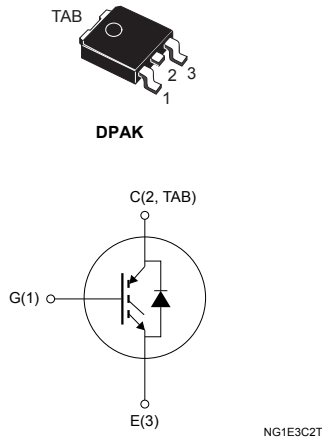


## Trench gate field-stop 600 V, 4 A high speed H series IGBT in a DPAK package



## Features

- Maximum junction temperature:  $T_J = 175\text{ °C}$
- Low  $V_{CE(sat)} = 1.6\text{ V (typ.) @ } I_C = 4\text{ A}$
- 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 $T_C = 25\text{ °C}$	8	A
	Continuous collector current at $T_C = 100\text{ °C}$	4	
$I_{CP}^{(1)}$	Pulsed collector current	16	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$I_F$	Continuous forward current $T_C = 25\text{ °C}$	8	A
	Continuous forward current at $T_C = 100\text{ °C}$	4	
$I_{FP}^{(1)}$	Pulsed forward current	16	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ °C}$	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

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

**Table 3. Static**

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

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GE} = 0\text{ V}$	-	461	-	$\mu\text{F}$
$C_{oes}$	Output capacitance			20		
$C_{res}$	Reverse transfer capacitance			9		
$Q_g$	Total gate charge	$V_{CC} = 480\text{ V}$ , $I_C = 3\text{ A}$ , $V_{GE} = 0\text{ to }15\text{ V}$ (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	$V_{CE} = 400\text{ V}$ , $I_C = 3\text{ A}$ , $R_G = 47\text{ }\Omega$ , $V_{GE} = 15\text{ V}$ (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	$V_{CE} = 400\text{ V}$ , $I_C = 3\text{ A}$ , $R_G = 47\text{ }\Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 175\text{ °C}$ (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	$V_{CC} \leq 360\text{ V}$ , $V_{GE} = 15\text{ V}$ , $R_G = 47\text{ }\Omega$	3	-	-	$\mu\text{s}$

**Table 6. Switching energy (inductive load)**

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

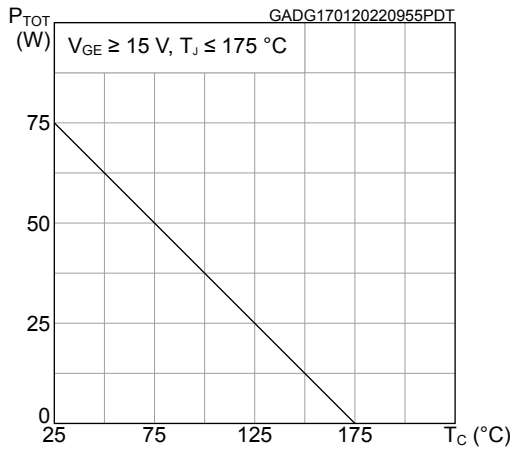
1. Including the reverse recovery of the diode.
2. Including the tail of the collector current.

**Table 7. Collector-emitter diode**

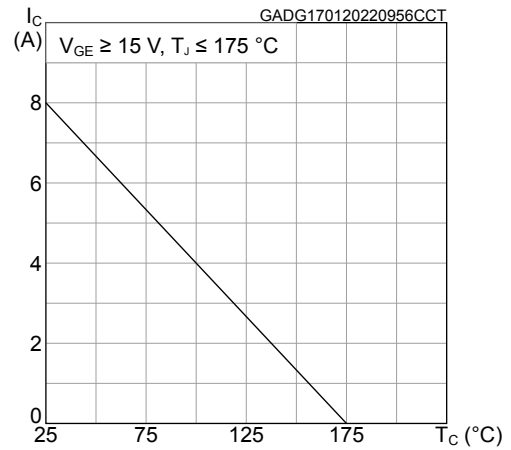
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_F$	Forward on-voltage	$I_F = 1\text{ A}$	-	1.3	-	V
		$I_F = 3\text{ A}$		1.75		
		$I_F = 3\text{ A}$ , $T_J = 175\text{ }^\circ\text{C}$		1.3		
		$I_F = 4\text{ A}$		1.85		
$t_{rr}$	Reverse recovery time	$V_{CC} = 400\text{ V}$ ; $I_F = 3\text{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

## 2.1 Electrical characteristics (curves)

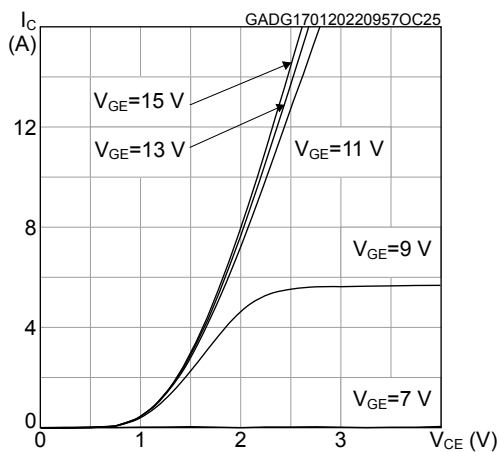
**Figure 1. Power dissipation vs case temperature**



