

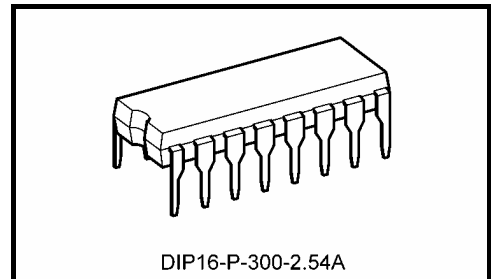
TC4521BP

TC4521BP 24-Stage Frequency Divider

TC4521BP is frequency divider consisting of 24 stages of flip-flop. The input section is equipped with an inverter to enable to use either RC oscillator circuit or crystal oscillator circuit and to accept pulse from external clock source.

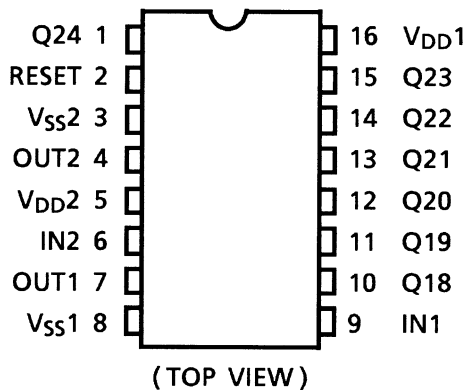
Each flip-flop is inverted by the falling edge of the output of previous stage flip-flop and this can count up to the maximum of $2^{24} = 16,777,216$.

Since six outputs, 2^{18} , 2^{19} , 2^{20} , 2^{21} , 2^{22} , and 2^{23} are available besides of 2^{24} , adjustment of frequency divided output can be achieved.



Weight: 1.00 g (typ.)

