

## Trench gate field-stop IGBT, HB series 650 V, 40 A high speed

Datasheet - production data

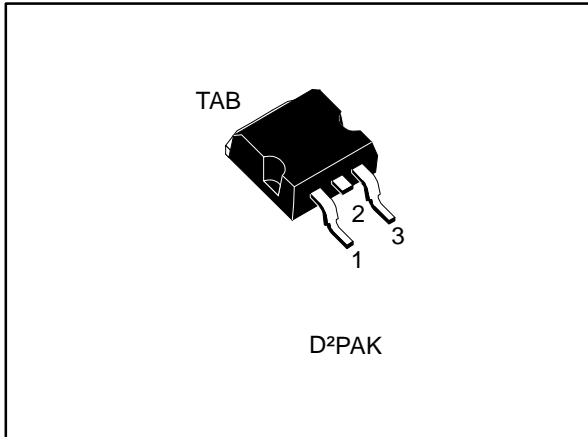


Figure 1: Internal schematic diagram

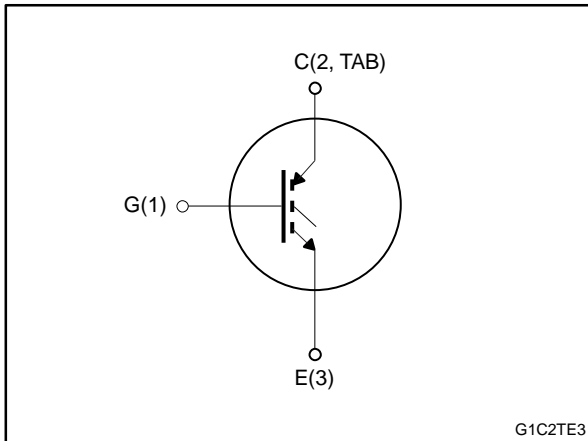


Table 1: Device summary

Order code	Marking	Package	Packing
STGB40H65FB	GB40H65FB	D <sup>2</sup> PAK	Tape and reel

### Features

- Maximum junction temperature:  $T_J = 175\text{ °C}$
- High speed switching series
- Minimized tail current
- Low saturation voltage:  $V_{CE(sat)} = 1.6\text{ V (typ.)}$   
@  $I_C = 40\text{ A}$
- Tight parameter distribution
- Safe paralleling
- Low thermal resistance

### Applications

- Photovoltaic inverters
- High frequency converters

### Description

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. The device is part of the new HB series of IGBTs, which represents an optimum compromise between conduction and switching loss to maximize the efficiency of any frequency converter. Furthermore, the slightly positive  $V_{CE(sat)}$  temperature coefficient and very tight parameter distribution result in safer paralleling operation.

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# 1 Electrical ratings

**Table 2: Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GE} = 0$ )	650	V
$I_C$	Continuous collector current at $T_C = 25\text{ °C}$	80	A
	Continuous collector current at $T_C = 100\text{ °C}$	40	
$I_{CP}^{(1)}$	Pulsed collector current	160	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	283	W
$T_{STG}$	Storage temperature range	- 55 to 150	°C
$T_J$	Operating junction temperature range	- 55 to 175	

**Notes:**

<sup>(1)</sup>Pulse width limited by maximum junction temperature.

**Table 3: Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance junction-case	0.53	°C/W
$R_{thJA}$	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	$V_{GE} = 0\text{ V}$ , $I_C = 2\text{ mA}$	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$ , $I_C = 40\text{ A}$		1.6	2	V
		$V_{GE} = 15\text{ V}$ , $I_C = 40\text{ A}$ , $T_J = 125\text{ °C}$		1.7		
		$V_{GE} = 15\text{ V}$ , $I_C = 40\text{ A}$ , $T_J = 175\text{ °C}$		1.8		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$ , $I_C = 1\text{ mA}$	5	6	7	V
$I_{CES}$	Collector cut-off current	$V_{GE} = 0\text{ V}$ , $V_{CE} = 650\text{ V}$			25	$\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current	$V_{CE} = 0\text{ V}$ , $V_{GE} = \pm 20\text{ V}$			$\pm 250$	nA

**Table 5: Dynamic characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GE} = 0\text{ V}$	-	5412	-	pF
$C_{oes}$	Output capacitance		-	198	-	
$C_{res}$	Reverse transfer capacitance		-	107	-	
$Q_g$	Total gate charge	$V_{CC} = 520\text{ V}$ , $I_C = 40\text{ A}$ , $V_{GE} = 15\text{ V}$ (see <a href="#">Figure 23</a> : "Gate charge test circuit")	-	210	-	nC
$Q_{ge}$	Gate-emitter charge		-	39	-	
$Q_{gc}$	Gate-collector charge		-	82	-	

Table 6: Switching characteristics (inductive load)

