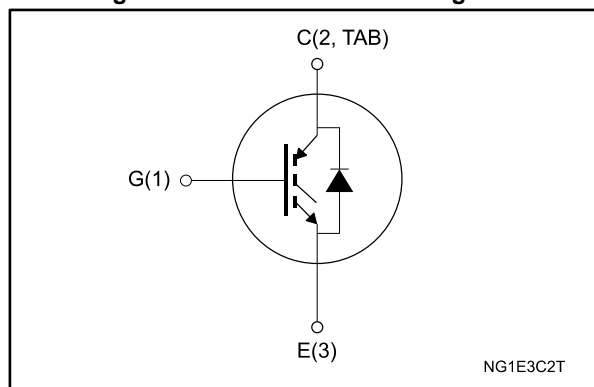


Figure 1: Internal schematic diagram



### Features

- Low on voltage drop ( $V_{CE(sat)}$ )
- Low  $C_{res} / C_{ies}$  ratio (no cross-conduction susceptibility)
- Very soft ultrafast recovery antiparallel diode
- Short-circuit withstand time 10  $\mu$ s

### Applications

- High frequency inverters
- SMPS and PFC in both hard switch and resonant topologies
- 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
STGB14NC60KDT4	GB14NC60KD	D <sup>2</sup> PAK	Tape and reel
STGF14NC60KD	GF14NC60KD	TO-220FP	Tube
STGP14NC60KD	GP14NC60KD	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<sup>2</sup>PAK (TO-263) type A package information ..... 11

    4.2 D<sup>2</sup>PAK (TO-263) type B package information ..... 14

    4.3 D<sup>2</sup>PAK (TO-263) type A packing information ..... 17

    4.4 D<sup>2</sup>PAK (TO-263) 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 <sup>2</sup> PAK, TO-220	TO-220FP	
V <sub>CEs</sub>	Collector-emitter voltage (V <sub>GE</sub> = 0 V)	600		V
I <sub>C</sub> <sup>(1)</sup>	Continuous collector current at T <sub>C</sub> = 25 °C	25	11	A
	Continuous collector current at T <sub>C</sub> = 100 °C	14	7	A
I <sub>CL</sub> <sup>(2)</sup>	Turn-off latching current	50		A
I <sub>CP</sub> <sup>(3)</sup>	Pulsed collector current	50		A
V <sub>GE</sub>	Gate-emitter voltage	±20		V
I <sub>F</sub>	Diode RMS forward current at T <sub>C</sub> =25°C	20		A
I <sub>FSM</sub>	Surge non repetitive forward current t <sub>p</sub> = 10 ms sinusoidal	55		A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	80	28	W
V <sub>ISO</sub>	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s; T <sub>C</sub> =25 °C)	2500		V
t <sub>scw</sub>	Short-circuit withstand time V <sub>CE</sub> = 300 V, T <sub>J</sub> = 125 °C, R <sub>G</sub> = 10 Ω, V <sub>GE</sub> = 12 V	10		µs
T <sub>stg</sub>	Storage temperature range	- 55 to 150		°C
T <sub>J</sub>	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<sub>clamp</sub> = 80 % V<sub>CEs</sub>, V<sub>GE</sub> = 15 V, R<sub>G</sub> = 10 Ω, T<sub>J</sub> = 150 °C.

(3) Pulse width limited by maximum junction temperature and turn-off within RBSOA.

**Table 3: Thermal data**

Symbol	Parameter	Value		Unit
		D <sup>2</sup> PAK, TO-220	TO-220FP	
R <sub>thj-case</sub>	Thermal resistance junction-case IGBT	1.56	4.5	°C/W
R <sub>thj-case</sub>	Thermal resistance junction-case diode	2.2	5.6	
R <sub>thj-amb</sub>	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	$V_{GE} = 15\text{ V}$ , $I_C = 7\text{ A}$		2.1	2.5	V
		$V_{GE} = 15\text{ V}$ , $I_C = 7\text{ A}$ , $T_j = 125\text{ °C}$		1.8		
$V_{GE(th)}$	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	$\mu\text{A}$
		$V_{CE} = 600\text{ V}$ , $V_{GE} = 0\text{ V}$ , $T_j = 125\text{ °C}$ <sup>(1)</sup>			1	mA
$I_{GES}$	Gate-emitter leakage current	$V_{CE} = 0\text{ V}$ , $V_{GE} = \pm 20\text{ V}$			$\pm 100$	nA
$g_{fs}$ <sup>(2)</sup>	Forward transconductance	$V_{CE} = 15\text{ V}$ , $I_C = 7\text{ A}$		3.2		S

**Notes:**

<sup>(1)</sup>Defined by design, not subject to production test.

<sup>(2)</sup>Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

Table 5: Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GE} = 0\text{ V}$	-	760	-	pF
$C_{oes}$	Output capacitance		-	86	-	
$C_{res}$	Reverse transfer capacitance		-	15.5	-	
$Q_g$	Total gate charge	$V_{CE} = 390\text{ V}$ , $I_C = 7\text{ A}$ , $V_{GE} = 0\text{ to }15\text{ V}$ (see <a href="#">Figure 19: "Gate charge test circuit"</a> )	-	34.4	-	nC
$Q_{ge}$	Gate-emitter charge		-	8.1	-	
$Q_{gc}$	Gate-collector charge		-	16.4	-	

