

Features

- Single-Supply Operation from 2.5V~+5.5V
- Rail-to-Rail Output
- -3dB Bandwidth(G=+1): 350MHz (Typ.)
- Low Input Bias Current: 1pA (Typ.)
- Quiescent Current: 4.2mA/Amplifier (Typ.)
- Operating Temperature: -40°C ~ +125°C
- Small Package:
 - CBM8091 Available in SOT23-5 and SC70-5 Packages
 - CBM8092 Available in SOP-8 and MSOP-8 Packages
 - CBM8094 Available in SOP-14 and TSSOP-14 Packages
 - CBM8091N Available in SOT23-6 and SC70-6 Packages
 - CBM8092N Available in MSOP-10 Packages

Application

- Imaging
- Photodiode Preamp
- DVD/CD
- Filters
- Professional Video and Cameras
- Hand Sets
- Base Stations
- to-D Driver

Description

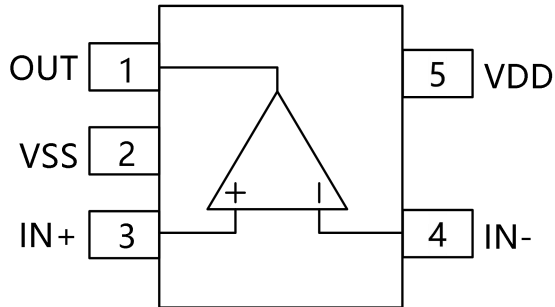
The CBM8091 / 1N (single), CBM8092 / 2N(dual), CBM8094 (quad) are rail-to-rail output voltage feedback amplifiers offering ease of use and low cost. They have bandwidth and slew rate typically found in current feedback amplifiers. All have a wide input common-mode voltage range and output voltage swing, making them easy to use on single supplies as low as 2.5V. Despite being low cost, the CBM8091 series provide excellent overall performance. They offer wide bandwidth to 350MHz (G = +1) along with 0.1dB flatness out to 58MHz (G = +2) and offer a typical low power of 4.2mA/amplifier.

The CBM8091 series is low distortion and fast settling make it ideal for buffering high speed A/D or D/A converters. The CBM8091 / 2N has a power-down disable feature that reduces the supply current to 75μA. These features make the CBM8091 / 2N ideal for portable and battery-powered applications where size and power are critical. All are specified over the extended -40 °C to +125°C temperature range.

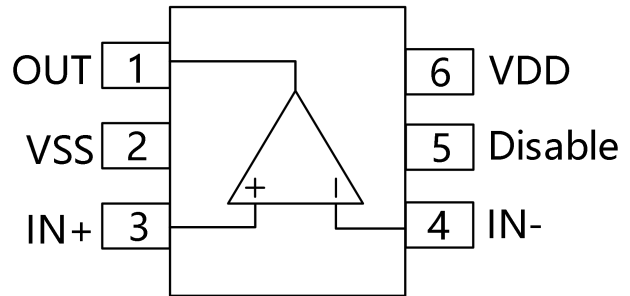
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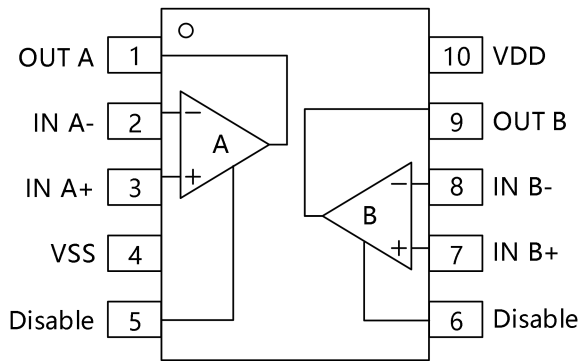
Pin Configurations



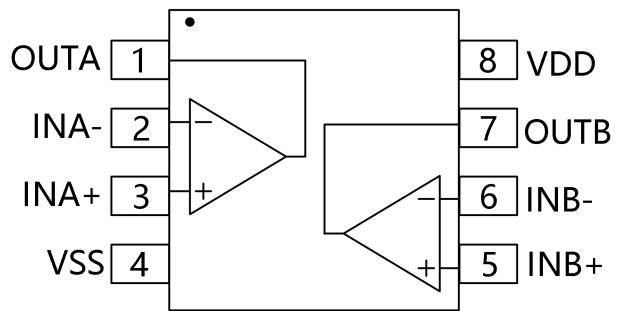
SOT23-5/SC70-5



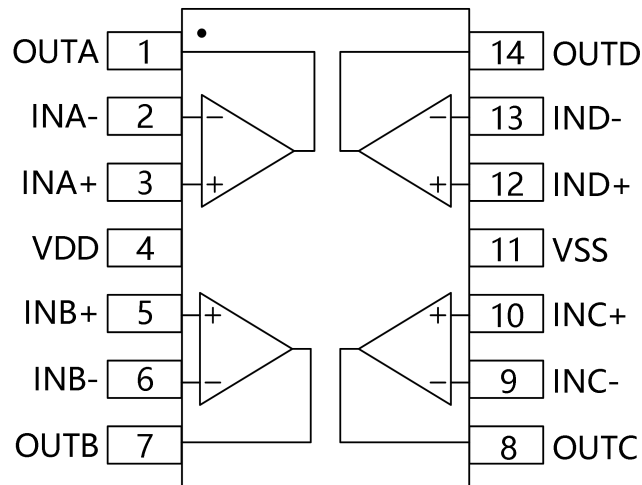
SOT23-5/SC70-6



MSOP-10



SOP-8/MSOP-8



SOP-14/TSSOP-14

Figure 1. Pin Assignment

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	-45°C	+125°C
Junction Temperature	+160°C	
Storage Temperature Range	-55°C	+150°C
Lead Temperature (soldering, 10sec)	+260°C	
Package Thermal Resistance ($T_A=+25^\circ\text{C}$)		
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	6KV	
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

($G=+2$, $R_F=600\Omega$, $R_G=600\Omega$, and $R_L=150\Omega$ connected to $V_S/2$, unless otherwise noted. Typical values are at $T_A = +25^\circ\text{C}$.)

