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STGW80V60DF STGWT80V60DF

Trench gate field-stop IGBT, V series
600 V, 80 A very high speed

Datasheet - production data

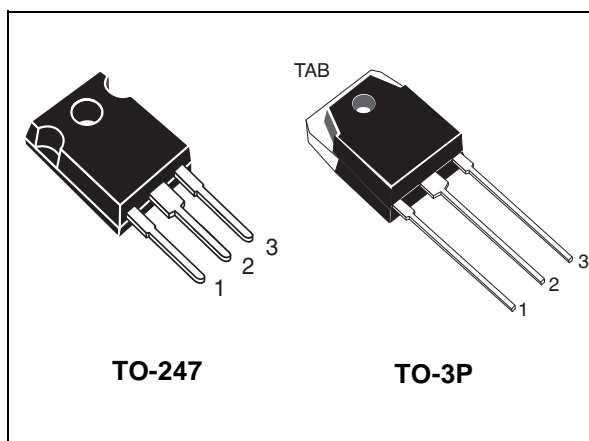
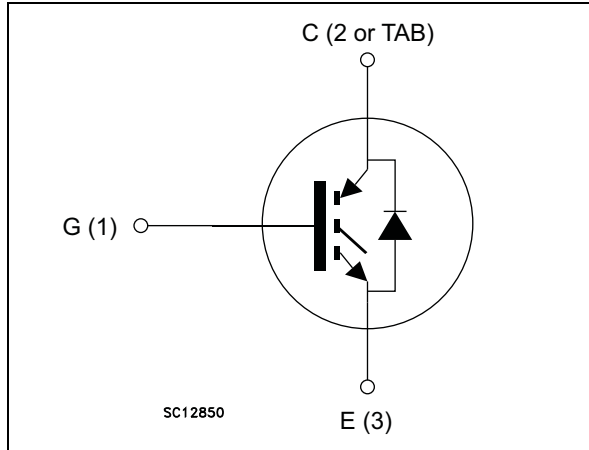


Figure 1. Internal schematic diagram



Features

- Maximum junction temperature: $T_J = 175\text{ °C}$
- Tail-less switching off
- $V_{CE(sat)} = 1.85\text{ V (typ.) @ } I_C = 80\text{ A}$
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- Very fast soft recovery antiparallel diode

Applications

- Photovoltaic inverters
- Uninterruptible power supply
- Welding
- Power factor correction
- Very high frequency 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
STGW80V60DF	GW80V60DF	TO-247	Tube
STGWT80V60DF	GWT80V60DF	TO-3P	Tube

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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 $T_C = 25\text{ °C}$	120 ⁽¹⁾	A
I_C	Continuous collector current at $T_C = 100\text{ °C}$	80	A
I_{CP} ⁽²⁾	Pulsed collector current	240	A
V_{GE}	Gate-emitter voltage	± 20	V
I_F	Continuous forward current at $T_C = 25\text{ °C}$	120 ⁽¹⁾	A
I_F	Continuous forward current at $T_C = 100\text{ °C}$	80	A
I_{FP} ⁽²⁾	Pulsed forward current	360	A
P_{TOT}	Total dissipation at $T_C = 25\text{ °C}$	469	W
T_{STG}	Storage temperature range	- 55 to 150	°C
T_J	Operating junction temperature	- 55 to 175	°C

1. Current level is limited by bond wires
2. Pulse width limited by maximum junction temperature

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case IGBT	0.32	°C/W
R_{thJC}	Thermal resistance junction-case diode	0.66	°C/W
R_{thJA}	Thermal resistance junction-ambient	50	°C/W

Electrical characteristics

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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 = 80 A		1.85	2.3	V
		V _{GE} = 15 V, I _C = 80 A T _J = 125 °C		2.15		
		V _{GE} = 15 V, I _C = 80 A T _J = 175 °C		2.4		
V _F	Forward on-voltage	I _F = 80 A		1.9	2.3	V
		I _F = 80 A T _J = 125 °C		1.6		V
		I _F = 80 A T _J = 175 °C		1.5		V
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			100	μA
I _{GES}	Gate-emitter leakage current (V _{CE} = 0)	V _{GE} = ± 20 V			250	nA

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Electrical characteristics
Table 5. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0$	-	10800	-	nF
C_{oes}	Output capacitance		-	390	-	pF
C_{res}	Reverse transfer capacitance		-	220	-	pF
Q_g	Total gate charge	$V_{CC} = 480\text{ V}$, $I_C = 80\text{ A}$, $V_{GE} = 15\text{ V}$, see Figure 29	-	448	-	nC
Q_{ge}	Gate-emitter charge		-	76	-	nC
Q_{gc}	Gate-collector charge		-	184	-	nC

Table 6. IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$, $I_C = 80\text{ A}$, $R_G = 5\ \Omega$, $V_{GE} = 15\text{ V}$, see Figure 28	-	60	-	ns
t_r	Current rise time		-	30	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	2200	-	A/ μ s
$t_{d(off)}$	Turn-off delay time		-	220	-	ns
t_f	Current fall time		-	17	-	ns
$E_{on}^{(1)}$	Turn-on switching losses		-	1.8	-	mJ
$E_{off}^{(2)}$	Turn-off switching losses		-	1	-	mJ
E_{ts}	Total switching losses		-	2.8	-	mJ
$t_{d(on)}$	Turn-on delay time		$V_{CE} = 400\text{ V}$, $I_C = 80\text{ A}$, $R_G = 5\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 175\text{ }^\circ\text{C}$, see Figure 28	-	60	-
t_r	Current rise time	-		30	-	ns
$(di/dt)_{on}$	Turn-on current slope	-		2100	-	A/ μ s
$t_{d(off)}$	Turn-off delay time	-		240	-	ns
t_f	Current fall time	-		22	-	ns
$E_{on}^{(1)}$	Turn-on switching losses	-		3.8	-	mJ
$E_{off}^{(2)}$	Turn-off switching losses	-		1.25	-	mJ
E_{ts}	Total switching losses	-		5.05	-	mJ

1. Energy losses include reverse recovery of the diode.
2. Turn-off losses include also the tail of the collector current.

