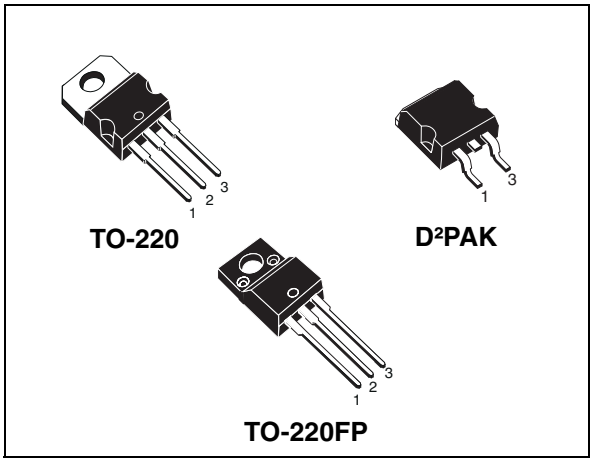
STGB19NC60KD, STGF19NC60KD, STGP19NC60KD

20 A, 600 V short-circuit rugged IGBT

Datasheet – production data

Features

- Low on-voltage drop ($V_{CE(sat)}$)
- Low C_{res} / C_{ies} ratio (no cross conduction susceptibility)
- Short circuit withstand time 10 µs
- IGBT co-packaged with Ultrafast free-wheeling diode



Applications

- High frequency inverters
- 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

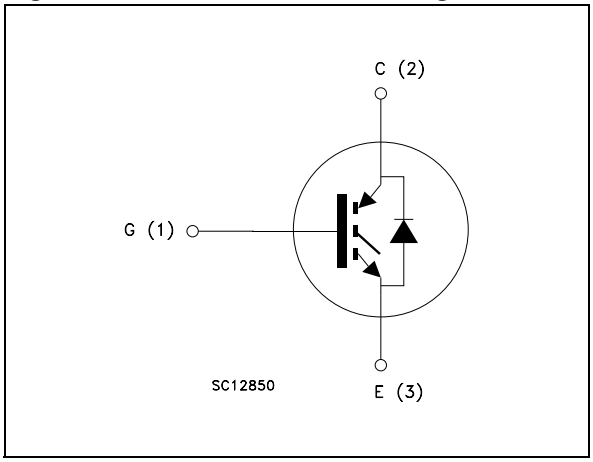


Table 1. Device summary

Order codes	Marking	Packages	Packaging
STGB19NC60KDT4	GB19NC60KD	D^2PAK	Tape and reel
STGF19NC60KD	GF19NC60KD	TO-220FP	Tube
STGP19NC60KD	GP19NC60KD	TO-220	Tube

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D²PAK TO-220	TO-220FP	
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	600		V
I_C (1)	Collector current (continuous) at T_C = 25 °C	35	16	A
I_C (1)	Collector current (continuous) at T_C = 100 °C	20	10	A
I_{CL} (2)	Turn-off latching current	75		A
I_{CP} (3)	Pulsed collector current	75		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	50		A
P_{TOT}	Total dissipation at T_C = 25 °C	125	32	W
t_{scw}	Short circuit withstand time, V_{CE} = 0.5 $V_{(BR)CES}$ T_j = 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:

$$I_c(T_c) = \frac{T_{J(MAX)} - T_c}{R_{thj-c} \times V_{CE(sat)(MAX)} \cdot (T_c, I_c)}$$

2. V_{clamp} = 80%,(V_{CES}), T_j =150°C, R_G = 10 Ω, V_{GE} = 15 V
3. Pulse width limited by max. junction temperature allowed

Table 3. Thermal resistance

Symbol	Parameter	Value		Unit
		D²PAK TO-220	TO-220FP	
$R_{thj\text{-}case}$	Thermal resistance junction-case IGBT max.	0.95	3.9	°C/W
	Thermal resistance junction-case diode max.	3	5.6	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max.	62.5		°C/W

2 Electrical characteristics

(T_{CASE} = 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
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 12 A V_{GE} = 15 V, I_C = 12 A, Tc = 125 °C		2.0 1.65	2.75	V V
I_{CES}	Collector cut-off current (V_{GE} = 0)	V_{CE} = 600 V V_{CE} = 600 V, T_C = 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
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE} = ±20 V			±100	nA
g_{fs} (1)	Forward transconductance	V_{CE} = 15 V , I_C = 12 A		15		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		1170 127 28		pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 480 V, I_C = 12 A, V_{GE} = 15 V *(see Figure 21)*		55 11 26		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} = 480 V, I_C = 12 A R_G = 10 Ω, V_{GE} = 15 V, *(see Figure 20)*		30 8 1450		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} = 480 V, I_C = 12 A R_G = 10 Ω, V_{GE} = 15 V, T_c = 125 °C *(see Figure 20)*		30 8 1380		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} = 480 V, I_C = 12 A R_G = 10 Ω, V_{GE} = 15 V, *(see Figure 20)*		35 105 85		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} = 480 V, I_C = 12 A, R_G = 10 Ω, V_{GE} = 15 V T_c = 125 °C *(see Figure 20)*		65 145 125		ns ns ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
Eon E_{off} (1) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 480 V, I_C = 12 A R_G = 10 Ω, V_{GE} = 15 V, *(see Figure 20)*		165 255 420		µJ µJ µJ
Eon E_{off} (1) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 480 V, I_C = 12 A R_G = 10 Ω, V_{GE} = 15 V, T_C = 125 °C *(see Figure 20)*		250 445 695		µJ µJ µJ

1. 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 = 12 A I_F = 12 A, T_c = 125 °C		1.9 1.6		V V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 12 A,V_R = 40 V, di/dt = 100 A/µs *(see Figure 23)*		31 30 2		ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 12 A,V_R = 40 V, T_c =125 °C, di/dt = 100 A/µs *(see Figure 23)*		50 70 4		ns nC A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

