



# STD95N2LH5 STP95N2LH5, STU95N2LH5

N-channel 25 V, 0.0038  $\Omega$ , 80 A, DPAK, IPAK, TO-220  
STripFET™ V Power MOSFET

## Features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>
STD95N2LH5	25 V	< 0.0045 $\Omega$	80 A
STP95N2LH5	25 V	< 0.0049 $\Omega$	80 A
STU95N2LH5	25 V	< 0.0049 $\Omega$	80 A

- R<sub>DS(on)</sub> \* Q<sub>g</sub> industry benchmark
- Extremely low on-resistance R<sub>DS(on)</sub>
- High avalanche ruggedness
- Low gate drive power losses

## Application

- Switching applications

## Description

This STripFET™V Power MOSFET technology is among the latest improvements, which have been especially tailored to achieve very low on-state resistance providing also one of the best-in-class FOM (figure of merit).

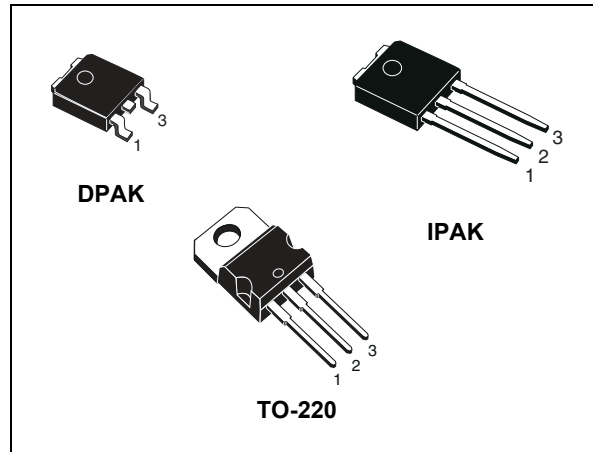


Figure 1. Internal schematic diagram

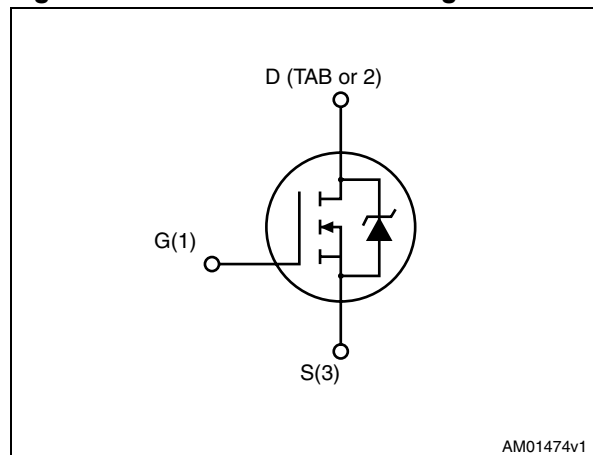


Table 1. Device summary

Order codes	Marking	Package	Packaging
STD95N2LH5	95N2LH5	DPAK	Tape and reel
STP95N2LH5	95N2LH5	TO-220	Tube
STU95N2LH5	95N2LH5	IPAK	Tube

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		DPAK/IPAK	TO-220	
$V_{DS}$	Drain-source voltage ( $V_{GS}=0$ )	25		V
$V_{GS}$	Gate-Source voltage	$\pm 22$		V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	80	95	A
$I_D$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	67		A
$I_{DM}^{(2)}$	Drain current (pulsed)	320	380	A
$P_{TOT}$	Total dissipation at $T_C = 25^\circ\text{C}$	70	80	W
	Derating factor	0.47		W/ $^\circ\text{C}$
$E_{AS}^{(3)}$	Single pulse avalanche energy	165		mJ
$T_j$ $T_{stg}$	Operating junction temperature Storage temperature	-55 to 175		$^\circ\text{C}$

1. Limited by wire bonding
2. Pulse width limited by safe operating area
3. Starting  $T_j = 25^\circ\text{C}$ ,  $I_d = 40\text{ A}$ ,  $V_{dd} = 20\text{ V}$

**Table 3. Thermal resistance**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	2.14	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-case max	100	$^\circ\text{C}/\text{W}$
$T_j$	Maximum lead temperature for soldering purpose	275	$^\circ\text{C}$

