



Product Change Notification / SYST-03EPML095

Date:

07-Nov-2021

Product Category:

Linear Op Amps

PCN Type:

Manufacturing Change

Notification Subject:

Data Sheet - MCP6071/MCP6072/MCP6074 Family Data Sheet Document Revision

Affected CPNs:

[SYST-03EPML095_Affected_CPN_11072021.pdf](#)

[SYST-03EPML095_Affected_CPN_11072021.csv](#)

Notification Text:

SYST-03EPML095

Microchip has released a new Product Documents for the MCP6071 Family Data Sheet of devices. If you are using one of these devices please read the document located at [MCP6072/MCP6074 Family Data Sheet](#).

Notification Status: Final

Description of Change:

Added Markings table for TDF package option, in Section 6.1 "Package Marking Information"

Impacts to Data Sheet: None

Reason for Change: To Improve Productivity

Change Implementation Status: Complete

Date Document Changes Effective: 07 Nov 2021

NOTE: Please be advised that this is a change to the document only the product has not been changed.

Markings to Distinguish Revised from Unrevised Devices: N/A

Attachments:

[MCP6071 Family Data Sheet](#)

Please contact your local [Microchip sales office](#) with questions or concerns regarding this notification.

Terms and Conditions:

If you wish to receive Microchip PCNs via email please register for our PCN email service at our [PCN home page](#) select register then fill in the required fields. You will find instructions about registering for Microchips PCN email service in the [PCN FAQ](#) section.

If you wish to change your PCN profile, including opt out, please go to the [PCN home page](#) select login and sign into your myMicrochip account. Select a profile option from the left navigation bar and make the applicable selections.

Affected Catalog Part Numbers (CPN)

MCP6071-E/SN
MCP6071T-E/MNY
MCP6071T-E/OT
MCP6071T-E/OTV02
MCP6071T-E/OTVAO
MCP6071T-E/SN
MCP6071T-E/SNV01
MCP6072-E/SN
MCP6072T-E/MNY
MCP6072T-E/SN
MCP6072T-E/SNV02
MCP6072T-E/SNVAO
MCP6074-E/SL
MCP6074-E/ST
MCP6074-E/STVAO
MCP6074T-E/SL
MCP6074T-E/ST
MCP6074T-E/STVAO

110 μ A, High Precision Op Amps

Features

- Low Offset Voltage: $\pm 150 \mu\text{V}$ (maximum)
- Low Quiescent Current: 110 μA (typical)
- Rail-to-Rail Input and Output
- Wide Supply Voltage Range: 1.8V to 6.0V
- Gain Bandwidth Product: 1.2 MHz (typical)
- Unity Gain Stable
- Extended Temperature Range: -40°C to $+125^\circ\text{C}$
- No Phase Reversal

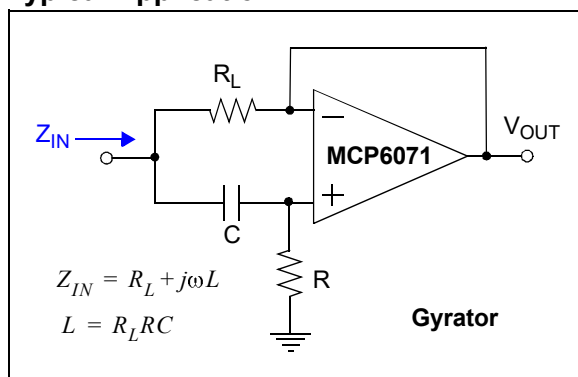
Applications

- Automotive
- Portable Instrumentation
- Sensor Conditioning
- Battery Powered Systems
- Medical Instrumentation
- Test Equipment
- Analog Filters

Design Aids

- SPICE Macro Models
- FilterLab[®] Software
- MAPS (Microchip Advanced Part Selector)
- Analog Demonstration and Evaluation Boards
- Application Notes

Typical Application



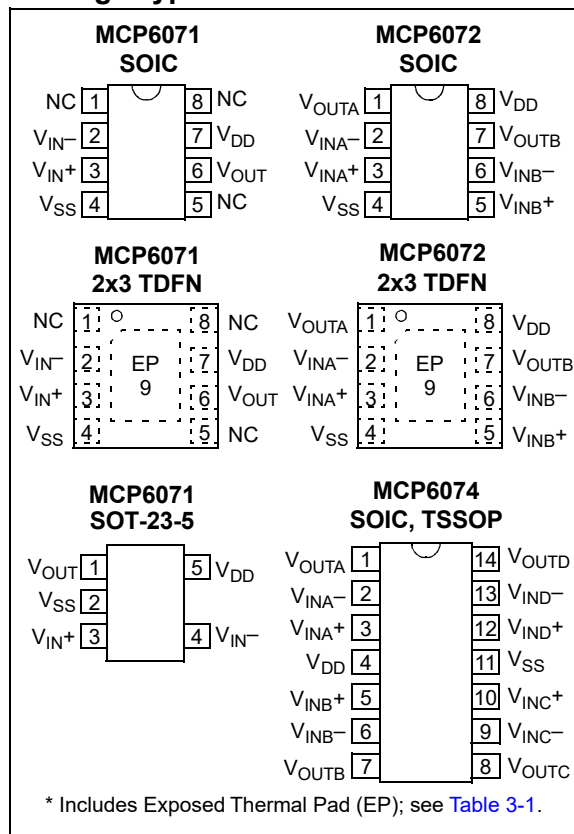
Description

The Microchip Technology Inc. MCP6071/2/4 family of operational amplifiers (op amps) has low input offset voltage ($\pm 150 \mu\text{V}$, maximum) and rail-to-rail input and output operation. This family is unity gain stable and has a gain bandwidth product of 1.2 MHz (typical). These devices operate with a single supply voltage as low as 1.8V, while drawing low quiescent current per amplifier (110 μA , typical). These features make the family of op amps well suited for single-supply, high precision, battery-powered applications.

The MCP6071/2/4 family is offered in single (MCP6071), dual (MCP6072), and quad (MCP6074) configurations.

The MCP6071/2/4 is designed with Microchip's advanced CMOS process. All devices are available in the extended temperature range, with a power supply range of 1.8V to 6.0V.

Package Types



MCP6071/2/4

1.0 ELECTRICAL CHARACTERISTICS

1.1 Absolute Maximum Ratings †

$V_{DD} - V_{SS}$	7.0V
Current at Input Pins	± 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; 400V

† **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 4.1.2 “Input Voltage Limits”.

1.2 Specifications

TABLE 1-1: DC ELECTRICAL SPECIFICATIONS

Electrical Characteristics: Unless otherwise indicated, $V_{DD} = +1.8V$ to $+6.0V$, $V_{SS} = GND$, $T_A = +25^{\circ}C$, $V_{CM} = V_{DD}/2$, $V_{OUT} \approx V_{DD}/2$, $V_L = V_{DD}/2$ and $R_L = 10$ k Ω to V_L . (Refer to Figure 1-1).						
Parameters	Sym	Min	Typ	Max	Units	Conditions
Input Offset						
Input Offset Voltage	V_{OS}	-150	—	+150	μV	$V_{DD} = 3.0V$, $V_{CM} = V_{DD}/3$
Input Offset Drift with Temperature	$\Delta V_{OS}/\Delta T_A$	—	± 1.5	—	$\mu V/^{\circ}C$	$T_A = -40^{\circ}C$ to $+85^{\circ}C$, $V_{DD} = 3.0V$, $V_{CM} = V_{DD}/3$
	$\Delta V_{OS}/\Delta T_A$	—	± 4.0	—	$\mu V/^{\circ}C$	$T_A = +85^{\circ}C$ to $+125^{\circ}C$, $V_{DD} = 3.0V$, $V_{CM} = V_{DD}/3$
Power Supply Rejection Ratio	PSRR	70	87	—	dB	$V_{CM} = V_{SS}$
Input Bias Current and Impedance						
Input Bias Current	I_B	—	± 1.0	100	pA	$T_A = +85^{\circ}C$ $T_A = +125^{\circ}C$
	I_B	—	60	—	pA	
	I_B	—	1100	5000	pA	
Input Offset Current	I_{OS}	—	± 1.0	—	pA	
Common Mode Input Impedance	Z_{CM}	—	$10^{13} 6$	—	ΩpF	
Differential Input Impedance	Z_{DIFF}	—	$10^{13} 6$	—	ΩpF	
Common Mode						
Common Mode Input Voltage Range	V_{CMR}	$V_{SS}-0.15$	—	$V_{DD}+0.15$	V	$V_{DD} = 1.8V$ (Note 1)
	V_{CMR}	$V_{SS}-0.3$	—	$V_{DD}+0.3$	V	$V_{DD} = 6.0V$ (Note 1)
Common Mode Rejection Ratio	CMRR	72	89	—	dB	$V_{CM} = -0.15V$ to $1.95V$, $V_{DD} = 1.8V$
		74	91	—	dB	$V_{CM} = -0.3V$ to $6.3V$, $V_{DD} = 6.0V$
		72	87	—	dB	$V_{CM} = 3.0V$ to $6.3V$, $V_{DD} = 6.0V$
		74	89	—	dB	$V_{CM} = -0.3V$ to $3.0V$, $V_{DD} = 6.0V$

Note 1: Figure 2-13 shows how V_{CMR} changed across temperature.

TABLE 1-1: DC ELECTRICAL SPECIFICATIONS (CONTINUED)

Electrical Characteristics: Unless otherwise indicated, $V_{DD} = +1.8V$ to $+6.0V$, $V_{SS} = GND$, $T_A = +25^\circ C$, $V_{CM} = V_{DD}/2$, $V_{OUT} \approx V_{DD}/2$, $V_L = V_{DD}/2$ and $R_L = 10\text{ k}\Omega$ to V_L . (Refer to [Figure 1-1](#)).

Parameters	Sym	Min	Typ	Max	Units	Conditions
Open-Loop Gain						
DC Open-Loop Gain (Large Signal)	A_{OL}	95	115	—	dB	$0.2V < V_{OUT} < (V_{DD}-0.2V)$ $V_{CM} = V_{SS}$
Output						
Maximum Output Voltage Swing	V_{OL}, V_{OH}	$V_{SS}+15$	—	$V_{DD}-15$	mV	0.5V input overdrive
Output Short-Circuit Current	I_{SC}	—	± 7	—	mA	$V_{DD} = 1.8V$
		—	± 28	—	mA	$V_{DD} = 6.0V$
Power Supply						
Supply Voltage	V_{DD}	1.8	—	6.0	V	
Quiescent Current per Amplifier	I_Q	50	110	170	μA	$I_O = 0$, $V_{DD} = 6.0V$ $V_{CM} = 0.9V_{DD}$

Note 1: [Figure 2-13](#) shows how V_{CMR} changed across temperature.

TABLE 1-2: AC ELECTRICAL SPECIFICATIONS

Electrical Characteristics: Unless otherwise indicated, $T_A = +25^\circ C$, $V_{DD} = +1.8$ to $+6.0V$, $V_{SS} = GND$, $V_{CM} = V_{DD}/2$, $V_{OUT} \approx V_{DD}/2$, $V_L = V_{DD}/2$, $R_L = 10\text{ k}\Omega$ to V_L and $C_L = 60\text{ pF}$. (Refer to [Figure 1-1](#)).

Parameters	Sym	Min	Typ	Max	Units	Conditions
AC Response						
Gain Bandwidth Product	GBWP	—	1.2	—	MHz	
Phase Margin	PM	—	57	—	$^\circ$	$G = +1\text{ V/V}$
Slew Rate	SR	—	0.5	—	V/ μs	
Noise						
Input Noise Voltage	E_{ni}	—	4.3	—	μV_{p-p}	$f = 0.1\text{ Hz to }10\text{ Hz}$
Input Noise Voltage Density	e_{ni}	—	19	—	nV/ \sqrt{Hz}	$f = 10\text{ kHz}$
Input Noise Current Density	i_{ni}	—	0.6	—	fA/ \sqrt{Hz}	$f = 1\text{ kHz}$

TABLE 1-3: TEMPERATURE SPECIFICATIONS

Electrical Characteristics: Unless otherwise indicated, $V_{DD} = +1.8V$ to $+6.0V$ and $V_{SS} = GND$.

Parameters	Sym	Min	Typ	Max	Units	Conditions
Temperature Ranges						
Operating Temperature Range	T_A	-40	—	+125	$^\circ C$	Note 1
Storage Temperature Range	T_A	-65	—	+150	$^\circ C$	
Thermal Package Resistances						
Thermal Resistance, 5L-SOT-23	θ_{JA}	—	220.7	—	$^\circ C/W$	
Thermal Resistance, 8L-2x3 TDFN	θ_{JA}	—	52.5	—	$^\circ C/W$	
Thermal Resistance, 8L-SOIC	θ_{JA}	—	149.5	—	$^\circ C/W$	
Thermal Resistance, 14L-SOIC	θ_{JA}	—	95.3	—	$^\circ C/W$	
Thermal Resistance, 14L-TSSOP	θ_{JA}	—	100	—	$^\circ C/W$	

Note 1: The internal junction temperature (T_J) must not exceed the absolute maximum specification of $+150^\circ C$.

MCP6071/2/4

1.3 Test Circuits

The circuit used for most DC and AC tests is shown in [Figure 1-1](#). This circuit can independently set V_{CM} and V_{OUT} ; see [Equation 1-1](#). Note that V_{CM} is not the circuit's common mode voltage ($(V_P + V_M)/2$), and that V_{OST} includes V_{OS} plus the effects (on the input offset error, V_{OST}) of temperature, CMRR, PSRR and A_{OL} .

EQUATION 1-1:

$$G_{DM} = R_F / R_G$$

$$V_{CM} = (V_P + V_{DD}/2) / 2$$

$$V_{OST} = V_{IN-} - V_{IN+}$$

$$V_{OUT} = (V_{DD}/2) + (V_P - V_M) + V_{OST}(1 + G_{DM})$$

Where:

G_{DM}	= Differential Mode Gain	(V/V)
V_{CM}	= Op Amp's Common Mode Input Voltage	(V)
V_{OST}	= Op Amp's Total Input Offset Voltage	(mV)

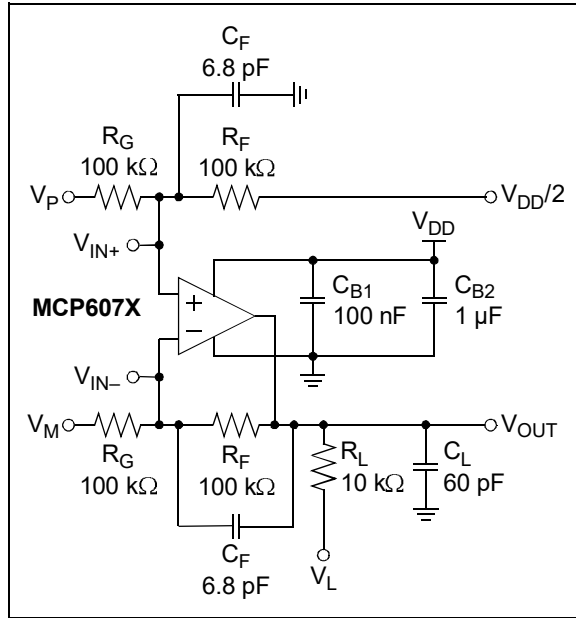


FIGURE 1-1: AC and DC Test Circuit for Most Specifications.

