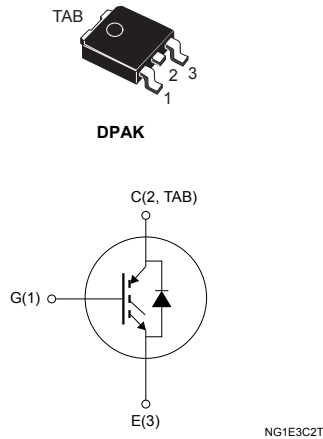


Trench gate field-stop 600 V, 4 A high speed H series IGBT in a DPAK package



Features

- Maximum junction temperature: $T_J = 175\text{ }^{\circ}\text{C}$
- 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	± 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	μA
I_{GES}	Gate-emitter leakage current	$V_{GE} = \pm 20\text{ V}$, $V_{CE} = 0\text{ V}$			± 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	-	pF
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	-	-	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	105				
E _{off} ⁽²⁾	Turn-off switching energy	92				
E _{ts}	Total switching energy	197				
		V _{CE} = 400 V, I _C = 3 A, R _G = 47 Ω, V _{GE} = 15 V, T _J = 175 °C				

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			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)

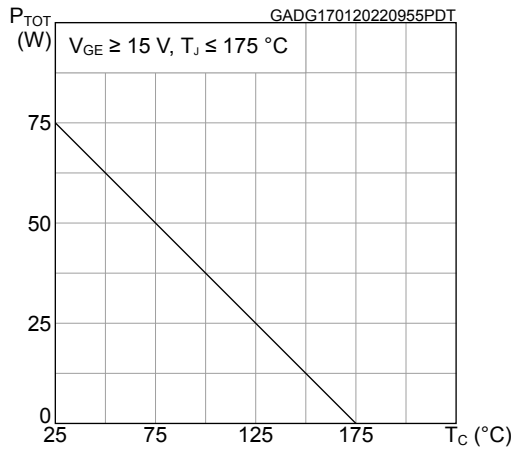
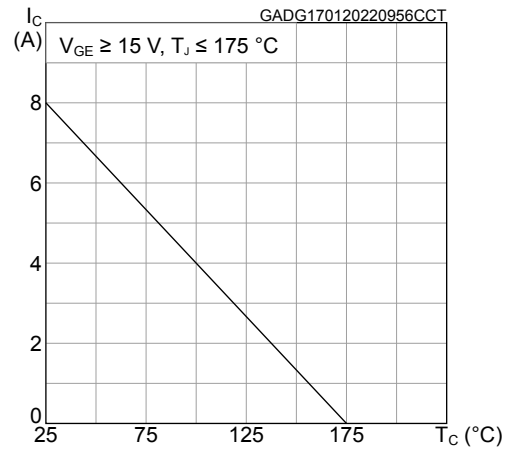
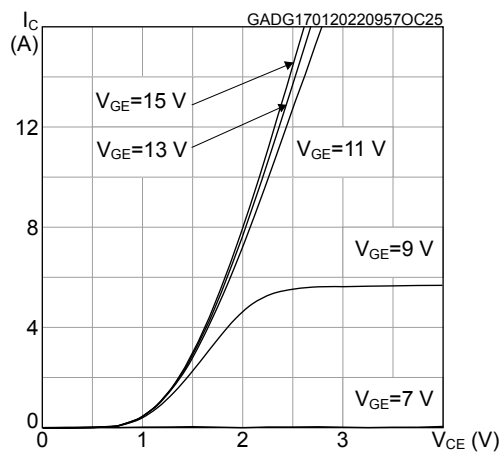
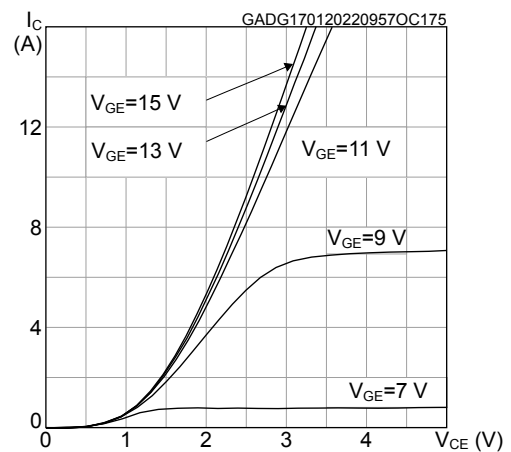
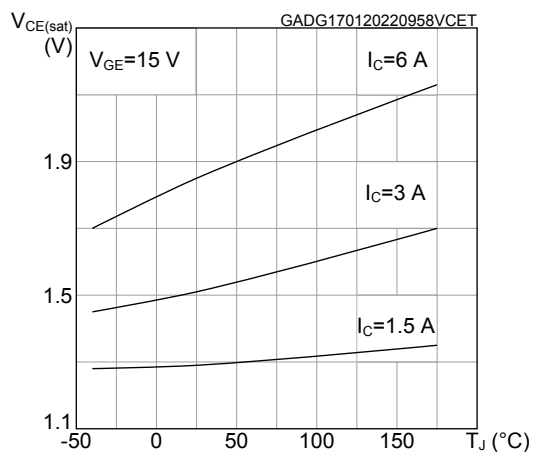
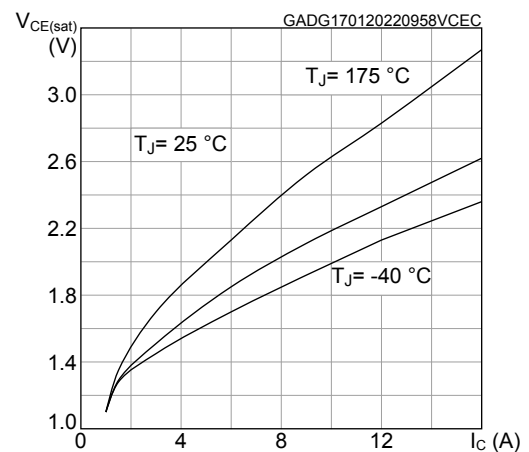
Figure 1. Power dissipation vs case temperature

