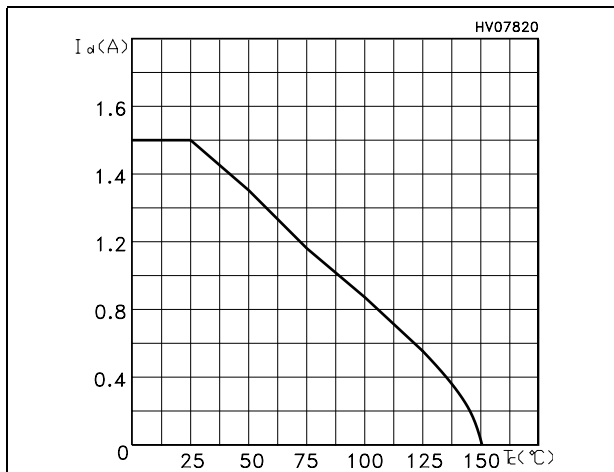
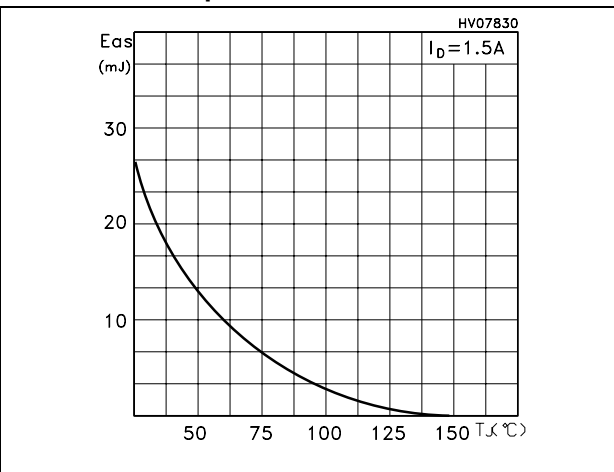


