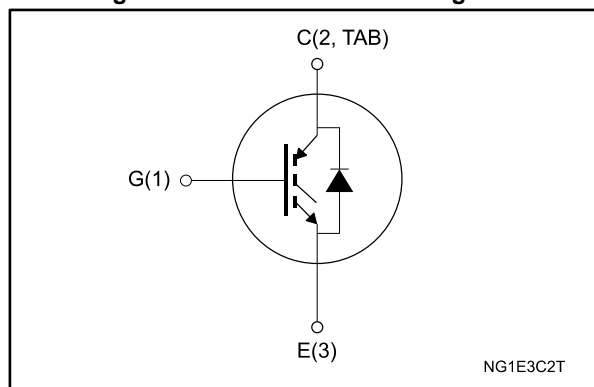


Figure 1: Internal schematic diagram



### Features

- Low on voltage drop ( $V_{CE(sat)}$ )
- Low  $C_{RES} / C_{IES}$  ratio (no cross-conduction susceptibility)
- Short-circuit withstand time 10  $\mu$ s
- 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	D <sup>2</sup> PAK	Tape and reel
STGF19NC60KD	GF19NC60KD	TO-220FP	Tube
STGP19NC60KD	GP19NC60KD	TO-220	

---

## Contents

<b>1</b>	<b>Electrical ratings .....</b>	<b>3</b>
<b>2</b>	<b>Electrical characteristics .....</b>	<b>4</b>
	2.1 Electrical characteristics (curves) .....	7
<b>3</b>	<b>Test circuits .....</b>	<b>10</b>
<b>4</b>	<b>Package information .....</b>	<b>11</b>
	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 type A packing information .....	17
	4.4 D <sup>2</sup> PAK type B packing information .....	19
	4.5 TO-220FP package information .....	21
	4.6 TO-220 type A package information.....	23
<b>5</b>	<b>Revision history .....</b>	<b>25</b>

# 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	35	16	A
	Continuous collector current at T <sub>C</sub> = 100 °C	20	10	A
I <sub>CL</sub> <sup>(2)</sup>	Turn-off latching current	75		A
I <sub>CP</sub> <sup>(3)</sup>	Pulsed collector current	75		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	50		A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	125	32	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:**

<sup>(1)</sup>Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{J(max)} - T_C}{R_{thj-c} \times V_{CE(sat)(max)}(T_{J(max)}, I_C(T_C))}$$

<sup>(2)</sup>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.

<sup>(3)</sup>Pulse width limited by maximum junction temperature.

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	3.9	°C/W
R <sub>thj-case</sub>	Thermal resistance junction-case diode	3	5.6	
R <sub>thj-amb</sub>	Thermal resistance junction-ambient	62.5		

## 2 Electrical characteristics

T<sub>C</sub> = 25 °C unless otherwise specified

Table 4: Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>(BR)CES</sub>	Collector-emitter breakdown voltage	I <sub>C</sub> = 1 mA, V <sub>GE</sub> = 0 V	600			V
V <sub>CE(sat)</sub>	Collector-emitter saturation voltage	V <sub>GE</sub> = 15 V, I <sub>C</sub> = 12 A		2.0	2.75	V
		V <sub>GE</sub> = 15 V, I <sub>C</sub> = 12 A, T <sub>C</sub> = 125 °C		1.65		
V <sub>GE(th)</sub>	Gate threshold voltage	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250 μA	4.5		6.5	V
I <sub>CES</sub>	Collector cut-off current	V <sub>CE</sub> = 600 V, V <sub>GE</sub> = 0 V			150	μA
		V <sub>CE</sub> = 600 V, V <sub>GE</sub> = 0 V, T <sub>C</sub> = 125 °C <sup>(1)</sup>			1	mA
I <sub>GES</sub>	Gate-emitter leakage current	V <sub>CE</sub> = 0 V, V <sub>GE</sub> = ±20 V			±100	nA

**Notes:**

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

Table 5: Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C <sub>ies</sub>	Input capacitance	V <sub>CE</sub> = 25 V, f = 1 MHz, V <sub>GE</sub> = 0 V	-	1170	-	pF
C <sub>oes</sub>	Output capacitance		-	127	-	
C <sub>res</sub>	Reverse transfer capacitance		-	28	-	
Q <sub>g</sub>	Total gate charge	V <sub>CE</sub> = 480 V, I <sub>C</sub> = 12 A, V <sub>GE</sub> = 0 to 15 V (see <a href="#">Figure 20: "Gate charge test circuit"</a> )	-	55	-	nC
Q <sub>ge</sub>	Gate-emitter charge		-	11	-	
Q <sub>gc</sub>	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 <i>Figure 19: "Test circuit for inductive load switching"</i> and <i>Figure 21: "Switching waveform"</i> )	-	30	-	ns
$t_r$	Current rise time		-	8	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1450	-	A/ $\mu$ 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 <i>Figure 19: "Test circuit for inductive load switching"</i> and <i>Figure 21: "Switching waveform"</i> )	-	30	-	ns
$t_r$	Current rise time		-	8	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1380	-	A/ $\mu$ 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 <i>Figure 19: "Test circuit for inductive load switching"</i> and <i>Figure 21: "Switching waveform"</i> )	-	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 <i>Figure 19: "Test circuit for inductive load switching"</i> and <i>Figure 21: "Switching waveform"</i> )	-	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 <i>Figure 19: "Test circuit for inductive load switching"</i> )	-	165	-	$\mu$ J
$E_{off(2)}$	Turn-off switching energy		-	255	-	$\mu$ J
$E_{ts}$	Total switching energy		-	420	-	$\mu$ 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 <i>Figure 19: "Test circuit for inductive load switching"</i> )	-	250	-	$\mu$ J
$E_{off(2)}$	Turn-off switching energy		-	445	-	$\mu$ J
$E_{ts}$	Total switching energy		-	695	-	$\mu$ 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> =12 A	-	1.9	-	V
		I <sub>F</sub> =12 A, T <sub>C</sub> =125 °C	-	1.6	-	V
t <sub>rr</sub>	Reverse recovery time	I <sub>F</sub> =12 A, V <sub>R</sub> =40 V, di/dt=100 A/μs (see <a href="#">Figure 22: "Diode reverse recovery waveform"</a> )	-	31	-	ns
Q <sub>rr</sub>	Reverse recovery charge		-	30	-	nC
I <sub>rrm</sub>	Reverse recovery current		-	2	-	A
t <sub>rr</sub>	Reverse recovery time	I <sub>F</sub> =12 A, V <sub>R</sub> =40 V, T <sub>C</sub> =125 °C, di/dt=100 A/μs (see <a href="#">Figure 22: "Diode reverse recovery waveform"</a> )	-	50	-	ns
Q <sub>rr</sub>	Reverse recovery charge		-	70	-	nC
I <sub>rrm</sub>	Reverse recovery current		-	4	-	A

