



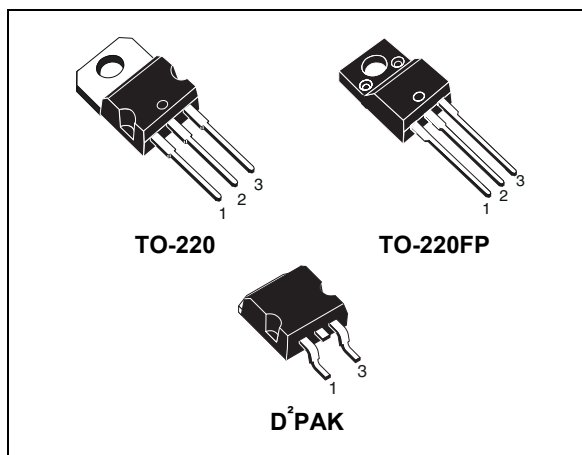
STGB10NC60KD STGF10NC60KD - STGP10NC60KD

N-channel 600V - 10A - D²PAK / TO-220 / TO-220FP
Short circuit rated PowerMESH™ IGBT

General features

Type	V _{CE(S)}	V _{CE(sat)} Max @25°C	I _C @100°C
STGB10NC60KD	600V	<2.5V	10A
STGP10NC60KD	600V	<2.5V	10A
STGF10NC60KD	600V	<2.5V	6A

- Lower on voltage drop (V_{cesat})
- Lower C_{RES} / C_{IES} ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode
- Short circuit withstand time 10μs



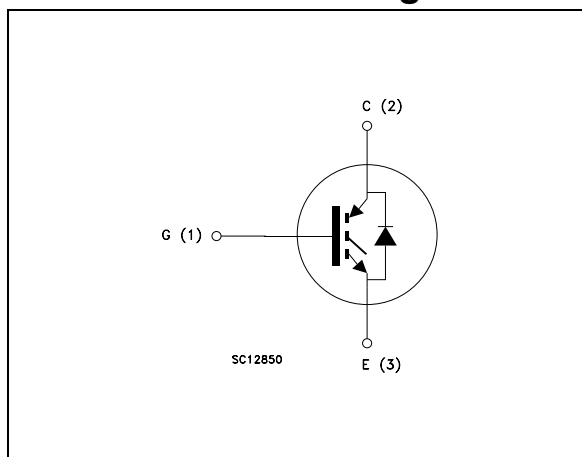
Description

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 “K” identifies a family optimized for high frequency motor control applications with short circuit withstand capability.

Applications

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

Internal schematic diagram



Order codes

Part number	Marking	Package	Packaging
STGB10NC60KDT4	GB10NC60KD	D ² PAK	Tape & reel
STGP10NC60KD	GP10NC60KD	TO-220	Tube
STGF10NC60KD	GF10NC60KD	TO-220FP	Tube

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1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D ² PAK/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	20	9	A
I _C ⁽¹⁾	Collector current (continuous) at T _C = 100°C	10	6	A
I _{CM} ⁽²⁾	Collector current (pulsed)	30		A
V _{GE}	Gate-emitter voltage	±20		V
I _F	Diode RMS forward current at T _C =25°C	10		A
P _{TOT}	Total dissipation at T _C = 25°C	60	25	W
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1s;T _C =25°C)	--	2500	
T _{stg}	Storage temperature	- 55 to 150		°C
T _j	Operating junction temperature			
T _{scw}	Short circuit withstand time	10		µs
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
R _{thj-case}	Thermal resistance junction-case Max	TO-220/D ² PAK	2.08	°C/W
		TO-220FP	5.0	°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
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{V}, I_C = 5\text{A}$		2.2	2.5	V
		$V_{GE} = 15\text{V}, I_C = 5\text{A}, T_C = 125^{\circ}\text{C}$		1.8		V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 250\ \mu\text{A}$	4.5		6.5	V
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE} = \text{Max rating}, T_C = 25^{\circ}\text{C}$			150	μA
		$V_{CE} = \text{Max rating}, T_C = 125^{\circ}\text{C}$			1	mA
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{V}, V_{CE} = 0$			± 100	nA
g_{fs}	Forward transconductance	$V_{CE} = 15\text{V}, I_C = 5\text{A}$		15		S