Table 6: Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390\text{ V}$ , $I_C = 7\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ (see <a href="#">Figure 18</a> : "Test circuit for inductive load switching" and <a href="#">Figure 20</a> : "Switching waveform")	-	22.5	-	ns
$t_r$	Current rise time		-	8.5	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	700	-	A/ $\mu$ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390\text{ V}$ , $I_C = 7\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125^\circ\text{C}$ (see <a href="#">Figure 18</a> : "Test circuit for inductive load switching" and <a href="#">Figure 20</a> : "Switching waveform")	-	22	-	ns
$t_r$	Current rise time		-	9.5	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	680	-	A/ $\mu$ s
$t_{r(off)}$	Off voltage rise time	$V_{CC} = 390\text{ V}$ , $I_C = 7\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ (see <a href="#">Figure 18</a> : "Test circuit for inductive load switching" and <a href="#">Figure 20</a> : "Switching waveform")	-	60	-	ns
$t_{d(off)}$	Turn-off delay time		-	116	-	ns
$t_f$	Current fall time		-	75	-	ns
$t_{r(off)}$	Off voltage rise time	$V_{CC} = 390\text{ V}$ , $I_C = 7\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125^\circ\text{C}$ (see <a href="#">Figure 18</a> : "Test circuit for inductive load switching" and <a href="#">Figure 20</a> : "Switching waveform")	-	24	-	ns
$t_{d(off)}$	Turn-off delay time		-	196	-	ns
$t_f$	Current fall time		-	144	-	ns

Table 7: Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on(1)}$	Turn-on switching energy	$V_{CC} = 390\text{ V}$ , $I_C = 7\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ (see <a href="#">Figure 18</a> : "Test circuit for inductive load switching")	-	82	-	$\mu$ J
$E_{off(2)}$	Turn-off switching energy		-	155	-	$\mu$ J
$E_{ts}$	Total switching energy		-	237	-	$\mu$ J
$E_{on(1)}$	Turn-on switching energy	$V_{CC} = 390\text{ V}$ , $I_C = 7\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125^\circ\text{C}$ (see <a href="#">Figure 18</a> : "Test circuit for inductive load switching")	-	131	-	$\mu$ J
$E_{off(2)}$	Turn-off switching energy		-	370	-	$\mu$ J
$E_{ts}$	Total switching energy		-	501	-	$\mu$ J

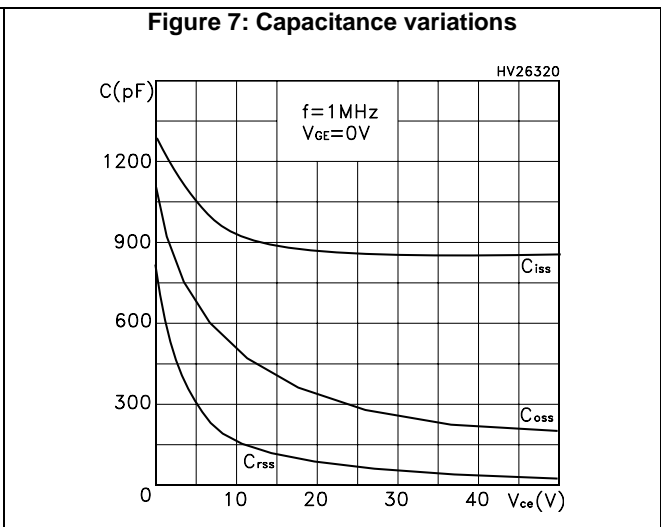
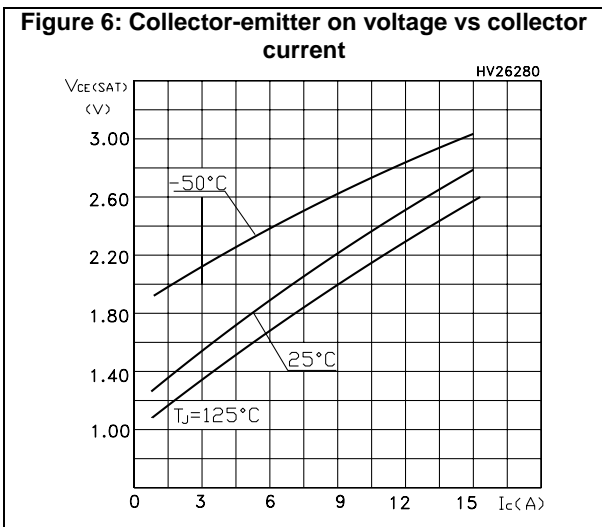
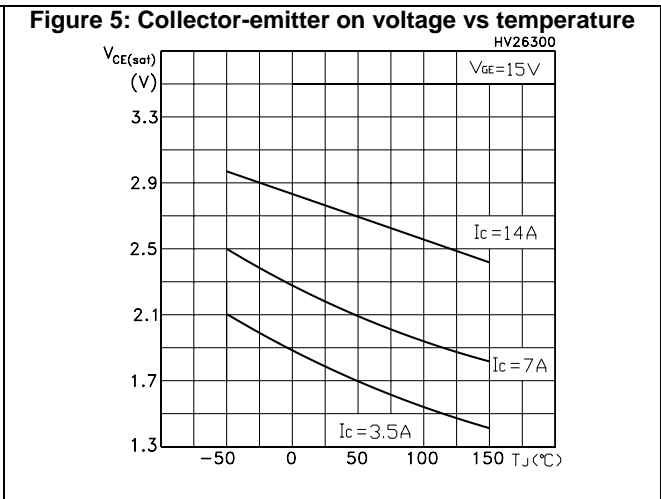
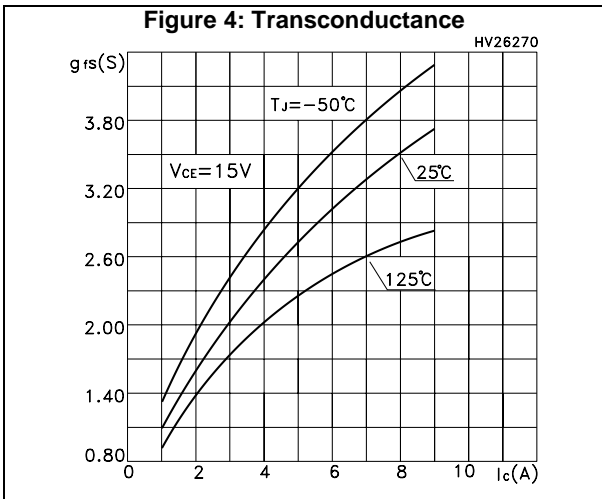
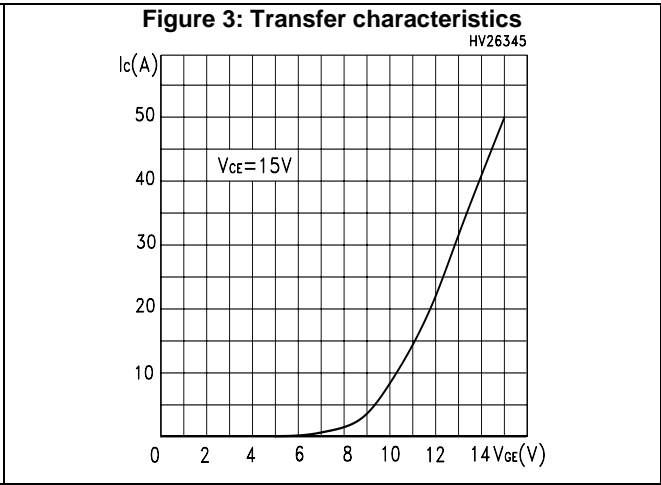
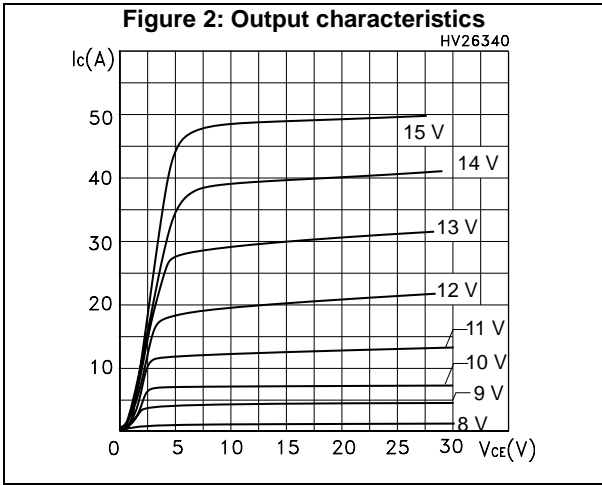
**Notes:**

