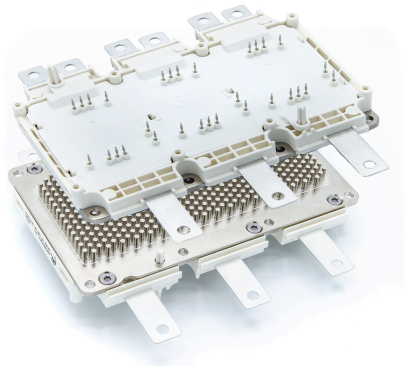
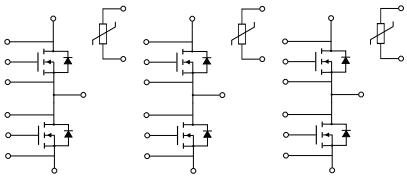
ADP300120W2-L

Datasheet

Automotive-grade ACEPACK DRIVE power module, sixpack topology 1200 V, 3.5 mΩ typ. SiC MOSFET gen.2 based



ACEPACK DRIVE



Features

- AQG 324 qualified
- 1200 V blocking voltage
- 3.5 mΩ of typical $R_{DS(on)}$
- Maximum operative junction temperature T_{Jop} = 175 °C
- Very low switching energy
- Low inductive compact design for higher power density
- Si_3N_4 AMB substrate to improve thermal performance
- SiC Power MOSFET chip sintered to substrate for improved lifetime
- 4.2 kV DC 1 s insulation
- Directly liquid cooled base plate with pin-fins
- Three integrated NTC temperature sensors
- Long AC bus bar compatible with phase current sensor

Application

- Traction main inverter

Description

The ACEPACK DRIVE is a compact sixpack module optimized for hybrid and electric vehicles traction inverters. This power module features switches based on the silicon carbide 2nd generation Power MOSFETs, characterized by very low $R_{DS(on)}$, very limited switching losses and an outstanding performance in synchronous rectification mode.

These characteristics can ensure a superb efficiency in the final application saving battery charging cycles. In addition, the copper base plate with a pin-fin base structure makes direct fluid cooling available for this power module minimizing thermal resistance.

A dedicated pin-out has been developed to obtain the best switching performances while press-fit pins ensure an optimal connection with the driving board.

Product status link
ADP300120W2-L

Product summary	
Order code	ADP300120W2-L
Marking	ADP300120W2-L
Package	ACEPACK DRIVE
Leads type	Press fit
Packing	Tray

1 Electrical ratings

1.1 Inverter switch

(T_J = 25°C, unless otherwise specified).

Table 1. Absolute maximum ratings - MOSFET

Symbol	Parameter	Value	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	1200	V
V_{GS}	Gate-source voltage	-10 to 22	V
V_{GSop}	Gate-source voltage - recommended operational values	-5 to 18	V
I_{DN} (1)	Nominal implemented current (limited by bonding wires)	860	A
I_D (1)	Continuous drain current at Tfluid = 65 °C (refer to T_{Jmax} = 175 °C)	290	A
I_{DM} (2)	Repetitive peak drain current	950	A
P_{TOT}	Total power dissipation at Tfluid = 65 °C	833	W
T_J	Operative junction temperature range under switching conditions	-40 to 175 (3)	°C

1. *Defined by design, not subject to production test.*
2. *Pulse width limited by maximum junction temperature.*
3. *Maximum baseplate temperature has to be always limited to 125 °C.*

