CoreadDvices
承芯微电子

CD8051_CD8052_CD8054

Low-Cost, High-Speed, Rail-to-Rail Output Amplifier

Version: Rev 1.0.0 Date: 2025-8-14

Features

- Single-Supply Operation from 2.5V~+5.5V
- Rail-to-Rail Output
- -3dB Bandwidth(G=+1): 150MHz (Typ.)
- Low Input Bias Current: 1pA (Typ.)
- Quiescent Current: 2.8mA/Amplifier (Typ.)
- Operating Temperature: -40°C ~ +125°C
- Small Package:

  CD8051 Available in SOT23-5 and SC70-5 Packages

  CD8052 Available in SOP-8 and MSOP-8 Packages

  CD8054 Available in SOP-14 and TSSOP-14 Packages

  CD8051N Available in SOT23-6 and SC70-6 Packages

  CD8052N Available in MSOP-10 Packages

Application

- CCD Imaging System
- Photo diode Preamp
- DVD/CD
- Filters
- Professional Video and
- Hand Sets
- Base Stations
- to-D Driver

Description

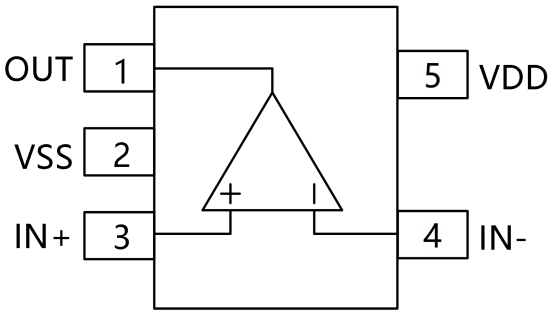
The CD8051 / 1N (single), CD8052 /2N(dual), CD8054 (quad) are rail-to-rail output voltage feedback amplifiers offering ease of use and low cost. They have bandwidth and slew rate typically found in current feedback amplifiers. All have a wide input common-mode voltage range and output voltage swing, making them easy to use on single supplies as low as 2.5V. Despite being low cost, the CD8051 series provide excellent overall performance. They offer wide bandwidth to 250MHz (G =+1) along with 0.1dB flatness out to 52MHz (G= +2) and offer a typical low power of 2.8mA/amplifier.

The CD8051 series is low distortion and fast settling make it ideal for buffering high speed A/D or D/A converters. The CD8051/2N has a power-down disable feature that reduces the supply current to 50μA. These features make the CD8051/2N ideal for portable and battery-powered applications where size and power are critical. All are specified over the extended -40 ℃ to +125℃ temperature range.

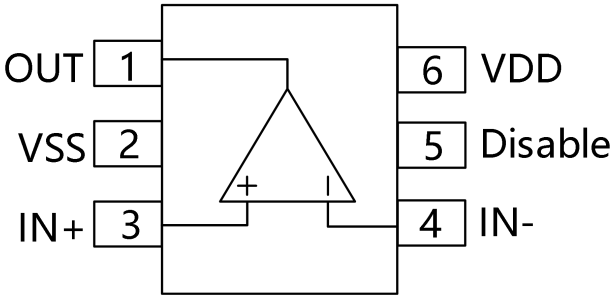
Chinese version:CD8051_CD8052_CD8054

Contents

Pin Configurations



SOT23-5/SC70-5



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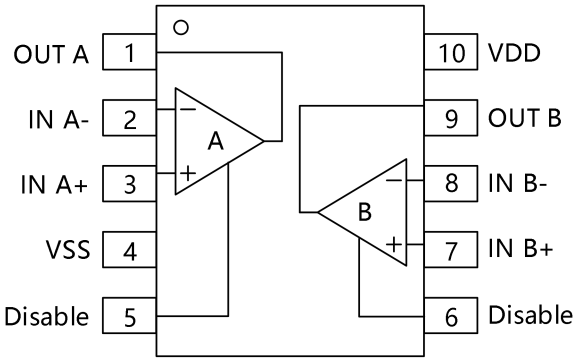

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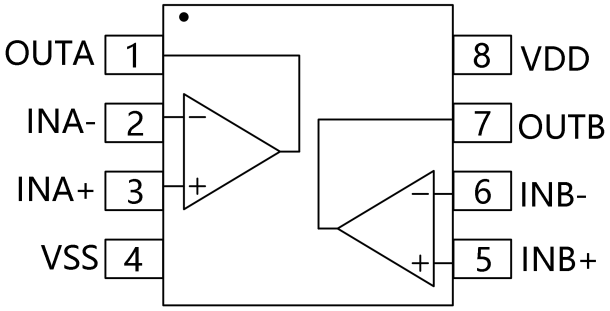

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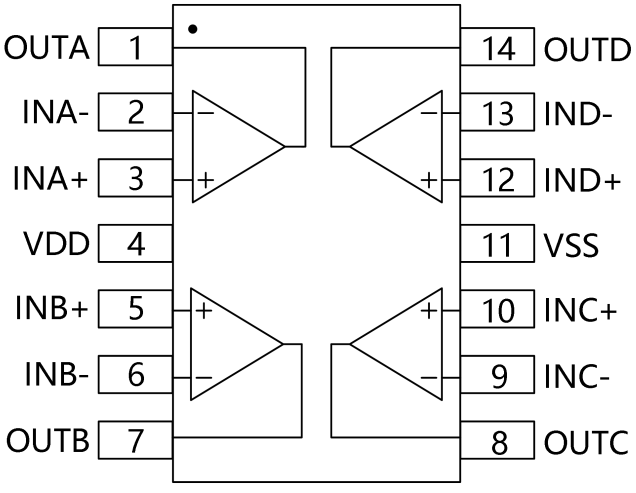


SOP-14/TSSOP-14

Figure 1. Pin Assignment Diagram

Absolute Maximum Ratings

Condition	Min	Max
Power Supply Voltage (V_{DD} to VSS)	-0.5V	+7.5V
Analog Input Voltage (IN+ or IN-)	VSS-0.5V	V_{DD}+0.5V
PDB Input Voltage	VSS-0.5V	+7V
Operating Temperature Range	-40℃	+125℃
Junction Temperature	+160℃	
Storage Temperature Range	-65℃	+150℃
Lead Temperature (soldering, 10sec)	+300℃	
Package Thermal Resistance (T_A=+25℃)		
SOP-8, θ_{JA}	125℃/W	
MSOP-8, θ_{JA}	216℃/W	
SOT23-5, θ_{JA}	190℃/W	
SOT23-6, θ_{JA}	190℃/W	
SC70-5, θ_{JA}	333℃/W	
ESD Susceptibility		
HBM	6KV	
MM	400V	

Chinese version:CD8051_CD8052_CD8054

Electrical characteristics

(G=+2, R_F=887Ω, R_G=887Ω, and R_L=150Ω connected to VDD/2, unless otherwise noted. Typical values are at T_A =+25°C.)

