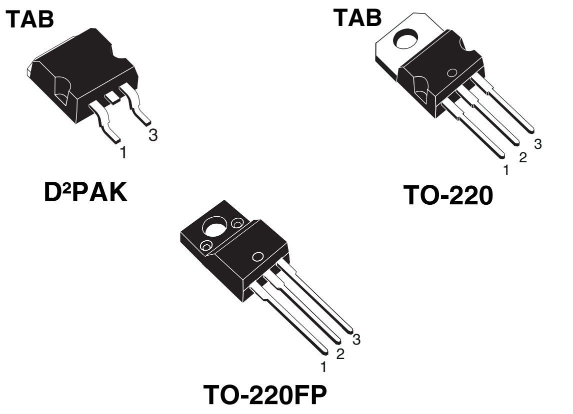
STGB14NC60KD
STGF14NC60KD, STGP14NC60KD

14 A, 600 V - short-circuit rugged IGBT

Features

- Short circuit withstand time 10µs.
- Low on-voltage drop ($V_{CE(sat)}$)
- Low C_{res} / C_{ies} ratio (no cross conduction susceptibility)
- Switching losses include diode recovery energy
- Very soft ultra fast recovery antiparallel diode



Applications

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

Description

This IGBT utilizes the advanced PowerMESH™ process resulting in an excellent trade-off between switching performance and low on-state behavior.

Figure 1. Internal schematic diagram

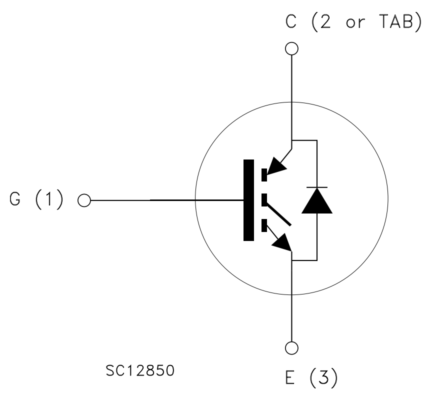


Table 1. Device summary

Order codes	Marking	Package	Packaging
STGB14NC60KDT4	GB14NC60KD	D²PAK	Tape and reel
STGF14NC60KD	GF14NC60KD	TO-220FP	Tube
STGP14NC60KD	GP14NC60KD	TO-220	Tube

Contents

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)	Continuous collector current at T_C = 25 °C	25	11	A
I_C (1)	Continuous collector current at T_C = 100 °C	14	7	A
I_{CL} (2)	Turn-off latching current	50		A
I_{CP} (3)	Pulsed collector current	50		A
V_{GE}	Gate-emitter voltage	±20		V
I_F	Diode RMS forward current at T_C = 25 °C	20		A
I_{FSM}	Surge non repetitive forward current t_p = 10 ms sinusoidal	55		A
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external hea sink (t=1 s; T_C = 25 °C)	--	2500	V
P_{TOT}	Total dissipation at T_C = 25 °C	80	28	W
t_{scw}	Short circuit withstand time, V_{CE} = 0.5$V_{BR(CES)}$, T_C = 125 °C, R_G = 10 Ω, V_{GE} = 12 V	10		µs
T_j	Operating junction temperature	– 55 to 150		°C

1. Calculated according to the iterative formula

$$I_C(T_C) = \frac{T_{j(max)} - T_C}{R_{thj-c} \times V_{CE(sat)(max)}(T_{j(max)}, I_C(T_C))}$$

2. Vclamp = 80% of V_{CES}, T_j =150 °C, R_G=10 Ω, V_{GE}=15 V
3. Pulse width limited by maximum junction temperature and turn-off within RBSOA

Table 3. Thermal data

Symbol	Parameter	Value		Unit
		TO-220/D²PAK	TO-220FP	
$R_{thj-case}$	Thermal resistance junction-case IGBT	1.56	4.5	°C/W
$R_{thj-case}$	Thermal resistance junction-case diode	2.2	5.6	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	62.5		°C/W

