

## Features

- Low offset voltage: 13  $\mu\text{V}$  maximum
- Input offset drift: 0.03  $\mu\text{V}/^\circ\text{C}$
- Single-supply operation: 2.7 V to 5.5 V
- High gain, CMRR, and PSRR
- Low input bias current: 25 pA
- Low supply current: 180  $\mu\text{A}$

## Application

- Sensor interfaces
- Mobile communications
- Temperature measurement
- Portable instrumentation
- Battery-powered devices
- Electronic scales

## Description

The CBM8538/CBM8539 are very high precision amplifiers featuring extremely low offset voltage, low input bias current, and low power consumption. The supply current is less than 215  $\mu\text{A}$  maximum per amplifier at 5.0 V. Operation is fully specified from 2.7 V to 5.0 V single supply ( $\pm 1.35\text{ V}$  to  $\pm 2.5\text{ V}$  dual supply).

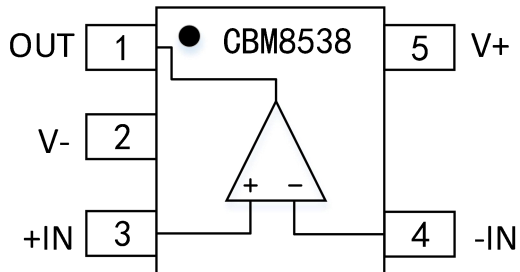
The CBM8538/CBM8539 operate at very low power making these amplifiers ideal for battery-powered devices and portable equipment. The CBM8538/CBM8539 are specified over the extended industrial temperature range ( $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ ).

The CBM8538 amplifier is available in 5-lead TSOT-23, and 8-lead, narrow body SOIC packages, and the CBM8539 amplifier is available in 8-lead, narrow body SOIC and 8-lead MSOP. See the Ordering Guide for the automotive part.

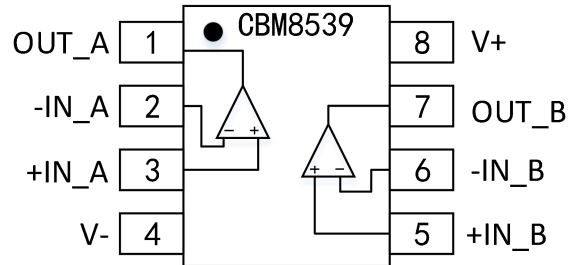
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## Pin Configurations



SOT23 Pin Configuration



MSOP/SOP Pin Configuration

## Pin Description

PIN N°	SYMBOL(CBM8538)	NAME AND FUNCTION
1	OUT	Output
2	V-	Negative power supply
3	+IN	None inverting input
4	-IN	inverting input
5	V+	Positive power supply

PIN N°	SYMBOL(CBM8539)	NAME AND FUNCTION
1	OUT_A	Output A
2	-IN_A	inverting input A
3	+IN_A	None inverting input A
4	V-	Negative power supply
5	+IN_B	V+/None inverting input B
6	-IN_B	inverting input B
7	OUT_B	Output B
8	V+	Positive power supply

## **Absolute Maximum Ratings <sup>(1)</sup>**

- Supply Voltage: 6V
- Input Voltage: GND – 0.3 V to VS + 0.3 V
- Differential Input Voltage: ±6 V
- Storage Temperature Range All Packages:  
–65°C to +150°C
- Operating Temperature Range All Packages:  
–40°C to +125°C
- Junction Temperature Range All Packages:  
–65°C to +150°C
- SOT23-5: 230°C/W ( $\theta_{JA}$ ) / 146°C/W ( $\theta_{JC}$ )
- MSOP-8: 145°C/W ( $\theta_{JA}$ ) / 45°C/W ( $\theta_{JC}$ )
- SOP-8: 125°C/W ( $\theta_{JA}$ ) / 43°C/W ( $\theta_{JC}$ )
- Lead Temperature (Soldering, 60s): 300°C

## Electrical Characteristics

( $V_S = 5\text{ V}$ ,  $V_{CM} = V_O = V_S/2$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

Table1.

