

MINI ANALOG SERIES CMOS COMPARATOR

S-89210A/89220A

The mini-analog series is a group of ICs that incorporate a general purpose analog circuit in a small package.

The S-89210A/89220A is a CMOS type comparator that has a phase compensation circuit, and that can be driven at a lower voltage with lower current consumption than existing bipolar comparators. These features make this product the ideal solution for small battery-powered portable equipment. The S-89210A/89220A is a single comparator.

■ Features

- Lower operating voltage than the conventional general-purpose comparators: $V_{DD} = 1.8$ to 5.5 V
- Low current consumption: $I_{DD} = 50$ μ A (S-89210A)
 $I_{DD} = 10$ μ A (S-89220A)
- Low input offset voltage: 4.0 mV (max.)
- Lead-free products

■ Application

- Cellular phones
- PDAs
- Notebook PCs
- Digital cameras
- Digital video cameras

■ Package

Package Name	Drawing Code		
	Package	Tape	Reel
SC-88A	NP005-B	NP005-B	NP005-B

■ Product Code List

Table 1

Current consumption	SC-88A
$I_{DD} = 50$ μ A	S-89210ACNC-1C0TFG
$I_{DD} = 10$ μ A	S-89220ACNC-1C1TFG

Remark Delivery form : Taping only

■ Pin Configuration

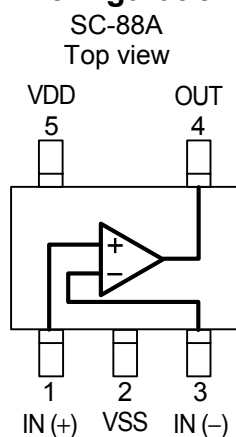


Figure 1

Table 2

Pin No.	Symbol	Description	Internal Equivalent Circuit
1	IN(+)	Non-inverted input pin	Figure 3
2	VSS	GND pin	—
3	IN(-)	Inverted input pin	Figure 3
4	OUT	Output pin	Figure 2
5	VDD	Positive power supply pin	Figure 4

■ Internal Equivalent Circuit

<1> Output pin

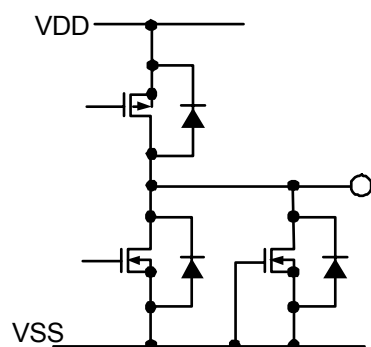


Figure 2

<2> Input pin

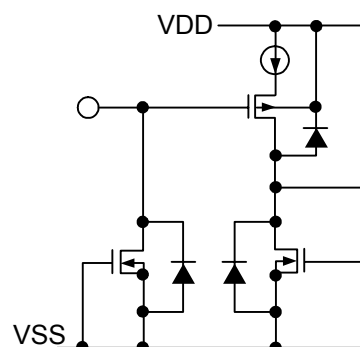


Figure 3

<3> VDD pin

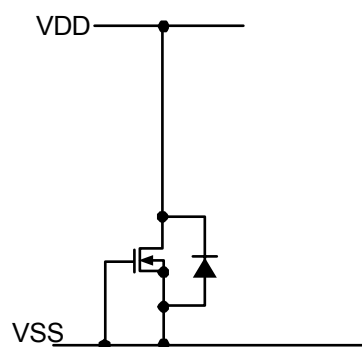


Figure 4

■ Absolute Maximum Ratings

Table 3

Parameter	Symbol	Ratings	Unit
Power supply voltage	$V_{DD} - V_{SS}$	10.0	V
Input voltage	V_{IN}	V_{SS} to V_{DD} (7.0 max.)	V
Output voltage	V_{OUT}	V_{SS} to V_{DD} (7.0 max.)	V
Differential input voltage	V_{IND}	± 7.0	V
Power dissipation	P_D	200	mW
Operating temperature range	T_{opr}	-40 to +85	°C
Storage temperature range	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 Operating Power Supply Voltage Range

Table 4

Parameter	Symbol	Range	Unit
Operating power supply voltage range	V_{DD}	1.8 to 5.5	V

■ **Electrical Characteristics**

1. $V_{DD} = 5.0\text{ V}$

Table 5

DC Characteristics ($V_{DD} = 5.0\text{ V}$)

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

Parameter	Symbol	Measurement Conditions	Min.	Typ.	Max.	Unit	Measurement Circuit
Current consumption	I_{DD}	S-89210A	—	50	120	μA	Figure 9
		S-89220A	—	10	30	μA	
Input offset voltage	V_{IO}	—	-4	± 3	+4	mV	Figure 5
Input offset current	I_{IO}	—	—	1	—	pA	—
Input bias current	I_{BIAS}	—	—	1	—	pA	—
Common-mode input voltage range	V_{CMR}	—	0	—	4.3	V	Figure 6
Maximum output swing voltage	V_{OH}	$I_{OH} = 20\text{ }\mu\text{A}$	4.7	—	—	V	Figure 7
	V_{OL}	$I_{OL} = 20\text{ }\mu\text{A}$	—	—	0.01		Figure 8
Common-mode input signal rejection ratio	CMRR	—	60	70	—	dB	Figure 6
Power supply voltage rejection ratio	PSRR	—	60	70	—	dB	Figure 5
Source current	I_{SOURCE}	S-89210A	120	—	—	μA	Figure 10
		S-89220A	25	—	—		
Sink current	I_{SINK}	$V_{OL} = 0.5\text{ V}$	9	—	—	mA	Figure 11

Table 6

AC Characteristics ($V_{DD} = 5.0\text{ V}$)

