

**AK2975****Precision High Speed Low Noise Operational Amplifier**

### 1. General Description

AK2975 is the dual channel Precision CMOS operational amplifiers which is available to output with low Input Offset Voltage ( $\pm 200\mu\text{V}$  typ.) , High Band Width and Low Noise.  
AK2975 is appropriated to Sensor Pre Amp. Applications.

### 2. Features

AK2975 is the dual channel Precision CMOS operational amplifiers which is available to output with low Input Offset Voltage ( $\pm 200\mu\text{V}$  typ.) , High Band Width and Low Noise.  
AK2975 is appropriated to Sensor Pre Amp. Applications.

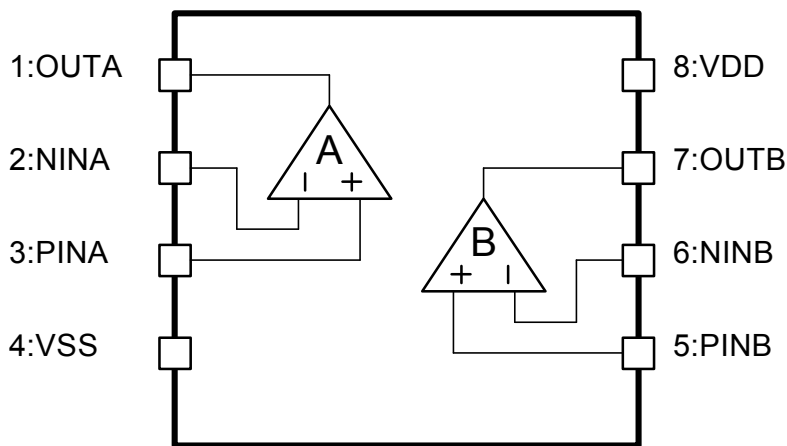
- Single Supply Operation Range : 2.7V ~ 5.5V
- Low Input Offset Voltage :  $\pm 200\mu\text{V}$  typ.
- Offset Drift :  $\pm 1\mu\text{V}/^\circ\text{C}$  typ.
- Input Voltage Noise :  $10\text{nVrms}/\sqrt{\text{Hz}}$  Typ. (@ 1kHz)
- Input Common Mode Range : VSS to VDD
- Output Voltage Range :  $[\text{VSS}+0.03]$  to  $[\text{VDD}-0.03]\text{V}$  @ (RL:10k $\Omega$ )
- Power Supply Current : 4mA/ch. typ. (VDD: 5V, No Load)
- Gain Bandwidth : 50MHz typ.
- Slew Rate : 20V/ $\mu\text{sec}$  typ.
- Operating Temperature Range :  $-40 \sim 125^\circ\text{C}$
- Package : MSOP8

Part Name	Channel Number	Package
AK2975H	2	MSOP8

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**4. Pin Location**



8-pin MSOP  
(AK2975H)

Figure 4.1 AK2975 Pin Location

### 5. Pin Function Descriptions

Pin number	Name	I/O (* 1)	Function
1	OUTA	AO	Amplifier A Output
2	NINA	AI	Amplifier A Inverted Input
3	PINA	AI	Amplifier A No Inverted Input
4	VSS	PWR	Power Supply Ground
5	PINB	AI	Amplifier B No Inverted Input
6	NINB	AI	Amplifier B Inverted Input
7	OUTB	AO	Amplifier B Output
8	VDD	PWR	Positive Power Supply

Note

- \* 1. PWR : Power Supply
- AI : Analog Input
- AO : Analog Output

### 6. Absolute Maximum Ratings

VSS=0V (\* 2)

Parameter	Symbol	Min	Max	Units
Supply Voltage	VDD	-0.3	6.5	V
Input Voltage	$V_{TD}$	-0.3	VDD + 0.3	V
Input Current	$I_{IN}$	-10	+10	mA
Storage Temperature Range	$T_{stg}$	-65	150	°C

Note

- \* 2. All voltage with respect to ground

[WARNING] Operational at or beyond these limits may result in permanent damage to the device.  
Normal operation is not guaranteed at these extremes.

### 7. Recommended Operating Conditions

VSS=0V (\* 2)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Operating Temperature Range	$T_a$	-40		125	°C	
Ground level (* 2)	VSS	0	0	0	V	
Supply Voltage	VDD	2.7		5.5	V	

[WARNING] We assume no responsibility for the usage beyond the conditions in this datasheet.

## 8. Electrical Characteristics

□ DC Characteristics ( typical condition is VDD= 5V, VCM= VDD/2 (\* 3), Ta= 25°C )

VDD= 5.0V, VCM= VDD/2, VSS= 0V, Ta= -40~125°C, unless otherwise noted

Parameter	Min.	Typ.	Max.	Units	Conditions
Input Voltage Offset :V <sub>IO</sub>		± 200	±1000	μV	V <sub>CM</sub> = VDD/2 (* 3)
Input Voltage Offset Drift :V <sub>IOD</sub>		± 1	±3.5	μV/°C	(* 4)
Input Bias Current :I <sub>S</sub>		± 1	± 200	pA	
Input Common Mode Range :V <sub>ICM</sub>	VSS		VDD	V	
Output Voltage Swing :V <sub>OM</sub>	0.03		VDD-0.03	V	R <sub>L</sub> ≥10kΩ
Common Mode Rejection Ratio:CMR	60	90		dB	(* 5)
Power Supply Rejection Ratio :SVR	80	100		dB	(* 6)
Large Signal Voltage Gain :A <sub>v</sub>	95	115		dB	R <sub>L</sub> ≥10kΩ connected to VDD/2 (* 7)
Output Short Current :I <sub>OS</sub>		± 450		mA	
Output Current :I <sub>O</sub>		± 350		mA	
Power Supply Current :I <sub>DD</sub>		4	5	mA/ch.	VDD:5V (* 8)