## 2.1 Electrical characteristics (curves)

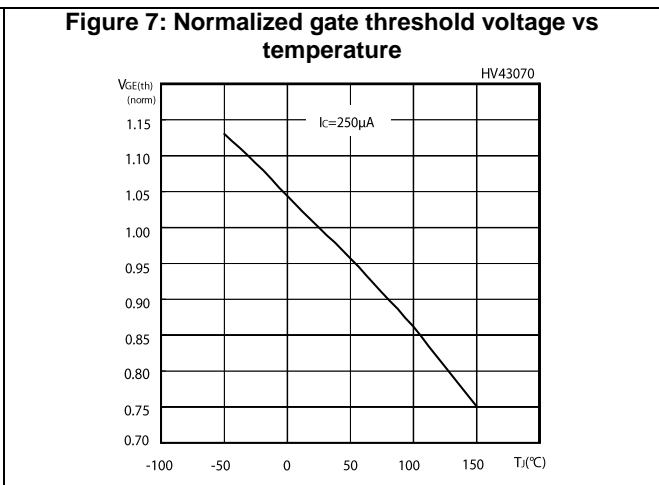
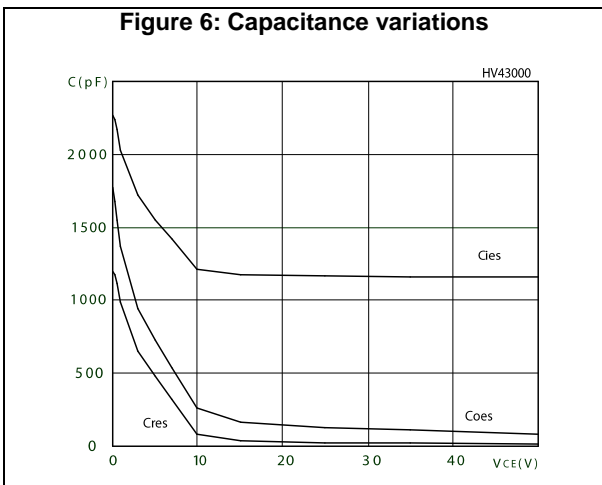
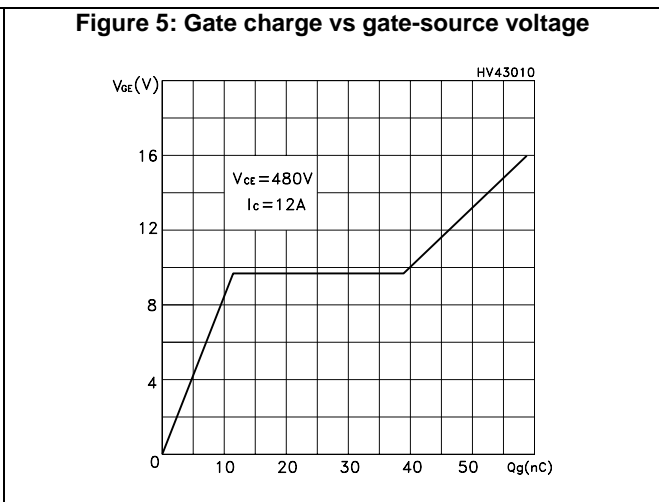
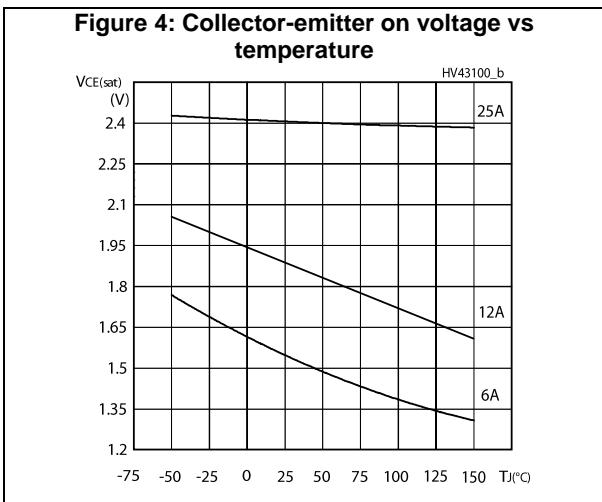
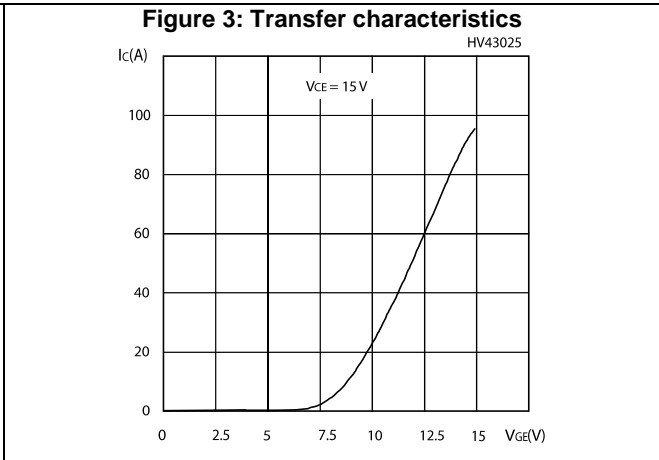
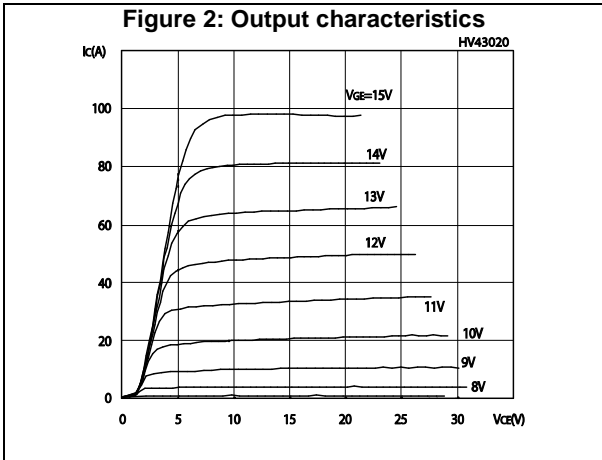


