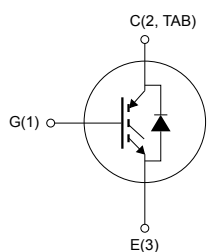
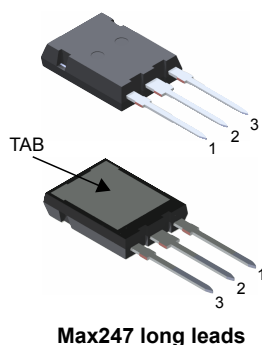


Trench gate field-stop, 1200 V, 50 A, low-loss M series IGBT in a Max247 long leads package



NG1E3C2T



Features

- Maximum junction temperature: $T_J = 175\text{ }^{\circ}\text{C}$
- 10 μs of short-circuit withstand time
- Low $V_{CE(sat)} = 1.7\text{ V (typ.) @ } I_C = 50\text{ A}$
- 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 ($V_{GE} = 0\text{ V}$)	1200	V
I_C	Continuous collector current at $T_C = 25\text{ °C}$	100	A
	Continuous collector current at $T_C = 100\text{ °C}$	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 $T_C = 25\text{ °C}$	100	A
	Continuous forward current at $T_C = 100\text{ °C}$	50	
$I_{FP}^{(1)}$	Pulsed forward current	200	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ °C}$	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

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

Table 3. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}$, $I_C = 2\text{ mA}$	1200			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 50\text{ A}$		1.7	2.2	V
		$V_{GE} = 15\text{ V}$, $I_C = 50\text{ A}$, $T_J = 125\text{ °C}$		1.95		
		$V_{GE} = 15\text{ V}$, $I_C = 50\text{ A}$, $T_J = 175\text{ °C}$		2.1		
V_F	Forward on-voltage	$I_F = 50\text{ A}$		2.80	3.95	V
		$I_F = 50\text{ A}$, $T_J = 125\text{ °C}$		2.3		
		$I_F = 50\text{ A}$, $T_J = 175\text{ °C}$		2.1		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 2\text{ mA}$	5	6	7	V
I_{CES}	Collector cut-off current	$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$			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	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	3152	-	pF
C_{oes}	Output capacitance		-	310	-	pF
C_{res}	Reverse transfer capacitance		-	123	-	pF
Q_g	Total gate charge	$V_{CC} = 960\text{ V}$, $I_C = 50\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (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	$V_{CE} = 600\text{ V}$, $I_C = 50\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$ (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/ μ s
$t_{d(off)}$	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	$V_{CE} = 600\text{ V}$, $I_C = 50\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$, $T_J = 175\text{ }^\circ\text{C}$ (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/ μ s
$t_{d(off)}$	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	$V_{CC} \leq 600\text{ V}$, $V_{GE} = 15\text{ V}$, $T_{Jstart} \leq 150\text{ }^\circ\text{C}$	10		-	μ s

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	$I_F = 50\text{ A}$, $V_R = 600\text{ V}$, $V_{GE} = 15\text{ V}$, $di/dt = 1700\text{ A}/\mu\text{s}$ (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/ μ s
E_{rr}	Reverse recovery energy		-	1.1	-	mJ
t_{rr}	Reverse recovery time	$I_F = 50\text{ A}$, $V_R = 600\text{ V}$, $V_{GE} = 15\text{ V}$, $di/dt = 1700\text{ A}/\mu\text{s}$, $T_J = 175\text{ }^\circ\text{C}$ (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/ μ s
E_{rr}	Reverse recovery energy		-	3.47	-	mJ

