# DTMF Generators

## Features

- Operating voltage: 2.0V~5.5V
- Serial mode for the HT9200A
- Serial/parallel mode for the HT9200B
- Low standby current
- Low total harmonic distortion
- 3.58MHz crystal or ceramic resonator
- HT9200A: 8-pin DIP/SOP package
- HT9200B: 14-pin SOP package


DIP-8


SOP-8


SOP-14

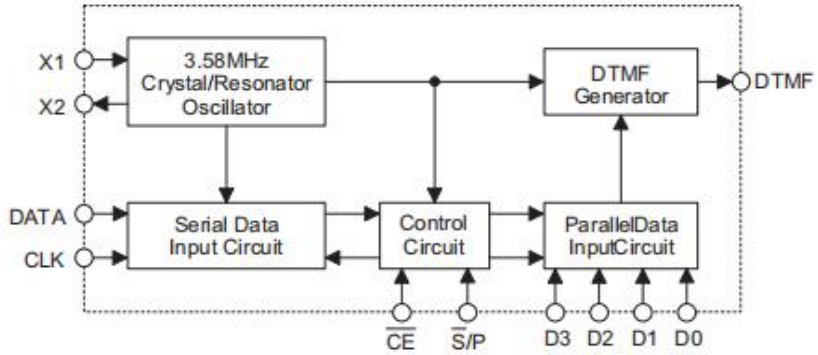
## Ordering Information

| DEVICE | Package Type | MARKING | Packing | Packing Qty |
|---|---|---|---|---|
| HT9200APRG | DIP-8 | HT9200A | TUBE | 2000pcs/box |
| HT9200ADRG | SOP-8 | HT9200A | REEL | 2500pcs/reel |
| HT9200BDRG | SOP-14 | HT9200B | REEL | 2500pcs/reel |

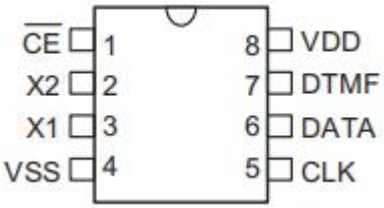
## General Description

The HT9200A/B tone generators are designed for MCU interfaces. They can be instructed by a MCU to gener ate 16 dual tones and 8 single tones from the DTMF pin. The HT9200A provides a serial mode whereas the HT9200B contains a selectable serial/parallel mode interface for various applications such as security systems, home automation, remote control through telephone lines, communication systems, etc.