PARAMETER	CONDITIONS	CBM8091-CBM8092-CBM8094-CBM8091N-CBM8092N							
		TYP	MIN/MAX OVER TEMPERATURE					UNITS	MIN/MAX
		+25°C	+25°C	0°C to 70°C	-40°C to 85°C	-40°C to 125°C			
DYNAMIC PERFORMANCE									
3dB Small Signal Bandwidth	$G=+1, V_O=0.1\text{Vp-p}, R_F=24\Omega, R_L=150\Omega$	335						MHz	TYP
	$G=+1, V_O=0.1\text{Vp-p}, R_F=24\Omega, R_L=1\text{k}\Omega$	330						MHz	TYP
	$G=+2, V_O=0.1\text{Vp-p}, R_L=50\Omega$	79						MHz	TYP
	$G=+2, V_O=0.1\text{Vp-p}, R_L=150\Omega$	130						MHz	TYP
	$G=+2, V_O=0.1\text{Vp-p}, R_L=1\text{k}\Omega$	165						MHz	TYP
	$G=+2, V_O=0.1\text{Vp-p}, R_L=10\text{k}\Omega$	172						MHz	TYP
Gain-Bandwidth Product	$G=+10, R_L=150\Omega$	180						MHz	TYP
	$G=+10, R_L=1\text{k}\Omega$	195						MHz	TYP
Bandwidth for 0.1dB Flatness	$G=+2, V_O=0.1\text{Vp-p}, R_L=150\Omega, R_F=600\Omega$	71						MHz	TYP
Slew Rate	$G=+1, 2\text{VOutputStep}$	119/-232						V/ μs	TYP
	$G=+2, 2\text{VOutputStep}$	135/-180						V/ μs	TYP
	$G=+2, 4\text{VOutputStep}$	142/-206						V/ μs	TYP
Rise-and-Fall Time	$G=+2, V_O=0.2\text{Vp-p}, 10\%\text{to}90\%$	3.5						ns	TYP

	$G = +2, V_O = 2V_{p-p}, 10\% \text{ to } 90\%$	8.5					ns	TYP
Settling Time to 0.1%	$G = +2, 2V_{\text{OutputStep}}$	35					ns	TYP
Overload Recovery Time	$V_{IN}, G = +V_S$	14.5					ns	TYP
NOISE/DISTORTION PERFORMANCE								
Input Voltage Noise	$f = 1\text{MHz}$	4.3					nV/Hz	TYP
Differential Gain Error (NTSC)	$G = +2, R_L = 150\Omega$	0.004					%	TYP
Differential Phase Error (NTSC)	$G = +2, R_L = 150\Omega$	0.08					degree	TYP
DC PERFORMANCE								
Input Offset Voltage (V_{OS})		± 2	± 8	± 8.5	± 9	± 9.3	mV	MAX
Input Offset Voltage Drift		2					$\mu\text{V}/^\circ\text{C}$	TYP
Input Bias Current (I_B)		1					pA	TYP
Input offset Current (I_{OS})		2					pA	TYP
Open-Loop Gain (A_{OL})	$V_O = 0.3\text{V to } 4.7\text{V}, R_L = 150\Omega$	80	75	74	74	70	dB	MIN
	$V_O = 0.2\text{V to } 4.8\text{V}, R_L = 1\text{k}\Omega$	104	92	91	91	80	dB	MIN
INPUT CHARACTERISTICS								
Input Common-Mode Voltage Range (V_{CM})		-0.2 to +3.8					V	TYP
Common-Mode Rejection Ratio (CMRR)	$V_{CM} = -0.1\text{V to } +3.5\text{V}$	80	66	65	65	62	dB	MIN

Electrical Performance Characteristics

($G=+2$, $R_F=600\Omega$, $R_G=600\Omega$, and $R_L=150\Omega$ connected to $V_S/2$, unless otherwise noted. Typical values are at $T_A = +25^\circ\text{C}$.)

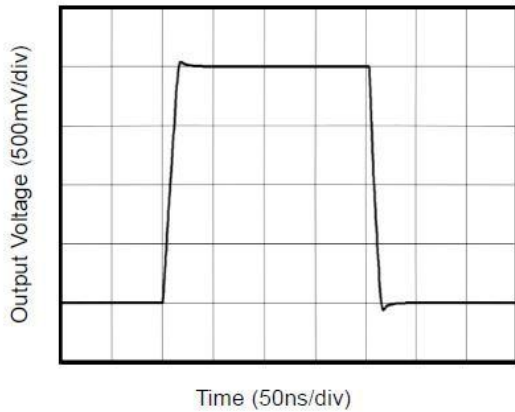
PARAMETER	CONDITIONS	CBM8091-CBM8092-CBM8094-CBM8091N-CBM8092N							
		TYP	MIN/MAX OVER TEMPERATURE					UNITS	MIN/MAX
		+25°C	+25°C	0°C to 70°C	-40°C to 85°C	-40°C to 125°C			
OUTPUT CHARACTERISTICS									
Output Voltage Swing from Rail	$R_L = 150\Omega$	0.12					V	TYP	
	$R_L = 1k\Omega$	0.03					V	TYP	
Output Current		120	100	98	93	87	mA	MIN	
Closed-Loop Output Impedance	$f < 100\text{kHz}$	0.045						TYP	
POWER-DOWN DISABLE									
(CBM8091/2N only) Turn-On Time									
Turn-On Time			108				ns	TYP	
Turn-Off Time			60				ns	TYP	
DISABLE Voltage-Off				0.8			V	MAX	
DISABLE Voltage-On				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)		4.2	5.3	5.6	5.7	6.1	mA	MAX	

Supply Current when Disabled per amplifier(CBM8091/2N only)		75	120	130	132	137	μA	MAX
Power Supply Rejection Ratio (PSRR)	$\Delta V_S = +2.7V \text{ to } +5.5V, V_{CM} = (-V_S) + 0.5$	80	67	67	65	62	dB	MIN

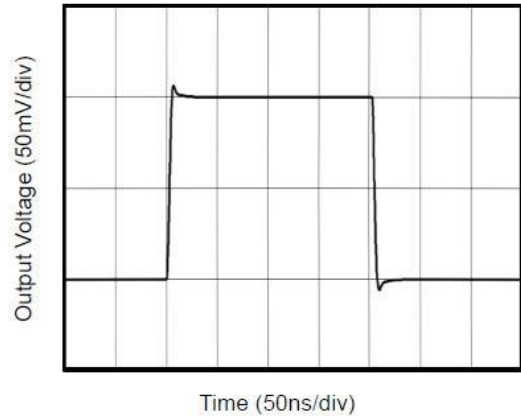
Typical Characteristics

($V_s = +5V, G = +2, R_F = 600\Omega, R_G = 600\Omega,$ and $R_L = 150\Omega$ connected to $V_s/2$, unless otherwise noted. Typical values are at $T_A = +25^\circ\text{C}$.)

