Temperature Switch with Latch S-8130AC

The S-8130AC is a temperature switch with a latch function having a built-in semiconductor temperature sensor. The output signal is inverted when the temperature is detected, and latched until a reset signal input or a detection of the power voltage lowering.

Low voltage operation down to 2.2 V is possible and the current consumption is low, 15 μA (typ.), due to CMOS configuration.

The S-8130AC consists of a temperature sensor having the temperature coefficient of −13 mV/°C, a reference voltage source, a comparator, voltage detection circuit, and noise suppression circuit all of which is enclosed in a small 8-Pin MSOP package.

Available temperature range is between −40 to +100 °C and wide application in temperature control can be achieved since the output linearity is excellent compared to other sensors including thermistors.

■ Features

- V_{SS} grounded temperature voltage output
- Low voltage operation : V_{DD} (min.)=2.2 V
- Low current consumption : 15 μA typ. (+25°C)
- Noise suppression at temperature detection
- Detection temperature is determined with external resistance
- Output logic level is fixed by the latch after temperature detection
- Small plastic package : 8-Pin MSOP

■ Applications

- Game console
- Electronic devices

■ Package

- 8-Pin MSOP (PKG drawing code : FN008-A)

■ Block diagram

S-8130ACXFN-XXX-T2 (Built-in temperature sensor and external setting for detection temperature)

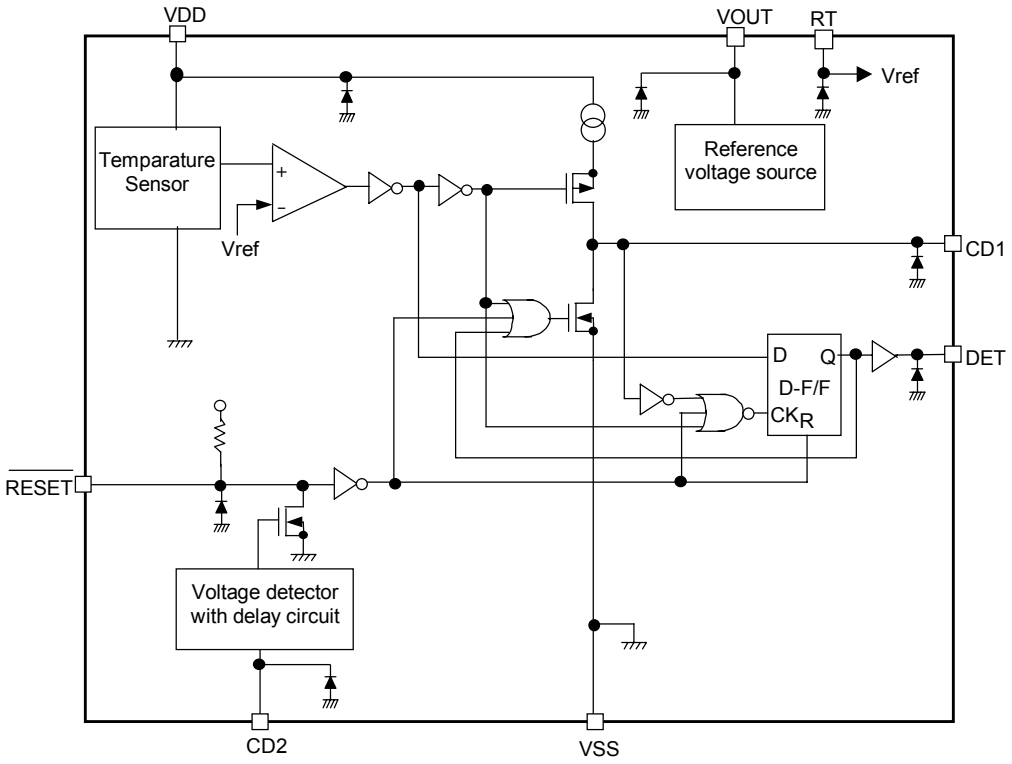


Figure 1

■ Selection Guide

Product name

S - 8130 A C X F N - X X X - T 2

- T2: Taping direction (Direction of IC in tape)
- XXX: Abbreviated Code
- X: Option code

Option list

- DET output should be high-active or low-active.
- Release voltage V_{RET} can be selected 0.1 V step in the range between 2.2 and 3.4 V.
- $\overline{\text{RESET}}$ pin should be selected from ″Pull-up″ or ″Nch Open Drain″.

