

Precision, Low Noise, CMOS, Rail-to-Rail Input and Output Operational Amplifier

PRODUCT DESCRIPTION

The MS8311 and MS8312 are single channel, dual channel rail-to-rail input and output, single power supply operational amplifiers respectively, which are featured by low offset voltage, low input noise and wide signal bandwidth.

The perfect features make it ideal for various applications, such as filter, integrator, photodiode amplifier and high-impedance sensor. Audio and some AC applications are benefited by wide bandwidth and low distortion features.

The operating temperature range of the MS8311 or MS8312 is -40°C to 125°C.

FEATURES

- Low Offset Voltage : 65 μ V (Typ), 300 μ V (Max)
- Low Input Bias Current
- Single Power Supply : 2.7V to 5.5V
- Low Noise : 11.5nV/ $\sqrt{\text{Hz}}$
- High Open-loop Gain : 120dB
- Wide Bandwidth : 10MHz
- Stable Unity Gain

APPLICATIONS

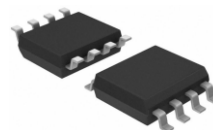
- Photodiode Amplification
- Multiple-order Filter
- Sensor
- Audio
- Bar Code Scanner

PRODUCT SPECIFICATION

Part Number	Package	Marking
MS8311	SOT23-5	8311
MS8312	SOP8	M8312
MS8312M	MSOP8	MS8312M



SOT23-5

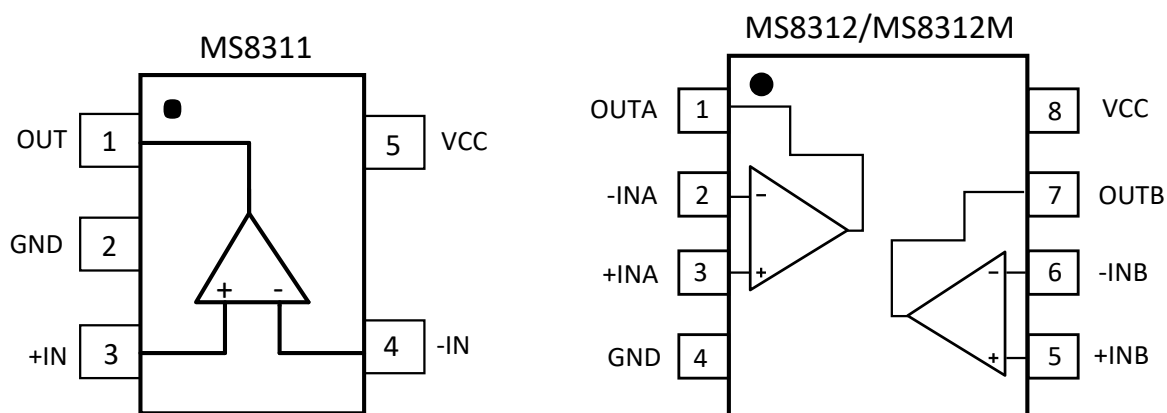


SOP8



MSOP8

PIN CONFIGURATION



PIN DESCRIPTION

Pin	Name	Type	Description
MS8311			
1	OUT	O	Channel Output
2	GND	-	Ground
3	+IN	I	Positive Input
4	-IN	I	Negative Input
5	VCC	-	Power Supply
MS8312/MS8312M			
1	OUTA	O	Channel A Output
2	-INA	I	Negative Input (Channel A)
3	+INA	I	Positive Input (Channel A)
4	GND	-	Ground
5	+INB	I	Positive Input (Channel B)
6	-INB	I	Negative Input (Channel B)
7	OUTB	O	Channel B Output
8	VCC	-	Power Supply

ABSOLUTE MAXIMUM RATINGS

Any exceeding absolute maximum rating application causes permanent damage to device. Because long-time absolute operation state affects device reliability. Absolute ratings just conclude from a series of extreme tests. It doesn't represent chip can operate normally in these extreme conditions.

Parameter	Symbol	Ratings	Unit
Power Supply	V_{CC}	6	V
Input Voltage		$0 \sim V_{CC}$	V
Differential Input Voltage		± 6	V
Junction Temperature	T_J	$-65 \sim 150$	$^{\circ}\text{C}$
Operating Temperature	T_A	$-40 \sim 125$	$^{\circ}\text{C}$
Storage Temperature	T_{STG}	$-65 \sim 150$	$^{\circ}\text{C}$
Lead Temperature		260	$^{\circ}\text{C}$

ELECTRICAL CHARACTERISTICS (5V)

$V_{CC}=5V$, $V_{CM}=2.5V$. Unless otherwise noted, $T_A = 25^{\circ}C \pm 2^{\circ}C$.

