

Figure 1: Internal schematic diagram

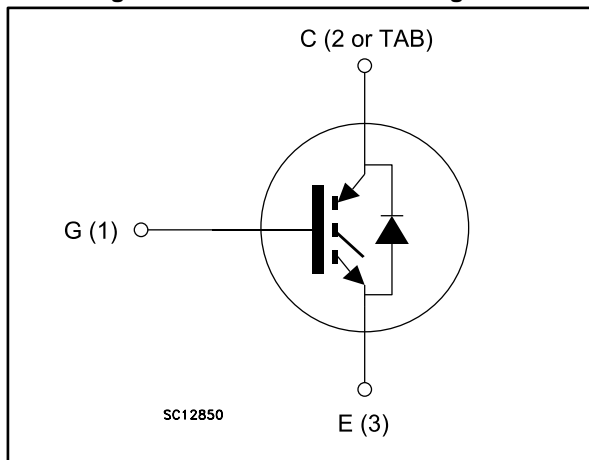


Table 1: Device summary

Order code	Marking	Package	Packing
STGB3HF60HD	GB3HF60HD	D ² PAK	Tape and reel
STGD3HF60HDT4	GD3HF60HD	DPAK	Tape and reel
STGF3HF60HD	GF3HF60HD	TO-220FP	Tube
STGP3HF60HD	GP3HF60HD	TO-220	Tube

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.

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
	2.1 Electrical characteristics (curves)	7
3	Test circuits	10
4	Package information	11
	4.1 D ² PAK (TO-263) package information	11
	4.2 D ² PAK (TO-263) packing information.....	14
	4.3 DPAK (TO-252) type A package information.....	16
	4.4 DPAK (TO-252) packing information.....	19
	4.5 TO-220FP package information	21
	4.6 TO-220 type A package information.....	23
5	Revision history	25

1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value			Unit
		DPAK	D ² PAK TO-220	TO-220FP	
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 = 10 ms sinusoidal	25			A
P _{TOT}	Total dissipation at T _C = 25 °C	38		18	W
T _{STG}	Storage temperature range	- 55 to 150			°C
T _j	Operating junction temperature range				

Notes:

⁽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 %, (V_{CES}), T_j = 150 °C, R_G = 10 Ω, V_{GE} = 15 V.

⁽³⁾Pulse width limited by maximum junction temperature range.

Table 3: Thermal data

Symbol	Parameter	Value			Unit
		DPAK	D ² PAK TO-220	TO-220FP	
R _{thj-case}	Thermal resistance junction-case IGBT	3.3		6.9	°C/W
	Thermal resistance junction-case diode	5		8	°C/W
R _{thj-amb}	Thermal resistance junction-ambient	100	62.5		°C/W

2 Electrical characteristics

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

Table 4: Static electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ($V_{GE} = 0$)	$I_C = 1\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 0.5\text{ A}$, $T_j = 125\text{ °C}$		1.4		V
		$V_{GE} = 15\text{ V}$, $I_C = 1.5\text{ A}$		2.45	2.95	
		$V_{GE} = 15\text{ V}$, $I_C = 1.5\text{ A}$, $T_j = 125\text{ °C}$		1.85		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	3.75		5.75	V
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE} = 600\text{ V}$			250	μA
		$V_{CE} = 600\text{ V}$, $T_j = 125\text{ °C}$			1	mA
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{ V}$			± 100	nA
g_{fs}	Forward transconductance	$V_{CE} = 15\text{ V}$, $I_C = 1.5\text{ A}$		1.5		S

Table 5: Dynamic electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0$	-	152	-	pF
C_{oes}	Output capacitance		-	14	-	pF
C_{res}	Reverse transfer capacitance		-	3	-	pF
Q_g	Total gate charge	$V_{CE} = 480\text{ V}$, $I_C = 1.5\text{ A}$, $V_{GE} = 15\text{ V}$ (see Figure 18: "Gate charge test circuit")	-	12	-	nC
Q_{ge}	Gate-emitter charge		-	2	-	nC
Q_{gc}	Gate-collector charge		-	6	-	nC

Table 6: Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 400\text{ V}$, $I_C = 1.5\text{ A}$ $R_G = 100\ \Omega$, $V_{GE} = 15\text{ V}$ (see Figure 17: "Test circuit for inductive load switching" Figure 19: "Switching waveform")	-	11	-	ns
t_r	Current rise time		-	4	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	285	-	A/ μ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 400\text{ V}$, $I_C = 1.5\text{ A}$ $R_G = 100\ \Omega$, $V_{GE} = 15\text{ V}$, $T_j = 125\text{ }^\circ\text{C}$ (see Figure 17: "Test circuit for inductive load switching" Figure 19: "Switching waveform")	-	10	-	ns
t_r	Current rise time		-	5	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	265	-	A/ μ s
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 400\text{ V}$, $I_C = 1.5\text{ A}$, $R_{GE} = 100\ \Omega$, $V_{GE} = 15\text{ V}$ (see Figure 17: "Test circuit for inductive load switching" Figure 19: "Switching waveform")	-	26	-	ns
$t_d(off)$	Turn-off delay time		-	60	-	ns
t_f	Current fall time		-	50	-	ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 400\text{ V}$, $I_C = 1.5\text{ A}$, $R_{GE} = 100\ \Omega$, $V_{GE} = 15\text{ V}$, $T_j = 125\text{ }^\circ\text{C}$ (see Figure 17: "Test circuit for inductive load switching" Figure 19: "Switching waveform")	-	64	-	ns
$t_d(off)$	Turn-off delay time		-	69	-	ns
t_f	Current fall time		-	71	-	ns

Table 7: Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching energy	$V_{CC} = 400\text{ V}$, $I_C = 1.5\text{ A}$ $R_G = 100\ \Omega$, $V_{GE} = 15\text{ V}$ (see Figure 17: "Test circuit for inductive load switching" Figure 19: "Switching waveform")	-	19	-	μ J
$E_{off}^{(2)}$	Turn-off switching energy		-	12	-	μ J
E_{ts}	Total switching energy		-	31	-	μ J
$E_{on}^{(1)}$	Turn-on switching energy	$V_{CC} = 400\text{ V}$, $I_C = 1.5\text{ A}$ $R_G = 100\ \Omega$, $V_{GE} = 15\text{ V}$, $T_j = 125\text{ }^\circ\text{C}$ (see Figure 17: "Test circuit for inductive load switching" Figure 19: "Switching waveform")	-	38	-	μ J
$E_{off}^{(2)}$	Turn-off switching energy		-	35	-	μ J
E_{ts}	Total switching energy		-	73	-	μ J

Notes:

