Features

- Single-Supply Operation from +2.1V ~ +5.5V
- Rail-to-Rail Input / Output
- Gain-Bandwidth Product: 6MHz (Typ.)
- Low Input Bias Current: 1pA (Typ.)
- Low Offset Voltage: 3.5mV (Max.)
- Quiescent Current: 470μA per Amplifier (Typ.)
- Operating Temperature: -40°C ~ +125°C
- Small Package:
  - CBM8631 Available in SOT23-5, SOP-8 and SC70-5 Packages
  - CBM8632 Available in SOP-8 and MSOP-8 Packages
  - CBM8634 Available in SOP-14 and TSSOP-14 Packages

Application

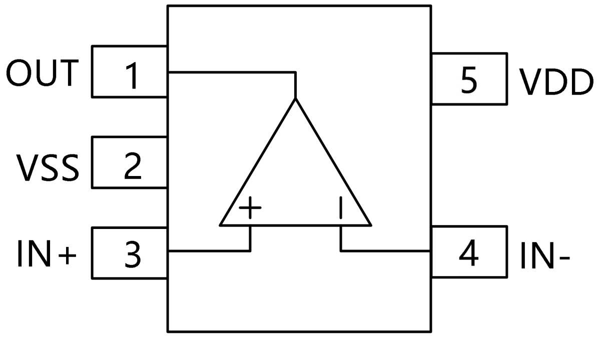
- Sensors
- Active Filters
- Cellular and Cordless Phones
- Laptops and PDAs
- Audio
- Handheld Test Equipment
- Battery-Powered Instrumentation
- A/D Converters

Description

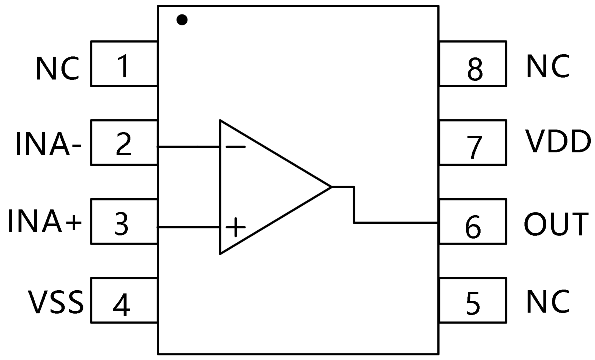
The CBM863X have a high gain-bandwidth product of 6MHz, a slew rate of 4.2V/μs, and a quiescent current of 470μA per amplifier at 5V. The CBM863X are designed to provide optimal performance in low voltage and low noise systems. They provide rail-to-rail output swing into heavy loads. The input common mode voltage range includes ground, and the maximum input offset voltage is 3.5mV for CBM863X. They are specified over the extended industrial temperature range (-40℃ to +125℃). The operating range is from 2.1V to 5.5V. The CBM8631 single is available in Green SC70-5, SOT23-5 and SOP-8 packages. The CBM8632 dual is available in Green SOP-8 and MSOP-8 packages. The CBM8634 Quad is available in Green SOP-14 and TSSOP-14 packages.

CATALOG

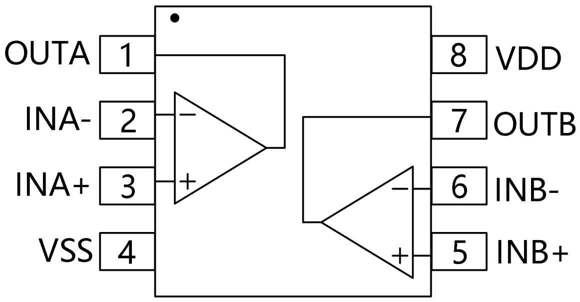
Pin Configurations



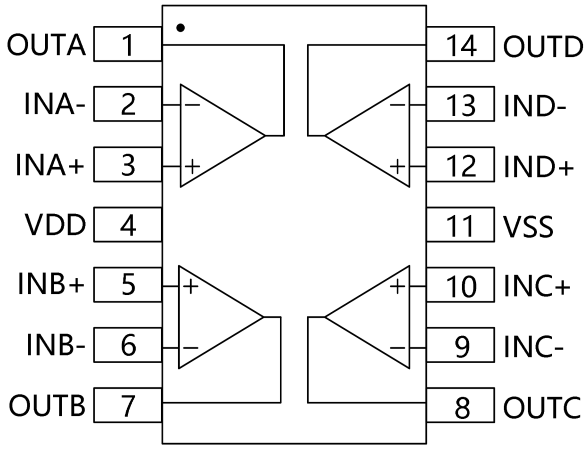
SOT23-5/SC70-5



SOP-8



MSOP-8/SOP-8



SOP-14/TSSOP-14

Figure 1. Pin Assignment Diagram

Absolute Maximum Ratings

Condition	Min	Max
Power Supply Voltage (V_{DD} to V_{SS})	-0.5V	+7.5V
Analog Input Voltage (IN+ or IN-)	V_{SS}-0.5V	V_{DD}+0.5V
PDB Input Voltage	V_{SS}-0.5V	+7V
Operating Temperature Range	-40℃	+125℃
Junction Temperature	+160℃	
Storage Temperature Range	-65℃	+150℃
Lead Temperature (soldering, 60sec)	+300℃	
Package Thermal Resistance (T_A=+25℃)		
SOP-8, θ_{JA}	125°C/W	
MSOP-8, θ_{JA}	216°C/W	
SOT23-5, θ_{JA}	190°C/W	
SOT23-6, θ_{JA}	190°C/W	
SC70-5, θ_{JA}	333°C/W	
ESD Susceptibility		
HBM	8KV	
MM	400V	

Note: Stress greater than 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 these or any other conditions outside those indicated in the operational sections of this specification are not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Electrical Characteristics

(At Vs=5V, T_A = +25℃, V_{CM} = V_S/2, R_L = 600KΩ, unless otherwise noted.)

