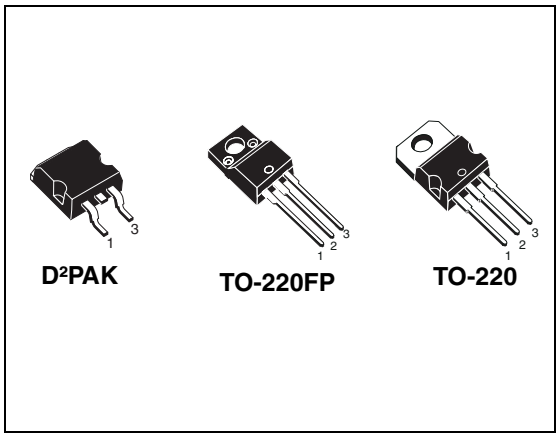
STGB10NC60HD - STGF10NC60HD
STGP10NC60HD

N-channel 600V - 10A - TO-220 - D²PAK - TO-220FP very fast PowerMESH™ IGBT

Features

Type	V_{CES}	$V_{CE(sat)}$ (Max)@ 25°C	I_C @100°C
STGB10NC60HD	600V	< 2.5V	10A
STGP10NC60HD	600V	< 2.5V	10A
STGF10NC60HD	600V	< 2.5V	6A

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



Applications

- High frequency motor controls
- Smps and pfc in both hard switch and resonant topologies
- Motor drivers

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 tfall) manta in ing a low voltage drop.

Figure 1. Internal schematic diagram

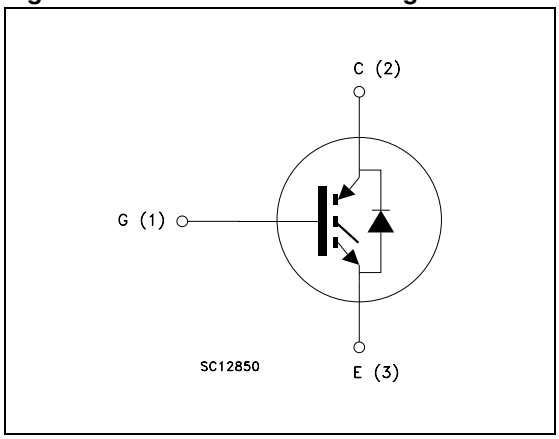


Table 1. Device summary

Order codes	Marking	Package	Packaging
STGB10NC60HD	GB10NC60HD	D²PAK	Tape & reel
STGP10NC60HD	GP10NC60HD	TO-220	Tube
STGF10NC60HD	GF10NC60HD	TO-220FP	Tube

Contents

1 Electrical ratings 3

2 Electrical characteristics 4

2.1 Electrical characteristics (curves) 7

3 Test circuit 10

4 Package mechanical data 11

5 Packaging mechanical data 14

6 Revision history 16

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220 / D²PAK	TO-220FP	
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	600		V
I_C(1)	Collector current (continuous) at T_C = 25°C	20	9	A
I_C(1)	Collector current (continuous) at T_C = 100°C	10	6	A
I_{CL}(2)	Collector current (pulsed)	40		A
I_F	Diode RMS forward current at T_C = 25°C	10		A
V_{GE}	Gate-emitter voltage	±20		V
P_{TOT}	Total dissipation at T_C = 25°C	65	23	W
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1s;Tc=25°C)	--	2500	V
T_j	Operating junction temperature	– 55 to 150		°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. V_{clamp}=80% of BVces, Tj=150°C, R_G=10Ω, V_{GE}=15V

Table 3. Thermal resistance

Symbol	Parameter	Value		Unit
		TO-220 / D²PAK	TO-220FP	
Rthj-case	Thermal resistance junction-case max	1.9	5	°C/W
Rthj-amb	Thermal resistance junction-ambient max	62.5		°C/W

2 Electrical characteristics

(T_{CASE}=25°C unless otherwise specified)

