Precision, CMOS, Rail-to-Rail Input /Output, Wideband Operational Amplifier

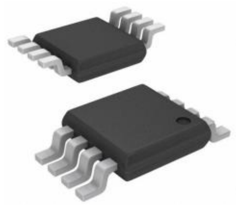
PRODUCT DESCRIPTION

The MS8601,MS8602,MS8604 are single,dual,four channel rail-to-rail input/output and single power amplifiers respectively. The device is featured by ultra-low offset voltage and wide signal bandwidth. And it adopts 1.8V to 5V single power supply (±0.9 V to ±2.5 V dual power).

The MS8601, MS8602, MS8604 integrates low offset voltage, ultra-low bias current and high speed characteristics, which are suitable for various applications, such as filter,integrator,diode amplifier,shunt sensor and high-impedance sensor. The low offset voltage, low offset voltage drift and noise features, making the device drift approach zero throughout the operating temperature, are beneficial to position and pressure sensor, medical device and strain gauge applications.

The operating temperature range of the MS8601, MS8602 or MS8604 is -40°C to 125°C. The MS8601, MS8602, MS8604 have lead SOT23-5, MSOP8, SOP14/TSSOP14 packages respectively.

SOT23-5



MSOP8

FEATURES

- Low Offset Voltage: 4µV(TYP)
- Low Offset Drift: 0.05µV/°C
- Raii-to-Rail Input/Output
- Single Power Supply: 1.8V to 5.5V
- Voltage Gain: 126dB(TYP) (Operating Voltage 5V)
- Power Supply Rejection Ratio: 123dB (TYP)
- Common-mode Rejection Ratio: 136dB (TYP)
- Ultra-low Input Bias Current: 11pA
- Low Operating Current: Each Channel 0.8mA (TYP)
- Overload Recovery Time: 50µs(Operating Voltage 5V)

SOP14

TSSOP14

APPLICATIONS

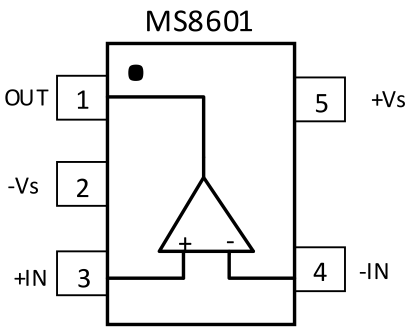
- Sensor and Medical Device
- Thermocouple Amplifier
- Precise Current Sensor
- Photodiode Amplifier
- Bar Code Scanner
- PA Control and Multi-order Filter

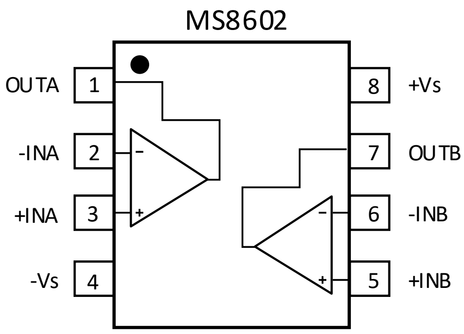
PRODUCT SPECIFICATION

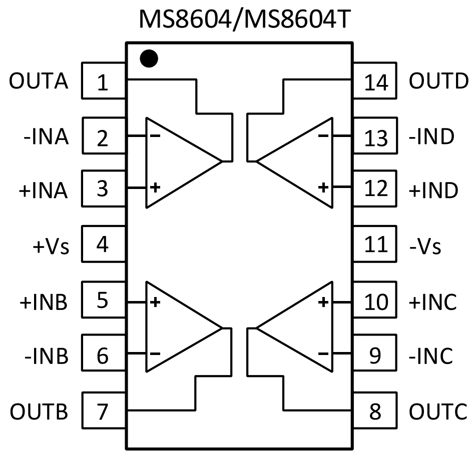
Part Number	Package	Marking
MS8601	SOT23-5	8601
MS8602	MSOP8	MS8602
*MS8604	SOP14	MS8604
*MS8604T	TSSOP14	MS8604T

*The package is not available temporarily. If necessary, please contact Hangzhou Ruimeng Sales Department Center.

