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STGW40H60DLFB, STGWT40H60DLFB

Trench gate field-stop IGBT, HB series
600 V, 40 A high speed

Datasheet - production data

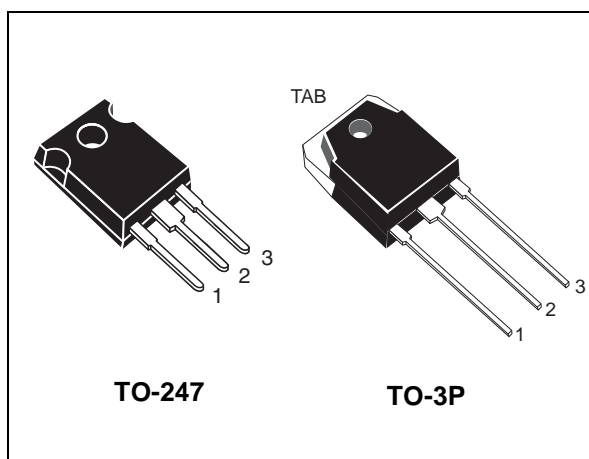
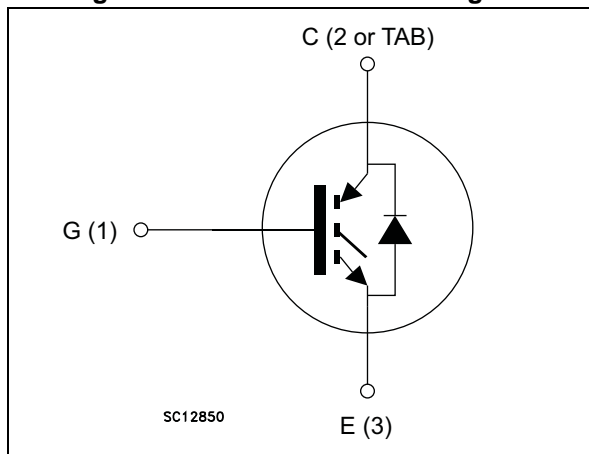


Figure 1. Internal schematic diagram



Features

- Maximum junction temperature: $T_J = 175\text{ °C}$
- High speed switching series
- Minimized tail current
- Low saturation voltage: $V_{CE(sat)} = 1.6\text{ V (typ.)}$
@ $I_C = 40\text{ A}$
- 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 $V_{CE(sat)}$ 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

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Electrical ratings

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	± 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	1.47	°C/W
R_{thJA}	Thermal resistance junction-ambient	50	°C/W

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2 Electrical characteristics

T_J = 25 °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 mA	600			V
V _{CE(sat)}	Collector-emitter saturation voltage	V _{GE} = 15 V, I _C = 40 A		1.6	2	V
		V _{GE} = 15 V, I _C = 40 A T _J = 125 °C		1.7		
		V _{GE} = 15 V, I _C = 40 A T _J = 175 °C		1.8		
V _F	Forward on-voltage	I _F = 40 A		1.55	1.8	V
		I _F = 40 A T _J = 125 °C		1.3		
		I _F = 40 A T _J = 175 °C		1.25		
V _{GE(th)}	Gate threshold voltage	V _{CE} = V _{GE} , I _C = 1 mA	5	6	7	V
I _{CES}	Collector cut-off current (V _{GE} = 0)	V _{CE} = 600 V			25	μA
I _{GES}	Gate-emitter leakage current (V _{CE} = 0)	V _{GE} = ± 20 V			250	nA

Table 5. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C _{ies}	Input capacitance	V _{CE} = 25 V, f = 1 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 V, I _C = 40 A, V _{GE} = 15 V, see Figure 27	-	210	-	nC
Q _{ge}	Gate-emitter charge		-	39	-	nC
Q _{gc}	Gate-collector charge		-	82	-	nC

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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 Figure 25		142		ns
t_f	Current fall time		-	27.6	-	ns
$E_{off}^{(1)}$	Turn-off switching losses		-	363	-	μJ
$t_{d(off)}$	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 Figure 25		141		ns
t_f	Current fall time		-	61	-	ns
$E_{off}^{(1)}$	Turn-off switching losses		-	764	-	μJ

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 Figure 26	-	190	-	μJ
		$V_{CC} = 320\text{ V}$, $R_G = 10\ \Omega$, $I_C = 40\text{ A}$, $L = 100\ \mu\text{H}$, $C_{snub} = 20\text{ nF}$, $T_J = 175\text{ }^\circ\text{C}$, see Figure 26	-	290	-	

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

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2.1 Electrical characteristics (curves)