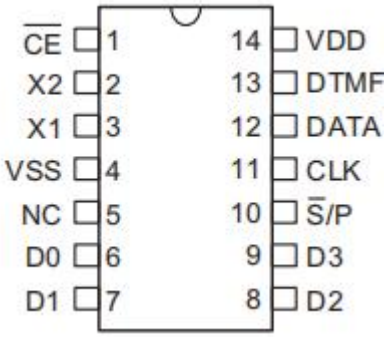
## Block Diagram




## Pin Assignment




HT9200A
DIP-8/SOP-8



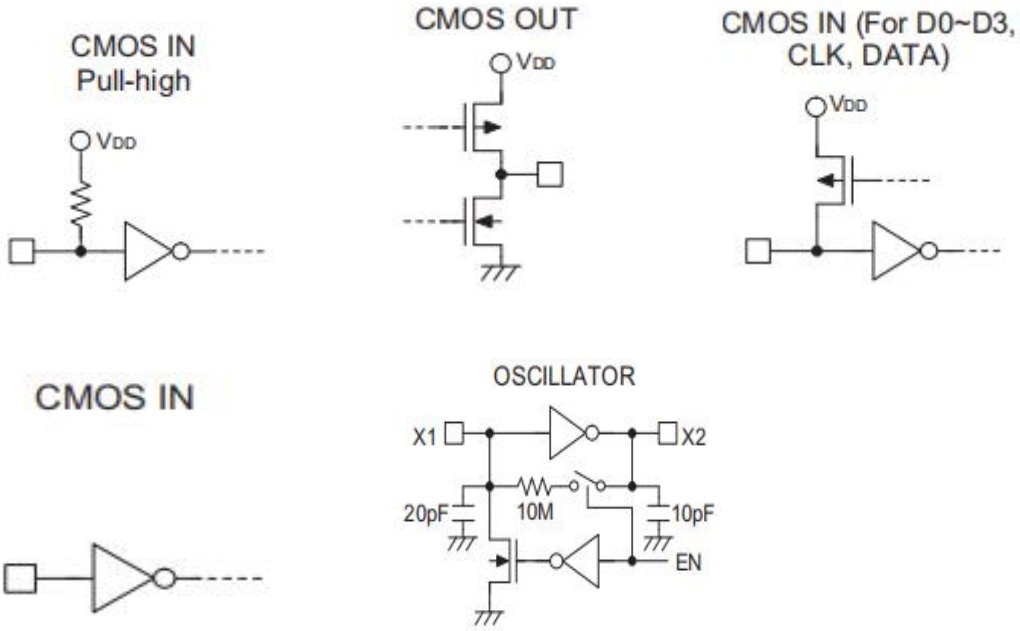

HT9200B
SOP-14

## Pin Description

| Pin Name | I/O | Internal Connection | Description |
|---|---|---|---|
| $\overline{CE}$ | I | CMOS IN Pull-high | Chip enable, active low |
| X2 | O | Oscillator | The system oscillator consists of an inverter, a bias resistor, and the required load capacitor on chip.<br>The oscillator function can be implemented by Connect a standard 3.579545MHz crystal to the X1 and X2 terminals. |
| X1 | I | | |
| VSS | | | Negative power suppl, ground |
| NC | | | No connection |
| D0~D3 | I | CMOS IN Pull-high or Floating | Data inputs for the parallel mode<br>When the IC is operating in the serial mode, the data input terminals (D0~D3) are included with a pull-high resistor. When the IC is operating in the parallel mode, these pins become floating. |
| $\overline{S}$/P | I | CMOS IN | Operation mode selection input<br>$\overline{S}$/P="H": Parallel mode<br>$\overline{S}$/P="L": Serial mode |
| CLK | I | CMOS IN Pull-high or Floating | Data synchronous clock input for the serial mode<br>When the IC is operating in the parallel mode, the input terminal (CLK) is included with a pull-high resistor. When the IC is operating in the serial mode, this pin becomes floating. |

| Pin Name | I/O | Internal Connection | Description |
|---|---|---|---|
| DATA | I | CMOS IN Pull-high or Floating | Data input terminal for the serial mode<br>When the IC is operating in the parallel mode, the input terminal (DATA) is included with a pull-high resistor. When the IC is operating in the serial mode, this pin becomes floating. |
| DTMF | O | CMOS OUT | Output terminal of the DTMF signal |
| VDD | | | Positive power supply, 2.0V~5.5V for normal operation |

Approximate internal connection circuits




## Absolute Maximum Ratings

| Condition | Min | Max | UNITS |
|---|---|---|---|
| Supply Voltage | -0.3 | 6 | V |
| Input Voltage | VSS-0.3 | VDD+0.3 | V |
| Storage Temperature | -50 | 125 | °C |
| Operating Temperature | -20 | 75 | °C |
| Lead Temperature (Soldering, 10 seconds) | - | 245 | °C |

Note: These are stress ratings only. Stresses exceeding the range specified under Absolute Maximum Ratings may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

