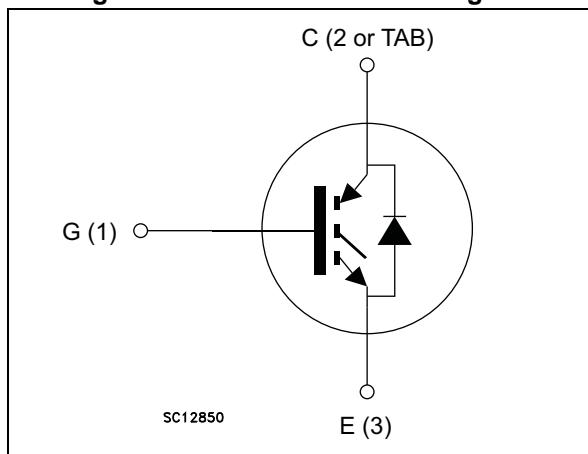


**Figure 1. Internal schematic diagram**



## Features

- Maximum junction temperature:  $T_J = 175 \text{ }^{\circ}\text{C}$
- High speed switching series
- Minimized tail current
- Low saturation voltage:  $V_{CE(\text{sat})} = 1.6 \text{ V (typ.)}$  @  $I_C = 40 \text{ A}$
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- Low  $V_F$  soft recovery co-packaged diode
- Lead free package

## Applications

- Induction heating
- Microwave oven
- Resonant 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 represent an optimum compromise between conduction and switching losses to maximize the efficiency of any frequency converter. Furthermore, a slightly positive  $V_{CE(\text{sat})}$  temperature coefficient and very tight parameter distribution result in safer paralleling operation.

**Table 1. Device summary**

Order code	Marking	Package	Packaging
STGW40H60DLFB	GW40H60DLFB	TO-247	Tube
STGWT40H60DLFB	GWT40H60DLFB	TO-3P	Tube

## Contents

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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 $T_C = 25^\circ\text{C}$	80	A
$I_C$	Continuous collector current at $T_C = 100^\circ\text{C}$	40	A
$I_{CP}^{(1)}$	Pulsed collector current	160	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$I_F$	Continuous forward current at $T_C = 25^\circ\text{C}$	80	A
$I_F$	Continuous forward current at $T_C = 100^\circ\text{C}$	40	A
$I_{FP}^{(1)}$	Pulsed forward current	160	A
$P_{TOT}$	Total dissipation at $T_C = 25^\circ\text{C}$	283	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 IGBT	0.53	$^\circ\text{C}/\text{W}$
$R_{thJC}$	Thermal resistance junction-case diode	1.47	$^\circ\text{C}/\text{W}$
$R_{thJA}$	Thermal resistance junction-ambient	50	$^\circ\text{C}/\text{W}$

## 2 Electrical characteristics

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

Table 4. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{CES}}$	Collector-emitter breakdown voltage ( $V_{GE} = 0$ )	$I_C = 2 \text{ mA}$	600			V
$V_{CE(\text{sat})}$	Collector-emitter saturation voltage	$V_{GE} = 15 \text{ V}, I_C = 40 \text{ A}$		1.6	2	V
		$V_{GE} = 15 \text{ V}, I_C = 40 \text{ A}$ $T_J = 125^\circ\text{C}$		1.7		
		$V_{GE} = 15 \text{ V}, I_C = 40 \text{ A}$ $T_J = 175^\circ\text{C}$		1.8		
$V_F$	Forward on-voltage	$I_F = 40 \text{ A}$		1.55	1.8	V
		$I_F = 40 \text{ A}$ $T_J = 125^\circ\text{C}$		1.3		
		$I_F = 40 \text{ A}$ $T_J = 175^\circ\text{C}$		1.25		
$V_{GE(\text{th})}$	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	$V_{CE} = 25 \text{ V}, f = 1 \text{ MHz}, V_{GE} = 0$	-	5412	-	pF
$C_{oes}$	Output capacitance		-	198	-	pF
$C_{res}$	Reverse transfer capacitance		-	107	-	pF
$Q_g$	Total gate charge	$V_{CC} = 480 \text{ V}, I_C = 40 \text{ A}, V_{GE} = 15 \text{ V}$ , see <a href="#">Figure 27</a>	-	210	-	nC
$Q_{ge}$	Gate-emitter charge		-	39	-	nC
$Q_{gc}$	Gate-collector charge		-	82	-	nC

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$	Turn-off delay time	$V_{CE} = 400 \text{ V}$ , $I_C = 40 \text{ A}$ , $R_G = 10 \Omega$ , $V_{GE} = 15 \text{ V}$ , see <a href="#">Figure 25</a>		142		ns
$t_f$	Current fall time		-	27.6	-	ns
$E_{off}^{(1)}$	Turn-off switching losses		-	363	-	$\mu\text{J}$
$t_{d(off)}$	Turn-off delay time	$V_{CE} = 400 \text{ V}$ , $I_C = 40 \text{ A}$ , $R_G = 10 \Omega$ , $V_{GE} = 15 \text{ V}$ , $T_J = 175 \text{ }^\circ\text{C}$ , see <a href="#">Figure 25</a>		141		ns
$t_f$	Current fall time		-	61	-	ns
$E_{off}^{(1)}$	Turn-off switching losses		-	764	-	$\mu\text{J}$

