

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC4538BP, TC4538BF

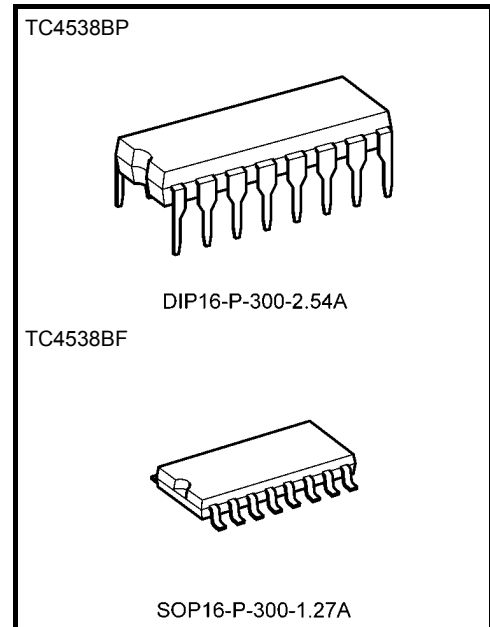
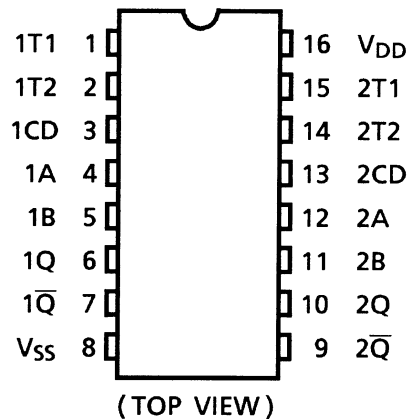
## TC4538BP/TC4538BF Dual Precision Retriggerable/Resettable Monostable Multivibrator

The TC4538BP/BF is the retriggerable/resettable monostable multivibrator and the trigger operation can be made at either the leading or trailing edge by 2 inputs of A and B. Since the output monostable pulse width is decided by time constant of the external resistor (RX) and the external capacitor (CX), it becomes possible to set a broad range of output pulse widths.

### Features

- $t_{wOUT} = 10 \text{ ms} \pm 5\%$  (at  $R_X = 100 \text{ k}\Omega$   $C_X = 0.1 \mu\text{F}$ ,  $V_{DD} = 10 \text{ V}$ )

### Pin Assignment



Weight  
 DIP16-P-300-2.54A : 1.00 g (typ.)  
 SOP16-P-300-1.27A : 0.18 g (typ.)

### Truth Table (Note)

Inputs			Outputs		Note
A	B	CD	Q	$\bar{Q}$	
	H	H			Output Enable
	L	H	L	H	Inhibit
H		H	L	H	Inhibit
L		H			Output Enable
*	*	L	L	H	Inhibit

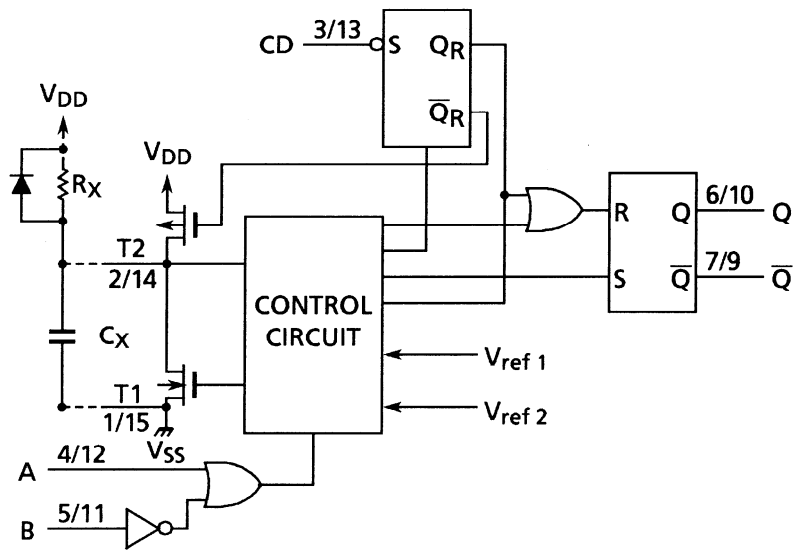
\*: Don't care

Note: In the case of using only one circuit, CD should be tied to GND,  $T_2$ ,  $T_1$ , Q,  $\bar{Q}$  should be tied to OPEN, and the other inputs should be tied to  $V_{CC}$  or GND.

