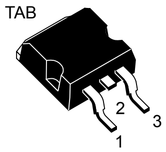
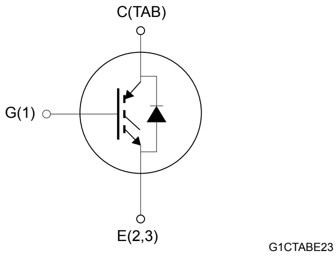
Datasheet

Automotive-grade trench gate field-stop, 650 V, 30 A, high-speed HB series IGBT in an H²PAK-2 package



H^2PAK-2



Features

- AEC-Q101 qualified
- High-speed switching series
- Maximum junction temperature: T_J = 175 °C
- $V_{CE(sat)}$ = 1.55 V (typ.) @ I_C = 30 A
- Safer paralleling
- Tight parameter distribution
- Low thermal resistance
- Soft and very fast recovery antiparallel diode

Applications

- DC/DC converter for EV/HEV
- HVAC and climate control

Description

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. The device is part of the new HB series of IGBTs, which represents an optimum compromise between conduction and switching loss to maximize the efficiency of any frequency converter. Furthermore, the slightly positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

Product status link
STGH30H65DFB-2AG

Product summary	
Order code	STGH30H65DFB-2AG
Marking	G30H65DFBAG
Package	H²PAK-2
Packing	Tape and reel

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	650	V
I_C	Continuous collector current at T_C = 25 °C	60	A
	Continuous collector current at T_C = 100 °C	30	
I_{CP} (1)	Pulsed collector current	90	A
V_{GE}	Gate-emitter voltage	±20	V
	Transient gate-emitter voltage (t_p ≤ 10 µs)	±30	
I_F	Continuous forward current at T_C = 25 °C	40	A
	Continuous forward current at T_C = 100 °C	20	
I_{FP} (1)	Pulsed forward current	60	A
P_{TOT}	Total power dissipation at T_C = 25 °C	260	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	0.58	°C/W
	Thermal resistance, junction-to-case diode	1.32	
R_{thJA}	Thermal resistance, junction-to-ambient	62.5	°C/W

2 Electrical characteristics

T_J = 25 °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 V, I_C = 2 mA	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 30 A		1.55	2.0	V
		V_{GE} = 15 V, I_C = 30 A, T_J = 125 °C		1.65		
		V_{GE} = 15 V, I_C = 30 A, T_J = 175 °C		1.75		
V_F	Forward on-voltage	I_F = 20 A		2.0	2.8	V
		I_F = 20 A, T_J = 125 °C		1.75		
		I_F = 20 A, T_J = 175 °C		1.65		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 1 mA	4.5	5.5	6.5	V
I_{CES}	Collector cut-off current	V_{GE} = 0 V, V_{CE} = 650 V			10	µA
I_{GES}	Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = ±20 V			±250	nA

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0 V	-	3695	-	pF
C_{oes}	Output capacitance		-	123	-	pF
C_{res}	Reverse transfer capacitance		-	73	-	pF
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 30 A, V_{GE} = 0 to 15 V (see Figure 28. Gate charge test circuit)	-	155	-	nC
Q_{ge}	Gate-emitter charge		-	24	-	nC
Q_{gc}	Gate-collector charge		-	63	-	nC

Table 5. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CC} = 400 V, I_C = 30 A, V_{GE} = 15 V, R_G = 10 Ω (see Figure 27. Test circuit for inductive load switching)	-	24	-	ns
t_r	Current rise time		-	20	-	ns
$di/dt_{(on)}$	Turn-on current slope		-	1100	-	A/µs
E_{on} (1)	Turn-on switching energy		-	555	-	µJ
$t_{d(off)}$	Turn-off delay time		-	170	-	ns
t_f	Current fall time		-	16	-	ns
E_{off} (2)	Turn-off switching energy		-	300	-	µJ
E_{ts}	Total switching energy		-	855	-	µJ
$t_{d(on)}$	Turn-on delay time	V_{CC} = 400 V, I_C = 30 A, V_{GE} = 15 V, R_G = 10 Ω, T_J = 175 °C (see Figure 27. Test circuit for inductive load switching)	-	23	-	ns
t_r	Current rise time		-	18	-	ns
$di/dt_{(on)}$	Turn-on current slope		-	1135	-	A/µs
E_{on} (1)	Turn-on switching energy		-	950	-	µJ
$t_{d(off)}$	Turn-off delay time		-	188	-	ns
t_f	Current fall time		-	56	-	ns
E_{off} (2)	Turn-off switching energy		-	500	-	µJ
E_{ts}	Total switching energy		-	1450	-	µJ

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 = 20 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 1000 A/µs (see Figure 30. Diode reverse recovery waveform)	-	28	-	ns
Q_{rr}	Reverse recovery charge		-	189	-	nC
I_{rrm}	Reverse recovery current		-	11.8	-	A
E_{rr}	Reverse recovery energy		-	78	-	µJ
t_{rr}	Reverse recovery time	I_F = 20 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 1000 A/µs, T_J = 175 °C (see Figure 30. Diode reverse recovery waveform)	-	139	-	ns
Q_{rr}	Reverse recovery charge		-	1160	-	nC
I_{rrm}	Reverse recovery current		-	16.8	-	A
E_{rr}	Reverse recovery energy		-	167	-	µJ

