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 μA (S-89210A)
  I_{DD} = 10 μA (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 μA	S-89210ACNC-1C0TFG
I_{DD} = 10 μA	S-89220ACNC-1C1TFG

Remark Delivery form : Taping only

■ Pin Configuration

SC-88A
Top view

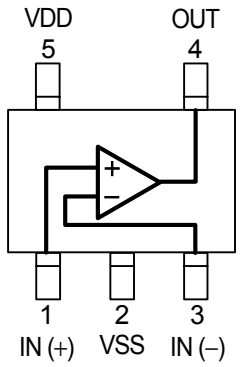


Figure 1

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

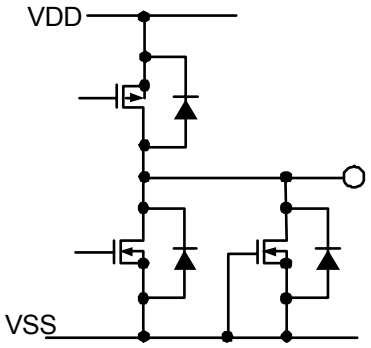


Figure 2

<2> Input pin

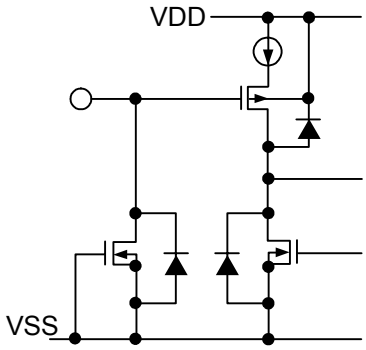


Figure 3

<3> VDD pin

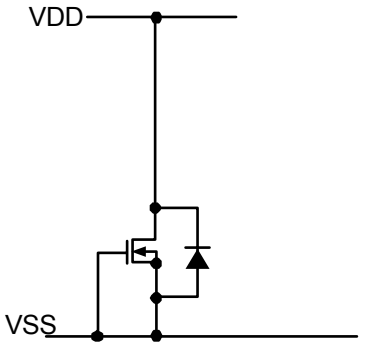


Figure 4

■ Absolute Maximum Ratings

Table 3

Parameter	Symbol	Ratings	Unit
Power supply voltage	V_{DD}	V_{SS}−0.3 to V_{SS}+10.0	V
Input voltage	V_{IN}	V_{SS}−0.3 to V_{SS}+7.0 (7.0 max.)	V
Output voltage	V_{OUT}	V_{SS}−0.3 to V_{DD}+0.3 (7.0 max.)	V
Differential input voltage	V_{IND}	±7.0	V
Power dissipation	P_D	200 (When not mounted on board)	mW
		350*1	mW
Operating temperature range	T_{opr}	−40 to +85	°C
Storage temperature range	T_{stg}	−55 to +125	°C

***1.** When mounted on board
[Mounted board]
(1) Board size : 114.3 mm × 76.2 mm × t1.6 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.

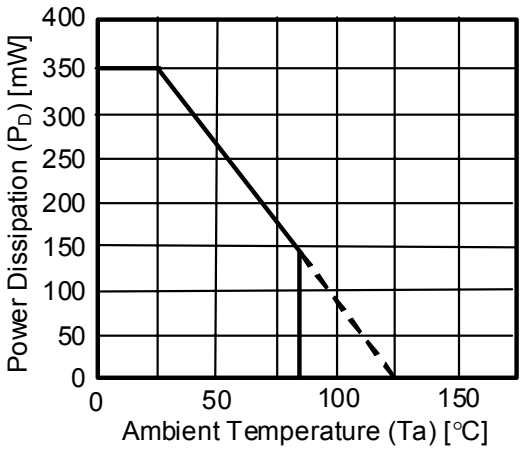


Figure 5 Power Dissipation of Package (When Mounted on Board)

■ 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 V

Table 5

DC Characteristics (V_{DD} = 5.0 V) (Ta = 25°C unless otherwise specified)

Parameter	Symbol	Measurement Conditions		Min.	Typ.	Max.	Unit	Measurement Circuit
Current consumption	I_{DD}	S-89210A		—	50	120	μA	**Figure 10**
		S-89220A		—	10	30	μA	
Input offset voltage	V_{IO}	—		–4	±3	+4	mV	**Figure 6**
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 7**
Maximum output	V_{OH}	I_{OH} = 20 μA		4.7	—	—	V	**Figure 8**
swing voltage	V_{OL}	I_{OL} = 20 μA				0.01		**Figure 9**
Common-mode input signal rejection ratio	CMRR	—		60	70	—	dB	**Figure 7**
Power supply voltage rejection ratio	PSRR	—		60	70	—	dB	**Figure 6**
Source current	I_{SOURCE}	S-89210A	V_{OH} = 0 V	120	—	—	μA	**Figure 11**
		S-89220A		25	—	—		
Sink current	I_{SINK}	V_{OL} = 0.5 V		9	—	—	mA	**Figure 12**

Table 6

AC Characteristics (V_{DD} = 5.0 V) (Ta = 25°C unless otherwise specified)