PIN CONFIGURATION







PIN DESCRIPTION

Pin	Name	Type	Description
		MS8601	
1	OUT	O	Channel Output
2	-Vs	-	Negative Power Supply
3	+IN	I	Positive Input
4	-IN	I	Negative Input
5	+Vs	-	Positive Power Supply
		MS8602	
1	OUTA	O	Channel A Output
2	-INA	I	Negative Input (Channel A)
3	+INA	I	Positive Input (Channel A)
4	-Vs	-	Negative Power Supply
5	+INB	I	Positive Input (Channel B)
6	-INB	I	Negative Input (Channel B)
7	OUTB	O	Channel B Output
8	+Vs	-	Positive Power Supply
		MS8604/MS8604T	
1	OUTA	O	Channel A Output
2	-INA	I	Negative Input (Channel A)
3	+INA	I	Positive Input (Channel A)
4	+Vs	-	Positive Power Supply
5	+INB	I	Positive Input (Channel B)
6	-INB	I	Negative Input (Channel B)
7	OUTB	O	Channel B Output
8	OUTC	O	Channel C Output
9	-INC	I	Negative Input (Channel C)
10	+INC	I	Positive Input (Channel C)
11	-Vs	-	Negative Power Supply
12	+IND	I	Positive Input (Channel D)
13	-IND	I	Negative Input (Channel D)
14	OUTD	O	Channel D Output

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	Vs	6	V
Input Voltage	VI	-Vs-0.3 ~ +Vs+0.3	V
Differential Input Voltage		±6	V
Junction Temperature		-65 ~ 150	°C
Operating Temperature	TA	-40 ~ 125	°C
Storage Temperature	Tstg	-60 ~ 150	°C
Lead Temperature (Soldering, 10s)		260	°C
ESD	HBM	4000	V
	MM	200	

ELECTRICAL CHARACTERISTICS (5V)

Unless otherwise noted, +Vs=5V, -Vs =0V, Vcm=2.5V, TA=25°C.

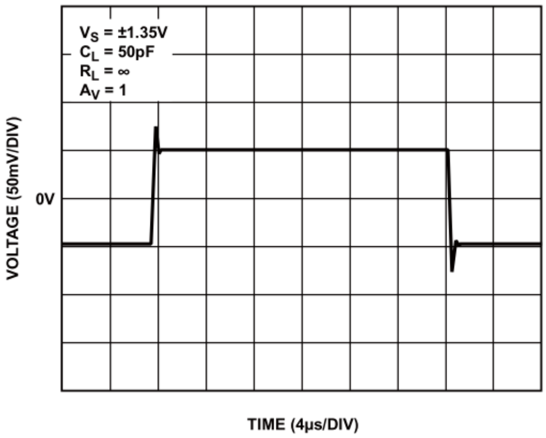
Parameter		Symbol	Condition	Min	Typ	Max	Unit
Input Characteristics							
Input Offset Voltage		V_{OS}			4	8	μV
			-40°C ≤ TA ≤ +125°C			10	
Input Bias Current	MS8601/8602/8604	I_B			30	100	PA
	MS8604				100	300	PA
			-40°C ≤ TA ≤ +125°C			1.5	nA
Input Offset Current		I_{OS}	-40°C ≤ TA ≤ +125°C		40	250	pA
Input Voltage				0		5	V
Common-mode Rejection Ratio		CMRR	VCM = 0V to 5V	120	140		dB
			-40°C ≤ TA ≤ +125°C	115	130		
Large Signal Gain		A_{VO}	RL= 10kΩ, Vo= 0.3V to 4.7V	127	145		dB
			-40°C ≤ TA ≤ +125°C	120	135		
Input Offset Voltage Drift		$\Delta V_{OS}/\Delta T_A$	-40°C ≤ TA ≤ +125°C		0.03	0.05	μV/°C
Output Characteristics							
Output High Voltage		V_{OH}	RL = 100kΩ to -Vs	4.99	4.996		V
			RL = 10kΩ to -Vs	4.99	4.995		V
Output Low Voltage		V_{OL}	RL = 100kΩ to +Vs		1	5	mV
			-40°C ≤ TA ≤ +125°C		2	5	
			RL = 10kΩ to +Vs		10	20	mV
			-40°C ≤ TA ≤ +125°C		15	20	
Short-circuit Current		I_{SC}	Vo= 2.5V,RL = 10Ω to GND	25	50		mA
Output Current		Io			30		mA
			-40°C ≤ TA ≤ +125°C		15		mA
Power Dissipation							
Power Supply Rejection Ratio		PSRR	Vs =1.8V to 5.5V, -40°C ≤ TA ≤ +125°C	115	130		dB
Quiescent Current/Amplifier		I_Q	Vo = Vs/2		0.85	1.1	mA
Dynamic Characteristics							
Gain Bandwidth Product		GBP	Av = +100		3.8		MHz
Slew Rate		SR	Av = +1,RL = 10kΩ		2.1		V/μs
Overload Recovery Time					0.05		ms
Noise Characteristics							
Voltage Noise		$e_{n\ P-P}$	0.1Hz to 10Hz		0.50		μV_{p-p}
Voltage Noise Density		e_n	f = 1kHz		22		$nV/\sqrt{Hz}$
Current Noise Density		i_n	f = 10Hz		5		$fA/\sqrt{Hz}$

ELECTRICAL CHARACTERISTICS (2.7V)

