

$E_{AS}$  180 mJ - 400 V - internally clamped IGBT

## Features

- AEC Q101 compliant
- 180 mJ of avalanche energy @  $T_C = 150\text{ }^\circ\text{C}$ ,  $L = 3\text{ mH}$
- ESD gate-emitter protection
- Gate-collector high voltage clamping
- Logic level gate drive
- Low saturation voltage
- High pulsed current capability
- Gate and gate-emitter resistor

## Application

- Pencil coil electronic ignition driver

## Description

This IGBT utilizes the advanced PowerMESH™ process resulting in an excellent trade-off between switching performance and low on-state behavior.

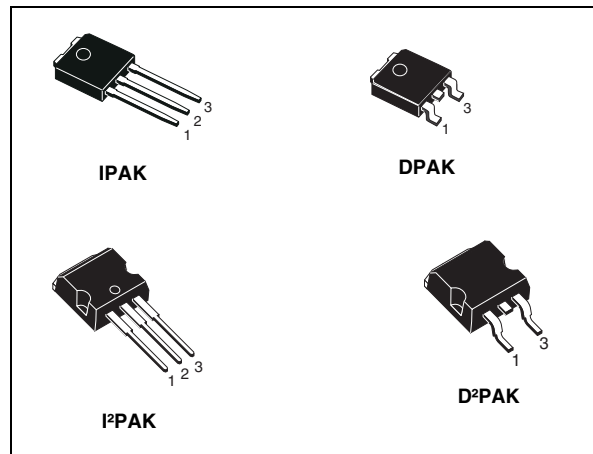


Figure 1. Internal schematic diagram

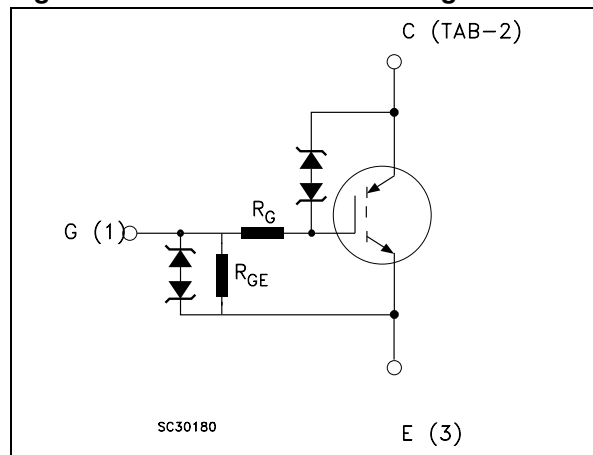


Table 1. Device summary

Order codes	Marking	Package	Packaging
STGD18N40LZT4	GD18N40LZ	DPAK	Tape and reel
STGD18N40LZ-1	GD18N40LZ	IPAK	Tube
STGB18N40LZT4	GB18N40LZ	D²PAK	Tape and reel
STGB18N40LZ-1	GB18N40LZ	I²PAK	Tube

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		DPAK IPAK	D <sup>2</sup> PAK I <sup>2</sup> PAK	
V <sub>CES</sub>	Collector-emitter voltage (V <sub>GE</sub> = 0)	V <sub>CES(clamped)</sub>		V
V <sub>ECS</sub>	Emitter collector voltage (V <sub>GE</sub> = 0)	20		V
I <sub>C</sub> <sup>(1)</sup>	Collector current (continuous) at T <sub>C</sub> = 100 °C	25	30	A
I <sub>CP</sub> <sup>(2)</sup>	Pulsed collector current	40		A
V <sub>GE</sub>	Gate-emitter voltage	V <sub>GE(clamped)</sub>		V
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	125	150	W
E <sub>AS</sub>	Single pulse energy T <sub>C</sub> = 25 °C, L = 3 mH, R <sub>G</sub> = 1 KΩ	300		mJ
E <sub>AS</sub>	Single pulse energy T <sub>C</sub> =150 °C, L = 3 mH, R <sub>G</sub> = 1 KΩ	180		mJ
E <sub>SD</sub>	Human body model, R= 1550 Ω, C = 100 pF	8		kV
	Machine model, R = 0, C = 100 pF	800		V
	Charged device model	2		kV
T <sub>stg</sub>	Storage temperature	- 55 to 175		°C
T <sub>j</sub>	Operating junction temperature			

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C) \cdot I_C}$$

2. Pulse width limited by max. junction temperature allowed

**Table 3. Thermal resistance**

Symbol	Parameter	Value		Unit
		DPAK IPAK	D <sup>2</sup> PAK I <sup>2</sup> PAK	
R <sub>thj-case</sub>	Thermal resistance junction-case max	1.2	1	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient max	65	62.5	°C/W

