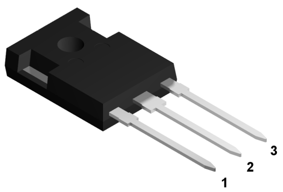
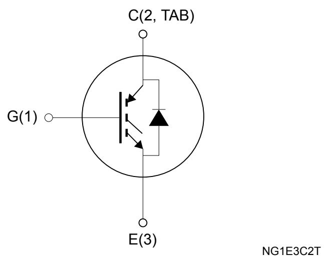
GWA75H65DRFB2AG

Datasheet

Automotive-grade trench gate field-stop, 650 V, 75 A, high-speed HB2 series IGBT in a TO-247 long leads package



TO-247 long leads



Product status link
GWA75H65DRFB2AG

Product summary	
Order code	GWA75H65DRFB2AG
Marking	G75H65DRFB2AG
Package	TO-247 long leads
Packing	Tube

Features

- AEC-Q101 qualified
- Maximum junction temperature: T_J = 175 °C
- Low $V_{CE(sat)}$ = 1.6 V (typ.) @ I_C = 75 A
- Co-packed with high ruggedness rectifier diode
- Minimized tail current
- Tight parameter distribution
- Low thermal resistance
- Positive $V_{CE(sat)}$ temperature coefficient

Applications

- DC/DC converter for EV/HEV
- On board charger (OBC)

Description

The newest IGBT 650 V HB2 series represents an evolution of the advanced proprietary trench gate field-stop structure. The performances are optimized both in conduction and switching energies for hard switching application. In this configuration, it has been co-packed with a high ruggedness rectifier diode targeting heavy duty and high reliability automotive applications.

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	123	A
	Continuous collector current at T_C = 100 °C	75	
I_{CP} [(1)]	Pulsed collector current ($t_p \leq$ 1 ms, T_J < 175 °C)	240	A
V_{GE}	Gate-emitter voltage	±20	V
	Transient gate-emitter voltage ($t_p \leq$ 10 µs, D < 0.01)	±30	
I_F	Continuous forward current at T_C = 25 °C	195	A
	Continuous forward current at T_C = 100 °C	75	
I_{FP} [(1)]	Pulsed forward current ($t_p \leq$ 1 ms, T_J < 175 °C)	240	A
P_{TOT}	Total power dissipation at T_C = 25 °C	395	W
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range	-55 to 175	°C

1. *Specified by design, not tested in production.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case, IGBT	0.38	°C/W
	Thermal resistance, junction-to-case, diode	0.38	
R_{thJA}	Thermal resistance, junction-to-ambient	50	°C/W

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 = 75 A		1.6	2	V
		V_{GE} = 15 V, I_C = 75 A, T_J = 125 °C		1.8		
		V_{GE} = 15 V, I_C = 75 A, T_J = 175 °C		1.9		
V_F	Forward on-voltage	I_F = 75 A		1.15	1.5	V
		I_F = 75 A, T_J = 125 °C		1.1		
		I_F = 75 A, T_J = 175 °C		1.07		
$V_{GE(th)}$	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	-	4400	-	pF
C_{oes}	Output capacitance		-	209	-	pF
C_{res}	Reverse transfer capacitance		-	120	-	pF
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 75 A, V_{GE} = 0 to 15 V (see Figure 28. Gate charge test circuit)	-	253	-	nC
Q_{ge}	Gate-emitter charge		-	33	-	nC
Q_{gc}	Gate-collector charge		-	126	-	nC

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 = 75 A, V_{GE} = 15 V, R_G = 2.2 Ω (see Figure 27. Test circuit for inductive load switching)	-	28	-	ns
t_r	Current rise time		-	46.7	-	ns
E_{on} (1)	Turn-on switching energy		-	12.9	-	mJ
$t_{d(off)}$	Turn-off delay time		-	103	-	ns
t_f	Current fall time		-	29	-	ns
E_{off} (2)	Turn-off switching energy		-	0.9	-	mJ
$t_{d(on)}$	Turn-on delay time	V_{CC} = 400 V, I_C = 75 A, V_{GE} = 15 V, R_G = 2.2 Ω, T_J = 175 °C (see Figure 27. Test circuit for inductive load switching)	-	28	-	ns
t_r	Current rise time		-	44	-	ns
E_{on} (1)	Turn-on switching energy		-	14.2	-	mJ
$t_{d(off)}$	Turn-off delay time		-	122	-	ns
t_f	Current fall time		-	70	-	ns
E_{off} (2)	Turn-off switching energy		-	14.7	-	mJ

