

CC6402 5V/12V/24V 450mA with Blocking Protection Single Coil Intelligent Fan Drive

FEATURES

- ◆ Built-in High Sensitivity Hall Sensor
- ◆ With blocking protection function, it will not destroy the IC or coil when blocking.
- ◆ Strong driving ability, can output up to 450mA continuous current
- ◆ Low power consumption, quiescent current 2mA
- ◆ Integrated low 1.6Ω R_{DS(ON)} full bridge driver
- ◆ Excellent temperature stability ensures that the IC can withstand extreme environments
- ◆ Mechanism resistive, the magnetic sensitivity will not be shifted due to external pressure.
- ◆ ESD (HBM) 6000V

APPLICATION

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

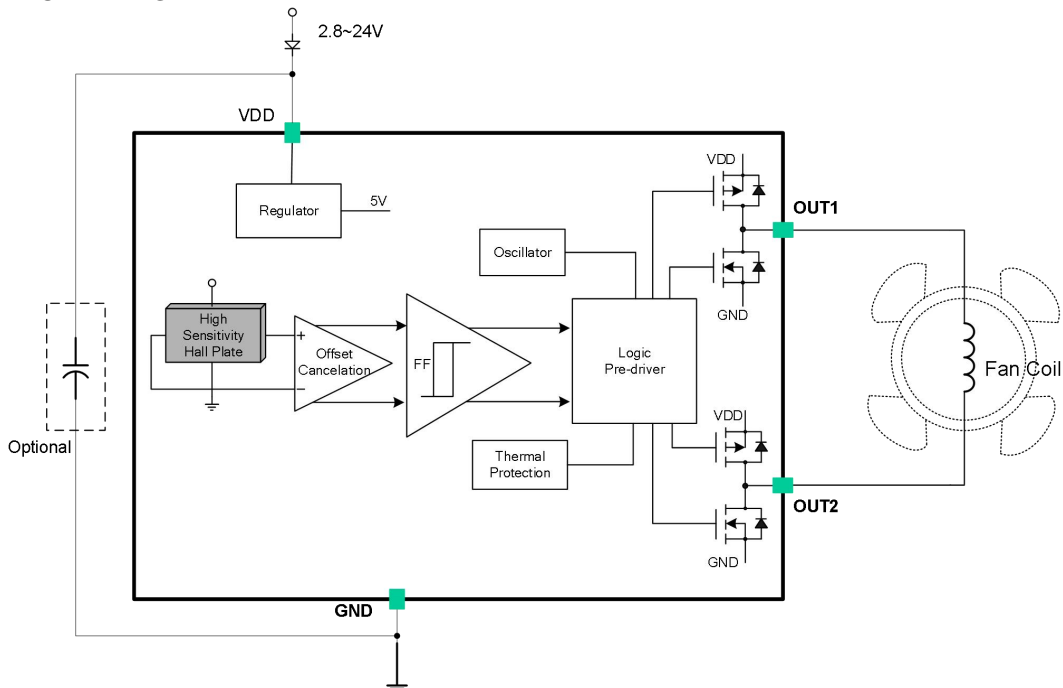
GENERAL DESCRIPTION

The CC6402 is a driver chip with high performance, single coil, and DC brushless motor (fan). The chip is designed and manufactured using an innovative advanced high-voltage BiCMOS process optimised for Hall sensors and motor drives. The chips contain high sensitivity Hall sensors, chopper offset cancellation modules, Hall temperature compensation units, voltage regulators and low R_{DS(ON)} full-bridge drivers and so on. CC6402 has low power consumption, with a quiescent current of only 2mA. It is much lower than similar products in the market, which helps to improve fan efficiency and enhance fan reliability.

CC6402 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. CC6402 can withstand the instantaneous 40V high voltage to ensure the reliability of the fan in various application environments.

CC6402 is available in TO-94 and SOT335 packages. The operation temperature range is -40~125°C.

