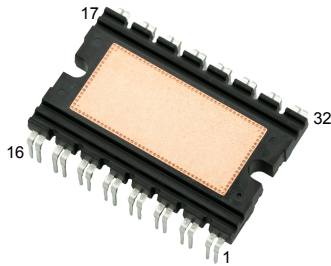



Automotive-grade ACEPACK DMT-32 power module, 3-phase four wire PFC topology, 1200 V, 84 mΩ typ. SiC Power MOSFET with rectifier diode and NTC



ACEPACK DMT-32

Features

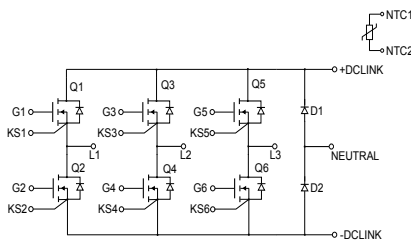
- AQC 324 qualified 
- 3-phase four wire PFC
 - 1200 V, 84 mΩ typ. SiC MOSFET (Q1, Q2, Q3, Q4, Q5, Q6)
 - 1200 V, 20 A rectifier diode (D1, D2)
 - Integrated NTC temperature sensor
- Maximum operating junction temperature $T_J = 175\text{ °C}$
- DBC Cu-AlN-Cu based substrate to improve thermal performance
- Isolation voltage 3 kV

Applications

- On board charger (OBC)

Description

This ACEPACK DMT-32 power module realizes a 3-phase four wire PFC topology with integrated NTC, tailored for the PFC 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.



Product status link

[M1TP80M12W2-2LA](#)

Product summary

Order code	M1TP80M12W2-2LA
Marking	M1TP80M12W2-2LA
Package	ACEPACK DMT-32
Packing	Tube

1 SiC Power MOSFET (Q1, Q2, Q3, Q4, Q5, Q6)

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
$V_{(BR)DSS}$	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 $T_C = 50\text{ }^\circ\text{C}$	30	A
$I_{DM}^{(1)}$	Drain current (pulsed, $t_p = 1\text{ ms}$)	58	A
T_J	Operating junction temperature range	-40 to 175	$^\circ\text{C}$

1. Pulse width is limited by safe operating area.

Table 2. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 18\text{ V}, I_D = 20\text{ A}$	-	84	114	m Ω
		$V_{GS} = 18\text{ V}, I_D = 20\text{ A}, T_J = 175\text{ }^\circ\text{C}$	-	178	-	
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 1\text{ mA}$	1.9	3.2	5	V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}$	-	-	10	μA
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}, V_{GS} = -10\text{ to }22\text{ V}$	-	-	± 100	nA
C_{iss}	Input capacitance	$V_{DS} = 800\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$	-	1230	-	pF
C_{oss}	Output capacitance		-	56	-	pF
C_{rSS}	Reverse transfer capacitance		-	15	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	1	-	Ω
Q_g	Total gate charge	$V_{DD} = 800\text{ V}, I_D = 20\text{ A},$ $V_{GS} = -5\text{ to }18\text{ V}$	-	63	-	nC
Q_{gs}	Gate-source charge		-	15	-	nC
Q_{gd}	Gate-drain charge		-	20	-	nC
E_{on}	Turn-on switching energy	$V_{DS} = 800\text{ V}, I_D = 20\text{ A},$	-	374	-	μJ
E_{off}	Turn-off switching energy	$R_{G(on)} = 12\text{ }\Omega, R_{G(off)} = 5.6\text{ }\Omega,$ $V_{GS} = -5\text{ to }18\text{ V}$	-	64	-	μJ
R_{thJC}	Thermal resistance, junction-to-case		-	0.54	-	$^\circ\text{C/W}$

