UMW MCP600x

1 MHz, Low-Power Op Amp

1.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 µA (typical) quiescent current. Additionally, the MCP6001/2/4 supports rail-torail input and output swing, with a common mode input voltage range of VDD + 300 mV to VSS – 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.

2.Features

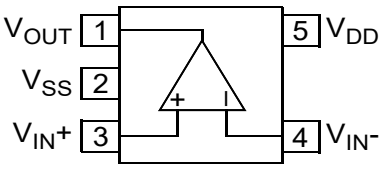
- Gain Bandwidth Product: 1 MHz (typical)
- Rail-to-Rail Input/Output
- Supply Voltage: 1.8V to 6.0V
- Supply Current: IQ = 100 µA (typical)
- Phase Margin: 90° (typical)
- Temperature Range:
  - Industrial: -40°C to +85°C
  - Extended: -40°C to +125°C
- Available in Single, Dual and Quad Packages

3.Applications

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

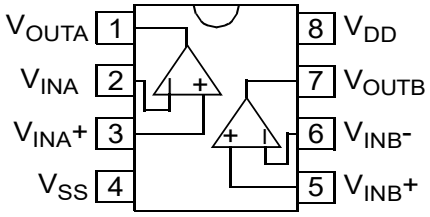
4.Pinning information

MCP6001



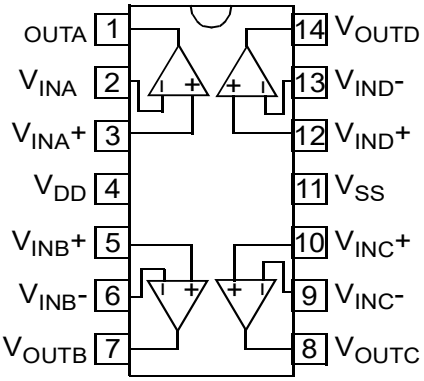
SC70-5/SOT23-5

MCP6002



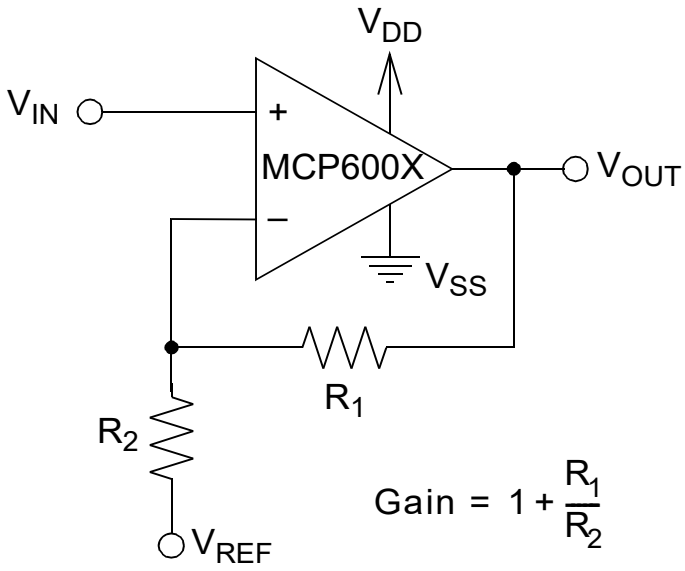
SOP-8

MCP6004



SOP-14/TSSOP-14

5.Typical Application



Noninverting Amplifier

6.1 DC Electrical Characteristics

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=10kΩ to V_L,and V_{OUT}≈V_{DD}/2 (refer to Figure 1-1).

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input **Offset**						
Input Offset Voltage	V_{OS}	V_{CM}=V_{SS} (Note 1)	-4.5		4.5	mV
Input Offset Drift with Temperature	$\Delta V_{OS}/\Delta T_A$	T_A=-40°C to +125°C, V_{CM}=V_{SS}		±2		µV/°C
Power Supply Rejection Ratio	PSRR	V_{CM}=V_{SS}		86		dB
Input Bias Current and Impedance						
Input Bias Current:	I_B			±1		pA
Industrial Temperature		T_A=+85°C		19		pA
Extended Temperature		T_A=+125°C		1100		pA
Input Offset Current	I_{OS}			±1		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	V_{CM}=-0.3V to 5.3V, V_{DD}=5V	60	76		dB
Open-Loop Gain						
DC Open-Loop Gain (Large Signal)	A_{OL}	V_{OUT}=0.3V to V_{DD}-0.3V, V_{CM}=V_{SS}	88	112		dB
Output						
Maximum Output Voltage Swing	V_{OL}, V_{OH}	V_{DD}=5.5V, 0.5V Input Overdrive	V_{SS}+25		V_{DD}-25	mV
Output Short Circuit Current	I_{SC}	V_{DD}=1.8V		±6		mA
		V_{DD}=5.5V		±23		mA
Power Supply						
Supply Voltage	V_{DD}	Note 2	1.8		6	V
Quiescent Current per Amplifer	I_Q	I_O=0, V_{DD}=5.5V, V_{CM}=5V	50	100	170	µA