Table 2. Electrical characteristics of the single switch

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$R_{DS(on)}$ (1)	Static drain-source on-resistance	V_{GS} = 18 V, I_{DS} = 300 A		3.5		mΩ
		V_{GS} = 18 V, I_{DS} = 300 A, T_J = 150 °C		6.5		
		V_{GS} = 18 V, I_{DS} = -300 A		3.2		
		V_{GS} = 18 V, I_{DS} = -300 A, T_J = 150 °C		6.0		
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_{DS} = 40 mA	1.9	3.1		V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 1200 V			100	µA
		V_{GS} = 0 V, V_{DS} = 1200 V, T_J = 150 °C			2	mA
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = -10 to 22 V		2		µA
C_{iss}	Input capacitance	V_{DS} = 800 V, f = 1 MHz, V_{GS} = 0 V		26.4		nF
C_{oss}	Output capacitance			1.12		
C_{rss}	Reverse transfer capacitance			0.22		
Q_g	Total gate charge	V_{DS} = 800 V, I_D = 400 A, V_{GS} = -5 V to 18 V		1.18		µC
Q_{gs}	Gate-emitter charge			0.33		
Q_{gd}	Gate-collector charge			0.44		
E_{on} (2)	Turn-on switching energy	V_{DD} = 800 V, V_{GS} = -5 to 18 V, R_G = 10 Ω, I_{DS} = 300 A		30.1		mJ
E_{off}	Turn-off switching energy	V_{DD} = 800 V, V_{GS} = -5 to 18 V, R_G = 4.7 Ω, I_{DS} = 300 A		16.1		mJ
R_{thJF} (3)	Thermal resistance, junction-to-fluid (flow rate = 10 LPM, Tfluid = 65 °C, single switch)			0.12		°C/W

1. *$R_{DS(on)}$ is referred to switch level.*
2. *Using active Miller clamp circuit.*
3. *Simulated value considering 50% water / 50% ethylene glycol cooling fluid.*

Table 3. Electrical characteristics - source-drain diode of the single switch

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{SD}	Forward on voltage drop	V_{GS} = 0 V, I_{SD} = 300 A		3		V
t_{rr}	Reverse recovery time	I_{SD} = 300 A, V_{DD} = 800 V, V_{GS} = -5 V to 18 V, R_G= 10 Ω		32		ns
Q_{rr}	Reverse recovery charge			1.6		µC
I_{RRM}	Reverse recovery current			85		A
E_{rec}	Reverse recovery energy			0.14		mJ

Note: Values are calculated taking in account an active Miller clamp circuit.

2 NTC

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

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
R_{25}	Resistance	T = 25 °C		5.0		kΩ
R100	Resistance	T = 100 °C		493		Ω
ΔR/R	Deviation of R_{100}		-5		+5	%
$B_{25/50}$	B-constant			3375		K
$B_{25/80}$				3411		K
T	Operating temperature range		-40		150	°C

3 ACEPACK DRIVE power module details

Table 5. Ratings for module

Symbol	Parameter		Value	Unit
V_{ISO}	Isolation voltage (f = 0 Hz, t = 1 s)		4.2	kV
	Internal isulation (class 1, IEC 61140)		Si_3N_4	
	Baseplate module material		Ni plated, Cu baseplate	
d_{creep}	Creepage distance	Terminal to heat sink	9.0	mm
		Terminal to terminal	9.0	mm
d_{clear}	Clearance distance	Terminal to heat sink	4.5	mm
		Terminal to terminal	4.5	mm
CTI	Comperative tracking index		>200	
L_s	Typical stray inductance drain to source module loop		10	nH
R_s	Typical module lead resistance, terminals to chip		0.5	mΩ
T_{stg}	Storage temperature range		-40 to 125	°C

4 Electrical characteristics (curves)

Figure 1. Typical output characteristics (T_J = -40°C)

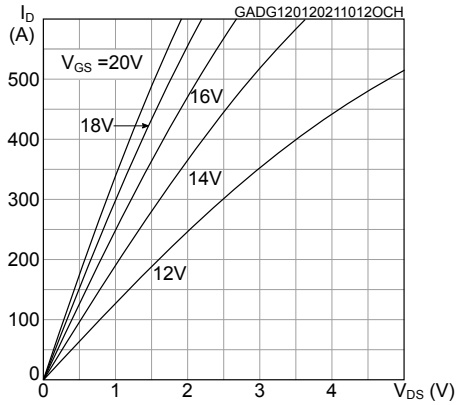


Figure 2. Typical output characteristics (T_J = 25°C)

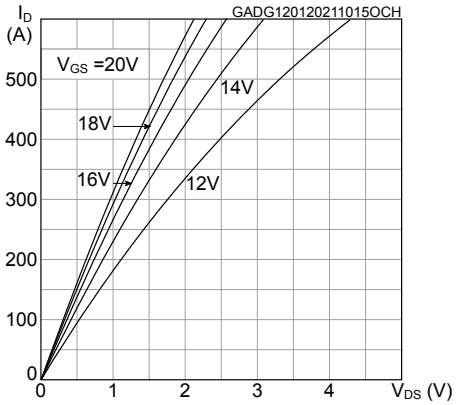


Figure 3. Typical output characteristics (T_J = 150 °C)

