

Description

MCP6001/2/4 family of operational amplifiers (op amps) is specifically designed for general-purpose applications. This family has a 1 MHz Gain Bandwidth Product (GBWP) and 90° phase margin (typical). It also maintains 45° phase margin (typical) with a 500 pF capacitive load. This family operates from a single supply voltage as low as 1.8V, while drawing 100 μ A (typical) quiescent current. Additionally, the MCP6001/2/4 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.

The MCP6001/2/4 family is available in the industrial and extended temperature ranges, with a power supply range of 1.8V to 6.0V.

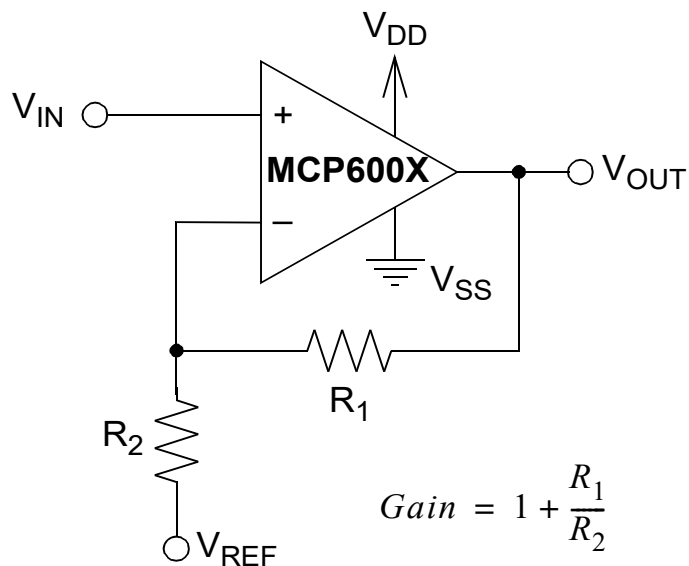
Features

- Gain Bandwidth Product: 1 MHz (typical)
- Rail-to-Rail Input/Output
- Supply Voltage: 1.8V to 6.0V
- Supply Current: $I_Q = 100$ μ A (typical)
- Phase Margin: 90° (typical)
- Temperature Range:
 - Industrial: -40°C to +85°C
 - Extended: -40°C to +125°C
- Available in Single, Dual and Quad Packages

Applications

- Portable Equipment
- Photodiode Amplifier
- Analog Filters
- Notebooks and PDAs
- Battery-Powered Systems

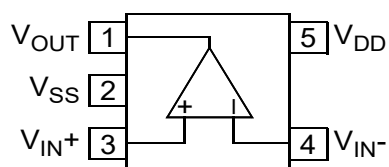
Typical Application



Noninverting Amplifier

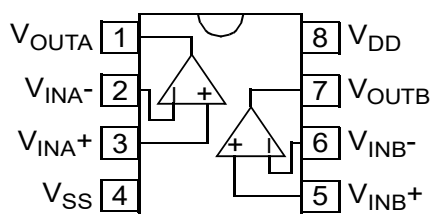
Package Types

MCP6001



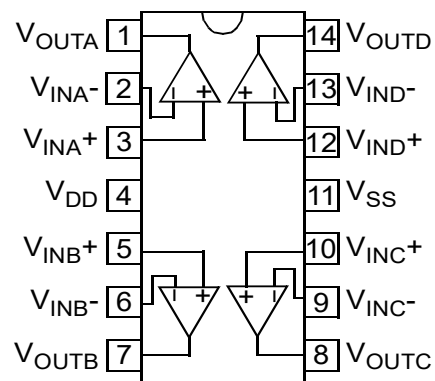
SC70-5, SOT23-5

MCP6002



SOP-8

MCP6004



SOP-14/TSSOP-14

DC ELECTRICAL SPECIFICATIONS

Electrical Characteristics: Unless otherwise indicated, T _A = +25°C, V _{DD} = +1.8V to +5.5V, V _{SS} = GND, V _{CM} = V _{DD} /2, V _L = V _{DD} /2, R _L = 10 kΩ to V _L , and V _{OUT} ≈ V _{DD} /2 (refer to Figure 1-1).						
Parameters	Sym	Min	Typ	Max	Units	Conditions
Input Offset						
Input Offset Voltage	V _{OS}	-4.5	—	+4.5	mV	V _{CM} = V _{SS} (Note 1)
Input Offset Drift with Temperature	ΔV _{OS} /ΔT _A	—	±2.0	—	μV/°C	T _A = -40°C to +125°C, V _{CM} = V _{SS}
Power Supply Rejection Ratio	PSRR	—	86	—	dB	V _{CM} = V _{SS}
Input Bias Current and Impedance						
Input Bias Current:	I _B	—	±1.0	—	pA	T _A = +85°C T _A = +125°C
Industrial Temperature	I _B	—	19	—	pA	
Extended Temperature	I _B	—	1100	—	pA	
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	76	—	dB	V _{CM} = -0.3V to 5.3V, V _{DD} = 5V
Open-Loop Gain						
DC Open-Loop Gain (Large Signal)	A _{OL}	88	112	—	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} + 25	—	V _{DD} – 25	mV	V _{DD} = 5.5V, 0.5V Input Overdrive
Output Short Circuit Current	I _{SC}	—	±6	—	mA	V _{DD} = 1.8V
		—	±23	—	mA	V _{DD} = 5.5V
Power Supply						
Supply Voltage	V _{DD}	1.8	—	6.0	V	Note 2
Quiescent Current per Amplifier	I _O	50	100	170	μA	I _O = 0, V _{DD} = 5.5V, V _{CM} = 5V

