

# DATA SHEET

For a complete data sheet, please also download:

- The IC04 LOCMOS HE4000B Logic Family Specifications HEF, HEC
- The IC04 LOCMOS HE4000B Logic Package Outlines/Information HEF, HEC

## **HEF4060B** **MSI**

14-stage ripple-carry binary counter/divider and oscillator

Product specification  
File under Integrated Circuits, IC04

January 1995

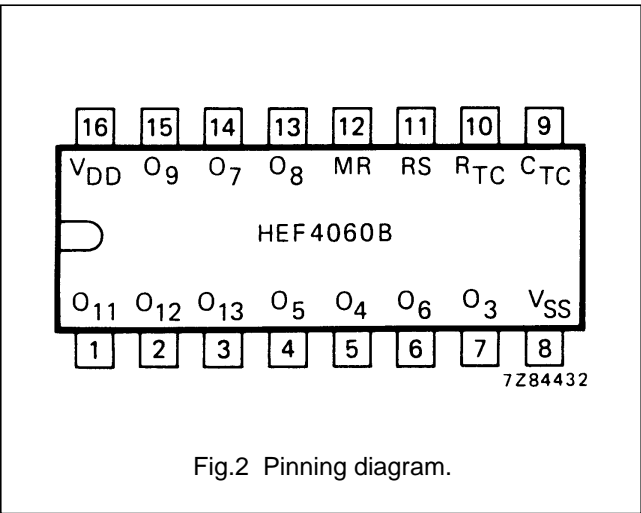
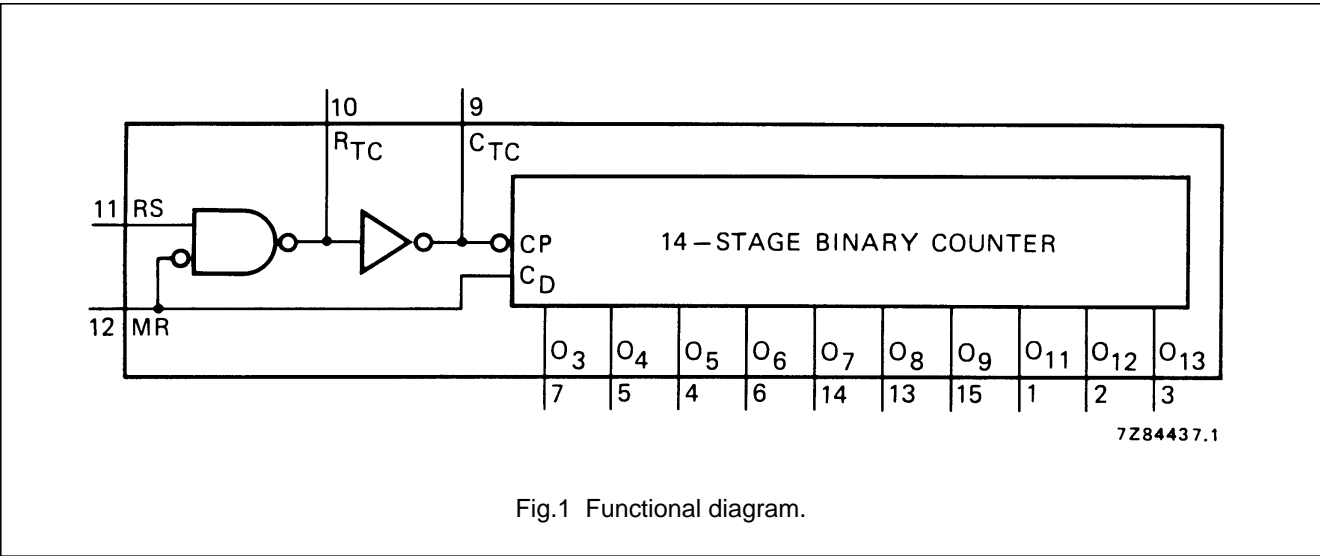
14-stage ripple-carry binary counter/divider and oscillator