### Notes

- \* 3. V<sub>CM</sub> means the common voltage of an input pin (PIN/NIN).
- \* 4.  $V_{IOD} = [(\text{high temperature side WST}(**)) - (\text{low temperature side WST}(**))]/[125^{\circ}\text{C} - (-40^{\circ}\text{C})]$   
\*\* WST is MIN. or MAX. value of V<sub>IO</sub>.  
ex.) If high temperature side is MAX. and low temperature side is MIN. the V<sub>IOD</sub> polarity is positive. And if high temperature side is MIN. and low temperature side is MAX. the V<sub>IOD</sub> polarity is negative.
- \* 5.  $CMRR = 20 \times \text{Log}[(VDD-VSS) / (\alpha)]$   
(α) is a Max. value among [(Offset at input = VDD)-(Offset at Input = VSS)] and [(Offset at input = VDD)-( Offset at input = VDD/2)] and [(Offset at input = VDD/2)-( Offset at input = VSS)].
- \* 6.  $PSRR = 20 \times \text{Log}[(\text{Max. supply voltage} - \text{Min. supply voltage}) / (\text{Offset at Max. supply voltage} - \text{Offset at Min. supply voltage})]$
- \* 7.  $A_v = 20 \times \text{LOG} [ ((VDD-0.2) - (VSS+0.2)) / ((\text{Offset at output} = VDD - 0.2) - (\text{Offset at output} = VSS + 0.2)) ]$
- \* 8. It contains consumption of one OPamp circuit. It doesn't include an output drive current.

□ AC Characteristics

VDD= 5.0V, V<sub>CM</sub>= VDD/2, VSS= 0V, Ta= -40~125°C, unless otherwise noted

Parameter	Min.	Typ.	Max.	Units	Conditions
Gain Bandwidth (GBW)		50		MHz	Ta=25°C
Slew Rate		20		V/μs	Ta=25°C
Input Voltage Noise		10		nVrms /√Hz	@1kHz :IIN1
		5		nVrms /√Hz	@10kHz :IIN2
THD+N		0.0003		%	Input:1kHz, 1Vrms, Av:1V/V, VDD=5.0V, BW:20Hz ~ 20kHz Ta=25°C
Overload Recovery Time :TOR		160		nsec	AV= -10 times, Input swing:300mV (±2.5V) @90% (* 9)
Input capacitance	Differential	8		pF	
	Common	7		pF	
Maximum Capacitance Loads :CL			1000	pF	If the 10Ω resistor is connected in series to the output.

Note

\* 9. The definition of “Overload Recovery Time” is following.

- Positive side overload recovery time (Time until it returns to VDD/2 from VDD saturation)

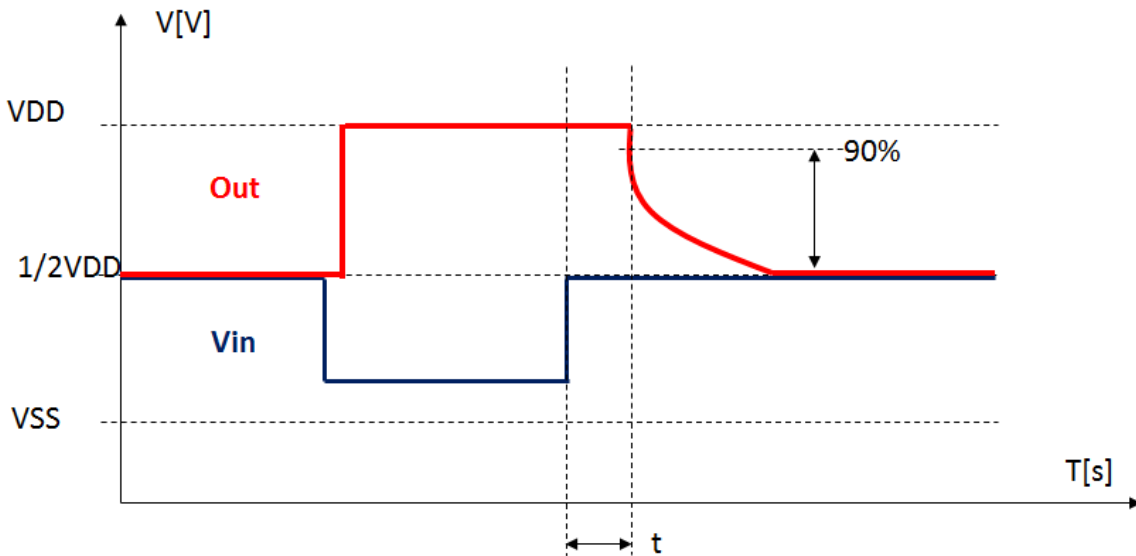


Figure 8.1 Positive side overload recovery time

- Negative side overload recovery time (Time until it returns to VDD/2 from VSS saturation)

