MINI ANALOG SERIES
0.7 μA Rail-to-Rail CMOS COMPARATOR

www.ablic.com

Rev.4.1_02

The mini analog series is a group of ICs that incorporate a general-purpose analog circuit in an ultra-small package.
The S-89530A/89531A Series are CMOS type comparators that feature Rail-to-Rail[*1] I/O and can be driven at a lower voltage and lower current consumpsion than existing comparators, making the S-89530A/89531A for use in battery-powered compact portable devices.

***1.** Rail-to-Rail is a registered trademark of Motorola Inc.

■ Features

- Can be driven lower voltage than existing general-purpose comparators: V_{DD} = 0.9 V to 5.5 V
- Low current consumption: I_{DD} = 0.7 μA (Typ.)
- Rail-to-Rail wide input and output voltage range: $V_{CMR} = V_{SS}$ to V_{DD}
- Low input offset voltage: 5.0 mV max.
- Lead-free, Sn100%, halogen-free[*1]

***1.** Refer to "**■ Product Code List**" for details.

■ Applications

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

■ Package

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

■ Product Code List

Table 1

Input Offset Voltage	Product Name (Single)
V_{IO} = 10 mV max.	S-89530ACNC-HCBTF☐
V_{IO} = 5 mV max.	S-89531ACNC-HCCTF☐

Remark ☐: G, S or U

■ Pin Configuration

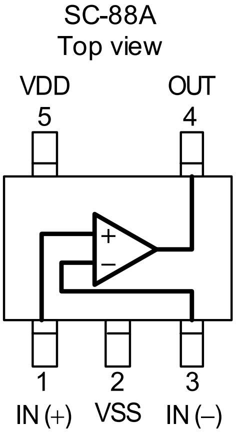


Figure 1

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 Circuits

(1) Output pin

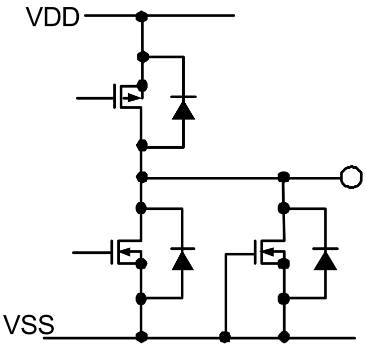


Figure 2

(2) Input pin

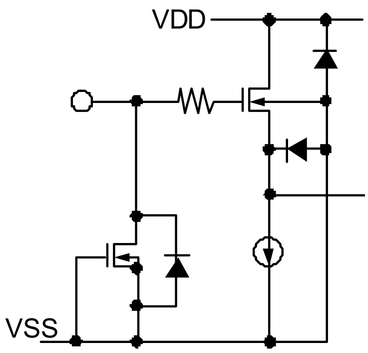


Figure 3

(3) VDD pin

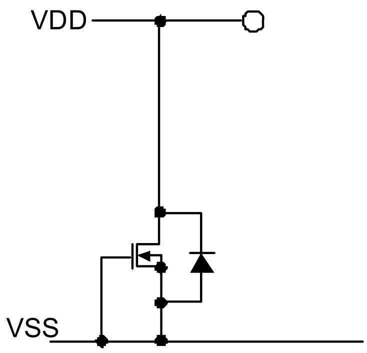


Figure 4

■ Absolute Maximum Ratings

Table 3

(Ta = 25°C unless otherwise specified)

Parameter	Symbol	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 (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}	±5.5	V
Power dissipation	P_D	200 (When not mounted on board)	mW
		350*1	mW
Operating 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.

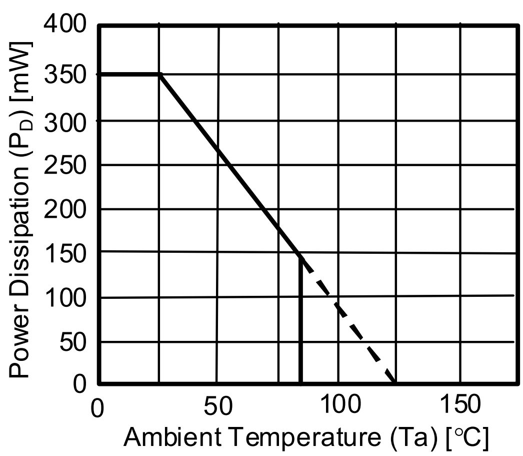


Figure 5 Power Dissipation of Package (When Mounted on Board)

■ Recommended Operating Voltage Range

Table 4

Parameter	Symbol	Range	Unit
Operating power supply voltage range	V_{DD}	0.9 to 5.5	V

■ Electrical Characteristics

The S-89530ACNC and S-89531ACNC only differ in the input offset voltage. All other specifications are the same.

