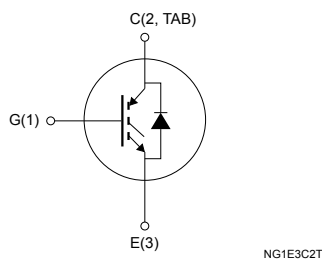
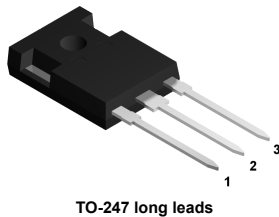


Trench gate field-stop, 650 V, 40 A, high-speed HB2 series IGBT in a TO-247 long leads package



Features

- Maximum junction temperature: $T_J = 175\text{ }^{\circ}\text{C}$
- Low $V_{CE(sat)} = 1.55\text{ V (typ.) @ } I_C = 40\text{ A}$
- Very fast and soft recovery co-packaged diode
- Minimized tail current
- Tight parameter distribution
- Low thermal resistance
- Positive $V_{CE(sat)}$ temperature coefficient

Applications

- Welding
- PFC converters - single phase input
- Solar inverters (string and central)
- Uninterruptable power supplies (UPS)
- EV charging - DC fast charging stations

Description

The newest IGBT 650 V HB2 series represents an evolution of the advanced proprietary trench gate field-stop structure. The performance of the HB2 series is optimized in terms of conduction, thanks to a better $V_{CE(sat)}$ behavior at low current values, as well as in terms of reduced switching energy. A very fast soft recovery diode is co-packaged in antiparallel with the IGBT. The result is a product specifically designed to maximize efficiency for a wide range of fast applications.



Product status link

STGWA40H65DFB2

Product summary

Order code	STGWA40H65DFB2
Marking	G40H65DFB2
Package	TO-247 long leads
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{GE} = 0\text{ V}$)	650	V
I_C	Continuous collector current at $T_C = 25\text{ °C}$	72	A
	Continuous collector current at $T_C = 100\text{ °C}$	45	
I_{CP}	Pulsed collector current ($t_p \leq 1\text{ }\mu\text{s}$, $T_J < 175\text{ °C}$)	160	
V_{GE}	Gate-emitter voltage	± 20	V
	Transient gate-emitter voltage ($t_p \leq 10\text{ }\mu\text{s}$)	± 30	
I_F	Continuous forward current at $T_C = 25\text{ °C}$	60	A
	Continuous forward current at $T_C = 100\text{ °C}$	38	
I_{FP}	Pulsed forward current ($t_p \leq 1\text{ }\mu\text{s}$, $T_J < 175\text{ °C}$)	160	
P_{TOT}	Total power dissipation at $T_C = 25\text{ °C}$	230	W
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range	-55 to 175	

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case IGBT	0.65	°C/W
	Thermal resistance junction-case diode	1.14	
R_{thJA}	Thermal resistance junction-ambient	50	

2 Electrical characteristics

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

Table 3. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}$, $I_C = 1\text{ mA}$	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 40\text{ A}$		1.55	2	V
		$V_{GE} = 15\text{ V}$, $I_C = 40\text{ A}$, $T_J = 125\text{ °C}$		1.75		
		$V_{GE} = 15\text{ V}$, $I_C = 40\text{ A}$, $T_J = 175\text{ °C}$		1.85		
V_F	Forward on-voltage	$I_F = 40\text{ A}$		1.7	2.45	V
		$I_F = 40\text{ A}$, $T_J = 125\text{ °C}$		1.4		
		$I_F = 40\text{ A}$, $T_J = 175\text{ °C}$		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 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	2300	-	pF
C_{oes}	Output capacitance		-	122	-	
C_{res}	Reverse transfer capacitance		-	64	-	
Q_g	Total gate charge	$V_{CC} = 520\text{ V}$, $I_C = 40\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 28. Gate charge test circuit)	-	153	-	nC
Q_{ge}	Gate-emitter charge		-	29	-	
Q_{gc}	Gate-collector charge		-	67	-	

