

## FEATURES

- Internally frequency compensated for unity gain
- Large DC voltage gain: 100dB
- Wide power supply range: 3V ~ 32V (or 1.5V ~ 16V)
- Input common-mode voltage range includes ground
- Large output voltage swing: 0V DC to  $V_{CC}-1.5V$  DC
- Power drain suitable for battery operation
- Low input offset voltage and offset current
- Differential input voltage range equal to the power supply voltage

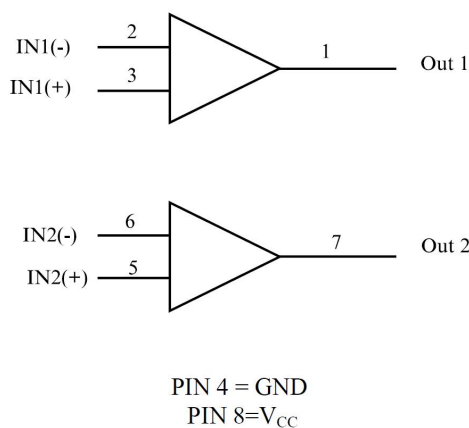
## GENERAL DESCRIPTION

The CBM2904 contains two independent high gain operational amplifiers with internal frequency compensation. The two op-amps operate over a wide voltage range from a single power supply. Also use a split power supply. The device has low power supply current drain, regardless of the power supply voltage. The low power drain also makes the CBM2904 a good choice for battery operation.

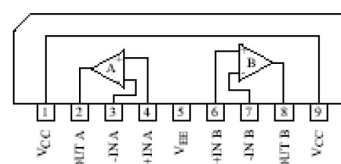
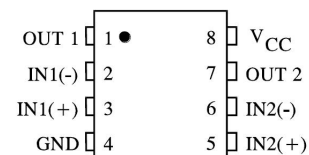
When your project calls for a traditional op-amp function, now you can streamline your design with a simple single power supply. Use ordinary  $+5V_{DC}$  common to practically any digital system or personal computer application, without requiring an extra 15V power supply just to have the interface electronics you need.

The CBM2904 is a versatile, rugged workhorse with a thousand-and-one uses, from amplifying signals from a variety of transducers to dc gain blocks, or any op-amp function. The attached pages offer some recipes that will have your project cooking in no time.

### LOGIC DIAGRAM



### PIN ASSIGNMENT



## MAXIMUM RATINGS\*

| Symbol    | Parameter                                      | Value       | Unit        |
|-----------|--|-------------|-------------|
| $V_{CC}$  | Power Supply Voltages                          |             |             |
|           | Single Supply                                  | 32          | V           |
|           | Split Supplies                                 | $\pm 16$    |             |
| $V_{IDR}$ | Input Differential Voltage Range (1)           | $\pm 32$    | V           |
| $V_{ICR}$ | Input Common Mode Voltage Range                | -0.3 to 32  | V           |
| $I_{SC}$  | Output Short Circuit Duration                  | Continuous  |             |
| $T_J$     | Junction Temperature                           |             | $^{\circ}C$ |
|           | Plastic Packages                               | 150         |             |
| $T_{stg}$ | Storage Temperature                            |             | $^{\circ}C$ |
|           | Plastic Packages                               | -55 to +125 |             |
| $I_{IN}$  | Input Current, per pin (2)                     | 50          | mA          |
| $T_L$     | Lead Temperature, 1mm from Case for 10 Seconds | 260         | $^{\circ}C$ |

\* Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device.

These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Functional operation should be restricted to the Recommended Operating Conditions.

+Derating - Plastic DIP: - 10 mW/ $^{\circ}C$  from 65 $^{\circ}C$  to 125 $^{\circ}C$

SOIC Package: - 7 mW/ $^{\circ}C$  from 65 $^{\circ}C$  to 125 $^{\circ}C$

Notes:

1. Split Power Supplies.
2.  $V_{IN} < -0.3V$ . This input current will only exist when voltage at any of the input leads is driven negative.

## Recommended Operating Conditions

| Symbol   | Parameter                                | Min              | Max            | Unit        |
|----------|--|------------------|----------------|-------------|
| $V_{CC}$ | DC Supply Voltage                        | $\pm 2.5$ or 5.0 | $\pm 15$ or 30 | V           |
| $T_A$    | Operating Temperature, All Package Types | -40              | +105           | $^{\circ}C$ |

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation,  $V_{IN}$  and  $V_{OUT}$  should be constrained to the range GND ( $V_{IN}$  or  $V_{OUT}$ )  $V_{CC}$ .

