SPECIFICATION

MODEL
K-DC318-A24-34

Krube

Model:K-DC318-A24-34

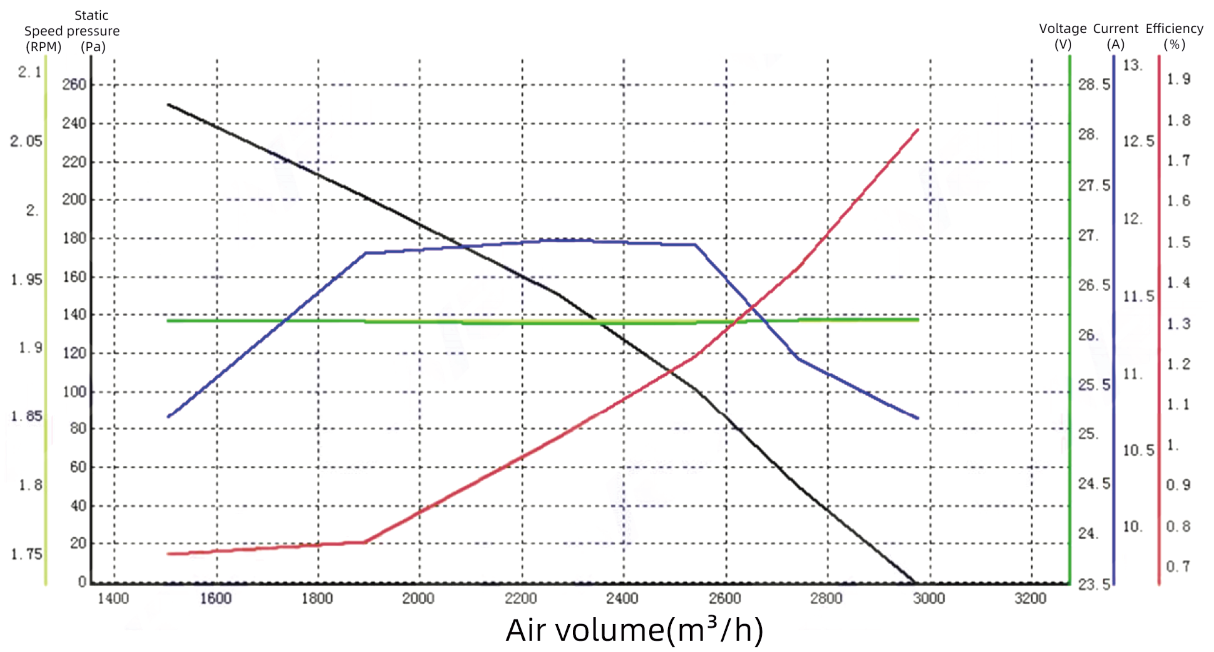
1.Product description

Unless otherwise noted, the parameters in this document are defined or tested under the following conditions.

- TAMB = 20 ℃ ± 5 ℃
- UB = 27.0 V ± 0.2 V (measured at connector end)

2.Curves

Axial flow fan air flow curves



Speed	3400rpm
Air density	1.20kg/m³

Air volume meter

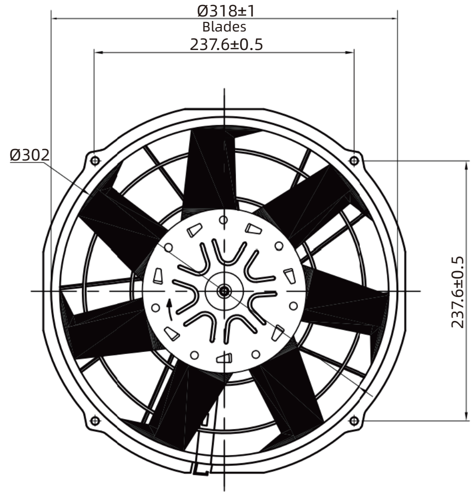
3.Noise

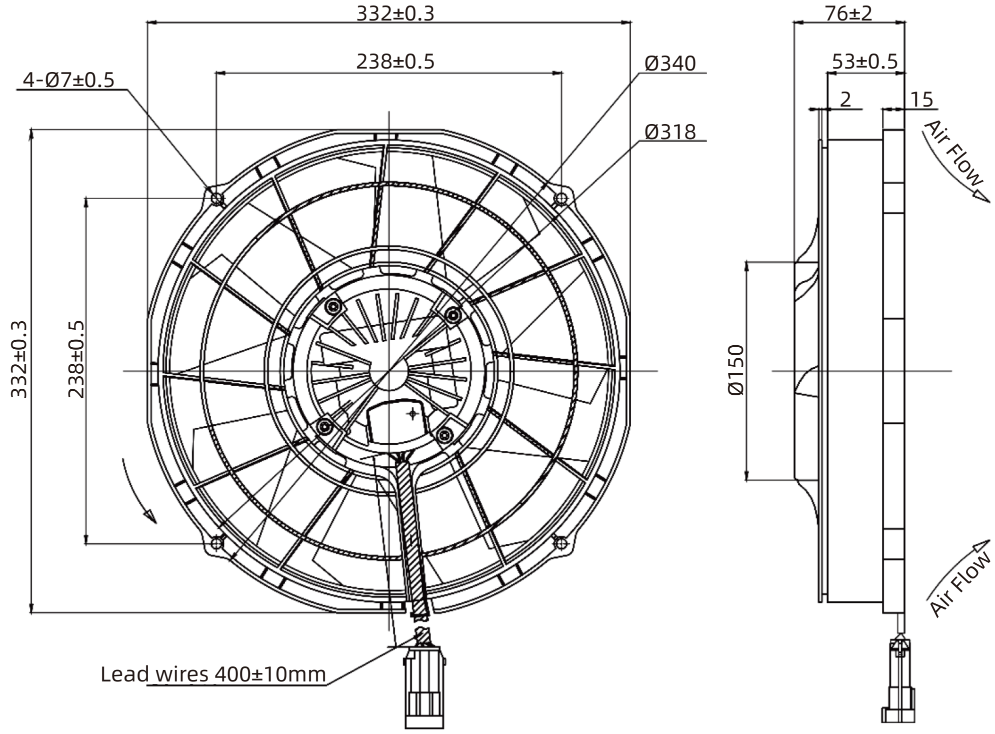
Noise	Distance between microphone and fan center
78dBA	1m±0.005m

