

钍地半导体
Tudi Semiconductor

# Product Specification

## TUDI-MCP601/1R/2/4

## 2.7V to 5.5V Single-Supply CMOS Operational Amplifier

网址 www.sztdbdt.com

**用芯智造·卓越品质**

**semiconductor device manufacturer**

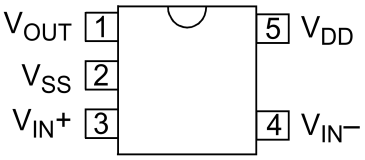
- Design
- research and development
- production
- and sales

## FEATURES

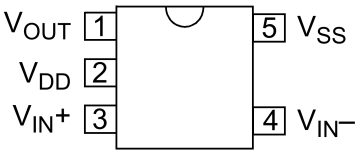
- Single-Supply Operation: 2.7V to 5.5V
- Rail-to-Rail OutputInput
- Range Includes Ground
- Gain-Bandwidth Product: 2.8 MHz (Typical)
- Unity-Gain Stable
- Low Quiescent Current: 230 µA/Amplifier (Typical)
- Temperature Range:
  - Industrial: –40°C to +85°C
  - Extended: –40°C to +125°C
- Available in Single, Dual, and Quad Packages

## APPLICATIONS

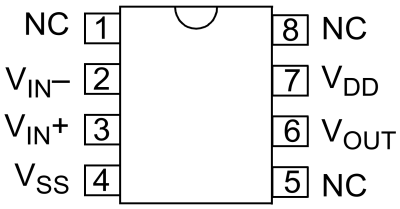
- Portable Devices
- A/D Converter Drivers
- Photodiode Preamplifiers
- Analog Filters
- Data Acquisition
- Laptops and PDAs
- Sensor Interfaces



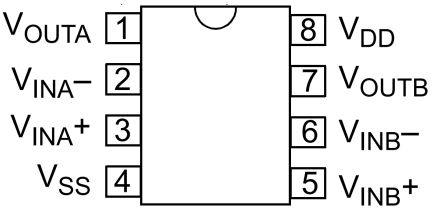
MCP601 SOT23-5



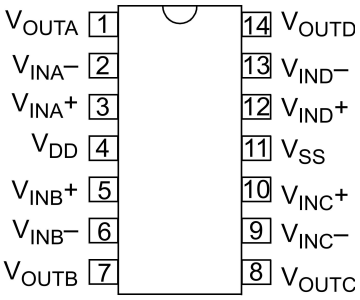
MCP601R SOT23-5



MCP601 PDIP, SOIC, TSSOP



MCP602 PDIP, SOIC, TSSOP



MCP604 PDIP, SOIC, TSSOP

## DESCRIPTION

The MCP601/1R/2/4 family of low-power operational amplifiers (op amps) is offered in single (MCP601), , dual (MCP602), and quad (MCP604) configurations. Manufactured using advanced CMOS technology, these devices feature low bias current, fast speed, high open-loop gain, and rail-to-rail output. The family operates from a single supply voltage as low as 2.7 V with a quiescent current consumption of less than 230 µA. In addition, the common-mode input voltage range extends 0.3 V below ground, making these amplifiers well suited for single-supply operation.

Owing to their low quiescent current, these devices are suitable for low-power battery-operated circuits. Their wide bandwidth makes them ideal as driver amplifiers for A/D converters, while their low input bias current renders them well suited for anti-aliasing filters.

The MCP601 and MCP602 are available in standard 8-pin PDIP, SOIC and TSSOP packages. The MCP601 and MCP601R are also offered in the standard 5-pin SOT-23 package. The MCP604 is supplied in standard 14-pin PDIP, SOIC and TSSOP packages.

The MCP601/2/4 family supports industrial and extended temperature ranges, with a supply voltage ranging from 2.7 V to 5.5 V.

# ELECTRICAL CHARACTERISTICS

## Absolute Maximum Ratings

$V_{DD}$ – $V_{SS}$ ..... 7.0V
All Inputs and Outputs ..... $V_{SS}$ – 0.3V to $V_{DD}$ + 0.3V
Differential Input Voltage ..... |$V_{DD}$ – VSS|
Output Short-Circuit Current ..... Continuous
Input Pin Current ..... ±2 mA
Input and Supply Pin Current ..... ±30 mA
Storage Temperature ..... –65°C to +150°C
Junction Temperature ..... +150°C
ESD Protection on All Pins (HBM; MM) ..... ⩾ 3 kV; 200V

Note: Operating the device beyond the above absolute maximum ratings may cause permanent damage to the device. The above parameters are only the maximum operating conditions; we do recommend operating the device beyond or outside the technical specifications. The stability of the device may be affected if it operates at the absolute maximum limits for an extended period

## Pin Function Table

| Name | Function |
|---|---|
| $V_{IN+}$,$V_{INA+}$,$V_{INB+}$,$V_{INC+}$,$V_{IND+}$ | Non-inverting Input |
| $V_{IN-}$,$V_{INA-}$,$V_{INB-}$,$V_{INC-}$,$V_{IND-}$ | Inverting Input |
| $V_{DD}$ | Positive Supply |
| $V_{SS}$ | Negative Supply |
| $V_{OUT}$,$V_{OUTA}$,$V_{OUTB}$,$V_{OUTC}$,$V_{OUTD}$ | Output |
| CS | Chip Select |
| NC | No Internal Connection |