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies} C_{oes} C_{res}	Input capacitance	$V_{CE} = 25\text{V}, f = 1\text{MHz},$ $V_{GE} = 0$		380		pF
	Output capacitance			46		pF
	Reverse transfer capacitance			8.5		pF
Q_g Q_{ge} Q_{gc}	Total gate charge	$V_{CE} = 390\text{V}, I_C = 5\text{A},$		19		nC
	Gate-emitter charge	$V_{GE} = 15\text{V},$		5		nC
	Gate-collector charge	(see Figure 18)		9		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 19)</i>		17 6 655		ns ns A/ μs
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 390V, I_C = 5A$ $R_G = 10\Omega, V_{GE} = 15V,$ $T_j = 125^\circ C$ <i>(see Figure 19)</i>		16.5 6.5 575		ns ns A/ μs
$t_r(V_{off})$ $t_{d(off)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390V, I_C = 5A,$ $R_{GE} = 10\Omega, V_{GE} = 15V, T_j = 25^\circ C$ <i>(see Figure 19)</i>		33 72 82		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 19)</i>		60 106 136		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 19)</i>		55 85 140		μJ μJ μJ
$E_{on}^{(1)}$ $E_{off}^{(2)}$ E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390V, I_C = 5A$ $R_G = 10\Omega, V_{GE} = 15V,$ $T_j = 125^\circ C$ <i>(see Figure 19)</i>		87 162 249		μJ μJ 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-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	$I_f = 2.5A$		1.6	2.1	V
		$I_f = 2.5A, T_j = 125^\circ C$		1.3		V
t_{rr}	Reverse recovery time	$I_f = 5A, V_R = 30V,$		23.5		ns
Q_{rr}	Reverse recovery charge	$T_j = 25^\circ C, di/dt = 100 A/\mu s$		16.5		nC
I_{rrm}	Reverse recovery current	(see Figure 20)		1.4		A
t_{rr}	Reverse recovery time	$I_f = 5A, V_R = 30V,$		39		ns
Q_{rr}	Reverse recovery charge	$T_j = 125^\circ C, di/dt = 100A/\mu s$		39		nC
I_{rrm}	Reverse recovery current	(see Figure 20)		2		A

