



MICROCHIP MCP6231/1R/1U/2/4

20 μ A, 300 kHz Rail-to-Rail Op Amp

Features

- Gain Bandwidth Product: 300 kHz (typical)
- Supply Current: $I_Q = 20 \mu\text{A}$ (typical)
- Supply Voltage: 1.8V to 6.0V
- Rail-to-Rail Input/Output
- Extended Temperature Range: -40°C to $+125^\circ\text{C}$
- Available in 5-Pin SC-70 and SOT-23 packages

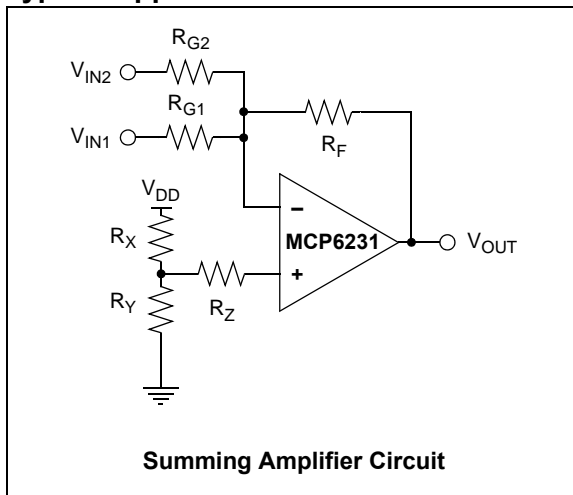
Applications

- Automotive
- Portable Equipment
- Transimpedance amplifiers
- Analog Filters
- Notebooks and PDAs
- Battery-Powered Systems

Design Aids

- SPICE Macro Models
- FilterLab[®] Software
- Mindi[™] Circuit Designer & Simulator
- Microchip Advanced Part Selector (MAPS)
- Analog Demonstration and Evaluation Boards
- Application Notes

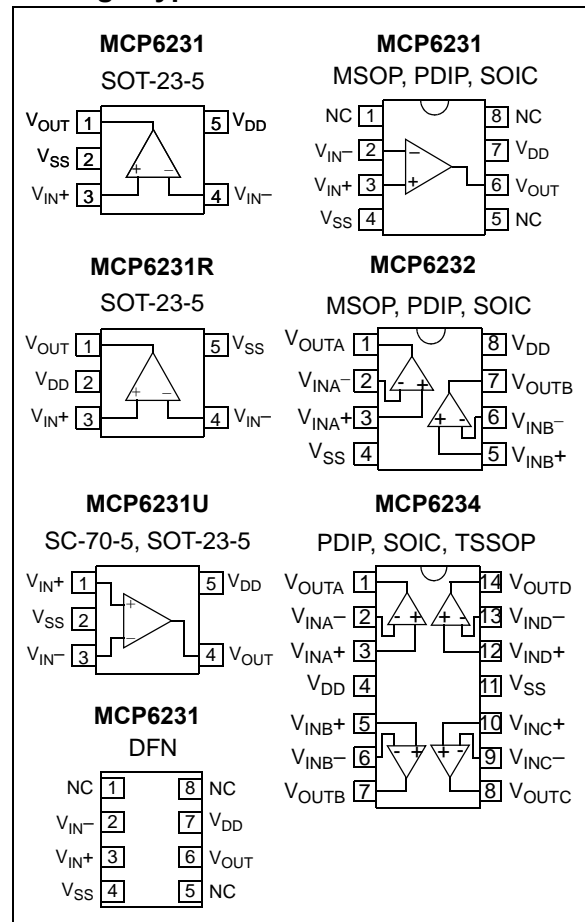
Typical Application



Description

The Microchip Technology Inc. MCP6231/1R/1U/2/4 operational amplifiers (op amps) provide wide bandwidth for the quiescent current. The MCP6231/1R/1U/2/4 family has a 300 kHz gain bandwidth product and 65°C (typical) phase margin. This family operates from a single supply voltage as low as 1.8V, while drawing 20 μA (typical) quiescent current. In addition, the MCP6231/1R/1U/2/4 family supports rail-to-rail input and output swing, with a common mode input voltage range of $V_{DD} + 300 \text{ mV}$ to $V_{SS} - 300 \text{ mV}$. These op amps are designed in one of Microchip's advanced CMOS processes.