Input Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input Offset Voltage	V_{OS}	$V_{CC}=5V$, $V_{CM}=2.5V$		65		μV
		$V_{CC}=5V$, $V_{CM}=0V \sim 5V$		80	300	
		$-40^{\circ}C \leq T_A \leq 125^{\circ}C$			750	
Input Bias Current	I_B			0.2		pA
Input Offset Current	I_{OS}			0.1		pA
Common-mode Rejection Ratio	CMRR	$V_{CM}=0V \sim 5V$	85	100		dB
		$-40^{\circ}C \leq T_A \leq 125^{\circ}C$	75	90		
Input Voltage			0		5	V
Large Signal Gain	A_{VO}	$R_L = 2k\Omega$, $V_O = 0.5V \sim 4.5V$	115	120		dB
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T_A$	$-40^{\circ}C \leq T_A \leq 125^{\circ}C$		1.5	10	$\mu V/^{\circ}C$
Input Capacitance	C_{DIFF}			2.6		pF
	C_{CM}			8.8		pF

Dynamic Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Unit Gain Bandwidth	GBP			10		MHz
Slew Rate	SR	$R_L = 2k\Omega$, $C_L = 16pF$		7		V/ μs
Setup Time 0.01%	t_s	0V~2V step, $A_V=1$		<1		μs
Phase Margin	Φ_O			65		Deg

Output Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Output High Voltage	V_{OH}	$I_L=1mA$	4.96	4.99		V
		$I_L=10mA$	4.7	4.79		
		$-40^{\circ}C \leq T_A \leq 125^{\circ}C$	4.7			
Output Low Voltage	V_{OL}	$I_L=1mA$		20	40	mV
		$I_L=10mA$		170	210	
		$-40^{\circ}C \leq T_A \leq 125^{\circ}C$			290	
Short-circuit Current	I_{SC}			± 80		mA
Closed-loop Output Impedance	Z_{OUT}	$f=1MHz, A_V=1$		11		Ω
Overload Recovery Time		$\pm 2.5V, R_L=10k,$ $V_{IN}=-50 \sim 50mV, A_{VO}=-100$		1.6		μs

Power Supply

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Power Supply Rejection Ratio	PSRR	$2.7V < V_{CM} < 5.5V$	85	95		dB
		$-40^{\circ}C \leq T_A \leq 125^{\circ}C$	70	90		dB
Supply Current/Amplifier	I_{SY}	$I_{OUT}=0mA$		1.5		mA
		$-40^{\circ}C \leq T_A \leq 125^{\circ}C$			1.8	

Noise Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
1/f Noise	e_{n-p-p}	$f=0.1Hz \sim 10Hz$		2.3	3.5	μV
Voltage Noise Density	e_n	$f = 1kHz$		11.5		$nV/\sqrt{Hz}$
		$f = 10kHz$		5		
Current Noise Density	i_n	$f = 1kHz$		0.01		$fA/\sqrt{Hz}$

ELECTRICAL CHARACTERISTICS (2.7V)

$V_{CC}=2.7V$, $V_{CM}=1.35V$. Unless otherwise noted, $T_A=25^{\circ}C\pm 2^{\circ}C$.

Input Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input Offset Voltage	V_{OS}	$V_{CC}=2.7V$, $V_{CM}=1.35V$		65		μV
		$V_{CC}=2.7V$, $V_{CM}=0V\sim 2.7V$		80	300	
		$-40^{\circ}C\leq T_A\leq 125^{\circ}C$			750	
Input Bias Current	I_B			0.2		pA
Input Offset Current	I_{OS}			0.1		pA
Common-mode Rejection Ratio	CMRR	$V_{CM}=0V\sim 2.7V$	115	120		dB
		$-40^{\circ}C\leq T_A\leq 125^{\circ}C$	70	85		
Input Voltage			0		2.7	V
Large Signal Gain	A_{VO}	$R_L=2k\Omega$, $V_O=0.5V\sim 2.2V$	110	118		dB
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T_A$	$-40^{\circ}C\leq T_A\leq 125^{\circ}C$		1.5	10	$\mu V/^{\circ}C$
Input Capacitance	C_{DIFF}			2.6		pF
	C_{CM}			8.8		pF

Dynamic Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Unit Gain Bandwidth	GBP			9.5		MHz
Slew Rate	SR	$R_L=2k\Omega$, $C_L=16pF$		7		V/ μs
Setup Time 0.01%	t_s	0V~1V step, $A_v=1$		<0.5		μs
Phase Margin	Φ_O			50		Deg

Output Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Output High Voltage	V_{OH}	$I_L=1mA$	2.6	2.66		V
		$-40^{\circ}C\leq T_A\leq 125^{\circ}C$	2.6			
Output Low Voltage	V_{OL}	$I_L=1mA$		25	40	mV
		$-40^{\circ}C\leq T_A\leq 125^{\circ}C$			50	
Short-circuit Current	I_{SC}			± 30		mA
Closed-loop Output Impedance	Z_{OUT}	$f=1MHz$, $A_v=1$		1.2		Ω

Power Supply

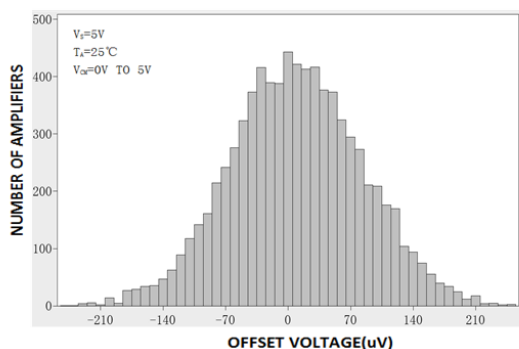
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Power Supply Rejection Ratio	PSRR	$2.7V < V_{CM} < 5V$	80	95		dB
		$-40^{\circ}C \leq T_A \leq 125^{\circ}C$	70	90		dB
Supply Current/Amplifier	I_{SY}	$I_{OUT}=0mA$		1.2		mA
		$-40^{\circ}C \leq T_A \leq 125^{\circ}C$			1.5	