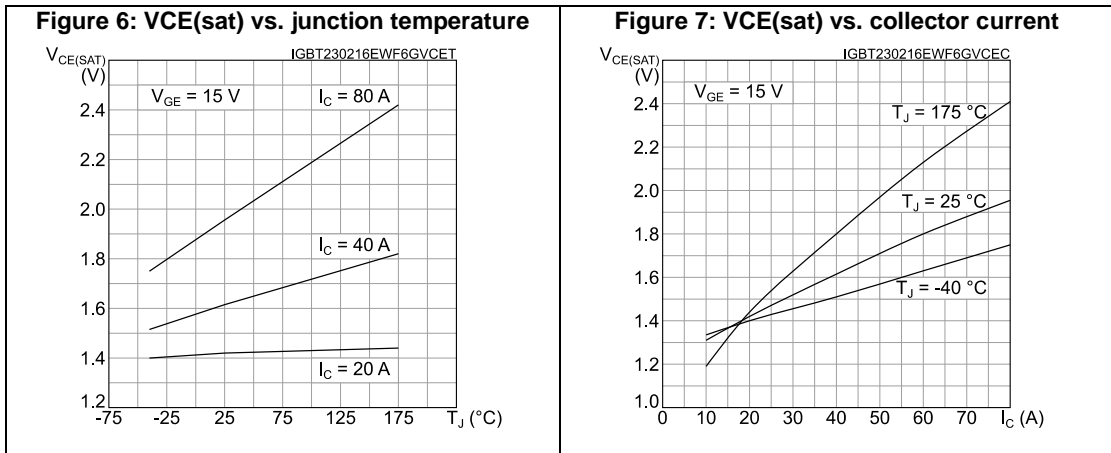
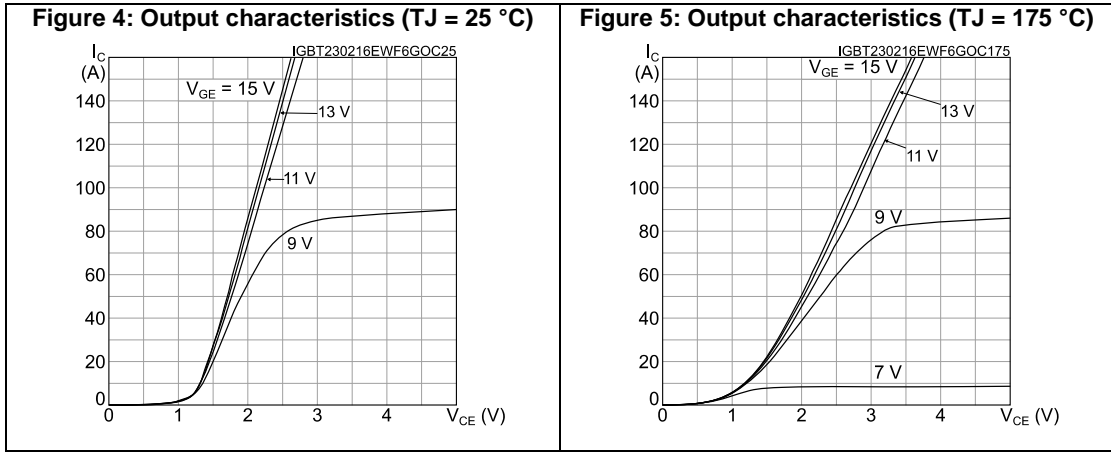
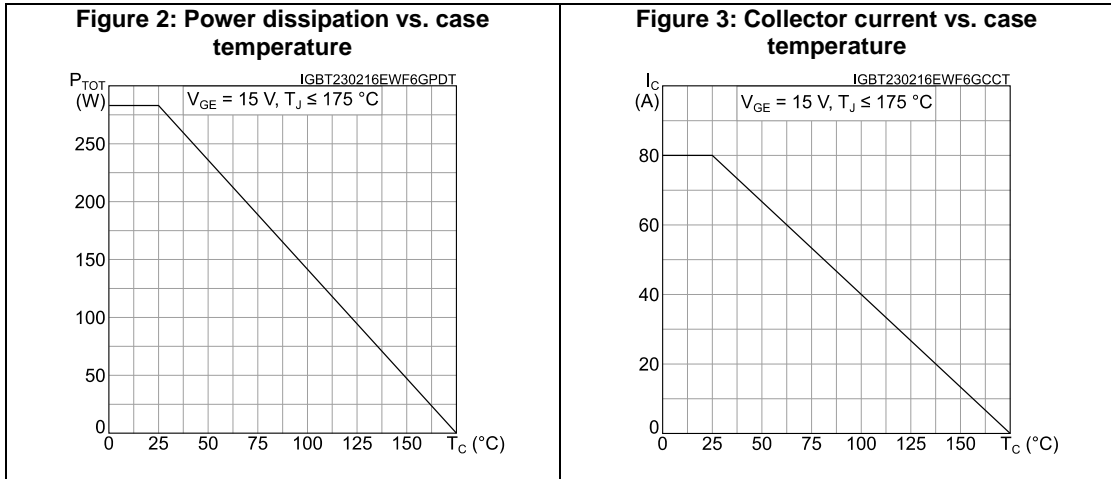
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$ , $I_C = 40\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 5\ \Omega$ (see <a href="#">Figure 22: "Test circuit for inductive load switching"</a> )		40	-	ns
$t_r$	Current rise time			13	-	
$(di/dt)_{on}$	Turn-on current slope			2413	-	A/ $\mu$ s
$t_{d(off)}$	Turn-off-delay time			142	-	ns
$t_f$	Current fall time			27	-	
$E_{on}^{(1)}$	Turn-on switching energy			498	-	$\mu$ J
$E_{off}^{(2)}$	Turn-off switching energy			363	-	
$E_{ts}$	Total switching energy		861	-		
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$ , $I_C = 40\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 5\ \Omega$ $T_J = 175\text{ }^\circ\text{C}$ (see <a href="#">Figure 22: "Test circuit for inductive load switching"</a> )		38	-	ns
$t_r$	Current rise time			14	-	
$(di/dt)_{on}$	Turn-on current slope			2186	-	A/ $\mu$ s
$t_{d(off)}$	Turn-off-delay time			141	-	ns
$t_f$	Current fall time			61	-	
$E_{on}^{(1)}$	Turn-on switching energy			1417	-	$\mu$ J
$E_{off}^{(2)}$	Turn-off switching energy			764	-	
$E_{ts}$	Total switching energy		2181	-		