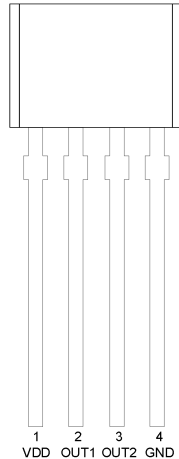
FUNCTION BLOCK DIAGRAM



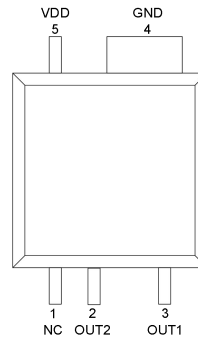
ORDERING INFORMATION

| Part No. | Package Code | Packing Form |
|----------|--------------|--------------------------|
| CC6402TO | TO (TO-94) | bulk, 1000 pcs/bulk |
| CC6402SS | SS (SOT335) | Tape reel, 10000pcs/reel |

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} | 40 | V |
| Peak Output Current | I_{PEAK} | TO-94 | 1500 |
| | | SOT335 | 1200 |
| Continuous Output Current | I_{CONT} | TO-94 | 450 |
| | | SOT335 | 360 |
| Operating Temperature Range | T_A | -40~125 | °C |
| Junction Temperature | T_J | 160 | °C |
| Thermal Resistance Junction - Ambient | R_{thJA} | TO-94 | 227 |
| | | SOT335 | 195 |
| Storage Temperature | T_S | -55~150 | °C |
| Magnetic Flux Density | B | Unlimited | mT |
| ESD susceptibility | 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} | 2.8 | 32 | V |
| Continuous Output Current | I_{OUTC} | - | 400 | mA |
| Ambient Temperature | T_A | -20 | 125 | °C |

ELECTRICAL PARAMETERS ($V_{DD}=18V$ @ 25°C room temperature, unless specified otherwise)

| Parameter | Symbol | Condition | Min | Typ. | Max | Unit |
|--|-----------------|-----------------------------|-----|---------------|-----|------|
| Fan Supply Voltage | V_{DD} | - | 2.8 | - | 36 | V |
| Supply Current | I_{DD} | - | - | 2 | 4 | mA |
| Output V_{SAT} (sink) | V_{SAT} | $V_{DD}=14V, I_{OUT}=200mA$ | - | 0.15 | - | V |
| Output V_{SAT} (source) | | $V_{DD}=14V, I_{OUT}=200mA$ | - | $V_{DD}-0.25$ | - | V |
| Output Rise Time | t_r | $R_L=820\Omega, C_L=20pF$ | - | 7 | - | us |
| Output Fall Time | t_f | $R_L=820\Omega, C_L=20pF$ | - | 7 | - | us |
| Output Dead Time | t_{DEAD} | $R_L=820\Omega, C_L=20pF$ | - | 60 | - | us |
| Locked Rotor ON Time | T_{ON} | $V_{DD}>7V$ | - | 0.33 | - | s |
| Locked Rotor OFF Time | T_{OFF} | $V_{DD}>7V$ | - | 2 | - | s |
| Over Temperature Protection ^① | T_{SD} | | | 160 | | °C |
| OTP Hysteresis | ΔT_{SD} | | | 30 | | °C |