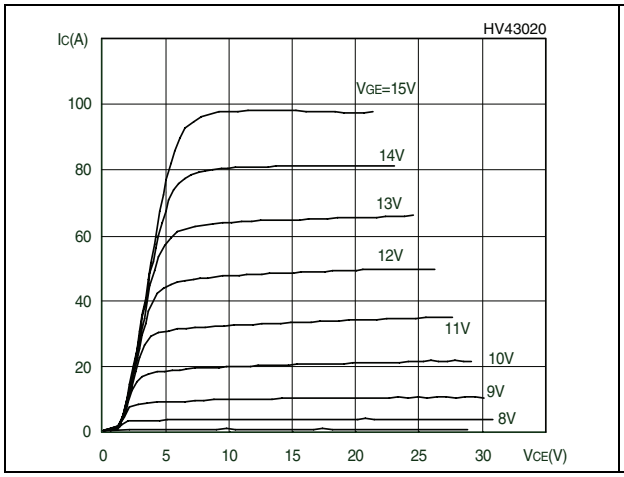


Figure 3. Transfer characteristics

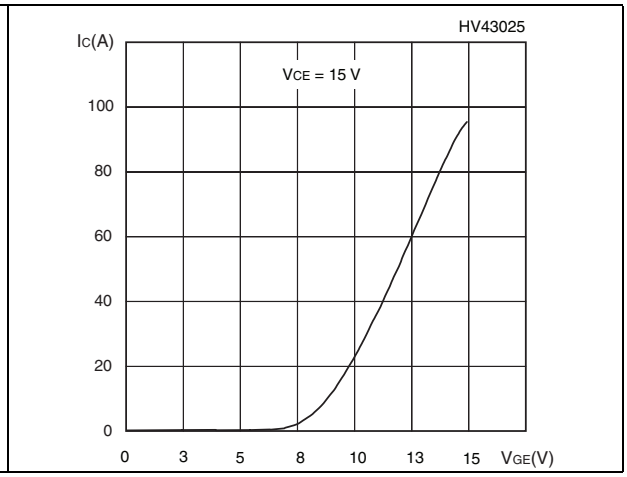


Figure 4. Transconductance

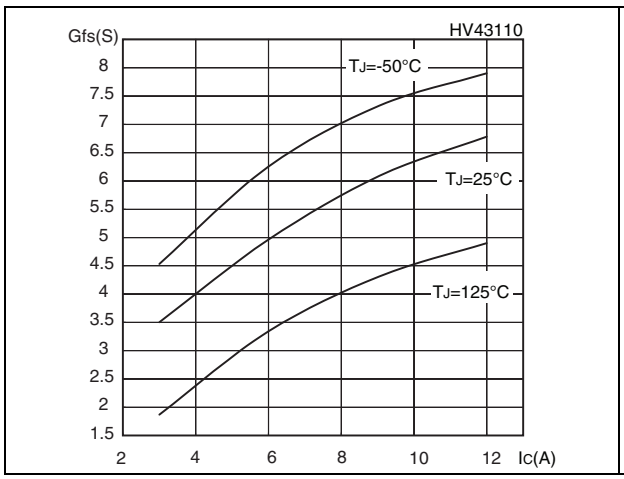


Figure 5. Collector-emitter on voltage vs. temperature

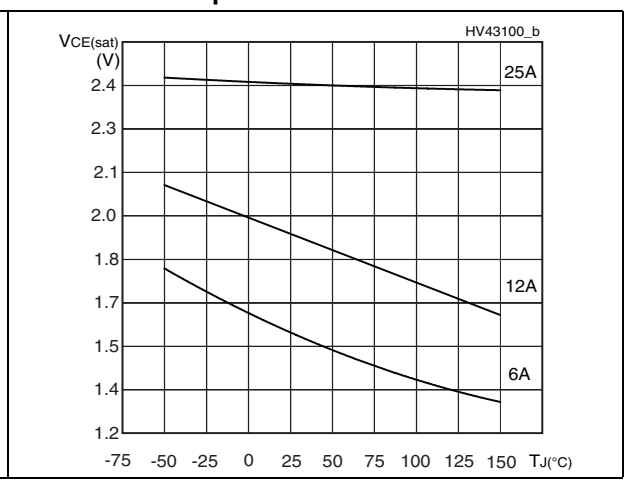


Figure 6. Gate charge vs. gate-source voltage

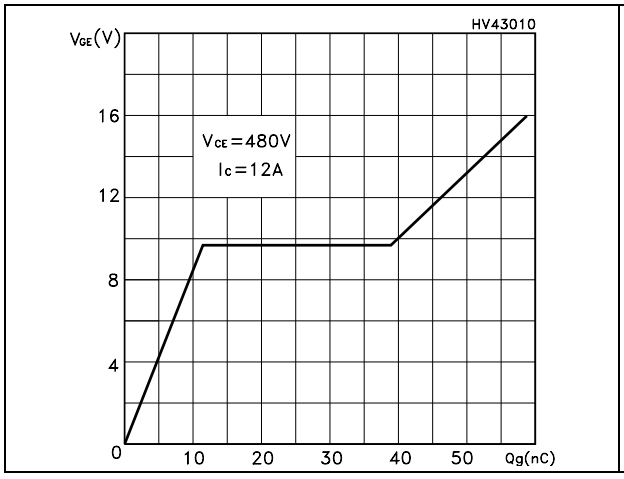


Figure 7. Capacitance variations

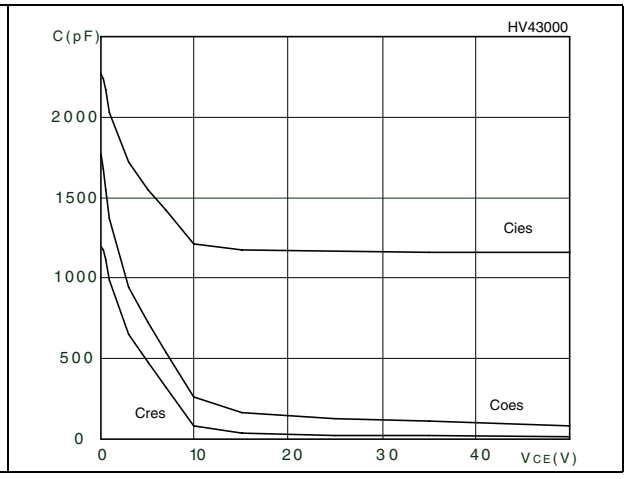


Figure 8. Normalized gate threshold voltage vs. temperature