# DC Characteristics

## Electrical Specifications

Unless otherwise noted, $T_A$ = +25°C, $V_{DD}$ = +2.7V to +5.5V, $V_{SS}$ = GND, $V_{CM}$ = $V_{DD}$/2, $V_{OUT}$ ≈ $V_{DD}$/2, and $R_L$ = 100 kΩ to $V_{DD}$/2.

| Parameter | Symbol | Min | Typ | MAX | Unit | Condition |
|---|---|---|---|---|---|---|
| **Input Distortion** | | | | | | |
| Input Offset Voltage | Vos | -2 | ±0.7 | +2 | mV | |
| Industrial Temperature Range | Vos | -3 | ±1 | +3 | mV | $T_A$=-40℃ to +85℃ |
| Extended Temperature Range | Vos | -4.5 | ±1 | +4.5 | mV | $T_A$=-40℃ to +125℃ |
| Input Offset Voltage Drift | Vos/$T_A$ | — | ±2.5 | — | pV1 | $T_A$=-40℃ to+125℃ |
| Power supply rejection ratio | $P_{SRR}$ | 80 | 88 | — | dB | $V_{DD}$=2.7V to 5.5V |
| **Input Current and Impedance** | | | | | | |
| Input Bias Current | $I_B$ | — | 1 | — | pA | |
| Industrial Temperature Range | $I_B$ | — | 20 | 60 | pA | $T_A$=+85℃ |
| Extended Temperature Range | $I_B$ | — | 450 | 5000 | pA | $T_A$=+125℃ |
| Input offset current | Ios | — | ±1 | — | pA | |
| Common-mode input impedance | $Z_{CM}$ | — | $10^{13}$ ‖6 | — | Ω ‖pF | |
| Differential input impedance | $Z_{DIFF}$ | — | $10^{13}$ ‖3 | — | Ω ‖pF | |
| **Common mode** | | | | | | |
| Common-modeinput range | $V_{CMR}$ | Vss-0.3 | — | $V_{DD}$-1.2 | V | |
| Common-moderejection ratio | $C_{MRR}$ | 75 | 90 | — | dB | $V_{DD}$=5.0V;$V_{CM}$=-0.3V to 3.8V |

## Electrical Specifications(Continue)

Unless otherwise noted, $T_A$ = +25°C, $V_{DD}$ = +2.7V to +5.5V, $V_{SS}$ = GND, $V_{CM}$ = $V_{DD}$/2, $V_{OUT}$ ≈ $V_{DD}$/2, and $R_L$ = 100 kΩ to $V_{DD}$/2.

| Parameters | Sym | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| **Open-loop Gain** | | | | | | |
| DC Open-loop Gain (large signal) | $A_{OL}$ | 100 | 115 | — | dB | $R_L$=25kΩ to $V_L$, $V_{OUT}$=0.1V to $V_{OD}$-0.1V |
| | $A_{OL}$ | 95 | 110 | — | dB | $R_L$=5 kΩ to $V_L$, $V_{OUT}$=0.1V to $V_{OD}$-0.1V |
| **Output** | | | | | | |
| Maximum Output Voltage Swing | $V_{OL}$,$V_{OH}$ | $V_{SS}$+15 | — | $V_{DD}$-20 | mV | $R_L$=25kΩ to $V_L$, Output overdrive =0.5V |
| | $V_{OL}$,$V_{OH}$ | $V_{SS}$+45 | — | $V_{DD}$-60 | mV | $R_L$=5kΩ to $V_L$, Output overdrive =0.5V |
| Linear Output Voltage Swing | $V_{OUT}$ | $V_{SS}$+100 | — | $V_{DD}$-100 | mV | $R_L$=25 kΩ to $V_L$,$A_{OL}$≥100 dB |
| | $V_{OUT}$ | $V_{SS}$+100 | — | $V_{DD}$-100 | mV | $R_L$=5kΩ to $V_L$,$A_{OL}$≥95dB |
| Output Short Circuit Current | $I_{SC}$ | — | ±22 | — | mA | $V_{DD}$=5.5V |
| | $I_{SC}$ | — | ±12 | — | mA | $V_{DD}$=2.7V |
| **Power Supply** | | | | | | |
| Supply Voltage | $V_{DD}$ | 2.7 | — | 6.0 | V | |
| Quiescent Current per Amplifier | $I_Q$ | — | 230 | 325 | μA | IO=0 |

# AC Characteristics

## Electrical Specifications

Unless otherwise noted,TA = +25°C, $V_{DD}$ = +2.7V to +5.5V, $V_{SS}$ = GND, $V_{CM}$ = $V_{DD}$/2, $V_{OUT}$ ≈ $V_{DD}$/2, $R_L$ = 100 kΩ to $V_{DD}$/2, and CL = 50 pF.

| Parameter | Symbol | MIN | TYP | MAX | Unit | Condition |
|---|---|---|---|---|---|---|
| **Frequency response** | | | | | | |
| Gain Bandwidth Product | GBWP | — | 2.8 | — | MHz | |
| Phase margin | PM | — | 50 | — | ° | G =+1V/V |
| Step response | | | | | | |
| Slew rate | SR | — | 2.3 | — | V/μs | G =+1V/V |
| Creation Time(0.01%) | $t_{settle}$ | — | 4.5 | — | μs | G=+1V/V,step 3.8V |
| **Noise** | | | | | | |
| Input noise voltage | $E_{ni}$ | — | 7 | — | $\mu V_{P-P}$ | f= 0.1Hz to 10 Hz |
| Input noise voltage density | $e_{ni}$ | — | 29 | — | nV/√Hz | f=1kHz |
| | $e_{ni}$ | — | 21 | — | nV/√Hz | f=10kHz |
| Input noise current density | $i_{ni}$ | — | 0.6 | — | fA/√Hz | f=1 kHz |

