



# STGB18N40LZ STGD18N40LZ, STGP18N40LZ

EAS 180 mJ - 390 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 application-specific IGBT utilizes the most advanced PowerMESH™ technology. The built-in Zener diodes between gate-collector and gate-emitter provide overvoltage protection capabilities. The device also exhibits low on-state voltage drop and low threshold drive for use in automotive ignition system.

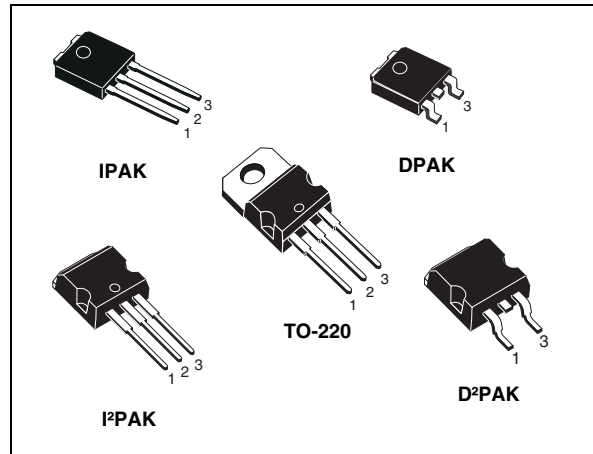


Figure 1. Internal schematic diagram

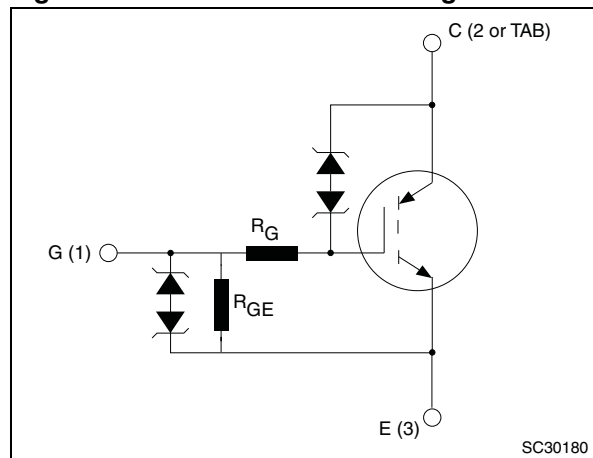


Table 1. Device summary

Order codes	Marking	Package	Packaging
STGB18N40LZ-1	GB18N40LZ	I <sup>2</sup> PAK	Tube
STGB18N40LZT4	GB18N40LZ	D <sup>2</sup> PAK	Tape and reel
STGD18N40LZ-1	GD18N40LZ	IPAK	Tube
STGD18N40LZT4	GD18N40LZ	DPAK	Tape and reel
STGP18N40LZ	GP18N40LZ	TO-220	Tube

# Contents

<b>1</b>	<b>Electrical ratings</b> .....	<b>3</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>4</b>
2.1	Electrical characteristics (curves) .....	6
<b>3</b>	<b>Test circuits</b> .....	<b>9</b>
<b>4</b>	<b>Package mechanical data</b> .....	<b>10</b>
<b>5</b>	<b>Packaging mechanical data</b> .....	<b>16</b>
<b>6</b>	<b>Revision history</b> .....	<b>18</b>

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		DPAK IPAK	D <sup>2</sup> PAK I <sup>2</sup> PAK, TO-220	
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, V <sub>CC</sub> = 50 V	300		mJ
E <sub>AS</sub>	Single pulse energy T <sub>C</sub> = 150 °C, L = 3 mH, V <sub>CC</sub> = 50 V	180		mJ
ESD	Human body model, R = 1.5 kΩ, 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

$$I_C(T_C) = \frac{T_{j(max)} - T_C}{R_{thj-c} \times V_{CE(sat)(max)}(T_{j(max)}, I_C(T_C))}$$

2. Pulse width limited by max. junction temperature allowed

**Table 3. Thermal data**

Symbol	Parameter	Value		Unit
		DPAK IPAK	D <sup>2</sup> PAK I <sup>2</sup> PAK, TO-220	
R <sub>thj-case</sub>	Thermal resistance junction-case	1.2	1	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient	100	62.5	°C/W

## 2 Electrical characteristics

( $T_J=25\text{ °C}$  unless otherwise specified)

