

Automotive-grade 10 A, 410 V internally clamped IGBT

Datasheet - production data

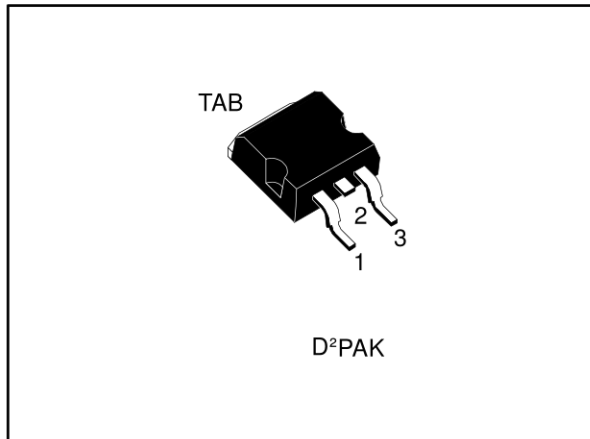
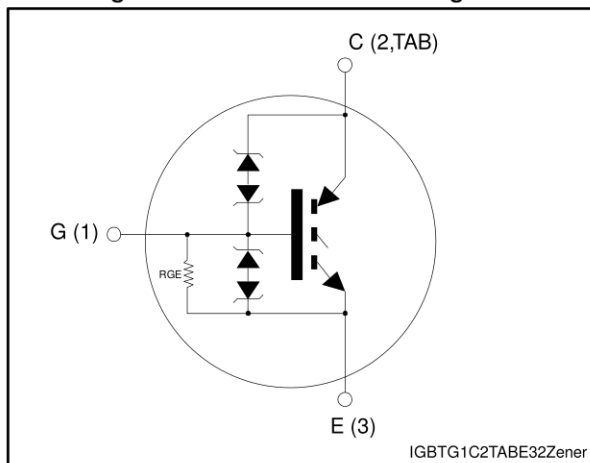


Figure 1: Internal schematic diagram



Features

Order code	V _{CES}	V _{CE(sat)} max.	I _C
STGB10NB40LZT4	Clamped	1.8 V	20 A

- AEC-Q101 qualified
- Low threshold voltage
- Low on-voltage drop
- Low gate charge
- High current capability
- High voltage clamping feature



Applications

- Switching applications

Description

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, PowerMESH™ with an overall outstanding performance. The built-in collector-gate Zener exhibits a very precise active clamping while the gate-emitter Zener supplies the ESD protection.

Table 1: Device summary

Order code	Marking	Package	Packing
STGB10NB40LZT4	GB10NB40LZ	D²PAK	Tape and reel

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1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{GE} = 0\text{ V}$)	$V_{CES(\text{clamped})}$	V
V_{ECS}	Emitter-collector voltage ($V_{GE} = 0\text{ V}$)	18	V
I_C	Continuous collector current at $T_C = 25\text{ °C}$	20	A
	Continuous collector current at $T_C = 100\text{ °C}$	10	A
$I_{CM}^{(1)}$	Collector current (pulsed)	40	A
E_{AS}	Single pulse energy $T_C = 25\text{ °C}$	300	mJ
V_{GE}	Gate-emitter voltage	$V_{GE(\text{clamped})}$	V
P_{TOT}	Total dissipation at $T_C = 25\text{ °C}$	150	W
ESD	Human body model, $R = 1.5\text{ k}\Omega$, $C = 100\text{ pF}$	4	kV
T_{STG}	Storage temperature range	- 55 to 175	°C
T_J	Operating junction temperature range		

Notes:

⁽¹⁾Pulse width limited by safe operating area.

Table 3: Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case	1	°C/W
R_{thJA}	Thermal resistance junction-ambient	62.5	°C/W