## 2 Electrical characteristics

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

**Table 4. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown Voltage	$I_D = 250\text{ }\mu\text{A}$ , $V_{GS} = 0$	25			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = 25\text{ V}$ $V_{DS} = 25\text{ V}$ , $T_c = 125^{\circ}\text{C}$			1 10	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 22\text{ V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	1			V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$ , $I_D = 40\text{ A}$ SMD version		0.0038	0.0045	$\Omega$
		$V_{GS} = 10\text{ V}$ , $I_D = 40\text{ A}$		0.0044	0.0049	$\Omega$
		$V_{GS} = 5\text{ V}$ , $I_D = 40\text{ A}$ SMD version		0.005	0.006	$\Omega$
		$V_{GS} = 5\text{ V}$ , $I_D = 40\text{ A}$		0.006	0.007	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	1817	-	pF
$C_{oss}$	Output capacitance			420		pF
$C_{rss}$	Reverse transfer capacitance			67		pF
$Q_g$	Total gate charge	$V_{DD} = 13\text{ V}$ , $I_D = 80\text{ A}$	-	13.4	-	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 5\text{ V}$		6.7		nC
$Q_{gd}$	Gate-drain charge	<a href="#">Figure 18</a>		4.1		nC
$Q_{gs1}$	Pre $V_{th}$ gate-to-source charge	$V_{DD} = 13\text{ V}$ , $I_D = 80\text{ A}$ <a href="#">Figure 21</a>	-	3.5	-	nC
$Q_{gs2}$	Post $V_{th}$ gate-to-source charge			3.2		nC
$R_G$	Gate input resistance	$f = 1\text{ MHz}$ gate bias Bias = 0 test signal level = 20 mV open drain	-	1.1	-	$\Omega$

**Table 6. Switching on/off (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on delay time Rise time	$V_{DD}=12.5\text{ V}$ , $I_D=40\text{ A}$ , $R_G=4.7\ \Omega$ , $V_{GS}=10\text{ V}$ <a href="#">Figure 17</a>	-	7 38	-	ns ns
$t_{d(off)}$ $t_f$	Turn-off delay time Fall time	$V_{DD}=12.5\text{ V}$ , $I_D=40\text{ A}$ , $R_G=4.7\ \Omega$ , $V_{GS}=10\text{ V}$ <a href="#">Figure 17</a>	-	22 7	-	ns ns

**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		80	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		320	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}=35\text{ A}$ , $V_{GS}=0$	-		1.1	V
$t_{rr}$	Reverse recovery time	$I_{SD}=80\text{ A}$ , $V_{DD}=20\text{ V}$	-	32.4		ns
$Q_{rr}$	Reverse recovery charge	$di/dt=100\text{ A}/\mu\text{s}$ ,	-	27.1		nC
$I_{RRM}$	Reverse recovery current	<a href="#">Figure 19</a>	-	1.7		A

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

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for DPAK, IPAK Figure 3. Thermal impedance for DPAK, IPAK

