

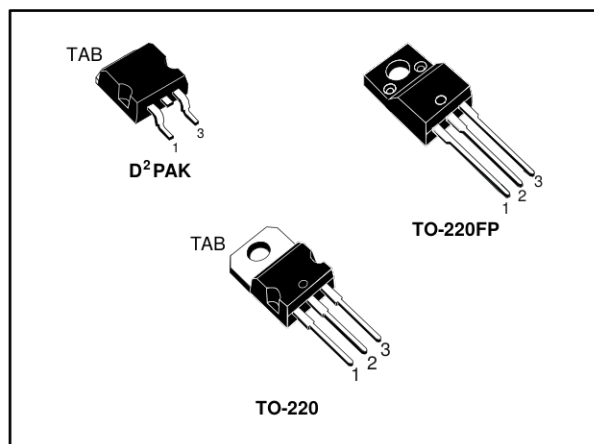
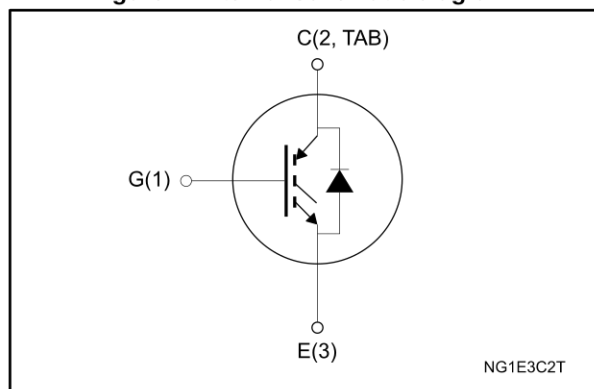


Figure 1: Internal schematic diagram



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 drives

Description

These devices are very fast IGBTs developed using advanced PowerMESH™ technology. This process guarantees an excellent trade-off between switching performance and low on-state behavior.

Table 1: Device summary

Order code	Marking	Package	Packing
STGB19NC60KDT4	GB19NC60KD	D²PAK	Tape and reel
STGF19NC60KD	GF19NC60KD	TO-220FP	Tube
STGP19NC60KD	GP19NC60KD	TO-220	

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) type A package information	11
4.2	D ² PAK (TO-263) type B package information	14
4.3	D ² PAK type A packing information	17
4.4	D ² PAK type B 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
		D ² PAK, TO-220	TO-220FP	
V _{CES}	Collector-emitter voltage (V _{GE} = 0 V)	600		V
I _C ⁽¹⁾	Continuous collector current at T _C = 25 °C	35	16	A
	Continuous collector current 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
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat-sink (t = 1 s; T _C = 25 °C)		2500	V
t _{scw}	Short-circuit withstand time V _{CE} = 300 V, T _J = 125 °C, R _G = 10 Ω, V _{GE} = 12 V	10		μs
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}, V_{GE} = 15 V, R_G = 10 Ω, T_J = 150 °C.

(3) Pulse width limited by maximum junction temperature.

Table 3: Thermal data

Symbol	Parameter	Value		Unit
		D ² PAK, TO-220	TO-220FP	
R _{thj-case}	Thermal resistance junction-case IGBT	1	3.9	°C/W
R _{thj-case}	Thermal resistance junction-case diode	3	5.6	
R _{thj-amb}	Thermal resistance junction-ambient	62.5		

2 Electrical characteristics

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

Table 4: Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$I_C = 1\text{ mA}$, $V_{GE} = 0\text{ V}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 12\text{ A}$		2.0	2.75	V
		$V_{GE} = 15\text{ V}$, $I_C = 12\text{ A}$, $T_C = 125\text{ °C}$		1.65		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	4.5		6.5	V
I_{CES}	Collector cut-off current	$V_{CE} = 600\text{ V}$, $V_{GE} = 0\text{ V}$			150	μA
		$V_{CE} = 600\text{ V}$, $V_{GE} = 0\text{ V}$, $T_C = 125\text{ °C}$ ⁽¹⁾			1	mA
I_{GES}	Gate-emitter leakage current	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$			± 100	nA

Notes:

⁽¹⁾Defined by design, not subject to production test.

Table 5: Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	1170	-	pF
C_{oes}	Output capacitance		-	127	-	
C_{res}	Reverse transfer capacitance		-	28	-	
Q_g	Total gate charge	$V_{CE} = 480\text{ V}$, $I_C = 12\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 20: "Gate charge test circuit")	-	55	-	nC
Q_{ge}	Gate-emitter charge		-	11	-	
Q_{gc}	Gate-collector charge		-	26	-	

Table 6: Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 480\text{ V}$, $I_C = 12\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$ (see Figure 19: "Test circuit for inductive load switching" and Figure 21: "Switching waveform")	-	30	-	ns
t_r	Current rise time		-	8	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1450	-	A/ μ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 480\text{ V}$, $I_C = 12\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_C = 125\text{ }^\circ\text{C}$ (see Figure 19: "Test circuit for inductive load switching" and Figure 21: "Switching waveform")	-	30	-	ns
t_r	Current rise time		-	8	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1380	-	A/ μ s
$t_{r(Voff)}$	Off voltage rise time	$V_{CC} = 480\text{ V}$, $I_C = 12\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$ (see Figure 19: "Test circuit for inductive load switching" and Figure 21: "Switching waveform")	-	35	-	ns
$t_{d(off)}$	Turn-off delay time		-	105	-	ns
t_f	Current fall time		-	85	-	ns
$t_{r(Voff)}$	Off voltage rise time	$V_{CC} = 480\text{ V}$, $I_C = 12\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_C = 125\text{ }^\circ\text{C}$ (see Figure 19: "Test circuit for inductive load switching" and Figure 21: "Switching waveform")	-	65	-	ns
$t_{d(off)}$	Turn-off delay time		-	145	-	ns
t_f	Current fall time		-	125	-	ns

Table 7: Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on(1)}$	Turn-on switching energy	$V_{CC} = 480\text{ V}$, $I_C = 12\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$ (see Figure 19: "Test circuit for inductive load switching")	-	165	-	μ J
$E_{off(2)}$	Turn-off switching energy		-	255	-	μ J
E_{ts}	Total switching energy		-	420	-	μ J
$E_{on(1)}$	Turn-on switching energy	$V_{CC} = 480\text{ V}$, $I_C = 12\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_C = 125\text{ }^\circ\text{C}$ (see Figure 19: "Test circuit for inductive load switching")	-	250	-	μ J
$E_{off(2)}$	Turn-off switching energy		-	445	-	μ J
E_{ts}	Total switching energy		-	695	-	μ J

Notes:

(1) Including the reverse recovery of the diode.