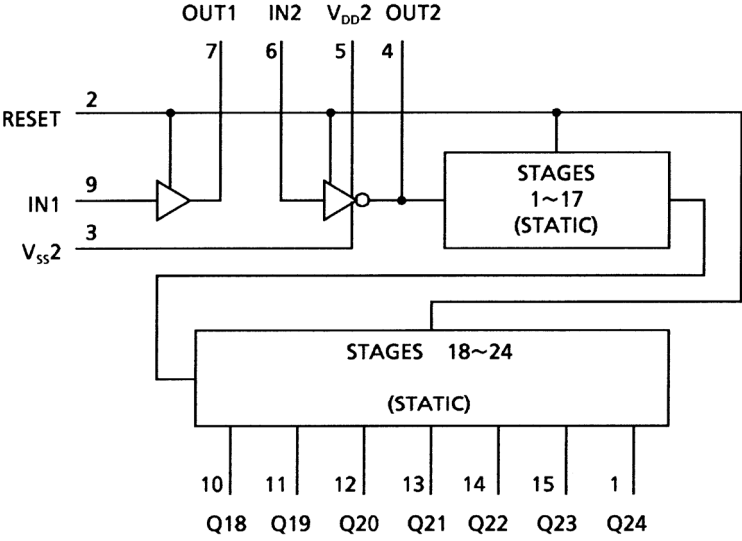
Pin Assignment



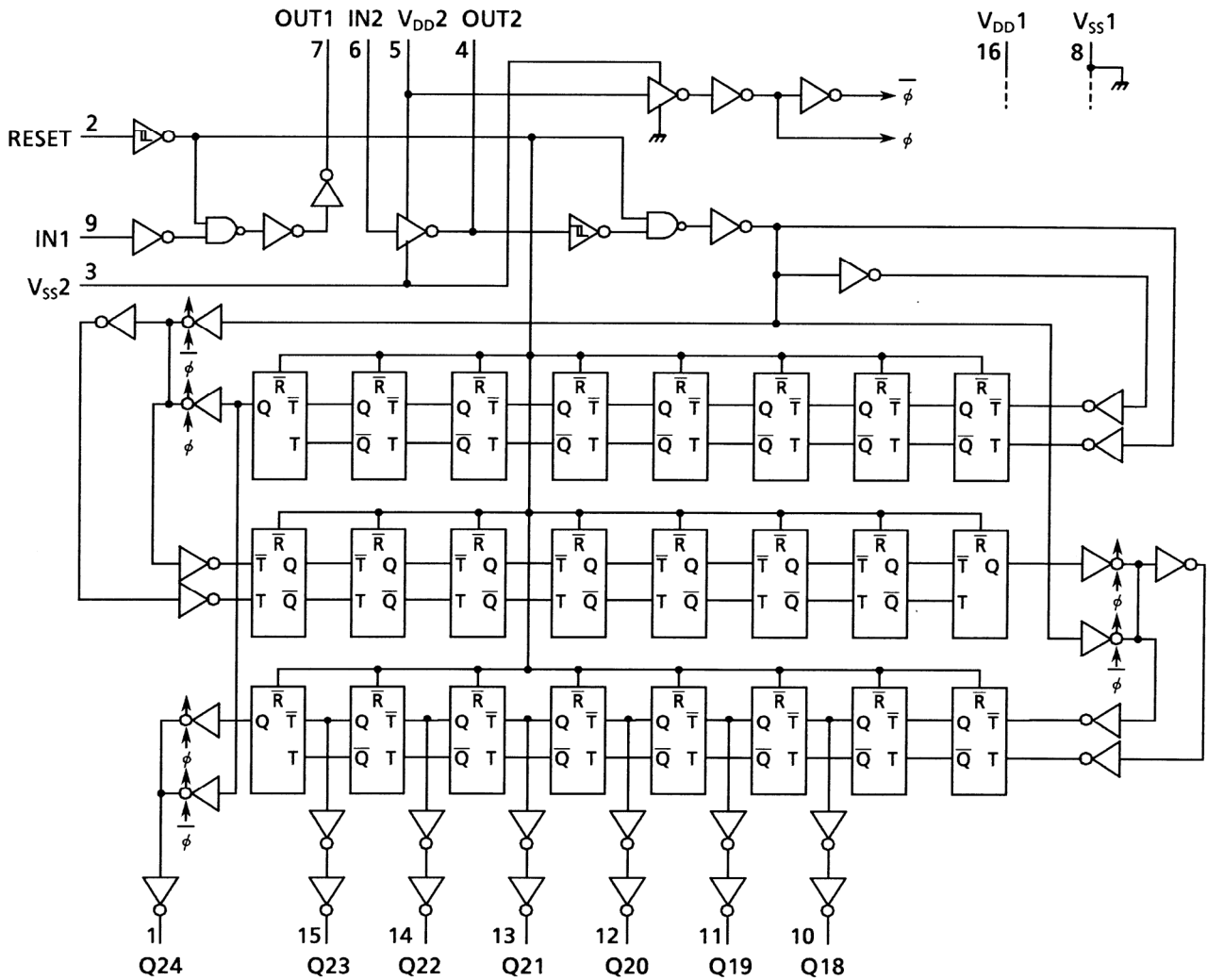
Count Capacity

Output	Count Capacity
Q18	$2^{18} = 262,144$
Q19	$2^{19} = 524,288$
Q20	$2^{20} = 1,048,576$
Q21	$2^{21} = 2,097,152$
Q22	$2^{22} = 4,194,304$
Q23	$2^{23} = 8,388,608$
Q24	$2^{24} = 16,777,216$