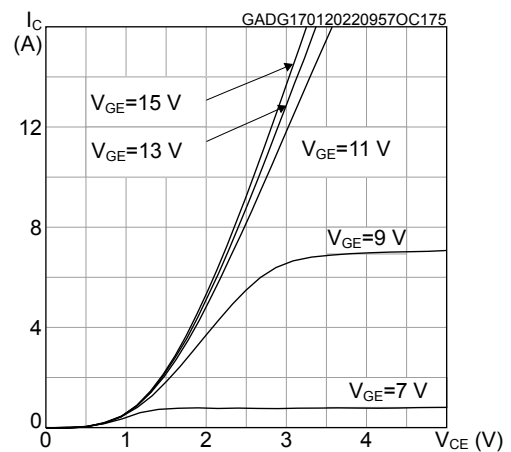
**Figure 2. Collector current vs case temperature**



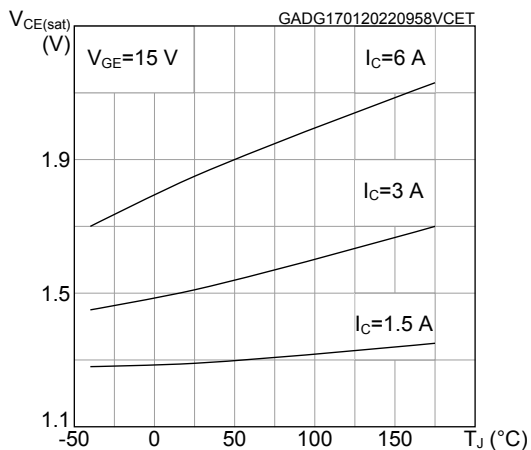
**Figure 3. Output characteristics (T<sub>J</sub> = 25°C)**



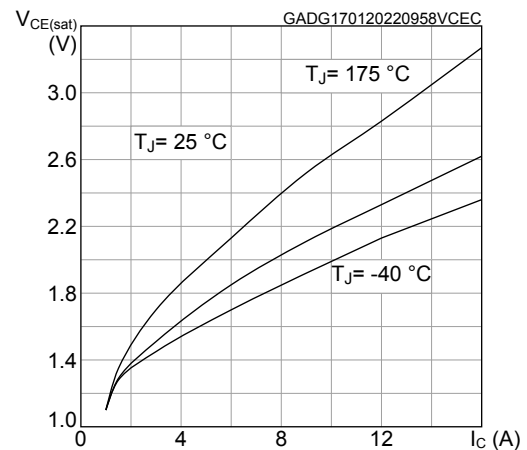
**Figure 4. Output characteristics (T<sub>J</sub> = 175°C)**



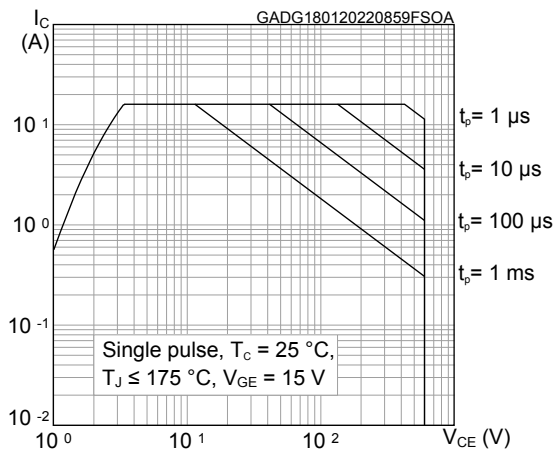
**Figure 5. V<sub>CE(sat)</sub> vs junction temperature**



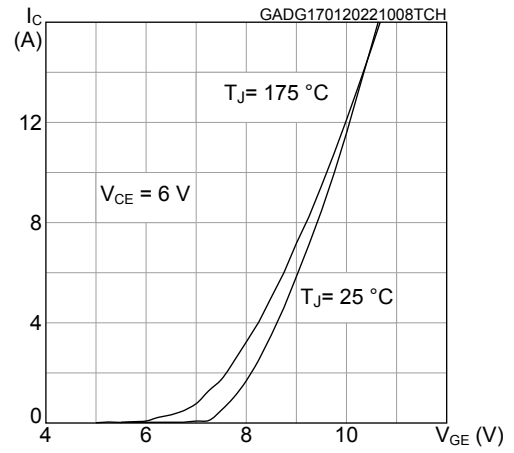
**Figure 6. V<sub>CE(sat)</sub> vs collector current**



