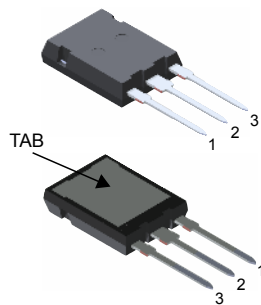
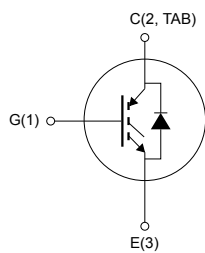


## Trench gate field-stop, 1200 V, 50 A, high-speed H series IGBT in a Max247 long leads package



Max247 long leads



NG1E3C2T



### Features

- Maximum junction temperature:  $T_J = 175\text{ °C}$
- 5  $\mu\text{s}$  of short-circuit withstand time
- Low  $V_{CE(sat)} = 2.1\text{ V (typ.) @ } I_C = 50\text{ A}$
- 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.

#### Product status link

[STGYA50H120DF2](#)

#### Product summary

Order code	STGYA50H120DF2
Marking	G50H120DF2
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	$\pm 20$	V
$I_F$	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	0.62	
$R_{thJA}$	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	$V_{GE} = 15\text{ V}, I_C = 50\text{ A}$		2.1	2.6	V
		$V_{GE} = 15\text{ V}, I_C = 50\text{ A}, T_J = 125\text{ °C}$		2.35		
		$V_{GE} = 15\text{ V}, I_C = 50\text{ A}, T_J = 175\text{ °C}$		2.5		
$V_F$	Forward on-voltage	$I_F = 50\text{ A}$		3.8		V
		$I_F = 50\text{ A}, T_J = 125\text{ °C}$		2.8		
		$I_F = 50\text{ A}, T_J = 175\text{ °C}$		2.6		
$V_{GE(th)}$	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	$\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current	$V_{CE} = 0\text{ V}, V_{GE} = \pm 20\text{ V}$			$\pm 250$	nA

**Table 4. Dynamic characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0\text{ V}$	-	4150	-	pF
$C_{oes}$	Output capacitance		-	288	-	pF
$C_{res}$	Reverse transfer capacitance		-	104	-	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)	-	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	$V_{CE} = 600\text{ V}$ , $I_C = 50\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 10\ \Omega$ (see Figure 28. Test circuit for inductive load switching)		40	-	ns
$t_r$	Current rise time			23	-	ns
$(di/dt)_{on}$	Turn-on current slope			1800	-	A/ $\mu$ s
$t_{d(off)}$	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		$V_{CE} = 600\text{ V}$ , $I_C = 50\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 10\ \Omega$ , $T_J = 175\text{ }^\circ\text{C}$ (see Figure 28. Test circuit for inductive load switching)		36	-
$t_r$	Current rise time			27	-	ns
$(di/dt)_{on}$	Turn-on current slope			1490	-	A/ $\mu$ s
$t_{d(off)}$	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	$V_{CC} \leq 600\text{ V}$ , $V_{GE} = 15\text{ V}$ , $T_{Jstart} \leq 150\text{ }^\circ\text{C}$		5		-

1. Including the reverse recovery of the diode.

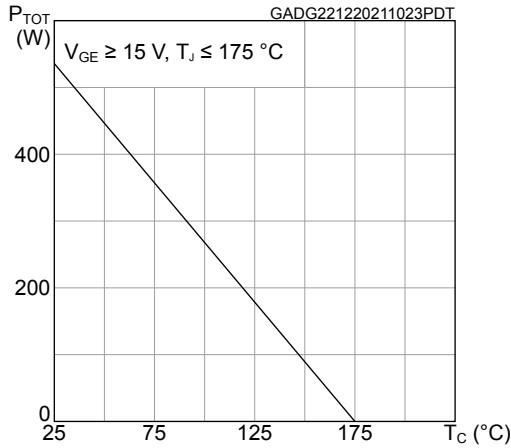
2. Including the tail of the collector current.

