

$E_{AS}$  450 mJ, 345 V, internally clamped IGBT

## Features

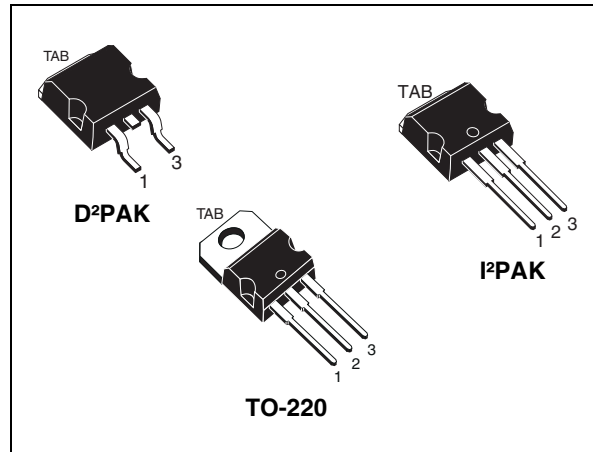
- Low threshold voltage
- Low on-voltage drop
- High voltage clamping feature
- Gate and gate-emitter integrated resistors

## Application

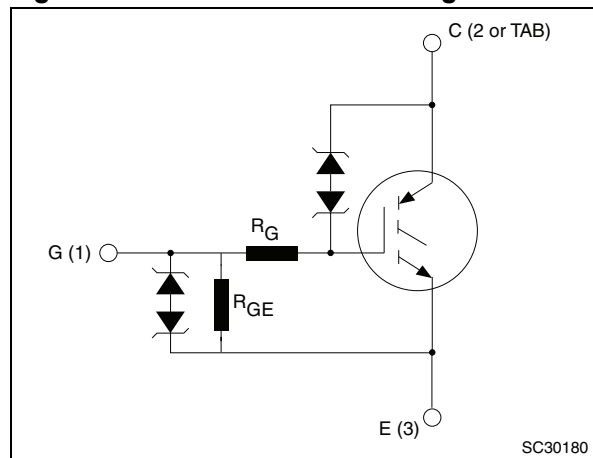
- Automotive ignition

## 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
STGB35N35LZ-1	GB35N35LZ	I <sup>2</sup> PAK	Tube
STGB35N35LZT4	GB35N35LZ	D <sup>2</sup> PAK	Tape and reel
STGP35N35LZ	GP35N35LZ	TO-220	Tube

# Contents

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# 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 ( $V_{GE} = 0$ )	20	V
$I_C^{(1)}$	Continuous collector current at $T_C = 25\text{ °C}$	40	A
$I_C^{(1)}$	Continuous collector current at $T_C = 100\text{ °C}$	30	A
$I_{CP}^{(2)}$	Pulsed collector current	80	A
$V_{GE}$	Gate-emitter voltage	$V_{GE}$ (clamped)	V
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	176	W
$E_{AS}$	Single pulse energy ( $T_C=25\text{ °C}$ , $L=1.6\text{ mH}$ , $I_C = 22\text{ A}$ , $V_{CC} = 50\text{ V}$ )	450	mJ
ESD	Human body model ( $R=1,5\text{ k}\Omega$ , $C=100\text{ pF}$ )	8	kV
	Machine model ( $R=0$ , $C=100\text{ pF}$ )	800	V
	Charged device model	2	kV
$T_{stg}$	Storage temperature	- 55 to 175	°C
$T_j$	Operating junction temperature		