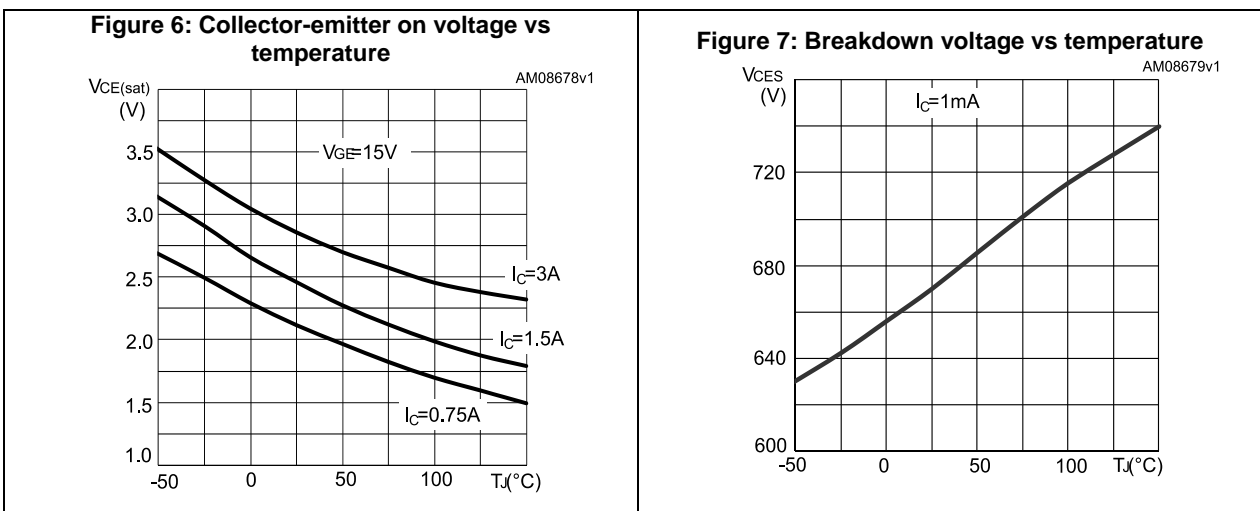
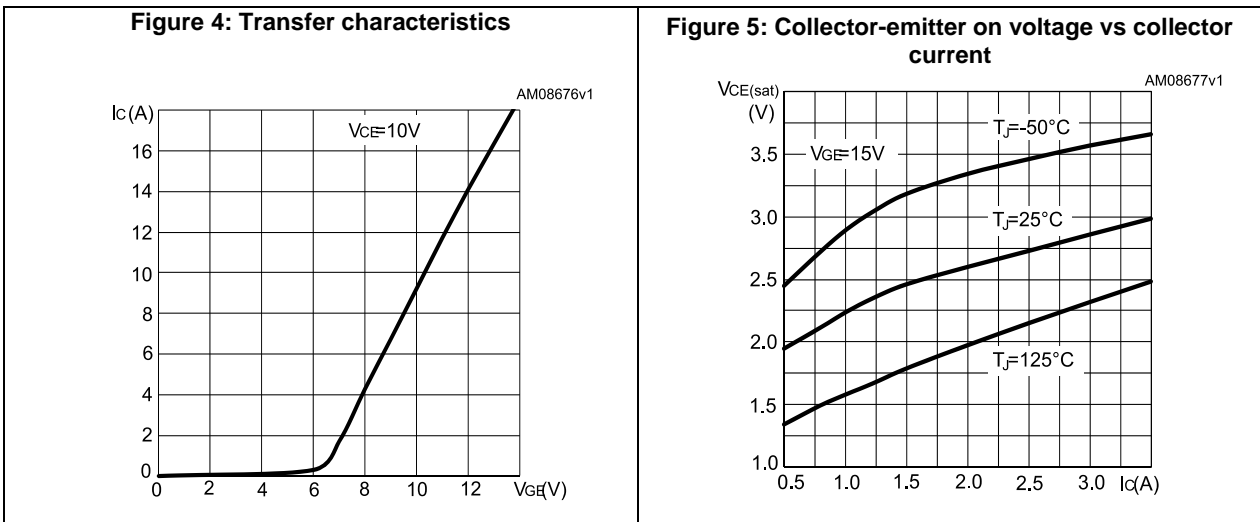
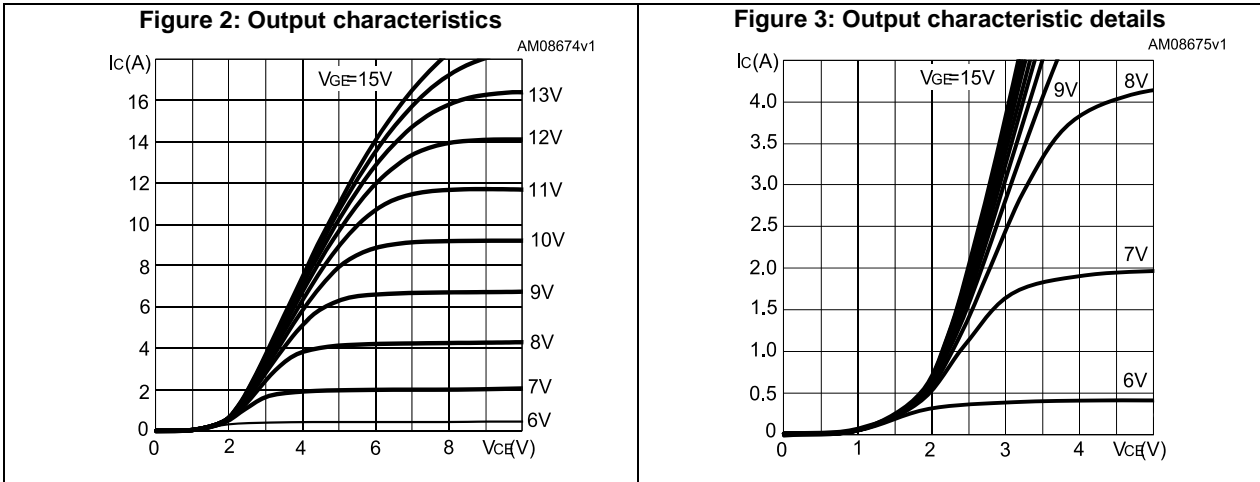
⁽¹⁾ E_{on} is the turn-on energy when a typical diode is used in the test circuit in [Figure 17: "Test circuit for inductive load switching"](#). If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs and diode are at the same temperature (25 °C and 125 °C).

⁽²⁾Turn-off energy 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	$I_F = 1.5 \text{ A}$	-	1.4	1.8	V
		$I_F = 1.5 \text{ A}, T_j = 125 \text{ }^\circ\text{C}$	-	1.15		
t_{rr}	Reverse recovery time	$I_F = 1.5 \text{ A}, V_R = 40 \text{ V},$ $di/dt = 100 \text{ A}/\mu\text{s}$ (see Figure 20: "Diode reverse recovery waveform")	-	85		ns
Q_{rr}	Reverse recovery charge		-	124		nC
I_{rrm}	Reverse recovery current		-	3		A
t_{rr}	Reverse recovery time	$I_F = 1.5 \text{ A}, V_R = 40 \text{ V},$ $T_j = 125 \text{ }^\circ\text{C}, di/dt = 100 \text{ A}/\mu\text{s}$ (see Figure 20: "Diode reverse recovery waveform")	-	114		ns
Q_{rr}	Reverse recovery charge		-	194		nC
I_{rrm}	Reverse recovery current		-	3.5		A