PARAMETER	CONDITION	CBM8538			
		MIN	TYP	MAX	UNIT
<b>INPUT CHARACTERISTICS</b>					
Input Offset Voltage ( $V_{OS}$ )			5	13	$\mu\text{V}$
Offset Voltage Drift ( $\Delta V_{OS}/\Delta T$ )	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		0.03	0.1	$\mu\text{V}/^\circ\text{C}$
Input Bias Current ( $I_b$ )			15	25	$\text{pA}$
Input Offset Current ( $I_{OS}$ )			20	50	$\text{pA}$
Input Voltage Range		0		5	$\text{V}$
Common-Mode Rejection Ratio (CMRR)	$V_{CM} = 0\text{V to } 5\text{V}$	115	150		$\text{dB}$
Open-Loop Voltage Gain ( $A_{OL}$ )	$R_L = 10\text{k}\Omega, V_O = 0.1\text{V to } 4.9\text{V}$	115	141		$\text{dB}$
<b>OUTPUT CHARACTERISTICS</b>					
Output Voltage High ( $V_{OH}$ )	$R_L = 100\text{k}\Omega$ 至地	4.99	4.998		$\text{V}$
	$R_L = 10\text{k}\Omega$ 至地	4.95	4.97		$\text{V}$
Output Voltage Low ( $V_{OL}$ )	$R_L = 100\text{k}\Omega$ 至 $V+$		1.9	5	$\text{mV}$
	$R_L = 10\text{k}\Omega$ 至 $V+$		17	20	$\text{mV}$
Short-Circuit Limit ( $I_{SC}$ )			$\pm 25$		$\text{mA}$
<b>POWER SUPPLY</b>					
Power Supply Rejection Ratio (PSRR)	$V_S = 2.7\text{V to } 5.5\text{V}$	115	130		$\text{dB}$
Supply Current/Amplifier ( $I_{SV}$ )	$V_O = V_S/2$		150	180	$\mu\text{A}$
<b>NOISE PERFORMANCE</b>					
Voltage Noise ( $e_n$ , p-p)	0.1Hz 至 10Hz		2		$\mu\text{Vp-p}$
Voltage Noise Density ( $e_n$ )	$f = 1\text{KHz}$		50		$\text{nV}/\sqrt{\text{Hz}}$
<b>DYNAMIC PERFORMANCE</b>					
Slew Rate (SR)	$R_L = 10\text{k}\Omega$		0.4		$\text{V}/\mu\text{s}$
Gain-Bandwidth Product (GBW)			430		$\text{KHz}$
Settling Time	$G = \pm 1, 2\text{ V step}, C_L = 20\text{ pF}, R_L = 1\text{ k}\Omega$		10		$\mu\text{s}$

( $V_S = 2.7V$ ,  $V_{CM} = V_S/2$ ,  $T_A = 25^\circ C$ , unless otherwise noted.)

Table 2.

PARAMETER	CONDITION	CBM8538			
		MIN	TYP	MAX	UNIT
<b>INPUT CHARACTERISTICS</b>					
Input Offset Voltage ( $V_{OS}$ )			5	13	$\mu V$
Offset Voltage Drift ( $\Delta V_{OS}/\Delta T$ )	$-40^\circ C \leq T_A \leq +125^\circ C$		0.03	0.1	$\mu V/^\circ C$
Input Bias Current ( $I_B$ )			15	25	pA
Input Offset Current ( $I_{OS}$ )			20	50	pA
Input Voltage Range		0		2.7	V
Common-Mode Rejection Ratio (CMRR)	$V_{CM} = 0V$ to 2.5V	110	140		dB
Open-Loop Voltage Gain ( $A_{OL}$ )	$R_L = 10k\Omega, V_O = 0.1V$ to 1.7V	110	140		dB
<b>OUTPUT CHARACTERISTICS</b>					
Output Voltage High ( $V_{OH}$ )	$R_L = 100k\Omega$ 至地	2.68	2.698		V
	$R_L = 10k\Omega$ 至地	2.67	2.68		V
Output Voltage Low ( $V_{OL}$ )	$R_L = 100k\Omega$ 至 $V+$		1.7	5	mV
	$R_L = 10k\Omega$ 至 $V+$		14	20	mV
Short-Circuit Limit ( $I_{SC}$ )			$\pm 8$		mA
<b>POWER SUPPLY</b>					
Power Supply Rejection Ratio (PSRR)	$V_S = 2.7V$ 至 5.5V	105	125		dB
Supply Current/Amplifier ( $I_{SV}$ )	$V_O = V_S/2$		150	180	$\mu A$
<b>NOISE PERFORMANCE</b>					
Voltage Noise ( $e_n$ , p-p)	0.1Hz 至 10Hz		2		$\mu Vp - p$
Voltage Noise Density ( $e_n$ )	$f = 1KHz$		50		$nV/\sqrt{Hz}$
<b>DYNAMIC PERFORMANCE</b>					
Slew Rate (SR)	$R_L = 10k\Omega$		0.35		V/ $\mu s$
Gain-Bandwidth Product (GBW)			430		KHz
Settling Time	$G = \pm 1, 1V$ step, $C_L = 20pF, R_L = 1k\Omega$		5		$\mu s$

( $V_S = 5\text{ V}$ ,  $V_{CM} = V_O = V_S/2$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

Table3.