1. Calculated according to the iterative formula:

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

2. Pulse width limited by maximum junction temperature

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.85	°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 ( $V_{GE}=0$ )	$I_C=2\text{ mA}$ , $T_j = -40\text{ °C to }150\text{ °C}$	320	345	380	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	14	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 ( $V_{CE} = 0$ )	$V_{GE} = \pm 10\text{ V}$	500	625	830	$\mu\text{A}$
$R_{GE}$	Gate emitter resistance		12	15	20	k $\Omega$
$R_G$	Gate resistance			1.5		k $\Omega$
$V_{GE(\text{th})}$	Gate threshold voltage	$V_{CE} = V_{GE}$ , $I_C = 1\text{ mA}$ , $T_j = -40\text{ °C}$	1.4			V
		$V_{CE} = V_{GE}$ , $I_C = 1\text{ mA}$	1.2	1.6	2.3	V
		$V_{CE} = V_{GE}$ , $I_C = 1\text{ mA}$ , $T_j = 150\text{ °C}$	0.7			V
$V_{CE(\text{sat})}$	Collector-emitter saturation voltage	$V_{GE} = 4.5\text{ V}$ , $I_C = 10\text{ A}$		1.15	1.5	V
		$V_{GE} = 4.5\text{ V}$ , $I_C = 15\text{ A}$		1.3	1.7	V

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GE} = 0$	-	700	-	pF
$C_{oes}$	Output capacitance		-	150	-	pF
$C_{res}$	Reverse transfer capacitance		-	6	-	pF

Table 6. Functional characteristics

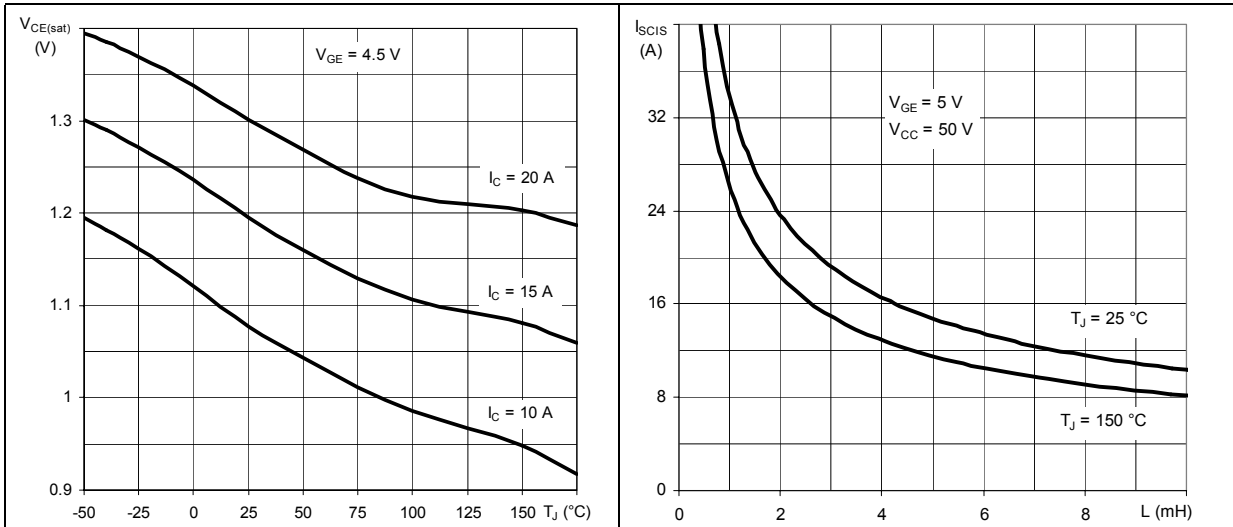
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
U.I.S.	Functional test open secondary coil	$R_G = 0$ , $T_j = 150\text{ °C}$ , $V_{CC} = 50\text{ V}$ , $V_{GE} = 5\text{ V}$ , $L = 1.6\text{ mH}$	18	-	-	A

Table 7. Switching time

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit	
$t_{d(on)}$ $t_r$	<b>Resistive load</b> Turn-on delay time	$V_{CC} = 14\text{ V}$ , $R_L = 1\ \Omega$ , $V_{GE} = 5\text{ V}$	-	1.1	-	$\mu\text{s}$	
	Rise time					7	$\mu\text{s}$
$t_{d(on)}$ $t_r$	<b>Resistive load</b> Turn-on delay time	$V_{CC} = 14\text{ V}$ , $R_L = 1\ \Omega$ , $V_{GE} = 5\text{ V}$ $T_j = 150\text{ °C}$	-	1	-	$\mu\text{s}$	
	Rise time					6.6	$\mu\text{s}$
$t_{d(off)}$ $t_f$ dv/dt	<b>Inductive load</b> Turn-off delay time	$V_{CC} = 300\text{ V}$ , $L = 1\text{ mH}$ $I_C = 15\text{ A}$ , $V_{GE} = 5\text{ V}$	-	26.5	-	$\mu\text{s}$	
	Fall time					5.5	$\mu\text{s}$
	Turn-off voltage slope					70	V/ $\mu\text{s}$
$t_{d(off)}$ $t_f$ dv/dt	<b>Inductive load</b> Turn-off delay time	$V_{CC} = 300\text{ V}$ , $L = 1\text{ mH}$ $I_C = 15\text{ A}$ , $V_{GE} = 5\text{ V}$ $T_j = 150\text{ °C}$	-	28	-	$\mu\text{s}$	
	Fall time					9	$\mu\text{s}$
	Turn-off voltage slope					65	V/ $\mu\text{s}$

