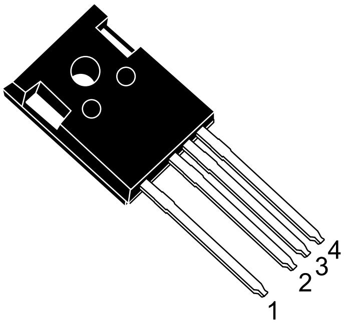
STGW40H65DFB-4

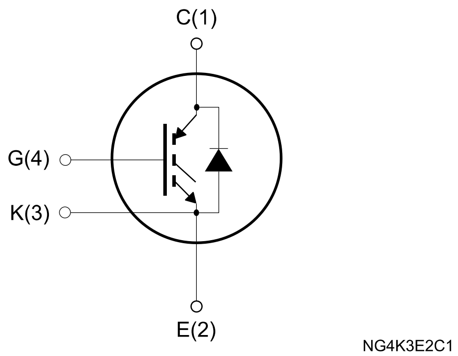
Trench gate field-stop IGBT, HB series 650 V, 40 A high speed in a TO247-4 package

Datasheet - production data



TO247-4

Figure 1: Internal schematic diagram



Features

- Maximum junction temperature: T_J = 175 °C
- Kelvin pin
- Minimized tail current
- Low saturation voltage: $V_{CE(sat)}$ = 1.6 V (typ.) @ I_C = 40 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 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.

Table 1: Device summary

Order code	Marking	Package	Packing
STGW40H65DFB-4	G40H65DFB	TO247-4	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 V)	650	V
I_C	Continuous collector current at T_C = 25 °C	80	A
I_C	Continuous collector current at T_C = 100 °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 °C	80	A
I_F	Continuous forward current at T_C = 100 °C	40	A
I_{FP}(1)	Pulsed forward current	160	A
P_{TOT}	Total dissipation at T_C = 25 °C	283	W
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range	-55 to 175	°C

Notes:

(1)Pulse width is 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	1.14	°C/W
R_{thJA}	Thermal resistance junction-ambient	50	°C/W

2 Electrical characteristics

T_C = 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 V, I_C = 2 mA	650			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		1.7	2.45	V
		I_F = 40 A, T_J = 125 °C		1.4		
		I_F = 40 A, T_J = 175 °C		1.3		
$V_{GE(th)}$	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			25	µA
I_{GES}	Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = ±20 V			±250	µA

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 V	-	5412	-	pF
C_{oes}	Output capacitance		-	198	-	
C_{res}	Reverse transfer capacitance		-	107	-	
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 40 A, V_{GE} = 0 to 15 V (see *Figure 29: " Gate charge test circuit"*)	-	210	-	nC
Q_{ge}	Gate-emitter charge		-	39	-	
Q_{gc}	Gate-collector charge		-	82	-	

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 V, I_C = 40 A, V_{GE} = 15 V, R_G = 5 Ω (see *Figure 28: " Test circuit for inductive load switching"*)	-	40	-	ns
t_r	Current rise time		-	13	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	2553	-	A/μs
$t_{d(off)}$	Turn-off-delay time		-	142	-	ns
t_f	Current fall time		-	26	-	ns
E_{on} (1)	Turn-on switching energy		-	200	-	μJ
E_{off} (2)	Turn-off switching energy		-	410	-	μJ
E_{ts}	Total switching energy		-	610	-	μJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 40 A, V_{GE} = 15 V, R_G = 5 Ω, T_J = 175 °C (see *Figure 28: " Test circuit for inductive load switching"*)	-	40	-	ns
t_r	Current rise time		-	14.8	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	2216	-	A/μs
$t_{d(off)}$	Turn-off-delay time		-	148	-	ns
t_f	Current fall time		-	61	-	ns
E_{on} (1)	Turn-on switching energy		-	472	-	μJ
E_{off} (2)	Turn-off switching energy		-	816	-	μJ
E_{ts}	Total switching energy		-	1288	-	μJ

Notes:

(1) Including the reverse recovery of the diode.

