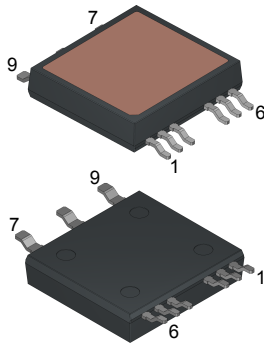
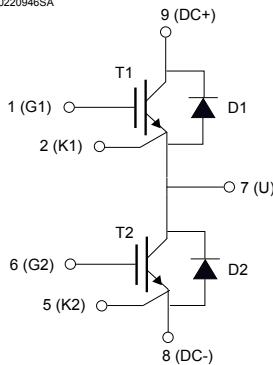



## Automotive-grade ACEPACK SMIT half-bridge topology 650 V, 80 A HB series IGBT with diode


**ACEPACK SMIT**

GADG031120220946SA



### Features

- AQC 324 qualified 
- High-speed switching series
- Maximum junction temperature:  $T_J = 175\text{ }^\circ\text{C}$
- Low  $V_{CE(sat)} = 1.7\text{ V (typ.) @ } I_C = 80\text{ A}$
- Minimized tail current
- Tight parameter distribution
- Low thermal resistance thanks to DBC substrate
- Positive temperature  $V_{CE(sat)}$  coefficient
- Soft and very fast recovery antiparallel diode
- Isolation rating of 3.4 kVrms/min

### Applications

- DC/DC converter for EV/HEV
- On board charger (OBC)

### Description

This device combines two IGBTs and diodes in half-bridge topology mounted on a very compact and rugged easily surface-mounted package. The device is part of the HB series IGBTs, which is optimized both in conduction and switching losses for soft commutation. A freewheeling diode with a low drop forward voltage is included in every switch. The result is a product specifically designed to maximize efficiency for any resonant and soft-switching applications.

#### Product status link

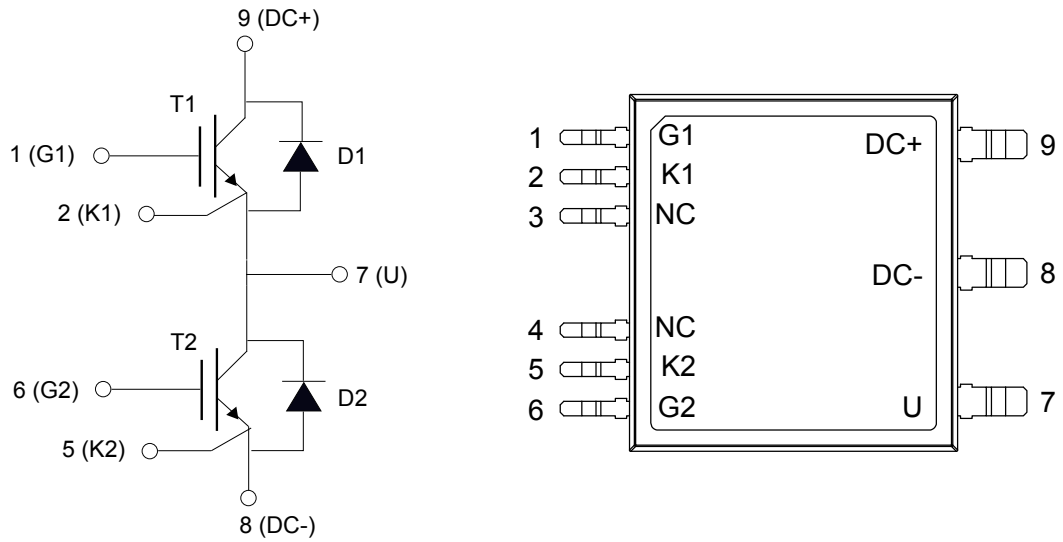
[STGSH80HB65DAG](#)

#### Product summary

<b>Order code</b>	STGSH80HB65DAG
<b>Marking</b>	GSH80HB65DAG
<b>Package</b>	ACEPACK SMIT
<b>Packing</b>	Tape and reel

# 1 Internal schematic and pin description

**Figure 1. Electrical topology and pin positioning**



GADG170820230949FF

**Table 1. Pin description**

Pin	Symbol	Description
1	G1	Gate of high-side IGBT
2	K1	Kelvin emitter of high-side IGBT
3	NC	Not connected
4	NC	Not connected
5	K2	Kelvin emitter of low-side IGBT
6	G2	Gate of low-side IGBT
7	U	Phase output
8	DC-	Negative DC input
9	DC+	Positive DC input

## 2 Electrical ratings

Data referred to each IGBT with co-packed diode.

