



# S-89230/89240 Series

## MINI ANALOG SERIES CMOS COMPARATOR

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Rev.3.0\_00

The mini-analog series is a group of ICs that incorporate a general purpose analog circuit in a small package. The S-89230/89240 Series is a CMOS type comparator works on a lower voltage and lower current consumption. These features make this product the ideal solution for small battery-powered portable equipment. This product is a dual comparator (with 2 circuits).

### ■ Features

- Lower operating voltage than the conventional general-purpose:  
 $V_{DD} = 1.8\text{ V to }5.5\text{ V}$
- Low current consumption (per circuit):  
 $I_{DD} = 23\ \mu\text{A Typ. (S-89230 Series)}$   
 $I_{DD} = 5\ \mu\text{A Typ. (S-89240 Series)}$
- Low input offset voltage:  
4.0 mV Max.
- Output full swing
- A dual comparator (with 2 circuits)
- Lead-free, Sn 100%, halogen-free<sup>\*1</sup>

\*1. Refer to “■ Product Name Structure” for details.

### ■ Applications

- Mobile phones
- Notebook PCs
- Digital cameras
- Digital video cameras

### ■ Packages

- SNT-8A
- TMSOP-8

■ Block Diagram

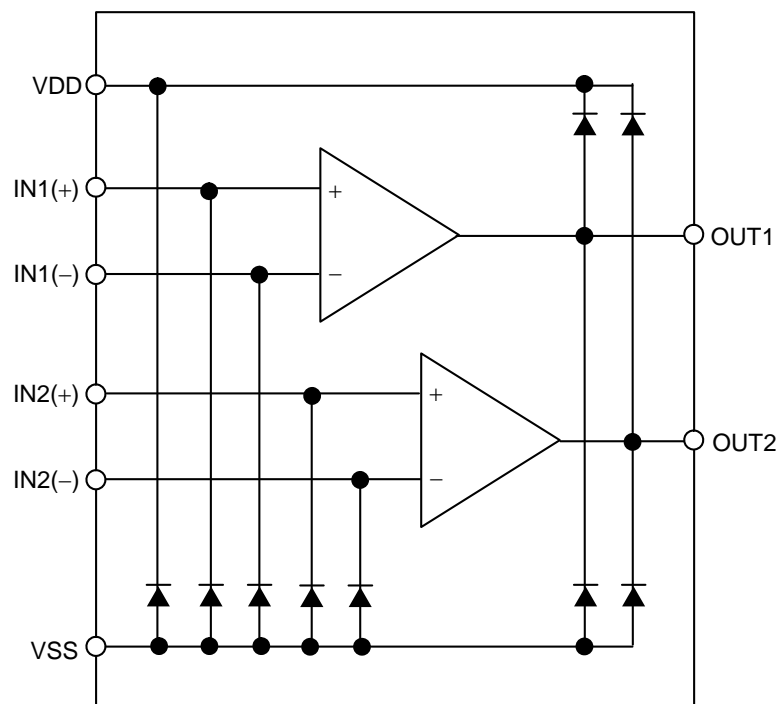
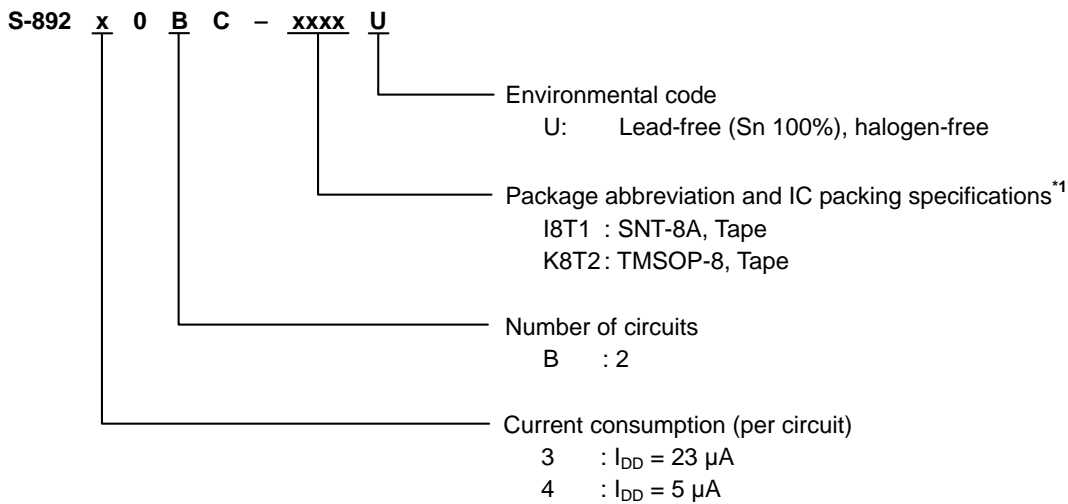


Figure 1

■ **Product Name Structure**

Users can select the product type and package for the S-89230/89240 Series. Refer to “1. Product name” regarding the contents of product name, “2. Package” regarding the package drawings and “3. Product name list” regarding the product type.

**1. Product name**



\*1. Refer to the tape specifications.

**2. Package**

Package Name	Drawing Code			
	Package	Tape	Reel	Land
SNT-8A	PH008-A-P-SD	PH008-A-C-SD	PH008-A-R-SD	PH008-A-L-SD
TMSOP-8	FM008-A-P-SD	FM008-A-C-SD	FM008-A-R-SD	—

**3. Product name list**

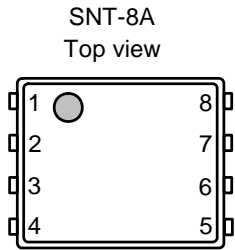
**Table 1**

Product name	Current consumption (per circuit)	Rise propagation delay time*1	Fall propagation delay time*1	Number of circuits	Package
S-89230BC-I8T1U	23 μA	26 μs	4 μs	2 circuits	SNT-8A
S-89230BC-K8T2U	23 μA	26 μs	4 μs	2 circuits	TMSOP-8
S-89240BC-I8T1U	5 μA	100 μs	18 μs	2 circuits	SNT-8A
S-89240BC-K8T2U	5 μA	100 μs	18 μs	2 circuits	TMSOP-8

\*1. The value when V<sub>DD</sub> = 3.0 V

**Remark** Please select products of environmental code = U for Sn 100%, halogen-free products.

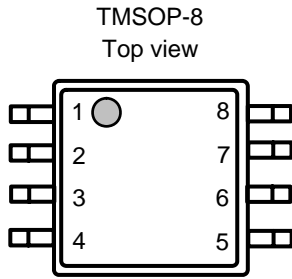
■ **Pin Configurations**



**Figure 2**

**Table 2**

Pin No.	Symbol	Description
1	OUT1	Output pin 1
2	IN1(-)	Inverted input pin 1
3	IN1(+)	Non-inverted input pin 1
4	VSS	GND pin
5	IN2(+)	Non-inverted input pin 2
6	IN2(-)	Inverted input pin 2
7	OUT2	Output pin 2
8	VDD	Positive power supply pin



**Figure 3**

**Table 3**

Pin No.	Symbol	Description
1	OUT1	Output pin 1
2	IN1(-)	Inverted input pin 1
3	IN1(+)	Non-inverted input pin 1
4	VSS	GND pin
5	IN2(+)	Non-inverted input pin 2
6	IN2(-)	Inverted input pin 2
7	OUT2	Output pin 2
8	VDD	Positive power supply pin

## ■ Absolute Maximum Ratings

Table 4

(Ta = +25°C unless otherwise specified)

Parameter	Symbol	Absolute maximum ratings	Unit	
Power supply voltage	$V_{DD}$	$V_{SS}-0.3$ to $V_{SS}+7.0$	V	
Input voltage	$V_{IN}$	$V_{SS}-0.3$ to $V_{SS}+7.0$	V	
Output voltage	$V_{OUT}$	$V_{SS}-0.3$ to $V_{DD}+0.3$	V	
Differential input voltage	$V_{IND}$	$\pm 7.0$	V	
Output pin current	$I_{SINK}$	20	mA	
Power dissipation	SNT-8A	$P_D$	450 <sup>*1</sup>	mW
	TMSOP-8		650 <sup>*1</sup>	mW
Operating ambient temperature	$T_{opr}$	-40 to +85	°C	
Storage temperature	$T_{stg}$	-55 to +125	°C	

