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

  - Regriggerable 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
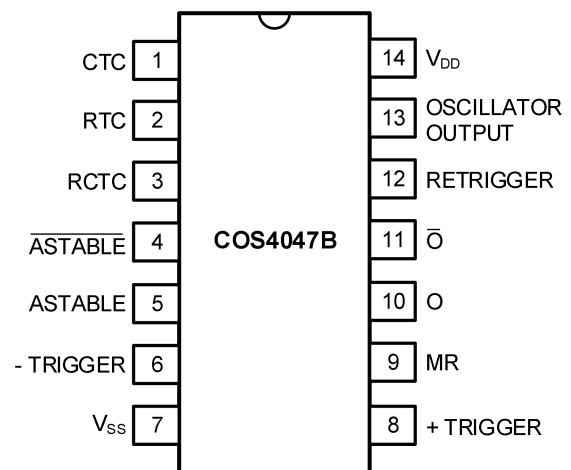
■ Packaging: SOP14/TSSOP14/DIP14

Applications

■ Digital Equipment

■ Timing Circuits

■ Frequency Multiplication/Division

General Description

The COS4047B is a retriggerable astable multi-vibrator 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°C ambient temperature.

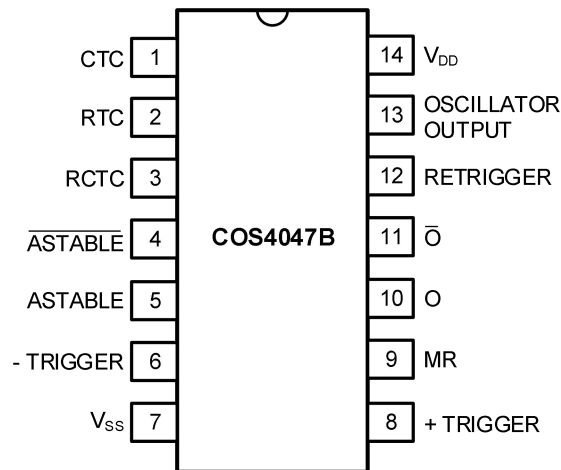|			
CTC	1	14	V_{DD}
RTC	2	13	OSCILLATOR OUTPUT
RCTC	3	12	RETRIGGER
$\overline{ASTABLE}$	4	11	$\overline{O}$
ASTABLE	5	10	O
- TRIGGER	6	9	MR
V_{SS}	7	8	+ TRIGGER