1. V_{DD} = 3.0 V

Table 5

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

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	Measurement circuit
Supply current	I_{DDH}	$V_{IN1} = V_{SS}$, $V_{IN2} = V_{DD}$, $R_L = \infty$	—	0.7	1.4	μA	**Figure 11**
	I_{DDL}	$V_{IN1} = V_{DD}$, $V_{IN2} = V_{SS}$, $R_L = \infty$	—	0.25	0.5		
Input offset voltage	V_{IO}	S-89530A: V_{CMR} = 1.5 V	−10	±5	+10	mV	**Figure 7**
		S-89531A: V_{CMR} = 1.5 V	−5	±3	+5		
Input offset current	I_{IO}	—	—	1	—	pA	—
Input bias current	I_{BIAS}	—	—	1	—		
Common-mode input voltage range	V_{CMR}	—	0	—	3.0	V	**Figure 8**
Voltage gain (open loop)	A_{VOL}	V_{CMR} = 1.5 V, R_L = 1 MΩ	—	86	—	dB	—
Maximum output swing voltage	V_{OH}	R_L = 1 MΩ	2.98	—	—	V	**Figure 9**
	V_{OL}	R_L = 1 MΩ	—	—	0.02		**Figure 10**
Common-mode input signal rejection ratio	CMRR	$V_{SS} \leq V_{CMR} \leq V_{DD}$	45	65	—	dB	**Figure 8**
Power supply voltage rejection ratio	PSRR	V_{DD} = 0.9 V to 5.5 V	66	75	—	dB	**Figure 6**
Source current*1	I_{SOURCE}	$V_{OUT} = V_{DD} - 0.1$ V	380	500	—	μA	**Figure 12**
		V_{OUT} = 0 V	4000	5500	—		
Sink current	I_{SINK}	V_{OUT} = 0.1 V	400	550	—	μA	**Figure 13**
		$V_{OUT} = V_{DD}$	4800	6000	—		

***1.** Be sure to use the product with a source current of no more than 7 mA.

Table 6

AC Characteristics (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 C_L = 15 pF (Refer to **Figure 14**)	—	110	—	μs
Fall propagation delay time	t_{PHL}		—	280	—	
Rise response time	t_{TLH}		—	10	—	
Fall response time	t_{THL}		—	30	—	

2. V_{DD} = 1.8 V

Table 7

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

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	Measurement circuit
Supply current	I_{DDH}	$V_{IN1} = V_{SS}$, $V_{IN2} = V_{DD}$, $R_L = \infty$	—	0.7	1.4	μA	**Figure 11**
	I_{DDL}	$V_{IN1} = V_{DD}$, $V_{IN2} = V_{SS}$, $R_L = \infty$	—	0.25	0.5		
Input offset voltage	V_{IO}	S-89530A: V_{CMR} = 0.9 V	–10	±5	+10	mV	**Figure 7**
		S-89531A: V_{CMR} = 0.9 V	–5	±3	+5		
Input offset current	I_{IO}	—	—	1	—	pA	—
Input bias current	I_{BIAS}	—	—	1	—		
Common-mode input voltage range	V_{CMR}	—	0	—	1.8	V	**Figure 8**
Voltage gain (open loop)	A_{VOL}	V_{CMR} = 0.9 V, R_L = 1 MΩ	—	80	—	dB	—
Maximum output swing voltage	V_{OH}	R_L = 1 MΩ	1.78	—	—	V	**Figure 9**
	V_{OL}	R_L = 1 MΩ	—	—	0.02		**Figure 10**
Common-mode input signal rejection ratio	CMRR	$V_{SS} \leq V_{CMR} \leq V_{DD}$	35	55	—	dB	**Figure 8**
		$V_{SS} \leq V_{CMR} \leq V_{DD} - 0.2$ V	45	60	—		
Power supply voltage rejection ratio	PSRR	V_{DD} = 0.9 V to 5.5 V	66	75	—	dB	**Figure 6**
Source current	I_{SOURCE}	$V_{OUT} = V_{DD} - 0.1$ V	200	250	—	μA	**Figure 12**
		V_{OUT} = 0 V	1000	1500	—		
Sink current	I_{SINK}	V_{OUT} = 0.1 V	220	300	—	μA	**Figure 13**
		$V_{OUT} = V_{DD}$	1200	1800	—		

Table 8

AC Characteristics (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 C_L = 15 pF (Refer to **Figure 14**)	—	90	—	μs
Fall propagation delay time	t_{PHL}		—	160	—	
Rise response time	t_{TLH}		—	8	—	
Fall response time	t_{THL}		—	25	—	

3. V_{DD} = 0.9 V

Table 9

DC Characteristics (V_{DD} = 0.9 V) (Ta = 25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	Measurement circuit
Supply current	I_{DDH}	$V_{IN1} = V_{SS}$, $V_{IN2} = V_{DD}$, $R_L = \infty$	—	0.7	1.3	μA	**Figure 11**
	I_{DDL}	$V_{IN1} = V_{DD}$, $V_{IN2} = V_{SS}$, $R_L = \infty$	—	0.25	0.5		
Input offset voltage	V_{IO}	S-89530A: V_{CMR} = 0.45 V	−10	±5	+10	mV	**Figure 7**
		S-89531A: V_{CMR} = 0.45 V	−5	±3	+5		
Input offset current	I_{IO}	—	—	1	—	pA	—
Input bias current	I_{BIAS}	—	—	1	—		
Common-mode input voltage range	V_{CMR}	—	0	—	0.9	V	**Figure 8**
Voltage gain (open loop)	A_{VOL}	V_{CMR} = 0.45 V, R_L = 1 MΩ	—	74	—	dB	—
Maximum output swing voltage	V_{OH}	R_L = 1 MΩ	0.88	—	—	V	**Figure 9**
	V_{OL}	R_L = 1 MΩ	—	—	0.02		**Figure 10**
Common-mode input signal rejection ratio	CMRR	$V_{SS} \le V_{CMR} \le V_{DD}$	25	50	—	dB	**Figure 8**
		$V_{SS} \le V_{CMR} \le V_{DD} - 0.3$ V	40	60	—		
Power supply voltage rejection ratio	PSRR	V_{DD} = 0.9 V to 5.5 V	66	75	—	dB	**Figure 6**
Source current	I_{SOURCE}	$V_{OUT} = V_{DD} - 0.1$ V	10	45	—	μA	**Figure 12**
		V_{OUT} = 0 V	12	70	—		
Sink current	I_{SINK}	V_{OUT} = 0.1 V	10	65	—	μA	**Figure 13**
		$V_{OUT} = V_{DD}$	12	120	—		