Parameter	Symbol	Measurement conditions		Min.	Typ.	Max.	Unit
Rise propagation delay time	t_{PLH}	S-89210A	Overdrive = 100 mV C_L = 15 pF (Refer to **Figure 13.**)	—	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	—	

2. V_{DD} = 3.0 V

Table 7

DC Characteristics (V_{DD} = 3.0 V) (Ta = 25°C unless otherwise specified)

Parameter	Symbol	Measurement Conditions		Min.	Typ.	Max.	Unit	Measurement Circuit
Current consumption	I_{DD}	S-89210A		—	50	120	μA	**Figure 10**
		S-89220A		—	10	30	μA	
Input offset voltage	V_{IO}	—		−4	±3	+4	mV	**Figure 6**
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 7**
Maximum output	V_{OH}	I_{OH} = 20 μA		2.7	—	—	V	**Figure 8**
swing voltage	V_{OL}	I_{OL} = 20 μA		—	—	0.01	V	**Figure 9**
Common-mode input signal rejection ratio	CMRR	—		60	70	—	dB	**Figure 7**
Power supply voltage rejection ratio	PSRR	—		60	70	—	dB	**Figure 6**
Source current	I_{SOURCE}	S-89210A	V_{OH} = 0 V	120	—	—	μA	**Figure 11**
	I_{SOURCE}	S-89220A		25	—	—		
Sink current	I_{SINK}	V_{OL} = 0.5 V		8	—	—	mA	**Figure 12**

Table 8

AC Characteristics (V_{DD} = 3.0 V) (Ta = 25°C unless otherwise specified)

Parameter	Symbol	Measurement conditions		Min.	Typ.	Max.	Unit
Rise propagation delay time	t_{PLH}	S-89210A	Overdrive = 100 mV C_L = 15 pF (Refer to **Figure 13.**)	—	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 V

Table 9

DC Characteristics (V_{DD} = 1.8 V) (Ta = 25°C unless otherwise specified)

Parameter	Symbol	Measurement Conditions		Min.	Typ.	Max.	Unit	Measurement Circuit
Current consumption	I_{DD}	S-89210A		—	50	120	μA	**Figure 10**
		S-89220A		—	10	30	μA	
Input offset voltage	V_{IO}	—		−4	±3	+4	mV	**Figure 6**
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 7**
Maximum output	V_{OH}	I_{OH} = 20 μA		1.5	—	—	V	**Figure 8**
swing voltage	V_{OL}	I_{OL} = 20 μA		—	—	0.01	V	**Figure 9**
Common-mode input signal rejection ratio	CMRR	—		60	70	—	dB	**Figure 7**
Power supply voltage rejection ratio	PSRR	—		60	70	—	dB	**Figure 6**
Source current	I_{SOURCE}	S-89210A	V_{OH} = 0 V	100	—	—	μA	**Figure 11**
	I_{SOURCE}	S-89220A		20	—	—		
Sink current	I_{SINK}	V_{OL} = 0.5 V		5	—	—	mA	**Figure 12**

Table 10

AC Characteristics (V_{DD} = 1.8 V) (Ta = 25°C unless otherwise specified)

Parameter	Symbol	Measurement conditions		Min.	Typ.	Max.	Unit
Rise propagation delay time	t_{PLH}	S-89210A	Overdrive = 100 mV C_L = 15 pF (Refer to **Figure 13.**)	—	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

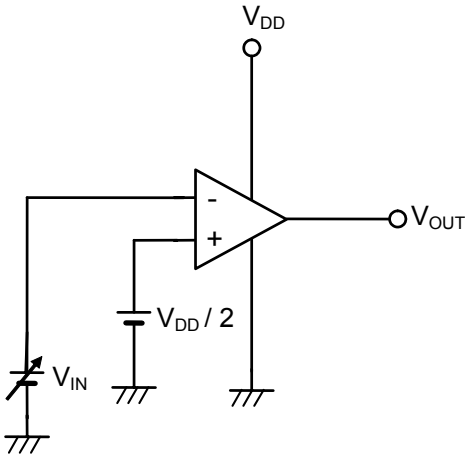


Figure 6

- **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 V: $V_{DD} = V_{DD1}$, $V_{IO} = V_{IO1}$
  When V_{DD} = 5.0 V: $V_{DD} = V_{DD2}$, $V_{IO} = V_{IO2}$

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

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

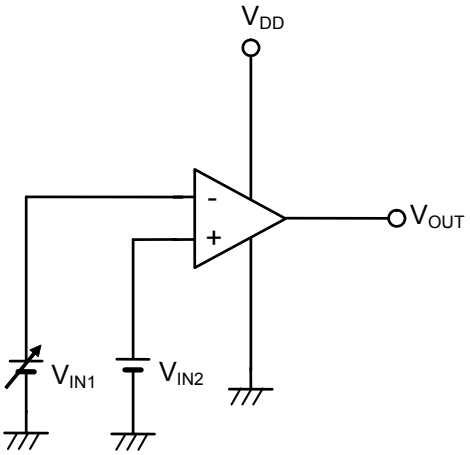


Figure 7

- **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 $V_{IN2} = V_{CMR}$ (max.): $V_{IN2} = V_{INH}$, $V_{IO} = V_{IO1}$
  When $V_{IN2} = V_{DD}$/2: $V_{IN2} = V_{INL}$, $V_{IO} = V_{IO2}$