## Electrical Characteristics

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| | | VDD | Conditions | | | | |
| $V_{DD}$ | Operating Voltage | - | - | 2 | - | 5.5 | V |
| $I_{DD}$ | Operating Current | 2.5V | $\overline{S}$/P=$V_{DD}$,D0~D3=$V_{SS}$, $\overline{CE}$=$V_{SS}$, No load | - | 240 | 2500 | μA |
| | | 5.0V | | - | 950 | 3000 | |
| $V_{IL}$ | "Low"Input Voltage | - | - | $V_{SS}$ | - | 0.2$V_{DD}$ | V |
| $V_{IH}$ | "High" Input Voltage | - | - | 0.8$V_{DD}$ | - | $V_{DD}$ | V |
| $I_{STB}$ | Standby Current | 2.5V | $\overline{S}$/P=$V_{DD}$,$\overline{CE}$=$V_{DD}$, no load | - | - | 1 | μA |
| | | 5.0V | | - | - | 2 | |
| $R_P$ | Pull-high Resistance | 2.5V | VOL=0V | 120 | 180 | 270 | kΩ |
| | | 5.0V | | 45 | 68 | 100 | |
| $t_{DE}$ | DTMF Output Delay Time (Parallel Mode) | 5V | - | - | tUP+6 | tUP+8 | ms |
| $V_{TDC}$ | DTMF Output DC Level | 2V~5.5V | DTMF Output | 0.45$V_{DD}$ | - | 0.75$V_{DD}$ | V |
| $I_{TOL}$ | DTMF Sink Current | 2.5V | $V_{DTMF}$=0.5V | 0.1 | | | mA |
| $V_{TAC}$ | DTMF Output AC Level | 2.5V | Row group, RL=5kΩ | 0.12 | 0.15 | 0.18 | Vrms |
| $A_{CR}$ | Column Pre-emphasis | 2.5V | Row group=0dB | 1 | 2 | 3 | dB |
| $R_L$ | DTMF Output Load | 2.5V | tHD ≤-23dB | 5 | - | - | kΩ |
| $t_{HD}$ | Tone Signal Distortion | 2.5V | RL=5kΩ | - | 30 | 23 | dB |
| $f_{CLK}$ | Clock Input Rate (Serial Mode) | - | - | - | 100 | 500 | kHz |
| $t_{UP}$ | Oscillator Starting Time (When $\overline{CE}$ is low) | 5.0V | The time from $\overline{CE}$ falling edge to normal oscillator operation | - | - | 10 | ms |
| $f_{OSC}$ | System Frequency | - | Crystal=3.5795MHz | 3.5759 | 3.5795 | 3.5831 | MHz |

## Functional Description

The HT9200A/B are DTMF generators for MCU interfaces. They are controlled by a MCU in the serial mode or the parallel mode (for the HT9200B only).

## Serial mode (HT9200A/B)

The HT9200A/B employ a data input, a 5-bit code, and a synchronous clock to transmit a DTMF signal. Every digit of a phone number to be transmitted is selected by a series of inputs which consist of 5-bit data. Of the 5 bits, the D0(LSB) is the first received bit. The HT9200A/B will latch data on the falling edge of the clock (CLK pin). The relationship between the digital codes and the tone output frequency is shown in Table 1. As for the control timing diagram, refer to Figure 1.

When the system is operating in the serial mode a pull-high resistor is attached to D0~D3 (for parallel mode) on the input terminal.

Table 1: Digits vs. input data vs. tone output frequency (serial mode)

| Digit | D4 | D3 | D2 | D1 | D0 | Tone Output Frequency (Hz) |
|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 1 | 697+1209 |
| 2 | 0 | 0 | 0 | 1 | 0 | 697+1336 |
| 3 | 0 | 0 | 0 | 1 | 1 | 697+1477 |
| 4 | 0 | 0 | 1 | 0 | 0 | 770+1209 |
| 5 | 0 | 0 | 1 | 0 | 1 | 770+1336 |
| 6 | 0 | 0 | 1 | 1 | 0 | 770+1477 |
| 7 | 0 | 0 | 1 | 1 | 1 | 852+1209 |
| 8 | 0 | 1 | 0 | 0 | 0 | 852+1336 |
| 9 | 0 | 1 | 0 | 0 | 1 | 852+1477 |
| 0 | 0 | 1 | 0 | 1 | 0 | 941+1336 |
| * | 0 | 1 | 0 | 1 | 1 | 941+1209 |
| # | 0 | 1 | 1 | 0 | 0 | 941+1477 |
| A | 0 | 1 | 1 | 0 | 1 | 697+1633 |
| B | 0 | 1 | 1 | 1 | 0 | 770+1633 |
| C | 0 | 1 | 1 | 1 | 1 | 852+1633 |
| D | 0 | 0 | 0 | 0 | 0 | 941+1633 |
| - | 1 | 0 | 0 | 0 | 0 | 697 |
| - | 1 | 0 | 0 | 0 | 1 | 770 |
| - | 1 | 0 | 0 | 1 | 0 | 852 |
| - | 1 | 0 | 0 | 1 | 1 | 941 |
| - | 1 | 0 | 1 | 0 | 0 | 1209 |
| - | 1 | 0 | 1 | 0 | 1 | 1336 |
| - | 1 | 0 | 1 | 1 | 0 | 1477 |
| - | 1 | 0 | 1 | 1 | 1 | 1633 |
| DTMF OFF | 1 | 1 | 1 | 1 | 1 | - |

