



# STGB10NC60HD STGP10NC60HD

N-channel 600V - 10A - TO-220 - D<sup>2</sup>PAK  
Very fast PowerMESH™ IGBT

## General features

Type	V <sub>CE(S)</sub>	V <sub>CE(sat)</sub> (Max)@ 25°C	I <sub>C</sub> @100°C
STGB10NC60HD	600V	< 2.5V	10A
STGP10NC60HD	600V	< 2.5V	10A

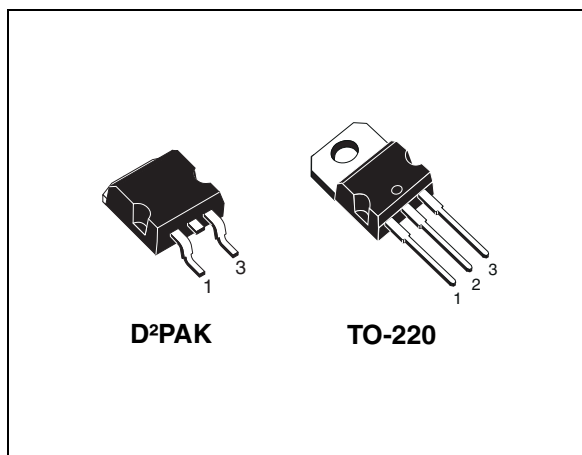
- Low on-voltage drop (V<sub>cesat</sub>)
- Low C<sub>RES</sub> / C<sub>I(ES)</sub> ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode

## Description

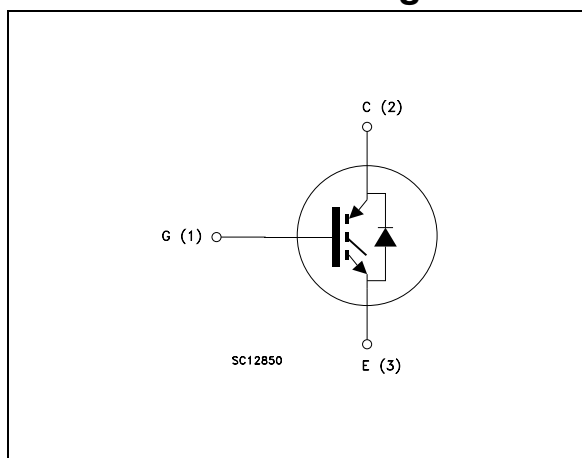
Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix “H” identifies a family optimized for high frequency applications in order to achieve very high switching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

## Applications

- High frequency motor controls
- Sm<sub>p</sub>s and p<sub>f</sub>c in both hard switch and resonant topologies
- Motor drivers



## Internal schematic diagram



## Order codes

Part Number	Marking	Package	Packaging
STGB10NC60HD	GB10NC60HD	D <sup>2</sup> PAK	Tape & reel
STGP10NC60HD	GP10NC60HD	TO-220	Tube

# 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 $T_C = 25^\circ\text{C}$	20	A
$I_C^{(1)}$	Collector current (continuous) at $T_C = 100^\circ\text{C}$	10	A
$I_{CL}^{(2)}$	Collector current (pulsed)	40	A
$I_F$	Diode RMS forward current at $T_C = 25^\circ\text{C}$	10	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$P_{TOT}$	Total dissipation at $T_C = 25^\circ\text{C}$	60	W
$T_{stg}$	Storage temperature	- 55 to 150	$^\circ\text{C}$
$T_j$	Operating junction temperature		

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.  $V_{clamp}=480\text{V}$ ,  $T_j=150^\circ\text{C}$ ,  $R_G=10\Omega$ ,  $V_{GE}=15\text{V}$

**Table 2. Thermal resistance**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	2.08	$^\circ\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	62.5	$^\circ\text{C/W}$