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{BR(CES)}$	Collector-emitter breakdown voltage (V_{GE}= 0)	I_C= 1mA	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE}= 15V, I_C= 5A V_{GE}= 15V, I_C= 5A, Tc= 125°C		1.9 1.7	2.5	V V
$V_{GE(th)}$	Gate threshold voltage	V_{CE}= V_{GE}, I_C= 250 µA	3.75		5.75	V
I_{CES}	Collector cut-off current (V_{GE} = 0)	V_{CE}= Max rating,T_C= 25°C V_{CE}=Max rating,T_C= 125°C			150 1	µA mA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE}= ±20V			±100	nA
g_{fs}	Forward transconductance	V_{CE} = 15V, I_C= 5A		3.5		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} = 25V, f = 1MHz, V_{GE} = 0		365 43 8.3		pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 390V, I_C = 5A, V_{GE} = 15V, *(see Figure 19)*		19.2 4.5 7		nC nC nC

Table 6. 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= 10Ω, V_{GE}= 15V, Tj= 25°C *(see Figure 18)* *(see Figure 20)*		14.2 5 1000		ns ns A/µs
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	V_{CC} = 390V, I_C = 5A R_G= 10Ω, V_{GE}= 15V, Tj=125°C *(see Figure 18)* *(see Figure 20)*		14 5 920		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 = 5A, R_{GE} = 10Ω, V_{GE} = 15V,T_J=25°C *(see Figure 18)* *(see Figure 20)*		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}=10Ω, V_{GE} =15V, Tj=125°C *(see Figure 18)* *(see Figure 20)*		50 108 139		ns ns ns

Table 7. 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= 10Ω, V_{GE}=15V, Tj=25°C *(see Figure 18)*		31.8 95 126.8		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 = 5A R_G= 10Ω, V_{GE}= 15V, Tj= 125°C *(see Figure 18)*		61.8 173 234.8		µJ µJ µJ

1. Eon is the turn-on losses when a typical diode is used in the test circuit in *Figure 18*. If the IGBT is offered in a package with a co-pak diode, the co-pack 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 8. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_f	Forward on-voltage	I_f = 2.5A I_f = 2.5A, Tj = 125°C		1.75 1.3	2.1	V V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_f = 5A,V_R = 40V, Tj = 25°C, di/dt = 100 A/µs *(see Figure 21)*		21.5 14.2 1.32		ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_f = 5A,V_R = 40V, Tj =125°C, di/dt = 100A/µs *(see Figure 21)*		33 30.5 1.85		ns nC A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