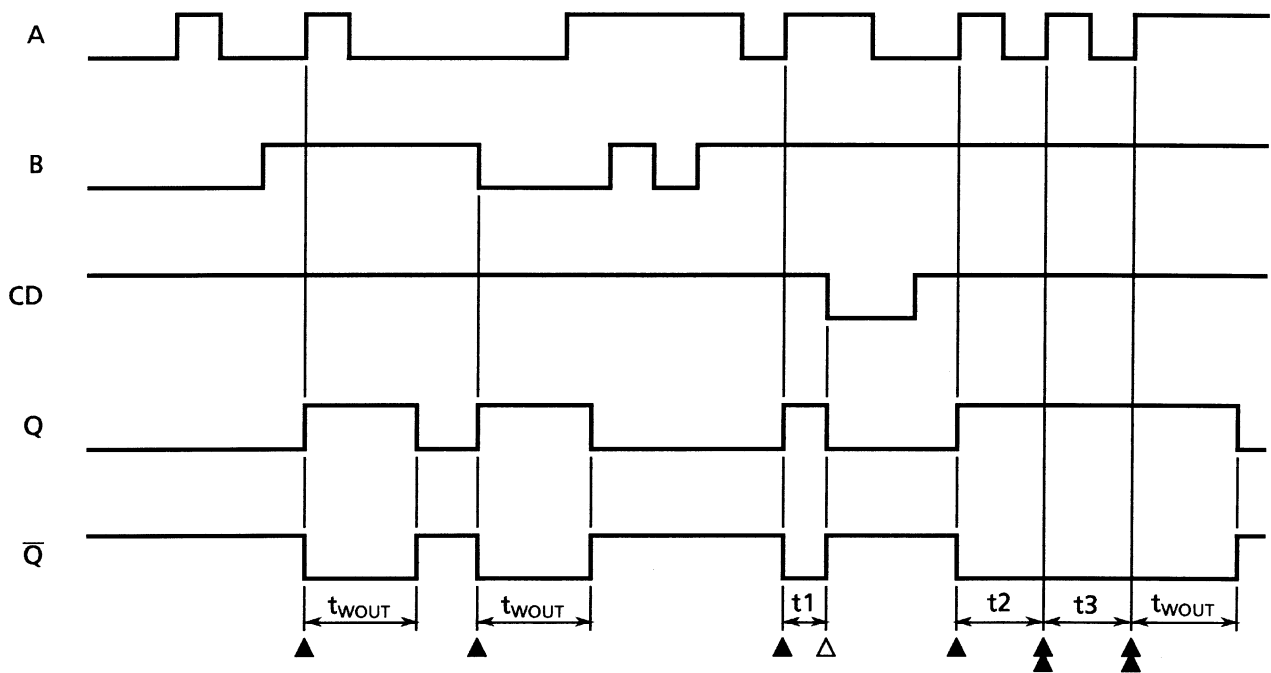
Start of commercial production  
1978-04

## Logic Diagram

1/2 TC4538BP/BF



## Timing Chart



- ▲ : TRIGGER
- ▲▲ : RETRIGGER
- △ : RESET

$$t_{wout} = C_X \cdot R_X$$

$$t_1 \cdot t_2 \cdot t_3 ; t_1 \cdot t_2 \cdot t_3 < t_{wout}$$

## Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
DC supply voltage	$V_{DD}$	$V_{SS} - 0.5$ to $V_{SS} + 20$	V
Input voltage	$V_{IN}$	$V_{SS} - 0.5$ to $V_{DD} + 0.5$	V
Output voltage	$V_{OUT}$	$V_{SS} - 0.5$ to $V_{DD} + 0.5$	V
DC input current	$I_{IN}$	$\pm 10$	mA
Power dissipation	$P_D$	300 (DIP)/180 (SOIC)	mW
Operating temperature range	$T_{opr}$	-40 to 85	°C
Storage temperature range	$T_{stg}$	-65 to 150	°C