\*1. When mounted on board

[Mounted board]

(1) Board size: 114.3 mm × 76.2 mm × 1.6 mm

(2) Board name: JEDEC STANDARD51-7

**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.

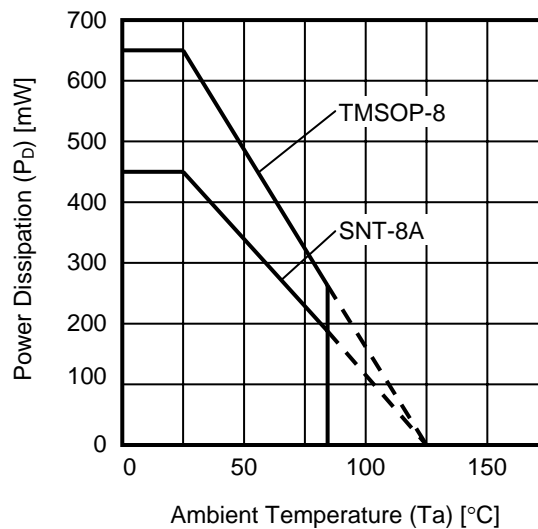


Figure 4 Power Dissipation of Package (When Mounted on Board)

■ **Electrical Characteristics**

**Table 5**

(Ta = +25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	Test Circuit
Range of operating power supply voltage	V <sub>DD</sub>	–	1.8	–	5.5	V	–

**1. V<sub>DD</sub> = 5.0 V**

**Table 6**

**DC Electrical Characteristics (V<sub>DD</sub> = 5.0 V)**

(Ta = +25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	Test Circuit	
Current consumption (per circuit)	I <sub>DD</sub>	S-89230 Series	–	23	40	μA	5	
		S-89240 Series	–	5	9	μA	5	
Input offset voltage drift	V <sub>IO</sub>	–	–4	±3	+4	mV	1	
Input offset voltage	$\frac{\Delta V_{IO}}{\Delta T_a}$	Ta = –40°C to +85°C	–	±10	–	μV/°C	1	
Input offset current	I <sub>IO</sub>	–	–	1	–	pA	–	
Input bias current	I <sub>BIAS</sub>	–	–	1	–	pA	–	
Common-mode input voltage range	V <sub>CMR</sub>	–	0	–	4.3	V	2	
Maximum output swing voltage	V <sub>OH</sub> V <sub>OL</sub>	R <sub>L</sub> = 1.0 MΩ	4.9	–	–	V	3	
		R <sub>L</sub> = 1.0 MΩ	–	–	0.01	V	4	
Common-mode input signal rejection ratio	CMRR	–	60	70	–	dB	2	
Power supply voltage rejection ratio	PSRR	–	60	70	–	dB	1	
Source current	I <sub>SOURCE</sub>	V <sub>OUT</sub> = 0 V	S-89230 Series	120	–	–	μA	6
			S-89240 Series	25	–	–	μA	6
Sink current	I <sub>SINK</sub>	V <sub>OUT</sub> = 0.5 V	S-89230 Series	5	–	–	mA	7
			S-89240 Series	3.5	–	–	mA	7

**Table 7**

**AC Electrical Characteristics (V<sub>DD</sub> = 5.0 V)**

(Ta = +25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
Rise propagation delay time	t <sub>PLH</sub>	Overdrive = 100 mV C <sub>L</sub> = 15 pF (Refer to <b>Figure 12</b> )	S-89230 Series	–	26	–	μs
			S-89240 Series	–	100	–	μs
Fall propagation delay time	t <sub>PHL</sub>		S-89230 Series	–	5	–	μs
			S-89240 Series	–	22	–	μs
Rise response time	t <sub>TLH</sub>		S-89230 Series	–	3	–	μs
			S-89240 Series	–	15	–	μs
Fall response time	t <sub>THL</sub>		S-89230 Series	–	3	–	μs
			S-89240 Series	–	15	–	μs

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**S-89230/89240 Series**

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**2.  $V_{DD} = 3.0\text{ V}$**

**Table 8**

**DC Electrical Characteristics ( $V_{DD} = 3.0\text{ V}$ )**

( $T_a = +25^\circ\text{C}$  unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	Test Circuit	
Current consumption (per circuit)	$I_{DD}$	S-89230 Series	–	23	40	$\mu\text{A}$	5	
		S-89240 Series	–	5	9	$\mu\text{A}$	5	
Input offset voltage drift	$V_{IO}$	–	–4	$\pm 3$	+4	mV	1	
Input offset voltage	$\frac{\Delta V_{IO}}{\Delta T_a}$	$T_a = -40^\circ\text{C}$ to $+85^\circ\text{C}$	–	$\pm 10$	–	$\mu\text{V}/^\circ\text{C}$	1	
Input offset current	$I_{IO}$	–	–	1	–	pA	–	
Input bias current	$I_{BIAS}$	–	–	1	–	pA	–	
Common-mode input voltage range	$V_{CMR}$	–	0	–	2.3	V	2	
Maximum output swing voltage	$V_{OH}$	$R_L = 1.0\text{ M}\Omega$	2.9	–	–	V	3	
	$V_{OL}$	$R_L = 1.0\text{ M}\Omega$	–	–	0.01	V	4	
Common-mode input signal rejection ratio	CMRR	–	60	70	–	dB	2	
Power supply voltage rejection ratio	PSRR	–	60	70	–	dB	1	
Source current	$I_{SOURCE}$	$V_{OUT} = 0\text{ V}$	S-89230 Series	120	–	–	$\mu\text{A}$	6
			S-89240 Series	25	–	–	$\mu\text{A}$	6
Sink current	$I_{SINK}$	$V_{OUT} = 0.5\text{ V}$	S-89230 Series	5	–	–	mA	7
			S-89240 Series	3.5	–	–	mA	7

**Table 9**

**AC Electrical Characteristics ( $V_{DD} = 3.0\text{ V}$ )**

( $T_a = +25^\circ\text{C}$  unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
Rise propagation delay time	$t_{PLH}$	Overdrive = 100 mV $C_L = 15\text{ pF}$ (Refer to <b>Figure 12</b> )	S-89230 Series	–	26	–	$\mu\text{s}$
			S-89240 Series	–	100	–	$\mu\text{s}$
Fall propagation delay time	$t_{PHL}$		S-89230 Series	–	4	–	$\mu\text{s}$
			S-89240 Series	–	18	–	$\mu\text{s}$
Rise response time	$t_{TLH}$		S-89230 Series	–	2	–	$\mu\text{s}$
			S-89240 Series	–	10	–	$\mu\text{s}$
Fall response time	$t_{THL}$		S-89230 Series	–	2	–	$\mu\text{s}$
			S-89240 Series	–	10	–	$\mu\text{s}$

**3.  $V_{DD} = 1.8\text{ V}$**

**Table 10**

**DC Electrical Characteristics ( $V_{DD} = 1.8\text{ V}$ )**

( $T_a = +25^\circ\text{C}$  unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	Test Circuit	
Current consumption (per circuit)	$I_{DD}$	S-89230 Series	–	23	40	$\mu\text{A}$	5	
		S-89240 Series	–	5	9	$\mu\text{A}$	5	
Input offset voltage drift	$V_{IO}$	–	–4	$\pm 3$	+4	mV	1	
Input offset voltage	$\frac{\Delta V_{IO}}{\Delta T_a}$	$T_a = -40^\circ\text{C}$ to $+85^\circ\text{C}$	–	$\pm 10$	–	$\mu\text{V}/^\circ\text{C}$	1	
Input offset current	$I_{IO}$	–	–	1	–	pA	–	
Input bias current	$I_{BIAS}$	–	–	1	–	pA	–	
Common-mode input voltage range	$V_{CMR}$	–	0	–	1.1	V	2	
Maximum output swing voltage	$V_{OH}$	$R_L = 1.0\text{ M}\Omega$	1.7	–	–	V	3	
	$V_{OL}$	$R_L = 1.0\text{ M}\Omega$	–	–	0.01	V	4	
Common-mode input signal rejection ratio	CMRR	–	60	70	–	dB	2	
Power supply voltage rejection ratio	PSRR	–	60	70	–	dB	1	
Source current	$I_{SOURCE}$	$V_{OUT} = 0\text{ V}$	S-89230 Series	100	–	–	$\mu\text{A}$	6
			S-89240 Series	20	–	–	$\mu\text{A}$	6
Sink current	$I_{SINK}$	$V_{OUT} = 0.5\text{ V}$	S-89230 Series	5	–	–	mA	7
			S-89240 Series	3.5	–	–	mA	7