Table 3. Reverse intrinsic SiC diode characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{SD}	Forward on voltage drop	$V_{GS} = 0\text{ V}, I_{SD} = 20\text{ A}$	-	3.4	-	V
t_{rr}	Reverse recovery time	$I_{SD} = 20\text{ A}, V_{DD} = 800\text{ V},$ $R_{G(on)} = 12\text{ }\Omega, R_{G(off)} = 5.6\text{ }\Omega$	-	14.1	-	ns
Q_{rr}	Reverse recovery charge		-	163	-	nC
I_{IRRM}	Reverse recovery current		-	19	-	A

1.1 Electrical characteristics diagrams (Q1, Q2, Q3, Q4, Q5, Q6)

Figure 1. Typical output characteristics ($T_J = 25\text{ }^\circ\text{C}$)

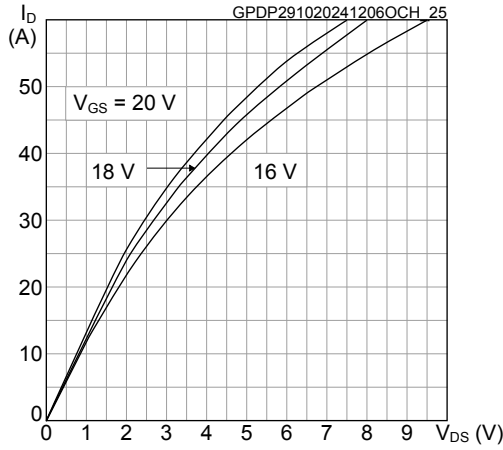


Figure 2. Typical output characteristics ($T_J = -40\text{ }^\circ\text{C}$)

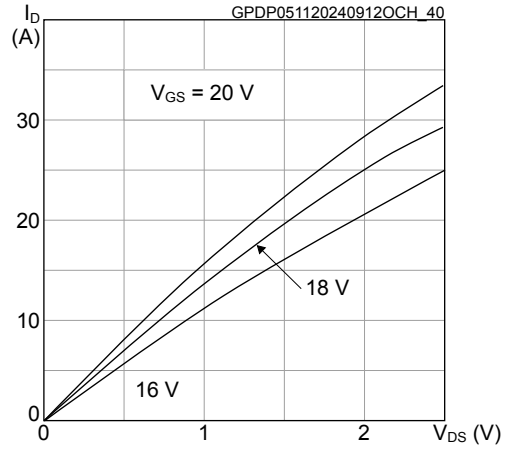


Figure 3. Typical output characteristics ($T_J = 175\text{ }^\circ\text{C}$)

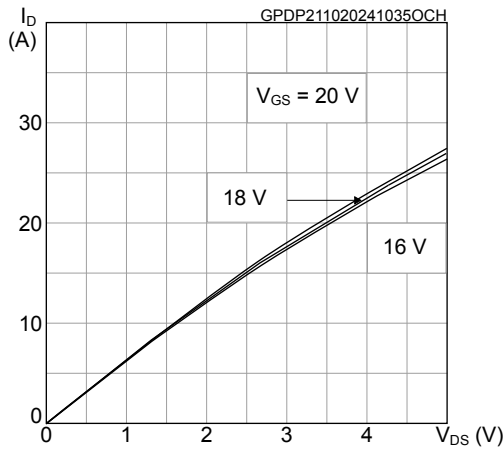


Figure 4. Typical transfer characteristics

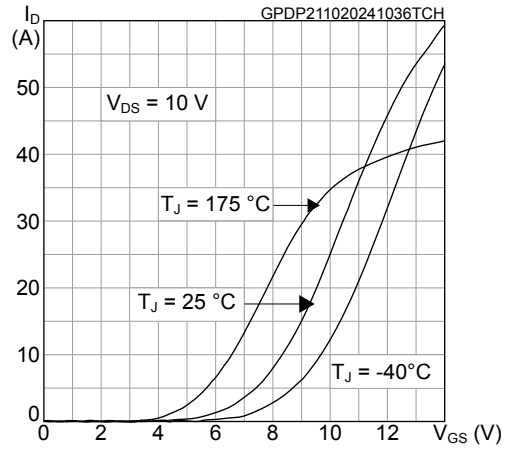


Figure 5. Typical reverse conduction characteristics ($T_J = 25\text{ }^\circ\text{C}$)