**Table 4. Static electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{CES(\text{clamped})}$	Collector emitter clamped voltage ( $V_{GE} = 0$ )	$I_C = 2\text{ mA}$ $T_J = -40\text{ °C to }150\text{ °C}$	360	390	420	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 ( $V_{GE} = 0$ )	$V_{CE} = 15\text{ V}, T_J = 150\text{ °C}$			10	$\mu\text{A}$
		$V_{CE} = 200\text{ V}, T_J = 150\text{ °C}$			100	$\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 10\text{ V}$	450	625	830	$\mu\text{A}$
$R_{GE}$	Gate emitter resistance		12	16	22	k $\Omega$
$R_G$	Gate resistance			1.6		k $\Omega$
$V_{GE(\text{th})}$	Gate threshold voltage	$V_{GE} = V_{CE}, I_C = 1\text{ mA}, T_J = -40\text{ °C}$	1.4			V
		$V_{GE} = V_{CE}, I_C = 1\text{ mA}$	1.2	1.6	2.3	V
		$V_{GE} = V_{CE}, I_C = 1\text{ mA}, T_J = 150\text{ °C}$	0.7			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
		$V_{GE} = 4.5\text{ V}, I_C = 10\text{ A}, T_J = 150\text{ °C}$		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		-	5	-	pF
$Q_g$	Gate charge	$V_{CE} = 280\text{ V}, I_C = 10\text{ A}, V_{GE} = 5\text{ V}$	-	29	-	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	$V_{CC} = 14\text{ V}$ , $R_L = 1\ \Omega$ , $V_{GE} = 5\text{ V}$	-	0.65	-	$\mu\text{s}$
	Rise time			3.5		
$t_{d(on)}$ $t_r$	<b>Resistive load</b> Turn-on delay time	$V_{CC} = 14\text{ V}$ , $R_L = 1\ \Omega$ , $V_{GE} = 5\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$	-	0.65	-	$\mu\text{s}$
	Rise time			3.8		
$t_{d(off)}$ $t_f$ dv/dt	<b>Inductive load</b> Turn-off delay time	$V_{CC} = 300\text{ V}$ , $L = 1\text{ mH}$ $I_C = 10\text{ A}$ , $V_{GE} = 5\text{ V}$	-	13.5	-	$\mu\text{s}$
	Fall time			5.5		
	Turn-off voltage slope			105		
$t_{d(off)}$ $t_f$ dv/dt	<b>Inductive load</b> Turn-off delay time	$V_{CC} = 300\text{ V}$ , $L = 1\text{ mH}$ $I_C = 10\text{ A}$ , $V_{GE} = 5\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$	-	14.2	-	$\mu\text{s}$
	Fall time			8		
	Turn-off voltage slope			97		