Figure 8: Collector-emitter on voltage vs collector current

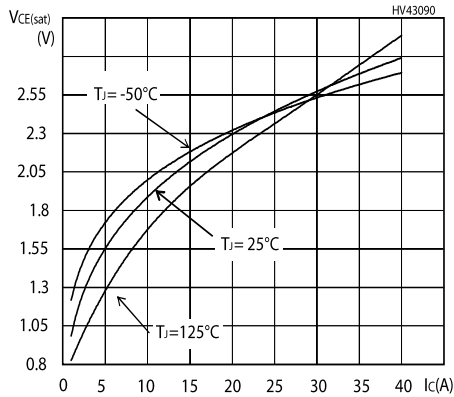


Figure 9: Normalized breakdown voltage vs temperature

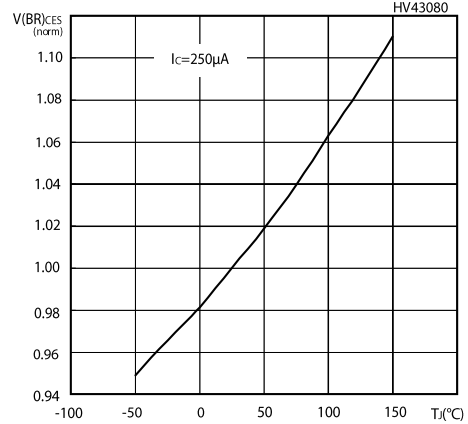


Figure 10: Switching energy vs temperature

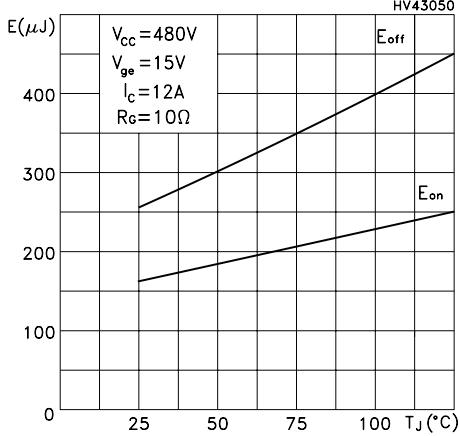


Figure 11: Switching energy vs. gate resistance

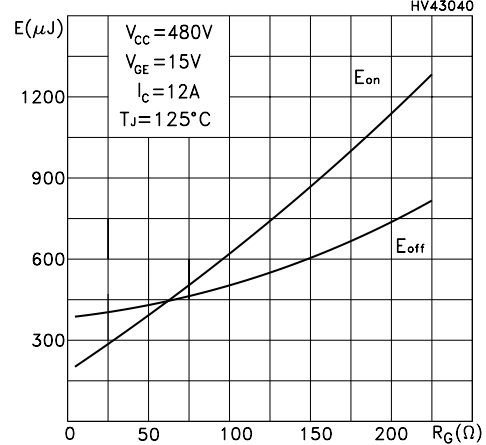


Figure 12: Switching energy vs collector current

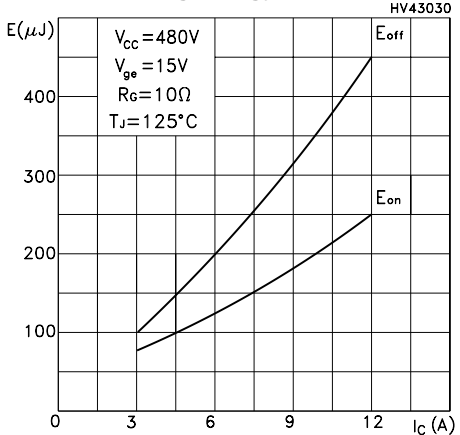


Figure 13: Turn-off SOA

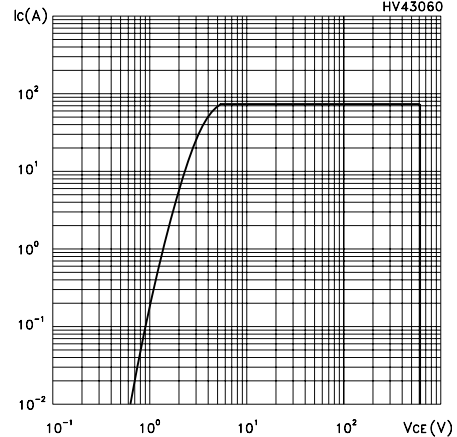




Figure 14: Emitter-collector diode characteristics

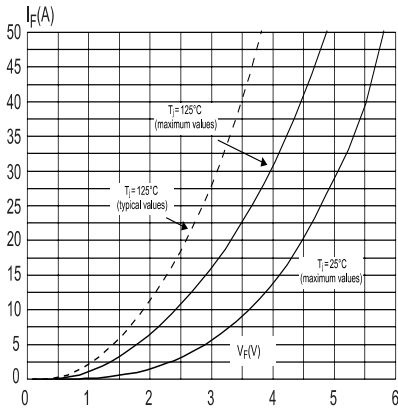


Figure 15: Thermal impedance for TO-220, D<sup>2</sup>PAK

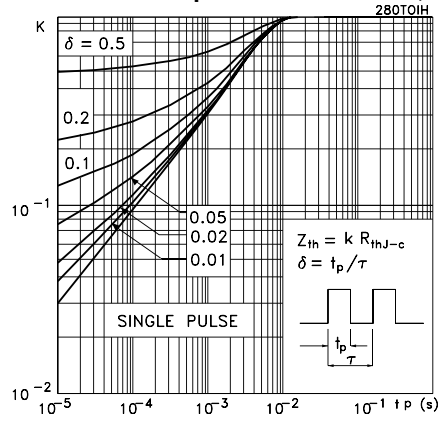


Figure 16: Thermal impedance for TO-220FP

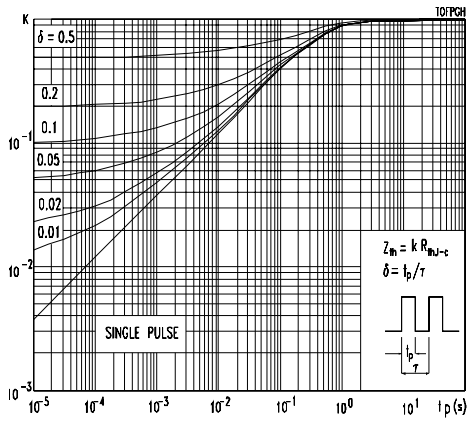


Figure 17: Maximum DC collector current vs T<sub>CASE</sub> for TO-220FP

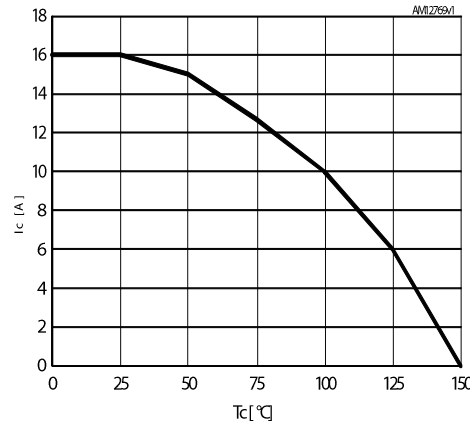
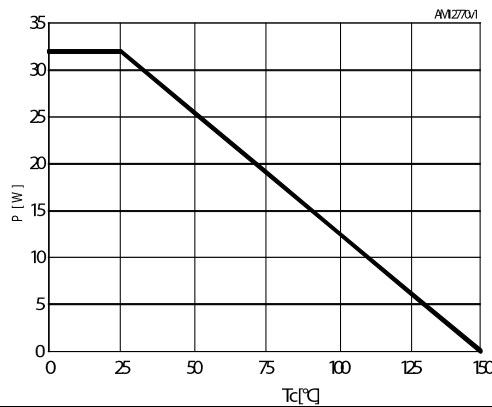
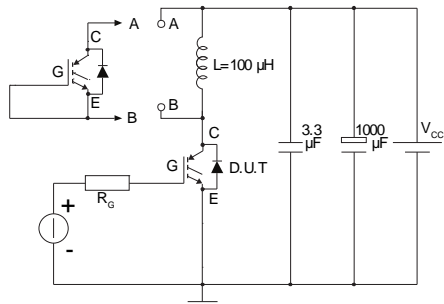


