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# Product Specification

## XBLW LM324

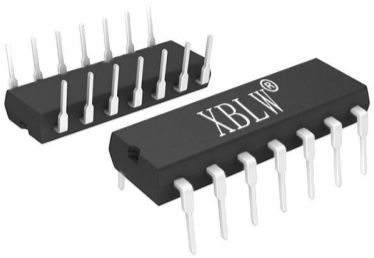
Quad Operational Amplifier

WEB | www.xinboleic.com

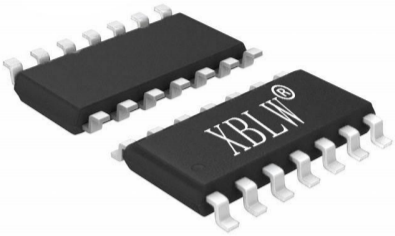
## Descriptions

The LM324 consists of four independent, high gain operational amplifiers with frequency compensation implemented internally.It suits for radio recorders and audio systems as tone equalization network and also used in other situations.

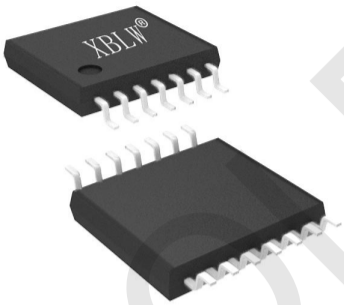
The chip is available in DIP 14 or SOP 14 plastic package.




DIP–14




SOP–14




TSSOP-14

## Feature

- No External Phase Compensation Circuit Required
- Supply Voltage Range:
  Single Power Supply: Vcc = 3V ~ 24V
  Dual Power Supply: Vcc = ±1.5V ~ ±12V
- Low Power Consumption: Icc = 0.6mA (typical) (RL = ∞)
- Input Voltage Range Close To Ground Level

## Applications

- Transducer Amplifiers
- DC Gain Blocks
- Conventional Op Amp Circuits

## Ordering Information

| Product Model | Package Type | Marking | Packing | Packing Qty |
|---|---|---|---|---|
| XBLW LM324N | DIP-14 | LM324N | Tube | 1000pcs/ Box |
| XBLW LM324DTR | SOP-14 | LM324 | Tape | 2500pcs/ Reel |
| XBLW LM324TDTR | TSSOP-14 | LM324 | Tape | 3000pcs/ Reel |

## Principle Introduction

LM324 is composed of four identical operational amplifiers. The unit circuit is shown in the figure. Its working principle is briefly described as follows: The input signal is added to the base of T1 and T4, and after differential amplification; T8 and T9 form the intermediate stage in compound amplification; the output stage is composed of T10 ~ T13. Among them, T12 is a protection tube. When the output current is too large, the voltage drop on R increases, causing T12 to saturate conducting, and the collector potential of T12 decreases to nearly 1/2 Vcc, so that the push-pull tubes T10, T11 and T13 are cut off, thereby playing a protective role. Capacitor C is a phase compensation capacitor.