PARAMETER	CONDITIONS	CD8051/CD8052/CD8054/CD8051N/CD8052N						
		TYP	MIN/MAX OVER TEMPERATURE					
		+25℃	+25℃	0℃ to 70℃	-40℃ to 85℃	-40℃ to 125℃	UNITS	MIN/MAX
DYNAMIC PERFORMANCE								
3dB Small Signal Bandwidth	G=+1,V_O=0.1Vp-,R_F=24Ω,R_L=150Ω	180	--	--	--	--	MHz	TYP
	G=+1,V_O=0.1Vp-p,R_F=24Ω,R_L=1kΩ	250	--	--	--	--	MHz	TYP
	G=+2,V_O=0.1Vp-p,R_L=50Ω	55	--	--	--	--	MHz	TYP
	G=+2,V_O=0.1Vp-p,R_L=150Ω	93	--	--	--	--	MHz	TYP
	G=+2,V_O=0.1Vp-p,R_L=1kΩ	122	--	--	--	--	MHz	TYP
	G=+2,V_O=0.1Vp-p,R_L=10kΩ	130	--	--	--	--	MHz	TYP
Gain-Bandwidth Product	G=+10,R_L=150Ω	115	--	--	--	--	MHz	TYP
	G=+10,R_L=1kΩ	150	--	--	--	--	MHz	TYP
Bandwidth for 0.1dB Flatness	G=+2,V_O=0.1Vp-,R_L=150Ω,R_F=887Ω	52	--	--	--	--	MHz	TYP
Slew Rate	G=+1,2VOutputStep	77/-151	--	--	--	--	V/μs	TYP
	G=+2,2VOutputStep	88/-119	--	--	--	--	V/μs	TYP
	G=+2,4VOutputStep	93/-131	--	--	--	--	V/μs	TYP
Rise-and-Fall Time	G=+2,V_O=0.2Vp-p,10%to90%	4.5	--	--	--	--	ns	TYP

	G=+2,V_O=2Vp-p,10% to90%	18	--	--	--	--	ns	TYP
Settling Time to 0.1%	G=+2,2VOutputStep	50	--	--	--	--	ns	TYP
Overload Recovery Time	V_{IN}·G=+VDD	18	--	--	--	--	ns	TYP
NOISE/DISTORTION PERFORMANCE								
Input Voltage Noise	f = 1MHz	4.9	--	--	--	--	nV/Hz	TYP
Differential Gain Error (NTSC)	G = +2, R_L = 150Ω	0.03	--	--	--	--	%	TYP
Differential Phase Error (NTSC)	G = +2, R_L = 1kΩ	0.08	--	--	--	--	degree	TYP
DC PERFORMANCE								
Input Offset Voltage (V_{OS})	VDD=2.5V;VSS=-2.5V ; VIN+=VIN-=VCM=0V ;	±2	±8	±8.9	±9.5	±9.8	mV	MAX
Input Offset Voltage Drift	--	2	--	--	--	--	μV/℃	TYP
Input Bias Current (I_B)	VDD=2.5V;VSS=-2.5V; VCM=VREF=0V	1	--	--	--	--	pA	TYP
Input offset Current (I_{OS})	VDD=2.5V;VSS=-2.5V; VCM=VREF=0V	2	--	--	--	--	pA	TYP
Open-Loop Gain (A_{OL})	V_O = 0.3V to 4.7V, R_L = 150Ω	80	75	74	74	73	dB	MIN
	V_O = 0.2V to 4.8V, R_L = 1kΩ	104	91	91	91	80	dB	MIN
INPUT CHARACTERISTICS								
Input Common-Mode Voltage Range (V_{CM})	--	-0.2 to +VDD -1	--	--	--	--	V	TYP
Common-Mode Rejection Ratio (CMRR)	VCM = -0.1V to +3.5V	80	66	65	65	62	dB	MIN

(G=+2, R_F=887Ω, R_G=887Ω, and R_L=150Ω connected to VDD/2, unless otherwise noted. Typical

values are at T_A =+25°C.)

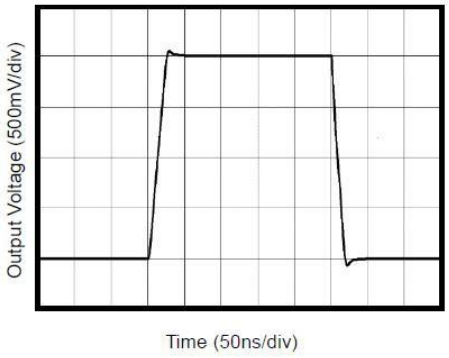
PARAMETER	CONDITIONS	CD8051/CD8052/CD8054/CD8051N/CD8052N						
		TYP	MIN/MAX OVER TEMPERATURE					
		+25℃	+25℃	0℃ to 70℃	-40℃ to 85℃	-40℃ to 125℃	UNITS	MIN/MAX
OUTPUT CHARACTERISTICS								
Output Voltage Swing from Rail	R_L = 150Ω	0.12	--	--	--	--	V	TYP
	R_L = 1kΩ	0.03	--	--	--	--	V	TYP
Output Current	f<100kHz	80	60	--	--	--	mA	MIN
Closed-Loop Output Impedance	--	0.08	--	--	--	--	Ω	TYP
POWER-DOWN DISABLE								
(CD8051/2N only) Turn-On Time	--	236	--	--	--	--	ns	TYP
Turn-Off Time	--	52	--	--	--	--	ns	TYP
Disable Voltage (Power-down mode enabled, output disabled)	--	--	0.8	--	--	--	V	MAX
Disable Voltage (Power-down mode disabled, output enabled)	--	--	2	--	--	--	V	MIN
POWER SUPPLY								
Operating Voltage Range	--	--	2.5	2.7	2.7	2.7	V	MIN
	--	--	5.5	5.5	5.5	5.5	V	MAX
Quiescent Current (per amplifier)	VDD = 2.5V;VSS=-2.5V; VIN+=VIN-=VCM =0V; Without RL	2.8	3.65	--	--	--	mA	MAX
Supply Current when Disabled per amplifier(CD8051/	ΔVDD = +2.7V to +5.5V, VCM = (-VDD) +0.5	50	70	85	100	137	μA	MAX

2N only)								
Power Supply Rejection Ratio (PSRR)	VDD +1.25V ~ +2.75V,VSS -1.25V~-2.75V VCM=0V, V_O=0V	80	67	67	62	62	dB	MIN

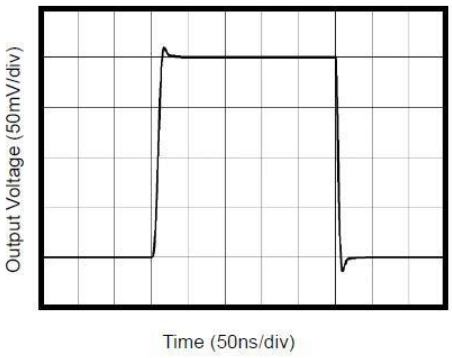
Typical Characteristics

(VDD=+5V,G=+2, R_F=887Ω,R_G=887Ω,and R_L=150Ωconnected to VDD/2, unless otherwise noted. Typical values are at T_A =+25°C.)

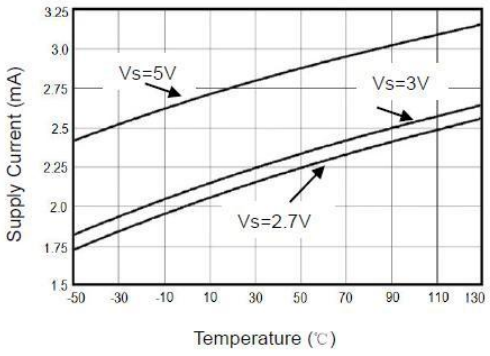
Non-Inverting Large-Signal Step Response



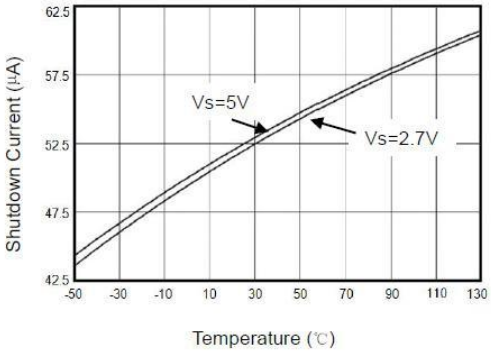
Non-Inverting Small-Signal Step Response



