



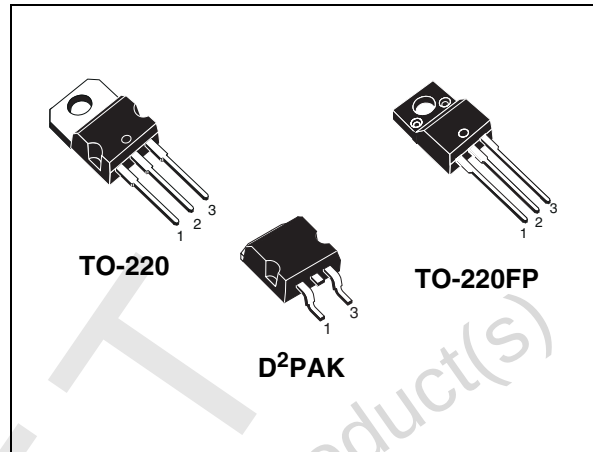
STGB12NB60KD STGF12NB60KD - STGP12NB60KD

N-channel 18A - 600V - TO-220 - TO-220FP - D²PAK
Short circuit proof PowerMESH™ IGBT

Features

Type	V _{CES}	V _{CE(sat)} (Max) @ 25°C	I _C @ 100°C
STGB12NB60KD	600V	< 2.8V	18A
STGF12NB60KD	600V	< 2.8V	7A
STGP12NB60KD	600V	< 2.8V	18A

- High input impedance
- Low on losses
- Low on gate charge
- High frequency operation
- Typical short circuit withstand time 10 micros
- Co-packaged antiparallel diode



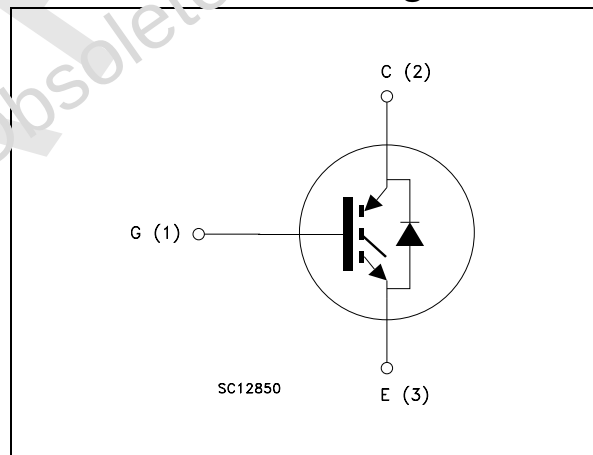
Description

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the Power MESH™ IGBTs, with outstanding performances. The suffix "K" identifies a family optimized for high frequency motor control applications (up to 50kHz) and short circuit proof in order to achieve very high switching performances (reduced t_{fall}) maintaining a low voltage drop.

Applications

- High frequency motor controls
- SMPS
- UPS

Internal schematic diagram



Order codes

Part number	Marking	Package	Packaging
STGB12NB60KD	GB12NB60KD	D ² PAK	Tape & reel
STGF12NB60KD	GF12NB60KD	TO-220FP	Tube
STGP12NB60KD	GP12NB60KD	TO-220	Tube

Contents

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1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220 / D ² PAK	TO-220FP	
V _{CES}	Collector-emitter voltage (V _{GS} = 0)	600		V
I _C ⁽¹⁾	Collector current (continuous) at T _C = 25°C	30	14	A
I _C ⁽¹⁾	Collector current (continuous) at T _C = 100°C	18	7	A
I _{CM} ⁽²⁾	Collector current (pulsed)	60		A
V _{GE}	Gate-emitter voltage	± 20		V
P _{TOT}	Total dissipation at T _C = 25°C	125	30	W
	Derating factor	1.0	0.23	
t _{sc}	Short circuit withstand	10		µs
T _{stg}	Storage temperature	– 65 to 150		°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. Pulse width limited by max junction temperature.

