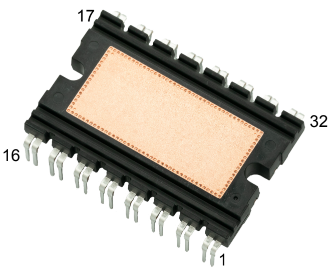
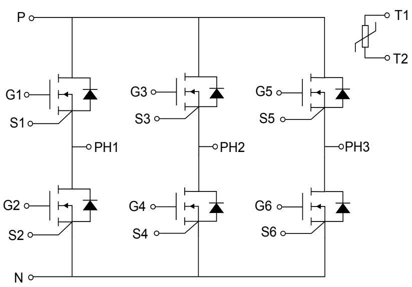
M1P45M12W2-1LA

Datasheet

Automotive-grade ACEPACK DMT-32 power module, sixpack topology, 1200 V, 47.5 mΩ typ. SiC Power MOSFET with NTC



ACEPACK DMT-32



STPOWER

Product status link
M1P45M12W2-1LA

Product summary	
Order code	M1P45M12W2-1LA
Marking	M1P45M12W2-1LA
Package	ACEPACK DMT-32
Packing	Tube

Features

- AQG 324 qualified
- 1200 V blocking voltage
- 47.5 mΩ of typical $R_{DS(on)}$
- Maximum operating junction temperature T_J = 175 °C
- DBC Cu-AlN-Cu based substrate to improve thermal performance
- Isolation voltage 3 kV
- Integrated NTC temperature sensor

Applications

- On board charger (OBC)

Description

This ACEPACK DMT-32 power module realizes a sixpack topology with integrated NTC, tailored for the DC/DC converter stage of the OBC in hybrid and electric vehicles. The power module features six silicon carbide Power MOSFETs of 2nd generation from STMicroelectronics. Thanks to the well-recognized chip technology, the ACEPACK DMT-32 ensures the best compromise between energy losses and high switching frequency operation mode. This module allows you to create complex topologies with very high power densities as well as high efficiency requirements. The AlN insulated substrate enables optimal thermal performance. Moreover, thanks to the specific design featuring grooves on the molding ensure a high creepage distance.

1 Inverter switch

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source breakdown voltage	1200	V
V_{GS}	Gate-source voltage	-10 to 22	V
	Gate-source voltage (recommended operating values)	-5 to 18	
I_D	Drain current (continuous) at T_C = 50 °C	30	A
I_{DM} (1)	Drain current (pulsed, t_p = 1 ms)	95	A
T_J	Operating junction temperature range	-40 to 175	°C

1. *Pulse width is limited by safe operating area.*

Table 2. Electrical characteristics - SiC MOSFET

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	1200			V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 18 V, I_D = 20 A		47.5	60.5	mΩ
		V_{GS} = 18 V, I_D = 20 A T_J = 175 °C		101		
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 1 mA	1.9	3.1	5	V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 1200 V			10	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = -10 to 22 V			±100	nA
C_{iss}	Input capacitance	V_{DS} = 800 V, f = 1 MHz, V_{GS} = 0 V		2086		pF
C_{oss}	Output capacitance			90		pF
C_{rss}	Reverse transfer capacitance			18		pF
R_G	Intrinsic gate resistance	f = 1 MHz open drain		1		Ω
Q_g	Total gate charge	V_{DD} = 800 V, I_D = 25 A, V_{GS} = -5 to 18 V		100		nC
Q_{gs}	Gate-source charge			22.4		nC
Q_{gd}	Gate-drain charge			60.7		nC
E_{on}	Turn-on switching energy	V_{DS} = 800 V, I_D = 25 A, V_{GS} = -5 to 18 V, $R_{G(on)}$ = 15 Ω, $R_{G(off)}$ = 2.2 Ω		518		µJ
E_{off}	Turn-off switching energy			86		µJ
E_{on}	Turn-on switching energy	V_{DS} = 800 V, I_D = 25 A, V_{GS} = -5 to 18 V, $R_{G(on)}$ = 15 Ω, $R_{G(off)}$ = 2.2 Ω, T_J = 175 °C		675		µJ
E_{off}	Turn-off switching energy			81		µJ
R_{thJC}	Thermal resistance, junction-to-case			0.38		°C/W

