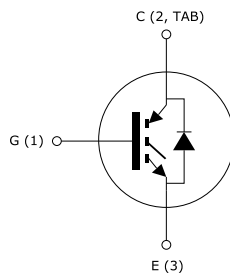
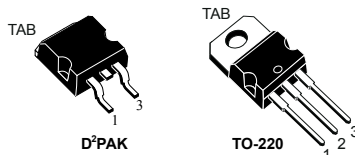


## Trench gate field-stop 600 V, 30 A high speed HB series IGBT



## Product status link

[STGB30H60DFB](#)
[STGP30H60DFB](#)

## Features

- Maximum junction temperature:  $T_J = 175\text{ }^\circ\text{C}$
- High speed switching series
- Minimized tail current
- Low saturation voltage:  $V_{CE(sat)} = 1.55\text{ V (typ.) @ } I_C = 30\text{ A}$
- Tight parameter distribution
- Safe paralleling
- Positive  $V_{CE(sat)}$  temperature coefficient
- Low thermal resistance
- Very fast soft recovery antiparallel diode

## Applications

- Photovoltaic inverters
- High frequency converters

## Description

These devices are IGBTs developed using an advanced proprietary trench gate field-stop structure. These devices are part of the new HB series of IGBTs, which represent 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.

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

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

1. Pulse width limited by maximum junction temperature.

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance junction-case IGBT	0.58	°C/W
$R_{thJC}$	Thermal resistance junction-case diode	2.08	
$R_{thJA}$	Thermal resistance junction-ambient	62.5	

## 2 Electrical characteristics

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

**Table 3. Static characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}, I_C = 2\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 30\text{ A}$		1.55	2	V
		$V_{GE} = 15\text{ V}, I_C = 30\text{ A}, T_J = 125\text{ °C}$		1.65		
		$V_{GE} = 15\text{ V}, I_C = 30\text{ A}, T_J = 175\text{ °C}$		1.75		
$V_F$	Forward on-voltage	$I_F = 30\text{ A}$		2	2.6	V
		$I_F = 30\text{ A}, T_J = 125\text{ °C}$		1.7		
		$I_F = 30\text{ A}, T_J = 175\text{ °C}$		1.6		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$	5	6	7	V
$I_{CES}$	Collector cut-off current	$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}$			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 4. Dynamic characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0\text{ V}$	-	3659	-	pF
$C_{oes}$	Output capacitance		-	101	-	
$C_{res}$	Reverse transfer capacitance		-	76	-	
$Q_g$	Total gate charge	$V_{CC} = 520\text{ V}, I_C = 30\text{ A}, V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 28. Gate charge test circuit)	-	149	-	nC
$Q_{ge}$	Gate-emitter charge		-	25	-	
$Q_{gc}$	Gate-collector charge		-	62	-	

**Table 5. IGBT switching characteristics (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit	
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 10\ \Omega$ (see Figure 27. Test circuit for inductive load switching)	-	37	-	ns	
$t_r$	Current rise time		-	14.6	-		
$(di/dt)_{on}$	Turn-on current slope		-	1643	-	A/ $\mu\text{s}$	
$t_{d(off)}$	Turn-off-delay time		$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 10\ \Omega$ , $T_J = 175\text{ }^\circ\text{C}$ (see Figure 27. Test circuit for inductive load switching)	-	146	-	ns
$t_f$	Current fall time			-	23	-	
$E_{on}^{(1)}$	Turn-on switching energy			-	383	-	$\mu\text{J}$
$E_{off}^{(2)}$	Turn-off switching energy			-	293	-	
$E_{ts}$	Total switching energy			-	676	-	
$t_{d(on)}$	Turn-on delay time			$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 10\ \Omega$ , $T_J = 175\text{ }^\circ\text{C}$ (see Figure 27. Test circuit for inductive load switching)	-	35	-
$t_r$	Current rise time	-	16.1		-		
$(di/dt)_{on}$	Turn-on current slope	-	1496		-	A/ $\mu\text{s}$	
$t_{d(off)}$	Turn-off-delay time	$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 10\ \Omega$ , $T_J = 175\text{ }^\circ\text{C}$ (see Figure 27. Test circuit for inductive load switching)	-		158	-	ns
$t_f$	Current fall time		-		65	-	
$E_{on}^{(1)}$	Turn-on switching energy		-		794	-	$\mu\text{J}$
$E_{off}^{(2)}$	Turn-off switching energy		-		572	-	
$E_{ts}$	Total switching energy		-		1366	-	

1. Including the reverse recovery of the diode.
2. Including the tail of the collector current.

**Table 6. Diode switching characteristics (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{rr}$	Reverse recovery time	$I_F = 30\text{ A}$ , $V_R = 400\text{ V}$ , $V_{GE} = 15\text{ V}$ , $di/dt = 1000\text{ A}/\mu\text{s}$ (see Figure 27. Test circuit for inductive load switching)	-	53	-	ns
$Q_{rr}$	Reverse recovery charge		-	384	-	nC
$I_{rrm}$	Reverse recovery current		-	14.5	-	A
$di_{rr}/dt$	Peak rate of fall of reverse recovery current during $t_b$		-	788	-	A/ $\mu\text{s}$
$E_{rr}$	Reverse recovery energy		-	104	-	$\mu\text{J}$
$t_{rr}$	Reverse recovery time	$I_F = 30\text{ A}$ , $V_R = 400\text{ V}$ , $V_{GE} = 15\text{ V}$ , $di/dt = 1000\text{ A}/\mu\text{s}$ , $T_J = 175\text{ }^\circ\text{C}$ (see Figure 27. Test circuit for inductive load switching)	-	104	-	ns
$Q_{rr}$	Reverse recovery charge		-	1352	-	nC
$I_{rrm}$	Reverse recovery current		-	26	-	A
$di_{rr}/dt$	Peak rate of fall of reverse recovery current during $t_b$		-	310	-	A/ $\mu\text{s}$
$E_{rr}$	Reverse recovery energy		-	407	-	$\mu\text{J}$