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 = 75 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 400 A/μs (see Figure 30. Diode reverse recovery waveform)	-	710	-	ns
Q_{rr}	Reverse recovery charge		-	44.6	-	μC
I_{rrm}	Reverse recovery current		-	120	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	290	-	A/μs
E_{rr}	Reverse recovery energy		-	7.45	-	mJ
t_{rr}	Reverse recovery time	I_F = 75 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 400 A/μs, T_J = 175 °C (see Figure 30. Diode reverse recovery waveform)	-	870	-	ns
Q_{rr}	Reverse recovery charge		-	54.5	-	μC
I_{rrm}	Reverse recovery current		-	122	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	223	-	A/μs
E_{rr}	Reverse recovery energy		-	9.2	-	mJ

2.1 Electrical characteristics (curves)

Figure 1. Total power dissipation vs temperature

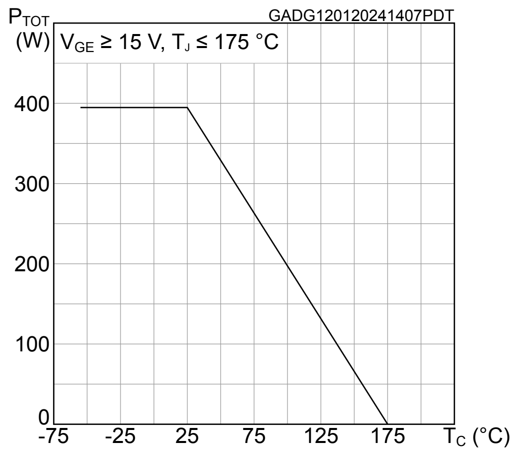


Figure 2. Collector current vs temperature

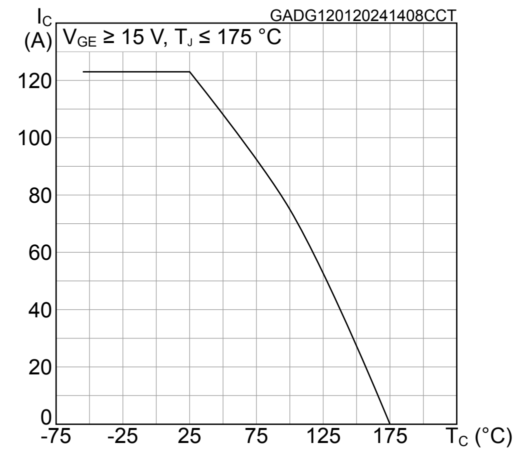


Figure 3. Typical output characteristics (T_J = 25 °C)

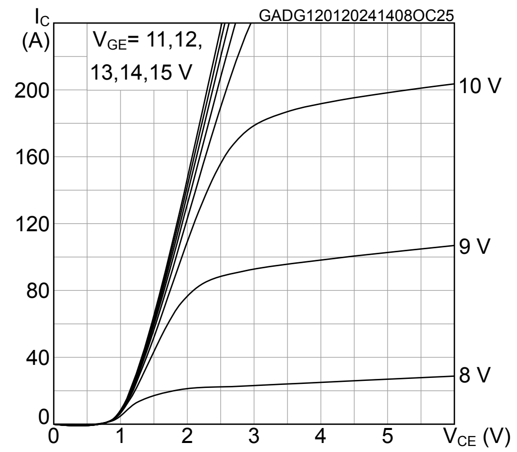


Figure 4. Typical output characteristics (T_J = 175 °C)