Figure 15. Maximum avalanche energy vs temperature





### 3 Test circuits

Figure 16. Switching times test circuit for resistive load

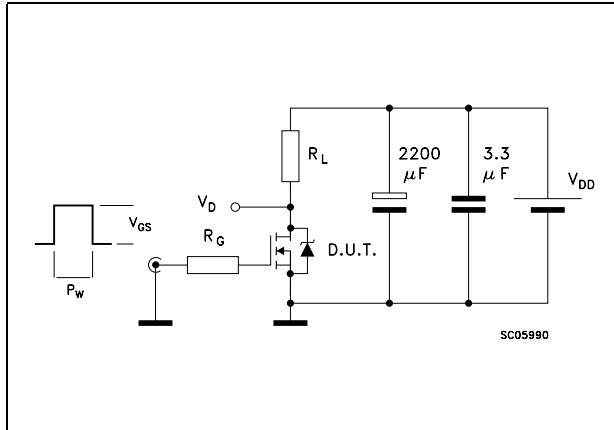


Figure 17. Gate charge test circuit

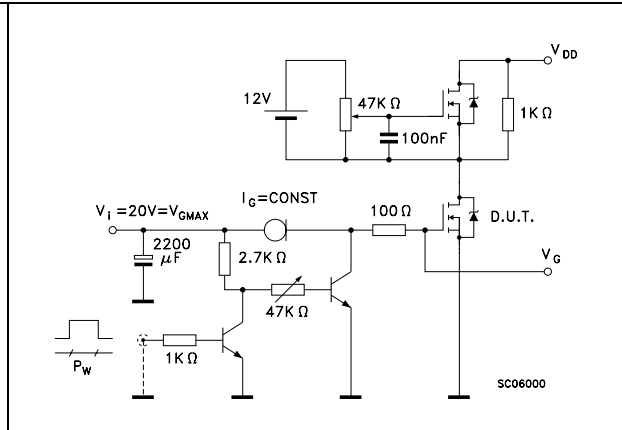


Figure 18. Test circuit for inductive load switching and diode recovery times

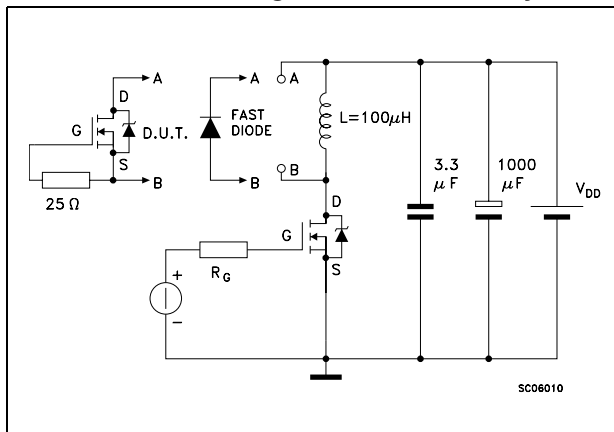


Figure 19. Unclamped inductive load test circuit

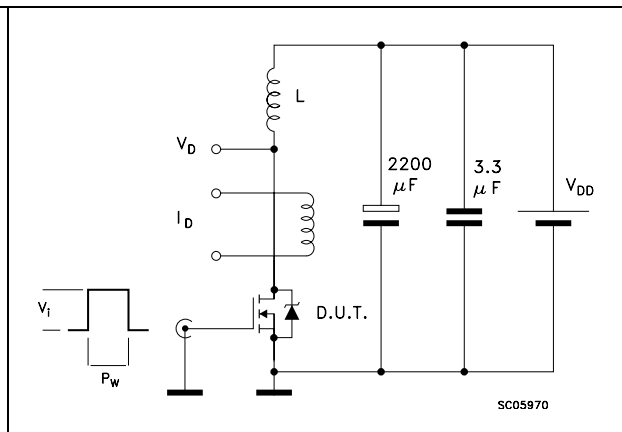


Figure 20. Unclamped inductive waveform

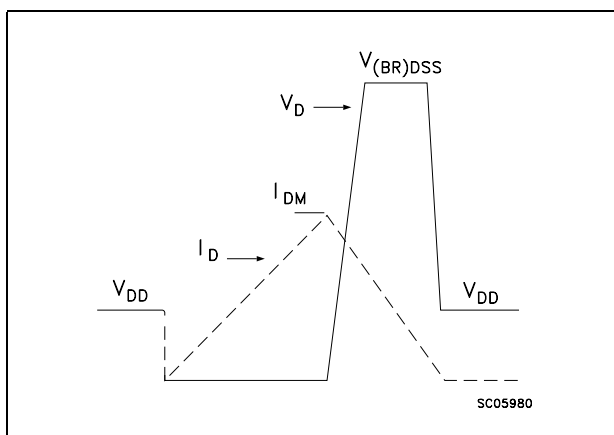
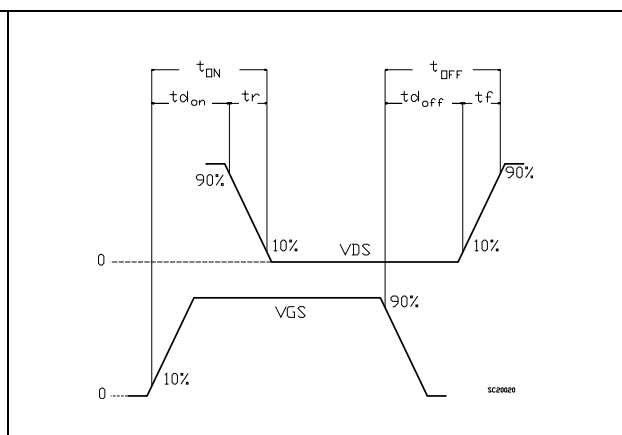


Figure 21. Switching time waveform

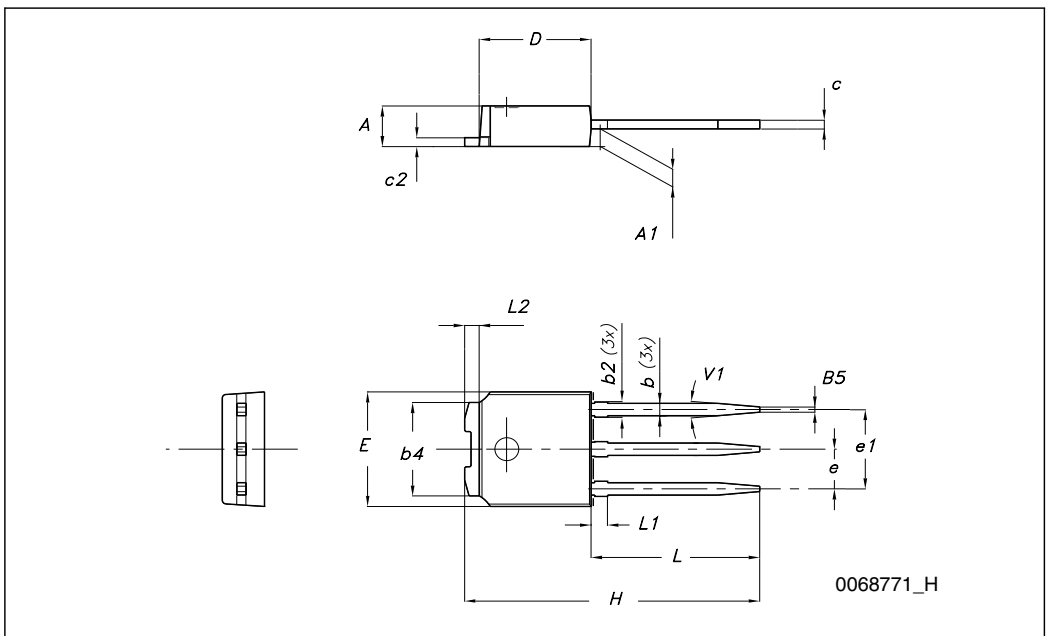


## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

**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 Revision history

**Table 9. Revision history**

Date	Revision	Changes
21-Jun-2004	2	Complete version
12-Jul-2006	3	New template
17-Apr-2009	4	Updated mechanical data New ECOPACK <sup>®</sup> statement in <a href="#">Section 4: Package mechanical data</a>

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