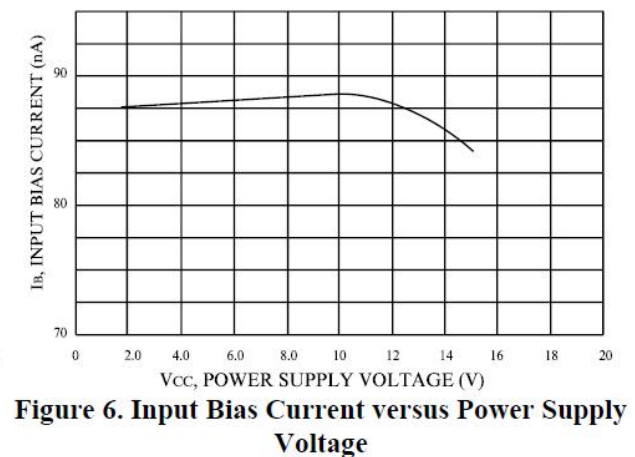
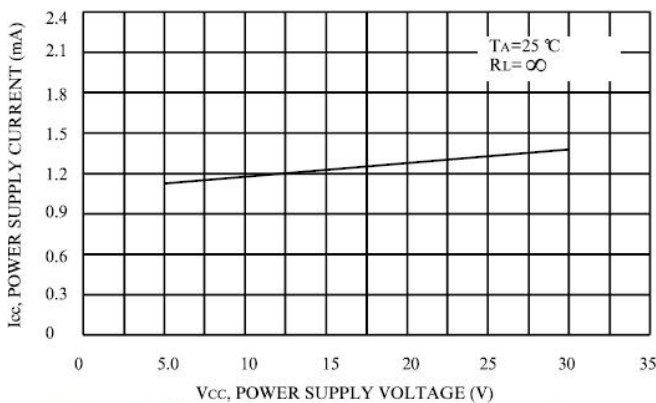
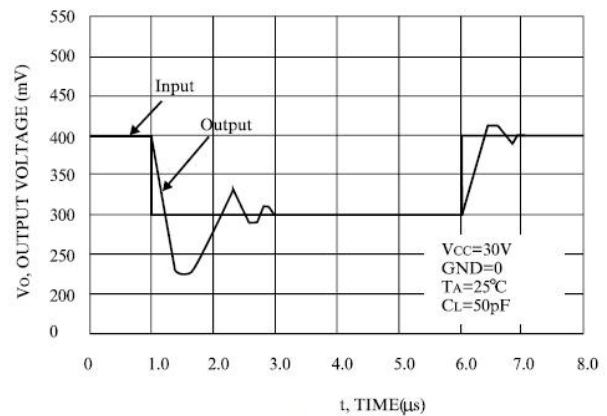
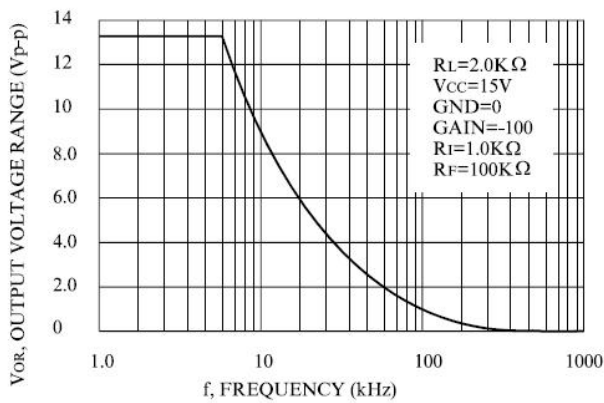
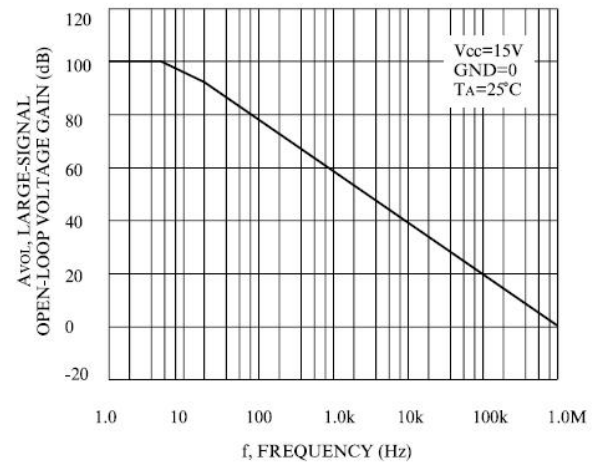
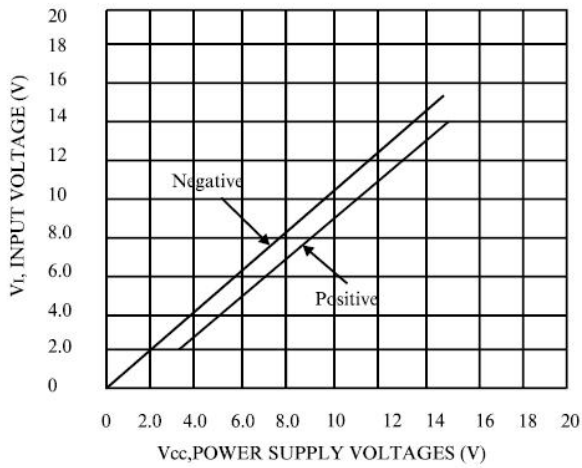
Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or  $V_{CC}$ ). Unused outputs must be left open.