(2) Including 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 = 40 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 100 A/µs (see *Figure 28: " Test circuit for inductive load switching"*)	-	62	-	ns
Q_{rr}	Reverse recovery charge		-	99	-	nC
I_{rrm}	Reverse recovery current		-	3.3	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	187	-	A/µs
E_{rr}	Reverse recovery energy		-	68	-	µJ
t_{rr}	Reverse recovery time	I_F = 40 A, V_R = 400 V, V_{GE} = 15 V, T_J = 175 °C, di/dt = 100 A/µs (see *Figure 28: " Test circuit for inductive load switching"*)	-	310	-	ns
Q_{rr}	Reverse recovery charge		-	1550	-	nC
I_{rrm}	Reverse recovery current		-	10	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	70	-	A/µs
E_{rr}	Reverse recovery energy		-	674	-	µJ

2.1 Electrical characteristics (curves)

Figure 2: Power dissipation vs. case temperature

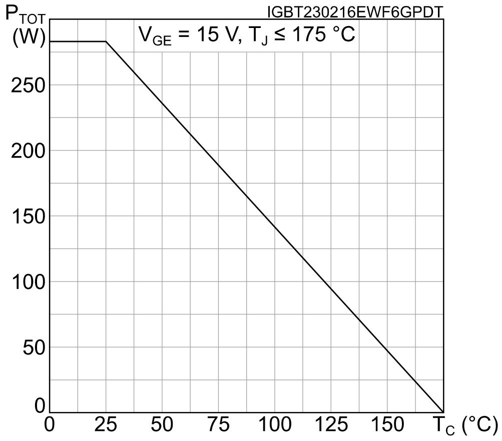


Figure 3: Collector current vs. case temperature

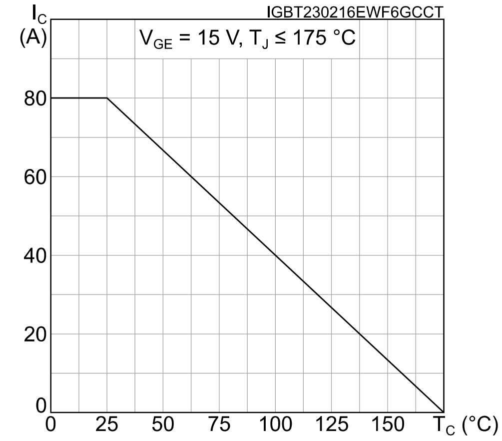


Figure 4: Output characteristics (TJ = 25°C)

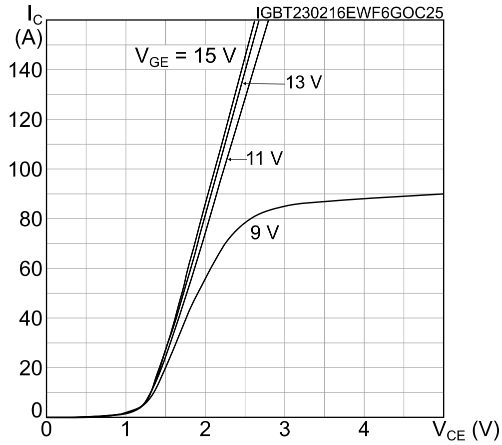


Figure 5: Output characteristics (TJ = 175°C)

