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STGWA40H65DFB

Trench gate field-stop IGBT, HB series 650 V, 40 A high speed

Datasheet - production data

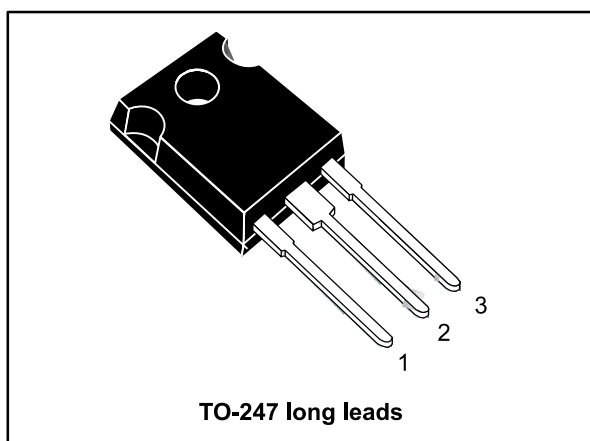
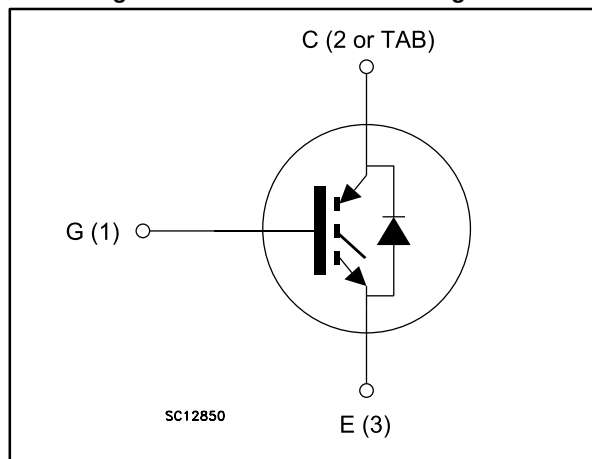


Figure 1: Internal schematic diagram



Features

- Maximum junction temperature: $T_J = 175\text{ }^{\circ}\text{C}$
- High speed switching series
- Minimized tail current
- Low saturation voltage: $V_{CE(sat)} = 1.6\text{ V (typ.)}$
@ $I_C = 40\text{ A}$
- Tight 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. 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
STGWA40H65DFB	G40H65DFB	TO-247 long leads	Tube

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
	2.1 Electrical characteristics (curves)	7
3	Test circuits	13
4	Package mechanical data	14
	4.1 TO-247 long lead package information	14
5	Revision history	16

STGWA40H65DFB

Electrical ratings

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 $T_C = 25\text{ }^{\circ}\text{C}$	80	A
	Continuous collector current at $T_C = 100\text{ }^{\circ}\text{C}$	40	
$I_{CP}^{(1)}$	Pulsed collector current	160	A
V_{GE}	Gate-emitter voltage	± 20	V
I_F	Continuous forward current at $T_C = 25\text{ }^{\circ}\text{C}$	80	A
	Continuous forward current at $T_C = 100\text{ }^{\circ}\text{C}$	40	
$I_{FP}^{(1)}$	Pulsed forward current	160	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	283	W
T_{STG}	Storage temperature range	- 55 to 150	$^{\circ}\text{C}$
T_J	Operating junction temperature range	- 55 to 175	

Notes:

⁽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	$^{\circ}\text{C/W}$
R_{thJC}	Thermal resistance junction-case diode	1.14	
R_{thJA}	Thermal resistance junction-ambient	50	

Electrical characteristics

STGWA40H65DFB

2 Electrical characteristics

$T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified

Table 4: Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}$, $I_C = 2\text{ mA}$	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 40\text{ A}$		1.6	2	V
		$V_{GE} = 15\text{ V}$, $I_C = 40\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$		1.7		
		$V_{GE} = 15\text{ V}$, $I_C = 40\text{ A}$, $T_J = 175\text{ }^{\circ}\text{C}$		1.8		
V_F	Forward on-voltage	$I_F = 40\text{ A}$		1.7	2.45	V
		$I_F = 40\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$		1.4		
		$I_F = 40\text{ A}$, $T_J = 175\text{ }^{\circ}\text{C}$		1.3		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 1\text{ mA}$	5	6	7	V
I_{CES}	Collector cut-off current	$V_{GE} = 0\text{ V}$, $V_{CE} = 650\text{ V}$			25	μA
I_{GES}	Gate-emitter leakage current	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$			± 250	nA