NOTES:

MCP6071/2/4

2.0 TYPICAL PERFORMANCE CURVES

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

Note: Unless otherwise indicated, $T_A = +25^\circ\text{C}$, $V_{DD} = +1.8\text{V}$ to $+6.0\text{V}$, $V_{SS} = \text{GND}$, $V_{CM} = V_{DD}/2$, $V_{OUT} \approx V_{DD}/2$, $V_L = V_{DD}/2$, $R_L = 10\text{ k}\Omega$ to V_L and $C_L = 60\text{ pF}$.

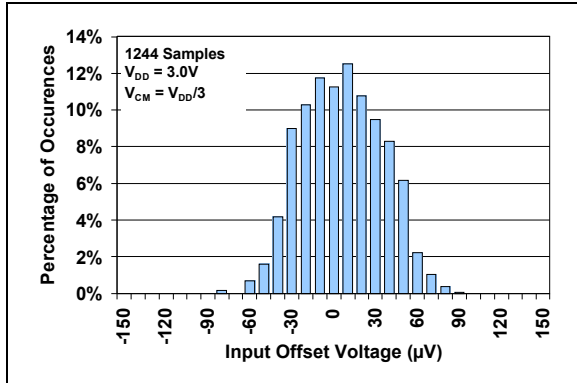


FIGURE 2-1: Input Offset Voltage with $V_{DD} = 3.0\text{V}$.

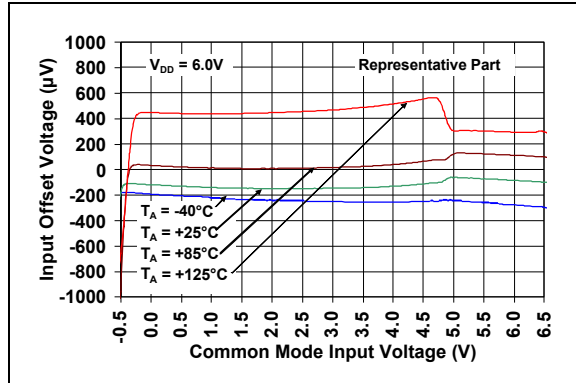


FIGURE 2-4: Input Offset Voltage vs. Common Mode Input Voltage with $V_{DD} = 6.0\text{V}$.

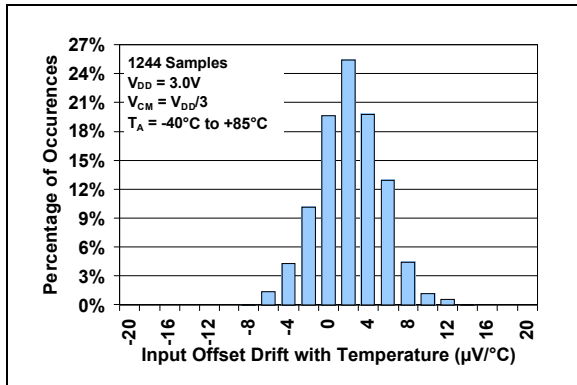


FIGURE 2-2: Input Offset Voltage Drift with $V_{DD} = 3.0\text{V}$ and $T_A \leq +85^\circ\text{C}$.

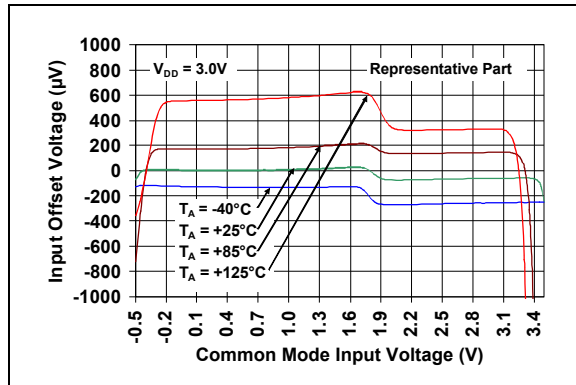


FIGURE 2-5: Input Offset Voltage vs. Common Mode Input Voltage with $V_{DD} = 3.0\text{V}$.

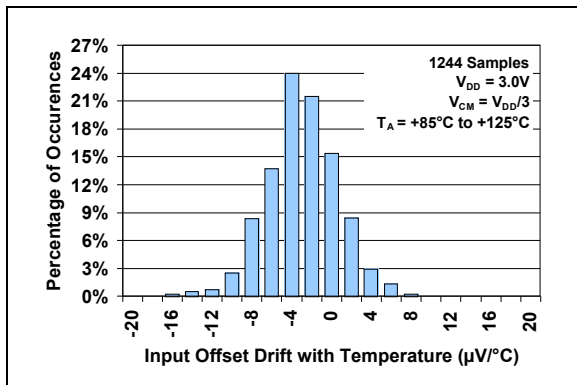


FIGURE 2-3: Input Offset Voltage Drift with $V_{DD} = 3.0\text{V}$ and $T_A \geq +85^\circ\text{C}$.

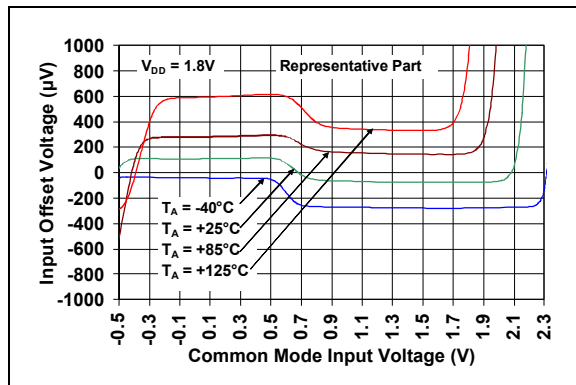


FIGURE 2-6: Input Offset Voltage vs. Common Mode Input Voltage with $V_{DD} = 1.8\text{V}$.

Note: Unless otherwise indicated, $T_A = +25^\circ\text{C}$, $V_{DD} = +1.8\text{V to } +6.0\text{V}$, $V_{SS} = \text{GND}$, $V_{CM} = V_{DD}/2$, $V_{OUT} \approx V_{DD}/2$, $V_L = V_{DD}/2$, $R_L = 10\text{ k}\Omega$ to V_L and $C_L = 60\text{ pF}$.

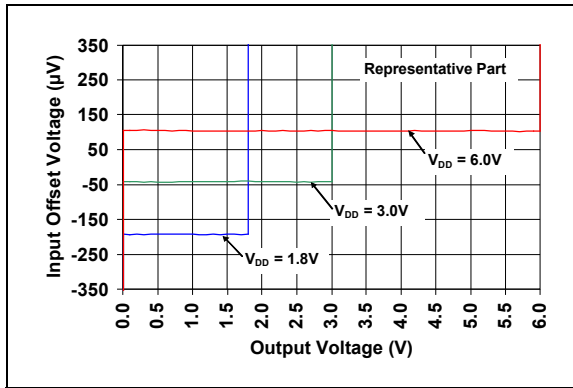


FIGURE 2-7: Input Offset Voltage vs. Output Voltage.

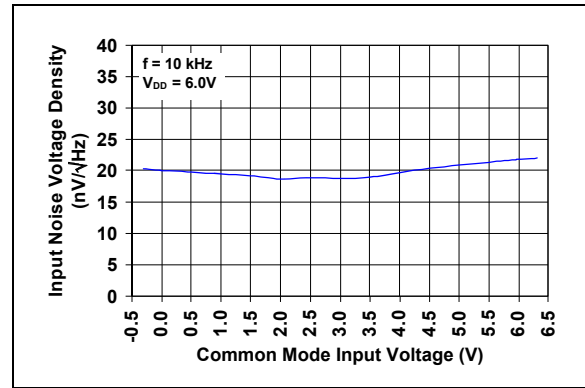


FIGURE 2-10: Input Noise Voltage Density vs. Common Mode Input Voltage.

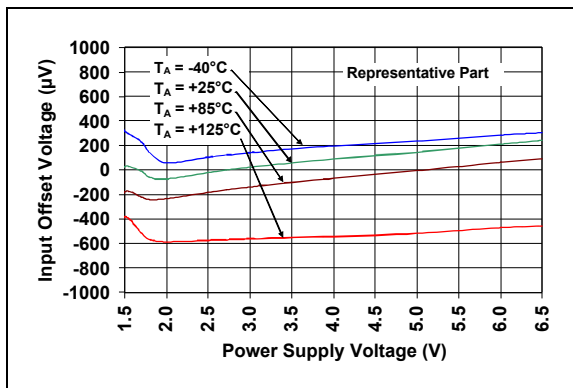


FIGURE 2-8: Input Offset Voltage vs. Power Supply Voltage.

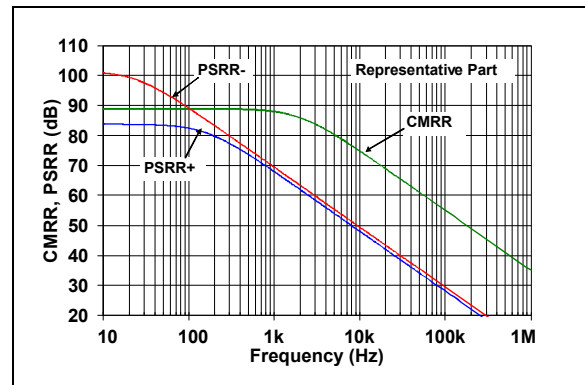


FIGURE 2-11: CMRR, PSRR vs. Frequency.

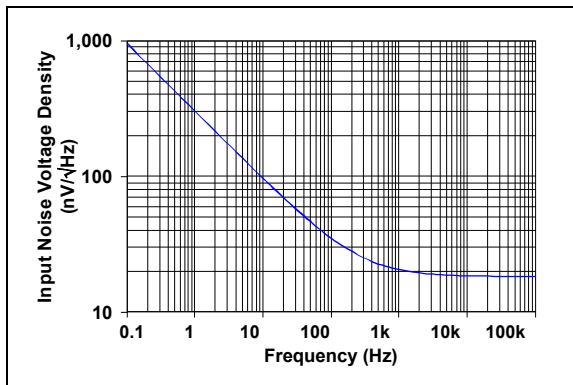


FIGURE 2-9: Input Noise Voltage Density vs. Frequency.

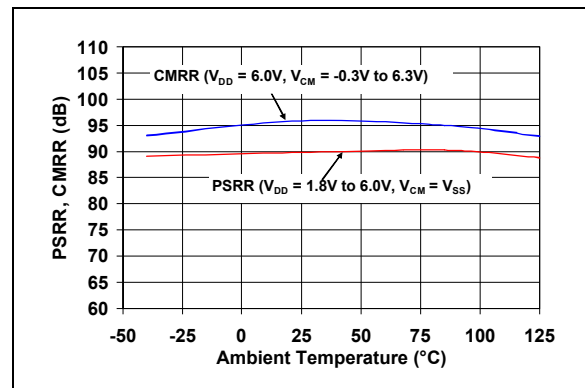


FIGURE 2-12: CMRR, PSRR vs. Ambient Temperature.

MCP6071/2/4

Note: Unless otherwise indicated, $T_A = +25^\circ\text{C}$, $V_{DD} = +1.8\text{V}$ to $+6.0\text{V}$, $V_{SS} = \text{GND}$, $V_{CM} = V_{DD}/2$, $V_{OUT} \approx V_{DD}/2$, $V_L = V_{DD}/2$, $R_L = 10\text{ k}\Omega$ to V_L and $C_L = 60\text{ pF}$.

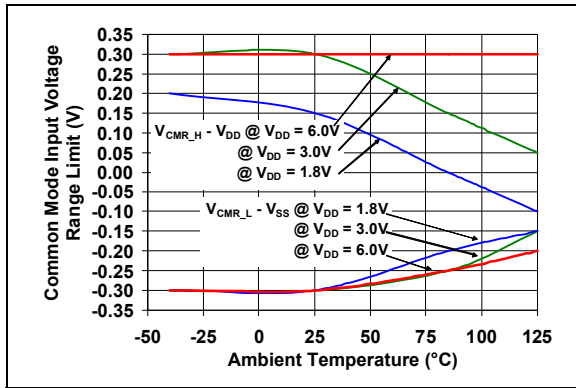


FIGURE 2-13: Common Mode Input Voltage Range Limit vs. Ambient Temperature.

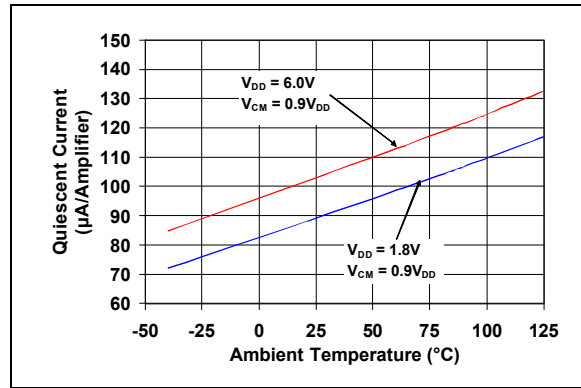


FIGURE 2-16: Quiescent Current vs. Ambient Temperature with $V_{CM} = 0.9V_{DD}$.

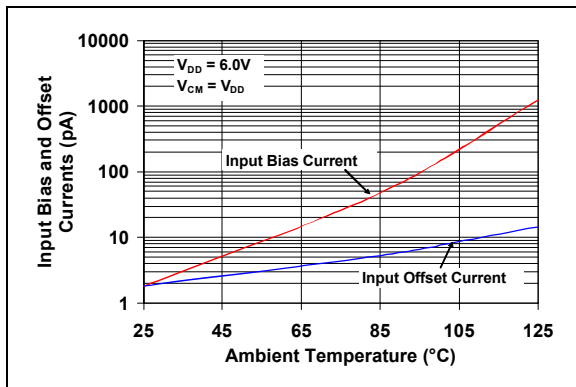


FIGURE 2-14: Input Bias, Offset Currents vs. Ambient Temperature.

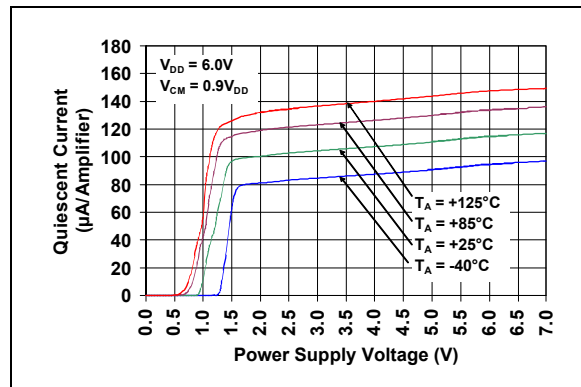


FIGURE 2-17: Quiescent Current vs. Power Supply Voltage with $V_{CM} = 0.9V_{DD}$.