Table 5. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 400\text{ V}$, $I_C = 40\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 4.7\ \Omega$ (see Figure 27. Test circuit for inductive load switching)	-	18	-	ns
t_r	Current rise time		-	10.2	-	ns
$E_{on}^{(1)}$	Turn-on switching energy		-	765	-	μJ
$t_{d(off)}$	Turn-off delay time		-	72	-	ns
t_f	Current fall time		-	40	-	ns
$E_{off}^{(2)}$	Turn-off switching energy		-	410	-	μJ
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 400\text{ V}$, $I_C = 40\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 4.7\ \Omega$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 27. Test circuit for inductive load switching)	-	22	-	ns
t_r	Current rise time		-	12	-	ns
$E_{on}^{(1)}$	Turn-on switching energy		-	1460	-	μJ
$t_{d(off)}$	Turn-off delay time		-	78	-	ns
t_f	Current fall time		-	80	-	ns
$E_{off}^{(2)}$	Turn-off switching energy		-	780	-	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	$I_F = 40\text{ A}$, $V_R = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $di/dt = 1000\text{ A}/\mu\text{s}$ (see Figure 30. Diode reverse recovery waveform)	-	75	-	ns
Q_{rr}	Reverse recovery charge		-	730	-	nC
I_{rrm}	Reverse recovery current		-	15	-	A
di_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	725	-	A/ μs
E_{rr}	Reverse recovery energy		-	139	-	μJ
t_{rr}	Reverse recovery time	$I_F = 40\text{ A}$, $V_R = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $di/dt = 1000\text{ A}/\mu\text{s}$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 30. Diode reverse recovery waveform)	-	125	-	ns
Q_{rr}	Reverse recovery charge		-	3110	-	nC
I_{rrm}	Reverse recovery current		-	37	-	A
di_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	845	-	A/ μs
E_{rr}	Reverse recovery energy		-	624	-	μJ

2.1 Electrical characteristics (curves)

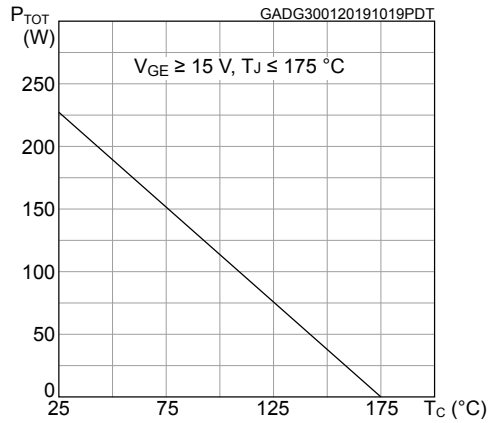
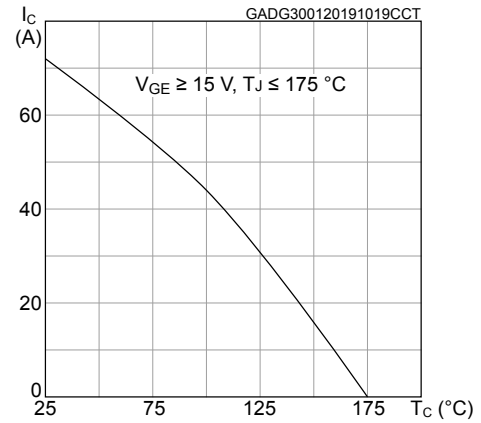
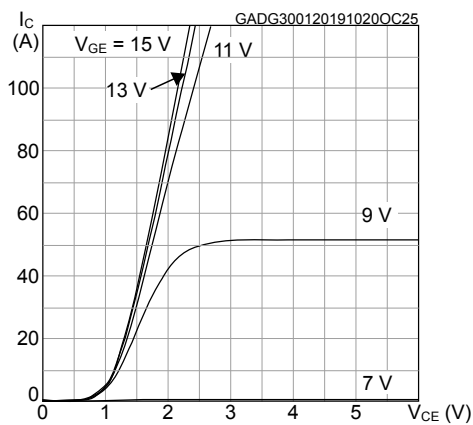
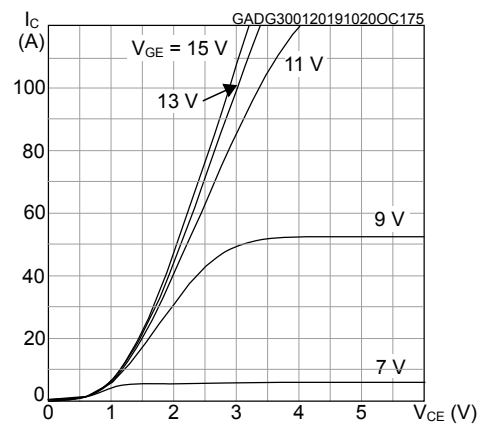
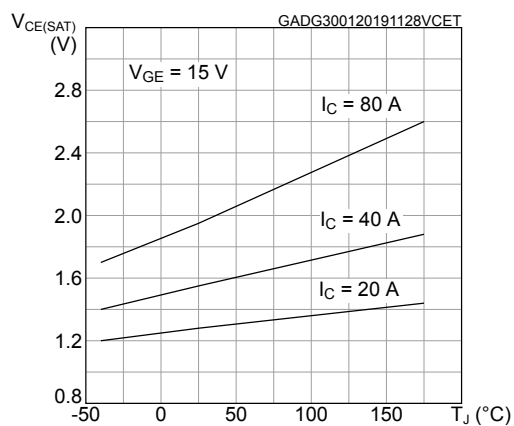
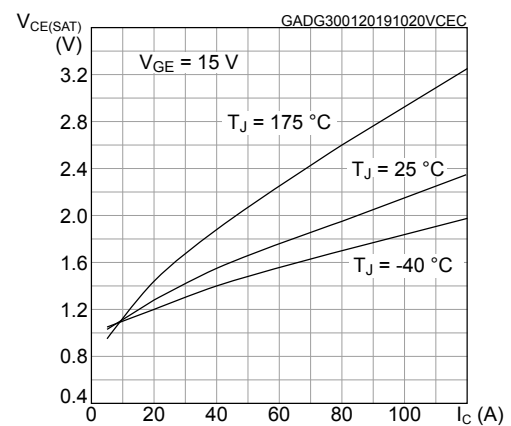
Figure 1. Power dissipation vs case temperature

