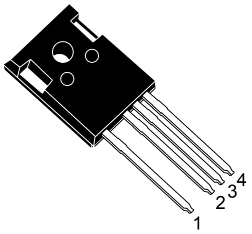
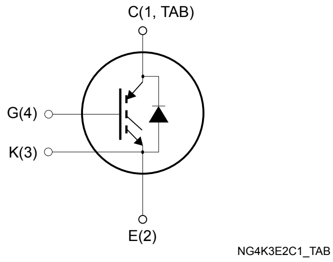
STGW80H65DFB-4

Datasheet

Trench gate field-stop 650 V, 80 A high speed HB series IGBT



TO247-4



Product status link
STGW80H65DFB-4

Product summary	
Order code	STGW80H65DFB-4
Marking	G80H65DFB
Package	TO-247-4
Packing	Tube

Features

- $V_{CE(sat)}$ = 1.6 V (typ.) @ I_C = 80 A
- Maximum junction temperature: T_J = 175 °C
- High speed switching series
- Minimized tail current
- Tight parameter distribution
- Safe paralleling
- Low thermal resistance
- Very fast soft recovery antiparallel diode
- Excellent switching performance thanks to the extra driving kelvin pin

Applications

- Photovoltaic inverters
- 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 new HB series of IGBTs, which represents an optimum compromise between conduction and switching loss to maximize the efficiency of any frequency converter. A faster switching event can be achieved by the Kelvin pin, which separates power path from driving signal. Furthermore, the slightly positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	650	V
I_C	Continuous collector current at T_C = 25 °C	120 (1)	A
	Continuous collector current at T_C = 100 °C	80	
I_{CP} (2)	Pulsed collector current (t_p ≤ 1 µs, T_J < 175 °C)	300	A
V_{GE}	Gate-emitter voltage	±20	V
	Transient gate-emitter voltage	±30	V
I_F	Continuous forward current at T_C = 25 °C	120 (1)	A
	Continuous forward current at T_C = 100 °C	80	
I_{FP} (2)	Pulsed forward current (t_p ≤ 1 µs, T_J < 175 °C)	300	A
P_{TOT}	Total power dissipation at T_C = 25 °C	470	W
T_{STG}	Storage temperature range	- 55 to 150	°C
T_J	Operating junction temperature range	- 55 to 175	

1. *Current level is limited by bond wires*
2. *Defined by design, not subject to production test.*

Table 2. 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_C = 25 °C unless otherwise specified

Table 3. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	V_{GE} = 0 V, I_C = 2 mA	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 80 A		1.6	2.0	V
		V_{GE} = 15 V, I_C = 80 A, T_J = 125 °C		1.8		
		V_{GE} = 15 V, I_C = 80 A, T_J = 175 °C		1.9		
V_F	Forward on-voltage	I_F = 80 A		2.15	2.8	V
		I_F = 80 A, T_J = 125 °C		1.8		
		I_F = 80 A, T_J = 175 °C		1.7		
$V_{GE(th)}$	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, V_{CE} = 650 V			100	µA
I_{GES}	Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = ±20 V			±250	nA

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE}= 25 V, f = 1 MHz, V_{GE} = 0 V	-	10.5	-	pF
C_{oes}	Output capacitance		-	0.38	-	
C_{res}	Reverse transfer capacitance		-	0.21	-	
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 80 A, V_{GE} = 0 to 15 V (see Figure 29. Gate charge test circuit)	-	414	-	nC
Q_{ge}	Gate-emitter charge		-	78	-	
Q_{gc}	Gate-collector charge		-	170	-	