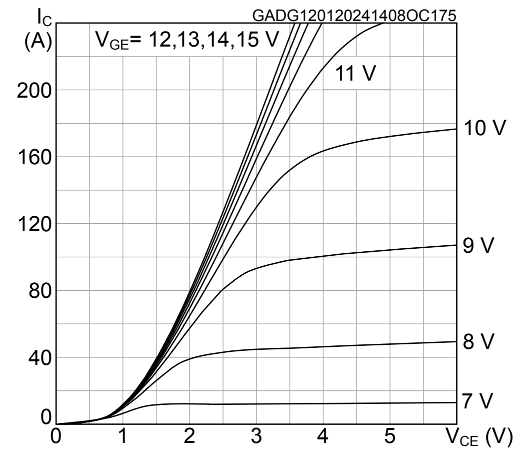


Figure 5. Typical transfer characteristics

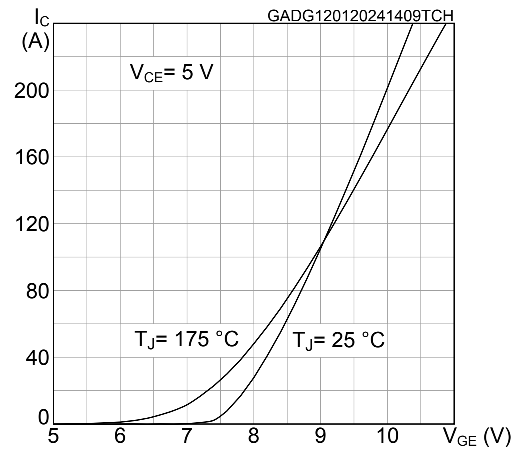


Figure 6. Typical $V_{CE(sat)}$ vs temperature

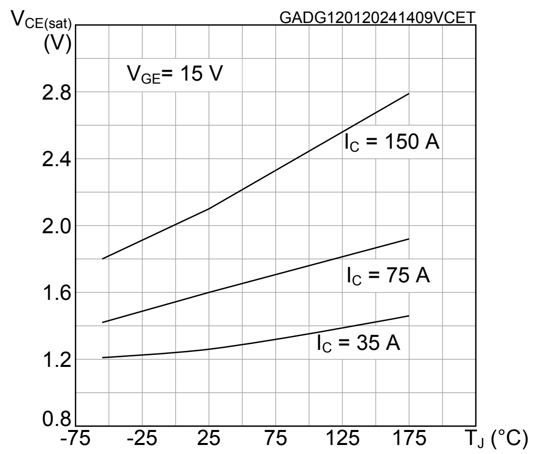


Figure 7. Typical $V_{CE(sat)}$ vs collector current

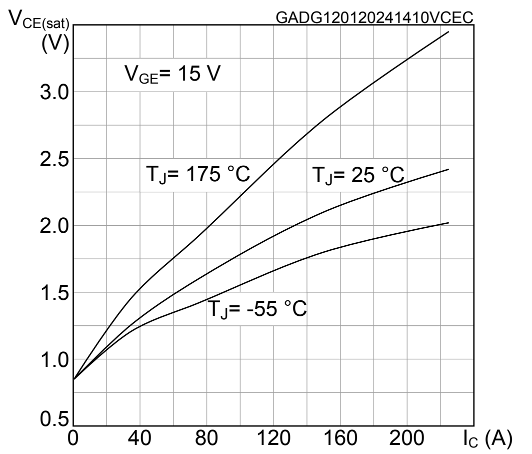


Figure 8. Forward bias safe operating area

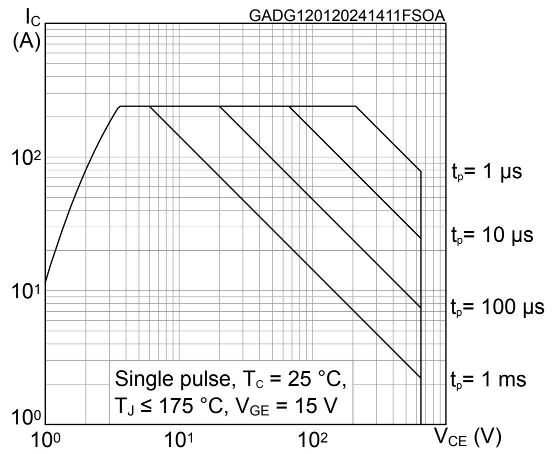


Figure 9. Diode typical V_F vs forward current

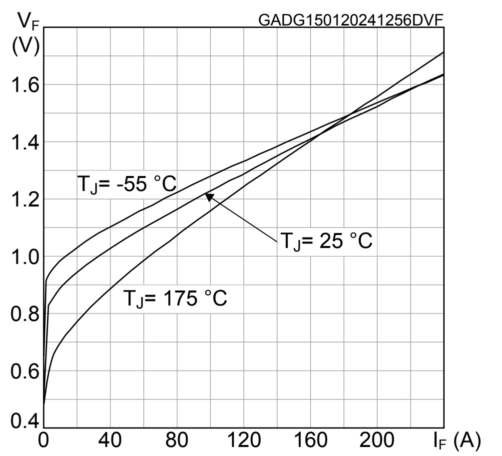