Table 5: Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	5412	-	pF
C_{oes}	Output capacitance		-	198	-	
C_{res}	Reverse transfer capacitance		-	107	-	
Q_g	Total gate charge	$V_{CC} = 520\text{ V}$, $I_C = 40\text{ A}$, $V_{GE} = 15\text{ V}$ (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	$V_{CE} = 400\text{ V}$, $I_C = 40\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 5\text{ }\Omega$ (see Figure 28: "Test circuit for inductive load switching")		40	-	ns
t_r	Current rise time			13	-	
$(di/dt)_{on}$	Turn-on current slope			2413	-	A/ μs
$t_{d(off)}$	Turn-off-delay time			142	-	ns
t_f	Current fall time			27	-	

STGWA40H65DFB

Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching energy	$V_{CE} = 400\text{ V}$, $I_C = 40\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 5\text{ }\Omega$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 28: "Test circuit for inductive load switching")		498	-	μJ
$E_{off}^{(2)}$	Turn-off switching energy			363	-	
E_{ts}	Total switching energy			861	-	
$t_{d(on)}$	Turn-on delay time			38	-	ns
t_r	Current rise time			14	-	
$(di/dt)_{on}$	Turn-on current slope			2186	-	A/ μs
$t_{d(off)}$	Turn-off-delay time			141	-	ns
t_f	Current fall time			61	-	
$E_{on}^{(1)}$	Turn-on switching energy			1417	-	μJ
$E_{off}^{(2)}$	Turn-off switching energy			764	-	
E_{ts}	Total switching energy			2181	-	

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	$I_F = 40\text{ A}$, $V_R = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $di/dt = 100\text{ A}/\mu\text{s}$ (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
dl_{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	$I_F = 40\text{ A}$, $V_R = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $T_J = 175\text{ }^\circ\text{C}$, $di/dt = 100\text{ A}/\mu\text{s}$	-	310	-	ns

Electrical characteristics

STGWA40H65DFB

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Q_{rr}	Reverse recovery charge	(see Figure 28: "Test circuit for inductive load switching")	-	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/ μ s
E_{rr}	Reverse recovery energy		-	674	-	μ J

STGWA40H65DFB

Electrical characteristics

2.1 Electrical characteristics (curves)

Figure 2: Power dissipation vs. case temperature

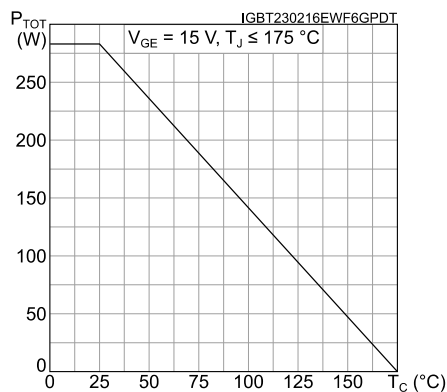


Figure 3: Collector current vs. case temperature

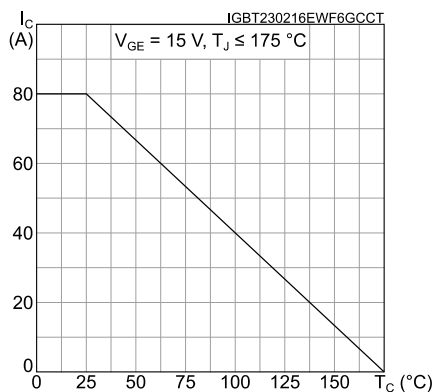


Figure 4: Output characteristics (T_J = 25 °C)

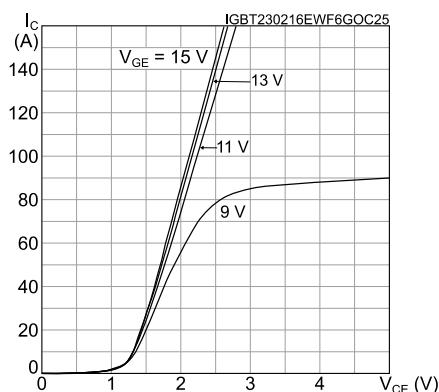


Figure 5: Output characteristics (T_J = 175 °C)