Table 1: Noise

4.Dimensions

4-1.Product drawing





Unit: mm

Figure 2. Two-dimensional view (back view and side view)

4-2.Weight

Fan weight	About 2.3Kg

Figure 3. Product image (front view and back view)

5.Connectors

Note: Connector:Sheath:185126
Terminal:185237
2.5mm²Waterproof plug: 324973
0.5mm²Waterproof plug: 324974
Terminal:185129
Positioning clip:185000

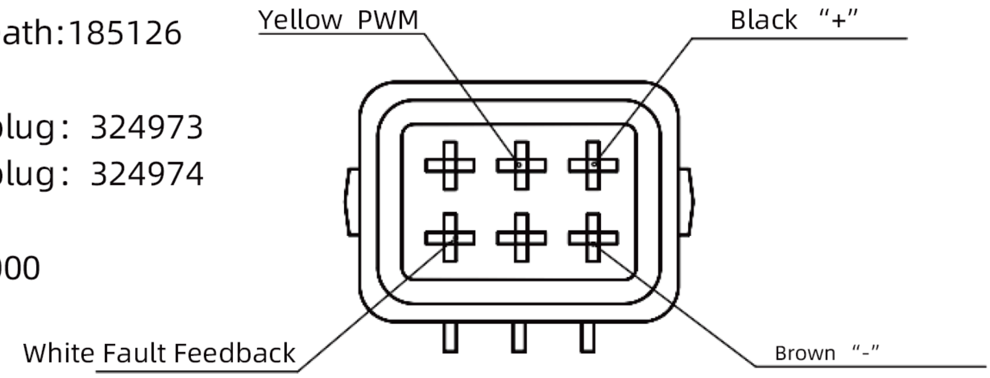


Figure 4. Lead arrangement diagram of the connector

Connector :12185126				
Identification number	+	−	PWM	FO
Pin number	1	2	3	6
Color	Black	Brown	Yellow	White
Cross-sectional area(mm2)	2.5	2.5	0.75	0.75

Table 2. Connector Lead Table

Note: It is forbidden to lift the fan directly by the wire harness.

6.Hardware Function

6-1. Fan drive

Figure 5 shows a schematic diagram of the fan drive.

E represents the entire circuit part, and M represents the motor. Drive stands for motor and circuit integration.

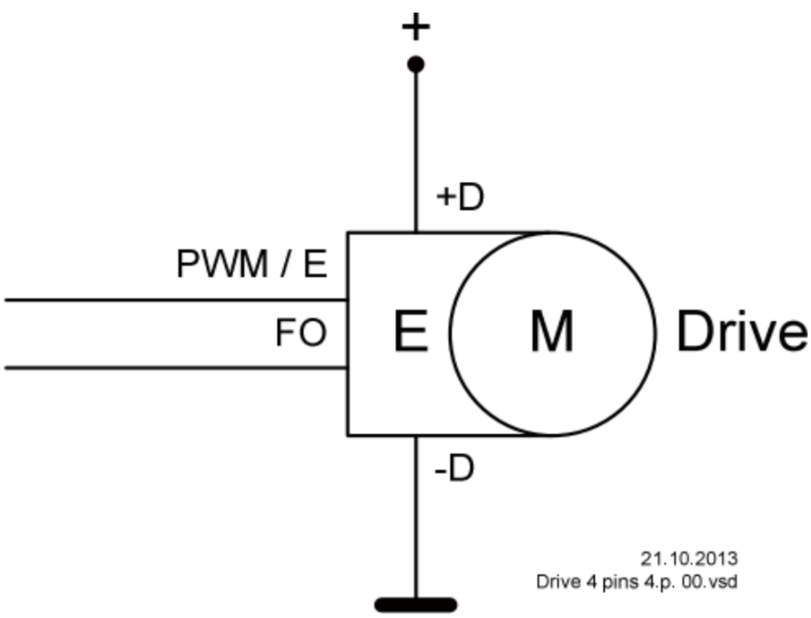


Figure 5. Fan drive diagram

6-2. Lead wire function of fan drive part

The driver's electrical interface consists of four leads:

- Positive input power supply: +D
- Input power supply negative: -D

Signal leads:

(1).Input: High level active digital PWM input: PWM/E

(2).Input: High level active feedback output FO

The signal lead PWM/E is used to control the drive mode, that is, the control input.