Figure 10. Typical I_C vs switching frequency

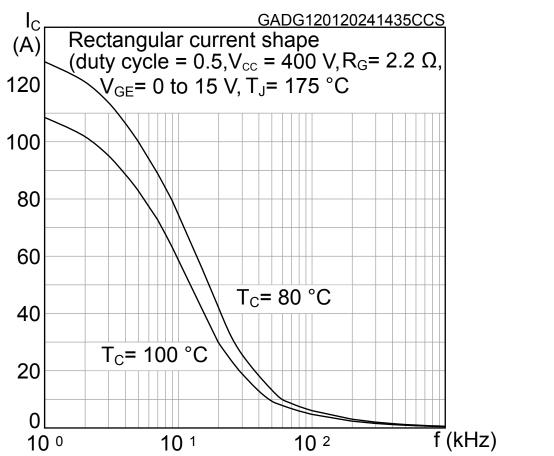


Figure 11. Normalized $V_{GE(th)}$ vs junction temperature

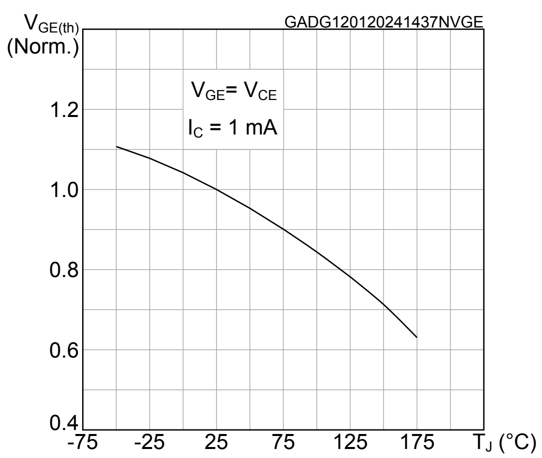


Figure 12. Normalized $V_{(BR)CES}$ vs junction temperature

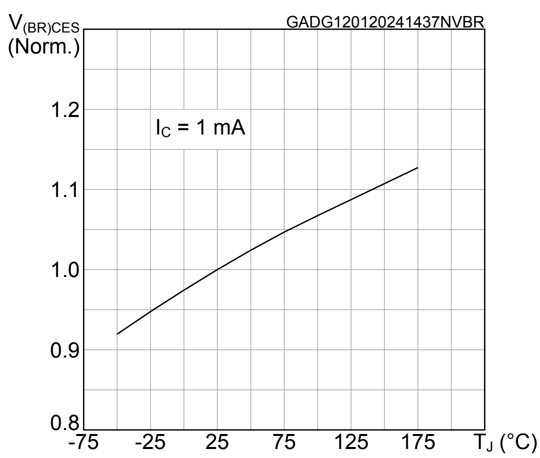


Figure 13. Typical capacitance characteristics

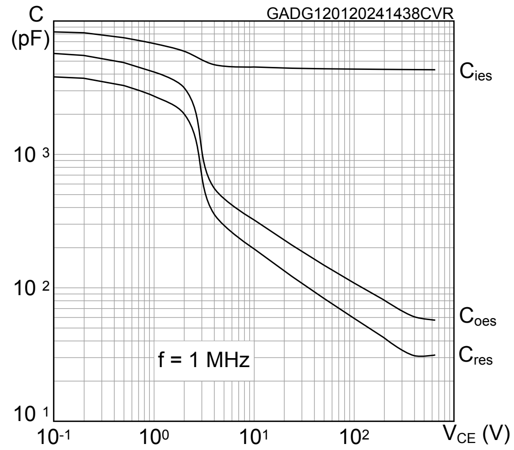


Figure 14. Typical gate charge characteristics

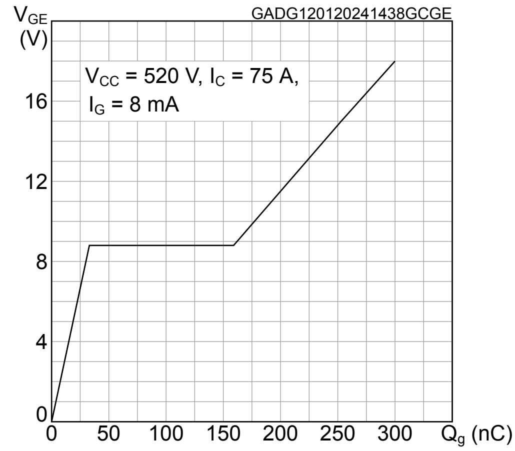