## 2.1 Electrical characteristics (curves)

Figure 2. Collector-emitter on voltage vs temperature

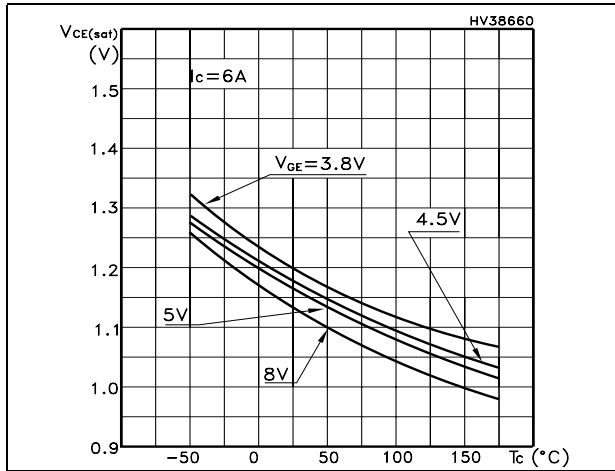


Figure 3. Collector-emitter on voltage vs temperature

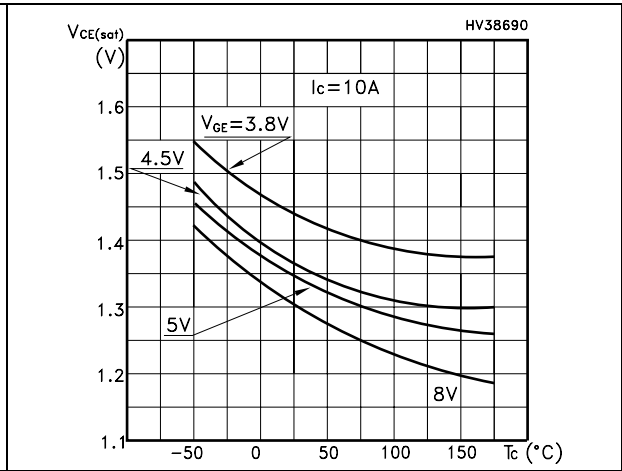


Figure 4. Collector-emitter on voltage vs temperature

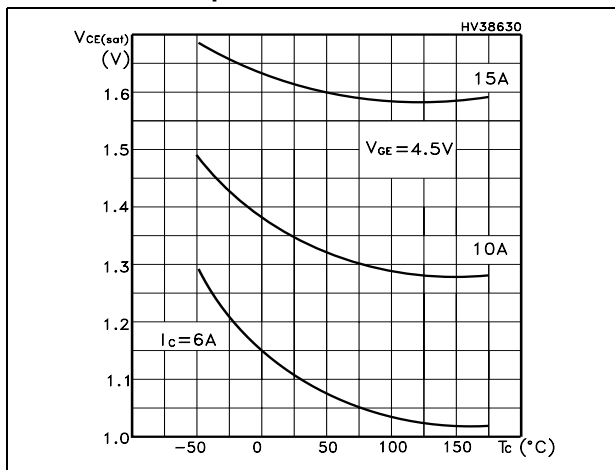


Figure 5. Self clamped inductive switch

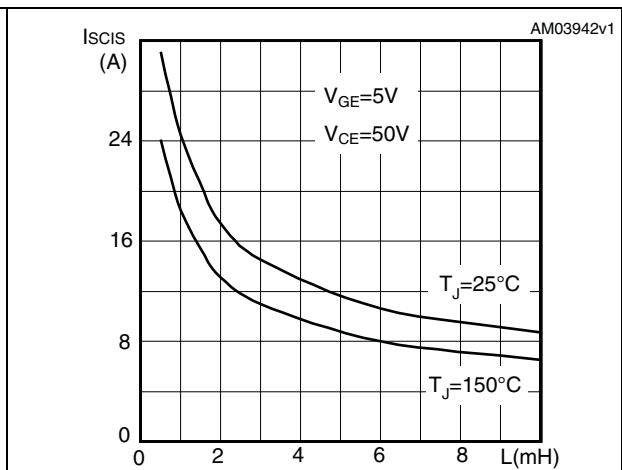


Figure 6. Output characteristics @ 25 °C

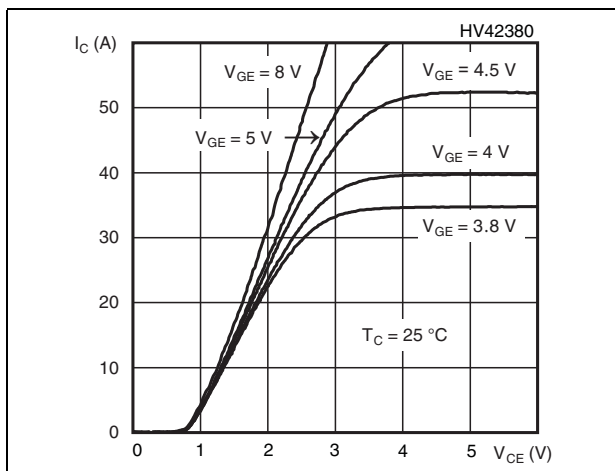


Figure 7. Output characteristics @ -40 °C

