

## Trench gate field-stop IGBT, V series 600 V, 30 A very high speed

Datasheet - production data

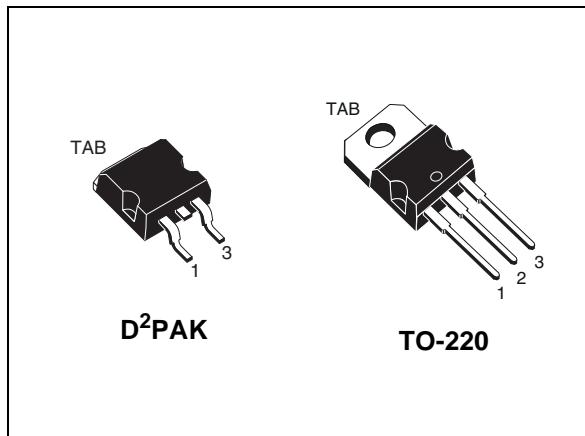
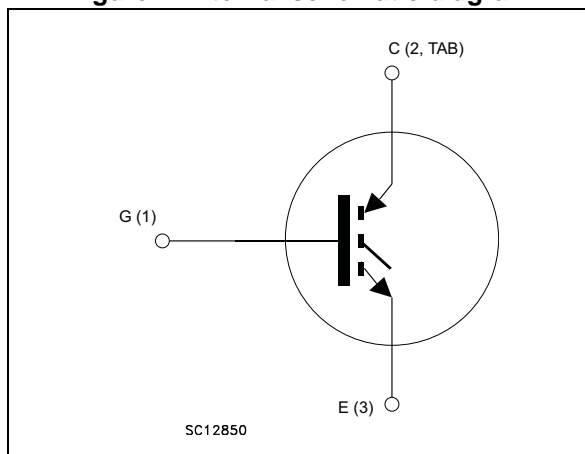


Figure 1. Internal schematic diagram



### Features

- Maximum junction temperature:  $T_J = 175\text{ °C}$
- Tail-less switching off
- $V_{CE(sat)} = 1.85\text{ V (typ.) @ } I_C = 30\text{ A}$
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance

### Applications

- Photovoltaic inverters
- Uninterruptible power supply
- Welding
- Power factor correction
- Very 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 V series of IGBTs, which represent an optimum compromise between conduction and switching losses to maximize the efficiency of very high frequency converters. Furthermore, a positive  $V_{CE(sat)}$  temperature coefficient and very tight parameter distribution result in safer paralleling operation.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STGB30V60F	GB30V60F	D <sup>2</sup> PAK	Tape and reel
STGP30V60F	GP30V60F	TO-220	Tube

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GE} = 0$ )	600	V
$I_C$	Continuous collector current at $T_C = 25\text{ °C}$	60	A
$I_C$	Continuous collector current at $T_C = 100\text{ °C}$	30	A
$I_{CP}^{(1)}$	Pulsed collector current	120	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	260	W
$T_{STG}$	Storage temperature range	- 55 to 150	$^{\circ}\text{C}$
$T_J$	Operating junction temperature	- 55 to 175	$^{\circ}\text{C}$

1. Pulse width limited by maximum junction temperature.

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance junction-case	0.58	$^{\circ}\text{C/W}$
$R_{thJA}$	Thermal resistance junction-ambient	62.5	$^{\circ}\text{C/W}$

## 2 Electrical characteristics

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

**Table 4. Static characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ( $V_{GE} = 0$ )	$I_C = 2\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 30\text{ A}$		1.85	2.3	V
		$V_{GE} = 15\text{ V}, I_C = 30\text{ A}$ $T_J = 125\text{ °C}$		2.15		
		$V_{GE} = 15\text{ V}, I_C = 30\text{ A}$ $T_J = 175\text{ °C}$		2.35		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$	5	6	7	V
$I_{CES}$	Collector cut-off current ( $V_{GE} = 0$ )	$V_{CE} = 600\text{ V}$			25	$\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{ V}$			250	nA

Table 5. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25 \text{ V}$ , $f = 1 \text{ MHz}$ , $V_{GE} = 0$	-	3750	-	pF
$C_{oes}$	Output capacitance		-	120	-	pF
$C_{res}$	Reverse transfer capacitance		-	77	-	pF
$Q_g$	Total gate charge	$V_{CC} = 480 \text{ V}$ , $I_C = 30 \text{ A}$ , $V_{GE} = 15 \text{ V}$ , see <a href="#">Figure 22</a>	-	163	-	nC
$Q_{ge}$	Gate-emitter charge		-	28	-	nC
$Q_{gc}$	Gate-collector charge		-	72	-	nC

Table 6. IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400 \text{ V}$ , $I_C = 30 \text{ A}$ , $R_G = 10 \Omega$ , $V_{GE} = 15 \text{ V}$ , see <a href="#">Figure 21</a>	-	45	-	ns
$t_r$	Current rise time		-	16	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1500	-	A/ $\mu$ s
$t_{d(off)}$	Turn-off delay time		-	189	-	ns
$t_f$	Current fall time		-	19	-	ns
$E_{on}^{(1)}$	Turn-on switching losses		-	383	-	$\mu$ J
$E_{off}^{(2)}$	Turn-off switching losses		-	233	-	$\mu$ J
$E_{ts}$	Total switching losses	-	616	-	$\mu$ J	
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400 \text{ V}$ , $I_C = 30 \text{ A}$ , $R_G = 10 \Omega$ , $V_{GE} = 15 \text{ V}$ , $T_J = 175 \text{ }^\circ\text{C}$ , see <a href="#">Figure 21</a>	-	42	-	ns
$t_r$	Current rise time		-	17	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1337	-	A/ $\mu$ s
$t_{d(off)}$	Turn-off delay time		-	193	-	ns
$t_f$	Current fall time		-	32	-	ns
$E_{on}^{(1)}$	Turn-on switching losses		-	794	-	$\mu$ J
$E_{off}^{(2)}$	Turn-off switching losses		-	378	-	$\mu$ J
$E_{ts}$	Total switching losses	-	1172	-	$\mu$ J	

1. Energy losses include reverse recovery of the external diode. The diode is the same of the copacked STGW30V60DF.
2. Turn-off losses include also the tail of the collector current.