2 Electrical characteristics

(T_j =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= 1 mA	600			V
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE}= ±20 V			±100	nA
I_{CES}	Collector cut-off current (V_{GE} = 0)	V_{CE}= 600 V V_{CE}= 600 V, T_j= 125 °C			150 1	µA mA
$V_{GE(th)}$	Gate threshold voltage	V_{CE}= V_{GE}, I_C= 250 µA	4.5		6.5	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE}= 15 V, I_C= 7 A V_{GE}= 15 V, I_C= 7 A, T_j= 125 °C		2.1 1.8	2.5	V V
g_{fs} (1)	Forward transconductance	V_{CE} = 15 V , I_C = 7 A		3.2		S

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

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} = 25 V, f = 1 MHz, V_{GE}= 0	-	760 86 15.5	-	pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 390 V, I_C = 7 A, V_{GE} = 15 V *(see Figure 19)*	-	34.4 8.1 16.4	-	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} = 390 V, I_C = 7 A R_G= 10 Ω, V_{GE}= 15 V, *(see Figure 18)*	-	22.5 8.5 700	-	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} = 390 V, I_C = 7 A R_G= 10 Ω, V_{GE}= 15 V, T_j= 125 °C *(see Figure 18)*	-	22 9.5 680	-	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} = 390 V, I_C = 7 A, R_{GE} = 10 Ω, V_{GE} = 15 V *(see Figure 18)*	-	60 116 75	-	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} = 390 V, I_C = 7 A, R_{GE} = 10 Ω, V_{GE} = 15 V T_j= 125 °C *(see Figure 18)*	-	24 196 144	-	ns ns ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
Eon (1) E_{off} (2) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 390 V, I_C = 7 A R_G= 10 Ω, V_{GE}= 15 V, *(see Figure 18)*	-	82 155 237	-	µJ µJ µJ
Eon (1) E_{off} (2) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 390 V, I_C = 7 A R_G= 10 Ω, V_{GE}= 15 V, T_j= 125 °C *(see Figure 18)*	-	131 370 501	-	µJ µJ µJ

1. Eon is the turn-on losses when a typical diode is used in the test circuit. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs and 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 = 7 A I_F = 7 A, T_C= 125 °C		1.8 1.3	2.1	V V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 7 A, V_R = 40 V, di/dt = 100 A/µs *(see Figure 21)*		37 40 2.1		ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 7 A, V_R = 40 V, T_j = 125 °C, di/dt = 100 A/µs *(see Figure 21)*		61 98 3.2		ns nC A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

