

### Features

- Designed for soft commutation only
- Maximum junction temperature:  $T_J = 175\text{ }^\circ\text{C}$
- Minimized tail current
- $V_{CE(sat)} = 2.0\text{ V (typ.) @ } I_C = 25\text{ A}$
- Tight parameters distribution
- Safe paralleling
- Low  $V_F$  soft recovery co-packaged diode
- Low thermal resistance
- Lead free package

### Applications

- Induction heating
- Microwave oven
- Resonant converters

### Description

These IGBTs are developed using an advanced proprietary trench gate field-stop structure and performance is optimized in both conduction and switching losses. A freewheeling diode with a low drop forward voltage is co-packaged. The result is a product specifically designed to maximize efficiency for any resonant and soft-switching application.

Figure 1. Internal schematic diagram

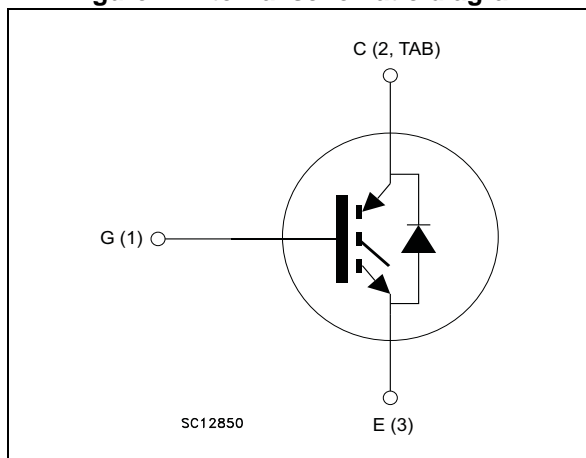


Table 1. Device summary

Order code	Marking	Package	Packaging
STGW28IH125DF	G28IH125DF	TO-247	Tube
STGWT28IH125DF	G28IH125DF	TO-3P	Tube

# 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) .....	6
<b>3</b>	<b>Test circuits</b> .....	<b>11</b>
<b>4</b>	<b>Package mechanical data</b> .....	<b>12</b>
<b>5</b>	<b>Revision history</b> .....	<b>16</b>

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GE} = 0$ )	1250	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
$I_F$	Continuous forward current at $T_C = 25\text{ °C}$	60	A
$I_F$	Continuous forward current at $T_C = 100\text{ °C}$	30	A
$I_{FP(1)}$	Pulsed forward current	120	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	375	W
$T_{STG}$	Storage temperature range	- 55 to 150	°C
$T_J$	Operating junction temperature	- 55 to 175	°C

1. Pulse width limited by maximum junction temperature.

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance junction-case IGBT	0.4	°C/W
$R_{thJC}$	Thermal resistance junction-case diode	1.47	°C/W
$R_{thJA}$	Thermal resistance junction-ambient	50	°C/W

## 2 Electrical characteristics

T<sub>J</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 (V <sub>GE</sub> = 0)	I <sub>C</sub> = 2 mA	1250			V
V <sub>CE(sat)</sub>	Collector-emitter saturation voltage	V <sub>GE</sub> = 15 V, I <sub>C</sub> = 25 A		2	2.5	V
		V <sub>GE</sub> = 15 V, I <sub>C</sub> = 25 A T <sub>J</sub> = 125 °C		2.2		
		V <sub>GE</sub> = 15 V, I <sub>C</sub> = 25 A T <sub>J</sub> = 175 °C		2.3		
		V <sub>GE</sub> = 15 V, I <sub>C</sub> = 50 A		2.65		
V <sub>F</sub>	Forward on-voltage	I <sub>F</sub> = 25 A		1.2	1.6	V
		I <sub>F</sub> = 50 A		1.45		
		I <sub>F</sub> = 25 A T <sub>J</sub> = 125 °C		1.2		
		I <sub>F</sub> = 25 A T <sub>J</sub> = 175 °C		1.2		
V <sub>GE(th)</sub>	Gate threshold voltage	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1 mA	5	6	7	V
I <sub>CES</sub>	Collector cut-off current (V <sub>GE</sub> = 0)	V <sub>CE</sub> = 1250 V			25	μA
I <sub>GES</sub>	Gate-emitter leakage current (V <sub>CE</sub> = 0)	V <sub>GE</sub> = ± 20 V			250	nA

**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	-	2035	-	pF
C <sub>oes</sub>	Output capacitance		-	139	-	pF
C <sub>res</sub>	Reverse transfer capacitance		-	52	-	pF
Q <sub>g</sub>	Total gate charge	V <sub>CC</sub> = 960 V, I <sub>C</sub> = 25 A, V <sub>GE</sub> = 15 V, see <a href="#">Figure 25</a>	-	114	-	nC
Q <sub>ge</sub>	Gate-emitter charge		-	11	-	nC
Q <sub>gc</sub>	Gate-collector charge		-	69	-	nC

