

## FEATURES

- HIGH GAIN BANDWIDTH:10MHz
- RAIL-TO-RAIL INPUT AND OUTPUT  
0.9mV Typical Vos
- INPUT VOLTAGE RANGE: -0.1V to +5.6V  
with Vs = 5.5V
- SUPPLY RANGE: +2.5V to +5.5V
- SHUTDOWN: CBMV721S/CBMV722S
- SPECIFIED UP TO +125°C
- MicroSIZE PACKAGES: SOT23-5, SOT23-6

## APPLICATIONS

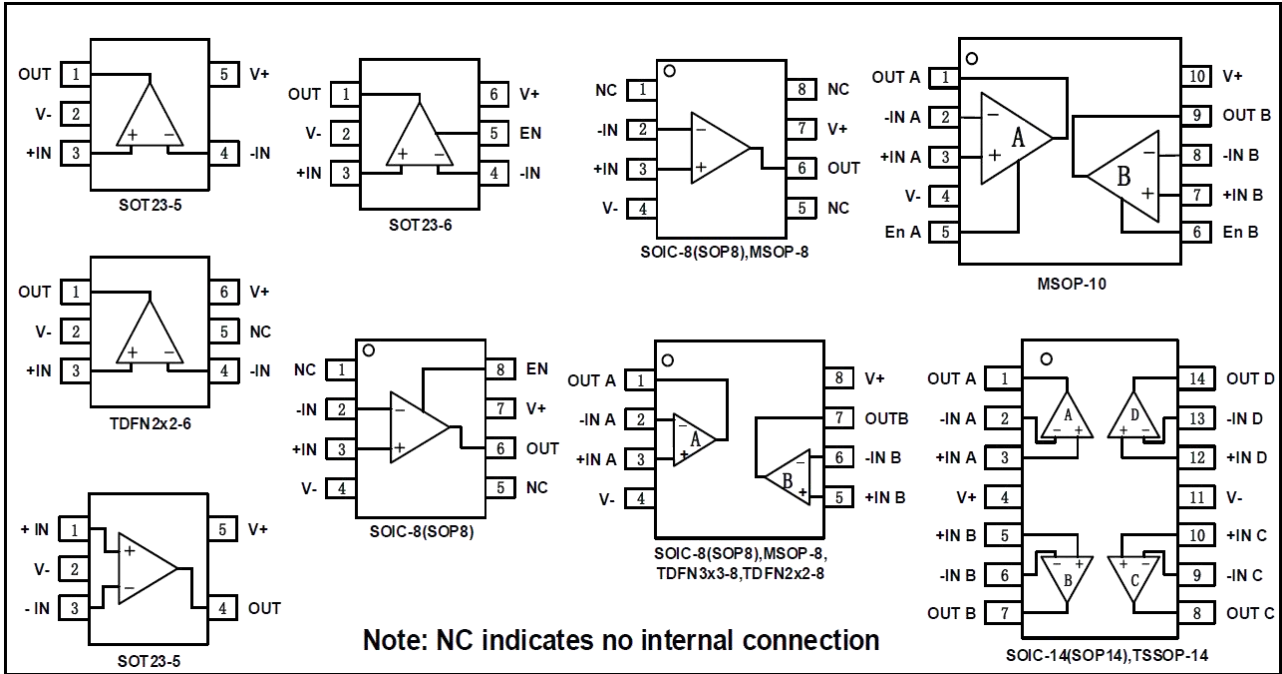
- SENSORS
- PHOTODIODE AMPLIFICATION
- ACTIVE FILTERS
- TEST EQUIPMENT
- DRIVING A/D CONVERTERS

## DESCRIPTION

The CBMV72X 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 (10MHz) and slew rate of 7V/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 CBMV721S, CBMV722S include a shutdown mode. Under logic control, the amplifiers can be switched from normal operation to a standby current that is less than 1uA. The CBMV72X 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 <sup>(1)</sup>

Supply Voltage, V+ to V-	7.0V
Input Terminals, Voltage <sup>(2)</sup> ....	- 0.5 to (V+) + 0.5V
Current <sup>(2)</sup> .....	±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 .....	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