PARAMETER	CONDITION	CBM8631/CBM8632/CBM8634						
		TYP	MIN/MAX OVER TEMPERATURE					
		+25℃	+25℃	0℃ to 70℃	-40℃ to 85℃	-40℃ to 125℃	UNITS	MIN/MAX
INPUT CHARACTERISTICS								
Input Offset Voltage (V_{OS})		0.8	3.5	3.9	4.3	4.6	mV	MAX
Input Bias Current (I_B)		1					pA	TYP
Input Offset Current (I_{OS})	V_S = 5.5V	1					pA	TYP
Input Common Mode Voltage Range (V_{CM})		-0.1 to +5.6					V	TYP
Common-Mode Rejection Ratio (CMRR)	V_S = 5.5V, VCM = -0.1V to 4V	90	73	70	70	65	dB	MIN
	V_S = 5.5V, VCM =-0.1V to 5.6V	83					dB	MIN
Large Signal Voltage Gain (A_{VO})	R_L = 600Ω, VO = 0.15V to 4.85V	97	90	87	86	79	dB	MIN
	R_L = 10kΩ, VO = 0.05V to 4.95V	108					dB	MIN
Input Offset Voltage Drift ($\Delta V_{OS}/\Delta_T$)		2.4					μV/℃	TYP
OUTPUT CHARACTERISTICS								
Output Voltage Swing from Rail	R_L = 600Ω	0.1					V	V
	R_L = 10kΩ	0.015					V	V
Output Current (I_{OUT})		53	49	45	40	35	mA	mV
Closed-Loop Output Impedance	f = 200kHz, G = 1	3					Ω	mA

POWER-DOWN DISABLE								
Turn-On Time		4						μs
Turn-Off Time		1.2						μs
POWER SUPPLY								
Operating Voltage Range		2.1	2.1	2.1	2.1	2.1	V	MIN
		5.5	5.5	5.5	5.5	5.5	V	MAX
Power Supply Rejection Ratio (PSRR)	V_S = +2.5V to +5.5V V_{CM} = (-VS) + 0.5V	91	74	72	72	68	dB	TYP
Quiescent Current/Amplifier (I_Q)	I_{OUT} = 0	470	650	727	750	815	μA	TYP

Electrical Characteristics

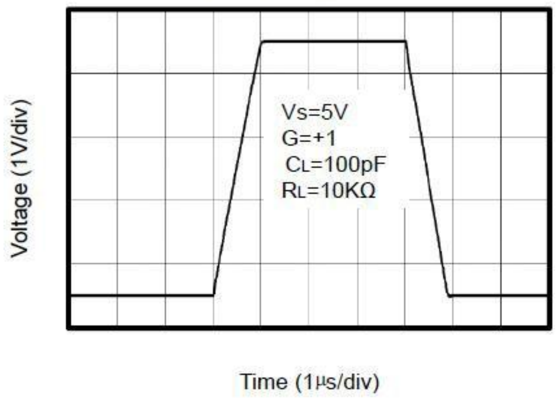
(At Vs=5V, T_A = +25℃, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.)

PARAMETER	CONDITION	CBM8631/CBM8632/CBM8634						
		TYP	MIN/MAX OVER TEMPERATURE					
		+25℃	+25℃	0℃ to 70℃	-40℃ to 85℃	-40℃ to 125℃	UNITS	MIN/MAX
DYNAMIC PERFORMANCE								
Gain-Bandwidth Product (GBP)	R_L = 10kΩ, CL = 100pF	6					MHz	TYP
Phase Margin (φ_O)	R_L = 10kΩ, CL = 100pF	53					Degrees	TYP
Full Power Bandwidth (BWP)	< 1% distortion, R_L = 600Ω	250					kHz	TYP
Slew Rate (SR)	G = +1, 2V Step, R_L = 10kΩ	4.2					V/μs	TYP
Settling Time to 0.1% (T_S)	G = +1, 2V Step, R_L = 600Ω	0.4					μs	TYP
Overload Recovery Time	V_{IN} ·Gain = VS, R_L = 600Ω	2.5					μs	TYP
NOISE PERFORMANCE								
Voltage Noise Density (e_n)	R_L = 600Ω	13					$nV/\sqrt{Hz}$	TYP
	R_L = 10kΩ	9.5					$nV/\sqrt{Hz}$	TYP

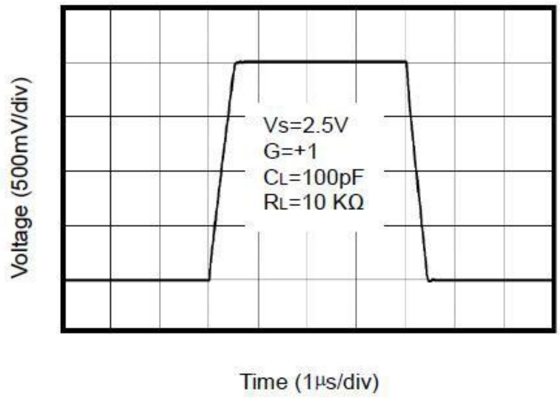
Typical Performance Characteristics

(At Vs=5V, T_A = +25℃, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.)