Table 3. Reverse intrinsic SiC diode characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{SD}	Forward on voltage drop	V_{GS} = 0 V, I_{SD} = 20 A	-	2.5	-	V
t_{rr}	Reverse recovery time	I_{SD} = 25 A, V_{DD} = 800 V, di/dt$_{on}$ = 2000 A/μs, V_{GS} = -5 to 18 V, R_G = 12 Ω	-	13.5	-	ns
Q_{rr}	Reverse recovery charge		-	189	-	nC
I_{RRM}	Reverse recovery current		-	24.4	-	A
t_{rr}	Reverse recovery time	I_{SD} = 25 A, V_{DD} = 800 V, di/dt$_{on}$ = 2000 A/μs, V_{GS} = -5 to 18 V, R_G = 12 Ω, T_J = 175 °C	-	31	-	ns
Q_{rr}	Reverse recovery charge		-	574	-	nC
I_{RRM}	Reverse recovery current		-	32	-	A

2 NTC

Table 4. Absolute maximum ratings for NTC temperature sensor, considered as stand-alone

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
R_{25}	Resistance rating	T = 25 °C		10		kΩ
$\Delta R_{25}/R$	Resistance tolerance		-2		+2	%
R_{100}	Resistance rating	T = 100 °C		674.8		Ω
$\Delta R_{100}/R$	Resistance tolerance		-4.75		4.75	%
$R_{25/50}$	B-value	T = 25 °C to 50 °C		3940		K
$R_{25/85}$		T = 25 °C to 85 °C		3980		
$R_{25/100}$		T = 25 °C to 100 °C (±1%)		4000		
T	Operating temperature range		-40		150	°C

3 Electrical topology and pin description

Figure 1. ACEPACK DMT-32 pin layout (bottom view)

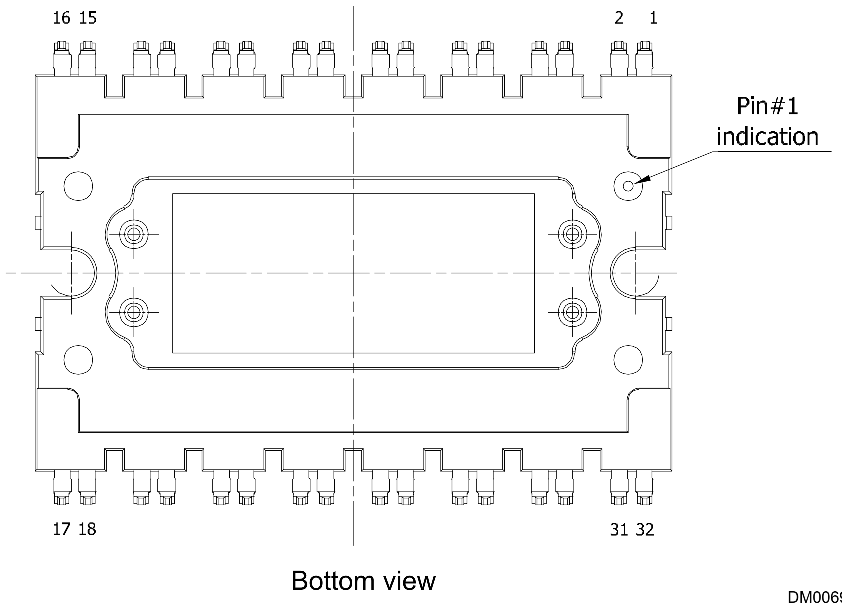


Table 5. Pin description

Pin	Description	Pin	Description
1	N	17	P
2	N	18	P
3	NC	19	G1
4	NC	20	S1
5	PH3	21	G2
6	PH3	22	S2
7	NC	23	G3
8	NC	24	S3
9	PH2	25	G4
10	PH2	26	S4
11	NC	27	G5
12	NC	28	S5
13	PH1	29	G6
14	PH1	30	S6
15	T2 (NTC)	31	NC
16	T1 (NTC)	32	NC