**Table 6. Diode switching characteristics (inductive load)**

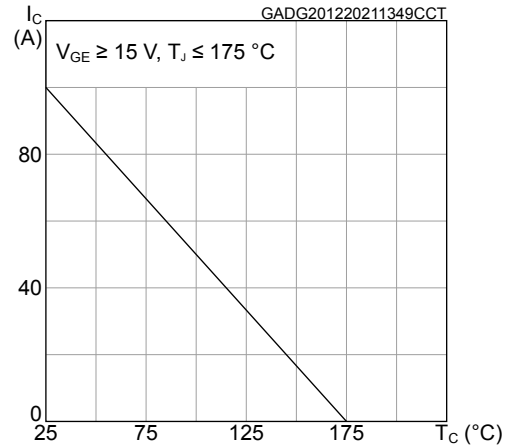
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit	
$t_{rr}$	Reverse recovery time	$I_F = 50\text{ A}$ , $V_R = 600\text{ V}$ , $V_{GE} = 15\text{ V}$ , $di/dt = 1550\text{ A}/\mu\text{s}$ (see Figure 28. Test circuit for inductive load switching)	-	340	-	ns	
$Q_{rr}$	Reverse recovery charge			-	1.7	-	$\mu$ C
$I_{rrm}$	Reverse recovery current			-	22	-	A
$dI_{rr}/dt$	Peak rate of fall of reverse recovery current during $t_b$			-	1310	-	A/ $\mu$ s
$E_{rr}$	Reverse recovery energy			-	0.71	-	mJ
$t_{rr}$	Reverse recovery time	$I_F = 50\text{ A}$ , $V_R = 600\text{ V}$ , $V_{GE} = 15\text{ V}$ , $di/dt = 1550\text{ A}/\mu\text{s}$ , $T_J = 175\text{ }^\circ\text{C}$ (see Figure 28. Test circuit for inductive load switching)	-	724	-	ns	
$Q_{rr}$	Reverse recovery charge			-	6.7	-	$\mu$ C
$I_{rrm}$	Reverse recovery current			-	37	-	A
$dI_{rr}/dt$	Peak rate of fall of reverse recovery current during $t_b$			-	210	-	A/ $\mu$ s
$E_{rr}$	Reverse recovery energy			-	3	-	mJ

## 2.1 Electrical characteristics (curves)

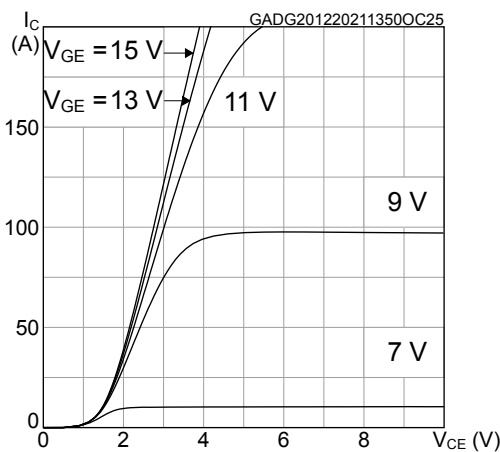
**Figure 1. Total power dissipation vs temperature**



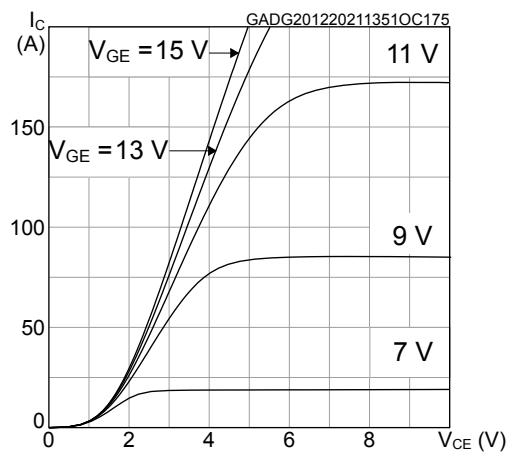
**Figure 2. Collector current vs case temperature**



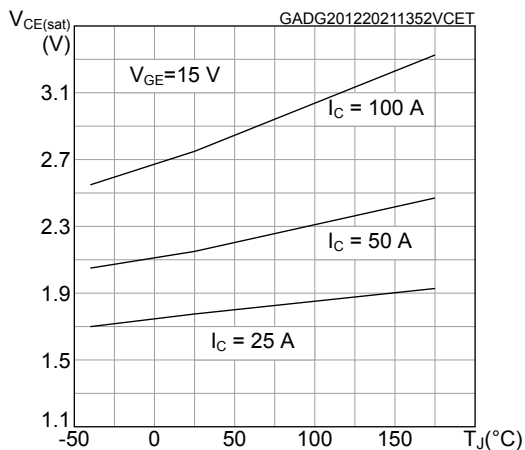
**Figure 3. Output characteristics (T<sub>J</sub> = 25 °C)**