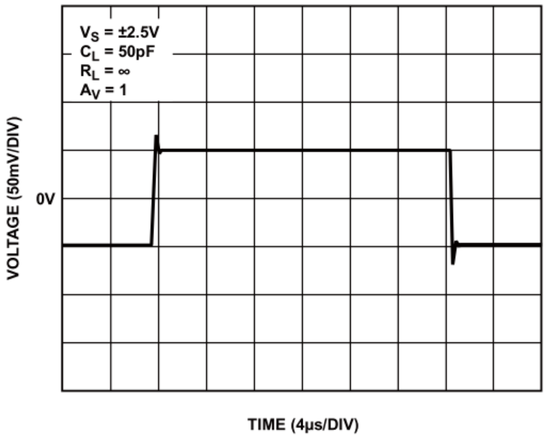
Unless otherwise noted, +Vs=2.7V, -Vs =0V,Vcm=1.35V, Vo=+1.35V, TA=25°C.

Parameter		Symbol	Condition	Min	Typ	Max	Unit
Input Characteristics							
Input Offset Voltage		V_{OS}			0.5	5	µV
			-40°C ≤ TA ≤ +125°C			10	µV
Input Bias Current		I_B			30	100	PA
	MS8604				100	300	PA
			-40°C ≤ TA ≤ +125°C		1.0	1.5	nA
Input Offset Current		I_{OS}	-40°C ≤ TA ≤ +125°C		50	250	pA
Input Voltage				0		2.7	V
Common-mode Rejection Ratio		CMRR	VCM = 0V to 2.7V	115	130		dB
			-40°C ≤ TA ≤ +125°C	110	120		dB
Large Signal Gain		A_{VO}	RL= 10kΩ, Vo= 0.3V to 2.4V	110	140		dB
			-40°C ≤ TA ≤ +125°C	105	130		dB
Input Offset Voltage Drift		$\Delta V_{OS}/\Delta T_A$	-40°C ≤ TA ≤ +125°C		0.03	0.05	µV/°C
Output Characteristics							
Output High Voltage		V_{OH}	RL = 100kΩ to -Vs	2.68	2.695		V
			RL = 10kΩ to -Vs	2.67	2.68		V
Output Low Voltage		V_{OL}	RL = 100kΩ to +Vs		1	5	mV
			-40°C ≤ TA ≤ +125°C		2	5	mV
			RL = 10kΩ to +Vs		10	20	mV
			-40°C ≤ TA ≤ +125°C		15	20	mV
Short-circuit Current		I_{SC}	Vo= 2.5V,RL = 10Ω to GND	10	15		mA
Output Current		Io			10		mA
			-40°C ≤ TA ≤ +125°C		5		mA
Power Dissipation							
Power Supply Rejection Ratio		PSRR	Vs =1.8V to 5.5V, -40°C ≤ TA ≤ +125°C	115	130		dB
Quiescent Current		I_Q	Vo = Vs/2		0.75	1.0	mA
			-40°C ≤ TA ≤ +125°C		0.9	1.2	mA
Dynamic Characteristics							
Gain Bandwidth Product		GBP	Av = +100		3.3		MHz
Slew Rate		SR	Av = +1,RL = 10kΩ		1.4		V/µs
Overload Recovery Time					0.05		ms
Noise Characteristics							
Voltage Noise		$e_{n\ P-P}$	0.1Hz to 10Hz		0.50		μV_{p-p}
Voltage Noise Density		e_n	f = 1kHz		22		$nV/\sqrt{Hz}$
Current Noise Density		i_n	f = 10Hz		5		$fA/\sqrt{Hz}$