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

- **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

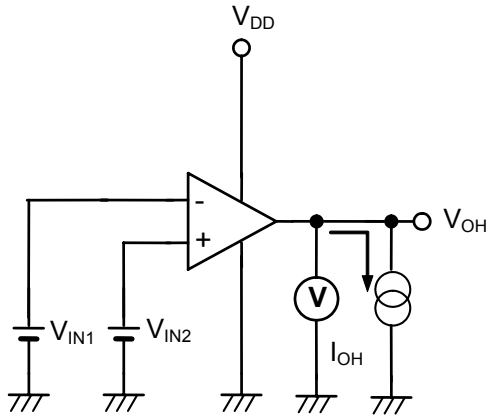


Figure 8

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

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

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

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

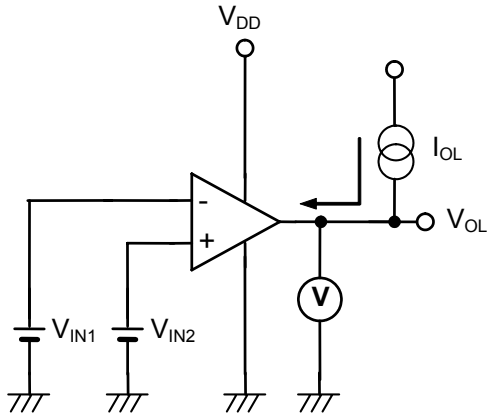


Figure 9

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

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

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

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

4. Current consumption

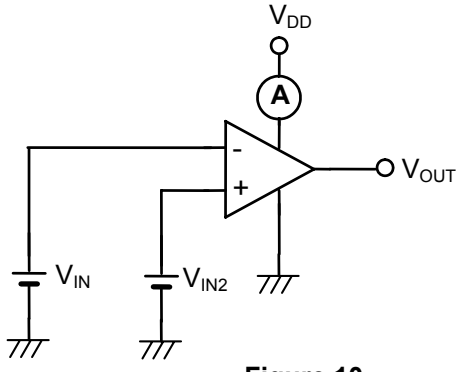


Figure 10

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

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

  $V_{IN2} = V_{DD}$

5. Source current

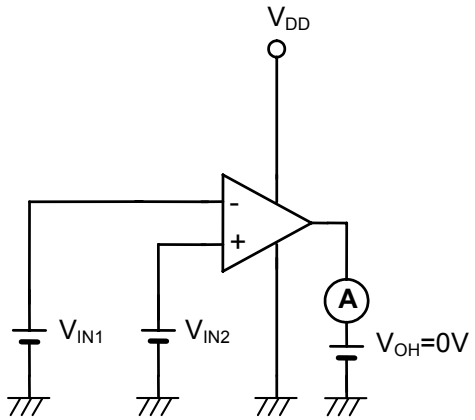


Figure 11

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

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

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

6. Sink current

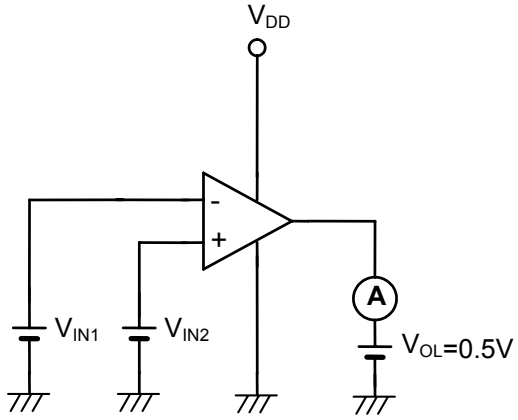


Figure 12

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

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

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

7. Propagation delay time / response time

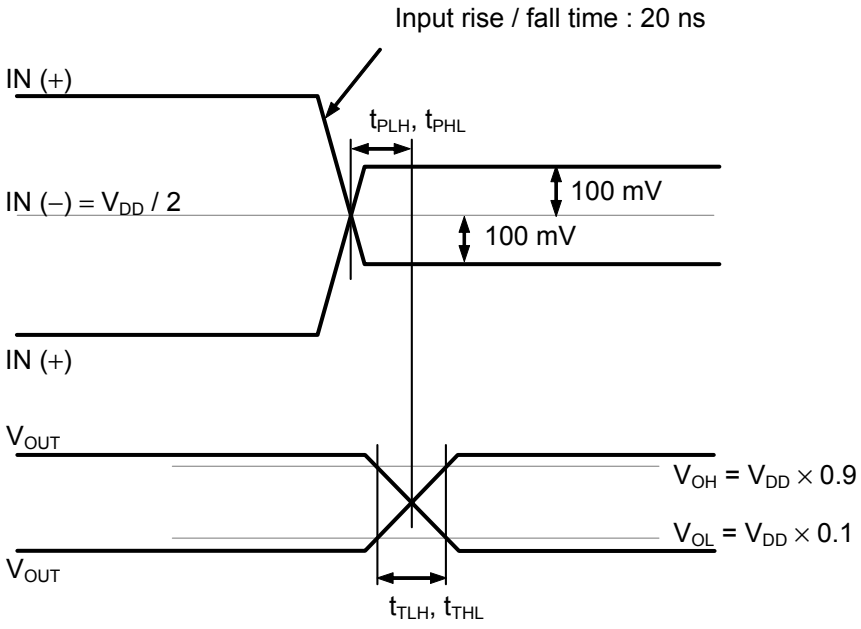


Figure 13

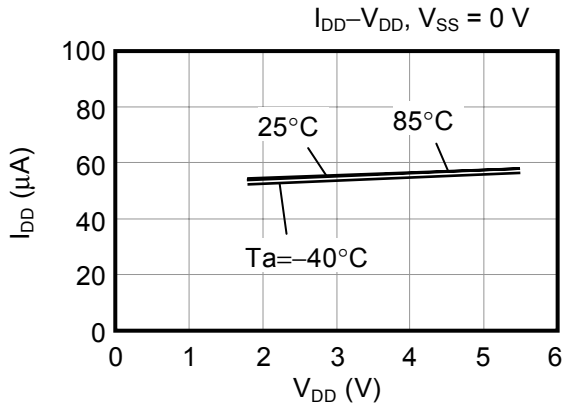
■ Precaution

- 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.

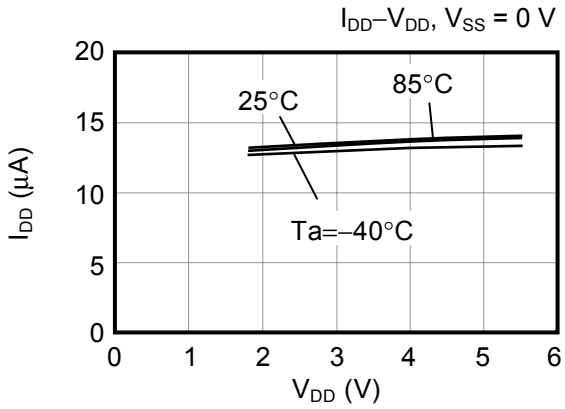
■ Characteristics (Reference Data)

