

Features

- Single-Supply Operation from +1.4V ~ +5.5V
- Rail-to-Rail Input / Output
- Gain-Bandwidth Product: 100KHz (Typ)
- Low Input Bias Current: 1pA (Typ)
- Low Offset Voltage: 3mV (Max)
- stable for Gains \geq 10
- Quiescent Current: 600nA per Amplifier (Typ)
- Chip Select with CBM8047H(active High) and CBM8047L(active Low)
- Operating Temperature: -40°C ~ +125°C
- Embedded RF Anti-EMI Filter
- Small Package:
 - CBM8045 Available in SOT23-5 and SC70-5 Packages
 - CBM8046 Available in SOP-8 and MSOP-8 Packages
 - CBM8047H Available in SOT23-6 and SC70-6 Packages
 - CBM8047L Available in SOT23-6 and SC70-6 Packages

Application

- ASIC Input or Output Amplifier
- Sensor Interface
- Medical Communication
- Smoke Detectors
- Audio Output
- Piezoelectric Transducer Amplifier
- Medical Instrumentation
- Portable Systems

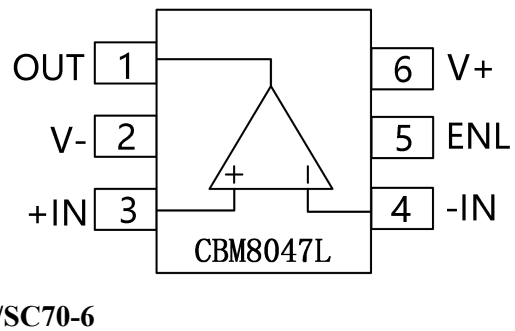
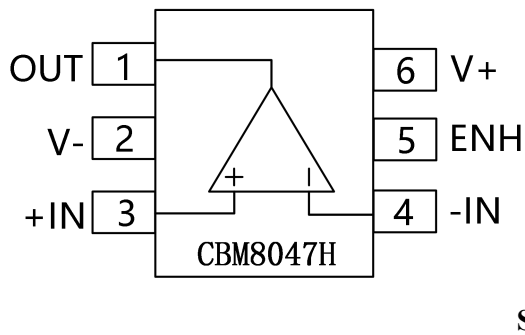
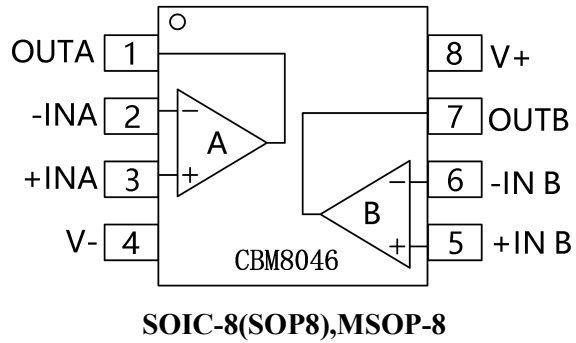
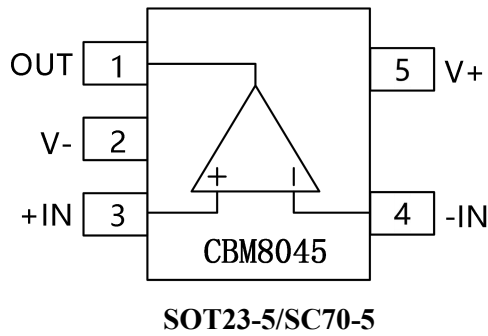
Description

The CBM804X family has a high gain-bandwidth product of 100KHz, a slew rate of 40V/ms, stable for gains \geq 10, and a quiescent current of 600nA/amplifier at 5V. The CBM804X family is 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 3mV for CBM804X family. They are specified over the extended industrial temperature range (-40°C to +125°C). The operating range is from 1.4V to 5.5V. The CBM8045 single is available in Green SC70-5 and SOT23-5 packages. The CBM8046 Dual is available in Green SOP-8 and MSOP-8 packages. The CBM8047 single is available in Green SC70-6 and SOT23-6 packages.

