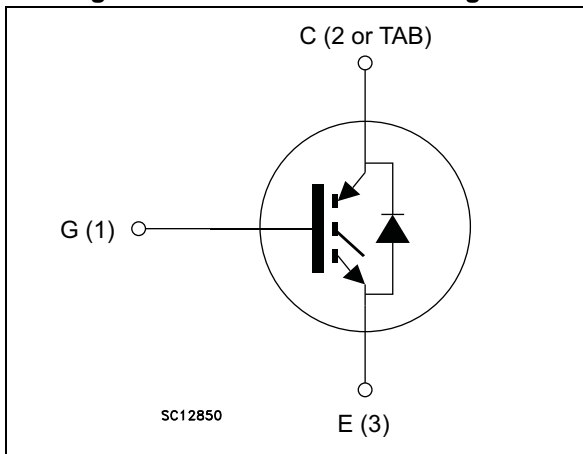


Figure 1. Internal schematic diagram



### Features

- Designed for soft commutation only
- Maximum junction temperature:  $T_J = 175\text{ }^\circ\text{C}$
- Tail-less switching off
- $V_{CE(sat)} = 1.8\text{ V (typ.) @ } I_C = 40\text{ A}$
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- Low  $V_F$  soft recovery co-packaged diode

### 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 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 code	Marking	Package	Packaging
STGW40V60DLF	GW40V60DLF	TO-247	Tube
STGWT40V60DLF	GWT40V60DLF	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 $T_C = 25\text{ °C}$	80	A
$I_C$	Continuous collector current at $T_C = 100\text{ °C}$	40	A
$I_{CP}^{(1)}$	Pulsed collector current	160	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$I_F$	Continuous forward current at $T_C = 25\text{ °C}$	80	A
$I_F$	Continuous forward current at $T_C = 100\text{ °C}$	40	A
$I_{FP(1)}$	Pulsed forward current	160	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	283	W
$T_{STG}$	Storage temperature range	- 55 to 150	°C
$T_J$	Operating junction temperature	- 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	0.53	°C/W
$R_{thJC}$	Thermal resistance junction-case diode	1.4	°C/W
$R_{thJA}$	Thermal resistance junction-ambient	50	°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	$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$		1.8	2.3	V
		$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$ $T_J = 125\text{ °C}$		2.15		
		$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$ $T_J = 175\text{ °C}$		2.35		
$V_F$	Forward on-voltage	$I_F = 40\text{ A}$		1.55	1.8	V
		$I_F = 40\text{ A}, T_J = 125\text{ °C}$		1.3		V
		$I_F = 40\text{ A}, T_J = 175\text{ °C}$		1.25		V
$V_{GE(th)}$	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	$V_{CE} = 25\text{ V}, f = 1\text{ MHz},$ $V_{GE} = 0$	-	5400	-	pF
$C_{oes}$	Output capacitance		-	220	-	pF
$C_{res}$	Reverse transfer capacitance		-	180	-	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> )	-	226	-	nC
$Q_{ge}$	Gate-emitter charge		-	38	-	nC
$Q_{gc}$	Gate-collector charge		-	95	-	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> )		208		ns
$t_f$	Current fall time		-	20	-	ns
$E_{off}^{(1)}$	Turn-off switching losses		-	411	-	$\mu\text{J}$
$t_{d(off)}$	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> )		220		ns
$t_f$	Current fall time		-	21	-	ns
$E_{off}^{(1)}$	Turn-off switching losses		-	560	-	$\mu\text{J}$

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> )	-	147	-	$\mu\text{J}$
		$V_{CC} = 320\text{ V}$ , $R_G = 10\ \Omega$ , $I_C = 40\text{ A}$ , $L = 100\ \mu\text{H}$ , $C_{snub} = 20\text{ nF}$ , $T_J = 175\text{ }^\circ\text{C}$ (see <a href="#">Figure 26</a> )	-	303	-	