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

## Operating Ranges ( $V_{SS} = 0$ V) (Note)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
DC supply voltage	$V_{DD}$	—	3	—	18	V
Input voltage	$V_{IN}$	—	0	—	$V_{DD}$	V
External resistance	$R_X$	—	5	—	1000	$k\Omega$
External capacitance	$C_X$	—	No limits			$\mu F$

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either  $V_{DD}$  or  $V_{SS}$ .

## Static Electrical Characteristics (V<sub>SS</sub> = 0 V)

Characteristics	Sym- bol	Test Condition	V <sub>DD</sub> (V)	-40°C		25°C			85°C		Unit	
				Min	Max	Min	Typ.	Max	Min	Max		
High-level output voltage	V <sub>OH</sub>	I <sub>OUT</sub>   < 1 μA V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub>	5	4.95	—	4.95	5.00	—	4.95	—	V	
			10	9.95	—	9.95	10.00	—	9.95	—		
			15	14.95	—	14.95	15.00	—	14.95	—		
Low-level output voltage	V <sub>OL</sub>	I <sub>OUT</sub>   < 1 μA V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub>	5	—	0.05	—	0.00	0.05	—	0.05	V	
			10	—	0.05	—	0.00	0.05	—	0.05		
			15	—	0.05	—	0.00	0.05	—	0.05		
Output high current	I <sub>OH</sub>	V <sub>OH</sub> = 4.6 V V <sub>OH</sub> = 2.5 V V <sub>OH</sub> = 9.5 V V <sub>OH</sub> = 13.5 V V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub>	5	-0.61	—	-0.51	-1.0	—	-0.42	—	mA	
			5	-2.50	—	-2.10	-4.0	—	-1.70	—		
			10	-1.50	—	-1.30	-2.2	—	-1.10	—		
			15	-4.00	—	-3.40	-9.0	—	-2.80	—		
Output low current	I <sub>OL</sub>	V <sub>OL</sub> = 0.4 V V <sub>OL</sub> = 0.5 V V <sub>OL</sub> = 1.5 V V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub>	5	0.61	—	0.51	1.5	—	0.42	—	mA	
			10	1.50	—	1.30	3.8	—	1.10	—		
			15	4.00	—	3.40	15.0	—	2.80	—		
			—	—	—	—	—	—	—	—		
Input high voltage	V <sub>IH</sub>	V <sub>OUT</sub> = 0.5 V, 4.5 V V <sub>OUT</sub> = 1.0 V, 9.0 V V <sub>OUT</sub> = 1.5 V, 13.5 V  I <sub>OUT</sub>   < 1 μA	5	3.5	—	3.5	2.75	—	3.5	—	V	
			10	7.0	—	7.0	5.50	—	7.0	—		
			15	11.0	—	11.0	8.25	—	11.0	—		
			—	—	—	—	—	—	—	—		
Input low voltage	V <sub>IL</sub>	V <sub>OUT</sub> = 0.5 V, 4.5 V V <sub>OUT</sub> = 1.0 V, 9.0 V V <sub>OUT</sub> = 1.5 V, 13.5 V  I <sub>OUT</sub>   < 1 μA	5	—	1.5	—	2.25	1.5	—	1.5	V	
			10	—	3.0	—	4.50	3.0	—	3.0		
			15	—	4.0	—	6.75	4.0	—	4.0		
			—	—	—	—	—	—	—	—		
Input current	"H" level	I <sub>IH</sub>	V <sub>IH</sub> = 18 V	18	—	0.1	—	10 <sup>-5</sup>	0.1	—	1.0	μA
	"L" level	I <sub>IL</sub>	V <sub>IL</sub> = 0 V	18	—	-0.1	—	-10 <sup>-5</sup>	-0.1	—	-1.0	
Quiescent supply current	I <sub>DD</sub>	V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub> (Note)	5	—	5	—	0.005	5	—	150	μA	
			10	—	10	—	0.010	10	—	300		
			15	—	20	—	0.015	20	—	600		

