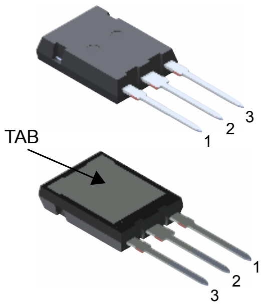
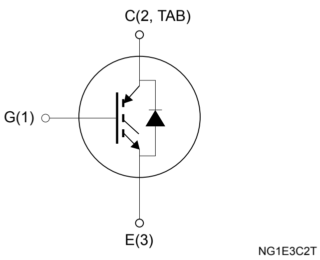
STGYA50H120DF2

Datasheet

Trench gate field-stop, 1200 V, 50 A, high-speed H series IGBT in a Max247 long leads package



Max247 long leads



Product status link
STGYA50H120DF2

Product summary	
Order code	STGYA50H120DF2
Marking	G50H120DF2
Package	Max247 long leads
Packing	Tube

Features

- Maximum junction temperature: T_J = 175 °C
- 5 µs of short-circuit withstand time
- Low $V_{CE(sat)}$ = 2.1 V (typ.) @ I_C = 50 A
- Tight parameter distribution
- Positive $V_{CE(sat)}$ temperature coefficient
- Low thermal resistance
- Very fast recovery antiparallel diode

Applications

- UPS
- Solar inverters
- Welding
- PFC

Description

This device is IGBT developed using an advanced proprietary trench gate field-stop structure. This device is part of the H series of IGBTs, which represent an optimum compromise between conduction and switching losses to maximize the efficiency of high switching frequency converters. Moreover, a slightly positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	1200	V
I_C	Continuous collector current at T_C = 25 °C	100	A
	Continuous collector current at T_C = 100 °C	50	
I_{CP} (1)	Pulsed collector current	200	A
V_{GE}	Gate-emitter voltage	±20	V
I_F	Continuous forward current at T_C = 25 °C	100	A
	Continuous forward current at T_C = 100 °C	50	
I_{FP} (1)	Pulsed forward current	200	A
P_{TOT}	Total power dissipation at T_C = 25 °C	535	W
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range	-55 to 175	°C

1. *Pulse width is limited by maximum junction temperature.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case IGBT	0.28	°C/W
	Thermal resistance, junction-to-case diode	0.62	
R_{thJA}	Thermal resistance, junction-to-ambient	50	°C/W

2 Electrical characteristics

T_J = 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 = 2 mA	1200			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 50 A		2.1	2.6	V
		V_{GE} = 15 V, I_C = 50 A, T_J = 125 °C		2.35		
		V_{GE} = 15 V, I_C = 50 A, T_J = 175 °C		2.5		
V_F	Forward on-voltage	I_F = 50 A		3.8		V
		I_F = 50 A, T_J = 125 °C		2.8		
		I_F = 50 A, T_J = 175 °C		2.6		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 2 mA	5	6	7	V
I_{CES}	Collector cut-off current	V_{GE} = 0 V, V_{CE} = 1200 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	-	4150	-	pF
C_{oes}	Output capacitance		-	288	-	pF
C_{res}	Reverse transfer capacitance		-	104	-	pF
Q_g	Total gate charge	V_{CC} = 960 V, I_C = 50 A, V_{GE} = 0 to 15 V (see Figure 29. Gate charge test circuit)	-	210	-	nC
Q_{ge}	Gate-emitter charge		-	29	-	nC
Q_{gc}	Gate-collector charge		-	103	-	nC

Table 5. IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CE} = 600 V, I_C = 50 A, V_{GE} = 15 V, R_G = 10 Ω (see Figure 28. Test circuit for inductive load switching)		40	-	ns
t_r	Current rise time			23	-	ns
$(di/dt)_{on}$	Turn-on current slope			1800	-	A/μs
$t_{d(off)}$	Turn-off delay time			284	-	ns
t_f	Current fall time			54	-	ns
E_{on} (1)	Turn-on switching energy			2	-	mJ
E_{off} (2)	Turn-off switching energy			2.1	-	mJ
E_{ts}	Total switching energy			4.1	-	mJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 600 V, I_C = 50 A, V_{GE} = 15 V, R_G = 10 Ω, T_J = 175 °C (see Figure 28. Test circuit for inductive load switching)		36	-	ns
t_r	Current rise time			27	-	ns
$(di/dt)_{on}$	Turn-on current slope			1490	-	A/μs
$t_{d(off)}$	Turn-off delay time			313	-	ns
t_f	Current fall time			167	-	ns
E_{on} (1)	Turn-on switching energy			3.18	-	mJ
E_{off} (2)	Turn-off switching energy			3.47	-	mJ
E_{ts}	Total switching energy			6.65	-	mJ
t_{sc}	Short-circuit withstand time	V_{CC} ≤ 600 V, V_{GE} = 15 V, T_{Jstart} ≤ 150 °C	5		-	μs

