

## Features

- HIGH GAIN BANDWIDTH:1.1MHz
- RAIL-TO-RAIL INPUT AND OUTPUT  
0.6mV Typical  $V_{OS}$
- INPUT VOLTAGE RANGE: -0.1V to +5.6V  
with  $V_s = 5.5V$
- SUPPLY RANGE: +2.5V to +5.5V
- SPECIFIED UP TO +125°C
- MicroSIZE PACKAGES: SOT23-5, SOT23-6

## Application

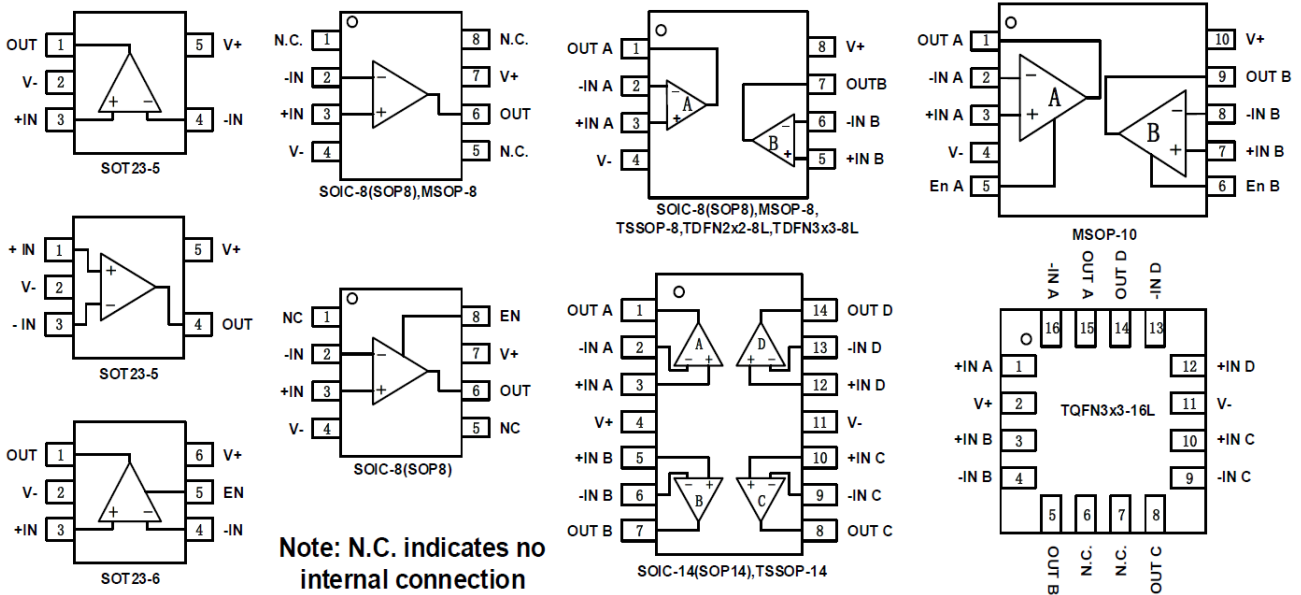
- SENSORS
- PHOTODIODE AMPLIFICATION
- ACTIVE FILTERS
- TEST EQUIPMENT
- DRIVING A/D CONVERTERS

## Description

The CBM8541, CBM8542, CBM8544, families of products offer low voltage operation and rail-to-rail input and output, as well as excellent speed/power consumption ratio, providing an excellent bandwidth (1.1MHz) and slew rate of 0.5V/us. The op-amps are unity gain stable and feature an ultra-low input bias current.

The devices are ideal for sensor interfaces, active filters and portable applications. The CBM8541, CBM8542, CBM8544, families of operational amplifiers are specified at the full temperature range of -40°C to +125°C under single or dual power supplies of 2.5V to 5.5V.

## PIN CONFIGURATIONS



## ABSOLUTE MAXIMUM RATINGS (1)

- Supply Voltage, V+ to V-.....7.0V
- Input Terminals, Voltage (2) ..... - 0.5 to (V+) + 0.5V  
Current (2)..... ±10mA
- Storage Temperature ..... -65°C to +150°C
- Operating Temperature ..... -40°C to +125°C
- Junction Temperature.....150°C
- Package Thermal Resistance @ T<sub>A</sub>= +25°C
- SOT23-5, SOT23-6.....200°C/W
- MSOP-10, SOIC-8, TSSOP-8 ..... 150°C/W
- SOIC-14, TSSOP-14.....100°C/W
- Lead Temperature (Soldering, 10s) .....260°C
- ESD Susceptibility
- HBM .....5000V
- MM .....400V

1. Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.
2. Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5V beyond the supply rails should be current-limited to 10mA or less.



## ESD SENSITIVITY CAUTION

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### ELECTRICAL CHARACTERISTICS

