CoreadDvices
承芯微电子

CD6001_CD6002_CD6004

1MHz, Low-Power Amplifiers

Version: Rev 1.0.0 Date: 2025-5-26

Features

- Low Quiescent Current: 80 μA/amp
- Supply Voltage: 2.1V to 6.0V
- Input Voltage Noise Density: 27nV/√Hz at 1 kHz
- Rail-to-Rail Input and Output
- Gain Bandwidth: 1 MHz
- Slew Rate: 0.7V/μs
- Low Offset Voltage: ±3mV Maximum
- Offset Voltage Temperature Drift: 2μV/°C
- Extended Temperature Range: –40°C to +125°C

Application

- Sensor Interface
- Smoke/Gas/Environment Sensors
- Portable Instruments and Mobile
- Active Filters, ASIC Input or Output

Description

The CD600X series are CMOS dual, and quad RRIO op-amps with low offset, low power and stable high frequency response. These devices own very good AC performance with 1MHz bandwidth, 0.6V/μs slew rate and low distortion while drawing only 80μA of quiescent current per amplifier. The input commonmode voltage range extends 300mV beyond V– and V+, and the outputs swing rail-to-rail. The CD600X family can be used as plug-in replacements for many commercially available op-amps to reduce power and improve input/output range and performance.

The combination of features makes the CD600X ideal choices for motor control and portable audio amplification, sound ports, and other consumer Audio. The CD600X Op-amp is very stable, and it is capable of driving heavy capacitive loads such as those found in LCDs. The ability to swing rail-to-rail at the inputs and outputs enables designers to buffer CMOS DACs, ASICs, or other wide output swing devices in single-supply systems.

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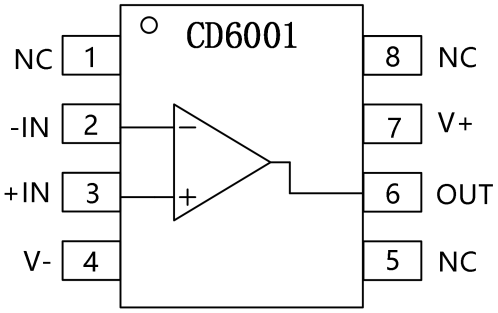
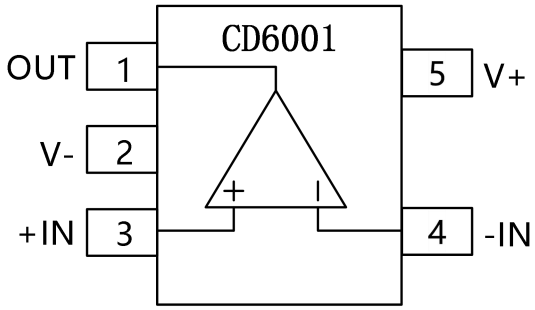
Contents

