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STGD3HF60HD
STGP3HF60HD

4.5 A, 600 V very fast IGBT with Ultrafast diode

Datasheet - production data

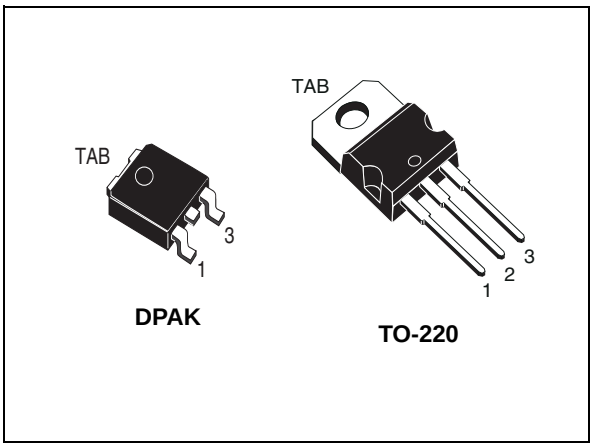
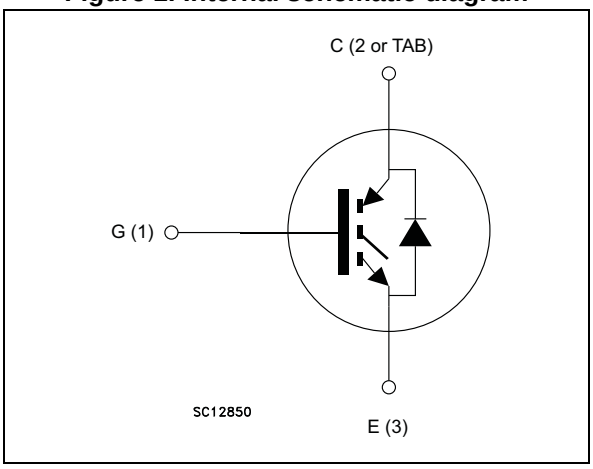


Figure 1. Internal schematic diagram



Features

- Minimal tail current
- Low conduction and switching losses
- Ultrafast soft recovery antiparallel diode

Applications

- Motor drive

Description

These devices are based on a new advanced planar technology concept to yield an IGBT with more stable switching performance (E_{off}) versus temperature, as well as lower conduction losses.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STGD3HF60HDT4	GD3HF60HD	DPAK	Tape and reel
STGP3HF60HD	GP3HF60HD	TO-220	Tube

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	600	V
I_C(1)	Continuous collector current at T_C = 25 °C	7.5	A
I_C(1)	Continuous collector current at T_C = 100 °C	4.5	A
I_{CL}(2)	Turn-off latching current	18	A
I_{CP}(3)	Pulsed collector current	18	A
V_{GE}	Gate-emitter voltage	±20	V
I_F	Diode RMS forward current at T_C = 25 °C	10	A
I_{FSM}	Surge non repetitive forward current t_p=10ms sinusoidal	25	A
P_{TOT}	Total dissipation at T_C = 25 °C	38	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. Vclamp = 80%,(V_{CES}), Tj =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
		DPAK	TO-220	
$R_{thj\text{-}case}$	Thermal resistance junction-case IGBT	3.3		°C/W
	Thermal resistance junction-case diode	5		°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	100	62.5	°C/W

2 Electrical characteristics

(T_j=25 °C unless otherwise specified).

Table 4. Static electrical characteristics

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= 0.5 A, T_j=125°C V_{GE} = 15 V, I_C= 1.5 A V_{GE}= 15 V, I_C= 1.5 A, T_j=125°C		1.4 2.45 1.85	2.95	V
$V_{GE(th)}$	Gate threshold voltage	V_{CE}= V_{GE}, I_C= 250 µA	3.75		5.75	V
I_{CES}	Collector cut-off current (V_{GE} = 0)	V_{CE} = 600 V V_{CE} = 600 V, T_j= 125 °C			250 1	µA mA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE} = ±20 V			±100	nA
g_{fs}	Forward transconductance	V_{CE} = 15 V, I_C= 1.5 A		1.5		S

Table 5. Dynamic electrical characteristics

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	-	152 14 3	-	pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 480 V, I_C = 1.5 A, V_{GE} = 15 V *(see Figure 18)*	-	12 2 6	-	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} = 400 V, I_C = 1.5 A R_G= 100 Ω, V_{GE} = 15 V *(see Figure 19)*	-	11 4 285	-	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} = 400 V, I_C = 1.5 A R_G = 100 Ω, V_{GE} = 15 V, T_j =125 °C *(see Figure 19)*	-	10 5 265	-	ns ns A/µs
$tr(Voff)$ $td(off)$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 400 V, I_C = 1.5 A, R_{GE} = 100 Ω, V_{GE} = 15 V *(see Figure 19)*	-	26 60 50	-	ns ns ns
$tr(Voff)$ $td(off)$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 400 V, I_C = 1.5 A, R_{GE} = 100 Ω, V_{GE} =15 V, T_j = 125 °C *(see Figure 19)*	-	64 69 71	-	ns ns ns

Table 7. 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} = 400 V, I_C = 1.5 A R_G = 100 Ω, V_{GE}=15 V *(see Figure 19)*	-	19 12 31	-	µJ µJ µJ
E_{on} (1) E_{off}(2) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 400 V, I_C = 1.5 A R_G = 100 Ω, V_{GE} = 15 V, T_j = 125 °C *(see Figure 19)*	-	38 35 73	-	µJ µJ µJ

