# Low Power Dissipation, High-Precise, Rail-to-Rail Input and Output Operational Amplifier

PRODUCT DESCRIPTION

The MS8231/8232 is a single-channel or a dual-channel rail-to-rail input and output operational amplifier with single power supply. These characteristics like low power dissipation and high precision make itself suitable for battery-powered system and portable electronic system.

The MS8231/8232 has stable unit gain and 13kHz signal bandwidth, making itself suitable for battery current detection and sensor signal processing circuits.
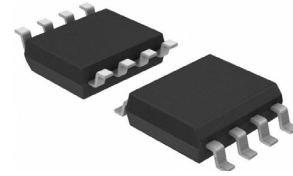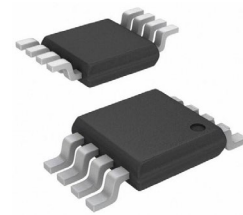
FEATURES

- Rail-to-Rail Input and Output
- Low Offset Voltage (Max): ±0.75mV
- Low Quiescent Current: 1µA
- Power Supply Voltage: 1.8V to 5.5V
- Gain Bandwidth: 13kHz
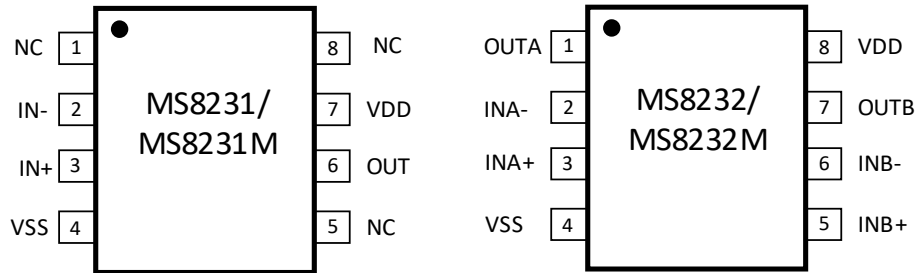- Temperature Range: -40°C to 120°C

APPLICATIONS

- Barcode Scanner
- Sensor
- Battery Current Detection
- Portable Electronic Product

PRODUCT SPECIFICATION

Part Number	Package	Marking
MS8231	SOP8	MS8231
*MS8231M	MSOP8	MS8231M
*MS8232	SOP8	MS8232
MS8232M	MSOP8	MS8232M

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

SOP8

MSOP8

PIN CONFIGURATION

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      MS8231/           MS8232/
      MS8231M           MS8232M

NC  1        8  NC   OUTA 1       8  VDD
IN- 2        7  VDD  INA- 2       7  OUTB
IN+ 3        6  OUT  INA+ 3       6  INB-
VSS 4        5  NC   VSS  4       5  INB+
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PIN DESCRIPTION

Pin	Name	Type	Description
MS8231/MS8231M			
1	NC	-	Not Connection
2	IN-	I	Negative Input
3	IN+	I	Positive Input
4	VSS	-	Negative Power Supply
5	NC	-	Not Connection
6	OUT	O	Channel Output
7	VDD	-	Positive Power Supply
8	NC	-	Not Connection
MS8232/MS8232M			
1	OUTA	O	Channel A Output
2	INA-	I	Negative Input (Channel A)
3	INA+	I	Positive Input (Channel A)
4	VSS	-	Negative Power Supply
5	INB+	I	Positive Input (Channel B)
6	INB-	I	Negative Input (Channel B)
7	OUTB	O	Channel B Output
8	VDD	-	Positive 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	$V_{DD}-V_{SS}$	7.0	V
Current on Input Pin		±2.0	mA
Analog Input	$V_{IN}+$, $V_{IN}-$	$V_{SS}-1.0 \sim V_{DD}+1.0$	V
Other Input and Output		$V_{SS}-0.3 \sim V_{DD}+0.3$	V
Differential Input Voltage		$|V_{DD}-V_{SS}|$	V
Current on Output and Power Supply Pins		±30	mA
Storage Temperature	T_{stg}	-60 ~ +150	°C
Operating Temperature Range	T_{opr}	-40 ~ +120	°C
ESD	HBM	>3k	V

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Range			Unit
		Min	Typ	Max	
Power Supply	V_{DD}	1.8	5	5.5	V

ELECTRICAL CHARACTERISTICS

V_{DD}=1.8V to 5.5V, V_{SS}=GND, V_{CM}=V_{DD}/2, V_{OUT}=V_{DD}/2, V_L=V_{DD}/2, R_L=1MΩ to V_L.