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

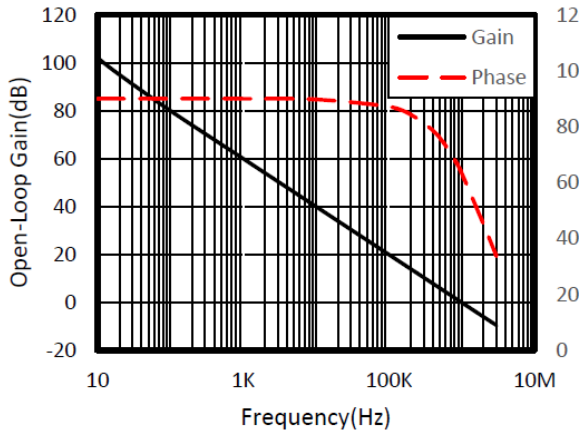
PARAMETER	CONDITIONS	$T_J$	CBM8541, CBM8542, CBM8544			UNIT	
			MIN	TYP	MAX		
			<b>POWER SUPPLY</b>				
$V_S$	Operating Voltage Range		$25^\circ\text{C}$	2.5		5.5	V
$I_Q$	Quiescent Current/Amplifier		$25^\circ\text{C}$		58	80	$\mu\text{A}$
PSRR	Power-Supply Rejection Ratio	$V_S=2.5\text{V to }5.5\text{V}$ , $V_{cm}=(V_-)+0.5\text{V}$	$25^\circ\text{C}$	72	90		dB
			$-40^\circ\text{C to }125^\circ\text{C}$	65			
<b>INPUT</b>							
$V_{os}$	Input Offset Voltage		$25^\circ\text{C}$		0.6	3	mV
$V_{os\ TC}$	Input Offset Voltage Average Drift	$-40^\circ\text{C to }125^\circ\text{C}$			2		$\mu\text{V}/^\circ\text{C}$
$I_B$	Input Bias Current		$25^\circ\text{C}$		1	10	pA
$I_{os}$	Input Offset Current		$25^\circ\text{C}$		1	10	pA
$V_{cm}$	Common-Mode Voltage Range	$V_S= 5.5\text{V}$	$25^\circ\text{C}$	-0.1		5.6	V
CMRR	Common-Mode Rejection Ratio	$V_S= 5.5\text{V}$ , $V_{cm}=-0.1\text{V to }4\text{V}$	$25^\circ\text{C}$	71	90		dB
			$-40^\circ\text{C to }125^\circ\text{C}$	68			
		$V_S= 5.5\text{V}$ , $V_{cm}=-0.1\text{V to }5.6\text{V}$	$25^\circ\text{C}$	60	80		
			$-40^\circ\text{C to }125^\circ\text{C}$	57			
<b>OUTPUT</b>							
AOL	Open-Loop Voltage Gain	$R_L=2\text{K}\Omega$ , $V_o=0.15\text{V to }4.85\text{V}$	$25^\circ\text{C}$	94	105		dB
			$-40^\circ\text{C to }125^\circ\text{C}$	85			
		$R_L=10\text{K}\Omega$ , $V_o=0.05\text{V to }4.95\text{V}$	$25^\circ\text{C}$	100	110		
			$-40^\circ\text{C to }125^\circ\text{C}$	90			
	Output Swing From Rail	$R_L=2\text{K}\Omega$	$25^\circ\text{C}$		25		mV
		$R_L=10\text{K}\Omega$			8		
$I_{out}$	Output Short-Circuit Current		$25^\circ\text{C}$		55		mA

FREQUENCY RESPONSE							
SR	Slew Rate		25°C		0.5		V/us
GBP	Gain-Bandwidth Product		25°C		1.1		MHz
PM	Phase Margin		25°C		64		°
ts	Setting Time,0.1%				1.3		us
	Overload Recovery Time	$V_{IN} \cdot Gain \geq V_s$			2.3		us
NOISE							
en	Input Voltage Noise Density	f = 1KHz	25°C		22		nV/ $\sqrt{Hz}$
		f = 10KHz	25°C		20		nV/ $\sqrt{Hz}$
ENABLE/SHUTDOWN(CBM8541,CBM8542)							
$I_{Q(OFF)}$	Supply Current in Shutdown		25°C		<1		uA
t <sub>OFF</sub>			25°C		3		us
t <sub>ON</sub>			25°C		20		us
V <sub>L</sub>	Shut Down		25°C	V-		(V-) +0.8	V
V <sub>H</sub>	Amplifier Is Active		25°C	(V-) +2		V+	V

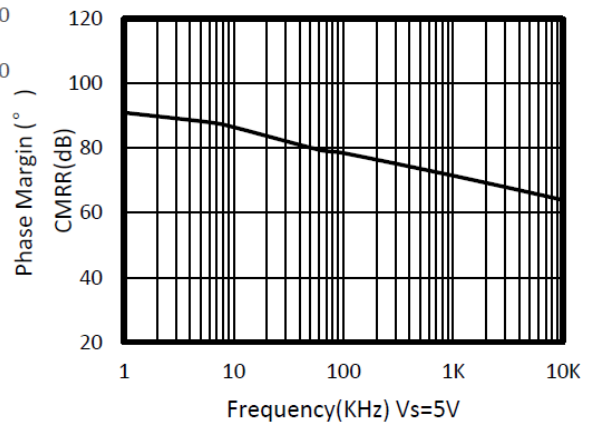
## TYPICAL CHARACTERISTICS

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.

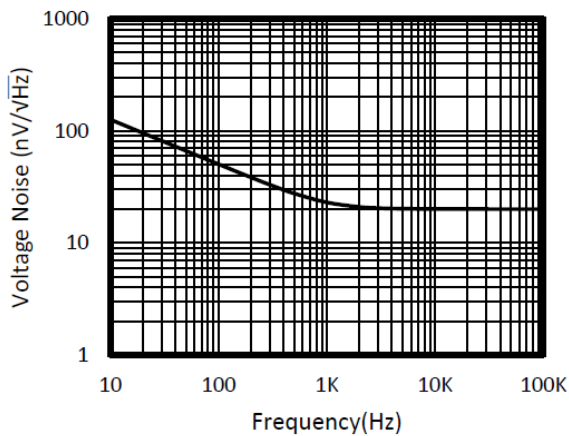
OPEN-LOOP GAIN AND PHASE vs FREQUENCY



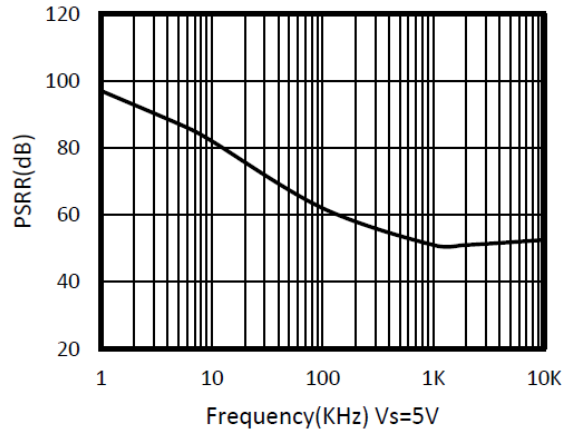
COMMON-MODE REJECTION RATIO vs FREQUENCY



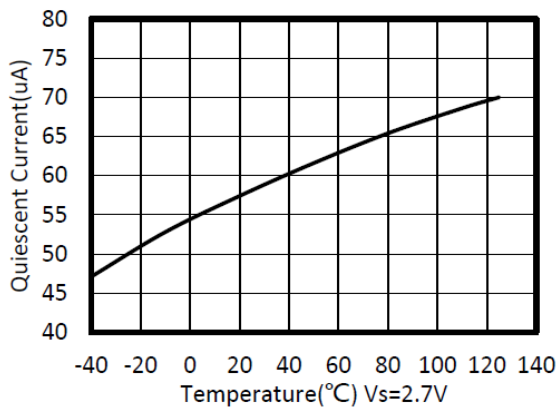
INPUT VOLTAGE NOISE SPECTRAL DENSITY vs FREQUENCY