## 2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature

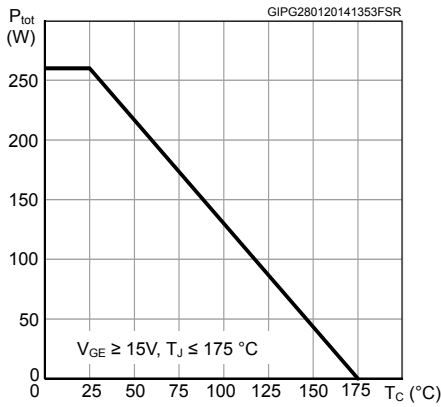


Figure 2. Collector current vs case temperature

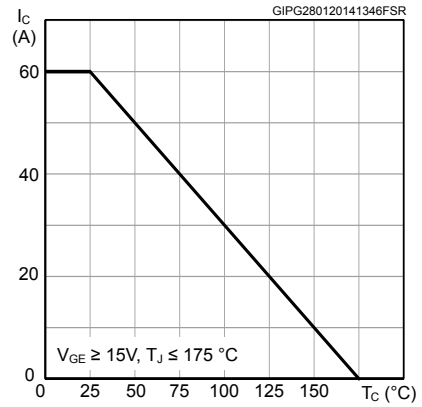


Figure 3. Output characteristics ( $T_J = 25^\circ C$ )

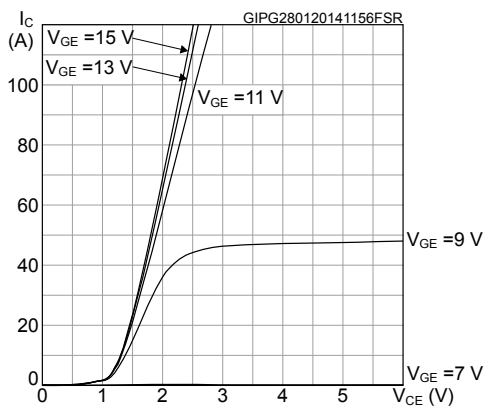


Figure 4. Output characteristics ( $T_J = 175^\circ C$ )