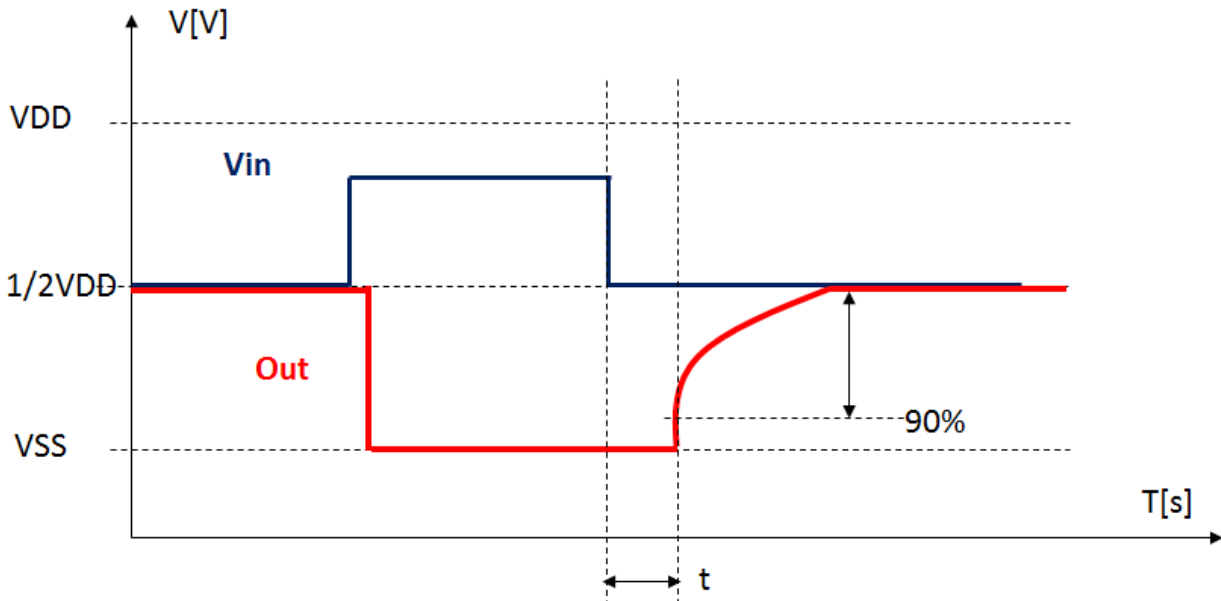


Figure 8.2 Negative side overload recovery time

Note

\* 10. Notes for a board design

AK2975 is high-bandwidth amplifier. Therefore if large impedance and inductance are included to a power supply line, the characteristic may get worse. Please place the decoupling capacitor of "0.1 $\mu$ F and 10 $\mu$ F" of a low loss near the power supply pin, between each power supply terminal and a ground.

**9. Typical Operating Characteristics (for reference)**

VDD:5.0V, Ta:25°C, CL=0pF unless otherwise noted

9.1 Current consumption – Operating temperature characteristics (Vin/Vout: VDD/2)

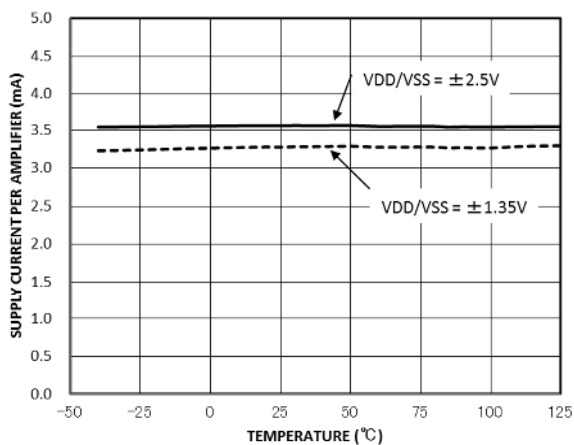


Figure 9.1 Current consumption vs. Operating temperature

[ 9. Typical Operating Characteristics (for reference) continuation]

9.2 Current consumption – Supply voltage characteristics (Vin/Vout: VDD/2)

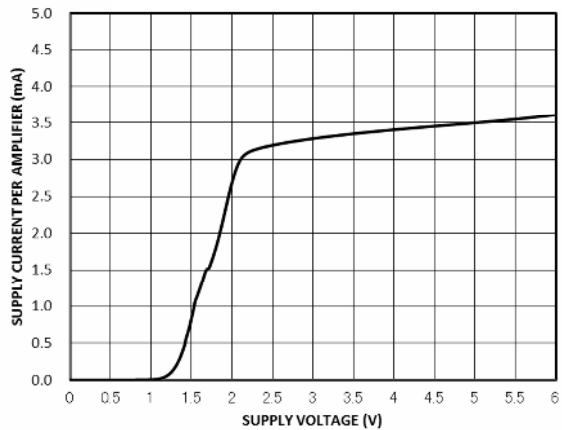


Figure 9.2 Current consumption vs. Supply voltage

9.3 Input offset – Temperature characteristics (Vin/Vout: VDD/2)

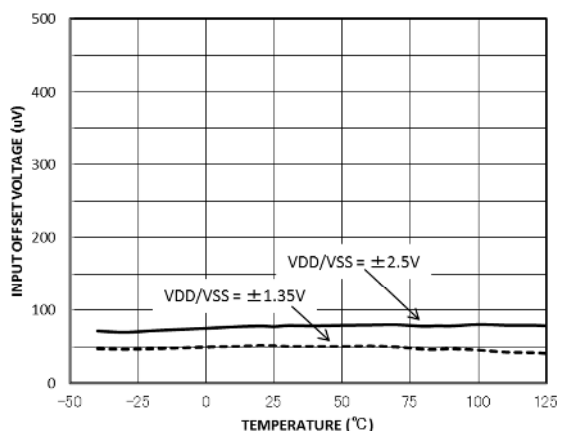


Figure 9.3 Input offset vs. Temperature

[ 9. Typical Operating Characteristics (for reference) continuation]