The signal lead FO can be used to feedback the rotational speed of the drive and to notify the failure mode when a failure occurs.

6-3. Driver interface

Figure 6 shows the wiring diagram of the CCU and the fan drive module.

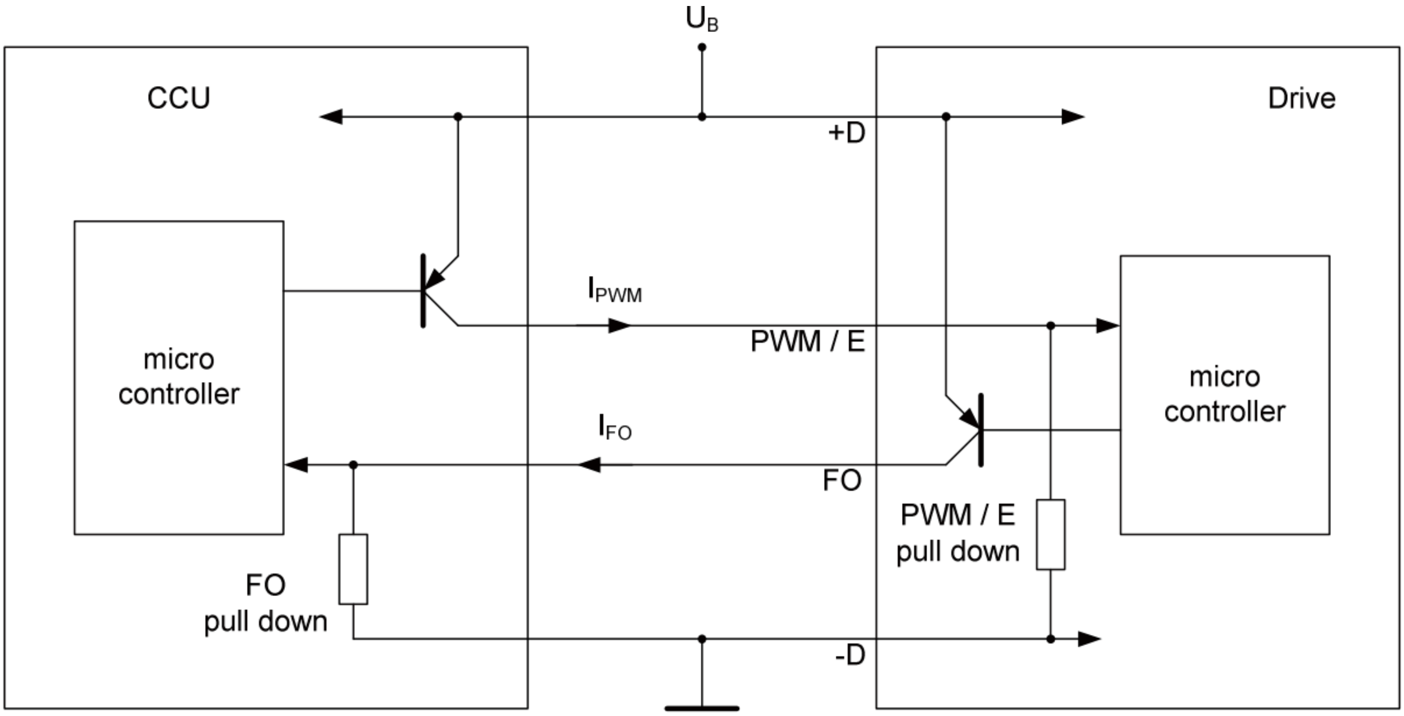


Figure 6. Driver interface

The circuit of CCU and the circuit of fan drive are connected by two unidirectional wiring harnesses.

The PWM signal input to the PWM/E line comes from the CCU, and a pull-down resistor (PWM/E pull-down) is added to the fan drive circuit to determine the recessive level.

This pull-down resistor is connected to the negative terminal of the input power supply: -D/GND.

The dominant (active) level of the input pin PWM/E is a high level, which is provided by the internal pnp transistor of the CCU when it is turned on (as shown in Figure 6).

The output FO comes from the drive circuit of the fan, and a pull-down resistor (FO pull-down) is added to the circuit end of the CCU.

The dominant (effective) level of the output pin FO is high level, which is provided by driving the internal pnp transistor to conduct (as shown in Figure 6).

6-4.PWM/E: Active high digital PWM input

Input PWM/E is used to activate the fan drive from static mode. Any corresponding pulse tends to the dominant level and lasts longer than the PWM duty cycle of Twakeup to activate the drive circuit.

It must be pointed out that the circuit activation level UEact and the PWM thresholds UPWMH, UPWML are independent of each other (see Figure 7).

