

## 10 A - 410 V internally clamped IGBT

### Features

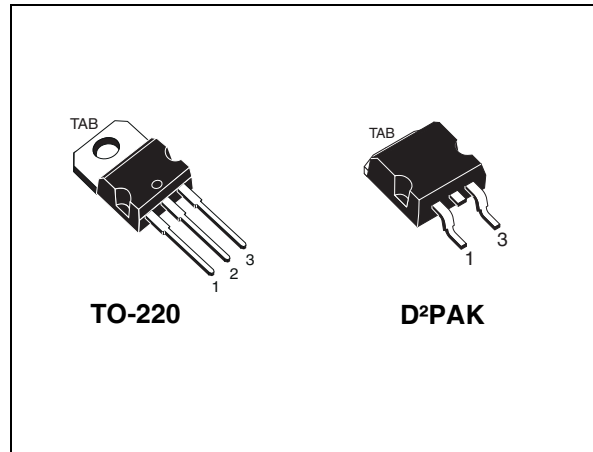
- Low threshold voltage
- Low on-voltage drop
- Low gate charge
- High current capability
- High voltage clamping feature

### Applications

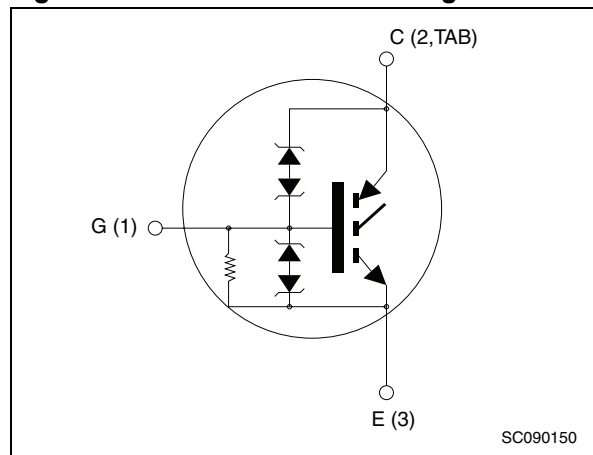
- Automotive ignition

### Description

This IGBT utilizes the advanced PowerMESH™ process resulting in an excellent trade-off between switching performance and low on-state behavior. The built in collector-gate Zener exhibits a very precise active clamping while the gate-emitter Zener supplies an ESD protection.



**Figure 1. Internal schematic diagram**



**Table 1. Device summary**

Order codes	Marking	Package	Packaging
STGB10NB37LZ	GB10NB37LZ	D <sup>2</sup> PAK	Tube
STGB10NB37LZT4	GB10NB37LZ	D <sup>2</sup> PAK	Tape and reel
STGP10NB37LZ	GP10NB37LZ	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>13</b>
<b>6</b>	<b>Revision history</b> .....	<b>14</b>

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GE} = 0$ )	$V_{CES}$ (clamped)	V
$V_{ECS}$	Emitter collector voltage ( $V_{GE} = 0$ )	18	V
$I_C^{(1)}$	Collector current (continuous) at $T_C = 25\text{ °C}$	20	A
$I_C^{(1)}$	Collector current (continuous) at $T_C = 100\text{ °C}$	10	A
$I_{CP}^{(2)}$	Pulsed collector current	40	A
$I_{CL}^{(3)}$	Turn-off latching current	40	A
$V_{GE}$	Gate-emitter voltage	$V_{GE}$ (clamped)	V
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	125	W
ESD(HBM)	Electrostatic sensitive discharge, human body model applied to all three pins ( $C=100\text{ pF}$ , $R=1.5\text{ k}\Omega$ )	4	kV
$E_{AS}$	Single pulse energy at $T_C = 25\text{ °C}$	300	mJ
$T_{stg}$	Storage temperature	- 65 to 175	°C
$T_j$	Operating junction temperature		

1. Calculated according to the iterative formula:

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

- Pulse width limited by maximum junction temperature and turn-off within RBSOA
- $V_{clamp} = 328\text{ V}$ ,  $T_C = 125\text{ °C}$ ,  $R_G=1\text{ k}\Omega$ ,  $V_{GE}=5\text{ V}$

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	1.2	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	62.5	°C/W