2.1 Electrical characteristics (curves)

Figure 1. Total power dissipation vs case temperature

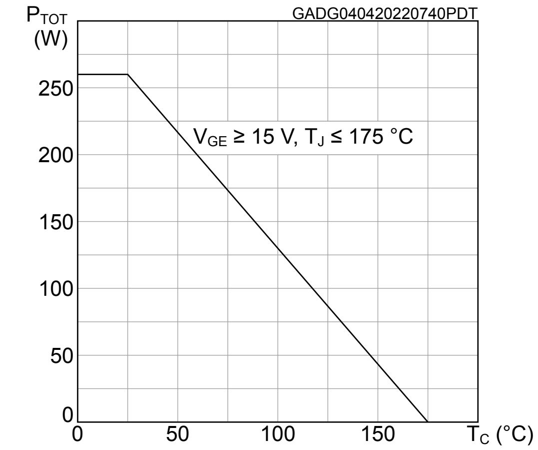


Figure 2. Collector current vs case temperature

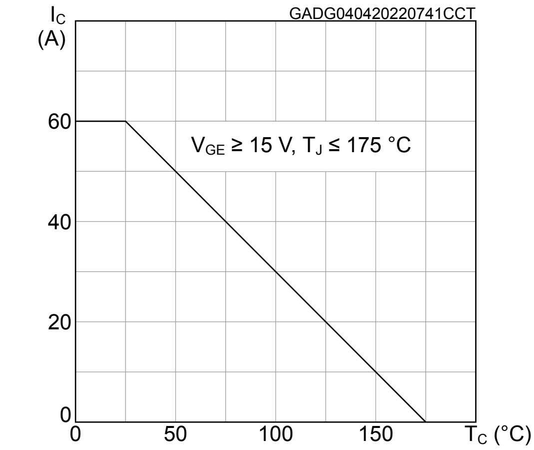


Figure 3. Output characteristics (T_J = 25 °C)

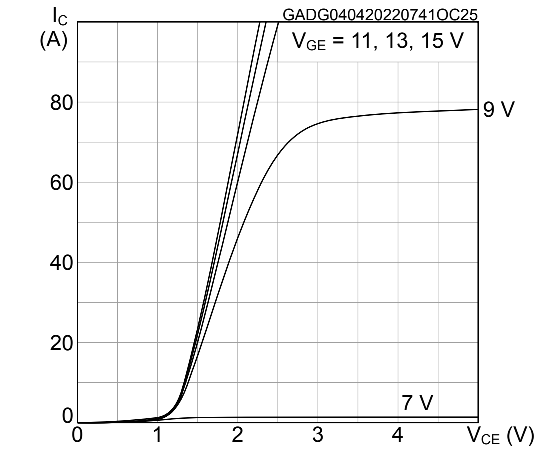


Figure 4. Output characteristics (T_J = 175 °C)

