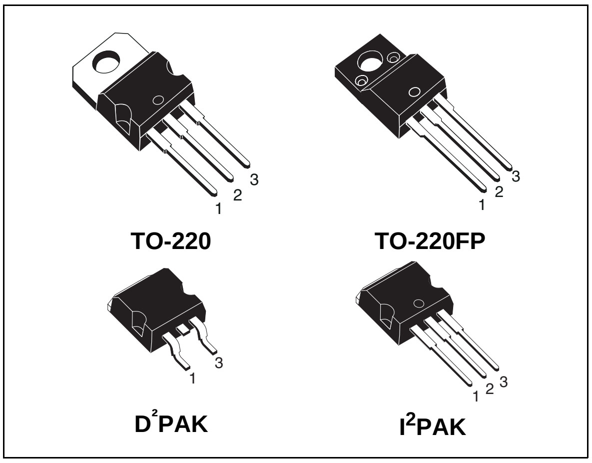
STGB6NC60HD - STGB6NC60HD-1
STGF6NC60HD - STGP6NC60HD

N-channel 600V - 7A - I^2PAK / D^2PAK / TO-220 / TO-220FP
Very fast PowerMESH™ IGBT

Features

Type	V_{CES}	$V_{CE(sat)}$max @25°C	I_C @100°C
STGB6NC60HD	600V	<2.5V	7A
STGB6NC60HD-1	600V	<2.5V	7A
STGP6NC60HD	600V	<2.5V	7A
STGF6NC60HD	600V	<2.5V	3A

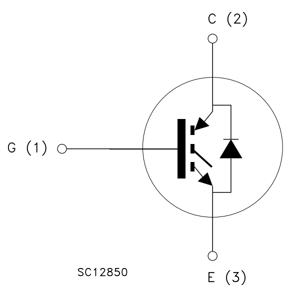
- Low on voltage drop (V_{cesat})
- Low C_{RES} / C_{IES} ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode
- High frequency operation



Description

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advaced 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 tfall) mantaining a low voltage drop.

Internal schematic diagram



Applications

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

Order codes

Part number	Marking	Package	Packaging
STGB6NC60HDT4	GB6NC60HD	D^2PAK	Tape & reel
STGB6NC60HD-1	GB6NC60HD	I^2PAK	Tube
STGP6NC60HD	GP6NC60HD	TO-220	Tube
STGF6NC60HD	GF6NC60HD	TO-220FP	Tube

Contents

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D²PAK/I²PAK/ TO-220	TO-220FP	
V_{CES}	Collector-emitter voltage (V_{GS} = 0)	600		V
I_C(1)	Collector current (continuous) at T_C = 25°C	15	6	A
I_C(1)	Collector current (continuous) at T_C = 100°C	7	3	A
I_{CM}(2)	Collector current (pulsed)	21		A
V_{GE}	Gate-emitter voltage	±20		V
I_F	Diode RMS forward current at Tc=25°C	10		A
P_{TOT}	Total dissipation at T_C = 25°C	56	20	W
V_{ISO}	Insulation withstand voltage A.C.(t=1sec;Tc=25°C)	--	2500	
T_{stg}	Storage temperature	– 55 to 150		°C
T_j	Operating junction temperature			
T_l	Maximum lead temperature for soldering purpose (for 10sec. 1.6 mm from case)	300		°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
Rthj-case	Thermal resistance junction-case max	**TO-220 D²PAK I²PAK**	2	°C/W
		TO-220FP	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 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= 3A V_{GE}= 15V, I_C= 3A, 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			10 1	µA mA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE} = ±20V , V_{CE}= 0			±100	nA
g_{fs}	Forward transconductance	V_{CE} = 15V, I_C= 3A		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} = 25V, f = 1MHz, 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} = 390V, I_C = 3A, V_{GE} = 15V, *(see Figure 18)*		13.6 3.4 5.1		nC nC nC
I_{CL}	Turn-off SOA minimum current	V_{clamp} = 390V, Tj = 150°C, R_G = 10Ω, V_{GE} = 15V		19		A