Package Types



MCP6231/1R/1U/2/4

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

$V_{DD} - V_{SS}$	7.0V
Current at Analog Input Pins (V_{IN+} , V_{IN-})	± 2 mA
Analog Inputs (V_{IN+} , V_{IN-}) ††	$V_{SS} - 1.0V$ to $V_{DD} + 1.0V$
All Other Inputs and Outputs	$V_{SS} - 0.3V$ to $V_{DD} + 0.3V$
Difference Input Voltage	$ V_{DD} - V_{SS} $
Output Short Circuit Current	Continuous
Current at Output and Supply Pins	± 30 mA
Storage Temperature	$-65^{\circ}C$ to $+150^{\circ}C$
Maximum Junction Temperature (T_J)	$+150^{\circ}C$
ESD Protection On All Pins (HBM; MM)	≥ 4 kV; 300V

† **Notice:** Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

†† See Section 4.1.2 “Input Voltage and Current Limits”.

DC ELECTRICAL CHARACTERISTICS

Electrical Characteristics: Unless otherwise indicated, $T_A = +25^{\circ}C$, $V_{DD} = +1.8V$ to $+5.5V$, $V_{SS} = GND$, $V_{CM} = V_{DD}/2$, $R_L = 100$ k Ω to $V_{DD}/2$ and $V_{OUT} \approx V_{DD}/2$.						
Parameters	Sym	Min	Typ	Max	Units	Conditions
Input Offset						
Input Offset Voltage	V_{OS}	-5.0	—	+5.0	mV	$V_{CM} = V_{SS}$
Extended Temperature	V_{OS}	-7.0	—	+7.0	mV	$T_A = -40^{\circ}C$ to $+125^{\circ}C$, $V_{CM} = V_{SS}$ (Note)
Input Offset Drift with Temperature	$\Delta V_{OS}/\Delta T_A$	—	± 3.0	—	$\mu V/^{\circ}C$	$T_A = -40^{\circ}C$ to $+125^{\circ}C$, $V_{CM} = V_{SS}$
Power Supply Rejection Ratio	PSRR	—	83	—	dB	$V_{CM} = V_{SS}$
Input Bias Current and Impedance						
Input Bias Current:	I_B	—	± 1.0	—	pA	
At Temperature	I_B	—	20	—	pA	$T_A = +85^{\circ}C$
At Temperature	I_B	—	1100	—	pA	$T_A = +125^{\circ}C$
Input Offset Current	I_{OS}	—	± 1.0	—	pA	
Common Mode Input Impedance	Z_{CM}	—	$10^{13} 6$	—	ΩpF	
Differential Input Impedance	Z_{DIFF}	—	$10^{13} 3$	—	ΩpF	
Common Mode						
Common Mode Input Range	V_{CMR}	$V_{SS} - 0.3$	—	$V_{DD} + 0.3$	V	
Common Mode Rejection Ratio	CMRR	61	75	—	dB	$V_{CM} = -0.3V$ to $5.3V$, $V_{DD} = 5V$
Open-Loop Gain						
DC Open-Loop Gain (large signal)	A_{OL}	90	110	—	dB	$V_{OUT} = 0.3V$ to $V_{DD} - 0.3V$, $V_{CM} = V_{SS}$
Output						
Maximum Output Voltage Swing	V_{OL} , V_{OH}	$V_{SS} + 35$	—	$V_{DD} - 35$	mV	$R_L = 10$ k Ω , 0.5V Input Overdrive
Output Short-Circuit Current	I_{SC}	—	± 6	—	mA	$V_{DD} = 1.8V$
	I_{SC}	—	± 23	—	mA	$V_{DD} = 5.5V$
Power Supply						
Supply Voltage	V_{DD}	1.8	—	6.0	V	
Quiescent Current per Amplifier	I_Q	10	20	30	μA	$I_O = 0$, $V_{CM} = V_{DD} - 0.5V$

Note 1: The SC-70 package is only tested at $+25^{\circ}C$.