2.1 Electrical characteristics (curves)

Figure 1. Output characteristics

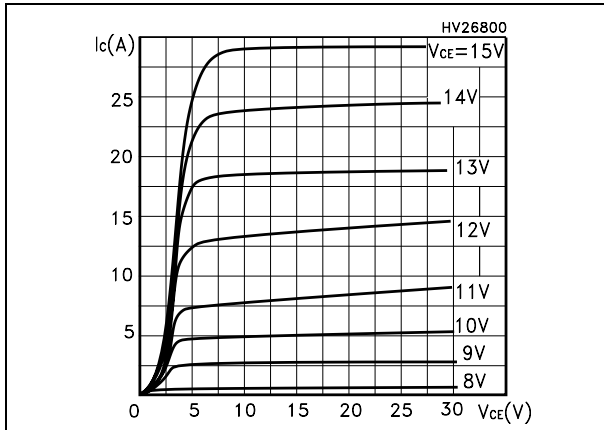


Figure 2. Transfer characteristics

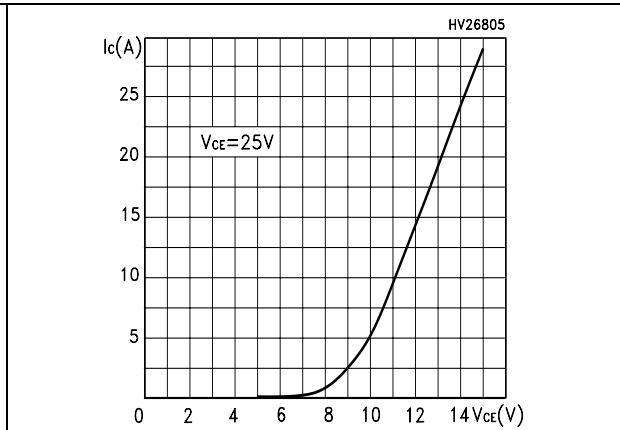


Figure 3. Transconductance

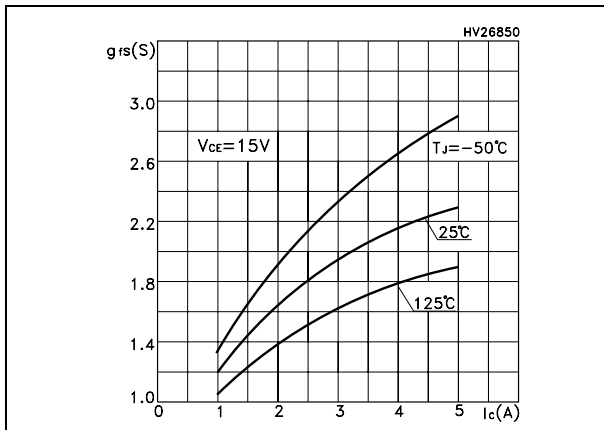


Figure 4. Collector-emitter on voltage vs temperature

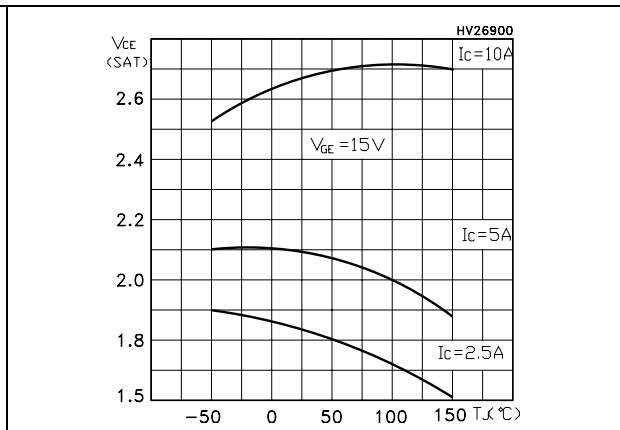