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

Parameter	Symbol	Measurement conditions	Min.	Typ.	Max.	Unit
Rise propagation delay time	t_{PLH}	S-89210A	—	45	—	μs
		S-89220A	—	230	—	
Fall propagation delay time	t_{PHL}	S-89210A	—	9	—	
		S-89220A	—	45	—	
Rise response time	t_{TLH}	S-89210A	—	3	—	
		S-89220A	—	15	—	
Fall response time	t_{THL}	S-89210A	—	3	—	
		S-89220A	—	15	—	

Overdrive = 100 mV
 $C_L = 15\text{ pF}$
 (Refer to **Figure 12.**)

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

Table 7

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

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

Parameter	Symbol	Measurement Conditions	Min.	Typ.	Max.	Unit	Measurement Circuit
Current consumption	I_{DD}	S-89210A	—	50	120	μA	Figure 9
		S-89220A	—	10	30	μA	
Input offset voltage	V_{IO}	—	-4	± 3	+4	mV	Figure 5
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	Figure 6
Maximum output swing voltage	V_{OH}	$I_{OH} = 20\text{ }\mu\text{A}$	2.7	—	—	V	Figure 7
	V_{OL}	$I_{OL} = 20\text{ }\mu\text{A}$	—	—	0.01	V	Figure 8
Common-mode input signal rejection ratio	CMRR	—	60	70	—	dB	Figure 6
Power supply voltage rejection ratio	PSRR	—	60	70	—	dB	Figure 5
Source current	I_{SOURCE}	S-89210A	$V_{OH} = 0\text{ V}$	120	—	μA	Figure 10
	I_{SOURCE}	S-89220A		25	—		
Sink current	I_{SINK}	$V_{OL} = 0.5\text{ V}$	8	—	—	mA	Figure 11

Table 8

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

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

Parameter	Symbol	Measurement conditions	Min.	Typ.	Max.	Unit
Rise propagation delay time	t_{PLH}	S-89210A	—	30	—	μs
		S-89220A	—	150	—	
Fall propagation delay time	t_{PHL}	S-89210A	—	6	—	
		S-89220A	—	30	—	
Rise response time	t_{TLH}	S-89210A	—	2	—	
		S-89220A	—	10	—	
Fall response time	t_{THL}	S-89210A	—	2	—	
		S-89220A	—	10	—	

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

Table 9

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

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

Parameter	Symbol	Measurement Conditions	Min.	Typ.	Max.	Unit	Measurement Circuit
Current consumption	I_{DD}	S-89210A	—	50	120	μA	Figure 9
		S-89220A	—	10	30	μA	
Input offset voltage	V_{IO}	—	-4	± 3	+4	mV	Figure 5
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	Figure 6
Maximum output swing voltage	V_{OH}	$I_{OH} = 20\text{ }\mu\text{A}$	1.5	—	—	V	Figure 7
	V_{OL}	$I_{OL} = 20\text{ }\mu\text{A}$	—	—	0.01	V	Figure 8
Common-mode input signal rejection ratio	CMRR	—	60	70	—	dB	Figure 6
Power supply voltage rejection ratio	PSRR	—	60	70	—	dB	Figure 5
Source current	I_{SOURCE}	S-89210A	$V_{OH} = 0\text{ V}$	100	—	μA	Figure 10
	I_{SOURCE}	S-89220A		20	—		
Sink current	I_{SINK}	$V_{OL} = 0.5\text{ V}$	5	—	—	mA	Figure 11

Table 10

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

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

Parameter	Symbol	Measurement conditions	Min.	Typ.	Max.	Unit
Rise propagation delay time	t_{PLH}	S-89210A	—	20	—	μs
		S-89220A	—	100	—	
Fall propagation delay time	t_{PHL}	S-89210A	—	5	—	
		S-89220A	—	25	—	
Rise response time	t_{TLH}	S-89210A	—	1.2	—	
		S-89220A	—	6	—	
Fall response time	t_{THL}	S-89210A	—	1.2	—	
		S-89220A	—	6	—	

■ Measurement Circuit

1. Power supply voltage rejection ratio, input offset voltage

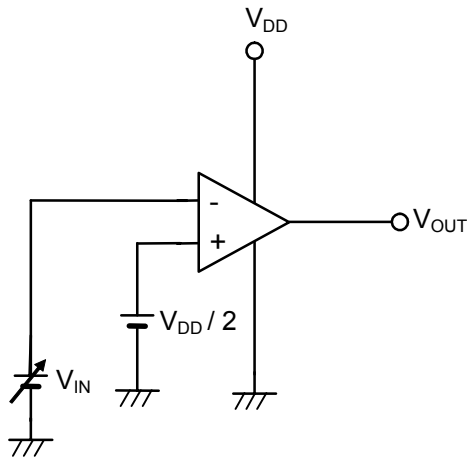


Figure 5

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

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

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

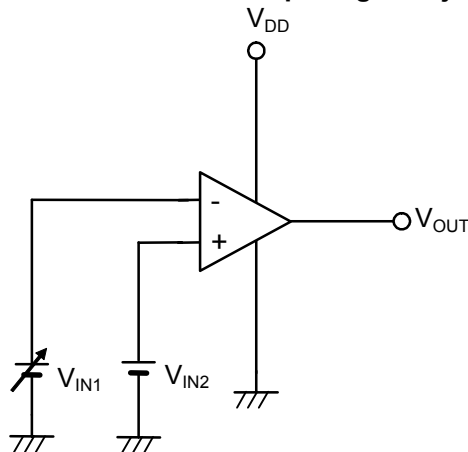


Figure 6

• 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} minus V_{IN2} after V_{OUT} is changed by changing V_{IN1} .