Product name	DET output	V_{RET}	$\overline{\text{RESET}}$
S-8130ACAFN-MAC-T2	High-active	2.4 V	Pull-up

When other combination is required, please ask our sales office.

■ Pin configuration

8-Pin MSOP
Top view

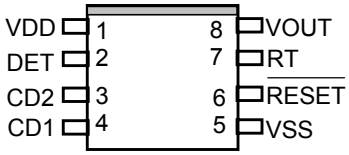


Figure 2

■ Pin Description

Pin No.	Pin Name	Function	Input/Output
1	VDD	Positive power supply pin	—
2	DET	Output pin for detection at the defined temperature	CMOS output : Output logic is selectable
3	CD2	Capacitor connection pin for delay time setting in voltage detection	Input/Output
4	CD1	Capacitor connection pin for noise filtering time	Input/Output
5	VSS	Ground pin	—
6	$\overline{\text{RESET}}$	Input/Output pin for reset Low-active	Input : CMOS Output : N channel open drain (Pull-up resistance is optional)
7	RT	Reference voltage input pin (short-circuited to VOUT pin internally)	Input
8	VOUT	Output pin for reference voltage from the internal comparator	Output

■ Absolute maximum ratings

(Ta = 25 °C unless otherwise specified)

Parameter	Symbol	Ratings	Unit
Supply voltage (V_{SS}=0.0 V)	V_{DD}	V_{SS}+12	V
Pin voltage	V_{OUT}, V_{RT}, $V_{\overline{RESET}}$, V_{DET}, V_{CD1}, V_{CD2}	V_{SS}−0.3 to V_{DD}+0.3	V
Operating temperature	T_{opr}	−40 to +100	°C
Storage temperature	T_{stg}	−55 to +125	°C

Caution The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

■ Recommended values for external parts

Parameters	Symbol	Value	Unit
CD1 capacitance	C_{D1}	4.7	nF
CD2 capacitance	C_{D2}	4.7	nF
Resistance between VOUT and RT	R_1	According to setting detection temperature	kΩ
Resistance between RT and VSS	R_2	According to setting detection temperature	kΩ

■ DC Electrical Characteristics

(Ta=25°C, V_{SS}=0 V unless otherwise specified)

Parameters	Symbol	Conditions		Min.	Typ.	Max.	Unit
Supply voltage	V_{DD}	—		2.2	—	10.0	V
Output current 1	I_{DETH}	V_{DD}=3 V Applied to DET pin	V_{DET}=2.2 V	2	4	—	mA
	I_{DETL}		V_{DET}=0.4 V	0.5	1	—	mA
Input voltage	V_{ONH}	Applied to $\overline{\text{RESET}}$ pin		0.8 × V_{DD}	—	V_{DD}	V
	V_{ONL}			V_{SS}	—	0.2 × V_{DD}	V
Pull-up resistance	R_{OL}	Applied to $\overline{\text{RESET}}$ pin V_{IN}=0 V, V_{DD}=3.0 V		30	100	300	kΩ
Sensor voltage	V_{SENSOR}	Ta=+60°C		—	1.562	—	V
		Ta=+100°C		—	1.029	—	V
Release voltage for voltage detector	V_R	—		V_{RET} × 0.98	V_{RET}	V_{RET} × 1.02	V
Hysteresis width for voltage detector	V_{HYS}	—		—	V_{RET} × 0.05	—	V
Output current for voltage detector	I_{RSTL}	V_{DD}=3.0 V, $V_{\overline{\text{RESET}}}$=0.5 V Applied to $\overline{\text{RESET}}$ pin		0.5	1	—	mA
Temperature coefficient for voltage detector	$\frac{\Delta V_{RET}}{\Delta Ta \bullet V_{RET}}$	Ta= −40 to 100°C		—	±100	—	ppm/°C
Output voltage	V_{VO}	V_{DD}=3.0 V, I_{OUT}=1.0 mA Applied to VOUT pin (when the external reference voltage is used)		1.960	2.000	2.040	V
Output current 2	I_{VO}	V_{DD}=2.6 V, Applied to VOUT pin (when the external reference voltage is used)		1.0 *1	—	—	mA
Operating current	I_{DD}	V_{DD}=3.3 V		—	15	30	μA

***1.** Output current can be drawn to this value. Current which exceeds this value should not be provided to the load.

■ AC Electrical Characteristics

(Ta=25°C unless otherwise specified)

