



## STGB6NC60H

N-channel 600V - 7A - D<sup>2</sup>PAK  
Very fast PowerMESH™ IGBT

### General features

Type	V <sub>CES</sub>	V <sub>CE(sat)</sub> max @25°C	I <sub>C</sub> @100°C
STGB6NC60H	600V	<2.5V	7A

- Low on voltage drop (V<sub>cesat</sub>)
- Low C<sub>RES</sub> / C<sub>IES</sub> ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode
- High frequency operation

### Description

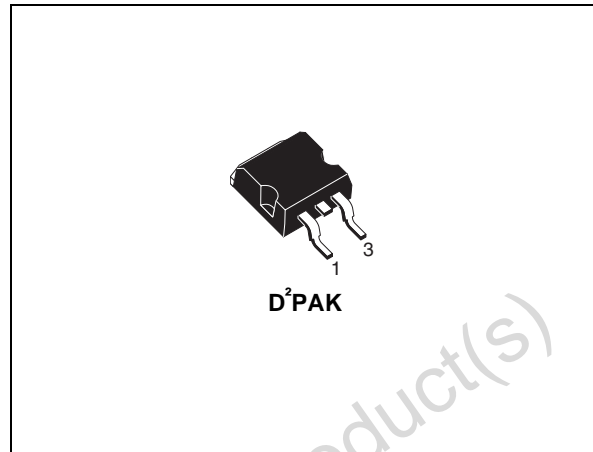
Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix "H" identifies a family optimized for high frequency application in order to achieve very high switching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

### Applications

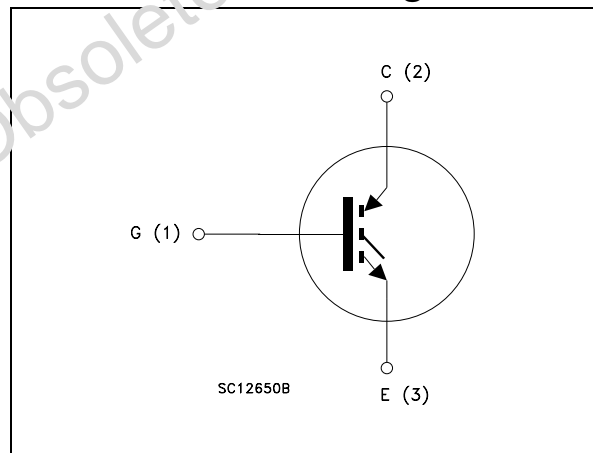
- High frequency inverters
- SMPS and PFC in both hard switch and resonant topologies
- Motor drivers

### Order codes

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



### Internal schematic diagram



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# 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
$V_{CE(sat)}$	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
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$ , $I_C = 250\text{ }\mu\text{A}$	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
$C_{ies}$ $C_{oes}$ $C_{res}$	Input capacitance Output capacitance Reverse transfer capacitance	$V_{CE} = 25\text{V}$ , $f = 1\text{MHz}$ , $V_{GE} = 0$		205 32 5.5		pF pF pF
$Q_g$ $Q_{ge}$ $Q_{gc}$	Total gate charge Gate-emitter charge Gate-collector charge	$V_{CE} = 390\text{V}$ , $I_C = 3\text{A}$ , $V_{GE} = 15\text{V}$ , (see Figure 16)		13.6 3.4 5.1		nC nC 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
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390V, I_C = 3A$		12		ns
$t_r$	Current rise time	$R_G = 10\Omega, V_{GE} = 15V,$		5		ns
$(di/dt)_{on}$	Turn-on current slope	$T_J = 25^\circ C$ (see Figure 17)		612		A/ $\mu s$
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390V, I_C = 3A$		13		ns
$t_r$	Current rise time	$R_G = 10\Omega, V_{GE} = 15V,$		4.3		ns
$(di/dt)_{on}$	Turn-on current slope	$T_J = 125^\circ C$ (see Figure 17)		560		A/ $\mu s$
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390V, I_C = 3A,$		40		ns
$t_{d(off)}$	Turn-off delay time	$R_{GE} = 10\Omega, V_{GE} = 15V,$		76		ns
$t_f$	Current fall time	$T_J = 25^\circ C$ (see Figure 17)		100		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390V, I_C = 3A,$		60		ns
$t_{d(off)}$	Turn-off delay time	$R_{GE} = 10\Omega, V_{GE} = 15V,$		98		ns
$t_f$	Current fall time	$T_J = 125^\circ C$ (see Figure 17)		124		ns

