

Features

- Single-Supply Operation from +2.7V~+5.5V
- Rail-to-Rail Input / Output
- Gain-Bandwidth Product: 5MHz (Typ.@25°C)
- Low Input Bias Current: 50pA (Typ.@25°C)
- Low Offset Voltage: 1μV (Typ. @25°C)
- Quiescent Current: 640μA per Amplifier (Typ)
- Operating Temperature: -40°C~+125°C
- Input Offset Drift: 0.005μV/°C
- High Gain,CMRR,PSRR:130dB
- High Slew Rate: 1.9V/μs
- Low Noise: 0.75μVp-p (0.01Hz~10Hz)

Applications

- Battery-Powered Instrumentation
- Active Filtering
- Weight Scale Sensor
- Temperature Sensors
- Medical/Industrial Instrumentation
- Pressure Sensors
- Strain Gage Amplifiers
- Power Converter/Inverter

Description

CBM855X series products include: CBM8551, CBM8552, CBM8554.The CBM855X amplifier is single/dual/quad channel amplifiers.

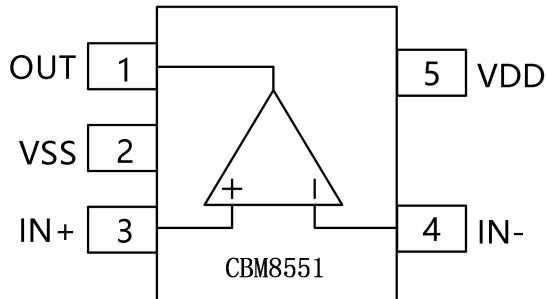
These products are micro-power, zero-drift CMOS operational amplifiers, the amplifiers offer bandwidth of 5MHz, rail-to-rail inputs and outputs,and single-supply operation from 2.7V to 5.5V. CBM855X uses chopper stabilized technique to provide very low offset voltage (1μV typ) and near zero drift over temperature. Low quiescent supply current of 640μA per amplifier and very low input offset voltage, low bias current of 50pA make the devices an ideal choice for low offset, low power consumption and high impedance applications. The CBM855X offers excellent CMRR without the crossover associated with traditional complementary input stages. This design results in superior performance for driving analog-to-digital converters (ADC) without degradation of differential linearity.

The CBM8551 is available in SOT23-5 and SOP-8 packages. And the CBM8552 is available in MSOP-8,SOP-8 and TSSOP8 packages. The CBM8554 Quad is available in Green SOP-14 and TSSOP-14 packages. The extended temperature range of -40°C to +125°C over all supply voltages offers additional design flexibility.

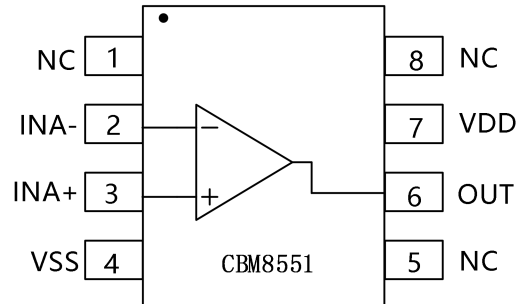
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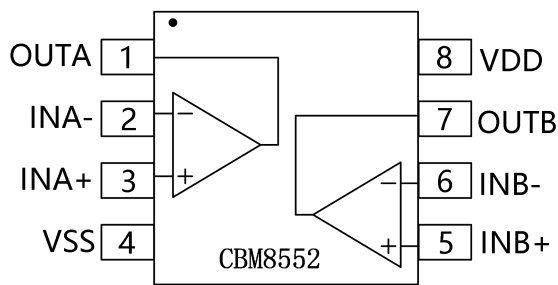
Pin Configurations



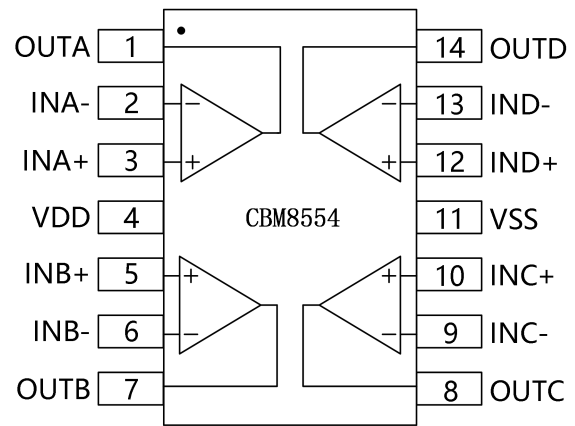
SOT23-5



SOP-8



MSOP-8 / SOP-8 / TSSOP8



SOP-14 / TSSOP-14

PIN_N	SYMBOL SOT23-5(CBM8551)	I/O	NAME AND FUNCTION
1	OUT	O	Output
2	VSS	--	Negative power supply
3	IN+	I	None inverting input
4	IN-	I	inverting input
5	VDD	--	Positive power supply
PIN_N	SYMBOL SOP-8(CBM8551)	I/O	NAME AND FUNCTION
1	NC	--	No connect
2	INA-	I	inverting input A
3	INA+	I	None inverting input A
4	VSS	--	Negative power supply

5	NC	--	No connect
6	OUT	I	inverting input B
7	VDD	--	Positive power supply
8	NC	--	No connect
PIN_N	SYMBOL MSOP-8/SOP-8/TSSOP8(CBM8552)	I/O	NAME AND FUNCTION
1	OUTA	O	Output A
2	INA-	I	inverting input A
3	INA+	I	None inverting input A
4	VSS	--	Negative power supply
5	INB+	I	None inverting input B
6	INB-	I	inverting input B
7	OUTB	O	Output B
8	VDD	--	Positive power supply
PIN N	SYMBOL TSSOP-14/SOP-14 (CBM8554)	I/O	NAME AND FUNCTION
1	OUTA	O	Output A
2	INA-	I	inverting input A
3	INA+	I	None inverting input A
4	VDD	--	Positive power supply
5	INB+	I	None inverting input B
6	INB-	I	inverting input B
7	OUTB	O	Output B
8	OUTC	O	Output C
9	INC-	I	inverting input C
10	INC+	I	None inverting input C
11	VSS	--	Negative power supply
12	IND+	I	None inverting input D
13	IND-	I	inverting input D
14	OUTD	O	Output D

