# S-89210/89220 Series

## MINI ANALOG SERIES
## CMOS COMPARATOR





The mini-analog series is a group of ICs that incorporate a general purpose analog circuit in a small package.
The S-89210/89220 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 single comparator (with 1 circuit).

## ■ Features

- Lower operating voltage than the conventional general-purpose: $V_{DD}$ = 1.8 V to 5.5 V
- Low current consumption: $I_{DD}$ = 50 μA Typ. (S-89210 Series), $I_{DD}$ = 10 μA Typ. (S-89220 Series)
- Low input offset voltage: 4.0 mV Max.
- Lead-free, halogen-free*1

***1.** Refer to "■ **Product Name Structure**" for details.

## ■ Application

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

## ■ Package

- SC-88A

## ■ Block Diagram

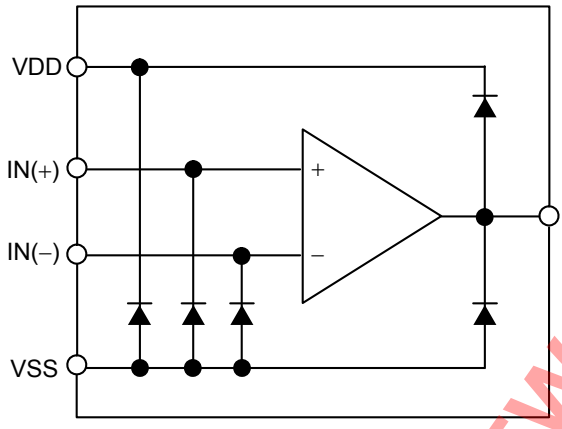



**Figure 1**

## ■ Product Name Structure

Users can select the product type for the S-89210/89220 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

**S-892 x 0 AC NC – xxx TF x**

- Environmental code
  - S: Lead-free, halogen-free
  - G: Lead-free (for details, please contact our sales office)
- IC direction in tape specifications*1
- Product code (abbreviation)*2
- Package name (abbreviation)
  - NC: SC-88A
- Current consumption
  - 1: $I_{DD}$ = 50 µA
  - 2: $I_{DD}$ = 10 µA

***1.** Refer to the tape specifications.
***2.** Refer to "**3. Product name list**".

### 2. Package

| Package Name | Drawing Code | | |
|---|---|---|---|
| | Package | Tape | Reel |
| SC-88A | NP005-B-P-SD | NP005-B-C-SD | NP005-B-R-SD |

### 3. Product name list

**Table 1**

| Product name | Current consumption | Rise propagation delay time*1 | Fall propagation delay time*1 |
|---|---|---|---|
| S-89210ACNC-1C0TFz | 50 µA | 30 µs | 6 µs |
| S-89220ACNC-1C1TFz | 10 µA | 150 µs | 30 µs |

***1.** The value when $V_{DD}$ = 3.0 V

**Remark** z: G or S

## ■ Pin Configuration

SC-88A
Top view

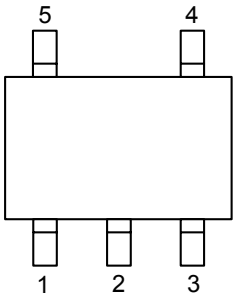



**Figure 2**

**Table 2**

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

## ■ Absolute Maximum Ratings

**Table 3**

(Ta = +25°C unless otherwise specified)

| Parameter | Symbol | Absolute Maximum 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 | V |
| Output voltage | $V_{OUT}$ | $V_{SS}$ − 0.3 to $V_{DD}$ + 0.3 | V |
| Differential input voltage | $V_{IND}$ | ±7.0 | V |
| Output pin current | $I_{SINK}$ | 13 | mA |
| Power dissipation | $P_D$ | 200 (When not mounted on board) | mW |
| | | 350*1 | 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 × 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.**

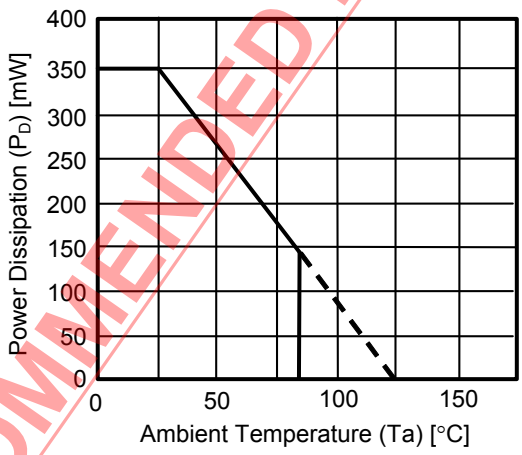



**Figure 3 Power Dissipation of Package (When Mounted on Board)**

## ■ Electrical Characteristics

**Table 4**

(Ta = +25°C unless otherwise specified)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit | Test Circuit |
|---|---|---|---|---|---|---|---|
| Range of operating power supply voltage | $V_{DD}$ | – | 1.8 | – | 5.5 | V | – |

### 1. $V_{DD}$ = 5.0 V

**Table 5**

**DC Electrical Characteristic ($V_{DD}$ = 5.0 V)** (Ta = +25°C unless otherwise specified)

| Parameter | Symbol | Conditions | | Min. | Typ. | Max. | Unit | Test Circuit |
|---|---|---|---|---|---|---|---|---|
| Current consumption | $I_{DD}$ | S-89210 Series | | – | 50 | 120 | μA | 5 |
| | | S-89220 Series | | – | 10 | 30 | μA | 5 |
| Input offset voltage | $V_{IO}$ | – | | –4 | ±3 | +4 | mV | 1 |
| 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 | 2 |
| Maximum output swing voltage | $V_{OH}$ | $I_{OH}$ = 20 μA | | 4.7 | – | – | V | 3 |
| | $V_{OL}$ | $I_{OL}$ = 20 μA | | – | – | 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 V | S-89210 Series | 120 | – | – | μA | 6 |
| | | | S-89220 Series | 25 | – | – | μA | 6 |
| Sink current | $I_{SINK}$ | $V_{OUT}$ = 0.5 V | | 9 | – | – | mA | 7 |