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 = 600 V, V_{GE} = 15 V, di/dt = 1550 A/μs (see Figure 28. Test circuit for inductive load switching)	-	340	-	ns
Q_{rr}	Reverse recovery charge		-	1.7	-	μC
I_{rrm}	Reverse recovery current		-	22	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	1310	-	A/μs
E_{rr}	Reverse recovery energy		-	0.71	-	mJ
t_{rr}	Reverse recovery time	I_F = 50 A, V_R = 600 V, V_{GE} = 15 V, di/dt = 1550 A/μs, T_J = 175 °C (see Figure 28. Test circuit for inductive load switching)	-	724	-	ns
Q_{rr}	Reverse recovery charge		-	6.7	-	μC
I_{rrm}	Reverse recovery current		-	37	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	210	-	A/μs
E_{rr}	Reverse recovery energy		-	3	-	mJ

2.1 Electrical characteristics (curves)

Figure 1. **Total power dissipation vs temperature**

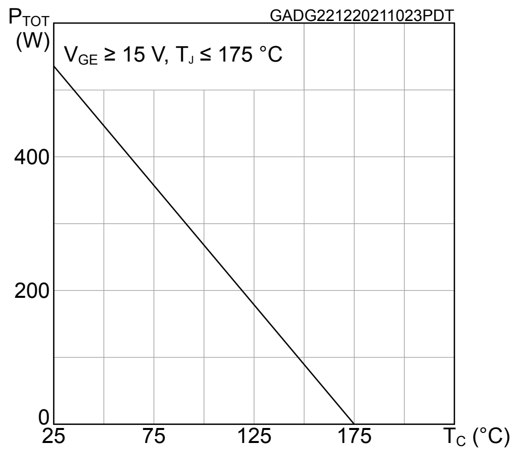


Figure 2. **Collector current vs case temperature**

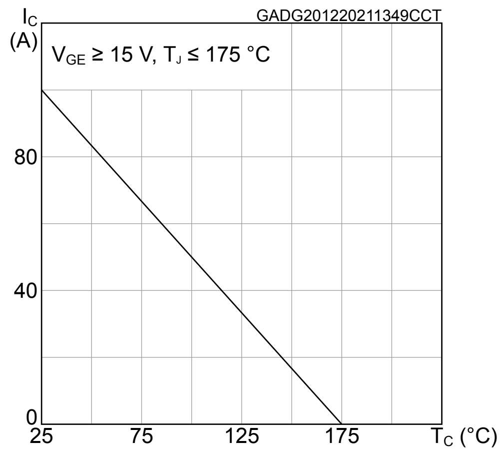


Figure 3. **Output characteristics (T_J = 25 °C)**

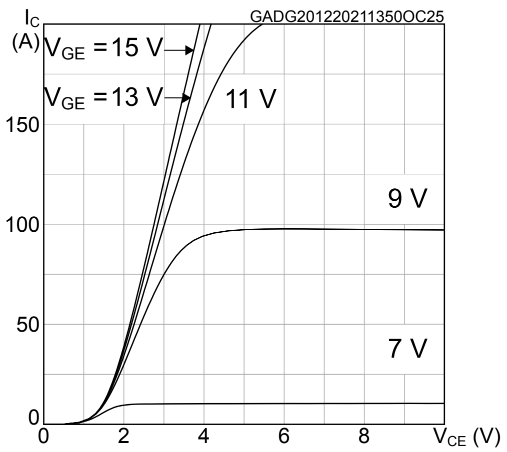


Figure 4. **Output characteristics (T_J = 175 °C)**

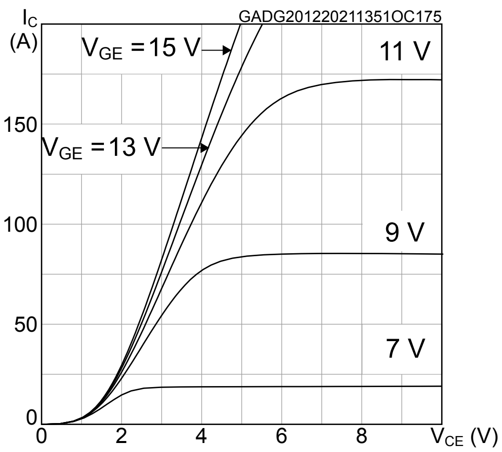


Figure 5. **$V_{CE(sat)}$ vs junction temperature**

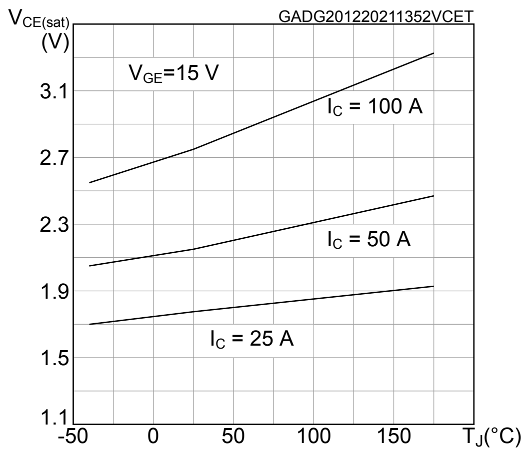