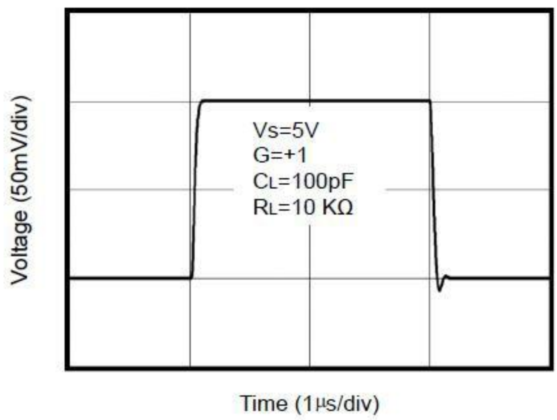
Large-Signal Step Response



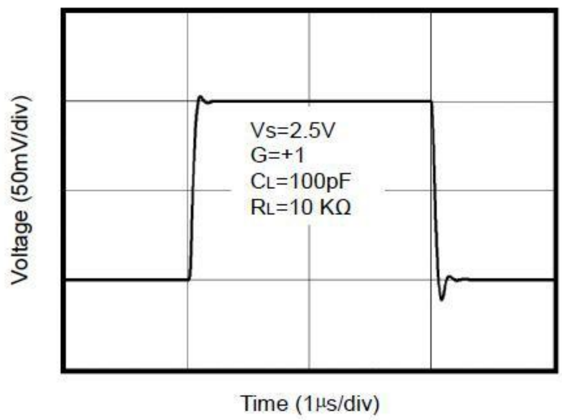
Large-Signal Step Response



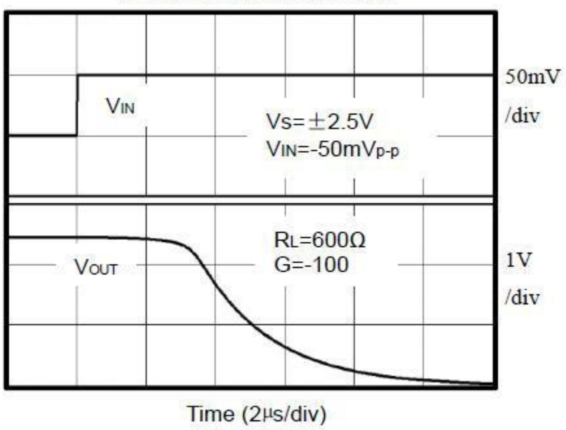
Small-Signal Step Response



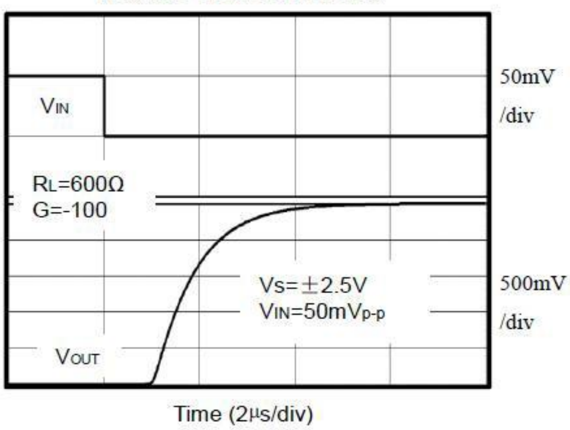
Small-Signal Step Response



Positive Overload Recovery



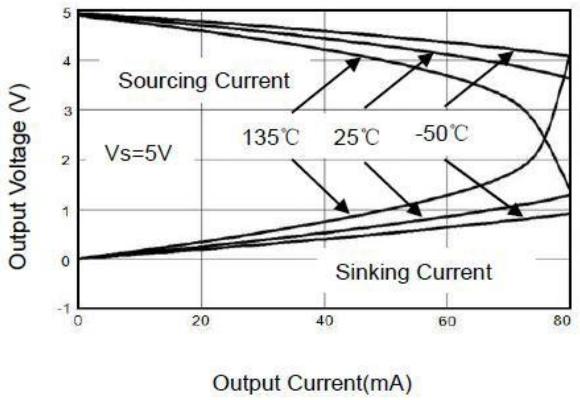
Negative Overload Recovery



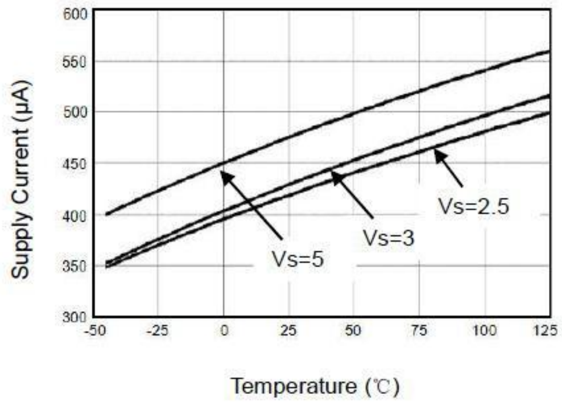
Typical Performance Characteristics

(At V_S=5V, T_A = +25℃, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.)

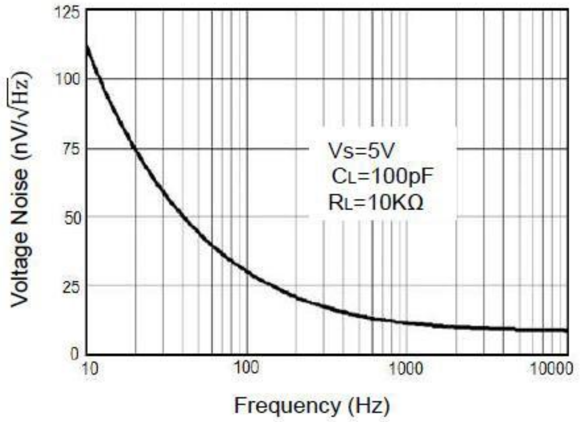
Output Voltage Swing vs.Output Current



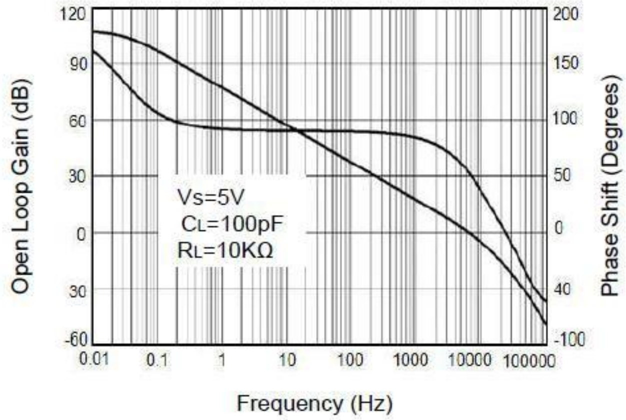
Supply Current vs. Temperature



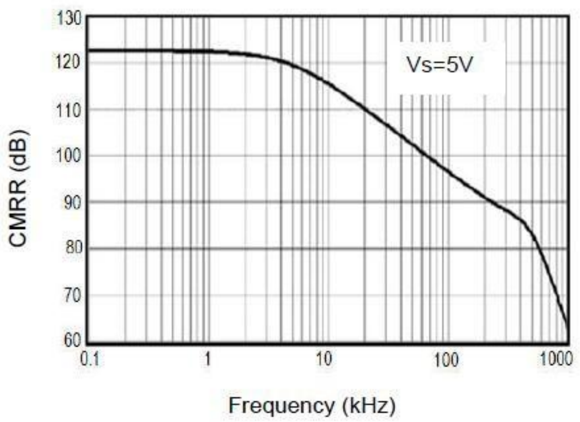
Input Voltage Noise Spectral Density vs. Frequency



