TEMPERATURE SWITCH IC WITH LATCH S-8130AC Series

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.
Since the temperature range of this IC is −40 to +100 °C, it is possible to achieve the extensive application for temperature control.

■ 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
- Lead-free products

■ Applications

- Game console
- Electronic devices

■ Package

Package Name	Drawing Code		
	Package	Tape	Reel
8-Pin MSOP	FN008-A	FN008-A	FN008-A

■ Block diagram

S-8130ACXFN-XXXT2G (Built-in temperature sensor and external setting for detection temperature)

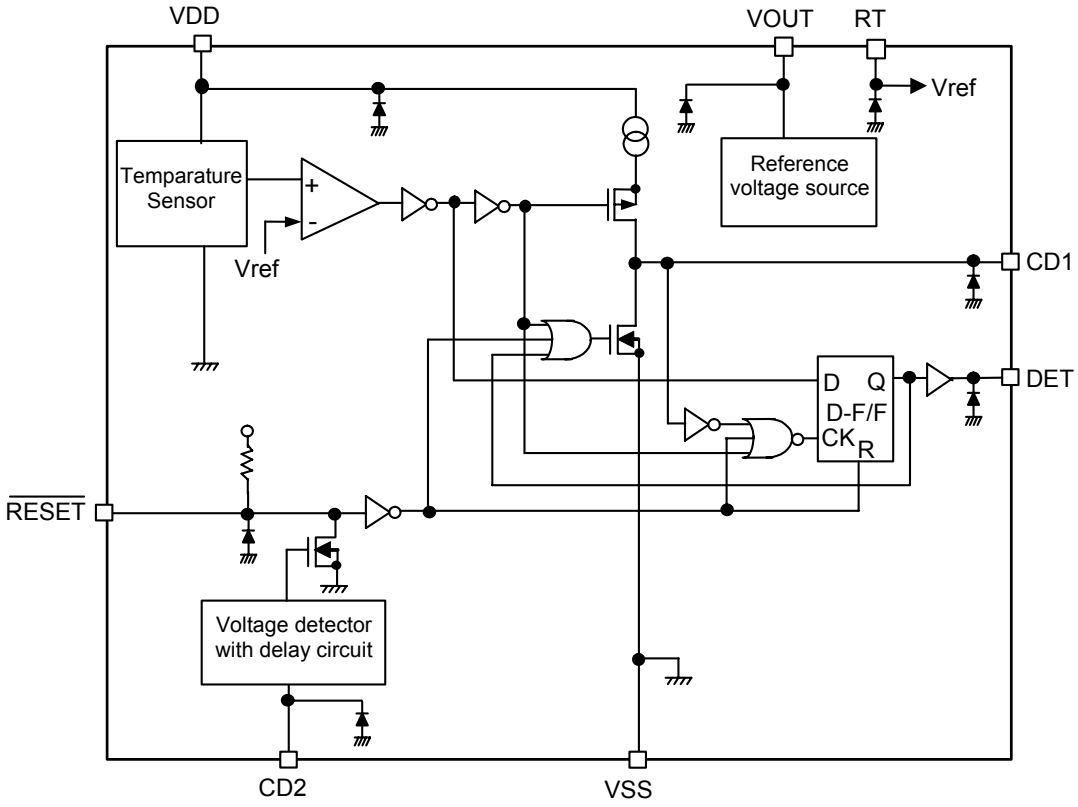


Figure 1

■ Selection Guide

Product name

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

- IC direction in tape specifications
- Abbreviated Code
- Option code

Option list

- DET output is selectable active high or active low.
- Release voltage V_{RET} is selectable in 0.1 V step in the range between 2.2 and 3.4 V.
- $\overline{\text{RESET}}$ pin is selectable “PuII-up” or “Nch Open Drain”.

Table 1

Product name	DET output	V_{RET}	$\overline{\text{RESET}}$
S-8130ACAFN-MACT2G	Active high	2.4 V	Pull-up

Remark Please contact our sales department for options other than those specified above.