Figure 2. Power dissipation vs. case temperature

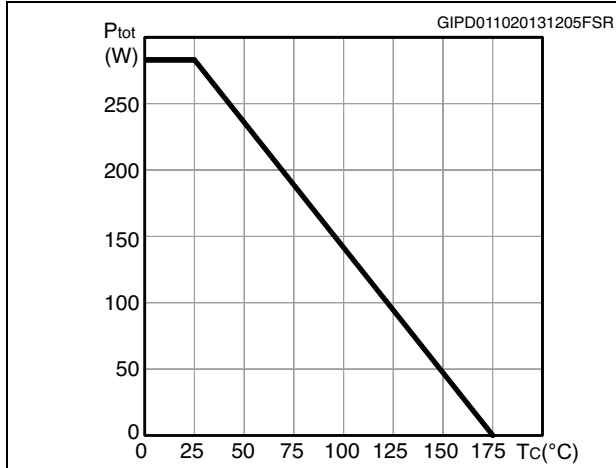


Figure 3. Collector current vs. case temperature

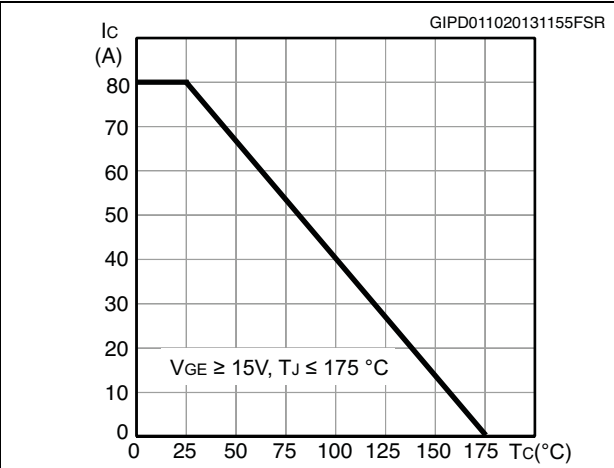


Figure 4. Output characteristics (T_J = 25°C)

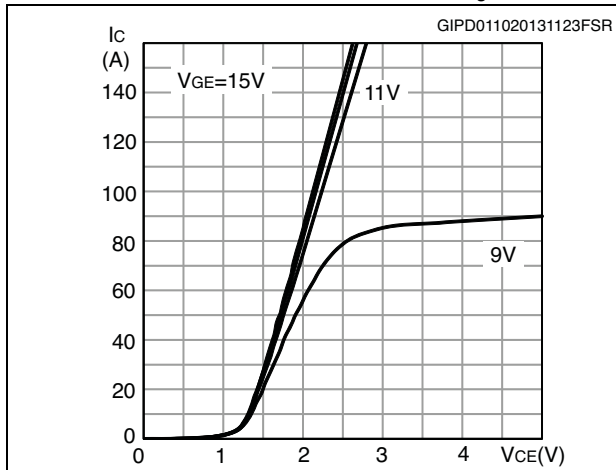


Figure 5. Output characteristics (T_J = 175°C)

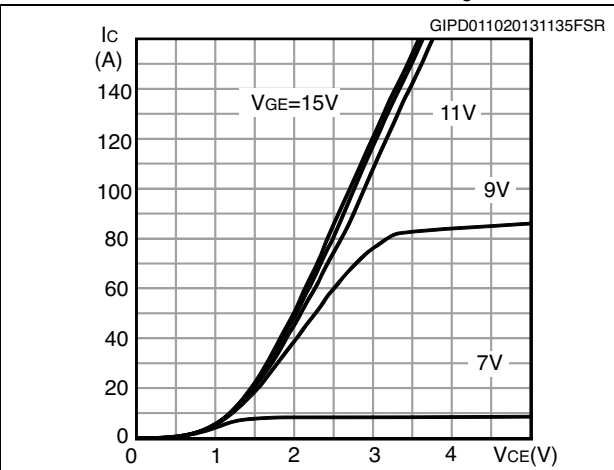


Figure 6. V_{CE(sat)} vs. junction temperature

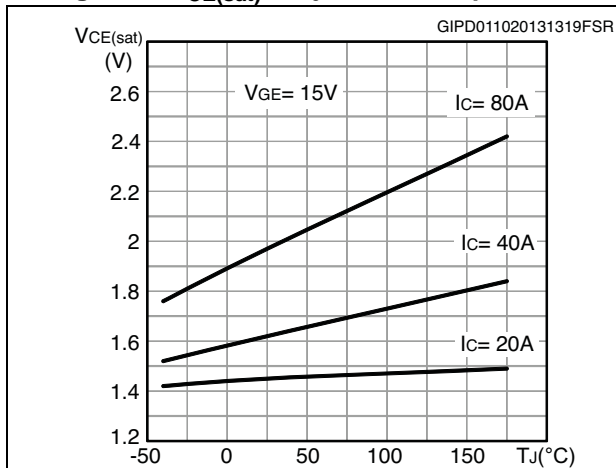
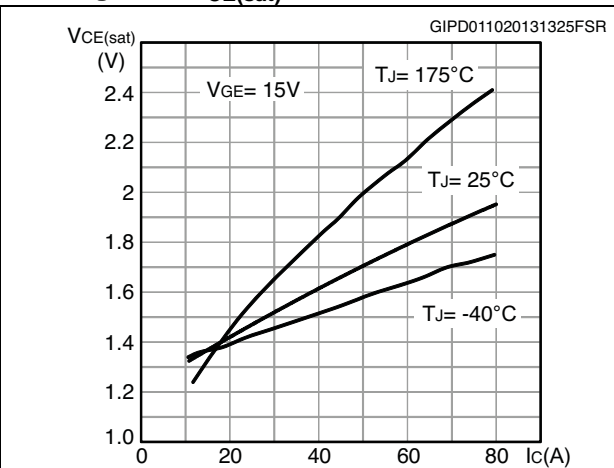


Figure 7. V_{CE(sat)} vs. collector current



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Figure 8. Collector current vs. switching frequency