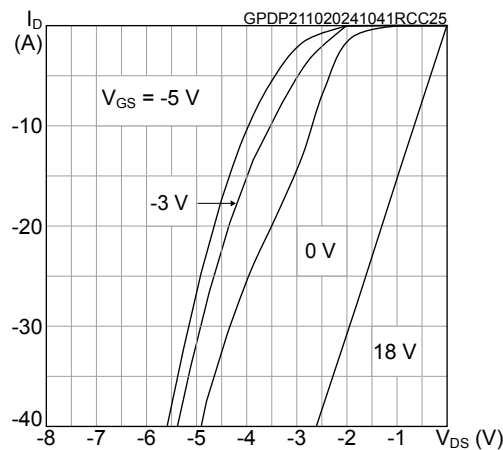


Figure 6. Typical reverse conduction characteristics ($T_J = -40\text{ }^\circ\text{C}$)

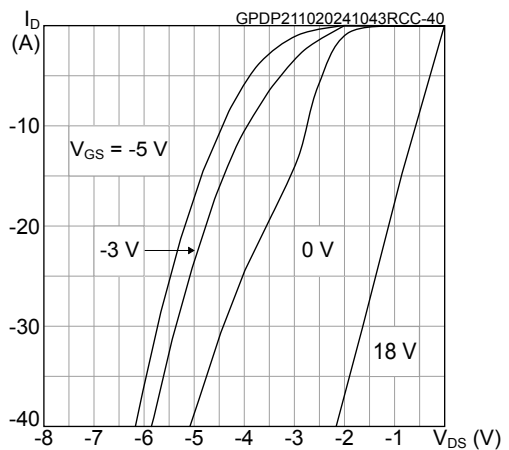


Figure 7. Typical reverse conduction characteristics
($T_J = 175\text{ }^\circ\text{C}$)

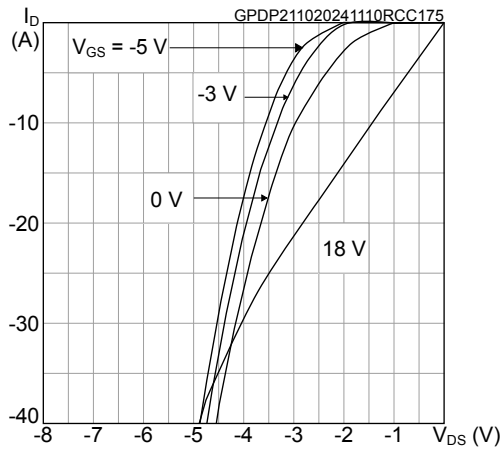


Figure 8. Typical switching energy vs drain current
($T_J = 175\text{ }^\circ\text{C}$)

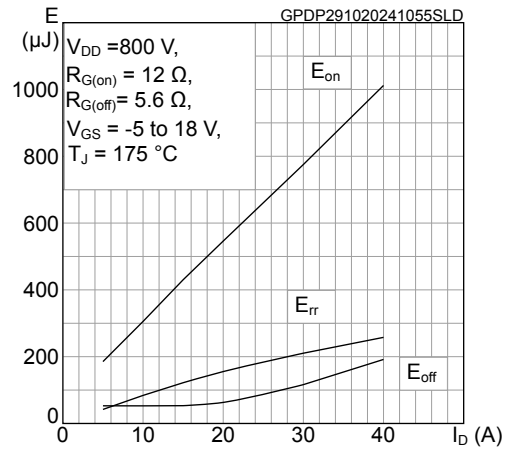


Figure 9. Typical switching energy vs drain current
($T_J = 25\text{ }^\circ\text{C}$)