Figure 18: Maximum power dissipation vs T<sub>CASE</sub> for TO-220FP



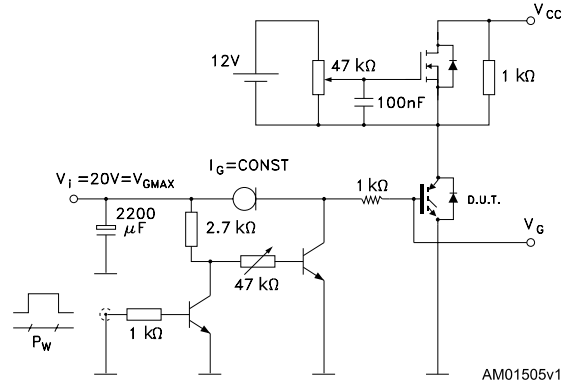
### 3 Test circuits

**Figure 19: Test circuit for inductive load switching**



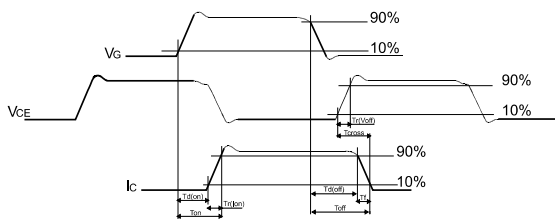
AM01504v1

**Figure 20: Gate charge test circuit**



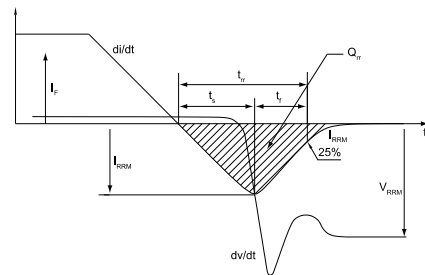
AM01505v1

**Figure 21: Switching waveform**



AM01506v1