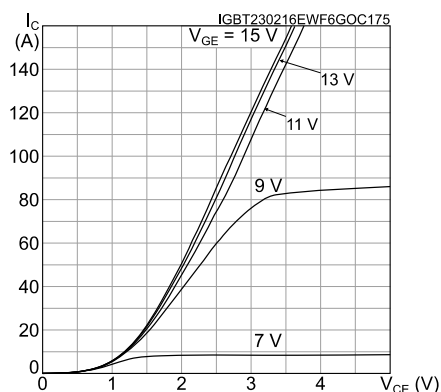


Figure 6: V_CE(sat) vs. junction temperature

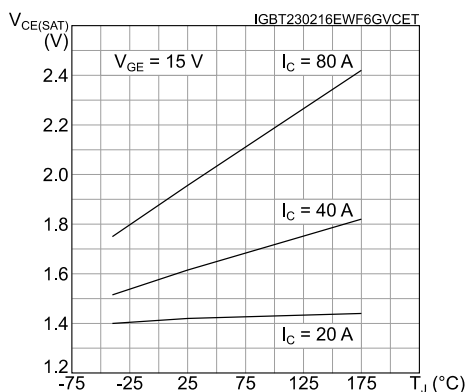
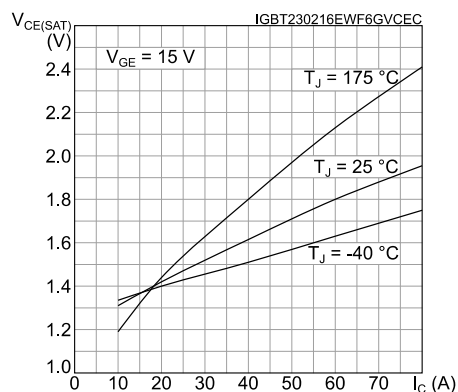