**Notes:**

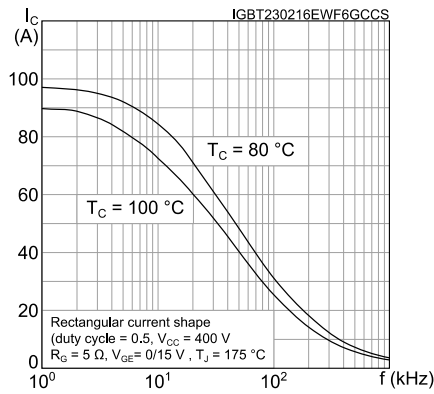
(1)Energy losses include reverse recovery of the external diode. The diode is the same of the co-packed STGW40H65DFB.

(2)Including the tail of the collector current.

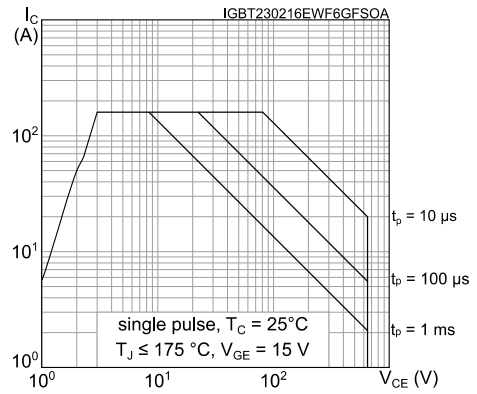
## 2.1 Electrical characteristics (curves)



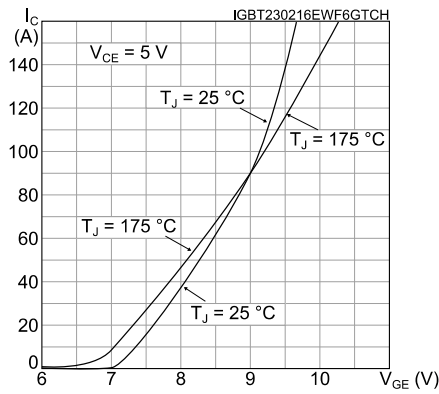
**Figure 8: Collector current vs. switching frequency**



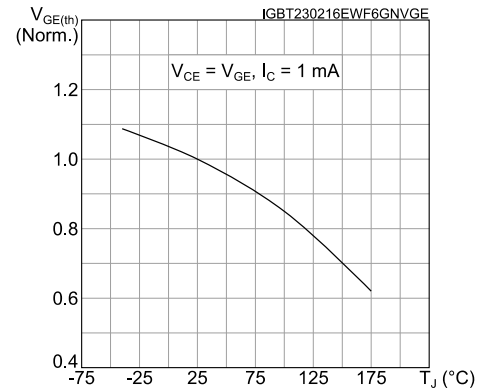
**Figure 9: Forward bias safe operating area**