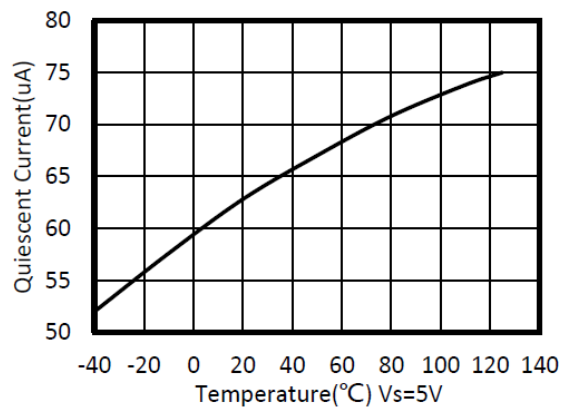
POWER-SUPPLY REJECTION RATIO vs FREQUENCY



QUIESCENT CURRENT vs TEMPERATURE

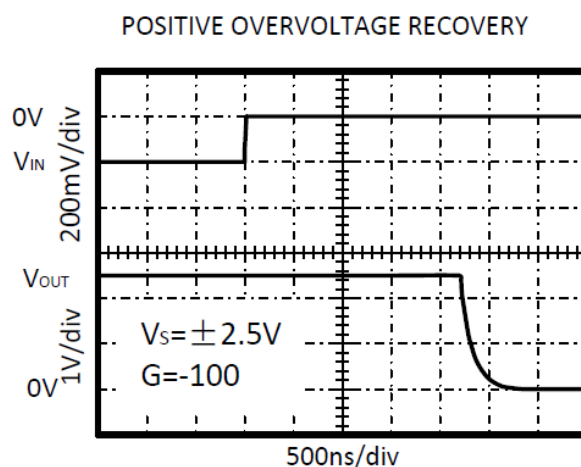
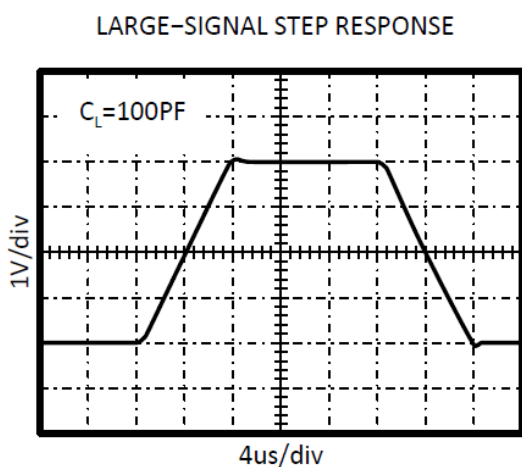
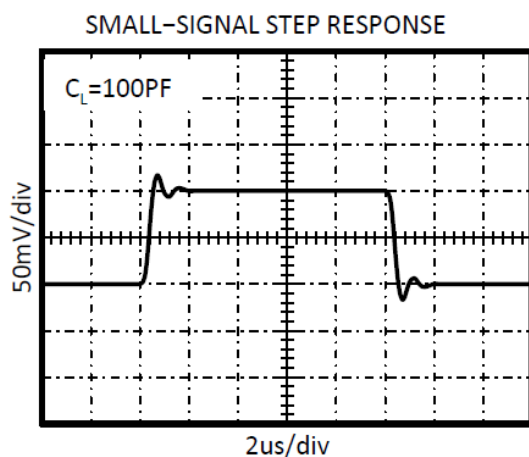
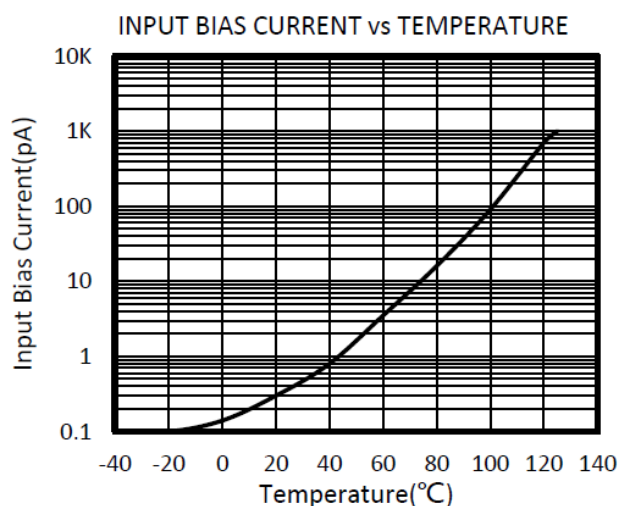
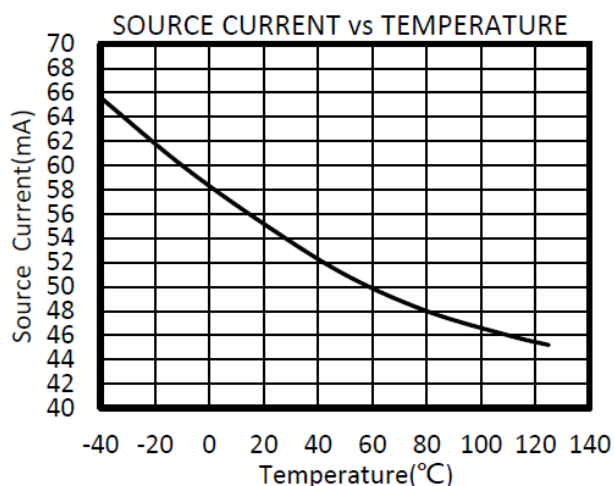
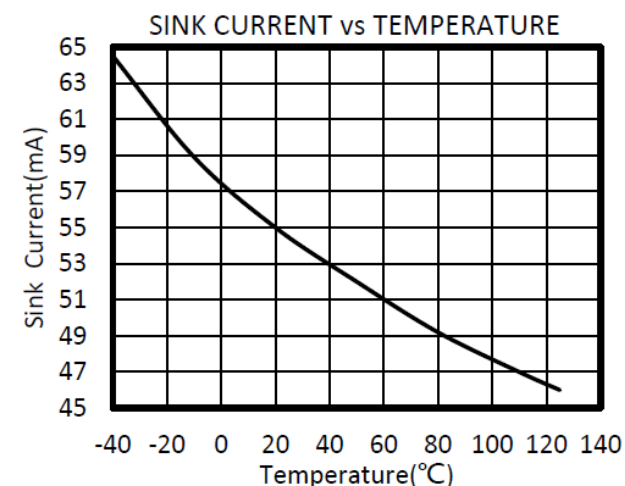