Unless otherwise noted, the temperature T_A=25°C±2°C.

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input Characteristics						
Input Offset Voltage	V_{OS}	V_{DD}=3V, V_{CM}=1.5V	-0.5		+0.5	mV
		V_{DD}=1.8V ~ 5.5V, V_{CM}=V_{DD}/2	-0.75		+0.75	
Input Bias Current	I_B	V_{DD}=5V		0.74		pA
		V_{DD}=1.8V		0.36		
Input Offset Current	I_{OS}	V_{DD}=5V		0.15		pA
		V_{DD}=1.8V		0.18		
Common-mode Rejection Ratio	CMRR	-0.3V< V_{CM} <2.1V, V_{DD}=1.8V	67	80		dB
		-0.3V< V_{CM} <5.8V, V_{DD}=5.5V	80	90		
		2.75V< V_{CM} <5.8V, V_{DD}=5.5V	70	89		
		-0.3V< V_{CM} <2.75V, V_{DD}=5.5V	72	93		
Common-mode Input Voltage Range	VCMR		-0.3		5.8	V
Large Signal Gain	A_{OL}	R_L= 50kΩ to V_L, 0.2V< V_{OUT} <(V_{DD}-0.2V)	95			dB
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta_T$	-40°C to 120°C		±3.0		µV/°C
Input Impedance	Z_{DIFF}			1013||6		Ω||pF
	Z_{CM}			1013||6		Ω||pF
Output Characteristics						
Output High-level Voltage	V_{OH}	R_L= 50kΩ to V_L		V_{DD}-10		mV
Output Low-level Voltage	V_{OL}	R_L= 50kΩ to V_L		V_{SS}+10		mV
Output Short-circuit Current	I_{SC}	V_{DD}=1.8V, V_{IN+}=1V, V_{IN-}=1.8V		±6		mA
		V_{DD}=1.8V, V_{IN+}=1.8V, V_{IN-}=1V		±8		
		V_{DD}=5.5V, V_{IN+}=2V, V_{IN-}=1V		±25		
		V_{DD}=5.5V, V_{IN+}=1V, V_{IN-}=2V		±52		
Power Supply						
Power Supply	V_{DD}		1.8		5.5	V
Power Supply Rejection Ratio	PSRR	V_{CM}= V_{SS}	70	92		dB
Quiescent Current/Amplifier	I_{SY}	I_O=0, V_{CM}= V_{DD}, V_{DD}=5.5V		1	1.4	µA

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Dynamic Characteristics						
Gain Bandwidth	GBW	VDD=5V, AV=1, VPP=2V, -3dB		13		kHz
Slew Rate	SR	RL= 1MΩ, CL=65pF, Rising Edge		3		V/ms
	SR	RL= 1MΩ, CL=65pF, Falling Edge		5		V/ms
Phase Margin	Φ_O			65		Deg
Noise Characteristics						
Input Voltage Noise	en p-p	f=0.1Hz to 10Hz		5		µVp-p
Voltage Noise Density	en	f = 1kHz		165		$nV/\sqrt{Hz}$
Current Noise Density	in	f = 1kHz		0.6		$fA/\sqrt{Hz}$

TYPICAL APPLICATION

Battery Current Detection

This kind of amplifier has wide common-mode input voltage, which is suitable for being used in high-side and low-side battery current detector. Its ultra-low quiescent current can prolong battery life. And its rail-to-rail output can be used to detect low current.

