

HD14521B

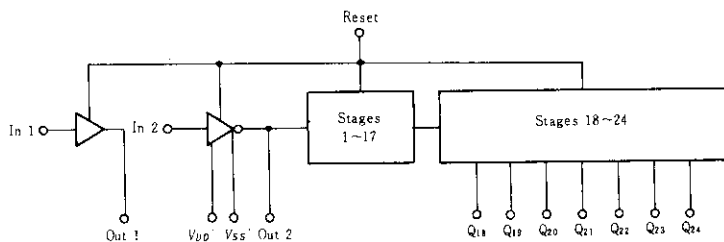
24-Stage Frequency Divider

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.

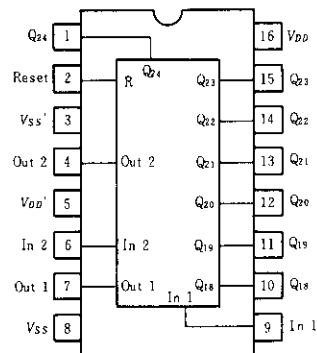
FEATURES

- 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



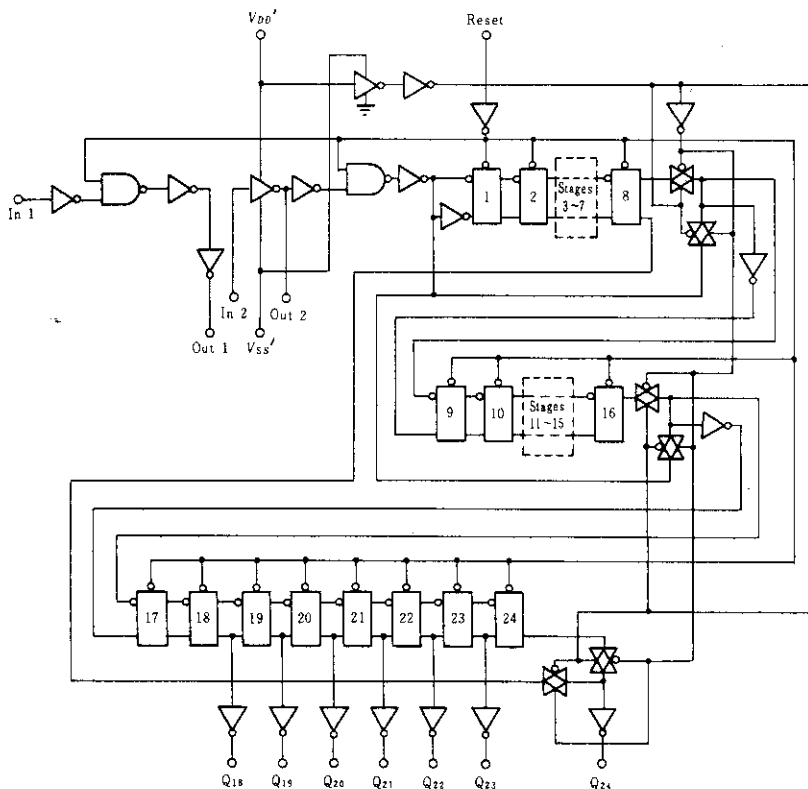
PIN ARRANGEMENT



(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



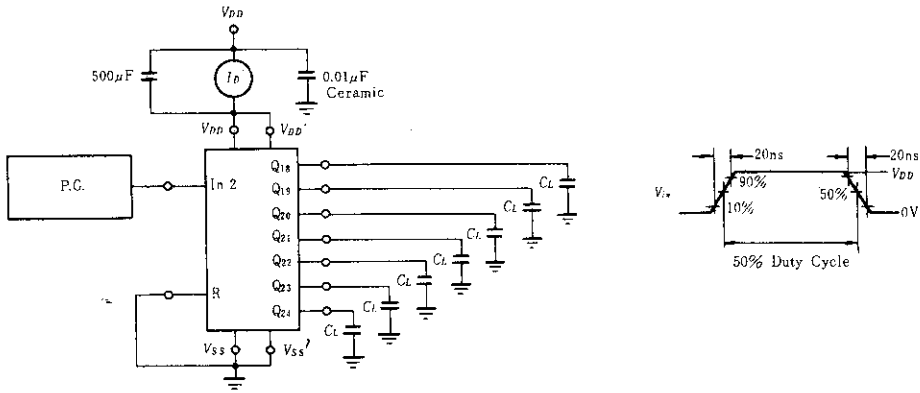
ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	V _{DD} (V)	Test Conditions	-40°C		25°C			85°C		Unit
				min	max	min	typ	max	min	max	
Output Voltage	V _{OL}	5.0	V _{in} = V _{DD} 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 _{OH}	5.0	V _{in} = 0 or V _{DD}	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 _{IL}	5.0	V _{out} = 4.5 or 0.5V	—	1.5	—	2.25	1.5	—	1.5	V
		10	V _{out} = 9.0 or 1.0V	—	3.0	—	4.50	3.0	—	3.0	
		15	V _{out} = 13.5 or 1.5V	—	4.0	—	6.75	4.0	—	4.0	
	V _{IH}	5.0	V _{out} = 0.5 or 4.5V	3.5	—	3.5	2.75	—	3.5	—	V
		10	V _{out} = 1.0 or 9.0V	7.0	—	7.0	5.50	—	7.0	—	