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 = 3A R_G= 10Ω, V_{GE} = 15V, Tj = 25°C *(see Figure 19)*		12 5 612		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 = 3A R_G = 10Ω, V_{GE} = 15V, Tj =125°C *(see Figure 19)*		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} = 10Ω , V_{GE} = 15V, T_J = 25°C *(see Figure 19)*		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} = 10Ω , V_{GE} =15V, Tj = 125°C *(see Figure 19)*		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 = 10Ω, V_{GE}=15V, Tj =25°C *(see Figure 19)*		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 = 10Ω, V_{GE} = 15V, Tj = 125°C *(see Figure 19)*		37 93 130		µJ µJ µJ

1. Eon is the tun-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-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 7. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_f	Forward on-voltage	I_f = 1.5A I_f = 1.5A, Tj = 125°C		1.6 1.3	2.1	V V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_f = 3A ,V_R = 40V, Tj = 25°C, di/dt = 100 A/µs *(see Figure 20)*		21 14 1.36		ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_f = 3A ,V_R = 40V, Tj =125°C, di/dt = 100A/µs *(see Figure 20)*		34 32 1.88		ns nC A

2.1 Electrical characteristics (curves)

Figure 1. Output characterisics

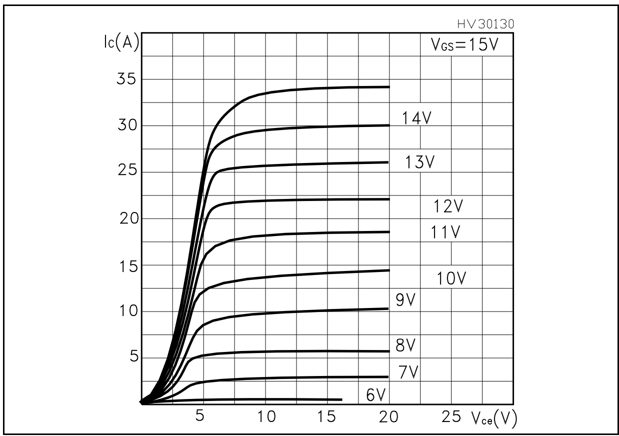