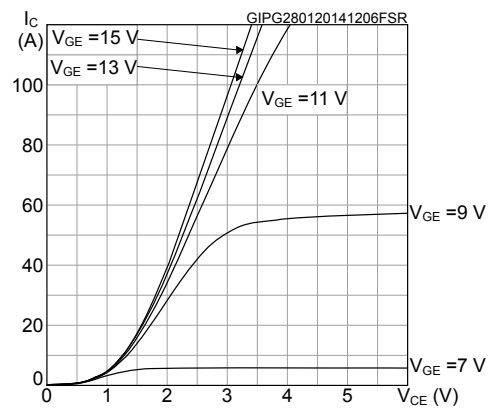


Figure 5.  $V_{CE(sat)}$  vs junction temperature

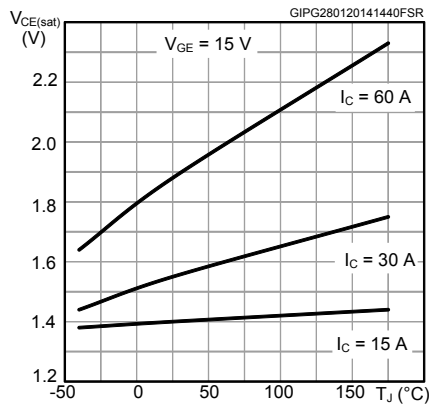
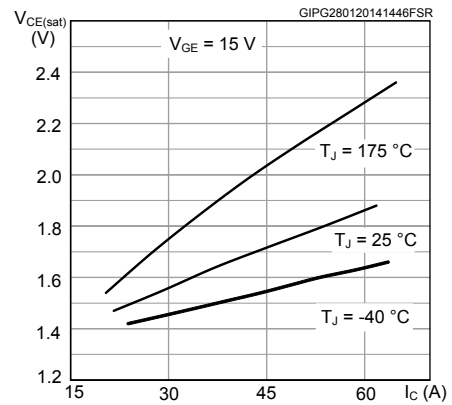
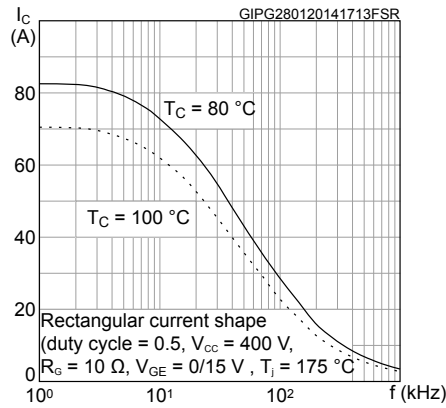
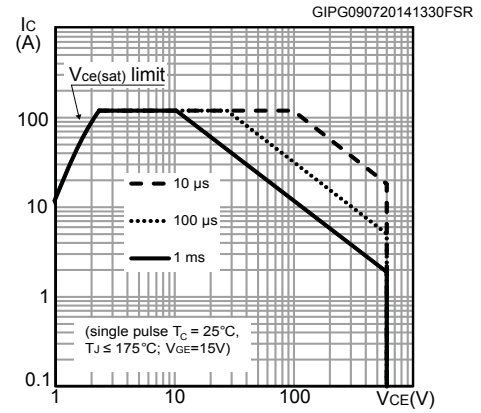
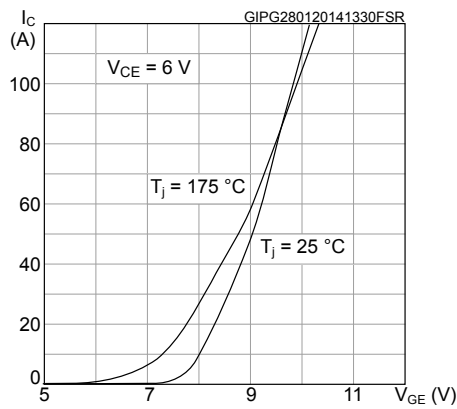
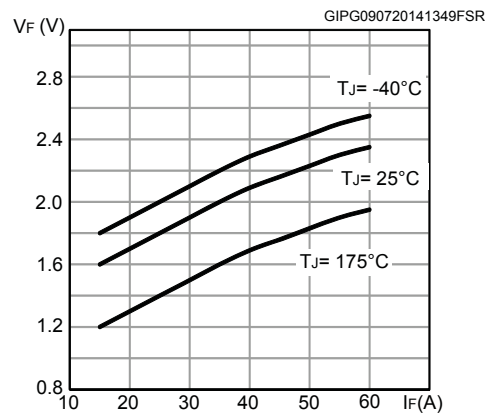
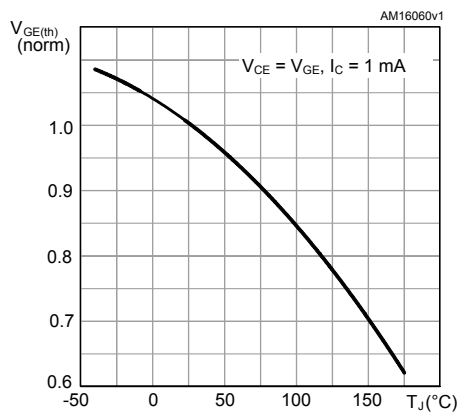
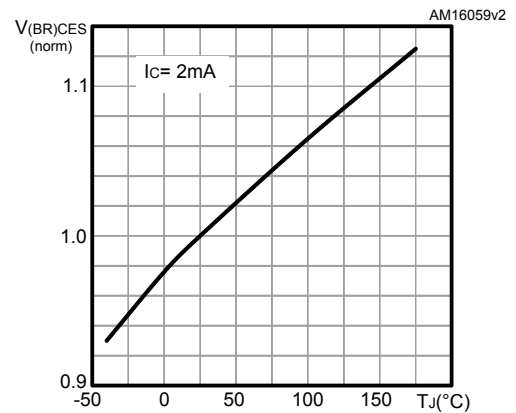
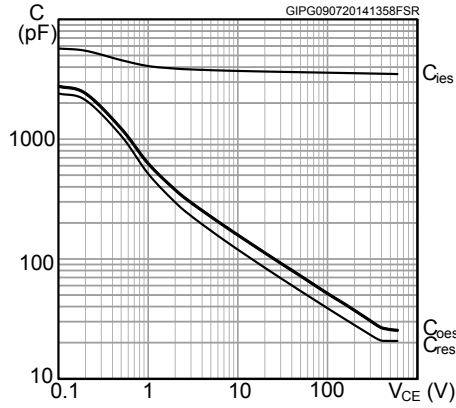
