MCP6241/1R/1U/2/4

50 µA, 550 kHz Rail-to-Rail Op Amp

Features

- Gain Bandwidth Product: 550 kHz (typical)
- Supply Current: I_Q = 50 µA (typical)
- Supply Voltage: 1.8V to 5.5V
- Rail-to-Rail Input/Output
- Extended Temperature Range: -40°C to +125°C
- Available in 5-pin SC-70 and SOT-23 packages

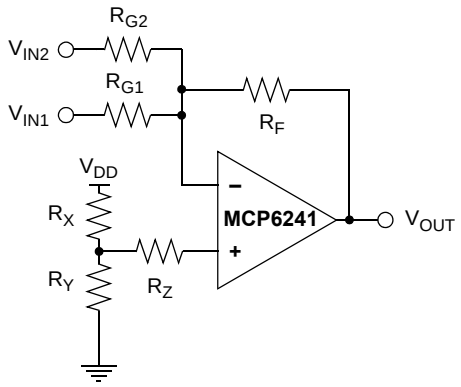
Applications

- Automotive
- Portable Equipment
- Photodiode (Transimpedance) Amplifier
- Analog Filters
- Notebooks and PDAs
- Battery-Powered Systems

Design Aids

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

Typical Application



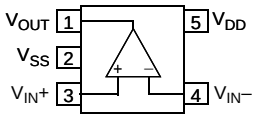
Summing Amplifier Circuit

Description

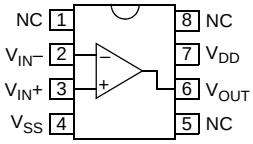
The Microchip Technology Inc. MCP6241/1R/1U/2/4 operational amplifiers (op amps) provide wide bandwidth for the quiescent current. The MCP6241/1R/1U/2/4 has a 550 kHz gain bandwidth product and 68° (typical) phase margin. This family operates from a single supply voltage as low as 1.8V, while drawing 50 µA (typical) quiescent current. In addition, the MCP6241/1R/1U/2/4 family supports rail-to-rail input and output swing, with a common mode input voltage range of V_{DD} + 300 mV to V_{SS} – 300 mV. These op amps are designed in one of Microchip's advanced CMOS processes.

Package Types

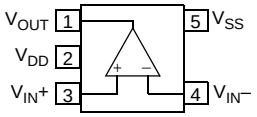
MCP6241
SOT-23-5



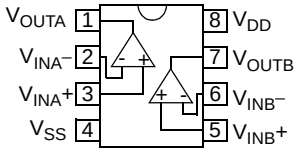
MCP6241
PDIP, SOIC, MSOP



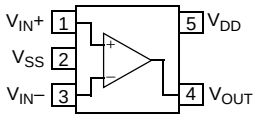
MCP6241R
SOT-23-5



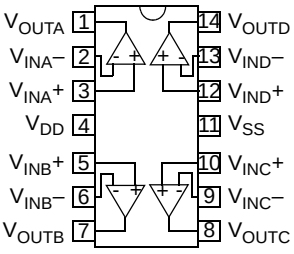
MCP6242
PDIP, SOIC, MSOP



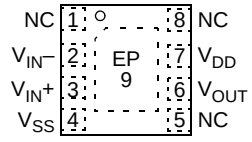
MCP6241U
SC-70-5, SOT-23-5



MCP6244
PDIP, SOIC, TSSOP



MCP6241
2x3 DFN*



* Includes Exposed Thermal Pad (EP); see Table 3-1.

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° C to +150°C
Maximum Junction Temperature (T_J).....+150°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°C, V_{DD} = +1.8V to +5.5V, V_{SS} = GND, $V_{CM} = V_{DD}/2$, R_L = 100 kΩ 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°C to +125°C, $V_{CM} = V_{SS}$ **(Note 1)**
Input Offset Drift with Temperature	$\Delta V_{OS}/\Delta T_A$	—	±3.0	—	µV/°C	T_A= -40°C to +125°C, $V_{CM} = V_{SS}$
Power Supply Rejection	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°C
At Temperature	I_B	—	1100	—	pA	T_A = +125°C
Input Offset Current	I_{OS}	—	±1.0	—	pA	
Common Mode Input Impedance	Z_{CM}	—	10^{13}||6	—	Ω||pF	
Differential Input Impedance	Z_{DIFF}	—	10^{13}||3	—	Ω||pF	
Common Mode						
Common Mode Input Range	V_{CMR}	V_{SS} – 0.3	—	V_{DD} + 0.3	V	
Common Mode Rejection Ratio	CMRR	60	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 kΩ, 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	—	5.5	V	
Quiescent Current per Amplifier	I_Q	30	50	70	µA	I_O = 0, $V_{CM} = V_{DD}$ – 0.5V

Note 1: The SC-70 package is only tested at +25°C.