Absolute Maximum Ratings

Parameter	Rating
Power Supply Voltage	7V
Analog Input Voltage (IN+ or IN-)	VSS-0.5V to VDD+0.5V
Differential Input Voltage	±5V
Operating Temperature Range	-40°C to +125°C
Junction Temperature	-65°C to 150°C
Storage Temperature Range	-65°C to 150°C
Lead Temperature (soldering, 10sec)	260°C
Package Thermal Resistance (T_A= +25°C)	
SOT23-5, θ _{JA}	190°C/W
SOP-8, θ _{JA}	158°C/W
MSOP-8, θ _{JA}	190°C/W
SOP-14, θ _{JA}	120°C/W
TSSOP-14, θ _{JA}	180°C/W
ESD Susceptibility	
HBM	5KV
MM	400V

Electrical Characteristics

$V_S = +5V$, $V_{CM} = +2.5V$, $V_O = +2.5V$, $T_A = +25^\circ C$, unless otherwise noted.

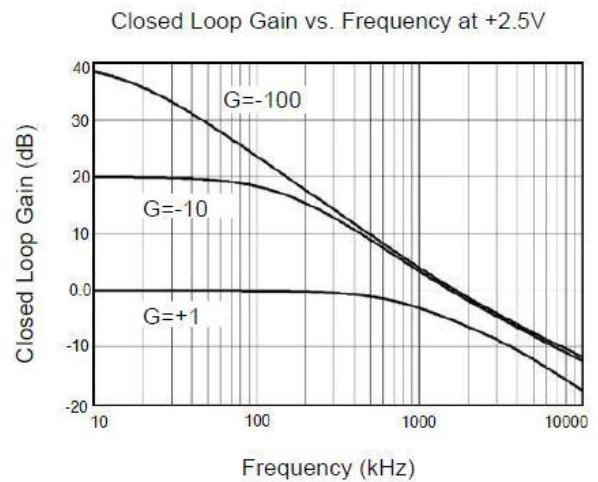
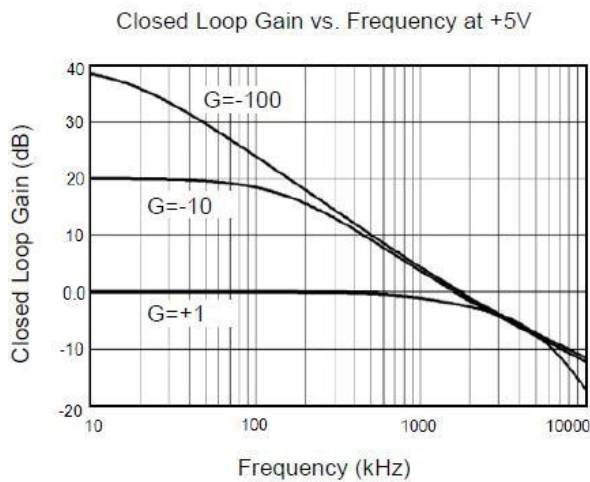
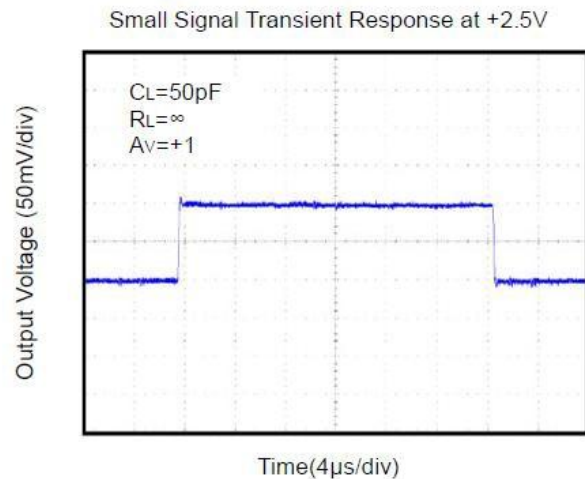
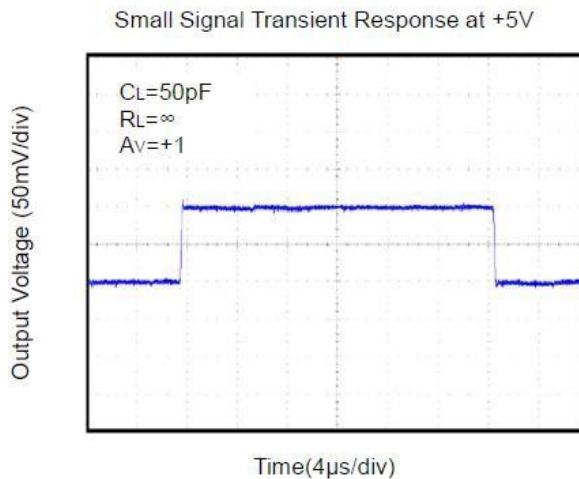
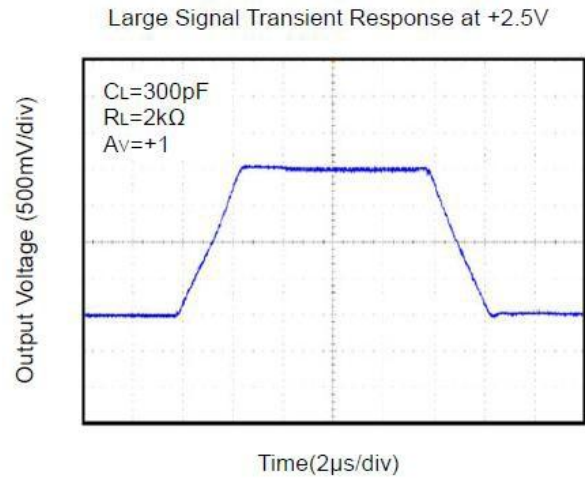
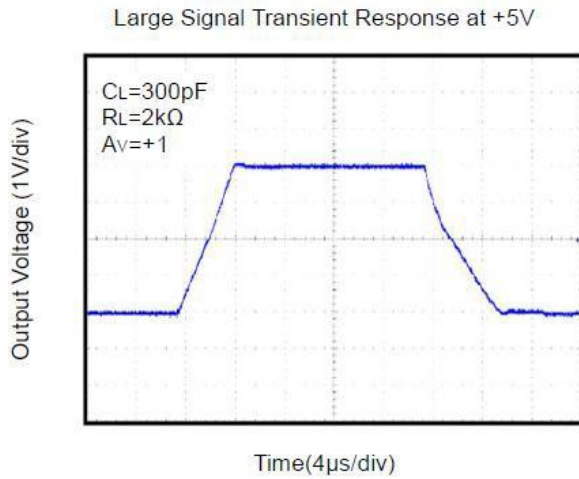
PARAMETER	CONDITION	CBM8551/CBM8552/CBM8554			
		MIN	TYP	MAX	UNIT
INPUT CHARACTERISTICS					
Input Offset Voltage (V_{OS})		--	1	5	μV
Input Bias Current (I_B)		--	50	150	pA
Input Offset Current (I_{OS})		--	30	100	pA
Common-Mode Rejection Ratio (CMRR)	$V_{CM} = 0V$ to $5V$	105	132	--	dB
Large Signal Voltage Gain (A_{VO})	$R_L = 10k\Omega$, $V_O = 0.3V$ to $4.7V$	105	135	--	dB
Input Offset Voltage Drift ($\Delta V_{OS}/\Delta T$)	$-40^\circ C \leq T_A \leq +125^\circ C$	--	0.005	0.04	$\mu V/^\circ C$
OUTPUT CHARACTERISTICS					
Output Voltage High (V_{OH})	$R_L = 100k\Omega$ to $-V_S$	4.99	4.998	--	V
	$R_L = 10k\Omega$ to $-V_S$	4.95	4.98	--	V
Output Voltage Low (V_{OL})	$R_L = 100k\Omega$ to $+V_S$	--	1	10	mV
	$R_L = 10k\Omega$ to $+V_S$	--	10	30	mV
Short Circuit Limit (I_{SC})		25	50	--	mA
Output Current (I_O)		--	30	--	mA
POWER SUPPLY					
Power Supply Rejection Ratio (PSRR)	$V_S = 2.7V$ to $5.5V$, $V_{CM} = 0$	105	132	--	dB
Quiescent Current/Per Amplifier (I_Q)	$V_O = 0V$, $R_L = 0\Omega$	--	640	900	μA
DYNAMIC PERFORMANCE					
Gain-Bandwidth Product (GBP)		4	5	6	MHz
Slew Rate (SR)		1	1.9	3	V/ μs
Overload Recovery Time		--	0.05	0.3	ms
NOISE PERFORMANCE					
Voltage Noise (e_n p-p)	0Hz to 10Hz	--	0.75	--	μV p-p
Voltage Noise Density (e_n)	$f = 1kHz$	--	35	--	nV/ \sqrt{Hz}