Figure 2. Collector current vs case temperature

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

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

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

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


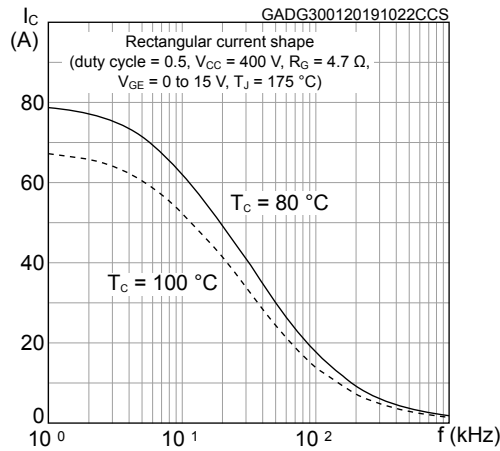
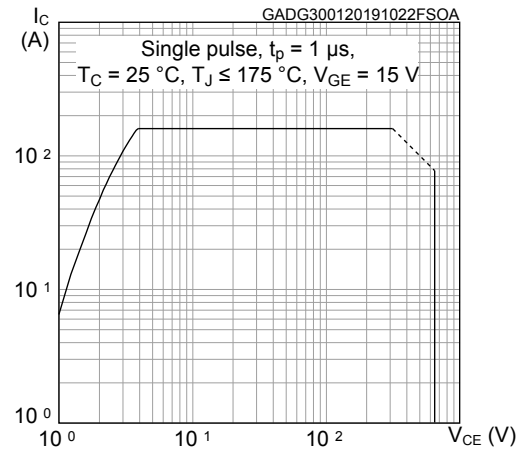
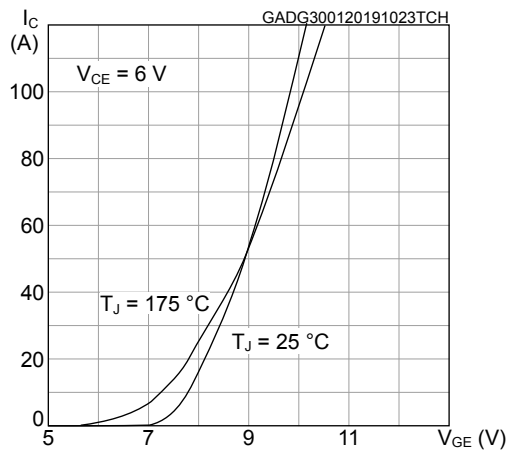
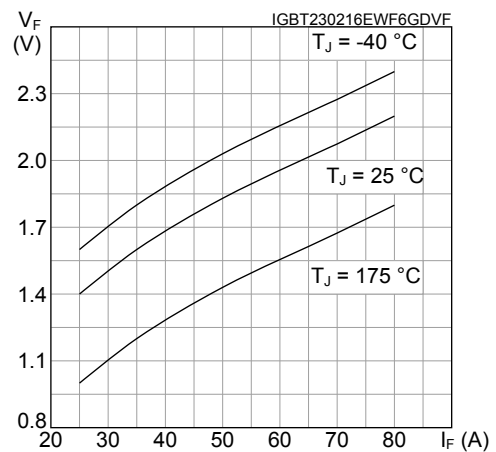
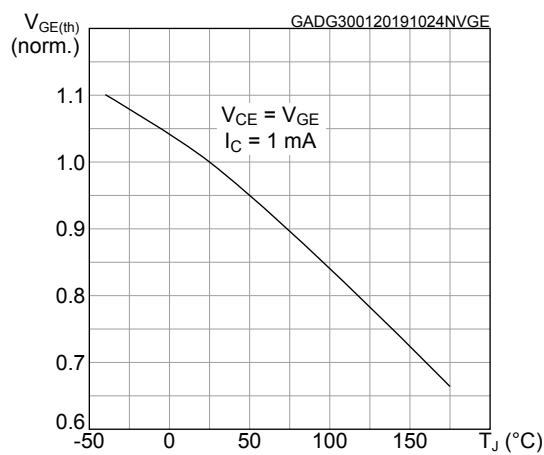
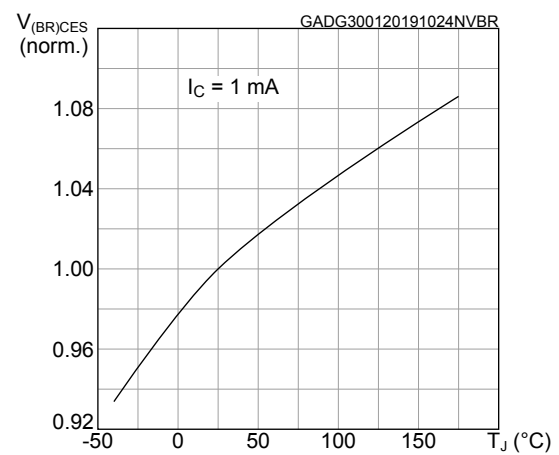
Figure 7. Collector current vs switching frequency