Measurement conditions:

When $V_{IN2} = V_{CMR} (\text{max.})$: $V_{IN2} = V_{INH}$, $V_{IO} = V_{IO1}$

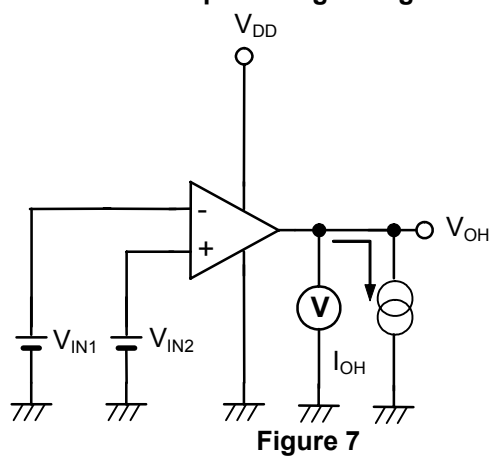
When $V_{IN2} = V_{DD}/2$: $V_{IN2} = V_{INL}$, $V_{IO} = V_{IO2}$

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

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

The common-mode input voltage range is the range of V_{IN2} in which V_{OUT} satisfies the common-mode input signal rejection ratio specifications.

3. Maximum output swing voltage

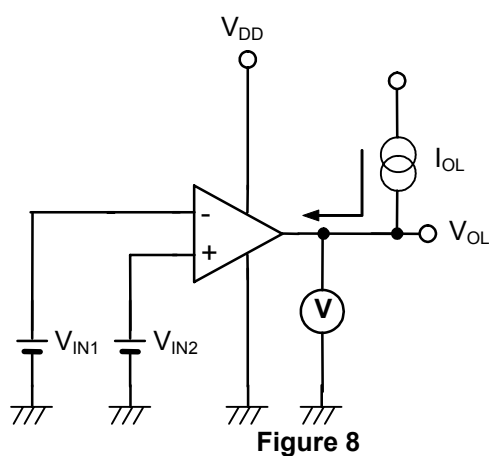


- **Maximum output swing voltage (V_{OH})**

Measurement conditions: $V_{IN1} = \frac{V_{DD}}{2} - 0.5\text{ V}$

$$V_{IN2} = \frac{V_{DD}}{2} + 0.5\text{ V}$$

$$I_{OH} = 20\text{ }\mu\text{A}$$



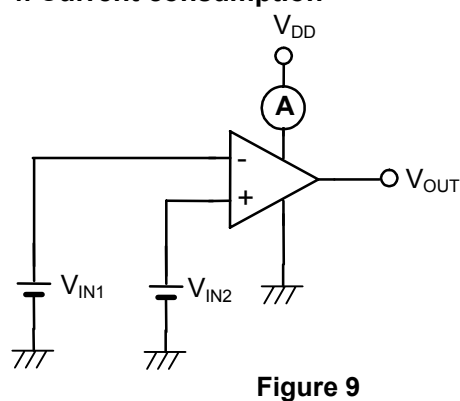
- **Maximum output swing voltage (V_{OL})**

