

CC6409

5V/12V 400mA Single Coil Fan Driver with Auto-Restart and Reverse Connection Protection

General Description

CC6409 is a one-chip solution for driving single-coil DC brushless fans and motors, which is fabricated with innovative high voltage BiCMOS process. The IC includes high sensitivity hall sensor, chopper stabilized amplifier, dynamic offset cancellation, thermal protection and a low $R_{DS(on)}$ full bridge driver.

CC6409 has auto-restart function. When the fan is mechanically blocking, IC will shutdown the coil current and restart every time until the blocking release. Thus, the current of coil is low enough and protect the fan from over-heating.

CC6409 integrated reverse connection protection function, without external reverse connection protection diode, saving cost for customers.

CC6409 is available in TO-94 and SOT335 packages. The operation temperature range is $-40\sim 125^{\circ}\text{C}$.

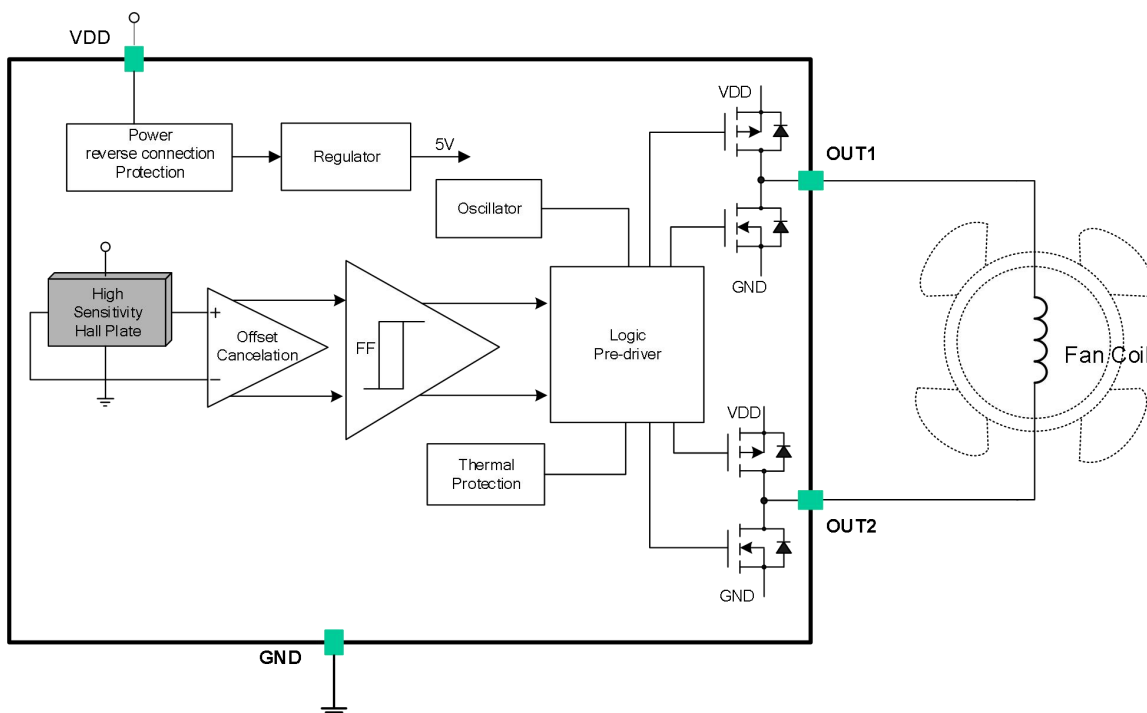
Features

- ◆ Locked Rotor Protection and Auto-restart
- ◆ Built-in High Sensitivity Hall Sensor
- ◆ Fan Power Reverse Connection Protection
- ◆ Maximum Continuous Driving Current: 400mA
- ◆ Low Power Consumption, Typical 2.3mA
- ◆ Good Temperature Stability
- ◆ Mechanism Resistive
- ◆ ESD (HBM) 6000V