Figure 7: V_CE(sat) vs. collector current



Electrical characteristics

STGWA40H65DFB

Figure 8: Collector current vs. switching frequency

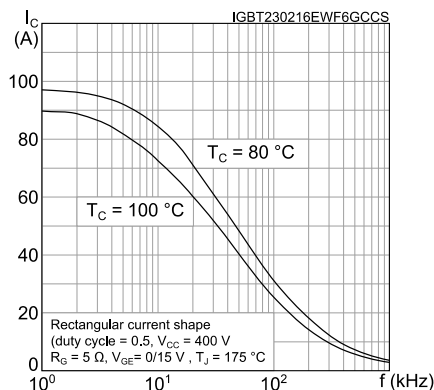


Figure 9: Forward bias safe operating area

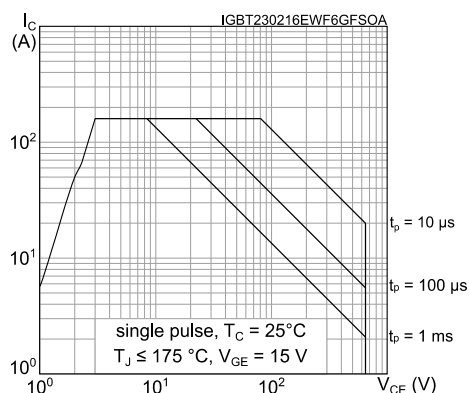


Figure 10: Transfer characteristics

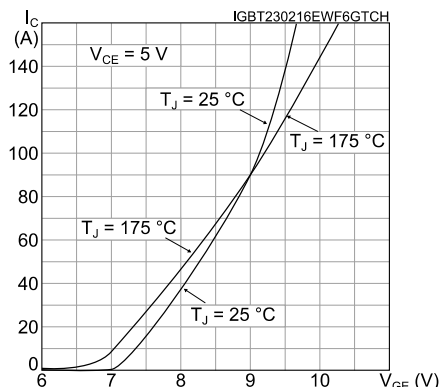


Figure 11: Diode V_F vs. forward current

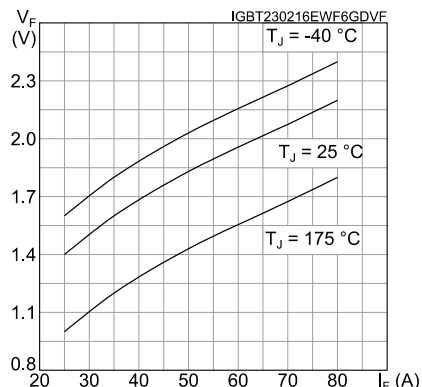


Figure 12: Normalized V_GE(th) vs. junction temperature

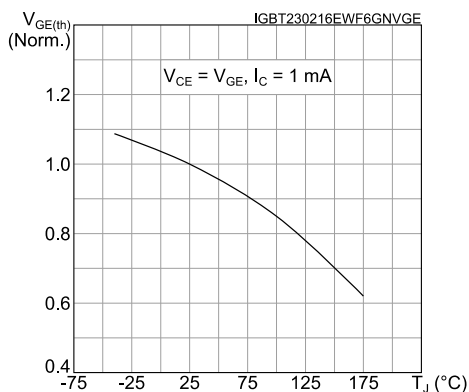
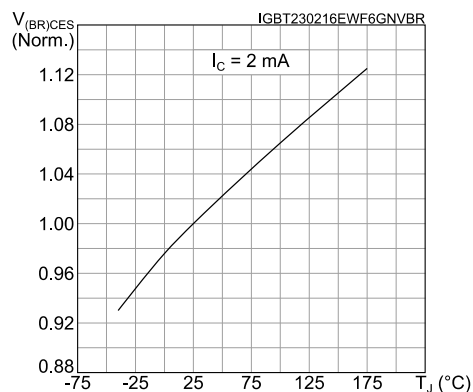


Figure 13: Normalized V_(BR)CES vs. junction temperature



STGWA40H65DFB

Electrical characteristics

Figure 14: Capacitance variations

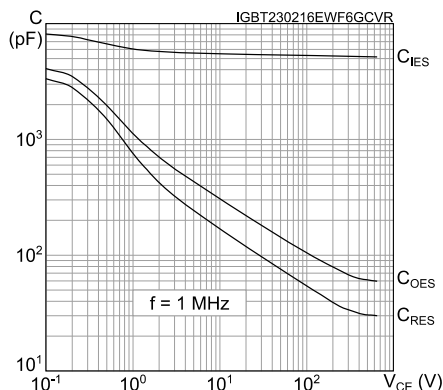


Figure 15: Gate charge vs. gate-emitter voltage

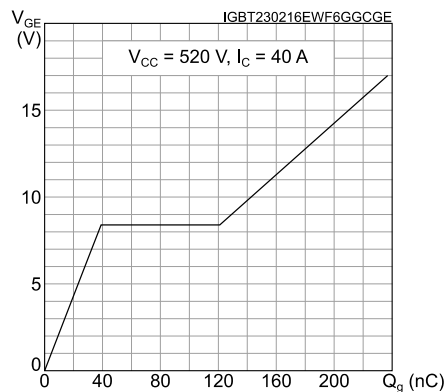


Figure 16: Switching energy vs. collector current

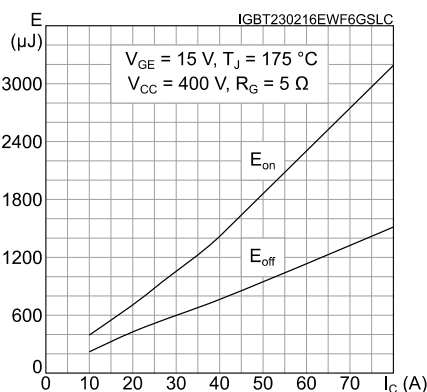


Figure 17: Switching energy vs. gate resistance

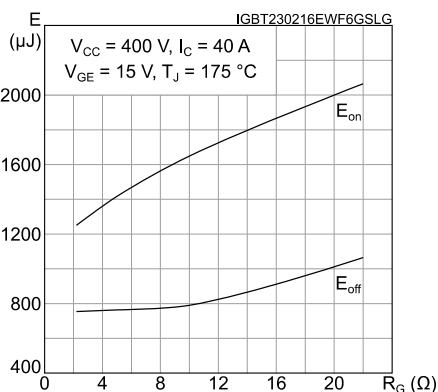


Figure 18: Switching energy vs. temperature

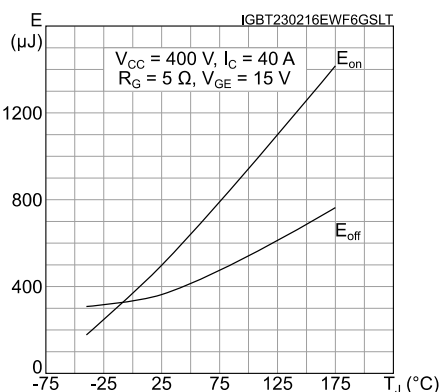
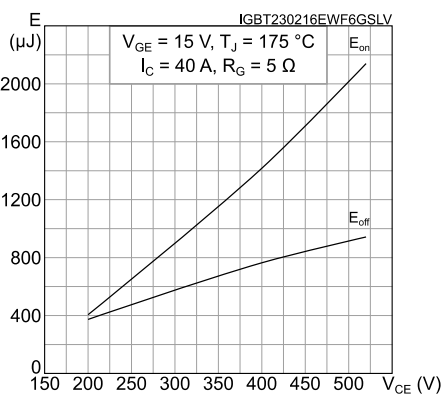


