



# STGB10NB60S STGP10NB60S, STGP10NB60SFP

16 A, 600 V, low drop IGBT

## Features

- Low on-voltage drop ( $V_{CE(sat)}$ )
- High current capability

## Applications

- Light dimmer
- Static relays
- Motor drive

## Description

This IGBT utilizes the advanced Power MESH™ process featuring extremely low on-state voltage drop in low-frequency working conditions (up to 1 kHz).

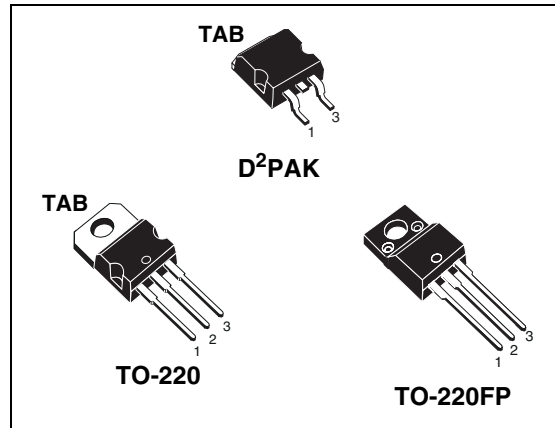


Figure 1. Internal schematic diagram

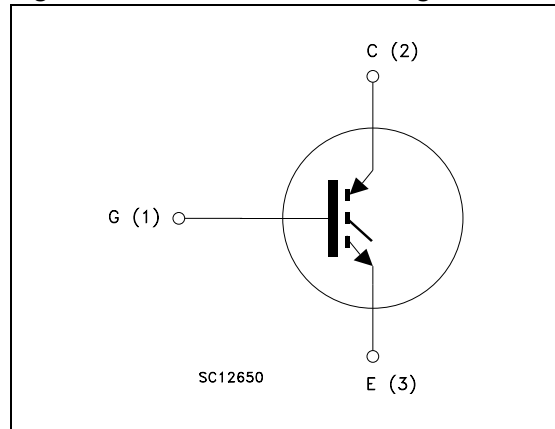


Table 1. Device summary

Order codes	Marking	Package	Packaging
STGB10NB60ST4	GB10NB60S	D <sup>2</sup> PAK	Tape and reel
STGP10NB60S	GP10NB60S	TO-220	Tube
STGP10NB60SFP	GP10NB60SFP	TO-220-FP	Tube

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		STGP10NB60SFP	STGB10NB60S STGP10NB60S	
$V_{CES}$	Collector-emitter voltage ( $V_{GE} = 0$ )	600		V
$I_C^{(1)}$	Continuous collector current at $T_C = 25\text{ °C}$	23	29	A
$I_C^{(1)}$	Continuous collector current at $T_C = 100\text{ °C}$	12	16	A
$I_{CL}^{(2)}$	Turn-off latching current	20		A
$I_{CP}^{(3)}$	Pulsed collector current	80		A
$V_{GE}$	Gate-emitter voltage	±20		V
$V_{ISO}$	Isolation withstand voltage (RMS) from all three leads to external heat sink ( $t=1\text{ s}$ ; $T_C = 25\text{ °C}$ )	2500		V
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	25	80	W
$T_j$	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.  $V_{clamp} = 80\%$  of  $V_{CES}$ ,  $T_j = 150\text{ °C}$ ,  $R_G = 1\text{ k}\Omega$ ,  $V_{GE} = 15\text{ V}$

3. Pulse width limited by maximum junction temperature and turn-off within RBSOA

**Table 3. Thermal data**

Symbol	Parameter	Value		Unit
		STGP10NB60SFP	STGB10NB60S STGP10NB60S	
$R_{thj-case}$	Thermal resistance junction-case	5	1.56	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	62.5		°C/W

## 2 Electrical characteristics

( $T_j = 25\text{ °C}$  unless otherwise specified)

**Table 4. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ( $V_{GE} = 0$ )	$I_C = 250\ \mu\text{A}$	600			V
$V_{(BR)ECS}$	Emitter-collector breakdown voltage ( $V_{GE} = 0$ )	$I_C = 1\ \text{mA}$	20			V
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\ \text{V}$			$\pm 100$	nA
$I_{CES}$	Collector cut-off current ( $V_{GE} = 0$ )	$V_{CE} = 600\ \text{V}$ $V_{CE} = 600\ \text{V}, T_j = 125\text{ °C}$			10 100	$\mu\text{A}$ $\mu\text{A}$
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 250\ \mu\text{A}$	2.5		5	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\ \text{V}, I_C = 5\ \text{A}$ $V_{GE} = 15\ \text{V}, I_C = 10\ \text{A}$ $V_{GE} = 15\ \text{V}, I_C = 10\ \text{A}, T_j = 125\text{ °C}$		1.15 1.35 1.25	1.75	V
$g_{fs}^{(1)}$	Forward transconductance	$V_{CE} = 15\ \text{V}, I_C = 10\ \text{A}$	5			S