## 2 Electrical characteristics

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

**Table 4. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{CES(\text{clamped})}$	Collector emitter clamped voltage ( $V_{GE} = 0$ )	$I_C = 2\text{ mA}$ , $T_J = -40\text{ °C to }150\text{ °C}$	380	410	440	V
$V_{(BR)ECS}$	Emitter collector break-down voltage ( $V_{GE} = 0$ )	$I_{EC} = 75\text{ mA}$	18			V
$V_{GE(\text{clamped})}$	Gate emitter clamped voltage	$I_G = \pm 2\text{ mA}$	12		16	V
$V_{CE(\text{sat})}$	Collector-emitter saturation voltage	$V_{GE} = 4.5\text{ V}$ , $I_C = 10\text{ A}$ $V_{GE} = 4.5\text{ V}$ , $I_C = 20\text{ A}$		1.2 1.3	1.8	V V
$V_{GE(\text{th})}$	Gate threshold voltage	$V_{CE} = V_{GE}$ , $I_C = 250\text{ }\mu\text{A}$ $T_J = -40\text{ °C to }150\text{ °C}$	0.6		2.2	V
$I_{CES}$	Collector cut-off current ( $V_{GE} = 0$ )	$V_{CE} = 15\text{ V}$ , $T_J = 150\text{ °C}$ $V_{CE} = 200\text{ V}$ , $T_J = 150\text{ °C}$			10 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 10\text{ V}$			$\pm 700$	$\mu\text{A}$
$R_{GE}$	Gate emitter resistance			20		k $\Omega$
$g_{fs}$	Forward transconductance	$V_{CE} = 25\text{ V}$ , $I_C = 20\text{ A}$		18		S

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$ $C_{oes}$ $C_{res}$	Input capacitance Output capacitance Reverse transfer capacitance	$V_{CE} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GE} = 0$		1300 105 12		pF pF pF
$Q_g$	Total gate charge	$V_{CE} = 328\text{ V}$ , $I_C = 10\text{ A}$ , $V_{GE} = 5\text{ V}$ , (see <a href="#">Figure 18</a> )		28		nC

**Table 6. Functional characteristics**

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
U.I.S.	Unclamped inductive switching current	$R_{G\text{OFF}} = 1\text{ k}\Omega$ , $L = 1\text{ mH}$ , $T_J = 125\text{ °C}$	13			A

**Table 7. Switching on/off (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 328 \text{ V}$ , $I_C = 10 \text{ A}$		1300		ns
$t_r$	Current rise time	$R_G = 1 \text{ k}\Omega$ , $V_{GE} = 5 \text{ V}$		270		ns
$(di/dt)_{on}$	Turn-on current slope	(see <a href="#">Figure 19</a> )		60		A/ $\mu$ s
$t_c$	Cross-over time	$V_{CC} = 328 \text{ V}$ , $I_C = 10 \text{ A}$		3.6		$\mu$ s
$t_r(V_{off})$	Off voltage rise time	$R_G = 1 \text{ k}\Omega$ , $V_{GE} = 5 \text{ V}$		2		$\mu$ s
$t_{d(off)}$	Delay time	(see <a href="#">Figure 19</a> )		8		$\mu$ s
$t_f$	Fall time			1.4		$\mu$ s
$t_c$	Cross-over time	$V_{CC} = 328 \text{ V}$ , $I_C = 10 \text{ A}$		5.7		$\mu$ s
$t_r(V_{off})$	Off voltage rise time	$R_G = 1 \text{ k}\Omega$ , $V_{GE} = 5 \text{ V}$ ,		2.7		$\mu$ s
$t_{d(off)}$	Delay time	$T_J = 125 \text{ }^\circ\text{C}$		9.2		$\mu$ s
$t_f$	Fall time	(see <a href="#">Figure 19</a> )		2.8		$\mu$ s

**Table 8. Switching energy (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 328 \text{ V}$ , $I_C = 10 \text{ A}$		2.4		mJ
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 1 \text{ k}\Omega$ , $V_{GE} = 5 \text{ V}$		5		mJ
$E_{ts}$	Total switching losses	(see <a href="#">Figure 19</a> )		7.4		mJ
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 328 \text{ V}$ , $I_C = 10 \text{ A}$		2.6		mJ
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 1 \text{ k}\Omega$ , $V_{GE} = 5 \text{ V}$ ,		8.7		mJ
$E_{ts}$	Total switching losses	$T_J = 125 \text{ }^\circ\text{C}$ (see <a href="#">Figure 19</a> )		11.3		mJ