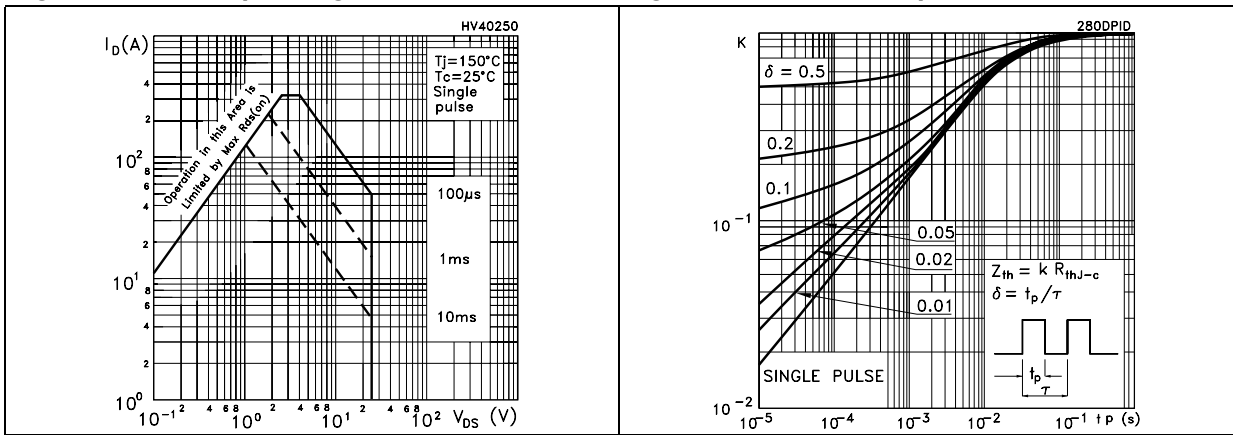


Figure 4. Safe operating area for TO-220

Figure 5. Thermal impedance for TO-220

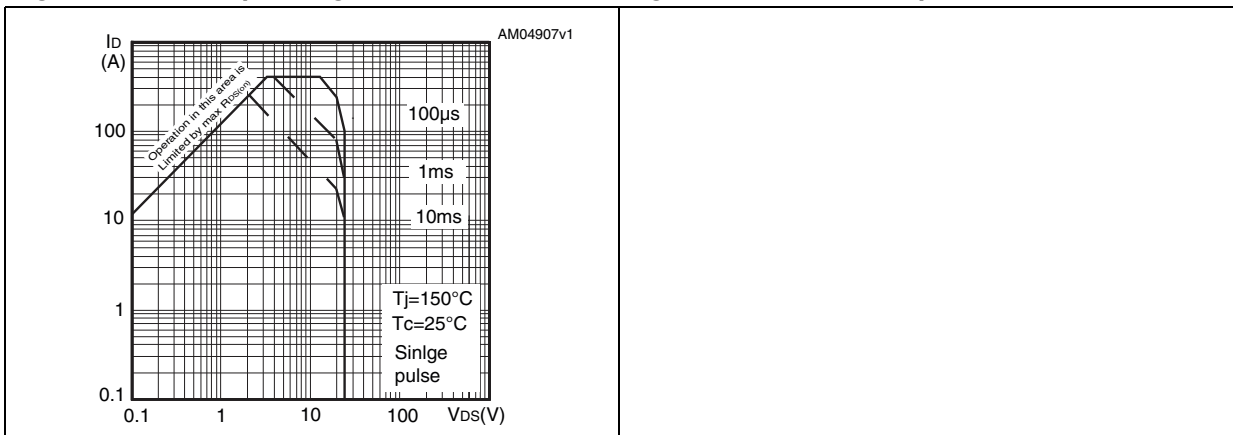


Figure 6. Output characteristics

Figure 7. Transfer characteristics

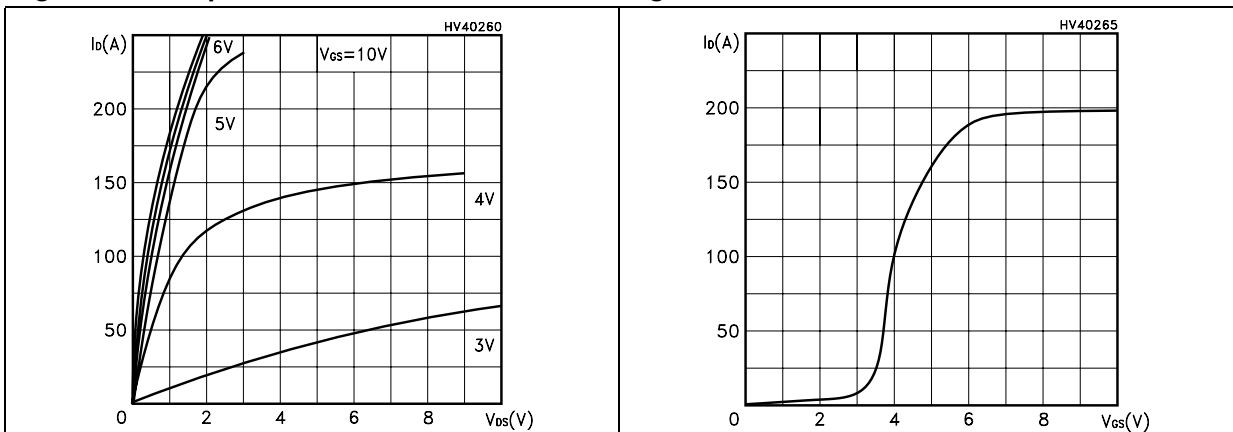


