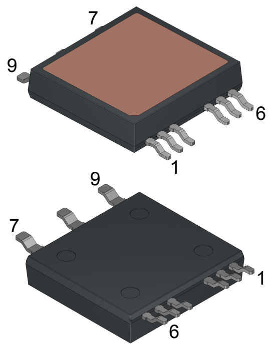
STGSH50M120D

Datasheet

ACEPACK SMIT half-bridge topology 1200 V, 50 A, M series IGBT with diode



ACEPACK SMIT

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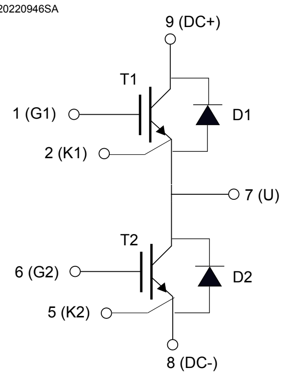


Features

- Low-loss and short-circuit rugged IGBTs
- Maximum junction temperature: T_J = 175 °C
- $V_{CE(sat)}$ = 1.8 V (typ.) @ I_C = 50 A
- Minimized tail current
- Tight parameter distribution
- Low thermal resistance
- Positive $V_{CE(sat)}$ temperature coefficient
- Soft and fast-recovery antiparallel diode
- Isolation rating of 3.4 kVrms/min

Applications

- Motor drives
- Industrial motor control

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 optimized both in conduction and switching losses for hard switching commutation, where short-circuit ruggedness is an essential feature. A freewheeling diode with a low drop forward voltage is included in every switch. The result is a product specifically designed to maximize efficiency and power density in industrial drives.

Product status link
STGSH50M120D

Product summary	
Order code	STGSH50M120D
Marking	GSH50M120D
Package	ACEPACK SMIT
Packing	Tape and reel

1 Internal schematic and pin description

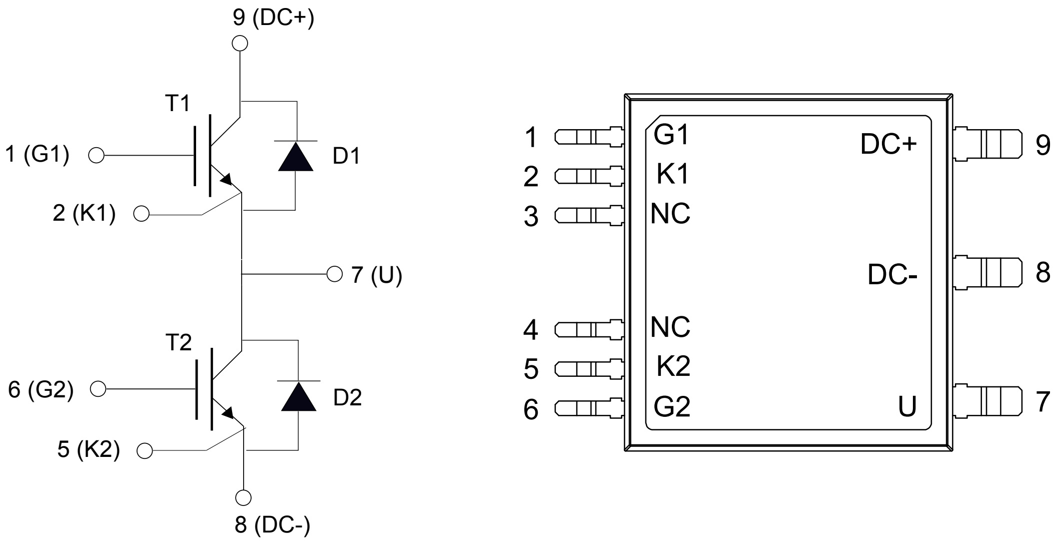


Figure 1. Electrical topology and pin positioning

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)	1200	V
I_C (1)	Continuous collector current at T_C = 100 °C	69	A
I_{CP} (2)	Pulsed collector current (t_p = 1 ms)	240	A
V_{GE}	Gate-emitter voltage	±20	V
I_F (1)	Continuous forward current at T_C = 100 °C	40	A
I_{FP} (2)	Pulsed forward current (t_p = 1 ms)	136	A
P_{TOT}	Total power dissipation at T_C = 25 °C	536	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	0.28	°C/W
	Thermal resistance, junction-to-case diode	0.7	

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 °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 V, I_C = 2 mA	1200			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 50 A		1.8	2.3	V
		V_{GE} = 15 V, I_C = 50 A, T_J = 125 °C		2.0		
		V_{GE} = 15 V, I_C = 50 A, T_J = 175 °C		2.2		
V_F	Forward on-voltage	I_F = 50 A		2.8		V
		I_F = 50 A, T_J = 125 °C		2.3		
		I_F = 50 A, T_J = 175 °C		2.0		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 2 mA	5	6	7	V
I_{CES}	Collector cut-off current	V_{GE} = 0 V, V_{CE} = 1200 V			25	µA
I_{GES}	Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = ±20 V			250	nA