Figure 5. Gate charge vs gate-source voltage

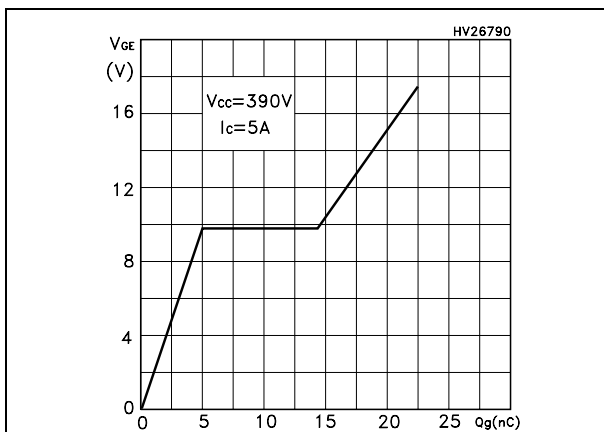


Figure 6. Capacitance variations

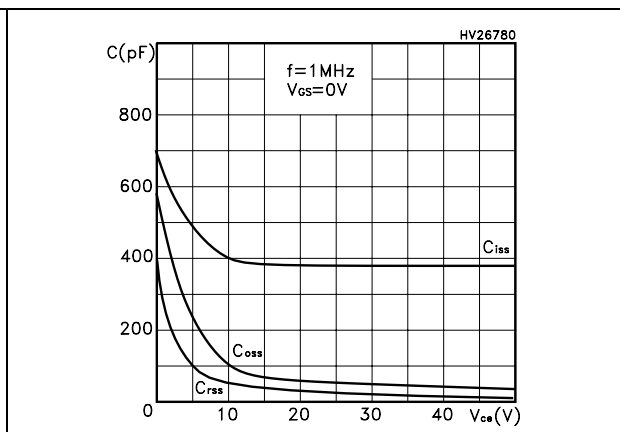


Figure 7. Normalized gate threshold voltage vs temperature

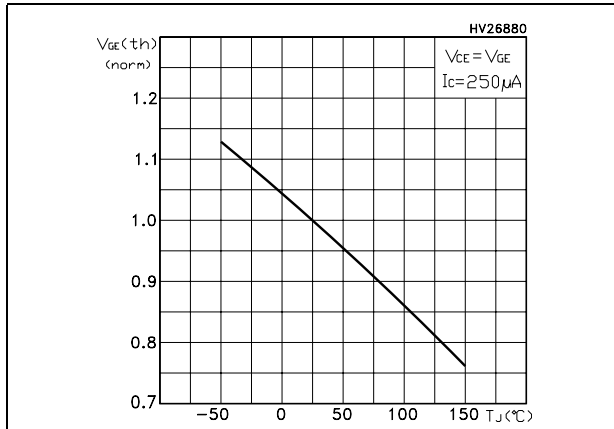


Figure 8. Collector-emitter on voltage vs collector current