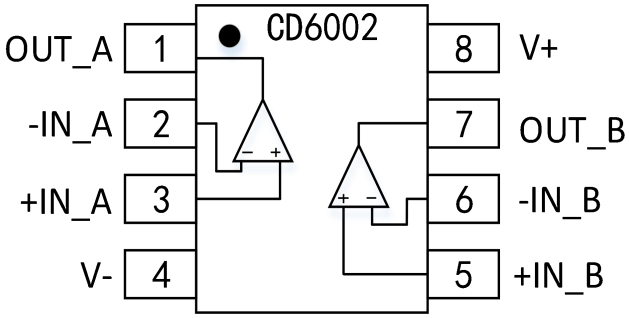
Pin Configurations



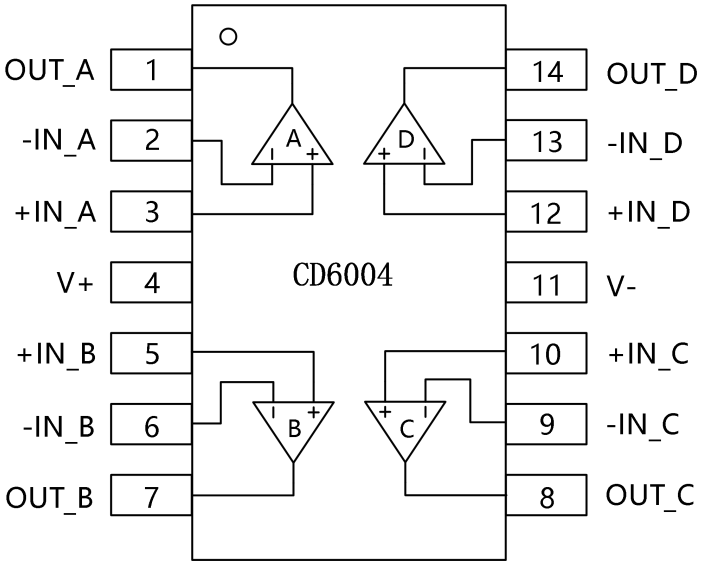
SOP-8



SOT23-5



SOIC-8(SOP8) , MSOP-8



SOIC-14(SOP14),TSSOP-14

Absolute Maximum Ratings

Parameter	Range
Supply Voltage(VS)	7V
Input Voltage	(V-)-0.3 to (V+)+0.3
Differential Input Voltag	±7 V
Input Current	±10mA
Output Short-Circuit Duration	continuously
Storage Temperature Range All Packages	−65℃ to +150℃
Operating Temperature Range All Packages	−40℃ to +125℃
Junction Temperature Range All Packages	−65℃ to +150℃
Thermal Information	
SOT23-5.	θ_{JA}=250℃/W，θ_{JC}=81℃/W
SC70-5	θ_{JA}=400℃/W
SOP-8	θ_{JA}=158℃/W，θ_{JC}=43℃/W
MSOP-8	θ_{JA}=210℃/W，θ_{JC}=45℃/W
SOP-14	θ_{JA}=120℃/W，θ_{JC}=36℃/W
TSSOP-14	θ_{JA}=180℃/W，θ_{JC}=35℃/W
Lead Temperature (Soldering, 10s)	260°C

Electrical characteristics

(All test condition is V_S = 5V, T_A = 25°C, R_L = 2kΩ, C_L =100pF, unless otherwise noted.)

PARAMETER		CONDITIONS	TJ	CD6001, CD6002, CD6004			UNIT
				MIN	TYP	MAX	
Power Supply							
Vs	Operating Voltage Range			2.1		6	V
I_Q	Quiescent Current/Amplifier				80	130	uA
P_{SRR}	Power-Supply Rejection Ratio			80	100		dB
Input Characteristics							
V_{OS}	Input Offset Voltage	V_{CM} = 0V to 3V		-3	0.5	3	mV
V_{OS} TC	Input Offset Voltage Average Drift		-40℃ to 125℃		2		uV/℃
I_B	Input Bias Current				1	10	pA
					25		pA
I_{OS}	Input Offset Current				1		pA

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C_{IN}	Input Capacitance	Differential Mode			8		pF
		Common Mode			7		pF
A_{OL}	Open-Loop Voltage Gain	R_L=10KΩ,		85	110		dB
V_{CM}	Common-Mode Voltage Range	Vs= 5.5V		(V-)-0.1		(V+)+0.1	V
CMRR	Common-Mode Rejection Ratio	V_{CM} = 0V to 3V		70	100		dB
Output Characteristics							
V_{OH}, V_{OL}	Maximum Output Voltage Swing	R_L=10KΩ			3	15	mV
I_{SC}	Output Short-Circuit Current				100		mA
Dynamic Performance							
S_R	Slew Rate	A_V = 1, V_{OUT} = 1.5V to 3.5V, C_{LOAD} = 60pF, R_{LOAD} = 1kΩ			0.7		V/us
G_{BP}	Gain-Bandwidth Product				1		MHz
P_M	Phase Margin	R_L= 1kΩ, C_L= 60pF			60		°
GM	Gain Margin	R_L= 1kΩ, C_L= 60pF			15		dB
Noise Performance							
E_N	Input Voltage Noise	f = 0.1Hz to 10Hz			8		μV_{PP}
e_N	Input Voltage Noise Density	f = 1KHz			27		$\mathbf{nV}/\sqrt{\boldsymbol{Hz}}$
I_N	Input Current Noise	f = 1KHz			2		fA/√Hz
THD+N	Total Harmonic Distortion and Noise	f = 1kHz, A_V =1, R_L = 2kΩ, V_{OUT} = 1Vp-p			0.003		%

Typical Characteristics

V_S = 5V, V_{CM} = 2.5V, R_L = Open, unless otherwise specified.

