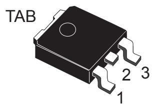
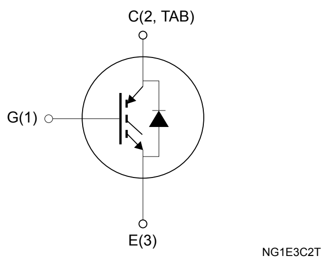
STGD4H60DF

Datasheet

Trench gate field-stop 600 V, 4 A high speed H series IGBT in a DPAK package



DPAK



Features

- Maximum junction temperature: T_J = 175 °C
- Low $V_{CE(sat)}$ = 1.6 V (typ.) @ I_C = 4 A
- Tight parameter distribution
- Low thermal resistance
- Short-circuit rated
- Soft and fast recovery antiparallel diode

Applications

- Industrial motor control
- Dishwashers
- Refrigerators and freezers
- Fans

Description

This device is an 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
STGD4H60DF

Product summary	
Order code	STGD4H60DF
Marking	G4H60DF
Package	DPAK
Packing	Tape and reel

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	600	V
I_C	Continuous collector current at T_C = 25 °C	8	A
	Continuous collector current at T_C = 100 °C	4	
I_{CP} (1)	Pulsed collector current	16	A
V_{GE}	Gate-emitter voltage	±20	V
I_F	Continuous forward current T_C = 25 °C	8	A
	Continuous forward current at T_C = 100 °C	4	
I_{FP} (1)	Pulsed forward current	16	A
P_{TOT}	Total power dissipation at T_C = 25 °C	75	W
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range	-55 to 175	

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

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case, IGBT	2	°C/W
R_{thJC}	Thermal resistance, junction-to-case, diode	4.5	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	100	°C/W

2 Electrical characteristics

T_C = 25 °C unless otherwise specified.

Table 3. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	V_{GE} = 0 V, I_C = 2 mA	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C= 1 A		1.1		V
		V_{GE} = 15 V, I_C= 3 A		1.5	1.95	
		V_{GE} = 15 V, I_C = 3 A, T_J = 125 °C		1.6		
		V_{GE} = 15 V, I_C = 3 A, T_J = 175 °C		1.7		
		V_{GE} = 15 V, I_C = 4 A		1.6		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 250 µA	5	6	7	V
I_{CES}	Collector cut-off current	V_{CE} = 600 V , V_{GE} = 0 V			25	µA
I_{GES}	Gate-emitter leakage current	V_{GE} = ±20 V , V_{CE} = 0 V			±250	nA

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0 V	-	461	-	pF
C_{oes}	Output capacitance			20		
C_{res}	Reverse transfer capacitance			9		
Q_g	Total gate charge	V_{CC} = 480 V, I_C = 3 A, V_{GE} = 0 to 15 V (see Figure 27. Gate charge test circuit)	-	35	-	nC
Q_{ge}	Gate-emitter charge			6		
Q_{gc}	Gate-collector charge			17		

Table 5. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 3 A, R_G = 47 Ω, V_{GE} = 15 V (see Figure 26. Test circuit for inductive load switching and Figure 28. Switching waveform)	-	35	-	ns
t_r	Current rise time			25		
$t_{d(off)}$	Turn-off delay time			121		
t_f	Current fall time			111		
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 3 A, R_G = 47 Ω, V_{GE} = 15 V, T_J = 175 °C (see Figure 26. Test circuit for inductive load switching and Figure 28. Switching waveform)	-	22	-	ns
t_r	Current rise time			30		
$t_{d(off)}$	Turn-off delay time			170		
t_f	Current fall time			180		
t_{sc}	Short-circuit withstand time	V_{CC} ≤ 360 V, V_{GE} = 15 V, R_G = 47 Ω	3	-	-	µs

Table 6. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on} (1)	Turn-on switching energy	V_{CE} = 400 V, I_C = 3 A, R_G = 47 Ω, V_{GE} = 15 V	-	68	-	µJ
E_{off} (2)	Turn-off switching energy			45		
E_{ts}	Total switching energy			113		
E_{on} (1)	Turn-on switching energy	V_{CE} = 400 V, I_C = 3 A, R_G = 47 Ω, V_{GE} = 15 V, T_J = 175 °C		105		
E_{off} (2)	Turn-off switching energy			92		
E_{ts}	Total switching energy			197		

1. *Including the reverse recovery of the diode.*
2. *Including the tail of the collector current.*

Table 7. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F	Forward on-voltage	I_F = 1 A		1.3		V
		I_F = 3 A	-	1.75	-	
		I_F = 3 A, T_J = 175 °C		1.3		
		I_F = 4 A		1.85		
t_{rr}	Reverse recovery time	V_{CC} = 400 V; I_F = 3 A; di_F/dt = 160 A / µs	-	73	-	ns
Q_{rr}	Reverse recovery charge			66		nC
I_{rrm}	Reverse recovery current			2.3		A
E_{rr}	Reverse recovery energy			9.9		µJ
t_{rr}	Reverse recovery time	V_{CC} = 400 V; I_F = 3 A; di_F/dt = 160 A / µs, T_J = 175 °C		118		ns
Q_{rr}	Reverse recovery charge			206		nC
I_{rrm}	Reverse recovery current			3.9		A
E_{rr}	Reverse recovery energy			41		µJ