2.1 Electrical characteristics (curves)



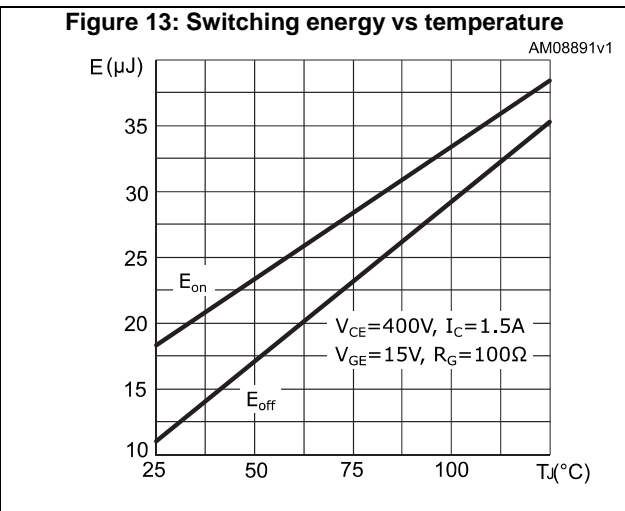
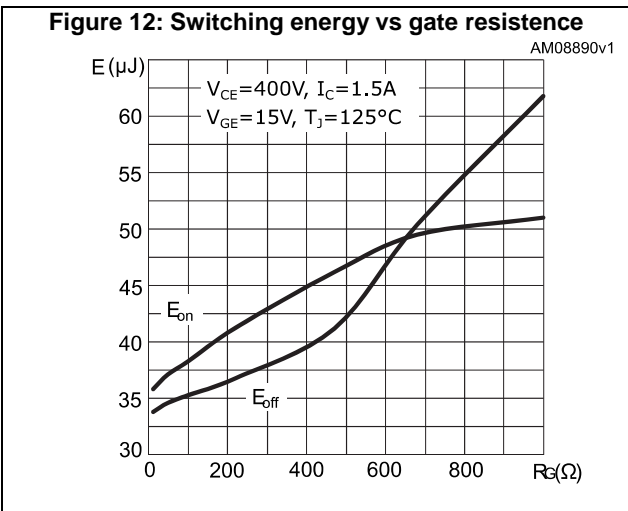
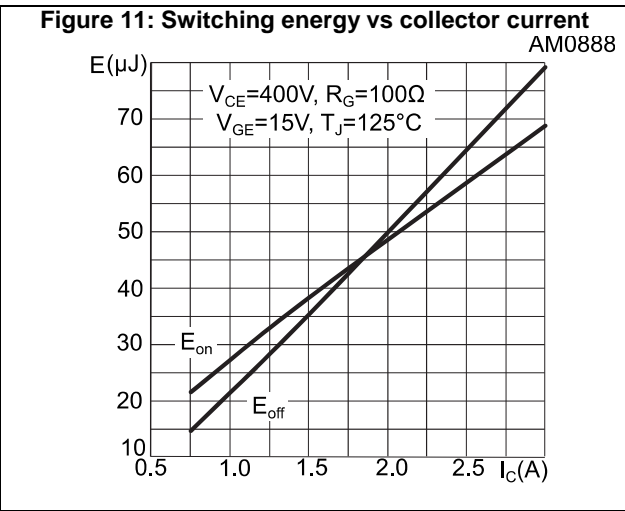
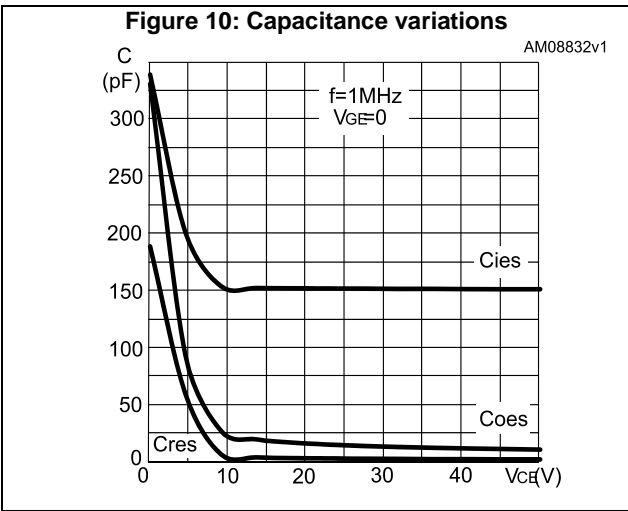
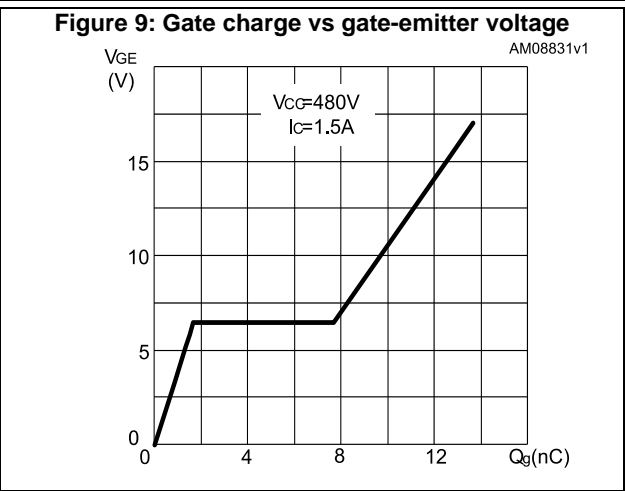
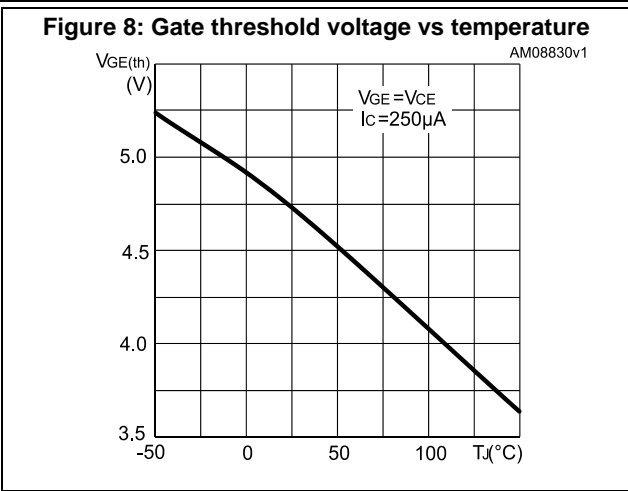


Figure 14: Turn-off SOA

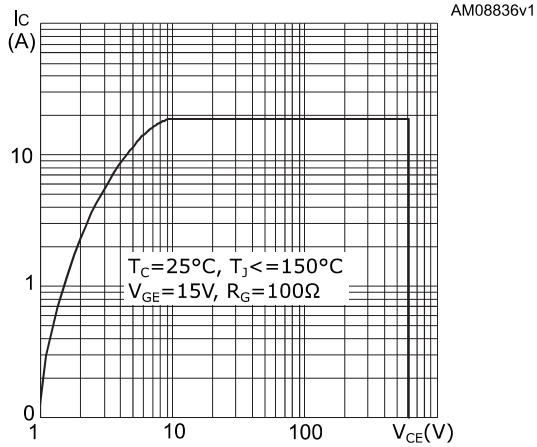


Figure 15: Diode forward on voltage

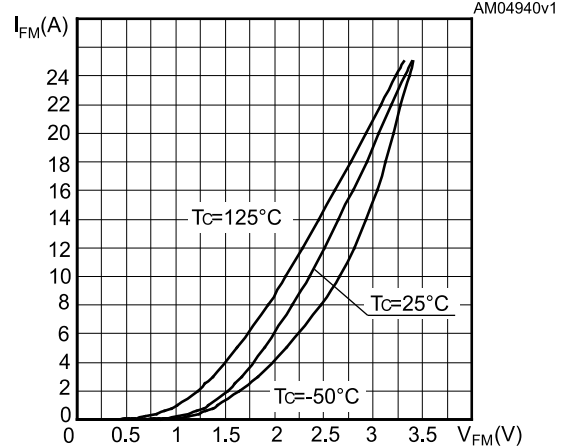
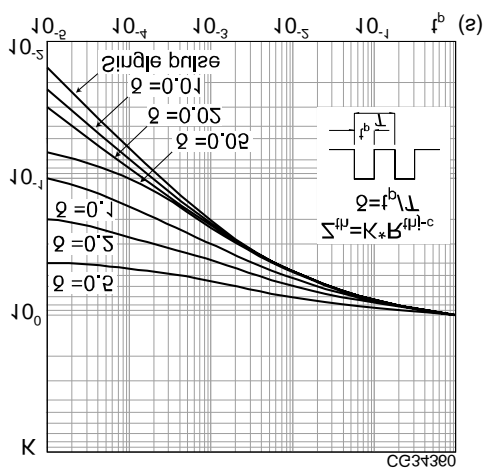
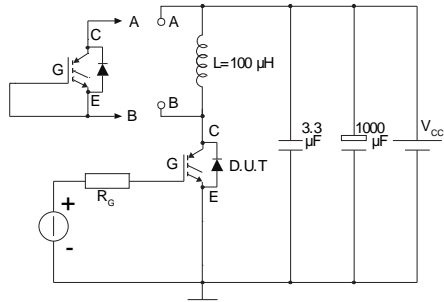