HEF4060B  
MSI

DESCRIPTION

The HEF4060B is a 14-stage ripple-carry binary counter/divider and oscillator with three oscillator terminals (RS, R<sub>TC</sub> and C<sub>TC</sub>), ten buffered outputs (O<sub>3</sub> to O<sub>9</sub> and O<sub>11</sub> to O<sub>13</sub>) and an overriding asynchronous master reset input (MR). The oscillator configuration allows design of either RC or crystal oscillator circuits. The oscillator may

be replaced by an external clock signal at input RS. The counter advances on the negative-going transition of RS. A HIGH level on MR resets the counter (O<sub>3</sub> to O<sub>9</sub> and O<sub>11</sub> to O<sub>13</sub> = LOW), independent of other input conditions. Schmitt-trigger action in the clock input makes the circuit highly tolerant to slower clock rise and fall times.



PINNING

MR	master reset
RS	clock input/oscillator pin
R <sub>TC</sub>	oscillator pin
C <sub>TC</sub>	external capacitor connection
O <sub>3</sub> to O <sub>9</sub>	counter outputs
O <sub>11</sub> to O <sub>13</sub>	

HEF4060BP(N): 16-lead DIL; plastic (SOT38-1)  
HEF4060BD(F): 16-lead DIL; ceramic (cerdip) (SOT74)  
HEF4060BT(D): 16-lead SO; plastic (SOT109-1)  
( ): Package Designator North America

FAMILY DATA, I<sub>DD</sub> LIMITS category MSI

See Family Specifications

## 14-stage ripple-carry binary counter/divider and oscillator

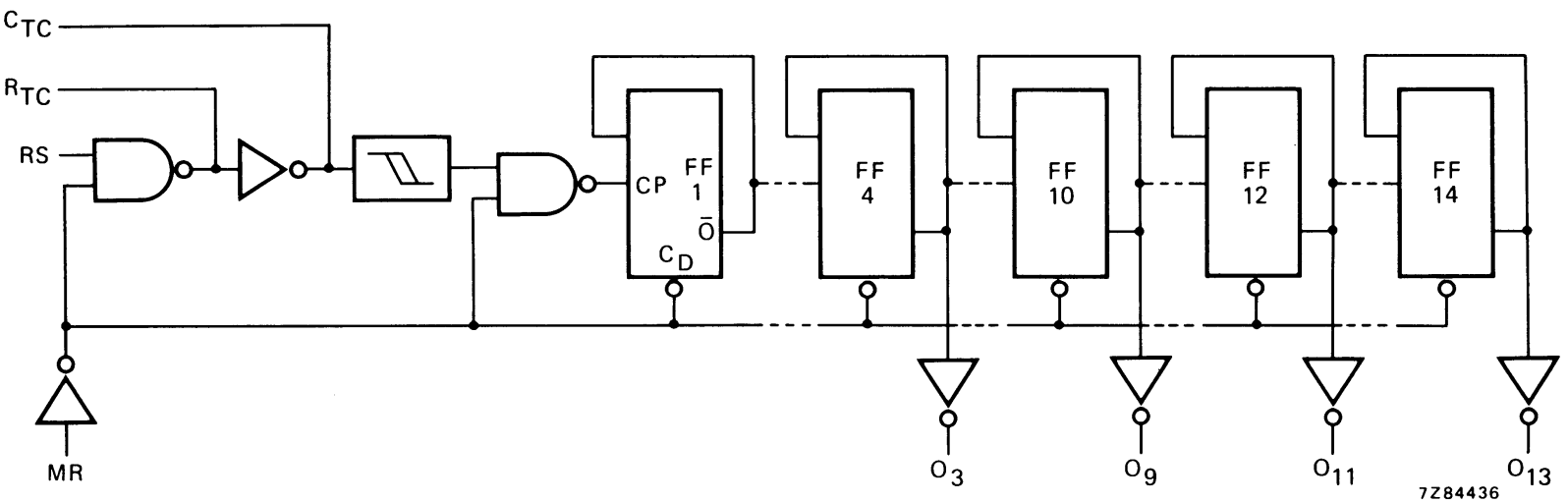
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Fig.3 Logic diagram.