		15	V _{out} = 1.5 or 13.5V	11.0	—	11.0	8.25	—	11.0	—	
Output Drive Current	I _{OH}	5.0	V _{OH} = 2.5V	-1.0	—	-0.8	-1.7	—	-0.6	—	mA
		5.0	V _{OH} = 4.6V	-0.2	—	-0.16	-0.36	—	-0.12	—	
		10	V _{OH} = 9.5V	-0.5	—	-0.4	-0.9	—	-0.3	—	
		15	V _{OH} = 13.5V	-1.4	—	-1.2	-3.5	—	-1.0	—	
	I _{OL}	5.0	V _{OL} = 0.4V	0.52	—	0.44	0.88	—	0.36	—	mA
		10	V _{OL} = 0.5V	1.3	—	1.1	2.25	—	0.9	—	
15		V _{OL} = 1.5V	3.6	—	3.0	8.8	—	2.4	—		
Input Current	I _{in}	15	—	—	±0.3	—	±0.0001	±0.3	—	±1.0	μA
Input Capacitance	C _{in}	—	V _{in} = 0	—	—	—	5.0	7.5	—	—	pF
Quiescent Current	I _{DD}	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 _T	5.0	Dynamic + I _{DD} , per Gate C _L = 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_{DD} = 5.0V I_T = (0.42 μA/kHz)f + I_{in}, @V_{DD} = 10V I_T = (0.85 μA/kHz)f + I_{in}, @V_{DD} = 15V I_T = (1.4 μA/kHz)f + I_{in}

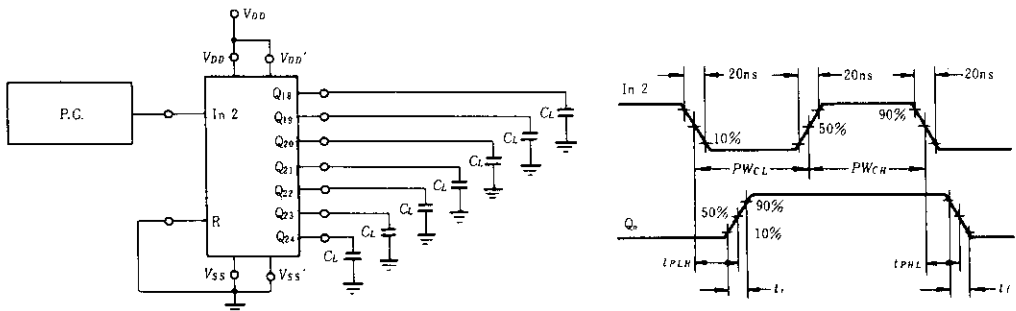
■ POWER DISSIPATION TEST CIRCUIT AND WAVEFORM



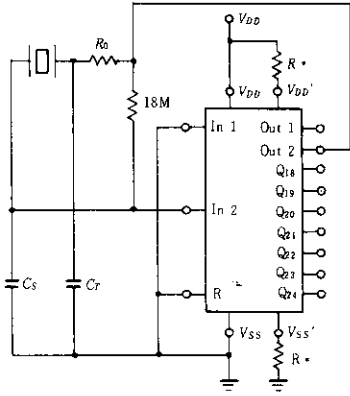
■ SWITCHING CHARACTERISTICS ($C_L=50\text{pF}$, $T_a=25^\circ\text{C}$)