6.2 AC Electrical Characteristics

T_A=+25°C, V_{DD}=+1.8V to +5.5V, V_{SS}=GND, V_{CM}=V_{DD}/2, V_L=V_{DD}/2, V_{OUT}≈V_{DD}/2, R_L=10kΩ to V_L, and C_L=60pF (refer to Figure 1-1).

Parameter	Symbol	Conditions	Min	Typ	Max	Units
AC Response						
Gain Bandwidth Product	GBWP			1		MHz
Phase Margin	PM	G=+1V/V		90		°C
Slew Rate	SR			0.6		V/μs
Noise						
Input Noise Voltage	E_{ni}	f=0.1Hz to 10Hz		6.1		$μV_{p-p}$
Input Noise Voltage Density	e_{ni}	f=1kHz		28		nV/√Hz
Input Noise Current Density	i_{ni}	f=1kHz		0.6		fA/√Hz

6.3 Electrical Characteristics

Unless otherwise indicated, V_{DD}=+1.8V to +5.5V and V_{SS}=GND.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Temperature Ranges						
Industrial Temperature Range	T_A		-40		85	°C
Extended Temperature Range	T_A		-40		125	°C
Operating Temperature Range	T_A	Note	-40		125	°C
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°C.

7.1 Typical characteristic

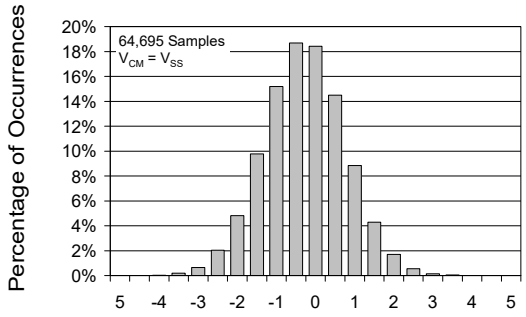


Figure 1: Input Offset Voltage.

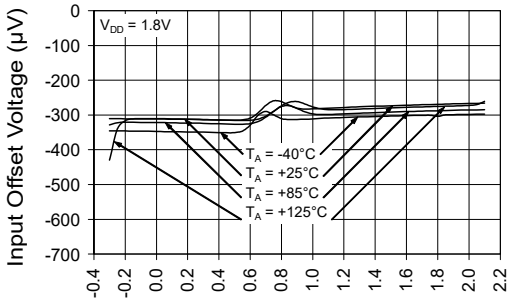


Figure 2: Input Offset Voltage vs. Common-Mode Input Voltage at V_{DD} = 1.8V.

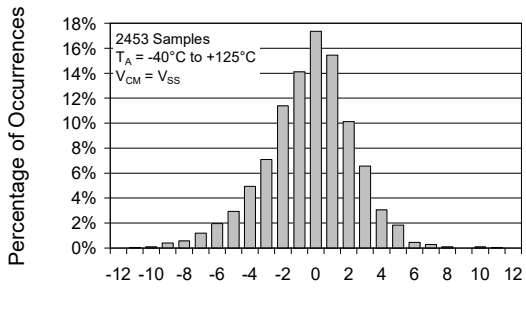


Figure 3: Input Offset Voltage Drift.

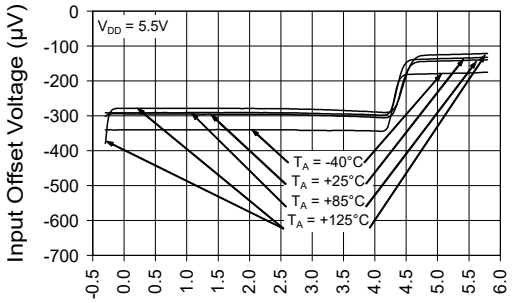


Figure 4: Input Offset Voltage vs. Common-Mode Input Voltage at V_{DD} = 5.5V.