Parameters	Symbol	Conditions	Min.	Typ.	Max.	Unit
Noise filtering time	T_{noise}	C_{D1}=4.7 nF, V_{DD}=3 V	10	30	50	ms
Delay time for voltage detector	T_{delay}	C_{D2}=4.7 nF, V_{DD}=3 V	10	30	50	ms

Definition of the symbols used in the voltage detection circuit

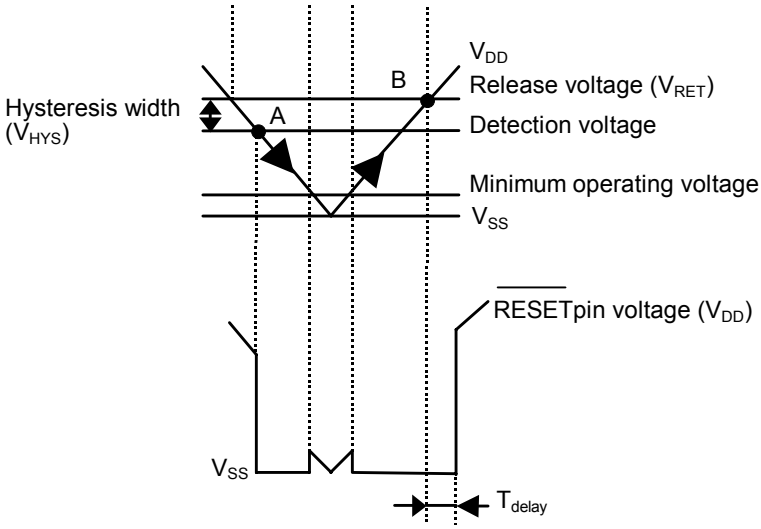


Figure 3

■ Description of Operation

1. Basic operation

S-8130AC series is a temperature switch which detects a certain temperature and sends a signal to an external device. Combination of the parameters such as release voltage and DET output logic can be selected.

In the following DET output is supposed to be high-active.

When the power voltage is turned on, the DET pin voltage goes to “L” since the flip-flop circuit in the detection circuit is cleared by the delayed voltage detection circuit. Temperature detection then starts and the DET pin is held “L” as long as the temperature is lower than the detection temperature. The temperature goes high and exceeds the detection temperature for longer than the time defined by the capacitor connected to the CD1 pin, then the DET pin goes to “H”. Once the over-temperature is detected and the DET pin goes to “H”, the state is held by the flip-flop circuit. In order to release the state the $\overline{\text{RESET}}$ pin voltage should be set to “L” by the external signal or the power voltage should be set under the detection voltage of the built-in detector to reset the internal circuit.

Note : The detection temperature can be set arbitrarily by connecting resistances between VOUT pin and RT pin, and between RT pin and VSS pin since the divided voltage is applied to the internal comparator as the reference voltage. Sufficient evaluation is needed to choose resistance values since the detection temperature is determined by the resistance temperature coefficient, IC characteristics, etc. Current which flows through these resistances should be less than 1 mA.

Noise filtering circuit

The noise filtering circuit prevents malfunction of the temperature switch caused by noise.

The noise filtering circuit starts charging of the capacitor connected to the CD1 pin when the output of the internal comparator enters active state due to an external noise or a rapid change in the power voltage. In the normal operation the flip-flop circuit is set when the capacitor is charged to a certain voltage. But in the noise triggered operation the comparator output goes back to inactive state and the CD1 pin voltage is held low since the charging of the capacitor is insufficient. As a result the DET pin is held low and malfunction does not occur.

Noise filtering time, T_{noise}, is determined by the time constant consisting of internal constant current and the capacitance C_{D1}, and calculated by the following equation.

T_{noise} (ms)=Noise fitering time coefficient $\times$ C_{D1}(nF)
Noise fitering time coefficient (25°C): Typ. 6.4

2. Voltage detection circuit with delay

The delay circuit of the voltage detector provides a delayed output signal to the $\overline{\text{RESET}}$ pin when the power voltage V_{DD} rises and exceeds the release voltage V_R. On the other hand no delay occurs when the power voltage V_{DD} goes lower than the detection voltage, V_R-V_{HYS}.
The delay time, T_{delay}, is determined by the time constant consisting of internal constant current and the capacitance C_{D2}, and calculated by the following equation.