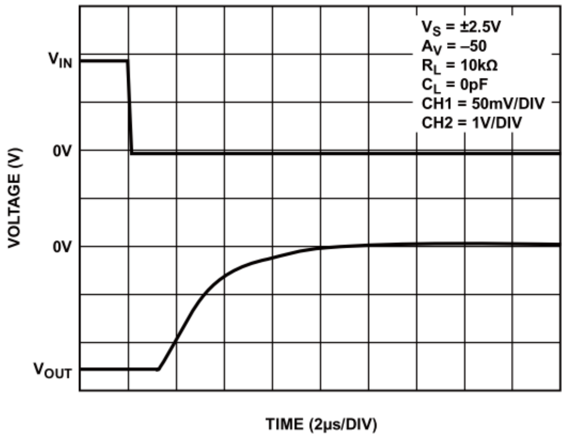
TYPICALC CURVES



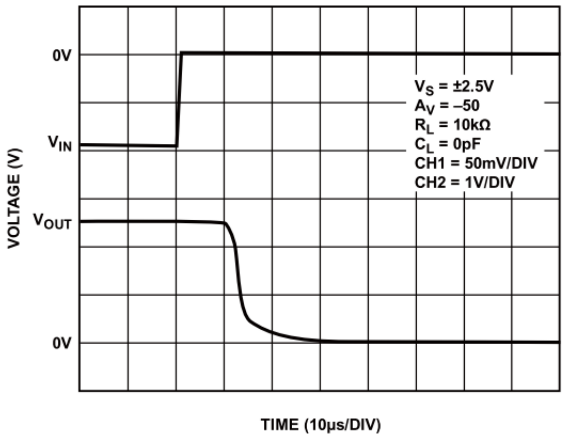
Small Signal Transient Response



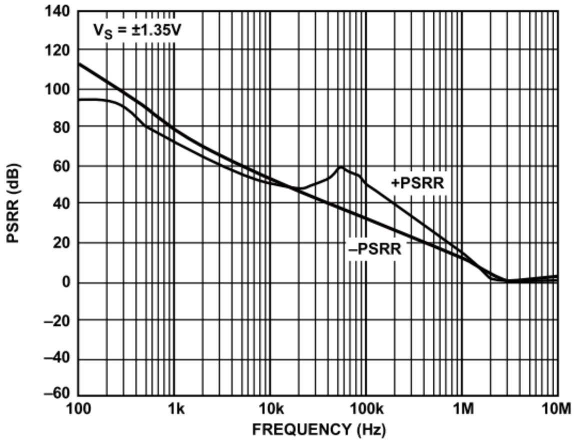
Small Signal Transient Response



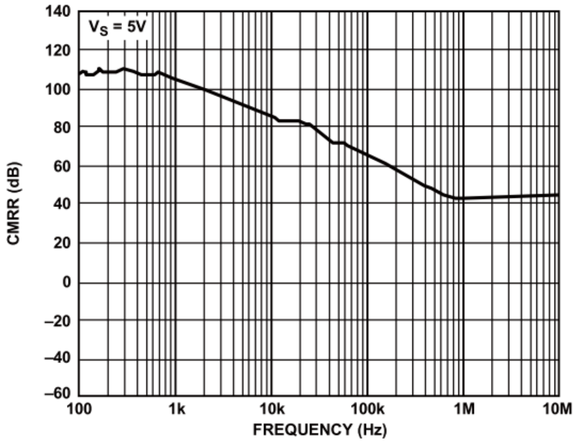
Positive Overvoltage Recovery Time



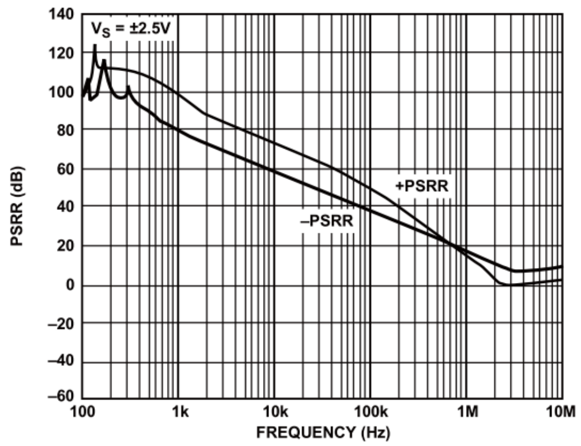
Negative Overvoltage Recovery Time



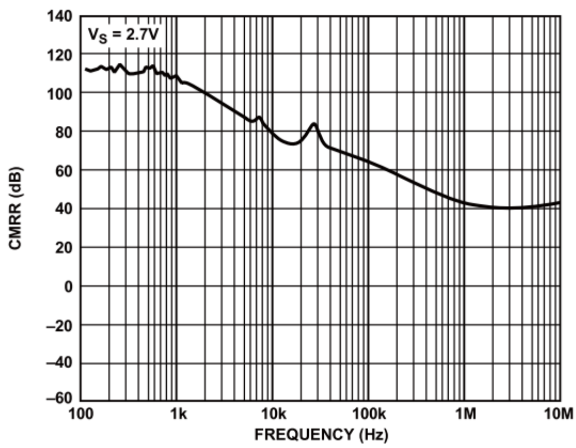
PSRR VS. Frequency



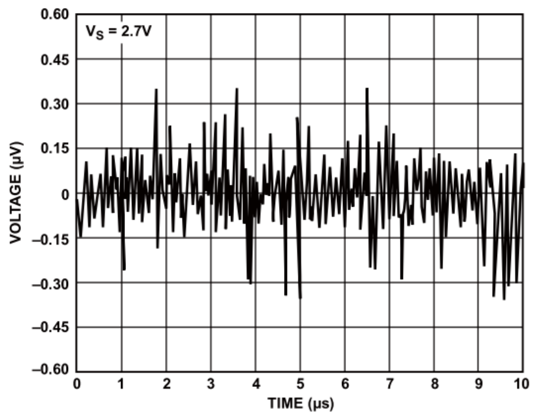
CMRR VS. Frequency



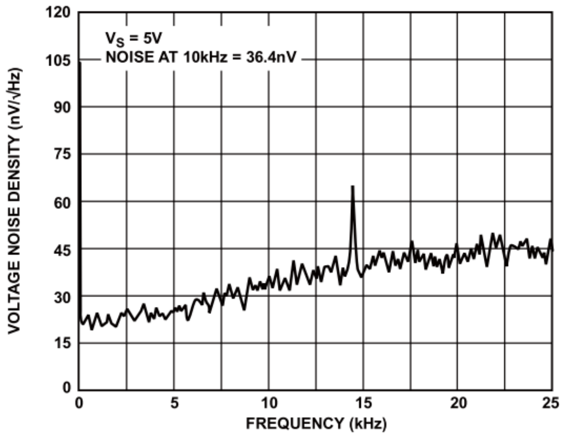
PSRR VS. Frequency



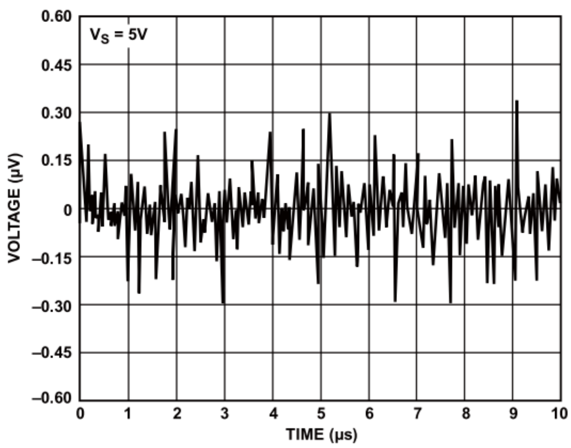
CMRR VS. Frequency



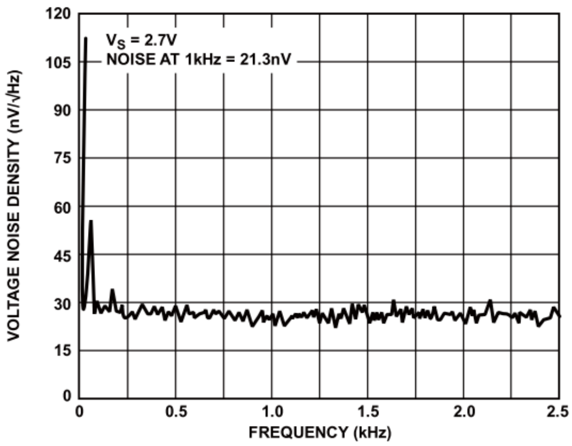
0.1Hz to 10Hz Noise



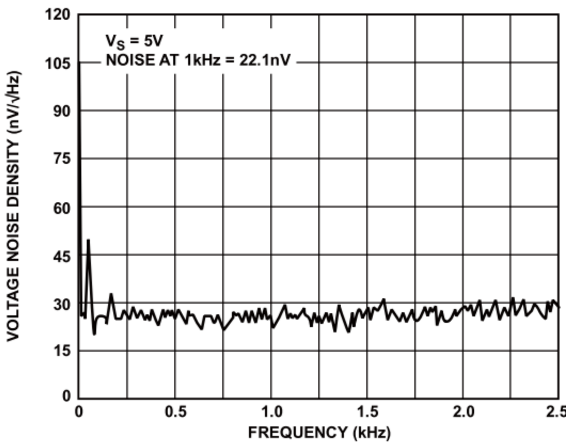
0Hzto 25kHz Voltage Noise Density on 5V



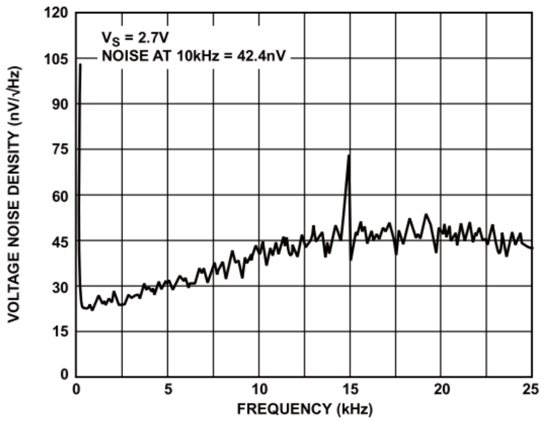
0.1Hz to 10Hz Noise