1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\ \text{V}, f = 1\ \text{MHz}, V_{GE} = 0$	-	610	-	pF
$C_{oes}$	Output capacitance			65		pF
$C_{res}$	Reverse transfer capacitance			12		pF
$Q_g$	Total gate charge	$V_{CE} = 400\ \text{V}, I_C = 10\ \text{A},$ $V_{GE} = 15\ \text{V}$ (see Figure 18)	-	33	-	nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 480\text{ V}$ , $I_C = 10\text{ A}$	-	0.7	-	$\mu\text{s}$
$t_r$	Current rise time	$R_G = 1\text{ k}\Omega$ , $V_{GE} = 15\text{ V}$	-	0.46	-	$\mu\text{s}$
$(di/dt)_{on}$	Turn-on current slope	(see Figure 17)	-	8	-	$\text{A}/\mu\text{s}$
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 480\text{ V}$ , $I_C = 10\text{ A}$	-	2.2	-	$\mu\text{s}$
$t_{d(off)}$	Turn-off delay time	$R_G = 1\text{ k}\Omega$ , $V_{GE} = 15\text{ V}$	-	1.2	-	$\mu\text{s}$
$t_f$	Current fall time	(see Figure 17)	-	1.2	-	$\mu\text{s}$
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 480\text{ V}$ , $I_C = 10\text{ A}$	-	3.8	-	$\mu\text{s}$
$t_{d(off)}$	Turn-off delay time	$R_G = 1\text{ k}\Omega$ , $V_{GE} = 15\text{ V}$ , $T_j = 125\text{ }^\circ\text{C}$	-	1.2	-	$\mu\text{s}$
$t_f$	Current fall time	(see Figure 17)	-	1.9	-	$\mu\text{s}$

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 480\text{ V}$ , $I_C = 10\text{ A}$	-	0.6	-	$\mu\text{J}$
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 1\text{ k}\Omega$ , $V_{GE} = 15\text{ V}$	-	5	-	$\mu\text{J}$
$E_{ts}$	Total switching losses	(see Figure 17)	-	5.6	-	$\mu\text{J}$
$E_{off}^{(2)}$	Turn-off switching losses	$V_{CC} = 480\text{ V}$ , $I_C = 10\text{ A}$ $R_G = 1\text{ k}\Omega$ , $V_{GE} = 15\text{ V}$ , $T_j = 125\text{ }^\circ\text{C}$	-	8	-	$\mu\text{J}$
		(see Figure 17)				

1.  $E_{on}$  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.