Figure 2. Transfer characteristics

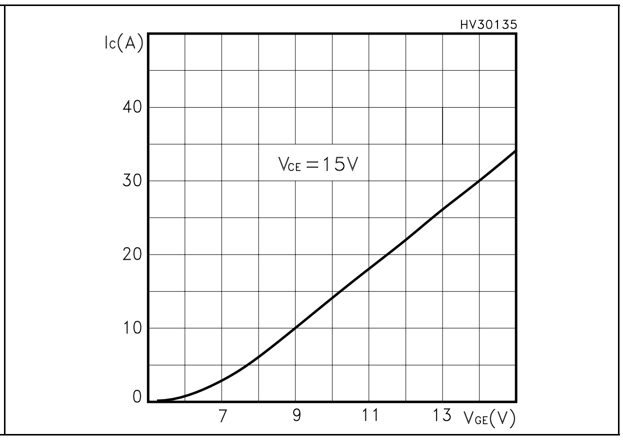


Figure 3. Transconductance

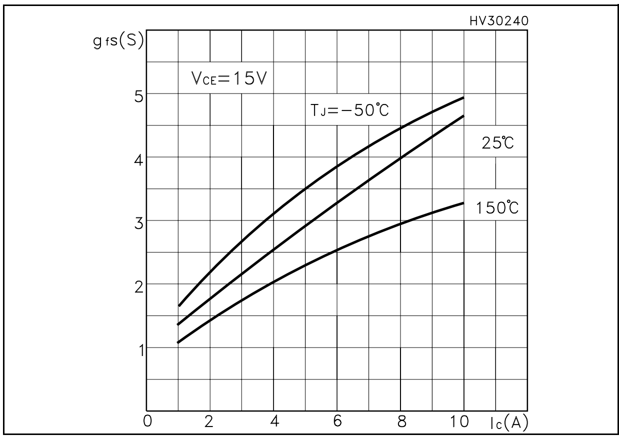


Figure 4. Collector-emitter on voltage vs temperature

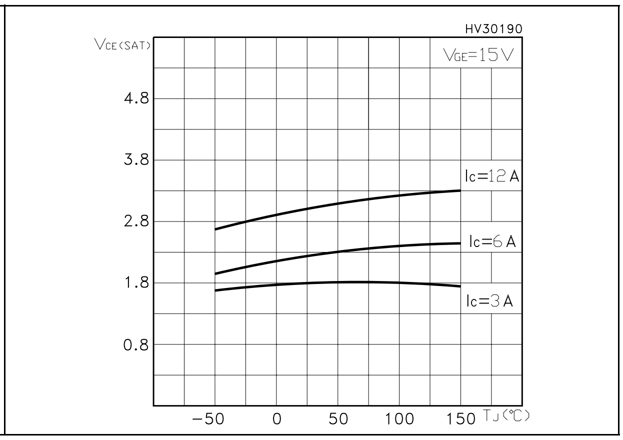


Figure 5. Gate charge vs gate-source voltage

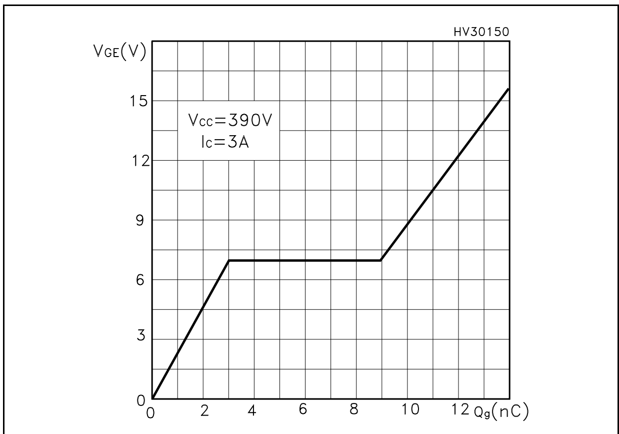


Figure 6. Capacitance variations

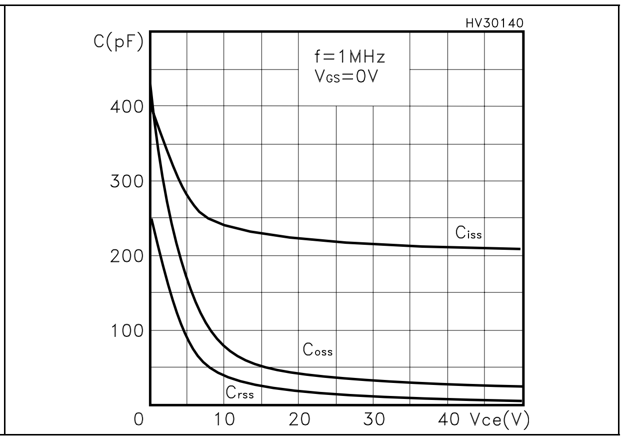


Figure 7. Normalized gate threshold voltage vs temperature

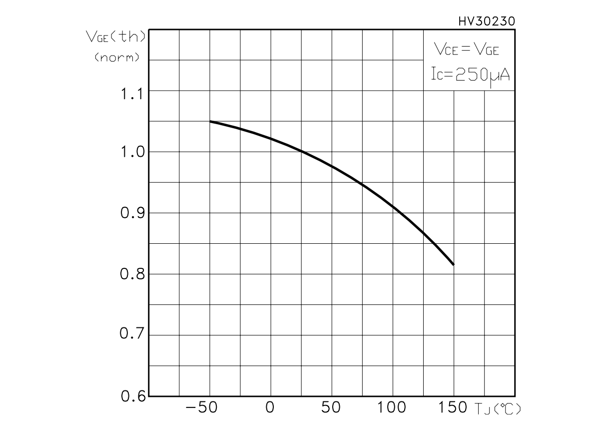


Figure 8. Collector-emitter on voltage vs collector current

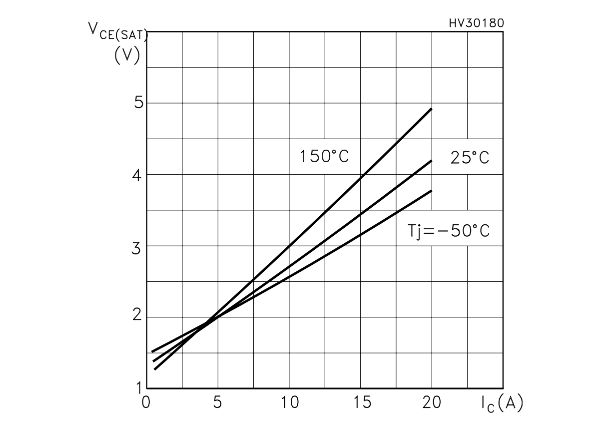