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GE} = 0$ V)	650	V
$I_C^{(1)}$	Continuous collector current at $T_C = 25$ °C	83	A
	Continuous collector current at $T_C = 100$ °C	65	
$I_{CP}^{(2)}$	Pulsed collector current ( $t_p = 1$ ms)	269	A
$V_{GE}$	Gate-emitter voltage	±20	V
	Transient gate-emitter voltage ( $t_p \leq 10$ μs)	±30	
$I_F^{(1)}$	Continuous forward current at $T_C = 25$ °C	83	A
	Continuous forward current at $T_C = 100$ °C	65	
$I_{FP}^{(2)}$	Pulsed forward current	187	A
$P_{TOT}$	Total power dissipation at $T_C = 25$ °C	250	W

1. Current limited by package.
2. Pulse width is limited by maximum junction temperature.

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance, junction-to-case IGBT	0.6	°C/W
	Thermal resistance, junction-to-case diode	0.8	

**Table 4. Total system**

Symbol	Parameter	Value	Unit
$V_{ISO}$	Isolation withstand voltage applied between each pin and heat sink plate (AC voltage 50/60 Hz, $t = 60$ s)	3.4	kVrms
$T_{STG}$	Storage temperature range	-55 to 150	°C
$T_J$	Operating junction temperature range	-55 to 175	°C

### 3 Electrical characteristics

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

**Table 5. Static characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 80\text{ A}$		1.7	2.1	V
		$V_{GE} = 15\text{ V}, I_C = 80\text{ A}, T_J = 125\text{ °C}$		1.85		
		$V_{GE} = 15\text{ V}, I_C = 80\text{ A}, T_J = 175\text{ °C}$		2.0		
$V_F$	Forward on-voltage	$I_F = 80\text{ A}$		1.9		V
		$I_F = 80\text{ A}, T_J = 125\text{ °C}$		1.5		
		$I_F = 80\text{ A}, T_J = 175\text{ °C}$		1.4		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$	4.5	5.5	6.5	V
$I_{CES}$	Collector cut-off current	$V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}$			10	$\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current	$V_{CE} = 0\text{ V}, V_{GE} = \pm 20\text{ V}$			800	nA

**Table 6. Dynamic characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0\text{ V}$	-	10450	-	pF
$C_{oes}$	Output capacitance		-	377	-	pF
$C_{res}$	Reverse transfer capacitance		-	206	-	pF
$Q_g$	Total gate charge	$V_{CC} = 520\text{ V}, I_C = 80\text{ A}, V_{GE} = 15\text{ V}$	-	456	-	nC

**Table 7. Switching characteristics (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 400\text{ V}$ , $V_{GK} = 0\text{ to }15\text{ V}$ , $R_G = 8.2\ \Omega$ , $I_C = 80\text{ A}$	-	65	-	ns
$t_r$	Current rise time		-	20	-	ns
$E_{on}^{(1)}$	Turn-on switching energy		-	0.95	-	mJ
$t_{d(off)}$	Turn-off delay time		-	284	-	ns
$t_f$	Current fall time		-	18	-	ns
$E_{off}^{(2)}$	Turn-off switching energy		-	1.3	-	mJ
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 400\text{ V}$ , $V_{GK} = 0\text{ to }15\text{ V}$ , $R_G = 8.2\ \Omega$ , $I_C = 80\text{ A}$ , $T_J = 175^\circ\text{C}$	-	64	-	ns
$t_r$	Current rise time		-	18	-	ns
$E_{on}^{(1)}$	Turn-on switching energy		-	2	-	mJ
$t_{d(off)}$	Turn-off delay time		-	281	-	ns
$t_f$	Current fall time		-	14	-	ns
$E_{off}^{(2)}$	Turn-off switching energy		-	2.2	-	mJ

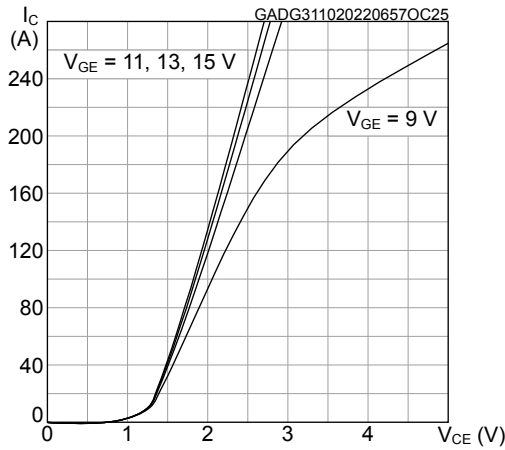
1. Including the reverse recovery of the diode
2. Including the tail of the collector current

**Table 8. Diode switching characteristics (inductive load)**

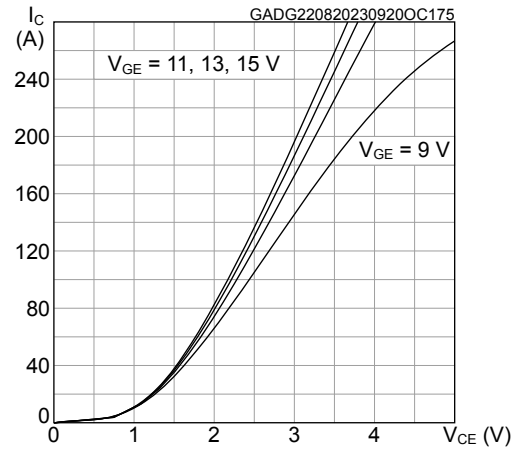
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{rr}$	Reverse recovery time	$I_F = 80\text{ A}$ , $V_R = 400\text{ V}$ , $V_{GK} = 15\text{ V}$ , $R_G = 8.2\ \Omega$	-	26	-	ns
$Q_{rr}$	Reverse recovery charge		-	1.2	-	$\mu\text{C}$
$I_{rrm}$	Reverse recovery current		-	90	-	A
$E_{rr}$	Reverse recovery energy		-	0.17	-	mJ
$t_{rr}$	Reverse recovery time	$I_F = 80\text{ A}$ , $V_R = 400\text{ V}$ , $V_{GK} = 15\text{ V}$ , $R_G = 8.2\ \Omega$ , $T_J = 175^\circ\text{C}$	-	59	-	ns
$Q_{rr}$	Reverse recovery charge		-	6.1	-	$\mu\text{C}$
$I_{rrm}$	Reverse recovery current		-	143	-	A
$E_{rr}$	Reverse recovery energy		-	1.3	-	mJ