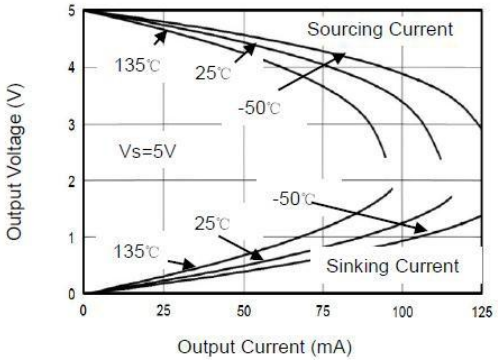
Supply Current vs. Temperature



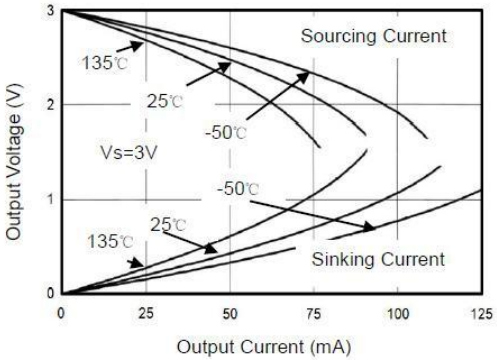
Sutdown Current vs. Temperature



Output Voltage Swing vs. Output Current



Output Voltage vs. Output Current

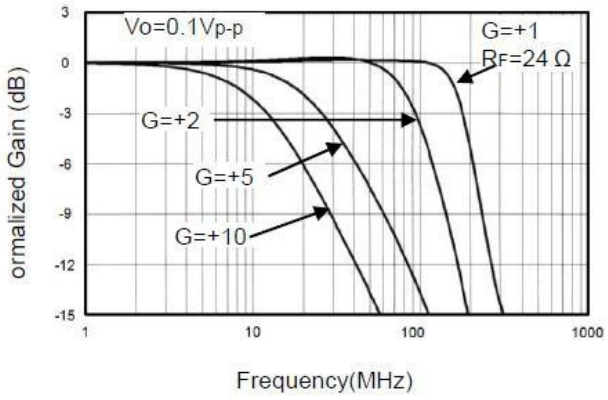


Chinese version:CD8051_CD8052_CD8054

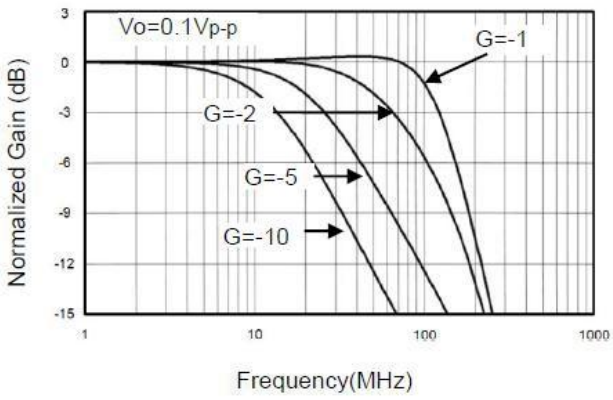
(VDD=+5V,G= +2, R_F=887Ω,R_G=887Ω,and R_L=150Ωconnected to VDD/2, unless otherwise noted.

Typical values are at T_A =+25°C.)

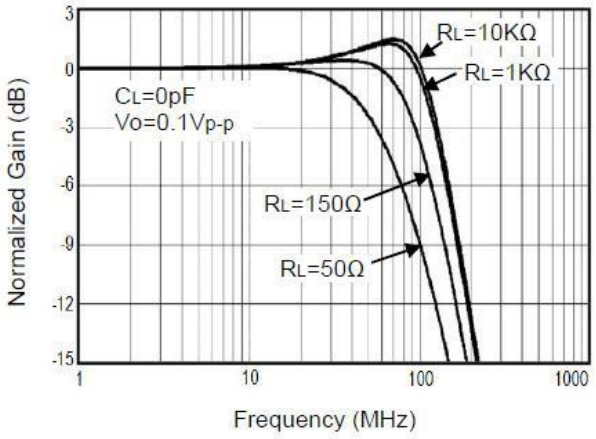
Non-Inverting Small Signal Frequency Response



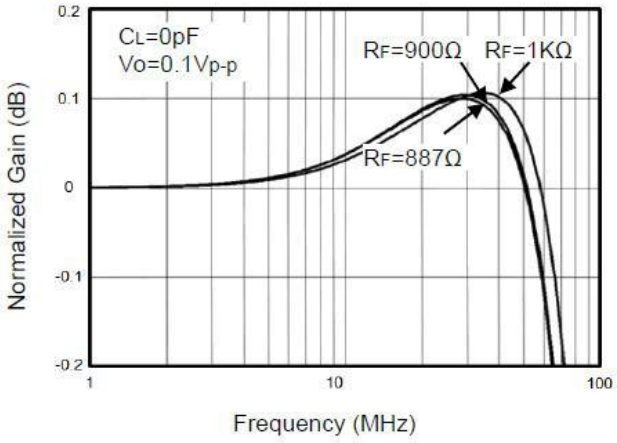
Inverting Small Signal Frequency Response