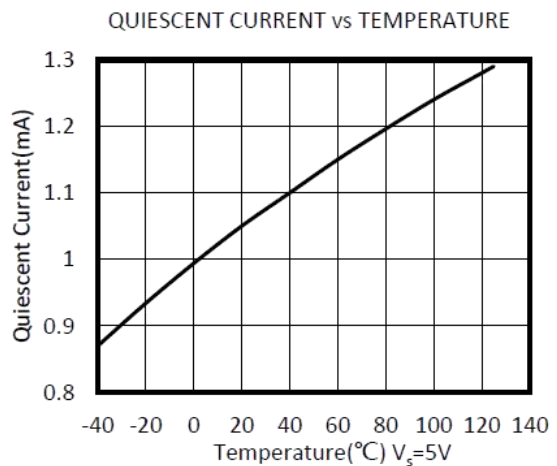
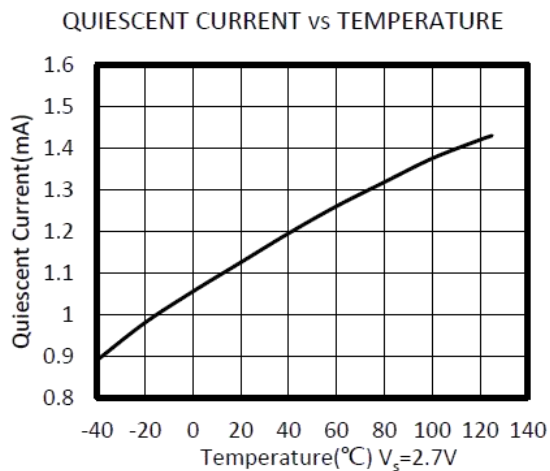
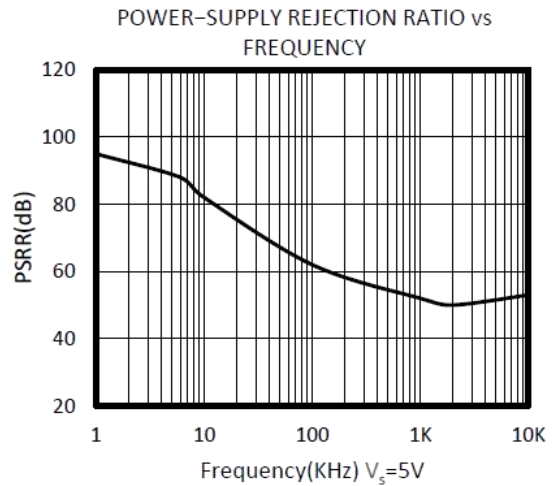
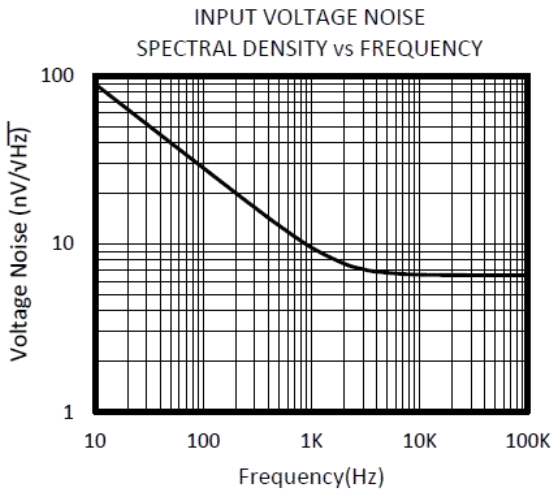
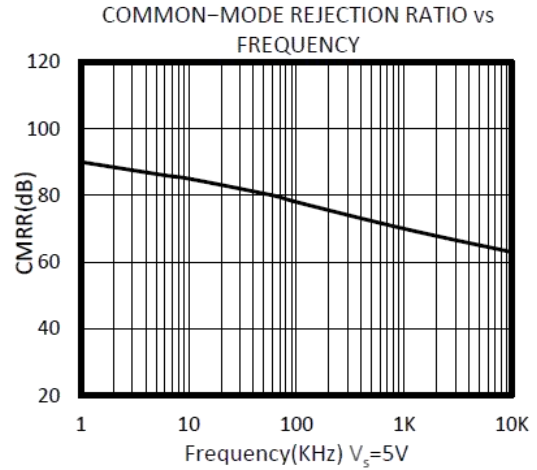
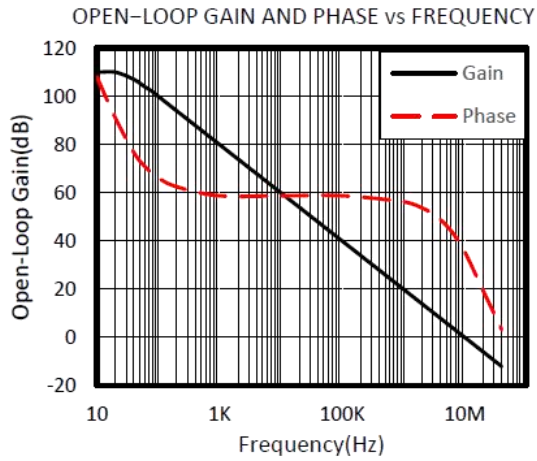
(At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ ,  $R_L = 10\text{k}\Omega$  connected to  $V_S/2$ , and  $V_{OUT} = V_S/2$ , unless otherwise noted.)

PARAMETER	CONDITIONS	$T_J$	CBMV721S,CBMV722S, CBMV721,CBMV722, CBMV724			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	$25^\circ\text{C}$		1.15	1.4	mA
PSRR	Power-Supply Rejection Ratio	$V_S = 2.5\text{V to } 5.5\text{V}$ , $V_{cm} = (V_-) + 0.5\text{V}$	$25^\circ\text{C}$	75	85	dB
			$-40^\circ\text{C to } 125^\circ\text{C}$	65		
<b>INPUT</b>						
$V_{OS}$	Input Offset Voltage	$25^\circ\text{C}$		0.5	2.5	mV
$V_{OS\ TC}$	Input Offset Voltage Average Drift	$-40^\circ\text{C to } 125^\circ\text{C}$		2.6		$\mu\text{V}/^\circ\text{C}$
$I_B$	Input Bias Current	$25^\circ\text{C}$		1	10	pA
$I_{OS}$	Input Offset Current	$25^\circ\text{C}$		1	10	pA

V <sub>cm</sub>	Common-Mode Voltage Range	V <sub>s</sub> = 5.5V	25°C	-0.1	5.6	V
CMRR	Common-Mode Rejection Ratio	V <sub>s</sub> = 5.5V, V <sub>cm</sub> =-0.1V to 4V	25°C	73	85	dB
			-40°C to 125°C	67		
		V <sub>s</sub> = 5.5V, V <sub>cm</sub> =-0.1V to 5.6V	25°C	60	75	
			-40°C to 125°C	57		
<b>OUTPUT</b>						
AOL	Open-Loop Voltage Gain	R <sub>L</sub> =2KΩ, V <sub>o</sub> =0.15V to 4.85V	25°C	86	95	dB
			-40°C to 125°C	65		
		R <sub>L</sub> =10KΩ, V <sub>o</sub> =0.05V to 4.95V	25°C	90	96	
			-40°C to 125°C	66		
	Output Swing From Rail	R <sub>L</sub> =2KΩ	25°C		52	mV
		R <sub>L</sub> =10KΩ			7	
I <sub>out</sub>	Output Short-Circuit Current		25°C		70	mA
<b>FREQUENCY RESPONSE</b>						
SR	Slew Rate		25°C		7	V/us
GBP	Gain-Bandwidth Product		25°C		10	MHz
PM	Phase Margin		25°C		62	°
t <sub>s</sub>	Setting Time,0.1%				0.2	us
	Overload Recovery Time	V <sub>IN</sub> ·Gain≥V <sub>S</sub>			0.35	us
<b>NOISE</b>						
e <sub>n</sub>	Input Voltage Noise Density	f=1 KHz	25°C		9.5	nV/√Hz
		f=10KHz	25°C		6.5	nV/√Hz
<b>ENABLE/SHUTDOWN(CBM721S,CBM722S)</b>						
I <sub>Q(OFF)</sub>	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