Figure 15. Typical switching energy vs collector current

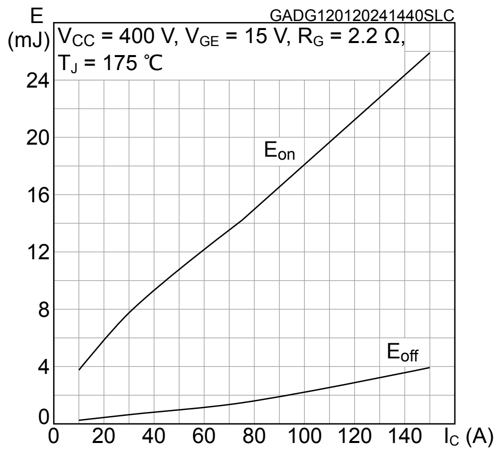


Figure 16. Typical switching energy vs temperature

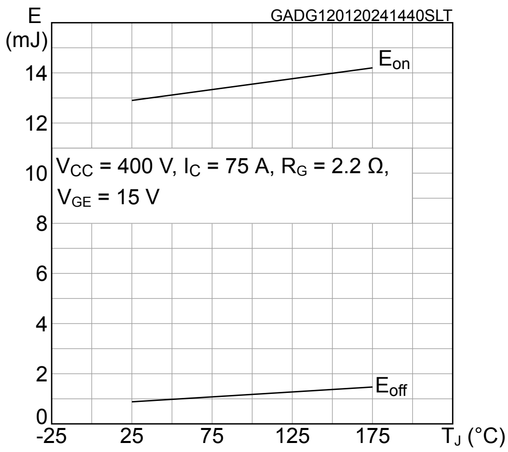


Figure 17. Typical switching energy vs V_{CE}

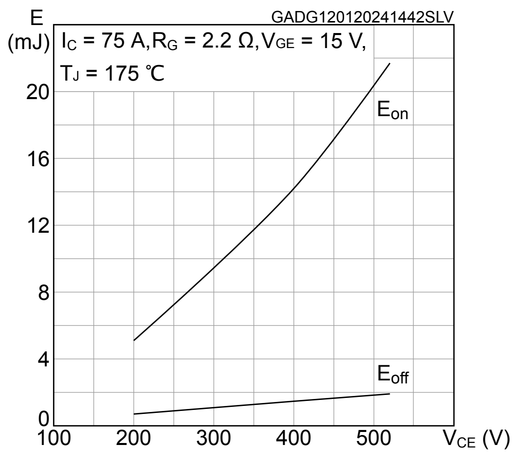


Figure 18. Typical switching energy vs gate resistance

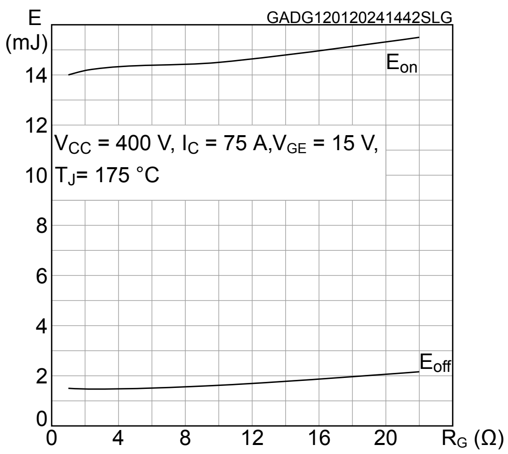


Figure 19. Typical switching times vs collector current

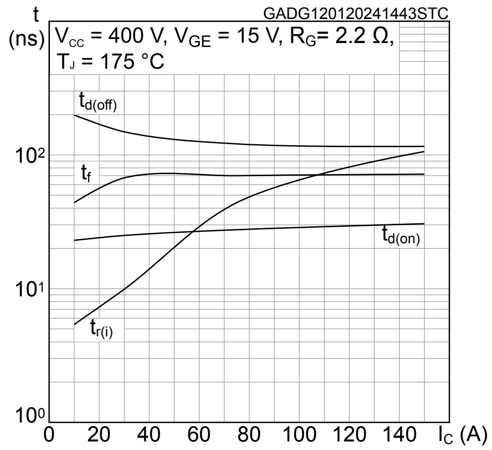


Figure 20. Typical switching times vs gate resistance