## 2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

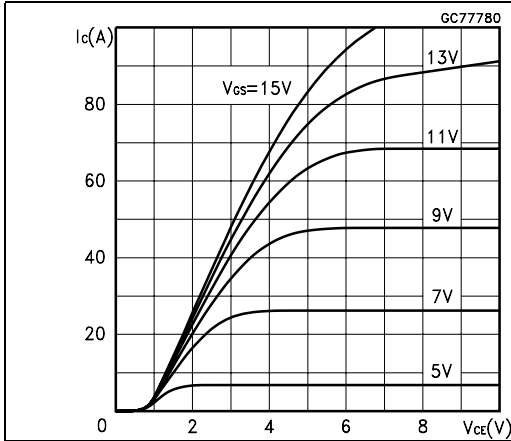


Figure 3. Transfer characteristics

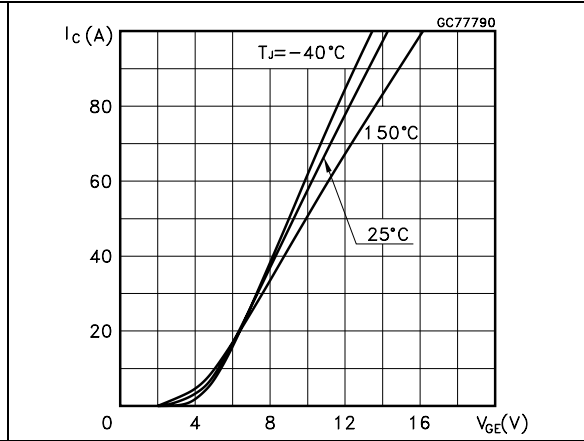


Figure 4. Transconductance

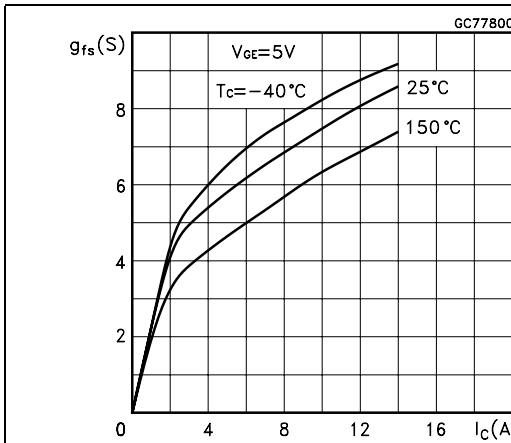


Figure 5. Collector-emitter on voltage vs temperature

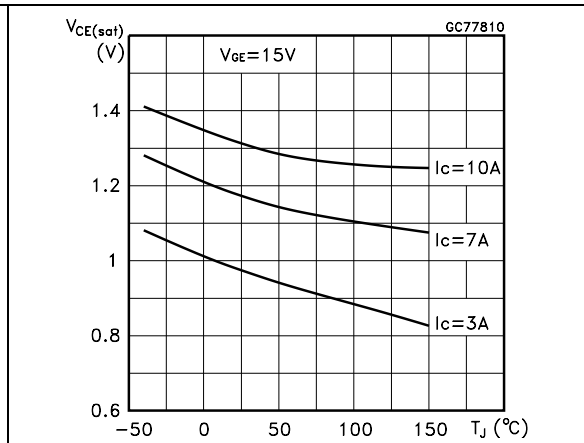


Figure 6. Collector-emitter on voltage vs collector current

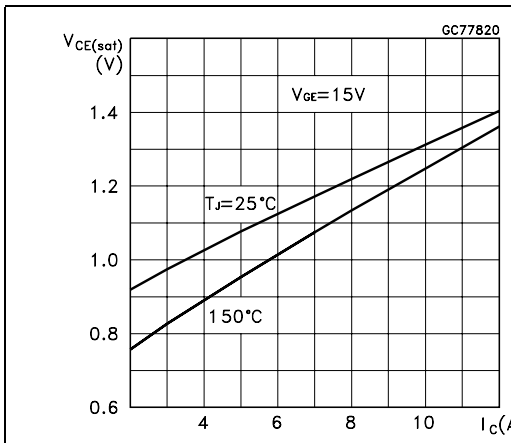


Figure 7. Normalized gate threshold vs temperature

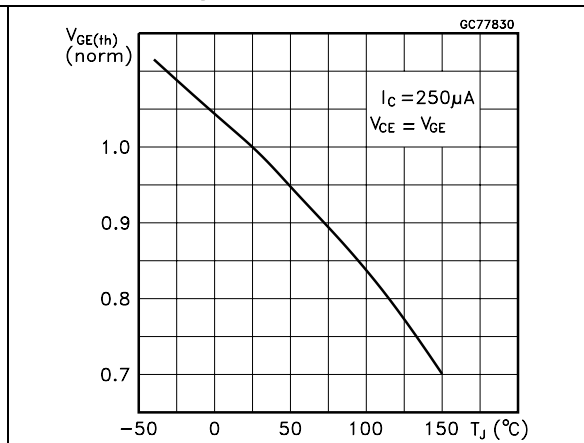


Figure 8. Normalized breakdown voltage vs temperature

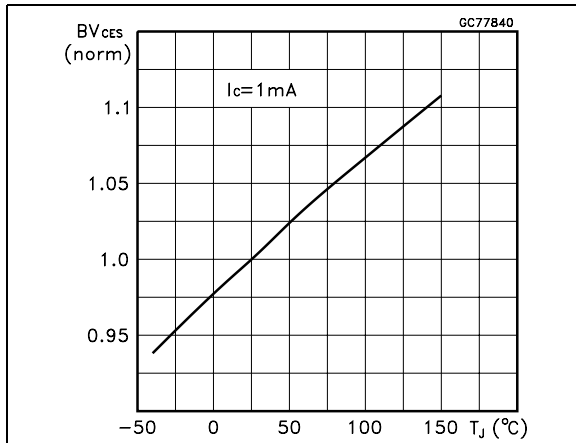