1. Current consumption vs. Power supply voltage

(a) S-89210A



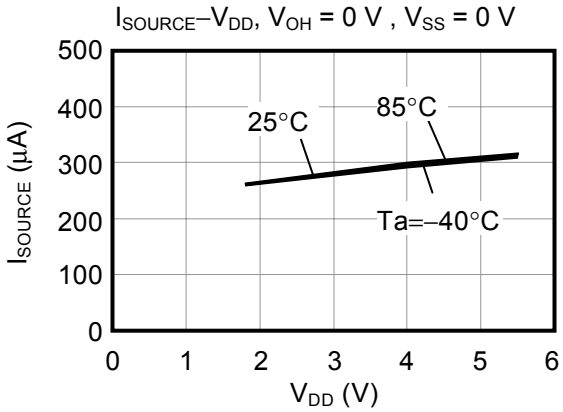
(b) S-89220A



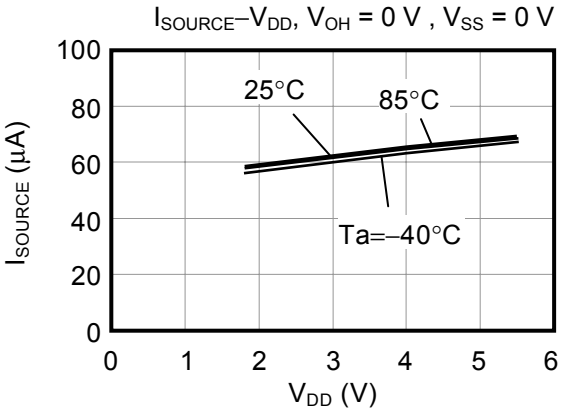
2. Output current

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

(a) S-89210A

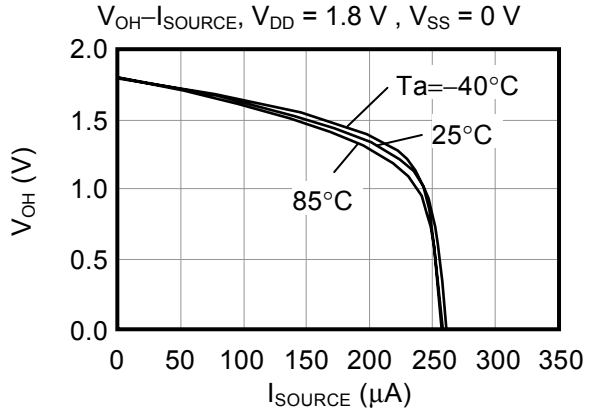


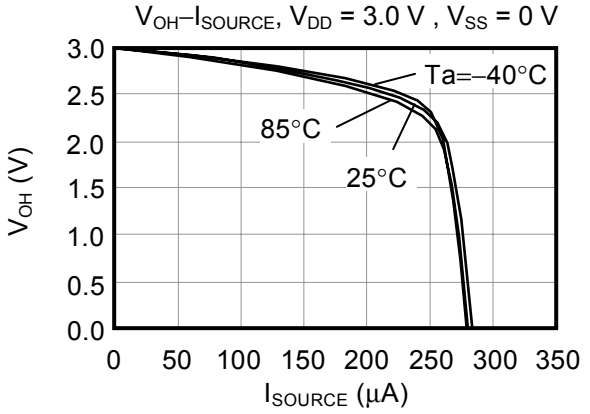