■ Pin configuration

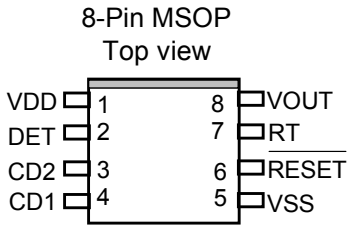


Figure 2

■ Pin Description

Table 2

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 Active low	Input : CMOS Output : N channel open drain (Pull-up resistance is optional)
7	RT	Reference voltage input pin	Input
8	VOUT	Reference voltage output pin for the internal comparator (Resistor connection pin when inputting the reference voltage by resistance division externally)	Output

■ Absolute maximum ratings

Table 3

(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
Power dissipation	P_D	300	mW
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

Table 4

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

Table 5

(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}=2.6 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. The current which exceeds this value should not be provided to the load.

■ AC Electrical Characteristics

Table 6

(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

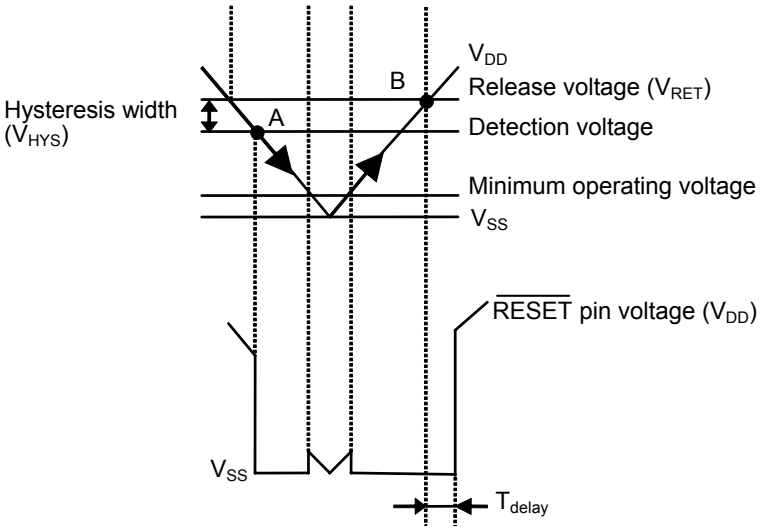


Figure 3

■ Description of Operation

1. Basic operation

S-8130AC series is a temperature switch which detects the temperature and sends a signal to an external device. The users can select a combination of the parameters such as release voltage and DET output logic. The following is the case that DET output is active high.

When the power voltage is turned on, the DET pin voltage goes to low 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 low as long as the temperature is lower than the detection temperature. The temperature rises and when the temperature exceeds the detection temperature; longer than the time defined by the capacitor connected to the CD1 pin, the DET pin goes to high. Once the over-temperature is detected and the DET pin goes to high, the state is held by the flip-flop circuit. In order to release the state the $\overline{RESET}$ pin voltage should be set to low 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. The current which flows through these resistances should be less than 1 mA.

Noise filtering circuit

The noise filtering circuit in this temperature switch prevents malfunction caused by noise.

The noise filtering circuit starts charging 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 degree of voltage. But by noise, the comparator's output goes back to inactive state and the CD1 pin voltage is held low since the charging to the capacitor C_{D1} 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 filtering time coefficient $\times$ C_{D1}(nF)

Noise filtering time coefficient (25°C): Typ. 6.4

2. Voltage detection circuit with delay

The delay circuit in 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

- Layout the board wiring so that the current does not flow into or flow 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. The difference occurs in delay time if the capacitor has a leak current. When the leak current is larger than the internal constant current, the voltage detection circuit does not release reset.

■ Application circuit

S-8130ACXFN-XXXT2G (used in built-in temperature sensor and external reference voltage)