**Table 6**

**AC Electrical Characteristic ($V_{DD}$ = 5.0 V)** (Ta = +25°C unless otherwise specified)

| Parameter | Symbol | Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Rise propagation delay time | $t_{PLH}$ | Overdrive = 100 mV<br>$C_L$ = 15 pF<br>(Refer to **Figure 11**) | S-89210 Series | – | 45 | – | μs |
| | | | S-89220 Series | – | 230 | – | μs |
| Fall propagation delay time | $t_{PHL}$ | | S-89210 Series | – | 9 | – | μs |
| | | | S-89220 Series | – | 45 | – | μs |
| Rise response time | $t_{TLH}$ | | S-89210 Series | – | 3 | – | μs |
| | | | S-89220 Series | – | 15 | – | μs |
| Fall response time | $t_{THL}$ | | S-89210 Series | – | 3 | – | μs |
| | | | S-89220 Series | – | 15 | | μs |

## 2. $V_{DD}$ = 3.0 V

**Table 7**

**DC Electrical Characteristic ($V_{DD}$ = 3.0 V)** (Ta = +25°C unless otherwise specified)

| Parameter | Symbol | Conditions | | Min. | Typ. | Max. | Unit | Test Circuit |
|---|---|---|---|---|---|---|---|---|
| Current consumption | $I_{DD}$ | S-89210 Series | | – | 50 | 120 | μA | 5 |
| | | S-89220 Series | | – | 10 | 30 | μA | 5 |
| Input offset voltage | $V_{IO}$ | – | | –4 | ±3 | +4 | mV | 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 | $V_{OH}$ | $I_{OH}$ = 20 μA | | 2.7 | – | – | V | 3 |
| | $V_{OL}$ | $I_{OL}$ = 20 μA | | – | – | 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 V | S-89210 Series | 120 | – | – | μA | 6 |
| | | | S-89220 Series | 25 | – | – | μA | 6 |
| Sink current | $I_{SINK}$ | $V_{OUT}$ = 0.5 V | | 8 | – | – | mA | 7 |

**Table 8**

**AC Electrical Characteristic ($V_{DD}$ = 3.0 V)** (Ta = +25°C unless otherwise specified)

| Parameter | Symbol | Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Rise propagation delay time | $t_{PLH}$ | Overdrive = 100 mV<br>$C_L$ = 15 pF<br>(Refer to **Figure 11**) | S-89210 Series | – | 30 | – | μs |
| | | | S-89220 Series | – | 150 | – | μs |
| Fall propagation delay time | $t_{PHL}$ | | S-89210 Series | – | 6 | – | μs |
| | | | S-89220 Series | – | 30 | – | μs |
| Rise response time | $t_{TLH}$ | | S-89210 Series | – | 2 | – | μs |
| | | | S-89220 Series | – | 10 | – | μs |
| Fall response time | $t_{THL}$ | | S-89210 Series | – | 2 | – | μs |
| | | | S-89220 Series | – | 10 | – | μs |

### 3. $V_{DD}$ = 1.8 V

**Table 9**

**DC Electrical Characteristic ($V_{DD}$ = 1.8 V)** (Ta = +25°C unless otherwise specified)

| Parameter | Symbol | Conditions | | Min. | Typ. | Max. | Unit | Test Circuit |
|---|---|---|---|---|---|---|---|---|
| Current consumption | $I_{DD}$ | S-89210 Series | | – | 50 | 120 | μA | 5 |
| | | S-89220 Series | | – | 10 | 30 | μA | 5 |
| Input offset voltage | $V_{IO}$ | – | | –4 | ±3 | +4 | mV | 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 | $V_{OH}$ | $I_{OH}$ = 20 μA | | 1.5 | – | – | V | 3 |
| | $V_{OL}$ | $I_{OL}$ = 20 μA | | – | – | 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 V | S-89210 Series | 100 | – | – | μA | 6 |
| | | | S-89220 Series | 20 | – | – | μA | 6 |
| Sink current | $I_{SINK}$ | $V_{OUT}$ = 0.5 V | | 5 | – | – | mA | 7 |

**Table 10**

**AC Electrical Characteristic ($V_{DD}$ = 1.8 V)** (Ta = +25°C unless otherwise specified)

| Parameter | Symbol | Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Rise propagation delay time | $t_{PLH}$ | Overdrive = 100 mV<br>$C_L$ = 15 pF<br>(Refer to **Figure 11**) | S-89210 Series | – | 20 | – | μs |
| | | | S-89220 Series | – | 100 | – | μs |
| Fall propagation delay time | $t_{PHL}$ | | S-89210 Series | – | 5 | – | μs |
| | | | S-89220 Series | – | 25 | – | μs |
| Rise response time | $t_{TLH}$ | | S-89210 Series | – | 1.2 | – | μs |
| | | | S-89220 Series | – | 6 | – | μs |
| Fall response time | $t_{THL}$ | | S-89210 Series | – | 1.2 | – | μs |
| | | | S-89220 Series | – | 6 | – | μs |

## ■ Test Circuit

### 1. Power supply voltage rejection ratio, input offset voltage

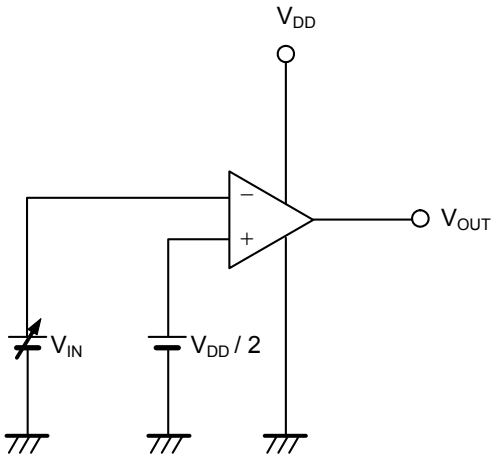



Figure 4

- **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 $V_{DD}$.