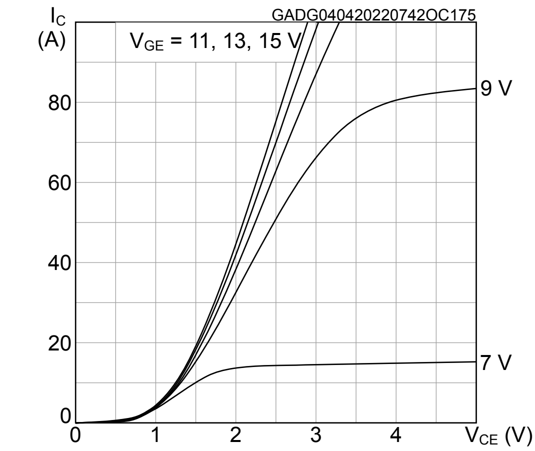


Figure 5. $V_{CE(sat)}$ vs junction temperature

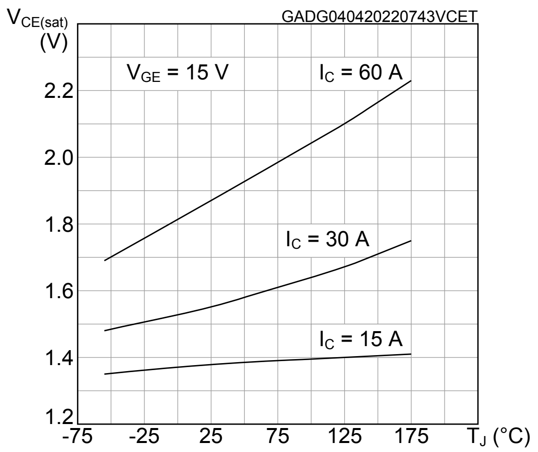


Figure 6. $V_{CE(sat)}$ vs collector current

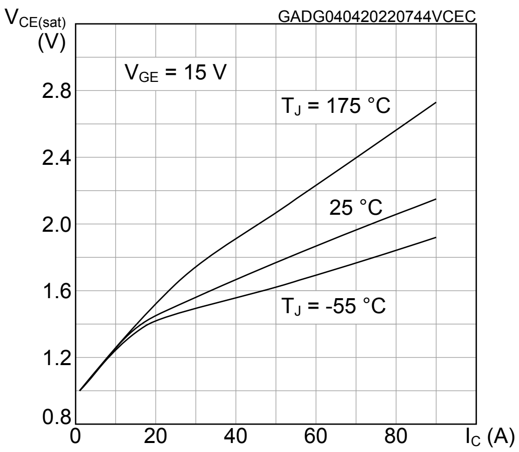


Figure 7. Forward bias safe operating area

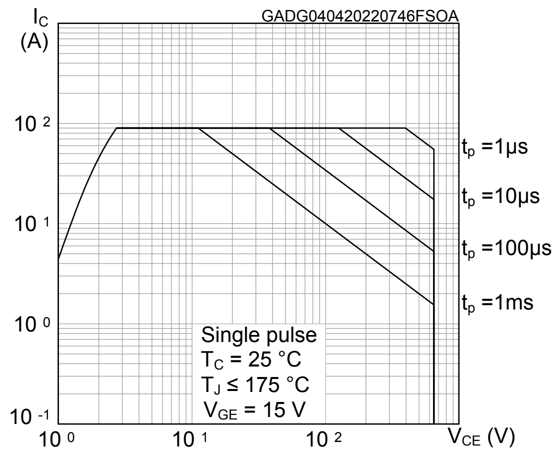


Figure 8. Collector current vs switching frequency

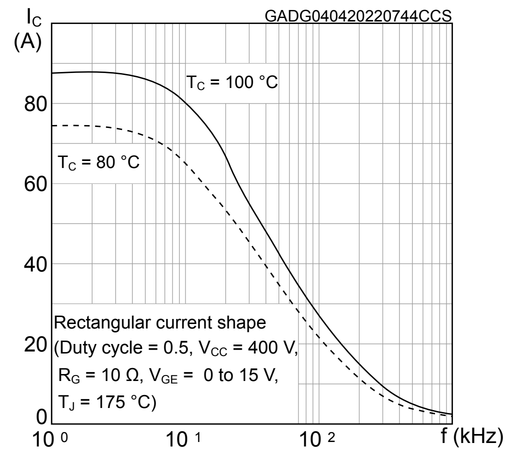


Figure 9. Transfer characteristics

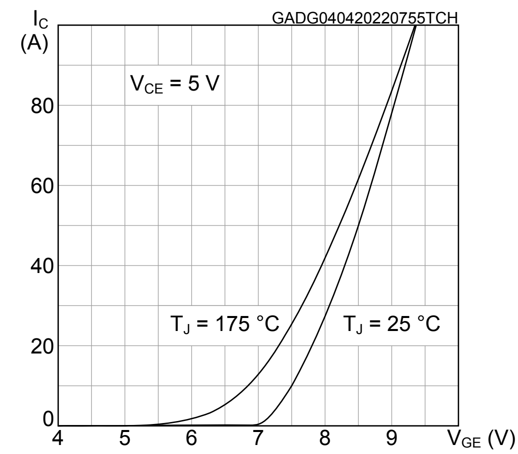


Figure 10. Diode V_F vs forward current

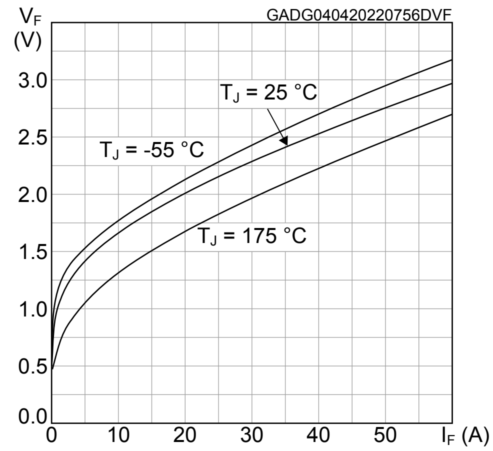


Figure 11. Normalized $V_{GE(th)}$ vs junction temperature

