



AiP224/AiP324

Quadruple Operational Amplifiers

Product Specification

Specification Revision History:

| Version | Date | Description |
|----------------|-------------|--|
| 2019-11-A1 | 2019-11 | New |
| 2021-12-A2 | 2021-12 | Modify supply voltage range; Add TSSOP14 packing information |
| | | |
| | | |



1、 General Description

AiP224/AiP324 consist of four independent high-gain frequency-compensated operational amplifiers that are designed specifically to operate from a single supply over a wide range of voltages. Operation from split supplies also is possible if the difference between the two supplies is 3V to 30V, and V_{CC} is at least 1.5V more positive than the input common-mode voltage. The low supply-current drain is independent of the magnitude of the supply voltage.

Applications include transducer amplifiers, DC amplification blocks, and all the conventional operational-amplifier circuits that now can be more easily implemented in single-supply-voltage systems.

Features:

- Wide Supply Ranges
Single Supply: 3V to 36V
Dual Supplies: $\pm 1.5V$ to $\pm 18V$
- Low Supply-Current Drain Independent of Supply Voltage: 0.8mA Typical
- Common-Mode Input Voltage Range Includes Ground, Allowing Direct Sensing Near Ground
- Low Input Bias and Offset Parameters
Input Offset Voltage: 3mV Typical
Input Offset Current: 2nA Typical
Input Bias Current: 20nA Typical
- Differential Input Voltage Range Equal to Maximum-Rated Supply Voltage: $\pm 36V$
- Open-Loop Differential Voltage Amplification: 100V/mV Typical
- Internal Frequency Compensation
- Packing Form: DIP14/SOP14/TSSOP14

**Ordering Information:****Tube packing specifications:**

| Part number | Packaging form | Marking code | Tube quantity | Boxed tube quantity | Boxed quantity | Notes |
|---------------|----------------|--------------|----------------|---------------------|------------------|--|
| AiP224SA14.TB | SOP14 | AiP224 | 50 PCS/tube | 200 tube/box | 10000 PCS/box | Dimensions of plastic enclosure: 8.7mm×3.9mm Pin spacing: 1.27mm |
| AiP324SA14.TB | | AiP324 | | | | |
| AiP224DA14.TB | DIP14 | AiP224 | 25 PCS/tube | 40 tube/box | 1000 PCS/box | Dimensions of plastic enclosure: 19.0mm×6.4mm Pin spacing: 2.54mm |
| AiP324DA14.TB | | AiP324 | | | | |
| AiP324TA14.TB | TSSOP14 | AiP324 | 94 PCS/tube | 200 tube/box | 18800 PCS/box | Dimensions of plastic enclosure: 5.0mm×4.4mm Pin spacing: 0.65mm |

Reel packing specifications:

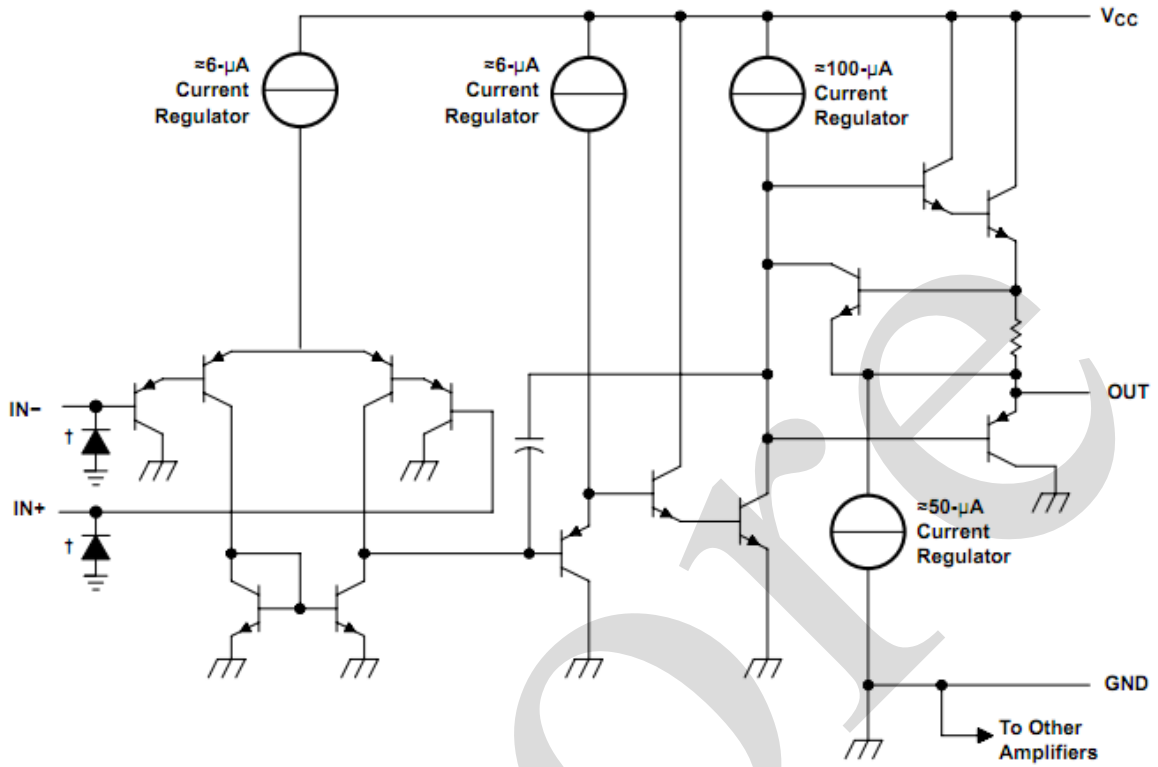
| Part number | Packaging form | Marking code | Reel quantity | Boxed reel quantity | Notes |
|---------------|----------------|--------------|------------------|---------------------|--|
| AiP224SA14.TR | SOP14 | AiP224 | 4000 PCS/reel | 8000 PCS/box | Dimensions of plastic enclosure: 8.7mm×3.9mm Pin spacing:1.27mm |
| AiP324SA14.TR | | AiP324 | | | |
| AiP324TA14.TR | TSSOP14 | AiP324 | 5000 PCS/reel | 10000 PCS/box | Dimensions of plastic enclosure: 5.0mm×4.4mm Pin spacing: 0.65mm |

Note: If the physical information is inconsistent with the ordering information, please refer to the actual product.

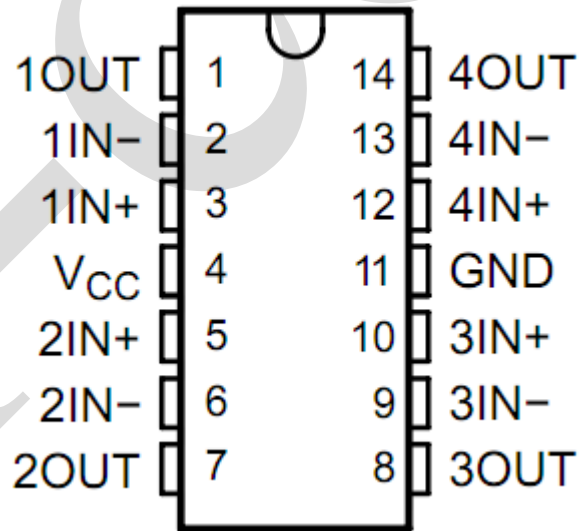


2、Block Diagram And Pin Description

2.1、Block Diagram



2.2、Pin Configurations





2.3、Pin Description

| Pin No. | Pin Name | Description |
|---------|-----------------|--------------------------|
| 1 | 1OUT | Channel 1 Output |
| 2 | 1IN- | Channel 1 Negative input |
| 3 | 1IN+ | Channel 1 Positive input |
| 4 | V _{CC} | Power supply |
| 5 | 2IN+ | Channel 2 Positive input |
| 6 | 2IN- | Channel 2 Negative input |
| 7 | 2OUT | Channel 2 Output |
| 8 | 3OUT | Channel 3 Output |
| 9 | 3IN- | Channel 3 Negative input |
| 10 | 3IN+ | Channel 3 Positive input |
| 11 | GND | Ground |
| 12 | 4IN+ | Channel 4 Positive input |
| 13 | 4IN- | Channel 4 Negative input |
| 14 | 4OUT | Channel 4 Output |

3、Electrical Parameter

3.1、Absolute Maximum Ratings

(T_{amb}=25℃, All voltage referenced to GND, unless otherwise specified)

| Characteristic | Symbol | Conditions | Value | | Unit |
|--|------------------|------------|------------|-----------|------|
| | | | AiP224 | AiP324 | |
| supply voltage | V _{CC} | - | 40 or ±20 | | V |
| differential input voltage | V _{ID} | - | ±40 | | V |
| input voltage | V _I | - | 40 | | V |
| operating temperature | T _{amb} | - | -40 to 125 | -40 to 85 | ℃ |
| operating virtual junction temperature | T _J | - | 150 | | ℃ |
| storage temperature | T _{stg} | - | -65 to 150 | | ℃ |
| soldering temperature | T _L | 10s | DIP14 | 245 | ℃ |
| | | | SOP14 | 250 | |