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature

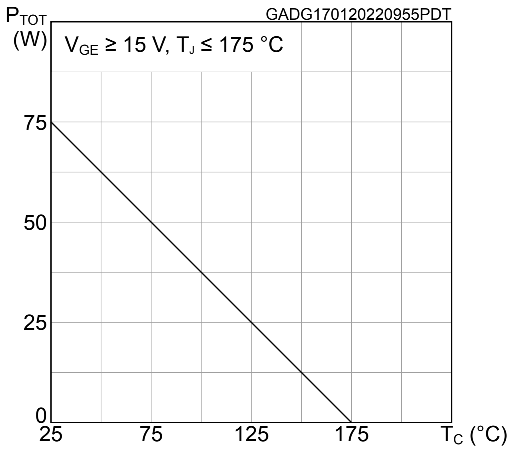


Figure 2. Collector current vs case temperature

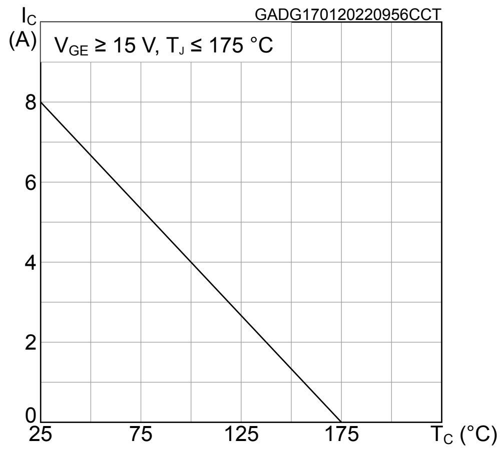


Figure 3. Output characteristics (T_J = 25°C)

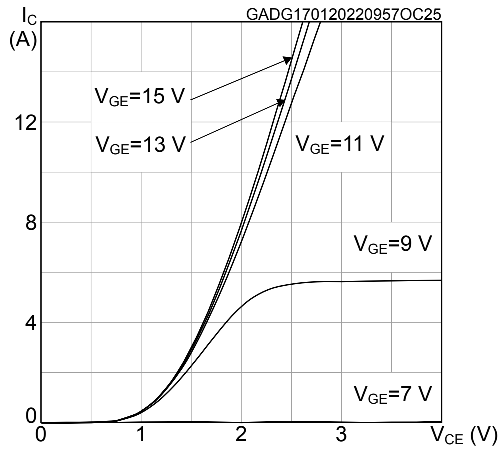


Figure 4. Output characteristics (T_J = 175°C)