AC ELECTRICAL CHARACTERISTICS

Electrical Characteristics: Unless otherwise indicated, T_A = +25°C, V_{DD} = +1.8 to 5.5V, V_{SS} = GND, V_{CM} = V_{DD}/2, V_{OUT} ≈ V_{DD}/2, R_L = 10 kΩ to V_{DD}/2 and C_L = 60 pF.

Parameters	Sym	Min	Typ	Max	Units	Conditions
AC Response						
Gain Bandwidth Product	GBWP	—	550	—	kHz	
Phase Margin	PM	—	68	—	°	G = +1 V/V
Slew Rate	SR	—	0.30	—	V/µs	
Noise						
Input Noise Voltage	E_{ni}	—	10	—	μV_{P-P}	f = 0.1 Hz to 10 Hz
Input Noise Voltage Density	e_{ni}	—	45	—	nV/√Hz	f = 1 kHz
Input Noise Current Density	i_{ni}	—	0.6	—	fA/√Hz	f = 1 kHz

TEMPERATURE CHARACTERISTICS

Electrical Characteristics: Unless otherwise indicated, V_{DD} = +1.8V to +5.5V and V_{SS} = 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 (2x3)	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°C.

1.1 Test Circuits

The test circuits used for the DC and AC tests are shown in Figure 1-1 and Figure 1-2. The bypass capacitors are laid out according to the rules discussed in **Section 4.6 "PCB Surface Leakage"**.

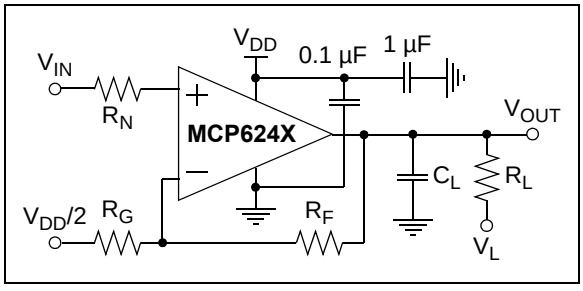


FIGURE 1-1: *AC and DC Test Circuit for Most Non-Inverting Gain Conditions.*

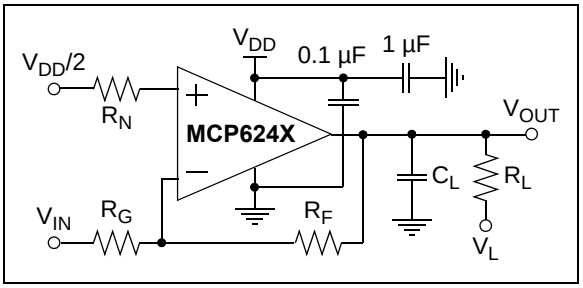
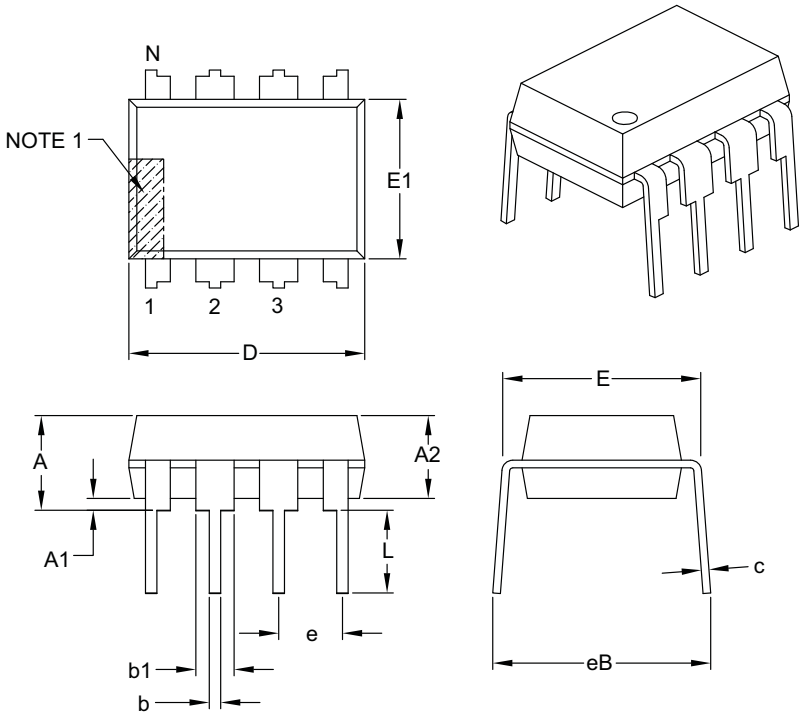


