

74HC4060; 74HCT4060

14-stage binary ripple counter with oscillator

Rev. 03 — 14 July 2008

Product data sheet

1. General description

The 74HC4060; 74HCT4060 are high-speed Si-gate CMOS device and is pin compatible with the HEF4060.

The 74HC4060; 74HCT4060 are 14-stage ripple-carry counter/dividers and oscillators with three oscillator terminals (RS, RTC and CTC), ten buffered outputs (Q3 to Q9 and Q11 to Q13) and an overriding asynchronous master reset (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. In this case keep the other oscillator pins (RTC and CTC) floating. 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. In the HCT version, the MR input is TTL compatible, but the RS input has CMOS input switching levels and can be driven by a TTL output by using a pull-up resistor to V_{CC} .

2. Features

- All active components on chip
- RC or crystal oscillator configuration
- Complies with JEDEC standard no. 7 A
- ESD protection:
 - ◆ HBM JESD22-A114E exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$

3. Applications

- Control counters
- Timers
- Frequency dividers
- Time-delay circuits

4. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC4060N 74HCT4060N	-40 °C to +125 °C	DIP16	plastic dual in-line package; 16 leads (300 mil)	SOT38-4
74HC4060D 74HCT4060D	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74HC4060DB 74HCT4060DB	-40 °C to +125 °C	SSOP16	plastic shrink small outline package; 16 leads; body width 5.3 mm	SOT338-1
74HC4060PW	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1
74HC4060BQ 74HCT4060BQ	-40 °C to +125 °C	DHVQFN16	plastic dual in-line compatible thermal-enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 × 3.5 × 0.85 mm	SOT763-1