## 2 Electrical characteristics

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

**Table 4. Static electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{CES(\text{clamped})}$	Collector emitter clamped voltage ( $V_{GE} = 0$ )	$I_C = 2 \text{ mA}$ , $R_G = 1 \text{ k}\Omega$ $T_C = -40^{\circ}\text{C}$ to $150^{\circ}\text{C}$	370	400	430	V
$V_{(BR)ECS}$	Emitter collector break-down voltage ( $V_{GE} = 0$ )	$I_C = 75 \text{ mA}$	20	28		V
$V_{GE(\text{clamped})}$	Gate emitter clamped voltage	$I_G = \pm 2 \text{ mA}$	12		16	V
$I_{CES}$	Collector cut-off current ( $V_{GE} = 0$ )	$V_{CE} = 15 \text{ V}$ , $T_C = 150^{\circ}\text{C}$			10	$\mu\text{A}$
		$V_{CE} = 200 \text{ V}$ , $T_C = 150^{\circ}\text{C}$			100	$\mu\text{A}$
$I_{GES}$	Gate cut-off current ( $V_{CE} = 0$ )	$V_{GE} = \pm 10 \text{ V}$	450	625	830	$\mu\text{A}$
$R_{GE}$	Gate emitter resistance		12	16	22	$\text{K}\Omega$
$R_G$	Gate resistance			1.6		$\text{K}\Omega$
$V_{GE(\text{th})}$	Gate threshold voltage	$V_{CE} = 12 \text{ V}$ , $I_C = 1 \text{ mA}$ , $T_C = -40^{\circ}\text{C}$	1.4			V
		$V_{CE} = 12 \text{ V}$ , $I_C = 1 \text{ mA}$	1.2	1.6	2.3	V
		$V_{CE} = 12 \text{ V}$ , $I_C = 1 \text{ mA}$ , $T_C = 150^{\circ}\text{C}$	0.7			V
$V_{GEP}$	Gate emitter plateau voltage	$V_{CE} = 12 \text{ V}$ , $I_C = 10 \text{ A}$		2.9		V
$V_{CE(\text{sat})}$	Collector emitter saturation voltage	$V_{GE} = 4.5 \text{ V}$ , $I_C = 10 \text{ A}$		1.35	1.7	V
		$V_{GE} = 4.5 \text{ V}$ , $I_C = 10 \text{ A}$ , $T_C = 150^{\circ}\text{C}$		1.30		V
		$V_{GE} = 3.8 \text{ V}$ , $I_C = 6 \text{ A}$		1.30		V

Table 5. Dynamic electrical characteristics

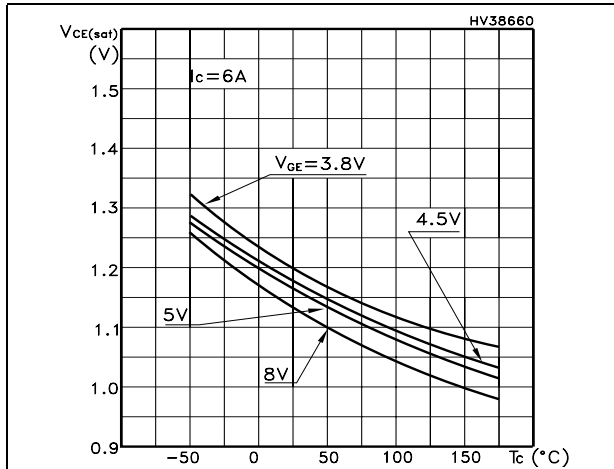
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25 \text{ V}$ , $f = 1 \text{ MHz}$ , $V_{GE} = 0$		490		pF
$C_{oes}$	Output capacitance			90		pF
$C_{res}$	Reverse transfer capacitance			6.5		pF
$Q_g$	Gate charge	$V_{CE} = 280 \text{ V}$ , $I_C = 10 \text{ A}$ , $V_{GE} = 5 \text{ V}$		23		nC