Table 6. 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	-	3152	-	pF
C_{oes}	Output capacitance		-	310	-	pF
C_{res}	Reverse transfer capacitance		-	123	-	pF
Q_g	Total gate charge	V_{CC} = 960 V, I_C = 50 A, V_{GE} = 0 to 15 V	-	194	-	nC

Table 7. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CC} = 600 V, V_{GK} = -15 to 15 V, R_G = 10 Ω, I_C = 50 A	-	68	-	ns
t_r	Current rise time		-	13	-	ns
E_{on} [1]	Turn-on switching energy		-	1.94	-	mJ
$t_{d(off)}$	Turn-off delay time		-	135	-	ns
t_f	Current fall time		-	197	-	ns
E_{off} [2]	Turn-off switching energy		-	3.44	-	mJ
$t_{d(on)}$	Turn-on delay time	V_{CC} = 600 V, V_{GK} = -15 to 15 V, R_G = 10 Ω, I_C = 50 A, T_J = 175 °C	-	69	-	ns
t_r	Current rise time		-	13	-	ns
E_{on} [1]	Turn-on switching energy		-	3.98	-	mJ
$t_{d(off)}$	Turn-off delay time		-	152	-	ns
t_f	Current fall time		-	296	-	ns
E_{off} [2]	Turn-off switching energy		-	4.6	-	mJ
t_{sc}	Short-circuit withstand time	V_{CC} ≤ 600 V, V_{GE} = 15 V, T_{Jstart} ≤ 150 °C	10			µs

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 = 50 A, V_R = 600 V, R_G= 10 Ω	-	294	-	ns
Q_{rr}	Reverse recovery charge		-	2.79	-	µC
I_{rrm}	Reverse recovery current		-	67	-	A
E_{rr}	Reverse recovery energy		-	0.94	-	mJ
t_{rr}	Reverse recovery time	I_F = 50 A, V_R = 600 V, R_G= 10 Ω, T_J = 175 °C	-	382	-	ns
Q_{rr}	Reverse recovery charge		-	7.52	-	µC
I_{rrm}	Reverse recovery current		-	82	-	A
E_{rr}	Reverse recovery energy		-	2.66	-	mJ

3.1 Electrical characteristics (curves)

Figure 2. Typical output characteristics (T_J = 25 °C)

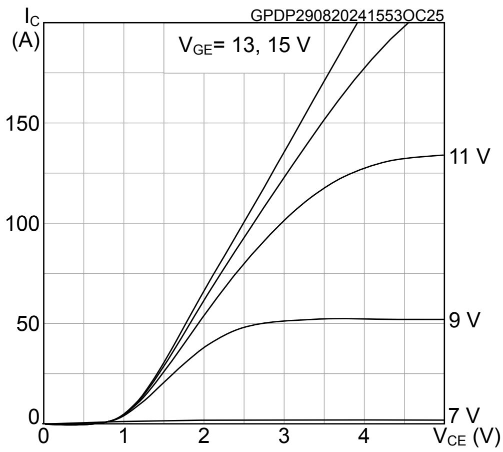


Figure 3. Typical output characteristics (T_J = 175 °C)