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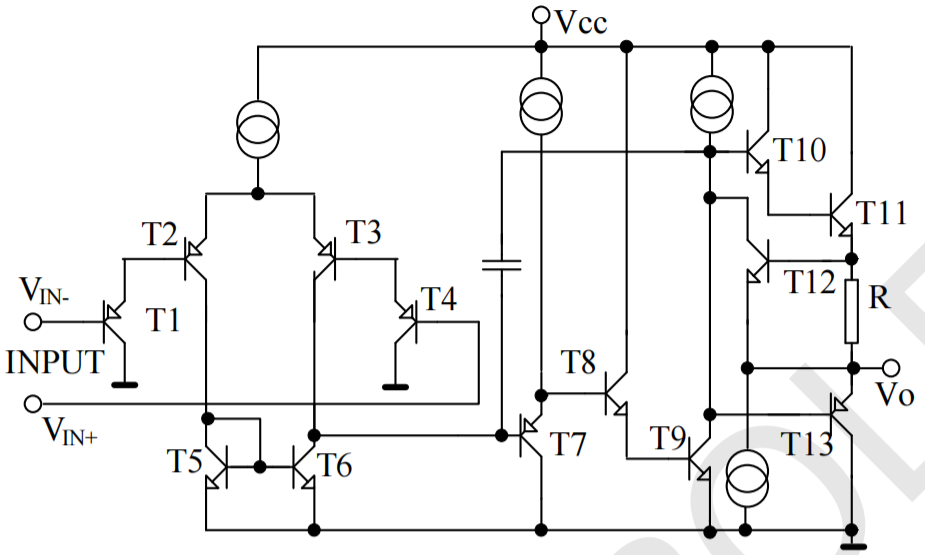
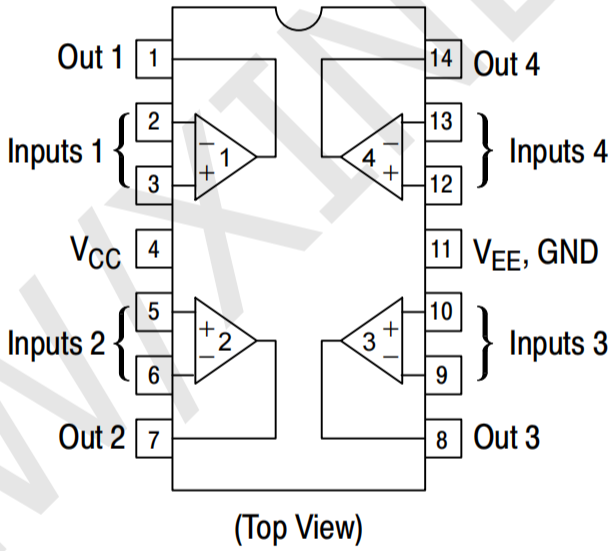
## Circuit Diagram




## Pin Connections




(Top View)

## Pins Configuration

| NO. | Function | Symbol | NO. | Function | Symbol |
|---|---|---|---|---|---|
| 1 | Output 1 | OUT 1 | 8 | Output 3 | OUT 3 |
| 2 | Reverse Input 1 | IN - (1) | 9 | Reverse Input 3 | IN - (3) |
| 3 | Forward Input 2 | IN+ (2) | 10 | Positive Input 3 | IN+ (3) |
| 4 | Power Supply | VCC | 11 | Ground | GND |
| 5 | Forward Input 2 | IN+ (2) | 12 | Positive Input 4 | IN+ (4) |
| 6 | Reverse Input 2 | IN - (1) | 13 | Reverse Input 4 | IN - (4) |
| 7 | Output 2 | OUT 2 | 14 | Output 4 | OUT4 |

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## Absolute Maximum Ratings

TA=25℃,unless otherwise noted

| Parameter Name | Symbol | Test conditions | Rating | Unit |
|---|---|---|---|---|
| Power Supply | Vcc | | 24 | V |
| Differential Input Voltage | $V_{ID}$ | | 24 | V |
| Maximum Input Voltage | $V_{IN}$ | | -0.3~24 | V |
| Allowable Power Dissipation | $P_D$ | | 600 | mW |
| Operating Temperature | Topr | | 0~+70 | ℃ |
| Storage Temperature | Tstg | | -55~+125 | ℃ |

## Electrical Characteristics

Unless otherwise noted,Tamb=25℃,Vcc=5.0V

| Parameters | Symbol | Test conditions | Min. | TYP. | Max. | Unit |
|---|---|---|---|---|---|---|
| Input Offset Voltage | $V_{IO}$ | | | ±2 | ±7 | mV |
| Input Offset Current | $I_{IO}$ | Iin（+）/Iin（-） | | ±5 | ±50 | nA |
| Input Bias Current | $I_{BA}$ | | | 45 | 250 | nA |
| Input Common Mode Voltage Range | $V_{ICM}$ | | 0 | | Vcc-1.5 | V |
| Common Mode Rejection Ratio | $K_{CMR}$ | | 65 | 80 | | dB |
| Strong Signal Voltage Gain | $G_V$ | Vcc=1.5V，RL≥2KΩ | 25 | 100 | | V/mA |
| Output Voltage Range | $V_O$ | | 0 | | Vcc-1.5 | V |
| Power Supply Ripple Rejection Ratio | $P_{SRR}$ | | 65 | 100 | | dB |
| Channel Separation | $C_S$ | f=1kHz~20kHz | | 120 | | dB |
| Current Consumption (1) | $I_{CC}$ | | | 0.6 | 2 | mA |
| Current Consumption (2) | $I_{CC}$ | Vcc=20V | | 1.5 | 3 | mA |
| Output Current (1) | $I_O$ | $V_{in}^+$=1V，$V_{in}^-$=0V | 20 | 40 | | mA |
| Output Current (2) | $I_O$ | $V_{in}^+$=0V，$V_{in}^-$=1V | 10 | 20 | | mA |