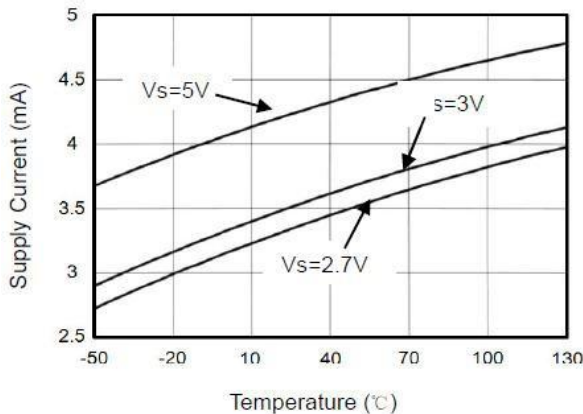
Non-Inverting Large-Signal Step Response



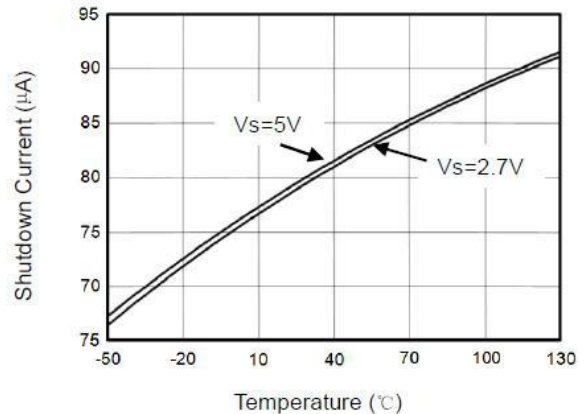
Non-Inverting Small-Signal Step Response



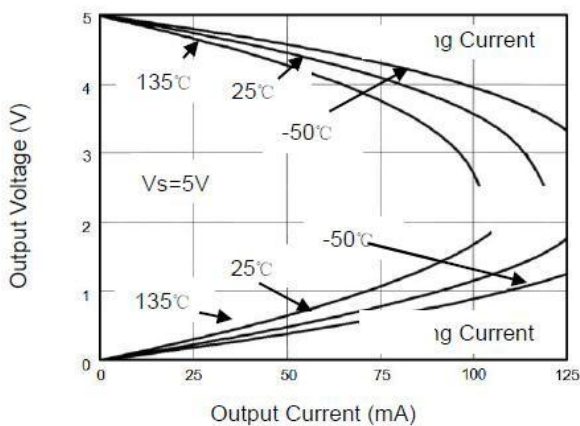
Supply Current vs. Temperature



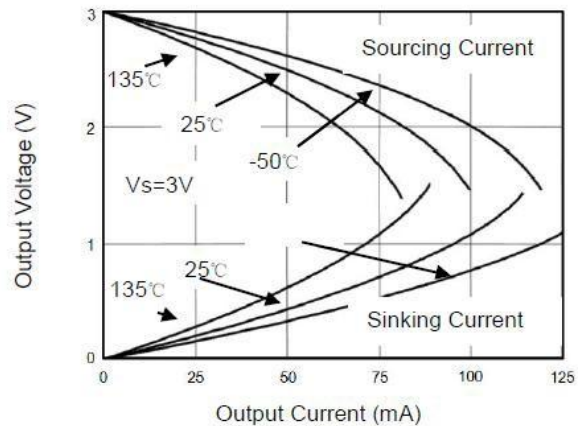
Shutdown Current vs. Temperature



Output Voltage Swing vs. Output Current

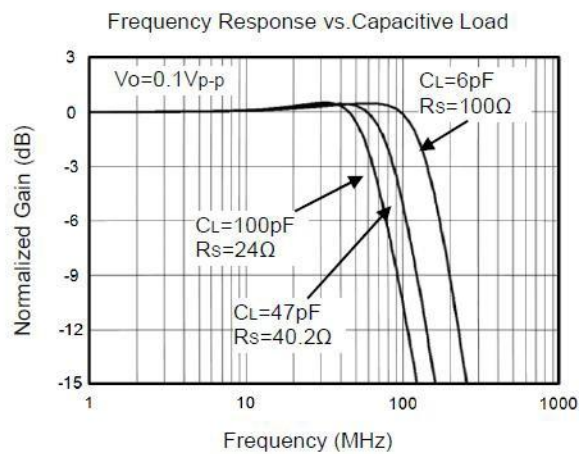
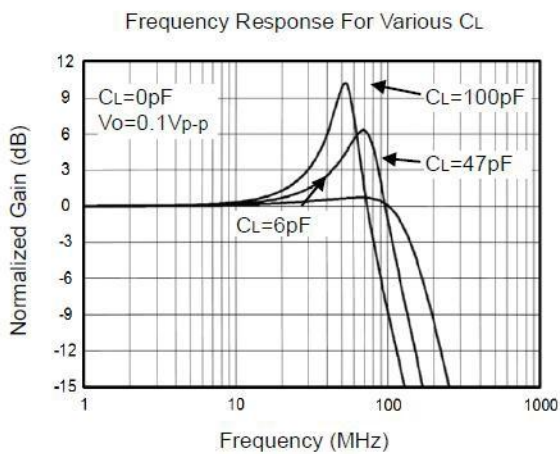
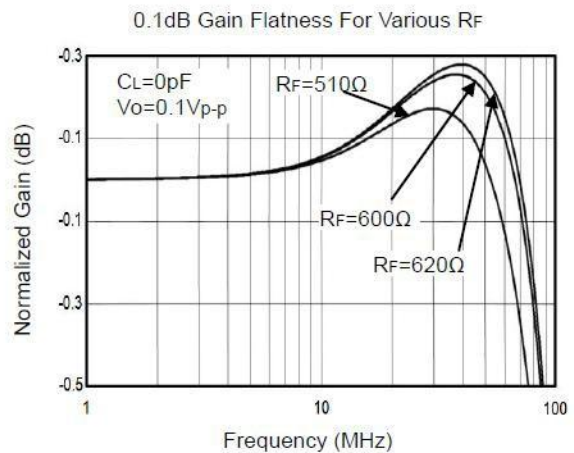
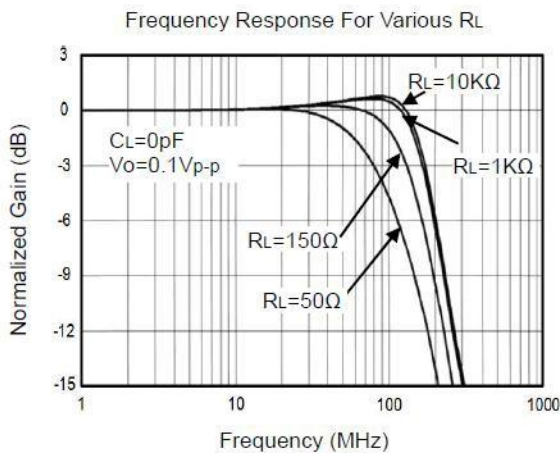
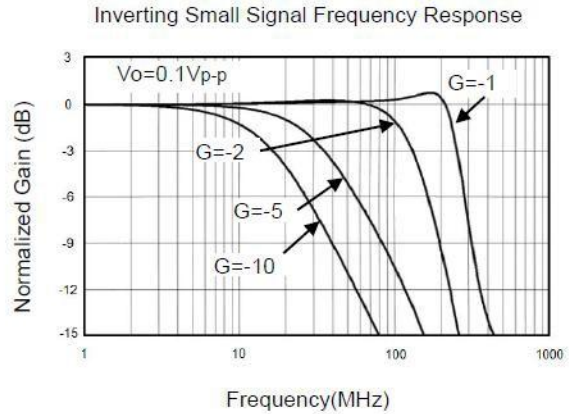
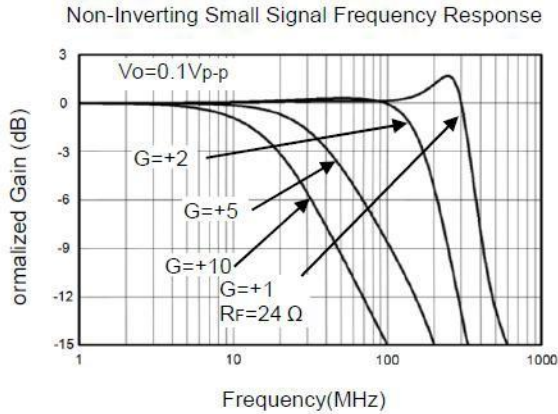