# Temperature Characteristics

## Electrical Specifications

Unless otherwise noted,$V_{DD}$ = +2.7V to +5.5V and $V_{SS}$ = GND

| parameter | symbol | ast value | representative value | crest value | unit | condition |
|---|---|---|---|---|---|---|
| Temperature range | | | | | | |
| Specified temperature range | $T_A$ | -40 | — | +85 | ℃ | Industrial-grade temperature sensors |
| | $T_A$ | -40 | — | +125 | ℃ | Extended-range temperature sensor |
| Operating temperature range | $T_A$ | -40 | — | +125 | ℃ | Note |
| Storage Temperature Range | $T_A$ | -65 | — | +150 | ℃ | |
| | | | | | | |
| Thermal Resistance,5L-SOT23 | $\theta_{JA}$ | — | 256 | — | ℃/W | |
| Thermal Resistance,8L-PDIP | $\theta_{JA}$ | — | 85 | — | ℃/W | |
| Thermal Resistance,8L-SOIC | $\theta_{JA}$ | — | 163 | — | ℃/W | |
| Thermal Resistance,8L-TSSOP | $\theta_{JA}$ | — | 124 | — | ℃/W | |
| Thermal Resistance,14L-PDIP | $\theta_{JA}$ | — | 70 | — | ℃/W | |
| Thermal Resistance,14L-SOIC | $\theta_{JA}$ | — | 120 | — | ℃/W | |
| Thermal Resistance,14L-TSSOP | $\theta_{JA}$ | — | 100 | — | ℃/W | |

Note: Industrial temperature grade devices can operate over the extended temperature range, but with reduced performance. Extended temperature specifications do not apply to industrial temperature grade devices. Under no circumstances should the internal junction temperature (TJ) exceed the absolute maximum rating of 150°C.

# Application Note

**Size:**P60X series op amps are unity-gain stable and suitable for a wide range of general-purpose applications. The smallfootprints of the P60X series packages save space on printed circuit boards and enable the design of smaller electronicproducts

**Power Supply Bypassing and Board Layout:**P60X series operates from a single 2.1V to 5.5V supply or dual ±1.05V to ±2.75V supplies. For best performance, a 0.1μFceramic capacitor should be placed close to the $V_{DD}$ pin in single supply operation. For dual supply operation, both $V_{DD}$ and $V_{SS}$ supplies should be bypassed to ground with separate 0.1μF ceramic capacitors.

**Low Supply Current:**The low supply current (typical 1.1mA per channel) of P60X series will help to maximize battery life. They are ideal forbattery powered systems

**Operating Voltage:**P60X series operate under wide input supply voltage (2.1V to 5.5V). In addition, all temperature specifications apply from -40 oC to +125 oC. Most behavior remains unchanged throughout the full operating voltage range. These guarantees ensureoperation throughout the single Li-Ion battery lifetime

**Rail-to-Rail Input:**The input common-mode range of P60X series extends 100mV beyond the supply rails ($V_{SS}$-0.1V to $V_{DD}$+0.1V). This isachieved by using complementary input stage. For normal operation, inputs should be limited to this range.

**Rail-to-Rail Output:**Rail-to-Rail output swing provides maximum possible dynamic range at the output. This is particularly important whenoperating in low supply voltages. The output voltage of P60X series can typically swing to less than 2mV from supply rail inlight resistive loads (>100kΩ), and 15mV of supply rail in moderate resistive loads (10kΩ).

**Capacitive Load Tolerance:**The P60X family is optimized for bandwidth and speed, not for driving capacitive loads. Output capacitance will create apole in the amplifier ’ s feedback path, leading to excessive peaking and potential oscillation. If dealing with load capacitance isa requirement of the application, the two strategies to consider are (1) using a small resistor in series with the amplifier ’ s outputand the load capacitance and (2) reducing the bandwidth of the amplifier ’ s feedback loop by increasing the overall noise gain.Figure 1. shows a unity gain follower using the series resistor strategy. The resistor isolates the output from the capacitanceand, more importantly, creates a zero in the feedback path that compensates for the pole created by the output capacitance.