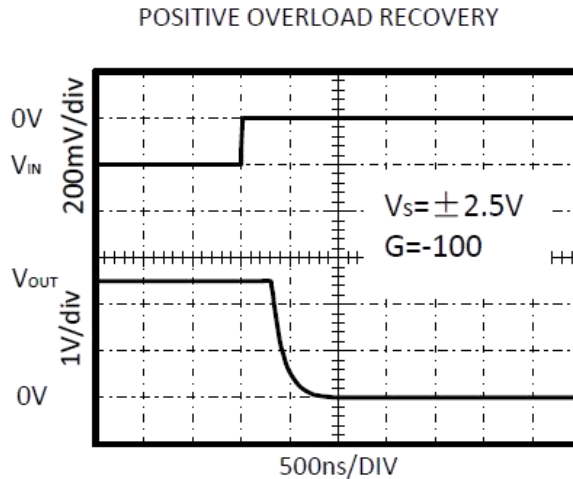
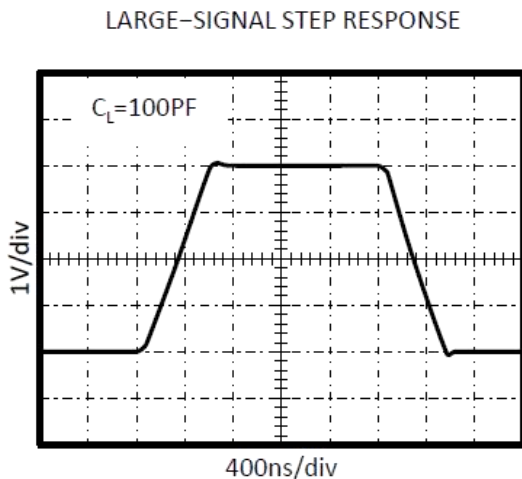
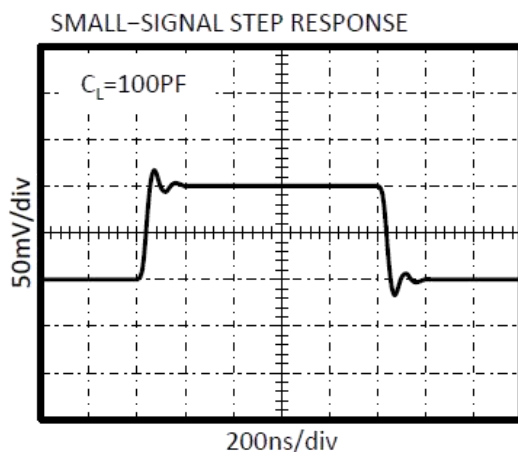
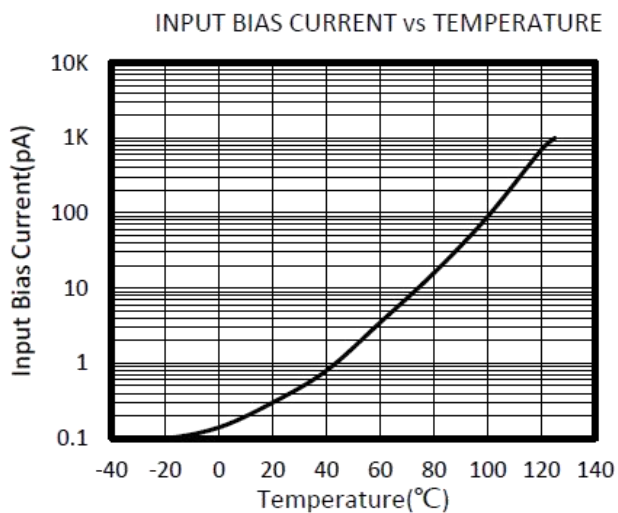
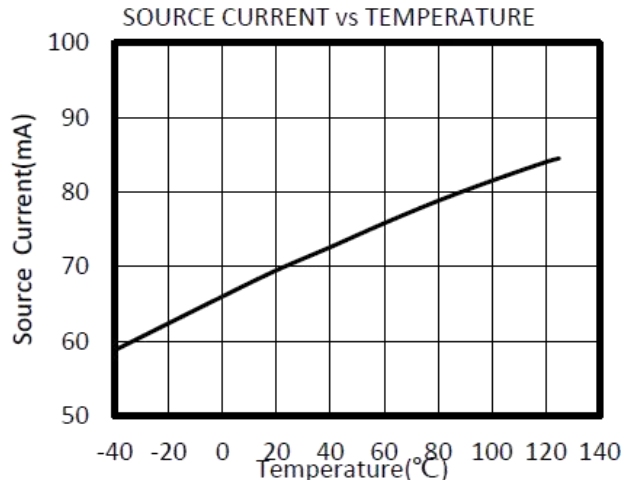
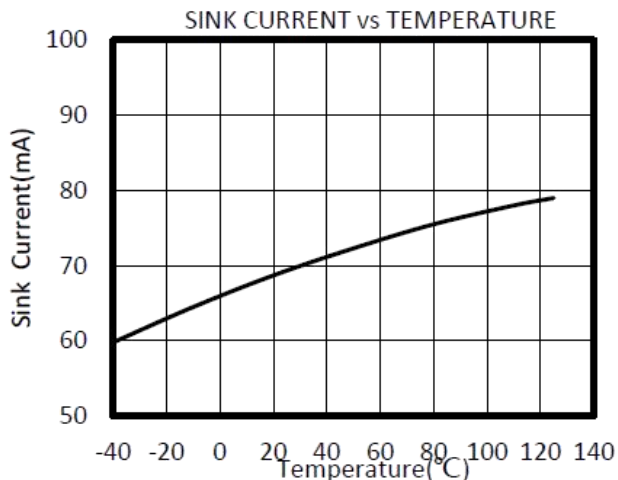
## TYPICAL CHARACTERISTICS