0Hz to 2.5kHz Voltage Noise Density on 2.7V



0Hz to 2.5kHz Voltage Noise Density on 5V



0Hz to 25kHz Voltage Noise Density on 2.7V

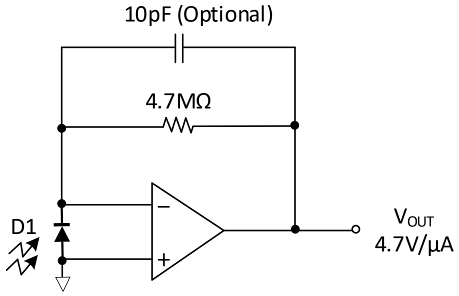
TYPICAL APPLICATIONS

High Source Impedance Application

The CMOS rail-to-rail input structure makes the input current ultra-low, the typical value 0.2 pA. Therefore, the MS860x could be used in some applications ,which have high source impedance or need large resistance around amplifier. For example, the low input bias current operational amplifier is required in photodiode amplifier circuit as shown below, in order to reduce output voltage error. The low input bias current and offset voltage of the MS8601 could reduce the offset error to the minimum. The current through the photodiode is directly proportional to the light power on surface. The 4.7MΩ resistance converts the current to voltage. Thus the MS8601 output increases at 4.7V/μA. The feedback capacitance constrains the circuit bandwidth to reduce excessive noise on high frequency:

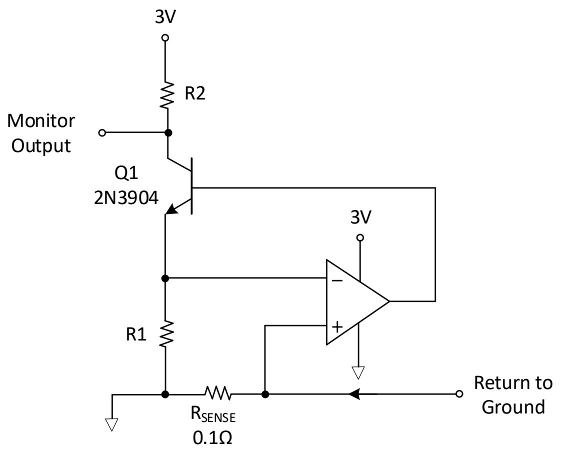
$$BW = \frac{1}{2\pi(4.7M\Omega)C_F}$$

The 10pF feedback capacitance could constrain the bandwidth to about 3.3 kHz.

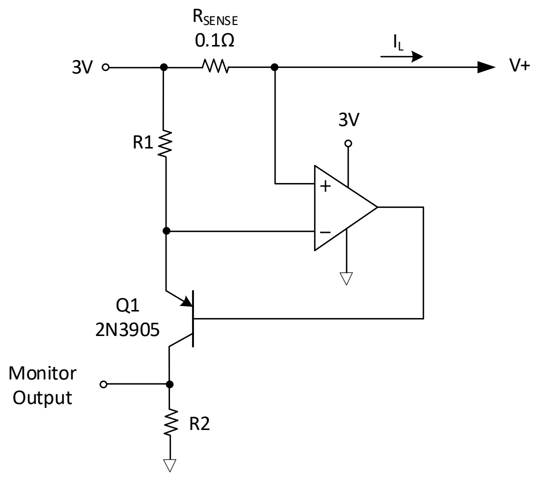


High-side and Low-side Precise Current Monitor

Due to the low input bias current and offset voltage, the MS860x could be applied to precise current monitor. The real rail-to-rail input characteristic allows the MS860x to monitor the current on high-side or low-side. Applying the two amplifiers of the MS8602, easily monitors current supply and return paths whether load or fault, as shown in following two circuits.



