SPECIFICATION

MODEL
K-DC097-G24-09

1.Unit definition

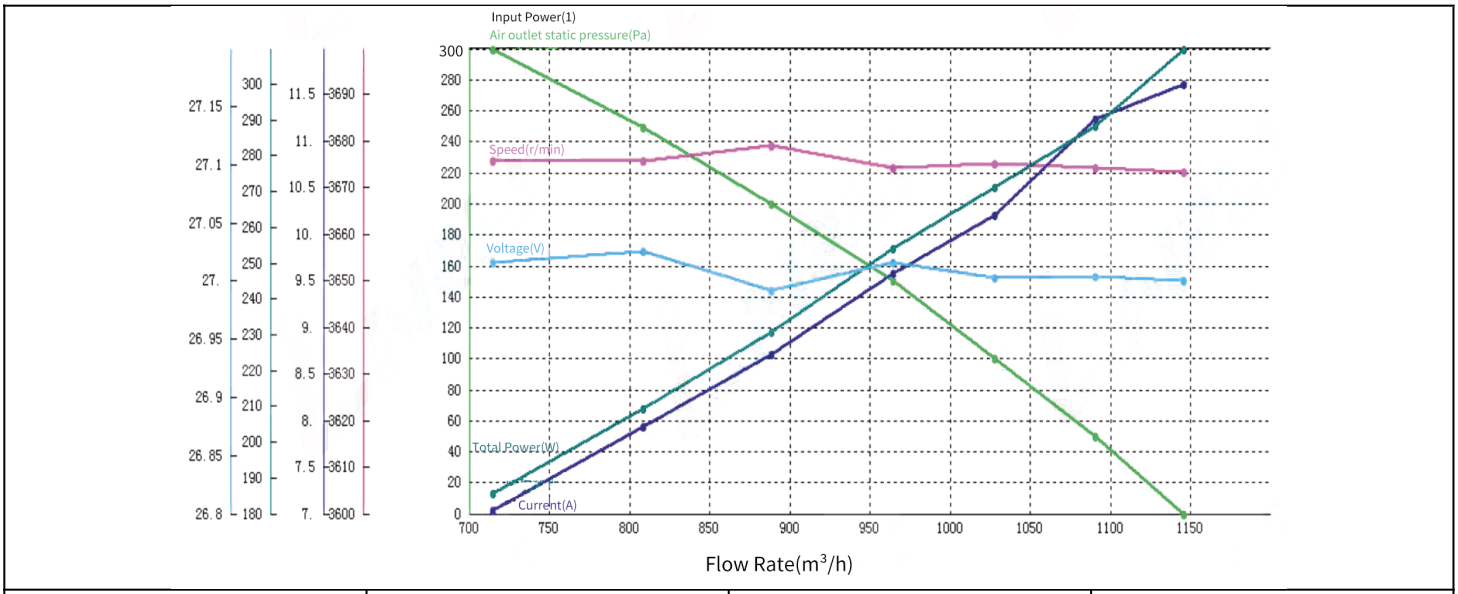
Unit		Physical Significance	Prefix	Unit Of Counting	
%	Percentage	Proportion	M	10^{6}	Million
Ω	Ohm	Resistance	K	10^{3}	Thousand
℃	Celsius	Temperature	m	10^{-3}	Milliseconds
A	Ampere	Electric Current	μ	10^{-6}	Micro
h	Hour	Time	n	10^{-9}	Accept
Dba	Decibel (A Sound Level)	Sound Intensity Level			
Hz	Hertz	Frequency	P	10^{-12}	Pico
Min	Minute	Time			
Pa	Pascal	Pressure			
Rpm	Rpm	Rotation Frequency			
S	Second	Time			
V	Volt	Voltage			
W	Watt	Power			

Key Words	Definition
CCU	Central control unit
Drive	Integration of Motors and Circuits
PWM	Pulse width modulation
R_i	Internal impedance
SBL	Brushless sealed motor
T	Temperature
T_{AMB}	Ambient temperature
U_b	Power voltage
U_n	Nominal voltage
rms	RMS