AC ELECTRICAL SPECIFICATIONS

Electrical Characteristics: Unless otherwise indicated, $T_A = +25^\circ\text{C}$, $V_{DD} = +1.8$ to 5.5V , $V_{SS} = \text{GND}$, $V_{CM} = V_{DD}/2$, $V_L = V_{DD}/2$, $V_{OUT} \approx V_{DD}/2$, $R_L = 10\text{ k}\Omega$ 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	—	1.0	—	MHz	
Phase Margin	PM	—	90	—	°	$G = +1\text{ V/V}$
Slew Rate	SR	—	0.6	—	$\text{V}/\mu\text{s}$	
Noise						
Input Noise Voltage	E_{ni}	—	6.1	—	$\mu\text{Vp-p}$	$f = 0.1\text{ Hz to }10\text{ Hz}$
Input Noise Voltage Density	e_{ni}	—	28	—	$\text{nV}/\sqrt{\text{Hz}}$	$f = 1\text{ kHz}$
Input Noise Current Density	i_{ni}	—	0.6	—	$\text{fA}/\sqrt{\text{Hz}}$	$f = 1\text{ kHz}$

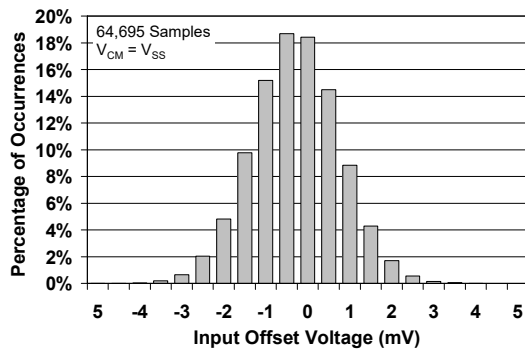
TEMPERATURE SPECIFICATIONS

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

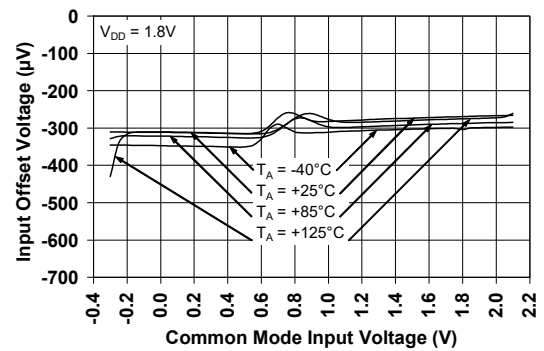
Parameters	Sym	Min	Typ	Max	Units	Conditions
Temperature Ranges						
Industrial Temperature Range	T_A	-40	—	+85	°C	
Extended Temperature Range	T_A	-40	—	+125	°C	
Operating Temperature Range	T_A	-40	—	+125	°C	Note
Storage Temperature Range	T_A	-65	—	+150	°C	
Thermal Package Resistances						
Thermal Resistance,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

Note: The industrial temperature devices operate over this extended temperature range, but with reduced performance. In any case, the internal Junction Temperature (T_J) must not exceed the Absolute Maximum specification of $+150^\circ\text{C}$.

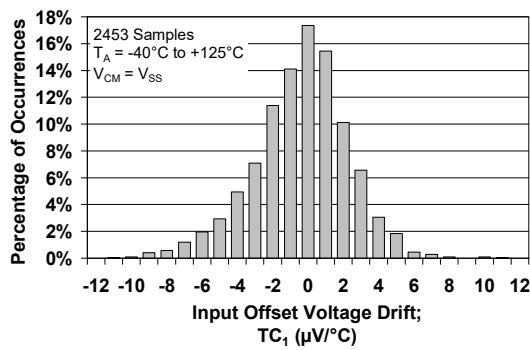
TYPICAL PERFORMANCE CURVES



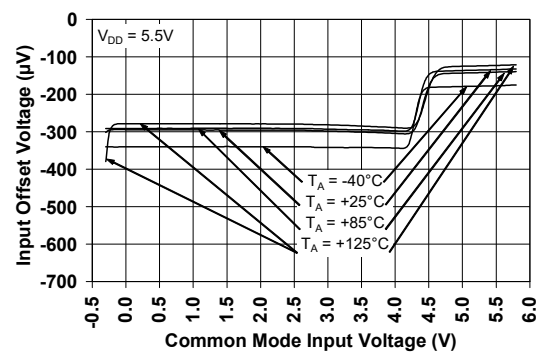
Input Offset Voltage.