Figure 6. **$V_{CE(sat)}$ vs collector current**

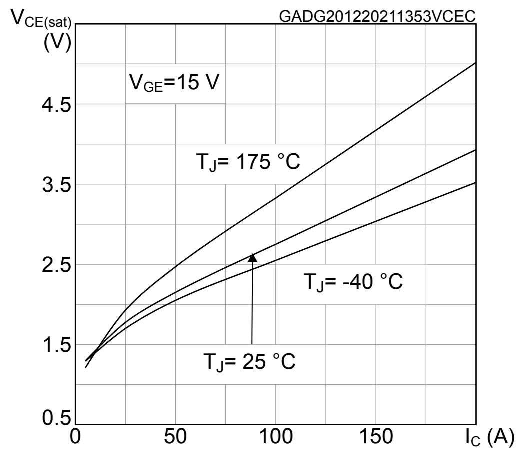


Figure 7. Collector current vs switching frequency

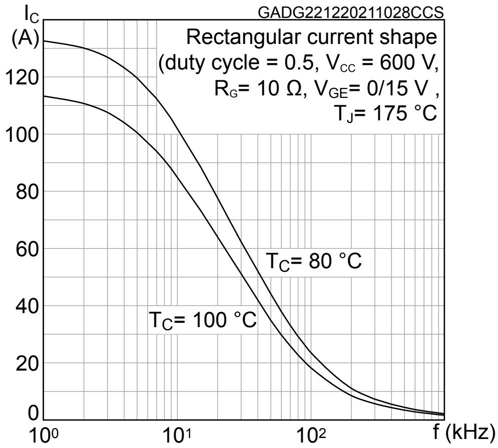


Figure 8. Safe operating area

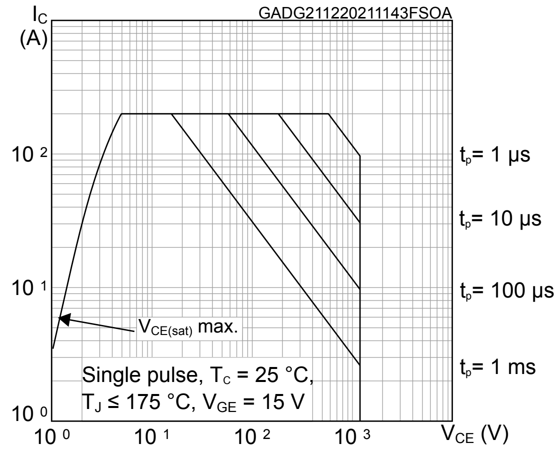


Figure 9. Transfer characteristics

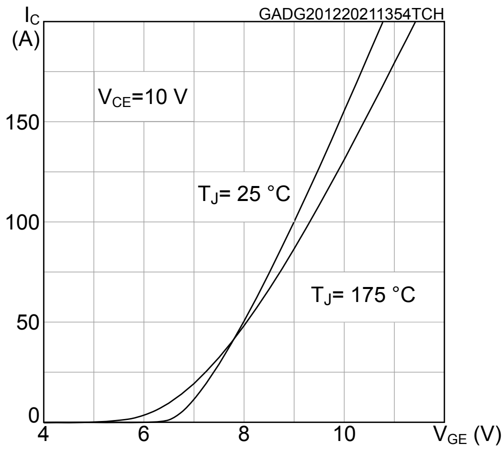


Figure 10. Diode V_F vs forward current

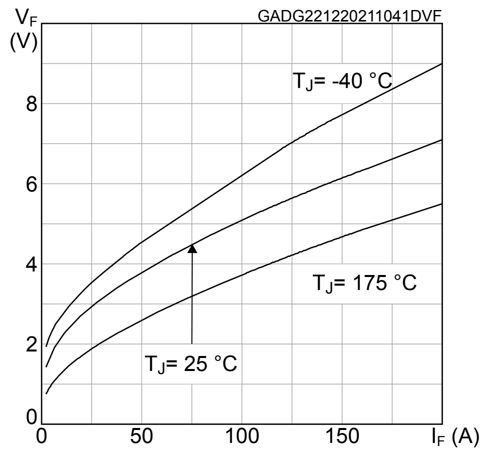


Figure 11. Normalized $V_{GE(th)}$ vs junction temperature

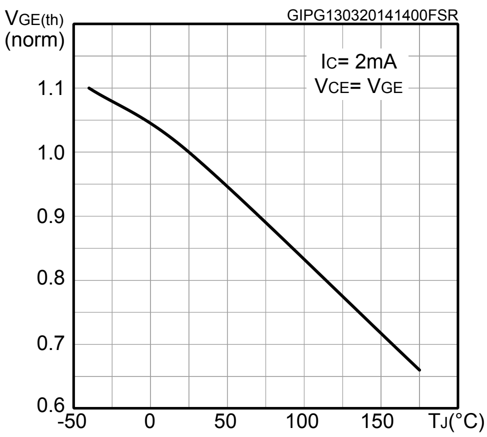


Figure 12. Normalized $V_{(BR)CES}$ vs junction temperature

