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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	80	A
	Continuous collector current at $T_C = 100$ °C	40	
I_{CP} ⁽¹⁾	Pulsed collector current	160	A
V_{GE}	Gate-emitter voltage	± 20	V
	Transient gate-emitter voltage	± 30	
I_F	Continuous forward current at $T_C = 25$ °C	80	A
	Continuous forward current at $T_C = 100$ °C	40	
I_{FP} ⁽¹⁾	Pulsed forward current	160	A
P_{TOT}	Total power 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	

1. Pulse width limited by maximum junction temperature.

Table 2. 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	
R_{thJA}	Thermal resistance junction-ambient	50	

2 Electrical characteristics

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

Table 3. Static characteristics

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

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{\text{CE}} = 25 \text{ V}$, $f = 1 \text{ MHz}$, $V_{\text{GE}} = 0 \text{ V}$	-	5412	-	pF
C_{oes}	Output capacitance		-	198	-	
C_{res}	Reverse transfer capacitance		-	107	-	
Q_g	Total gate charge	$V_{\text{CC}} = 520 \text{ V}$, $I_C = 40 \text{ A}$, $V_{\text{GE}} = 0$ to 15 V (see Figure 28. Gate charge test circuit)	-	210	-	nC
Q_{ge}	Gate-emitter charge		-	39	-	
Q_{gc}	Gate-collector charge		-	82	-	

Table 5. IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400 \text{ V}, I_C = 40 \text{ A}, V_{GE} = 15 \text{ V}, R_G = 5 \Omega$ (see Figure 27. Test circuit for inductive load switching)		40	-	ns
t_r	Current rise time			13	-	ns
$(di/dt)_{on}$	Turn-on current slope			2413	-	A/μs
$t_{d(off)}$	Turn-off-delay time			142	-	ns
t_f	Current fall time			27	-	ns
$E_{on}^{(1)}$	Turn-on switching energy			498	-	μJ
$E_{off}^{(2)}$	Turn-off switching energy			363	-	μJ
E_{ts}	Total switching energy			861	-	μJ
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400 \text{ V}, I_C = 40 \text{ A}, V_{GE} = 15 \text{ V}, R_G = 5 \Omega, T_J = 175 \text{ °C}$ (see Figure 27. Test circuit for inductive load switching)		38	-	ns
t_r	Current rise time			14	-	ns
$(di/dt)_{on}$	Turn-on current slope			2186	-	A/μs
$t_{d(off)}$	Turn-off-delay time			141	-	ns
t_f	Current fall time			61	-	ns
$E_{on}^{(1)}$	Turn-on switching energy			1417	-	μJ
$E_{off}^{(2)}$	Turn-off switching energy			764	-	μJ
E_{ts}	Total switching energy			2181	-	μJ

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	$I_F = 40 \text{ A}, V_R = 400 \text{ V}, V_{GE} = 15 \text{ V}$ $di/dt = 100 \text{ A/μs}$ (see Figure 27. 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	$I_F = 40 \text{ A}, V_R = 400 \text{ V}, V_{GE} = 15 \text{ V}, T_J = 175 \text{ °C}$ $di/dt = 100 \text{ A/μs}$ (see Figure 27. Test circuit for inductive load switching)	-	310	-	ns
Q_{rr}	Reverse recovery charge		-	1550	-	nC
I_{rrm}	Reverse recovery current		-	10	-	A
dl_{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 1. Power dissipation vs case temperature