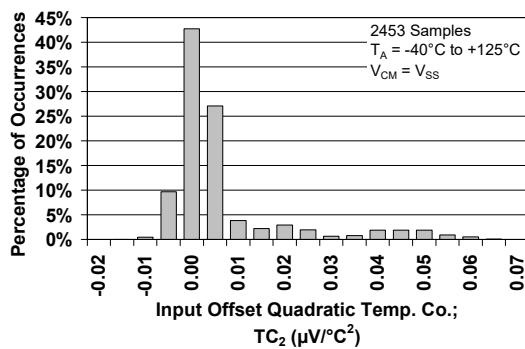
Input Offset Voltage vs. Common-Mode Input Voltage at $V_{DD} = 1.8V$.



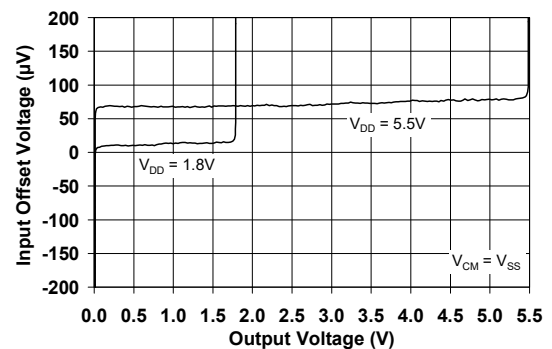
Input Offset Voltage Drift.



Input Offset Voltage vs. Common-Mode Input Voltage at $V_{DD} = 5.5V$.

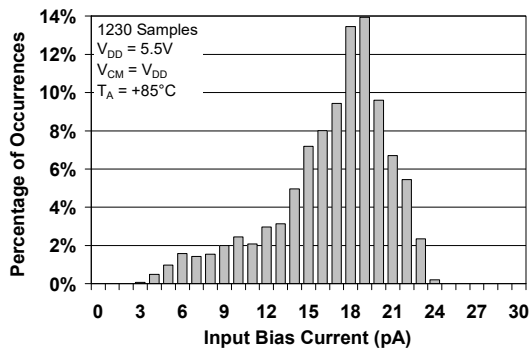


Input Offset Quadratic Temp. Co.

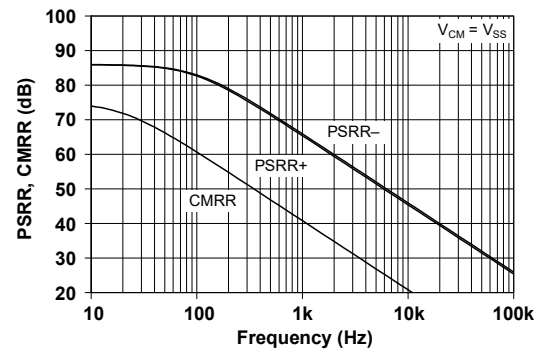


Input Offset Voltage vs. Output Voltage.

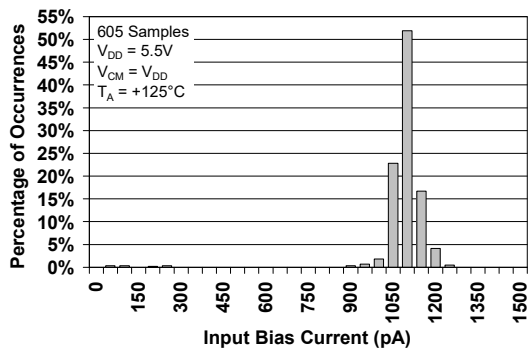
Note: Unless otherwise indicated, $T_A = +25^{\circ}C$, $V_{DD} = +1.8V$ to $+5.5V$, $V_{SS} = GND$, $V_{CM} = V_{DD}/2$, $V_{OUT} \approx V_{DD}/2$, $V_L = V_{DD}/2$, $R_L = 10\text{ k}\Omega$ to V_L and $C_L = 60\text{ pF}$.



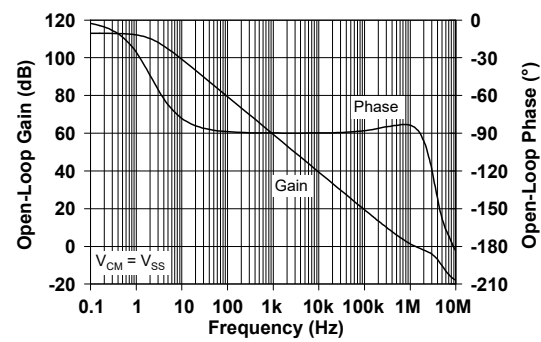
Input Bias Current at +85°C.