Note: The codes not listed in Table 1 are not used D4 is MSB

For the HT9200B, the $\overline{S}$/P pin has to be connected low for serial mode operation.

**Parallel mode ( HT9200B)**

The HT9200B provides four data inputs D0~D3 to generate their corresponding DTMF signals. The $\overline{S}$/P has to be connected high to select the parallel operation mode. Then the input data codes should be determined. Finally, the $\overline{CE}$ is connected low to transmit the DTMF signal from the DTMF pin.

The TDE time (about 6ms) will be delayed from the $\overline{CE}$ falling edge to the DTMF signal output.

The relationship between the digital codes and the tone output frequency is illustrated in Table 2. As for the control timing diagram, see Figure 2. When the system is operating in the parallel mode, D0~D3 are all in the floating state. Thus, these data input pins should not float.

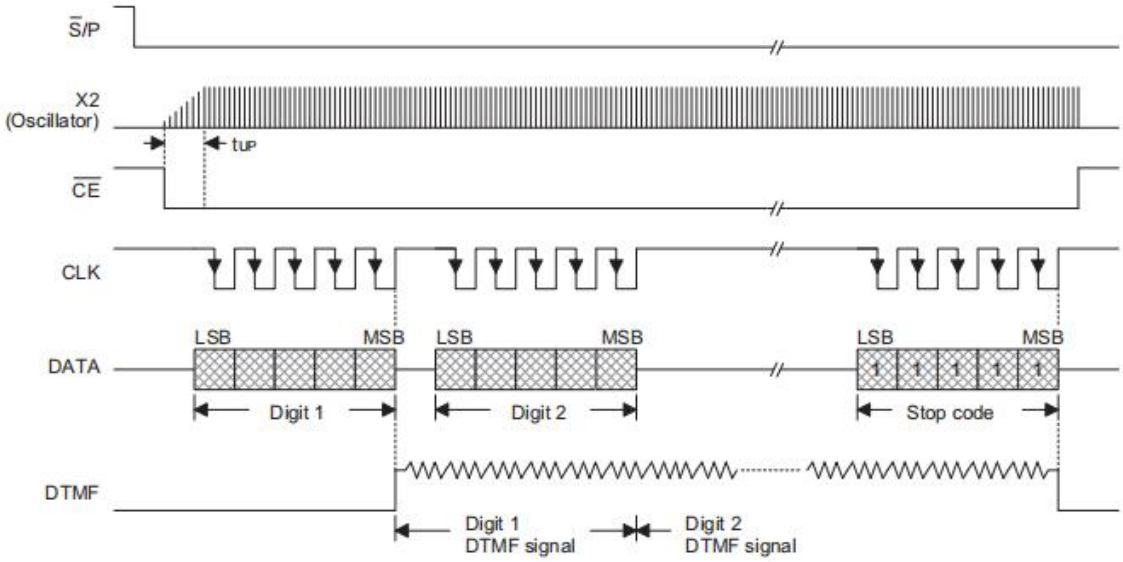
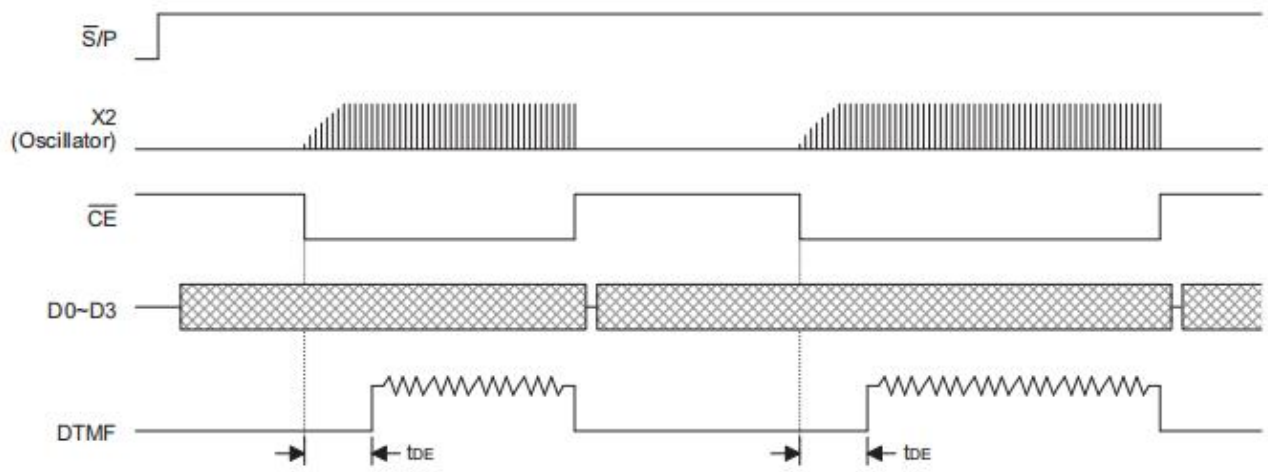