Output Voltage vs. Output Current



Typical Characteristics

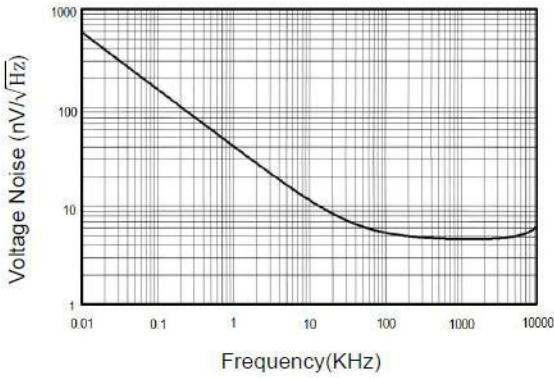
($V_s = +5V, G = +2, R_f = 600\Omega, R_G = 600\Omega,$ and $R_L = 150\Omega$ connected to $V_s/2$, unless otherwise noted. Typical values are at $T_A = +25^\circ C$.)



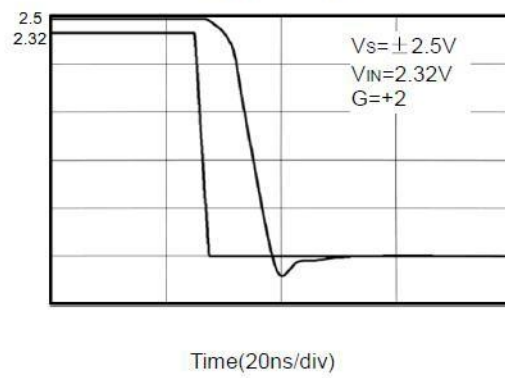
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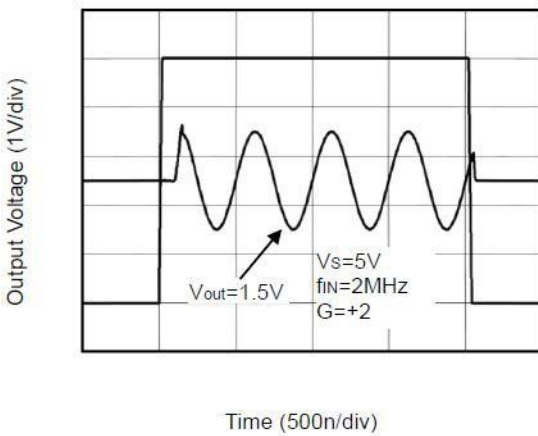
Input Voltage Noise Spectral Density vs. Frequency



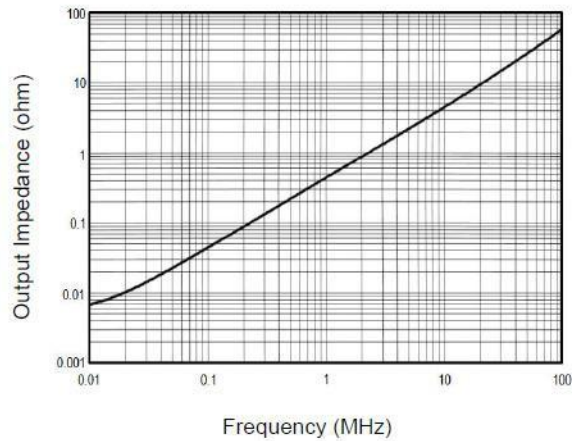
Overload Recovery Time



Large-Signal Disable/Enable Response



Closed-Loop Output Impedance vs Frequency



Application Notes

Size

CBM809X series op amps are unity-gain stable and suitable for a wide range of general-purpose applications. The small footprints of the CBM809X series packages save space on printed circuit boards and enable the design of smaller electronic products.

Power Supply Bypassing and Board Layout

CBM809X series operates from a single 2.5V to 5.5V supply or dual $\pm 1.25V$ to $\pm 2.75V$ supplies. For best performance, a 0.1 μF 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 μF ceramic capacitors.

Low Supply Current

The low supply current (typical 4.2mA per channel) of CBM809X series will help to maximize battery life. They are ideal for battery powered systems.

Operating Voltage

CBM809X series operate under wide input supply voltage (2.5V to 5.5V). In addition, all temperature specifications apply from $-40^{\circ}C$ to $+125^{\circ}C$. Most behavior remains unchanged throughout the full operating voltage range. These guarantees ensure operation throughout the single Li-Ion battery lifetime

Rail-to-Rail 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 CBM809X series can typically swing to less than 30mV from supply rail in light resistive loads ($>1k\Omega$), and 120mV of supply rail in moderate resistive loads (150 Ω).

Capacitive Load Tolerance

The CBM809X 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.

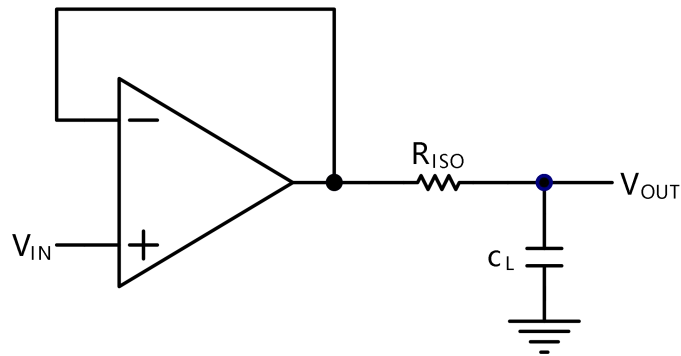


Figure 2. Indirectly Driving a Capacitive Load Using Isolation Resistor

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 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.