- (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 <sub>F</sub>	Forward on-voltage	I <sub>F</sub> =7 A	-	1.8	2.1	V
		I <sub>F</sub> =7 A, T <sub>j</sub> =125 °C	-	1.3		V
t <sub>rr</sub>	Reverse recovery time	I <sub>F</sub> =7 A, V <sub>R</sub> =40 V, di/dt=100 A/μs (see <a href="#">Figure 21</a> : "Diode reverse recovery waveform")	-	37		ns
Q <sub>rr</sub>	Reverse recovery charge		-	40		nC
I <sub>rrm</sub>	Reverse recovery current		-	2.1		A
t <sub>rr</sub>	Reverse recovery time	I <sub>F</sub> =7 A, V <sub>R</sub> =40 V, T <sub>j</sub> =125 °C, di/dt=100 A/μs (see <a href="#">Figure 21</a> : "Diode reverse recovery waveform")	-	61		ns
Q <sub>rr</sub>	Reverse recovery charge		-	98		nC
I <sub>rrm</sub>	Reverse recovery current		-	3.2		A

## 2.1 Electrical characteristics (curves)



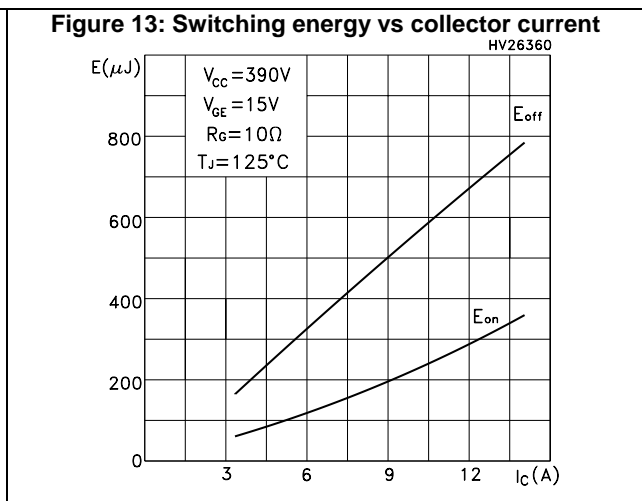
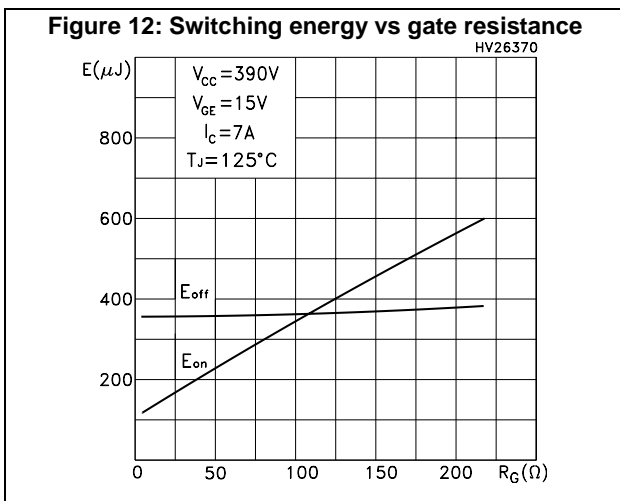
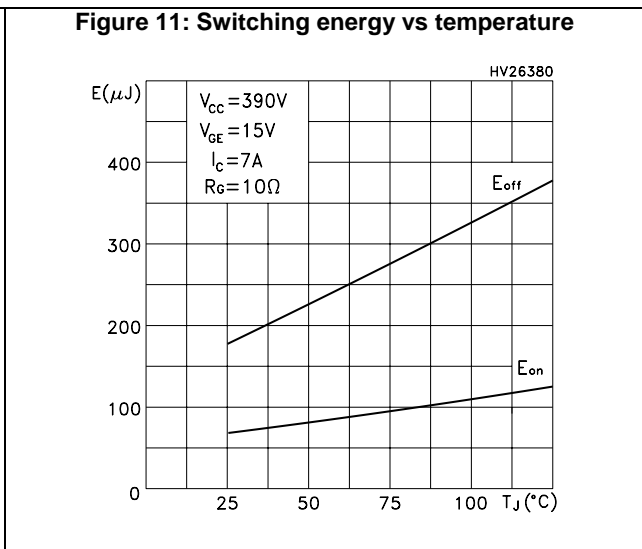
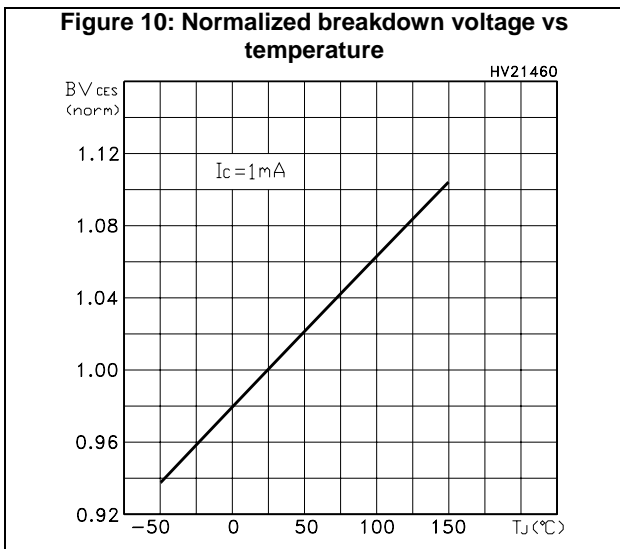
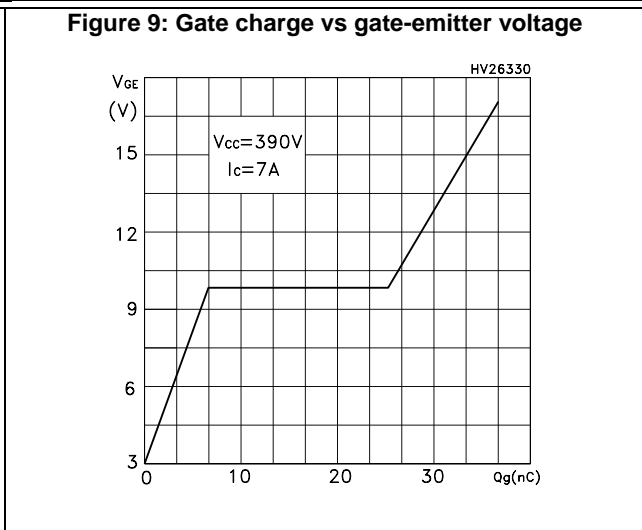
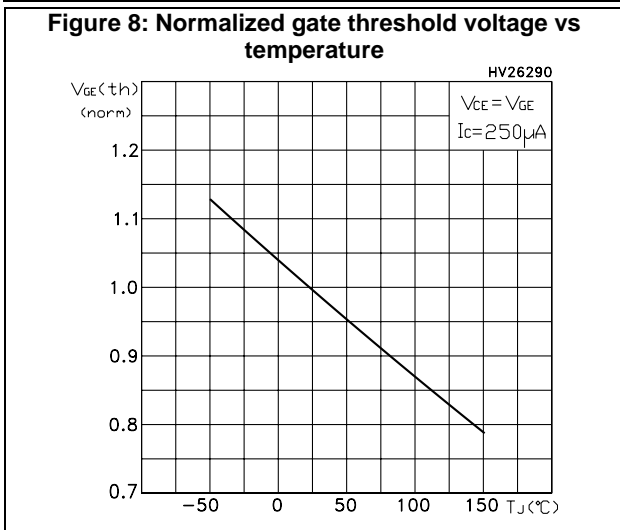