3.2、Recommended Operating Conditions

| Characteristic | Symbol | Conditions | Min | Max | Unit |
|--------------------------------|------------------|------------|--------|-----|--------------------|
| Supply voltage | V _{CC} | - | AiP224 | 3 | 36 |
| | | | AiP324 | | |
| Common-mode voltage | V _{CM} | - | AiP224 | 0 | V _{CC} -2 |
| | | | AiP324 | | |
| Operating free air temperature | T _{amb} | - | AiP224 | 125 | ℃ |
| | | | AiP324 | 85 | |



3.3、Electrical Characteristics

3.3.1、Electrical Characteristics

($V_{CC}=5V$, $T_{amb}=25^{\circ}C$, unless otherwise noted)

| Characteristic | Symbol | Conditions | | T_{amb} | Specification parameters | | | | | | Unit |
|--|-----------------|---|---------------------|---------------|--------------------------|----------|----------|-------------------|----------|----------|------|
| | | | | | AiP224 | | | AiP324 | | | |
| | | | | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| input offset voltage | V_{IO} | $V_{CC}=5$ to $36V$, $V_{IC}=V_{ICR(min)}$, $V_O=1.4V$ | | $25^{\circ}C$ | - | 3 | 5 | - | 3 | 7 | mV |
| | | | | Full range | - | - | 7 | - | - | 9 | |
| input offset current | I_{IO} | $V_O=1.4V$ | | $25^{\circ}C$ | - | 2 | 30 | - | 2 | 50 | nA |
| | | | | Full range | - | - | 100 | - | - | 150 | |
| input bias current | I_{IB} | $V_O=1.4V$ | | $25^{\circ}C$ | - | -20 | -150 | - | -20 | -250 | nA |
| | | | | Full range | - | - | -300 | - | - | -500 | |
| common-mode input voltage range | V_{ICR} | $V_{CC}=5\sim 36V$ | | $25^{\circ}C$ | 0 to $V_{CC}-1.5$ | - | - | 0 to $V_{CC}-1.5$ | - | - | V |
| | | | | Full range | 0 to $V_{CC}-2$ | - | - | 0 to $V_{CC}-2$ | - | - | |
| High-level output voltage | V_{OH} | $R_L=2k\Omega$ | | $25^{\circ}C$ | 3.5 | - | - | 3.5 | - | - | V |
| | | $V_{CC}=36V$ | $R_L=2k\Omega$ | Full range | 26 | - | - | 26 | - | - | |
| | | | $R_L\geq 10k\Omega$ | Full range | 27 | 28 | - | 27 | 28 | - | |
| Low-level output voltage | V_{OL} | $R_L\leq 10k\Omega$ | | Full range | - | 5 | 20 | - | 5 | 20 | mV |
| large-signal differential voltage amplification | A_{VD} | $V_{CC}=15V$, $V_O=1V$ to $11V$, $R_L\geq 2k\Omega$ | | $25^{\circ}C$ | 50 | 100 | - | 25 | 100 | - | V/mV |
| | | | | Full range | 25 | - | - | 15 | - | - | |
| common-mode rejection ratio | CMRR | $V_{CC}=5$ to $36V$, $V_{IC}=V_{ICR(min)}$ | | $25^{\circ}C$ | 70 | 80 | - | 65 | 80 | - | dB |
| supply-voltage rejection ratio ($\Delta V_{CC}/\Delta V_{IO}$) | k_{SVR} | $V_{CC}=5$ to $36V$ | | $25^{\circ}C$ | 65 | 100 | - | 65 | 100 | - | dB |
| crosstalk attenuation | V_{O1}/V_{O2} | $f=1kHz$ to $20kHz$ | | $25^{\circ}C$ | - | 120 | - | - | 120 | - | dB |
| output current | I_O | $V_{CC}=15V$, $V_{ID}=1V$, $V_O=0$ | Source | $25^{\circ}C$ | -20 | -30 | -60 | -20 | -30 | -60 | mA |
| | | | | Full range | -10 | - | - | -10 | - | - | |
| | | $V_{CC}=15V$, $V_{ID}=-1V$, $V_O=15V$ | Sink | $25^{\circ}C$ | 10 | 20 | - | 10 | 20 | - | |
| | | | | Full range | 5 | - | - | 5 | - | - | |
| | | $V_{ID}=-1V$, $V_O=200mV$ | | $25^{\circ}C$ | 12 | 30 | - | 12 | 30 | - | uA |
| short-circuit output current | I_{OS} | $V_{CC}=5V$, $V_O=0V$, $GND=-5V$ | | $25^{\circ}C$ | - | ± 40 | ± 60 | - | ± 40 | ± 60 | mA |