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

## 2.1 Electrical characteristics (curves)

Figure 2. Power dissipation vs. case temperature

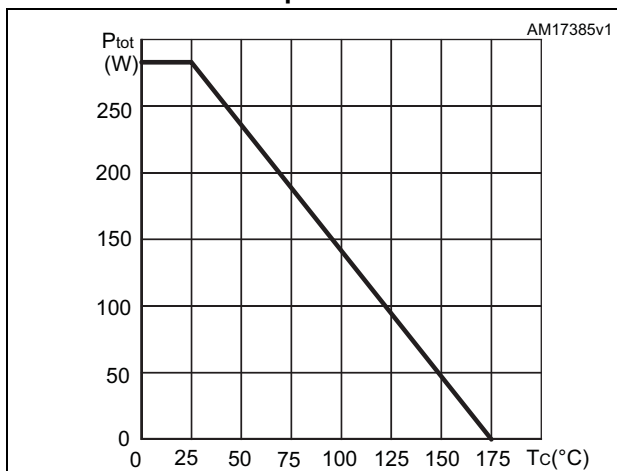


Figure 3. Collector current vs. case temperature

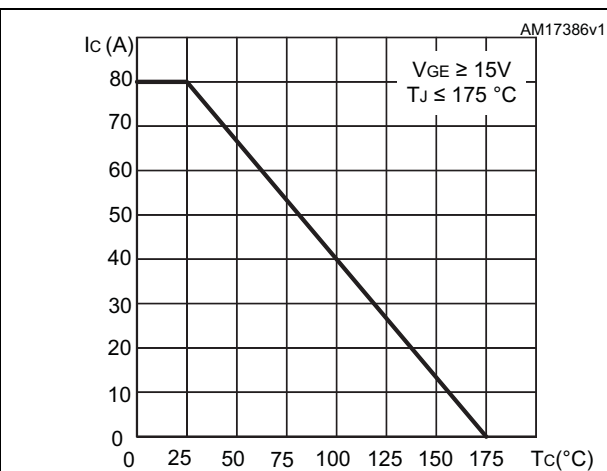


Figure 4. Output characteristics (T<sub>J</sub>=25°C)

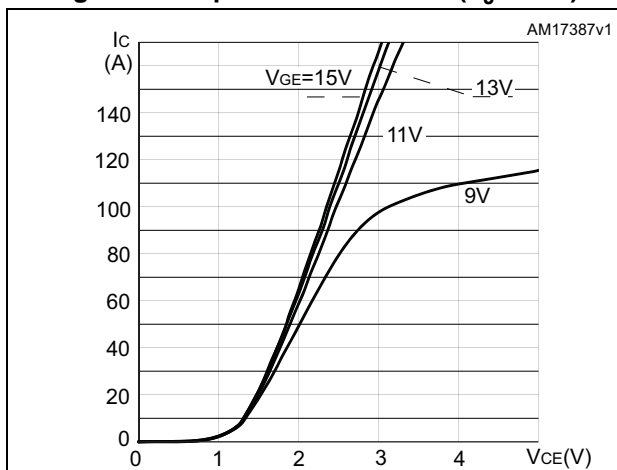


Figure 5. Output characteristics (T<sub>J</sub>=175°C)