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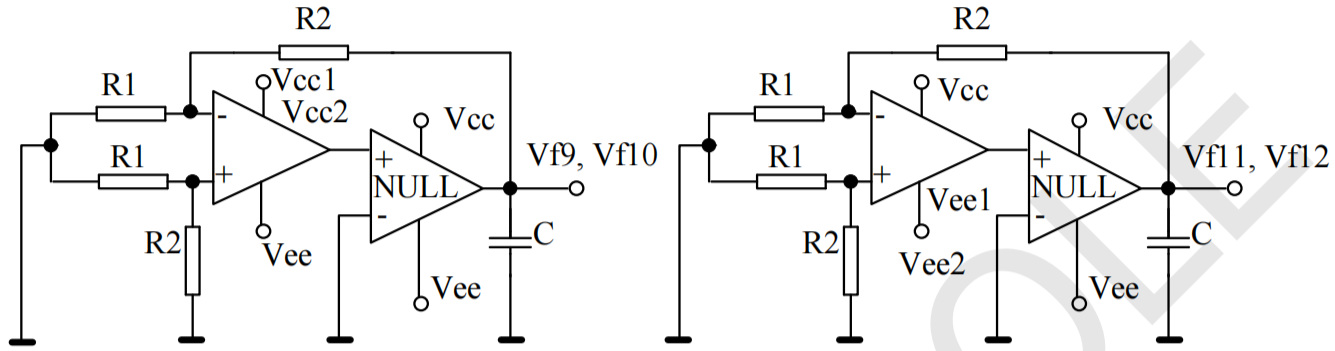
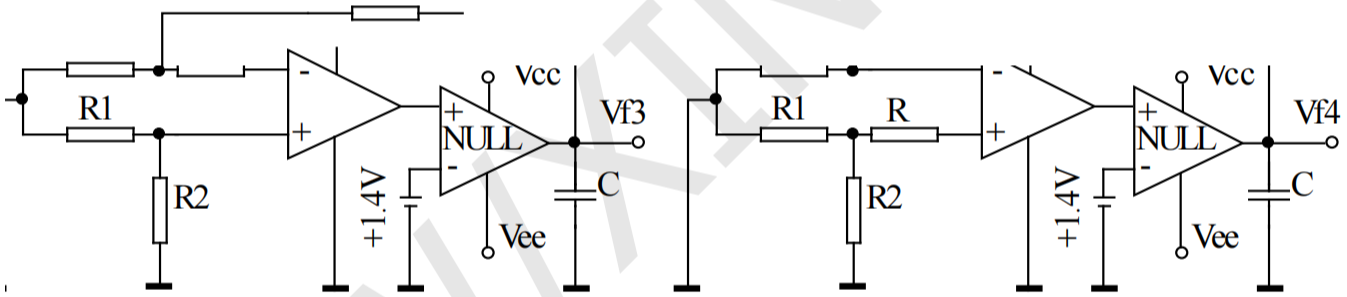
Null refers to the Amplifier.