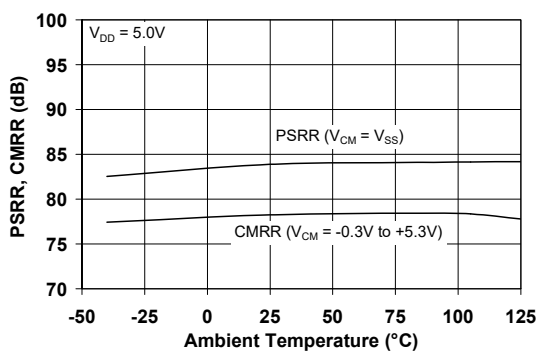
PSRR, CMRR vs. Frequency.



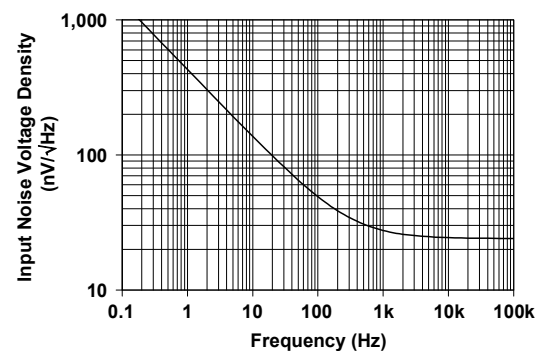
Input Bias Current at +125°C.



Open-Loop Gain, Phase vs. Frequency.

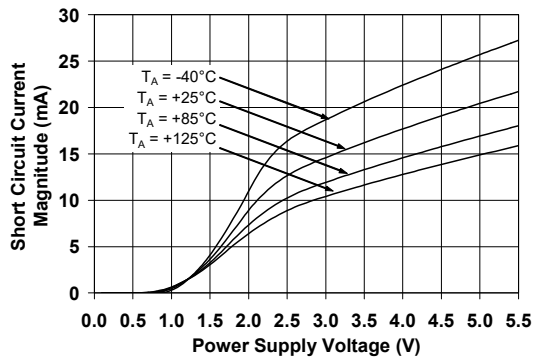


CMRR, PSRR vs. Ambient Temperature.

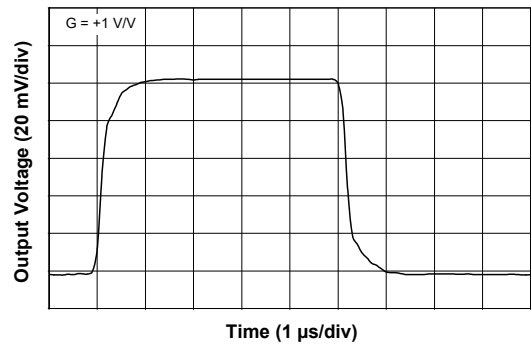


Input Noise Voltage Density vs. Frequency.

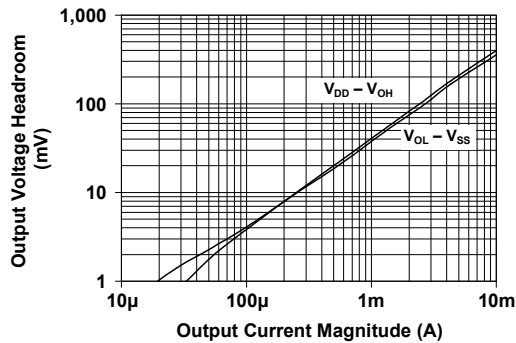
Note: Unless otherwise indicated, $T_A = +25^\circ\text{C}$, $V_{DD} = +1.8\text{V}$ to $+5.5\text{V}$, $V_{SS} = \text{GND}$, $V_{CM} = V_{DD}/2$, $V_{OUT} \approx V_{DD}/2$, $V_L = V_{DD}/2$, $R_L = 10\text{ k}\Omega$ to V_L and $C_L = 60\text{ pF}$.



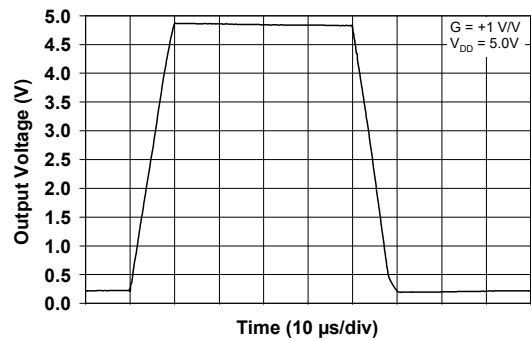
Output Short-Circuit Current vs. Power Supply Voltage.



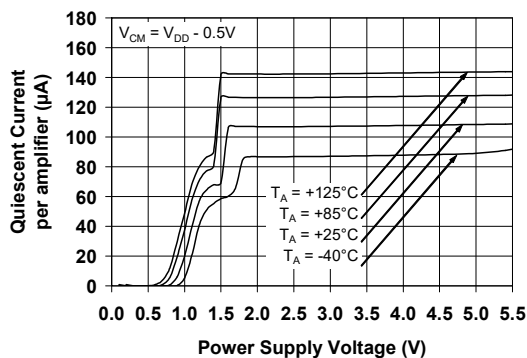
Small-Signal, Noninverting Pulse Response.



