

3V-30V CMOS Low-Power Monostable / Astable Multivibrator

Features

- Wide operation voltage range: 3V to 30V
- Low power consumption
- Monostable (one shot) or astable (free-running) operation
- True and complemented buffered outputs
- Only one external resistor and capacitor required
- Monostable Multivibrator:
 - Positive- or negative-edge triggering
 - Output pulse width independent of trigger pulse duration
 - Retriggerable option for pulse-width expansion
 - Long pulse width possible using small RC components with external counter provision
 - Fast recovery time independent of pulse width
 - Pulse-width accuracy maintained at duty cycles approaching 100%
- Astable Multivibrator:
 - 50% duty cycle
 - Oscillator output available
 - Free-running or gatable operating modes
- Packaging: SOP14/TSSOP14/DIP14

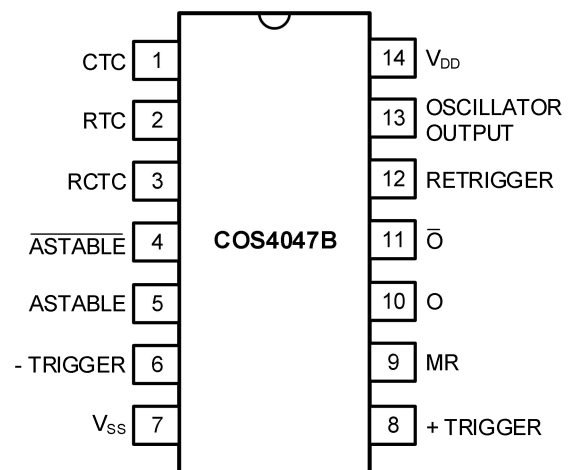
Applications

- Digital Equipment
- Timing Circuits
- Frequency Multiplication/Division

General Description

The COS4047B is a retriggerable astable multivibrator that can be configured as either a positive-edge or negative-edge triggered monostable multivibrator. The output pulse width is programmed by selection of external components (R_t and C_t). Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{DD} .

The COS4047B is available in 14-lead plastic SOP14, TSSOP14 and DIP14, and is specified for operation from -40°C to $+85^{\circ}\text{C}$ ambient temperature.



Pin Diagram

Rev1.0

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1. Pin Configuration and Functions