**Table 11**

**AC Electrical Characteristics ( $V_{DD} = 1.8\text{ V}$ )**

( $T_a = +25^\circ\text{C}$  unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
Rise propagation delay time	$t_{PLH}$	Overdrive = 100 mV $C_L = 15\text{ pF}$ (Refer to <b>Figure 12</b> )	S-89230 Series	–	18	–	$\mu\text{s}$
			S-89240 Series	–	87	–	$\mu\text{s}$
Fall propagation delay time	$t_{PHL}$		S-89230 Series	–	3.5	–	$\mu\text{s}$
			S-89240 Series	–	15	–	$\mu\text{s}$
Rise response time	$t_{TLH}$		S-89230 Series	–	1.2	–	$\mu\text{s}$
			S-89240 Series	–	6	–	$\mu\text{s}$
Fall response time	$t_{THL}$		S-89230 Series	–	1.2	–	$\mu\text{s}$
			S-89240 Series	–	6	–	$\mu\text{s}$

■ Test Circuit (Per Circuit)

1. Power supply voltage rejection ratio, input offset voltage

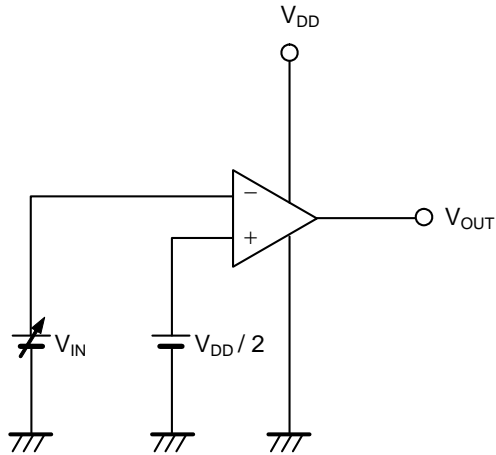


Figure 5

• Power supply voltage rejection ratio (PSRR)  
Input offset voltage ( $V_{IO}$ )

The input offset voltage ( $V_{IO}$ ) is defined as  $V_{IN} - V_{DD} / 2$  when  $V_{OUT}$  is changed by changing  $V_{IN}$  to  $V_{DD} / 2$  level. The power supply voltage rejection ratio (PSRR) can be calculated by following expression, with the value of  $V_{IO}$  measured at each  $V_{DD}$ .

Measurement conditions:

When  $V_{DD} = 1.8\text{ V}$ :  $V_{DD} = V_{DD1}$ ,  $V_{IO} = V_{IO1}$

When  $V_{DD} = 5.0\text{ V}$ :  $V_{DD} = V_{DD2}$ ,  $V_{IO} = V_{IO2}$

$$PSRR = 20 \log \left( \frac{V_{DD1} - V_{DD2}}{V_{IO1} - V_{IO2}} \right)$$

2. Common-mode input signal rejection ratio, common-mode input voltage range

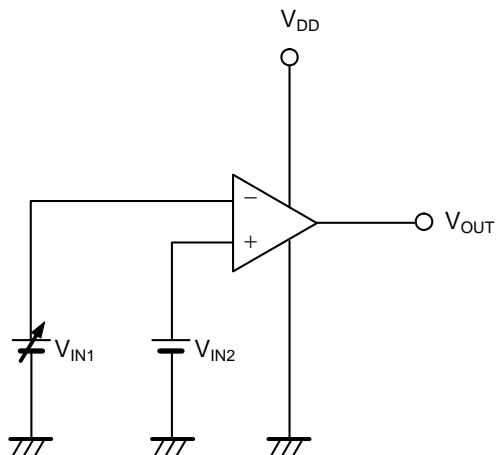


Figure 6

• Common-mode input signal rejection ratio (CMRR)

The common-mode input signal rejection ratio (CMRR) can be calculated by the following expression, with the offset voltage ( $V_{IO}$ ) set as  $V_{IN1} - V_{IN2}$  after  $V_{OUT}$  is changed by changing  $V_{IN1}$ .

Measurement conditions:

When  $V_{IN2} = V_{CMR\ Max.}$ :  $V_{IN2} = V_{INH}$ ,  $V_{IO} = V_{IO1}$

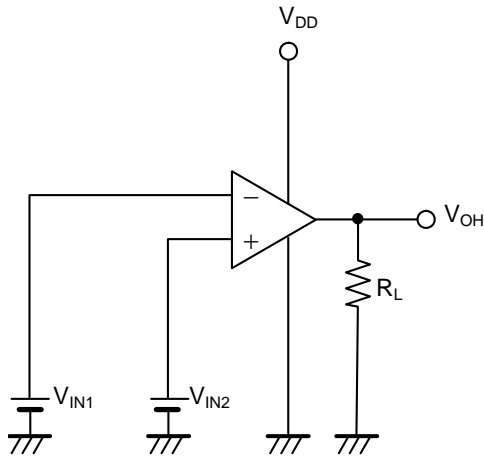
When  $V_{IN2} = V_{DD}/2$ :  $V_{IN2} = V_{INL}$ ,  $V_{IO} = V_{IO2}$

$$CMRR = 20 \log \left( \frac{V_{INH} - V_{INL}}{V_{IO1} - V_{IO2}} \right)$$

• Common-mode input voltage range ( $V_{CMR}$ )

Varying  $V_{IN2}$ , the range of  $V_{IN2}$  that satisfies the common-mode input signal rejection ratio (CMRR) is the common-mode input voltage range ( $V_{CMR}$ ).

**3. Maximum output swing voltage ( $V_{OH}$ )**



**Figure 7**

• **Maximum output swing voltage ( $V_{OH}$ )**

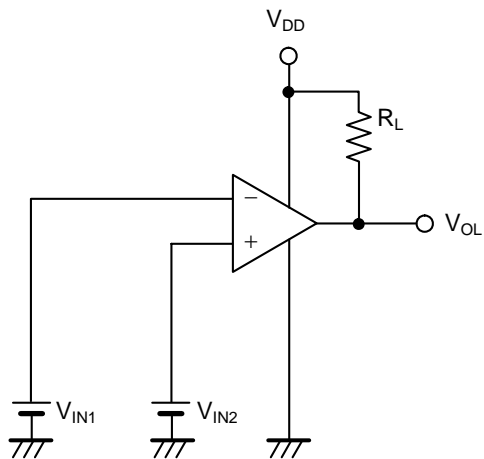
Test conditions:

$$V_{IN1} = \frac{V_{DD}}{2} - 0.1 \text{ V}$$

$$V_{IN2} = \frac{V_{DD}}{2} + 0.1 \text{ V}$$

$$R_L = 1 \text{ M}\Omega$$

**4. Maximum output swing voltage ( $V_{OL}$ )**



**Figure 8**

• **Maximum output swing voltage ( $V_{OL}$ )**

Test conditions:

$$V_{IN1} = \frac{V_{DD}}{2} + 0.1 \text{ V}$$

$$V_{IN2} = \frac{V_{DD}}{2} - 0.1 \text{ V}$$

$$R_L = 1 \text{ M}\Omega$$

5. Current consumption

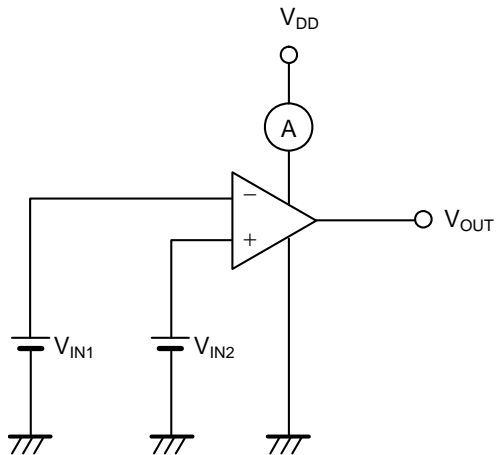


Figure 9

• Current consumption ( $I_{DD}$ )