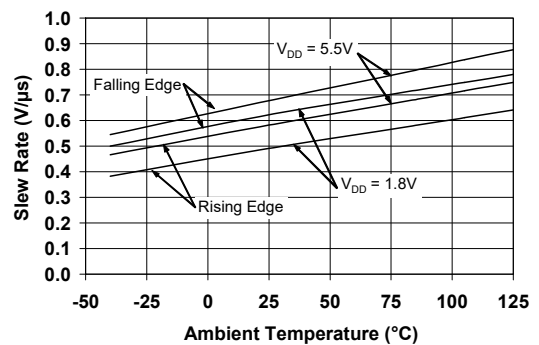
Output Voltage Headroom vs. Output Current Magnitude.



Large-Signal, Noninverting Pulse Response.

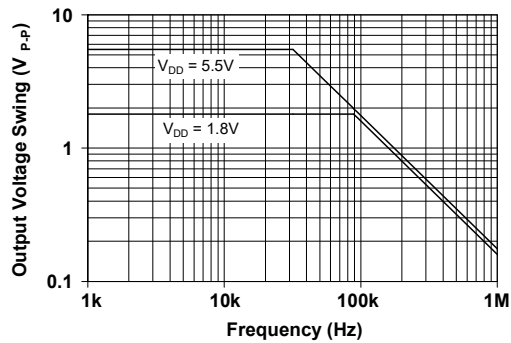


Quiescent Current vs. Power Supply Voltage.

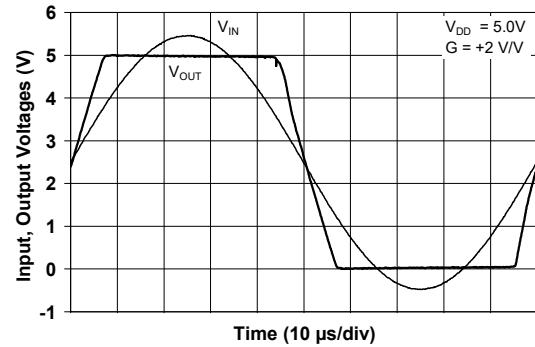


Slew Rate vs. Ambient Temperature.

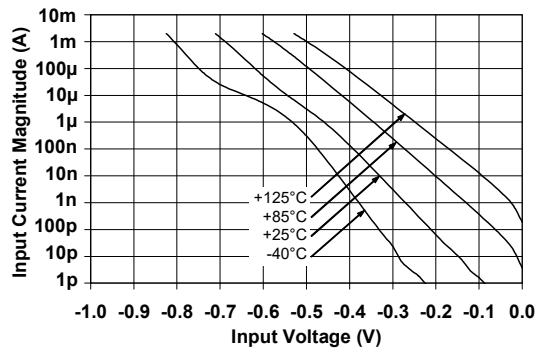
Note: Unless otherwise indicated, $T_A = +25^\circ\text{C}$, $V_{DD} = +1.8 \text{ V}$ to $+5.5 \text{ V}$, $V_{SS} = \text{GND}$, $V_{CM} = V_{DD}/2$, $V_{OUT} \approx V_{DD}/2$, $V_L = V_{DD}/2$, $R_L = 10 \text{ k}\Omega$ to V_L and $C_L = 60 \text{ pF}$.



Output Voltage Swing vs. Frequency.



The MCP6001/2/4 Show No Phase Reversal.