Table 10

AC Characteristics (V_{DD} = 0.9 V) (Ta = 25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Rise propagation delay time	t_{PLH}	Overdrive = 100 mV C_L = 15 pF (Refer to **Figure 14**)	—	65	—	μs
Fall propagation delay time	t_{PHL}		—	65	—	
Rise response time	t_{TLH}		—	5	—	
Fall response time	t_{THL}		—	20	—	

■ Measurement Circuits

1. Power supply voltage rejection ratio

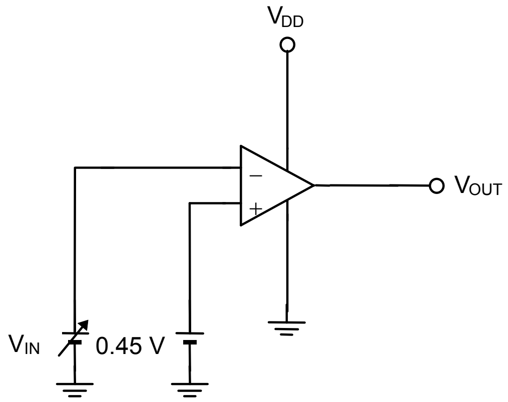


Figure 6

- The power supply voltage rejection ratio (PSRR) is calculated by the following expression, with the value of V_{IO} measured at each V_{DD}.

  Measurement conditions:
  When V_{DD} = 0.9 V: $V_{DD} = V_{DD1}$, $V_{IO} = V_{IO1}$
  When V_{DD} = 5.5 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. Input offset voltage

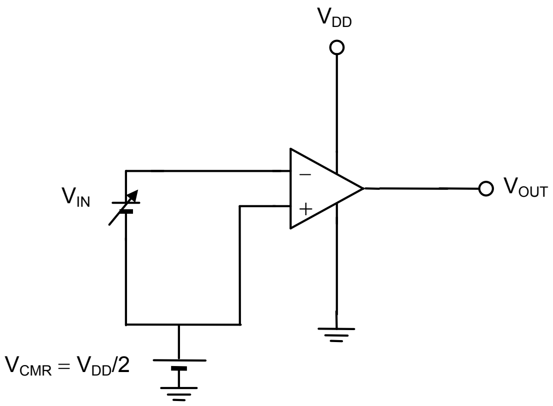


Figure 7

- Input offset voltage (V_{IO})

  The input offset voltage (V_{IO}) is defined as V_{IN} at which V_{OUT} changes by changing V_{IN}.

3. Common-mode input signal rejection rate, common-mode input voltage range

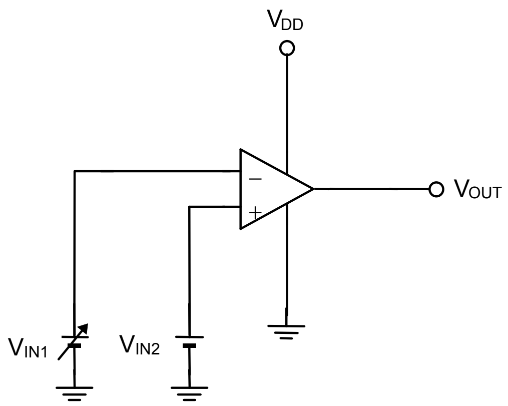


Figure 8

- 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}) defined as V_{IN1} minus V_{IN2} at which V_{OUT} is changed by changing V_{IN1}.

  Measurement conditions:
  When $V_{IN2} = V_{CMR}$ (max.): $V_{IO} = V_{IO1}$
  When $V_{IN2} = V_{CMR}$ (min.): $V_{IO} = V_{IO2}$

$$\text{CMRR} = 20\log\left(\left|\frac{V_{CMR}(\text{max.}) - V_{CMR}(\text{min.})}{V_{IO1} - V_{IO2}}\right|\right)$$

- Common-mode input voltage range (V_{CMR})
  The common-mode input voltage range is the range of V_{IN2} within which V_{OUT} satisfies the common mode input signal rejection ratio specification.

4. Maximum output swing voltage

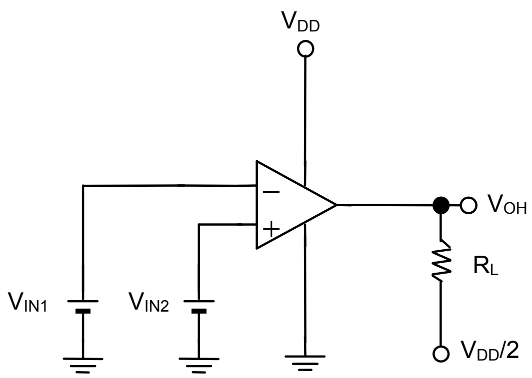


Figure 9

- Maximum output swing voltage (V_{OH})
  Measurement conditions: $V_{IN1} = \frac{V_{DD}}{2} - 0.1\,V$