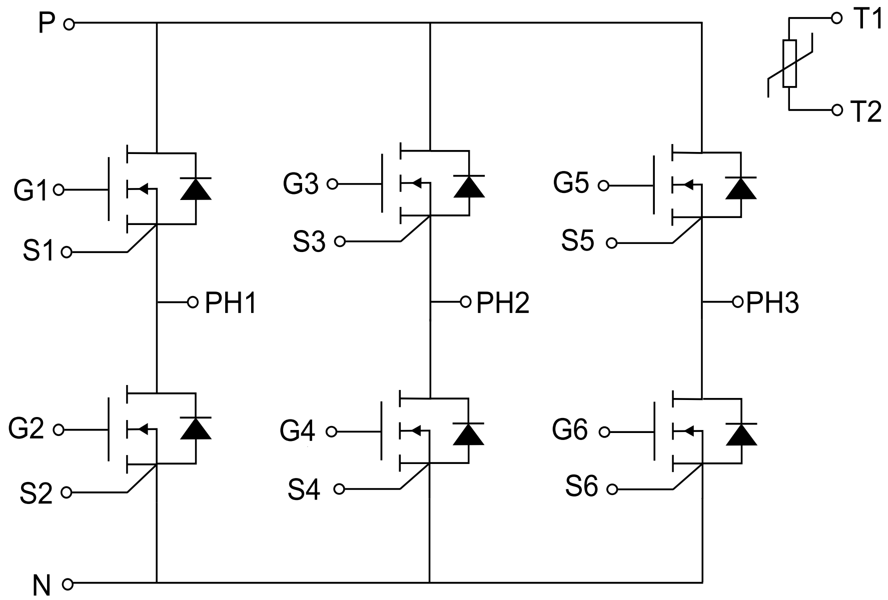


Figure 2. Electrical topology and pin description

4 Electrical characteristics (curves)

Figure 3. Typical output characteristics (T_J = -40 °C)

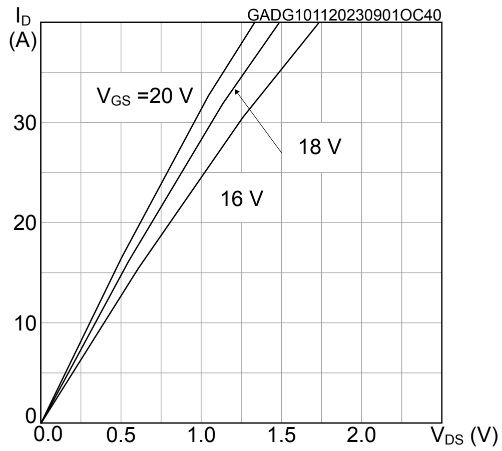


Figure 4. Typical output characteristics (T_J = 25 °C)

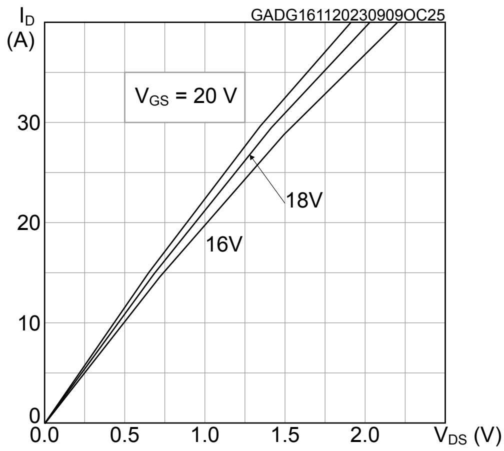


Figure 5. Typical output characteristics (T_J = 175 °C)