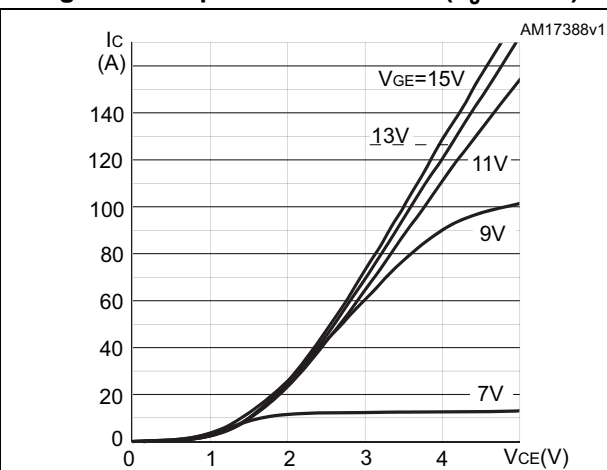


Figure 6. V<sub>CE(sat)</sub> vs. junction temperature

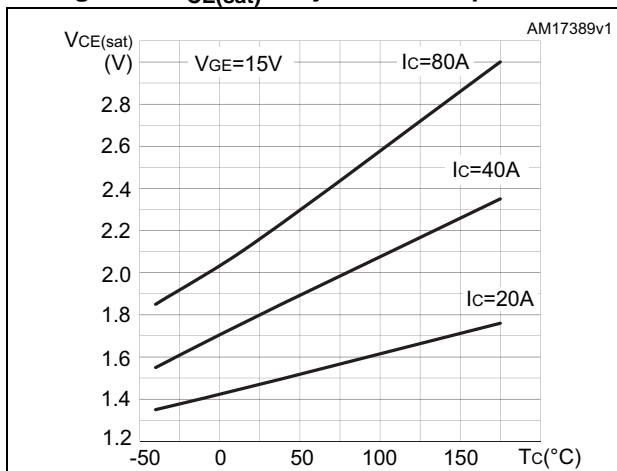


Figure 7. V<sub>CE(sat)</sub> vs. collector current

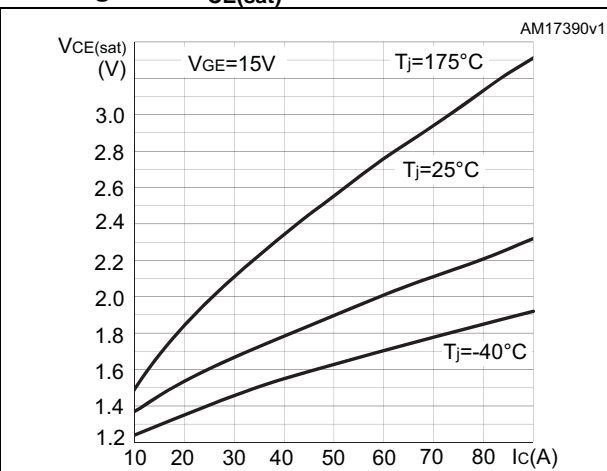


Figure 8. Collector current vs. switching frequency

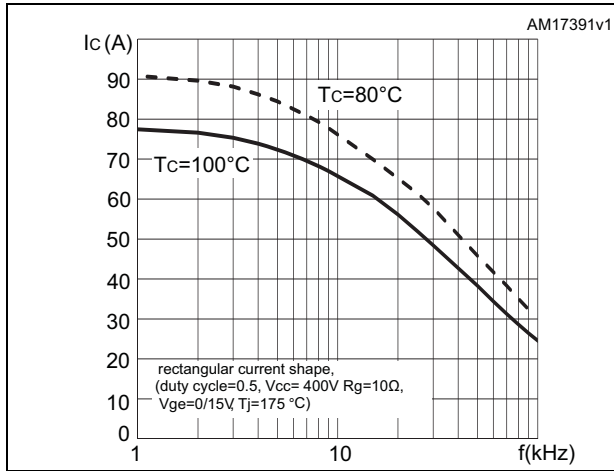


Figure 9. Forward bias safe operating area

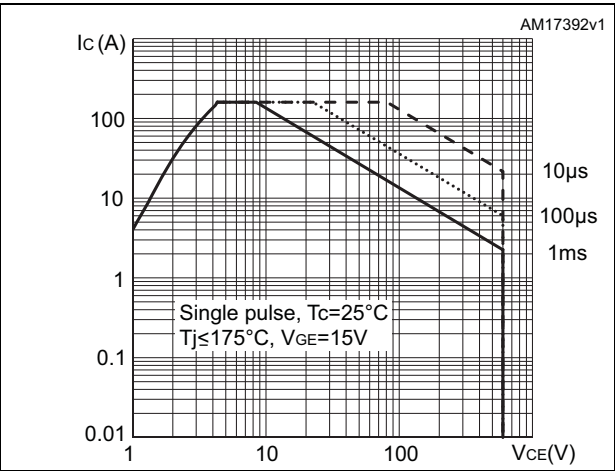


Figure 10. Transfer characteristics