1. Eon is the turn-on losses when a typical diode is used in the test circuit in *(see Figure 20)*. If the IGBT is offered in a package with a co-pak 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 = 1.5 A I_F = 1.5 A, T_j=125 °C	-	1.4 1.15	1.8	V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 1.5 A, V_R = 40 V, di/dt = 100 A/µs *(see Figure 20)*	-	85 124 3		ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 1.5 A,V_R = 40 V, T_j =125 °C, di/dt = 100 A/µs *(see Figure 20)*	-	114 194 3.5		ns nC A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

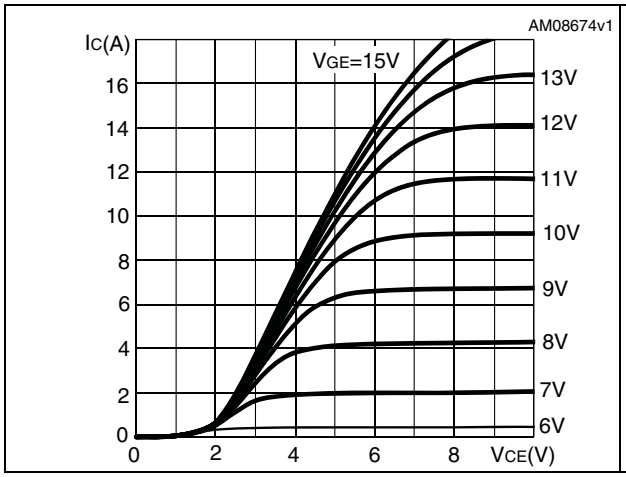