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

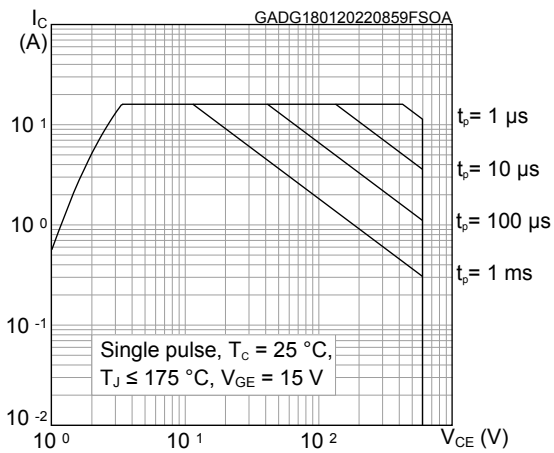


Figure 8. Transfer characteristics

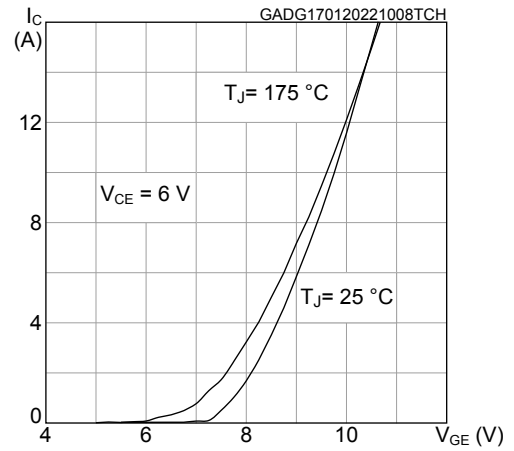


Figure 9. Diode V_F vs forward current

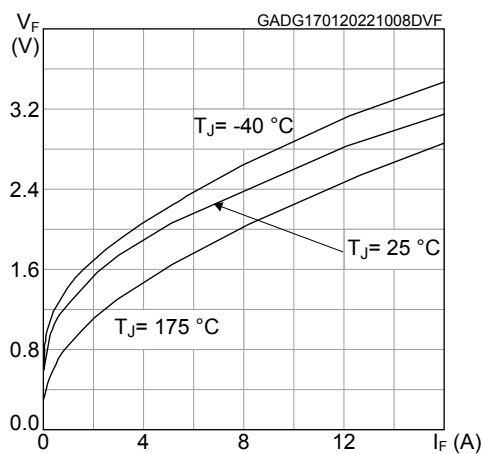


Figure 10. Normalized V_GE(th) vs junction temperature

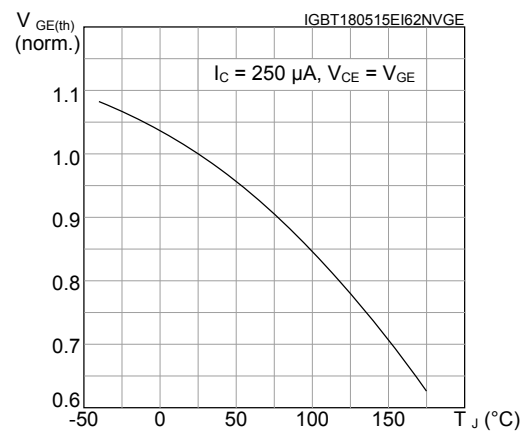


Figure 11. Normalized V_BR(CES) vs junction temperature