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	μs
			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	ns	
		10	—	500	1500		
		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	μs
			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

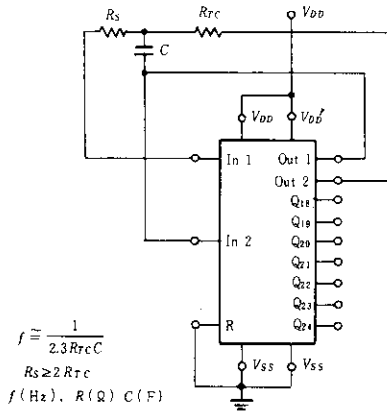


Characteristic		500kHz Circuit	500kHz Circuit	Unit	
Crystal Characteristics	Resonant Frequency	500	50	kHz	
	Cut	S	N		
	Equivalent Resistance, R_s	1.0	6.2	k Ω	
External Resistor/ Capacitor Values	R_o	47	750	k Ω	
	C_T	82	82	pF	
	C_s	20	20	pF	
Frequency Change as a Function of V_{DD}	V_{DD} Change from 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

Optional for low power operation.

* Complete oscillator includes crystal, capacitors, and resistors.

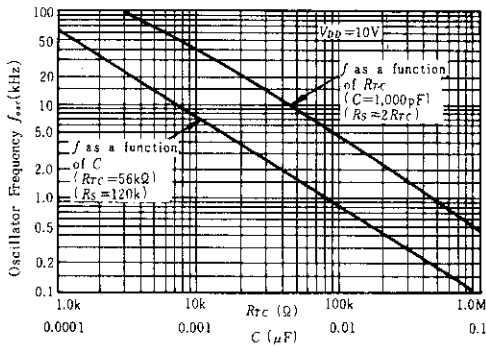
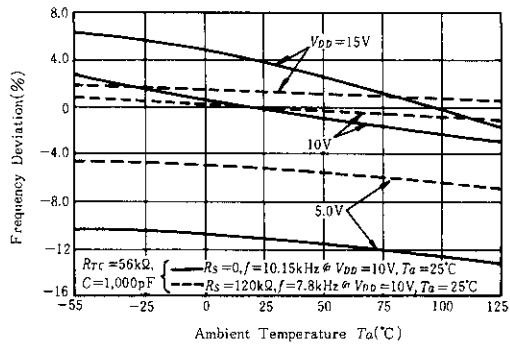
■ RC OSCILLATOR CIRCUIT

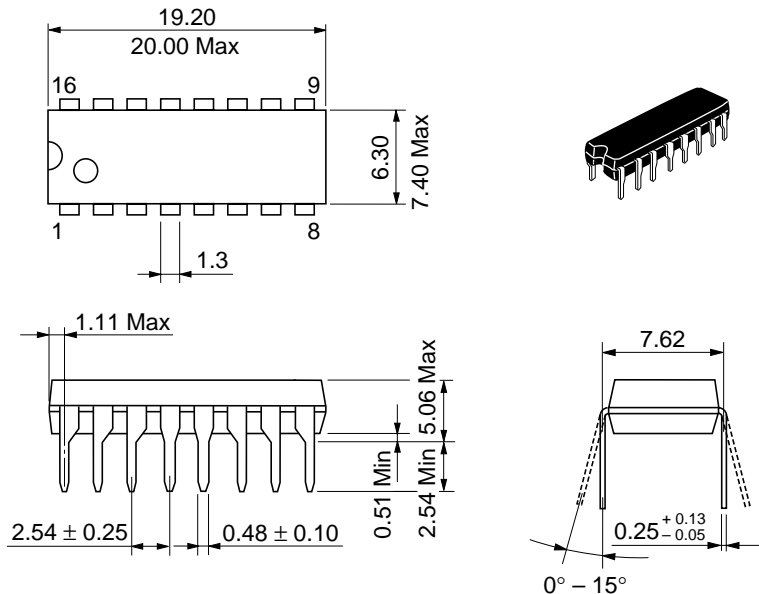


$$f \approx \frac{1}{2.3 Rrc C}$$

$$R_s \geq 2 Rrc$$

f (Hz), R (Ω), C (F)





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

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