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature

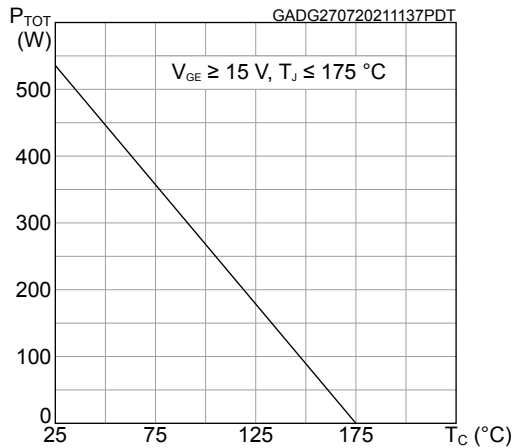


Figure 2. Collector current vs case temperature

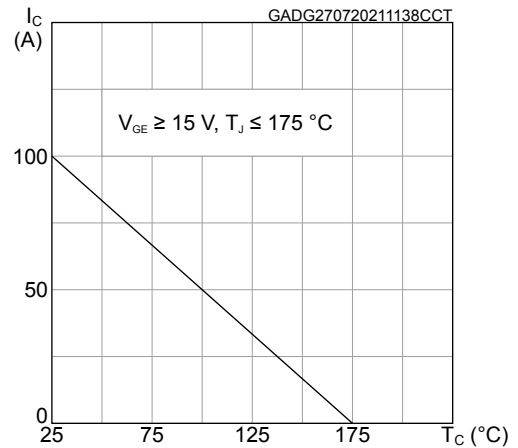


Figure 3. Output characteristics (T_J = 25 °C)

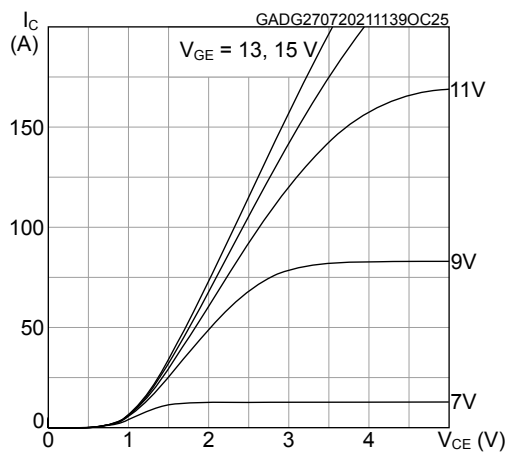


Figure 4. Output characteristics (T_J = 175 °C)