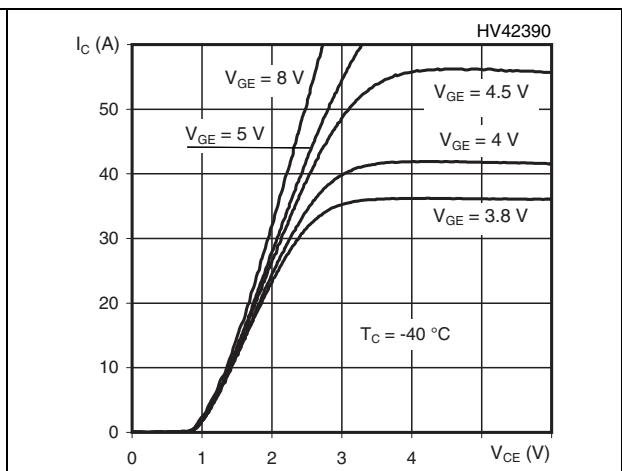


Figure 8. Output characteristics @ 175 °C

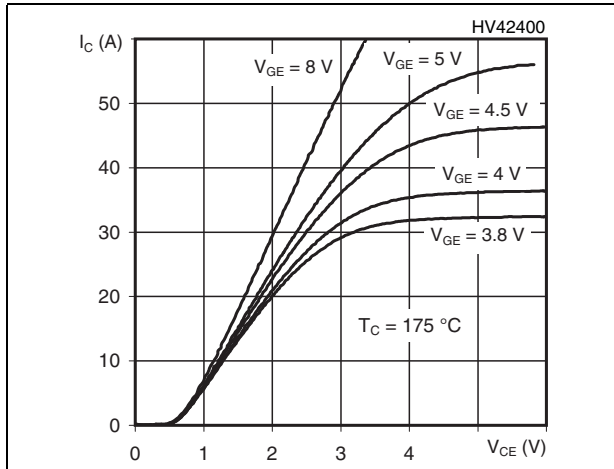


Figure 9. Transfer characteristics

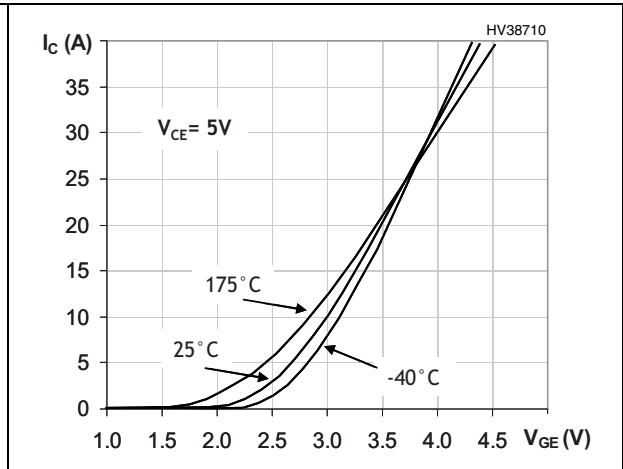


Figure 10. Collector cut-off current vs. temperature

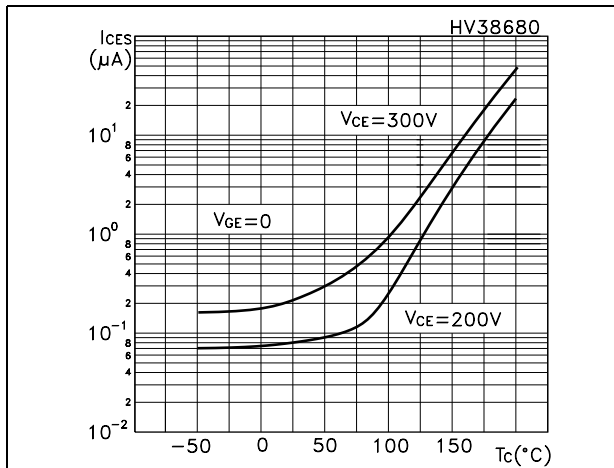


Figure 11. Normalized collector emitter voltage vs temperature

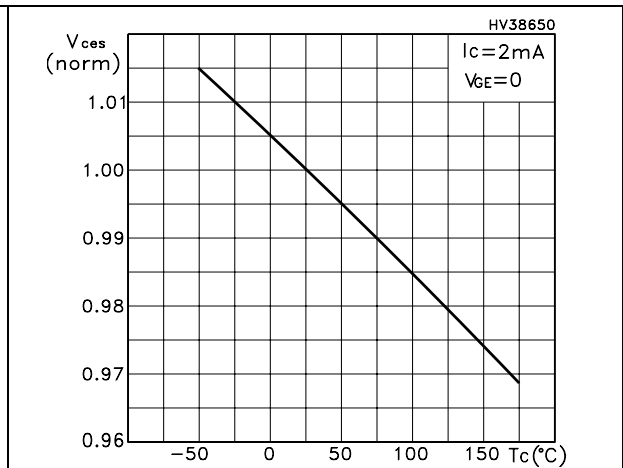


Figure 12. Normalized gate threshold voltage vs temperature

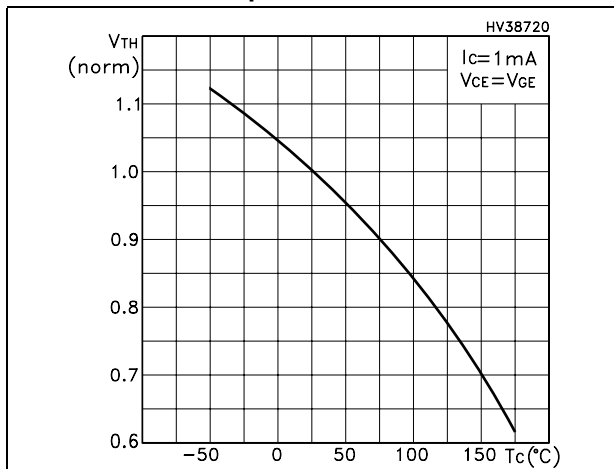