9.4 Distribution of Input offset drift (VDD:5V, Vin/Vout: VDD/2, Ta:-40 to 125°C)

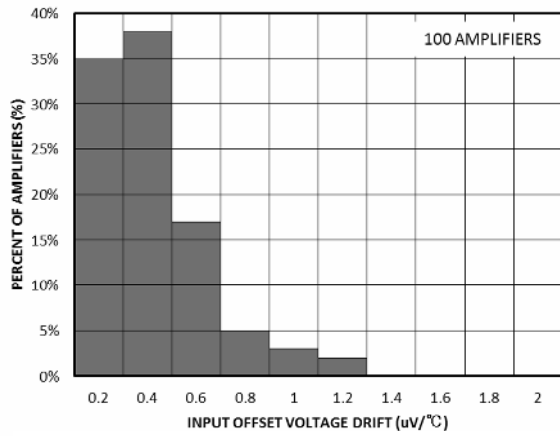


Figure 9.4 Input offset drift distribution

9.5 Distribution of Input offset (VDD:5V, Vin/Vout: VDD/2, Ta:-40 to 125°C)

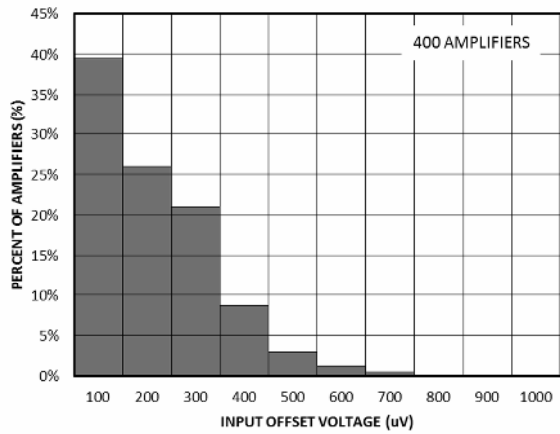


Figure 9.5 Input offset distribution

9.6 Input Bias current – Temperature characteristics

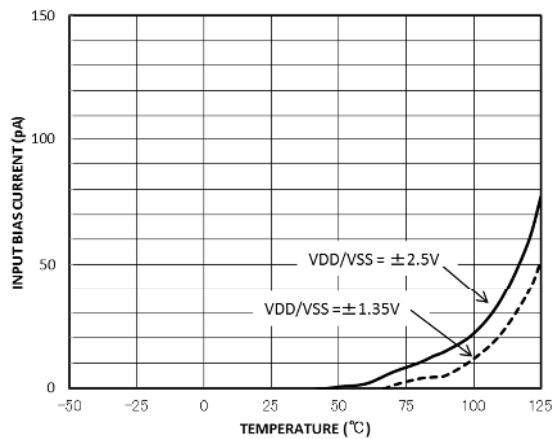


Figure 9.6 Input Bias current vs. Temperature



[ 9. Typical Operating Characteristics (for reference) continuation]

9.7 Output Voltage - Load current characteristics

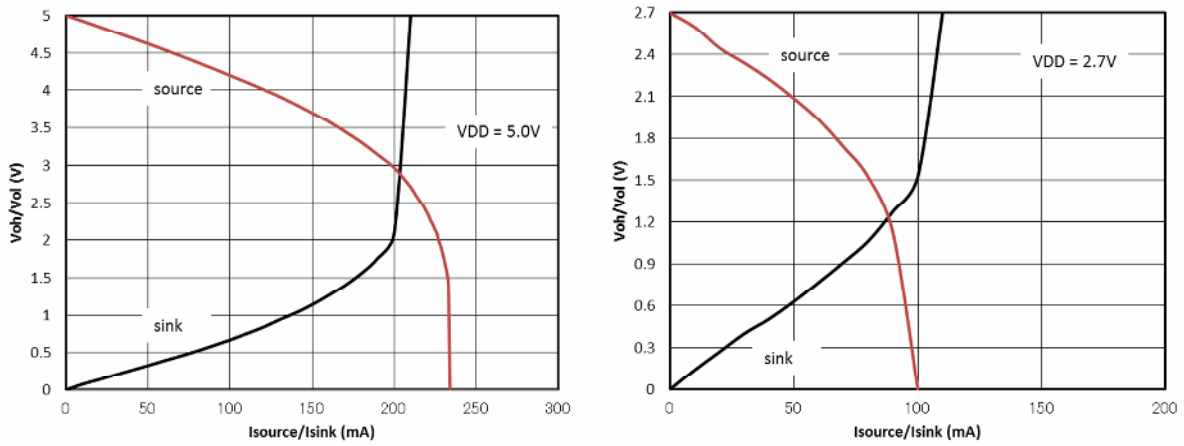


Figure 9.7 Output Voltage vs. Load current

9.8 Short circuit current – Supply Voltage characteristics

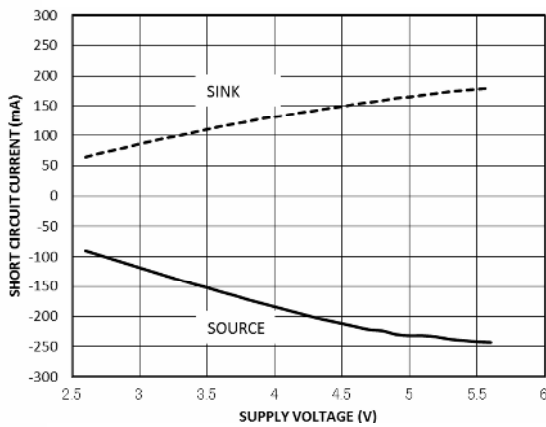


Figure 9.8 Short circuit current vs. Supply voltage

9.9 Short circuit current – Temperature characteristics

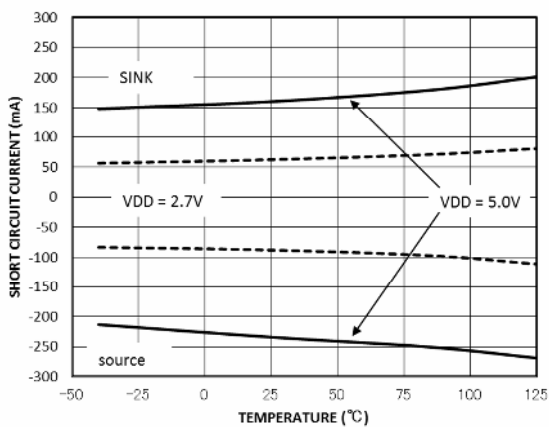


Figure 9.9 Short circuit current vs. Temperature

[ 9. Typical Operating Characteristics (for reference) continuation]

