

This IC incorporates a general purpose analog circuit in a small package. This is a zero-drift operational amplifier with Rail-to-Rail input and output, which uses chopper-stabilizing techniques to provide low input offset voltage.

The S-89630AB is a dual operational amplifier (2 circuits), which is suitable for applications requiring less offset voltage.

## ■ Features

- Low input offset voltage:  $V_{IO} = +50 \mu\text{V max. (} T_a = -40^\circ\text{C to } +125^\circ\text{C)}$
- Low input offset voltage drift:  $\frac{\Delta V_{IO}}{\Delta T_a} = \pm 25 \text{ nV}/^\circ\text{C typ. (} V_{DD} = 30.0 \text{ V, } T_a = -40^\circ\text{C to } +125^\circ\text{C)}$
- Operation power supply voltage range:  $V_{DD} = 4.0 \text{ V to } 36.0 \text{ V (Single supply)}$   
 $V_{DD} = \pm 2.0 \text{ V to } \pm 18.0 \text{ V (Dual supply)}$
- Low current consumption (Per circuit):  $I_{DD} = 250 \mu\text{A typ.}$
- Low input noise voltage:  $V_{NOISE\_pp} = 0.8 \mu\text{Vpp typ. (} f = 0.1 \text{ Hz to } 10 \text{ Hz)}$
- Low input noise voltage density:  $V_{NOISE} = 25 \text{ nV}/\sqrt{\text{Hz}} \text{ typ. (} f = 1 \text{ kHz)}$
- Built-in output current limit circuit: Overcurrent limit when output pin is short-circuited
- Internal phase compensation: No external parts required
- Rail-to-Rail input and output
- Operation temperature range:  $T_a = -40^\circ\text{C to } +125^\circ\text{C}$
- Lead-free (Sn 100%), halogen-free

## ■ Applications

- High-accuracy current detection
- Various sensor interfaces
- Strain gauge amplifier

## ■ Package

- TMSOP-8

■ Block Diagram

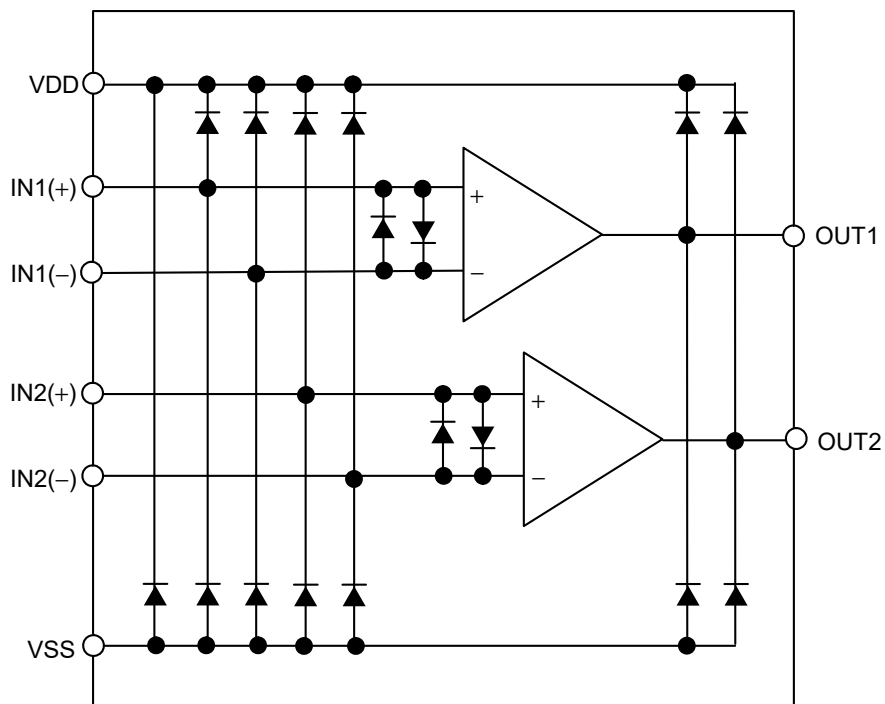
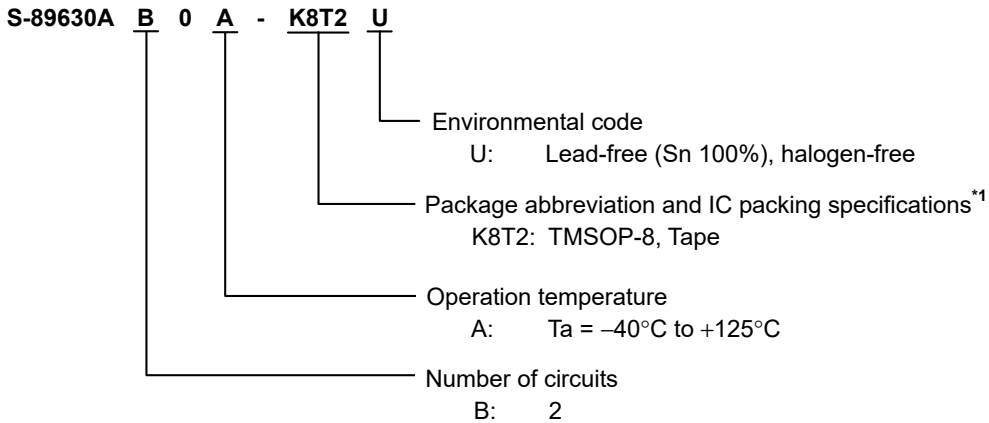


Figure 1

■ **Product Name Structure**

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 drawing.

2. **Package**

**Table 1 Package Drawing Codes**

Package Name	Dimension	Tape	Reel
TMSOP-8	FM008-A-P-SD	FM008-A-C-SD	FM008-A-R-SD

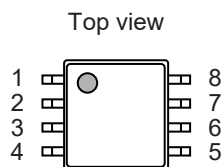
3. **Product name list**

**Table 2**

Product Name	Package
S-89630AB0A-K8T2U	TMSOP-8

■ Pin Configuration

1. TMSOP-8



**Figure 2**

**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

(T<sub>j</sub> = -40°C to +150°C unless otherwise specified)

Item	Symbol	Absolute Maximum Rating	Unit
Power supply voltage	V <sub>DD</sub>	V <sub>SS</sub> - 0.3 to V <sub>SS</sub> + 45.0	V
Input voltage	V <sub>IN(+)</sub> , V <sub>IN(-)</sub>	V <sub>SS</sub> - 0.3 to V <sub>DD</sub> + 0.3	V
Output voltage	V <sub>OUT</sub>	V <sub>SS</sub> - 0.3 to V <sub>DD</sub> + 0.3	V
Differential input voltage	V <sub>IND</sub>	±0.5	V
Input pin current	I <sub>IN</sub>	±10.0	mA
Junction temperature	T <sub>j</sub>	-40 to +150	°C
Operation ambient temperature	T <sub>opr</sub>	-40 to +125	°C
Storage temperature	T <sub>stg</sub>	-40 to +150	°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.

■ Thermal Resistance Value

Table 5

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	
Junction-to-ambient thermal resistance*1	θ <sub>JA</sub>	TMSOP-8	Board A	-	160	-	°C/W
			Board B	-	133	-	°C/W
			Board C	-	-	-	°C/W
			Board D	-	-	-	°C/W
			Board E	-	-	-	°C/W

\*1. Test environment: compliance with JEDEC STANDARD JESD51-2A

**Remark** Refer to "■ Power Dissipation" and "Test Board" for details.

■ Electrical Characteristics

1. Recommended operation conditions

Table 6

(Ta = -40°C to +125°C unless otherwise specified)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Operation power supply voltage range	V <sub>DD</sub>	–	4.0	–	36.0	V	–

2. V<sub>DD</sub> = 5.0 V

Table 7

(Ta = -40°C to +125°C unless otherwise specified)

DC Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Current consumption (2 circuits)	I <sub>DD</sub>	V <sub>CMR</sub> = V <sub>OUT</sub> = $\frac{V_{DD}}{2}$	–	500	760	μA	5
Input offset voltage	V <sub>IO</sub>	V <sub>CMR</sub> = $\frac{V_{DD}}{2}$	–50	±10	+50	μV	1
Input offset voltage drift	$\frac{\Delta V_{IO}}{\Delta T_a}$	V <sub>CMR</sub> = $\frac{V_{DD}}{2}$	–125	±30	+125	nV/°C	1
Input bias current	I <sub>BIAS</sub>	–	–	3	10	nA	9,10
Input offset current	I <sub>IO</sub>	–	–	3	10	nA	9,10
Common-mode input voltage range	V <sub>CMR</sub>	–	V <sub>SS</sub>	–	V <sub>DD</sub>	V	2
Voltage gain (open loop)	A <sub>VOL</sub>	V <sub>SS</sub> + 0.5 V ≤ V <sub>OUT</sub> ≤ V <sub>DD</sub> – 0.5 V, V <sub>CMR</sub> = $\frac{V_{DD}}{2}$ , R <sub>L</sub> = 10 kΩ	93	110	–	dB	8
Maximum output swing voltage	V <sub>OH</sub>	I <sub>SOURCE</sub> = 100 μA	4.9	–	–	V	3
		I <sub>SOURCE</sub> = 1 mA	4.7	–	–	V	3
	V <sub>OL</sub>	I <sub>SINK</sub> = 100 μA	–	–	0.1	V	4
		I <sub>SINK</sub> = 1 mA	–	–	0.3	V	4
Common-mode input signal rejection ratio	CMRR	V <sub>SS</sub> ≤ V <sub>CMR</sub> ≤ V <sub>DD</sub>	93	110	–	dB	2
Power supply voltage rejection ratio	PSRR	4.0 V ≤ V <sub>DD</sub> ≤ 36.0 V	116	130	–	dB	1
Source current	I <sub>SOURCE</sub>	V <sub>OUT</sub> = V <sub>DD</sub> – 0.1 V	0.40	0.60	–	mA	6
Sink current	I <sub>SINK</sub>	V <sub>OUT</sub> = 0.1 V	0.25	0.50	–	mA	7
Output pin short-circuit current (source)	I <sub>SHORT_SOURCE</sub>	V <sub>OUT</sub> = 0 V	–	16.0	–	mA	–
Output pin short-circuit current (sink)	I <sub>SHORT_SINK</sub>	V <sub>OUT</sub> = V <sub>DD</sub>	–	15.0	–	mA	–