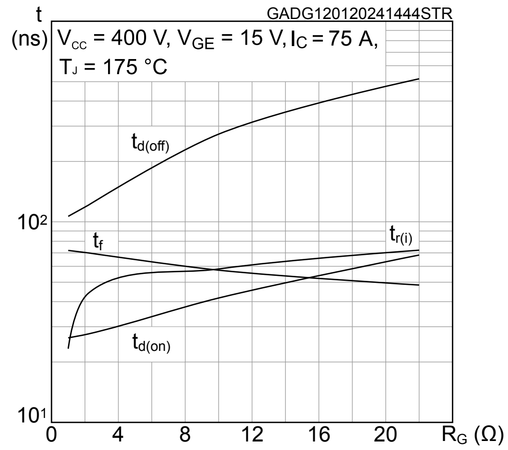


Figure 21. Typical reverse recovery current vs diode current slope

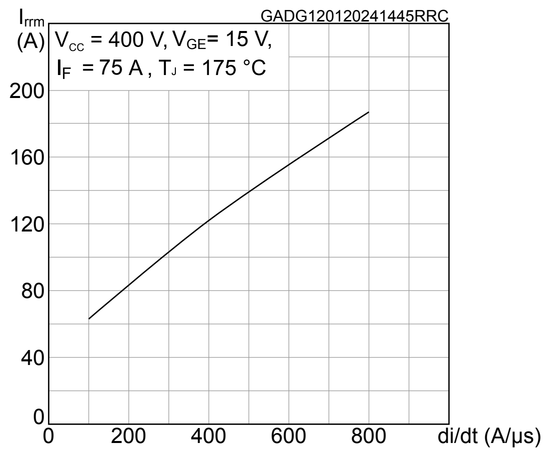


Figure 22. Typical reverse recovery time vs diode current slope

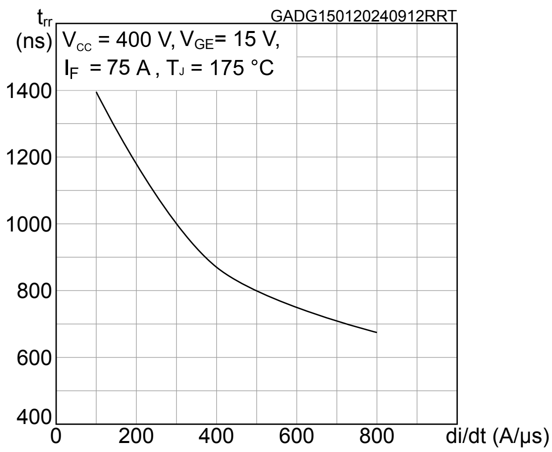


Figure 23. Typical reverse recovery charge vs diode current slope

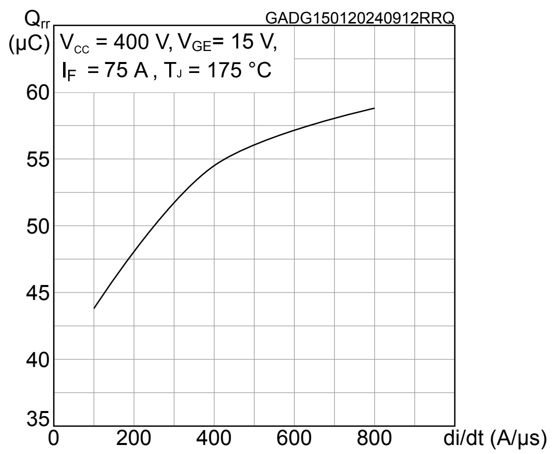


Figure 24. Typical reverse recovery energy vs diode current slope

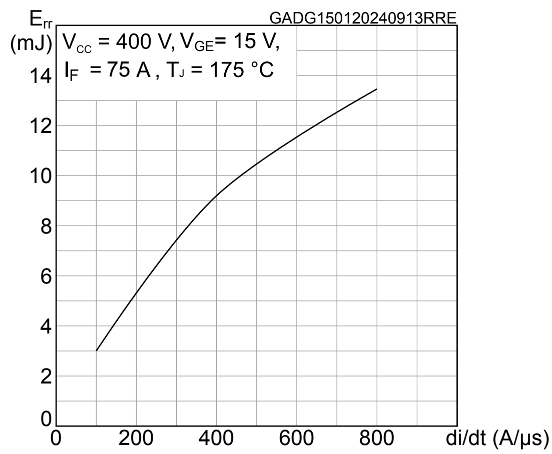