2.Nominal Data

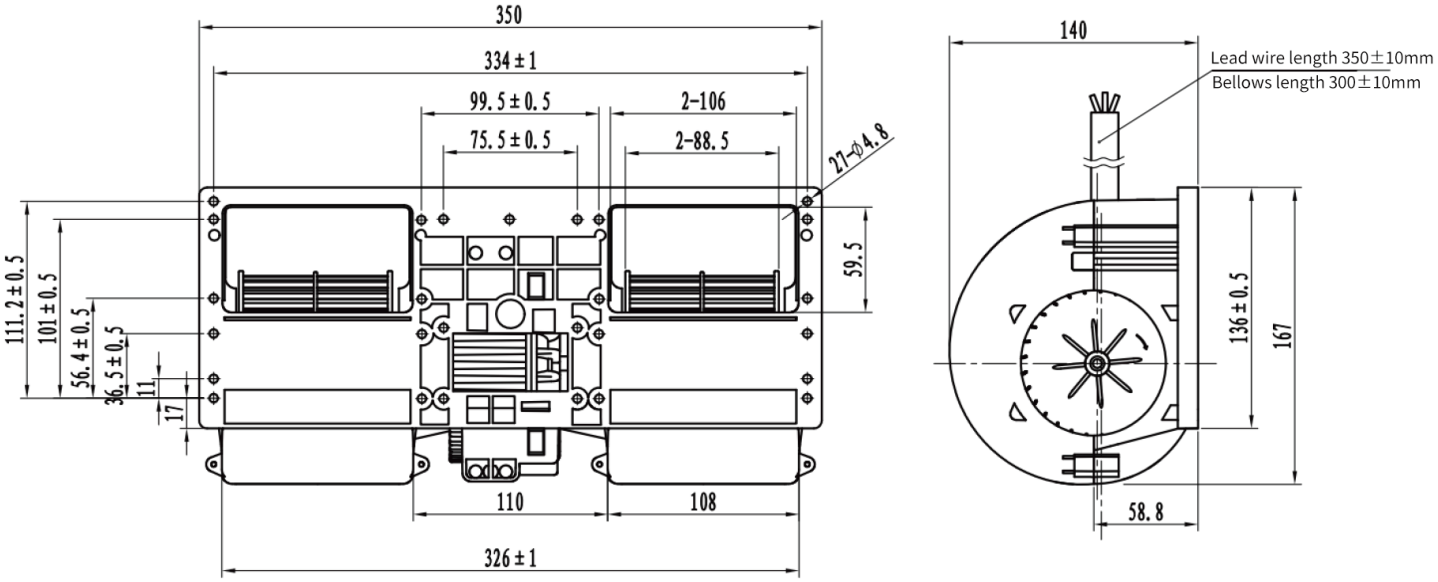
Maximum speed	rpm	3650@(27V)
minimum speed	rpm	900
Noise level at maximum speed	dBA	76,1 meter away
weight	kg	2.3
Working voltage range	V	16-32.0,connector
Voltage up to maximum speed	V	24.0,connector
Working environment temperature range	℃	-40～+85
Speed derating threshold	℃	+85（1）
storage temperature range	℃	-40～+125
life	h	20000h,depends on the application environment
Time from 0 RPM to full RPM	S	14
Load dump protection (pulse 5b)	V	65 (Pulse peak voltage U_s * - ISO16750-2:2010)
reverse polarity protection		YES
Notes:(1) Due to the thermal inertia of the system, rapid temperature changes will not cause the fan to derate. Overloading may have the expectation of causing derating.		

3.Air volume curve



Power Voltage	27.0V （Connector）	Test no	2020063015
Air density	1.138kg/m³	Ambient temperature	25℃±5℃