### 3.1 Electrical characteristics (curves)

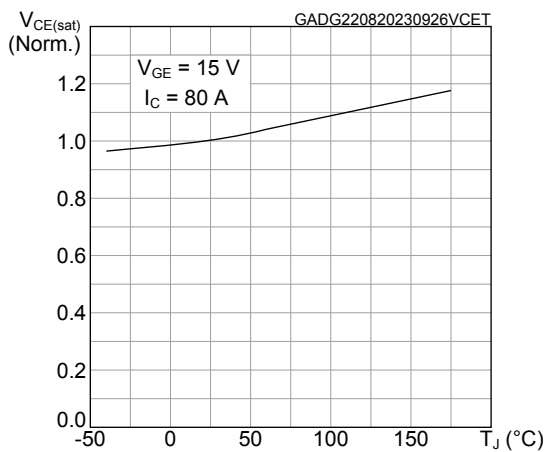
**Figure 2. Typical output characteristics ( $T_J = 25\text{ }^\circ\text{C}$ )**



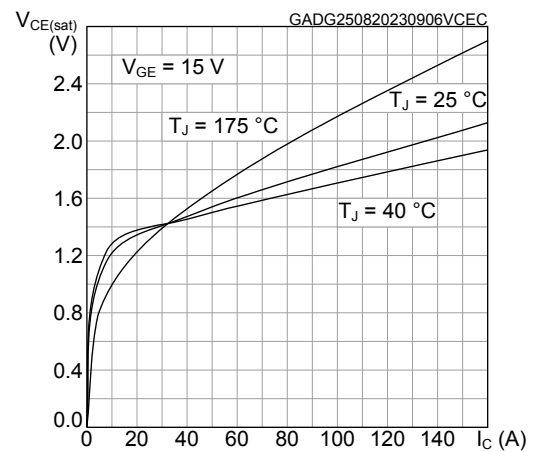
**Figure 3. Typical output characteristics ( $T_J = 175\text{ }^\circ\text{C}$ )**



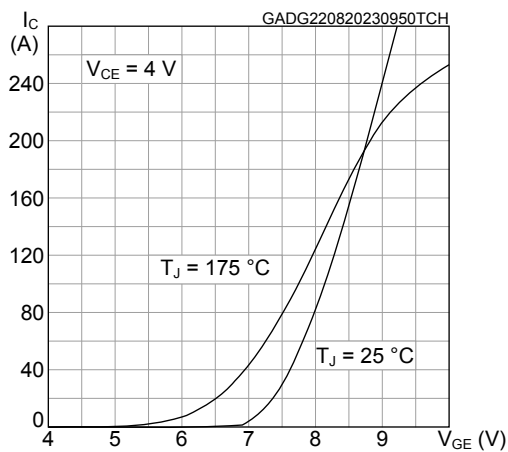
**Figure 4. Normalized  $V_{CE(sat)}$  vs temperature**



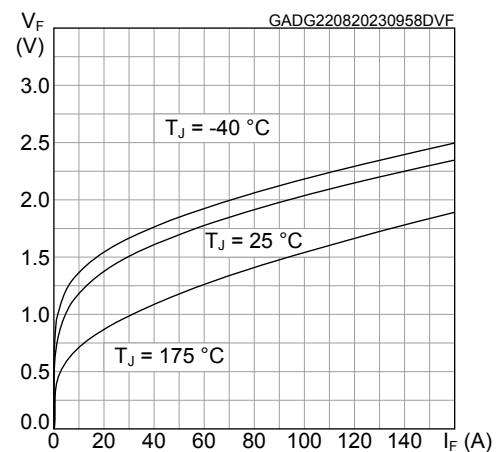
**Figure 5. Typical  $V_{CE(sat)}$  vs collector current**



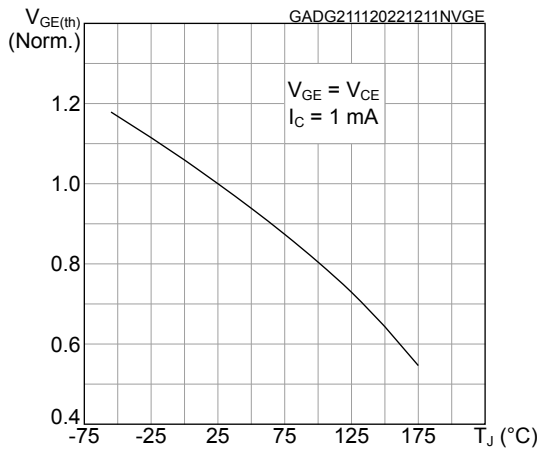
**Figure 6. Typical transfer characteristics**