5. Functional diagram

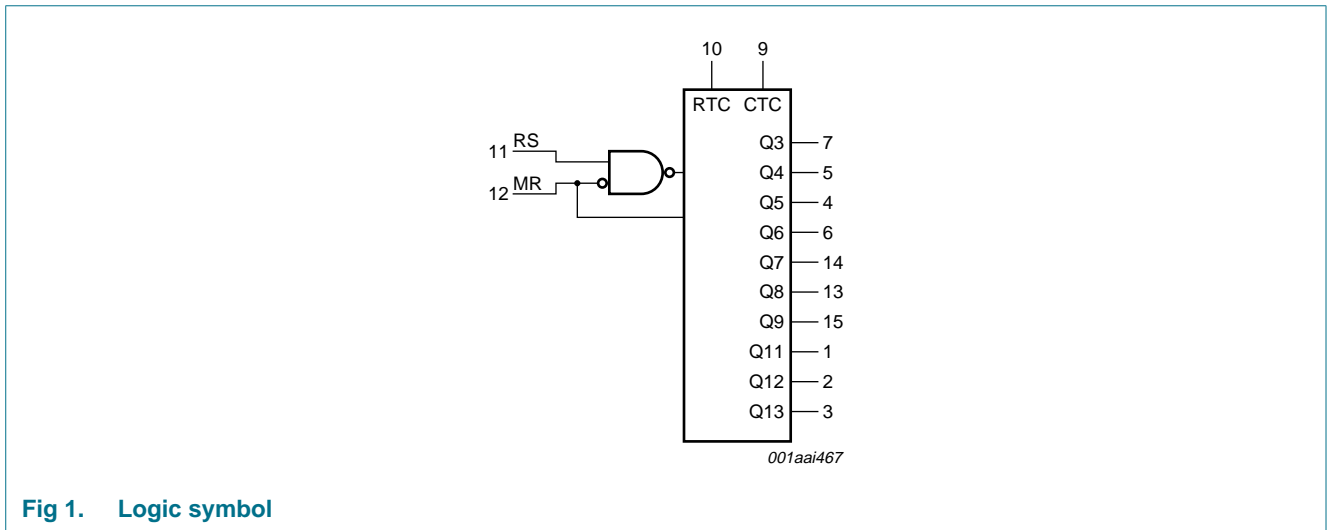


Fig 1. Logic symbol

7. Functional description

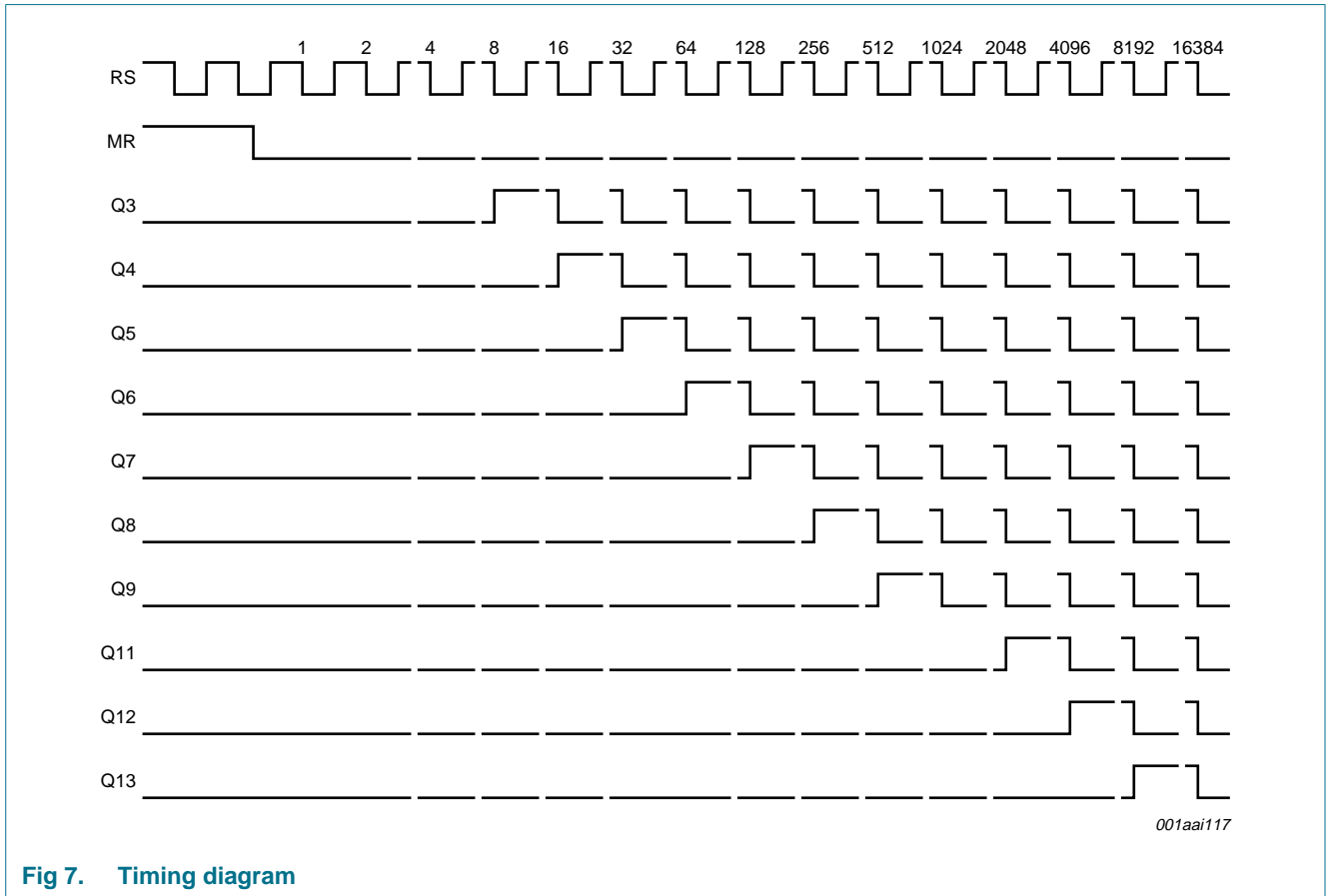


Fig 7. Timing diagram

8. Limiting values

Table 3. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
V _{CC}	supply voltage		-0.5	+7	V
I _{IK}	input clamping current	V _I < -0.5 V or V _I > V _{CC} + 0.5 V	[1] -	±20	mA
I _{OK}	output clamping current	V _O < -0.5 V or V _O > V _{CC} + 0.5 V	[1] -	±20	mA
I _O	output current	-0.5 V < V _O < V _{CC} + 0.5 V	-	±25	mA
I _{CC}	supply current		-	50	mA
I _{GND}	ground current		-50	-	mA
T _{stg}	storage temperature		-65	+150	°C

Table 3. Limiting values ...continued

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit	
P _{tot}	total power dissipation	T _{amb} = -40 °C to +125 °C				
		DIP16 package	[2]	-	750	mW
		SO16 package	[3]	-	500	mW
		(T)SSOP16 package	[4]	-	500	mW
		DHVQFN16 package	[5]	-	500	mW

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

[2] P_{tot} derates linearly with 12 mW/K above 70 °C.

[3] P_{tot} derates linearly with 8 mW/K above 70 °C.