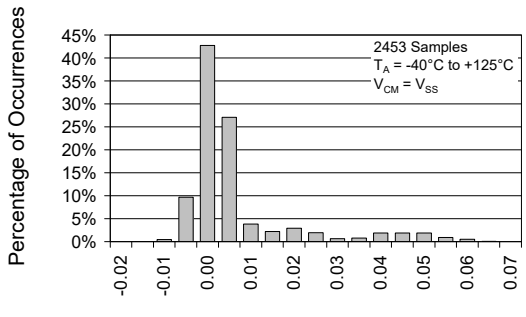


Figure 5: Input Offset Quadratic Temp. Co.

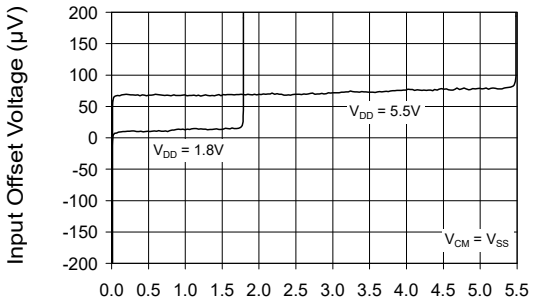


Figure 6: Input Offset Voltage vs. Output Voltage.

7.2 Typical characteristic

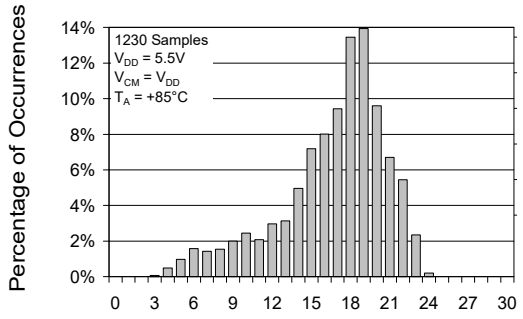


Figure 7: Input Bias Current at +85°C.

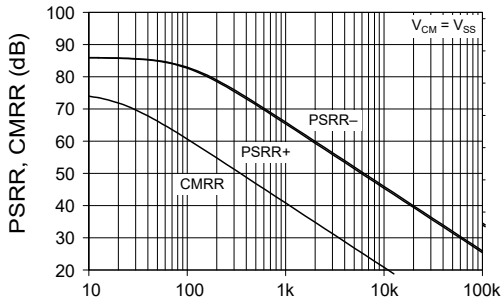


Figure 8: PSRR, CMRR vs. Frequency.

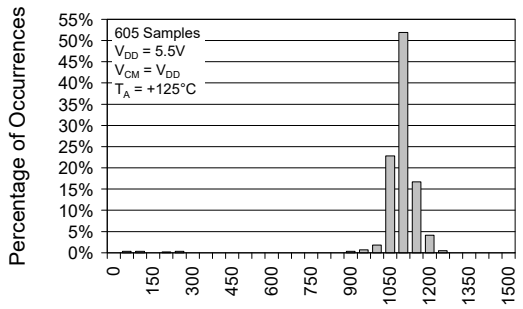


Figure 9: Input Bias Current at +125°C.

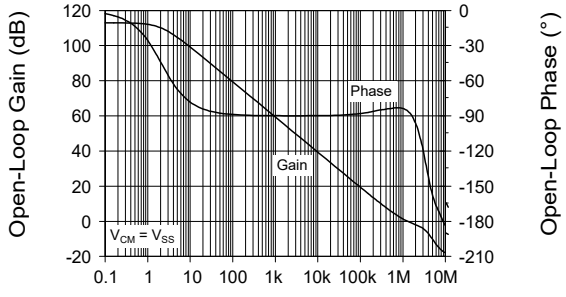


Figure 10: Open-Loop Gain, Phase vs. Frequency.

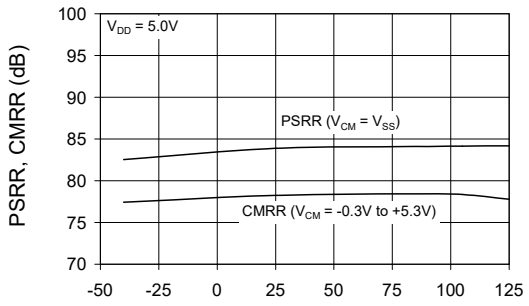


Figure 11: CMRR, PSRR vs. Ambient Temperature.

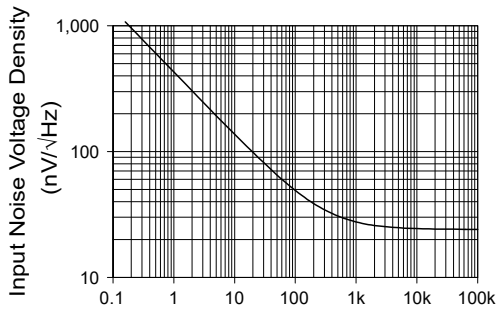


Figure 12: Input Noise Voltage Density vs. Frequency.