Figure 1

Table 2: Digits vs. input data vs. tone output frequency (parallel mode)

| Digit | D3 | D2 | D1 | D0 | Tone Output Frequency (Hz) |
|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 1 | 697+1209 |
| 2 | 0 | 0 | 1 | 0 | 697+1336 |
| 3 | 0 | 0 | 1 | 1 | 697+1477 |
| 4 | 0 | 1 | 0 | 0 | 770+1209 |
| 5 | 0 | 1 | 0 | 1 | 770+1336 |
| 6 | 0 | 1 | 1 | 0 | 770+1477 |
| 7 | 0 | 1 | 1 | 1 | 852+1209 |
| 8 | 1 | 0 | 0 | 0 | 852+1336 |
| 9 | 1 | 0 | 0 | 1 | 852+1477 |
| 0 | 1 | 0 | 1 | 0 | 941+1336 |
| * | 1 | 0 | 1 | 1 | 941+1209 |
| # | 1 | 1 | 0 | 0 | 941+1477 |
| A | 1 | 1 | 0 | 1 | 697+1633 |
| B | 1 | 1 | 1 | 0 | 770+1633 |
| C | 1 | 1 | 1 | 1 | 852+1633 |
| D | 0 | 0 | 0 | 0 | 941+1633 |




Note:The data (D0~D3)should be ready before the $\overline{CE}$ becomes low.