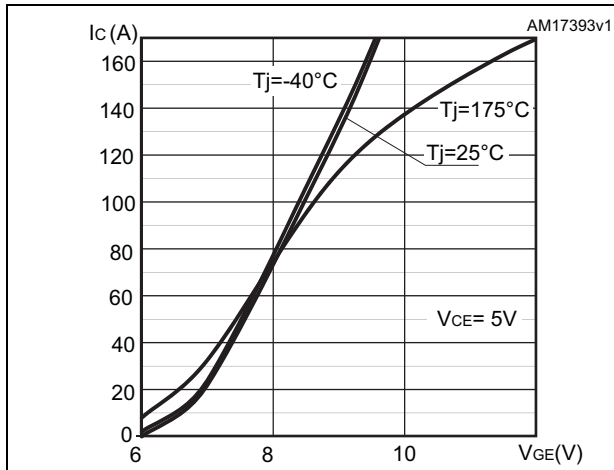


Figure 11. Diode  $V_F$  vs. forward current

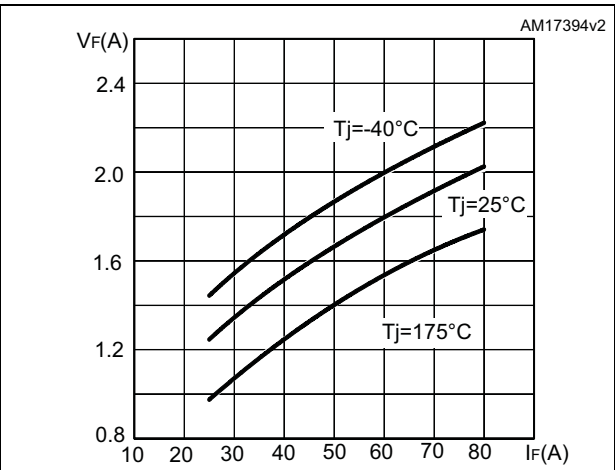


Figure 12. Normalized  $V_{GE(th)}$  vs junction temperature

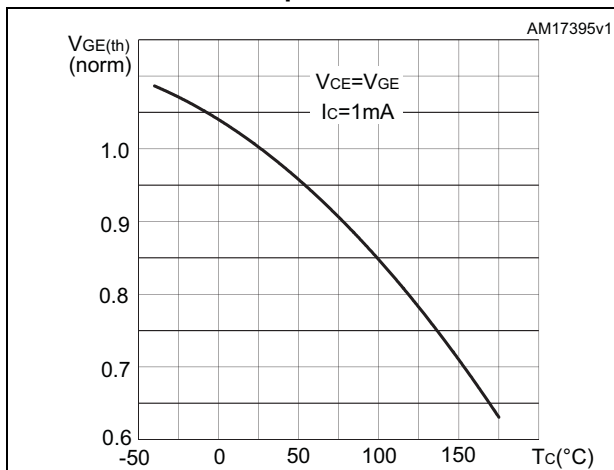


Figure 13. Normalized  $V_{(BR)CES}$  vs. junction temperature

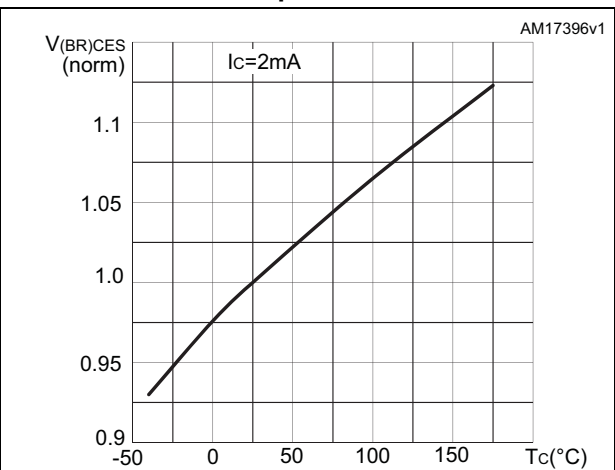


Figure 14. Capacitance variations

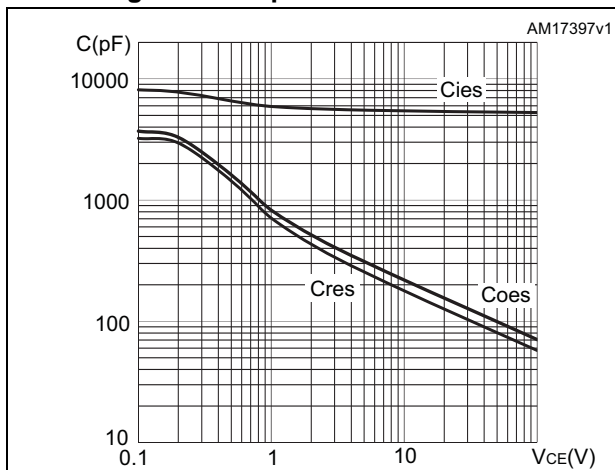