## 2 Electrical characteristics

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

**Table 3. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{BR(CES)}$	Collector-emitter breakdown voltage	$I_C = 1mA, V_{GE} = 0$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15V, I_C = 5A$ $V_{GE} = 15V, I_C = 5A, T_C = 125^{\circ}C$		1.9 1.7	2.5	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 250 \mu A$	3.75		5.75	V
$I_{CES}$	Collector cut-off current ( $V_{GE} = 0$ )	$V_{CE} = \text{Max rating}, T_C = 25^{\circ}C$ $V_{CE} = \text{Max rating}, T_C = 125^{\circ}C$			150 1	$\mu A$ mA
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20V, V_{CE} = 0$			$\pm 100$	nA
$g_{fs}$	Forward transconductance	$V_{CE} = 15V, I_C = 5A$		3.5		S

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25V, f = 1MHz,$ $V_{GE} = 0$		365		pF
$C_{oes}$	Output capacitance			43		pF
$C_{res}$	Reverse transfer capacitance			8.3		pF
$Q_g$	Total gate charge	$V_{CE} = 390V, I_C = 5A,$		19.2		nC
$Q_{ge}$	Gate-emitter charge	$V_{GE} = 15V,$		4.5		nC
$Q_{gc}$	Gate-collector charge	(see Figure 17)		7		nC

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$ $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 390V, I_C = 5A$ $R_G = 10\Omega, V_{GE} = 15V, T_j = 25^\circ C$ <i>(see Figure 16)</i>		14.2 5 1000		ns ns A/ $\mu s$
$t_{d(on)}$ $t_r$ $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 390V, I_C = 5A$ $R_G = 10\Omega, V_{GE} = 15V,$ $T_j = 125^\circ C$ <i>(see Figure 16)</i>		14 5 920		ns ns A/ $\mu s$
$t_r(V_{off})$ $t_{d(off)}$ $t_f$	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390V, I_C = 5A,$ $R_{GE} = 10\Omega, V_{GE} = 15V, T_j = 25^\circ C$ <i>(see Figure 16)</i>		27 72 85		ns ns ns
$t_r(V_{off})$ $t_{d(off)}$ $t_f$	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390V, I_C = 5A,$ $R_{GE} = 10\Omega, V_{GE} = 15V,$ $T_j = 125^\circ C$ <i>(see Figure 16)</i>		50 108 139		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	$V_{CC} = 390V, I_C = 5A$ $R_G = 10\Omega, V_{GE} = 15V,$ $T_j = 25^\circ C$ <i>(see Figure 16)</i>		31.8 95 126.8		$\mu J$ $\mu J$ $\mu J$
$E_{on}^{(1)}$ $E_{off}^{(2)}$ $E_{ts}$	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390V, I_C = 5A$ $R_G = 10\Omega, V_{GE} = 15V,$ $T_j = 125^\circ C$ <i>(see Figure 16)</i>		61.8 173 234.8		$\mu J$ $\mu J$ $\mu J$

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

Table 7. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_f$	Forward on-voltage	$I_f = 2.5A$ $I_f = 2.5A, T_j = 125^\circ C$		1.75	2.1	V
				1.3		V
$t_{rr}$	Reverse recovery time	$I_f = 5A, V_R = 40V,$ $T_j = 25^\circ C, di/dt = 100 A/\mu s$ <i>(see Figure 19)</i>		21.5		ns
$Q_{rr}$	Reverse recovery charge			14.2		nC
$I_{rrm}$	Reverse recovery current			1.32		A
$t_{rr}$	Reverse recovery time	$I_f = 5A, V_R = 40V,$ $T_j = 125^\circ C, di/dt = 100A/\mu s$ <i>(see Figure 19)</i>		33		ns
$Q_{rr}$	Reverse recovery charge			30.5		nC
$I_{rrm}$	Reverse recovery current			1.85		A