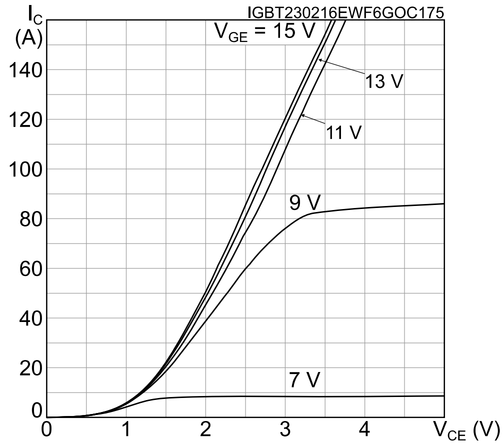


Figure 6: VCE(sat) vs. junction temperature

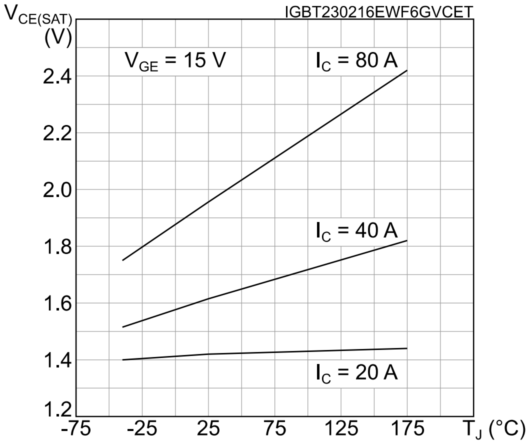


Figure 7: VCE(sat) vs. collector current

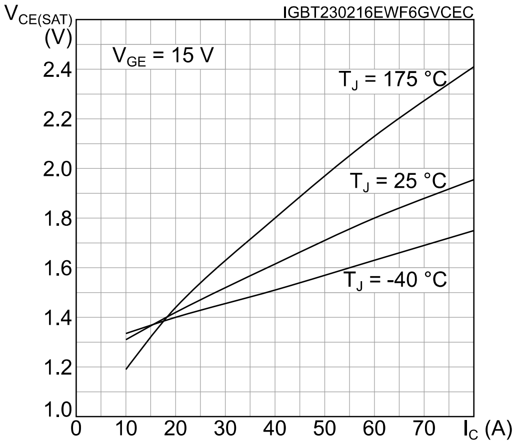


Figure 8: Collector current vs. switching frequency

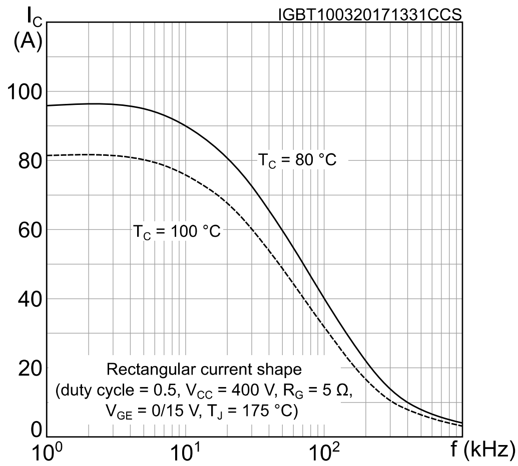


Figure 9: Forward bias safe operating area

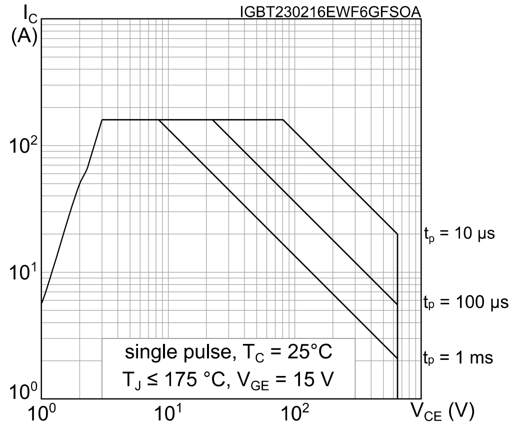


Figure 10: Transfer characteristics

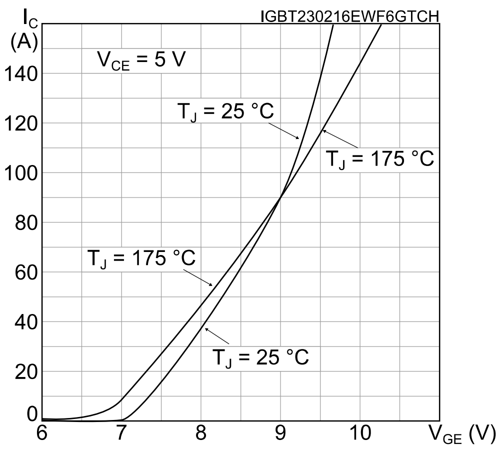


Figure 11: Diode VF vs. forward current