Catalog

Features.....	1
Application.....	1
Description.....	1
Catalog.....	2
Pin Configurations.....	3
Absolute Maximum Ratings ⁽¹⁾	4
Electrical Characteristics.....	5
Typical Characteristics.....	6
Application Notes.....	7
Typical Application Circuits.....	10
Package Outline Dimensions.....	11
SC70-5.....	11
SOT23-5.....	12
SOIC-8(SOP-8).....	13
MSOP-8.....	14
SC70-6.....	15
SOT23-6.....	16
Package/Ordering Information.....	17

Pin Configurations



**ENH active at high level, ENL active at low level

Absolute Maximum Ratings ⁽¹⁾

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 °C	+125 °C
Junction Temperature	+160 °C	
Storage Temperature Range	-55 °C	+150 °C
Lead Temperature (soldering, 10sec)	+260 °C	
Package Thermal Resistance ($T_A = +25$ °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	
SC70-6, θ_{JA}	333 °C/W	
ESD Susceptibility		
HBM	6KV	
MM	300V	

1. 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

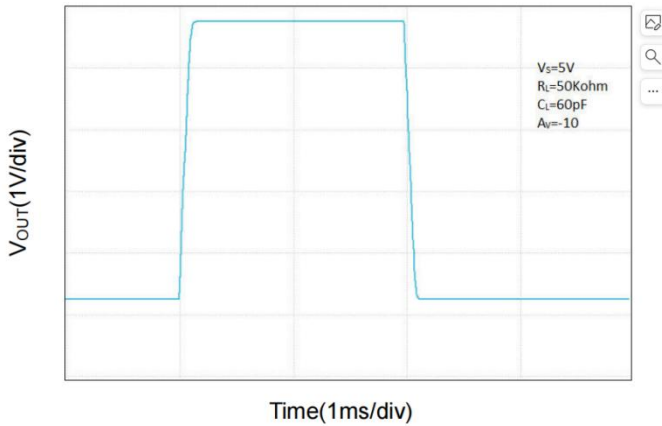
(At $V_S = +5V$, $AV=10$, $R_L = 1M\Omega$ connected to $V_S/2$, and $V_{OUT} = V_S/2$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	CBM8045/CBM8046/CBM8047			UNIT
			MIN	TYP	MAX	
INPUT CHARACTERISTICS						
Input Offset Voltage	V_{OS}	$V_{CM} = V_S/2$	0.4		3	mV
Input Bias Current	I_B		1			pA
Input Offset Current	I_{OS}		1			pA
Common-Mode Voltage Range	V_{CM}	$V_S = 5.5V$	-0.1 to +5.6			V
Common-Mode Rejection Ratio	CMRR	$V_S = 5V, V_{CM} = -0.1V$ to $2.5V$	76	71		dB
		$V_S = 5V, V_{CM} = -0.1V$ to $5.1V$	82	68		
Open-Loop Voltage Gain	A_{OL}	$V_S=1.4V, R_L = 50k\Omega, V_O = V_S-0.1V$	86	69		dB
		$V_S=5V, R_L = 50k\Omega, V_O = V_S-0.1V$	92	84		
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$		2.5			$\mu V/^\circ C$
OUTPUT CHARACTERISTICS						
Output Voltage Swing from Rail	V_{OH}	$V_S=1.4V, R_L = 50k\Omega$	1.395	1.390		V
	V_{OL}		4.5		10	mV
	V_{OH}	$V_S=5V, R_L = 50k\Omega$	4.997	4.990		V
	V_{OL}		3.5		10	mV
Output Current	I_{SOURCE}	$R_L = 10\Omega$ to $V_S/2$	20			mA
	I_{SINK}		20			
POWER SUPPLY						
Operating Voltage Range			1.4			V
			5.5			V
Power Supply Rejection Ratio	PSRR	$V_S = +1.4V$ to $+5.5V, V_{CM} = +0.5V$	84	77		dB
Quiescent Current / Amplifier	I_Q		600			nA
Shutdown Current / Amplifier	I_{Q_off}	CBM8047H / CBM8047L	54			nA
DYNAMIC PERFORMANCE (CL = 100pF)						
Slew Rate	SR	$G = +10, 2V$ Output Step	40			V/ms
Gain-Bandwidth Product	GBP		100			KHz