Test conditions:  
 $V_{IN} = V_{SS}$   
 $V_{IN} = V_{CMR Max.}$

6. Source current

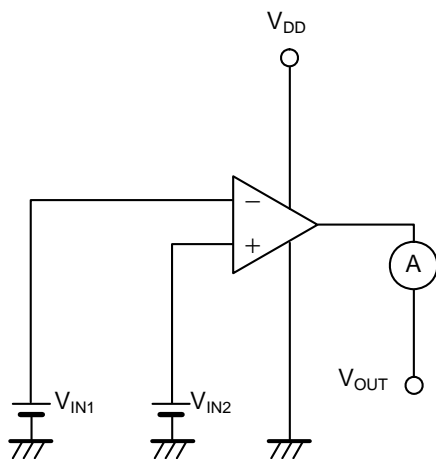


Figure 10

• Source current ( $I_{SOURCE}$ )

Test conditions:  
 $V_{OUT} = 0 V$   
 $V_{IN1} = \frac{V_{DD}}{2} - 0.5 V$   
 $V_{IN2} = \frac{V_{DD}}{2} + 0.5 V$

7. Sink current

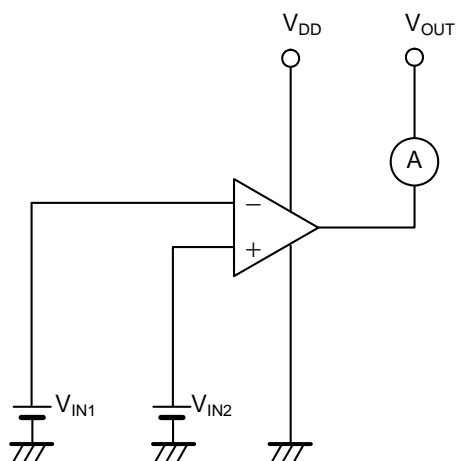
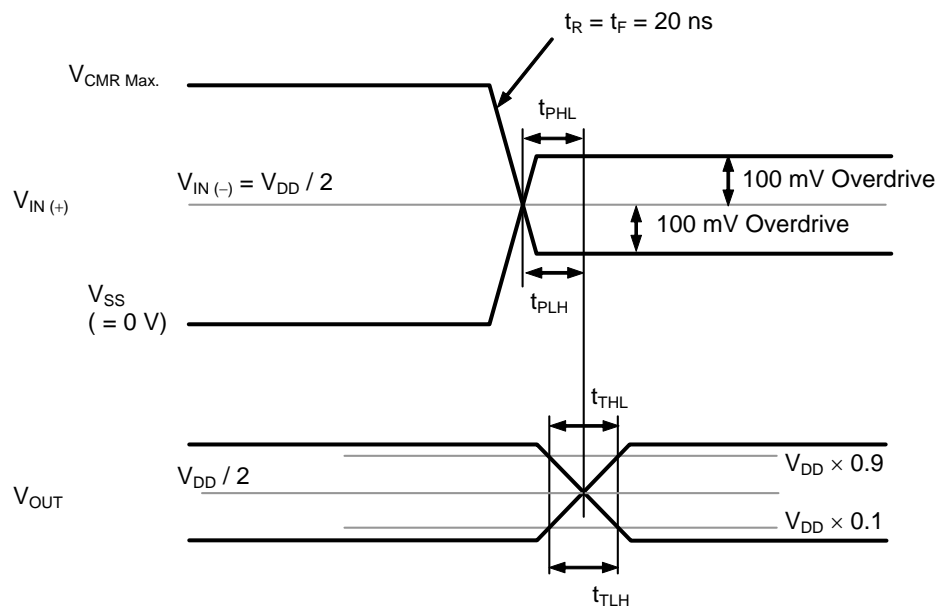


Figure 11

• Sink current ( $I_{SINK}$ )

Test conditions:  
 $V_{OUT} = 0.5 V$   
 $V_{IN1} = \frac{V_{DD}}{2} + 0.5 V$   
 $V_{IN2} = \frac{V_{DD}}{2} - 0.5 V$

**8. Propagation time, response time**



**Figure 12**

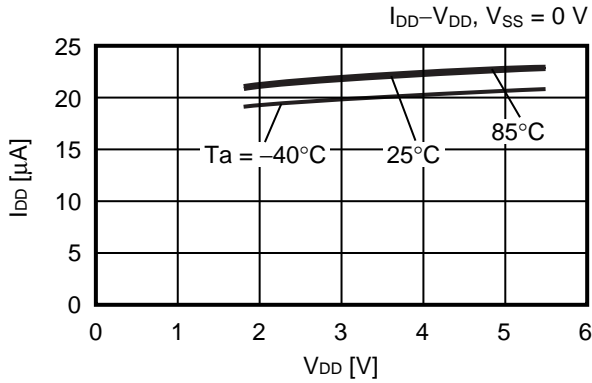
## ■ Precautions

- Do not apply an electrostatic discharge to this IC that exceeds performance ratings of the built-in electrostatic protection circuit.
- SII claims no responsibility for any disputes arising out of or in connection with any infringement by products including this IC of patents owned by a third party.