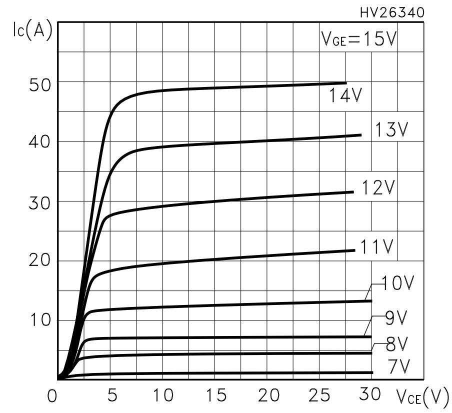


Figure 3. Transfer characteristics

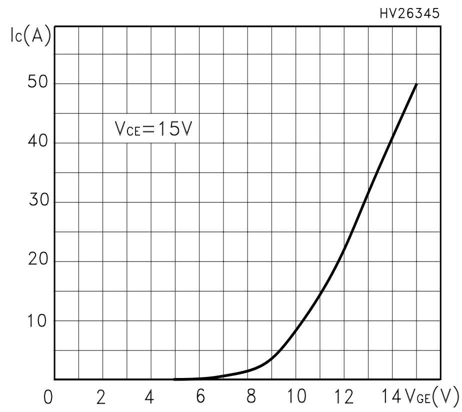


Figure 4. Transconductance

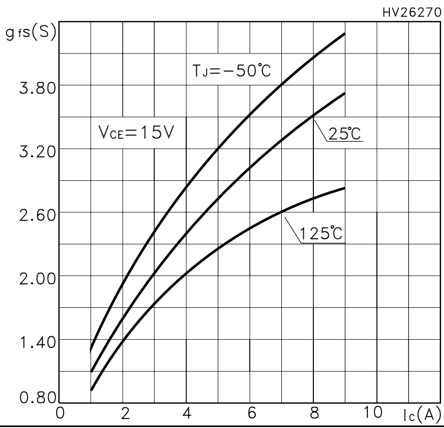


Figure 5. Collector-emitter on voltage vs temperature

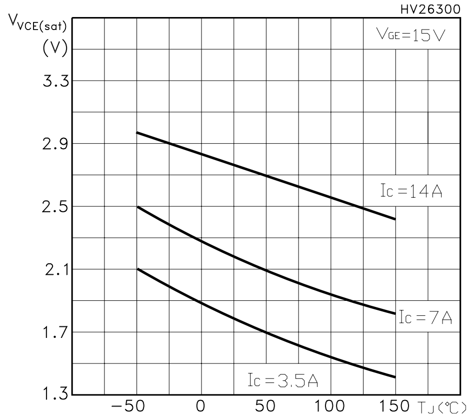


Figure 6. Collector-emitter on voltage vs collector current

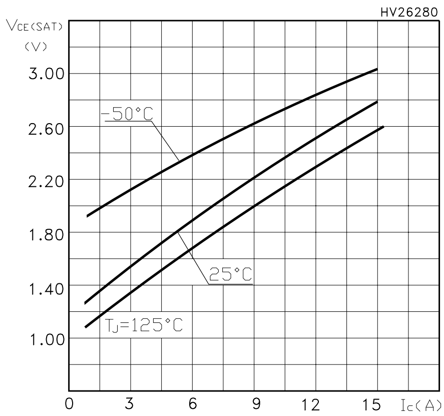


Figure 7. Normalized gate threshold vs temperature