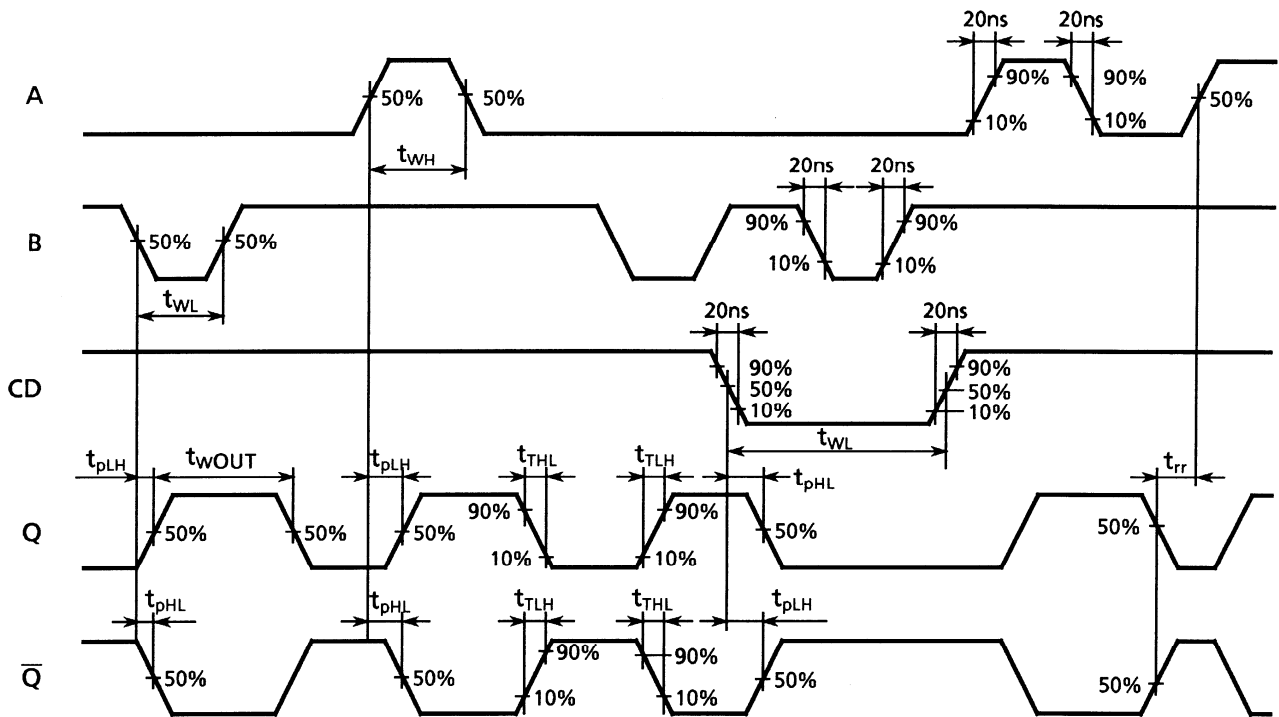
Note: All valid input combinations.