Noise Characteristics

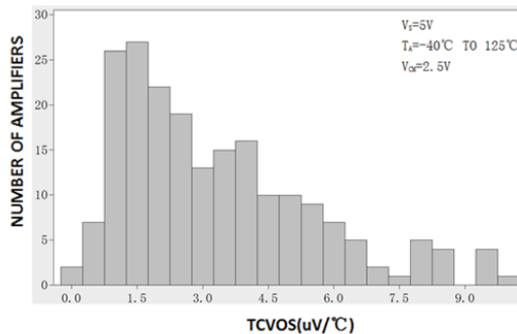
Parameter	Symbol	Condition	Min	Typ	Max	Unit
1/f Noise	e_{n-p-p}	$f=0.1Hz \sim 10Hz$		2.3	3.5	μV
Voltage Noise Density	e_n	$f = 1kHz$		11.5		$nV/\sqrt{Hz}$
		$f = 10kHz$		5		
Current Noise Density	i_n	$f = 1kHz$		0.01		$fA/\sqrt{Hz}$

TYPICAL CURVES

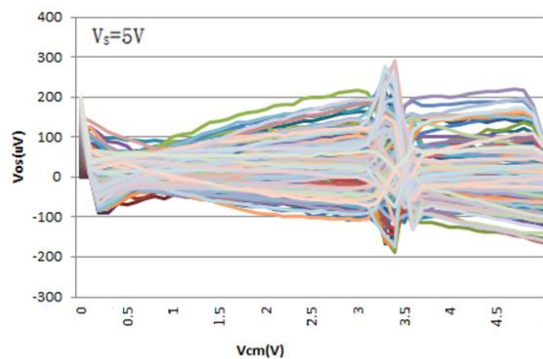
Input Offset Voltage Distribution



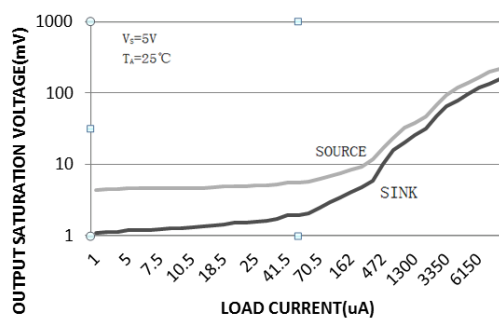
Input Offset Voltage Drift Distribution



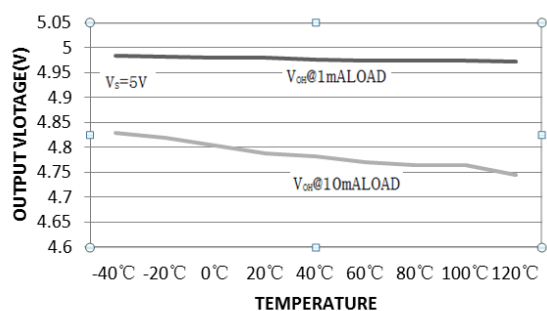
Input Offset Voltage vs. Common-Mode Voltage



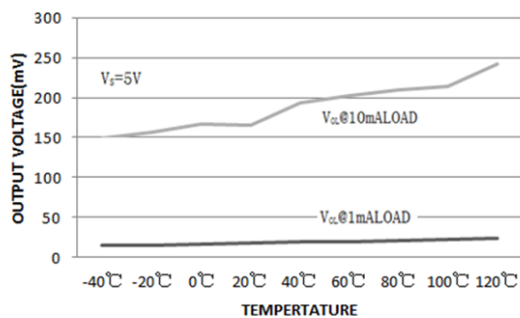
Output Saturation Voltage vs. Load Current



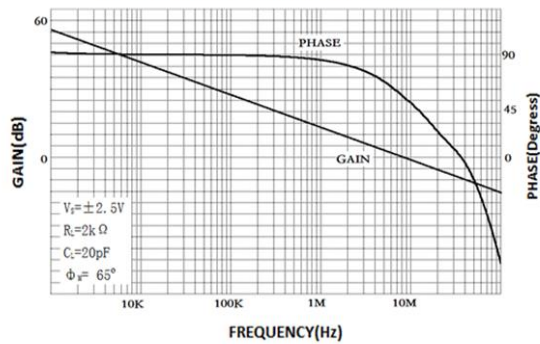
Output Voltage Swing High vs. Temperature



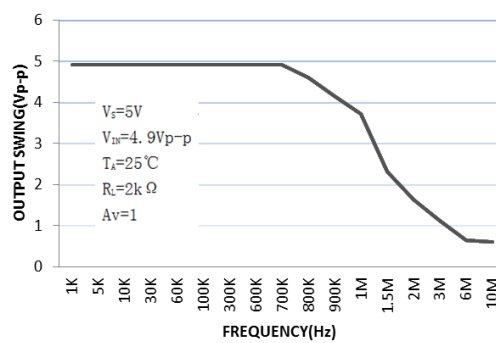
Output Voltage Swing Low vs. Temperature