(b) S-89220A

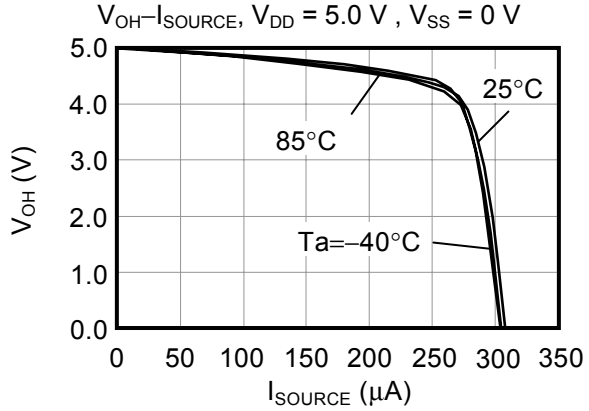


2-2. Output voltage (V_{OH}) vs. I_{SOURCE}

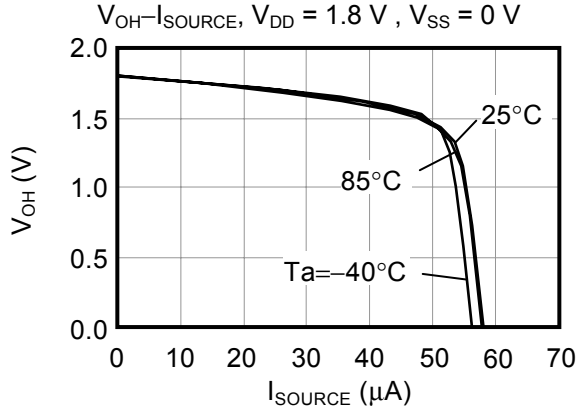
(a) S-89210A

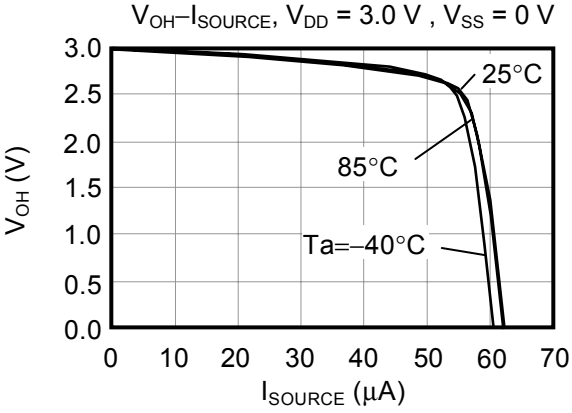


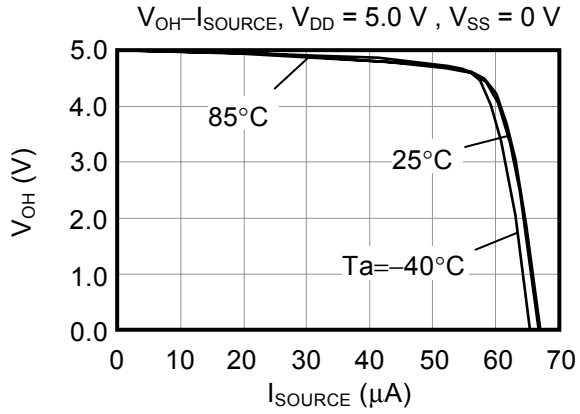




(b) S-89220A

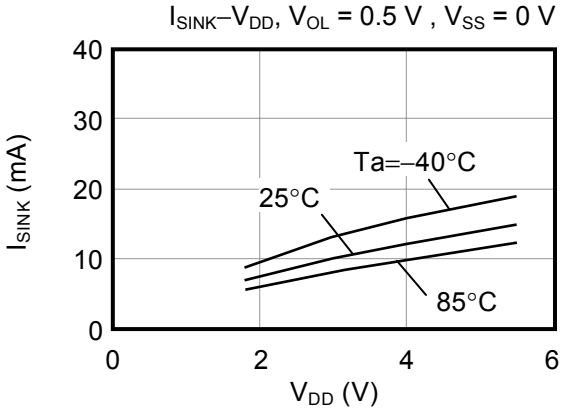