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

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

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

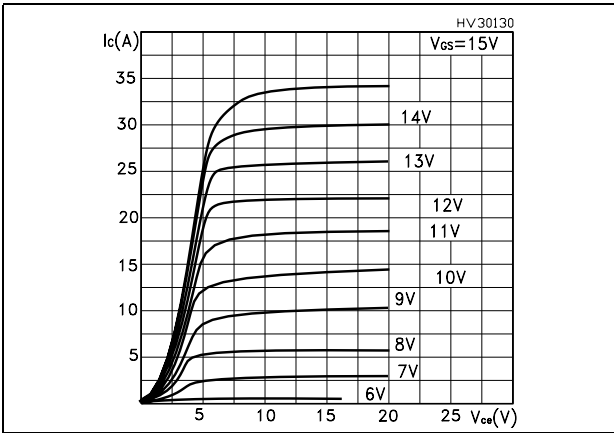


Figure 2. Transfer characteristics

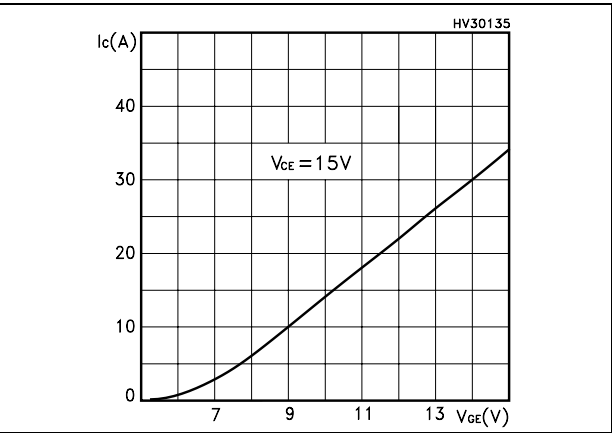


Figure 3. Transconductance

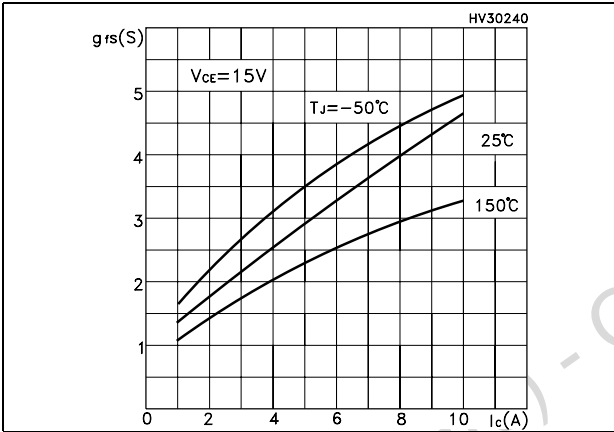


Figure 4. Collector-emitter on voltage vs temperature

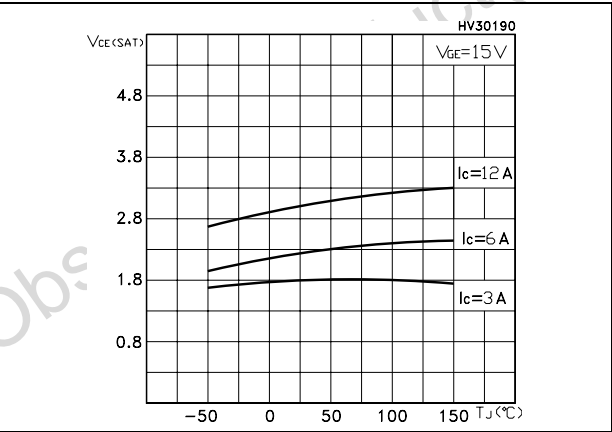