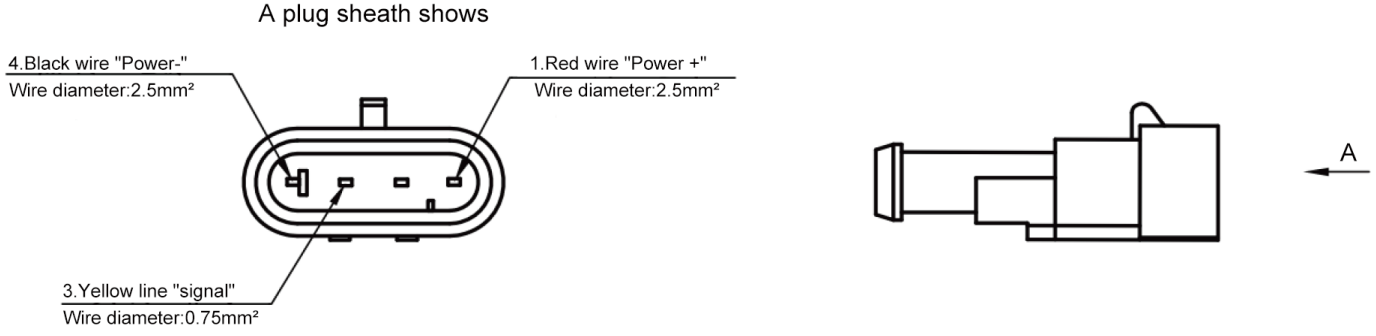
4.Product Drawing



All dimensions in the above figures are in mm. Use M4 screws to fix the fan, and the nominal tightening torque is 3 +1/0Nm.

The definition of the nominal tightening torque applies to new, clean and lubrication-free bolts.

5.Connectors and Harnesses



Connector: AMP 282106-1			
Id.	Positive pole of power supply +D	PWMA/E	Negative pole of power supply -D
Terminal No.	1	3	4
Harness color	Red	Yellow	Black
Section[mm²]	2.5	0.75	2.5

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

6.Technical description

Standard		Conform to the regulations in QC/T 708.
IP rating		IP68、IP6K and IP9K
Allowable maximum power supply ripple factor	rms	3.5% (depending on actual working conditions)
Fuses		According to ISO8820 Part 3, specified fuses must be used in the wiring.

7.Test conditions

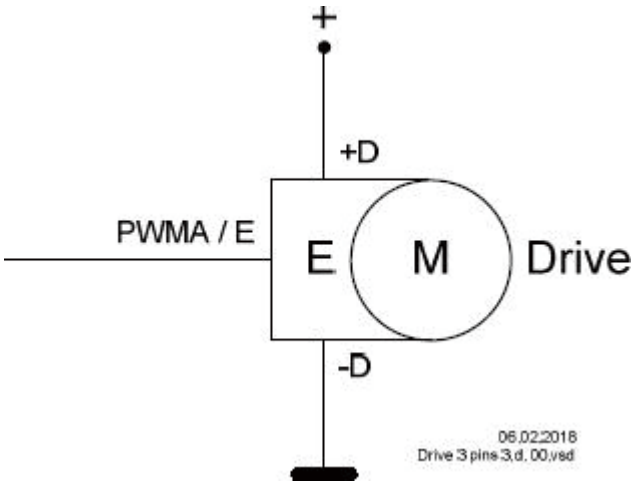
Unless otherwise stated, the following are the fan test conditions:

- T_{AMB} = 25 °C ± 5 °C and
- U_B= 27.0 V ± 0.2 V (Fan Connector Location)

8.Hardware function parameters

8-1. Fan drive

The fan drive diagram is as follows.



E stands for the whole circuit part and M stands for the motor. Drive stands for motor and circuit integration.

8-2. Functions of each lead wire driven by the fan

The electrical portion of the driver consists of three leads:

Power leads:

- Positive power supply: +D
- Negative pole of power supply: -D

Signal leads:

1.Input: High-level active digital PWM input / Analog input: PWMA/E

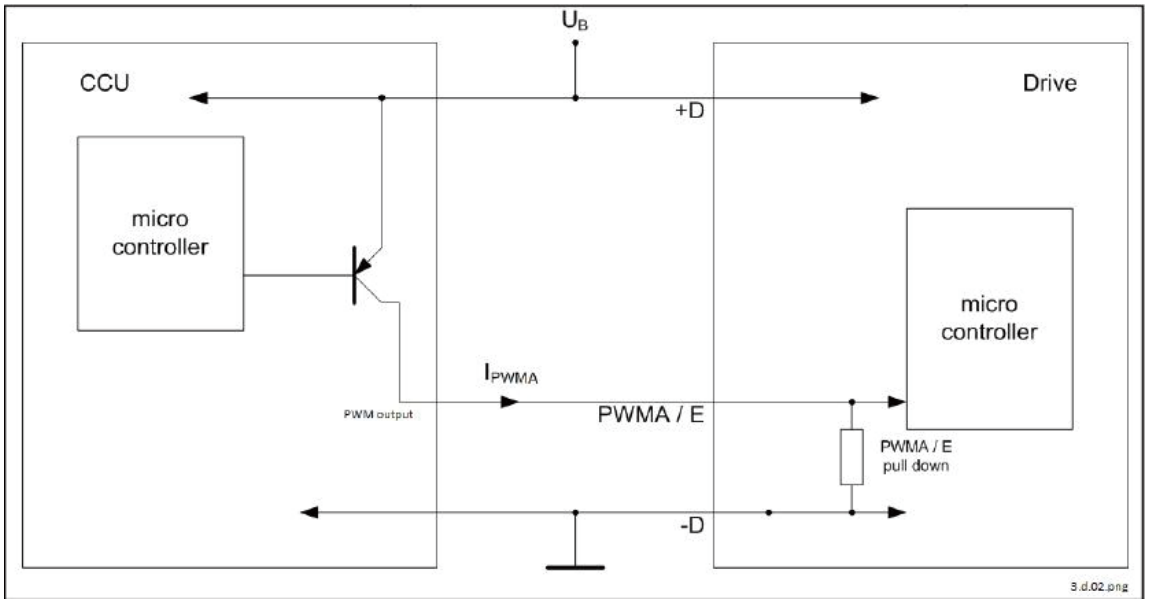
The signal lead PWMA/E is used to control the drive mode, which is the control input.