Measurement conditions: $V_{IN1} = \frac{V_{DD}}{2} + 0.5\text{ V}$

$$V_{IN2} = \frac{V_{DD}}{2} - 0.5\text{ V}$$

$$I_{OL} = 20\text{ }\mu\text{A}$$

4. Current consumption



- **Current consumption (I_{DD})**

Measurement conditions: $V_{IN1} = V_{SS}$
 $V_{IN2} = V_{DD}$

5. Source current

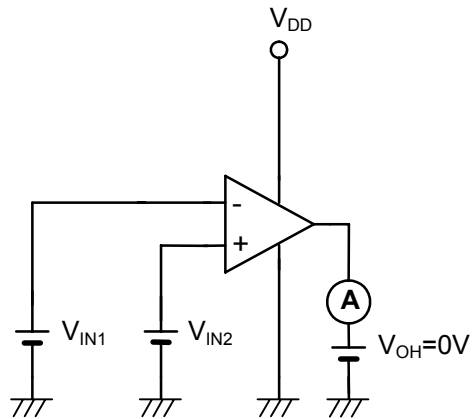


Figure 10

- **Source current (I_{SOURCE})**

Measurement conditions: $V_{IN1} = \frac{V_{DD}}{2} - 0.5\text{ V}$

$$V_{IN2} = \frac{V_{DD}}{2} + 0.5\text{ V}$$

6. Sink current

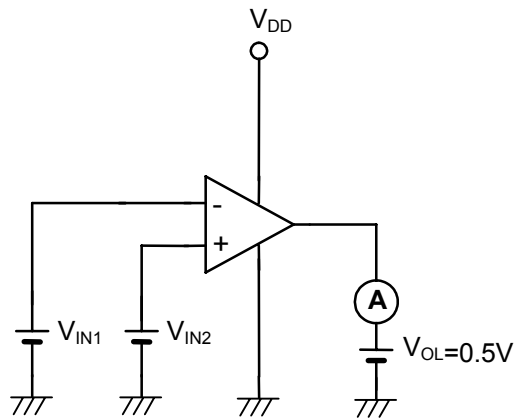


Figure 11

- **Sink current (I_{SINK})**

Measurement conditions: $V_{IN1} = \frac{V_{DD}}{2} + 0.5\text{ V}$

$$V_{IN2} = \frac{V_{DD}}{2} - 0.5\text{ V}$$

7. Propagation delay time / response time

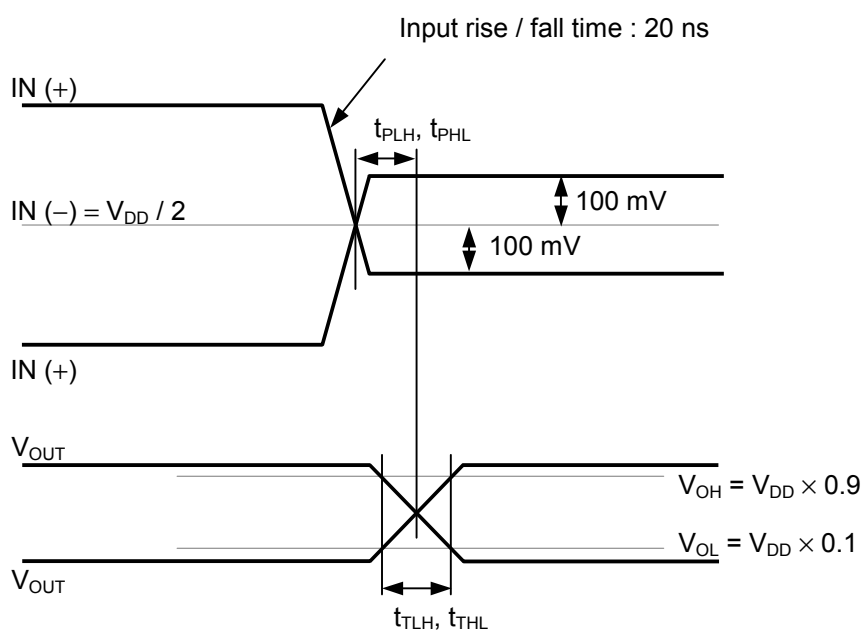


Figure 12

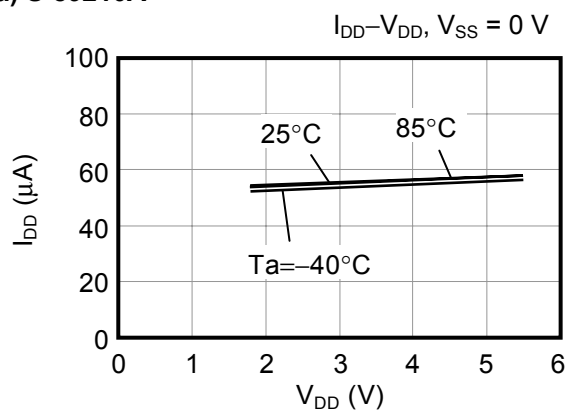
■ **Precaution**

- 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.

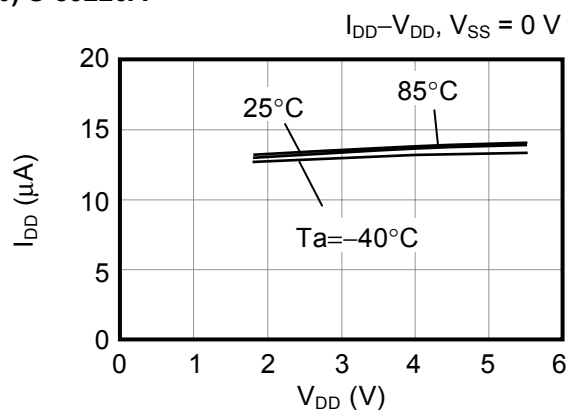
■ Characteristics (Reference Data)