Figure 9. Normalized breakdown voltage vs temperature

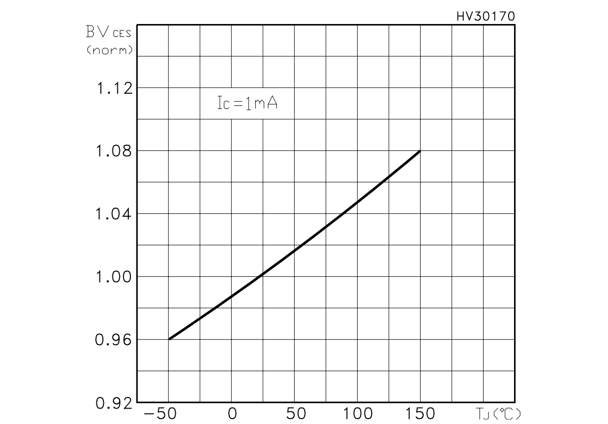


Figure 10. Switching losses vs temperature

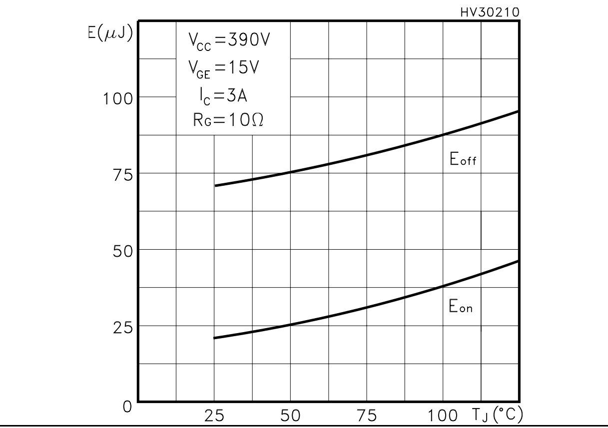


Figure 11. Switching losses vs gate resistance

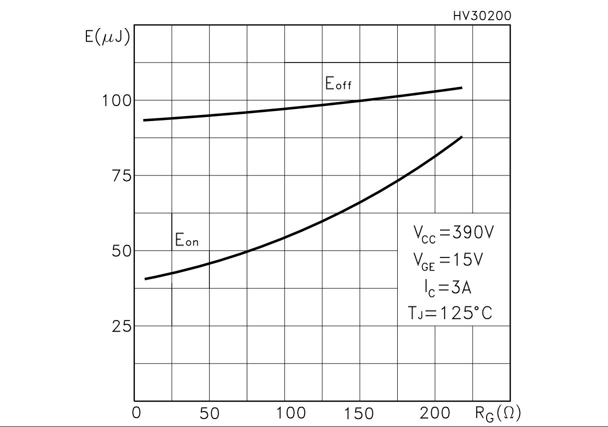


Figure 12. Switching losses vs collector current

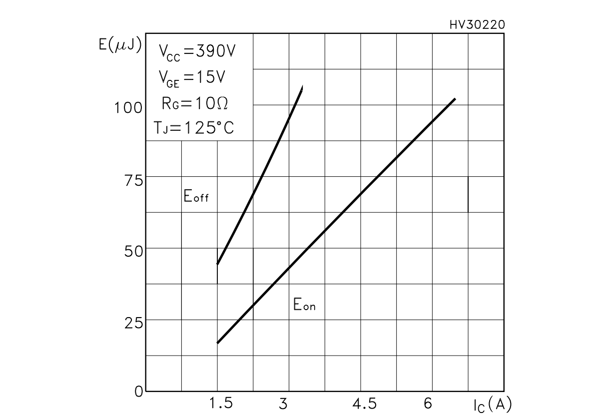


Figure 13. Thermal impedance for TO-220 / D²PAK / I²PAK

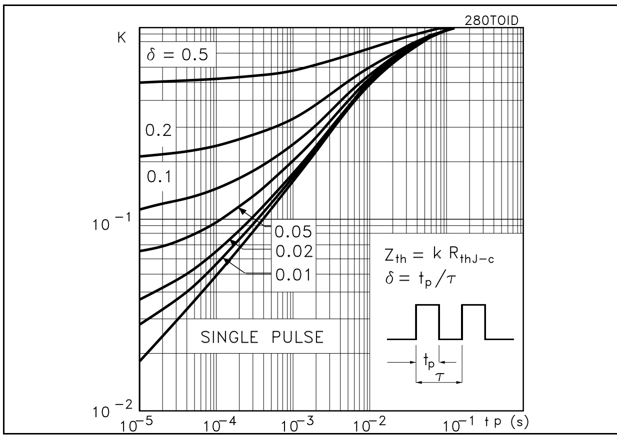


Figure 14. Turn-off SOA

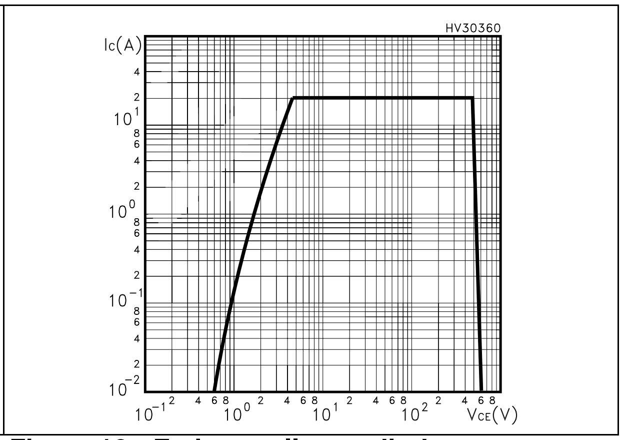


Figure 15. Thermal impedance for TO-220FP

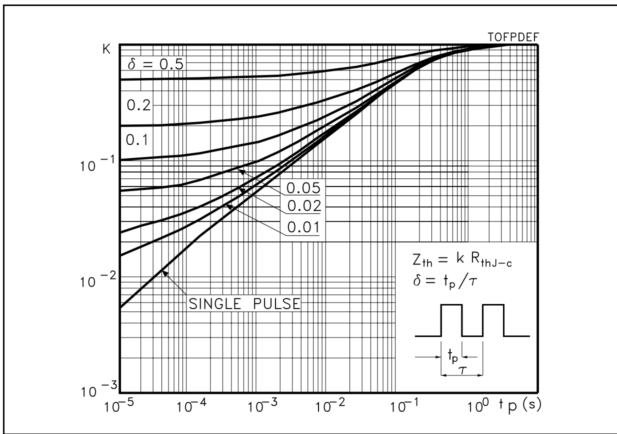
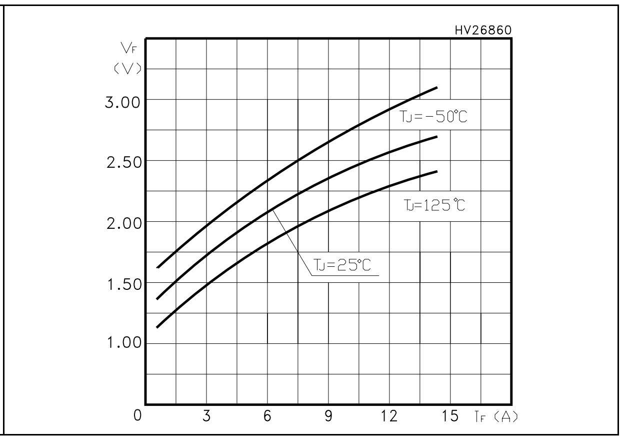