1.  $E_{on}$  is the turn-on losses when a typical diode is used in the test circuit in figure 2. If the IGBT is offered in a package with a co-pak diode, the co-pak diode is used as external diode. IGBTs & Diode are at the same temperature (25 °C and 125 °C)
2. Turn-off losses include also the tail of the collector current

## 2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

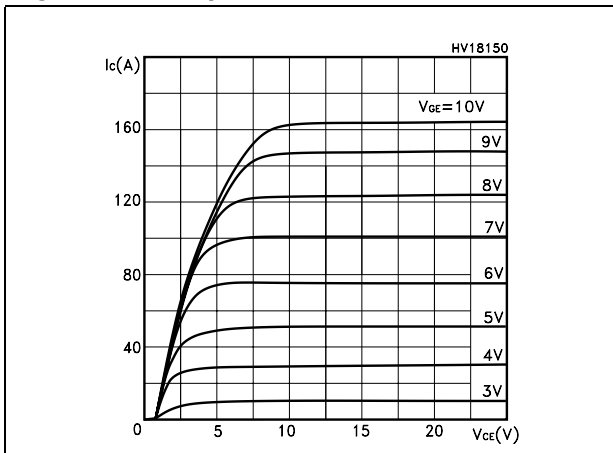


Figure 3. Transfer characteristics

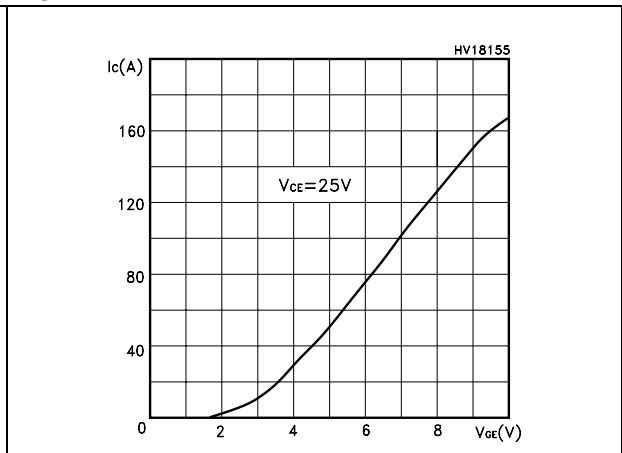


Figure 4. Transconductance

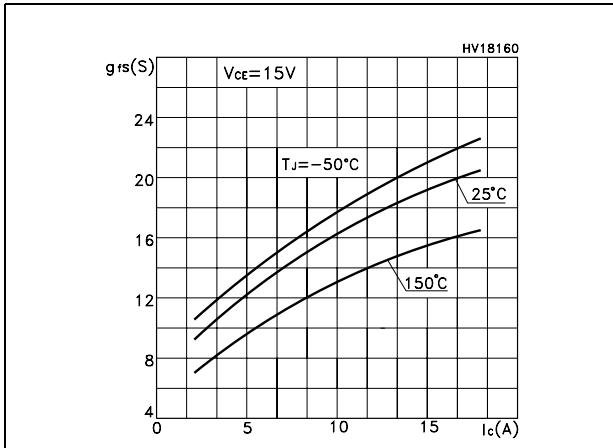


Figure 5. Collector-emitter on voltage vs temperature

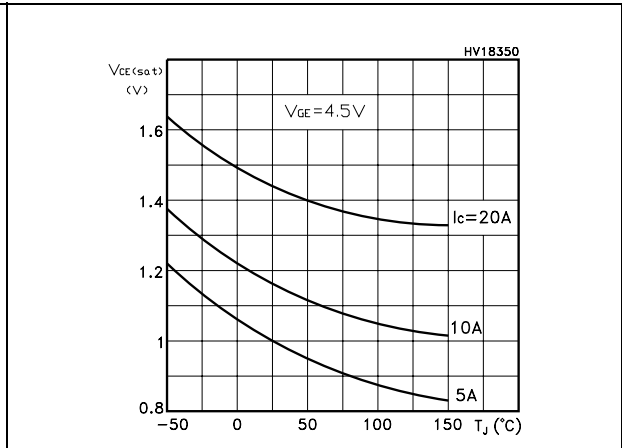


Figure 6. Gate charge vs gate-source voltage Figure 7. Capacitance variations

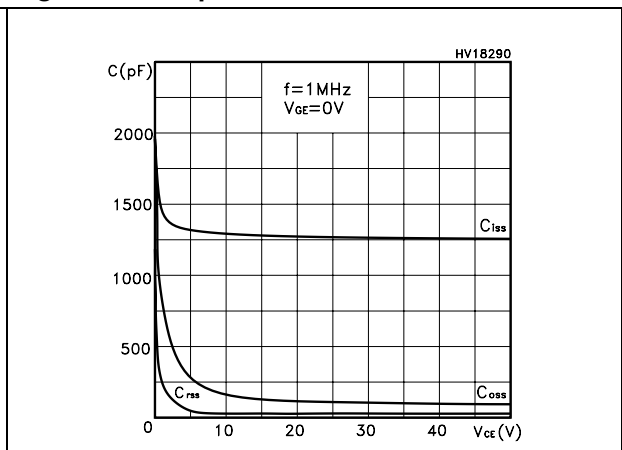
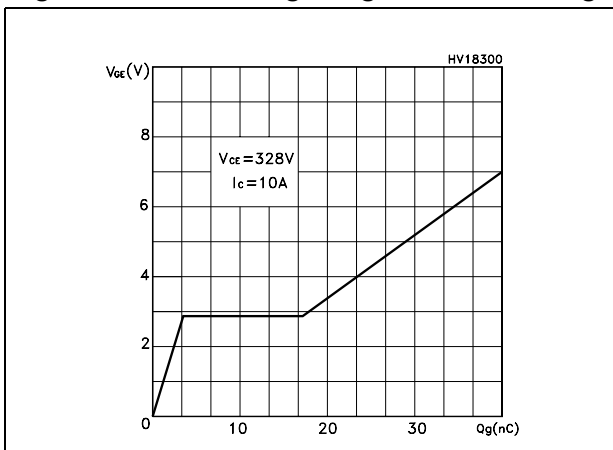