Table 6. Switching on/off

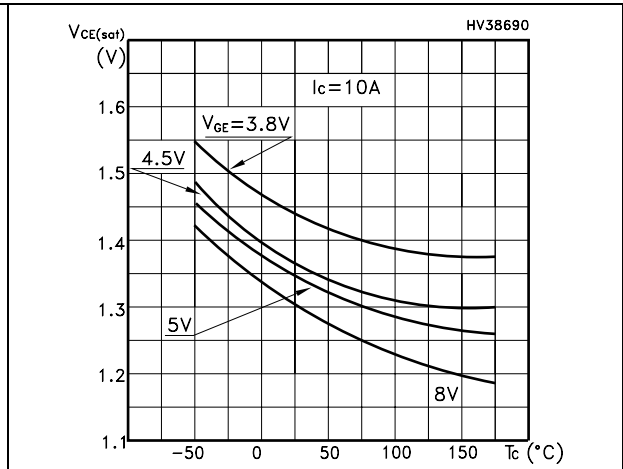
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	<b>Resistive load</b> Turn-on delay time	$V_{CC} = 14 \text{ V}$ , $I_C = 10 \text{ A}$ $R_G = 1 \text{ k}\Omega$ , $V_{GE} = 5 \text{ V}$		1		$\mu\text{s}$
	Rise time			5.8		$\mu\text{s}$
$t_{d(on)}$ $t_r$	<b>Resistive load</b> Turn-on delay time	$V_{CC} = 14 \text{ V}$ , $I_C = 10 \text{ A}$ $R_G = 1 \text{ k}\Omega$ , $V_{GE} = 5 \text{ V}$ , $T_C = 150 \text{ }^\circ\text{C}$		1		$\mu\text{s}$
	Rise time			5.9		$\mu\text{s}$
$t_{d(off)}$ $t_f$ dv/dt	<b>Inductive load</b> Turn-off delay time	$V_{CC} = 300 \text{ V}$ , $L = 1 \text{ mH}$ $R_G = 1 \text{ k}\Omega$ , $V_{GE} = 5 \text{ V}$		14		$\mu\text{s}$
	Fall time			6.7		$\mu\text{s}$
	Turn-off voltage slope			90		V/ $\mu\text{s}$
$t_{d(off)}$ $t_f$ dv/dt	<b>Inductive load</b> Turn-off delay time	$V_{CC} = 300 \text{ V}$ , $L = 1 \text{ mH}$ $R_G = 1 \text{ k}\Omega$ , $V_{GE} = 5 \text{ V}$ , $T_C = 150 \text{ }^\circ\text{C}$		15		$\mu\text{s}$
	Fall time			9.8		$\mu\text{s}$
	Turn-off voltage slope			80		V/ $\mu\text{s}$

## 2.1 Electrical characteristics (curves)

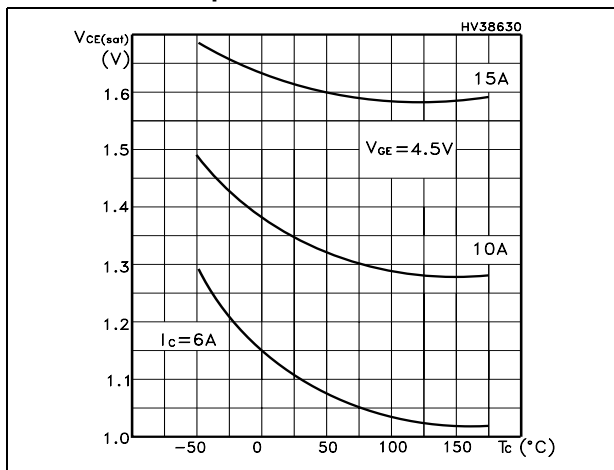
**Figure 2. Collector-emitter voltage vs temperature**



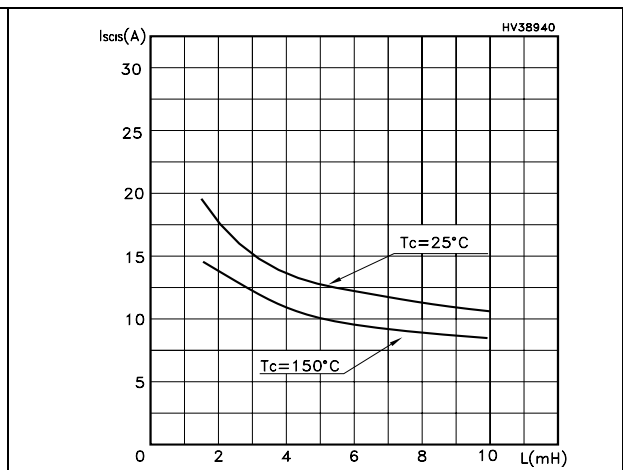
**Figure 3. Collector-emitter voltage vs temperature**



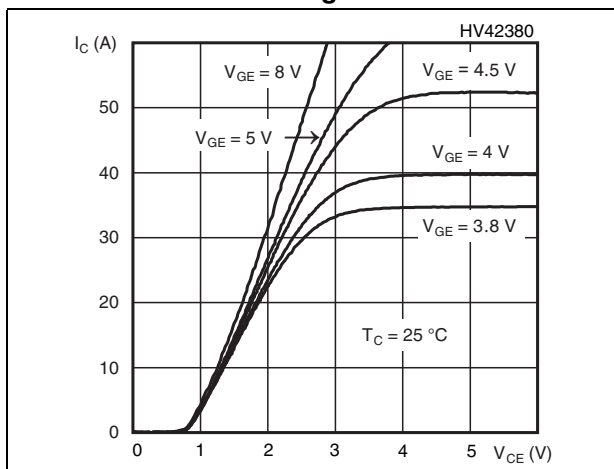
**Figure 4. Collector-emitter voltage vs temperature**