## 2.1 Electrical characteristics (curves)

**Figure 2. Collector-emitter saturation voltage vs temperature**      **Figure 3. Self clamped inductive switch**



**Figure 4. Output characteristics ( $T_J = 25$  °C)**      **Figure 5. Output characteristics ( $T_J = -40$  °C)**

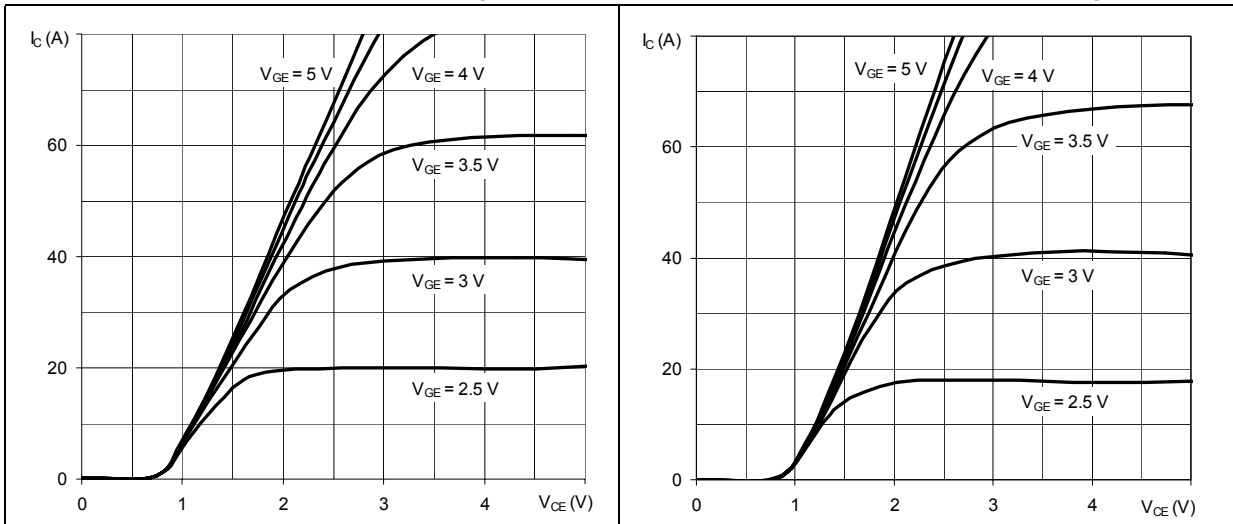


Figure 6. Output characteristics ( $T_J = 175\text{ }^\circ\text{C}$ ) Figure 7. Transfer characteristics

