

# 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.

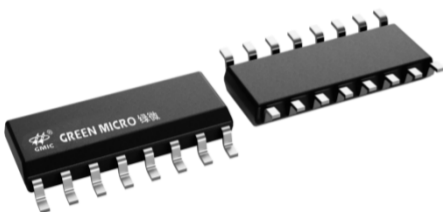
It operates over a recommended  $V_{DD}$  power supply range of 3V to 15V referenced to  $V_{SS}$  (usually ground).

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

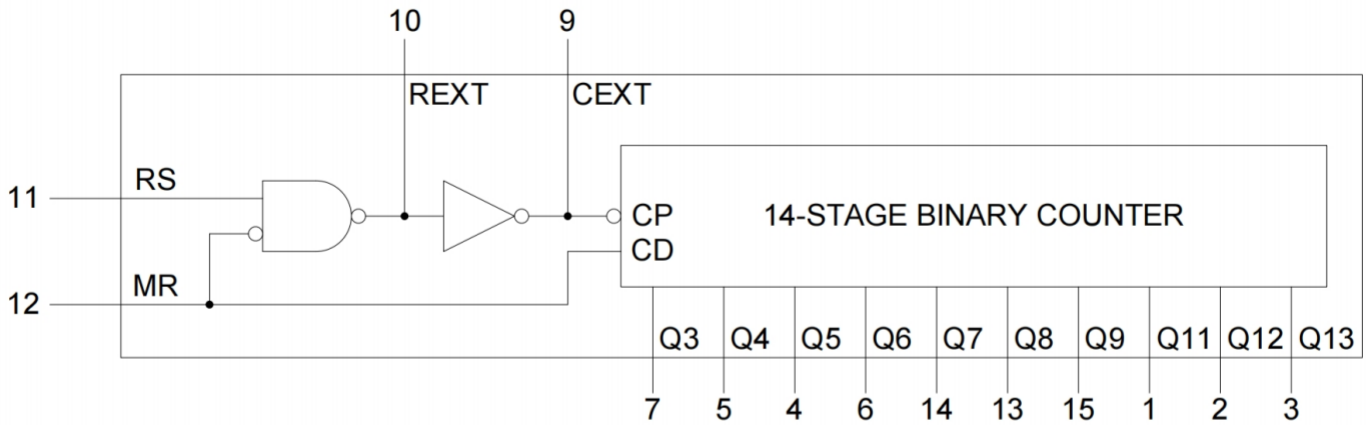


Figure 1. Functional diagram

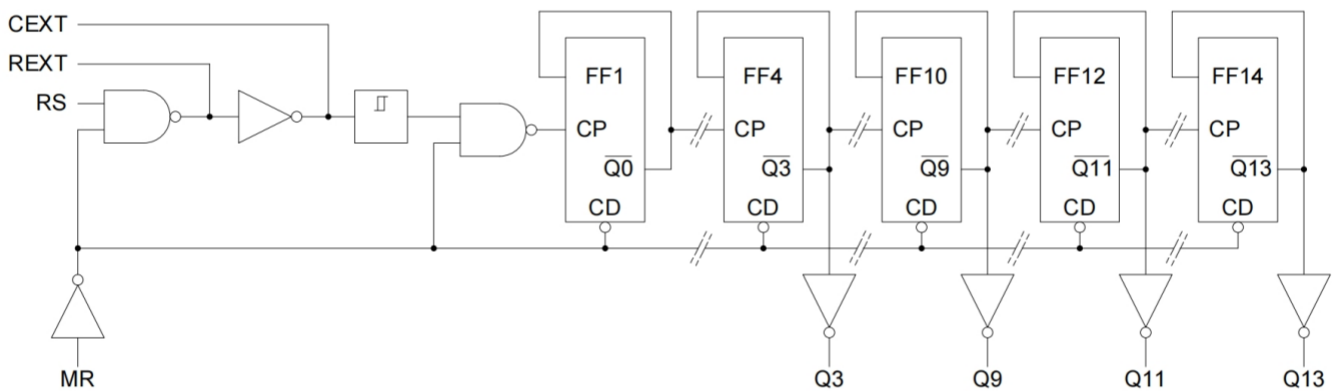
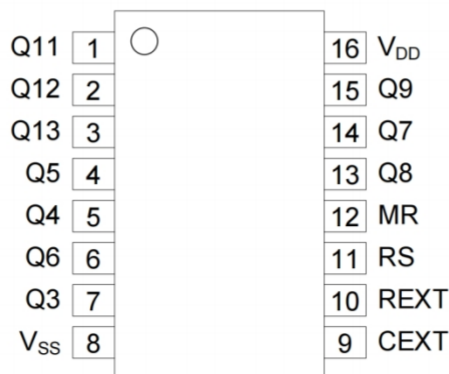


Figure 2. Logic diagram

### 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 <sub>SS</sub>	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 <sub>DD</sub>	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<sub>SS</sub> (ground=0V), unless otherwise specified.)