Pin Diagram

1. Pin Configuration and Functions

Figure 1 Pin Diagram

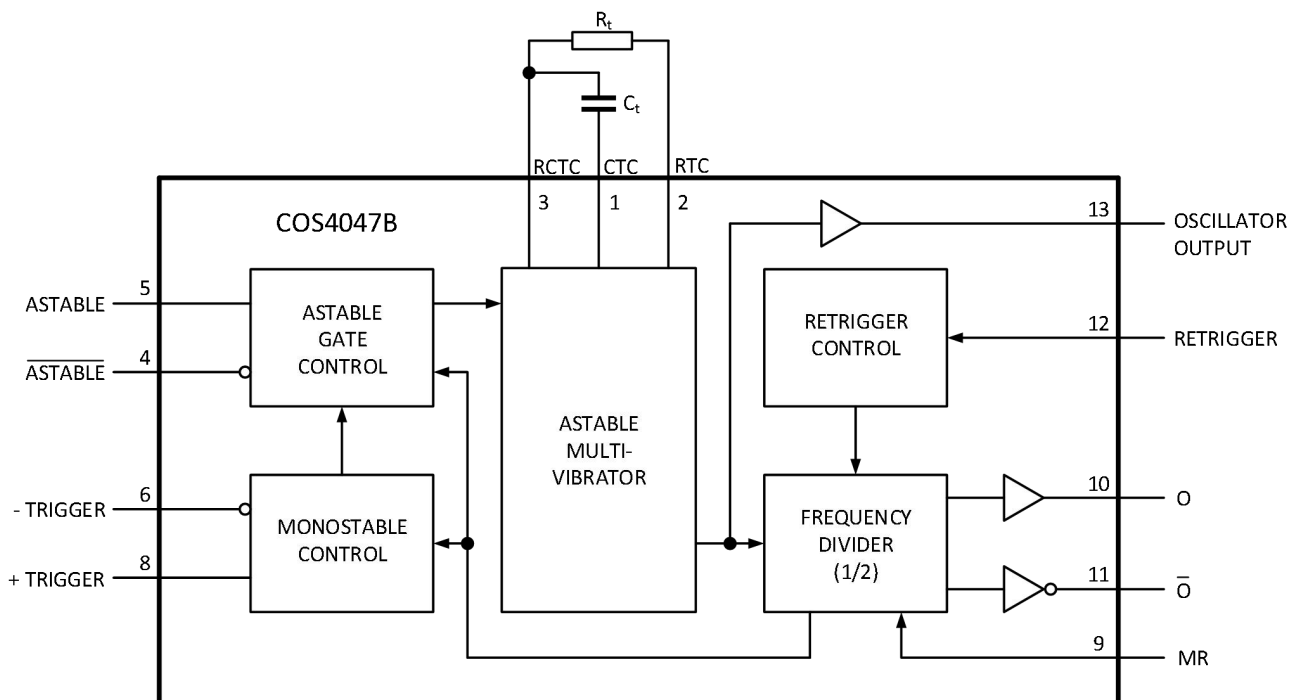Figure 2. COS4047B Logic Block Diagram

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	Vss	Ground
8	$+$ TRIGGER	Input
9	MR	Master reset 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	36	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, $R_{\theta JA}$ (Juntion-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 ºC, 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	-	

Parameter	Symbol			VDD				Unit
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 ºC, V_{DD}=5V/10V/15V, unless otherwise noted. See Figure 3 for waveform.)