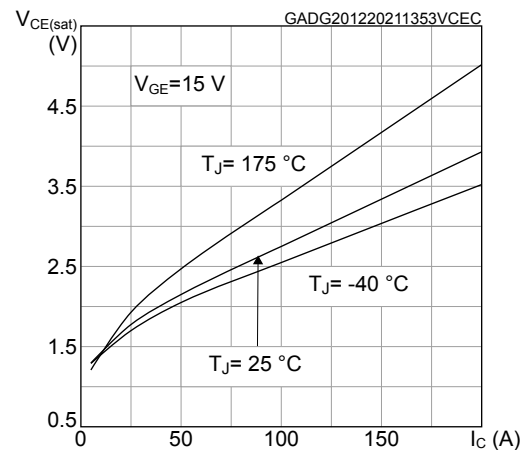
**Figure 4. Output characteristics (T<sub>J</sub> = 175 °C)**



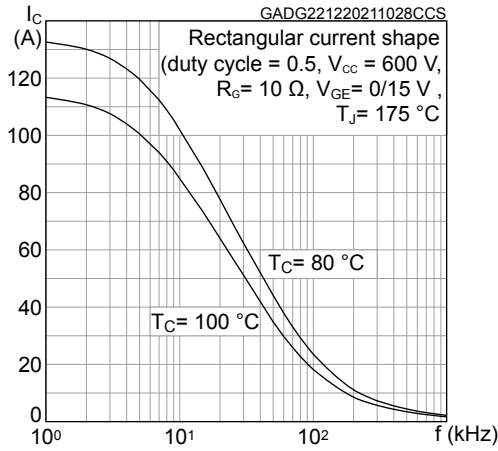
**Figure 5. V<sub>CE(sat)</sub> vs junction temperature**



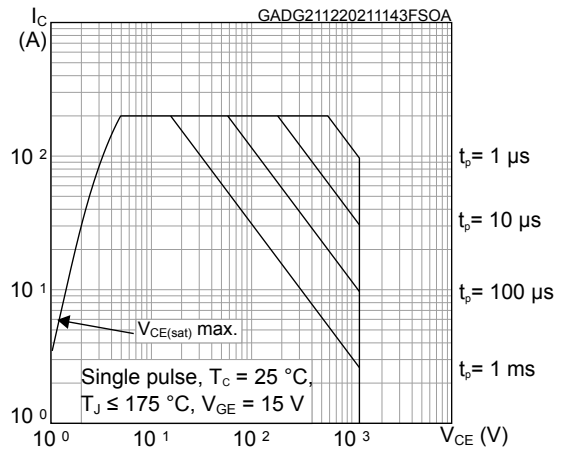
**Figure 6. V<sub>CE(sat)</sub> vs collector current**



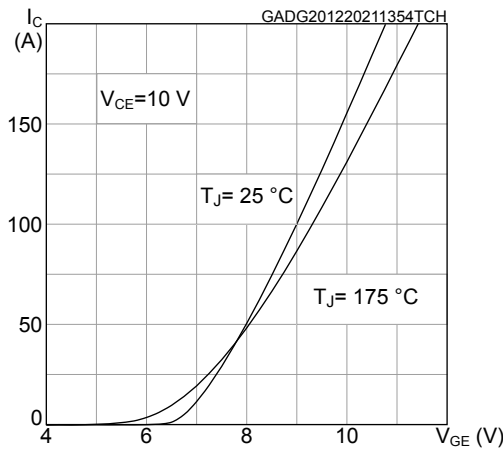
**Figure 7. Collector current vs switching frequency**



