

# HD14521B

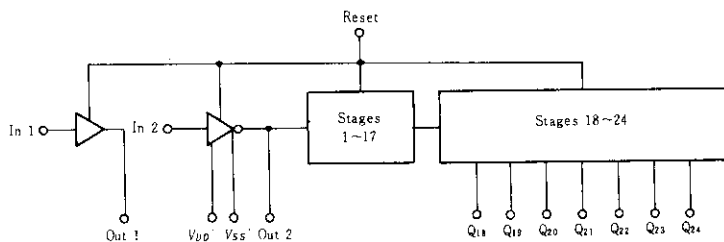
## 24-Stage Frequency Divider

The HD14521B consists of a chain of 24 flip-flops with an input circuit that allows three modes of operation. The input will function as a crystal oscillator, an RC oscillator, or as an input buffer for an external oscillator. Each flip-flop divides the frequency of the previous flip-flop by two, consequently this part will count up to  $2^{24} = 16,777,216$ . The outputs of the last seven-stages are available for added flexibility.

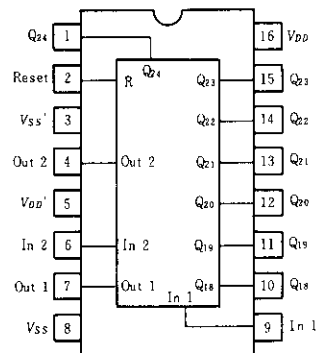
### FEATURES

- Quiescent Current = 5nA/pkg typ. @5V f(max)=9MHz typ @10V
- All Stages are Resettable
- Reset Disables the RC Oscillator for Low Standby Power Drain
- RC and Crystal Oscillator Outputs are capable of Driving External Loads
- Test Mode to Reduce Test time
- VDD' and VSS' Pins Brought Out on Crystal Oscillator Inverter to Allow the Connection of External Resistors for Low-power Operation
- Supply Voltage Range = 3 to 18V
- Capable of Driving One Low-power Schottky TTL Load Over the Rated Temperature Range

### BLOCK DIAGRAM



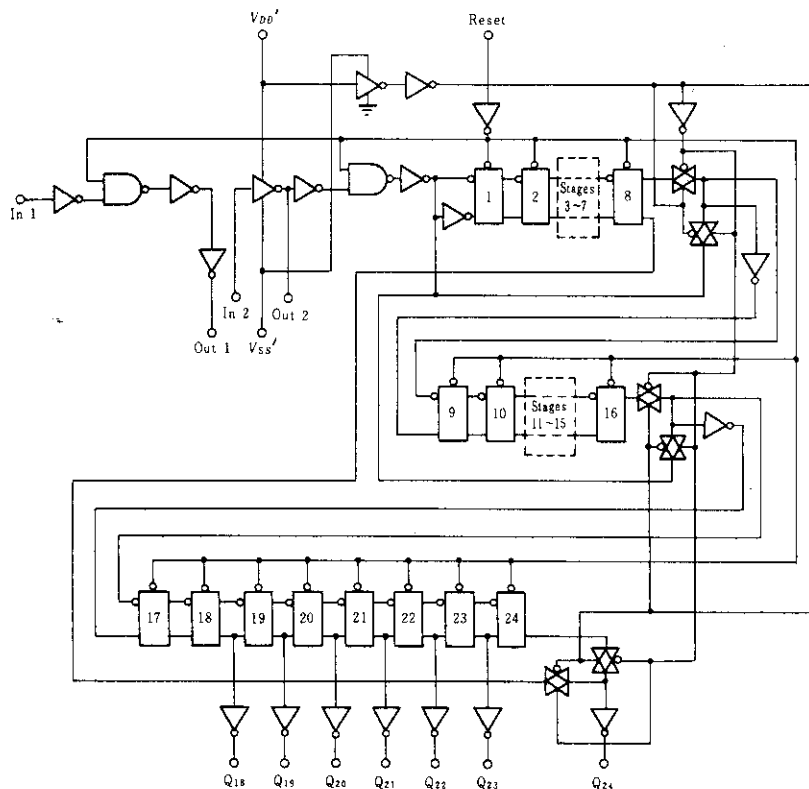
### PIN ARRANGEMENT



(Top View)