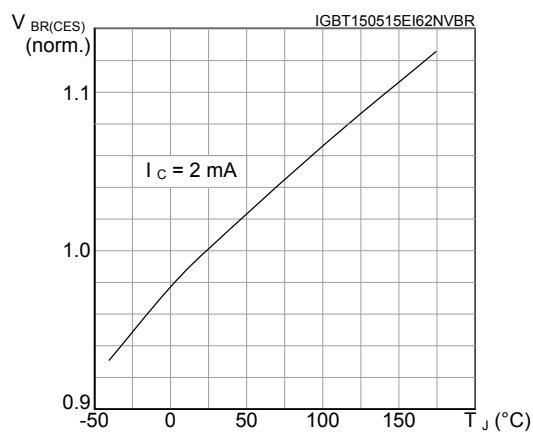


Figure 12. Capacitance variation

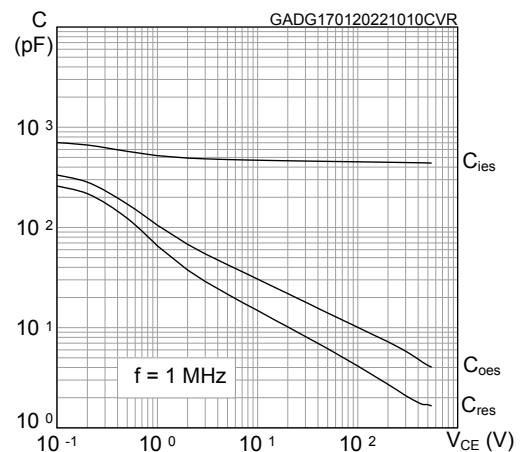


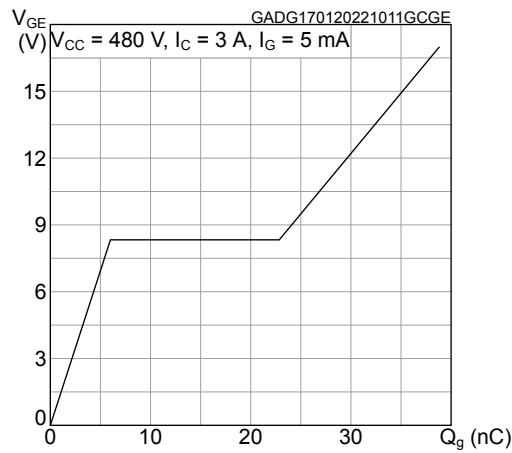
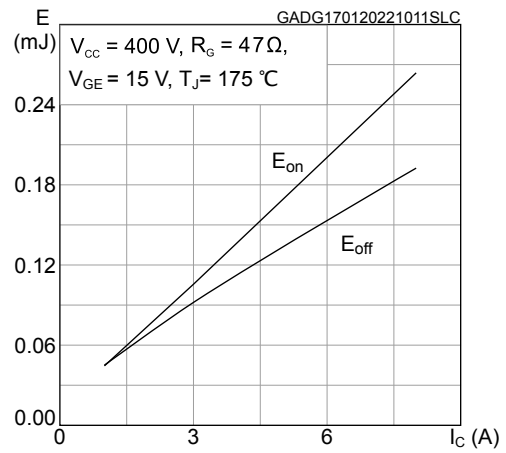
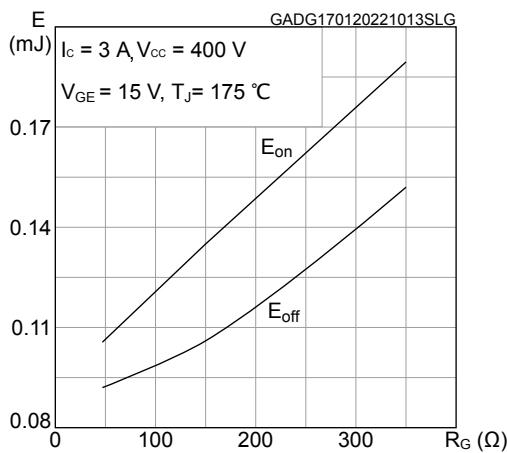
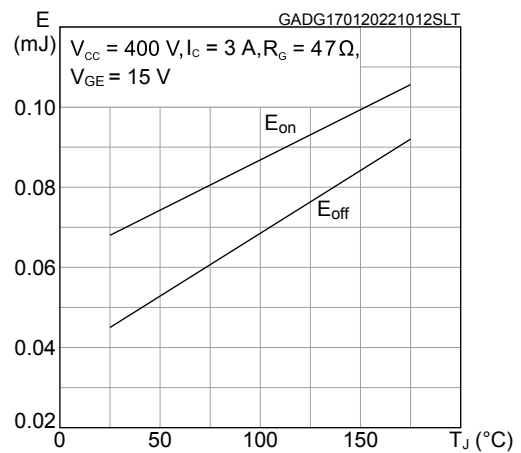
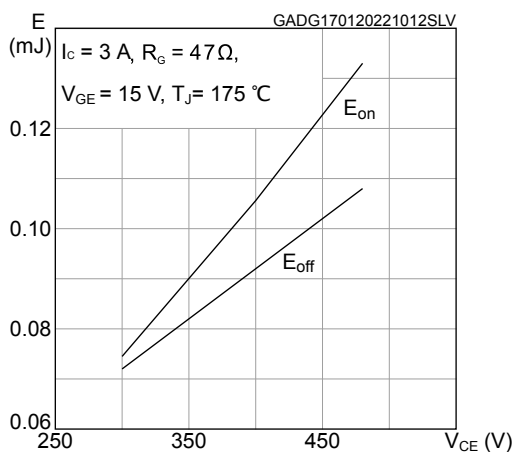
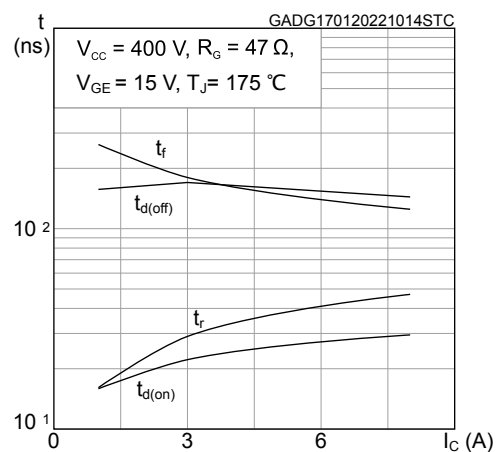
Figure 13. Gate charge vs. gate-emitter voltage