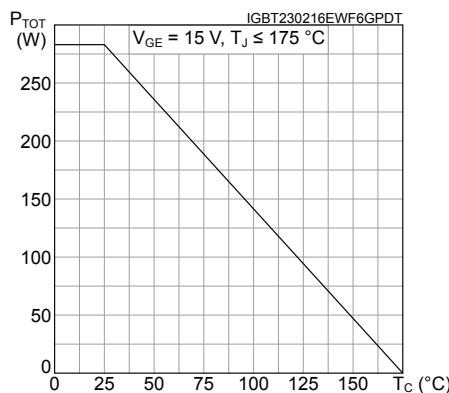


Figure 2. Collector current vs case temperature

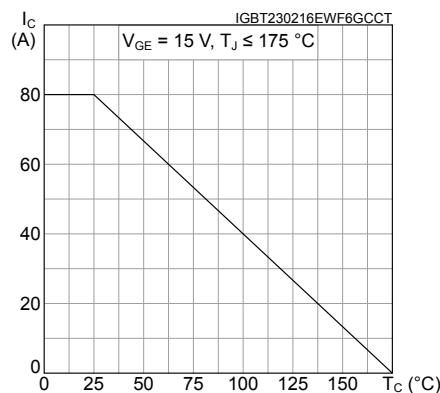


Figure 3. Output characteristics ($T_J = 25 \text{ }^{\circ}\text{C}$)

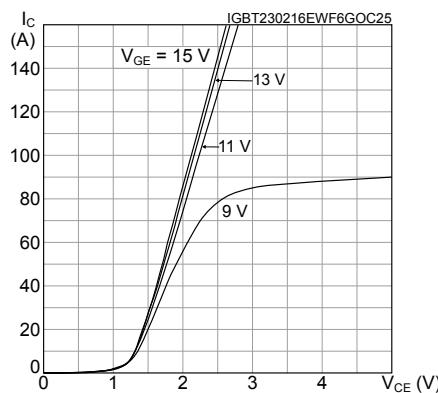


Figure 4. Output characteristics ($T_J = 175 \text{ }^{\circ}\text{C}$)