## 2.1 Electrical characteristics (curves)

Figure 2. Power dissipation vs. case temperature

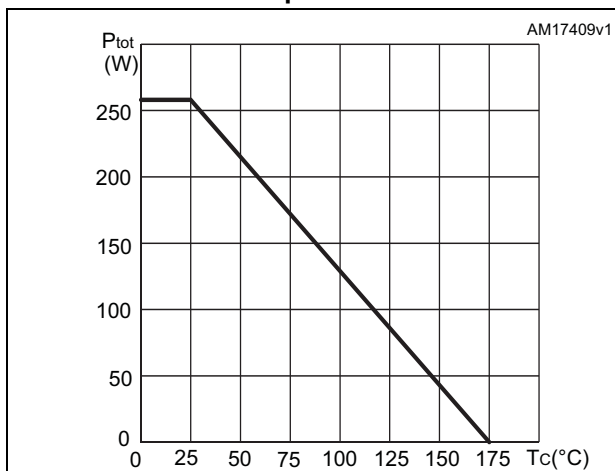


Figure 3. Collector current vs. case temperature

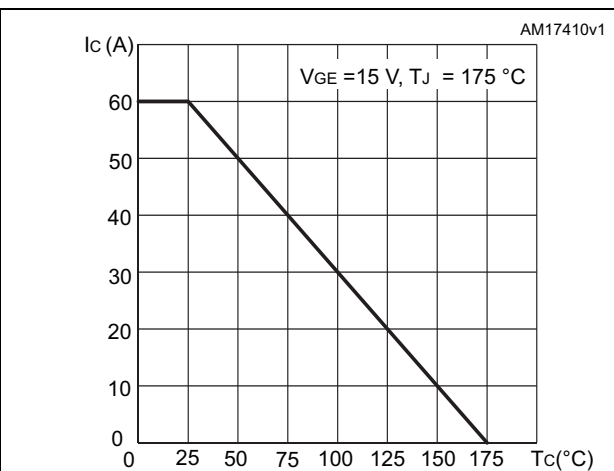


Figure 4. Output characteristics (Tj=25°C)

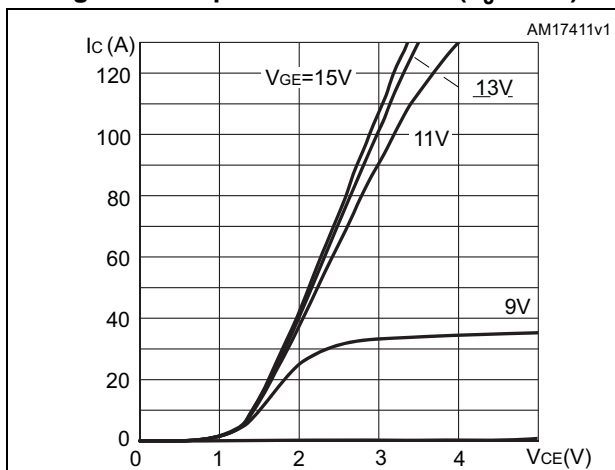


Figure 5. Output characteristics (Tj=175°C)