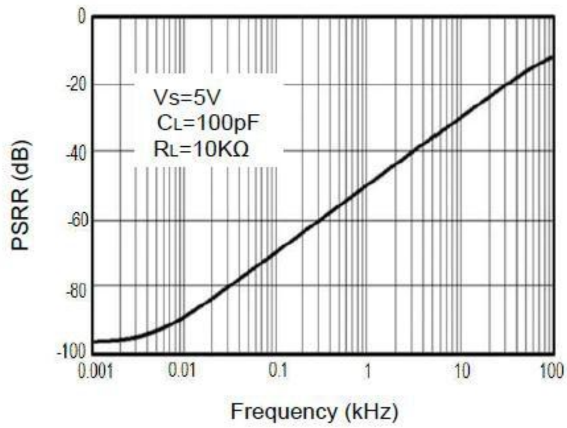
Open Loop Gain, Phase Shift vs. Frequency



CMRR vs. Frequency



PSRR vs. Frequency



Application Notes

Size

CBM863X series op amps are unity-gain stable and suitable for a wide range of general-purpose applications. The small footprints of the CBM863X series packages save space on printed circuit boards and enable the design of smaller electronic products.

Power Supply Bypassing and Board Layout

CBM863X series operates from a single 2.1V to 5.5V supply or dual ±1.05V 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 470uA per channel) of CBM863X series will help to maximize battery life. They are ideal for battery powered systems

Operating Voltage

CBM863X series operate under wide input supply voltage (2.1V 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 ensure operation throughout the single Li-Ion battery lifetime

Rail-to-Rail Input

The input common-mode range of CBM863X series extends 100mV beyond the supply rails (VSS-0.1V to VDD+0.1V). This is achieved by using complementary input stage. For normal operation, inputs should be limited to this range.

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 CBM863X series can typically swing to less than 2mV from supply rail in light resistive loads (>100kΩ), and 60mV of supply rail in moderate resistive loads (10kΩ).

Capacitive Load Tolerance

The CBM863x 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.

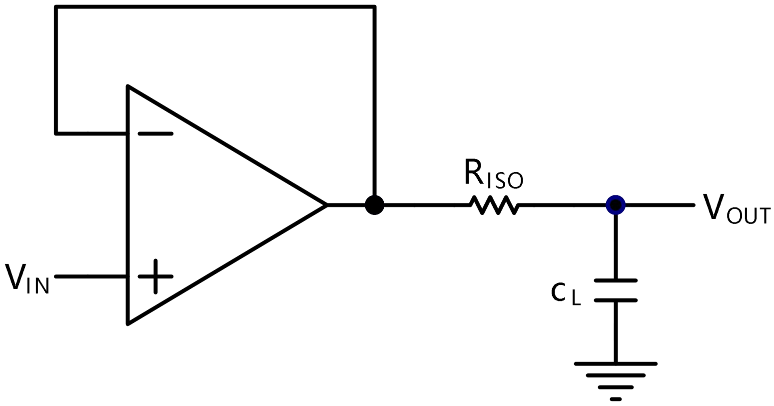


Figure 2. Indirectly Driving a Capacitive Load Using Isolation Resistor

The bigger the R_{ISO} resistor value, the more stable V_{OUT} will be. However, if there is a resistive load R_L 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 $_{RISO}$ 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.

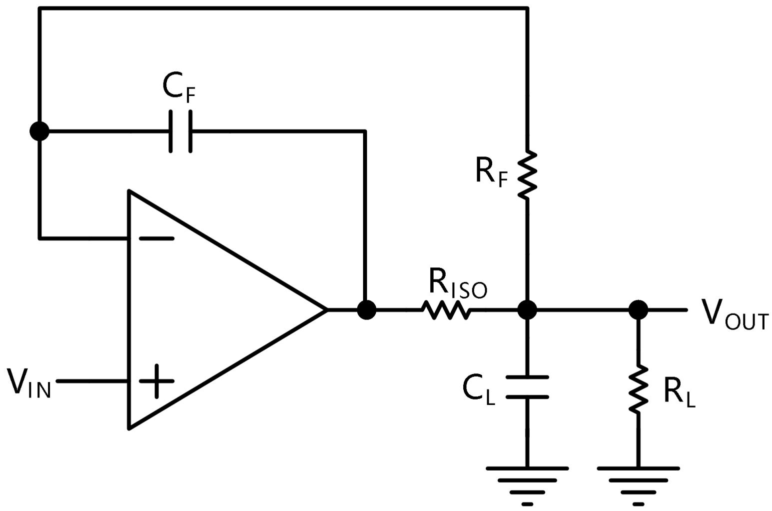


Figure 3. Indirectly Driving a Capacitive Load with DC Accuracy

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 CBM863X.

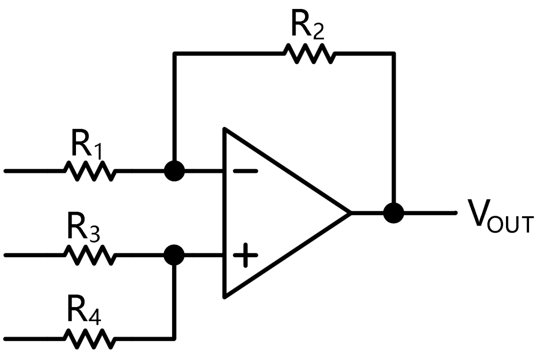


Figure 4. Differential Amplifier

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

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

$$V_{OUT}=\frac{R_2}{R_1}(V_{IP}-V_{IN})+V_{REF}$$

Low Pass Active Filter

The low pass active filter is shown in Figure 5. The DC gain is defined by –R2/R1. The filter has a -20dB/decade roll-off after its corner frequency fC=1/(2πR_3C_1).

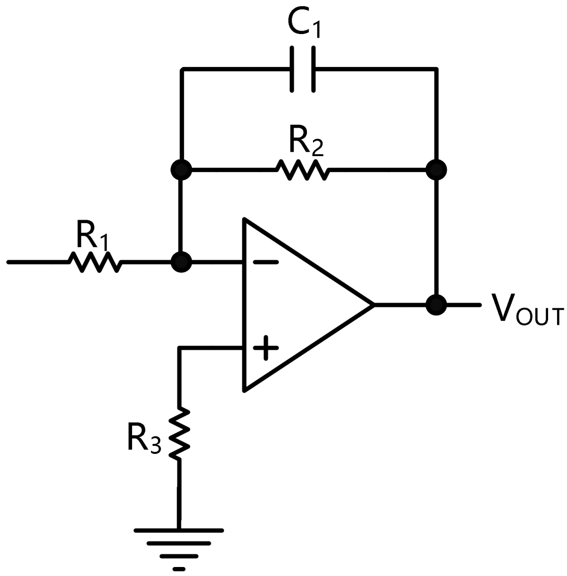


Figure 5. Low Pass Active Filter

Instrumentation Amplifier

The triple CBM863X can be used to build a three-op-amp instrumentation amplifier as shown in Figure 6. The amplifier in Figure 6 is a high input impedance differential amplifier with gain of R_2/R_1. The two differential voltage followers assure the high input impedance of the amplifier.