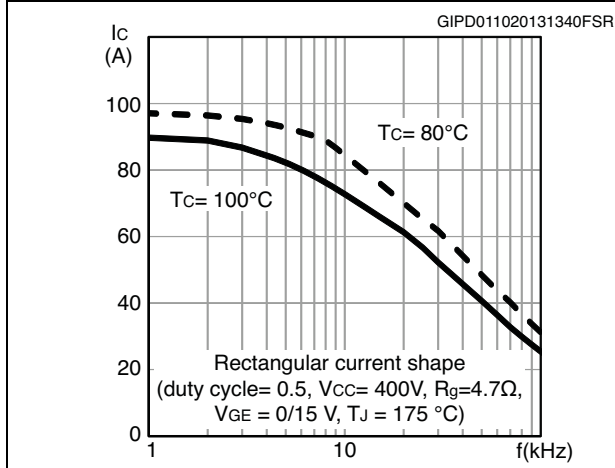


Figure 9. Forward bias safe operating area

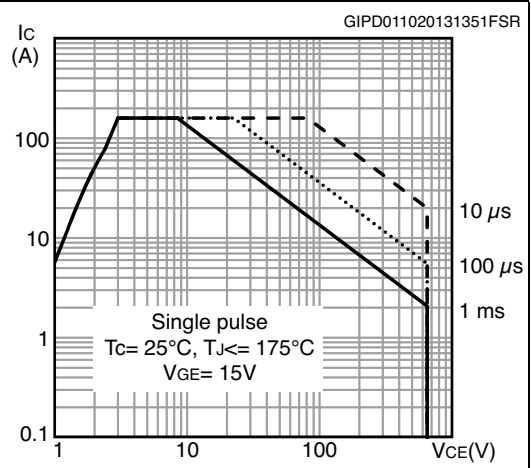


Figure 10. Transfer characteristics

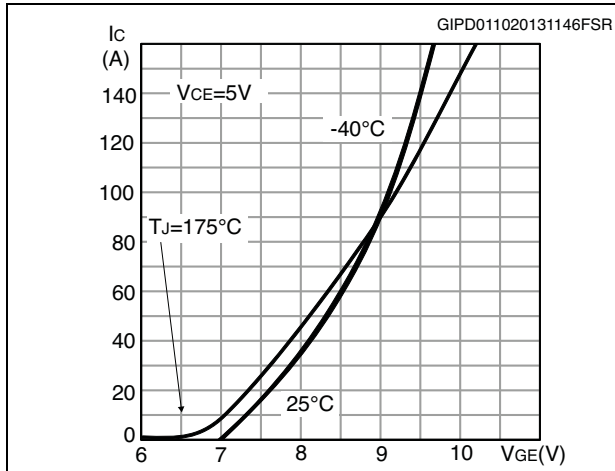


Figure 11. Diode V_F vs. forward current

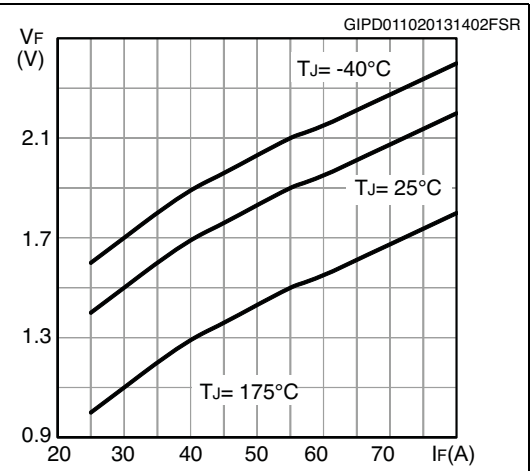


Figure 12. Normalized $V_{GE(th)}$ vs junction temperature

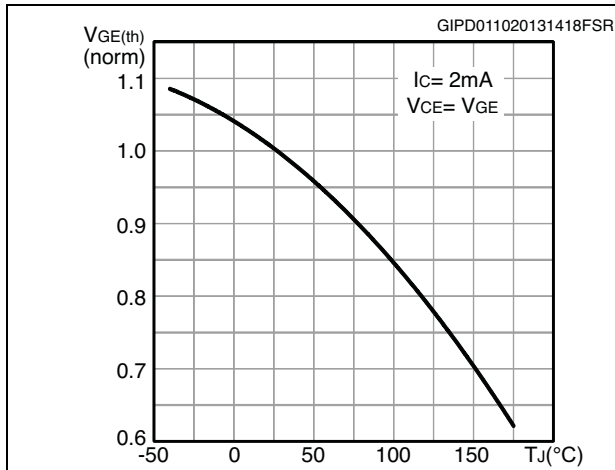
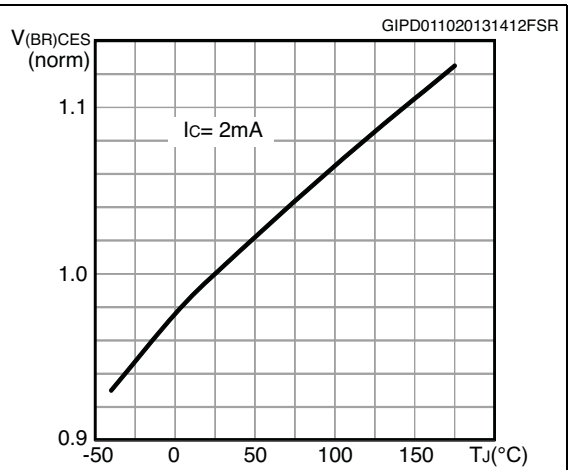


Figure 13. Normalized $V_{(BR)CES}$ vs. junction temperature



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Figure 14. Capacitance variation