Figure 8. Normalized  $B_{V_{DS}}$  vs temperature

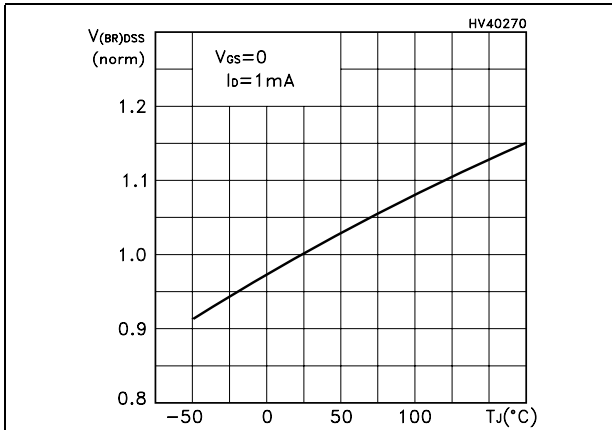


Figure 9. Static drain-source on resistance

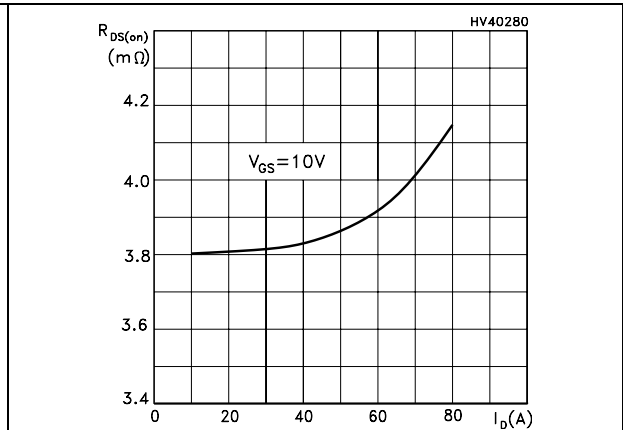


Figure 10. Gate charge vs gate-source voltage

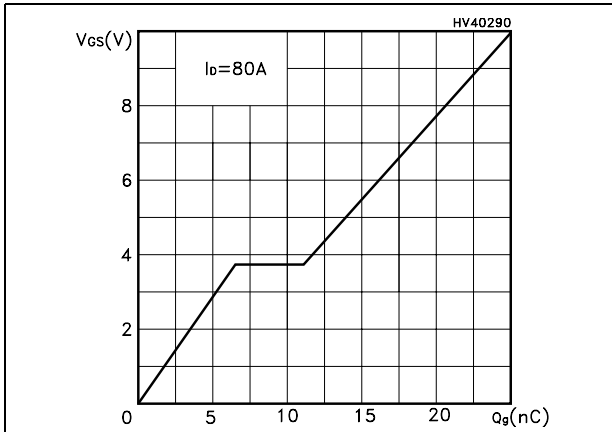


Figure 11. Capacitance variations