2 Electrical characteristics

$T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified

Table 4: Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{CES(\text{clamped})}$	Collector-emitter clamped voltage	$I_C = 2\text{ mA}$, $V_{GE} = 0\text{ V}$, $T_J = -40\text{ }^{\circ}\text{C}$ to $150\text{ }^{\circ}\text{C}$	380	410	440	V
$V_{(BR)ECS}$	Emitter-collector break-down voltage	$I_C = 75\text{ mA}$, $V_{GE} = 0\text{ V}$	18			V
$V_{GE(\text{clamped})}$	Gate-emitter clamped voltage	$I_G = \pm 2\text{ mA}$	12		16	V
$V_{CE(\text{sat})}$	Collector-emitter saturation voltage	$V_{GE} = 4.5\text{ V}$, $I_C = 10\text{ A}$		1.2	1.8	V
		$V_{GE} = 4.5\text{ V}$, $I_C = 20\text{ A}$		1.3		
$V_{GE(\text{th})}$	Gate-threshold voltage	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$, $T_J = -40\text{ }^{\circ}\text{C}$ to $150\text{ }^{\circ}\text{C}$	0.6		2.2	V
I_{CES}	Collector cut-off current	$V_{CE} = 15\text{ V}$, $V_{GE} = 0\text{ V}$, $T_J = 150\text{ }^{\circ}\text{C}$			10	μA
		$V_{CE} = 200\text{ V}$, $V_{GE} = 0\text{ V}$, $T_J = 150\text{ }^{\circ}\text{C}$			100	μA
I_{GES}	Gate-emitter leakage current	$V_{GE} = \pm 10\text{ V}$, $V_{CE} = 0\text{ V}$			± 700	μA
R_{GE}	Gate emitter resistance			20		k Ω

Table 5: Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g_{fs}	Forward transconductance	$V_{CE} = 15\text{ V}$, $I_C = 10\text{ A}$	-	18	-	S
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	1300	-	pF
C_{oes}	Output capacitance		-	105	-	
C_{res}	Reverse transfer capacitance		-	12	-	
Q_g	Total gate charge	$V_{CE} = 328\text{ V}$, $I_C = 10\text{ A}$, $V_{GE} = 5\text{ V}$	-	28	-	nC

Table 6: Functional characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CL}	Latching current	$V_{\text{Clamp}} = 328\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}$ $R_{\text{GOFF}} = 1\text{ k}\Omega$, $V_{GE} = 5\text{ V}$		40	-	A
U.I.S.	Functional test open secondary coil	$R_{\text{GOFF}} = 1\text{ k}\Omega$, $L = 1\text{ mH}$, $T_C = 125\text{ }^{\circ}\text{C}$	13		-	A

Table 7: IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 328 \text{ V}$, $I_C = 10 \text{ A}$, $R_G = 1 \text{ k}\Omega$, $V_{GE} = 5 \text{ V}$	-	1300	-	ns
t_r	Rise time		-	270	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	60	-	A/ μ s
E_{on}	Turn-on switching energy	$V_{CC} = 328 \text{ V}$, $I_C = 10 \text{ A}$, $R_G = 1 \text{ k}\Omega$, $V_{GE} = 5 \text{ V}$	-	2.4	-	mJ
		$V_{CC} = 328 \text{ V}$, $I_C = 10 \text{ A}$, $R_G = 1 \text{ k}\Omega$, $V_{GE} = 5 \text{ V}$, $T_c = 125 \text{ }^\circ\text{C}$	-	2.6	-	mJ
t_c	Cross-over time	$V_{CC} = 328 \text{ V}$, $I_C = 10 \text{ A}$, $R_{GE} = 1 \text{ k}\Omega$, $V_{GE} = 5 \text{ V}$	-	3.6	-	μ s
$t_{r(Voff)}$	Off voltage rise time		-	2	-	μ s
$t_{d(off)}$	Turn-off-delay time		-	8	-	μ s
t_f	Fall time		-	1.4	-	μ s
$E_{off}^{(1)}$	Turn-off switching energy		-	5	-	mJ
t_c	Cross-over time	$V_{CC} = 328 \text{ V}$, $I_C = 10 \text{ A}$, $R_{GE} = 1 \text{ k}\Omega$, $V_{GE} = 5 \text{ V}$, $T_J = 125 \text{ }^\circ\text{C}$	-	5.7	-	μ s
$t_{r(Voff)}$	Off voltage rise time		-	2.7	-	μ s
$t_{d(off)}$	Turn-off-delay time		-	9.2	-	μ s
t_f	Fall time		-	2.8	-	μ s
$E_{off}^{(1)}$	Turn-off switching energy		-	8.7	-	mJ

Notes:⁽¹⁾Including the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 2: Output characteristics