Figure 8. Normalized gate threshold voltage vs temperature

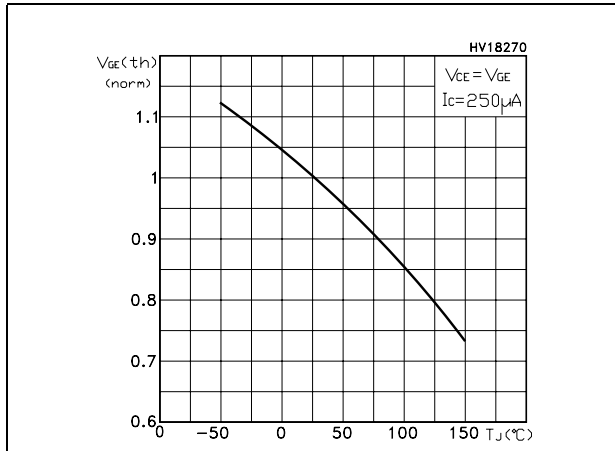


Figure 9. Collector-emitter on voltage vs collector current

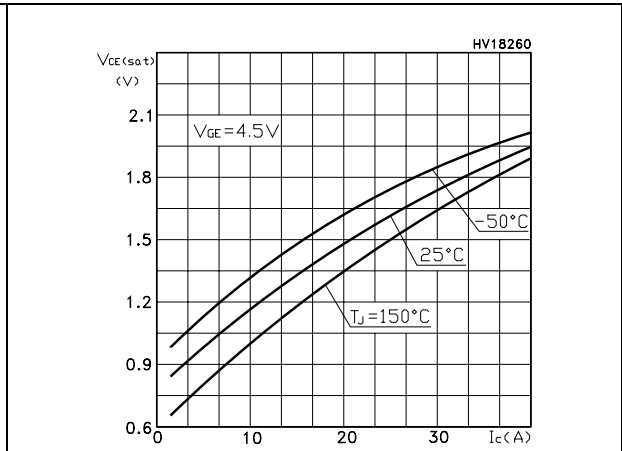


Figure 10. Normalized clamping voltage vs temperature

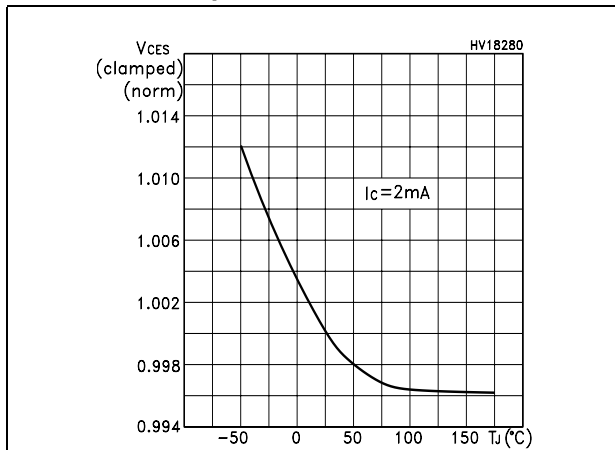


Figure 11. Switching losses vs temperature

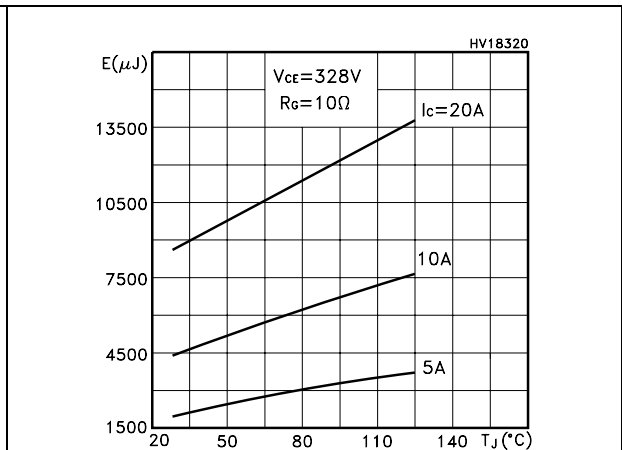