| | | | | | | | | | | |
|---------------------------------|----------|--|------------|---|-----|-----|---|-----|-----|-----------------|
| supply current(four amplifiers) | I_{CC} | $V_O=2.5V$, No Load | Full range | - | 0.8 | 1.2 | - | 0.8 | 1.2 | mA |
| | | $V_{CC}=36V$, $V_O=0.5V_{CC}$, No Load | Full range | - | 1.4 | 3 | - | 1.4 | 3 | |
| slew rate at unity gain | SR | $V_{CC}=\pm 18V$, $R_L=1M\Omega$, $C_L=30pF$, $V_I=\pm 10V$, Figure 11 | Full range | - | 0.5 | - | - | 0.5 | - | V/us |
| unity-gain bandwidth | B_1 | $V_{CC}=\pm 18V$, $R_L=1M\Omega$, $C_L=20pF$, Figure 11 | Full range | - | 1.2 | - | - | 1.2 | - | MHz |
| equivalent input noise voltage | V_n | $V_{CC}=\pm 18V$, $R_s=100\Omega$, $f=1kHz$, $V_I=0V$, Figure 12 | Full range | - | 35 | - | - | 35 | - | nV/ \sqrt{Hz} |

4、Characteristic Curve

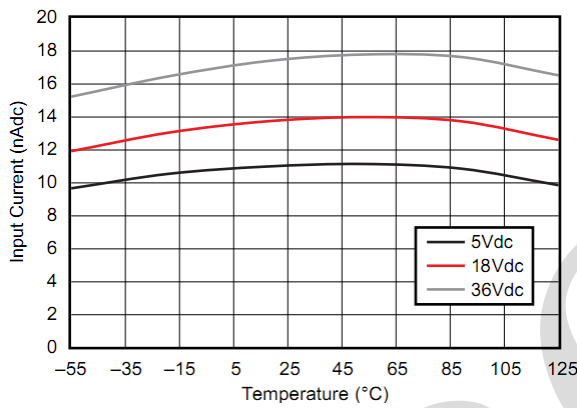


Figure 1: Input Current with Temperature

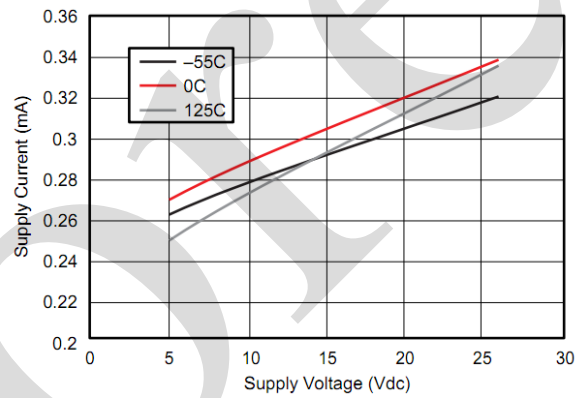


Figure 2: Supply Current with Supply Voltage

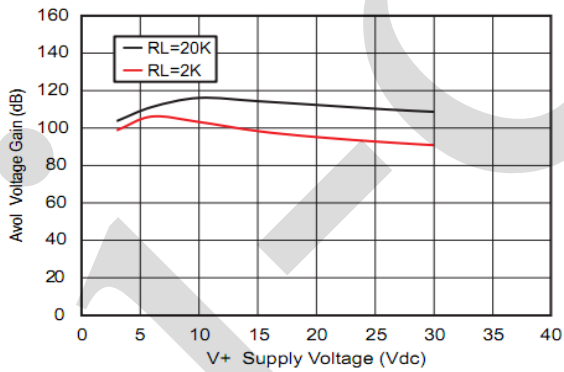


Figure 3: Avol Voltage Gain with V+ Supply Voltage

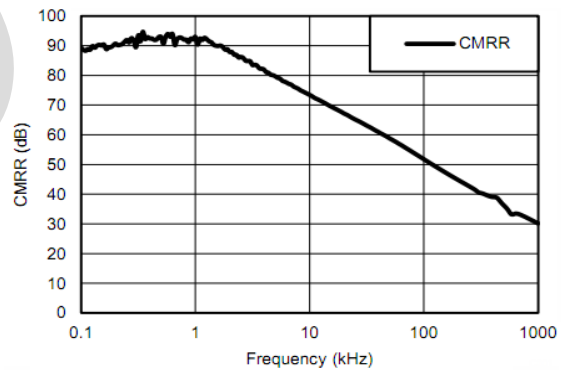


Figure 4: CMRR with Frequency

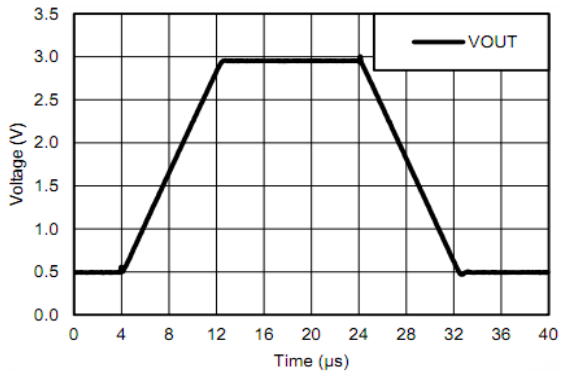


Figure 5: Large Signal Response (50 pF)

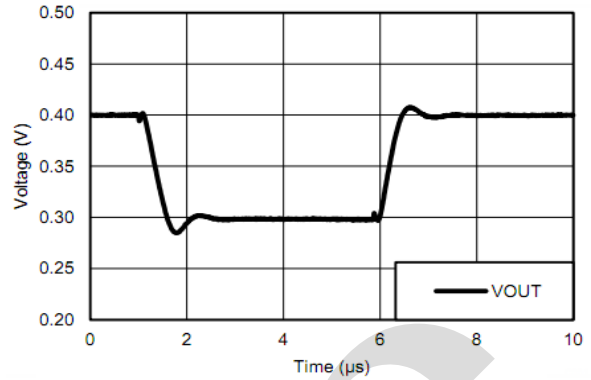


Figure 6: Small Signal Response (50 pF)