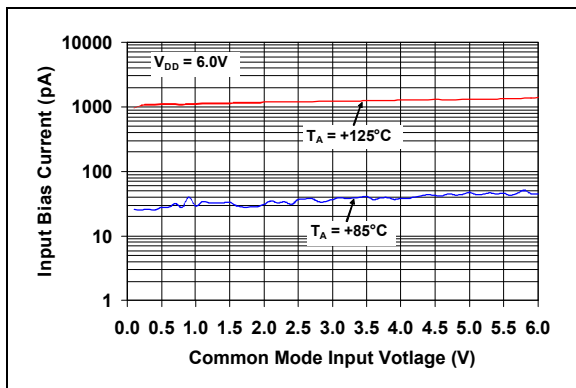


FIGURE 2-15: Input Bias Current vs. Common Mode Input Voltage.

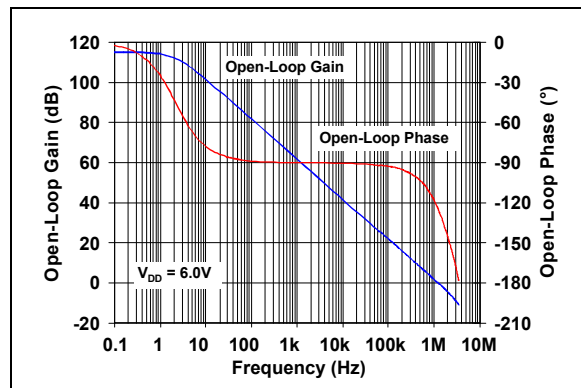


FIGURE 2-18: Open-Loop Gain, Phase vs. Frequency.

Note: Unless otherwise indicated, $T_A = +25^\circ\text{C}$, $V_{DD} = +1.8\text{V}$ to $+6.0\text{V}$, $V_{SS} = \text{GND}$, $V_{CM} = V_{DD}/2$, $V_{OUT} \approx V_{DD}/2$, $V_L = V_{DD}/2$, $R_L = 10\text{ k}\Omega$ to V_L and $C_L = 60\text{ pF}$.

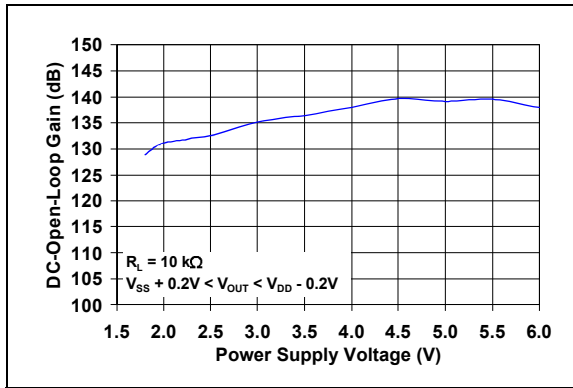


FIGURE 2-19: DC Open-Loop Gain vs. Power Supply Voltage.

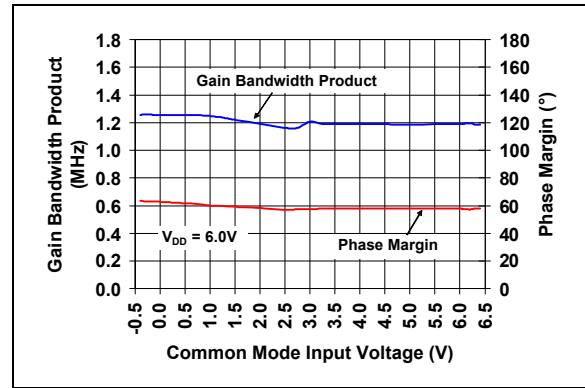


FIGURE 2-22: Gain Bandwidth Product, Phase Margin vs. Common Mode Input Voltage.

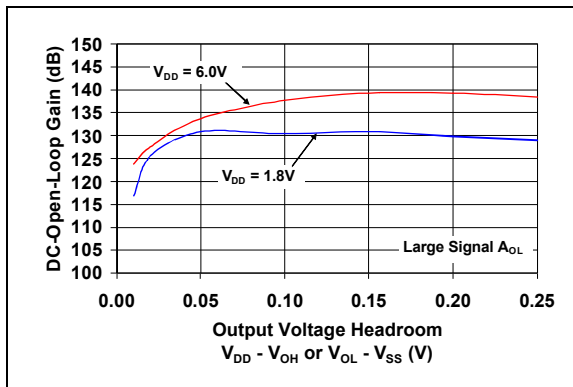


FIGURE 2-20: DC Open-Loop Gain vs. Output Voltage Headroom.

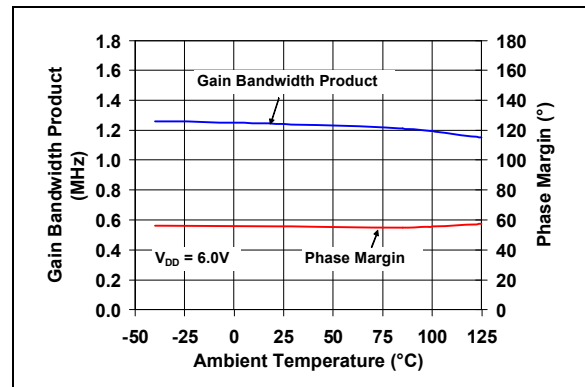


FIGURE 2-23: Gain Bandwidth Product, Phase Margin vs. Ambient Temperature.

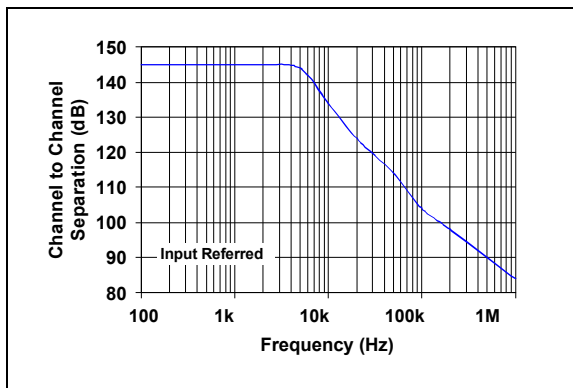


FIGURE 2-21: Channel-to-Channel Separation vs. Frequency (MCP6072/4 only).

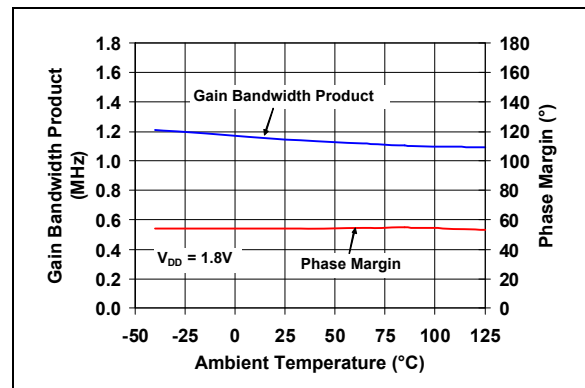


FIGURE 2-24: Gain Bandwidth Product, Phase Margin vs. Ambient Temperature.

MCP6071/2/4

Note: Unless otherwise indicated, $T_A = +25^\circ\text{C}$, $V_{DD} = +1.8\text{V}$ to $+6.0\text{V}$, $V_{SS} = \text{GND}$, $V_{CM} = V_{DD}/2$, $V_{OUT} \approx V_{DD}/2$, $V_L = V_{DD}/2$, $R_L = 10\text{ k}\Omega$ to V_L and $C_L = 60\text{ pF}$.

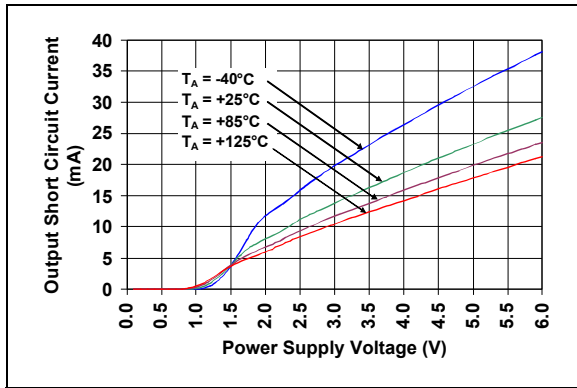


FIGURE 2-25: Output Short Circuit Current vs. Power Supply Voltage.

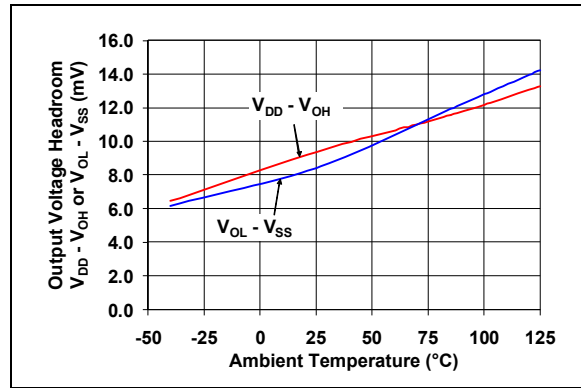


FIGURE 2-28: Output Voltage Headroom vs. Ambient Temperature.

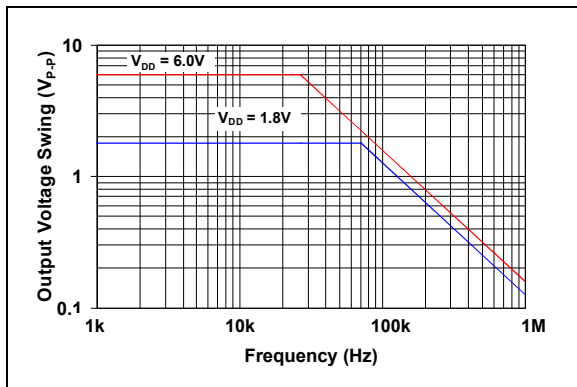


FIGURE 2-26: Output Voltage Swing vs. Frequency.

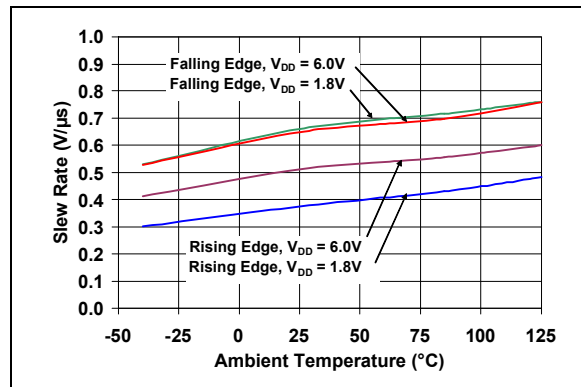


FIGURE 2-29: Slew Rate vs. Ambient Temperature.

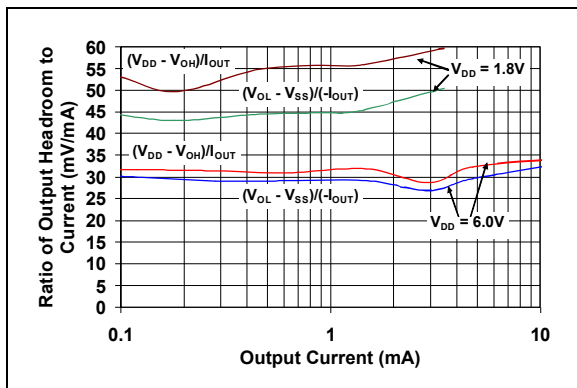


FIGURE 2-27: Ratio of Output Voltage Headroom to Output Current vs. Output Current.

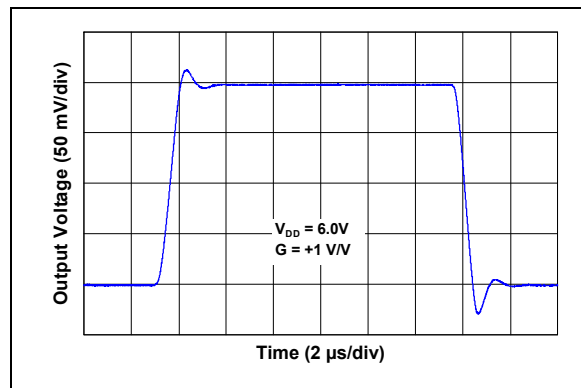


FIGURE 2-30: Small Signal Noninverting Pulse Response.

Note: Unless otherwise indicated, $T_A = +25^\circ\text{C}$, $V_{DD} = +1.8\text{V}$ to $+6.0\text{V}$, $V_{SS} = \text{GND}$, $V_{CM} = V_{DD}/2$, $V_{OUT} \approx V_{DD}/2$, $V_L = V_{DD}/2$, $R_L = 10\text{ k}\Omega$ to V_L and $C_L = 60\text{ pF}$.

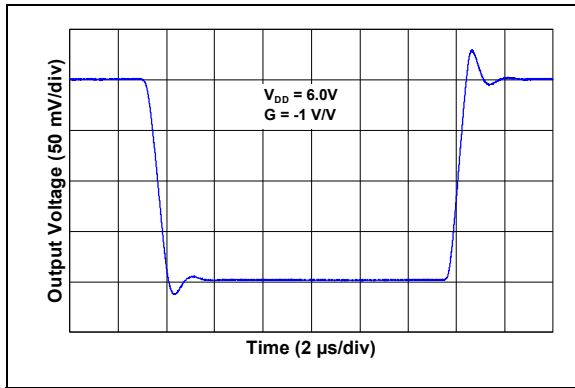


FIGURE 2-31: Small Signal Inverting Pulse Response.

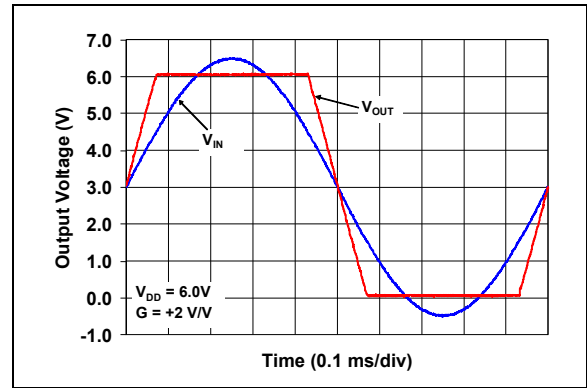


FIGURE 2-34: The MCP6071/2/4 Shows No Phase Reversal.

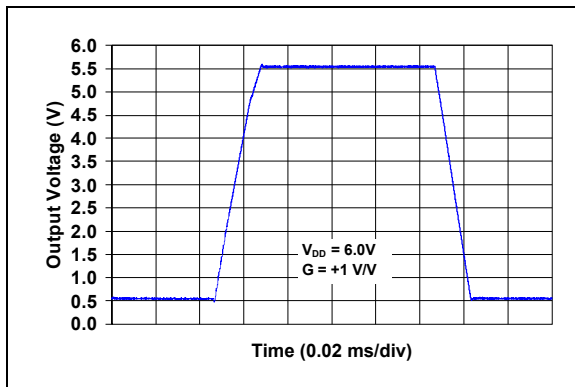


FIGURE 2-32: Large Signal Noninverting Pulse Response.

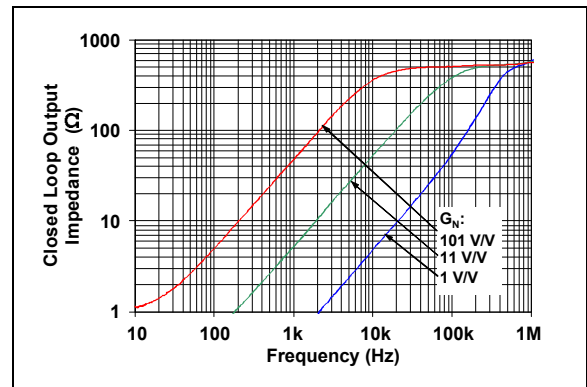


FIGURE 2-35: Closed Loop Output Impedance vs. Frequency.