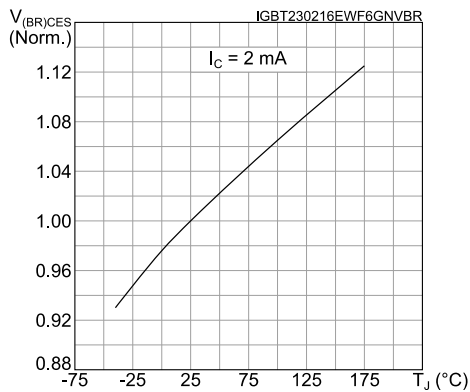
**Figure 10: Transfer characteristics**



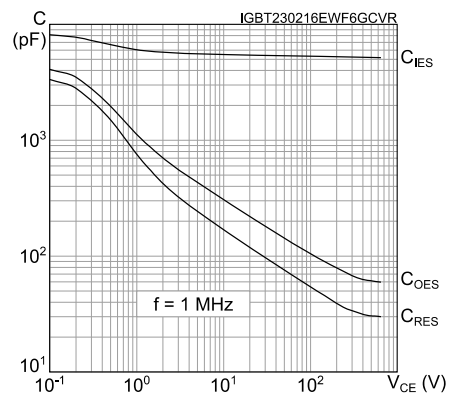
**Figure 11: Normalized V<sub>GE(th)</sub> vs. junction temperature**



**Figure 12: Normalized V<sub>(BR)CES</sub> vs. junction temperature**



**Figure 13: Capacitance variations**



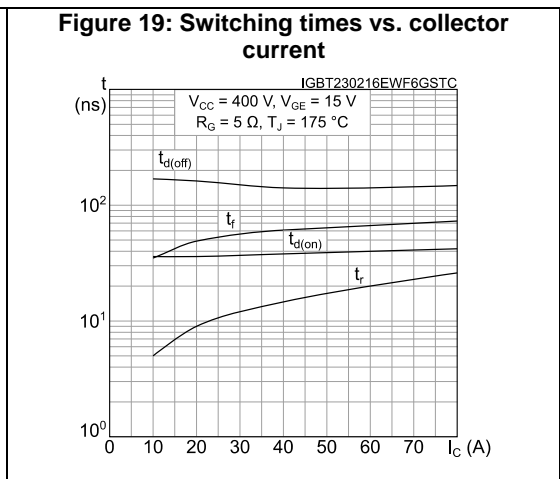
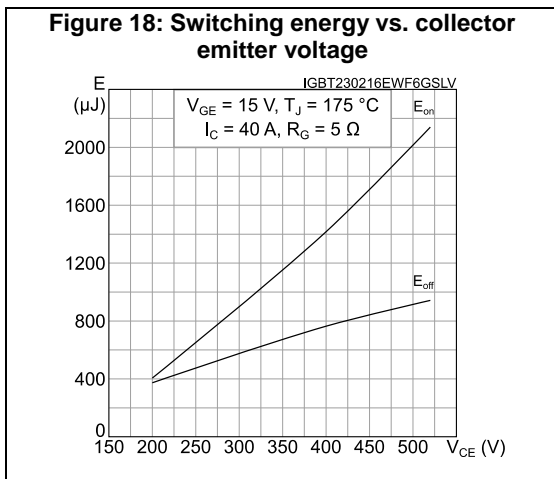
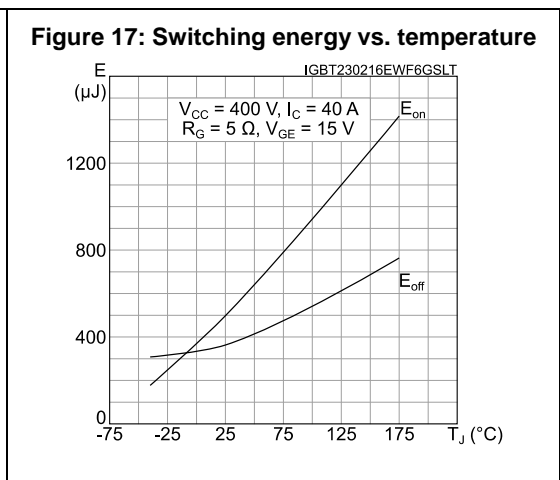
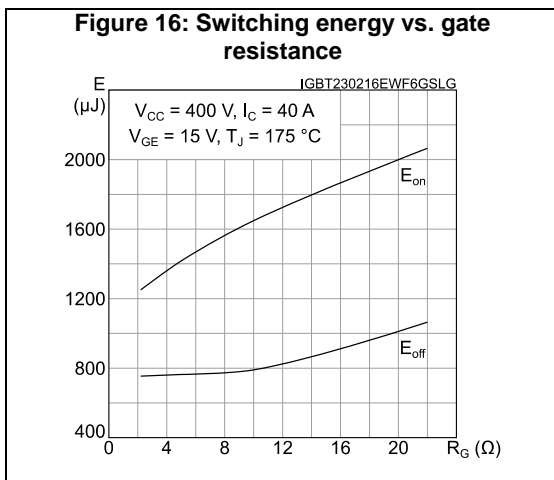
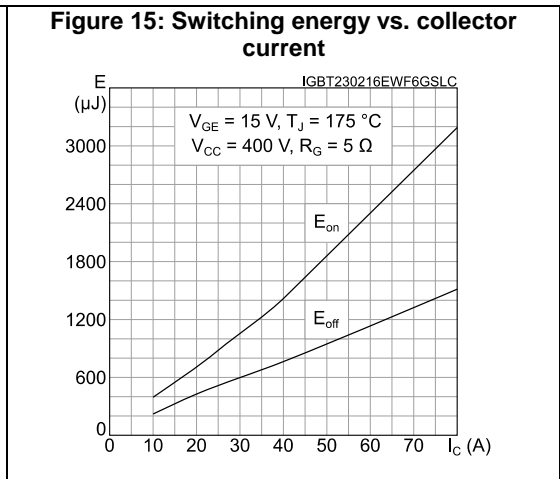
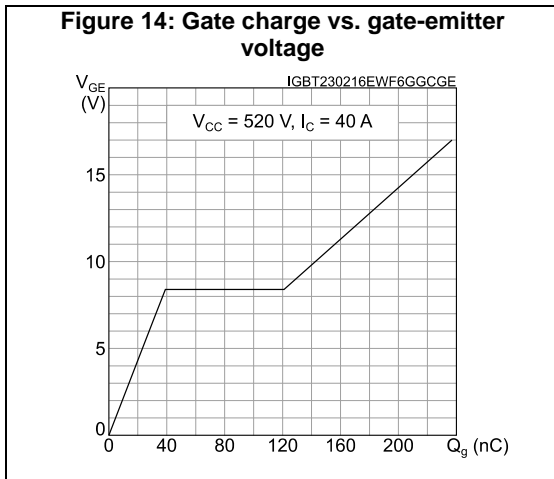