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

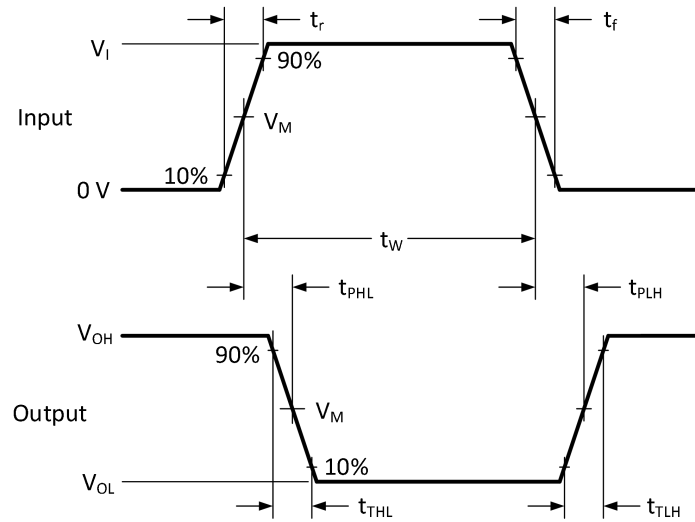|					
Propagation Delay Time (t_{PLH}, t_{PHL}) (ASTABLE, $\overline{\text{ASTABLE}}$ to O, $\overline{\text{O}}$)	5	-	150	300	ns
	10	-	65	130	
	15	-	50	100	
Propagation Delay Time (t_{PLH}, t_{PHL}) ($+/-$ TRIGGER to O, $\overline{\text{O}}$)	5	-	160	320	ns
	10	-	65	130	
	15	-	50	100	
Propagation Delay Time (t_{PLH}, t_{PHL}) (RETRIGGER to O, $\overline{\text{O}}$)	5	-	65	130	ns
	10	-	30	60	
	15	-	25	50	
Propagation Delay Time (t_{PLH}, t_{PHL}) (MR to O, $\overline{\text{O}}$)	5	-	100	200	ns
	10	-	45	90	
	15	-	35	70	
Transition Time (t_{PLH}, t_{PHL}) (OSC. OUT to O, $\overline{\text{O}}$)	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 Transistion 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 $+\text{TRIGGER}$, $-\text{TRIGGER}$, 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 (Ct) must be connected between CTC and RCTC, and an external resistor (Rt) 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 R_tC_t
True Gating	4, 6, 14	7, 8, 9, 12	5	10, 11, 13	$t_A(13)$ = 2.2 R_tC_t
Complement Gating	6, 14	5, 7, 8, 9, 12	4	10, 11, 13	(See Figure 4)
Monostable Multivibration					
Positive-Edge Trigger	4, 14	5, 6, 7, 9, 12	8	10, 11	
Negative-Edge Trigger	4, 8, 14	5, 7, 9, 12	6	10, 11	$t_M(10,11)$ = 2.48 R_tC_t
Retriggerable	4, 14	5, 6, 7, 9	8, 12	10, 11	(See Figure 5)
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.
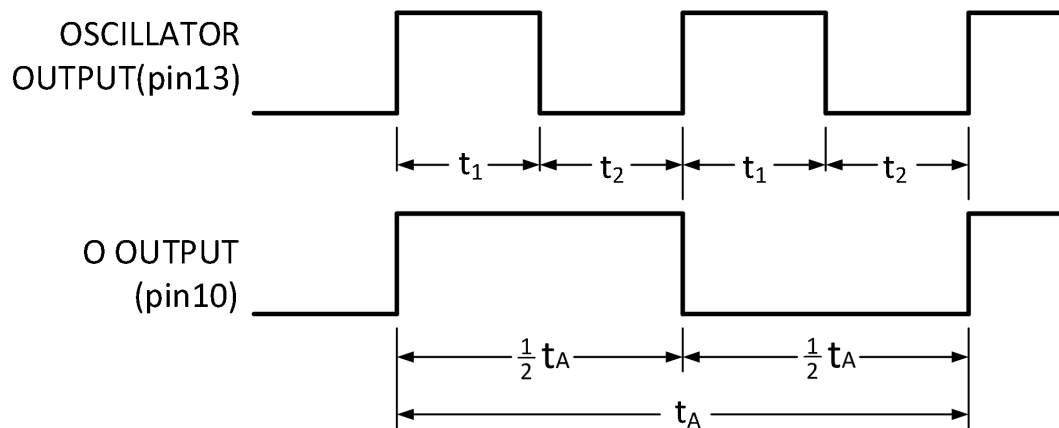(2) Input pulse to RESET of external counting chip: external counting chip output to pin 4.
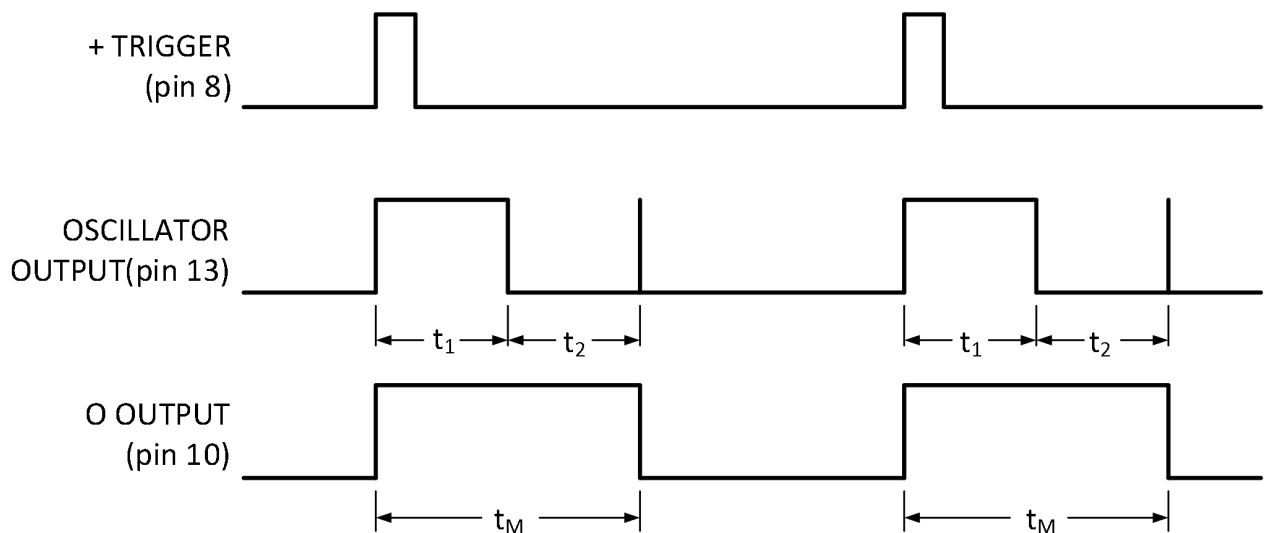
Figure 4. Astable Mode Waveforms