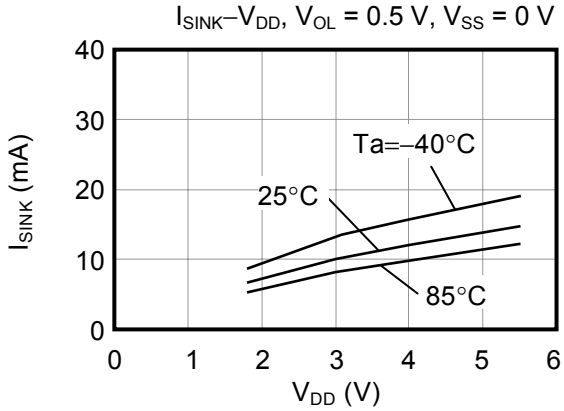


2-3. I_{SINK} vs. Power supply voltage

(a) S-89210A

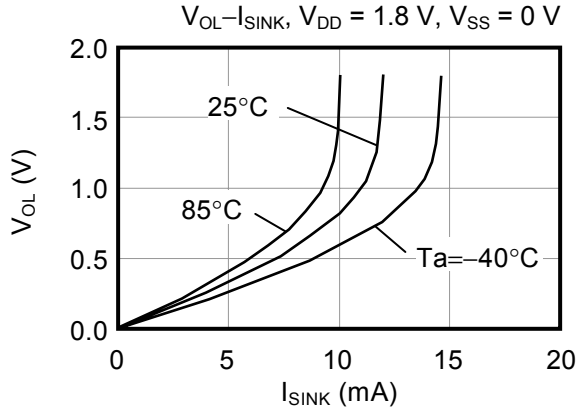


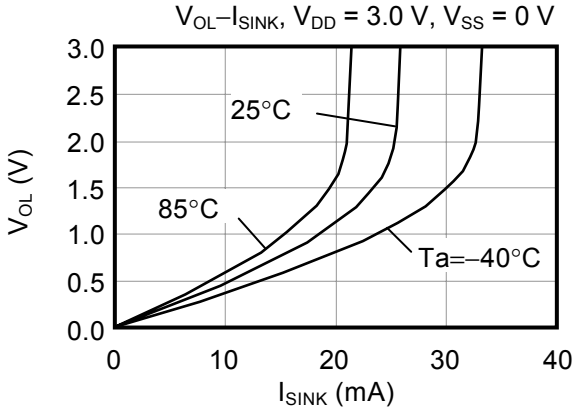
(b) S-89220A

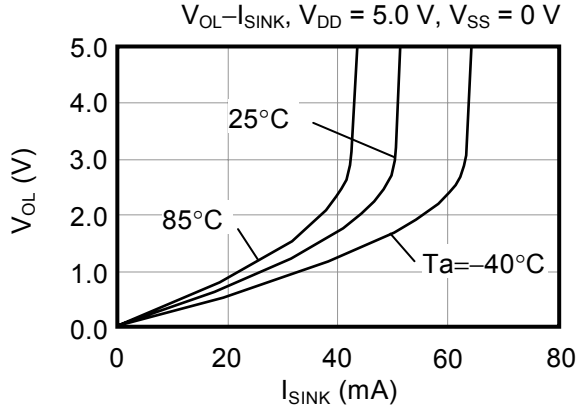


2-4. Output voltage (V_{OL}) vs. I_{SINK}

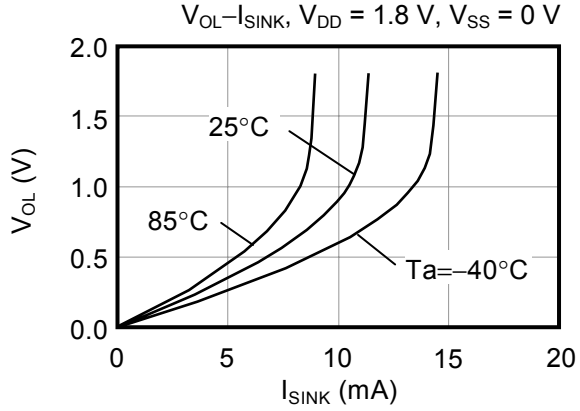