Figure 5. Gate charge vs gate-source voltage

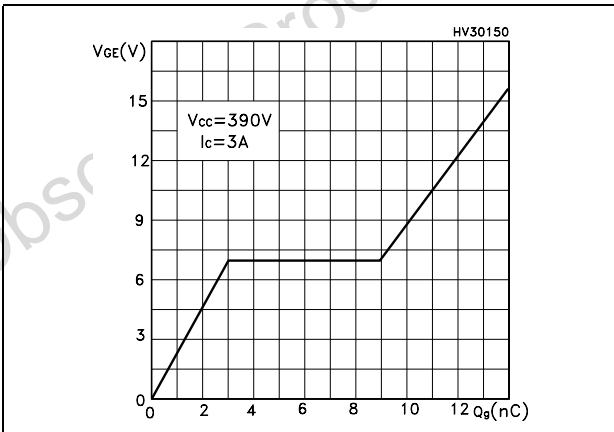


Figure 6. Capacitance variations

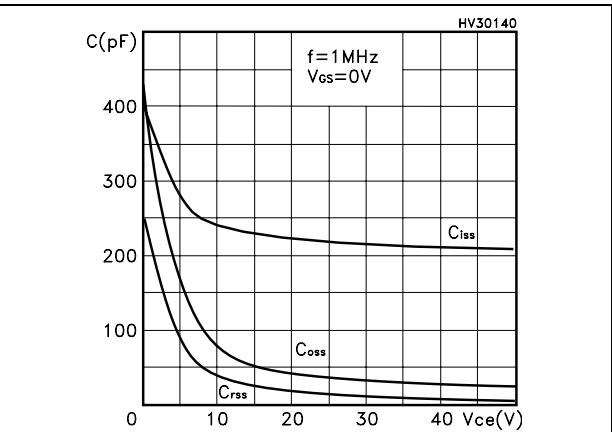


Figure 7. Normalized gate threshold voltage vs temperature

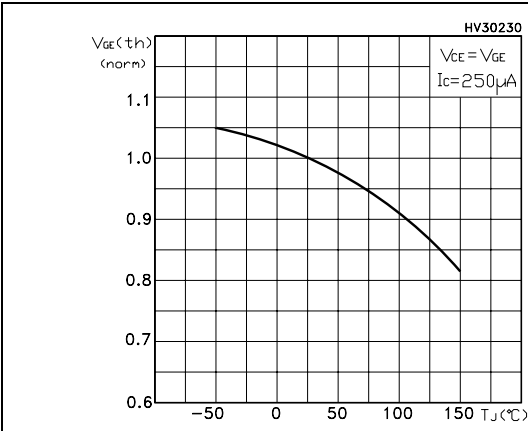


Figure 8. Collector-emitter on voltage vs collector current

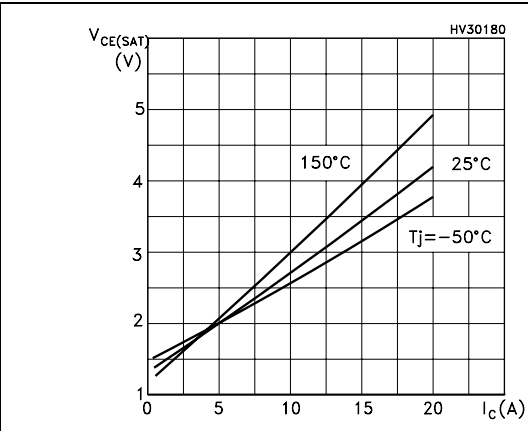


Figure 9. Normalized breakdown voltage vs temperature