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

  $R_L = 1\ M\Omega$

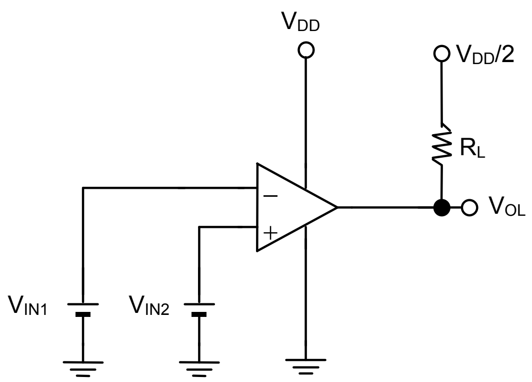


Figure 10

- Maximum output swing voltage (V_{OL})
  Measurement conditions: $V_{IN1} = \frac{V_{DD}}{2} + 0.1\,V$

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

  $R_L = 1\ M\Omega$

5. Supply current

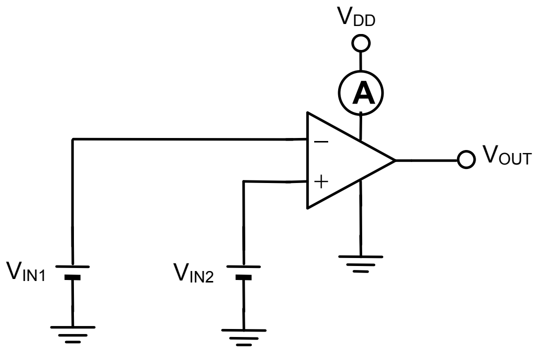


Figure 11

- Supply current (I_{DDH})
  Measurement conditions: $V_{IN1} = V_{SS}$
  $V_{IN2} = V_{DD}$
- Supply current (I_{DDL})
  Measurement conditions: $V_{IN1} = V_{DD}$
  $V_{IN2} = V_{SS}$

6. Source current

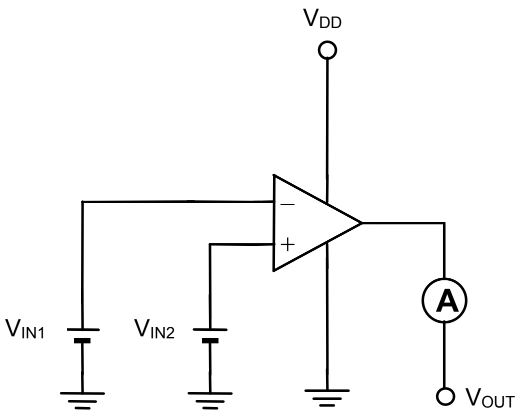


Figure 12

- Source current (I_{SOURCE})
  Measurement conditions: $V_{IN1} = \frac{V_{DD}}{2} - 0.1\,V$
  $V_{IN2} = \frac{V_{DD}}{2} + 0.1\,V$
  $V_{OUT} = V_{DD} - 0.1$ V or
  $V_{OUT} = 0$ V

7. Sink current

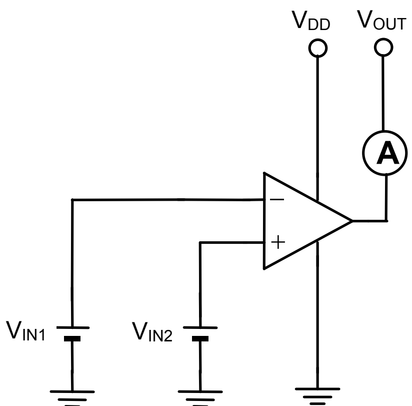


Figure 13

- Sink current (I_{SINK})
  Measurement conditions: $V_{IN1} = \frac{V_{DD}}{2} + 0.1\,V$
  $V_{IN2} = \frac{V_{DD}}{2} - 0.1\,V$
  $V_{OUT} = 0.1$ V or
  $V_{OUT} = V_{DD}$

8. Propagation delay time/transient response time

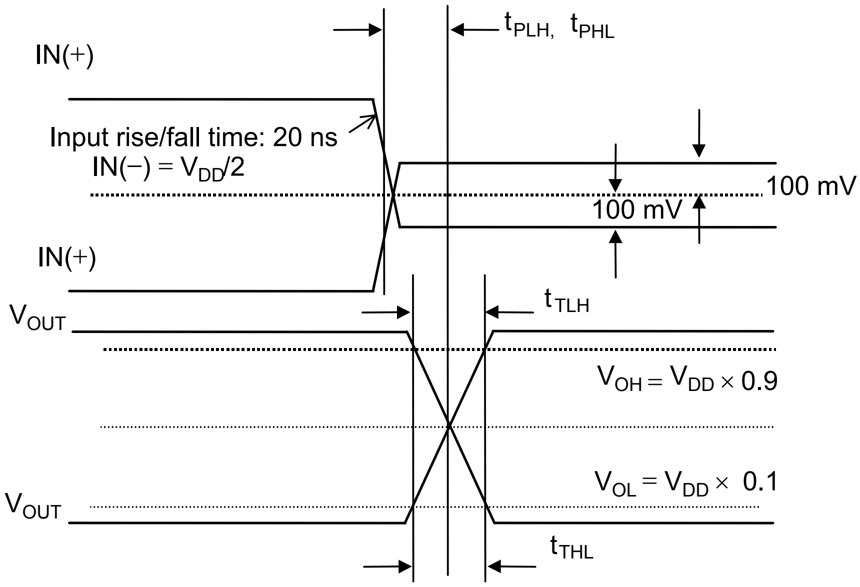


Figure 14

■ Cautions

- When R_L = 100 kΩ, V_{OH} may rise only 0.65 V if the temperature is –40°C and V_{DD} = 0.9 V.

