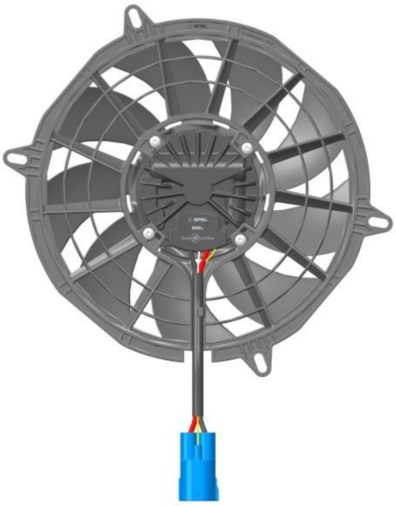
Datasheet

VA99 - ABL315P/N - 101A/SH

Product name:	VA99 - ABL315P/N - 101A/SH
Fan diameter:	Ø 280 mm
Nominal voltage:	12 V
Part number:	30107059A



Revision: 000

25.03.2014

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2 Units and acronyms

Unit		Physical Quantity	Prefix	Dimension	
%	percent	Proportionality	M	10^{6}	mega
Ω	Ohm	Electrical Resistance	k	10^{3}	kilo
°C	degree Celsius	Temperature	m	10^{-3}	milli
A	Ampere	Current	µ	10^{-6}	micro
h	hours	Time	n	10^{-9}	nano
dBA	deciBel (A-weighting)	Sound pressure level			
Hz	Hertz	Frequency	p	10^{-12}	pico
min	minute	Time			
Pa	Pascal	Pressure			
rpm	Revolutions per minute	Rotation frequency			
s	second	Time			
V	Volt	Voltage			
W	Watt	Power			

Table 1: Units of measurements table

Key Word	Description
AMPL_IN	Amplitude PWM input signal
CCU	Custom Control Unit
Drive	Motor with axially integrated electronics
IGN	Ignition (KL15)
PWM	Pulse Width Modulation
R_i	Input Resistance
SBL	Sealed brushless
T	Temperature
T_{AMB}	Ambient Temperature
U_B	Supply voltage
U_n	Nominal supply Voltage
rms	root mean square

Table 2: Acronyms table

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3 General conditions

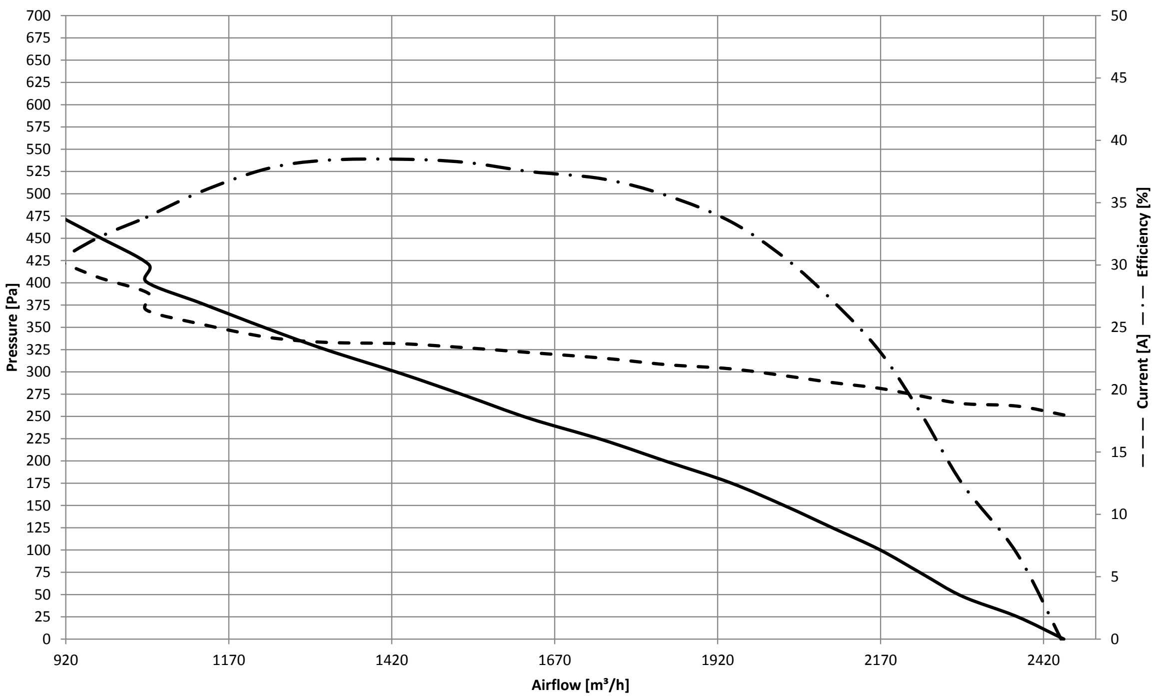
The below conditions are assumed:

- T_{AMB} = 20 °C ± 5 °C and
- U_B= 13.0 V ± 0.2 V at the Drive connector

unless otherwise specified.

4 Air performance

Axial Fan Module performance curve	Test number: 11383



Rotational speed	3800 rpm
Air density	1.175 kg / m^3

Table 3: Axial Fan Module VA99 - ABL315P/N - 101A/SH Air performance table

5 Noise performance

Sound pressure level	73.8 dBA
Distance of the microphone	1 m ± 0.005 m from the centre of gravity of the fan module

Table 4: Axial Fan Module VA99 - ABL315P/N - 101A/SH Noise performance table

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6 Mechanical data

6.1 Dimensions

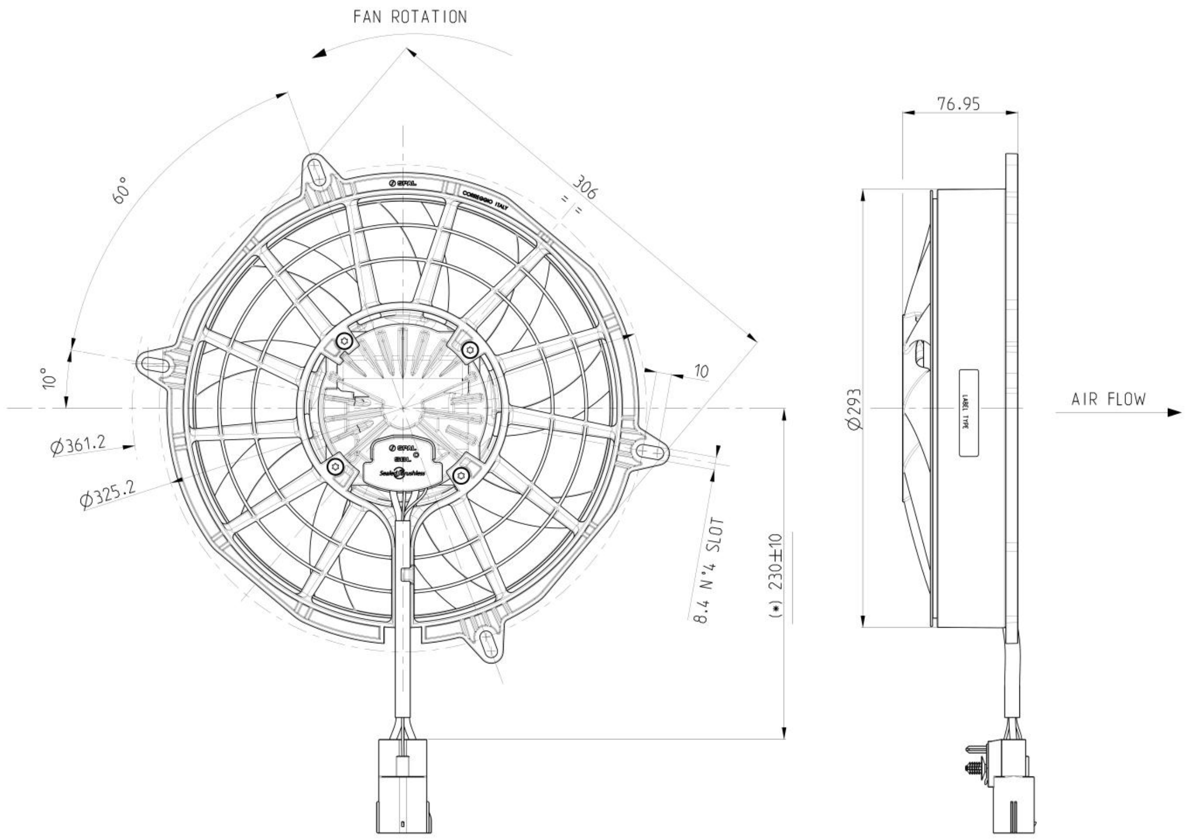

Figure 1: Axial Fan Module VA99 - ABL315P/N - 101A/SH 2D technical scheme

All dimensions are expressed in mm.