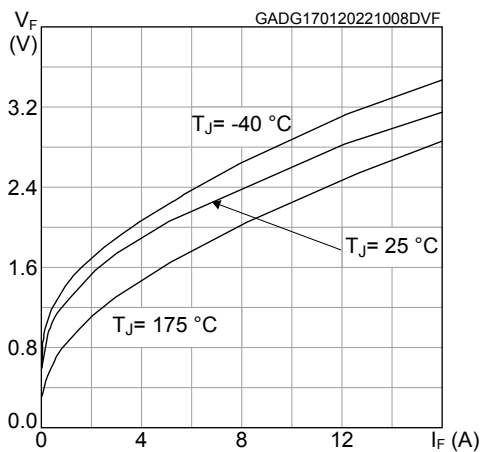
**Figure 7. Forward bias safe operating area**



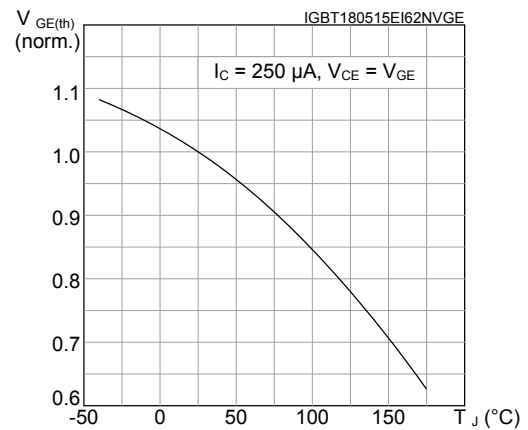
**Figure 8. Transfer characteristics**



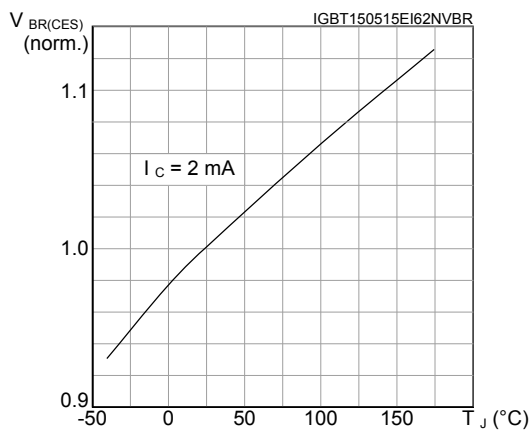
**Figure 9. Diode V\_F vs forward current**



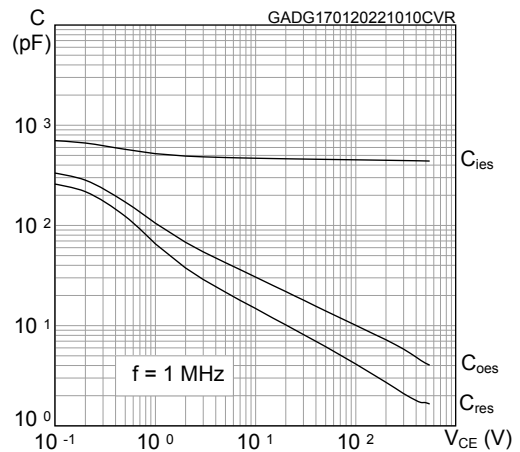
**Figure 10. Normalized V\_GE(th) vs junction temperature**



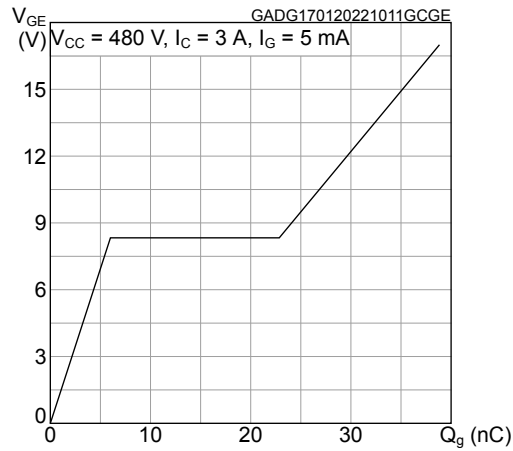
**Figure 11. Normalized V\_BR(CES) vs junction temperature**