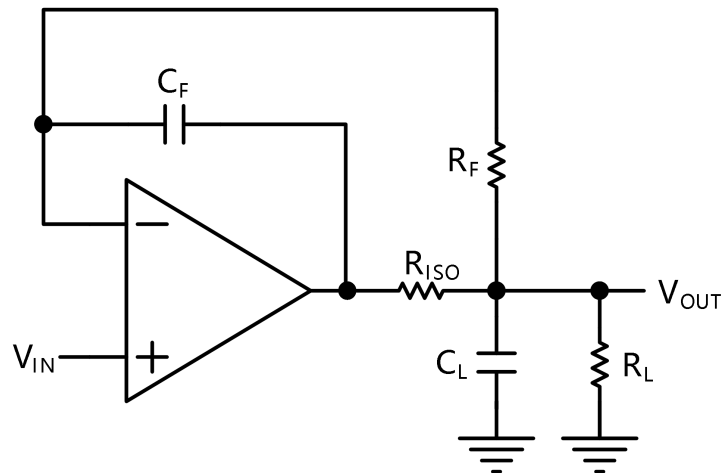


Figure 3. Indirectly Driving a Capacitive Load with DC Accuracy

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 CBM809X.

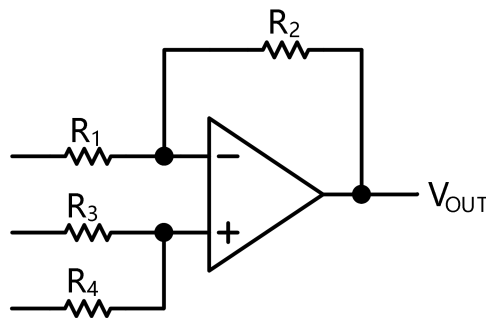


Figure 4. Differential Amplifier

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

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 $f_C=1/(2\pi R_3 C_1)$.

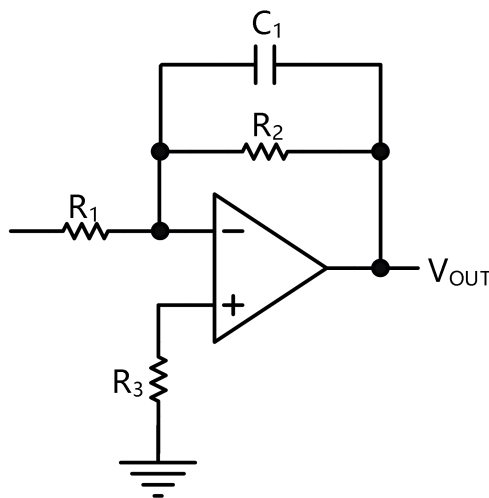


Figure 5. Low Pass Active Filter

Driving Video

The CBM809X can be used in video applications like in Figure 6.

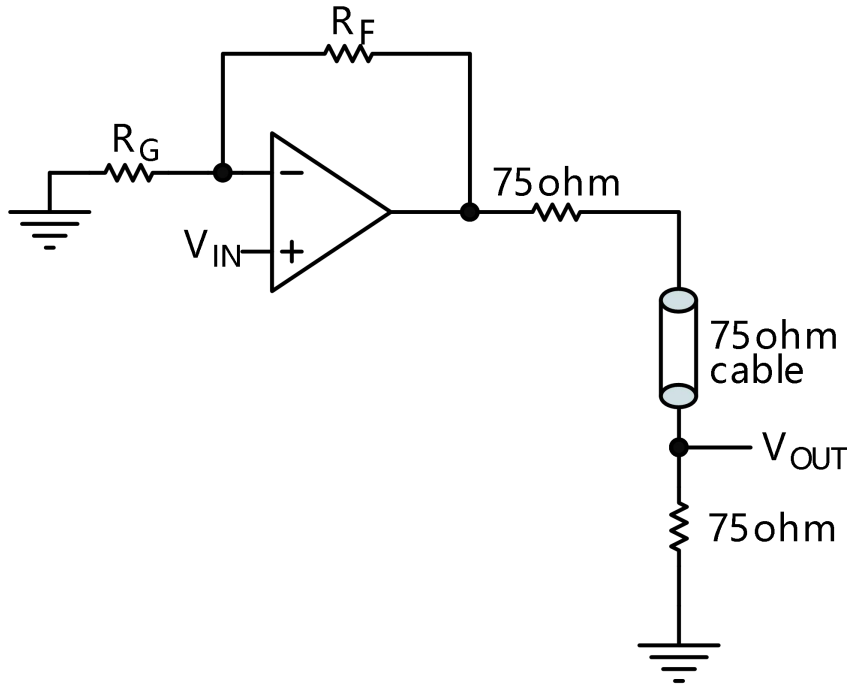
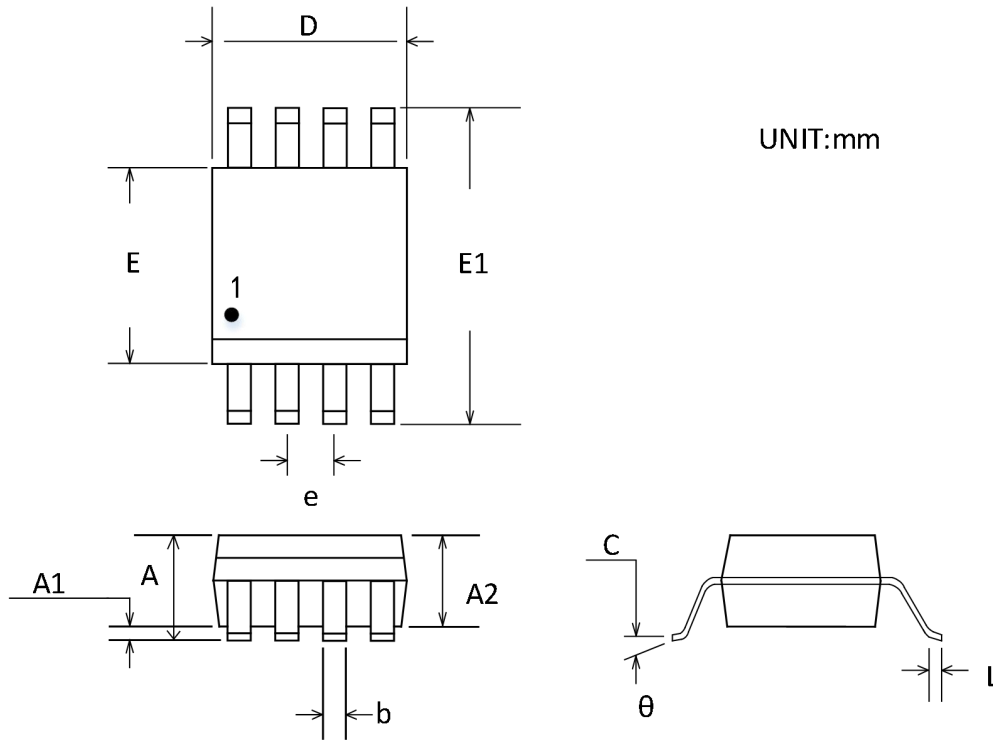