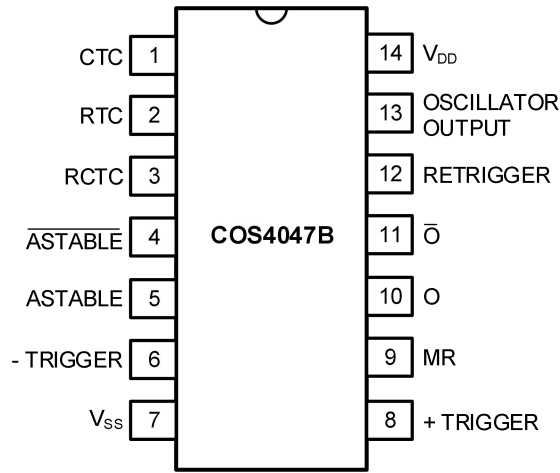


Figure 1 Pin Diagram

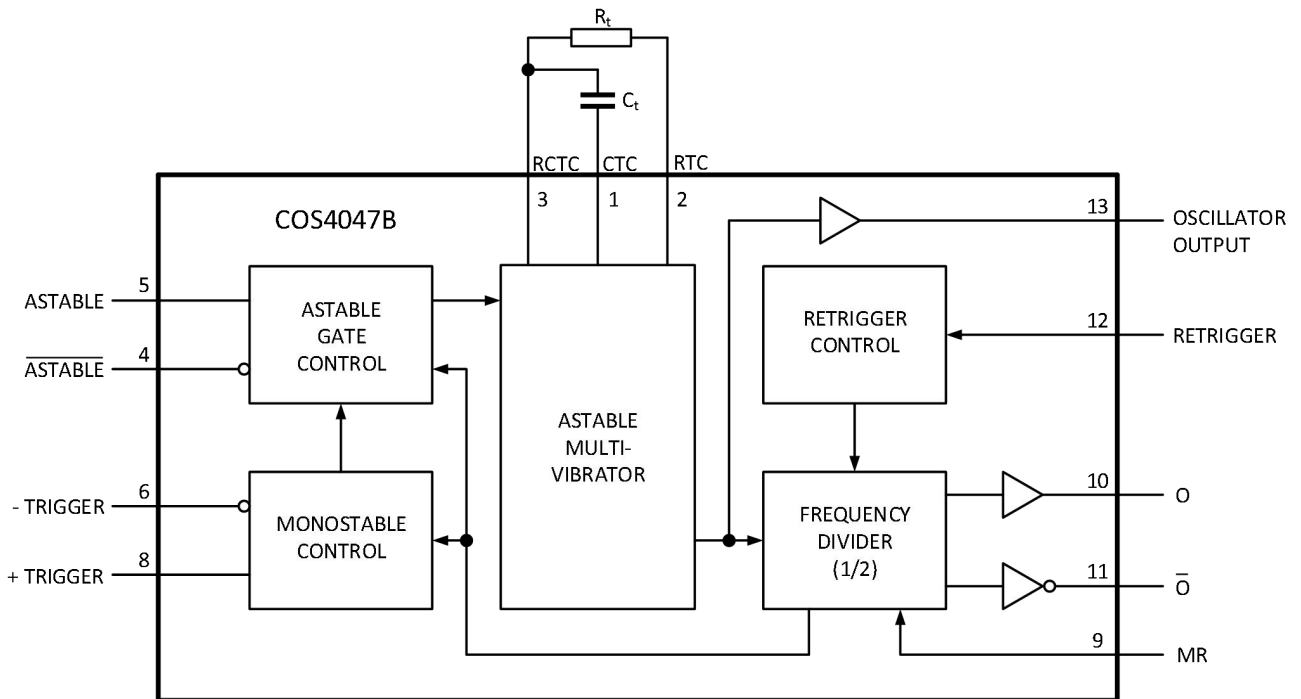


Figure 2. COS4047B Logic Block Diagram

Pin Description

| Pin | Name | Description |
|-----|-----------------------------|--|
| 1 | CTC | External capacitor connection |
| 2 | RTC | External resistor connection |
| 3 | RCTC | External capacitor / resistor connection |
| 4 | $\overline{\text{ASTABLE}}$ | Input |
| 5 | ASTABLE | Input |
| 6 | - TRIGGER | Input |
| 7 | V _{SS} | Ground |
| 8 | + TRIGGER | Input |
| 10 | 0 | Output |
| 11 | $\overline{0}$ | Output |
| 12 | RETRIGGER | Input |
| 13 | OSCILLATOR OUTPUT | Oscillator output |
| 14 | V _{DD} | Supply voltage |

2. Product Specification

2.1 Absolute Maximum Ratings ⁽¹⁾

| Parameter | Min | Max | Unit |
|--|------|-----------------------|------|
| DC supply voltage, V _{DD} | -0.5 | 40 | V |
| Input voltages, V _I | -0.5 | V _{DD} + 0.5 | V |
| Input clamping current, I _{IK} | | ± 10 | mA |
| Output clamping current, I _{OK} | | ± 10 | mA |
| Input / output current, I _{I/O} | | ± 10 | mA |
| Supply current, I _{DD} | | 50 | mA |
| Operating junction temperature, T _j | -40 | +125 | °C |
| Storage temperature, T _{stg} | -55 | +150 | °C |

(1) Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

2.2 Thermal Data

| Parameter | Rating | Unit |
|--|---|------|
| Package Thermal Resistance, $R_{\theta JA}$ (Junction-to-ambient) | 82 (SOP14) 105 (TSSOP14) 70 (DIP14) | °C/W |

2.3 Recommended Operating Conditions

| Parameter | Min. | Typ. | Max. | Unit |
|--------------------------------|------|------|----------|------|
| DC Supply voltage, V_{DD} | 3 | - | 30 | V |
| Input voltage, V_I | 0 | - | V_{DD} | V |
| Operating ambient temperature | -40 | - | +85 | °C |
| Operating junction temperature | -40 | - | +125 | °C |