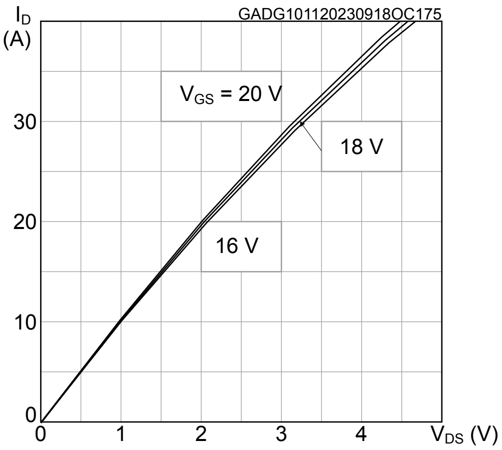


Figure 6. Typical transfer characteristics

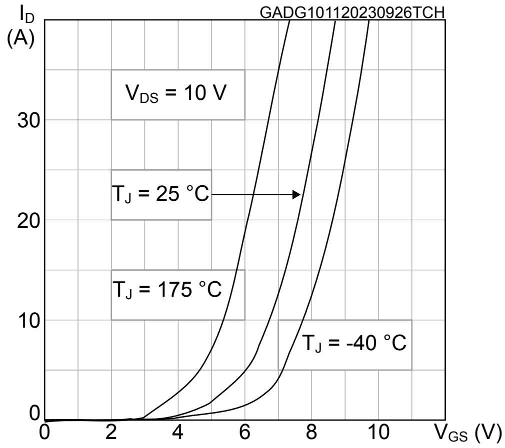


Figure 7. Typical reverse conduction characteristics (T_J = -40 °C)

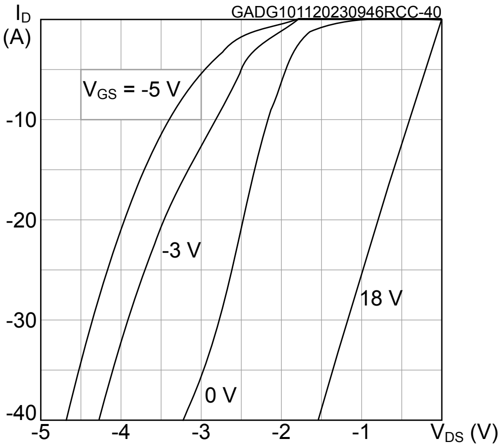


Figure 8. Typical reverse conduction characteristics (T_J = 25 °C)

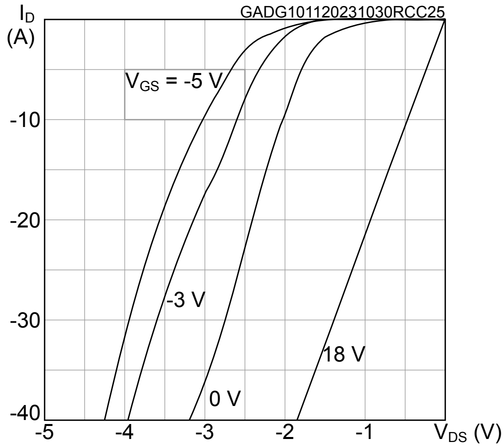


Figure 9. Typical reverse conduction characteristics (T_J = 175 °C)