Figure 3. Output characteristic details

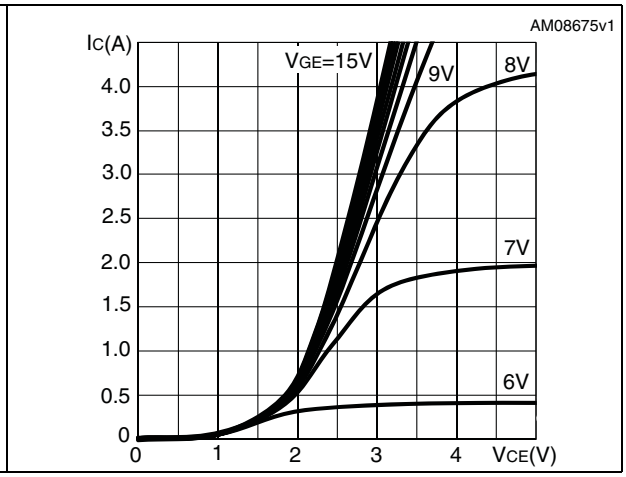


Figure 4. Transfer characteristics

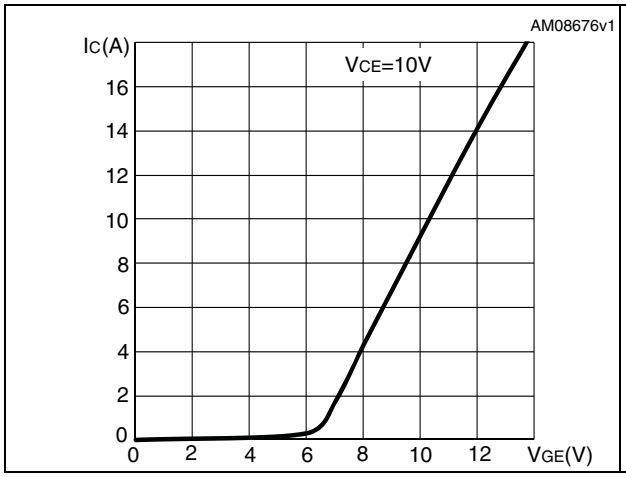


Figure 5. Collector-emitter on voltage vs collector current

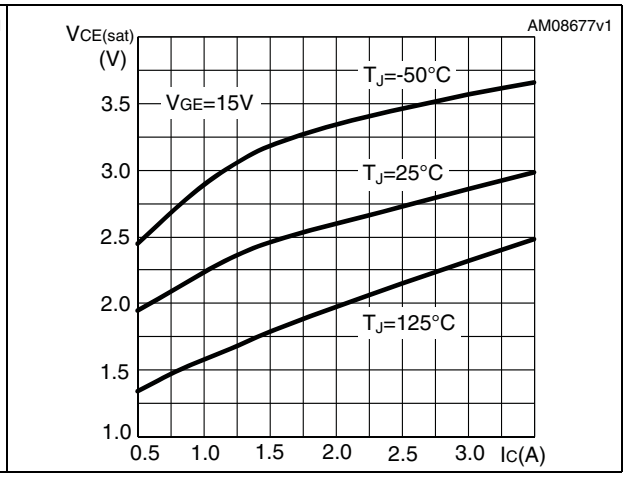


Figure 6. Collector-emitter on voltage vs temperature

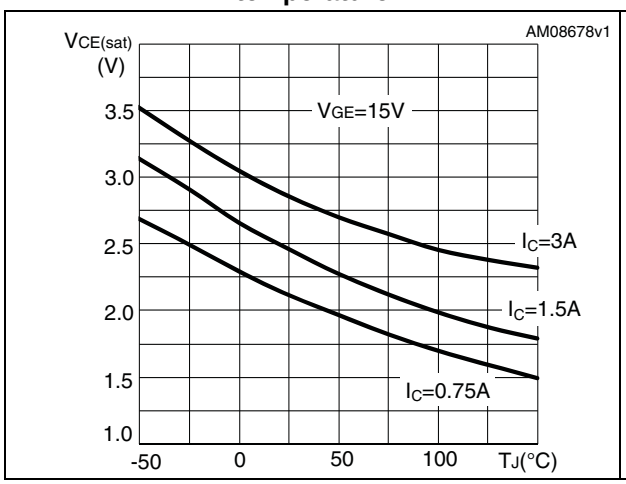


Figure 7. Breakdown voltage vs temperature

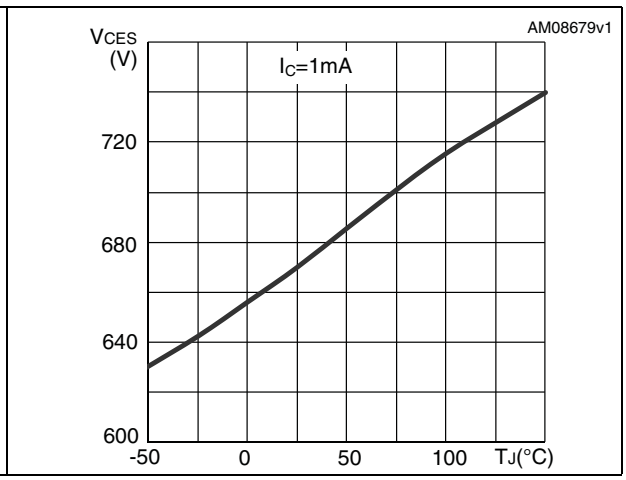


Figure 8. Gate threshold voltage vs temperature

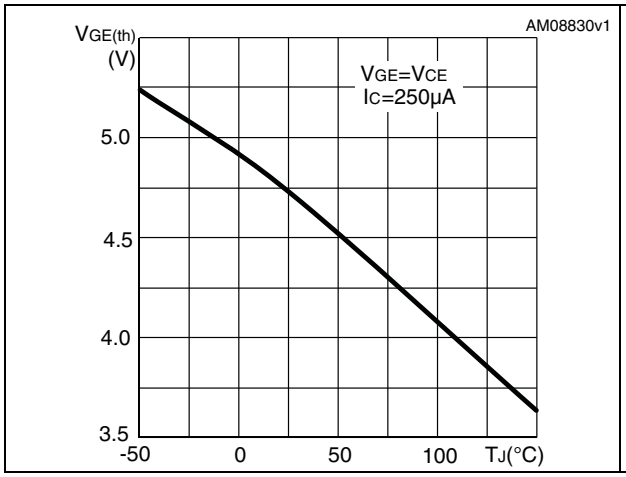


Figure 9. Gate charge vs gate-emitter voltage