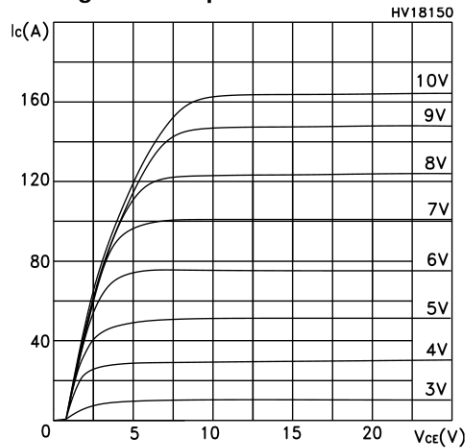


Figure 3: Transfer characteristics

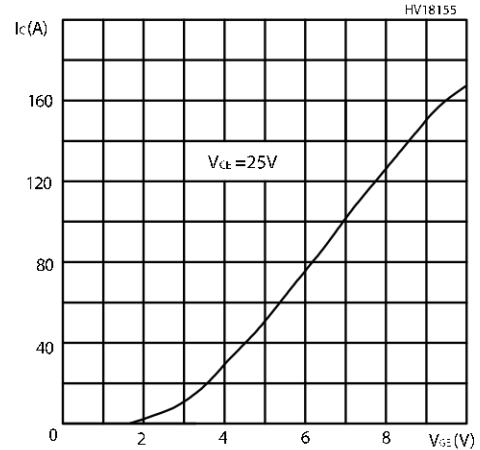


Figure 4: Transconductance

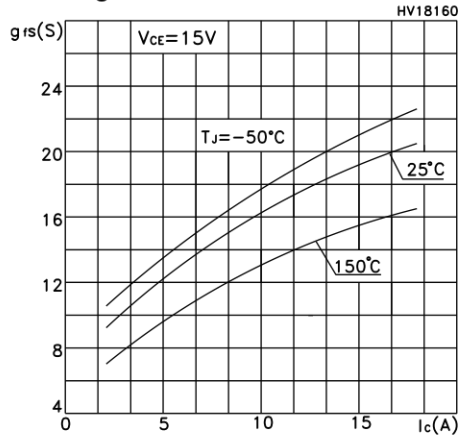


Figure 5: Normalized collector-emitter on voltage vs temperature

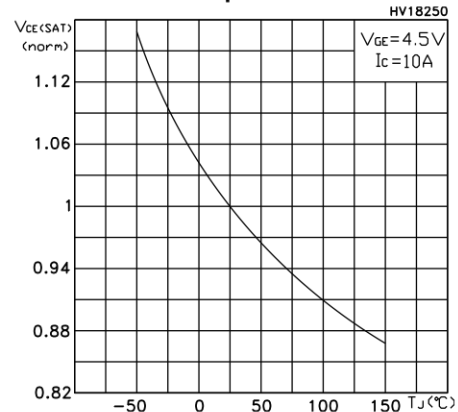


Figure 6: Collector-emitter on voltage vs temperature

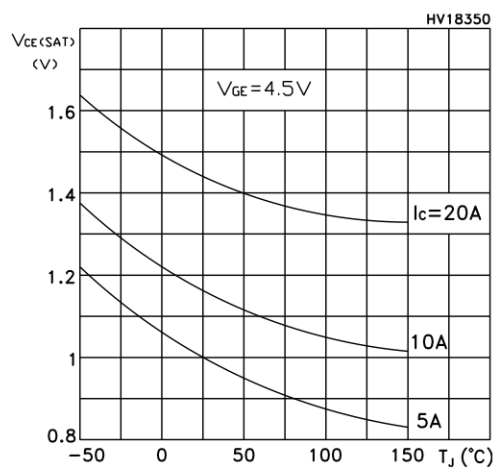


Figure 7: Collector-emitter on voltage vs collector current

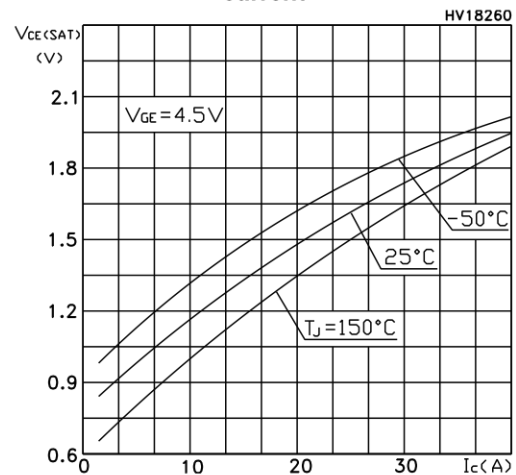


Figure 8: Gate threshold vs temperature