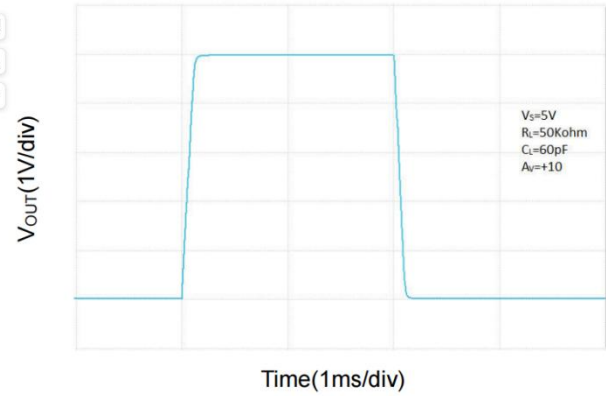
Typical Characteristics

At $T_A = +25^\circ\text{C}$, $V_S = +5\text{V}$, $A_V = 10$, and $R_L = 100\text{K}\Omega$ connected to $V_S/2$, unless otherwise noted.

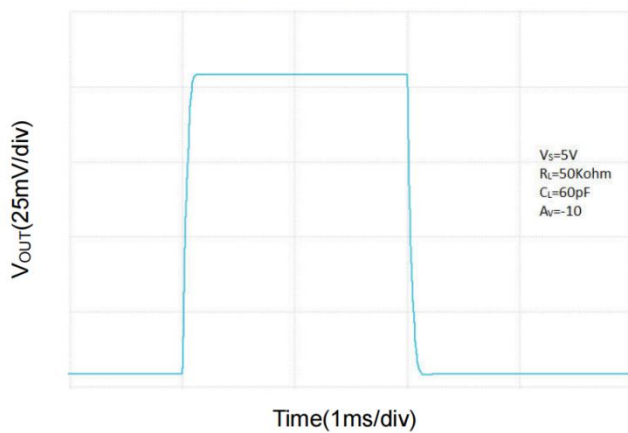
Large Signal Inverting Pulse Response



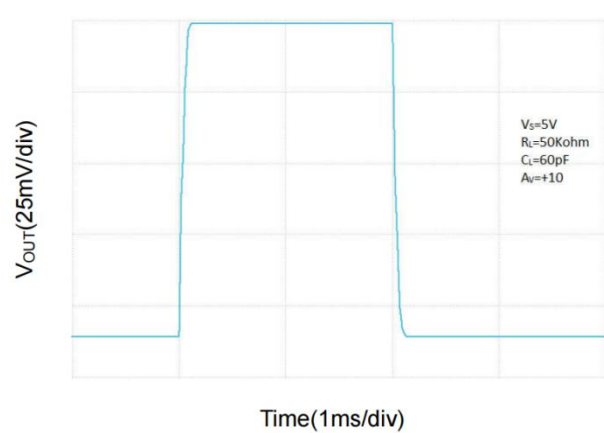
Large Signal Non-Inverting Pulse Response