Figure 16: Thermal impedance



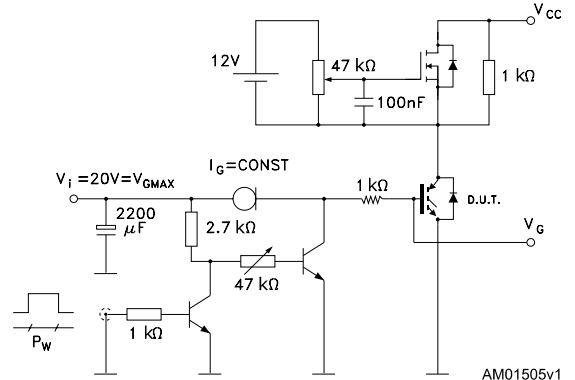
3 Test circuits

Figure 17: Test circuit for inductive load switching



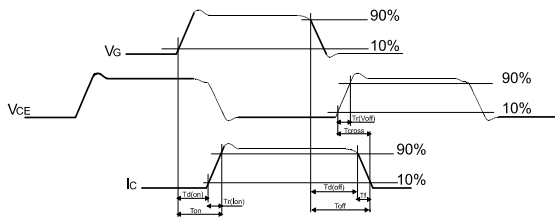
AM01504v1

Figure 18: Gate charge test circuit



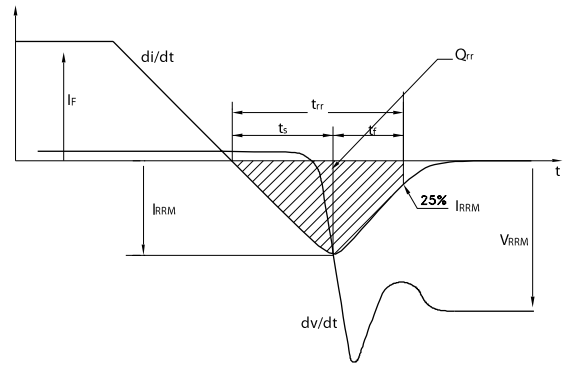
AM01505v1

Figure 19: Switching waveform



AM01506v1

Figure 20: Diode reverse recovery waveform



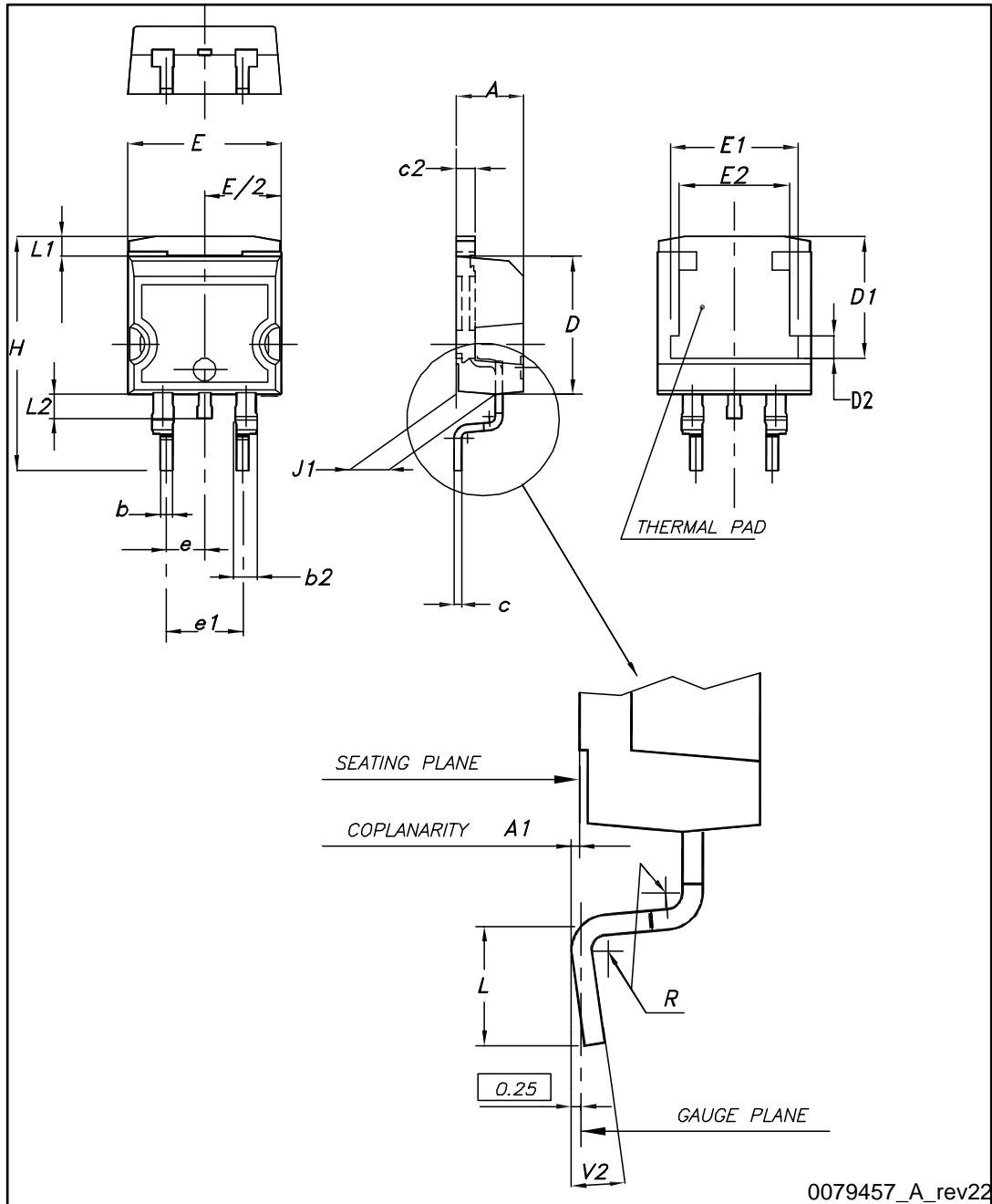
AM01507v1

4 Package information

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.