The battery current detection circuit is shown in Figure 1. 10Ω resistance minimizes power dissipation. Battery current, I_{DD} passes through 10Ω resistor and causes voltage drop. The common-mode input voltage of operational amplifier is kept below V_{DD} within the allowable range. Within the maximum output voltage range, the output is also below V_{DD}.
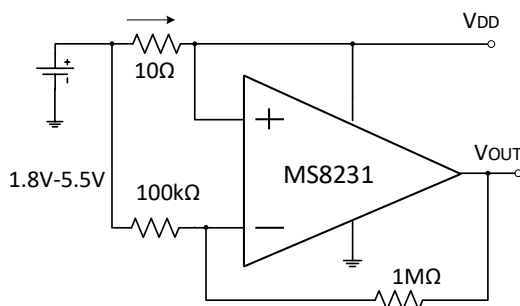
$$I_{DD} = \frac{V_{DD} - V_{OUT}}{(10V/V) \times (10\Omega)}$$

Figure 1. Battery Current Detection Circuit

High-Precision Comparator

In front end of comparator, operational amplifier with high gain can be used to improve the input offset performance and precision. The circuit diagram is shown in Figure 2, the gain is 11V/V.
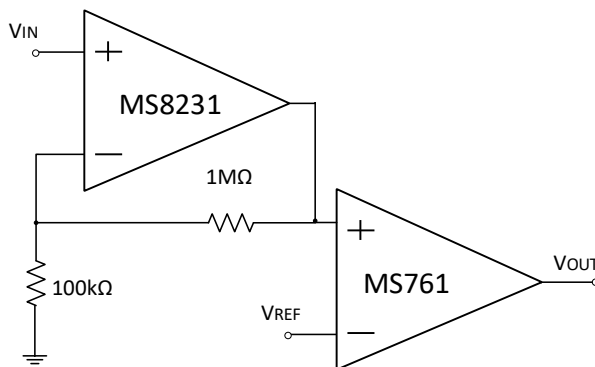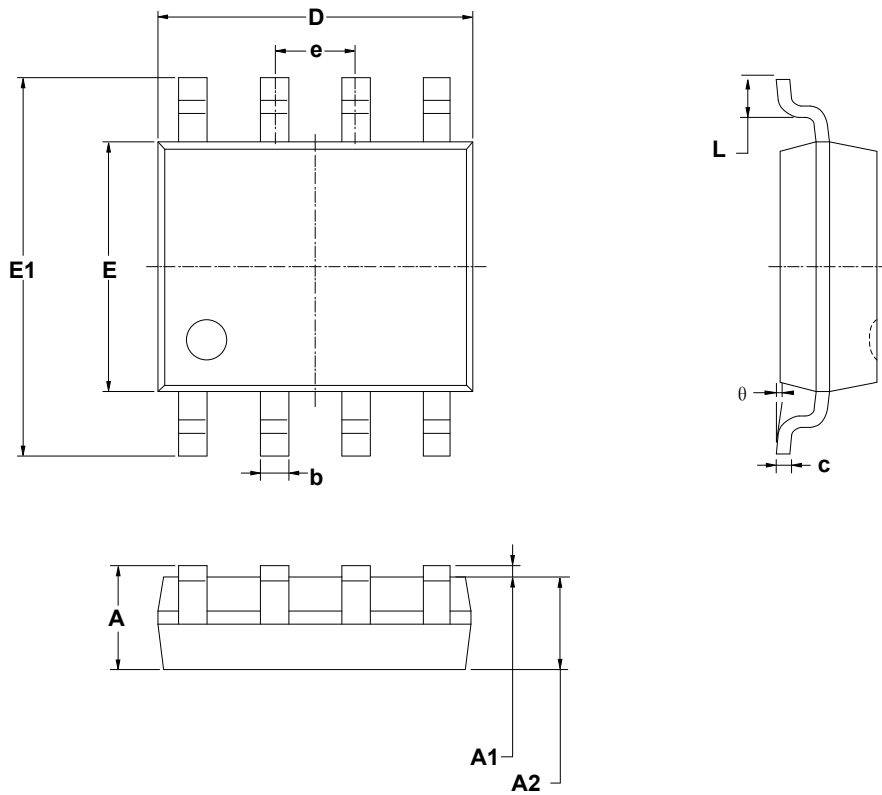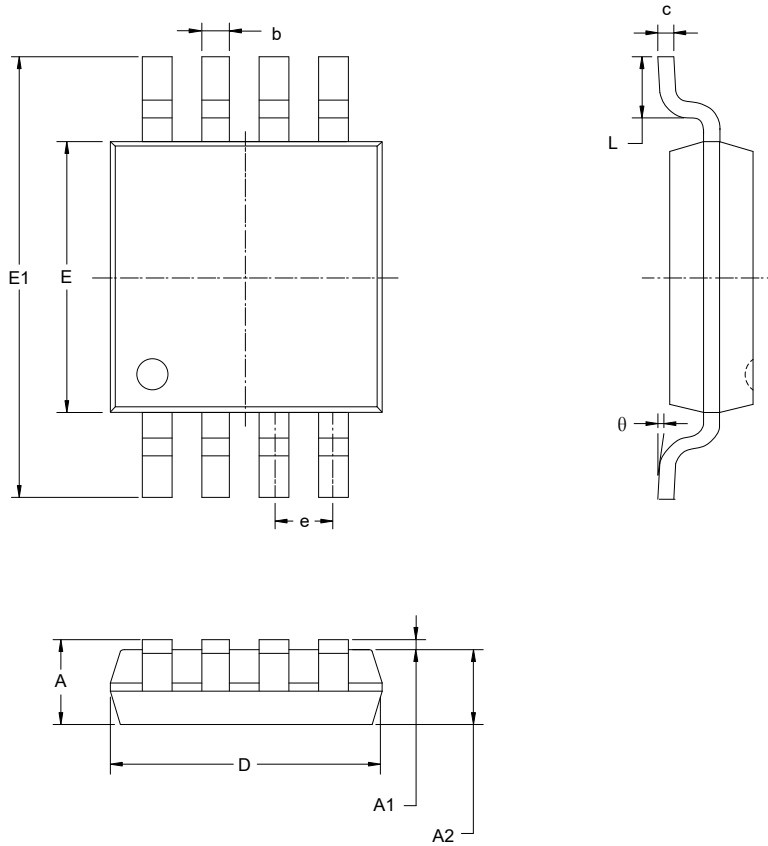
Figure 2. High-precision Comparator