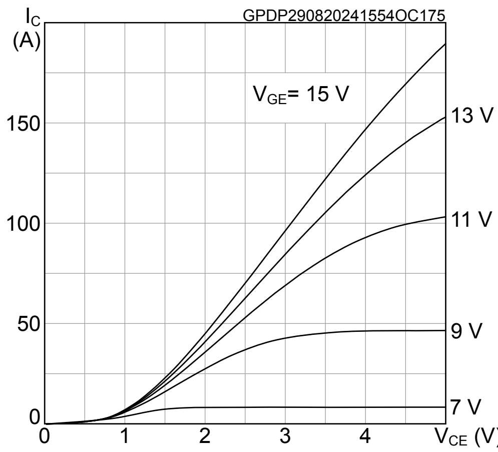


Figure 4. Normalized $V_{CE(sat)}$ vs temperature

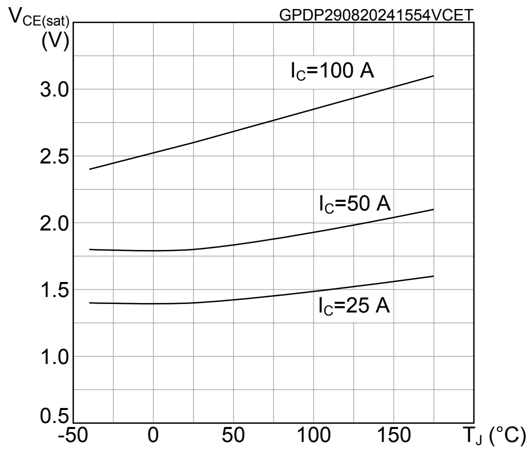


Figure 5. Typical $V_{CE(sat)}$ vs collector current

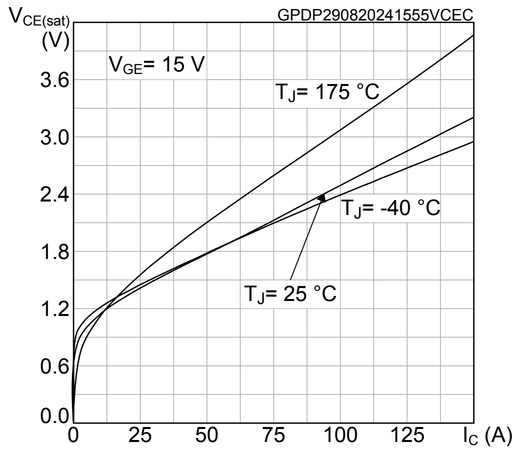


Figure 6. Typical transfer characteristics

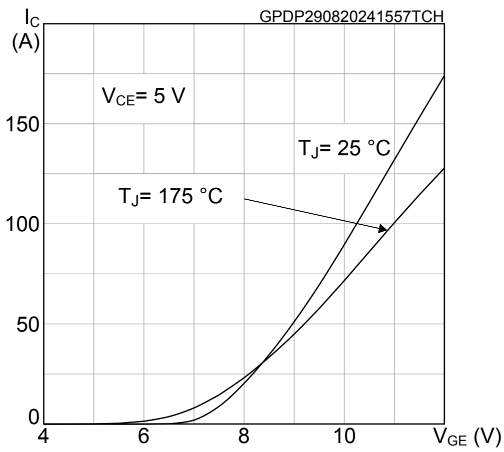


Figure 7. Typical diode V_F vs forward current

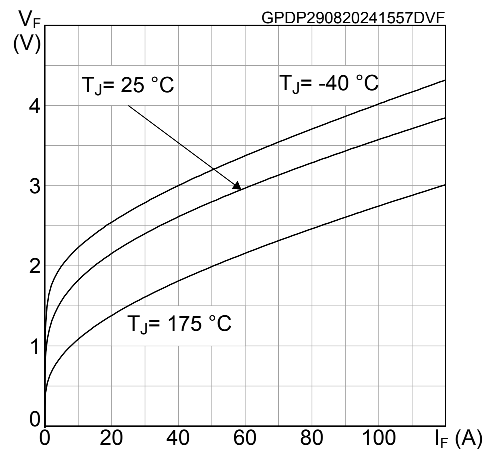


Figure 8. Normalized $V_{GE(th)}$ vs temperature

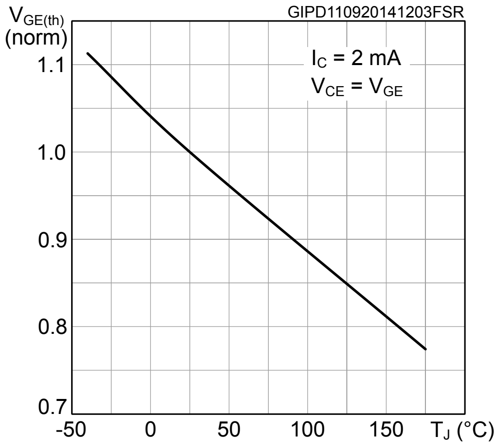


Figure 9. Normalized $V_{(BR)CES}$ vs temperature