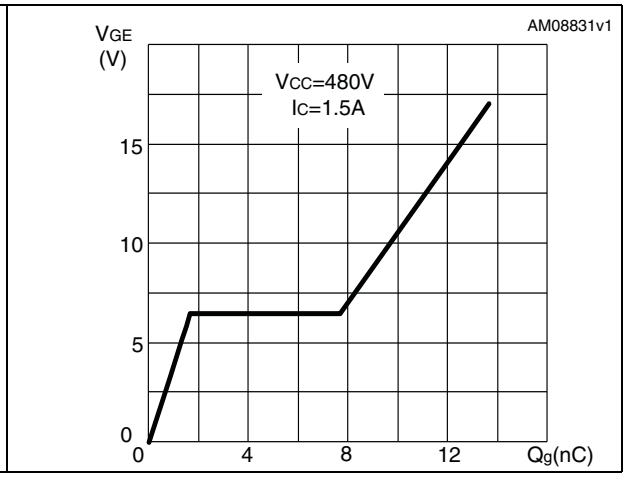


Figure 10. Capacitance variations

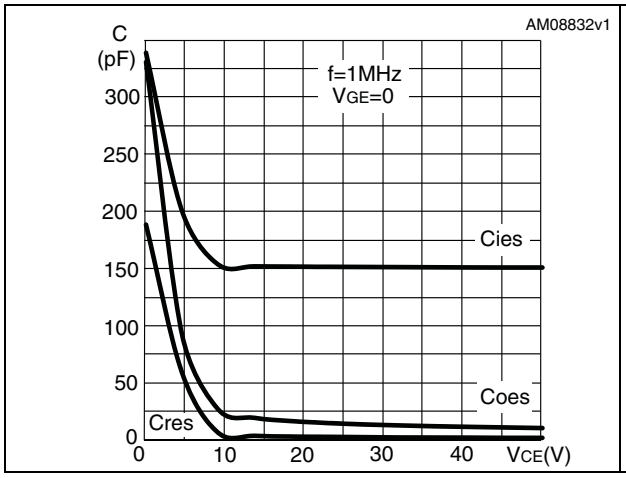


Figure 11. Switching losses vs collector current

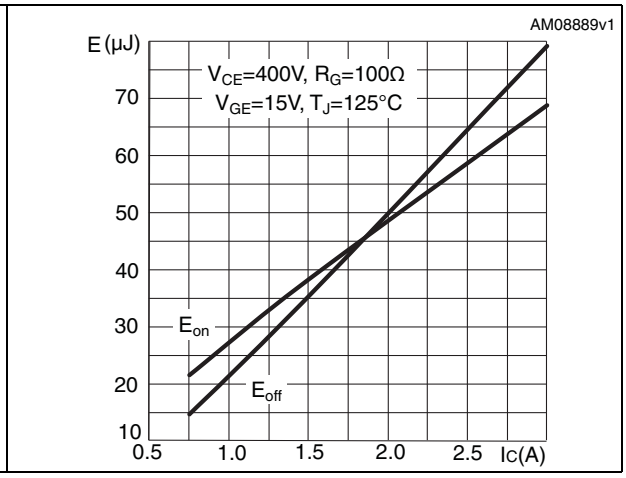


Figure 12. Switching losses vs gate resistence

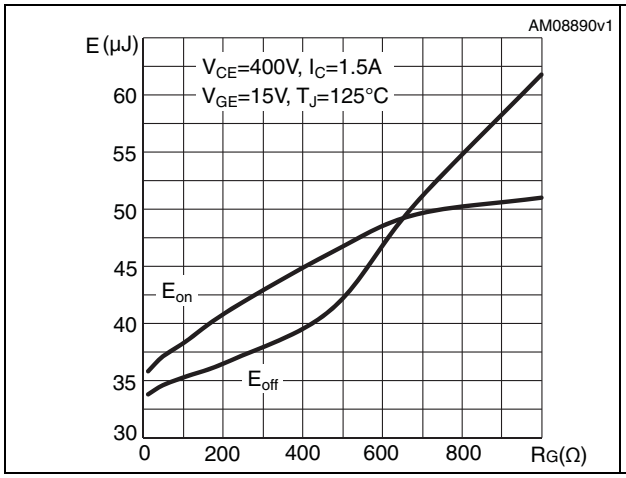


Figure 13. Switching losses vs temperature

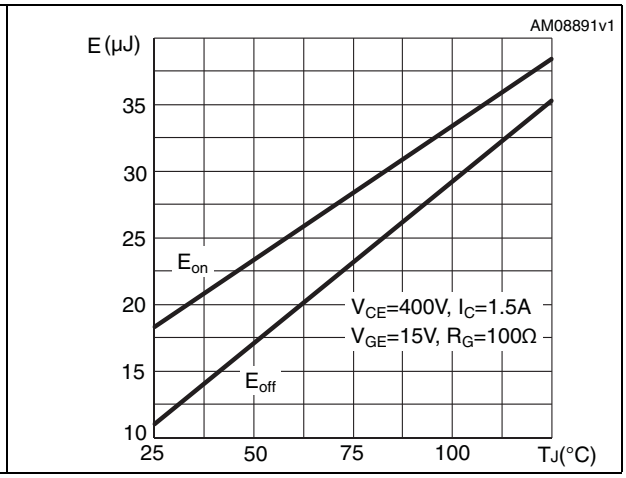


Figure 14. Turn-off SOA

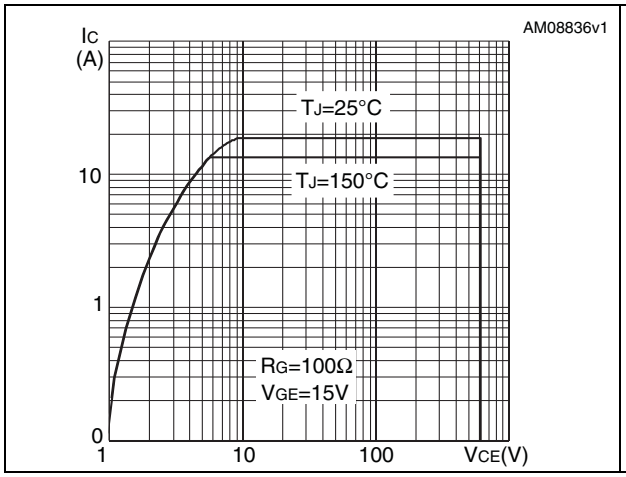


Figure 15. Diode forward on voltage

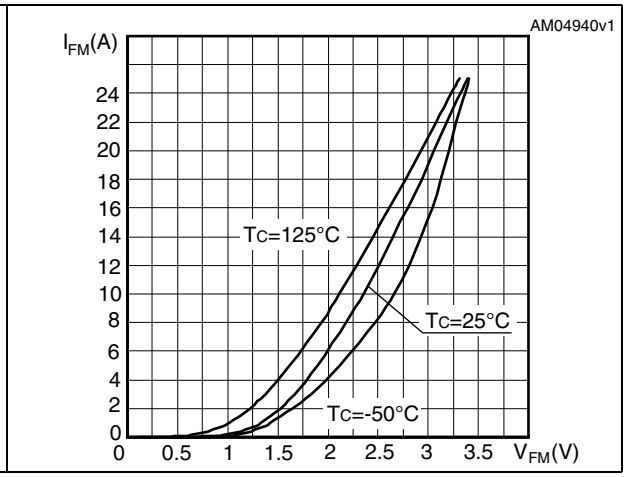
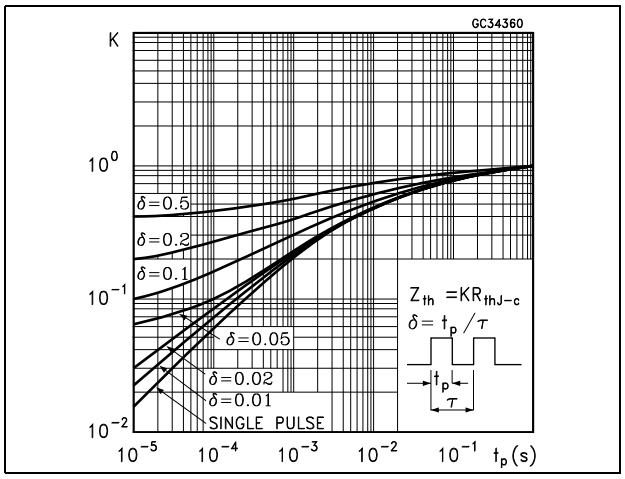


