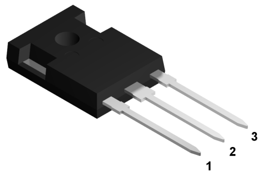
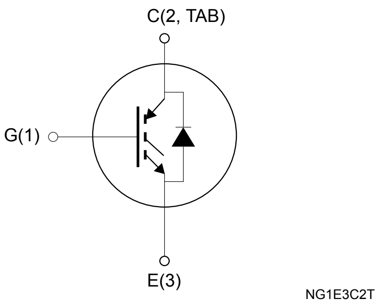
Trench gate field-stop, 650 V, 50 A, high-speed HB2 series IGBT in a TO-247 long leads package



TO-247 long leads



Features

- Maximum junction temperature: T_J = 175 °C
- Low $V_{CE(sat)}$ = 1.55 V(typ.) @ I_C = 50 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
- Power factor correction
- UPS
- Solar inverters
- Chargers

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
STGWA50H65DFB2

Product summary	
Order code	STGWA50H65DFB2
Marking	G50H65DFB2
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 V)	650	V
I_C	Continuous collector current at T_C = 25 °C	86	A
	Continuous collector current at T_C = 100 °C	53	
I_{CP} (1)(2)	Pulsed collector current	150	
V_{GE}	Gate-emitter voltage	±20	V
	Transient gate-emitter voltage ($t_p \leq 10$ µs)	±30	
I_F	Continuous forward current at T_C = 25 °C	60	A
	Continuous forward current at T_C = 100 °C	38	
I_{FP} (1)	Pulsed forward current ($t_p \leq 1$ µs, T_J < 175 °C)	150	
P_{TOT}	Total power dissipation at T_C = 25 °C	272	W
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range	-55 to 175	

1. *Defined by design, not subject to production test.*
2. *Pulse width is limited by maximum junction temperature.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case IGBT	0.55	°C/W
	Thermal resistance junction-case diode	1.14	
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 = 1 mA	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 50 A		1.55	2	V
		V_{GE} = 15 V, I_C = 50 A, T_J = 125 °C		1.8		
		V_{GE} = 15 V, I_C = 50 A, T_J = 175 °C		1.9		
V_F	Forward on-voltage	I_F = 50 A		1.85	2.45	V
		I_F = 50 A, T_J = 125 °C		1.65		
		I_F = 50 A, T_J = 175 °C		1.45		
$V_{GE(th)}$	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	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	-	2928	-	pF
C_{oes}	Output capacitance		-	162	-	
C_{res}	Reverse transfer capacitance		-	78	-	
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 50 A, V_{GE} = 0 to 15 V (see Figure 28. Gate charge test circuit)	-	151	-	nC
Q_{ge}	Gate-emitter charge		-	30	-	
Q_{gc}	Gate-collector charge		-	63	-	

Table 5. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CC} = 400 V, I_C = 50 A, V_{GE} = 15 V, R_G = 4.7 Ω (see Figure 27. Test circuit for inductive load switching)	-	28	-	ns
t_r	Current rise time		-	20	-	ns
E_{on} (1)	Turn-on switching energy		-	910	-	μJ
$t_{d(off)}$	Turn-off delay time		-	115	-	ns
t_f	Current fall time		-	40	-	ns
E_{off} (2)	Turn-off switching energy		-	580	-	μJ
$t_{d(on)}$	Turn-on delay time	V_{CC} = 400 V, I_C = 50 A, V_{GE} = 15 V, R_G = 4.7 Ω, T_J = 175 °C (see Figure 27. Test circuit for inductive load switching)	-	24	-	ns
t_r	Current rise time		-	17	-	ns
E_{on} (1)	Turn-on switching energy		-	1800	-	μJ
$t_{d(off)}$	Turn-off delay time		-	135	-	ns
t_f	Current fall time		-	90	-	ns
E_{off} (2)	Turn-off switching energy		-	1090	-	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 = 50 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 1000 A/μs (see Figure 30. Diode reverse recovery waveform)	-	92	-	ns
Q_{rr}	Reverse recovery charge		-	673	-	nC
I_{rrm}	Reverse recovery current		-	20.9	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	675	-	A/μs
E_{rr}	Reverse recovery energy		-	138	-	μJ
t_{rr}	Reverse recovery time	I_F = 50 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 1000 A/μs, T_J = 175 °C (see Figure 30. Diode reverse recovery waveform)	-	209	-	ns
Q_{rr}	Reverse recovery charge		-	3500	-	nC
I_{rrm}	Reverse recovery current		-	45.8	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	600	-	A/μs
E_{rr}	Reverse recovery energy		-	841	-	μJ