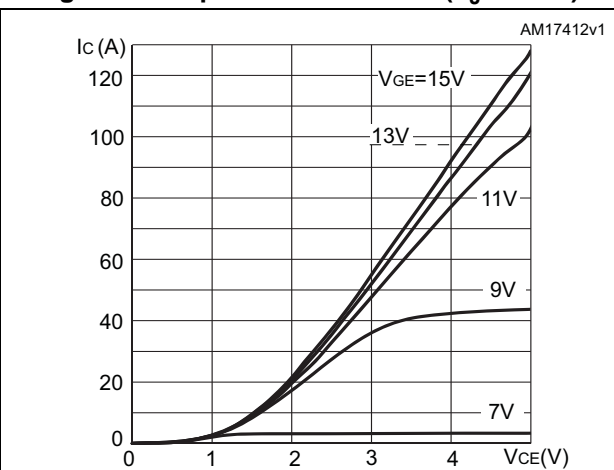


Figure 6. VCE(sat) vs. junction temperature

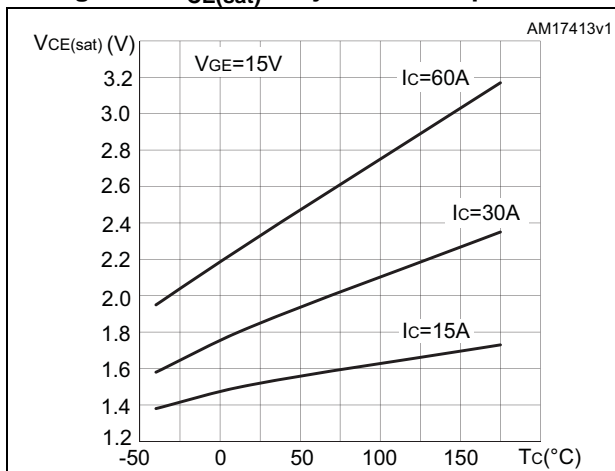


Figure 7. VCE(sat) vs. collector current

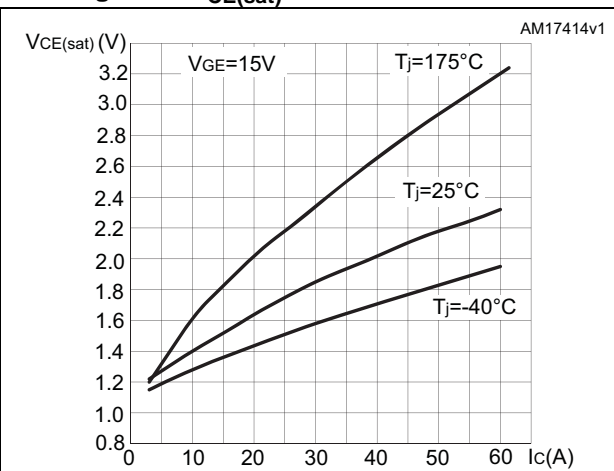


Figure 8. Normalized  $V_{GE(th)}$  vs junction temperature

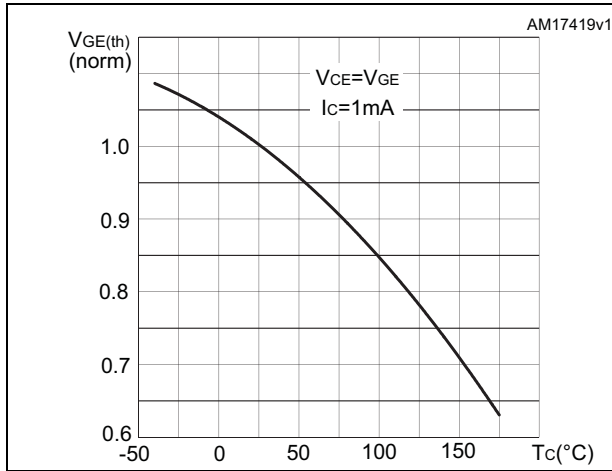


Figure 9. Normalized  $V_{(BR)CES}$  vs. junction temperature

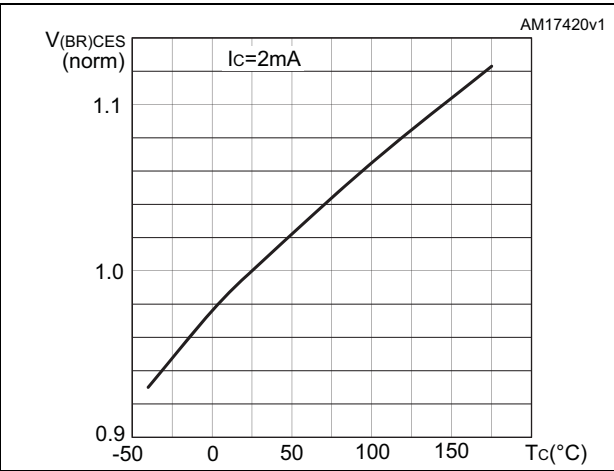


Figure 10. Capacitance variations