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

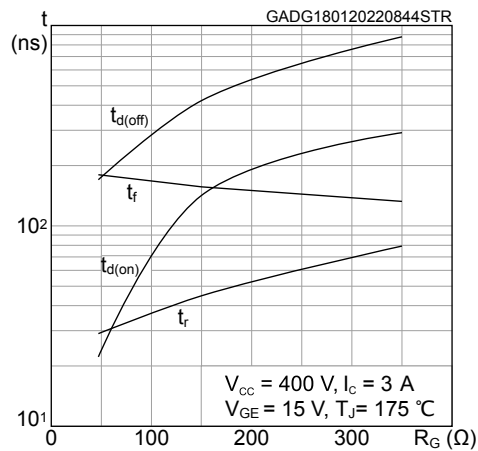


Figure 20. Reverse recovery current vs diode current slope

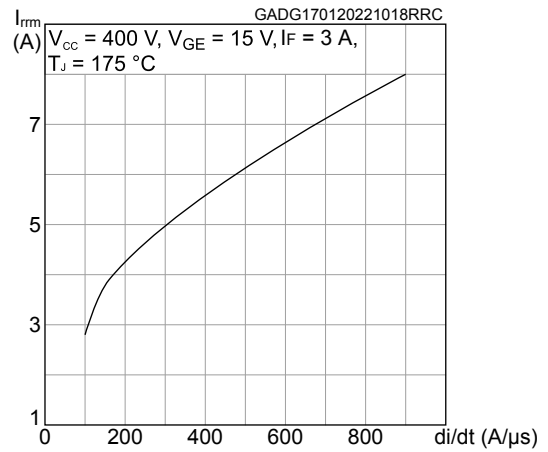


Figure 21. Reverse recovery time vs diode current slope

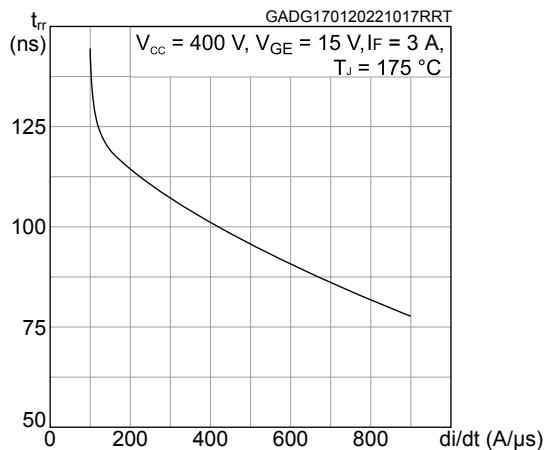


Figure 22. Reverse recovery charge vs diode current slope

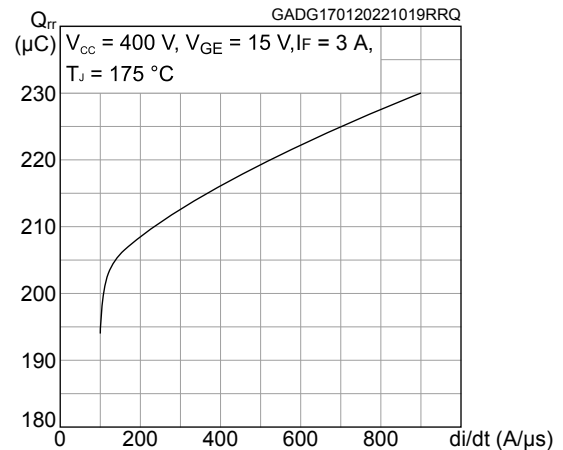


Figure 23. Reverse recovery energy vs diode current slope

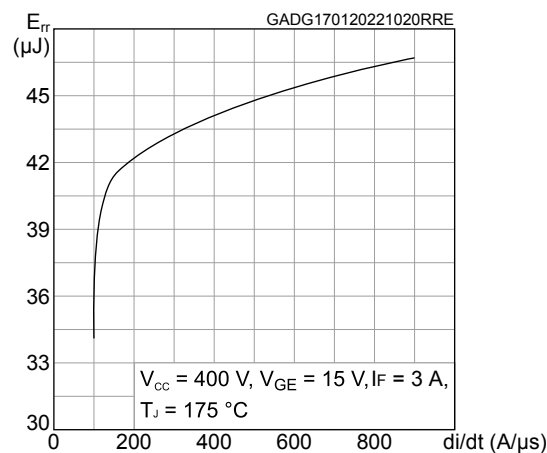


Figure 24. Thermal impedance for IGBT

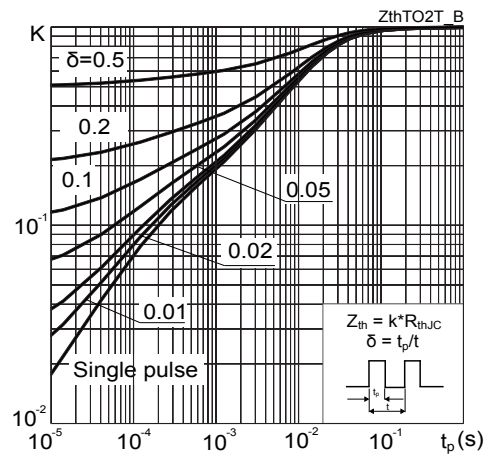
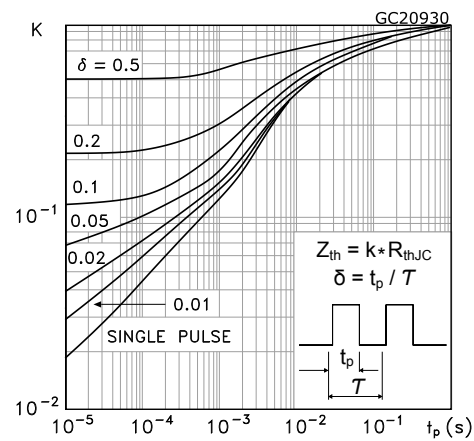