Application

- ◆ Single Phase BLDC Fans
- ◆ Single Phase BLDC Motors

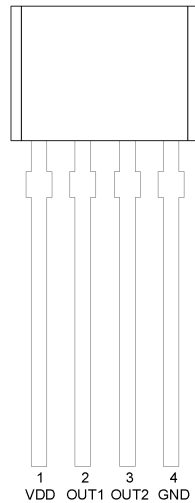
Function Block Diagram



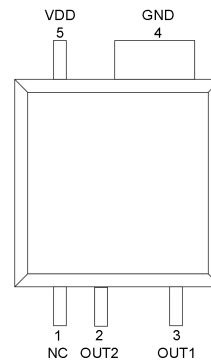
Ordering Information

Part No.	Packing Form	Package Code
CC6409TO	bulk, 1000 pcs/bulk	TO (TO-94)
CC6409SS	Tape reel, 10000pcs/reel	SS (SOT335)

PIN Configurations



TO-94



SOT335

Pin Name	Number (TO-94)	Number (SOT335)	Function
VDD	1	5	Supply Voltage
OUT1	2	3	H bridge output 1
OUT2	3	2	H bridge output 2
GND	4	4	GND
NC	-	1	NC

Absolute Maximum Ratings

Parameter	symbol	value	unit	
Fan supply voltage	V_{DD}	20	V	
Peak Output Current	I_{PEAK}	1000	mA	
Continuous Output Current	I_{CONT}	TO-94	400	mA
		SOT335	320	
Operating Temperature Range	T_A	-40~125	°C	
Junction Temperature	T_J	160	°C	
Thermal Resistance Junction - Ambient	R_{thJA}	TO-94	227	°C/W
		SOT335	195	
Storage Temperature	T_S	-55~150	°C	
Magnetic Flux Density	B	Unlimited	mT	
ESD susceptibility (HBM)	ESD(HBM)	6000	V	

Note: Exceeding the absolute maximum ratings may cause permanent damage. Exposure to absolute-maximum rated conditions for extended periods may degrade device reliability.

Recommended Operation Conditions

Parameter	symbol	MIN	MAX	unit
Fan supply voltage	V _{DD}	2.5	20	V
Continuous Output Current	I _{OUTC}	-	350	mA
Ambient Temperature	T _A	-20	85	°C

Electrical Parameters (V_{DD}=12V @ 25°C room temperature, unless specified otherwise)

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Fan Supply Voltage	V _{DD}	-	2.5	-	20	V
Power Clamp Voltage	V _{CLP}	Power supply series resistance 100 Ω	-	24	-	V
Supply Current	I _{DD}	-	-	2.3	4	mA
Output V _{SAT} (sink)	V _{SAT}	V _{DD} =14V, I _{out} =200mA	-	0.2	-	V
Output V _{SAT} (source)		V _{DD} =14V, I _{out} =200mA	-	V _{DD} -0.4	-	V
Output Rise Time	t _r	R _L =820Ω, C _L =20pF	-	1	-	us
Output Fall Time	t _f	R _L =820Ω, C _L =20pF	-	2	-	us
Output Dead Time	t _{Dead}	R _L =820Ω, C _L =20pF	-	35	-	us
Locked Rotor ON Time	T _{ON}		-	0.33	-	s
Locked Rotor OFF Time	T _{OFF}		-	2	-	s
Reverse Current	I _{REV}	V _{DD} = -25V	-	-	1	uA