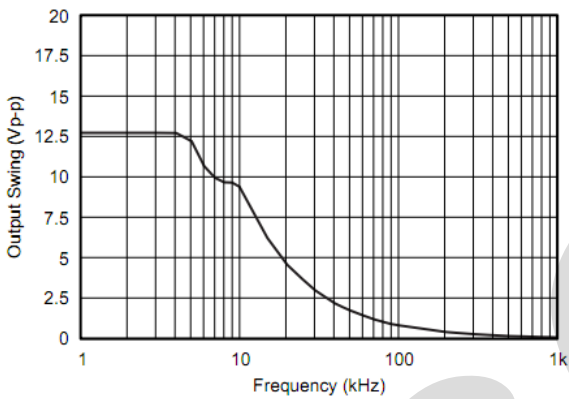


Figure 7: Output Swing with Frequency

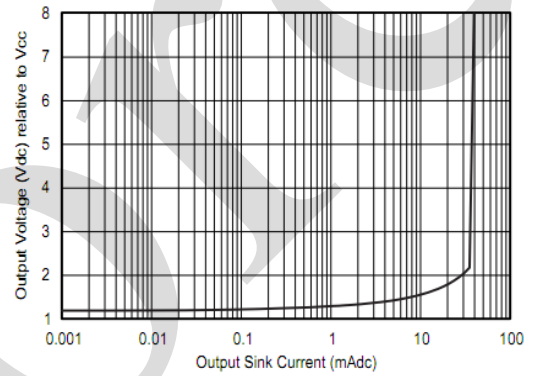


Figure 8: Output Voltage with Output Sink Current

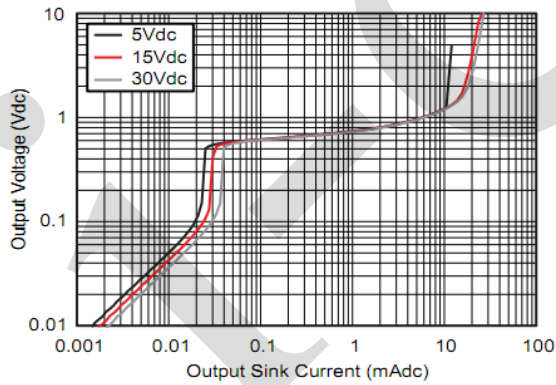


Figure 9: Output Voltage with Output Sink Current

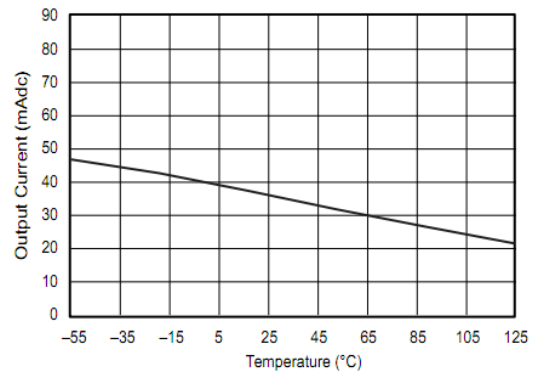


Figure 10: Output Current with Temperature



5、 Testing Circuit

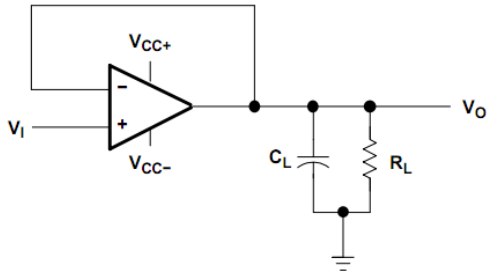


Figure 11: Unity-Gain Amplifier

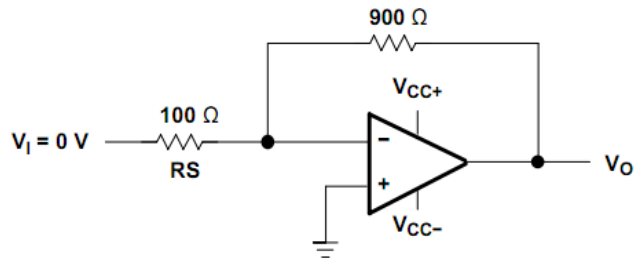
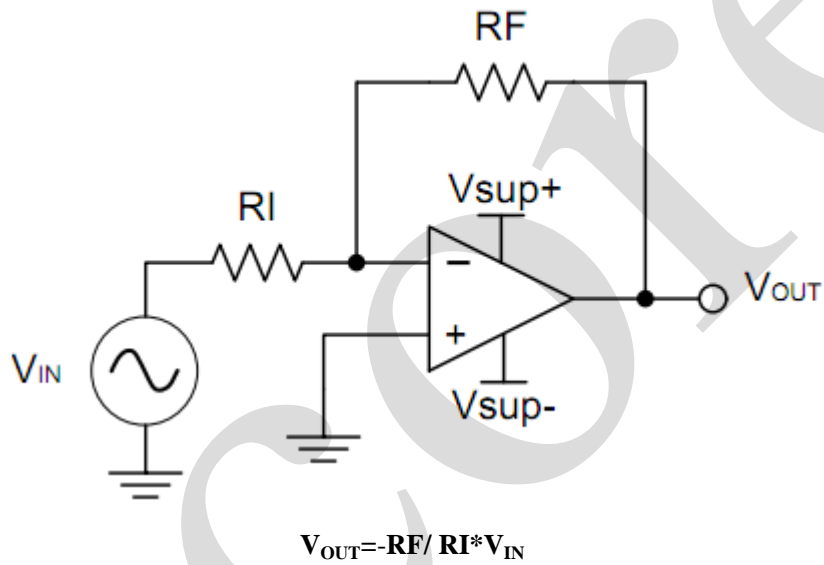