**DC ELECTRICAL CHARACTERISTICS ( $T_A = -40$  to  $+105^\circ\text{C}$ )**

| Symbol                   | Parameter                                   | Test Conditions   | Guaranteed Limit |     |             | Unit              |
|--------------------------|---|---|------------------|-----|-------------|-------------------|
|                          |   |   | Min              | Typ | Max         |                   |
| $V_{IO}$                 | Maximum Input Offset Voltage                | $V_O = 1.4V$ , $V_{CC} = 5.0-30V$ ;<br>$R_S = 0\Omega$ , $V_{ICM} = 0V$ to $V_{CC} - 1.7V$  |                  |     | 9.0<br>5.0* | mV                |
| $\Delta V_{IO}/\Delta T$ | Input Offset Voltage Drift                  | $R_S = 0\Omega$ , $V_{CC} = 30V$  |                  | 7.0 |             | $\mu V/^\circ C$  |
| $I_{IO}$                 | Maximum Input Offset Current                | $V_{CC} = 5.0V$   |                  |     | 150<br>50*  | nA                |
| $\Delta I_{IO}/\Delta T$ | Input Offset Current Drift                  | $R_S = 0\Omega$ , $V_{CC} = 30V$  |                  | 10  |             | $pA/^\circ C$     |
| $I_{IB}$                 | Maximum Input Bias Current                  | $V_{CC} = 5.0V$   |                  |     | 500<br>250* | nA                |
| $V_{ICR}$                | Input Common Mode Voltage Range             | $V_{CC} = 30V$  | 0                |     | 28          | V                 |
| $I_{CC}$                 | Maximum Power Supply Current                | $R_L = \infty$ , $V_{CC} = 30V$ , $V_O = 0V$<br>$R_L = \infty$ , $V_{CC} = 5V$ , $V_O = 0V$   | 0.3<br>0.3       |     | 3<br>1.2    | mA                |
| $A_{VOL}$                | Minimum Large Signal Open-Loop Voltage Gain | $V_{CC} = 15V$ , $R_L \geq 2K\Omega$  | 15<br>25*        |     |             | V/mV              |
| $V_{OH}$                 | Minimum Output High-Level Voltage Swing     | $V_{CC} = 30V$ , $R_L = 2K\Omega$<br>$V_{CC} = 30V$ , $R_L = 10K\Omega$   | 26<br>27         |     |             | V                 |
| $V_{OL}$                 | Maximum Output Low-Level Voltage Swing      | $V_{CC} = 5V$ , $R_L = 10K\Omega$   |                  |     | 20          | mV                |
| CMR                      | Common Mode Rejection                       | $V_{CC} = 30V$ , $R_S = 10K\Omega$  | 65*              |     |             | dB                |
| PSR                      | Power Supply Rejection                      | $V_{CC} = 30V$  | 65*              |     |             | dB                |
| CS                       | Channel Separation                          | $f = 1KHz$ to $20KHz$ , $V_{CC} = 30V$  | -120             |     |             | dB                |
| $I_{SC}$                 | Maximum Output Short Circuit to GND         | $V_{CC} = 5.0V$<br>$V_O = 0V$   |                  |     |             | mA                |
| $I_{source}$             | Minimum Source Output Current               | $V_{IN+} = 1V$ , $V_{IN-} = 0V$ ,<br>$V_{CC} = 15V$ , $V_O = 2V$  | 10               |     |             | mA                |
| $I_{sink}$               | Minimum Output Sink Current                 | $V_{IN+} = 0V$ , $V_{IN-} = 1V$ ,<br>$V_{CC} = 15V$ , $V_O = 15V$<br>$V_{IN+} = 0V$ , $V_{IN-} = 1V$ ,<br>$V_{CC} = 15V$ , $V_O = 0.2V$ | 5<br>10*<br>12*  |     |             | mA<br><br>$\mu A$ |
| $V_{IDR}$                | Differential Input Voltage Range            | All $V_{IN}$ GND or V-Supply (if used)  |                  |     | $V_{CC}^*$  | V                 |