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

LOGIC DIAGRAM



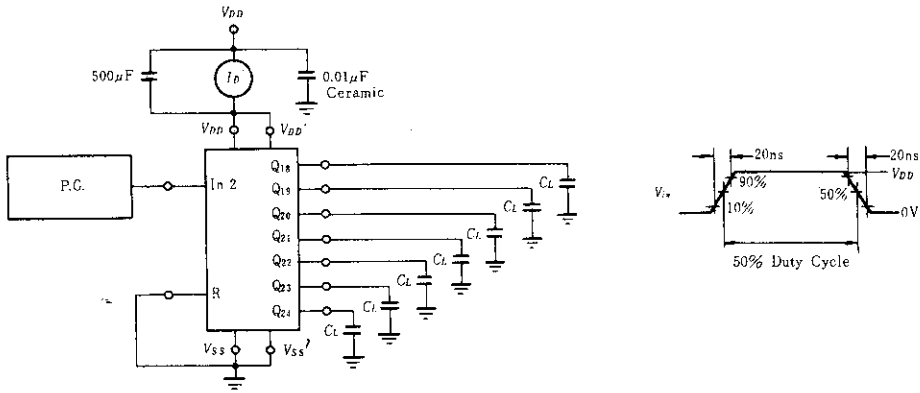
ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	V <sub>DD</sub> (V)	Test Conditions	-40°C		25°C			85°C		Unit
				min	max	min	typ	max	min	max	
Output Voltage	V <sub>OL</sub>	5.0	V <sub>in</sub> = V <sub>DD</sub> or 0	—	0.05	—	0	0.05	—	0.05	V
		10		—	0.05	—	0	0.05	—	0.05	
		15		—	0.05	—	0	0.05	—	0.05	
	V <sub>OH</sub>	5.0	V <sub>in</sub> = 0 or V <sub>DD</sub>	4.95	—	4.95	5.0	—	4.95	—	V
		10		9.95	—	9.95	10	—	9.95	—	
		15		14.95	—	14.95	15	—	14.95	—	
Input Voltage	V <sub>IL</sub>	5.0	V <sub>out</sub> = 4.5 or 0.5V	—	1.5	—	2.25	1.5	—	1.5	V
		10	V <sub>out</sub> = 9.0 or 1.0V	—	3.0	—	4.50	3.0	—	3.0	
		15	V <sub>out</sub> = 13.5 or 1.5V	—	4.0	—	6.75	4.0	—	4.0	
	V <sub>IH</sub>	5.0	V <sub>out</sub> = 0.5 or 4.5V	3.5	—	3.5	2.75	—	3.5	—	V
		10	V <sub>out</sub> = 1.0 or 9.0V	7.0	—	7.0	5.50	—	7.0	—	
		15	V <sub>out</sub> = 1.5 or 13.5V	11.0	—	11.0	8.25	—	11.0	—	
Output Drive Current	I <sub>OH</sub>	5.0	V <sub>OH</sub> = 2.5V	-1.0	—	-0.8	-1.7	—	-0.6	—	mA
		5.0	V <sub>OH</sub> = 4.6V	-0.2	—	-0.16	-0.36	—	-0.12	—	
		10	V <sub>OH</sub> = 9.5V	-0.5	—	-0.4	-0.9	—	-0.3	—	
		15	V <sub>OH</sub> = 13.5V	-1.4	—	-1.2	-3.5	—	-1.0	—	
	I <sub>OL</sub>	5.0	V <sub>OL</sub> = 0.4V	0.52	—	0.44	0.88	—	0.36	—	mA
		10	V <sub>OL</sub> = 0.5V	1.3	—	1.1	2.25	—	0.9	—	
15		V <sub>OL</sub> = 1.5V	3.6	—	3.0	8.8	—	2.4	—		
Input Current	I <sub>in</sub>	15	—	—	±0.3	—	±0.0001	±0.3	—	±1.0	µA
Input Capacitance	C <sub>in</sub>	—	V <sub>in</sub> = 0	—	—	—	5.0	7.5	—	—	pF
Quiescent Current	I <sub>DD</sub>	5.0	Zero Signal, per Package	—	20	—	0.005	20	—	150	µA
		10		—	40	—	0.010	40	—	300	
		15		—	80	—	0.015	80	—	600	
Total Supply Current*	I <sub>T</sub>	5.0	Dynamic + I <sub>DD</sub> , per Gate C <sub>L</sub> = 50 pF, f = 1 kHz	—	—	—	0.42	—	—	—	µA
		10		—	—	—	0.85	—	—	—	
		15		—	—	—	1.4	—	—	—	

\* To calculate total supply current at frequency other than 1kHz.