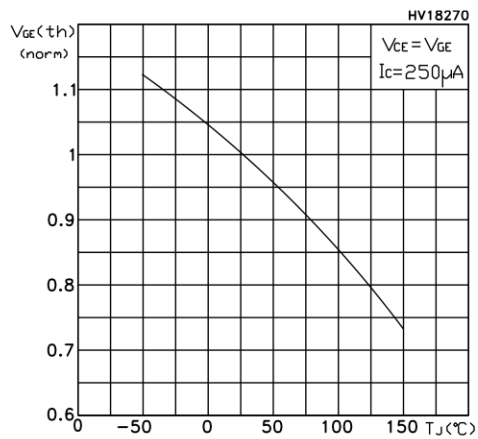


Figure 9: Normalized clamping voltage vs temperature

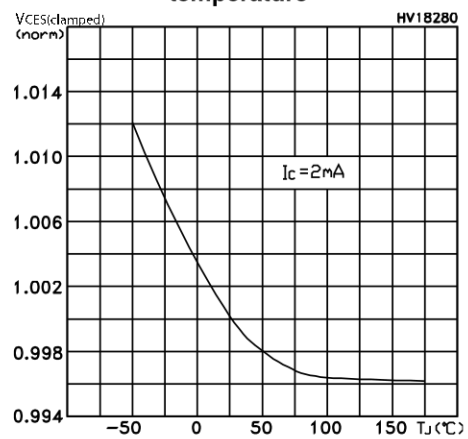


Figure 10: Capacitance variations

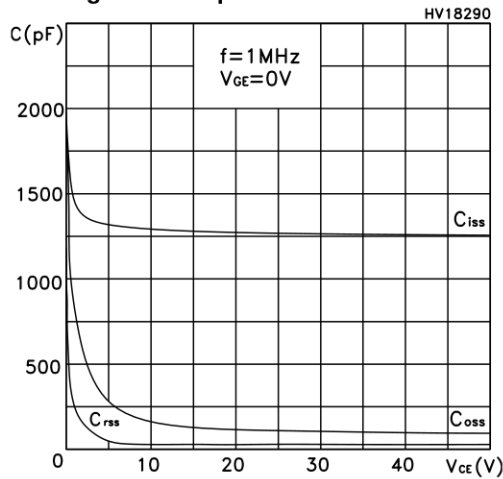


Figure 11: Gate charge vs gate-emitter voltage

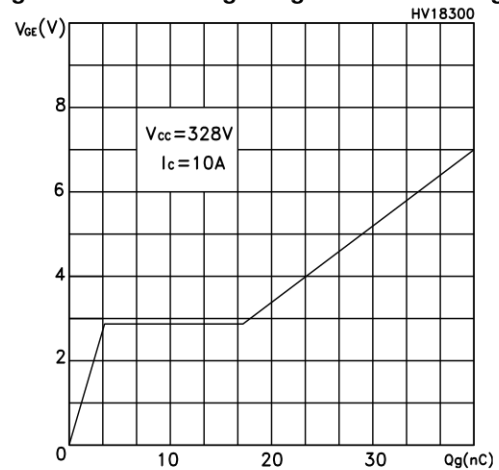


Figure 12: Total switching energy vs gate resistance

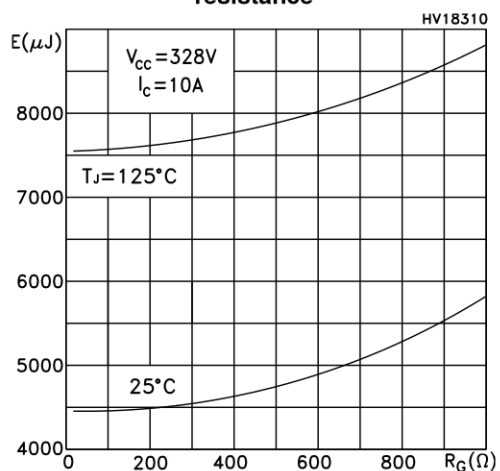


Figure 13: Total switching energy vs temperature

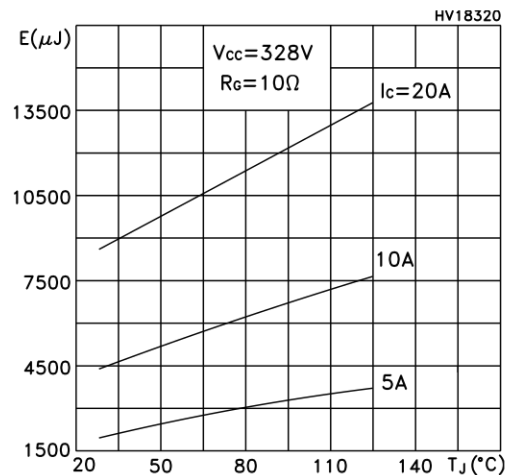


Figure 14: Total switching energy vs collector current