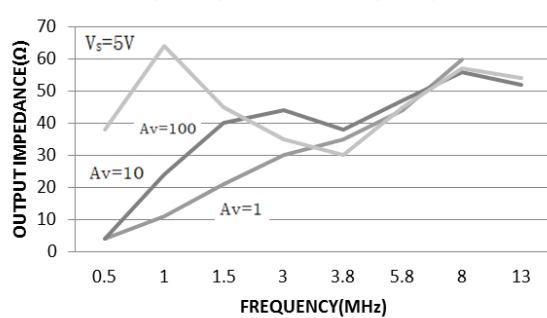
Open-Loop Gain and phase vs. Frequency



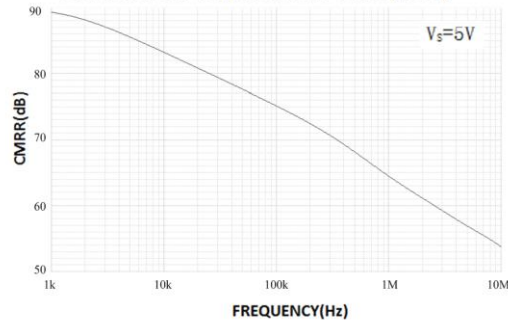
Closed-Loop Output Voltage Swing vs. Frequency



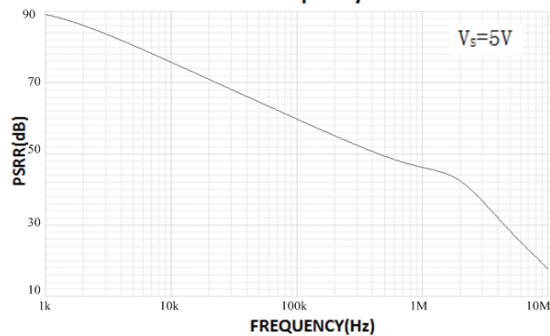
Output Impedance vs. Frequency



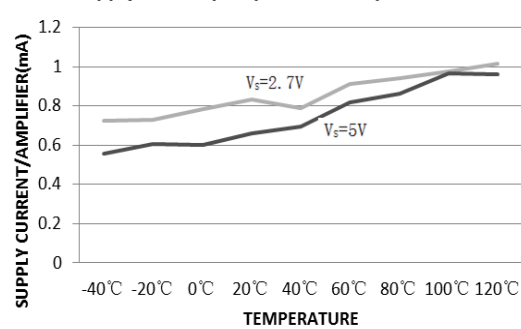
Common-Mode Rejection Ratio vs. Frequency



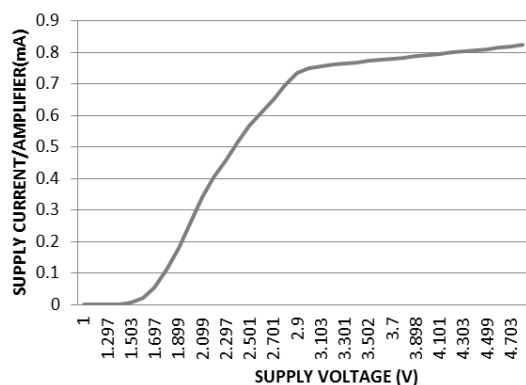
PSRR vs. Frequency



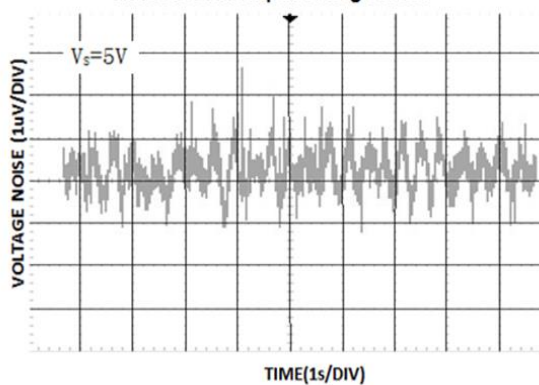
Supply Current/Amplifier vs. Temperature



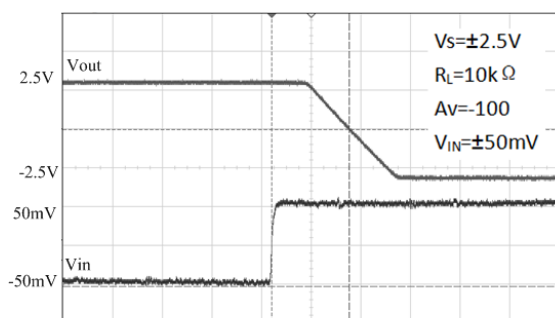
Supply Current/Amplifier vs. Supply Voltage