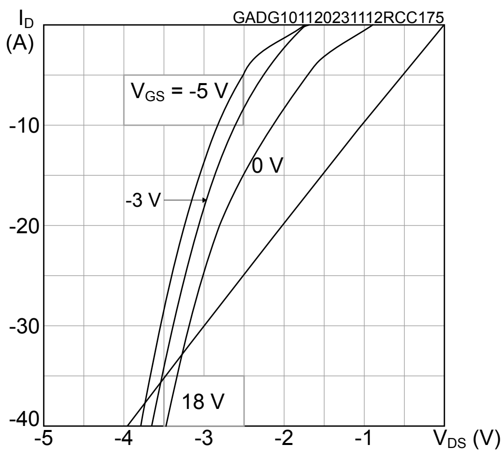


Figure 10. Typical switching energy vs temperature

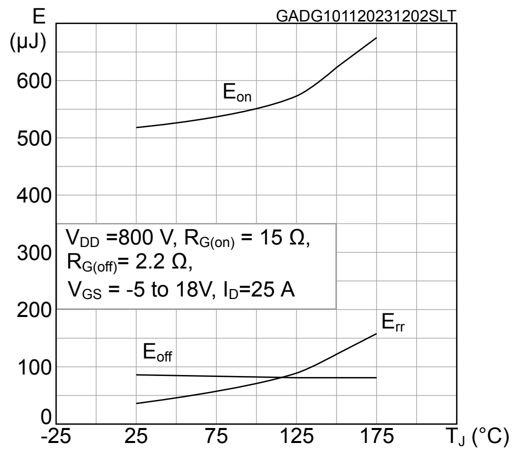


Figure 11. Typical switching energy vs drain current (T_J = 25 °C)

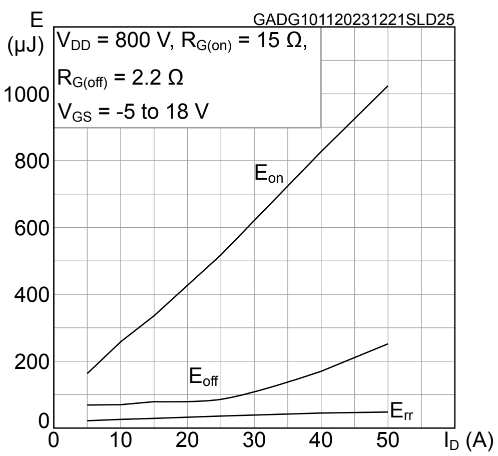


Figure 12. Typical switching energy vs drain current (T_J = 175 °C)

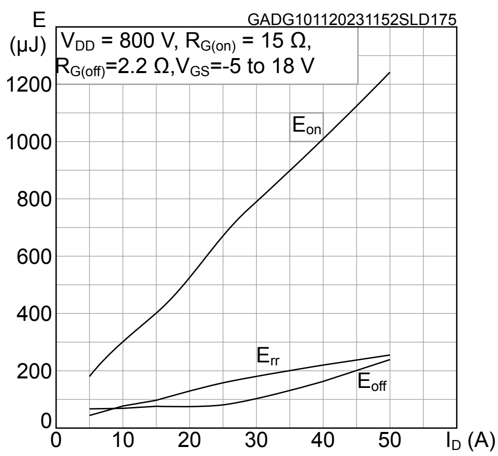


Figure 13. Typical switching energy vs gate resistance (T_J = 25 °C)

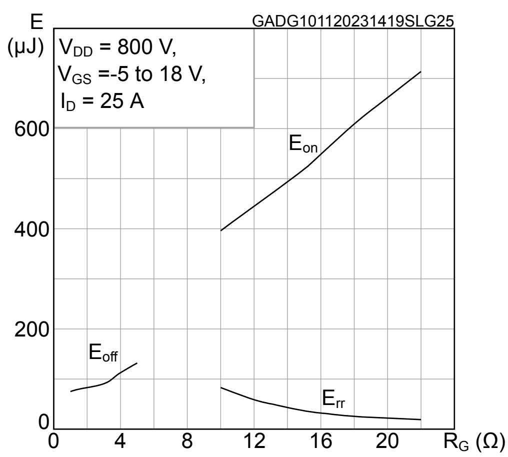
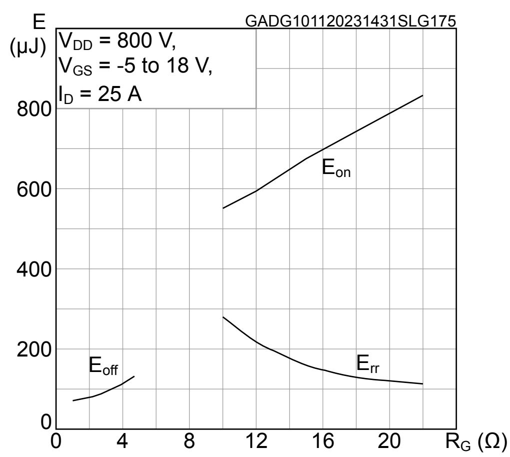