Table 8

(Ta = -40°C to +125°C unless otherwise specified)

AC Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Slew rate	SR	R <sub>L</sub> = 1.0 MΩ, C <sub>L</sub> = 15 pF (Refer to <b>Figure 13</b> and <b>Figure 14</b> ), V <sub>IN(+)</sub> = 1.5 V ↔ 3.5 V	–	0.45	–	V/μs
Gain-bandwidth product	GBP	C <sub>L</sub> = 0 pF	–	1.2	–	MHz
Maximum load capacitance	C <sub>L</sub>	–	–	470	–	pF
Input noise voltage	V <sub>NOISE_pp</sub>	f = 0.1 Hz to 10 Hz	–	0.8	–	μVpp
Input noise voltage density	V <sub>NOISE</sub>	f = 1 kHz	–	25	–	nV/√Hz

**3.  $V_{DD} = 30.0\text{ V}$**

**Table 9**

**DC Electrical Characteristics**

( $T_a = -40^\circ\text{C}$  to  $+125^\circ\text{C}$  unless otherwise specified)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Current consumption (2 circuits)	$I_{DD}$	$V_{CMR} = V_{OUT} = \frac{V_{DD}}{2}$	–	500	760	$\mu\text{A}$	5
Input offset voltage	$V_{IO}$	$V_{CMR} = \frac{V_{DD}}{2}$	–50	$\pm 10$	+50	$\mu\text{V}$	1
Input offset voltage drift	$\frac{\Delta V_{IO}}{\Delta T_a}$	$V_{CMR} = \frac{V_{DD}}{2}$	–120	$\pm 25$	+120	$\text{nV}/^\circ\text{C}$	1
Input bias current	$I_{BIAS}$	–	–	3	10	$\text{nA}$	9,10
Input offset current	$I_{IO}$	–	–	3	10	$\text{nA}$	9,10
Common-mode input voltage range	$V_{CMR}$	–	$V_{SS}$	–	$V_{DD}$	$\text{V}$	2
Voltage gain (open loop)	$A_{VOL}$	$V_{SS} + 0.5\text{ V} \leq V_{OUT} \leq V_{DD} - 0.5\text{ V}$ , $V_{CMR} = \frac{V_{DD}}{2}$ , $R_L = 10\text{ k}\Omega$	106	120	–	$\text{dB}$	8
Maximum output swing voltage	$V_{OH}$	$I_{SOURCE} = 100\ \mu\text{A}$	29.9	–	–	$\text{V}$	3
		$I_{SOURCE} = 1\text{ mA}$	29.7	–	–	$\text{V}$	3
	$V_{OL}$	$I_{SINK} = 100\ \mu\text{A}$	–	–	0.1	$\text{V}$	4
		$I_{SINK} = 1\text{ mA}$	–	–	0.3	$\text{V}$	4
Common-mode input signal rejection ratio	$CMRR$	$V_{SS} \leq V_{CMR} \leq V_{DD}$	106	120	–	$\text{dB}$	2
Power supply voltage rejection ratio	$PSRR$	$4.0\text{ V} \leq V_{DD} \leq 36.0\text{ V}$	116	130	–	$\text{dB}$	1
Source current	$I_{SOURCE}$	$V_{OUT} = V_{DD} - 0.1\text{ V}$	0.40	0.60	–	$\text{mA}$	6
Sink current	$I_{SINK}$	$V_{OUT} = 0.1\text{ V}$	0.25	0.50	–	$\text{mA}$	7
Output pin short-circuit current (source)	$I_{SHORT\_SOURCE}$	$V_{OUT} = 0\text{ V}$	–	16.0	–	$\text{mA}$	–
Output pin short-circuit current (sink)	$I_{SHORT\_SINK}$	$V_{OUT} = V_{DD}$	–	15.0	–	$\text{mA}$	–



Table 10

AC Electrical Characteristics (Ta = -40°C to +125°C unless otherwise specified)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Slew rate	SR	R <sub>L</sub> = 1.0 MΩ, C <sub>L</sub> = 15 pF (Refer to <b>Figure 13</b> and <b>Figure 14</b> ), V <sub>IN(+)</sub> = 14.0 V ↔ 16.0 V	–	0.45	–	V/μs
Gain-bandwidth product	GBP	C <sub>L</sub> = 0 pF	–	1.2	–	MHz
Maximum load capacitance	C <sub>L</sub>	–	–	470	–	pF
Input noise voltage	V <sub>NOISE_pp</sub>	f = 0.1 Hz to 10 Hz	–	0.8	–	μVpp
Input noise voltage density	V <sub>NOISE</sub>	f = 1 kHz	–	25	–	nV/√Hz

■ Test Circuits (Per circuit)

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

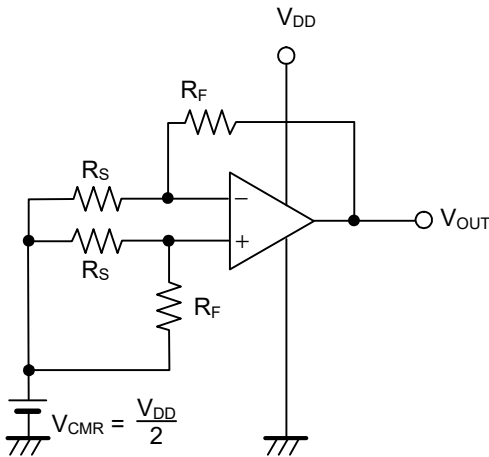


Figure 3 Test Circuit 1

• Power supply voltage rejection ratio (PSRR)

The power supply voltage rejection ratio (PSRR) can be calculated by the following expression, with  $V_{OUT}$  measured at each  $V_{DD}$ .

Test conditions:

$$V_{DD} = 4.0 \text{ V}: V_{DD} = V_{DD1}, V_{OUT} = V_{OUT1}$$

$$V_{DD} = 36.0 \text{ V}: V_{DD} = V_{DD2}, V_{OUT} = V_{OUT2}$$

$$PSRR = 20 \log \left( \left| \frac{V_{DD1} - V_{DD2}}{\left( V_{OUT1} - \frac{V_{DD1}}{2} \right) - \left( V_{OUT2} - \frac{V_{DD2}}{2} \right)} \right| \times \frac{R_F + R_S}{R_S} \right)$$

• Input offset voltage ( $V_{IO}$ )

$$V_{IO} = \left( V_{OUT} - \frac{V_{DD}}{2} \right) \times \frac{R_S}{R_F + R_S}$$

• Input offset voltage drift  $\left( \frac{\Delta V_{IO}}{\Delta T_a} \right)$

The input offset voltage drift  $\left( \frac{\Delta V_{IO}}{\Delta T_a} \right)$  can be calculated by the following expression, with  $V_{OUT}$  measured at each temperature.

Test conditions:

$$T_a = -40^\circ\text{C}: V_{IO} = V_{IO1}$$

$$T_a = +125^\circ\text{C}: V_{IO} = V_{IO2}$$

$$\frac{\Delta V_{IO}}{\Delta T_a} = \frac{V_{IO2} - V_{IO1}}{+125^\circ\text{C} - (-40^\circ\text{C})}$$

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

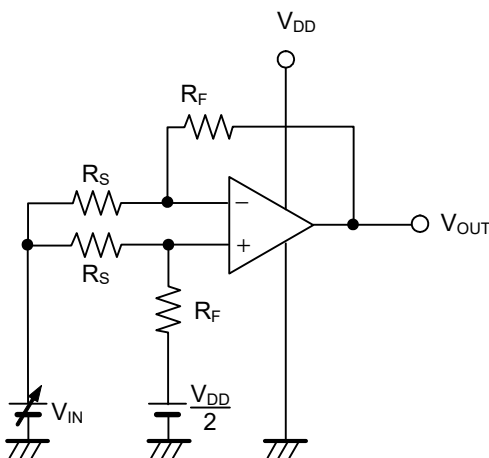


Figure 4 Test Circuit 2

• Common-mode input signal rejection ratio (CMRR)

The common-mode input signal rejection ratio (CMRR) can be calculated by the following expression, with  $V_{OUT}$  measured at each  $V_{IN}$ .

Test conditions:

$$V_{IN} = V_{CMR \text{ Max.}}: V_{IN} = V_{IN1}, V_{OUT} = V_{OUT1}$$

$$V_{IN} = V_{CMR \text{ Min.}}: V_{IN} = V_{IN2}, V_{OUT} = V_{OUT2}$$

$$CMRR = 20 \log \left( \left| \frac{V_{IN1} - V_{IN2}}{V_{OUT1} - V_{OUT2}} \right| \times \frac{R_F + R_S}{R_S} \right)$$

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

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

**3. Maximum output swing voltage**

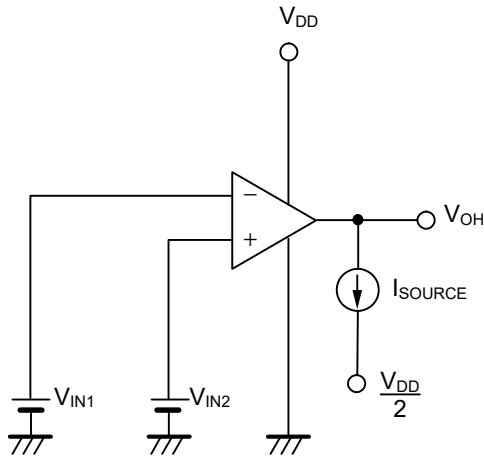


Figure 5 Test Circuit 3

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

Test conditions:

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

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

$$I_{SOURCE} = 100 \mu\text{A}, 1 \text{ mA}$$

**4. Maximum output swing voltage**

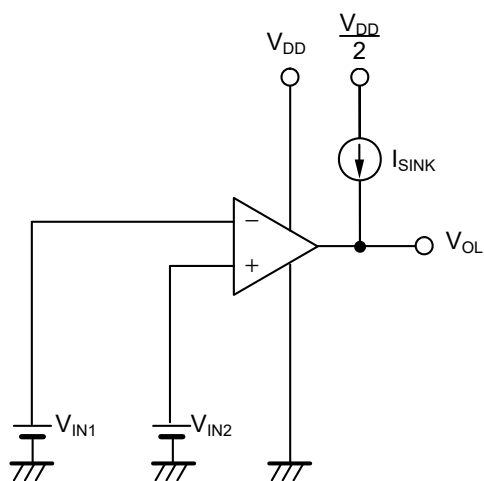


Figure 6 Test Circuit 4

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

Test conditions:

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

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

$$I_{SINK} = 100 \mu\text{A}, 1 \text{ mA}$$

**5. Current consumption**

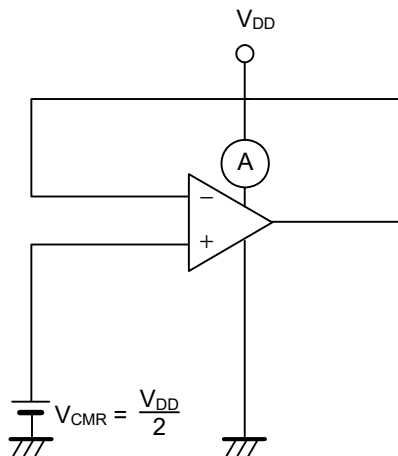


Figure 7 Test Circuit 5

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

6. Source current

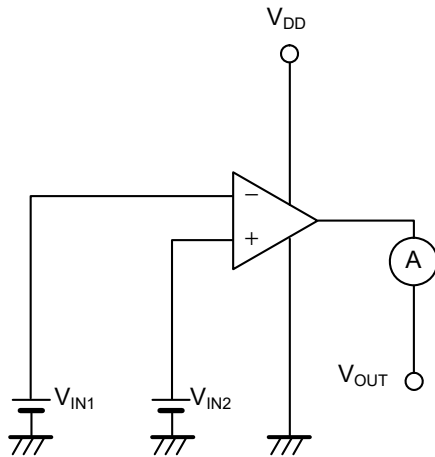


Figure 8 Test Circuit 6

• Source current ( $I_{SOURCE}$ )

Test conditions:

$$V_{OUT} = V_{DD} - 0.1 \text{ V}$$

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

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

7. Sink current

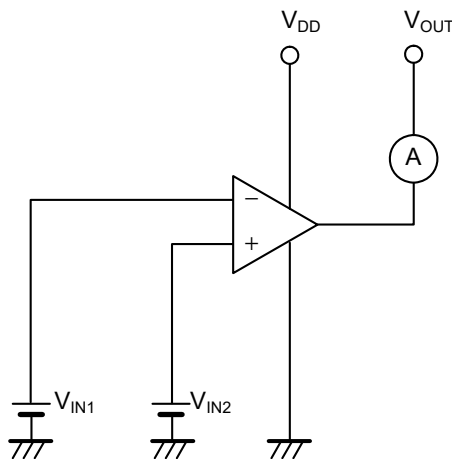


Figure 9 Test Circuit 7

• Sink current ( $I_{SINK}$ )

Test conditions:

$$V_{OUT} = 0.1 \text{ V}$$

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

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

8. Voltage gain

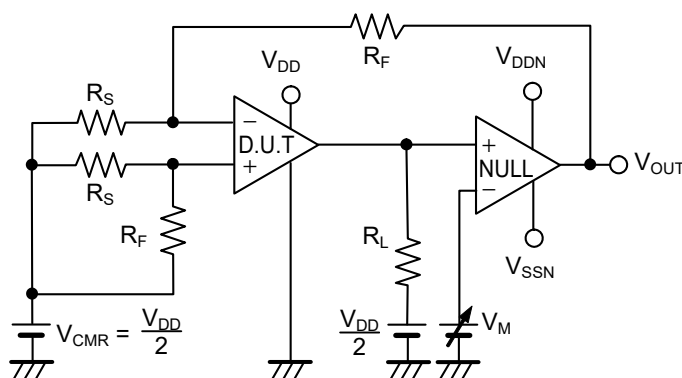


Figure 10 Test Circuit 8

• Voltage gain (open loop) ( $A_{VOL}$ )

The voltage gain ( $A_{VOL}$ ) can be calculated by the following expression, with  $V_{OUT}$  measured at each  $V_M$ .

Test conditions:

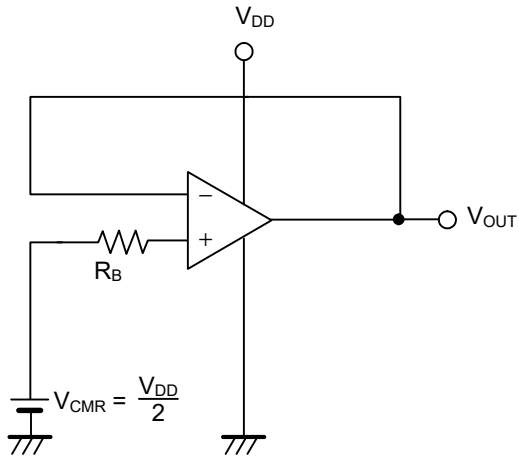
$$V_M = V_{DD} - 0.5 \text{ V}: V_M = V_{M1}, V_{OUT} = V_{OUT1}$$

$$V_M = V_{SS} + 0.5 \text{ V}: V_M = V_{M2}, V_{OUT} = V_{OUT2}$$

$$A_{VOL} = 20 \log \left( \left| \frac{V_{M1} - V_{M2}}{V_{OUT1} - V_{OUT2}} \right| \times \frac{R_F + R_S}{R_S} \right)$$

$$R_L = 10 \text{ k}\Omega$$

**9. Input bias current, input offset current**



**Figure 11 Test Circuit 9**

• **Input bias current ( $I_{BIAS}$ )**

Test conditions:

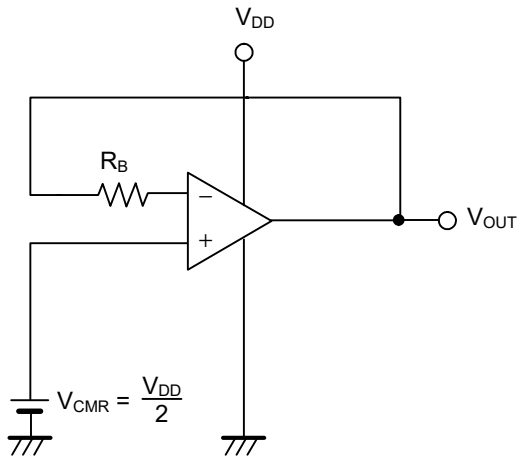
$$I_{BIAS(+)} = \frac{-1 \times (V_{OUT} - \frac{V_{DD}}{2})}{R_B}$$

$$I_{BIAS(-)} = \frac{V_{OUT} - \frac{V_{DD}}{2}}{R_B}$$

$$I_{BIAS} = \frac{|I_{BIAS(+)} + I_{BIAS(-)}|}{2}$$

• **Input offset current ( $I_{IO}$ )**

$$I_{IO} = |I_{BIAS(-)} - I_{BIAS(+)}|$$



**Figure 12 Test Circuit 10**

10. Slew rate

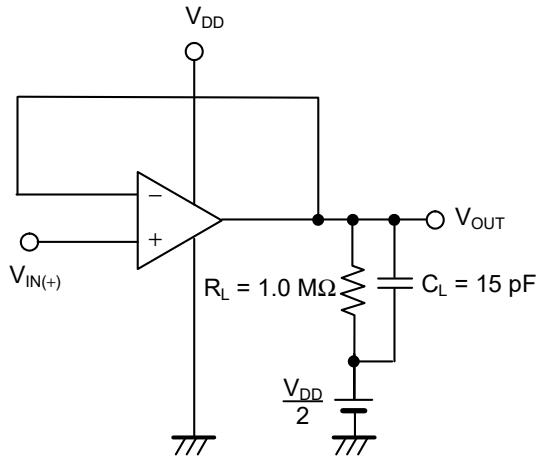


Figure 13 Test Circuit 11

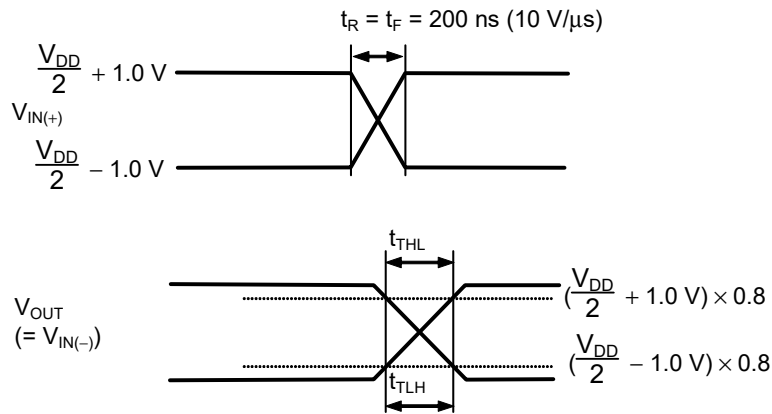


Figure 14

• Slew rate (SR)

When falling  

$$SR = \frac{1.6 \text{ V}}{t_{THL}}$$

When rising  

$$SR = \frac{1.6 \text{ V}}{t_{TLH}}$$

■ Precautions

- Generally an operational amplifier may cause oscillation depending on the selection of external parts. Perform thorough evaluation using the actual application to set the constants.
- 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.
- This IC operates stably even directly connecting a load capacitance of 470 pF or less to the output pin, as shown in **Figure 15**. When connecting a load capacitance of 470 pF or more, connect a resistor of 100 Ω or more as shown in **Figure 16**. In case of connecting a filter for noise prevention, and connecting a load capacitance of 470 pF or more, also connect a resistor of 100 Ω or more as shown in **Figure 17**.