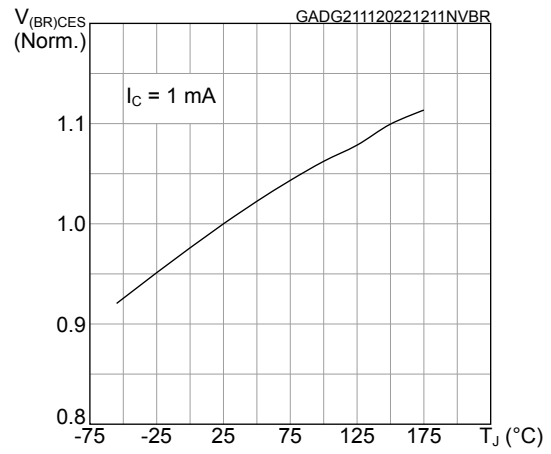
**Figure 7. Typical diode  $V_F$  vs forward current**



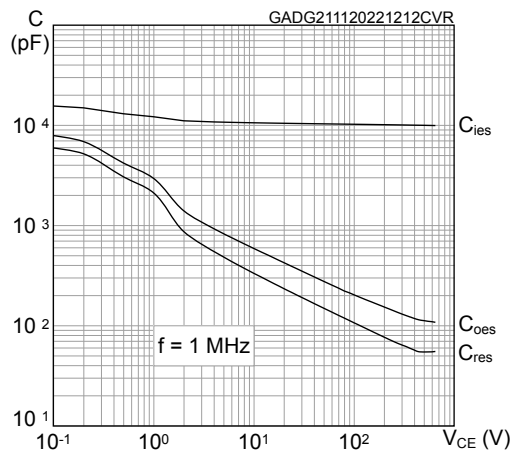
**Figure 8. Normalized  $V_{GE(th)}$  vs temperature**



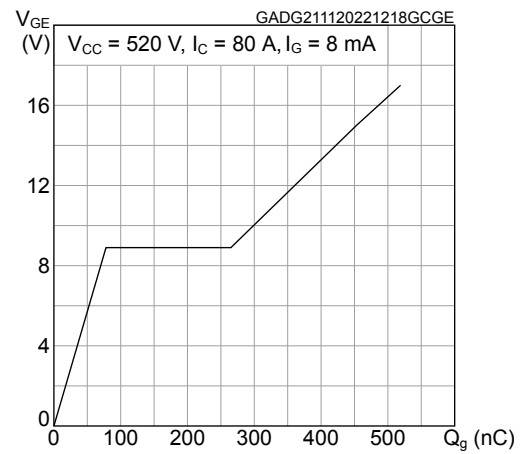
**Figure 9. Normalized  $V_{(BR)CES}$  vs temperature**



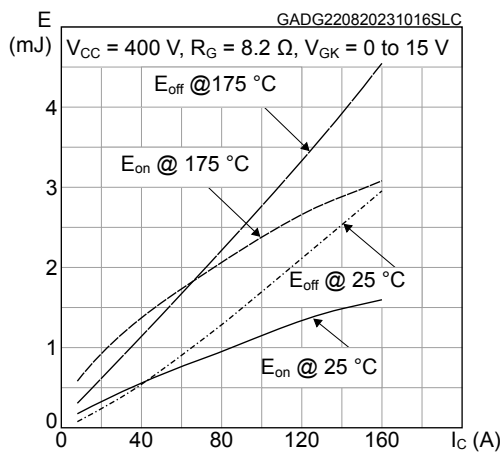
**Figure 10. Typical capacitance characteristics**



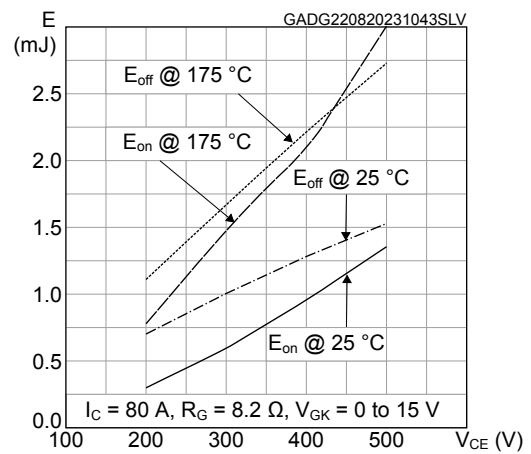
**Figure 11. Typical gate charge characteristics**



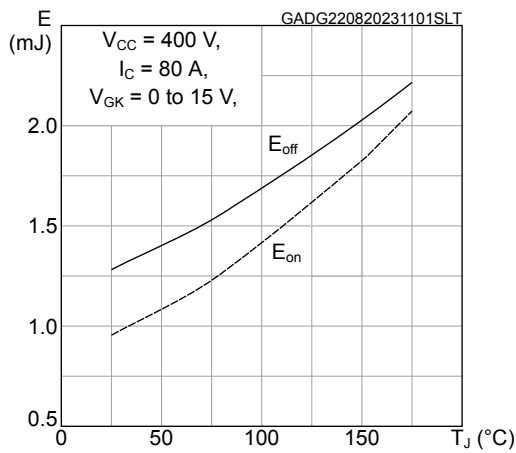
**Figure 12. Typical switching energy vs collector current**