[4] P_{tot} derates linearly with 5.5 mW/K above 60 °C.

[5] P_{tot} derates linearly with 4.5 mW/K above 60 °C.

9. Recommended operating conditions

Table 4. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC4060			74HCT4060			Unit
			Min	Typ	Max	Min	Typ	Max	
V _{CC}	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V _I	input voltage		0	-	V _{CC}	0	-	V _{CC}	V
V _O	output voltage		0	-	V _{CC}	0	-	V _{CC}	V
T _{amb}	ambient temperature		-40	-	+125	-40	-	+125	°C
Δt/ΔV	input transition rise and fall rate	V _{CC} = 2.0 V	-	-	625	-	-	-	ns/V
		V _{CC} = 4.5 V	-	1.67	139	-	1.67	139	ns/V
		V _{CC} = 6.0 V	-	-	83	-	-	-	ns/V

10. Static characteristics

Table 5. Static characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC4060										
V _{IH}	HIGH-level input voltage	MR input								
		V _{CC} = 2.0 V	1.5	1.3	-	1.5	-	1.5	-	V
		V _{CC} = 4.5 V	3.15	2.4	-	3.15	-	3.15	-	V
		V _{CC} = 6.0 V	4.2	3.1	-	4.2	-	4.2	-	V
		RS input								
		V _{CC} = 2.0 V	1.7	-	-	1.7	-	1.7	-	V
V _{CC} = 4.5 V	3.6	-	-	3.6	-	3.6	-	V		
V _{CC} = 6.0 V	4.8	-	-	4.8	-	4.8	-	V		

Table 5. Static characteristics ...continued

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit	
			Min	Typ	Max	Min	Max	Min	Max		
V _{IL}	LOW-level input voltage	MR input									
		V _{CC} = 2.0 V	-	0.8	0.5	-	0.5	-	0.5	V	
		V _{CC} = 4.5 V	-	2.1	1.35	-	1.35	-	1.35	V	
		V _{CC} = 6.0 V	-	2.8	1.8	-	1.8	-	1.8	V	
		RS input									
		V _{CC} = 2.0 V	-	-	0.3	-	0.3	-	0.3	V	
		V _{CC} = 4.5 V	-	-	0.9	-	0.9	-	0.9	V	
		V _{CC} = 6.0 V	-	-	1.2	-	1.2	-	1.2	V	
		V _{OH}	HIGH-level output voltage	RTC output; RS = MR = GND							
I _O = -20 µA; V _{CC} = 2.0 V	1.9			2.0	-	1.9	-	1.9	-	V	
I _O = -20 µA; V _{CC} = 4.5 V	4.4			4.5	-	4.4	-	4.4	-	V	
I _O = -20 µA; V _{CC} = 6.0 V	5.9			6.0	-	5.9	-	5.9	-	V	
I _O = -2.6 mA; V _{CC} = 4.5 V	3.98			-	-	3.84	-	3.7	-	V	
I _O = -3.3 mA; V _{CC} = 6.0 V	5.48			-	-	5.34	-	5.2	-	V	
RTC output; RS = MR = V _{CC}											
I _O = -20 µA; V _{CC} = 2.0 V	1.9			2.0	-	1.9	-	1.9	-	V	
I _O = -20 µA; V _{CC} = 4.5 V	4.4			4.5	-	4.4	-	4.4	-	V	
I _O = -20 µA; V _{CC} = 6.0 V	5.9			6.0	-	5.9	-	5.9	-	V	
I _O = -0.65 mA; V _{CC} = 4.5 V	3.98			-	-	3.84	-	3.7	-	V	
I _O = -0.85 mA; V _{CC} = 6.0 V	5.48			-	-	5.34	-	5.2	-	V	
CTC output; RS = V _{IH} ; MR = V _{IL}											
I _O = -3.2 mA; V _{CC} = 4.5 V	3.98			-	-	3.84	-	3.7	-	V	
I _O = -4.2 mA; V _{CC} = 6.0 V	5.48			-	-	5.34	-	5.2	-	V	
V _I = V _{IH} or V _{IL} ; except RTC output											
I _O = -20 µA; V _{CC} = 2.0 V	1.9			2.0	-	1.9	-	1.9	-	V	
I _O = -20 µA; V _{CC} = 4.5 V	4.4			4.5	-	4.4	-	4.4	-	V	
I _O = -20 µA; V _{CC} = 6.0 V	5.9			6.0	-	5.9	-	5.9	-	V	
V _I = V _{IH} or V _{IL} ; except RTC and CTC outputs											
I _O = -4.0 mA; V _{CC} = 4.5 V	3.98			-	-	3.84	-	3.7	-	V	
I _O = -5.2 mA; V _{CC} = 6.0 V	5.48	-	-	5.34	-	5.2	-	V			