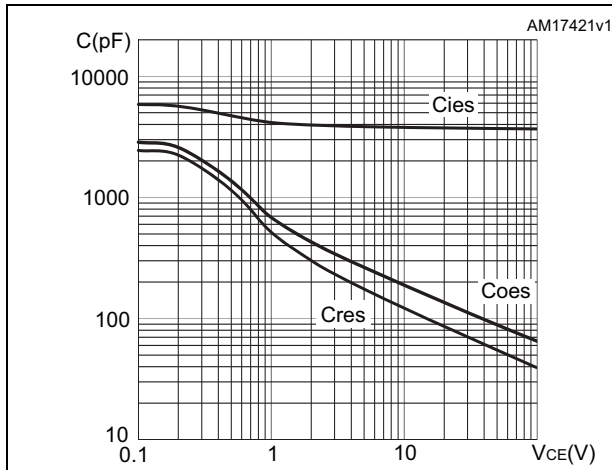


Figure 11. Gate charge vs. gate-emitter voltage

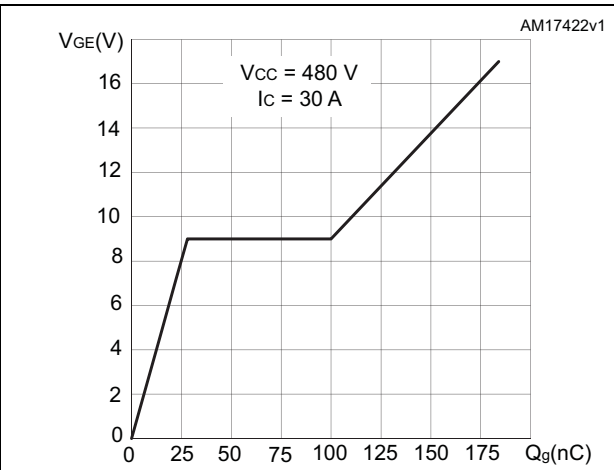


Figure 12. Switching losses vs. collector current

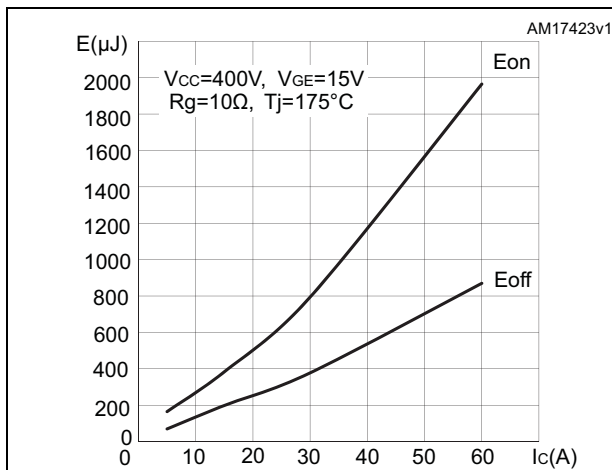


Figure 13. Switching losses vs. gate resistance

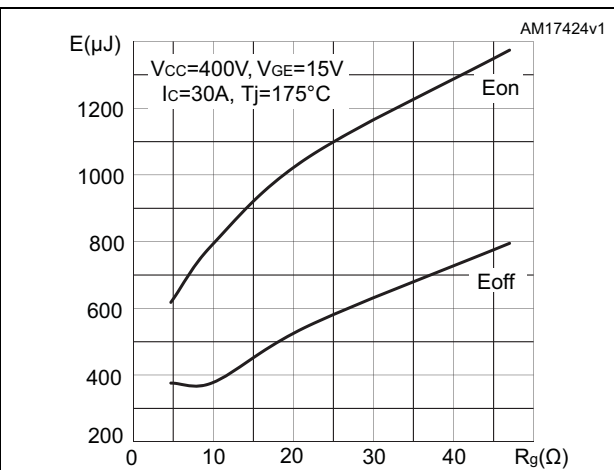


Figure 14. Switching losses vs. junction temperature

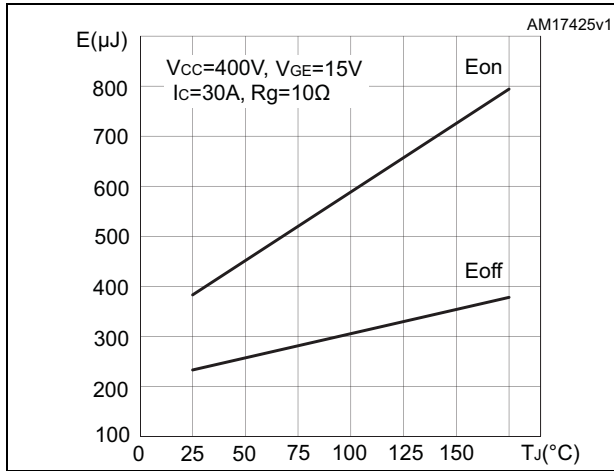