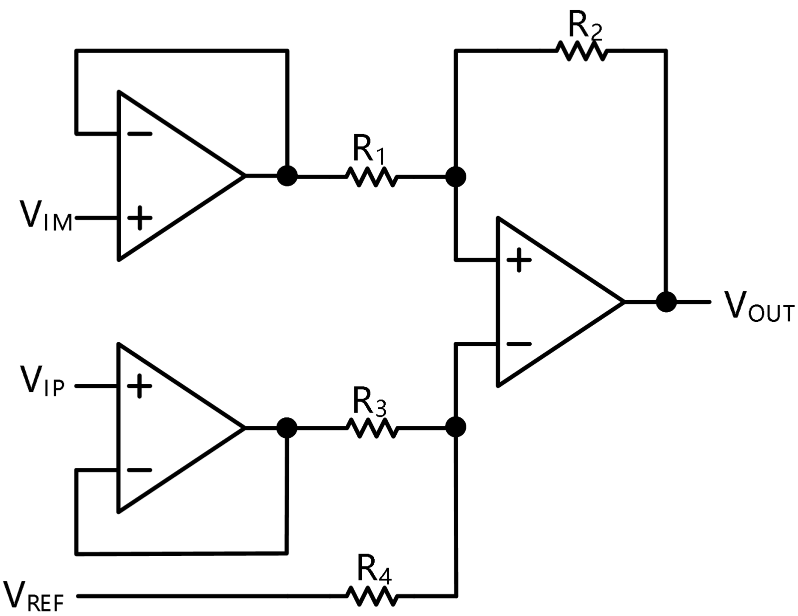
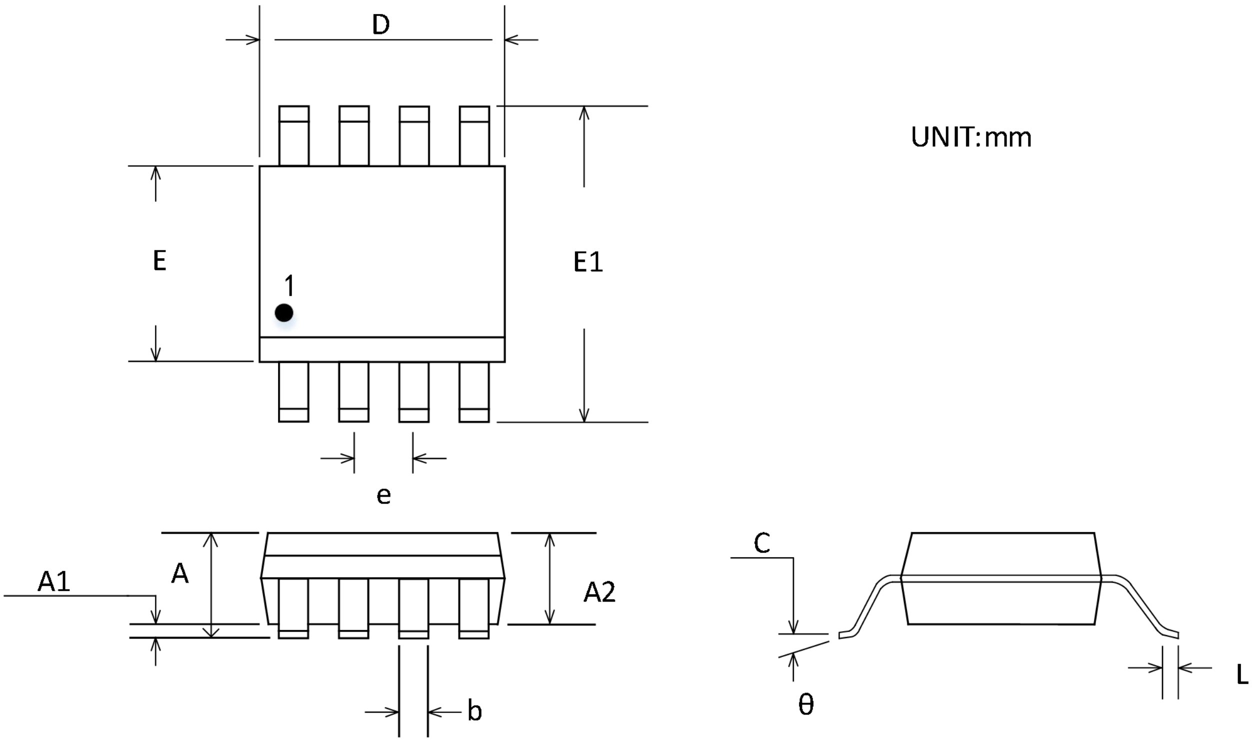