  Test 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

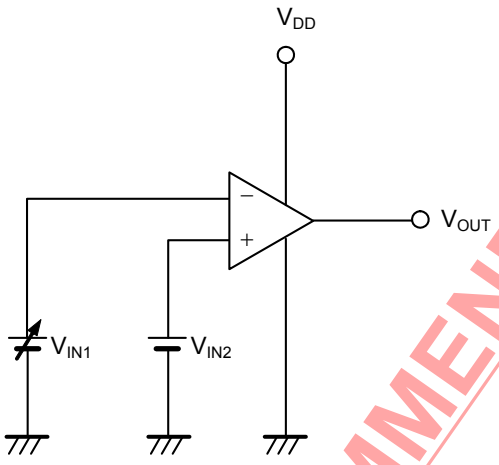



Figure 5

- **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 $V_{IN1}$.

  Test 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 ($V_{CMR}$)**
  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 ($V_{OH}$)

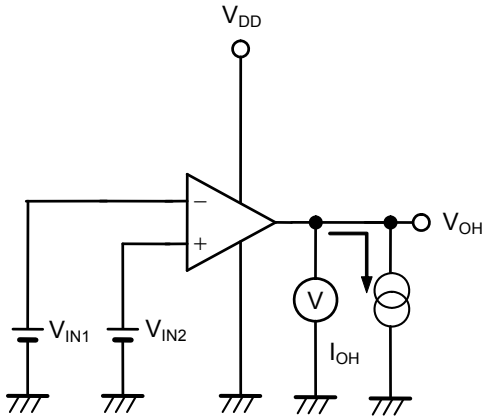



Figure 6

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

  Test conditions:

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

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

  $I_{OH} = 20$ μA

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

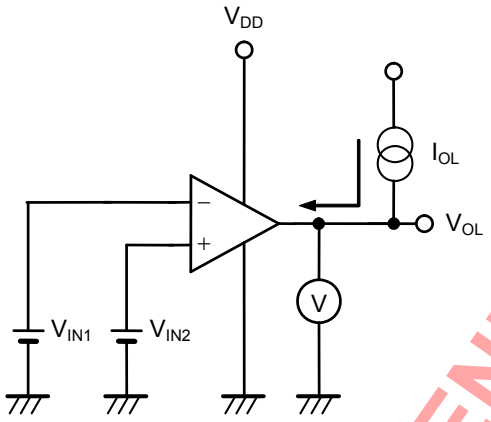



Figure 7

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

  Test conditions:

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

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

  $I_{OL} = 20$ μA

## 5. Current consumption

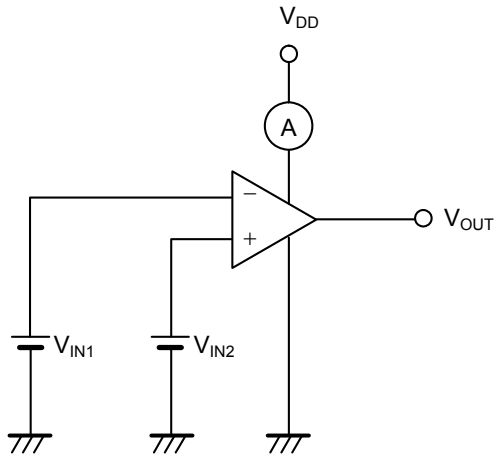



Figure 8

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

  Test conditions:
  $V_{IN1} = V_{SS}$
  $V_{IN2} = V_{CMR\ Max.}$

## 6. Source current

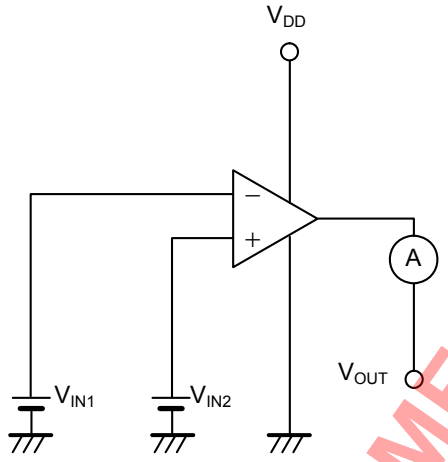



Figure 9

- **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

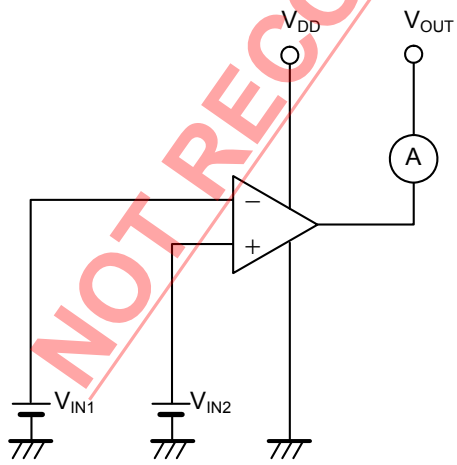



Figure 10

- **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

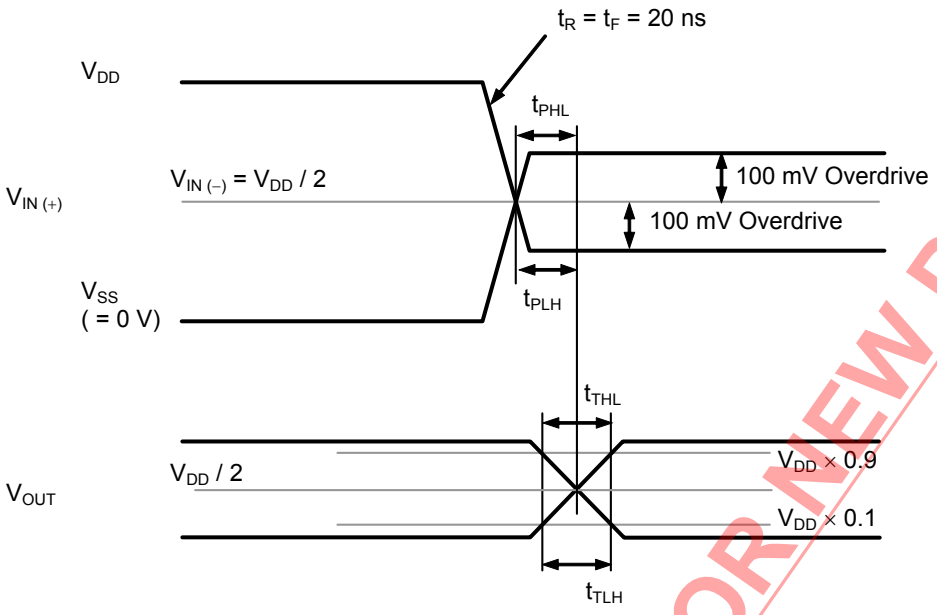



**Figure 11**

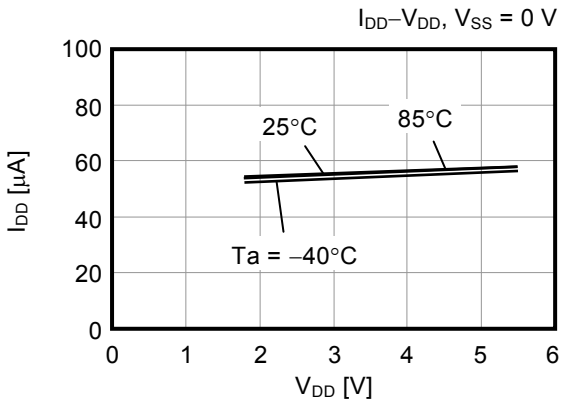
## ■ Precautions

- Do not apply an electrostatic discharge to this IC that exceeds performance ratings of the built-in electrostatic protection circuit.
- ABLIC Inc. 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.
- Use this IC with the output pin current 13 mA or less.

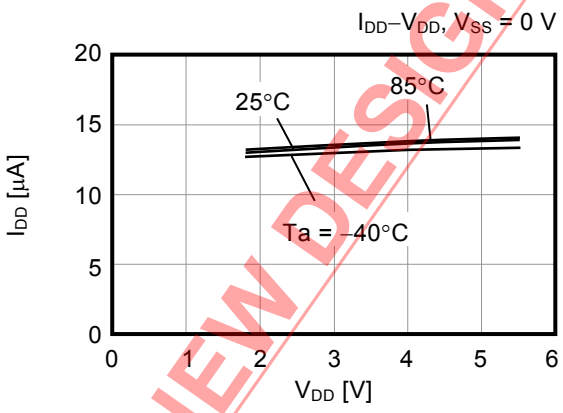
## ■ Characteristics (Typical Data)