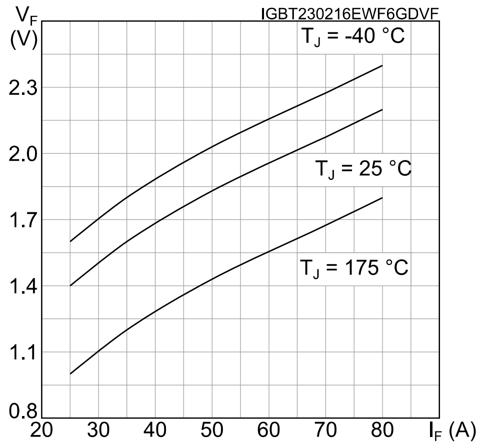


Figure 12: Normalized VGE(th) vs junction temperature

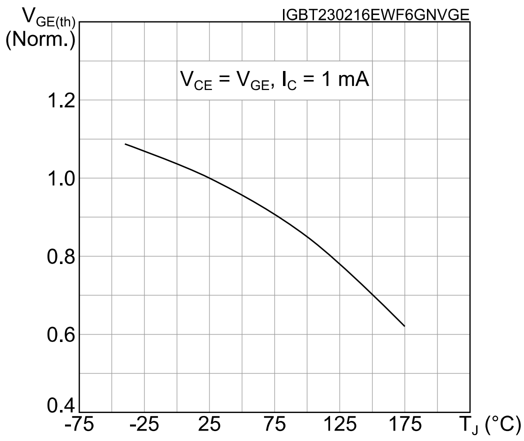


Figure 13: Normalized V(BR)CES vs. junction temperature

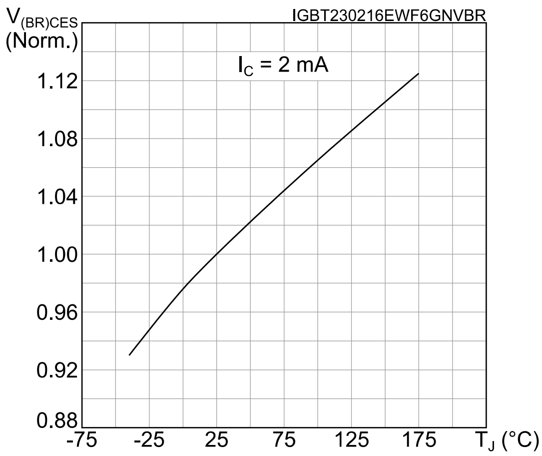


Figure 14: Capacitance variations

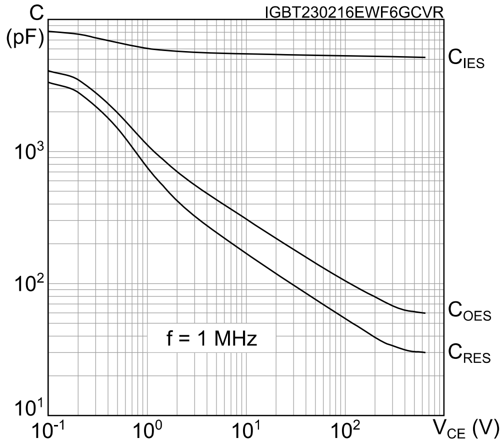


Figure 15: Gate charge vs. gate-emitter voltage

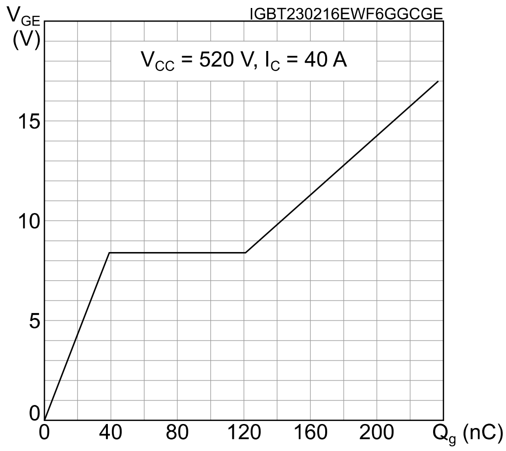


Figure 16: Switching energy vs collector current