(2) Including the tail of the collector current.

Table 8: Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F	Forward on-voltage	$I_F=12\text{ A}$	-	1.9	-	V
		$I_F=12\text{ A}$, $T_C=125\text{ °C}$	-	1.6	-	V
t_{rr}	Reverse recovery time	$I_F=12\text{ A}$, $V_R=40\text{ V}$, $di/dt=100\text{ A/}\mu\text{s}$ (see Figure 22: "Diode reverse recovery waveform")	-	31	-	ns
Q_{rr}	Reverse recovery charge		-	30	-	nC
I_{rrm}	Reverse recovery current		-	2	-	A
t_{rr}	Reverse recovery time	$I_F=12\text{ A}$, $V_R=40\text{ V}$, $T_C=125\text{ °C}$, $di/dt=100\text{ A/}\mu\text{s}$ (see Figure 22: "Diode reverse recovery waveform")	-	50	-	ns
Q_{rr}	Reverse recovery charge		-	70	-	nC
I_{rrm}	Reverse recovery current		-	4	-	A

2.1 Electrical characteristics (curves)

Figure 2: Output characteristics

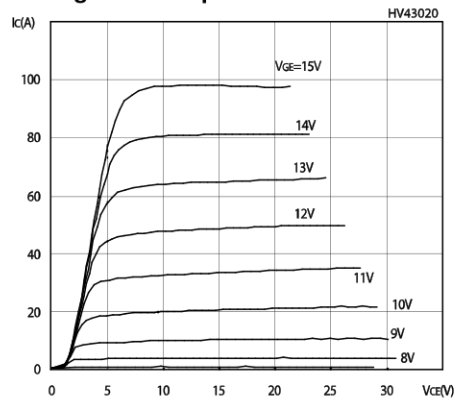


Figure 3: Transfer characteristics

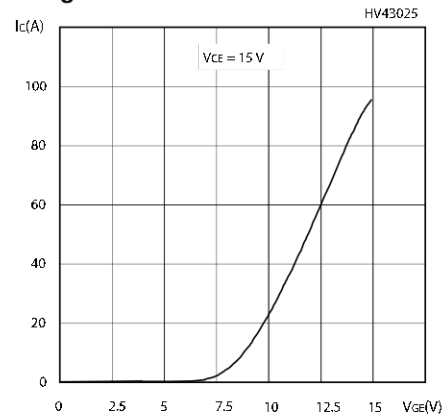


Figure 4: Collector-emitter on voltage vs temperature

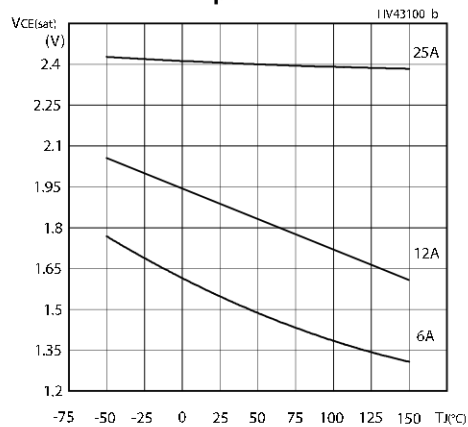


Figure 5: Gate charge vs gate-source voltage

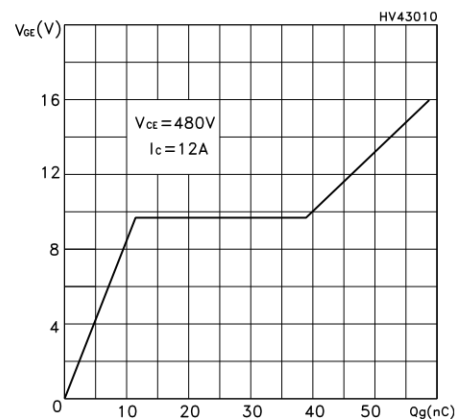


Figure 6: Capacitance variations