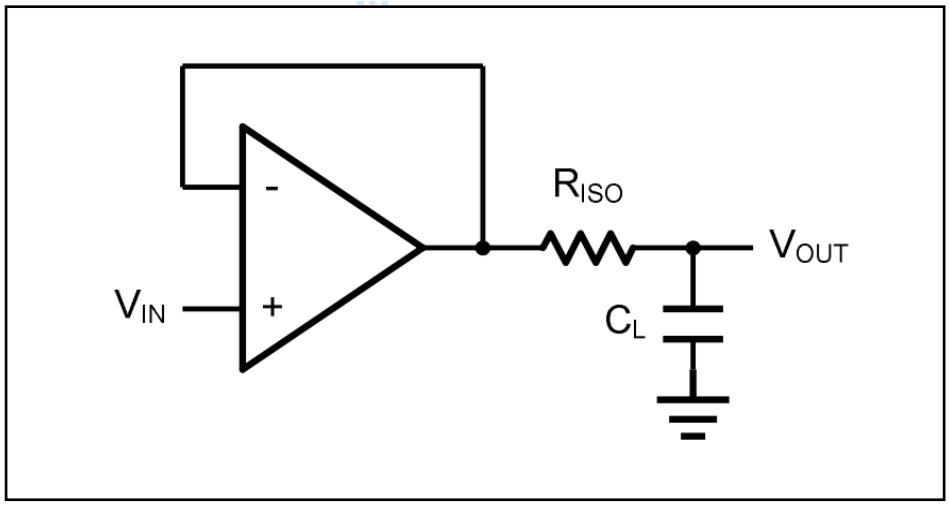



Figure 1. Indirectly Driving a Capacitive Load Using Isolation Resistor

The bigger the $R_{ISO}$ resistor value, the more stable $V_{OUT}$ will be. However, if there is a resistive load RL in parallel with thecapacitive load, a voltage divider (proportional to $R_{ISO}/R_L$) is formed, this will result in a gain error.The circuit in Figure 3 is an improvement to the one in Figure 2. RF provides the DC accuracy by feed-forward the $V_{IN}$ to $R_L$. $C_F$ and $R_{ISO}$ serve to counteract the loss of phase margin by feeding the high frequency component of the output signal back to theamplifier ' s inverting input, thereby preserving the phase margin in the overall feedback loop . Capacitive drive can be increasedby increasing the value of $C_F$. This in turn will slow down the pulse response

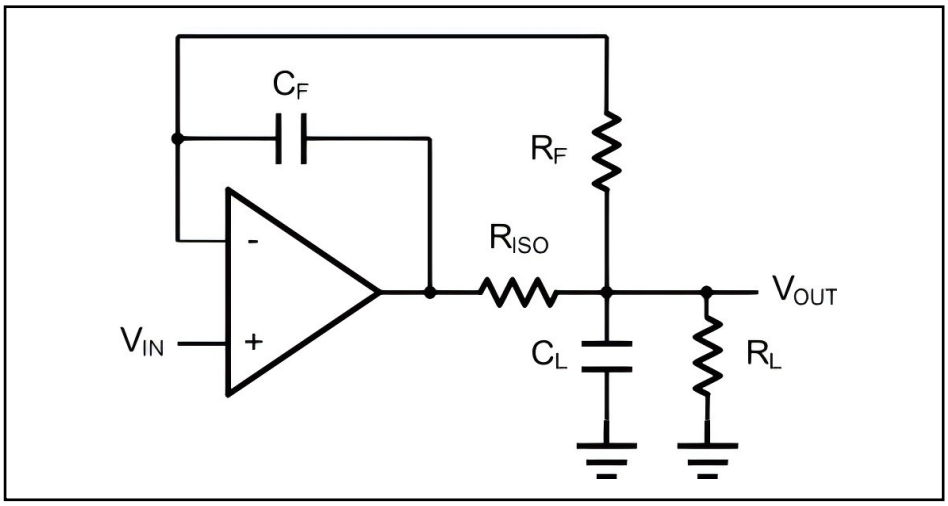



Figure 3. Indirectly Driving a Capacitive Load with DC Accuracy

# Order information

| Order Number | Package | Package Quantity | Marking On The park | Temperature |
|---|---|---|---|---|
| MCP601T-I/OT-TUDI | SOT23-5 | Tape,Reel,3000 | SAxx | -40℃ to +85℃ |
| MCP601T-I/SN-TUDI | SOP8 | Tape,Reel,4000 | 601I/SN | |
| | | | MCP601I/SN | |
| MCP601T-I/ST-TUDI | TSSOP8 | Tape,Reel,4000 | 601I | |
| MCP601-I/P-TUDI | DIP8 | Tube,50,A box of 2000 | MCP601-I/P | |
| MCP601RT-I/OT-TUDI | SOT-23-5 | Tape,Reel,3000 | SJxx | |
| MCP602T-I/SN-TUDI | SOP8 | Tape,Reel,4000 | MCP602ISN | |
| | | | TD602I/SN | |
| MCP602T-I/ST-TUDI | TSSOP8 | Tape,Reel,4000 | 602I | |
| MCP602-I/P-TUDI | DIP8 | Tube,50,A box of 2000 | MCP602-I/P | |
| MCP604T-I/SL-TUDI | SOP14 | Tape,Reel,4000 | MCP604-I/SL | |
| | | | MCP604T-I/SL | |
| MCP604T-I/ST-TUDI | TSSOP14 | Tape,Reel,4000 | TD604I | |
| | | | 604I | |
| MCP604-I/P-TUDI | DIP14 | Tube,25,A box of 1000 | MCP604-I/P | |