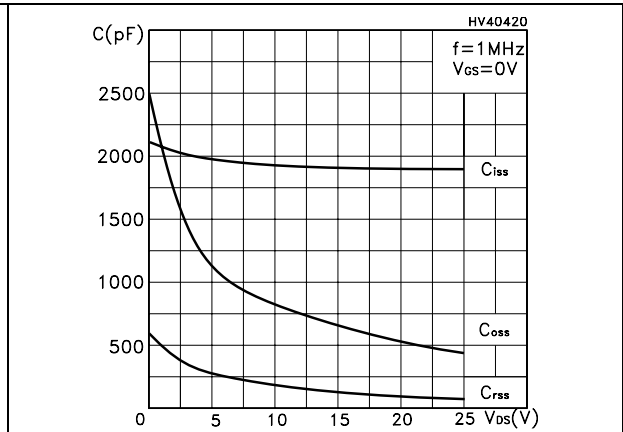


Figure 12. Normalized gate threshold voltage vs temperature

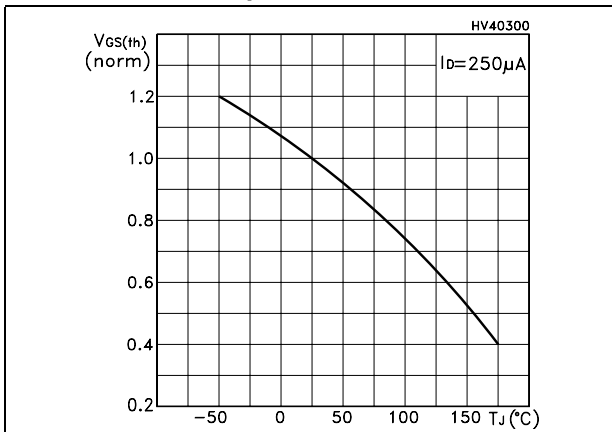


Figure 13. Normalized on resistance vs temperature

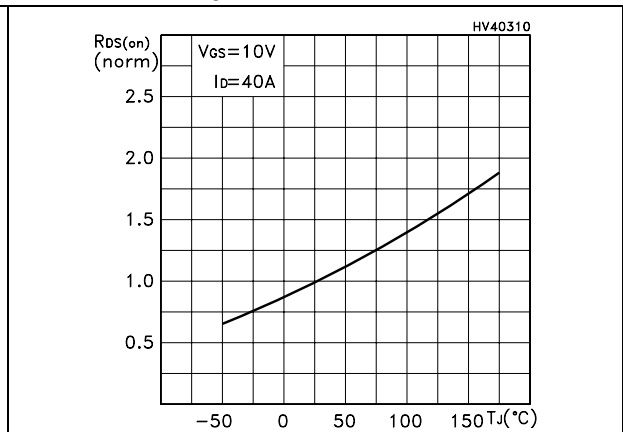
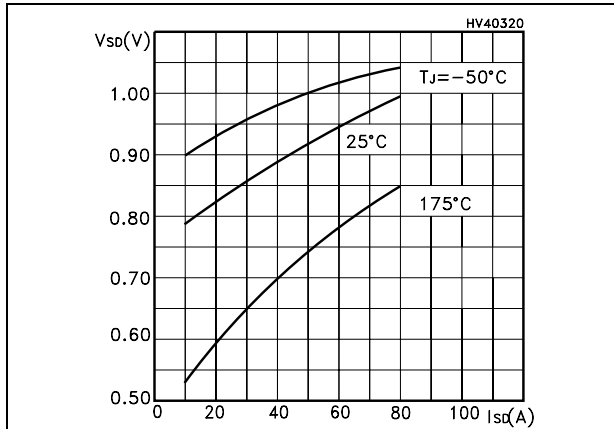