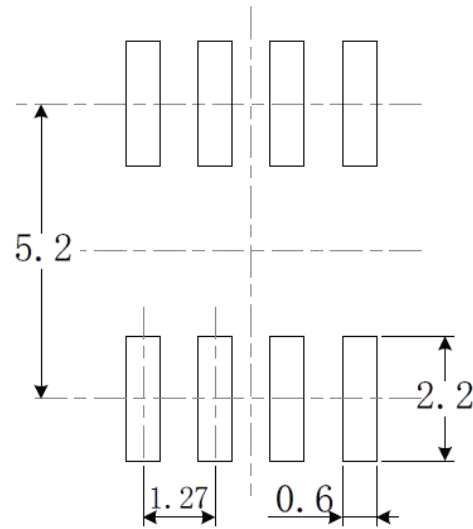
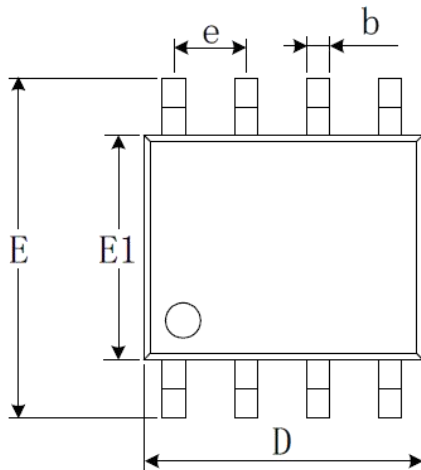
 \*= $@25^\circ C$

## TYPICAL PERFORMANCE CHARACTERISTICS

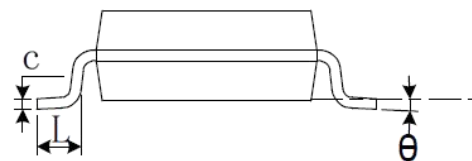
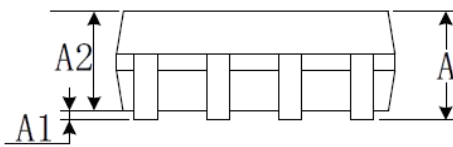


PACKAGE

SOP-8

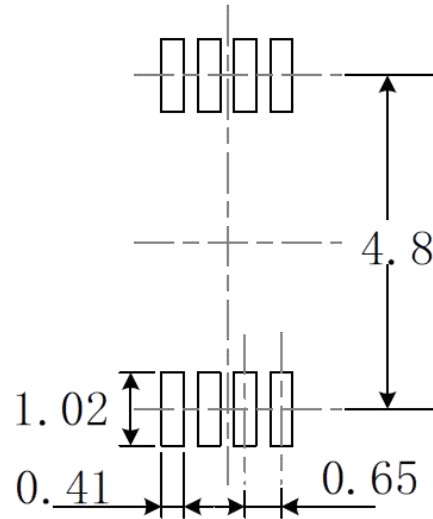
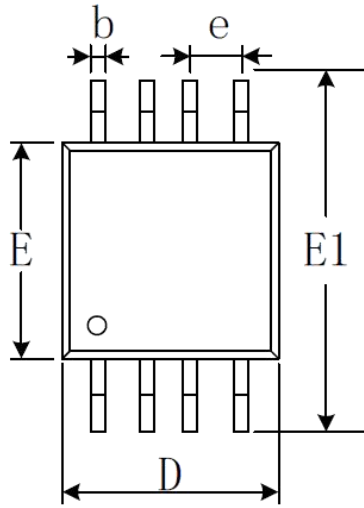


RECOMMENDED LAND PATTERN (Unit: mm)

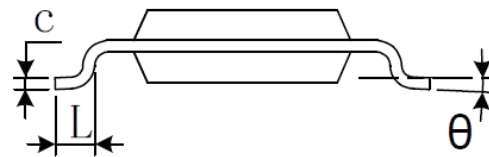
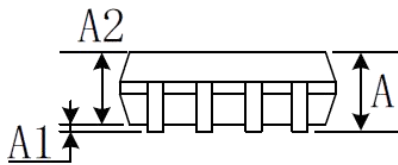


| Symbol   | Dimensions In Millimeters |       | Dimensions Inches |       |
|----------|---------------------------|-------|-------------------|-------|
|          | Min                       | Max   | Min               | Max   |
| A        | 1.350                     | 1.750 | 0.053             | 0.069 |
| 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 |
| $\theta$ | 0°                        | 8°    | 0°                | 8°    |

MSOP-8



RECOMMENDED LAND PATTERN (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 |
| $\theta$ | 0°                        | 6°    | 0°                | 6°    |

## PACKAGE/ORDERING INFORMATION

| PRODUCT | ORDERING NUMBER | TEMPRANGE   | PACKAGE | PAKEAGE MARKING | TRANSPOT MEDIA,QUANTILY |
|---------|-----------------|-------------|---------|-----------------|-------------------------|
| CBM2904 | CBM2904AS8      | -40°C~105°C | SOP-8   | CBM2904A        | Reel.2500               |
|         | CBM2904AMS8     | -40°C~105°C | MSOP-8  | 2904A           | Reel.3000               |