1. Turn-off losses include also the tail of the collector current.

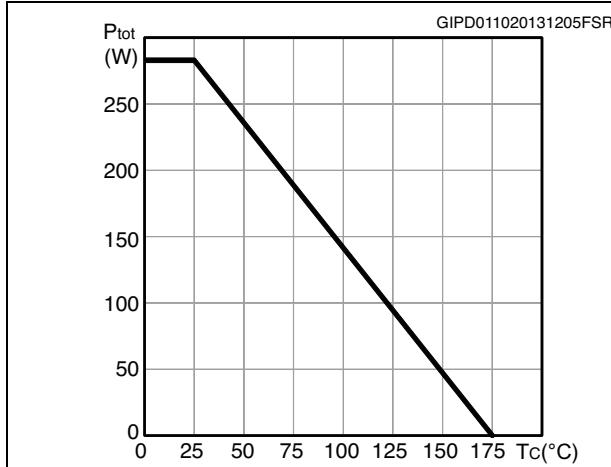
**Table 7. IGBT switching characteristics (capacitive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{off}^{(1)}$	Turn-off switching losses	$V_{CC} = 320 \text{ V}$ , $R_G = 10 \Omega$ , $I_C = 40 \text{ A}$ , $L = 100 \mu\text{H}$ , $C_{snub} = 20 \text{ nF}$ , see <a href="#">Figure 26</a>	-	190	-	$\mu\text{J}$
		$V_{CC} = 320 \text{ V}$ , $R_G = 10 \Omega$ , $I_C = 40 \text{ A}$ , $L = 100 \mu\text{H}$ , $C_{snub} = 20 \text{ nF}$ , $T_J = 175 \text{ }^\circ\text{C}$ , see <a href="#">Figure 26</a>	-	290	-	

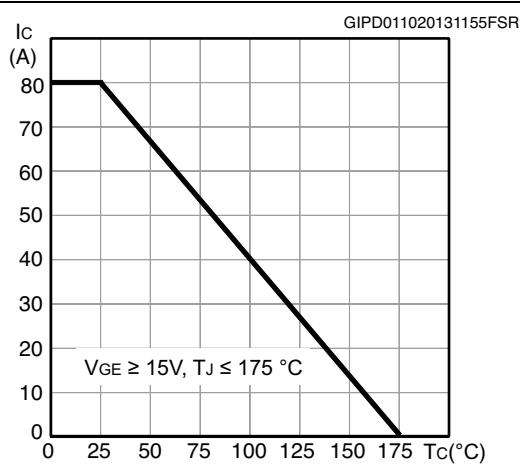
1. Turn-off losses include also the tail of the collector current.

## 2.1 Electrical characteristics (curves)

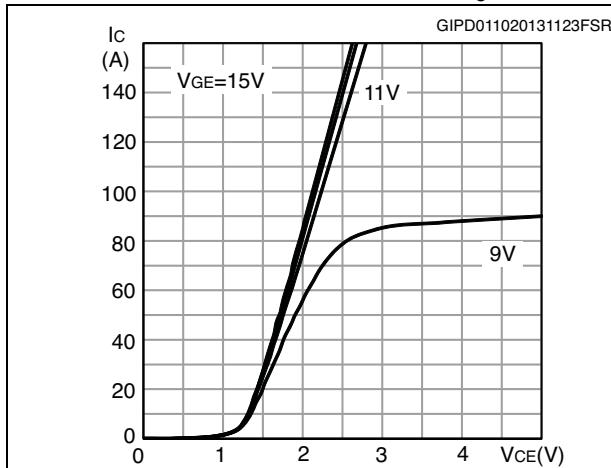
**Figure 2. Power dissipation vs. case temperature**



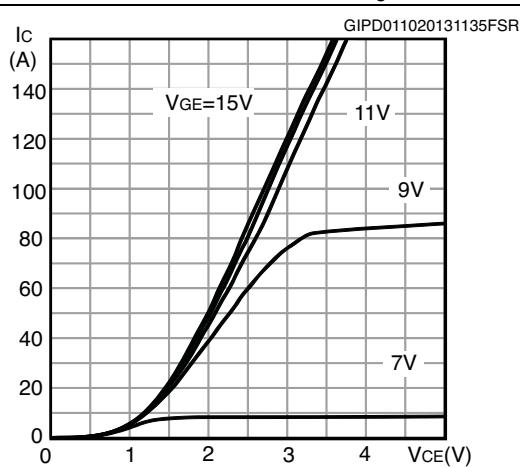
**Figure 3. Collector current vs. case temperature**



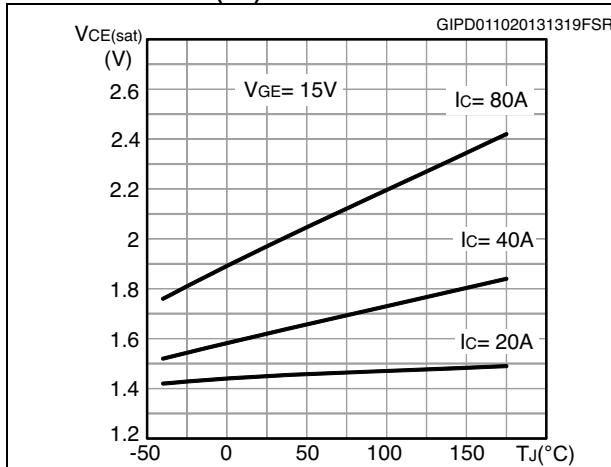
**Figure 4. Output characteristics ( $T_J = 25^\circ\text{C}$ )**



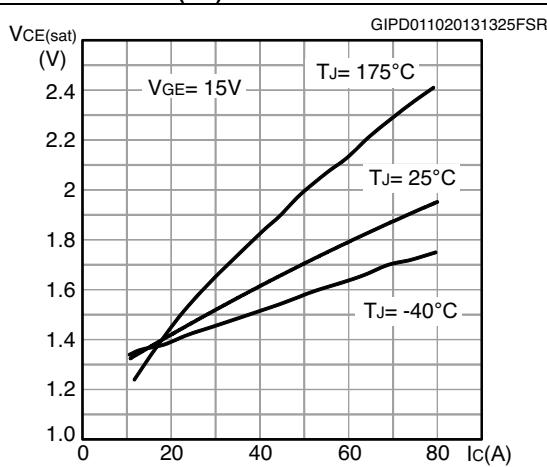
**Figure 5. Output characteristics ( $T_J = 175^\circ\text{C}$ )**