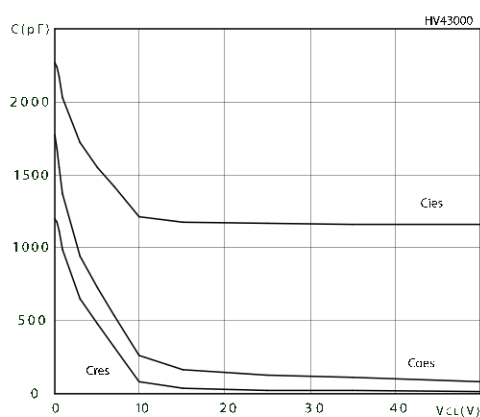


Figure 7: Normalized gate threshold voltage vs temperature

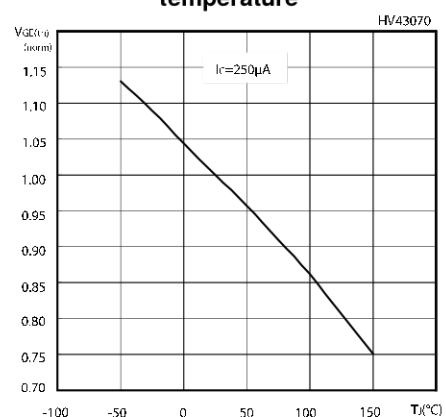


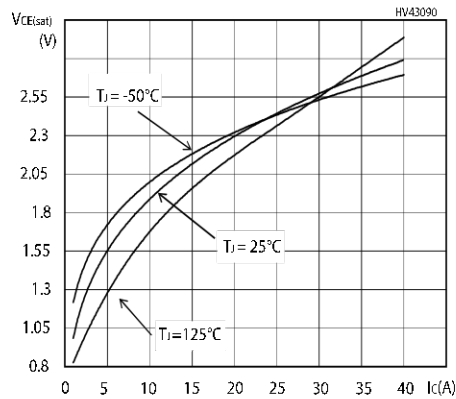
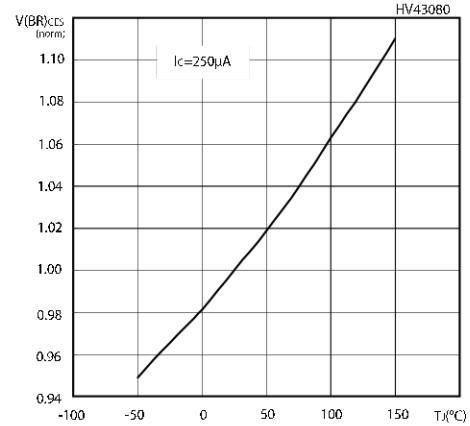
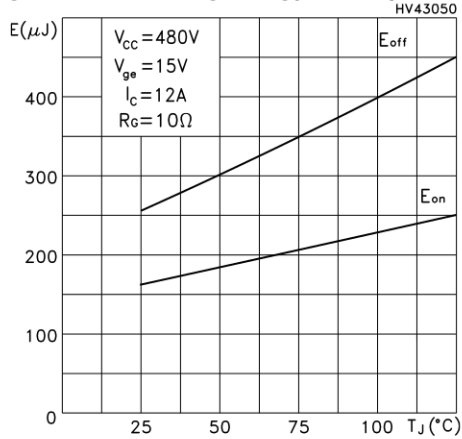
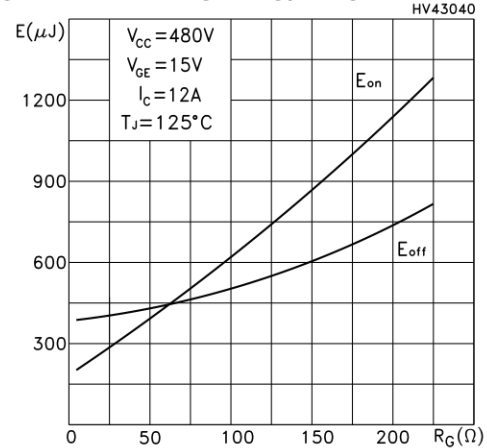
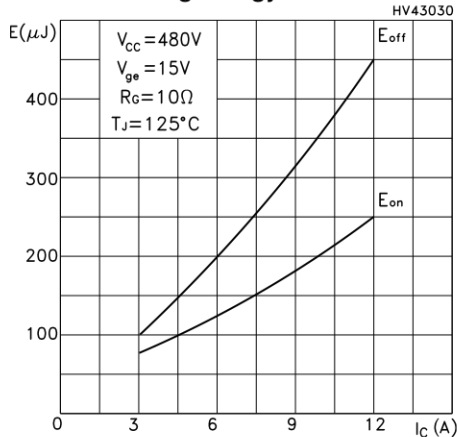
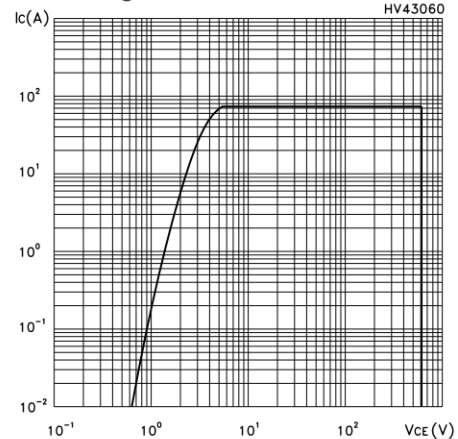
Figure 8: Collector-emitter on voltage vs collector current**Figure 9: Normalized breakdown voltage vs temperature****Figure 10: Switching energy vs temperature****Figure 11: Switching energy vs. gate resistance****Figure 12: Switching energy vs collector current****Figure 13: Turn-off SOA**

Figure 14: Emitter-collector diode characteristics

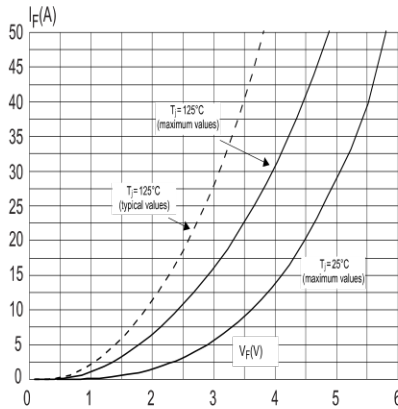


Figure 15: Thermal impedance for TO-220, D²PAK

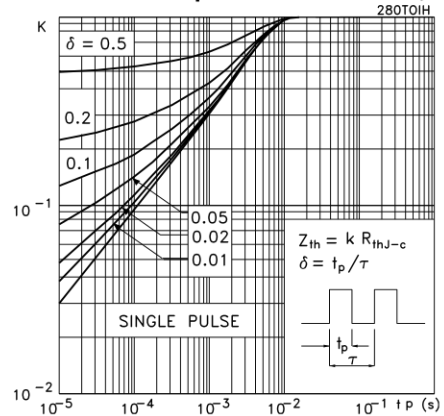


Figure 16: Thermal impedance for TO-220FP

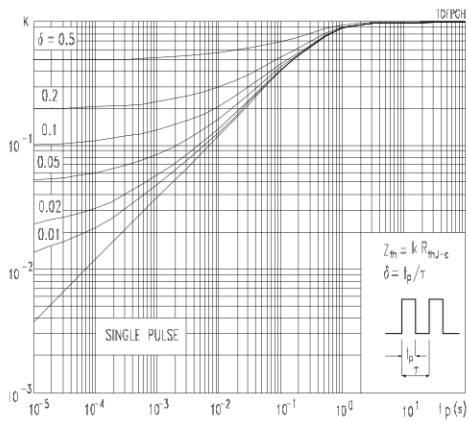


Figure 17: Maximum DC collector current vs T_{CASE} for TO-220FP

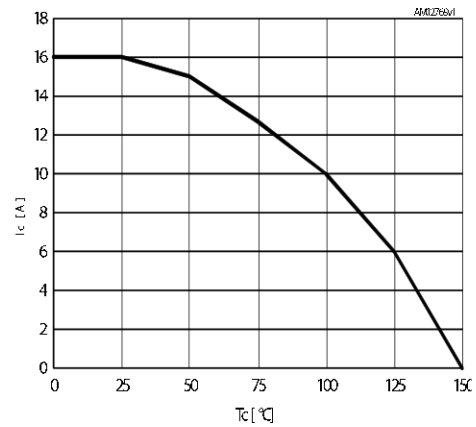
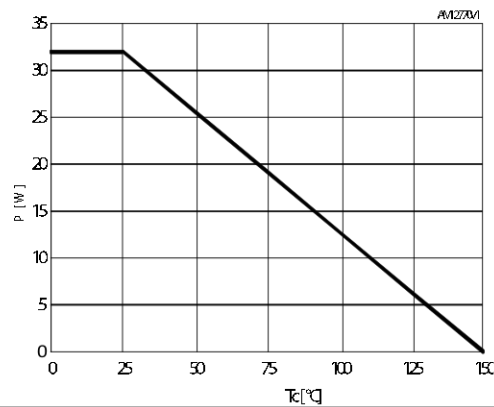