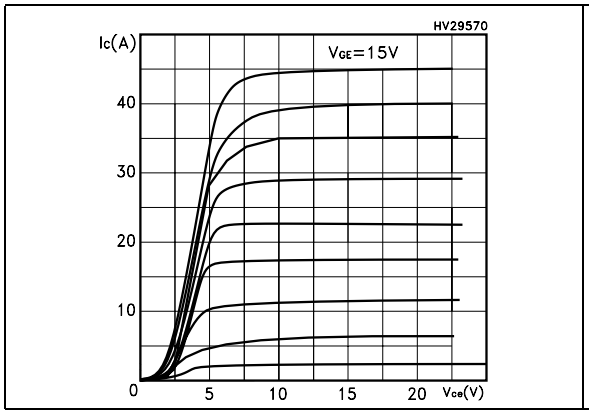


Figure 3. Transfer characteristics

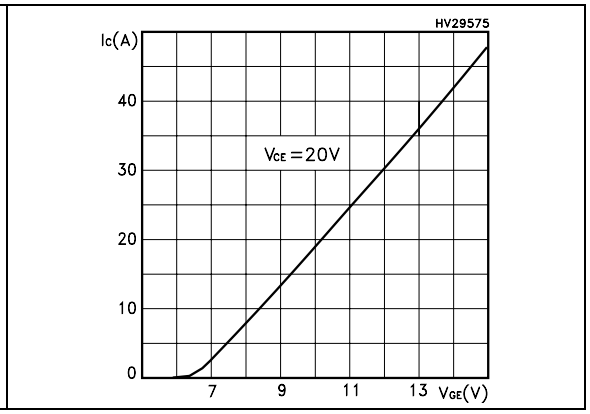


Figure 4. Transconductance

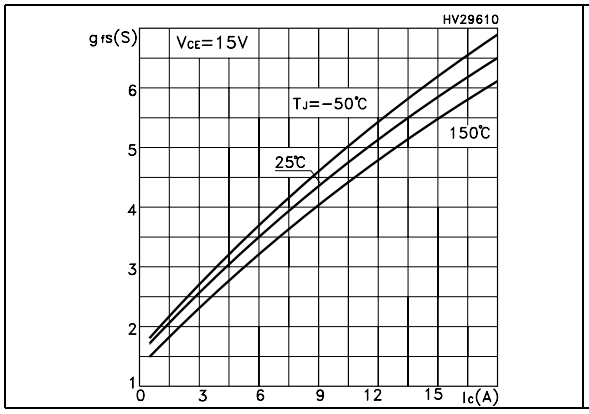


Figure 5. Collector-emitter on voltage vs temperature

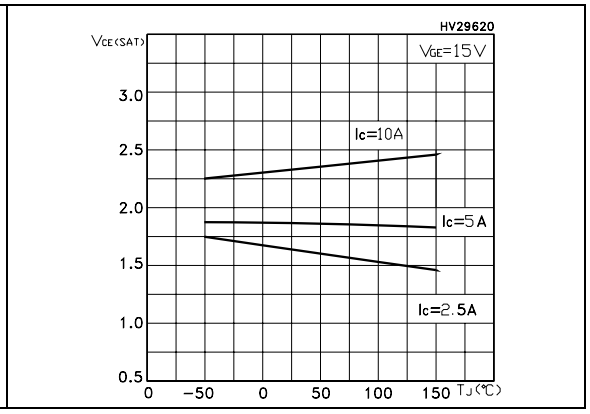


Figure 6. Gate charge vs gate-source voltage

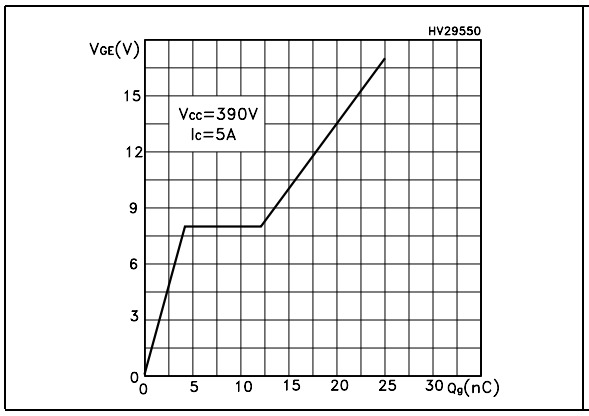


Figure 7. Capacitance variations

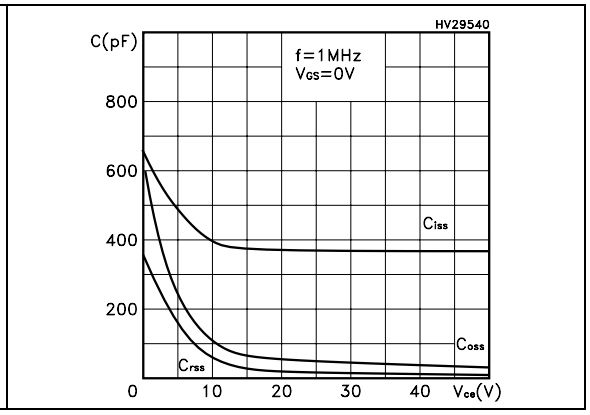