Figure 14: Thermal impedance for D<sup>2</sup>PAK and TO-220

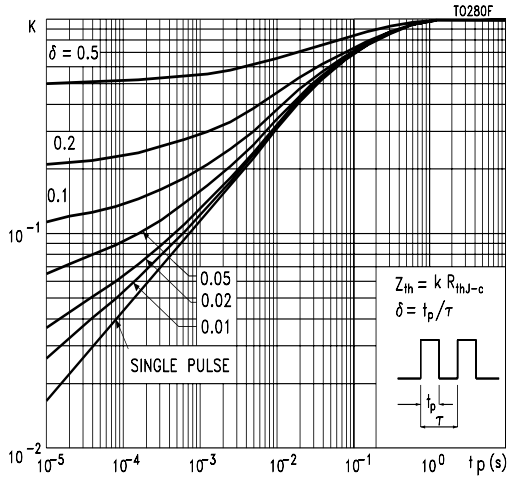


Figure 15: Turn-off SOA

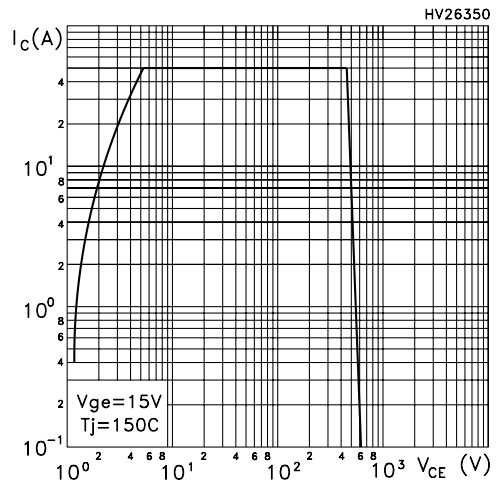


Figure 16: Thermal impedance for TO-220FP

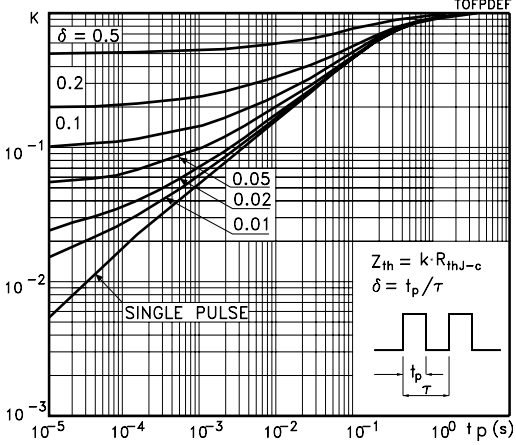
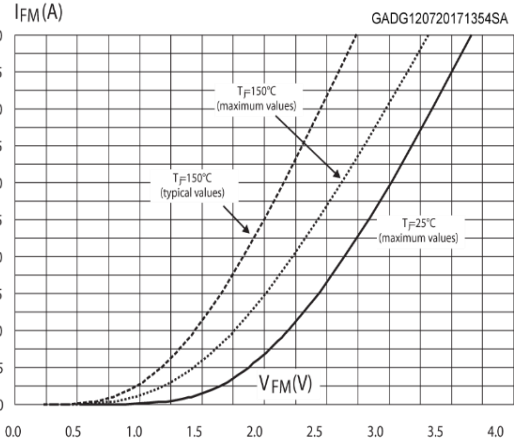
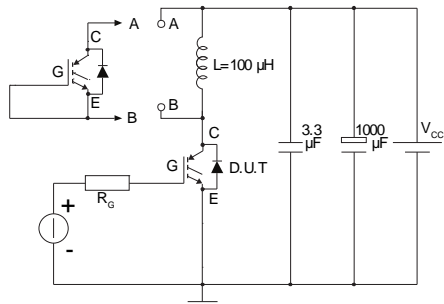