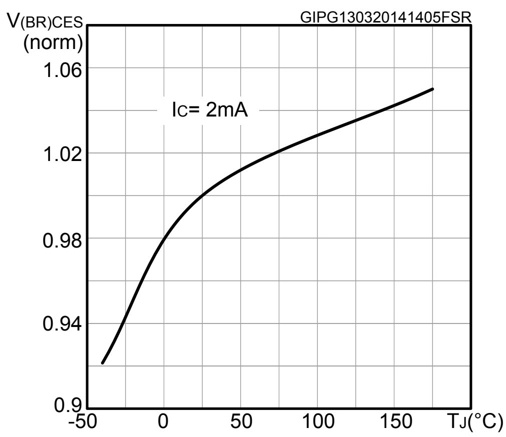


Figure 13. Capacitance variations

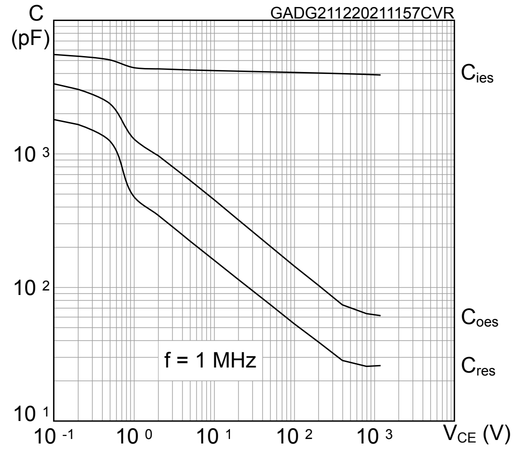


Figure 14. Gate charge vs gate-emitter voltage

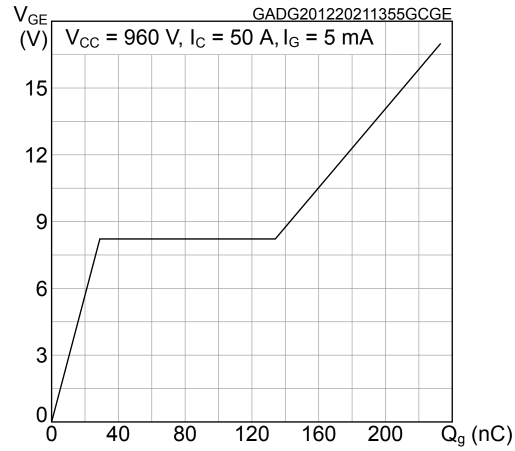


Figure 15. Switching energy vs collector current

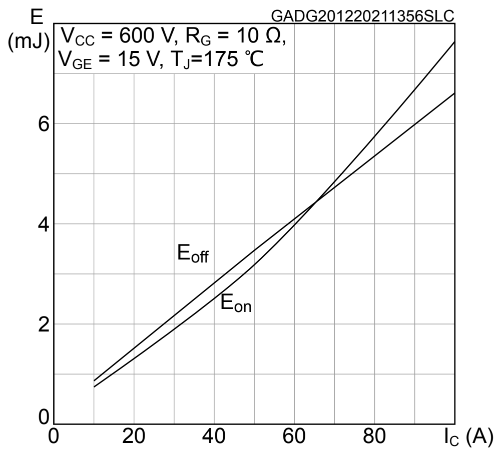


Figure 16. Switching energy vs gate resistance

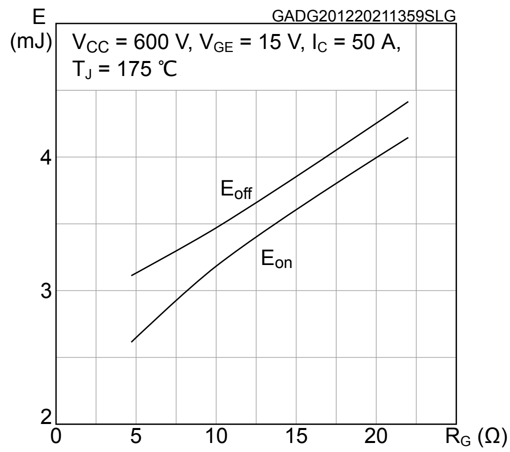


Figure 17. Switching energy vs junction temperature

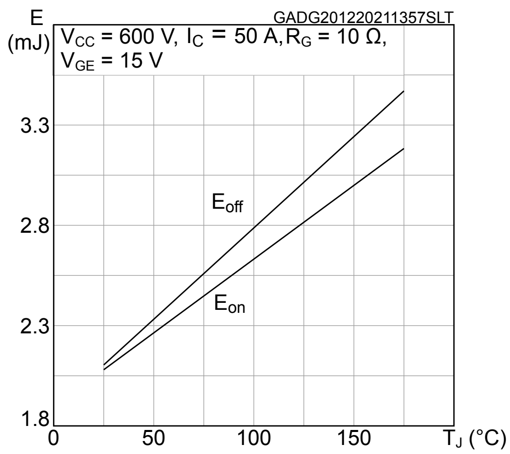


Figure 18. Switching energy vs collector emitter voltage

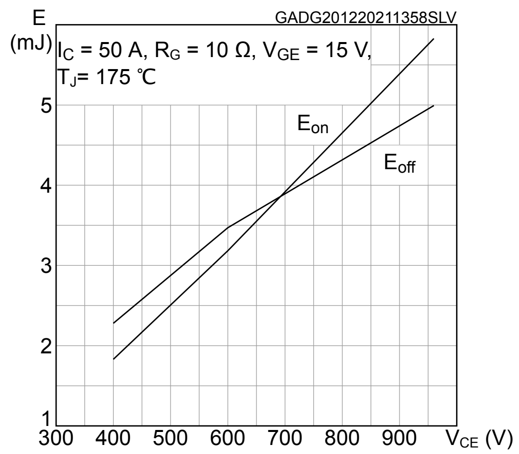