Figure 8. Normalized gate threshold voltage vs temperature

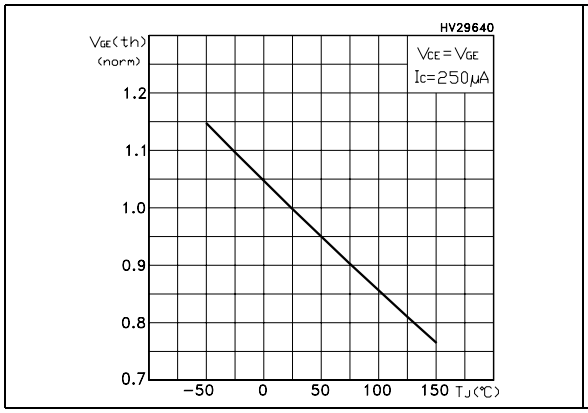


Figure 9. Collector-emitter on voltage vs collector current

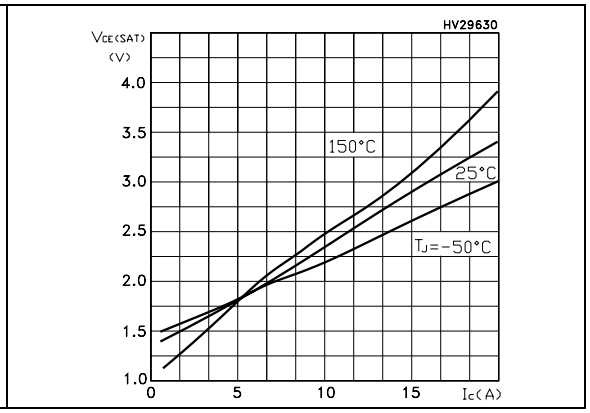


Figure 10. Normalized breakdown voltage vs temperature

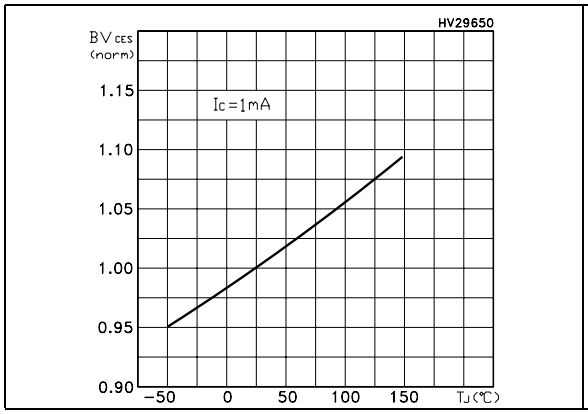


Figure 11. Switching losses vs temperature

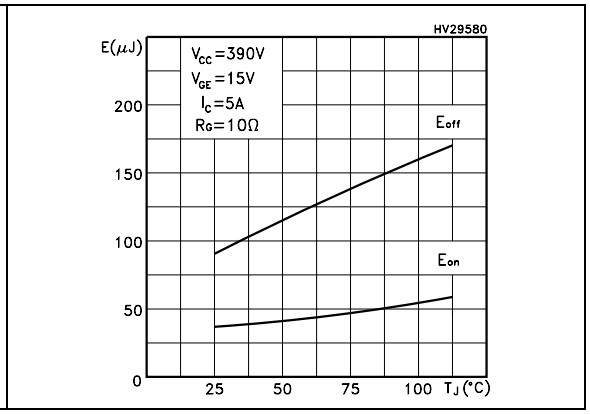


Figure 12. Switching losses vs gate resistance