Figure 18: Maximum power dissipation vs T_{CASE} for TO-220FP



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) type A package information

Figure 23: D²PAK (TO-263) type A package outline

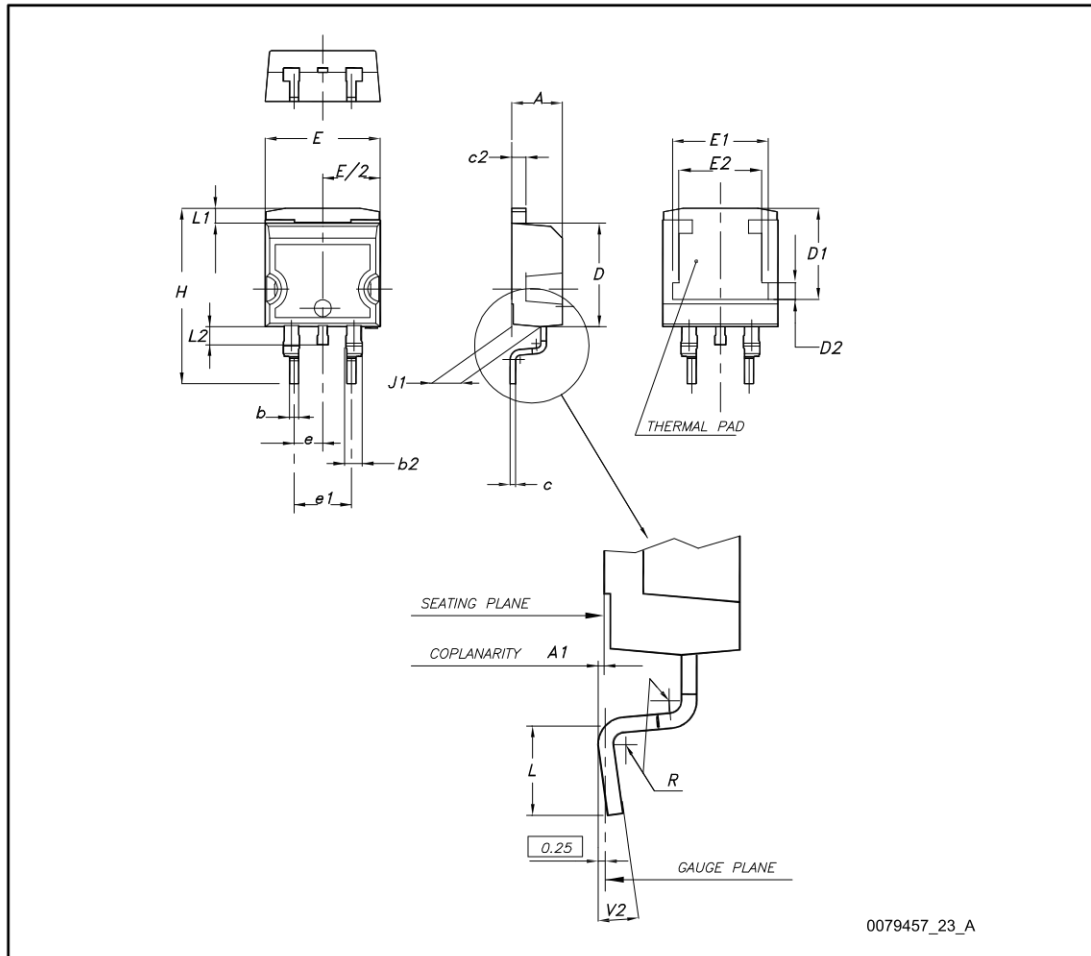
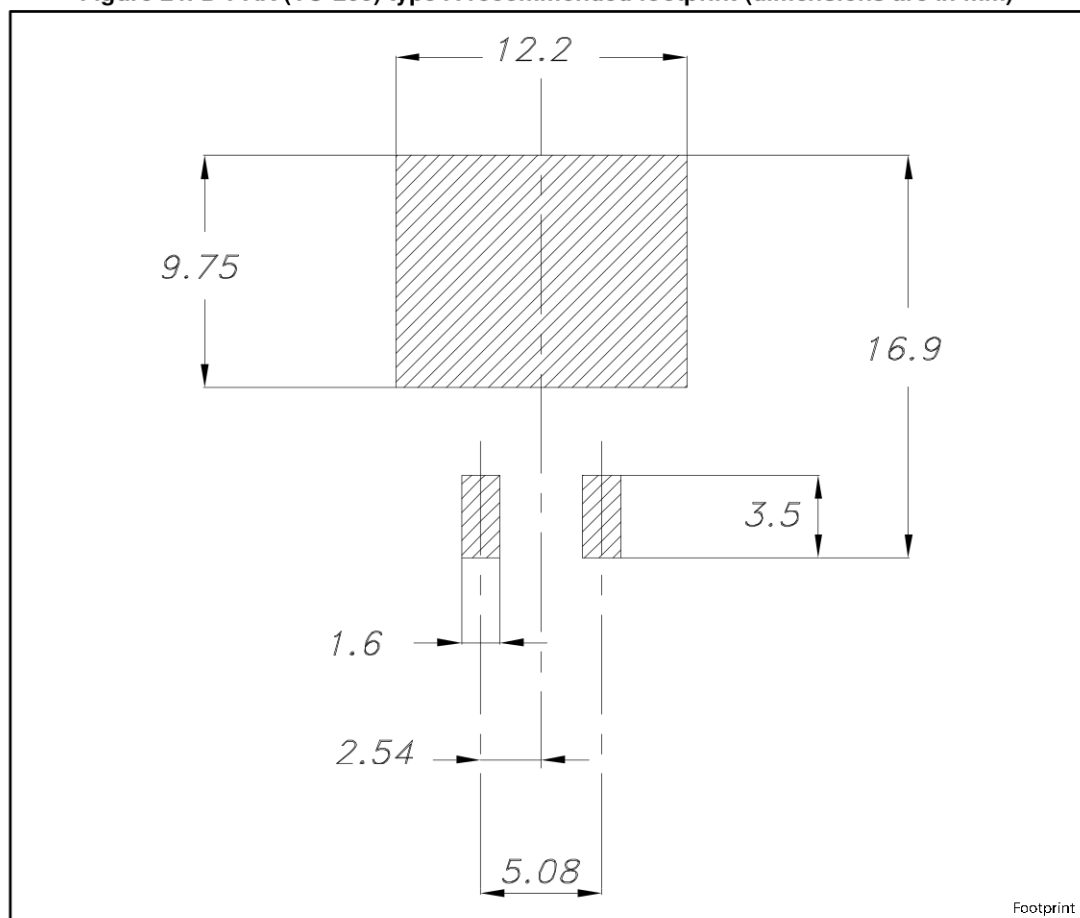