**Figure 22: 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](http://www.st.com). ECOPACK® is an ST trademark.

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

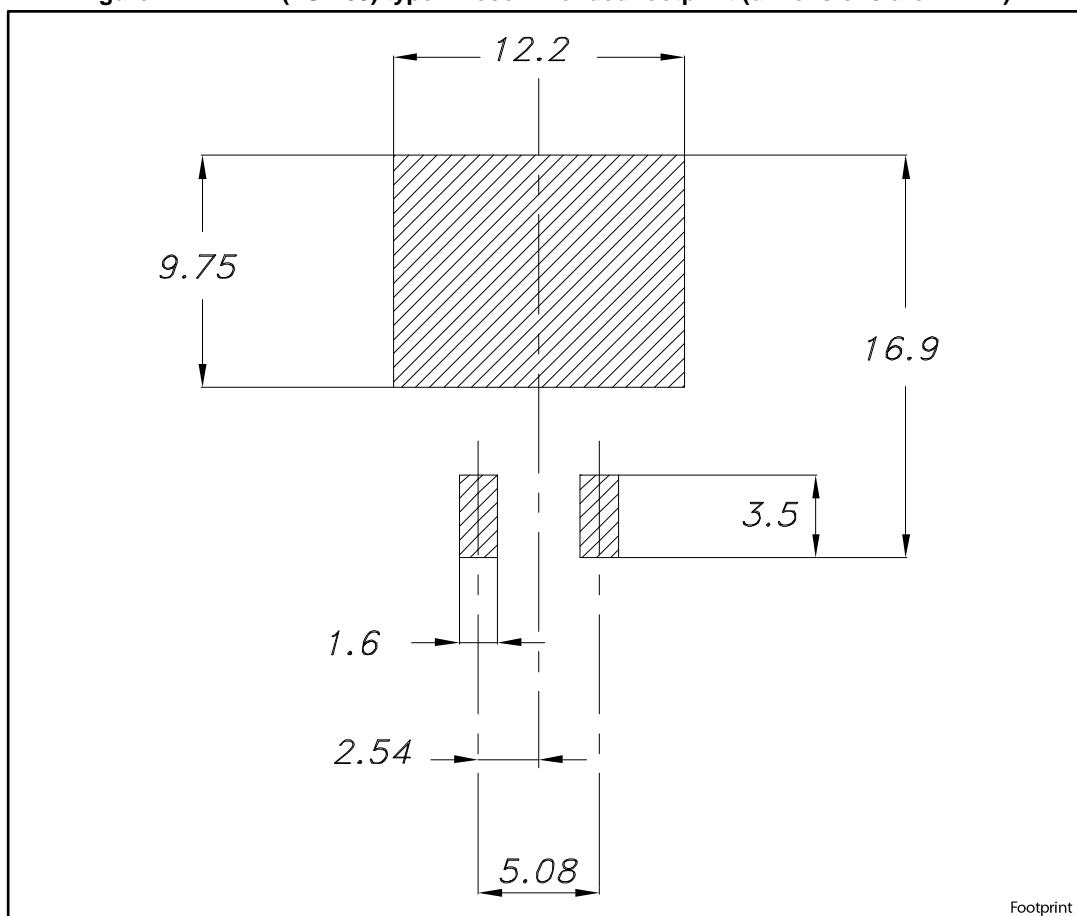
Figure 23: D<sup>2</sup>PAK (TO-263) type A package outline



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 24: 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 25: D<sup>2</sup>PAK (TO-263) type B package outline

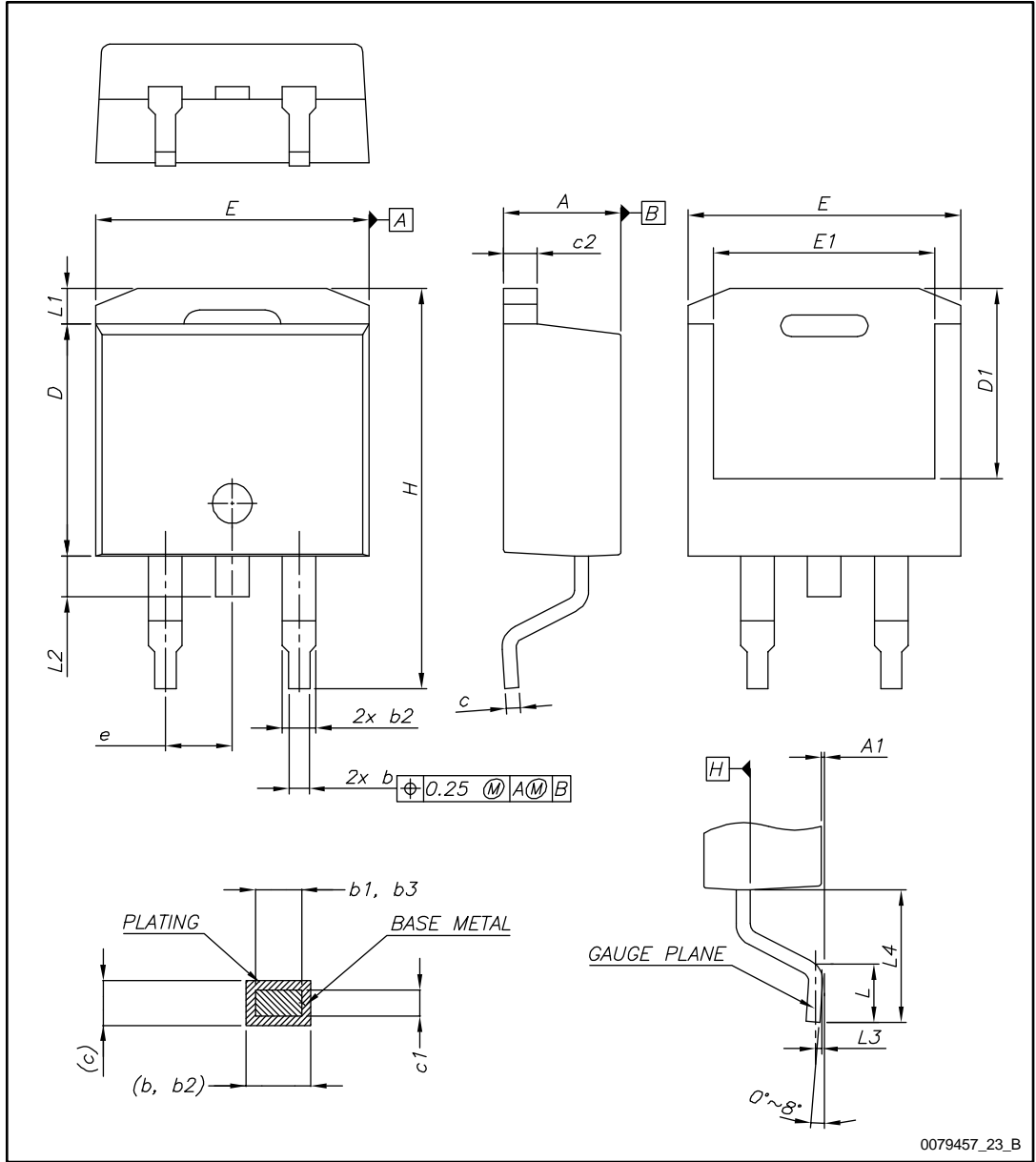
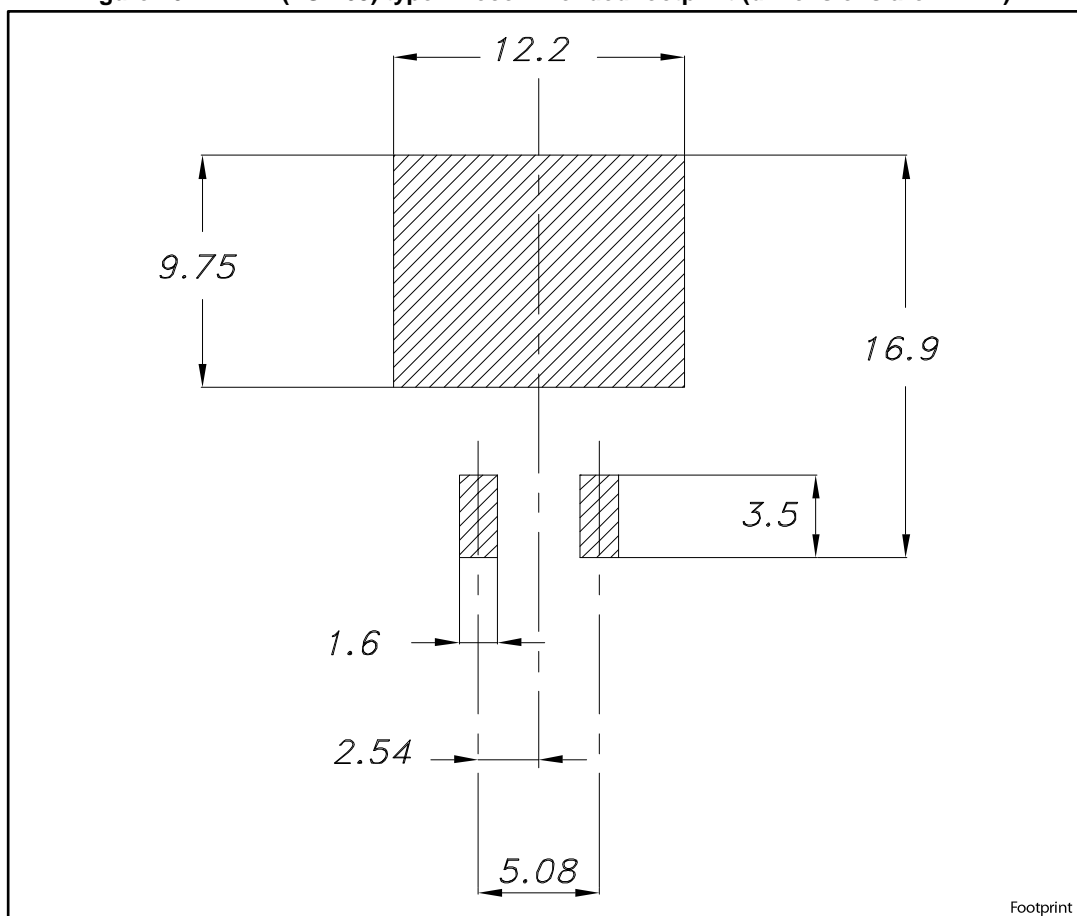