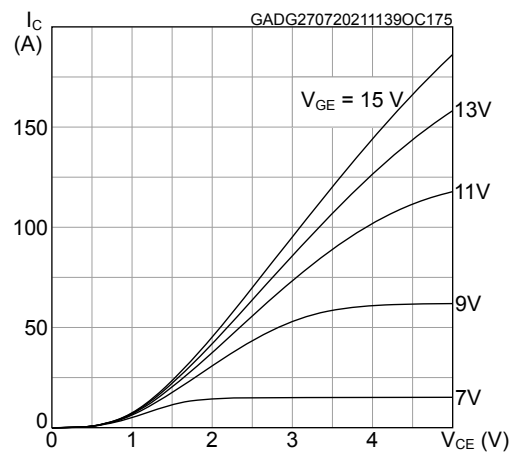


Figure 5. V_{CE(sat)} vs junction temperature

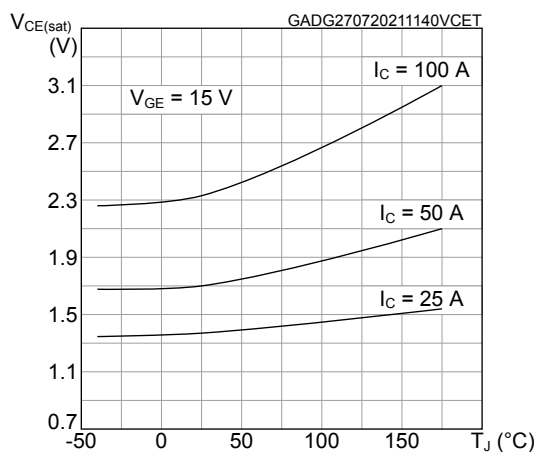


Figure 6. V_{CE(sat)} vs collector current

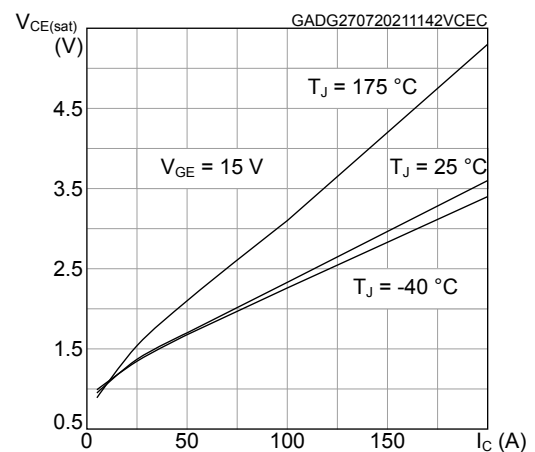


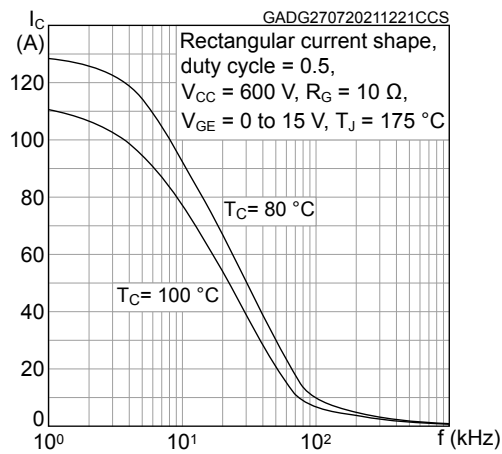