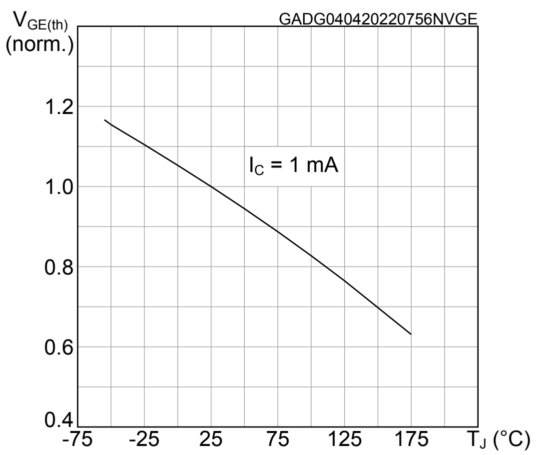


Figure 12. Normalized $V_{(BR)CES}$ vs junction temperature

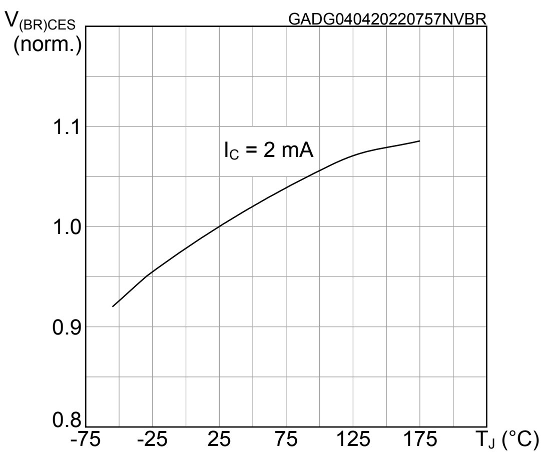


Figure 13. Capacitance variations

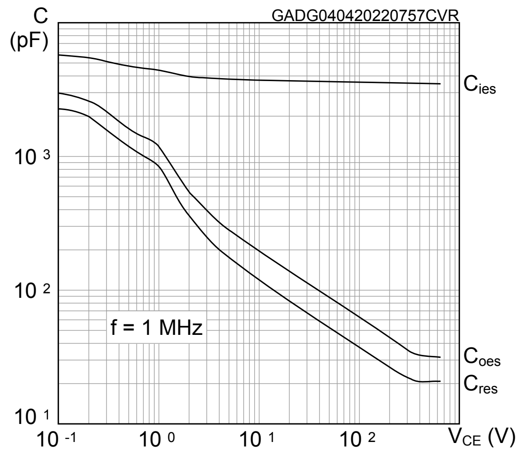


Figure 14. Gate charge vs gate-emitter voltage

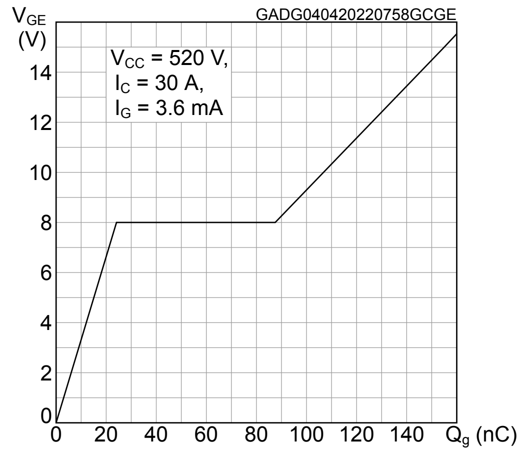


Figure 15. Switching energy vs collector current

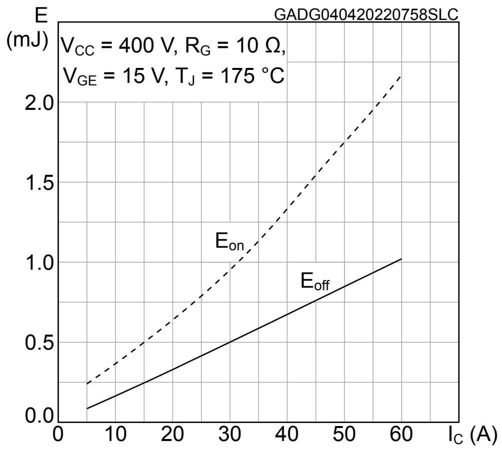


Figure 16. Switching energy vs temperature

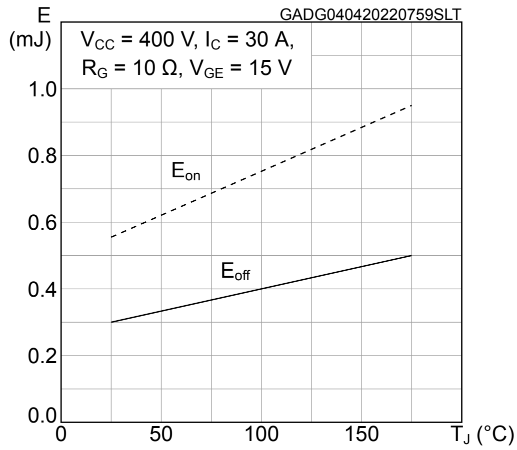


Figure 17. Switching energy vs collector emitter voltage

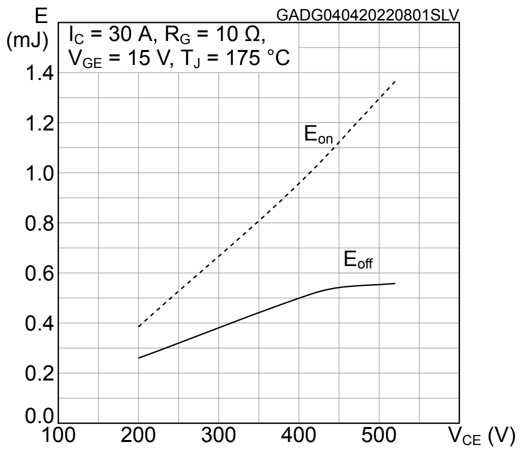
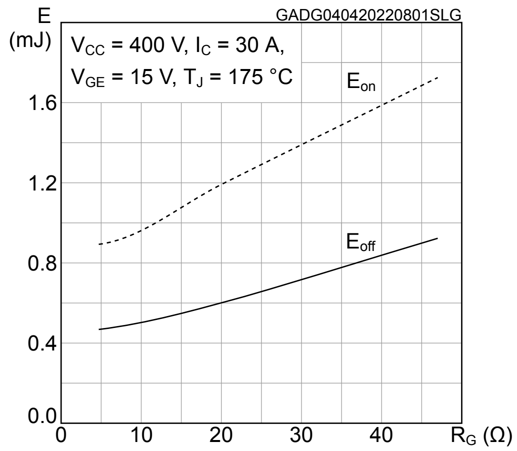