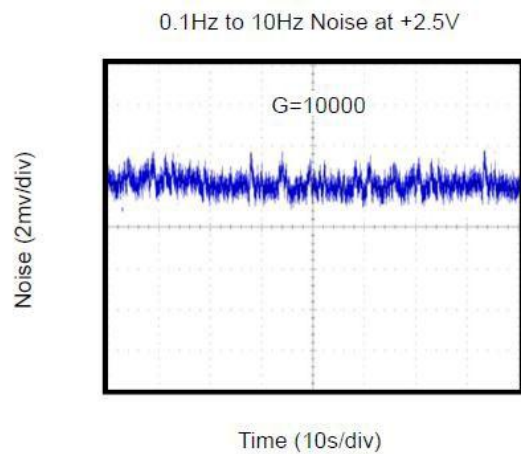
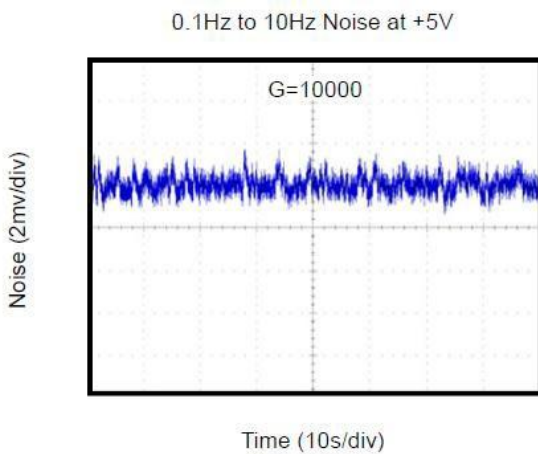
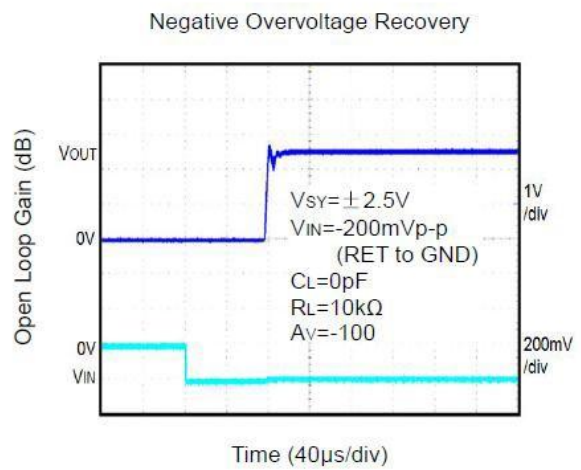
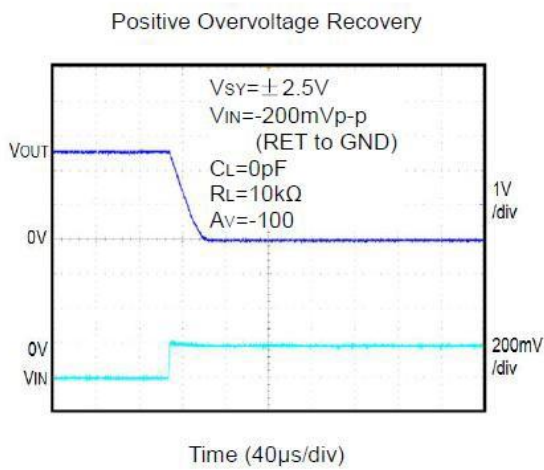
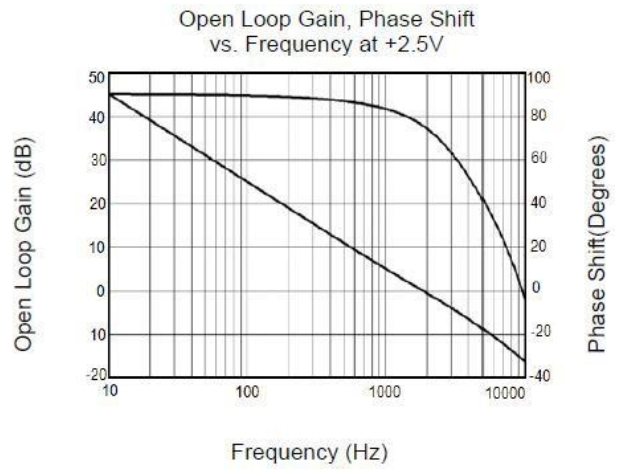
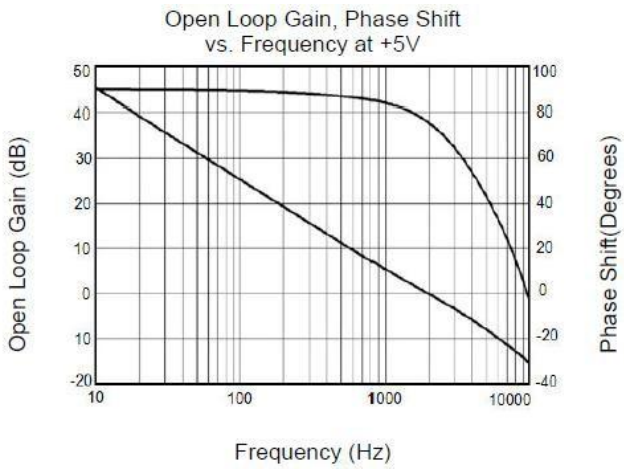
$V_S = +2.7V$, $V_{CM} = +1.35V$, $V_O = +1.35V$, $T_A = +25^\circ C$, unless otherwise noted.