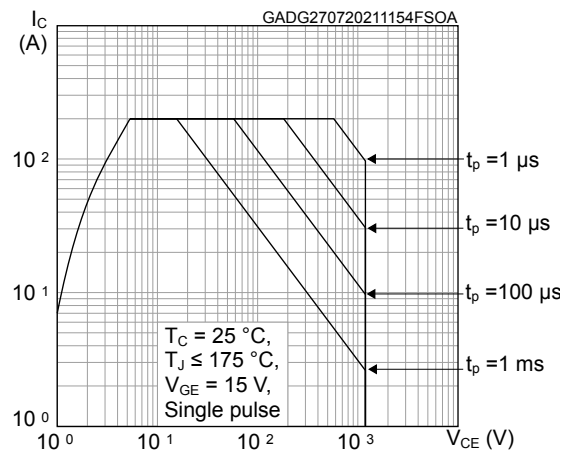
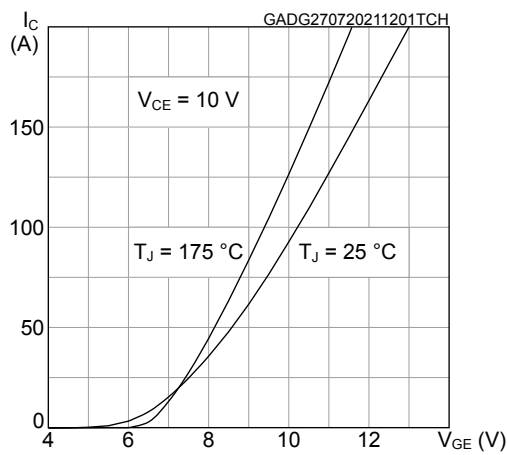
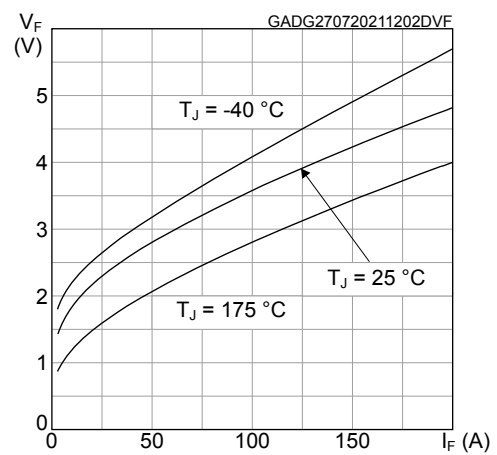
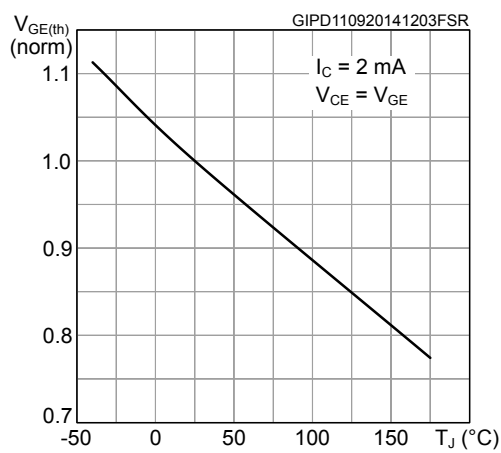
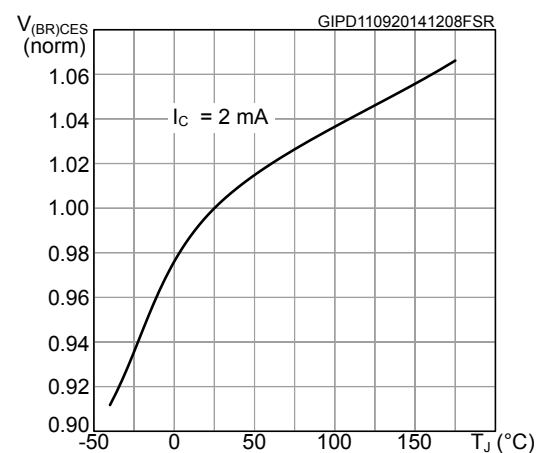
Figure 7. Collector current vs switching frequency

