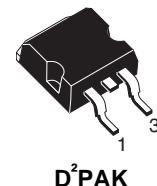


## General features

Type	$V_{CES}$	$V_{CE(sat)}^{\max}$ @ 25°C	$I_C$ @ 100°C
STGB6NC60H	600V	<2.5V	7A

- Low on voltage drop ( $V_{cesat}$ )
- Low  $C_{RES}$  /  $C_{IES}$  ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode
- High frequency operation



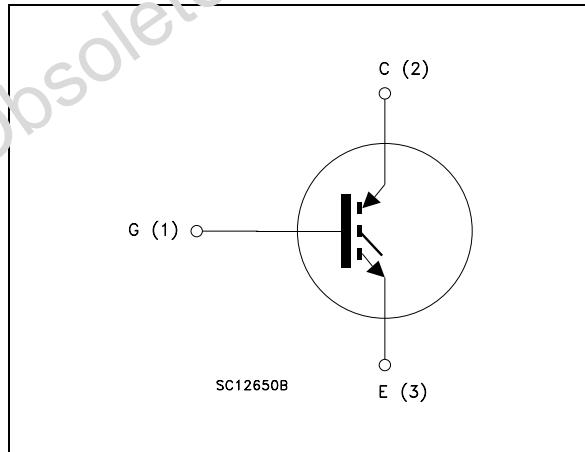
## Description

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix "H" identifies a family optimized for high frequency application in order to achieve very high switching performances (reduced t<sub>fall</sub>) maintaining a low voltage drop.

## Applications

- High frequency inverters
- SMPS and PFC in both hard switch and resonant topologies
- Motor drivers

## Internal schematic diagram



## Order codes

Part number	Marking	Package	Packaging
STGB6NC60HT4	GB6NC60H	D <sup>2</sup> PAK	Tape & reel

## Contents

<b>1</b>	<b>Electrical ratings</b>	<b>3</b>
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Obsolete Product(s) - Obsolete Product(s)

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GS} = 0$ )	600	V
$I_C^{(1)}$	Collector current (continuous) at $T_C = 25^\circ\text{C}$	15	A
$I_C^{(1)}$	Collector current (continuous) at $T_C = 100^\circ\text{C}$	7	A
$I_{CM}^{(2)}$	Collector current (pulsed)	21	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$P_{TOT}$	Total dissipation at $T_C = 25^\circ\text{C}$	56	W
$T_{stg}$	Storage temperature	– 55 to 150	$^\circ\text{C}$
$T_j$	Operating junction temperature		
$T_l$	Maximum lead temperature for soldering purpose (for 10sec. 1.6 mm from case)	300	$^\circ\text{C}$

1. Calculated according to the iterative formula::

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

2. Pulse width limited by max junction temperature

**Table 2. Thermal resistance**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	2	$^\circ\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	62.5	$^\circ\text{C/W}$

## 2 Electrical characteristics

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

**Table 3. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{BR(CES)}$	Collector-emitter breakdown voltage	$I_C = 1\text{mA}$ , $V_{GE} = 0$	600			V
$V_{CE(\text{sat})}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{V}$ , $I_C = 3\text{A}$ $V_{GE} = 15\text{V}$ , $I_C = 3\text{A}$ , $T_c = 125^{\circ}\text{C}$		1.9 1.7	2.5	V V
$V_{GE(\text{th})}$	Gate threshold voltage	$V_{CE} = V_{GE}$ , $I_C = 250\text{\mu A}$	3.75		5.75	V
$I_{CES}$	Collector cut-off current ( $V_{GE} = 0$ )	$V_{CE} = \text{Max rating}$ , $T_C = 25^{\circ}\text{C}$ $V_{CE} = \text{Max rating}$ , $T_C = 125^{\circ}\text{C}$			10 1	$\mu\text{A}$ mA
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{V}$ , $V_{CE} = 0$			$\pm 100$	nA
$g_{fs}$	Forward transconductance	$V_{CE} = 15\text{V}$ , $I_C = 3\text{A}$		3		s