Figure 6. Instrument Amplifier

Package Outline Dimensions

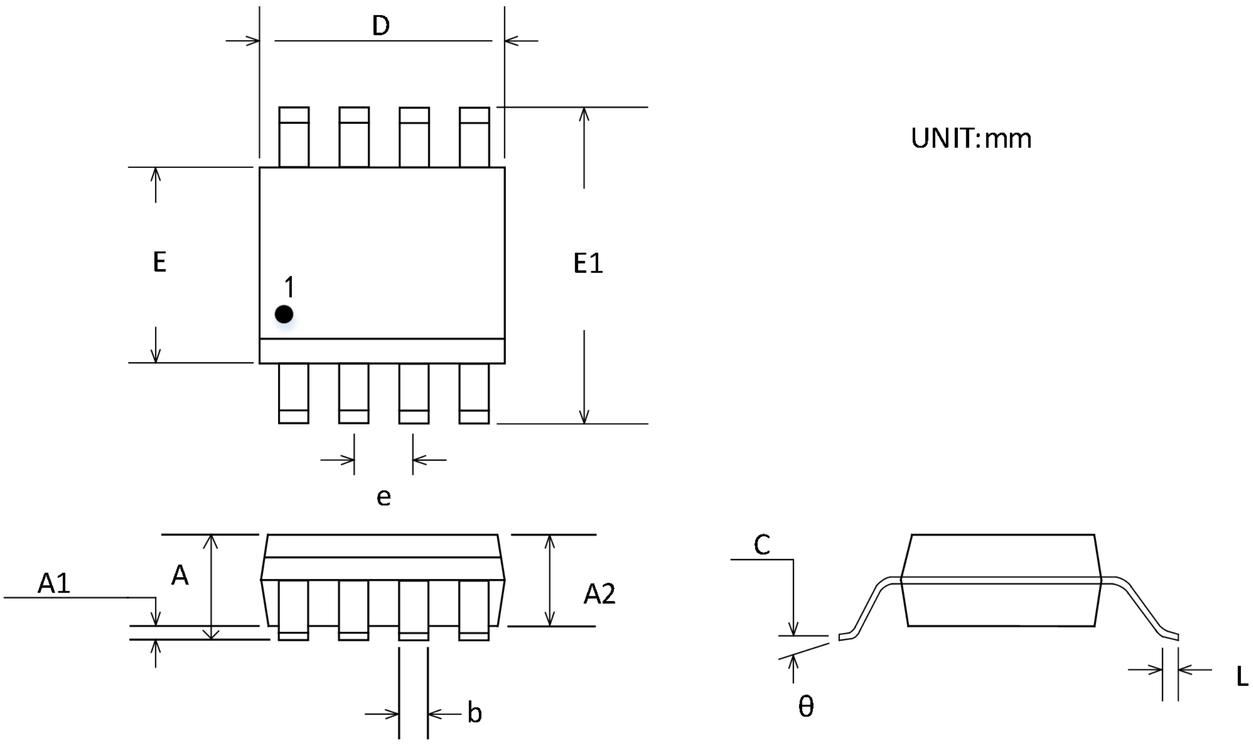
MSOP-8



UNIT:mm

Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026 BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