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.



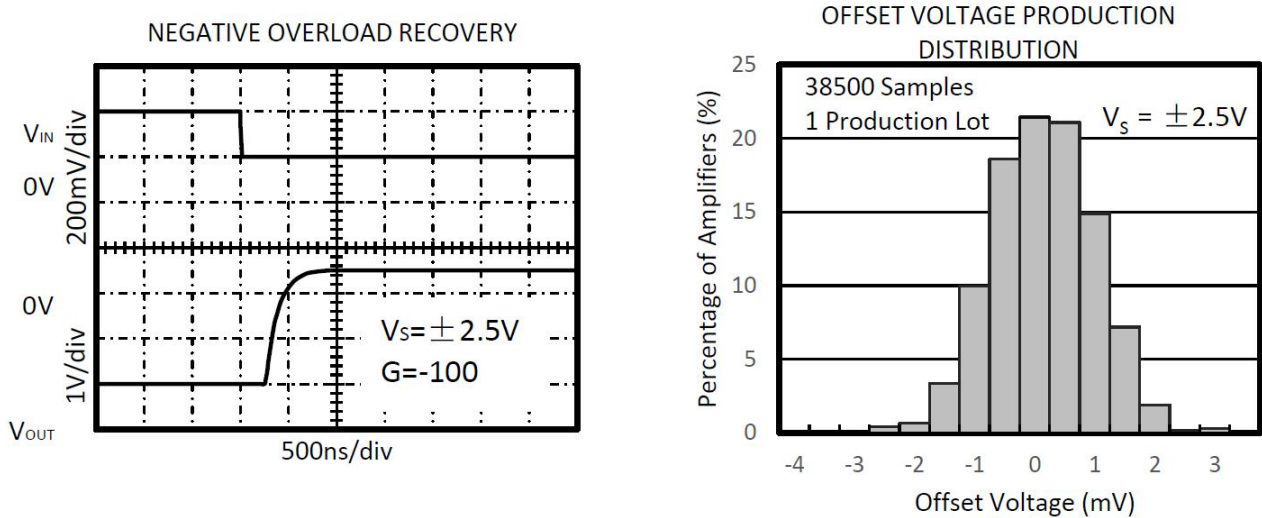
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### APPLICATION NOTES

The CBMV721, CBMV722, CBMV724, CBMV721S, CBMV722S are high precision, rail-to-rail operational amplifiers that can be run from a single-supply voltage 2.5V to 5.5V ( $\pm 1.25\text{V}$  to  $\pm 2.75\text{V}$ ). 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.

### CBMV721S/CBMV722S ENABLE FUNCTION

The CBMV721S/CBMV722S includes a shutdown mode. Under logic control, the amplifiers can be switched from normal mode to a standby current of 1uA. When the Enable pin is connected to high, the amplifier is active. Connecting Enable low disables the amplifier, and places the amplifier, and place the output in a high-impedance state.

## LAYOUT GUIDELINS

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.

## INSTRUMENTATION AMPLIFIER

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

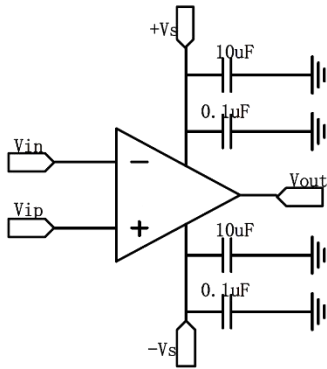


Figure1. Amplifier with Bypass Capacitors

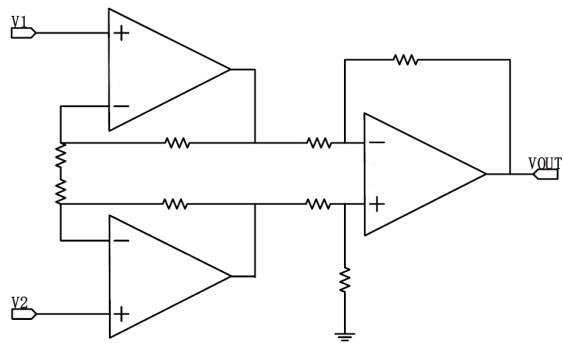
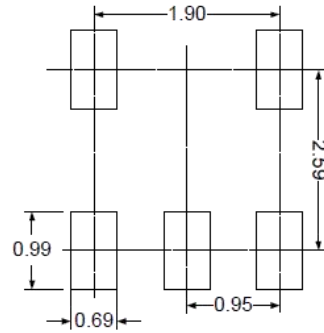
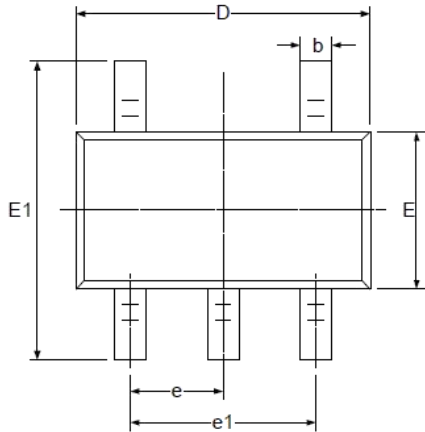