Figure 14. Source-drain diode forward characteristics





### 3 Test circuits

Figure 15. Unclamped inductive load test circuit

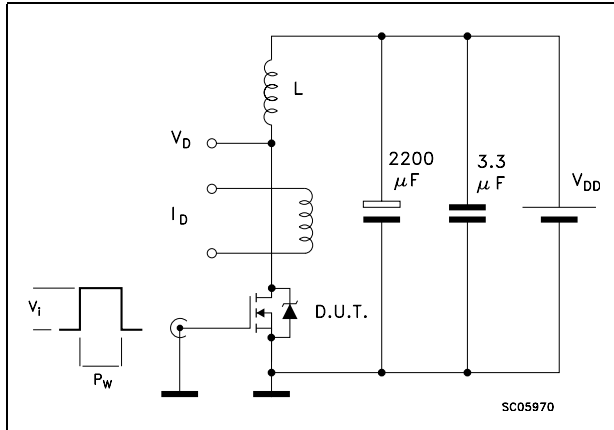


Figure 16. Unclamped inductive waveform

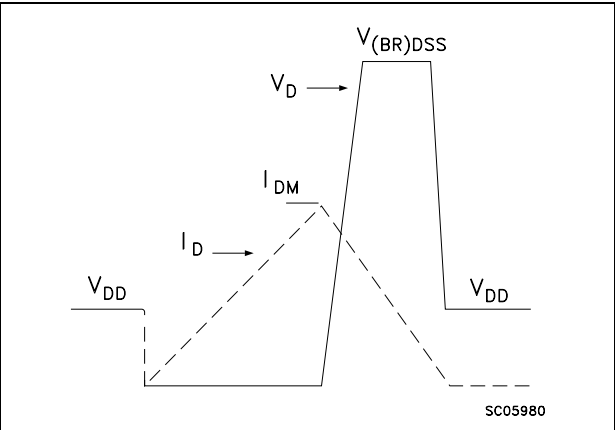


Figure 17. Switching times test circuit for resistive load

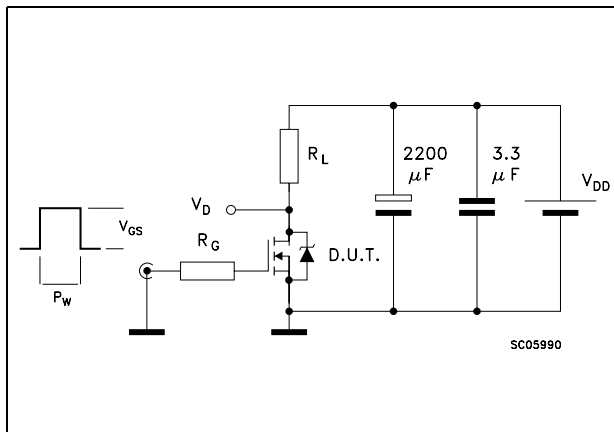


Figure 18. Gate charge test circuit

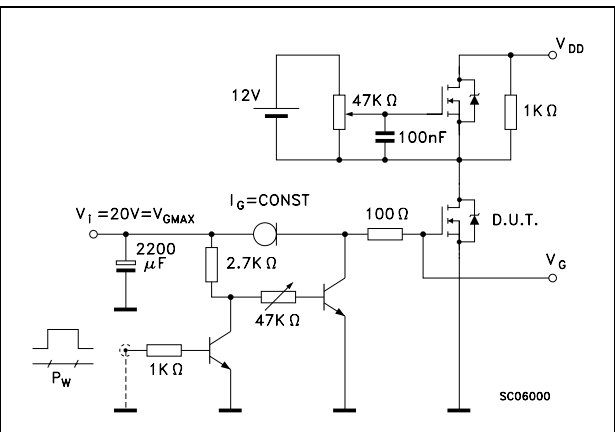


Figure 19. Test circuit for inductive load switching and diode recovery times

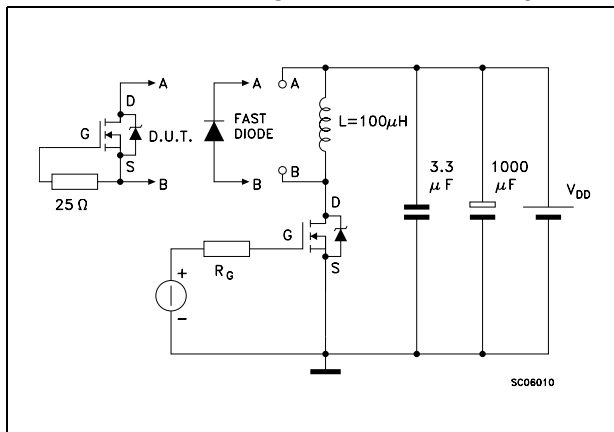


Figure 20. Switching time waveform

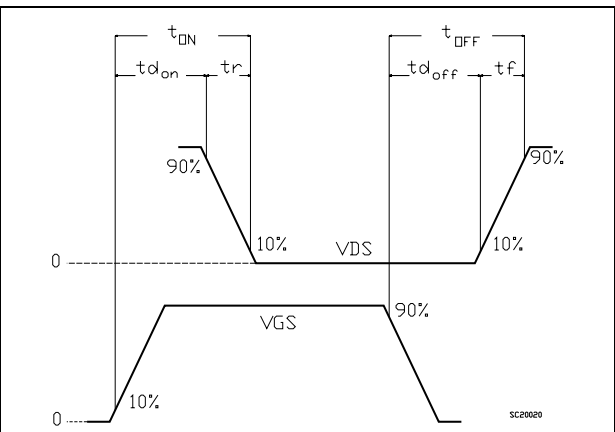
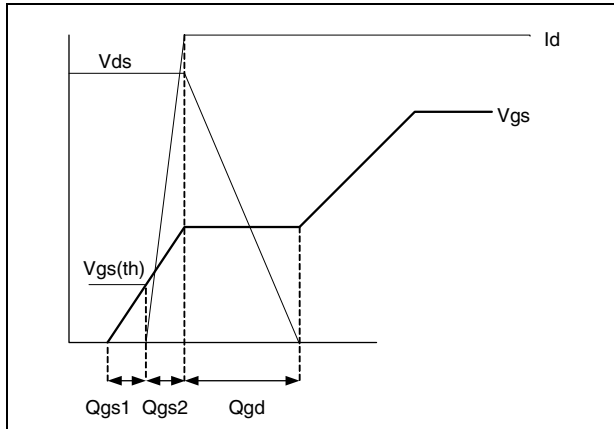