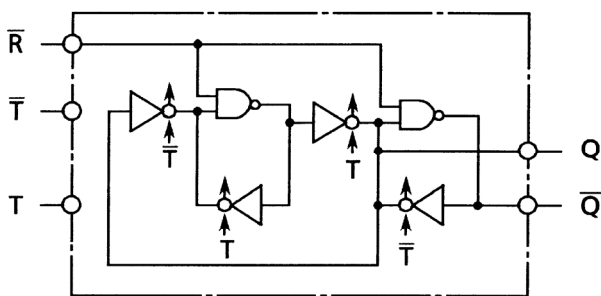
Block Diagram



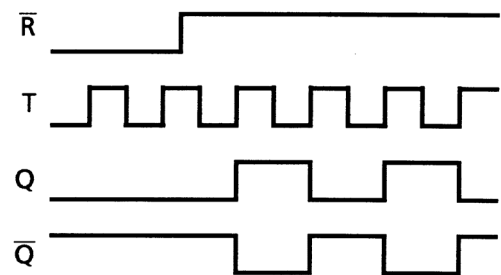
Logic Diagram



Internal Flip Flop Logic Diagram



Flip Flop Timing Chart



Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
DC supply voltage	V _{DD1}	V _{SS1} - 0.5~V _{SS1} + 20	V
	V _{DD2}	V _{SS1} - 0.5~V _{DD1} + 0.5	
Input voltage	V _{IN}	V _{SS1} - 0.5~V _{DD1} + 0.5	V
Output voltage	V _{OUT}	V _{SS1} - 0.5~V _{DD1} + 0.5	V
DC input current	I _{IN}	±10	mA
Power dissipation	P _D	300	mW
Operating temperature range	T _{opr}	-40~85	°C
Storage temperature range	T _{stg}	-65~150	°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_{SS1} = V_{SS2} = 0 V) (Note)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
DC supply voltage	V _{DD1} , V _{DD2}	—	3	—	18	V
Input voltage	V _{IN}	—	0	—	V _{DD1}	V

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_{SS1} = V_{SS2} = 0 V, V_{DD1} = V_{DD2})

Characteristics	Sym- bol	Test Condition	V _{DD} (V)	-40°C		25°C			85°C		Unit	
				Min	Max	Min	Typ.	Max	Min	Max		
High-level output voltage	V _{OH}	I _{OUT} < 1 μA V _{IN} = V _{SS} , V _{DD}	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 _{OL}	I _{OUT} < 1 μA V _{IN} = V _{SS} , V _{DD}	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 _{OH}	V _{OH} = 4.6 V V _{OH} = 2.5 V V _{OH} = 9.5 V V _{OH} = 13.5 V V _{IN} = V _{SS} , V _{DD}	5	-0.61	—	-0.51	-1.0	—	-0.42	—	mA	
			5	-2.5	—	-2.1	-4.0	—	-1.7	—		
			10	-1.5	—	-1.3	-2.2	—	-1.1	—		
			15	-4.0	—	-3.4	-9.0	—	-2.8	—		
Output low current	I _{OL}	V _{OL} = 0.4 V V _{OL} = 0.5 V V _{OL} = 1.5 V V _{IN} = V _{SS} , V _{DD}	5	0.61	—	0.51	1.2	—	0.42	—	mA	
			10	1.5	—	1.3	3.2	—	1.1	—		
			15	4.0	—	3.4	12.0	—	2.8	—		
Input high voltage	V _{IH}	V _{OUT} = 0.5 V, 4.5 V V _{OUT} = 1.0 V, 9.0 V V _{OUT} = 1.5 V, 13.5 V I _{OUT} < 1 μA	5	3.5	—	3.5	2.75	—	3.5	—	V	
			10	7.0	—	7.0	5.5	—	7.0	—		
			15	11.0	—	11.0	8.25	—	11.0	—		
Input low voltage	V _{IL}	V _{OUT} = 0.5 V, 4.5 V V _{OUT} = 1.0 V, 9.0 V V _{OUT} = 1.5 V, 13.5 V I _{OUT} < 1 μA	5	—	1.5	—	2.25	1.5	—	1.5	V	
			10	—	3.0	—	4.5	3.0	—	3.0		
			15	—	4.0	—	6.75	4.0	—	4.0		
Input current	"H" level	I _{IH}	V _{IH} = 18 V	18	—	0.1	—	10 ⁻⁵	0.1	—	1.0	μA
	"L" level	I _{IL}	V _{IL} = 0 V	18	—	-0.1	—	-10 ⁻⁵	-0.1	—	-1.0	
Quiescent supply current	I _{DD}	V _{IN} = V _{SS} , V _{DD} (Note)	5	—	5	—	0.005	5	—	150	μA	
			10	—	10	—	0.010	10	—	300		
			15	—	20	—	0.015	20	—	600		