Note:① Guaranteed by design

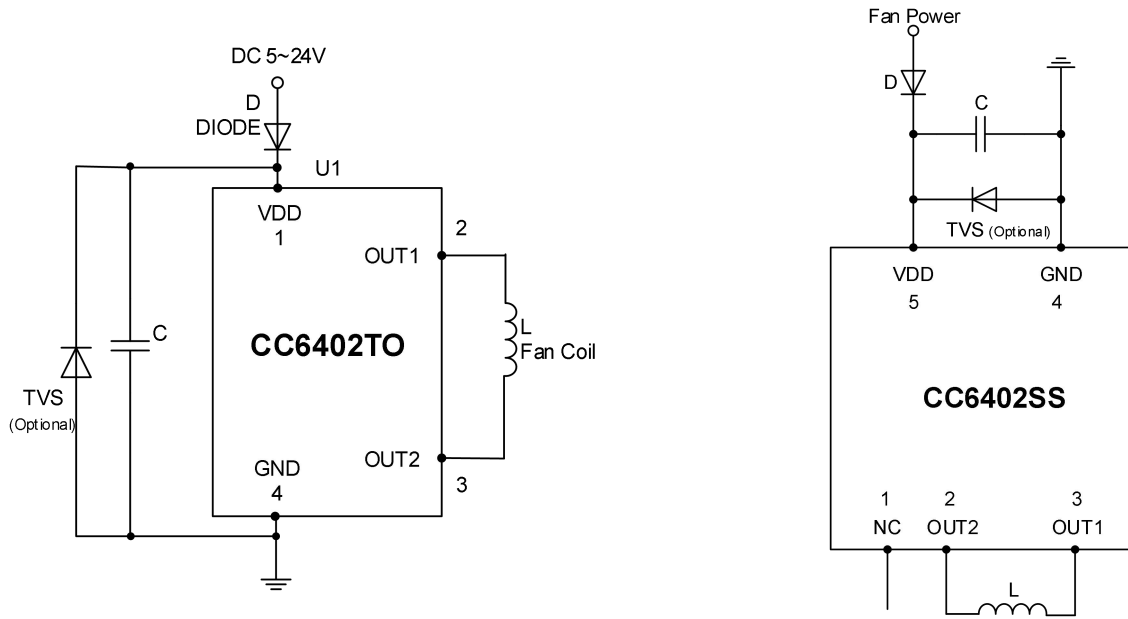
MAGNETIC SPECIFICATIONS

| 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

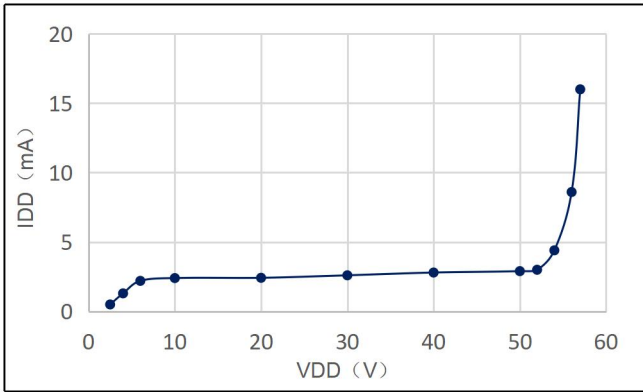


CC6402 typical application circuit

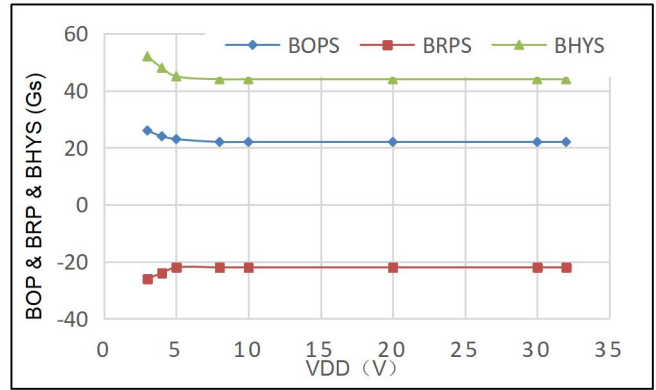
NOTE:

- Capacitor C can improve the reliability and efficiency of fans. Schottky diode D can decrease the operation voltage.
- Capacitor C can decrease the spike of power pin.
- TVS is optional, which can improve the ability to absorb external abnormal conditions.