Figure 25. Thermal impedance for diode



3 Test circuits

Figure 26. Test circuit for inductive load switching

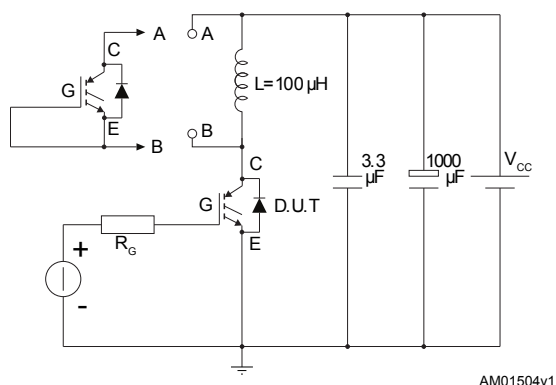


Figure 27. Gate charge test circuit

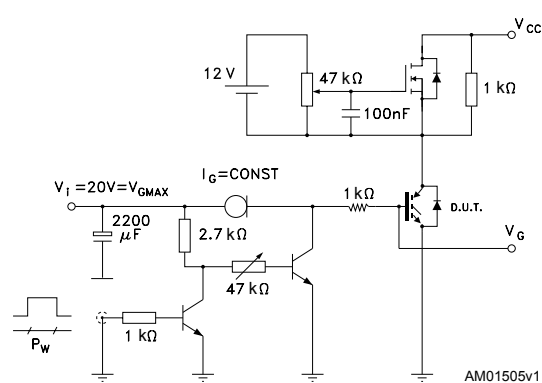


Figure 28. Switching waveform

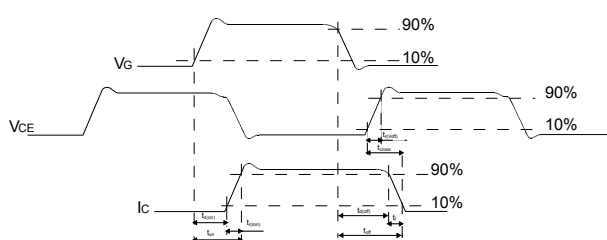
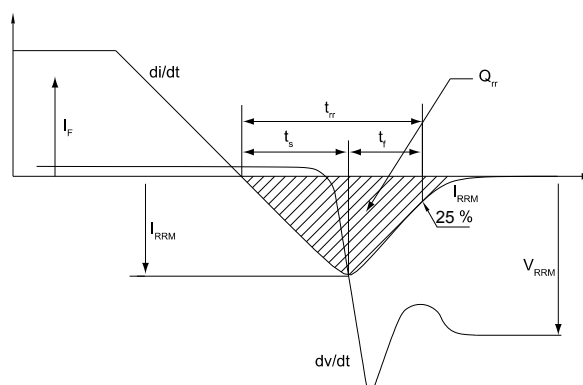