Table 9: D²PAK (TO-263) type A package mechanical data

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	10.00		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 24: D²PAK (TO-263) type A recommended footprint (dimensions are in mm)



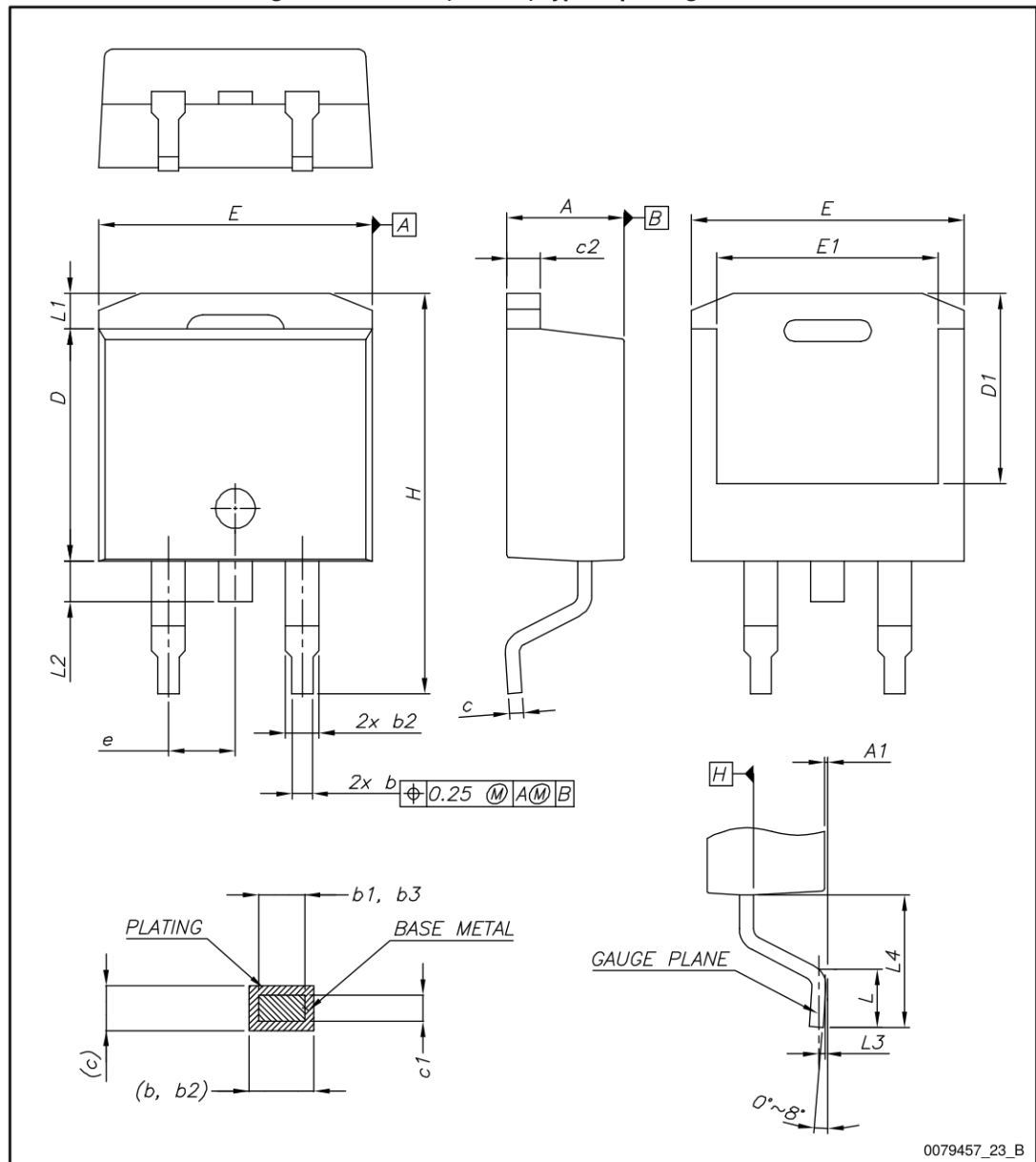
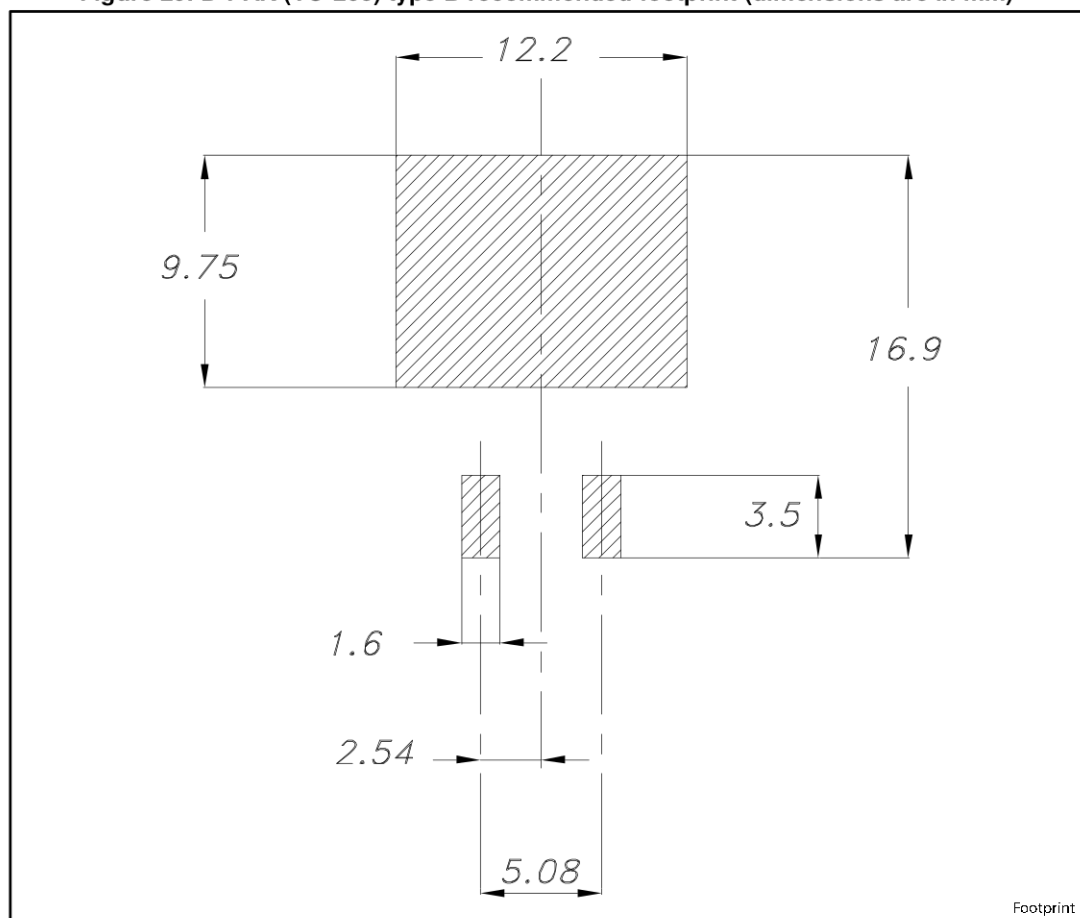
4.2 D²PAK (TO-263) type B package informationFigure 25: D²PAK (TO-263) type B package outline