Electrical characteristics

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Table 7. Diode switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{rr}	Reverse recovery time	$I_F = 80\text{ A}$, $V_R = 400\text{ V}$, $di/dt = 1000\text{ A}/\mu\text{s}$, $V_{GE} = 15\text{ V}$, see Figure 28	-	60	-	ns
Q_{rr}	Reverse recovery charge		-	112	-	nC
I_{rrm}	Reverse recovery current		-	3.6	-	A
dl_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	140	-	$\text{A}/\mu\text{s}$
E_{rr}	Reverse recovery energy		-	70	-	μJ
t_{rr}	Reverse recovery time	$I_F = 80\text{ A}$, $V_R = 400\text{ V}$, $di/dt = 1000\text{ A}/\mu\text{s}$, $V_{GE} = 15\text{ V}$; $T_J = 175\text{ }^\circ\text{C}$ see Figure 28	-	340	-	ns
Q_{rr}	Reverse recovery charge		-	2200	-	nC
I_{rrm}	Reverse recovery current		-	13	-	A
dl_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	70	-	$\text{A}/\mu\text{s}$
E_{rr}	Reverse recovery energy		-	880	-	μJ

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Electrical characteristics

2.1 Electrical characteristics (curves)

Figure 2. Power dissipation vs. case temperature

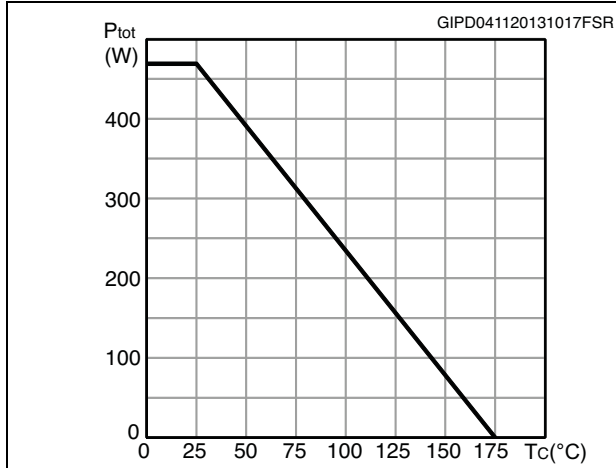


Figure 3. Collector current vs. case temperature

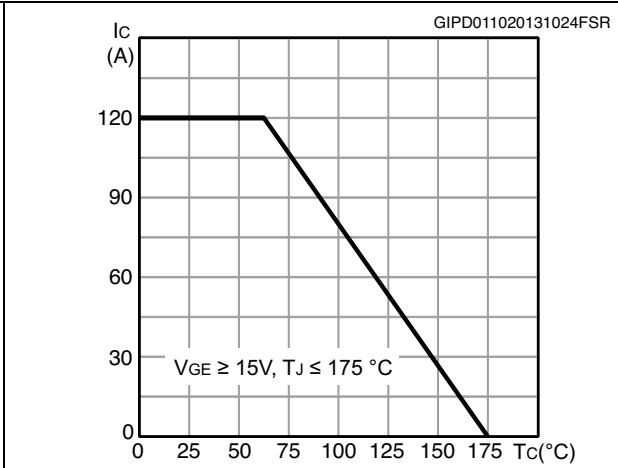


Figure 4. Output characteristics (T_J = 25°C)

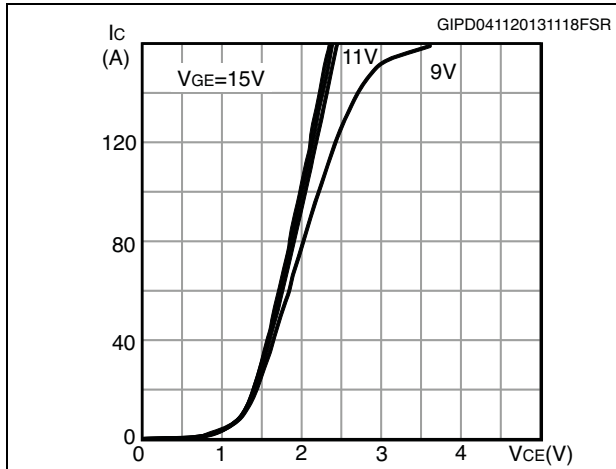


Figure 5. Output characteristics (T_J = 175°C)