Figure 8. Safe operating area

Figure 9. Transfer characteristics

Figure 10. Diode VF vs forward current

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

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


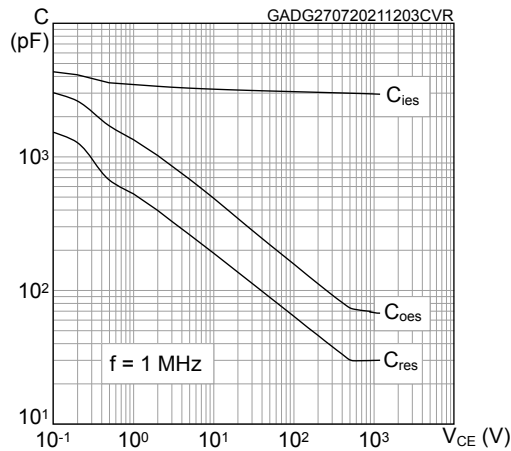
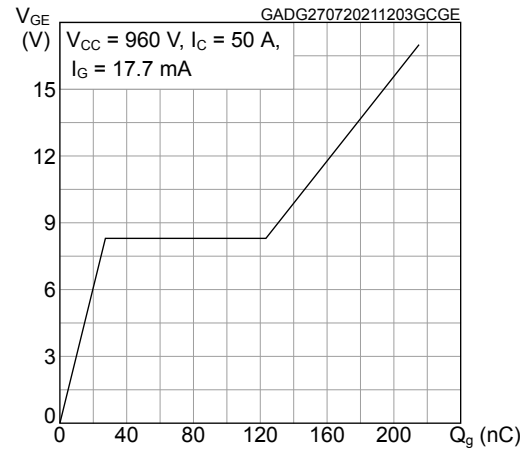
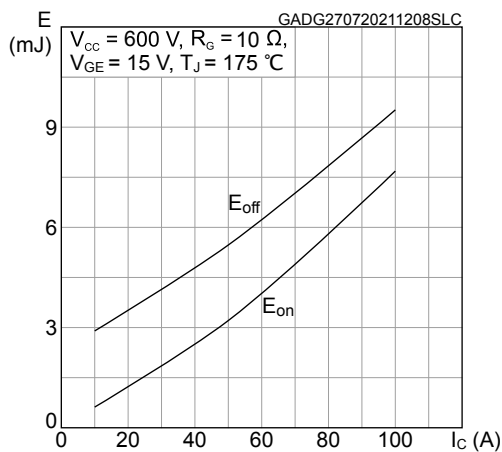
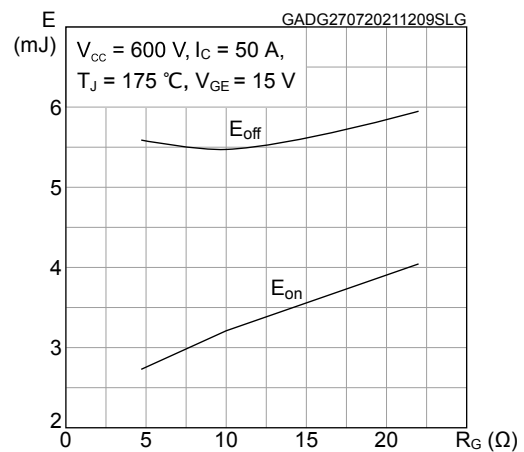
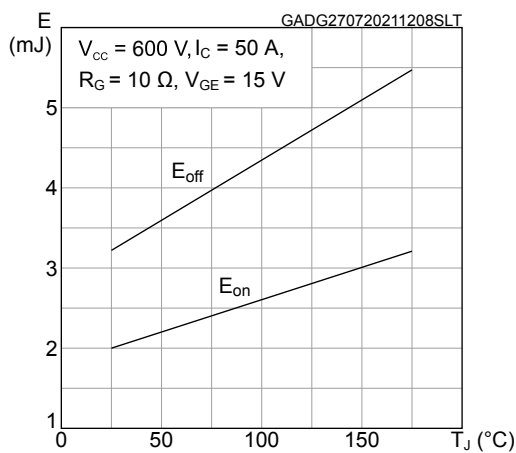
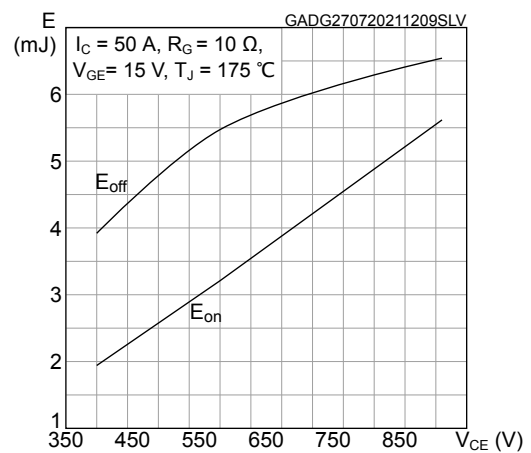
Figure 13. Capacitance variations