Figure 18. Switching energy vs gate resistance



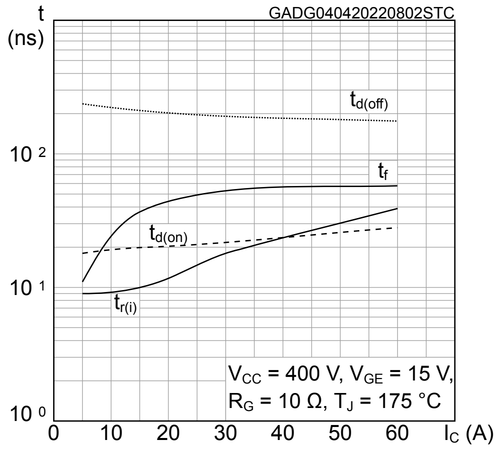


Figure 19. Switching times vs collector current

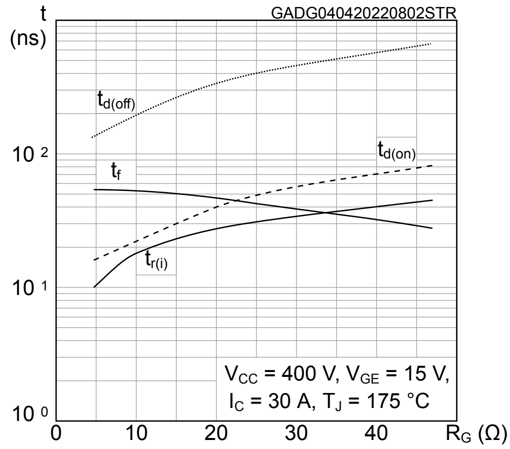


Figure 20. Switching times vs gate resistance

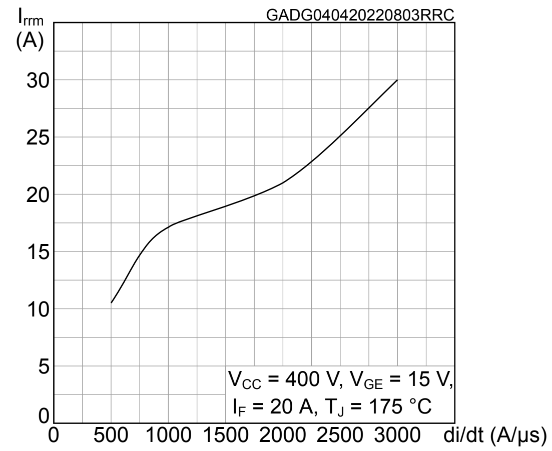


Figure 21. Reverse recovery current vs diode current slope

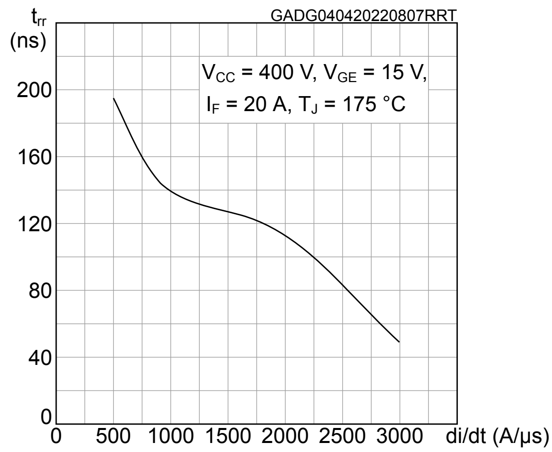


Figure 22. Reverse recovery time vs diode current slope

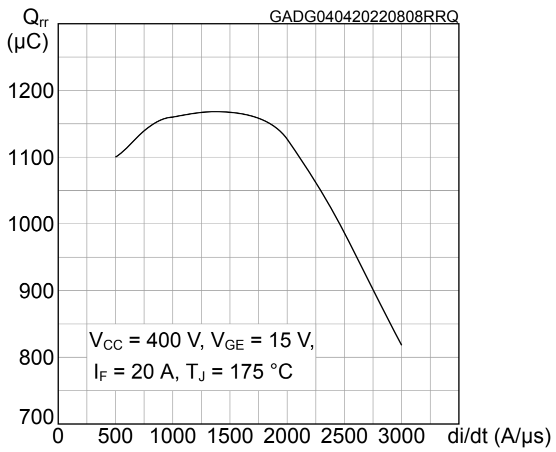


Figure 23. Reverse recovery charge vs diode current slope

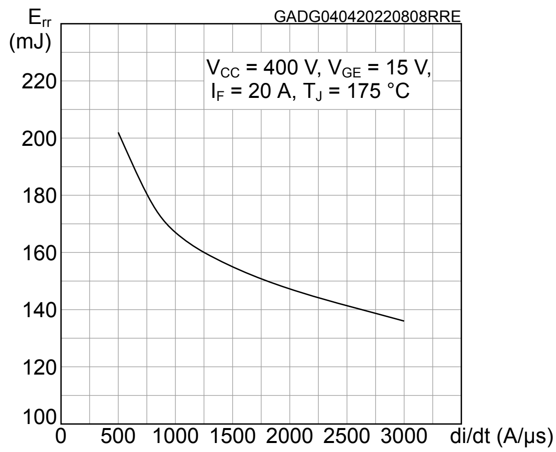


Figure 24. Reverse recovery energy vs diode current slope