### 1. Current consumption ($I_{DD}$) vs. Power supply voltage ($V_{DD}$)

(1) S-89210 Series



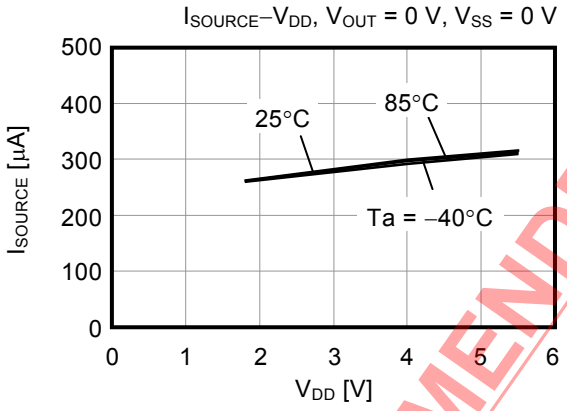

(2) S-89220 Series



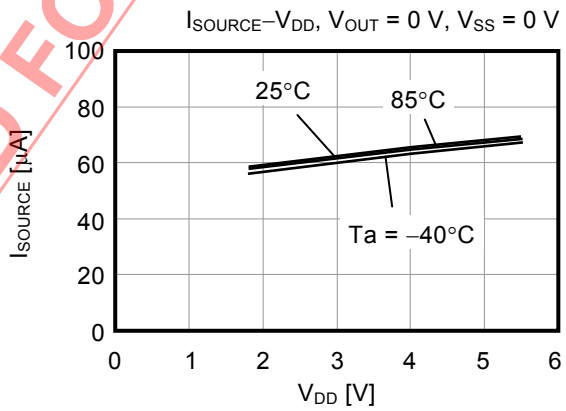

### 2. Output current characteristics

#### 2. 1 Source current ($I_{SOURCE}$) vs. Power supply voltage ($V_{DD}$)

(1) S-89210 Series

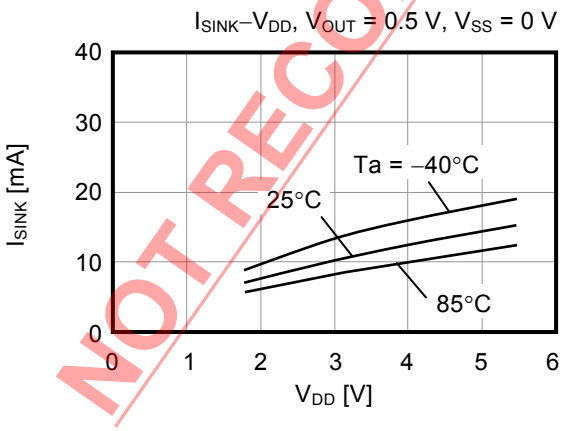



(2) S-89220 Series

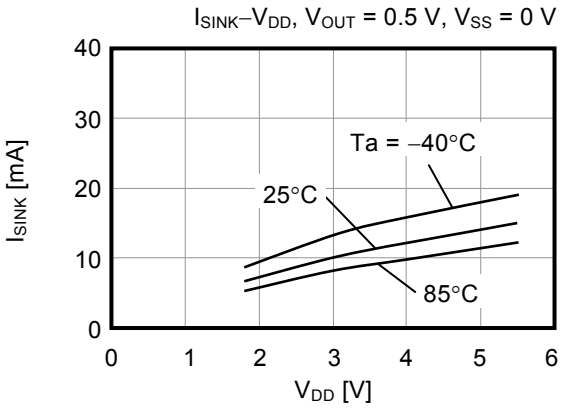



#### 2. 2 Sink current ($I_{SINK}$) vs. Power supply voltage ($V_{DD}$)

(1) S-89210 Series



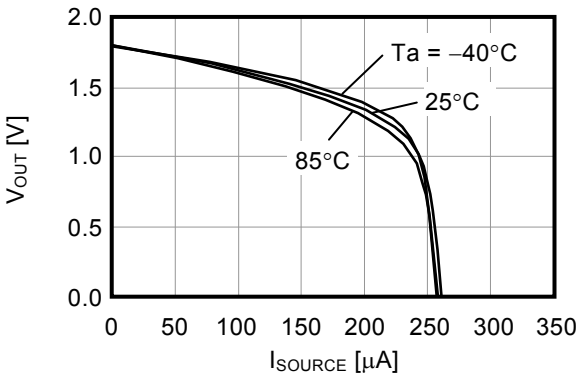

(2) S-89220 Series



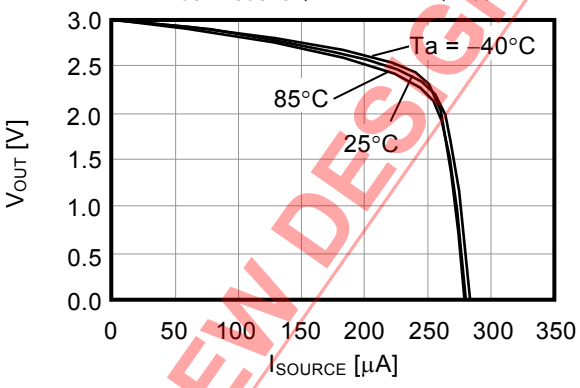
### 2. 3 Output voltage ($V_{OUT}$) vs. Source current ($I_{SOURCE}$)

#### (1) S-89210 Series

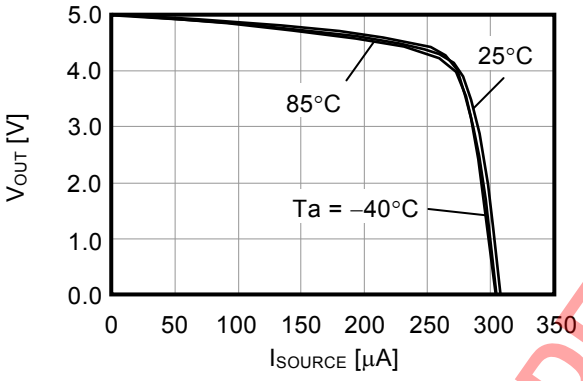
$V_{OUT}$–$I_{SOURCE}$, $V_{DD}$ = 1.8 V, $V_{SS}$ = 0 V




$V_{OUT}$–$I_{SOURCE}$, $V_{DD}$ = 3.0 V, $V_{SS}$ = 0 V

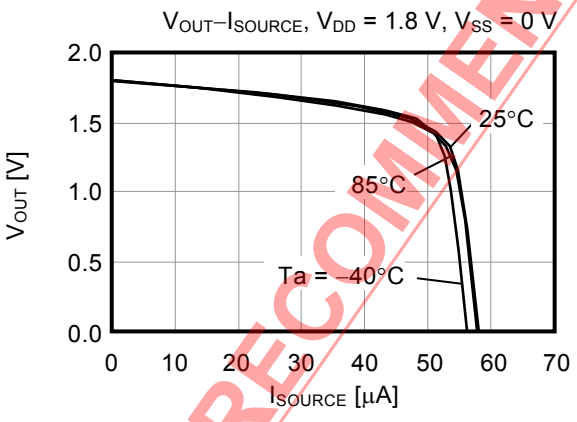



$V_{OUT}$–$I_{SOURCE}$, $V_{DD}$ = 5.0 V, $V_{SS}$ = 0 V

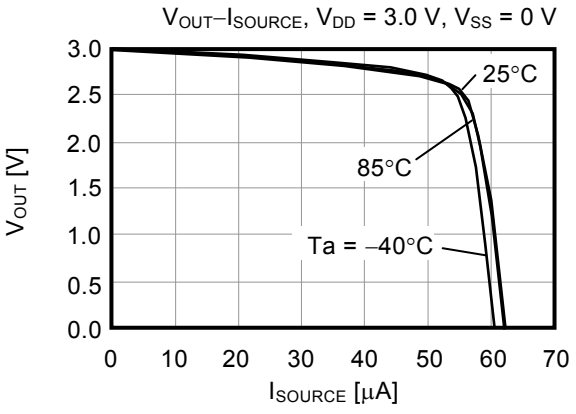



#### (2) S-89220 Series

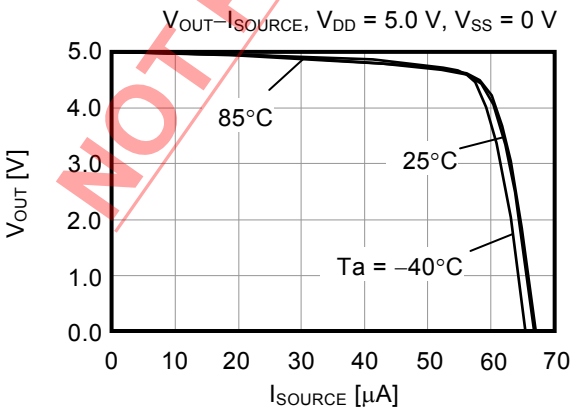
$V_{OUT}$–$I_{SOURCE}$, $V_{DD}$ = 1.8 V, $V_{SS}$ = 0 V




