

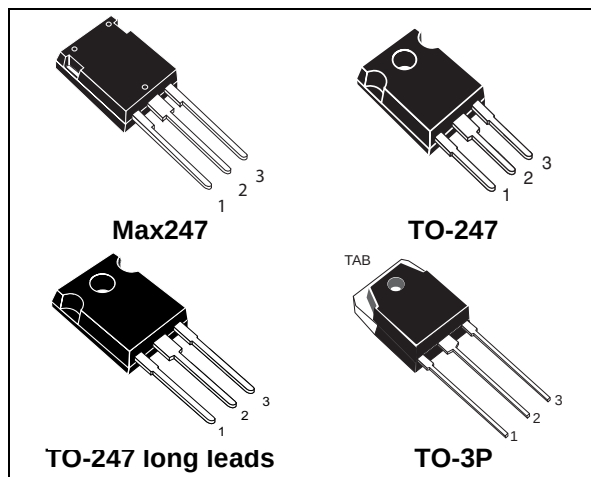
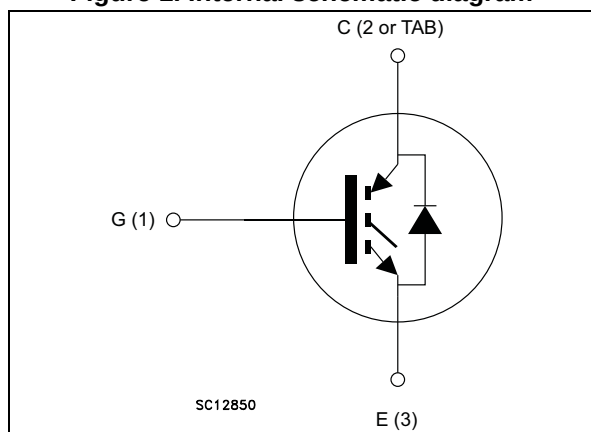


Figure 1. Internal schematic diagram



Features

- Maximum junction temperature: $T_J = 175\text{ }^{\circ}\text{C}$
- High speed switching series
- Minimized tail current
- $V_{CE(sat)} = 1.6\text{ V (typ.) @ } I_C = 80\text{ A}$
- Tight parameter distribution
- Safe paralleling
- Low thermal resistance
- Very fast soft recovery antiparallel diode

Applications

- Photovoltaic inverters
- High frequency converters

Description

This device is an IGBT developed using an advanced proprietary trench gate and 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	Packing
STGY80H65DFB	GY80H65DFB	Max247	Tube
STGW80H65DFB	GW80H65DFB	TO-247	Tube
STGWA80H65DFB	GW80H65DFB	TO-247 long leads	Tube
STGWT80H65DFB	GWT80H65DFB	TO-3P	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{GE} = 0$)	650	V
I_C	Continuous collector current at $T_C = 25\text{ °C}$	120 ⁽¹⁾	A
	Continuous collector current at $T_C = 100\text{ °C}$	80	
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
	Continuous forward current at $T_C = 100\text{ °C}$	80	
I_{FP} ⁽²⁾	Pulsed forward current	240	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	

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	
R_{thJA}	Thermal resistance junction-ambient	50	

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 ($V_{GE} = 0$)	$I_C = 2\text{ mA}$	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 80\text{ A}$		1.6	2	V
		$V_{GE} = 15\text{ V}$, $I_C = 80\text{ A}$ $T_J = 125\text{ °C}$		1.8		
		$V_{GE} = 15\text{ V}$, $I_C = 80\text{ A}$ $T_J = 175\text{ °C}$		1.9		
V_F	Forward on-voltage	$I_F = 80\text{ A}$		1.9	2.3	V
		$I_F = 80\text{ A}$ $T_J = 125\text{ °C}$		1.6		
		$I_F = 80\text{ A}$ $T_J = 175\text{ °C}$		1.5		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 1\text{ mA}$	5	6	7	V
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE} = 650\text{ V}$			100	μA
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	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0$	-	10524	-	pF
C_{oes}	Output capacitance		-	385	-	
C_{res}	Reverse transfer capacitance		-	215	-	
Q_g	Total gate charge	$V_{CC} = 520\text{ V}$, $I_C = 80\text{ A}$, $V_{GE} = 15\text{ V}$, see Figure 29	-	414	-	nC
Q_{ge}	Gate-emitter charge		-	78	-	
Q_{gc}	Gate-collector charge		-	170	-	

Table 6. IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$, $I_C = 80\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, see Figure 28	-	84	-	ns
t_r	Current rise time		-	52	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1270	-	A/ μ s
$t_{d(off)}$	Turn-off delay time		-	280	-	ns
t_f	Current fall time		-	31	-	ns
$E_{on}^{(1)}$	Turn-on switching losses		-	2.1	-	mJ
$E_{off}^{(2)}$	Turn-off switching losses		-	1.5	-	mJ
E_{ts}	Total switching losses		-	3.6	-	mJ
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$, $I_C = 80\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 175\text{ }^\circ\text{C}$, see Figure 28	-	77	-	ns
t_r	Current rise time		-	51	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1270	-	A/ μ s
$t_{d(off)}$	Turn-off delay time		-	328	-	ns
t_f	Current fall time		-	30	-	ns
$E_{on}^{(1)}$	Turn-on switching losses		-	4.4	-	mJ
$E_{off}^{(2)}$	Turn-off switching losses		-	2.1	-	mJ
E_{ts}	Total switching losses		-	6.5	-	mJ

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

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	-	85	-	ns
Q_{rr}	Reverse recovery charge		-	1105	-	nC
I_{rrm}	Reverse recovery current		-	26	-	A
dl_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	722	-	A/ μ s
E_{rr}	Reverse recovery energy		-	267	-	μ J
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	-	149	-	ns
Q_{rr}	Reverse recovery charge		-	4920	-	nC
I_{rrm}	Reverse recovery current		-	66	-	A
dl_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	546	-	A/ μ s
E_{rr}	Reverse recovery energy		-	1172	-	μ J

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics ($T_J = 25^\circ\text{C}$)

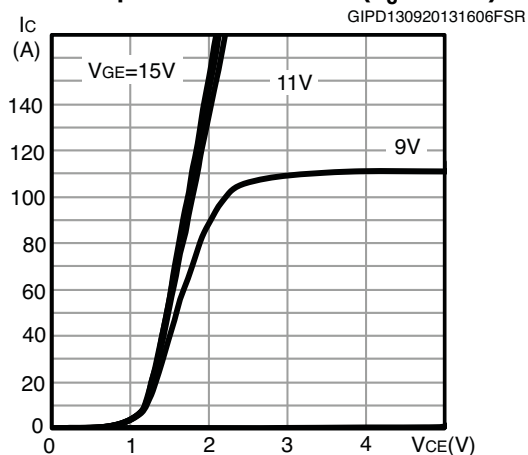


Figure 3. Output characteristics ($T_J = 175^\circ\text{C}$)