Figure 14. Typical switching energy vs gate resistance (T_J = 175 °C)



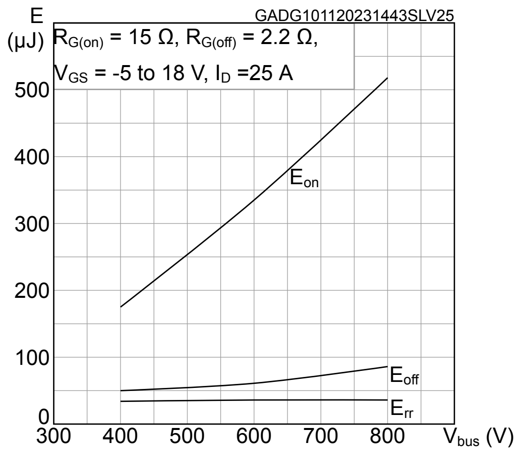


Figure 15. Typical switching energy vs bus voltage (T_J = 25 °C)

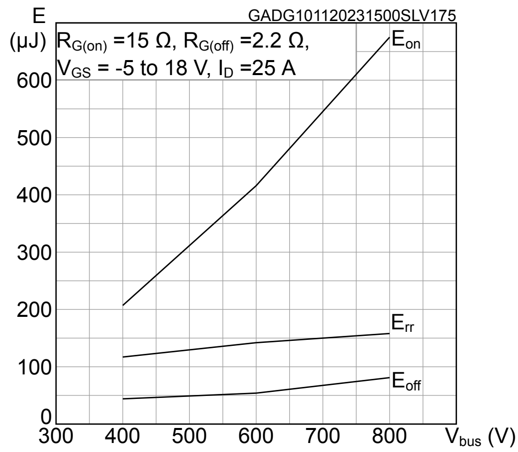


Figure 16. Typical switching energy vs bus voltage (T_J = 175 °C)

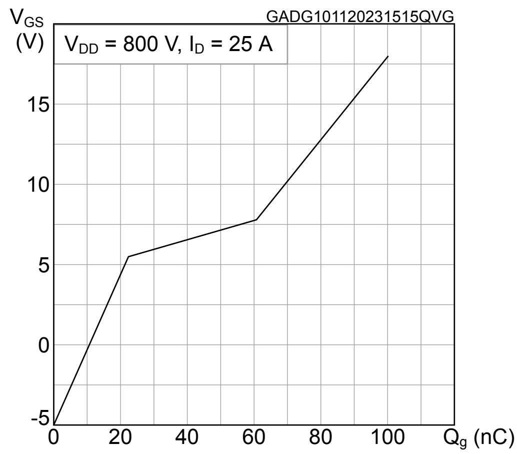


Figure 17. Typical gate charge characteristics

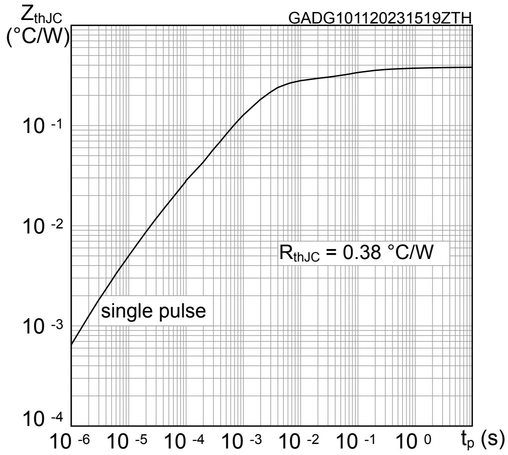


Figure 18. Typical transient thermal impedance

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. ECOPACK is an ST trademark.