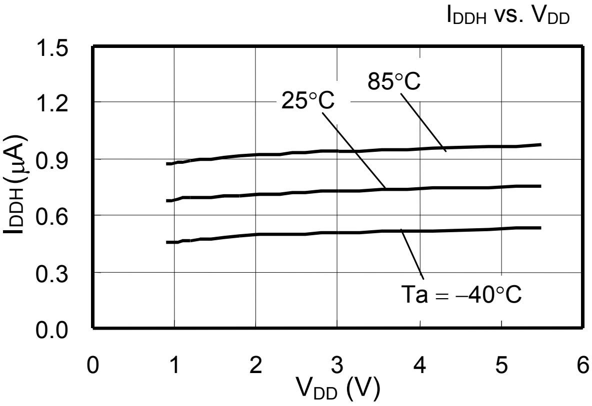
  If the temperature is –20°C, however, V_{OH} rises to 0.8 V, which is 100 mV below V_{DD}, when V_{DD} = 0.9 V, even if R_L = 100 kΩ.

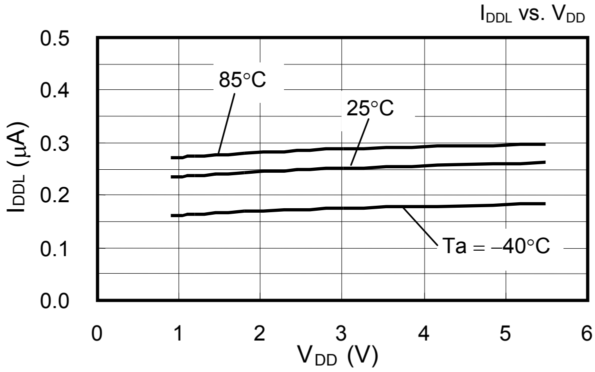
  If V_{DD} is 1.2 V, V_{OH} rises to 0.88 V, which is 20 mV below V_{DD} when R_L = 100 kΩ, even at –40°C.

  The temperature characteristics data described above can be used as reference data. Note that 100% testing under these conditions has not been performed.
- Be sure to use the product with a source current of no more than 7 mA.
- Do not apply an electrostatic discharge to this IC that exceeds the performance ratings of the built-in electrostatic protection circuit.

■ Characteristics (Reference Data)

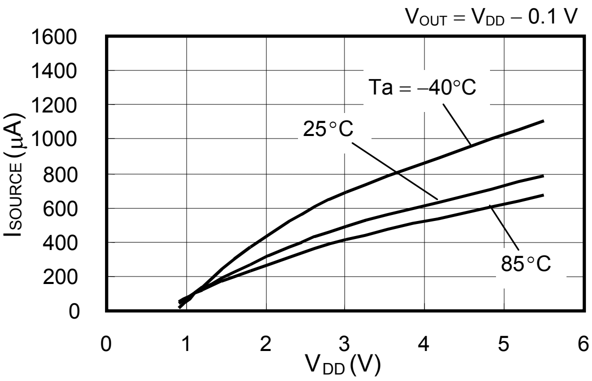
1. Current consumption vs. Power supply voltage



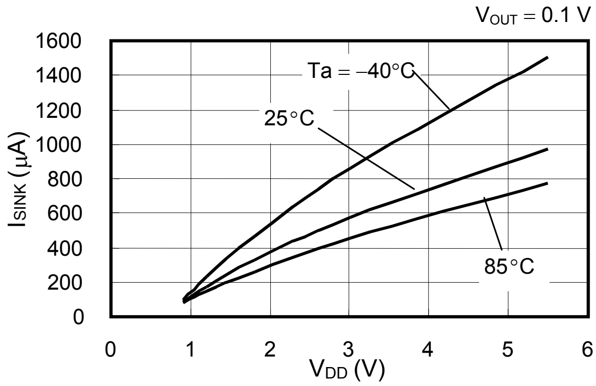


2. Output current

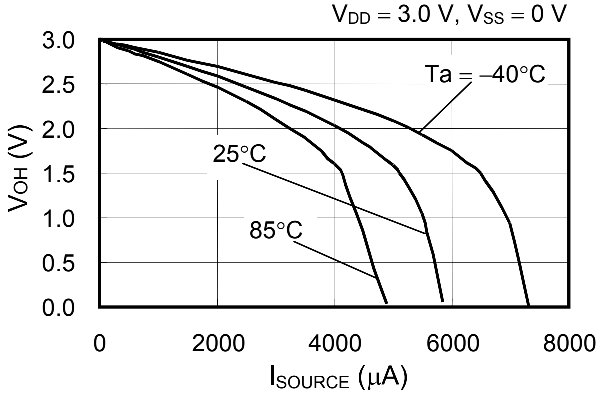
2-1. I_{SOURCE} vs. Power supply voltage