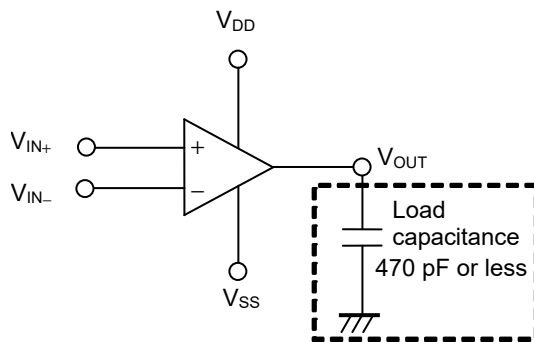


Figure 15

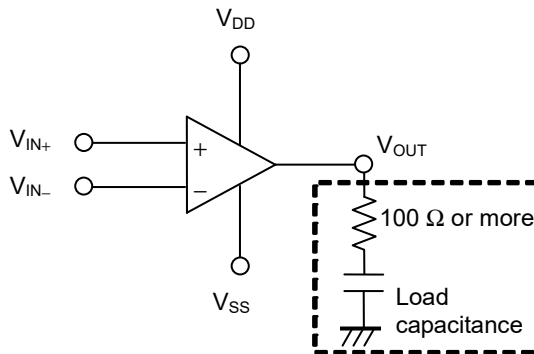


Figure 16

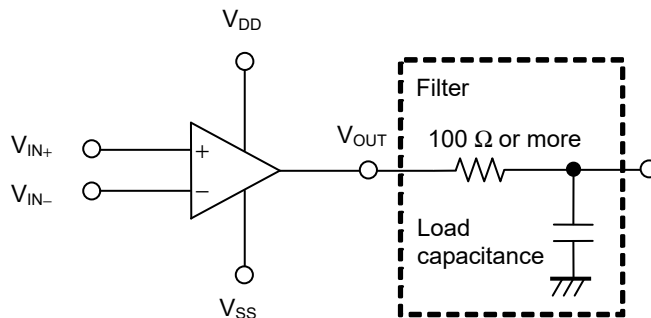


Figure 17

**Caution** The above connection diagrams and constants will not guarantee successful operation. Perform thorough evaluation using the actual application to set the constants.

■ Precaution for use

1. Methods for protection against application of overvoltage to input pin

ESD protection elements are connected to the input pins as shown in **Figure 1**. If the input voltage ( $V_{IN}$ ) exceeds the  $V_{IN}$  absolute maximum rating  $V_{DD} + 0.3$  V, there is a risk of the input pin current which flows through the ESD protection element exceeding  $\pm 10.0$  mA (the absolute maximum rating). In this case, connect a current limiting resistor ( $R_{LIMIT}$ ) to the input pin as shown in **Figure 18** to limit the input pin current to less than  $\pm 10.0$  mA. However, error voltage and noise generate as a result of input bias current and input offset current. Select the lowest possible resistance when connecting the  $R_{LIMIT}$ .

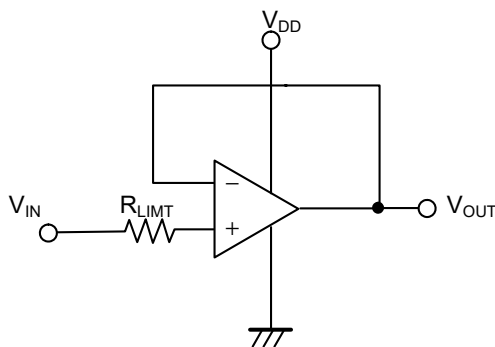


Figure 18

2. Input voltage range (input crossover distortion)

This IC has two sets of differential circuits in order to achieve the Rail-to-Rail input voltage range. The differential circuits used switch based on the common-mode input voltage range ( $V_{CMR}$ ). Differences in the characteristics of the two sets of differential circuits result in the generation of distortion of the output voltage which is referred to as "input crossover distortion" when the differential circuits switch.

The differential circuit switching voltage of this IC is approximately between  $V_{DD} - 2.2$  V and  $V_{DD} - 1.2$  V. When using this IC in applications which require high-accuracy measurement, avoid the range near the differential circuit switching voltage in order to avoid changes in input offset voltage caused by input crossover distortion and changes in input offset voltage drift.

This IC is a chopper-stabilized zero-drift amplifier; therefore, it always cancels input offset voltage. For this reason, the input crossover distortion is kept extremely small when compared to standard operational amplifiers. However, please contact our sales representatives when using this IC near the differential circuit switching voltage.

Refer to "8. Input offset voltage ( $V_{IO}$ ) vs. Common-mode input voltage range ( $V_{CMR}$ )" in "■ Characteristics (Typical Data)".

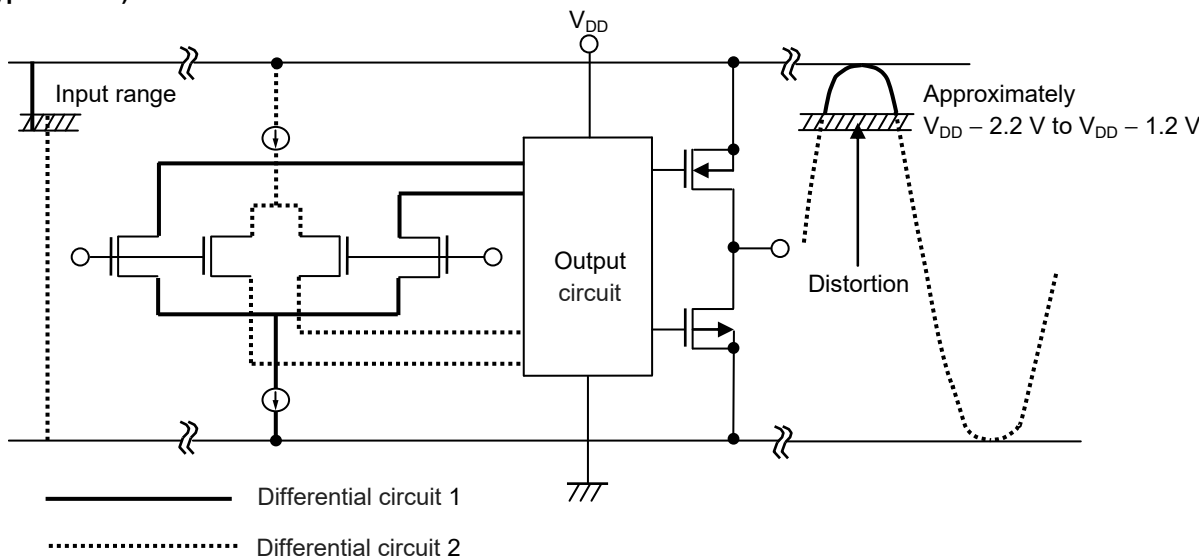
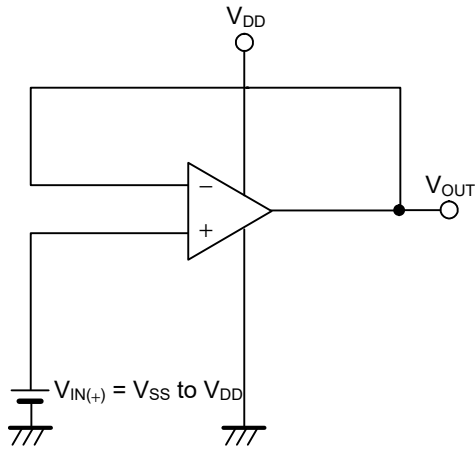


Figure 19



### 3. Recommended processing methods for unused circuit

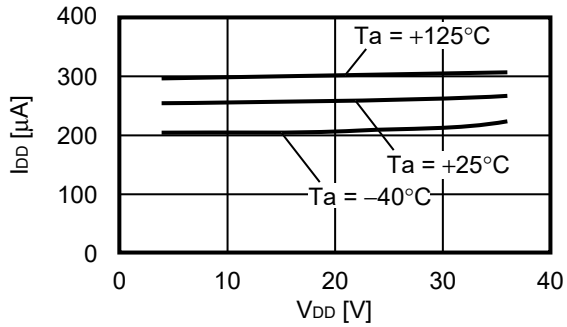
When using only a single circuit of this IC, it is recommended that the unused circuit be connected as shown in **Figure 20**. Set the non-inverted input pin voltage ( $V_{IN(+)}$ ) within the common-mode input voltage range ( $V_{CMR}$ ).



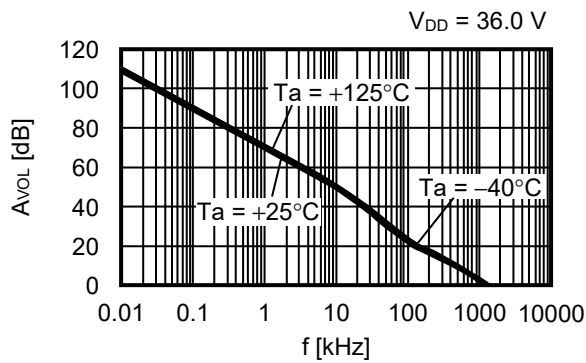
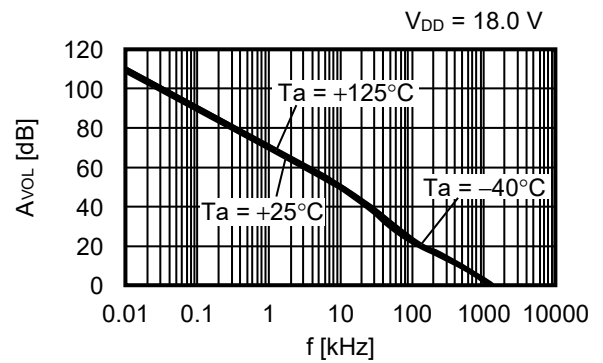
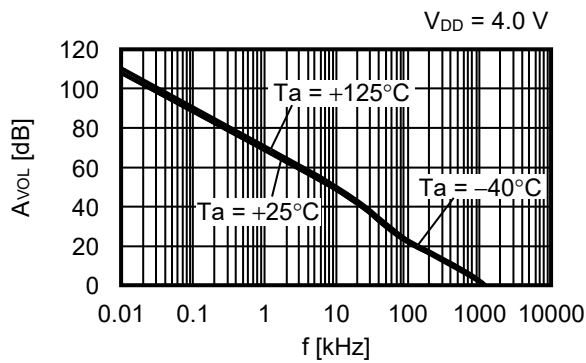
**Figure 20**