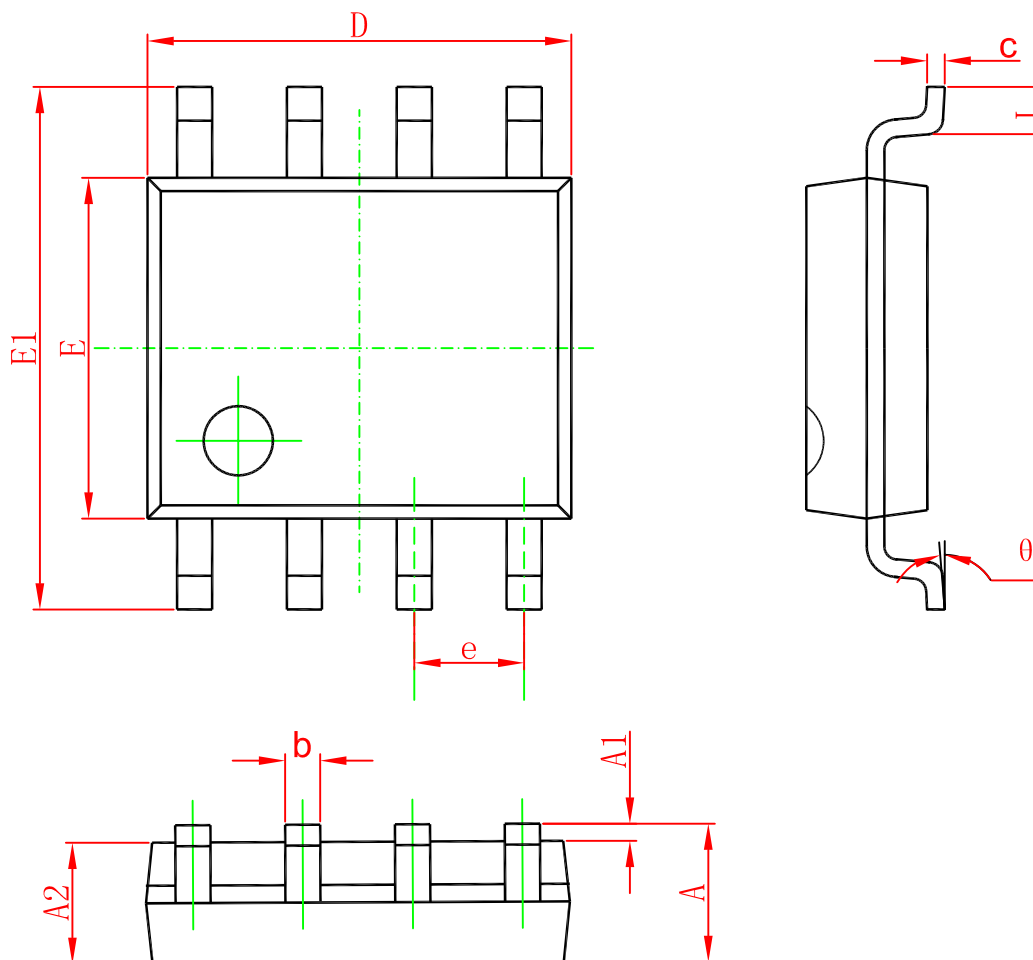


Measured Input Current vs. Input Voltage (below V_{SS}).

Note: Unless otherwise indicated, $T_A = +25^\circ\text{C}$, $V_{DD} = +1.8\text{V}$ to $+5.5\text{V}$, $V_{SS} = \text{GND}$, $V_{CM} = V_{DD}/2$, $V_{OUT} \approx V_{DD}/2$, $V_L = V_{DD}/2$, $R_L = 10\text{ k}\Omega$ to V_L and $C_L = 60\text{ pF}$.