Figure 19. Switching times vs collector current

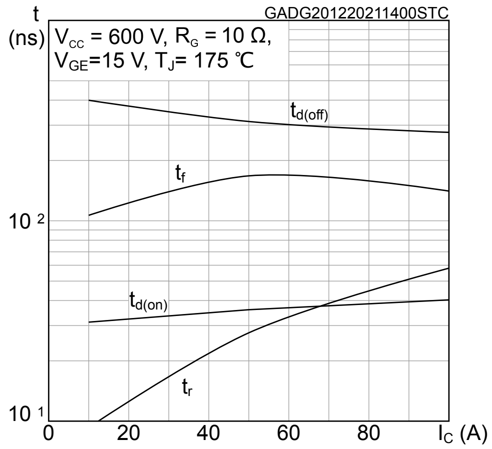


Figure 20. Switching times vs gate resistance

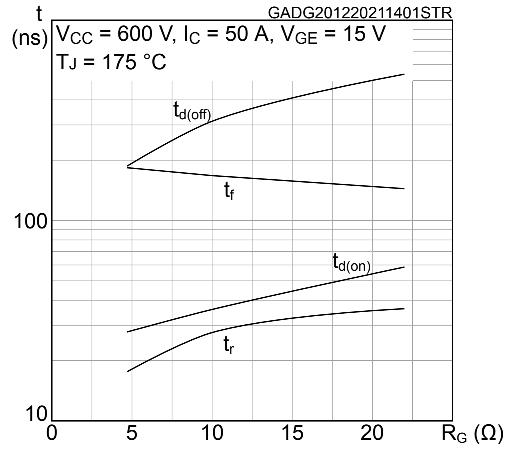


Figure 21. Reverse recovery current vs diode current slope

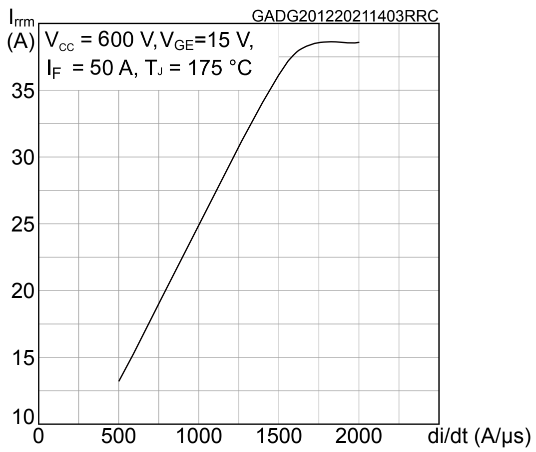


Figure 22. Reverse recovery time vs diode current slope

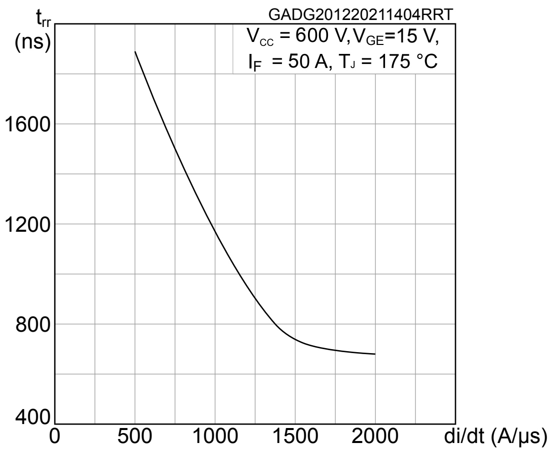


Figure 23. Reverse recovery charge vs diode current slope

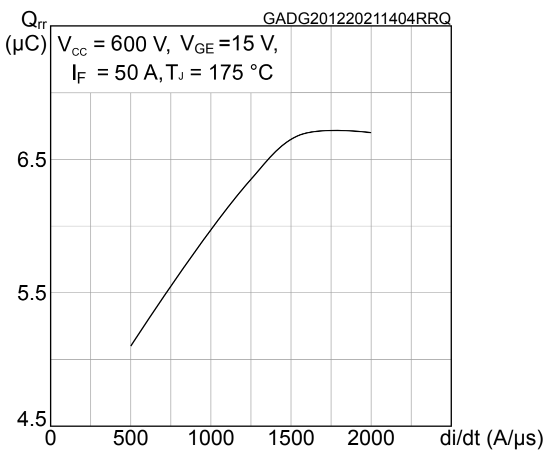


Figure 24. Reverse recovery energy vs diode current slope

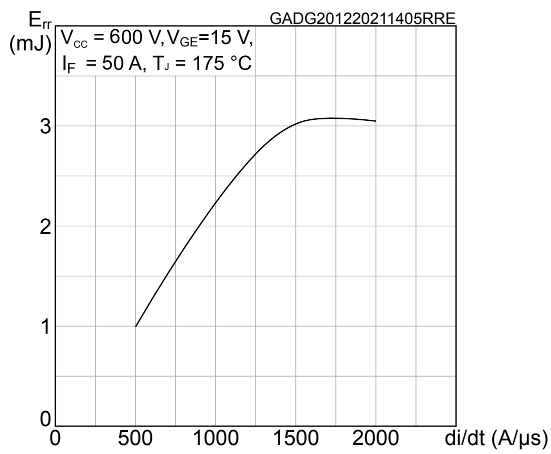


Figure 25. Normalized transient thermal impedance for IGBT