QUIESCENT CURRENT vs TEMPERATURE



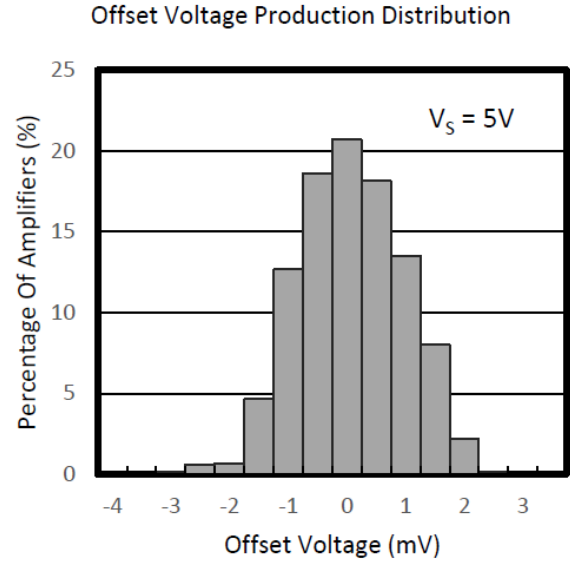
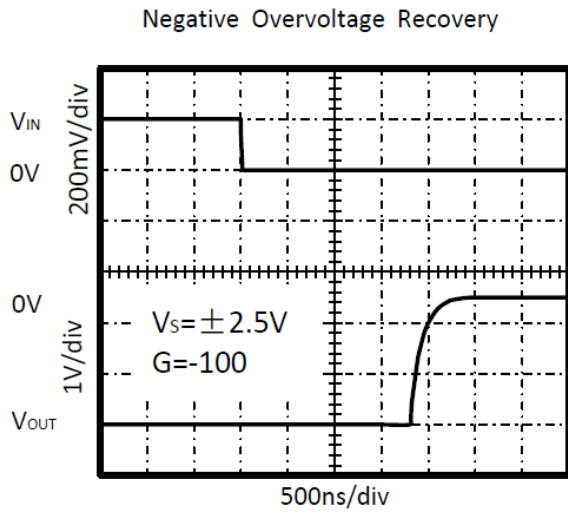
## TYPICAL CHARACTERISTICS

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.



## 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

The CBM8541, CBM8542, CBM8544 are high precision, rail-to-rail operational amplifiers that can be run from a single-supply voltage 2.5V to 5.5V ( $\pm 1.25V$  to  $\pm 2.75V$ ). Supply voltages higher than 7V (absolute maximum) can permanently damage the amplifier.

Rail-to-rail input and output swing significantly increases dynamic range, especially in low-supply applications.

Good layout practice mandates use of a 0.1uF capacitor place closely across the supply pins.

## LAYOUT GUIDELINES

Attention to good layout practices is always recommended. Keep traces short. When possible, use a PCB ground plane with surface-mount components placed as close to the device pins as possible. Place a 0.1uF capacitor closely across the supply pins.

These guidelines should be applied throughout the analog circuit to improve performance and provide benefits such as reducing the EMI susceptibility.

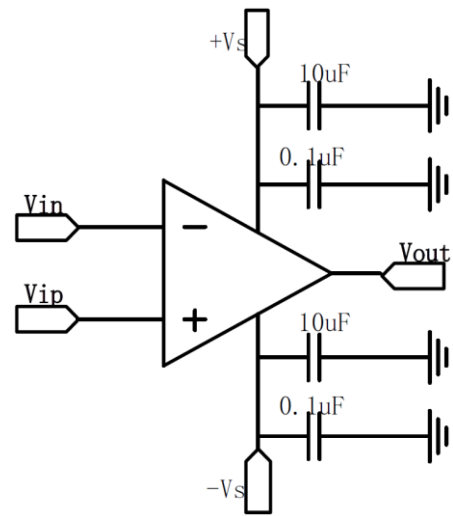


Figure1. Amplifier with Bypass Capacitors

## INSTRUMENTATION AMPLIFIER

In the three-op amp, instrumentation amplifier configuration shown in Figure2.

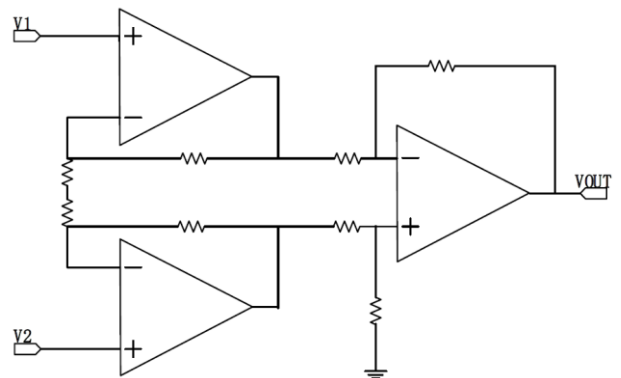
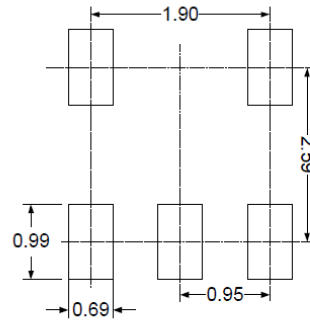
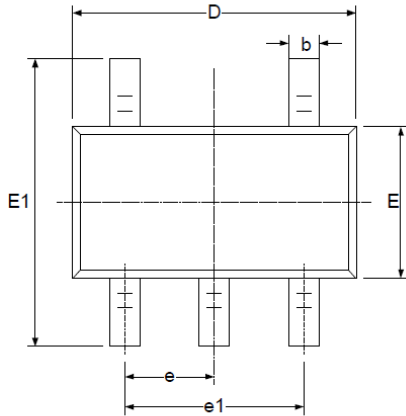