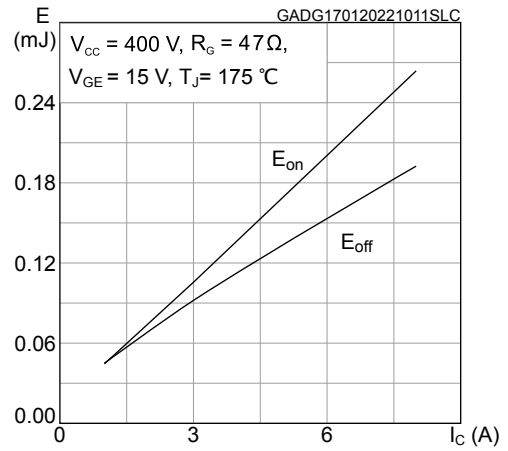
**Figure 12. Capacitance variation**



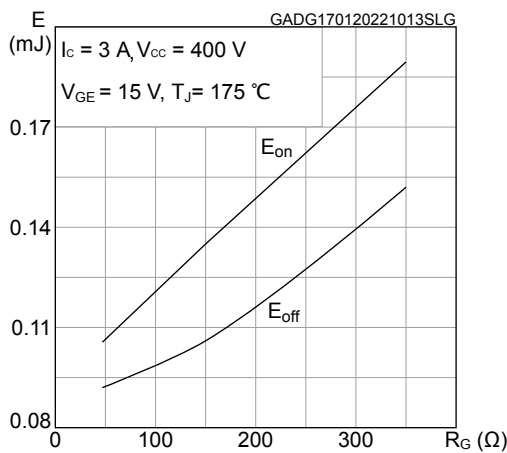
**Figure 13. Gate charge vs. gate-emitter voltage**



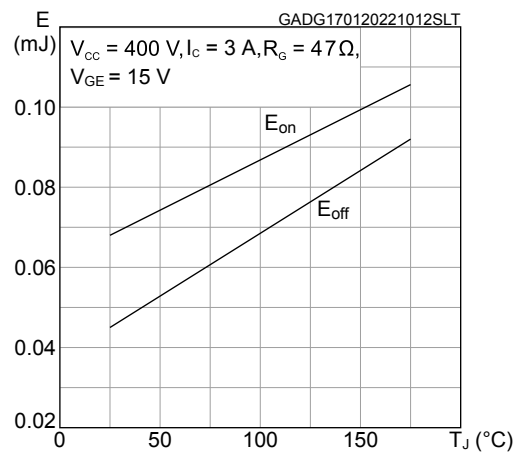
**Figure 14. Switching energy vs collector current**



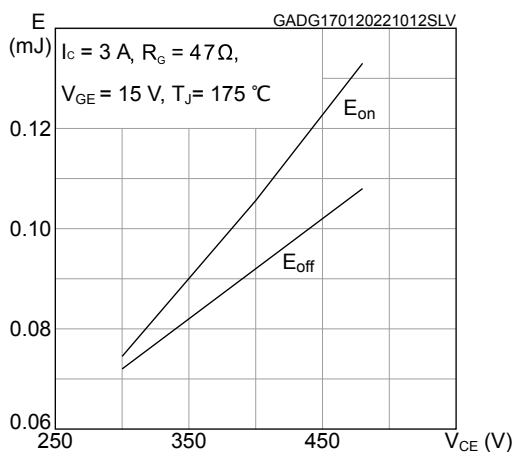
**Figure 15. Switching energy vs gate resistance**



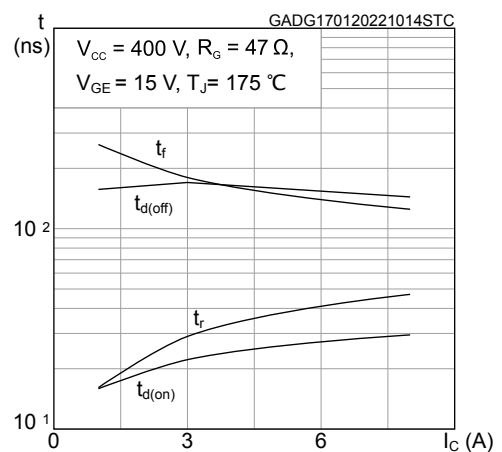
**Figure 16. Switching energy vs temperature**



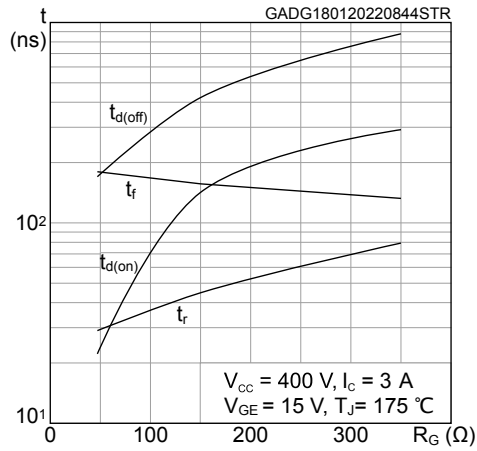
**Figure 17. Switching energy vs collector-emitter voltage**



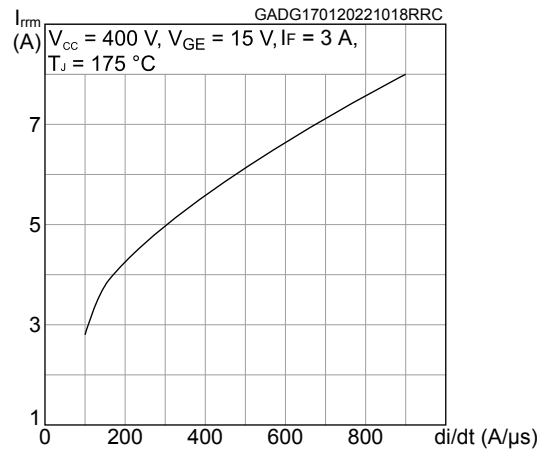
**Figure 18. Switching times vs collector current**