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 Rt or Ct value to maintain oscillation. However, for accuracy, Ct must be much larger than the inherent stray capacitance in the system (unless this capacitance can be measured and taken into account). Rt must be much larger than the CMOS 'ON' resistance in series with it, which typically is hundreds of ohms

The recommended values for Rt and Ct to comply with the calculated formulae without trimming should be:

• Ct ≥ 100 pF, up to any practical value, for astable modes;

• Ct ≥ 1000 pF, up to any practical value, for monostable modes;

• 10 kΩ ≤ Rt ≤ 1 MΩ

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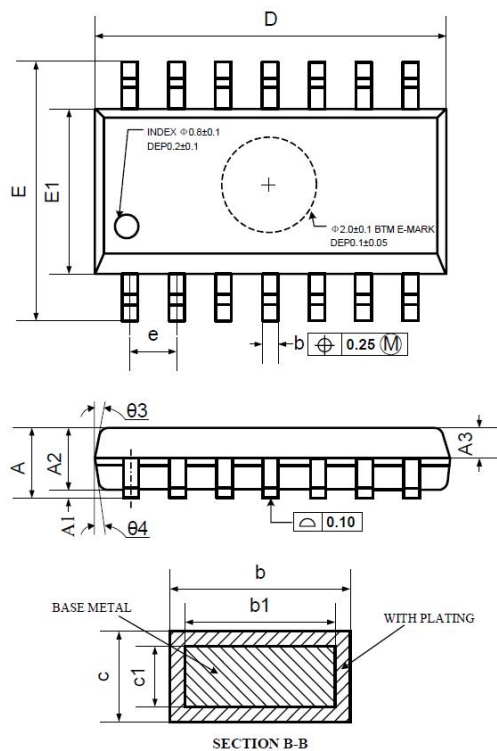
Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	1.35	1.60	1.75
A1	0.10	0.15	0.25
A2	1.25	1.45	1.65
A3	0.55	0.65	0.75
b	0.36		0.49
b1	0.35	0.40	0.45
c	0.16		0.25
c1	0.15	0.20	0.25
D	8.53	8.63	8.73
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
L	0.45	0.60	0.80
L1	1.04 REF		
L2	0.25 BSC		
R	0.07		
R1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