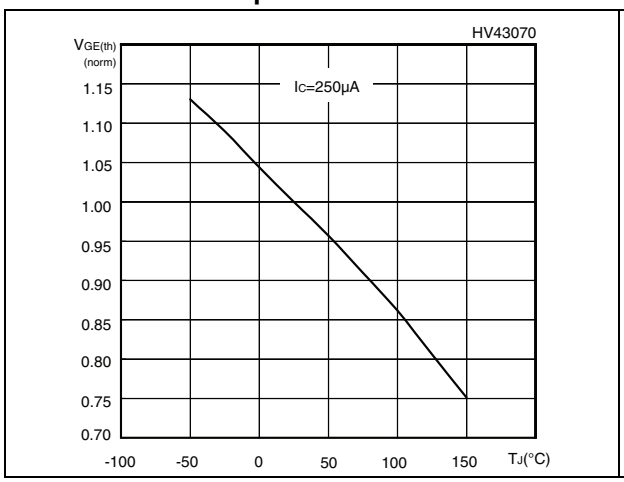


Figure 9. Collector-emitter on voltage vs. collector current

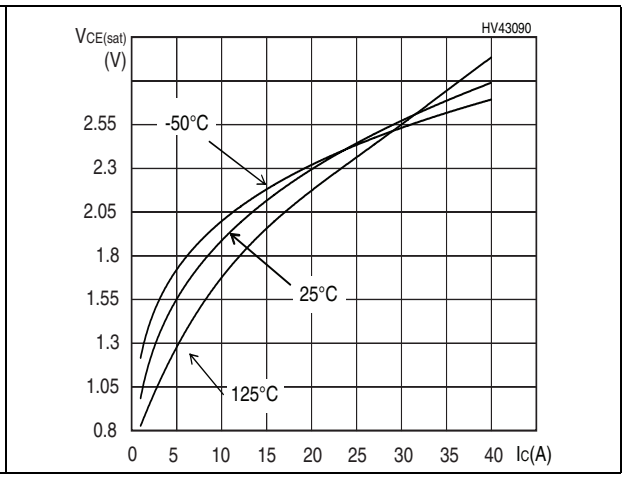


Figure 10. Normalized breakdown voltage vs. temperature

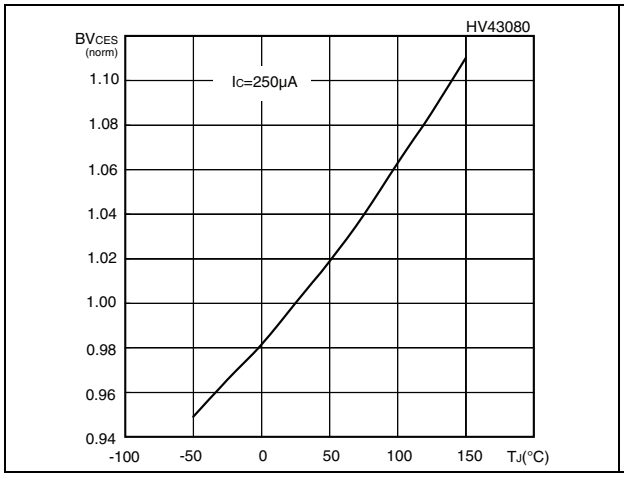


Figure 11. Switching losses vs. temperature

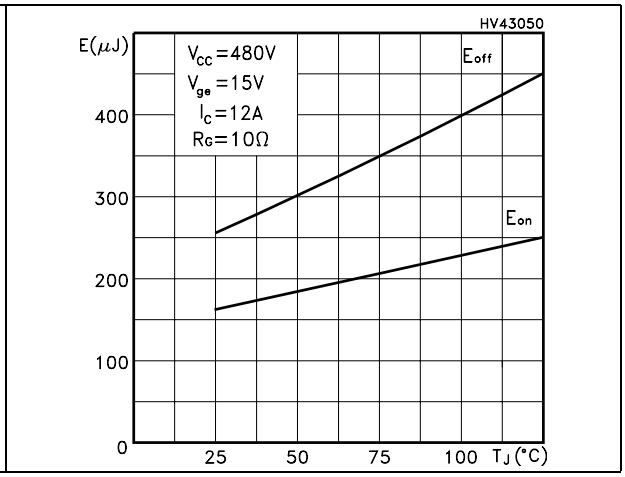


Figure 12. Switching losses vs. gate resistance

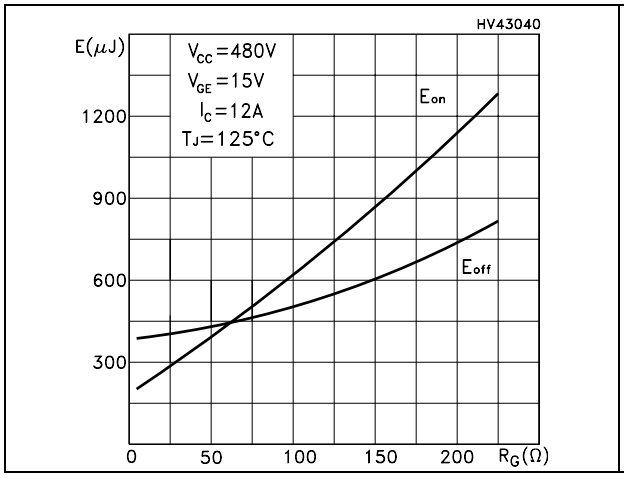


Figure 13. Switching losses vs. collector current