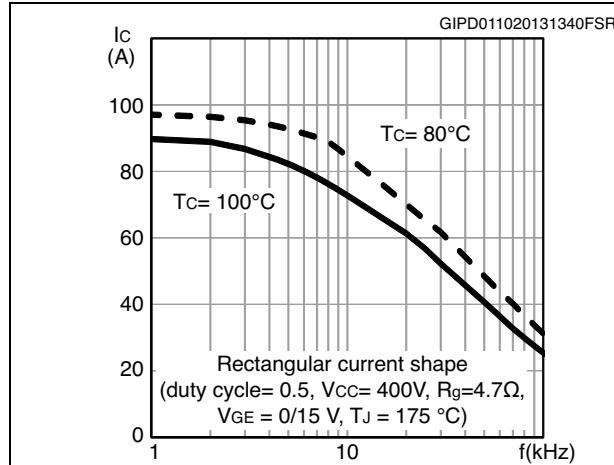
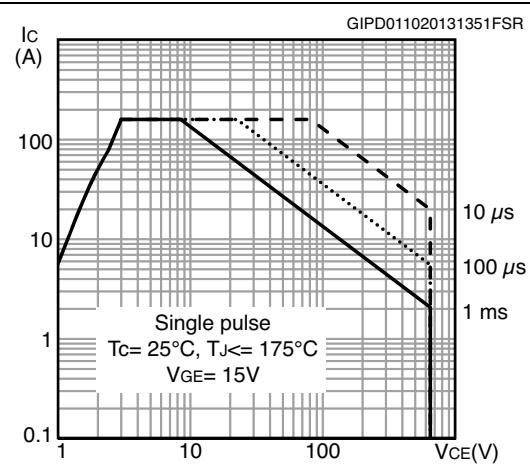
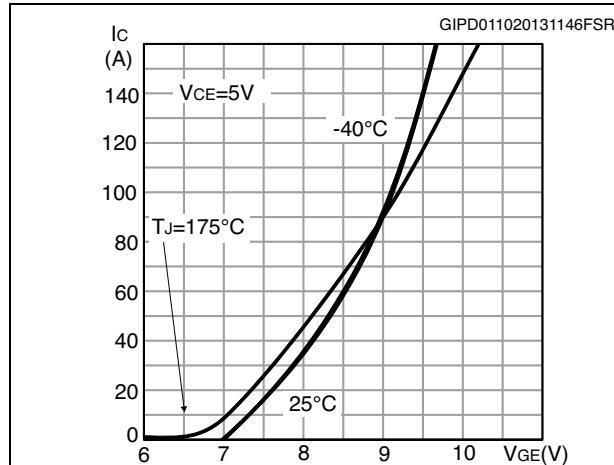
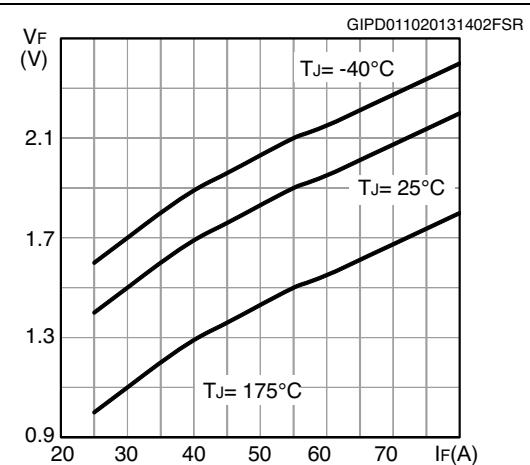
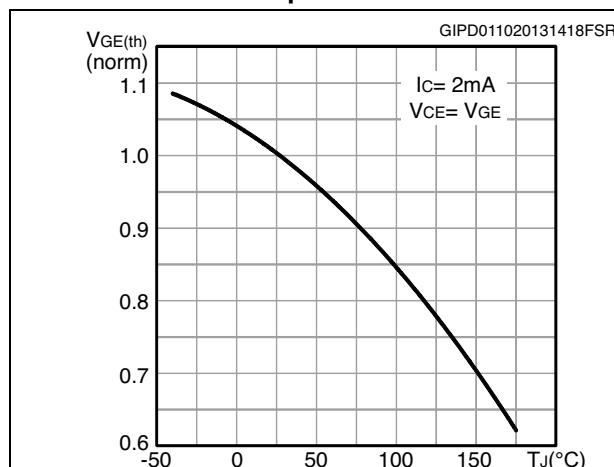
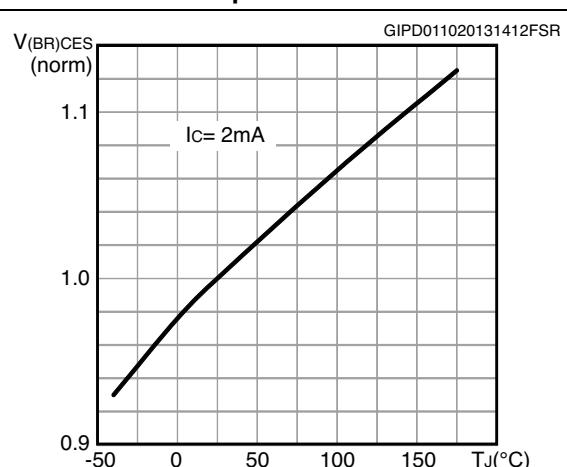