Table 6. IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$	Turn-off delay time	$V_{CE} = 600\text{ V}$ , $I_C = 25\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , see <a href="#">Figure 23</a>	-	128	-	ns
$t_f$	Current fall time		-	82	-	ns
$E_{off}^{(1)}$	Turn-off switching losses		-	0.72	-	mJ
$t_{d(off)}$	Turn-off delay time	$V_{CE} = 600\text{ V}$ , $I_C = 25\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 175\text{ }^\circ\text{C}$ , see <a href="#">Figure 23</a>	-	132	-	ns
$t_f$	Current fall time		-	190	-	ns
$E_{off}^{(1)}$	Turn-off switching losses		-	1.53	-	mJ

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	$V_{CC} = 900\text{ V}$ , $R_G = 10\ \Omega$ , $I_C = 50\text{ A}$ , $L = 500\ \mu\text{H}$ , $C_{snub} = 330\text{ nF}$ , see <a href="#">Figure 24</a>	-	230	-	$\mu\text{J}$
		$V_{CC} = 900\text{ V}$ , $R_G = 10\ \Omega$ , $I_C = 50\text{ A}$ , $L = 500\ \mu\text{H}$ , $C_{snub} = 330\text{ nF}$ , $T_J = 175\text{ }^\circ\text{C}$ , see <a href="#">Figure 24</a>	-	520	-	

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

## 2.1 Electrical characteristics (curves)

Figure 2. Power dissipation vs. case temperature

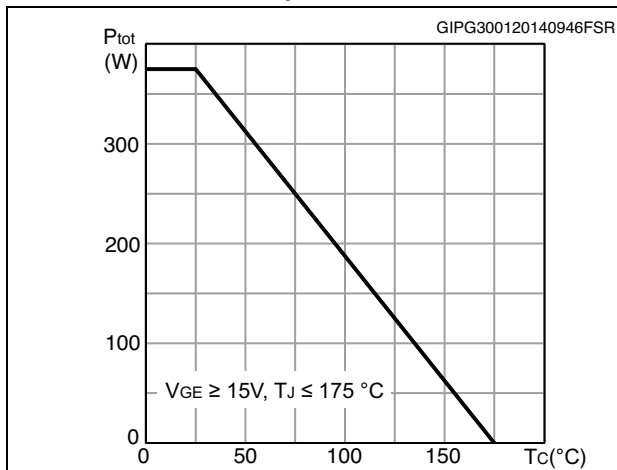


Figure 3. Collector current vs. case temperature

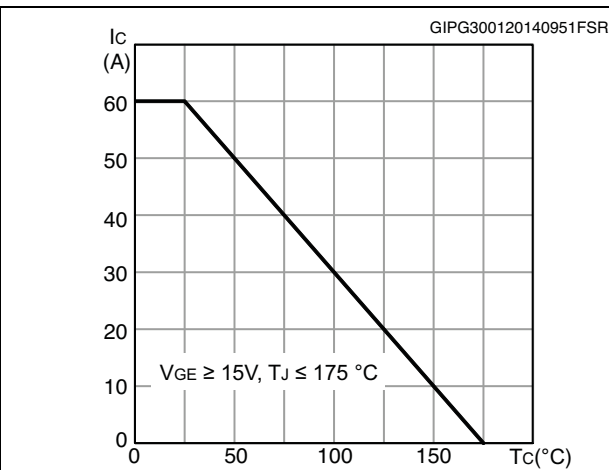


Figure 4. Output characteristics (T<sub>J</sub> = 25°C)

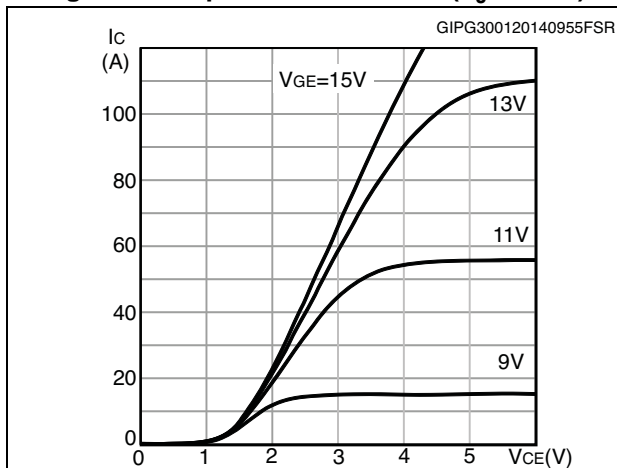


Figure 5. Output characteristics (T<sub>J</sub> = 175°C)

