

HEF4060

DATASHEET

Specification Revision History:

Version	Date	Description
V1.0	2021/09	New
V1.1	2023/05	Modify Ordering Information
V1.2	2024/02	Modify Ordering Information
V1.3	2025/05	Add application precautions and overall typesetting.

General Description

HEF4060 is a 14-stage ripple-carry binary counter/divider and oscillator with three oscillator terminals (RS, REXT and CEXT), ten buffered outputs (Q3 to Q9 and Q11 to Q13) 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 (Q3 to Q9 and Q11 to Q13=LOW), independent of other input conditions.

It operates over a recommended VDD power supply range of 3V to 15V referenced to VSS (usually ground).

Unused inputs must be connected to V_{DD} , V_{SS} , or another input.

Features

- ※Wide supply voltage range from 3V to 15V
- ※Tolerant of slow clock rise and fall times
- ※Fully static operation
- ※5V, 10V, and 15V parametric ratings
- ※Standardized symmetrical output characteristics
- ※Inputs and outputs are protected against electrostatic effects
- ※Specified from -40°C to +125°C
- ※Packaging information: SOP16

The appearance of the product



SOP-16

Ordering Information

Product Model	Package Type	Marking	Packing	Packing Qty
HEF4060BES	SOP-16	HEF4060B S357	REEL	2500PCS/REEL