Figure 16. Thermal impedance



3 Test circuits

Figure 17. Test circuit for inductive load switching

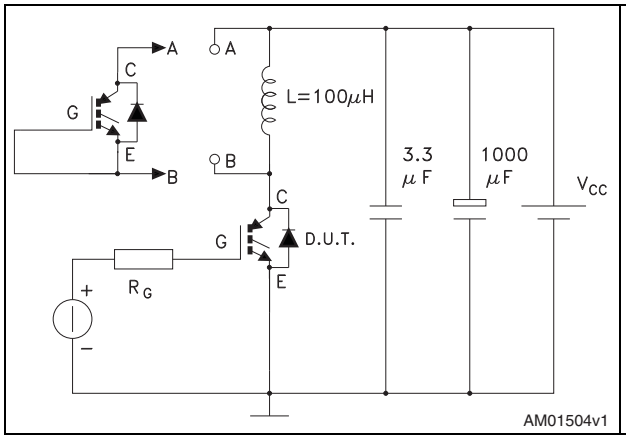


Figure 18. Gate charge test circuit

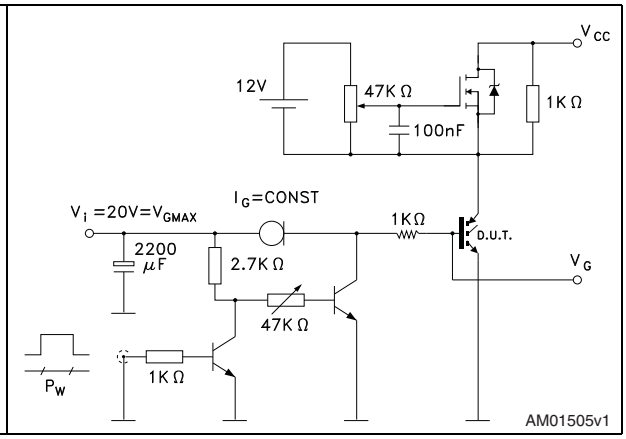


Figure 19. Switching waveform

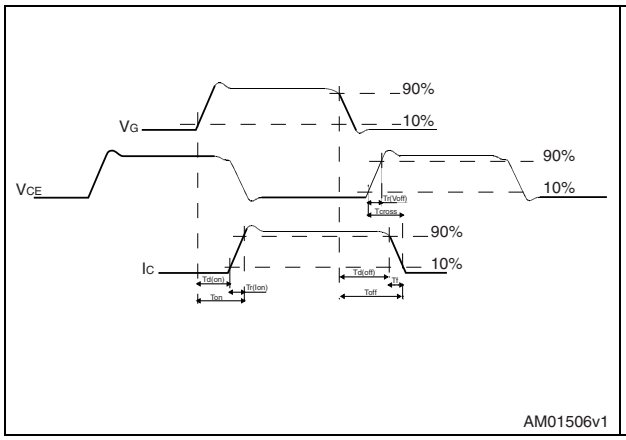
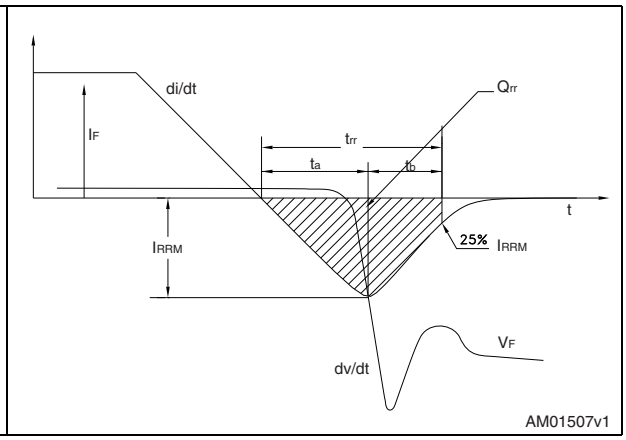


Figure 20. Diode recovery time waveform



4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in 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.

Table 9. DPAK (TO-252) type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
(L1)		2.80	
L2		0.80	
L4	0.60		1.00
R		0.20	
V2	0°		8°