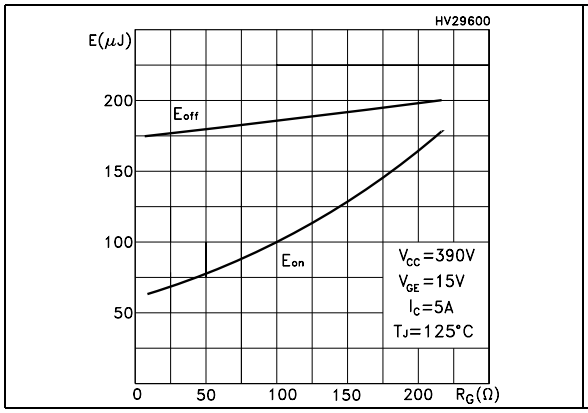


Figure 13. Switching losses vs collector current

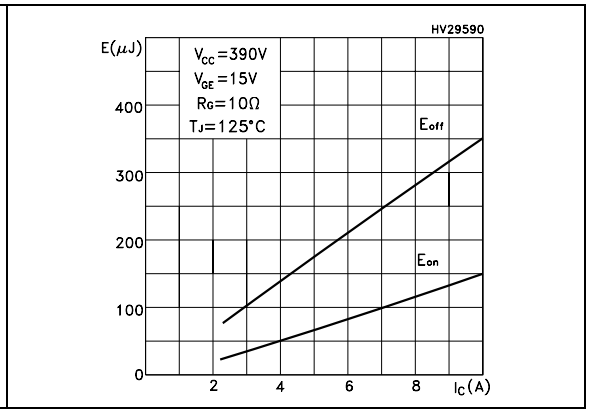


Figure 14. Thermal Impedance for TO-220 / D²PAK

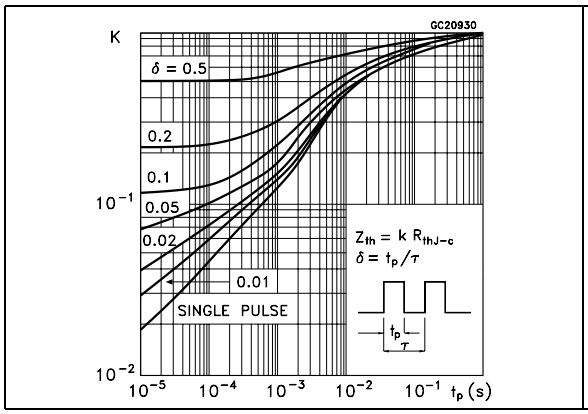


Figure 15. Turn-off SOA

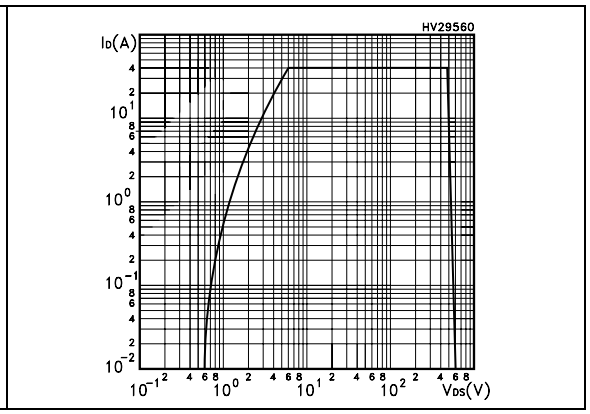


Figure 16. Thermal Impedance for TO-220FP

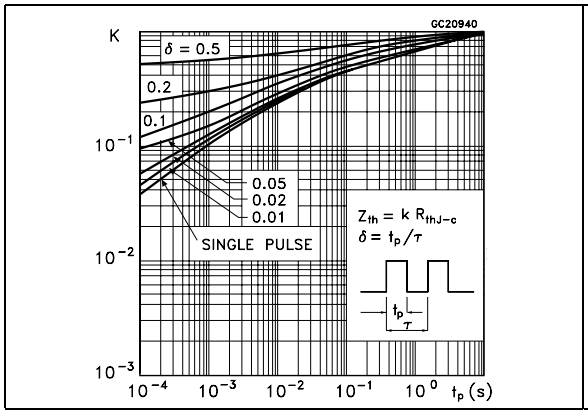
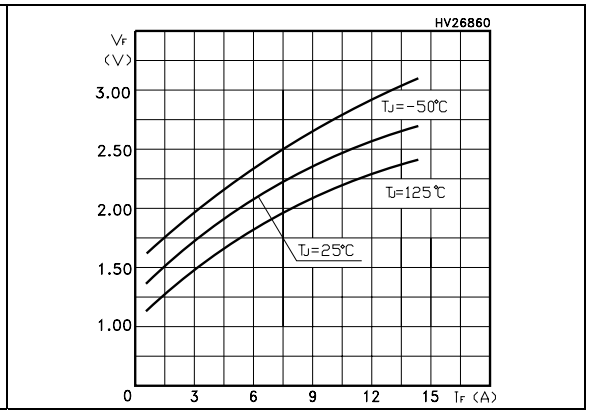