Block Diagram And Pin Description

Block Diagram

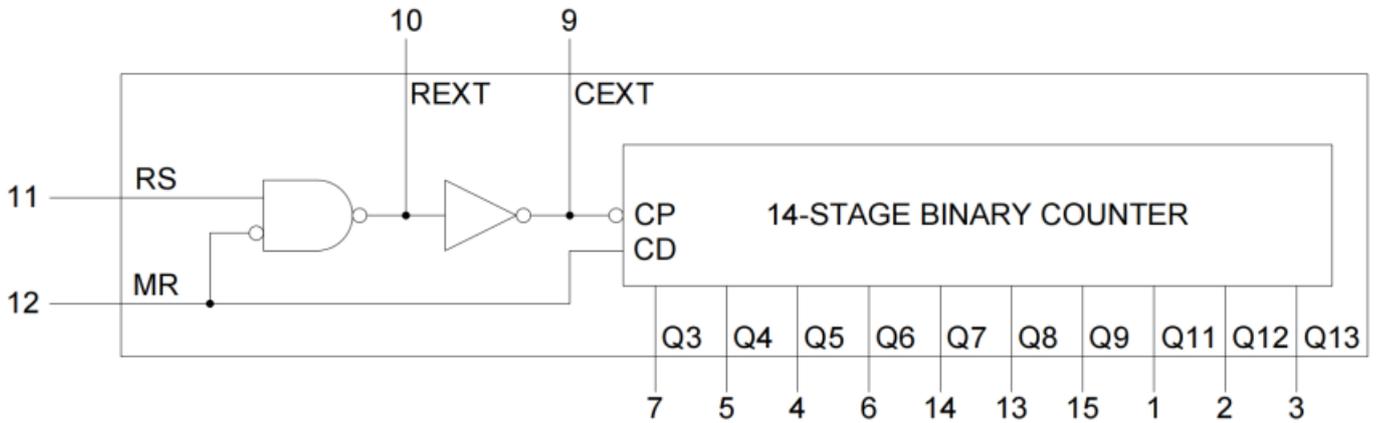


Figure 1. Functional diagram

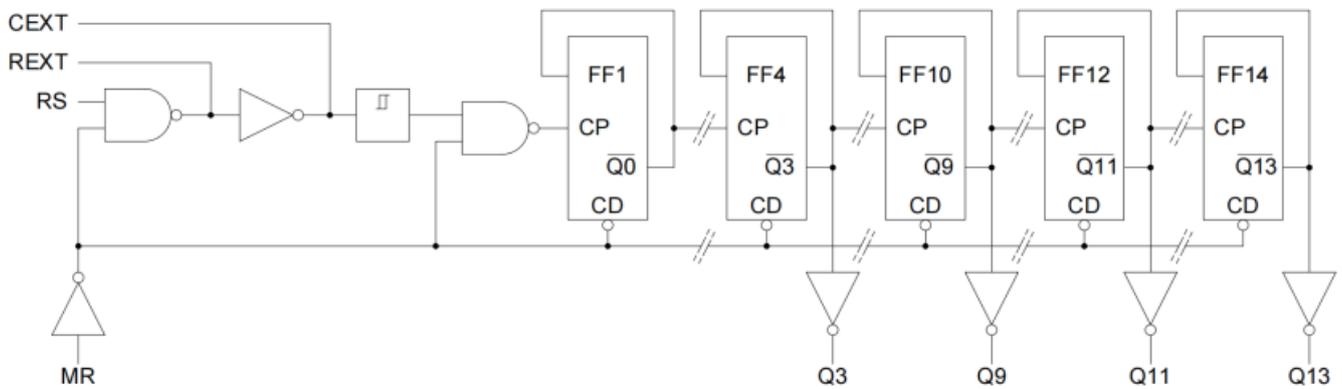
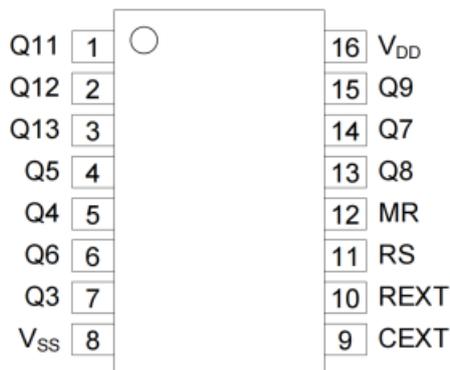


Figure 2. Logic diagram

Pin Configurations



Pin Description

Pin No.	Pin Name	Description
1	Q11	counter output
2	Q12	counter output
3	Q13	counter output
4	Q5	counter output
5	Q4	counter output
6	Q6	counter output
7	Q3	counter output
8	V _{SS}	ground (0V)
9	CEXT	external capacitor connection
10	REXT	oscillator pin
11	RS	clock input/oscillator pin
12	MR	master reset
13	Q8	counter output
14	Q7	counter output
15	Q9	counter output
16	V _{DD}	supply voltage

Function Table

Input		Output
RS	MR	Q3 to Q9 and Q11 to Q13
↑	L	no change
↓	L	count
X	H	L

Note: H=HIGH voltage level; L=LOW voltage level; X=don't care; ↑=LOW-to-HIGH clock transition.

Electrical Parameter

Absolute Maximum Ratings

(Voltages are referenced to V_{SS} (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions		Min.	Max.	Unit
supply voltage	V _{DD}	-		-0.5	+18	V
DC input current	I _{IK}	any one input		-	±10	mA
input voltage	V _I	all inputs		-0.5	V _{DD} +0.5	V
storage temperature	T _{stg}	-		-65	+150	°C
total power dissipation	P _{tot}	-		-	500	mW
device dissipation	P	per output transistor		-	100	mW
soldering temperature	T _L	10s	DIP	245		°C
			SOP/TSSOP	260		°C

Recommended Operating Conditions

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
supply voltage	V _{DD}	-		3	-	15	V
ambient temperature	T _{amb}	in free air		-40	-	+125	°C
input pulse width	t _w	f=100kHz	V _{DD} =5V	100	-	-	ns
			V _{DD} =10V	40	-	-	ns
			V _{DD} =15V	30	-	-	ns
input pulse rise and fall time	t _{rin} , t _{fin}	V _{DD} =5V		unlimited			-
		V _{DD} =10V					-
		V _{DD} =15V					-
input pulse frequency	f _{RS}	external pulse source	V _{DD} =5V	-	-	3.5	MHz
			V _{DD} =10V	-	-	8	MHz
			V _{DD} =15V	-	-	12	MHz
reset pulse width	t _{WR}	V _{DD} =5V		120	-	-	ns
		V _{DD} =10V		60	-	-	ns
		V _{DD} =15V		40	-	-	ns