Figure 20: Switching times vs. gate resistance

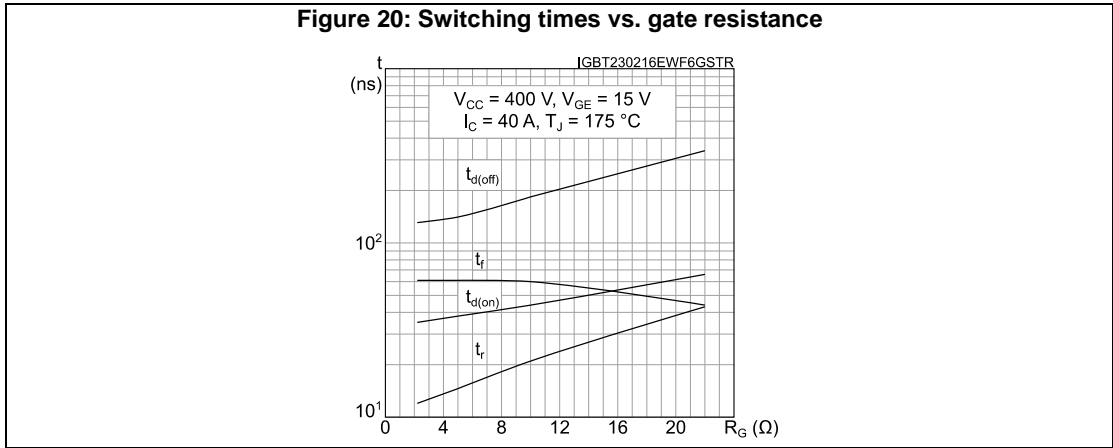
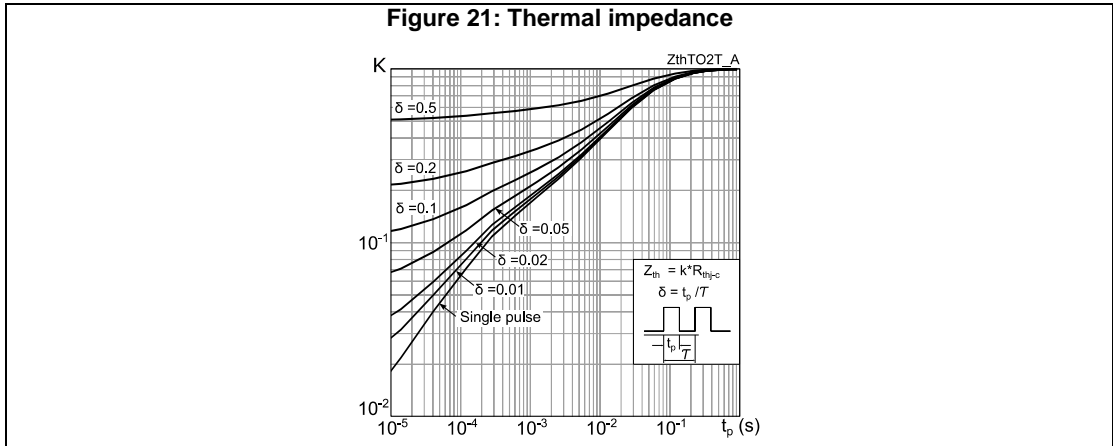
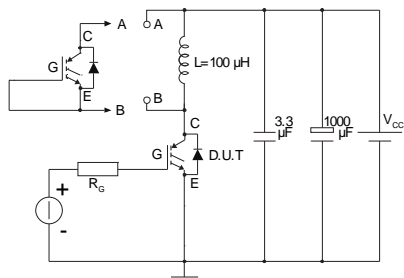