Figure 13. Normalized collector emitter on voltage vs temperature

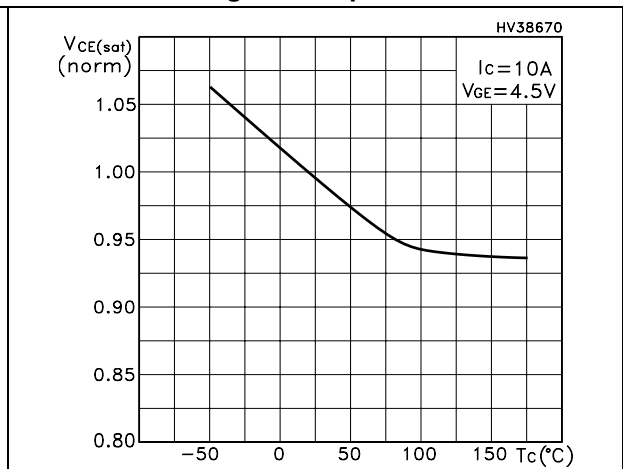


Figure 14. Thermal impedance for D<sup>2</sup>PAK, I<sup>2</sup>PAK, TO-220

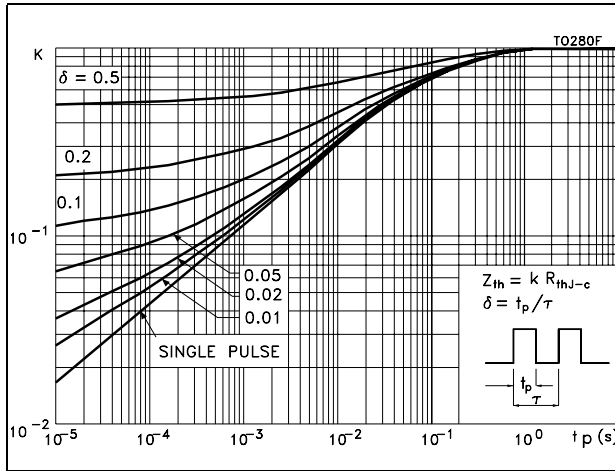
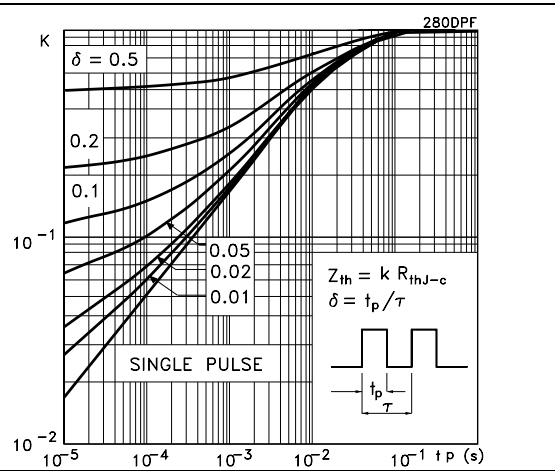


Figure 15. Thermal impedance for DPAK, IPAQ





### 3 Test circuits

Figure 16. Inductive load switching

Figure 17. Resistive load switching

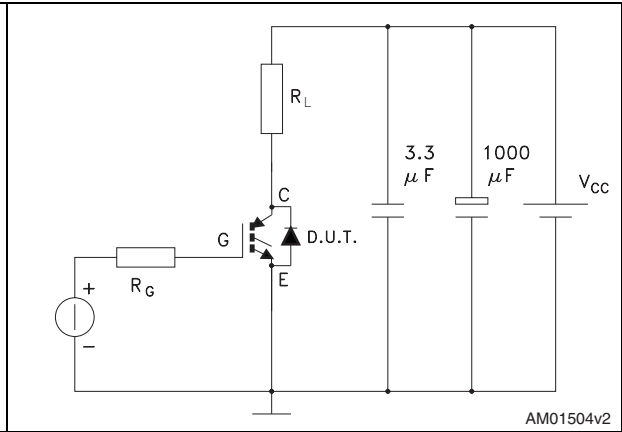
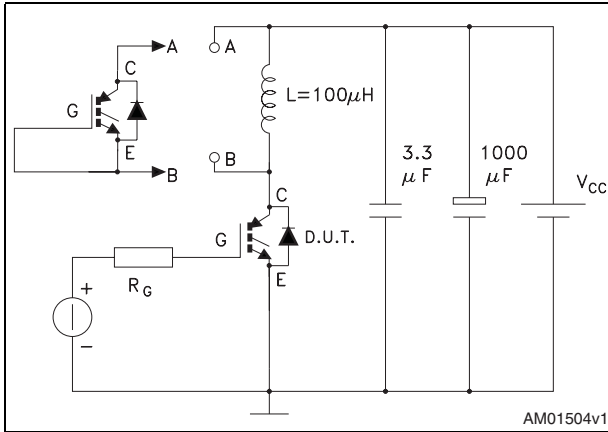
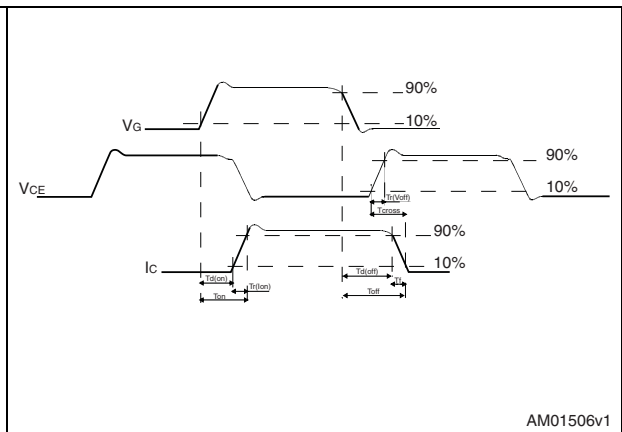
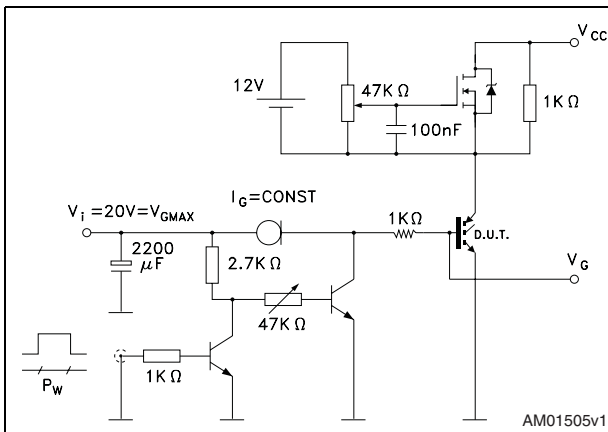