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature

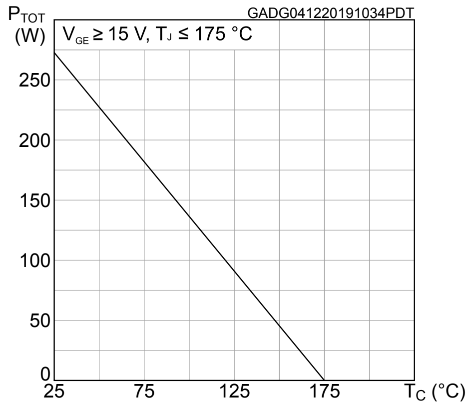


Figure 2. Collector current vs case temperature

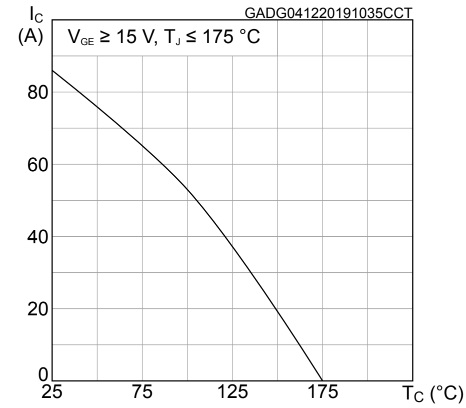


Figure 3. Output characteristics (T_J = 25 °C)

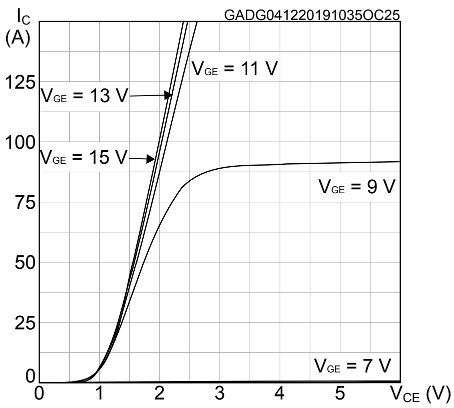


Figure 4. Output characteristics (T_J = 175 °C)

