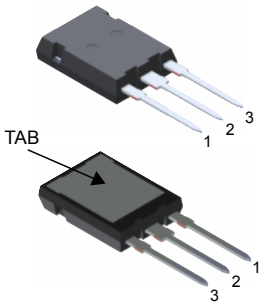
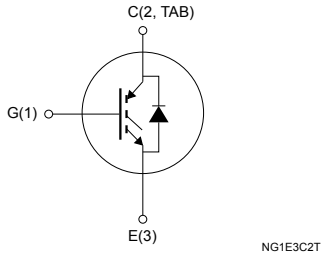
STGYA50M120DF3

Datasheet

Trench gate field-stop, 1200 V, 50 A, low-loss M series IGBT in a Max247 long leads package



Max247 long leads



Features

- Maximum junction temperature: T_J = 175 °C
- 10 µs of short-circuit withstand time
- Low $V_{CE(sat)}$ = 1.7 V (typ.) @ I_C = 50 A
- Tight parameter distribution
- Positive $V_{CE(sat)}$ temperature coefficient
- Low thermal resistance
- Soft- and fast-recovery antiparallel diode

Applications

- Industrial drives
- UPS
- Solar inverters
- General purpose inverter

Description

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. The device is part of the M series IGBTs, which represent an optimal balance between inverter system performance and efficiency where the low-loss and the short-circuit functionality is essential. Furthermore, the positive $V_{CE(sat)}$ temperature coefficient and the tight parameter distribution result in safer paralleling operation.

Product status link
STGYA50M120DF3

Product summary	
Order code	STGYA50M120DF3
Marking	G50M120DF3
Package	Max247 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)	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
	Transient gate-emitter voltage	±30	
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	0.48	
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		1.7	2.2	V
		V_{GE} = 15 V, I_C = 50 A, T_J = 125 °C		1.95		
		V_{GE} = 15 V, I_C = 50 A, T_J = 175 °C		2.1		
V_F	Forward on-voltage	I_F = 50 A		2.80	3.95	V
		I_F = 50 A, T_J = 125 °C		2.3		
		I_F = 50 A, T_J = 175 °C		2.1		
$V_{GE(th)}$	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	-	3152	-	pF
C_{oes}	Output capacitance		-	310	-	pF
C_{res}	Reverse transfer capacitance		-	123	-	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)	-	194	-	nC
Q_{ge}	Gate-emitter charge		-	27	-	nC
Q_{gc}	Gate-collector charge		-	96	-	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)		38	-	ns
t_r	Current rise time			16	-	ns
$(di/dt)_{on}$	Turn-on current slope			2580	-	A/µs
$t_{d(off)}$	Turn-off delay time			258	-	ns
t_f	Current fall time			142	-	ns
E_{on} (1)	Turn-on switching energy			2	-	mJ
E_{off} (2)	Turn-off switching energy			3.2	-	mJ
E_{ts}	Total switching energy			5.2	-	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			18	-	ns
$(di/dt)_{on}$	Turn-on current slope			2400	-	A/µs
$t_{d(off)}$	Turn-off delay time			296	-	ns
t_f	Current fall time			311	-	ns
E_{on} (1)	Turn-on switching energy			3.2	-	mJ
E_{off} (2)	Turn-off switching energy			5.4	-	mJ
E_{ts}	Total switching energy			8.6	-	mJ
t_{sc}	Short-circuit withstand time	V_{CC} ≤ 600 V, V_{GE} = 15 V, T_{Jstart} ≤ 150 °C	10		-	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 = 1700 A/µs (see Figure 28. Test circuit for inductive load switching)	-	325	-	ns
Q_{rr}	Reverse recovery charge		-	2.2	-	µC
I_{rrm}	Reverse recovery current		-	20	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	60	-	A/µs
E_{rr}	Reverse recovery energy		-	1.1	-	mJ
t_{rr}	Reverse recovery time	I_F = 50 A, V_R = 600 V, V_{GE} = 15 V, di/dt = 1700 A/µs, T_J = 175 °C (see Figure 28. Test circuit for inductive load switching)	-	750	-	ns
Q_{rr}	Reverse recovery charge		-	7.65	-	µC
I_{rrm}	Reverse recovery current		-	41	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	65	-	A/µs
E_{rr}	Reverse recovery energy		-	3.47	-	mJ