Table 5. **IGBT switching characteristics (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 80 A, V_{GE} = 15 V, R_G = 10 Ω (see Figure 28. Test circuit for inductive load switching)		75	-	ns
t_r	Current rise time			35	-	
$(di/dt)_{on}$	Turn-on current slope			1750	-	A/μs
$t_{d(off)}$	Turn-off-delay time			336	-	ns
t_f	Current fall time			23	-	
E_{on} (1)	Turn-on switching energy			1	-	mJ
E_{off} (2)	Turn-off switching energy			1.7	-	
E_{ts}	Total switching energy			2.7	-	
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 80 A, V_{GE} = 15 V, R_G = 10 Ω, T_J = 175 °C (see Figure 28. Test circuit for inductive load switching)		66	-	ns
t_r	Current rise time			38	-	
$(di/dt)_{on}$	Turn-on current slope			1670	-	A/μs
$t_{d(off)}$	Turn-off-delay time			403	-	ns
t_f	Current fall time			45	-	
E_{on} (1)	Turn-on switching energy			1.5	-	mJ
E_{off} (2)	Turn-off switching energy			2.47	-	
E_{ts}	Total switching energy			3.97	-	

1. *Including the reverse recovery of the diode.*
2. *Including the tail of the collector current.*

Table 6. **Diode switching characteristics (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{rr}	Reverse recovery time	I_F = 80 A, V_R = 400 V, V_{GE} = 15 V di/dt = 1000 A/μs (see Figure 28. Test circuit for inductive load switching)	-	112	-	ns
Q_{rr}	Reverse recovery charge		-	955	-	nC
I_{rrm}	Reverse recovery current		-	27.2	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	1515	-	A/μs
E_{rr}	Reverse recovery energy		-	170	-	μJ
t_{rr}	Reverse recovery time	I_F = 80 A, V_R = 400 V, V_{GE} = 15 V, T_J = 175 °C di/dt = 1000 A/μs (see Figure 28. Test circuit for inductive load switching)	-	164	-	ns
Q_{rr}	Reverse recovery charge		-	3838	-	nC
I_{rrm}	Reverse recovery current		-	52	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	785	-	A/μs
E_{rr}	Reverse recovery energy		-	635	-	μJ

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs. case temperature

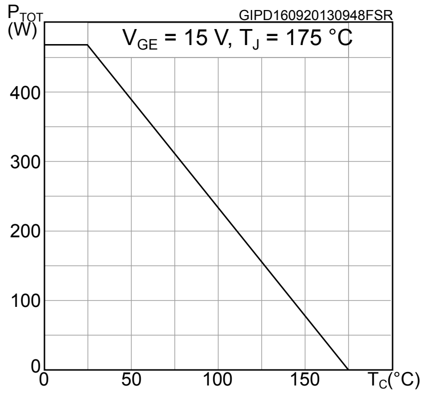


Figure 2. Collector current vs. case temperature

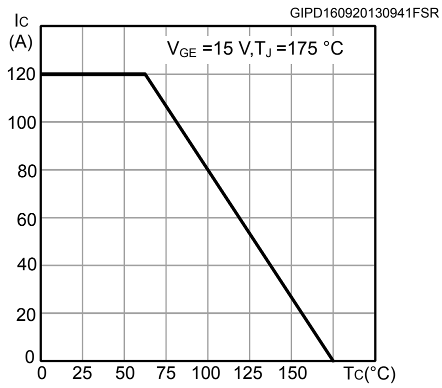


Figure 3. Output characteristics (T_J = 25 °C)

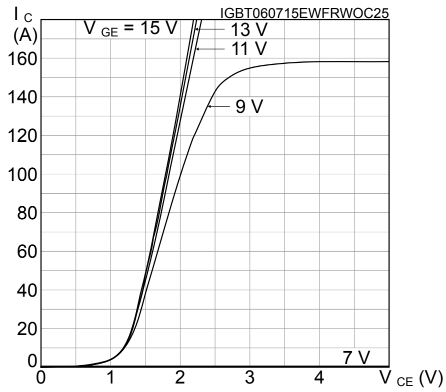


Figure 4. Output characteristics (T_J = 175 °C)