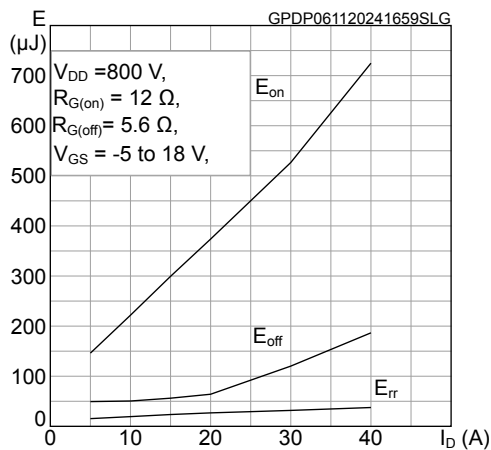


Figure 10. Typical switching energy vs gate resistance
($T_J = 175\text{ }^\circ\text{C}$)

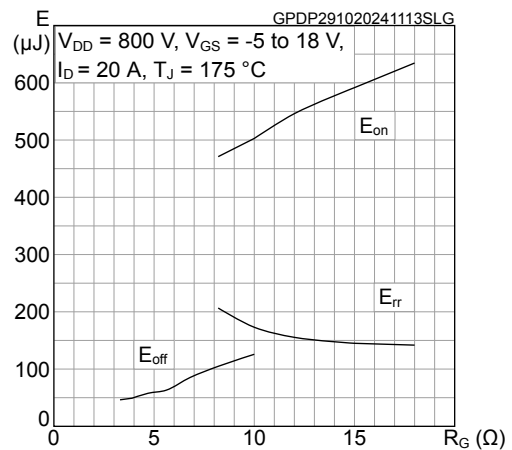


Figure 11. Typical switching energy vs gate resistance
($T_J = 25\text{ }^\circ\text{C}$)

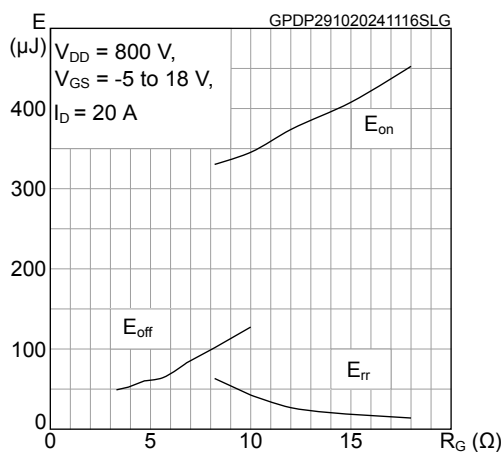


Figure 12. Typical switching energy vs temperature

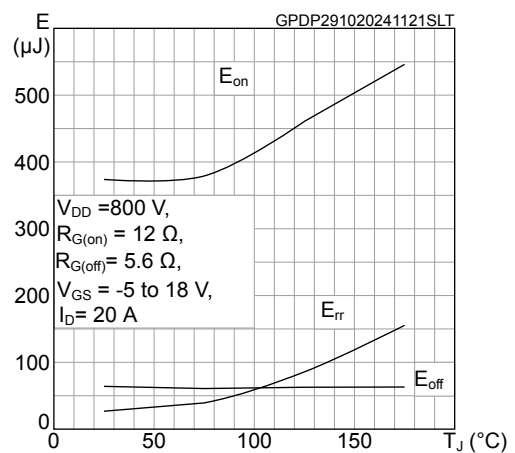


Figure 13. Typical switching energy vs supply voltage
($T_J = 175\text{ }^\circ\text{C}$)