Table 5. Static characteristics ...continued

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit	
			Min	Typ	Max	Min	Max	Min	Max		
V _{OL}	LOW-level output voltage	RTC output; RS = V _{CC} ; MR = GND									
		I _O = 20 μA; V _{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V	
		I _O = 20 μA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V	
		I _O = 20 μA; V _{CC} = 6.0 V	-	0	0.1	-	0.1	-	0.1	V	
		I _O = 2.6 mA; V _{CC} = 4.5 V	-	-	0.26	-	0.33	-	0.4	V	
		I _O = 3.3 mA; V _{CC} = 6.0 V	-	-	0.26	-	0.33	-	0.4	V	
		CTC output; RS = V _{IL} ; MR = V _{IH}									
		I _O = 3.2 mA; V _{CC} = 4.5 V	-	-	0.26	-	0.33	-	0.4	V	
		I _O = 4.2 mA; V _{CC} = 6.0 V	-	-	0.26	-	0.33	-	0.4	V	
		V _I = V _{IH} or V _{IL} ; except RTC output									
		I _O = 20 μA; V _{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V	
		I _O = 20 μA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V	
		I _O = 20 μA; V _{CC} = 6.0 V	-	0	0.1	-	0.1	-	0.1	V	
V _I = V _{IH} or V _{IL} ; except RTC and CTC outputs											
I _O = 4.0 mA; V _{CC} = 4.5 V	-	-	0.26	-	0.33	-	0.4	V			
I _O = 5.2 mA; V _{CC} = 6.0 V	-	-	0.26	-	0.33	-	0.4	V			
I _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 6.0 V	-	-	±0.1	-	±1.0	-	±1.0	μA	
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V	-	-	8.0	-	80	-	160	μA	
C _I	input capacitance		-	3.5	-	-	-	-	-	pF	
74HCT4060											
V _{IH}	HIGH-level input voltage	MR input; V _{CC} = 4.5 V to 5.5 V	[1]	2.0	-	-	2.0	-	2.0	-	V
V _{IL}	LOW-level input voltage	MR input; V _{CC} = 4.5 V to 5.5 V	[1]	-	-	0.8	-	0.8	-	0.8	V

Table 5. Static characteristics ...continued

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
V _{OH}	HIGH-level output voltage	RTC output; RS = MR = V _{CC}								
		I _O = -20 μA; V _{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -0.65 mA; V _{CC} = 4.5 V	3.98	-	-	3.84	-	3.7	-	V
		RTC output; RS = MR = GND								
		I _O = -20 μA; V _{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -2.6 mA; V _{CC} = 4.5 V	3.98	-	-	3.84	-	3.7	-	V
		CTC output; RS = V _{IH} ; MR = V _{IL}								
		I _O = -3.2 mA; V _{CC} = 4.5 V	3.98	-	-	3.84	-	3.7	-	V
		V _I = V _{IH} or V _{IL} ; except RTC output								
		I _O = -20 μA; V _{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL} ; except RTC and CTC outputs								
		I _O = -4.0 mA; V _{CC} = 4.5 V	3.98	-	-	3.84	-	3.7	-	V
		RTC output; RS = V _{CC} ; MR = GND								
		I _O = 20 μA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 2.6 mA; V _{CC} = 4.5 V	-	-	0.26	-	0.33	-	0.4	V
		CTC output; RS = V _{IL} ; MR = V _{IH}								
		I _O = 3.2 mA; V _{CC} = 4.5 V	-	-	0.26	-	0.33	-	0.4	V
		V _I = V _{IH} or V _{IL} ; except RTC output								
		I _O = 20 μA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		V _I = V _{IH} or V _{IL} ; except RTC and CTC outputs								
I _O = 4.0 mA; V _{CC} = 4.5 V	-	-	0.26	-	0.33	-	0.4	V		
I _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 5.5 V	-	-	±0.1	-	±1.0	-	±1.0	μA
I _{CC}	supply current	V _I = V _{CC} or GND; V _{CC} = 5.5 V; I _O = 0 A	-	-	8.0	-	80	-	160	μA
ΔI _{CC}	additional supply current	per input pin; V _I = V _{CC} - 2.1 V; other inputs at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V; I _O = 0 A	-	40	144	-	180	-	196	μA
C _I	input capacitance		-	3.5	-	-	-	-	-	pF

[1] For HCT4060, only input MR (pin 12) has TTL input switching levels.