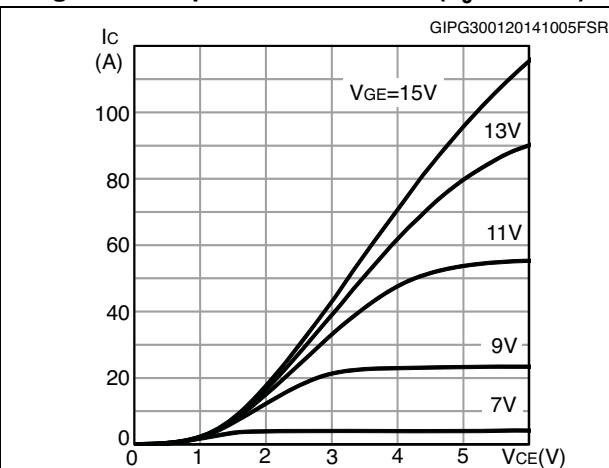


Figure 6. V<sub>CE(sat)</sub> vs. junction temperature

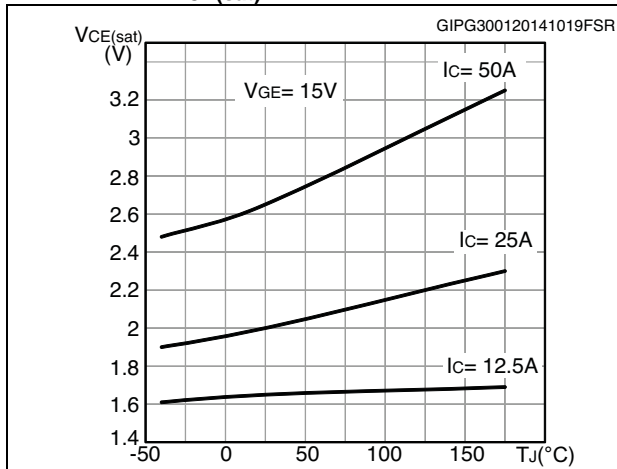


Figure 7. V<sub>CE(sat)</sub> vs. collector current

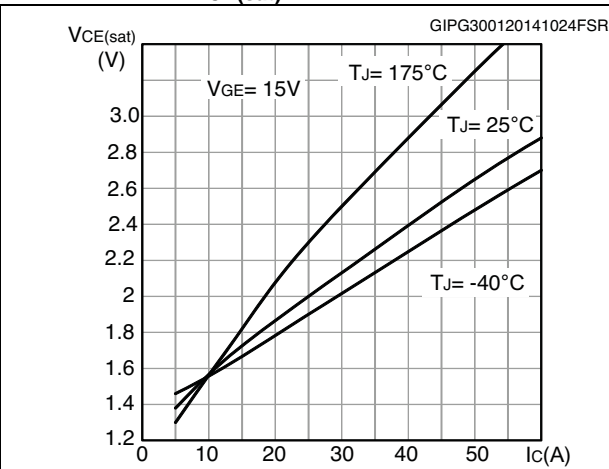


Figure 8. Forward bias safe operating area

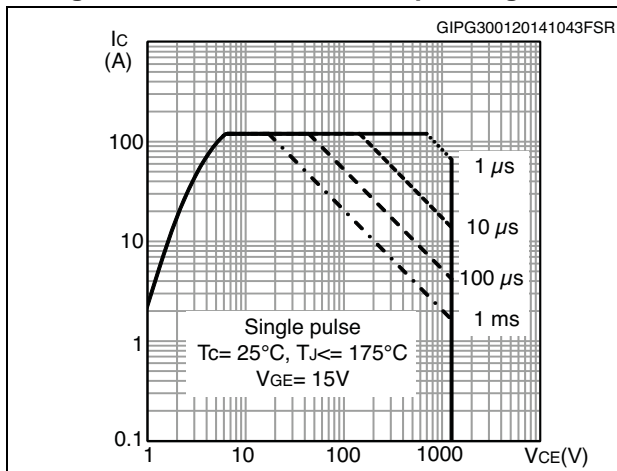


Figure 9. Transfer characteristics