Figure 15. Switching losses vs. collector emitter voltage

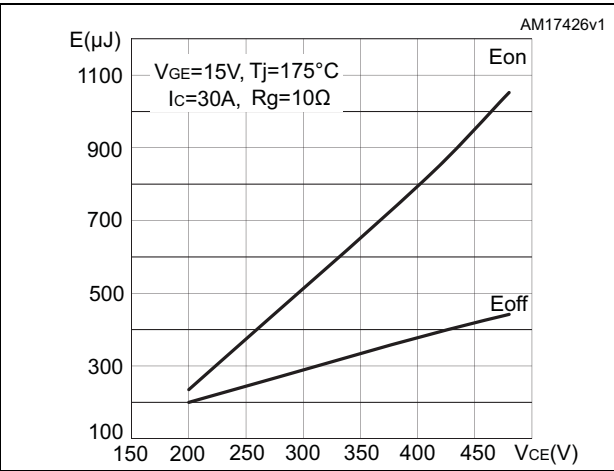


Figure 16. Switching times vs. collector current

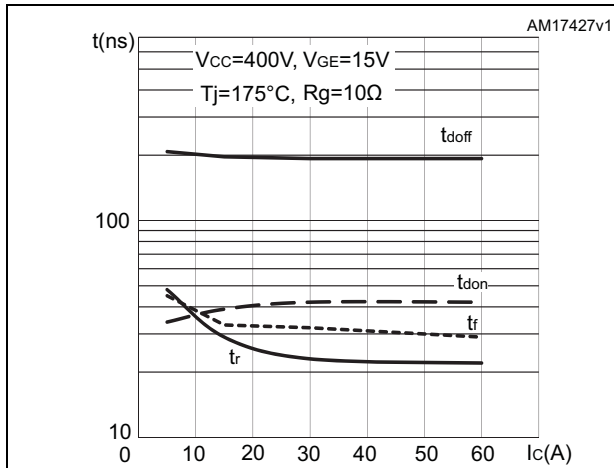


Figure 17. Switching times vs. gate resistance

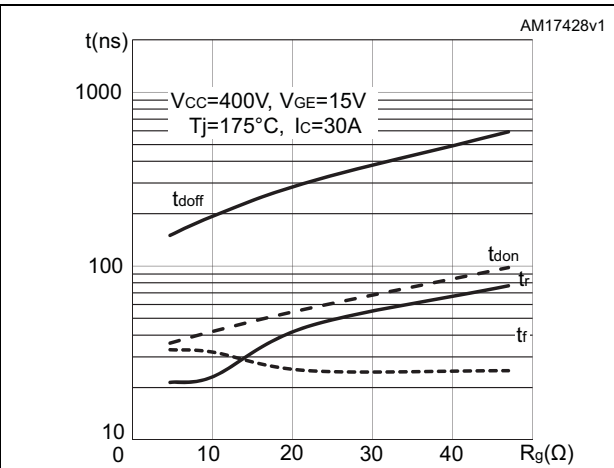


Figure 18. Transfer characteristics

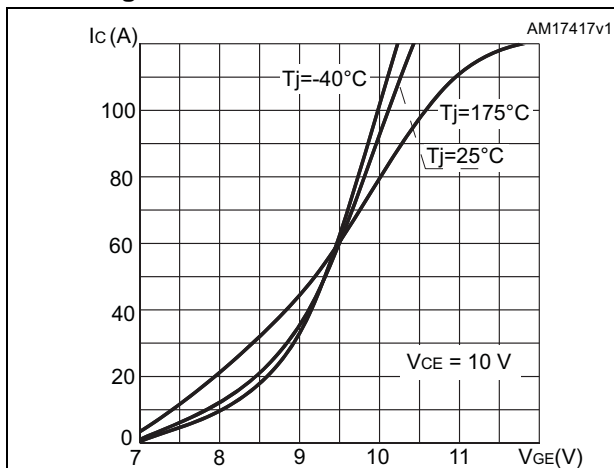


Figure 19. Safe operating area

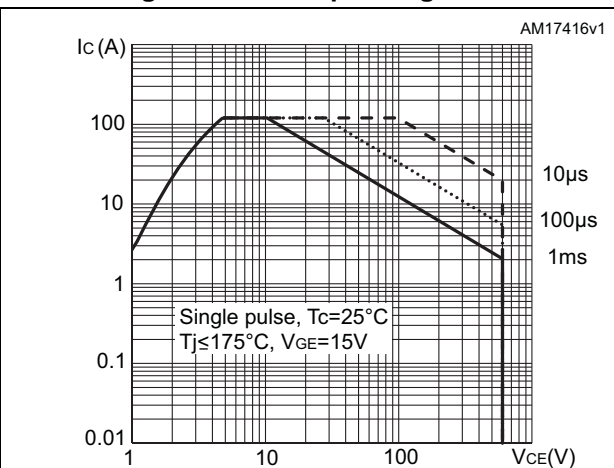
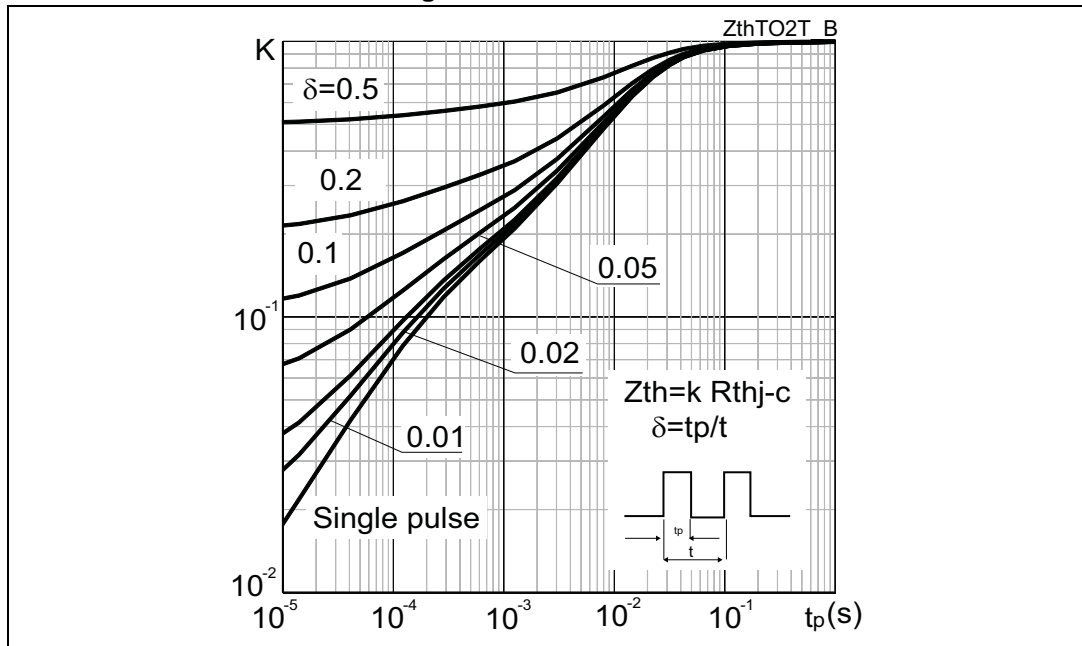