1. Current consumption vs. Power supply voltage

(a) S-89210A



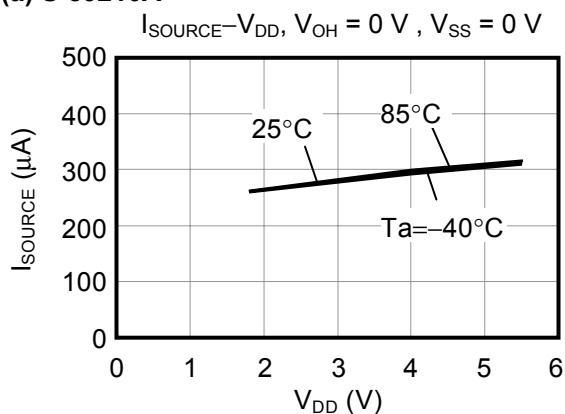
(b) S-89220A



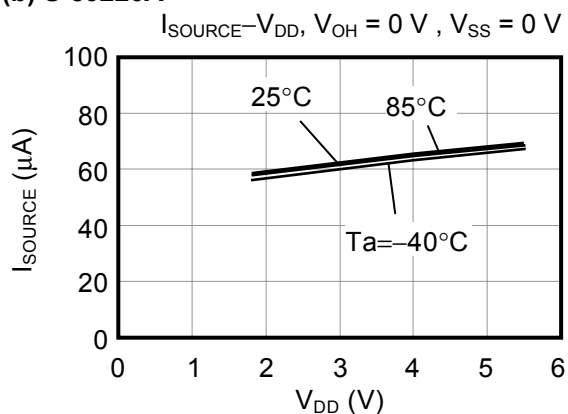
2. Output current

2-1. I_{SOURCE} vs. Power supply voltage

(a) S-89210A

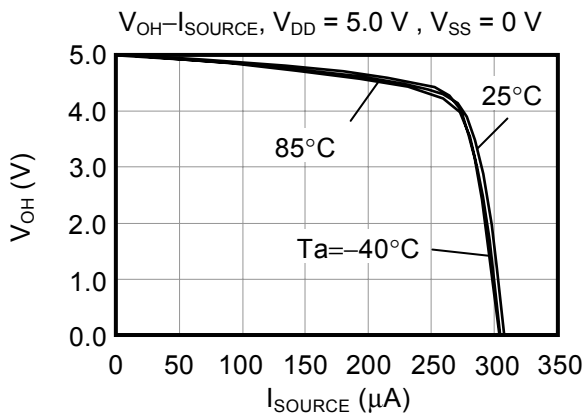
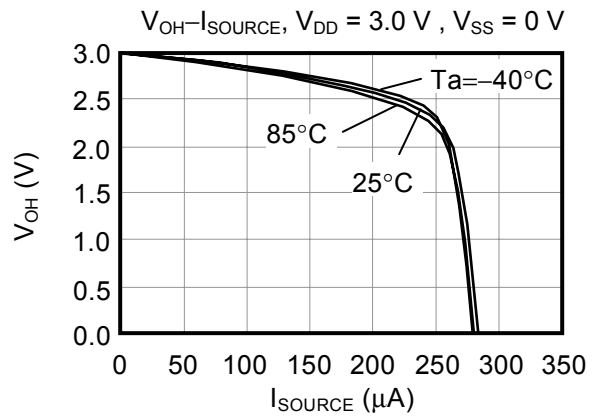
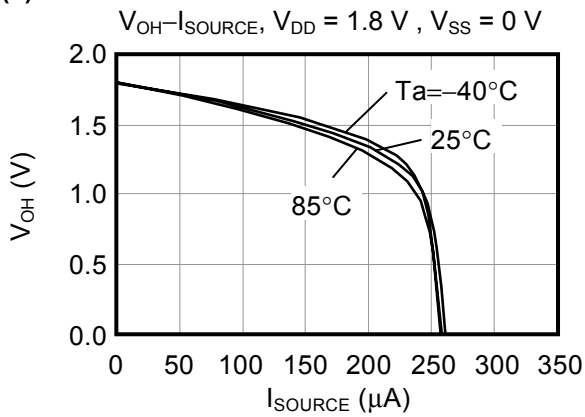


(b) S-89220A

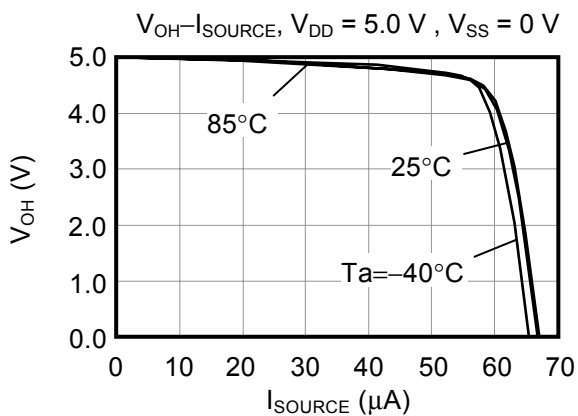
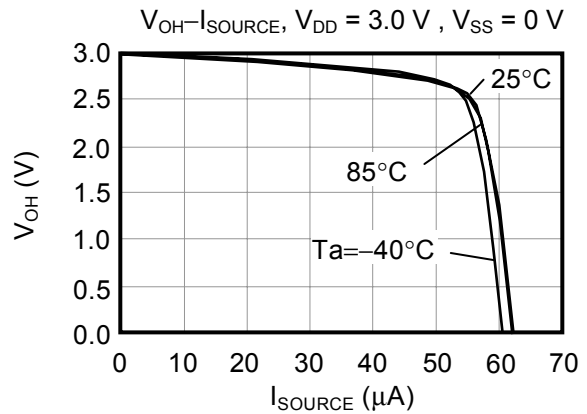
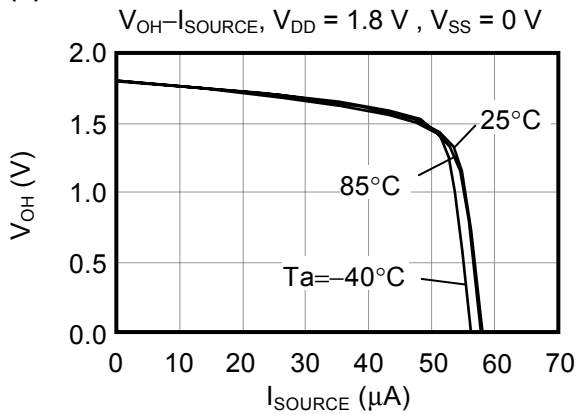


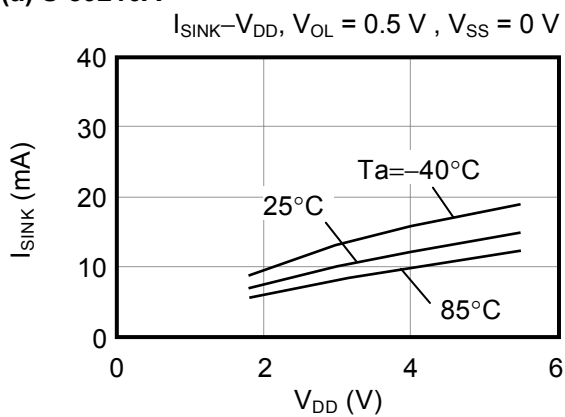
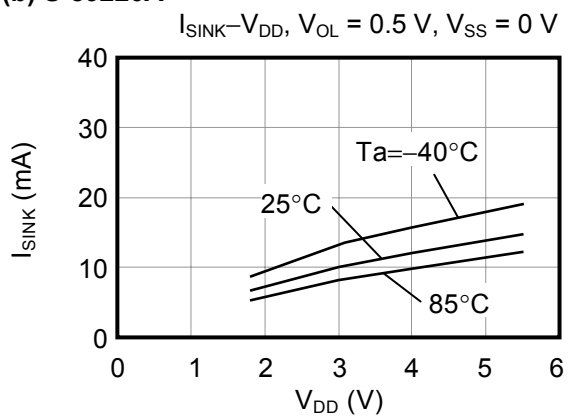
2-2. Output voltage (V_{OH}) vs. I_{SOURCE}