Item	Min. value	Typical value	Max. value	Unit	Code
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	15.5			V	$U_{PWMH\ 1)}$
PWM/E low level			7	V	$U_{PWML1)}$
E activation level	14			V	$U_{Eact\ 2)}$
PWM/E resolution		1		%	dc_{resol}
PWM/E accuracy		1		%	dc_{accu}
PWM/E current	-10%	5	+10%	mA	I_{PWM}
PWM/E activation pulse	150			μs	T_{wakeup}

Table 2 PWM/E: Active High Digital PWM Input Parameter Table

1): The PWM threshold requires the operating temperature range of the circuit to be -40℃ to 130℃;

2): The activation level UEact requires the circuit to operate over a temperature range of -40℃ to 130℃

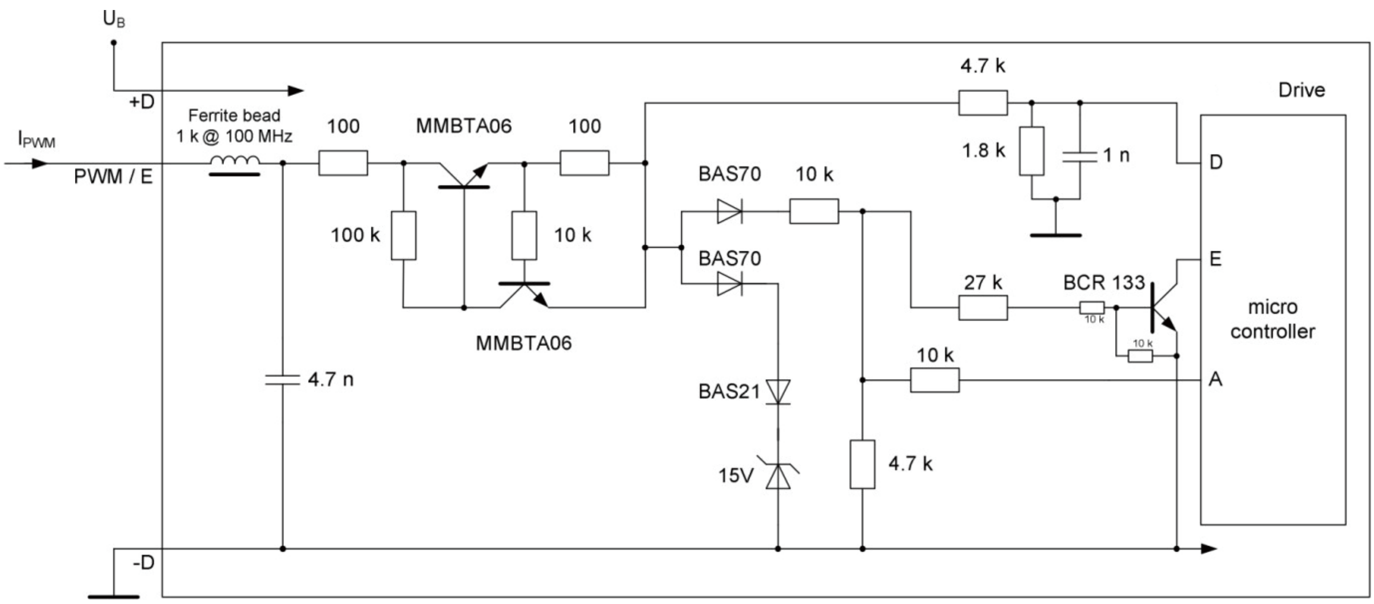


Figure 7 PWM/E: Active High Digital PWM Input Circuit Diagram

6-5.FO: High level active feedback output

Item	Min. value	Typical value	Max. value	Unit	Code
FO voltage	U_B-2V		U_B	V	U_{FO}
FO current			50	mA	I_{FO}