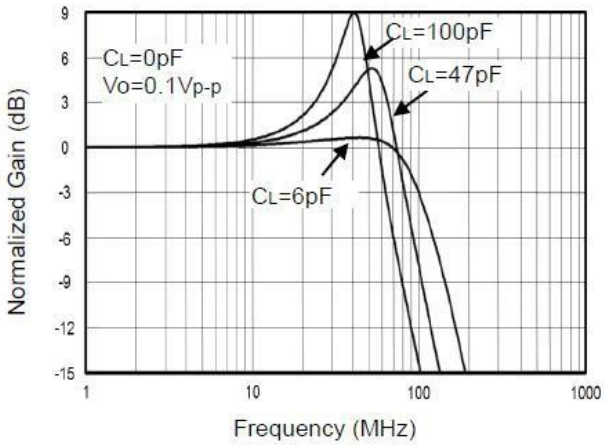
Frequency Response For Various RL



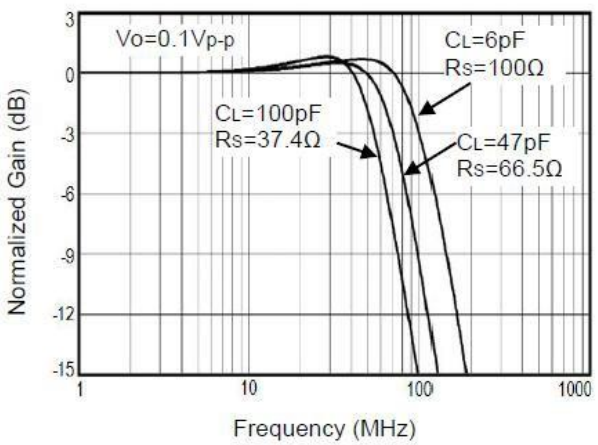
0.1dB Gain Flatness For Various RF



Frequency Response For Various CL

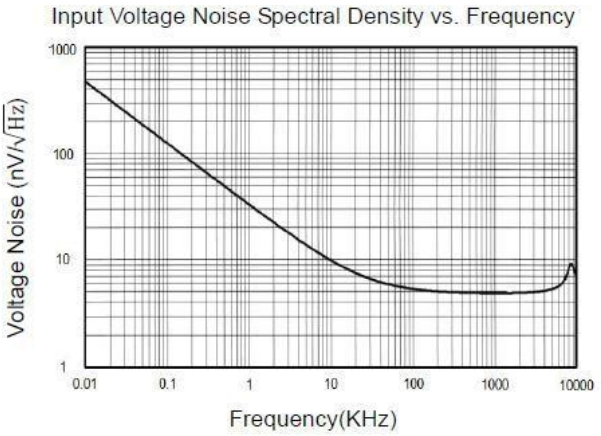


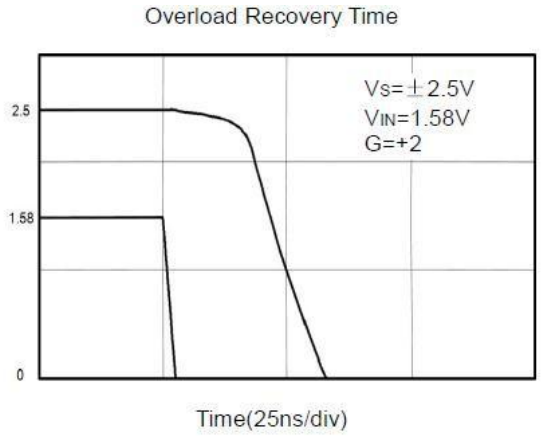
Frequency Response vs.Capacitive Load

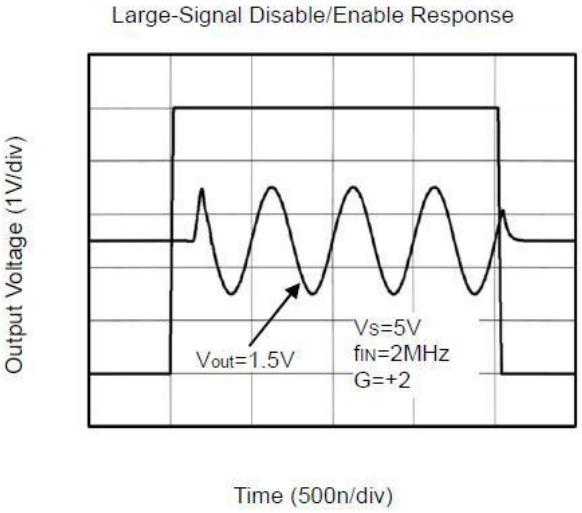


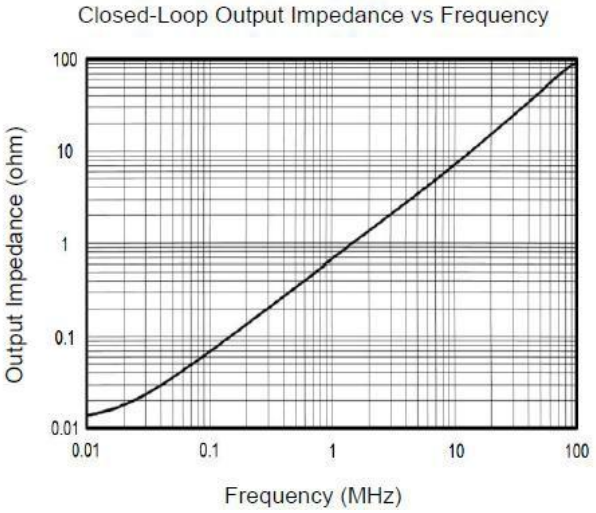
(VDD=+5V,G= +2, R_F=887Ω,R_G=887Ω,and R_L=150Ωconnected to VDD/2, unless otherwise noted.

Typical values are at T_A =+25°C.)









Application Notes

Driving Capacitive Loads

CD805X series op amps are unity-gain stable and suitable for a wide range of general-purpose applications. The small footprints of the CD805X series packages save space on printed circuit boards and enable the design of smaller electronic products.

Power Supply Bypassing and Board Layout

CD805X series operates from a single 2.5V to 5.5V supply or dual ±1.25V to ±2.75V supplies. For best performance, a 0.1µF ceramic capacitor should be placed close to the VDD pin in single supply operation. For dual supply operation, both VDD and VSS supplies should be bypassed to ground with separate 0.1µF ceramic capacitors.

Low Supply Current

The low supply current (typical 2.8mA per channel) of CD805X series will help to maximize battery life. They are ideal for battery powered systems

Operating Voltage

CD805X series operate under wide input supply voltage (2.5V to 5.5V). In addition, all temperature specifications apply from -40℃ to +125℃. Most behavior remains unchanged throughout the full operating voltage range. These guarantees ensureoperation throughout the single Li-Ion battery lifetime

Rail-to-Rail Output

Rail-to-Rail output swing provides maximum possible dynamic range at the output. This is particularly important when operating in low supply voltages. The output voltage of CD805X series can typically swing to less than 8mV from supply rail in light resistive loads (>1kΩ), and 30mV of supply rail in moderate resistive loads (150Ω).

Capacitive Load Tolerance

The CD805X family is optimized for bandwidth and speed, not for driving capacitive loads. Output capacitance will create a pole in the amplifier’ s feedback path, leading to excessive peaking and potential oscillation. If dealing with load capacitance is a requirement of the application, the two strategies to consider are (1) using a small resistor in series with the amplifier’ s output and the load capacitance and (2) reducing the bandwidth of the amplifier’ s feedback loop by increasing the overall noise gain. Figure 2. shows a unity gain follower using the series resistor strategy. The resistor isolates the output from the capacitance and, more importantly, creates a zero in the feedback path that compensates for the pole created by the output capacitance.

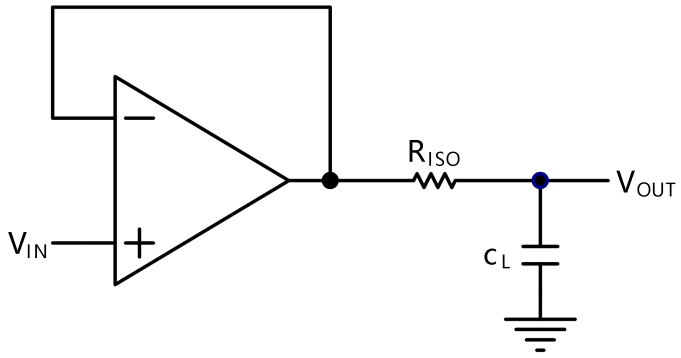


Figure 2. Indirectly Driving a Capacitive Load Using Isolation Resistor

The bigger the RISO resistor value, the more stable VOUT will be. However, if there is a resistive load RL in parallel with the capacitive load, a voltage divider (proportional to R_{ISO}/R_L) is formed, this will result in a gain error.

The circuit in Figure 3 is an improvement to the one in Figure 2. R_F provides the DC accuracy by feed-forward the V_{IN} to R_L. C_F and R_{ISO} serve to counteract the loss of phase margin by feeding the high frequency component of the output signal back to the amplifier’ s inverting input,

thereby preserving the phase margin in the overall feedback loop. Capacitive drive can be increased by increasing the value of C_F. This in turn will slow down the pulse response.

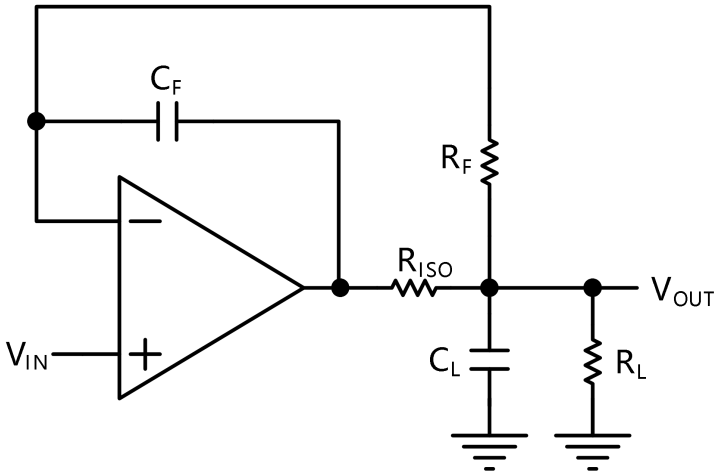


Figure 3. Indirectly Driving a Capacitive Load with DC Accuracy

Typical Application Circuits

Differential amplifier

The differential amplifier allows the subtraction of two input voltages or cancellation of a signal common the two inputs. It is useful as a computational amplifier in making a differential to single-end conversion or in rejecting a common mode signal. Figure 4. shown the differential amplifier using CD805X.