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance			205		pF
$C_{oes}$	Output capacitance	$V_{CE} = 25\text{V}$ , $f = 1\text{MHz}$ , $V_{GE} = 0$		32		pF
$C_{res}$	Reverse transfer capacitance			5.5		pF
$Q_g$	Total gate charge			13.6		nC
$Q_{ge}$	Gate-emitter charge	$V_{CE} = 390\text{V}$ , $I_C = 3\text{A}$ , $V_{GE} = 15\text{V}$ ,		3.4		nC
$Q_{gc}$	Gate-collector charge	(see Figure 16)		5.1		nC
$I_{CL}$	Turn-off SOA minimum current	$V_{clamp} = 390\text{V}$ , $T_j = 150^{\circ}\text{C}$ , $R_G = 10\Omega$ , $V_{GE} = 15\text{V}$		19		A

**Table 5. Switching on/off (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$ ( $di/dt$ ) <sub>on</sub>	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 390V$ , $I_C = 3A$ $R_G = 10\Omega$ , $V_{GE} = 15V$ , $T_J = 25^\circ C$ (see Figure 17)		12 5 612		ns ns A/μs
$t_{d(on)}$ $t_r$ ( $di/dt$ ) <sub>on</sub>	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 390V$ , $I_C = 3A$ $R_G = 10\Omega$ , $V_{GE} = 15V$ , $T_J = 125^\circ C$ (see Figure 17)		13 4.3 560		ns ns A/μs
$t_r(V_{off})$ $t_{d(off)}$ $t_f$	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390V$ , $I_C = 3A$ , $R_{GE} = 10\Omega$ , $V_{GE} = 15V$ , $T_J = 25^\circ C$ (see Figure 17)		40 76 100		ns ns ns
$t_r(V_{off})$ $t_{d(off)}$ $t_f$	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390V$ , $I_C = 3A$ , $R_{GE} = 10\Omega$ , $V_{GE} = 15V$ , $T_J = 125^\circ C$ (see Figure 17)		60 98 124		ns ns ns

**Table 6. Switching energy (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$ $E_{off}^{(2)}$ $E_{ts}$	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390V$ , $I_C = 3A$ $R_G = 10\Omega$ , $V_{GE} = 15V$ , $T_J = 25^\circ C$ (see Figure 17)		20 68 88		μJ μJ μJ
$E_{on}^{(1)}$ $E_{off}^{(2)}$ $E_{ts}$	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390V$ , $I_C = 3A$ $R_G = 10\Omega$ , $V_{GE} = 15V$ , $T_J = 125^\circ C$ (see Figure 17)		37 93 130		μJ μJ μJ

1.  $E_{on}$  is the turn-on losses when a typical diode is used in the test circuit in figure 17. 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 ( $25^\circ C$  and  $125^\circ C$ )
2. Turn-off losses include also the tail of the collector current