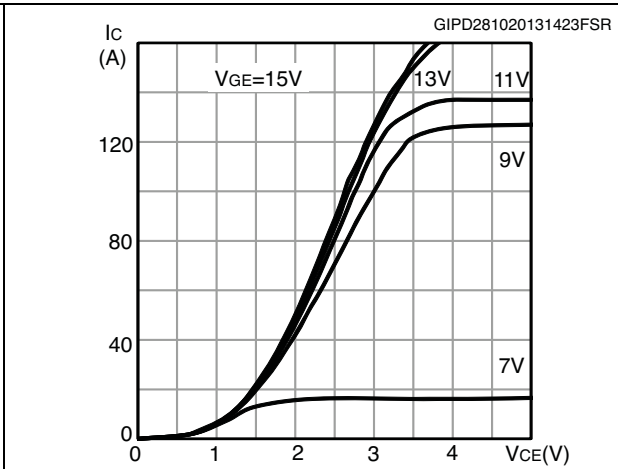


Figure 6. V_{CE(sat)} vs. junction temperature

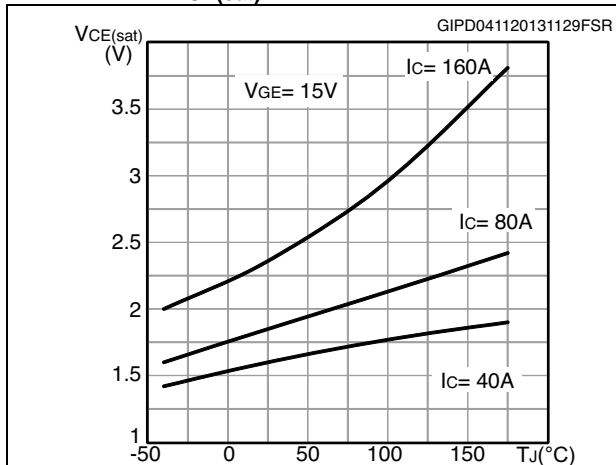
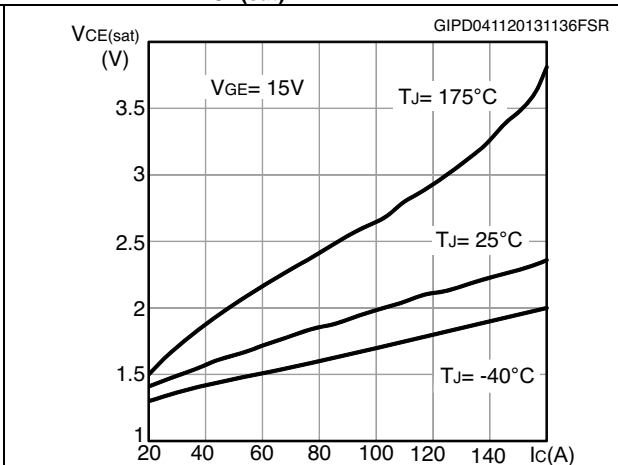


Figure 7. V_{CE(sat)} vs. collector current



Electrical characteristics

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Figure 8. Collector current vs. switching frequency