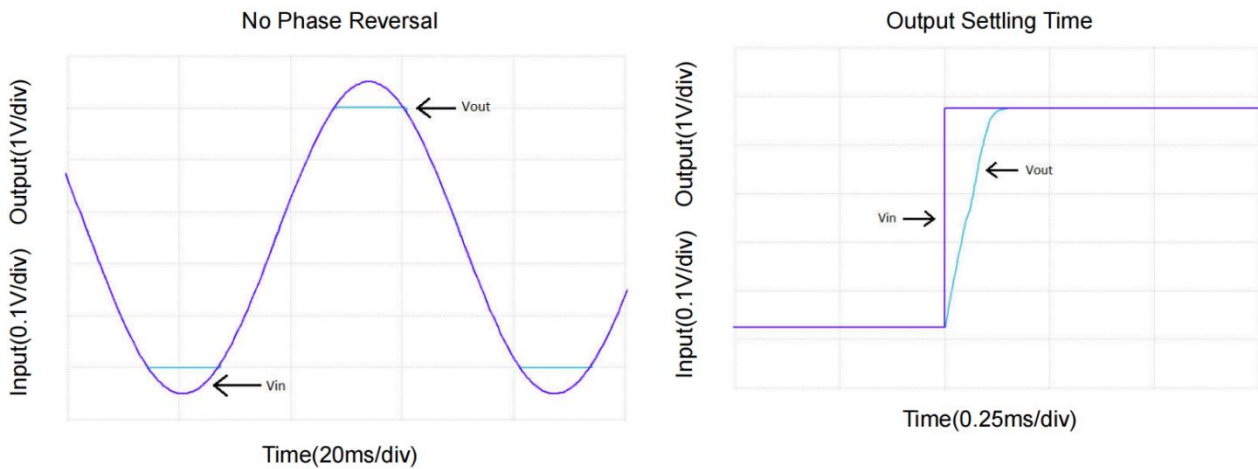
Small Signal Inverting Pulse Response



Small Signal Non-Inverting Pulse Response



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



Application Notes

Size

CBM804X family series op amps are stable for gains ≥ 10 and suitable for a wide range of general-purpose applications. The small footprints of the CBM804X family packages save space on printed circuit boards and enable the design of smaller electronic products.

Power Supply Bypassing and Board Layout

CBM804X family series operates from a single 1.4V to 5.5V supply or dual $\pm 0.7\text{V}$ to $\pm 2.75\text{V}$ supplies. For best performance, a $0.1\mu\text{F}$ ceramic capacitor should be placed close to the V_{DD} pin in single supply operation. For dual supply operation, both V_{DD} and V_{SS} supplies should be bypassed to ground with separate $0.1\mu\text{F}$ ceramic capacitors.

Low Supply Current

The low supply current (typical 600nA per channel) of CBM804X family will help to maximize battery life. They are ideal for battery powered systems.

Operating Voltage

CBM804X family operates under wide input supply voltage (1.4V 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 CBM804X family extends 100mV beyond the supply rails ($V_{SS}-0.1V$ to $V_{DD}+0.1V$). 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 CBM804X family can typically swing to less than 50mV from supply rail in light resistive loads ($>50k\Omega$).

Capacitive Load Tolerance

The CBM804X 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 non-inverting gain circuit 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.

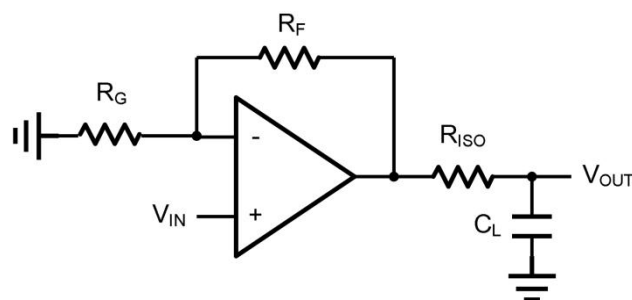


Figure 2. Indirectly Driving a Capacitive Load Using Isolation Resistor

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.

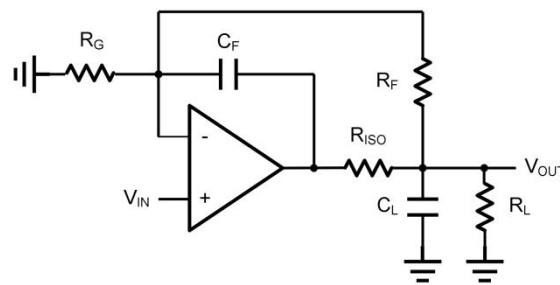


Figure 3. Indirectly Driving a Capacitive Load with DC Accuracy

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 CBM804X family.

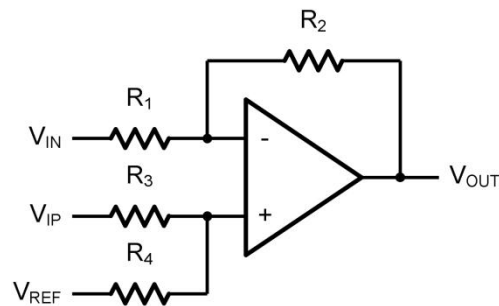


Figure 4. Differential Amplifier

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

If the resistor ratios are equal (i.e. $R_1=R_3$ and $R_2=R_4$), then

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

CBM804X family series op amps are stable for gains ≥ 10 , so R_2/R_1 should ≥ 10 .

Low Pass Active Filter

The low pass active filter is shown in Figure 5. The DC gain is defined by $-R_2/R_1$ (R_2/R_1 should ≥ 10), The filter has a -20dB/decade roll-off after its corner frequency $f_c=1/(2\pi R_3 C_1)$.