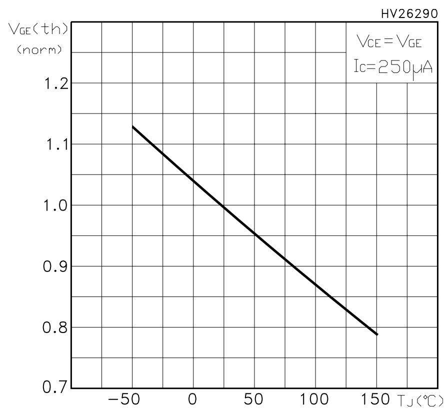


Figure 8. Normalized breakdown voltage vs temperature

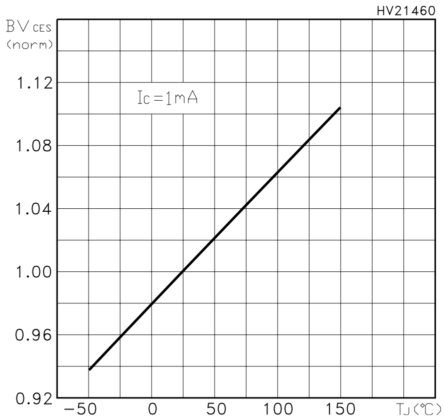


Figure 9. Gate charge vs gate-emitter voltage

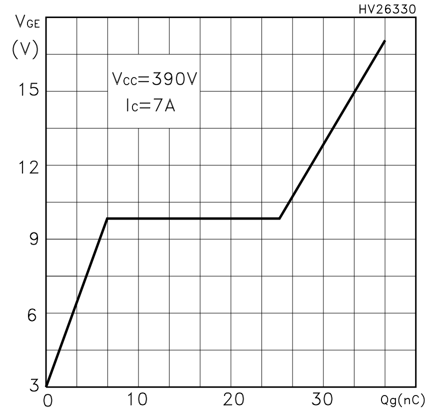


Figure 10. Capacitance variations

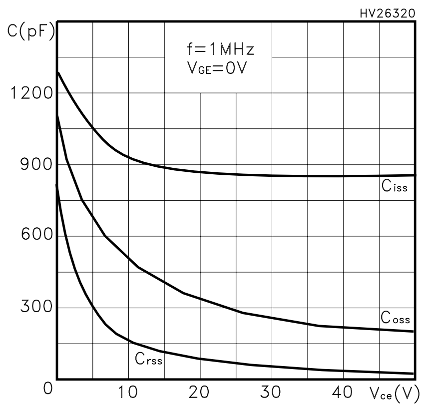


Figure 11. Switching losses vs temperature

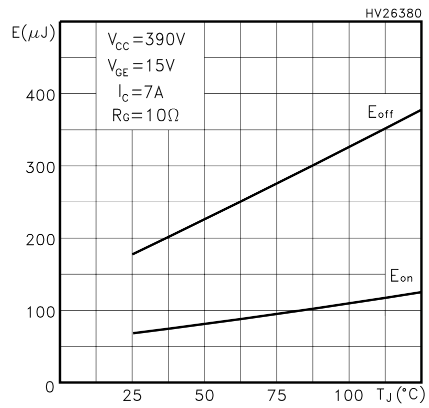


Figure 12. Switching losses vs gate resistance