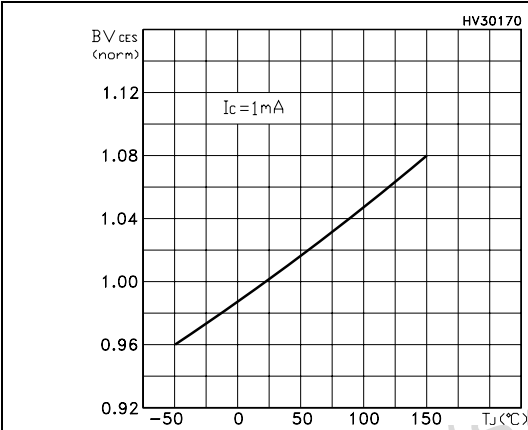


Figure 10. Switching losses vs temperature

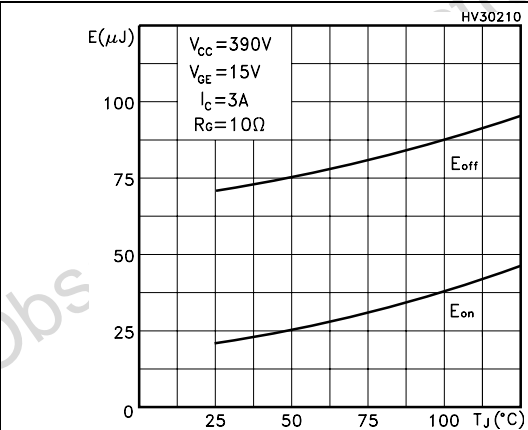


Figure 11. Switching losses vs gate resistance

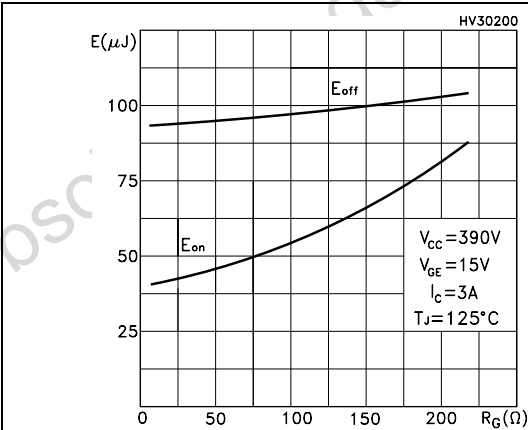


Figure 12. Switching losses vs collector current

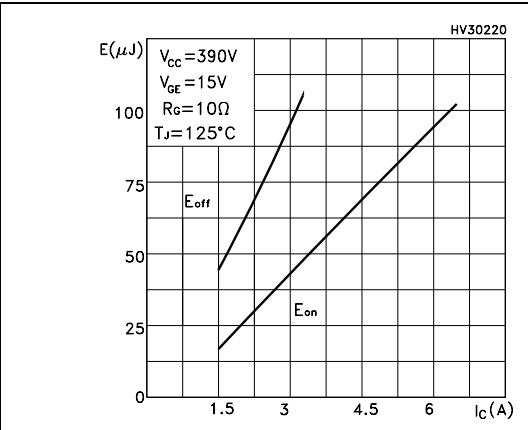


Figure 13. Thermal impedance

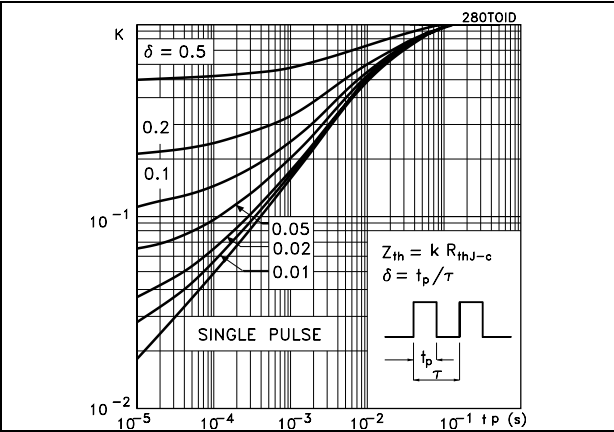
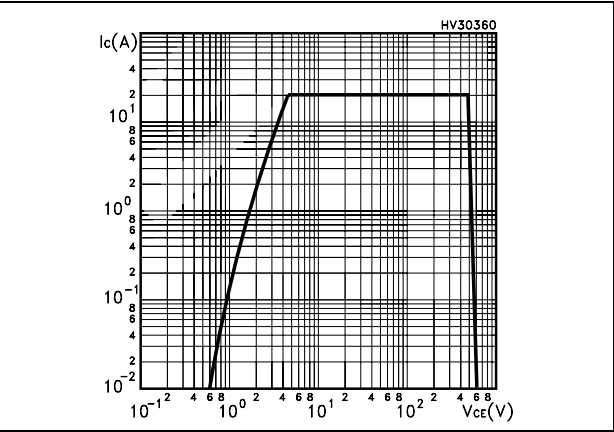