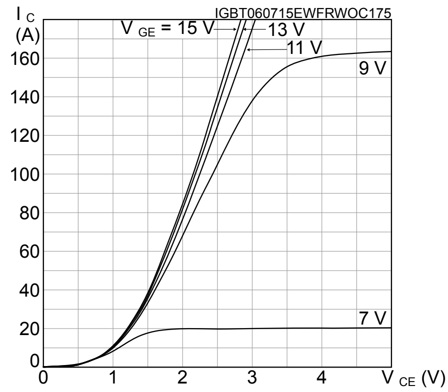


Figure 5. V_{CE}(sat) vs. junction temperature

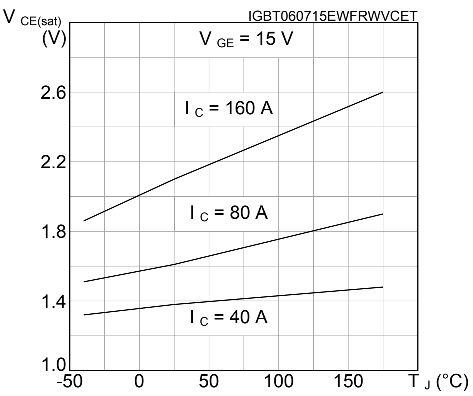


Figure 6. V_{CE}(sat) vs. collector current

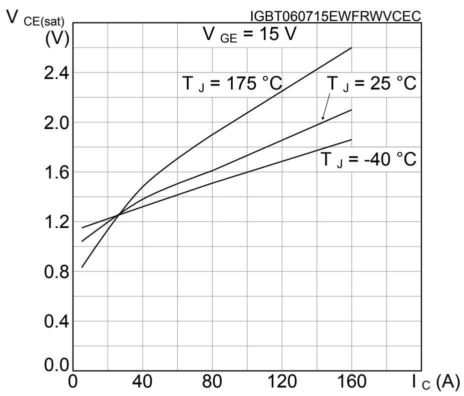


Figure 7. Collector current vs. switching frequency

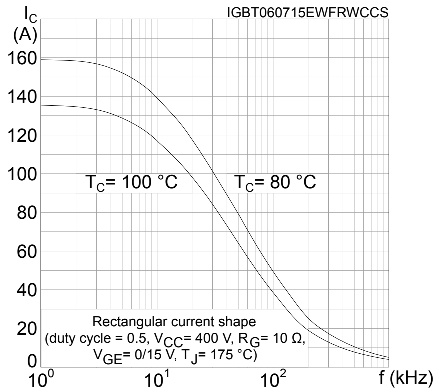


Figure 8. Forward bias safe operating area

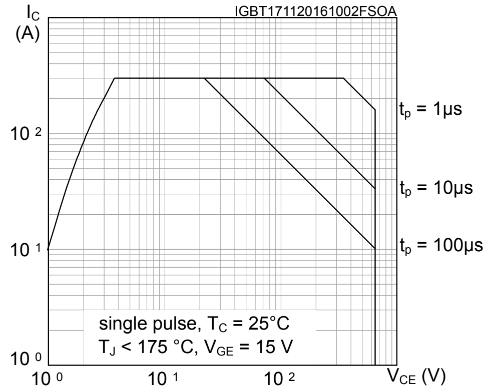


Figure 9. Transfer characteristics

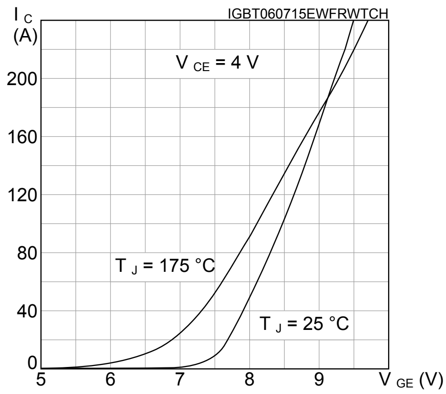