6.2 Weight

Parameters	Typical	Unit
Weight of the Axial Fan Module VA99 - ABL315P/N - 101A/SH (approximate)	2.20	kg

Table 5: Axial Fan Module VA99 - ABL315P/N - 101A/SH Weight

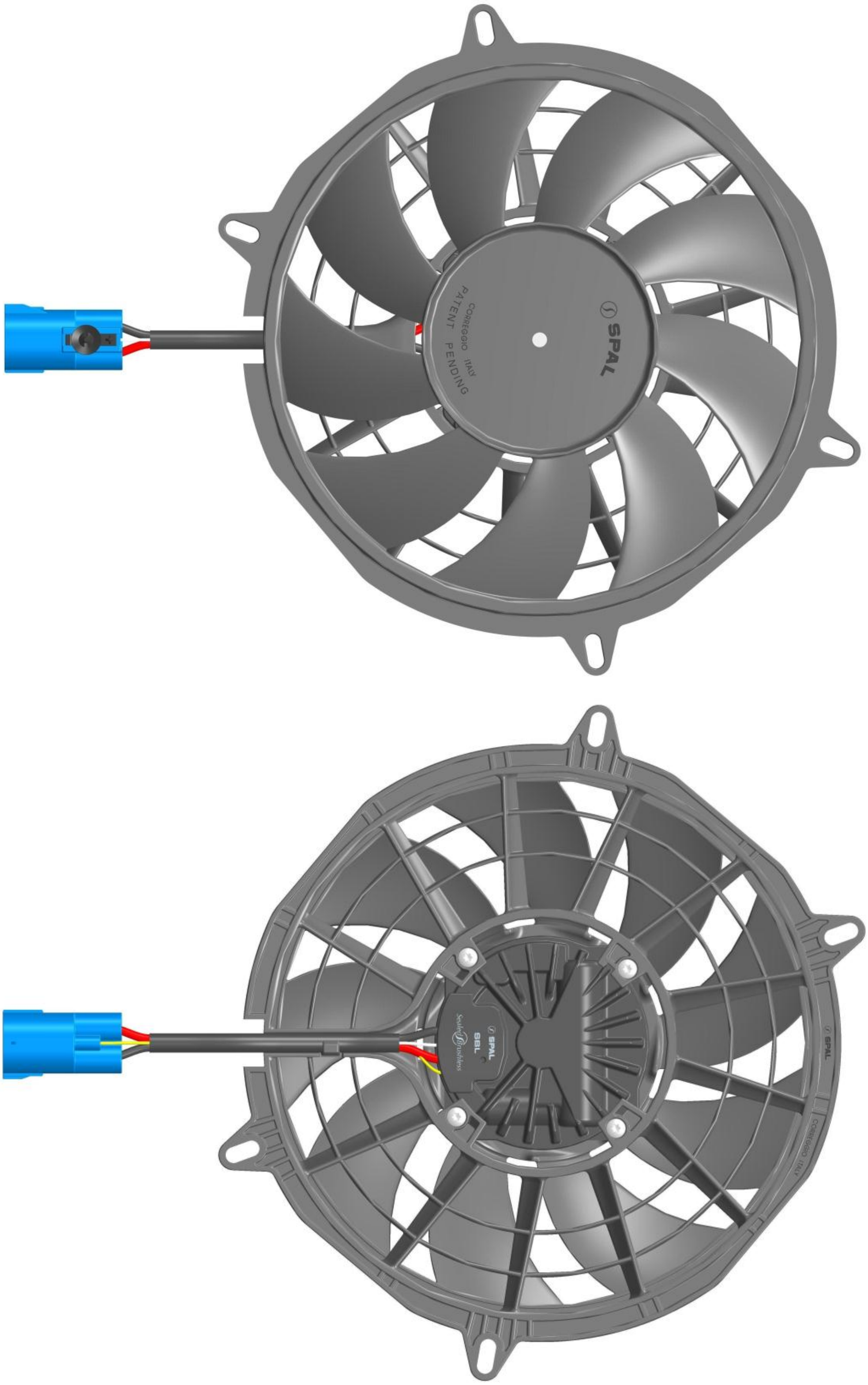

Figure 2: Axial Fan Module VA99 - ABL315P/N - 101A/SH 3D rendering, front view and rear view

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7 Connector and wires

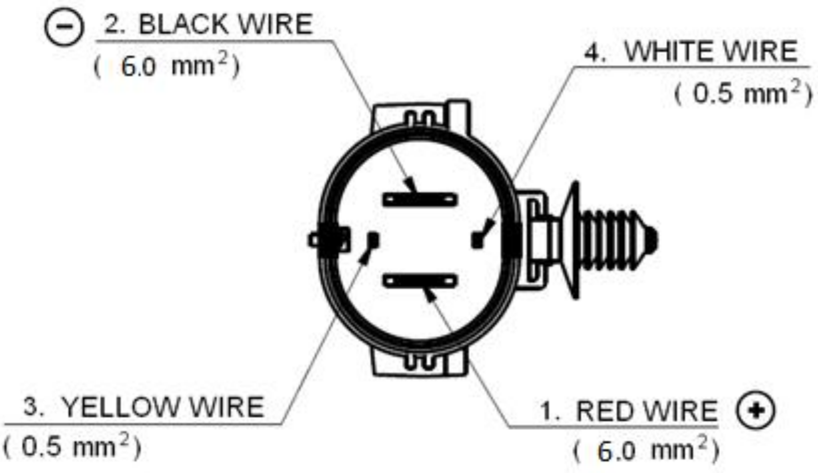

Figure 3: Connector with pinout

Connector:YAZAKI HYBRID				
Part number: 7282-8497-90				
Identification (*)	+D	-D	A	PWM* / E*
Pin number	1	2	3	4
Wire Color	RED	BLACK	YELLOW	WHITE
Sealing p/n	7158-3035	7158-3035	7158-3030-50	7158-3030-50
Pin p/n	7114-3250	7114-3250	7114-4102-02	7114-4102-02
Section [mm^2]	6.0	6.0	0.5	0.5

Table 6: Pinout description

(*) For abbreviations see chapter Drive pin functions 8.2
NOTE: Never handle the fan module via the cable harness.

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8 Hardware functions

The below following characteristic values are valid under the conditions
- T_{AMB} = 20 °C ± 5 °C and
- U_B = 13 V ± 0.2 V at the connector

unless not otherwise specified.

8.1 Drive diagram

In Figure 4 the Drive diagram is shown.
E stands for integrated electronics. M stands for motor. Drive stands for motor with axial integrated electronics.

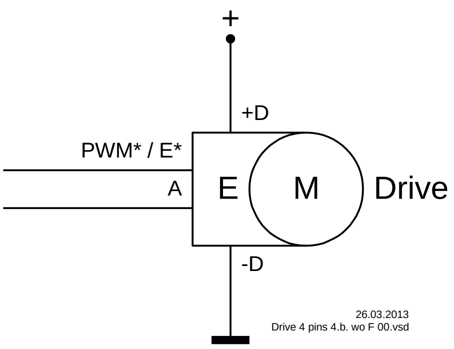

Figure 4: Drive diagram

8.2 Drive pin functions

The electrical Drive interface consists of 4 pins:
Power pins:
- supply voltage plus: +D
- supply voltage minus: -D

Signal pins:
1. Input: digital PWM input / active low: PWM* / E*
2. Input: analog input: A

The signal pin PWM* / E* is used to control the Drive mode, it is the control input.
The signal pin A can be used to control the speed of the Drive.

8.3 Interface hardware for Digital control: pin PWM* / E*

The input PWM* / E* is used to wake up the Drive from Quiescent current mode. Any PWM duty cycle that guarantees a pulse going to the dominant level for more than T_{wakeup} will wake up the Drive electronics.

Parameters	Min	Typical	Max	Unit	Denomination
PWM* / E* frequency range	50	100	500	Hz	f_{PWM}
PWM* / E* duty cycle range	0		100	%	dc_{min} .. dc_{max}
PWM* / E* high level voltage	U_B * 0.65			V	U_{PWMH}
PWM* / E* low level voltage			U_B * 0.40	V	U_{PWML}
PWM* / E* resolution		1		%	dc_{resol}

Parameters	Min	Typical	Max	Unit	Denomination
PWM* / E* accuracy		1		%	dc_{accu}
PWM* / E* current	-10 %	4.8	+10 %	mA	I_{PWM*}
PWM* / E* wakeup pulse	150			µs	T_{wakeup}