Table 2. Thermal resistance

Symbol	Parameter	Value		Unit
		TO-220 / D ² PAK	TO-220FP	
R _{thj-case}	Thermal resistance junction-case Max	1.0	4.2	°C/W
R _{thj-amb}	Thermal resistance junction-ambient Max	62.5		°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
I_{CES}	Collector-emitter leakage current ($V_{CE} = 0$)	$V_{CE} = \text{Max rating}$, $T_C = 25^{\circ}\text{C}$ $V_{CE} = \text{Max rating}$, $T_C = 125^{\circ}\text{C}$			50 100	μA mA
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{V}$, $V_{CE} = 0$			± 100	nA
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 250\mu\text{A}$	5		7	V
$V_{CE(SAT)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{V}$, $I_C = 12\text{A}$ $V_{GE} = 15\text{V}$, $I_C = 12\text{A}$, $T_C = 125^{\circ}\text{C}$		2.2 1.7	2.8	V V
$g_{fs}^{(1)}$	Forward transconductance	$V_{CE} = 15\text{V}$, $I_C = 12\text{A}$		5		S

1. Pulsed: Pulse duration = 300 μs , duty cycle 1.5%

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies} C_{oes} C_{res}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{CE} = 25\text{V}$, $f = 1\text{MHz}$, $V_{GE} = 0$		890 110 22		pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	$V_{CE} = 480\text{V}$, $I_C = 12\text{A}$, $V_{GE} = 15\text{V}$ (see Figure 18)		54 8 31		nC nC nC
I_{CL}	Turn-off SOA minimum current	$V_{clamp} = 480\text{V}$, $T_J = 125^{\circ}\text{C}$, $R_G = 10\Omega$, $V_{GE} = 15\text{V}$		48		A

Table 5. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 480V, I_C = 12A$		25		ns
t_r	Current rise time	$R_G = 10\Omega, V_{GE} = 15V,$		14.5		ns
$(di/dt)_{on}$	Turn-on current slope	$T_j = 25^\circ C$ (see Figure 17)		760		A/ μs
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 480V, I_C = 12A$		24		ns
t_r	Current rise time	$R_G = 10\Omega, V_{GE} = 15V,$		15		ns
$(di/dt)_{on}$	Turn-on current slope	$T_j = 125^\circ C$ (see Figure 17)		590		A/ μs
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 480V, I_C = 12A,$		25		ns
$t_{d(off)}$	Turn-off delay time	$R_{GE} = 10\Omega, V_{GE} = 15V$		96		ns
t_c	Cross-over time	$T_J = 25^\circ C$ (see Figure 17)		130		ns
t_f	Current fall time			100		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 480V, I_C = 12A,$		80		ns
$t_{d(off)}$	Turn-off delay time	$R_{GE} = 10\Omega, V_{GE} = 15V$		150		ns
t_c	Cross-over time	$T_j = 125^\circ C$ (see Figure 17)		310		ns
t_f	Current fall time			220		ns

Table 6. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 480V, I_C = 12A$		152		μJ
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\Omega, V_{GE} = 15V,$		258		μJ
E_{ts}	Total switching losses	$T_j = 25^\circ C$ (see Figure 17)		410		μJ
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 480V, I_C = 12A,$		180		μJ
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\Omega, V_{GE} = 15V,$		1100		μJ
E_{ts}	Total switching losses	$T_j = 125^\circ C$ (see Figure 17)		1280		μJ

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-pack diode, the co-pack 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.

Table 7. Collector-emitter diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
I_f	Forward current				12	A
I_{fm}	Forward current pulsed				48	A
V_f	Forward on-voltage	$I_f = 6A$ $I_f = 6A, T_j = 125^\circ C$		1.3 1.1	1.9	V V
t_{rr}	Reverse recovery time	$I_f = 6A, V_R = 40V,$		37		ns
Q_{rr}	Reverse recovery charge	$T_j = 25^\circ C, di/dt = 100A/\mu s$		40		nC
I_{rrm}	Reverse recovery current	(see Figure 20)		2.1		A
t_{rr}	Reverse recovery time	$I_f = 6A, V_R = 40V,$		61		ns
Q_{rr}	Reverse recovery charge	$T_j = 125^\circ C, di/dt = 100A/\mu s$		98		nC
I_{rrm}	Reverse recovery current	(see Figure 20)		3.2		A