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature

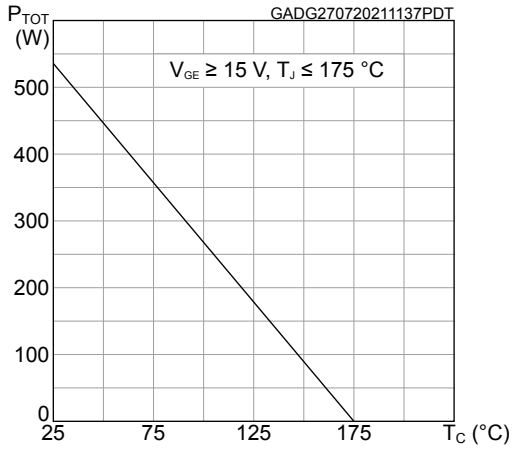


Figure 2. Collector current vs case temperature

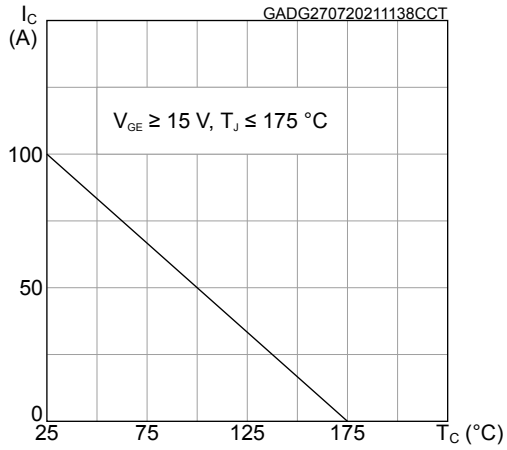


Figure 3. Output characteristics (T_J = 25 °C)

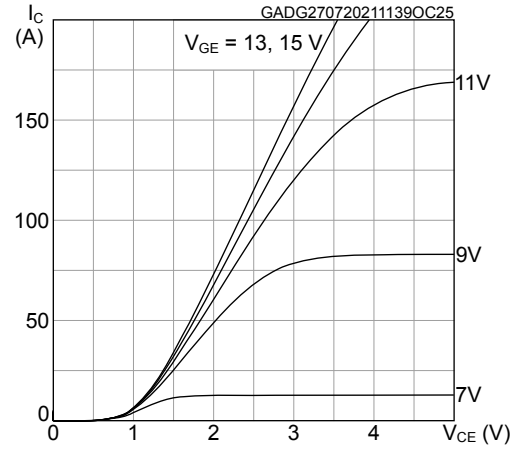


Figure 4. Output characteristics (T_J = 175 °C)