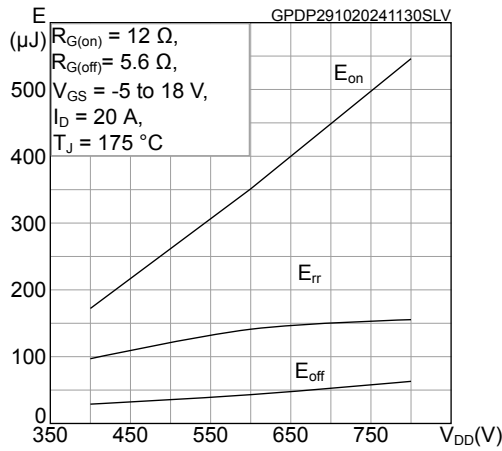


Figure 14. Typical switching energy vs supply voltage
($T_J = 25\text{ }^\circ\text{C}$)

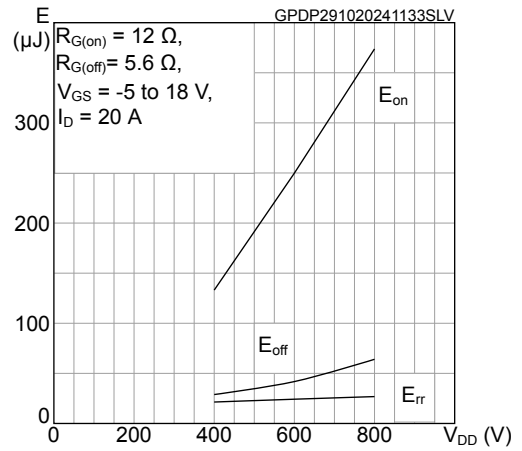


Figure 15. Typical gate charge characteristics

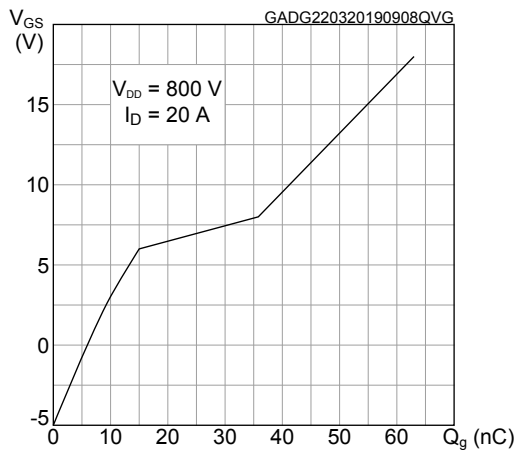


Figure 16. Typical capacitance characteristics

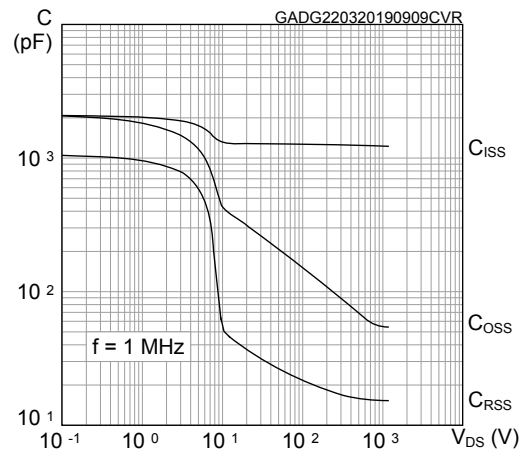
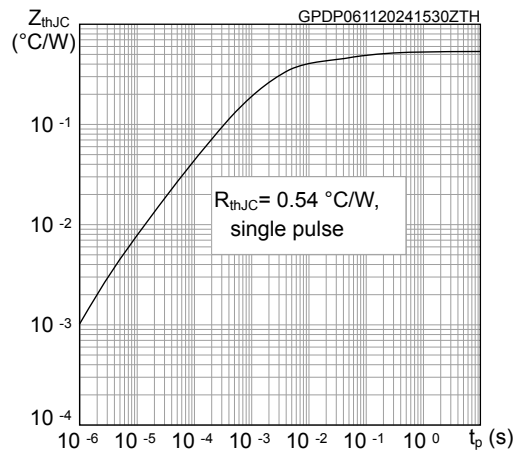


Figure 17. SiC maximum transient thermal impedance



2 Rectifier diode (D1, D2)

All characteristics listed here are from datasheet of discrete component STBR3012-Y.