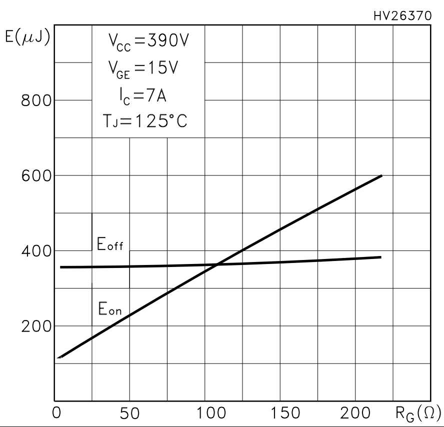


Figure 13. Switching losses vs collector current

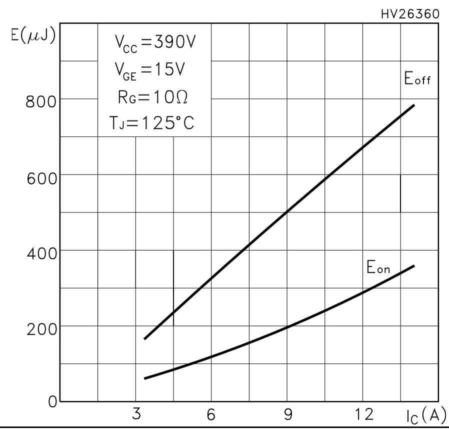


Figure 14. Thermal impedance for TO-220 and D^2PAK

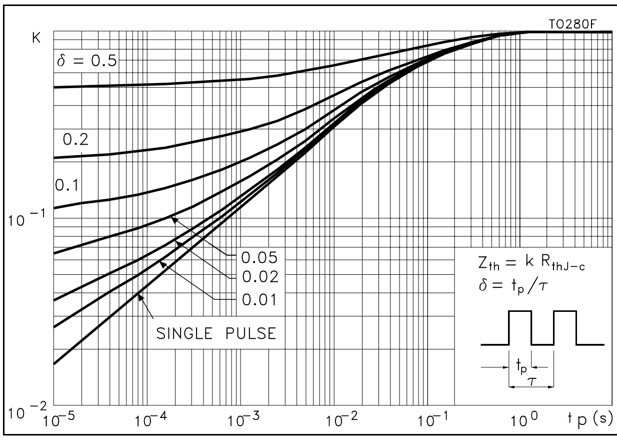


Figure 15. Turn-off SOA

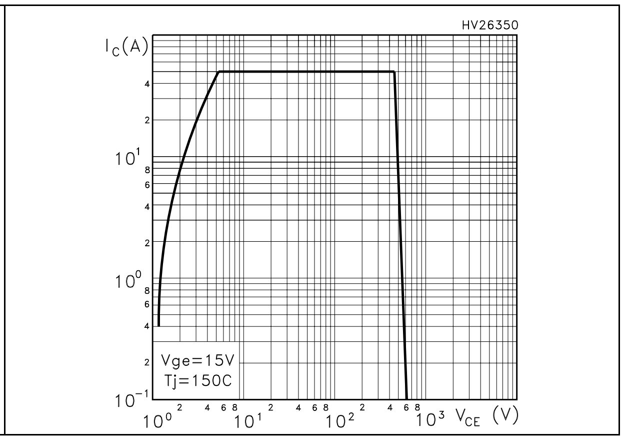


Figure 16. Thermal impedance for TO-220FP

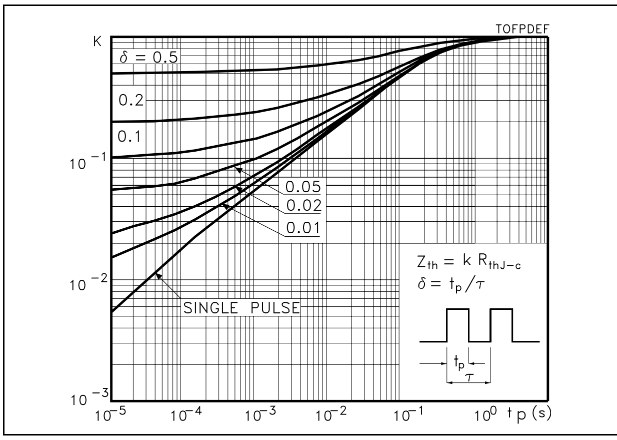
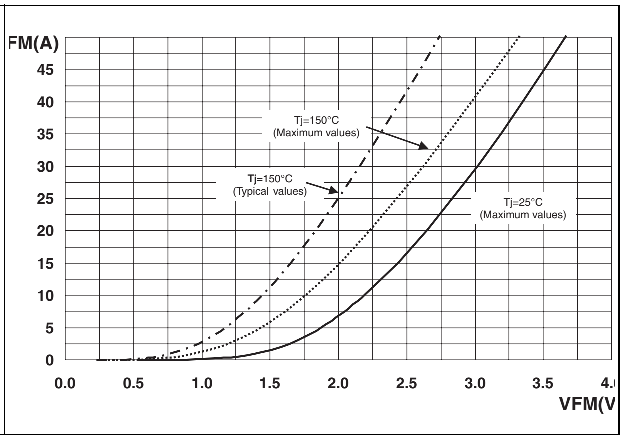