Figure 15. Gate charge vs. gate-emitter voltage

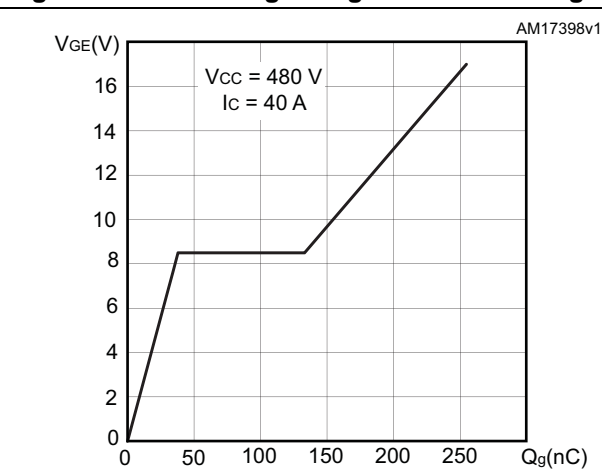


Figure 16. Switching-off losses vs. collector current

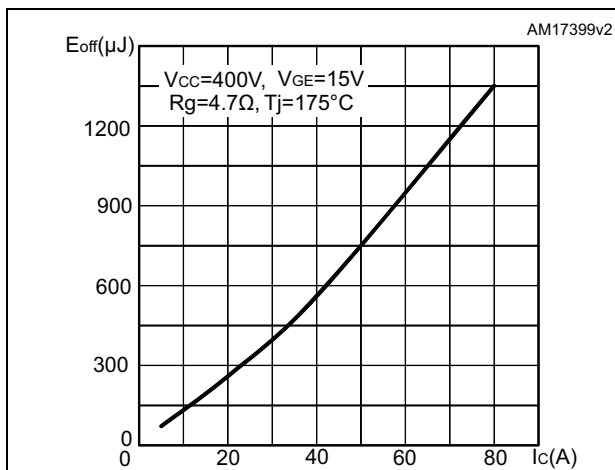


Figure 17. Switching-off losses vs. gate resistance

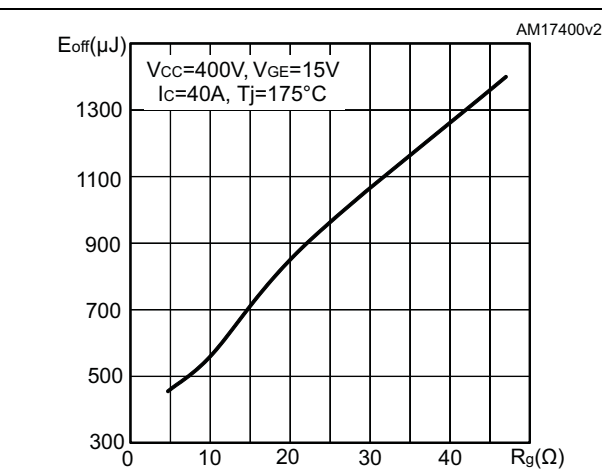


Figure 18. Switching-off losses vs. junction temperature

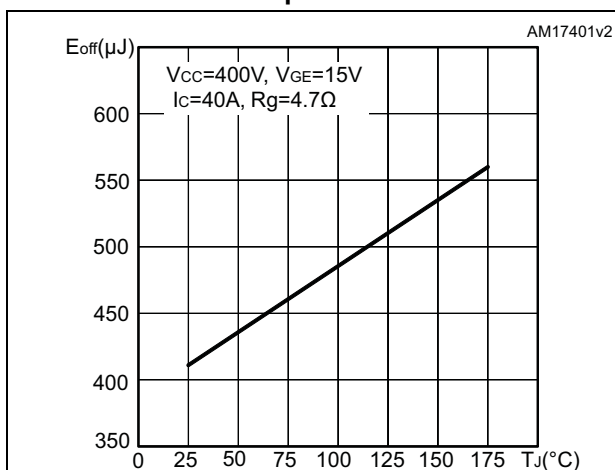


Figure 19. Switching-off losses vs. collector emitter voltage