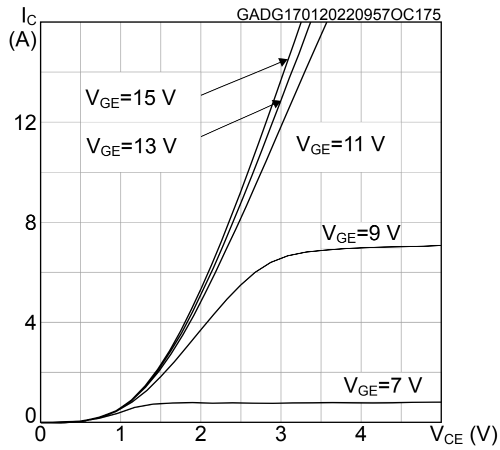


Figure 5. $V_{CE(sat)}$ vs junction temperature

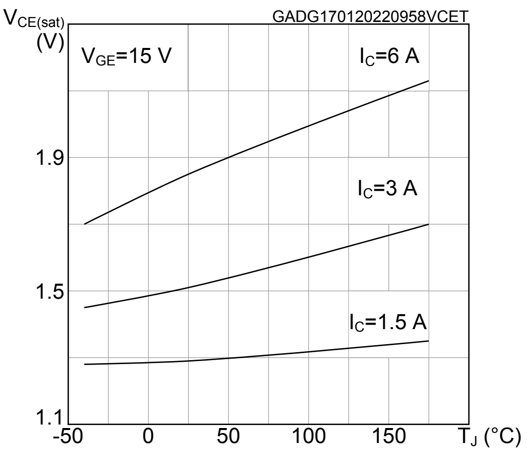


Figure 6. $V_{CE(sat)}$ vs collector current

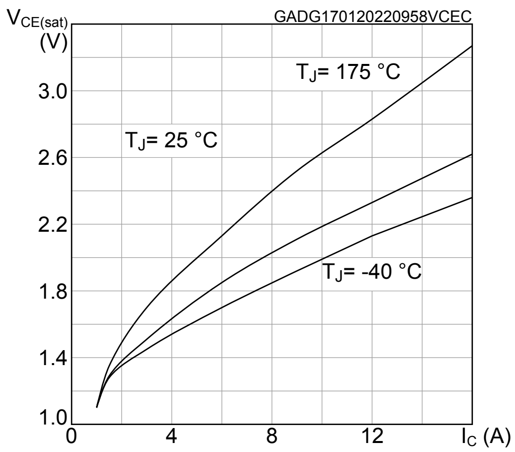


Figure 7. Forward bias safe operating area

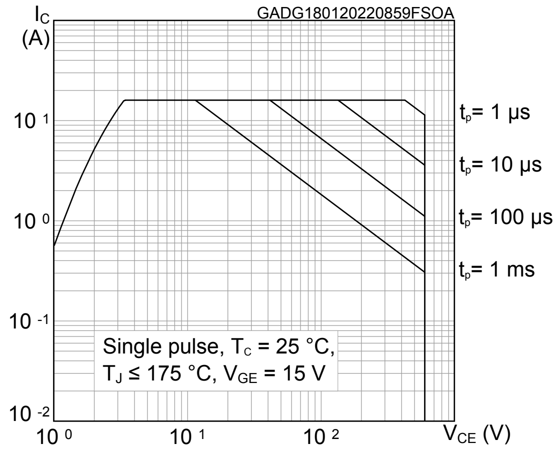


Figure 8. Transfer characteristics

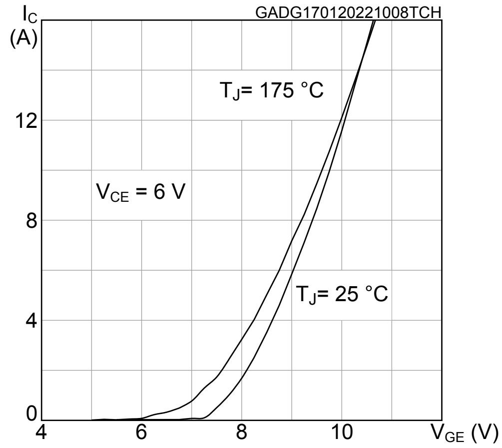


Figure 9. Diode V_F vs forward current

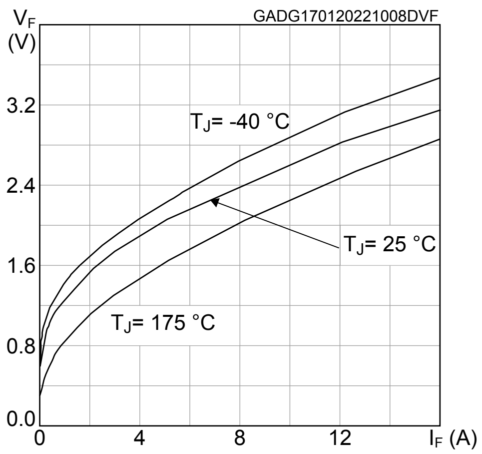


Figure 10. Normalized $V_{GE(th)}$ vs junction temperature

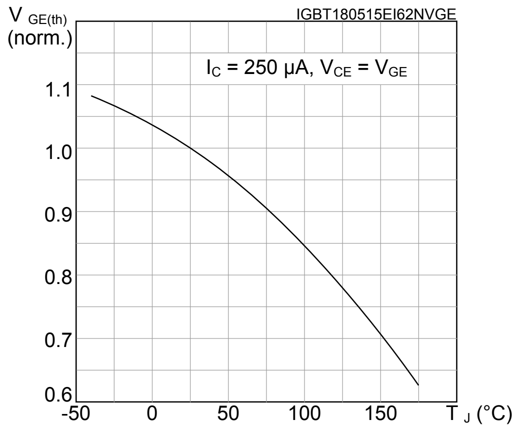


Figure 11. Normalized $V_{(BR)CES}$ vs junction temperature