Figure 17. Forward voltage drop versus forward current



3 Test circuits

Figure 18. Test circuit for inductive load switching

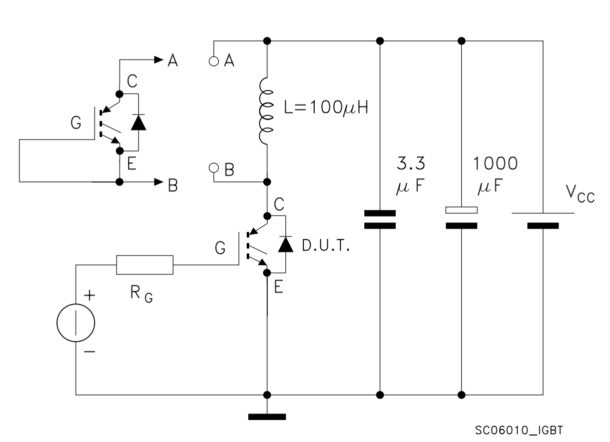


Figure 19. Gate charge test circuit

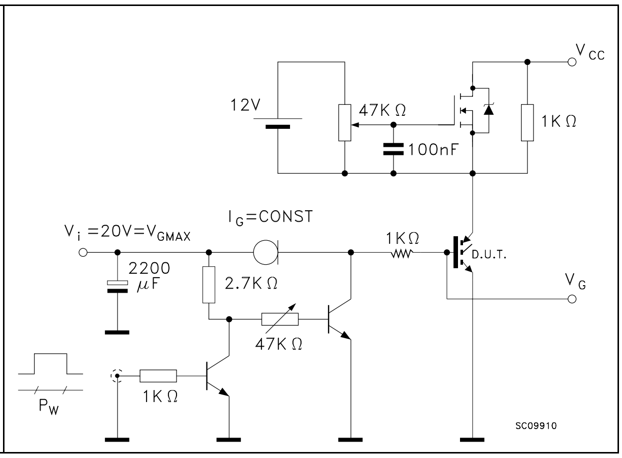


Figure 20. Switching waveforms

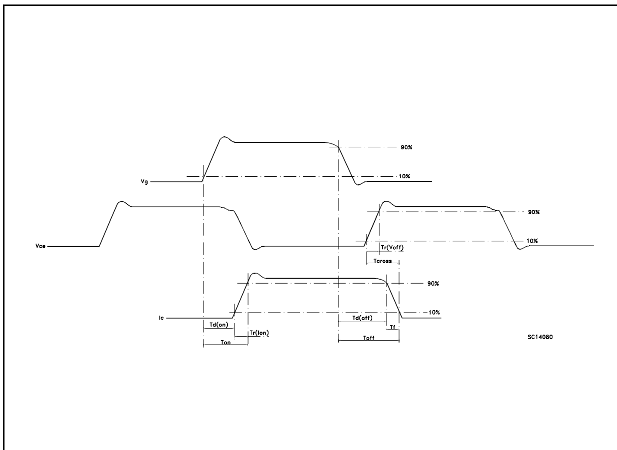
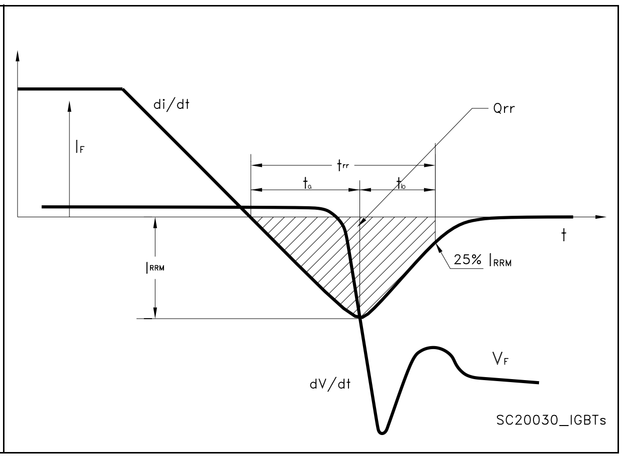


Figure 21. Diode recovery times waveform



4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

D^2PAK (TO-263) mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
A1	0.03		0.23	0.001		0.009
b	0.70		0.93	0.027		0.037
b2	1.14		1.70	0.045		0.067
c	0.45		0.60	0.017		0.024
c2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1	7.50			0.295		
E	10		10.40	0.394		0.409
E1	8.50			0.334		
e		2.54			0.1	
e1	4.88		5.28	0.192		0.208
H	15		15.85	0.590		0.624
J1	2.49		2.69	0.099		0.106
L	2.29		2.79	0.090		0.110
L1	1.27		1.40	0.05		0.055
L2	1.30		1.75	0.051		0.069
R		0.4			0.016	
V2	0°		8°	0°		8°