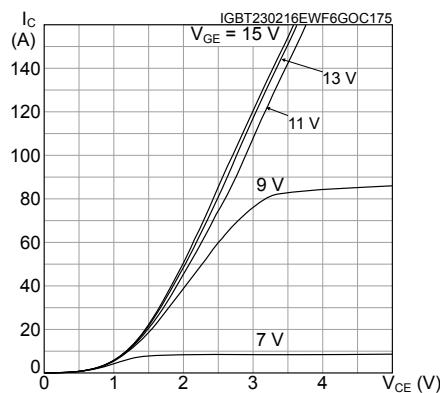


Figure 5. $V_{CE(sat)}$ vs junction temperature

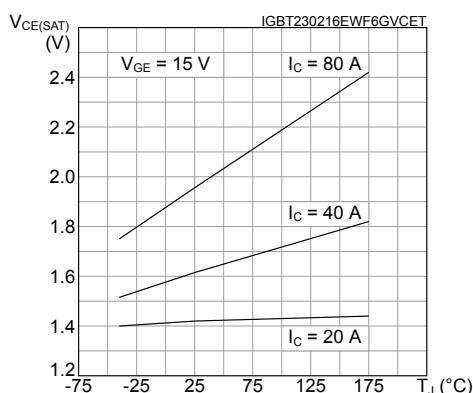


Figure 6. $V_{CE(sat)}$ vs collector current

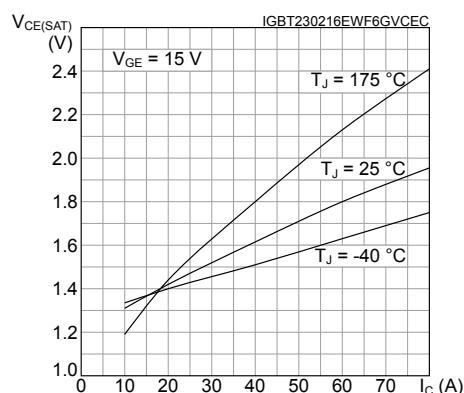


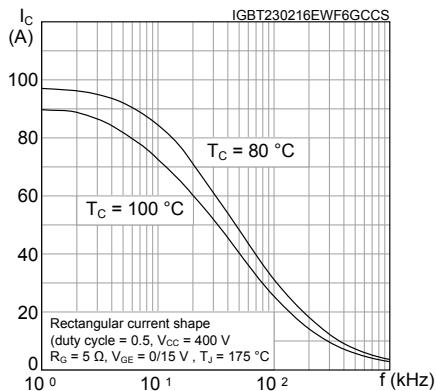
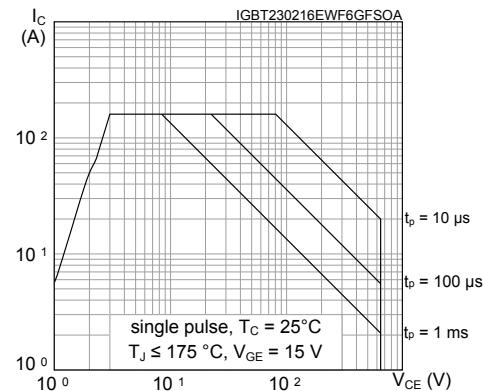
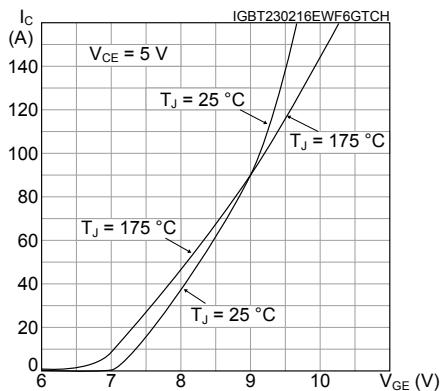
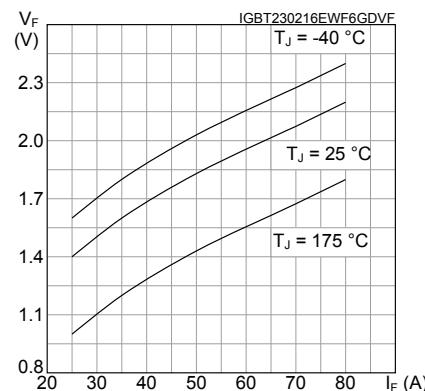
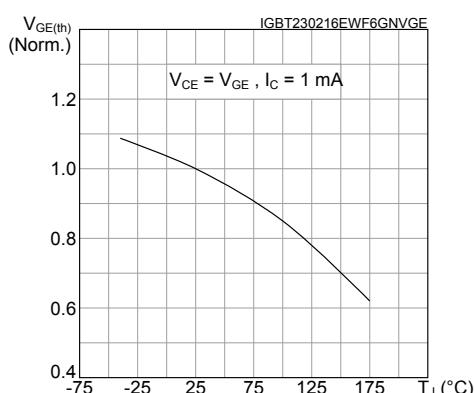
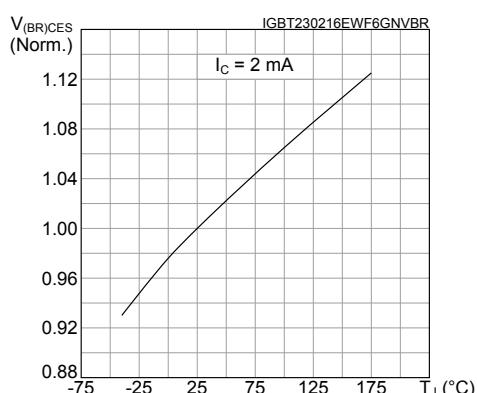
Figure 7. Collector current vs switching frequency