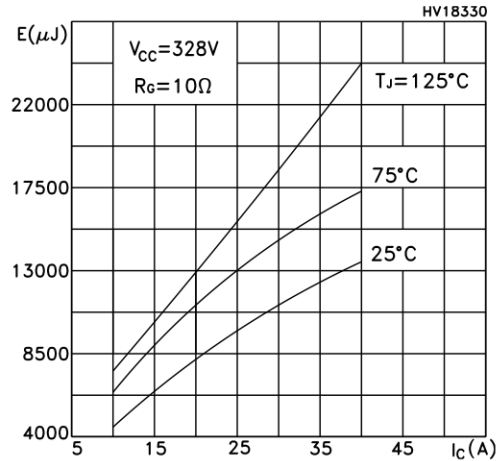


Figure 15: Thermal impedance

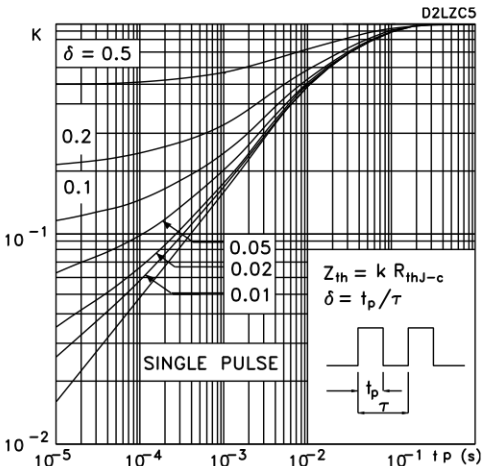
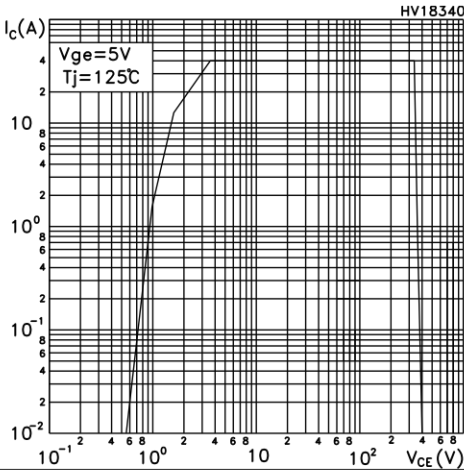


Figure 16: Turn-Off SOA



3 Test circuits

Figure 17: Unclamped inductive load test circuit

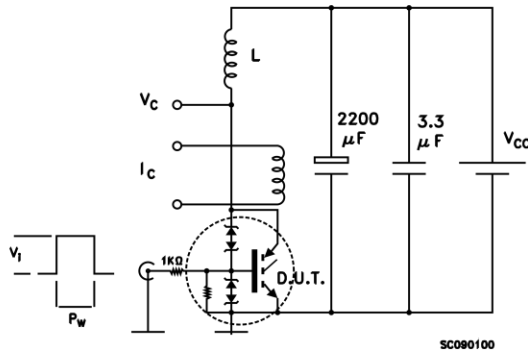


Figure 18: Unclamped inductive waveform

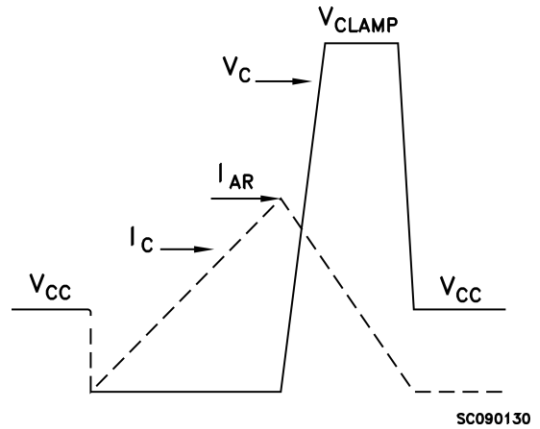


Figure 19: Test circuit for inductive load switching and diode recovery times

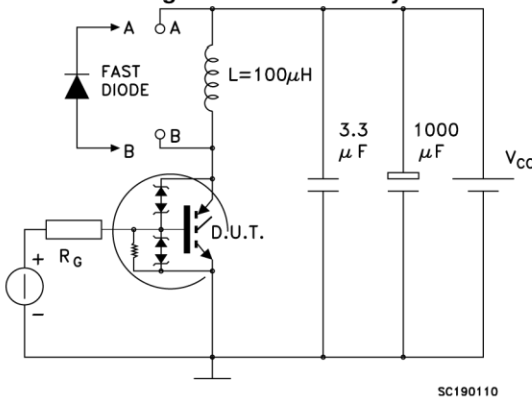
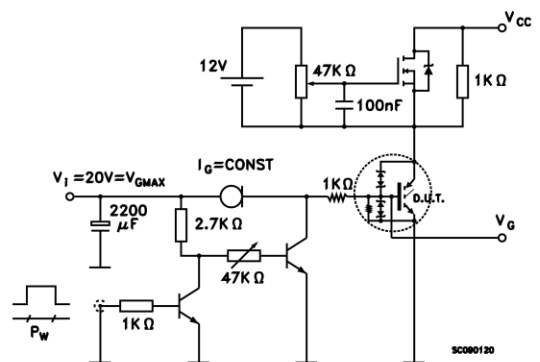