■ **Characteristics (Typical Data)**

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

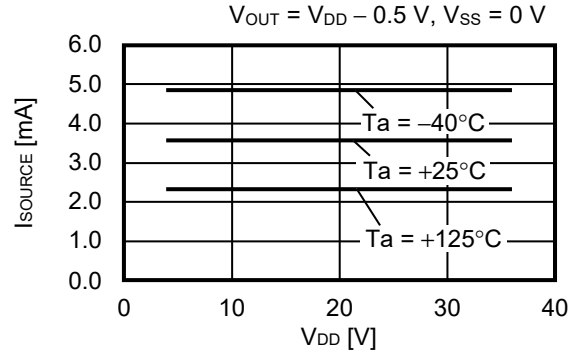
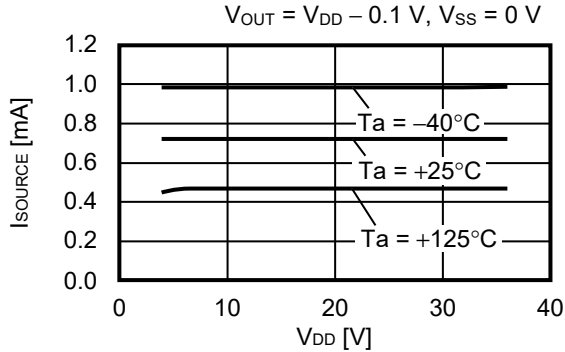


2. **Voltage gain ( $A_{VOL}$ ) vs. Frequency (f)**

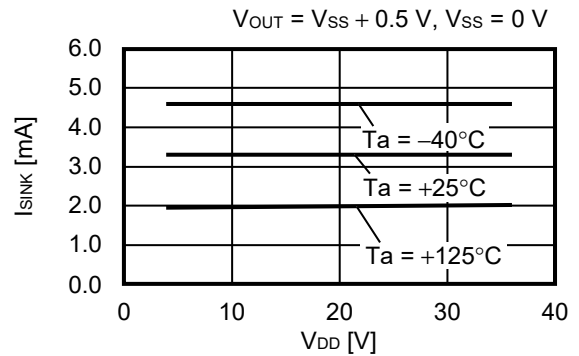
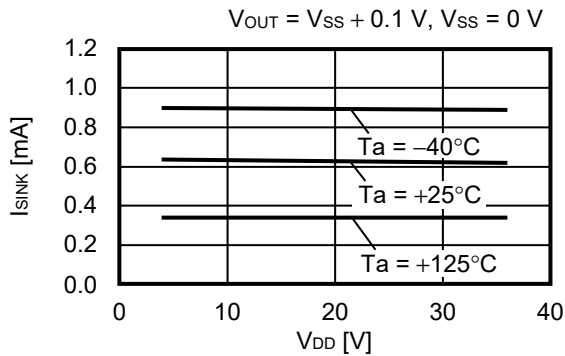


3. Output current

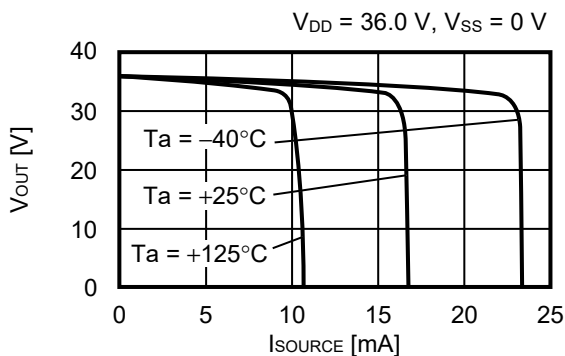
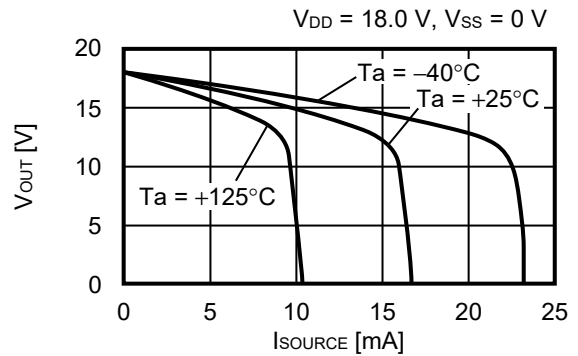
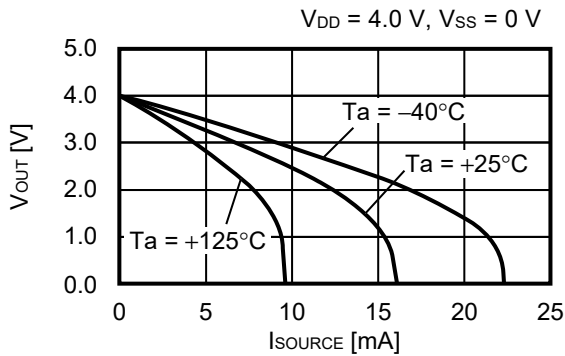
3.1 Source current ( $I_{SOURCE}$ ) vs. Power supply voltage ( $V_{DD}$ )



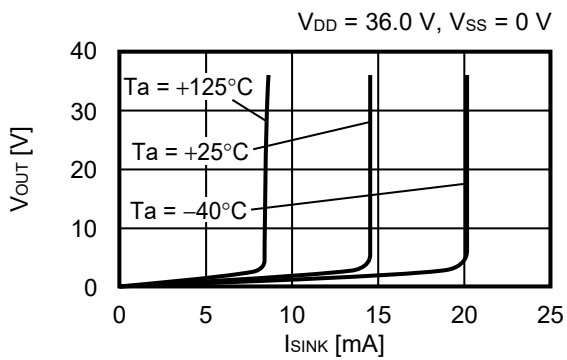
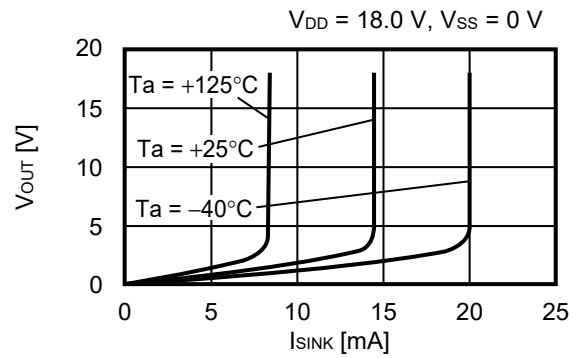
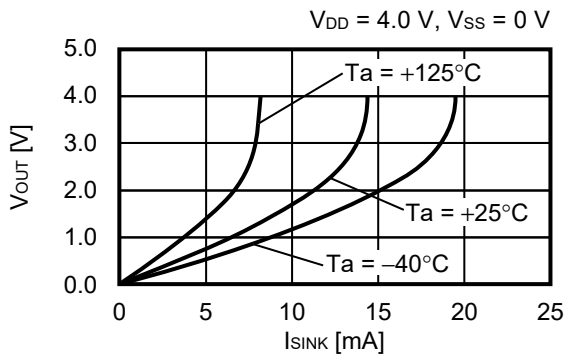
3.2 Sink current ( $I_{SINK}$ ) vs. Power supply voltage ( $V_{DD}$ )



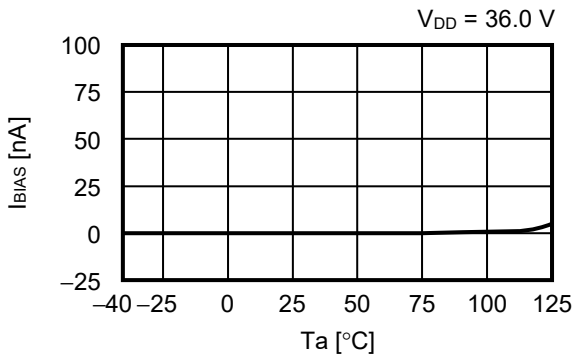
3.3 Output voltage ( $V_{OUT}$ ) vs. Source current ( $I_{SOURCE}$ )



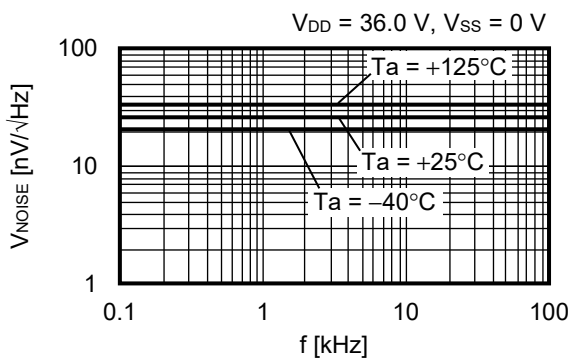
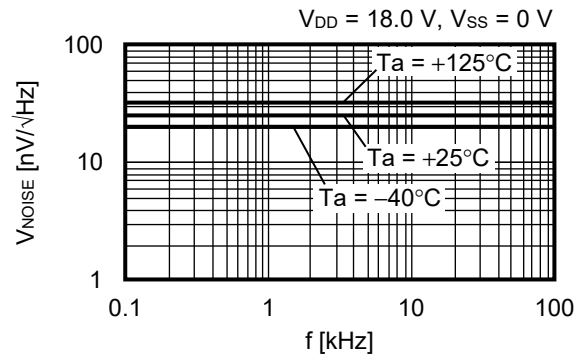
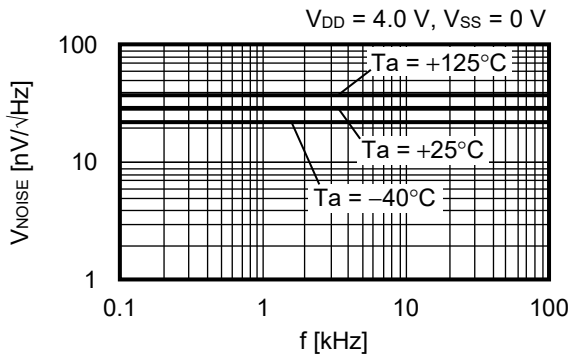
**3. 4 Output voltage ( $V_{OUT}$ ) vs. Sink current ( $I_{SINK}$ )**