## 2.1 Electrical characteristics (curves)

Figure 1. Output characteristics

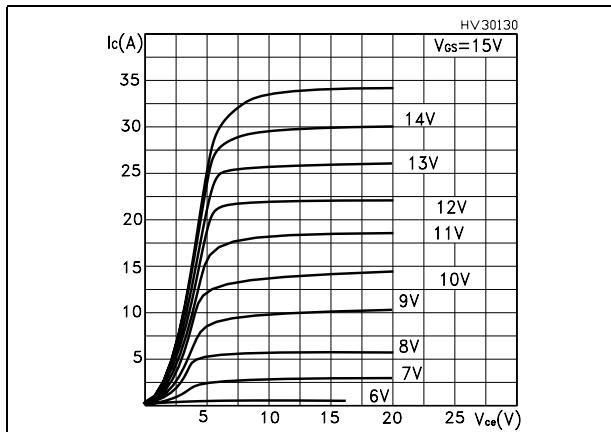


Figure 2. Transfer characteristics

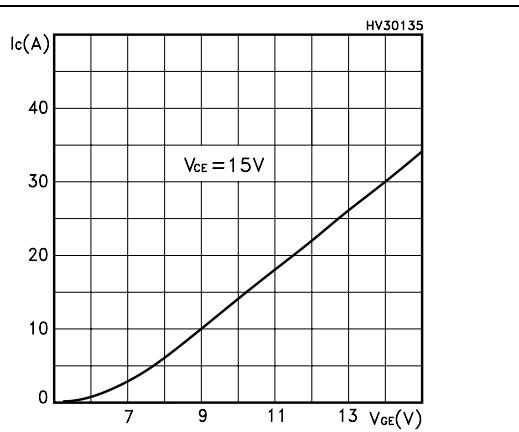


Figure 3. Transconductance

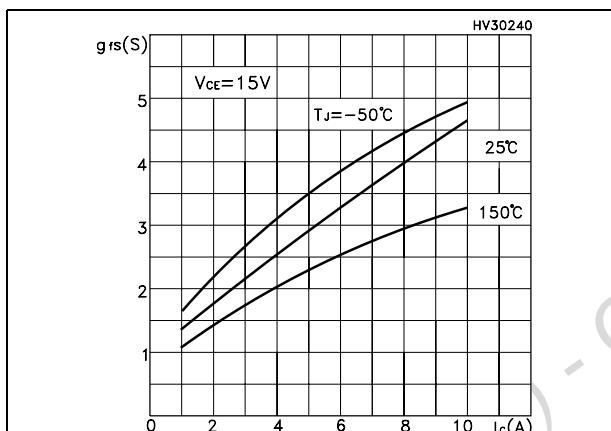


Figure 4. Collector-emitter on voltage vs temperature

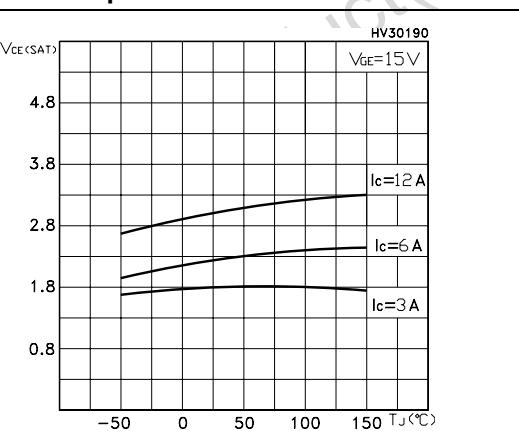


Figure 5. Gate charge vs gate-source voltage

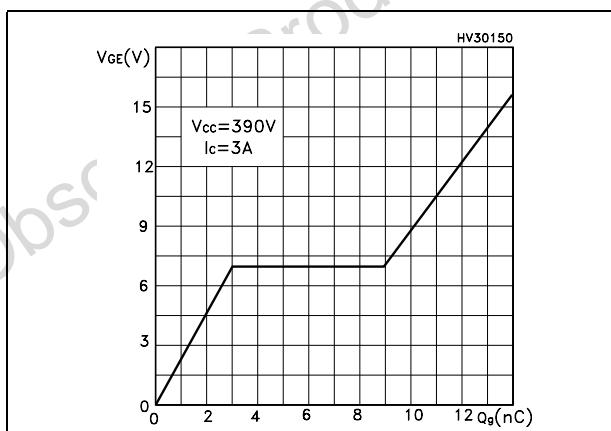
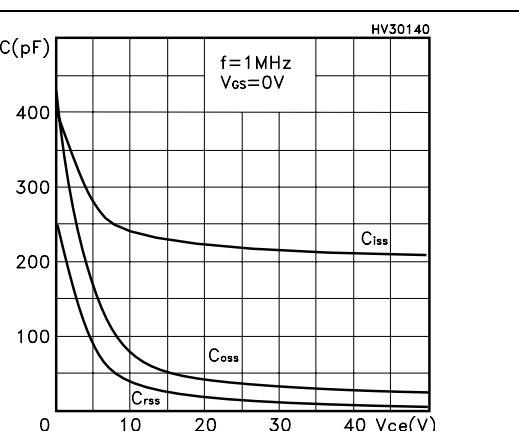
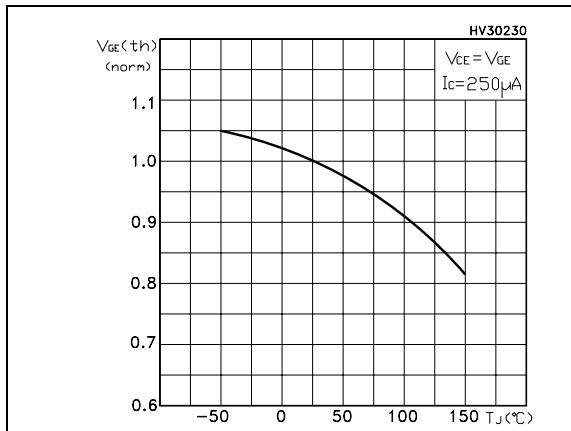