## Dynamic Electrical Characteristics (Ta = 25°C, VSS = 0 V, CL = 50 pF)

Characteristics	Symbol	Test Condition	VDD (V)	Min	Typ.	Max	Unit
Output transition time (low to high)	t <sub>TLH</sub>	—	5	—	80	200	ns
			10	—	50	100	
			15	—	40	80	
Output transition time (high to low)	t <sub>THL</sub>	—	5	—	80	200	ns
			10	—	50	100	
			15	—	40	80	
Propagation delay time (A, B-Q, $\bar{Q}$ )	t <sub>pLH</sub> t <sub>pHL</sub>	—	5	—	380	760	ns
			10	—	150	300	
			15	—	100	220	
Propagation delay time (CD-Q, $\bar{Q}$ )	t <sub>pLH</sub> t <sub>pHL</sub>	—	5	—	280	560	ns
			10	—	110	250	
			15	—	75	190	
Min input pulse width (A, B)	t <sub>WH</sub> t <sub>WL</sub>	—	5	—	60	120	ns
			10	—	30	60	
			15	—	25	50	
Min pulse width (CD)	t <sub>WL</sub>	—	5	—	95	190	ns
			10	—	45	90	
			15	—	35	70	
Min retrigger time	t <sub>rr</sub>	—	5	—	0	—	ns
			10	—	0	—	
			15	—	0	—	
Output pulse width	t <sub>wOUT</sub>	R <sub>X</sub> = 100 kΩ C <sub>X</sub> = 0.002 μF	5	—	206	—	μs
			10	—	204	—	
			15	—	205	—	
		R <sub>X</sub> = 100 kΩ C <sub>X</sub> = 0.1 μF	5	9.30	9.95	10.40	ms
			10	9.50	10.00	10.50	
			15	9.55	10.05	10.65	
		R <sub>X</sub> = 100 kΩ C <sub>X</sub> = 10 μF	5	—	0.98	—	s
			10	—	1.00	—	
			15	—	1.01	—	
Pulse width match between circuits in the same package	Δt <sub>wOUT</sub>	$\frac{t_{wOUT}(Q2) - t_w(Q1)}{t_{wOUT}(Q1)} \times 100$	5	—	±1	—	%
			10	—	±1	—	
			15	—	±1	—	
Input capacitance	C <sub>IN</sub>	—	—	—	5	7.5	pF