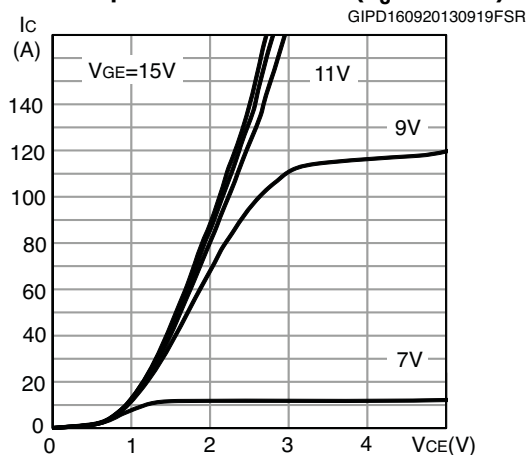


Figure 4. Transfer characteristics

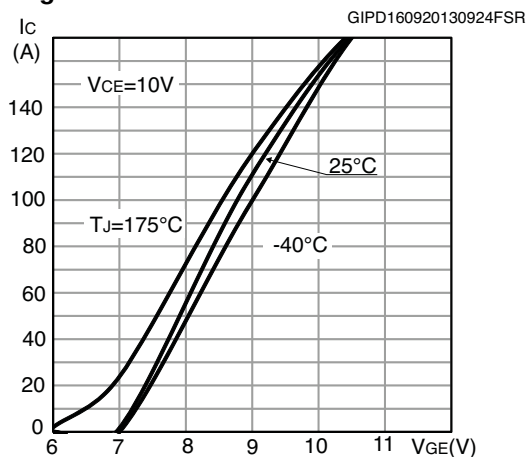


Figure 5. Collector current vs. case temperature

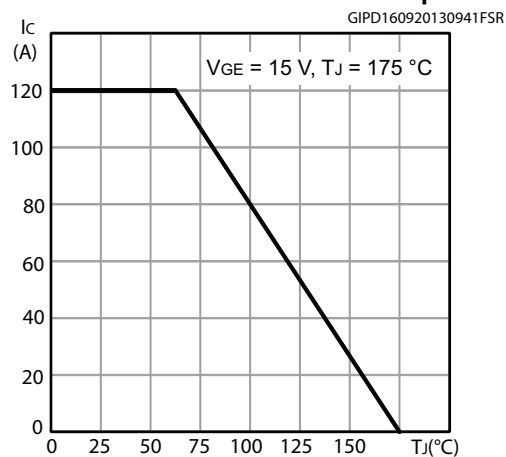


Figure 6. Power dissipation vs. case temperature

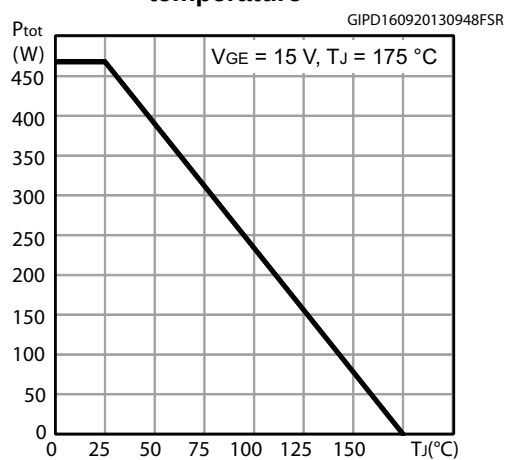


Figure 7. $V_{CE(sat)}$ vs. junction temperature