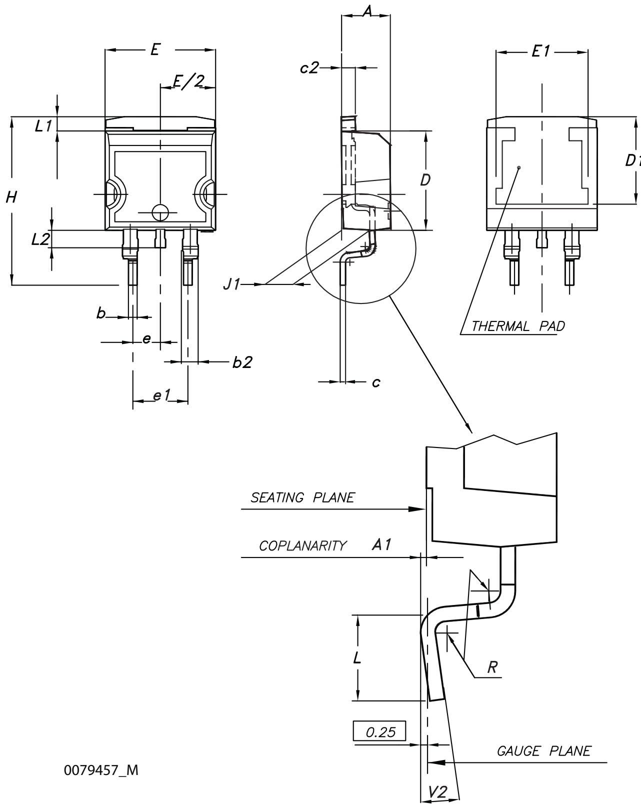
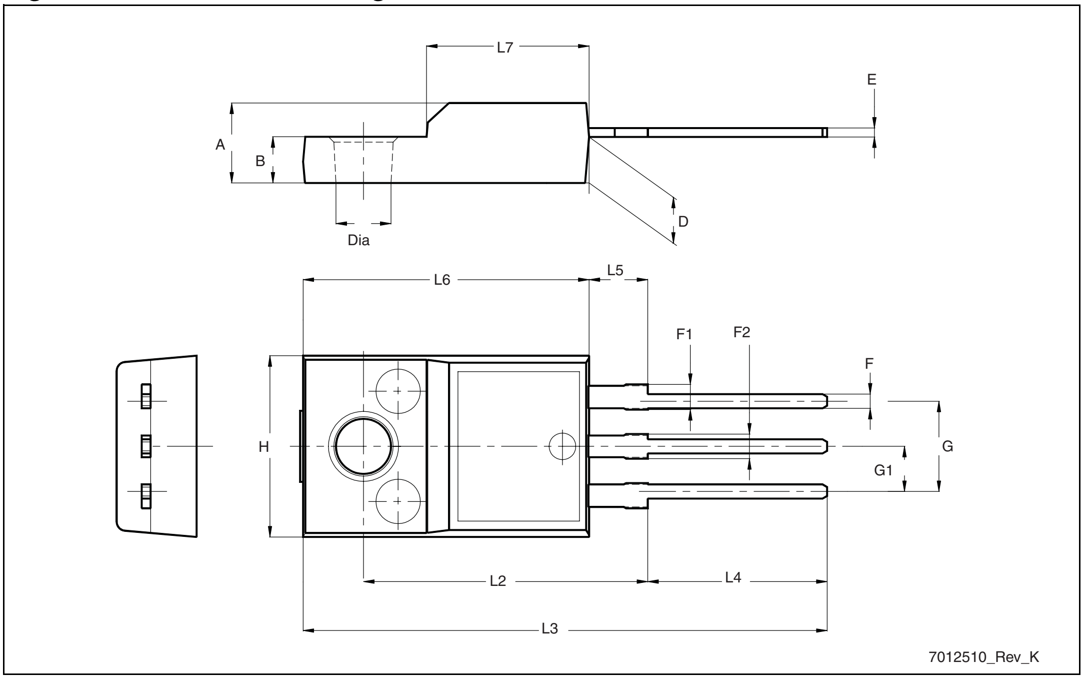


Table 9. TO-220FP mechanical data

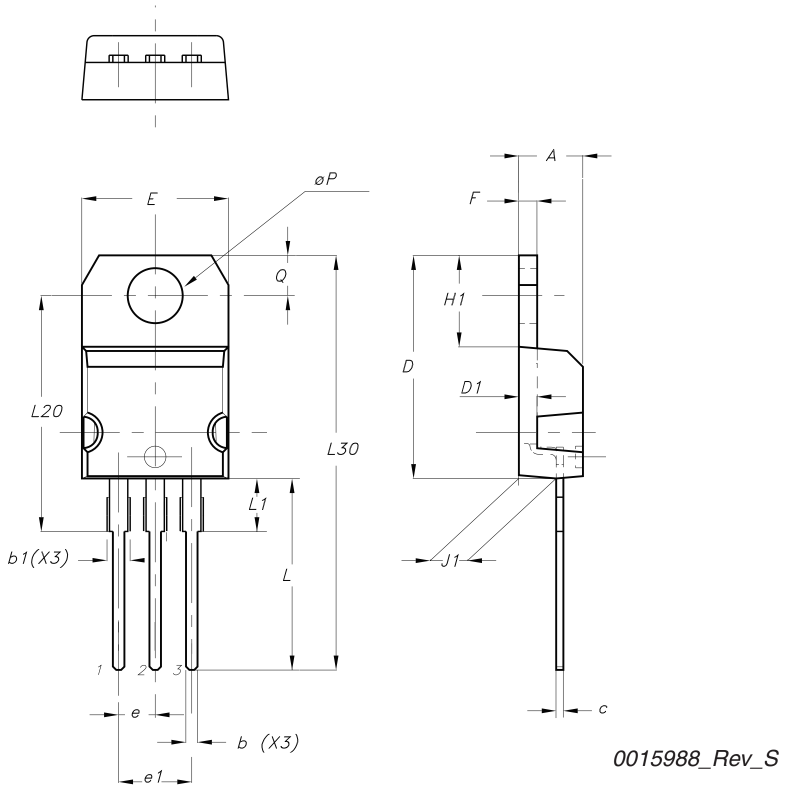
Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