Figure 20: Gate charge test circuit



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) type A package information

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

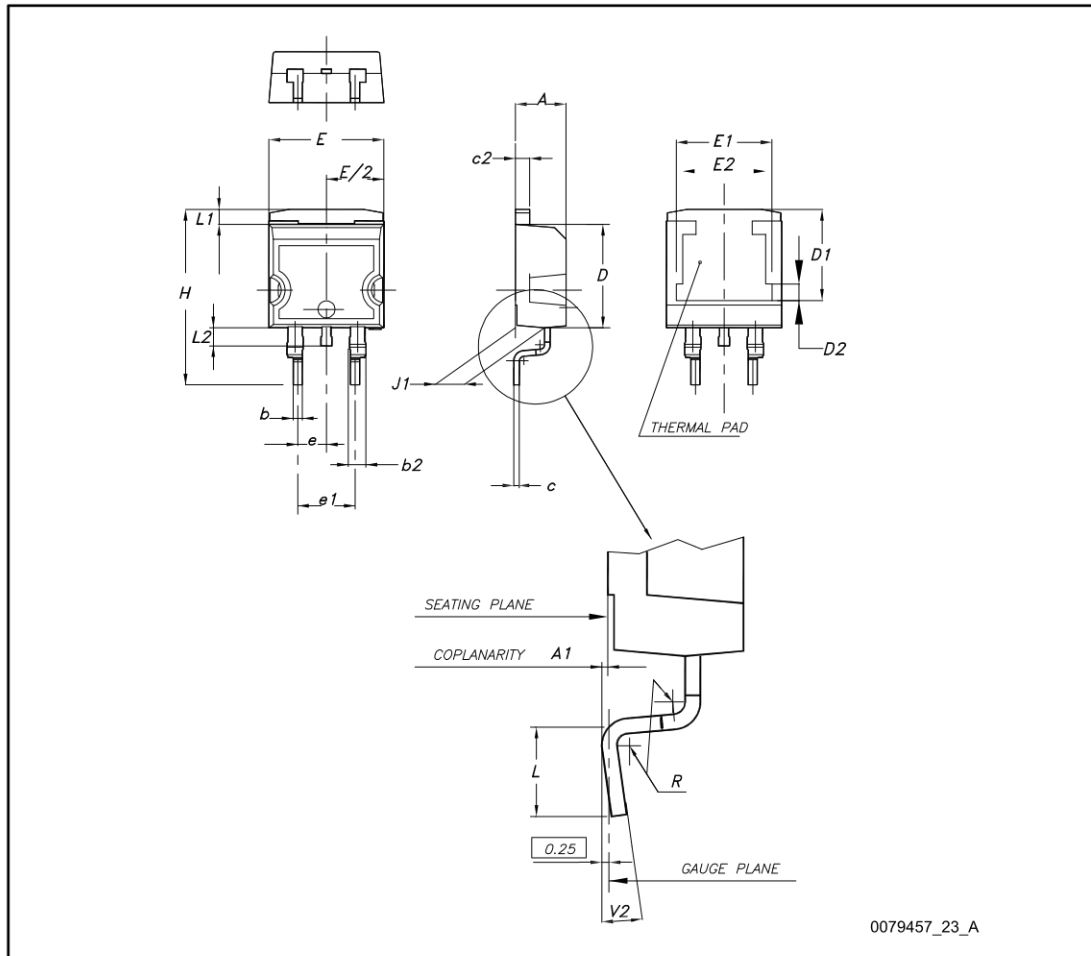
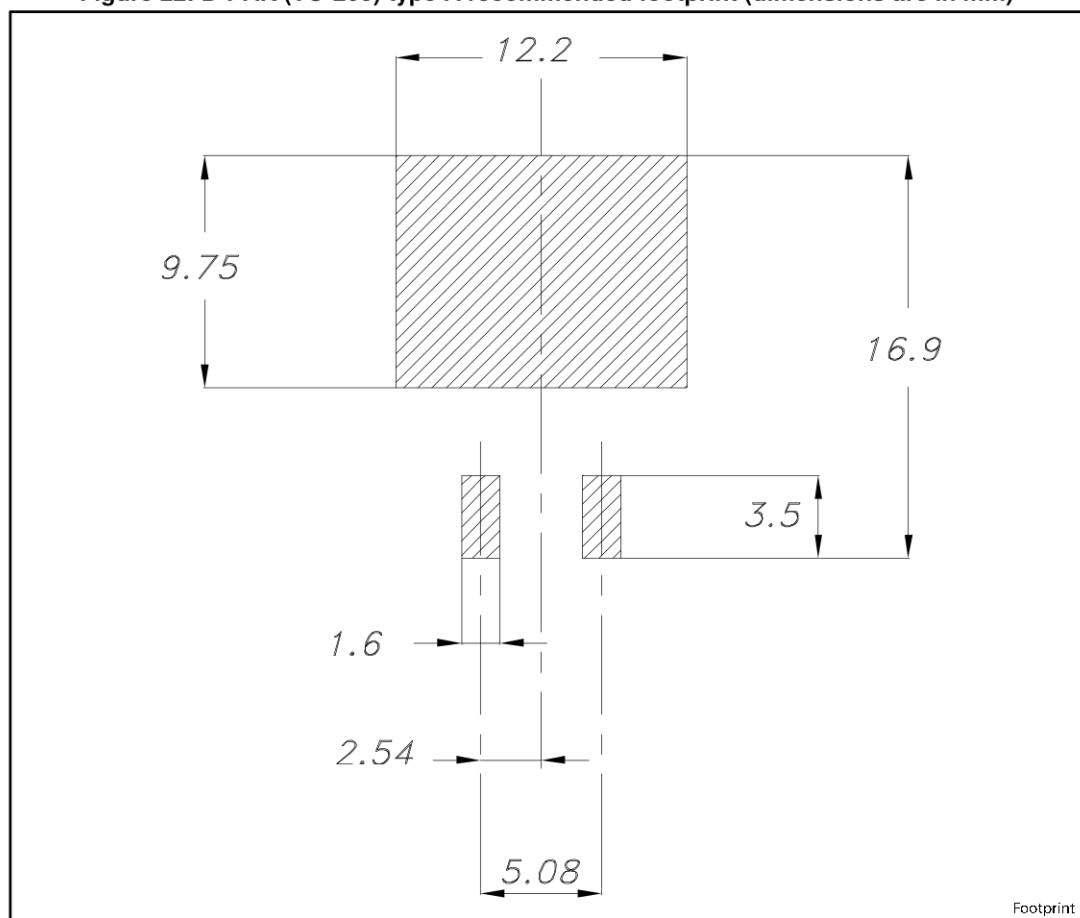