2.1 Electrical characteristics (curves)

Figure 1. Output characteristics

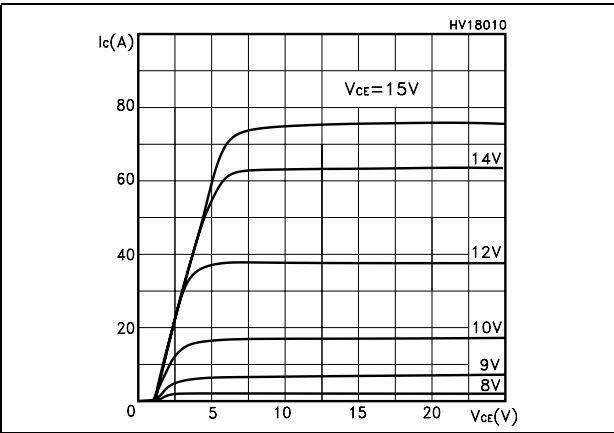


Figure 2. Transfer characteristics

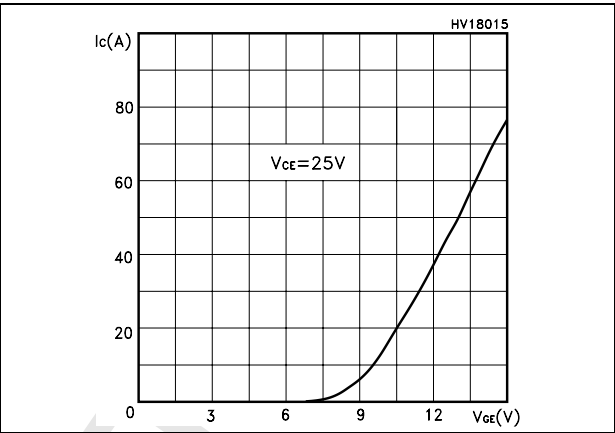


Figure 3. Transconductance

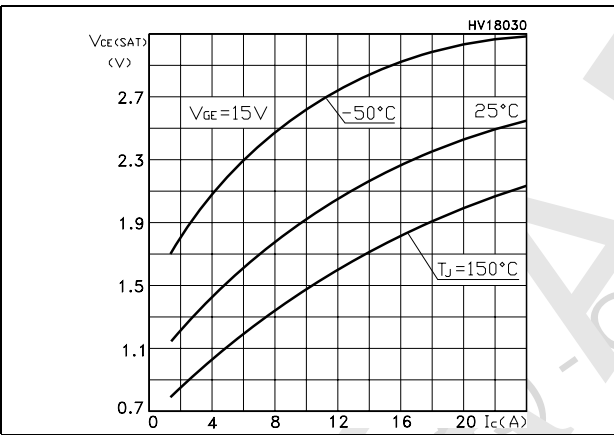


Figure 4. Collector-emitter on voltage vs temperature

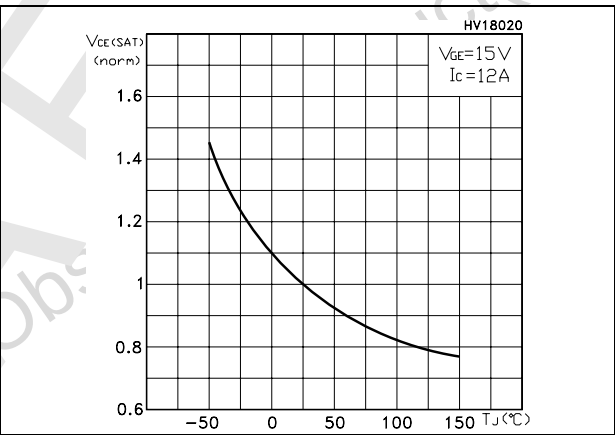


Figure 5. Collector-emitter on voltage vs collector current

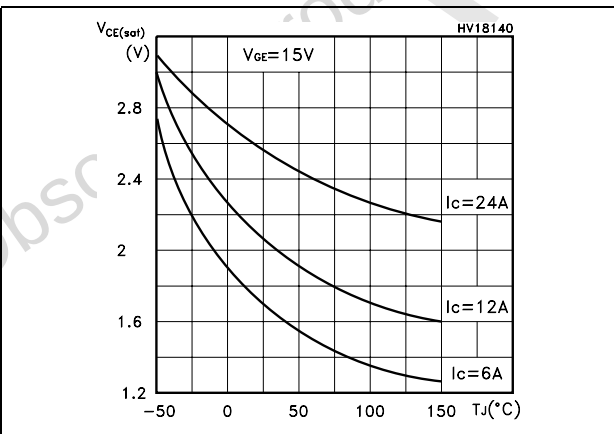