Figure 10. Diode V_F vs. forward current

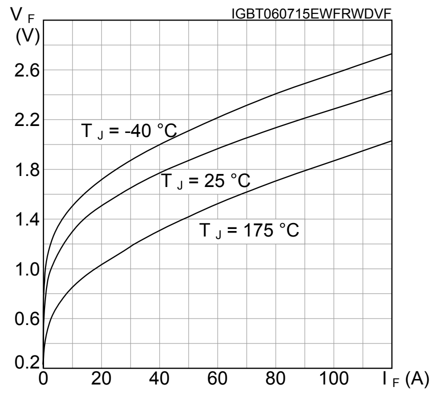


Figure 11. Normalized $V_{GE(th)}$ vs. junction temperature

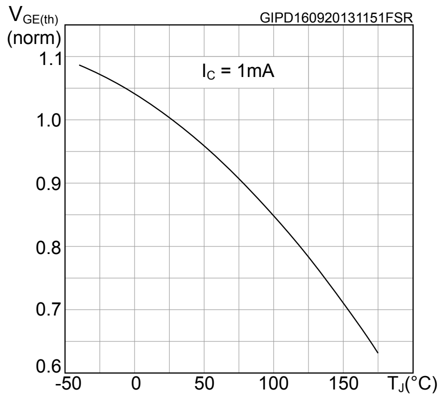


Figure 12. Normalized $V_{(BR)CES}$ vs. junction temperature

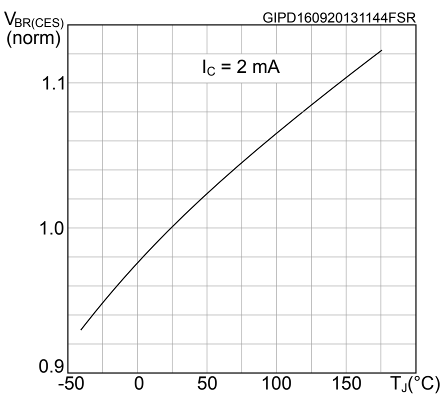


Figure 13. Capacitance variations

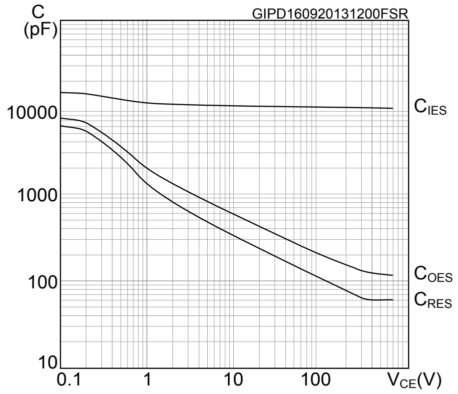


Figure 14. Gate charge vs. gate-emitter voltage

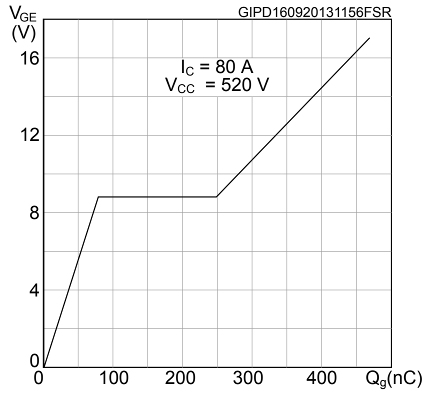


Figure 15. Switching energy vs. collector current