Figure 18. Gate charge test circuit

Figure 19. Switching waveform

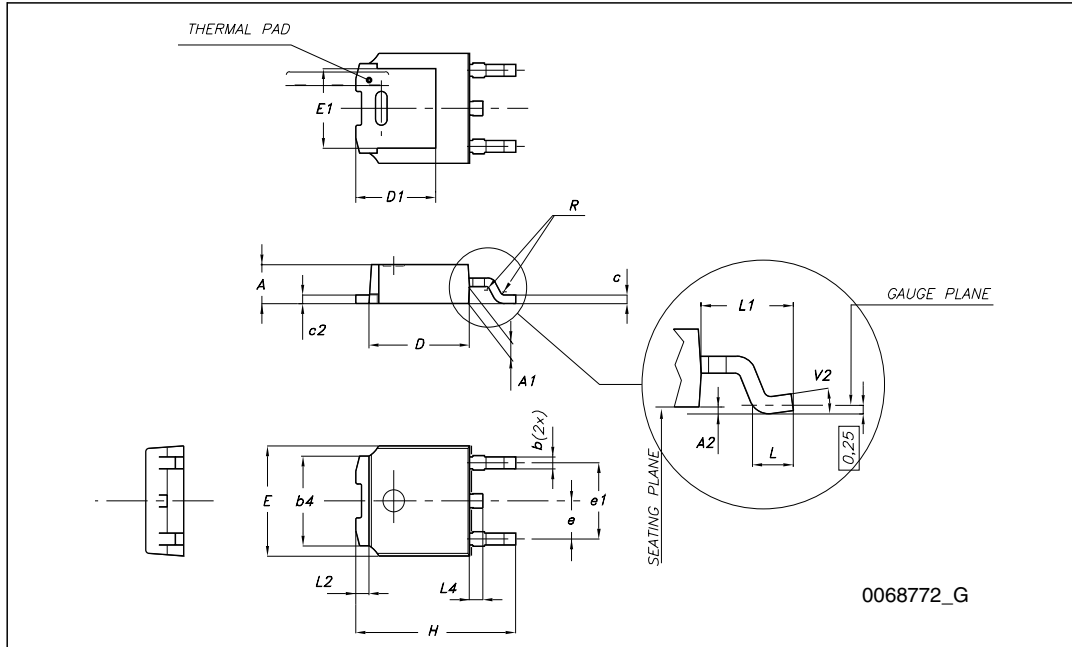


## 4 Package mechanical data

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.