PARAMETER	CONDITION	CBM8551/CBM8552/CBM8554			
		MIN	TYP	MAX	UNIT
INPUT CHARACTERISTICS					
Input Offset Voltage (V_{OS})		--	1	5	μV
Input Bias Current (I_B)		--	48	150	μA
Input Offset Current (I_{OS})		--	28	100	μA
Common-Mode Rejection Ratio (CMRR)	$V_{CM} = 0V$ to $2.7V$	105	130	--	dB
Large Signal Voltage Gain (A_{VO})	$R_L = 10k\Omega$, $V_O = 0.3V$ to $2.4V$	105	132	--	dB
Input Offset Voltage Drift ($\Delta V_{OS}/\Delta T$)	$-40^\circ C \leq T_A \leq +125^\circ C$	--	0.005	0.04	$\mu V/^\circ C$
OUTPUT CHARACTERISTICS					
Output Voltage High (V_{OH})	$R_L = 100k\Omega$ to $-V_S$	2.685	2.697	--	V
	$R_L = 10k\Omega$ to $-V_S$	2.67	2.68	--	V
Output Voltage Low (V_{OL})	$R_L = 100k\Omega$ to $+V_S$	--	1	10	mV
	$R_L = 10k\Omega$ to $+V_S$	--	10	30	mV
Short Circuit Limit (I_{SC})		10	15	--	mA
Output Current (I_O)		--	10	--	mA
POWER SUPPLY					
Power Supply Rejection Ratio (PSRR)	$V_S = 2.7V$ to $5.5V$	105	130	--	dB
Quiescent Current (I_Q)/Per Amplifier	$V_O = 0V$, $R_L = 0\Omega$	--	620	880	μA
DYNAMIC PERFORMANCE					
Gain-Bandwidth Product (GBP)		4	4.9	6	MHz
Slew Rate (SR)	$R_L = 10k\Omega$	1	1.8	3	$V/\mu s$
Overload Recovery Time		--	0.05	0.3	ms
NOISE PERFORMANCE					
Voltage Noise (E_n p-p)	0Hz to 10Hz	--	0.75	--	$\mu Vp-p$
Voltage Noise Density (E_n)	$f = 1kHz$	--	35	--	nV/\sqrt{Hz}

Typical Characteristics

At $T_A = 25^\circ\text{C}$, $V_S = 5\text{V}$, $R_L = 10\text{k}\Omega$ connected to $V_S/2$, $V_{OUT} = V_S/2$, unless otherwise noted.





Application Notes

Size

CBM855X series op amps are unity-gain stable and suitable for a wide range of general-purpose applications. The small footprints of the CBM855X series packages save space on printed circuit boards and enable the design of smaller electronic products.

Power Supply Bypassing and Board Layout

CBM855X series operates from a single 2.7V to 5.5V supply or dual $\pm 1.35\text{V}$ to $\pm 2.75\text{V}$ supplies. For best performance, a $0.1\mu\text{F}$ 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 $0.1\mu\text{F}$ ceramic capacitors.

Low Supply Current

The low supply current (typical $640\mu\text{A}$ per channel) of CBM855X series will help to maximize battery life. They are ideal for battery powered systems

Operating Voltage

CBM855X series operate under wide input supply voltage (2.7V to 5.5V). In addition, all temperature specifications apply from -40°C to $+125^{\circ}\text{C}$. 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 CBM855X series extends 100mV beyond the supply rails ($\text{VSS}-0.1\text{V}$ to $\text{VDD}+0.1\text{V}$). 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 CBM855X series can typically swing to less than 5mV from supply rail in light resistive loads ($>100\text{k}\Omega$), and 60mV of supply rail in moderate resistive loads ($10\text{k}\Omega$).

Capacitive Load Tolerance

The CBM855X 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 using a small resistor in series with the amplifier's

output and the load capacitance and 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.