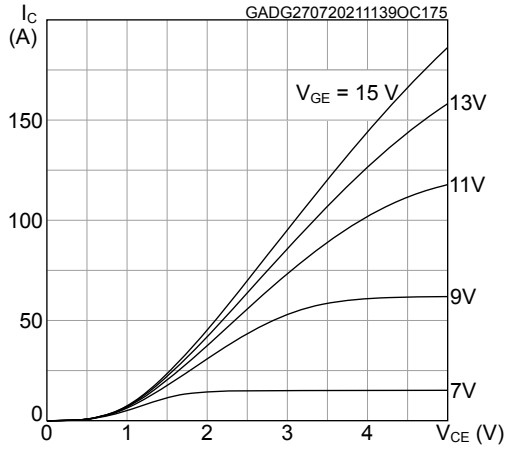


Figure 5. $V_{CE(sat)}$ vs junction temperature

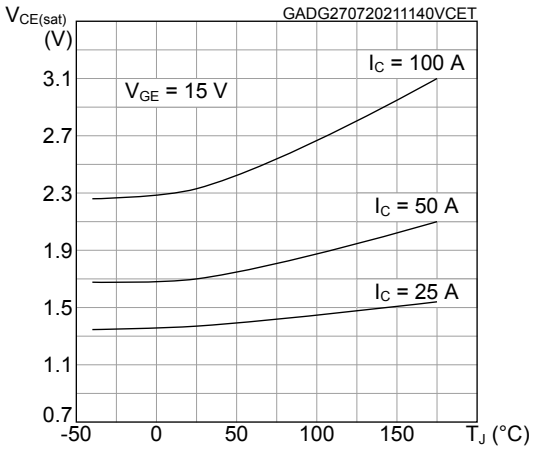


Figure 6. $V_{CE(sat)}$ vs collector current

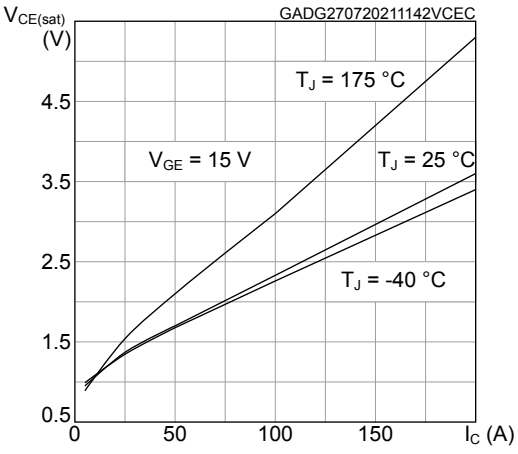


Figure 7. Collector current vs switching frequency

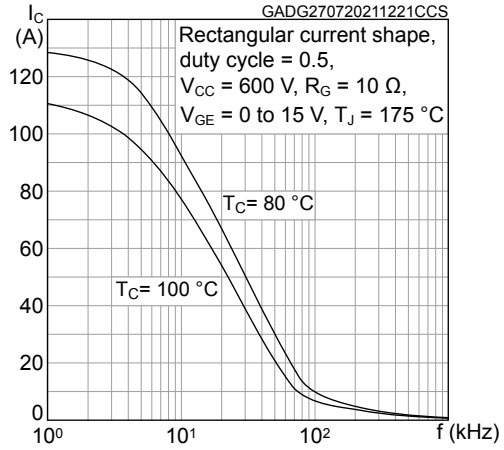


Figure 8. Safe operating area

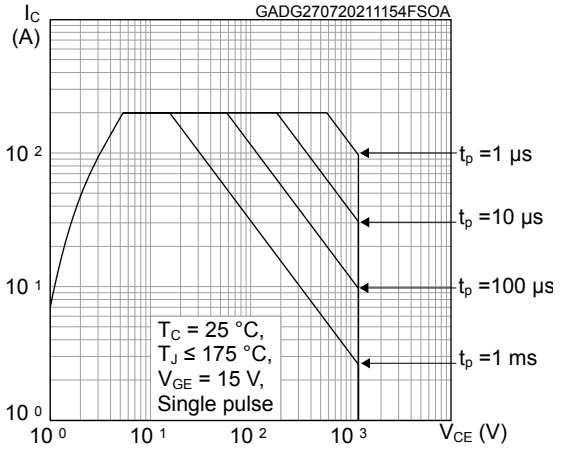


Figure 9. Transfer characteristics

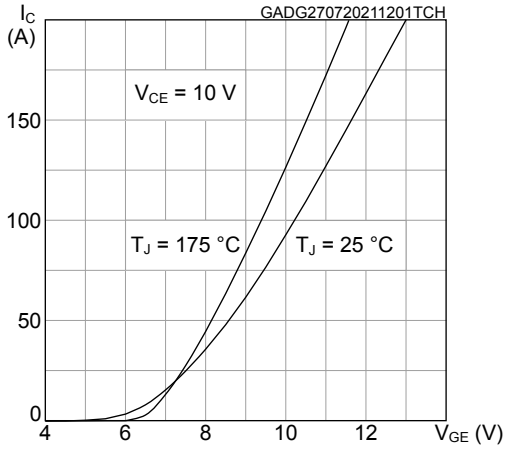


Figure 10. Diode V_F vs forward current