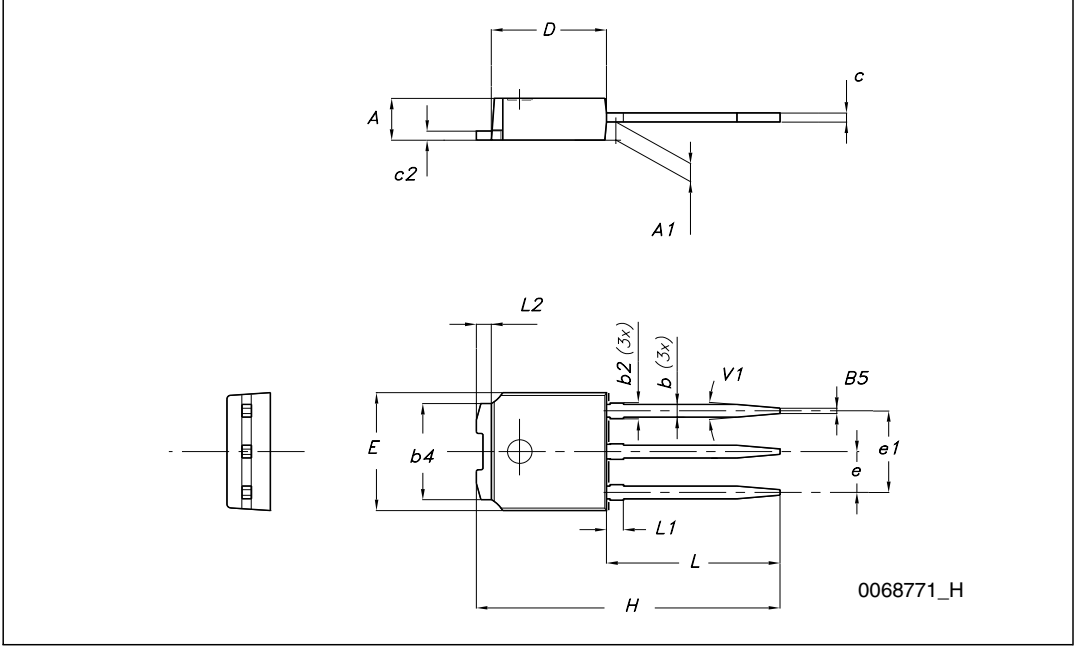
**TO-252 (DPAK) mechanical data**

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°



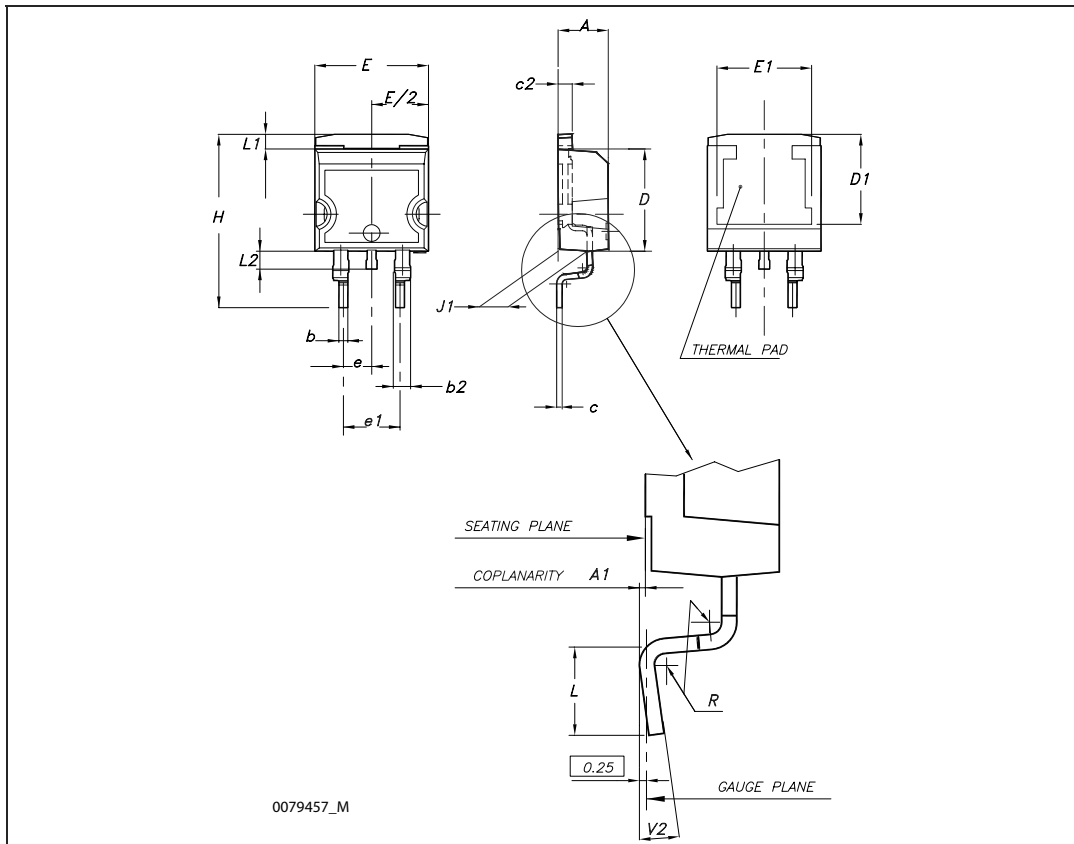
**TO-251 (IPAK) mechanical data**

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°	



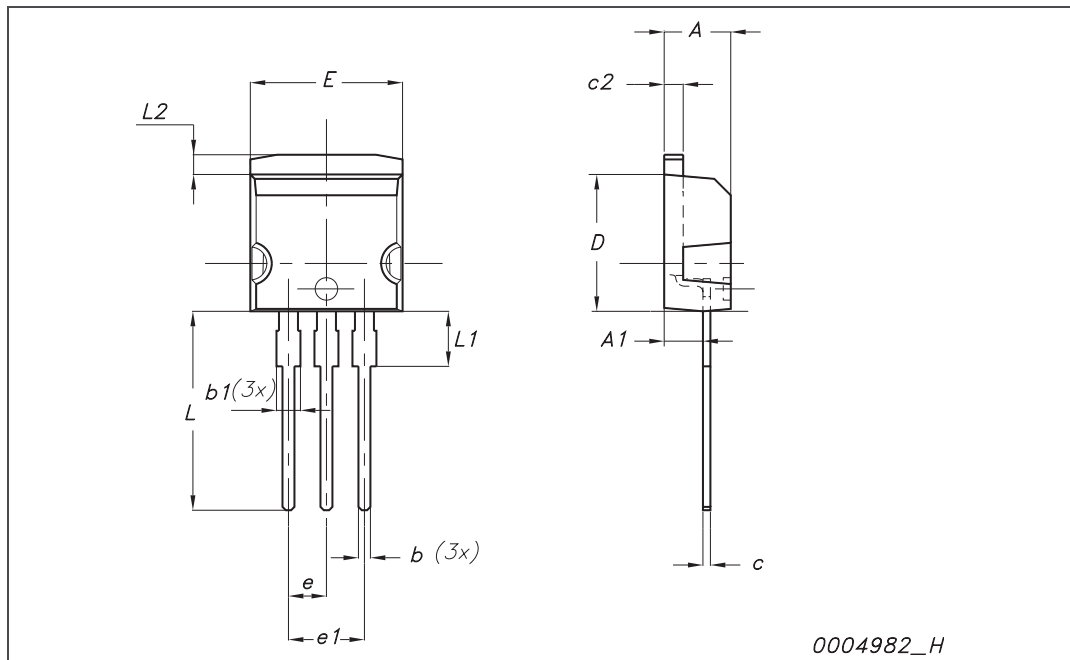
D<sup>2</sup>PAK (TO-263) mechanical data