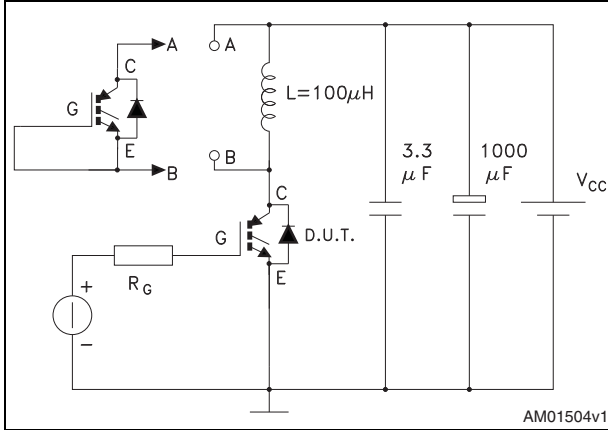


Figure 20. Thermal data



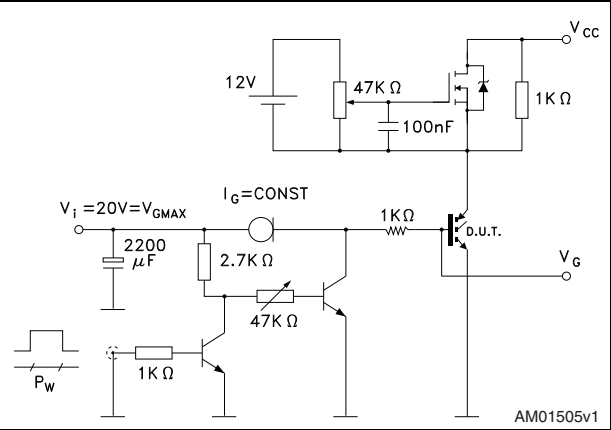
### 3 Test circuits

Figure 21. Test circuit for inductive load switching



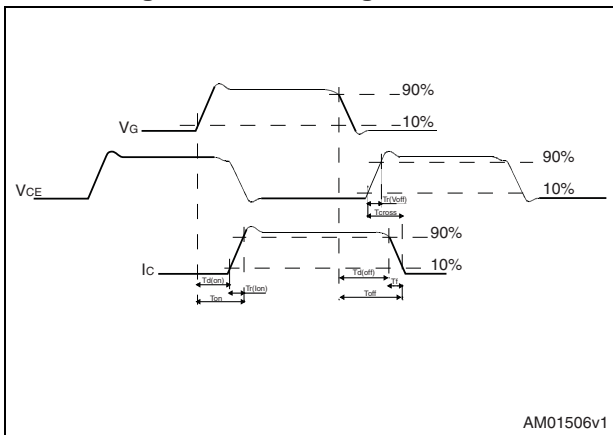
AM01504v1

Figure 22. Gate charge test circuit



AM01505v1

Figure 23. Switching waveform



AM01506v1

## 4 Package mechanical data

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, STGB30V60F

Figure 24. D<sup>2</sup>PAK (TO-263) drawing

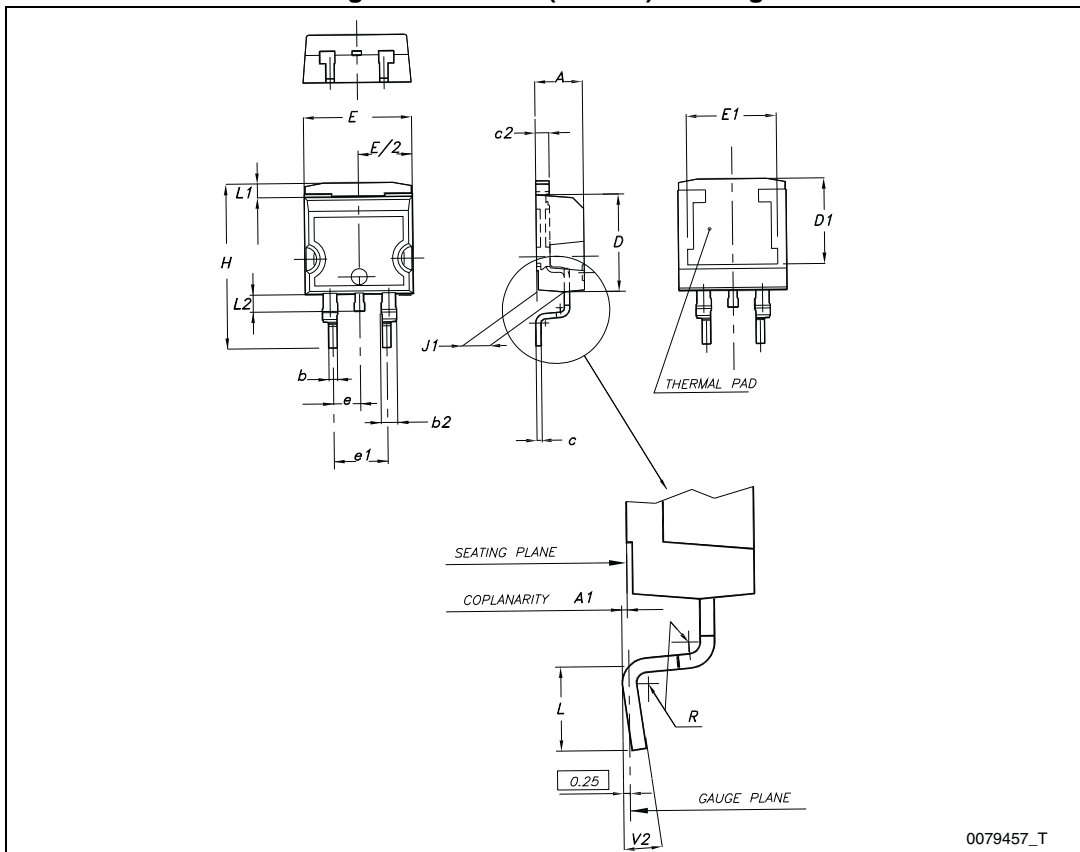
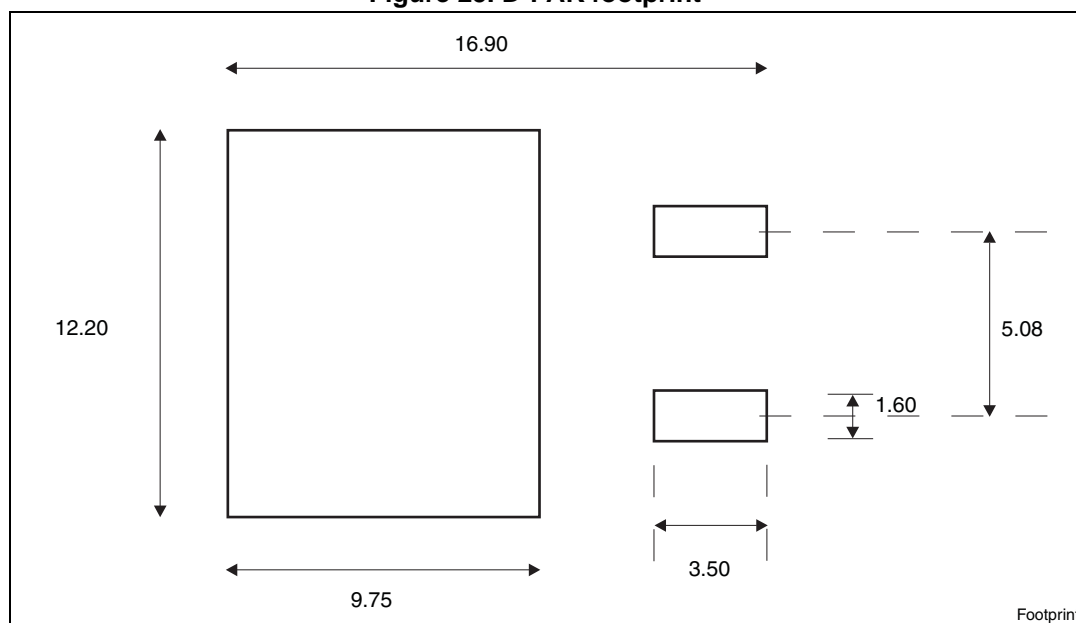