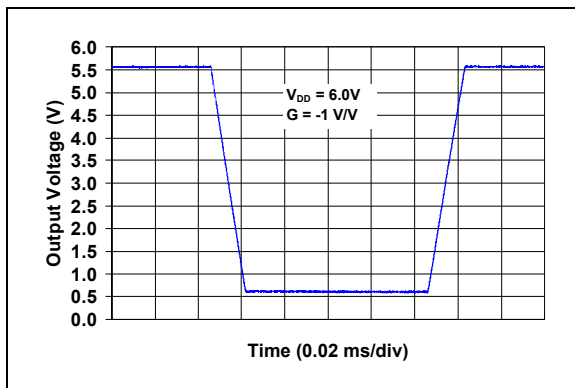


FIGURE 2-33: Large Signal Inverting Pulse Response.

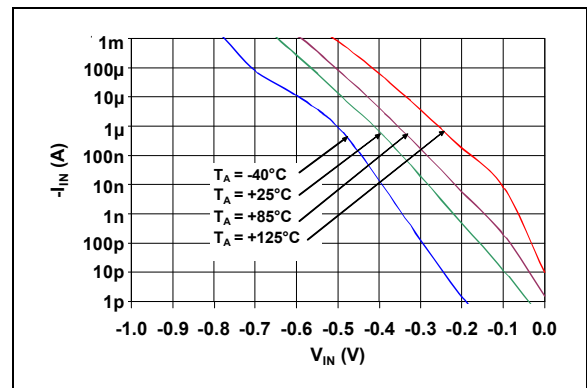


FIGURE 2-36: Measured Input Current vs. Input Voltage (below V_{SS}).

MCP6071/2/4

3.0 PIN DESCRIPTIONS

Descriptions of the pins are listed in [Table 3-1](#).

TABLE 3-1: PIN FUNCTION TABLE

MCP6071			MCP6072		MCP6074	Symbol	Description
SOIC	SOT-23-5	2x3 TDFN	SOIC	2x3 TDFN	SOIC, TSSOP		
6	1	6	1	1	1	V_{OUT}, V_{OUTA}	Analog Output (op amp A)
2	4	2	2	2	2	V_{IN}^-, V_{INA}^-	Inverting Input (op amp A)
3	3	3	3	3	3	V_{IN}^+, V_{INA}^+	Noninverting Input (op amp A)
7	5	7	8	8	4	V_{DD}	Positive Power Supply
—	—	—	5	5	5	V_{INB}^+	Noninverting Input (op amp B)
—	—	—	6	6	6	V_{INB}^-	Inverting Input (op amp B)
—	—	—	7	7	7	V_{OUTB}	Analog Output (op amp B)
—	—	—	—	—	8	V_{OUTC}	Analog Output (op amp C)
—	—	—	—	—	9	V_{INC}^-	Inverting Input (op amp C)
—	—	—	—	—	10	V_{INC}^+	Noninverting Input (op amp C)
4	2	4	4	4	11	V_{SS}	Negative Power Supply
—	—	—	—	—	12	V_{IND}^+	Noninverting Input (op amp D)
—	—	—	—	—	13	V_{IND}^-	Inverting Input (op amp D)
—	—	—	—	—	14	V_{OUTD}	Analog Output (op amp D)
1, 5, 8	—	1, 5, 8	—	—	—	NC	No Internal Connection
—	—	9	—	9	—	EP	Exposed Thermal Pad (EP); must be connected to V_{SS} .

3.1 Analog Outputs

The output pins are low-impedance voltage sources.

3.2 Analog Inputs

The noninverting and inverting inputs are high-impedance CMOS inputs with low bias currents.

3.3 Power Supply Pins

The positive power supply (V_{DD}) is 1.8V to 6.0V higher than the negative power supply (V_{SS}). For normal operation, the other pins are at voltages between V_{SS} and V_{DD} .

Typically, these parts are used in a single (positive) supply configuration. In this case, V_{SS} is connected to ground and V_{DD} is connected to the supply. V_{DD} will need bypass capacitors.

3.4 Exposed Thermal Pad (EP)

There is an internal electrical connection between the Exposed Thermal Pad (EP) and the V_{SS} pin; they must be connected to the same potential on the Printed Circuit Board (PCB).

NOTES:

MCP6071/2/4

4.0 APPLICATION INFORMATION

The MCP6071/2/4 family of op amps is manufactured using Microchip's state-of-the-art CMOS process and is specifically designed for low-power, high precision applications.

4.1 Rail-to-Rail Input

4.1.1 PHASE REVERSAL

The MCP6071/2/4 op amps are designed to prevent phase reversal when the input pins exceed the supply voltages. [Figure 2-34](#) shows the input voltage exceeding the supply voltage without any phase reversal.

4.1.2 INPUT VOLTAGE LIMITS

In order to prevent damage and/or improper operation of these amplifiers, the circuit must limit the voltages at the input pins (see [Section 1.1, Absolute Maximum Ratings †](#)).

The ESD protection on the inputs can be depicted as shown in [Figure 4-1](#). This structure was chosen to protect the input transistors and to minimize input bias current (I_B).

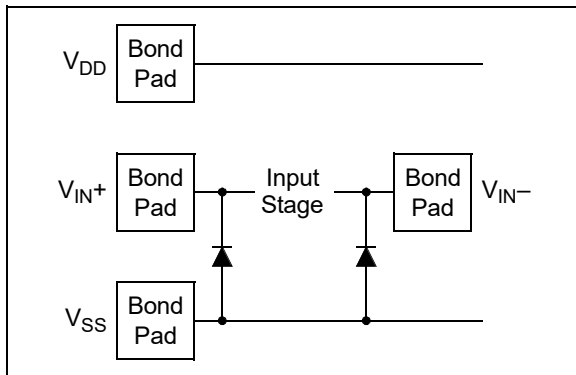


FIGURE 4-1: Simplified Analog Input ESD Structures.

The input ESD diodes clamp the inputs when they try to go more than one diode drop below V_{SS} . They also clamp any voltages that go well above V_{DD} ; their breakdown voltage is high enough to allow normal operation, but not low enough to protect against slow over-voltage (beyond V_{DD}) events. Very fast ESD events (that meet the spec) are limited so that damage does not occur.

In some applications, it may be necessary to prevent excessive voltages from reaching the op amp inputs. [Figure 4-2](#) shows one approach to protecting these inputs.

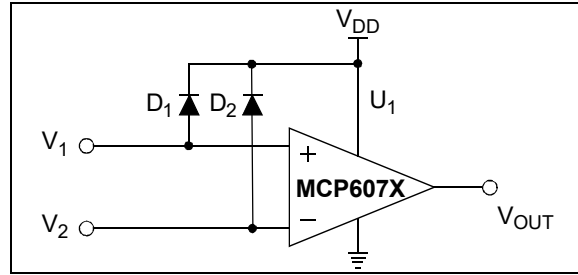


FIGURE 4-2: Protecting the Analog Inputs.

A significant amount of current can flow out of the inputs when the Common Mode voltage (V_{CM}) is below ground (V_{SS}). See [Figure 2-36](#).

4.1.3 INPUT CURRENT LIMITS

In order to prevent damage and/or improper operation of these amplifiers, the circuit must limit the voltages at the input pins (see [Section 1.1, Absolute Maximum Ratings †](#)).

[Figure 4-3](#) shows one approach to protecting these inputs. The resistors R_1 and R_2 limit the possible currents in or out of the input pins (and the ESD diodes, D_1 and D_2). The diode currents will go through either V_{DD} or V_{SS} .

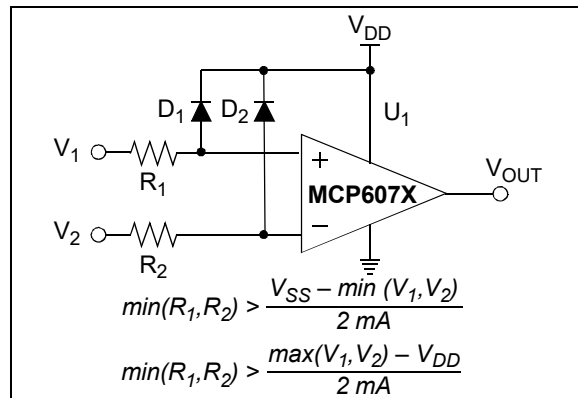


FIGURE 4-3: Protecting the Analog Inputs.

4.1.4 NORMAL OPERATION

The input stage of the MCP6071/2/4 op amps use two differential input stages in parallel. One operates at a low common mode input voltage (V_{CM}), while the other operates at a high V_{CM} . With this topology, the device operates with a V_{CM} up to 300 mV above V_{DD} and 300 mV below V_{SS} . (See [Figure 2-13](#)). The input offset voltage is measured at $V_{CM} = V_{SS} - 0.3V$ and $V_{DD} + 0.3V$ to ensure proper operation.

The transition between the input stages occurs when V_{CM} is near $V_{DD} - 1.1V$ (See [Figures 2-4, 2-5](#) and [Figure 2-6](#)). For the best distortion performance and gain linearity, with noninverting gains, avoid this region of operation.

4.2 Rail-to-Rail Output

The output voltage range of the MCP6071/2/4 op amps is $V_{SS} + 15 \text{ mV}$ (minimum) and $V_{DD} - 15 \text{ mV}$ (maximum) when $R_L = 10 \text{ k}\Omega$ is connected to $V_{DD}/2$ and $V_{DD} = 6.0\text{V}$. Refer to [Figures 2-27](#) and [2-28](#) for more information.

4.3 Capacitive Loads

Driving large capacitive loads can cause stability problems for voltage feedback op amps. As the load capacitance increases, the feedback loop's phase margin decreases and the closed-loop bandwidth is reduced. This produces gain peaking in the frequency response, with overshoot and ringing in the step response. While a unity-gain buffer ($G = +1$) is the most sensitive to capacitive loads, all gains show the same general behavior.

When driving large capacitive loads with these op amps (e.g., $> 100 \text{ pF}$ when $G = +1$), a small series resistor at the output (R_{ISO} in [Figure 4-4](#)) improves the feedback loop's phase margin (stability) by making the output load resistive at higher frequencies. The bandwidth will be generally lower than the bandwidth with no capacitance load.

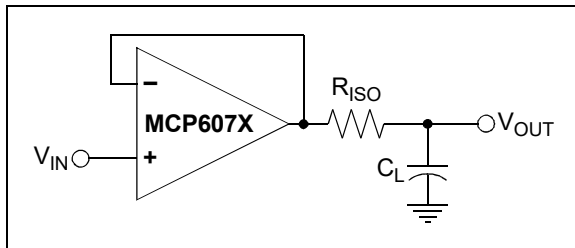


FIGURE 4-4: Output Resistor, R_{ISO} Stabilizes Large Capacitive Loads.

[Figure 4-5](#) gives recommended R_{ISO} values for different capacitive loads and gains. The x-axis is the normalized load capacitance (C_L/G_N), where G_N is the circuit's noise gain. For noninverting gains, G_N and the Signal Gain are equal. For inverting gains, G_N is $1 + |\text{Signal Gain}|$ (e.g., -1 V/V gives $G_N = +2 \text{ V/V}$).

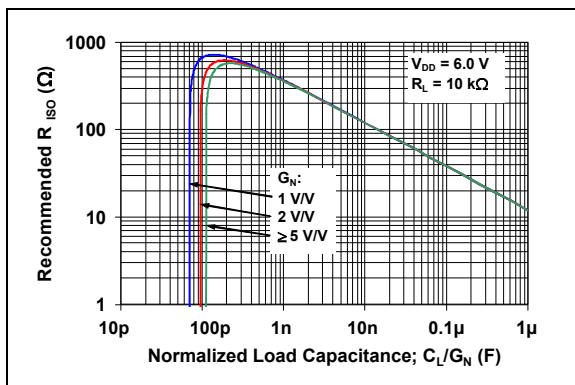


FIGURE 4-5: Recommended R_{ISO} Values for Capacitive Loads.

After selecting R_{ISO} for your circuit, double-check the resulting frequency response peaking and step response overshoot. Modify R_{ISO} 's value until the response is reasonable. Bench evaluation and simulations with the MCP6071/2/4 SPICE macro model are very helpful.

4.4 Supply Bypass

With this family of operational amplifiers, the power supply pin (V_{DD} for single-supply) should have a local bypass capacitor (i.e., $0.01 \mu\text{F}$ to $0.1 \mu\text{F}$) within 2 mm for good high frequency performance. It can use a bulk capacitor (i.e., $1 \mu\text{F}$ or larger) within 100 mm to provide large, slow currents. This bulk capacitor can be shared with other analog parts.

4.5 Unused Op Amps

An unused op amp in a quad package (MCP6074) should be configured as shown in [Figure 4-6](#). These circuits prevent the output from toggling and causing crosstalk. Circuit A sets the op amp at its minimum noise gain. The resistor divider produces any desired reference voltage within the output voltage range of the op amp; the op amp buffers that reference voltage. Circuit B uses the minimum number of components and operates as a comparator, but it may draw more current.

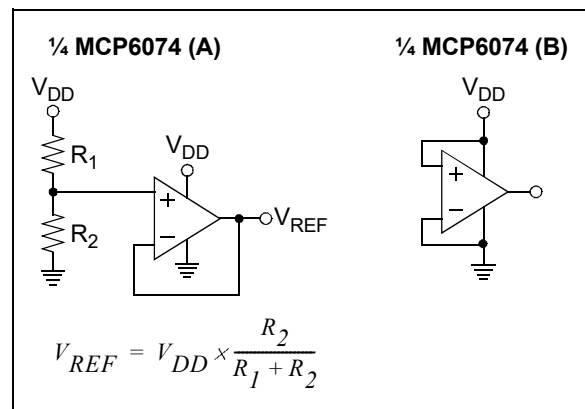


FIGURE 4-6: Unused Op Amps.

MCP6071/2/4

4.6 PCB Surface Leakage

In applications where low input bias current is critical, Printed Circuit Board (PCB) surface leakage effects need to be considered. Surface leakage is caused by humidity, dust or other contamination on the board. Under low humidity conditions, a typical resistance between nearby traces is $10^{12}\Omega$. A 5V difference would cause 5 pA of current to flow; which is greater than the MCP6071/2/4 family's bias current at +25°C (± 1.0 pA, typical).

The easiest way to reduce surface leakage is to use a guard ring around sensitive pins (or traces). The guard ring is biased at the same voltage as the sensitive pin. An example of this type of layout is shown in [Figure 4-7](#).

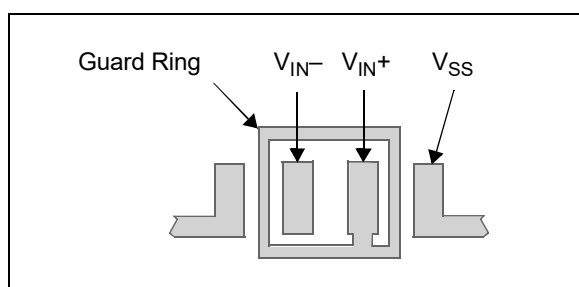


FIGURE 4-7: Example Guard Ring Layout for Inverting Gain.