Figure2. Amplifier instrumentation amplifier

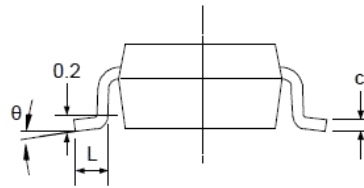
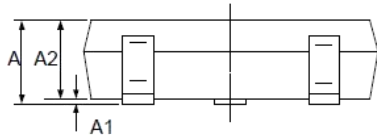


## PACKAGE OUTLINE DIMENSIONS

### SOT23-5

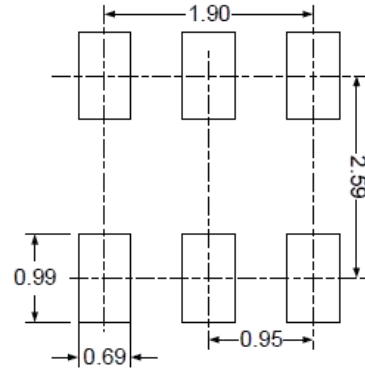
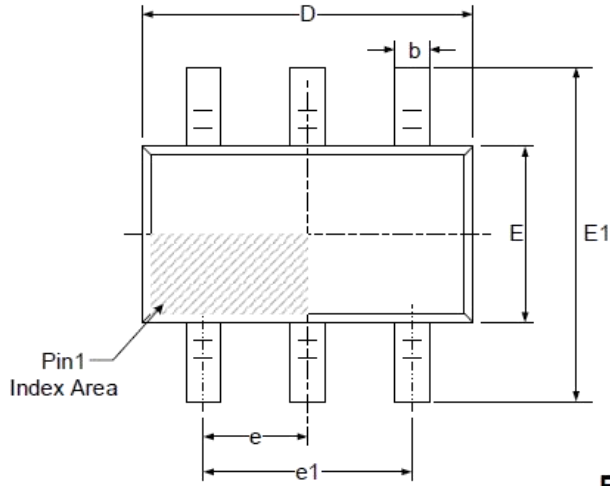


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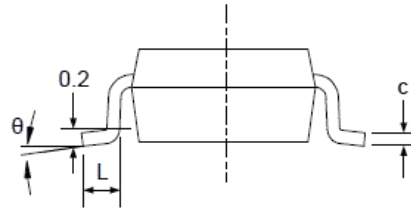
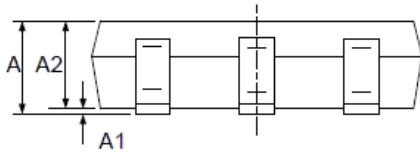


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 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

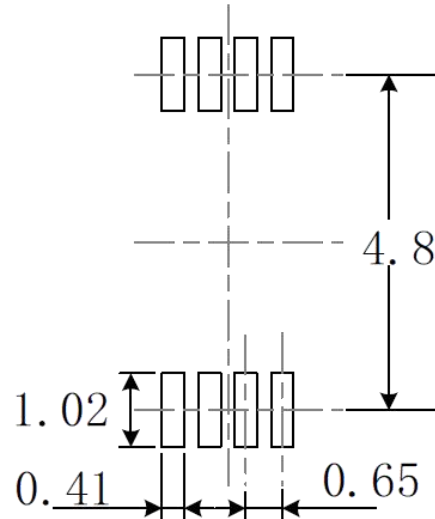
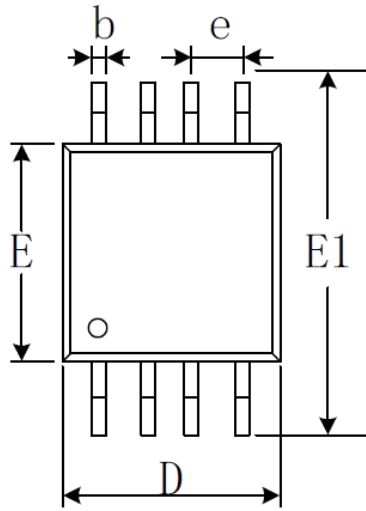


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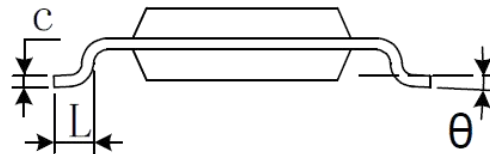
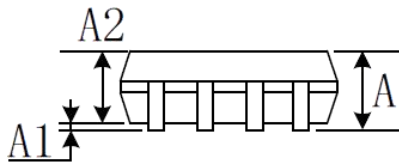


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
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E	1.500	1.700	0.059	0.067
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e	0.950 BSC		0.037 BSC	
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L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