Figure 9. Gate charge vs gate-emitter voltage

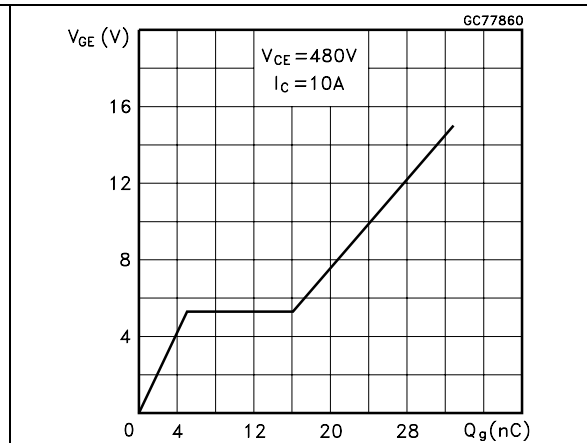


Figure 10. Capacitance variations

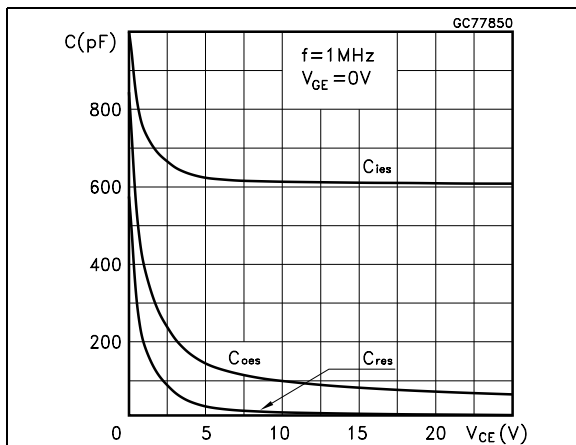


Figure 11. Switching losses vs temperature

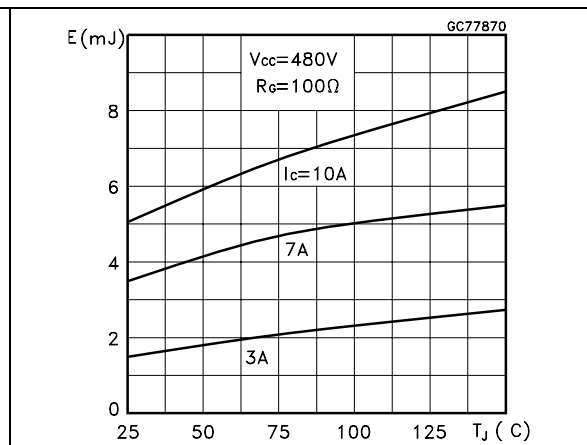


Figure 12. Switching losses vs gate resistance

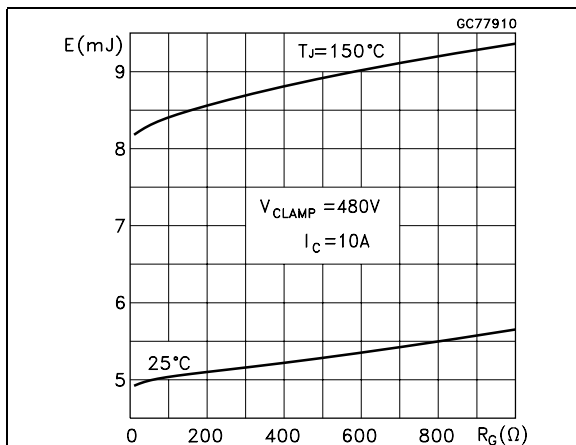


Figure 13. Switching losses vs collector current

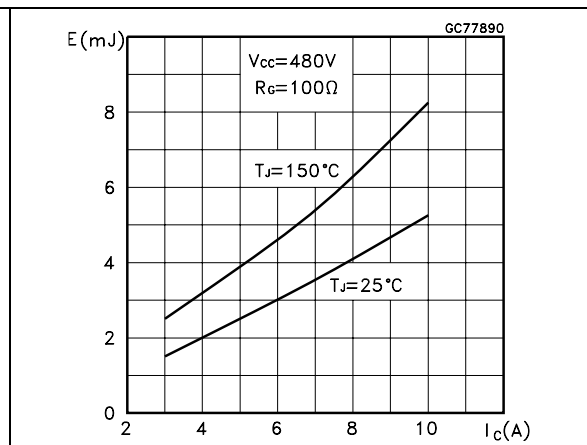


Figure 14. Thermal impedance for TO-220 and D<sup>2</sup>PAK      Figure 15. Thermal impedance for TO-220FP

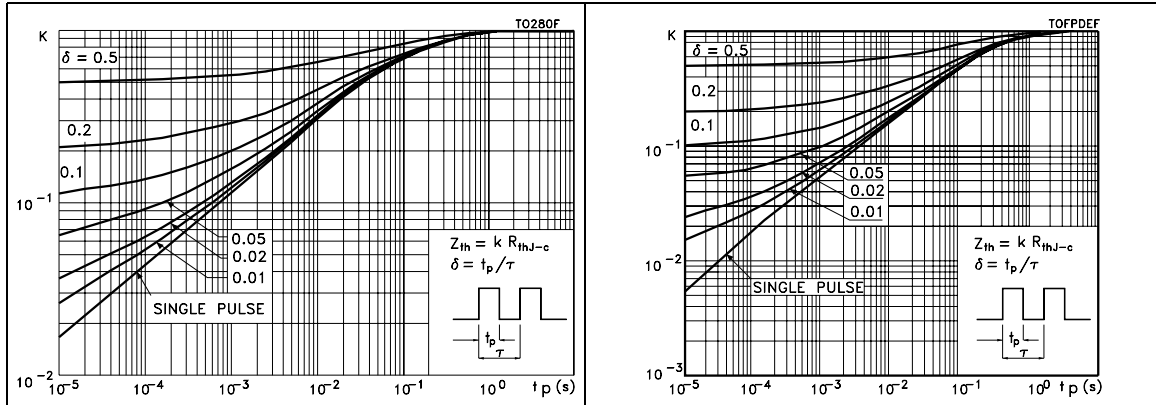
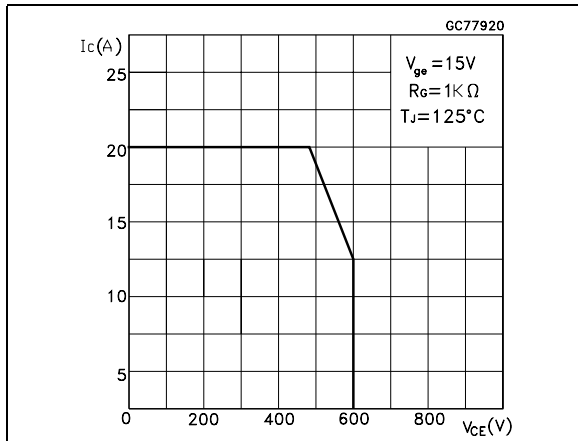