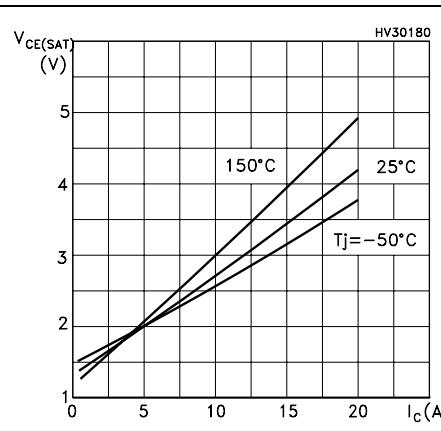
Figure 6. Capacitance variations



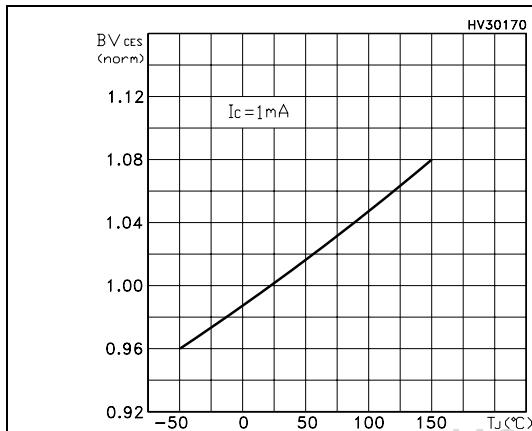
**Figure 7. Normalized gate threshold voltage vs temperature**



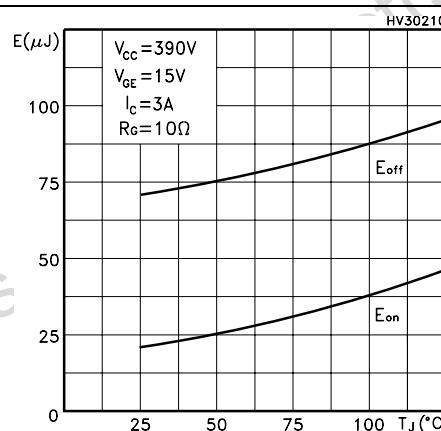
**Figure 8. Collector-emitter on voltage vs collector current**



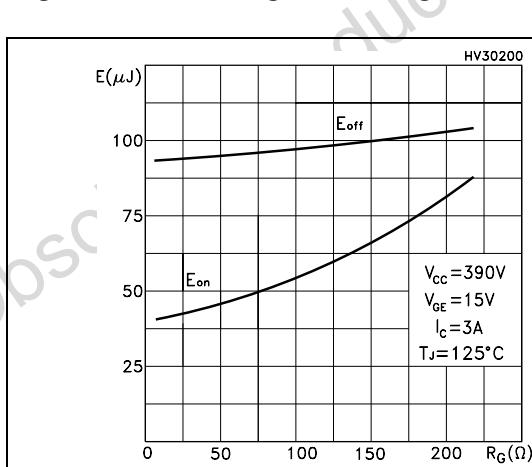
**Figure 9. Normalized breakdown voltage vs temperature**