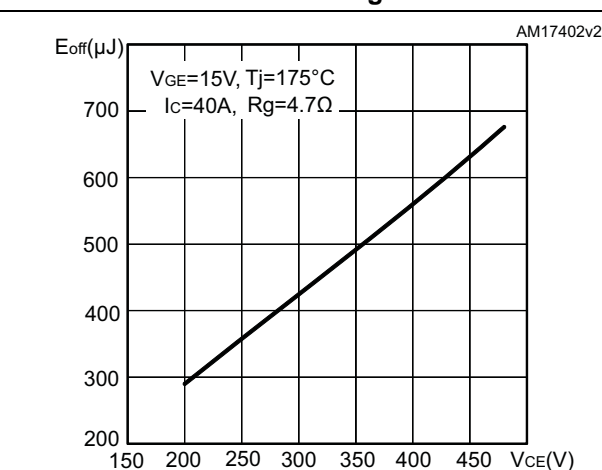




Figure 20. Switching times vs. collector current

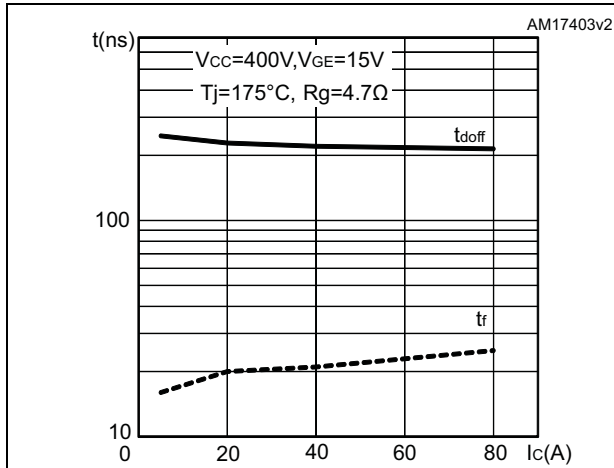


Figure 21. Switching times vs. gate resistance

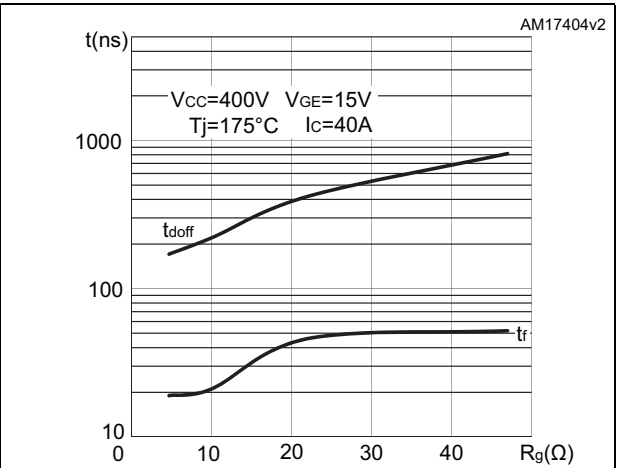


Figure 22. Switching-off losses vs. capacitive load

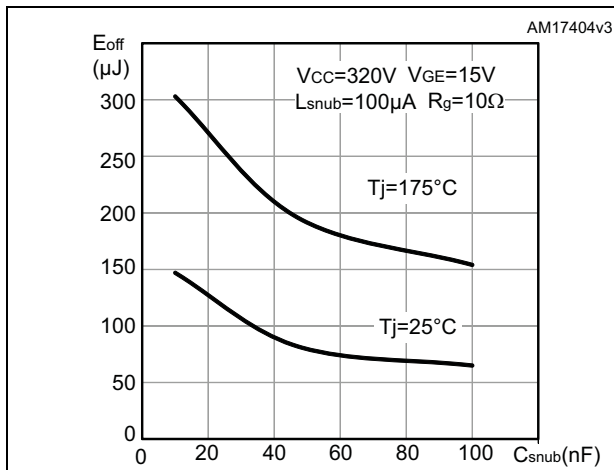


Figure 23. Thermal data for IGBT

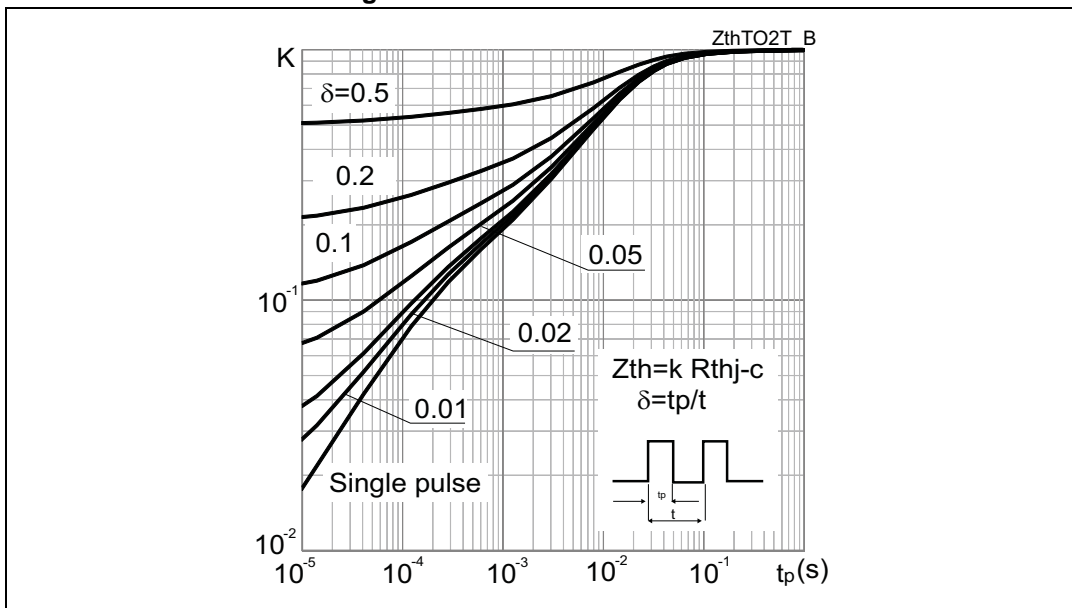
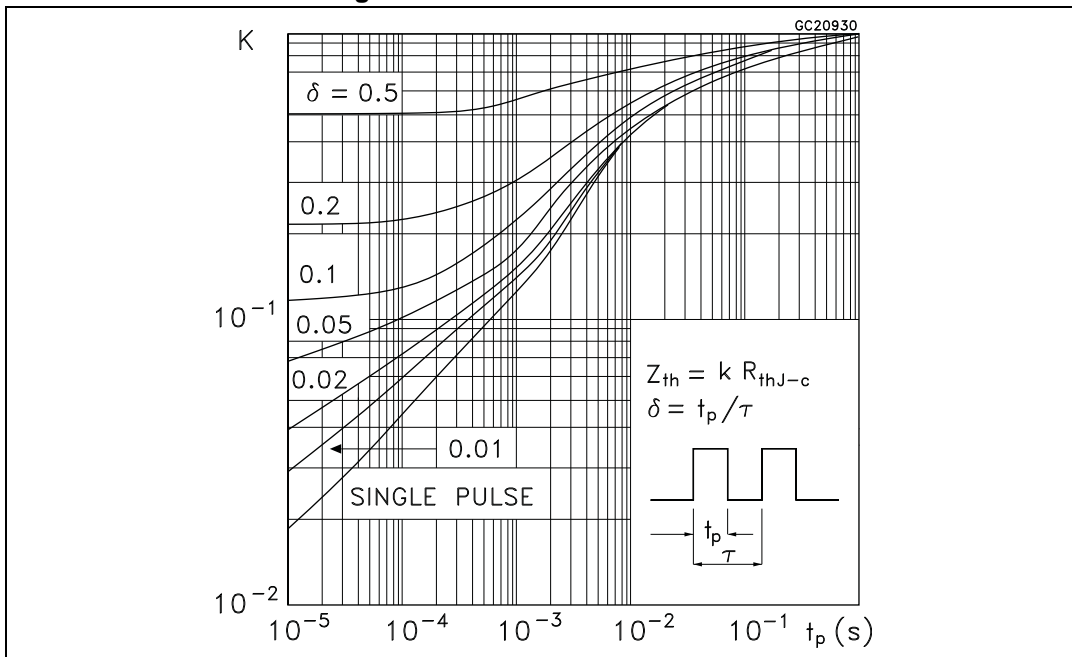