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

### Recommended Operating Conditions

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

## Electrical Characteristics

### DC Characteristics 1

(T<sub>amb</sub>=25°C, voltages are referenced to V<sub>SS</sub> (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions (V)			T <sub>amb</sub> =25°C			Unit
		V <sub>O</sub>	V <sub>IN</sub>	V <sub>DD</sub>	Min.	Typ.	Max.	
supply current	I <sub>DD</sub>	-	0, 5	5	-	-	5	uA
		-	0, 10	10	-	-	10	uA
		-	0, 15	15	-	-	20	uA
LOW-level output current	I <sub>OL</sub>	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 <sub>OH</sub>	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 <sub>OL</sub>	-	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 <sub>OH</sub>	-	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 <sub>IL</sub>	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 <sub>IH</sub>	0.5, 4.5	-	5	3.5	-	-	V
		1, 9	-	10	7	-	-	V
		1.5, 13.5	-	15	11	-	-	V
input leakage current	I <sub>I</sub>	-	0, 15	15	-	-	± 1	uA

## 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	uA
		-	0, 10	10	-	10	-	300	uA
		-	0, 15	15	-	20	-	600	uA
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	-	$\pm 1$	-	$\pm 1$	uA

### 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	$\mu\text{A}$
		-	0, 10	10	-	10	-	300	$\mu\text{A}$
		-	0, 15	15	-	20	-	600	$\mu\text{A}$
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	-	$\pm 1$	-	$\pm 1$	$\mu\text{A}$

## 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	$C_i$	any input	-	5	7.5	pF	

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

## AC Characteristics 2

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

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

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

## Testing Circuit

### AC Testing Circuit

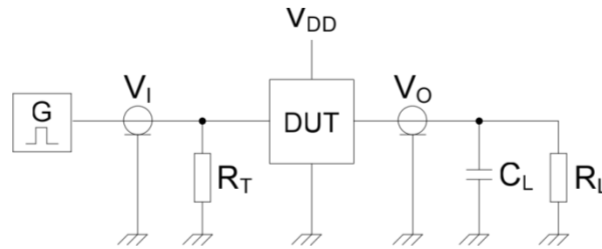


Figure 3. Test circuit for switching times

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

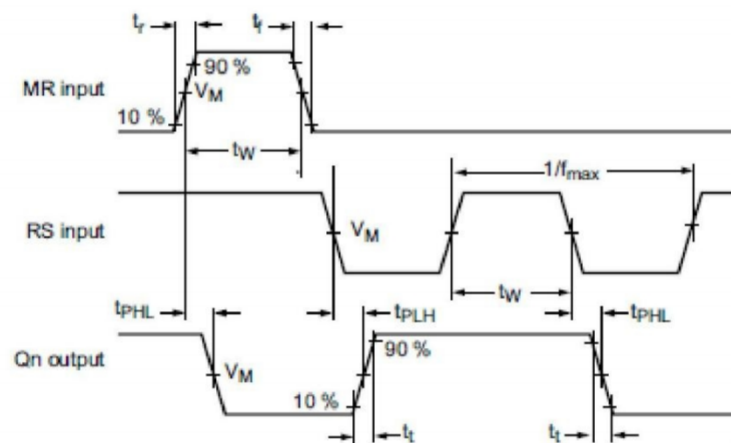


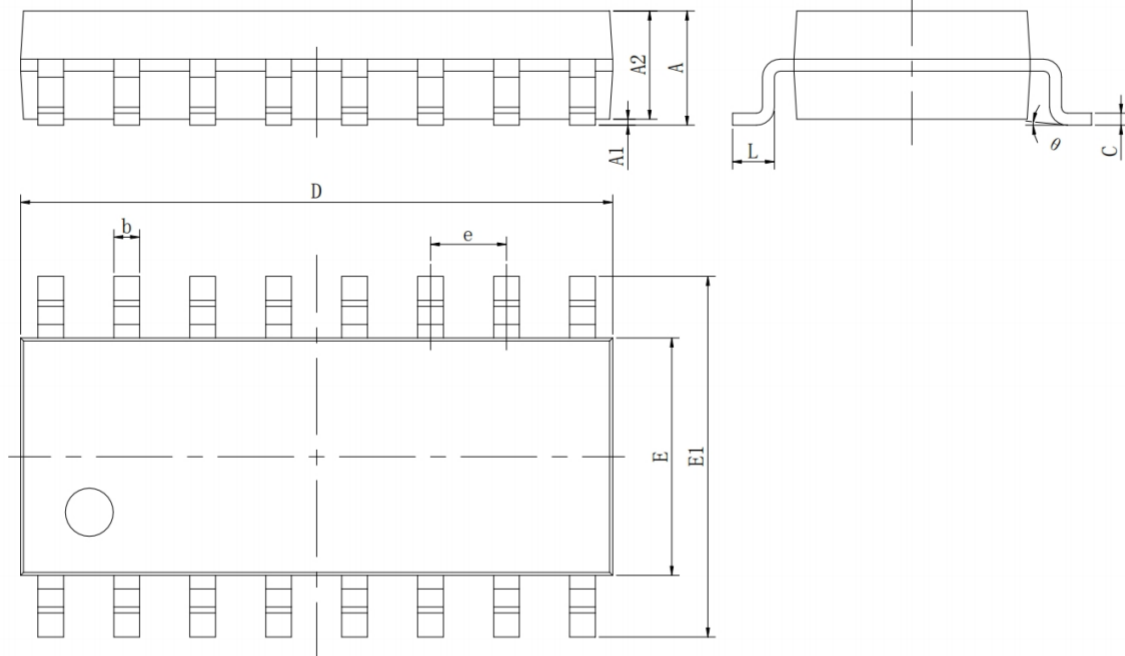
Figure 4. Waveforms showing propagation delays

### 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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