(a) S-89210A



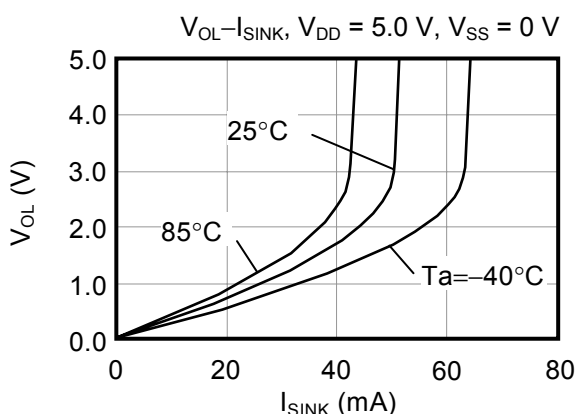
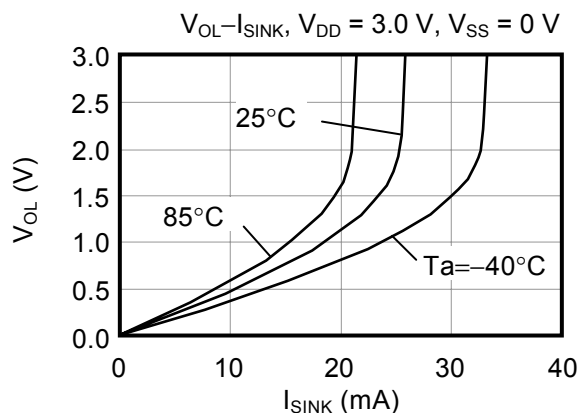
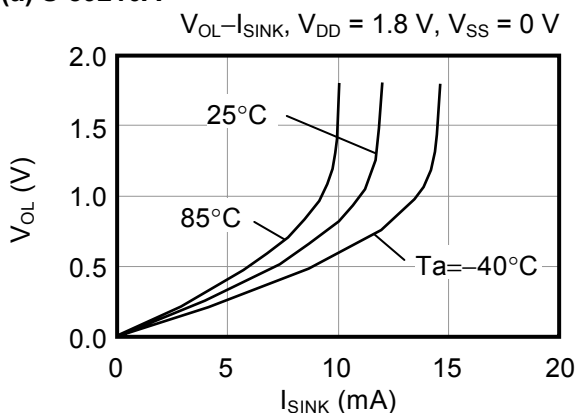
(b) S-89220A



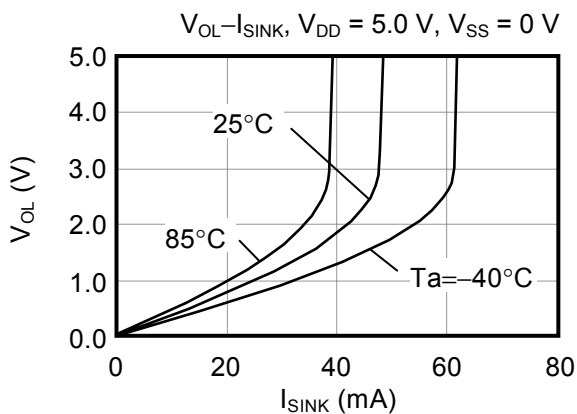
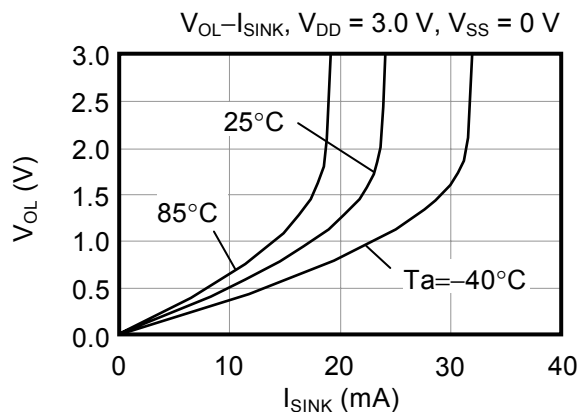
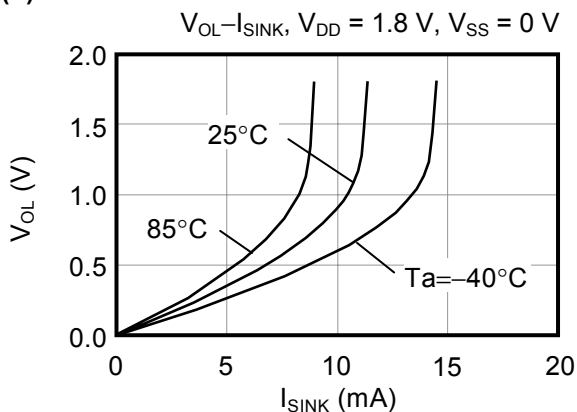
2-3. I_{SINK} vs. Power supply voltage**(a) S-89210A****(b) S-89220A**