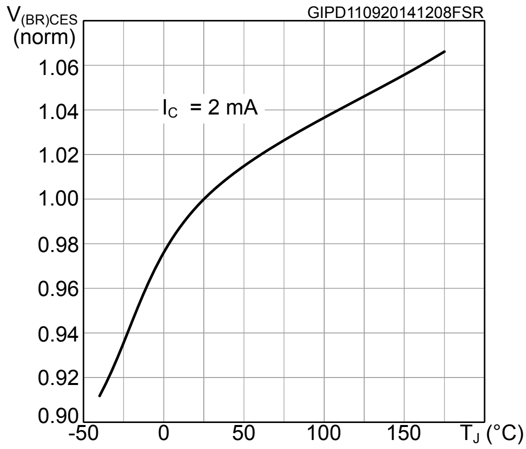


Figure 10. Typical capacitance characteristics

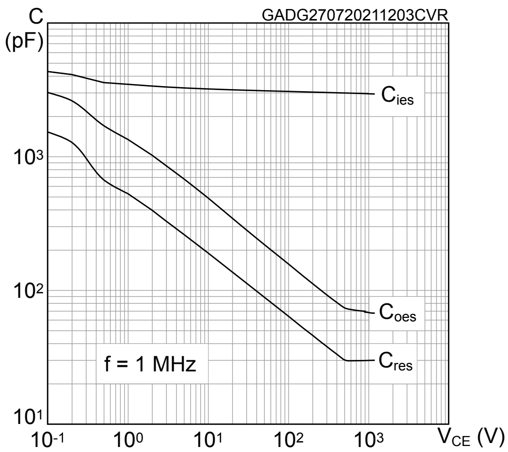


Figure 11. Typical gate charge characteristics

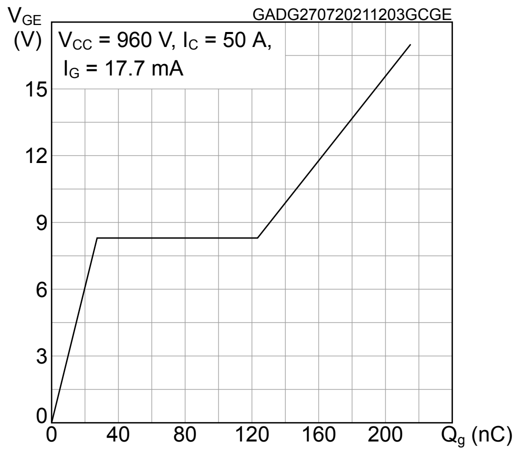


Figure 12. Typical switching energy vs collector current

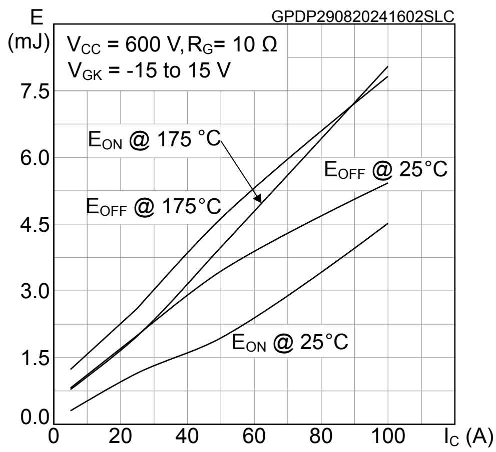


Figure 13. Typical switching energy vs supply voltage

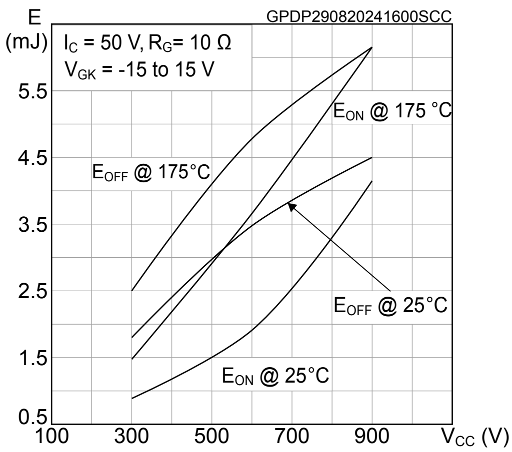


Figure 14. Typical switching energy vs temperature

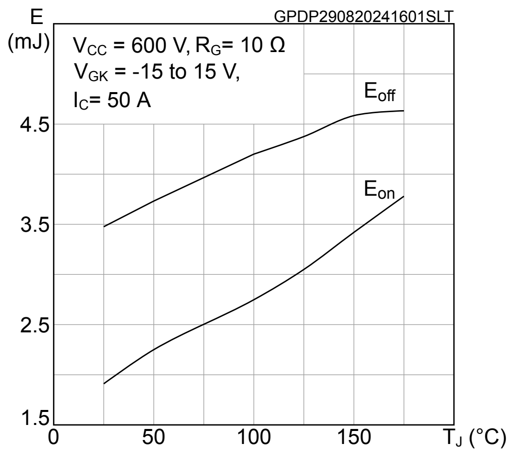