The PWMA/E lead can input either an active-high PWM signal or an analog signal.

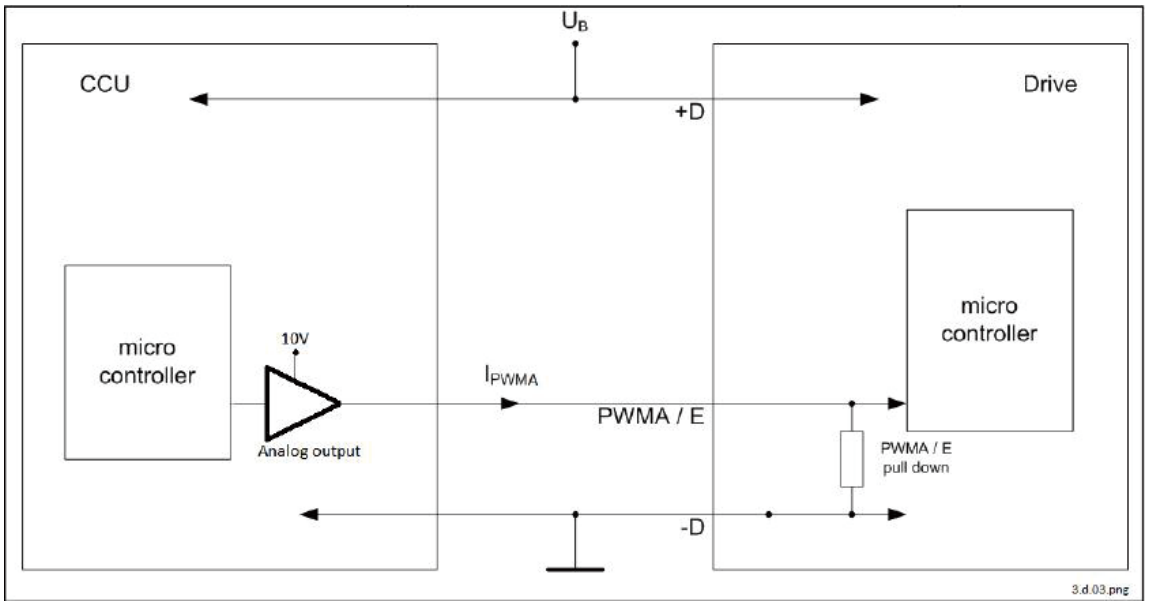
The reason why it is called digital PWMA high-level active input is because the way PWMA/E processes the input PWM signal is: the PWMA signal is filtered and processed, and then read by the microcontroller in the drive circuit as an analog signal input. In this mode, relatively high base frequency PWMA (>100Hz) can be used.

9.Driver interface

The drive interface is the wiring diagram of the CCU and the fan drive module



Input active high digital PWM signal



Input analog signal

The circuit of CCU and the circuit of fan drive are connected through a unidirectional wiring harness.

The PWMA signal input to the PWMA/E line comes from the CCU, and a pull-down resistor (PWMA/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 PWMA/E is high. When the input is a PWM signal, the high level is provided by the internal pnp transistor of the CCU when it is turned on (as shown in the figure above), and when an analog signal is input, it is set by the internal analog input of the CCU.