MSOP-8

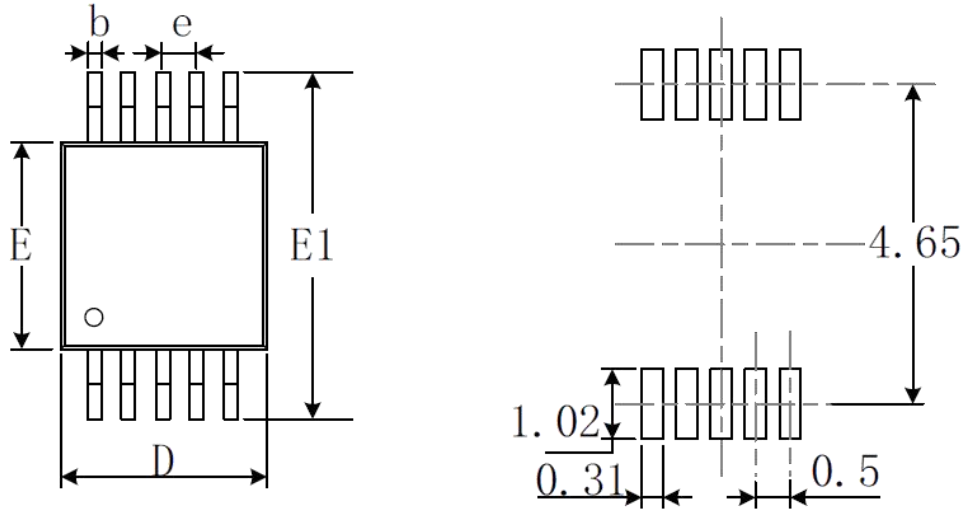


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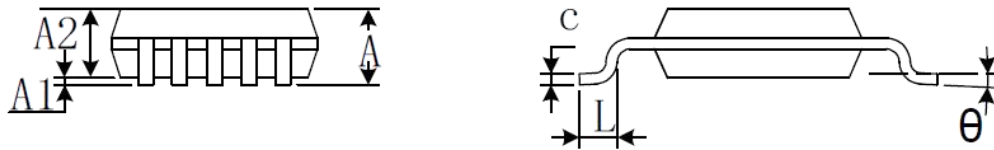


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026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

## MSOP-10

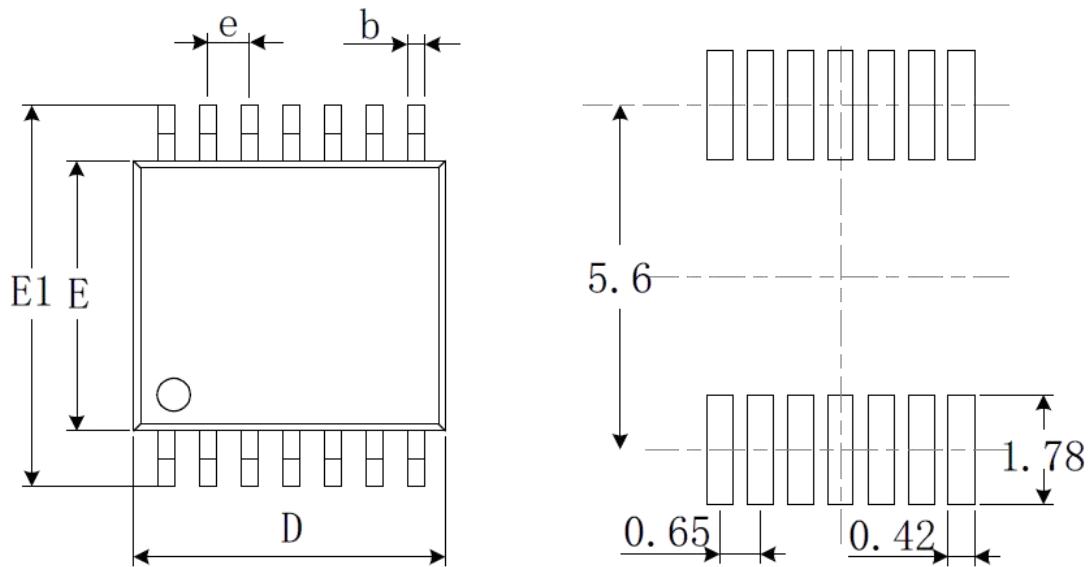


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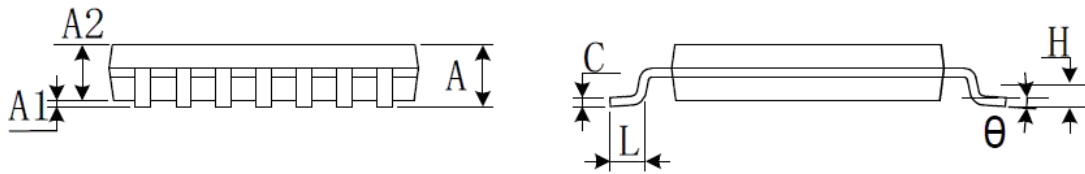


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.50 BSC		0.020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

## TSSOP-14

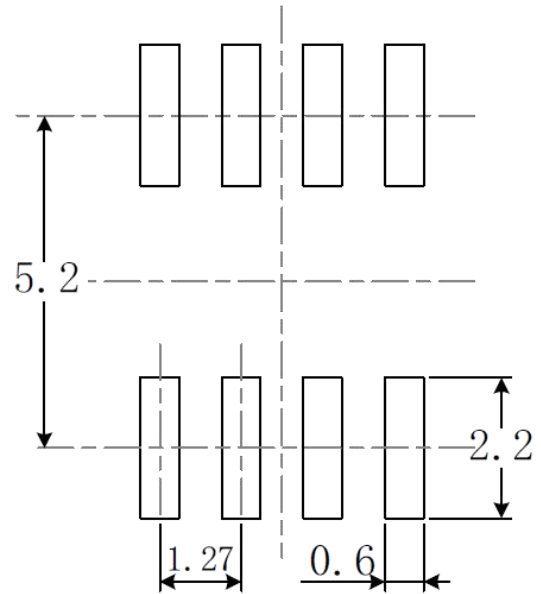
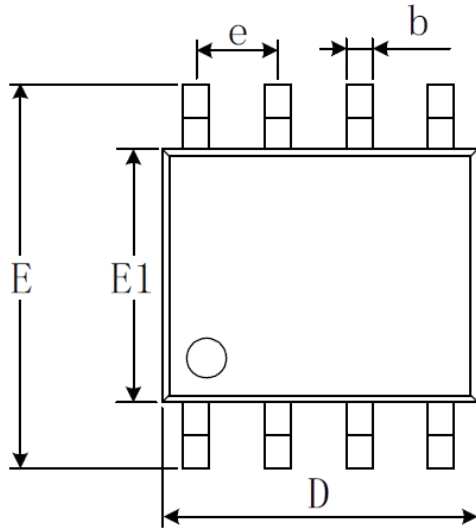