2.4 Static Electrical Characteristics

(Typical values are at $T_A=25\text{ °C}$, $V_{DD}=5V/10V/15V$, unless otherwise noted.)

| Parameter | Symbol | Conditions | | | Min. | Typ. | Max. | Unit |
|---|----------|------------|-------------|-------------|------|------|------|---------|
| | | $V_O(V)$ | $V_{IN}(V)$ | $V_{DD}(V)$ | | | | |
| Quiescent Supply Current ($I_O=0$) | I_{DD} | - | 0, 5 | 5 | - | 0.02 | 1 | μA |
| | | - | 0, 10 | 10 | - | 0.02 | 2 | |
| | | - | 0, 15 | 15 | - | 0.02 | 4 | |
| | | - | 0, 20 | 20 | - | 0.04 | 20 | |
| Output Low (Sink) Current | I_{OL} | 0.4 | 0, 5 | 5 | 0.45 | 1 | - | mA |
| | | 0.5 | 0, 10 | 10 | 0.90 | 2.6 | - | |
| | | 1.5 | 0, 15 | 15 | 3.34 | 6.8 | - | |

| | | | | | | | | |
|------------------------------|----------|-----------|-------|----|-------|------|-----------|---------|
| Output High (Source) Current | I_{OH} | 4.6 | 0, 5 | 5 | -0.51 | -1 | - | mA |
| | | 2.5 | 0, 5 | 5 | -1.6 | -3.2 | - | |
| | | 9.5 | 0, 10 | 10 | -1.3 | -2.6 | - | |
| | | 13.5 | 0, 15 | 15 | -3.4 | -6.8 | - | |
| Output Voltage: Low-Level | V_{OL} | - | 0, 5 | 5 | - | 0 | 0.05 | V |
| | | - | 0, 10 | 10 | - | 0 | 0.05 | |
| | | - | 0, 15 | 15 | - | 0 | 0.05 | |
| Output Voltage: High-Level | V_{OH} | - | 0, 5 | 5 | 4.95 | 5 | - | V |
| | | - | 0, 10 | 10 | 9.95 | 10 | - | |
| | | - | 0, 15 | 15 | 14.95 | 15 | - | |
| Input Low Voltage | V_{IL} | 0.5, 4.5 | - | 5 | - | - | 1.5 | V |
| | | 1, 9 | - | 10 | - | - | 3 | |
| | | 1.5, 13.5 | - | 15 | - | - | 4 | |
| Input High Voltage | V_{IH} | 0.5, 4.5 | - | 5 | 3.5 | - | - | V |
| | | 1.9 | - | 10 | 7 | - | - | |
| | | 1.5, 13.5 | - | 15 | 11 | - | - | |
| Input Leakage Current | I_{IK} | - | 0, 18 | 18 | - | - | ± 0.1 | μA |

2.5 Switching Characteristics

(Typical values are at $T_A=25\text{ }^\circ\text{C}$, $V_{DD}=5\text{V}/10\text{V}/15\text{V}$, unless otherwise noted. See Figure 3 for waveform.)

| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|--|--------------------|------|------|------|------|
| | $V_{DD}(\text{V})$ | | | | |
| Propagation Delay Time (t_{PLH} , t_{PHL}) (ASTABLE, $\overline{\text{ASTABLE}}$ to Osc. Out) | 5 | - | 90 | 200 | ns |
| | 10 | - | 40 | 100 | |
| | 15 | - | 30 | 60 | |