4.1 D²PAK (TO-263) package information

Figure 21: D²PAK (TO-263) type A package outline

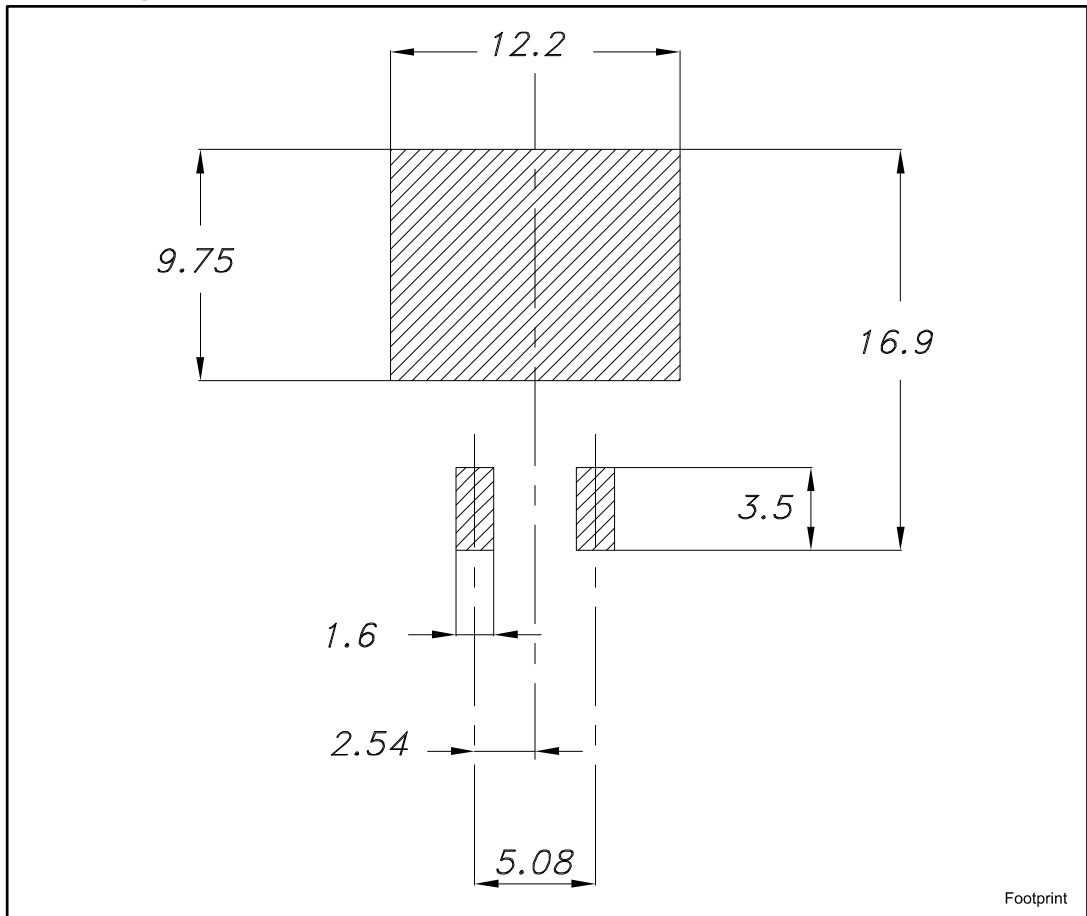


0079457_A_rev22

Table 9: D²PAK (TO-263) type A package 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	7.75	8.00
D2	1.10	1.30	1.50
E	10		10.40
E1	8.50	8.70	8.90
E2	6.85	7.05	7.25
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 22: D²PAK (TO-263) recommended footprint (dimensions are in mm)



4.2 D²PAK (TO-263) packing information

Figure 23: Tape outline

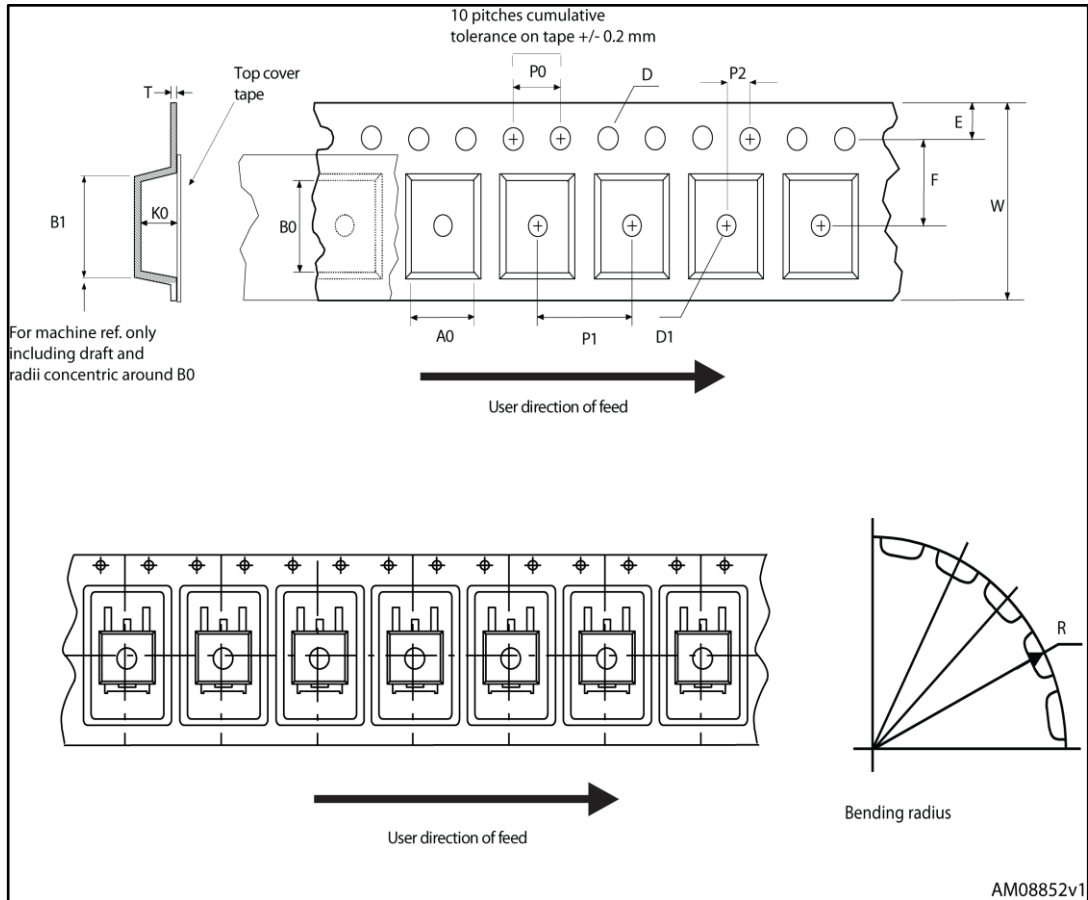
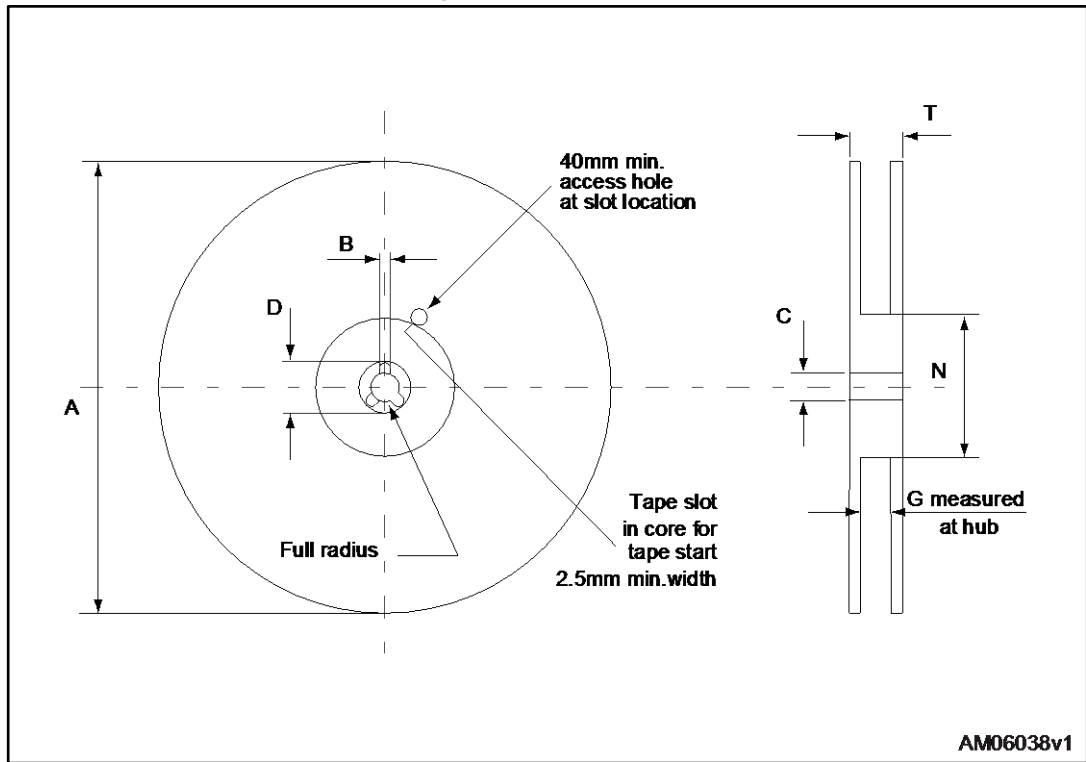