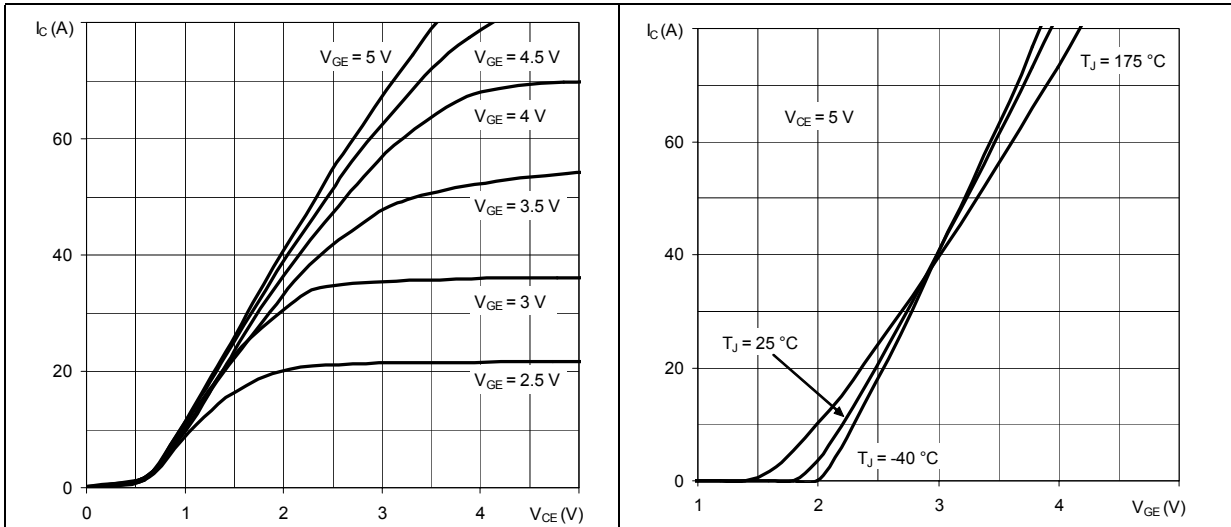


Figure 8. Collector cut-off current vs temperature

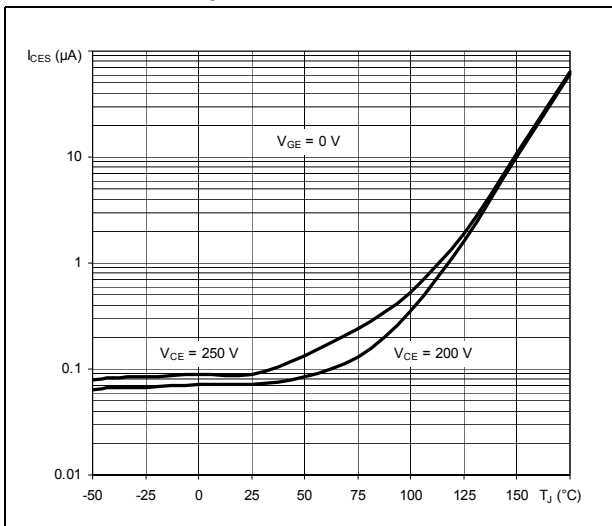


Figure 9. Normalized collector emitter voltage vs temperature

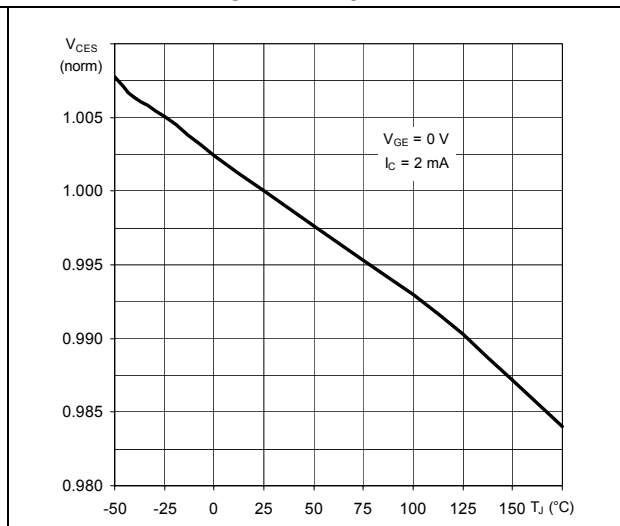