9.10 Closed loop gain – Frequency characteristics

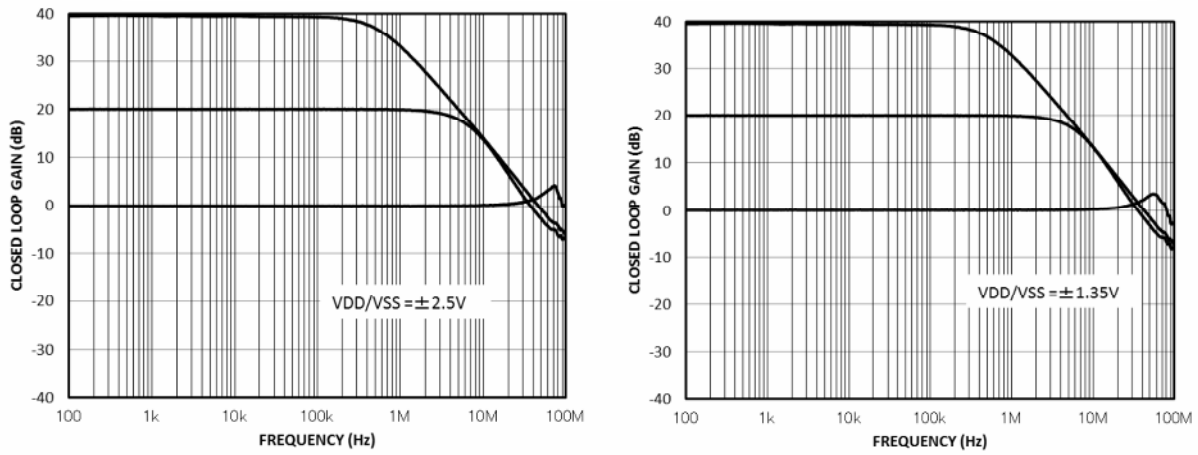


Figure 9.10 Closed loop gain vs. Frequency

9.11 Open loop gain – Frequency characteristics

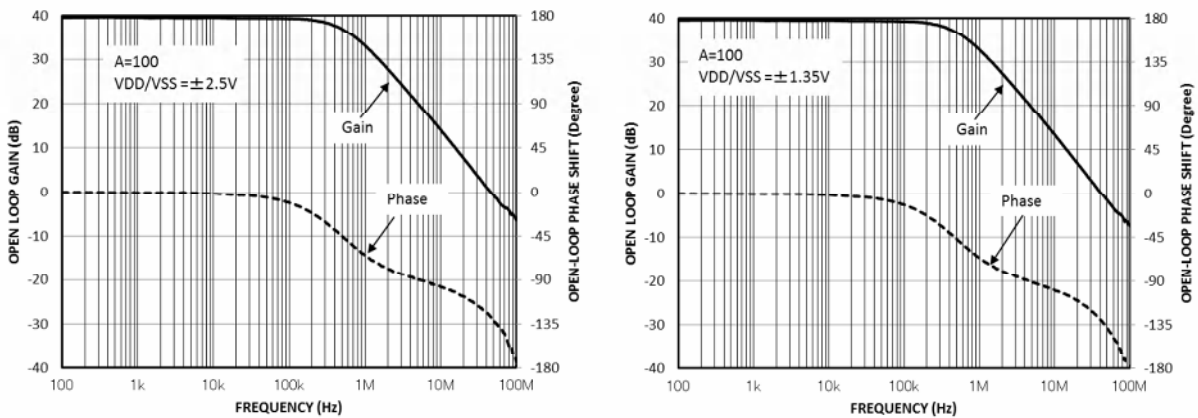


Figure 9.11 Open loop gain vs. Frequency

9.12 Input voltage noise – Frequency characteristics

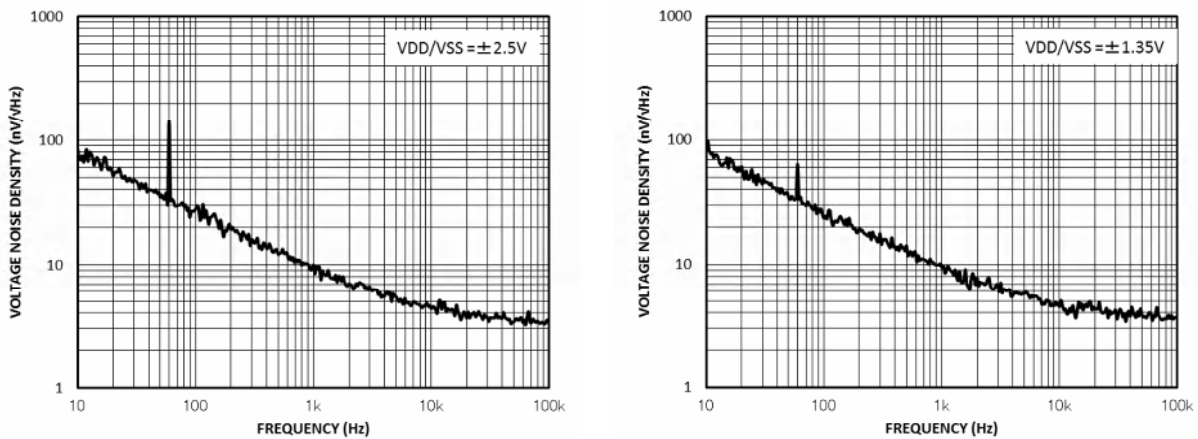


Figure 9.12 Input voltage noise vs. Frequency

[ 9. Typical Operating Characteristics (for reference) continuation]