Figure 21. DPAK (TO-252) type A drawing

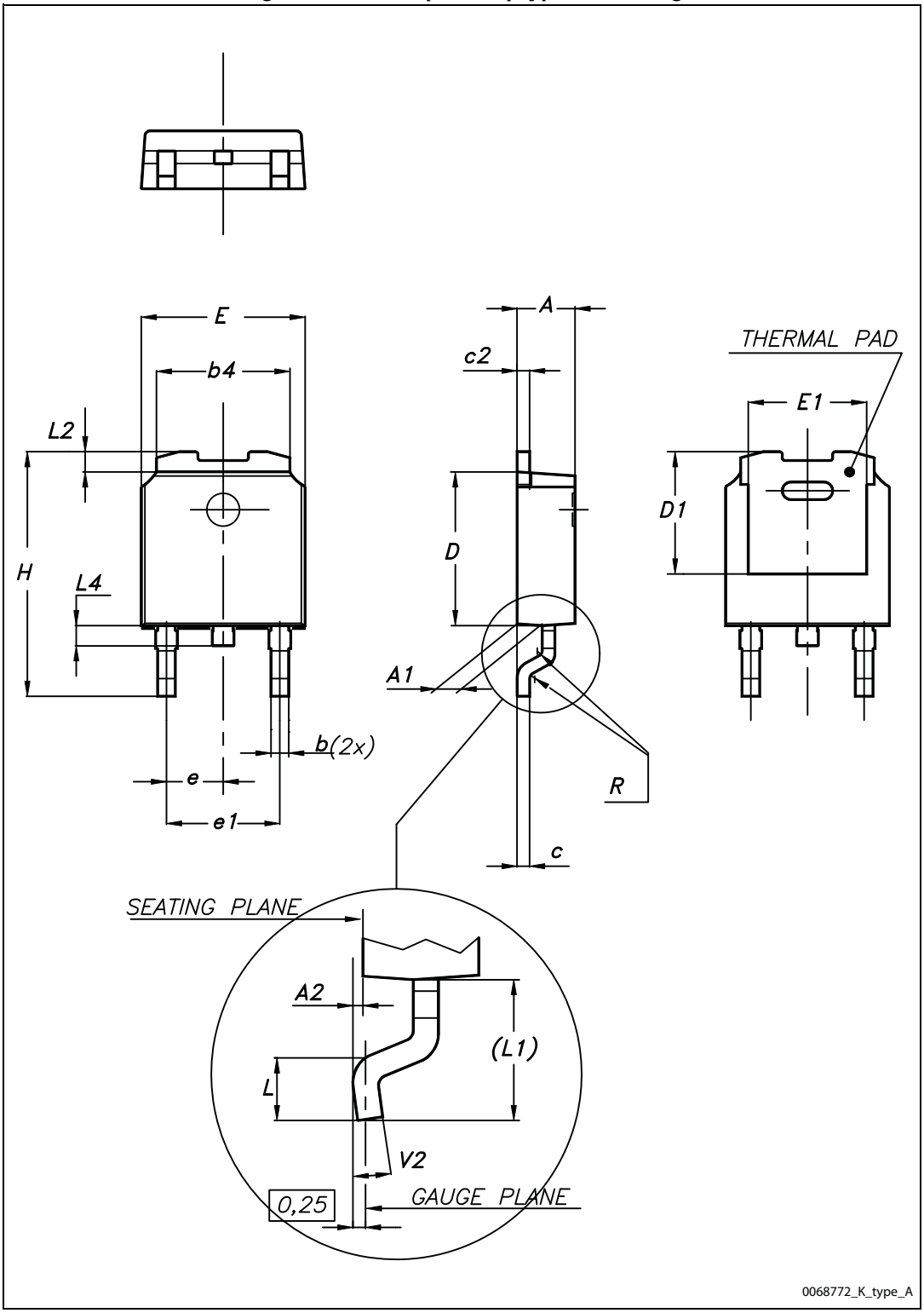
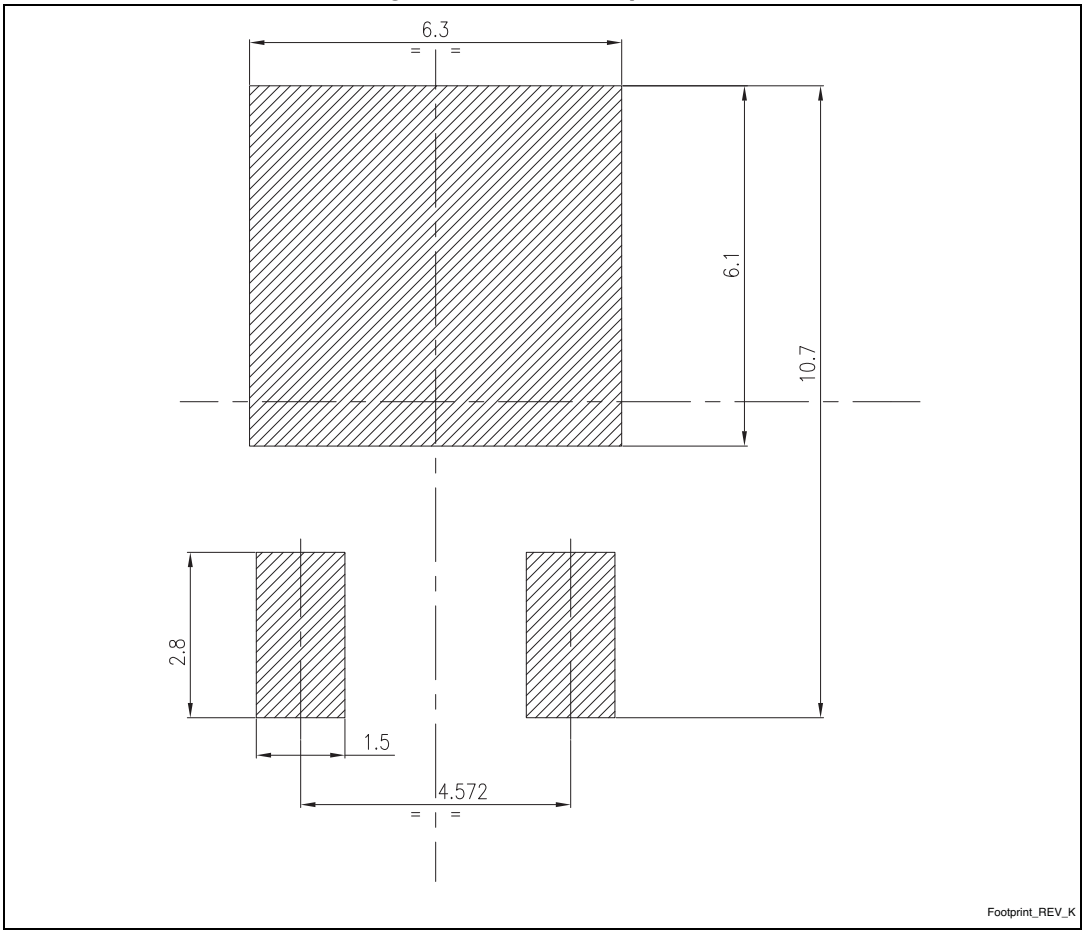