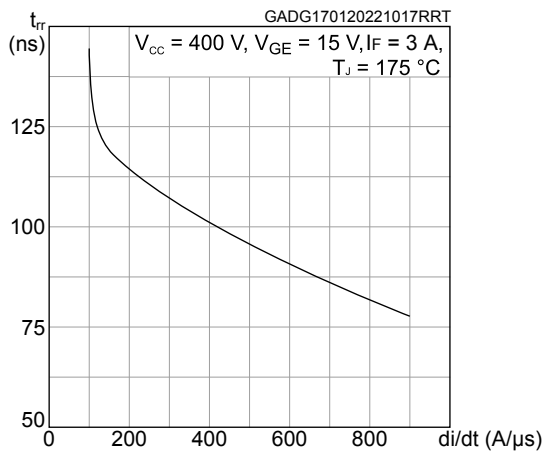
**Figure 19. Switching times vs gate resistance**



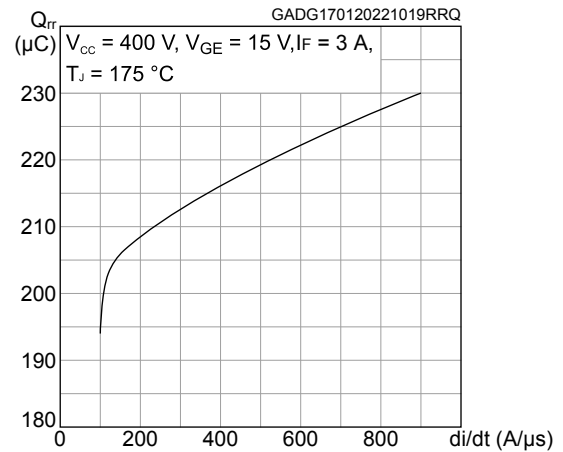
**Figure 20. Reverse recovery current vs diode current slope**



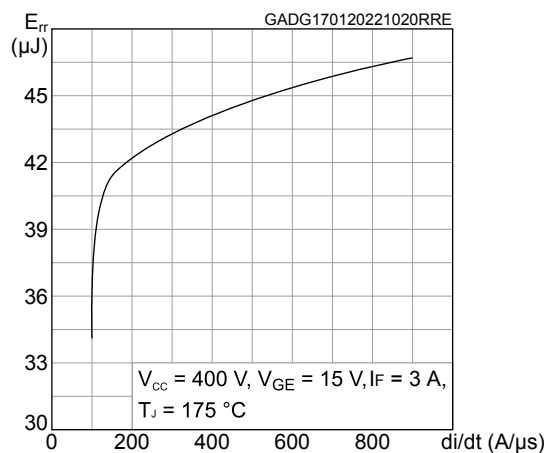
**Figure 21. Reverse recovery time vs diode current slope**