@V<sub>DD</sub> = 5.0V I<sub>T</sub> = (0.42 µA/kHz)f + I<sub>in</sub>, @V<sub>DD</sub> = 10V I<sub>T</sub> = (0.85 µA/kHz)f + I<sub>in</sub>, @V<sub>DD</sub> = 15V I<sub>T</sub> = (1.4 µA/kHz)f + I<sub>in</sub>

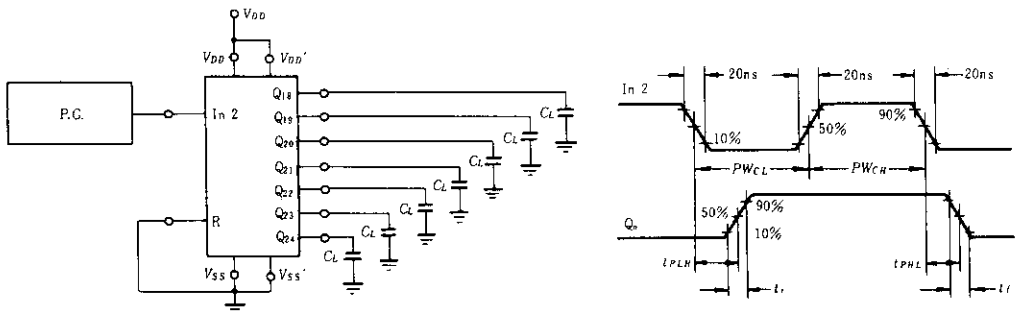
■ POWER DISSIPATION TEST CIRCUIT AND WAVEFORM



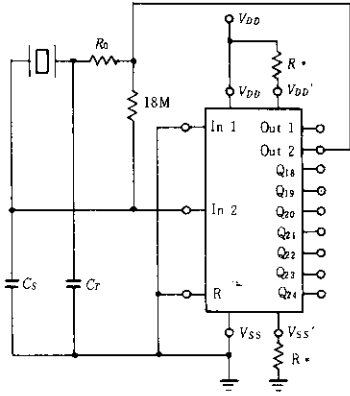
■ SWITCHING CHARACTERISTICS ( $C_L=50\text{pF}$ ,  $T_a=25^\circ\text{C}$ )

Characteristic	Symbol	$V_{DD}$ (V)	min	typ	max	Unit	
Output Rise Time	$t_r$	5.0	—	180	400	ns	
		10	—	90	200		
		15	—	65	160		
Output Fall Time	$t_f$	5.0	—	120	250	ns	
		10	—	60	125		
		15	—	40	100		
Propagation Delay Time	Clock to $Q_{18}$	$t_{PLH}$	5.0	—	4.5	13.5	$\mu\text{s}$
			10	—	1.7	5.2	
			15	—	1.2	3.9	
	Clock to $Q_{24}$	$t_{PHL}$	5.0	—	6.0	18	
			10	—	2.2	6.5	
			15	—	1.5	5.0	
Reset to $Q_n$	$t_{PHL}$	5.0	—	1300	4000		
		10	—	500	1500	ns	
		15	—	350	1200		
Clock Pulse Width	$PW_C$	5.0	385	140	—		ns
		10	150	55	—		
		15	120	40	—		
Clock Frequency	$PRF$	5.0	—	3.5	1.5	MHz	
		10	—	9.0	3.5		
		15	—	12	4.5		
Clock Pulse Rise and Fall Time	$t_r, t_f$	5.0	—	—	15	$\mu\text{s}$	
		10	—	—	15		
		15	—	—	15		
Reset Pulse Width	$PW_R$	5.0	1800	700	—	ns	
		10	900	300	—		
		15	700	200	—		

■ SWITCHING TIME TEST CIRCUIT



CRYSTAL OSCILLATOR CIRCUIT

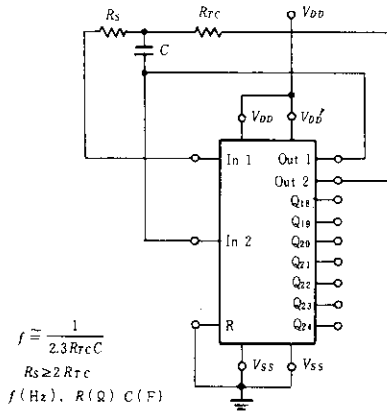


Optional for low power operation.