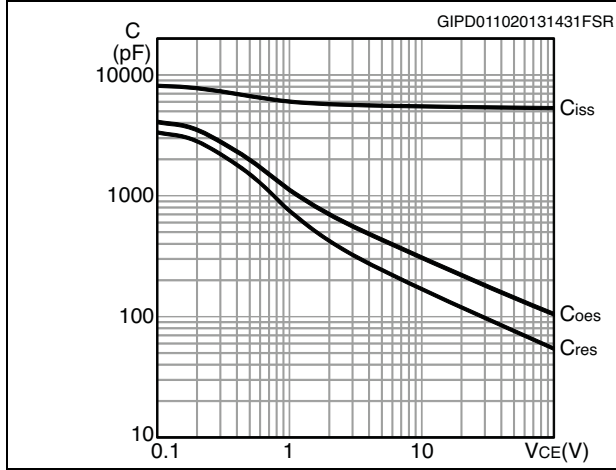


Figure 15. Gate charge vs. gate-emitter voltage

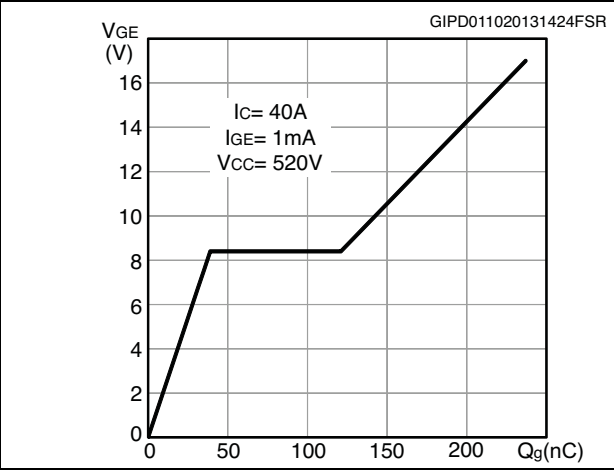


Figure 16. Switching-off loss vs collector current

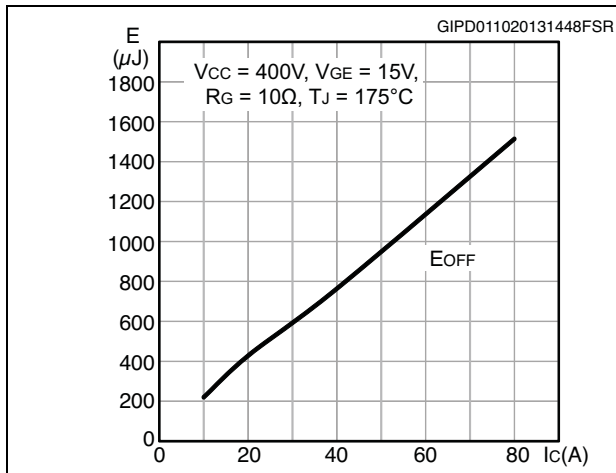


Figure 17. Switching-off loss vs gate resistance

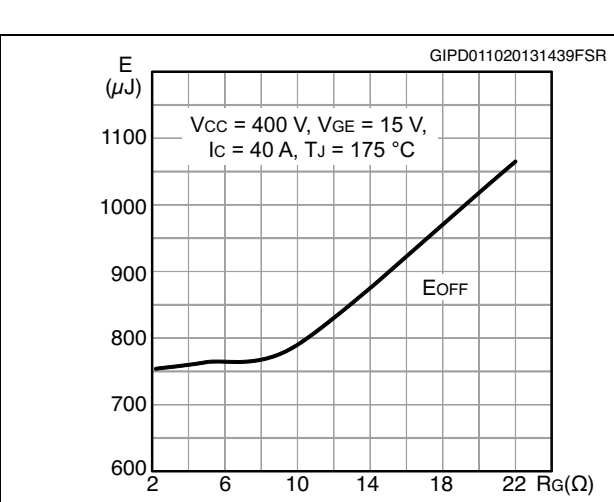


Figure 18. Switching-off loss vs temperature

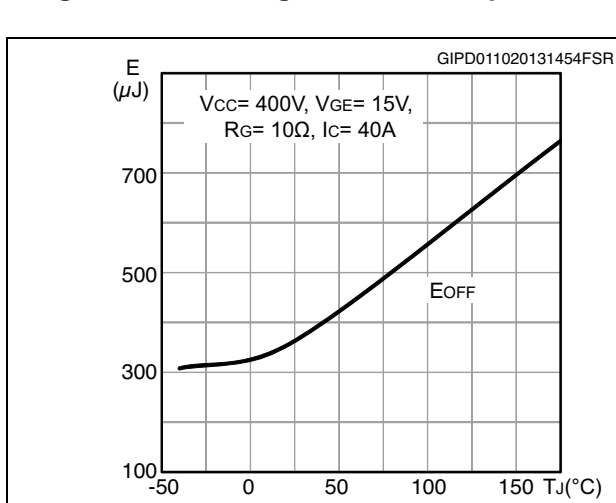
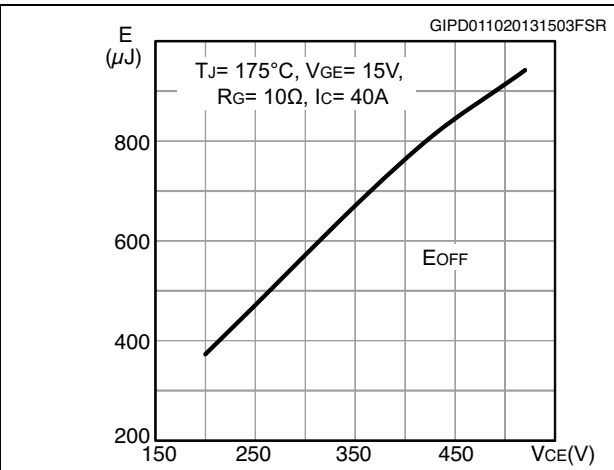