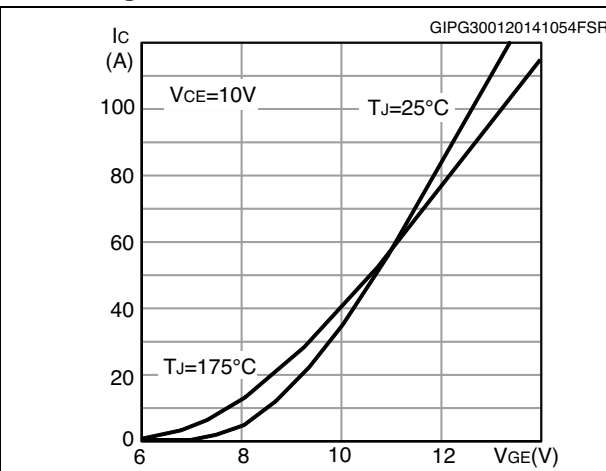


Figure 10. Diode VF vs. forward current

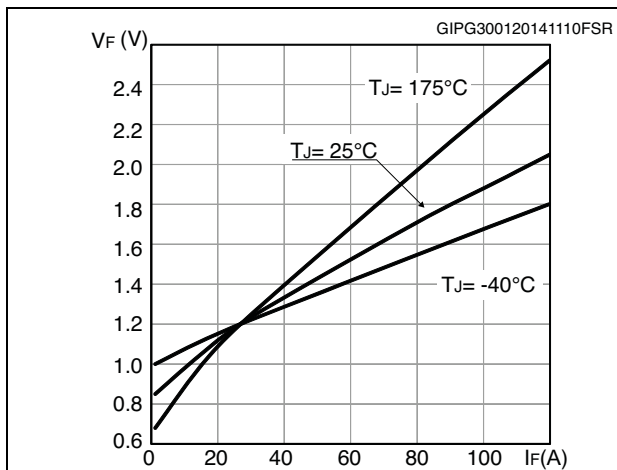


Figure 11. Normalized VGE(th) vs junction temperature

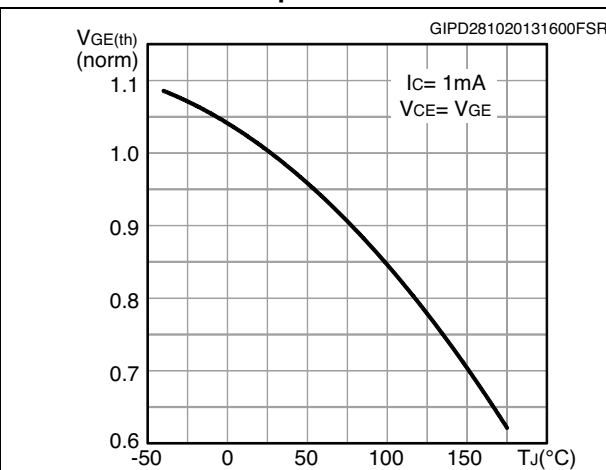


Figure 12. Normalized V(BR)CES vs. junction temperature

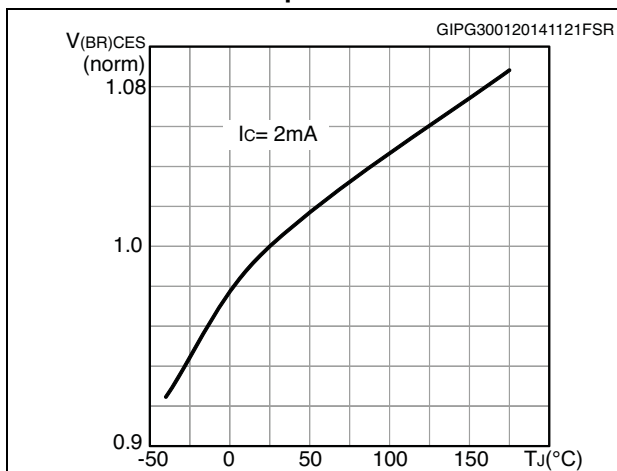


Figure 13. Capacitance variation

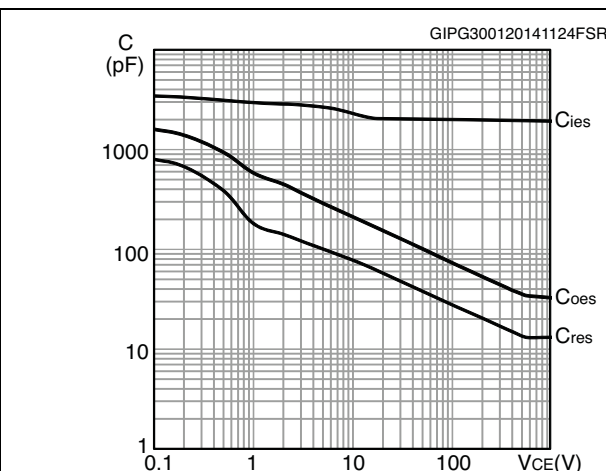