## 2.1 Electrical characteristics (curves)

Figure 1. Output characteristics

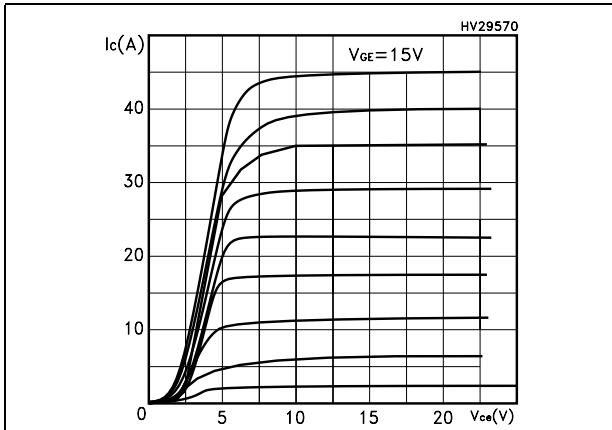


Figure 2. Transfer characteristics

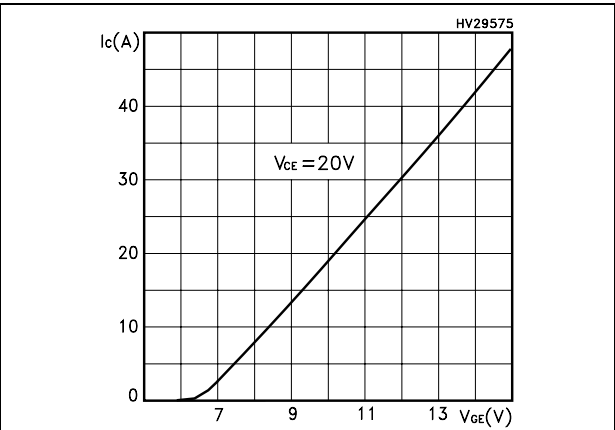


Figure 3. Transconductance

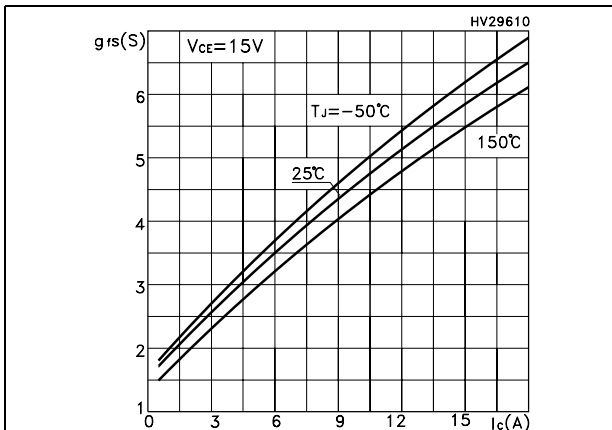


Figure 4. Collector-emitter on voltage vs temperature

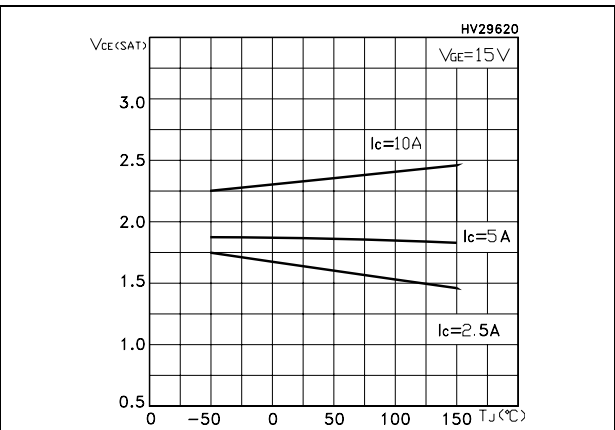


Figure 5. Gate charge vs gate-source voltage