Table 10: D<sup>2</sup>PAK (TO-263) type B mechanical data

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





### 4.3 D<sup>2</sup>PAK type A packing information

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

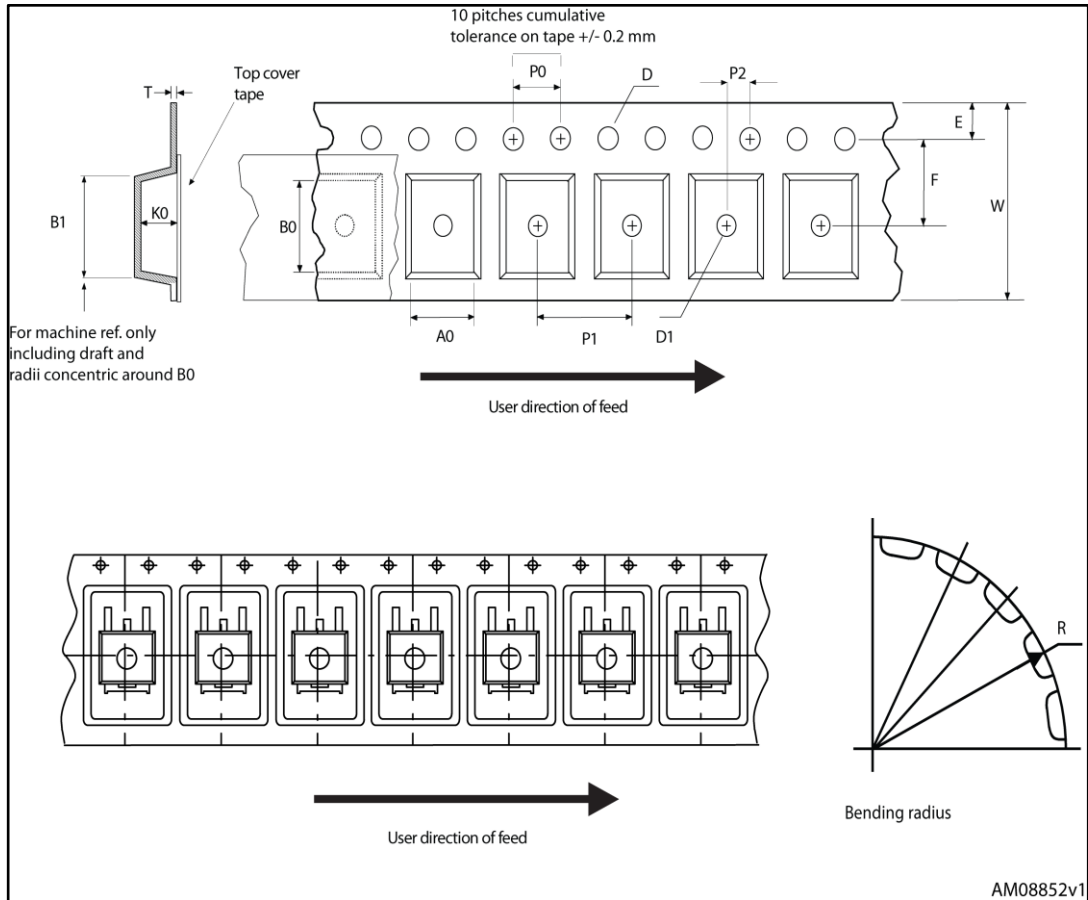


Figure 28: D<sup>2</sup>PAK type A reel outline

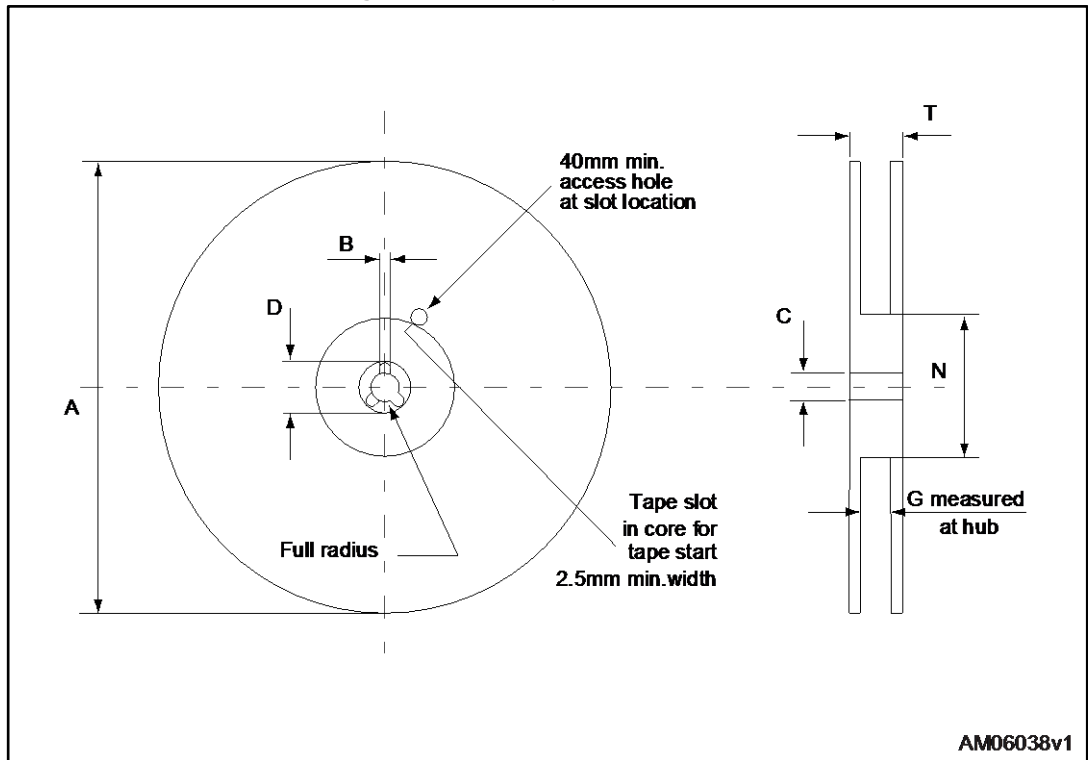


Table 11: D<sup>2</sup>PAK type A tape and reel mechanical data

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 type B packing information

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