Waveform for Measurement of Dynamic Characteristics

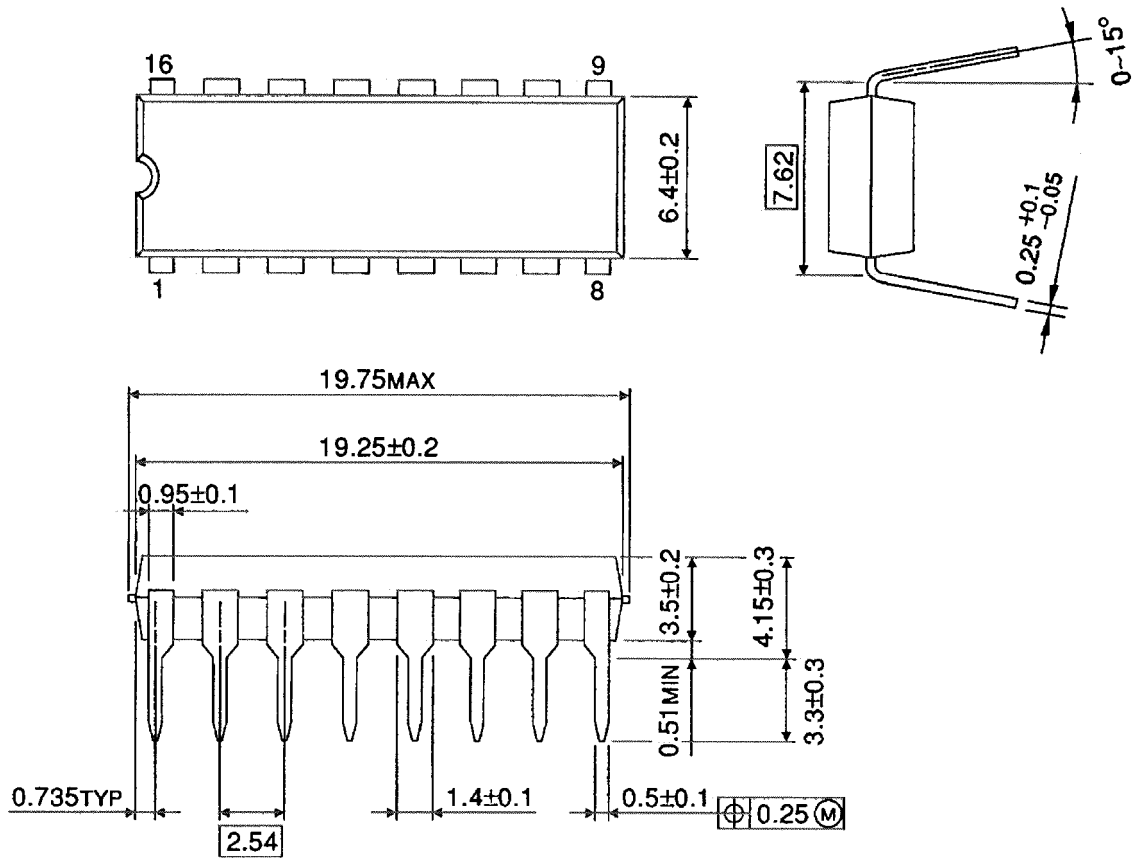
Waveform



## Package Dimensions

DIP16-P-300-2.54A

Unit : mm

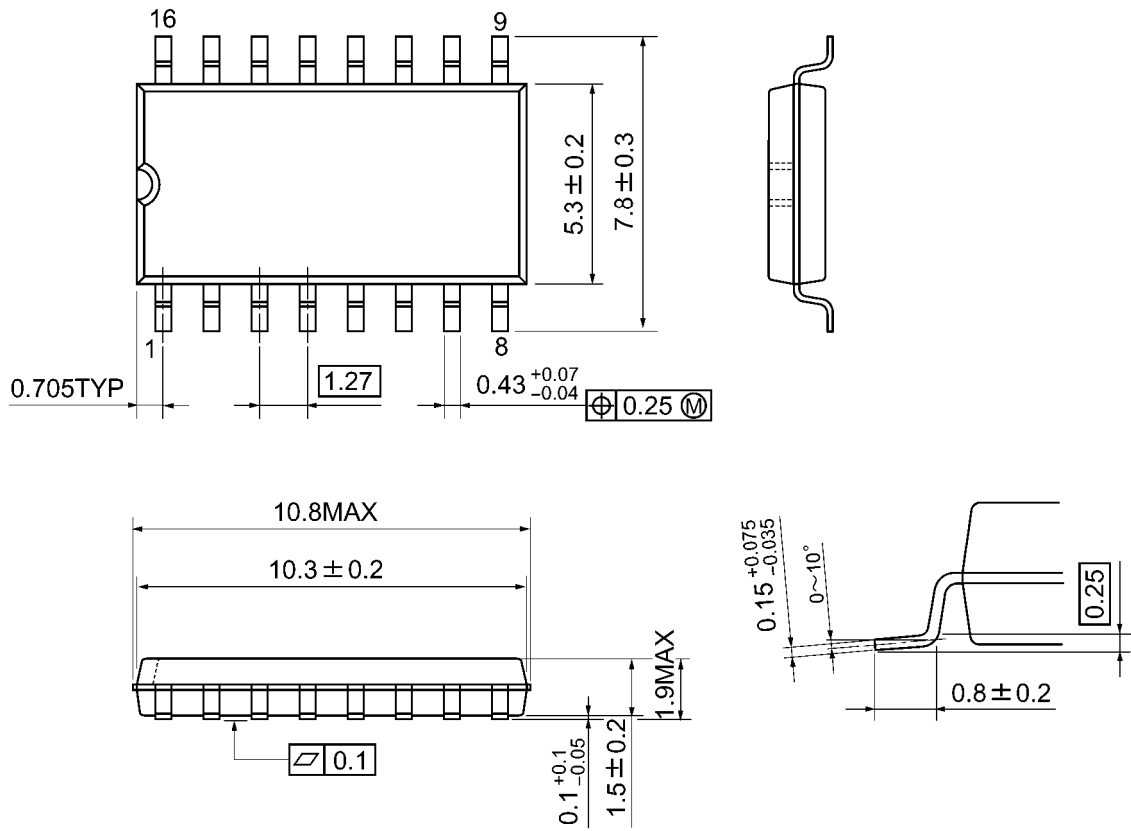


Weight: 1.00 g (typ.)

## Package Dimensions

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)



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