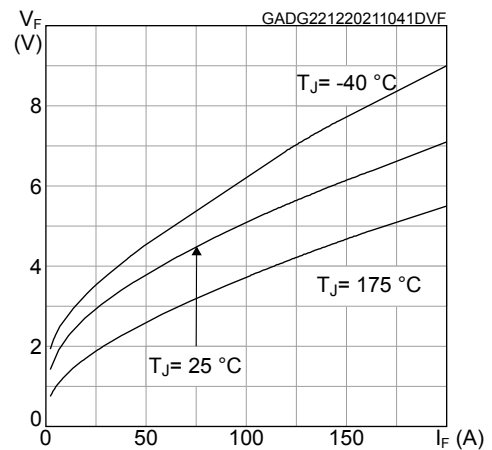
**Figure 8. Safe operating area**



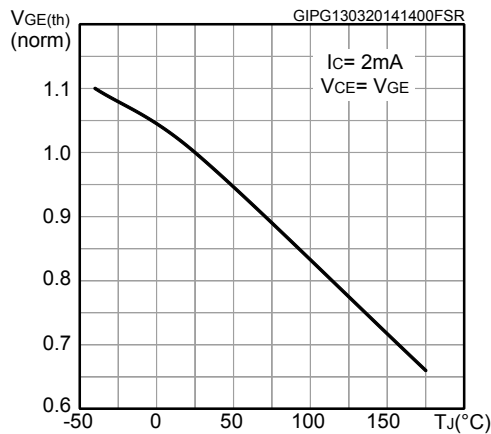
**Figure 9. Transfer characteristics**



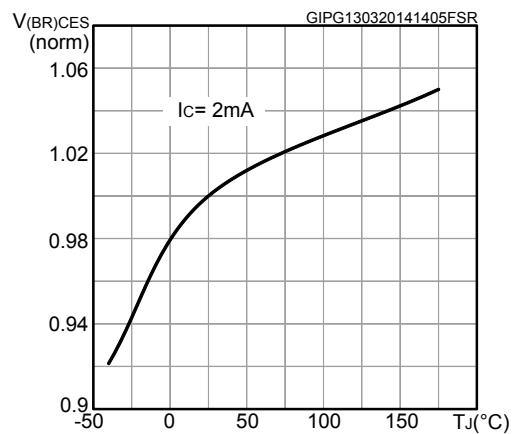
**Figure 10. Diode Vf vs forward current**



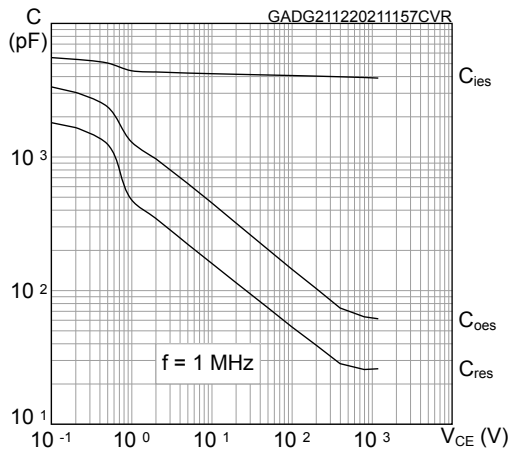
**Figure 11. Normalized VGE(th) vs junction temperature**



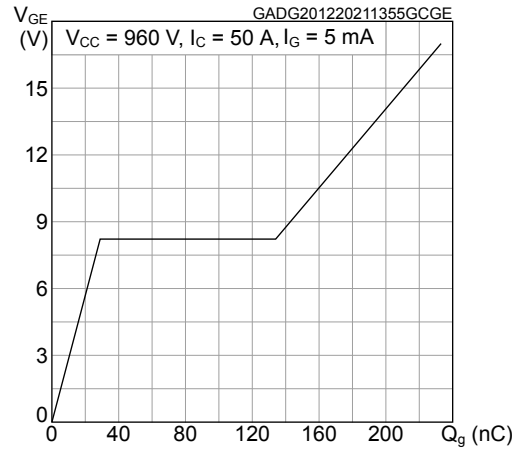
**Figure 12. Normalized V(BR)CES vs junction temperature**