Note 2: All parts with date codes February 2007 and later have been screened to ensure operation at $V_{DD} = 6.0V$. However, the other minimum and maximum specifications are measured at 1.8V and 5.5V

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AC ELECTRICAL CHARACTERISTICS

Electrical Characteristics: Unless otherwise indicated, $T_A = +25^\circ\text{C}$, $V_{DD} = +1.8$ to 5.5V , $V_{SS} = \text{GND}$, $V_{CM} = V_{DD}/2$, $V_{OUT} \approx V_{DD}/2$, $R_L = 100\text{ k}\Omega$ to $V_{DD}/2$ and $C_L = 60\text{ pF}$.

Parameters	Sym	Min	Typ	Max	Units	Conditions
AC Response						
Gain Bandwidth Product	GBWP	—	300	—	kHz	
Phase Margin	PM	—	65	—	°	$G = +1\text{ V/V}$
Slew Rate	SR	—	0.15	—	$\text{V}/\mu\text{s}$	
Noise						
Input Noise Voltage	E_{ni}	—	6.0	—	$\mu\text{V}_{\text{P-P}}$	$f = 0.1\text{ Hz to }10\text{ Hz}$
Input Noise Voltage Density	e_{ni}	—	52	—	$\text{nV}/\sqrt{\text{Hz}}$	$f = 1\text{ kHz}$
Input Noise Current Density	i_{ni}	—	0.6	—	$\text{fA}/\sqrt{\text{Hz}}$	$f = 1\text{ kHz}$

TEMPERATURE CHARACTERISTICS

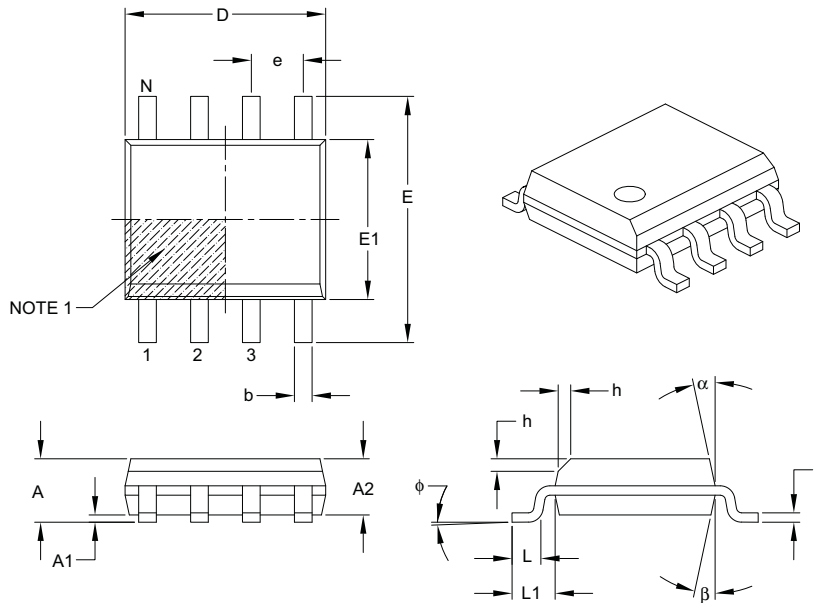
Electrical Characteristics: Unless otherwise indicated, $V_{DD} = +1.8\text{V}$ to $+5.5\text{V}$ and $V_{SS} = \text{GND}$.

Parameters	Sym	Min	Typ	Max	Units	Conditions
Temperature Ranges						
Extended Temperature Range	T_A	-40	—	+125	°C	
Operating Temperature Range	T_A	-40	—	+125	°C	Note
Storage Temperature Range	T_A	-65	—	+150	°C	
Thermal Package Resistances						
Thermal Resistance, 5L-SC70	θ_{JA}	—	331	—	°C/W	
Thermal Resistance, 5L-SOT-23	θ_{JA}	—	256	—	°C/W	
Thermal Resistance, 8L-DFN	θ_{JA}	—	84.5	—	°C/W	
Thermal Resistance, 8L-MSOP	θ_{JA}	—	206	—	°C/W	
Thermal Resistance, 8L-PDIP	θ_{JA}	—	85	—	°C/W	
Thermal Resistance, 8L-SOIC	θ_{JA}	—	163	—	°C/W	
Thermal Resistance, 14L-PDIP	θ_{JA}	—	70	—	°C/W	
Thermal Resistance, 14L-SOIC	θ_{JA}	—	120	—	°C/W	
Thermal Resistance, 14L-TSSOP	θ_{JA}	—	100	—	°C/W	

Note: The internal Junction Temperature (T_J) must not exceed the Absolute Maximum specification of $+150^\circ\text{C}$.