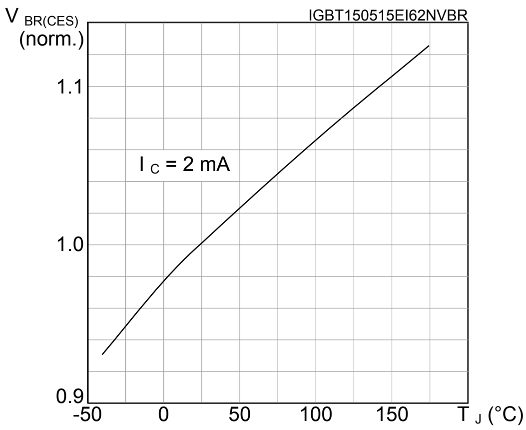


Figure 12. Capacitance variation

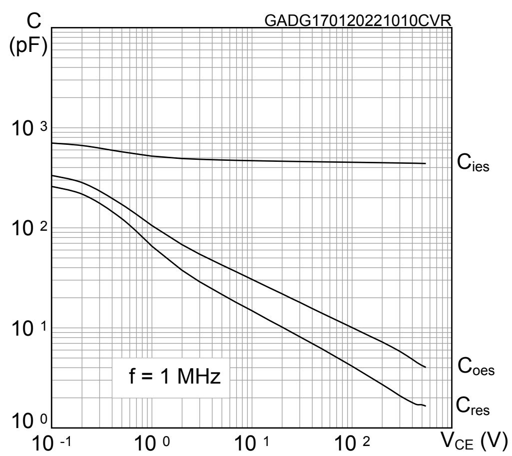


Figure 13. Gate charge vs. gate-emitter voltage

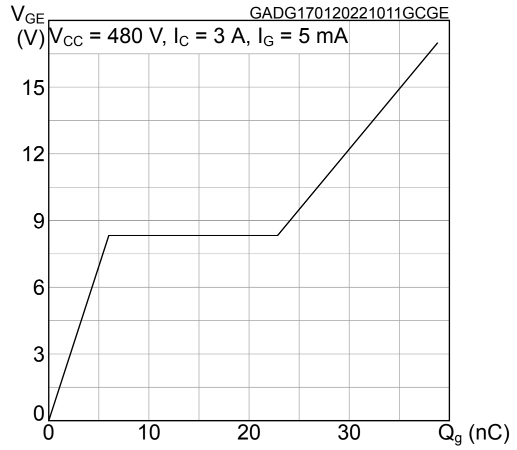


Figure 14. Switching energy vs collector current

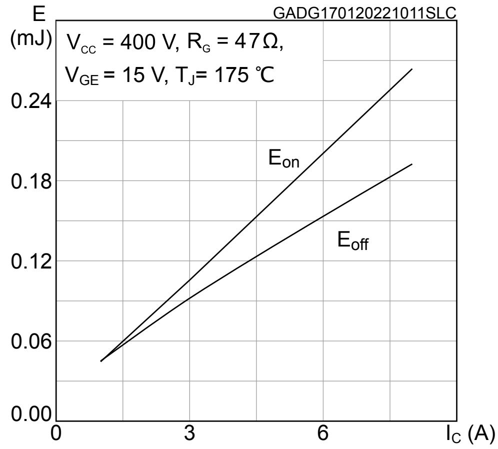


Figure 15. Switching energy vs gate resistance

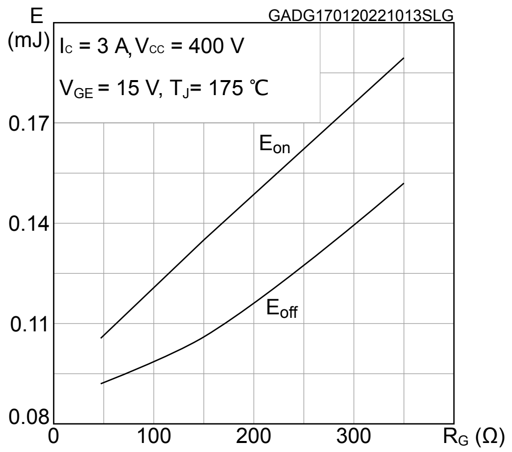


Figure 16. Switching energy vs temperature

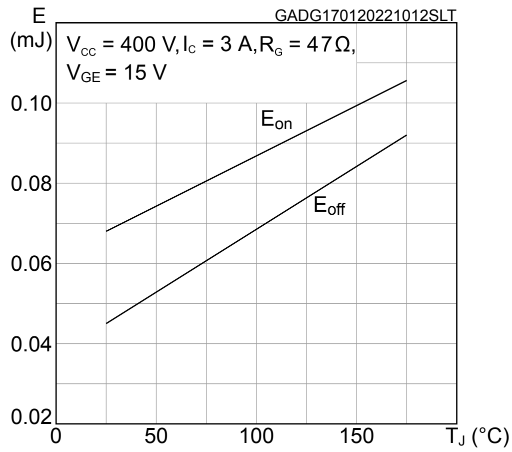


Figure 17. Switching energy vs collector-emitter voltage

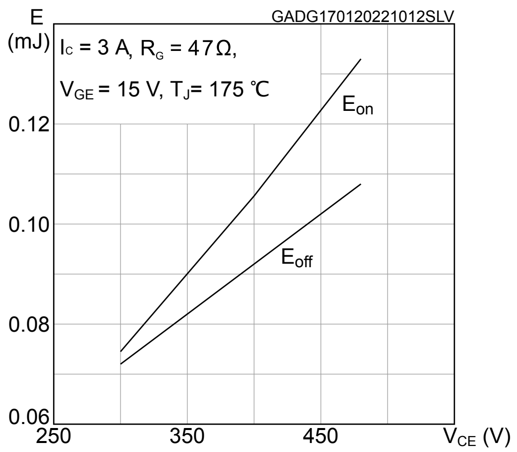


Figure 18. Switching times vs collector current