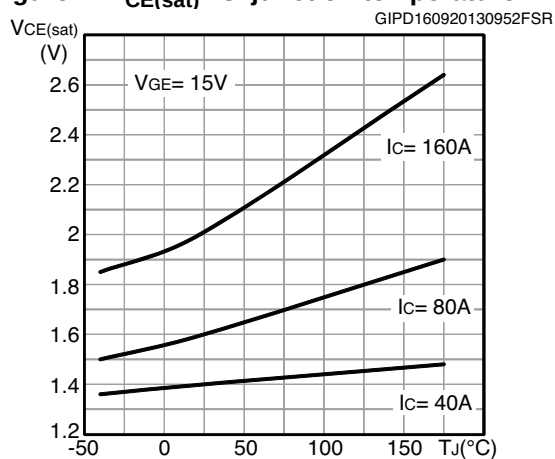


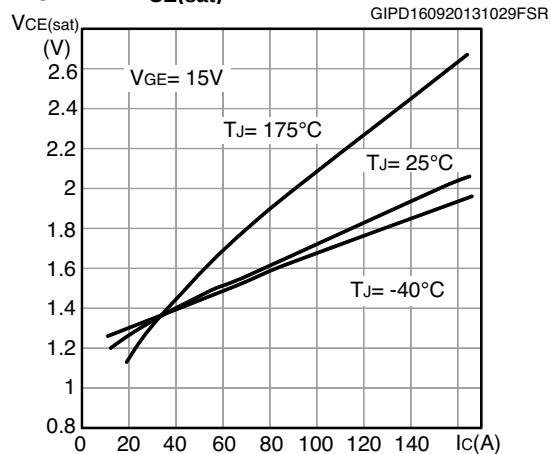
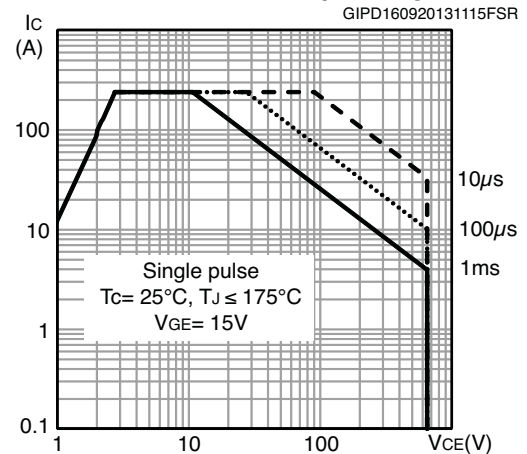
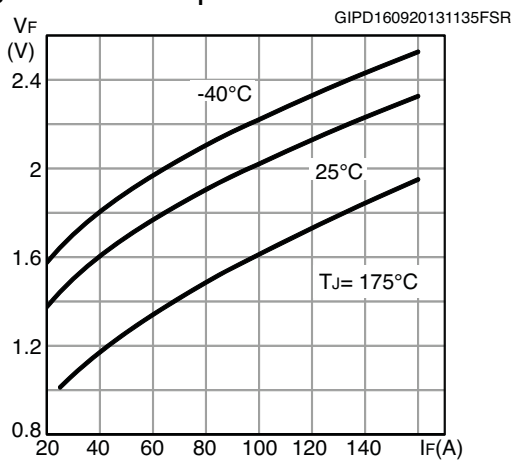
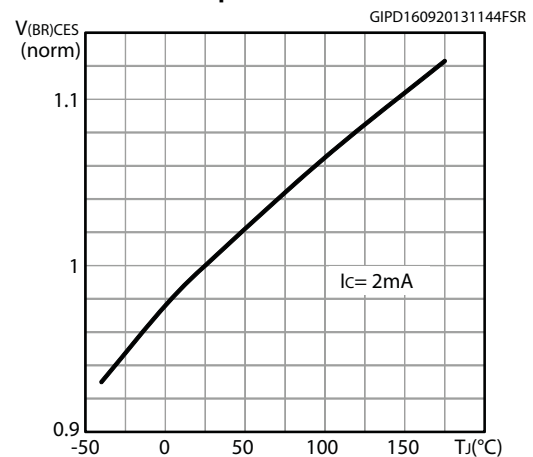
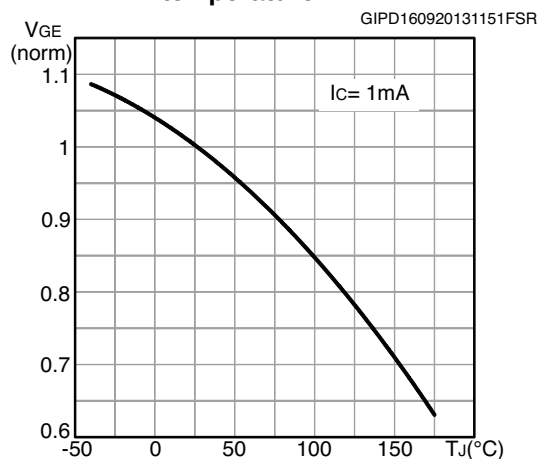
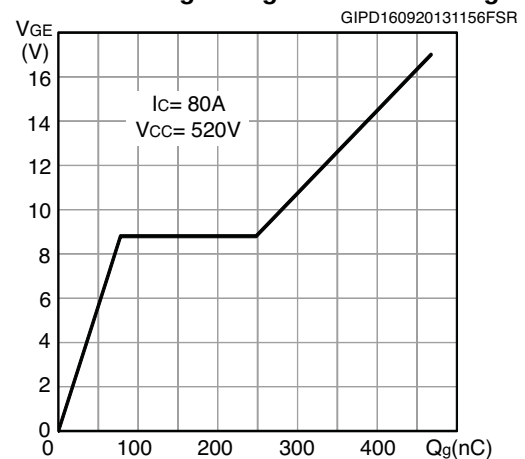
Figure 8. $V_{CE(sat)}$ vs. collector current