**Figure 22. Reverse recovery charge vs diode current slope**

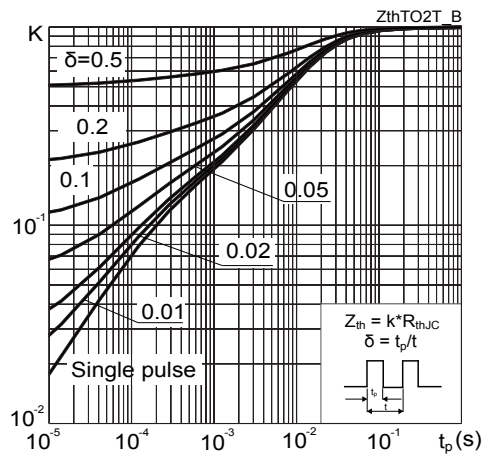


**Figure 23. Reverse recovery energy vs diode current slope**

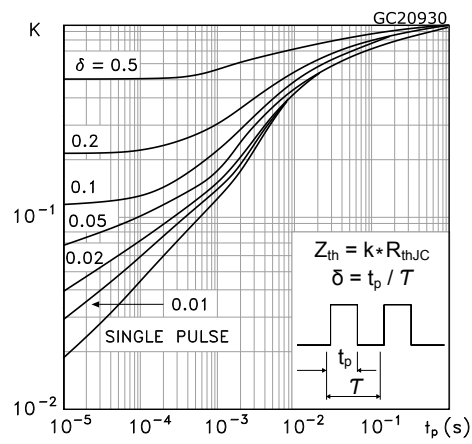




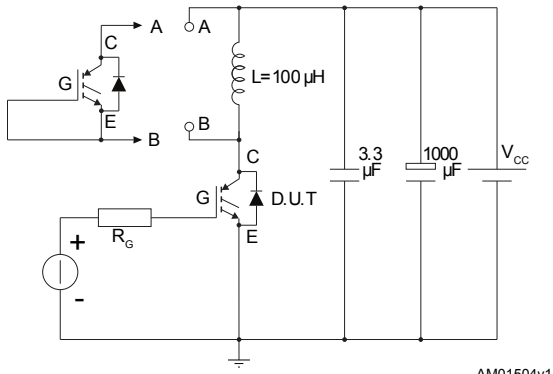
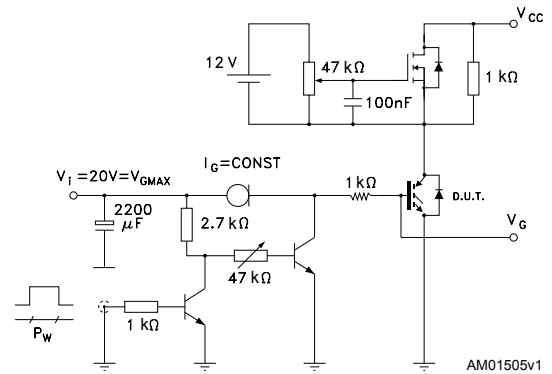