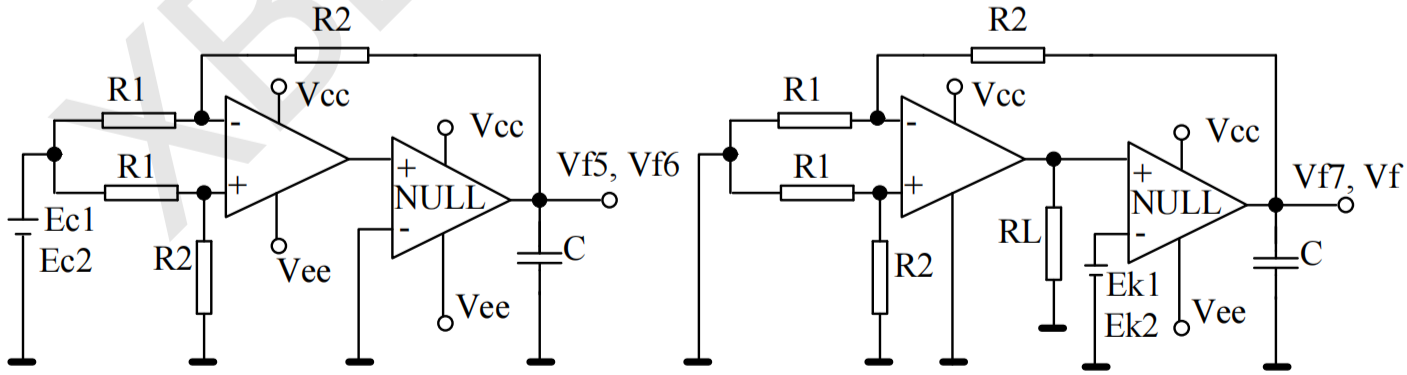

PSRR (+) =20log| (Vcc1-Vcc2) (1+R2/R1) / (Vf9-Vf10) | PSRR (-) =20log| (Vee1-Vee2) (1+R2/R1) / (Vf11-Vf12|

Power ripple rejection ratio PSRR test diagram




IBA= ( Vf4-Vf3 ) /2R ( 1+R2/R1 )

Input bias current IBA test diagram




CMR=20log| (Ec1-Ec2) (1+R2/R1) / (Vf5-Vf6|

Common-mode rejection CMR and common-mode input voltage range VICM test chart

Gv= (Ek1-Ek2) (1+R2/R1) / (Vf8-Vf7)

Voltage gain Gv test diagram

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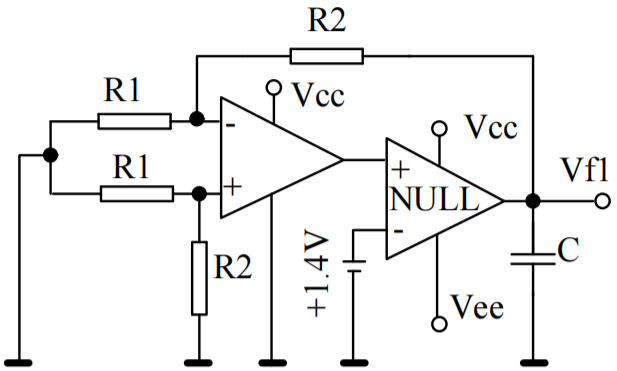
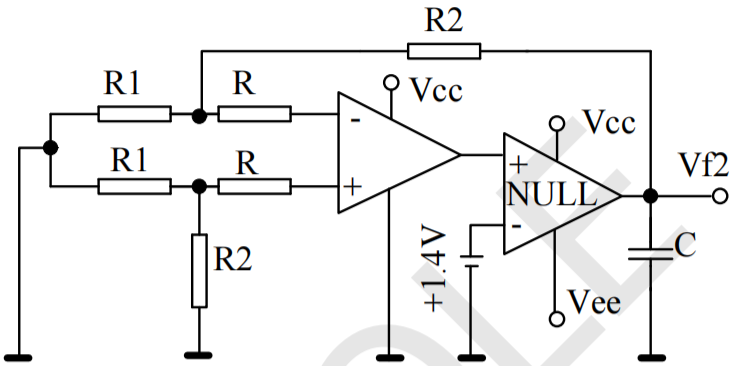