10.Hardware interface: PWMA / E lead

10-1. Digital Control: PWMA / E lead

Input PWMA / E activates the fan drive from static mode. Any PWM duty cycle will wake up the fan driver as long as the dominant level time of the input exceeds Twakeup.

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

Data	Min. Value	Typical Value	Max.Value	Units	Code
PWMA / E (Frequency Range)	50	100	500	Hz	f_{PWM} 3)
PWMA / E (Duty Cycle Range)	0		100	%	dc_{min} .. dc_{max}
PWMA / E (High level)	12			V	U_{PWMH} 1)
PWMA / E (Low level)			1	V	U_{PWML} 1)
PWMA / E (Resolution)		±1		%	dc_{resol}
PWMA / E (Accuracy)		±3		%	dc_{accu}
PWMA / E (Current)	-10%	0.45	+10%	mA	I_{PWMA}
PWMA (Activation duty cycle)	4	7	9	%	dc_{Eact}2)
PWM/E (Leakage current (static))			4	μA	
E (Wake up level)	1.4			V	DC_{PWMA} 1)
PWMA / E (Wake-up pulse)	150			μs	T_{wakeup}

1) The PWMA threshold requires the operating temperature range of the circuit to be -40°C to 120°C;

2) The activation level dcEact requires the circuit to operate over a temperature range of -40°C to 120°C.

10-2. Analog Control: PWMA / E lead

Input PWMA / E activates the fan drive from static mode. Any voltage above DCPWMA will wake up the fan driver.

Data	Min. Value	Typical Value	Max.Value	Units	Code
PWMA / E (Rated Voltage Range)	0		10	V	
PWMA / E (Current)	0		100	mA	I_{PWMA} at 10V
PWMA / E (Max. Absolute Voltage)	-32		35	V	
PWMA / E (Leakage current (static))			1	μ A	
PWMA / E (Wake up level)	1.4	±1		V	DC_{PWMA} 1)

11.Software functions

11-1.Drive mode

There are four working modes for fan drive, the main difference is the difference in current consumption:

1. Static mode
2. Activation mode
3. Operating mode
4. Failure modes

The drive mode of the fan varies with the duty cycle of the control input pin PWM*/E* and the analog input voltage level of pin A.

NO.	Drive Mode	Current consumption	Driver 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 duty cycle of PWM signal or analog input voltage level.
4	Failure modes	< 40 mA	Depends on fault and alarm

When PWMA/E receives a 0% duty cycle (recessive level) signal, the fan drive enters static mode,

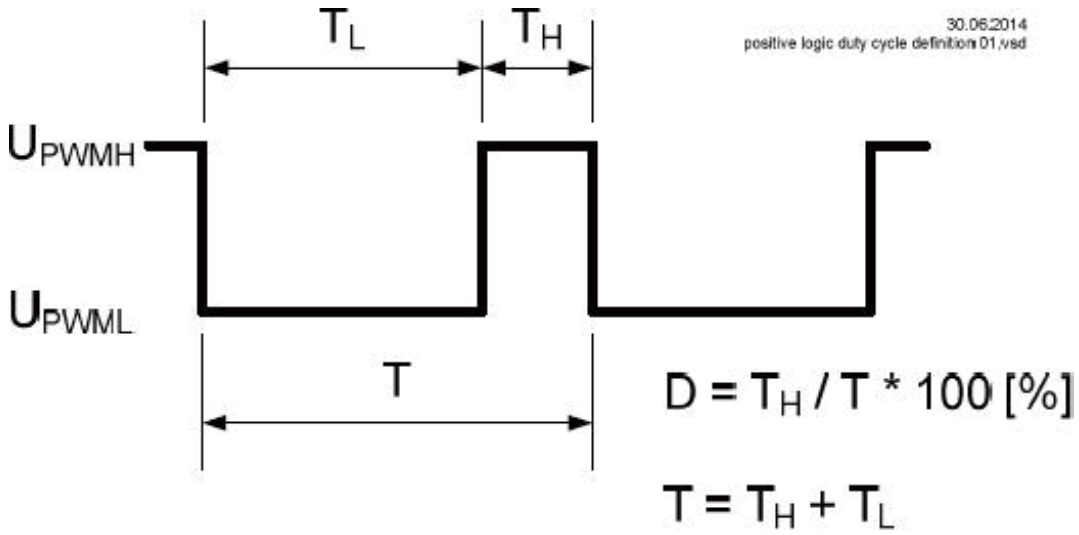
When the PWM duty cycle is greater than dcEact and the conditions in section 12 are met, the fan driver will enter active mode.