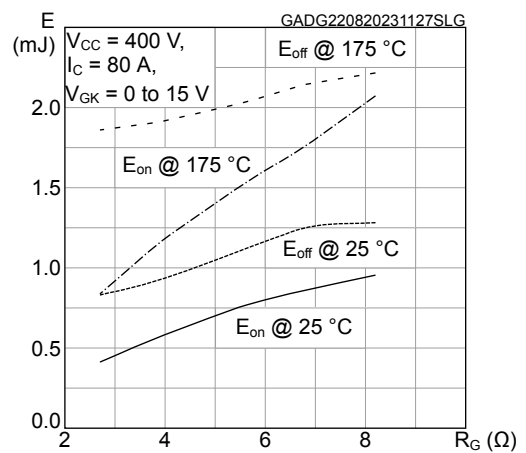
**Figure 13. Typical switching energy vs supply voltage**



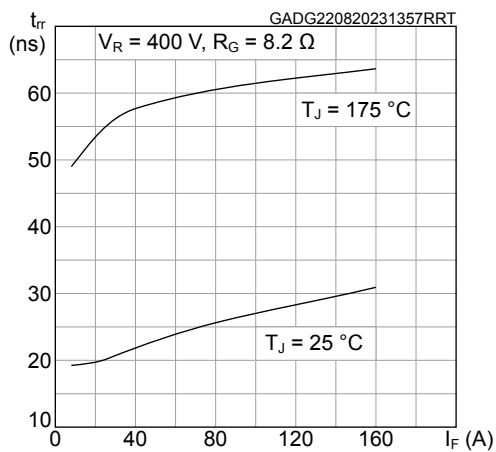
**Figure 14. Typical switching energy vs temperature**



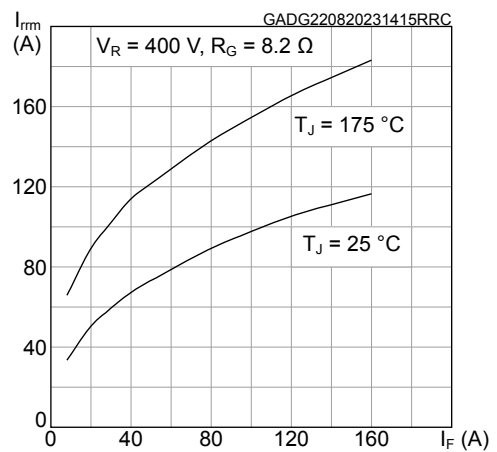
**Figure 15. Typical switching energy vs  $R_G$**



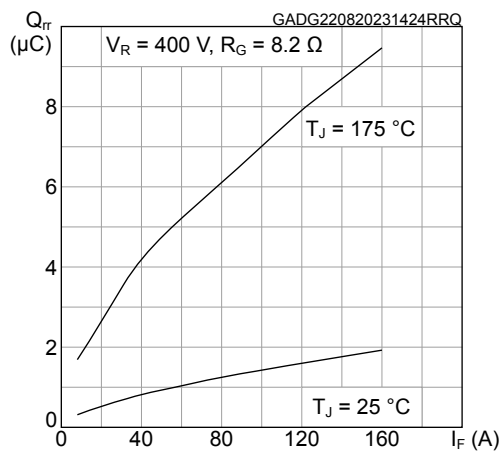
**Figure 16. Diode reverse recovery time vs forward current**



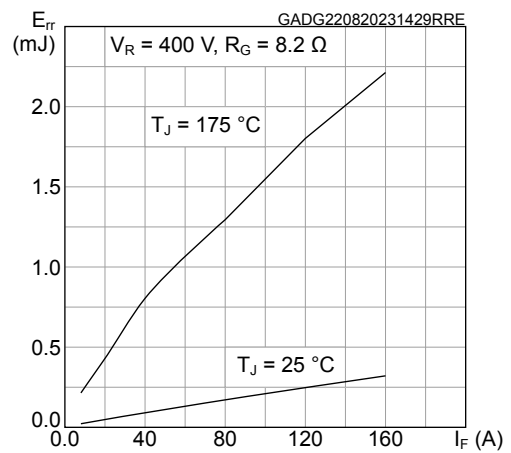
**Figure 17. Diode reverse recovery current vs forward current**



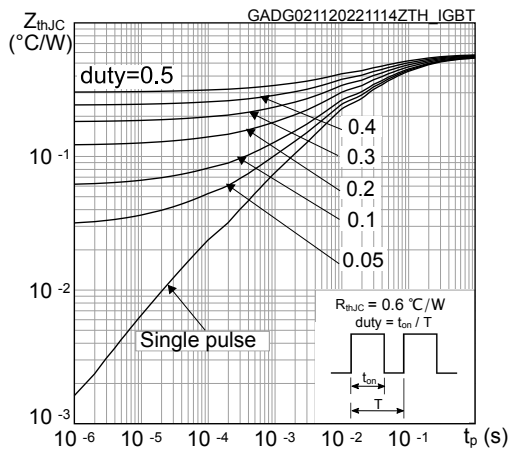
**Figure 18. Diode reverse recovery charge vs forward current**