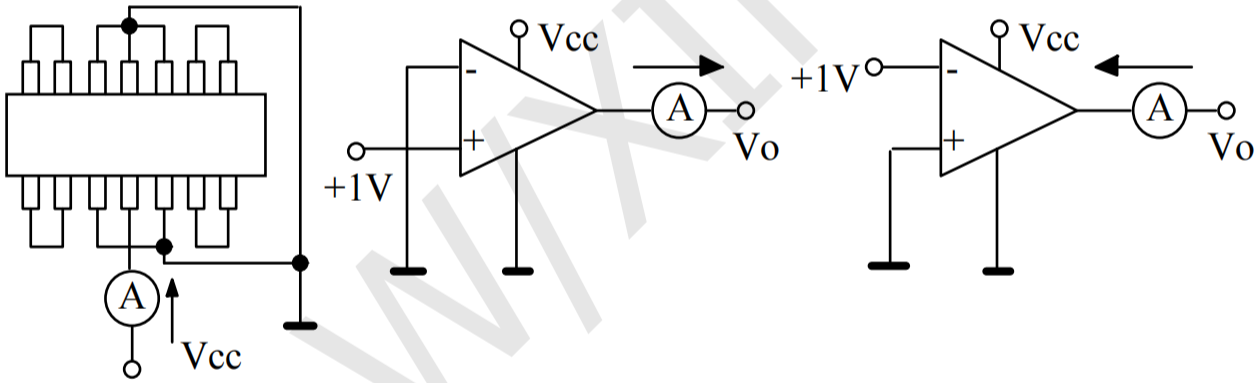

Vio=Vf1/（1+R2/R1）

Input offset voltage Vio test diagram

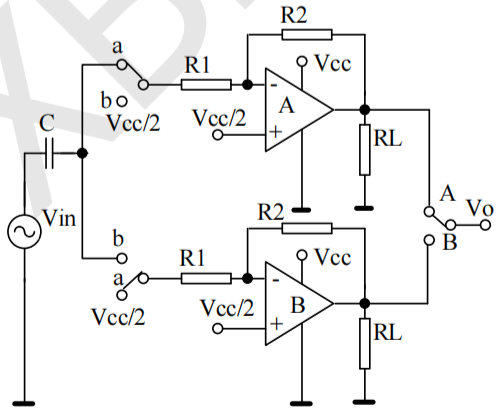



Iio=（Vf2-Vf1）/R（1+R2/R1）

Input offset current Iio test diagram




Consumption current Icc and output current Io test diagram




SW：A

Cs(A → B)=20log(R2 * $V_{OA}$)/(R1 * $V_{OB}$)

SW： B

Cs(B → A)=20log(R2 * $V_{OB}$)/(R1 * $V_{OA}$)

Channel separation Cs test diagram

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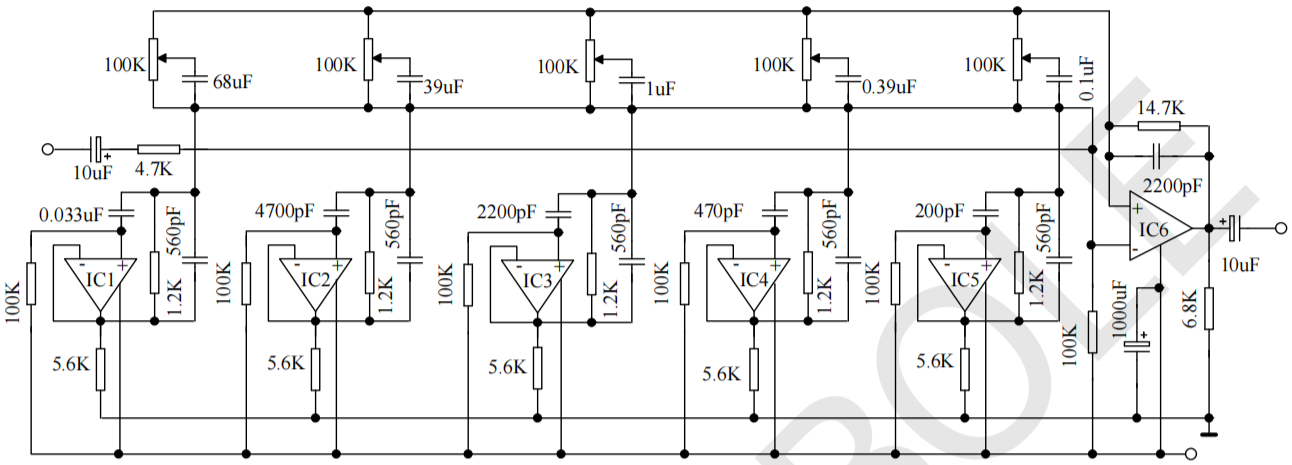
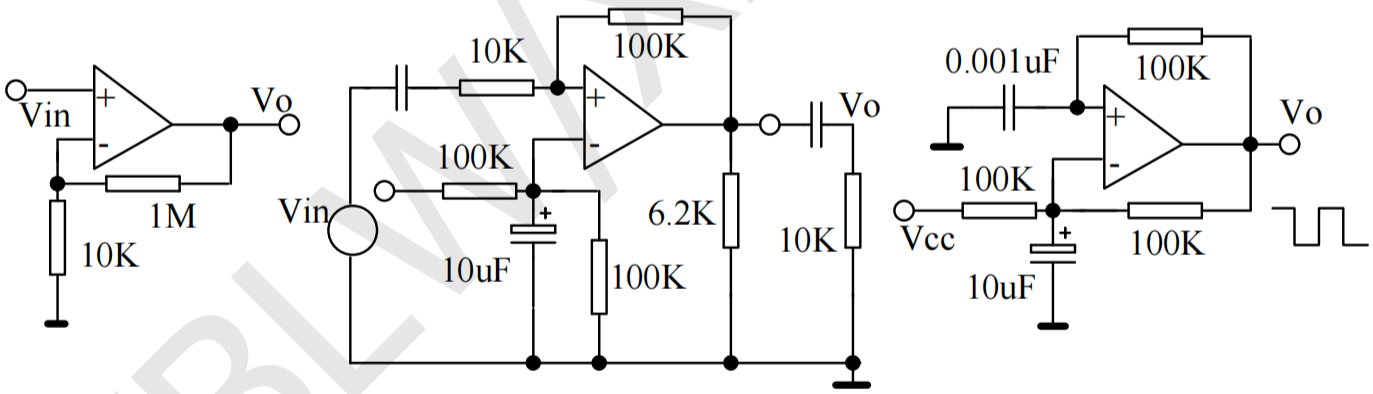
## Applications