Figure 17. Emitter-collector diode characteristics



3 Test circuit

Figure 18. Test circuit for inductive load switching

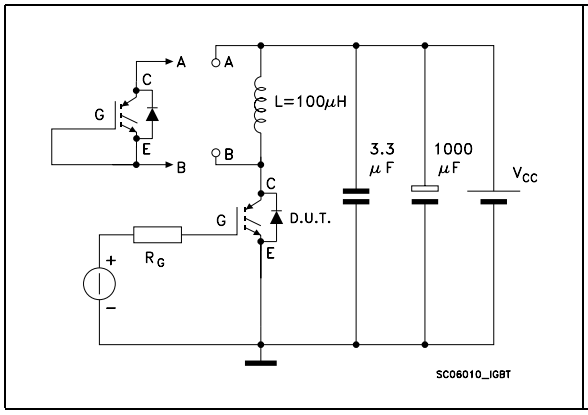


Figure 19. Gate charge test circuit

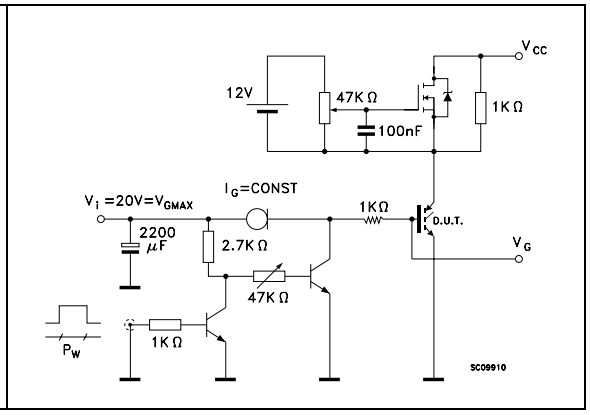


Figure 20. Switching waveform

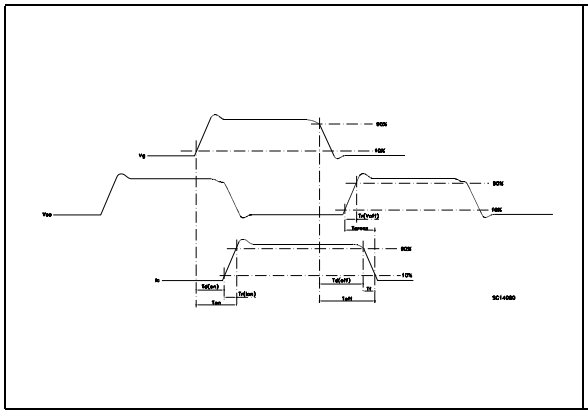
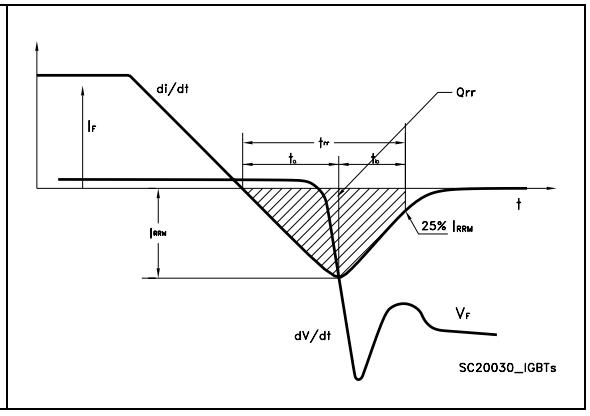