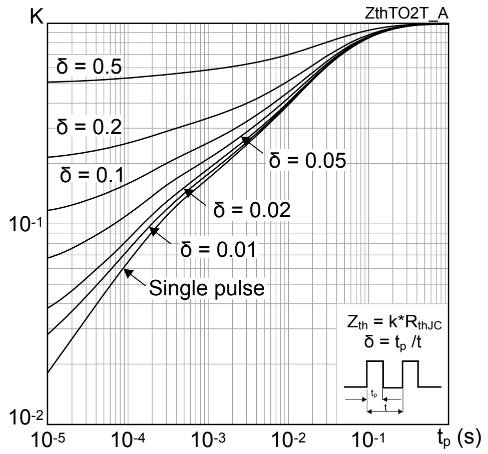
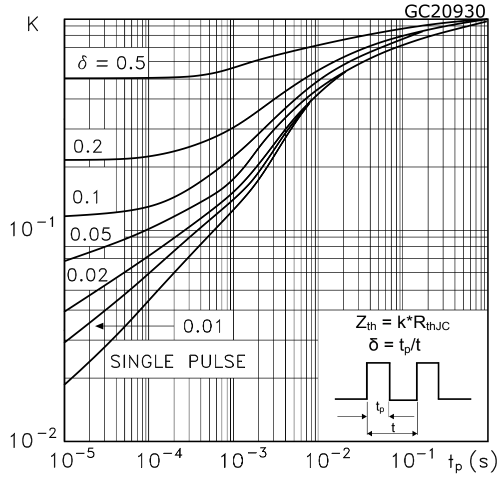


Figure 26. Normalized transient thermal impedance for diode



3 Test circuits

Figure 27. Test circuit for inductive load switching

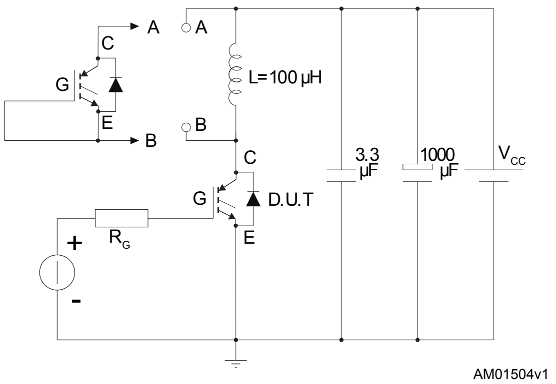


Figure 28. Gate charge test circuit

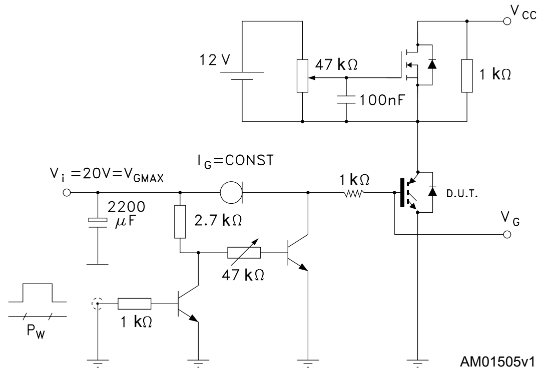


Figure 29. Switching waveform

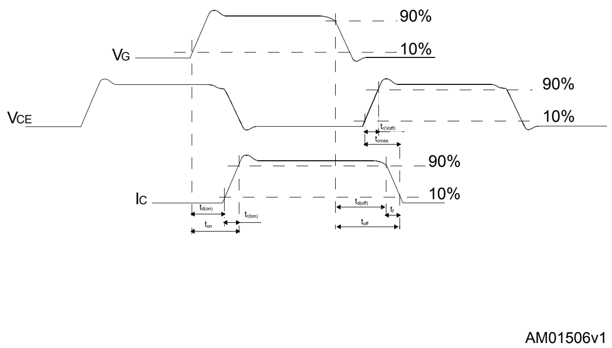
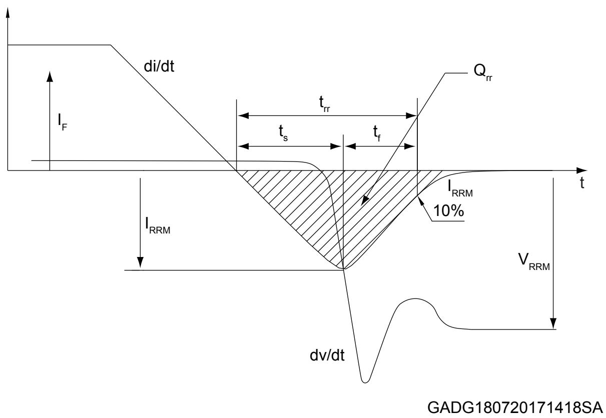


Figure 30. Diode reverse recovery waveform



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 Max247 long leads package information