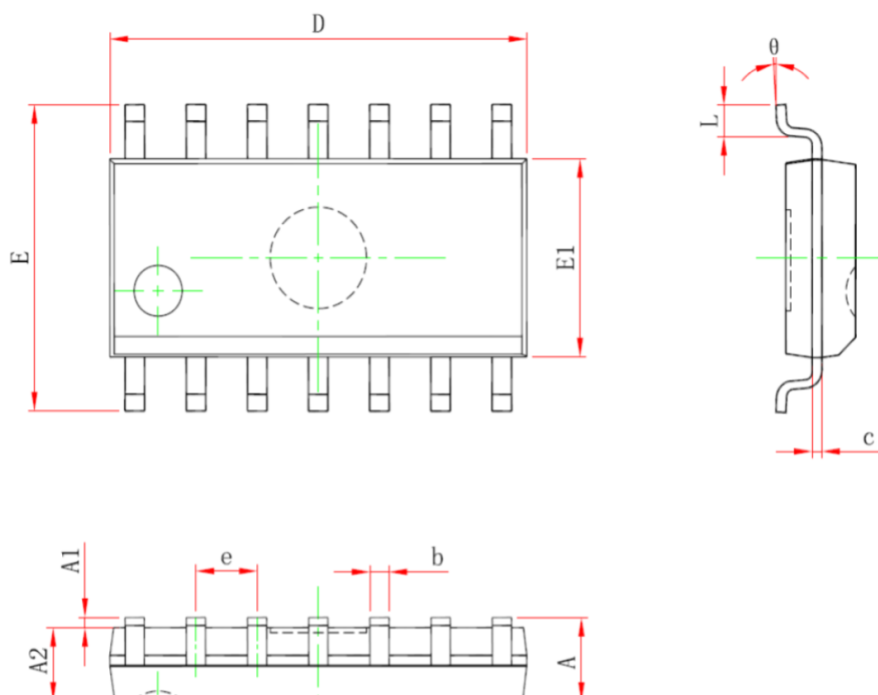
Package Mechanical

SOP-8



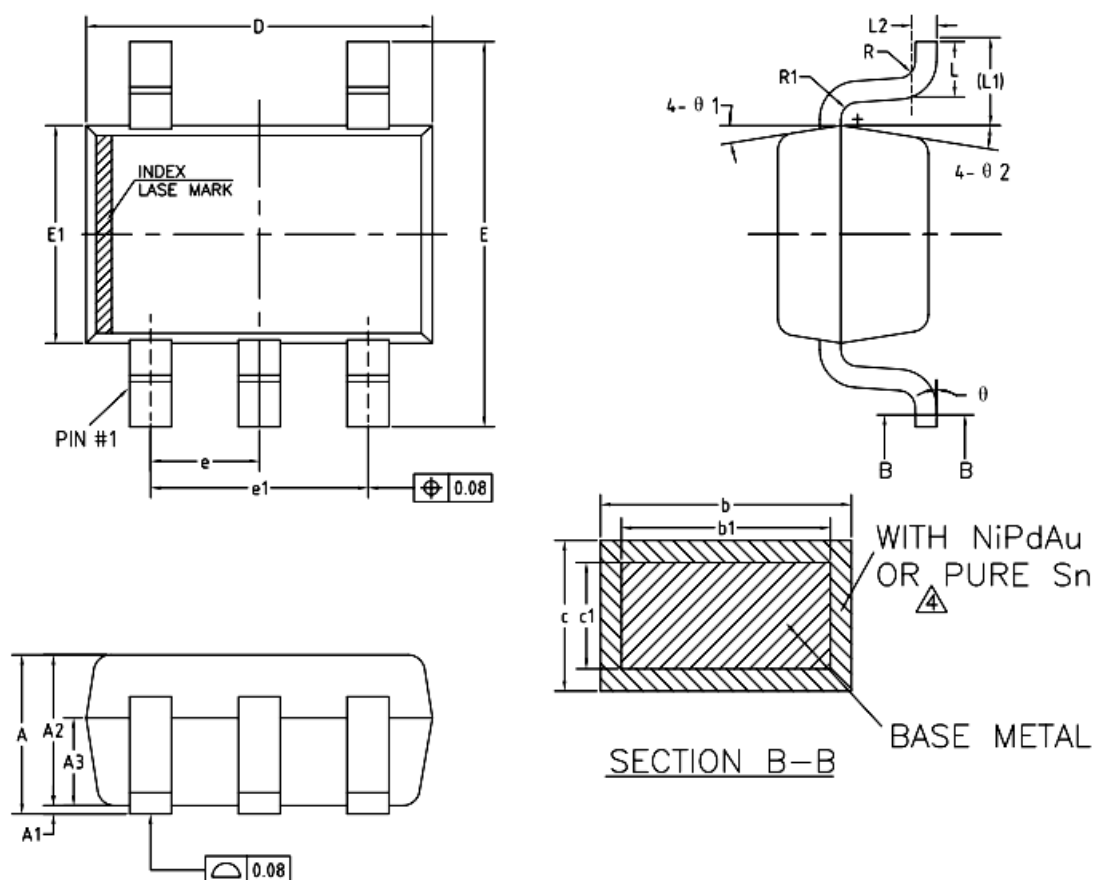
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

SOP-14



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	—	1.750	—	0.069
A1	0.100	0.250	0.004	0.010
A2	1.250	—	0.049	—
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	8.450	8.850	0.333	0.348
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