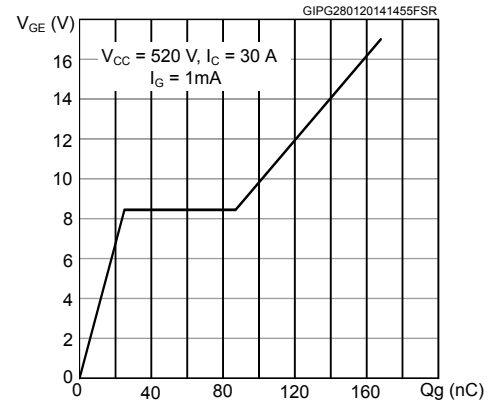
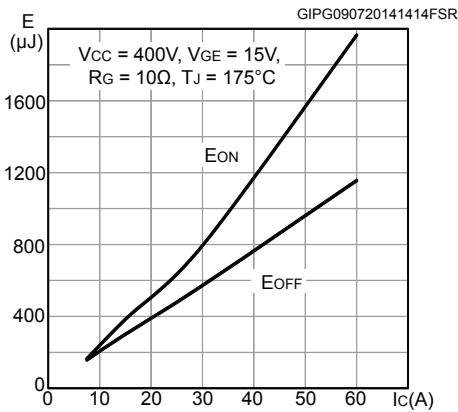
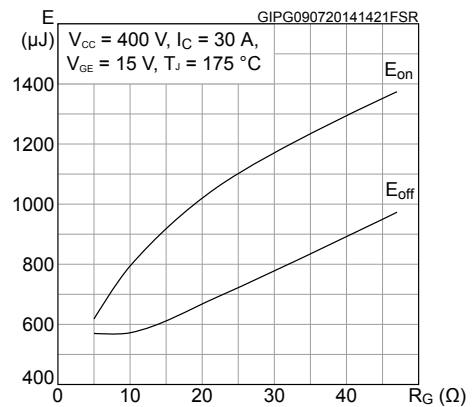
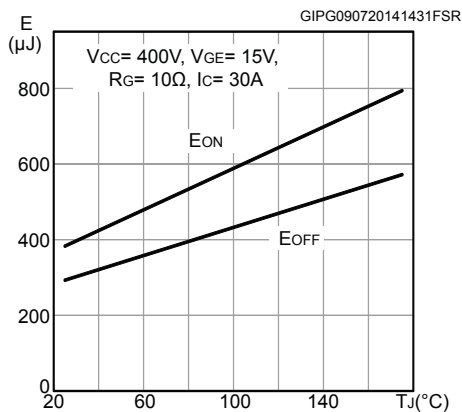
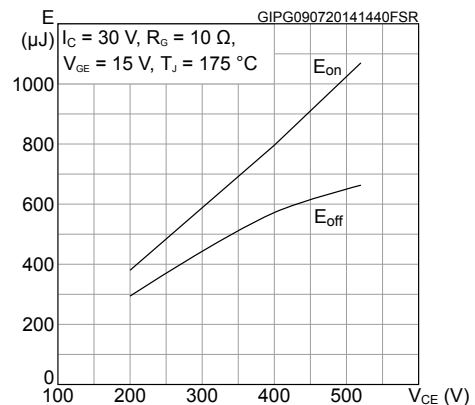
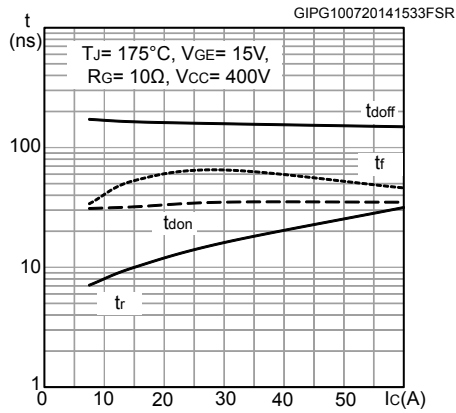
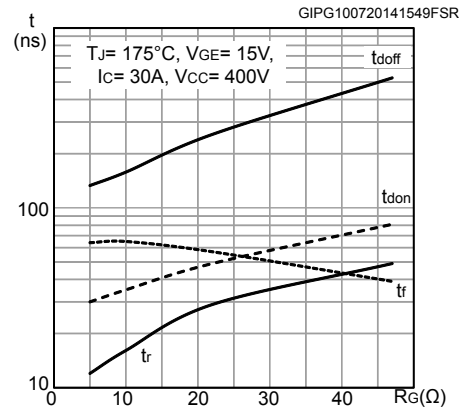
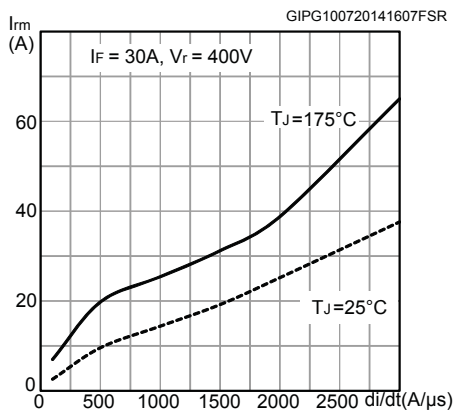
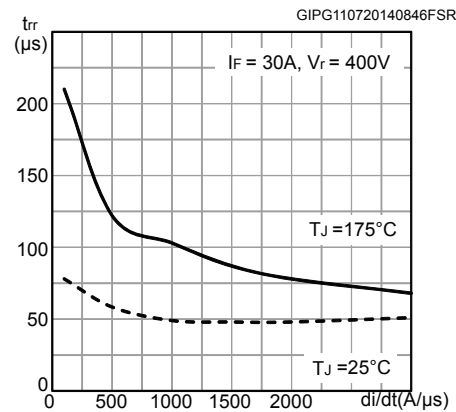
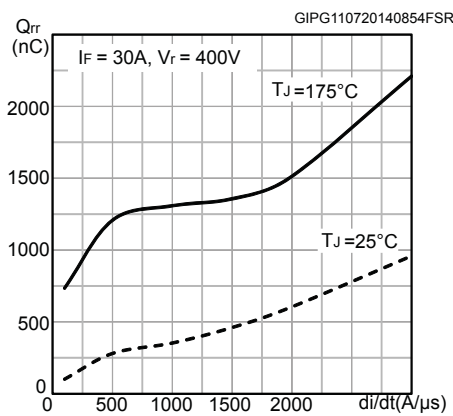
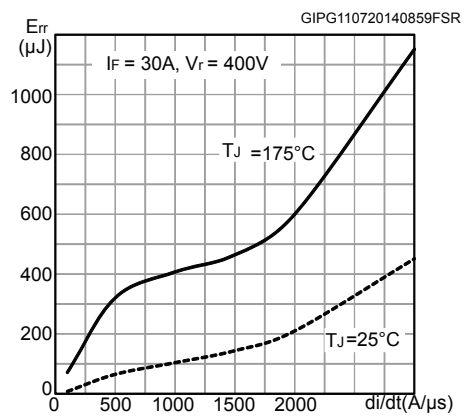