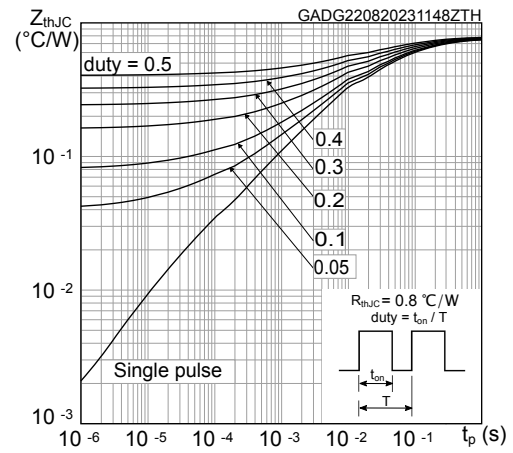
**Figure 19. Diode reverse recovery energy vs forward current**



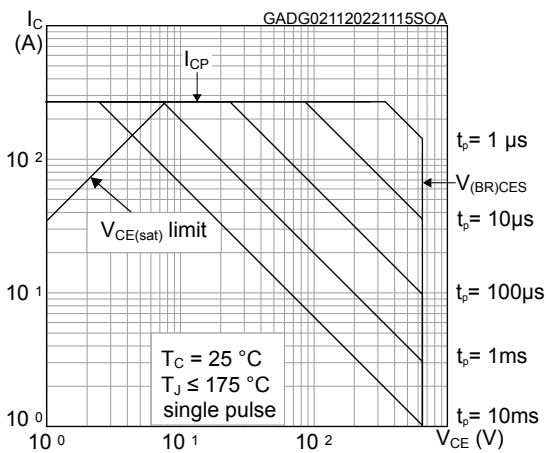
**Figure 20. Maximum transient thermal impedance for IGBT**



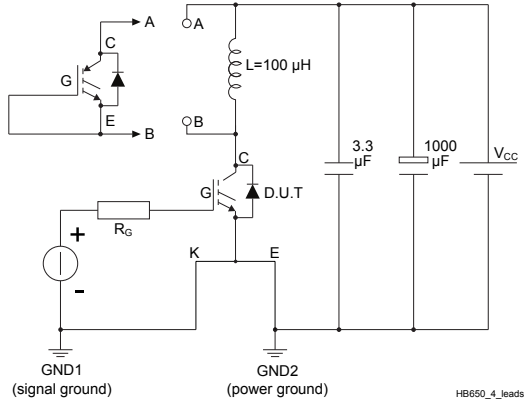
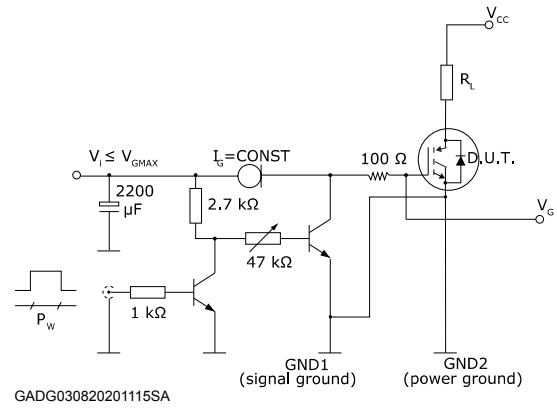
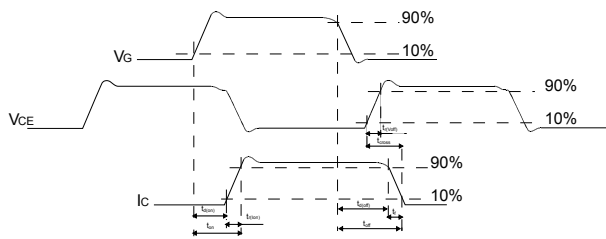
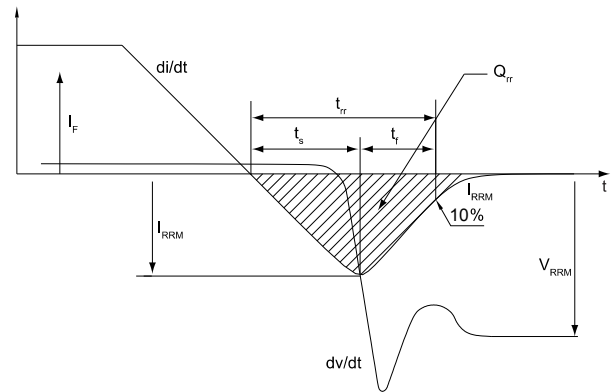
**Figure 21. Maximum transient thermal impedance for diode**