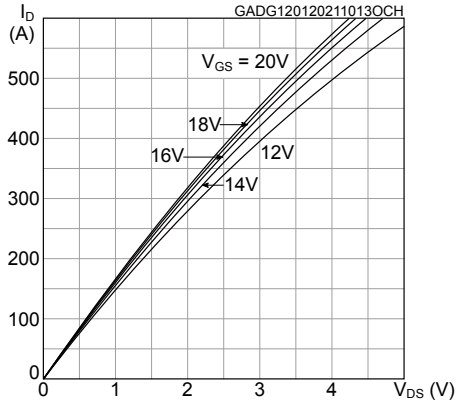


Figure 4. Typical reverse conduction characteristics (T_J = -40°C)

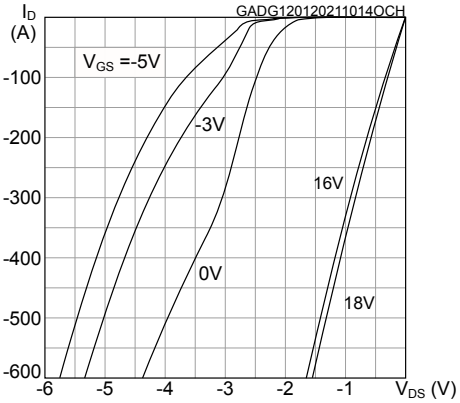


Figure 5. Typical reverse conduction characteristics (T_J = 25°C)

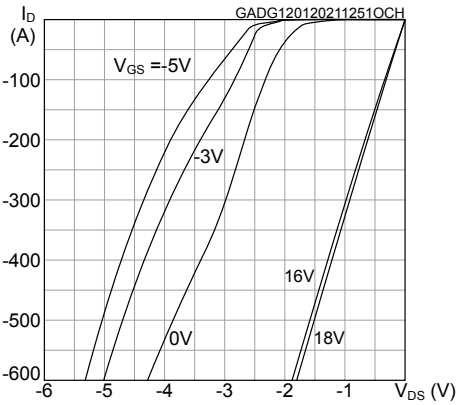


Figure 6. Typical reverse conduction characteristics (T_J = 150°C)