Figure 16. Turn-off SOA





### 3 Test circuits

Figure 17. Test circuit for inductive load switching

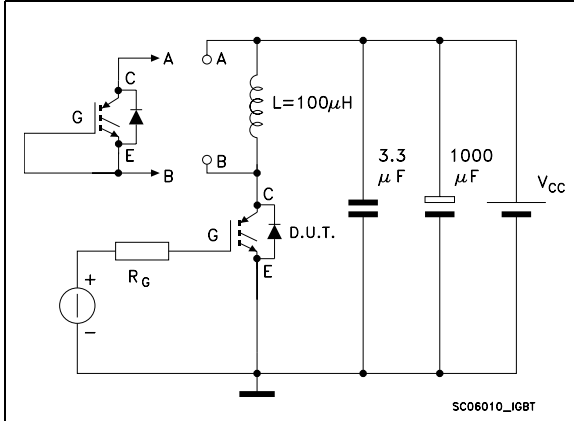


Figure 18. Gate charge test circuit

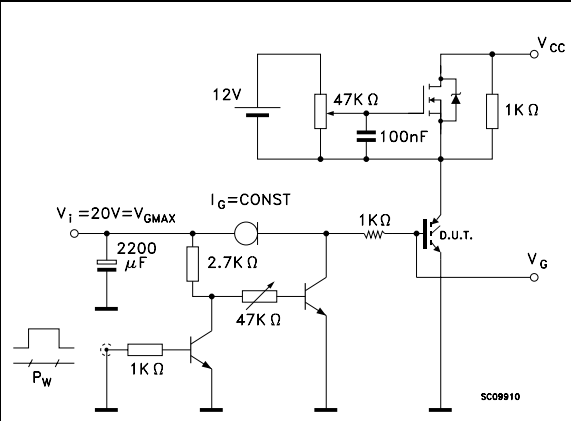
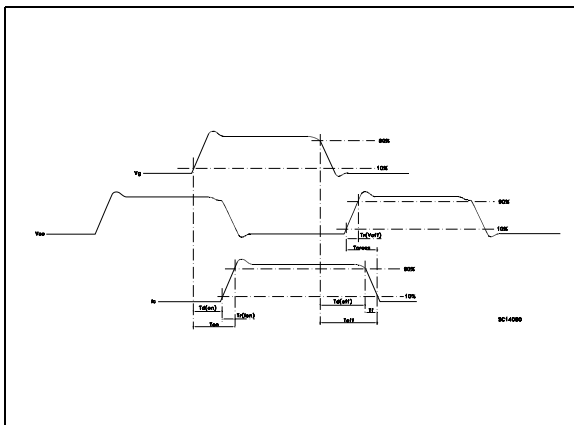