Figure 21. Gate charge waveform

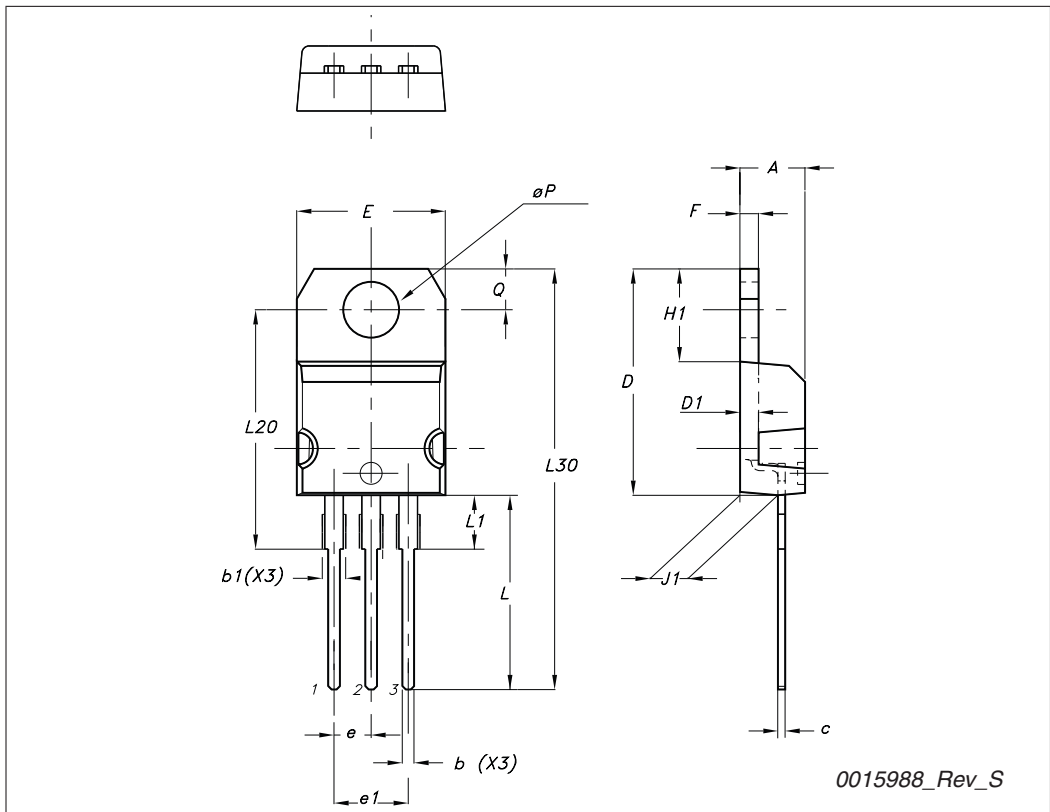


## 4 Package mechanical data

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.