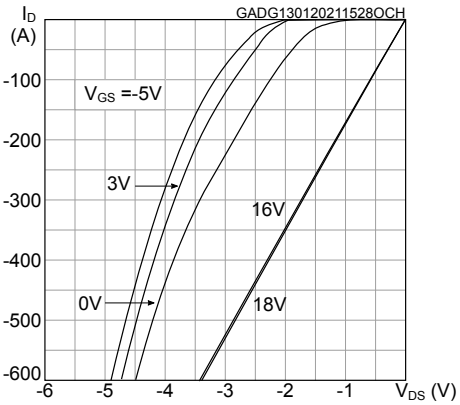


Figure 7. Typical transfer characteristics

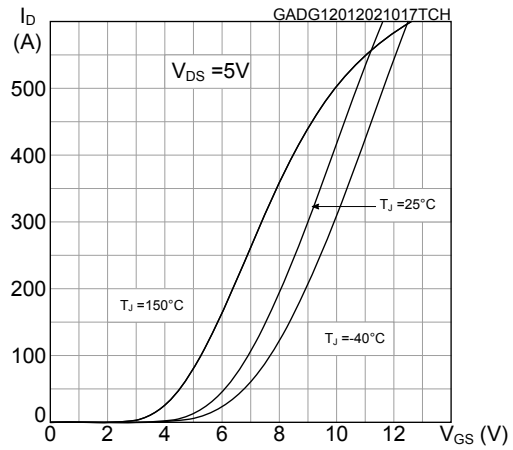


Figure 8. Normalized breakdown voltage vs temperature

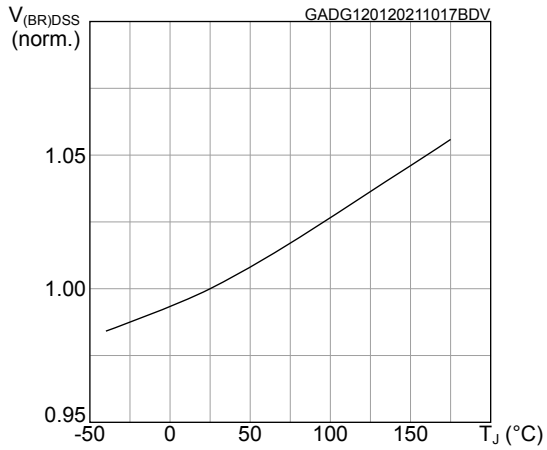


Figure 9. Typical switching energy vs drain current

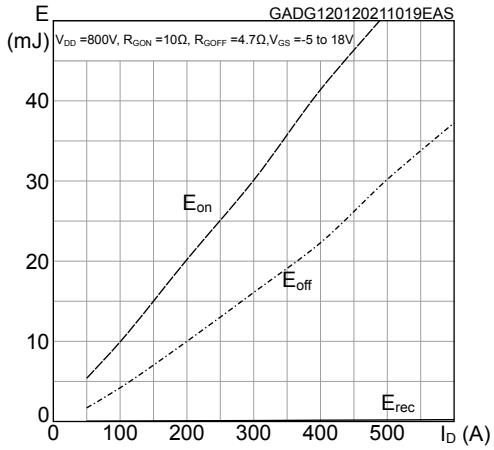


Figure 10. Typical switching energy vs gate resistance

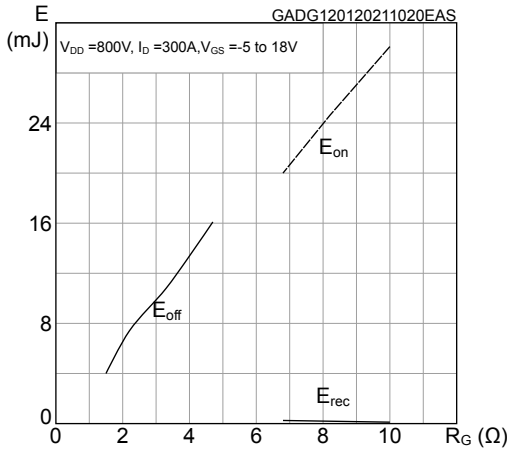


Figure 11. Typical switching energy vs temperature

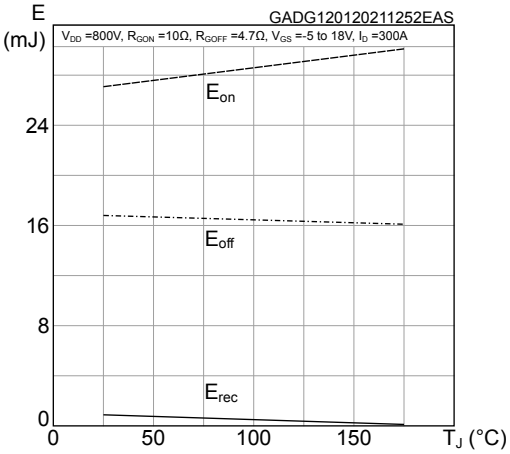