11. Dynamic characteristics

Table 6. Dynamic characteristics

$GND = 0\text{ V}$; $C_L = 50\text{ pF}$ unless otherwise specified; for test circuit see [Figure 11](#).

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC4060										
t_{pd}	propagation delay	RS to Q3; see Figure 8 ^[1]								
		$V_{CC} = 2.0\text{ V}$	-	99	300	-	375	-	450	ns
		$V_{CC} = 4.5\text{ V}$	-	36	60	-	75	-	90	ns
		$V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$	-	31	-	-	-	-	-	ns
		$V_{CC} = 6.0\text{ V}$	-	29	51	-	64	-	77	ns
		Qn to Qn+1; see Figure 9 ^[2]								
		$V_{CC} = 2.0\text{ V}$	-	22	80	-	100	-	120	ns
		$V_{CC} = 4.5\text{ V}$	-	8	16	-	20	-	24	ns
	$V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$	-	6	-	-	-	-	-	ns	
	$V_{CC} = 6.0\text{ V}$	-	6	14	-	17	-	20	ns	
t_{PHL}	HIGH to LOW propagation delay	MR to Qn; see Figure 10								
		$V_{CC} = 2.0\text{ V}$	-	55	175	-	220	-	265	ns
		$V_{CC} = 4.5\text{ V}$	-	20	35	-	44	-	53	ns
		$V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$	-	17	-	-	-	-	-	ns
	$V_{CC} = 6.0\text{ V}$	-	16	30	-	37	-	45	ns	
t_t	transition time	Qn; see Figure 8 ^[3]								
		$V_{CC} = 2.0\text{ V}$	-	19	75	-	95	-	110	ns
		$V_{CC} = 4.5\text{ V}$	-	7	15	-	19	-	22	ns
		$V_{CC} = 6.0\text{ V}$	-	6	13	-	16	-	19	ns
t_W	pulse width	RS (HIGH or LOW); see Figure 8								
		$V_{CC} = 2.0\text{ V}$	80	17	-	100	-	120	-	ns
		$V_{CC} = 4.5\text{ V}$	16	6	-	20	-	24	-	ns
		$V_{CC} = 6.0\text{ V}$	14	5	-	17	-	20	-	ns
		MR (HIGH); see Figure 10								
		$V_{CC} = 2.0\text{ V}$	80	25	-	100	-	120	-	ns
		$V_{CC} = 4.5\text{ V}$	16	9	-	20	-	24	-	ns
		$V_{CC} = 6.0\text{ V}$	14	7	-	17	-	20	-	ns
t_{rec}	recovery time	MR to RS; see Figure 10								
		$V_{CC} = 2.0\text{ V}$	100	28	-	125	-	150	-	ns
		$V_{CC} = 4.5\text{ V}$	20	10	-	25	-	30	-	ns
		$V_{CC} = 6.0\text{ V}$	17	8	-	21	-	26	-	ns

Table 6. Dynamic characteristics ...continued
GND = 0 V; C_L = 50 pF unless otherwise specified; for test circuit see Figure 11.