Figure 21: Thermal impedance



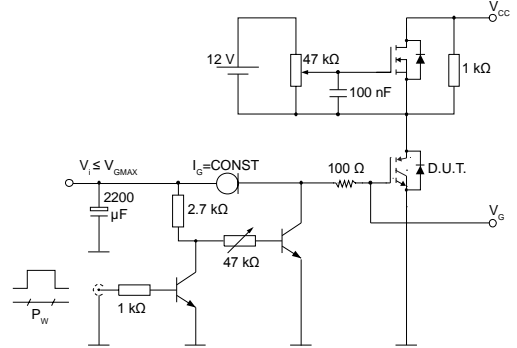
### 3 Test circuits

**Figure 22: Test circuit for inductive load switching**



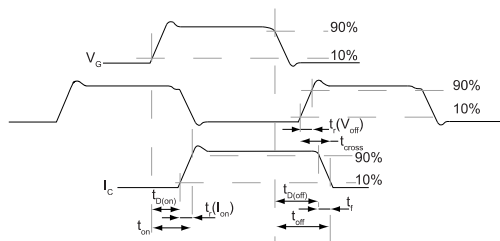
AM01504v1

**Figure 23: Gate charge test circuit**



AM01505v1

**Figure 24: Switching waveform**



AM01506v1

## 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 package information

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

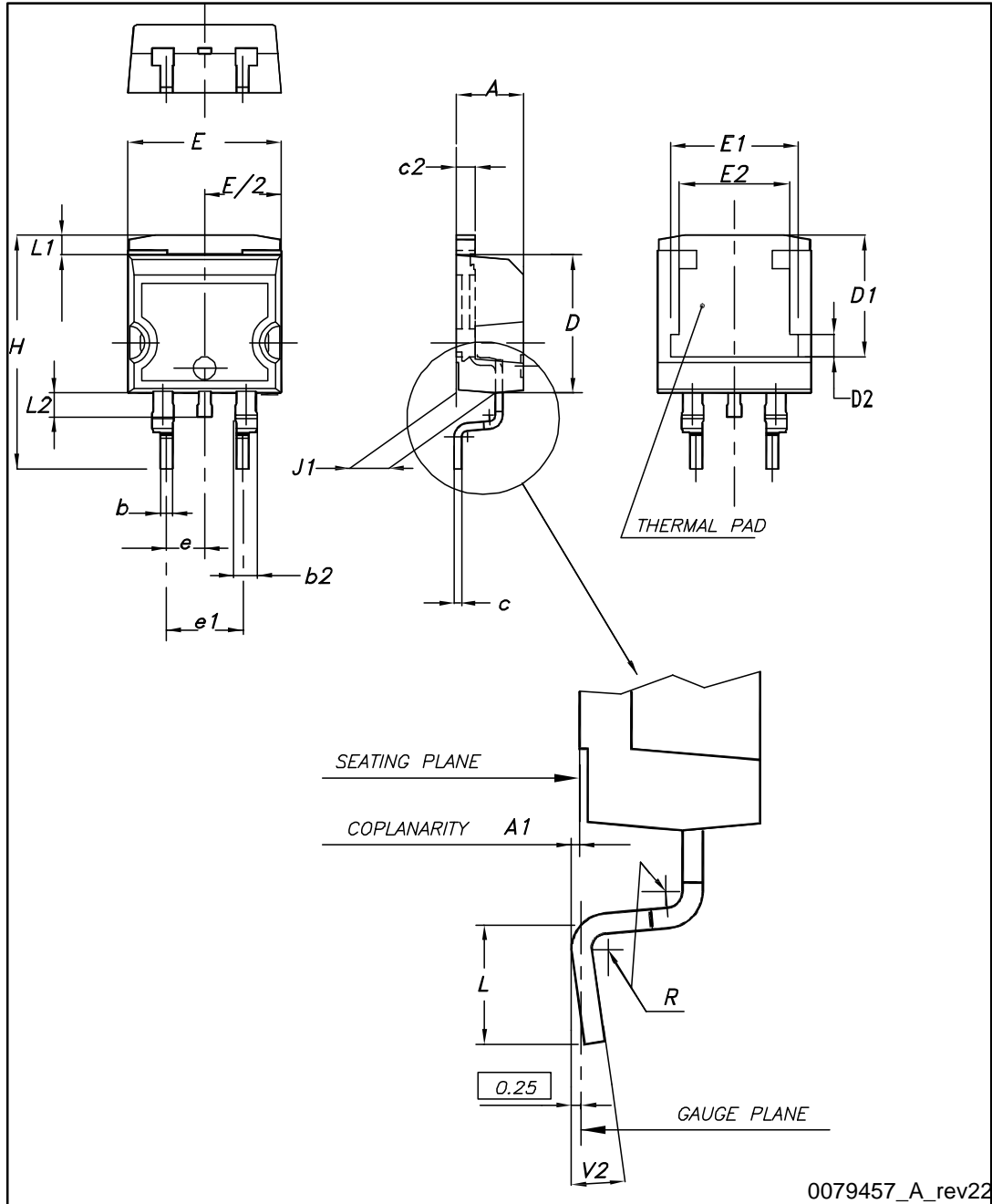
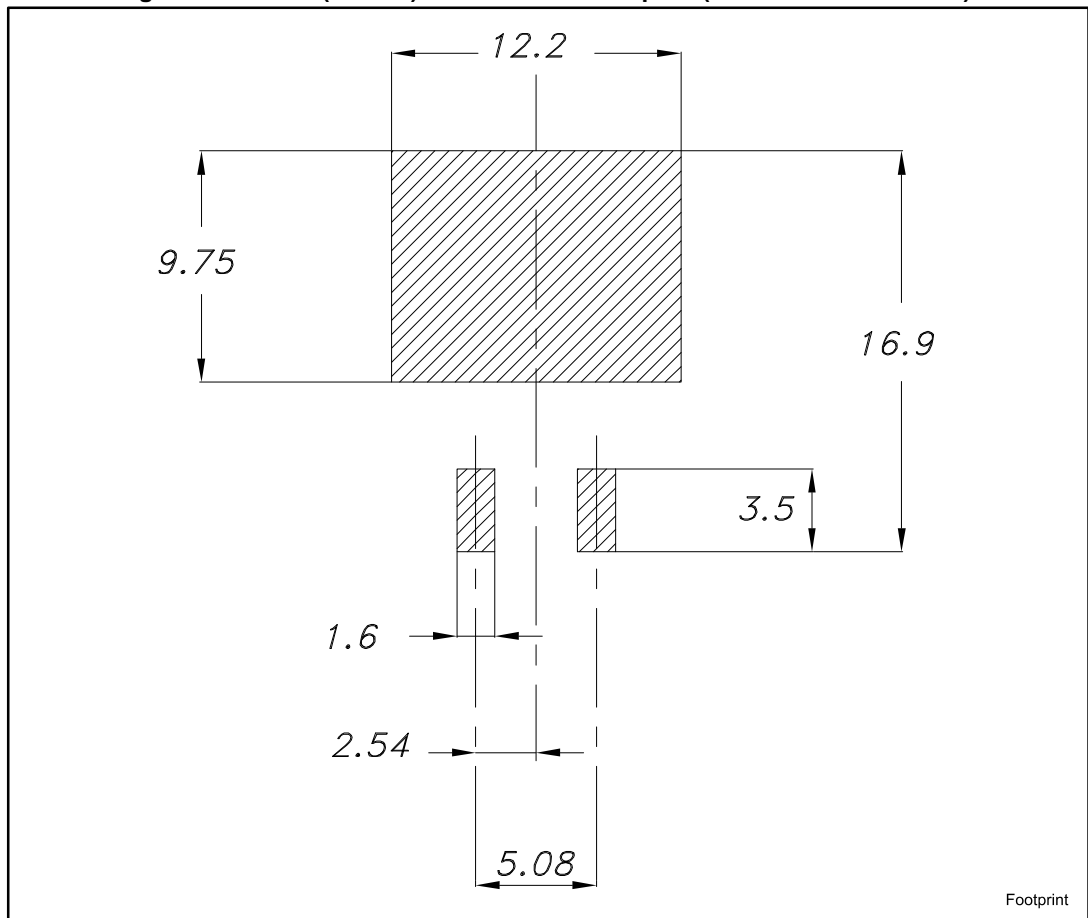