Figure 12. Typical switching energy vs breakdown voltage

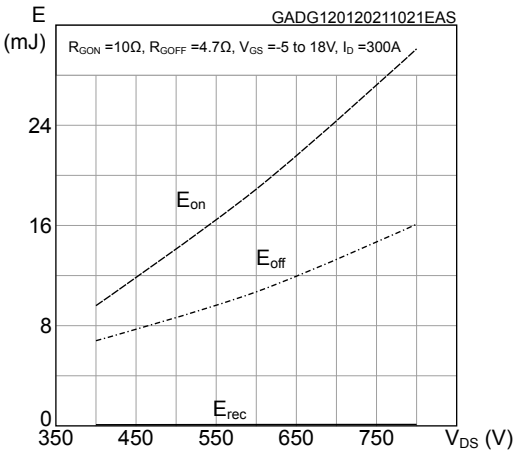


Figure 13. Typical capacitance characteristics

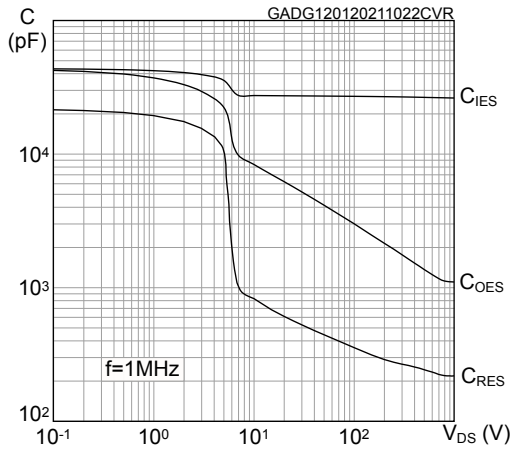


Figure 14. Typical gate charge characteristics

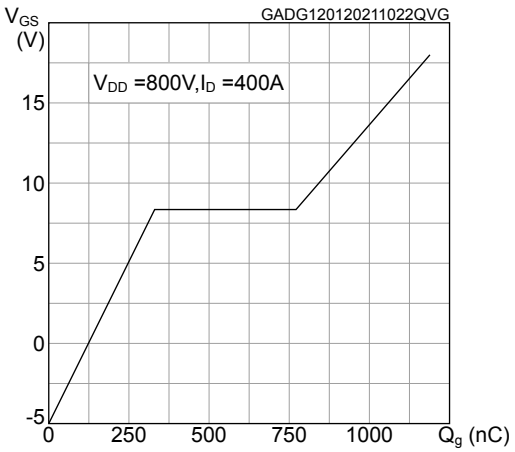


Figure 15. Typical transient thermal impedance

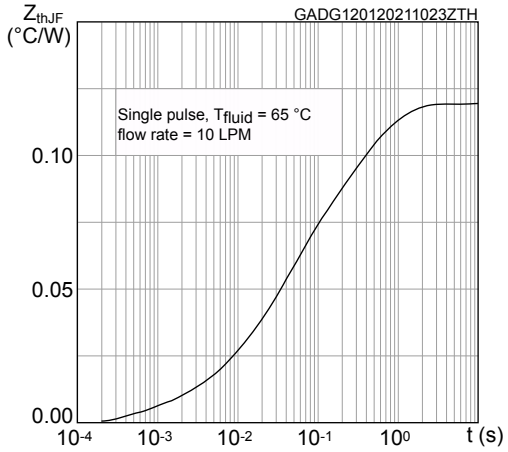


Figure 16. Typical thermal resistance vs flow rate

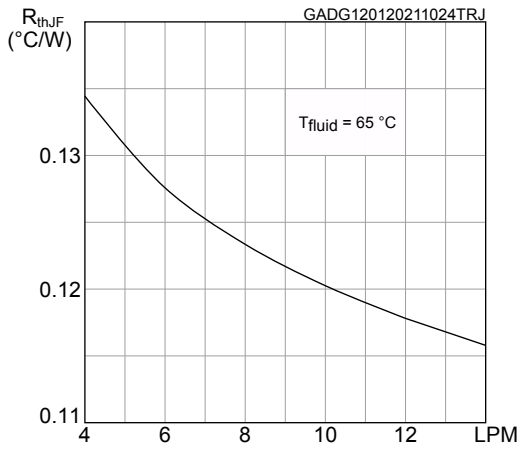
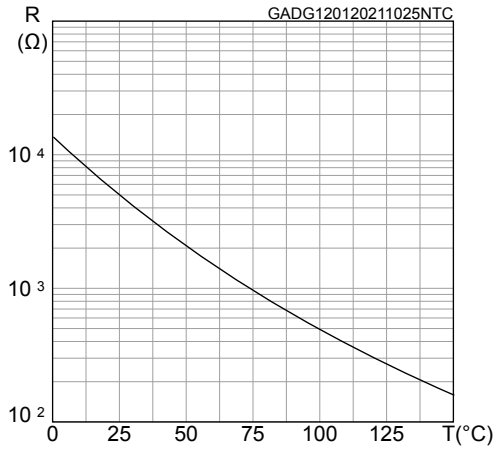
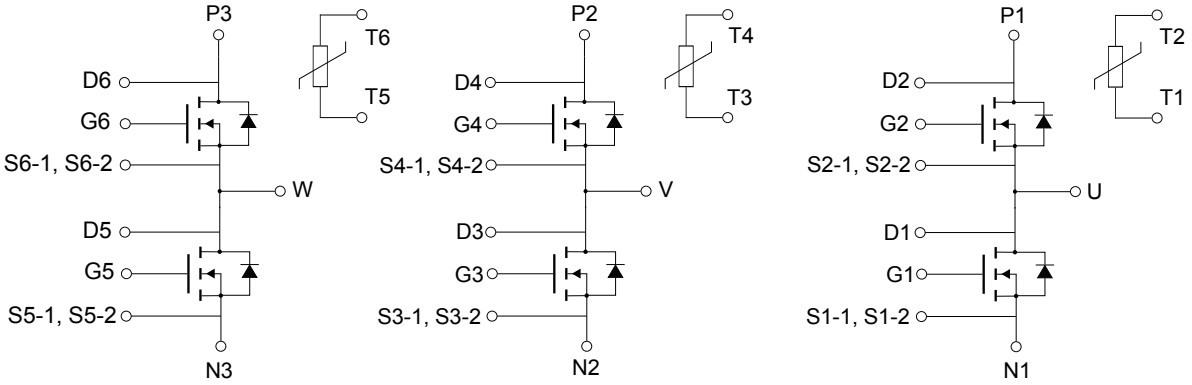