**Figure 22. Forward bias safe operating area**



## 4 Test circuits

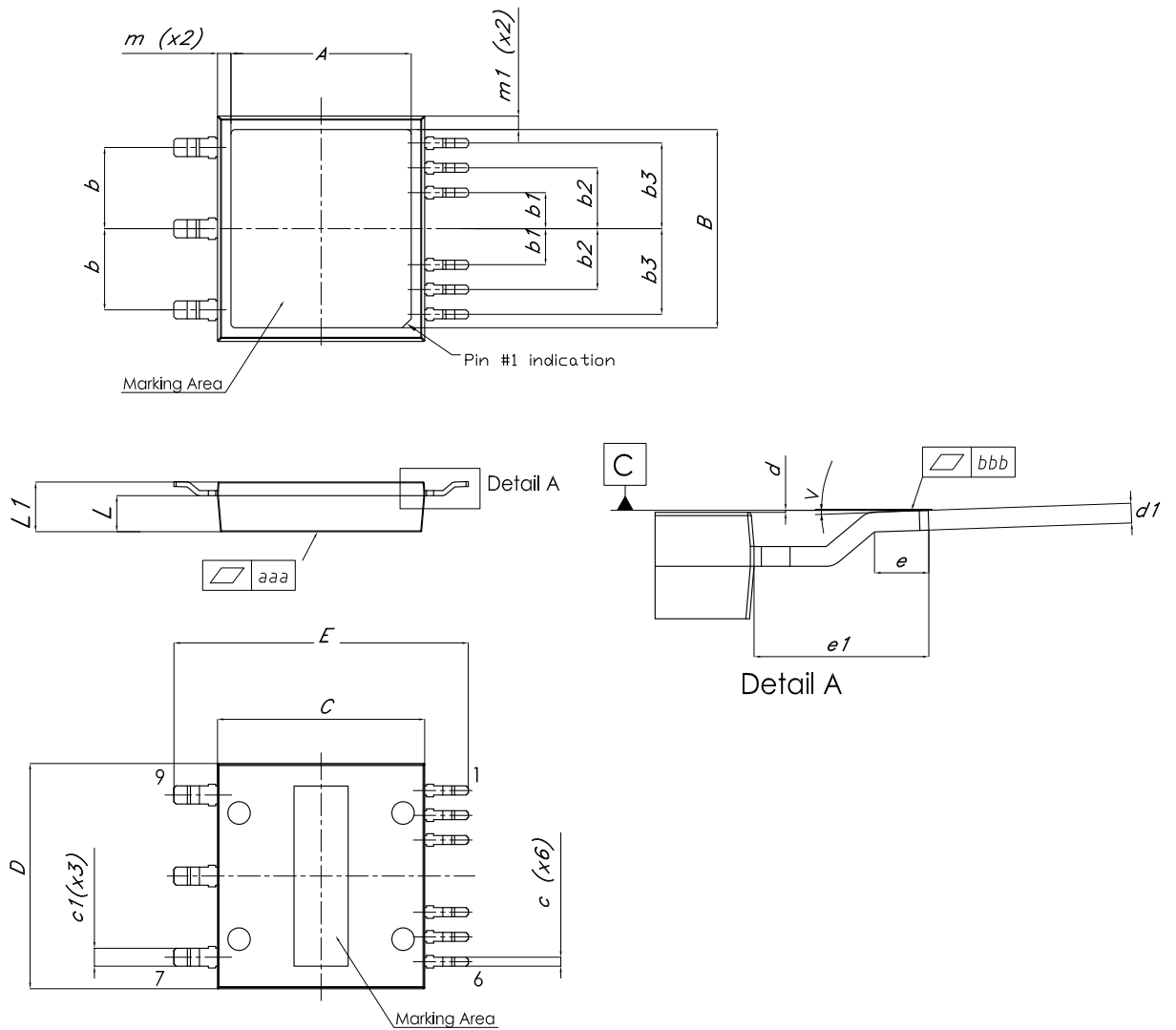
**Figure 23. Test circuit for inductive load switching**

**Figure 24. Gate charge test circuit**

**Figure 25. Switching waveform**

**Figure 26. Diode reverse recovery waveform**


## 5 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.

### 5.1 ACEPACK SMIT package information

Figure 27. ACEPACK SMIT package outline

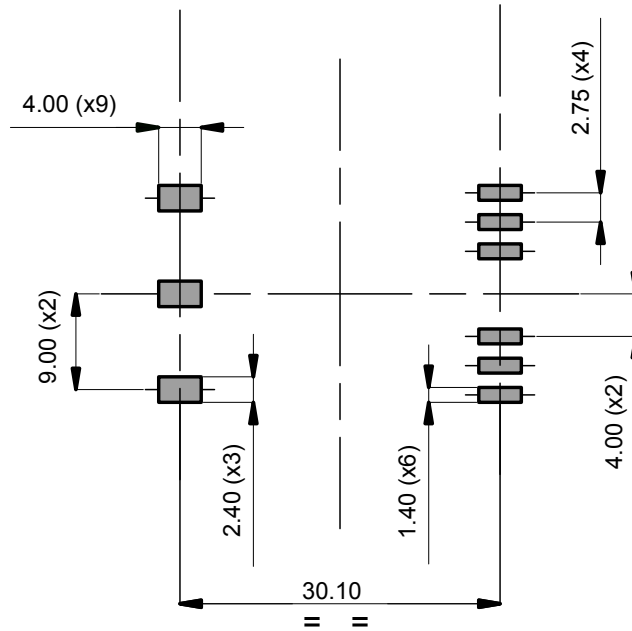


DM00447519\_Rev.6

**Table 9. ACEPACK SMIT package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	19.50	20.00	20.50
B	21.50	22.00	22.50
C	22.80	23.00	23.20
D	24.80	25.00	25.20
E	32.20	32.70	33.20
b		9.00	
b1		4.00	
b2		6.75	
b3		9.50	
c	0.95	1.00	1.10
c1	1.95	2.00	2.10
d	0.00		0.15
d1	0.45	0.55	0.65
e	1.30	1.50	1.70
e1	4.65	4.85	5.05
L	3.95	4.00	4.05
L1	5.40	5.50	5.60
m	1.30	1.50	1.80
m1	1.30	1.50	1.80
V	0°	2°	4°
aaa	0.01		0.05
bbb	0.00		0.10