5.1 ACEPACK DMT-32 package information

Figure 19. ACEPACK DMT-32 package outline

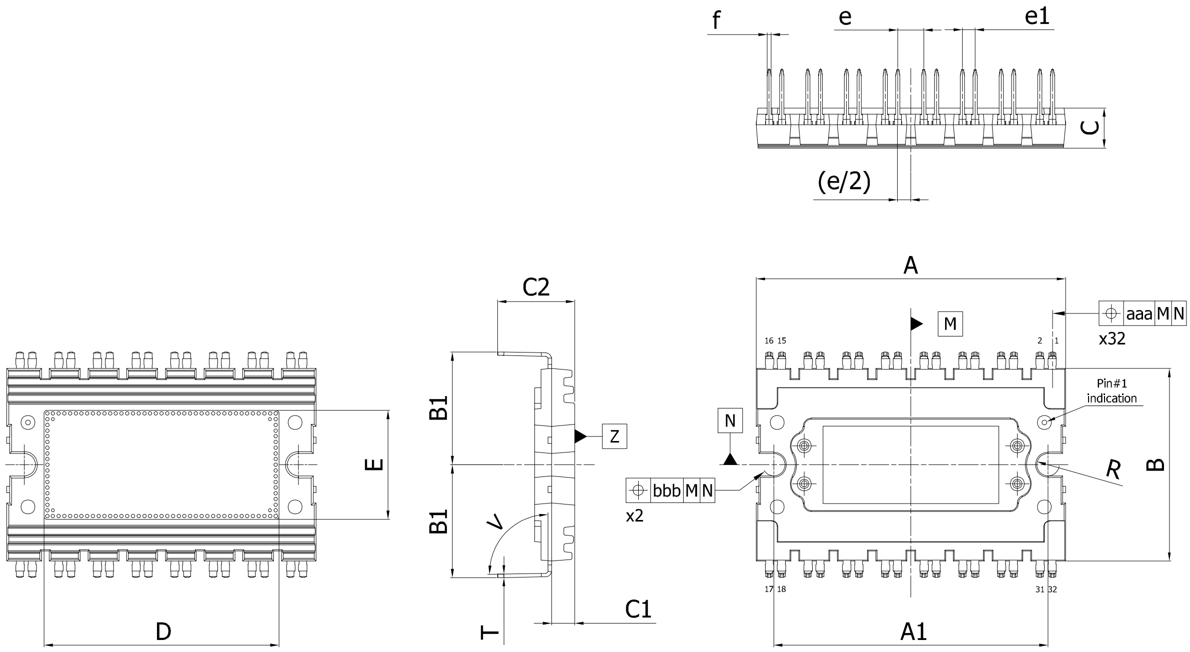


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Table 6. ACEPACK DMT-32 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	43.50	44.00	44.50
A1	38.80	39.00	39.20
B	26.90	27.40	27.90
B1	15.90	16.05	16.20
C	5.50	5.70	5.90
C1	3.15	3.30	3.45
C2	10.85	11.00	11.15
e	3.50	3.70	3.90
e1	1.60	1.80	2.00
D	33.00	33.40	33.80
E	15.10	15.50	15.90
f	0.60	0.65	0.70
R	1.60		1.70
T	0.48	0.53	0.58
V	90°		93°
aaa		0.30	
bbb		0.15	

Table 7. Ratings for module

Symbol	Parameter	Value	Unit
V_{ISO}	Isolation voltage (f = 50 Hz, t = 60 s)	3	kV
CTI	Comparative tracking index	600	V
T_{stg}	Storage temperature range	-40 to 150	°C

Revision history

Table 8. Document revision history

Date	Revision	Changes
26-Apr-2022	1	First release.
17-Nov-2023	2	Updated title, *Features*, *Schematic* and *Description* on cover page. Updated *Section 1 Inverter switch*. Updated *Section 3 Electrical topology and pin description*. Added *Section 4 Electrical characteristics (curves)*. Minor text changes.
10-Jul-2024	3	Updated Features and Description on cover page. Minor text changes.

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