Figure 6.  $V_{CE(sat)}$  vs collector current

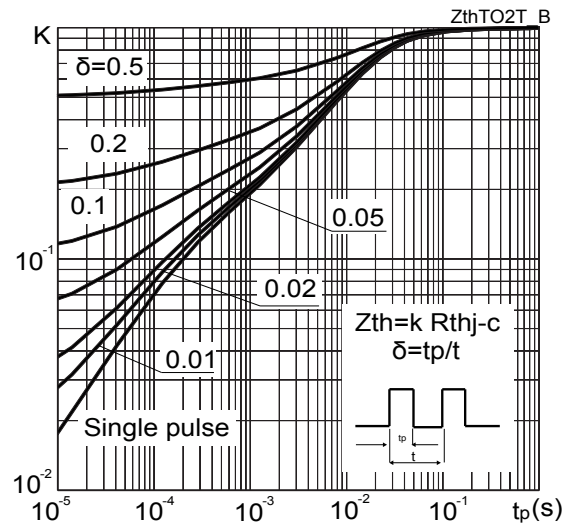
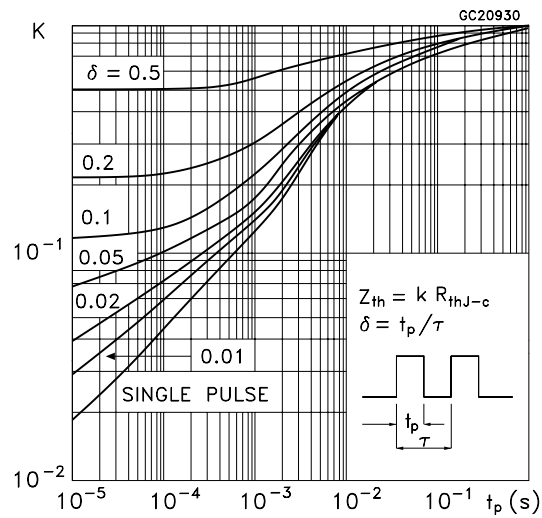


**Figure 7. Collector current vs switching frequency**

**Figure 8. Forward bias safe operating area**

**Figure 9. Transfer characteristics**

**Figure 10. Diode V<sub>F</sub> vs forward current**

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

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


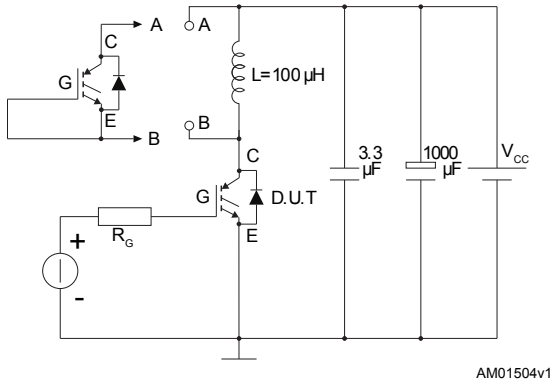
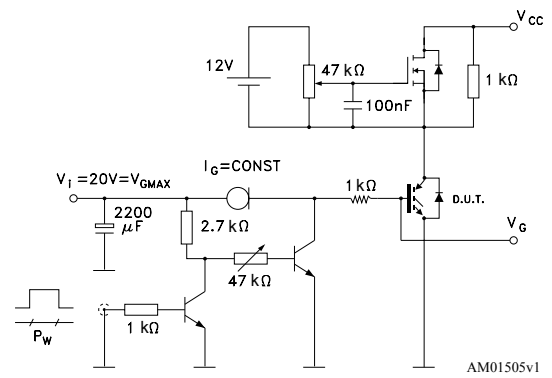
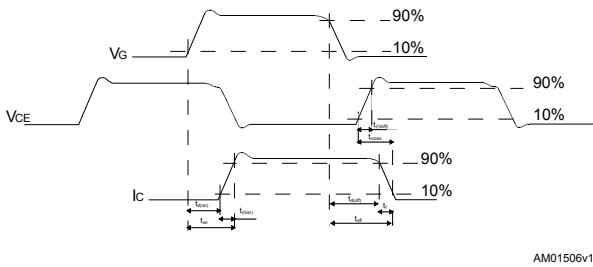
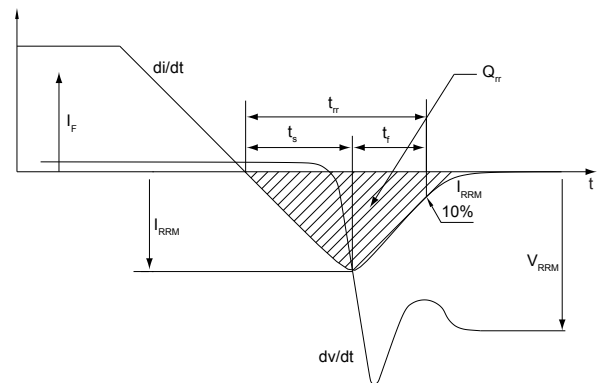
**Figure 13. Capacitance variations**