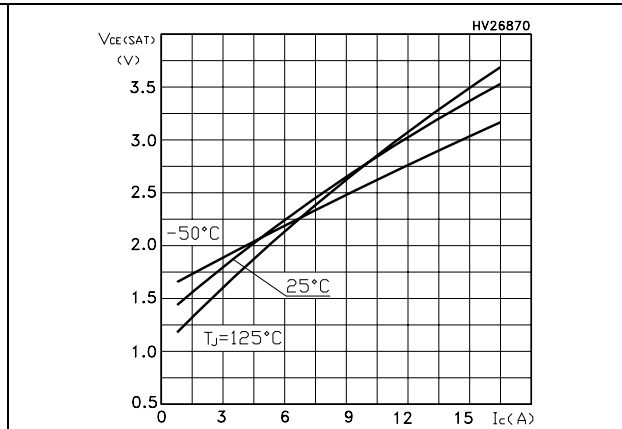


Figure 9. Normalized breakdown voltage vs temperature

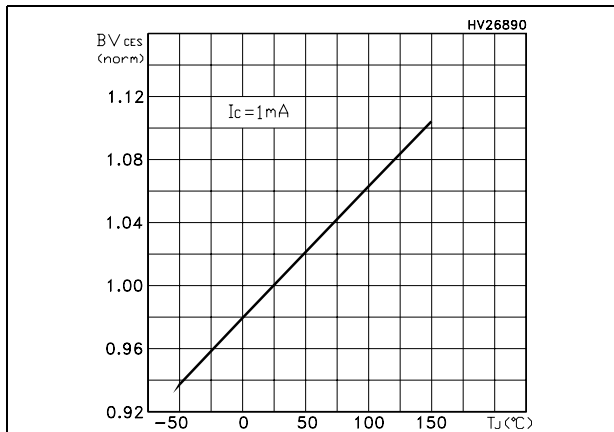


Figure 10. Switching losses vs temperature

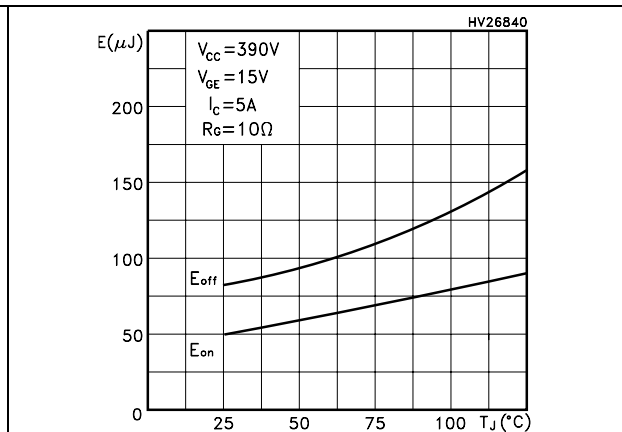


Figure 11. Switching losses vs gate resistance

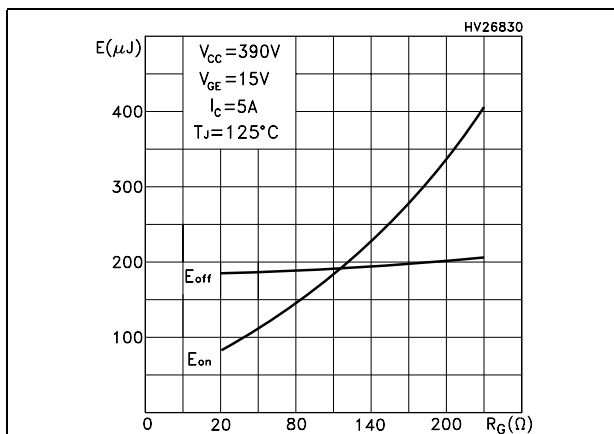


Figure 12. Switching losses vs collector current