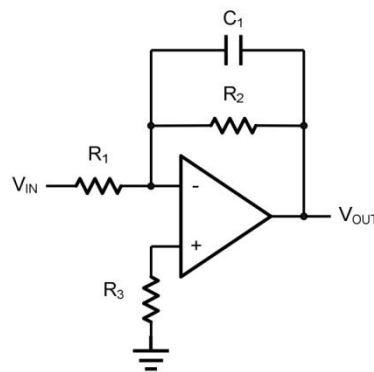
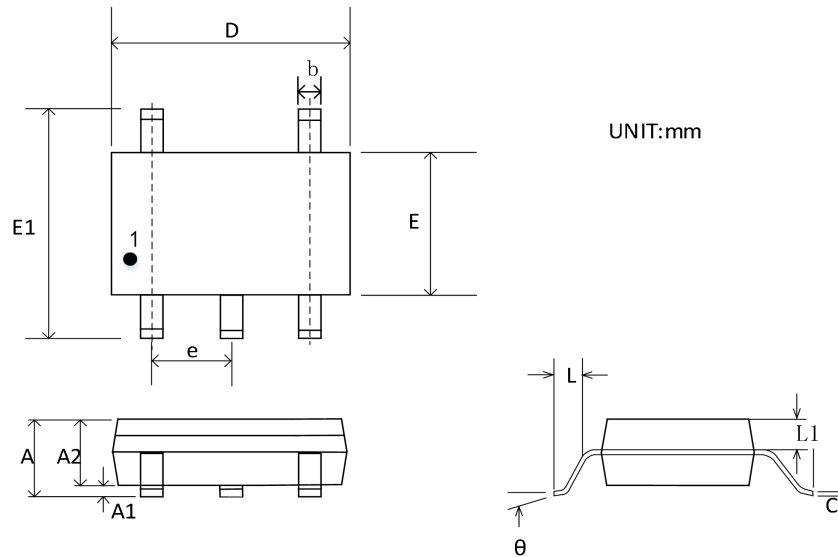