Figure 19. Switching-off loss vs collector-emitter voltage



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Electrical characteristics

Figure 20. Switching times vs. collector current **Figure 21. Switching times vs. gate resistance**

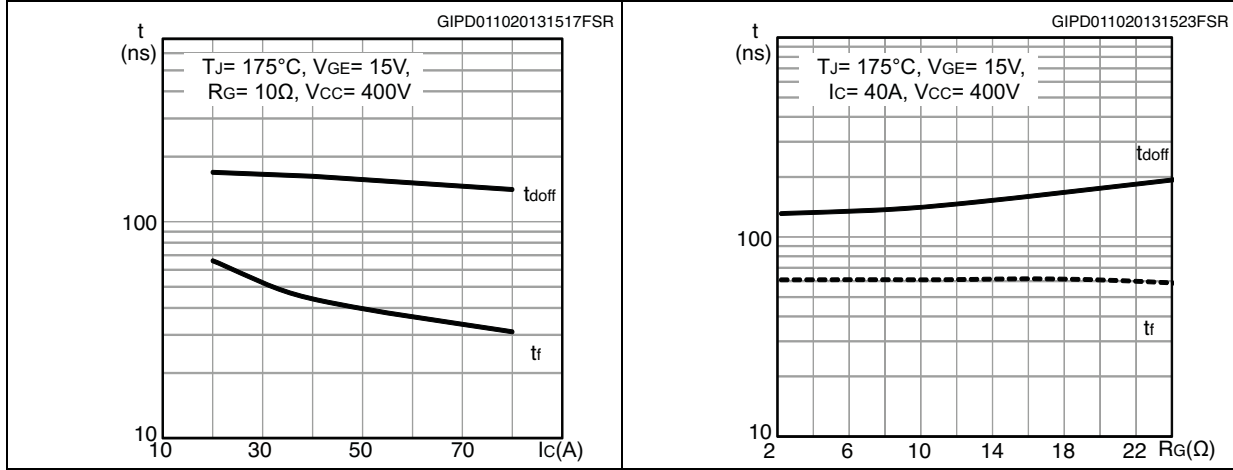
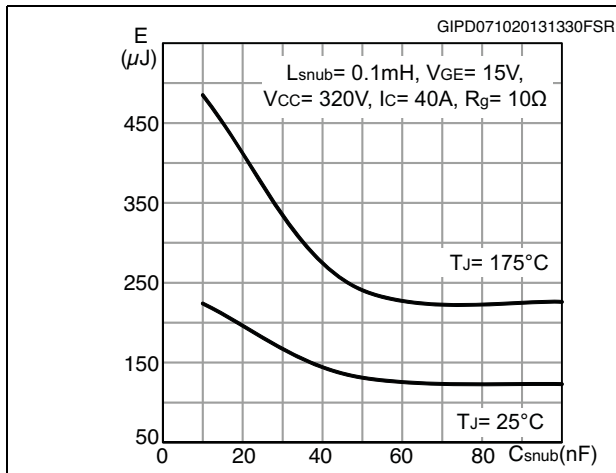