Table 7. D<sup>2</sup>PAK (TO-263) mechanical data

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		
E	10		10.40
E1	8.50		
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°

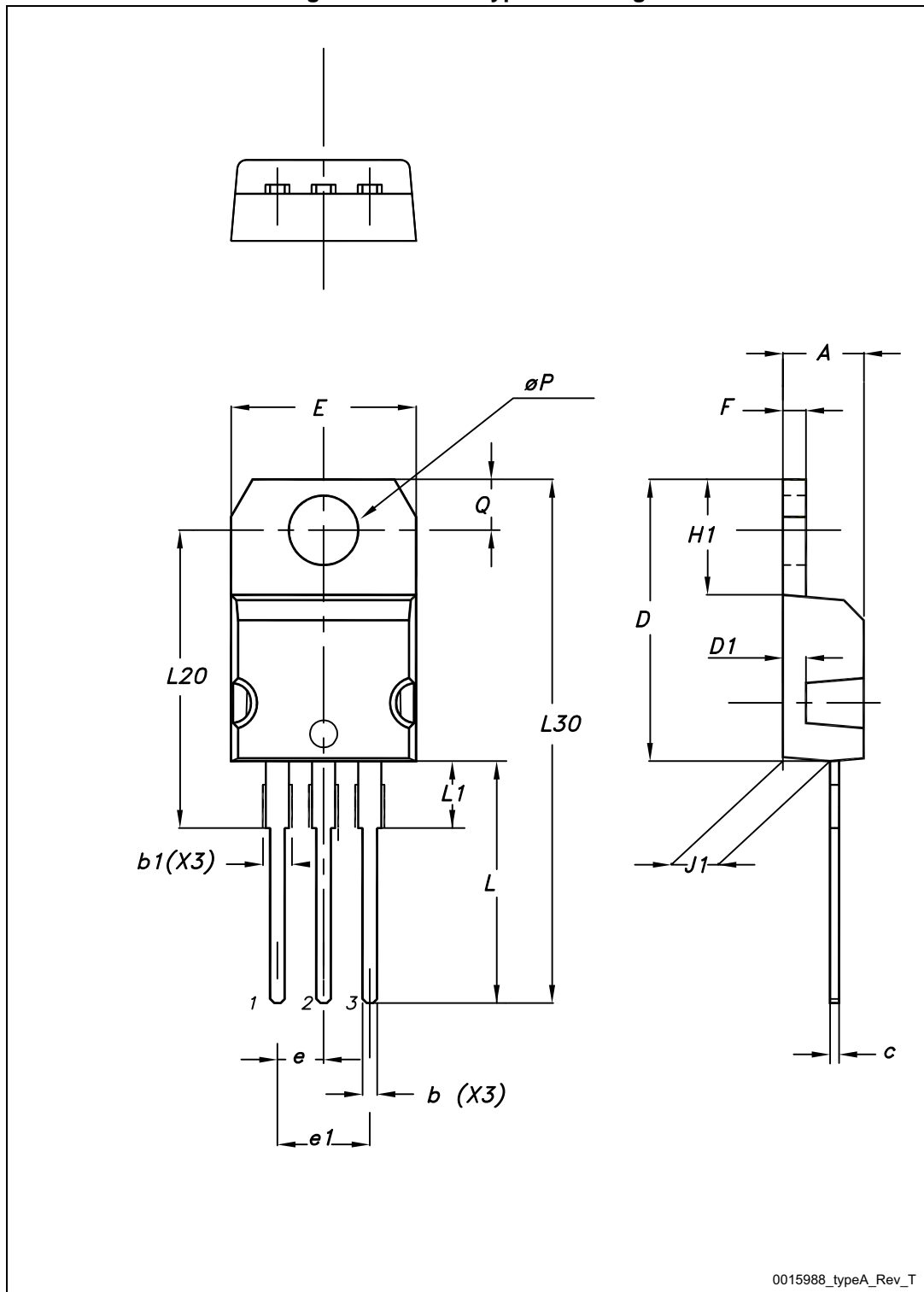
Figure 25. D<sup>2</sup>PAK footprint<sup>(a)</sup>



a. All dimension are in millimeters.

### 4.2 TO-220, STGP30V60F

Figure 26. TO-220 type A drawing



0015988\_typeA\_Rev\_T

Table 8. TO-220 type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		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		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
ØP	3.75		3.85
Q	2.65		2.95