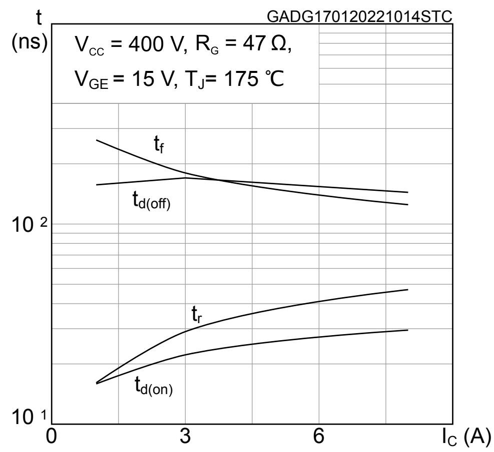


Figure 19. Switching times vs gate resistance

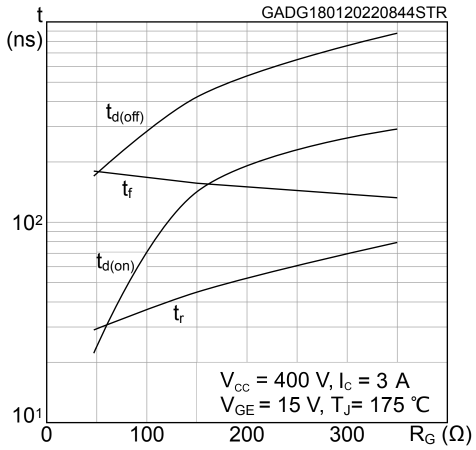


Figure 20. Reverse recovery current vs diode current slope

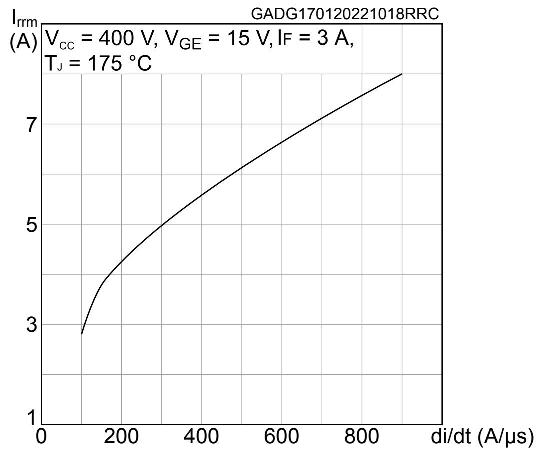


Figure 21. Reverse recovery time vs diode current slope

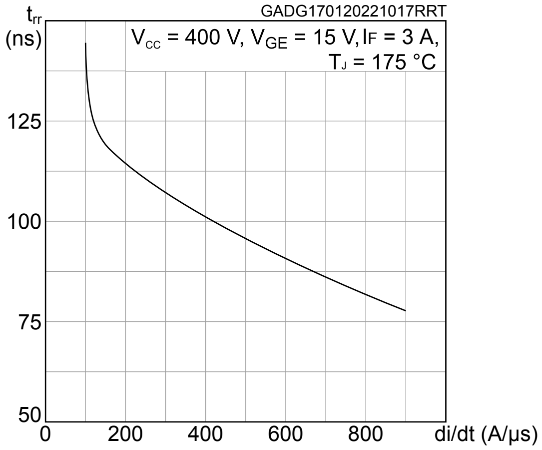


Figure 22. Reverse recovery charge vs diode current slope

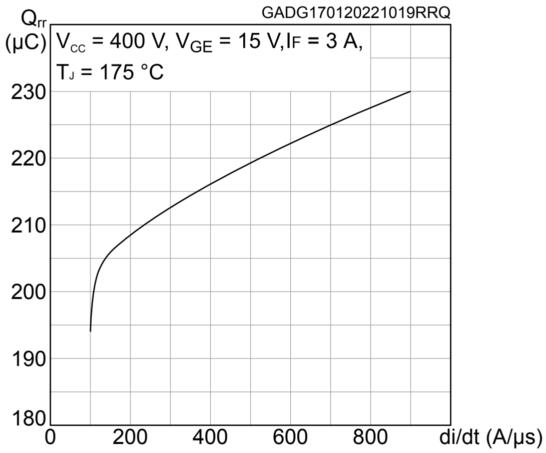


Figure 23. Reverse recovery energy vs diode current slope

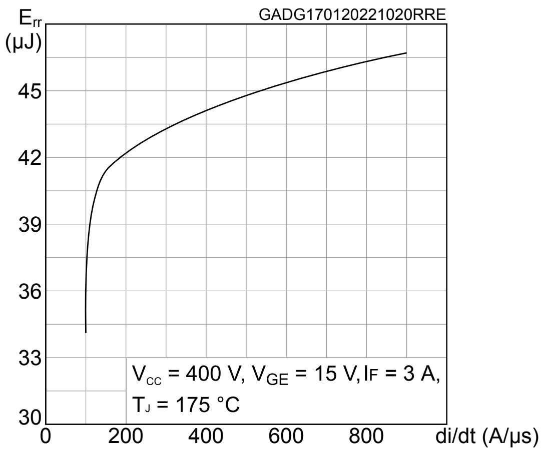


Figure 24. Thermal impedance for IGBT

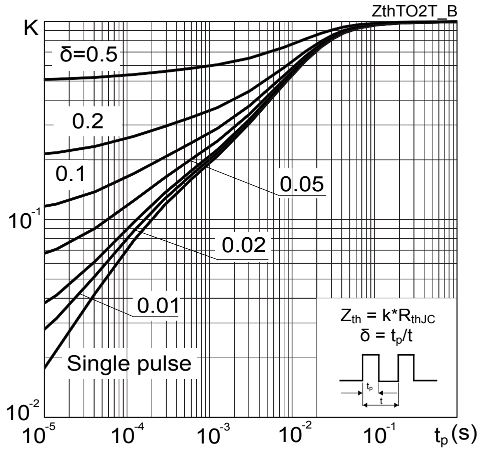
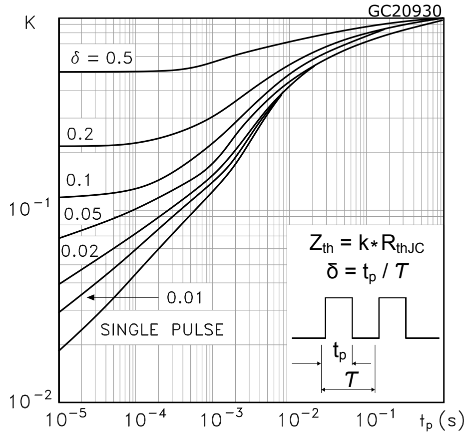