Figure 8. Forward bias safe operating area

Figure 9. Transfer characteristics

Figure 10. Diode VF vs forward current

Figure 11. Normalized VGE(th) vs junction temperature

Figure 12. Normalized V(BR)CES vs junction temperature


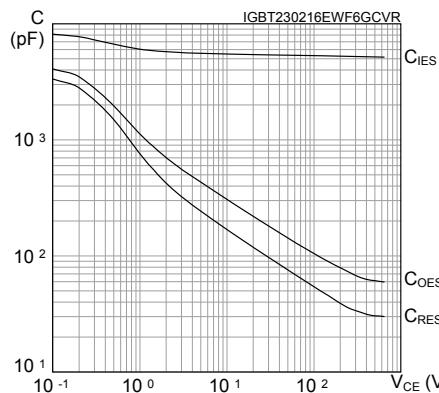
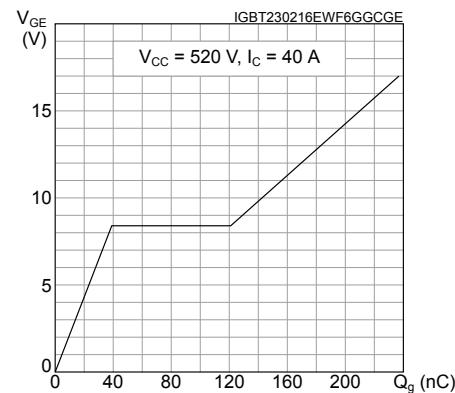
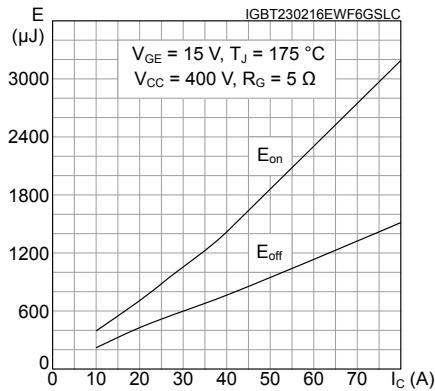
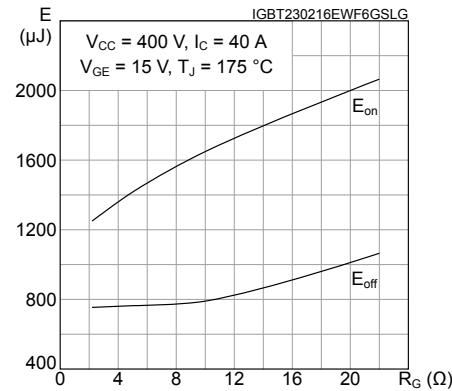
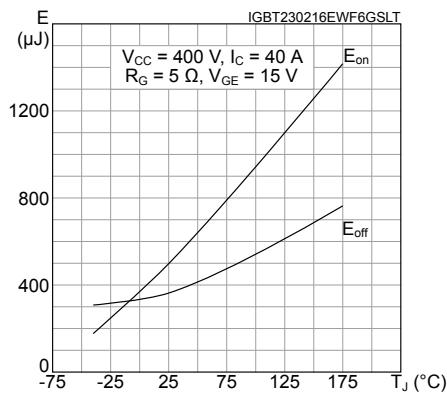
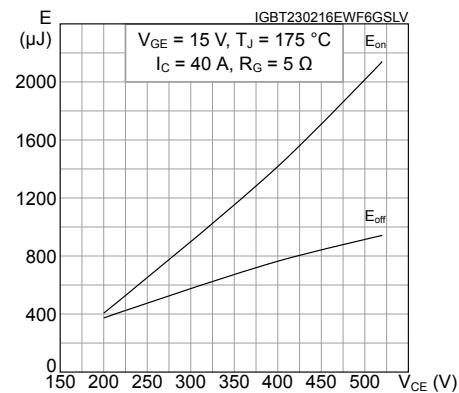
Figure 13. Capacitance variations