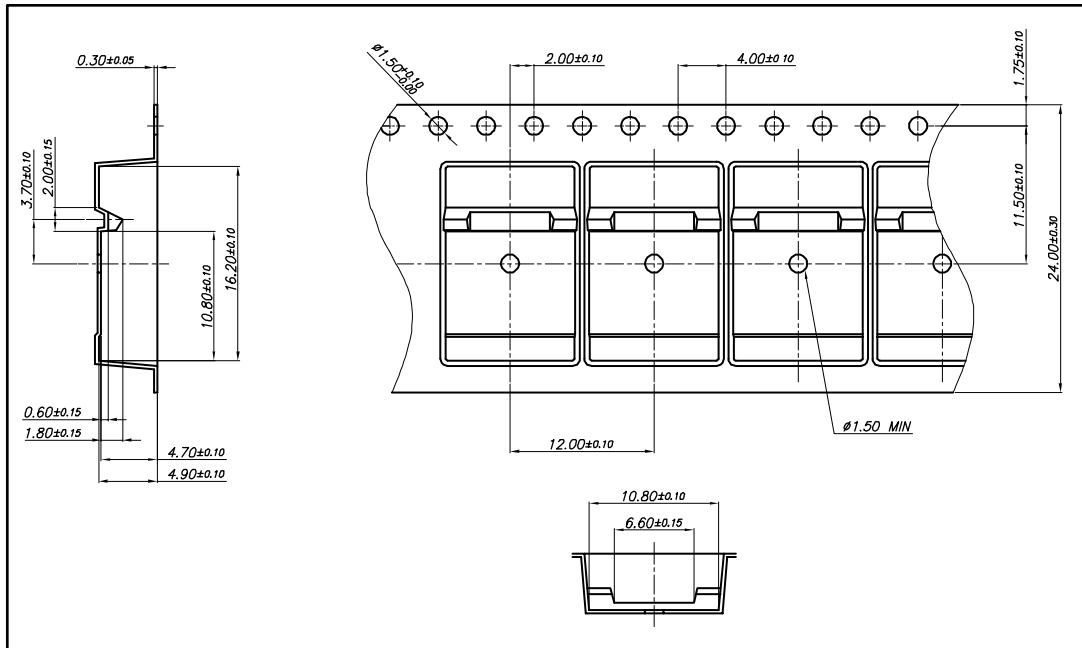


Figure 30: D<sup>2</sup>PAK type B reel outline

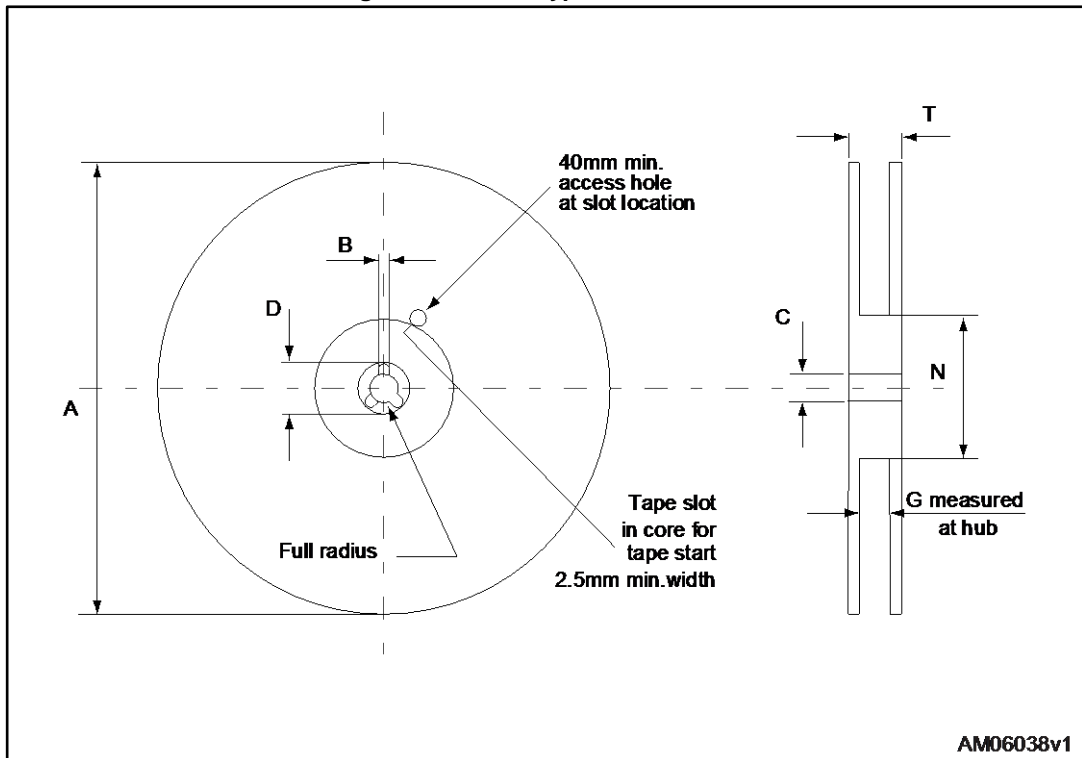
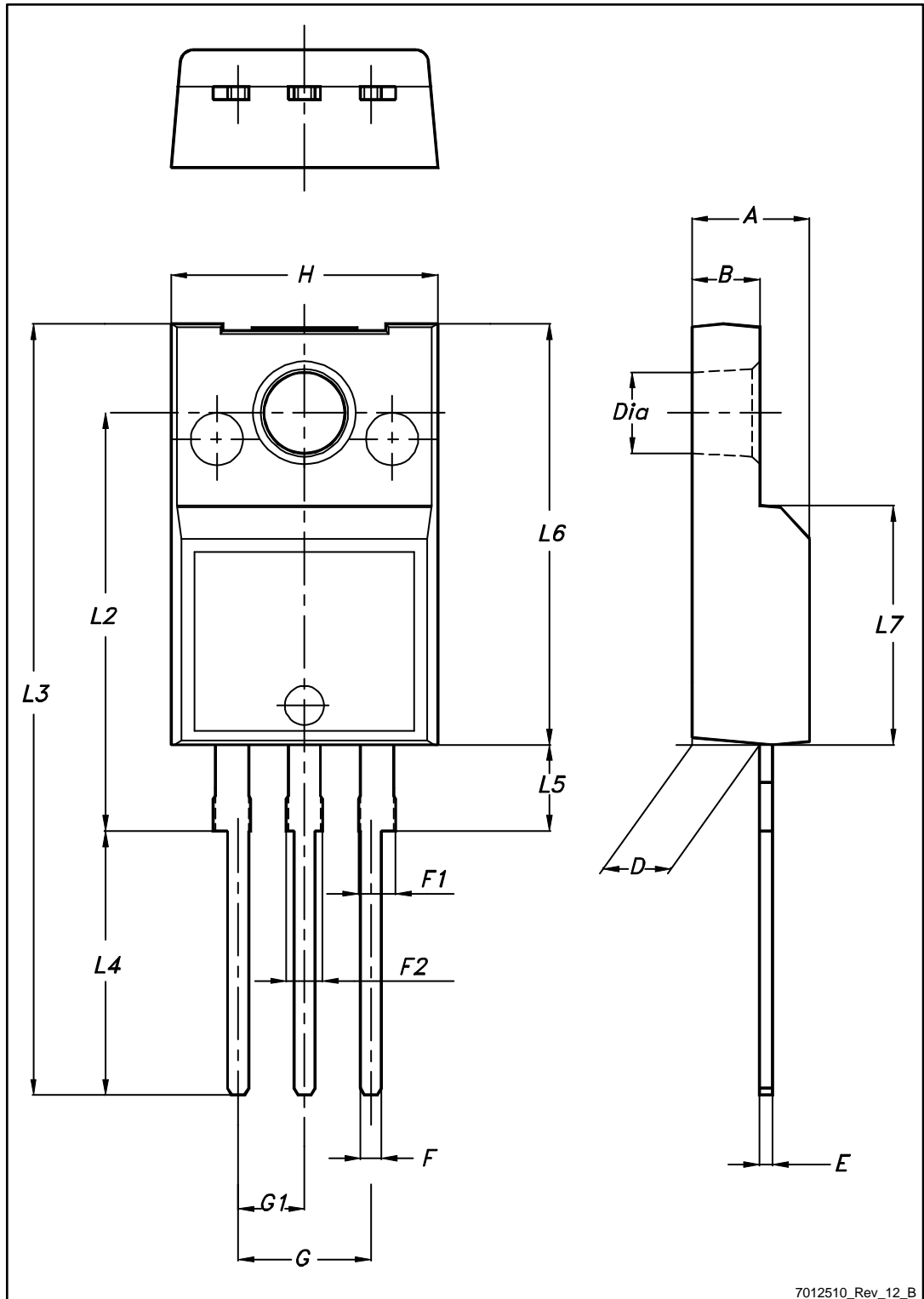


Table 12: D<sup>2</sup>PAK type B reel mechanical data

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 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



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
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 <sup>2</sup> 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 <i>Table 2: "Absolute maximum ratings"</i> , <i>Table 3: "Thermal data"</i> , and <i>Table 4: "Static characteristics"</i> . Modified <i>Figure 3: "Transfer characteristics"</i> , <i>Figure 4: "Collector-emitter on voltage vs temperature"</i> and <i>Figure 8: "Collector-emitter on voltage vs collector current"</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

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



## JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: [ocean@oceanchips.ru](mailto:ocean@oceanchips.ru)

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А