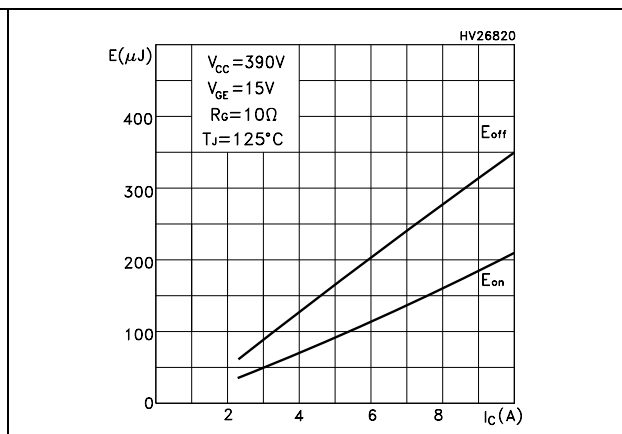


Figure 13. Thermal impedance for TO-220/
D²PAK

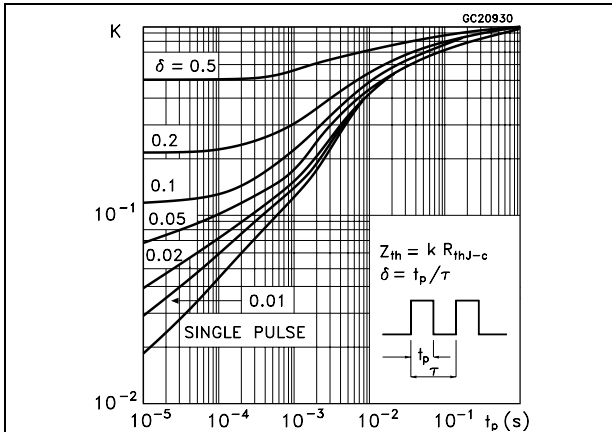


Figure 14. Turn-off SOA

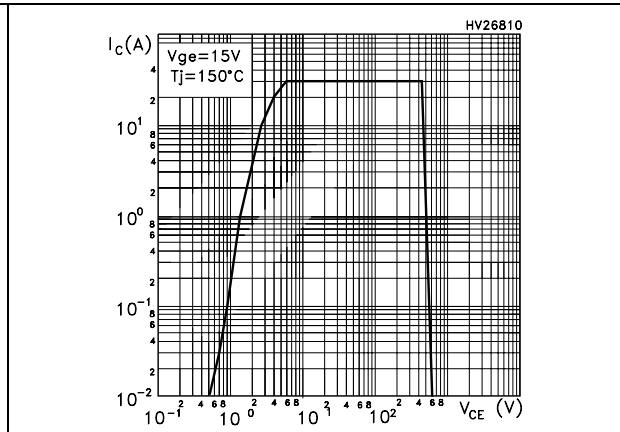


Figure 15. Emitter-collector diode
characteristics

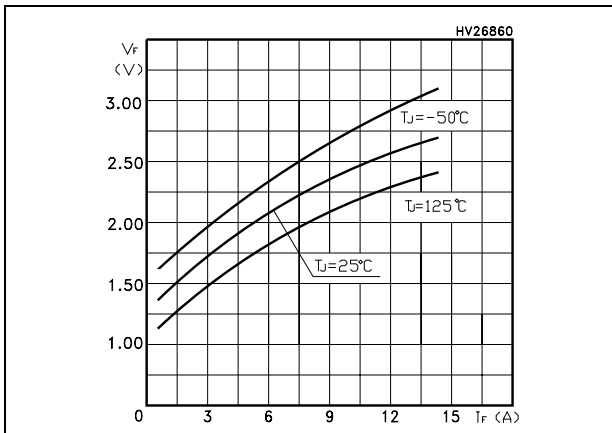
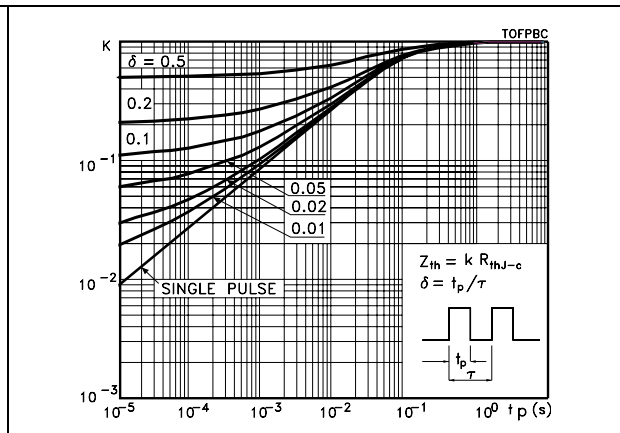