Characteristic		500kHz Circuit	500kHz Circuit	Unit	
Crystal Characteristics	Resonant Frequency	500	50	kHz	
	Cut	S	N		
	Equivalent Resistance, $R_s$	1.0	6.2	k $\Omega$	
External Resistor/ Capacitor Values	$R_o$	47	750	k $\Omega$	
	$C_T$	82	82	pF	
	$C_s$	20	20	pF	
Frequency Change as a Function of $V_{DD}$	$V_{DD}$ Change from 5V to 10V	+6.0	+2.0	ppm	
	$V_{DD}$ Change from 10V to 15V	+2.0	+2.0	ppm	
Frequency Change as a Function of Temperature ( $V_{DD}=10V$ )	-55~+25 $^{\circ}C$	HD14521B Only	-4.0	-2.0	ppm
		Complete Osc. *	+100	+120	ppm
	+25~+125 $^{\circ}C$	HD14521B Only	-2.0	-2.0	ppm
		Complete Osc. *	-160	-560	ppm

\* Complete oscillator includes crystal, capacitors, and resistors.

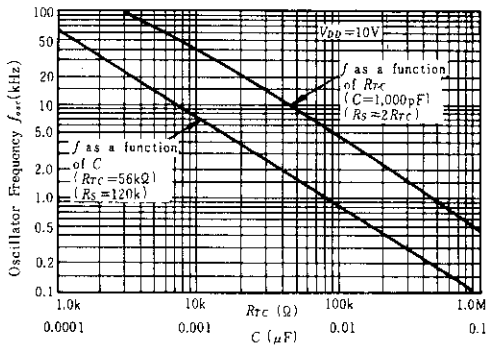
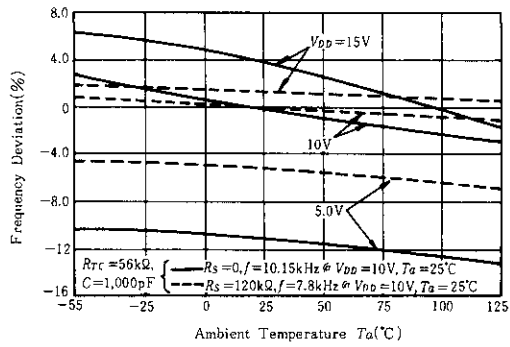
RC OSCILLATOR CIRCUIT

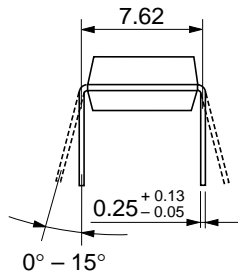
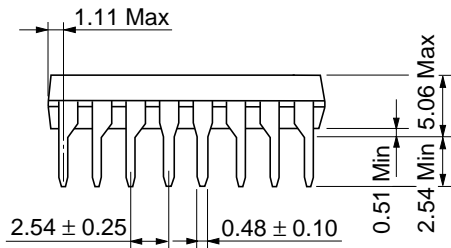
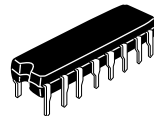
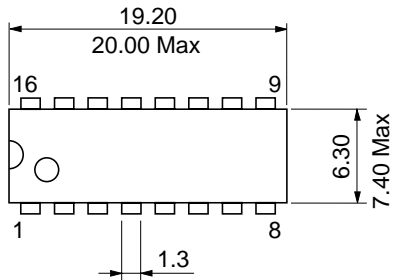


$$f \approx \frac{1}{2.3 RrC}$$

$$R_s \geq 2 RrC$$

$f$  (Hz),  $R$  ( $\Omega$ ),  $C$  (F)





Hitachi Code	DP-16
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	1.07 g

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