Figure 24. Thermal data for diode





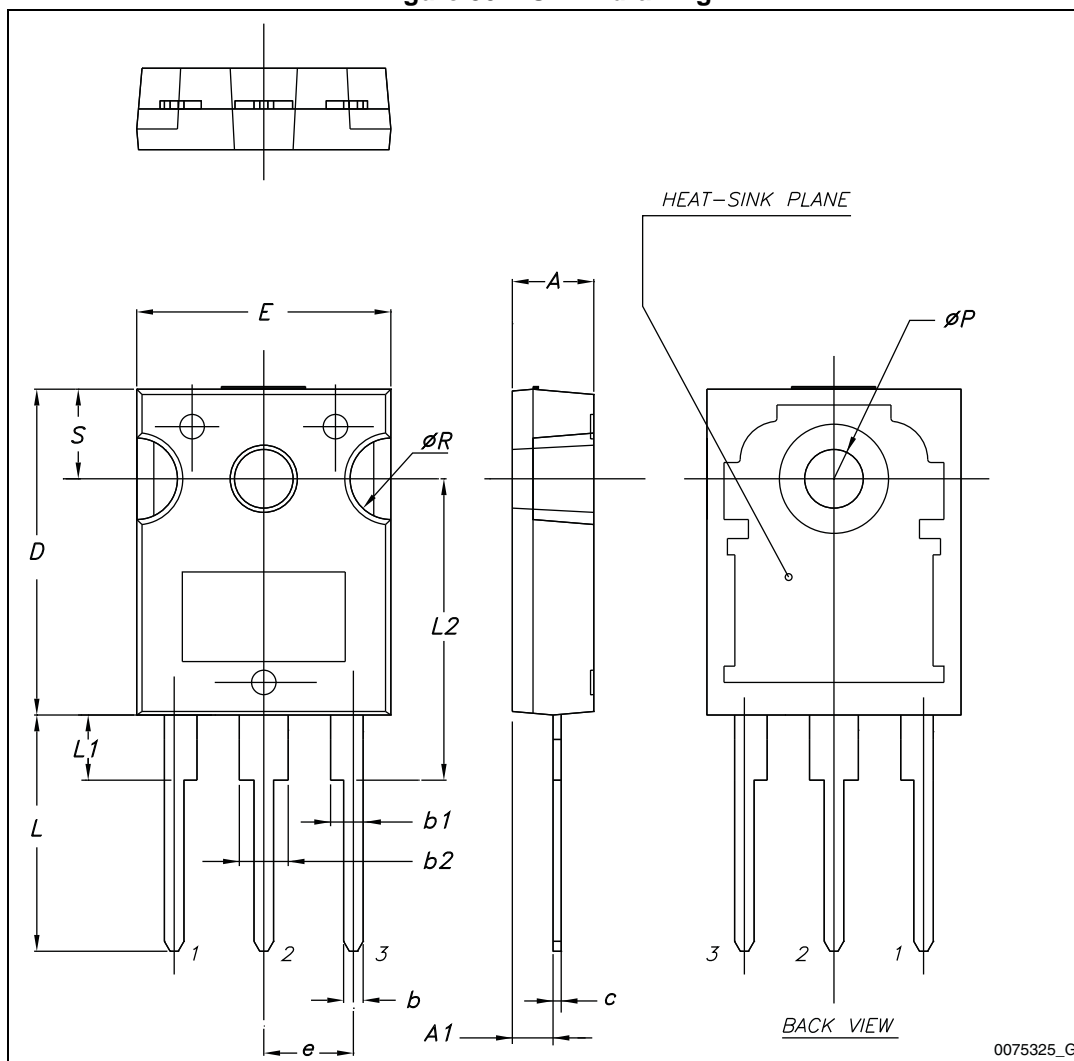
## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