Figure 6. Normalized gate threshold vs temperature

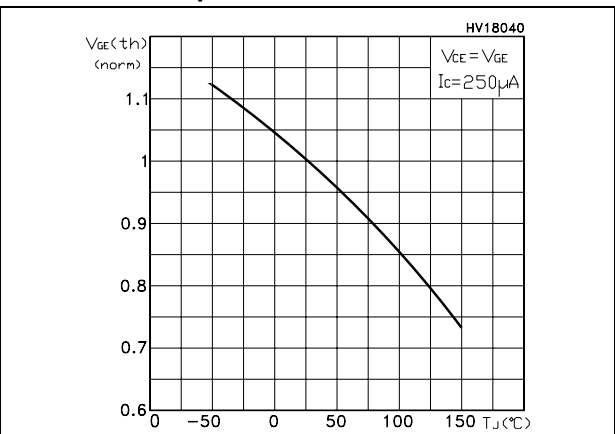


Figure 7. Normalized breakdown voltage vs temperature

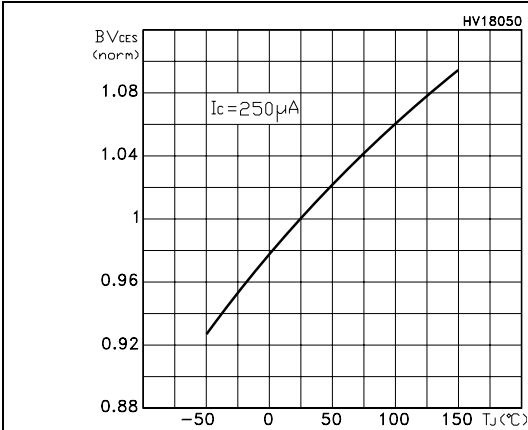


Figure 8. Gate charge vs gate-emitter voltage

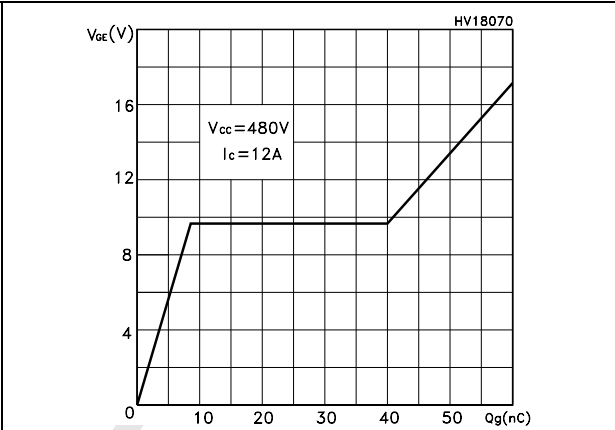


Figure 9. Capacitance variations

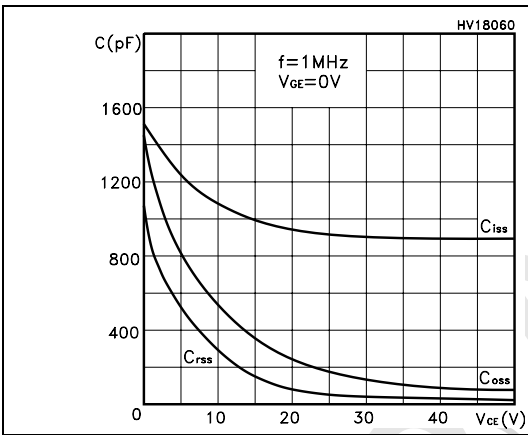


Figure 10. Switching losses vs temperature

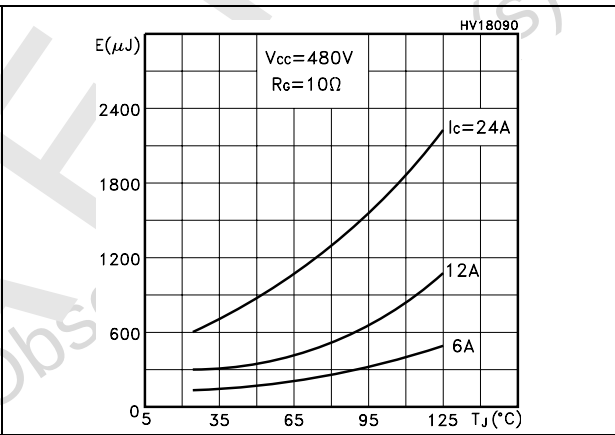


Figure 11. Switching losses vs gate resistance