Figure 19: Switching energy vs. collector emitter voltage



Electrical characteristics

STGWA40H65DFB

Figure 20: Switching times vs. collector current

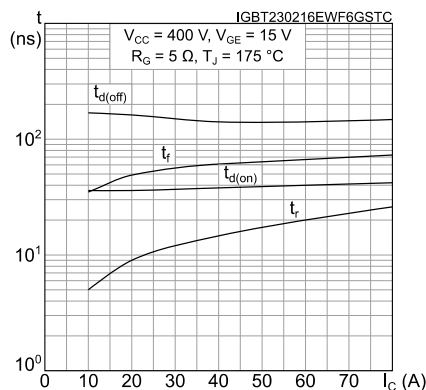


Figure 21: Switching times vs. gate resistance

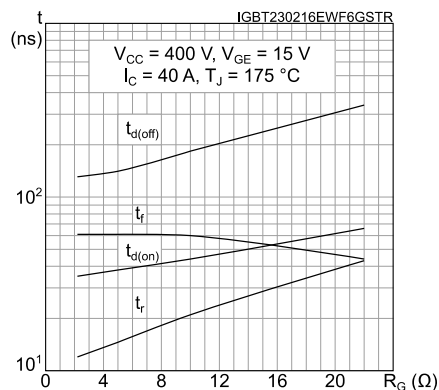


Figure 22: Reverse recovery current vs. diode current slope

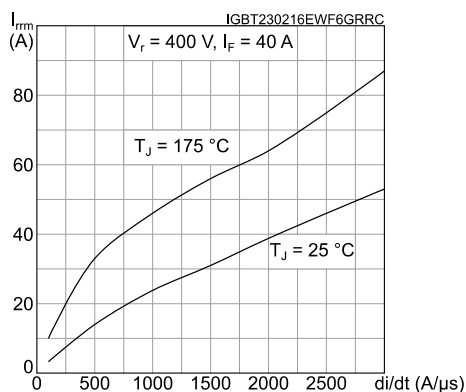


Figure 23: Reverse recovery time vs. diode current slope

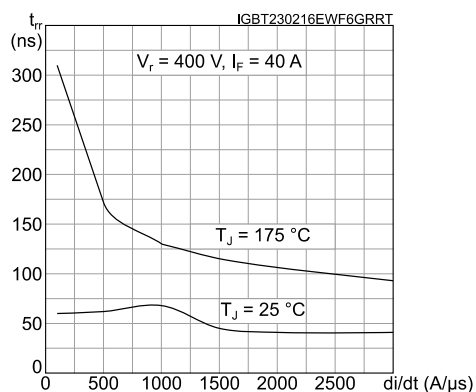


Figure 24: Reverse recovery charge vs. diode current slope

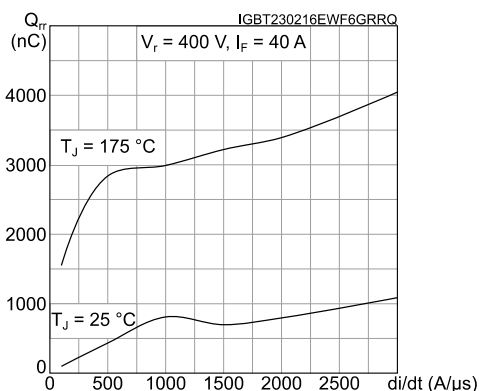
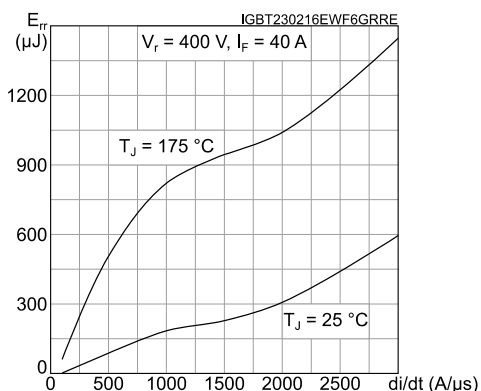