$V_{OUT}$–$I_{SOURCE}$, $V_{DD}$ = 3.0 V, $V_{SS}$ = 0 V



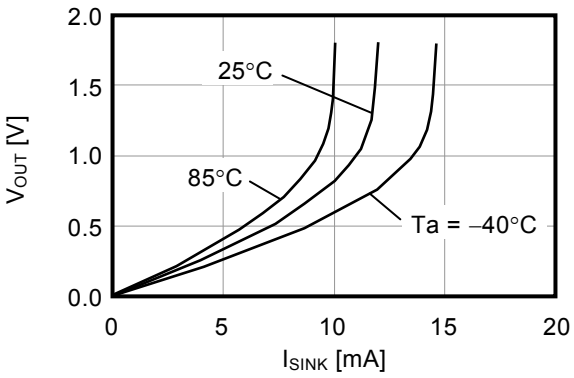

$V_{OUT}$–$I_{SOURCE}$, $V_{DD}$ = 5.0 V, $V_{SS}$ = 0 V



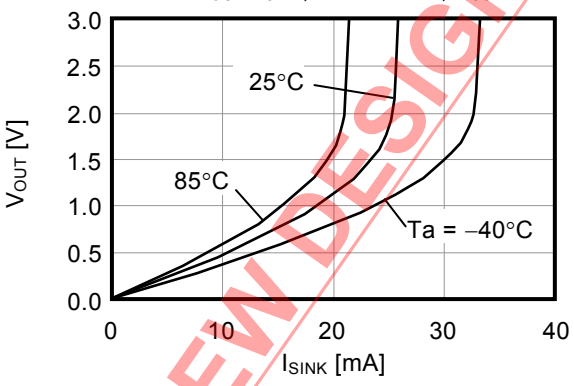
### 2. 4 Output voltage ($V_{OUT}$) vs. Sink current ($I_{SINK}$)

#### (1) S-89210 Series

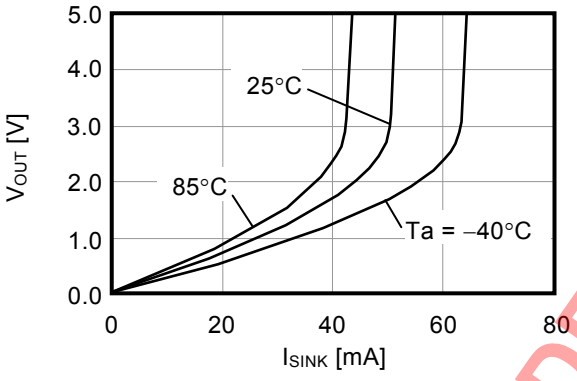
$V_{OUT}$–$I_{SINK}$, $V_{DD}$ = 1.8 V, $V_{SS}$ = 0 V




$V_{OUT}$–$I_{SINK}$, $V_{DD}$ = 3.0 V, $V_{SS}$ = 0 V

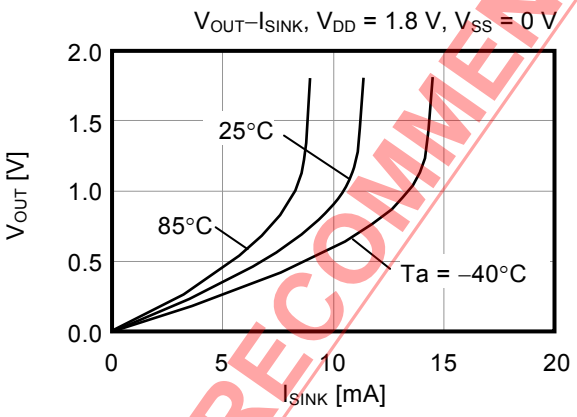



$V_{OUT}$–$I_{SINK}$, $V_{DD}$ = 5.0 V, $V_{SS}$ = 0 V

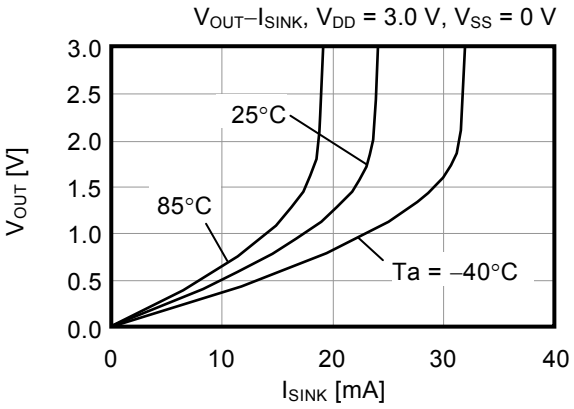



#### (2) S-89220 Series

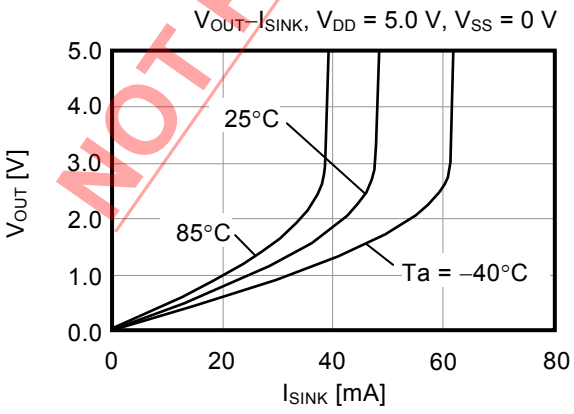
$V_{OUT}$–$I_{SINK}$, $V_{DD}$ = 1.8 V, $V_{SS}$ = 0 V