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

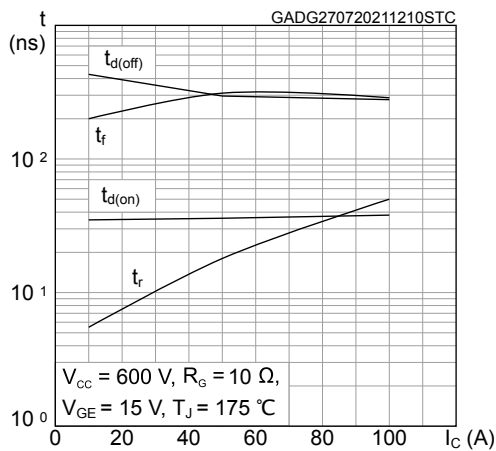


Figure 20. Switching times vs gate resistance

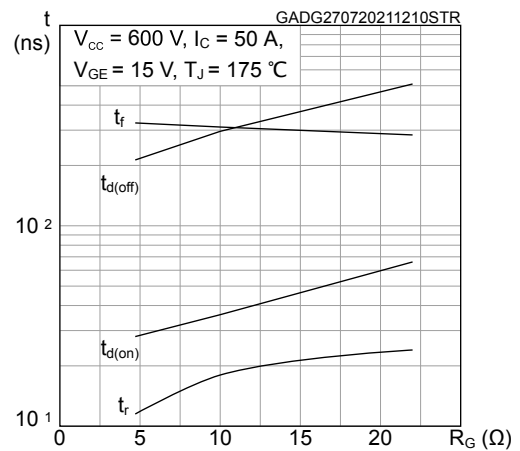


Figure 21. Reverse recovery current vs diode current slope

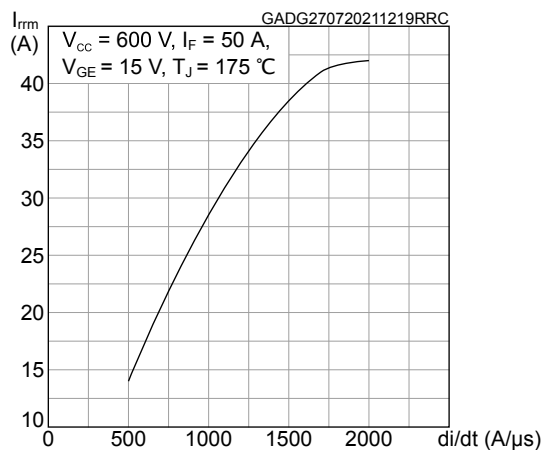


Figure 22. Reverse recovery time vs diode current slope

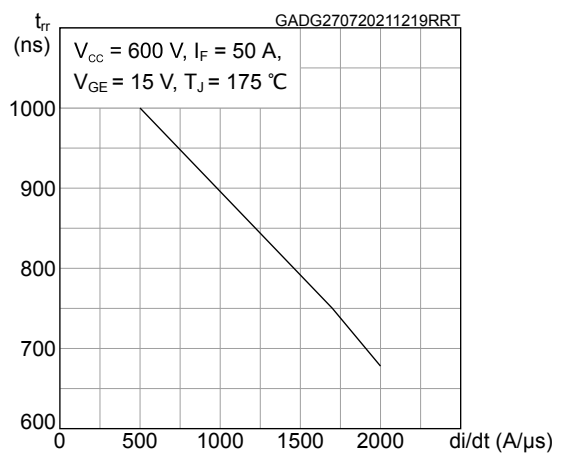


Figure 23. Reverse recovery charge vs diode current slope