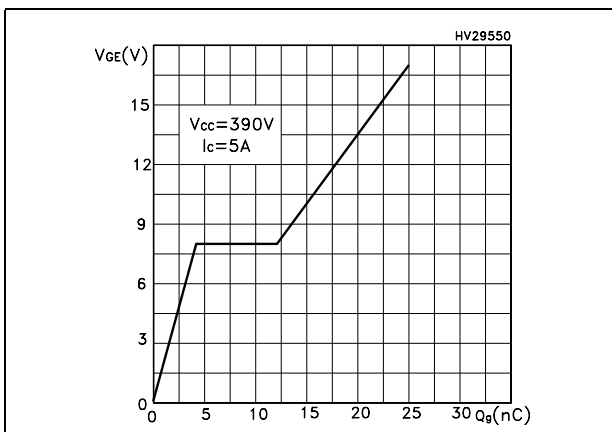


Figure 6. Capacitance variations

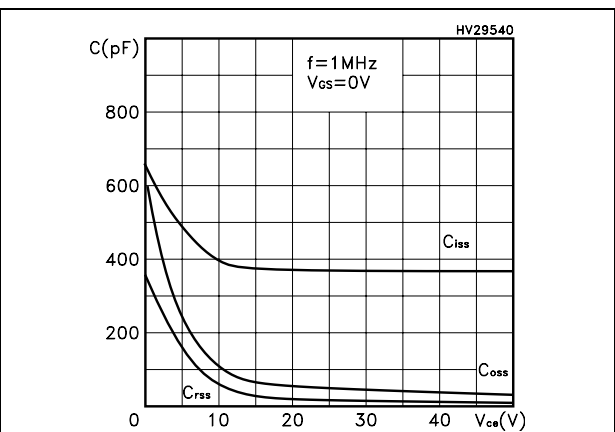


Figure 7. Normalized gate threshold voltage vs temperature

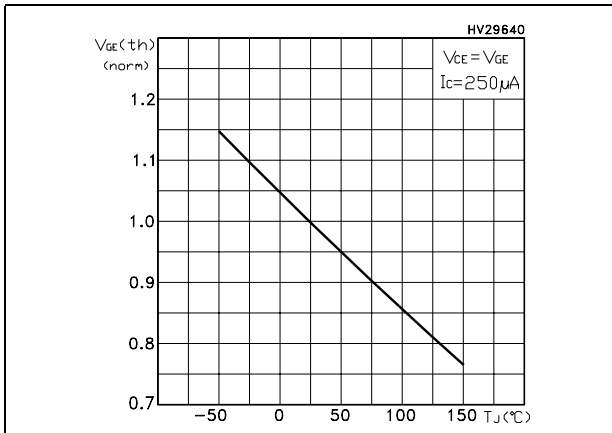


Figure 8. Collector-emitter on voltage vs collector current

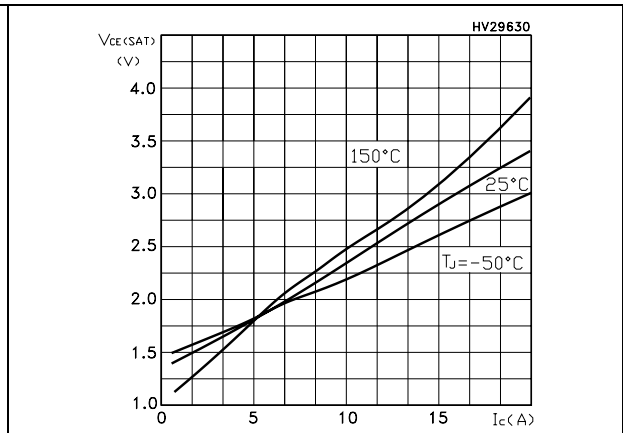


Figure 9. Normalized breakdown voltage vs temperature

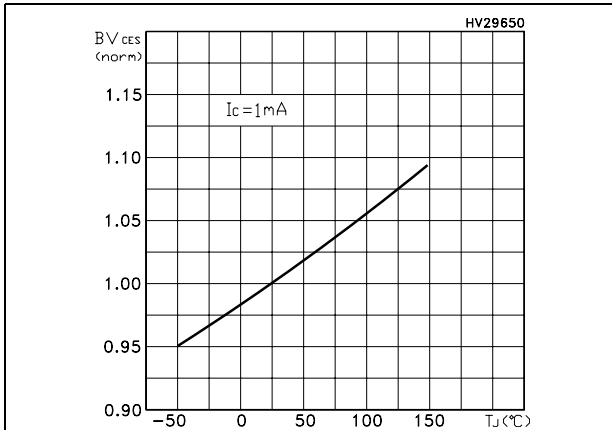