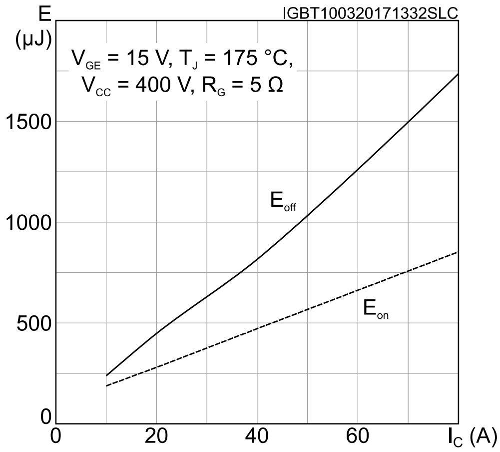


Figure 17: Switching energy vs gate resistance

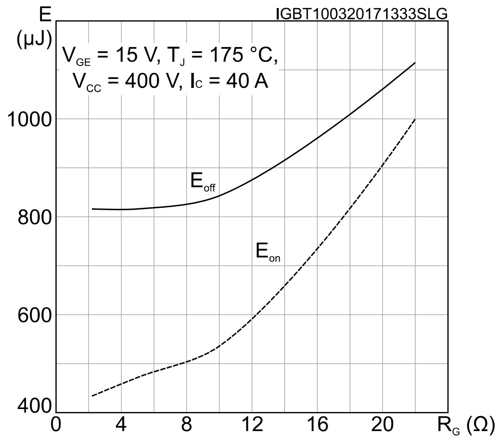


Figure 18: Switching energy vs temperature

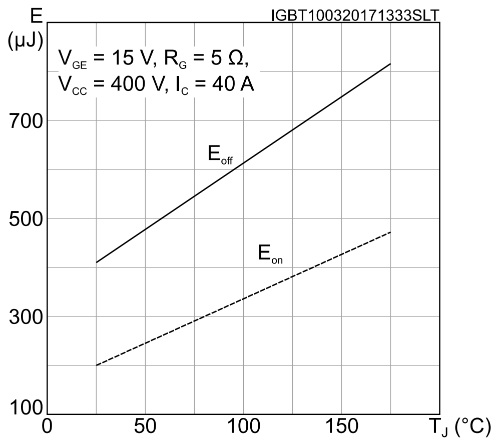


Figure 19: Switching energy vs. collector emitter voltage

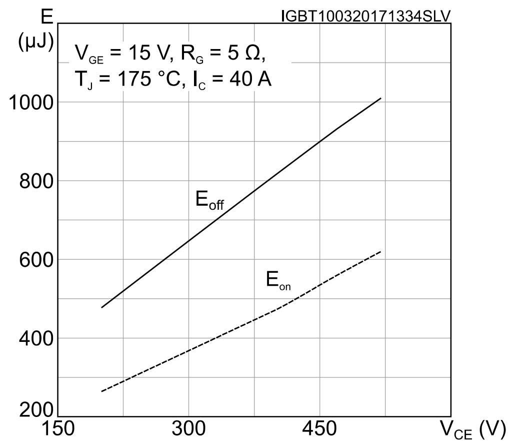


Figure 20: Switching times vs. collector current

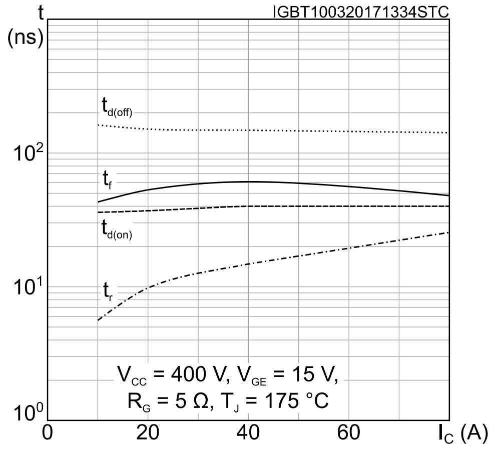


Figure 21: Switching times vs. gate resistance

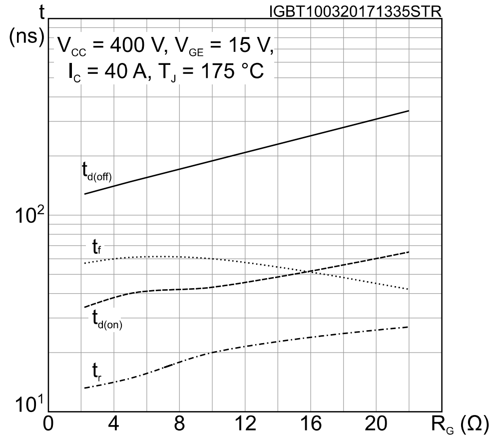