7.3 Typical characteristic

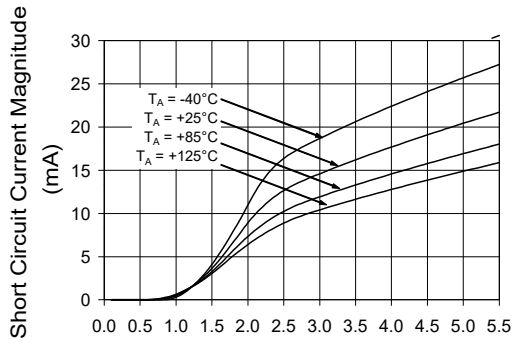


Figure 13: Output Short-Circuit Current vs. Power Supply Voltage.

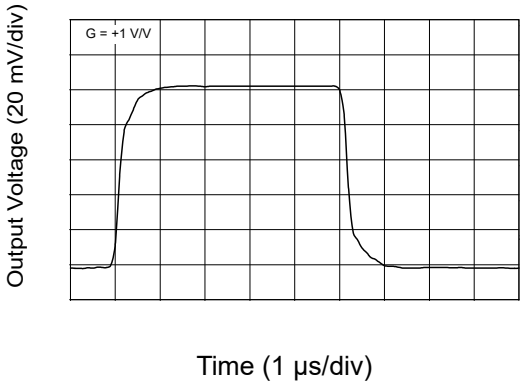


Figure 14: Small-Signal, Noninverting Pulse Response.

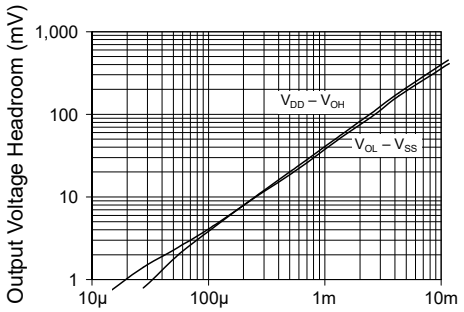


Figure 15: Output Voltage Headroom vs. Output Current Magnitude.

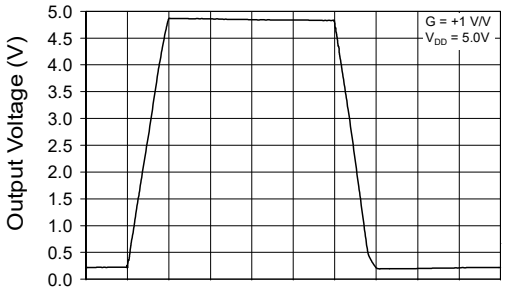


Figure 16: Large-Signal, Noninverting Pulse Response.

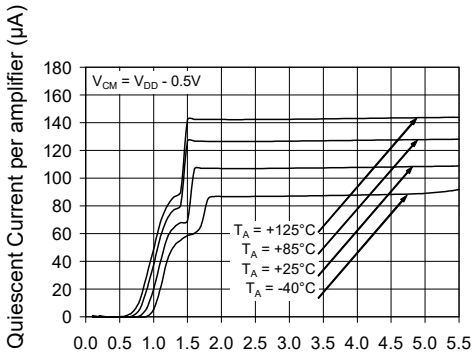


Figure 17: Quiescent Current vs. Power Supply Voltage.

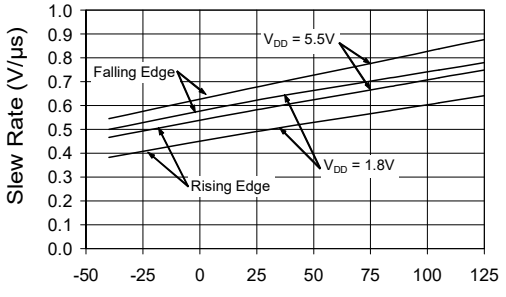


Figure 18: Slew Rate vs. Ambient Temperature.

7.4 Typical characteristic

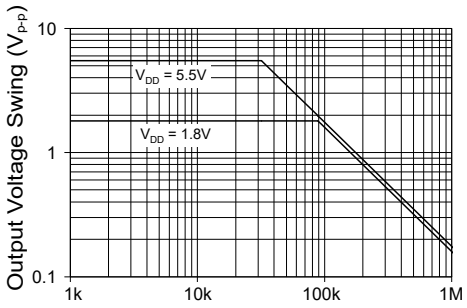


Figure 19: Output Voltage Swing vs. Frequency.