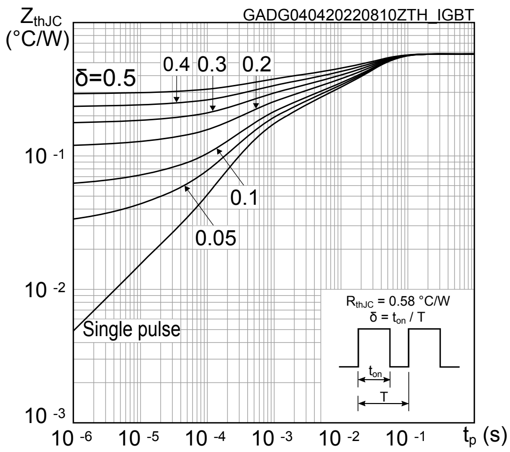


Figure 25. Maximum transient thermal impedance for IGBT

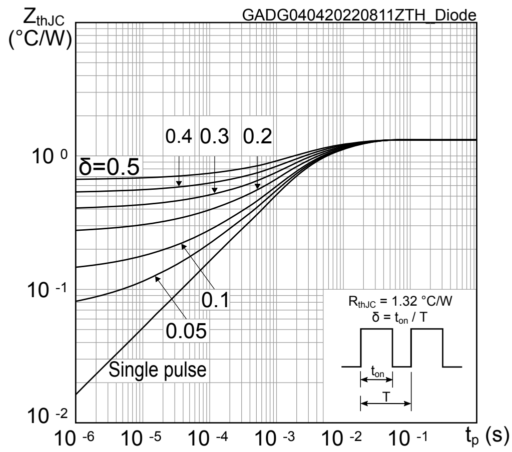


Figure 26. Maximum transient thermal impedance for diode

3 Test circuits

Figure 27. Test circuit for inductive load switching

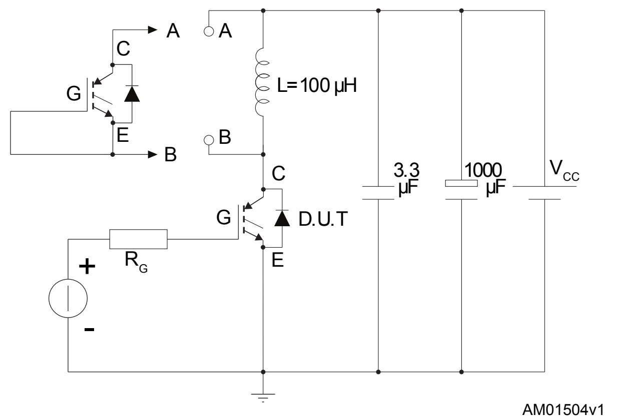


Figure 28. Gate charge test circuit

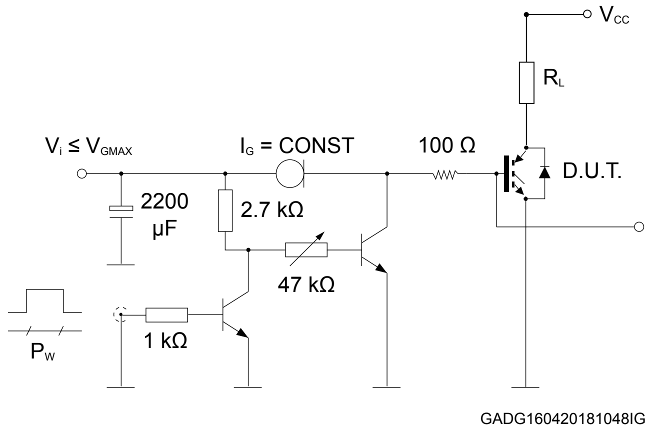


Figure 29. Switching waveform

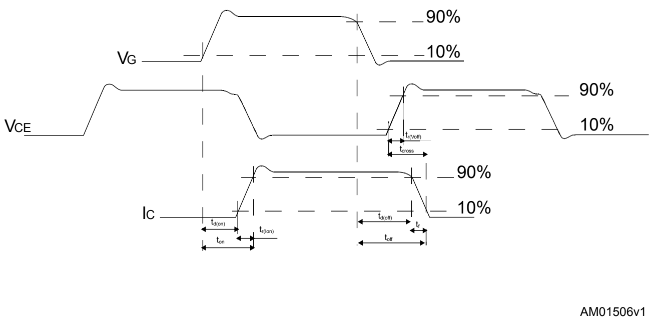
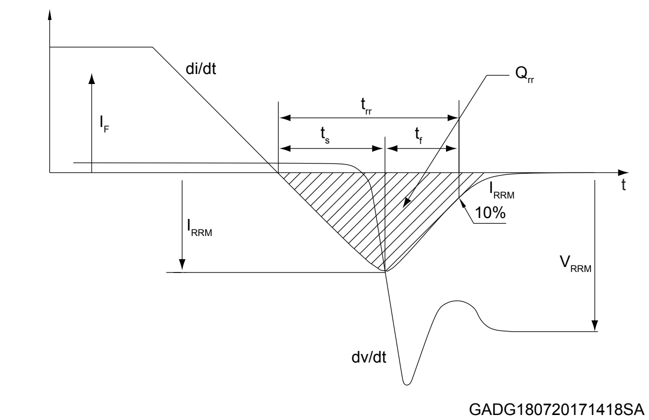


Figure 30. Diode reverse recovery waveform



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 H²PAK-2 package information