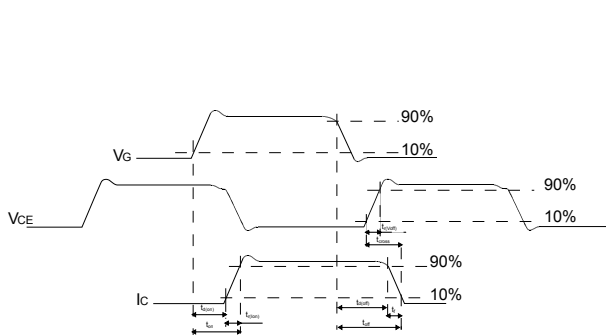
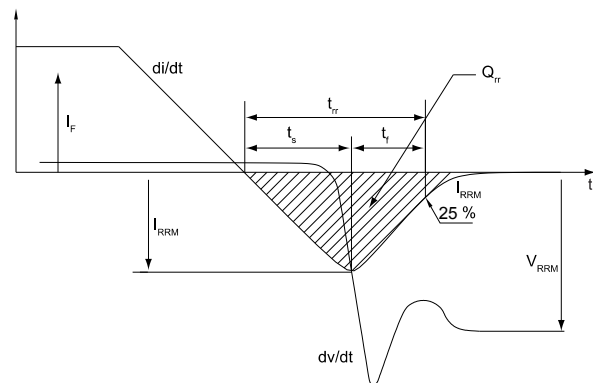
**Figure 24. Thermal impedance for IGBT**



**Figure 25. Thermal impedance for diode**



### 3 Test circuits

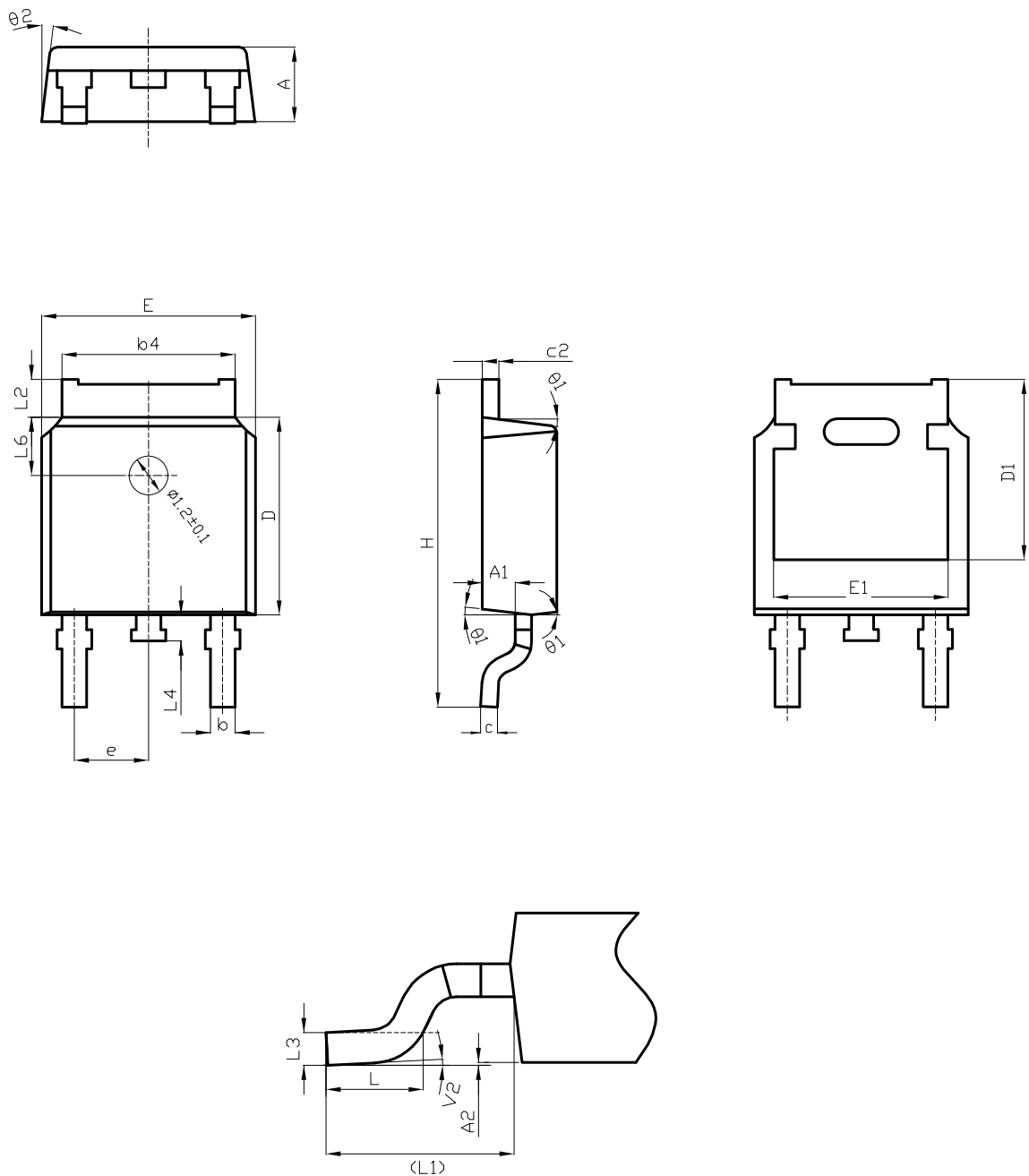
**Figure 26. Test circuit for inductive load switching**