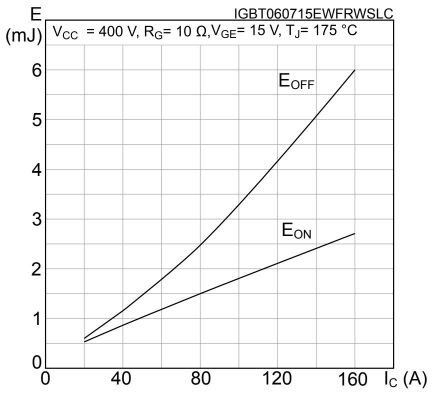


Figure 16. Switching energy vs. gate resistance

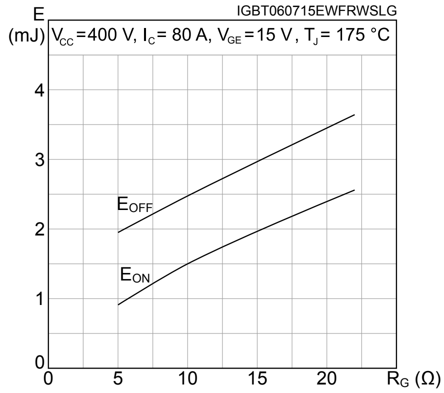


Figure 17. Switching energy vs. temperature

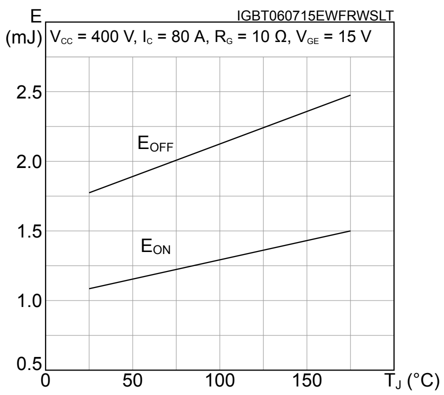


Figure 18. Switching energy vs. collector emitter voltage

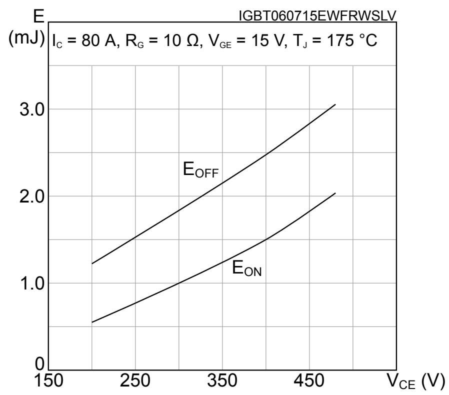


Figure 19. Switching times vs. collector current

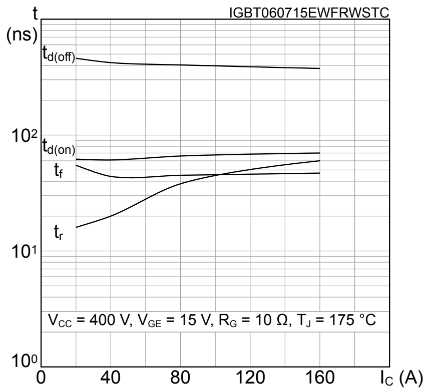


Figure 20. Switching times vs. gate resistance

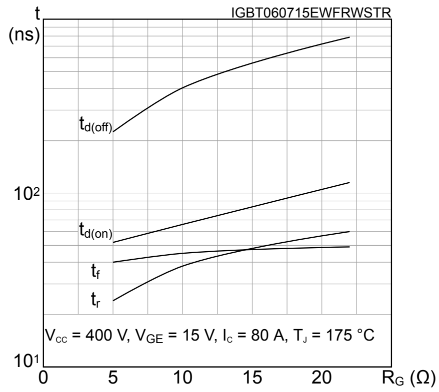