Figure 31. H²PAK-2 package outline

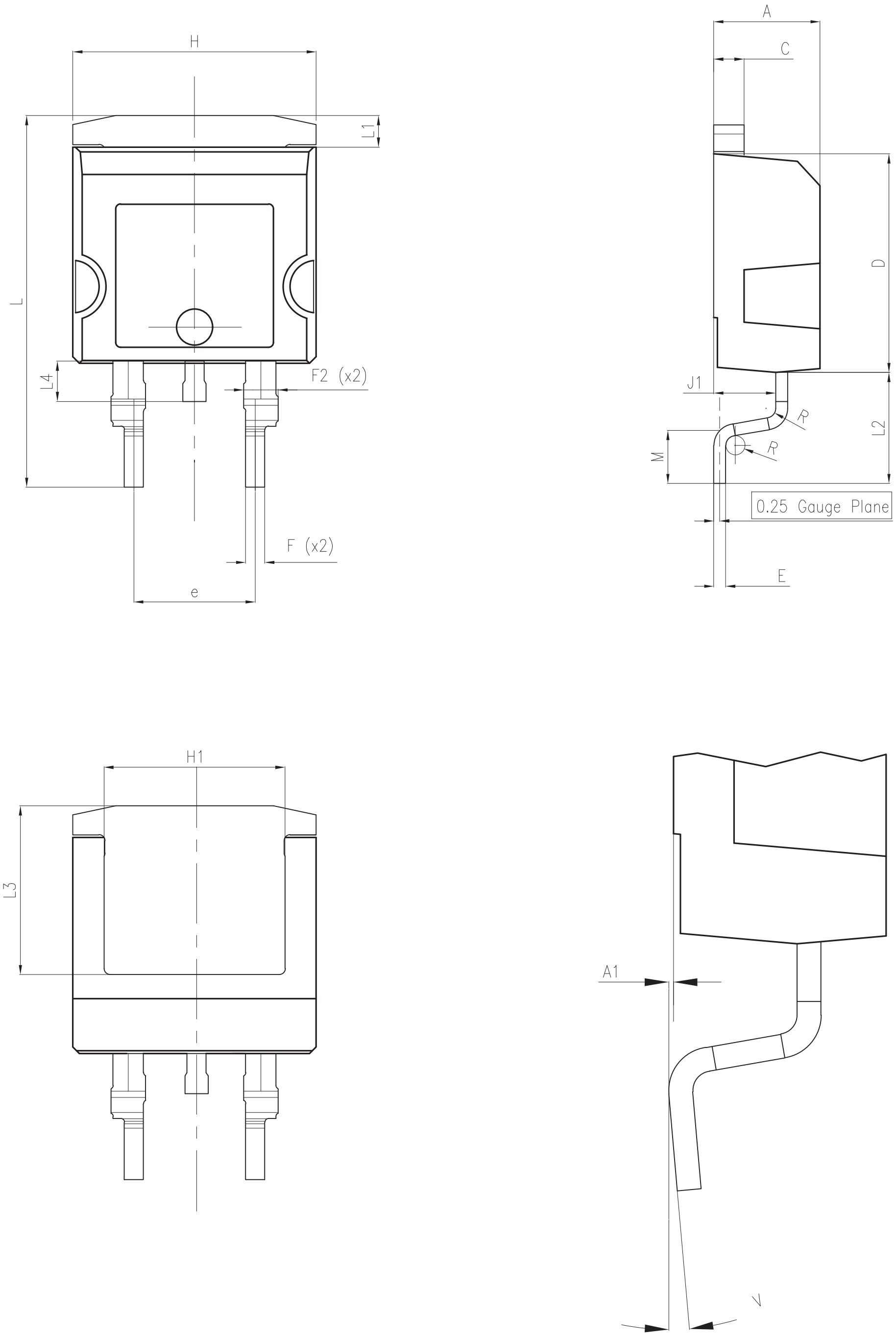


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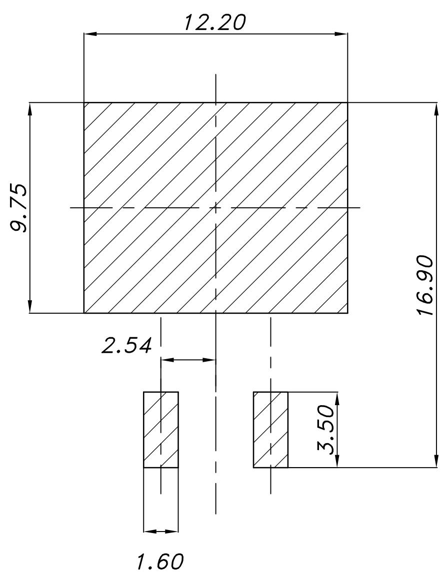
Table 7. H²PAK-2 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.30		4.70
A1	0.03		0.20
C	1.17		1.37
D	8.95		9.35
e	4.98		5.18
E	0.50		0.90
F	0.78		0.85
F2	1.14		1.70
H	10.00		10.40
H1	7.40	-	7.80
J1	2.49		2.69
L	15.30		15.80
L1	1.27		1.40
L2	4.93		5.23
L3	6.85		7.25
L4	1.50		1.70
M	2.60		2.90
R	0.20		0.60
V	0°		8°

Figure 32. H²PAK-2 recommended footprint



Note: Dimensions are in mm.