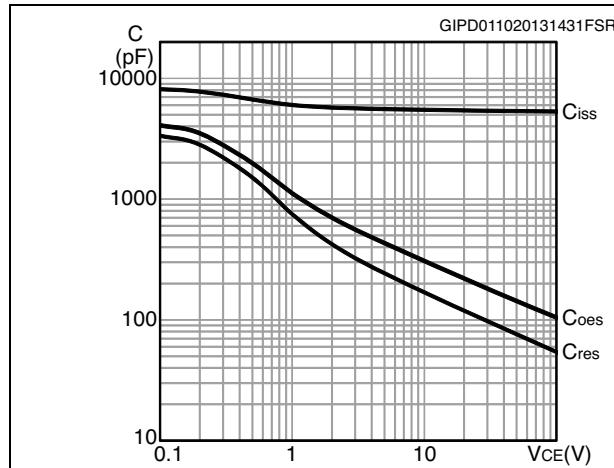
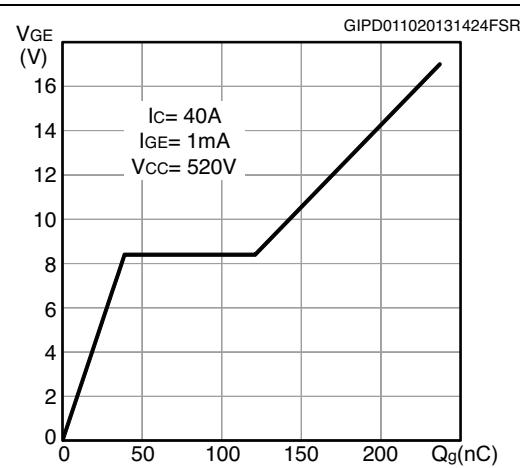
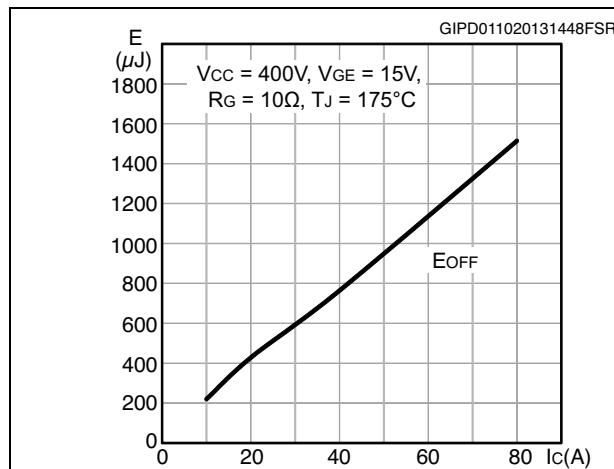
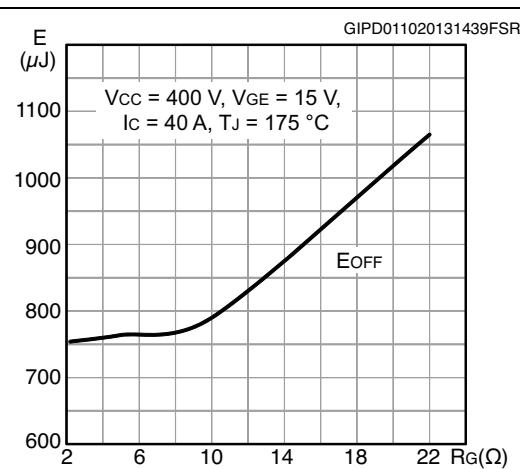
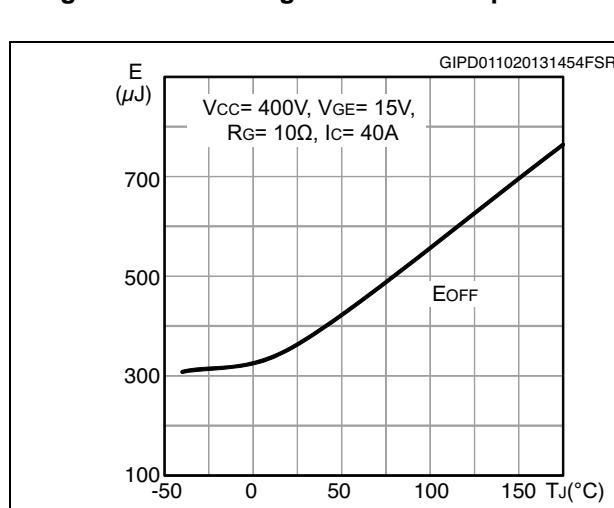
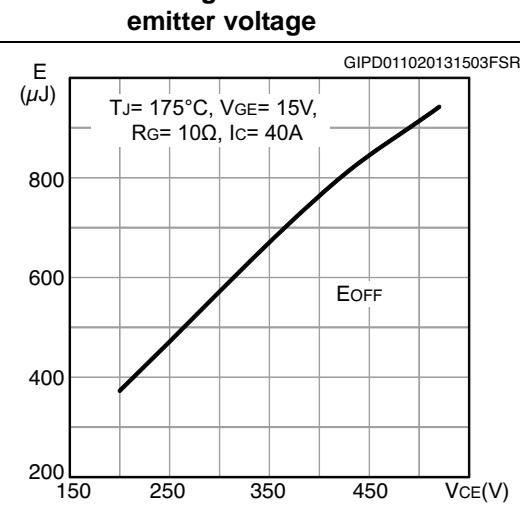
**Figure 6.  $V_{CE(\text{sat})}$  vs. junction temperature**