Figure 22: Reverse recovery current vs. diode current slope

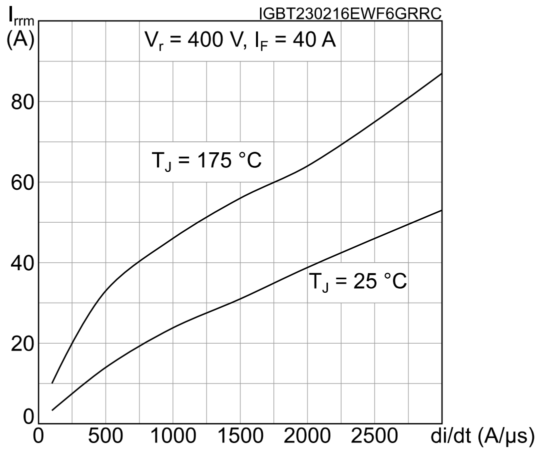


Figure 23: Reverse recovery time vs. diode current slope

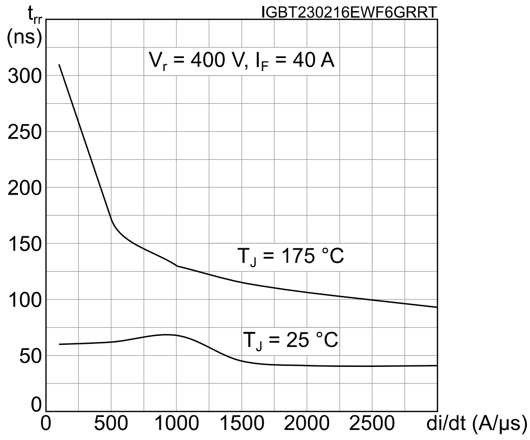


Figure 24: Reverse recovery charge vs. diode current slope

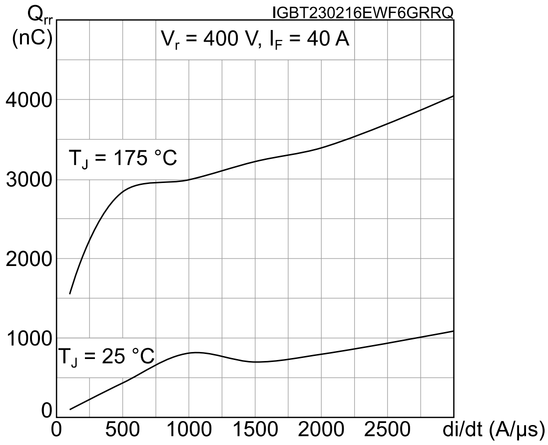


Figure 25: Reverse recovery energy vs. diode current slope

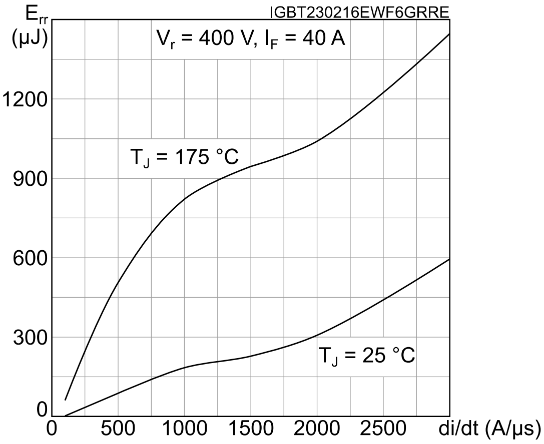


Figure 26: Thermal impedance for IGBT

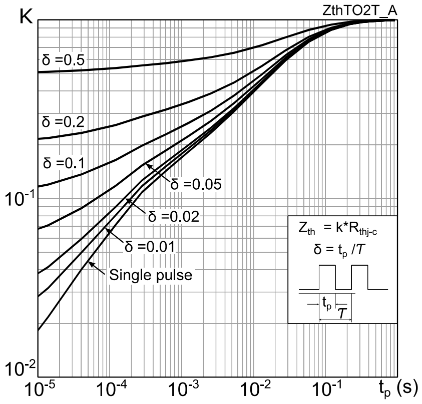
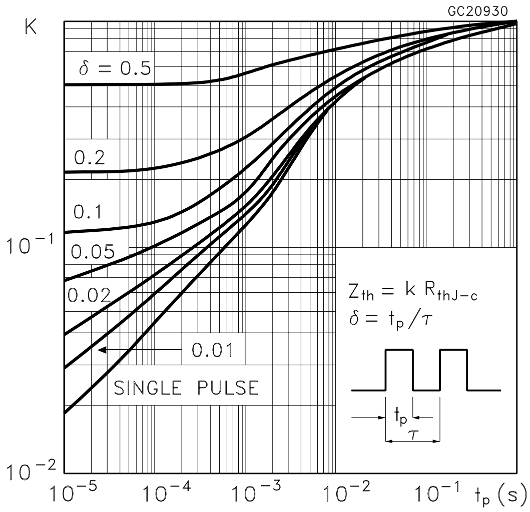