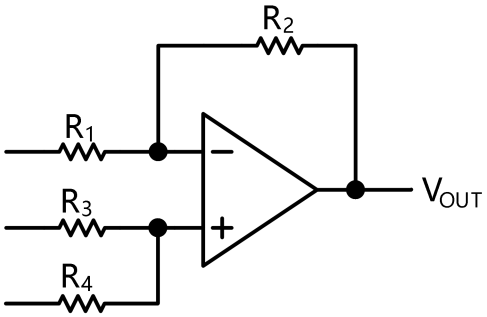


Figure 4. Differential Amplifier

$$V_{OUT} = \left(\frac{R_1 + R_2}{R_3 + R_4}\right)\frac{R_4}{R_1}V_{It} - \frac{R2}{R1}V_{It} + \left(\frac{R_1 + R_2}{R_3 + R_4}\right)\frac{R_3}{R_1}V_{Rth}$$

If the resistor ratios are equal (i.e. R1=R3 and R2=R4), then

$$V_{OUT} = \frac{R_2}{R_1}(V_{It} - V_{It}) + V_{Rth}$$

Low Pass Active Filter

The low pass active filter is shown in Figure 5. The DC gain is defined by $-R_2/R_1$. The filter has a -20dB/decade roll-off after its corner frequency $fC=1/(2\pi R_3 C_1)$.

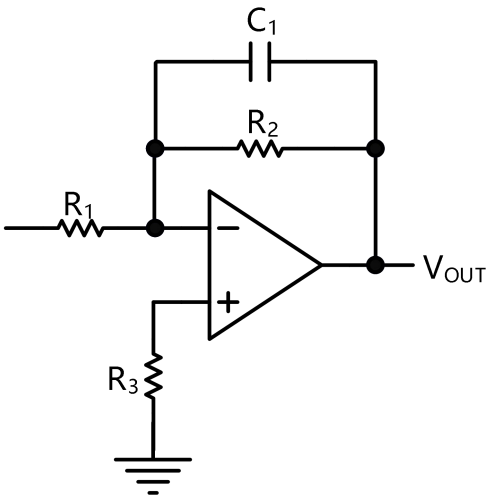


Figure 5. Low Pass Active Filter

Driving Video

The CD805x can be used in video applications like in Figure 6.

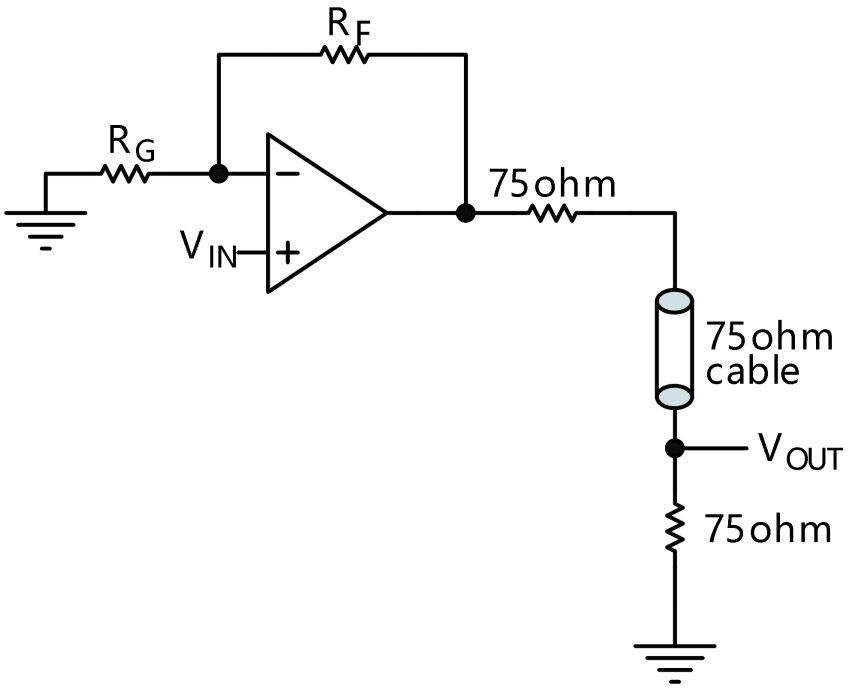
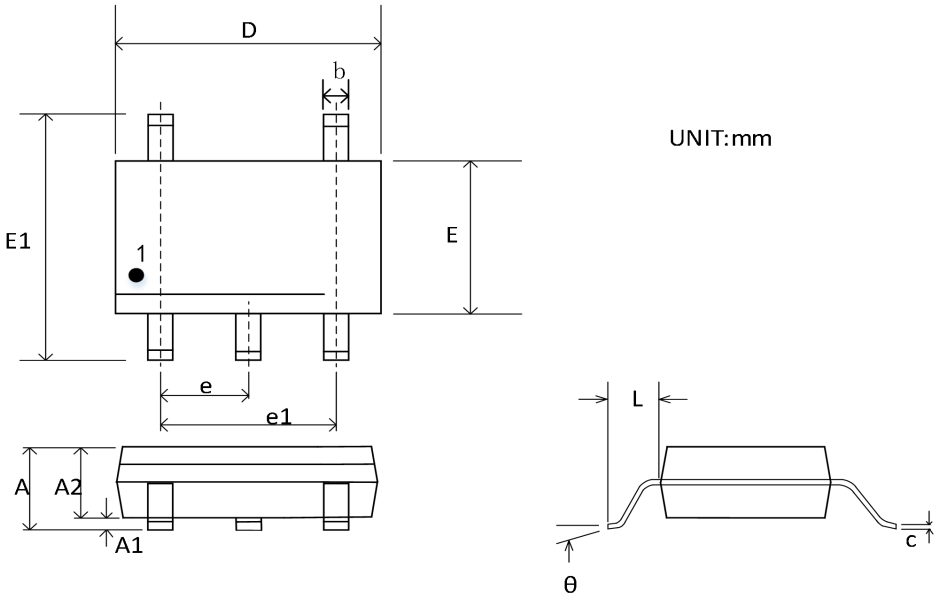