**Figure 10. Switching losses vs temperature**



**Figure 11. Switching losses vs gate resistance**



**Figure 12. Switching losses vs collector current**

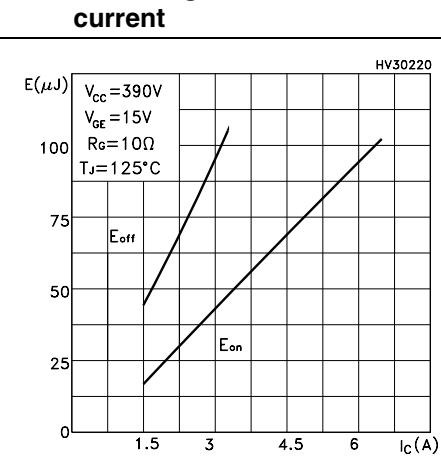


Figure 13. Thermal impedance

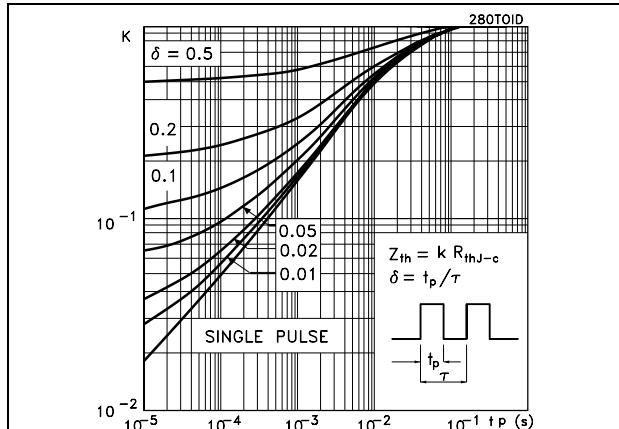
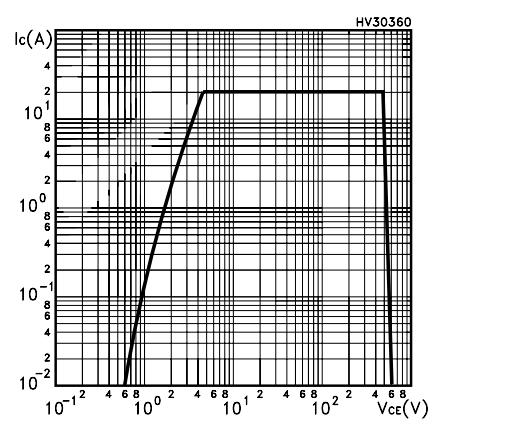


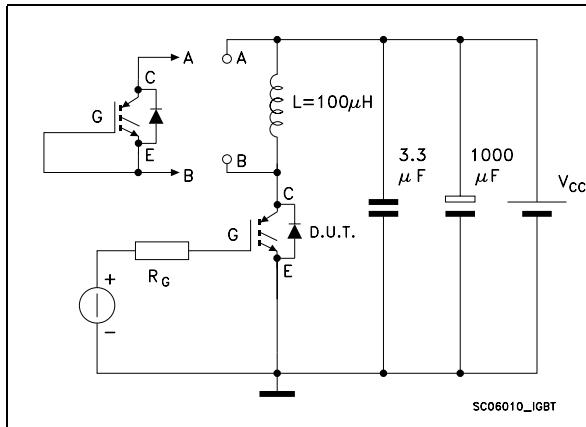
Figure 14. Turn-off SOA



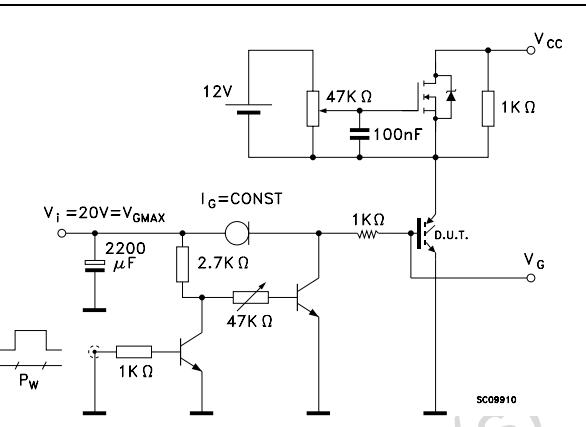
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### 3 Test circuit