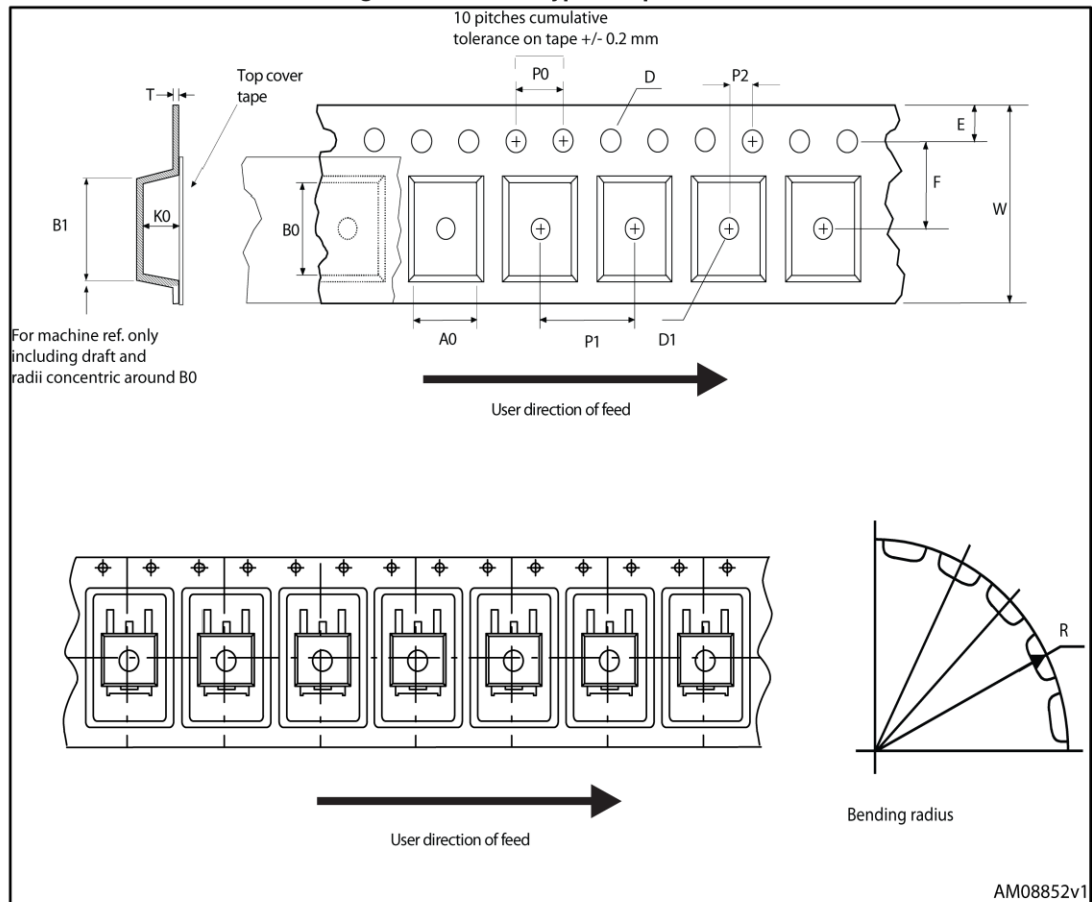
Table 10: D²PAK (TO-263) type B mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.36		4.56
A1	0		0.25
b	0.70		0.90
b1	0.51		0.89
b2	1.17		1.37
b3	1.36		1.46
c	0.38		0.694
c1	0.38		0.534
c2	1.19		1.34
D	8.60		9.00
D1	6.90		7.50
E	10.15		10.55
E1	8.10		8.70
e	2.54 BSC		
H	15.00		15.60
L	1.90		2.50
L1			1.65
L2			1.78
L3		0.25	
L4	4.78		5.28

Figure 26: D²PAK (TO-263) type B recommended footprint (dimensions are in mm)