Figure 6. Typical video driving

Chinese version:CD8051_CD8052_CD8054

Package Outline Dimensions

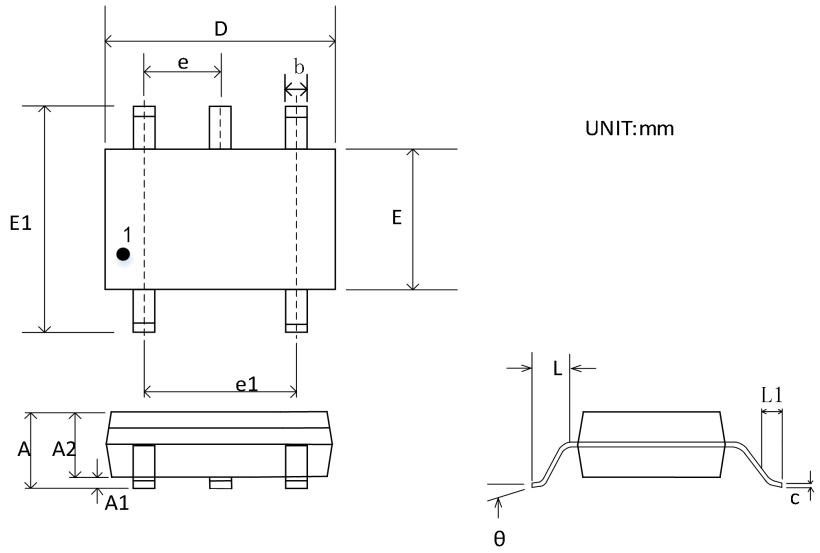
SOT23-5



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

Chinese version:CD8051_CD8052_CD8054

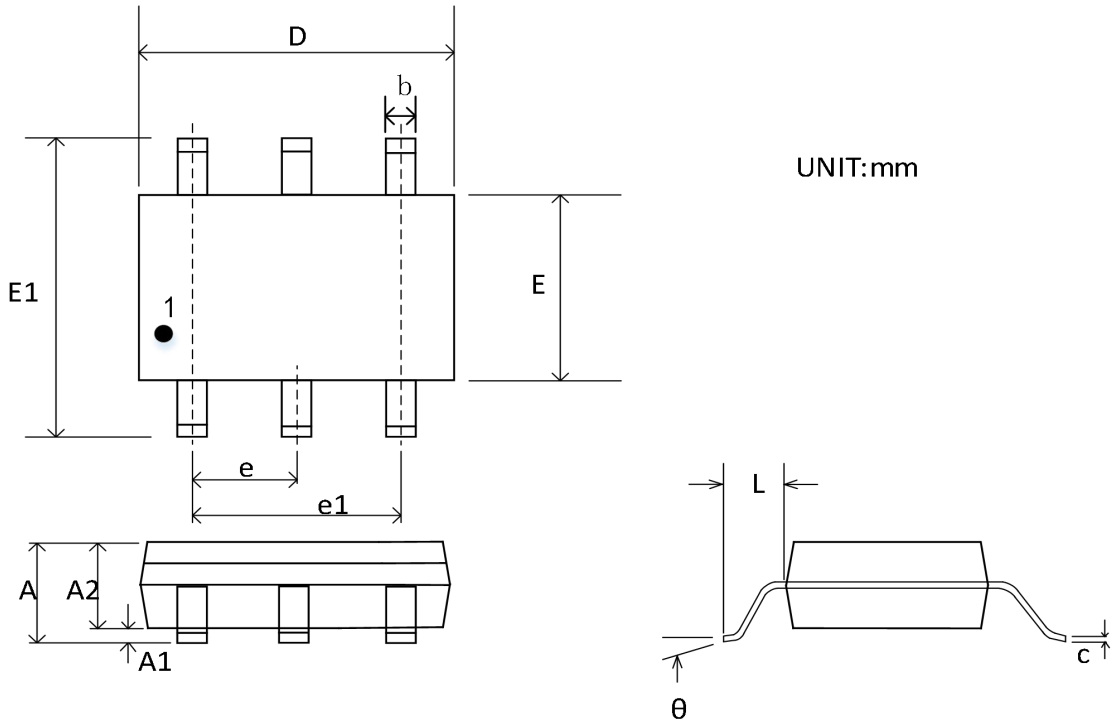
SC70-5



Symbol	Dimensions In Millimeters	
	Min	Max
A	0.900	1.100
A1	0.000	0.100
A2	0.900	1.000
b	0.150	0.350
C	0.080	0.150
D	2.000	2.200
E	1.150	1.350
E1	2.150	2.450
e	0.650 TYP	
e1	1.200	1.400
L	0.525 REF	
L1	0.260	0.460
θ	0°	8°

Chinese version:CD8051_CD8052_CD8054

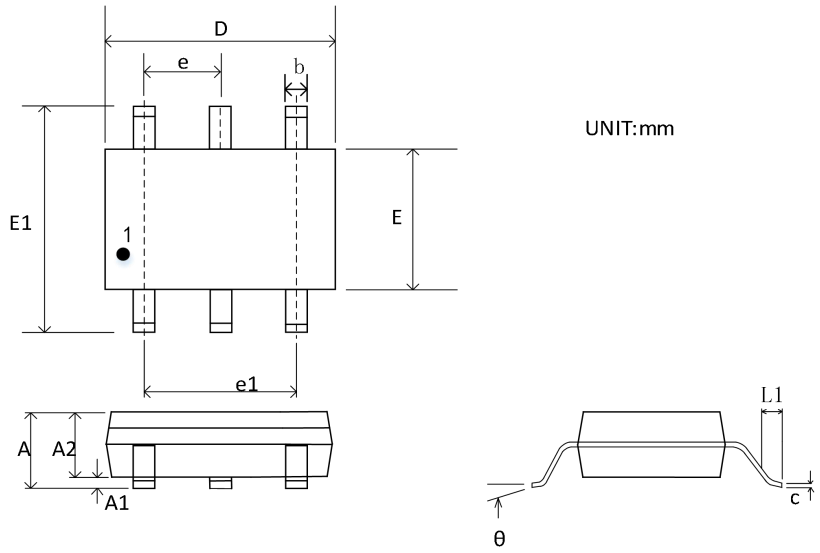
SOT23-6



UNIT:mm

Symbol	Dimensions In Millimeters	
	Min	Max
A	1.050	1.250
A1	0.000	0.100
A2	1.050	1.150
b	0.300	0.500
C	0.100	0.200
D	2.820	3.020
E	1.500	1.700
E1	2.650	2.950
e	0.950 BSC	
e1	1.900 BSC	0.075 BSC
L	0.300	
θ	0°	8°