Figure 14. Turn-off SOA





### 3 Test circuit

Figure 15. Test circuit for inductive load switching

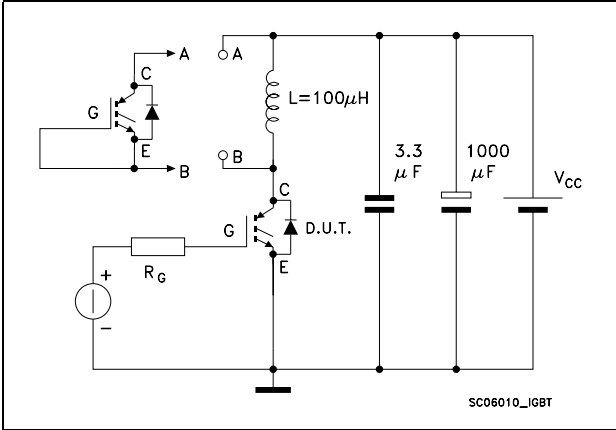


Figure 16. Gate charge test circuit

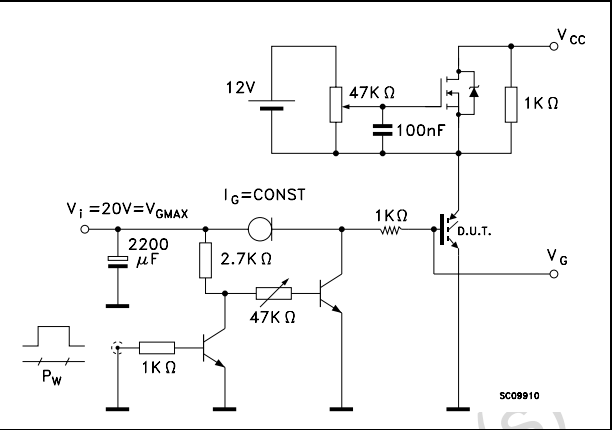


Figure 17. Switching waveform

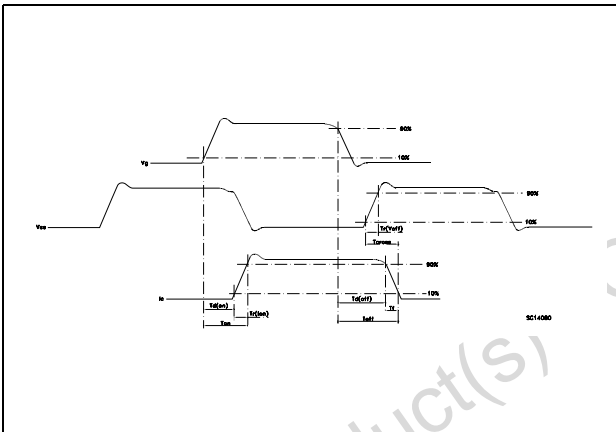
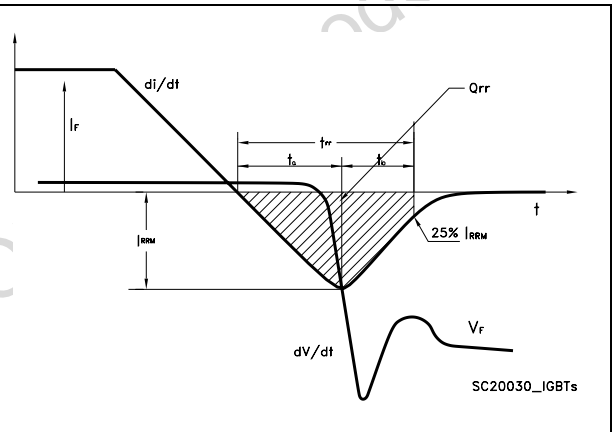


Figure 18. Diode recovery time waveform



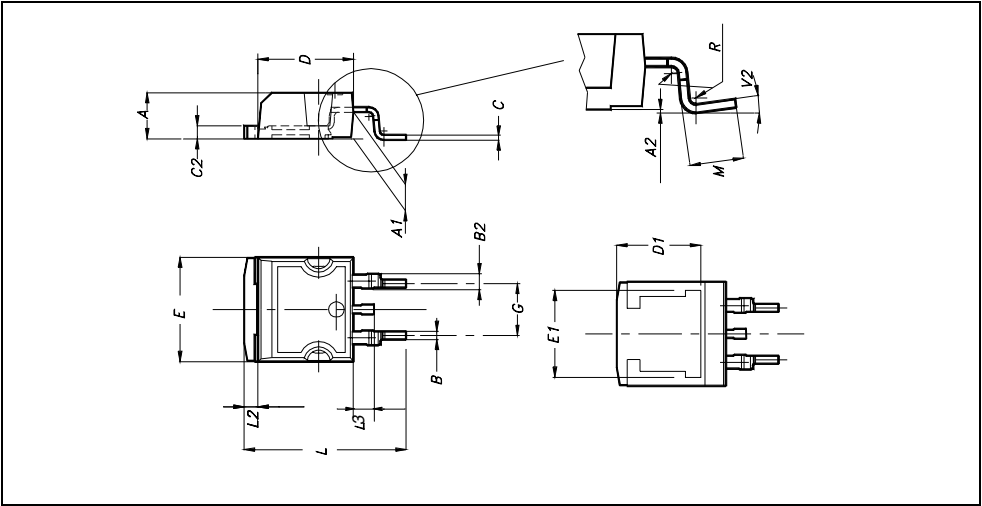
## 4 Package mechanical data

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)