Figure 2

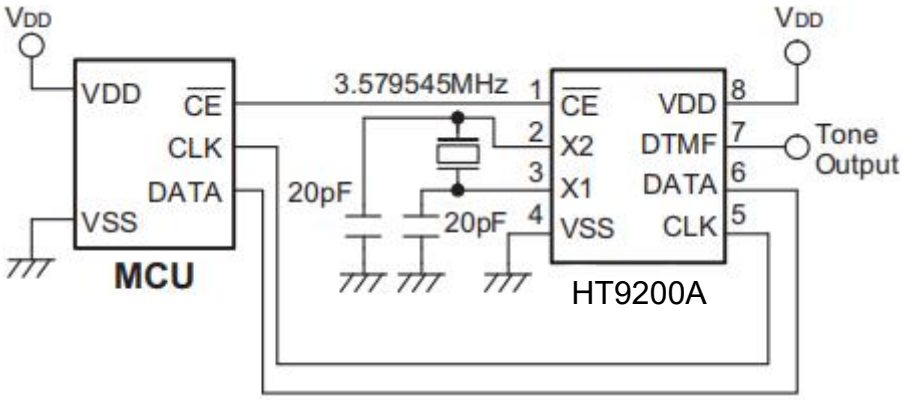
## Tone frequency

| Output Frequency (Hz) | | %Error |
|---|---|---|
| Specified | Actual | |
| 697 | 699 | +0.29% |
| 770 | 766 | –0.52% |
| 852 | 847 | –0.59% |
| 941 | 948 | +0.74% |
| 1209 | 1215 | +0.50% |
| 1336 | 1332 | –0.30% |
| 1477 | 1472 | –0.34% |

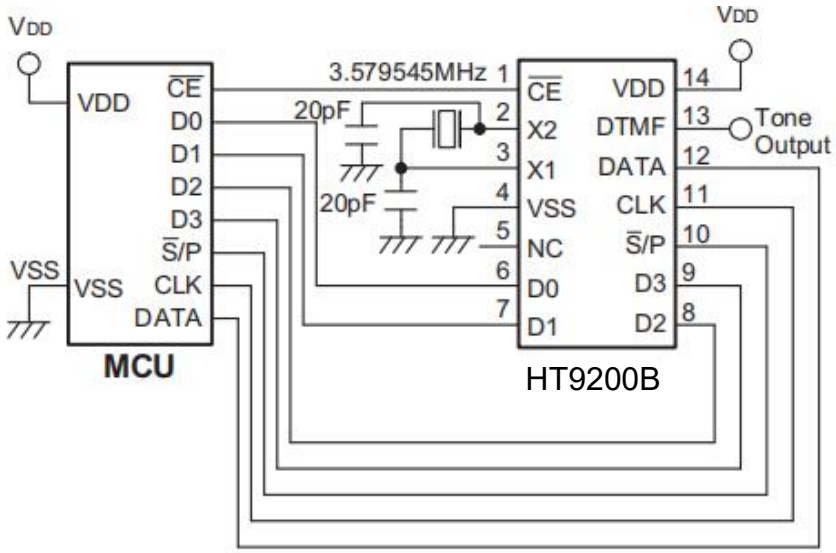
% Error does not contain the crystal frequency drift