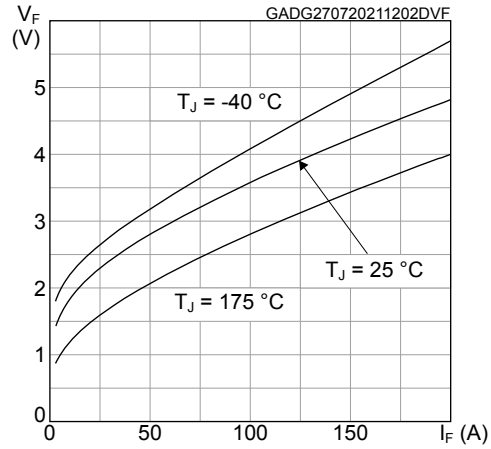


Figure 11. Normalized $V_{GE(th)}$ vs junction temperature

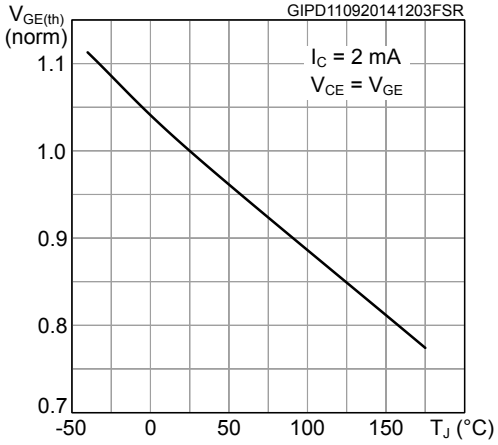


Figure 12. Normalized $V_{(BR)CES}$ vs junction temperature

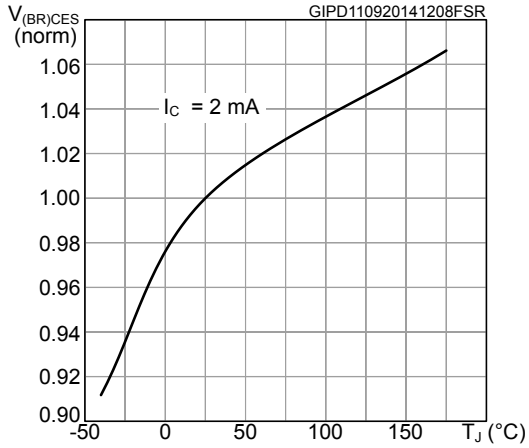


Figure 13. Capacitance variations

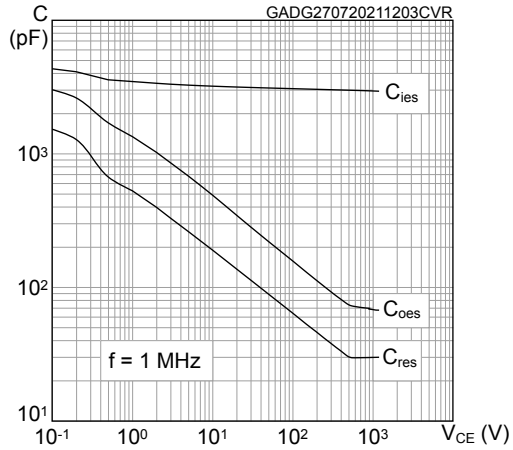


Figure 14. Gate charge vs gate-emitter voltage

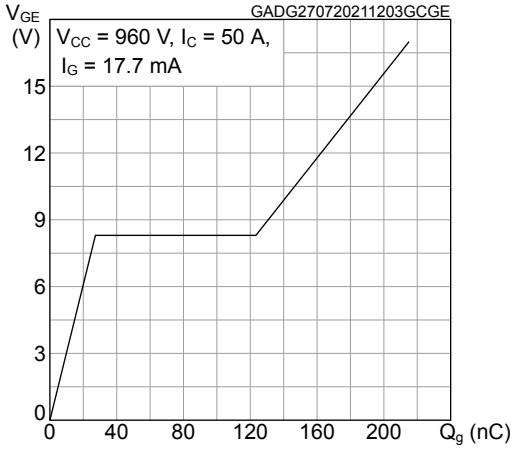


Figure 15. Switching energy vs collector current

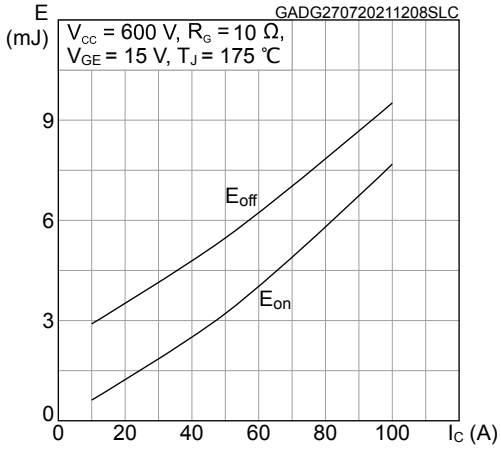