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°



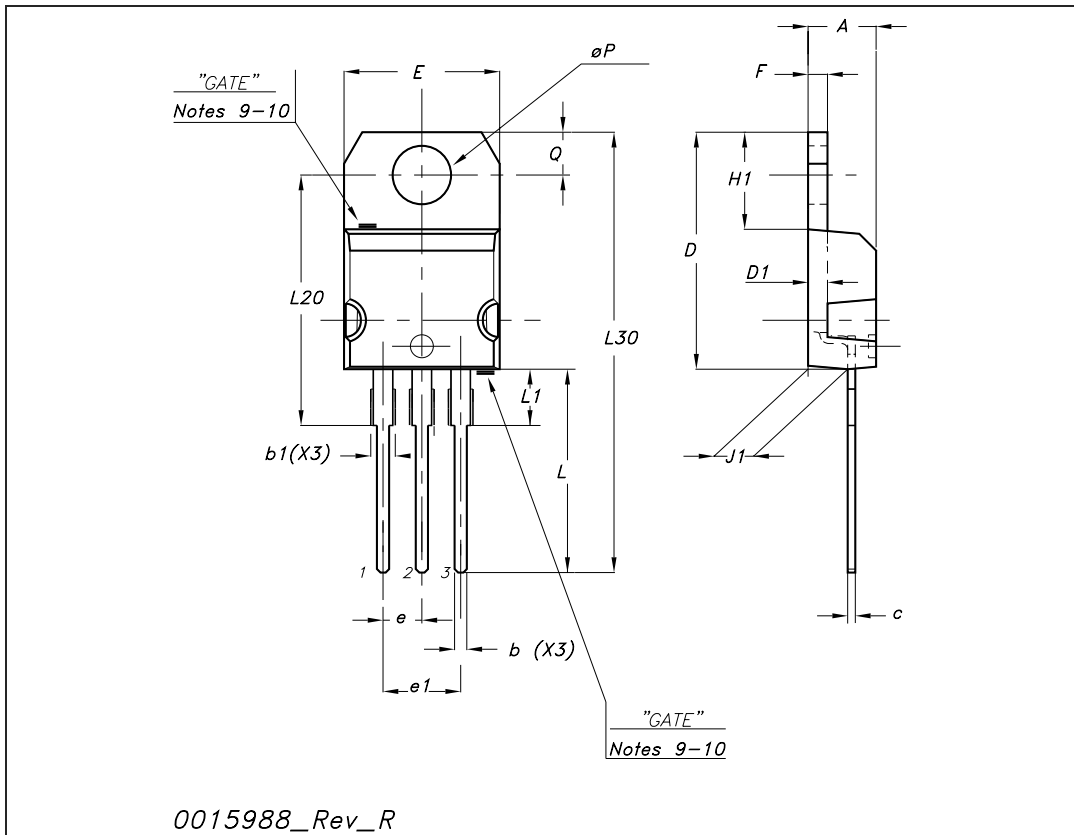
I<sup>2</sup>PAK (TO-262) mechanical data

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



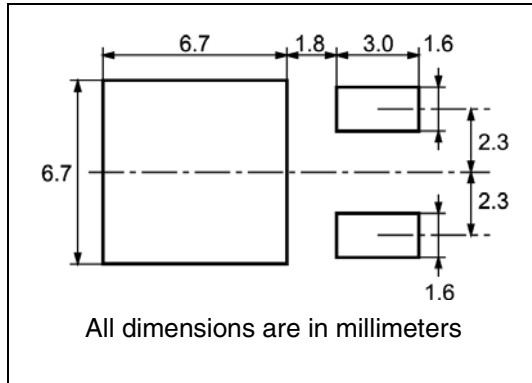
TO-220 mechanical data

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	1.14		1.70	0.044		0.066
c	0.48		0.70	0.019		0.027
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
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		0.051
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	
∅P	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



## 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

#### BASE QTY

2500
------

#### BULK QTY

2500
------

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

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

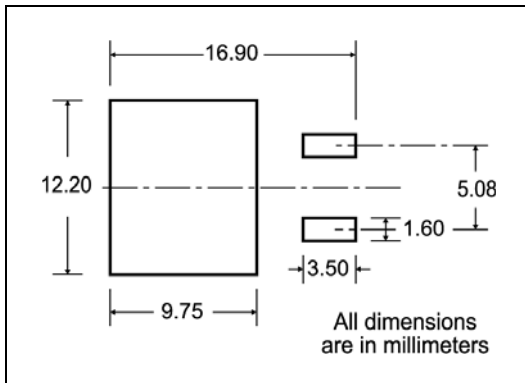
TRL

FEED DIRECTION

Bending radius R min.



### D<sup>2</sup>PAK 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

**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

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

TRL

FEED DIRECTION

Bending radius R min.

\* 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> .
07-May-2008	3	Modified <a href="#">Figure 9</a>
31-Mar-2009	4	Added new package, mechanical data: TO-220
18-May-2009	5	Modified <a href="#">Figure 5</a>

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