**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

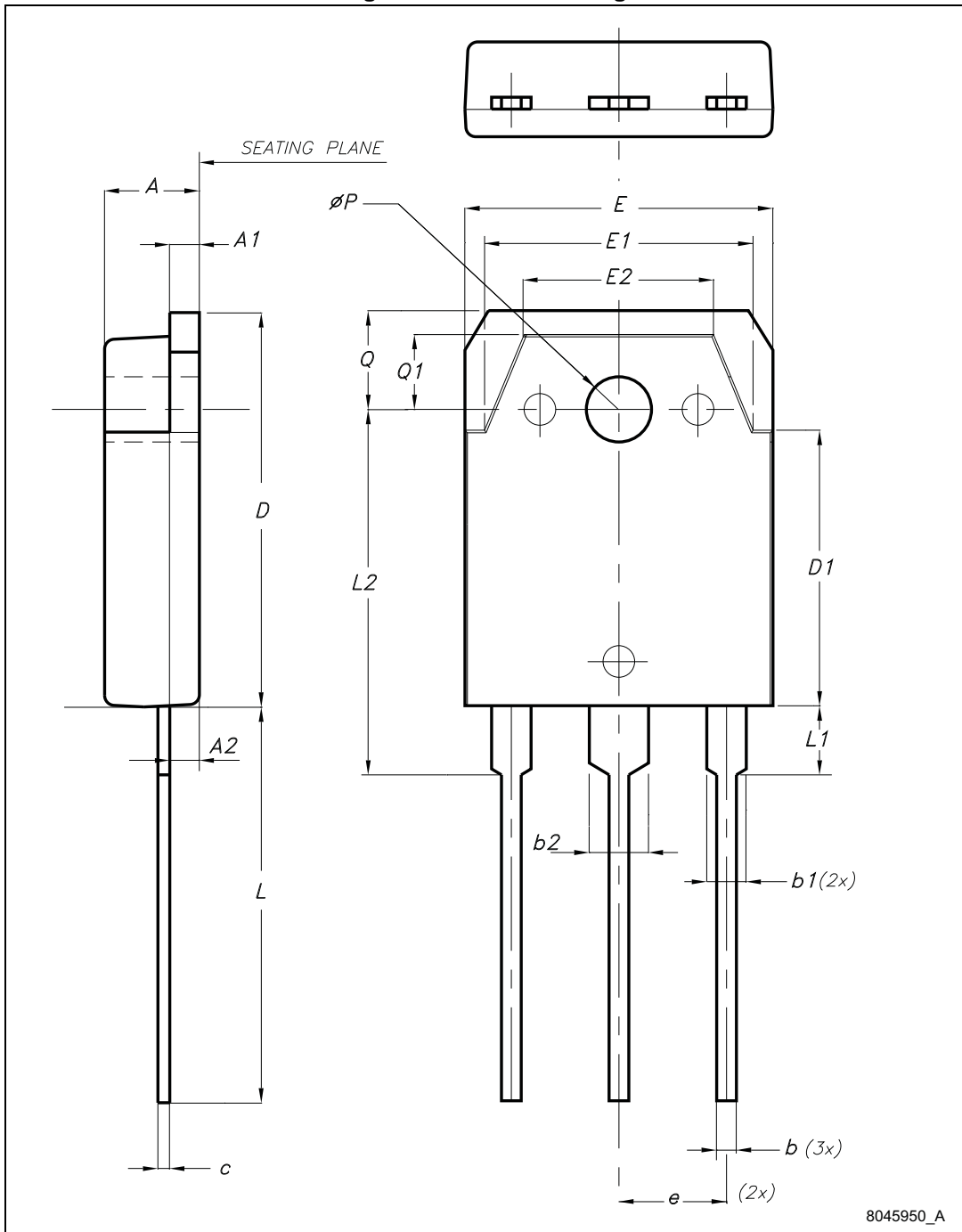


0075325\_G

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
07-Feb-2013	1	Initial release.
17-Jun-2013	2	Document status promoted from preliminary to production data.
01-Jul-2013	3	Updated <a href="#">Section 2.1: Electrical characteristics (curves)</a> and <a href="#">Section Table 7.: IGBT switching characteristics (capacitive load)</a>
21-Oct-2013	4	Updated title, features and description in cover page.



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