Electrical Characteristics

DC Characteristics 1

(T_{amb}=25°C, voltages are referenced to V_{SS} (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions (V)			T _{amb} =25°C			Unit
		V _O	V _{IN}	V _{DD}	Min.	Typ.	Max.	
supply current	I _{DD}	-	0,5	5	-	-	5	µA
		-	0,10	10	-	-	10	µA
		-	0,15	15	-	-	20	µA
LOW-level output current	I _{OL}	0.4	0,5	5	0.51	1	-	mA
		0.5	0,10	10	1.3	2.6	-	mA
		1.5	0,15	15	3.4	6.8	-	mA
HIGH-level output current	I _{OH}	4.6	0,5	5	-0.51	-1	-	mA
		2.5	0,5	5	-1.6	-3.2	-	mA
		9.5	0,10	10	-1.3	-2.6	-	mA
		13.5	0,15	15	-3.4	-6.8	-	mA
LOW-level output voltage	V _{OL}	-	0,5	5	-	0	0.05	V
		-	0,10	10	-	0	0.05	V
		-	0,15	15	-	0	0.05	V
HIGH-level output voltage	V _{OH}	-	0,5	5	4.95	5	-	V
		-	0,10	10	9.95	10	-	V
		-	0,15	15	14.95	15	-	V
LOW-level input voltage	V _{IL}	0.5,4.5	-	5	-	-	1.5	V
		1,9	-	10	-	-	3	V
		1.5, 13.5	-	15	-	-	4	V
HIGH-level input voltage	V _{IH}	0.5,4.5	-	5	3.5	-	-	V
		1,9	-	10	7	-	-	V
		1.5, 13.5	-	15	11	-	-	V
input leakage current	I _I	-	0,15	15	-	-	± 1	µA

DC Characteristics 2

($T_{amb} = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, voltages are referenced to V_{SS} (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions (V)			$T_{amb} = -40^{\circ}\text{C}$		$T_{amb} = +85^{\circ}\text{C}$		Unit
		V_O	V_{IN}	V_{DD}	Min.	Max.	Min.	Max.	
supply current	I_{DD}	-	0,5	5	-	5	-	150	μA
		-	0,10	10	-	10	-	300	μA
		-	0,15	15	-	20	-	600	μA
LOW-level output current	I_{OL}	0.4	0,5	5	0.61	-	0.42	-	mA
		0.5	0,10	10	1.5	-	1.1	-	mA
		1.5	0,15	15	4	-	2.8	-	mA
HIGH-level output current	I_{OH}	4.6	0,5	5	-0.61	-	-0.42	-	mA
		2.5	0,5	5	-1.8	-	-1.3	-	mA
		9.5	0,10	10	-1.5	-	-1.1	-	mA
		13.5	0,15	15	-4	-	-2.8	-	mA
LOW-level output voltage	V_{OL}	-	0,5	5	-	0.05	-	0.05	V
		-	0,10	10	-	0.05	-	0.05	V
		-	0,15	15	-	0.05	-	0.05	V
HIGH-level output voltage	V_{OH}	-	0,5	5	4.95	-	4.95	-	V
		-	0,10	10	9.95	-	9.95	-	V
		-	0,15	15	14.95	-	14.95	-	V
LOW-level input voltage	V_{IL}	0.5,4.5	-	5	-	1.5	-	1.5	V
		1,9	-	10	-	3	-	3	V
		1.5,13.5	-	15	-	4	-	4	V
HIGH-level input voltage	V_{IH}	0.5,4.5	-	5	3.5	-	3.5	-	V
		1,9	-	10	7	-	7	-	V
		1.5,13.5	-	15	11	-	11	-	V
input leakage current	I_I	-	0,15	15	-	± 1	-	± 1	μA