Figure 5. Low Pass Active Filter

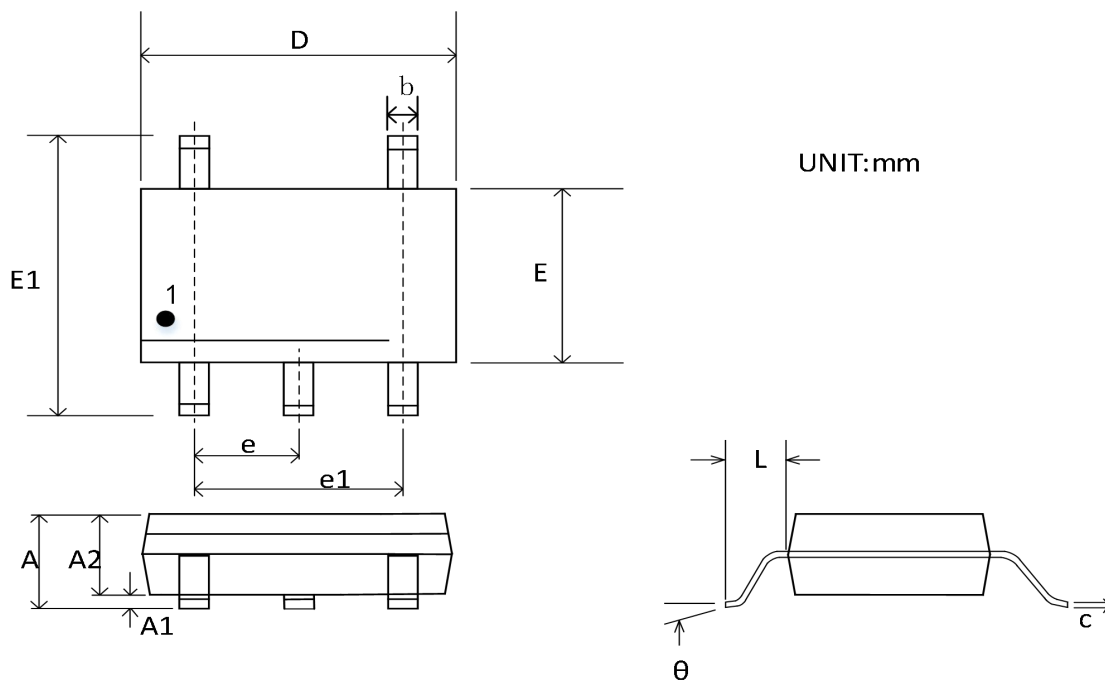
Package Outline Dimensions

SC70-5



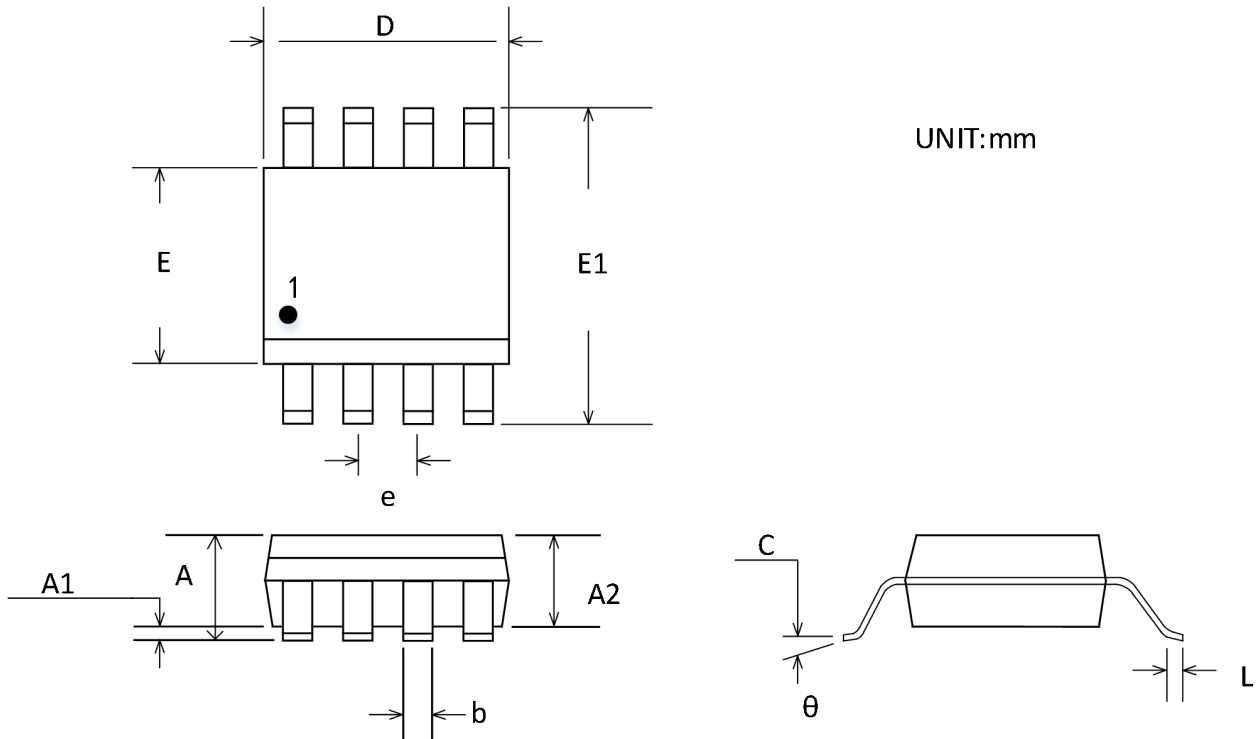
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	0.800	1.100	0.031	0.043
A1	--	0.100	--	0.004
A2	0.700	1.000	0.028	0.051
b	0.150	0.300	0.006	0.012
C	0.080	0.220	0.003	0.009
D	1.800	2.200	0.071	0.087
E	1.150	1.350	0.045	0.053
E1	1.800	2.400	0.071	0.094
e	0.650 BSC		0.026BSC	
L	0.260	0.460	0.010	0.018
L1	0.100	0.400	0.004	0.016