Figure 25. Thermal impedance for diode



3 Test circuits

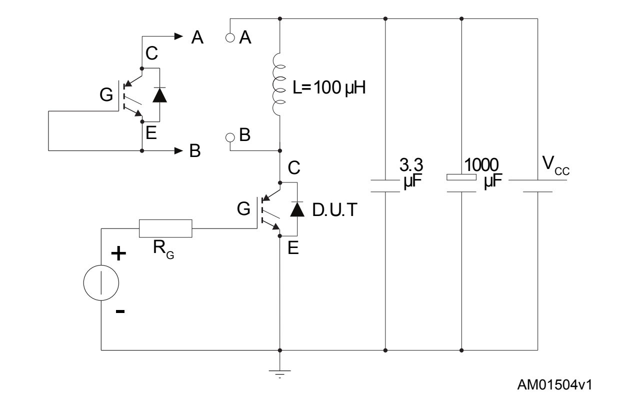


Figure 26. Test circuit for inductive load switching

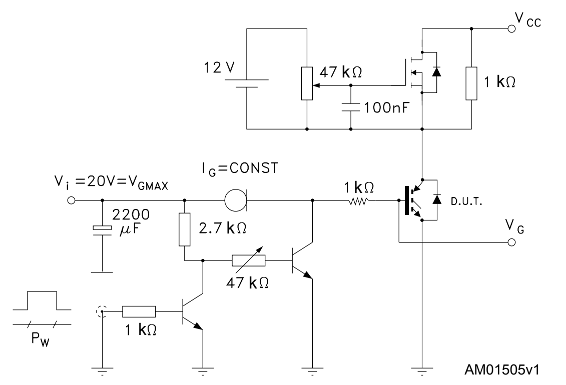


Figure 27. Gate charge test circuit

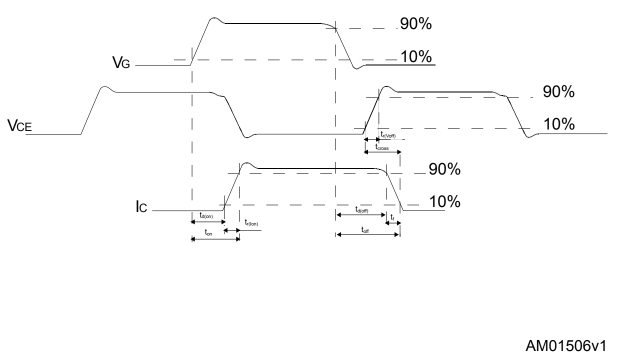


Figure 28. Switching waveform

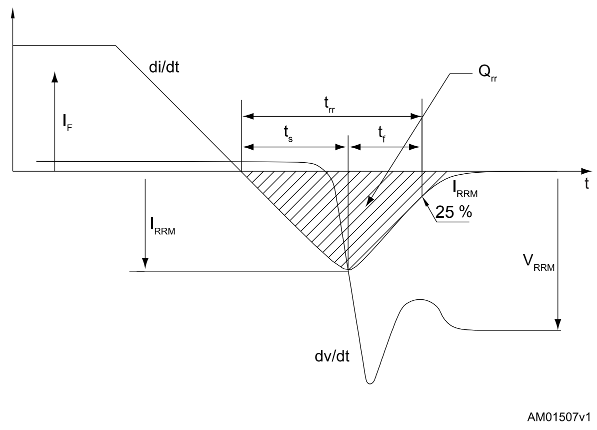


Figure 29. Diode reverse recovery waveform

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 DPAK (TO-252) type C2 package information