| | | | | | |
|--|----|-----|-----|-----|----|
| Propagation Delay Time (t_{PLH} , t_{PHL}) (ASTABLE, $\overline{\text{ASTABLE}}$ to 0, $\overline{0}$) | 5 | - | 150 | 300 | ns |
| | 10 | - | 65 | 130 | |
| | 15 | - | 50 | 100 | |
| Propagation Delay Time (t_{PLH} , t_{PHL}) (+/- TRIGGER to 0, $\overline{0}$) | 5 | - | 160 | 320 | ns |
| | 10 | - | 65 | 130 | |
| | 15 | - | 50 | 100 | |
| Propagation Delay Time (t_{PLH} , t_{PHL}) (RETRIGGER to 0, $\overline{0}$) | 5 | - | 65 | 130 | ns |
| | 10 | - | 30 | 60 | |
| | 15 | - | 25 | 50 | |
| Propagation Delay Time (t_{PLH} , t_{PHL}) (MR to 0, $\overline{0}$) | 5 | - | 100 | 200 | ns |
| | 10 | - | 45 | 90 | |
| | 15 | - | 35 | 70 | |
| Transition Time (t_{PLH} , t_{PHL}) (OSC. OUT to 0, $\overline{0}$) | 5 | - | 60 | 120 | ns |
| | 10 | - | 30 | 60 | |
| | 15 | - | 20 | 40 | |
| Pulse Width (any input except MR) | 5 | 220 | 110 | - | ns |
| | 10 | 110 | 50 | - | |
| | 15 | 70 | 35 | - | |
| Pulse Width (MR HIGH) | 5 | 60 | 30 | - | ns |
| | 10 | 30 | 15 | - | |
| | 15 | 20 | 10 | - | |

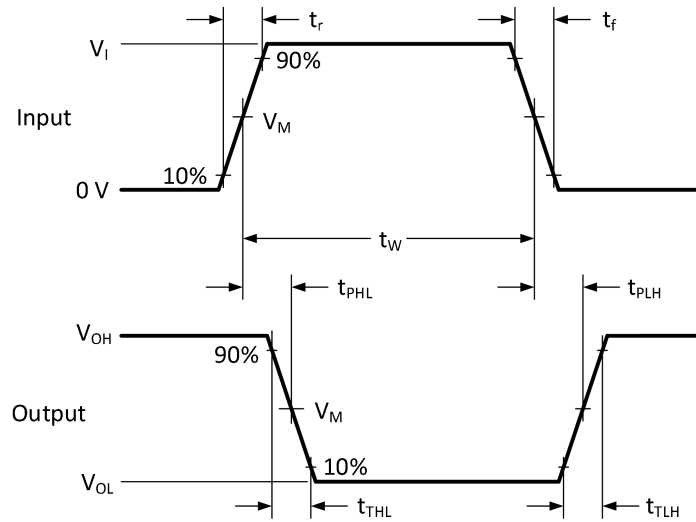


Figure 3. Input and Output Propagation delays, Output Transition Time and Pulse Width

3. Functional Description

The COS4047B consists of a gate-able astable multivibrator incorporating logic techniques to permit positive or negative edge-triggered monostable multivibrator action with retriggering and external counting options.

Inputs include +TRIGGER, -TRIGGER, ASTABLE, $\overline{\text{ASTABLE}}$, RETRIGGER and MR (master reset). Buffered outputs are 0, $\overline{0}$ and OSCILLATOR OUTPUT. In all modes of operation an external capacitor (C_t) must be connected between CTC and RCTC, and an external resistor (R_t) must be connected between RTC and RCTC.

A HIGH level on the ASTABLE input enables astable operation. The period of the square wave at 0 and $\overline{0}$ outputs is a function of the external components employed. 'True' input pulses on the ASTABLE or 'complement' pulses on the $\overline{\text{ASTABLE}}$ input, allow the circuit to be used as a gate-able multivibrator. The OSCILLATOR OUTPUT period is half of the O output in the astable mode. However, a 50% duty factor is not guaranteed at this output.

In the monostable mode, positive edge-triggering is accomplished by applying a leading-edge pulse to the +TRIGGER input and a LOW level to the –TRIGGER input. For negative edge-triggering, a trailing-edge pulse is applied to the –TRIGGER and a HIGH level to the +TRIGGER. Input pulses may be of any duration relative to the output pulse. The multivibrator can be retriggered (on the leading-edge only) by applying a common pulse to both the RETRIGGER and +TRIGGER inputs. In this mode, the output pulse remains HIGH as long as the input pulse period is shorter than the period determined by the RC components.

An external count down option implements coupling O to an external ‘N’ counter and resetting the counter with the trigger pulse. The counter output pulse is fed back to the $\overline{\text{ASTABLE}}$ input and has a duration equal to N times the period of the multivibrator. A HIGH level on the MR input assures no output pulse during an ON-power condition. This input can also be activated to terminate the output pulse at any time. In the monostable mode, a HIGH level or power-ON reset pulse must be applied to MR, whenever V_{DD} is applied.