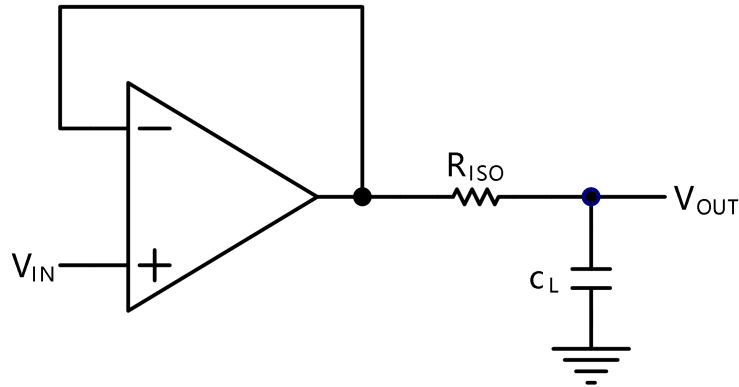


Figure 2. Indirectly Driving a Capacitive Load Using Isolation Resistor

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 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.

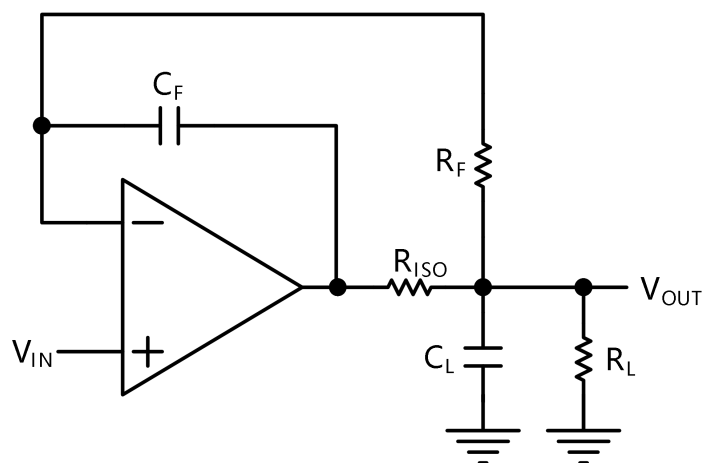


Figure 3. Indirectly Driving a Capacitive Load with DC Accuracy

Typical Application Circuits

Differential amplifier

The differential amplifier allows the subtraction of two input voltages or cancellation of a signal common to 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 CBM855X.

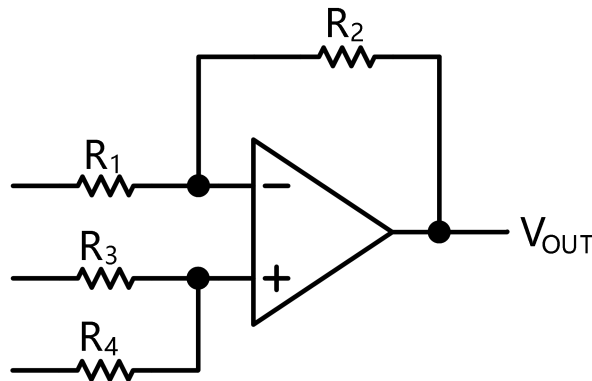


Figure 4. Differential Amplifier

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

If the resistor ratios are equal (i.e. $R_1=R_3$ and $R_2=R_4$), 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 $-R_2/R_1$. The filter has a -20dB/decade roll-off after its corner frequency $f_c = 1/(2\pi R_3 C_1)$.

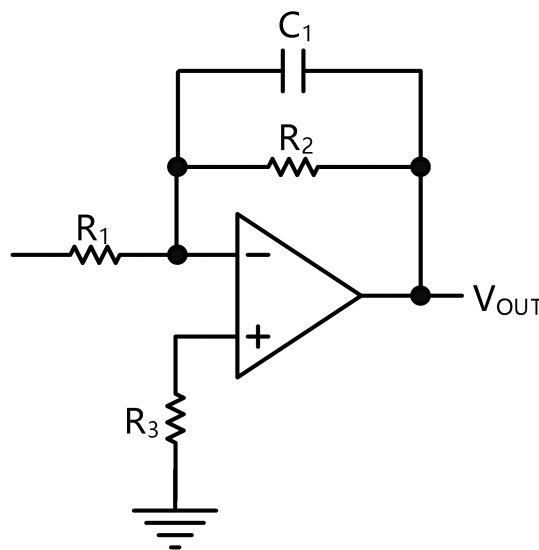


Figure 5. Low Pass Active Filter

Instrumentation Amplifier

The triple CBM855X 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.