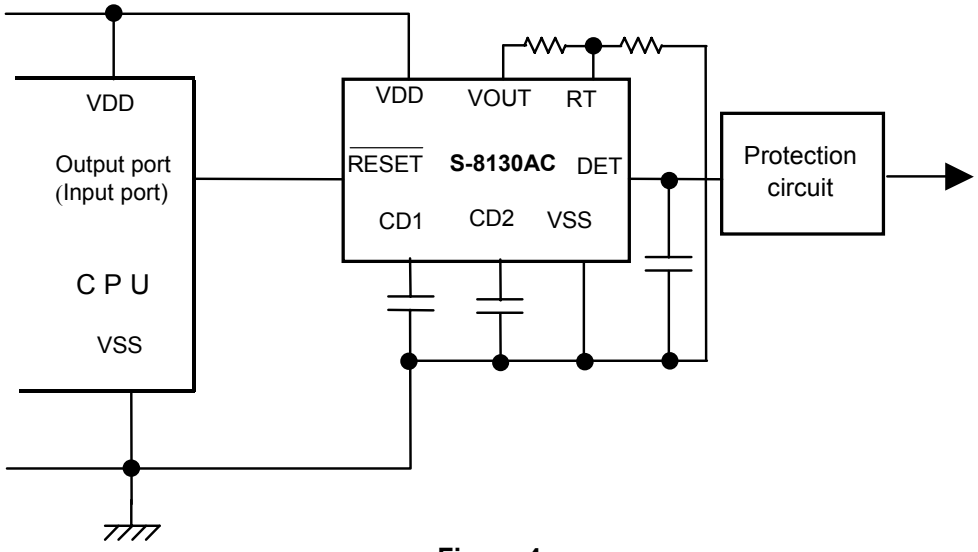


Figure 4

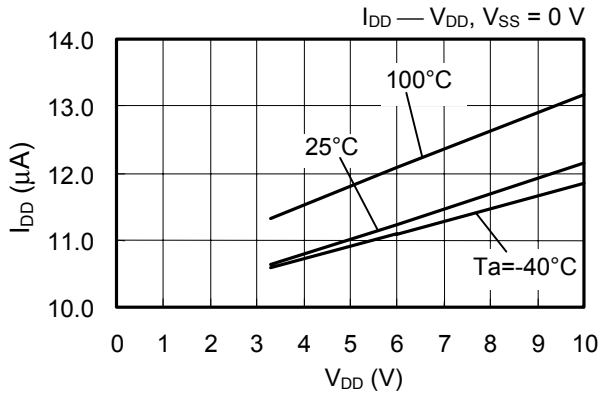
Caution The above connection diagram will not guarantee successful operation. Perform thorough evaluation using actual application to set the constant.

■ Precautions

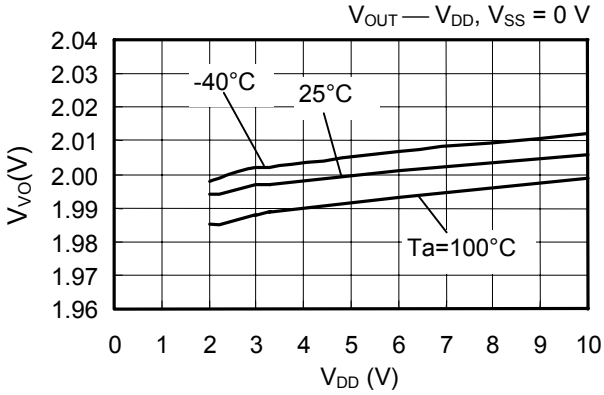
(1) Since the S-8130AC has a voltage detector inside, control for the $\overline{\text{RESET}}$ pin is not necessary to activate the circuit as seen in **Figure 4**. In this case the $\overline{\text{RESET}}$ pin should be open.
(2) The current which is provided to the resistances from the VOUT pin should 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

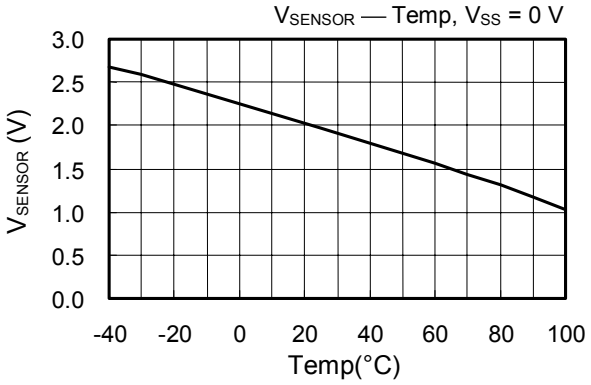
1. Current consumption vs. power voltage