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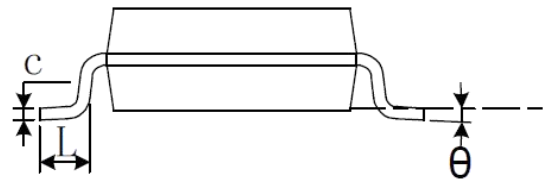
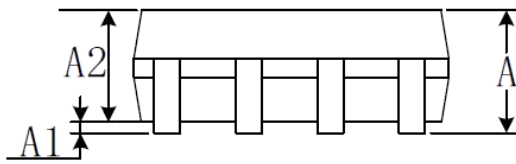


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650 BSC		0.026 BSC	
L	0.500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

SOIC-8(SOP8)

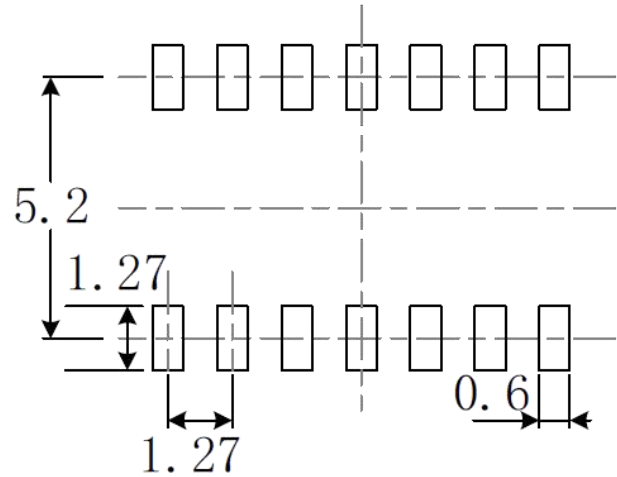
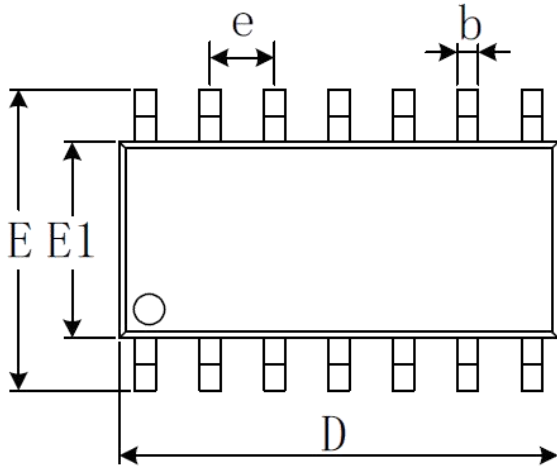


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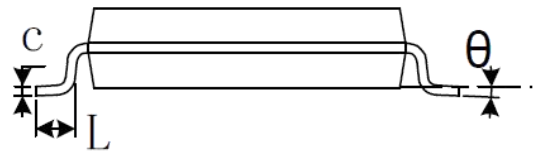
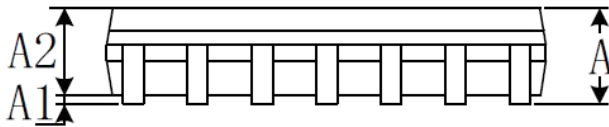


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.800	5.000	0.189	0.197
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050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

SOIC-14(SOP14)

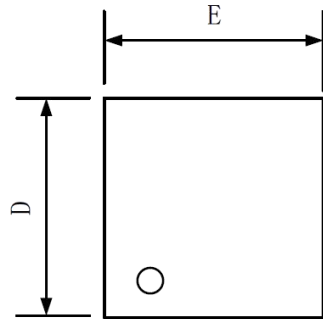


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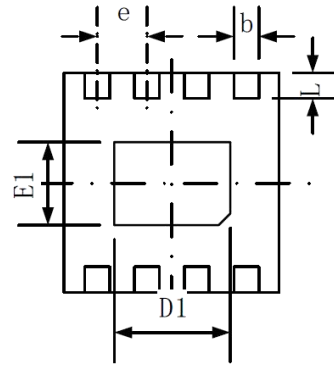


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	MIN	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	8.450	8.850	0.333	0.348
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
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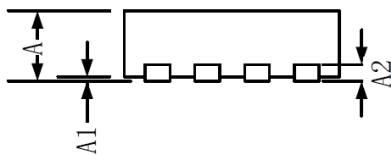
TDFN-2x2-8