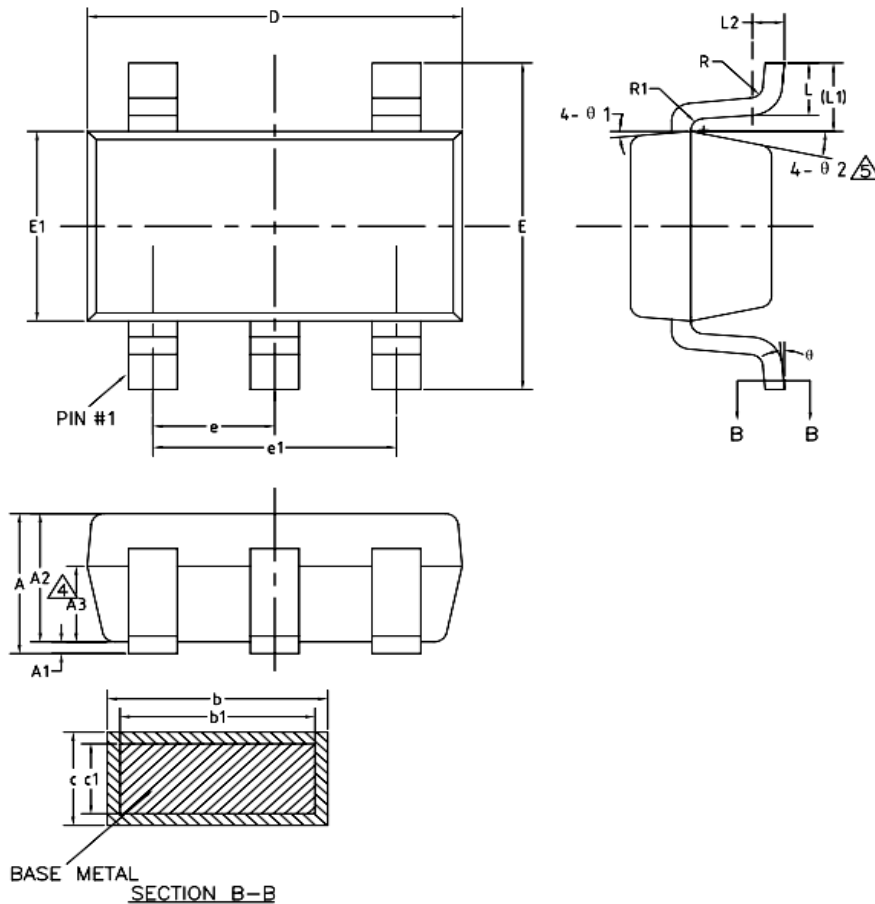
SC70-5



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.85	—	1.05
A1	0	—	0.10
A2	0.80	0.90	1.00
A3	0.47	0.52	0.57
b NiPdAu	0.22	—	0.29
PURE Sn	0.23	—	0.33
b1	0.22	0.25	0.28
c NiPdAu	0.115	—	0.15
PURE Sn	0.12	—	0.18
c1	0.115	0.13	0.14
D	2.02	2.07	2.12
E	2.20	2.30	2.40
E1	1.25	1.30	1.35
e	0.60	0.65	0.70
e1	1.20	1.30	1.40
L	0.28	0.33	0.38
L1	0.50REF		
L2	0.15BSC		
R	0.10	—	—
R1	0.10	—	0.25
θ	0°	—	8°
θ 1	6°	9°	12°
θ 2	6°	9°	12°

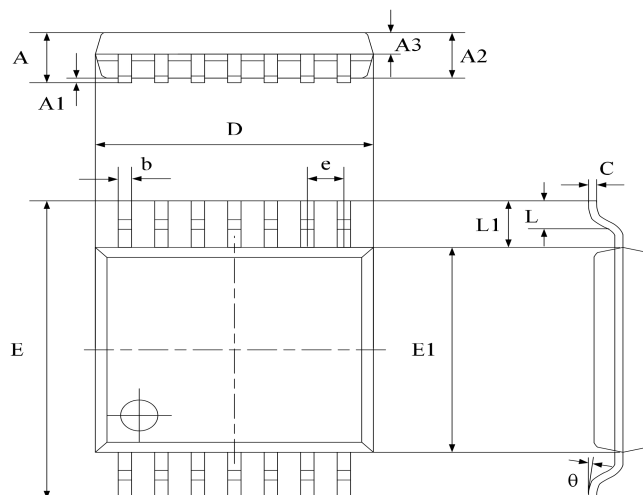
SOT23-5



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	—	—	1.25
A1	0	—	0.15
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.36	—	0.50
b1	0.36	0.38	0.45
c	0.14	—	0.20
c1	0.14	0.15	0.16
D	2.826	2.926	3.026
E	2.60	2.80	3.00
E1	1.526	1.626	1.726
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
L	0.35	0.45	0.60
L1	0.59REF		
L2	0.25BSC		
R	0.10	—	—
R1	0.10	—	0.25
θ	0°	—	8°
θ 1	3°	5°	7°
θ 2	6°	—	14°

TSSOP-14



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	-	1.200	-	0.0472
A1	0.050	0.150	0.002	0.006
A2	0.900	1.050	0.037	0.043
A3	0.390	0.490	0.016	0.020
b	0.200	0.290	0.008	0.012
C	0.130	0.180	0.005	0.007
D	4.860	5.060	0.198	0.207
E	6.200	6.600	0.253	0.269
E1	4.300	4.500	0.176	0.184
e	0.650 typ.		0.0256 typ.	
L1	1.000 ref.		0.0393 ref.	
L	0.450	0.750	0.018	0.031
θ	0°	8°	0°	8°

Ordering information

Order code	Package	Baseqty	Deliverymode	Marking	Temperature Range
UMW MCP6001T-I/OT	SOT23-5	3000	Tape and reel	AAXX U	-40°C to +85°C
UMW MCP6001T-E/OT	SOT23-5	3000	Tape and reel	CDXX U	-40°C to +125°C
UMW MCP6001T-I/LT	SC70-5	3000	Tape and reel	AAXX U	-40°C to +85°C
UMW MCP6002T-I/SN	SOP-8	2500	Tape and reel	MCP6002	-40°C to +85°C
UMW MCP6002T-E/SN	SOP-8	2500	Tape and reel	MCP6002	-40°C to +125°C
UMW MCP6004T-I/SL	SOP-14	2500	Tape and reel	MCP6004	-40°C to +85°C
UMW MCP6004T-E/SL	SOP-14	2500	Tape and reel	MCP6004	-40°C to +125°C
UMW MCP6004T-I/ST	TSSOP-14	4000	Tape and reel	6004T	-40°C to +85°C
UMW MCP6004T-E/ST	TSSOP-14	4000	Tape and reel	6004T	-40°C to +125°C