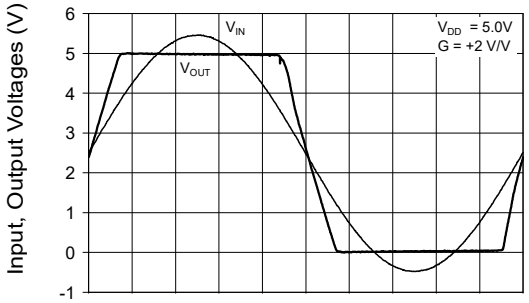


Figure 20: The MCP6001/2/4 Show No Phase Reversal.

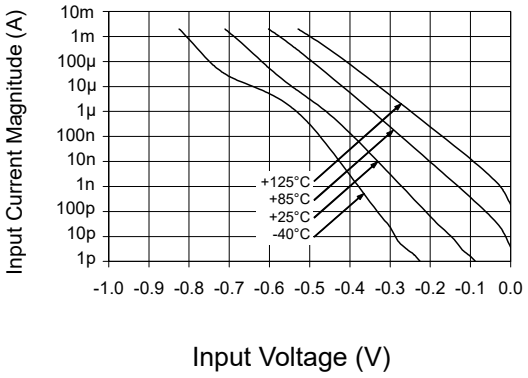
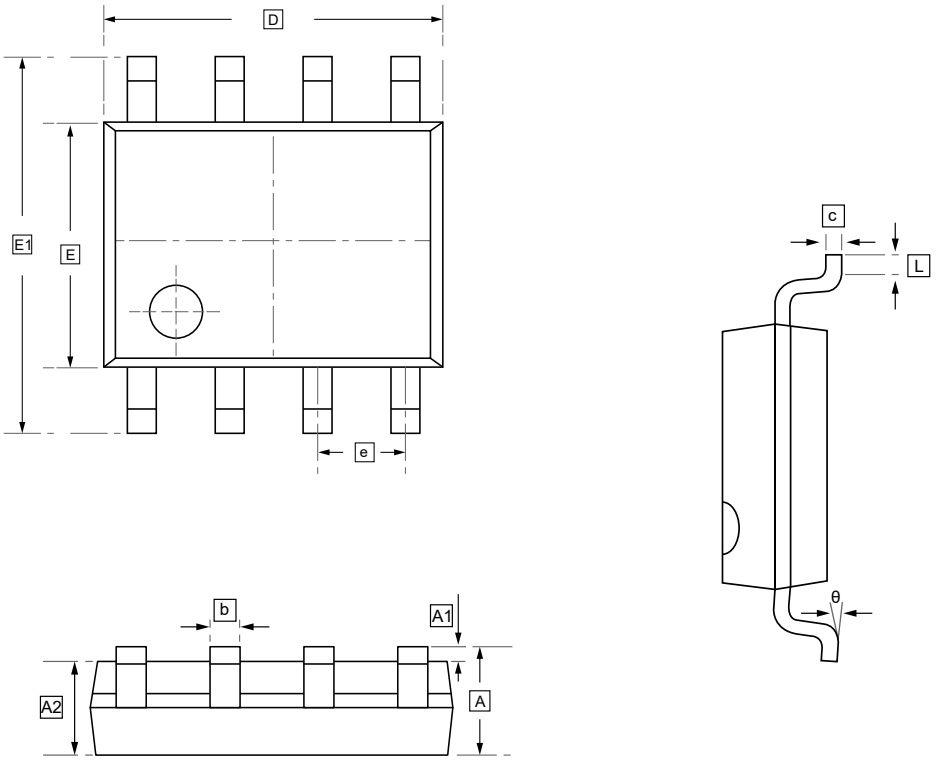


Figure 21: Measured Input Current vs. Input Voltage (below V_{SS}).