Figure 31. Max247 long leads package outline

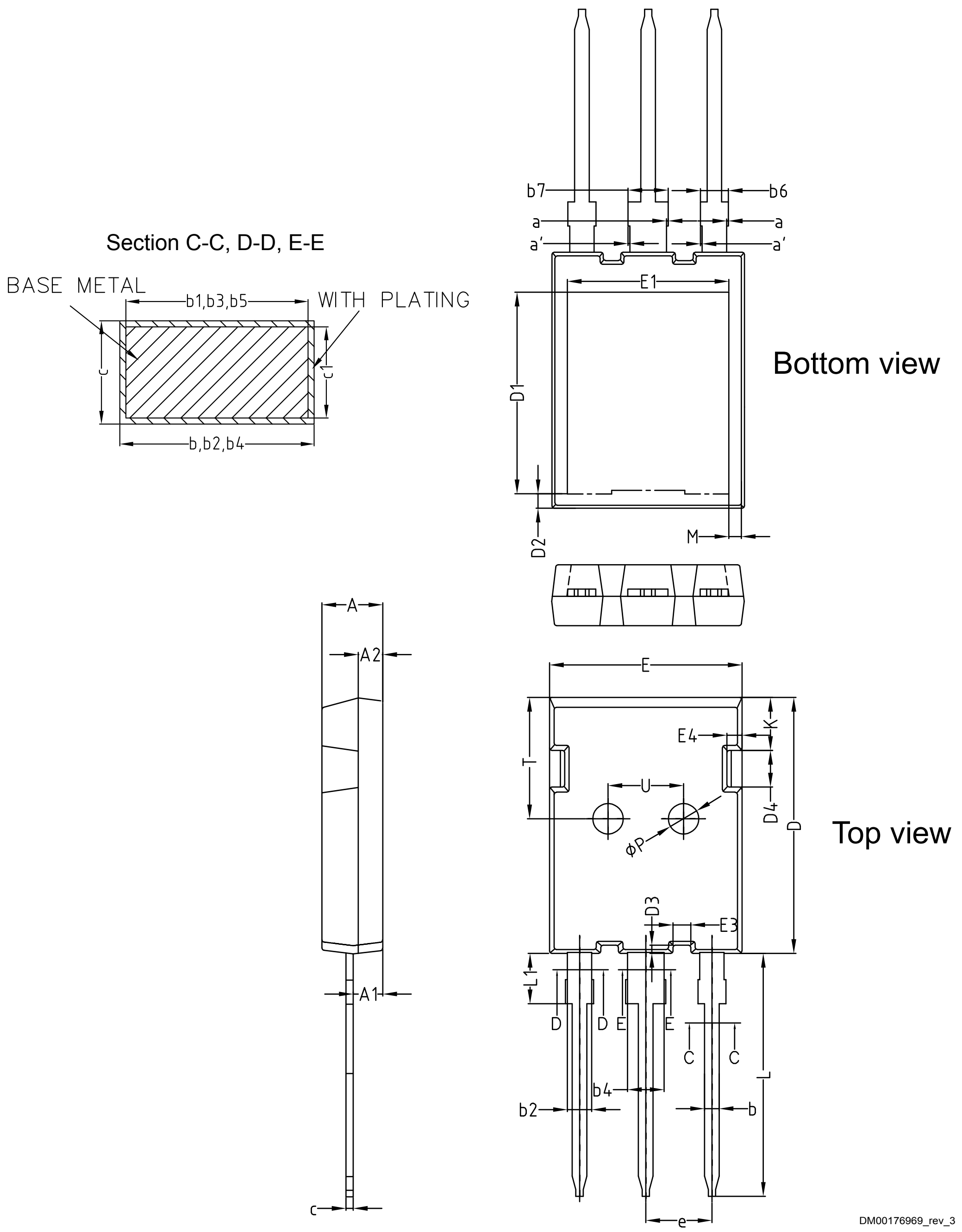


Table 7. **Max247 long leads package mechanical data**

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
a	0		0.15
a'	0		0.15
b	1.16		1.26
b1	1.15	1.20	1.22
b2	1.96		2.06
b3	1.95	2.00	2.02
b4	2.96		3.06
b5	2.95	3.00	3.02
b6			2.25
b7			3.25
c	0.59		0.66
c1	0.58	0.60	0.62
D	20.90	21.00	21.10
D1	16.25	16.55	16.85
D2	1.05	1.17	1.35
D3	0.58	0.68	0.78
D4	2.90	3.00	3.10
E	15.70	15.80	15.90
E1	13.10	13.26	13.50
E3	1.35	1.45	1.55
E4	1.14	1.24	1.34
e	5.34	5.44	5.54
K	4.25	4.35	4.45
L	19.80	19.92	20.10
L1	3.90		4.30
M	0.70		1.30
P	2.40	2.50	2.60
T	9.80		10.20
U	6.00		6.40

Revision history

Table 8. **Document revision history**

Date	Revision	Changes
12-Jan-2022	1	First release.

Contents