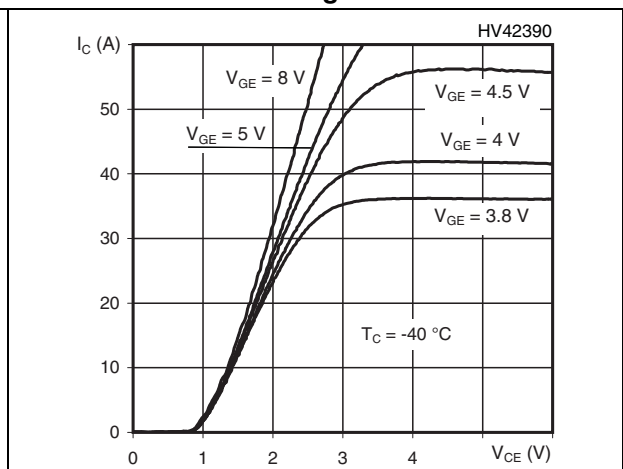
**Figure 5. Self clamped inductive switch**



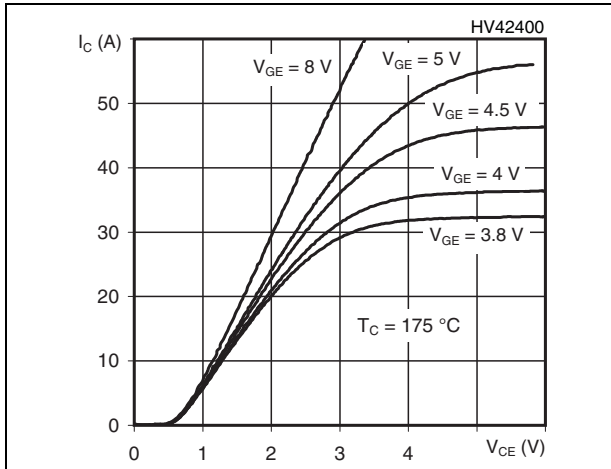
**Figure 6. Collector current vs collector emitter voltage @ 25 °C**



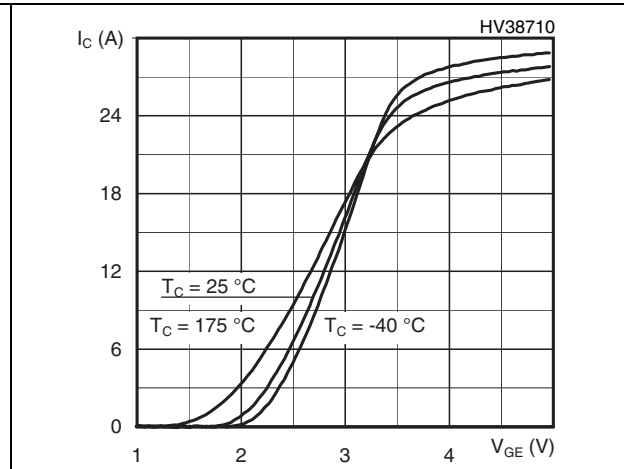
**Figure 7. Collector current vs collector emitter voltage @ -40 °C**



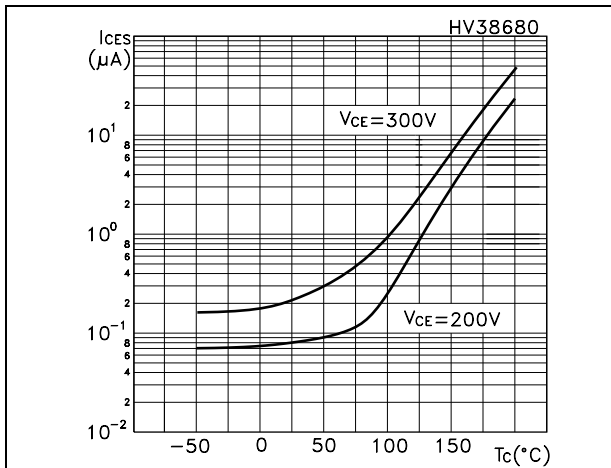
**Figure 8. Collector current vs collector emitter voltage @ 175 °C**