Figure 21. Reverse recovery current vs. diode current slope

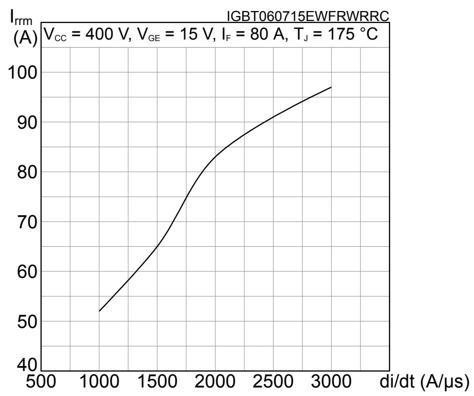


Figure 22. Reverse recovery time vs. diode current slope

Figure 23. Reverse recovery charge vs. diode current slope

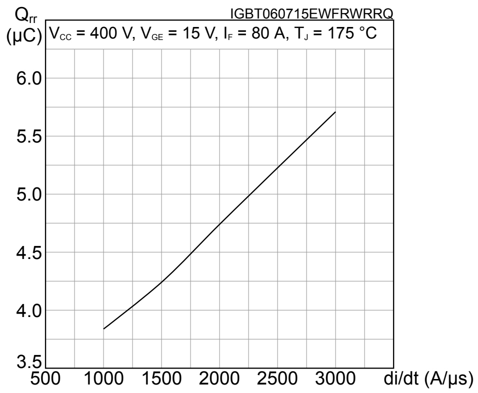


Figure 24. Reverse recovery energy vs. diode current slope

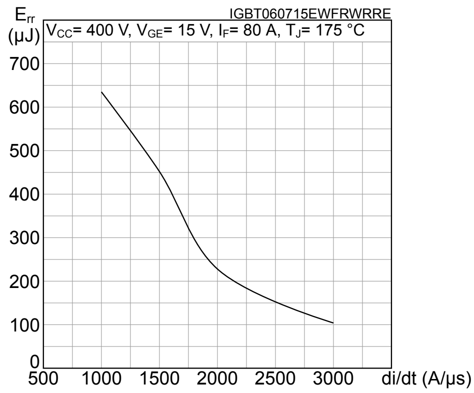


Figure 25. Thermal impedance for IGBT

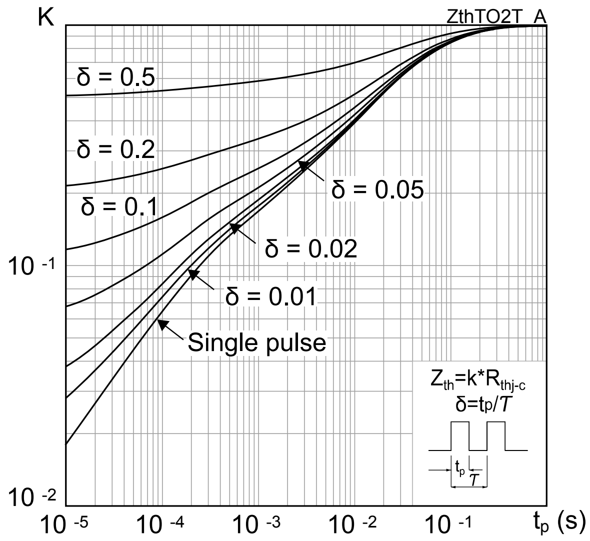
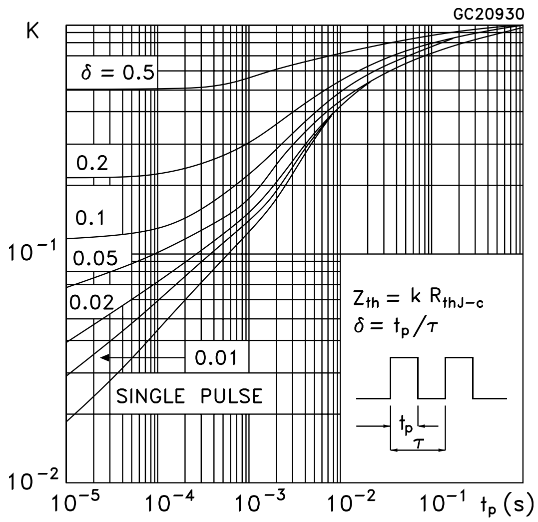