4.3 D²PAK type A packing information

Figure 27: D²PAK type A tape outline



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			

4.4 D²PAK type B packing information

Figure 29: D²PAK type B tape outline

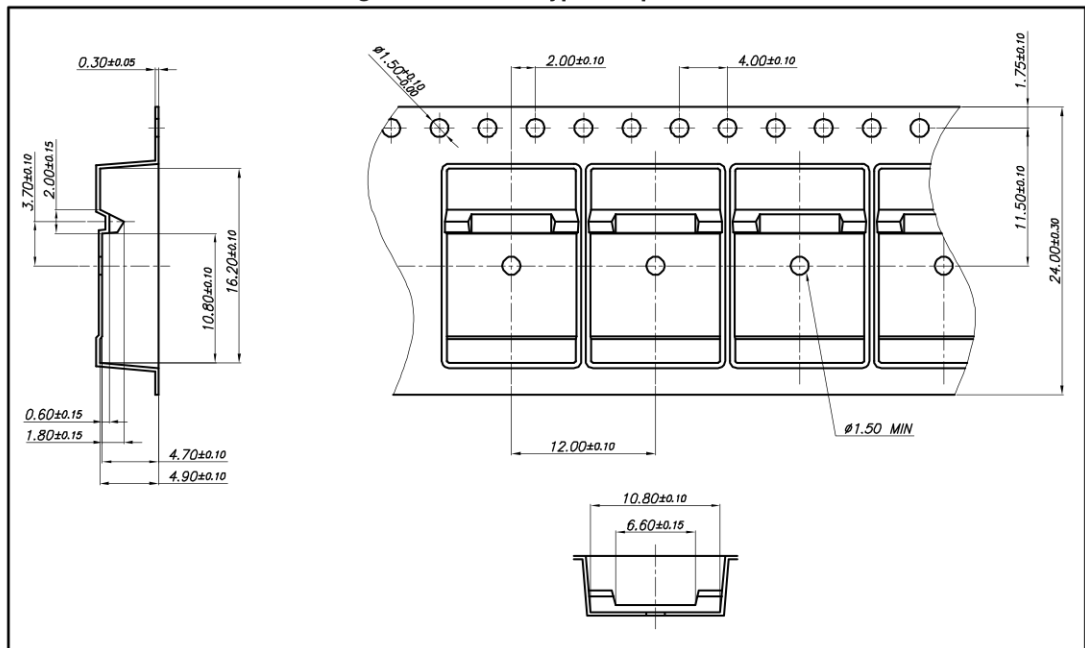


Figure 30: D²PAK type B reel outline

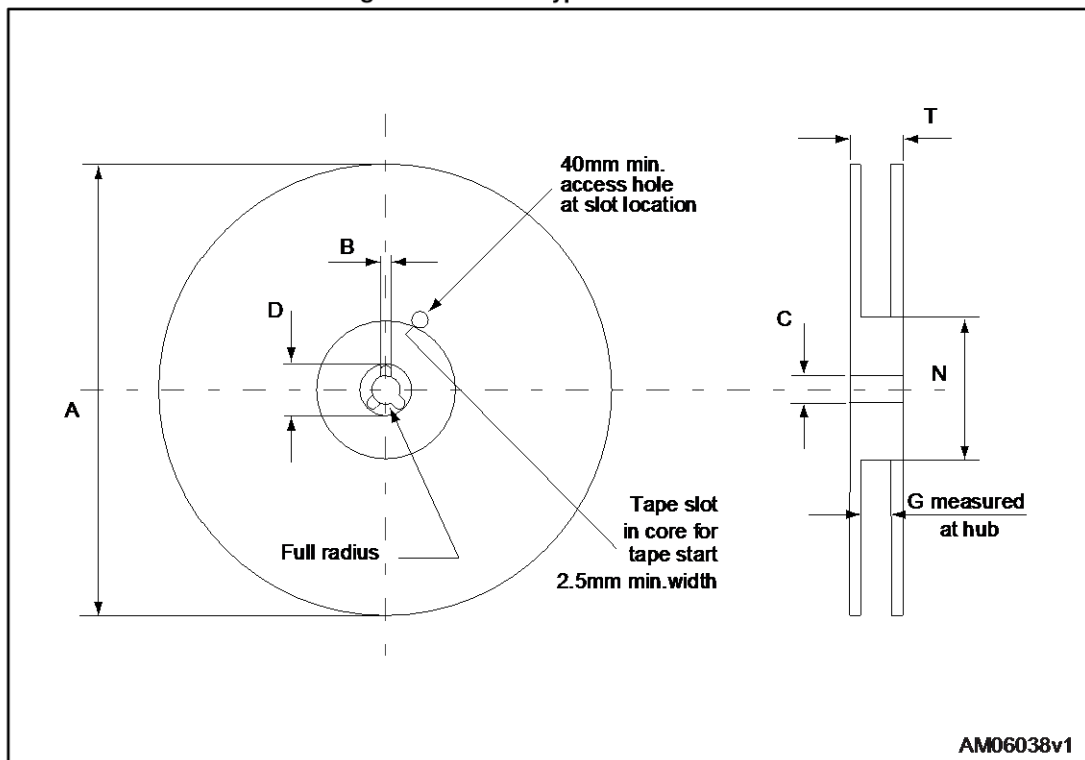
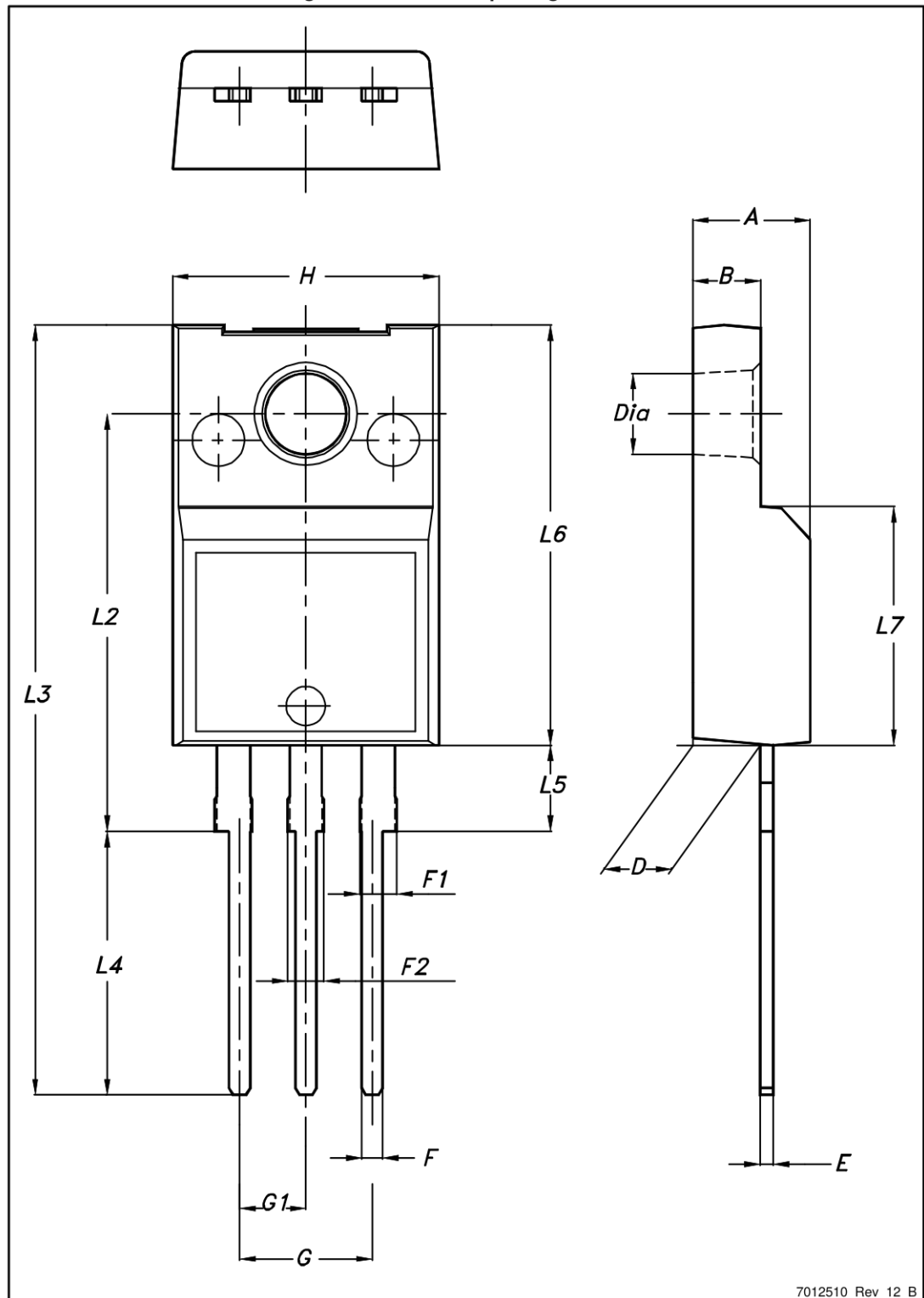