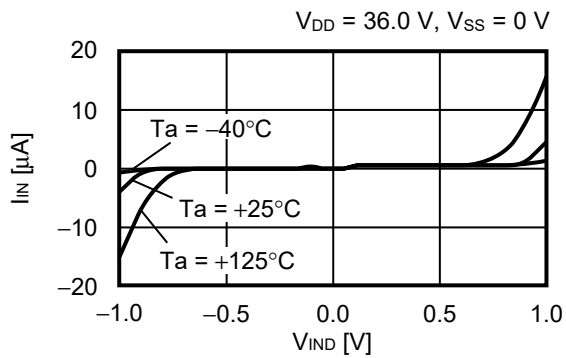
**4. Input bias current ( $I_{BIAS}$ ) vs. Temperature ( $T_a$ )**



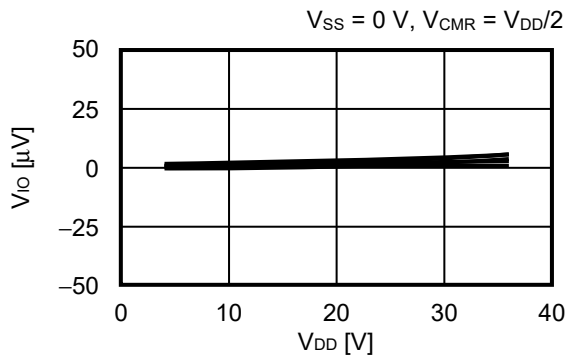
**5. Input noise voltage density ( $V_{NOISE}$ ) vs. Frequency (f)**



**6. Input pin current ( $I_{IN}$ ) vs. Differential input voltage ( $V_{IND}$ )**

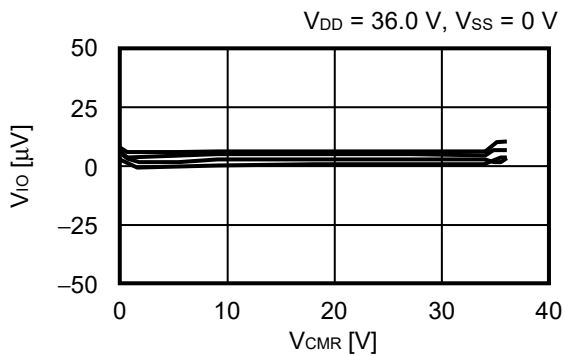
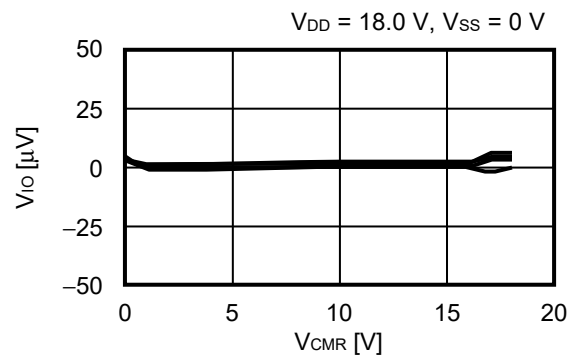
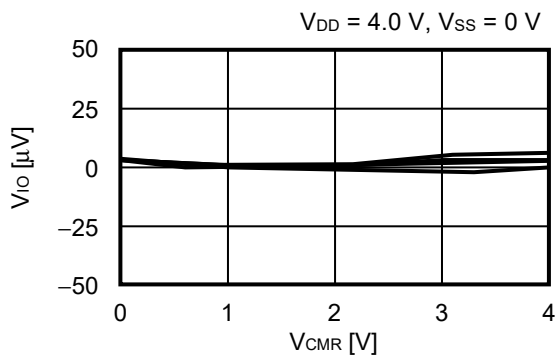


**7. Input offset voltage ( $V_{IO}$ ) vs. Power supply voltage ( $V_{DD}$ )**



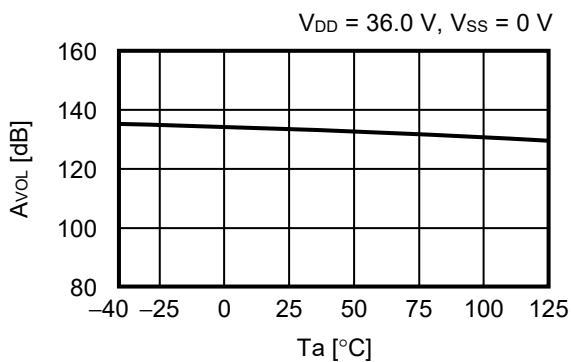
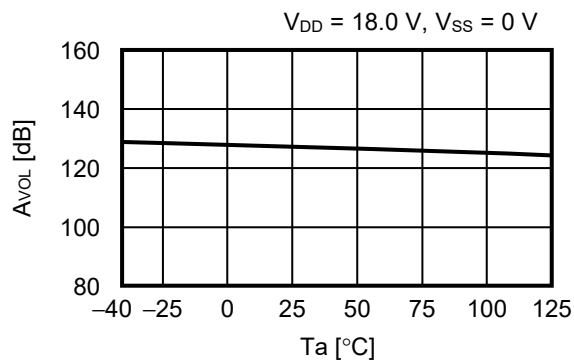
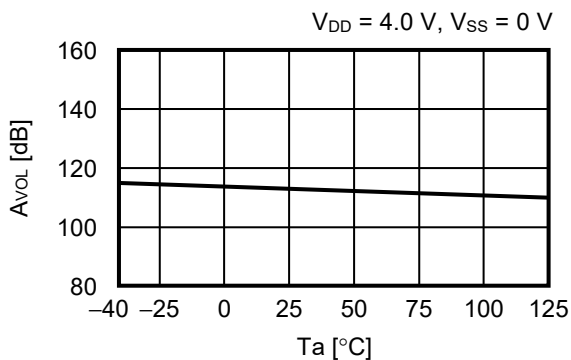
**Remark** Measured six samples

**8. Input offset voltage ( $V_{IO}$ ) vs. Common-mode input voltage range ( $V_{CMR}$ )**

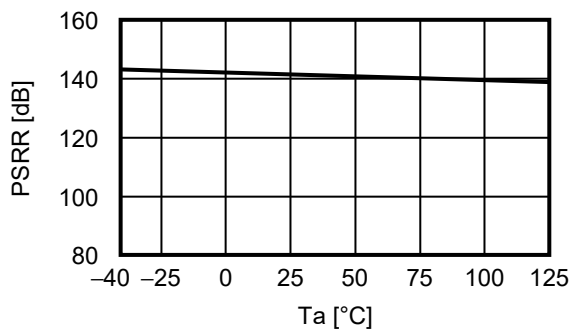


**Remark** Measured four samples

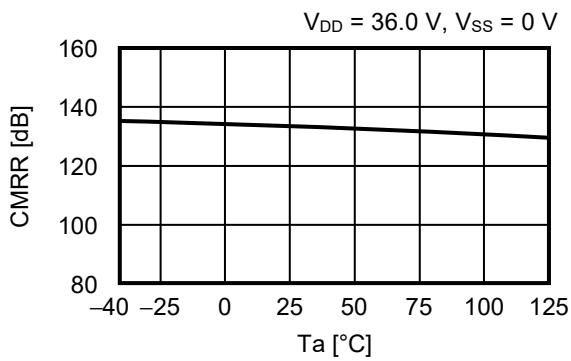
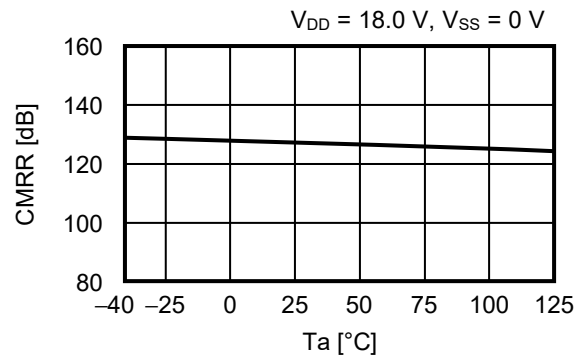
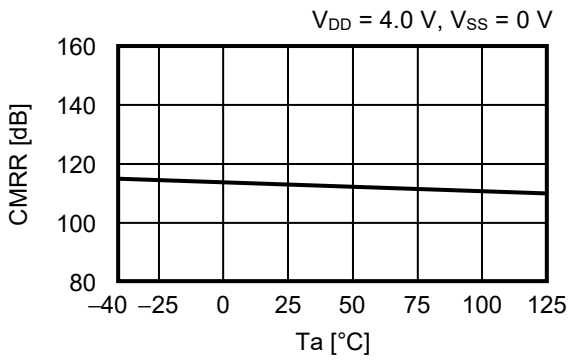
**9. Voltage gain (open loop) ( $A_{VOL}$ ) vs. Temperature ( $T_a$ )**



**10. Power supply voltage rejection ratio (PSRR) vs. Temperature ( $T_a$ )**



11. Common-mode input signal rejection ratio (CMRR) vs. Temperature (Ta)

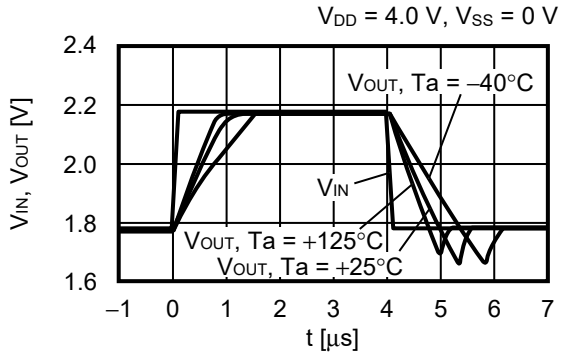




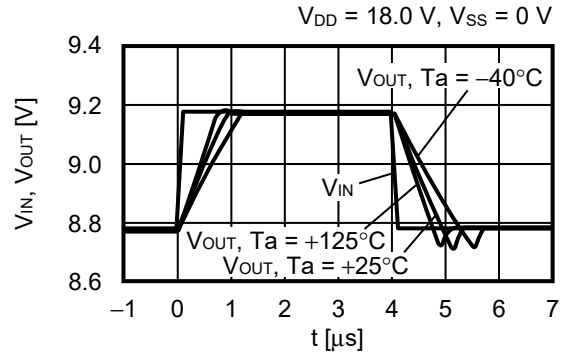
**12. Step response (Slew rate)**

**12.1 Input signal width (0.4 V)**

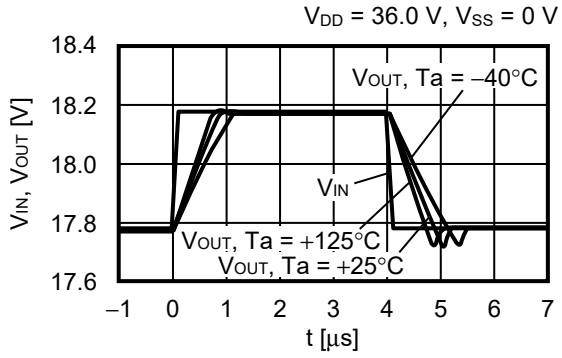
**12.1.1  $V_{IN(+)} = 1.8\text{ V} \leftrightarrow 2.2\text{ V}$**