Figure 16. Switching energy vs gate resistance

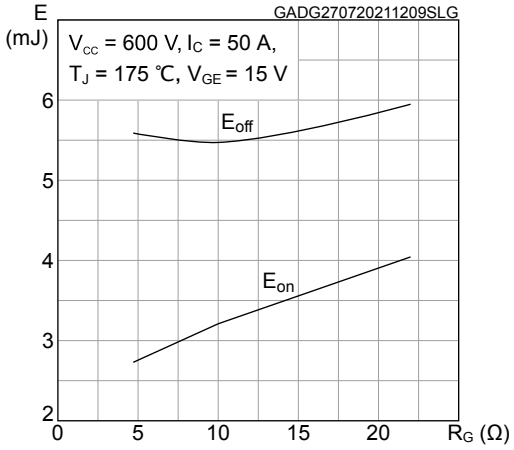


Figure 17. Switching energy vs junction temperature

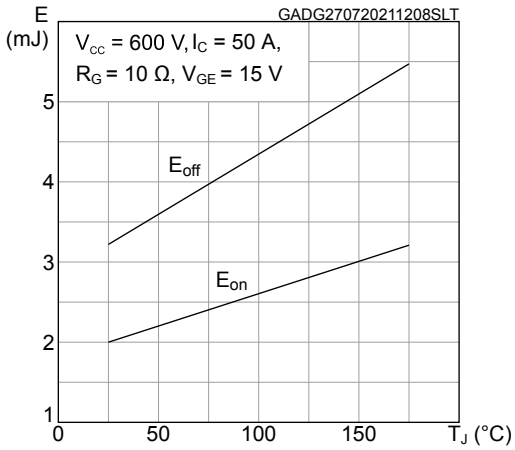


Figure 18. Switching energy vs collector emitter voltage

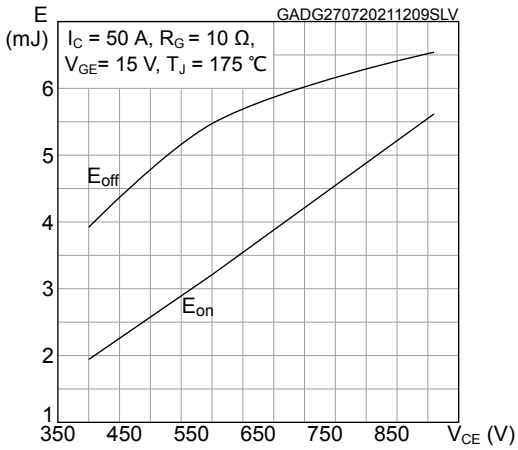


Figure 19. Switching times vs collector current

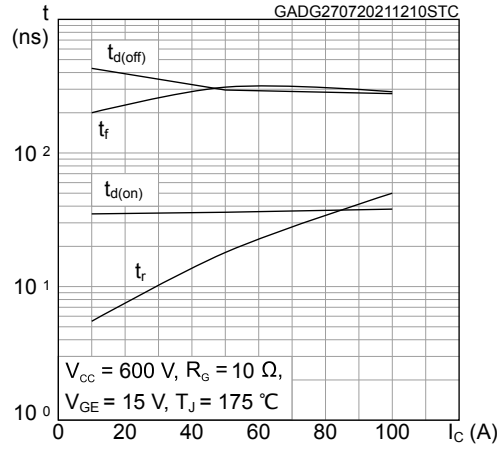


Figure 20. Switching times vs gate resistance

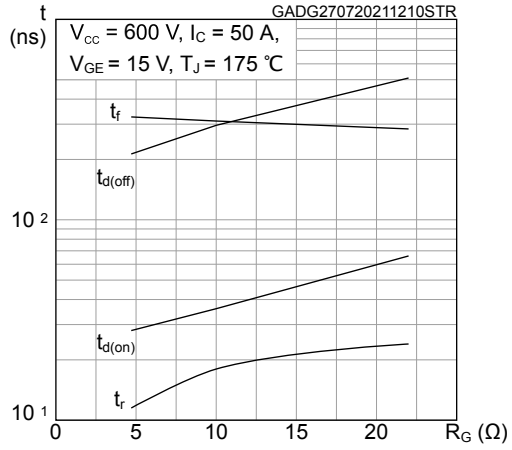