Figure 10. Normalized gate threshold voltage vs temperature

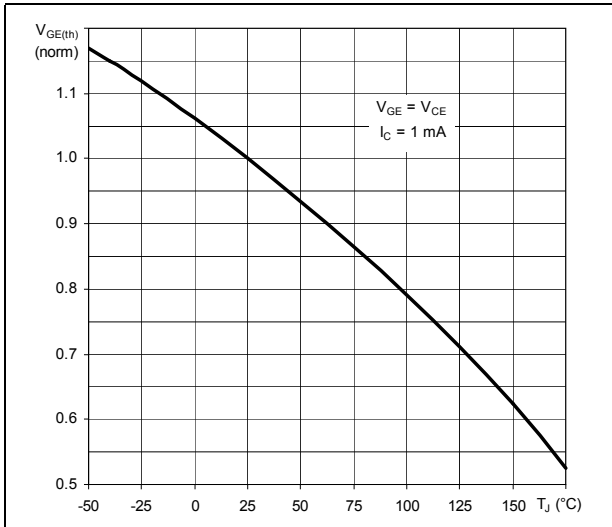


Figure 11. Gate charge

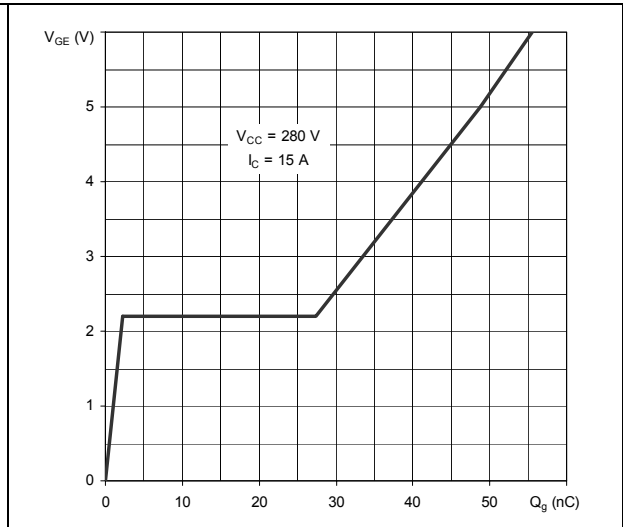
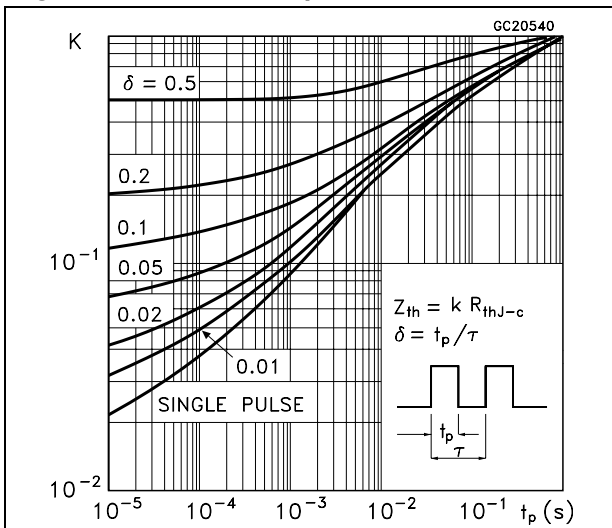