Figure 14. Gate charge vs. gate-emitter voltage

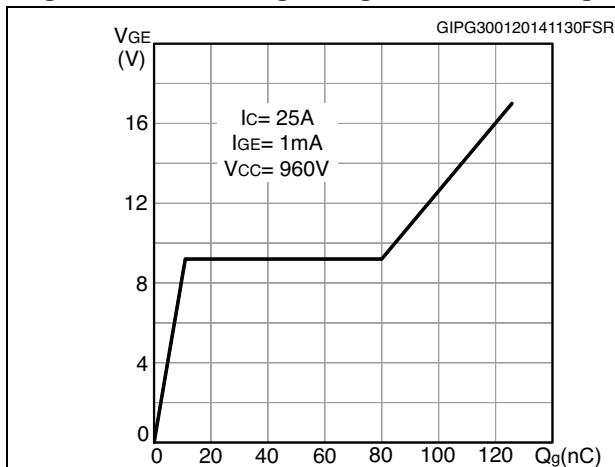


Figure 15. Switching loss vs collector current

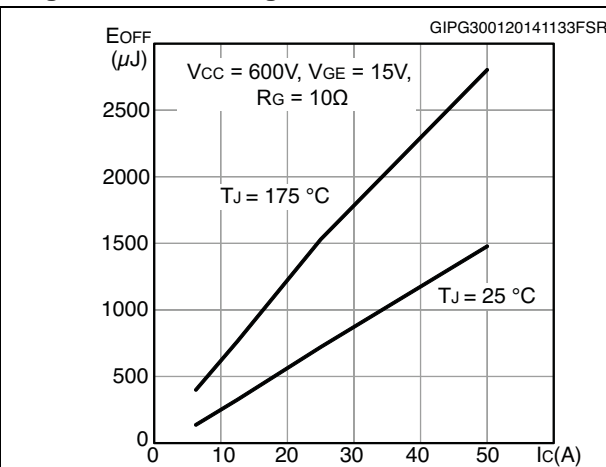


Figure 16. Switching loss vs gate resistance

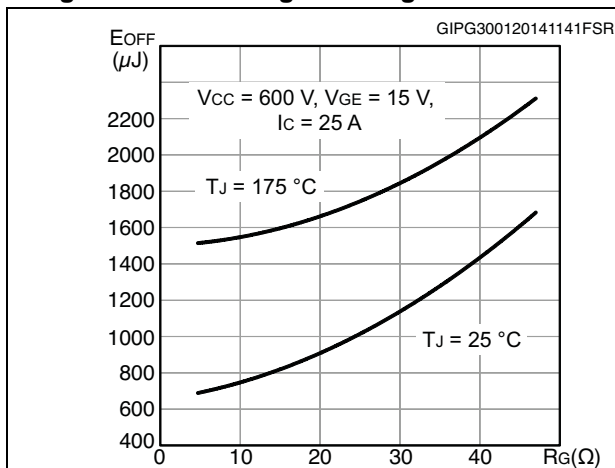


Figure 17. Switching loss vs temperature

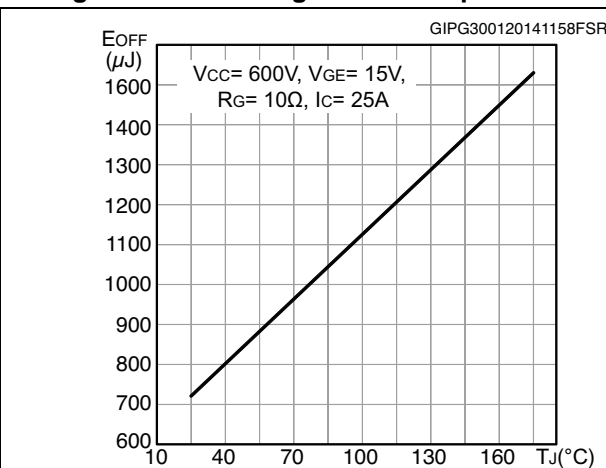