Figure 22. DPAK footprint [(a)]

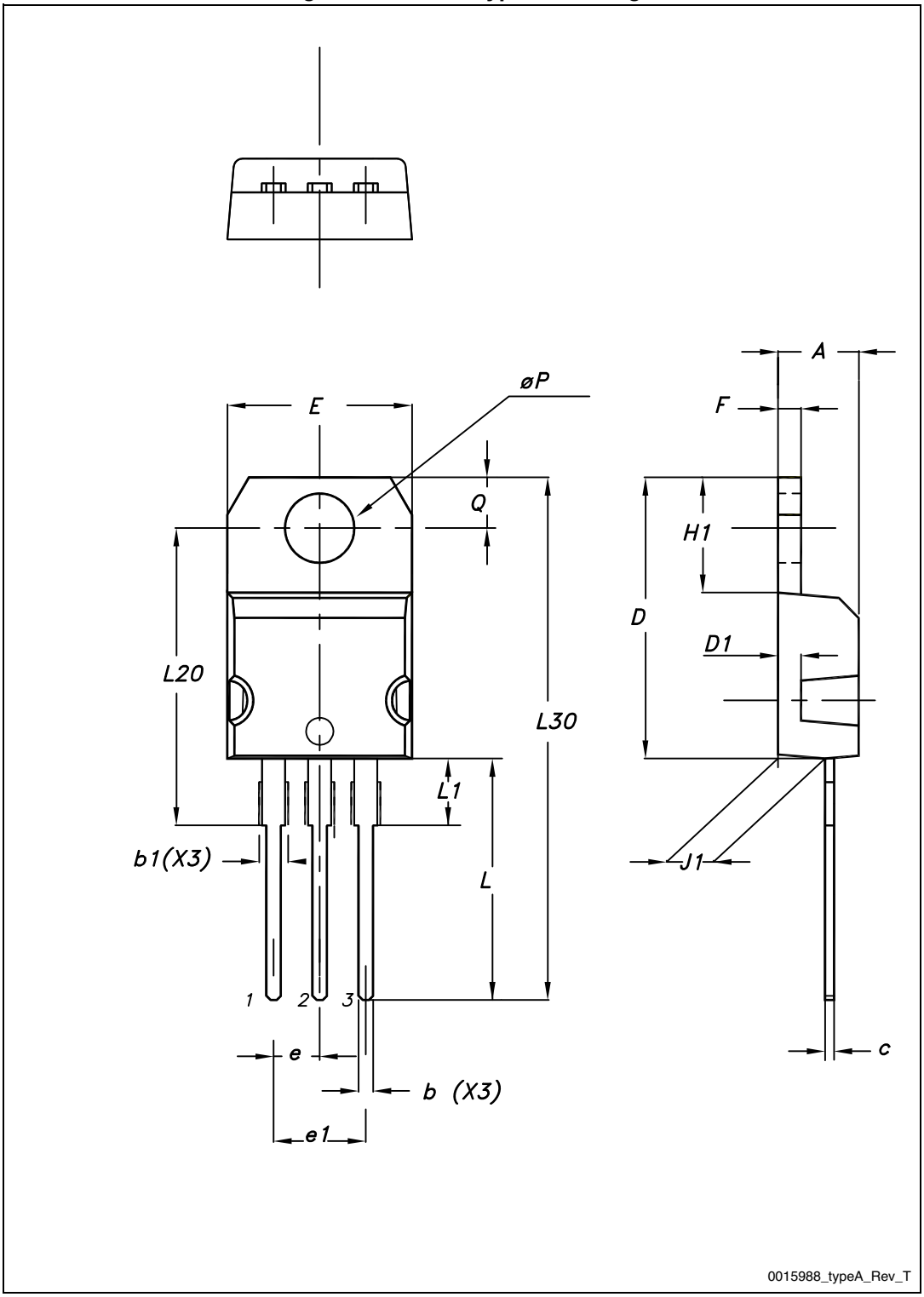


a. All dimensions are in millimeters

Table 10. 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

Figure 23. TO-220 type A drawing



5 Packaging mechanical data

Table 11. DPAK (TO-252) tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	6.8	7	A		330
B0	10.4	10.6	B	1.5	
B1		12.1	C	12.8	13.2
D	1.5	1.6	D	20.2	
D1	1.5		G	16.4	18.4
E	1.65	1.85	N	50	
F	7.4	7.6	T		22.4
K0	2.55	2.75			
P0	3.9	4.1	Base qty.		2500
P1	7.9	8.1	Bulk qty.		2500
P2	1.9	2.1			
R	40				
T	0.25	0.35			
W	15.7	16.3			

Figure 24. Tape for DPAK (TO-252)