DC Characteristics 3

($T_{amb} = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, voltages are referenced to V_{SS} (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions (V)			$T_{amb} = -40^{\circ}\text{C}$		$T_{amb} = +125^{\circ}\text{C}$		Unit
		V_o	V_{in}	V_{DD}	Min.	Max.	Min.	Max.	
supply current	I_{DD}	-	0,5	5	-	5	-	150	μA
		-	0,10	10	-	10	-	300	μA
		-	0,15	15	-	20	-	600	μA
LOW-level output current	I_{OL}	0.4	0,5	5	0.61	-	0.36	-	mA
		0.5	0,10	10	1.5	-	0.9	-	mA
		1.5	0,15	15	4	-	2.4	-	mA
HIGH-level output current	I_{OH}	4.6	0,5	5	-0.61	-	-0.36	-	mA
		2.5	0,5	5	-1.8	-	-1.15	-	mA
		9.5	0,10	10	-1.5	-	-0.9	-	mA
		13.5	0,15	15	-4	-	-2.4	-	mA
LOW-level output voltage	V_{OL}	-	0,5	5	-	0.05	-	0.05	V
		-	0,10	10	-	0.05	-	0.05	V
		-	0,15	15	-	0.05	-	0.05	V
HIGH-level output voltage	V_{OH}	-	0,5	5	4.95	-	4.95	-	V
		-	0,10	10	9.95	-	9.95	-	V
		-	0,15	15	14.95	-	14.95	-	V
LOW-level input voltage	V_{IL}	0.5,4.5	-	5	-	1.5	-	1.5	V
		1,9	-	10	-	3	-	3	V
		1.5,13.5	-	15	-	4	-	4	V
HIGH-level input voltage	V_{IH}	0.5,4.5	-	5	3.5	-	3.5	-	V
		1,9	-	10	7	-	7	-	V
		1.5,13.5	-	15	11	-	11	-	V
input leakage current	I_i	-	0,15	15	-	± 1	-	± 1	μA

AC Characteristics 1

($T_{amb}=25^{\circ}\text{C}$, $V_{SS}=0\text{V}$, $t_r, t_f=20\text{ns}$, $C_L=50\text{pF}$, $R_L=200\text{k}\Omega$, unless otherwise specified.)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
propagation delay time	t_{PHL}, t_{PLH}	RS to Q3 out; see Figure 4	$V_{DD}=5\text{V}$	-	370	740	ns
			$V_{DD}=10\text{V}$	-	150	300	ns
			$V_{DD}=15\text{V}$	-	100	200	ns
		Qn to Qn+1; see Figure 4	$V_{DD}=5\text{V}$	-	100	200	ns
			$V_{DD}=10\text{V}$	-	50	100	ns
			$V_{DD}=15\text{V}$	-	40	80	ns
		MR to Qn; see Figure 4	$V_{DD}=5\text{V}$	-	180	360	ns
			$V_{DD}=10\text{V}$	-	80	160	ns
			$V_{DD}=15\text{V}$	-	50	100	ns
transition time	t_t	see Figure 4	$V_{DD}=5\text{V}$	-	100	200	ns
			$V_{DD}=10\text{V}$	-	50	100	ns
			$V_{DD}=15\text{V}$	-	40	80	ns
pulse width	t_w	minimum width; $f=100\text{kHz}$; RS HIGH;	$V_{DD}=5\text{V}$	-	50	100	ns
			$V_{DD}=10\text{V}$	-	20	40	ns
			$V_{DD}=15\text{V}$	-	15	30	ns
		minimum width; MR HIGH; see Figure 4	$V_{DD}=5\text{V}$	-	60	120	ns
			$V_{DD}=10\text{V}$	-	30	60	ns
			$V_{DD}=15\text{V}$	-	20	40	ns
input pulse rise and fall time	t_{rIN}, t_{fIN}	-	$V_{DD}=5\text{V}$	unlimited			-
			$V_{DD}=10\text{V}$				-
			$V_{DD}=15\text{V}$				-
maximum clock frequency	f_{max}	input RS; see Figure 4	$V_{DD}=5\text{V}$	3.5	7	-	MHz
			$V_{DD}=10\text{V}$	8	16	-	MHz
			$V_{DD}=15\text{V}$	12	24	-	MHz
input capacitance	C_L	any input	-	5	7.5	pF	

Note: t_t is the same as t_{TLH} and t_{THL} .