Figure 19. Switching waveforms



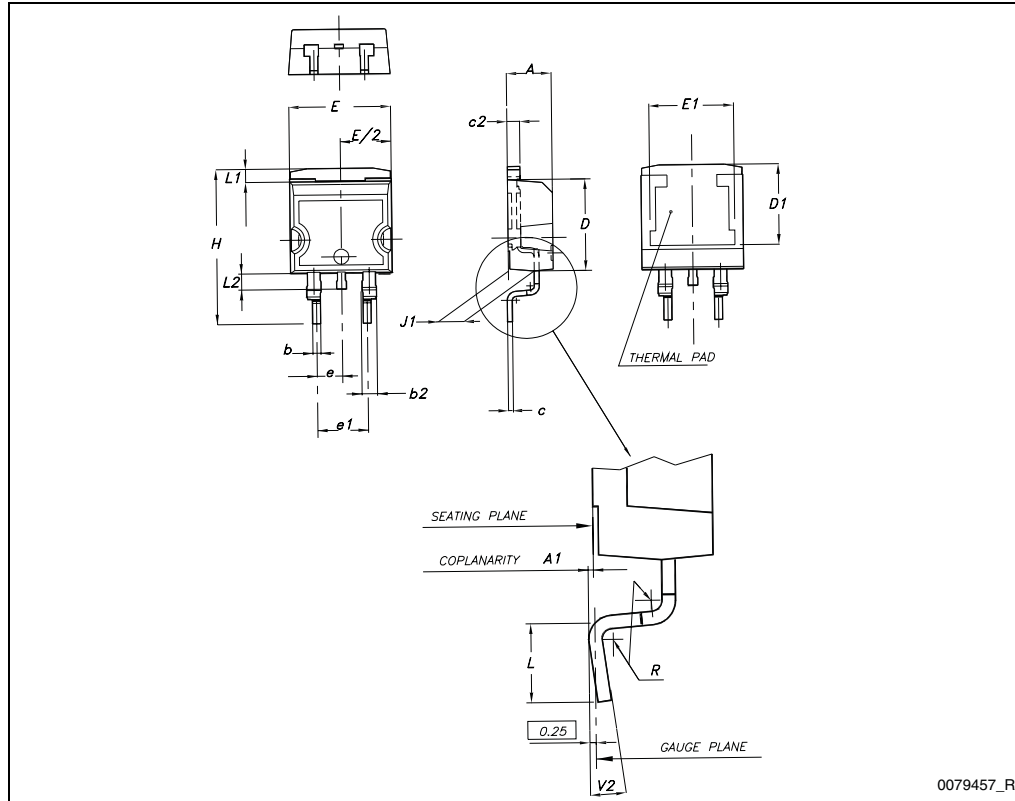
## 4 Package mechanical data

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

Table 8. D<sup>2</sup>PAK (TO-263) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50		
E	10		10.40
E1	8.50		
e		2.54	
e1	4.88		5.28
H	15		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°

Figure 20. D<sup>2</sup>PAK (TO-263) drawing



0079457\_R

Table 9. 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	
ØP	3.75		3.85
Q	2.65		2.95

Figure 21. TO-220 type A drawing

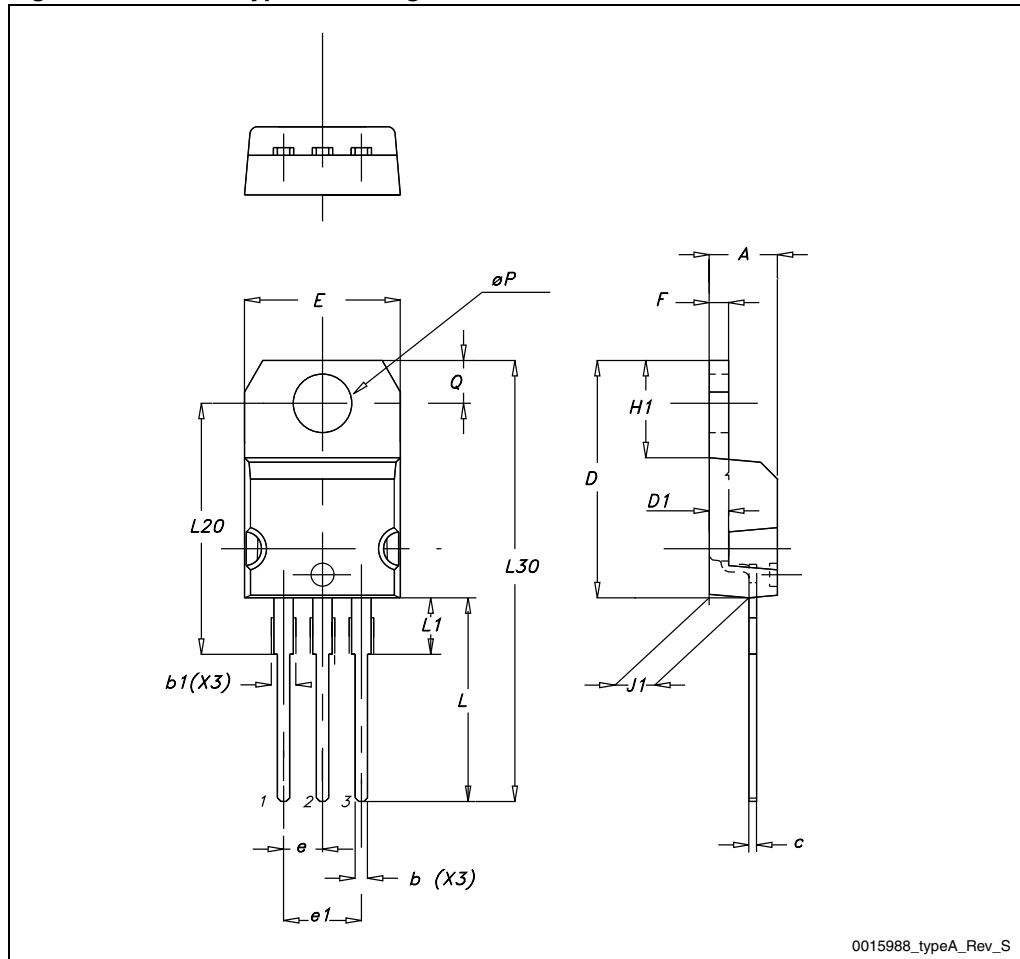
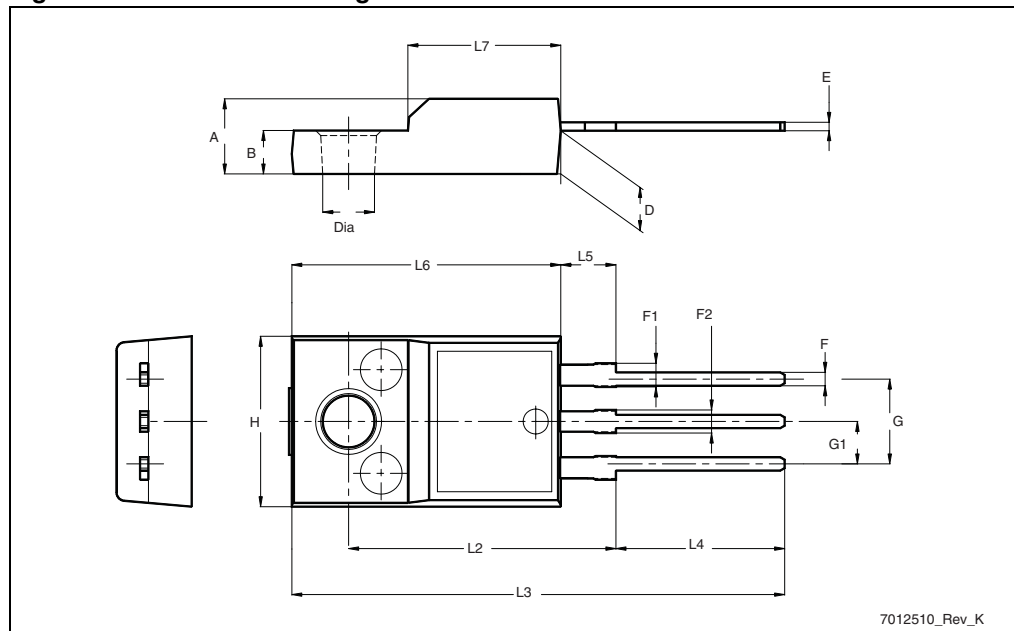