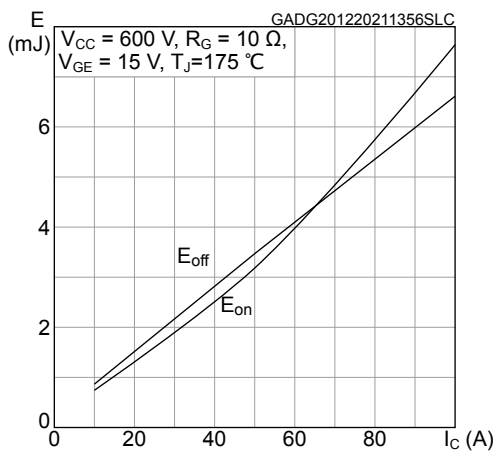
**Figure 13. Capacitance variations**



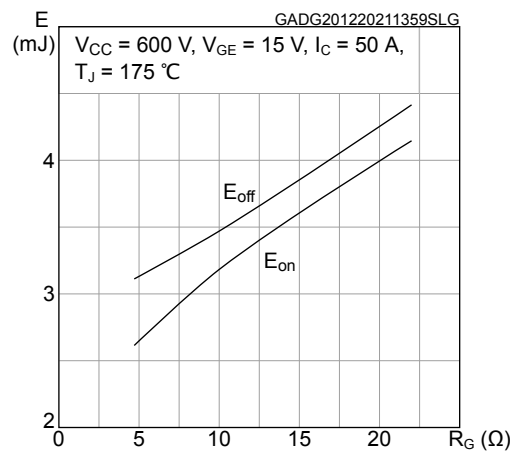
**Figure 14. Gate charge vs gate-emitter voltage**



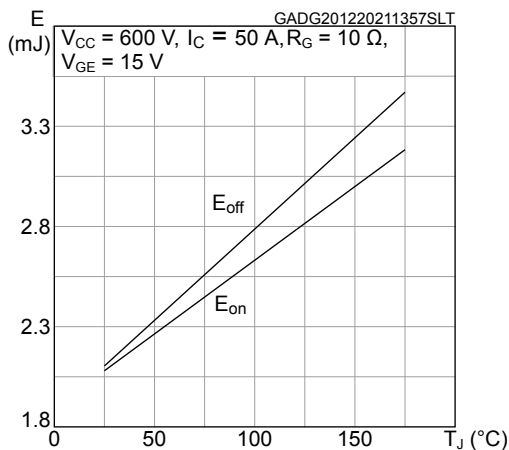
**Figure 15. Switching energy vs collector current**



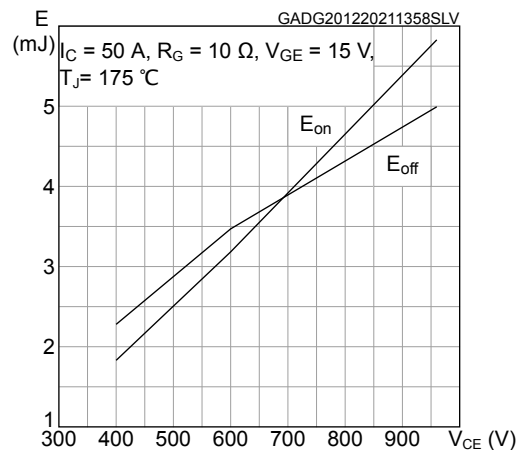
**Figure 16. Switching energy vs gate resistance**



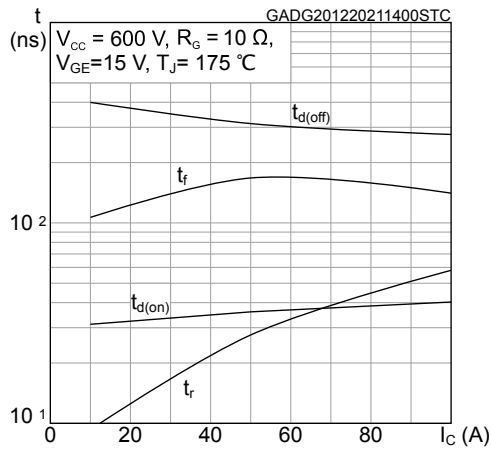
**Figure 17. Switching energy vs junction temperature**