Figure 10. Switching losses vs temperature

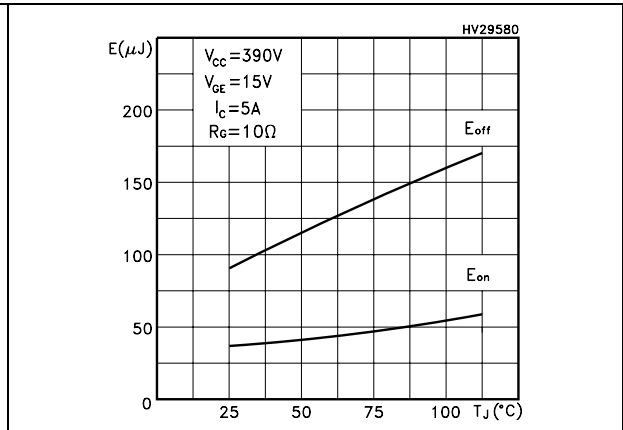


Figure 11. Switching losses vs gate resistance

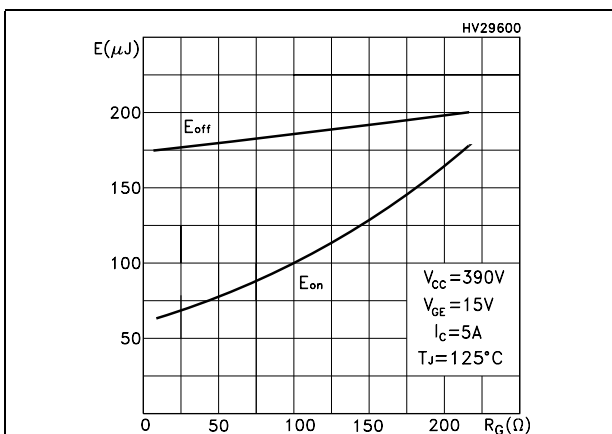


Figure 12. Switching losses vs collector current

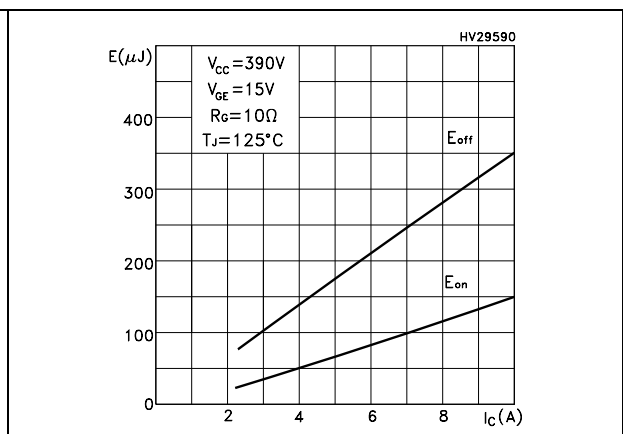


Figure 13. Thermal Impedance

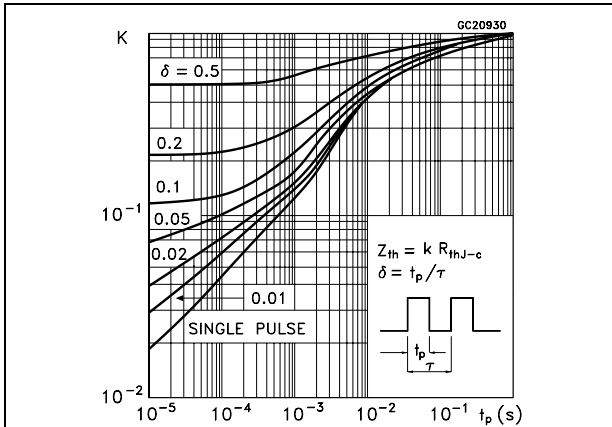


Figure 14. Turn-off SOA

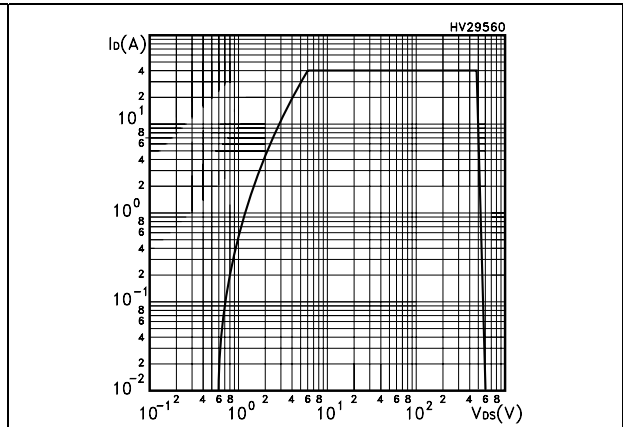
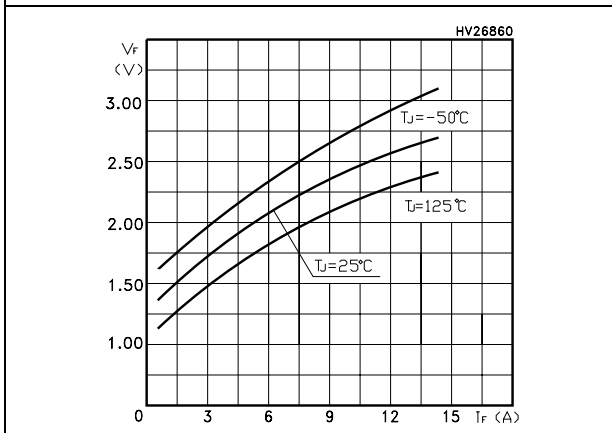