1. Noninverting Gain and Unity-Gain Buffer:
 - a. Connect the noninverting pin (V_{IN+}) to the input with a wire that does not touch the PCB surface.
 - b. Connect the guard ring to the inverting input pin (V_{IN-}). This biases the guard ring to the common mode input voltage.
2. Inverting Gain and Transimpedance Gain Amplifiers (convert current to voltage, such as photo detectors):
 - a. Connect the guard ring to the noninverting input pin (V_{IN+}). This biases the guard ring to the same reference voltage as the op amp (e.g., $V_{DD}/2$ or ground).
 - b. Connect the inverting pin (V_{IN-}) to the input with a wire that does not touch the PCB surface.

4.7 Application Circuits

4.7.1 GYRATOR

The MCP6071/2/4 op amps can be used in gyrator applications. The gyrator is an electric circuit which can make a capacitive circuit behave inductively.

Figure 4-8 shows an example of a gyrator simulating inductance, with an approximately equivalent circuit below. The two Z_{IN} have similar values in typical applications. The primary application for a gyrator is to reduce the size and cost of a system by removing the need for bulky, heavy and expensive inductors. For example, RLC bandpass filter characteristics can be realized with capacitors, resistors and operational amplifiers without using inductors. Moreover, gyrators will typically have higher accuracy than real inductors, due to the lower cost of precision capacitors than inductors.

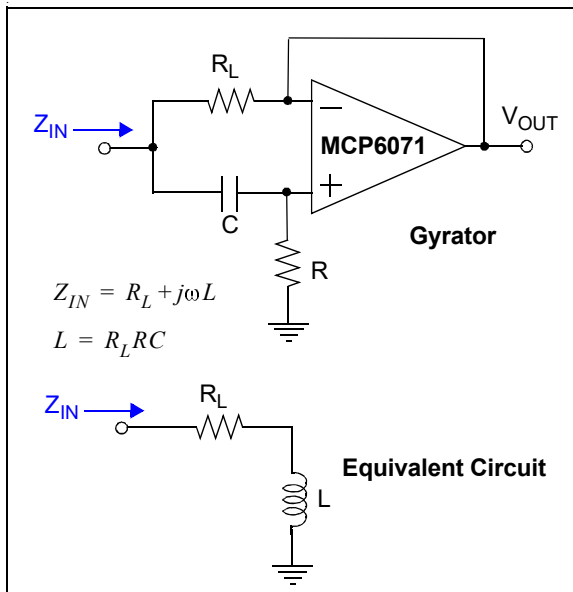


FIGURE 4-8: Gyrator.

4.7.2 INSTRUMENTATION AMPLIFIER

The MCP6071/2/4 op amps are well suited for conditioning sensor signals in battery-powered applications. Figure 4-9 shows a two op amp instrumentation amplifier, using the MCP6072, that works well for applications requiring rejection of common mode noise at higher gains. The reference voltage (V_{REF}) is supplied by a low impedance source. In single supply applications, V_{REF} is typically $V_{DD}/2$.

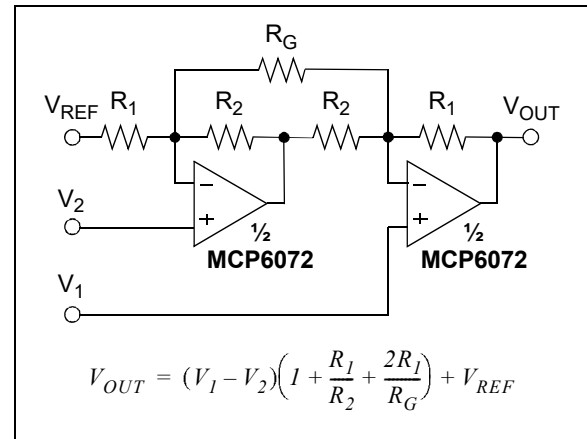


FIGURE 4-9: Two Op Amp Instrumentation Amplifier.

To obtain the best CMRR possible, and not limit the performance by the resistor tolerances, set a high gain with the R_G resistor.

4.7.3 PRECISION COMPARATOR

Use high gain before a comparator to improve the latter's input offset performance. Figure 4-10 shows a gain of 11 V/V placed before a comparator. The reference voltage V_{REF} can be any value between the supply rails.

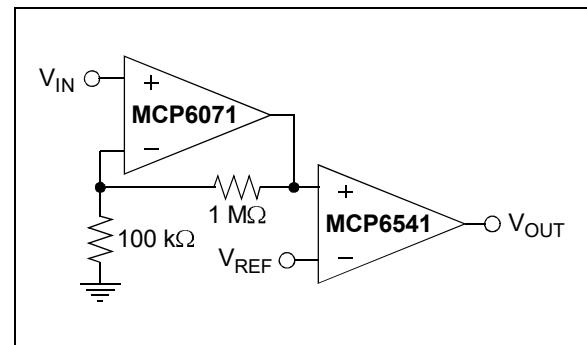


FIGURE 4-10: Precision, Noninverting Comparator.

5.0 DESIGN AIDS

Microchip provides the basic design tools needed for the MCP6071/2/4 family of op amps.

5.1 SPICE Macro Model

The latest SPICE macro model for the MCP6071/2/4 op amps is available on the Microchip web site at www.microchip.com. The model was written and tested in official Orcad (Cadence) owned PSPICE. For the other simulators, it may require translation.

The model covers a wide aspect of the op amp's electrical specifications. Not only does the model cover voltage, current, and resistance of the op amp, but it also covers the temperature and noise effects on the behavior of the op amp. The model has not been verified outside of the specification range listed in the op amp data sheet. The model behaviors under these conditions can not be guaranteed that it will match the actual op amp performance.

Moreover, the model is intended to be an initial design tool. Bench testing is a very important part of any design and cannot be replaced with simulations. Also, simulation results using this macro model need to be validated by comparing them to the data sheet specifications and characteristic curves.

5.2 FilterLab[®] Software

Microchip's FilterLab[®] software is an innovative software tool that simplifies analog active filter (using op amps) design. Available at no cost from the Microchip web site at www.microchip.com/filterlab, the FilterLab design tool provides full schematic diagrams of the filter circuit with component values. It also outputs the filter circuit in SPICE format, which can be used with the macro model to simulate actual filter performance.

5.3 MAPS (Microchip Advanced Part Selector)

MAPS is a software tool that helps semiconductor professionals efficiently identify Microchip devices that fit a particular design requirement. Available at no cost from the Microchip website at www.microchip.com/maps, the MAPS is an overall selection tool for Microchip's product portfolio that includes Analog, Memory, MCUs and DSCs. Using this tool you can define a filter to sort features for a parametric search of devices and export side-by-side technical comparison reports. Helpful links are also provided for Data Sheets, purchase, and sampling of Microchip parts.

5.4 Analog Demonstration and Evaluation Boards

Microchip offers a broad spectrum of Analog Demonstration and Evaluation Boards that are designed to help you achieve faster time to market. For a complete listing of these boards and their corresponding user's guides and technical information, visit the Microchip web site at www.microchip.com/analogtools.

Some boards that are especially useful are:

- MCP6XXX Amplifier Evaluation Board 1
- MCP6XXX Amplifier Evaluation Board 2
- MCP6XXX Amplifier Evaluation Board 3
- MCP6XXX Amplifier Evaluation Board 4
- Active Filter Demo Board Kit
- 5/6-Pin SOT-23 Evaluation Board, P/N VSUPEV2
- 8-Pin SOIC/MSOP/TSSOP/DIP Evaluation Board, P/N SOIC8EV
- 14-Pin SOIC/TSSOP/DIP Evaluation Board, P/N SOIC14EV

5.5 Application Notes

The following Microchip Analog Design Note and Application Notes are available on the Microchip web site at www.microchip.com/appnotes and are recommended as supplemental reference resources.

- **ADN003:** "Select the Right Operational Amplifier for your Filtering Circuits", DS21821
- **AN722:** "Operational Amplifier Topologies and DC Specifications", DS00722
- **AN723:** "Operational Amplifier AC Specifications and Applications", DS00723
- **AN884:** "Driving Capacitive Loads With Op Amps", DS00884
- **AN990:** "Analog Sensor Conditioning Circuits – An Overview", DS00990
- **AN1177:** "Op Amp Precision Design: DC Errors", DS01177
- **AN1228:** "Op Amp Precision Design: Random Noise", DS01228
- **AN1332:** "Current Sensing Circuit Concepts and Fundamentals", DS01332

These application notes and others are listed in the design guide:

- "Signal Chain Design Guide", DS21825

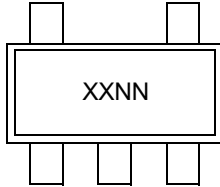
NOTES:

MCP6071/2/4

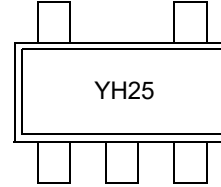
6.0 PACKAGING INFORMATION

6.1 Package Marking Information

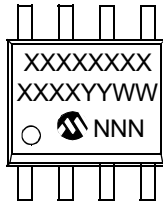
5-Lead SOT-23 (MCP6071)



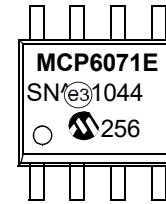
Example:



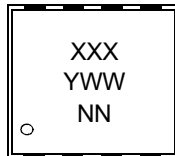
8-Lead SOIC (150 mil) (MCP6071, MCP6072)



Example:

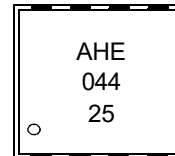


8-Lead 2x3 TDFN (MCP6071, MCP6072)



Device	Marking
MCP6071	AHE
MCP6072	AHF

Example:

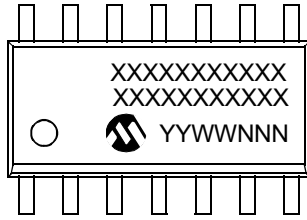


Legend:	XX...X	Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator (e3) can be found on the outer packaging for this package.

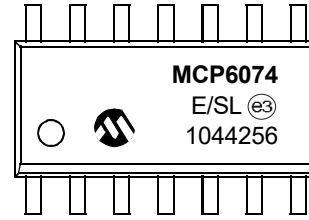
Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.

Package Marking Information (Continuation)

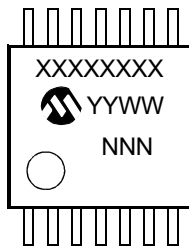
14-Lead SOIC (150 mil) (MCP6074)



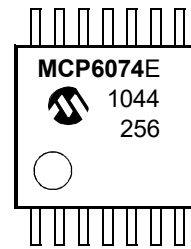
Example:



14-Lead TSSOP (MCP6074)



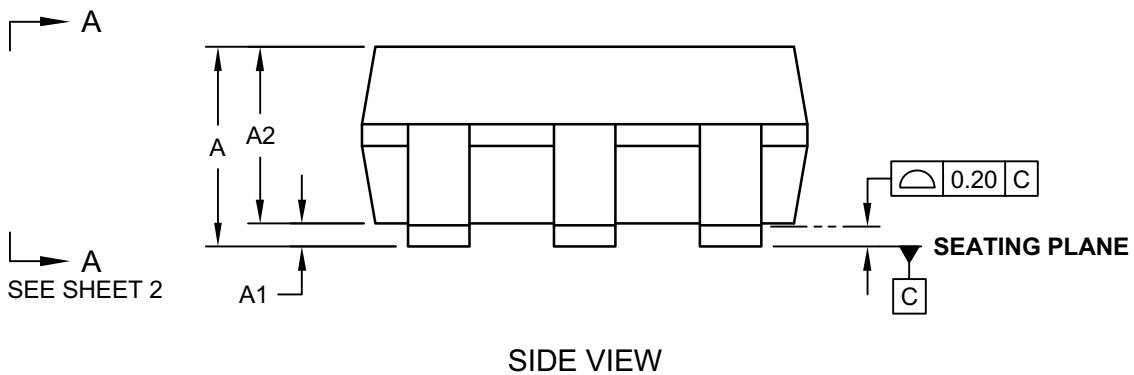
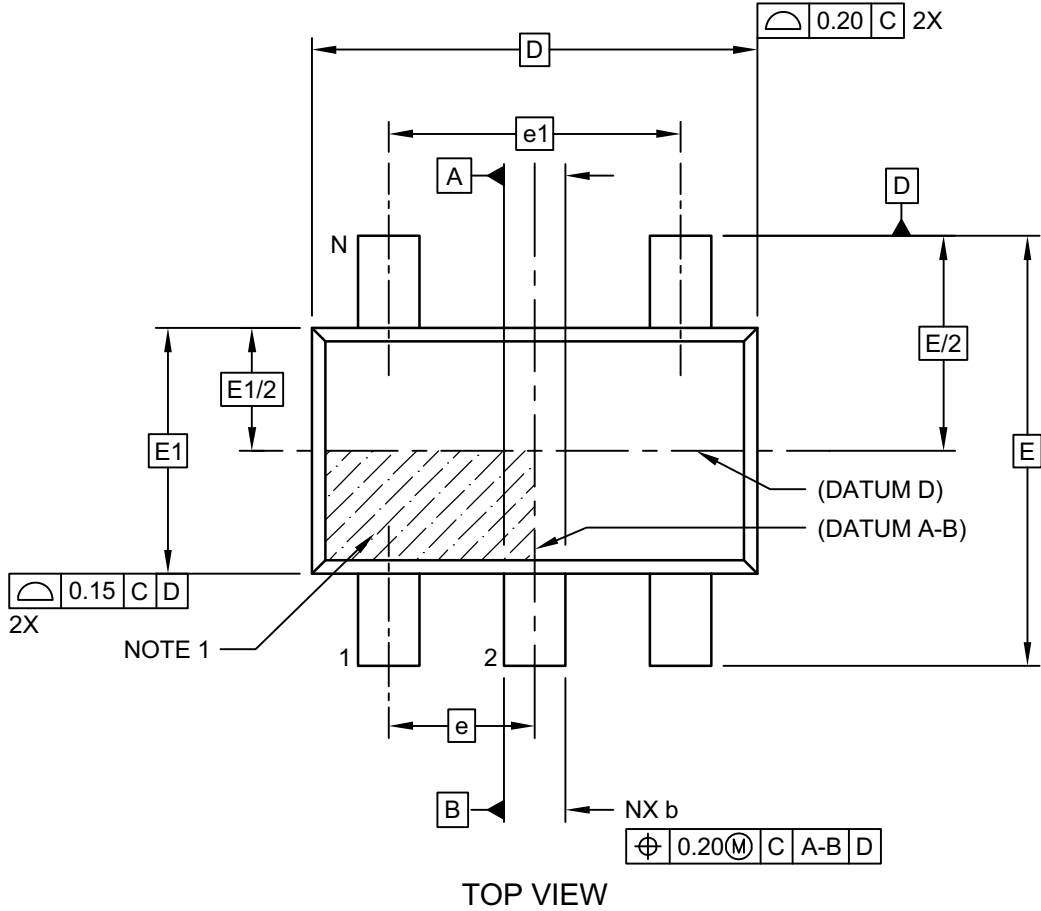
Example:



MCP6071/2/4

5-Lead Plastic Small Outline Transistor (OT) [SOT23]

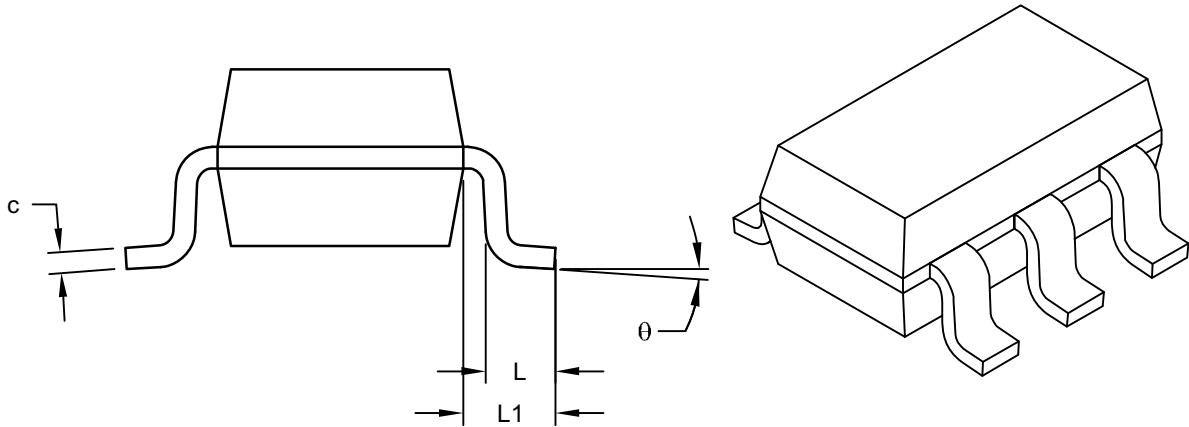
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Microchip Technology Drawing C04-091-OT Rev F Sheet 1 of 2

5-Lead Plastic Small Outline Transistor (OT) [SOT23]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



VIEW A-A
SHEET 1

Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	5		
Pitch	e	0.95 BSC		
Outside lead pitch	e1	1.90 BSC		
Overall Height	A	0.90	-	1.45
Molded Package Thickness	A2	0.89	-	1.30
Standoff	A1	-	-	0.15
Overall Width	E	2.80 BSC		
Molded Package Width	E1	1.60 BSC		
Overall Length	D	2.90 BSC		
Foot Length	L	0.30	-	0.60
Footprint	L1	0.60 REF		
Foot Angle	ϕ	0°	-	10°
Lead Thickness	c	0.08	-	0.26
Lead Width	b	0.20	-	0.51

Notes:

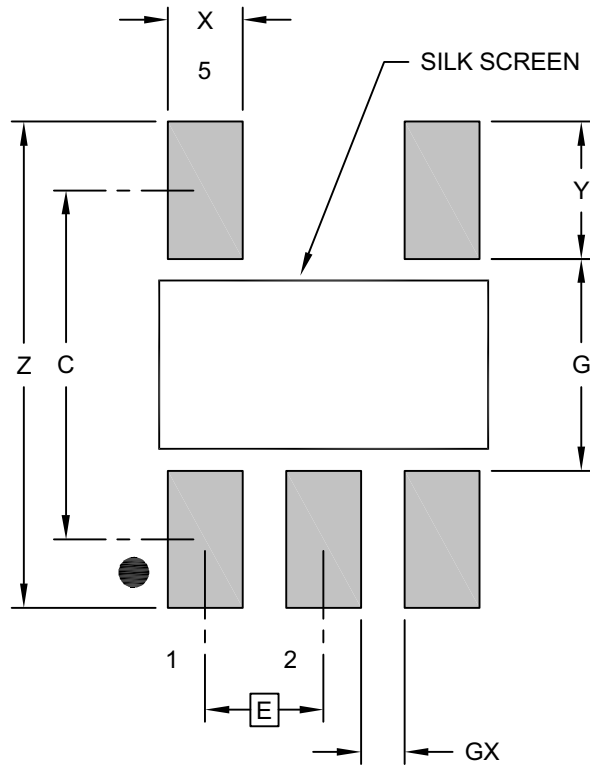
- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.25mm per side.
- Dimensioning and tolerancing per ASME Y14.5M
 BSC: Basic Dimension. Theoretically exact value shown without tolerances.
 REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-091-OT Rev F Sheet 2 of 2

MCP6071/2/4

5-Lead Plastic Small Outline Transistor (OT) [SOT23]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



RECOMMENDED LAND PATTERN

Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Contact Pitch	E	0.95 BSC		
Contact Pad Spacing	C		2.80	
Contact Pad Width (X5)	X			0.60
Contact Pad Length (X5)	Y			1.10
Distance Between Pads	G	1.70		
Distance Between Pads	GX	0.35		
Overall Width	Z			3.90

Notes:

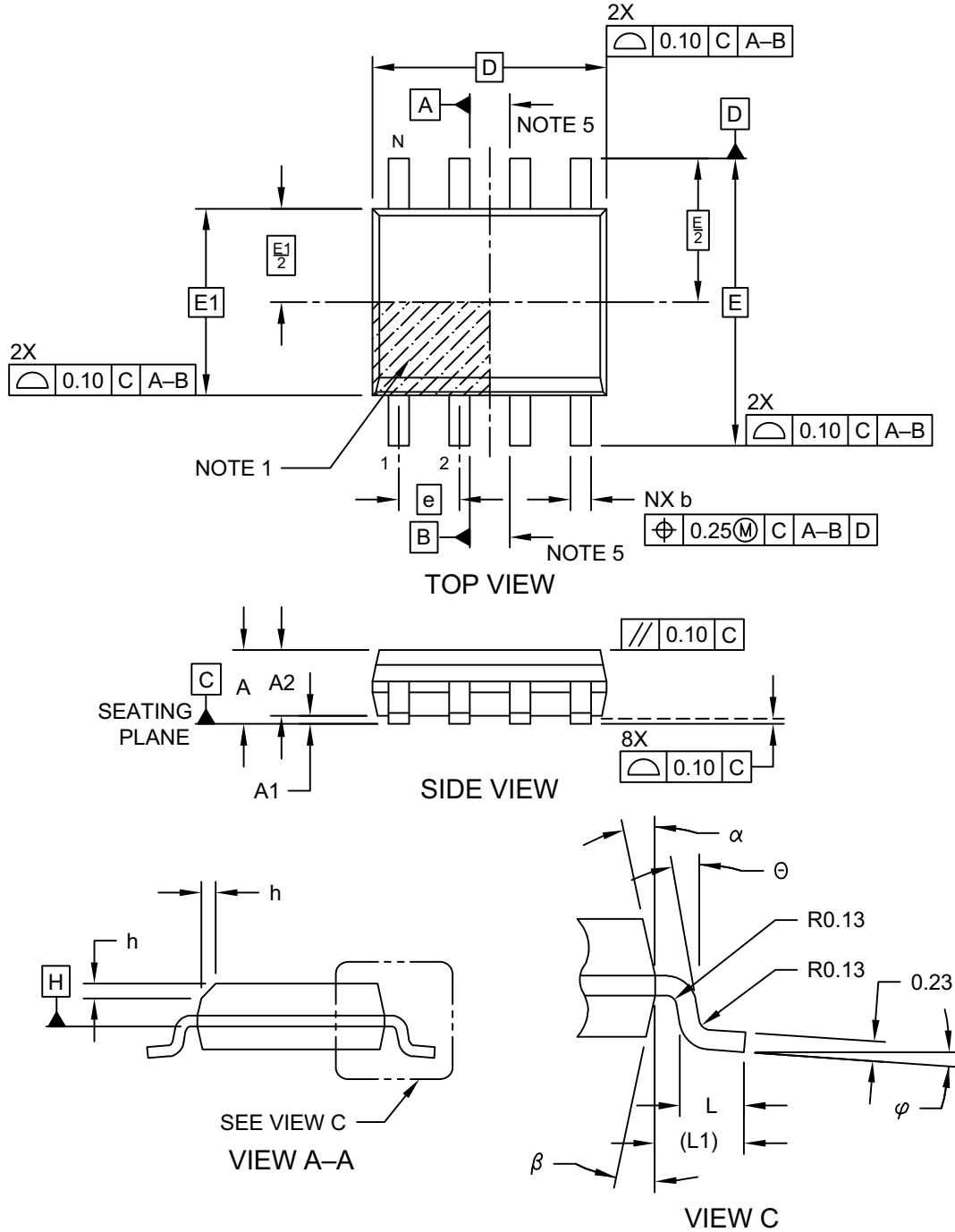
1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2091-OT Rev F

8-Lead Plastic Small Outline (SN) - Narrow, 3.90 mm (.150 In.) Body [SOIC]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>

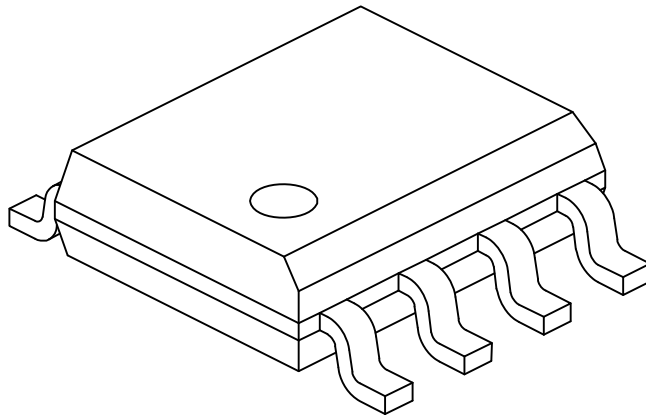


Microchip Technology Drawing No. C04-057-SN Rev F Sheet 1 of 2

MCP6071/2/4

8-Lead Plastic Small Outline (SN) - Narrow, 3.90 mm (.150 In.) Body [SOIC]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



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°

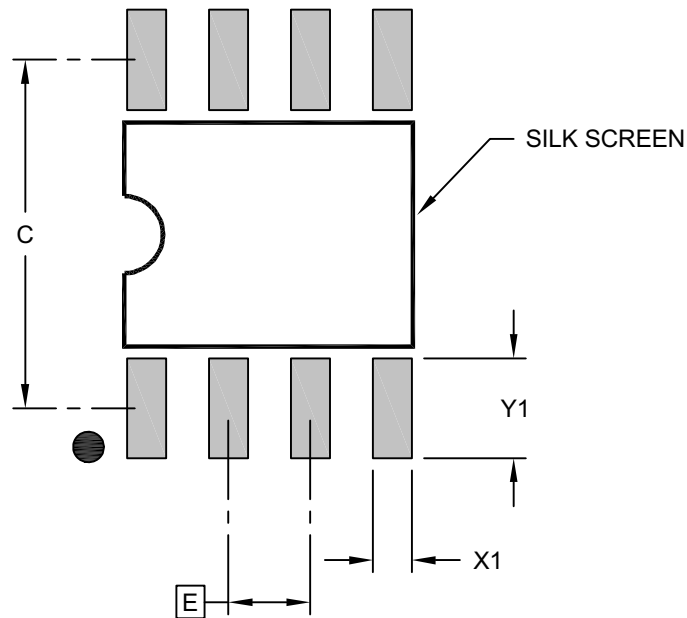
Notes:

1. Pin 1 visual index feature may vary, but must be located within 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 0.15mm per side.
4. 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.
5. Datums A & B to be determined at Datum H.

Microchip Technology Drawing No. C04-057-SN Rev F Sheet 2 of 2

8-Lead Plastic Small Outline (SN) - Narrow, 3.90 mm (.150 In.) Body [SOIC]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



RECOMMENDED LAND PATTERN

Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Contact Pitch	E	1.27 BSC		
Contact Pad Spacing	C		5.40	
Contact Pad Width (X8)	X1			0.60
Contact Pad Length (X8)	Y1			1.55

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

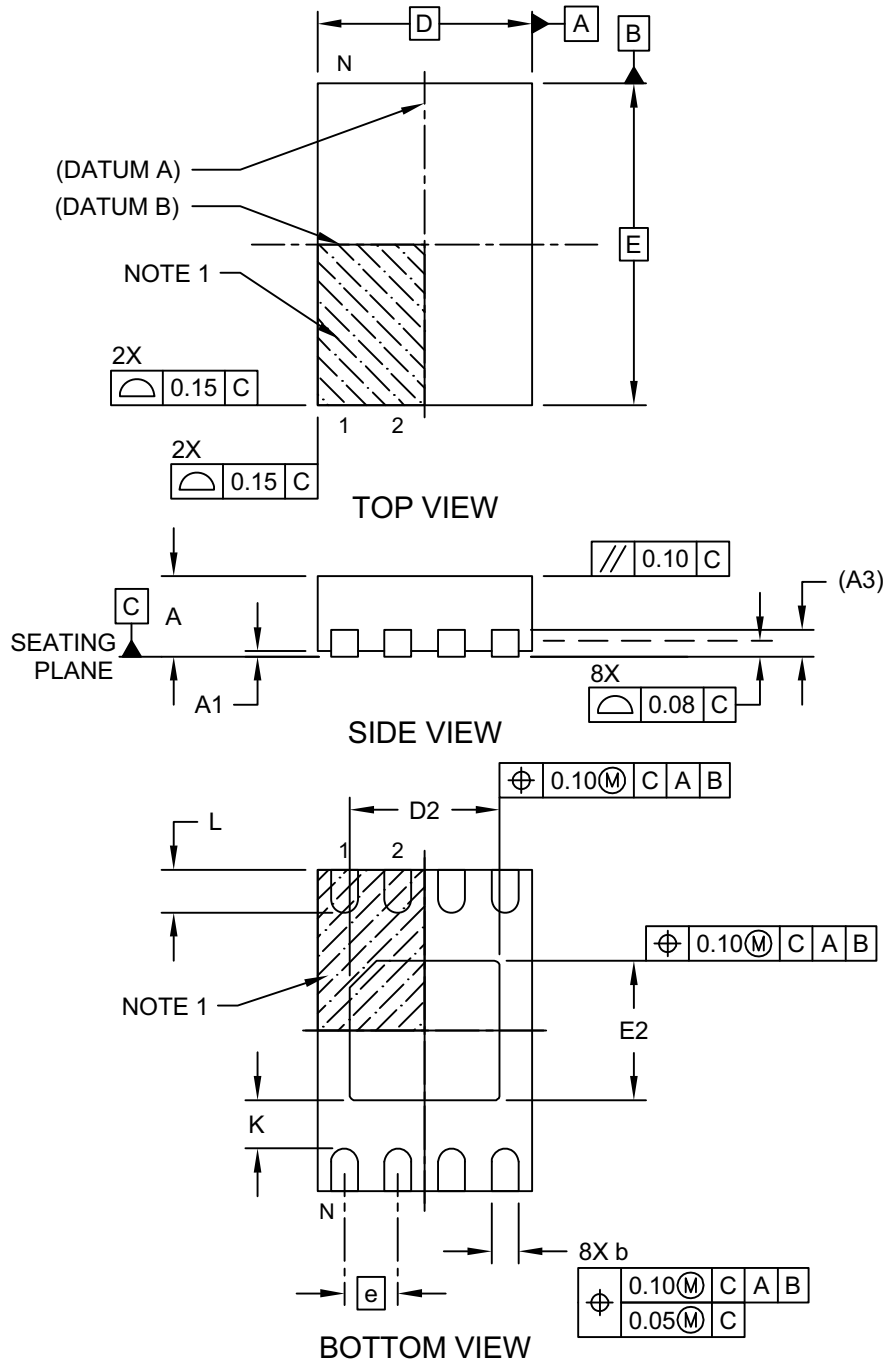
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-2057-SN Rev F