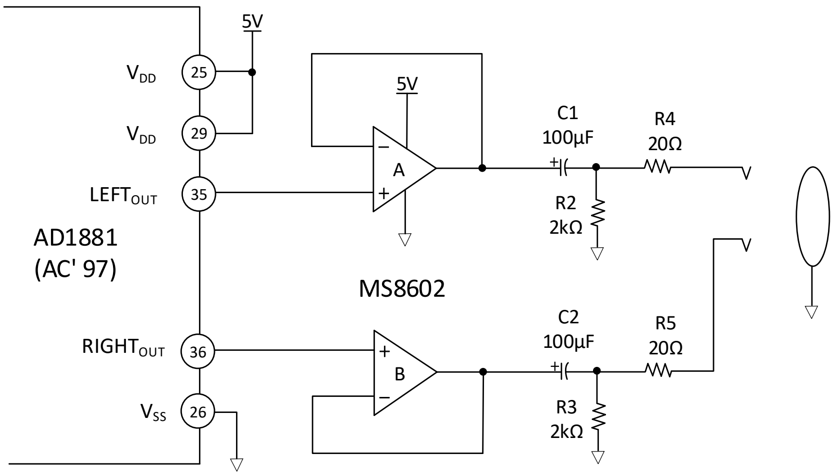
Low-side Current Monitor



High-side Current Monitor

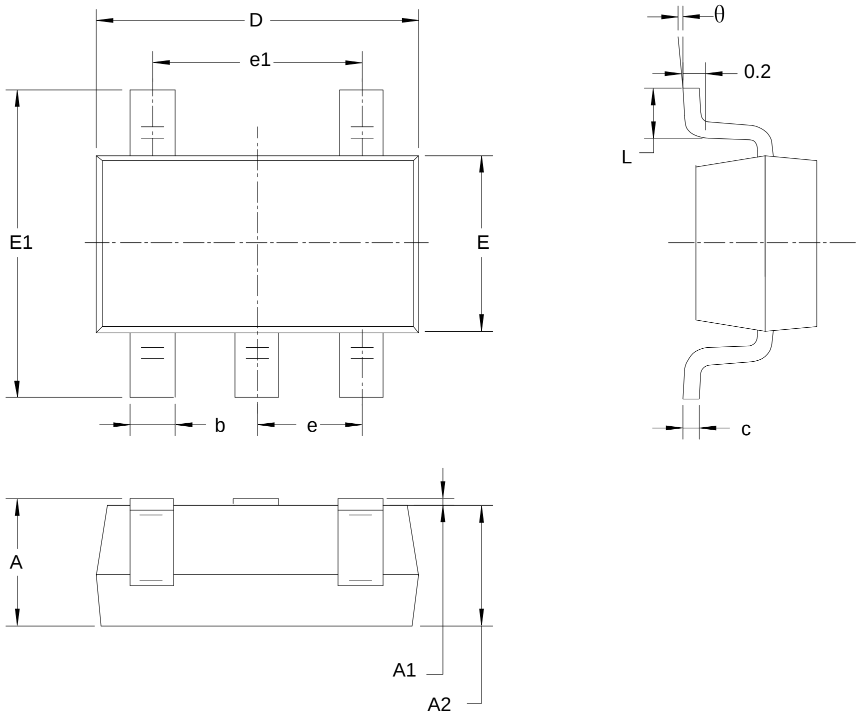
Compatible with PC100 Computer Audio Application

Because of low distortion and rail-to-rail input/output features, the MS860x is the optimal selection for various low cost and single power audio applications, from microphone magnifying to line output buffer. In unit gain,the typical THD+N is 0.004% or -86dB and the load resistance could be up to 600Ω. And it meets the PC100 specification about the requirements for portable and desktop computer audio. The following diagram shows the how to interface with AC'97 codec to drive line output. The MS8602 is used as unit gain buffer of the left and right outputs of the AC'97 code. The 100μF output coupling capacitor is used as blocking capacitor, and 20Ω series resistor protects amplifier from the jack short-circuit influence.