Figure 12. Thermal impedance





### 3 Test circuits

Figure 13. Test circuit for inductive load switching

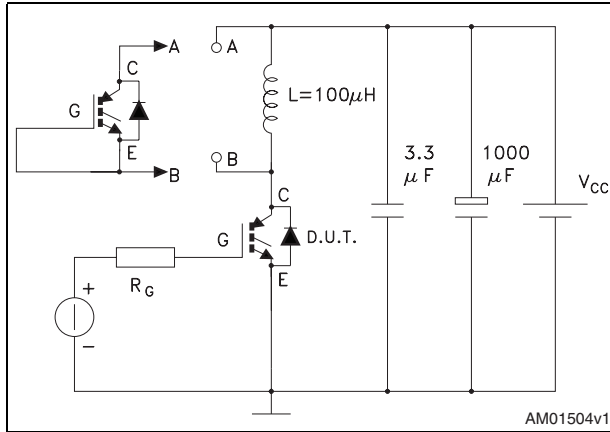


Figure 14. Gate charge test circuit

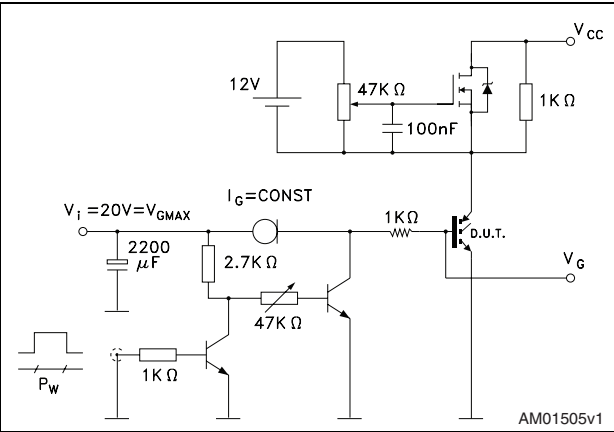
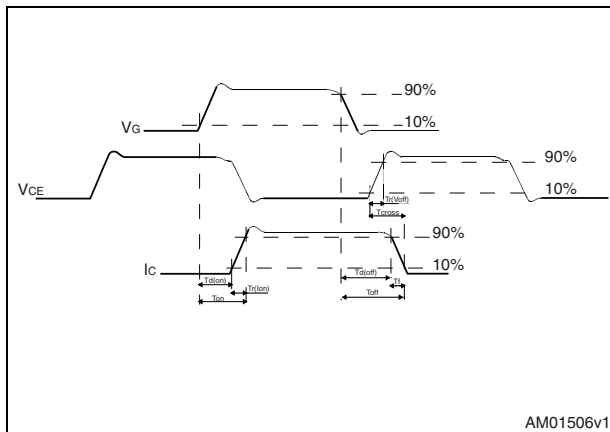