Figure 16. Emitter-collector diode characteristics



3 Test circuit

Figure 17. Test circuit for inductive load switching

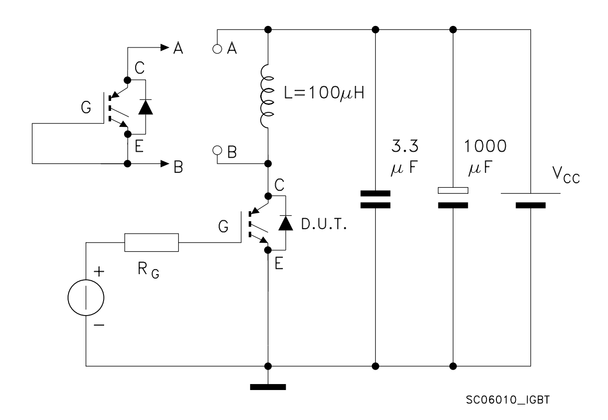


Figure 18. Gate charge test circuit

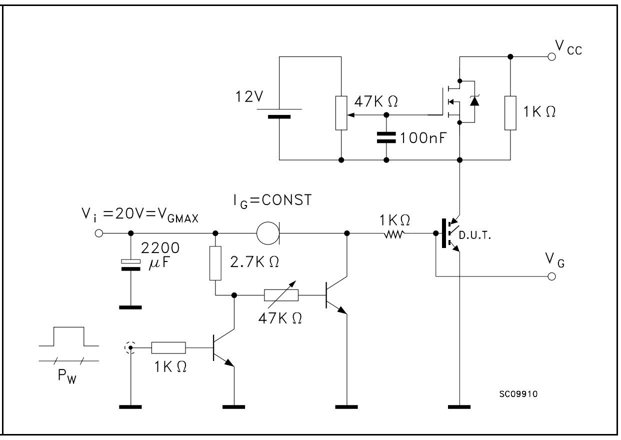


Figure 19. Switching waveform

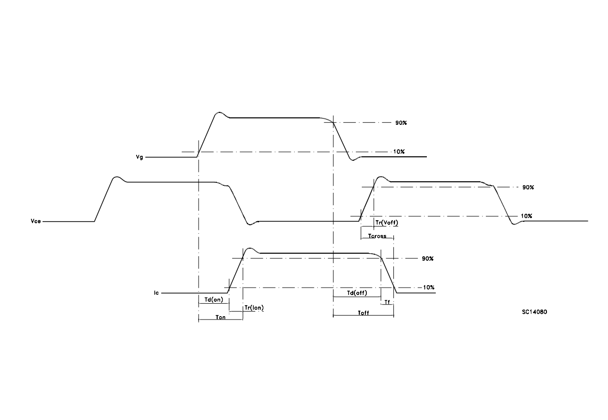
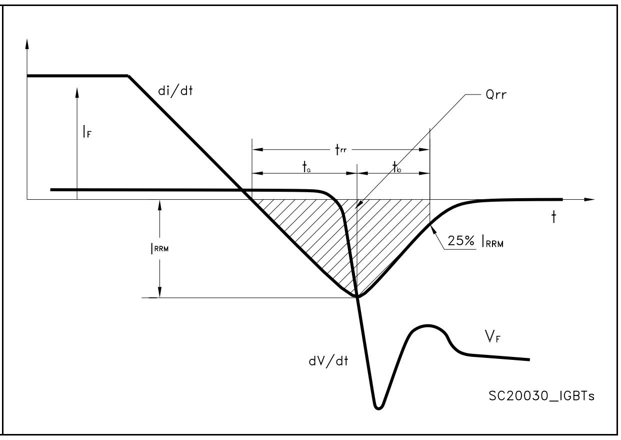