Obsolete Product(s) - Obsolete Product(s)

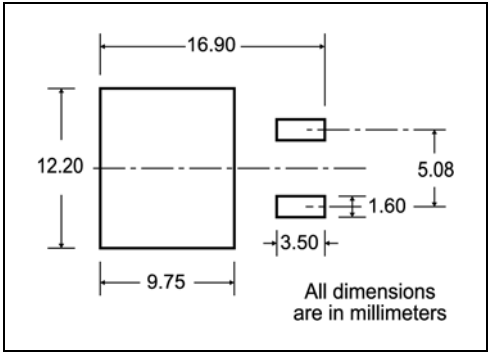
D<sup>2</sup>PAK MECHANICAL DATA

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°			

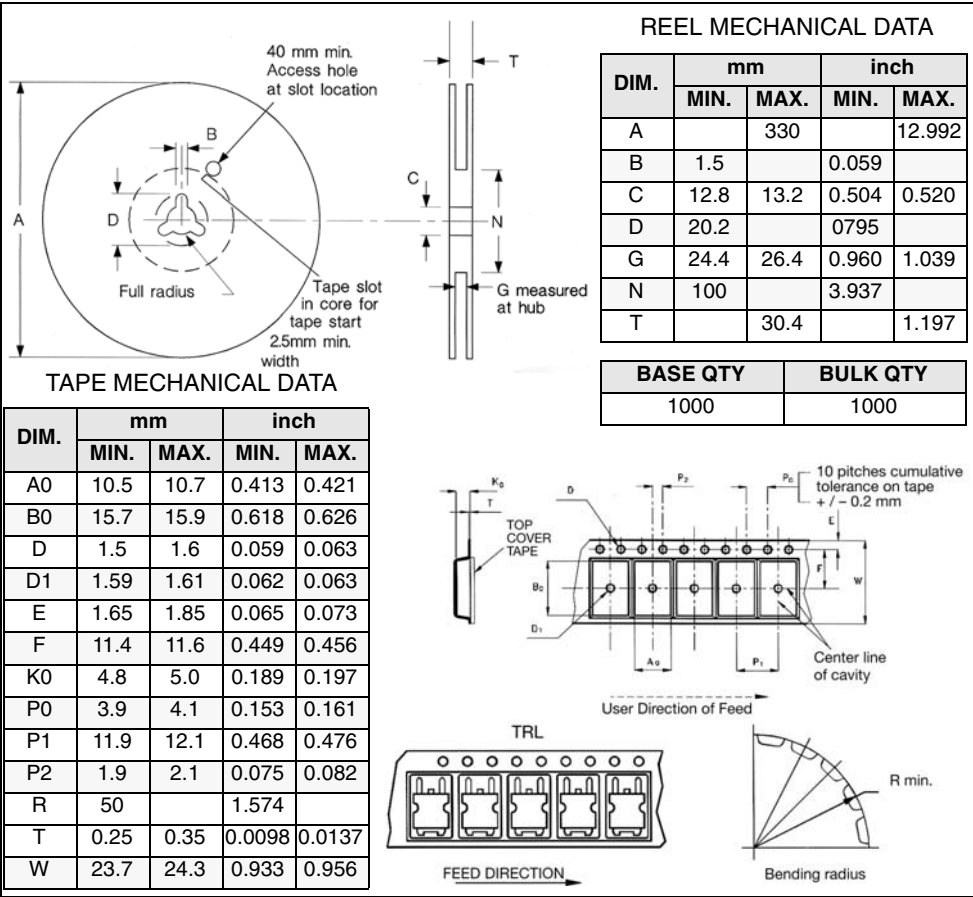


# 5 Packaging mechanical data

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



## TAPE AND REEL SHIPMENT



\* 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

Obsolete Product(s) - Obsolete Product(s)

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