Figure 12. Switching losses vs gate resistance

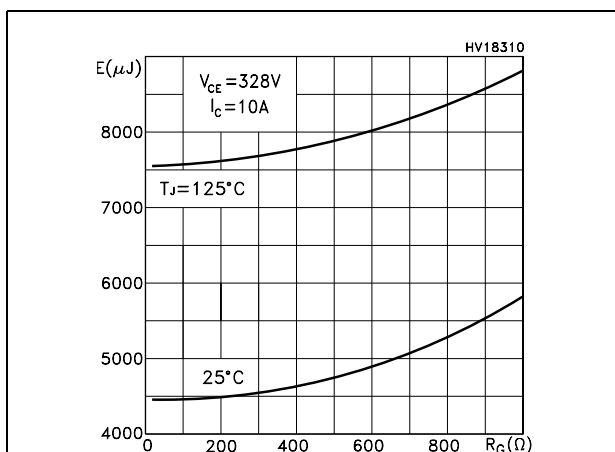


Figure 13. Switching losses vs collector current

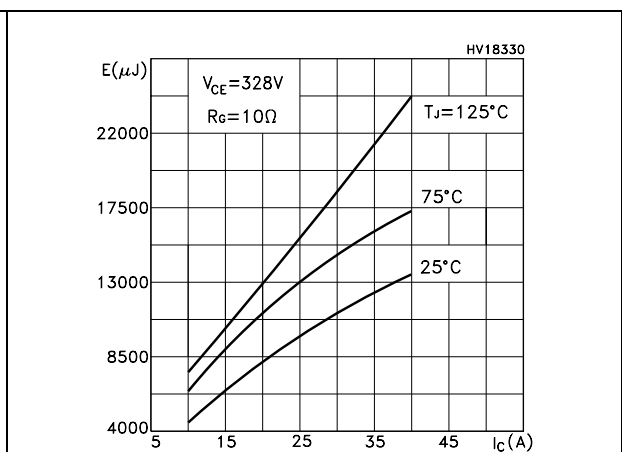


Figure 14. Thermal impedance

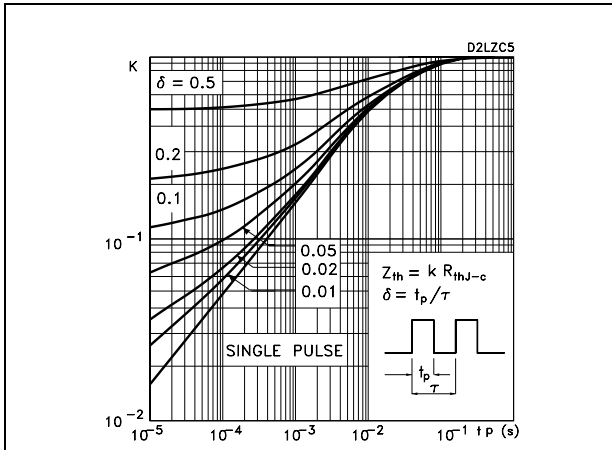


Figure 15. Turn-off SOA

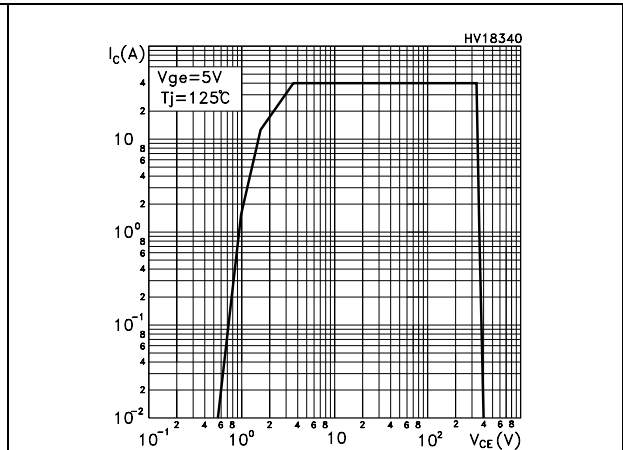
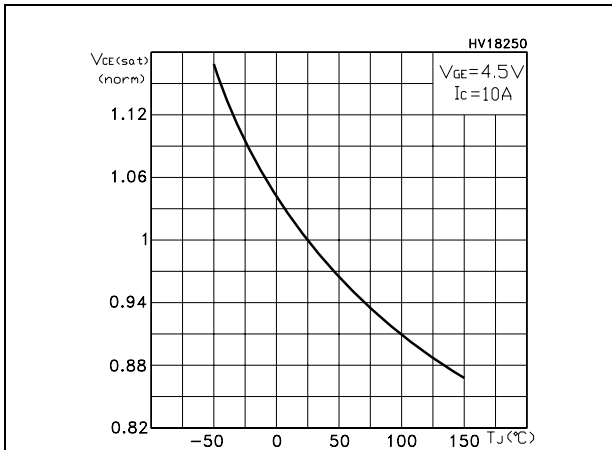