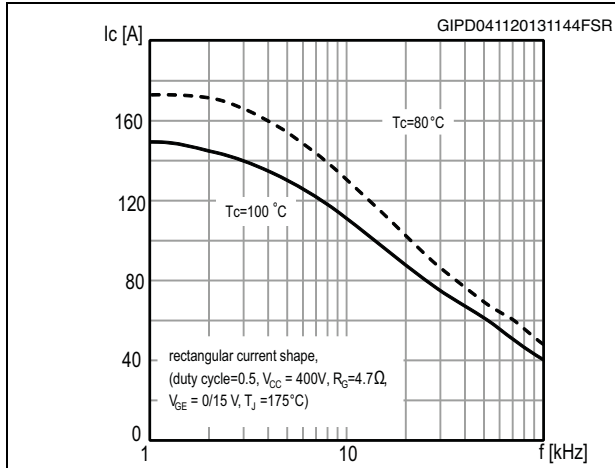


Figure 9. Forward bias safe operating area

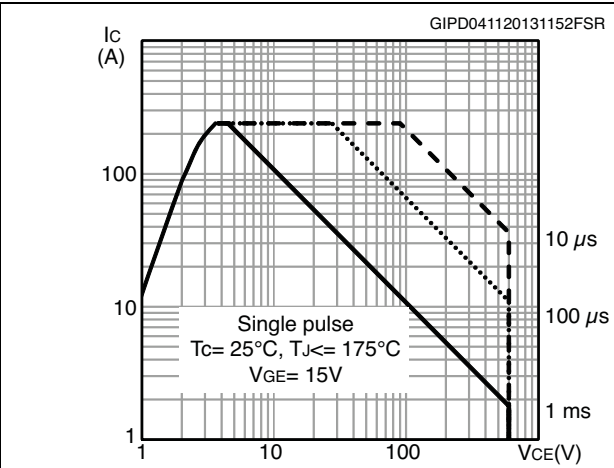


Figure 10. Transfer characteristics

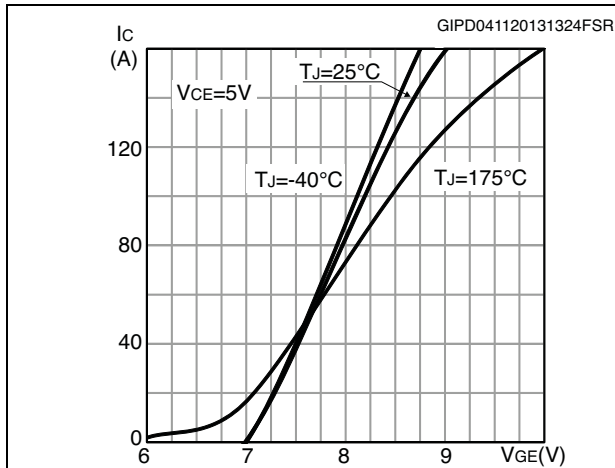


Figure 11. Diode VF vs. forward current

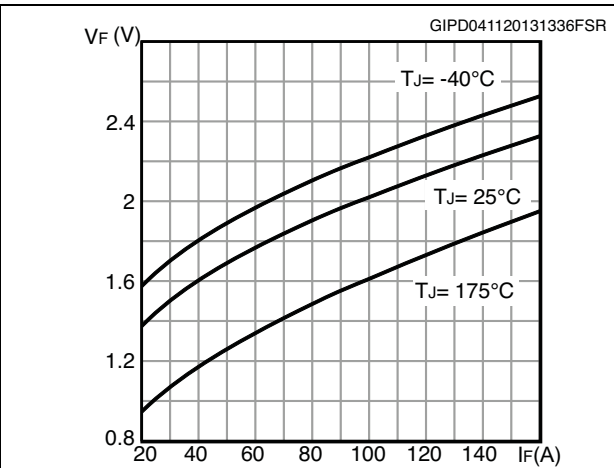


Figure 12. Normalized VGE(th) vs junction temperature

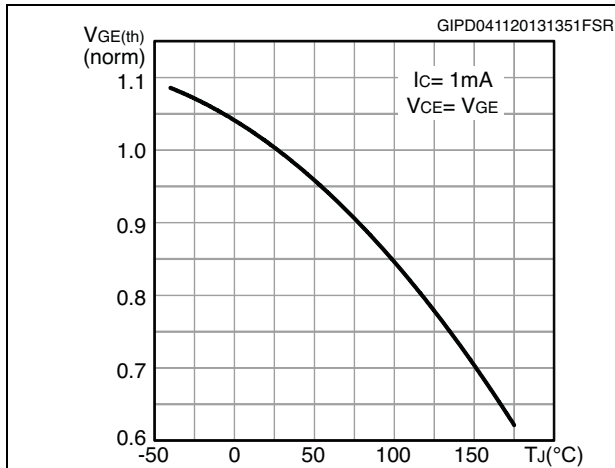
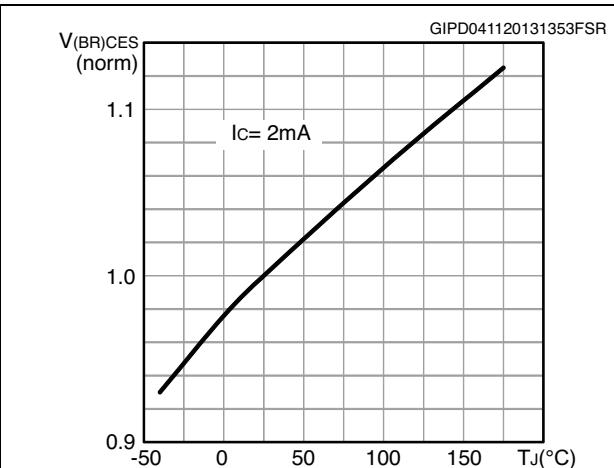