If the duty cycle of the PWM signal input to the PWMA/E lead reaches the ratio required for the fan drive to operate, the fan drive will enter the run mode, see Section 13.2.

In the event of an operational failure, the fan drive enters a failure mode (see 13.5).

11-2.Digital Control: PWM Input Transfer Function

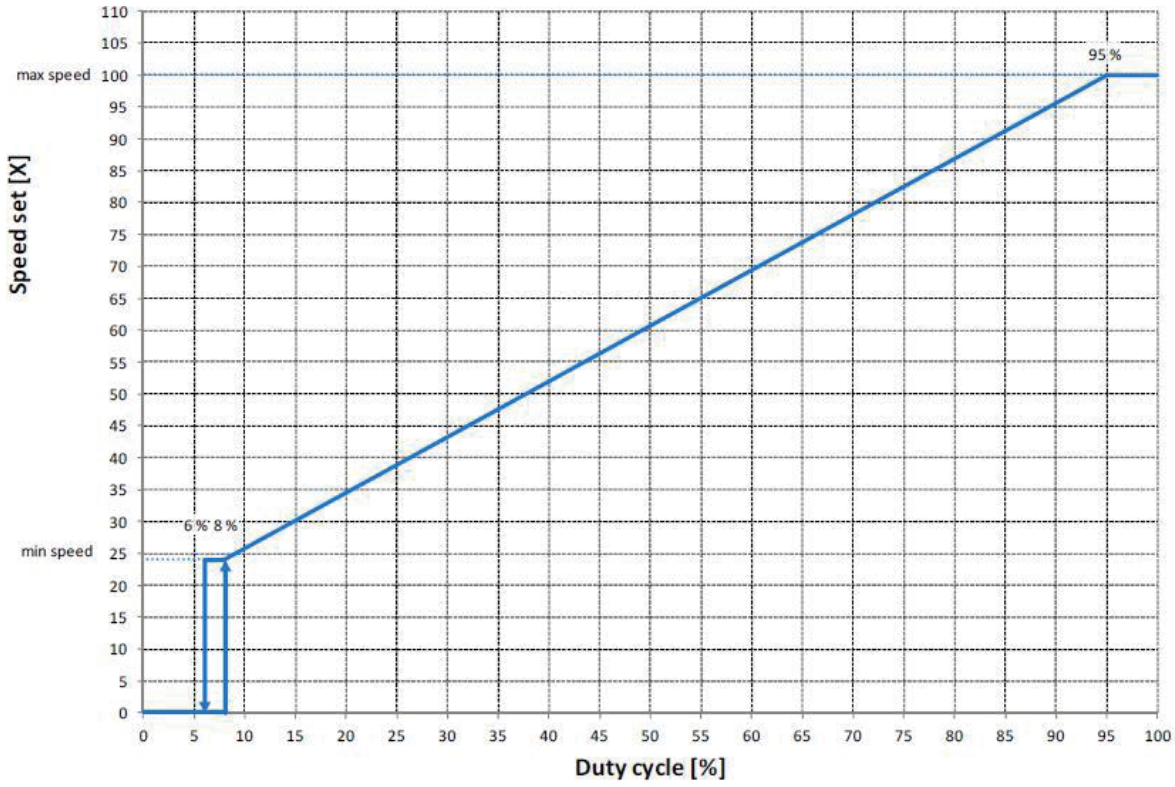
The PWM input transfer function refers to the relationship between the driving speed and the duty cycle of the PWM signal received by the PWMA/E signal line, and is active at high level.



Refer to the definition below:

- Continuous low state is 0% duty cycle (recessive level);
- Continuous high state is 100% duty cycle (dominant level)

Based on the duty cycle definition, the PWM input transfer function is shown in the figure below.



Static pressure 0Pa, PWM input transfer function.