Figure 16. Thermal impedance for TO-220FP



3 Test circuit

Figure 17. Test circuit for inductive load switching

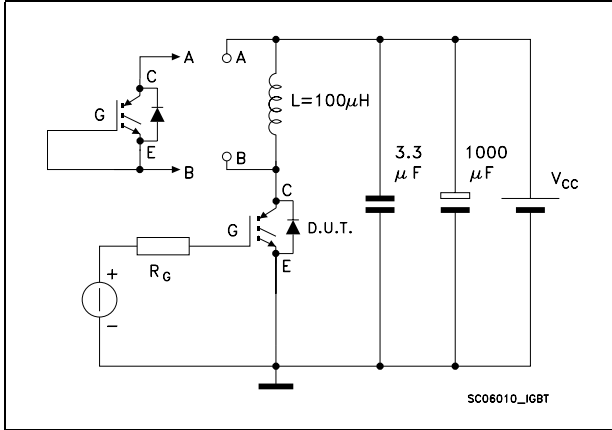


Figure 18. Gate charge test circuit

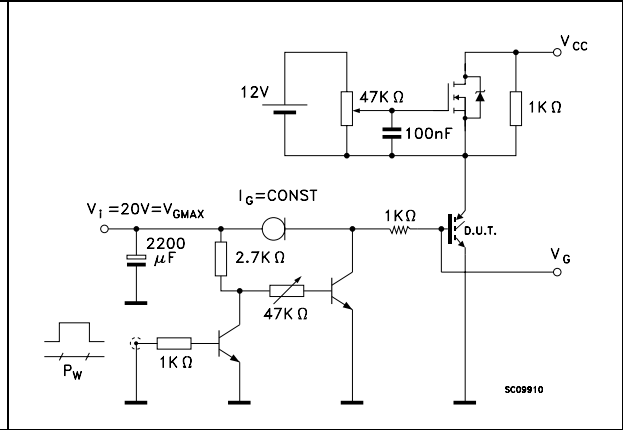


Figure 19. Switching waveform

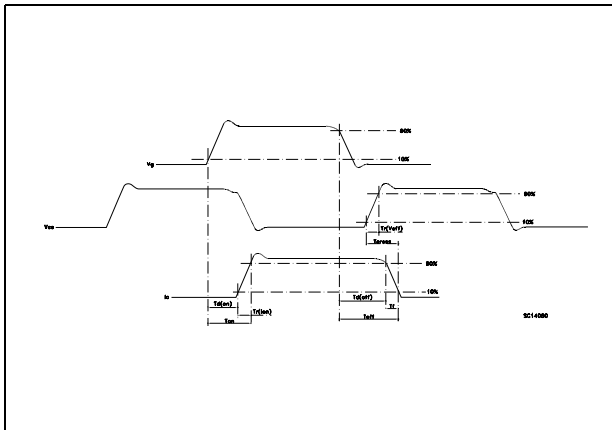
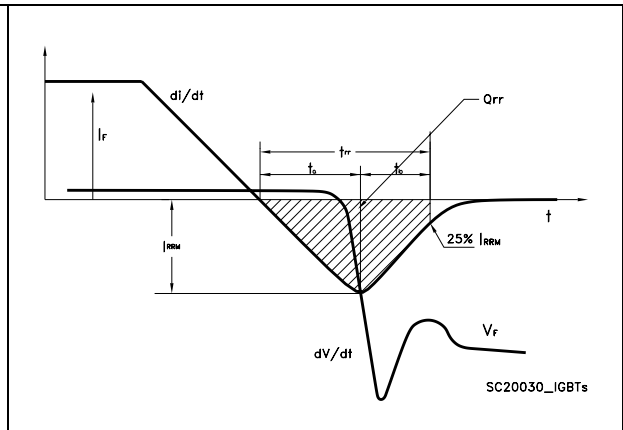