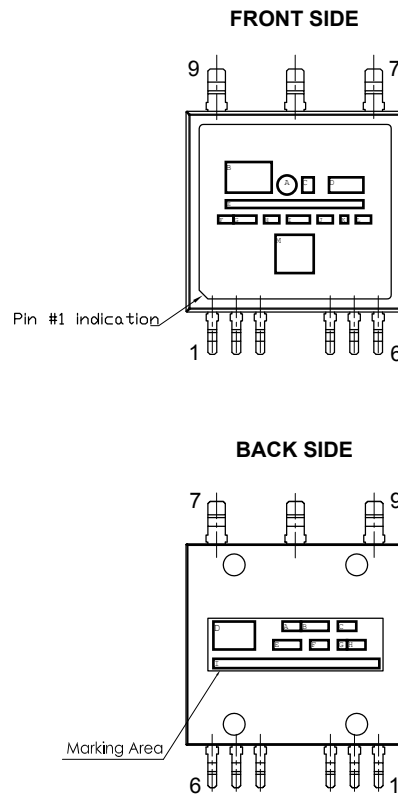
**Figure 28. ACEPACK SMIT recommended footprint**



DM00447519\_FP\_Rev.6

Note: Dimensions in mm.

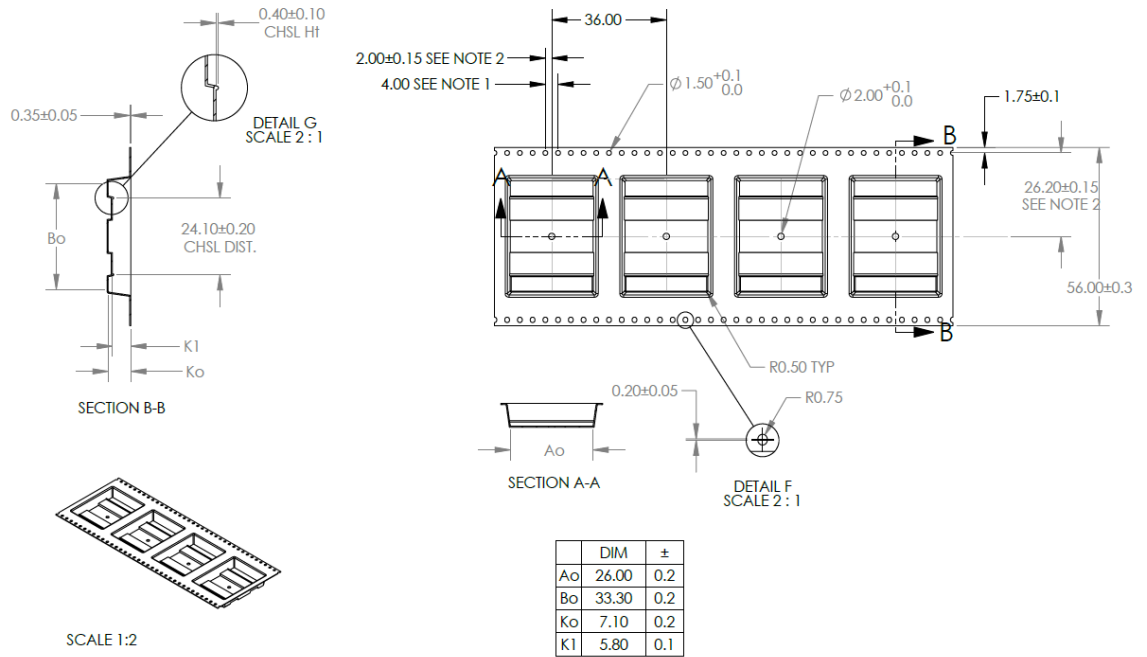
**Figure 29. ACEPACK SMIT marking orientation vs pinout**



DM00447519\_MO\_Rev.6

## 5.2 ACEPACK SMIT packing information

Figure 30. ACEPACK SMIT tape outline



NOTES:

1. TO SPROCKET HOLE PITCH CUMULATIVE TOLERANCE  $\pm 0.2$
2. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE.
3.  $A_o$  AND  $B_o$  ARE MEASURED ON A PLANE AT A DISTANCE "R" ABOVE THE BOTTOM OF THE POCKET.

DM00631393\_Tape\_Rev.1

Note: Dimensions in mm.

## Revision history

**Table 10. Document revision history**

Date	Revision	Changes
14-Nov-2022	1	First release.
28-Aug-2023	2	<p>Updated <a href="#">Features</a> on cover page.</p> <p>Added <a href="#">Table 4. Total system</a>.</p> <p>Added <a href="#">Section 1 Internal schematic and pin description</a> and removed <i>"Topology, pin description and positioning"</i>.</p> <p>Added <a href="#">Section 4 Test circuits</a>.</p> <p>Updated <a href="#">Table 5. Static characteristics</a>, <a href="#">Table 7. Switching characteristics (inductive load)</a> and <a href="#">Table 8. Diode switching characteristics (inductive load)</a>.</p> <p>Updated <a href="#">Section 3.1 Electrical characteristics (curves)</a>.</p>

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<b>3.1</b>	<b>Electrical characteristics (curves)</b> .....	<b>6</b>
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