Figure 16. Normalized collector-emitter on voltage vs temperature





### 3 Test circuits

Figure 17. Test circuit for inductive load switching

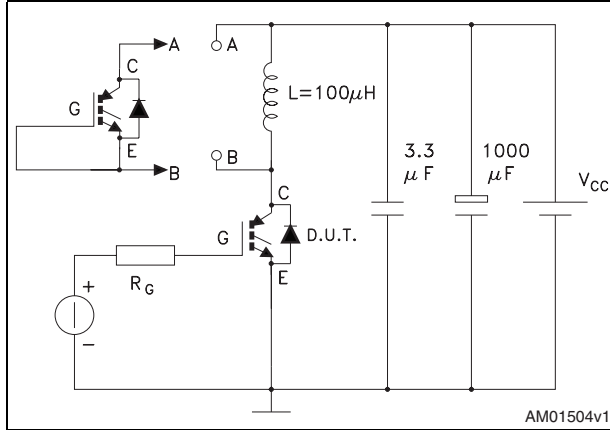


Figure 18. Gate charge test circuit

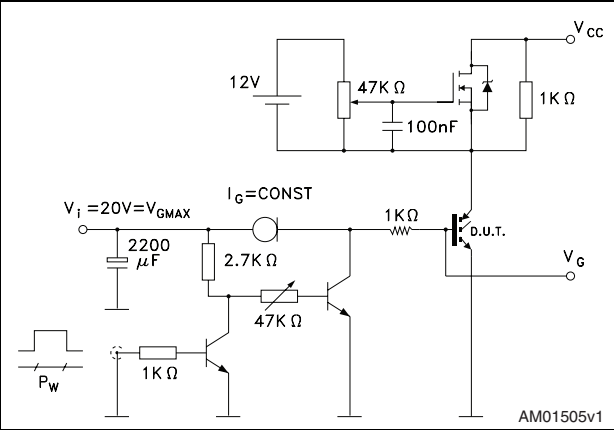
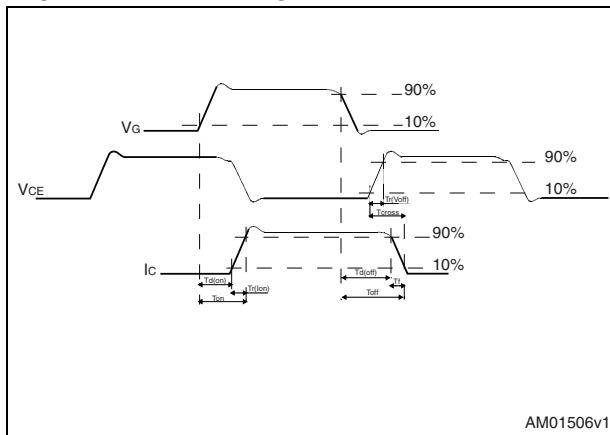


Figure 19. Switching waveform

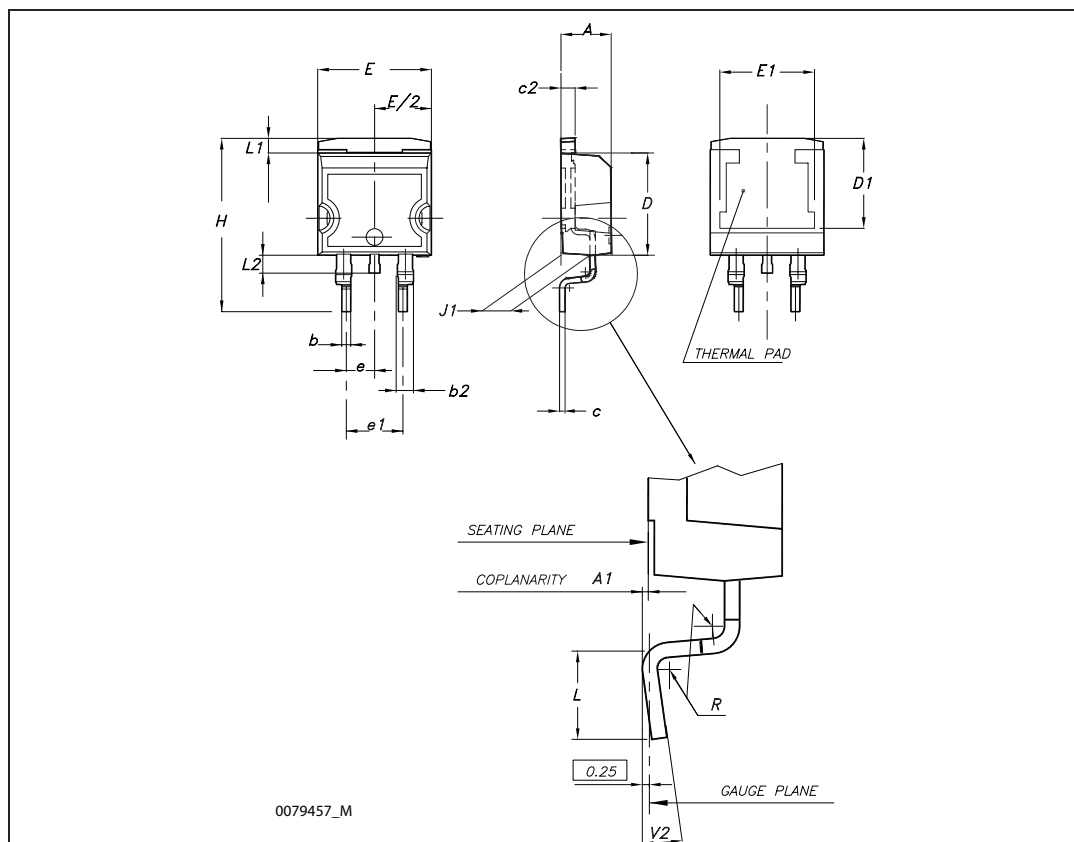


## 4 Package mechanical data

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.