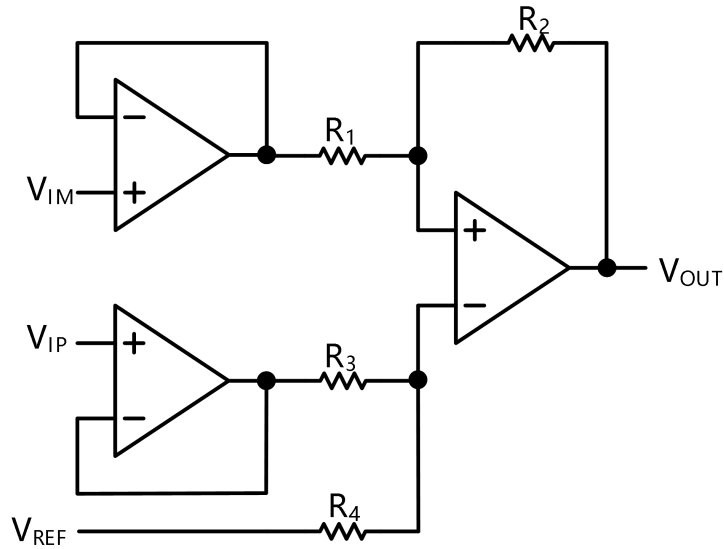
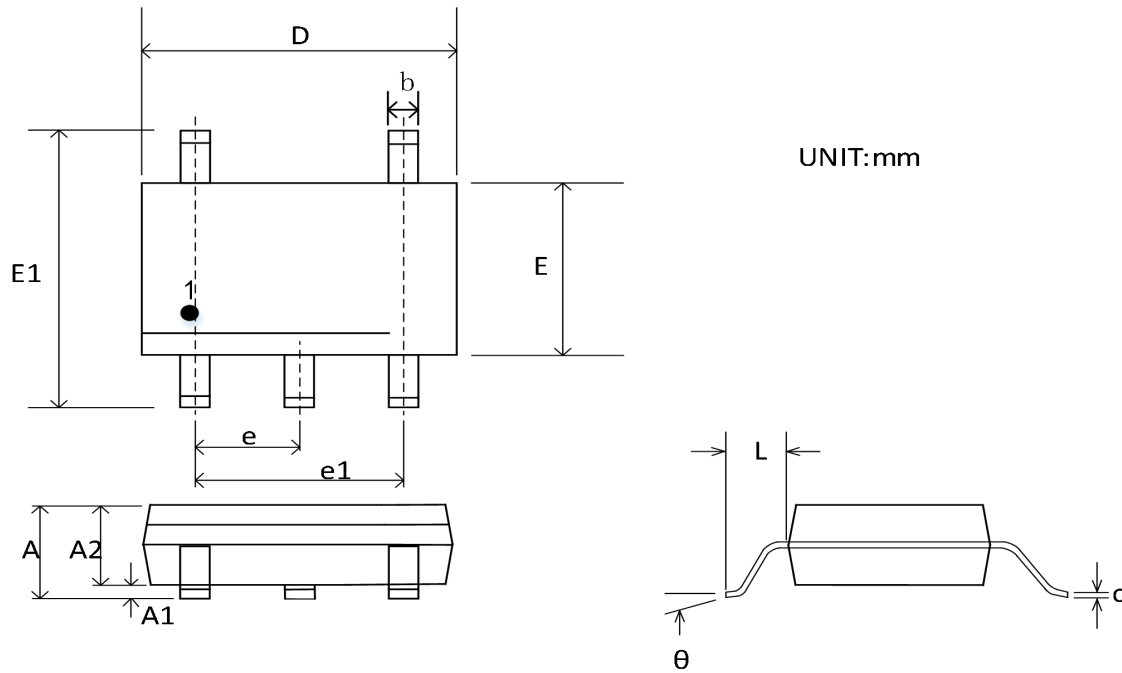