Table 10. TO-220FP mechanical data

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

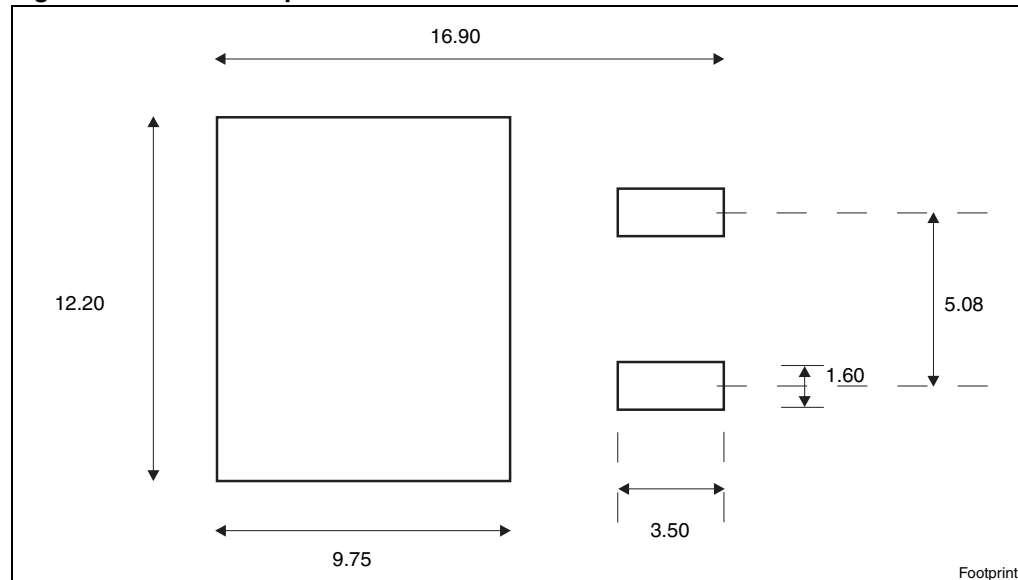


## 5 Packaging mechanical data

Table 11. D<sup>2</sup>PAK (TO-263) tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1		Base qty	1000
P2	1.9	2.1		Bulk qty	1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

Figure 23. D<sup>2</sup>PAK footprint (a)



a. All dimension are in millimeters.