Figure 21. Diode recovery time waveform

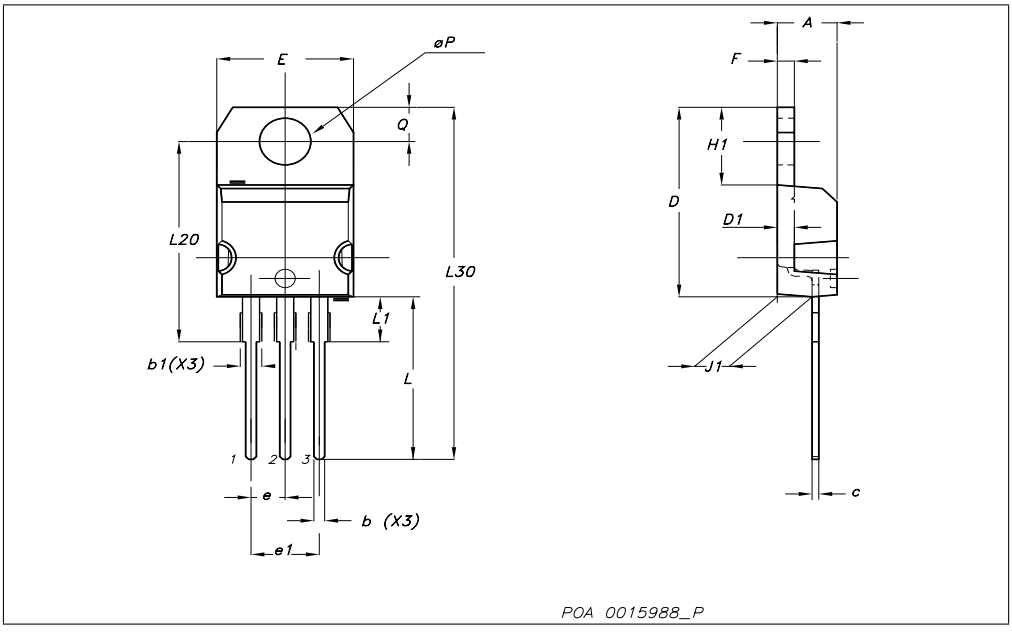


4 Package mechanical data

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*

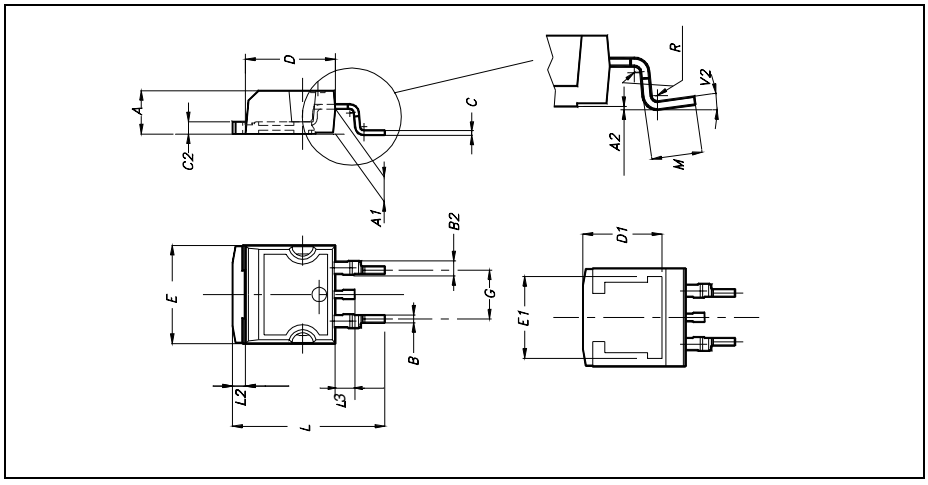
TO-220 mechanical data

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	1.14		1.70	0.044		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
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		0.051
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	
∅P	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