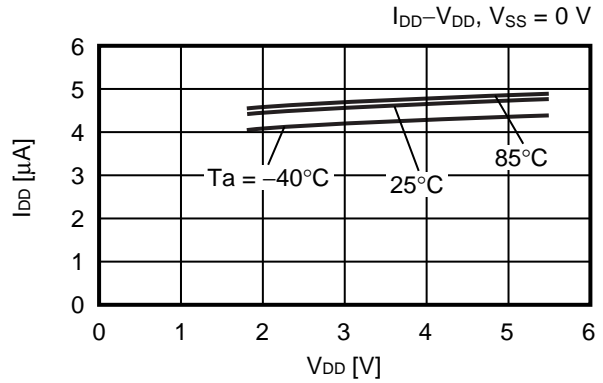
**■ Characteristics (Typical Data)**

**1. Current consumption (per circuit,  $I_{DD}$ ) vs. Power supply voltage ( $V_{DD}$ )**

**(1) S-89230 Series**



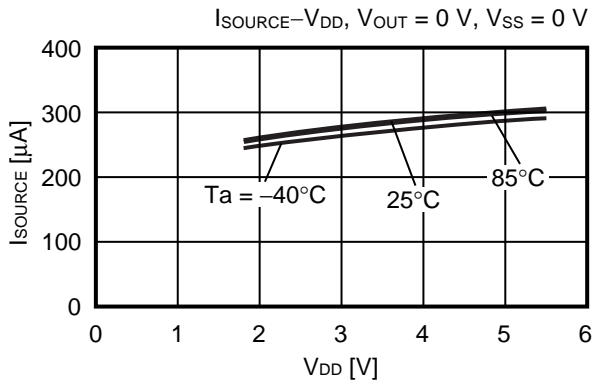
**(2) S-89240 Series**



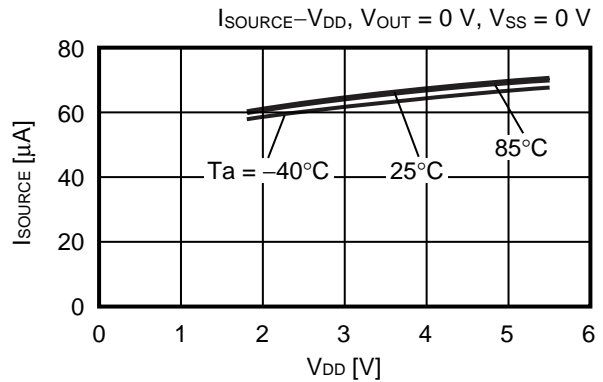
**2. Output current characteristics**

**2.1 Source current ( $I_{SOURCE}$ ) vs. Power supply voltage ( $V_{DD}$ )**

**(1) S-89230 Series**

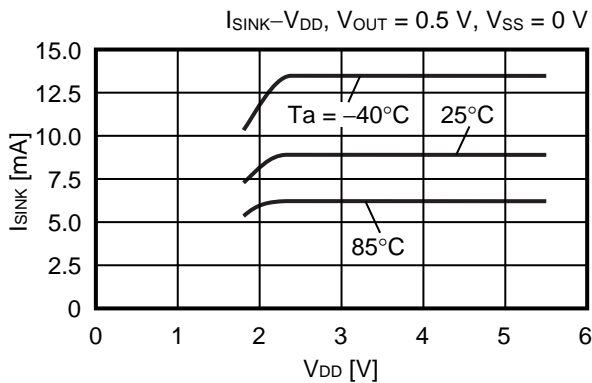


**(2) S-89240 Series**

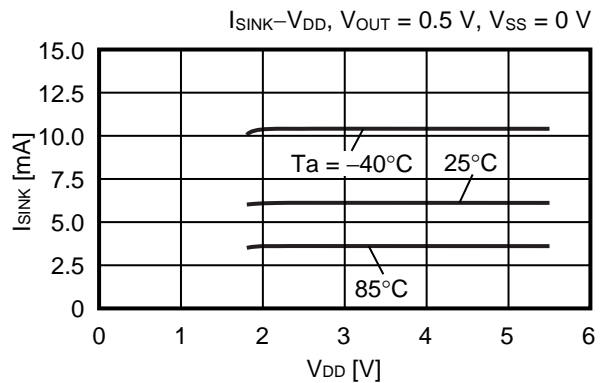


**2.2 Sink current ( $I_{SINK}$ ) vs. Power supply voltage ( $V_{DD}$ )**

**(1) S-89230 Series**

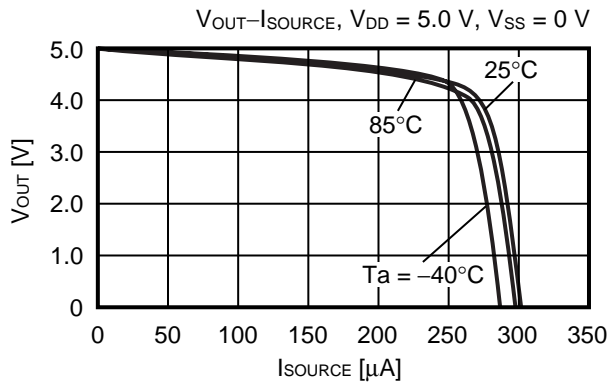
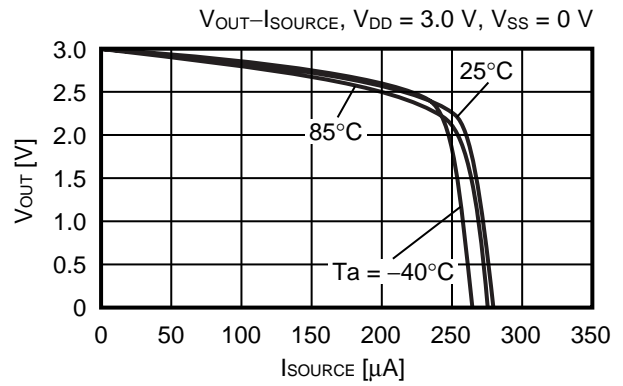
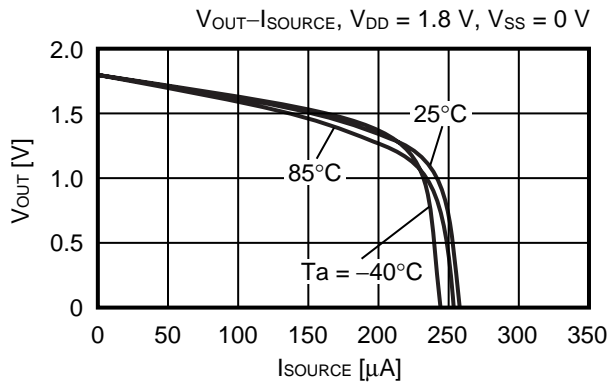


**(2) S-89240 Series**

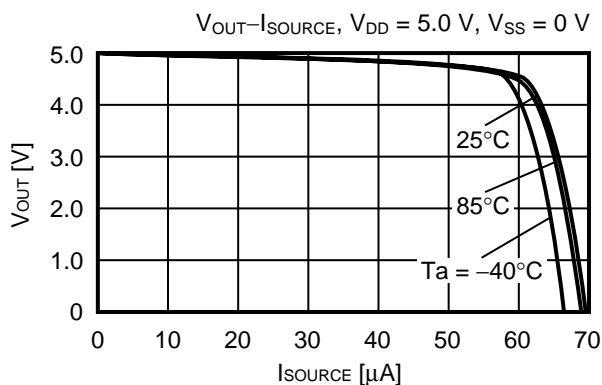
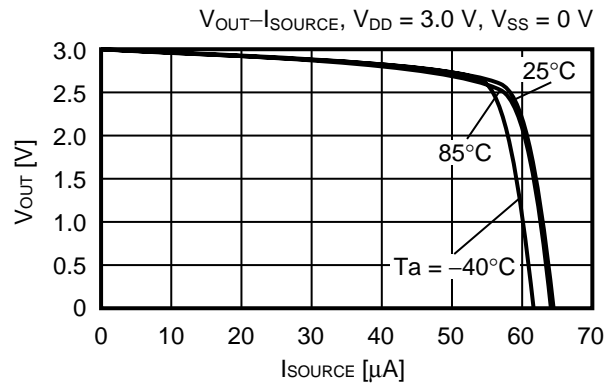
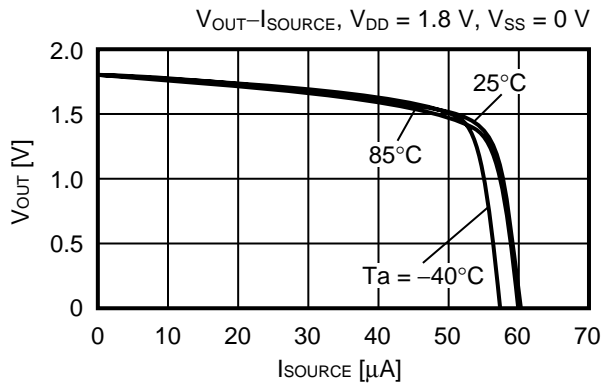


2.3 Output voltage ( $V_{OUT}$ ) vs. Source current ( $I_{SOURCE}$ )

(1) S-89230 Series

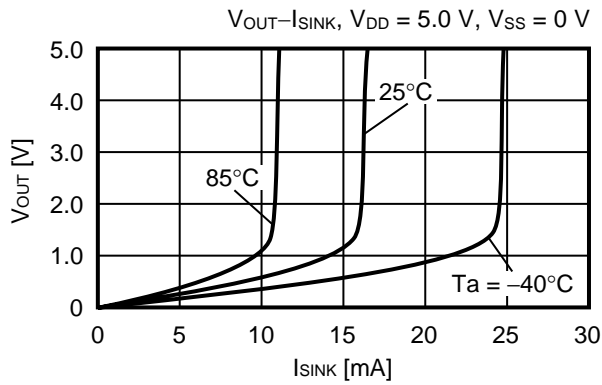
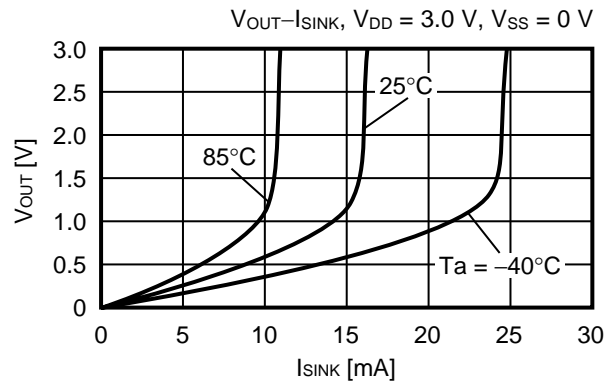
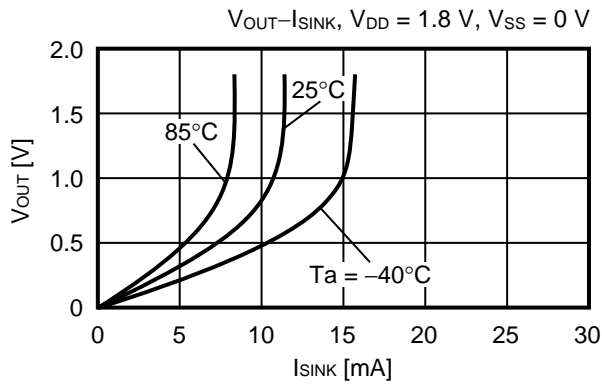