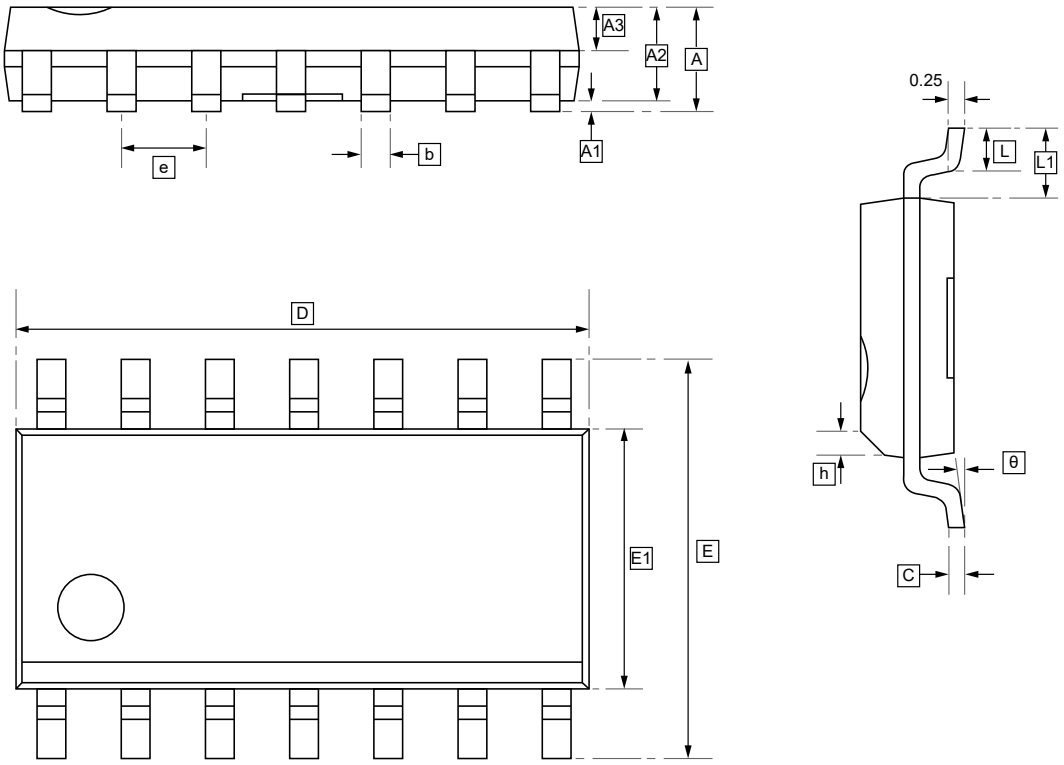
8.1 SOP-8 Package Outline Dimensions



DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	b	c	D	E	E1	e	L	θ
Min	1.350	0.000	1.350	0.330	0.170	4.700	3.800	5.800	1.270	0.400	0°
Max	1.750	0.100	1.550	0.510	0.250	5.100	4.000	6.200	BSC	1.270	8°