Figure 29. Diode reverse recovery waveform

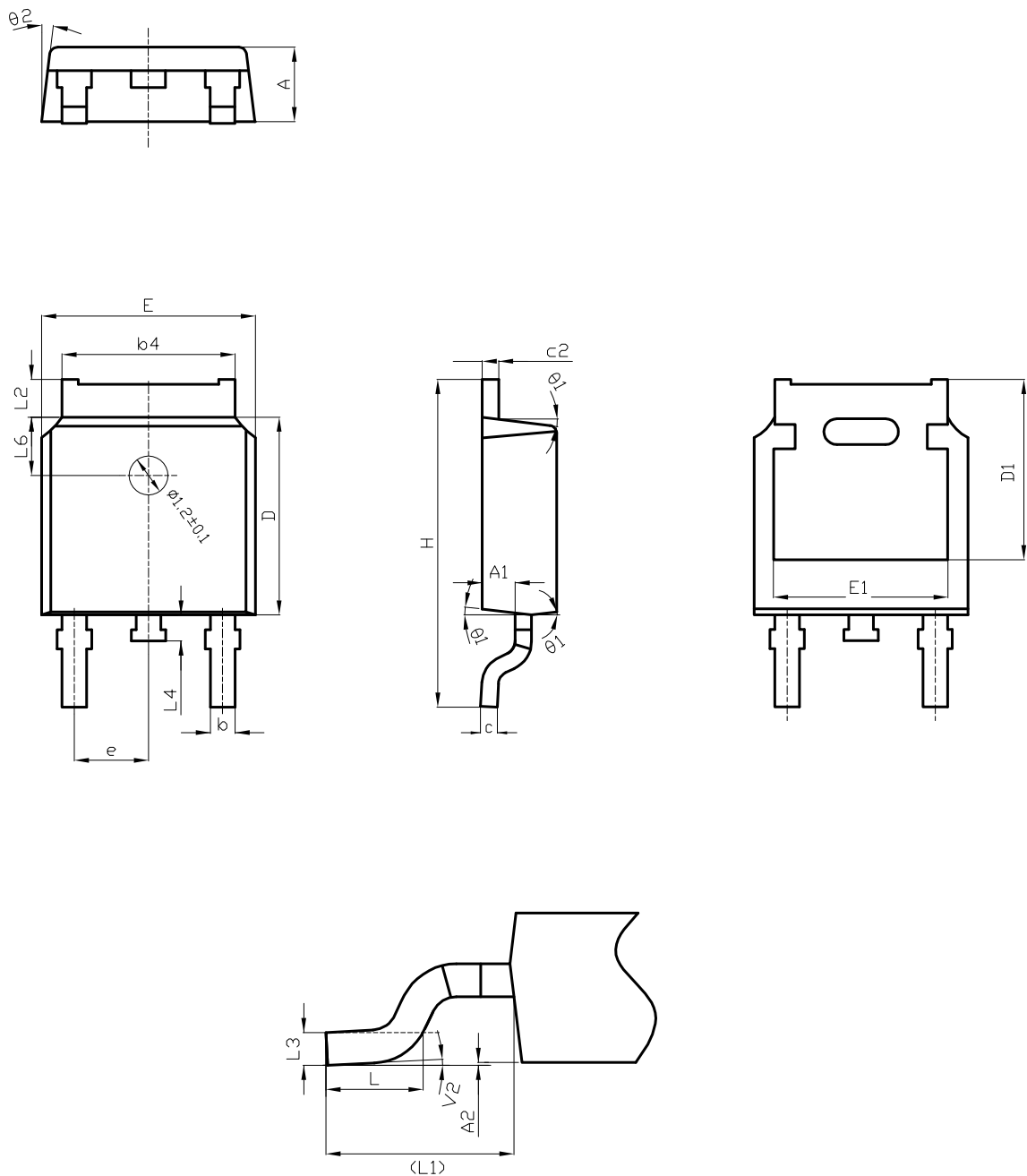


4 Package information

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

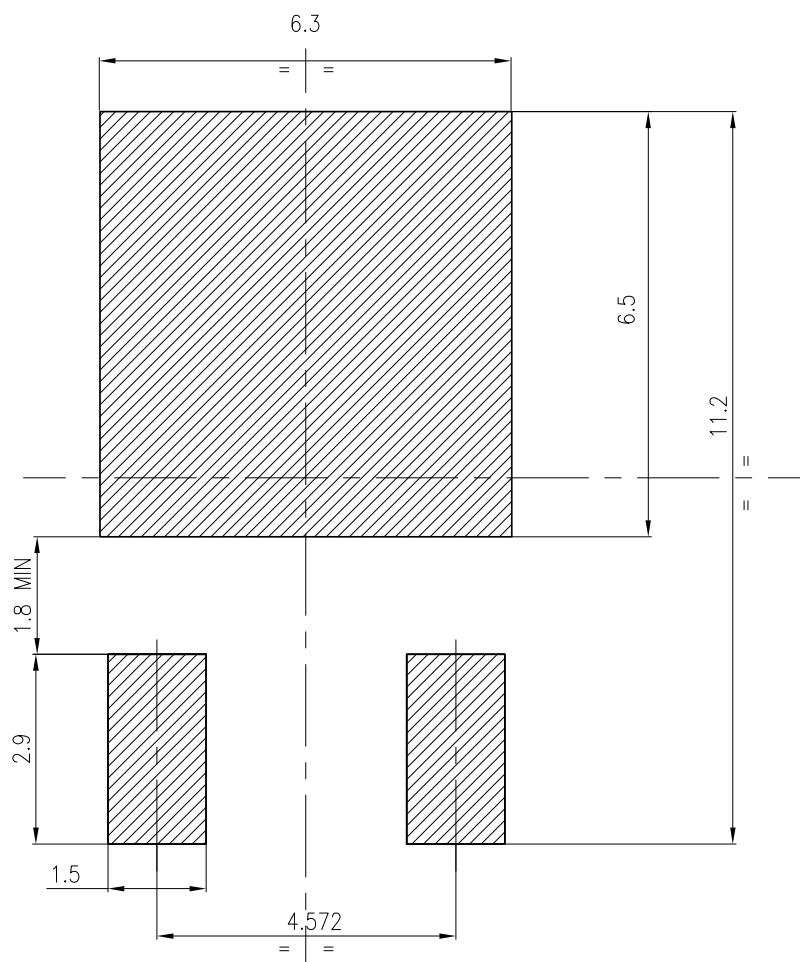


0068772_type-C2_rev31

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°

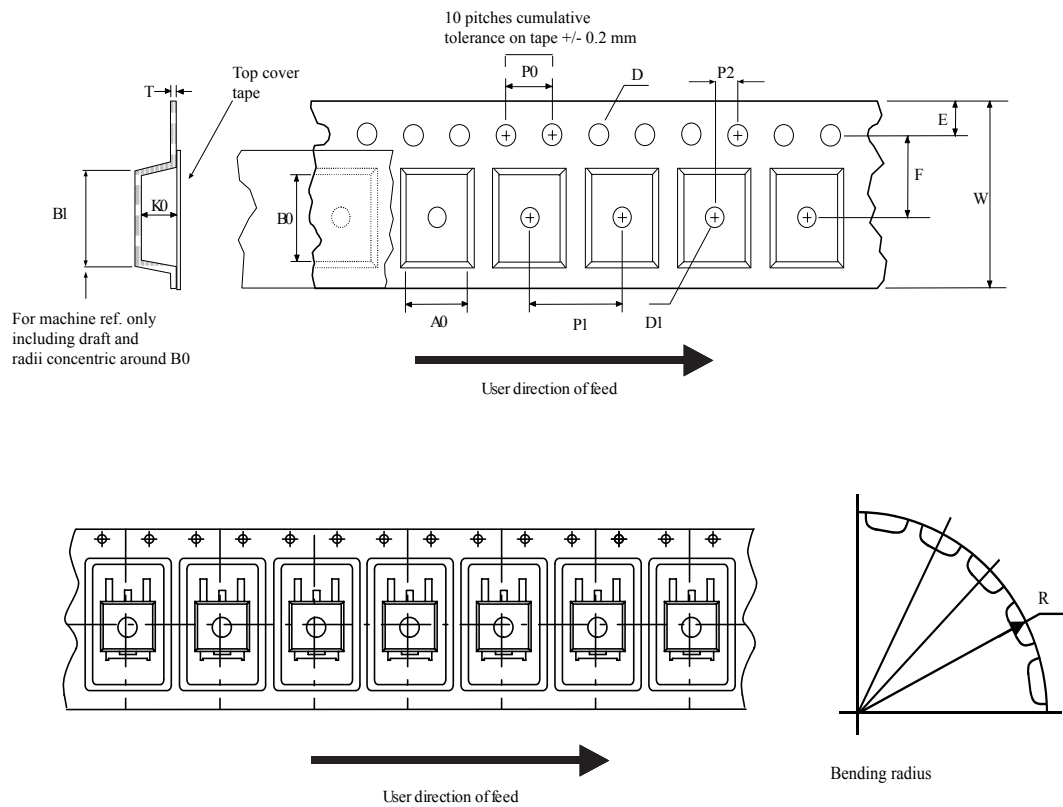
Figure 31. DPAK (TO-252) recommended footprint (dimensions are in mm)



FP_0068772_32

4.2 DPAK (TO-252) packing information

Figure 32. DPAK (TO-252) tape outline



AM08852v1

Technical drawing of a tape reel showing front and side views with dimensions and labels.

Front View (Left):

- A:** Overall diameter of the reel.
- B:** Distance from the center to the edge of the tape slot.
- C:** Distance from the center to the edge of the tape slot.
- D:** Distance from the center to the edge of the tape slot.
- Full radius:** Label pointing to the outer edge of the reel.
- Tape slot in core for tape start:** Label pointing to the slot in the center.
- 40mm min. access hole at slot location:** Label pointing to the access hole.
- 2.5mm min. width:** Label pointing to the width of the tape slot.

Side View (Right):

- C:** Thickness of the reel.
- N:** Distance from the center to the edge of the tape slot.
- T:** Thickness of the tape.
- G measured at hub:** Label pointing to the distance from the center to the edge of the tape slot.

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) .

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