(a) S-89210A

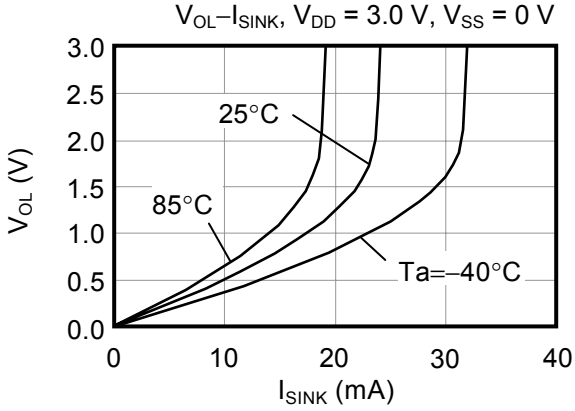


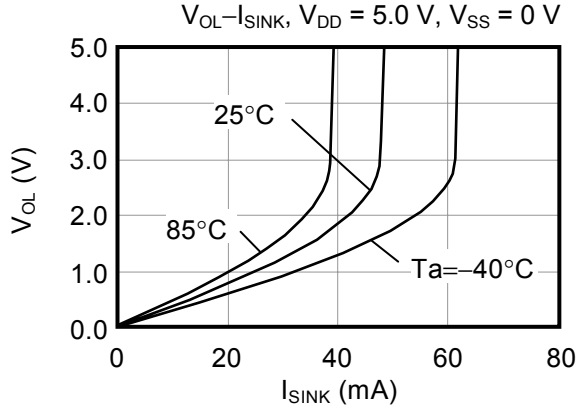


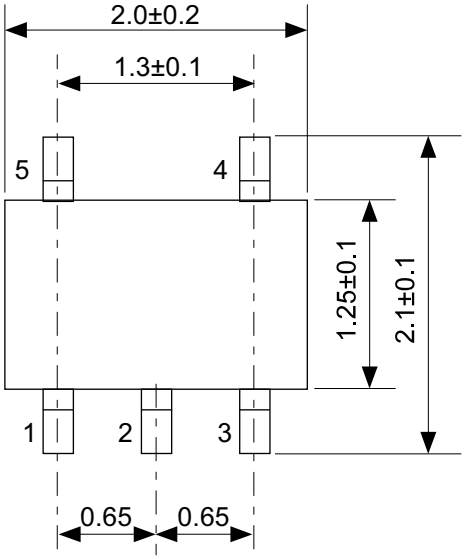


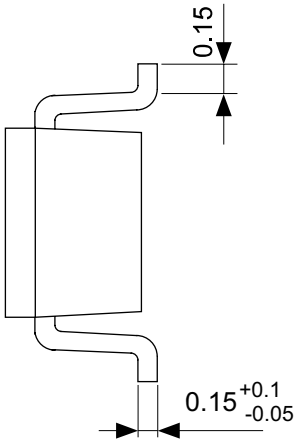
(b) S-89220A

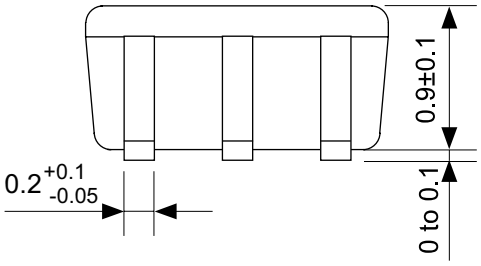






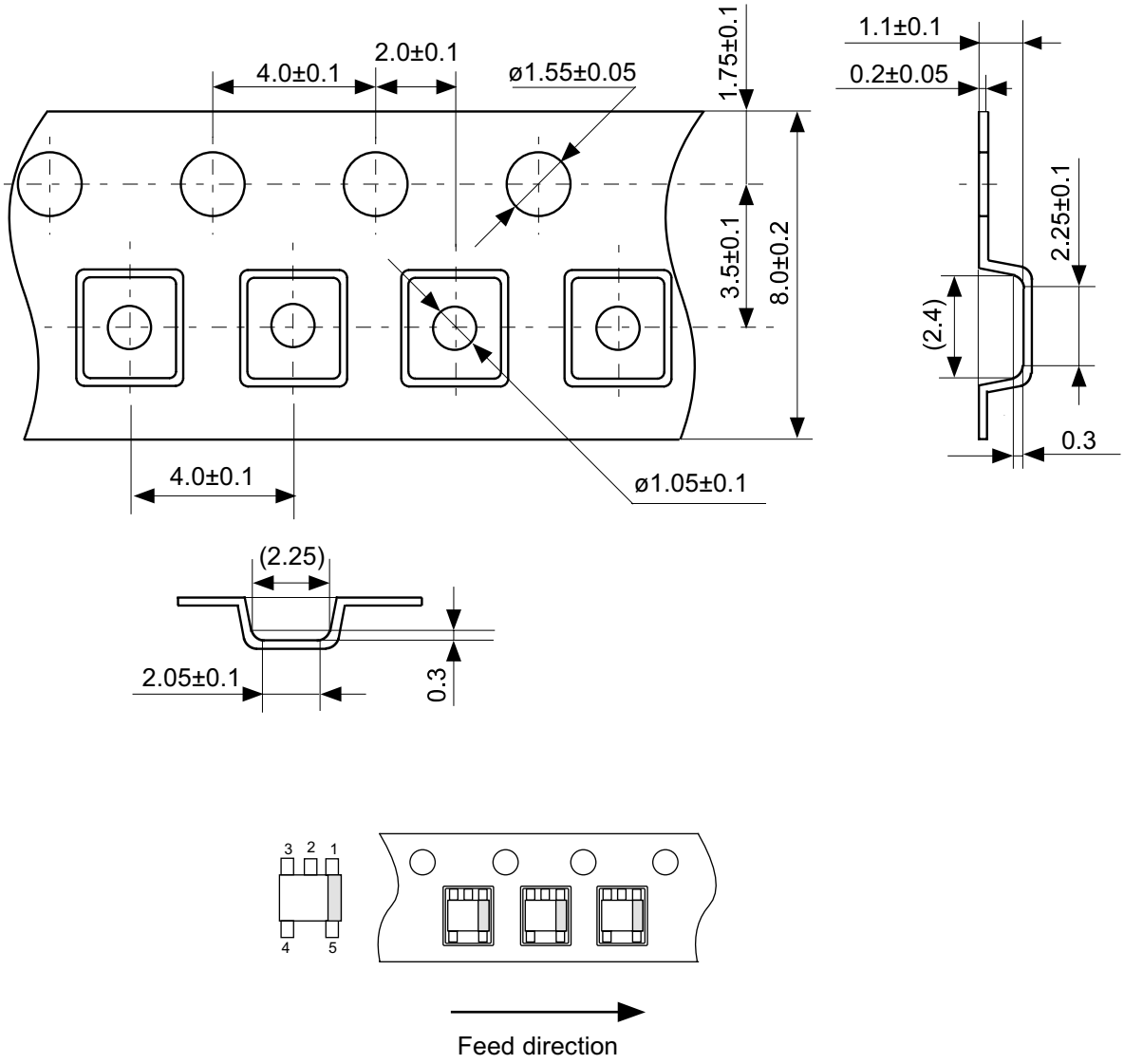