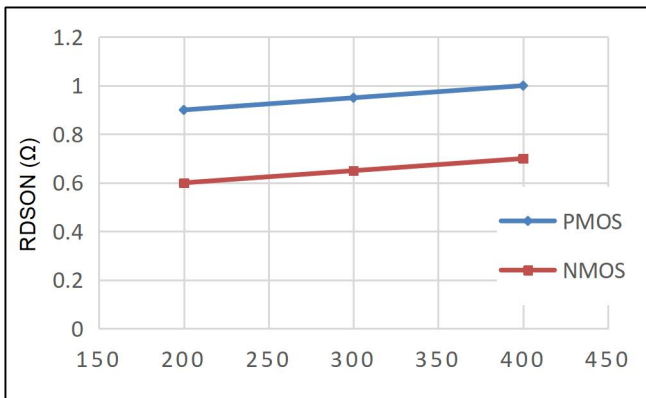
CURVE & WAVEFORM



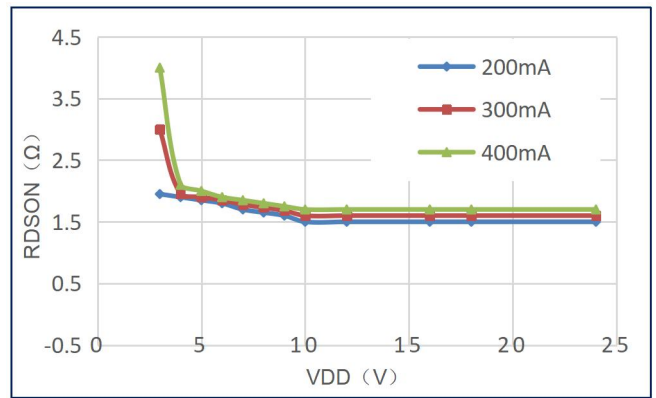
IDD vs. VDD



BOP & BRP & BHYS vs. VDD



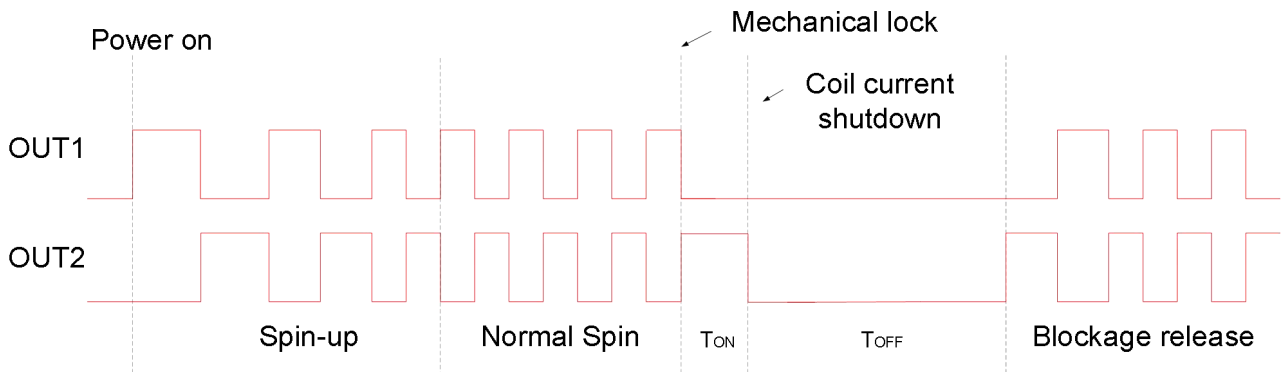
RDSON vs. IOUT



RDSON vs. VDD

FEATURES

This product has built-in jam protection. When the fan is jammed with a blockage, the jam protection shuts off the fan coil current and then tries to restart it every 2 seconds. The cycling of the switch reduces the average current to 1/7th of normal card blocking, enough to protect the fan from damage due to overheating.



POWER DISSIPATION & MAXIMUM OUTPUT CURRENT

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

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

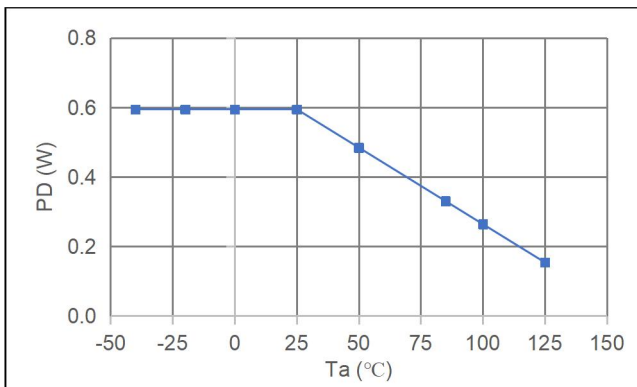
While normal operation, the power dissipated in CC6402:

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

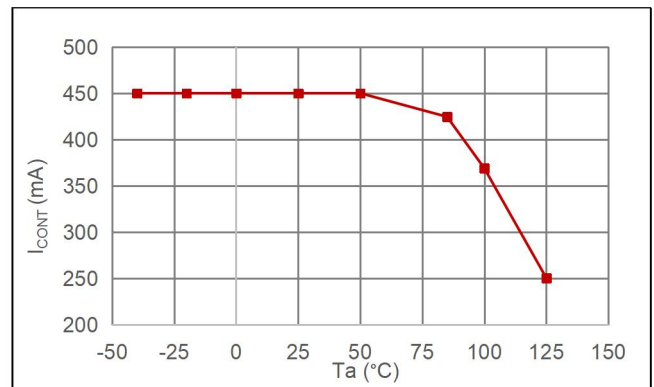
The maximum output current I_{MAX} :

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

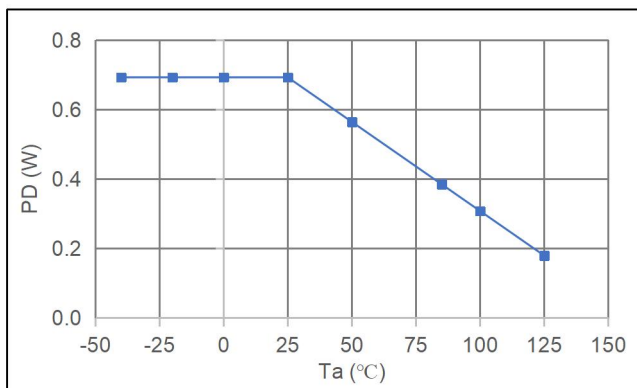
The PD curve and the output current curve



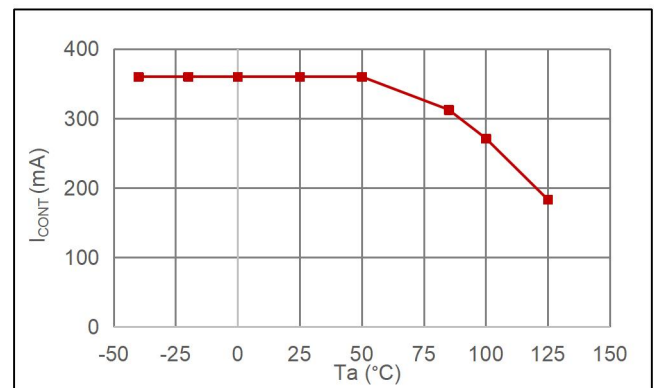
Power Dissipation of TO-94



Maximum Output Current TO-94



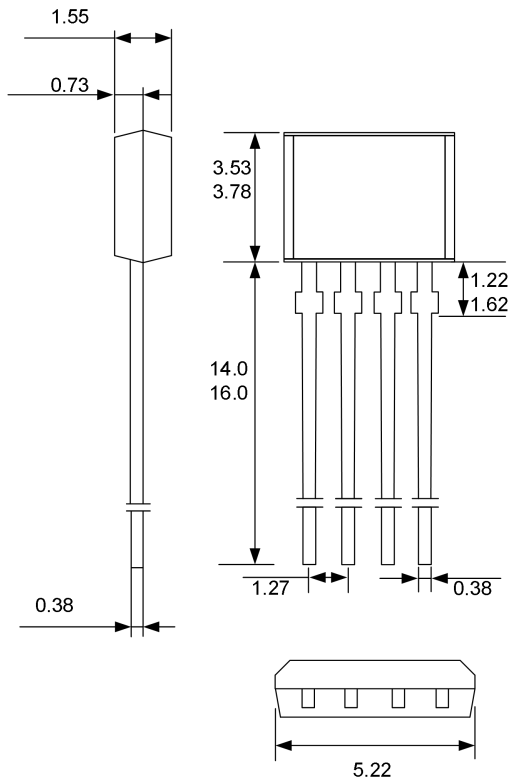
Power Dissipation of SOT335



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: CC6402 - Name of the device