4. Application Information

4.1 Functional Terminal Connections⁽¹⁾

| Function | Terminal Connections | | | Output Pulse From Pins | Output Period or Pulse Width |
|-----------------------------------|----------------------|-------------------|-------|------------------------|---|
| | V_{DD} | V_{SS} | Input | | |
| Astable Multivibration | | | | | |
| Free Running | 4, 5, 6, 14 | 7, 8, 9, 12 | - | 10, 11, 13 | $t_A(10,11) = 4.4 RC$ $t_A(13) = 2.2 RC$ (See Figure 4) |
| True Gating | 4, 6, 14 | 7, 8, 9, 12 | 5 | 10, 11, 13 | |
| Complement Gating | 6, 14 | 5, 7, 8, 9, 12 | 4 | 10, 11, 13 | |
| Monostable Multivibration | | | | | |
| Positive-Edge Trigger | 4, 14 | 5, 6, 7, 9, 12 | 8 | 10, 11 | $t_M(10,11) = 2.48 RC$ (See Figure 5) |
| Negative-Edge Trigger | 4, 8, 14 | 5, 7, 9, 12 | 6 | 10, 11 | |
| Retriggerable | 4, 14 | 5, 6, 7, 9 | 8, 12 | 10, 11 | |
| External Countdown ⁽²⁾ | 14 | 5, 6, 7, 8, 9, 12 | - | 10, 11 | |

(1) In all cases, external resistor between pins 2 and 3, external capacitor between pins 1 and 3.

(2) Input pulse to RESET of external counting chip: external counting chip output to pin 4.