PARAMETER	CONDITION	CBM8539			
		MIN	TYP	MAX	UNIT
<b>INPUT CHARACTERISTICS</b>					
Input Offset Voltage ( $V_{OS}$ )			5	15	$\mu\text{V}$
Offset Voltage Drift ( $\Delta V_{OS}/\Delta T$ )	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		0.03	0.1	$\mu\text{V}/^\circ\text{C}$
Input Bias Current ( $I_B$ )			15	60	$\text{pA}$
Input Offset Current ( $I_{OS}$ )			20	70	$\text{pA}$
Input Voltage Range		0		5	$\text{V}$
Common-Mode Rejection Ratio (CMRR)	$V_{CM} = 0\text{V to } 5\text{V}$	115	135		$\text{dB}$
Open-Loop Voltage Gain ( $A_{OL}$ )	$R_L = 10\text{k}\Omega, V_O = 0.1\text{V to } 4.9\text{V}$	110	130		$\text{dB}$
<b>OUTPUT CHARACTERISTICS</b>					
Output Voltage High ( $V_{OH}$ )	$R_L = 100\text{k}\Omega$ 至地	4.99	4.994		$\text{V}$
	$R_L = 10\text{k}\Omega$ 至地	4.95	4.97		$\text{V}$
Output Voltage Low ( $V_{OL}$ )	$R_L = 100\text{k}\Omega$ 至 $V+$		5	7	$\text{mV}$
	$R_L = 10\text{k}\Omega$ 至 $V+$		20	25	$\text{mV}$
Short-Circuit Limit ( $I_{SC}$ )			$\pm 25$		$\text{mA}$
<b>POWER SUPPLY</b>					
Power Supply Rejection Ratio (PSRR)	$V_S = 2.7\text{V to } 5.5\text{V}$	105	125		$\text{dB}$
Supply Current/Amplifier ( $I_{SV}$ )	$V_O = V_S/2$		170	210	$\mu\text{A}$
<b>NOISE PERFORMANCE</b>					
Voltage Noise ( $e_n$ , p-p)	0.1Hz 至 10Hz		1.2		$\mu\text{Vp-p}$
Voltage Noise Density ( $e_n$ )	$f = 1\text{KHz}$		52		$\text{nV}/\sqrt{\text{Hz}}$
<b>DYNAMIC PERFORMANCE</b>					
Slew Rate (SR)	$R_L = 10\text{k}\Omega$		0.4		$\text{V}/\mu\text{s}$
Gain-Bandwidth Product (GBW)			430		$\text{KHz}$
Settling Time	$G = \pm 1, 2\text{ V step}, C_L = 20\text{ pF}, R_L = 1\text{ k}\Omega$		10		$\mu\text{s}$

( $V_S = 2.7V$ ,  $V_{CM} = V_S/2$ ,  $T_A = 25^\circ C$ , unless otherwise noted.)

Table 4.