Table 3 FO: Active High Feedback Output Parameters

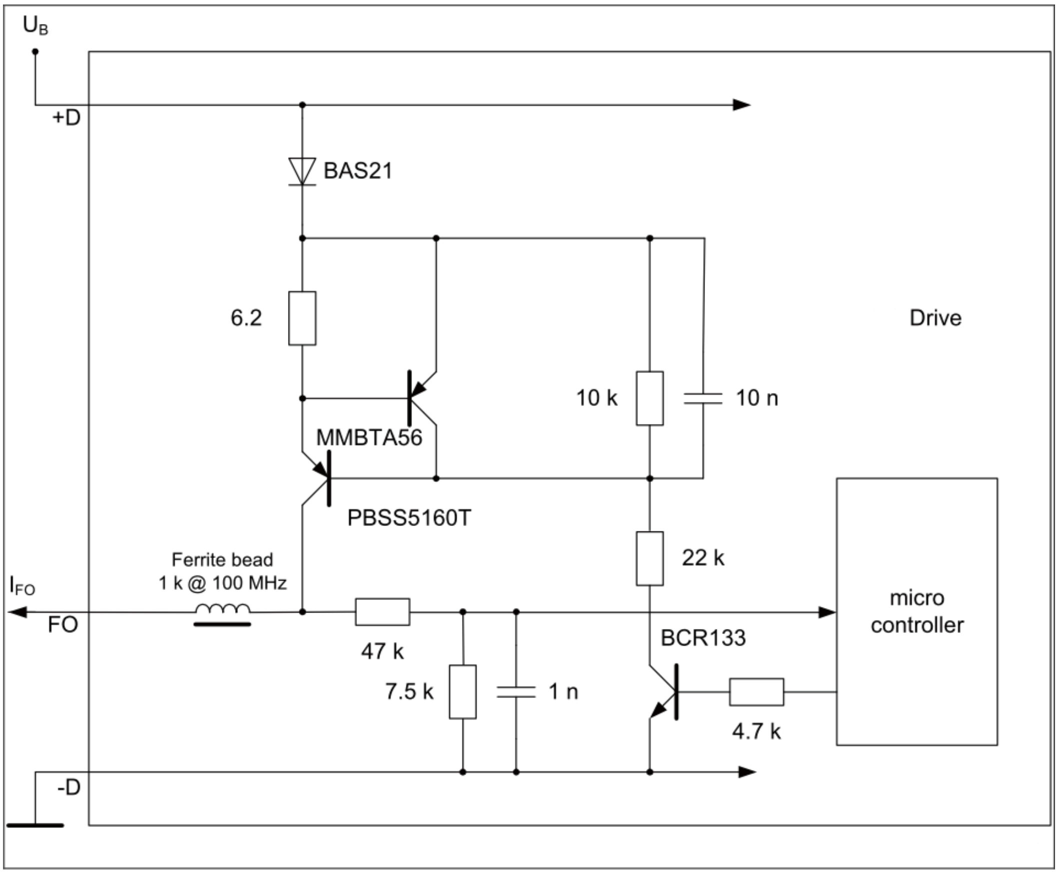


Figure 8 FO: High level active feedback output circuit diagram

7.Software function parameters

7-1.Control input PWM/E

The control input PWM/E signal is used for:

1). Set drive mode

2). Drive speed set point

The control input PWM/E signal is a PWM signal with fixed frequency and variable duty cycle.

7-2. Drive mode

Fan drives have different working modes, the main difference is the difference in current consumption:

1).Static mode

2).Activation mode

3).Operating mode

4).Failure modes

No.	Operation Mode	Consumption of current	Fan Speed
1	Static mode	<100 μA	0
2	Activation mode	<40 mA	0
3	Operating mode	Depends on required speed and load conditions	Depends on the duty cycle of the PWM signal
4	Failure modes	<40 mA	Depending on specific failure

Table 4 Drive Mode

When the PWM/E line receives a 100% duty cycle (recessive level) signal for more than (n/fPWM) ± 2%, the fan drive will enter static mode, n is a plausibility check The number of samples of the PWM period, fPWM is the PWM fundamental frequency. Therefore, the time at which the fan drive enters static mode depends on the actual PWM base frequency and the number of samples for the plausibility check.

If the duty cycle of the PWM signal reaches the ratio required for fan drive operation (see Figure 13), and the value of this duty cycle is valid, the fan drive will enter the run mode.

When there is a fault in operation, the fan drive will enter the failure mode.

7-3. Drive speed set point

The drive electronics checks the PWM signal on the control input signal PWM /E. To improve the signal-to-noise ratio, the speed of the drive is set only if the PWM signal is active and is the same for more than np out of n consecutive duty cycles (see Figure 9 and Figure 10). The value of n is set to 6 (the total number of plausibility check duty cycles), the value of np is set to 4 (the same number of duty cycles is required), the first duty cycle of the plausibility check box will be used as the remaining n- 1 reference value for duty cycle measurement.

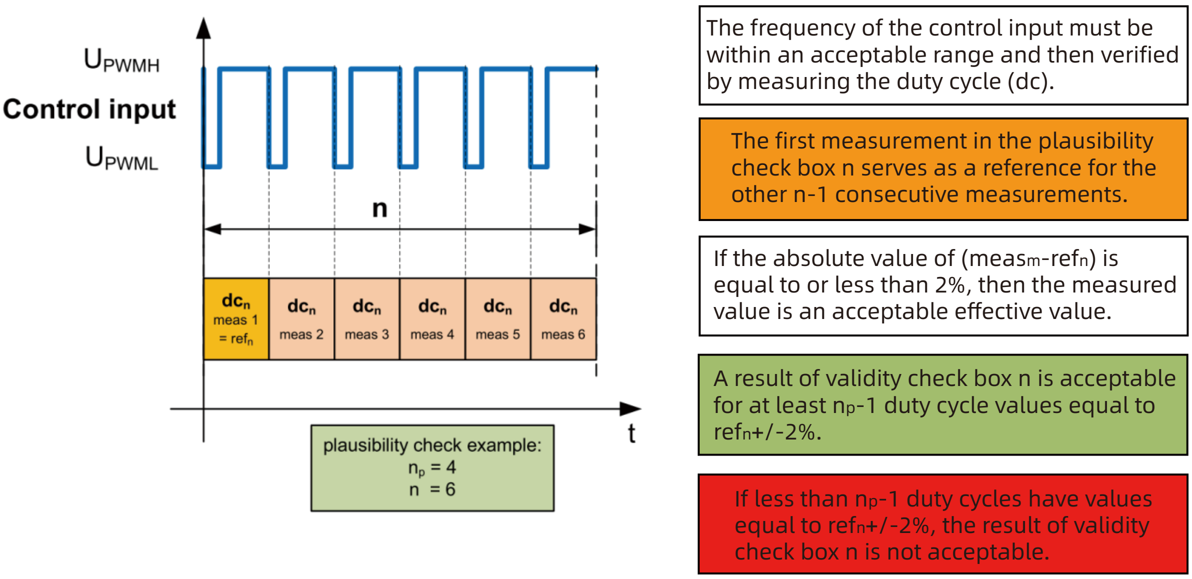


Figure 9 Plausibility check box n

The plausibility check delays the response to the PWM value.

Latency can be added for too low PWM frequency: e.g. 50Hz add 0.22s (worst case 4/6 plausibility check loses 11 samples)! This time (TPWMDELAY) depends on the value of n, n_p and the PWM frequency f_{PWM}.