Figure 20. Diode recovery time waveform

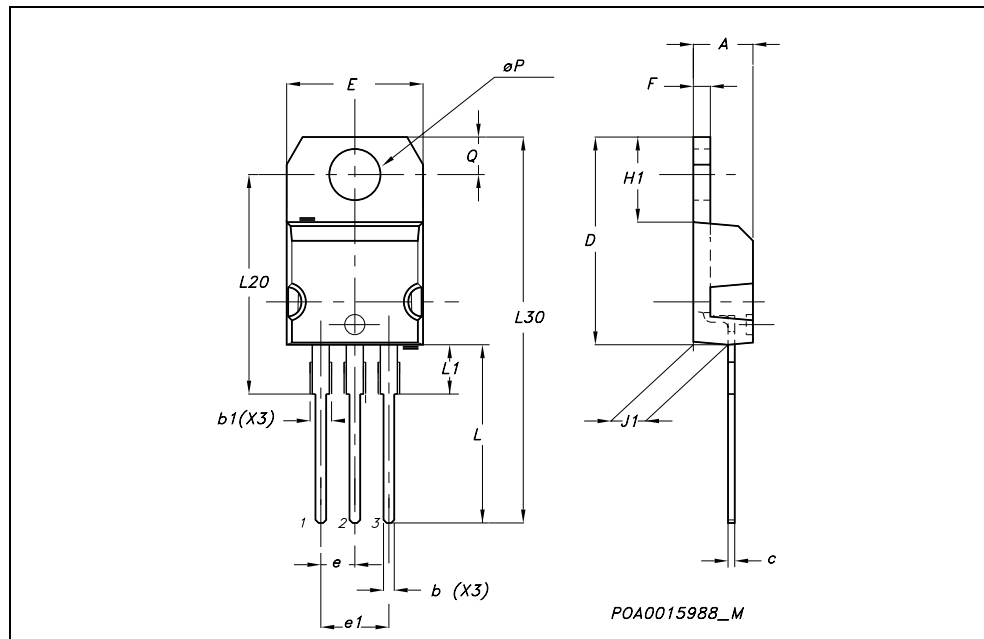


4 Package mechanical data

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

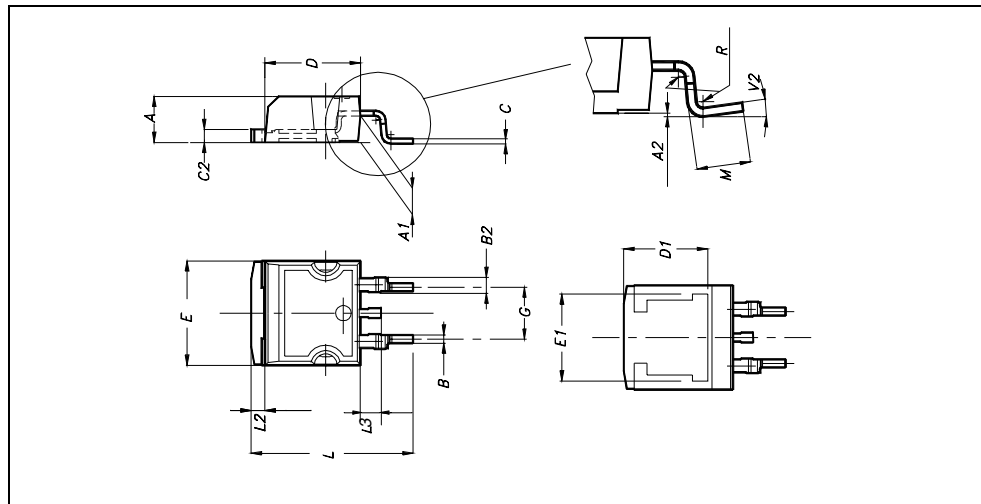
TO-220 MECHANICAL DATA

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



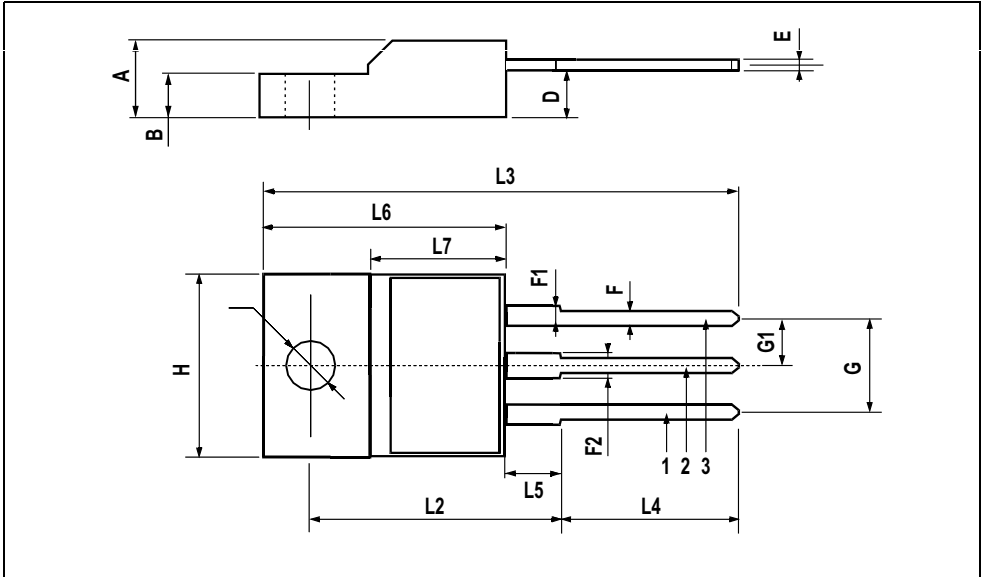
D²PAK MECHANICAL DATA

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-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

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

Center line of cavity

User Direction of Feed

FEED DIRECTION

TRL

Bending radius R min.

* on sales type

6 Revision history

Table 8. Revision history

Date	Revision	Changes
14-Jun-2005	1	New release
19-Jul-2005	2	Complete version
27-Jan-2006	3	Inserted ecopack indication
01-Mar-2006	4	The document has been reformatted
08-Feb-2007	5	Modified value on Table 5.: Switching on/off (inductive load)

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