Figure 26. Thermal impedance for diode



3 Test circuits

Figure 27. Test circuit for inductive load switching

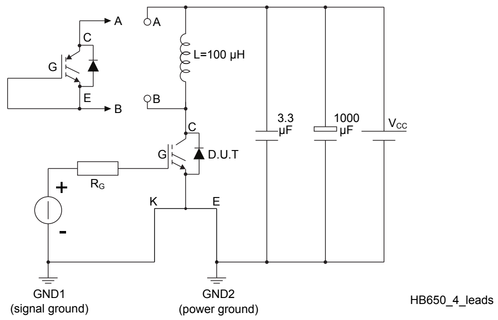


Figure 28. Gate charge test circuit

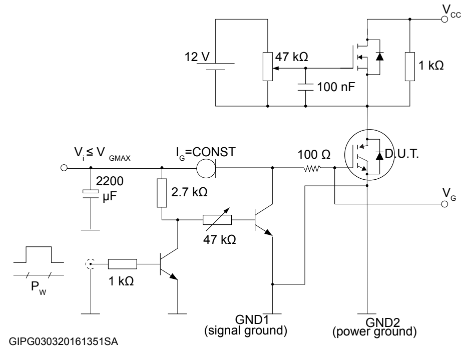


Figure 29. Switching waveform

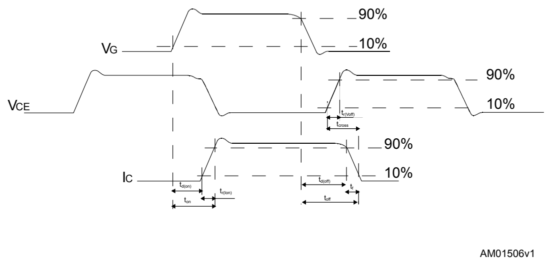
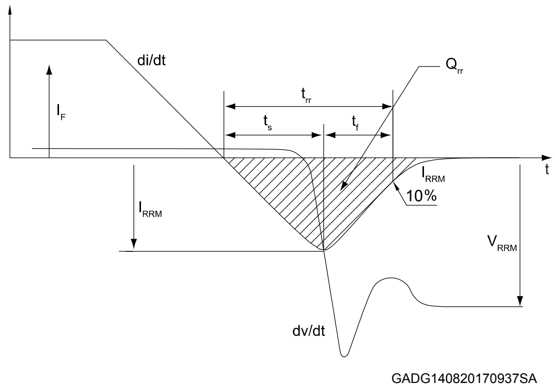


Figure 30. Diode reverse recovery waveform



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 TO247-4 package information