8.2 SOP-14 Package Outline Dimensions

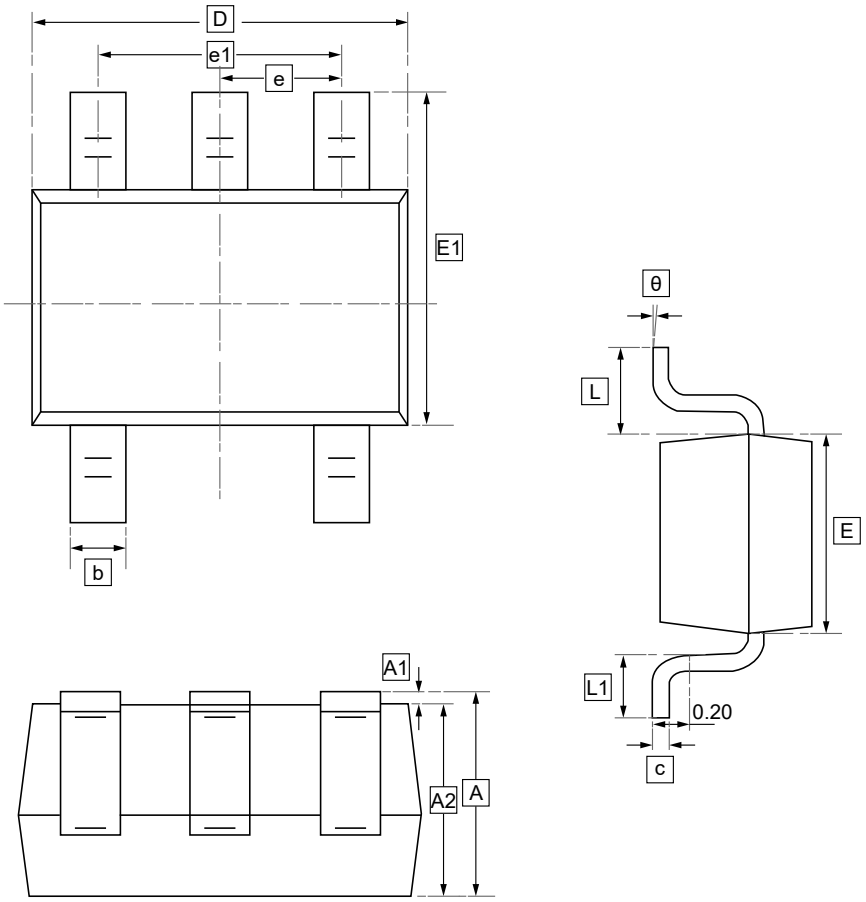


DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	A3	b	C	D	E	E1	e	h	L
Min	-	0.05	1.35	0.65	0.203	0.17	8.45	5.80	3.80	1.24	0.25	0.40
Max	1.75	0.25	1.55	0.75	0.305	0.25	8.85	6.20	4.00	1.30	0.50	0.80

Symbol	L1	θ
Min	1.00	0°
Max	1.10	8°

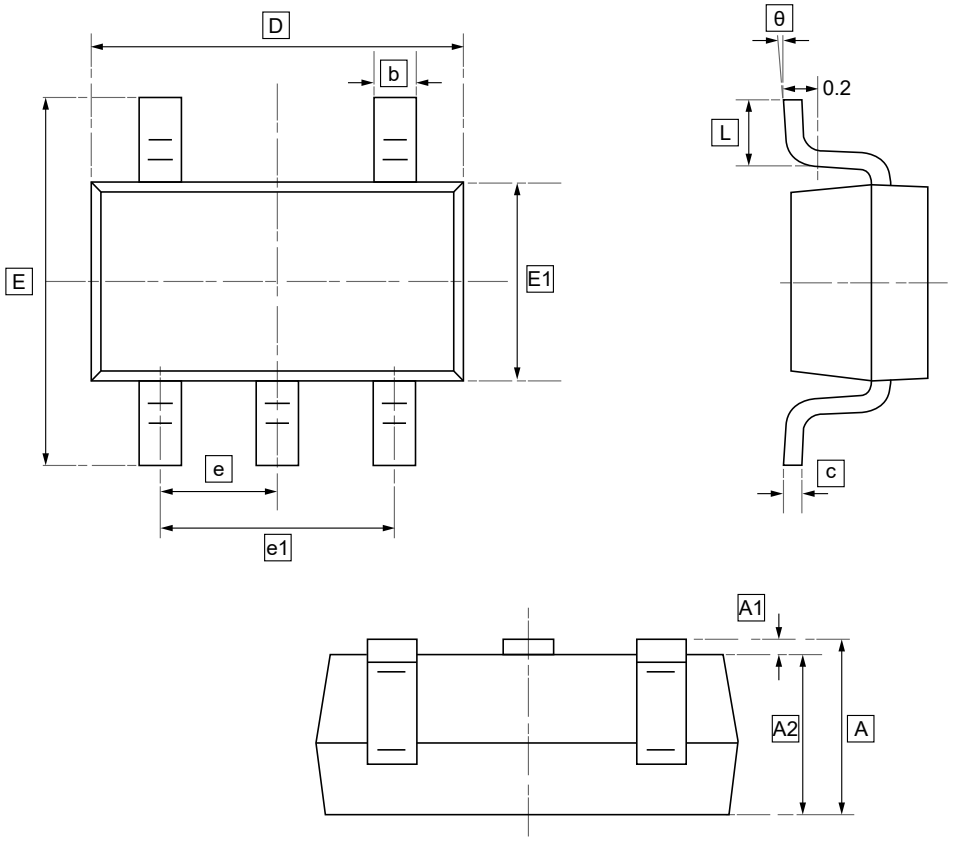
8.3 SC70-5 Package Outline Dimensions



DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	b	c	D	E	E1	e	e1	L	θ
Min	0.90	0.00	0.90	0.15	0.08	2.05	1.15	2.15	0.65	1.20	0.26	7°
Max	1.10	0.10	1.00	0.35	0.15	2.25	1.35	2.45	TYP	1.40	0.46	REF.