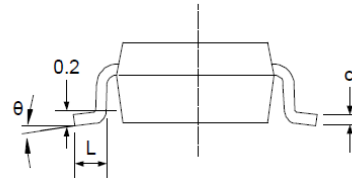
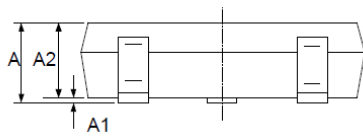
Figure2. Amplifier instrumentation amplifier

## PACKAGE OUTLINE DIMENSIONS

### SOT23-5

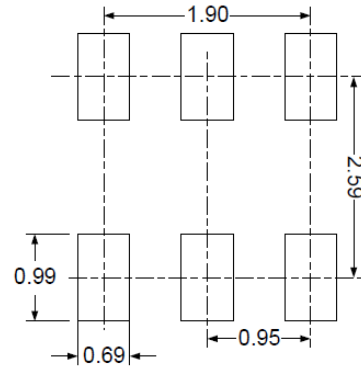
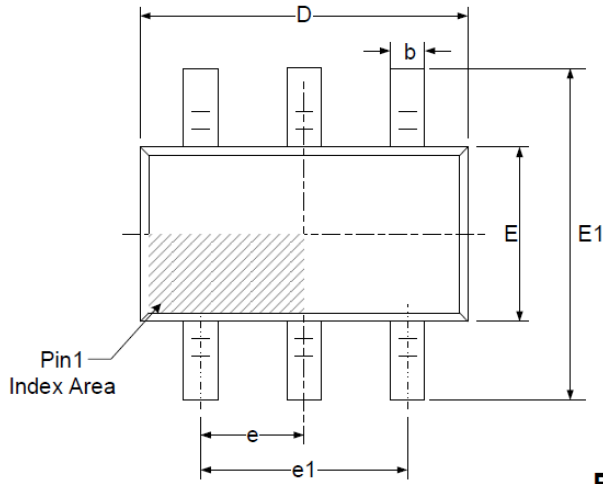


RECOMMENDED LAND PATTERN (Unit: mm)

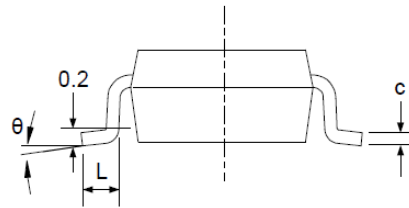
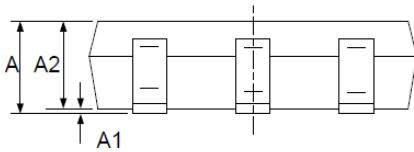


Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC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

## SOT23-6

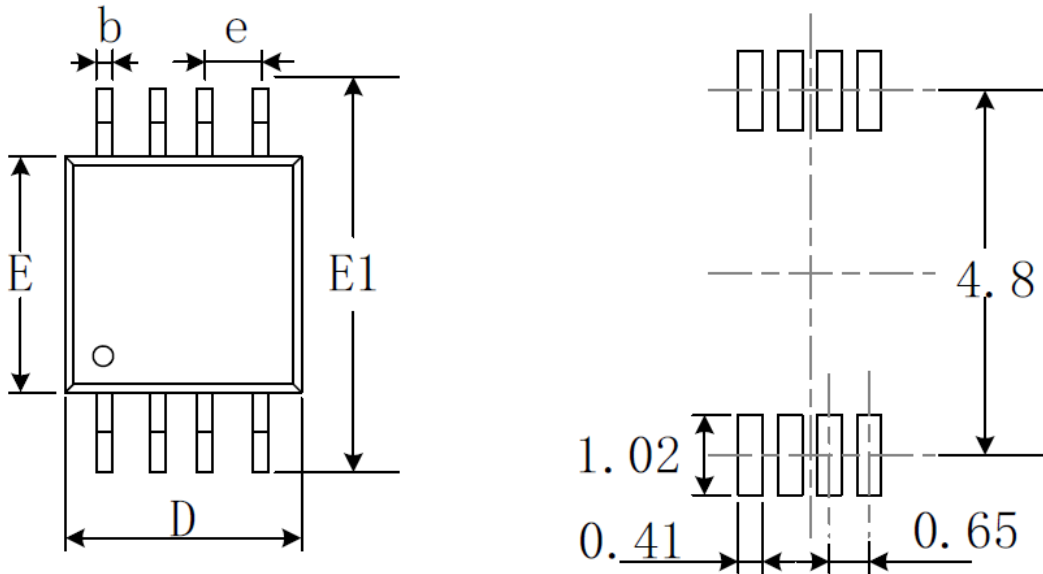


**RECOMMENDED LAND PATTERN (Unit: mm)**

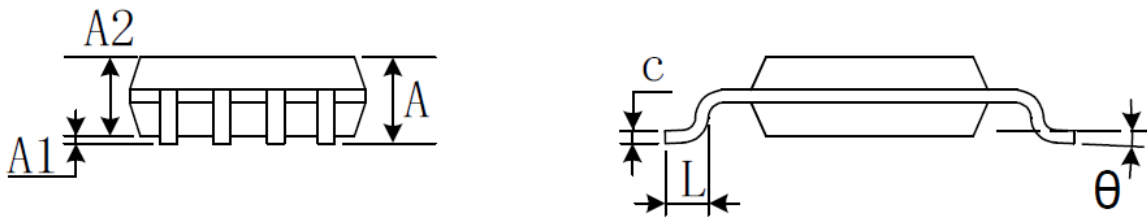


Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC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