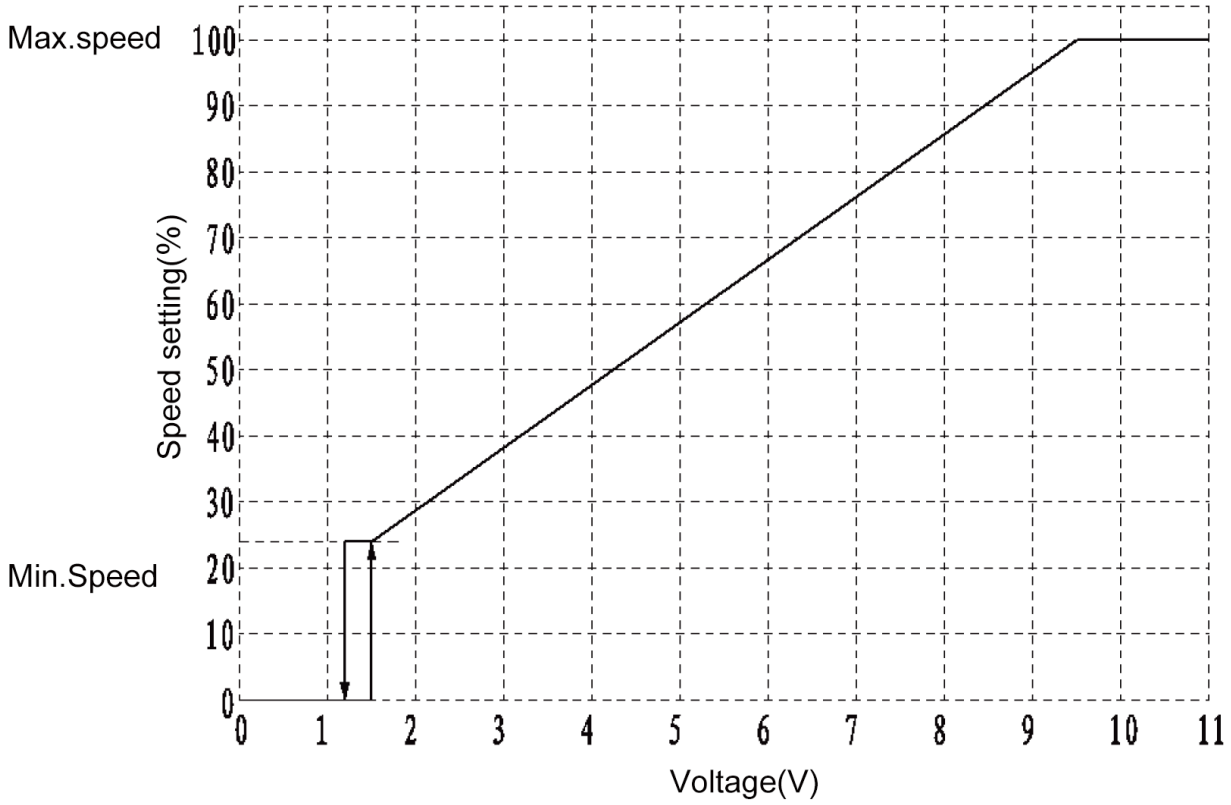
11-3.Digitally Controlled Drive Speed Setpoint

The drive electronics checks the PWM signal on the control input signal PWMA/E. To improve the signal-to-noise ratio, the speed of the drive is only set when the PWM signal is active and the duty cycle is the same for enough consecutive periods.

The plausibility check slightly delays the driver's response to a change in the PWM duty cycle value. The delay time is 0.2s or less.

11-4.Analog Control: Analog Input Transfer Function

The transfer function of the analog input refers to the conversion relationship between the driving speed and the analog voltage on the PWMA/E signal line, please refer to the figure below:



11-5.Driver Failure Modes

failure mode	Troubleshooting	Fault Feedback(*)
Drive stalled	Once a locked rotor is detected, the following strategy will be implemented: After a locked rotor is detected, the drive waits for 5 seconds before trying to start again. If it still fails, the driver will increase the wait 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.	N/A
drive overload	By detecting the current, once the drive is found to be overloaded, the fan will work at reduced speed.	N/A
overcurrent	Once the current reaches the overcurrent threshold, the driver will stop working.	N/A
drive overheating	When the drive is detected to be overheated (derating temperature point), the fan will reduce the speed to work; When the maximum operating temperature point is exceeded, the driver will stop working.	N/A
overvoltage/undervoltage	If the supply voltage exceeds the operating voltage range, the drive will stop working.	N/A
internal failure	When an internal fault is found during the boot self-test, the drive will stop working.	N/A

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. No fault feedback since there are no leads to feed the signal back to the CCU.