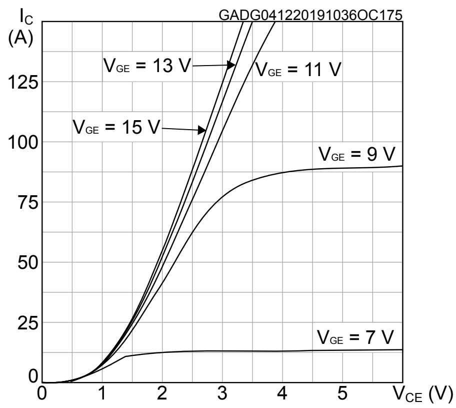


Figure 5. $V_{CE(sat)}$ vs junction temperature

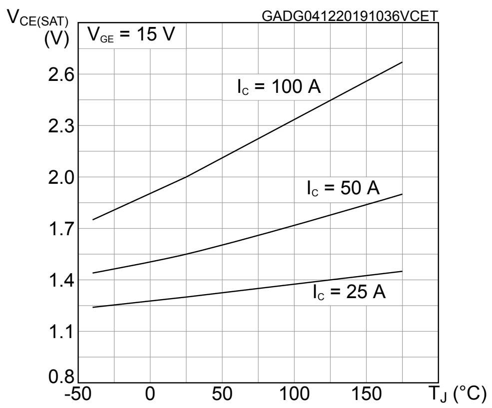


Figure 6. $V_{CE(sat)}$ vs collector current

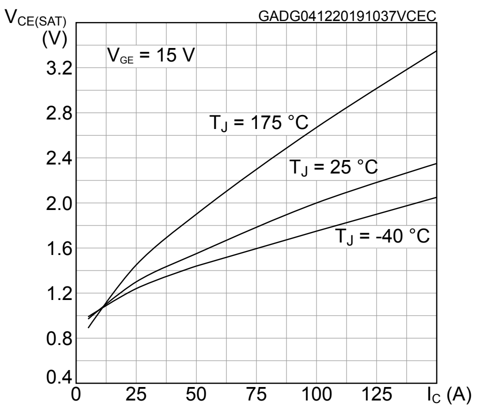


Figure 7. Collector current vs switching frequency

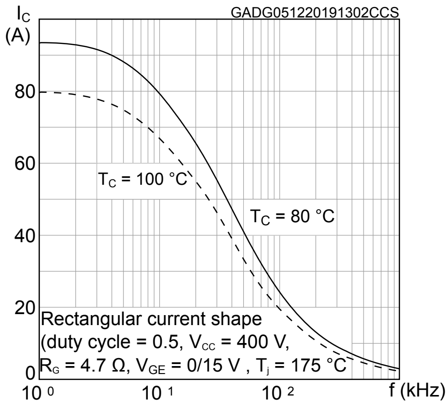


Figure 8. Forward bias safe operating area

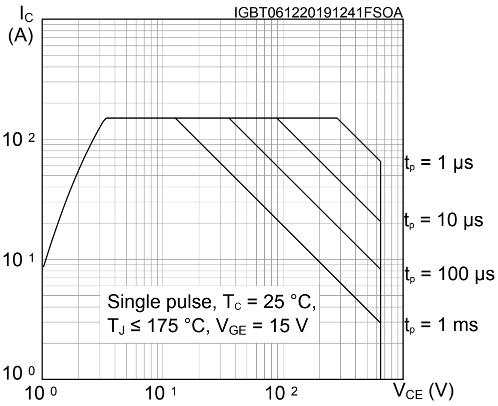


Figure 9. Transfer characteristics

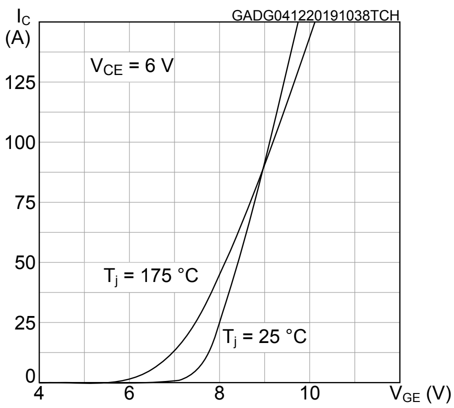


Figure 10. Diode V_F vs forward current

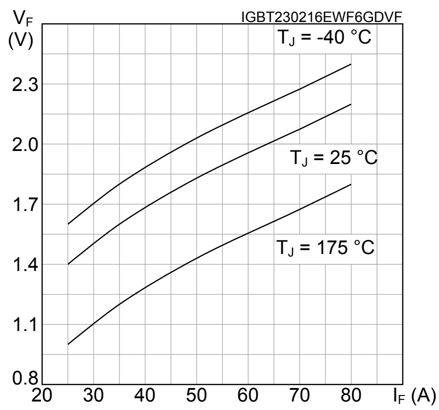


Figure 11. Normalized $V_{GE(th)}$ vs junction temperature

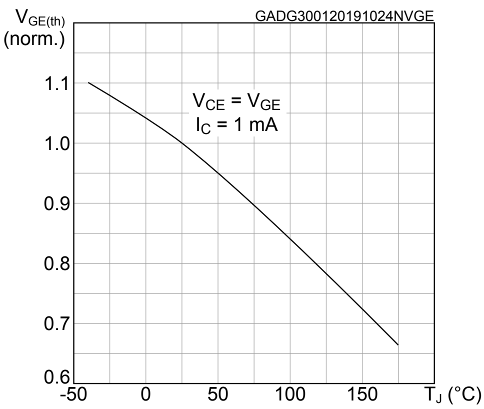
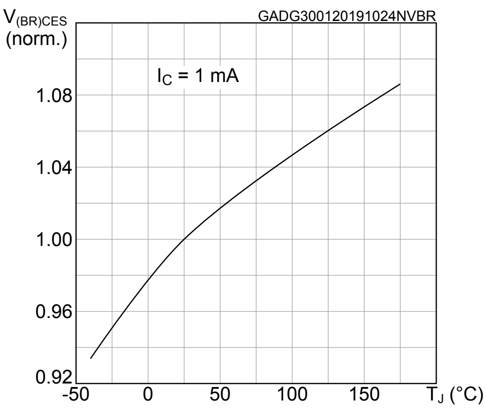