9.13 CMRR – Frequency characteristics

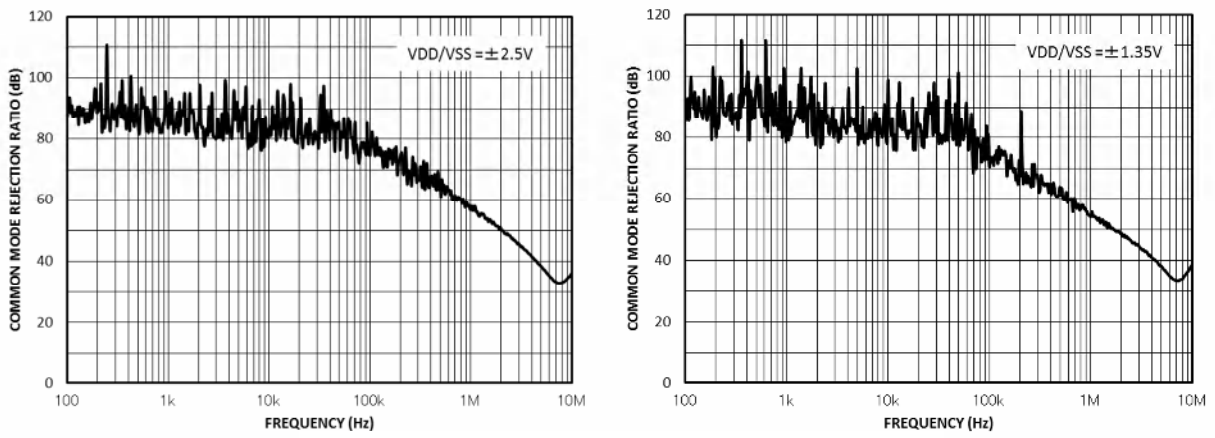


Figure 9.13 CMRR vs. Frequency

9.14 PSRR – Frequency characteristics

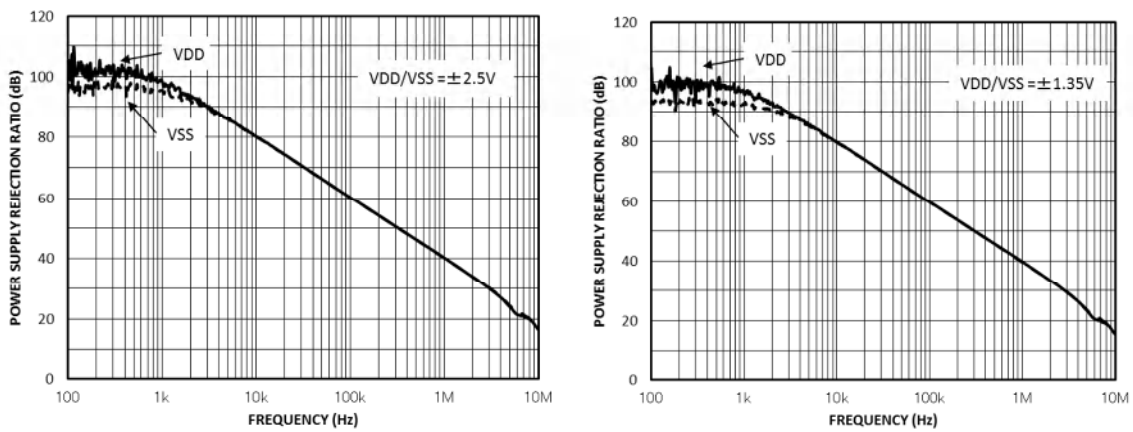


Figure 9.14 PSRR vs. Frequency

9.15 Output Impedance – Frequency characteristics

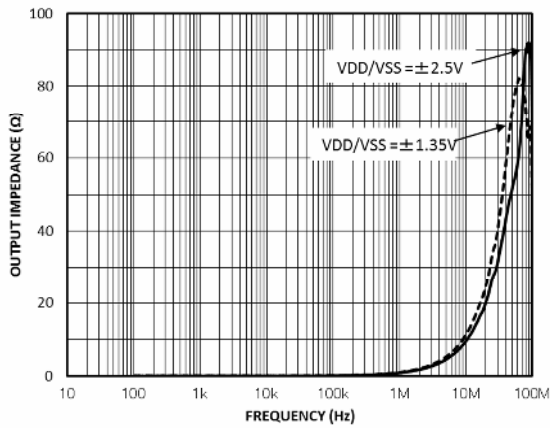


Figure 9.15 Output Impedance vs. Frequency

[ 9. Typical Operating Characteristics (for reference) continuation]