Figure 15. Typical switching energy vs R_G

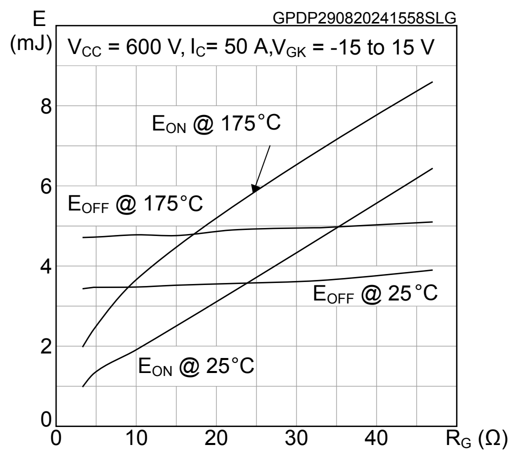


Figure 16. Diode reverse recovery time vs forward current

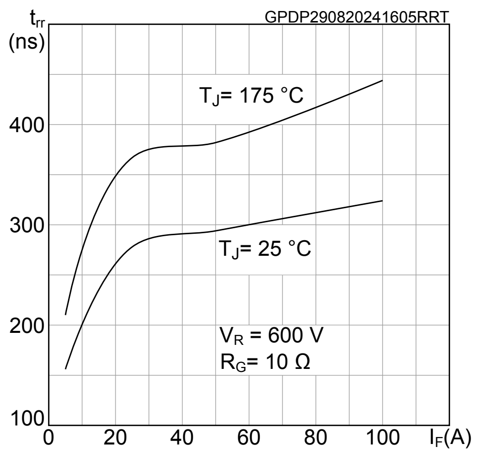


Figure 17. Diode reverse recovery current vs forward current

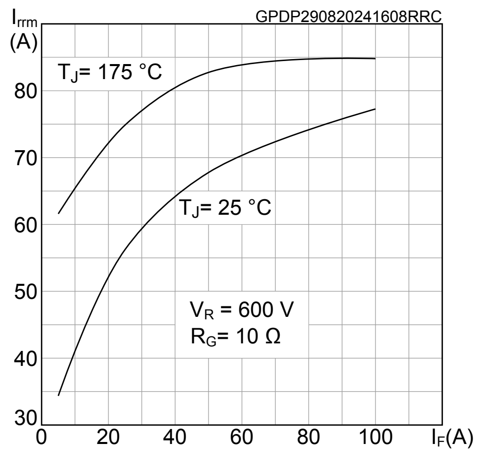


Figure 18. Diode reverse recovery energy vs forward current

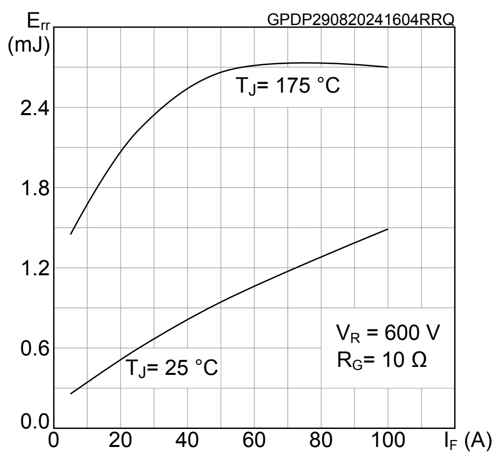


Figure 19. Diode reverse recovery charge vs forward current

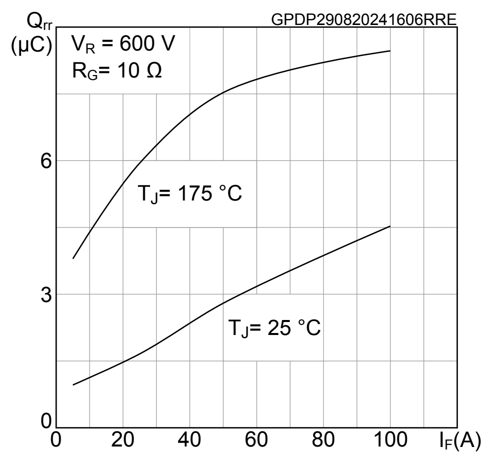


Figure 20. Maximum transient thermal impedance for IGBT