Figure 12: Noise-Test Circuit

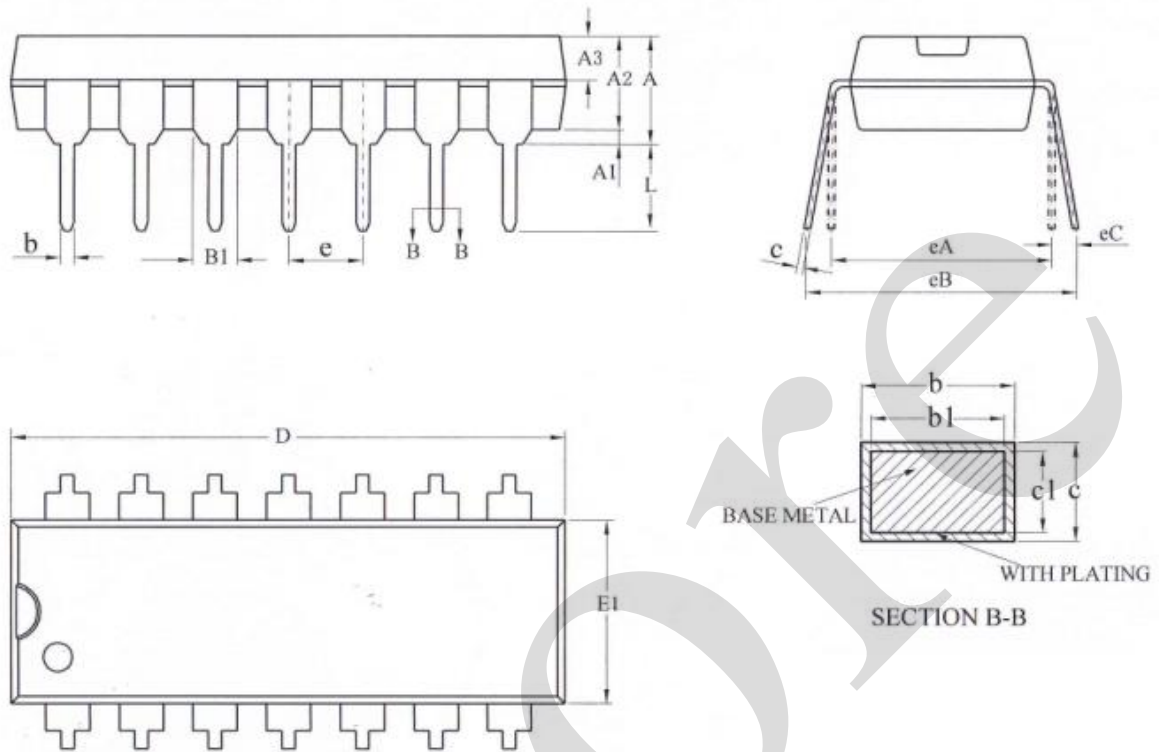
6、 Typical Application Circuit And Application Note