Figure 17: Forward voltage drop vs forward current



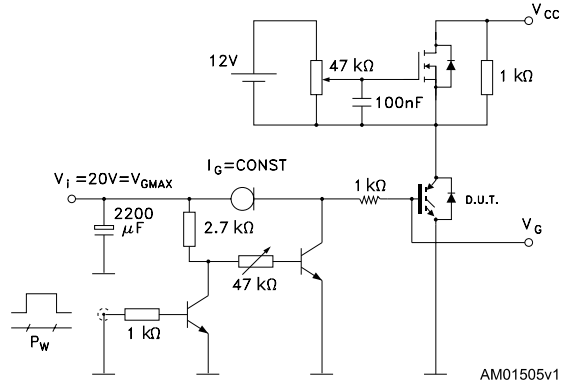
### 3 Test circuits

**Figure 18: Test circuit for inductive load switching**



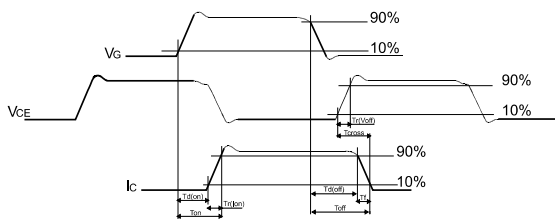
AM01504v1

**Figure 19: Gate charge test circuit**



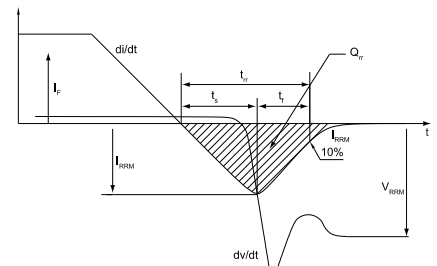
AM01505v1

**Figure 20: Switching waveform**



AM01506v1

**Figure 21: Diode reverse recovery waveform**



GADG180720171418SA

## 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](http://www.st.com). ECOPACK® is an ST trademark.

### 4.1 D<sup>2</sup>PAK (TO-263) type A package information

Figure 22: D<sup>2</sup>PAK (TO-263) type A package outline

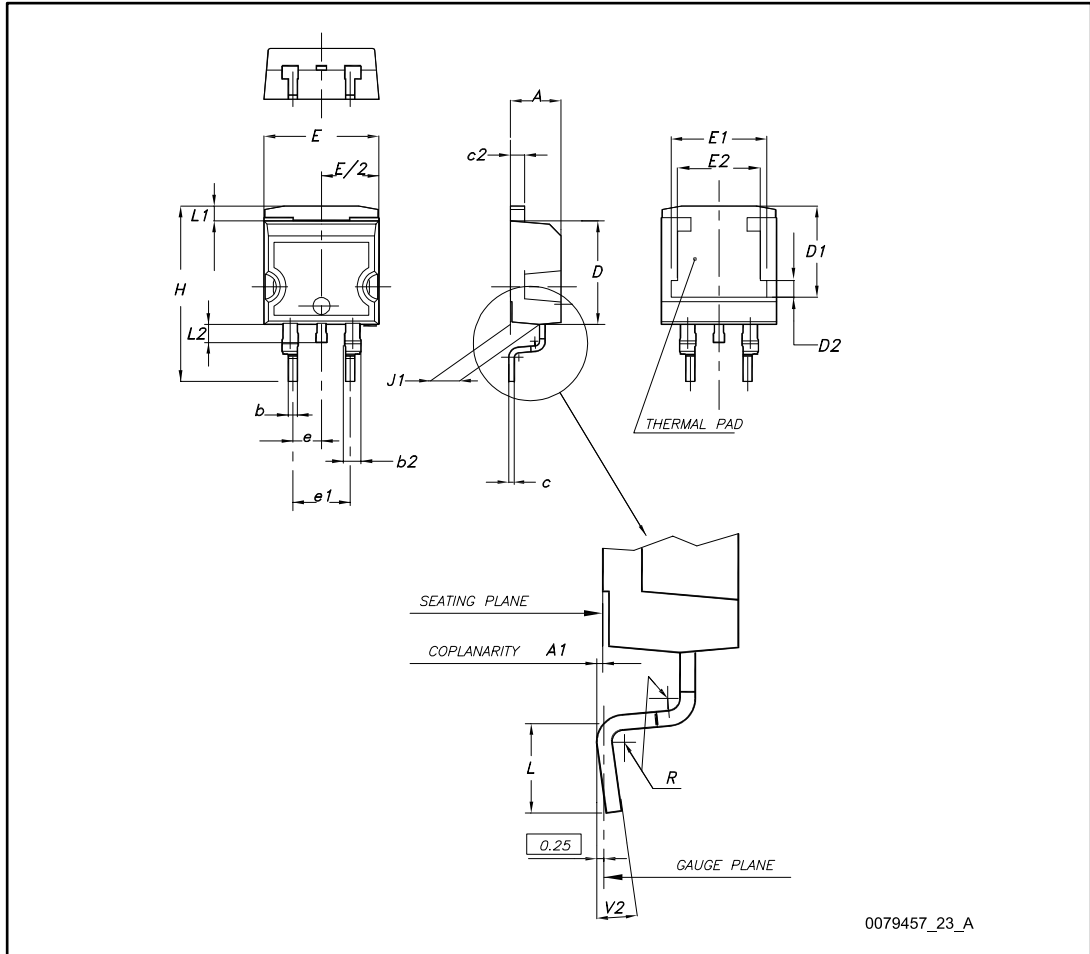


Table 9: D<sup>2</sup>PAK (TO-263) type A package mechanical data

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 23: D<sup>2</sup>PAK (TO-263) type A recommended footprint (dimensions are in mm)



### 4.2 D<sup>2</sup>PAK (TO-263) type B package information

Figure 24: D<sup>2</sup>PAK (TO-263) type B package outline



Table 10: D<sup>2</sup>PAK (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 25: D<sup>2</sup>PAK (TO-263) type B recommended footprint (dimensions are in mm)