The LM324 is used in five-frequency tone control circuits




LM324 Other applications

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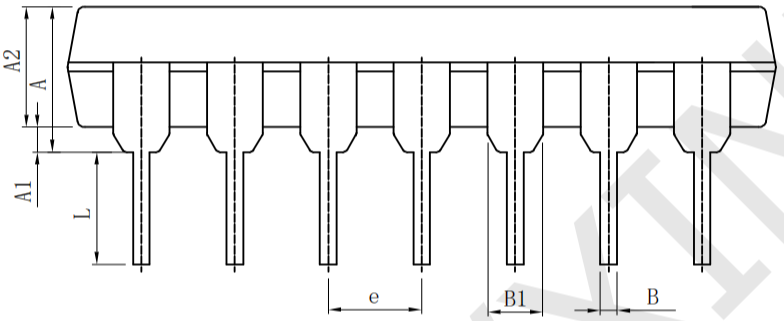
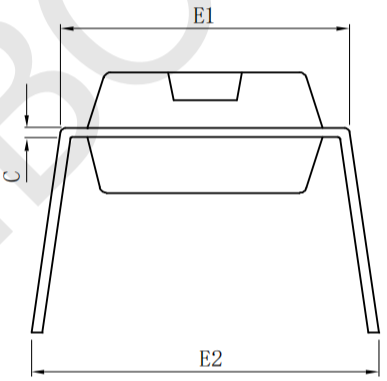
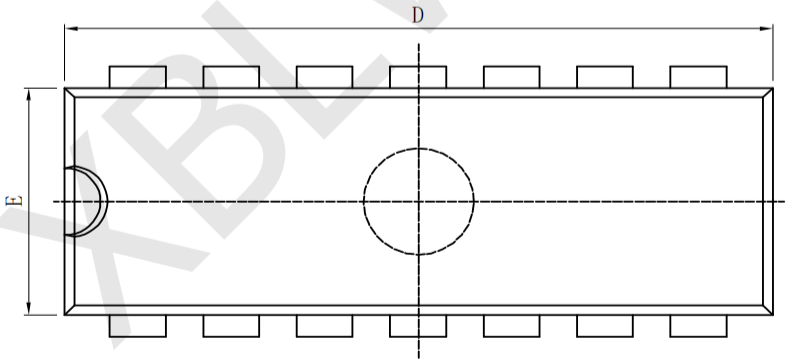
## Package Information