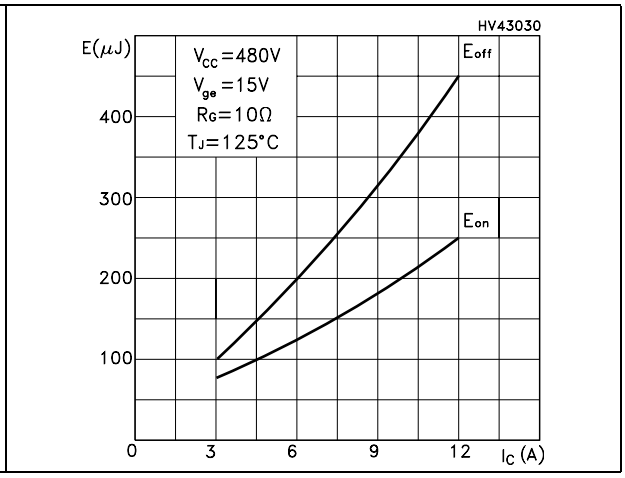


Figure 14. Turn-off SOA

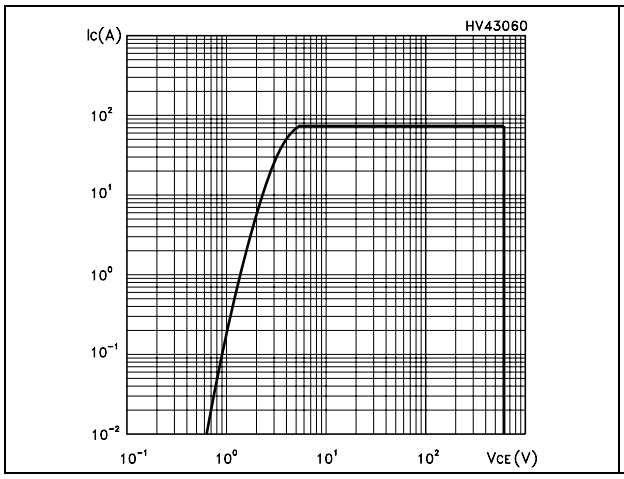


Figure 15. Emitter-collector diode characteristics

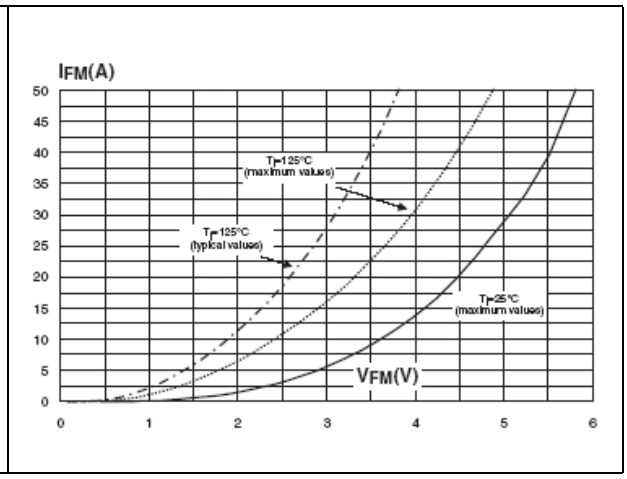


Figure 16. Thermal impedance for TO-220, D²PAK

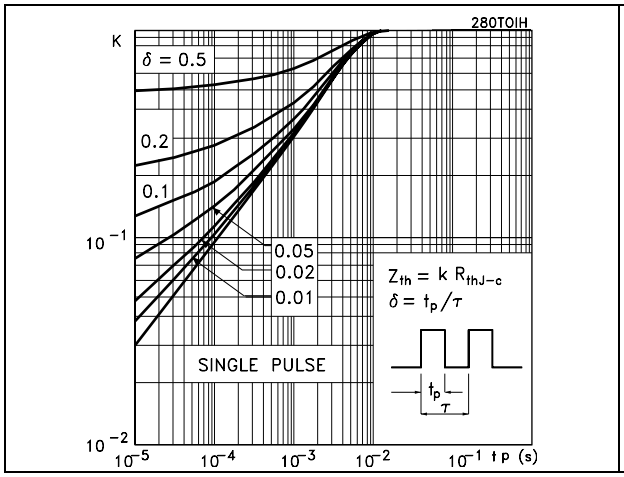


Figure 17. Thermal impedance for TO-220FP

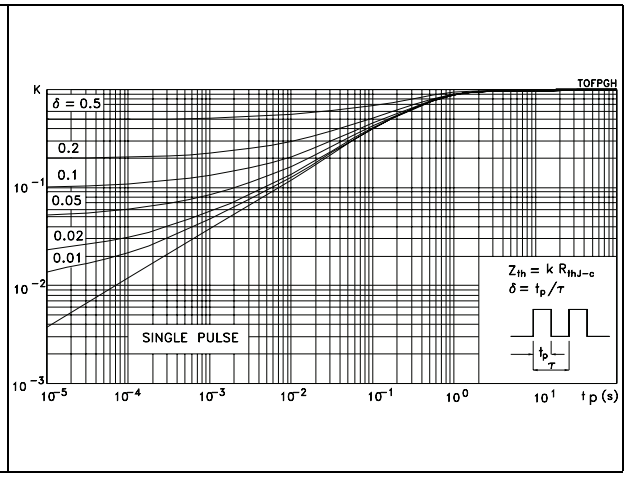


Figure 18. Maximum DC collector current vs. T_{CASE} for TO-220FP

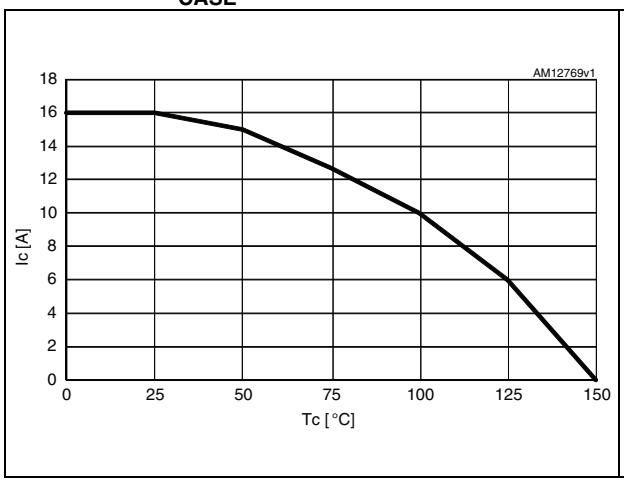