SOT23-5



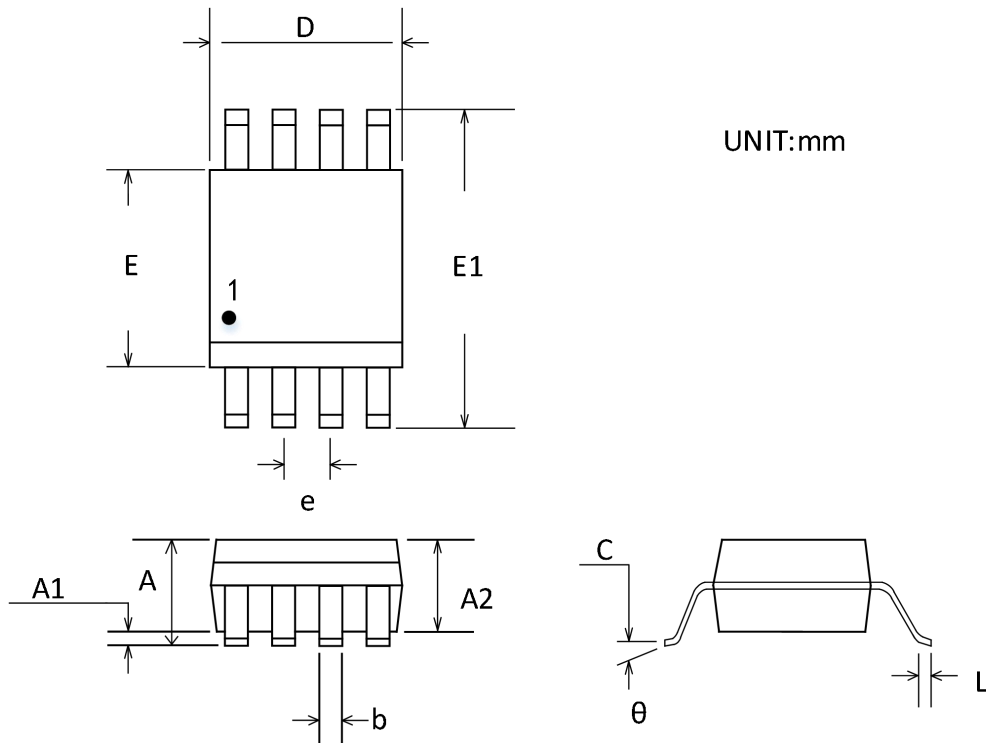
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC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

SOIC-8(SOP-8)



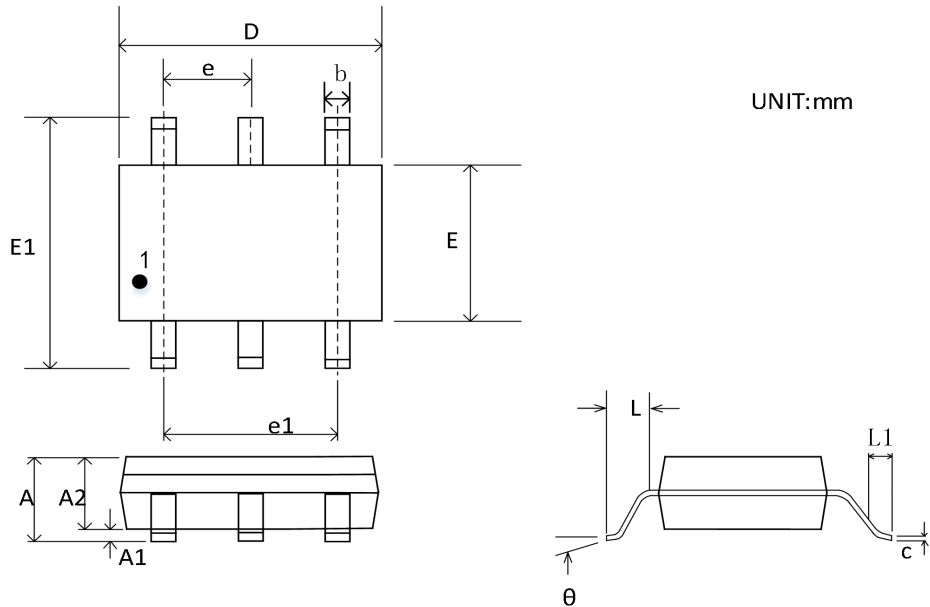
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D				
E	4.800	5.000	0.189	0.197
E1	5.800	6.200	0.228	0.244
e	1.270 BSC		0.050 BSC	
L	0.400	1.270	0.016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