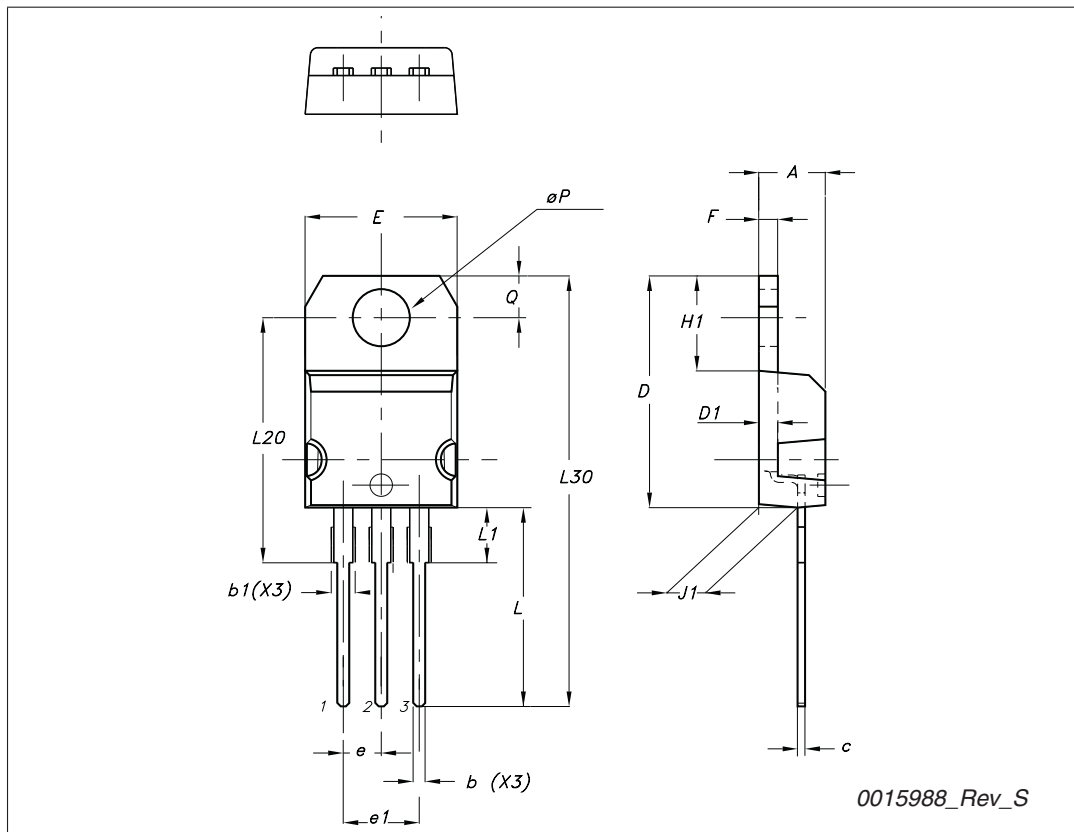
D<sup>2</sup>PAK (TO-263) mechanical data

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°



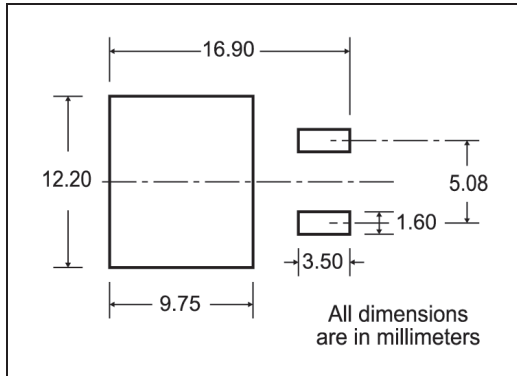
TO-220 type A mechanical data

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



# 5 Packaging mechanical data

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

G measured at hub

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.

## 6 Revision history

**Table 9. Document revision history**

Date	Revision	Changes
23-Jan-2006	2	
11-Feb-2009	3	Added new package, mechanical data TO-220
06-Nov-2009	4	TO-220 mechanical data has been updated.

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