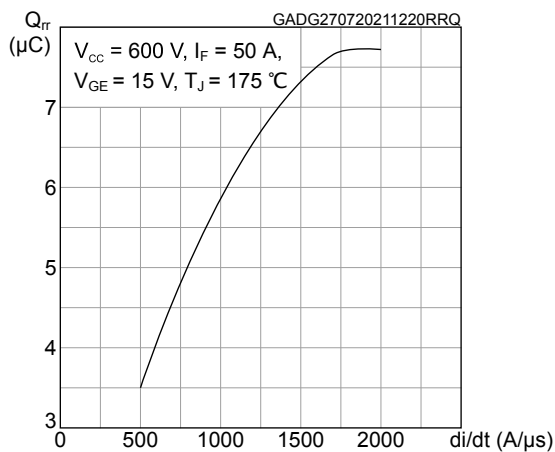


Figure 24. Reverse recovery energy vs diode current slope

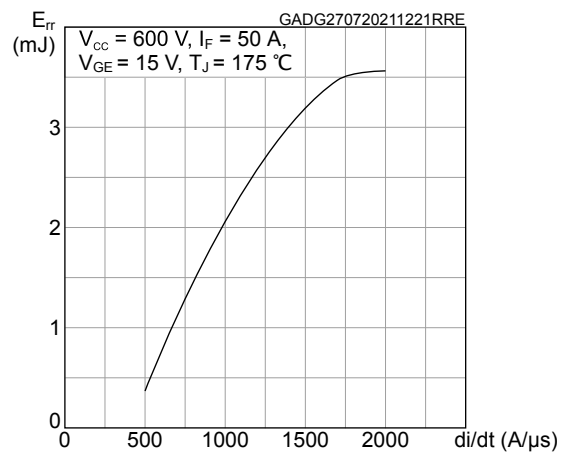


Figure 25. Thermal impedance for IGBT

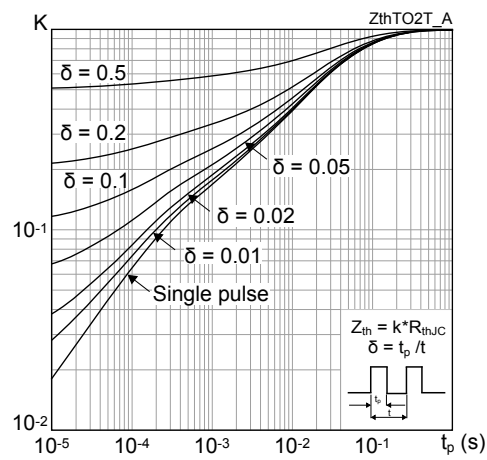
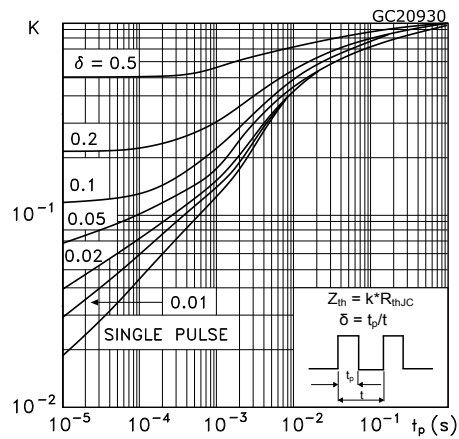
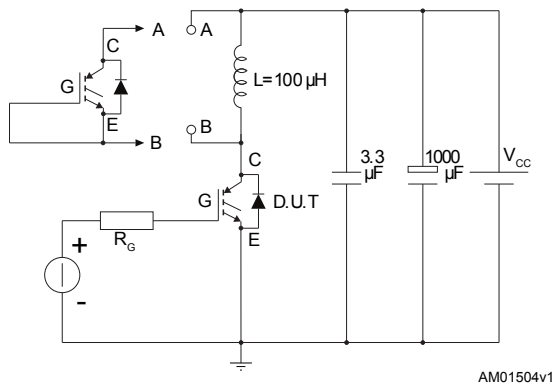
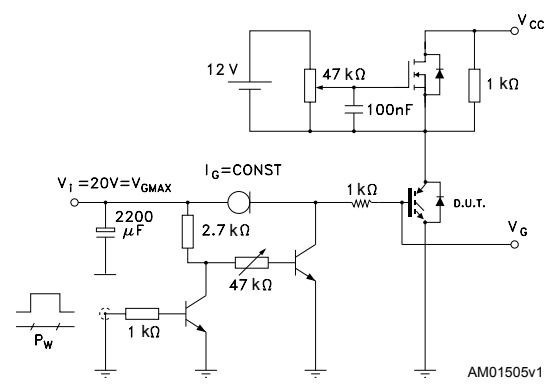
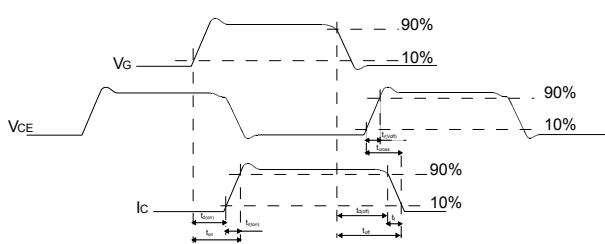
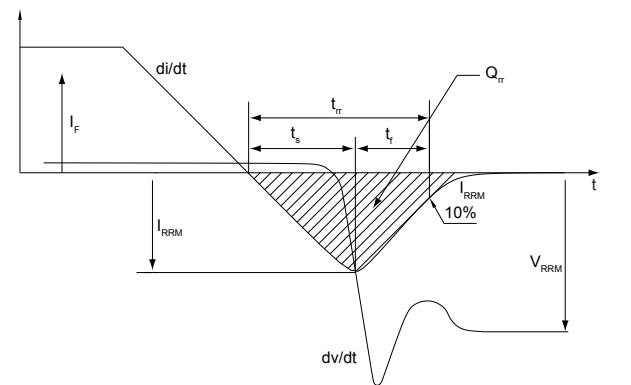