Table 8: D²PAK (TO-263) type A package mechanical data

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	10.00		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	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.40	
V2	0°		8°

Figure 22: D²PAK (TO-263) type A recommended footprint (dimensions are in mm)

4.2 Packing information

Figure 23: D2PAK type A tape outline

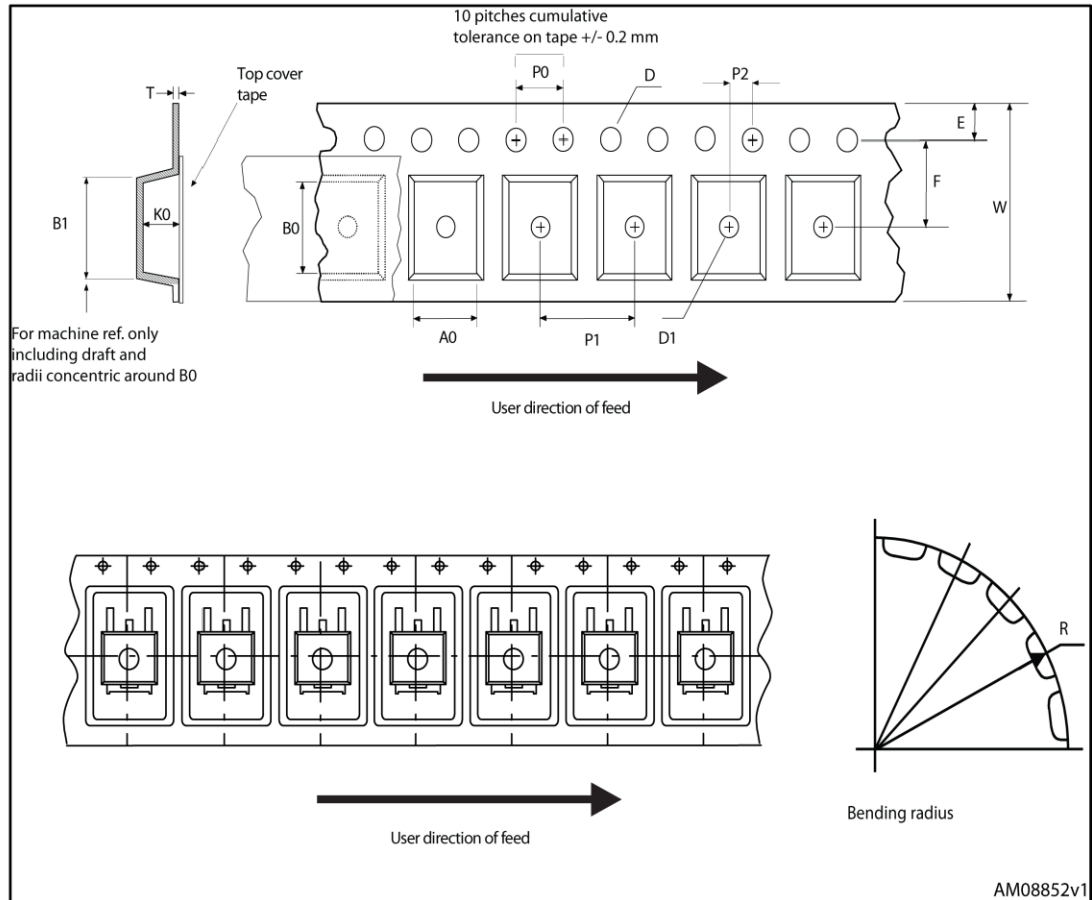
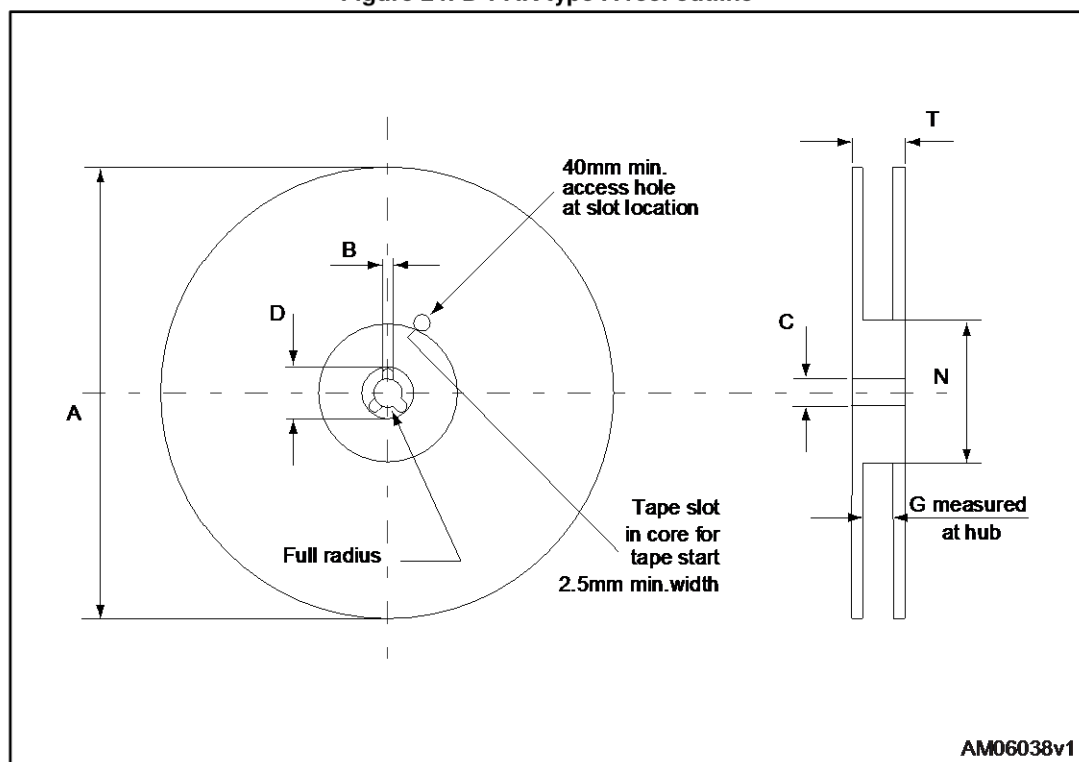


Figure 24: D²PAK type A reel outlineTable 9: D²PAK type A tape and reel mechanical data

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			

5 Revision history

Table 10: Document revision history

Date	Revision	Changes
01-Mar-2017	1	First release.

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