Figure 25. IGBT maximum transient thermal impedance

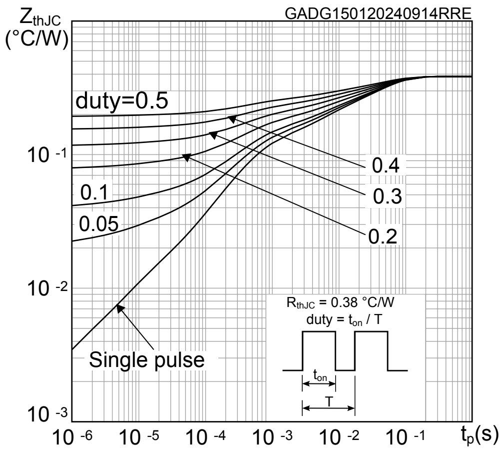
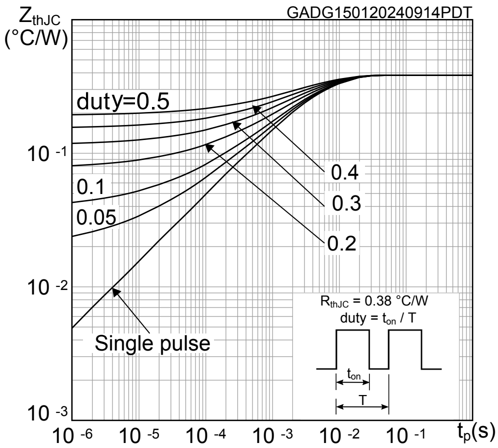


Figure 26. Diode maximum transient thermal impedance



3 Test circuits

Figure 27. Test circuit for inductive load switching

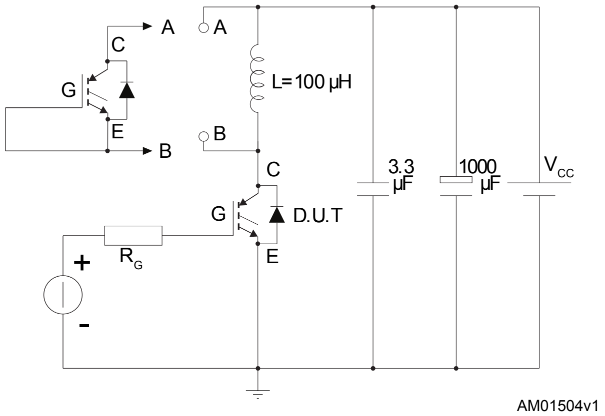


Figure 28. Gate charge test circuit

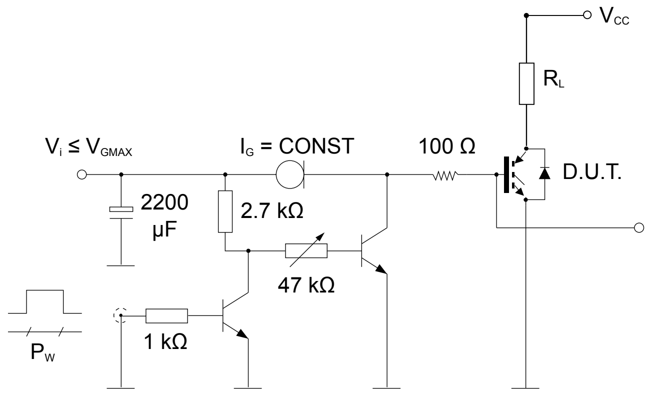


Figure 29. Switching waveform

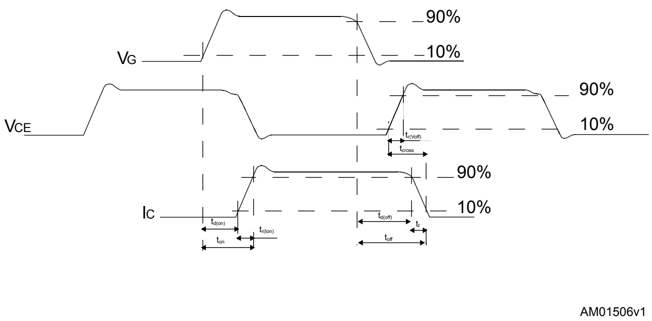
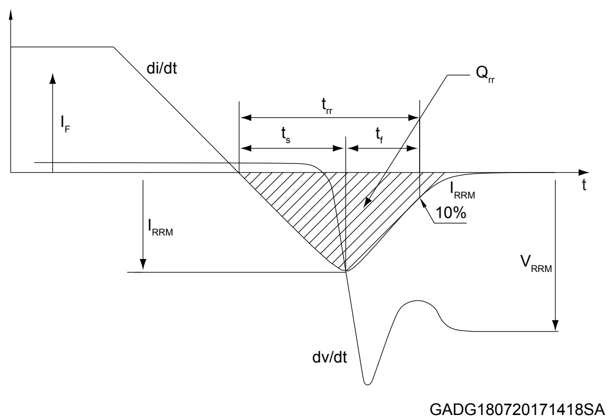