Table 4. Absolute maximum ratings (limiting values at 25 °C, unless otherwise specified)

Symbol	Parameter	Value	Unit
V_{RSM}	Non-repetitive surge reverse voltage	1600	V
V_{RRM}	Repetitive peak reverse voltage	$T_j = -40\text{ °C to }+175\text{ °C}$	V
$I_{F(RMS)}$	Forward rms current	30	A
T_j	Operating junction temperature	-40 to +175	°C

Table 5. Static electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_R^{(1)}$	Reverse leakage current	$V_R = V_{RRM}$	-	-	2	μA
		$V_R = V_{RRM}, T_j = 150\text{ °C}$	-	10	100	
$V_F^{(2)}$	Forward voltage drop	$I_F = 20\text{ A}$	-	1.10	-	V
		$I_F = 20\text{ A}, T_j = 150\text{ °C}$	-	0.97	-	
$R_{th(j-c)}$	Thermal resistance junction to case		-	0.45	-	°C/W

1. Pulse test: $t_p = 5\text{ ms}, \delta < 2\%$.

2. Pulse test: $t_p = 380\text{ }\mu\text{s}, \delta < 2\%$.

To evaluate the conduction losses, use the following equation:

$$P = 0.96 \times I_{F(AV)} + 0.008 \times I_{F(RMS)}^2$$

2.1 Electrical characteristics diagrams (D1, D2)

Figure 18. Diode typical forward voltage drop vs forward current

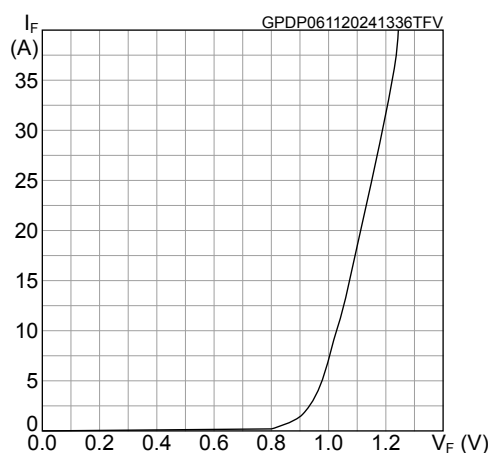
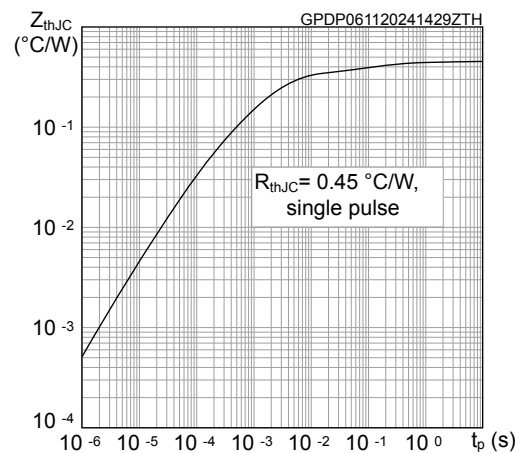