(2) S-89240 Series

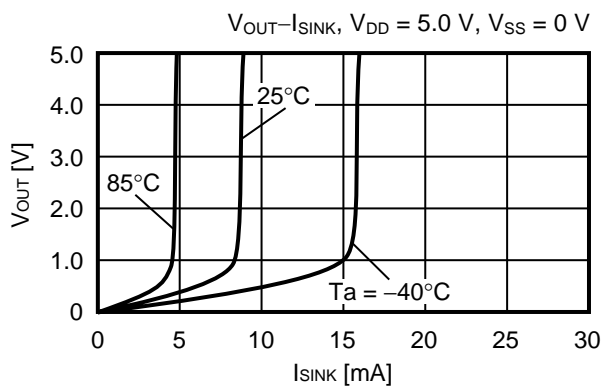
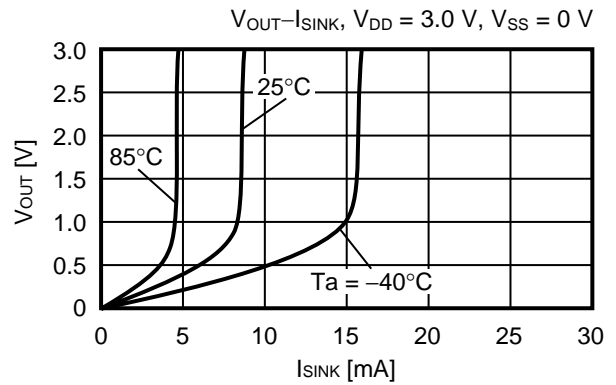
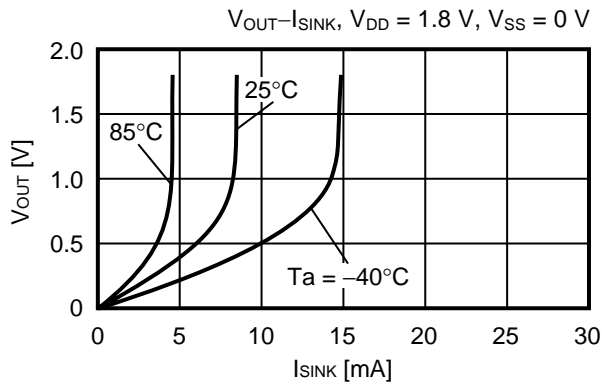


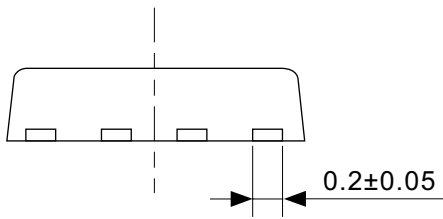
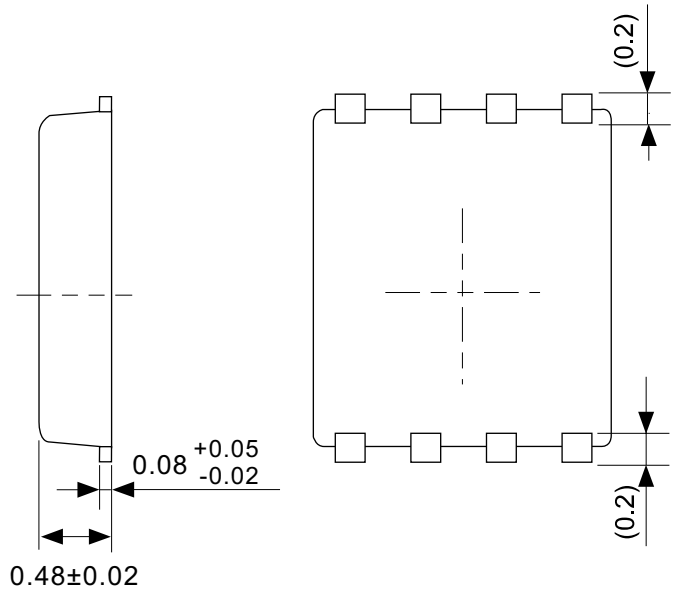
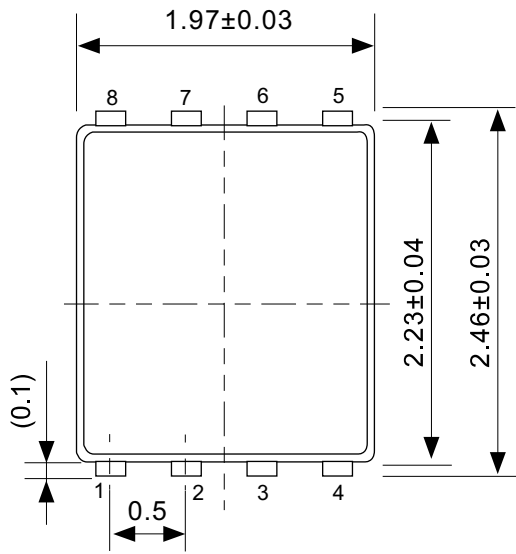
**2.4 Output voltage ( $V_{OUT}$ ) vs. Sink current ( $I_{SINK}$ )**

**(1) S-89230 Series**



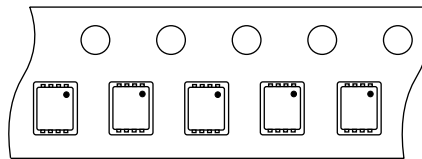
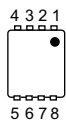
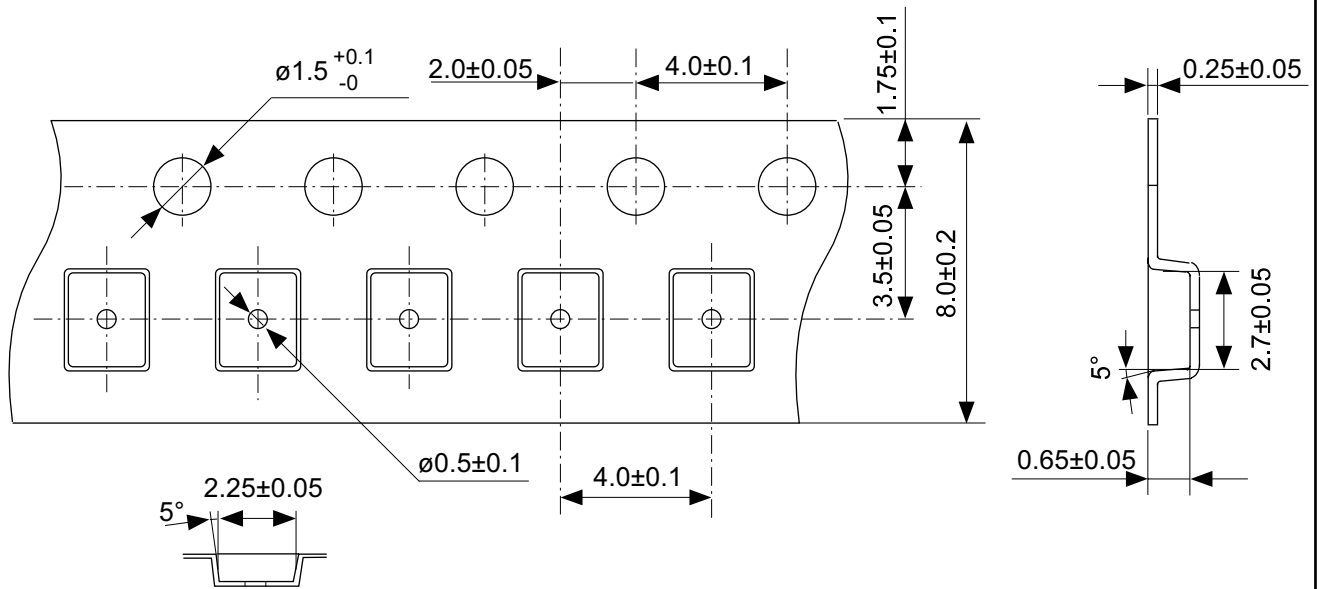
**(2) S-89240 Series**