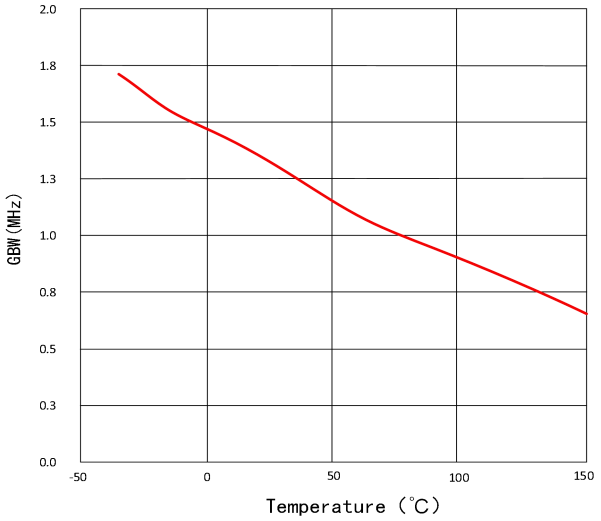

Figure 1. Unity Gain Bandwidth vs. Temperature

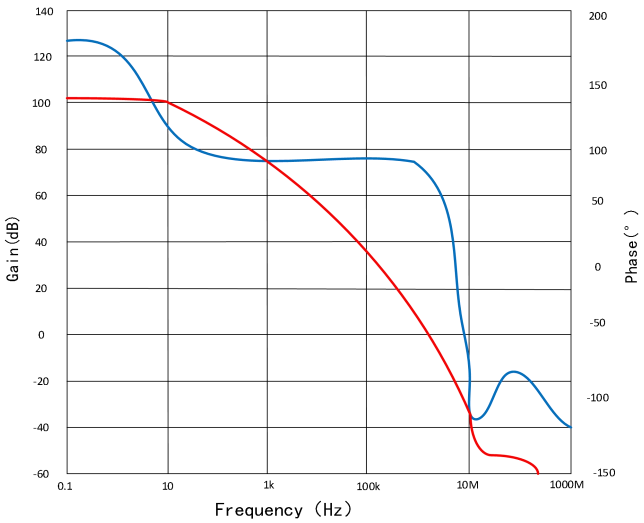

Figure 2. Open-Loop Gain and Phase

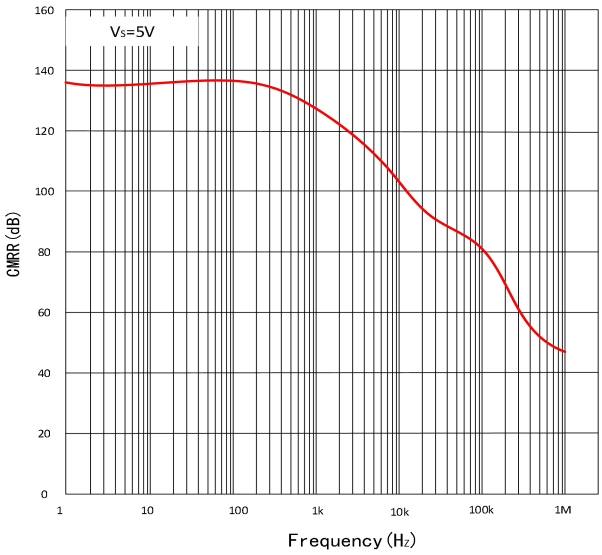

Figure 3. CMRR vs. Frequency

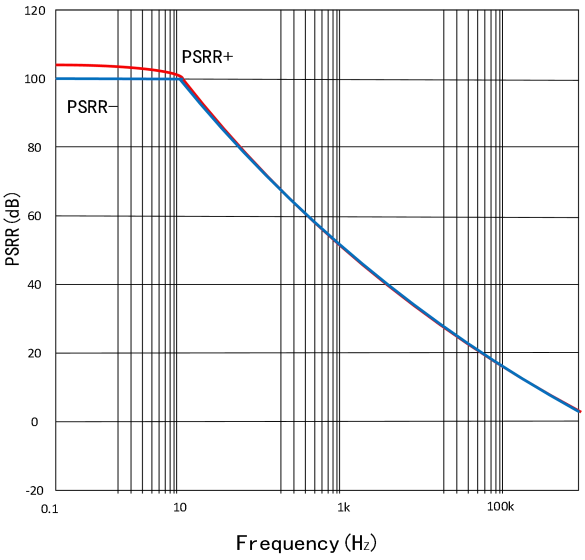

Figure 4. PSRR vs. Frequency

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Application Notes

Low Supply Voltage and Low Power Consumption

The CD600X family of operational amplifiers can operate with power supply voltages from 2.1 V to 6.0 V. Each amplifier draws only 80 μA quiescent current. The low supply voltage capability and low supply current are ideal for portable applications demanding high capacitive load driving capability and stable wide bandwidth. The CD600X family is optimized for wide bandwidth low power applications. They have an industry leading high GBWP to power ratio and are unity gain stable for any capacitive load. When the load capacitance increases, the increased capacitance at the output pushed the non-dominant pole to lower frequency in the open loop frequency response, lowering the phase and gain margin. Higher gain configurations tend to have better capacitive drive capability than lower gain configurations due to lower closed loop bandwidth and hence higher phase margin.

Ground Sensing and Rail to Rail Output