Figure 19. Diode maximum transient thermal impedance



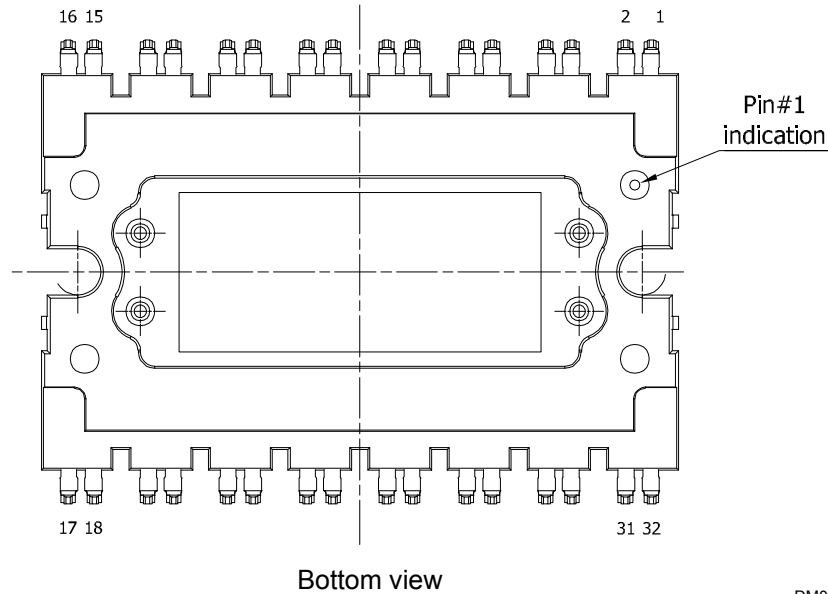
3 NTC

Table 6. 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	-	k Ω
$\Delta R_{25}/R$	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 ($\pm 1\%$)	-	4000	-	
T	Operating temperature range		-40	-	150	°C

4 Electrical topology and pin description

Figure 20. ACEPACK DMT-32 pin layout (bottom view)

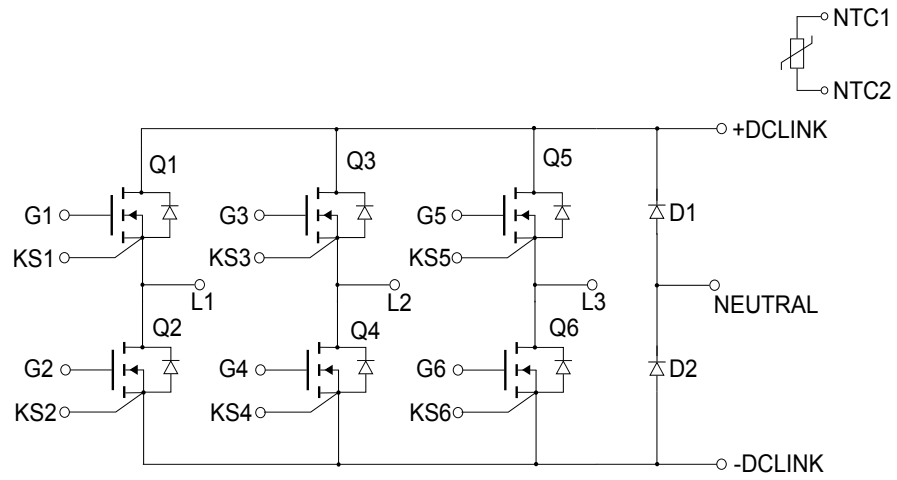


DM00692330_rev_6_pin_layout

Table 7. Pin description

Pin	Description	Pin	Description
1	-DCLINK	17	+DCLINK
2	-DCLINK	18	+DCLINK
3	NC	19	G6
4	NC	20	KS6
5	L1	21	G5
6	L1	22	KS5
7	L2	23	G3
8	L2	24	KS3
9	NEUTRAL	25	KS4
10	NEUTRAL	26	G4
11	L3	27	KS1
12	L3	28	G1
13	NC	29	KS2
14	NC	30	G2
15	NTC1	31	NC
16	NTC2	32	NC