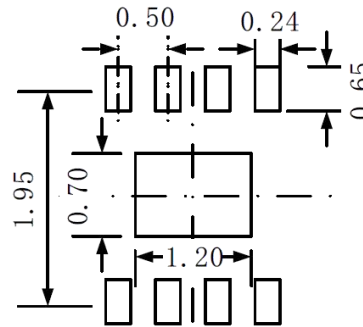
TOP VIEW



BOTTOM VIEW



SIDE VIEW

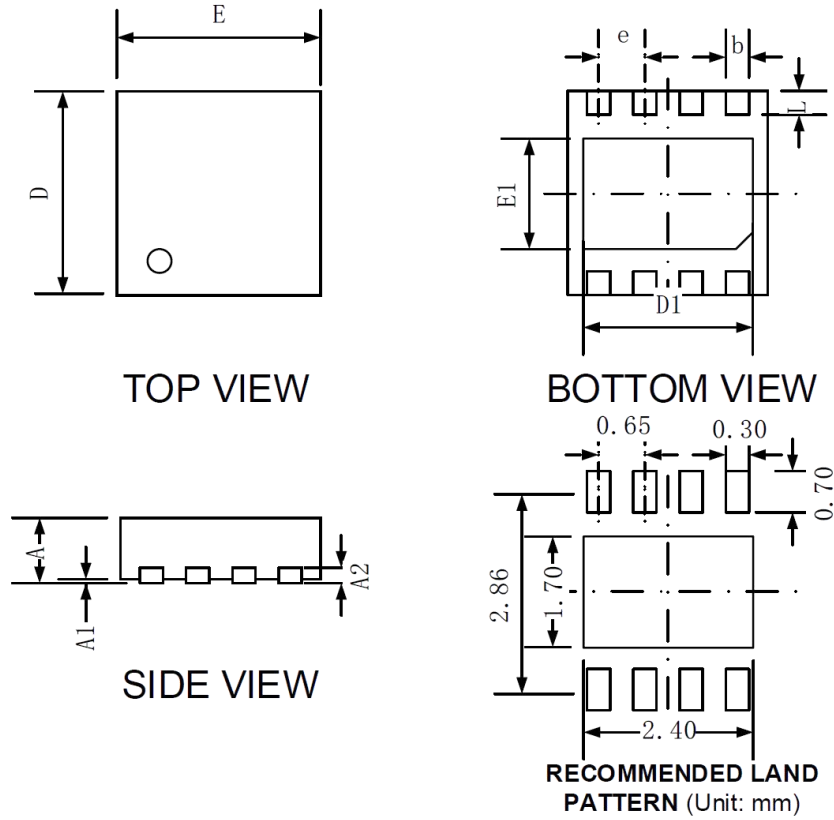


RECOMMENDED LAND  
PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In 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

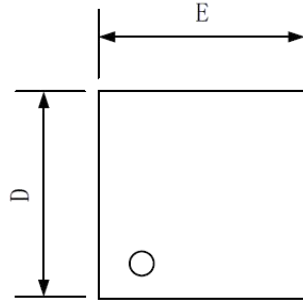


TDFN-3x3-8

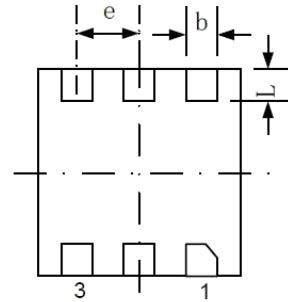


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	Max	Min	Max
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203		0.008	
b	0.300	0.400	0.012	0.016
D	2.900	3.100	0.114	0.122
D1	2.510	2.610	0.099	0.103
E	2.900	3.100	0.114	0.122
E1	1.550	1.650	0.061	0.065
e	0.650 TYP		0.026 TYP	
L	0.350	0.450	0.014	0.018

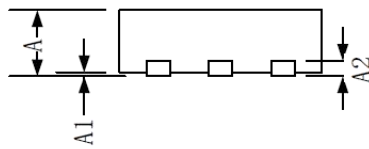
**TDFN2x2-6**



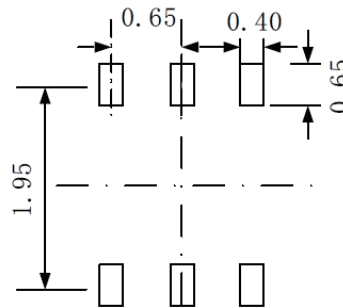
**TOP VIEW**



**BOTTOM VIEW**



**SIDE VIEW**



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

Symbol	Dimensions In Millimeters		Dimensions In 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	0.012
D	1.900	2.100	0.075	0.083
E	1.900	2.100	0.075	0.083
e	0.650 TYP		0.026 TYP	
L	0.250	0.400	0.010	0.018

### PACKAGE/ORDERING INFORMATION

PRODUCT	ORDERING NUMBER	TEMPRANGE	PACKAGE	PAKEAGE MARKING	TRANSPOT MEDIA,QUANTILY
CBMV721	CBMV721AS8	-40°C~125°C	SOIC-8(SOP8)	CBMV721	Tape and Reel,2500
	CBMV721AST5	-40°C~125°C	SOT23-5	721	Tape and Reel,3000
	CBMV721BST5	-40°C~125°C	SOT23-5	721B	Tape and Reel,3000
	CBMV721AMS8	-40°C~125°C	MSOP-8	CBMV721	Tape and Reel,3000
	CBMV721ATDE6	-40°C~125°C	TDFN2x2-6	721	Tape and Reel,3000
CBMV721S	CBMV721SA8	-40°C~125°C	SOIC-8(SOP8)	CBMV721S	Tape and Reel,2500
	CBMV721SAT6	-40°C~125°C	SOT23-6	721S	Tape and Reel,3000
CBMV722	CBMV722AS8	-40°C~125°C	SOIC-8(SOP8)	CBMV722	Tape and Reel,2500
	CBMV722AMS8	-40°C~125°C	MSOP-8	CBMV722	Tape and Reel,3000
	CBMV722ATDE8	-40°C~125°C	TDFN2x2-8	CBMV722	Tape and Reel,3000
	CBMV722ATDC8	-40°C~125°C	TDFN3x3-8	CBMV722	Tape and Reel,3000
CBMV722S	CBMV722SA8	-40°C~125°C	MSOP-10	CBMV722S	Tape and Reel,3000
CBMV724	CBMV724AS14	-40°C~125°C	SOIC-14(SOP14)	CBMV724	Tape and Reel,2500
	CBMV724AST14	-40°C~125°C	TSSOP-14	CBMV724	Tape and Reel,3000

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