**Figure 7.  $V_{CE(\text{sat})}$  vs. collector current**



**Figure 8. Collector current vs. switching frequency****Figure 9. Forward bias safe operating area****Figure 10. Transfer characteristics****Figure 11. Diode  $V_F$  vs. forward current****Figure 12. Normalized  $V_{GE(\text{th})}$  vs junction temperature****Figure 13. Normalized  $V_{(BR)CES}$  vs. junction temperature**

**Figure 14. Capacitance variation****Figure 15. Gate charge vs. gate-emitter voltage****Figure 16. Switching-off loss vs collector current****Figure 17. Switching-off loss vs gate resistance****Figure 18. Switching-off loss vs temperature****Figure 19. Switching-off loss vs collector-emitter voltage**

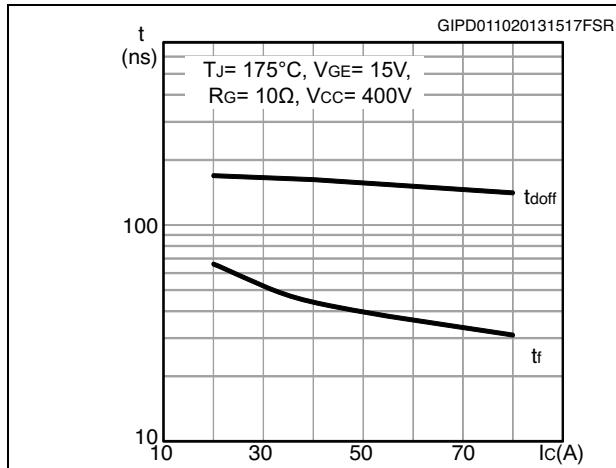
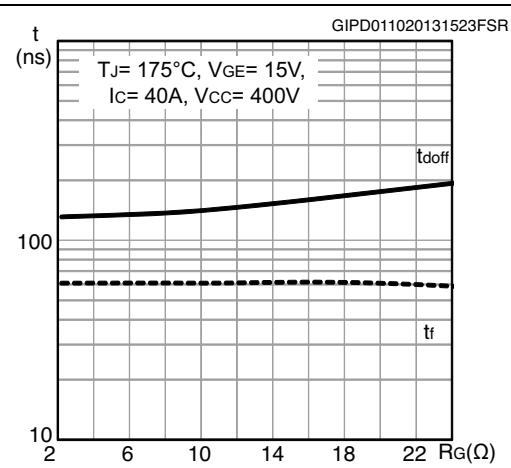
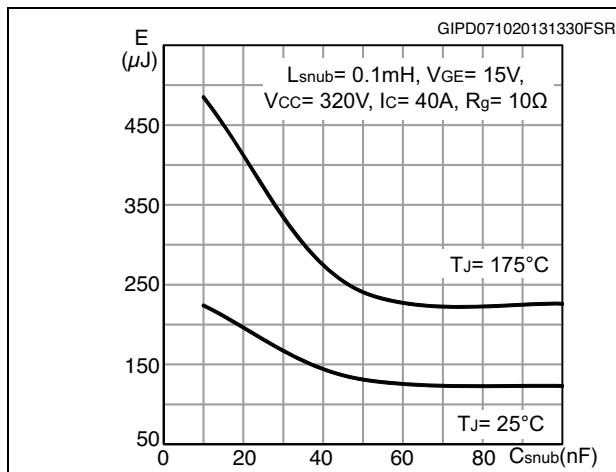
**Figure 20. Switching times vs. collector current****Figure 21. Switching times vs. gate resistance****Figure 22. Switching-off losses vs. capacitive load**