Figure 6. Instrument Amplifier

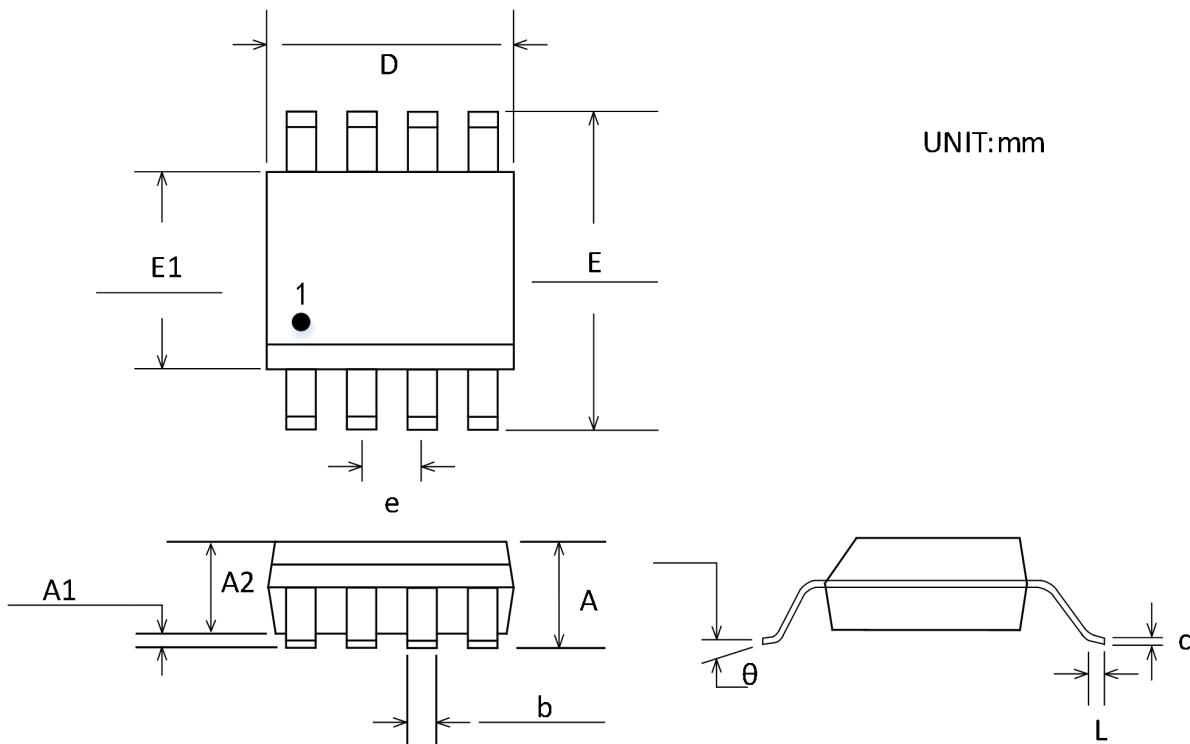
Package Outline Dimensions

SOT23-5



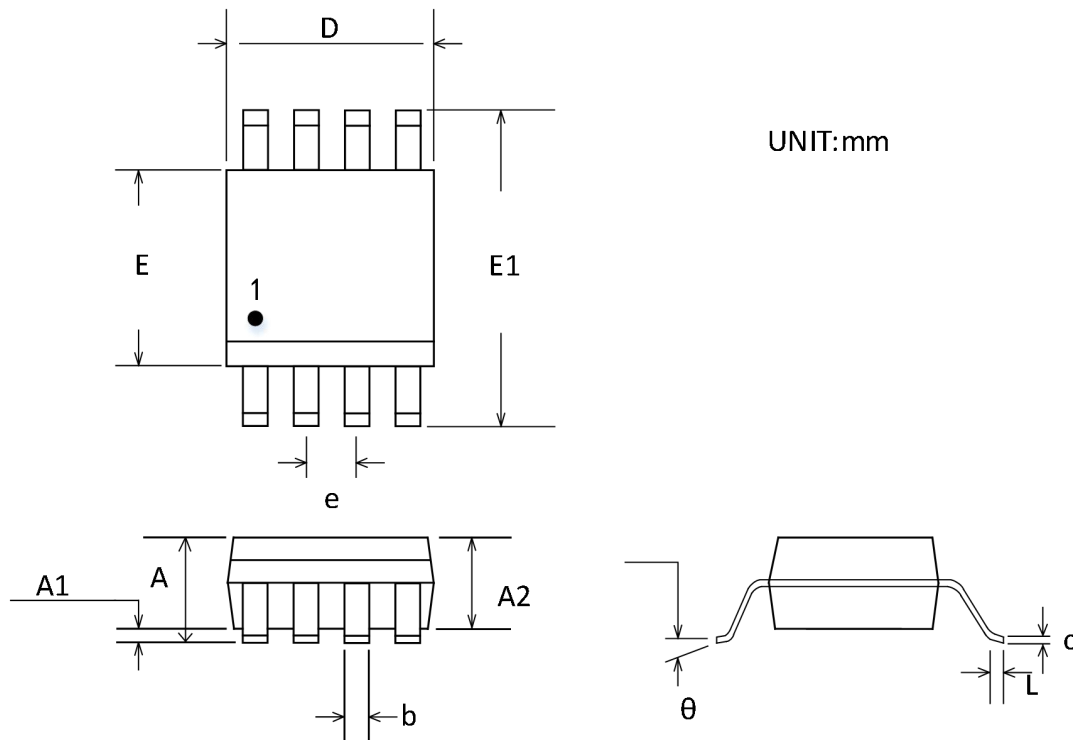
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC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

SOP-8



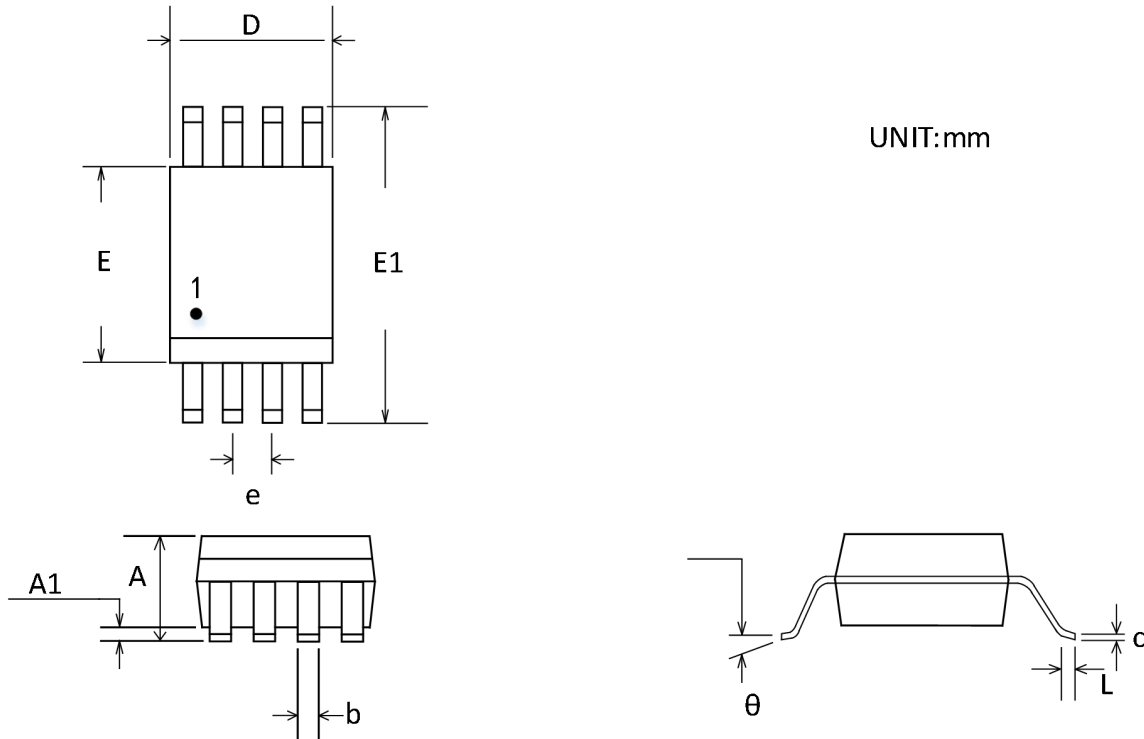
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.800	5.000	0.189	0.197
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.27 (BSC)		0.05 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

MSOP-8



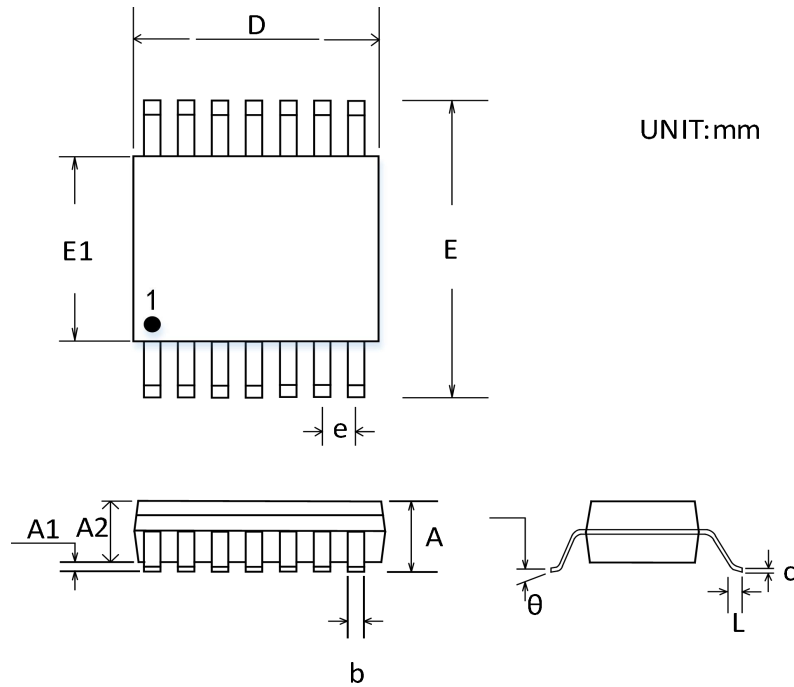
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.90	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650(BSC)		0.026(BSC)	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