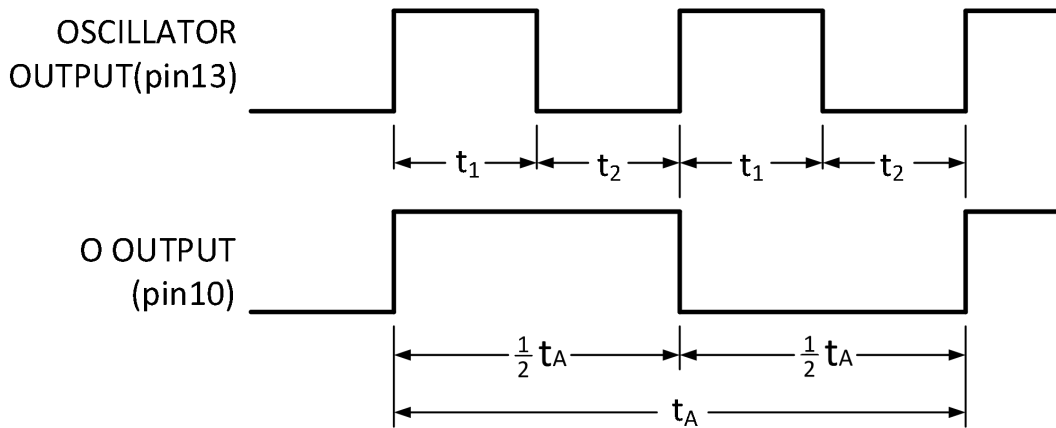


Figure 4. Astable Mode Waveforms

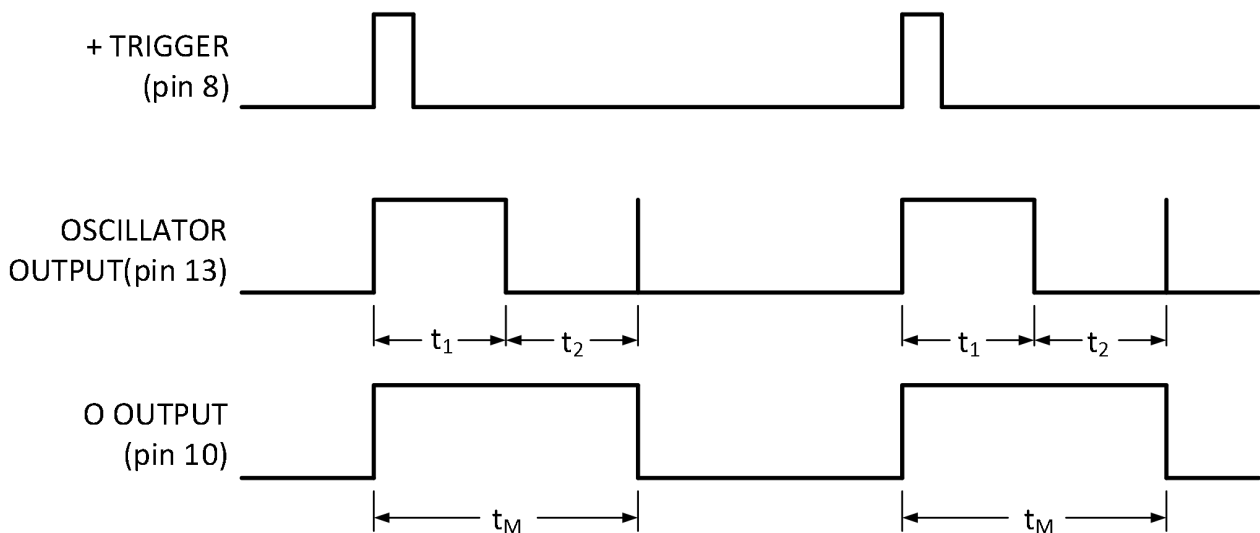


Figure 5. Monostable Waveforms

4.2 Timing Component Selections

The capacitor used in the circuit should be non-polarized and have low leakage (that is the parallel resistance of the capacitor should be an order of magnitude greater than the external resistor used). There is no upper or lower limit for either R_t or C_t value to maintain oscillation. However, for accuracy, C_t must be much larger than the inherent stray capacitance in the system (unless this capacitance can be measured and taken into account). R_t must be much larger than the CMOS 'ON' resistance in series with it, which typically is hundreds of ohms

The recommended values for R_t and C_t to comply with previously calculated formulae without trimming should be:

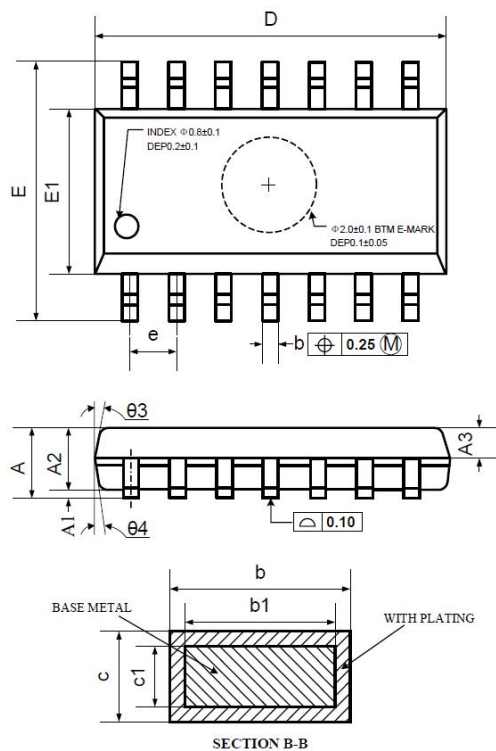
- $C_t \geq 100$ pF, up to any practical value, for astable modes;
- $C_t \geq 1000$ pF, up to any practical value, for monostable modes;
- $10 \text{ k}\Omega \leq R_t \leq 1 \text{ M}\Omega$