Figure 21. Reverse recovery current vs diode current slope

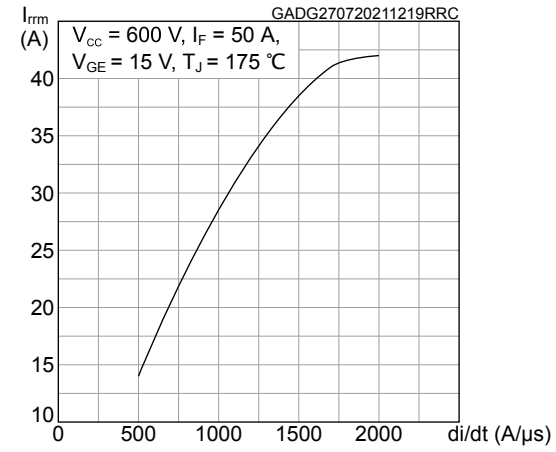


Figure 22. Reverse recovery time vs diode current slope

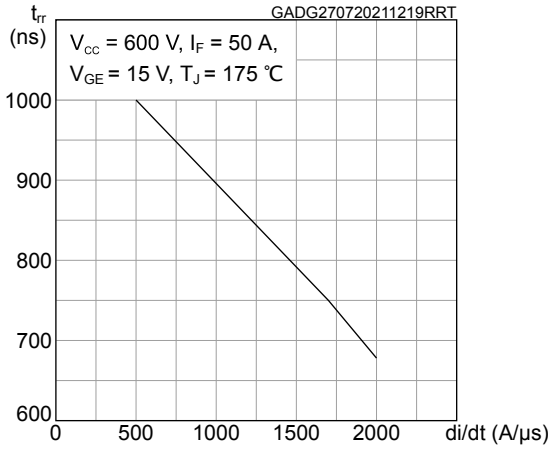


Figure 23. Reverse recovery charge vs diode current slope

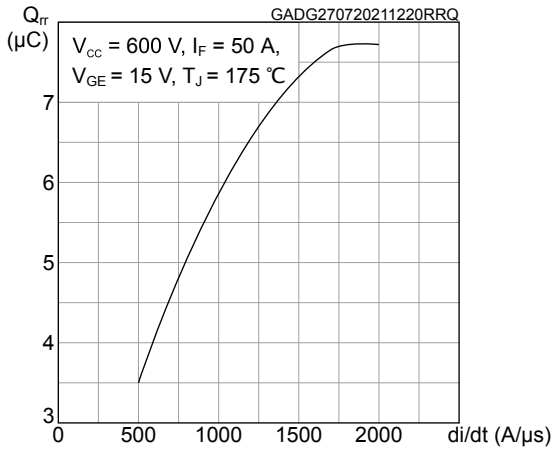


Figure 24. Reverse recovery energy vs diode current slope

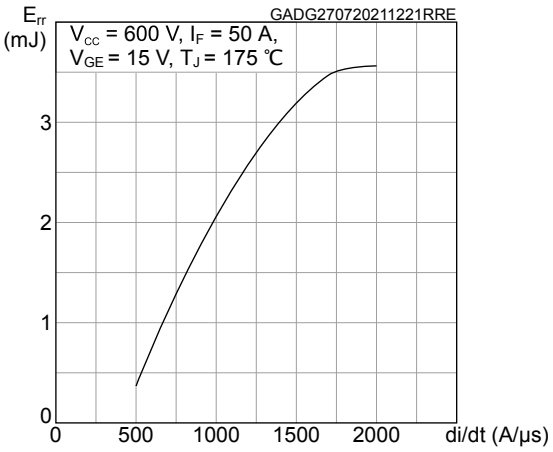


Figure 25. Thermal impedance for IGBT

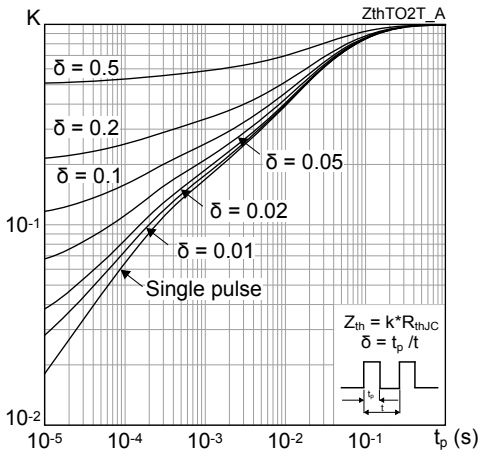
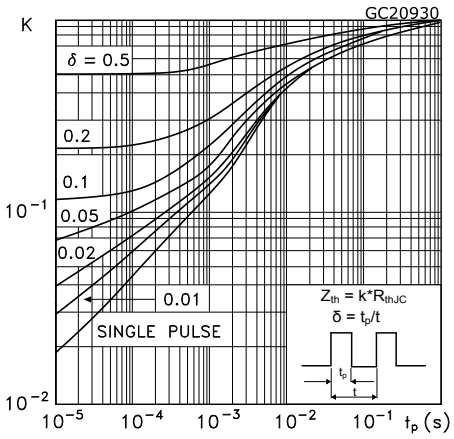