T_{delay} (ms)=Delay coefficient $\times$ C_{D2} (nF)
Delay coefficient (25°C): Min. 4.3, Typ. 6.4, Max. 8.5

- When the board wiring is made, attention should be paid that no current flows into or flows out of the CD2 pin to have correct delay time since the impedance of the CD2 pin is high.
- Capacitance of the external capacitor C_{D2} has no limitation as long as its leak current is negligible compared to the internal constant current. Error in delay time occurs If the capacitor has leak current. When the leak current is larger than the internal constant current, no release takes place.

■ Application circuit

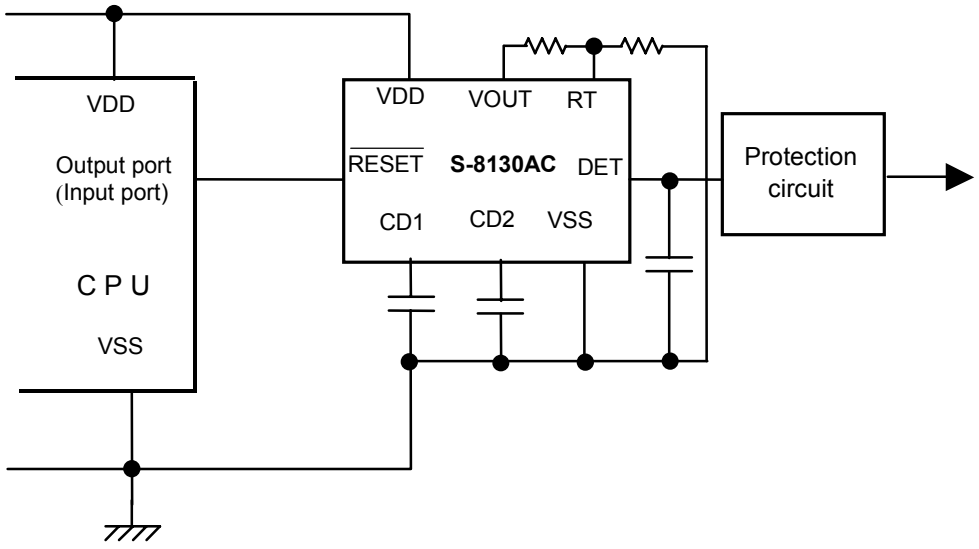


Figure 4

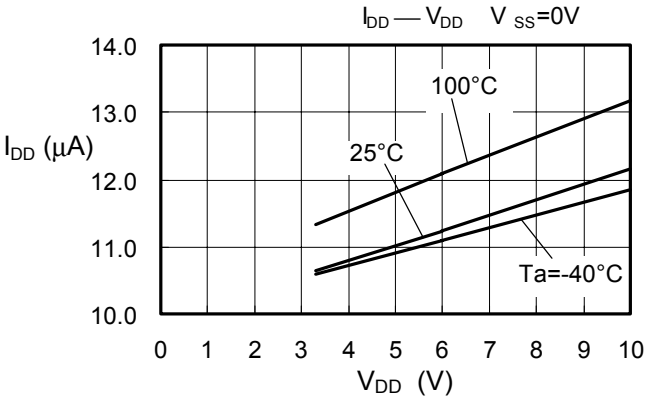
Caution The above connection diagram will not guarantee successful operation.

■ Precautions

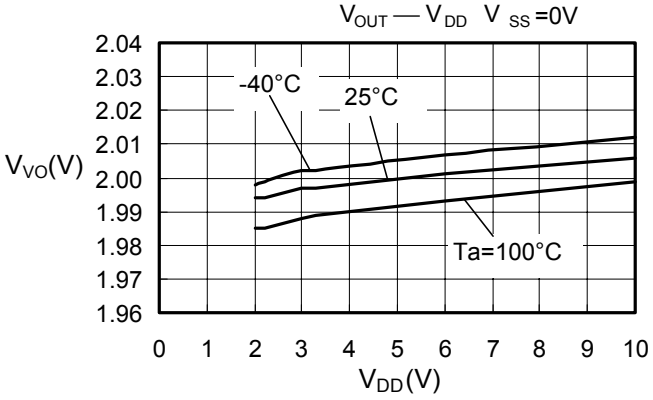
(1) Since the S-8130AC has a voltage detector inside, control for the $\overline{\text{RESET}}$ pin is not necessary to activate the circuit unlike the **Figure 4**. In this case the $\overline{\text{RESET}}$ pin should be open.
(2) Current which is provided to the resistances from the VOUT pin should be less than 1 mA.
(3) A capacitor of around 1 μF should be connected to the DET pin to prevent malfunction caused by a noise due to the power on.
(4) Do not apply an electrostatic discharge to this IC that exceeds the performance ratings of the built-in electrostatic protection circuit.