Figure 22. TO-220FP drawing



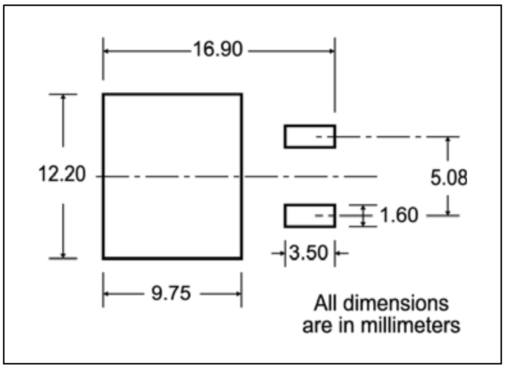
TO-220 type A mechanical data

Dim	mm		
	Min	Typ	Max
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
∅P	3.75		3.85
Q	2.65		2.95

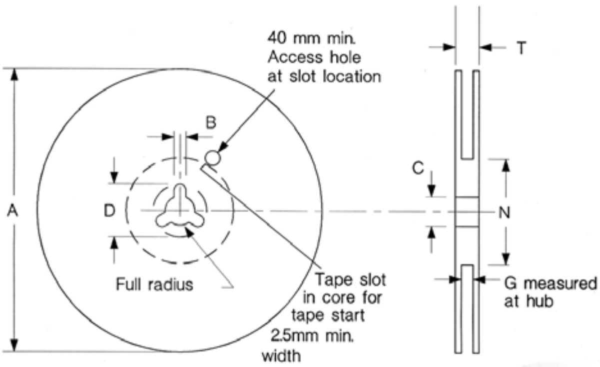


5 Packaging mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT



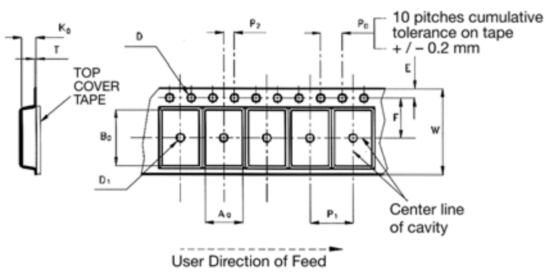
REEL MECHANICAL DATA

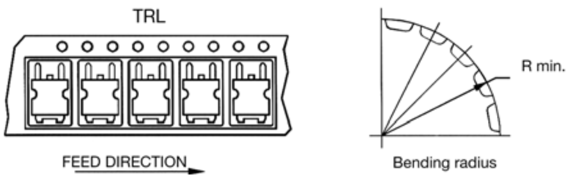
DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0795	
G	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

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 10. Document revision history

Date	Revision	Changes
14-Jun-2005	1	New release
05-Jul-2005	2	Complete version
22-Jul-2005	3	Value changed in table 6
27-Jan-2006	4	Inserted ecopack indication
28-Apr-2006	5	New template, modified curves *6* and *8*
02-Apr-2008	6	Modified test conditions on *Table 4*
15-Mar-2010	7	Updated packages mechanical data.