Figure 13. Normalized V(BR)CES vs. junction temperature



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Electrical characteristics

Figure 14. Capacitance variation

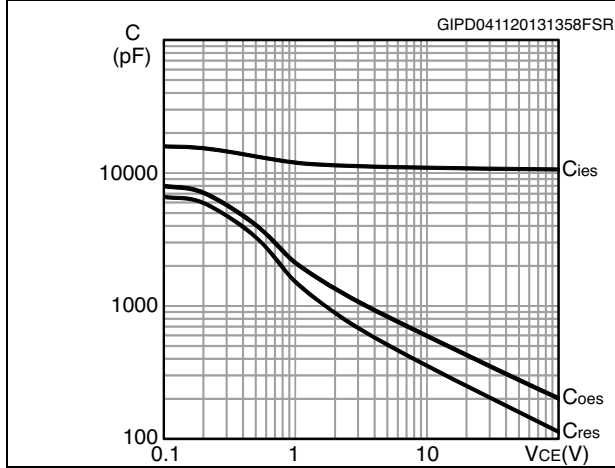


Figure 15. Gate charge vs. gate-emitter voltage

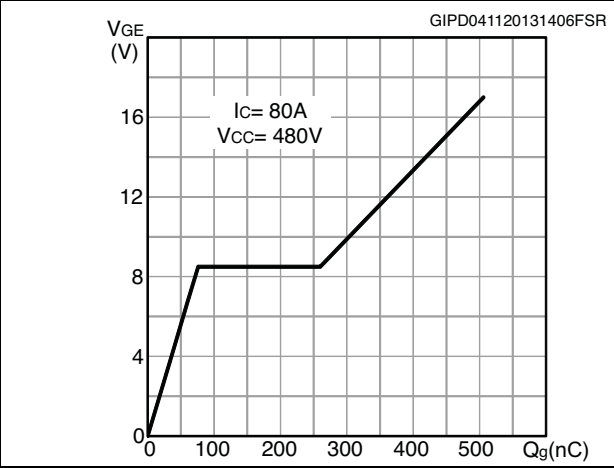


Figure 16. Switching loss vs collector current

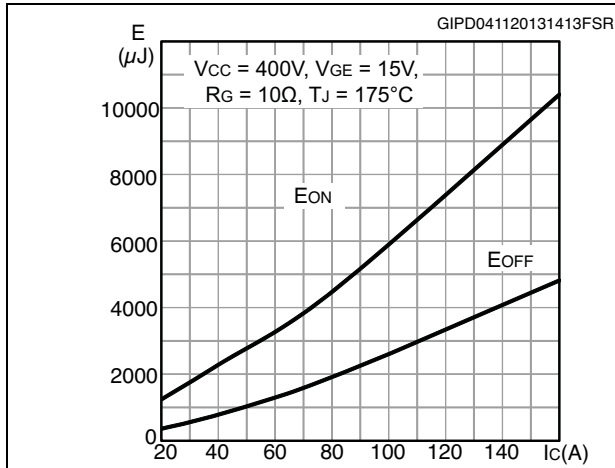


Figure 17. Switching loss vs gate resistance

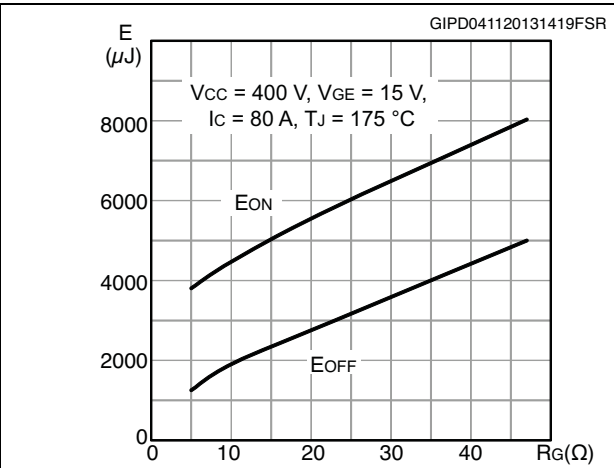


Figure 18. Switching loss vs temperature

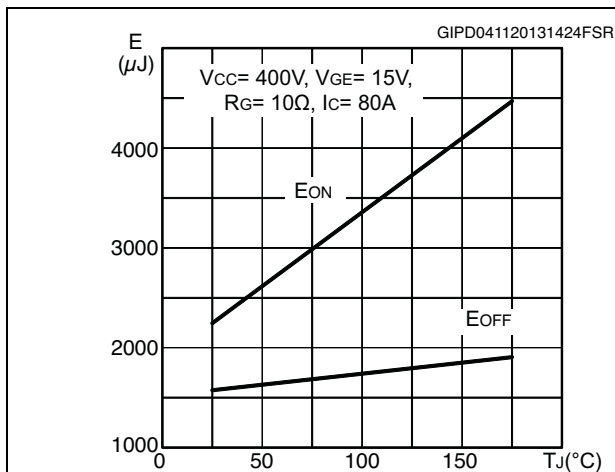
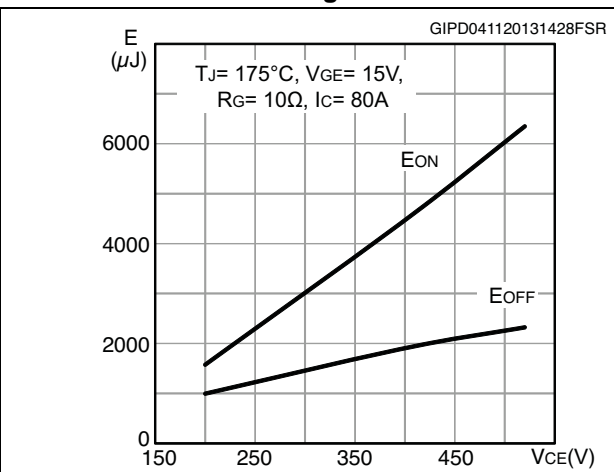


Figure 19. Switching loss vs collector-emitter voltage



Electrical characteristics

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

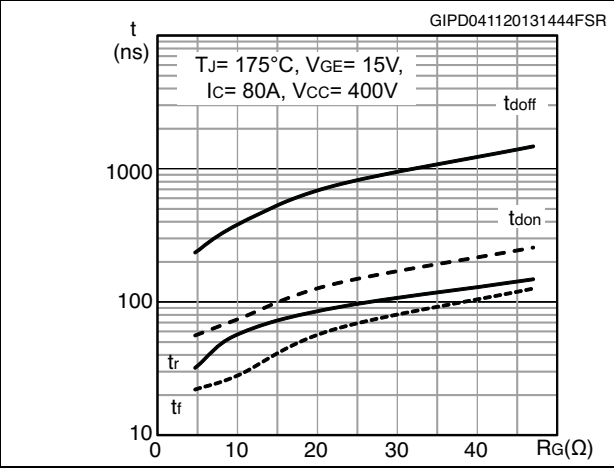
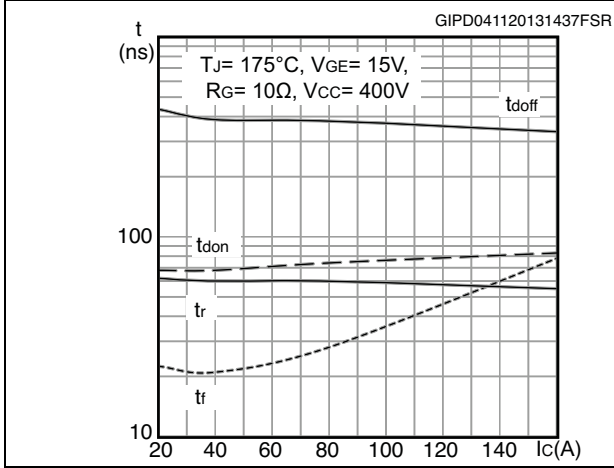


Figure 22. Reverse recovery current vs. diode current slope

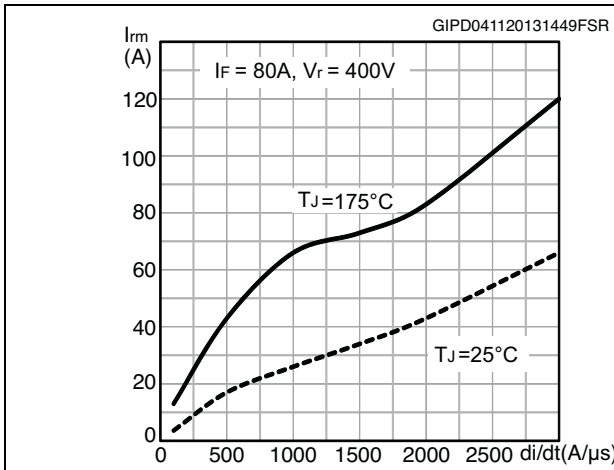


Figure 23. Reverse recovery time vs. diode current slope

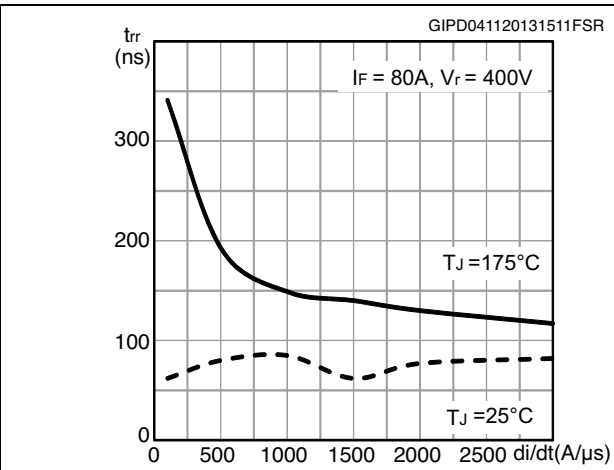


Figure 24. Reverse recovery charge vs. diode current slope

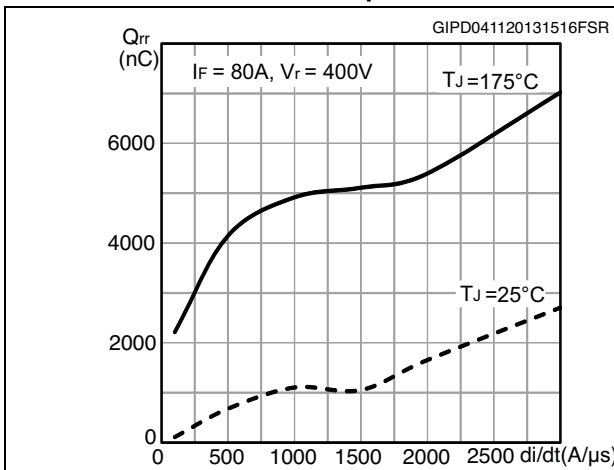
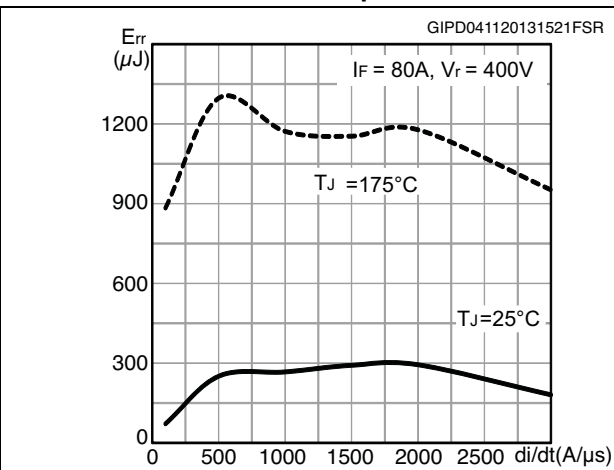