Figure 23. Thermal impedance for IGBT

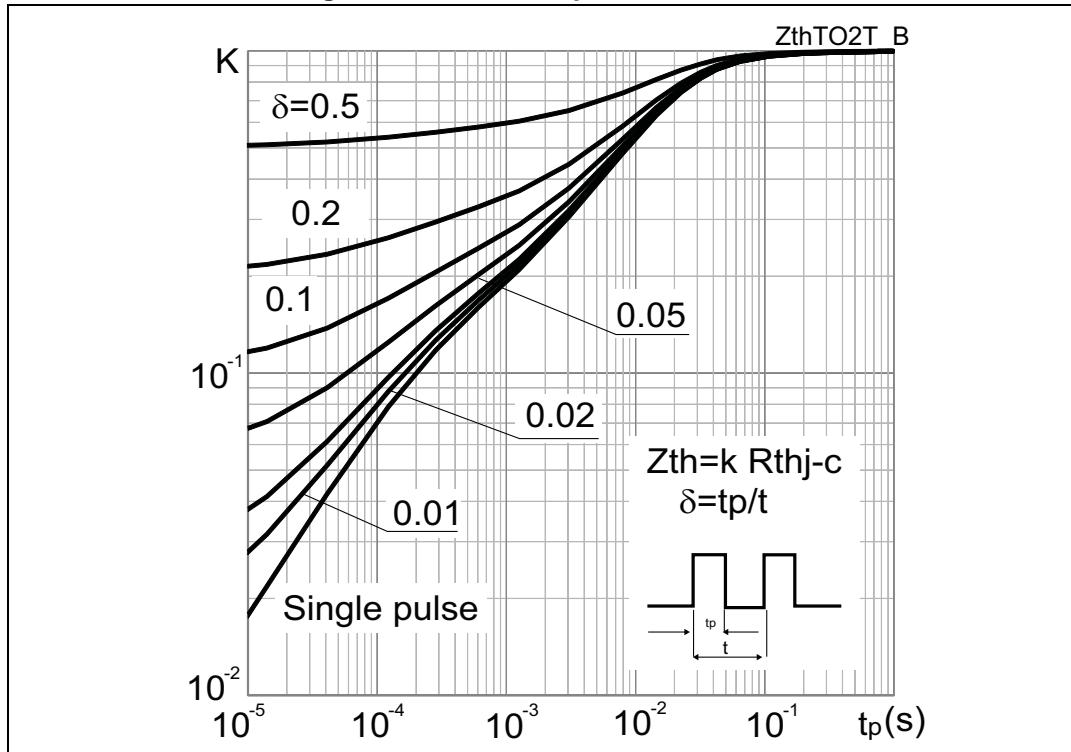
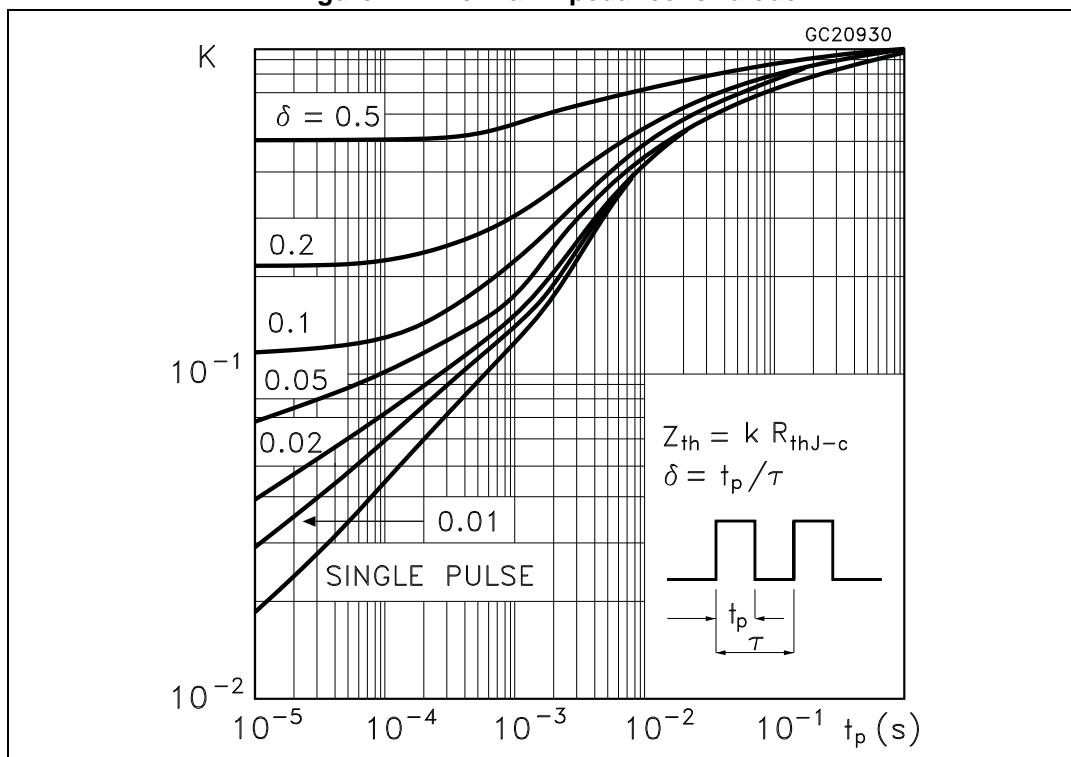
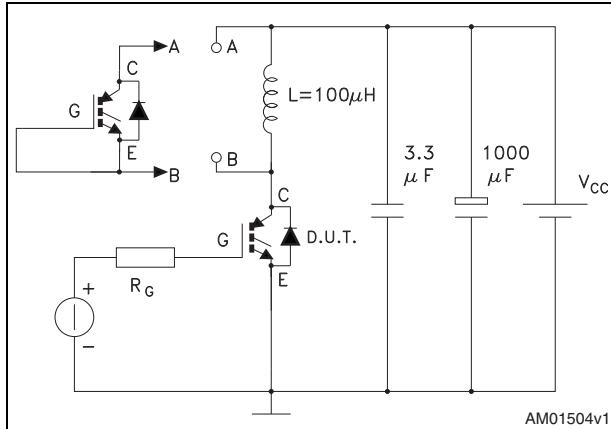


Figure 24. Thermal impedance for diode

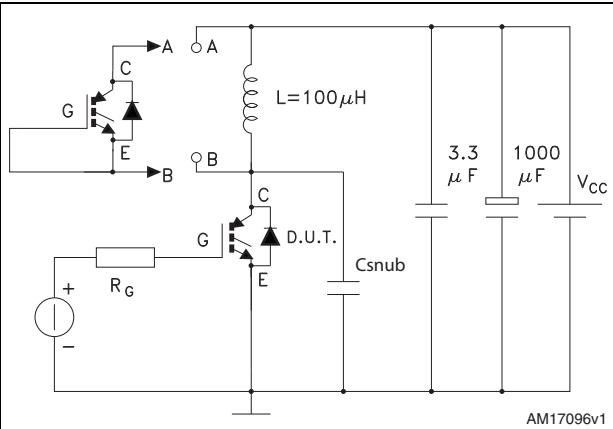


### 3 Test circuits

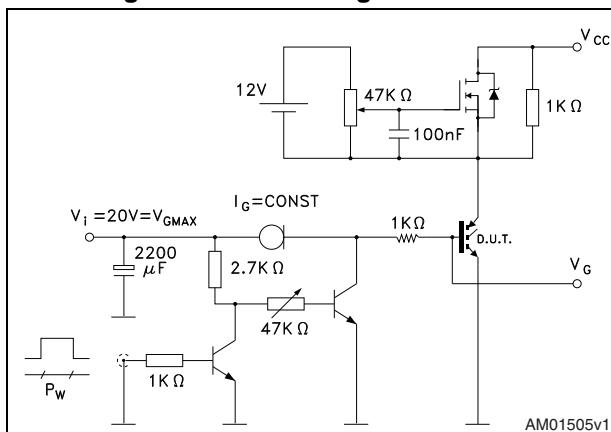
**Figure 25. Test circuit for inductive load switching**