Figure 24: Reel outline



AM06038v1

Table 10: D²PAK 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 quantity		1000
P2	1.9	2.1	Bulk quantity		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

4.3 DPAK (TO-252) type A package information

Figure 25: DPAK (TO-252) type A package outline

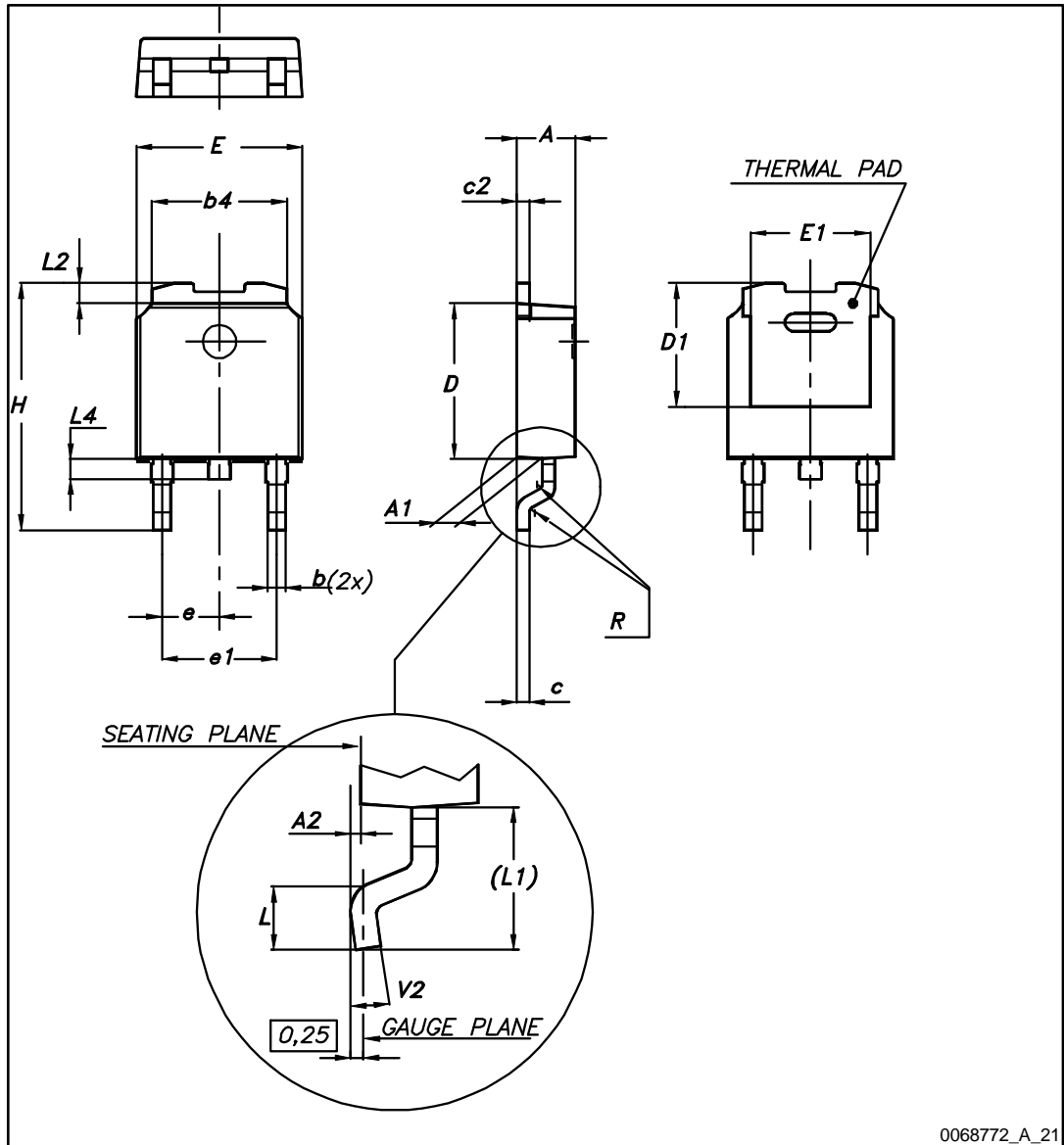
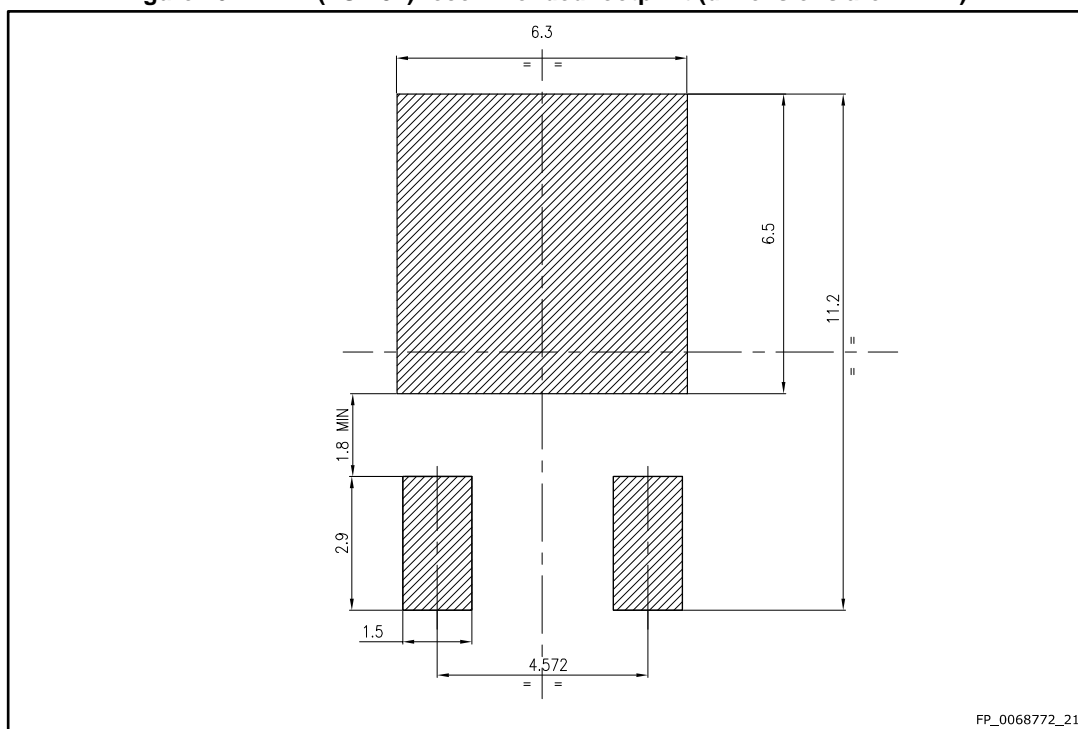