The CD600X family has excellent output drive capability, delivering over 100mA of output drive current. The output stage is a rail-to rail topology that is capable of swinging to within 10mV of either rail. Since the inputs can go 300mV beyond either rail, the op-amp can easily perform true ground sensing.

The maximum output current is a function of total supply voltage. As the supply voltage to the amplifier increases, the output current capability also increases. Attention must be paid to keep the junction temperature of the IC below 150°C when the output is in continuous short-circuit. The output of the amplifier has reverse-biased ESD diodes connected to each supply. The output should not be forced more than 0.5V beyond either supply, otherwise current will flow through these diodes.

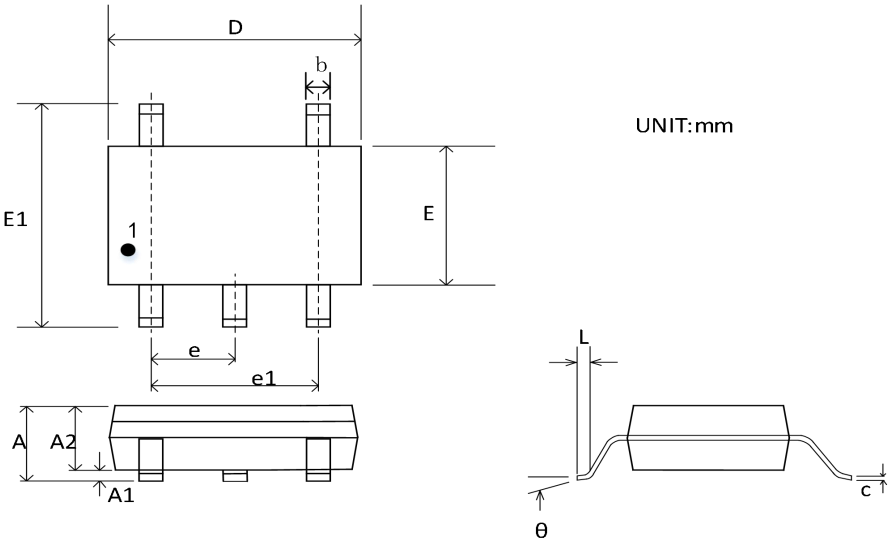
Driving Large Capacitive Load

The CD600X family of OPA is designed to drive large capacitive loads. Refer to Typical Performance Characteristics for “Phase Margin vs. Load Capacitance”. As always, larger load capacitance decreases overall phase margin in a feedback system where internal frequency compensation is utilized. 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 output step response. The unity-gain buffer (G = +1V/V) is the most sensitive to large capacitive loads.

When driving large capacitive loads with the CD600X OPA family (e.g., > 200pF when G = +1V/V), a small series resistor at the output improves the feedback loops phase margin and stability by making the output load resistive at higher frequencies.