Figure 18. Switching loss vs collector-emitter voltage

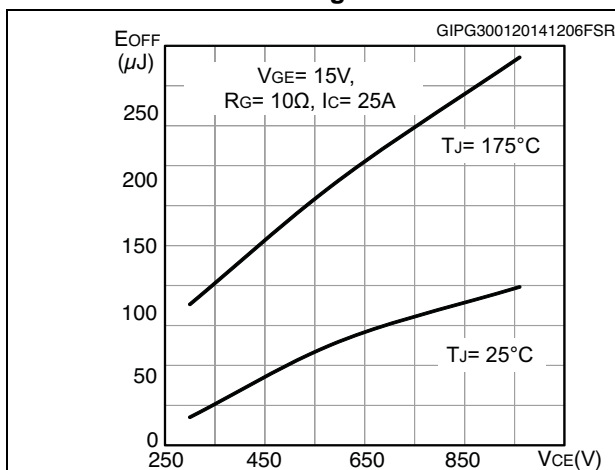


Figure 19. Switching times vs. collector current

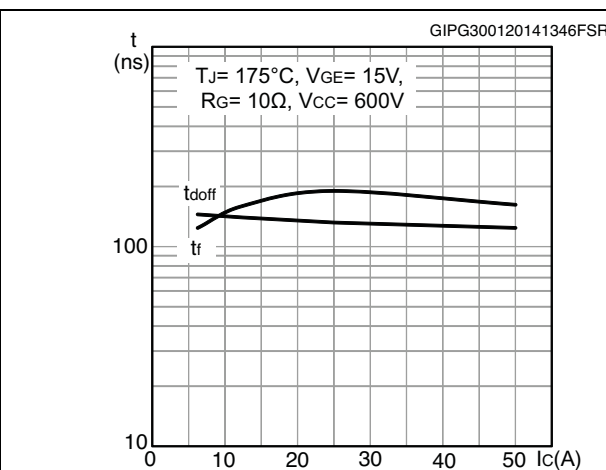




Figure 20. Switching times vs. gate resistance

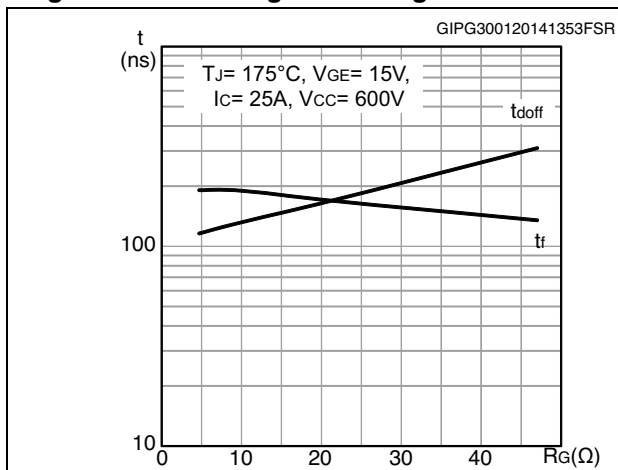


Figure 21. Thermal impedance for IGBT

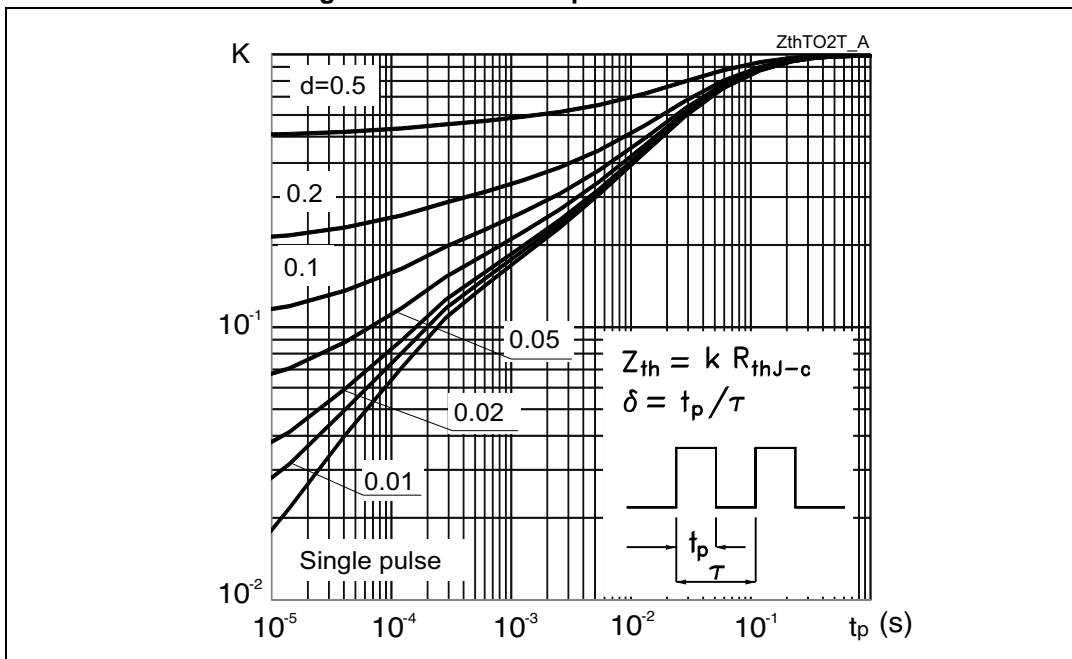
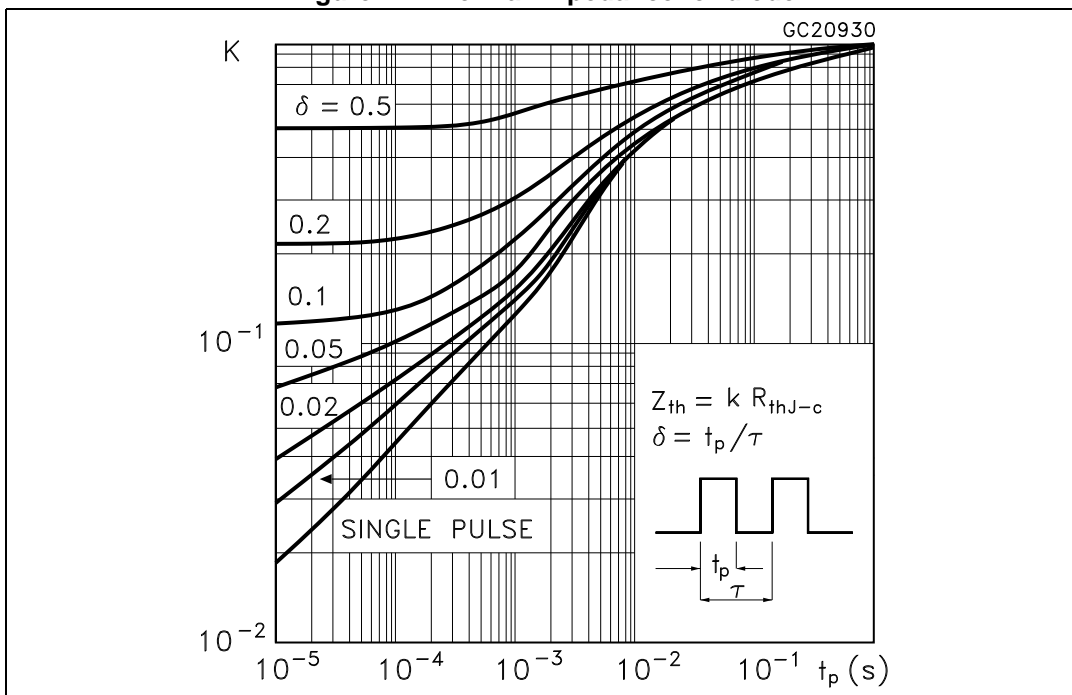