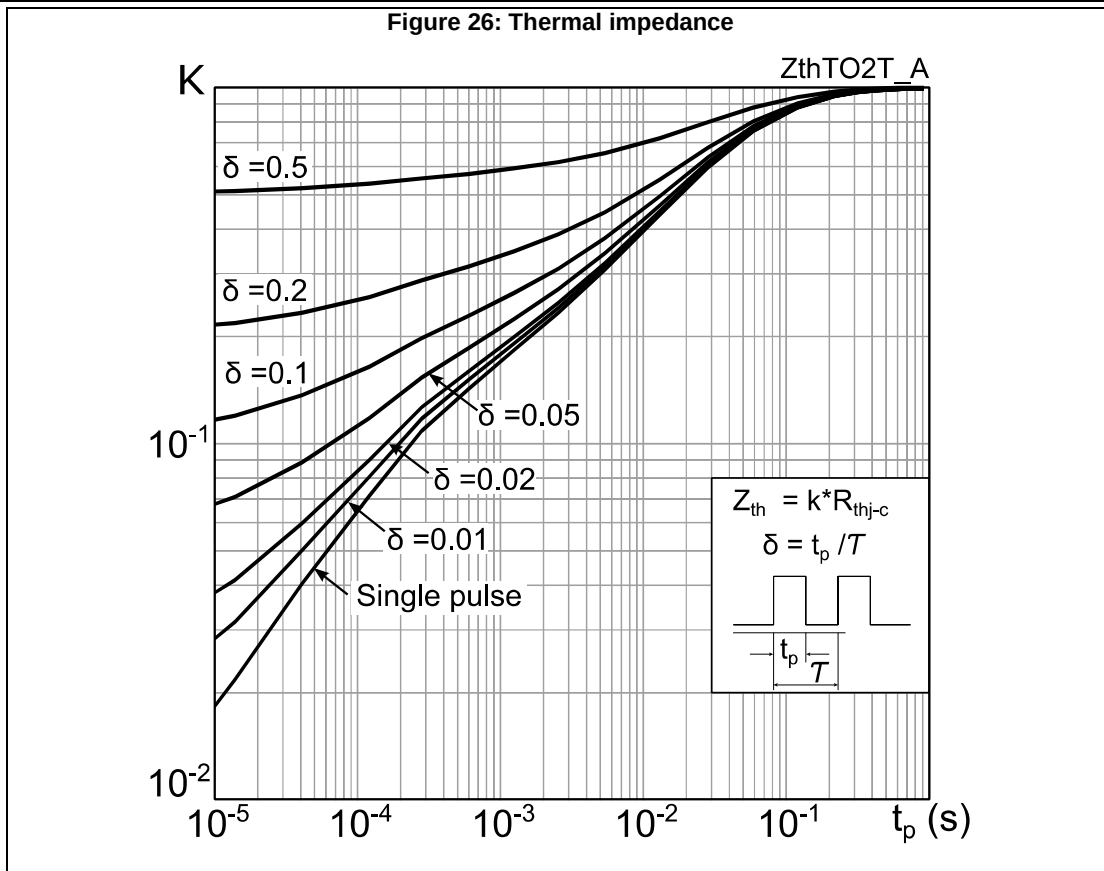
Figure 25: Reverse recovery energy vs. diode current slope