Package Outline Dimensions

SOT23-5



Symbol	Dimensions In Millimeters	
	Min	Max
A	--	1.450
A1	--	0.150
A2	0.900	1.300
b	0.300	0.500
c	0.080	0.220
D	2.900 BSC	
E	1.600 BSC	
E1	2.80 BSC	
e	0.950 BSC	
e1	1.900 BSC	
L	0.300	0.600
θ	0°	8°

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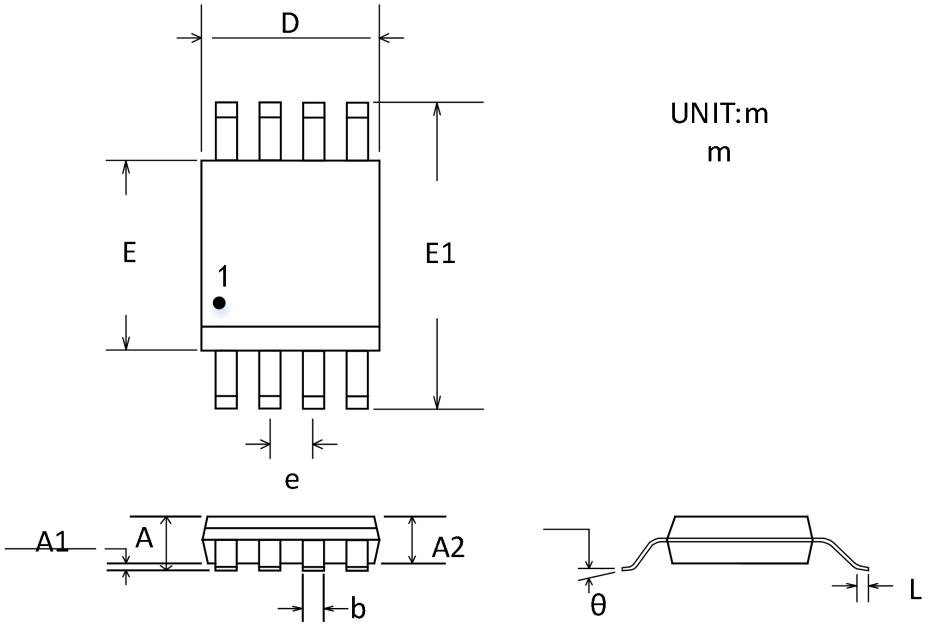
MSOP-8



UNIT:m
m

Symbol	Dimensions In Millimeters	
	Min	Max
A	0.820	1.100
A1	0.000	0.150
A2	0.750	0.950
b	0.220	0.380
D	2.800	3.200
E	2.800	3.200
E1	4.650	5.150
e	0.650 BSC	
L	0.400	0.800
θ	0°	8°

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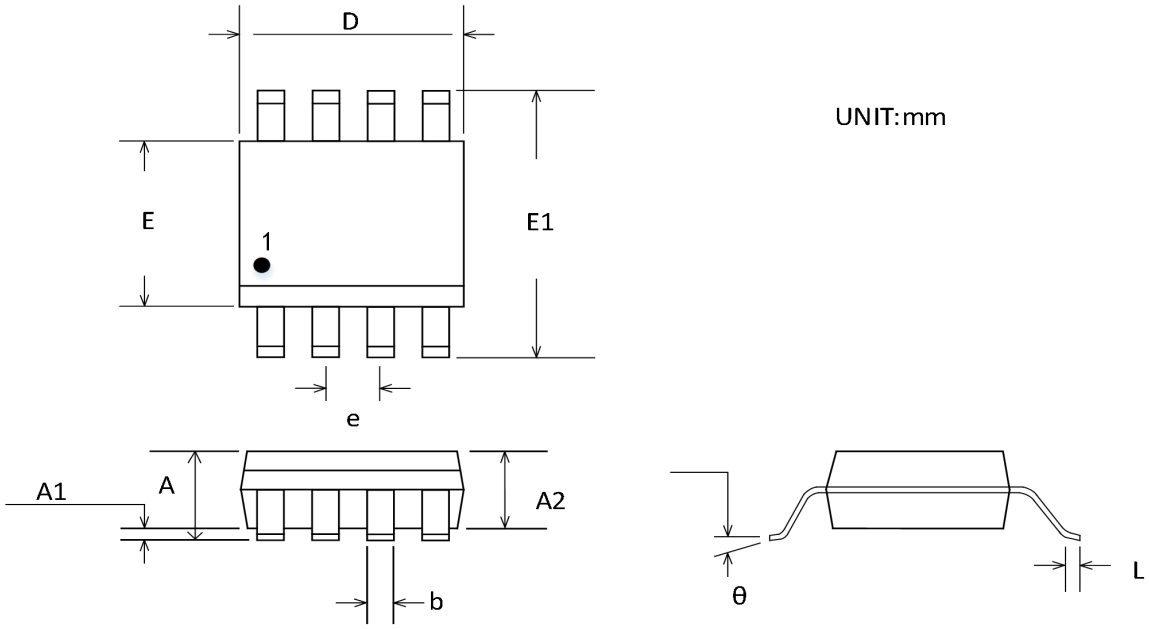
SOP-8