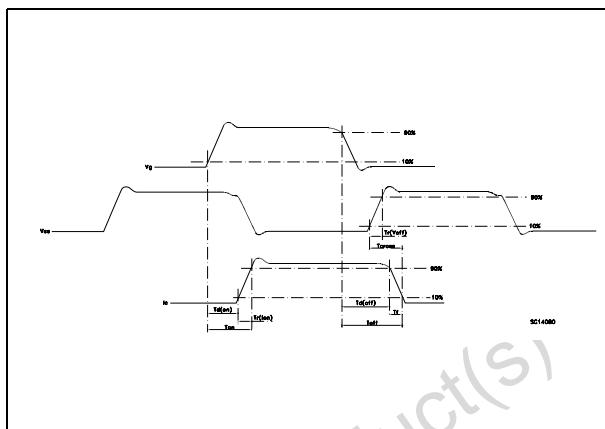
**Figure 15. Test circuit for inductive load switching**



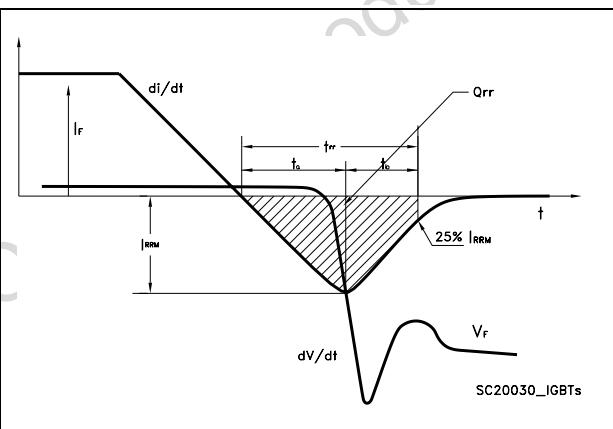
**Figure 16. Gate charge test circuit**



**Figure 17. Switching waveform**



**Figure 18. Diode recovery time waveform**



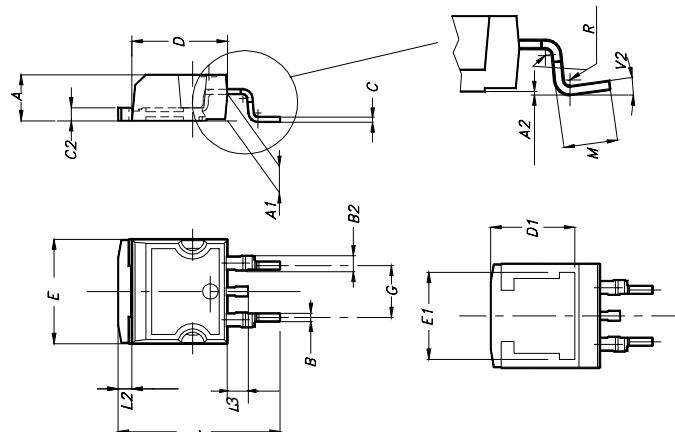
## 4 Package mechanical data

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)

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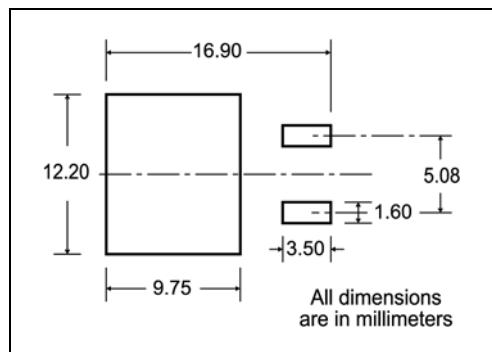
D<sup>2</sup>PAK MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.393		
E1		8.5			0.334	
G	4.88		5.28	0.192		0.208
L	15		15.85	0.590		0.625
L2	1.27		1.4	0.050		0.055
L3	1.4		1.75	0.055		0.068
M	2.4		3.2	0.094		0.126
R		0.4			0.015	
V2	0°		4°			



## 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	

\* on sales type

## 6 Revision history

**Table 7. Revision history**

Date	Revision	Changes
18-Nov-2005	1	First Release
27-jul-2006	2	New template

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