Figure 9. Forward bias safe operating area

Figure 10. Diode V_F vs. forward current

Figure 11. Normalized $V_{(BR)CES}$ vs. junction temperature

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

Figure 13. Gate charge vs. gate-emitter voltage


Figure 14. Switching loss vs. temperature

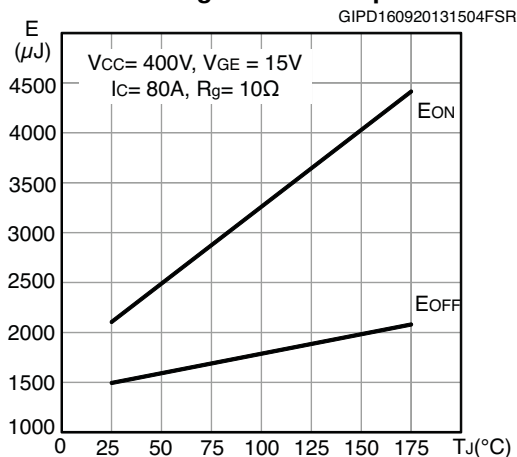


Figure 15. Switching loss vs. gate resistance

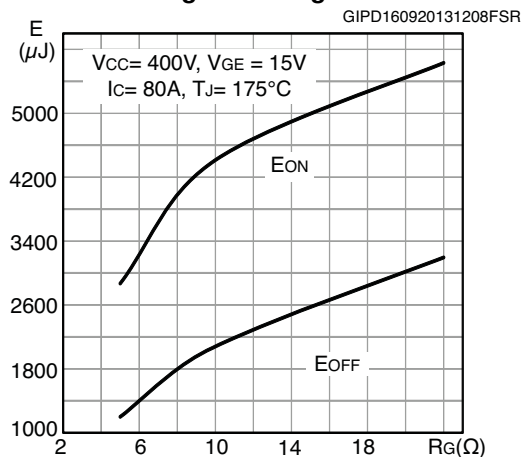


Figure 16. Switching loss vs. collector current

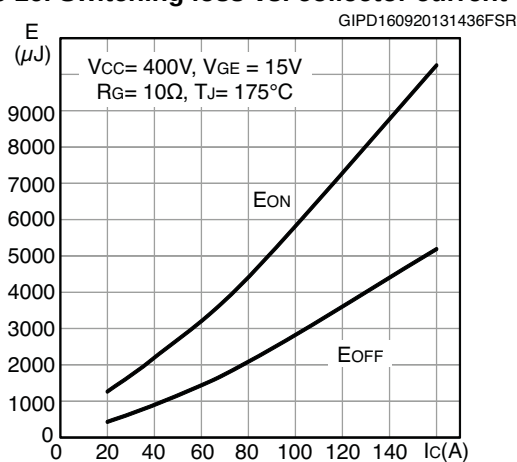


Figure 17. Switching loss vs. collector emitter voltage

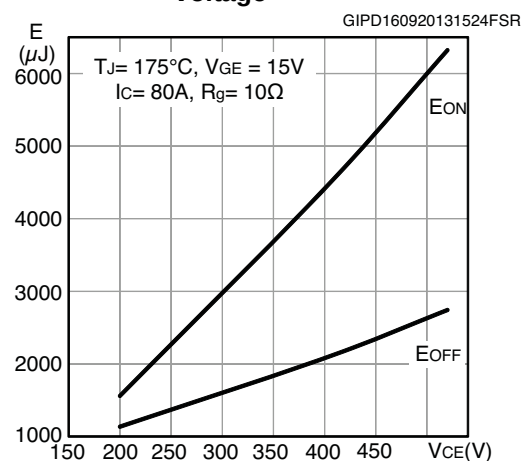


Figure 18. Switching times vs. collector current

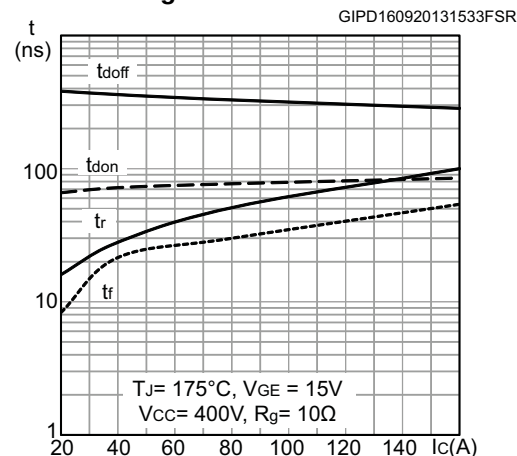


Figure 19. Switching times vs. gate resistance

