

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

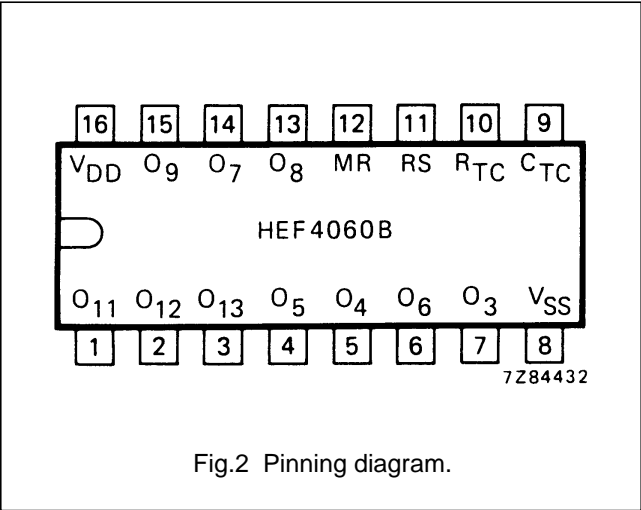
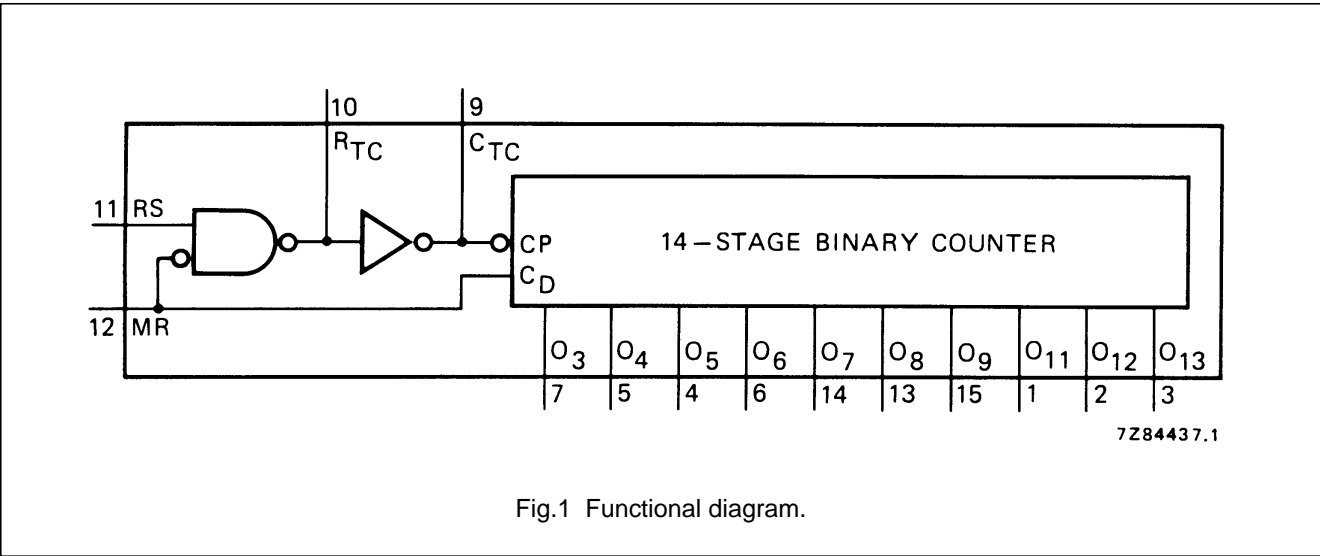
January 1995

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

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DESCRIPTION

The HEF4060B is a 14-stage ripple-carry binary counter/divider and oscillator with three oscillator terminals (RS, R_{TC} and C_{TC}), ten buffered outputs (O₃ to O₉ and O₁₁ to O₁₃) 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 (O₃ to O₉ and O₁₁ to O₁₃ = 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

RS

R_{TC}

C_{TC}

O₃ to O₉

O₁₁ to O₁₃

master reset

clock input/oscillator pin

oscillator pin

external capacitor connection

counter outputs
- 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_{DD} LIMITS category MSI