Figure 15. Switching waveform



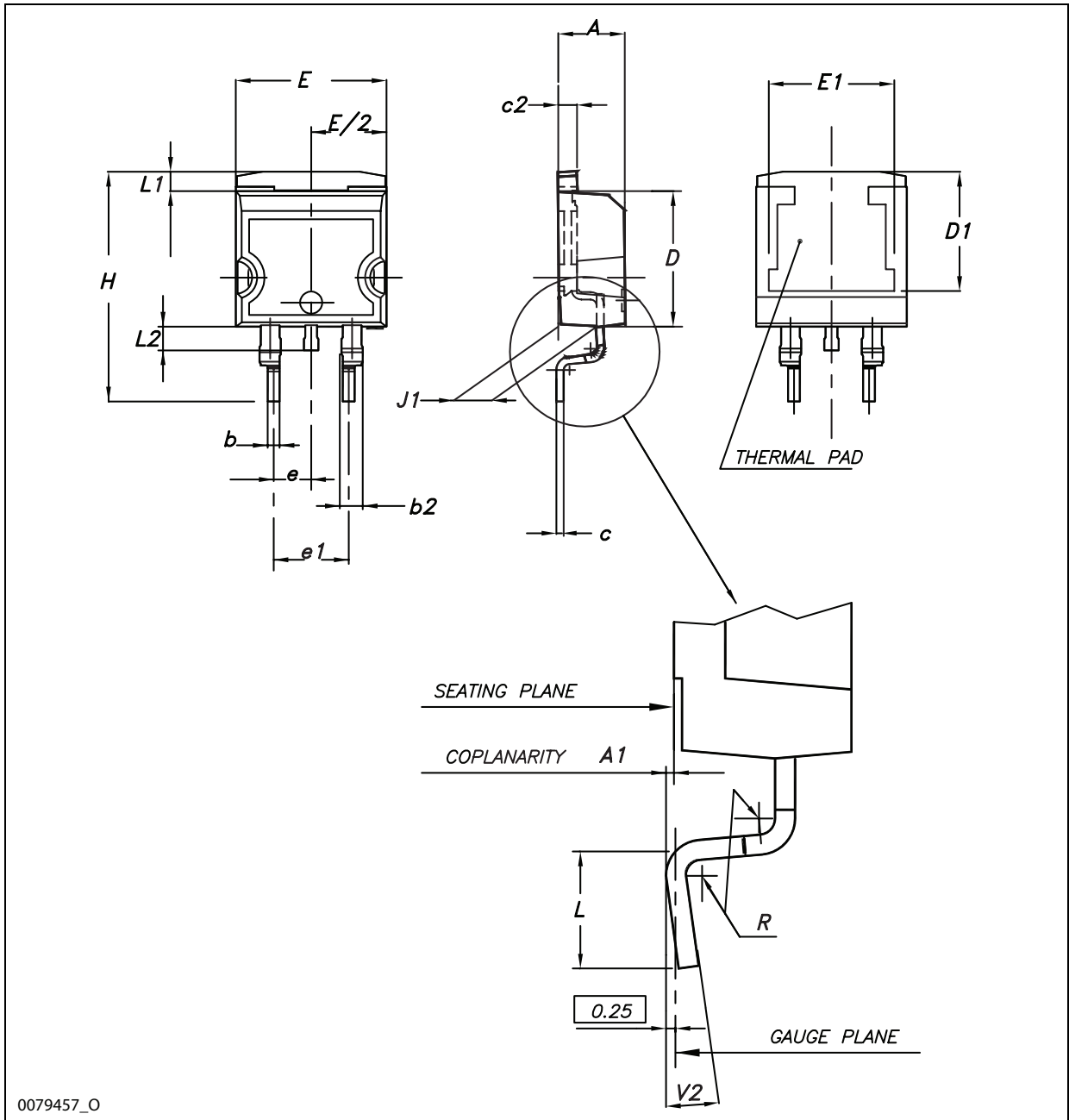
## 4 Package mechanical data

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

Table 8. D<sup>2</sup>PAK mechanical data

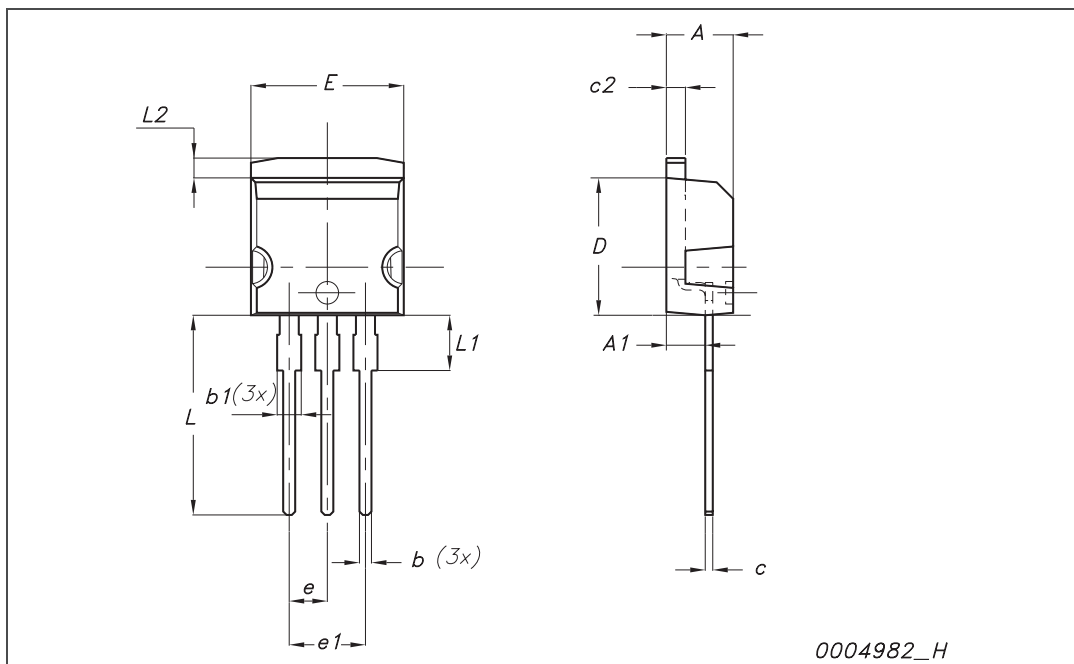
Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50		
E	10		10.40
E1	8.50		
e		2.54	
e1	4.88		5.28
H	15		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°