Figure 15. Emitter-collector diode characteristics





### 3 Test circuit

Figure 16. Test circuit for inductive load switching

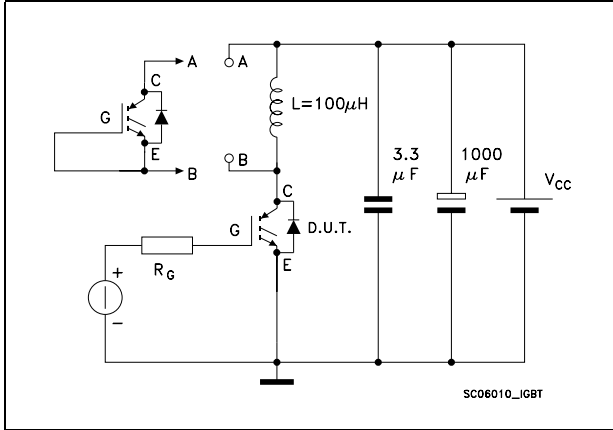


Figure 17. Gate charge test circuit

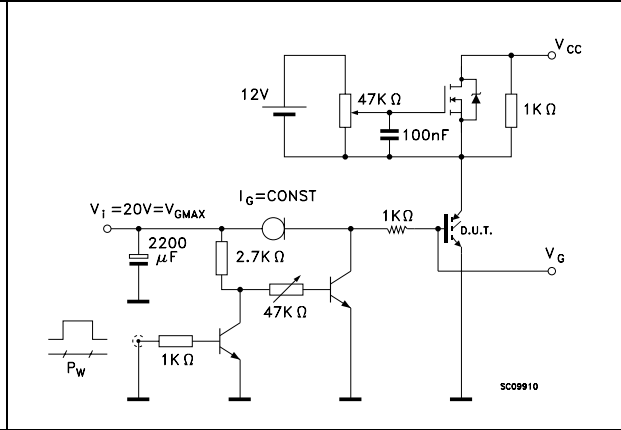


Figure 18. Switching waveform

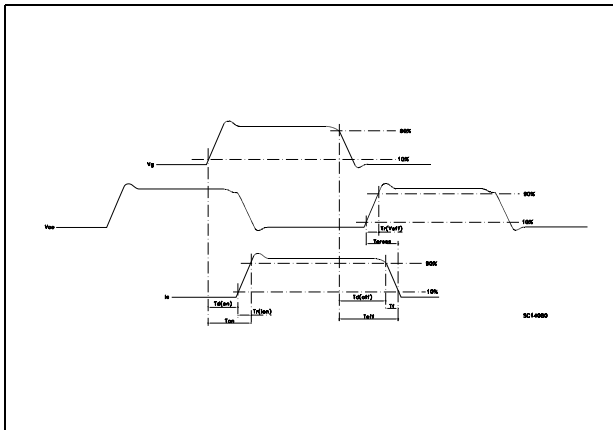
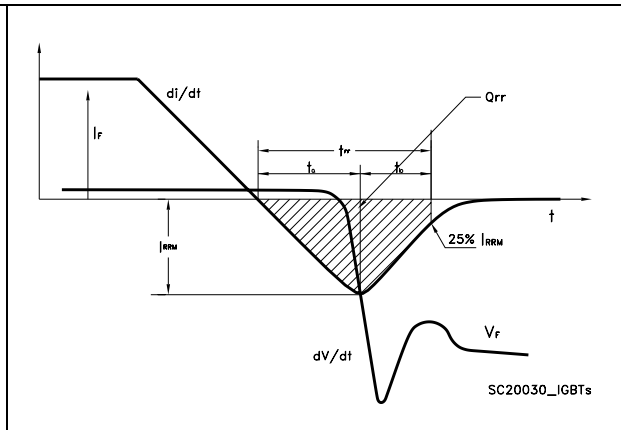


Figure 19. Diode recovery time waveform



## 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)

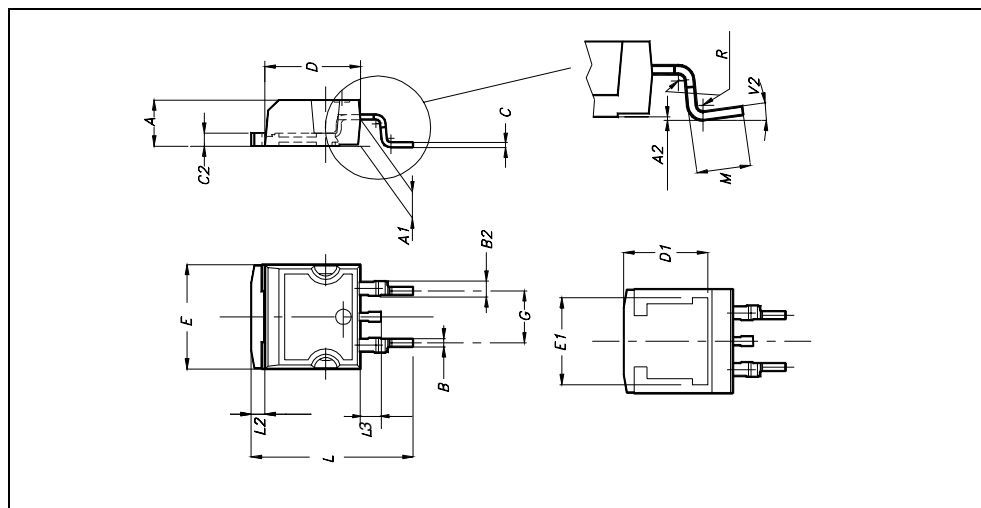
**TO-220 MECHANICAL DATA**

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	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
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		0.052
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	
øP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



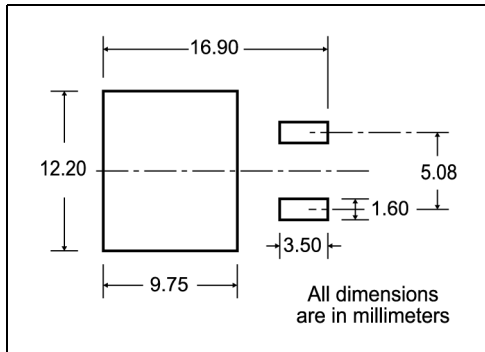
**D<sup>2</sup>PAK MECHANICAL DATA**

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

10 pitches cumulative tolerance on tape +/- 0.2 mm

\* on sales type

## 6 Revision history

**Table 8. Revision history**

<b>Date</b>	<b>Revision</b>	<b>Changes</b>
30-Jan-2006	1	Initial release.
06-Nov-2006	2	Complete version
08-Feb-2007	3	The document has been reformatted

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