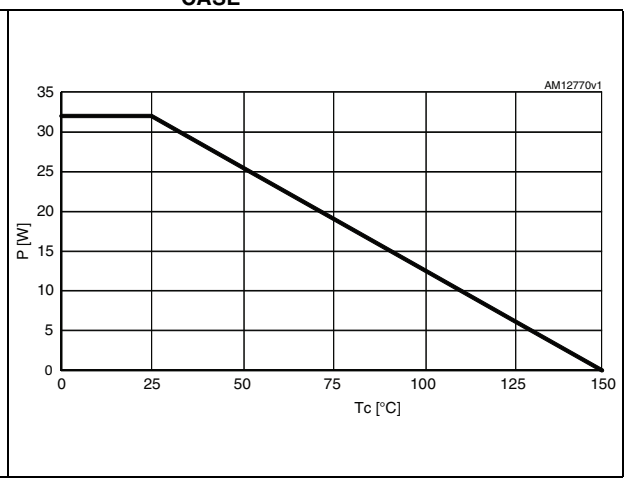


Figure 19. Maximum power dissipation vs. T_{CASE} for TO-220FP



3 Test circuits

Figure 20. Test circuit for inductive load switching

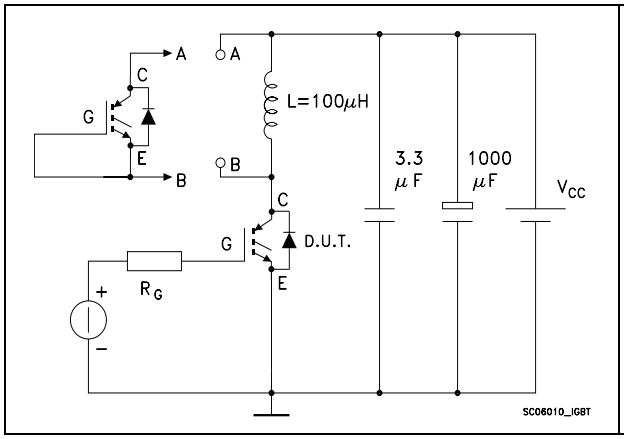


Figure 21. Gate charge test circuit

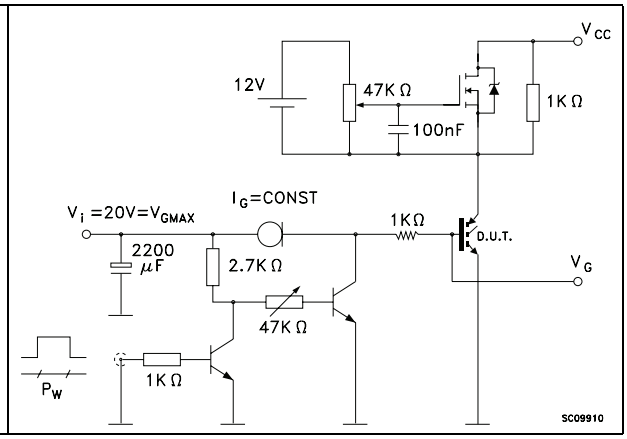


Figure 22. Switching waveforms

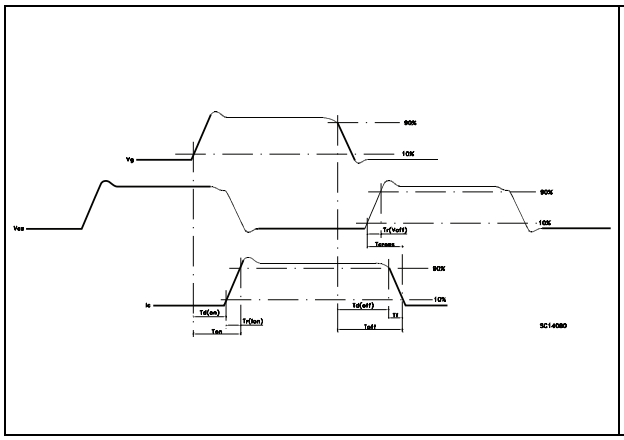
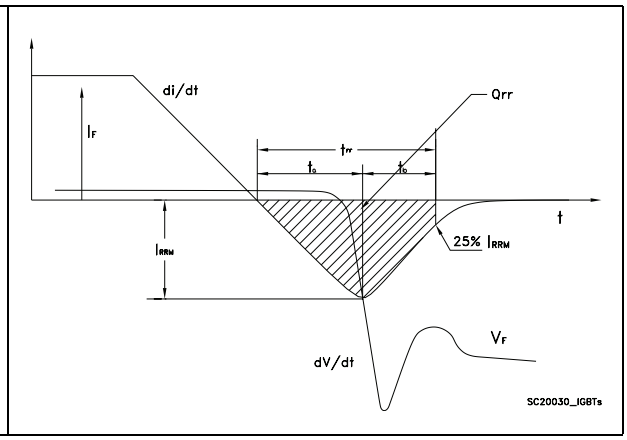


Figure 23. Diode recovery times waveform



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.