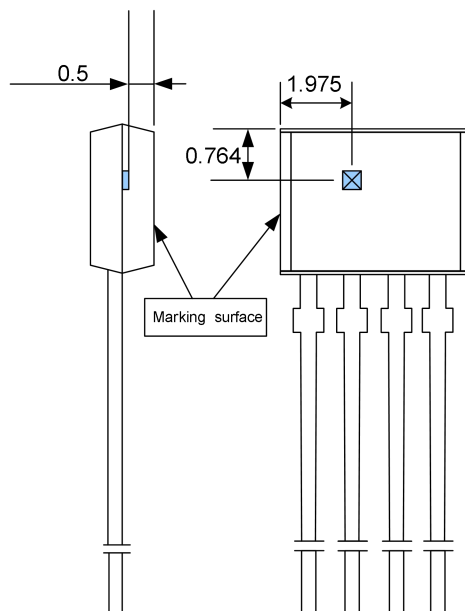
2nd Line: XXYYWW

XX - assembler code

YY - assembly year (last 2 digits)

WW - assembly week number

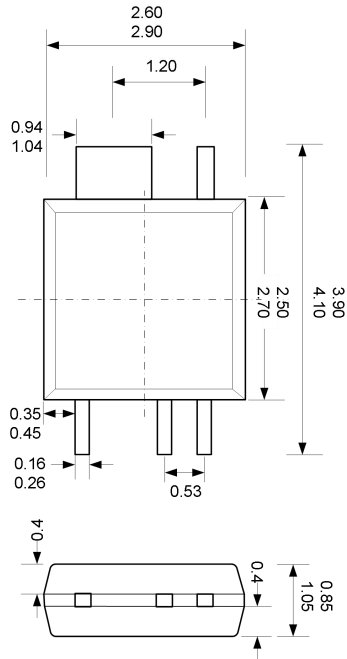
Hall Location



Notes:

All Dimensions are in millimeters

2) SOT335 Package



Note:

1. All dimensions are millimeters

Back Marking:

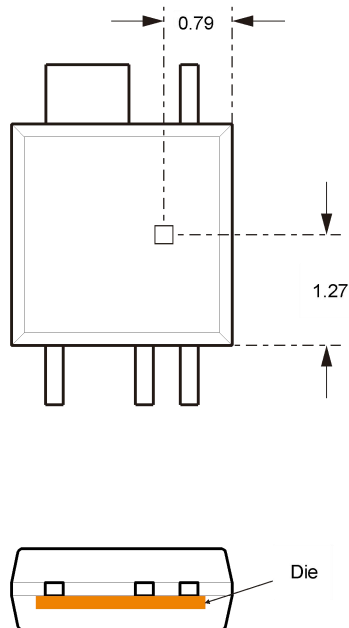
1'st line: CC6402 – product name

2'nd line: YYWW

YY – last 2 digits of year

WW – week

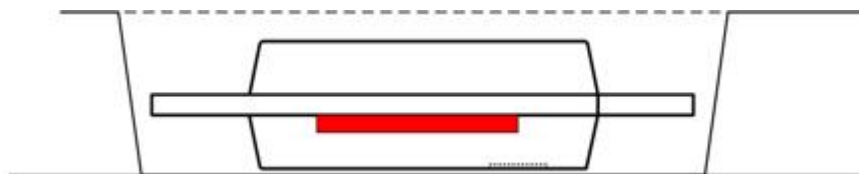
Hall location



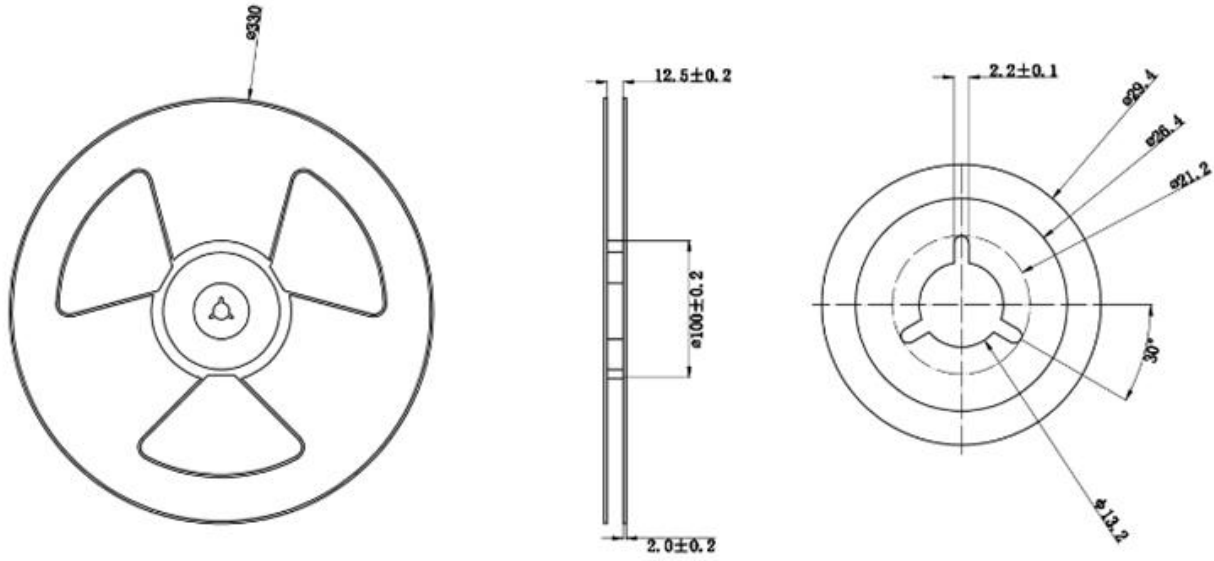
Note:

1. All dimensions are millimeters

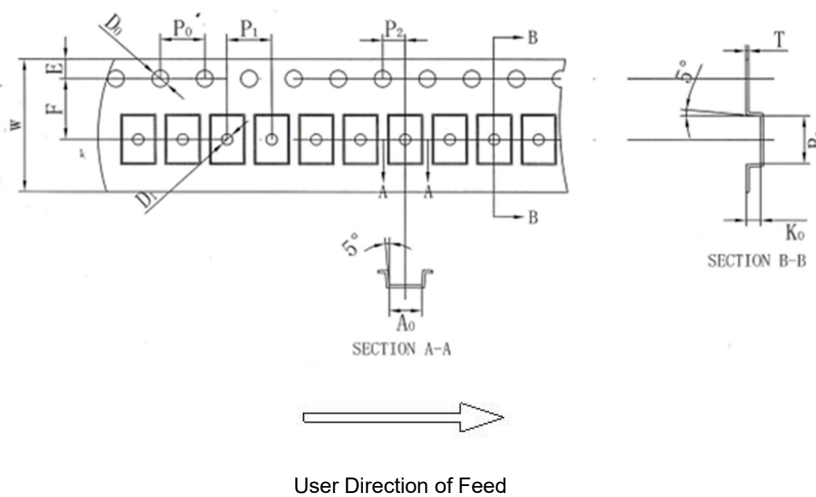
Information of carrier tape



PACKAGING & TAPE REEL (SOT335)



Information of Reel size



| Symbol | Millimeters | | |
|----------------|-------------|---------|-------|
| | Min | Typical | Max |
| W | 11.90 | 12.00 | 12.05 |
| A ₀ | 2.90 | 2.95 | 3.00 |
| B ₀ | 4.30 | 4.35 | 4.40 |
| K ₀ | 1.30 | 1.35 | 1.40 |
| E | 1.65 | 1.75 | 1.85 |
| F | 5.40 | 5.50 | 5.60 |
| D ₁ | - | 1.00 | 1.10 |
| D ₀ | - | 1.50 | 1.60 |
| P ₀ | 3.90 | 4.00 | 4.10 |
| P ₁ | 3.90 | 4.00 | 4.10 |
| P ₂ | 1.95 | 2.00 | 2.05 |
| t | 0.20 | 0.25 | 0.30 |

Note:

1. All dimensions are millimeters

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

REVISION HISTORY

| Revision Date | Description of Revision | Revision |
|---------------|---|----------|
| 2024.04 | Delete the F_{PWM} parameter from the <i>RECOMMENDED OPERATION CONDITIONS</i> . | rev1.8 |

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

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