■ Typical Characteristics

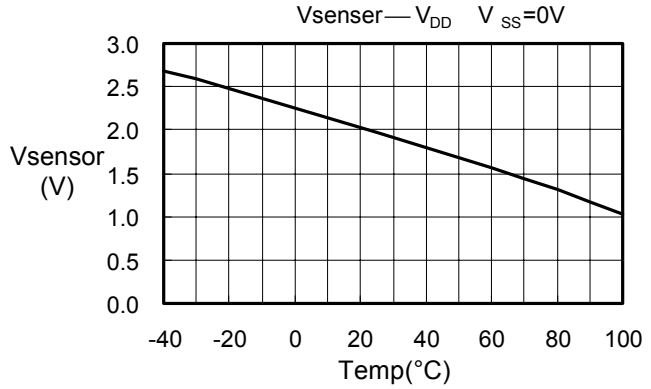
1. Current consumption vs. power voltage



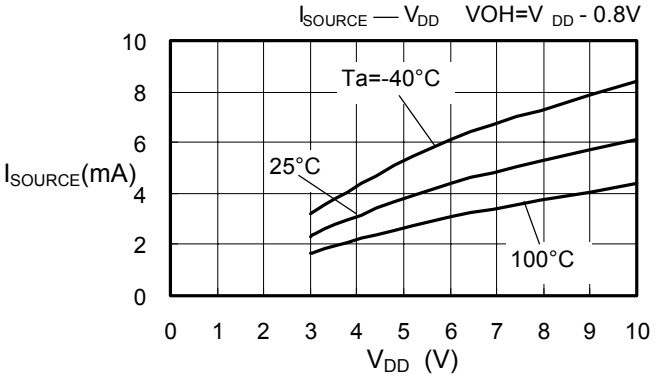
2. Reference voltage vs. Power voltage



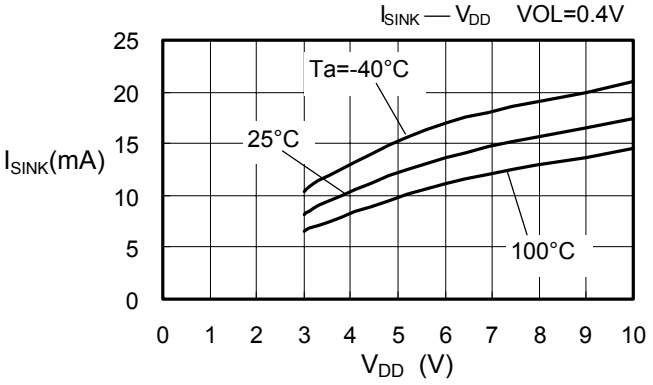
3. Temperature sensor output vs. temperature



4. DET pin I_{SOURCE}-V_{DD} characteristics



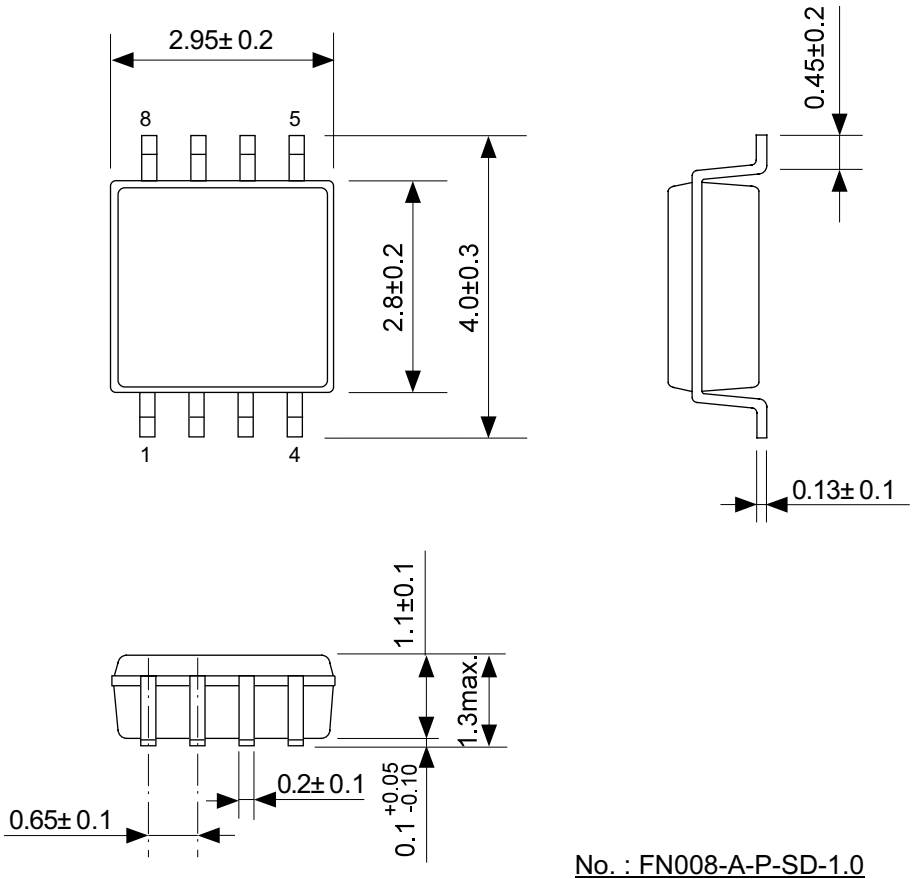
5. DET pin I_{SINK}-V_{DD} characteristics