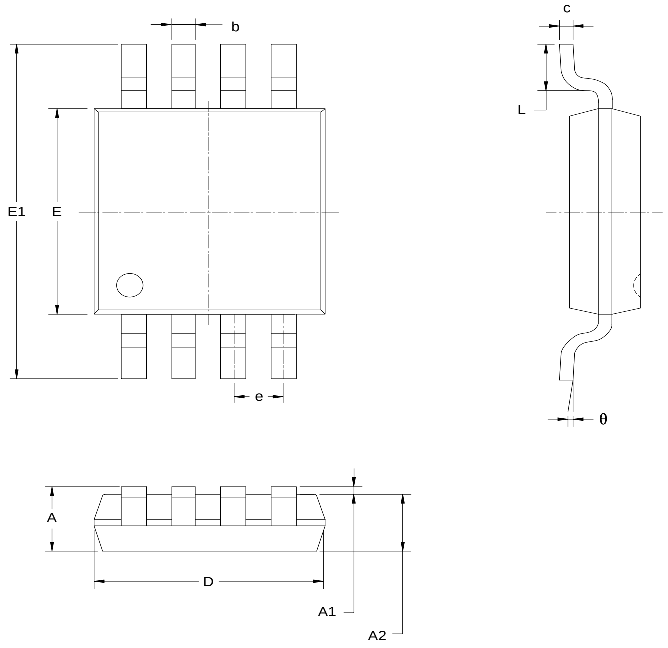
PACKAGE OUTLINE DIMENSIONS

SOT23-5



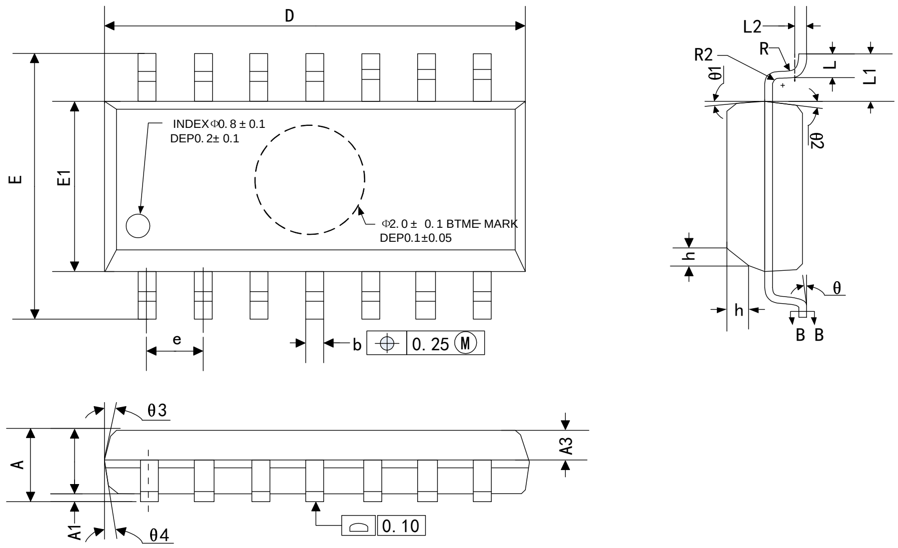
Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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

MSOP8



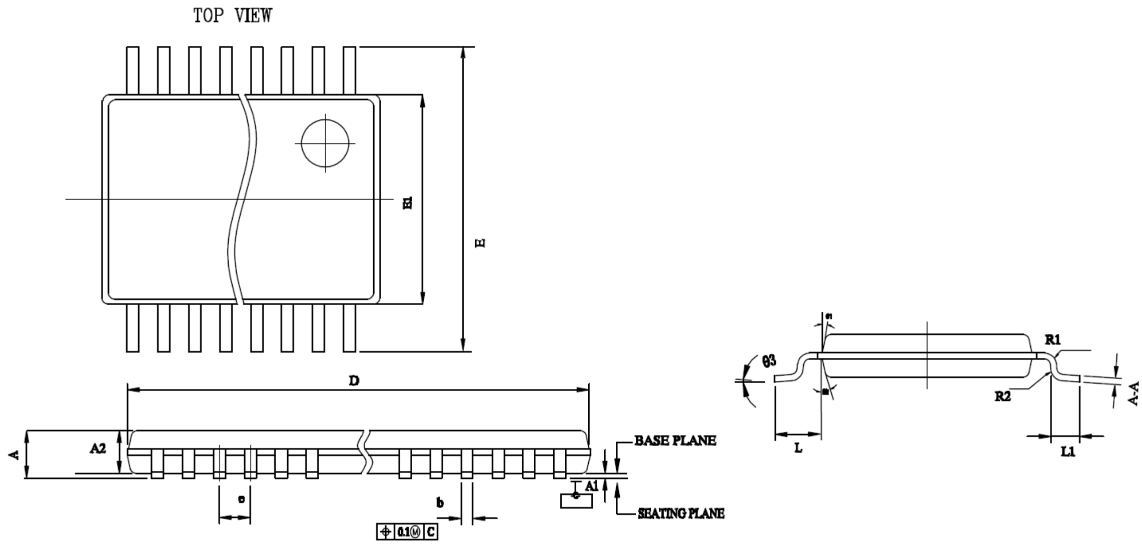
Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650BSC		0.026BSC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

SOP14



Symbol	Dimensions in Millimeters		
	Min	Typ	Max
A	1.35		1.75
A1	0.10		0.25
A2	1.25		1.65
A3	0.55		0.75
D	8.53		8.73
E	5.80		6.20
E1	3.80		4.00
e	1.27 BSC		
L	0.45		0.80
L1	1.04 REF		
L2	0.25 BSC		
R	0.07		
R1	0.07		
h	0.30		0.50
θ	0 º		8 º
θ1	6 º	8º	10 º
θ2	6 º	8º	10 º
θ3	5 º	7º	9 º
θ4	5 º	7º	9 º

TSSOP14



Symbol	Dimensions in Millimeters	
	Min	Max
A		1.2
A1	0.05	0.15
A2	0.8	1.05
E	6.25	6.55
E1	4.3	4.5
D	4.9	5.1
L		1
L1	0.45	0.75
e	0.65	
b	0.19	0.3
R1	0.15TYP	
R2	0.15TYP	
A-A	0.09	0.2
θ1	12°TYP	
θ2	12°TYP	
θ3	0	8°

MARKING and PACKAGING SPECIFICATIONS

1. Marking Drawing Description

Product Name： 8601, MS8602, MS8604, MS8604T

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
MS8601	SOT23-5	3000	10	30000	4	120000
MS8602	MSOP8	3000	1	3000	8	24000
MS8604	SOP14	2500	1	2500	8	20000
MS8604T	TSSOP14	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.

+86-571-89966911

Rm701, No.9 Building, No. 1 WeiYe Road, Puyan Street, Binjiang District, Hangzhou, Zhejiang

http:// www.relmon.com