9.16 Maximum output swing – Frequency characteristics

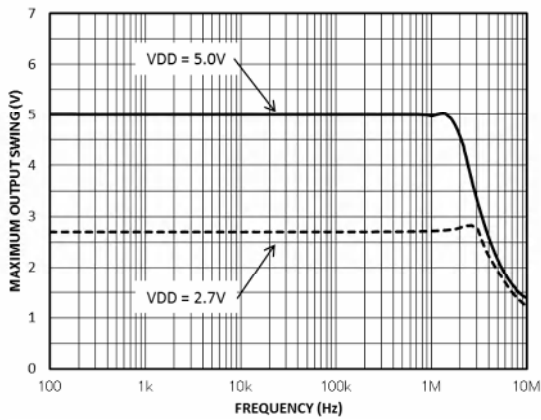


Figure 9.16 Maximum output swing vs. Frequency

9.17 THD +Noise – Output amplitude

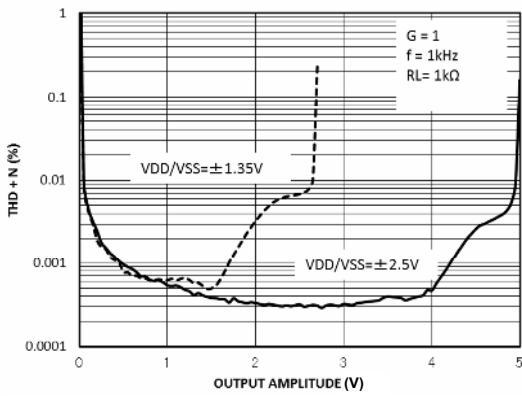


Figure 9.17 THD +Noise vs. Output swing

9.18 THD +Noise – Frequency characteristics

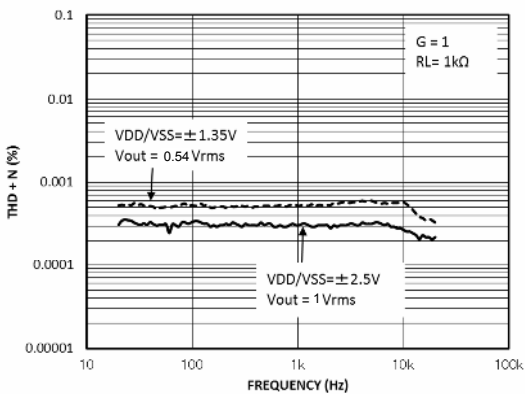


Figure 9.18 THD +Noise vs. Frequency

[ 9. Typical Operating Characteristics (for reference) continuation]

9.19 Small signal step response (CL:0pF)

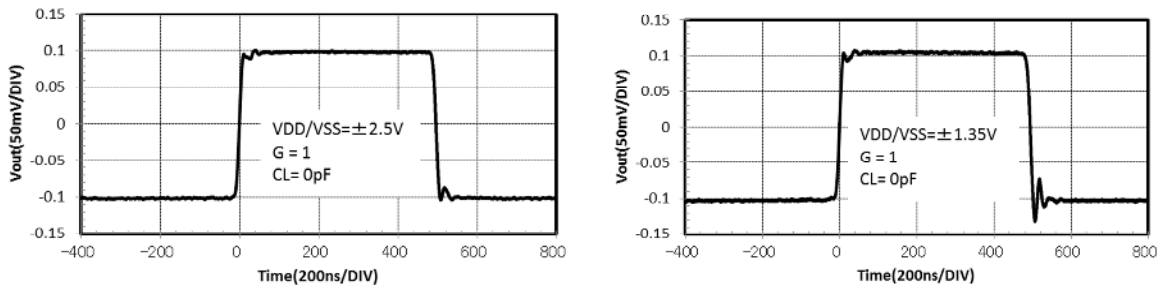


Figure 9.19 Small signal step response

9.20 Large signal step response (CL:0pF)

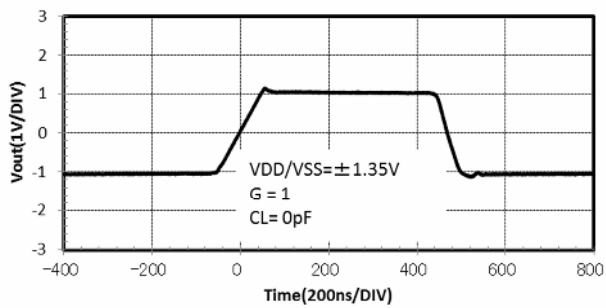


Figure 9.19 Large signal step response

9.21 Small output swing – Frequency characteristics (CL:1000pF,RL:10Ω)

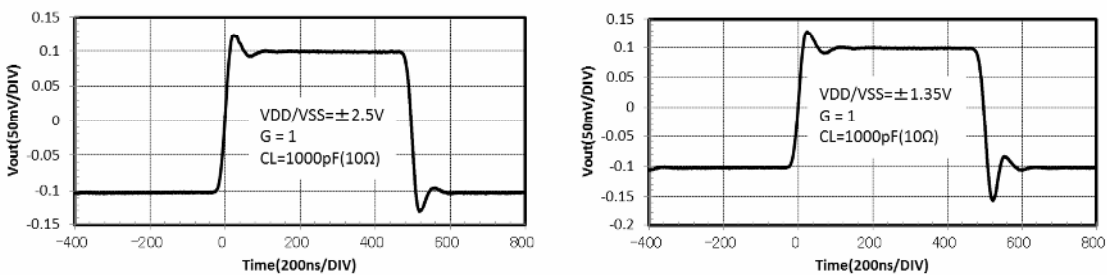


Figure 9.21 Small signal step response

9.22 Large signal step response (CL:1000pF,RL:10Ω)

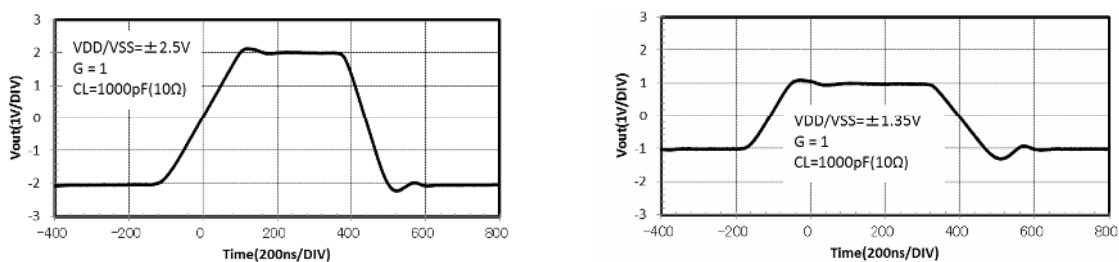


Figure 9.22 Large signal step response

[ 9. Typical Operating Characteristics (for reference) continuation]