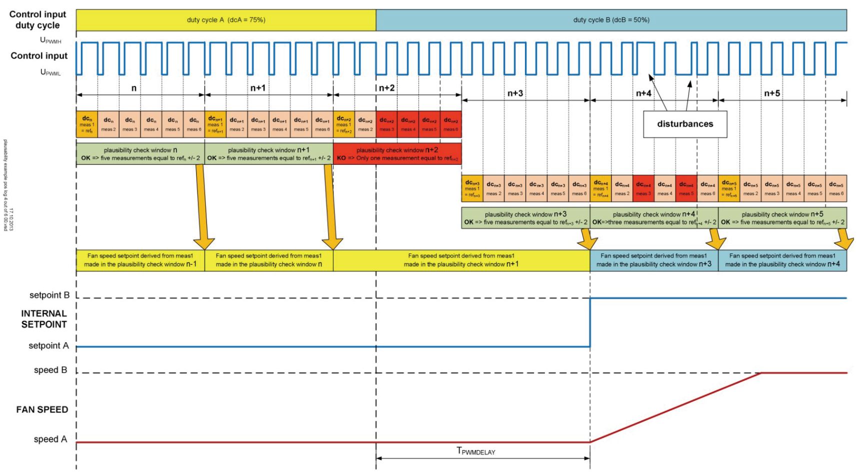


Figure 10 Example of authenticity check 4/6

7-4. Response time of drive speed set point

If the duty cycle of the PWM/E terminal changes, the driver will start to change the speed after a delay time, the delay time is $T_{PWMDELAY}$. This delay is caused by the plausibility check and depends on the PWM frequency at the PWM/E terminal, and the delay time is in the range of n/f_{PWM}~$(n+ n_p)/f_{PWM}$.

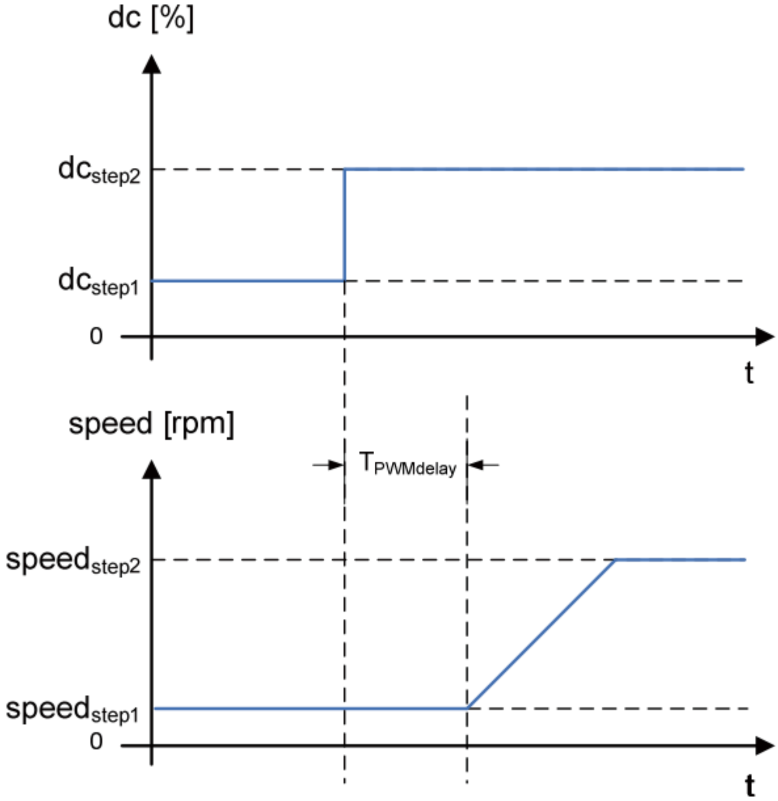


Figure 11 Drive Speed Setpoint Reaction Time

The speed can be set according to the transfer function of speed and PWM duty cycle (see Figure 13).

7-5. Transfer function of driving speed and PWM duty cycle

This transfer function refers to the relationship between the driving speed and the PWM duty cycle of the PWM/E terminal.

Refer to Figure 12 for the definition of the duty cycle, that is, "Positive Logic Duty Cycle Definition".

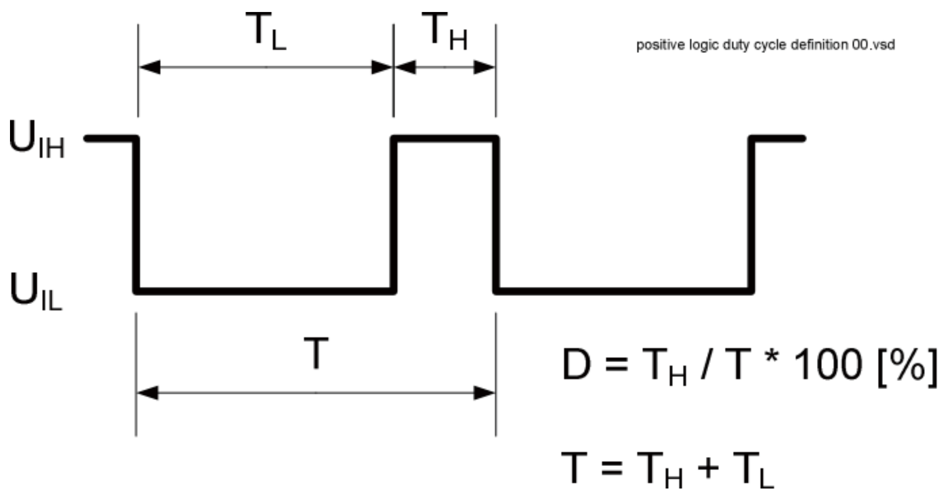


Figure 12 "Positive Logic Duty Cycle" in Duty Cycle Definition

Refer to the definition of duty cycle and the input characteristics of PWM/E:
- Continuous low state is 0% duty cycle (recessive level)
- Continuous high state is 100% duty cycle (dominant level)

Based on the duty cycle definition, this transfer function is shown in Figure 13.