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


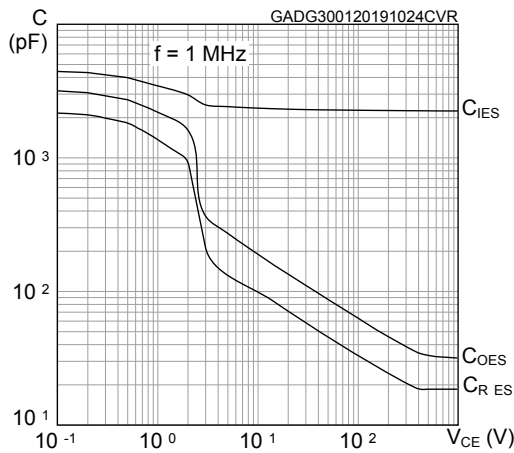
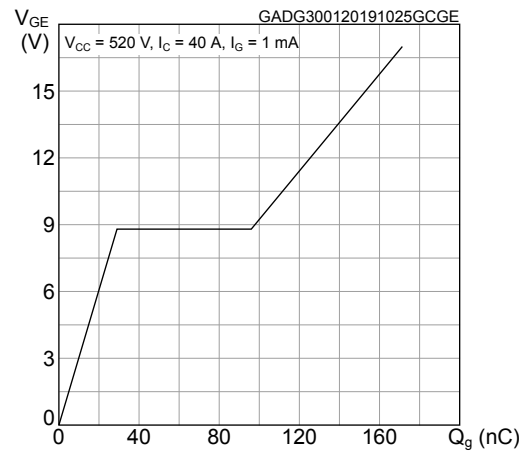
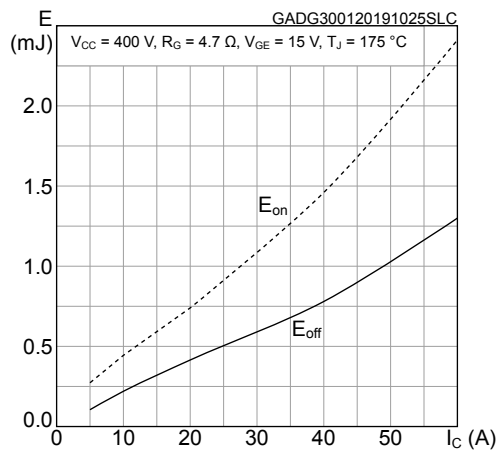
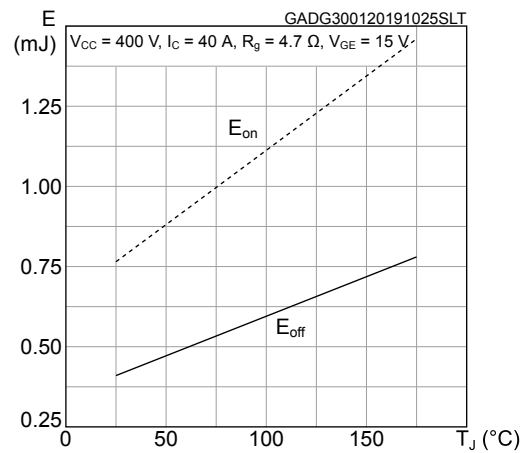
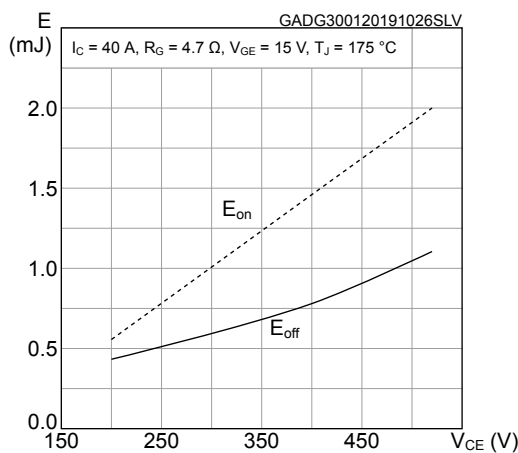
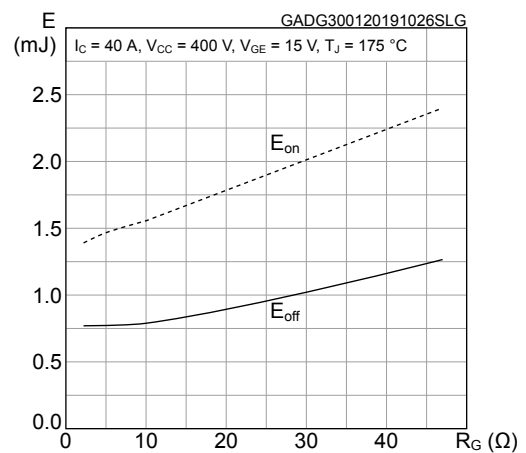
Figure 13. Capacitance variations