## Application Circuits

Serial mode

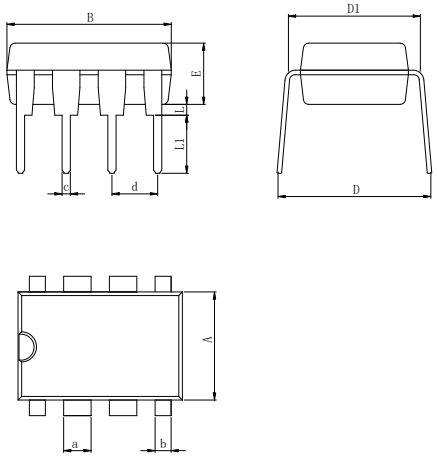



Serial/parallel mode



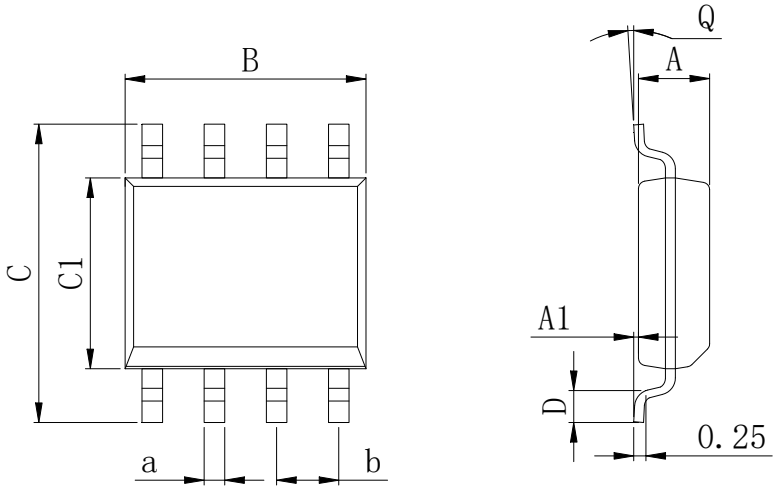
## Physical Dimensions

DIP-8




| Dimensions In Millimeters(DIP-8) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Symbol:** | A | B | D | D1 | E | L | L1 | a | b | c | d |
| **Min:** | 6.10 | 9.00 | 8.10 | 7.42 | 3.10 | 0.50 | 3.00 | 1.50 | 0.85 | 0.40 | 2.54 BSC |
| **Max:** | 6.68 | 9.50 | 10.9 | 7.82 | 3.55 | 0.70 | 3.60 | 1.55 | 0.90 | 0.50 | |

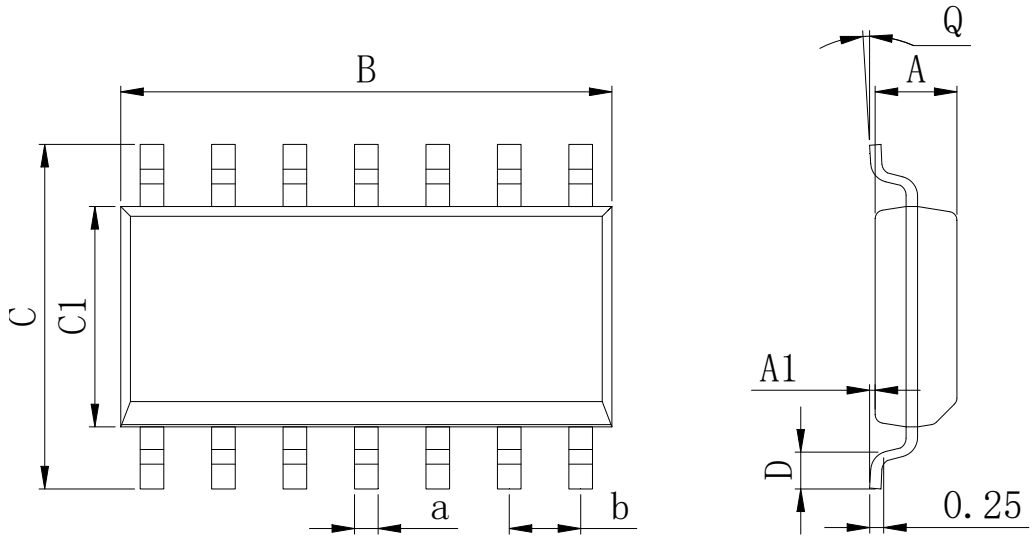
SOP-8 (150mil)




| Dimensions In Millimeters(SOP-8) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Symbol:** | A | A1 | B | C | C1 | D | Q | a | b |
| **Min:** | 1.35 | 0.05 | 4.90 | 5.80 | 3.80 | 0.40 | 0° | 0.35 | 1.27 BSC |
| **Max:** | 1.55 | 0.20 | 5.10 | 6.20 | 4.00 | 0.80 | 8° | 0.45 | |

## Physical Dimensions

SOP-14




| Dimensions In Millimeters(SOP-14) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Symbol:** | A | A1 | B | C | C1 | D | Q | a | b |
| **Min:** | 1.35 | 0.05 | 8.55 | 5.80 | 3.80 | 0.40 | 0° | 0.35 | 1.27 BSC |
| **Max:** | 1.55 | 0.20 | 8.75 | 6.20 | 4.00 | 0.80 | 8° | 0.45 | |

## Revision History

| DATE | REVISION | PAGE |
|---|---|---|
| 2014-6-9 | New | 1-12 |
| 2023-8-30 | Update encapsulation type、Update Lead Temperature、Updated DIP-8 dimension | 1、3、9 |

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