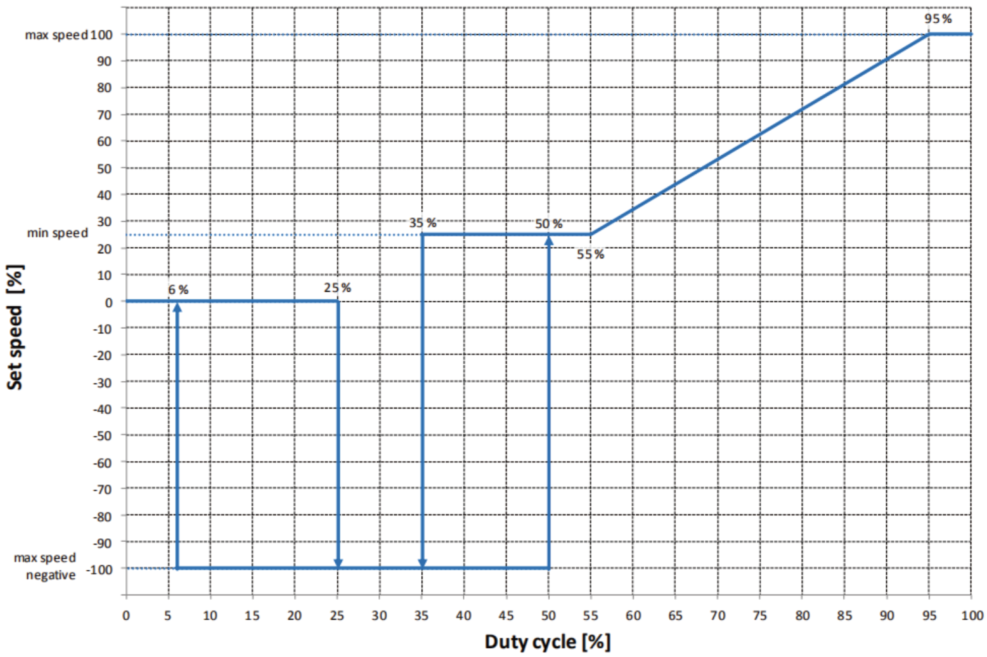


Figure 13 Transfer function of driving speed and PWM duty cycle

7-6. Failure mode of driving mode

The feedback output signal FO* is used to inform the drive of failure modes (see Section 7.6.3). When encountering the following conditions, the fan driver will enter the failure mode and stop driving.

1).Drive stalled

2).Driver overheating

3).Undervoltage

4).Overvoltage

5).Overcurrent

6).Drive internal failure

7-6-1. Failure mode of drive stall

There are two possibilities to cause the drive to stall: drive internal factors (small probability) and drive external factors (high probability). For example, snow accumulation may cause the fan to stall, but after a certain period of operation, the heat accumulated due to the fan stalling will make the fault (snow accumulation) disappear, and the fan can then run again. The following recovery strategies are used to improve availability.

After the first detection of a drive stall, the drive waits for 5 seconds before attempting to start again. If it still fails, the driver will wait for

Increase the time by 5 seconds and try to start again. The interval increases all the way up to 25 seconds, and the driver will keep trying to start for as long as there is a valid PWM duty cycle to run the drive.

The maximum interval is set so that the fan will not overheat due to frequent attempts to start at the highest ambient temperature.

7-6-2. Failure mode of drive internal failure

The failure causes of the internal failure mode of the drive can be roughly summarized as the following points:

- failure of the voltage measurement chain
- faulty current measurement chain
- failure of the temperature measurement chain
- failure of the rotor position signal measuring chain
- MOSFET drive circuit failure

7-6-3. Failure Mode Notification

The output FO is always at recessive level when the drive is in standstill mode, active mode and running mode (until the minimum speed is reached).

If the driver is in fail mode, the output FO is pulled to the dominant level.

After exiting the failure mode, the output terminal FO will be pulled back to the recessive level.

Exception:

In the failure mode of undervoltage and overvoltage, there will be no fault notification, because the stopping of the drive is not caused by the problem of the drive, but by external factors.

7-6-4. Fault recovery strategy

The design of the driver complies with the following basic and mandatory requirements:

Under no circumstances can any driver failure trigger a subsequent failure that could lead to a major accident of the vehicle.

After ensuring the above security requirements, it is still necessary to meet the maximum availability requirements of the driver.

This means that a corresponding restart process or method should be configured for all failure modes.

In any case, the driver will attempt to recover from the fault when it receives a valid PWM signal that requires the driver to operate. If the fault disappears, the drive should immediately exit the failure mode.

8.Voltage

Item	Min. value	Typical value	Max. value	Unit
Nominal supply voltage		24.0		V
Operating supply voltage range (measured at the connector)	16.0		32.0	V
Mains voltage at which the fan reaches max. speed (measured at the connector)	13.0		32.0	V

Table 5 Specifications of power supply voltage (measured at the connector)

9.Fuse protection

According to ISO8820 part 3, specified fuses must be used in the wiring. The specific fuse rating needs to be determined by the customer with reference to the specific application (such as the harness length of the application vehicle, the section thickness of the power harness, and the type of fuse).