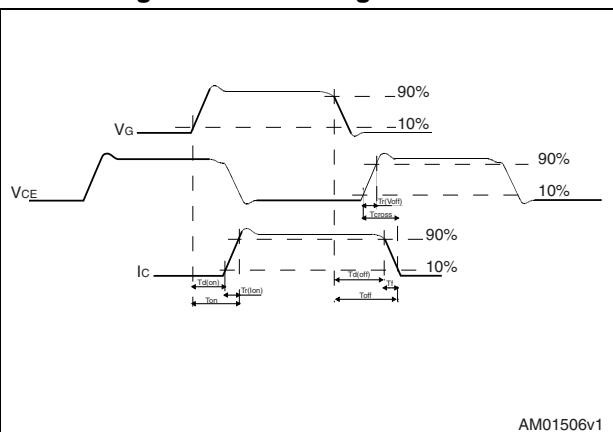
**Figure 26. Test circuit for capacitive load switching**



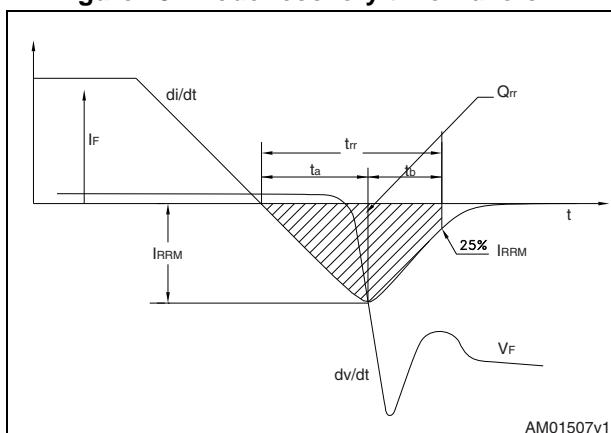
**Figure 27. Gate charge test circuit**



**Figure 28. Switching waveform**



**Figure 29. Diode recovery time waveform**



## 4 Package mechanical data

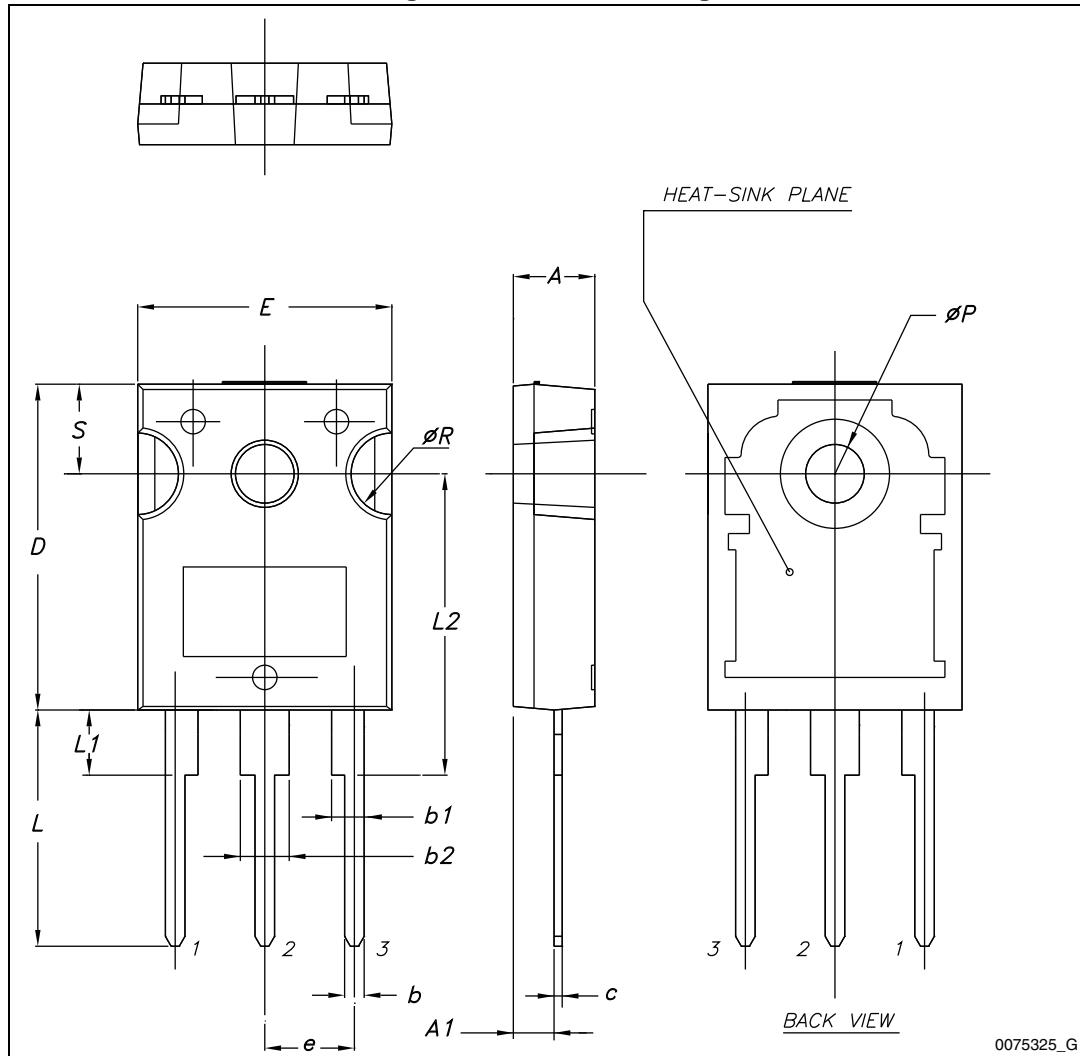
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com).  
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### 4.1 TO-247, STGW40H60DLFB