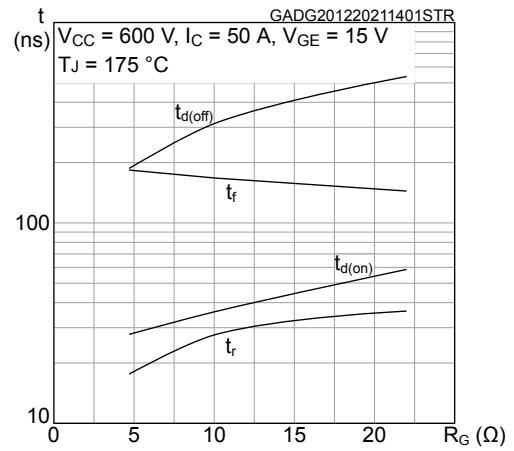
**Figure 18. Switching energy vs collector emitter voltage**



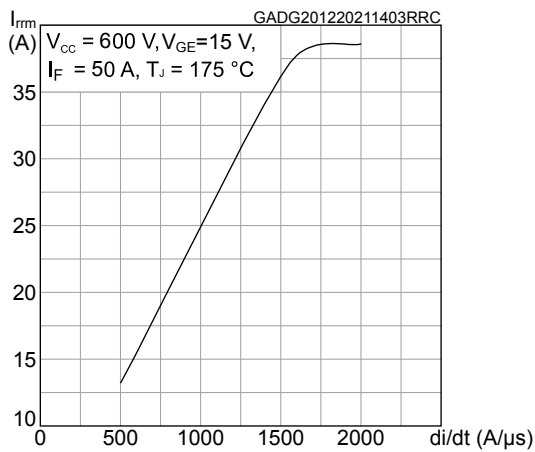
**Figure 19. Switching times vs collector current**



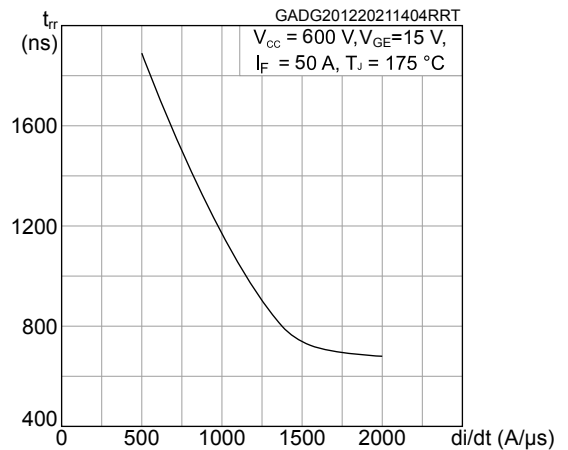
**Figure 20. Switching times vs gate resistance**



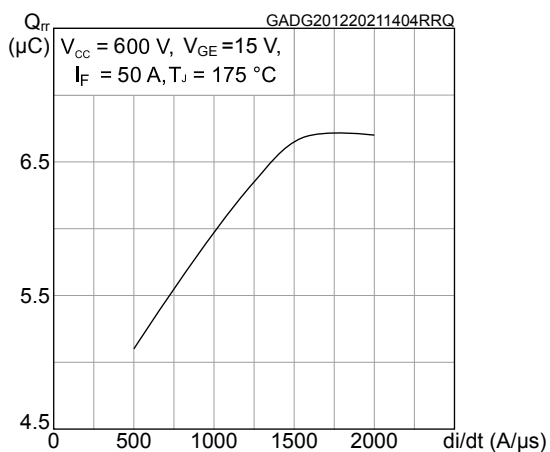
**Figure 21. Reverse recovery current vs diode current slope**