Figure 12. Normalized $V_{(BR)CES}$ vs junction temperature



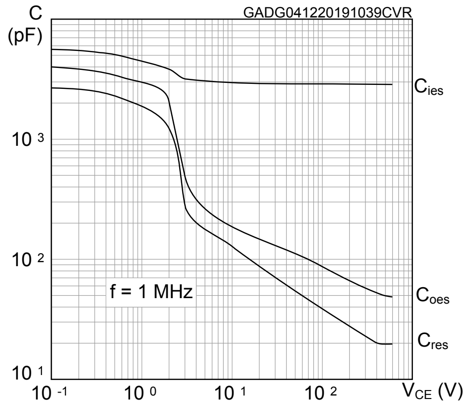


Figure 13. Capacitance variations

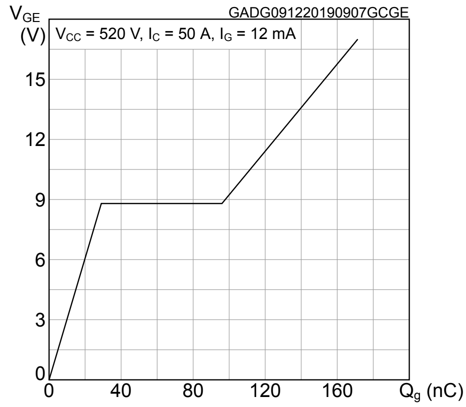


Figure 14. Gate charge vs gate-emitter voltage

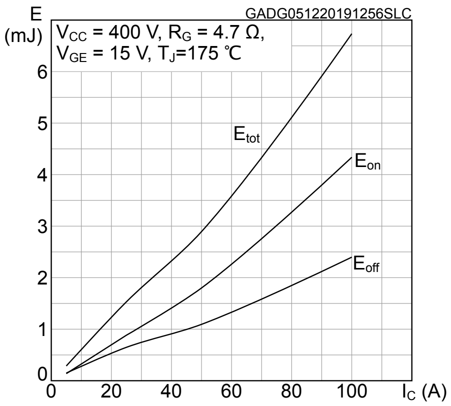


Figure 15. Switching energy vs collector current

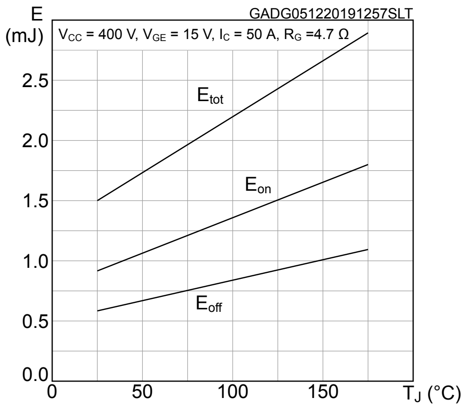


Figure 16. Switching energy vs temperature

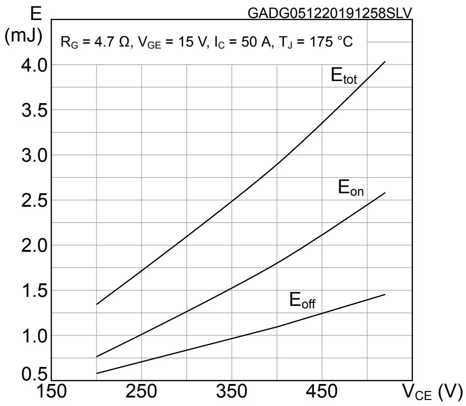


Figure 17. Switching energy vs collector emitter voltage

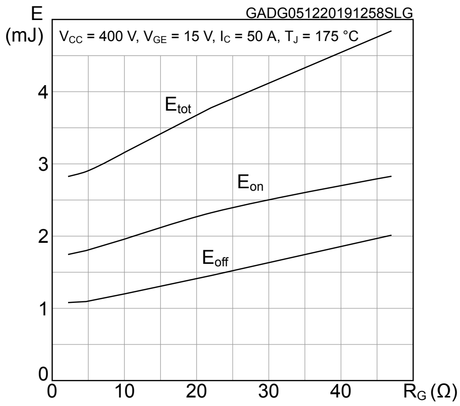


Figure 18. Switching energy vs gate resistance

Figure 19. Switching times vs collector current