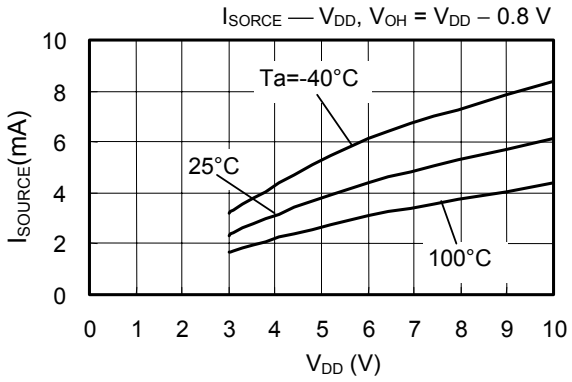
2. Reference voltage vs. Power voltage



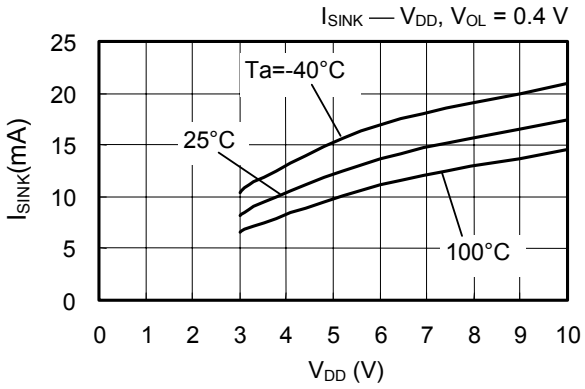
3. Temperature sensor output vs. temperature