Table 7: digital PWM input / active low: PWM* / E* parameters

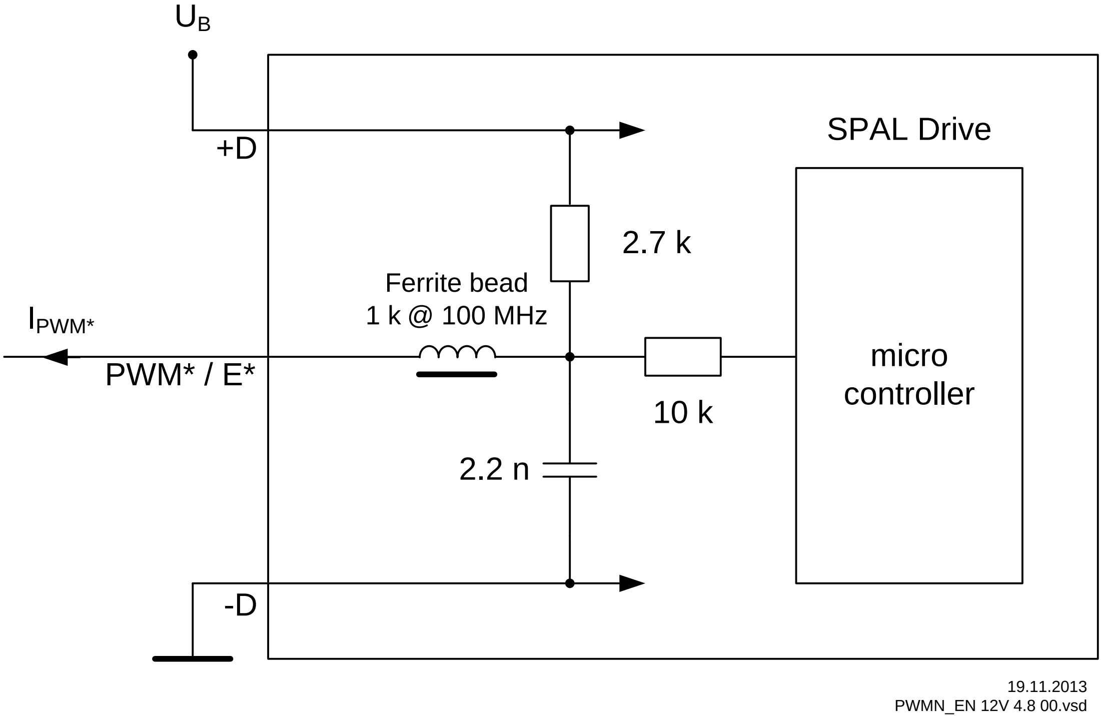

Figure 5: digital PWM input / active low: PWM* / E* implementation

8.4 Interface hardware for Analog control: pin A

Parameters	Min	Typical	Max	Unit	Denomination
A voltage range	0		10	V	U_A
absolut maximum A voltage	-32		35	V	U_{Amax}
A current range	0		0.32	mA	I_A
A maximum current	-1.8		1.8	mA	I_{Amax}

Table 8: analog input: A parameters

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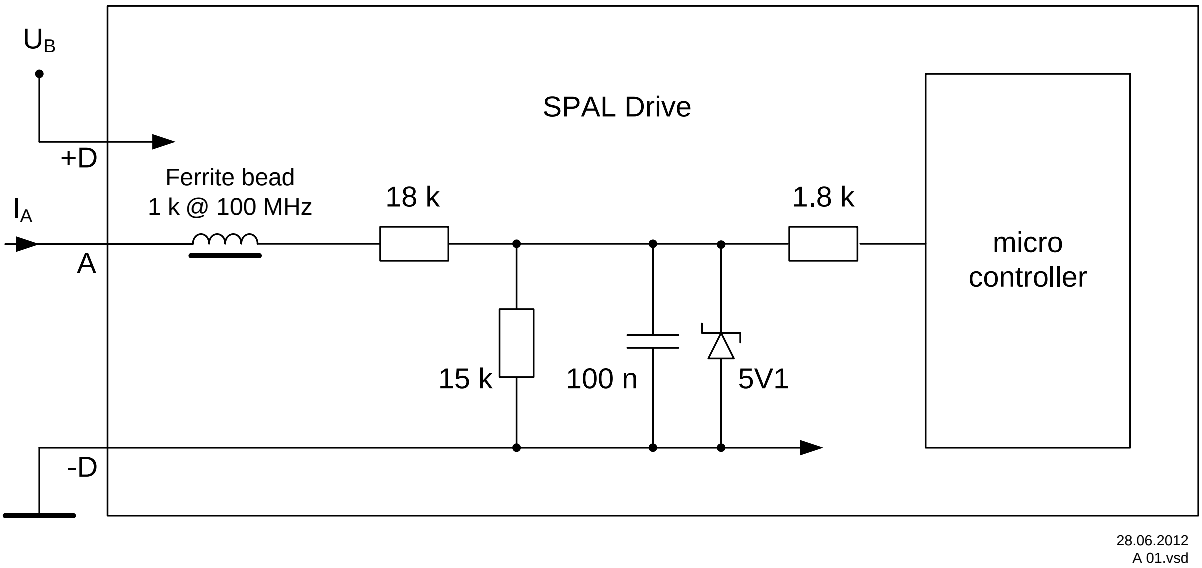

Figure 6: analog input: A implementation

9 Software functions

9.1 Drive modes

The Drive has different working modes related mainly to the Drive current consumption:

1. Quiescent current mode
2. Electronics active mode
3. Run mode
4. Failure mode

The Drive mode (see Table 9) changes accordingly to the control input duty cycle on pin PWM* / E* (see Figure 11) and the voltage level on analog input A (see Figure 12).

No.	Drive mode	Current consumption	Drive speed
1	Quiescent current mode	< 100 µA	0
2	Electronics active mode	< 40 mA	0
3	Run mode	depending on the requested speed and on the load	depending on the PWM duty cycle or the analog input voltage level
4	Failure mode	< 40 mA	depending on the failure

Table 9: Drive modes

The Quiescent current mode is entered when the pin PWM* / E* is longer than (n / f_{PWM} + 2 s) ± 2 % on 100 % duty cycle (recessive level). n is the number of PWM period samples to be taken for the plausibility check (see chapter 9.2). f_{PWM} is the PWM base frequency. Therefore the time to go into Quiescent current mode depends on the actual PWM base frequency and the number of samples for the plausibility check. Additionally 2 s are waited after the detection of the absence of the PWM signal before finally going into Quiescent current mode.

The Electronics active mode is entered with any PWM duty cycle value between 0 % and < 100 % if the condition from chapter 8.3 is fulfilled (T_{wakeup}).
The Run mode is entered

- if the PWM duty cycle on pin PWM* / E* has a value where the Drive is asked to run (see Figure 11 and chapter 9.4) and the PWM duty cycle value is valid according to the chapter 9.3 or
- if the analog signal on pin analog input A has a value where the Drive is asked to run (see Figure 12 and chapter 9.5).

The Failure mode is entered in case of failures of the Drive (see chapter 9.6).

9.2 Drive speed set point with Digital control

The PWM signal on the control input PWM* / E* is measured by the Drive electronics. For improving noise signal ratio the PWM signal becomes only valid and is only used to set the speed of the Drive when n_p out of n consecutive duty cycle measurements are equal (see Figure 7 and Figure 8).
The value for n window is set to 6 (number of duty cycle measurements made in a plausibility check).
The value for n_p value is set to 4 (number of duty cycle measurements which need to be equal).
The first duty cycle measurement made in a plausibility check window is treated as reference for the other n - 1 measurements.

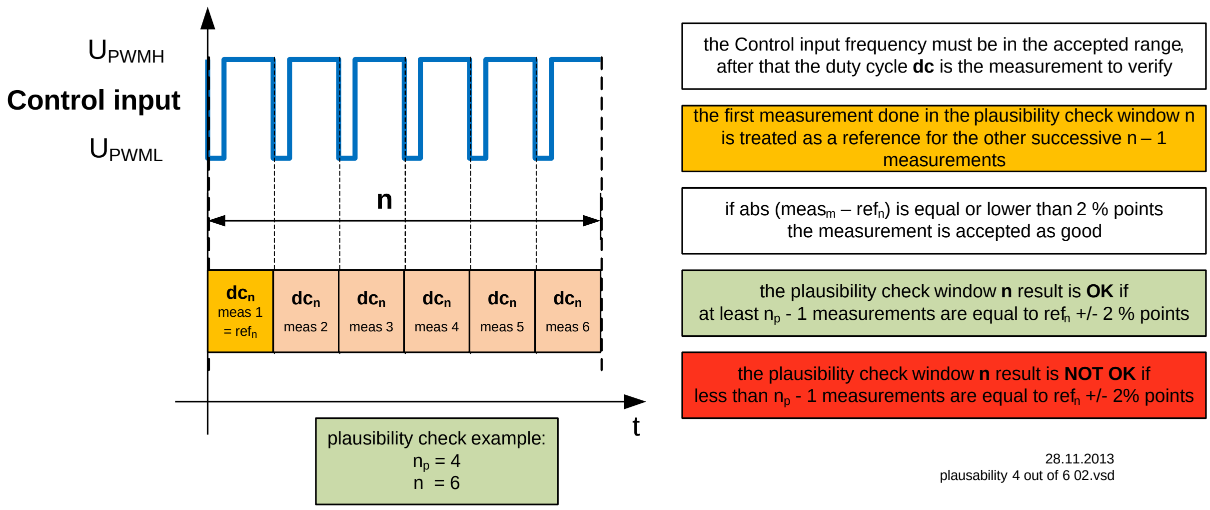

Figure 7: Plausibility check window n

This plausibility test delays the response to the PWM value.
In case of low PWM frequency this can add a delay: e. g. at 50 Hz 0.22 s (in case 4 out of 6 plausibility check 11 samples are lost in the worst case)! It is called $T_{PWMdelay}$ and depends beside the values of n and n_p also on the PWM frequency f_{PWM}. See also chapter 9.3.

The speed is set according to Figure 11: Digital control: transfer function PWM input and chapter 9.4.