Figure 25. Reverse recovery energy vs. diode current slope



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Electrical characteristics

Figure 26. Thermal impedance for IGBT

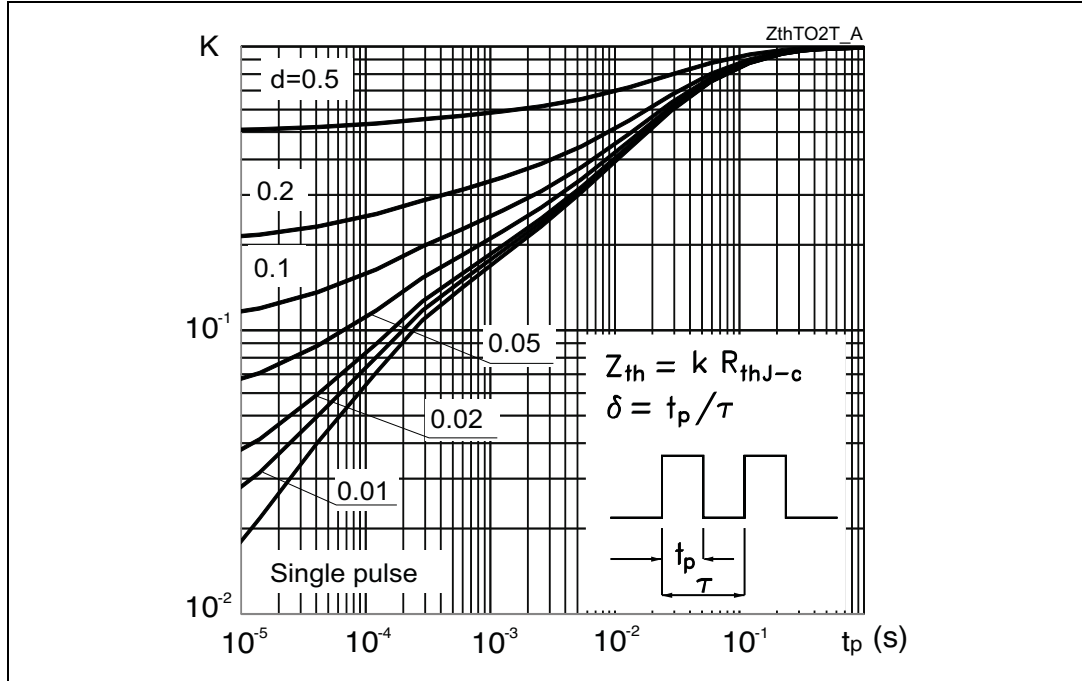
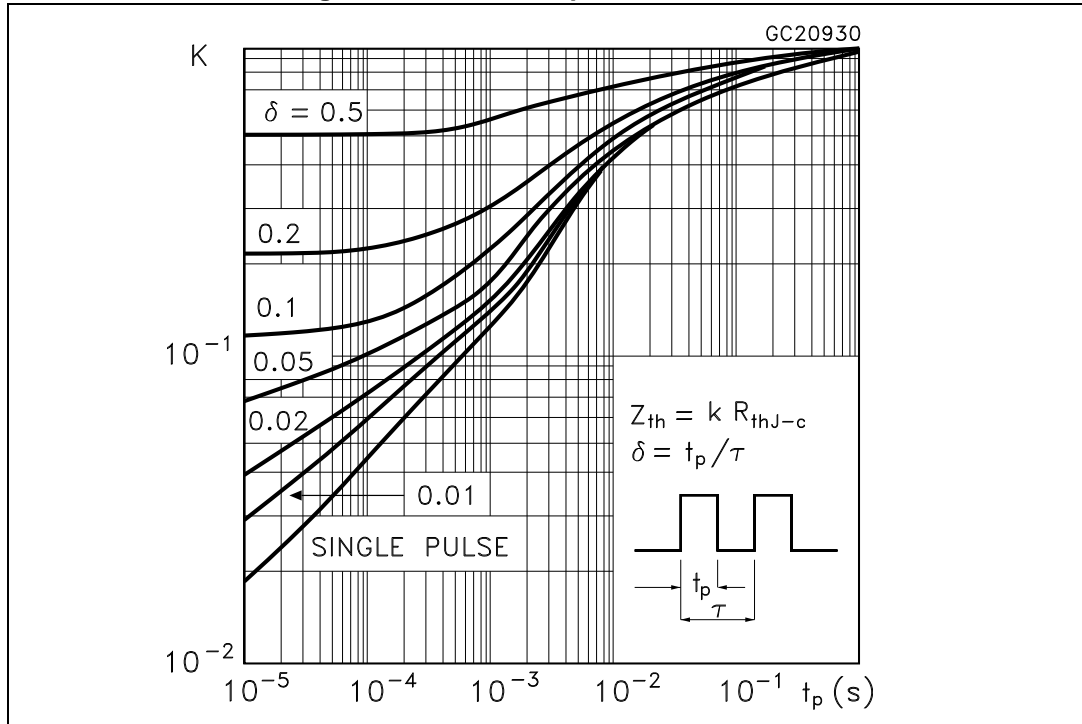