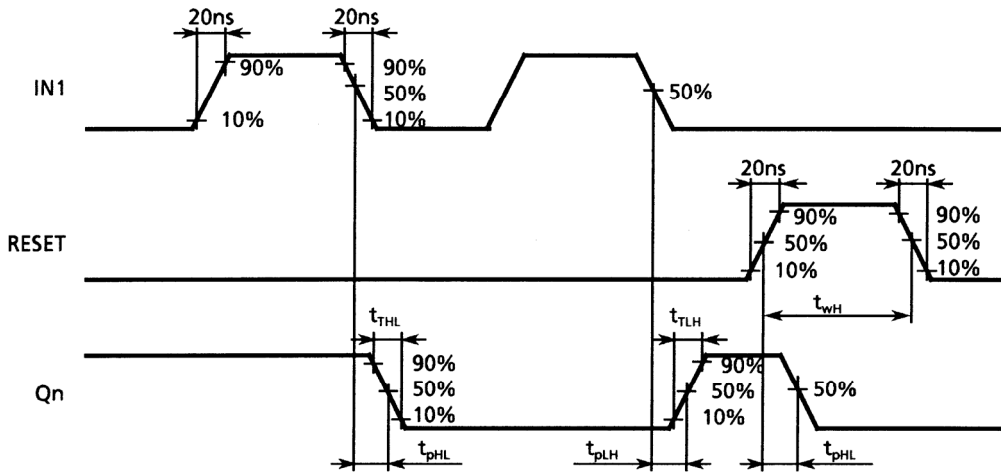
Note: All valid input combinations.

Dynamic Electrical Characteristics

($T_a = 25^\circ\text{C}$, $V_{SS1} = V_{SS2} = 0\text{ V}$, $V_{DD1} = V_{DD2}$, $C_L = 50\text{ pF}$)

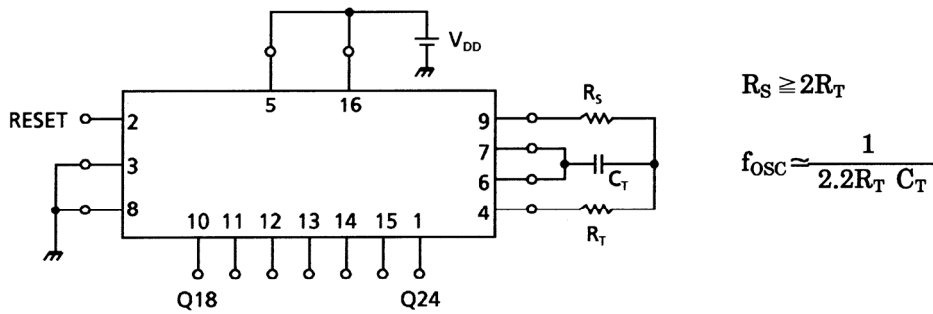
Characteristics	Symbol	Test Condition	V _{DD} (V)	Min	Typ.	Max	Unit
Output transition time (low to high)	t _{TLH}	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Output transition time (high to low)	t _{THL}	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Propagation delay time (IN2-Q18)	t _{pLH} t _{pHL}	—	5	—	1.1	9.0	μs
			10	—	0.5	3.5	
			15	—	0.3	2.7	
Propagation delay time (IN2-Q24)	t _{pLH} t _{pHL}	—	5	—	1.4	12	μs
			10	—	0.6	4.5	
			15	—	0.4	3.5	
Propagation delay time (RESET-Qn)	t _{pHL}	—	5	—	220	2600	ns
			10	—	100	1000	
			15	—	70	750	
Max clock frequency	f _{CL}	—	5	3	9.5	—	MHz
			10	6	17.5	—	
			15	8	23.5	—	
Max clock input rise time Max clock input fall time	t _{rCL} t _{fCL}	—	5	No limit			μs
			10				
			15				
Min clock pulse width	t _w	—	5	—	55	385	ns
			10	—	25	150	
			15	—	16	120	
Min pulse width (RESET)	t _{WH}	—	5	—	60	385	ns
			10	—	26	150	
			15	—	20	120	
Input capacitance	C _{IN}	—	—	5	7.5	pF	