Figure 14. Gate charge vs gate-emitter voltage

Figure 15. Switching energy vs collector current

Figure 16. Switching energy vs temperature

Figure 17. Switching energy vs collector emitter voltage

Figure 18. Switching energy vs gate resistance


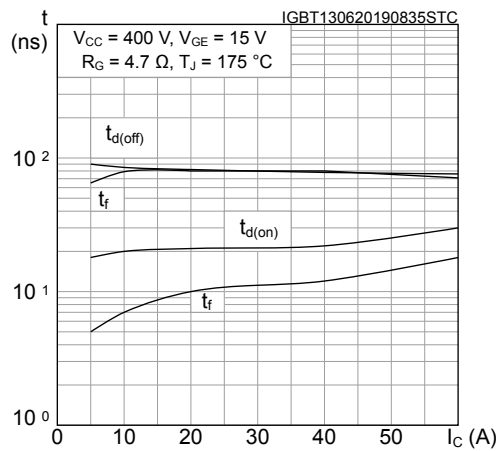
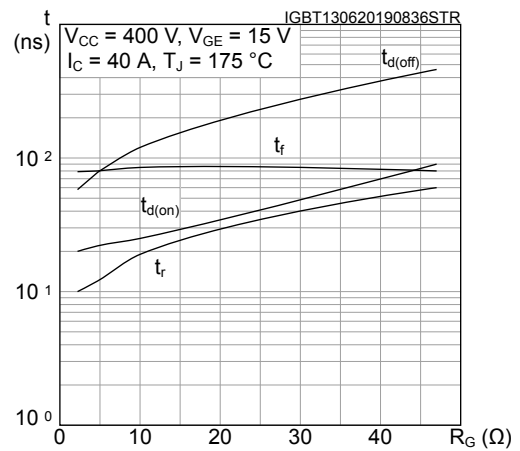
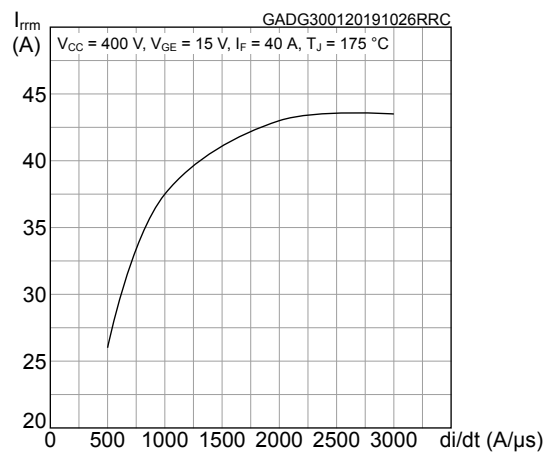
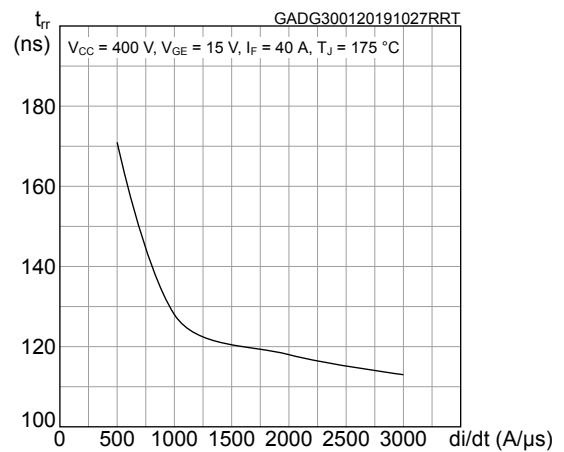
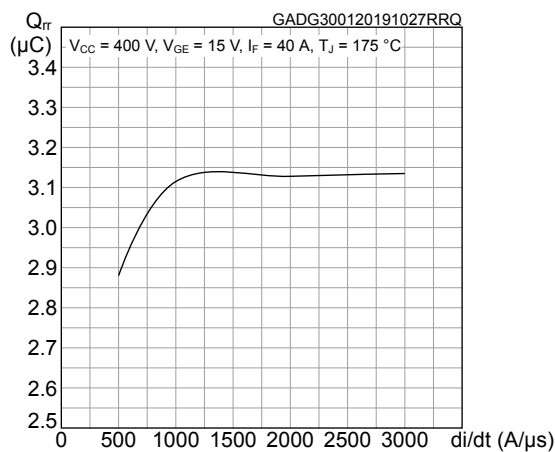
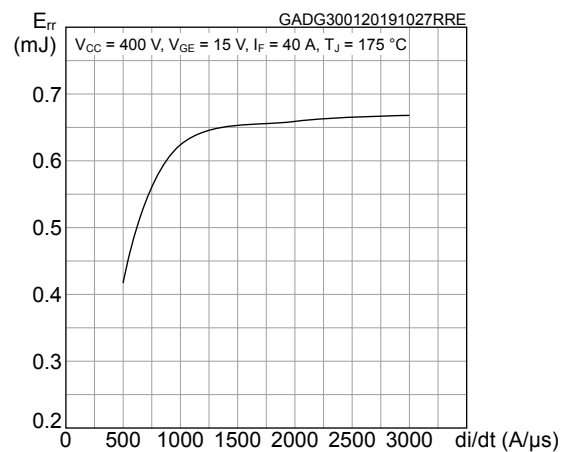
Figure 19. Switching times vs collector current