Table 8. TO-247 mechanical data

Dim.	mm.		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

Figure 30. TO-247 drawing

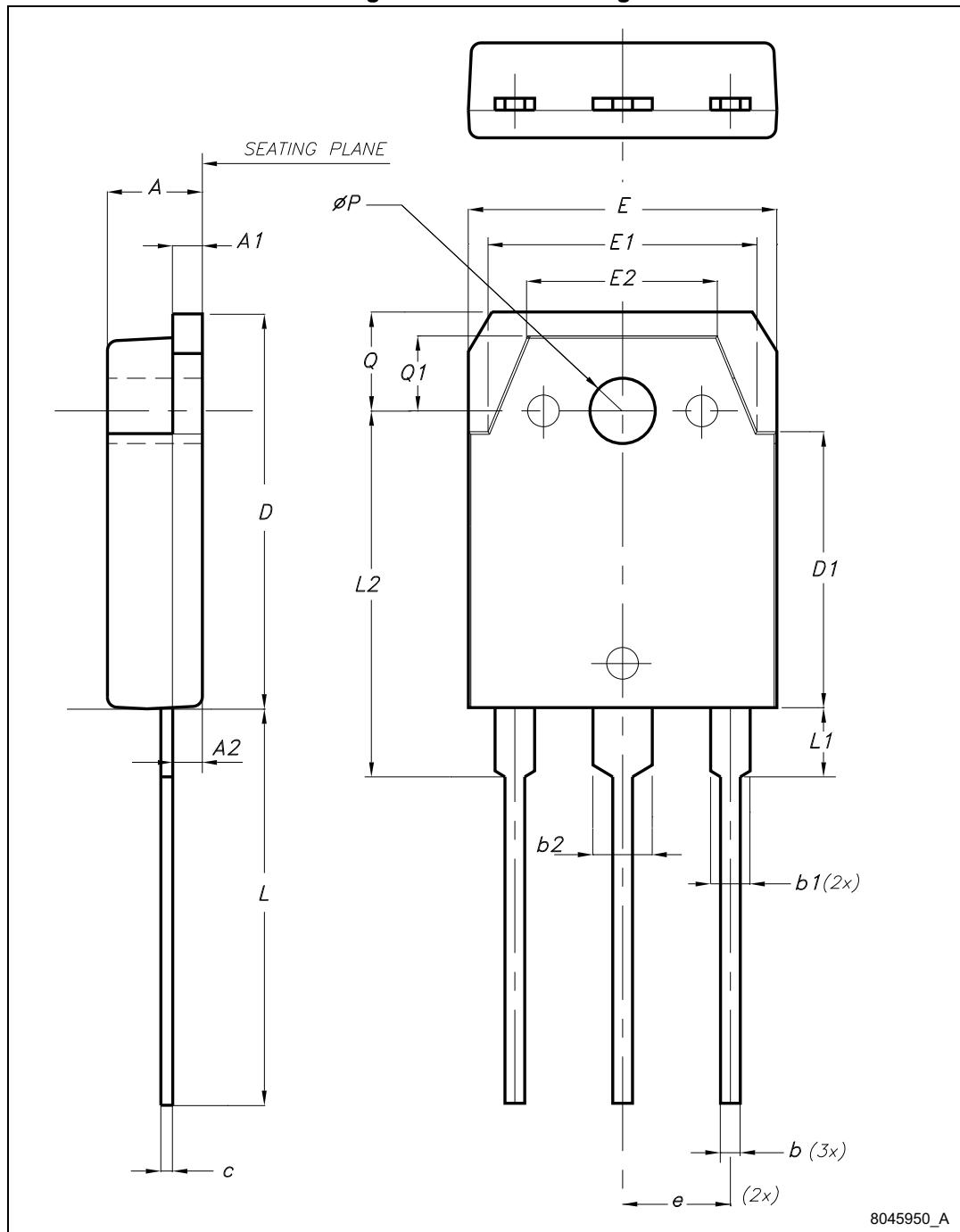


## 4.2 TO-3P, STGWT40H60DLFB

Table 9. TO-3P mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.60		5
A1	1.45	1.50	1.65
A2	1.20	1.40	1.60
b	0.80	1	1.20
b1	1.80		2.20
b2	2.80		3.20
c	0.55	0.60	0.75
D	19.70	19.90	20.10
D1		13.90	
E	15.40		15.80
E1		13.60	
E2		9.60	
e	5.15	5.45	5.75
L	19.50	20	20.50
L1		3.50	
L2	18.20	18.40	18.60
øP	3.10		3.30
Q		5	
Q1		3.80	

Figure 31. TO-3P drawing



## 5 Revision history

Table 10. Document revision history

Date	Revision	Changes
12-Mar-2013	1	Initial release.
07-Oct-2013	2	Document status changed from preliminary to production data. Added <a href="#">Section 2.1: Electrical characteristics (curves)</a> . Minor text changes.
13-Mar-2014	3	Updated title and description in cover page.
18-Mar-2014	4	Updated title in cover page and <a href="#">Section 4: Package mechanical data</a> .

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"LifeElectronics" LLC

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