UNIT:mm

Symbol	Dimensions In Millimeters	
	Min	Max
A	1.350	1.750
A1	0.100	0.250
A2	1.350	1.550
b	0.310	0.510
D	4.800	5.000
E	3.800	4.000
E1	5.800	6.200
e	1.270 BSC	
L	0.400	1.270
θ	0°	8°

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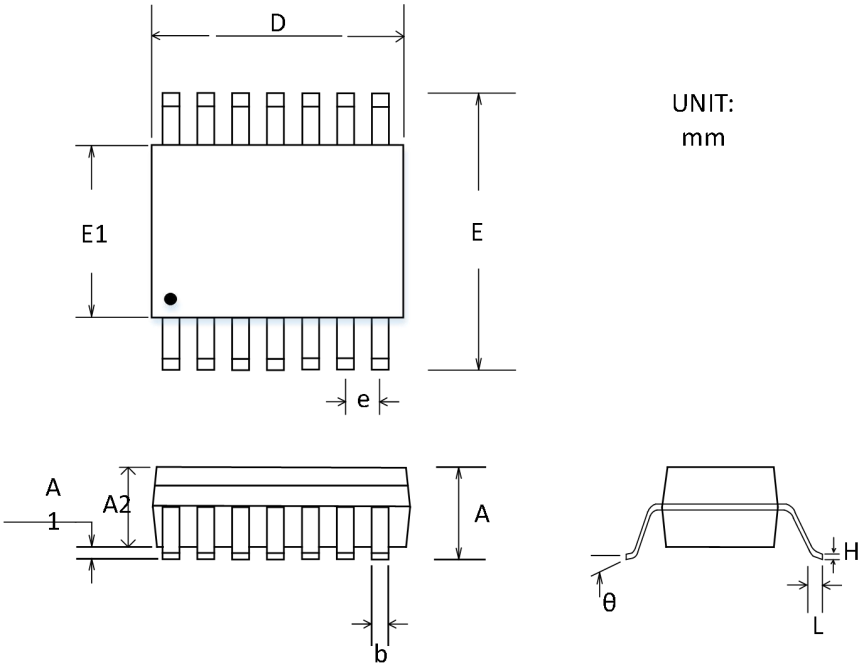
TSSOP-14



UNIT:
mm

Symbol	Dimensions In Millimeters	
	Min	Max
A	1.20MAX	
A1	0.05	0.15
A2	0.80	1.05
b	0.19	0.30
D	4.90	5.10
E	6.40BSC	
E1	4.30	4.50
e	0.65BSC	
H	0.09	0.20
L	0.45	0.75
θ	0°	8°