Figure 27: Thermal impedance for diode



3 Test circuits

Figure 28: Test circuit for inductive load switching

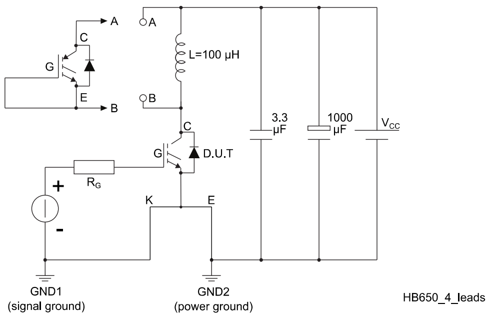


Figure 29: Gate charge test circuit

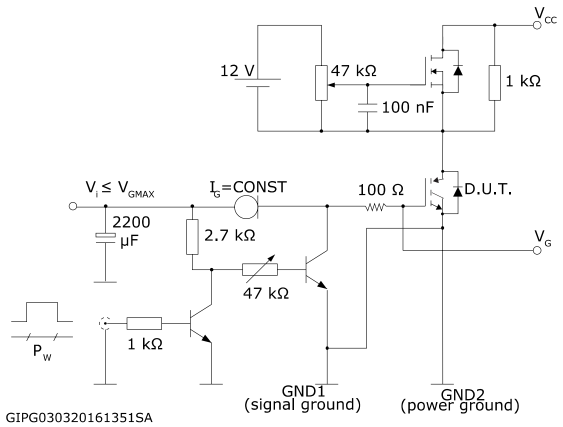


Figure 30: Switching waveform

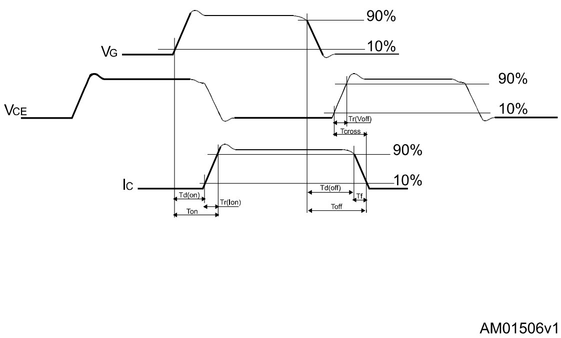
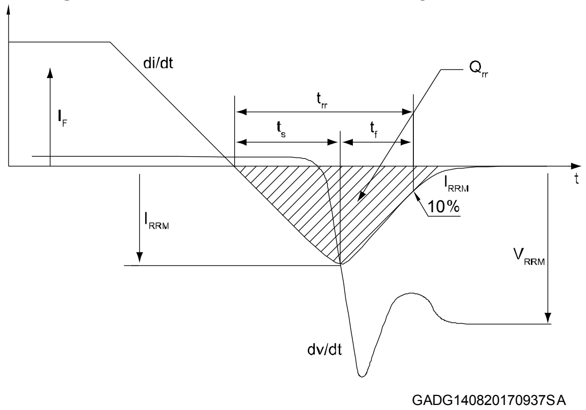


Figure 31: Diode reverse recovery waveform



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 TO247-4 package information