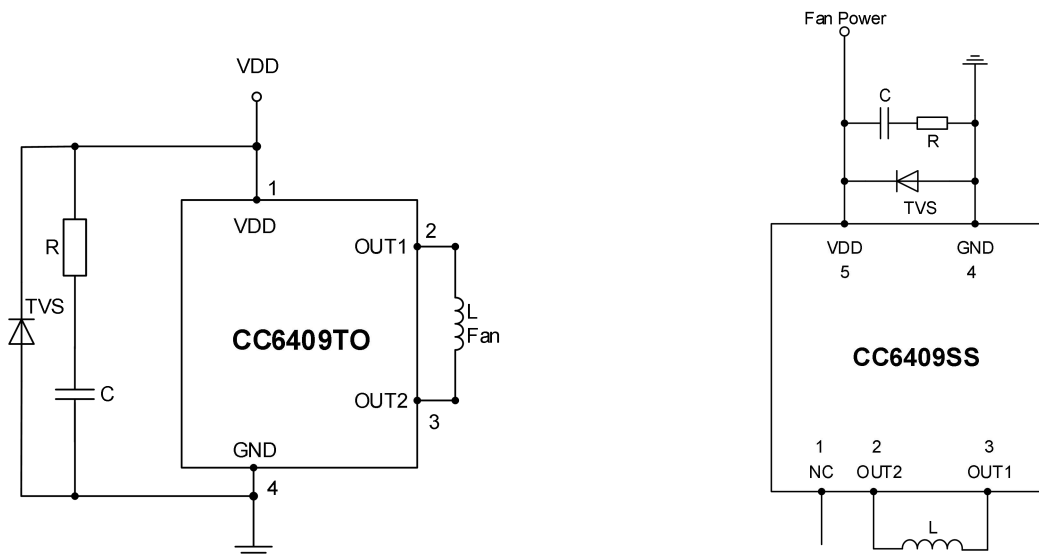
Magnetic Specifications

Parameter	Symbol	Min	Typ.	Max	Unit
Operate Point	B _{OP}	5	25	45	Gauss
Release Point	B _{RP}	-45	-25	-5	Gauss
Hysteresis	B _{HYS}	20	50	80	Gauss

Driver Output vs. Magnetic Pole

Parameter	Test Condition	OUT1	OUT2
North Pole	B < B _{RP}	High	Low
South Pole	B > B _{OP}	Low	High

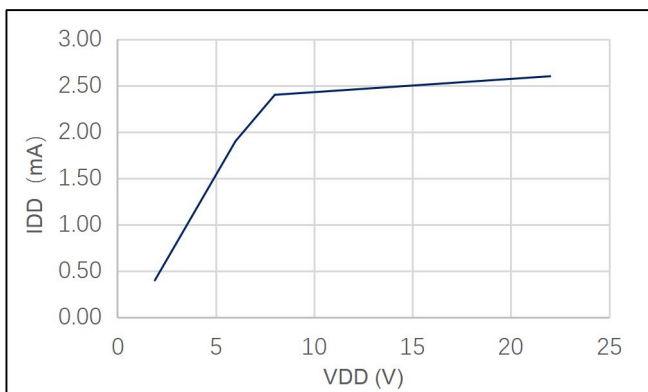
Typical Application Circuit



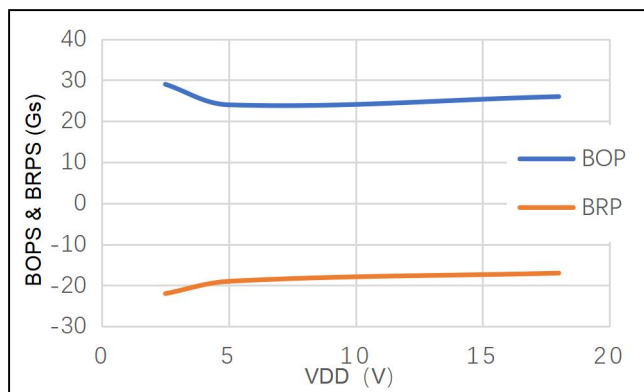
Note:

- a) Bypass RC circuit (recommended) can reduce the electromagnetic noise of the fan, while absorbing the fan coil surge current, improve the reliability of the fan, the specific parameters are related to the actual model, rotation current, starting current, etc.
- b) TVS is optional, which can improve the ability to absorb external abnormal conditions.