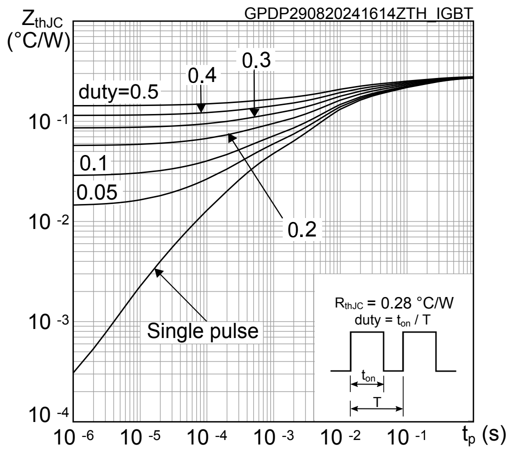


Figure 21. Maximum transient thermal impedance for diode

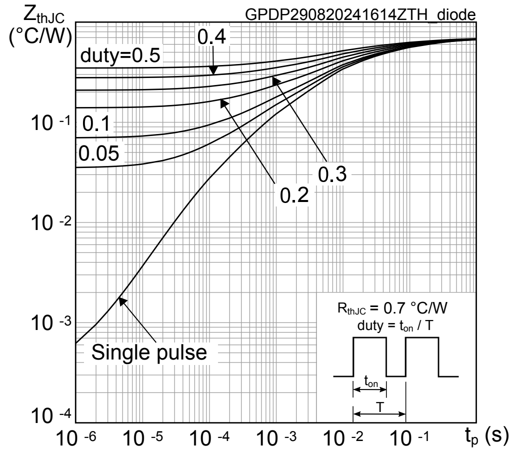
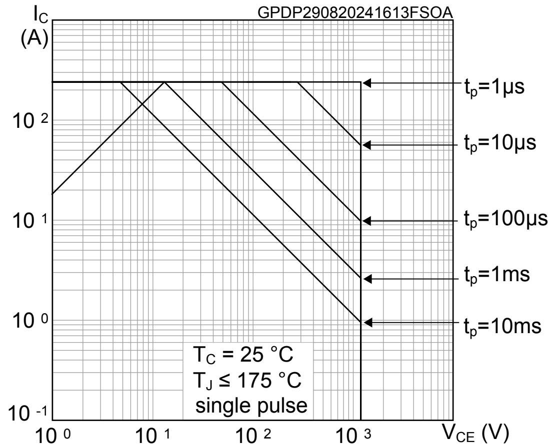


Figure 22. Forward bias safe operating area



4 Test circuits

Figure 23. Test circuit for inductive load switching

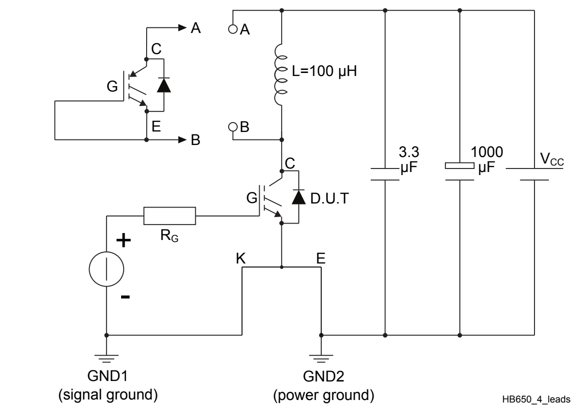


Figure 24. Gate charge test circuit

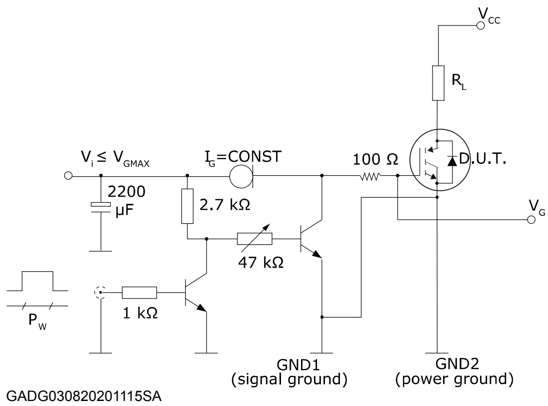


Figure 25. Switching waveform

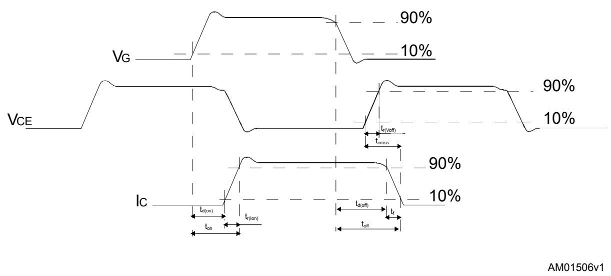
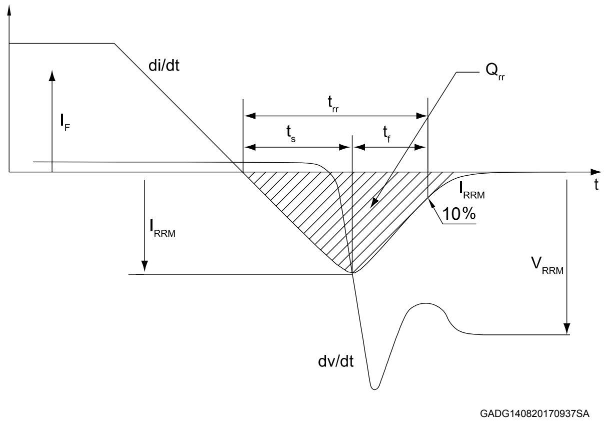