Figure 31. TO247-4 package outline

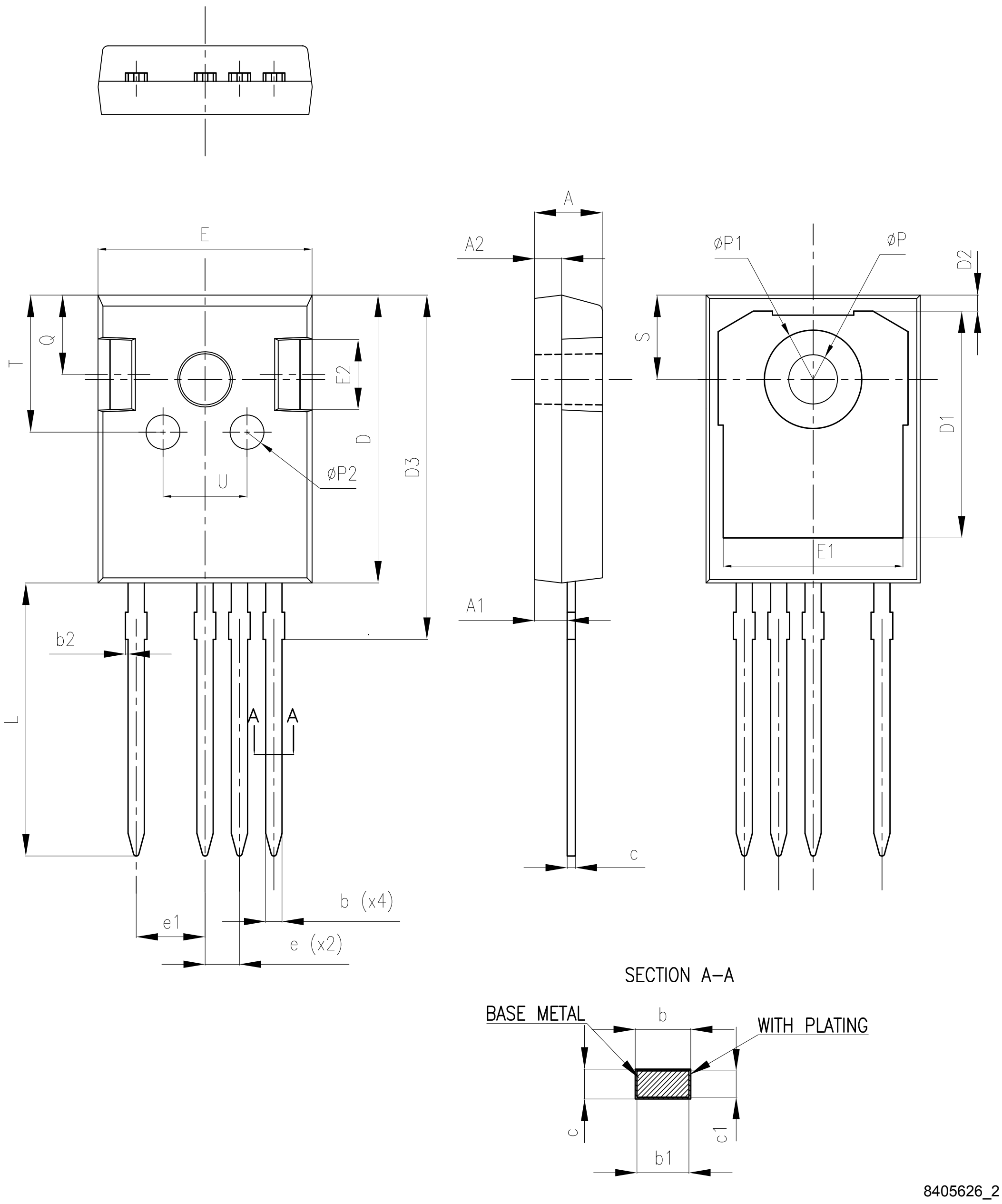


Table 7. TO247-4 mechanical data

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		1.29
b1	1.15	1.20	1.25
b2	0		0.20
c	0.59		0.66
c1	0.58	0.60	0.62
D	20.90	21.00	21.10
D1	16.25	16.55	16.85
D2	1.05	1.20	1.35
D3	24.97	25.12	25.27
E	15.70	15.80	15.90
E1	13.10	13.30	13.50
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	2.44	2.54	2.64
e1	4.98	5.08	5.18
L	19.80	19.92	20.10
P	3.50	3.60	3.70
P1			7.40
P2	2.40	2.50	2.60
Q	5.60		6.00
S		6.15	
T	9.80		10.20
U	6.00		6.40

Revision history

Table 8. **Document revision history**

Date	Revision	Changes
05-Aug-2015	1	First release.
17-Nov-2016	2	Updated features in cover page. Updated *Table 2: "Absolute maximum ratings"* and *Figure 9: "Forward bias safe operating area"*. Minor text changes.
03-Mar-2017	3	Updated the title in cover page, *Table 2: "Absolute maximum ratings"*,*Table 4: "Static characteristics"* and *Table 6: "IGBT switching characteristics (inductive load)"*. Minor text changes.
03-Jul-2019	4	Updated Table 1. Absolute maximum ratings. Minor text changes.

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