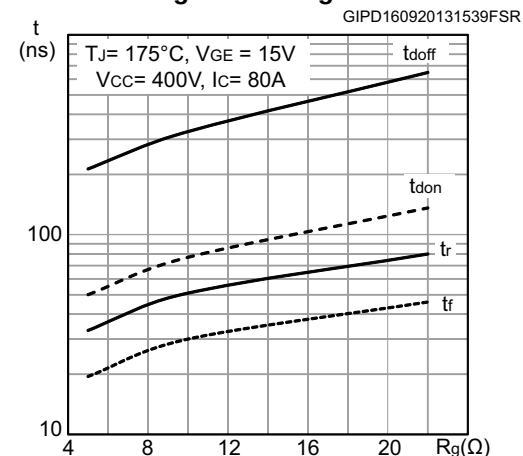


Figure 20. Reverse recovery current vs. diode current slope

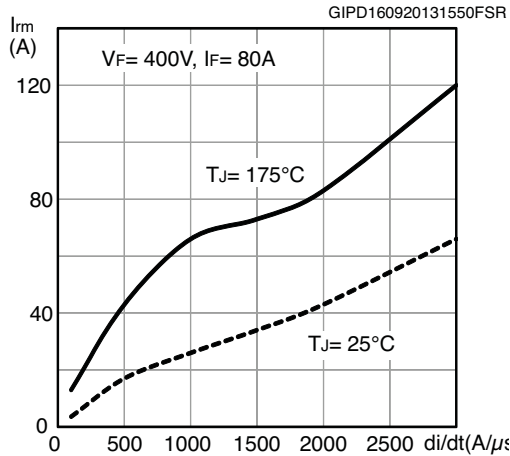


Figure 21. Reverse recovery time vs. diode current slope

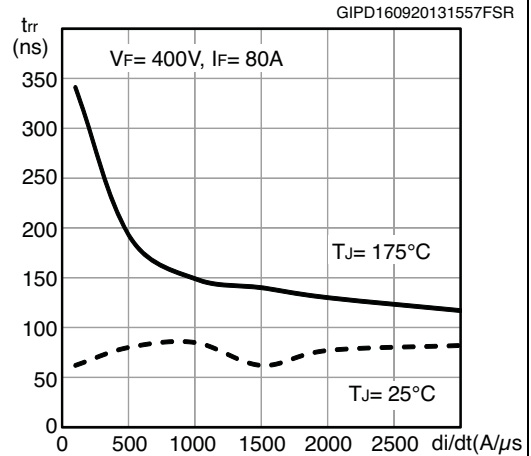


Figure 22. Reverse recovery charge vs. diode current slope

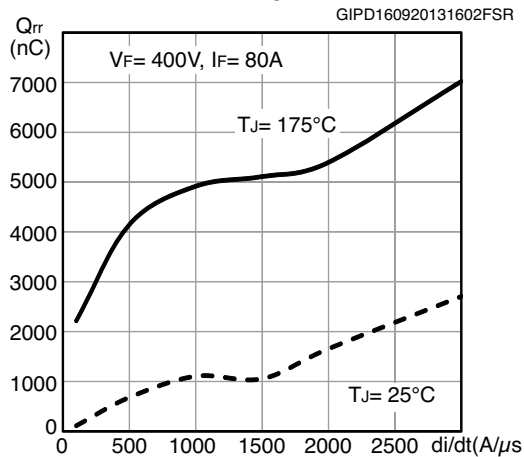


Figure 23. Reverse recovery energy vs. diode current slope

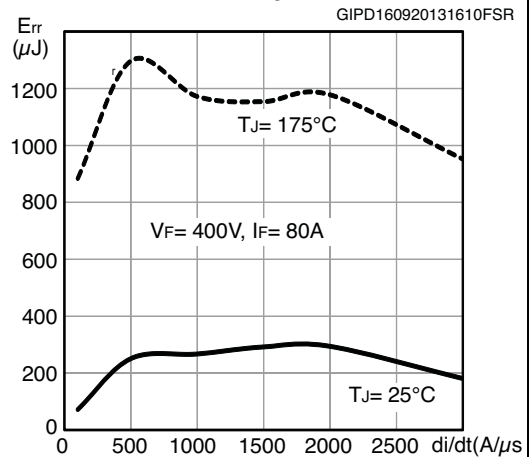


Figure 24. Capacitance variations

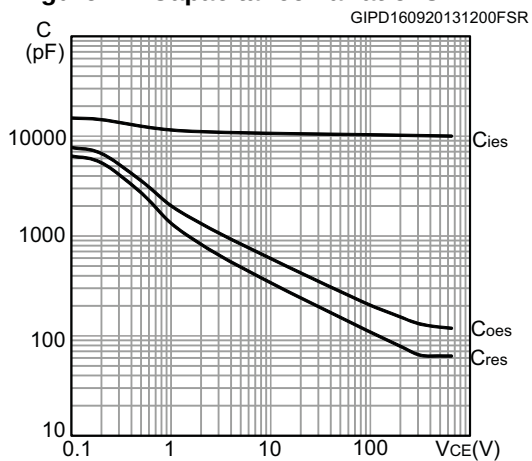


Figure 25. Collector current vs. switching frequency

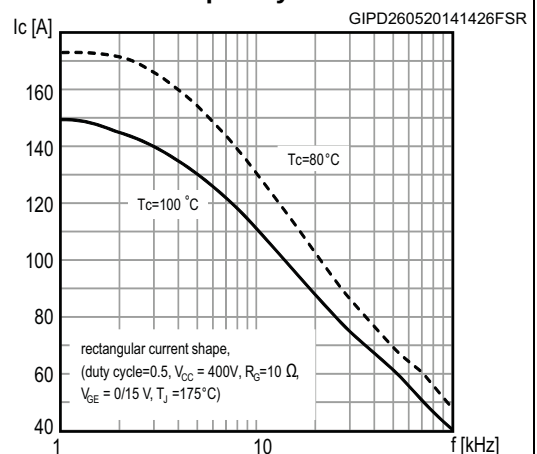


Figure 26. Thermal impedance for IGBT

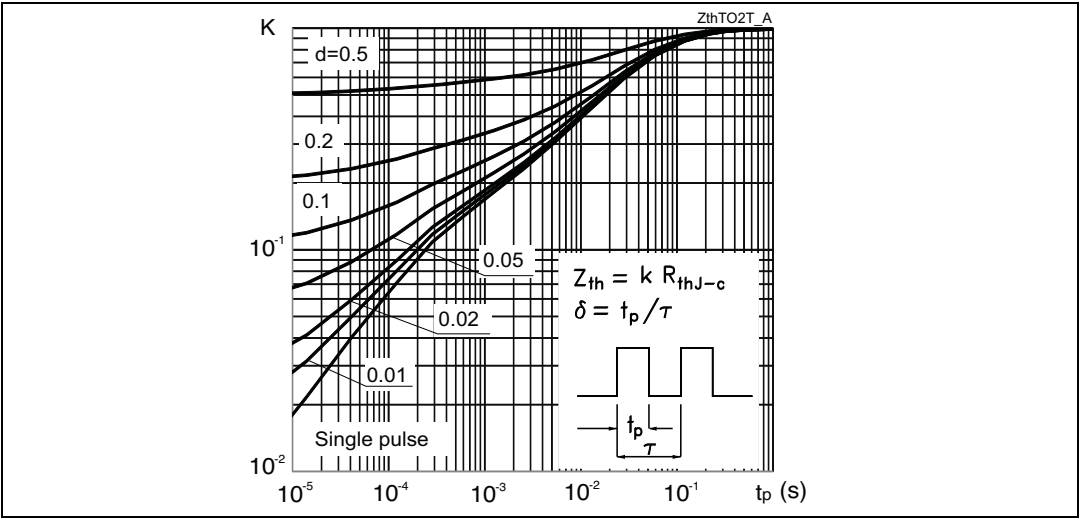
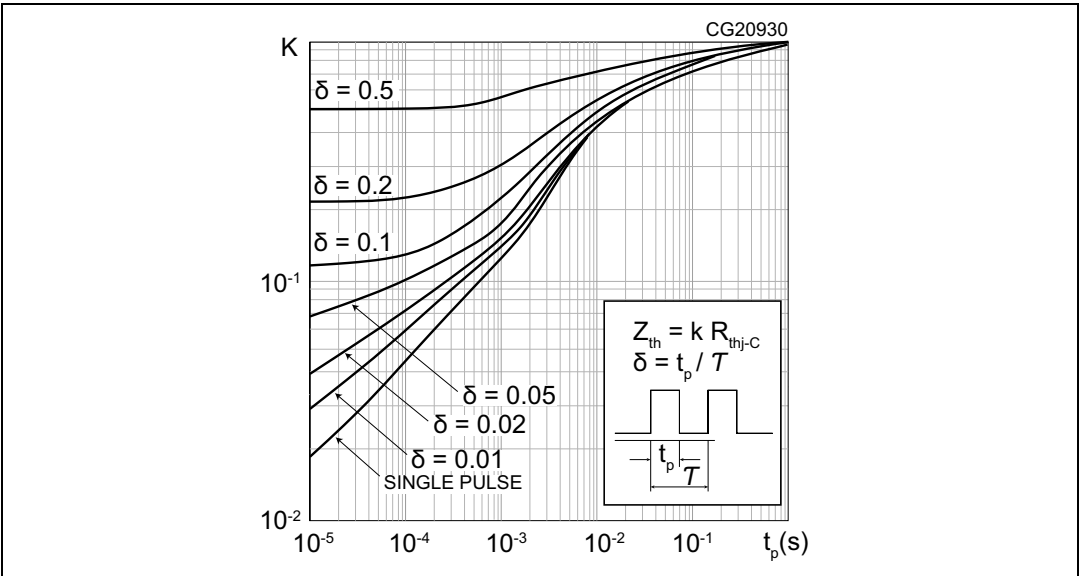