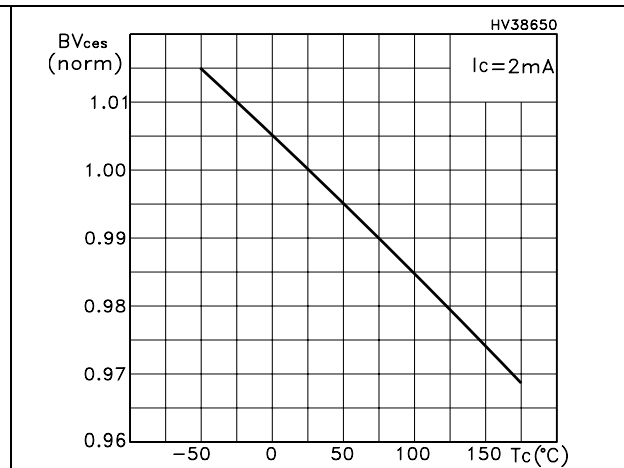
**Figure 9. Transfer characteristics**



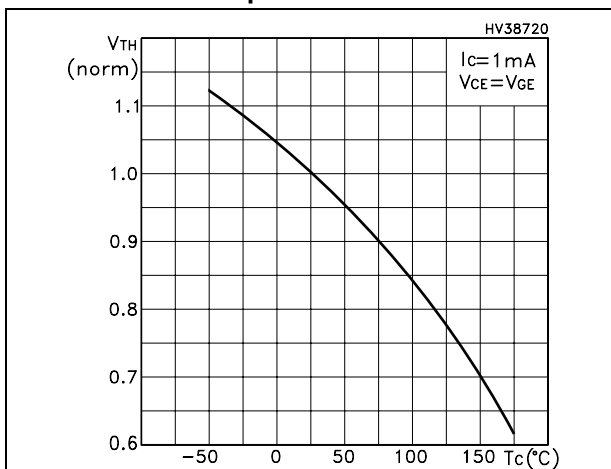
**Figure 10. Collector emitter leakage current vs. temperature**



**Figure 11. Normalized collector emitter breakdown voltage vs temperature**



**Figure 12. Normalized gate threshold voltage vs temperature**



**Figure 13. Normalized collector emitter voltage vs temperature**

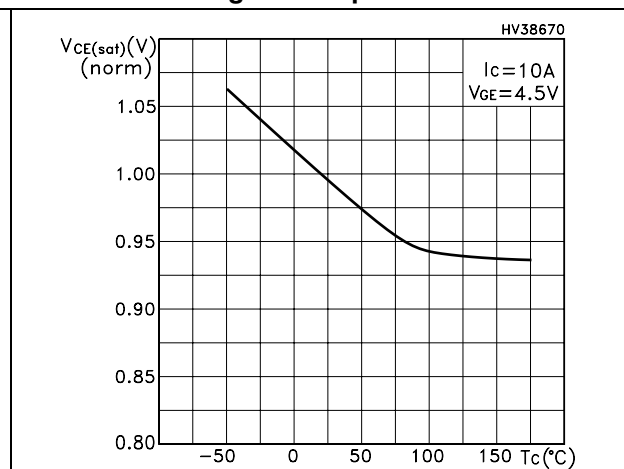


Figure 14. Thermal impedance for D<sup>2</sup>PAK / I<sup>2</sup>PAK

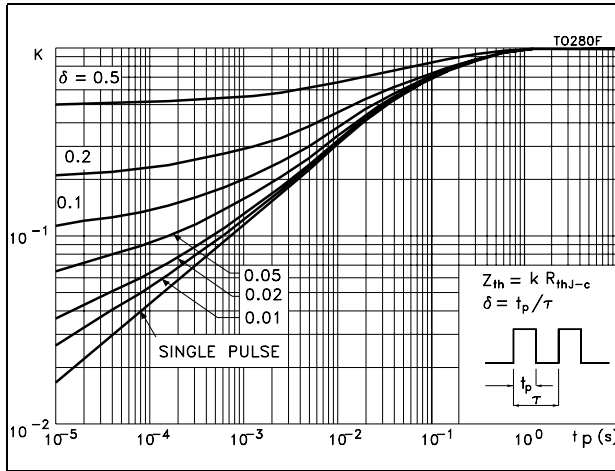
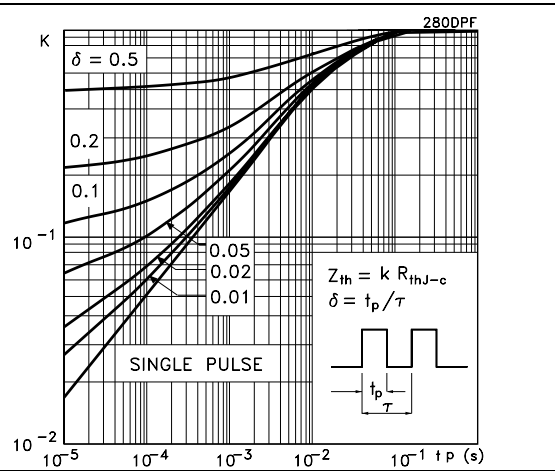