Figure 26. Thermal impedance for diode



3 Test circuits

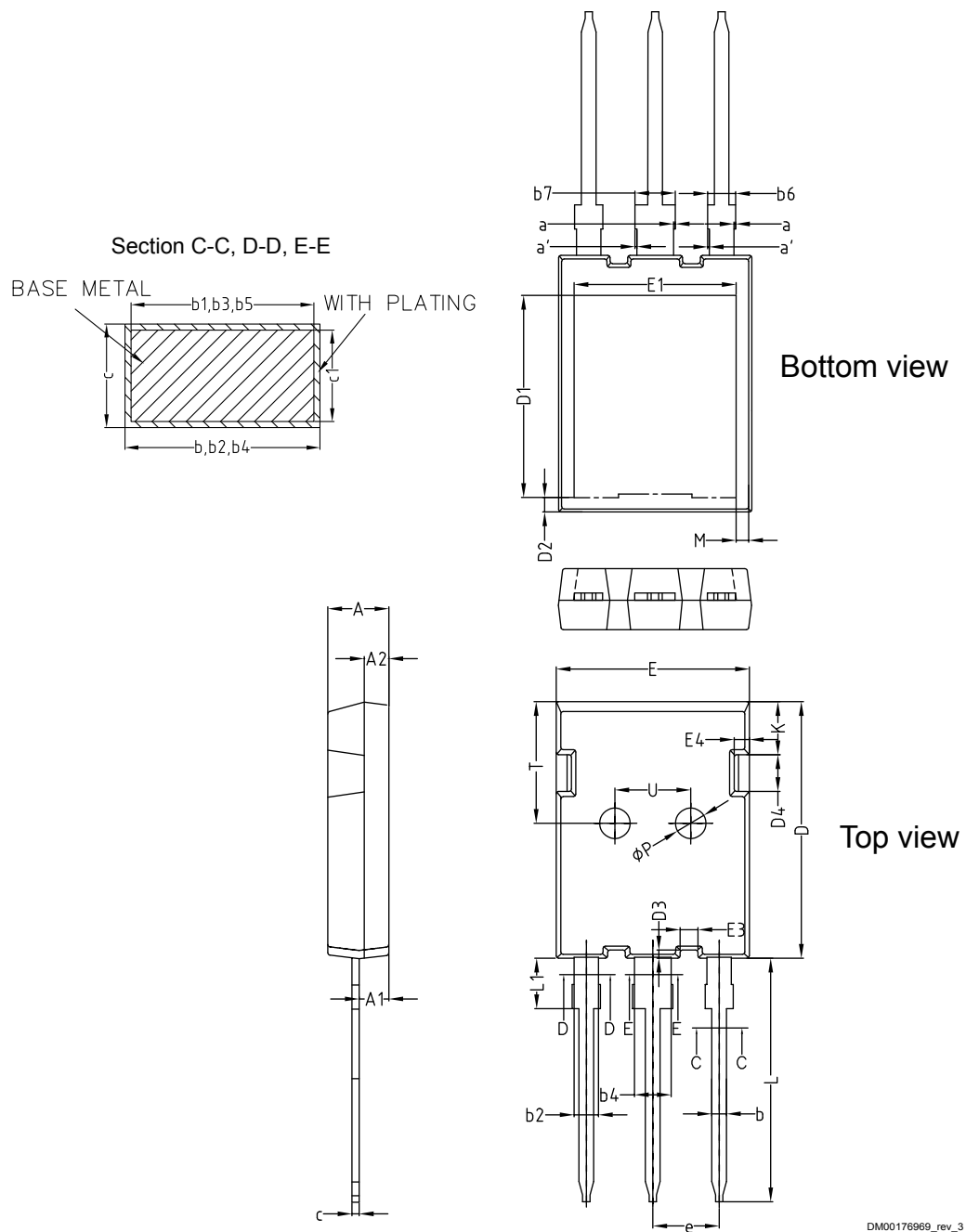
Figure 27. Test circuit for inductive load switching

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



DM00176969_rev_3

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.

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