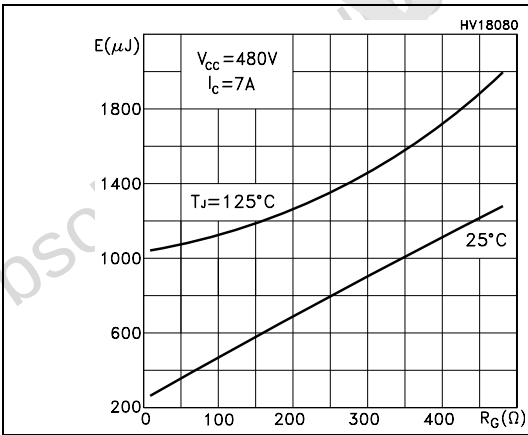


Figure 12. Switching losses vs collector current

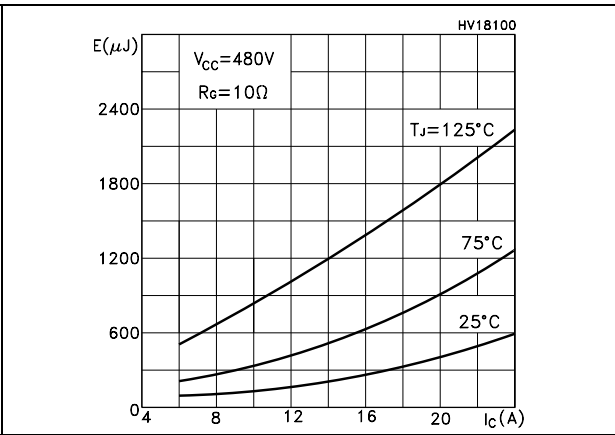


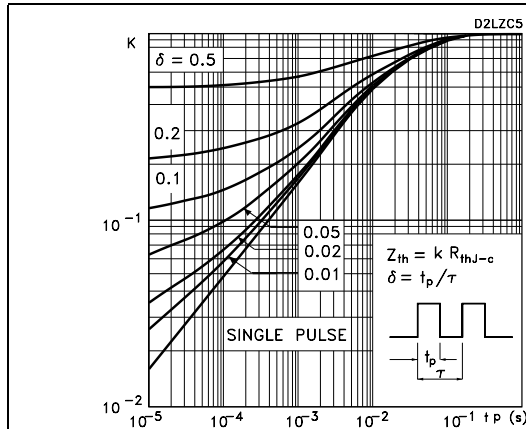
Figure 13. Thermal impedance for TO-220 / D²PAK

Figure 14. Thermal impedance for TO-220FP

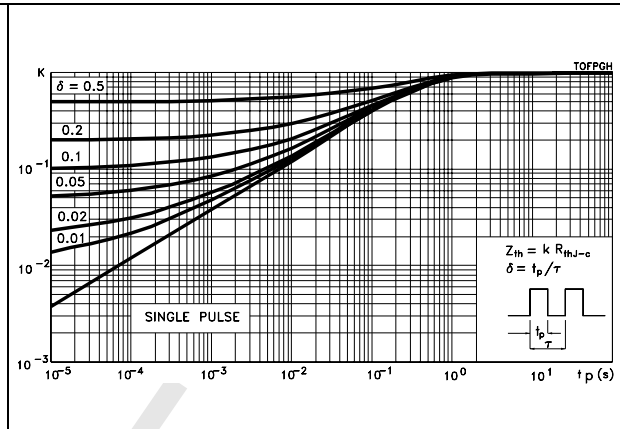


Figure 15. Collector-emitter diode characteristics

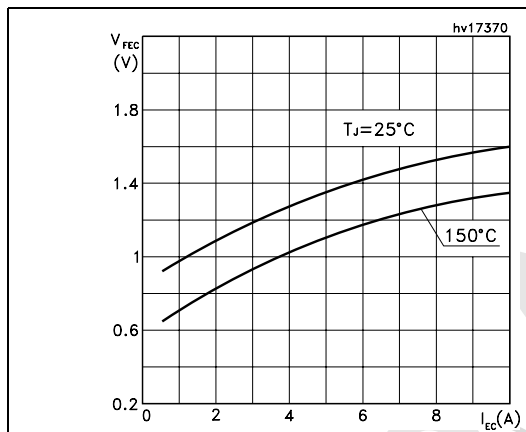
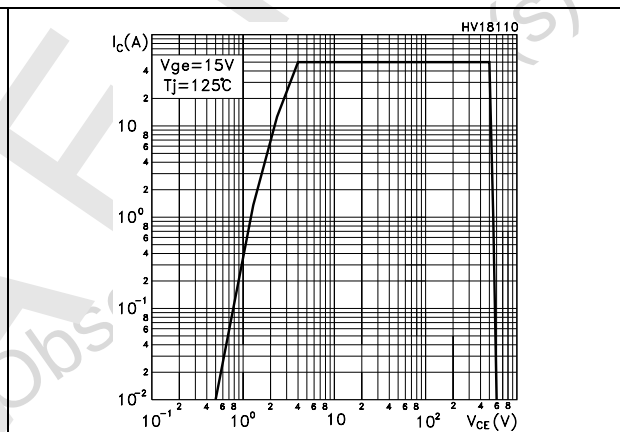