6.2 TSSOP14 (Package Outline Dimensions)
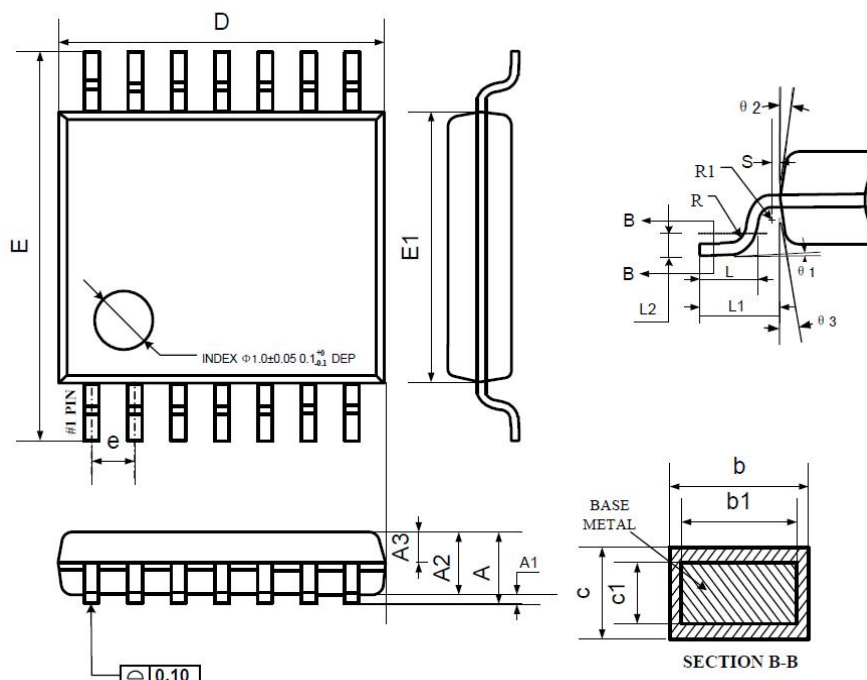
Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	—	—	1.20
A1	0.05	—	0.15
A2	0.90	1.00	1.05
A3	0.34	0.44	0.54
b	0.20	—	0.28
b1	0.20	0.22	0.24
c	0.10	—	0.19
c1	0.10	0.13	0.15
D	4.86	4.96	5.06
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65 BSC		
L	0.45	0.60	0.75
L1	1.00 REF		
L2	0.25 BSC		
R	0.09	—	—
R1	0.09	—	—
S	0.20	—	—
θ1	0°	—	8°
θ2	10°	12°	14°
θ3	10°	12°	14°

6.3 DIP14 (Package Outline Dimensions)
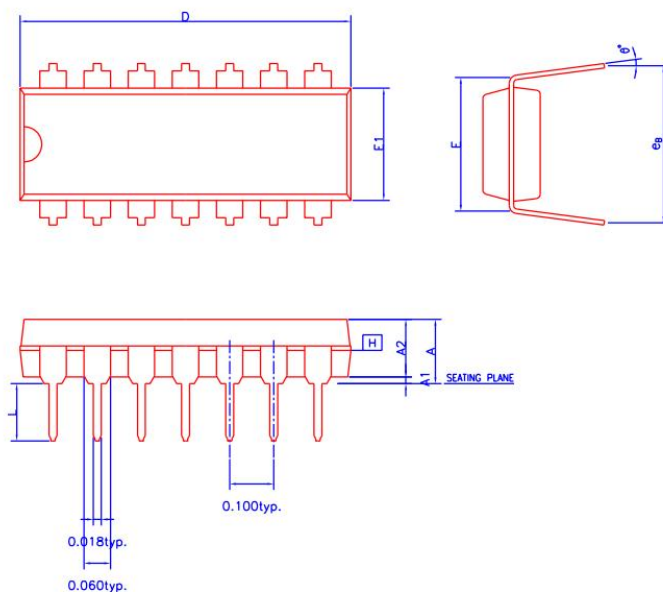
SYMBOLS	MIN.	NOR.	MAX.
A	–	–	0.210
A1	0.015	–	–
A2	0.125	0.130	0.135
D	0.735	0.750	0.775
E	0.300 BSC.		
E1	0.245	0.250	0.255
L	0.115	0.130	0.150
eB	0.335	0.355	0.375
θ°	0	7	15

UNIT : INCH