Figure 20. Diode recovery time waveform

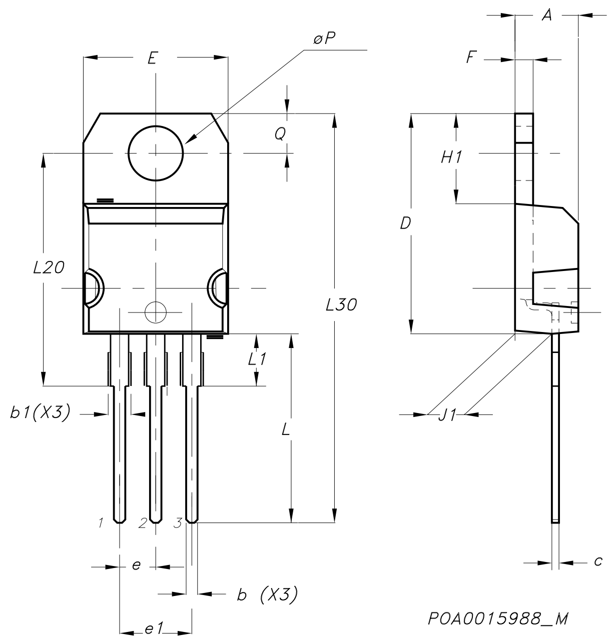


4 Package mechanical data

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*

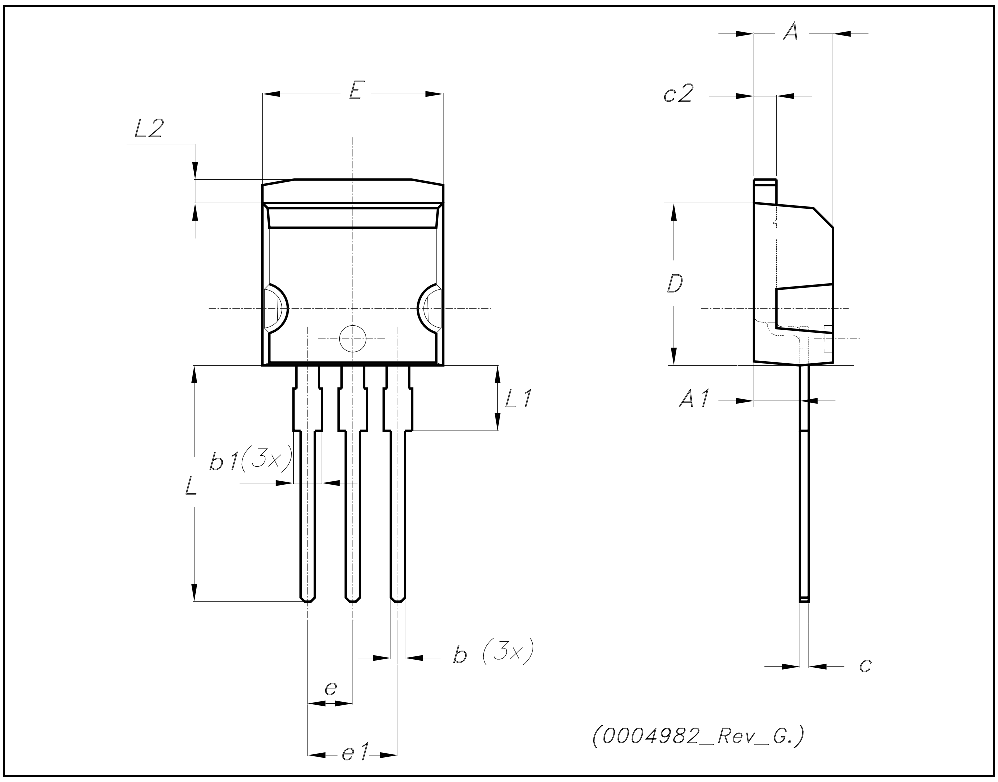
TO-220 MECHANICAL DATA

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	1.15		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