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

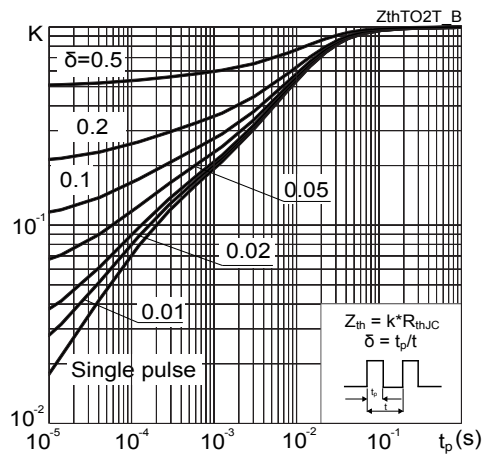
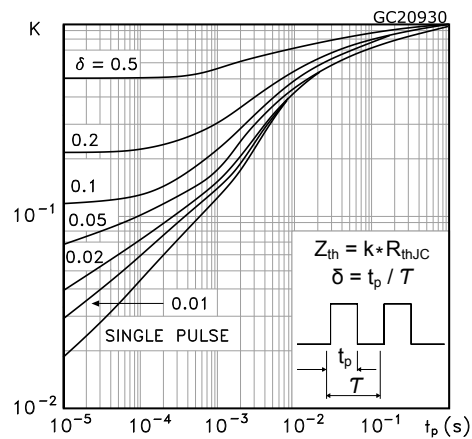
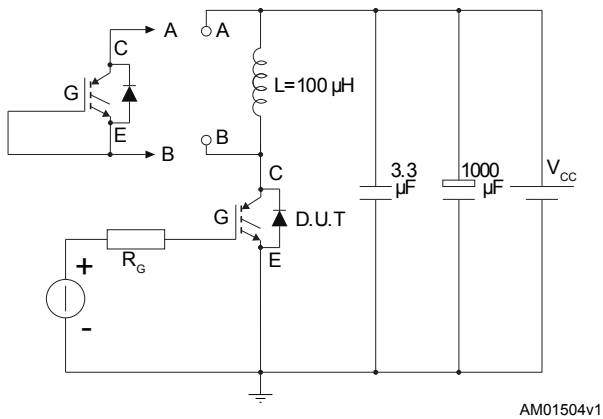
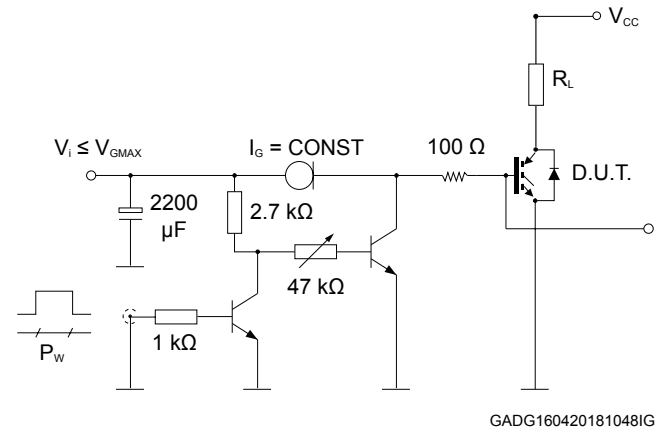
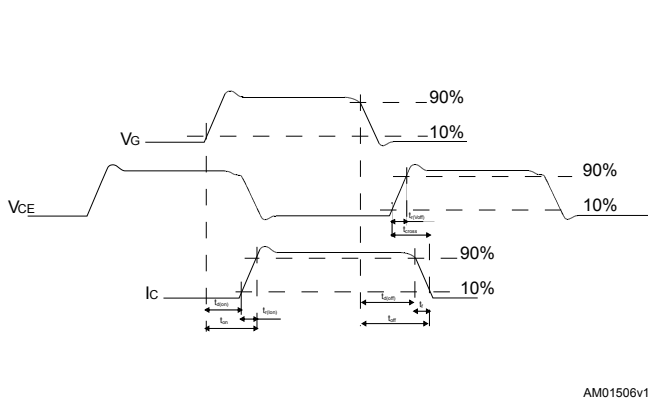
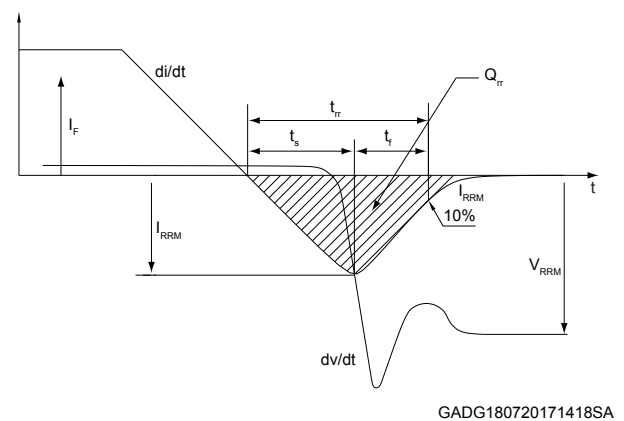