MSOP-8



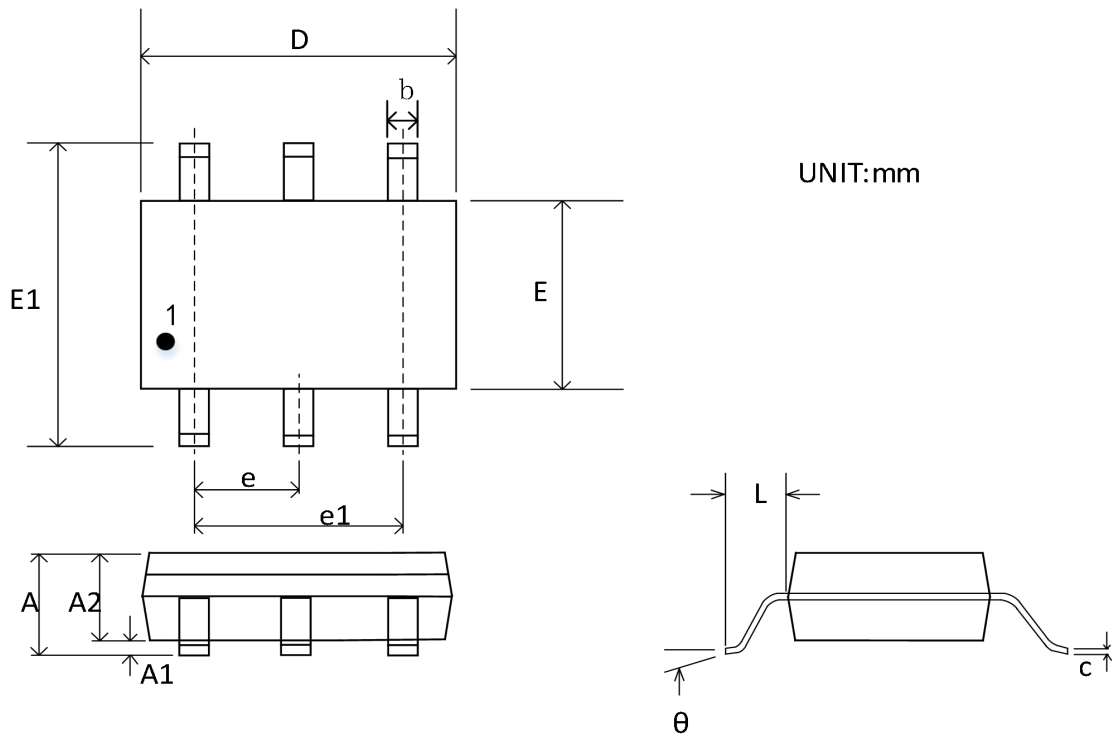
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026 BSC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

SC70-6



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	2.150	2.450	0.085	0.096
E1	1.150	1.350	0.045	0.053
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	
θ	0°	8°	0°	8°

Package/Ordering Information

CHANNEL	ORDERING NUMBER	TEMPRANGE	PACKAGE	PAKEAGE MARKING	TRANSPOT MEDIA,QUANTILY
Single	CBM8045ASC7	-40°C~125°C	SC70-5		Tape and Reel, 3000
Single	CBM8045AST5	-40°C~125°C	SOT23-5		Tape and Reel, 3000
Dual	CBM8046AS8	-40°C~125°C	SOP-8	CBM8046A	Tape and Reel, 2500
Dual	CBM8046AS8-RL	-40°C~125°C	SOP-8	CBM8046A	Tape and Reel, 3000
Dual	CBM8046AS8-REEL	-40°C~125°C	SOP-8	CBM8046A	Tape and Reel, 4000
Dual	CBM8046AMS8	-40°C~125°C	MSOP-8	A46	Tape and Reel, 3000
Single	CBM8047HSC7	-40°C~125°C	SC70-6		Tape and Reel, 3000
Single	CBM8047HST6	-40°C~125°C	SOT23-6		Tape and Reel, 3000
Single	CBM8047LSC7	-40°C~125°C	SC70-6		Tape and Reel, 3000
Single	CBM8047LST6	-40°C~125°C	SOT23-6		Tape and Reel, 3000