**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**

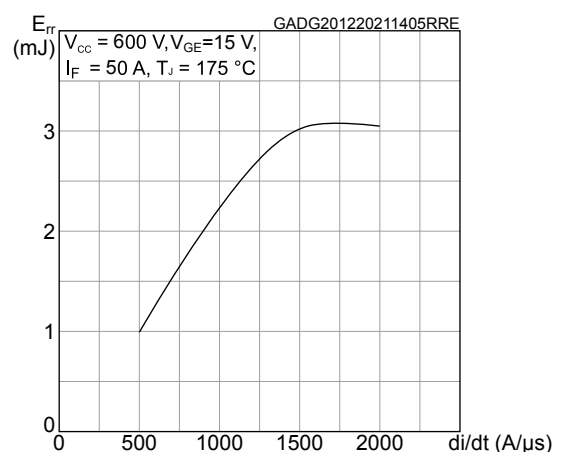




Figure 25. Normalized transient thermal impedance for IGBT

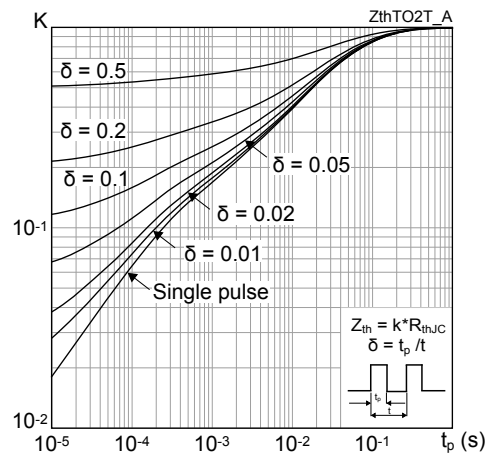
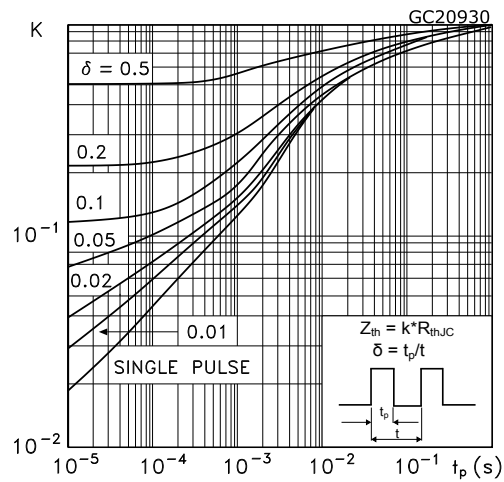
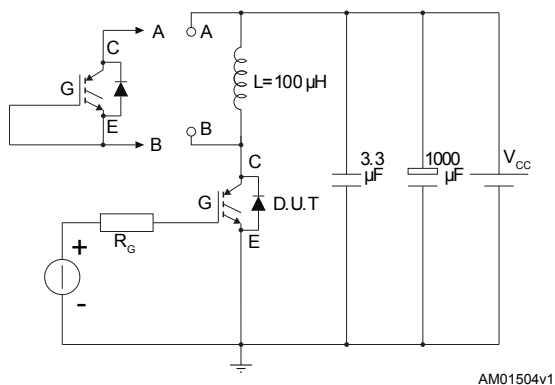


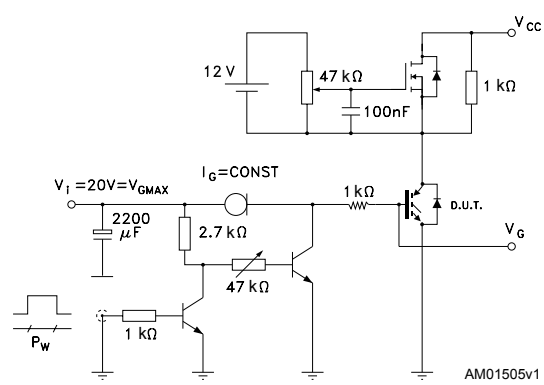
Figure 26. Normalized transient thermal impedance for diode