Figure 27. Thermal impedance for diode



Test circuits

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3 Test circuits

Figure 28. Test circuit for inductive load switching

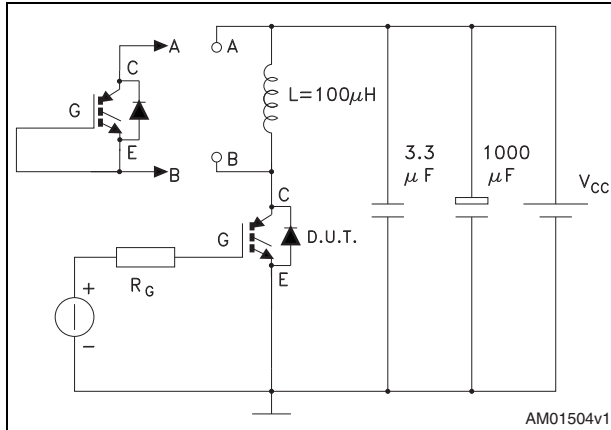


Figure 29. Gate charge test circuit

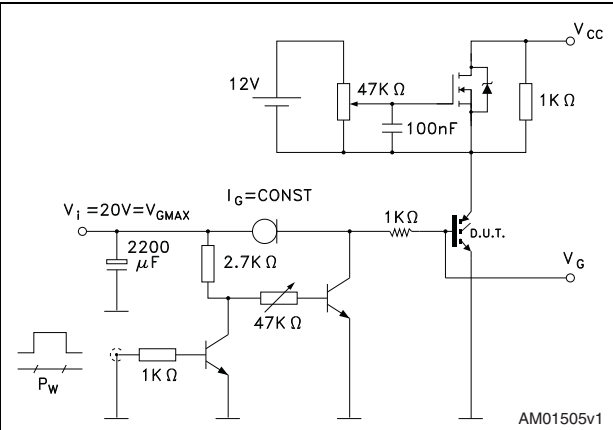


Figure 30. Switching waveform

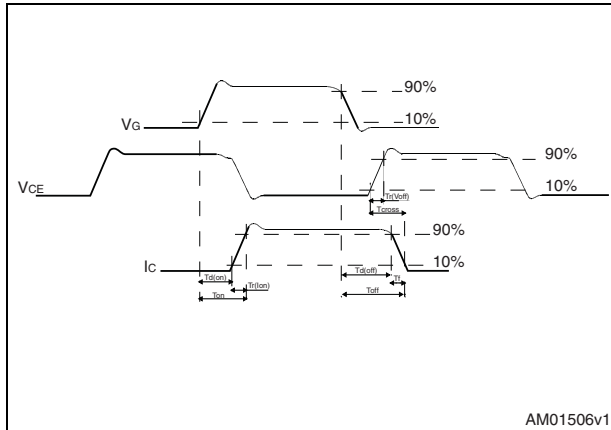
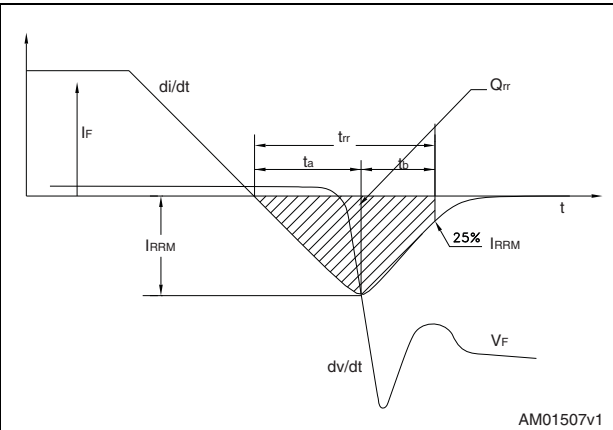


Figure 31. Diode recovery time waveform



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Package mechanical data

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. ECOPACK is an ST trademark.