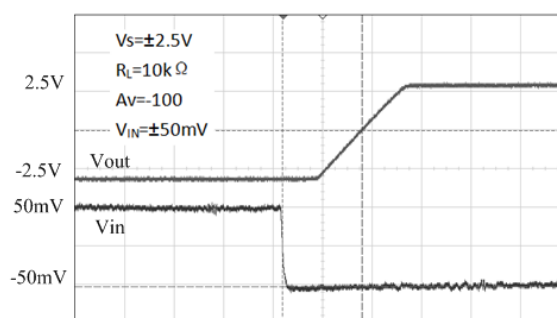
0.1Hz to 10Hz Input Voltage Noise



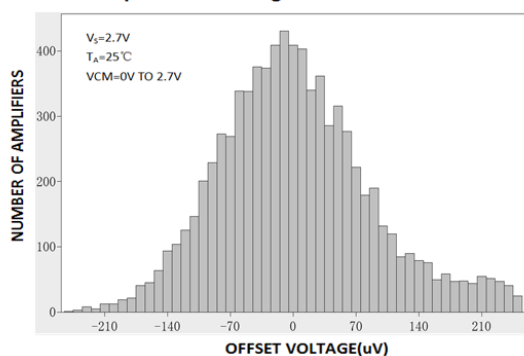
Positive Overload Recovery



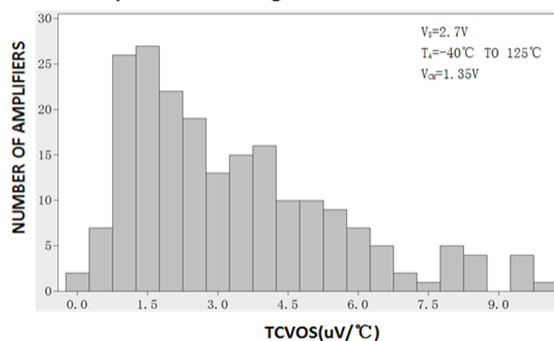
Negative Overload Recovery

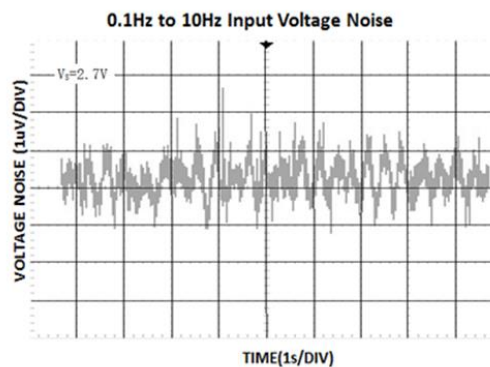
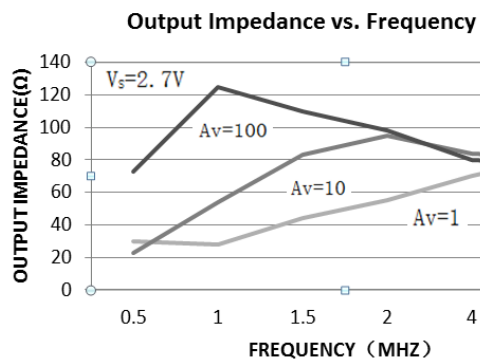
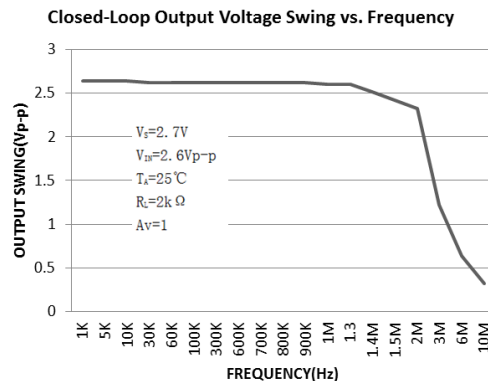
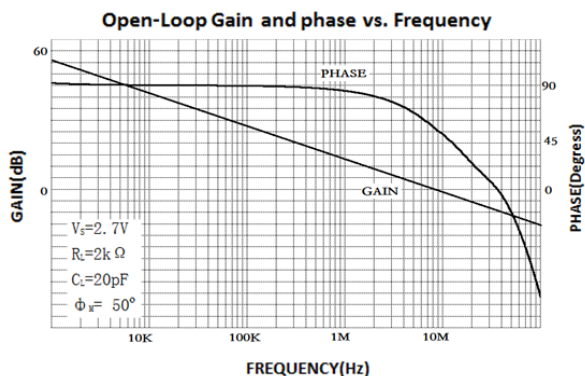
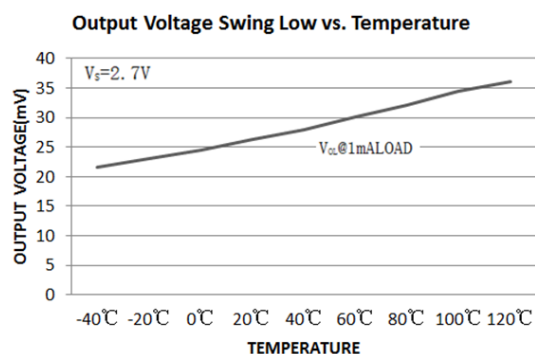
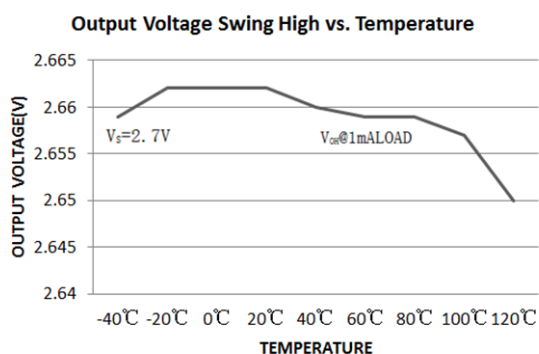
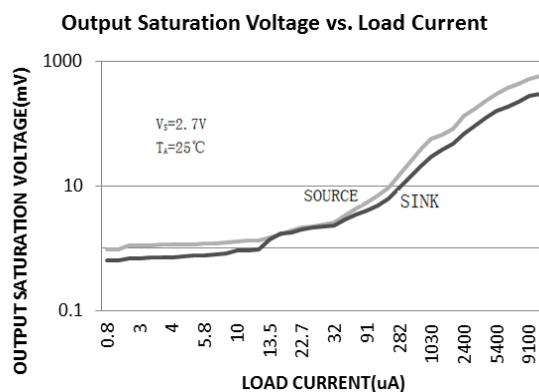
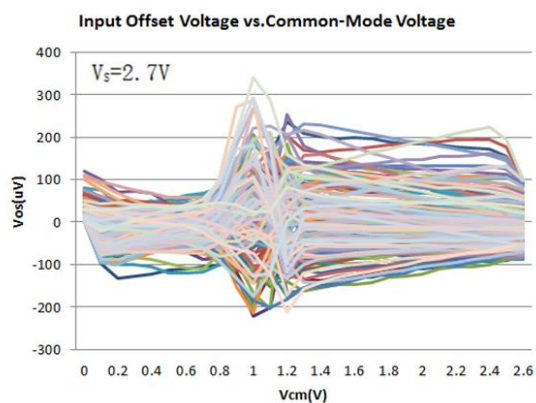