PACKAGE OUTLINE DIMENSIONS

SOP8

Symbol	Dimensions in Millimeters		
	Min	Typ	Max
A	-	-	1.75
A1	0.10	-	0.225
A2	1.30	1.40	1.50
b	0.39	-	0.47
c	0.20	-	0.24
D	4.80	4.90	5.00
E	3.80	3.90	4.00
E1	5.80	6.00	6.20
e	1.27BSC		
L	0.50	-	0.80
θ	0°	-	8°

MSOP8

Symbol	Dimensions in Millimeters		
	Min	Typ	Max
A	-	-	1.10
A1	0.05	-	0.15
A2	0.75	0.85	0.95
b	0.28	-	0.36
c	0.15	-	0.19
D	2.90	3.00	3.10
E	2.90	3.00	3.10
E1	4.70	4.90	5.10
e	0.65BSC		
L	0.40	-	0.70
θ	0°	-	8°

MARKING and PACKAGING SPECIFICATION

1. Marking Drawing Description
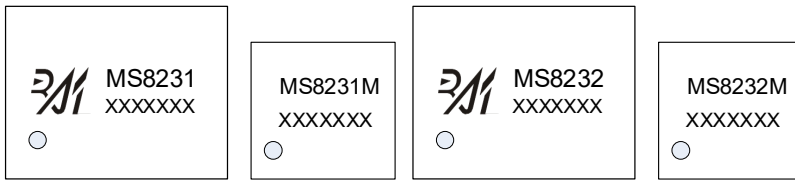
Product Name: MS8231, MS8231M, MS8232, MS8232M

Product Code: XXXXXXX

2. Marking Drawing Demand

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

3. Packaging Specification

Device	Package	Piece/Reel	Reel/Box	Piece/Box	Box/Carton	Piece/Carton
MS8231	SOP8	2500	1	2500	8	20000
MS8231M	MSOP8	3000	1	3000	8	24000
MS8232	SOP8	2500	1	2500	8	20000
MS8232M	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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