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


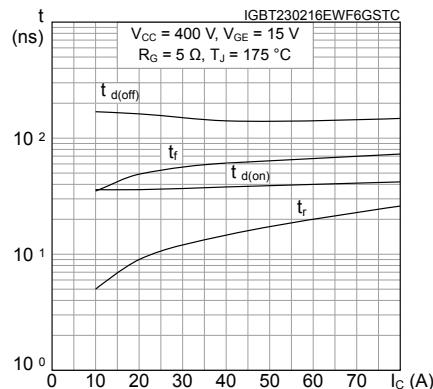
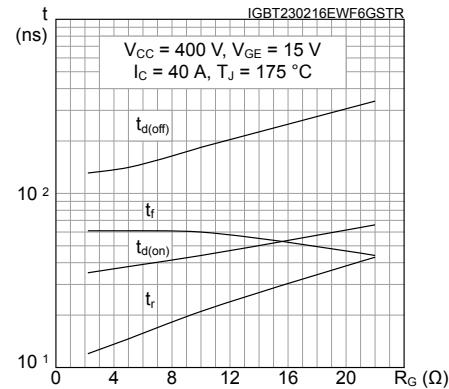
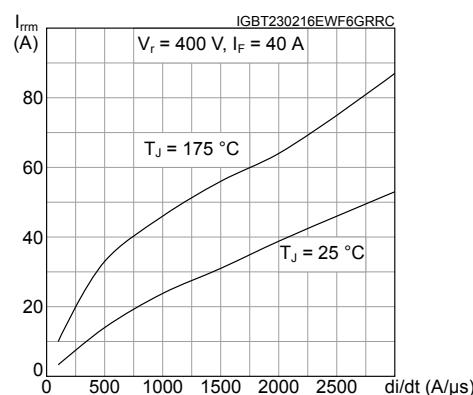
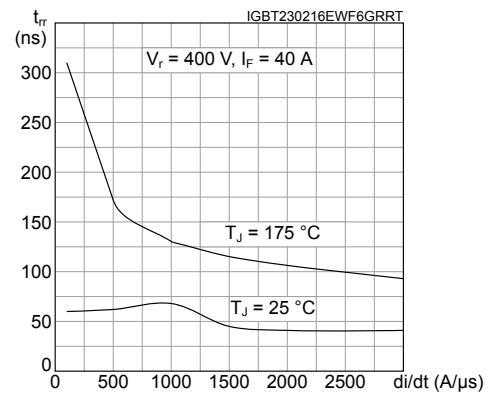
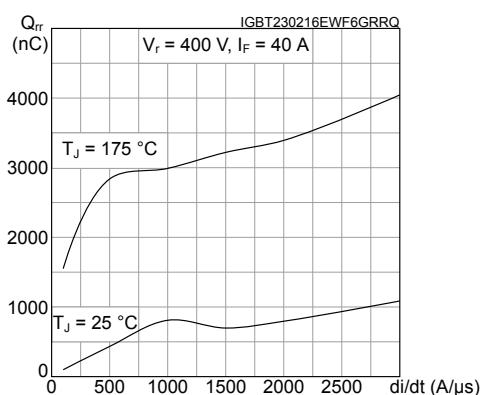
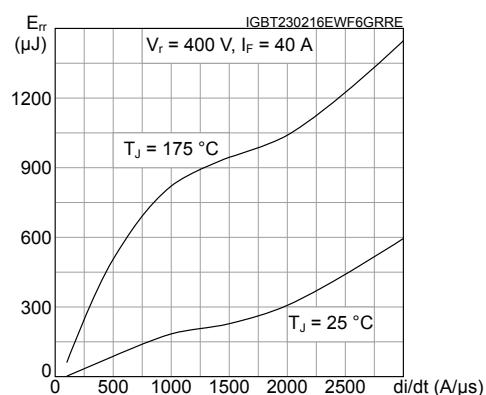
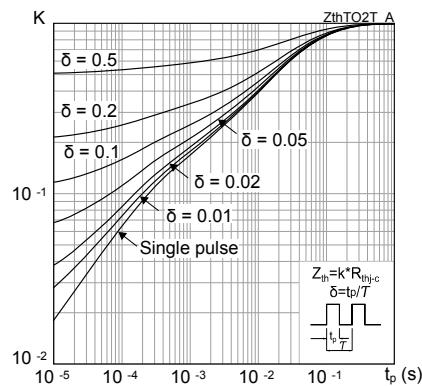
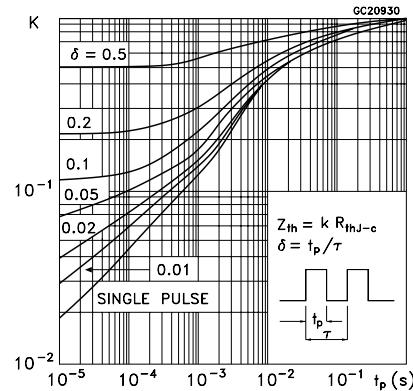
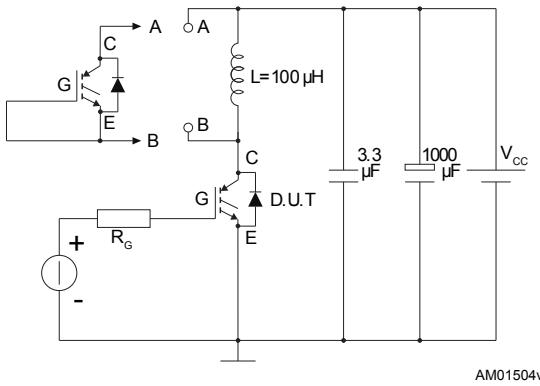
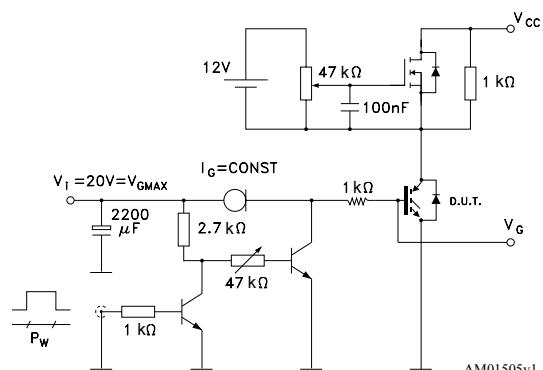
Figure 19. Switching times vs collector current