## MSOP-8

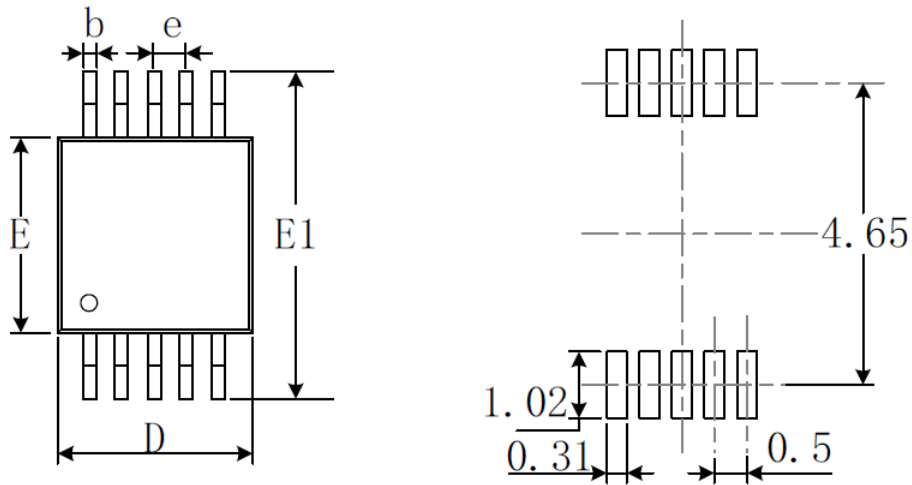


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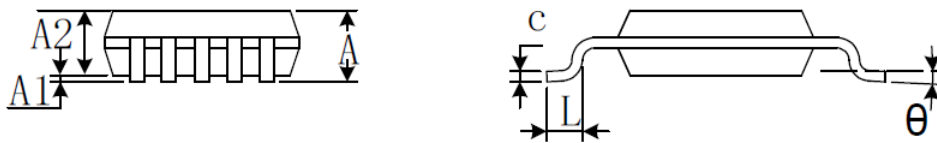


Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026 BSC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

## MSOP-10

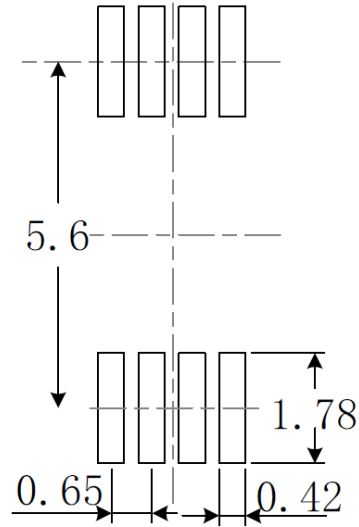
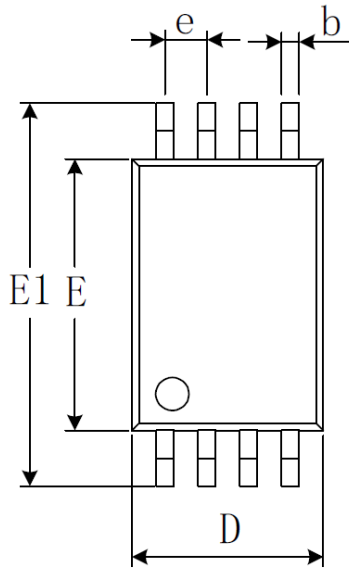


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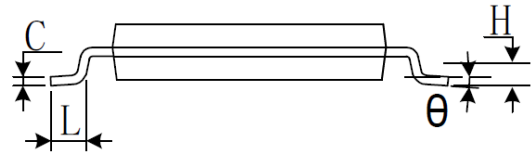
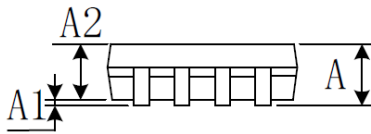


Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.50 BSC		0.020 BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

## TSSOP-8

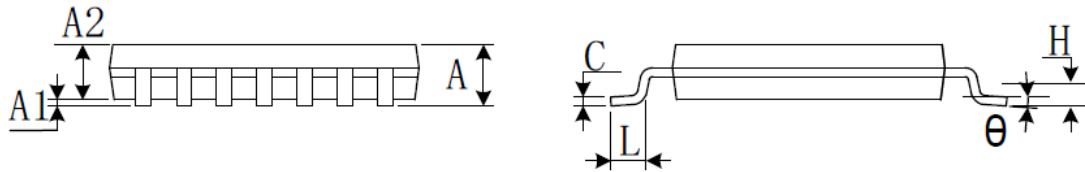
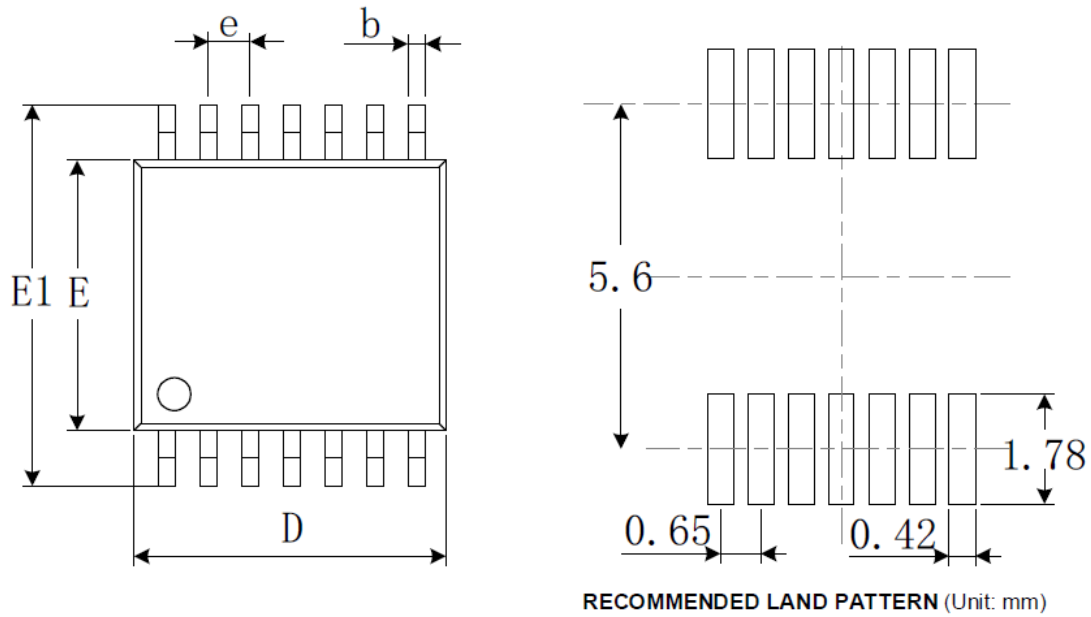


RECOMMENDED LAND PATTERN (Unit: mm)