Figure 27. thermal impedance for diode



3 Test circuits

Figure 28. Test circuit for inductive load switching

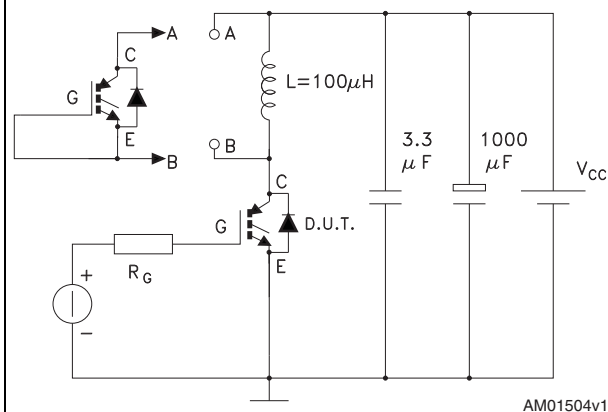


Figure 29. Gate charge test circuit

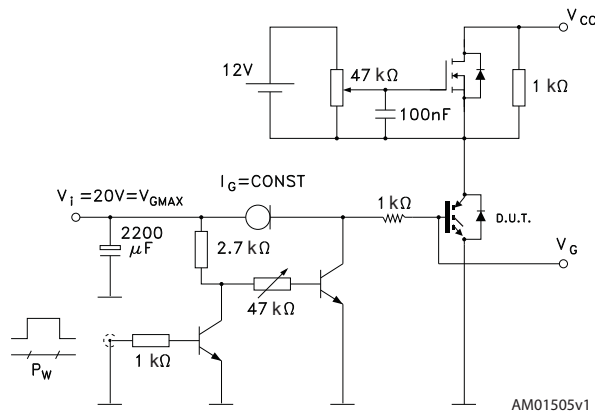


Figure 30. Switching waveform

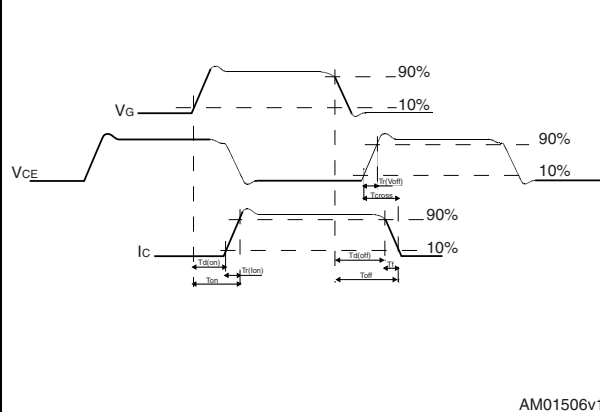
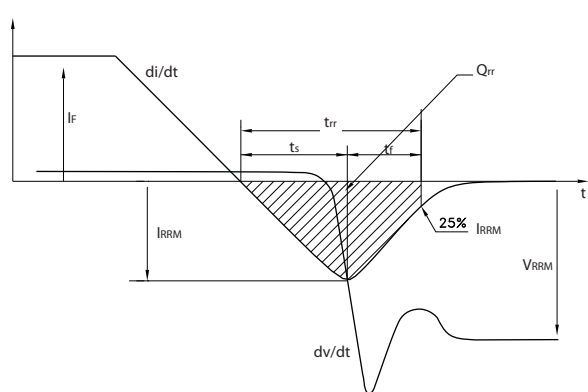


Figure 31. Diode reverse recovery waveform



4 Package information

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.

4.1 Max247 package information

Figure 32. Max247 package outline

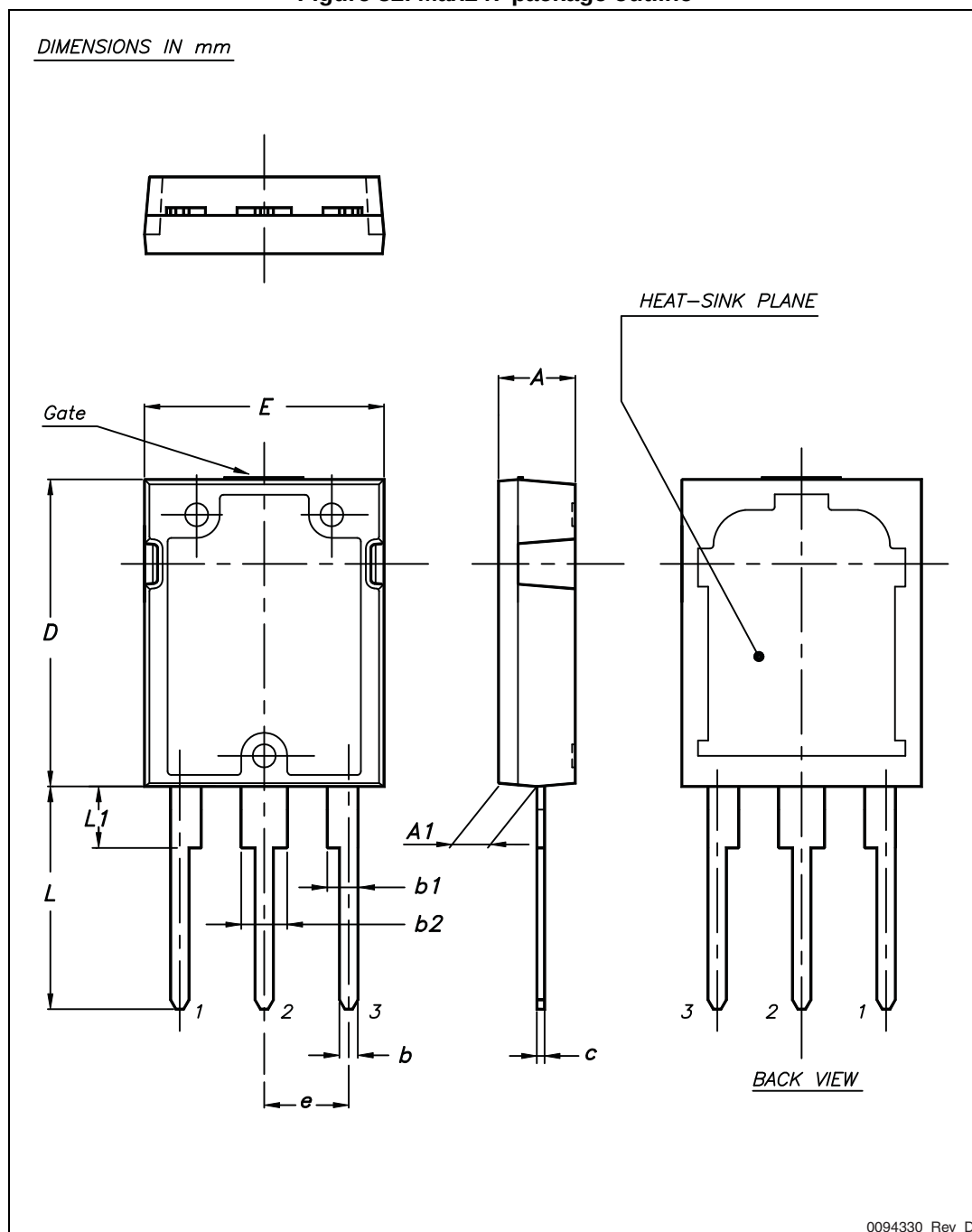


Table 8. Max247 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.70		5.30
A1	2.20		2.60
b	1.00		1.40
b1	2.00		2.40
b2	3.00		3.40
c	0.40		0.80
D	19.70		20.30
e	5.35		5.55
E	15.30		15.90
L	14.20		15.20
L1	3.70		4.30