Figure 26. Thermal impedance for diode



3 Test circuits

Figure 27. Test circuit for inductive load switching

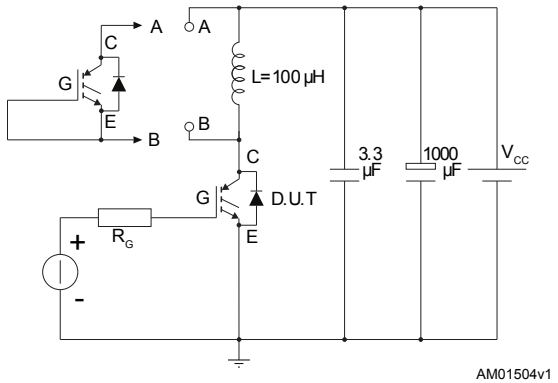


Figure 28. Gate charge test circuit

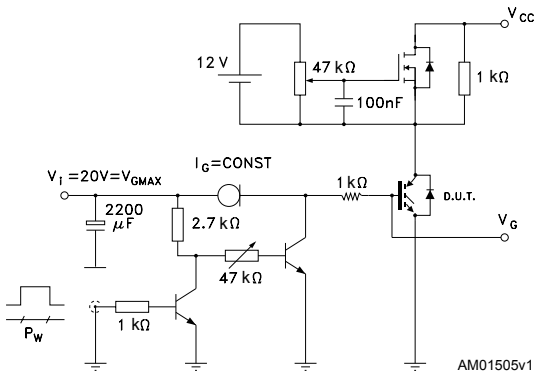


Figure 29. Switching waveform

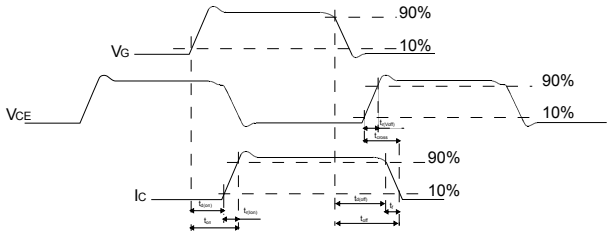
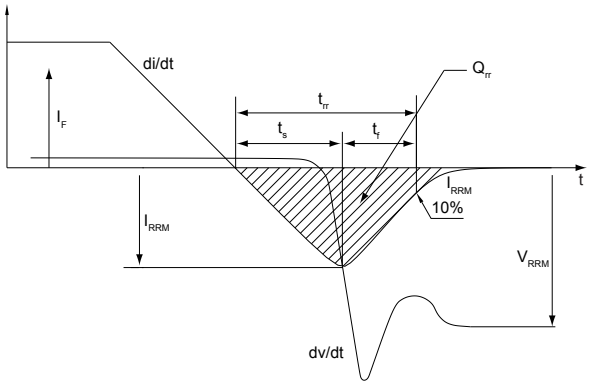


Figure 30. Diode reverse recovery waveform



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 Max247 long leads package information