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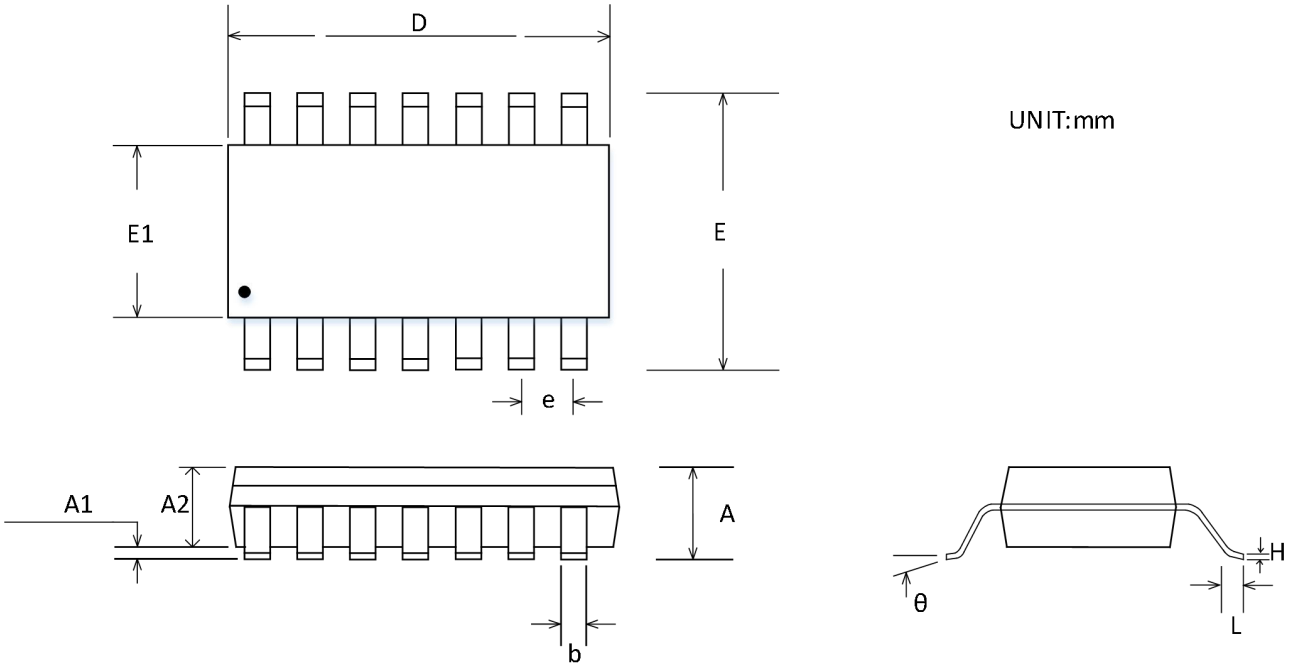
SOP-14



UNIT:mm

Symbol	Dimensions In Millimeters	
	Min	Max
A	1.35	1.75
A1	0.10	0.25
A2	1.25	1.50
b	0.31	0.51
D	8.55	8.75
E	5.80	6.20
E1	3.80	4.00
e	1.27BSC	
H	0.17	0.25
L	0.40	1.27
θ	0°	8°

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Package/Ordering Information

MODEL	TEMPERATURE	PACKAGE DESCRIPTION	PACKAGE OPTION
CD6001AS8	-40℃~125℃	SOP-8	Tape and Reel, 2500
CD6001AS8-RL	-40℃~125℃	SOP-8	Tape and Reel, 3000
CD6001AS8-REEL	-40℃~125℃	SOP-8	Tape and Reel, 4000
CD6001AST5	-40℃~125℃	SOT23-5	Tape and Reel, 3000
CD6002AS8	-40℃~125℃	SOP-8	Tape and Reel, 2500
CD6002AS8-RL	-40℃~125℃	SOP-8	Tape and Reel, 3000
CD6002AS8-REEL	-40℃~125℃	SOP-8	Tape and Reel, 4000
CD6002AMS8	-40℃~125℃	MSOP-8	Tape and Reel, 3000
CD6004AS14	-40℃~125℃	SOP-14	Tape and Reel, 2500
CD6004AS14-RL	-40℃~125℃	SOP-14	Tape and Reel, 3000
CD6004AS14-REEL	-40℃~125℃	SOP-14	Tape and Reel, 4000
CD6004ATS14	-40℃~125℃	TSSOP-14	Tape and Reel, 2500
CD6004ATS14-RL	-40℃~125℃	TSSOP-14	Tape and Reel, 3000
CD6004ATS14-REEL	-40℃~125℃	TSSOP-14	Tape and Reel, 4000
CD6001AS8	-40℃~125℃	SOP-8	Tape and Reel, 2500

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Revision Log

Version	Revision date	Change content	Reason for Change	Modified by	Reviewed By	Note
V1.0	2025.5.26	Initial version	Regular update	WW	LYL	

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