7、 Package Information

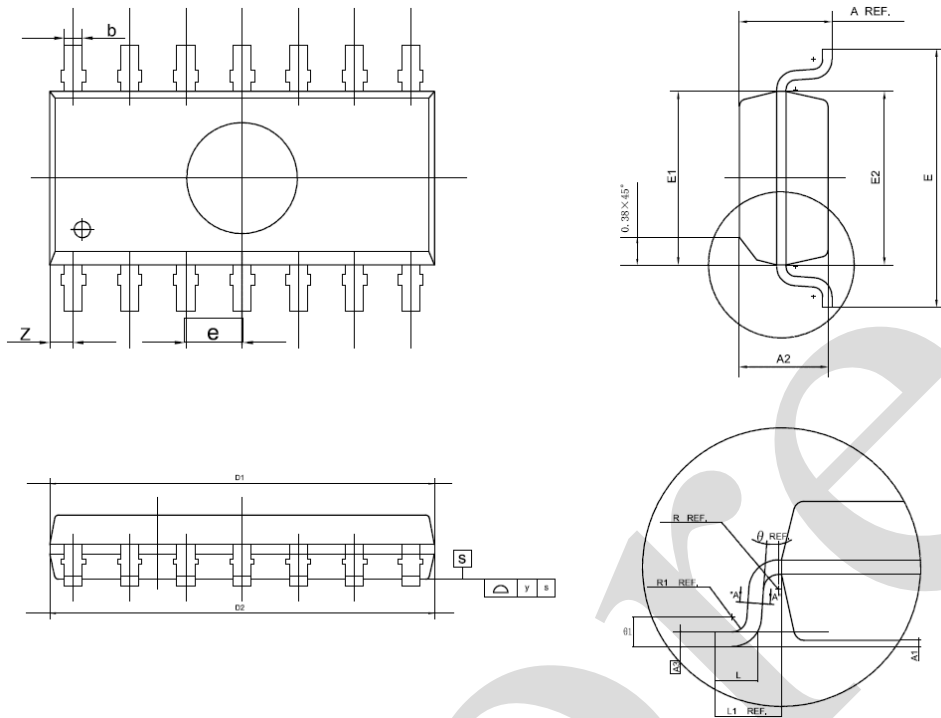
7.1、 DIP14



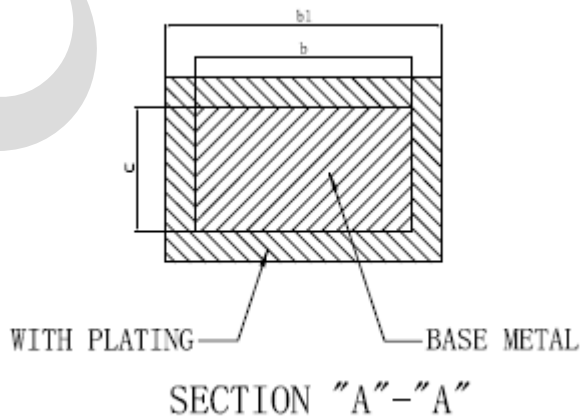
| SYMBOL | MILLIMETER | | |
|--------|------------|-------|-------|
| | MIN | NOM | MAX |
| A | 3.60 | 3.80 | 4.00 |
| A1 | 0.51 | — | — |
| A2 | 3.20 | 3.30 | 3.40 |
| A3 | 1.47 | 1.52 | 1.57 |
| b | 0.44 | — | 0.52 |
| b1 | 0.43 | 0.46 | 0.49 |
| B1 | 1.52REF | | |
| c | 0.25 | — | 0.29 |
| c1 | 0.24 | 0.25 | 0.26 |
| D | 19.00 | 19.10 | 19.20 |
| E1 | 6.25 | 6.35 | 6.45 |
| e | 2.54BSC | | |
| eA | 7.62REF | | |
| eB | 7.62 | — | 9.30 |
| eC | 0 | — | 0.84 |
| L | 3.00 | — | — |



7.2、SOP14



| Symbol | Min | Nom | Max |
|--------|-------|-------|-------|
| A | 1.500 | 1.600 | 1.700 |
| A1 | 0.100 | 0.150 | 0.200 |
| A2 | 1.400 | 1.450 | 1.500 |
| A3 | ----- | 0.223 | ----- |
| b | 0.356 | 0.406 | 0.456 |
| b1 | 0.366 | 0.426 | 0.486 |
| c | ----- | 0.203 | ----- |
| D1 | 8.600 | 8.650 | 8.700 |
| D2 | 8.610 | 8.660 | 8.710 |
| E | 5.900 | 6.000 | 6.100 |
| E1 | 3.800 | 3.900 | 4.000 |
| E2 | 3.850 | 3.950 | 4.050 |
| e | ----- | 1.270 | ----- |
| L | 0.560 | 0.660 | 0.760 |
| L1 | 0.950 | 1.050 | 1.150 |
| R | ----- | 0.200 | ----- |
| R1 | ----- | 0.300 | ----- |
| θ | 0 | ----- | ----- |
| θ 1 | 0 | ----- | 10° |
| y | ----- | ----- | 0.1 |
| Z | ----- | 0.520 | ----- |





8、 Statements And Notes:

8.1、 The name and content of Hazardous substances or Elements in the product

| Part name | Hazardous substances or Elements | | | | | | | | | |
|-------------------------|---|-------------------------------|-------------------------------|-------------------------------|--------------------------|--------------------------------|-------------------|-----------------------|---------------------------|----------------------|