Figure 26. Diode reverse recovery waveform

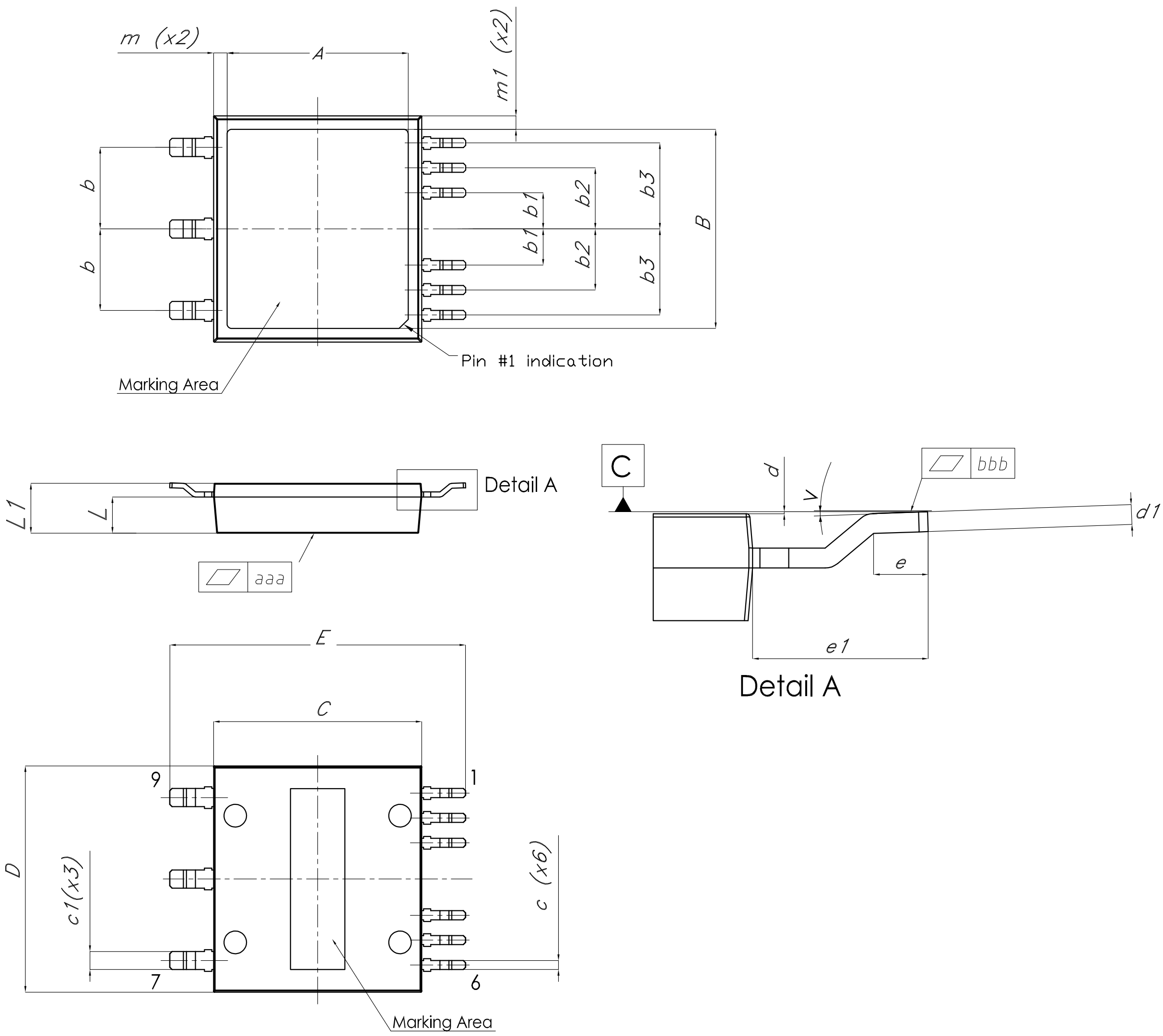


5 Package information

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.