No. PH008-A-P-SD-2.0

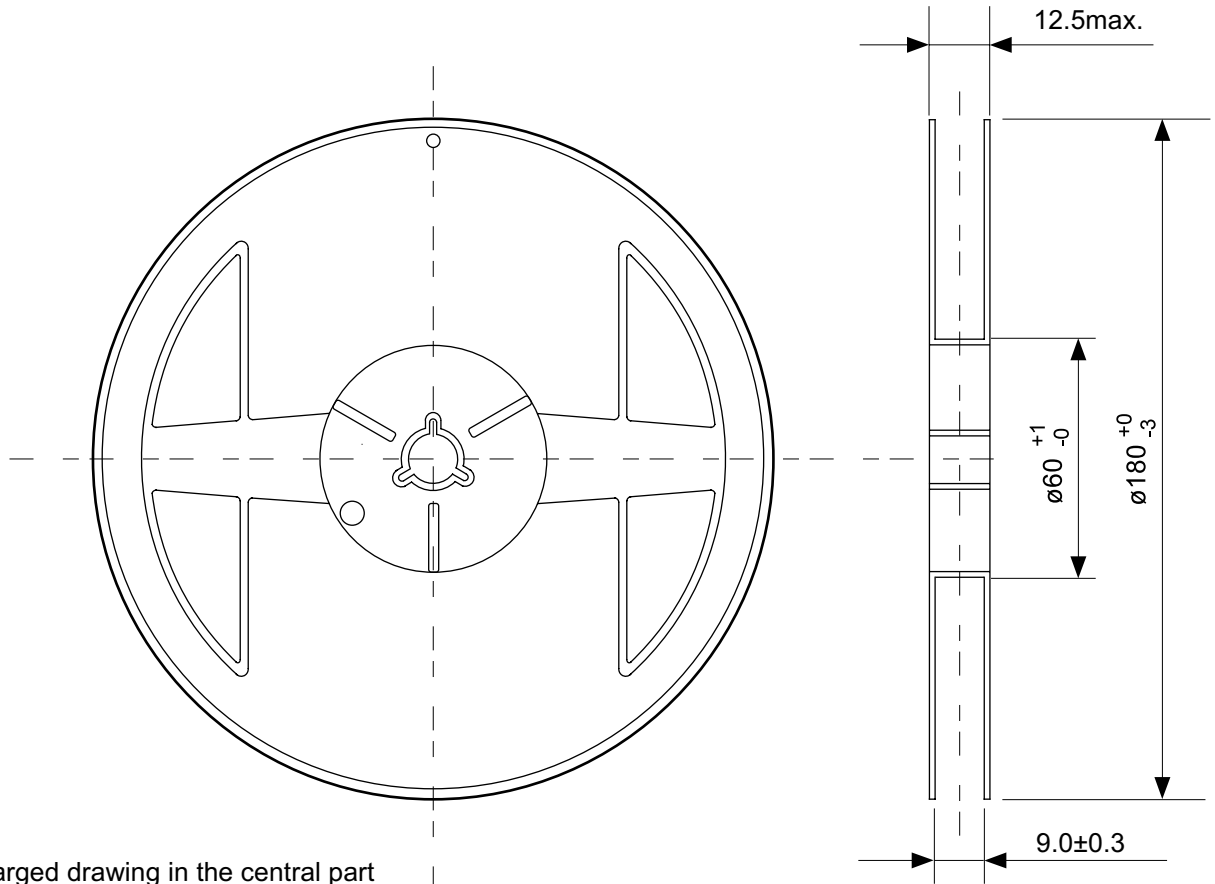
TITLE	SNT-8A-A-PKG Dimensions
No.	PH008-A-P-SD-2.0
SCALE	
UNIT	mm
Seiko Instruments Inc.	



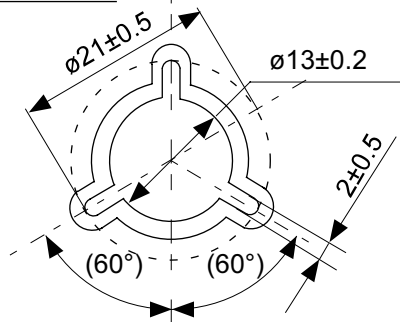
Feed direction

No. PH008-A-C-SD-1.0

TITLE	SNT-8A-A-Carrier Tape
No.	PH008-A-C-SD-1.0
SCALE	
UNIT	mm
Seiko Instruments Inc.	

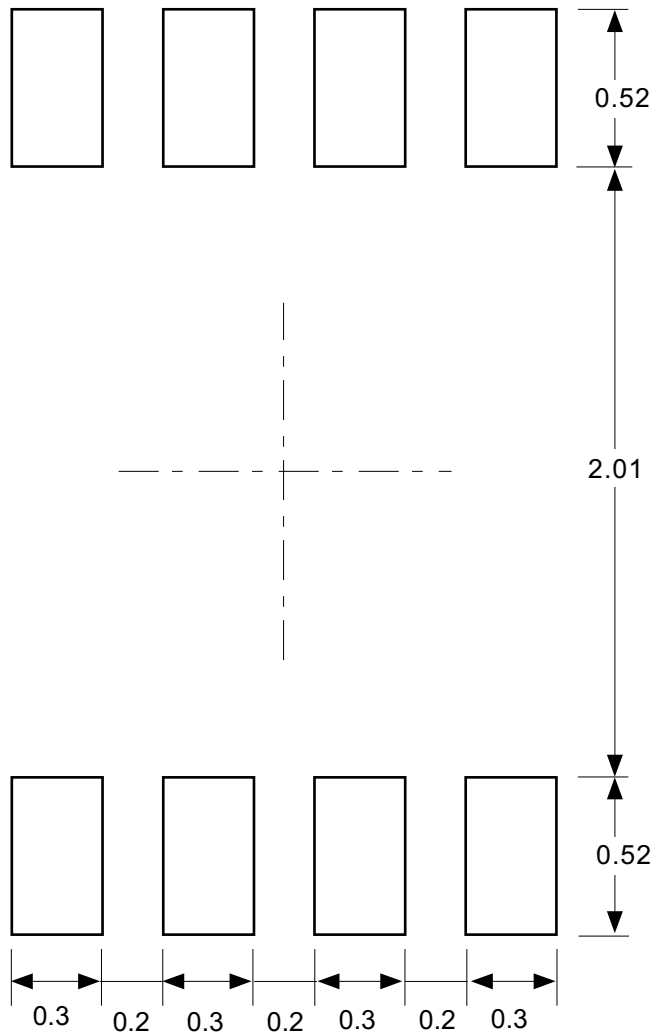


Enlarged drawing in the central part



No. PH008-A-R-SD-1.0

TITLE	SNT-8A-A-Reel		
No.	PH008-A-R-SD-1.0		
SCALE		QTY.	5,000
UNIT	mm		
Seiko Instruments Inc.			

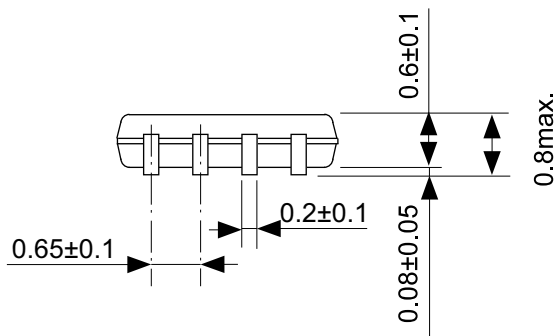
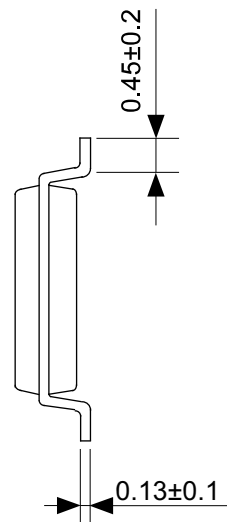
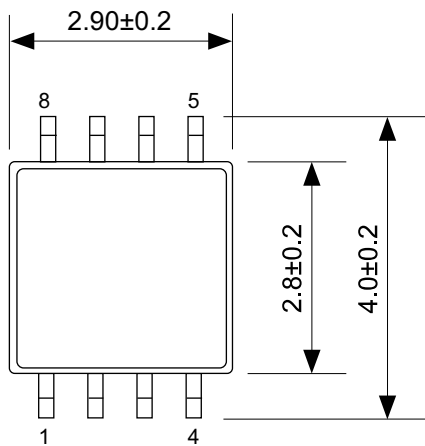


Caution Making the wire pattern under the package is possible. However, note that the package may be upraised due to the thickness made by the silk screen printing and of a solder resist on the pattern because this package does not have the standoff.