See Family Specifications

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

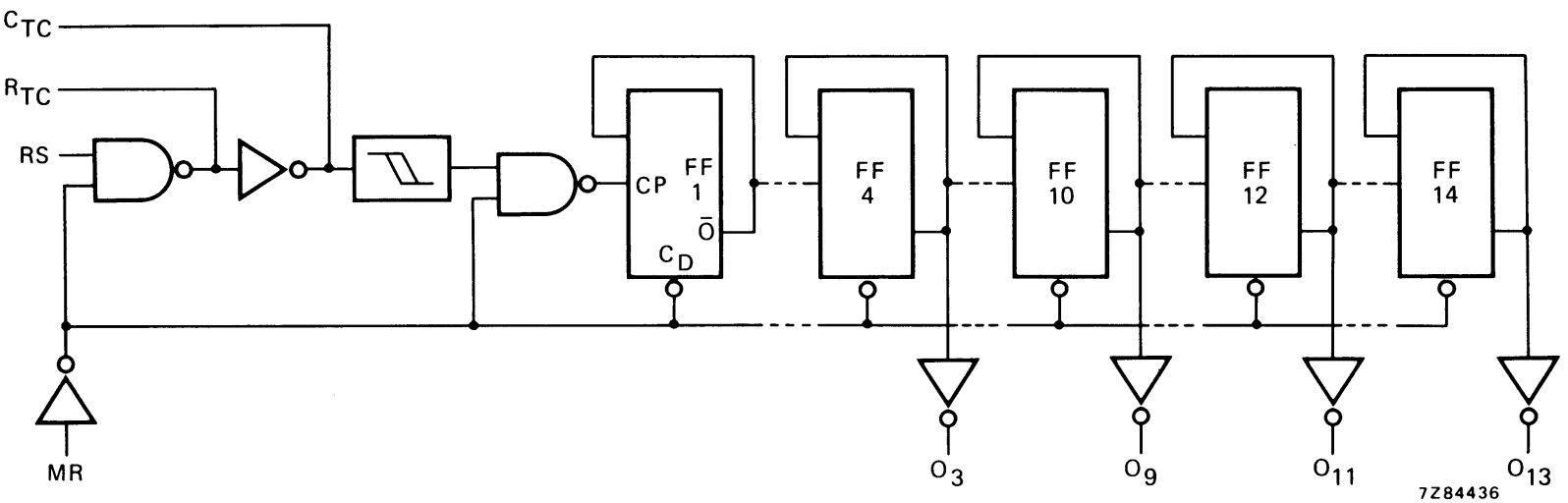
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Fig.3 Logic diagram.

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AC CHARACTERISTICS

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

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

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AC CHARACTERISTICS

$V_{SS} = 0 \text{ V}$; $T_{amb} = 25 \text{ }^{\circ}\text{C}$; input transition times $\leq 20 \text{ ns}$

	V _{DD} V	TYPICAL FORMULA FOR P (μW) ⁽¹⁾
Dynamic power dissipation per package (P)	5 10 15	700 f _i + f _o C _L V _{DD} ² 3 300 f _i + f _o C _L V _{DD} ² 8 900 f _i + f _o C _L V _{DD} ²
Total power dissipation when using the on-chip oscillator (P)	5 10 15	700 f _{osc} + f _o C _L V _{DD} ² + 2C _t V _{DD} ² f _{osc} + 690 V _{DD} 3 300 f _{osc} + f _o C _L V _{DD} ² + 2C _t V _{DD} ² f _{osc} + 6 900 V _{DD} 8 900 f _{osc} + f _o C _L V _{DD} ² + 2C _t V _{DD} ² f _{osc} + 22 000 V _{DD}

Notes

1. where:

 f_i = input frequency (MHz) f_o = output frequency (MHz)