**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](http://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**

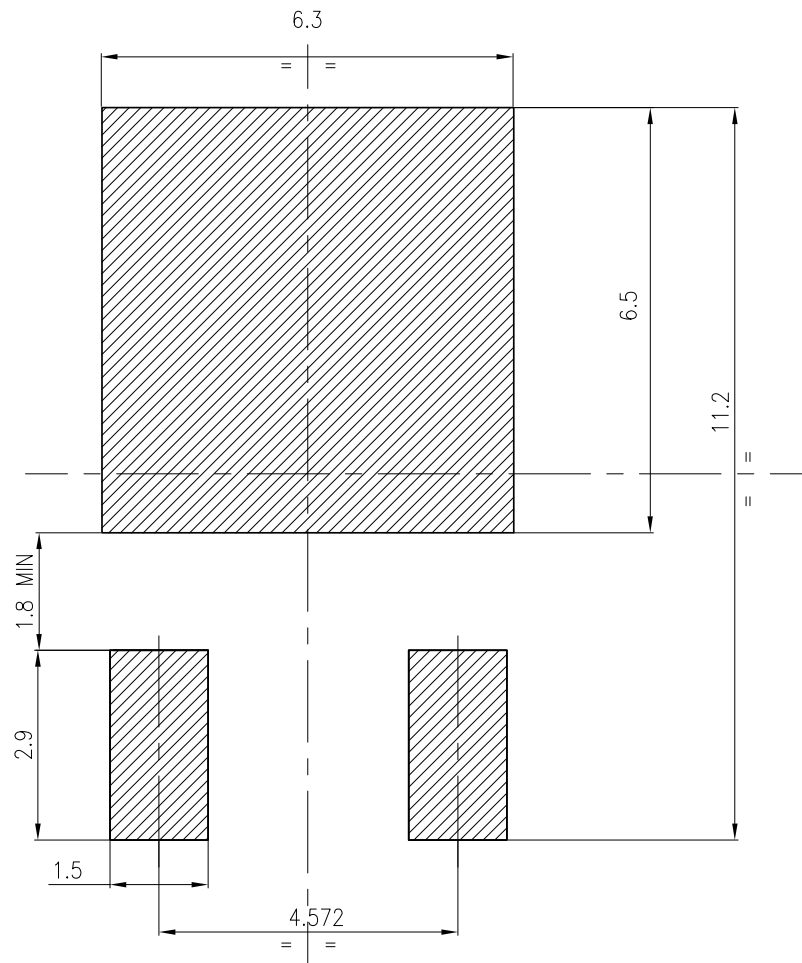


0068772\_type-C2\_rev31

**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°

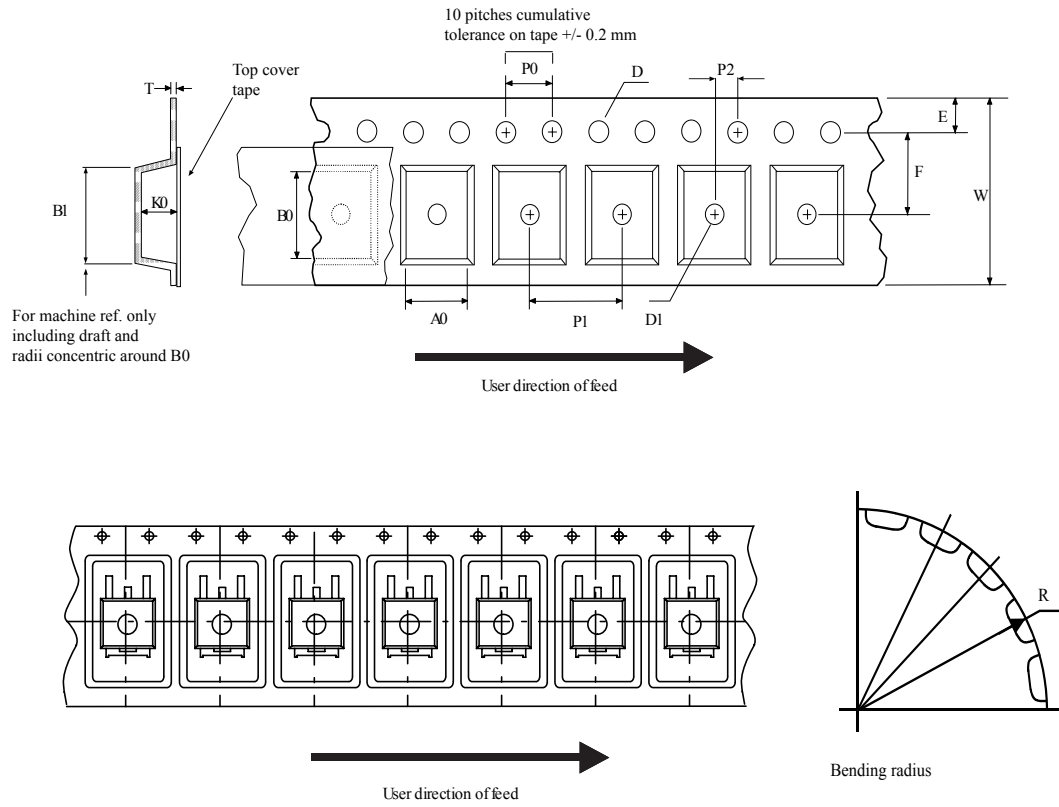
Figure 31. DPAK (TO-252) recommended footprint (dimensions are in mm)



FP\_0068772\_32

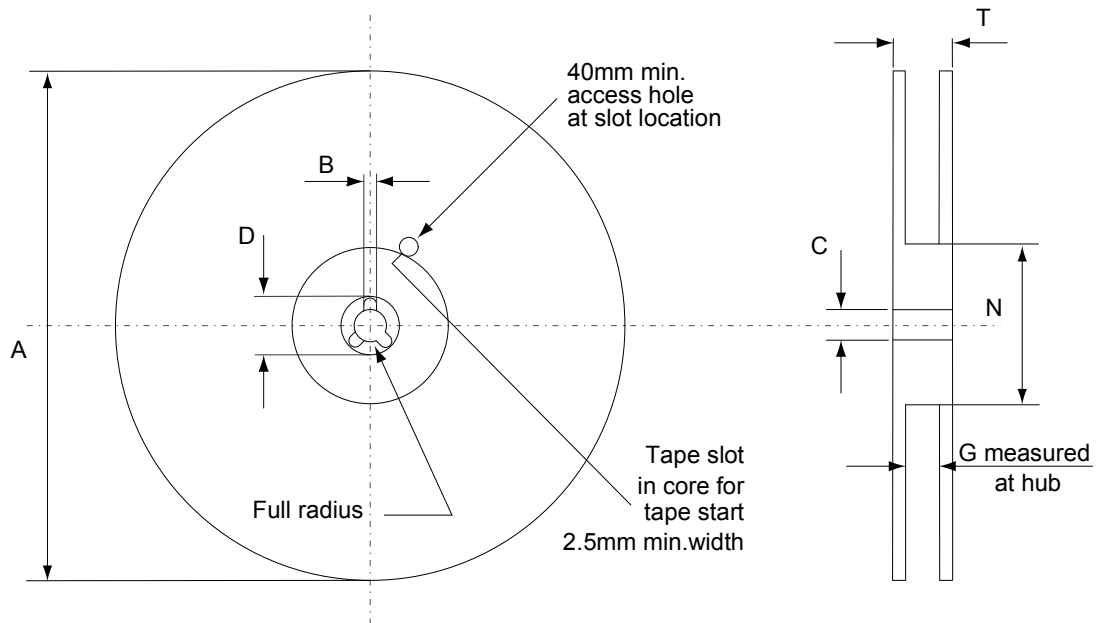
## 4.2 DPAK (TO-252) packing information

Figure 32. DPAK (TO-252) tape outline



AM08852v1

**Figure 33. DPAK (TO-252) reel outline**



AM06038v1

**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 <a href="#">Table 5</a> . Switching characteristics (inductive load).



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