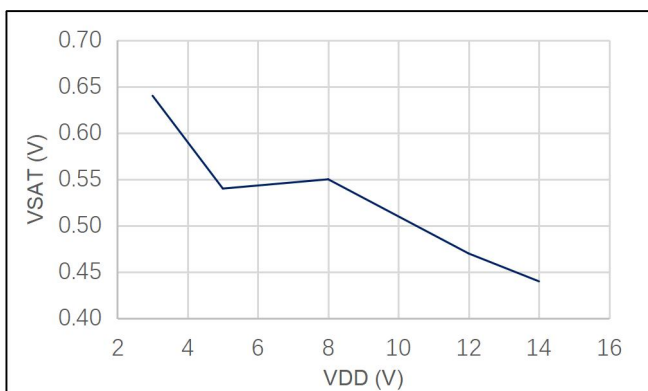
Waveform



IDD vs. VDD



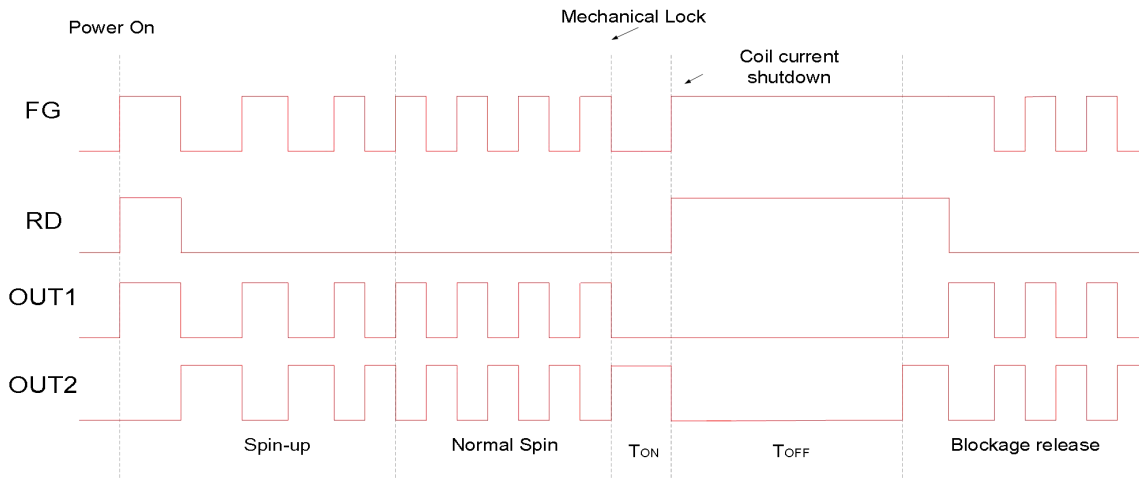
BOP&BRP vs. VDD



VSAT vs. VDD

Typical Application Waveform

CC6409 is an efficient one-chip solution for driving single-coil brushless DC fans and motors. The locked rotor protection will shutdown the coil current when the rotor is mechanically blocked over 0.33s. And try to restart every 2s until the locking is released. The current flow through the coil is only 1/7 of normal operation, to prevent fans from the damage of overheat.



Power Dissipation & Maximum Output Current

The power dissipation is determined by the following equation (Note: K is the recommended coefficient):

$$P_{D(MAX)} = (T_J - T_A) / \theta_J \times K$$

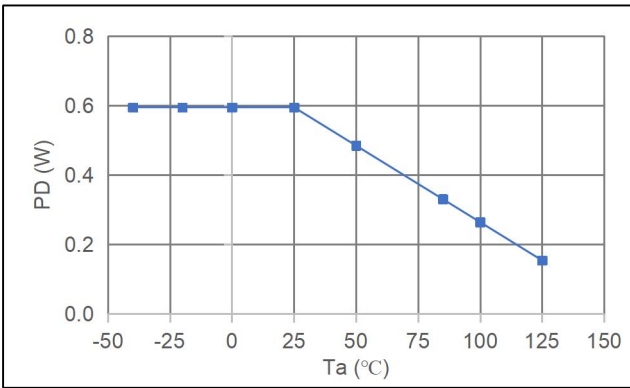
While normal operation, the power dissipated in CC6409:

$$P = I_{CONT}^2 \times R_{DS(ON)} + V_{DD} \times I_{DD}$$

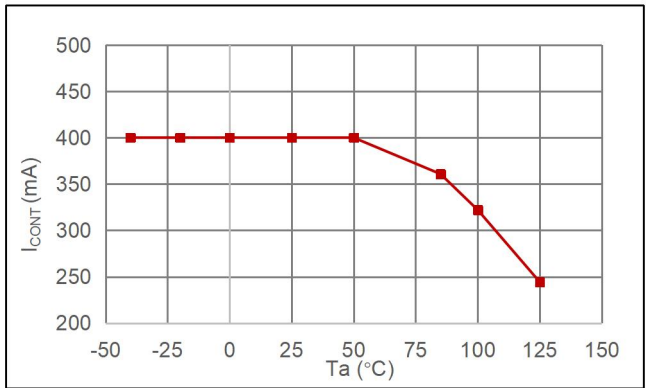
The maximum output current I_{MAX} :

$$I_{MAX} = \sqrt{(P_{D(MAX)} - V_{DD} \times I_{DD}) / R_{DS(ON)}}$$

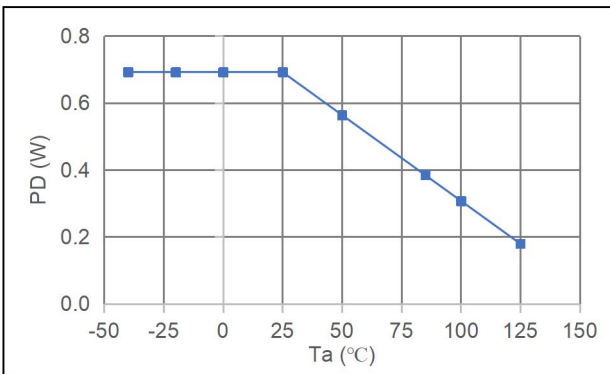
The PD curve and the output current curve:



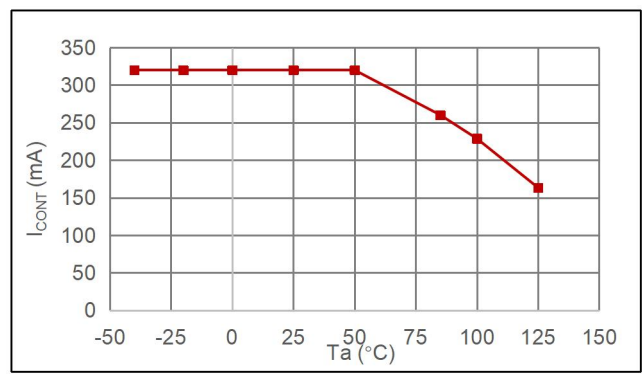
Power Dissipation of TO-94



Maximum Output Current TO-94



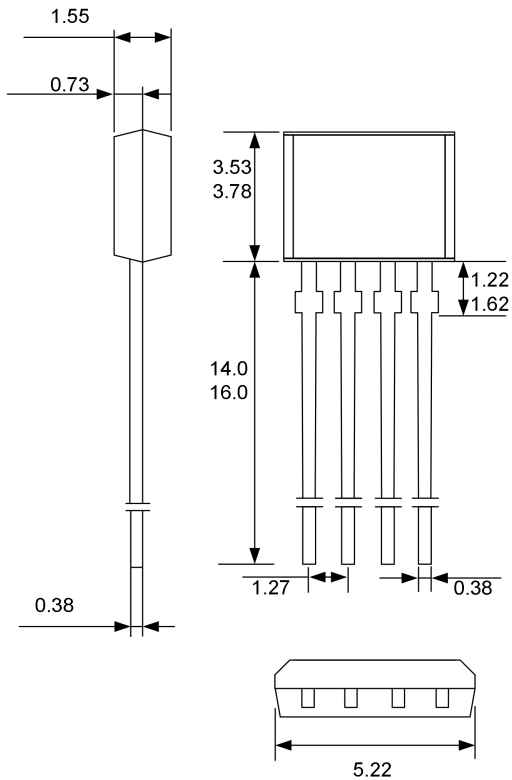
Power Dissipation of SOT335



Maximum Output Current SOT335

Package Informations

1) TO-94 Package



Notes:

1. All dimensions are in millimeters
2. In order to maintain the reliability, it is suggested that the pin length should be greater than 2.5mm.