MCP6071/2/4

8-Lead Plastic Dual Flat, No Lead Package (MN) – 2x3x0.8 mm Body [TDFN] With 1.4x1.3 mm Exposed Pad (JEDEC Package type WDFN)

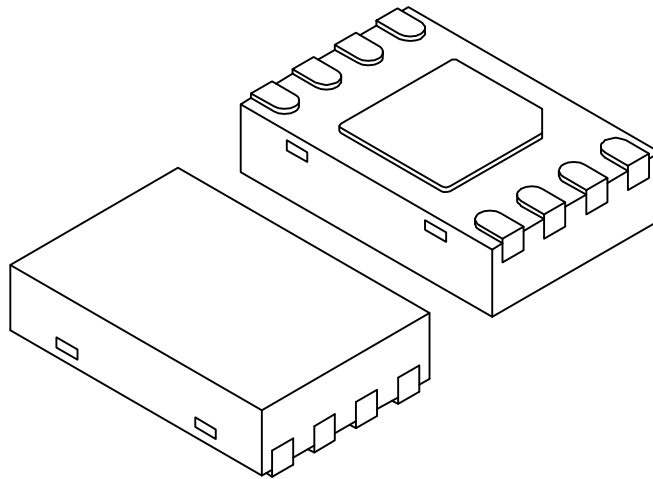
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Microchip Technology Drawing No. C04-129-MN Rev E Sheet 1 of 2

8-Lead Plastic Dual Flat, No Lead Package (MN) – 2x3x0.8 mm Body [TDFN] With 1.4x1.3 mm Exposed Pad (JEDEC Package type WDFN)

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	0.50 BSC		
Overall Height	A	0.70	0.75	0.80
Standoff	A1	0.00	0.02	0.05
Contact Thickness	A3	0.20 REF		
Overall Length	D	2.00 BSC		
Overall Width	E	3.00 BSC		
Exposed Pad Length	D2	1.35	1.40	1.45
Exposed Pad Width	E2	1.25	1.30	1.35
Contact Width	b	0.20	0.25	0.30
Contact Length	L	0.25	0.30	0.45
Contact-to-Exposed Pad	K	0.20	-	-

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Package may have one or more exposed tie bars at ends.
3. Package is saw singulated
4. Dimensioning and tolerancing per ASME Y14.5M

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

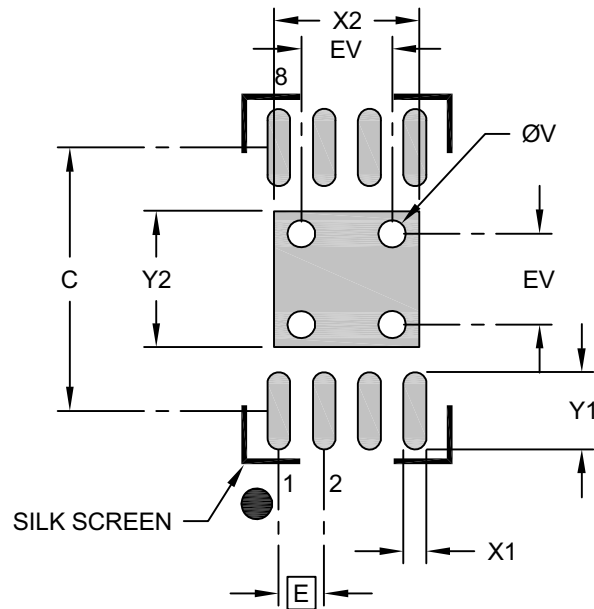
REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing No. C04-129-MN Rev E Sheet 2 of 2

MCP6071/2/4

8-Lead Plastic Dual Flat, No Lead Package (MN) – 2x3x0.8 mm Body [TDFN] With 1.4x1.3 mm Exposed Pad (JEDEC Package type WDFN)

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packageing>



RECOMMENDED LAND PATTERN

Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Contact Pitch	E	0.50 BSC		
Optional Center Pad Width	X2			1.60
Optional Center Pad Length	Y2			1.50
Contact Pad Spacing	C		2.90	
Contact Pad Width (X8)	X1			0.25
Contact Pad Length (X8)	Y1			0.85
Thermal Via Diameter	V		0.30	
Thermal Via Pitch	EV		1.00	

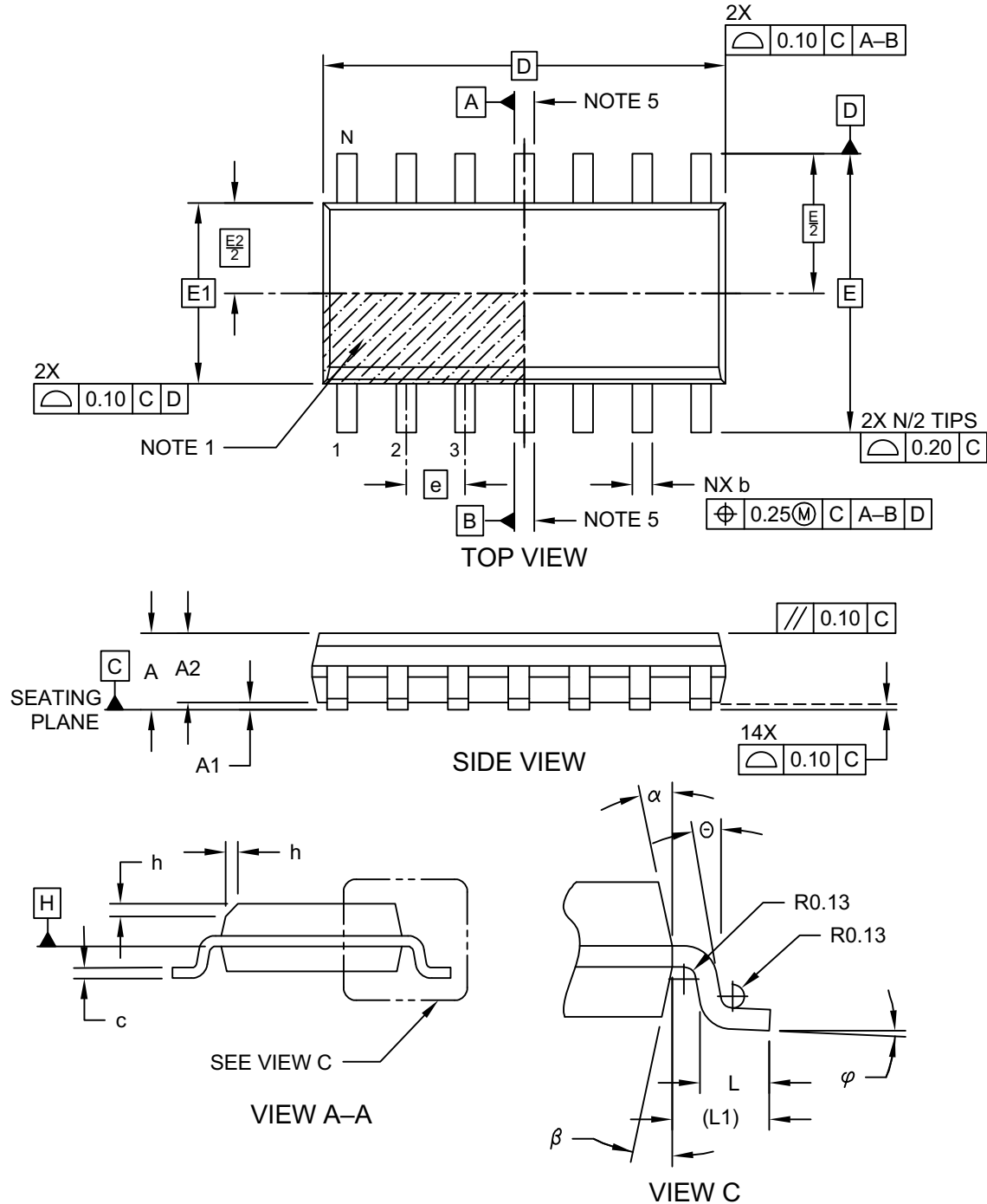
Notes:

1. Dimensioning and tolerancing per ASME Y14.5M
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
2. For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

Microchip Technology Drawing No. C04-129-MN Rev. B

14-Lead Plastic Small Outline (SL) - Narrow, 3.90 mm Body [SOIC]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>

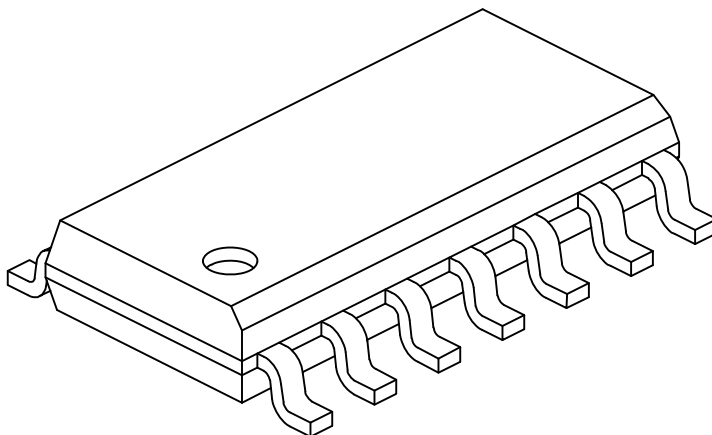


Microchip Technology Drawing No. C04-065-SL Rev D Sheet 1 of 2

MCP6071/2/4

14-Lead Plastic Small Outline (SL) - Narrow, 3.90 mm Body [SOIC]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	14		
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	8.65 BSC		
Chamfer (Optional)	h	0.25	-	0.50
Foot Length	L	0.40	-	1.27
Footprint	L1	1.04 REF		
Lead Angle	∅	0°	-	-
Foot Angle	φ	0°	-	8°
Lead Thickness	c	0.10	-	0.25
Lead Width	b	0.31	-	0.51
Mold Draft Angle Top	α	5°	-	15°
Mold Draft Angle Bottom	β	5°	-	15°

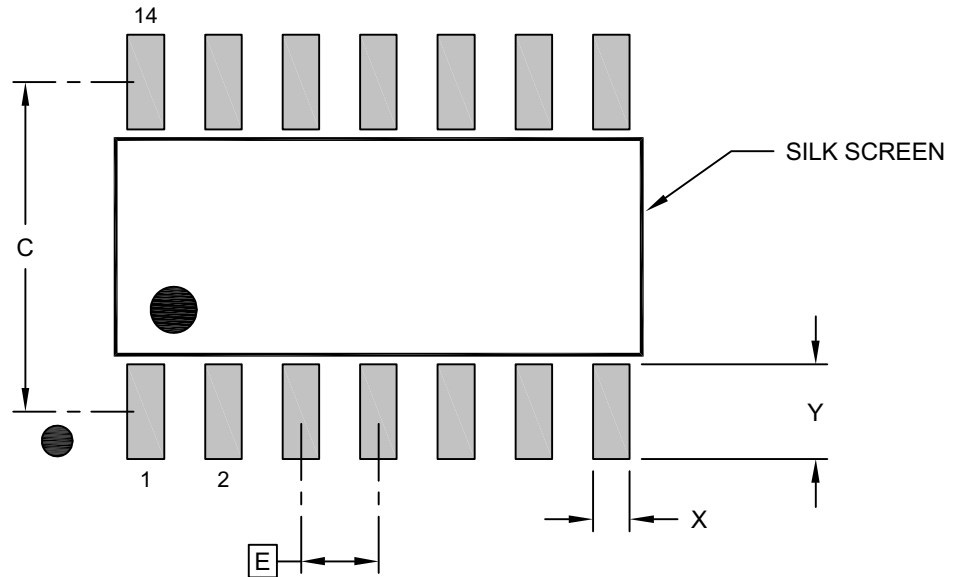
Notes:

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- § Significant Characteristic
- Dimension D does not include mold flash, protrusions or gate burrs, which shall not exceed 0.15 mm per end. Dimension E1 does not include interlead flash or protrusion, which shall not exceed 0.25 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.
- Datums A & B to be determined at Datum H.

Microchip Technology Drawing No. C04-065-SL Rev D Sheet 2 of 2

14-Lead Plastic Small Outline (SL) - Narrow, 3.90 mm Body [SOIC]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



RECOMMENDED LAND PATTERN

Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Contact Pitch	E		1.27 BSC	
Contact Pad Spacing	C		5.40	
Contact Pad Width (X14)	X			0.60
Contact Pad Length (X14)	Y			1.55

Notes:

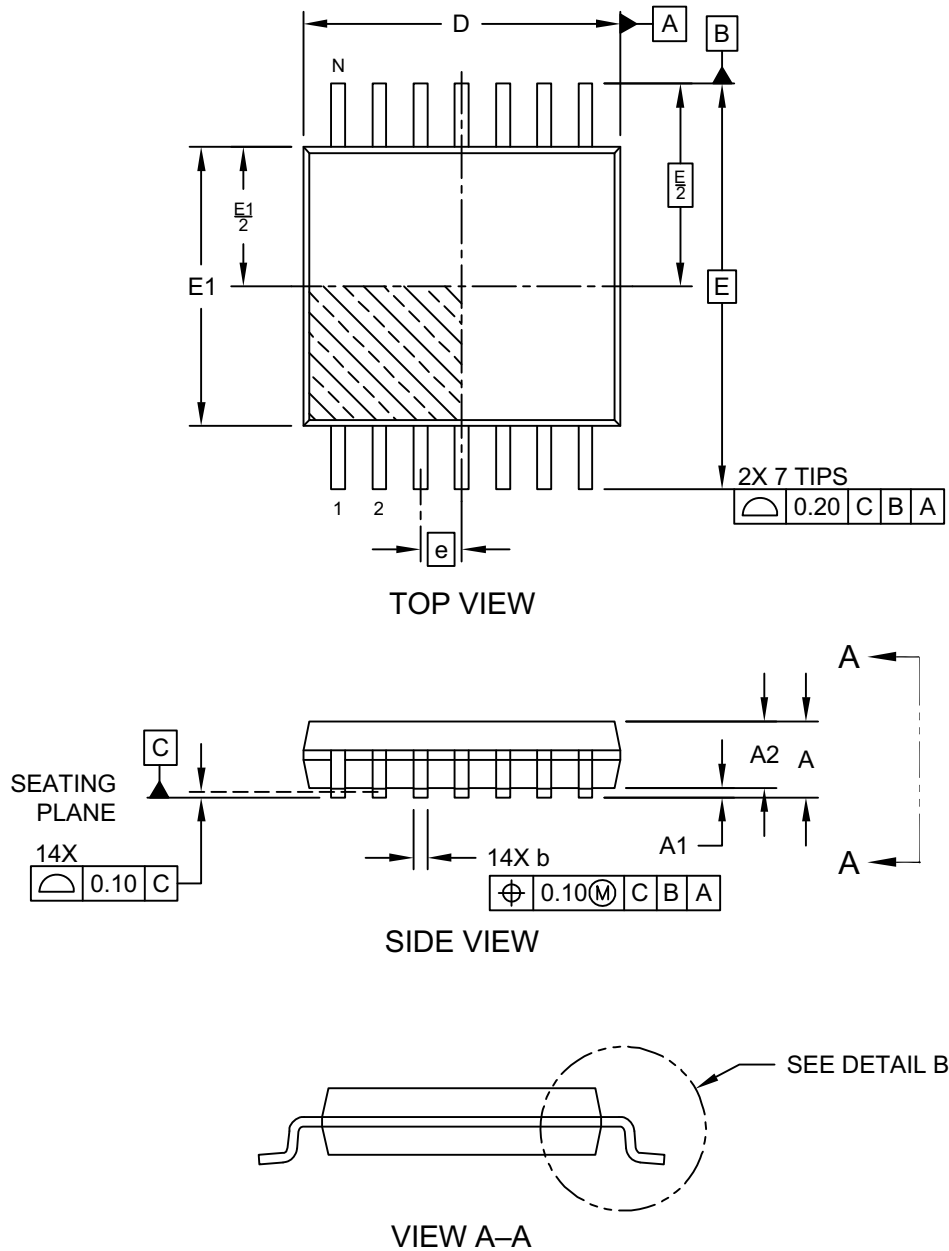
1. Dimensioning and tolerancing per ASME Y14.5M
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2065-SL Rev D