Figure 26. Thermal impedance for diode



3 Test circuits

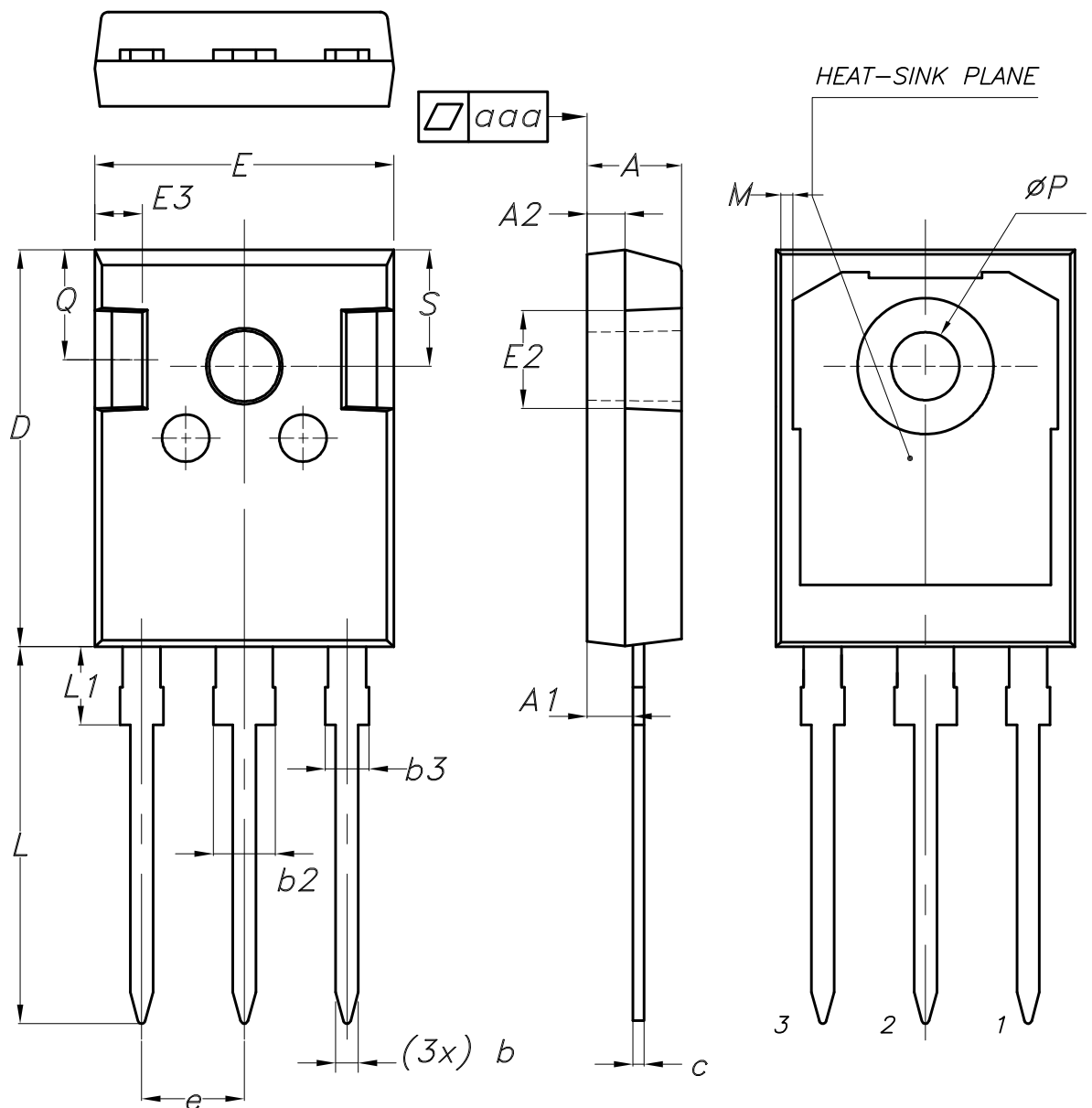
Figure 27. Test circuit for inductive load switching

Figure 28. Gate charge test circuit

Figure 29. Switching waveform

Figure 30. Diode reverse recovery waveform


4 Package information

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 leads package information

Figure 31. TO-247 long leads package outline



BACK VIEW

8463846_5

Table 7. 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
M	0.35		0.95
P	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25
aaa		0.04	0.10

Revision history

Table 8. Document revision history

Date	Version	Changes
15-Mar-2019	1	First release.
12-Jun-2019	2	Modified <i>Table 1. Absolute maximum ratings</i> , <i>Table 2. Thermal data</i> , <i>Table 5. Switching characteristics (inductive load)</i> . Modified <i>Figure 15. Switching energy vs collector current</i> , <i>Figure 16. Switching energy vs temperature</i> , <i>Figure 17. Switching energy vs collector emitter voltage</i> , <i>Figure 18. Switching energy vs gate resistance</i> , <i>Figure 19. Switching times vs collector current</i> and <i>Figure 20. Switching times vs gate resistance</i> . Minor text changes.
08-Oct-2024	3	Updated Section 4.1: TO-247 long leads package information . Minor text changes.

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