Figure 32. TO-247 drawing

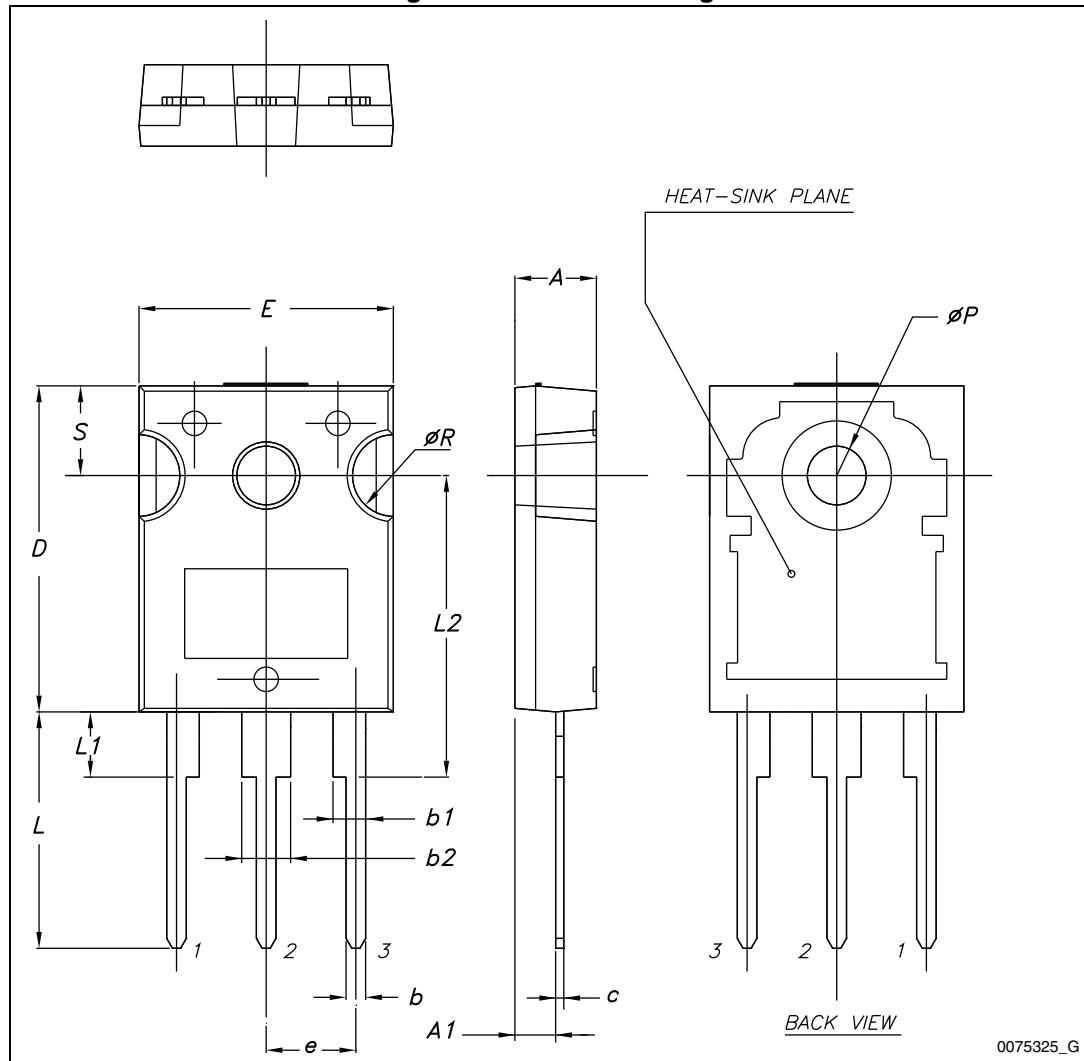


Table 8. TO-247 mechanical data

Dim.	mm.		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40

Package mechanical data

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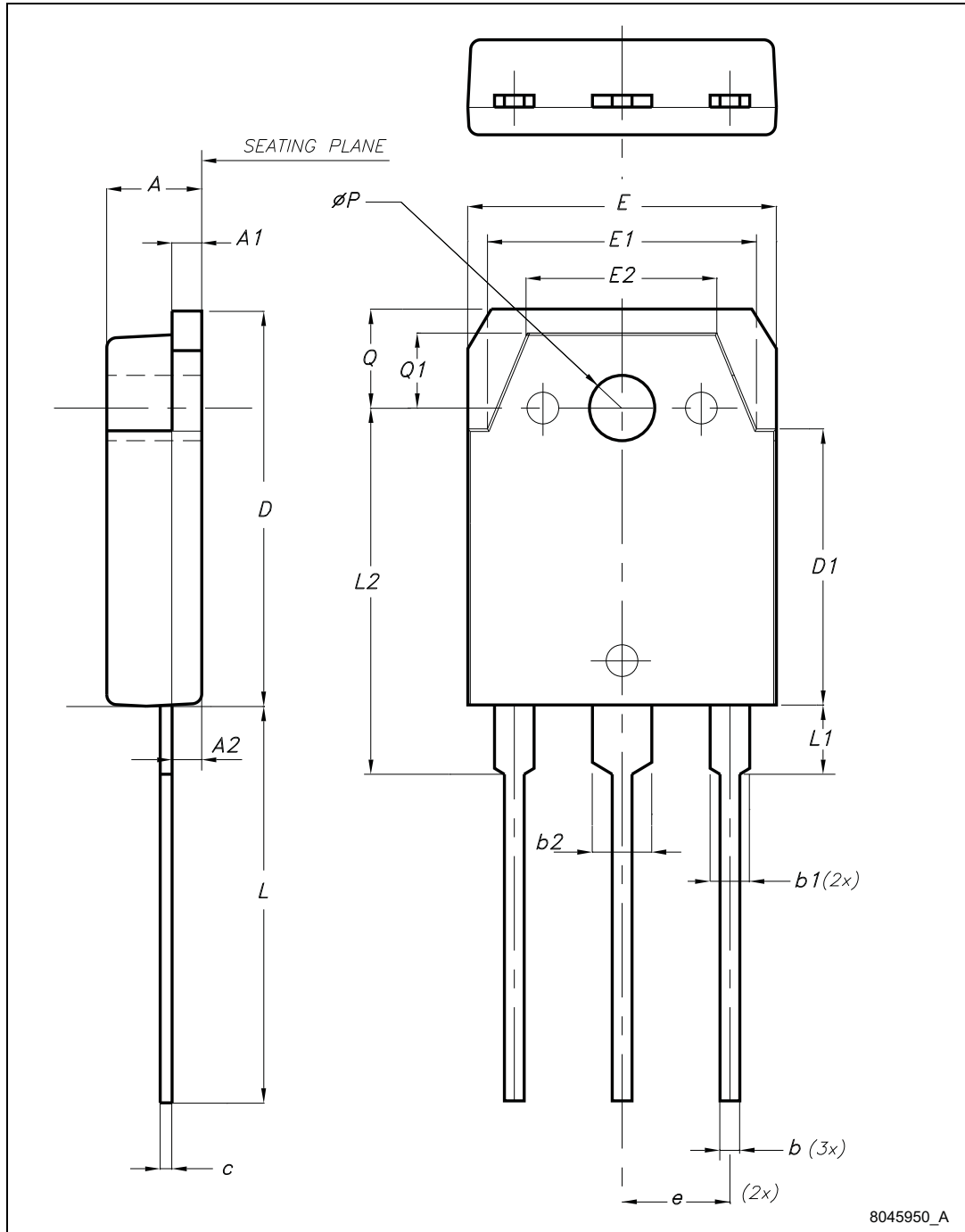
Table 8. TO-247 mechanical data

Dim.	mm.		
	Min.	Typ.	Max.
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

STGW80V60DF, STGWT80V60DF

Package mechanical data

Figure 33. TO-3P drawing



Package mechanical data

STGW80V60DF, STGWT80V60DF

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
12-Mar-2013	1	Initial release.
10-Jan-2014	2	Updated title, features and description in cover page. Document status promoted from preliminary to production data. Updated Table 4: Static characteristics , Table 5: Dynamic characteristics , Table 6: IGBT switching characteristics (inductive load) and Table 7: Diode switching characteristics (inductive load) . Inserted Section 2.1: Electrical characteristics (curves) .

STGW80V60DF, STGWT80V60DF

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