### 4.3 D<sup>2</sup>PAK (TO-263) type A packing information

Figure 26: D<sup>2</sup>PAK type A tape outline

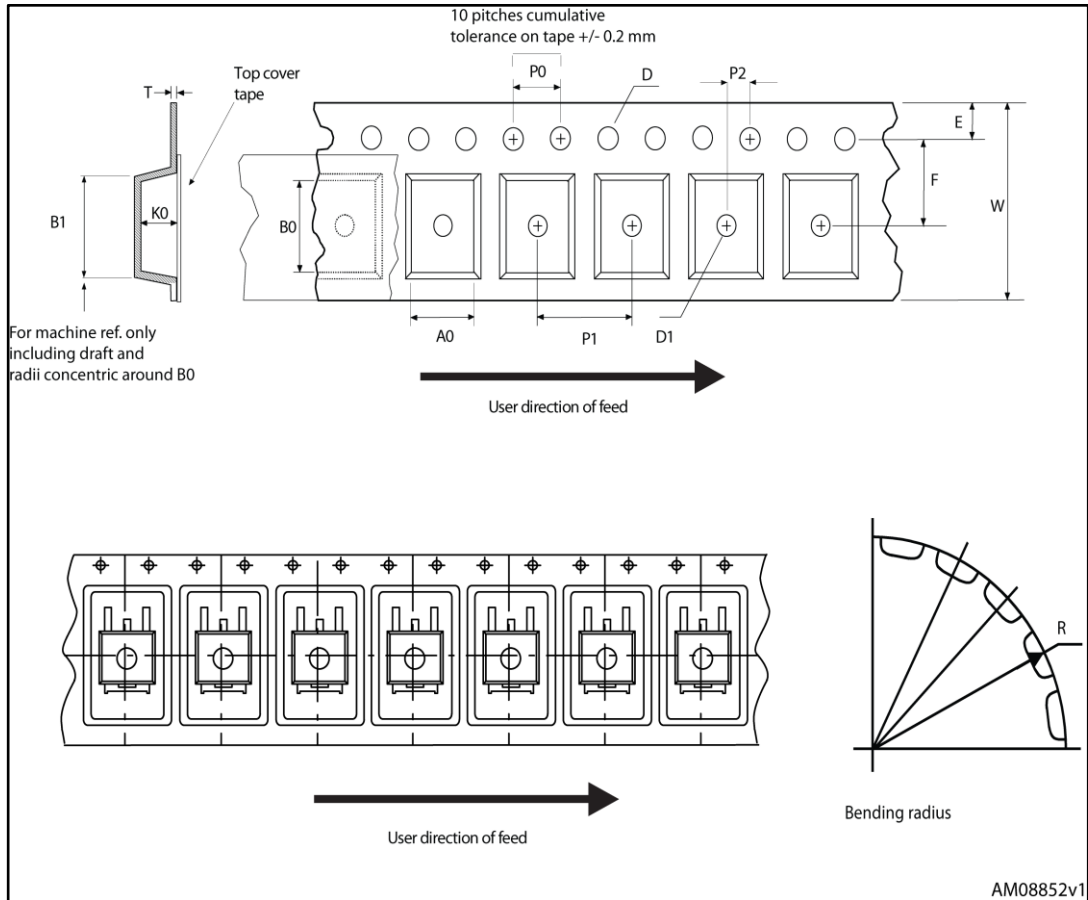


Figure 27: D<sup>2</sup>PAK type A reel outline

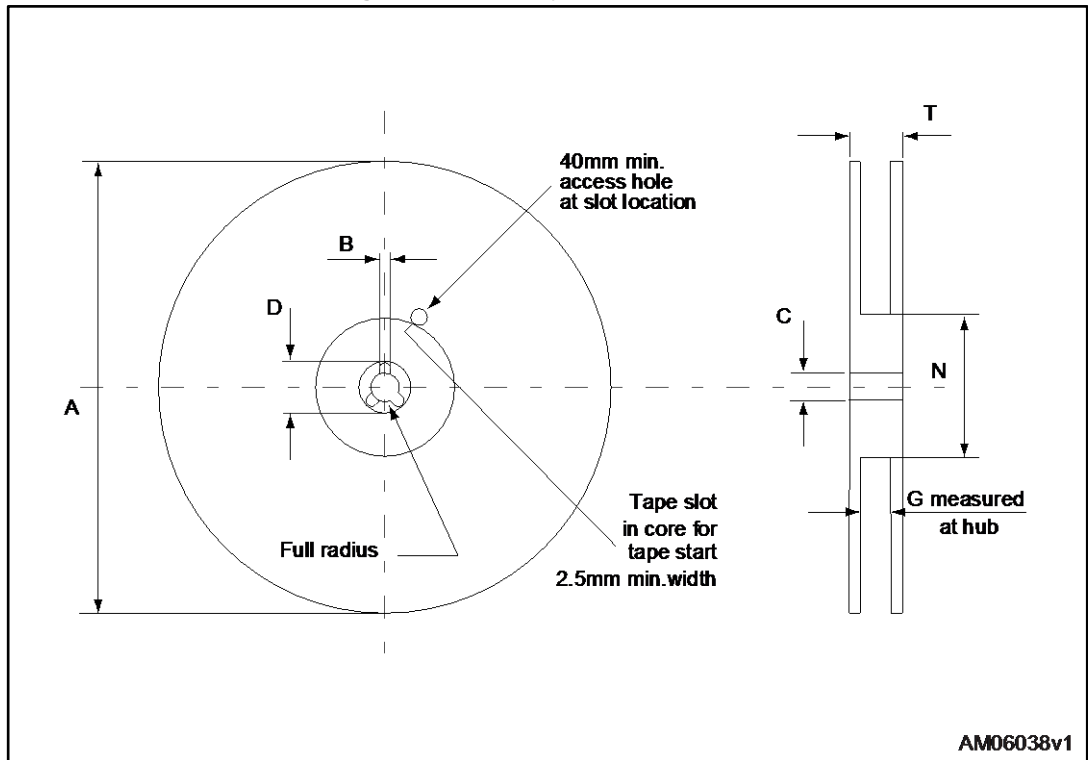


Table 11: D<sup>2</sup>PAK type A tape and reel mechanical data

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			

### 4.4 D<sup>2</sup>PAK (TO-263) type B packing information

Figure 28: D<sup>2</sup>PAK type B tape outline

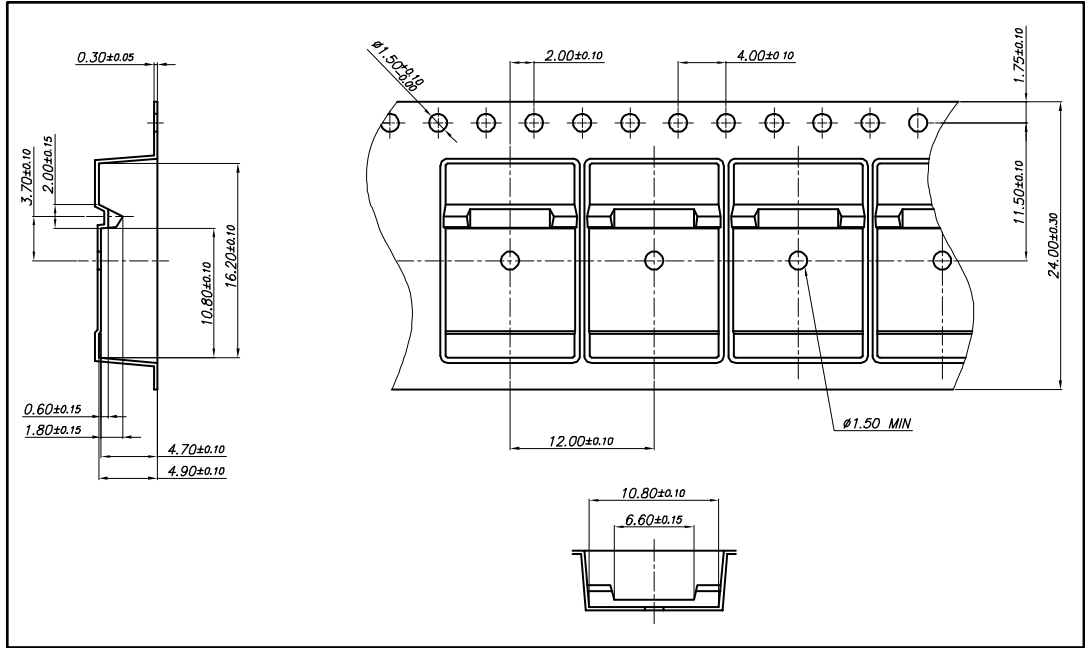