Figure 22. Switching-off losses vs. capacitive load



Electrical characteristics

STGW40H60DLFB, STGWT40H60DLFB

Figure 23. Thermal impedance for IGBT

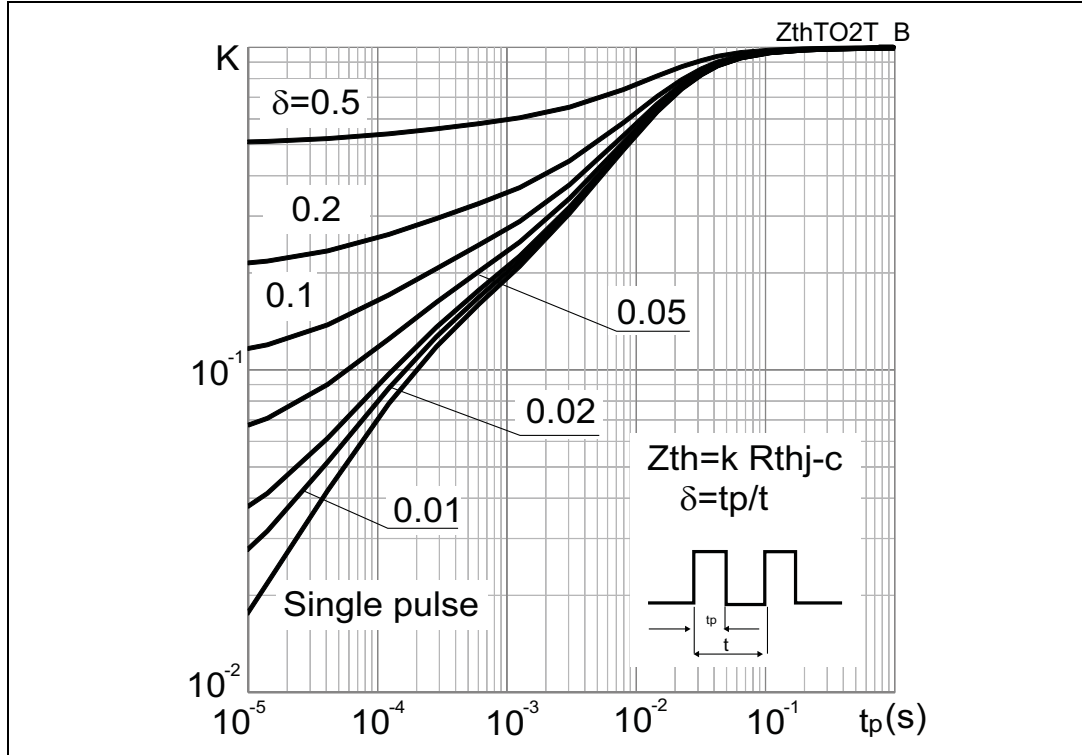
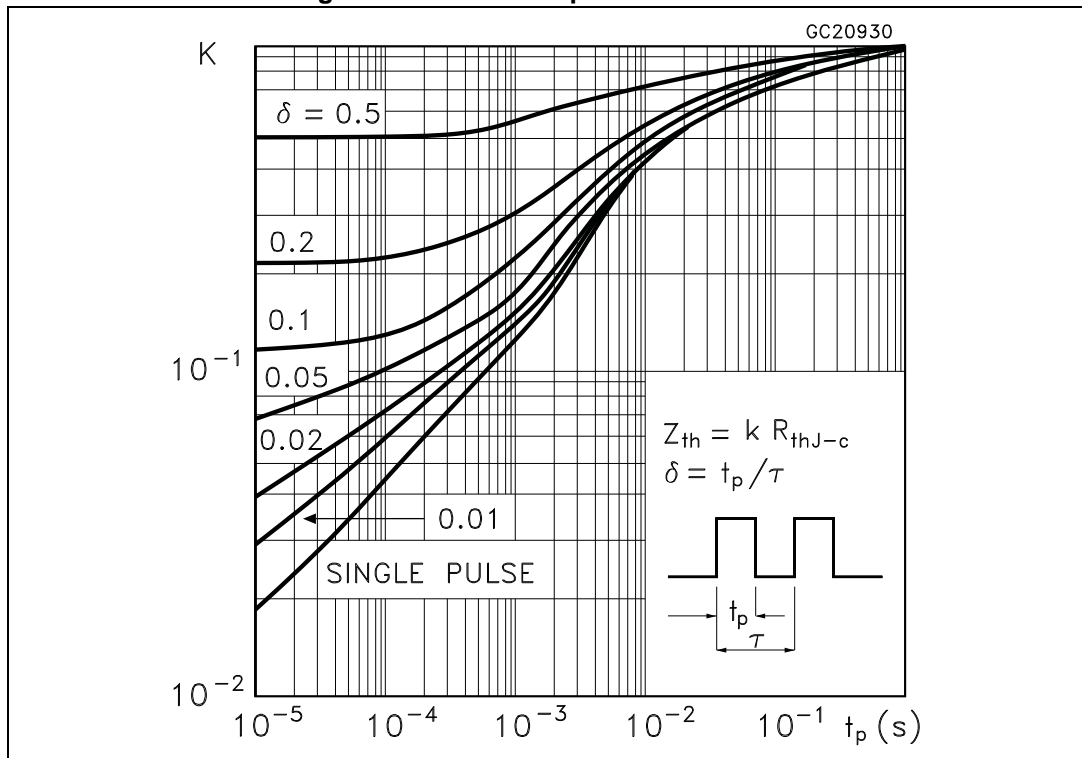