TSSOP-8



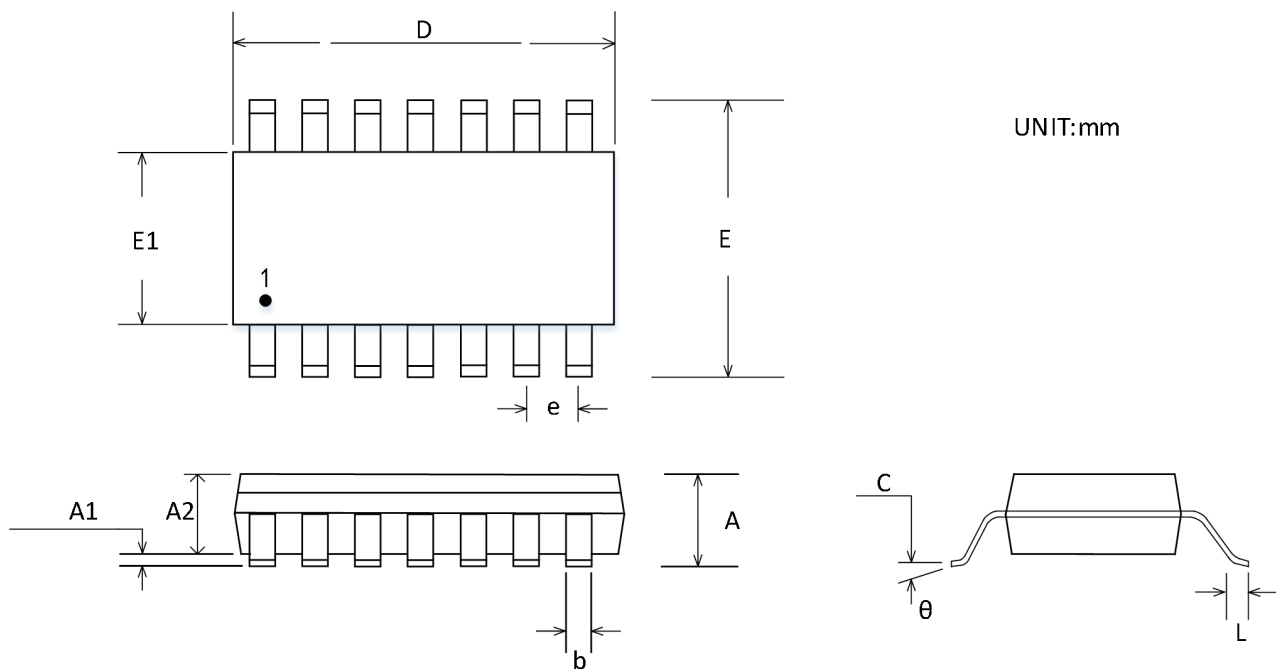
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	--	1.20	--	0.0039
A1	0.05	0.15	0.0002	0.0005
b	0.19	0.30	0.0006	0.0010
c	0.09	0.20	0.0003	0.0007
D	2.90	3.10	0.0095	0.0101
E	4.30	4.50	0.0141	0.0148
E1	6.40BSC		0.0210BSC	
e	0.65 BSC		0.0021 BSC	
L	0.45	0.75	0.0015	0.0025
θ	0°	8°	0°	6°

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	6.250	6.550	0.246	0.258
E1	4.300	4.500	0.169	0.177
e	0.650(BSC)		0.026(BSC)	
L	0.500	0.700	0.020	0.028
H	0.25 TYP		0.01 TYP	
θ	0°	8°	0°	8°

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	1.27(BSC)		0.05(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

Package/Ordering Information

ORDERING NUMBER	TEMPRANGE	PACKAGE	PAKEAGE MARKING	TRANSPOT MEDIA,QUANTILY
CBM8551AST5	-40°C~125°C	SOT23-5	8551	Tape and Reel, 3000
CBM8551AS8	-40°C~125°C	SOP-8	CBM8551A	Tape and Reel, 2500
CBM8551AS8-RL	-40°C~125°C	SOP-8	CBM8551	Tape and Reel, 3000
CBM8551AS8-REEL	-40°C~125°C	SOP-8	CBM8551	Tape and Reel, 4000
CBM8551AMS8	-40°C~125°C	MSOP-8	AFO	Tape and Reel, 3000
CBM8552AS8	-40°C~125°C	SOP-8	CBM8552	Tape and Reel, 2500
CBM8552AS8-RL	-40°C~125°C	SOP-8	CBM8552	Tape and Reel, 3000
CBM8552AS8-REEL	-40°C~125°C	SOP-8	CBM8552	Tape and Reel, 4000
CBM8552AMS8	-40°C~125°C	MSOP-8	A52	Tape and Reel, 3000
CBM8552ATS8	-40°C~125°C	TSSOP-8	52T	Tape and Reel, 2500
CBM8552ATS8-RL	-40°C~125°C	TSSOP-8	52T	Tape and Reel, 3000
CBM8552ATS8-REEL	-40°C~125°C	TSSOP-8	52T	Tape and Reel, 4000
CBM8554ATS14	-40°C~125°C	TSSOP-14	CBM8554AT	Tape and Reel, 2500
CBM8554ATS14-RL	-40°C~125°C	TSSOP-14	CBM8554AT	Tape and Reel, 3000
CBM8554ATS14-REEL	-40°C~125°C	TSSOP-14	CBM8554AT	Tape and Reel, 4000
CBM8554AS14	-40°C~125°C	SOP-14	CBM8554AS	Tape and Reel, 2500
CBM8554AS14-RL	-40°C~125°C	SOP-14	CBM8554AS	Tape and Reel, 3000
CBM8554AS14-REEL	-40°C~125°C	SOP-14	CBM8554AS	Tape and Reel, 4000