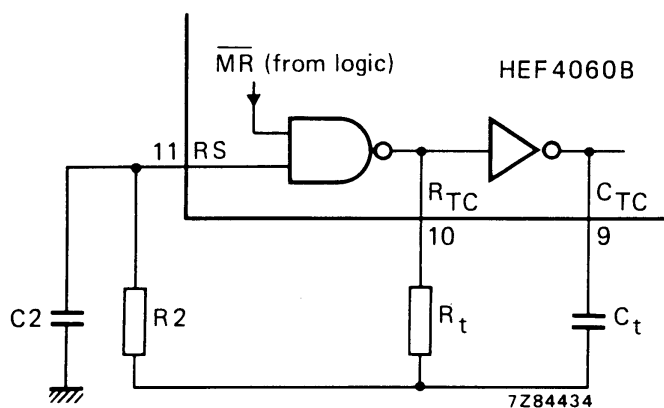
C_L = load capacitance (pF)

 V_{DD} = supply voltage (V)

C_t = timing capacitance (pF)

 f_{osc} = oscillator frequency (MHz)

RC oscillator



Typical formula for oscillator frequency:

$$f_{osc} = \frac{1}{2,3 \times R_t \times C_t}$$

Fig.4 External component connection for RC 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 $V_{DD} = 5\text{ V}$, $300\ \Omega$ at $V_{DD} = 10\text{ V}$ and $200\ \Omega$ at $V_{DD} = 15\text{ V}$.

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

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

Typical crystal oscillator circuit

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

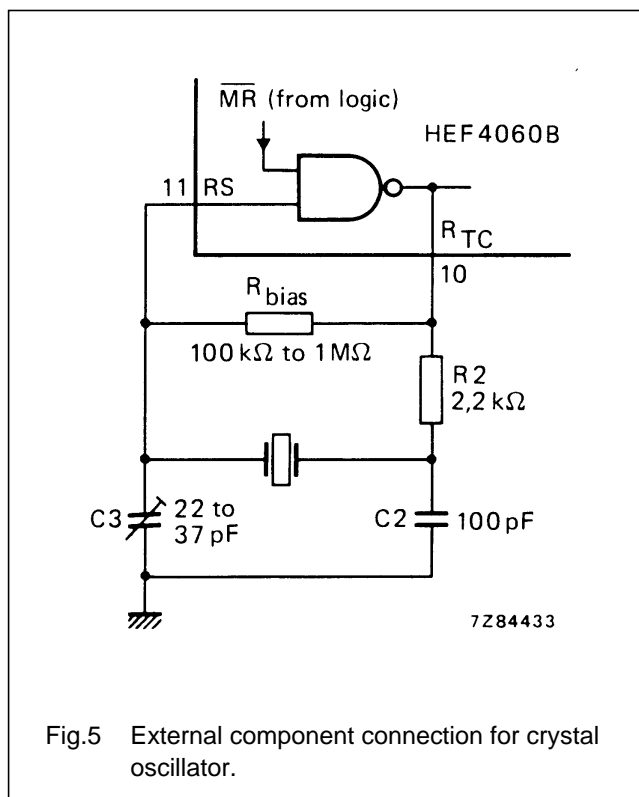


Fig.5 External component connection for crystal oscillator.

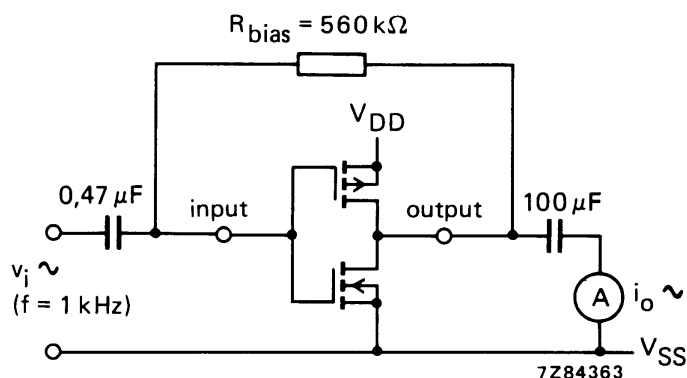


Fig.6 Test set-up for measuring forward transconductance $g_{fs} = di_o/dv_i$ at v_o is constant (see also graph Fig.7); $MR = LOW$.

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