Figure 31. Max247 long leads package outline

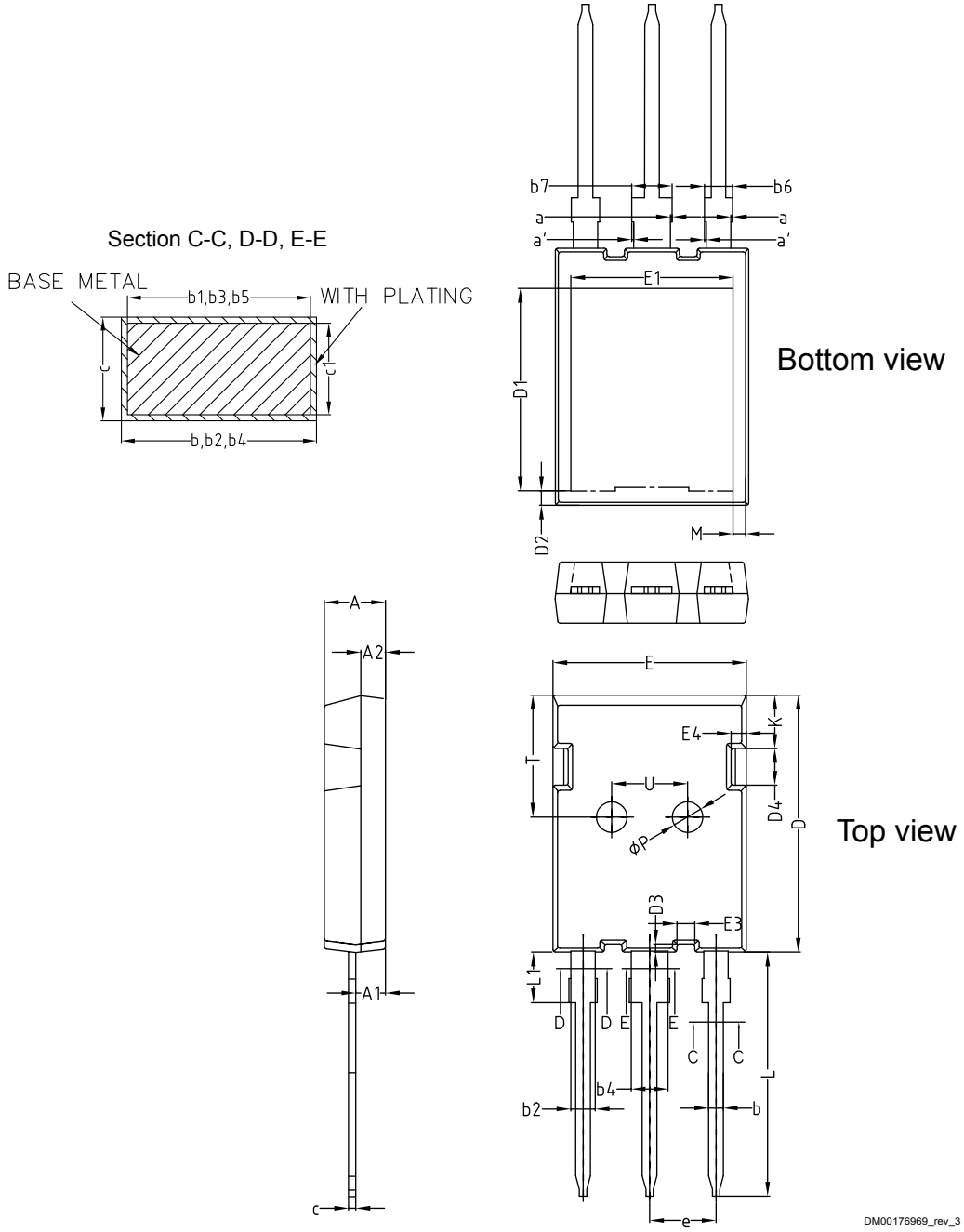


Table 7. **Max247 long leads package mechanical data**

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
03-Aug-2021	1	First release.
01-Oct-2021	2	Modified Figure 8. Collector current vs switching frequency.

Contents

1 **Electrical ratings** 2

2 **Electrical characteristics** 3

2.1 Electrical characteristics (curves) 5

3 **Test circuits** 10

4 **Package information** 11

4.1 Max247 long leads package information 11

Revision history 13

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