Figure 15. Thermal impedance for DPAK / IPAQ





### 3 Test circuits

Figure 16. Test circuit for inductive load switching

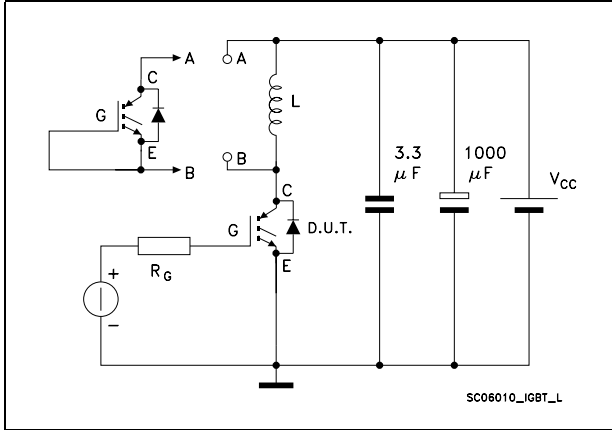


Figure 18. Switching waveform

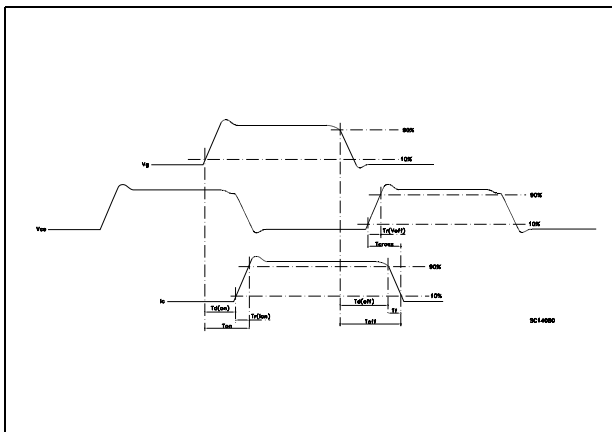


Figure 17. Gate charge test circuit

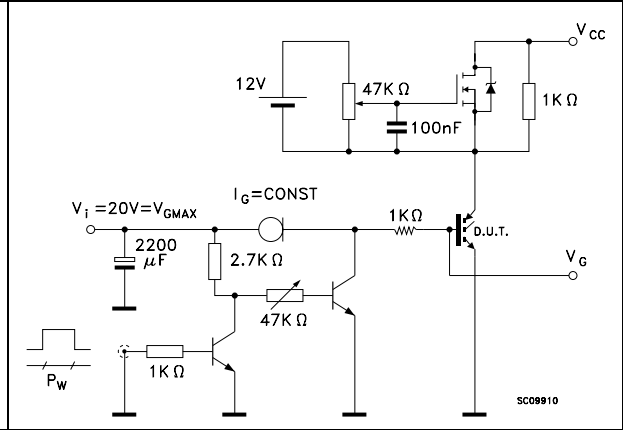
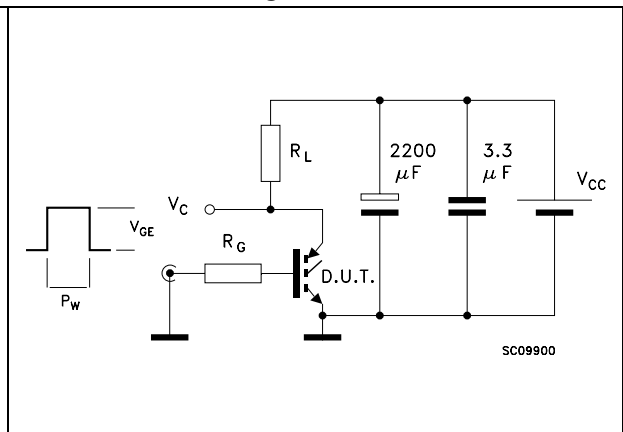


Figure 19. Test circuit for resistive load switching

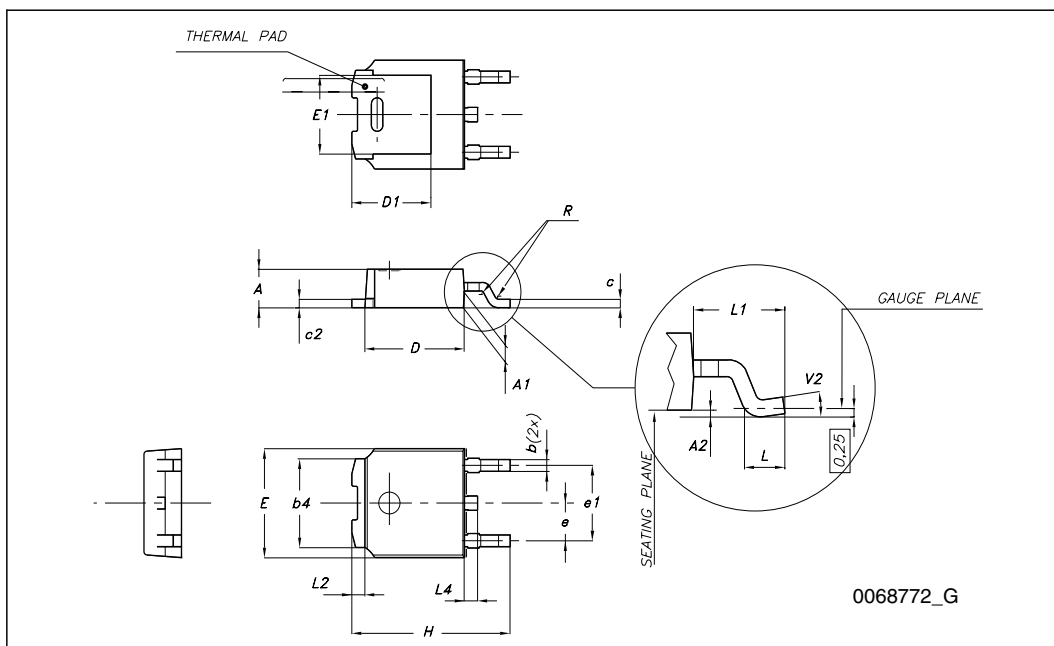


## 4 Package mechanical data

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](http://www.st.com)