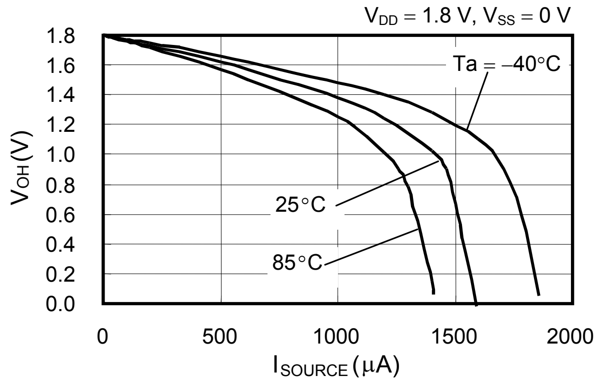


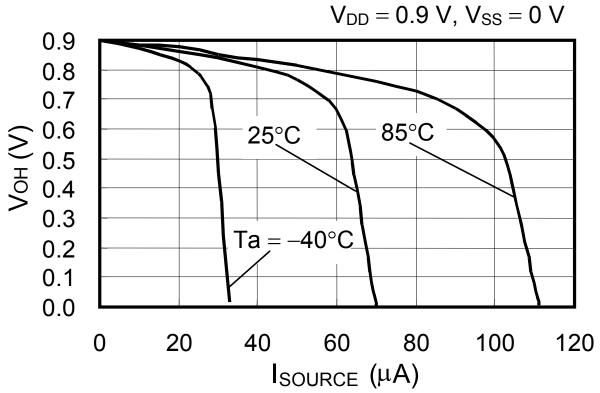
I_{SINK} vs. Power supply voltage



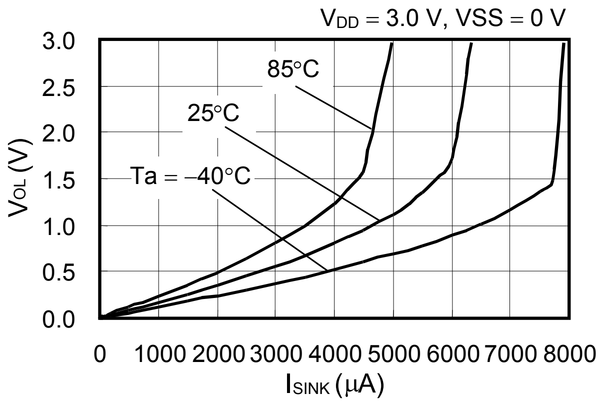
2-2. Output voltage (V_{OH}) vs. I_{SOURCE}