Marking:

1st Line: CC6409 - Name of the device

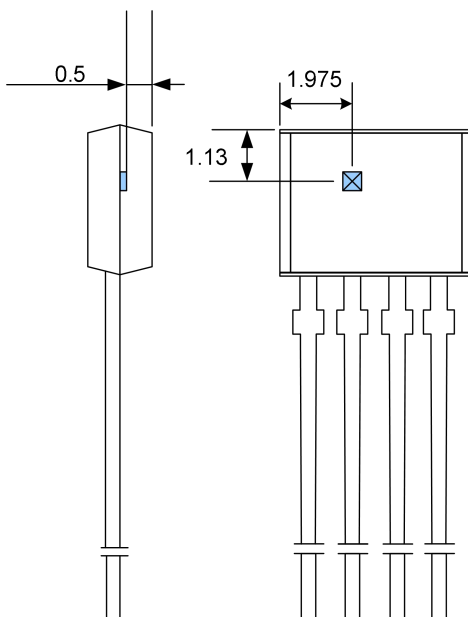
2nd Line: XXYYWW

XX - assembler code

YY - assembly year (last 2 digits)

WW - assembly week number

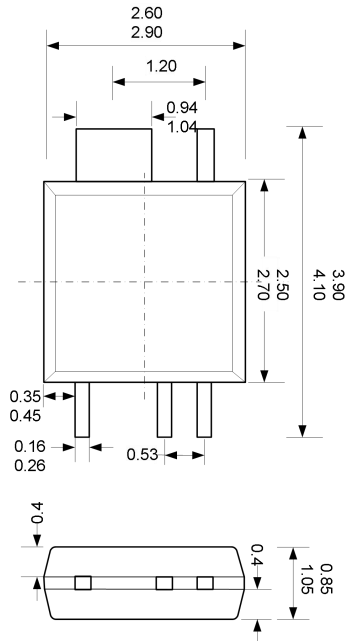
Hall Location



Notes:

1. All Dimensions are in millimeters

2) SOT335 Package



Note:

1. All dimensions are millimeters

Back Marking:

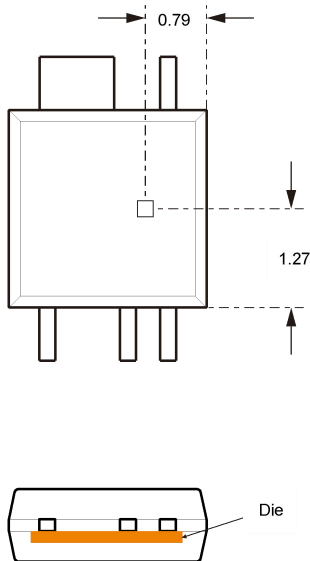
1'st line: 6409 – product name

2'nd line: YYWW

YY – last 2 digits of year

WW – week

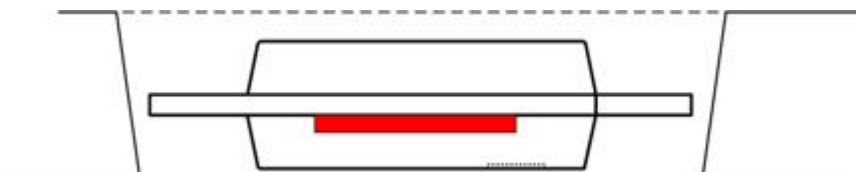
Hall location



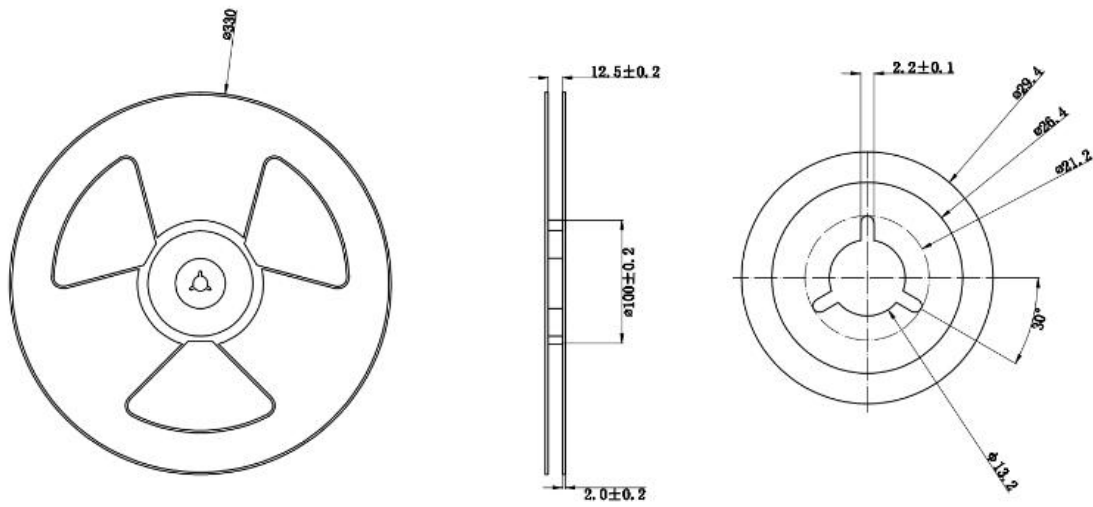
Note:

1. All dimensions are millimeters

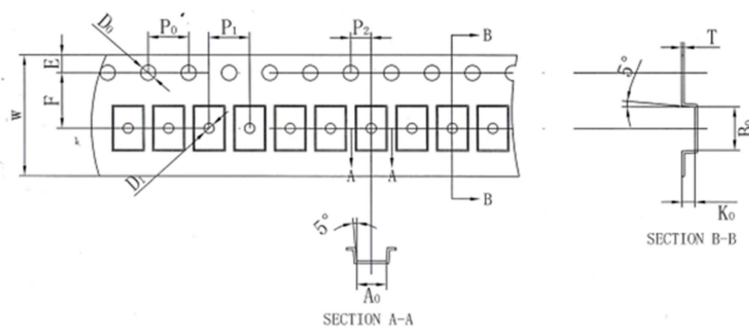
Information of carrier tape



Packaging & Tape reel (SOT335)



Information of Reel size



User Direction of Feed

Note: Each plate has 100 ± 5 grids in front of the tape and 100 ± 5 in the tail

Symbol	Millimeters		
	Min	Typical	Max
W	11.90	12.00	12.05
A0	2.90	2.95-	3.00
B0	4.30	4.35	4.40
K0	1.30	1.35	1.40
E	1.65	1.75	1.85
F	5.40	5.50	5.60
D1	-	1.00	1.10
D0	-	1.50	1.60
P0	3.90	4.00	4.10
P1	3.90	4.00	4.10
P2	1.95	2.00	2.05
t	0.20	0.25	0.30

Note:

1. All dimensions are millimeters

CrossChip

CrossChip Microsystems Inc. was founded in 2013, is a national high-tech enterprise, engaged in integrated circuit design and sales. The company has strong technical strength, has more than 60 kinds of patents, mainly used in Hall sensor signal processing, with the following product lines:

- ✓ High precision linear Hall sensor
- ✓ All kinds of Hall switches
- ✓ Single phase motor drive
- ✓ Single chip current sensor
- ✓ AMR Magnetoresistance sensor
- ✓ Isolation drive class chip

Contact us

Chengdu

Address: 4th floor, unit 2, building 3, No. 88, Tianchen Road, Gaoxinxi Zone, Chengdu, Sichuan Province

Tel: + 86 - 028 - 87787685

Email: support@crosschipmicro.com

Website: <https://www.crosschipmicro.com>

Shenzhen

Address: 605 room, 6F, Beike building, NO.18 Keyuan Rd, Yuehai Street, Nanshan District, Shenzhen

Shanghai

Address: Room 602, Building 1, Shengda Tiandi Yuanchuanggu, No. 88, Shengrong Road, Pudong New District, Shanghai

Suzhou

Address: NO.78 Jinshan Rd East, Suzhou High-tech Zone, Huqiu District, Suzhou City, Jiangsu Province