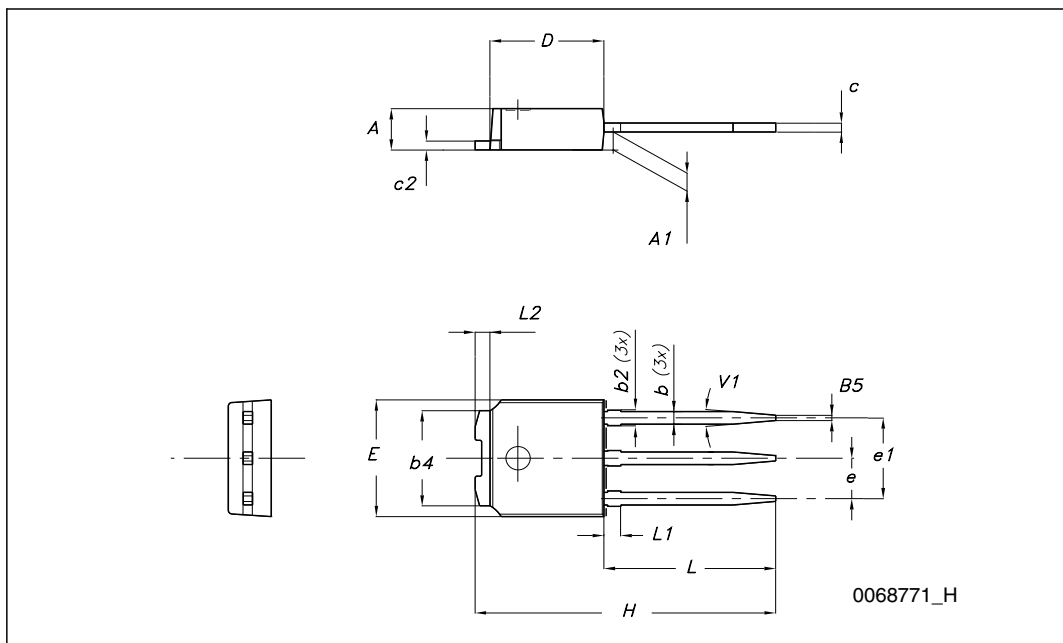
**TO-252 (DPAK) mechanical data**

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°



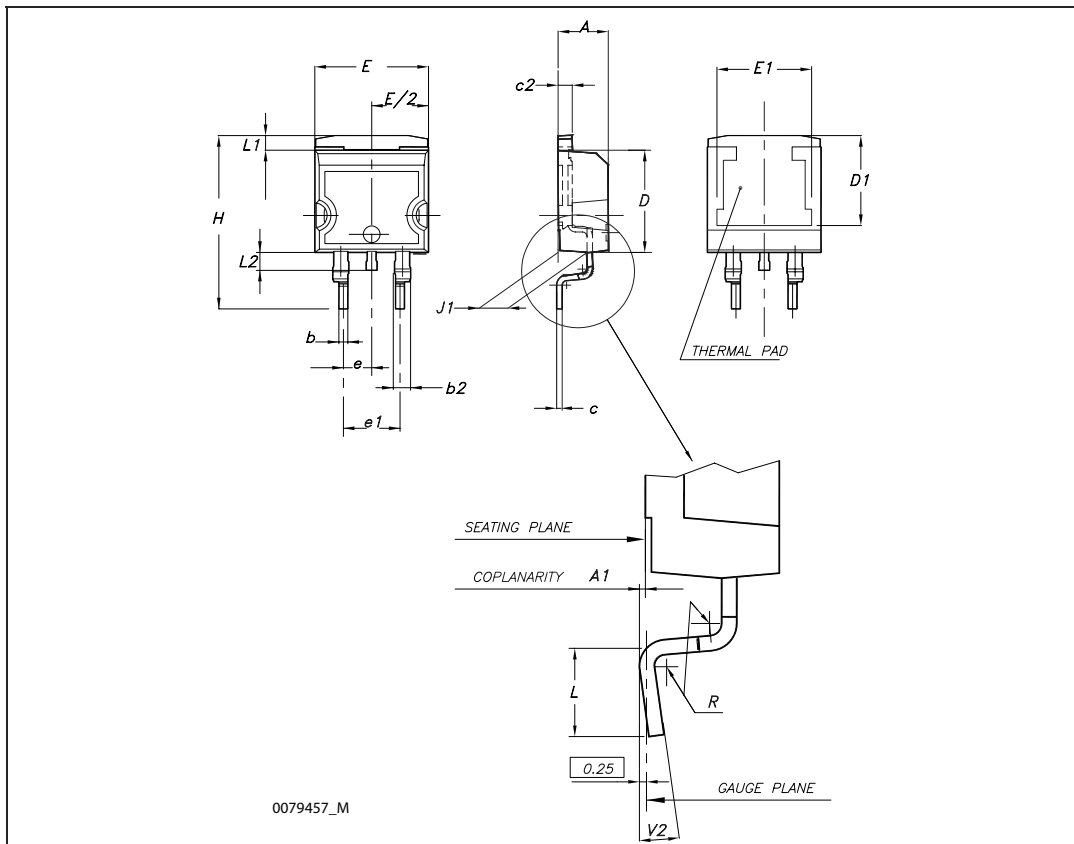
**TO-251 (IPAK) mechanical data**

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°	



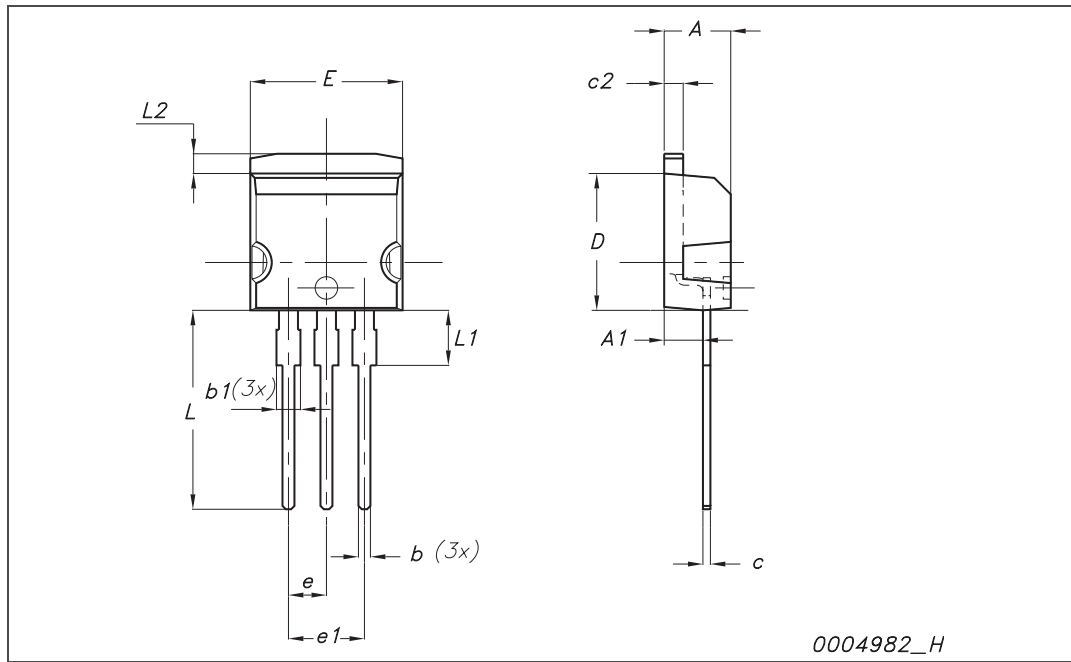
D<sup>2</sup>PAK (TO-263) mechanical data

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°



I<sup>2</sup>PAK (TO-262) mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
A1	2.40		2.72	0.094		0.107
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.49		0.70	0.019		0.027
c2	1.23		1.32	0.048		0.052
D	8.95		9.35	0.352		0.368
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
E	10		10.40	0.393		0.410
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L2	1.27		1.40	0.050		0.055



# 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

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	

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

TOP COVER TAPE

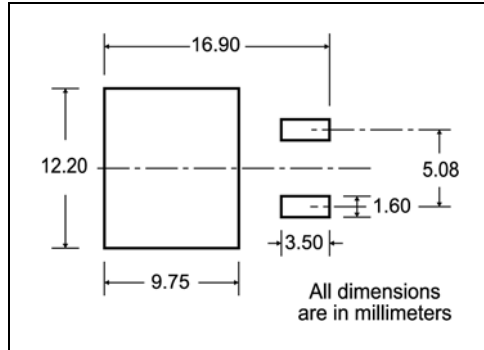
Center line of cavity

User Direction of Feed

FEED DIRECTION

Bending radius R min.

**D<sup>2</sup>PAK FOOTPRINT**



**TAPE AND REEL SHIPMENT**

**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

**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	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

BASE QTY	BULK QTY
1000	1000

\* on sales type



## 6 Revision history

Table 7. Document revision history

Date	Revision	Changes
18-Jan-2008	1	Initial release.
07-Mar-2008	2	Modified <a href="#">Figure 7</a> , <a href="#">Figure 8</a> , <a href="#">Figure 10</a> .

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