Figure 16. Turn-off SOA



3 Test circuit

Figure 17. Test circuit for inductive load switching

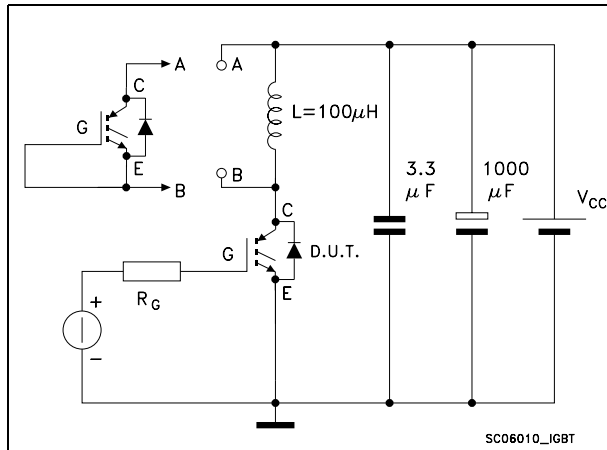


Figure 18. Gate charge test circuit

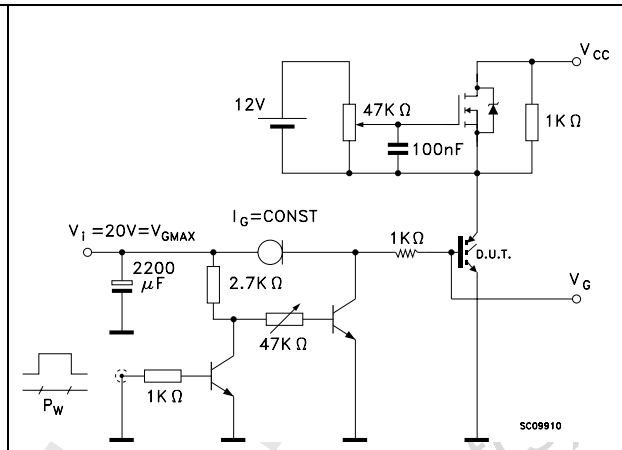


Figure 19. Switching waveforms

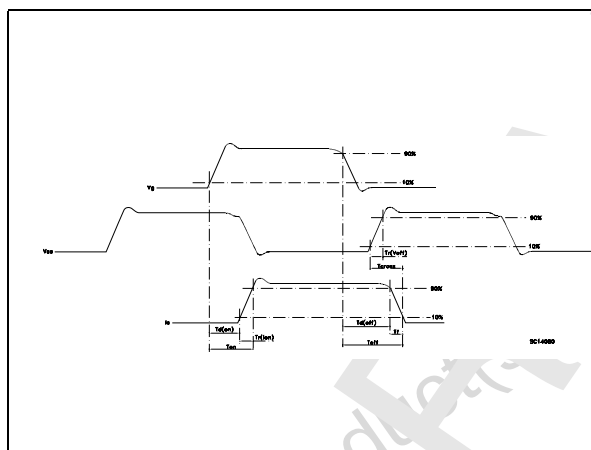
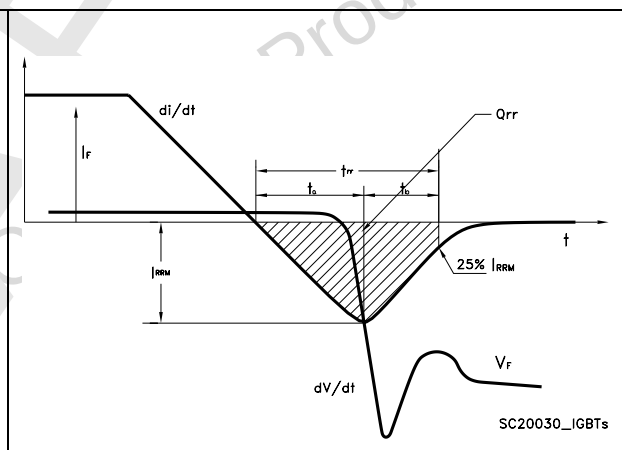