AC Characteristics 2

(RC Operation, $T_{amb}=25^{\circ}\text{C}$, $V_{SS}=0\text{V}$, $t_r, t_f=20\text{ns}$, $C_L=50\text{pF}$, $R_L=200\text{k}\Omega$, unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
variation of frequency (unit to unit)	-	$C_x=200\text{pF}$	$V_{DD}=5\text{V}$	-	$23 \pm 10\%$	-	kHz
		$R_s=560\text{k}\Omega$	$V_{DD}=10\text{V}$	-	$24 \pm 10\%$	-	kHz
		$R_x=50\text{k}\Omega$	$V_{DD}=15\text{V}$	-	$25 \pm 10\%$	-	kHz
variation of frequency with voltage change (same unit)	-	$C_x=200\text{pF}$	5V to 10V	-	1.5	-	kHz
		$R_s=560\text{k}\Omega$ $R_x=50\text{k}\Omega$	10V to 15V	-	0.5	-	kHz
R_x max	-	$C_x=10\mu\text{F}, V_{DD}=5\text{V}$		-	-	20	M Ω
		$C_x=50\mu\text{F}, V_{DD}=10\text{V}$		-	-	20	M Ω
		$C_x=10\mu\text{F}, V_{DD}=15\text{V}$		-	-	10	M Ω
C_x max	-	$R_x=500\text{k}\Omega, V_{DD}=5\text{V}$		-	-	1000	μF
		$R_x=300\text{k}\Omega, V_{DD}=10\text{V}$		-	-	50	μF
		$R_x=300\text{k}\Omega, V_{DD}=15\text{V}$		-	-	50	μF
Maximum oscillator frequency	-	$C_x=15\text{pF}$ $R_s=30\text{k}\Omega$ $R_x=15\text{k}\Omega$	$V_{DD}=10\text{V}$	530	650	810	kHz
			$V_{DD}=15\text{V}$	690	800	940	kHz
drive current at CEXT (for oscillator design)	I_{OL}	$V_o=0.4\text{V}, V_{DD}=5\text{V}$		0.16	0.35	-	mA
		$V_o=0.5\text{V}, V_{DD}=10\text{V}$		0.42	0.8	-	mA
		$V_o=1.5\text{V}, V_{DD}=15\text{V}$		1	2	-	mA
	I_{OH}	$V_o=4.6\text{V}, V_{DD}=5\text{V}$		-0.16	-0.35	-	mA
		$V_o=9.5\text{V}, V_{DD}=10\text{V}$		-0.42	-0.8	-	mA
		$V_o=13.5\text{V}, V_{DD}=15\text{V}$		-1	-2	-	mA

Note: RC oscillator applications are not recommended at supply voltages below 7V for $R_x < 50\text{k}\Omega$.

Testing Circuit

AC Testing Circuit

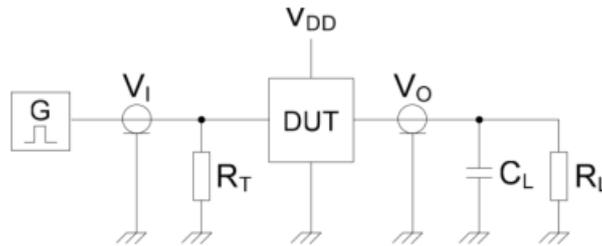


Figure 3. Test circuit for switching times

Definitions for test circuit:

DUT=Device Under Test.

C_L =Load capacitance including jig and probe capacitance.

R_T =Termination resistance should be equal to the output impedance Z_O of the pulse generator.

R_L = Load resistance.