Figure 30. Diode reverse recovery waveform



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

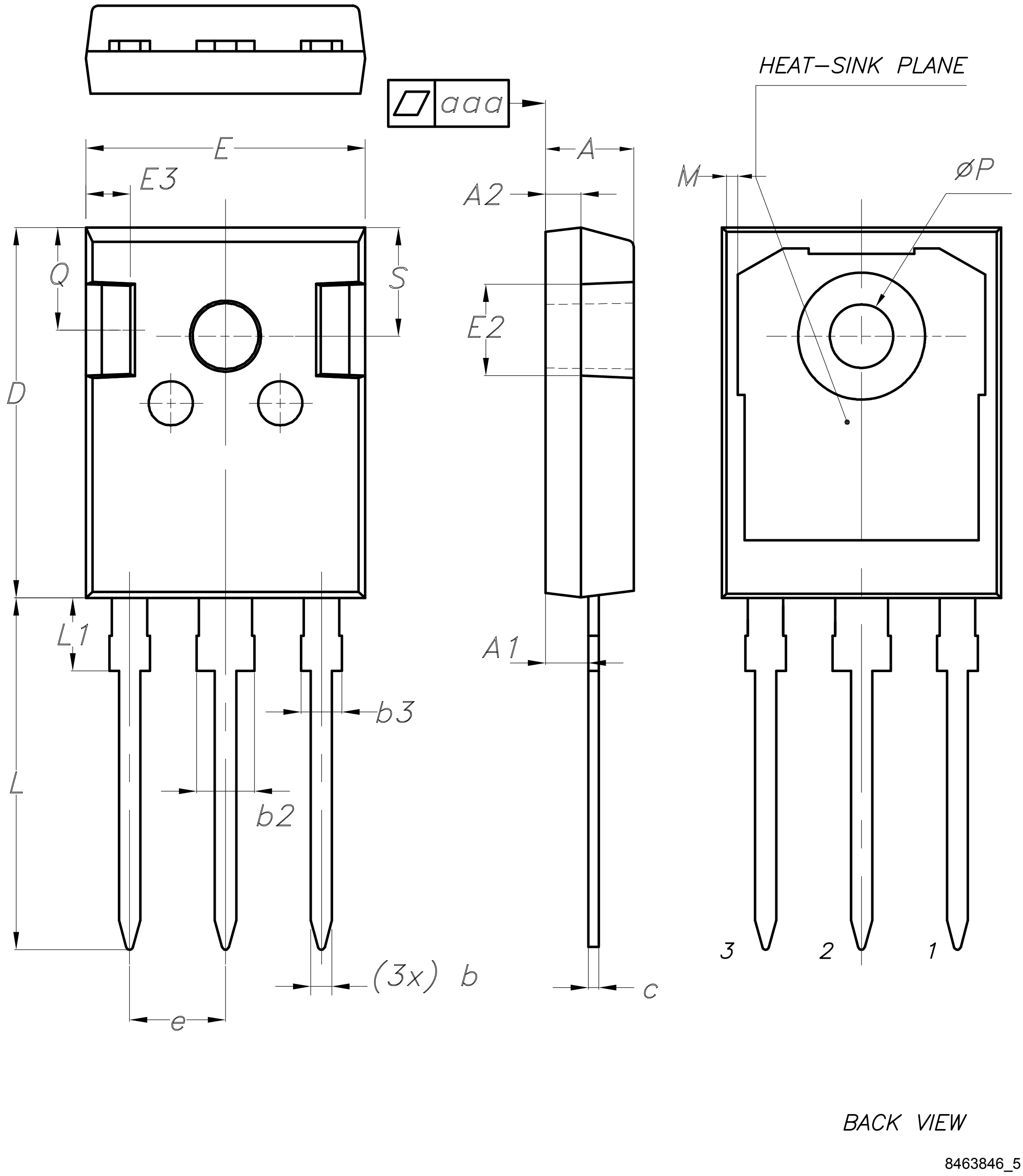


Table 7. **TO-247 long leads package mechanical data**

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
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	Revision	Changes
17-Jan-2024	1	First release.

Contents