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	0.48		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	
∅P	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116

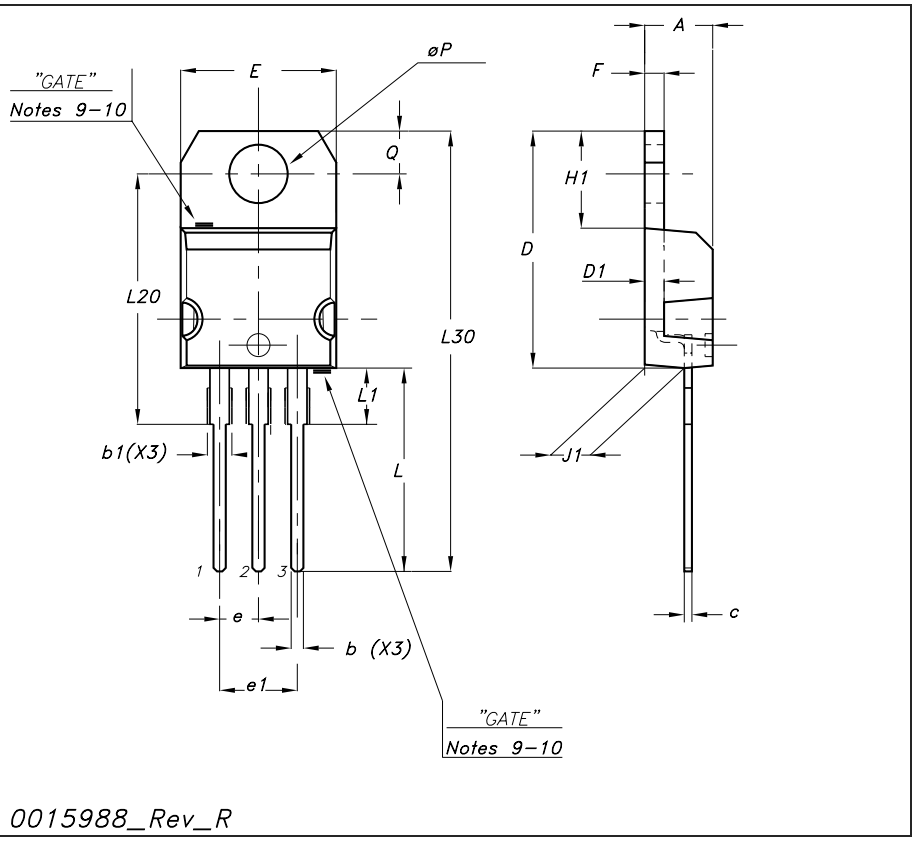


Table 9. TO-220FP mechanical data