STGWA40H65DFB

Electrical characteristics

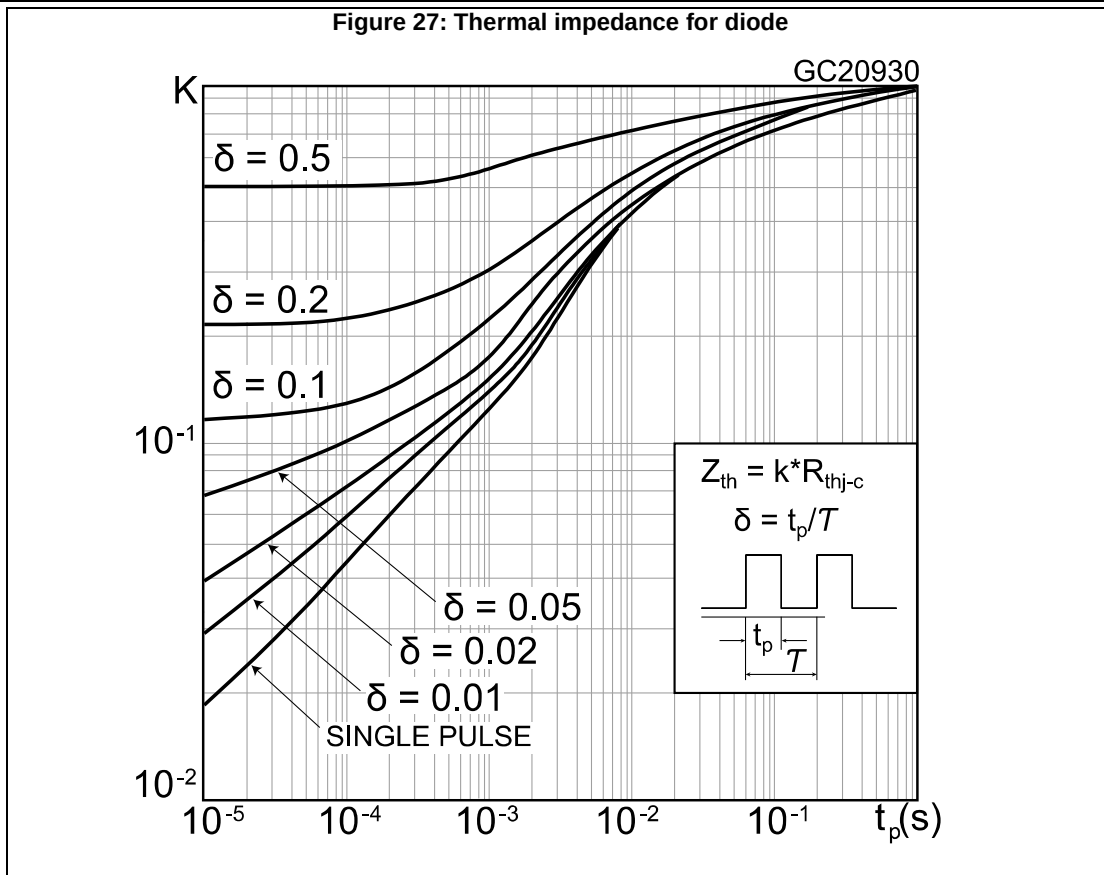
Figure 26: Thermal impedance



Electrical characteristics

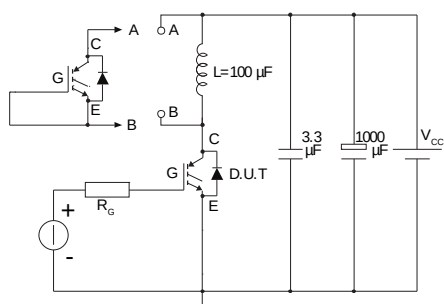
STGWA40H65DFB

Figure 27: Thermal impedance for diode



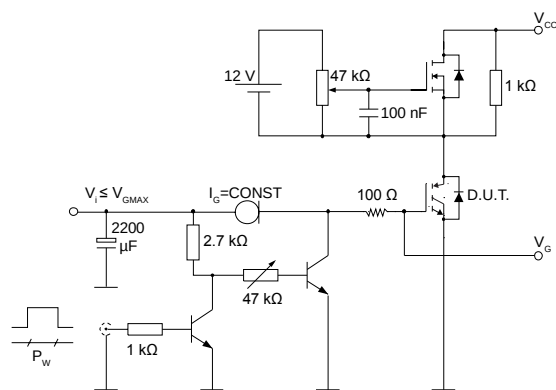
3 Test circuits

Figure 28: Test circuit for inductive load switching



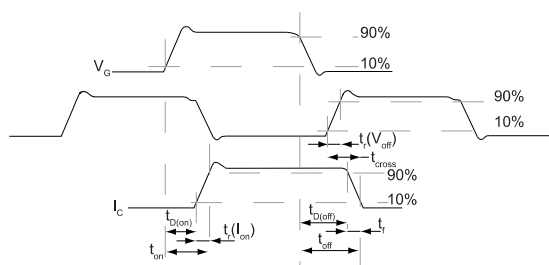
AM01504v1

Figure 29: Gate charge test circuit



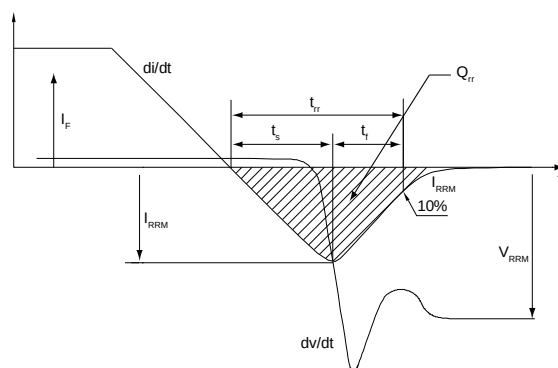
AM01505v1

Figure 30: Switching waveform



AM01506v1

Figure 31: Diode reverse recovery waveform