Table 7: D<sup>2</sup>PAK (TO-263) type A package mechanical data

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



## 4.2 D<sup>2</sup>PAK packing information

Figure 27: Tape outline

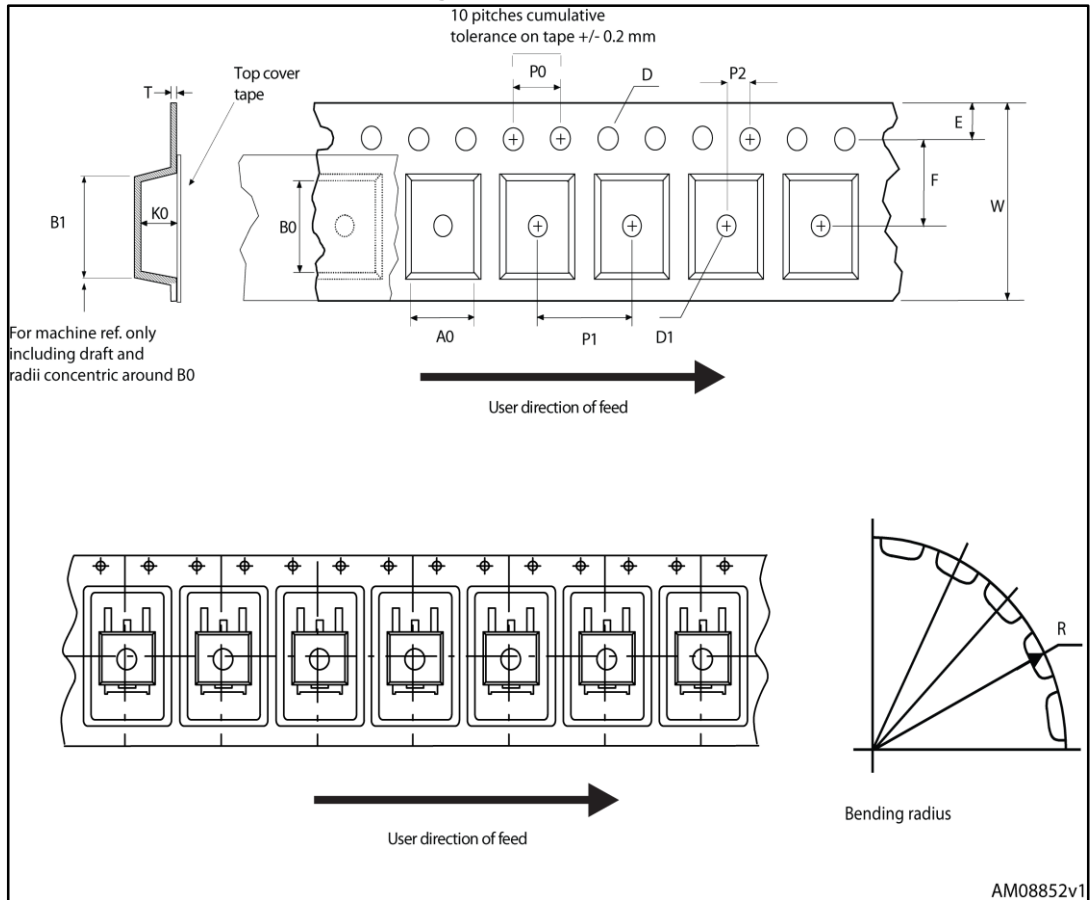


Figure 28: Reel outline

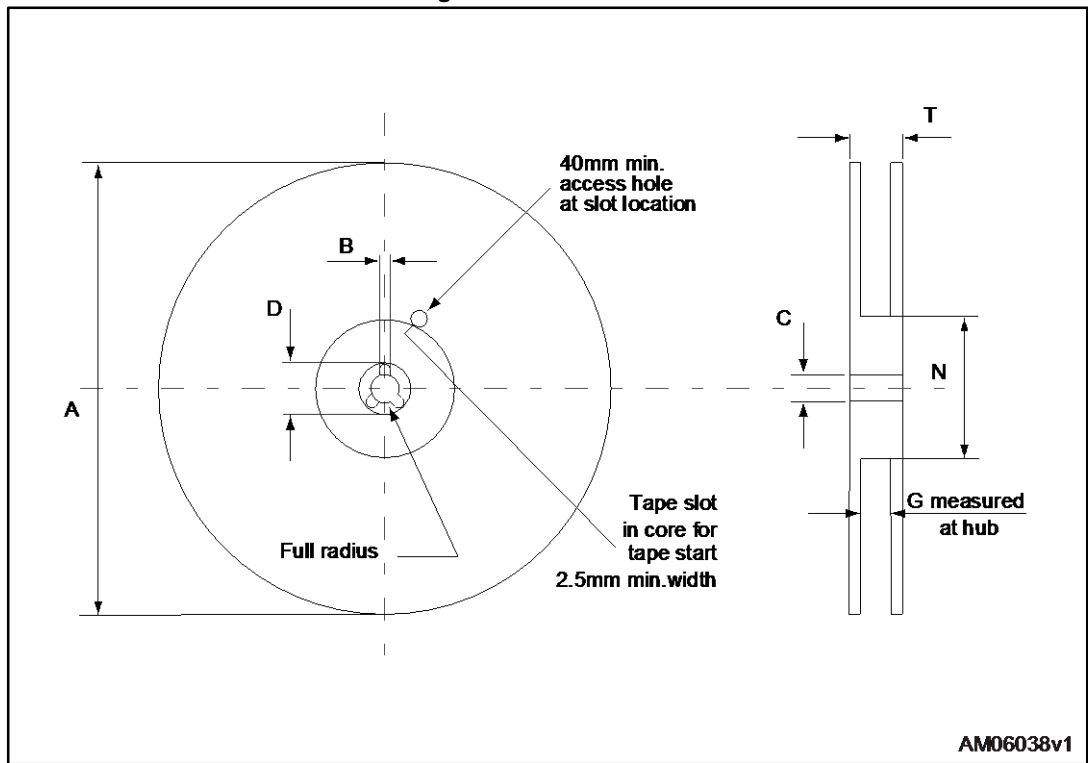


Table 8: D<sup>2</sup>PAK tape and reel mechanical data

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 9: Document revision history

Date	Revision	Changes
27-Jun-2016	1	Initial release.



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