Figure 17. Typical NTC resistance vs temperature



5 Electrical topology and pin description

Figure 18. **Electrical topology and pin description**

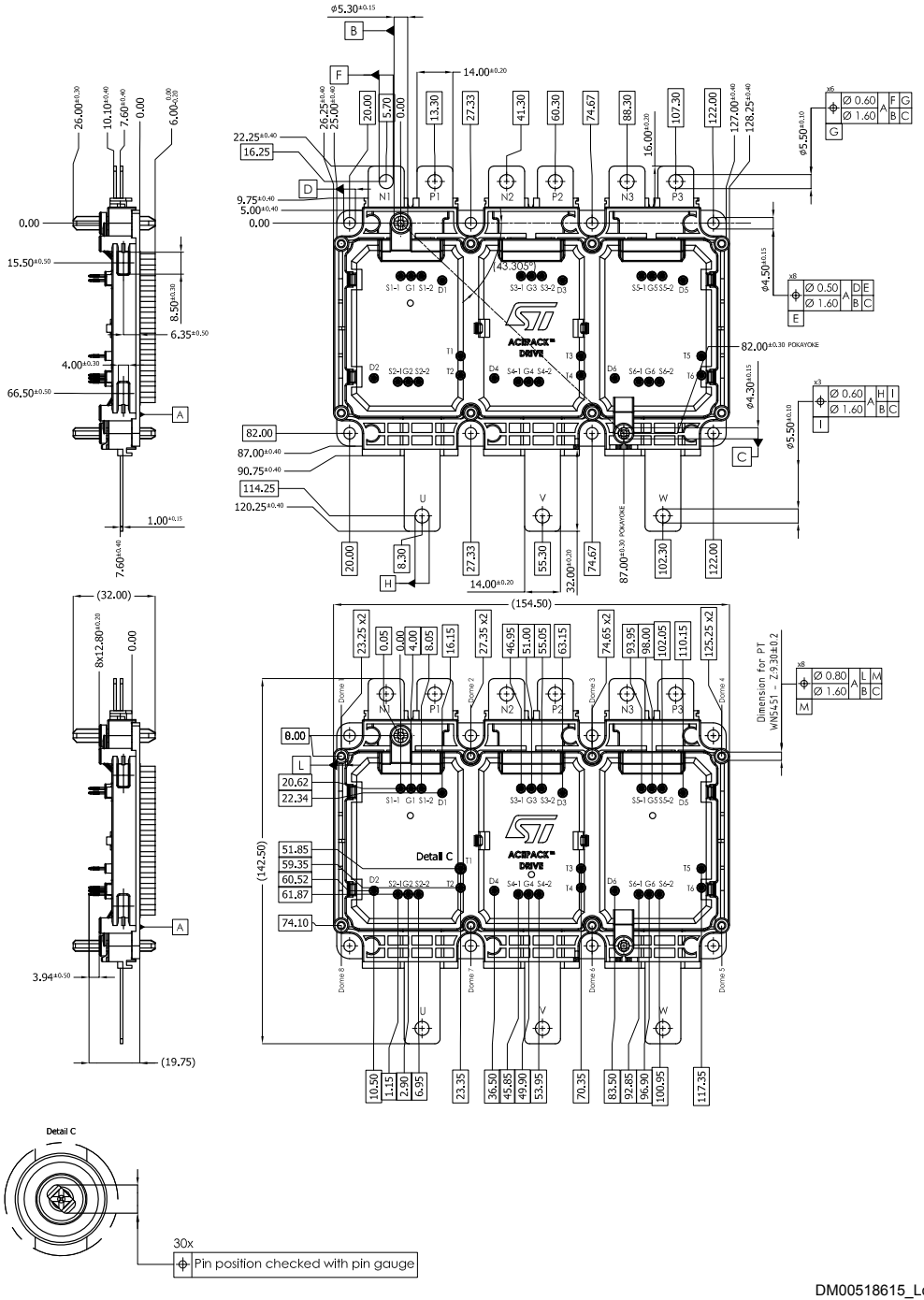


6 Package information

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.

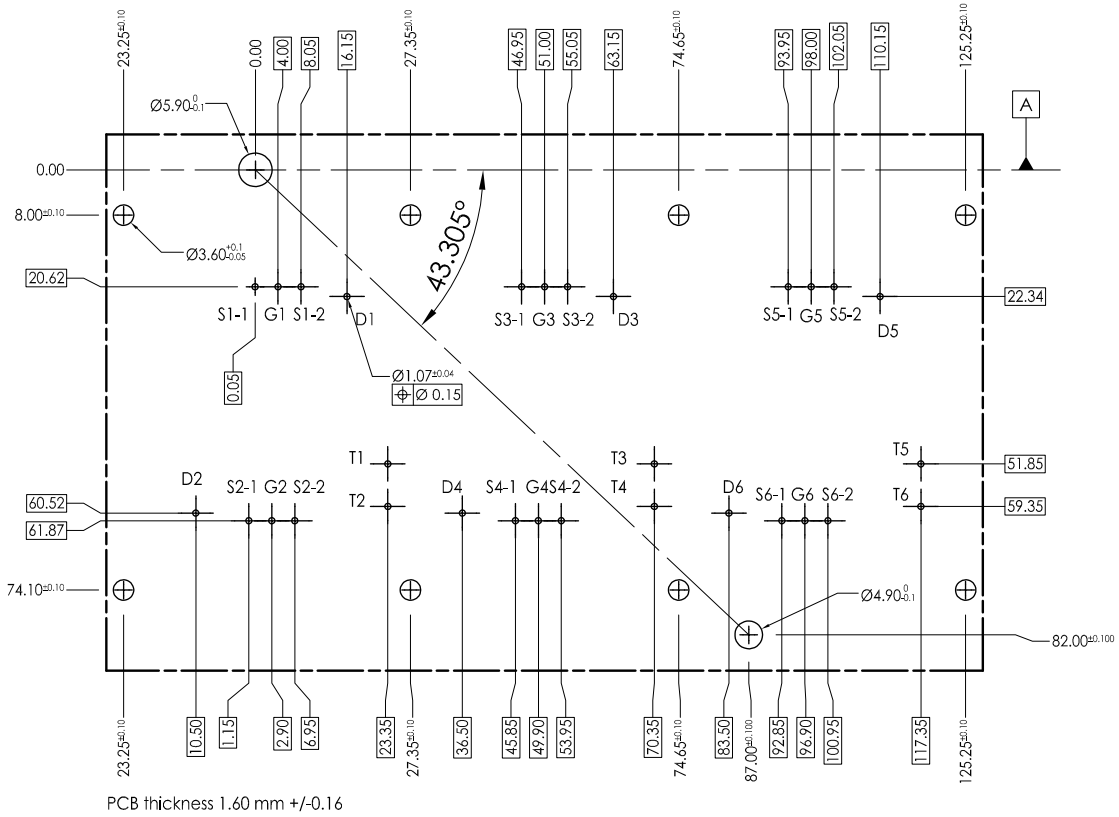
6.1 ACEPACK DRIVE package information

Figure 19. ACEPACK DRIVE long tab package outline (dimensions are in mm.)



DM00518615_Long_REV3

Figure 20. **ACEPACK DRIVE PCB drawing (dimensions are in mm.)**



DM00518615_PCB_Rev3

Revision history

Table 6. **Document revision history**

Date	Version	Changes
12-Apr-2021	1	First release.
22-Apr-2021	2	Updated title, features and description in cover page.

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