Figure 20. Diode recovery times waveform

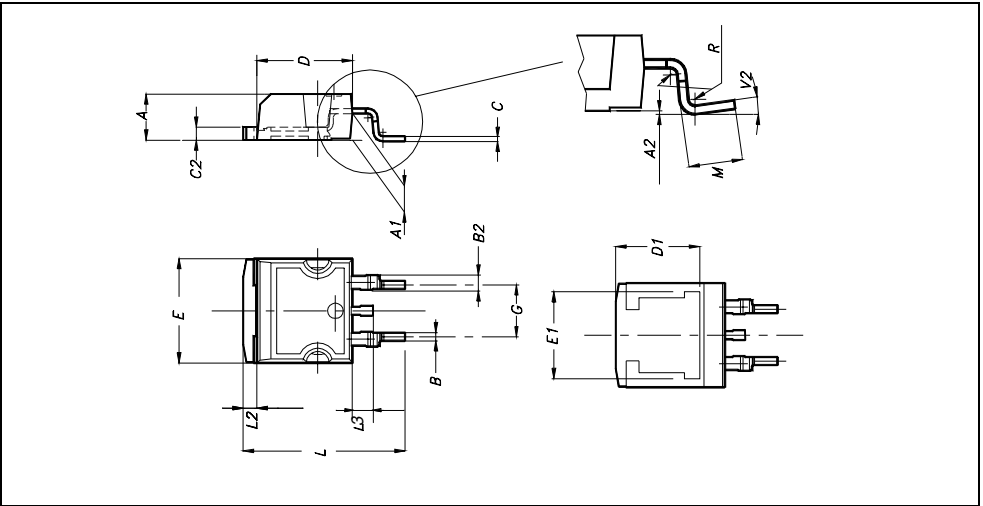


4 Package mechanical data

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

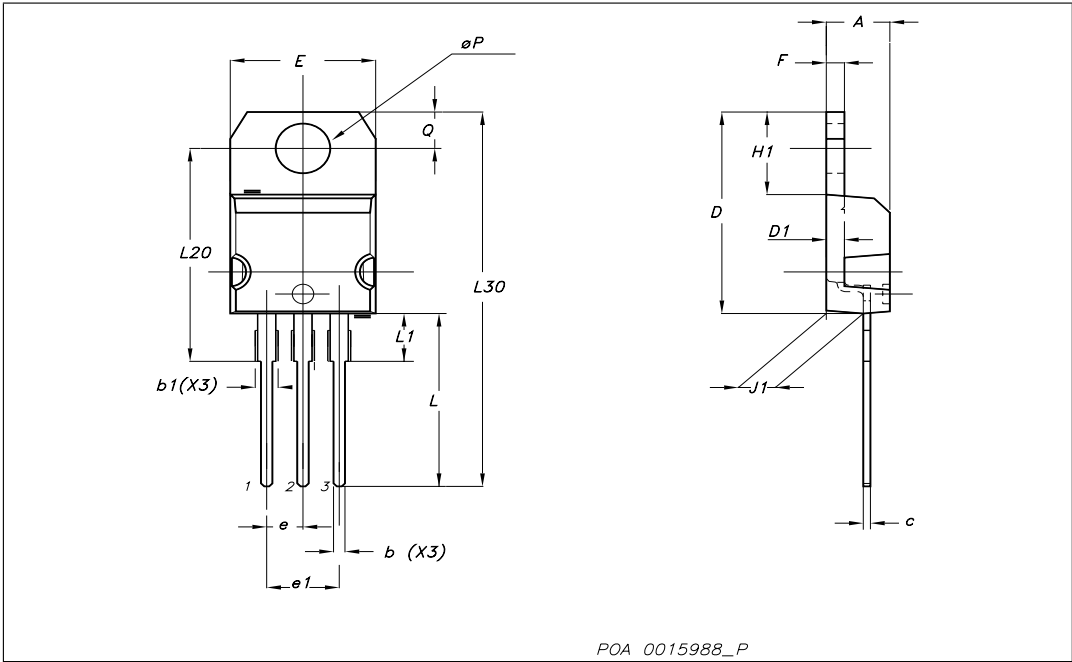
D²PAK MECHANICAL DATA

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	0°		4°			



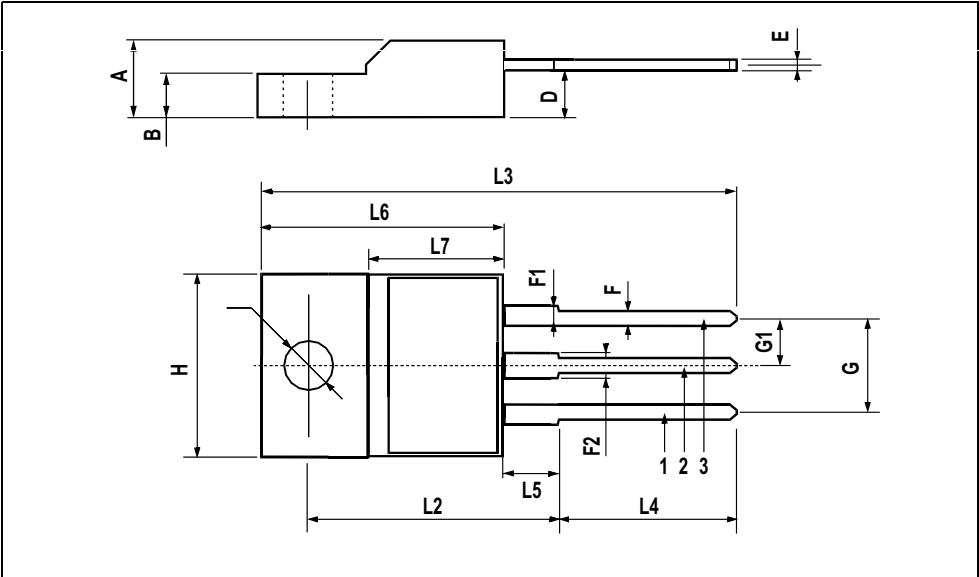
TO-220 mechanical data

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	
ØP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