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**

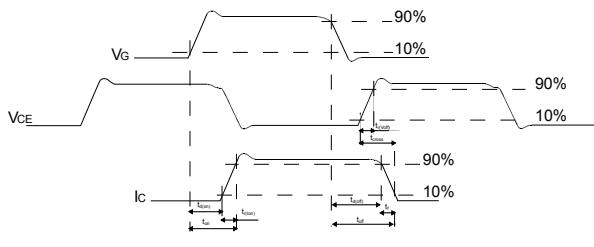
3 Test circuits

Figure 27. Test circuit for inductive load switching


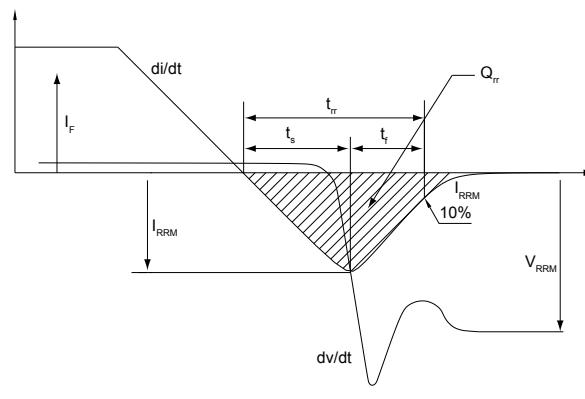
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Figure 28. Gate charge test circuit


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Figure 29. Switching waveform


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Figure 30. Diode reverse recovery waveform