Figure 24. Tape

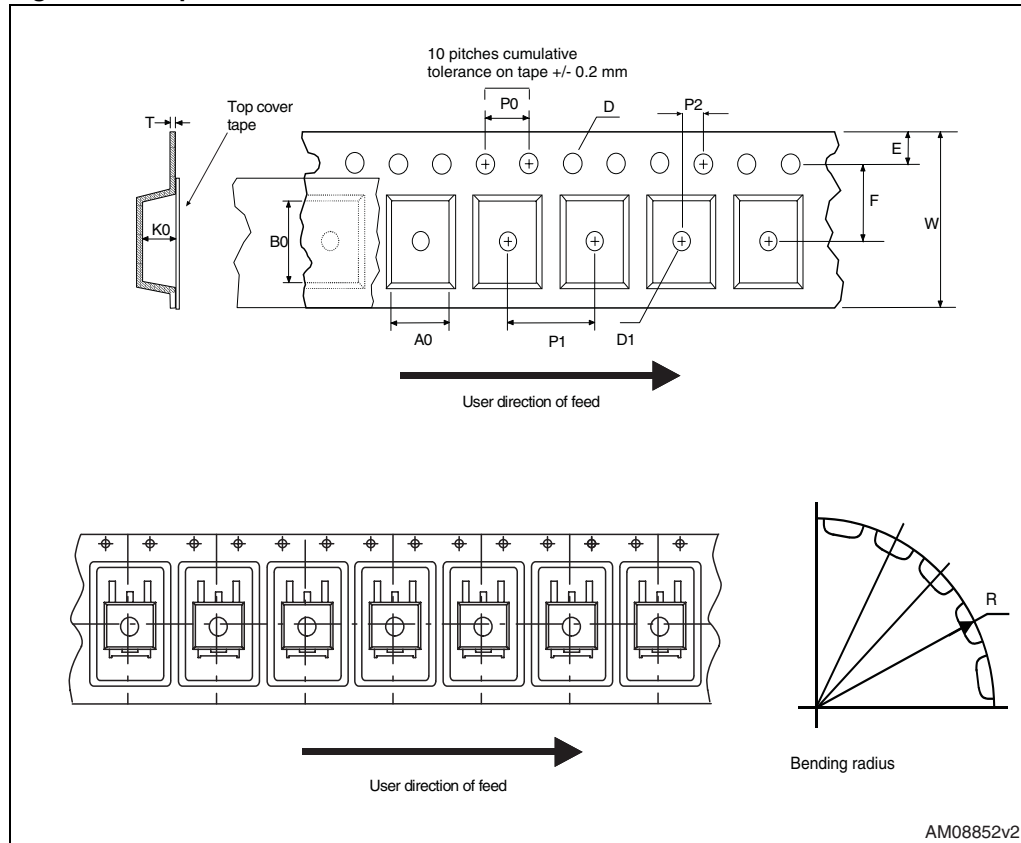
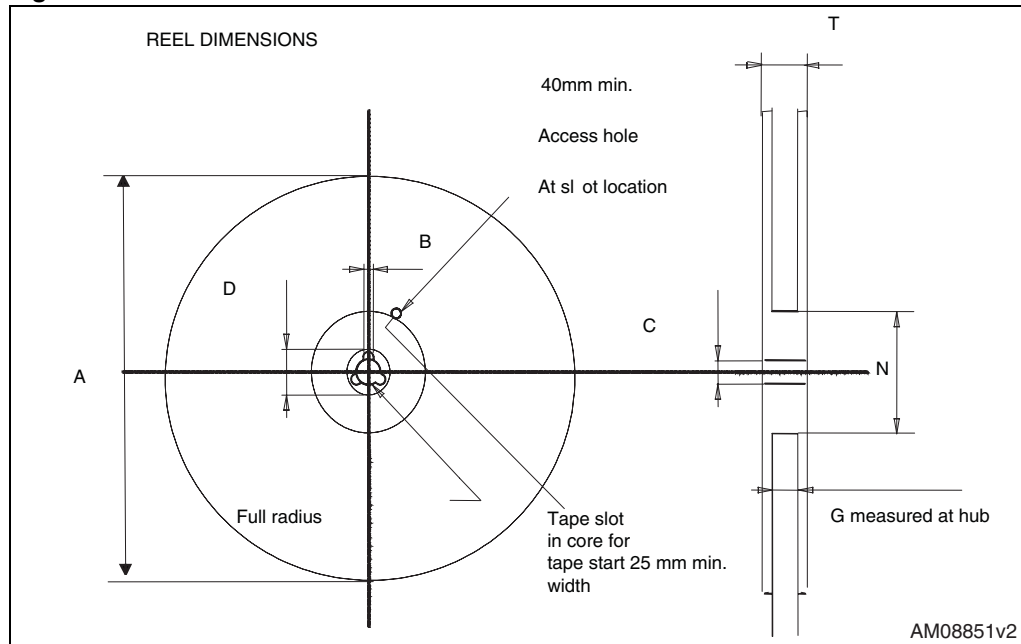


Figure 25. Reel



## 6 Revision history

**Table 12. Document revision history**

Date	Revision	Changes
10-Nov-2004	1	New release.
28-Feb-2005	2	Some values changed in <a href="#">Table 4: Static</a> .
16-Dec-2010	3	Updated <a href="#">Table 2: Absolute maximum ratings</a> . Updated mechanical data <a href="#">Section 4: Package mechanical data</a> .

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