MCP6231/1R/1U/2/4

8-Lead Plastic Small Outline (SN) – Narrow, 3.90 mm Body [SOIC]



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	1.27 BSC		
Overall Height	A	–	–	1.75
Molded Package Thickness	A2	1.25	–	–
Standoff §	A1	0.10	–	0.25
Overall Width	E	6.00 BSC		
Molded Package Width	E1	3.90 BSC		
Overall Length	D	4.90 BSC		
Chamfer (optional)	h	0.25	–	0.50
Foot Length	L	0.40	–	1.27
Footprint	L1	1.04 REF		
Foot Angle	ϕ	0°	–	8°
Lead Thickness	c	0.17	–	0.25
Lead Width	b	0.31	–	0.51
Mold Draft Angle Top	α	5°	–	15°
Mold Draft Angle Bottom	β	5°	–	15°

Notes:

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- § Significant Characteristic.
- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15 mm per side.
- Dimensioning and tolerancing per ASME Y14.5M.

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-057B

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

<u>PART NO.</u>	<u>X</u>	<u>-X</u>	<u>/XX</u>	Examples:
Device	Tape and Reel and/or Alternate Pinout	Temperature Range	Package	
<p>Device:</p> <p>MCP6231: Single Op Amp (MSOP, PDIP, SOIC) MCP6231T: Single Op Amp (Tape and Reel) (MSOP, SOIC, SOT-23) MCP6231RT: Single Op Amp (Tape and Reel) (SOT-23) MCP6231UT: Single Op Amp (Tape and Reel) (SC-70, SOT-23) MCP6232: Dual Op Amp MCP6232T: Dual Op Amp (Tape and Reel) (MSOP, SOIC) MCP6234: Quad Op Amp MCP6234T: Quad Op Amp (Tape and Reel) (TSSOP, SOIC)</p> <p>Temperature Range: E = -40° C to +125° C</p> <p>Package:</p> <p>LT = Plastic Package (SC-70), 5-lead (MCP6231U only) MC = Plastic Dual Flat No-Lead (DFN) 2x3, 8-lead (MCP6231 only) MS = Plastic Micro Small Outline (MSOP), 8-lead P = Plastic DIP (300 mil Body), 8-lead, 14-lead OT = Plastic Small Outline Transistor (SOT-23), 5-lead (MCP6231, MCP6231R, MCP6231U) SN = Plastic SOIC (150 mil Body), 8-lead SL = Plastic SOIC (150 mil Body), 14-lead ST = Plastic TSSOP (4.4 mil Body), 14-lead</p>				<p>a) MCP6231-E/MC: Extended Temperature 8LD DFN package.</p> <p>b) MCP6231-E/MS: Extended Temperature 8LD MSOP package.</p> <p>c) MCP6231UT-E/LT: Tape and Reel, Extended Temperature 5LD SC-70 package</p> <p>d) MCP6231-E/P: Extended Temperature 8LD PDIP package.</p> <p>e) MCP6231RT-E/OT: Tape and Reel, Extended Temperature 5LD SOT-23 package</p> <p>f) MCP6231UT-E/OT: Tape and Reel, Extended Temperature 5LD SOT-23.</p> <p>g) MCP6231-E/SN: Extended Temperature 8LD SOIC package.</p> <p>a) MCP6232-E/SN: Extended Temperature 8LD SOIC package.</p> <p>b) MCP6232-E/MS: Extended Temperature 8LD MSOP package.</p> <p>c) MCP6232-E/P: Extended Temperature 8LD PDIP package</p> <p>d) MCP6232T-E/SN: Tape and Reel, Extended Temperature 8LD SOIC package</p> <p>a) MCP6234-E/P: Extended Temperature 14LD PDIP package</p> <p>b) MCP6234-E/SL: Extended Temperature 14LD SOIC package</p> <p>c) MCP6234-E/ST: Extended Temperature, 14LD TSSOP package</p> <p>d) MCP6234T-E/SL: Tape and Reel, Extended Temperature 14LD SOIC package</p> <p>e) MCP6234T-E/ST: Tape and Reel, Extended Temperature 14LD TSSOP package</p>