Figure 6. Typical video driving

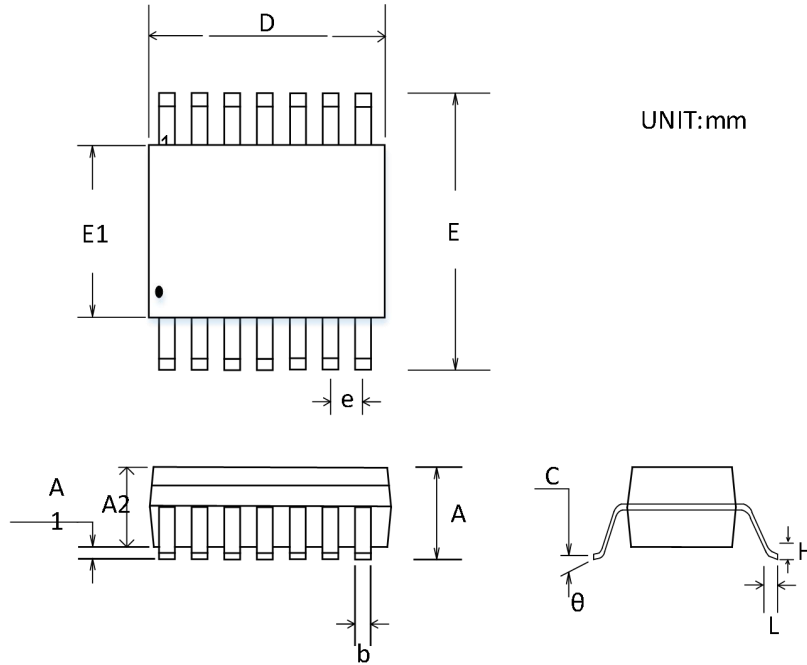
Package Outline Dimensions

MSOP-8



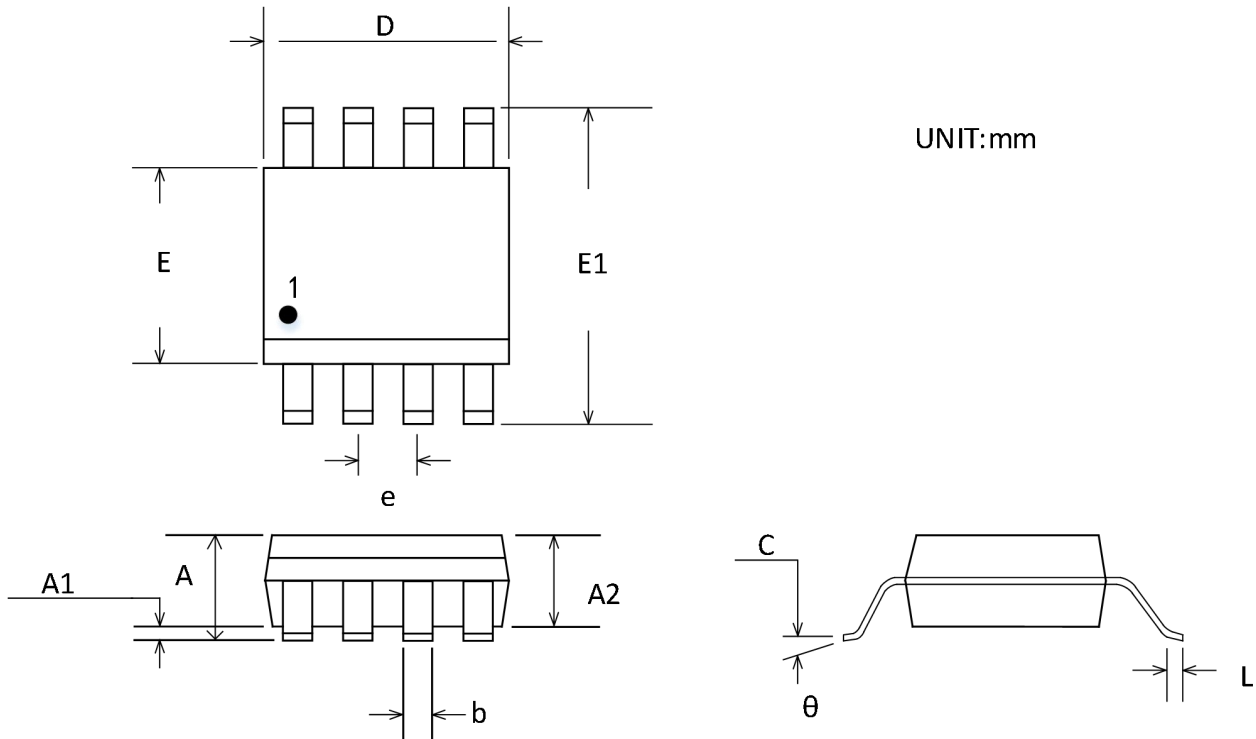
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026 BSC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

TSSOP-14



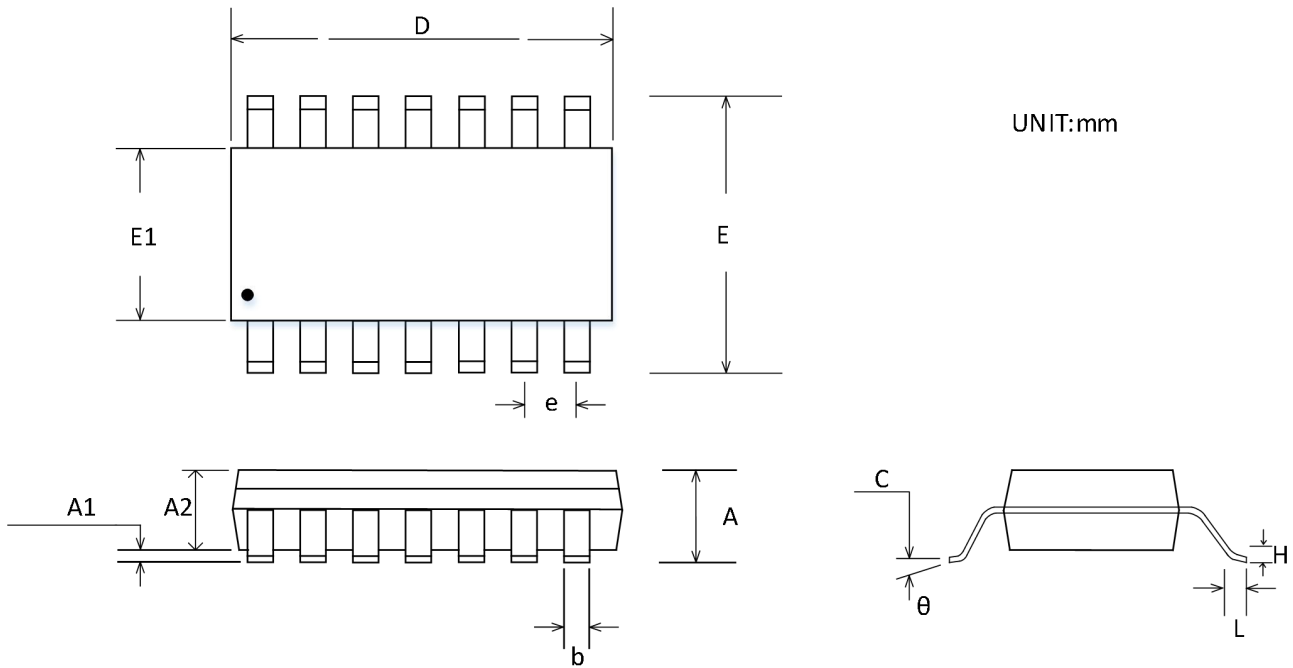
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650 BSC		0.026 BSC	
L	0.500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