Figure 32: TO247-4 package outline

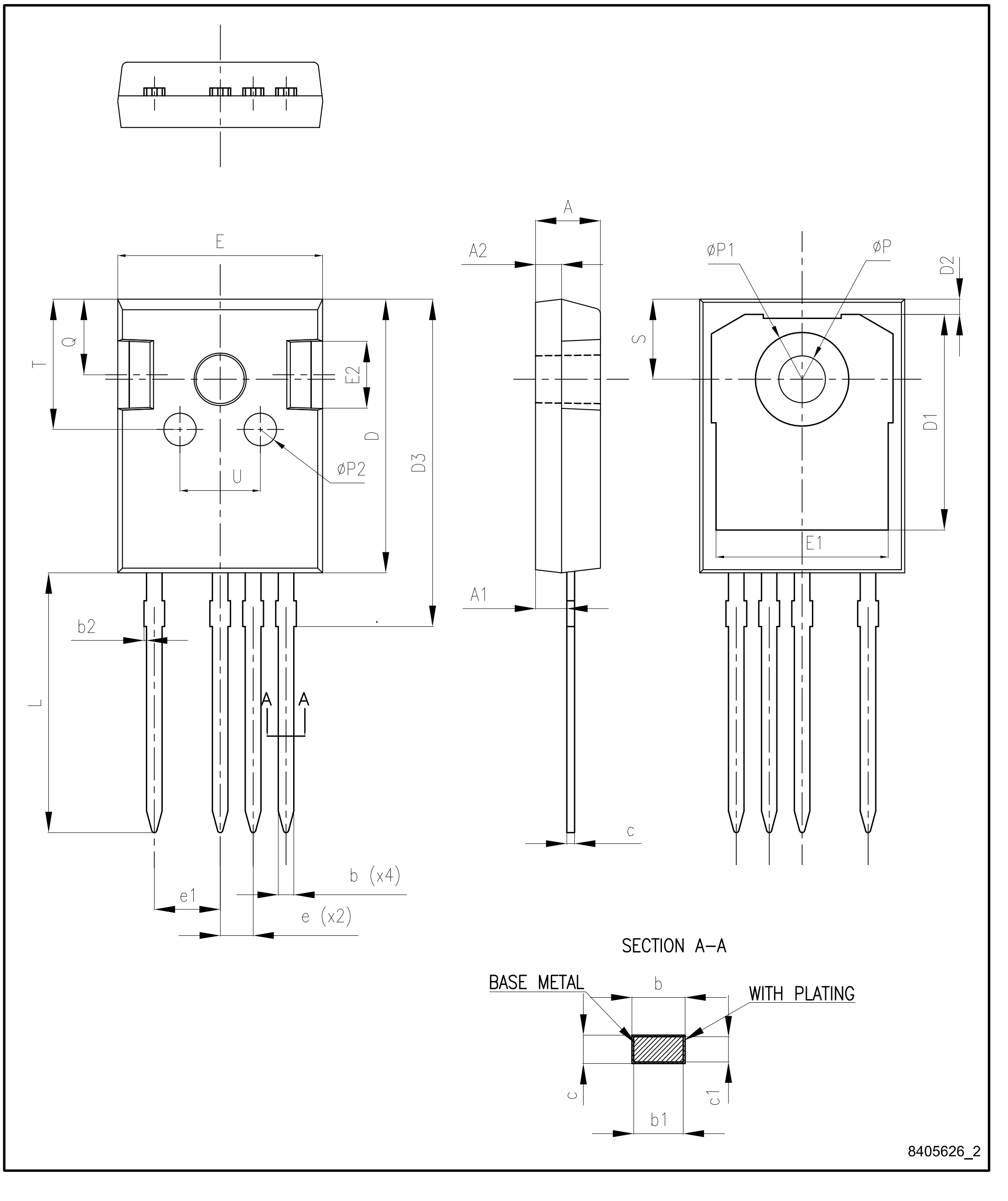


Table 8: TO247-4 mechanical data

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

5 Revision history

Table 9: Document revision history

Date	Revision	Changes
04-Mar-2016	1	First release
13-Mar-2017	2	Updated Table 6: "IGBT switching characteristics (inductive load)". Updated Section 2.1: "Electrical characteristics (curves)". Minor text changes
17-Aug-2017	3	Updated title in cover page. Updated *Table 7: "Diode switching characteristics (inductive load)"*. Updated *Section 4.1: "TO247-4 package information"* Minor text changes.