■ 8-Pin MSOP

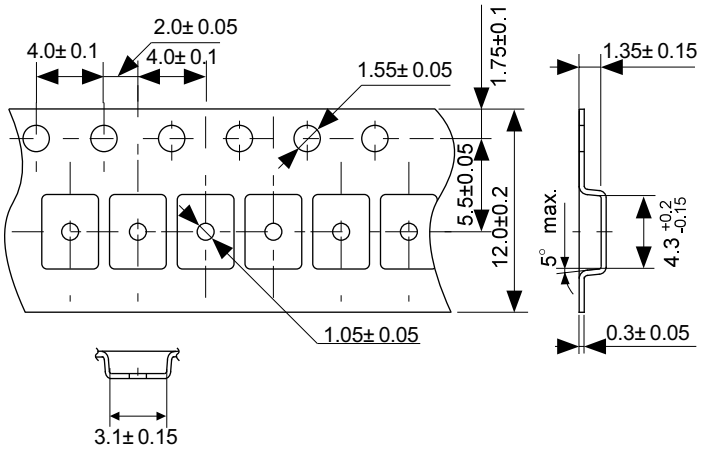
FN008-A **Rev.1.0** 020213

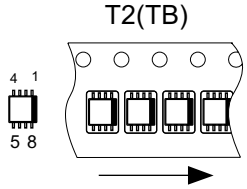
● Dimensions



No. : FN008-A-P-SD-1.0

● Tape Specifications



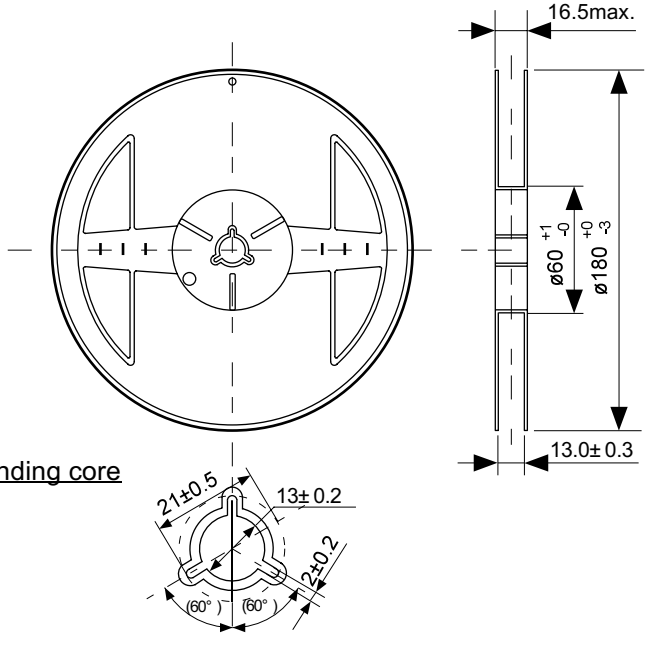


Feed direction

No. : FN008-A-C-SD-1.0

● Reel Specifications

3000 pcs/reel



No. : FN008-A-R-SD-1.0

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