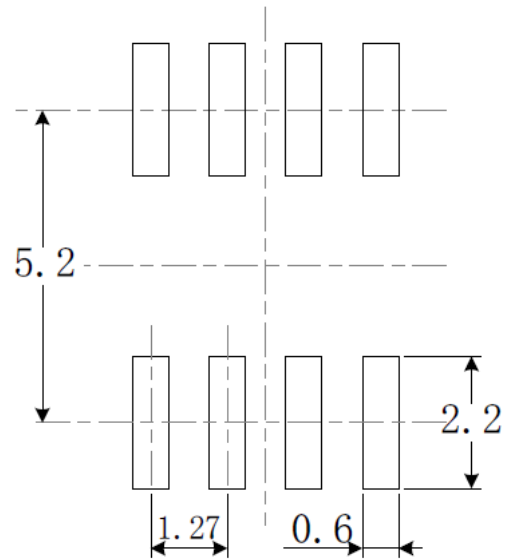
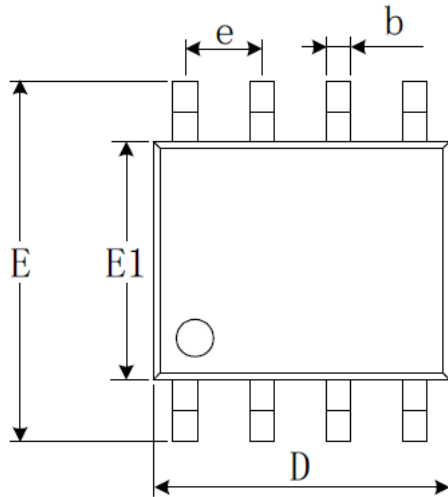
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	2.900	3.100	0.114	0.122
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650 BSC		0.026 BSC	
L	0.500	0.700	0.020	0.028
H	0.25 TYP		0.01 TYP	
$\theta$	1°	7°	1°	7°

## TSSOP-14

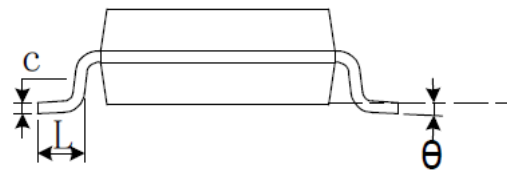
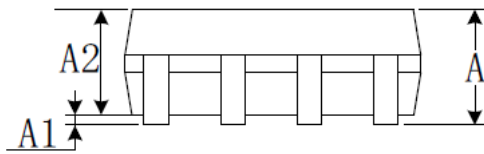


Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650 BSC		0.026 BSC	
L	0.500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

## SOIC-8(SOP8)



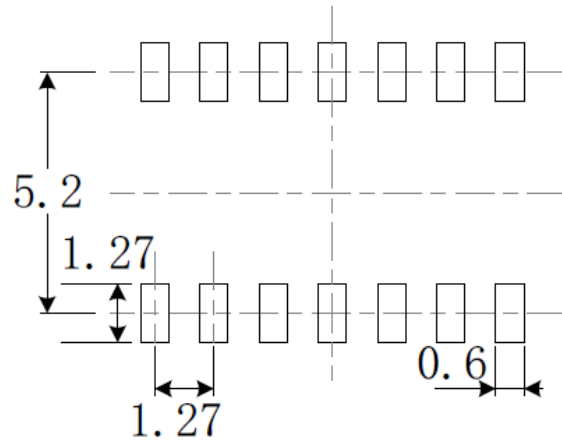
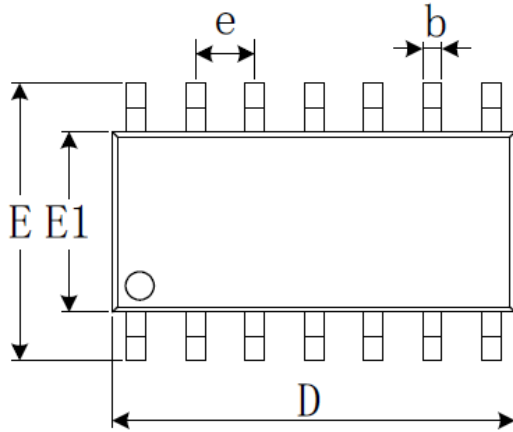
RECOMMENDED LAND PATTERN (Unit: mm)



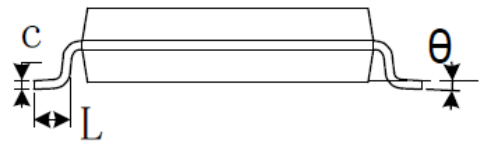
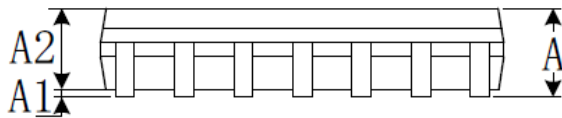
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.800	5.000	0.189	0.197
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC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



## SOIC-14(SOP14)

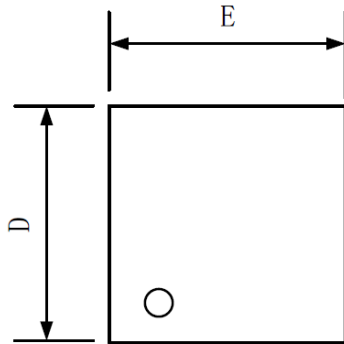


RECOMMENDED LAND PATTERN (Unit: mm)

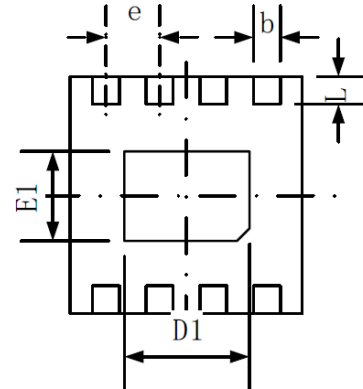


Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	8.450	8.850	0.333	0.348
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
$\theta$	0°	8°	0°	8°