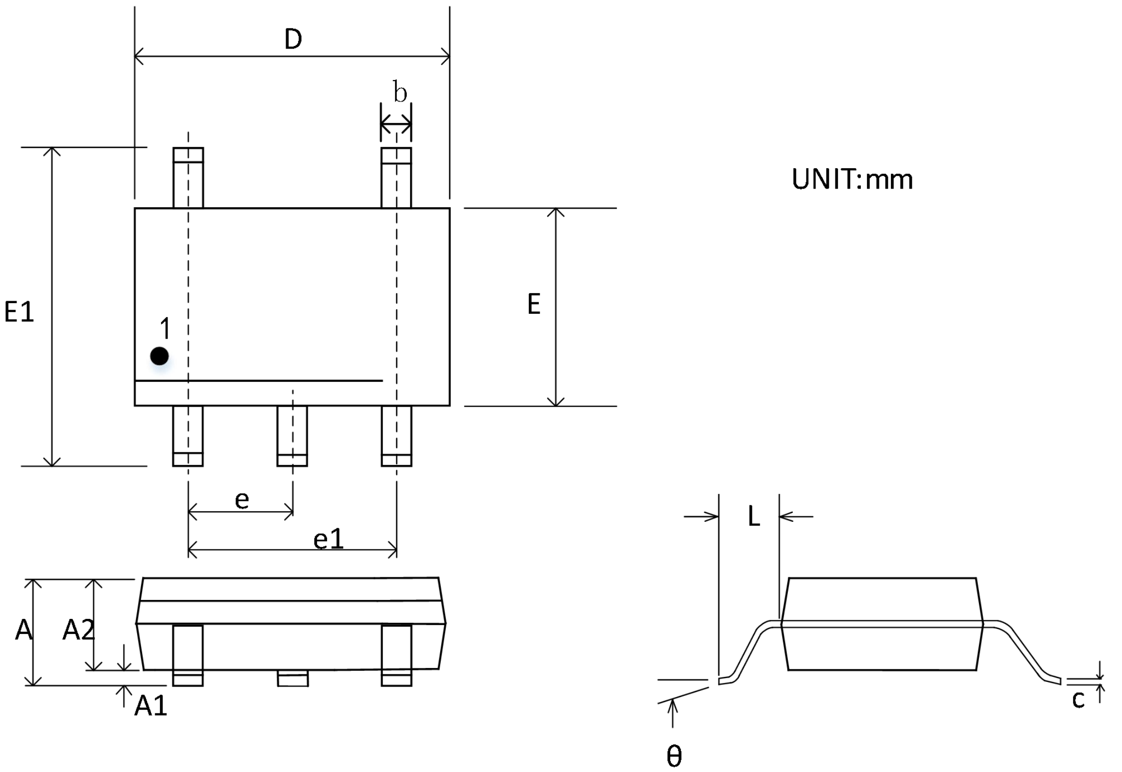
SOP8



UNIT:mm

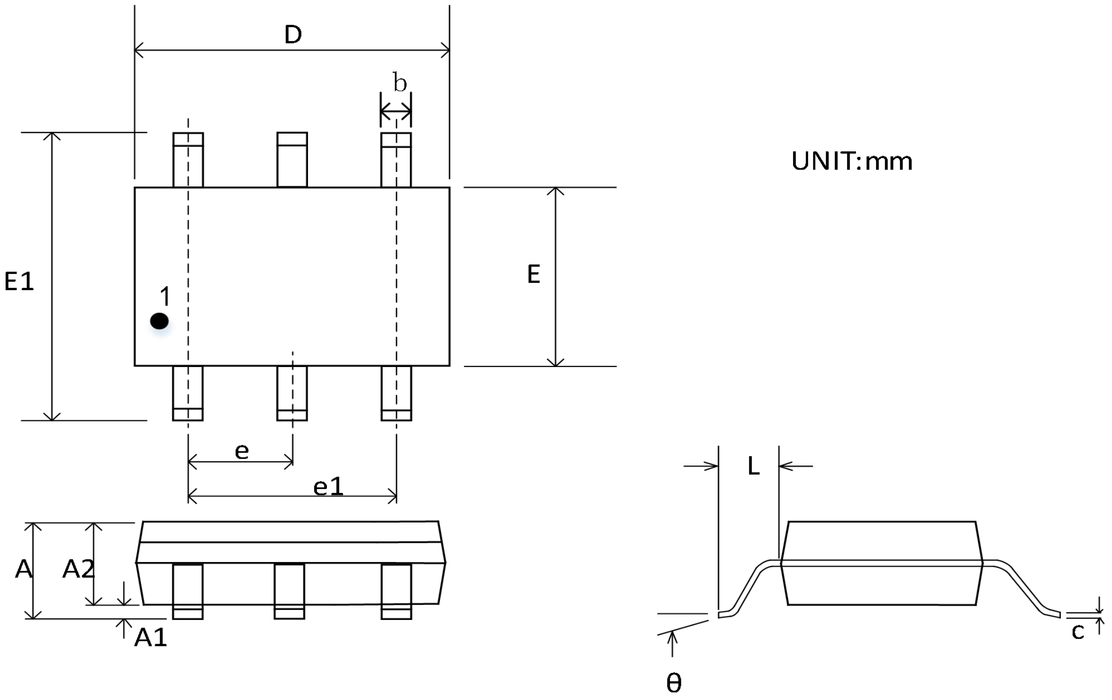
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.800	5.000	0.189	0.197
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

SOT23-5



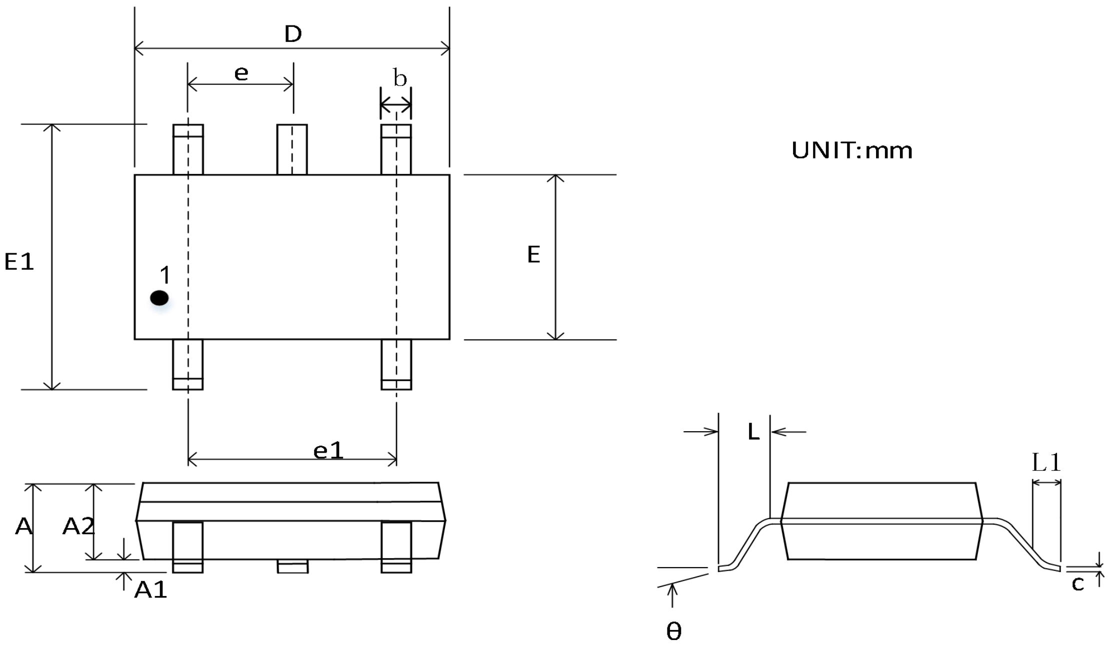
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

SOT23-6



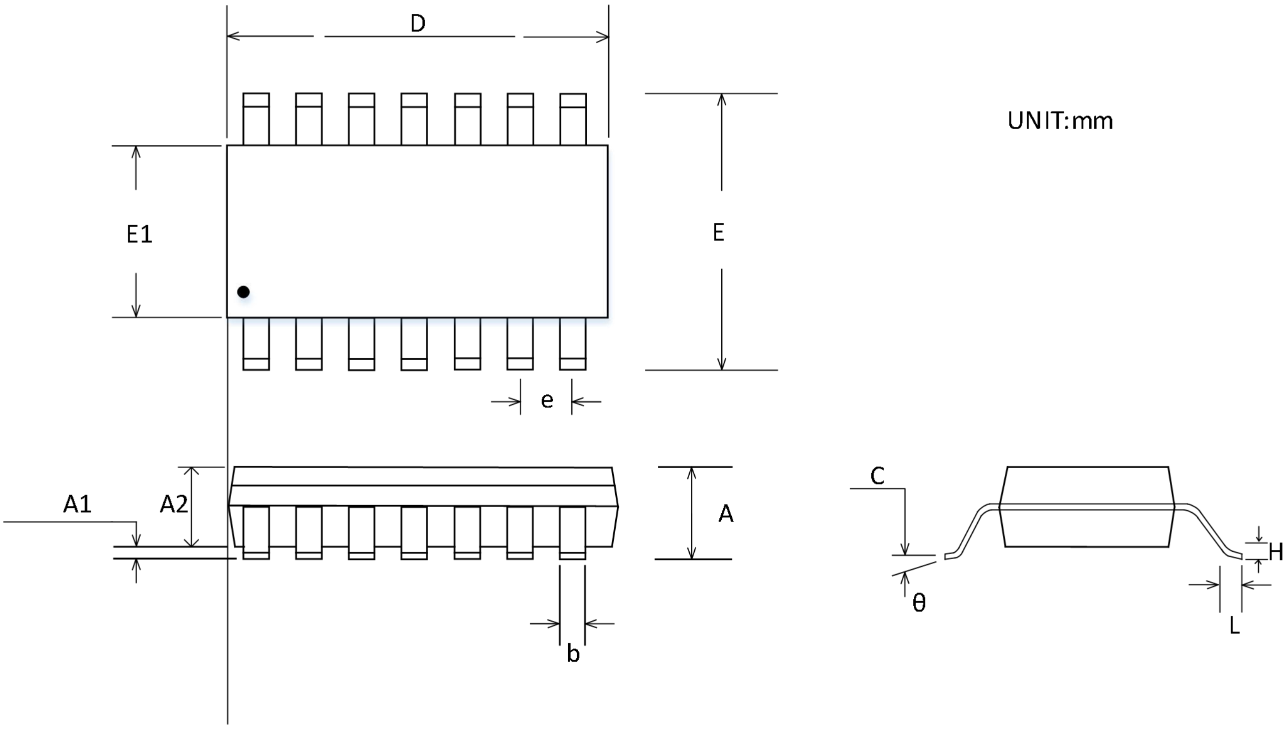
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
C	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.900 BSC	0.075 BSC		
L	0.300		0.600	
θ	0°	8°	0°	8°