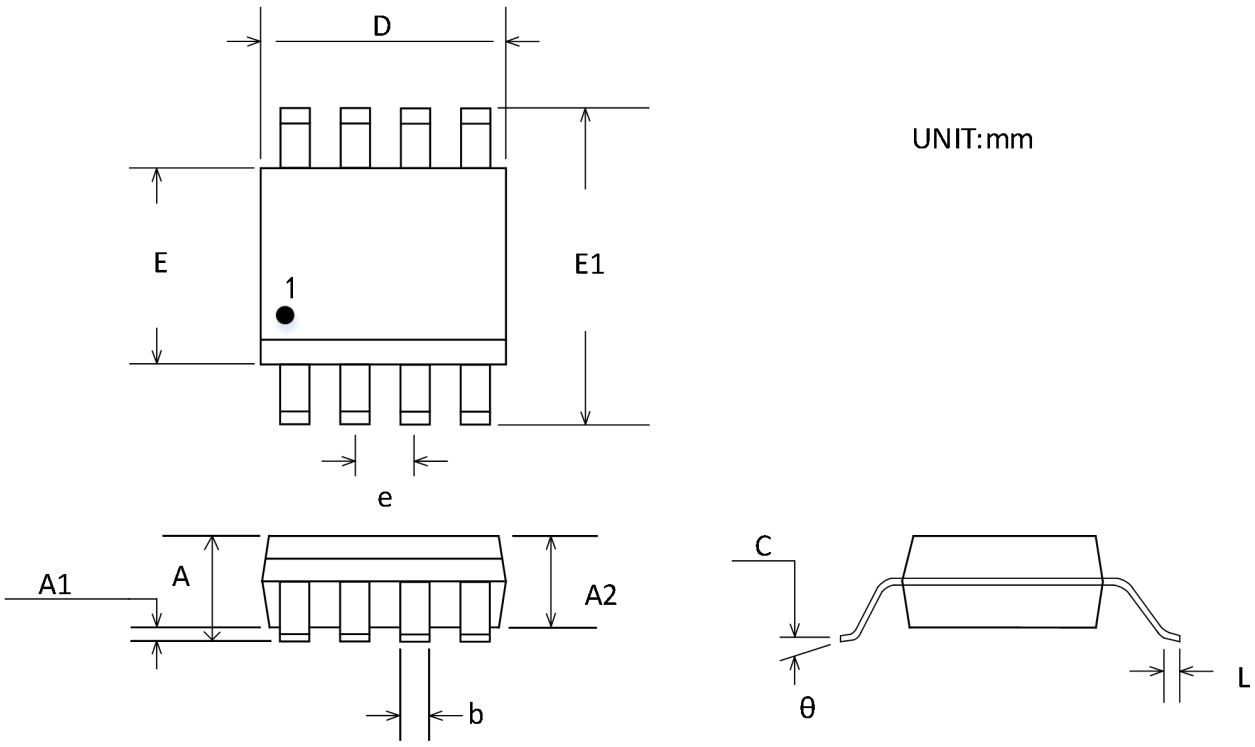
SC70-6



Symbol	Dimensions In Millimeters	
	Min	Max
A	0.800	1.100
A1	0.000	0.100
A2	0.700	1.000
b	0.150	0.300
C	0.150BSC	
D	1.850	2.150
E	1.100	1.400
E1	1.800	2.400
e	0.650 TYP	
e1	1.200	1.400
L1	0.260	0.460
θ	0°	8°

Chinese version:CD8051_CD8052_CD8054

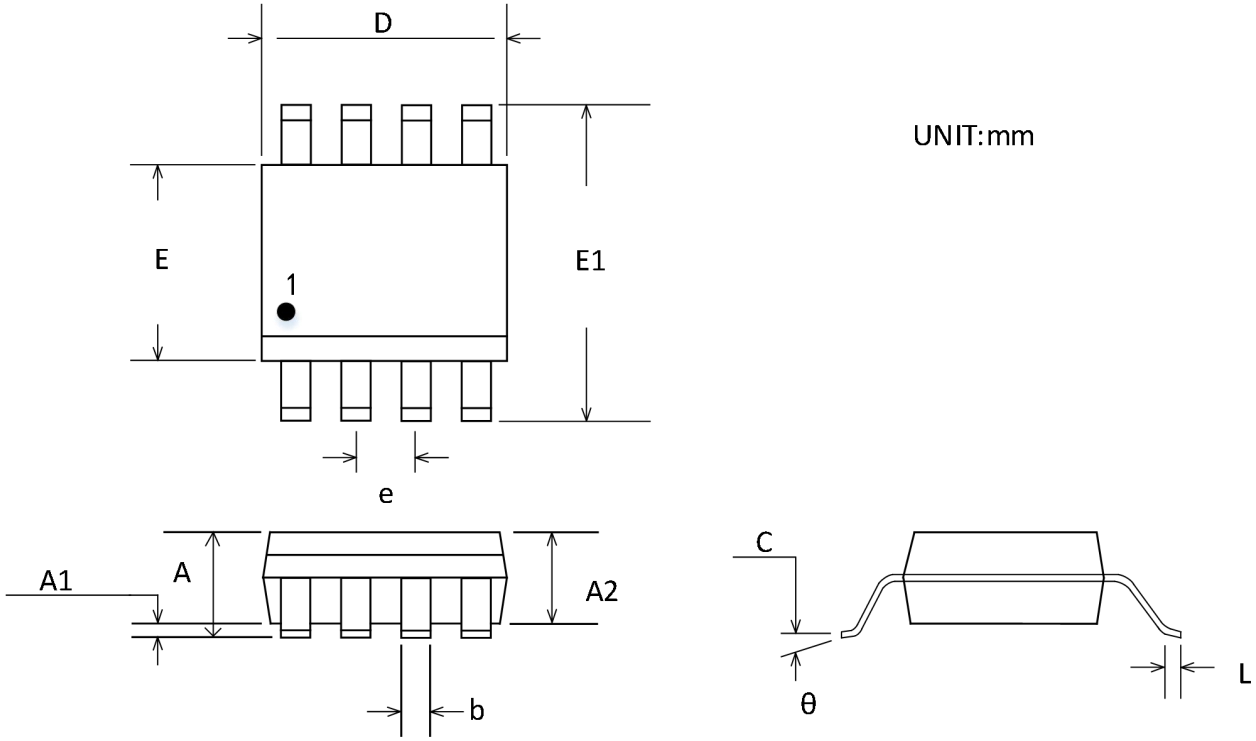
MSOP-8



UNIT:mm

Symbol	Dimensions In Millimeters	
	Min	Max
A	0.820	1.100
A1	0.020	0.150
A2	0.750	0.950
b	0.250	0.380
c	0.090	0.230
D	2.900	3.100
E	2.900	3.100
E1	4.750	5.050
e	0.650 BSC	
L	0.400	0.800
θ	0°	6°

SOP-8

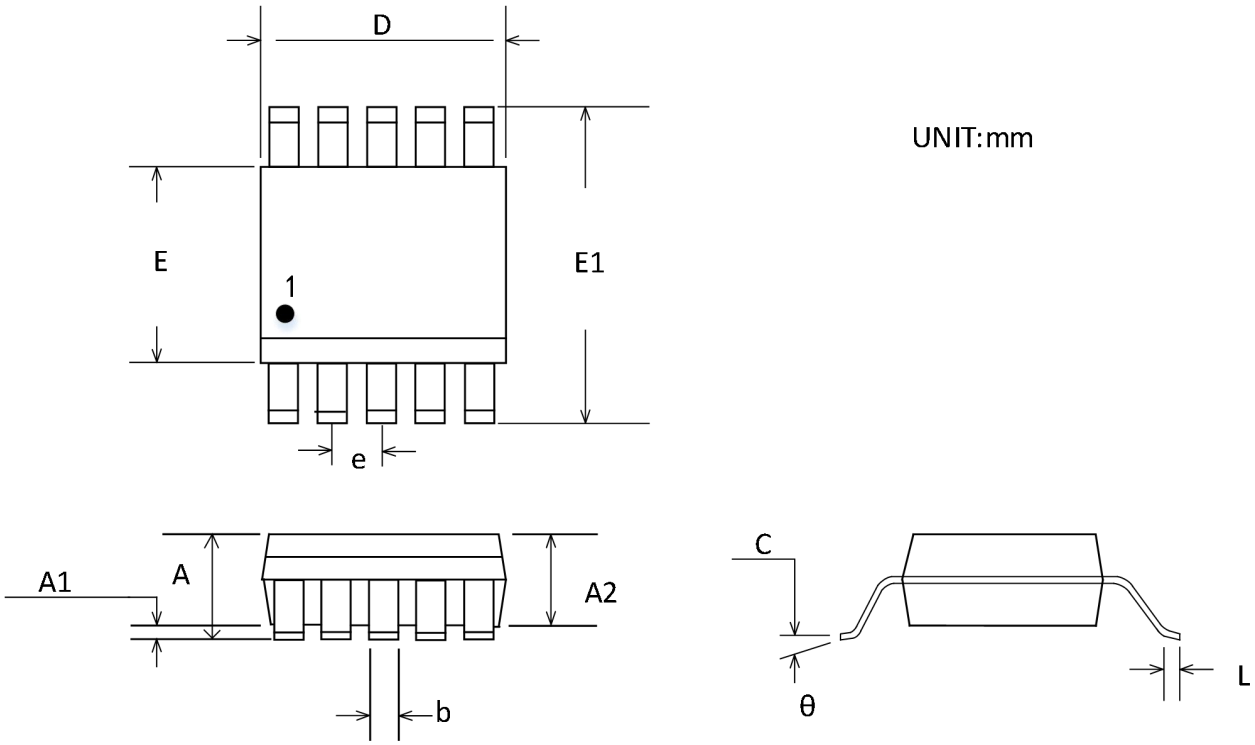


UNIT:mm

Symbol	Dimensions In Millimeters	
	Min	Max
A	1.350	1.750
A1	0.100	0.250
A2	1.350	1.550
b	0.330	0.510
c	0.170	0.250
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°