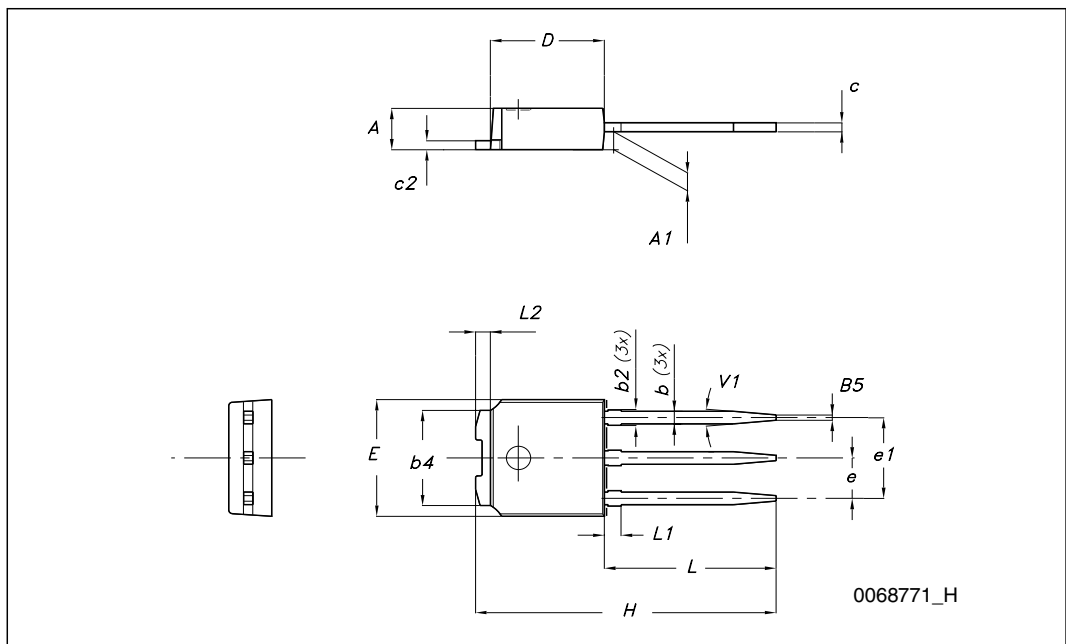
TO-220 type A mechanical data

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



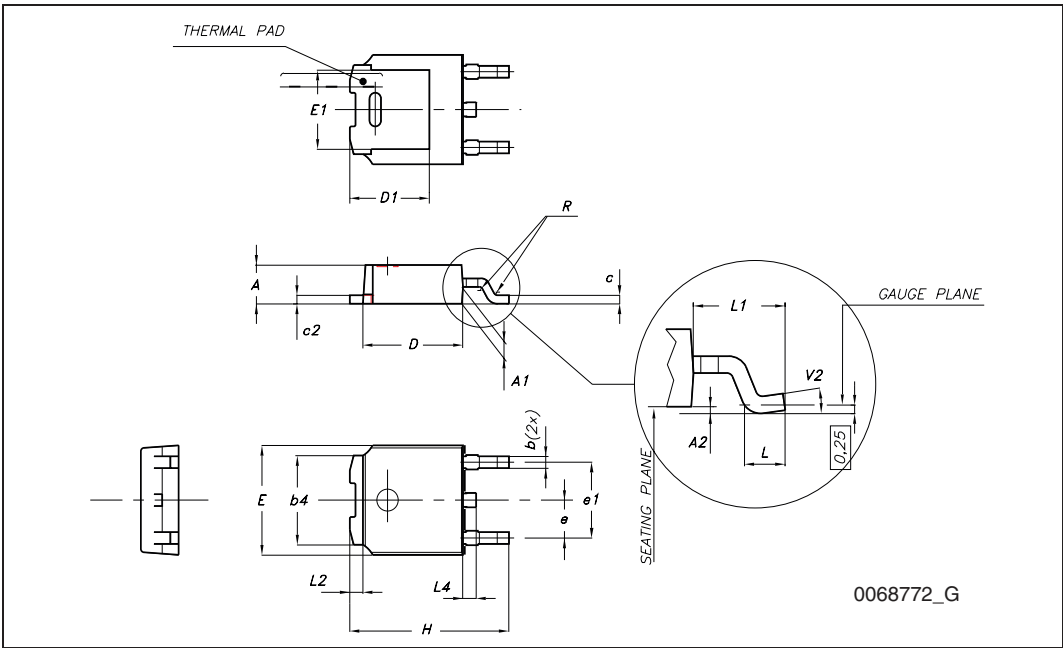
**TO-251 (IPAK) mechanical data**

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 °	



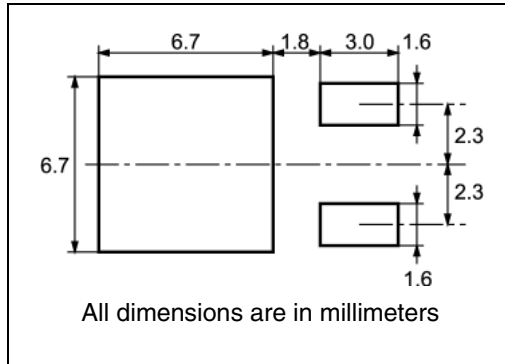
TO-252 (DPAK) mechanical data

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°



# 5 Packaging mechanical data

## DPAK FOOTPRINT



## TAPE AND REEL SHIPMENT

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 2.5mm min. width

G measured at hub

### 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

### 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

### TAPE MECHANICAL DATA (continued)

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

FEED DIRECTION

Bending radius R min.

For machine ref. only including draft and radii concentric around B0

## 6 Revision history

**Table 8. Document revision history**

Date	Revision	Changes
16-Oct-2007	1	First release
20-Feb-2008	2	Modified <a href="#">Table 4.: Static</a>
23-Sep-2008	3	$V_{GS}$ value has been changed on <a href="#">Table 2</a> and <a href="#">Table 5</a>
20-Apr-2009	4	Added device in TO-220
26-Apr-2010	5	<ul style="list-style-type: none"><li>– <a href="#">Table 1: Device summary</a> has been corrected</li><li>– <a href="#">Section 4: Package mechanical data</a> has been updated</li></ul>



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