Figure 22. Thermal impedance for diode



### 3 Test circuits

Figure 23. Test circuit for inductive load switching



Figure 24. Test circuit for capacitive load switching

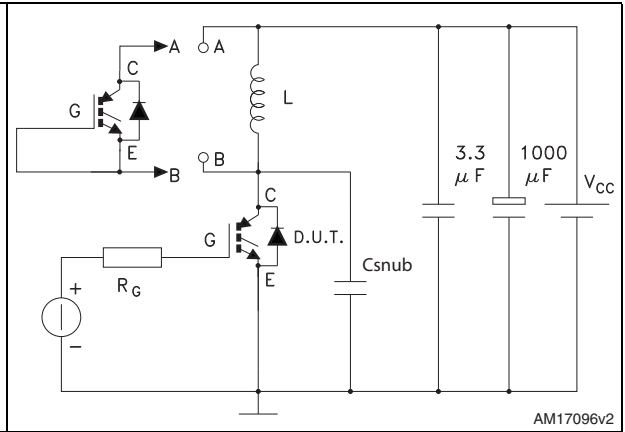


Figure 25. Gate charge test circuit



Figure 26. Switching 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). ECOPACK is an ST trademark.

Figure 27. TO-247 drawing

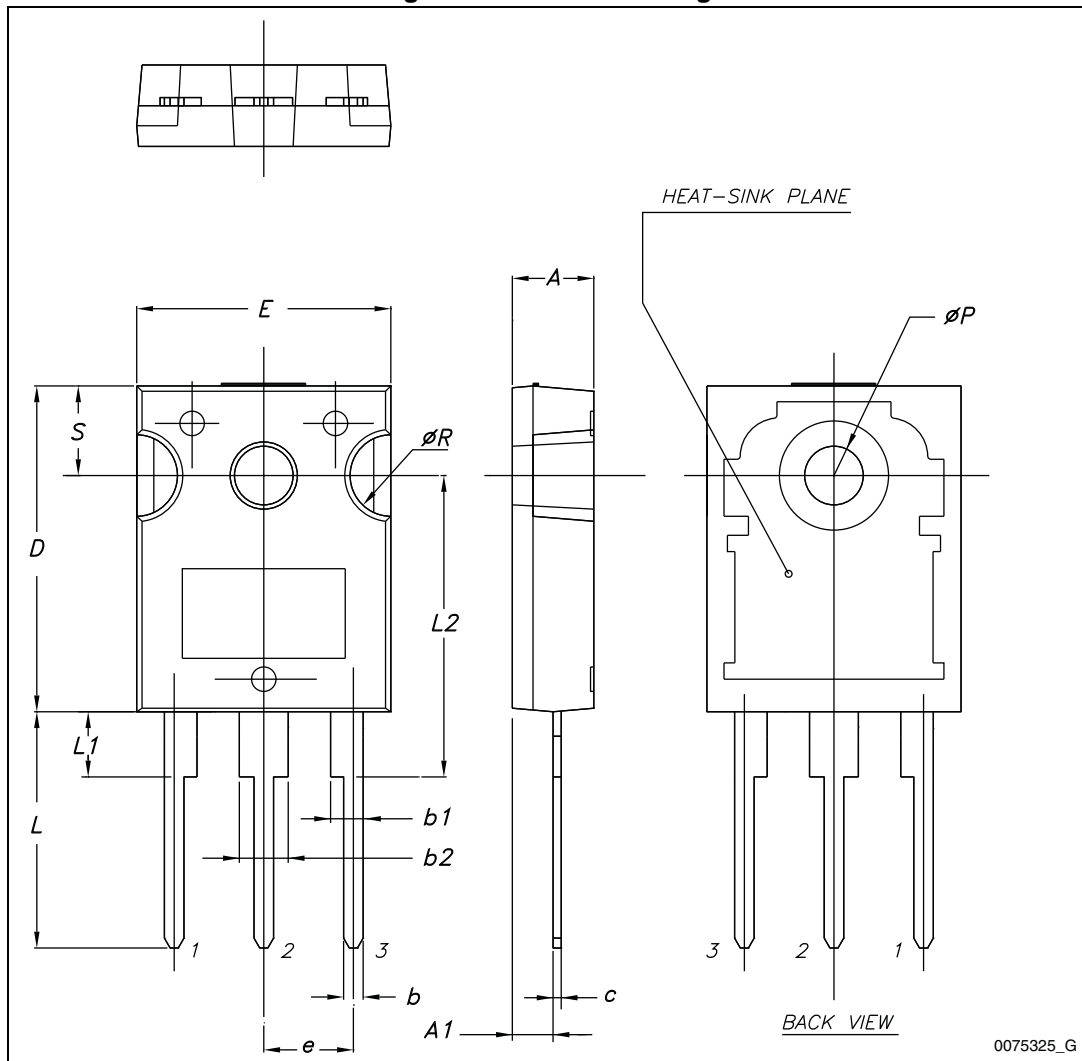


Table 8. TO-247 mechanical data

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 28. TO-3P drawing

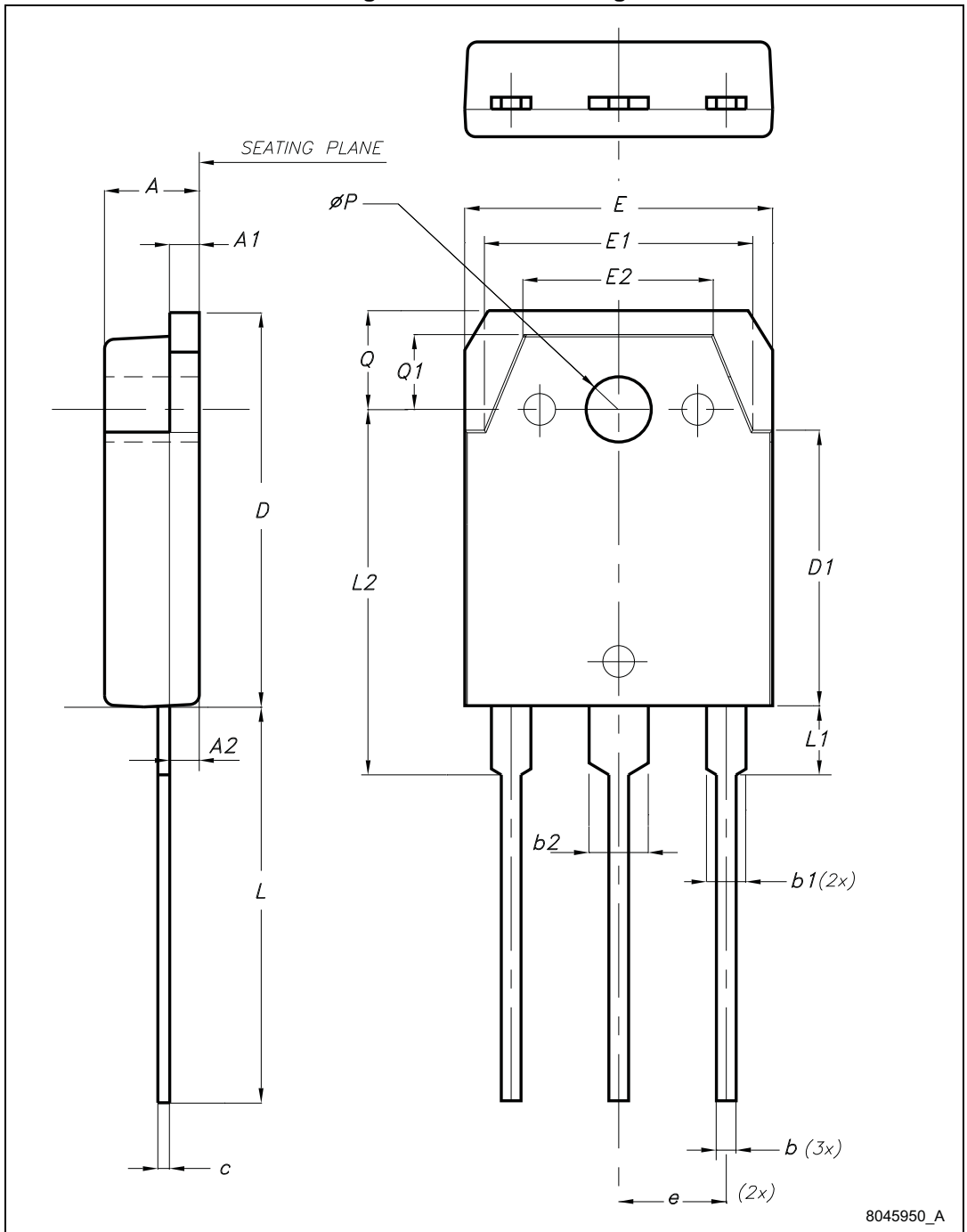


Table 9. TO-3P mechanical data

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	

## 5 Revision history

Table 10. Document revision history

Date	Revision	Changes
20-Jan-2014	1	Initial release.
03-Feb-2014	2	Document status promoted from preliminary to production data. Updated <i>Table 2: Absolute maximum ratings</i> , <i>Table 4: Static characteristics</i> , <i>Table 5: Dynamic characteristics</i> , <i>Table 6: IGBT switching characteristics (inductive load)</i> and <i>Table 7: IGBT switching characteristics (capacitive load)</i> . Inserted <i>Section 2.1: Electrical characteristics (curves)</i> . Minor text changes.



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