SOP8



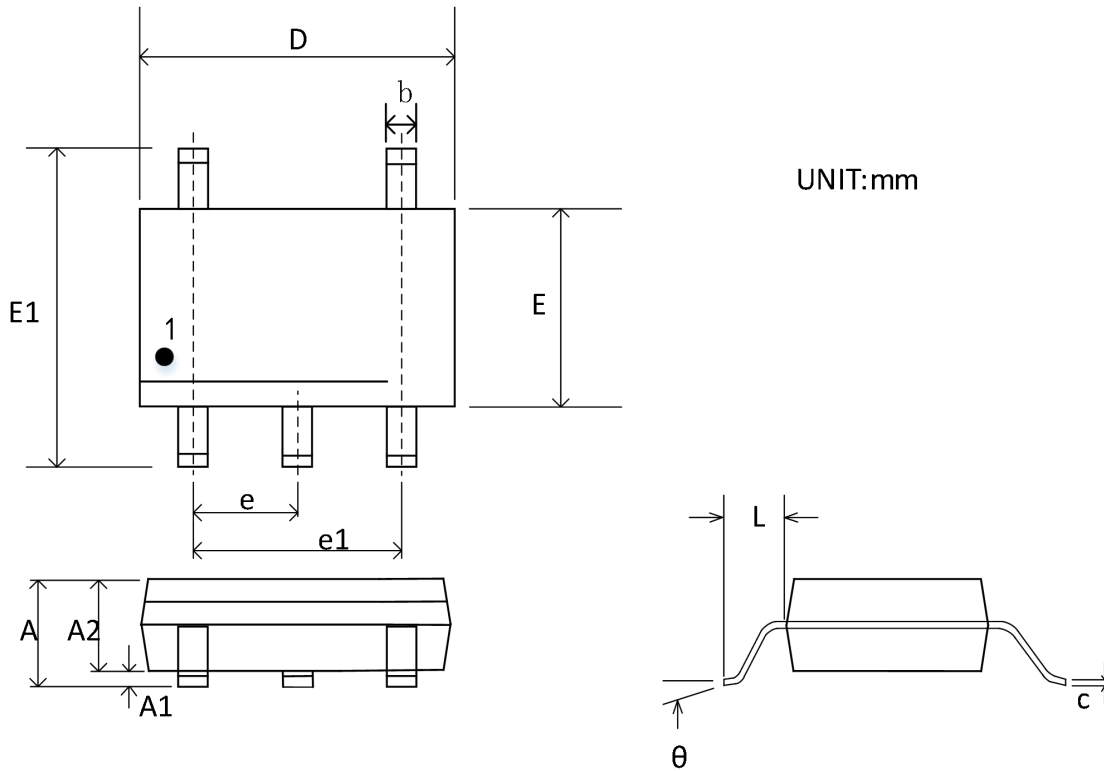
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

SOP14



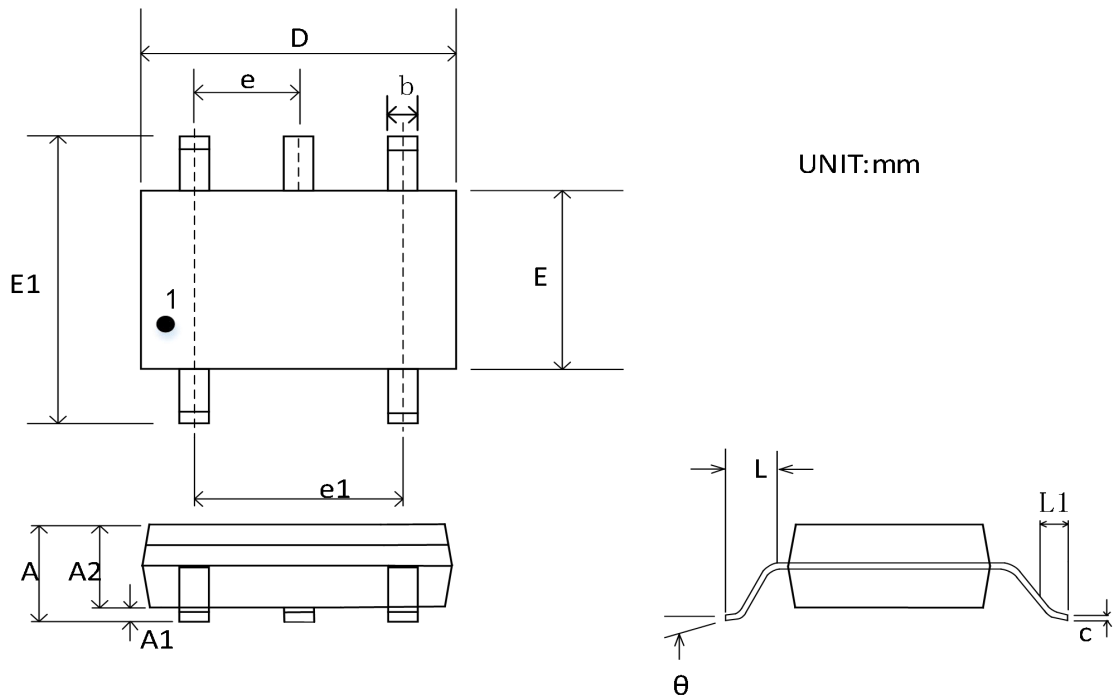
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.250	1.650	0.049	0.065
b	0.360	0.490	0.014	0.019
c	0.100	0.250	0.004	0.010
D	8.530	8.730	0.336	0.344
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
L	0.450	0.800	0.018	0.032
R1	0°	8°	0°	8°