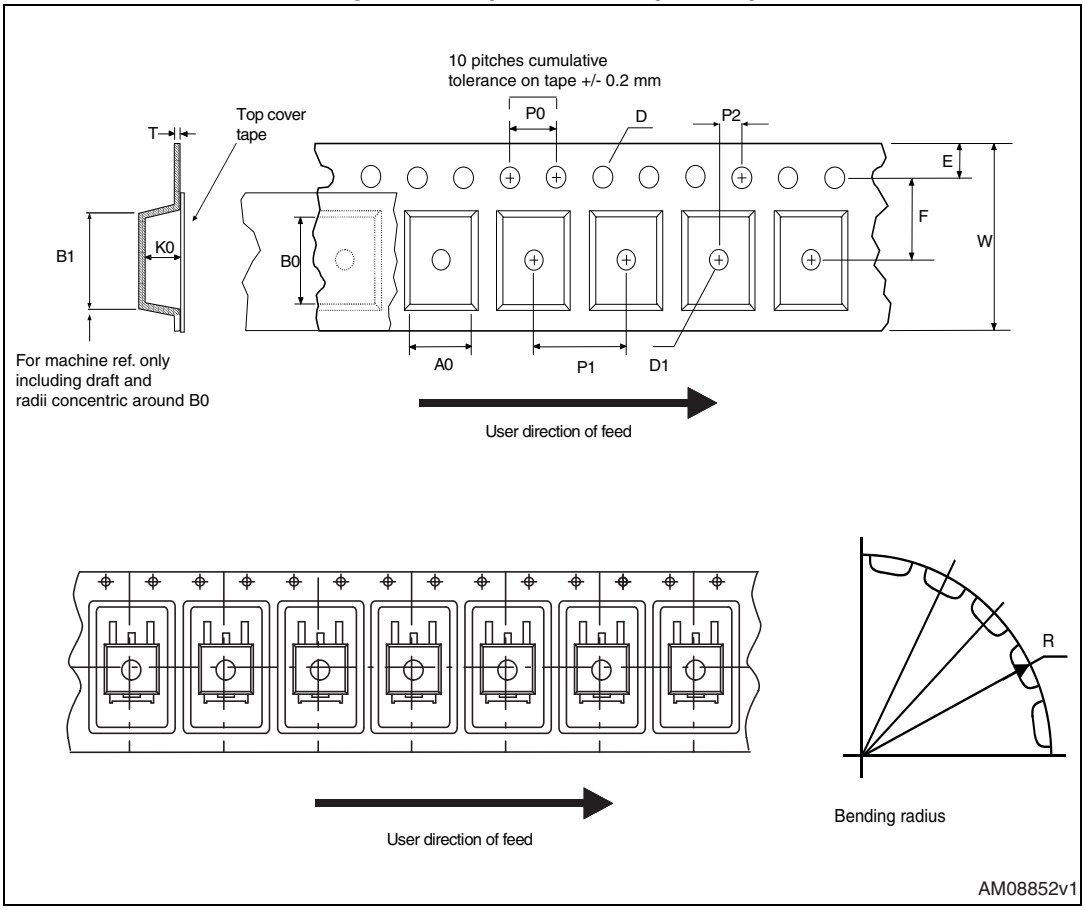
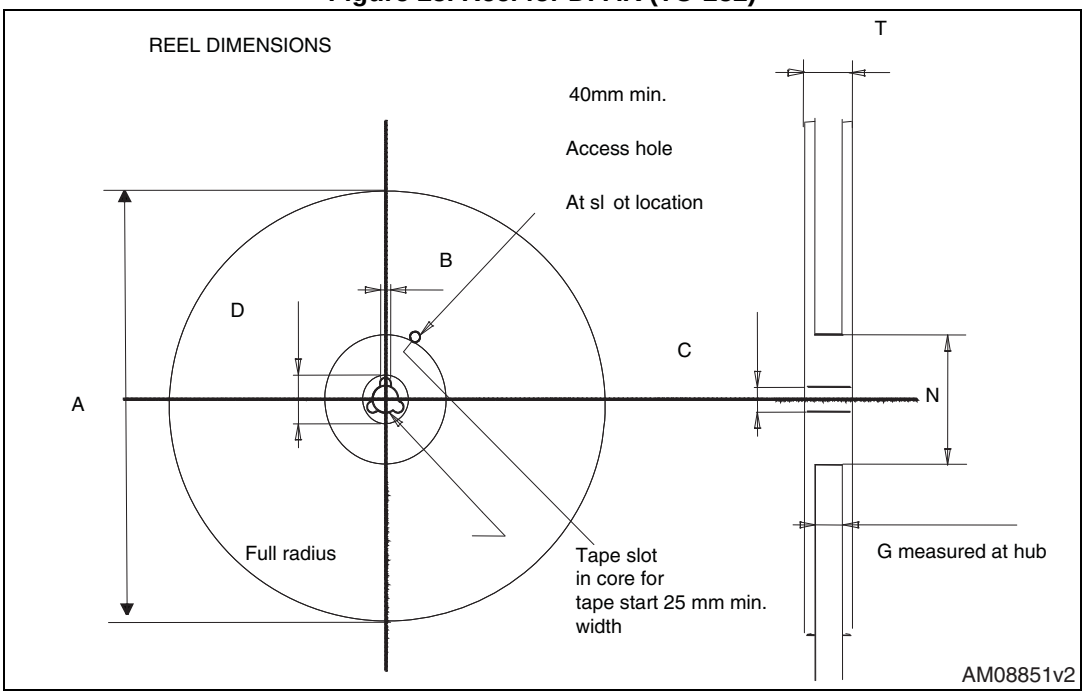


Figure 25. Reel for DPAK (TO-252)



6 Revision history

Table 12. Document revision history

Date	Revision	Changes
29-Jun-2010	1	First release.
09-Sep-2010	2	Some values changed in *Table 2*.
22-Dec-2010	3	Document status promoted from preliminary data to datasheet.
24-Sep-2013	4	Added device in TO-220. Updated *Table 1: Device summary*, *Table 3: Thermal data* and *Section 4: Package mechanical data* accordingly.

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