Table 11: DPAK (TO-252) type A mechanical data

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	4.95	5.10	5.25
E	6.40		6.60
E1	4.60	4.70	4.80
e	2.16	2.28	2.40
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
(L1)	2.60	2.80	3.00
L2	0.65	0.80	0.95
L4	0.60		1.00
R		0.20	
V2	0°		8°

Figure 26: DPAK (TO-252) recommended footprint (dimensions are in mm)



4.4 DPAK (TO-252) packing information

Figure 27: DPAK (TO-252) tape outline

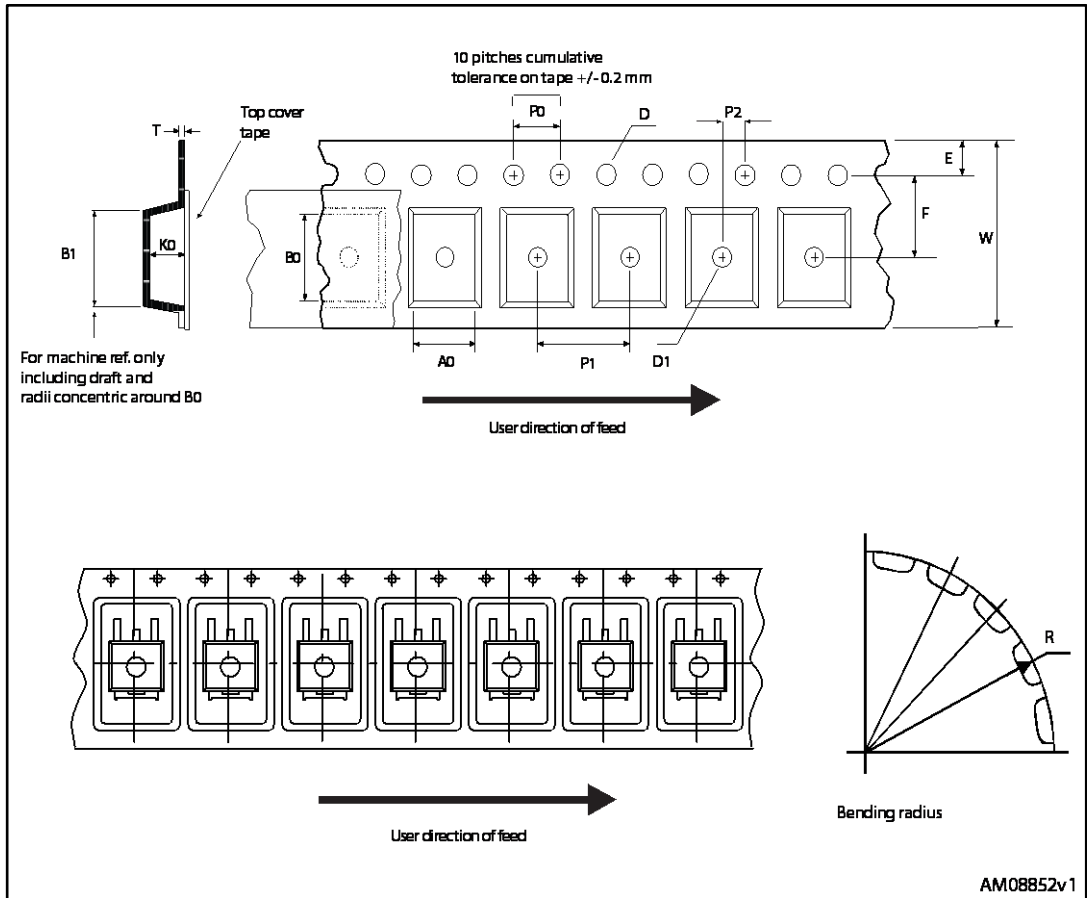


Figure 28: DPAK (TO-252) reel outline

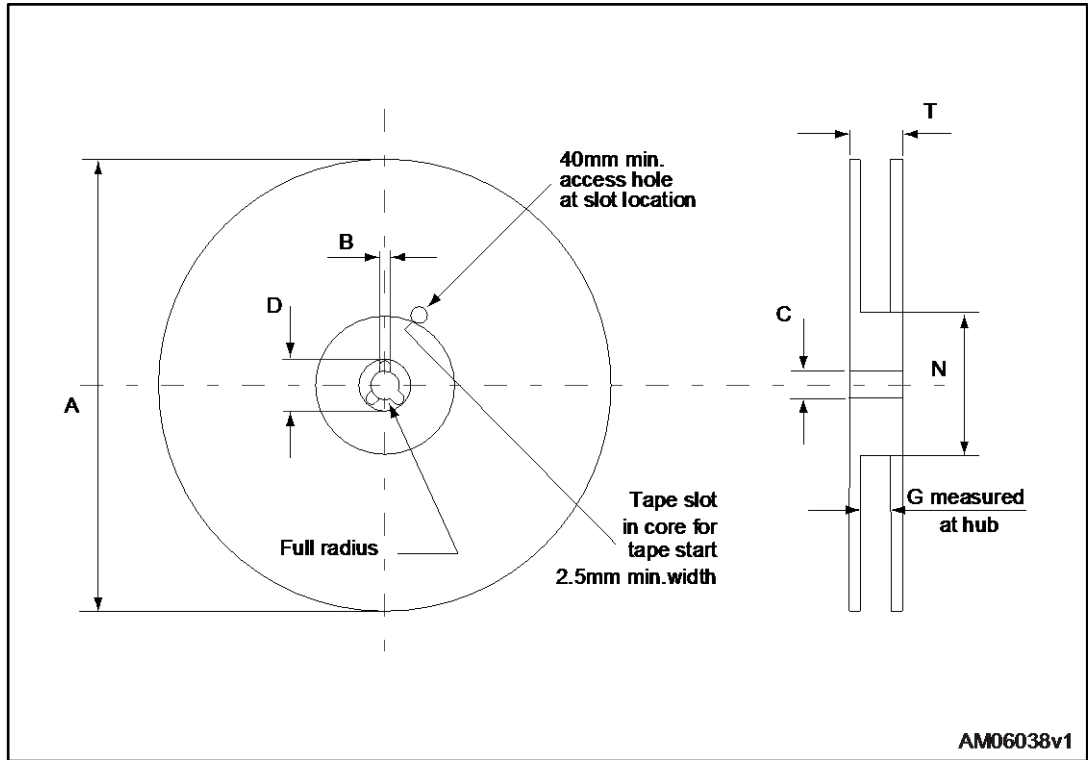
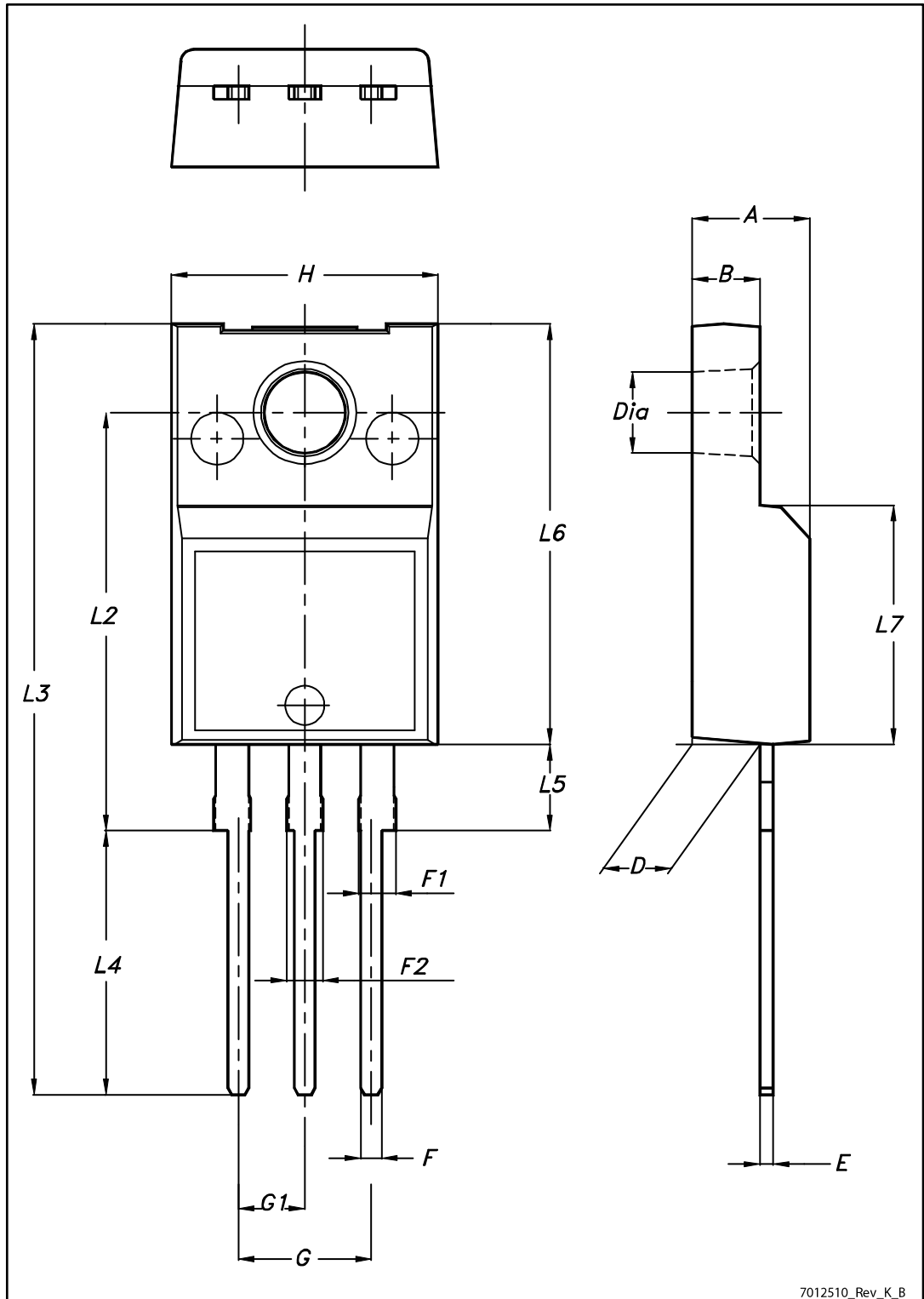