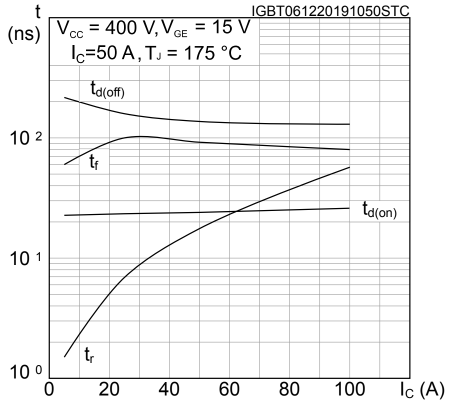


Figure 20. Switching times vs gate resistance

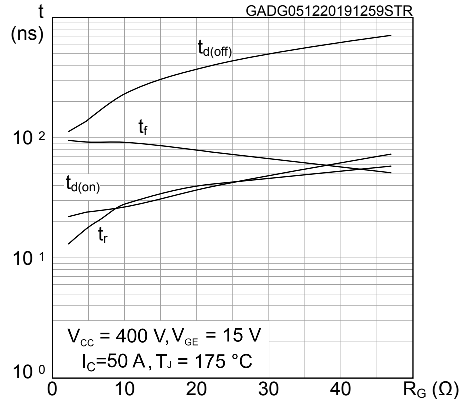


Figure 21. Reverse recovery current vs diode current slope

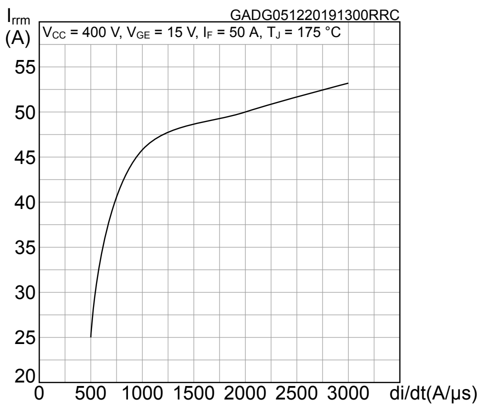


Figure 22. Reverse recovery time vs diode current slope

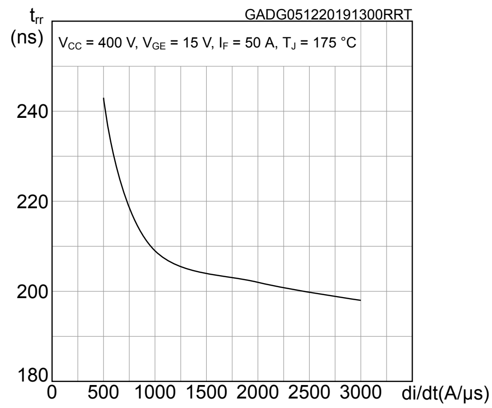


Figure 23. Reverse recovery charge vs diode current slope

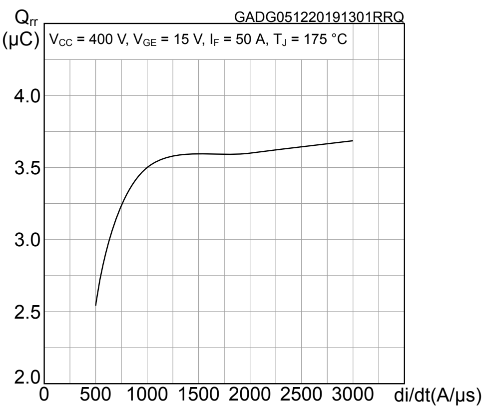


Figure 24. Reverse recovery energy vs diode current slope

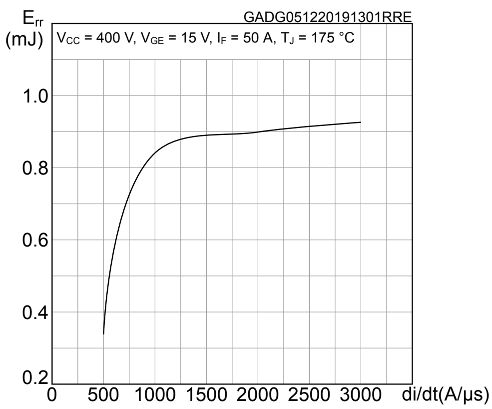


Figure 25. Thermal impedance for IGBT

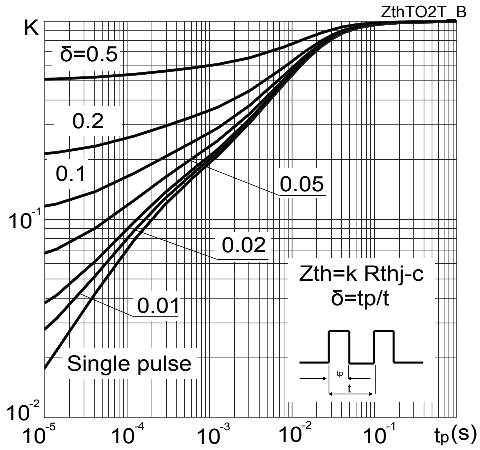
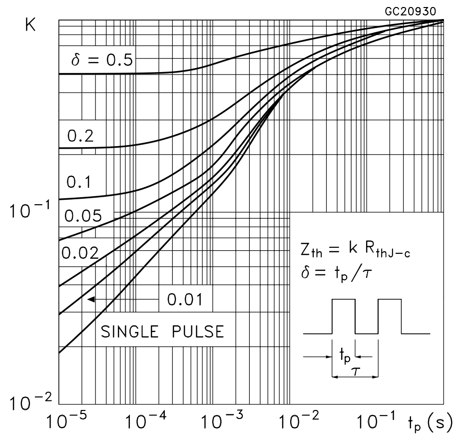