· DIP-14

| Size / Symbol | Dimensions In Millimeters | | Size / Symbol | Dimensions In Inches | |
|---|---|---|---|---|---|
| | Min(mm) | Max(mm) | | Min(in) | Max(in) |
| A | 3.710 | 4.310 | A | 0.146 | 0.170 |
| A1 | 0.510 | | A1 | 0.020 | |
| A2 | 3.200 | 3.600 | A2 | 0.126 | 0.142 |
| B | 0.380 | 0.570 | B | 0.015 | 0.022 |
| B1 | 1.524(BSC) | | B1 | 0.060(BSC) | |
| C | 0.204 | 0.360 | C | 0.008 | 0.014 |
| D | 18.800 | 19.200 | D | 0.740 | 0.756 |
| E | 6.200 | 6.600 | E | 0.244 | 0.260 |
| E1 | 7.320 | 7.920 | E1 | 0.288 | 0.312 |
| e | 2.540(BSC) | | e | 0.100(BSC) | |
| L | 3.000 | 3.600 | L | 0.118 | 0.142 |
| E2 | 8.400 | 9.000 | E2 | 0.331 | 0.354 |

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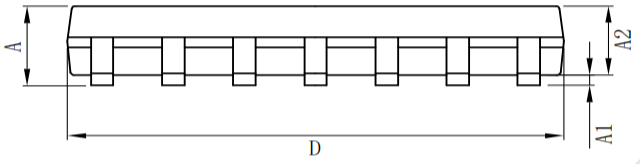
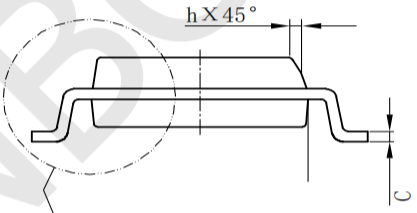
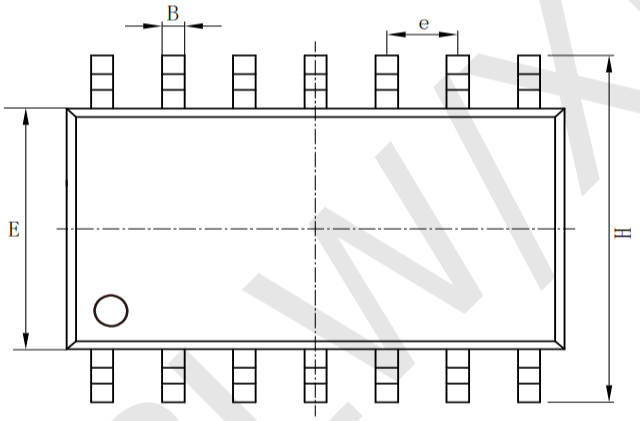
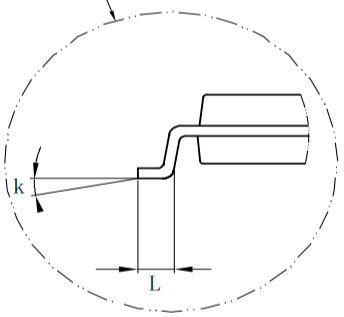
· SOP-14

| Size / Symbol | Dimensions In Millimeters | | Size / Symbol | Dimensions In Inches | |
|---|---|---|---|---|---|
| | Min( mm) | Max( mm) | | Min( in) | Max( in) |
| A | 1.350 | 1.750 | A | 0.050 | 0.068 |
| A1 | 0.100 | 0.250 | A1 | 0.004 | 0.009 |
| A2 | 1.100 | 1.650 | A2 | 0.040 | 0.060 |
| B | 0.330 | 0.510 | B | 0.010 | 0.020 |
| C | 0.190 | 0.250 | C | 0.007 | 0.009 |
| D | 8.550 | 8.750 | D | 0.330 | 0.340 |
| E | 3.800 | 4.000 | E | 0.150 | 0.150 |
| e | 1.27 | | e | 0.05 | |
| H | 5.800 | 6.200 | H | 0.220 | 0.240 |
| h | 0.250 | 0.500 | h | 0.009 | 0.020 |
| L | 0.400 | 1.270 | L | 0.015 | 0.050 |
| k | 8° (max) | | k | 8° (max) | |