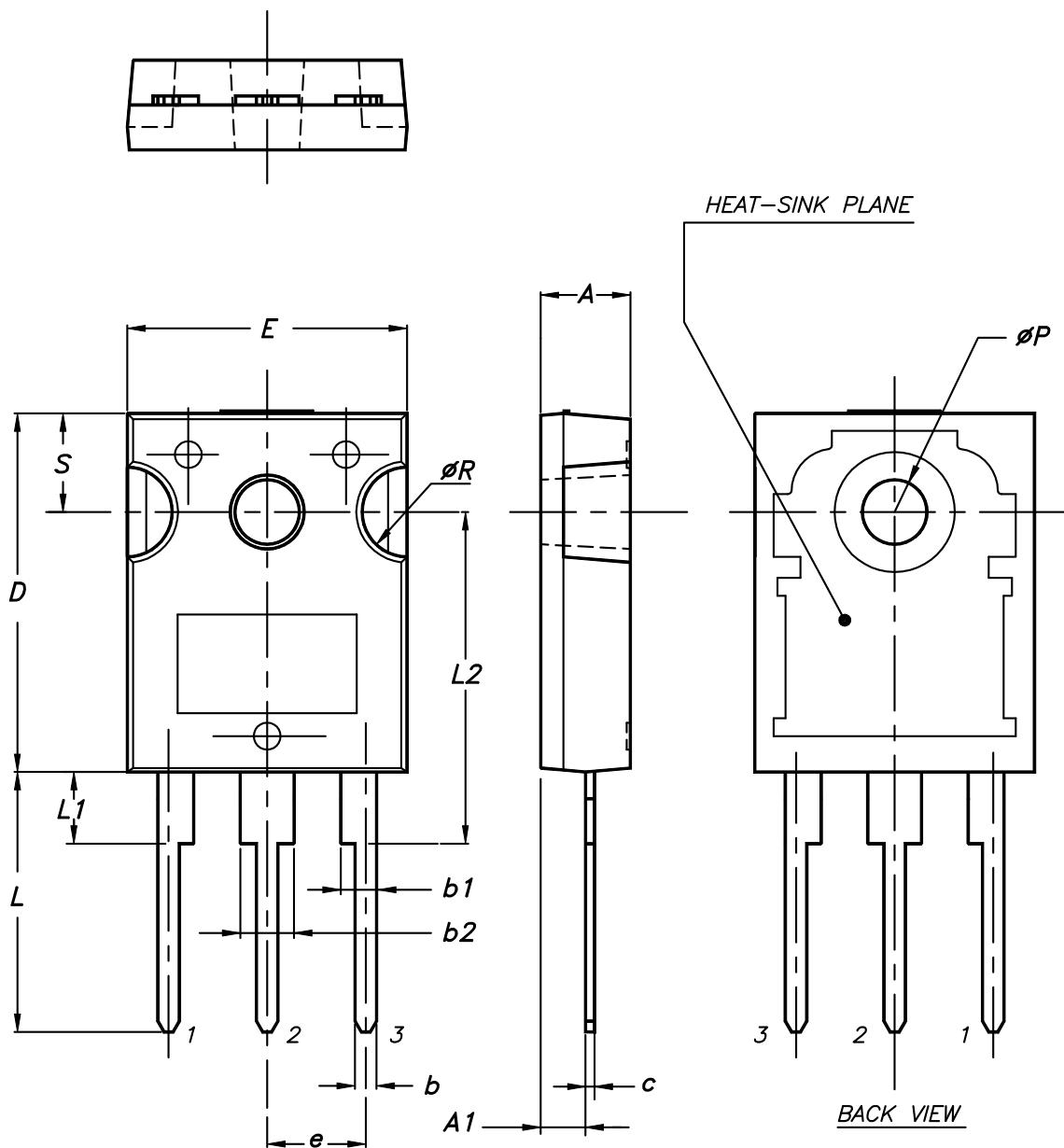
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4 Package information

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 TO-247 package information

Figure 31. TO-247 package outline



0075325_9

Table 7. 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

Revision history

Table 8. Document revision history

Date	Revision	Changes
12-Mar-2013	1	Initial release.
09-Sep-2013	2	<ul style="list-style-type: none">– Modified: VCE(sat) values in cover page– Modified: VCE(sat), VF and VGE(th) typical and max values in Table 4– Modified: entire typical values in Table 5, 6 and 7– Minor text changes– Added: Section 2.1: Electrical characteristics (curves)
11-Sep-2013	3	<ul style="list-style-type: none">– Updated TSTG value in Table 2: Absolute maximum ratings.
23-Sep-2013	4	<ul style="list-style-type: none">– Updated units in Table 6: IGBT switching characteristics (inductive load).
31-Oct-2013	5	Updated VCE(sat) in Table 4: Static characteristics.
24-Feb-2014	6	Updated title and description in cover page.
23-Feb-2016	7	<p>Throughout document:</p> <ul style="list-style-type: none">- added TO-247 long leads package details- text and formatting changes <p>In "Electrical ratings":</p> <ul style="list-style-type: none">- updated "Absolute maximum ratings" table. <p>In "Electrical characteristics":</p> <ul style="list-style-type: none">- updated "Static characteristics", "IGBT switching characteristics (inductive load)" and "Diode switching characteristics (inductive load)" tables. <p>Updated "Electrical characteristics (curves)" section.</p> <p>Updated "Package information" section.</p>
07-Jun-2016	8	The part numbers STGWA40H65DFB and STGWT40H65DFB have been moved to a separate datasheet.
19-Jun-2019	9	<p>Removed maturity status indication from cover page. The document status is production data.</p> <p>Updated title in cover page.</p> <p>Updated Table 1. Absolute maximum ratings.</p> <p>Minor text changes.</p>

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