Waveforms for Measurement of Dynamic Characteristics

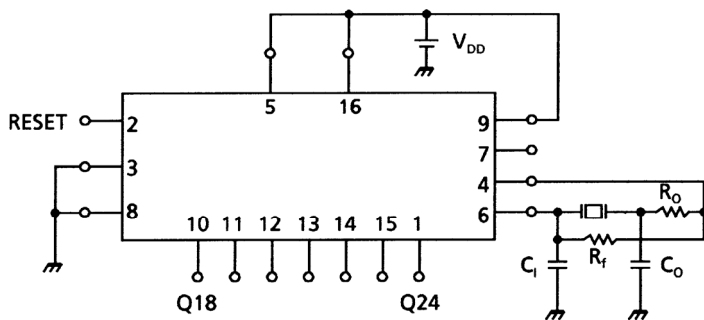


Application Circuit

When CR Oscillation is Used as Time Reference



When Crystal Oscillation is Used as the Time Reference



Typical Data

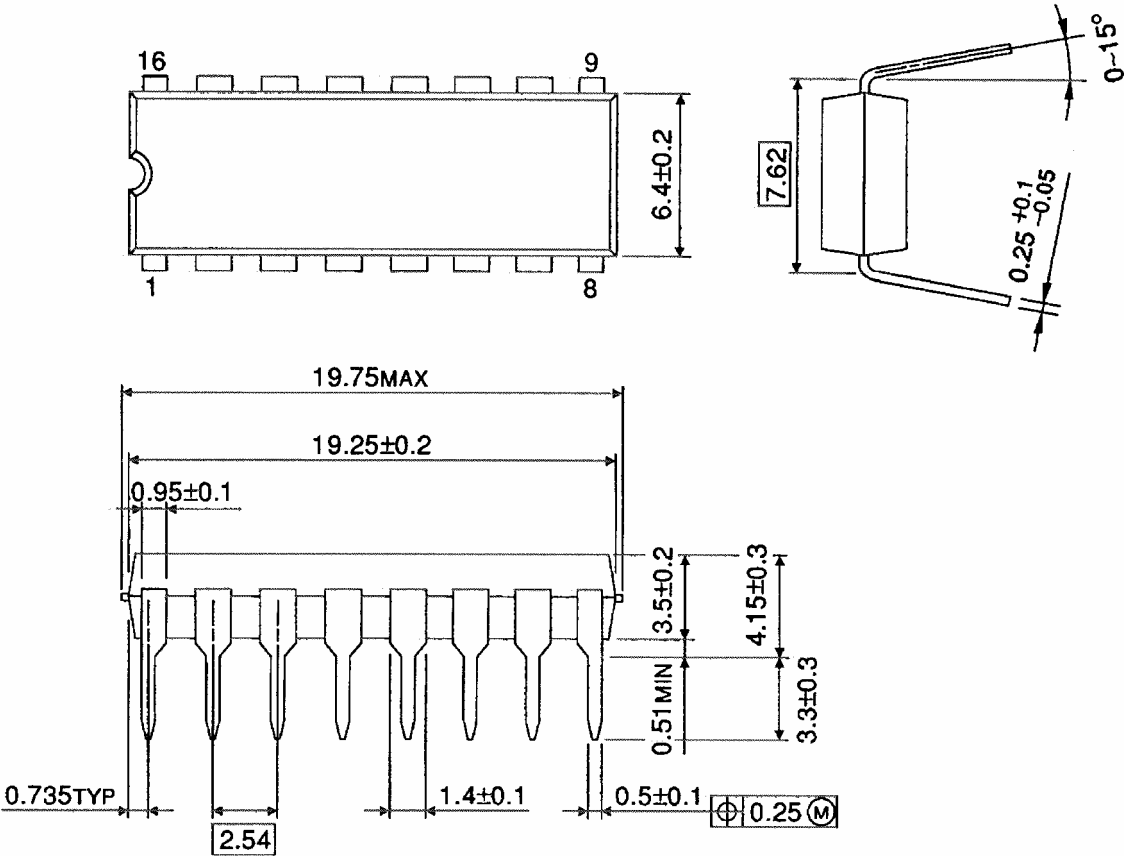
X'tal (Hz)	C ₁ , C ₀ (pF)	R ₀ (Ω)
32.768 k	23	500 k
100 k	60	100 k
1 M	45~50	100
4.194304 M	12~15	0

R_f = 10 MΩ

Package Dimensions

DIP16-P-300-2.54A

Unit : mm



Weight: 1.00 g (typ.)

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20070701-EN GENERAL

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