# 14-stage ripple-carry binary counter/divider and oscillator

## HEF4060B MSI

### AC CHARACTERISTICS

$V_{SS} = 0$  V;  $T_{amb} = 25$  °C;  $C_L = 50$  pF; input transition times  $\leq 20$  ns

	$V_{DD}$ V	SYMBOL	MIN.	TYP.	MAX.	TYPICAL EXTRAPOLATION FORMULA
Propagation delays RS $\rightarrow$ O <sub>3</sub> HIGH to LOW  LOW to HIGH  O <sub>n</sub> $\rightarrow$ O <sub>n+1</sub> HIGH to LOW  LOW to HIGH  MR $\rightarrow$ O <sub>n</sub> HIGH to LOW	5	t <sub>PHL</sub>	210	420	ns	183 ns + (0,55 ns/pF) C <sub>L</sub>
	10		80	160	ns	69 ns + (0,23 ns/pF) C <sub>L</sub>
	15		50	100	ns	42 ns + (0,16 ns/pF) C <sub>L</sub>
	5	t <sub>PLH</sub>	210	420	ns	183 ns + (0,55 ns/pF) C <sub>L</sub>
	10		80	160	ns	69 ns + (0,23 ns/pF) C <sub>L</sub>
	15		50	100	ns	42 ns + (0,16 ns/pF) C <sub>L</sub>
	5	t <sub>PHL</sub>	25	50	ns	
	10		10	20	ns	
	15		6	12	ns	
	5	t <sub>PLH</sub>	25	50	ns	
	10		10	20	ns	
	15		6	12	ns	
	5	t <sub>PHL</sub>	100	200	ns	73 ns + (0,55 ns/pF) C <sub>L</sub>
	10		40	80	ns	29 ns + (0,23 ns/pF) C <sub>L</sub>
	15		30	60	ns	22 ns + (0,16 ns/pF) C <sub>L</sub>
Output transition times HIGH to LOW  LOW to HIGH	5	t <sub>THL</sub>	60	120	ns	10 ns + (1,0 ns/pF) C <sub>L</sub>
	10		30	60	ns	9 ns + (0,42 ns/pF) C <sub>L</sub>
	15		20	40	ns	6 ns + (0,28 ns/pF) C <sub>L</sub>
	5	t <sub>TLH</sub>	60	120	ns	10 ns + (1,0 ns/pF) C <sub>L</sub>
	10		30	60	ns	9 ns + (0,42 ns/pF) C <sub>L</sub>
	15		20	40	ns	6 ns + (0,28 ns/pF) C <sub>L</sub>
Minimum clock pulse width input RS HIGH	5	t <sub>WRSH</sub>	120	60	ns	
	10		50	25	ns	
	15		30	15	ns	
Minimum MR pulse width; HIGH	5	t <sub>WMRH</sub>	50	25	ns	
	10		30	15	ns	
	15		20	10	ns	
Recovery time for MR	5	t <sub>RMR</sub>	160	80	ns	
	10		80	40	ns	
	15		60	30	ns	
Maximum clock pulse frequency input RS	5	f <sub>max</sub>	4	8	MHz	
	10		10	20	MHz	
	15		15	30	MHz	

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AC CHARACTERISTICS

V<sub>SS</sub> = 0 V; T<sub>amb</sub> = 25 °C; input transition times ≤ 20 ns

	V <sub>DD</sub> V	TYPICAL FORMULA FOR P (μW) <sup>(1)</sup>
Dynamic power dissipation per package (P)	5	700 f <sub>i</sub> + f <sub>o</sub> C <sub>L</sub> V <sub>DD</sub> <sup>2</sup>
	10	3 300 f <sub>i</sub> + f <sub>o</sub> C <sub>L</sub> V <sub>DD</sub> <sup>2</sup>
	15	8 900 f <sub>i</sub> + f <sub>o</sub> C <sub>L</sub> V <sub>DD</sub> <sup>2</sup>
Total power dissipation when using the on-chip oscillator (P)	5	700 f <sub>osc</sub> + f <sub>o</sub> C <sub>L</sub> V <sub>DD</sub> <sup>2</sup> + 2C <sub>t</sub> V <sub>DD</sub> <sup>2</sup> f <sub>osc</sub> + 690 V <sub>DD</sub>
	10	3 300 f <sub>osc</sub> + f <sub>o</sub> C <sub>L</sub> V <sub>DD</sub> <sup>2</sup> + 2C <sub>t</sub> V <sub>DD</sub> <sup>2</sup> f <sub>osc</sub> + 6 900 V <sub>DD</sub>
	15	8 900 f <sub>osc</sub> + f <sub>o</sub> C <sub>L</sub> V <sub>DD</sub> <sup>2</sup> + 2C <sub>t</sub> V <sub>DD</sub> <sup>2</sup> f <sub>osc</sub> + 22 000 V <sub>DD</sub>