PARAMETER	CONDITION	CBM8539			
		MIN	TYP	MAX	UNIT
<b>INPUT CHARACTERISTICS</b>					
Input Offset Voltage ( $V_{OS}$ )			5	16	$\mu V$
Offset Voltage Drift ( $\Delta V_{OS}/\Delta T$ )	$-40^\circ C \leq T_A \leq +125^\circ C$		0.03	0.1	$\mu V/^\circ C$
Input Bias Current ( $I_B$ )			15	25	pA
Input Offset Current ( $I_{OS}$ )			20	50	pA
Input Voltage Range		0		2.7	V
Common-Mode Rejection Ratio (CMRR)	$V_{CM} = 0V$ to 2.5V	110	130		dB
Open-Loop Voltage Gain ( $A_{OL}$ )	$R_L = 10k\Omega, V_O = 0.1V$ to 2.6V	110	130		dB
<b>OUTPUT CHARACTERISTICS</b>					
Output Voltage High ( $V_{OH}$ )	$R_L = 100k\Omega$ 至地	2.68	2.693		V
	$R_L = 10k\Omega$ 至地	2.67	2.68		V
Output Voltage Low ( $V_{OL}$ )	$R_L = 100k\Omega$ 至 $V+$		5	7	mV
	$R_L = 10k\Omega$ 至 $V+$		14	20	mV
Short-Circuit Limit ( $I_{SC}$ )			$\pm 8$		mA
<b>POWER SUPPLY</b>					
Power Supply Rejection Ratio (PSRR)	$V_S = 2.7V$ 至 5.5V	105	125		dB
Supply Current/Amplifier ( $I_{SV}$ )	$V_O = V_S/2$		150	180	$\mu A$
<b>NOISE PERFORMANCE</b>					
Voltage Noise ( $e_n$ , p-p)	0.1Hz 至 10Hz		2		$\mu Vp - p$
Voltage Noise Density ( $e_n$ )	$f = 1KHz$		55		$nV/\sqrt{Hz}$
<b>DYNAMIC PERFORMANCE</b>					
Slew Rate (SR)	$R_L = 10k\Omega$		0.35		V/ $\mu s$
Gain-Bandwidth Product (GBW)			430		KHz
Settling Time	$G = \pm 1, 1V$ step, $C_L = 20pF, R_L = \infty$		8		$\mu s$

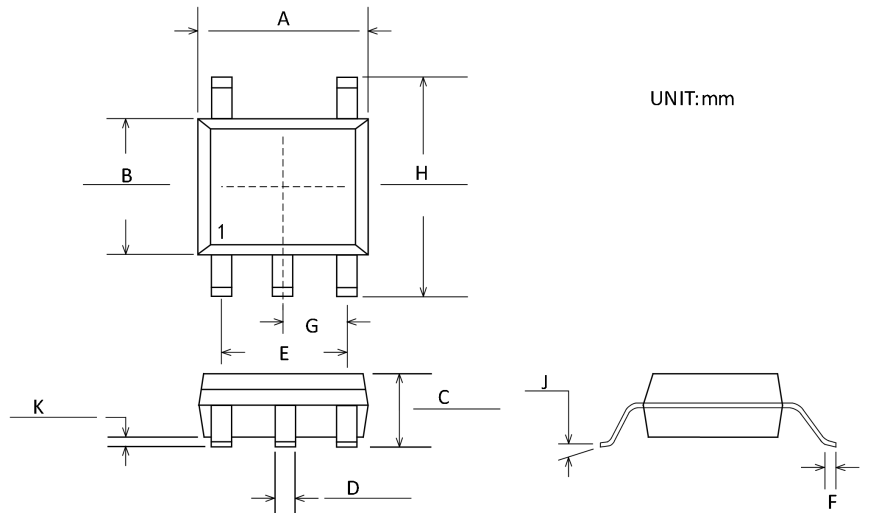


## Typical Characteristics

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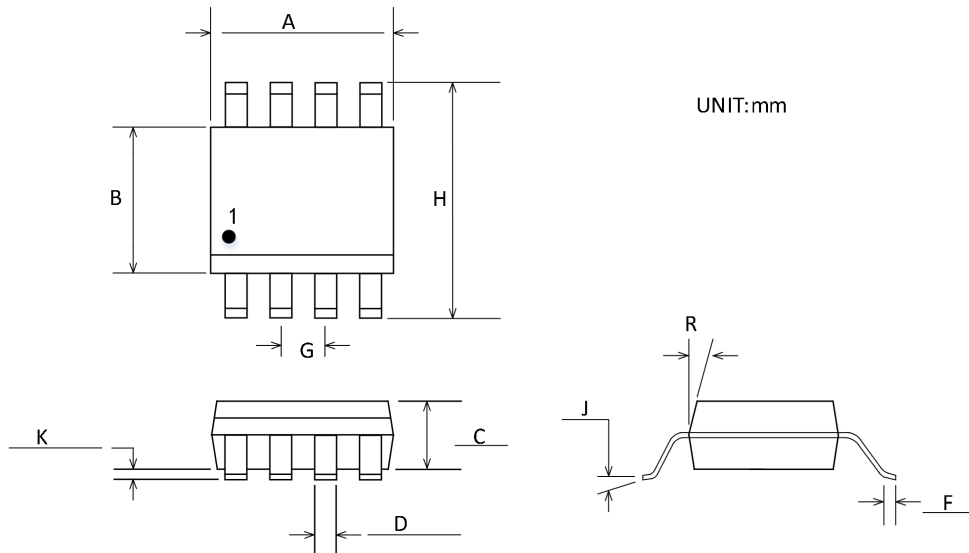
## Package Outline Dimensions