4.2 TO-247 package information

Figure 33. TO-247 package outline

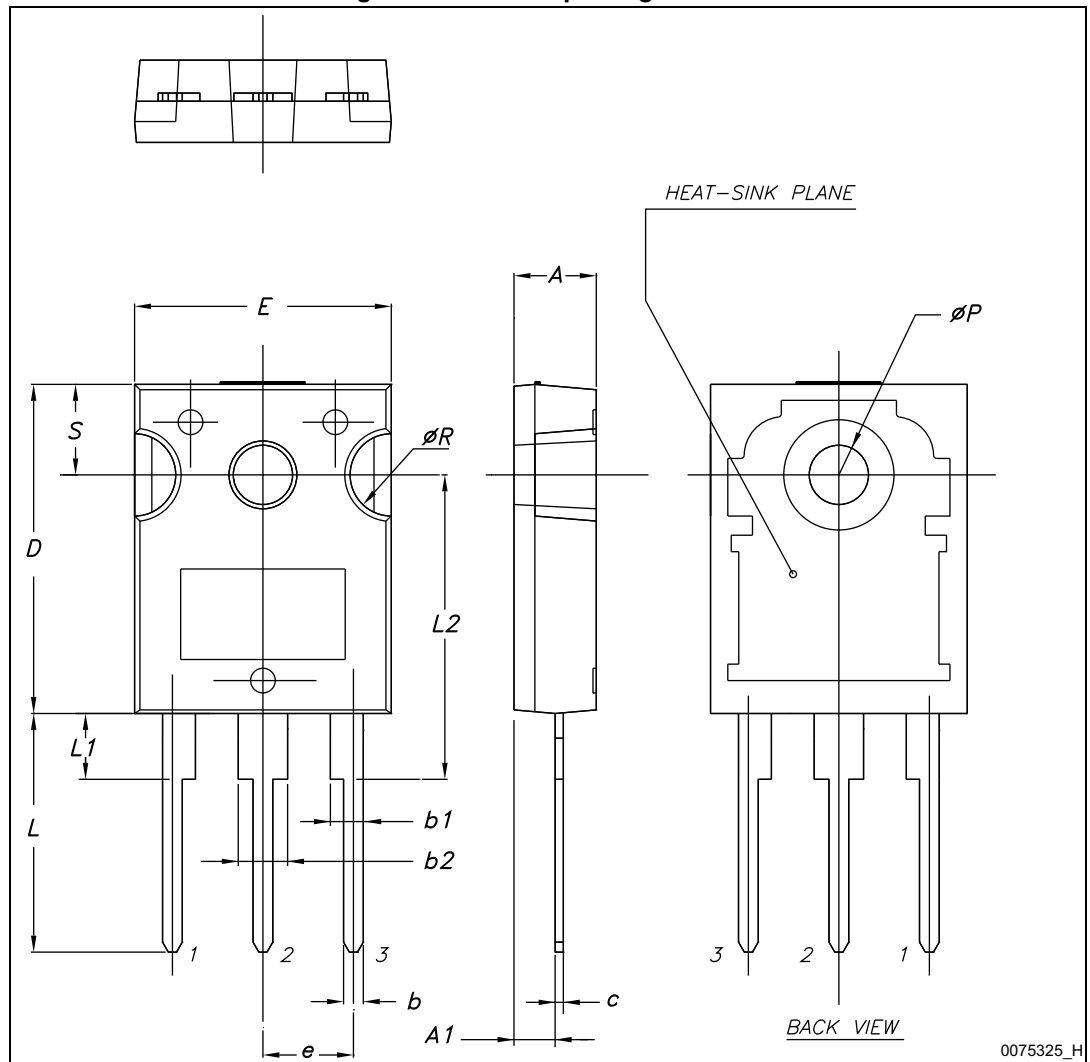


Table 9. TO-247 package mechanical data

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

4.3 TO-247 long leads package information

Figure 34. TO-247 long leads package outline

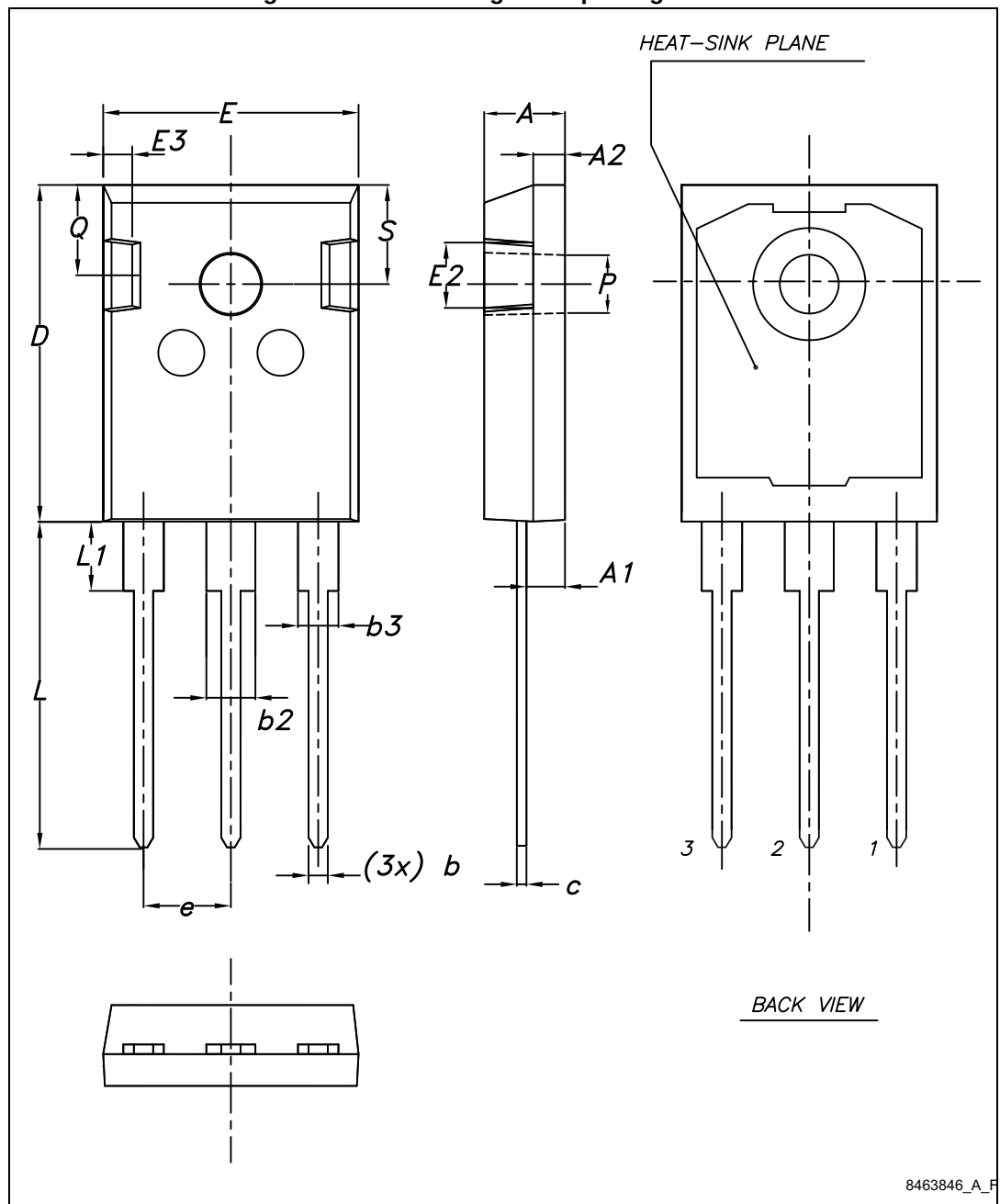


Table 10. TO-247 long leads package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
b	1.16		1.26
b2			3.25
b3			2.25
c	0.59		0.66
D	20.90	21.00	21.10
E	15.70	15.80	15.90
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	5.34	5.44	5.54
L	19.80	19.92	20.10
L1			4.30
P	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25