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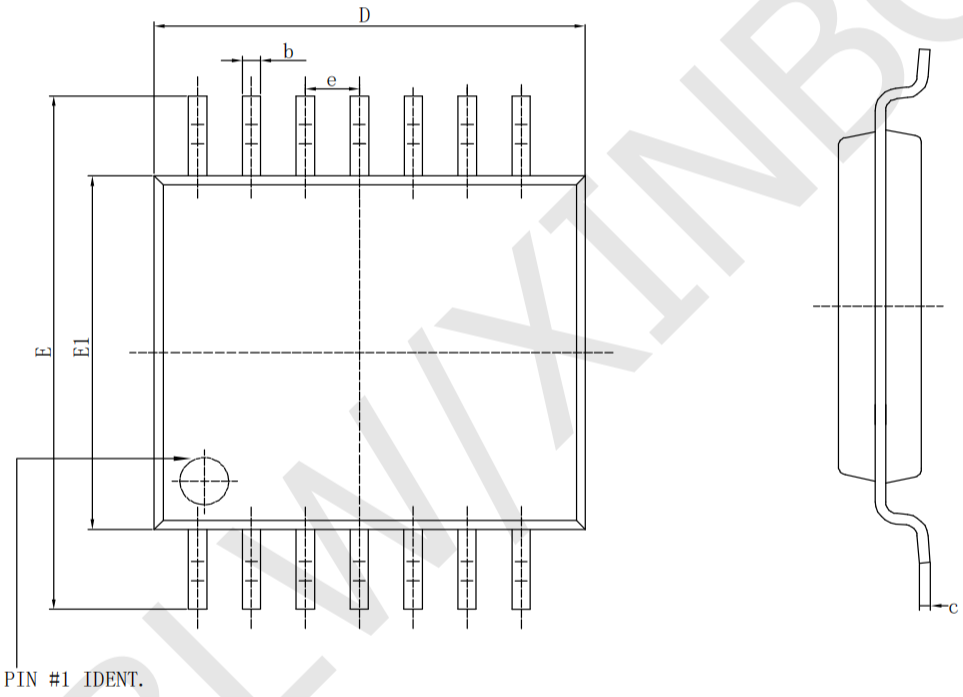
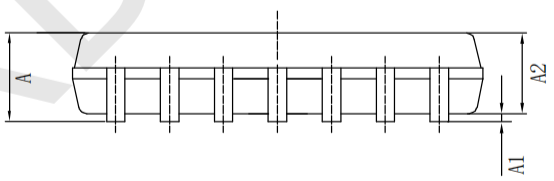
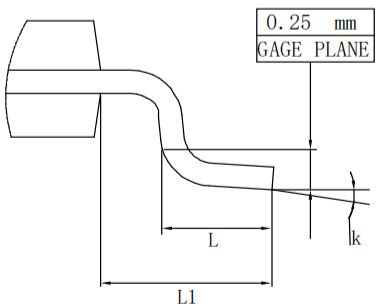
## · TSSOP-14

| Size / Symbol | Dimensions In Millimeters | | Size / Symbol | Dimensions In Inches | |
|---|---|---|---|---|---|
| | Min(mm) | Max(mm) | | Min(in) | Max(in) |
| A | | 1.200 | A | | 0.047 |
| A1 | 0.050 | 0.150 | A1 | 0.002 | 0.006 |
| A2 | 0.800 | 1.050 | A2 | 0.031 | 0.041 |
| b | 0.190 | 0.300 | b | 0.007 | 0.012 |
| c | 0.090 | 0.200 | c | 0.004 | 0.0089 |
| D | 4.900 | 5.100 | D | 0.193 | 0.201 |
| E | 6.200 | 6.600 | E | 0.244 | 0.260 |
| E1 | 4.300 | 4.500 | E1 | 0.169 | 0.176 |
| e | 0.65 | | e | 0.0256 | |
| L | 0.450 | 0.750 | L | 0.018 | 0.030 |
| L1 | 1.00 | | L1 | 0.039 | |
| k | 0° | 8° | k | 0° | 8° |

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