**Figure 14. Gate charge vs. gate-emitter voltage**

**Figure 15. Switching energy vs collector current**

**Figure 16. Switching energy vs gate resistance**

**Figure 17. Switching energy vs temperature**

**Figure 18. Switching energy vs collector emitter voltage**


**Figure 19. Switching times vs collector current**

**Figure 20. Switching times vs gate resistance**

**Figure 21. Reverse recovery current vs diode current slope**

**Figure 22. Reverse recovery time vs diode current slope**

**Figure 23. Reverse recovery charge vs diode current slope**

**Figure 24. Reverse recovery energy vs diode current slope**




**Figure 25. Thermal impedance for IGBT**

**Figure 26. Thermal impedance for diode**


### 3 Test circuits

**Figure 27. Test circuit for inductive load switching**

**Figure 28. Gate charge test circuit**

**Figure 29. Switching waveform**

**Figure 30. Diode reverse recovery waveform**


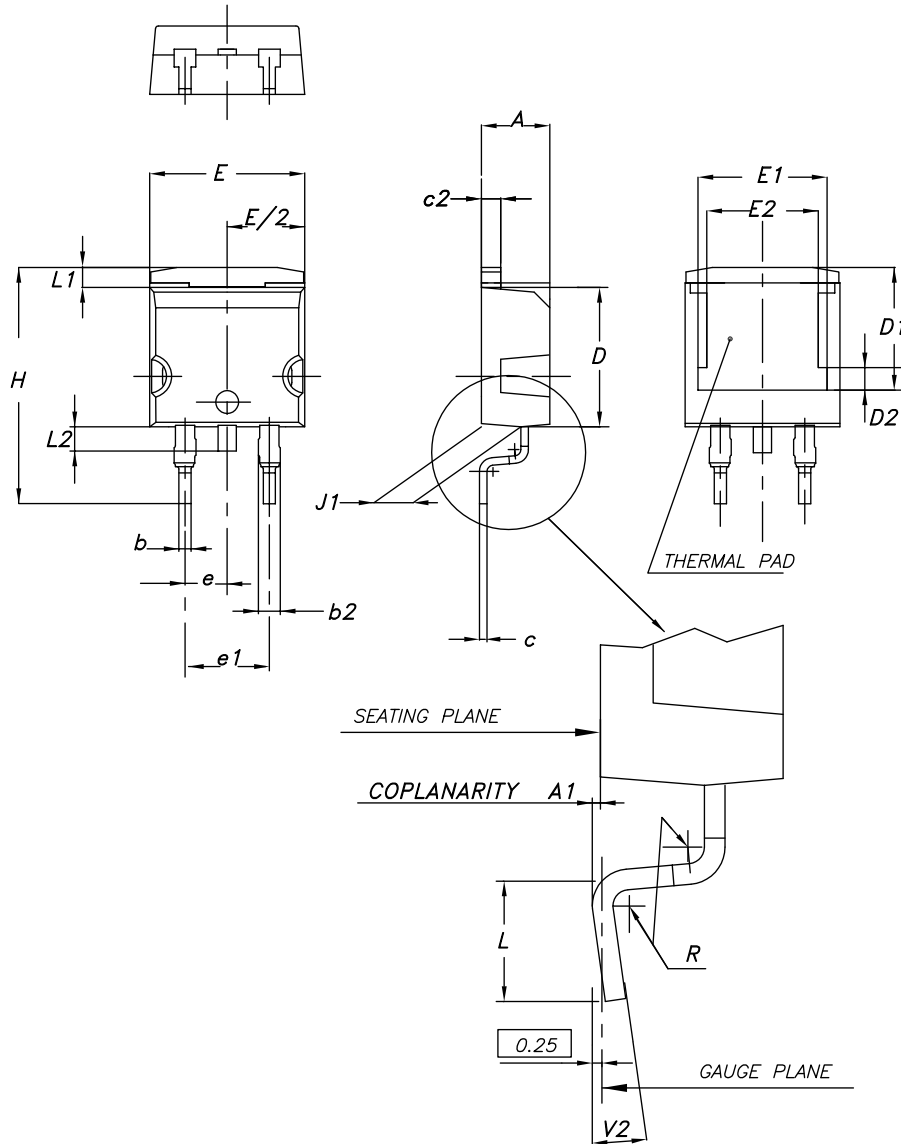
## 4 Package information

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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 A2 package information