5. Ordering Information

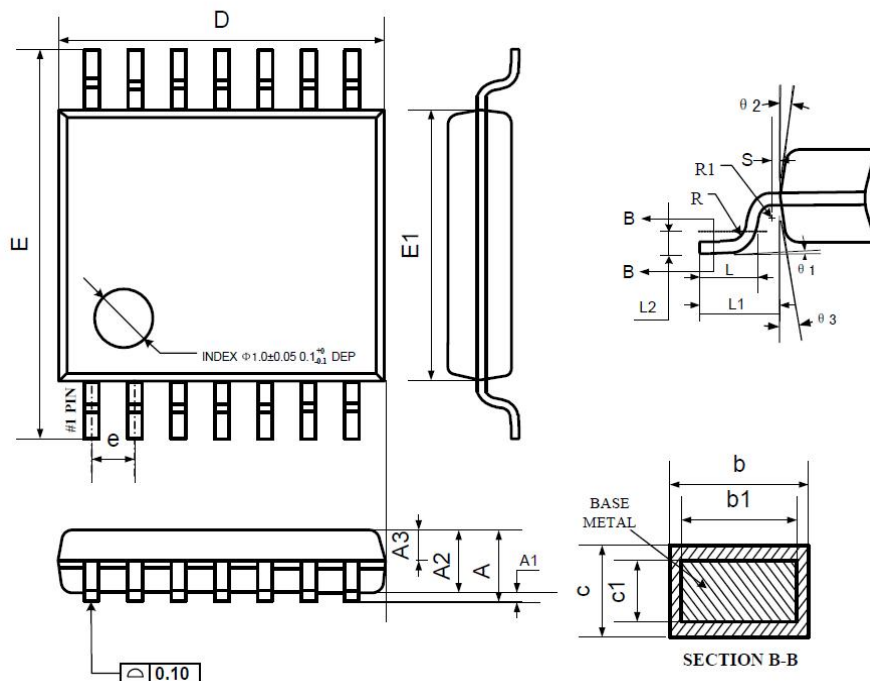
| Model | Order Number | Package | Package Option | Marking Information |
|----------|--------------|----------|---------------------|---------------------|
| COS4047B | COS4047BS | SOP-14 | Tape and Reel, 3000 | COS4047B |
| | COS4047BT | TSSOP-14 | Tape and Reel, 3000 | COS4047B |
| | COS4047BD | DIP14 | Tape and Reel, 3000 | COS4047B |

6. Package Information

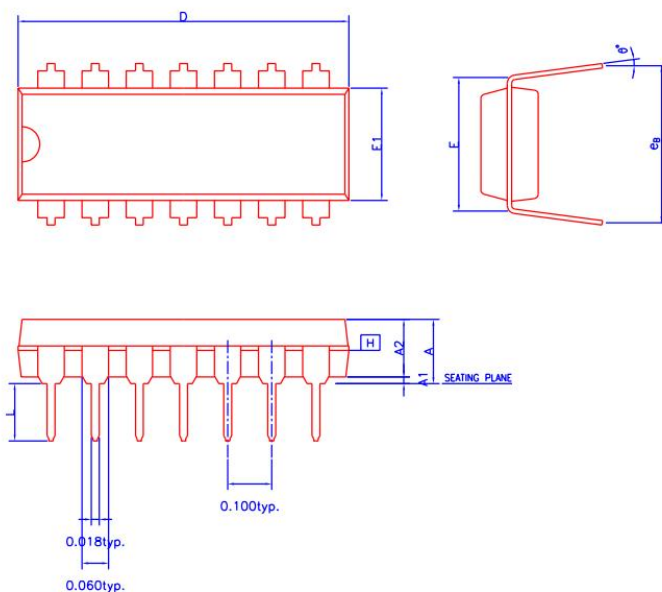
6.1 SOP14 (Package Outline Dimensions)



| 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° |
| θ_1 | 6° | 8° | 10° |
| θ_2 | 6° | 8° | 10° |
| θ_3 | 5° | 7° | 9° |
| θ_4 | 5° | 7° | 9° |

6.2 TSSOP14 (Package Outline Dimensions)


| 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 | — | — |
| $\theta 1$ | 0° | — | 8° |
| $\theta 2$ | 10° | 12° | 14° |
| $\theta 3$ | 10° | 12° | 14° |

6.3 DIP14 (Package Outline Dimensions)


| SYMBOLS | MIN. | NOR. | MAX. |
|----------------|------------|-------|-------|
| A | — | — | 0.210 |
| A1 | 0.015 | — | — |
| A2 | 0.125 | 0.130 | 0.135 |
| D | 0.735 | 0.750 | 0.775 |
| E | 0.300 BSC. | | |
| E1 | 0.245 | 0.250 | 0.255 |
| L | 0.115 | 0.130 | 0.150 |
| e_B | 0.335 | 0.355 | 0.375 |
| θ° | 0 | 7 | 15 |

UNIT : INCH