Input Offset Voltage Distribution



Input Offset Voltage Drift Distribution

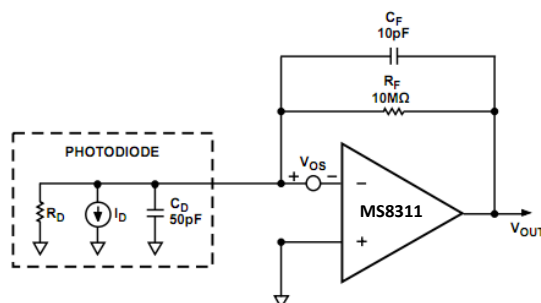




TYPICAL APPLICATIONS

Photodiode Pre-amplifier

The MS831X series has the advantages of low offset voltage and low input current. It could be applicable to photodiode field. In addition, the low noise feature provides high sensitivity for application lines.



The input bias current of the amplifier would generate a error item, that is proportional to R_F . And the offset voltage would cause dark current due to shunt resistance R_D . The output terminal of the amplifier indicates the error item. The formula of error voltage is as follows:

$$E_O = V_{OS} \left(1 + \frac{R_F}{R_D} \right) + R_F I_B$$

R_F/R_D could be ignored.

At room temperature, for the MS8311, the input bias current is 0.2pA. The offset voltage is 20μV. The typical value of R_D is 1GΩ.

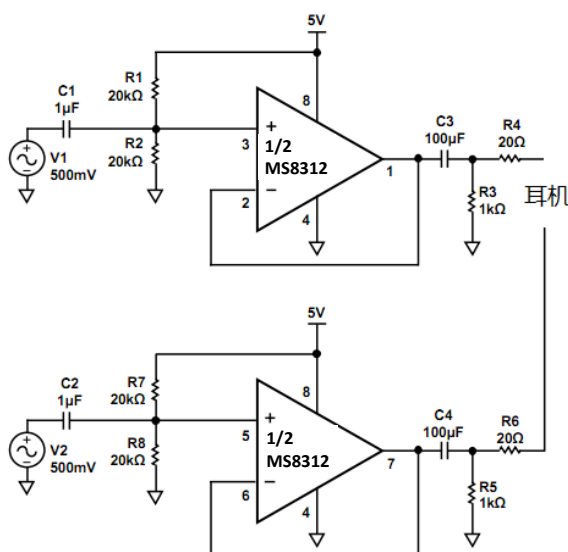
The error voltage is about 100μV at room temperature. Then it increases to 1mV at 85°C. The formula of the maximum realized signal bandwidth is as follows:

$$f_{MAX} = \sqrt{\frac{f_t}{2\pi R_F C_F}}$$

f_t is unity gain infrequency of the amplifier .

Audio and PDA Applications

The MS831X series is characterized by low distortion and wide dynamic range, which is beneficial to audio and PDA applications, including microphone amplifier and line output buffer.



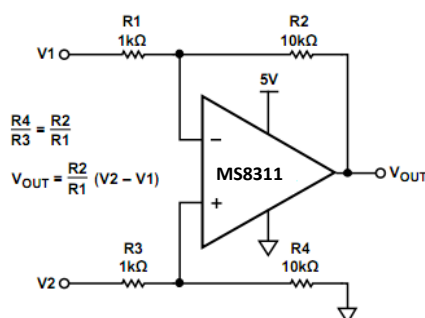
In above diagram, R1 and R2 bias input voltage as half of power supply voltage, thus maximizing signal bandwidth range. C1 and C2 are used to AC couple input signal. C1, R1 and R2 make up a high-pass filter, and the corner frequency is $1/[2\pi(R1 || R2)C1]$. The high output of the MS8312 can drive large resistance load.

The circuit can drive 16Ω earphone as shown above. And the THD+N maintains about -60dB among the whole audio range.