Figure 31. D<sup>2</sup>PAK (TO-263) type A2 package outline

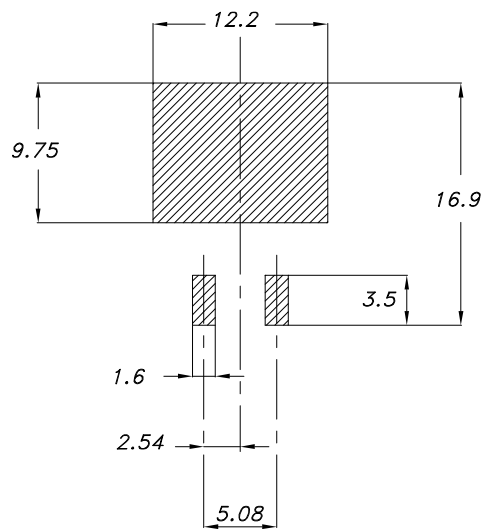


0079457\_A2\_26

Table 7. D<sup>2</sup>PAK (TO-263) type A2 package mechanical data

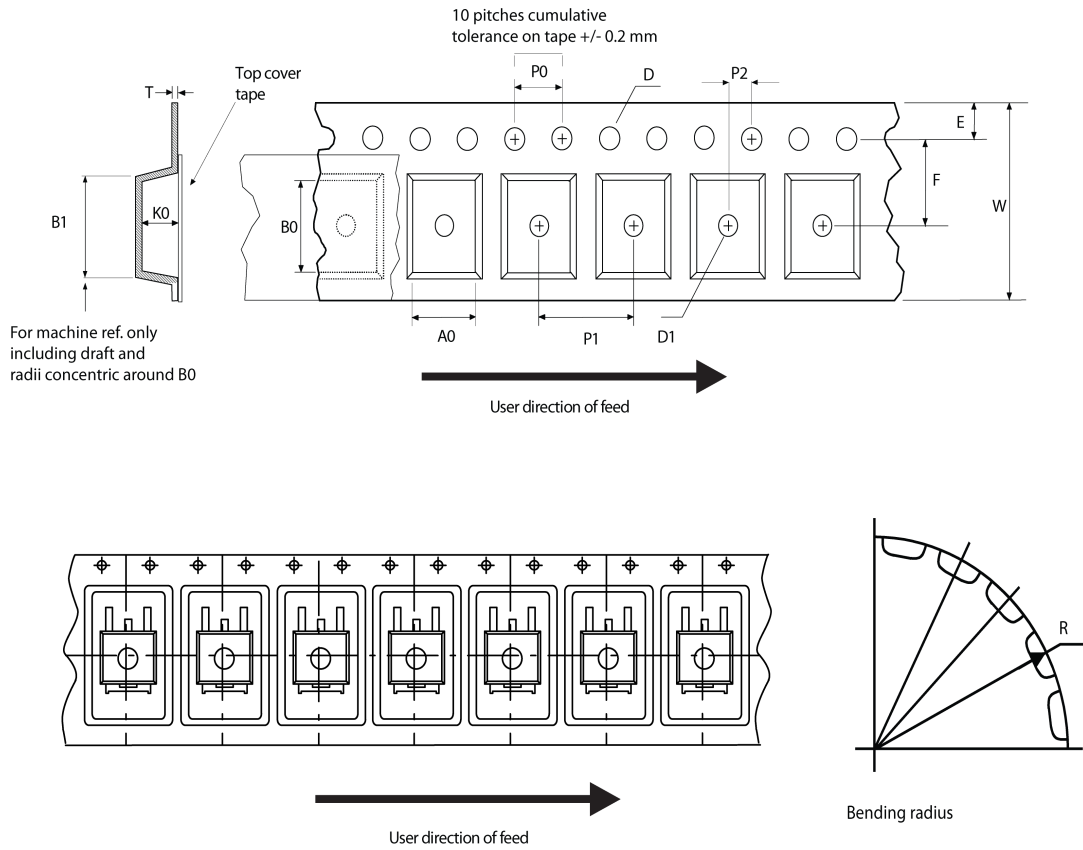
Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10.00		10.40
E1	8.70	8.90	9.10
E2	7.30	7.50	7.70
e		2.54	
e1	4.88		5.28
H	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.40	
V2	0°		8°

Figure 32. D<sup>2</sup>PAK (TO-263) recommended footprint (dimensions are in mm)



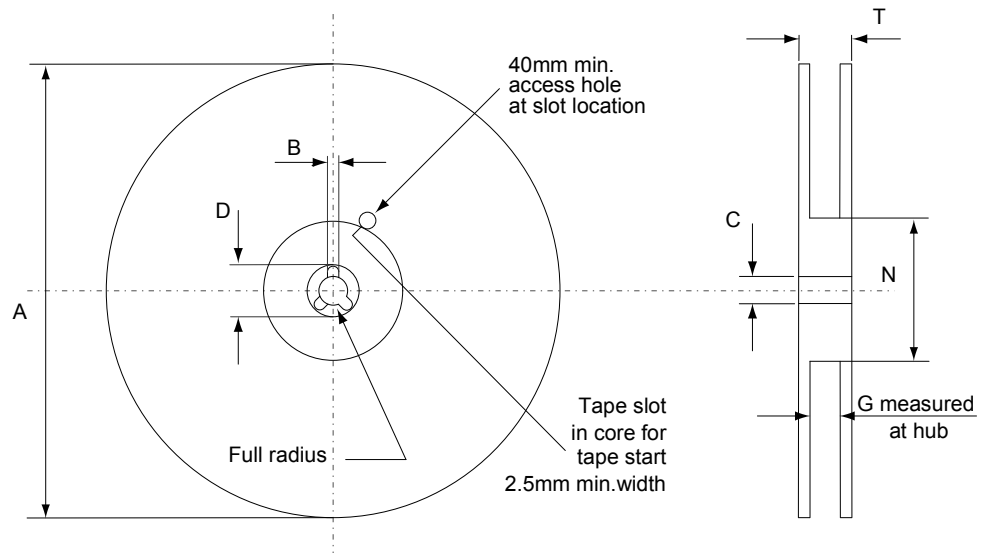
## 4.2 D<sup>2</sup>PAK packing information