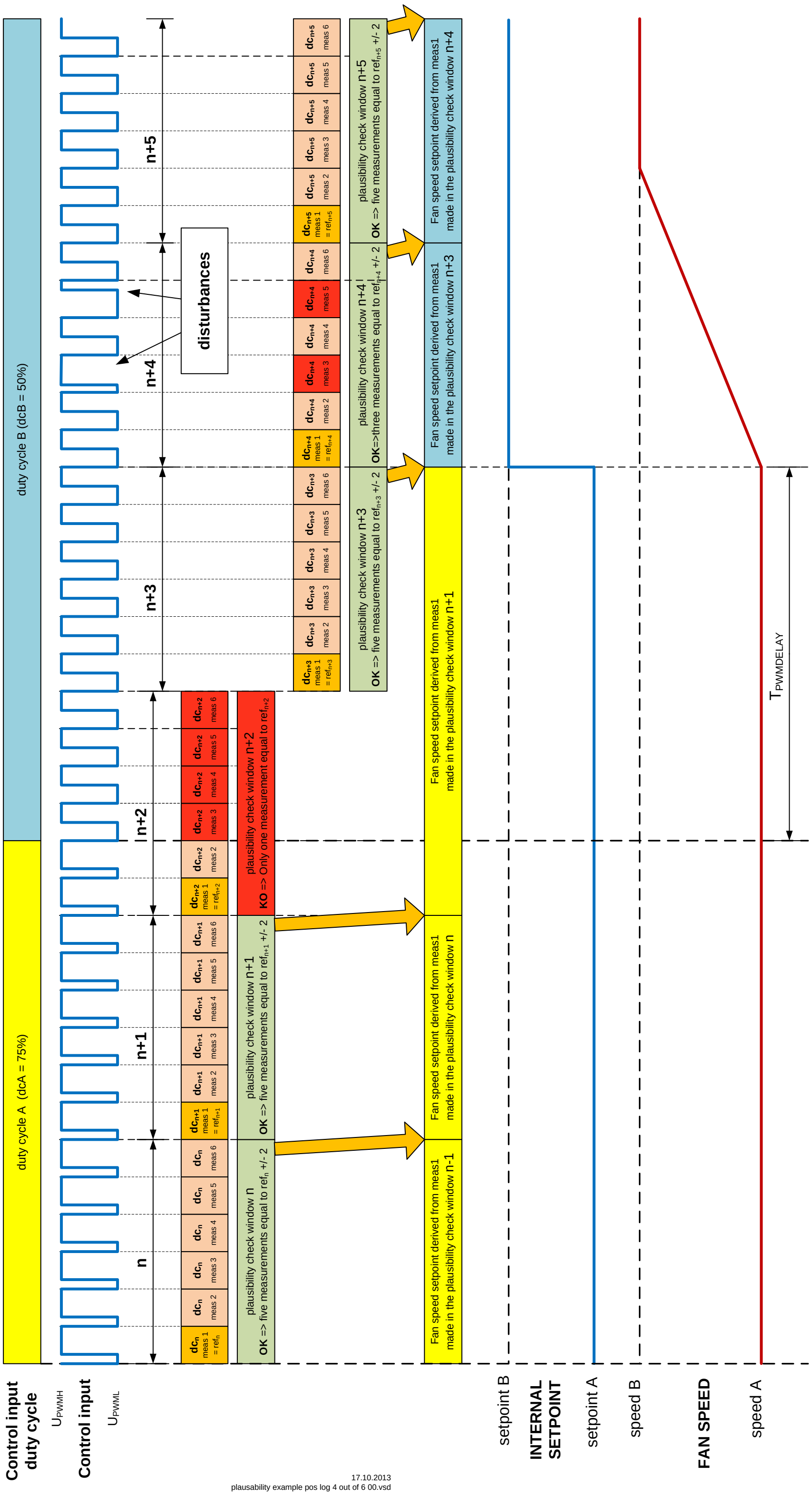

Figure 8: Plausibility check example for the case 4 out of 6

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9.3 Drive speed set point reaction time

If the PWM* / E* duty cycle dc changes the Drive speed starts to change accordingly after a delay time called $T_{PWMdelay}$. This delay is due to plausibility check and depends on the PWM frequency on PWM* / E*. This delay value ranges from n / f_{PWM} to (n + n_p) / f_{PWM}.

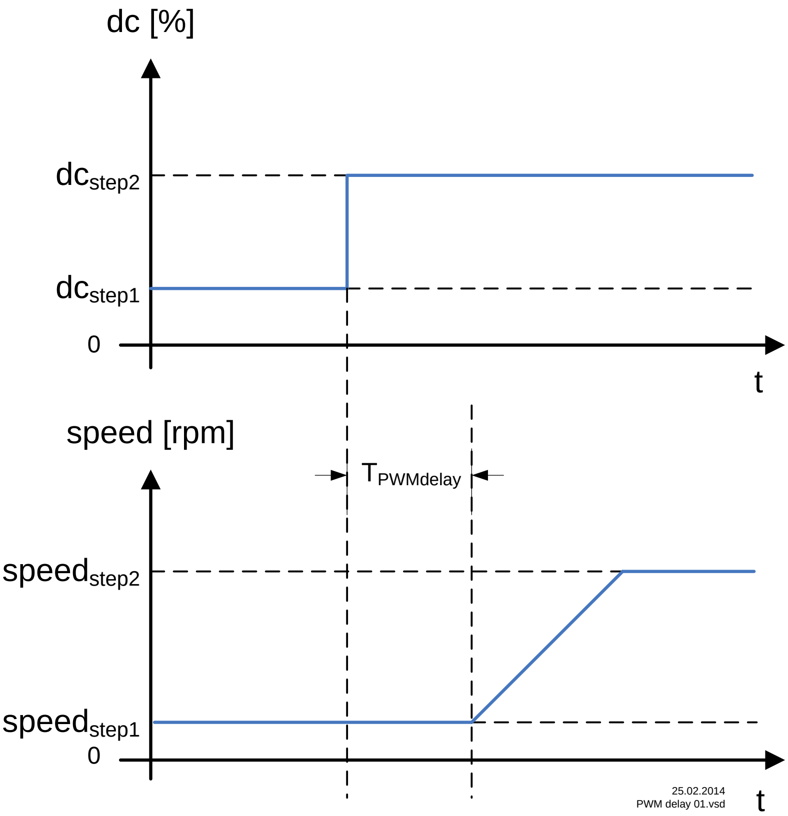

Figure 9: Drive speed set point reaction time

The speed is set according to the Digital control: transfer function PWM input (see Figure 11).

9.4 Digital control: transfer function PWM input

The transfer function PWM input is the relation between the Drive speed and the duty cycle on the pin digital PWM input / active low: PWM* / E*.

The duty cycle is defined according to Figure 10. It is called ”positive logic duty cycle definition”.

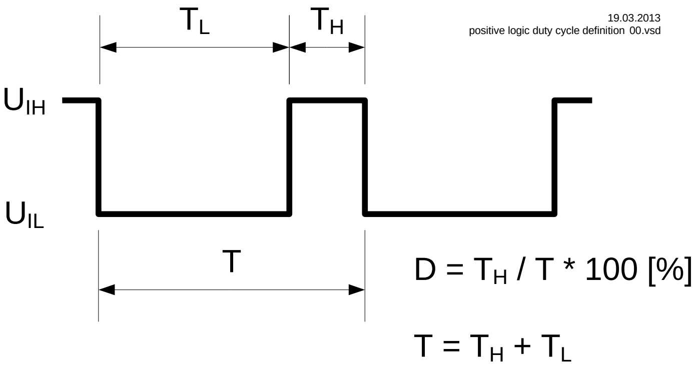

Figure 10: duty cycle definition "positive logic duty cycle definition"

Considering this definition,

- continuous low voltage is 0 % duty cycle (dominant level)
- continuous high voltage is 100 % duty cycle (recessive level)

Based on this duty cycle definition the transfer function PWM input is shown in Figure 11.

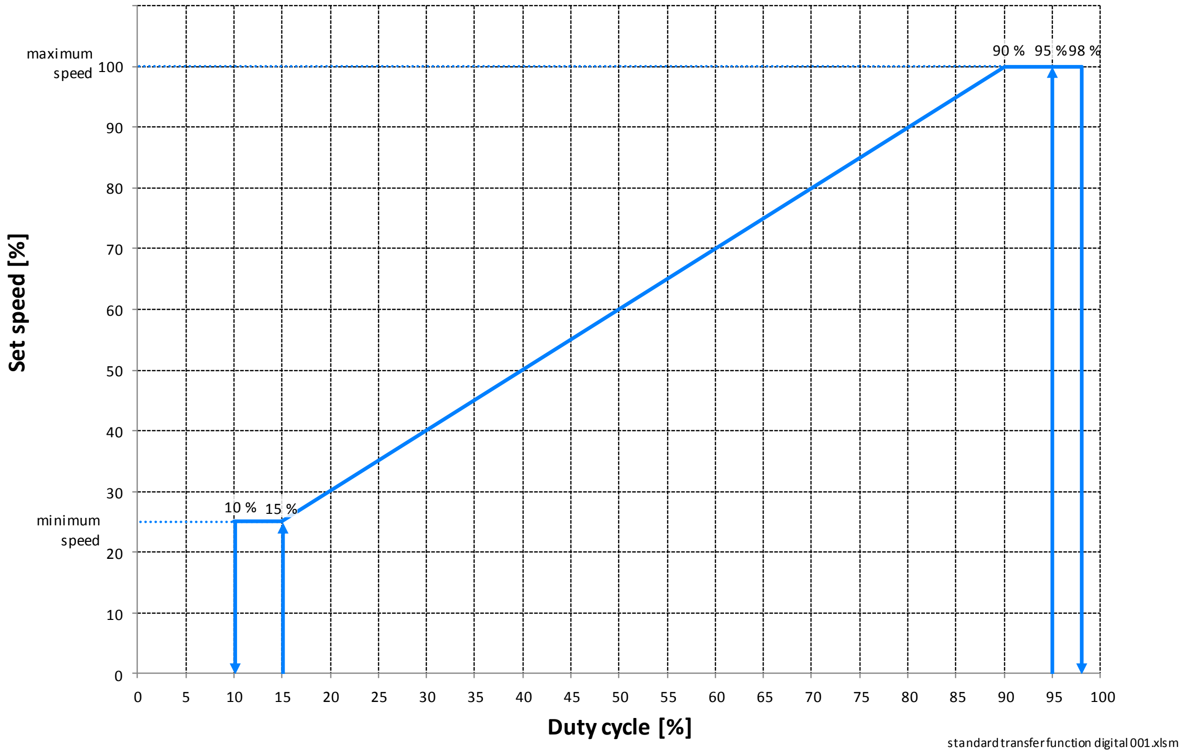

Figure 11: Digital control: transfer function PWM input

The transfer function PWM input is used for

- mode 7: Digital control and
- mode 8: Mixed analog / digital control

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9.5 Analog control: transfer function analog input