Figure 26. Thermal impedance for diode



3 Test circuits

Figure 27. Test circuit for inductive load switching

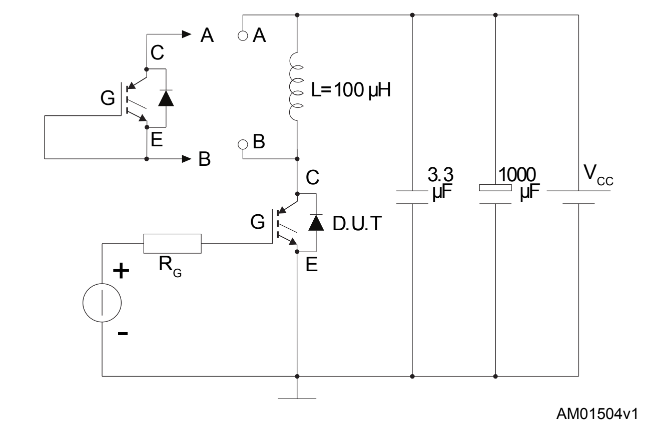


Figure 28. Gate charge test circuit

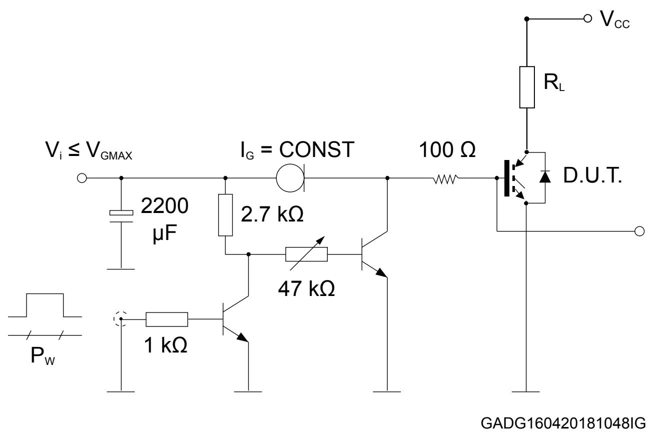


Figure 29. Switching waveform

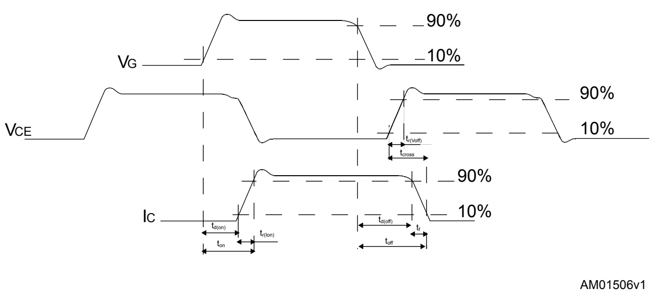
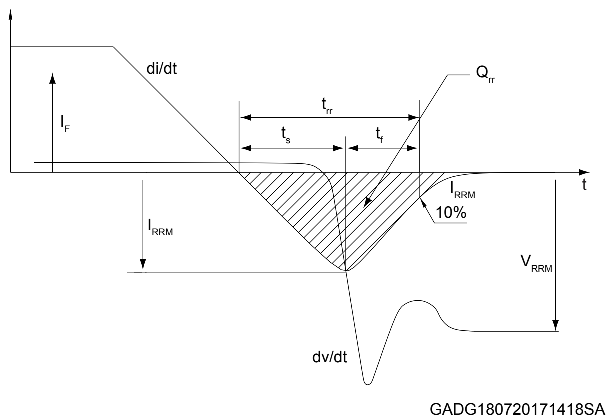


Figure 30. Diode reverse recovery waveform



4 Package information