9.23 Over load recovery time

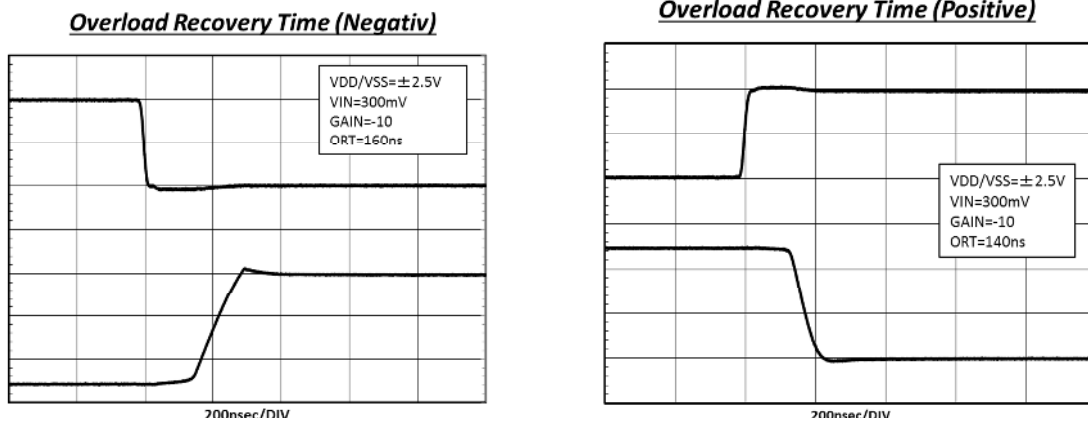
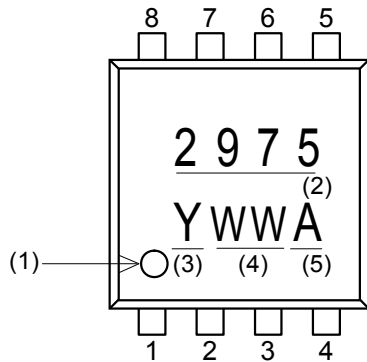


Figure 9.23 Overload recovery time

**10. Package**

10.1 Marking

- MSOP8

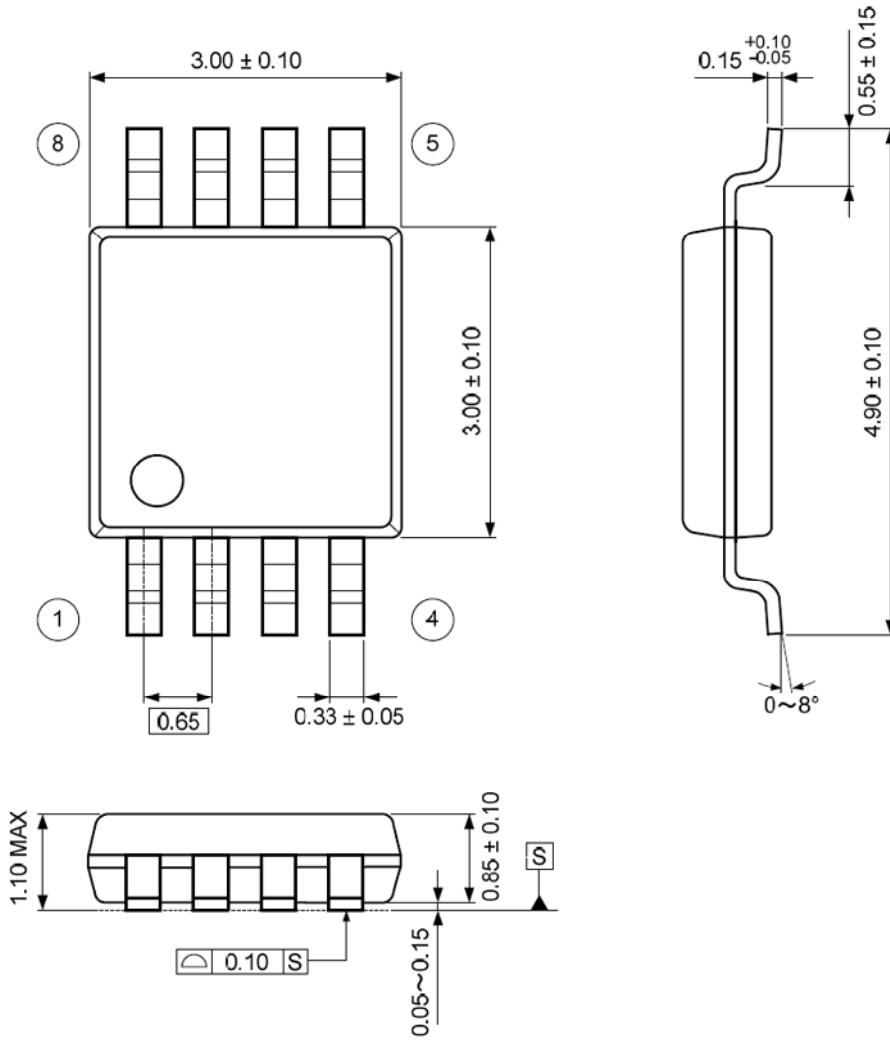


- (1) 1 pin
- (2) Part No. (AK2975:2975)
- (3) Date code (Year)
- (4) Date code (Week)
- (5) In-house control code

10.2 Outline Dimensions

- MSOP8 Package Outline

(UNIT: mm)



<b>11. Ordering Guide</b>
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AK2975H

-40 ~ 125°C

8-pin MSOP



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