Figure 33. D<sup>2</sup>PAK tape outline



AM08852v1

Figure 34. D<sup>2</sup>PAK reel outline



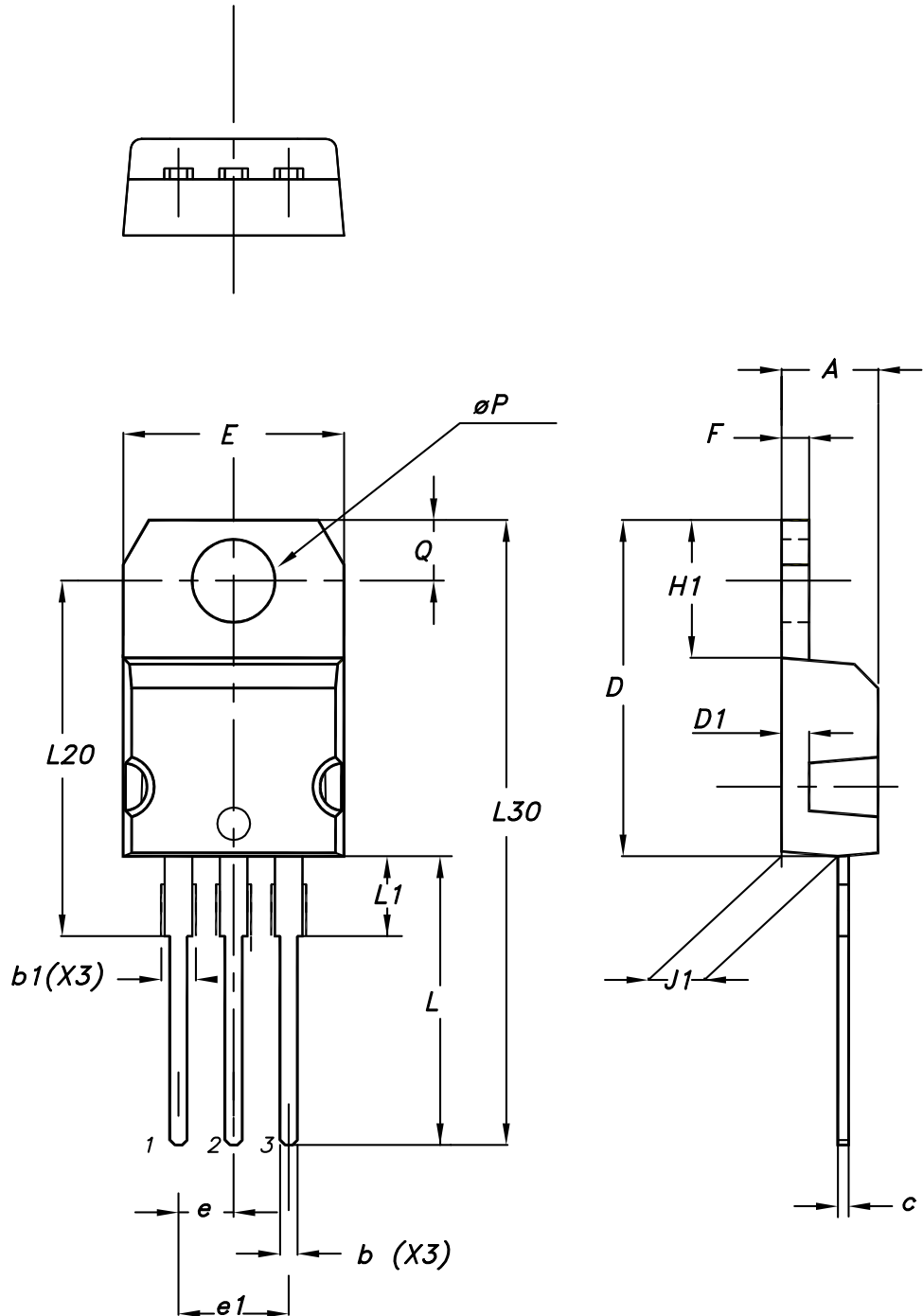
AM06038v1

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			

### 4.3 TO-220 type A package information

Figure 35. TO-220 type A package outline



0015988\_typeA\_Rev\_22



**Table 9. 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 Ordering information

Table 10. Order codes

Order code	Marking	Package	Packing
STGB30H60DFB	GB30H60DFB	D <sup>2</sup> PAK	Tape and reel
STGP30H60DFB	GP30H60DFB	TO-220	Tube

## Revision history

**Table 11. Document revision history**

Date	Revision	Changes
07-Aug-2014	1	Initial release.
28-Oct-2015	2	Updated <i>Figure 23</i> and <i>Section 5</i> . Minor text changes.
23-May-2019	3	Modified <i>Figure 3</i> . Output characteristics ( $T_J = 25\text{ }^\circ\text{C}$ ), <i>Figure 4</i> . Output characteristics ( $T_J = 175\text{ }^\circ\text{C}$ ), <i>Figure 9</i> . Transfer characteristics, <i>Figure 7</i> . Collector current vs switching frequency, <i>Figure 18</i> . Switching energy vs collector emitter voltage. Minor text changes.

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<b>4.1</b>	<b>D<sup>2</sup>PAK (TO-263) type A2 package information</b> .....	<b>11</b>
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