注意 パッケージ下への配線パターン形成は可能ですが、本パッケージはスタンドオフが無いので、パターン上のレジスト厚み、シルク印刷の厚みによってパッケージが持ち上がる場合がありますのでご配慮ください。

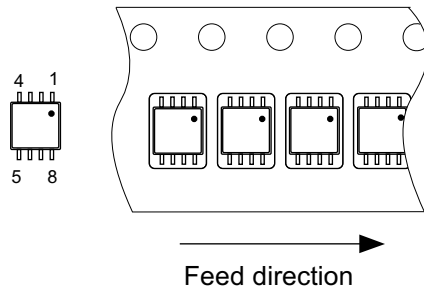
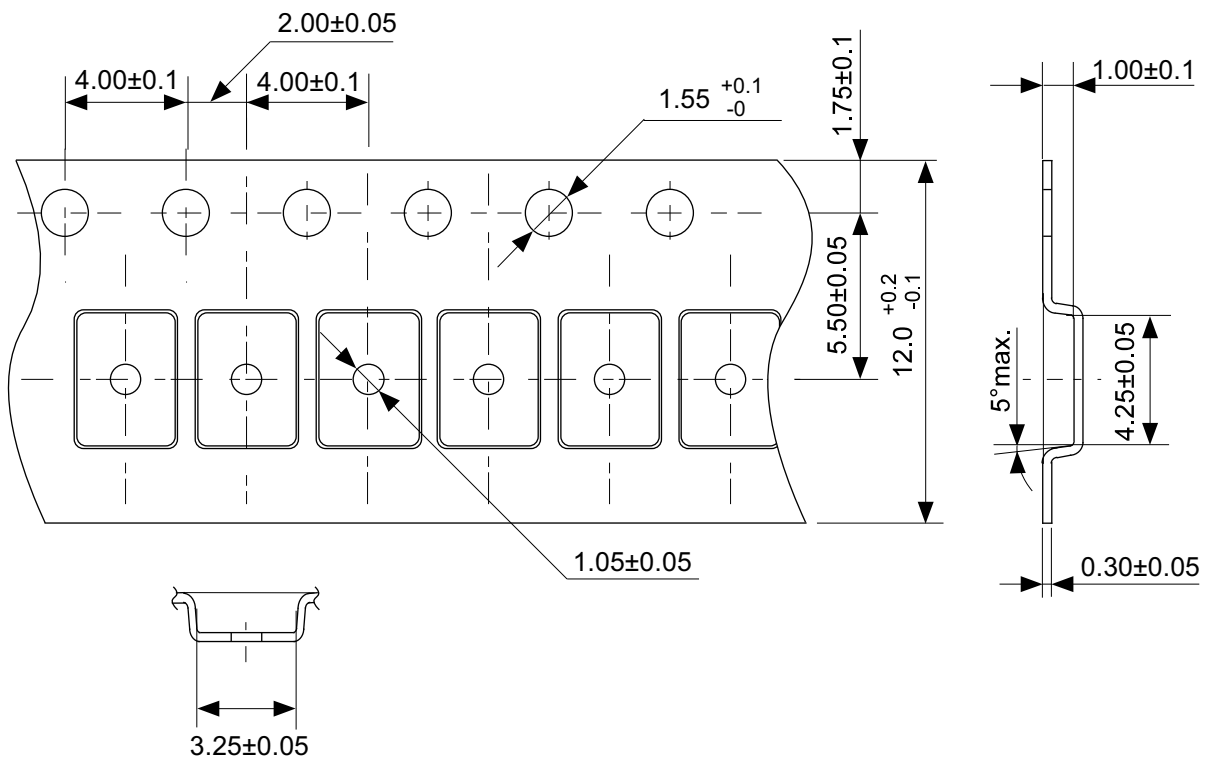
No. PH008-A-L-SD-3.0

TITLE	SNT-8A-A-Land Recommendation
No.	PH008-A-L-SD-3.0
SCALE	
UNIT	mm
Seiko Instruments Inc.	



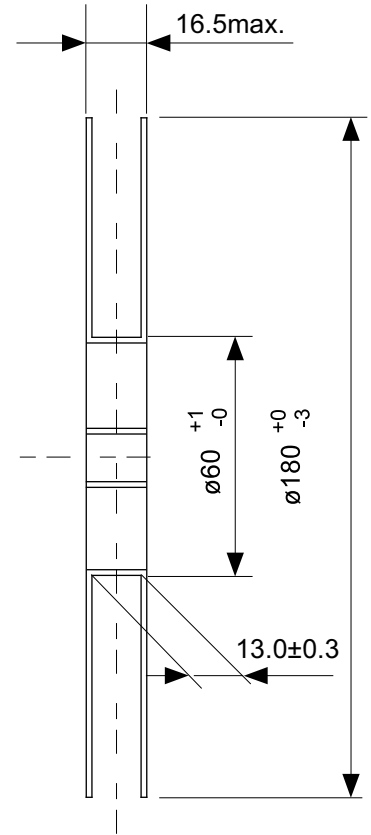
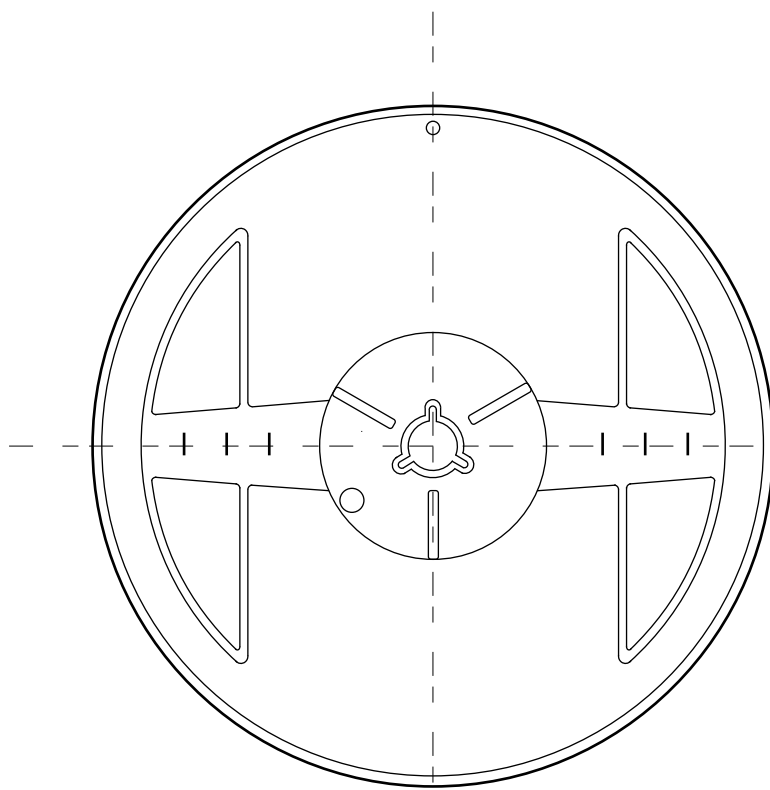
No. FM008-A-P-SD-1.0

TITLE	TMSOP8-A-PKG Dimensions
No.	FM008-A-P-SD-1.0
SCALE	
UNIT	mm
Seiko Instruments Inc.	

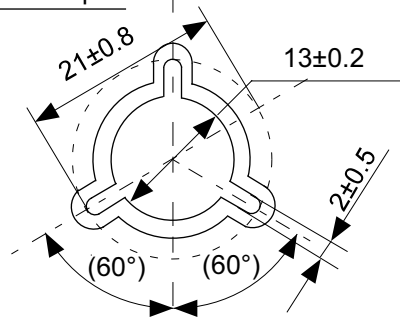


No. FM008-A-C-SD-1.0

TITLE	TMSOP8-A-Carrier Tape
No.	FM008-A-C-SD-1.0
SCALE	
UNIT	mm
Seiko Instruments Inc.	



Enlarged drawing in the central part



No. FM008-A-R-SD-1.0

TITLE	TMSOP8-A-Reel		
No.	FM008-A-R-SD-1.0		
SCALE		QTY.	4,000
UNIT	mm		
Seiko Instruments Inc.			



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