**12.1.2  $V_{IN(+)} = 8.8\text{ V} \leftrightarrow 9.2\text{ V}$**

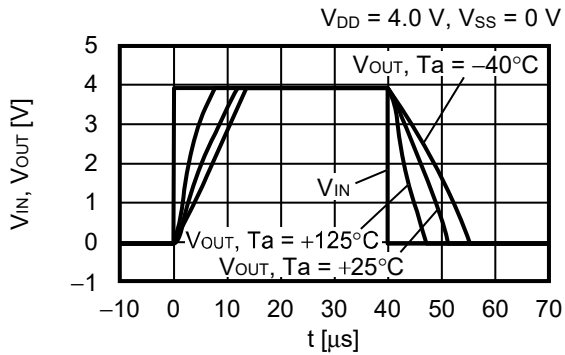


**12.1.3  $V_{IN(+)} = 17.8\text{ V} \leftrightarrow 18.2\text{ V}$**

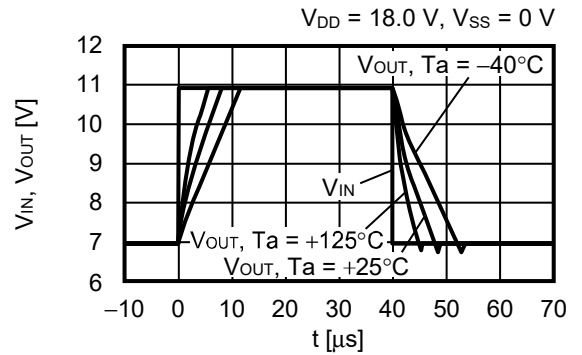


12.2 Input signal width (4.0 V)

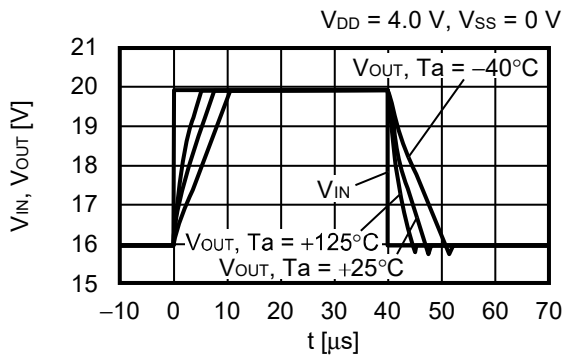
12.2.1  $V_{IN(+)} = 0\text{ V} \leftrightarrow 4.0\text{ V}$



12.2.2  $V_{IN(+)} = 7.0\text{ V} \leftrightarrow 11.0\text{ V}$

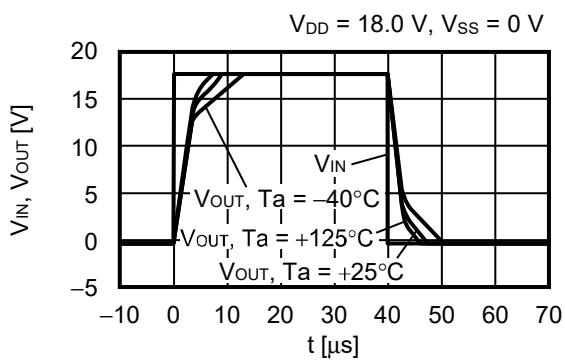


12.2.3  $V_{IN(+)} = 16.0\text{ V} \leftrightarrow 20.0\text{ V}$

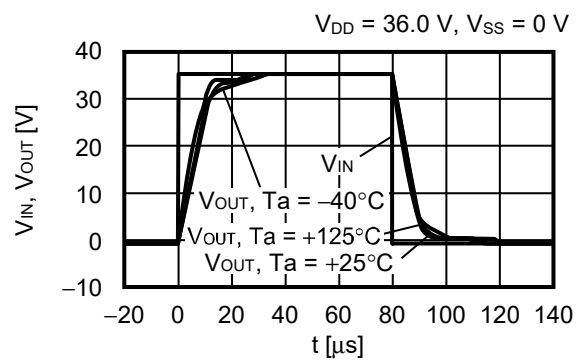


12.3 Input signal width ( $V_{SS} \leftrightarrow V_{DD}$ )

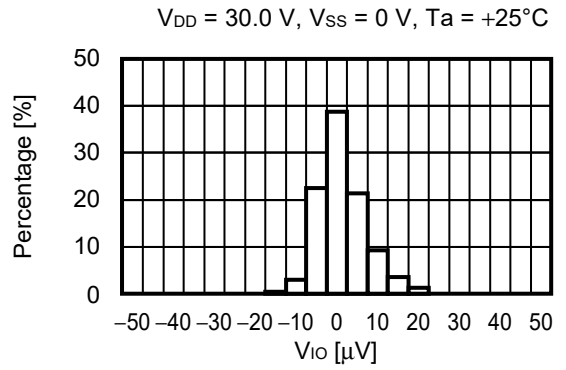
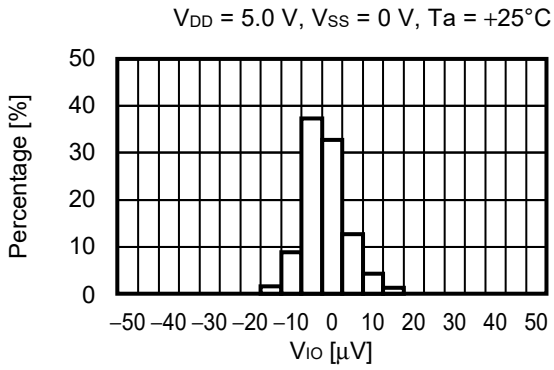
12.3.1  $V_{IN(+)} = 0\text{ V} \leftrightarrow 18.0\text{ V}$



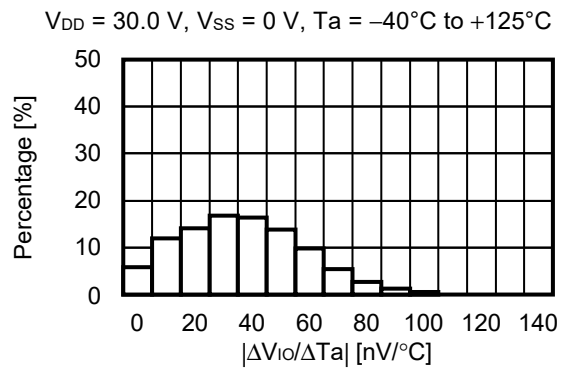
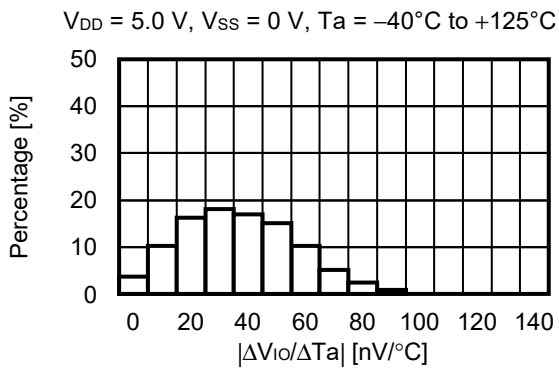
12.3.2  $V_{IN(+)} = 0\text{ V} \leftrightarrow 36.0\text{ V}$