| | Lead and lead compounds | Mercury and mercury compounds | Cadmium and cadmium compounds | Hexavalent chromium compounds | Polybrominated biphenyls | Polybrominated biphenyl ethers | Dibutyl phthalate | Butylbenzyl phthalate | Di-2-ethylhexyl phthalate | Diisobutyl phthalate |
| Lead frame | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Plastic resin | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Chip | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The lead | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Plastic sheet installed | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| explanation | ○: Indicates that the content of hazardous substances or elements in the detection limit of the following the SJ/T11363-2006 standard. ×: Indicates that the content of hazardous substances or elements exceeding the SJ/T11363-2006 Standard limit requirements. | | | | | | | | | |

8.2、 Notion:

Recommended carefully reading this information before the use of this product;

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[E2-A](#) [UPC458G2-E1-A](#) [UPC824G2-E2-A](#) [UPC4574G2-E2-A](#) [UPC4558G2-E2-A](#) [UPC4560G2-E1-A](#) [UPC258G2-E1-A](#) [UPC4742GR-9LG-](#)
[E1-A](#) [UPC4742G2-E1-A](#) [UPC832G2-E2-A](#) [UPC842G2-E1-A](#) [UPC802G2-E1-A](#) [UPC4741G2-E2-A](#) [UPC4572G2-E2-A](#) [UPC844GR-9LG-](#)
[E2-A](#) [UPC259G2-E1-A](#) [UPC4741G2-E1-A](#) [UPC4558G2-E1-A](#) [UPC1251GR-9LG-E1-A](#) [UPC4744G2-E1-A](#) [UPC4092G2-E1-A](#)
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