Figure 24. Thermal impedance for diode



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Test circuits

3 Test circuits

Figure 25. Test circuit for inductive load switching

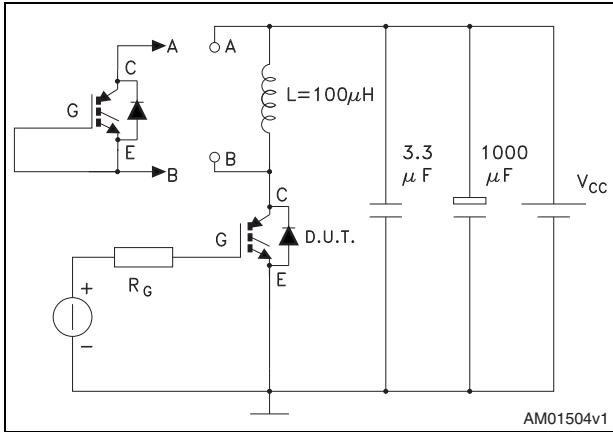


Figure 26. Test circuit for capacitive load switching

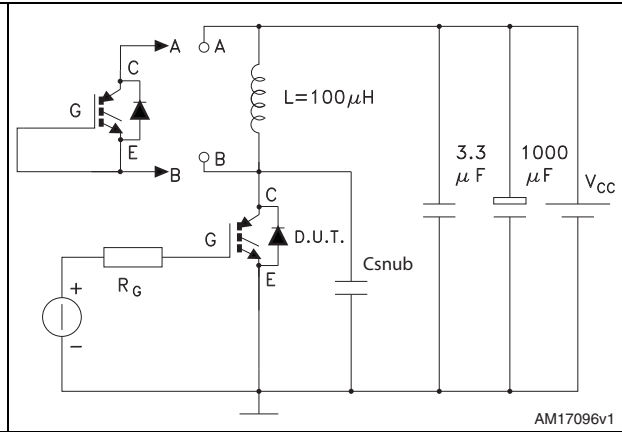


Figure 27. Gate charge test circuit

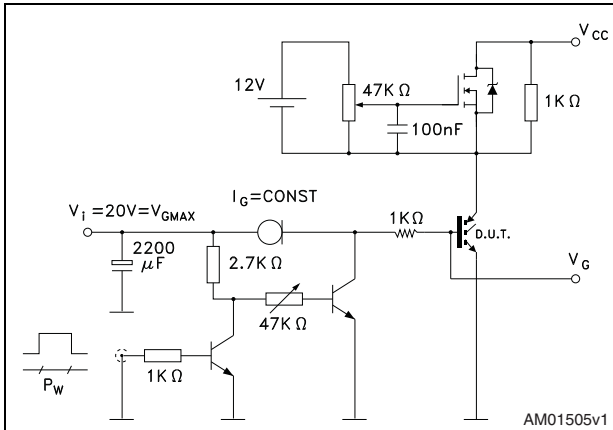


Figure 28. Switching waveform

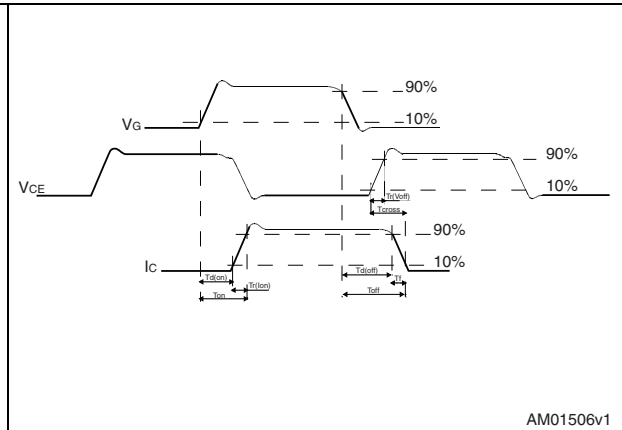
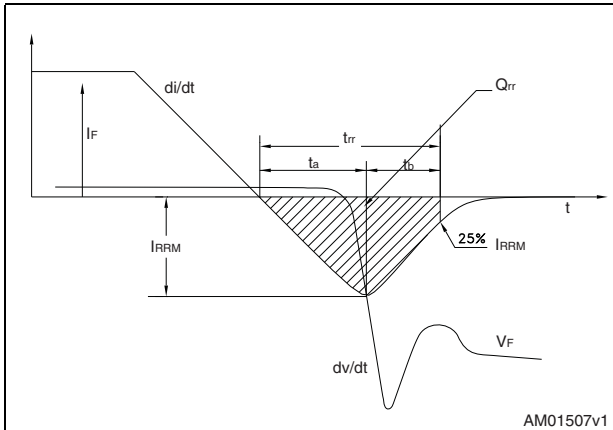