SC70-5



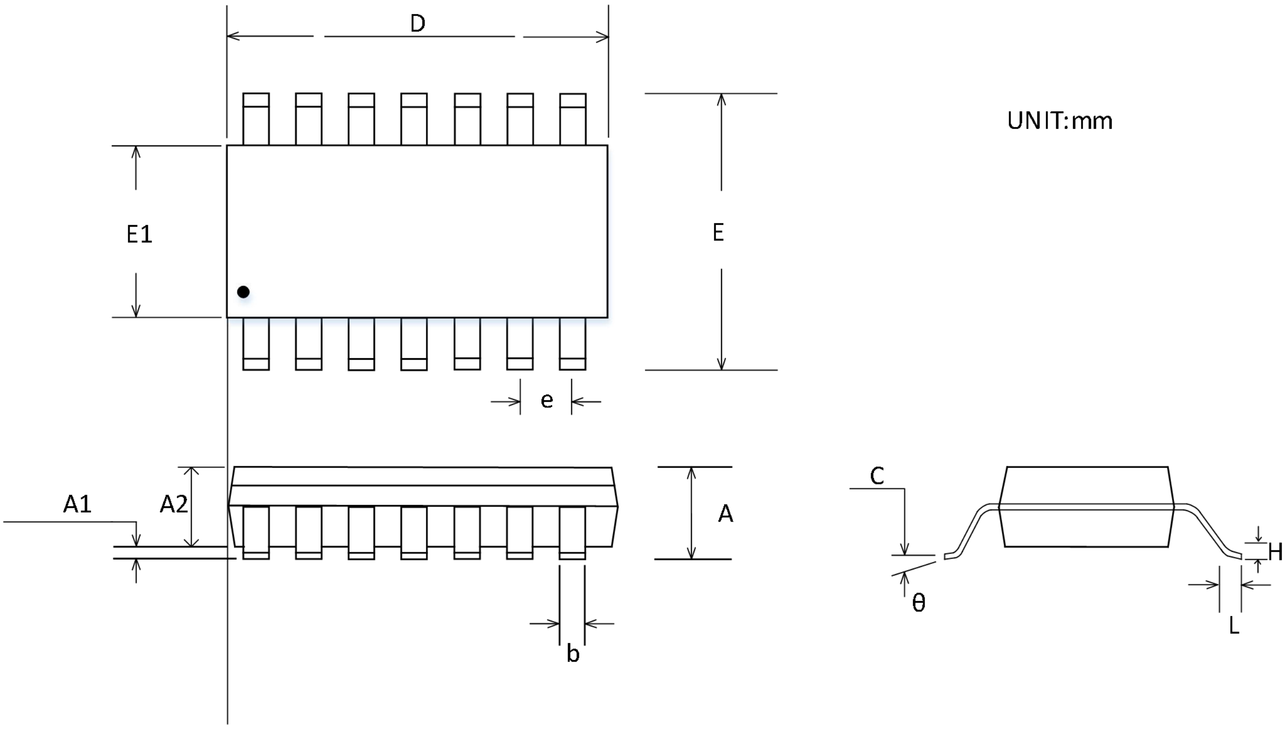
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
C	0.080	0.150	0.003	0.006
D	2.000	2.200	0.079	0.087
E	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.650 TYP		0.026TYP	
e1	1.200	1.400	0.047	0.055
L	0.525 REF		0.021 REF	
L1	0.260	0.460	0.010	0.018
θ	0°	8°	0°	8°

TSSOP-14



Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650 BSC		0.026 BSC	
L	0.500	0.700	0.020	0.028
H	0.25 TYP		0.01 TYP	
θ	1°	7°	1°	7°

SOIC-14(SOP14)



Symbol	Dimensions In Millimeters		Dimensions 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	0.310	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
R1	0°	8°	0°	8°

Package/Ordering Information

ORDERING NUMBER	TEMPRANGE	PACKAGE	PAKEAGE MARKING	TRANSPOT MEDIA,QUANTILY
CBM8631ASC7	-40℃~125℃	SC70-5	631C	Tape and Reel, 3000
CBM8631AST5	-40℃~125℃	SOT23-5	631S	Tape and Reel, 3000
CBM8631AS8	-40℃~125℃	SOP-8	CBM8631A	Tape and Reel, 2500
CBM8631AS8-RL	-40℃~125℃	SOP-8	CBM8631A	Tape and Reel, 3000
CBM8631AS8-REEL	-40℃~125℃	SOP-8	CBM8631A	Tape and Reel, 4000
CBM8632AS8	-40℃~125℃	SOP8	CBM8632A	Tape and Reel, 2500
CBM8632AS8-RL	-40℃~125℃	SOP8	CBM8632A	Tape and Reel, 3000
CBM8632AS8-REEL	-40℃~125℃	SOP8	CBM8632A	Tape and Reel, 4000
CBM8632AMS8	-40℃~125℃	MSOP-8	8632M	Tape and Reel, 3000
CBM8634AS14	-40℃~125℃	SOP-14	CBM8634AS	Tape and Reel, 2500
CBM8634AS14-RL	-40℃~125℃	SOP-14	CBM8634AS	Tape and Reel, 3000
CBM8634AS14-REEL	-40℃~125℃	SOP-14	CBM8634AS	Tape and Reel, 4000
CBM8634ATS14	-40℃~125℃	TSSOP-14	CBM8634AT	Tape and Reel, 2500
CBM8634ATS14-RL	-40℃~125℃	TSSOP-14	CBM8634AT	Tape and Reel, 3000
CBM8634ATS14-REEL	-40℃~125℃	TSSOP-14	CBM8634AT	Tape and Reel, 4000