Notes

1. where:
- f<sub>i</sub> = input frequency (MHz)

f<sub>o</sub> = output frequency (MHz)

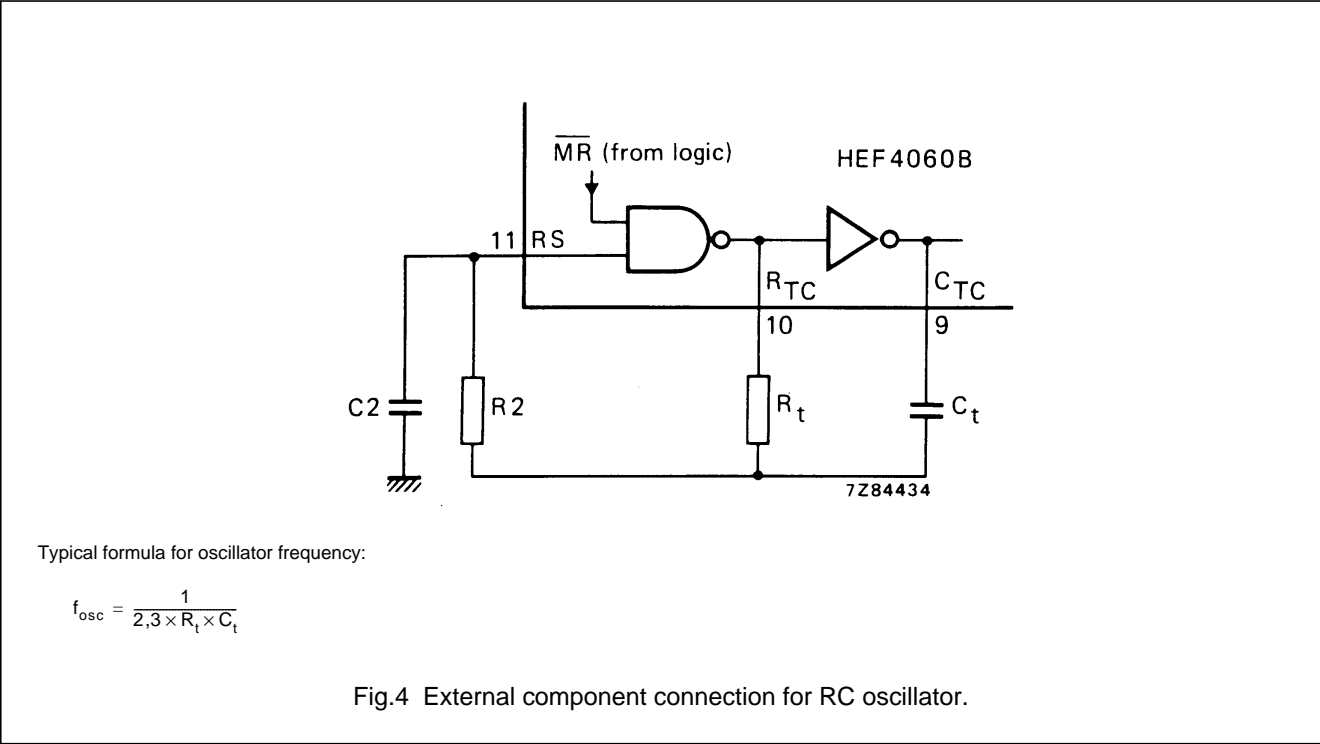
C<sub>L</sub> = load capacitance (pF)

V<sub>DD</sub> = supply voltage (V)