The transfer function analog input is the relation between the Drive speed and the duty cycle on the pin analog input A (see Figure 12).

The transfer function analog input is used for
- mode 4: Analog control 1,
- mode 5: Analog control 2,
- mode 6: Analog control with enable low and
- mode 8: Mixed analog / digital control

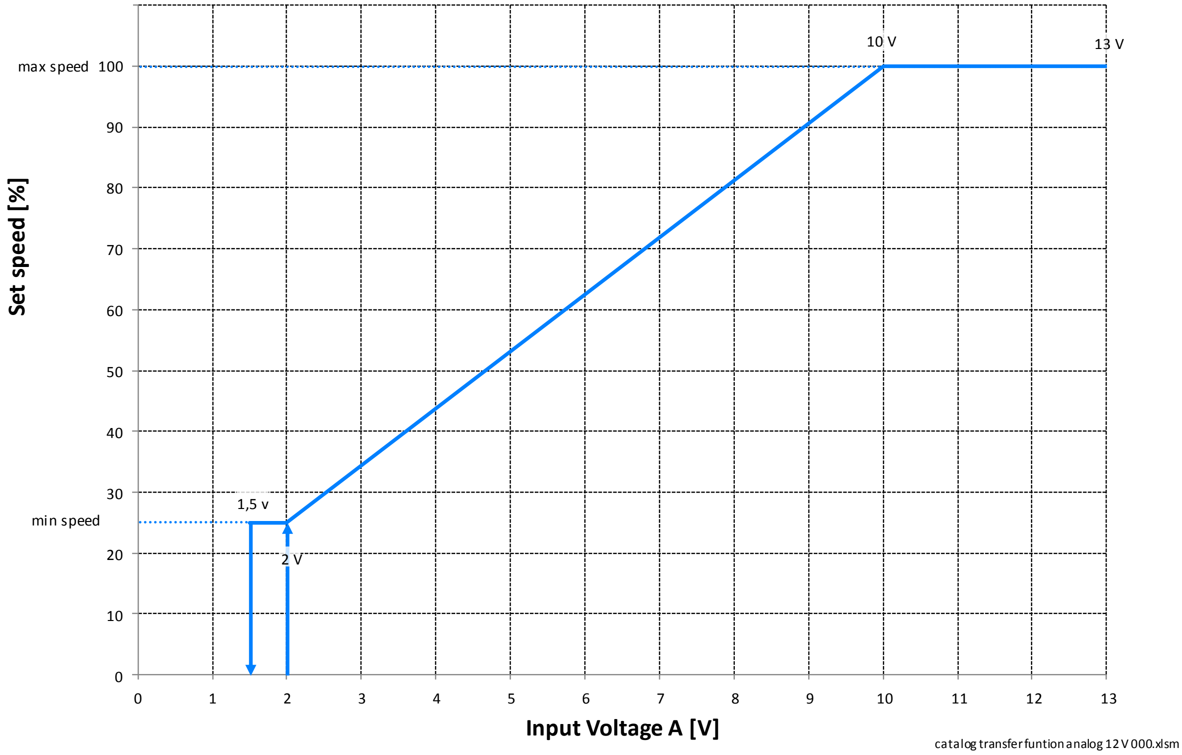

Figure 12: Analog control: transfer function analog input 24 V version

9.6 Drive mode Failure modes

There are the following cases where the Drive will go into Failure mode and stop the Drive:
1. Drive blocked
2. Drive overheated
3. Drive overloaded
4. Under voltage
5. Over voltage
6. Over current
7. Internal Drive failure

9.6.1 Failure mode Drive overloaded

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If the current draw is higher than the expected current draw derived from the fan curve plus a tolerance margin the Drive will reduce the speed. In this way also the case of a soft stall condition is covered.
This behavior of the Drive can be interpreted also as a speed dependent current limiting.

9.6.2 Failure mode Drive blocked

The reason for the Failure mode Drive blocked can be (unlikely) Drive internal or (more likely) Drive external. E. g. snow could block the fan module. This failure can disappear after a certain time due heating up of the application because of missing fan function. But then the fan can run again.
In order to provide a high fan module availability the following recovery strategy is used.

After the first detection of the Failure mode Drive blocked a delay of 5 s till the next start attempt is introduced. If this start attempt fails again a delay increased by further 5 s till the next start attempt is introduced. This delay increase is repeated till the delay between the attempts is 25 s. Then this delay is kept for ever as long a valid PWM duty cycle is detected which asks the Drive to run.
The maximum delay time is set in such a way that the Drive is not overheating due to the start attempts under the condition of the maximum ambient temperature.

9.6.3 Failure mode Drive overheated

Two cases of overheating have to be distinguished:
1. Overheating but the Drive can still run at a reduced speed respect to the requested speed
2. Overheating and the Drive cannot run anymore

9.6.4 Failure mode Under voltage and Over voltage

If the supply voltage is outside the specified range the Drive will stop.
If the supply voltage is below the design voltage of the Drive the speed might be lower than the requested speed.

9.6.5 Failure mode Over current

Beside the mentioned speed dependent current limiting (see chapter 9.6.1) also an Over current protection function is implemented what switches off the Drive.

9.6.6 Failure mode Internal Drive failure

Under the Failure mode Internal Drive failure the following possible internal failures summarized:
- Voltage measurement chain defect
- Current measurement chain defect
- Temperature measurement chains defect
- Rotor position signal measurement chain defect
- MOS FET driver circuitry failures

9.6.7 Failure recovery strategy

The Drive is designed with the following fundamental and mandatory requirement:
In any case any failure in the Drive MUST NOT generate follow up failures in the vehicle with catastrophic results.
Nevertheless directly after the above mentioned requirement for safety comes the requirement for maximum availability of the Drive.

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This means that in all cases of failures a certain restart procedure or method is implemented.
In all cases the Drive tries to recover from failures when a valid PWM signal is detected which asks the Drive to run.

10 Application notes

10.1 Drive interface

The Drive interface (the connection between the Drive and the user system) can be done in 8 ways (see also Table 10) depending if and how the two signal inputs PWM* / E* and A are used:

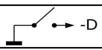
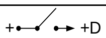
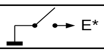
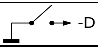
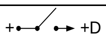
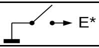
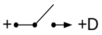
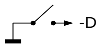
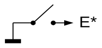
Mode description	**Mode**	+D	-D	PWM* / E*	A	**Pins**	
On / off to minus	1	+		-	+		4
On / off to plus	2		-	-	+		4
On / off with enable low	3	+	-		+		4
Analog control 1	4	+		-	analog		4
Analog control 2	5		-	-	analog		4
Analog control with enable low	6	+	-		analog		4
Digital control	7	+	-	PWM	n. c.	3	
Mixed analog / digital control	8	+	-	PWM	analog		4

Table 10: operating modes

+D : Drive positive supply
-D : Drive negative supply
PWM* / E* : PWM input / low active enable input
A : analog input

\+ : connected to plus
\- : connected to minus
analog : analog voltage signal
PWM : PWM signal
n. c. : not connected
 : switch of the Drive positive supply to plus
 : switch of the Drive negative supply to minus / GND
 : switch active low enable input to minus / GND

10.2 Interface mode 1: On / off to minus

To realize the mode On / off to minus with the Drive Interface for Catalog Product it is necessary to put
- A to +D and
- PWM* / E* to -D.

See also Figure 13.

When the switch S1 is switched on the Drive goes after the initialization of the electronics to full speed.

This mode can be used if the CCU which controls the Drive has limited capabilities or does not even exist. The Drive is just switched on and off via any power switch like a relay, MOS FET, or even just a switch.
The appropriate current rating for this "switch" has to be dimensioned according to the current consumption of the Drive.