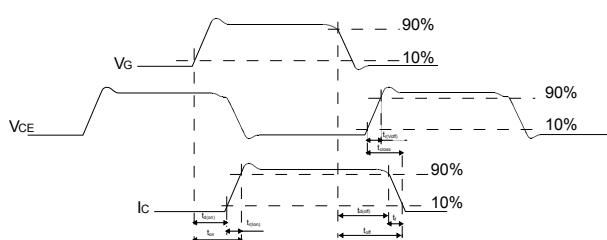
### 3 Test circuits

**Figure 27. Test circuit for inductive load switching**


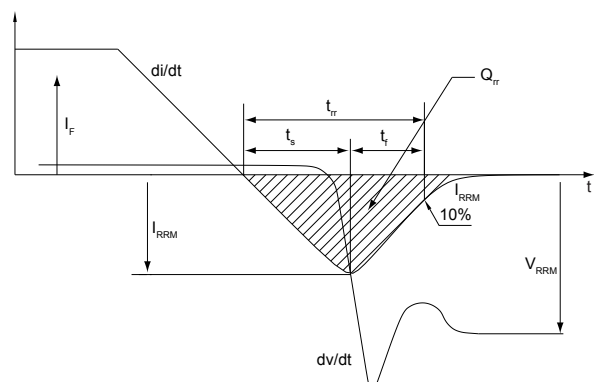
AM01504v1

**Figure 28. Gate charge test circuit**


AM01505v1

**Figure 29. Switching waveform**


AM01506v1

**Figure 30. Diode reverse recovery waveform**


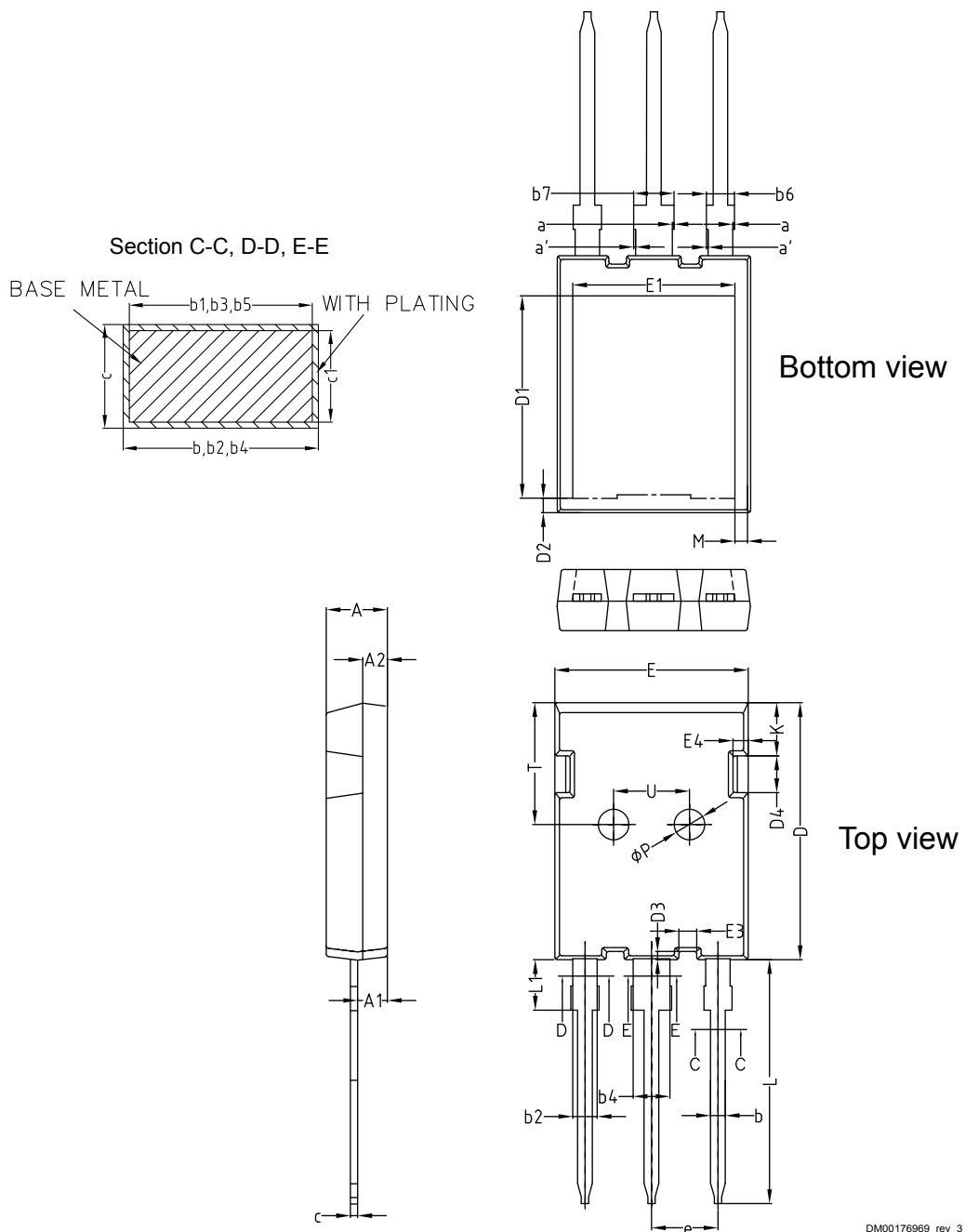
GADG180720171418SA

## 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](http://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
12-Jan-2022	1	First release.

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