AC Testing Waveforms

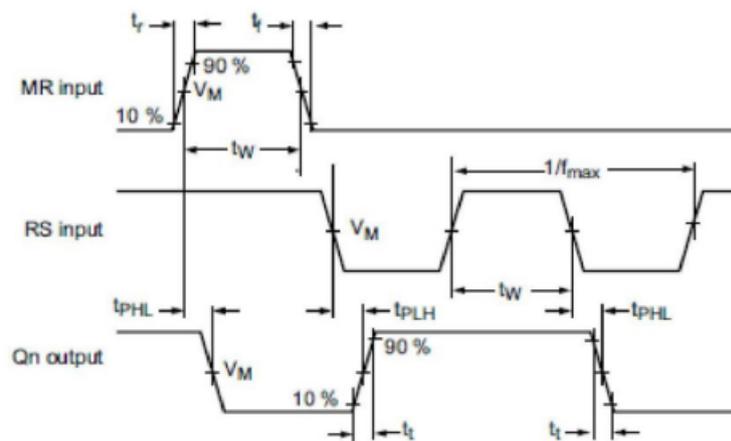


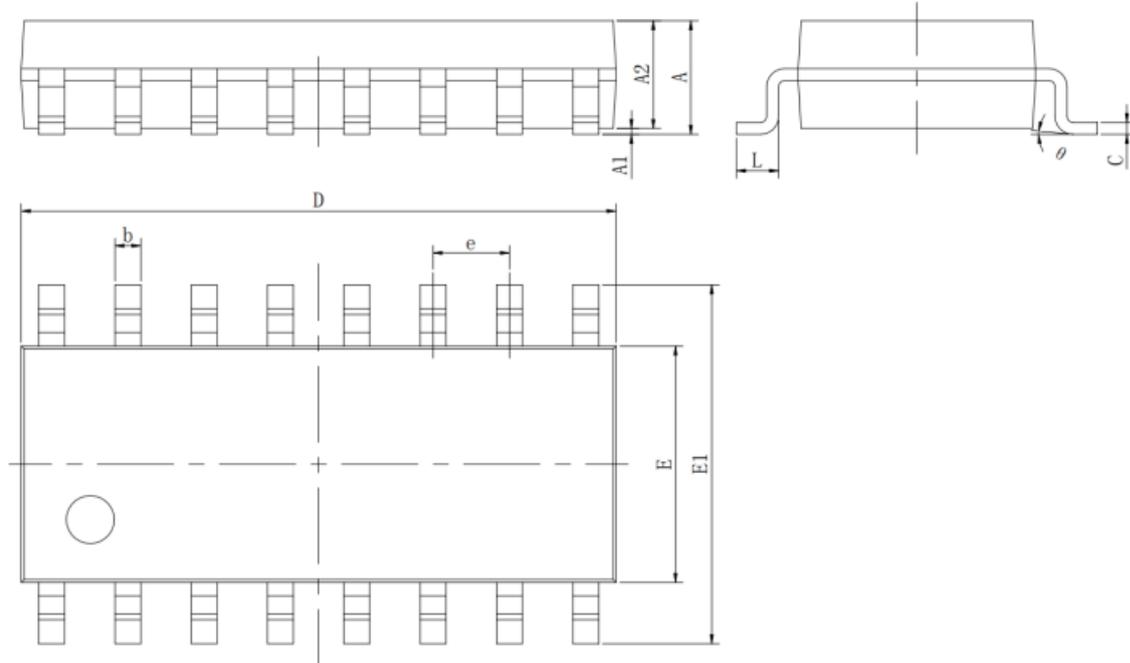
Figure 4. Waveforms showing propagation delays

Measurement Points

Supply voltage	Input	Output
V_{DD}	V_M	V_M
5V to 15V	$0.5 \times V_{DD}$	$0.5 \times V_{DD}$

Test Data

Supply voltage	Input		Load
V_{DD}	V_I	t_r, t_f	C_L
5V to 15V	V_{SS} or V_{DD}	$\leq 20\text{ns}$	50pF

Outline Dimensions
SOP16
Unit : mm


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	9.800	10.200	0.386	0.402
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

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