**13. Input offset voltage distribution**

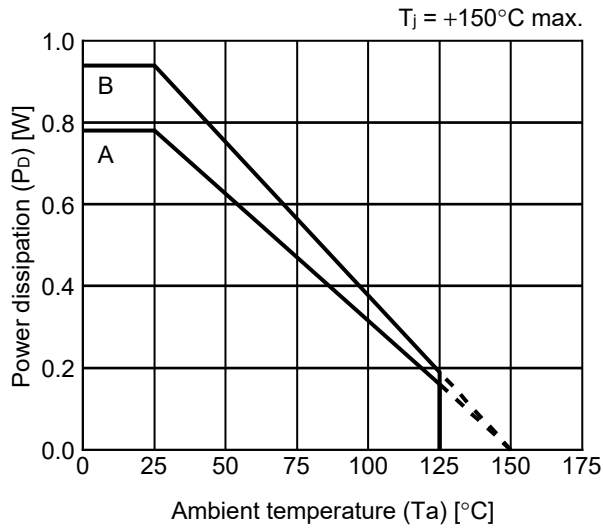


**14. Input offset voltage drift distribution**

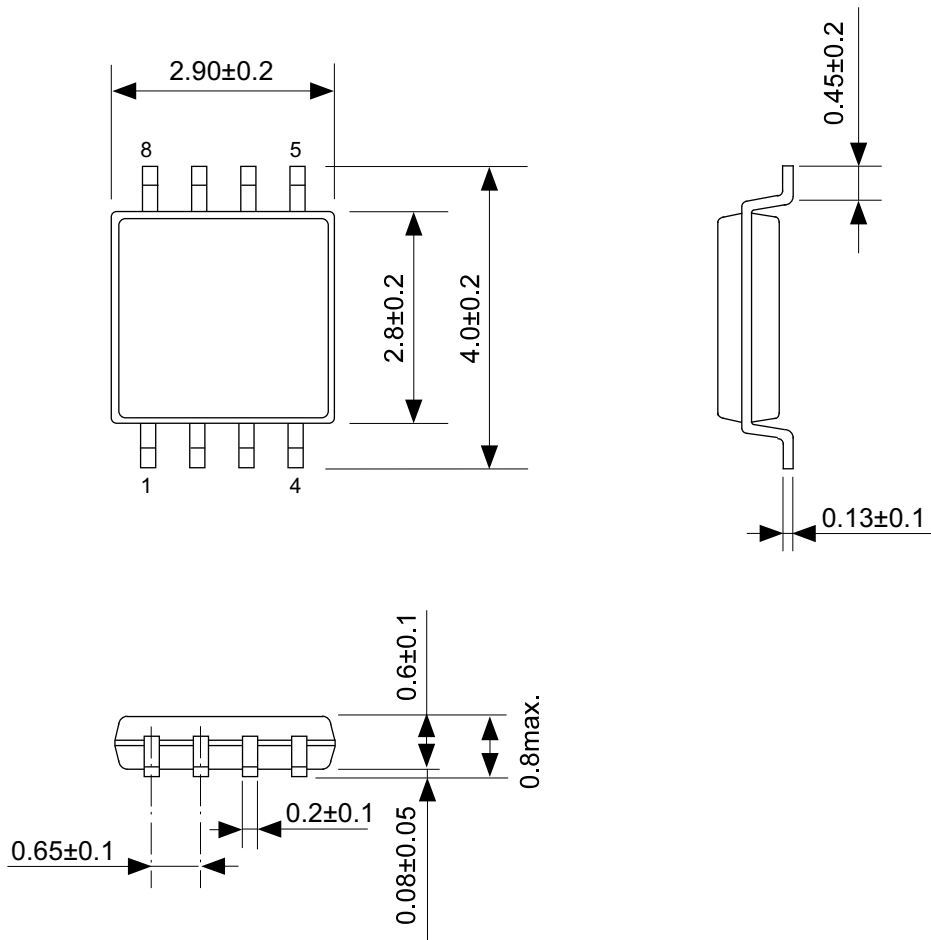


■ **Power Dissipation**

**TMSOP-8**

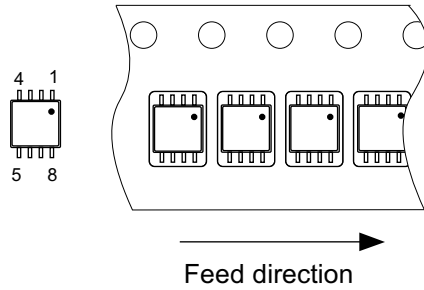
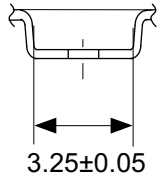
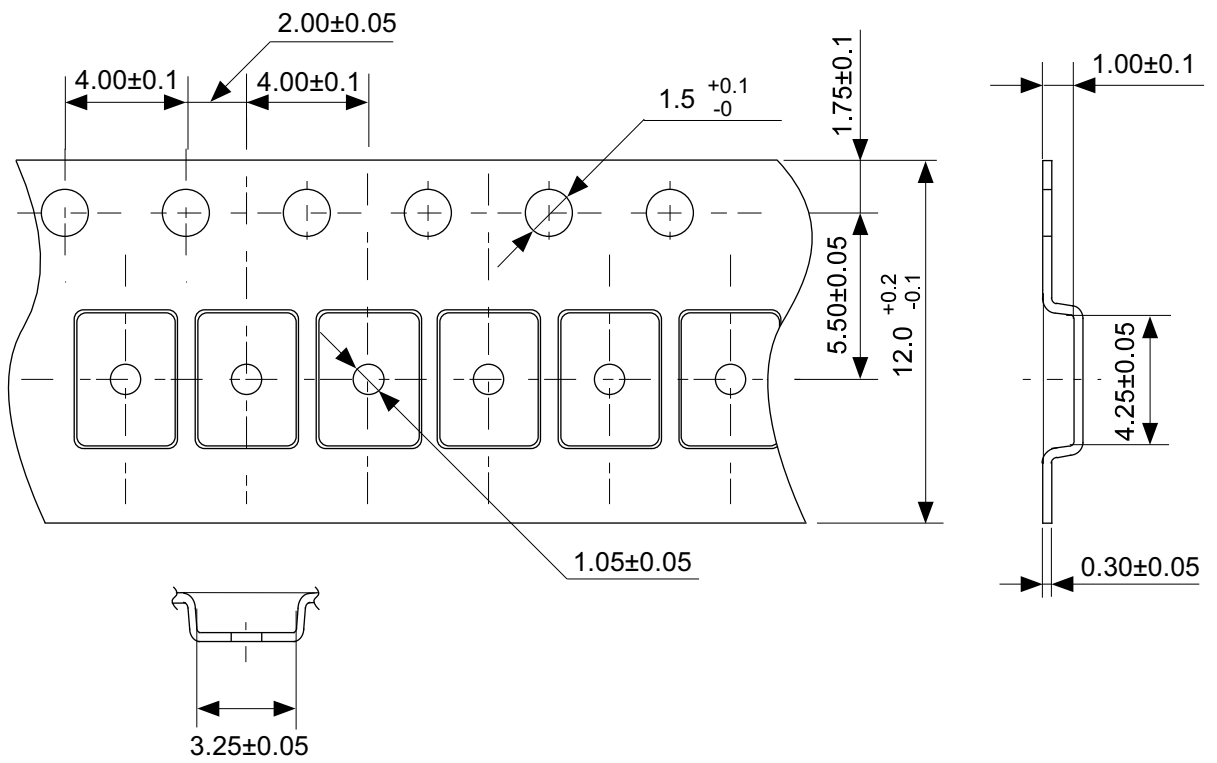


Board	Power Dissipation ( $P_D$ )
A	0.78 W
B	0.94 W
C	—
D	—
E	—



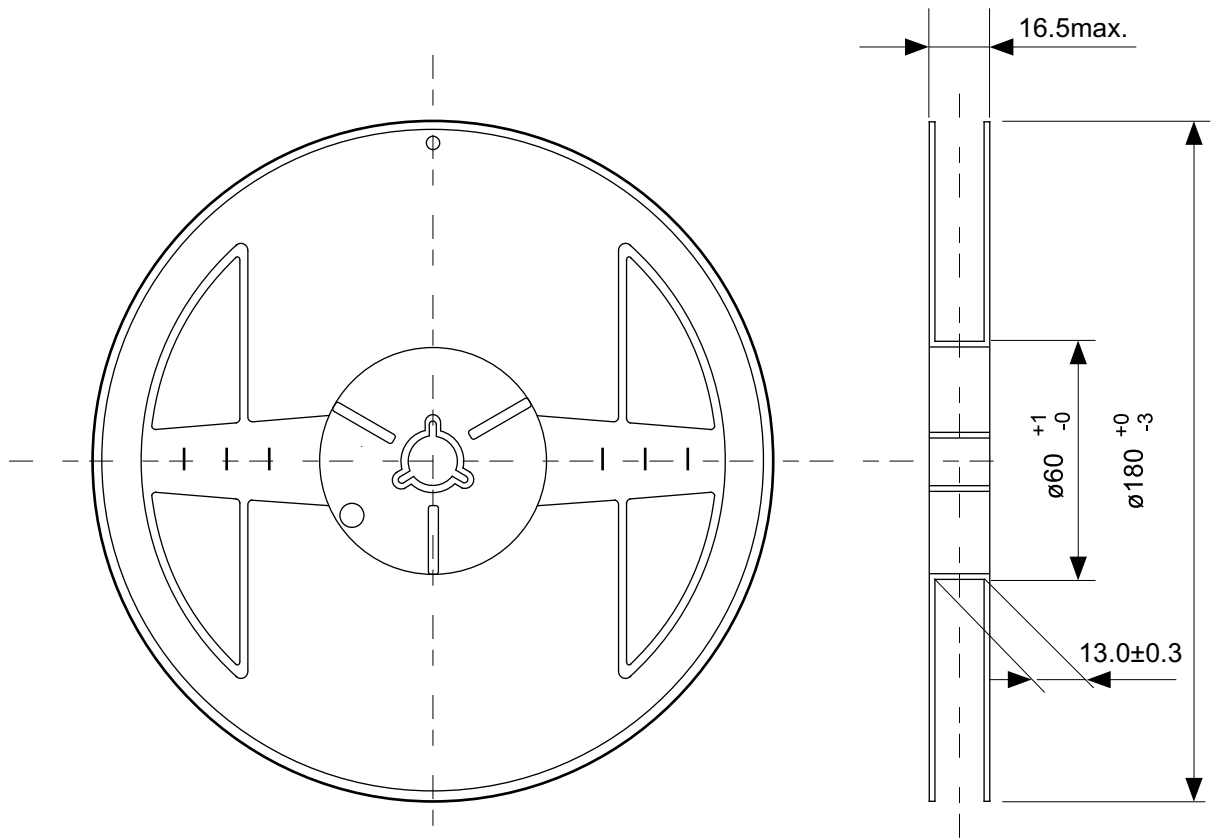
No. FM008-A-P-SD-1.2

TITLE	TMSOP8-A-PKG Dimensions
No.	FM008-A-P-SD-1.2
ANGLE	
UNIT	mm
<b>ABLIC Inc.</b>	

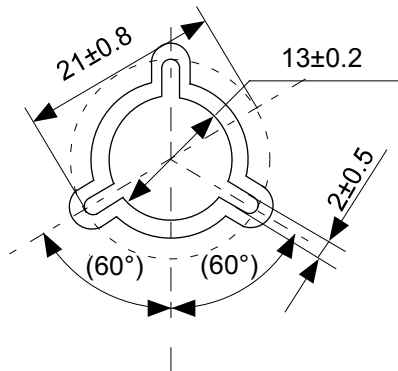


No. FM008-A-C-SD-2.0

TITLE	TMSOP8-A-Carrier Tape
No.	FM008-A-C-SD-2.0
ANGLE	
UNIT	mm
<b>ABLIC Inc.</b>	



Enlarged drawing in the central part



No. FM008-A-R-SD-1.0

TITLE	TMSOP8-A-Reel		
No.	FM008-A-R-SD-1.0		
ANGLE		QTY.	4,000
UNIT	mm		
<b>ABLIC Inc.</b>			

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2.4-2019.07