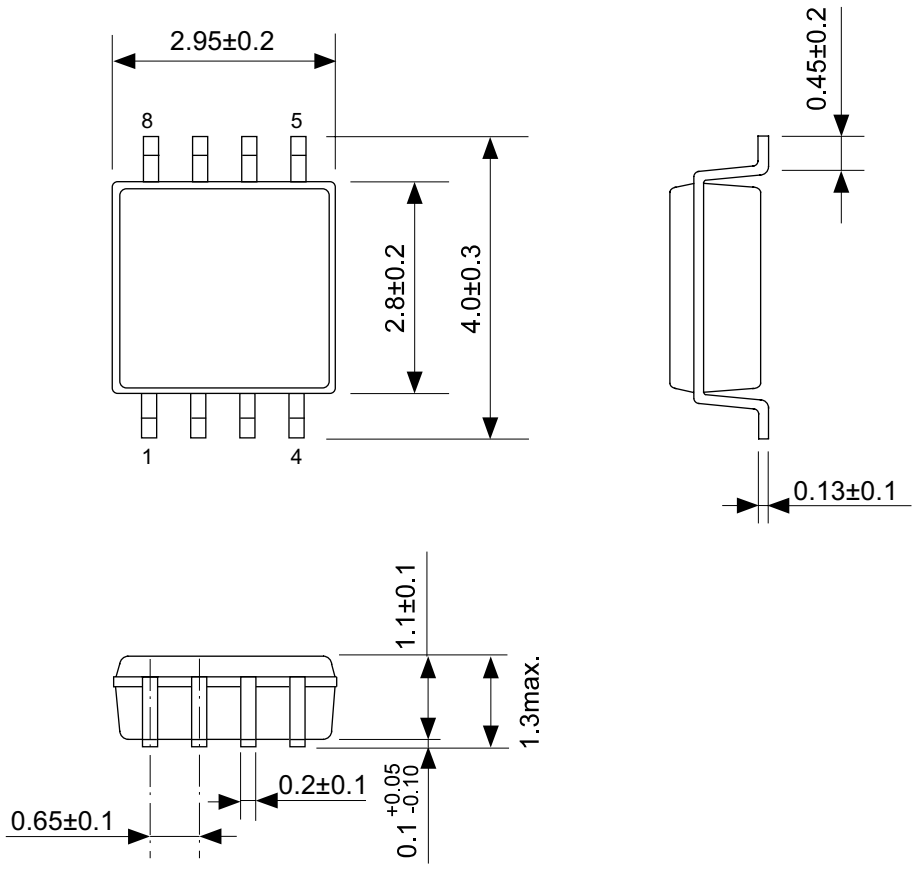


4. DET pin I_{SOURCE}-V_{DD} characteristics



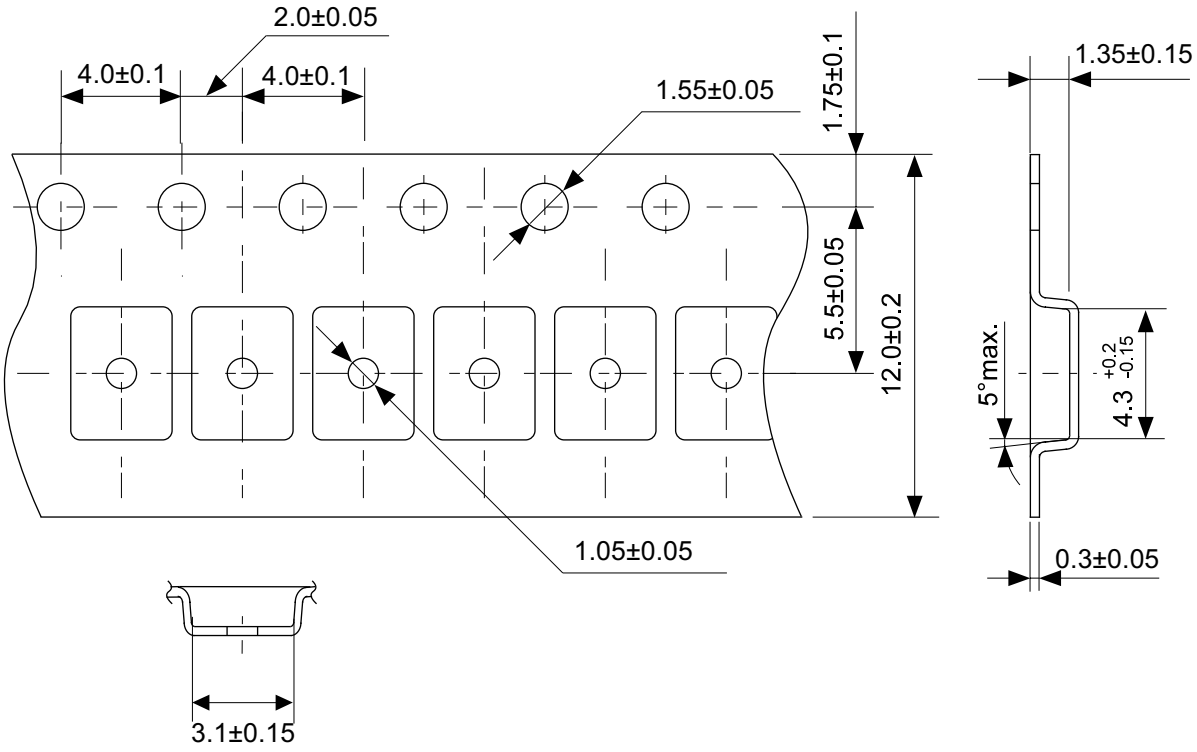
5. DET pin I_{SINK}-V_{DD} characteristics