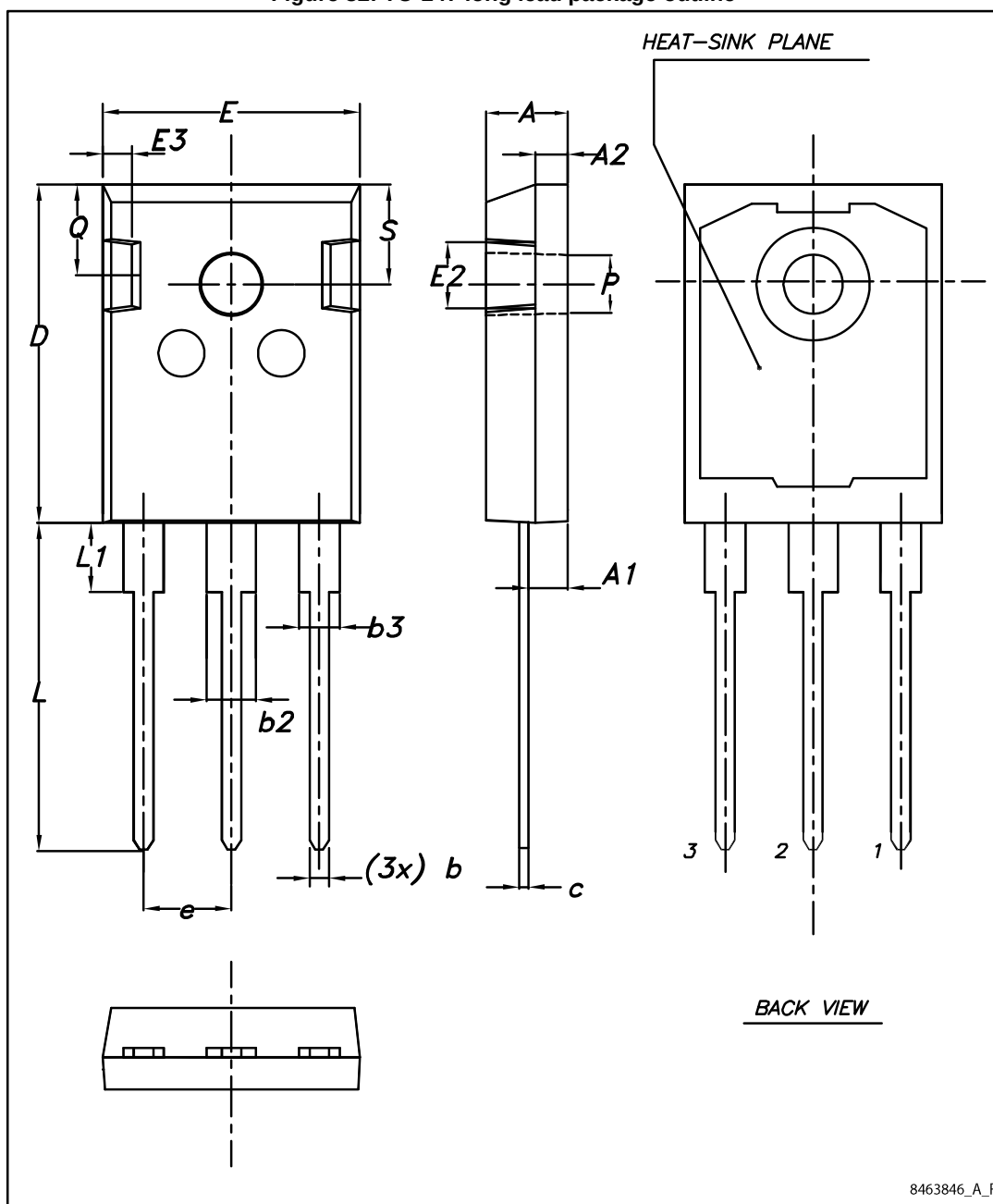
AM01507v1

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.

4.1 TO-247 long lead package information

Figure 32: TO-247 long lead package outline



STGWA40H65DFB
Package mechanical data
Table 8: TO-247 long lead 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

5 Revision history

Table 9: Document revision history

Date	Revision	Changes
06-Jun-2016	1	Initial version. Part number previously included in datasheet DocID024363.

STGWA40H65DFB

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