Table 12: D²PAK type B reel mechanical data

Dim.	mm	
	Min.	Max.
A		330
B	1.5	
C	12.8	13.2
D	20.2	
G	24.4	26.4
N	100	
T		30.4

4.5 TO-220FP package information

Figure 31: TO-220FP package outline



7012510_Rev_12_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 32: TO-220 type A package outline

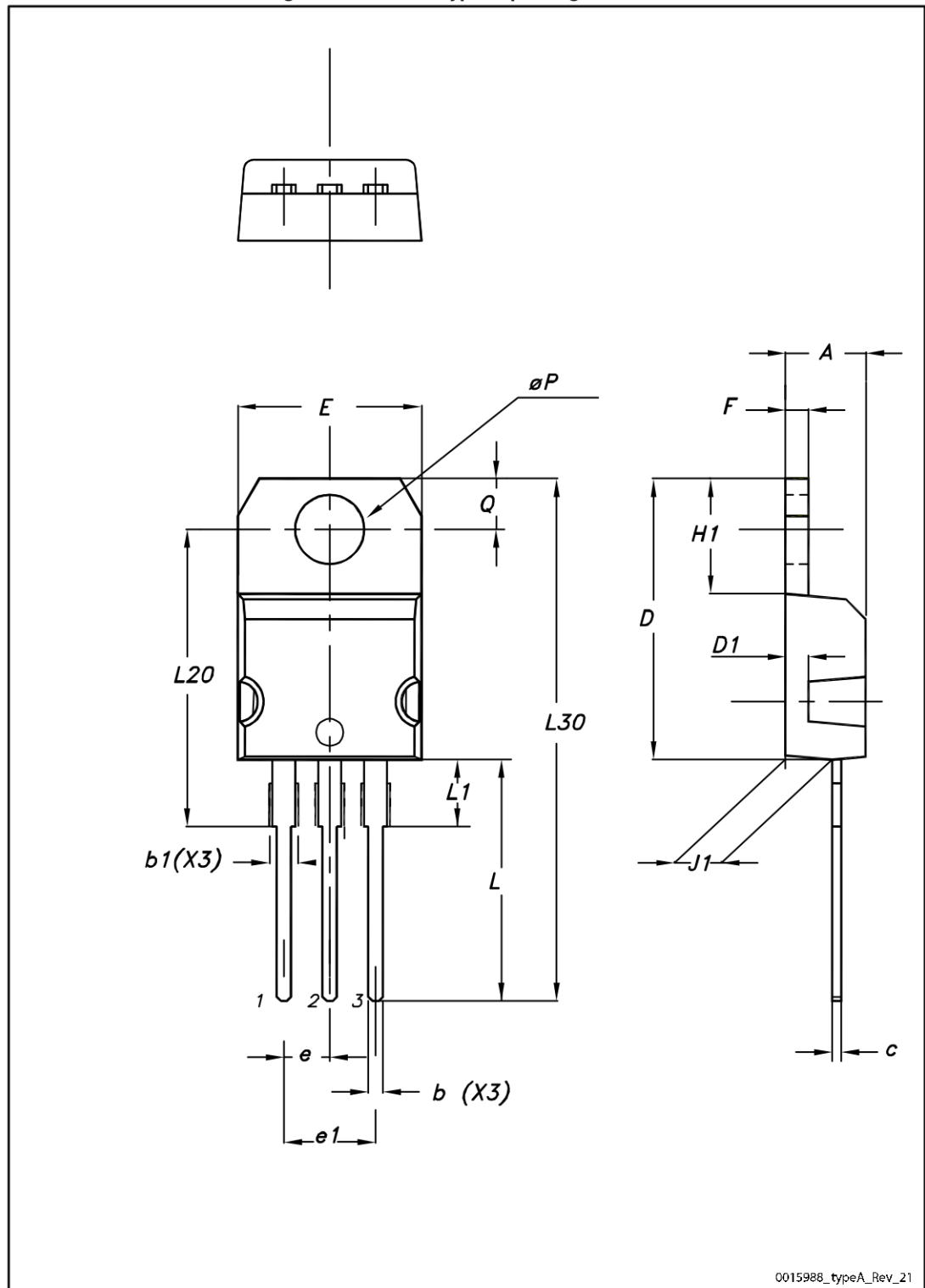


Table 14: TO-220 type A package mechanical data

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
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, D ² PAK and Figure 17: Thermal impedance for TO-220FP
31-Jul-2012	3	Added: Figure 18 and Figure 19 on page 8.
17-Jul-2017	4	Modified internal schematic diagram on cover page Modified Table 2: "Absolute maximum ratings" , Table 3: "Thermal data" , and Table 4: "Static characteristics" . Modified Figure 3: "Transfer characteristics" , Figure 4: "Collector-emitter on voltage vs temperature" and Figure 8: "Collector-emitter on voltage vs collector current" . Updated Section 4: "Package information" . 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.

© 2017 STMicroelectronics – All rights reserved