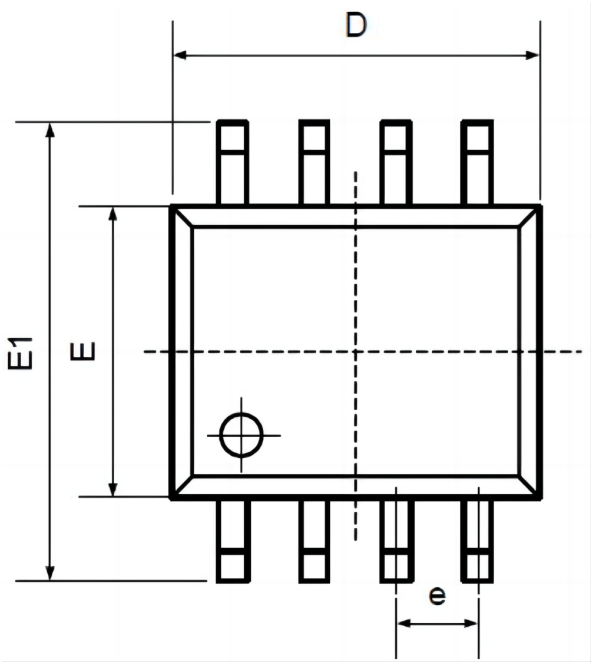
# Order information

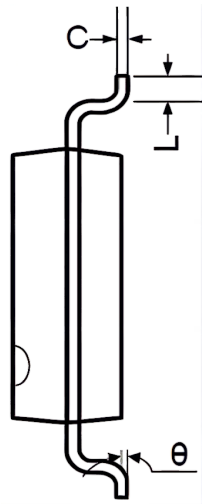
| Order Number | Package | Package Quantity | Marking On The park | Temperature |
|---|---|---|---|---|
| MCP601T-E/SN-TUDI | SOP8 | Tape,Reel,4000 | MCP601E/SN | -40°C to +125°C |
| MCP601T-E/ST-TUDI | TSSOP8 | Tape,Reel,4000 | 601E | |
| MCP601T-E/OT-TUDI | SOT23-5 | Tape,Reel,3000 | SLxx | |
| MCP601-E/P-TUDI | DIP8 | Tube,50,A box of 2000 | MCP601-E/P | |
| MCP601RT-E/OT-TUDI | SOT23-5 | Tape,Reel,3000 | SMxx | |
| MCP602-E/P-TUDI | DIP8 | Tube,50,A box of 2000 | MCP602-E/P | |
| MCP602T-E/ST-TUDI | TSSOP8 | Tape,Reel,4000 | 602E | |
| MCP602T-E/SN-TUDI | SOP8 | Tape,Reel,4000 | MCP602E/SN | |
| MCP604T-E/ST-TUDI | TSSOP14 | Tape,Reel,4000 | 604E | |
| MCP604T-E/SL-TUDI | SOP14 | Tape,Reel,4000 | MCP604E/SL | |
| MCP604-E/P-TUDI | DIP14 | Tube,25,A box of 1000 | MCP604-E/P | |

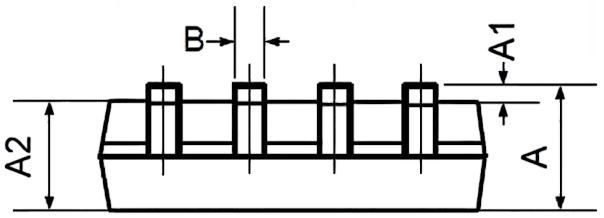
# Revision history

| | Date | Revision | Page |
|---|---|---|---|
| V1.0 | 2021/12 | New | 1-17 |
| V1.1 | 2025/3 | Update model and PDF template | 1-19 |

# Package SOP8

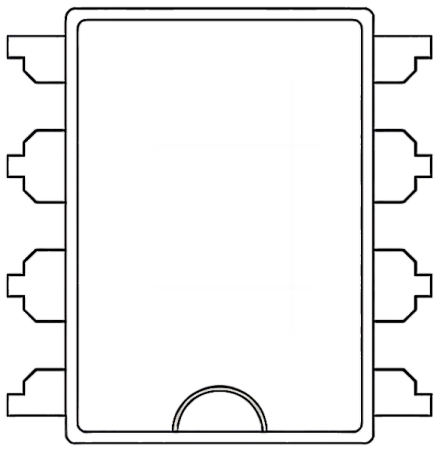


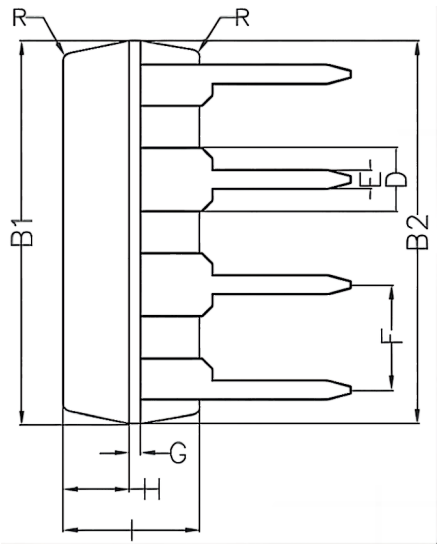



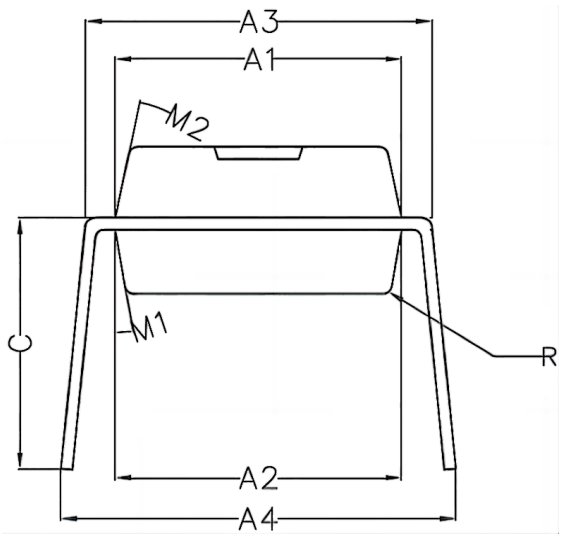




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.350 | 1.750 | 0.053 | 0.069 |
| A1 | 0.100 | 0.250 | 0.004 | 0.010 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| B | 0.330 | 0.510 | 0.013 | 0.020 |
| C | 0.190 | 0.250 | 0.007 | 0.010 |
| D | 4.780 | 5.000 | 0.188 | 0.197 |
| E | 3.800 | 4.000 | 0.150 | 0.157 |
| E1 | 5.800 | 6.300 | 0.228 | 0.248 |
| e | 1.270TYP | | 0.050TYP | |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |

# Package DIP8

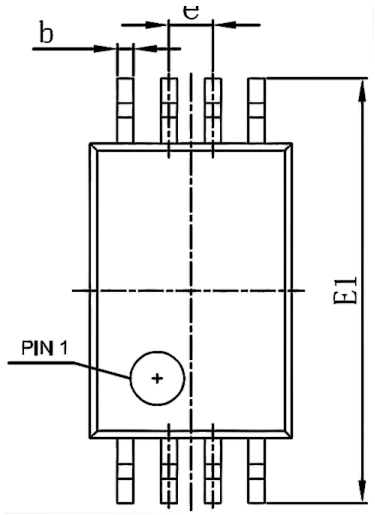


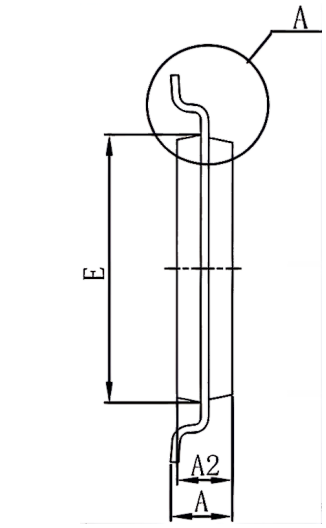


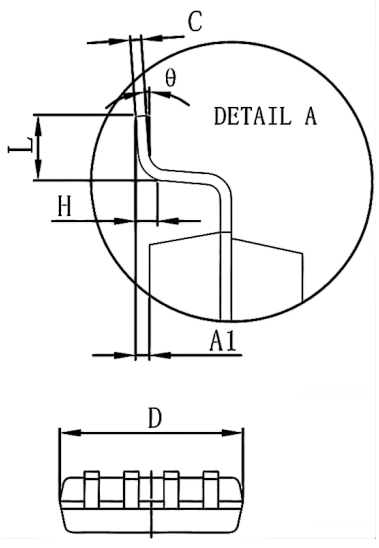




| Symbol | Min | Non | Max |
|---|---|---|---|
| A1 | 6.28 | 6.33 | 6.38 |
| A2 | 6.33 | 6.38 | 6.43 |
| A3 | 7.52 | 7.62 | 7.72 |
| A4 | 7.80 | 8.40 | 9.00 |
| B1 | 9.15 | 9.20 | 9.25 |
| B2 | 9.20 | 9.25 | 9.30 |
| C | | 5.57 | |
| D | | 1.52 | |
| E | 0.43 | 0.45 | 0.47 |
| F | | 2.54 | |
| G | | 0.25 | |
| H | 1.54 | 1.59 | 1.64 |
| 工 | 3.22 | 3.27 | 3.32 |
| R | | 0.20 | |
| M1 | 9° | 10° | 11° |
| M2 | 11° | 12° | 13° |