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 24. TO-220FP drawing

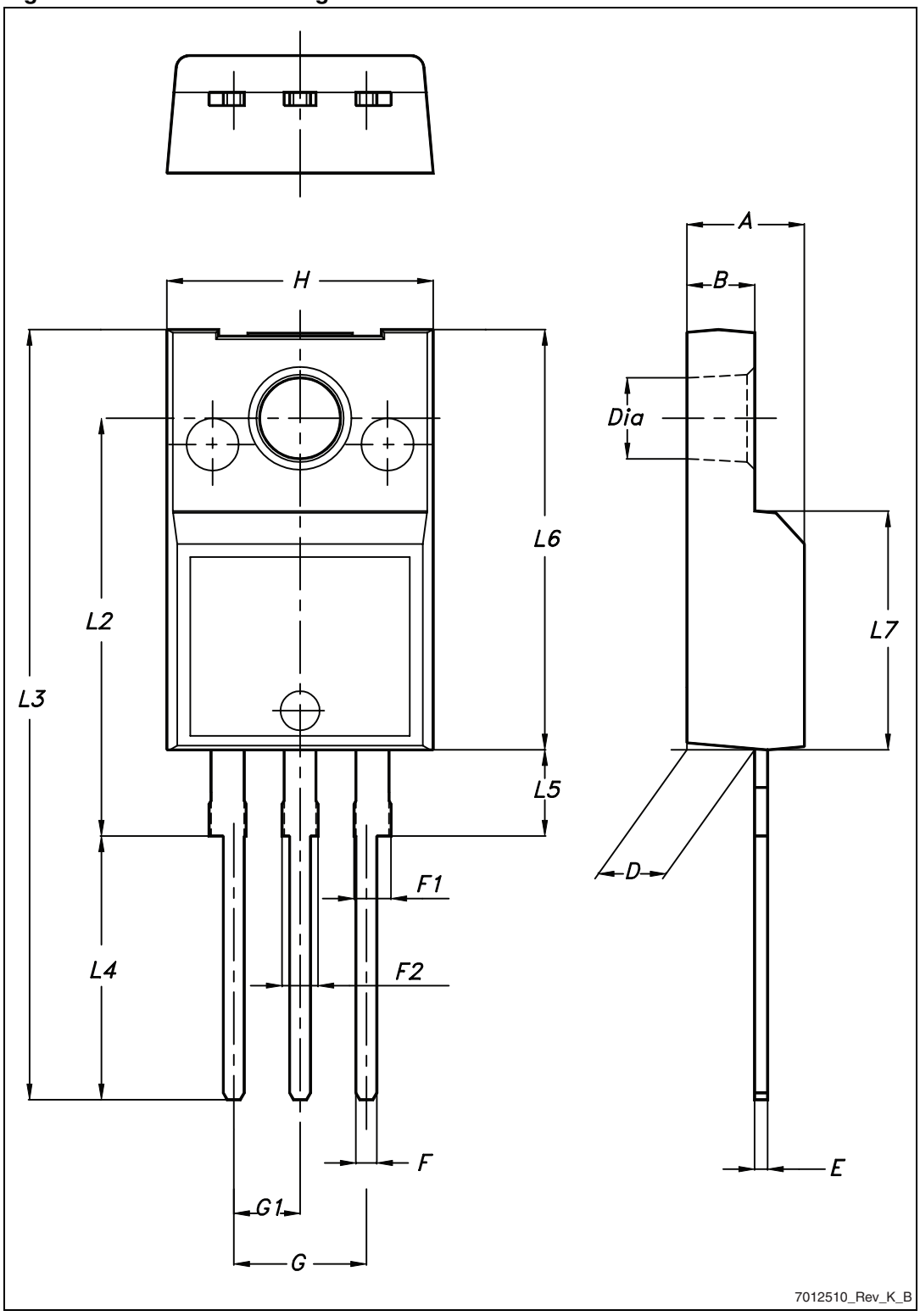


Table 10. D²PAK (TO-263) mechanical data

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 25. D²PAK (TO-263) drawing

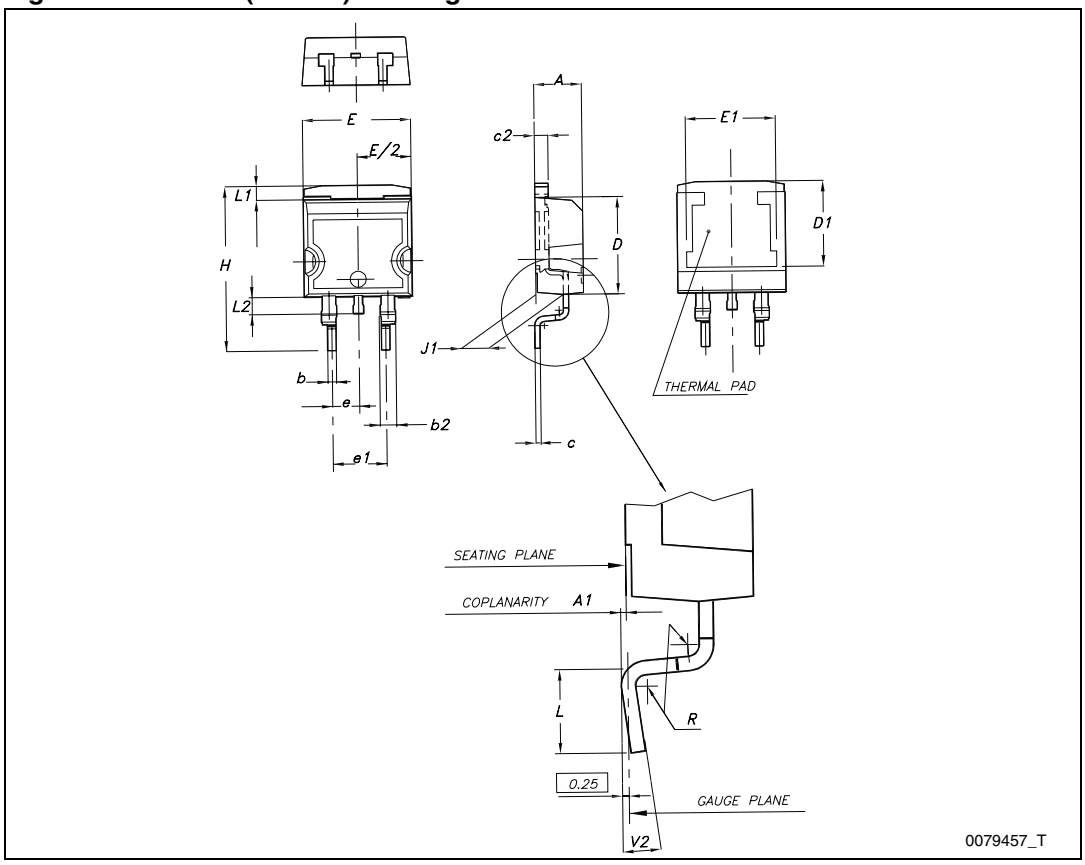
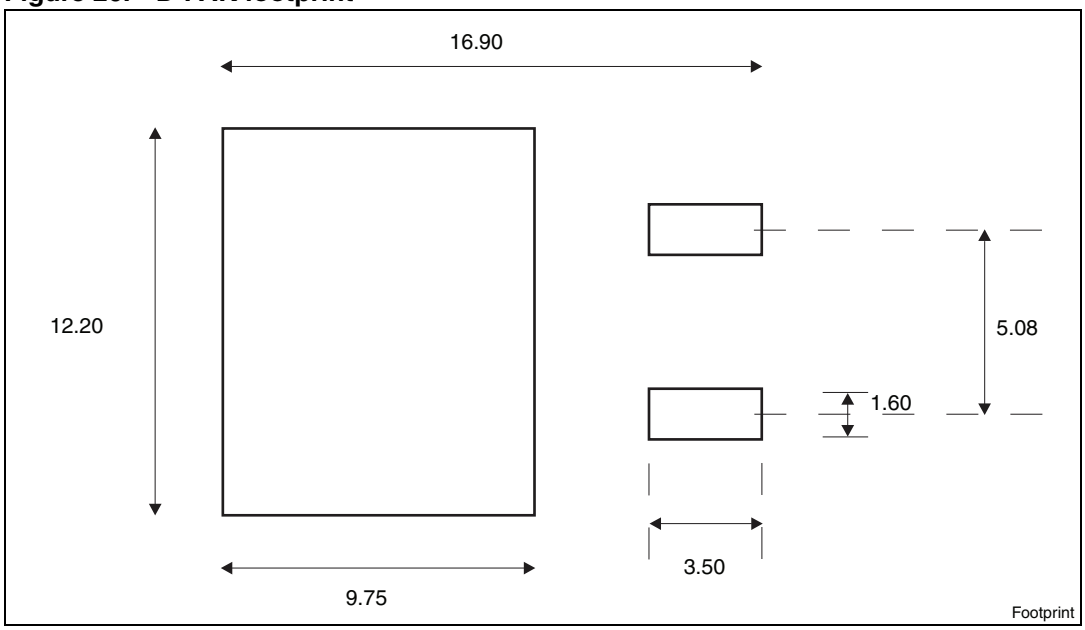