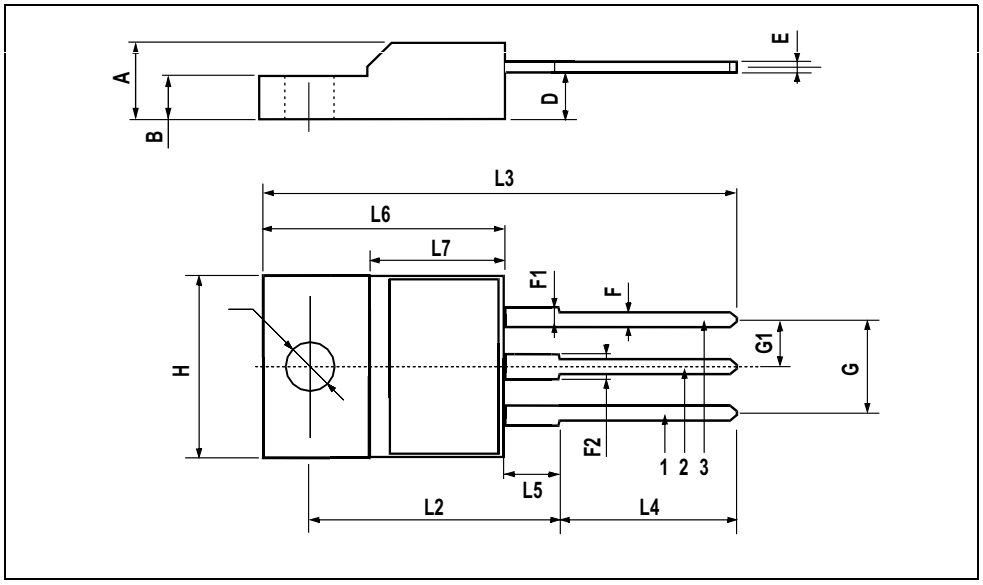
D^2PAK MECHANICAL DATA

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	0º		4º			



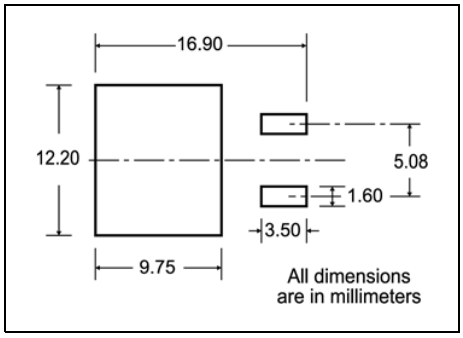
TO-220FP MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.7	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
H	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	.0385		0.417
L5	2.9		3.6	0.114		0.141
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
Ø	3		3.2	0.118		0.126

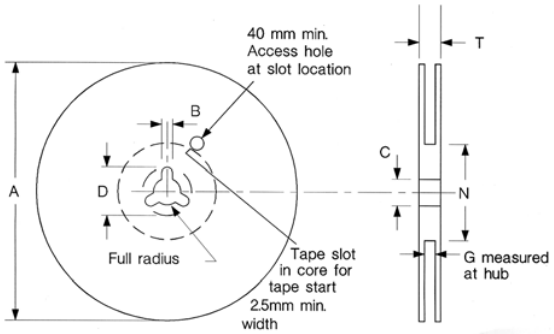


5 Packaging mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT



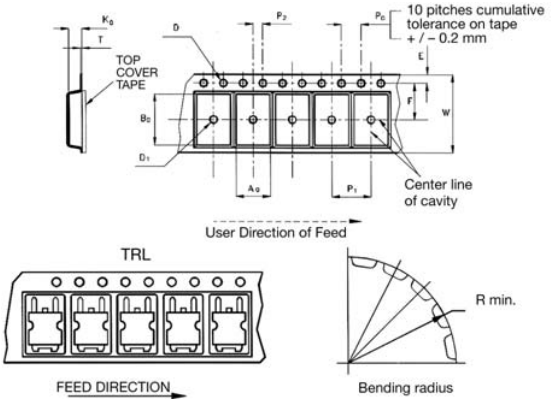
REEL MECHANICAL DATA

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		0795	
G	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

BASE QTY	BULK QTY
1000	1000

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



* on sales type

6 Revision history

Table 9. Document revision history

Date	Revision	Changes
30-Jan-2006	1	Initial release.
06-Nov-2006	2	Complete version
08-Feb-2007	3	The document has been reformatted
05-Oct-2007	4	Added TO-220FP, *Table 2* has been updated

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