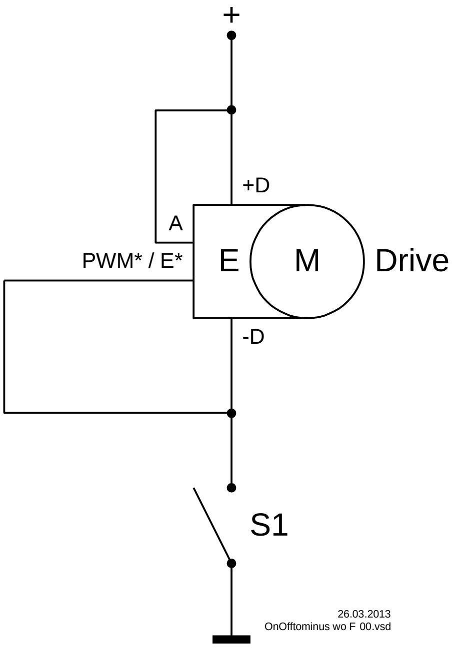


Figure 13: Interface mode 1: On / off to minus

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10.3 Interface mode 2: On / off to plus

To realize the mode On / off to plus with the Drive Interface for Catalog Product it is necessary to put

- A to +D and
- PWM* / E* to -D.

See also Figure 14.

When the switch S1 is switched on the Drive goes after the initialization of the electronics to full speed.

This mode can be used if the CCU which controls the Drive has limited capabilities or does not even exist. The Drive is just switched on and off via any power switch like a relay, MOS FET, or even just a switch.
The appropriate current rating for this “switch” has to be dimensioned according to the current consumption of the Drive.

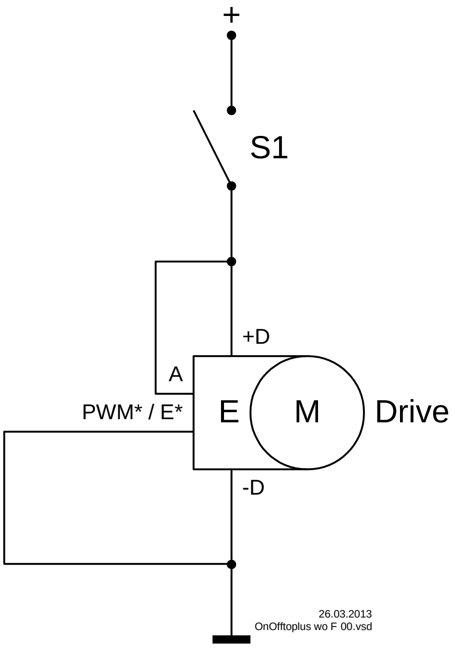

Figure 14: Interface mode 2: On / off to plus

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10.4 Interface mode 3: On / off with enable low

To realize the mode On / off with enable low with the Drive Interface for Catalog Product it is necessary

- A to +D and
- to use PWM* / E* as an low active enable.

See also Figure 15.

In mode 3 the Drive can stay always on supply voltage and is controlled by a low current enable input which can be driven by simple low cost low side signal driver in the CCU.

When the enable input PWM* / E* goes to high, the Drive goes after a short time into the quiescent current mode.

When the enable pin PWM* / E* is driven low, the Drive goes to full speed after the initialization of the electronics.

This mode can be used if the CCU which controls the Drive has limited capabilities or does not even exist.
The appropriate sink current rating of the driver for the enable pin PWM* / E* has to be dimensioned according to the current consumption of the pin PWM* / E*.

The circuit structure to drive the pin PWM* / E* can be any active low "open collector" Typical circuitry as depicted in Figure 15.

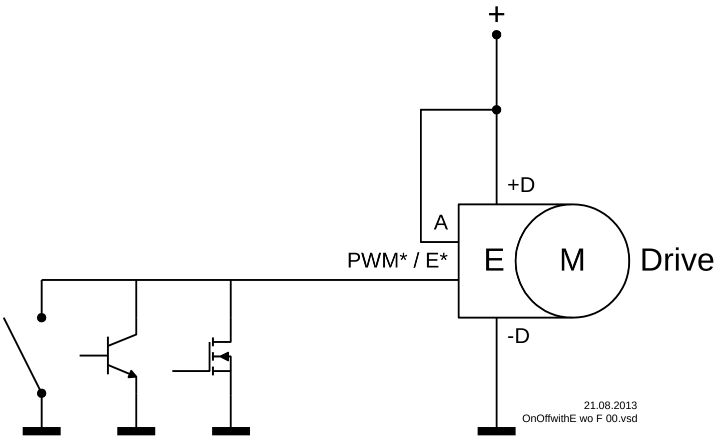

Figure 15: Interface mode 3: On / off with enable low

10.5 Interface mode 4: Analog control 1

To realize the mode Analog control 1 with the Drive Interface for Catalog Product it is necessary
- to use A as an analog input and
- to put PWM* / E* to -D.

See also Figure 16.

When the switch S1 is switched on the Drive goes after the initialization of the electronics to the speed requested by the analog input A.

The appropriate current rating for this "switch" has to be dimensioned according to the current consumption of the Drive.

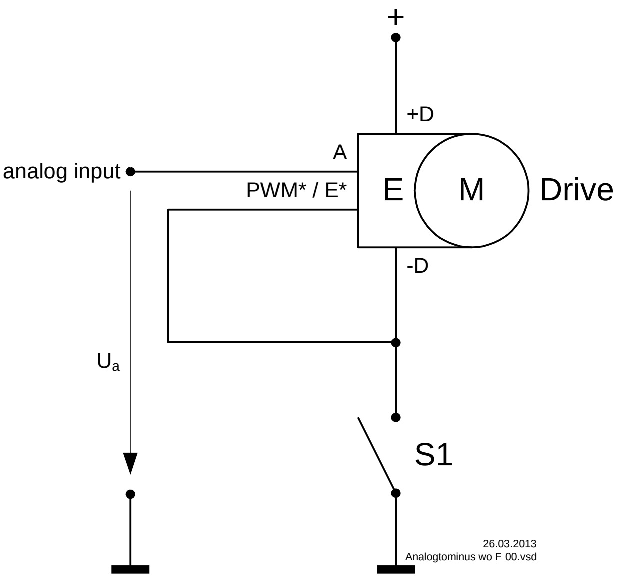

Figure 16: Interface mode 4: Analog control 1

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10.6 Interface mode 5: Analog control 2

To realize the mode Analog control 2 with the Drive Interface for Catalog Product it is necessary
- to use A as an analog input and
- to put PWM* / E* to -D.

See also Figure 17.

When the switch S1 is switched on the Drive goes after the initialization of the electronics to the speed requested by the analog input A.

The appropriate current rating for this "switch" has to be dimensioned according to the current consumption of the Drive.

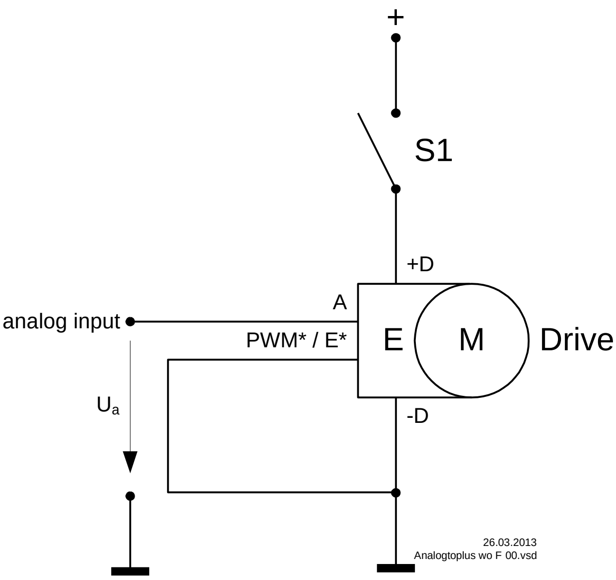

Figure 17: Interface mode 5: Analog control 2

10.7 Interface mode 6: Analog control with enable low

To realize the mode Analog control with enable low with the Drive Interface for Catalog Product it is necessary

- to use A as an analog input and
- to use PWM* / E* as a low active enable.

See also Figure 18.

In mode 6 the Drive can stay always on supply voltage and is controlled by a low current enable input which can be driven by simple low cost low side signal driver in the CCU.

When the enable input PWM* / E* goes to high, the Drive goes after a short time into the quiescent current mode.

When the enable pin PWM* / E* is driven low, the Drive goes to the speed requested by the analog input A after the initialization of the electronics.

The appropriate sink current rating of the driver for the enable pin PWM* / E* has to be dimensioned according to the current consumption of the pin PWM* / E*.

The circuit structure to drive the pin PWM* / E* can be any active low “open collector” Typical circuitry as depicted in Figure 18.

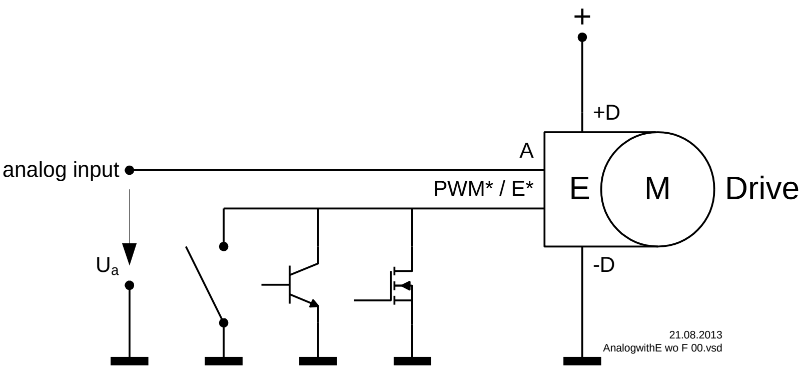

Figure 18: Interface mode 6: Analog control with enable low

In this operating mode the supply voltage plus is usually connected permanently. To run the Drive first the pin PWM* / E* has to be connected to supply voltage minus and afterwards the Drive speed can be then controlled with an analog voltage on the pin A.