Figure 30. **DPAK (TO-252) type C2 package outline**

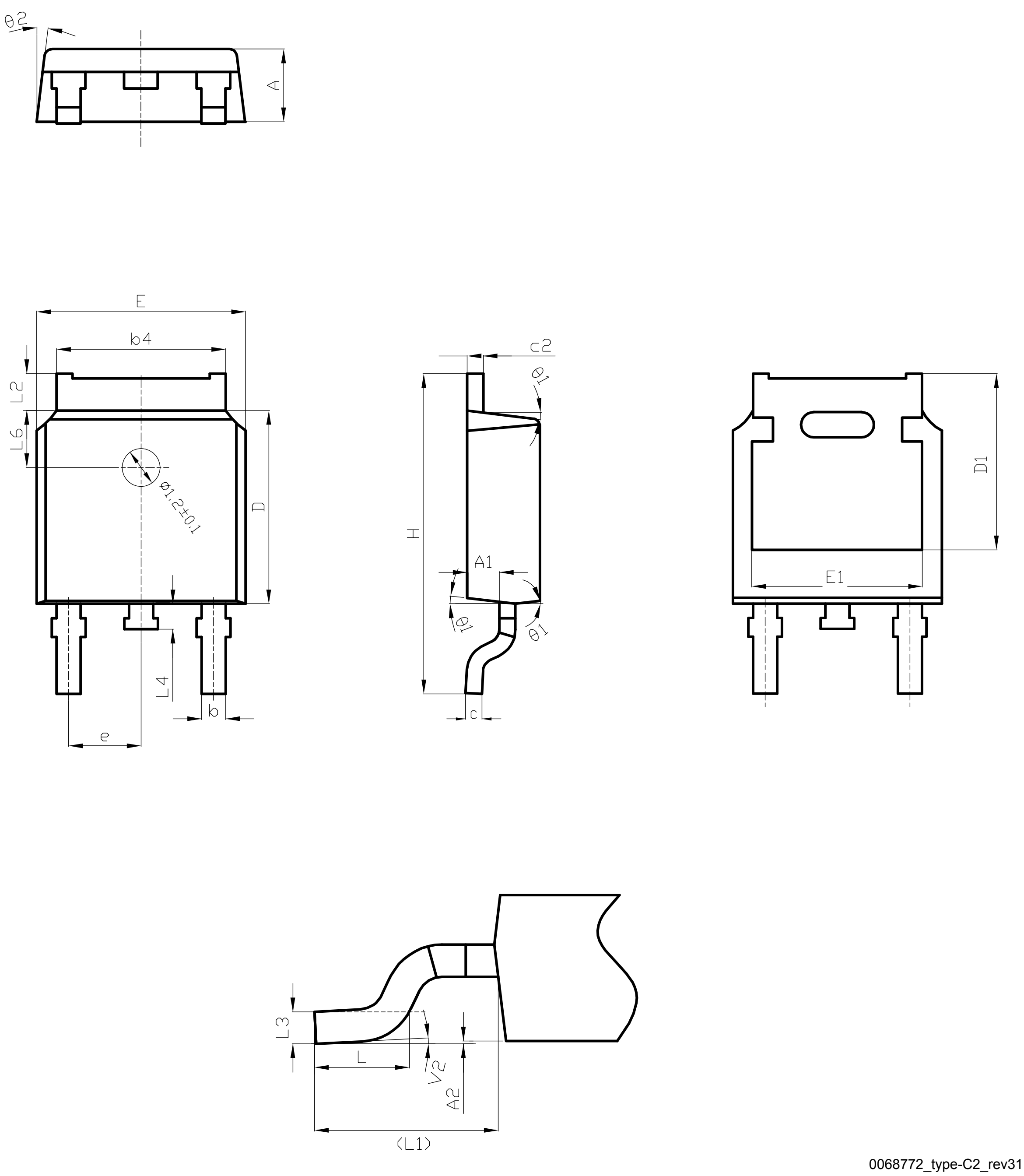
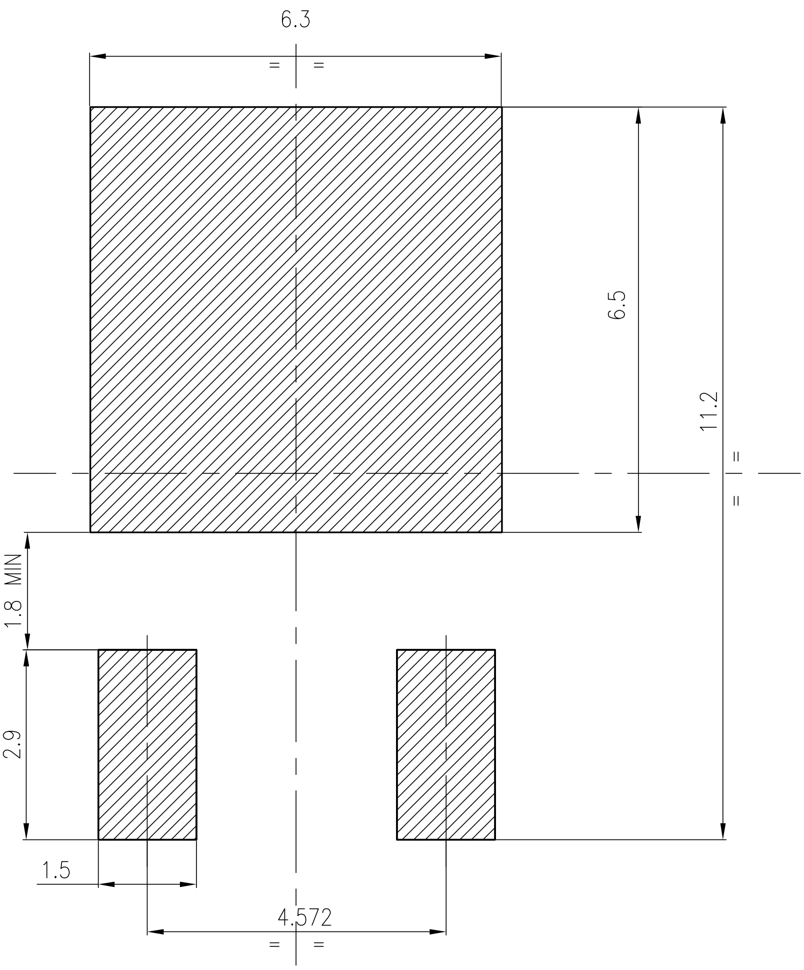


Table 8. **DPAK (TO-252) type C2 mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.38
A1	0.90	1.01	1.10
A2	0.00		0.10
b	0.72		0.85
b4	5.13	5.33	5.46
c	0.47		0.60
c2	0.47		0.60
D	6.00	6.10	6.20
D1	5.10	5.35	5.60
E	6.50	6.60	6.70
E1	5.00	5.20	5.40
e	2.186	2.286	2.386
H	9.80	10.10	10.40
L	1.40	1.50	1.70
L1	2.90 REF		
L2	0.90		1.25
L3	0.51 BSC		
L4	0.60	0.80	1.00
L6	1.80 BSC		
θ1	5°	7°	9°
θ2	5°	7°	9°
V2	0°		8°

Figure 31. DPAK (TO-252) recommended footprint (dimensions are in mm)



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4.2 DPAK (TO-252) packing information