10.Residual ripple of power supply

The max. value of power supply residual ripple RMS that the driver can accept is 1%.
If high residual ripple is present in the application, please contact Krubo Company to find a solution for your specific requirements.

11. Reverse polarity protection

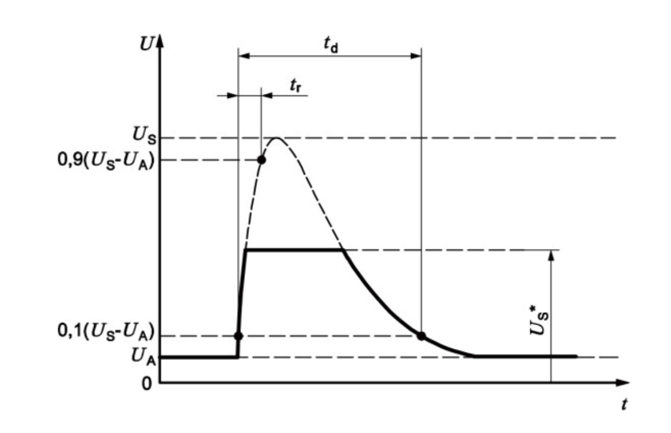
The drive circuit is protected against reverse polarity, which ensures that the drive will not malfunction when the power line is temporarily or permanently reversed during application. In this case, the motor stops and the feedback output signal is not activated. Class C functional status as defined by ISO16750-1 (fan is properly connected and fully functional after completion of reverse polarity test). The requirements of Chapter 9 (fuse protection) must be applied.

Item	Data	Unit
Reverse supply voltage	-27.0	V
Temperature	Room temperature	K
Time	2	Min.

Table 6 Reverse polarity protection test parameters

12.Throw load protection

Type of pulse：5b(inhibited)		
Item	Value	Unit
Peak pulse voltage（US）	65	V
U_A	28.0 ± 0.2	V
Internal resistance（Ri）	6	Ω
Pulse duration (td)	350	ms
Rising slope (tr)	10 (0/-5)	ms
Pulse number	10	#
Pulse interval	60	s



13.Typical values of rated parameters

·Working temperature range: -40 ~ +120 ℃
·Storage temperature range: -40 ~ +125 ℃
·Service life: up to 40,000 hours depending on the application environment.

14.Speed

Item	Data	Unit
Min.Speed	850	RPM
Max.Speed	3400	RPM

Table 6 Axial Fan K-DC318-A24-34 Speed range

15. Thermal Derating Curve

This curve is referenced to steady state (continuous) operating conditions.

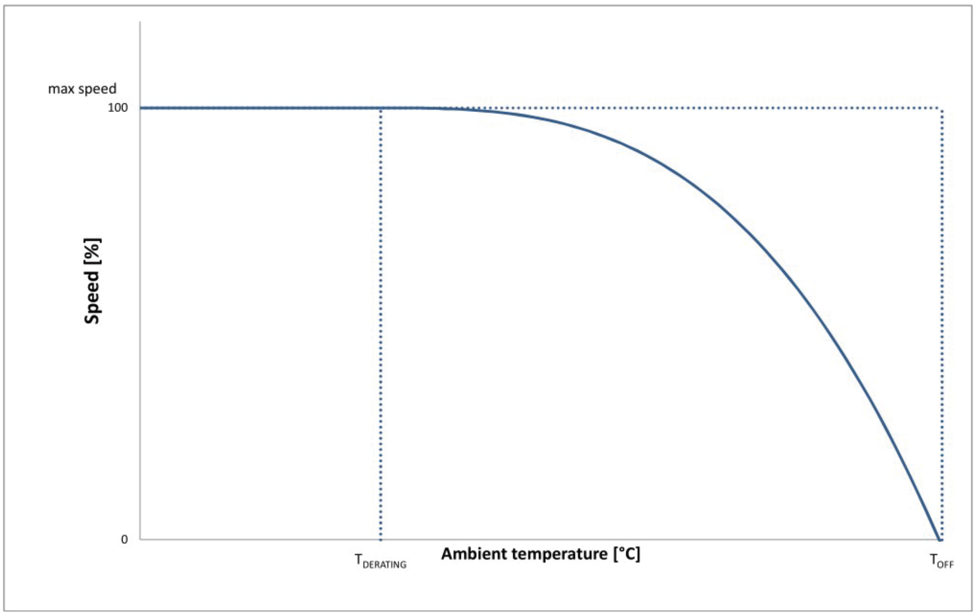


Figure 14 Thermal Derating Curve

Item	Typical value	Unit
Derating temperature	+95	℃
Stop temperature	+120	℃

Figure 14 only depicts the thermal derating characteristics.

The derating of axial fan K-DC318-A24-34 and the value of the stop temperature TOFF are nominal values.

Due to the thermal inertia of the system, a change in ambient temperature of a few minutes will not affect the thermal derating curve of the axial fan speed.

Note: The above data are assuming the fan is under "normal" load conditions. If the fan is overloaded, the speed of the axial fan will reach the thermal derating state earlier.

16.Performance of sealing

The fan is designed according to IP6K9K and IP68 protection levels.