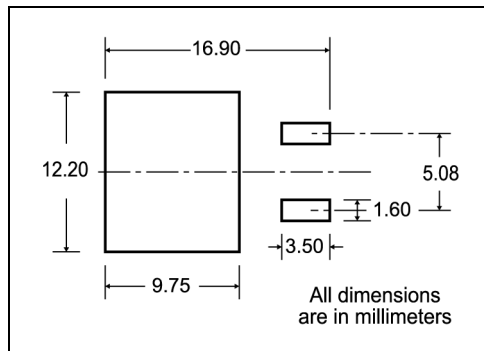
TO-220FP MECHANICAL DATA

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

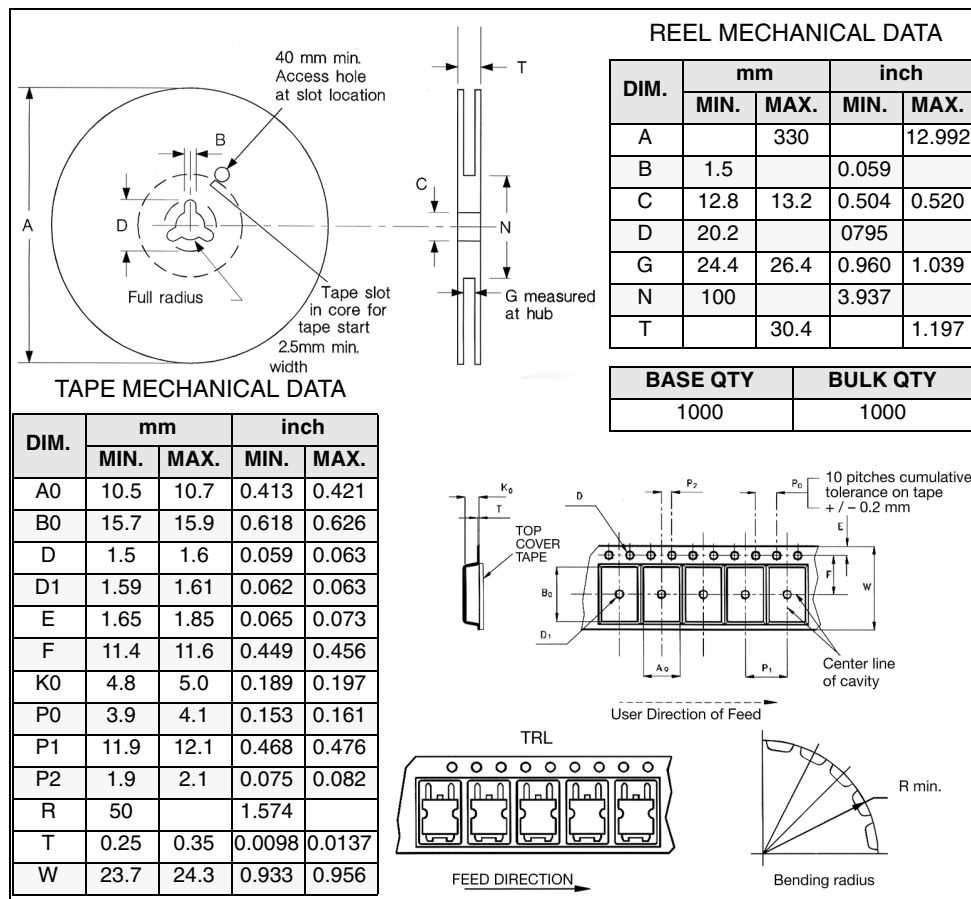


5 Packaging mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT



* on sales type

6 Revision history

Table 8. Revision history

Date	Revision	Changes
16-Apr-2007	3	The document has been reformatted

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