Figure 29: D<sup>2</sup>PAK type B reel outline

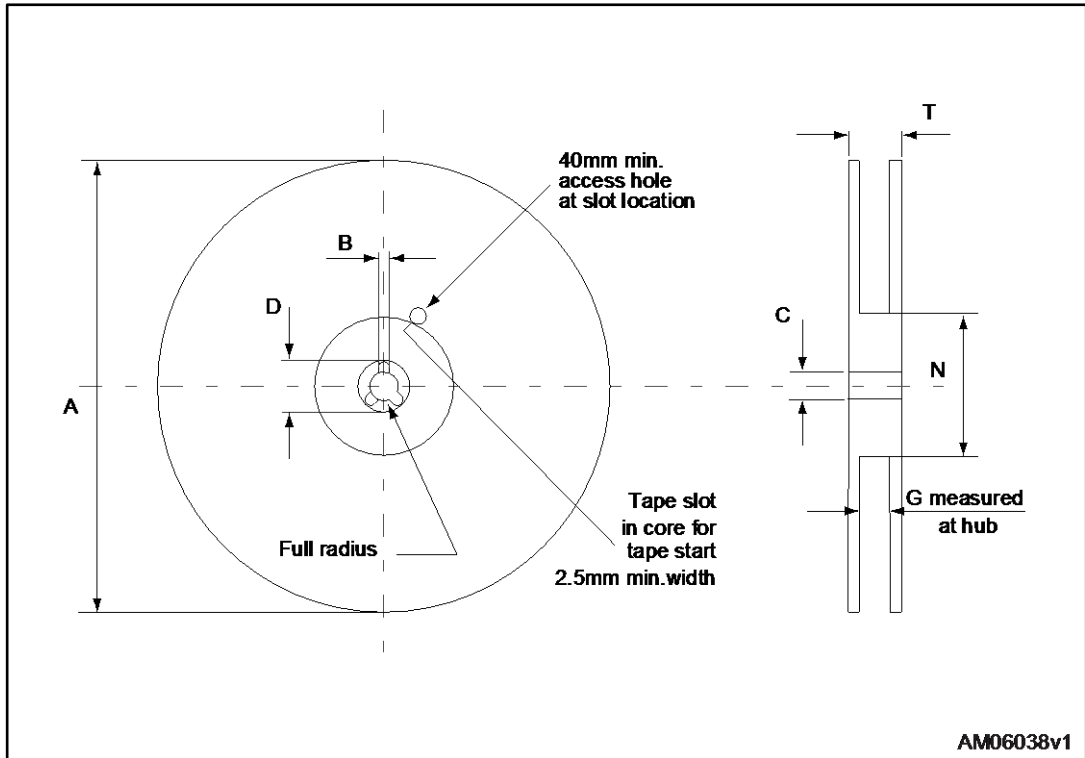
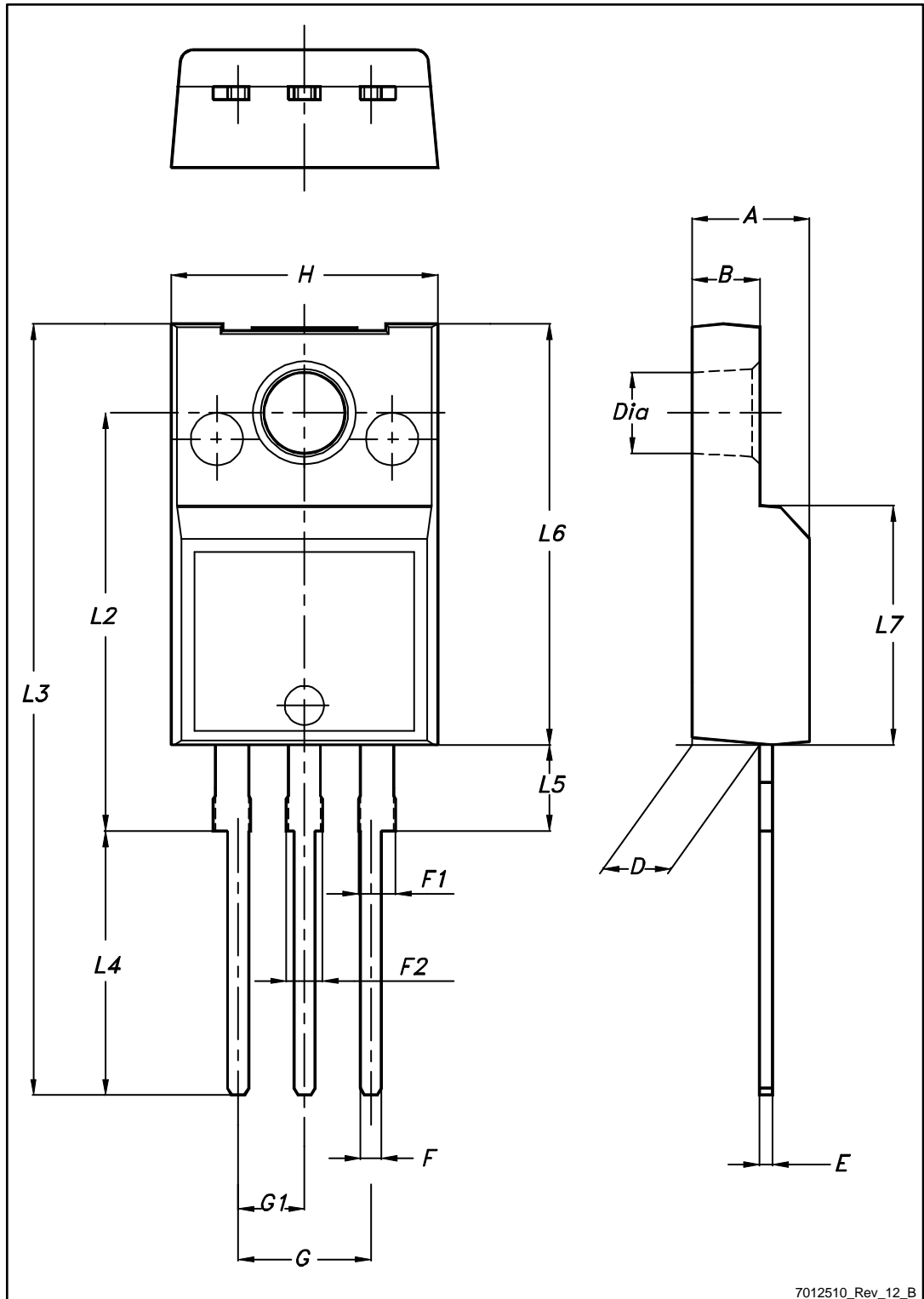


Table 12: D<sup>2</sup>PAK type B reel mechanical data

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 30: 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 31: TO-220 type A package outline



0015988\_typeA\_Rev\_21

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
14-Jun-2005	1	New release
05-Jul-2005	2	Complete version
22-Jul-2005	3	Value changed in table 6
27-Jan-2006	4	Inserted ecopack indication
28-Apr-2006	5	New template, modified curves 6 and 8
02-Apr-2008	6	Modified test conditions on Table 4
15-Mar-2010	7	Updated packages mechanical data.
12-Jul-2017	8	Modified <i>Table 6: "Switching on/off (inductive load)"</i> , <i>Table 7: "Switching energy (inductive load)"</i> and <i>Table 8: "Collector-emitter diode"</i> . Updated <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.

© 2017 STMicroelectronics – All rights reserved