### SOT23-5



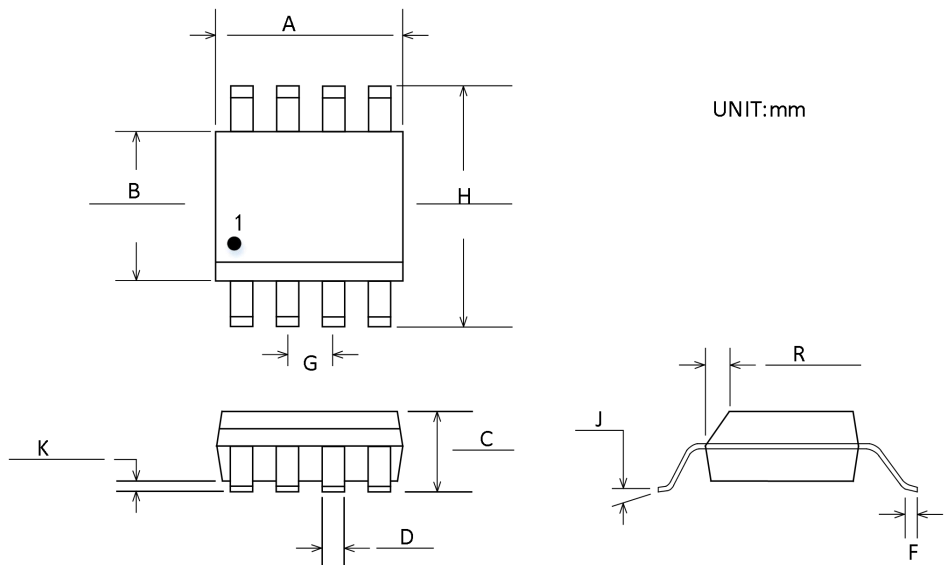
Symbol	Dimensions In Millimeters	
	Min	Max
A	2.90BSC	
B	1.60BSC	
C	1.0MAX	
D	0.30	0.50
E	1.90BSC	
F	0.30	0.60
G	0.95BSC	
H	2.80BSC	
J	0°	10°
K	0.10MAX	

## MSOP-8



Symbol	Dimensions In Millimeters	
	Min	Max
A	2.80	3.20
B	2.80	3.20
C	1.10MAX	
D	0.25	0.40
F	0.40	0.80
G	0.65BSC	
H	4.65	5.15
J	0°	6°
K	0.05	0.15
R	15°MAX	

## SOP-8



Symbol	Dimensions In Millimeters	
	Min	Max
A	4.80	5.00
B	3.80	4.00
C	1.35	1.75
D	0.31	0.51
F	0.40	1.27
G	1.27BSC	
H	5.80	6.20
J	0°	8°
K	0.10	0.25
R	0.25	0.50

## Package/Ordering Information

ORDERING NUMBER	OPERATING TEMPERATURE	PACKAGE DESCRIPTION	MAKING INFORMATION	PACKAGE OPTION
CBM8538AST5	-40°C~125°C	SOT23-5	A38	Tape and Reel, 3000
CBM8538AS8	-40°C~125°C	SOP-8	CBM8538A	Tape and Reel, 2500
CBM8538AS8-RL	-40°C~125°C	SOP-8	CBM8538A	Tape and Reel, 3000
CBM8538AS8-REEL	-40°C~125°C	SOP-8	CBM8538A	Tape and Reel, 4000
CBM8538AMS8	-40°C~125°C	MSOP-8	A8M	Tape and Reel, 3000
CBM8539AS8	-40°C~125°C	SOP-8	CBM8539A	Tape and Reel, 2500
CBM8539AS8-RL	-40°C~125°C	SOP-8	CBM8539A	Tape and Reel, 3000
CBM8539AS8-REEL	-40°C~125°C	SOP-8	CBM8539A	Tape and Reel, 4000
CBM8539AMS8	-40°C~125°C	MSOP-8	ATN	Tape and Reel, 3000