# Package TSSOP8



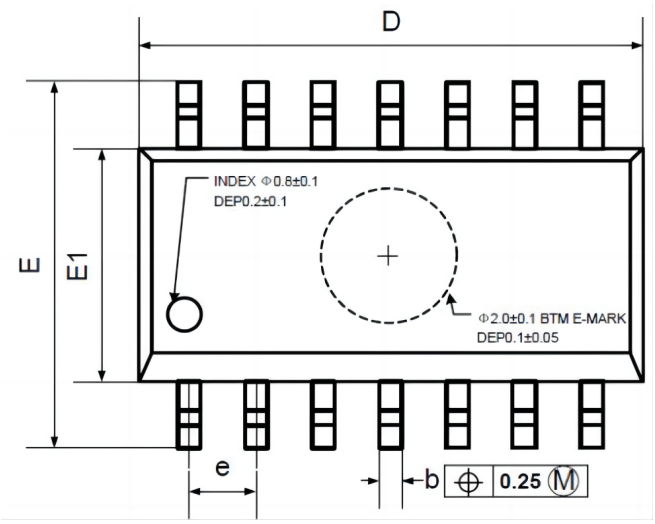



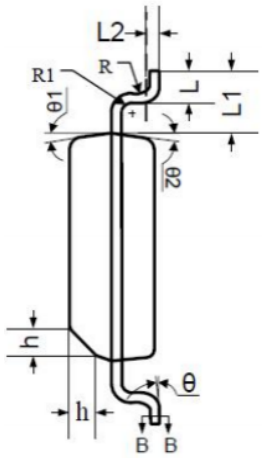


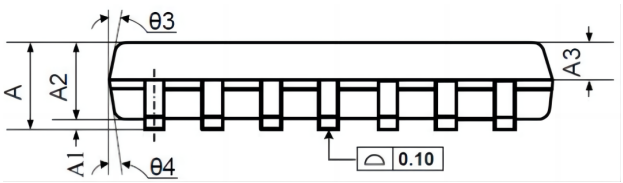


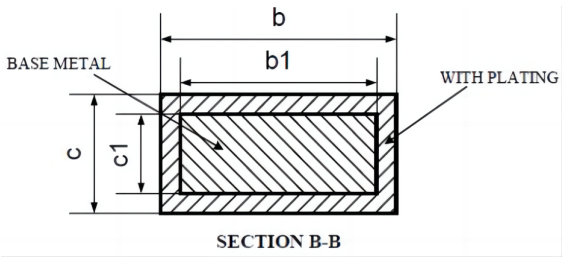
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| D | 2.900 | 3.100 | 0.114 | 0.122 |
| E | 4.300 | 4.500 | 0.169 | 0.177 |
| b | 0.190 | 0.300 | 0.007 | 0.012 |
| C | 0.090 | 0.200 | 0.004 | 0.008 |
| E1 | 6.250 | 6.550 | 0.246 | 0.258 |
| A | | 1.200 | | 0.047 |
| A2 | 0.800 | 1.000 | 0.031 | 0.039 |
| A1 | 0.050 | 0.150 | 0.002 | 0.006 |
| e | 0.65(BSC) | | 0.026(BSC) | |
| L | 0.500 | 0.700 | 0.020 | 0.028 |
| H | 0.25(TYP) | | 0.01(TYP) | |
| θ | 1° | | 1° | |

# Package SOP14



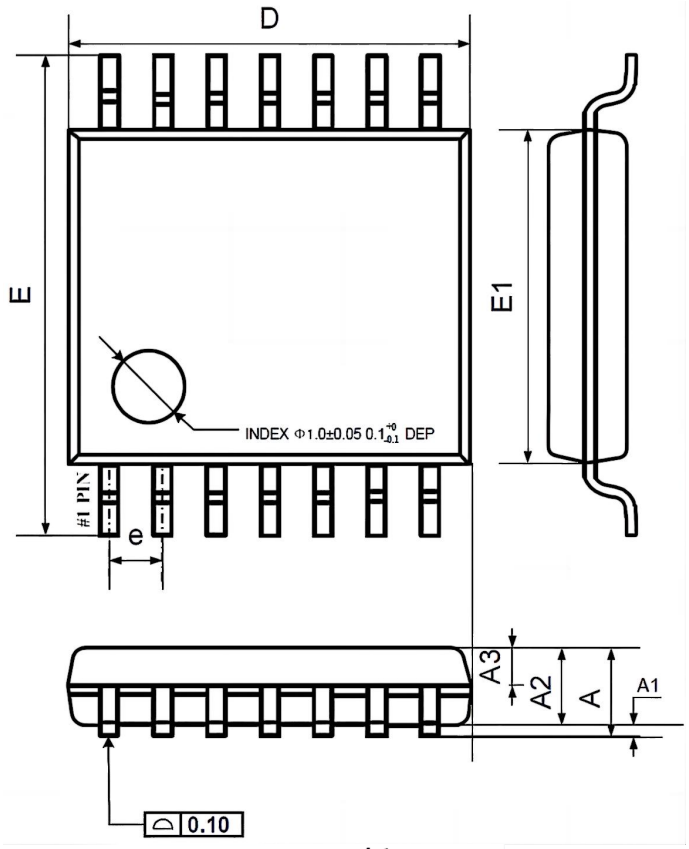



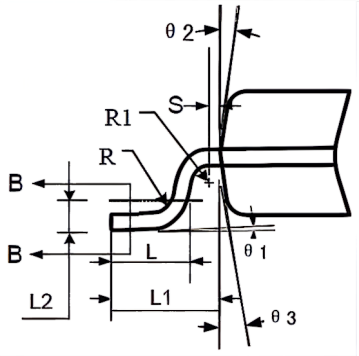



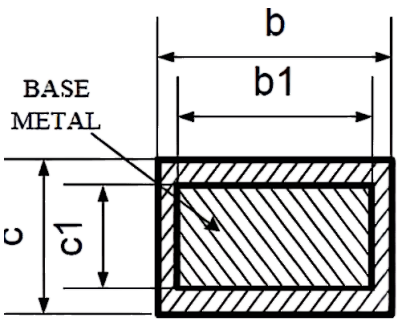




| Symbol | Dimensions In Millimeters | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 1.35 | 1.60 | 1.75 |
| A1 | 0.10 | 0.15 | 0.25 |
| A2 | 1.25 | 1.45 | 1.65 |
| A3 | 0.55 | 0.65 | 0.75 |
| b | 0.36 | | 0.49 |
| b1 | 0.35 | 0.40 | 0.45 |
| C | 0.16 | | 0.25 |
| c1 | 0.15 | 0.20 | 0.25 |
| D | 8.53 | 8.63 | 8.73 |
| E | 5.80 | 6.00 | 6.20 |
| E1 | 3.80 | 3.90 | 4.00 |
| e | 1.27 BSC | | |
| L | 0.45 | 0.60 | 0.80 |
| L1 | 1.04 REF | | |
| L2 | 0.25 BSC | | |
| R | 0.07 | | |
| R1 | 0.07 | | |
| h | 0.30 | 0.40 | 0.50 |
| θ | 0° | | 8° |
| θ1 | 6° | 8° | 10° |
| θ2 | 6° | 8° | 10° |
| θ3 | 5° | 7° | 9° |
| θ4 | 5° | 7° | 9° |