Figure 21. Electrical topology and pin description



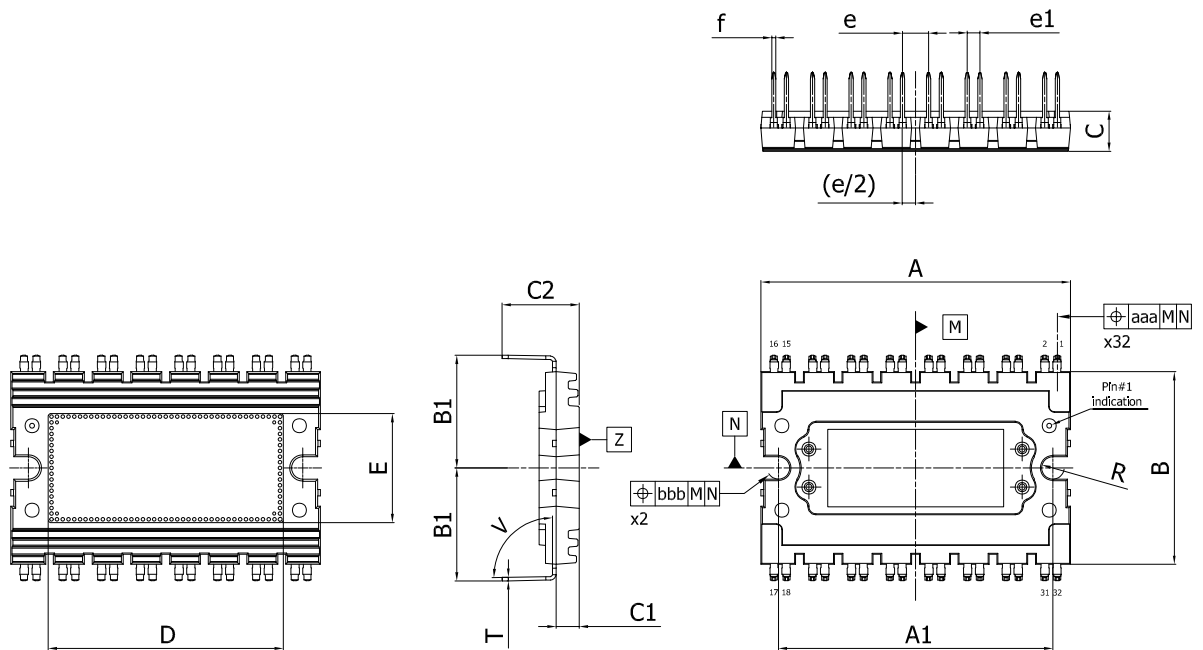
GADG310520211336SA

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 DMT-32 package information

Figure 22. ACEPACK DMT-32 package outline



DM00692330_6

Table 8. 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 9. 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 10. Document revision history

Date	Revision	Changes
08-Jul-2021	1	First release.
20-Oct-2021	2	Updated <i>Section Application</i> in in cover page. Minor text changes.
16-Dec-2021	3	Updated <i>Section 5.1 ACEPACK DMT-32 package information</i> . Minor text changes.
05-Jul-2022	4	Updated <i>Table 5. Static electrical characteristics</i> . Updated <i>Figure 3. ACEPACK DMT-32 package outline</i> . Updated <i>Table 8. ACEPACK DMT-32 package mechanical data</i> . Updated <i>Table 9. Absolute maximum ratings of ACEPACK DMT-32 package</i> .
12-Feb-2024	5	Updated <i>Features, Applications and Description</i> . Updated <i>Section 1: SiC Power MOSFET (Q1, Q2, Q3, Q4, Q5, Q6)</i> and <i>Section 2: Rectifier diode (D1, D2)</i> . Added <i>Section 5: Electrical characteristics (curves)</i> .
13-Jan-2025	6	Updated <i>Title, Section Features and Section Description</i> on cover page. Updated <i>Table 2. Electrical characteristics and Table 6. Absolute maximum ratings for NTC temperature sensor, considered as stand-alone</i> . Updated <i>Section 1.1: Electrical characteristics diagrams (Q1, Q2, Q3, Q4, Q5, Q6)</i> . Added <i>Section 2.1: Electrical characteristics diagrams (D1, D2)</i> .

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2	Rectifier diode (D1, D2)	6
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