SOT23-5



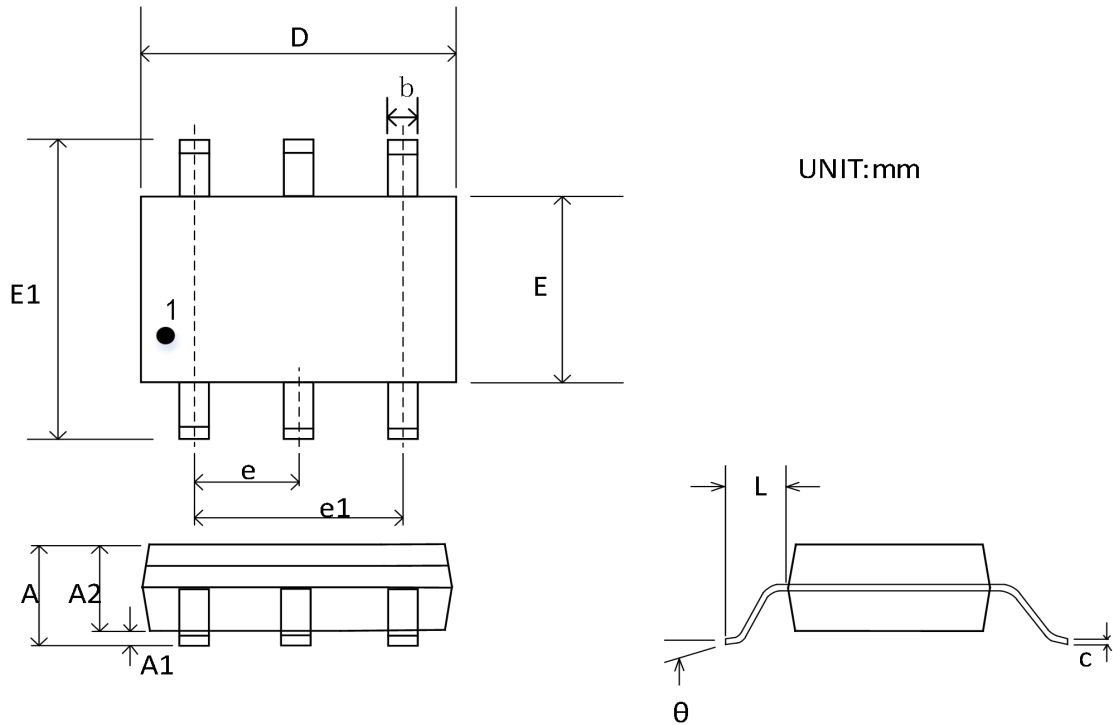
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC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

SC70-5



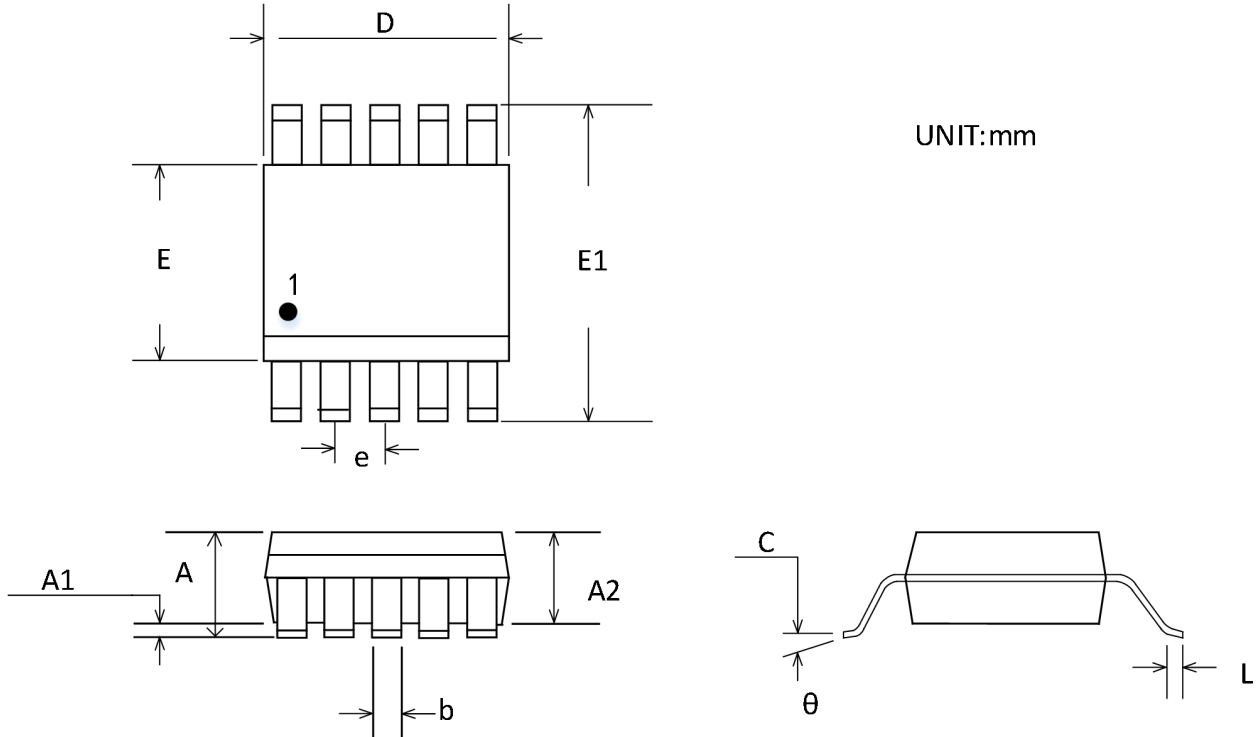
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
C	0.080	0.150	0.003	0.006
D	2.000	2.200	0.079	0.087
E	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.650 TYP		0.026TYP	
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°

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	0.012	0.024
θ	0°	8°	0°	8°

MSOP-10



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	0.180	0.280	0.007	0.011
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	0.50 BSC		0.020 BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

Package/Ordering Information

CHANNEL	ORDER NUMBER	PACKAGE DESCRIPTION	MARKING INFORMATION	PACKAGE OPTION
Single	CBM8091ASC5	SC70-5	8091	Tape and Reel,3000
Single	CBM8091AST5	SOT23-5	8091	Tape and Reel, 3000
Single With shutdown	CBM8091NSC6	SC70-6	8091N	Tape and Reel, 3000
Single With shutdown	CBM8091NST6	SOT23-6	8091N	Tape and Reel, 3000
Dual	CBM8092AS8	SOP-8	CBM8092A	Tape and Reel, 2500
Dual	CBM8092AS8-RL	SOP-8	CBM8092A	Tape and Reel, 3000
Dual	CBM8092AS8-REEL	SOP-8	CBM8092A	Tape and Reel, 4000
Dual	CBM8092AMS8	MSOP-8	CBM8092	Tape and Reel, 3000
Dual With shutdown	CBM8092NMS10	MSOP-10	CBM8092N	Tape and Reel, 3000
Quad	CBM8094ATS14	TSSOP-14	CBM8094AT	Tape and Reel, 2500
Quad	CBM8094ATS14-RL	TSSOP-14	CBM8094AT	Tape and Reel, 3000
Quad	CBM8094ATS14-REEL	TSSOP-14	CBM8094T	Tape and Reel, 4000
Quad	CBM8094AS14	SOP-14	CBM8094AS	Tape and Reel, 2500
Quad	CBM8094AS14-RL	SOP-14	CBM8094AS	Tape and Reel, 3000
Quad	CBM8094AS14-REEL	SOP-14	CBM8094AS	Tape and Reel, 4000