MCP6071/2/4

14Lead Thin Shrink Small Outline Package [ST] 4.4 mm Body [TSSOP]

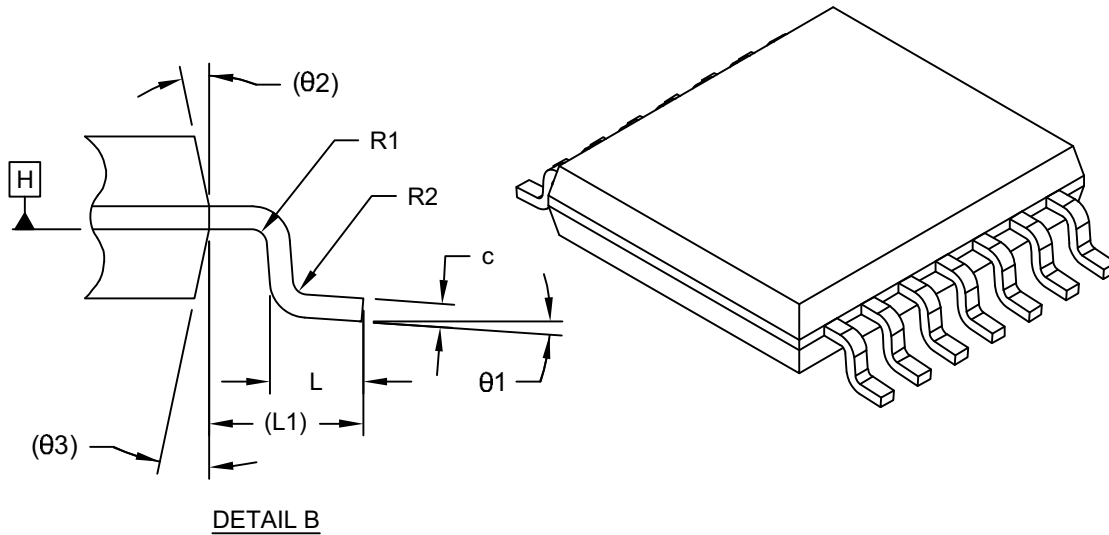
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Microchip Technology Drawing C04-087 Rev D Sheet 1 of 2

14Lead Thin Shrink Small Outline Package [ST] 4.4 mm Body [TSSOP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Dimension	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Terminals	N	14		
Pitch	e	0.65 BSC		
Overall Height	A	–	–	1.20
Standoff	A1	0.05	–	0.15
Molded Package Thickness	A2	0.80	1.00	1.05
Overall Length	D	4.90	5.00	5.10
Overall Width	E	6.40 BSC		
Molded Package Width	E1	4.30	4.40	4.50
Terminal Width	b	0.19	–	0.30
Terminal Thickness	c	0.09	–	0.20
Terminal Length	L	0.45	0.60	0.75
Footprint	L1	1.00 REF		
Lead Bend Radius	R1	0.09	–	–
Lead Bend Radius	R2	0.09	–	–
Foot Angle	θ1	0°	–	8°
Mold Draft Angle	θ2	–	12° REF	–
Mold Draft Angle	θ3	–	12° REF	–

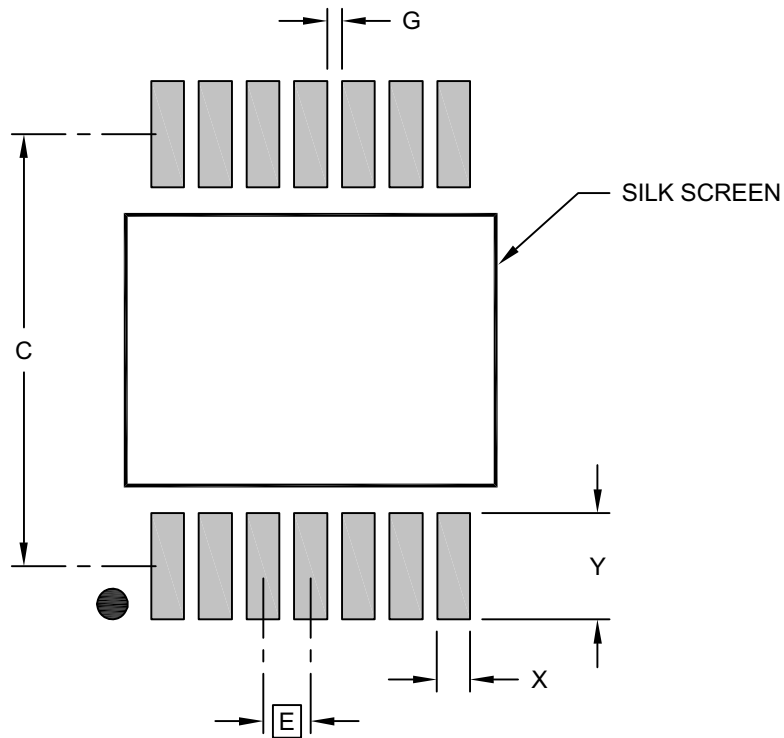
Notes:

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- 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.

MCP6071/2/4

14Lead Thin Shrink Small Outline Package [ST] 4.4 mm Body [TSSOP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



RECOMMENDED LAND PATTERN

Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Contact Pitch	E	0.65 BSC		
Contact Pad Spacing	C		5.90	
Contact Pad Width (Xnn)	X			0.45
Contact Pad Length (Xnn)	Y			1.45
Contact Pad to Contact Pad (Xnn)	G	0.20		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-2087 Rev D

APPENDIX A: REVISION HISTORY

Revision C (November 2021)

The following is the list of modifications:

- Added Markings table for TDF package option, in [Section 6.1 “Package Marking Information”](#).

Revision B (December 2010)

The following is the list of modifications:

- Added new SOT-23-5 package type for MCP6071 device.
- Corrected [Figures 2-13, 2-22, 2-23, 2-24, 2-28, 2-29 and 2-34](#) in [Section 2.0 “Typical Performance Curves”](#).
- Modified [Table 3-1](#) to show the pin column for MCP6071, SOT-23-5 package.
- Updated [Section 4.1.2 “Input Voltage Limits”](#).
- Added [Section 4.1.3 “Input Current Limits”](#).
- Added new document item in [Section 5.5 “Application Notes”](#).
- Updated the [Product Identification System](#) page.

Revision A (March 2009)

- Original Release of this Document.

MCP6071/2/4

NOTES:

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>/XX</u>	Examples:
Device	Temperature Range	Package	
Device:	MCP6071:	Single Op Amp	a) MCP6071T-E/OT: Tape and Reel, 5LD SOT-23 package
	MCP6071T:	Single Op Amp (Tape and Reel) (SOIC, SOT-23 and 2x3 TDFN)	b) MCP6071-E/SN: 8LD SOIC package
	MCP6072:	Dual Op Amp	c) MCP6071T-E/SN: Tape and Reel, 8LD SOIC package
	MCP6072T:	Dual Op Amp (Tape and Reel) (SOIC and 2x3 TDFN)	d) MCP6071T-E/MNY: Tape and Reel, 8LD 2x3 TDFN package
	MCP6074:	Quad Op Amp	a) MCP6072-E/SN: 8LD SOIC package
	MCP6074T:	Quad Op Amp (Tape and Reel) (SOIC and TSSOP)	b) MCP6072T-E/SN: Tape and Reel, 8LD SOIC package
Temperature Range:	E	= -40°C to +125°C	c) MCP6072T-E/MNY: Tape and Reel, 8LD 2x3 TDFN package
Package:	MNY *	= Plastic Dual Flat, No Lead, (2x3 TDFN) 8-lead	a) MCP6074-E/SL: 14LD SOIC package
	OT	= Plastic Small Outline Transistor (SOT-23), 5-lead	b) MCP6074T-E/SL: Tape and Reel, 14LD SOIC package
	SL	= Plastic SOIC (150 mil Body), 14-lead	c) MCP6074-E/ST: 14LD TSSOP package
	SN	= Plastic SOIC, (150 mil Body), 8-lead	d) MCP6074T-E/ST: Tape and Reel, 14LD TSSOP package
	ST	= Plastic TSSOP (4.4mm Body), 14-lead	
	* Y = Nickel palladium gold manufacturing designator. Only available on the TDFN package.		

MCP6071/2/4

NOTES:

Note the following details of the code protection feature on Microchip products:

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner, within operating specifications, and under normal conditions.
- Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip product is strictly prohibited and may violate the Digital Millennium Copyright Act.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is “unbreakable”. Code protection is constantly evolving. Microchip is committed to continuously improving the code protection features of our products.

This publication and the information herein may be used only with Microchip products, including to design, test, and integrate Microchip products with your application. Use of this information in any other manner violates these terms. Information regarding device applications is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. Contact your local Microchip sales office for additional support or, obtain additional support at <https://www.microchip.com/en-us/support/design-help/client-support-services>.

THIS INFORMATION IS PROVIDED BY MICROCHIP "AS IS". MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE, OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL, OR CONSEQUENTIAL LOSS, DAMAGE, COST, OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP'S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION.

Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.

Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AnyRate, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, CryptoMemory, CryptoRF, dsPIC, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Klear, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

AgileSwitch, APT, ClockWorks, The Embedded Control Solutions Company, EtherSynch, Flashtec, Hyper Speed Control, HyperLight Load, IntelliMOS, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, QuietWire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, TrueTime, WinPath, and ZL are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, Augmented Switching, BlueSky, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, Espresso T1S, EtherGREEN, GridTime, IdealBridge, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, Inter-Chip Connectivity, JitterBlocker, Knob-on-Display, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, NVM Express, NVMe, Omniscient Code Generation, PICDEM, PICDEM.net, PICKit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, RTAX, RTG4, SAM-ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SmartHLS, SMART-I.S., storClad, SQL, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, TSHARC, USBCheck, VariSense, VectorBlox, VeriPHY, ViewSpan, WiperLock, XpressConnect, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, Symmcom, and Trusted Time are registered trademarks of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2009-2021, Microchip Technology Incorporated and its subsidiaries.

All Rights Reserved.

ISBN: 978-1-5224-9256-6



MICROCHIP

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
<http://www.microchip.com/support>
Web Address:
www.microchip.com

Atlanta

Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Austin, TX

Tel: 512-257-3370

Boston

Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago

Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas

Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit

Novi, MI
Tel: 248-848-4000

Houston, TX

Tel: 281-894-5983

Indianapolis

Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453
Tel: 317-536-2380

Los Angeles

Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608
Tel: 951-273-7800

Raleigh, NC

Tel: 919-844-7510

New York, NY

Tel: 631-435-6000

San Jose, CA

Tel: 408-735-9110
Tel: 408-436-4270

Canada - Toronto

Tel: 905-695-1980
Fax: 905-695-2078

ASIA/PACIFIC

Australia - Sydney
Tel: 61-2-9868-6733

China - Beijing
Tel: 86-10-8569-7000

China - Chengdu
Tel: 86-28-8665-5511

China - Chongqing
Tel: 86-23-8980-9588

China - Dongguan
Tel: 86-769-8702-9880

China - Guangzhou
Tel: 86-20-8755-8029

China - Hangzhou
Tel: 86-571-8792-8115

China - Hong Kong SAR
Tel: 852-2943-5100

China - Nanjing
Tel: 86-25-8473-2460

China - Qingdao
Tel: 86-532-8502-7355

China - Shanghai
Tel: 86-21-3326-8000

China - Shenyang
Tel: 86-24-2334-2829

China - Shenzhen
Tel: 86-755-8864-2200

China - Suzhou
Tel: 86-186-6233-1526

China - Wuhan
Tel: 86-27-5980-5300

China - Xian
Tel: 86-29-8833-7252

China - Xiamen
Tel: 86-592-2388138

China - Zhuhai
Tel: 86-756-3210040

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444

India - New Delhi
Tel: 91-11-4160-8631

India - Pune
Tel: 91-20-4121-0141

Japan - Osaka
Tel: 81-6-6152-7160

Japan - Tokyo
Tel: 81-3-6880-3770

Korea - Daegu
Tel: 82-53-744-4301

Korea - Seoul
Tel: 82-2-554-7200

Malaysia - Kuala Lumpur
Tel: 60-3-7651-7906

Malaysia - Penang
Tel: 60-4-227-8870

Philippines - Manila
Tel: 63-2-634-9065

Singapore
Tel: 65-6334-8870

Taiwan - Hsin Chu
Tel: 886-3-577-8366

Taiwan - Kaohsiung
Tel: 886-7-213-7830

Taiwan - Taipei
Tel: 886-2-2508-8600

Thailand - Bangkok
Tel: 66-2-694-1351

Vietnam - Ho Chi Minh
Tel: 84-28-5448-2100

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4485-5910
Fax: 45-4485-2829

Finland - Espoo
Tel: 358-9-4520-820

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Garching
Tel: 49-8931-9700

Germany - Haan
Tel: 49-2129-3766400

Germany - Heilbronn
Tel: 49-7131-72400

Germany - Karlsruhe
Tel: 49-721-625370

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Germany - Rosenheim
Tel: 49-8031-354-560

Israel - Ra'anana
Tel: 972-9-744-7705

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Italy - Padova
Tel: 39-049-7625286

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Norway - Trondheim
Tel: 47-7288-4388

Poland - Warsaw
Tel: 48-22-3325737

Romania - Bucharest
Tel: 40-21-407-87-50

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

Sweden - Gothenberg
Tel: 46-31-704-60-40

Sweden - Stockholm
Tel: 46-8-5090-4654

UK - Wokingham
Tel: 44-118-921-5800
Fax: 44-118-921-5820