Instrument Amplifier

The MS831X serial has low offset voltage and low noise features and suitable for instrument amplifiers.

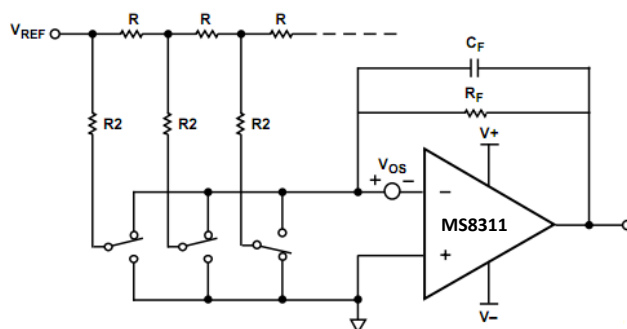
The differential amplifiers are widely applied to high-precision circuits to improve common-mode rejection ratio, which could be up to 85dB-95dB.



DAC Conversion

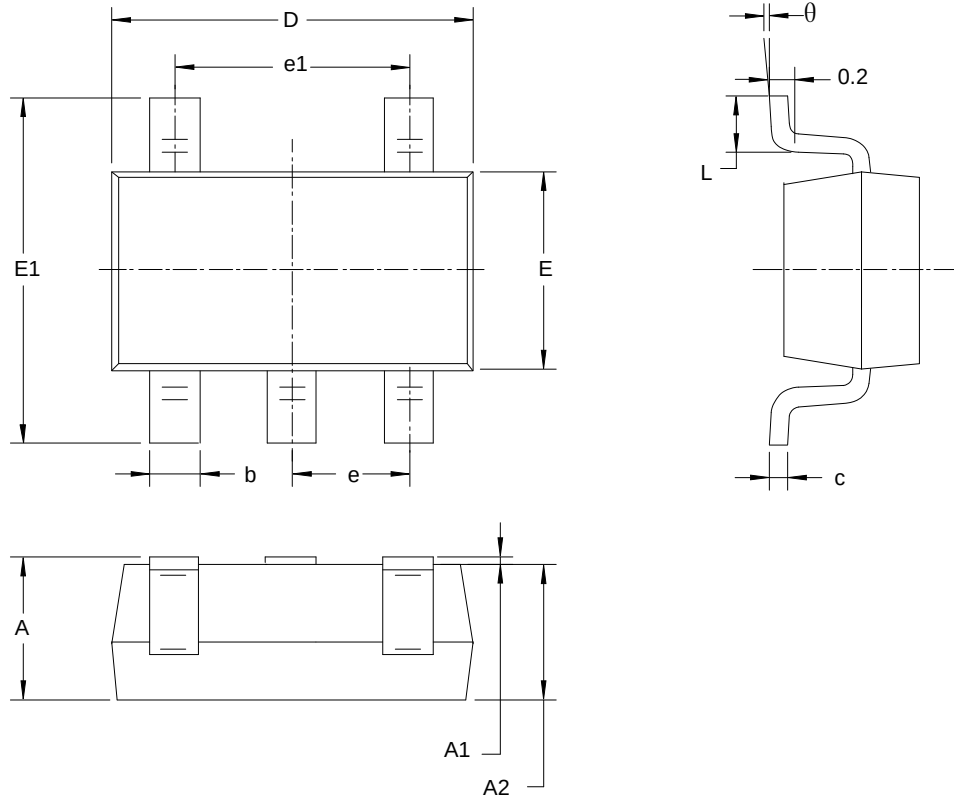
The MS831X serial is featured by low bias current and low offset voltage, and it is the optimal selection for output buffer of current output DAC.

The following diagram is typical structure of the MS8311 applied to the output terminal of 12-bit DAC.