Figure 16. D<sup>2</sup>PAK mechanical data drawing



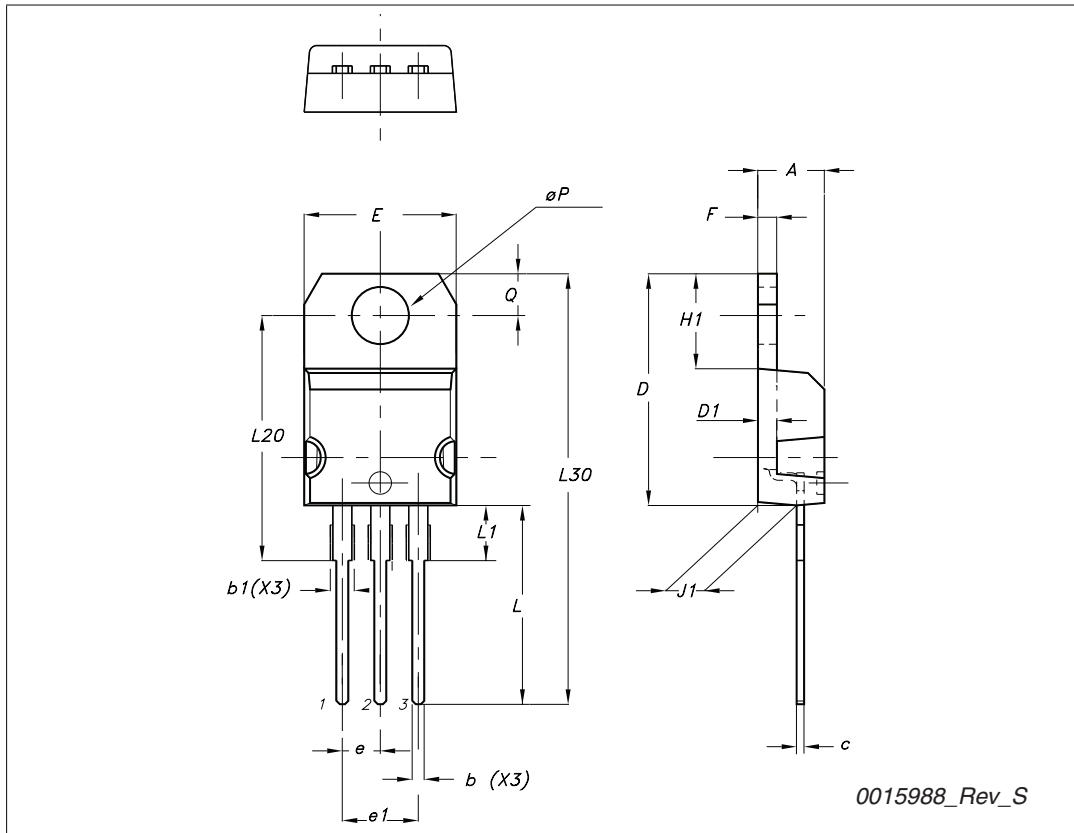
I<sup>2</sup>PAK (TO-262) mechanical data

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



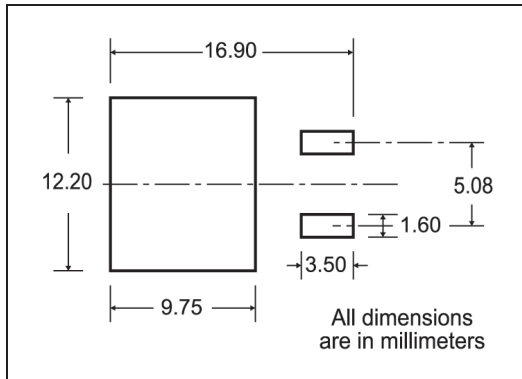
TO-220 type A mechanical data

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

**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

Bending radius

## 6 Revision history

**Table 9. Document revision history**

Date	Revision	Changes
29-Mar-2006	1	Initial release.
03-Jun-2009	2	Document status promoted from preliminary data to datasheet.
05-Nov-2009	3	Inserted <a href="#">Chapter 2.1: Electrical characteristics (curves)</a>
16-Feb-2010	4	Added new package, mechanical data: TO-220
03-Jun-2010	5	<ul style="list-style-type: none"><li>– Added <a href="#">Figure 12: Thermal impedance</a></li><li>– Modified <a href="#">Figure 4</a>, <a href="#">Figure 5</a>, <a href="#">Figure 6</a> and <a href="#">Figure 7</a></li><li>– D<sup>2</sup>PAK mechanical data has been updated</li></ul>



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