4.4 TO-3P package information

Figure 35. TO-3P package outline

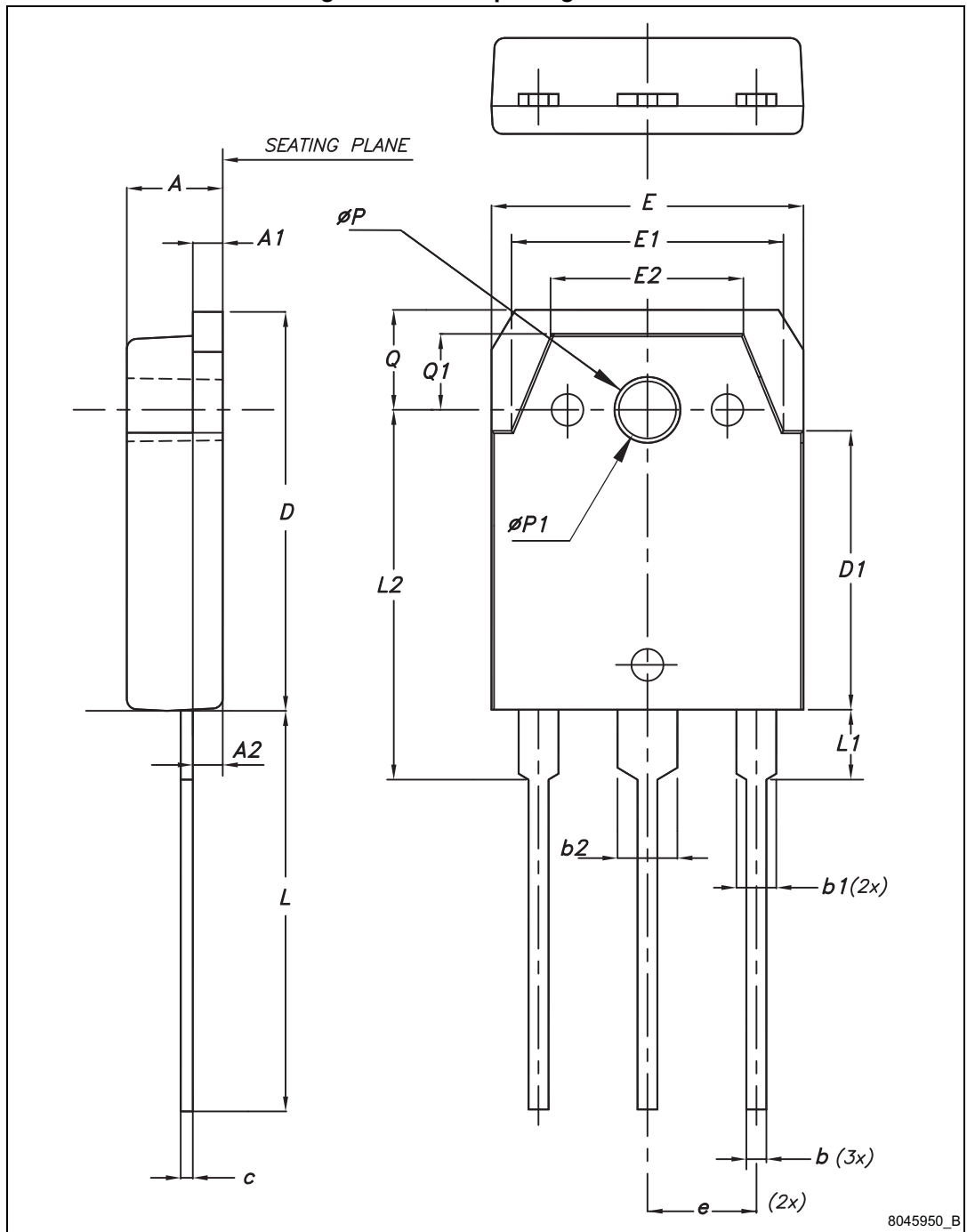


Table 11. TO-3P package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.60	4.80	5
A1	1.45	1.50	1.65
A2	1.20	1.40	1.60
b	0.80	1.00	1.20
b1	1.80	2.00	2.20
b2	2.80	3.00	3.20
c	0.55	0.60	0.75
D	19.70	19.90	20.10
D1	13.70	13.90	14.10
E	15.40	15.60	15.80
E1	13.40	13.60	13.80
E2	9.40	9.60	9.90
e	5.15	5.45	5.75
L	19.80	20	20.20
L1	3.30	3.50	3.70
L2	18.20	18.40	18.60
øP	3.30	3.40	3.50
øP1	3.10	3.20	3.30
Q	4.80	5	5.20
Q1	3.60	3.80	4

5 Revision history

Table 12. Document revision history

Date	Revision	Changes
12-Mar-2013	1	Initial release.
18-Sep-2013	2	Document status promoted from preliminary to production data. Added Section 2.1: Electrical characteristics (curves)
20-Nov-2013	3	Added device in Max247. Modified Table 1 accordingly. Updated Section 4: Package information . Minor text changes in cover page.
24-Jan-2014	4	Updated title and description in cover page. Updated Table 6: IGBT switching characteristics (inductive load) , Table 7: Diode switching characteristics (inductive load) , Figure 9: Forward bias safe operating area and Figure 14: Switching loss vs. temperature .
13-Jun-2014	5	Updated Figure 5: Collector current vs. case temperature , Figure 6: Power dissipation vs. case temperature , Figure 18: Switching times vs. collector current , Figure 19: Switching times vs. gate resistance and Figure 24: Capacitance variations . Added Figure 25: Collector current vs. switching frequency . Updated Section 4: Package information .
07-May-2015	6	Added TO-247 long leads package information

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