5.1 ACEPACK SMIT package information

Figure 27. **ACEPACK SMIT package outline**

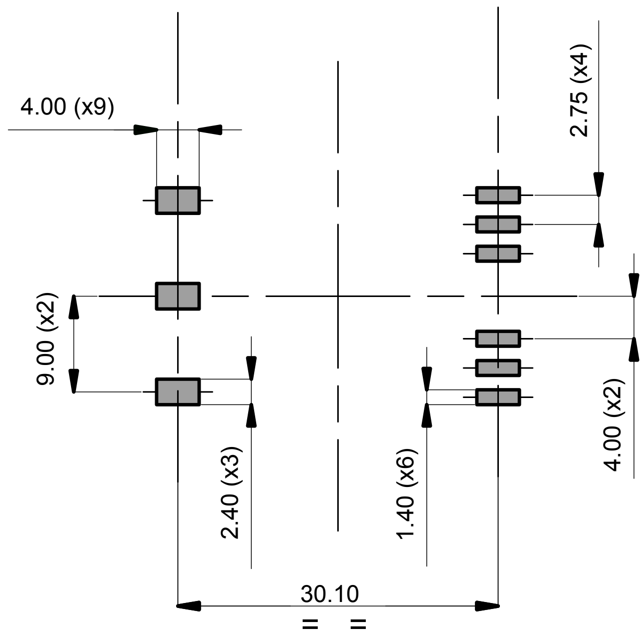


DM00447519_Rev.7

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

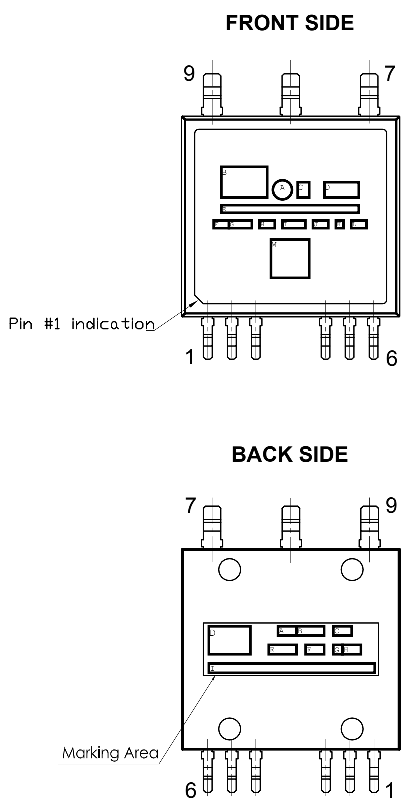
Figure 28. ACEPACK SMIT recommended footprint



DM00447519_FP_Rev.7

Note: Dimensions in mm.

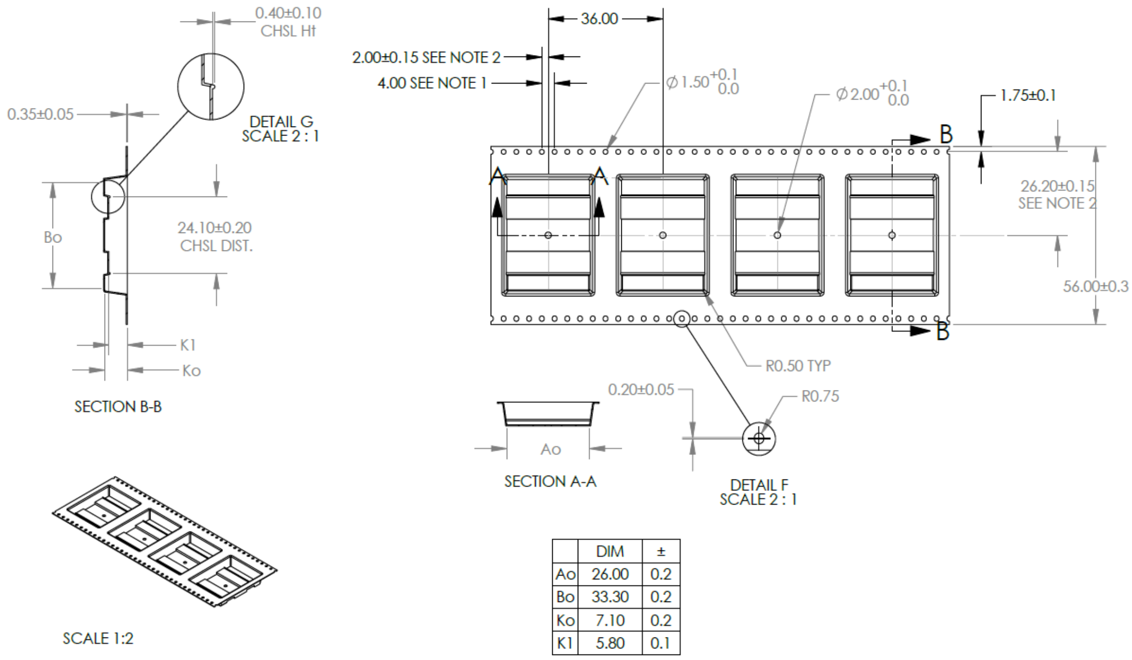
Figure 29. ACEPACK SMIT marking orientation vs pinout



DM00447519_MO_Rev.7

5.2 ACEPACK SMIT packing information

Figure 30. **ACEPACK SMIT tape outline**



	DIM	±
Ao	26.00	0.2
Bo	33.30	0.2
Ko	7.10	0.2
K1	5.80	0.1

NOTES:
1. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.2
2. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE.
3. Ao AND Bo 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
09-Sep-2024	1	First release.
11-Nov-2024	2	Updated Table 2. Absolute maximum ratings and Table 5. Static characteristics.

Contents