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10.8 Interface mode 7: Digital control

To realize the mode Digital control with the Drive Interface for Catalog Product it is necessary
- to apply a PWM signal on the pin PWM* / E*.

See also Figure 19.

In mode 7 the Drive can stay always on supply voltage and is controlled by a low current PWM and enable PWM* / E* input which can be driven by simple low cost low side signal driver in the CCU.

When the enable input PWM* / E* goes to high, the Drive goes after a short time into the quiescent current mode.

When the enable pin PWM* / E* is driven with PWM, the Drive goes to the speed requested by the duty cycle after the initialization of the electronics.

The appropriate sink current rating of the driver for the enable pin PWM* / E* has to be dimensioned according to the current consumption of the pin PWM* / E*.

The circuit structure to drive the pin PWM* / E* can be any active low "open collector" Typical circuitry as depicted in Figure 19.

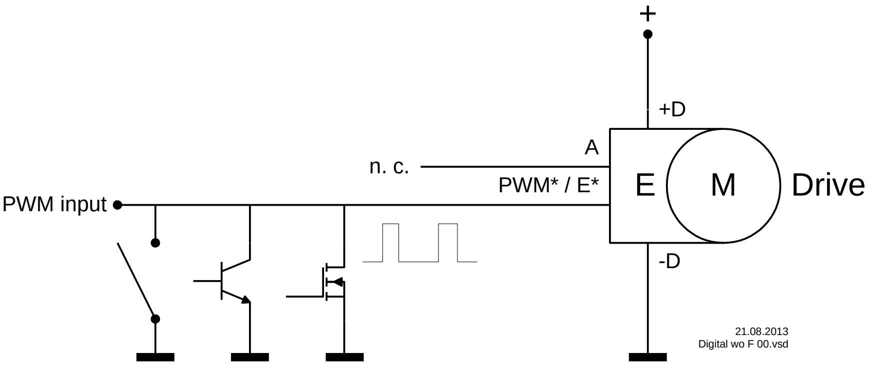

Figure 19: Interface mode 7: Digital control

In this operating mode the supply voltage plus is usually connected permanently. To run the Drive on the pin PWM* / E* a PWM signal has to be applied and with the duty cycle of the PWM signal the Drive speed can be then controlled.

10.9 Interface mode 8: Mixed analog / digital control

To realize the mode Mixed analog / digital control with the Drive Interface for Catalog Product it is necessary

- to use A as an analog input and
- to apply a PWM signal on the pin PWM* / E*.

See also Figure 20.

In mode 8 the Drive can stay always on supply voltage and is controlled by a low current PWM and enable PWM* / E* input which can be driven by simple low cost low side signal driver in the CCU.

When the enable input PWM* / E* goes to high, the Drive goes after a short time into the quiescent current mode.

When the enable pin PWM* / E* is driven low (switched to supply voltage minus), the Drive goes to the speed requested by the analog input A after the initialization of the electronics (if the electronics is not already activated).
When the enable pin PWM* / E* is driven with PWM, the Drive goes to the speed requested by the duty cycle after the initialization of the electronics (if the electronics is not already activated).
The appropriate sink current rating of the driver for the enable pin PWM* / E* has to be dimensioned according to the current consumption of the pin PWM* / E*.

The circuit structure to drive the pin PWM* / E* can be any active low “open collector” Typical circuitry as depicted in Figure 20.

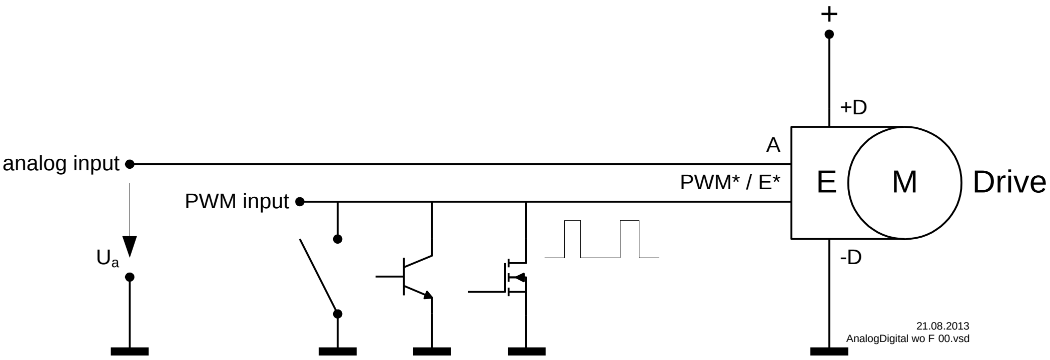

Figure 20: Interface mode 8: Mixed analog / digital control

In this operating mode the supply voltage plus is usually connected permanently. To run the Drive on the pin PWM* / E* a PWM signal has to be applied and with the duty cycle of the PWM signal the Drive speed can be then controlled. If the pin PWM* / E* is switched to supply voltage minus the Drive speed can be then controlled with an analog voltage on the pin A.
So a mixed control with either digital or analog input is possible. The priority has the digital PWM signal.

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10.10 Interface parallel configuration

The Drives can be used in a parallel configuration in the PWM driven modes as well as in analog driven modes and also in the combines analog / PWM mode in such a way that the control lines are connected in parallel as shown in Figure 21 for the example of two Drives.

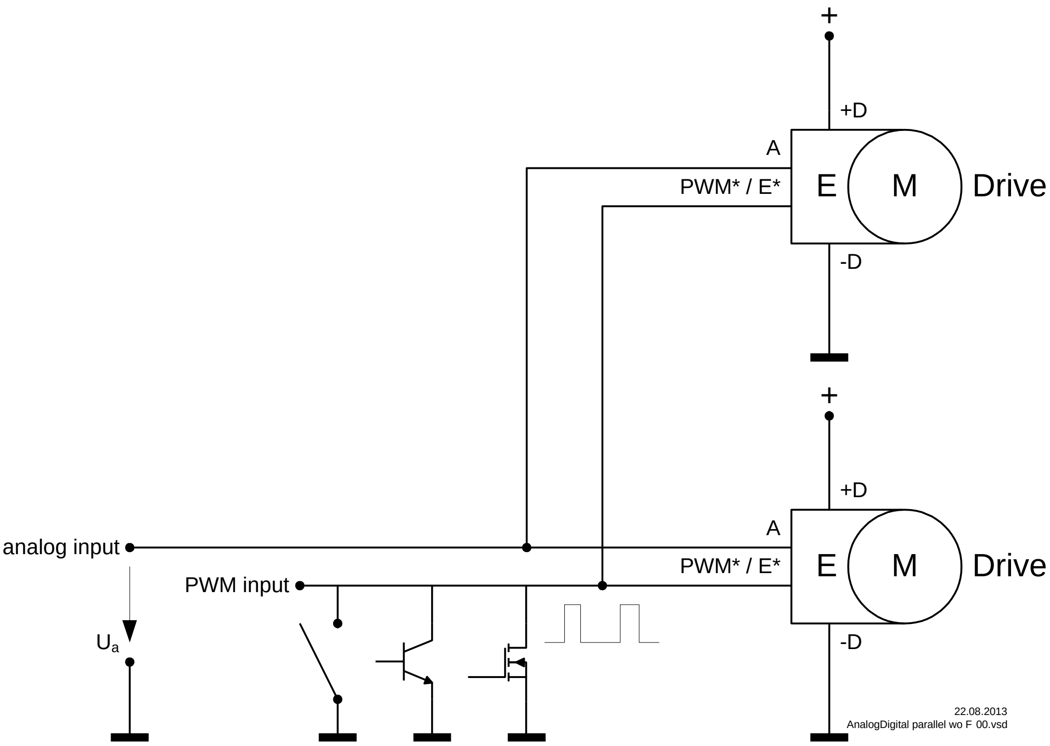

Figure 21: Interface parallel configuration

There is no limitation from the Drive's point of view in paralleling them. Nevertheless from the CCU's point of view for dimensioning the driver stage which controls digitally via the PWM* / E* inputs of the Drives or which controls analog via the A inputs of the Drives the speed of the Drives it has to be considered that all of the Drives needs a certain current each (see Table 7 and Table 8). The output driver stage of the CCU needs to capable of driving minimum the input currents of PWM* / E* and / or A times the number of the Drives.