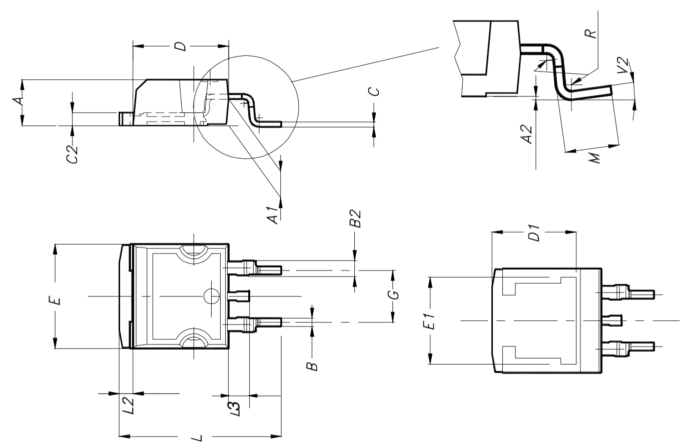
TO-262 (I^2PAK) MECHANICAL DATA

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



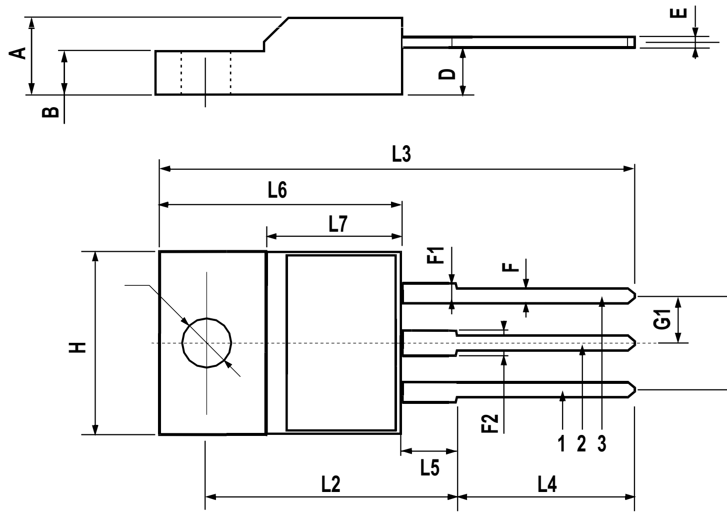
D²PAK MECHANICAL DATA

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			



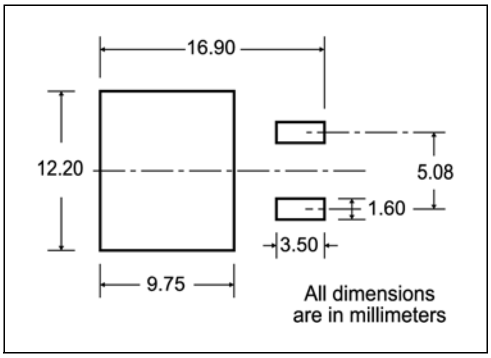
TO-220FP MECHANICAL DATA

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

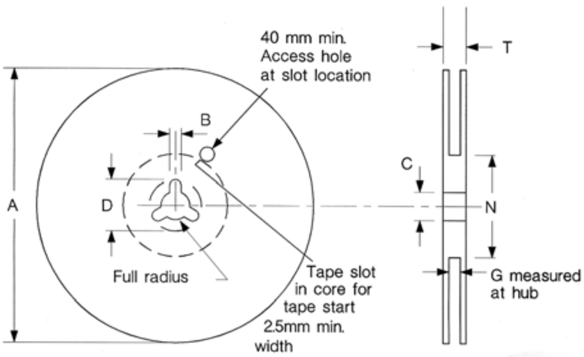


5 Packaging mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT



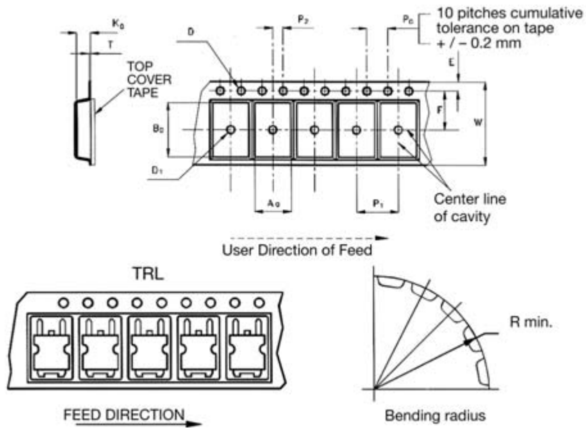
REEL MECHANICAL DATA

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 8. Revision history

Date	Revision	Changes
28-Nov-2005	1	First Release
07-Mar-2006	2	Complete version
31-Jul-2006	3	Modified *Figure 10*.
26-Apr-2007	4	Inserted package I^2PAK