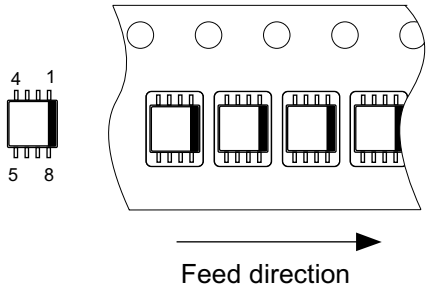




No. FN008-A-P-SD-1.1

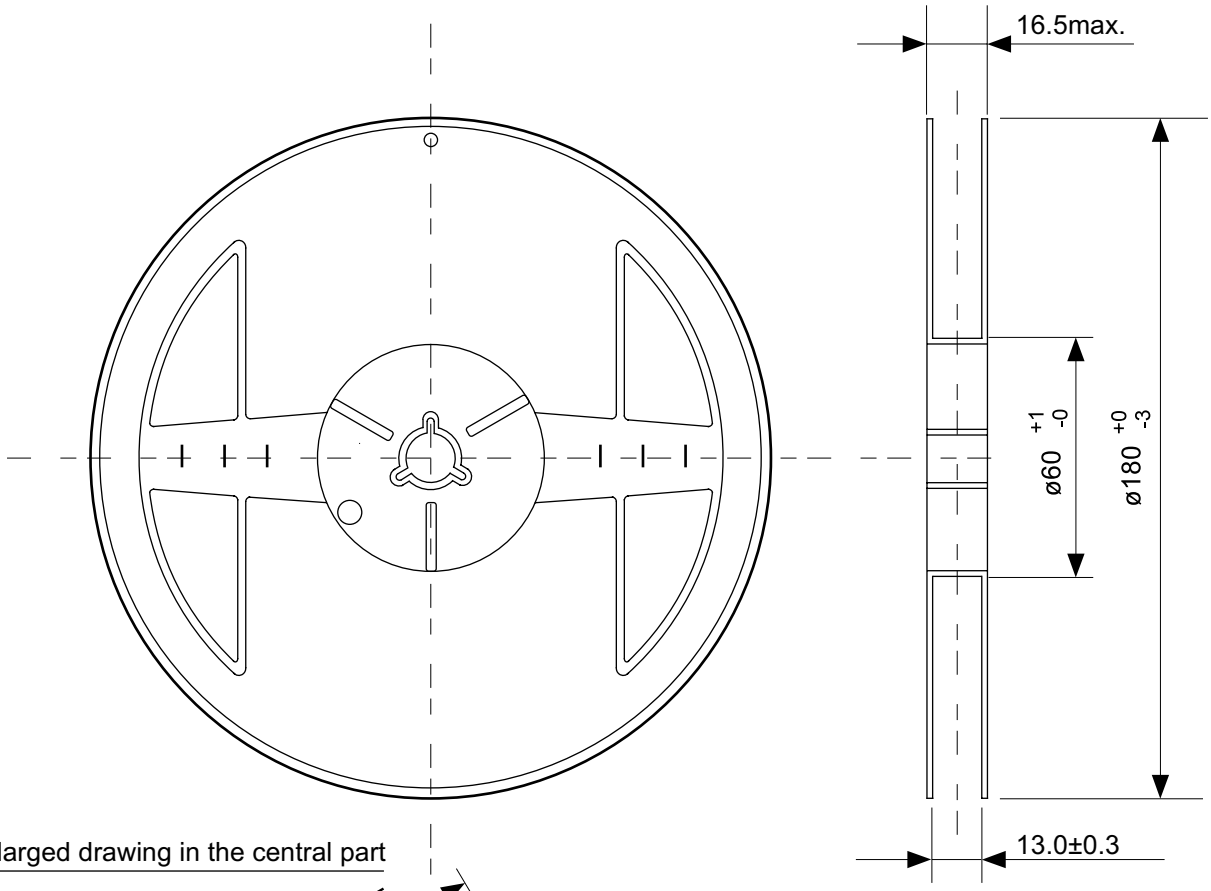
TITLE	MSOP8-A-PKG Dimensions
No.	FN008-A-P-SD-1.1
SCALE	
UNIT	mm
Seiko Instruments Inc.	



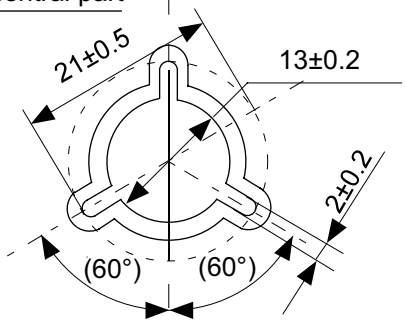


No. FN008-A-C-SD-1.1

TITLE	MSOP8-A-Carrier Tape
No.	FN008-A-C-SD-1.1
SCALE	
UNIT	mm
Seiko Instruments Inc.	



Enlarged drawing in the central part



No. FN008-A-R-SD-1.1

TITLE	MSOP8-A-Reel		
No.	FN008-A-R-SD-1.1		
SCALE		QTY.	3,000
UNIT	mm		
Seiko Instruments Inc.			

- The information described herein is subject to change without notice.
- Seiko Instruments Inc. is not responsible for any problems caused by circuits or diagrams described herein whose related industrial properties, patents, or other rights belong to third parties. The application circuit examples explain typical applications of the products, and do not guarantee the success of any specific mass-production design.
- When the products described herein are regulated products subject to the Wassenaar Arrangement or other agreements, they may not be exported without authorization from the appropriate governmental authority.
- Use of the information described herein for other purposes and/or reproduction or copying without the express permission of Seiko Instruments Inc. is strictly prohibited.
- The products described herein cannot be used as part of any device or equipment affecting the human body, such as exercise equipment, medical equipment, security systems, gas equipment, or any apparatus installed in airplanes and other vehicles, without prior written permission of Seiko Instruments Inc.
- Although Seiko Instruments Inc. exerts the greatest possible effort to ensure high quality and reliability, the failure or malfunction of semiconductor products may occur. The user of these products should therefore give thorough consideration to safety design, including redundancy, fire-prevention measures, and malfunction prevention, to prevent any accidents, fires, or community damage that may ensue.