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11 Startup behavior

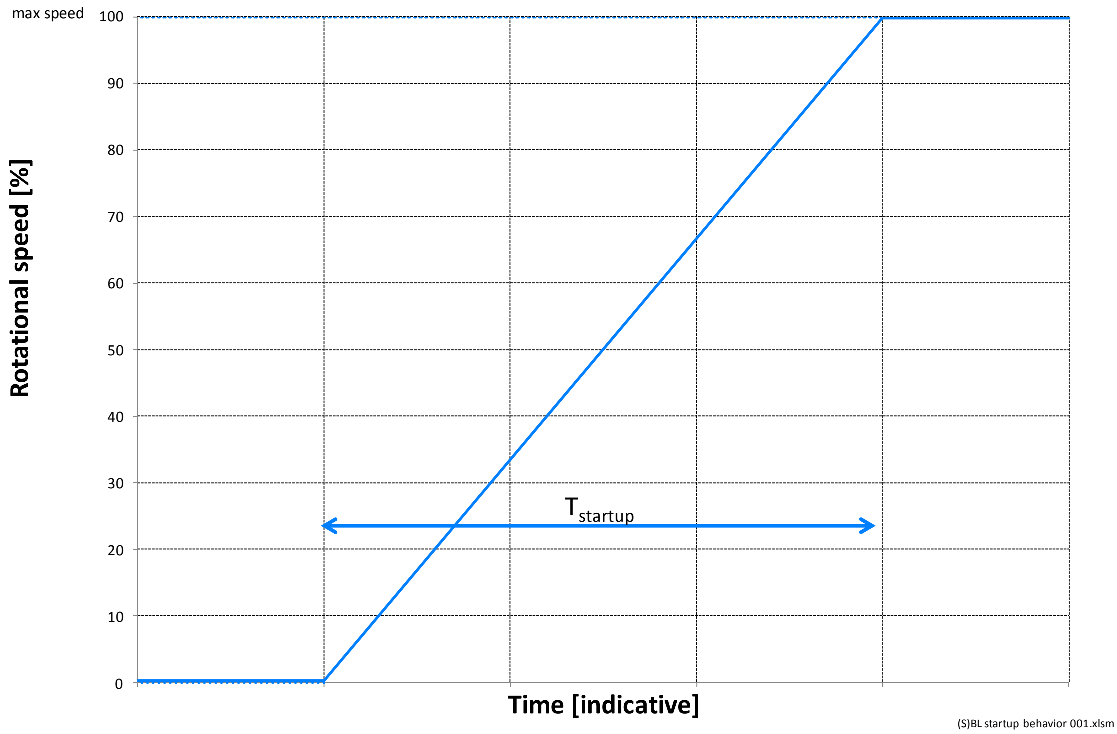

Figure 22: Startup behavior

The Drive is in Electronics active mode. $T_{startup}$ is the time from the application of the max speed PWM duty cycle to the max speed.

Parameter	Typical	Unit
$T_{startup}$	15.0	s

Table 11: Startup behavior

12 Supply Voltage

Parameters	Min.	Typical	Max.	Unit
Nominal supply voltage		12.0		V
Operating supply voltage range (measured at Drive connector)	9.0		16.0	V
Supply voltage at which the Axial Fan Module can deliver the maximum speed (measured at Drive connector)	13.0		16.0	V

Table 12: Supply voltage specifications (measured at Drive connector)

13 Fuse protection

An automotive fuse according ISO8820 part 3 must be used in the application wire harness. Depending on the application of the fan, it will be necessary to define and verify the correct fuse level

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by the customer (due to the length of the vehicle cable harness, cross section of the power wires, fuse type).

14 Power supply residual ripple

The maximum value of power supply rms ripple acceptable for the Drive is 1 %.
In case of application with high residual ripple values, please contact SPAL in order to find the suitable solution for your specific requirements.

15 Reverse polarity protection

The electronic unit is protected against either temporary or permanent application of a reverse polarity on the power supply line. In this situation, the motor remains stopped without feedback output signal activation. Functional status class C as defined in ISO 16750-1 (device fully functional after the test and after correcting the polarity). Prescriptions of chapter 13 must be applied.

Parameters	Value	Unit
Reverse supply voltage	-13.5	V
Temperature	Room temperature	K
Time	2	min

Table 13: Reverse polarity test parameters

16 Load dump protection

Capability for limited load dump according to ISO16750-2:2010 specifications, chapter 4.6.4.2.2.

Pulse type: 5b (suppressed)		
Parameters	**Value**	**Unit**
Pulse peak voltage (U_S*)	35	V
U_A	14 ± 0.2	V
Internal resistance (Ri)	2	Ω
Impulse duration (t_d)	400	ms
Rising slope (t_r)	10 (0 / -5)	ms
Pulses number	10	#
Time interval between pulses	60	s

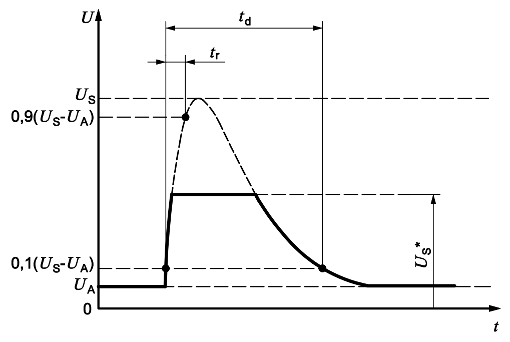

Table 14: Load dump parameters

17 Typical ratings

- Operating temperature range: -40 ÷ +120 °C
- Storage temperature range: -40 ÷ +125 °C
- Lifetime: up to 40000 hours depending on mission profile

18 Rotational speed range

Parameters	Typical	Unit
Min speed	950	rpm
Max speed	3800	rpm

Table 15: Rotational speed range for Axial Fan Module VA99 - ABL315P/N - 101A/SH

19 Thermal derating curve

This curve refers to steady state (continuous) operating condition.

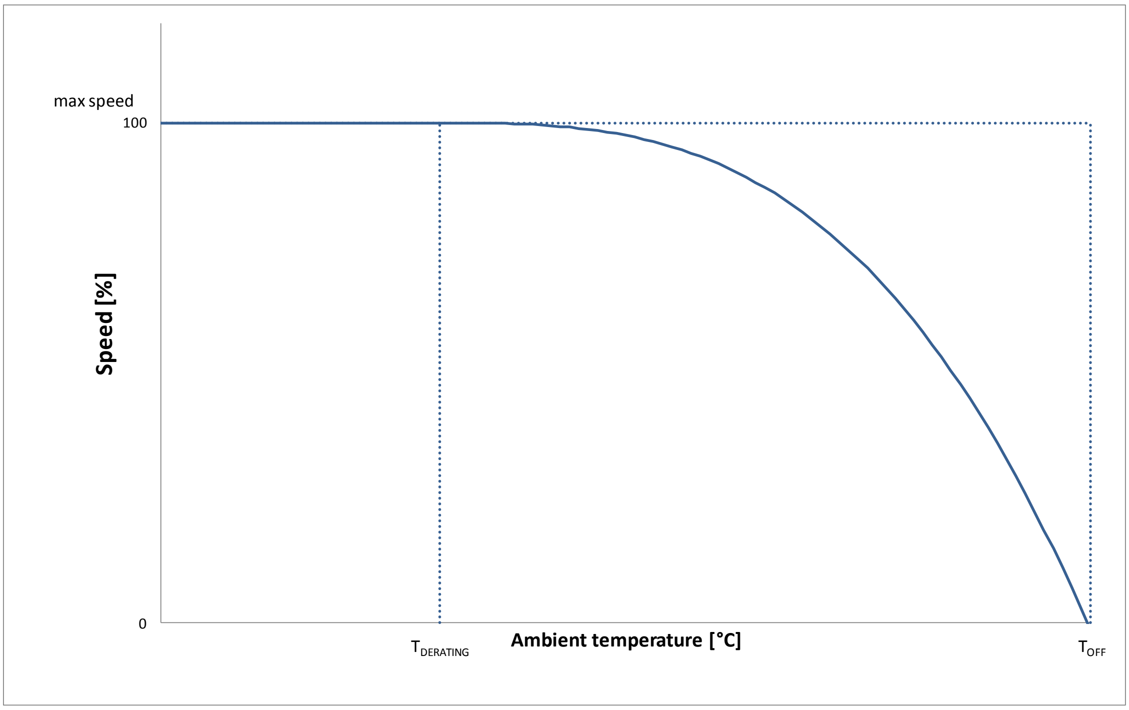

Figure 23: Thermal derating curve

Parameters	Typical	Unit
$T_{DERATING}$	+105	°C
T_{OFF}	+120	°C

Table 16: Indicative normalized derating curve for Axial Fan Module VA99 - ABL315P/N - 101A/SH

The Figure 23 is only depicting the behavior.
The values for the starting of the derating $T_{DERATING}$ and for the point when the Axial Fan Module VA99 - ABL315P/N - 101A/SH is switching off T_{OFF} are nominal values.

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Few minutes ambient temperature transients do not engage the derating curve of Axial Fan Module rotational speed, owing to the thermal inertia of the system.
NOTE: above data assume “nominal” fan load at those temperatures. Overloads will anticipate thermal derating of the Axial Fan Module rotational speed.

20 Standards and Directives

The product complies with the following standard / directives

Standard Code	Description
72/245/EC and updates	Automotive EMC directive
ECE Reg. 10-03 and updates	Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility
2002/95/EC RoHS	Restriction of Hazardous Substances Directive
2000/53/EC and updates	End-of Life Vehicle 2000/53/EC

Table 17: Standards and directives

21 Sealing

Motor designed for IP6K9K and IP68 protection.

22 Document change history

Initial document author: Alice Guazzetti
Latest revision: 000

Document author	Date	Revision	Comment
Alice Guazzetti	24.03.2014	000	Initial Version

Table 18: Document change history

Document status: released

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