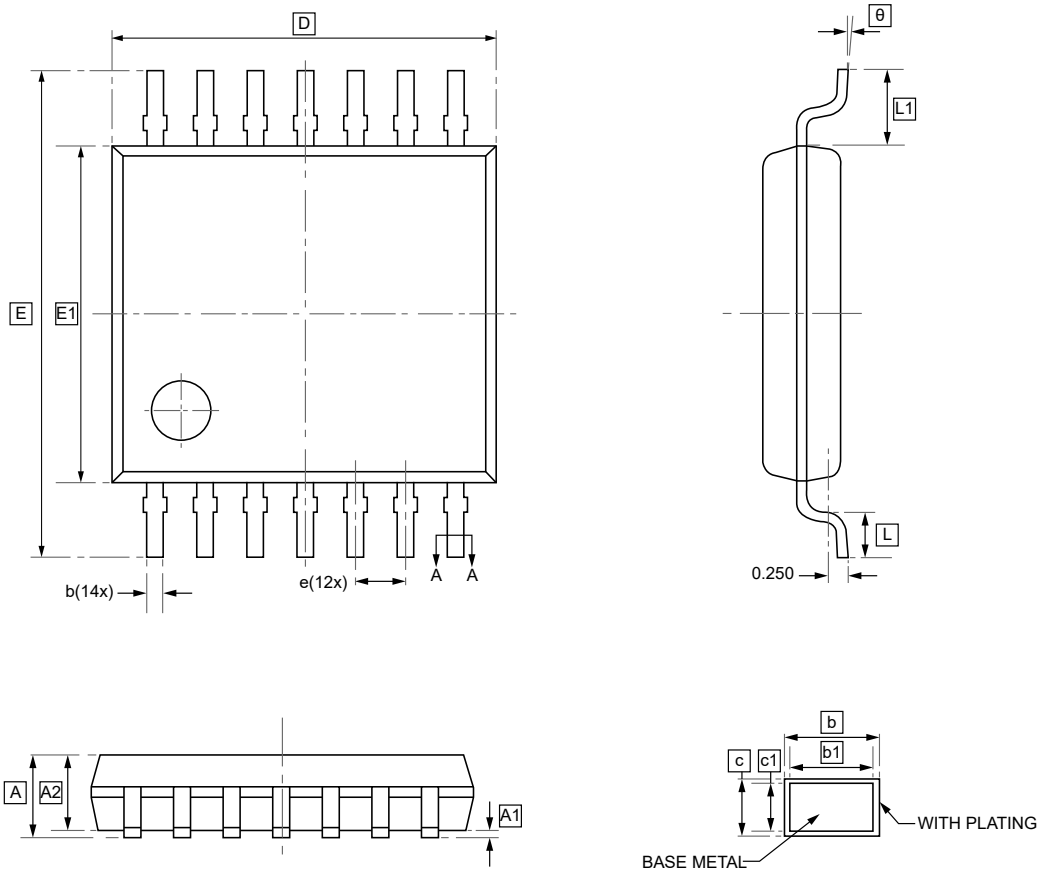
8.4 SOT23-5 Package Outline Dimensions



DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	b	c	D	E1	E	e	e1	L	θ
Min	1.050	0.000	1.050	0.300	0.100	2.820	1.500	2.650	0.950	1.800	0.300	0°
Max	1.250	0.100	1.150	0.500	0.200	3.020	1.700	2.950	BSC	2.000	0.600	8°

8.5 TSSOP-14 Package Outline Dimensions

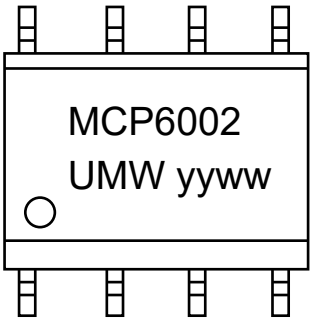


DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	b	b1	c	c1	D	E	E1	e	L1
Min	-	0.05	0.90	0.20	0.19	0.13	0.120	4.90	6.20	4.30	0.65	0.85
Max	1.20	0.15	1.05	0.28	0.25	0.17	0.14	5.10	6.60	4.50	BSC	1.15

Symbol	L	θ
Min	0.45	0°
Max	0.75	8°

9.Ordering information



yy: Year Code
ww: Week Code

Order Code	Marking	Package	Base QTY	Delivery Mode
UMW MCP6001T-I/OT	AAXX	SOT23-5	3000	Tape and reel
UMW MCP6001T-E/OT	CDXX	SOT23-5	3000	Tape and reel
UMW MCP6001T-I/LT	AAXX	SC70-5	3000	Tape and reel
UMW MCP6002T-I/SN	MCP6002	SOP-8	2500	Tape and reel
UMW MCP6002T-E/SN	MCP6002	SOP-8	2500	Tape and reel
UMW MCP6004T-I/SL	MCP6004	SOP-14	2500	Tape and reel
UMW MCP6004T-E/SL	MCP6004	SOP-14	2500	Tape and reel
UMW MCP6004T-/ST	6004T	TSSOP-14	4000	Tape and reel
UMW MCP6004T-E/ST	6004T	TSSOP-14	4000	Tape and reel

10.Disclaimer

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