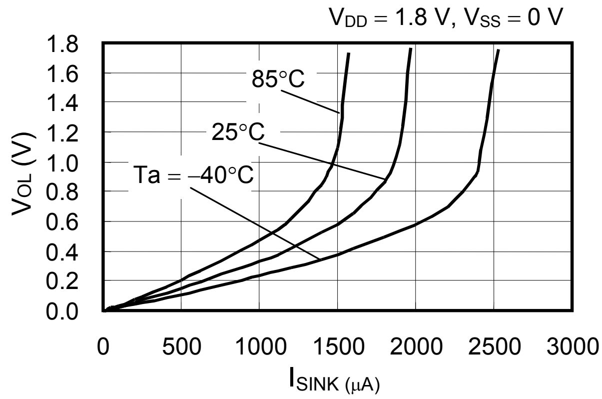


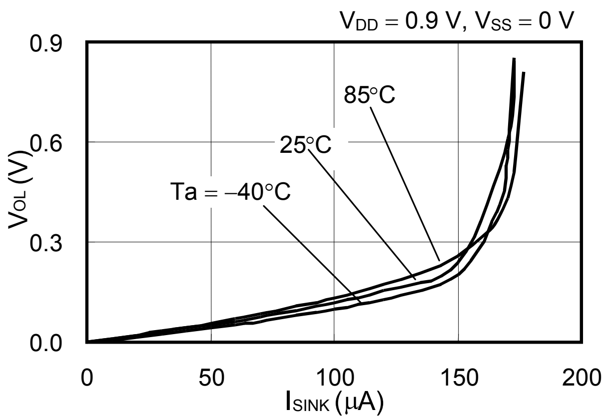


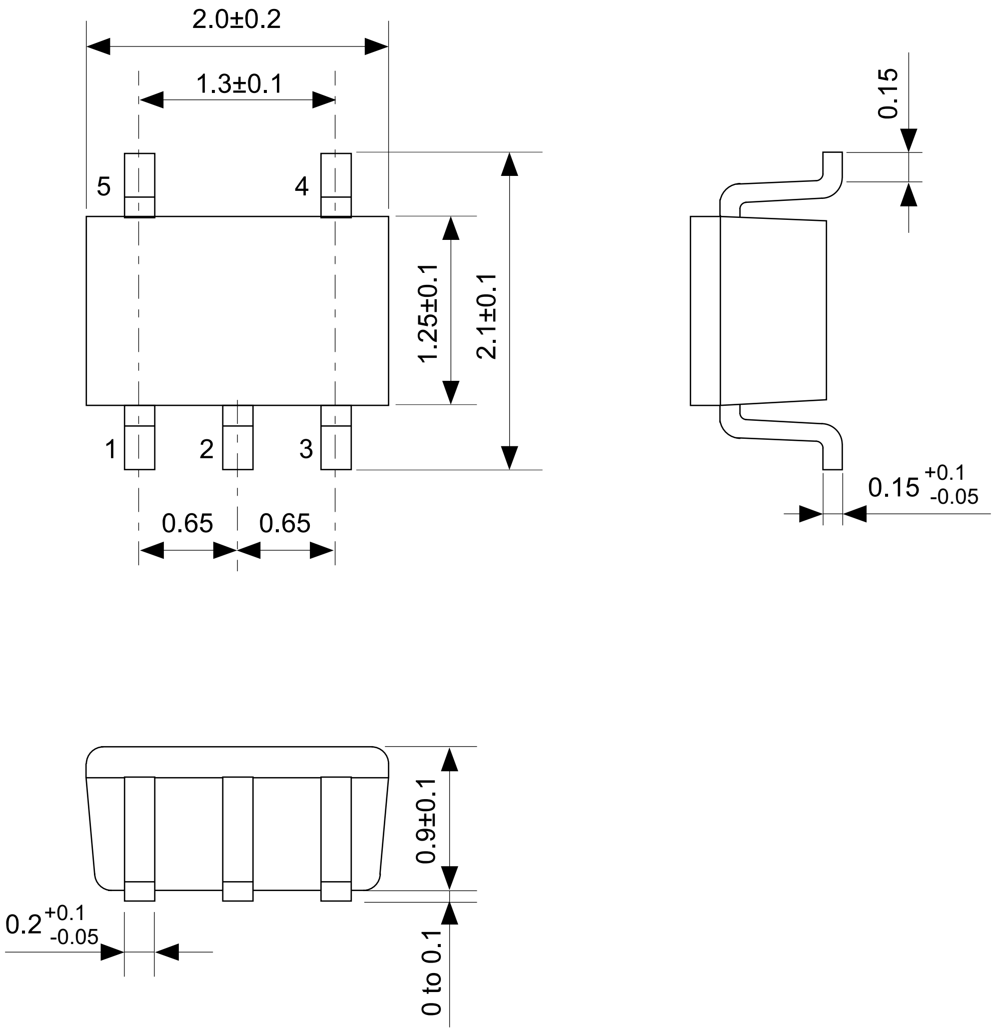


2-3. Output Voltage (V_{OL}) vs. I_{SINK}



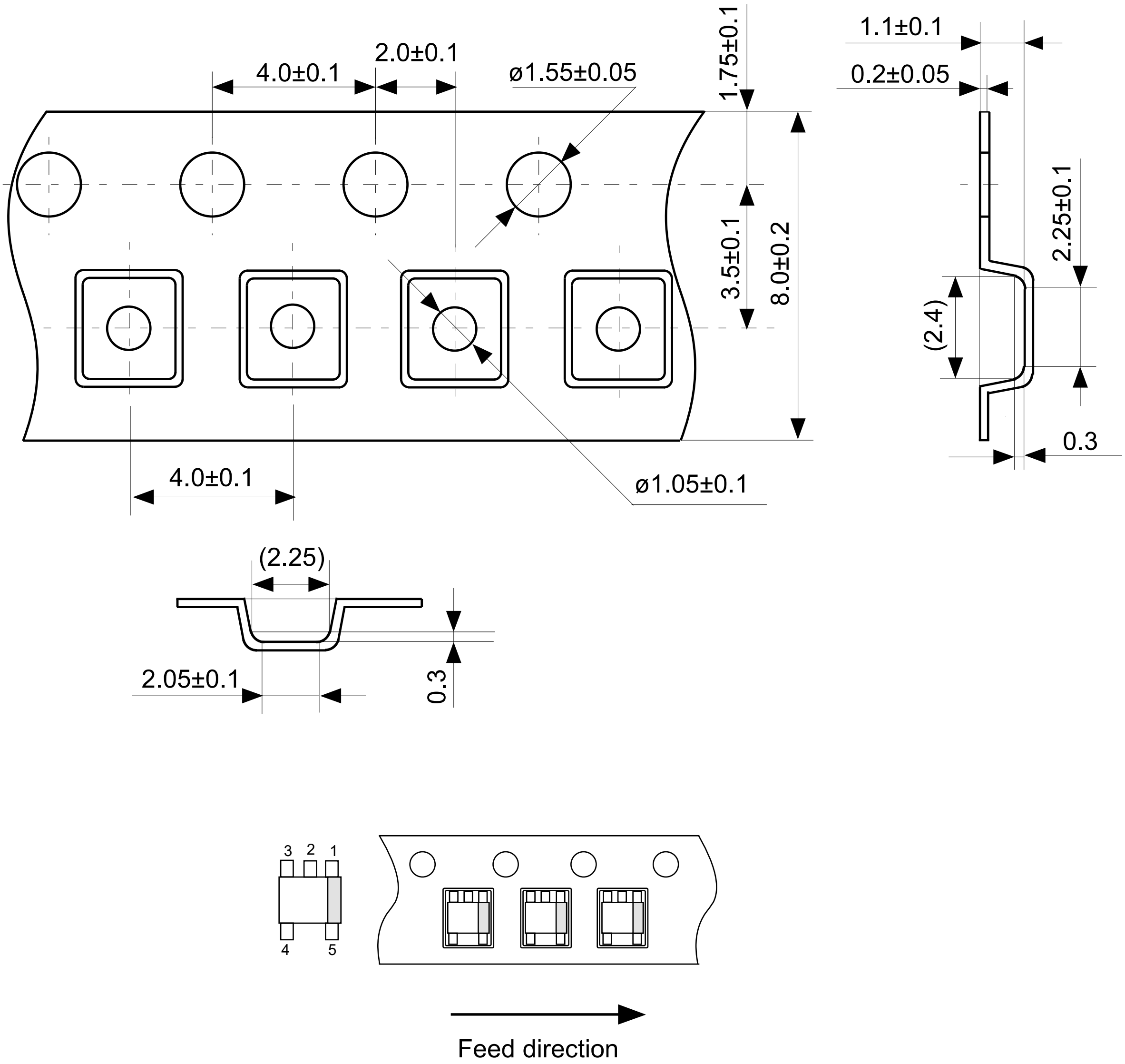






No. NP005-B-P-SD-1.2

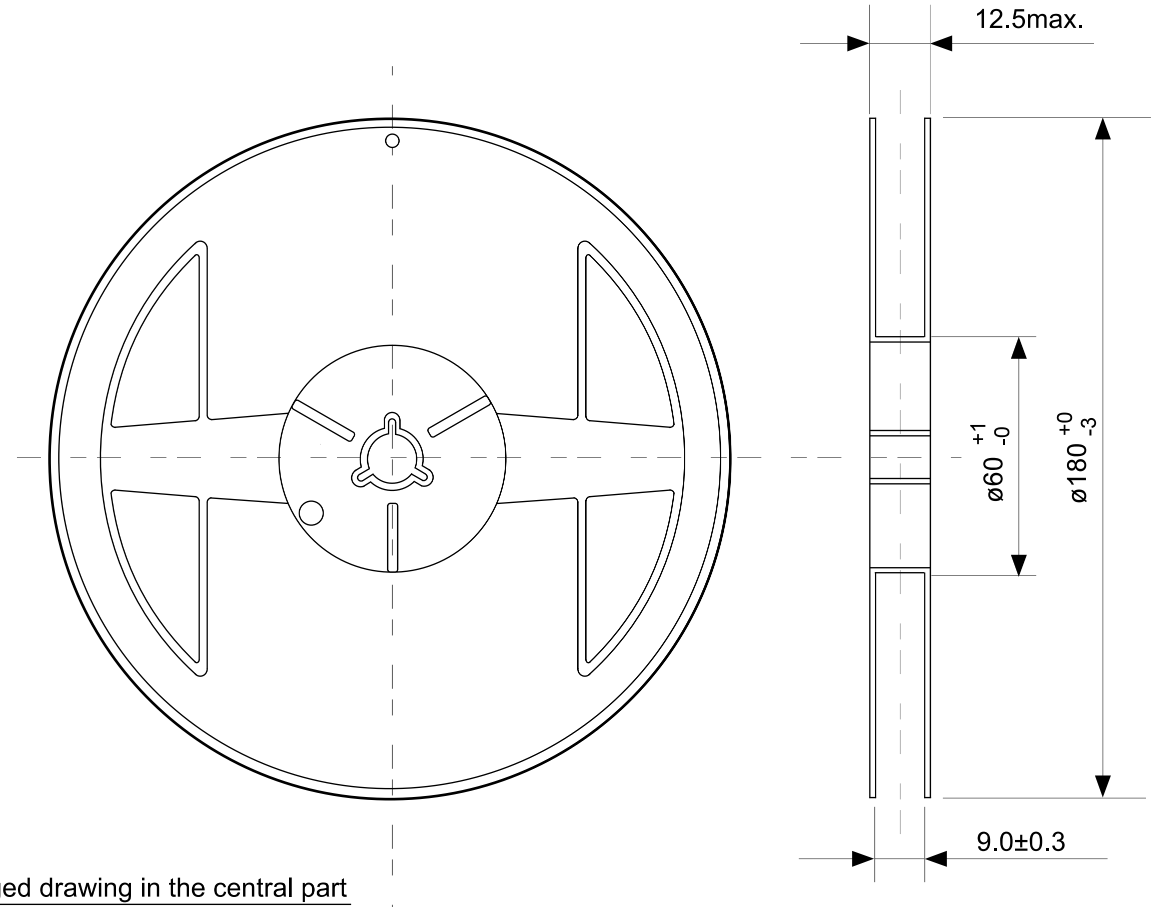
TITLE	SC88A-B-PKG Dimensions
No.	NP005-B-P-SD-1.2
ANGLE	
UNIT	mm
ABLIC Inc.	



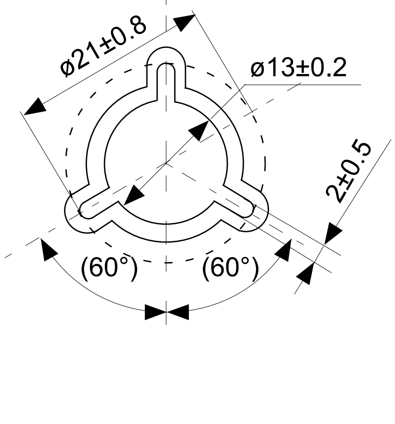
No. NP005-B-C-SD-2.0

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

ABLIC 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		
ANGLE		QTY.	3,000
UNIT	mm		

ABLIC Inc.

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   The entire system in which the products are used must be sufficiently evaluated and judged whether the products are allowed to apply for the system on customer's own responsibility.
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11. The products do not affect human health under normal use. However, they contain chemical substances and heavy metals and should therefore not be put in the mouth. The fracture surfaces of wafers and chips may be sharp. Be careful when handling these with the bare hands to prevent injuries, etc.
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15. This Disclaimers have been delivered in a text using the Japanese language, which text, despite any translations into the English language and the Chinese language, shall be controlling.

2.4-2019.07

OCEAN CHIPS

Океан Электроники

Поставка электронных компонентов

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения **«JONHON»**, а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов **«FORSTAR»**.

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).

Телефон: 8 (812) 309-75-97 (многоканальный)
Факс: 8 (812) 320-03-32
Электронная почта: ocean@oceanchips.ru
Web: http://oceanchips.ru/
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А