C<sub>t</sub> = timing capacitance (pF)

f<sub>osc</sub> = oscillator frequency (MHz)

RC oscillator



# 14-stage ripple-carry binary counter/divider and oscillator

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## Timing component limitations

The oscillator frequency is mainly determined by  $R_t C_t$ , provided  $R_t \ll R_2$  and  $R_2 C_2 \ll R_t C_t$ . The function of  $R_2$  is to minimize the influence of the forward voltage across the input protection diodes on the frequency. The stray capacitance  $C_2$  should be kept as small as possible. In consideration of accuracy,  $C_t$  must be larger than the inherent stray capacitance.  $R_t$  must be larger than the LOCMOS 'ON' resistance in series with it, which typically is 500  $\Omega$  at  $V_{DD} = 5$  V, 300  $\Omega$  at  $V_{DD} = 10$  V and 200  $\Omega$  at  $V_{DD} = 15$  V.

The recommended values for these components to maintain agreement with the typical oscillation formula are:

$C_t \geq 100$  pF, up to any practical value,  
 $10$  k $\Omega \leq R_t \leq 1$  M $\Omega$ .

## Typical crystal oscillator circuit

In Fig.5,  $R_2$  is the power limiting resistor. For starting and maintaining oscillation a minimum transconductance is necessary.

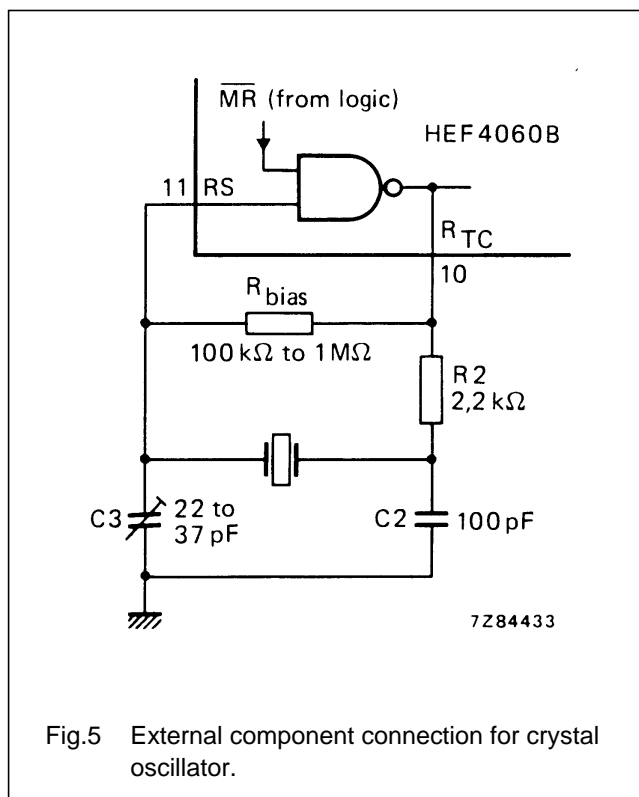


Fig.5 External component connection for crystal oscillator.

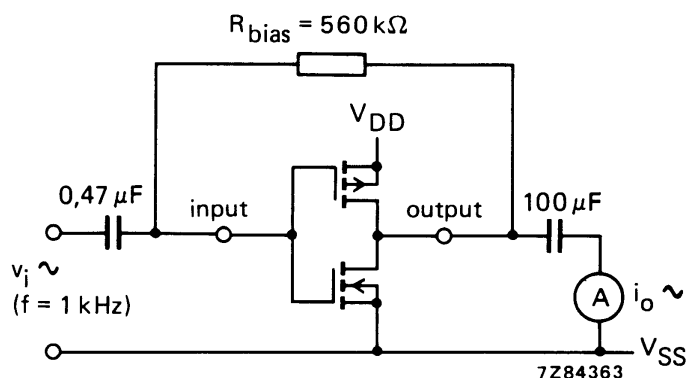


Fig.6 Test set-up for measuring forward transconductance  $g_{fs} = di_o/dv_i$  at  $v_o$  is constant (see also graph Fig.7);  $MR = LOW$ .

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