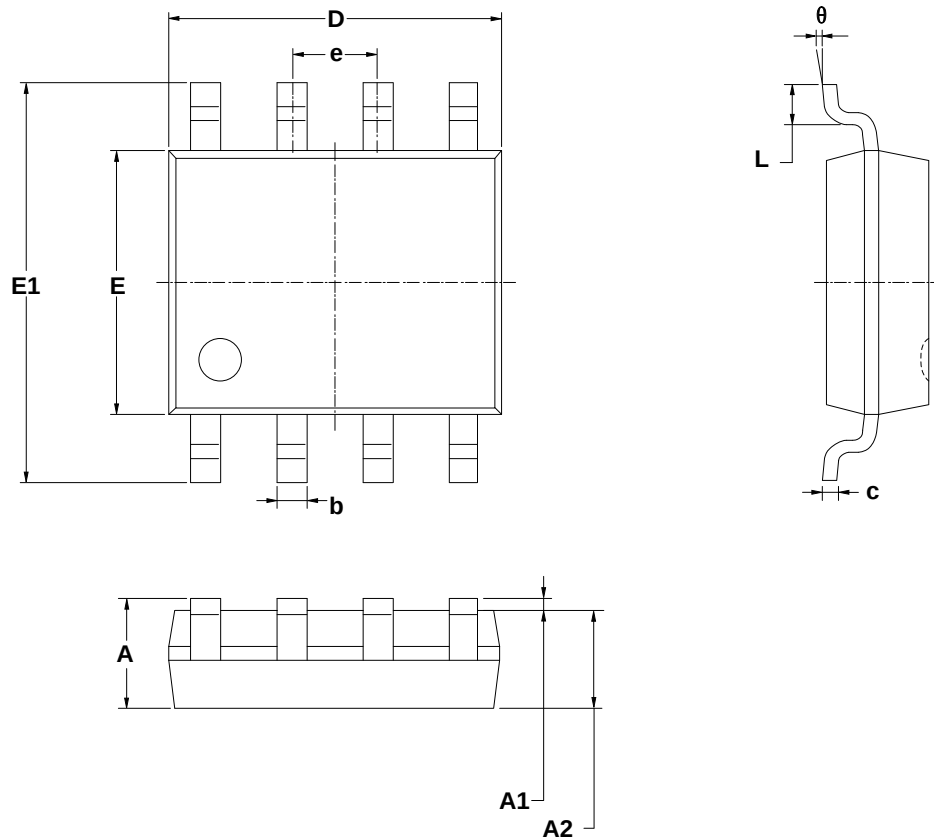
PACKAGE OUTLINE DIMENSIONS

SOT23-5



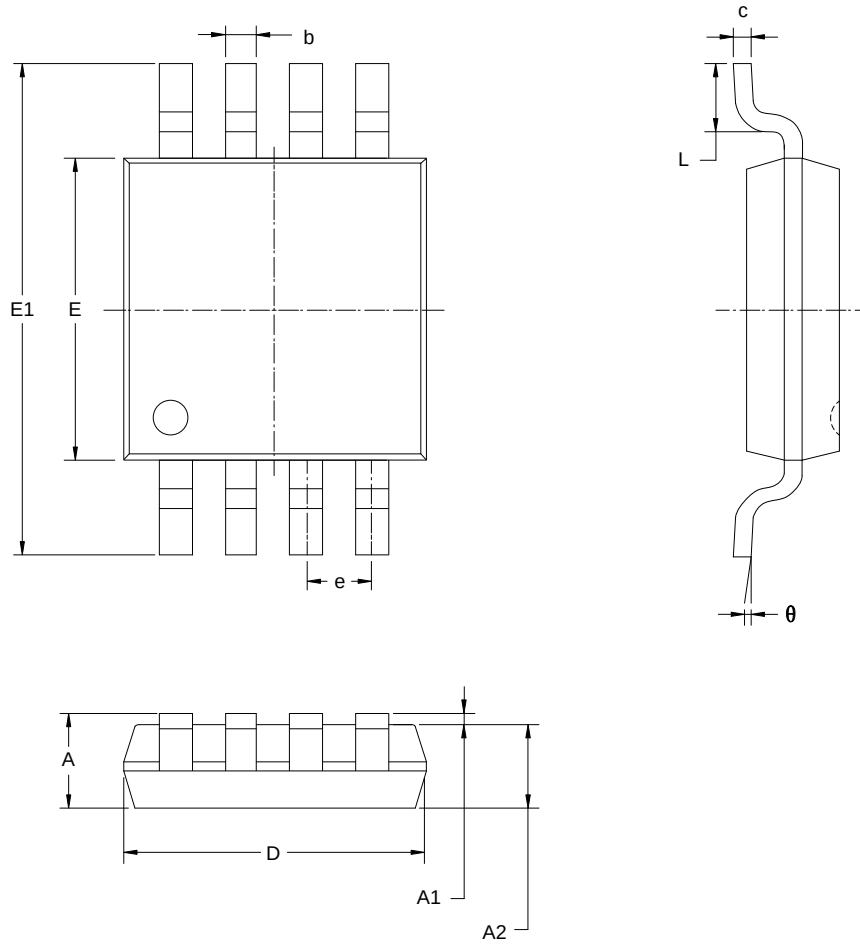
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.900 BSC		0.075 BSC	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

SOP8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
θ	0 °	8 °	0 °	8 °

MSOP8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650BSC		0.026BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

MARKING and PACKAGING SPECIFICATIONS

1. Marking Drawing Description



Product Name : 8311, MS8312, MS8312M

Product Code : XXXX, XXXXXX

2. Marking Drawing Demand

Laser printing, contents in the middle, font type Arial.

3. Packaging Specifications

Device	Package	Piece/Reel	Reel/Box	Piece /Box	Box/Carton	Piece/Carton
MS8311	SOT23-5	3000	10	30000	4	120000
MS8312	SOP8	4000	1	4000	8	32000
MS8312M	MSOP8	3000	1	3000	8	24000

STATEMENT

- All Revision Rights of Datasheets Reserved for Ruimeng. Don't release additional notice.
Customer should get latest version information and verify the integrity before placing order.
- When using Ruimeng products to design and produce, purchaser has the responsibility to observe safety standard and adopt corresponding precautions, in order to avoid personal injury and property loss caused by potential failure risk.
- The process of improving product is endless. And our company would sincerely provide more excellent product for customer.

**MOS CIRCUIT OPERATION PRECAUTIONS**

Static electricity can be generated in many places. The following precautions can be taken to effectively prevent the damage of MOS circuit caused by electrostatic discharge:

1. The operator shall ground through the anti-static wristband.
2. The equipment shell must be grounded.
3. The tools used in the assembly process must be grounded.
4. Must use conductor packaging or anti-static materials packaging or transportation.



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