# Package TSSOP14

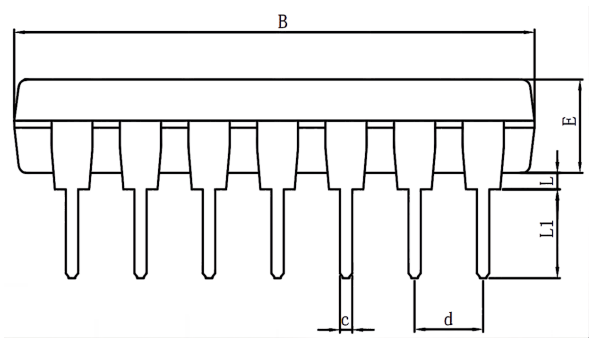


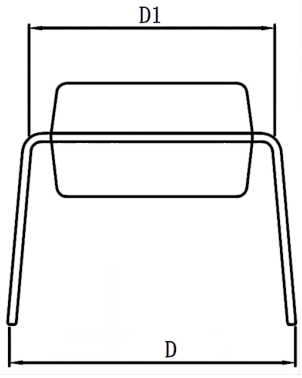



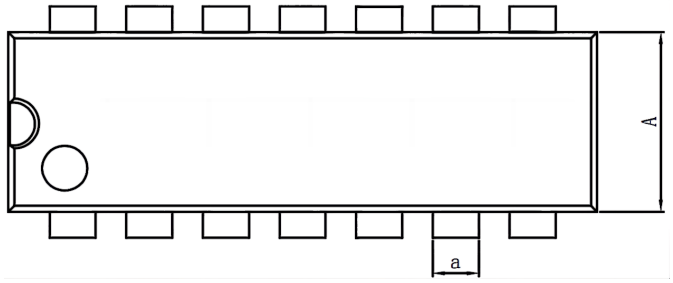




| Symbol | Dimensions In Millimeters | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | — | — | 1.20 |
| A1 | 0.05 | — | 0.15 |
| A2 | 0.90 | 1.00 | 1.05 |
| A3 | 0.34 | 0.44 | 0.54 |
| b | 0.20 | — | 0.28 |
| b1 | 0.20 | 0.22 | 0.24 |
| C | 0.10 | — | 0.19 |
| c1 | 0.10 | 0.13 | 0.15 |
| D | 4.86 | 4.96 | 5.06 |
| E | 6.20 | 6.40 | 6.60 |
| E1 | 4.30 | 4.40 | 4.50 |
| e | 0.65 BSC | | |
| L | 0.45 | 0.60 | 0.75 |
| L1 | 1.00 REF | | |
| L2 | 0.25 BSC | | |
| R | 0.09 | — | — |
| R1 | 0.09 | — | — |
| S | 0.20 | — | — |
| θ1 | 0° | — | 8° |
| θ2 | 10° | 12° | 14° |
| θ3 | 10° | 12° | 14° |

# Package DIP14

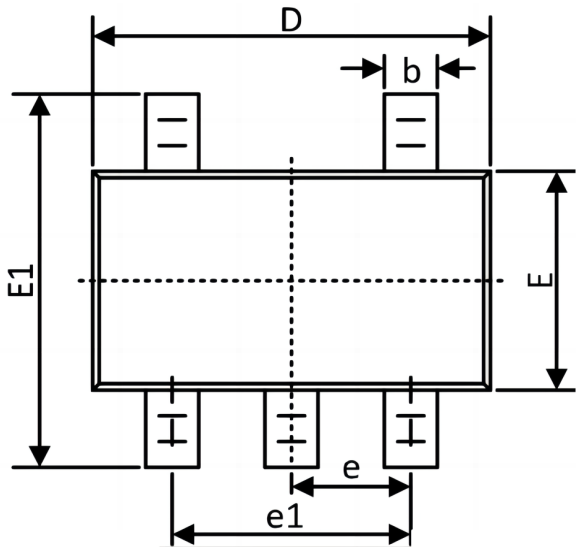


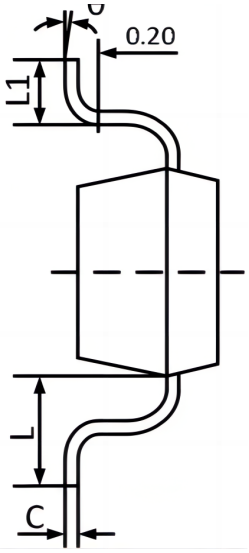



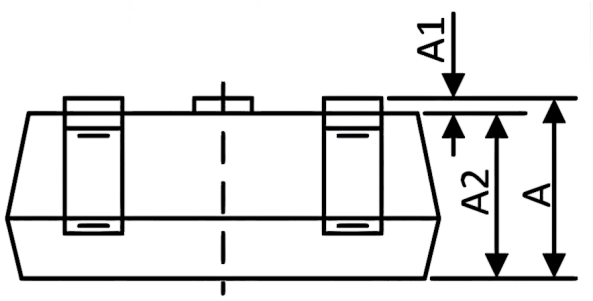




| DIM. | MIN | TYP | MAX | DIM. | MIN | TYP | MAX |
|---|---|---|---|---|---|---|---|
| A | 6.100 | 6.300 | 6.680 | a | 1.504 | 1.524 | 1.544 |
| B | 18.940 | 19.200 | 19.560 | C | 0.437 | 0.457 | 0.477 |
| D | 8.200 | 8.700 | 9.200 | d | 2.530 | 2.540 | 2.550 |
| D1 | 7.42 | 7.62 | 7.82 | L | 0.500 | — | 0.800 |
| E | 3.100 | 3.300 | 3.550 | L1 | 3.000 | 3.200 | 3.600 |

# Package SOT23-5




| 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 | 0.400 | 0.012 | 0.016 |
| 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 | 0.950TYP | | 0.037TYP | |
| e1 | 1.800 | 2.000 | 0.071 | 0.079 |
| L | 0.700REF | | 0.028REF | |
| L1 | 0.300 | 0.600 | 0.012 | 0.024 |
| θ | 0° | 8° | 0° | 8° |

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