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 leads package information

Figure 31. TO-247 long leads package outline

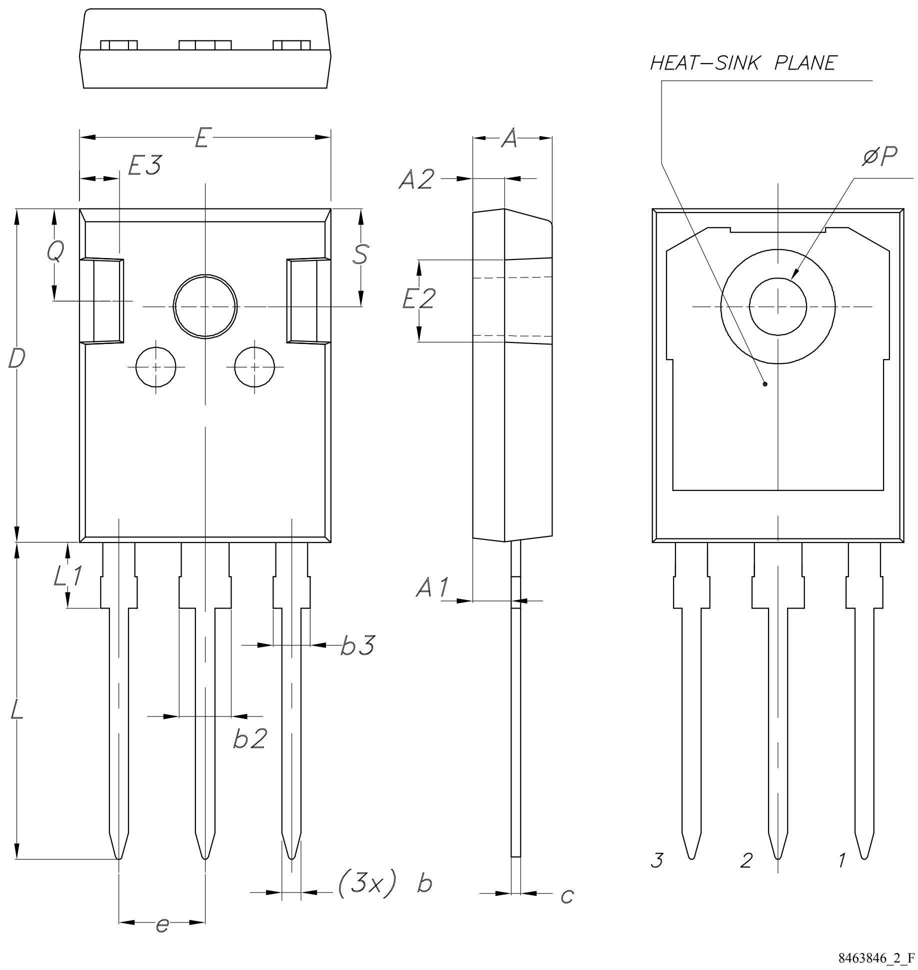


Table 7. TO-247 long leads package mechanical data

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
P	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25

Revision history

Table 8. **Document revision history**

Date	Version	Changes
09-Dec-2019	1	First release.

Contents