FIGURE 1-2: *AC and DC Test Circuit for Most Inverting Gain Conditions.*

8-Lead Plastic Dual In-Line (P) – 300 mil Body [PDIP]



Units		INCHES		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		8	
Pitch	e		.100 BSC	
Top to Seating Plane	A	–	–	.210
Molded Package Thickness	A2	.115	.130	.195
Base to Seating Plane	A1	.015	–	–
Shoulder to Shoulder Width	E	.290	.310	.325
Molded Package Width	E1	.240	.250	.280
Overall Length	D	.348	.365	.400
Tip to Seating Plane	L	.115	.130	.150
Lead Thickness	c	.008	.010	.015
Upper Lead Width	b1	.040	.060	.070
Lower Lead Width	b	.014	.018	.022
Overall Row Spacing §	eB	–	–	.430

Notes:

1. Pin 1 visual index feature may vary, but must be located with the hatched area.
2. § Significant Characteristic.
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" per side.
4. Dimensioning and tolerancing per ASME Y14.5M.

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

Microchip Technology Drawing C04-018B

PRODUCT IDENTIFICATION SYSTEM

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

PART NO.	X	-X	/XX
Device	Tape and Reel and/or Alternate Pinout	Temperature Range	Package

Device:	MCP6241:	Single Op Amp (MSOP, PDIP, SOIC)
	MCP6241T:	Single Op Amp (Tape and Reel) (MSOP, SOIC, SOT-23)
	MCP6241RT:	Single Op Amp (Tape and Reel) (SOT-23)
	MCP6241UT:	Single Op Amp (Tape and Reel) (SC-70, SOT-23)
	MCP6242:	Dual Op Amp
	MCP6242T:	Dual Op Amp (Tape and Reel) (MSOP, SOIC)
	MCP6244:	Quad Op Amp
	MCP6244T:	Quad Op Amp (Tape and Reel) (SOIC, TSSOP)
Temperature Range:	E = -40° C to +125° C	
Package:	LT = Plastic Package (SC-70), 5-lead (MCP6241U only)	
	MC = Plastic Dual Flat, No Lead (DFN), 8-lead, (MCP6241 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 (MCP6241, MCP6241R, MCP6241U)	
	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	

Examples:

a)	MCP6241-E/SN:	Extended Temp., 8LD SOIC package.
b)	MCP6241-E/MS:	Extended Temp., 8LD MSOP package.
c)	MCP6241-E/P:	Extended Temp., 8LD PDIP package.
d)	MCP6241-E/MC:	Extended Temp., 8LD DFN package.
e)	MCP6241RT-E/OT:	Tape and Reel, Extended Temp., 5LD SOT-23 package
f)	MCP6241UT-E/OT:	Tape and Reel, Extended Temp., 5LD SOT-23 package.
g)	MCP6241UT-E/LT:	Tape and Reel, Extended Temp., 5LD SC-70 package.
a)	MCP6242-E/SN:	Extended Temp., 8LD SOIC package.
b)	MCP6242-E/MS:	Extended Temp., 8LD MSOP package.
c)	MCP6242-E/P:	Extended Temp., 8LD PDIP package.
d)	MCP6242T-E/SN:	Tape and Reel, Extended Temp., 8LD SOIC package.
a)	MCP6244-E/P:	Extended Temp., 14LD PDIP package.
b)	MCP6244-E/SL:	Extended Temp., 14LD SOIC package.
c)	MCP6244-E/ST:	Extended Temp., 14LD TSSOP package.
d)	MCP6244T-E/SL:	Tape and Reel, Extended Temp., 14LD SOIC package.
e)	MCP6244T-E/ST:	Tape and Reel, Extended Temp., 14LD TSSOP package.