4.2 Packing information

Figure 33. Tape outline

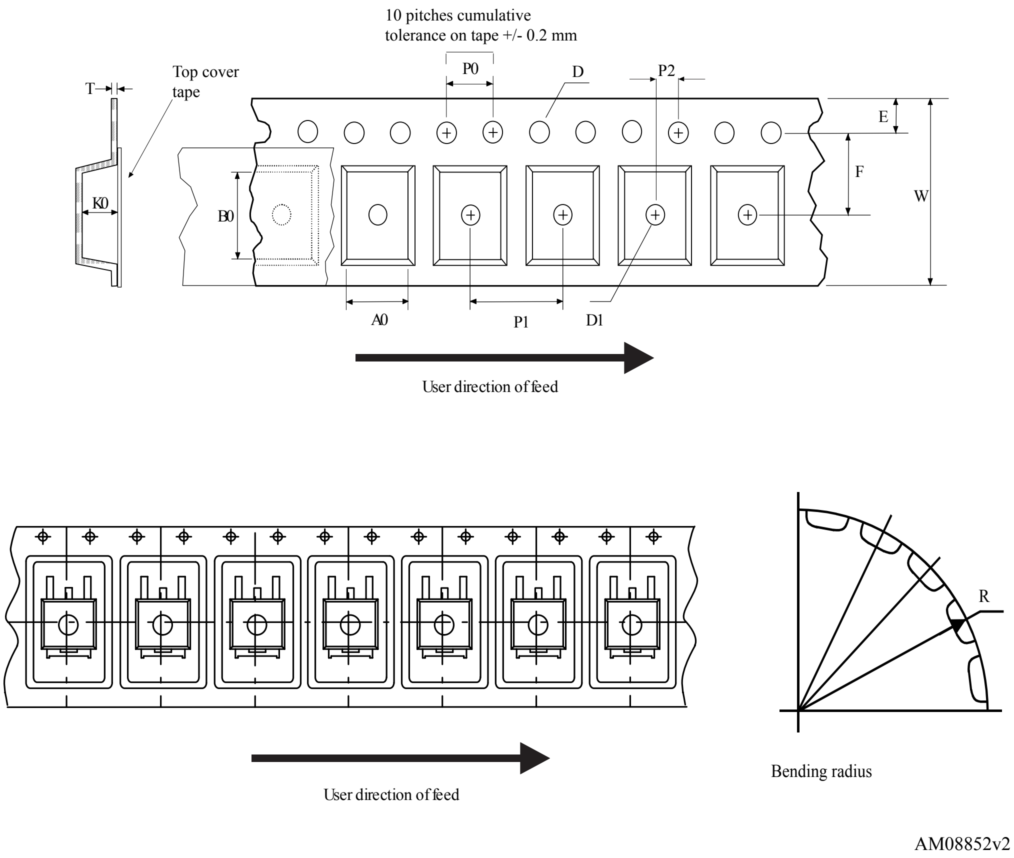


Figure 34. Reel outline

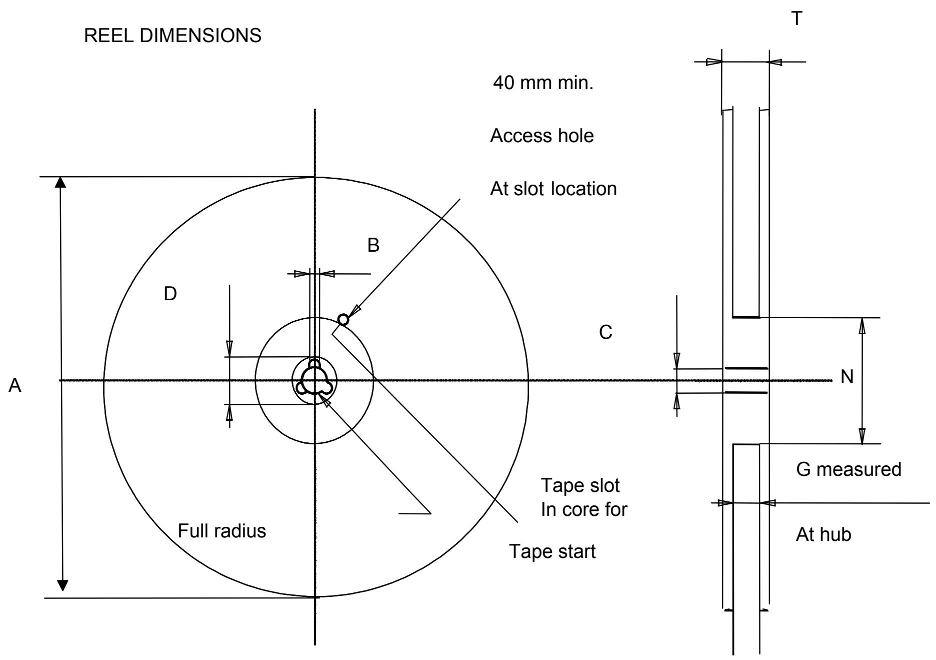


Table 8. Tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1	Base quantity		1000
P2	1.9	2.1	Bulk quantity		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

Revision history

Table 9. **Document revision history**

Date	Revision	Changes
05-Apr-2022	1	First release.
13-Apr-2022	2	Updated Table 3. Static characteristics and Table 4. Dynamic characteristics. Updated Figure 12. Normalized $V_{(BR)CES}$ vs junction temperature.

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