Chinese version:CD8051_CD8052_CD8054

MSOP-10

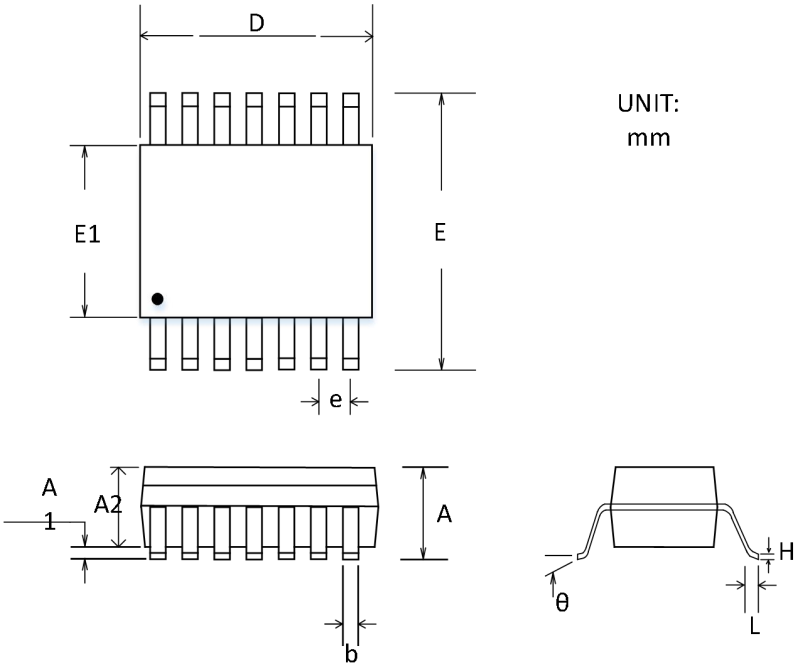


UNIT:mm

Symbol	Dimensions In Millimeters	
	Min	Max
A	0.820	1.100
A1	0.020	0.150
A2	0.750	0.950
b	0.180	0.280
c	0.090	0.230
D	2.900	3.100
E	2.900	3.100
E1	4.750	5.050
e	0.50 BSC	
L	0.400	0.800
θ	0°	6°

Chinese version:CD8051_CD8052_CD8054

TSSOP-14

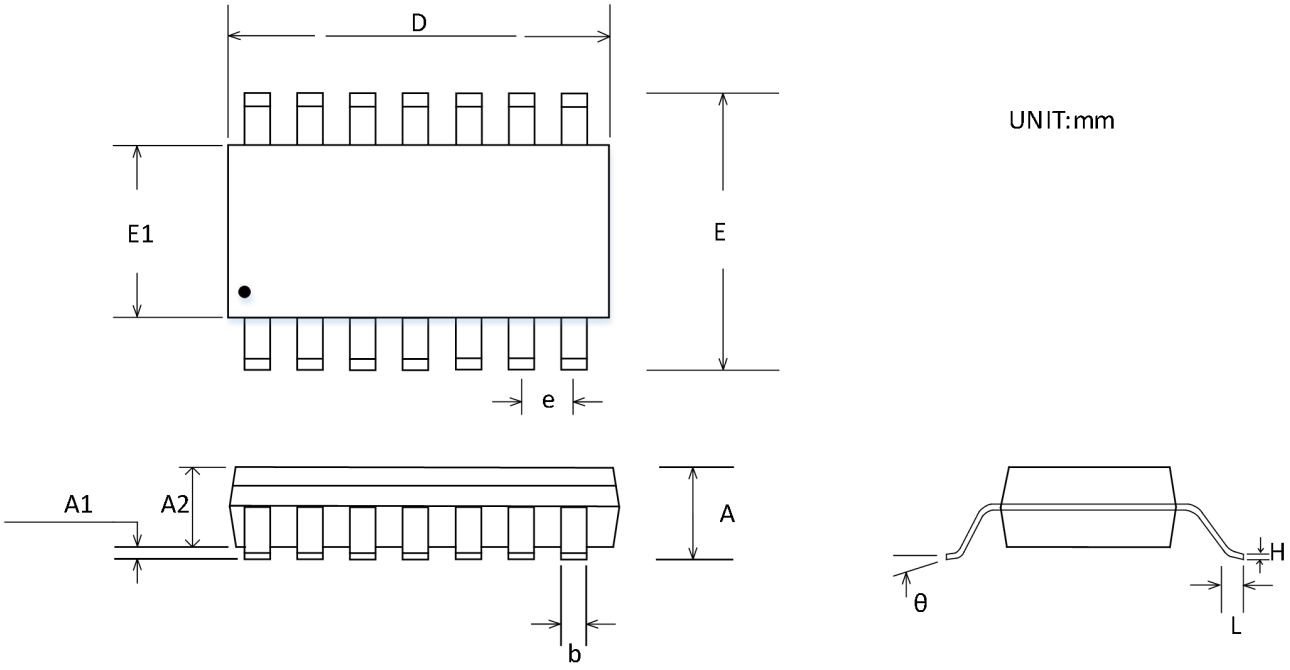


UNIT:
mm

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°

Chinese version:CD8051_CD8052_CD8054

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°

Chinese version:CD8051_CD8052_CD8054

Package/Ordering Information

MODEL	TEMPERATURE	PACKAGE DESCRIPTION	PACKAGE OPTION
CD8051ASC5	-40℃~125℃	SC70-5	Tape and Reel, 3000
CD8051AST5	-40℃~125℃	SOT23-5	Tape and Reel, 3000
CD8051NSC6	-40℃~125℃	SC70-6	Tape and Reel, 3000
CD8051NST6	-40℃~125℃	SOT23-6	Tape and Reel, 3000
CD8052AS8	-40℃~125℃	SOP-8	Tape and Reel, 2500
CD8052AS8-RL	-40℃~125℃	SOP-8	Tape and Reel, 3000
CD8052AS8-REEL	-40℃~125℃	SOP-8	Tape and Reel, 4000
CD8052AMS8	-40℃~125℃	MSOP-8	Tape and Reel, 3000
CD8052NMS10	-40℃~125℃	MSOP-10	Tape and Reel, 3000
CD8054ATS14	-40℃~125℃	TSSOP-14	Tape and Reel, 2500
CD8054ATS14-RL	-40℃~125℃	TSSOP-14	Tape and Reel, 3000
CD8054ATS14-REEL	-40℃~125℃	TSSOP-14	Tape and Reel, 4000
CD8054AS14	-40℃~125℃	SOP-14	Tape and Reel, 2500
CD8054AS14-RL	-40℃~125℃	SOP-14	Tape and Reel, 3000
CD8054AS14-REEL	-40℃~125℃	SOP-14	Tape and Reel, 4000

Revision Log

Version	Revision date	Change content	Reason for Change	Modified by	Reviewed By	Note
V1.0	2025.8.14	Initial version	Regular update	WW	LYL	
V1.1	2025.11.14	Update the Power-down Description for CBM8051N/ CBM8052N Product	Error updates	WW	LYL	