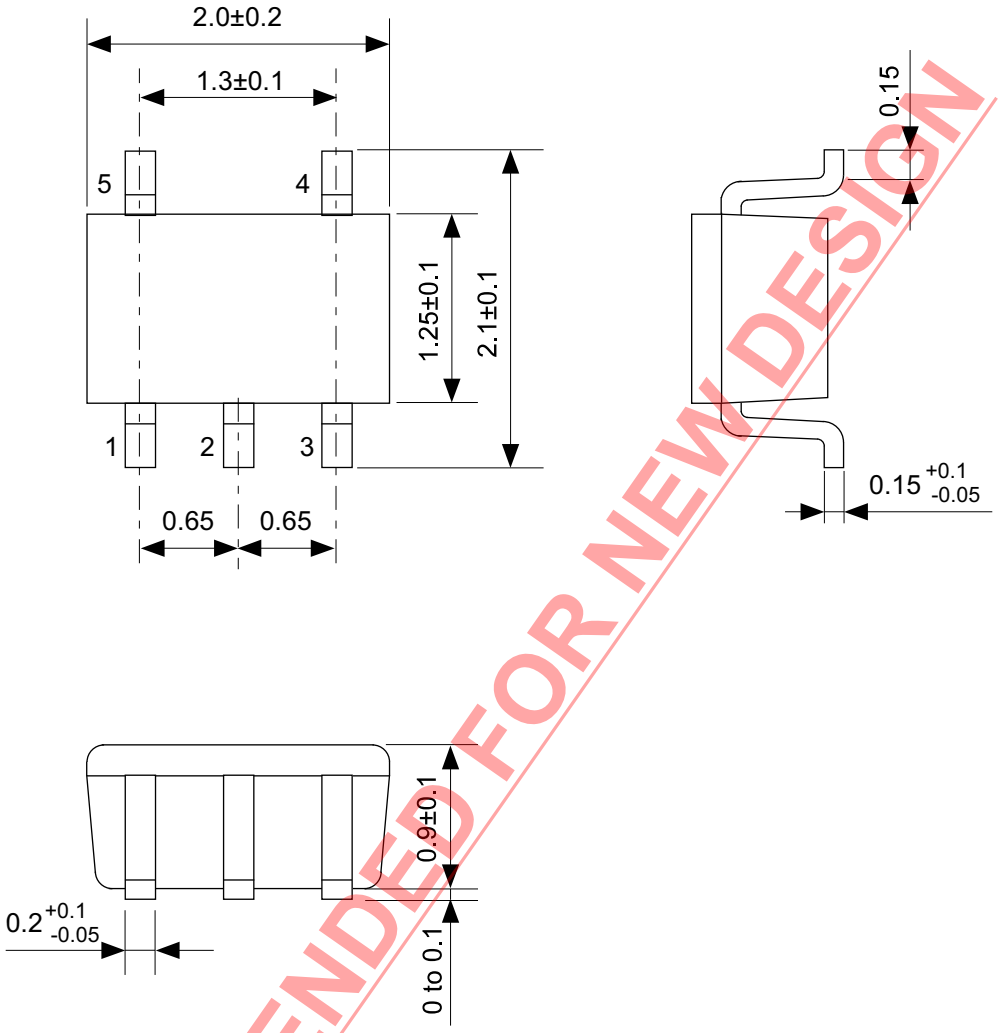



$V_{OUT}$–$I_{SINK}$, $V_{DD}$ = 3.0 V, $V_{SS}$ = 0 V




$V_{OUT}$–$I_{SINK}$, $V_{DD}$ = 5.0 V, $V_{SS}$ = 0 V








No. NP005-B-P-SD-1.2

| | |
|---|---|
| TITLE | SC88A-B-PKG Dimensions |
| No. | NP005-B-P-SD-1.2 |
| ANGLE | |
| UNIT | mm |
| | |

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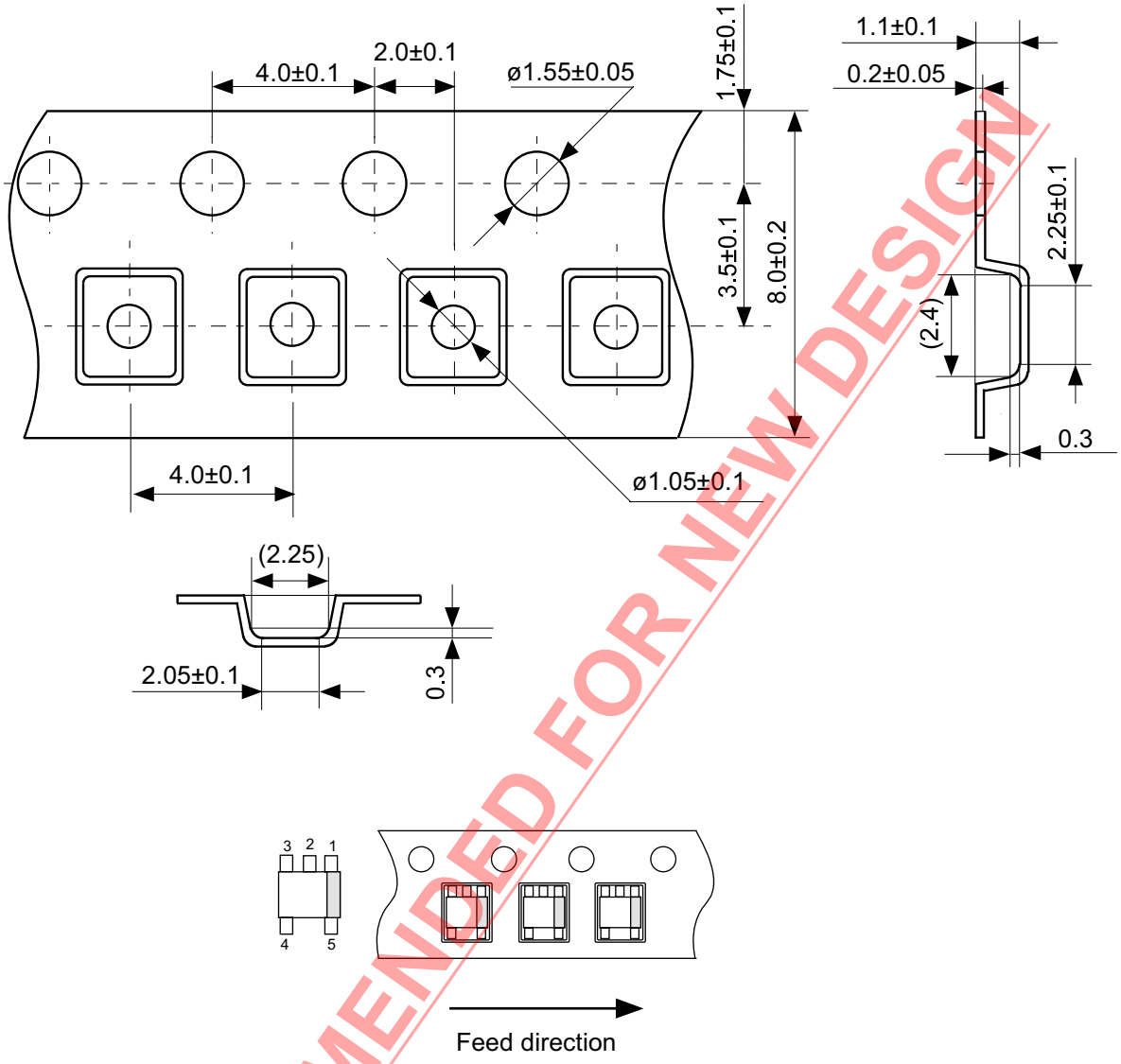