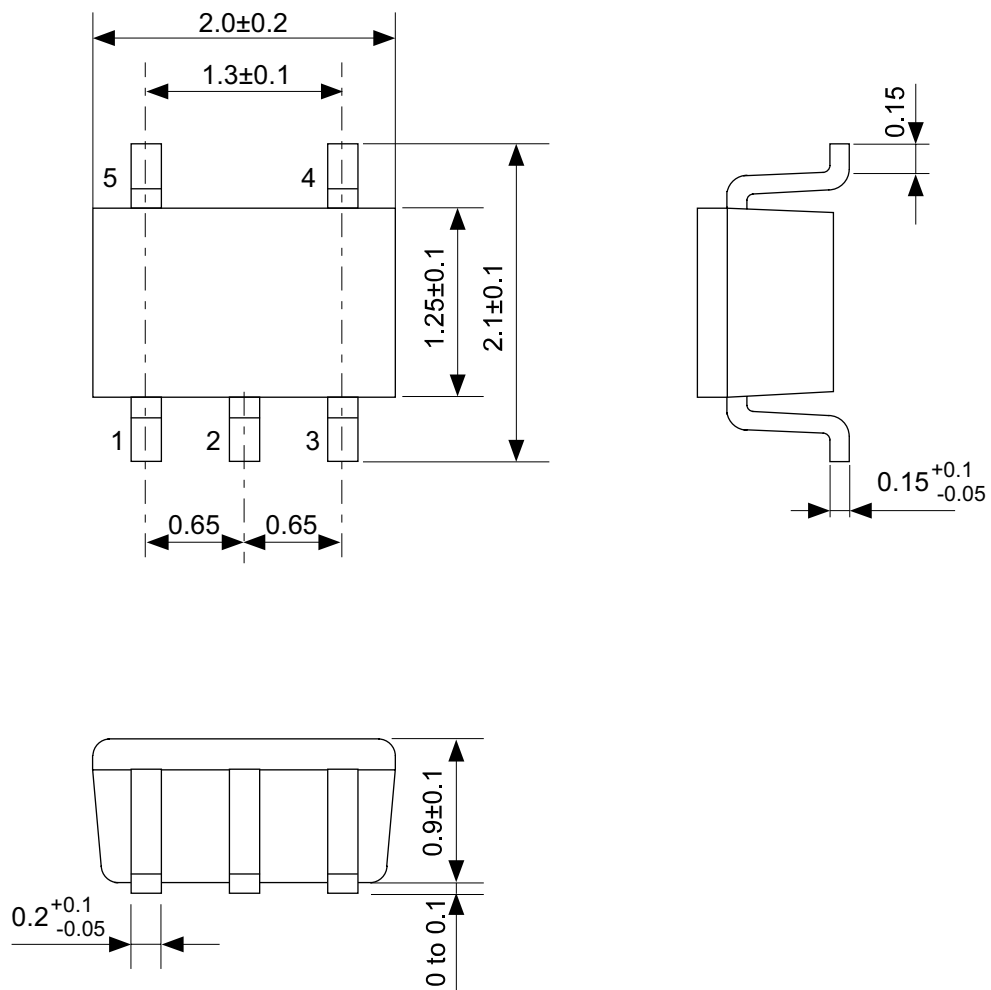
2-4. Output voltage (V_{OL}) vs. I_{SINK}