Figure 26. D²PAK footprint [a]



a. All dimension are in millimeters

5 Packing mechanical data

Table 11. D²PAK (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 27. Tape

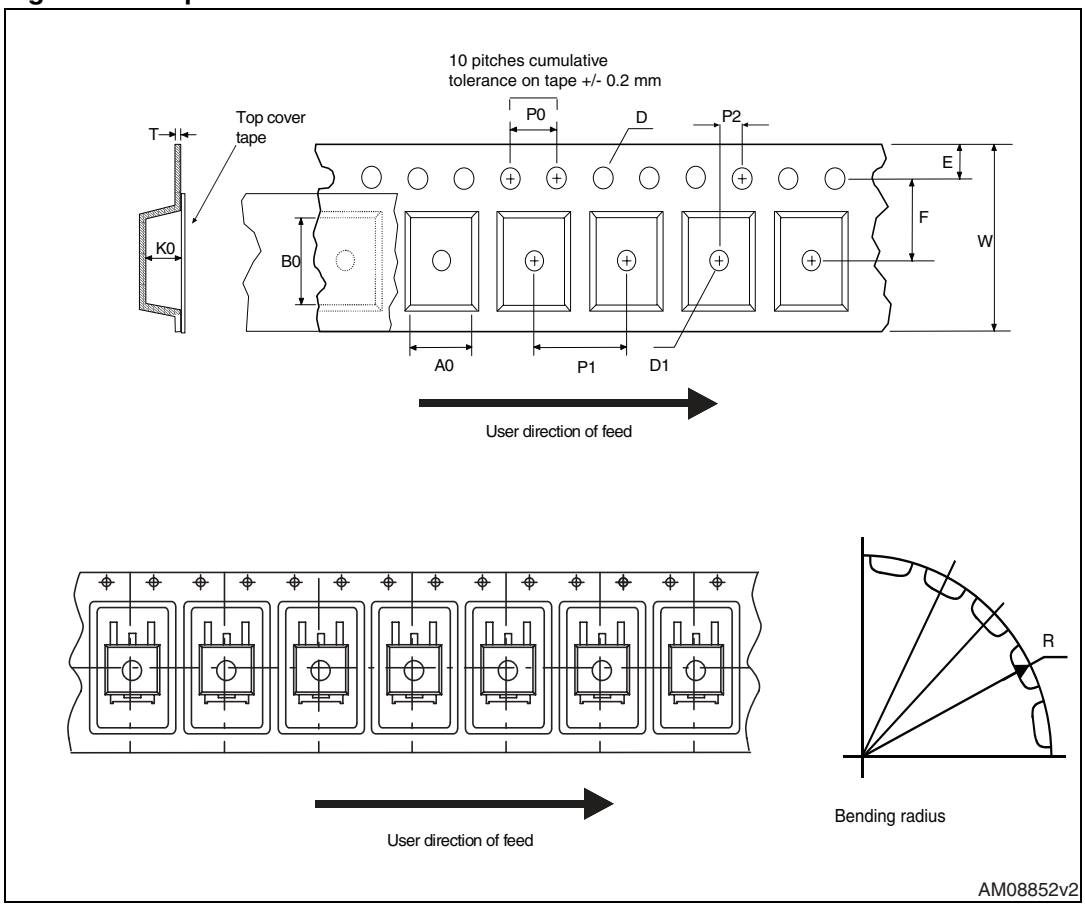
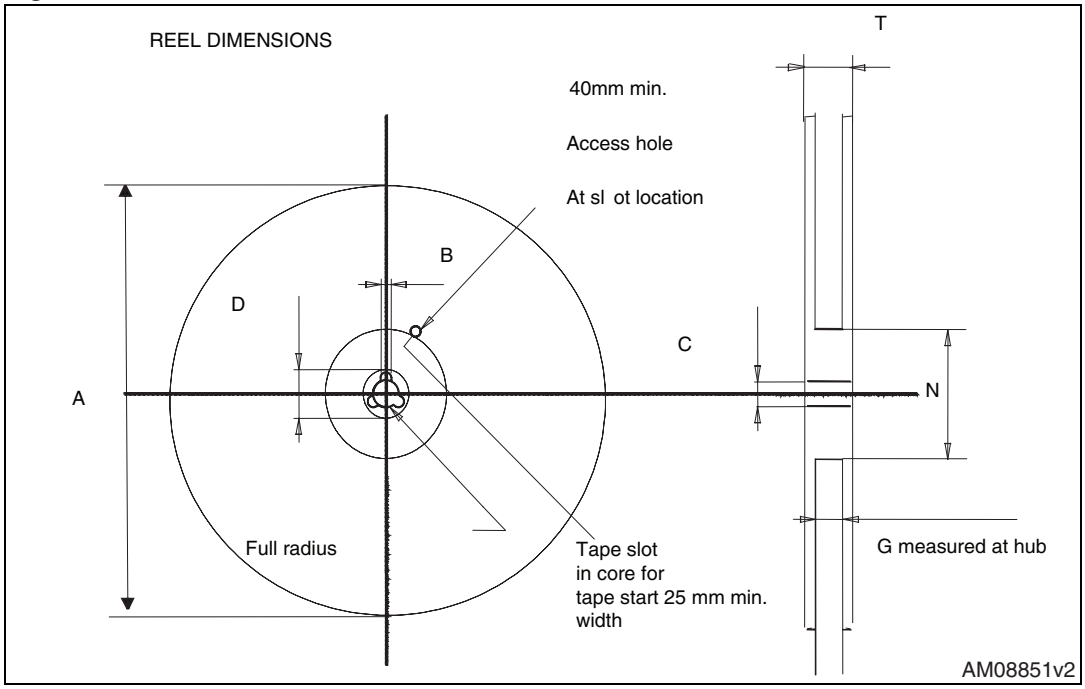


Figure 28. Reel



6 Revision history

Table 12. Document revision history

Date	Revision	Changes
08-May-2008	1	Initial release
28-May-2008	2	– Value on *Table 3: Thermal resistance* has been changed. – Inserted *Figure 16: Thermal impedance for TO-220, D²PAK* and *Figure 17: Thermal impedance for TO-220FP*
31-Jul-2012	3	Added: *Figure 18* and *Figure 19 on page 8*.