No. NP005-B-C-SD-2.0

| | |
|---|---|
| TITLE | SC88A-B-Carrier Tape |
| No. | NP005-B-C-SD-2.0 |
| ANGLE | |
| UNIT | mm |
| | |

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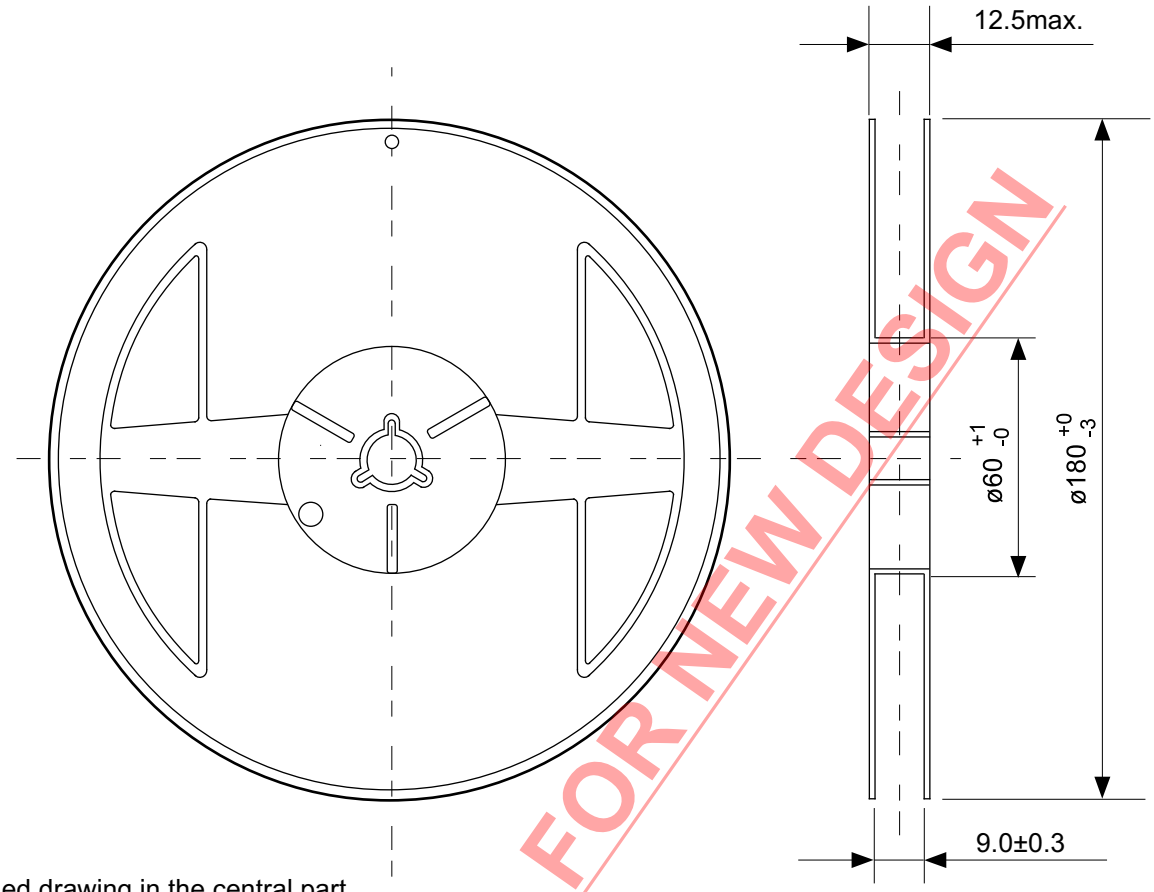
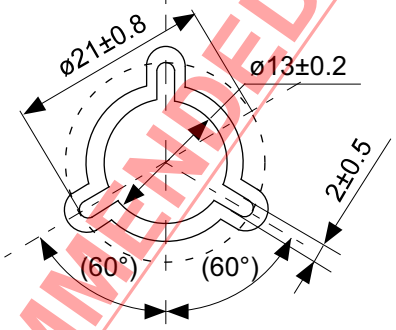



Enlarged drawing in the central part






No. NP005-B-R-SD-2.1

| | | | |
|---|---|---|---|
| TITLE | SC88A-B-Reel | | |
| No. | NP005-B-R-SD-2.1 | | |
| ANGLE | | QTY. | 3,000 |
| UNIT | mm | | |
| | | | |

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