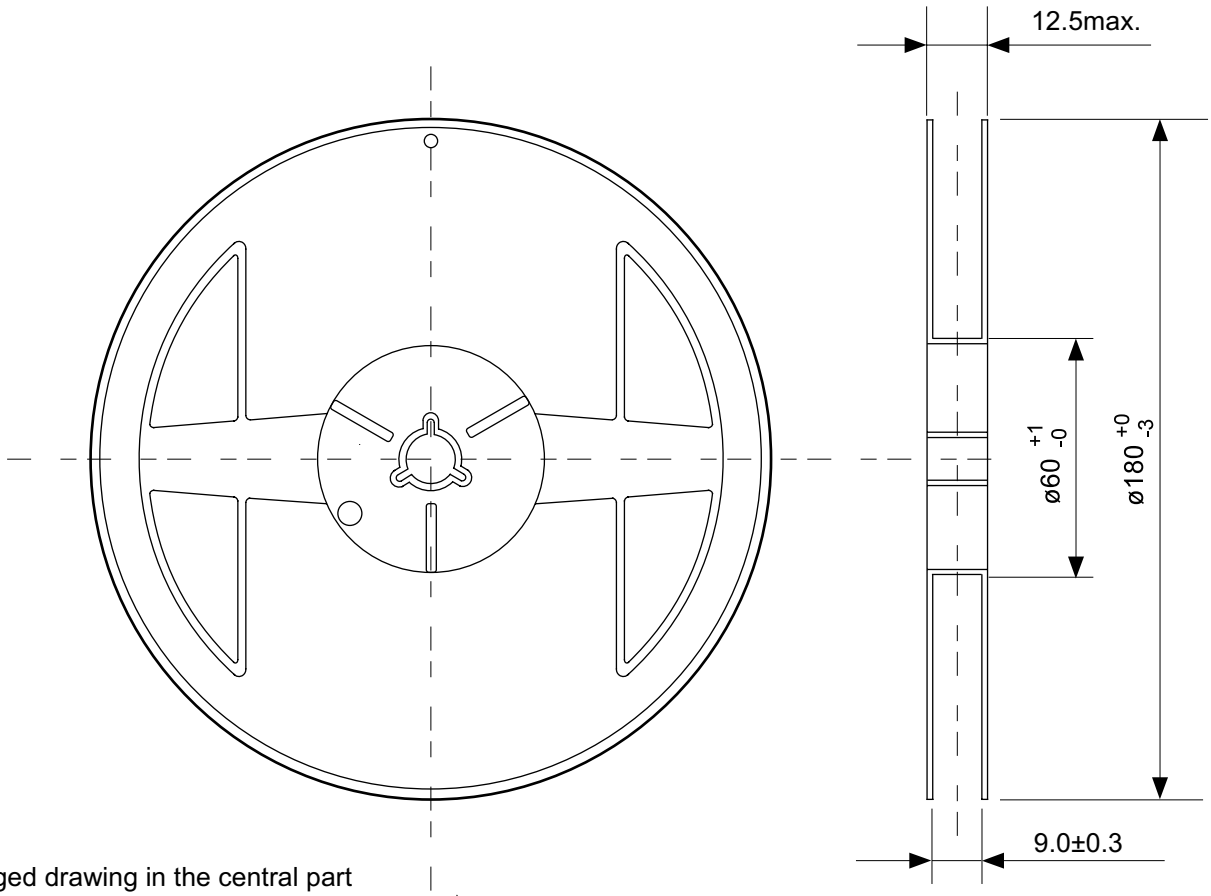
No. NP005-B-P-SD-1.1

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

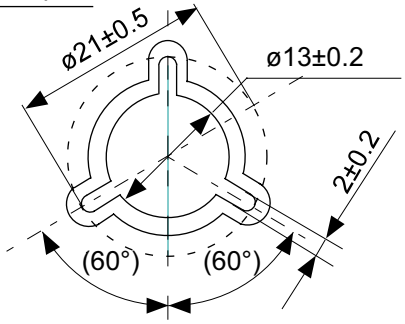


No. NP005-B-C-SD-2.0

TITLE	SC88A-B-Carrier Tape
No.	NP005-B-C-SD-2.0
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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