Figure 32. DPAK (TO-252) tape outline

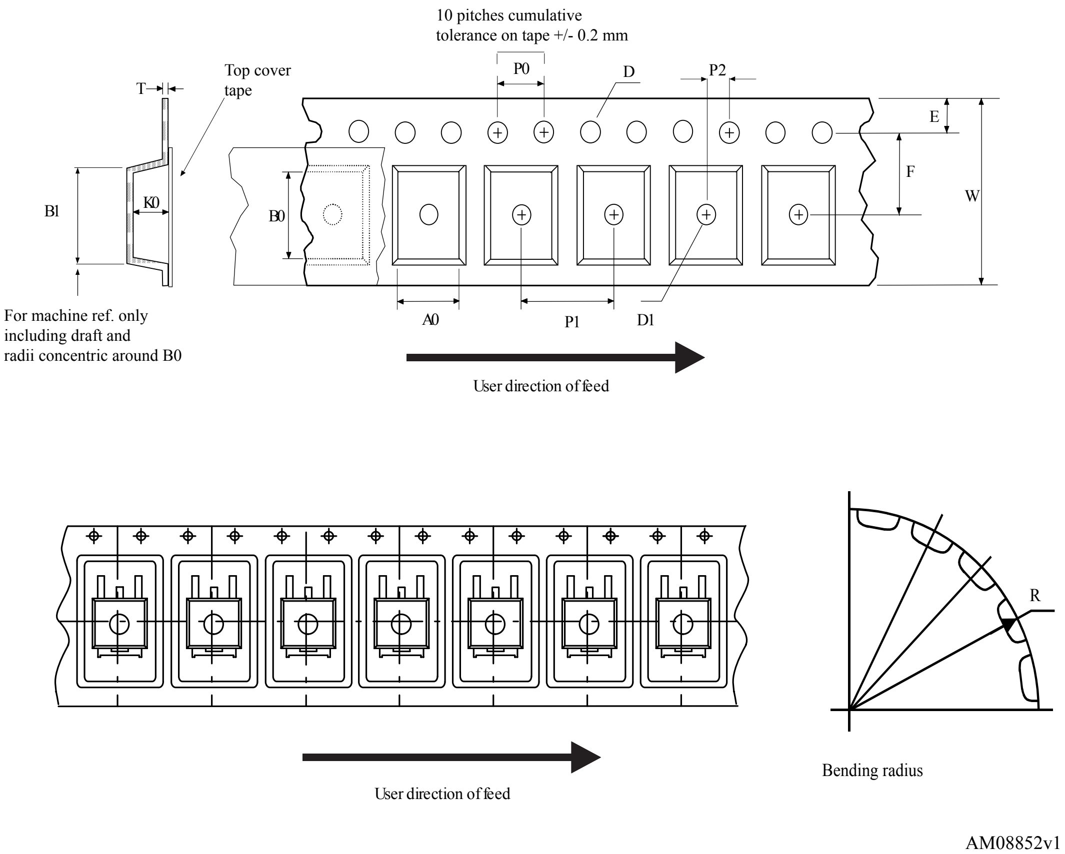

Figure 33. DPAK (TO-252) reel outline

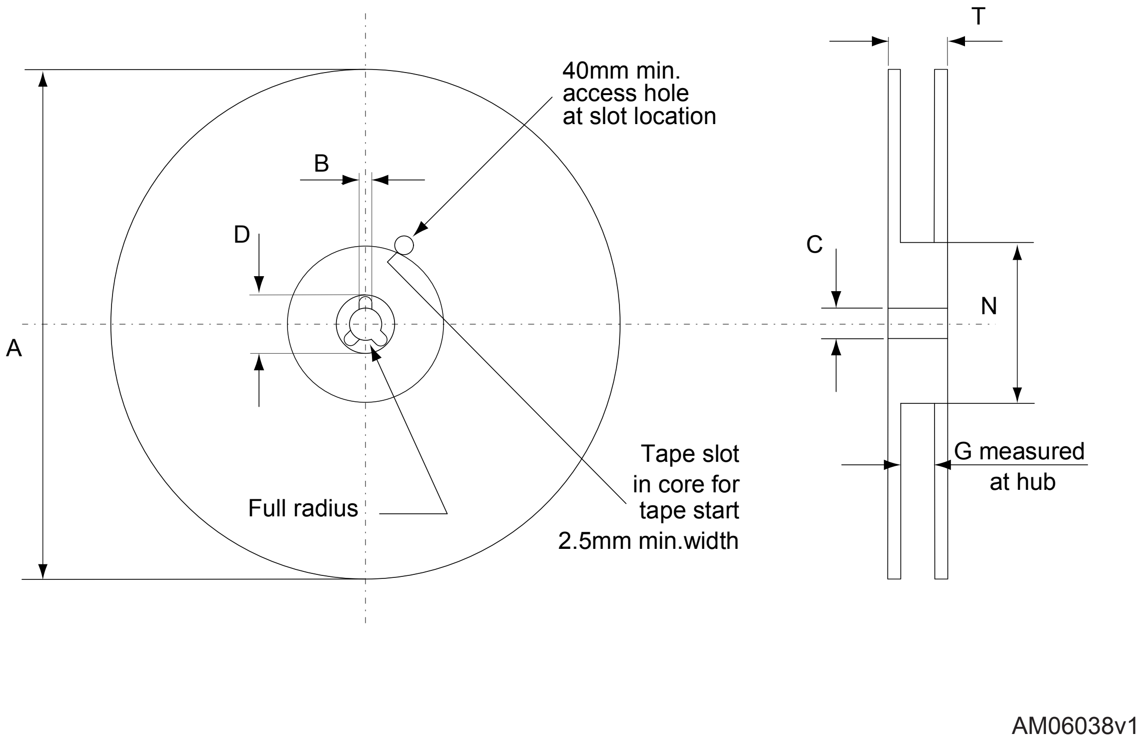

Table 9. DPAK (TO-252) tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	6.8	7	A		330
B0	10.4	10.6	B	1.5	
B1		12.1	C	12.8	13.2
D	1.5	1.6	D	20.2	
D1	1.5		G	16.4	18.4
E	1.65	1.85	N	50	
F	7.4	7.6	T		22.4
K0	2.55	2.75			
P0	3.9	4.1	Base qty.		2500
P1	7.9	8.1	Bulk qty.		2500
P2	1.9	2.1			
R	40				
T	0.25	0.35			
W	15.7	16.3			

Revision history

Table 10. Document revision history

Date	Revision	Changes
20-Jan-2022	1	First release.
23-Feb-2023	2	Updated Table 5. Switching characteristics (inductive load).

Contents