Figure 29. Diode recovery time waveform



Package mechanical data

STGW40H60DLFB, STGWT40H60DLFB

4 Package mechanical data

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4.1 TO-247, STGW40H60DLFB

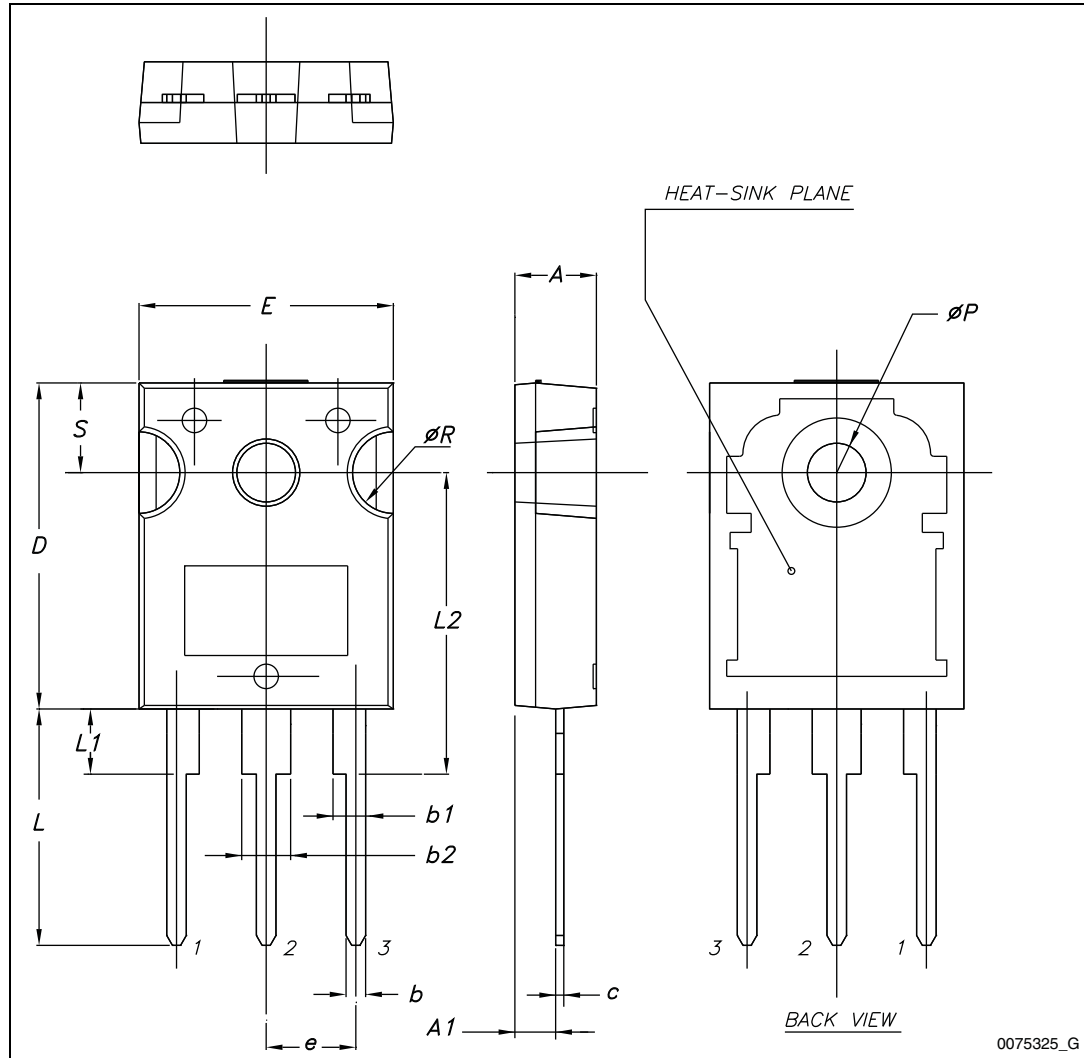
Table 8. TO-247 mechanical data

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

STGW40H60DLFB, STGWT40H60DLFB

Package mechanical data

Figure 30. TO-247 drawing



Package mechanical data

STGW40H60DLFB, STGWT40H60DLFB

4.2 TO-3P, STGWT40H60DLFB

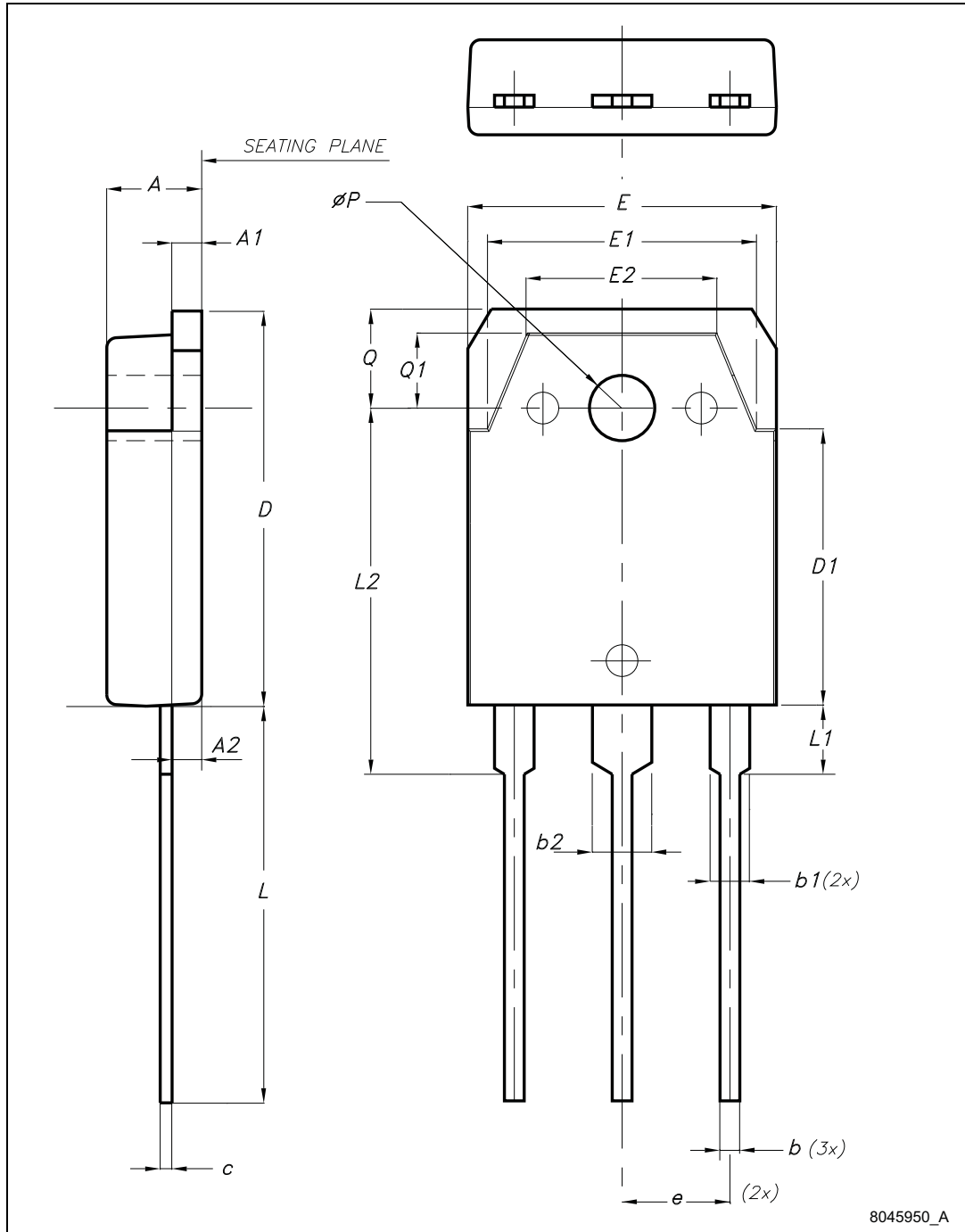
Table 9. TO-3P mechanical data

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	

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Package mechanical data

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 Section 2.1: Electrical characteristics (curves) . Minor text changes.
13-Mar-2014	3	Updated title and description in cover page.
18-Mar-2014	4	Updated title in cover page and Section 4: Package mechanical data .

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