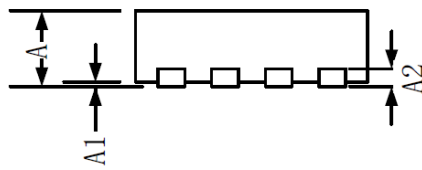
TDFN-2×2-8L



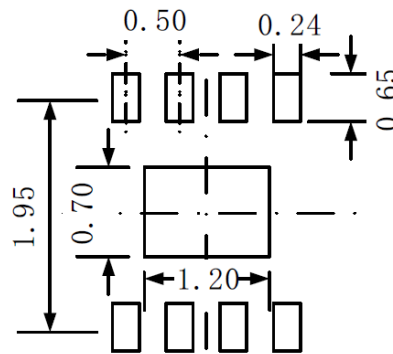
TOP VIEW



BOTTOM VIEW



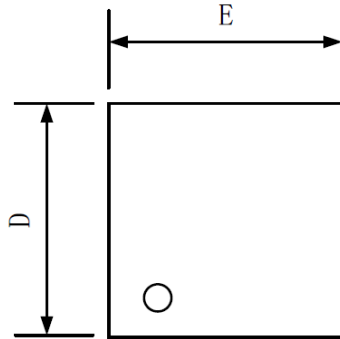
SIDE VIEW



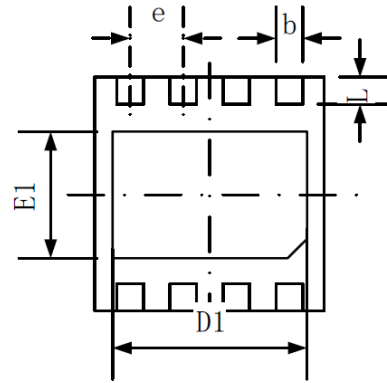
RECOMMENDED LAND  
PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 TYP		0.008 TYP	
b	0.180	0.300	0.007	0.012
D	1.900	2.100	0.075	0.083
D1	1.100	1.300	0.043	0.051
E	1.900	2.100	0.075	0.083
E1	0.600	0.800	0.024	0.031
e	0.500 TYP		0.020 TYP	
L	0.250	0.450	0.010	0.018

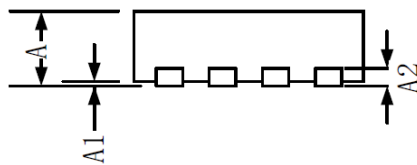
TDFN-3×3-8L



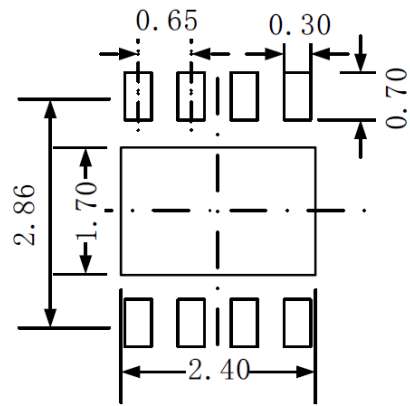
TOP VIEW



BOTTOM VIEW



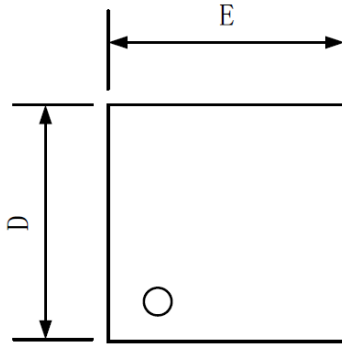
SIDE VIEW



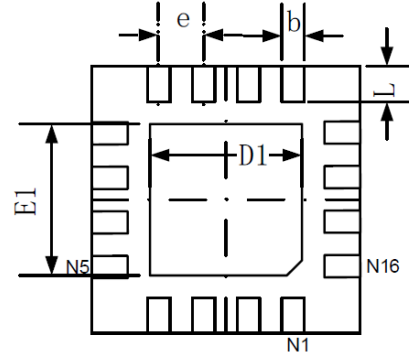
RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 TYP		0.008 TYP	
b	0.250	0.350	0.010	0.014
D	2.900	3.100	0.114	0.122
D1	2.350	2.450	0.093	0.096
E	2.900	3.100	0.114	0.122
E1	1.650	1.750	0.065	0.069
e	0.650 TYP		0.026 TYP	
L	0.370	0.470	0.015	0.019

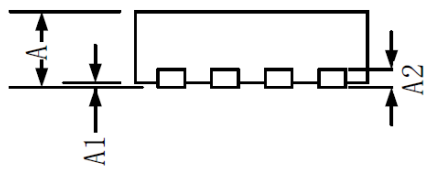
## TQFN-3×3-16L



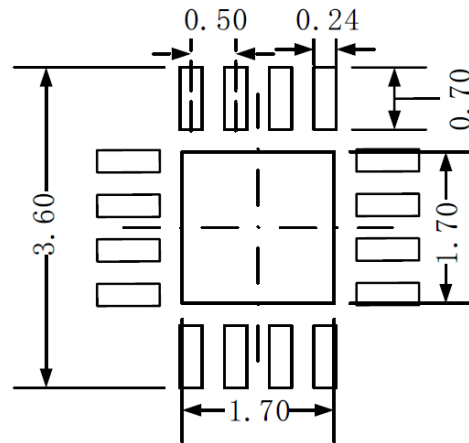
TOP VIEW



BOTTOM VIEW



SIDE VIEW



RECOMMENDED LAND PATTERN  
(Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 TYP		0.008 TYP	
b	0.180	0.300	0.007	0.012
D	2.900	3.100	0.114	0.122
D1	1.600	1.800	0.063	0.071
E	2.900	3.100	0.114	0.122
E1	1.600	1.800	0.063	0.071
e	0.500 TYP		0.020 TYP	
L	0.300	0.500	0.012	0.020

**PACKAGE/ORDERING INFORMATION**

PRODUCT	ORDERING NUMBER	TEMPRANGE	PACKAGE	PAKEAGE MARKING	TRANSPOT MEDIA,QUANTILY
CBM8541	CBM8541AST5	-40°C~125°C	SOT23-5	8541	Reel,3000
	CBM8541ASC7	-40°C~125°C	SC70-5	8541C	Reel,3000
	CBM8541AS8	-40°C~125°C	SOP-8	CBM8541A	Reel,2500
CBM8542	CBM8542AS8	-40°C~125°C	SOP-8	CBM8542A	Reel,2500
	CBM8542AMS8	-40°C~125°C	MSOP-8	8542M	Reel,3000
	CBM8542ATS8	-40°C~125°C	TSSOP-8	8542	Reel,2500
CBM8544	CBM8544AS14	-40°C~125°C	SOP-14	CBM8544AS	Reel,2500
CBM8544Q	CBM8544AST14	-40°C~125°C	TSSOP-14	CBM8544AST	Reel,3000
	CBM8544AQ16	-40°C~125°C	TQFN-3*3-16	CBM8544AQ	Reel,3000

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