# 5 Packaging mechanical data

Figure 27. Tape

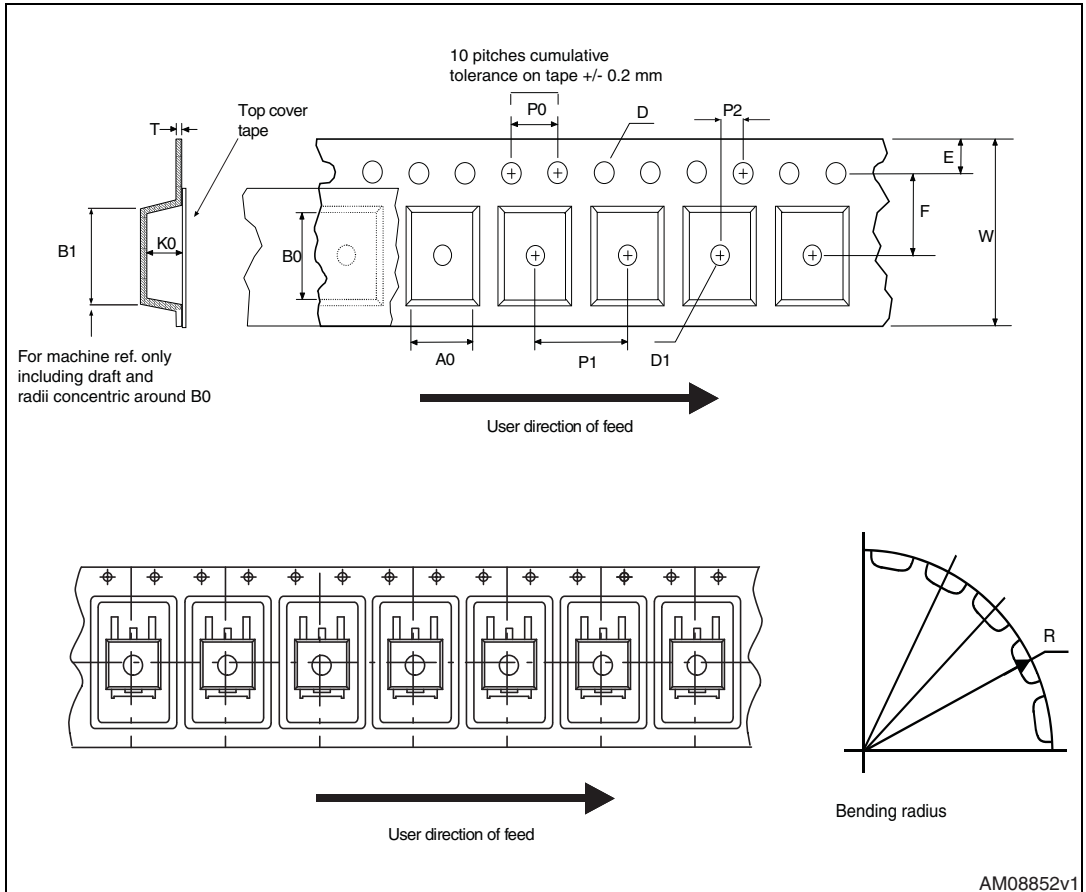




Figure 28. Reel

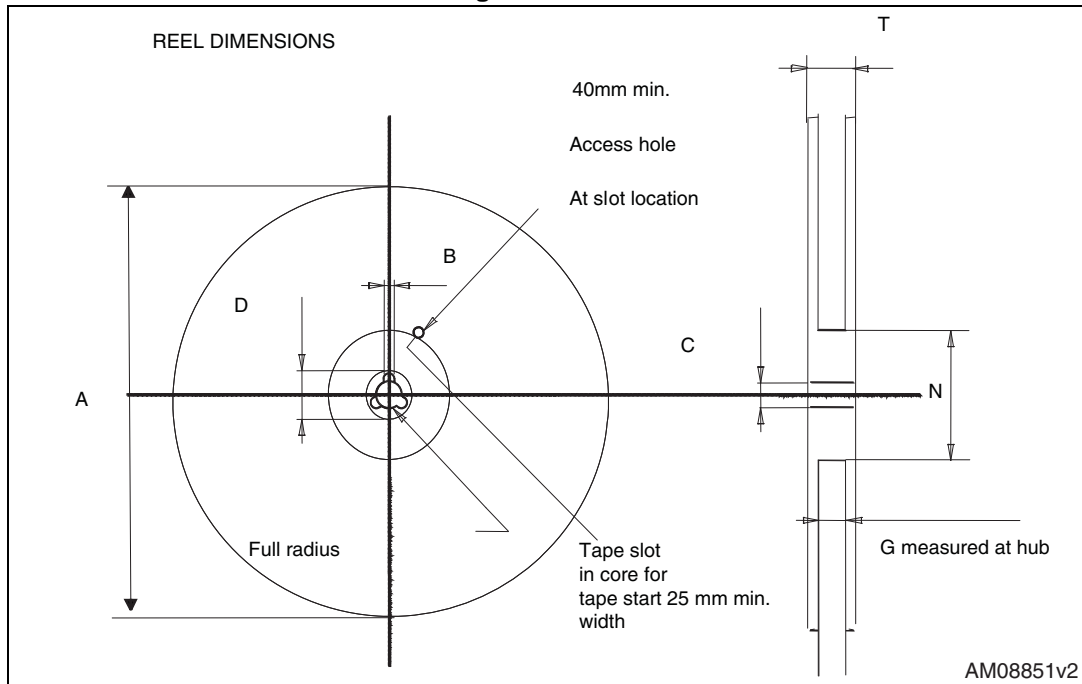


Table 9. D<sup>2</sup>PAK (TO-263) tape and reel mechanical data

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 qty		1000
P2	1.9	2.1	Bulk qty		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

## 6 Revision history

Table 10. Document revision history

Date	Revision	Changes
26-Jul-2013	1	Initial release.
29-Jul-2013	2	Updated <i>Table 3: Thermal data</i> and added <i>Figure 19: Safe operating area</i> .
08-Oct-2013	3	Updated title, description and features in cover page.
08-Apr-2014	4	Updated <i>Table 4: Static characteristics</i> , <i>Figure 3: Collector current vs. case temperature</i> , <i>Figure 16: Switching times vs. collector current</i> , <i>Figure 18: Transfer characteristics</i> .

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