Table 12: DPAK (TO-252) tape and reel mechanical data

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			

4.5 TO-220FP package information

Figure 29: TO-220FP package outline



7012510_Rev_K_B

Table 13: TO-220FP package 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

4.6 TO-220 type A package information

Figure 30: TO-220 type A package outline

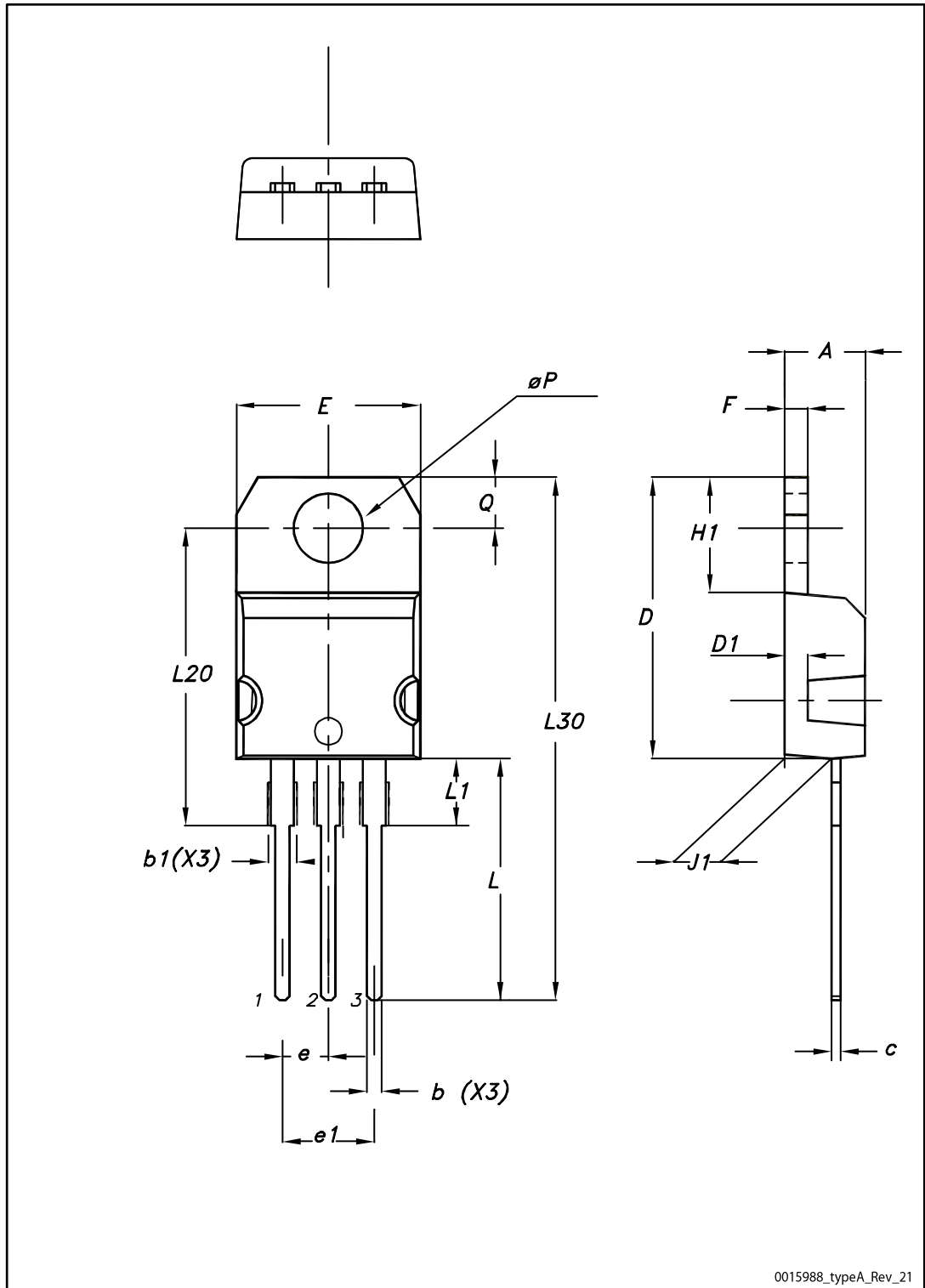


Table 14: TO-220 type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		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	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95

5 Revision history

Table 15: Document revision history

Date	Revision	Changes
29-Jun-2010	1	First release.
09-Sep-2010	2	Some values changed in <i>Table 2</i> .
22-Dec-2010	3	Document status promoted from preliminary data to datasheet.
24-Sep-2013	4	Added device in TO-220. Updated <i>Table 1: Device summary</i> , <i>Table 3: Thermal data</i> and <i>Section 4: Package mechanical data</i> accordingly.
19-Sep-2016	5	Added the order codes STGB3HF60HD and STGF3HF60HD. Added TO-220FP and D ² PAK packages. Updated <i>Table 1: "Device summary"</i> , <i>Section 1: "Electrical ratings"</i> , <i>Section 4: "Package information"</i> . Minor text changes.

IMPORTANT NOTICE – PLEASE READ CAREFULLY

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2016 STMicroelectronics – All rights reserved