(a) S-89210A



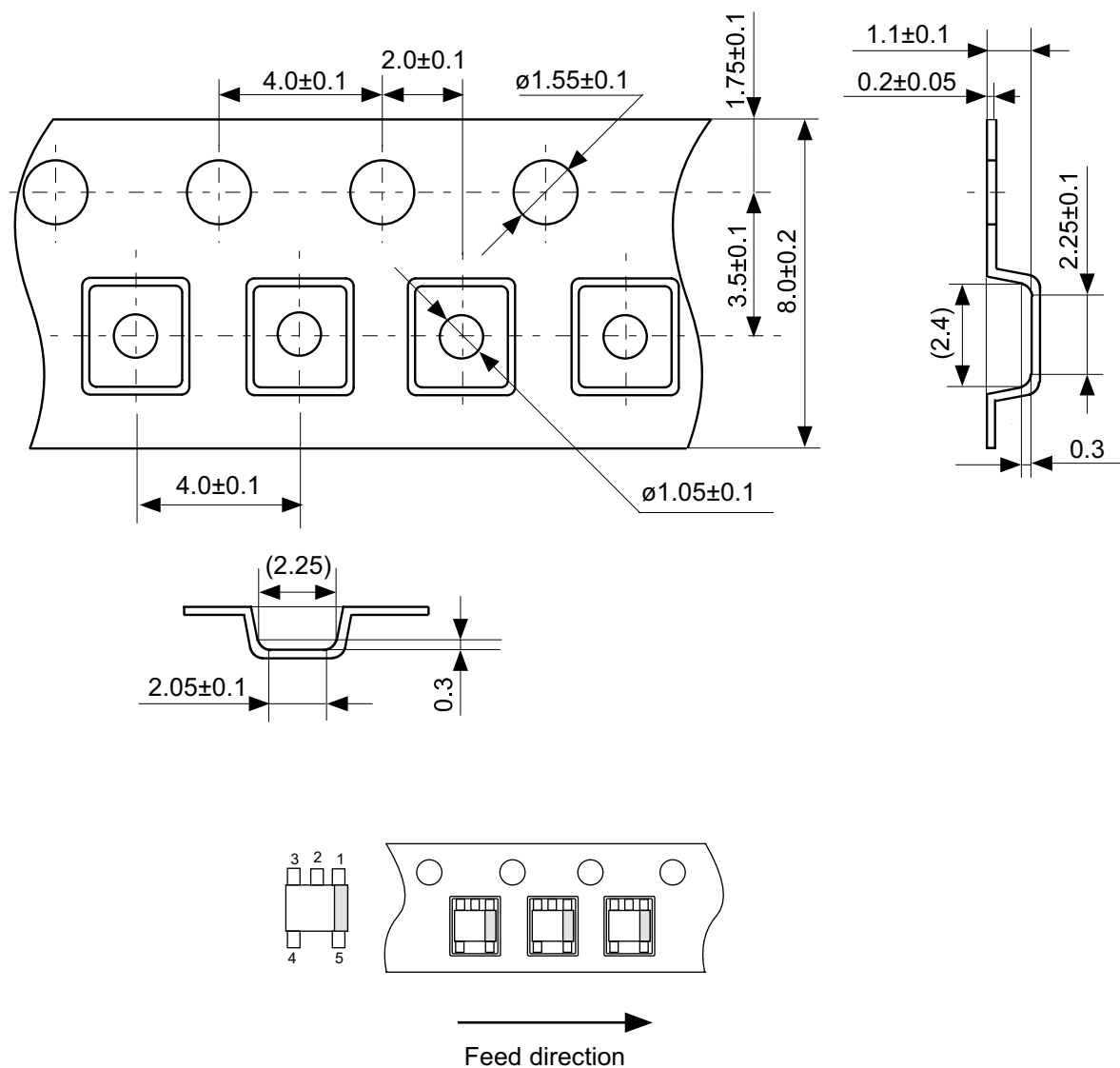
(b) S-89220A





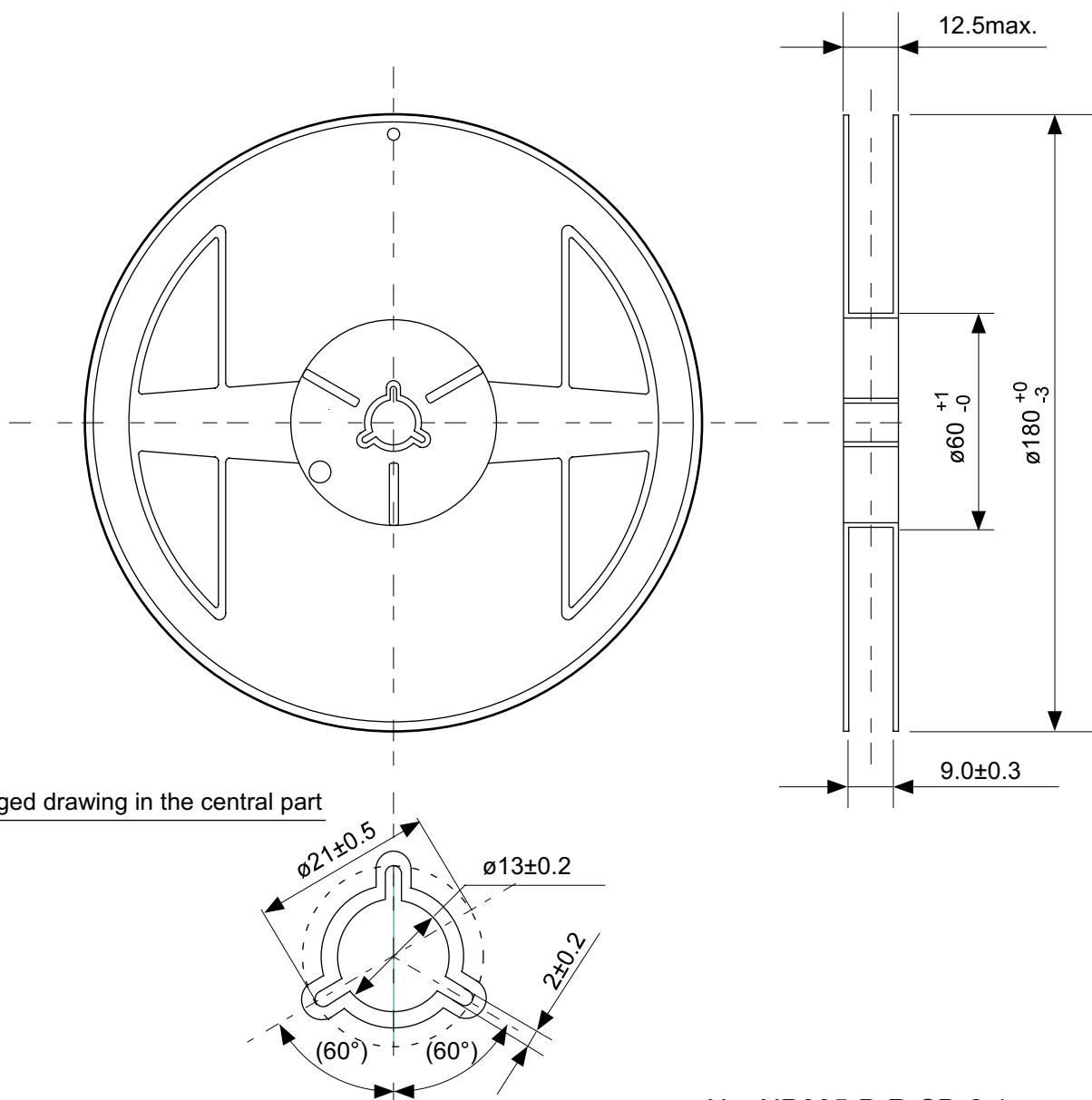
No. NP005-B-P-SD-1.1

TITLE	SC88A-B-PKG Dimensions
No.	NP005-B-P-SD-1.1
SCALE	
UNIT	mm
Seiko Instruments Inc.	



No. NP005-B-C-SD-1.1

TITLE	SC88A-B-Carrier Tape
No.	NP005-B-C-SD-1.1
SCALE	
UNIT	mm
Seiko Instruments Inc.	



Enlarged drawing in the central part

No. NP005-B-R-SD-2.1

TITLE	SC88A-B-Reel		
No.	NP005-B-R-SD-2.1		
SCALE		QTY.	3000
UNIT	mm		
Seiko Instruments Inc.			

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