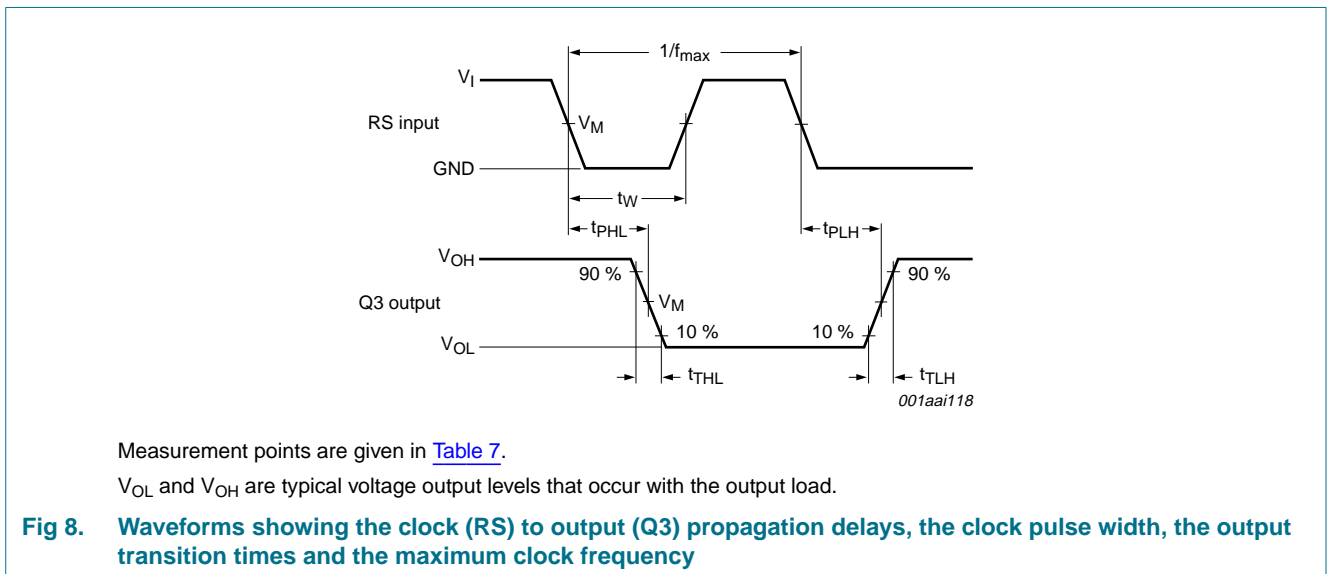
Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit	
			Min	Typ	Max	Min	Max	Min	Max		
f _{max}	maximum frequency	RS; see Figure 8									
		V _{CC} = 2.0 V	6	26	-	4.8	-	4	-	MHz	
		V _{CC} = 4.5 V	30	80	-	24	-	20	-	MHz	
		V _{CC} = 5.0 V; C _L = 15 pF	-	87	-	-	-	-	-	MHz	
		V _{CC} = 6.0 V	35	95	-	28	-	24	-	MHz	
C _{PD}	power dissipation capacitance	V _I = GND to V _{CC} ; V _{CC} = 5 V; f _i = 1 MHz	[4]	-	40	-	-	-	-	pF	
74HCT4060											
t _{pd}	propagation delay	RS to Q3; see Figure 8	[1]								
		V _{CC} = 4.5 V	-	33	66	-	83	-	99	ns	
		V _{CC} = 5.0 V; C _L = 15 pF	-	31	-	-	-	-	-	ns	
		Qn to Qn+1; see Figure 9	[2]								
		V _{CC} = 4.5 V	-	8	16	-	20	-	24	ns	
		V _{CC} = 5.0 V; C _L = 15 pF	-	6	-	-	-	-	ns		
t _{PHL}	HIGH to LOW propagation delay	MR to Qn; see Figure 10									
		V _{CC} = 4.5 V	-	21	44	-	55	-	66	ns	
		V _{CC} = 5.0 V; C _L = 15 pF	-	18	-	-	-	-	ns		
t _t	transition time	Qn; see Figure 8	[3]								
		V _{CC} = 4.5 V	-	7	15	-	19	-	22	ns	
t _W	pulse width	RS (HIGH or LOW); see Figure 8									
		V _{CC} = 4.5 V	16	6	-	20	-	24	-	ns	
		MR (HIGH); see Figure 10									
		V _{CC} = 4.5 V	16	6	-	20	-	24	-	ns	
t _{rec}	recovery time	MR to RS; see Figure 10									
		V _{CC} = 4.5 V	26	13	-	33	-	39	-	ns	
f _{max}	maximum frequency	RS; see Figure 8									
		V _{CC} = 4.5 V	30	80	-	24	-	20	-	MHz	
		V _{CC} = 5.0 V; C _L = 15 pF	-	88	-	-	-	-	-	MHz	

Table 6. Dynamic characteristics ...continued
GND = 0 V; C_L = 50 pF unless otherwise specified; for test circuit see Figure 11.

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
C _{PD}	power dissipation capacitance	V _I = GND to V _{CC} - 1.5 V; V _{CC} = 5 V; f _i = 1 MHz	[4]	-	40	-	-	-	-	pF

- [1] t_{pd} is the same as t_{PHL} and t_{PLH}.
- [2] Q_{n+1} is the next Q_n output.
- [3] t_i is the same as t_{THL} and t_{TLH}.
- [4] C_{PD} is used to determine the dynamic power dissipation (P_D in μW):
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$ where:
 f_i = input frequency in MHz;
 f_o = output frequency in MHz;
 C_L = output load capacitance in pF;
 V_{CC} = supply voltage in V;
 N = number of inputs switching;
 $\sum(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

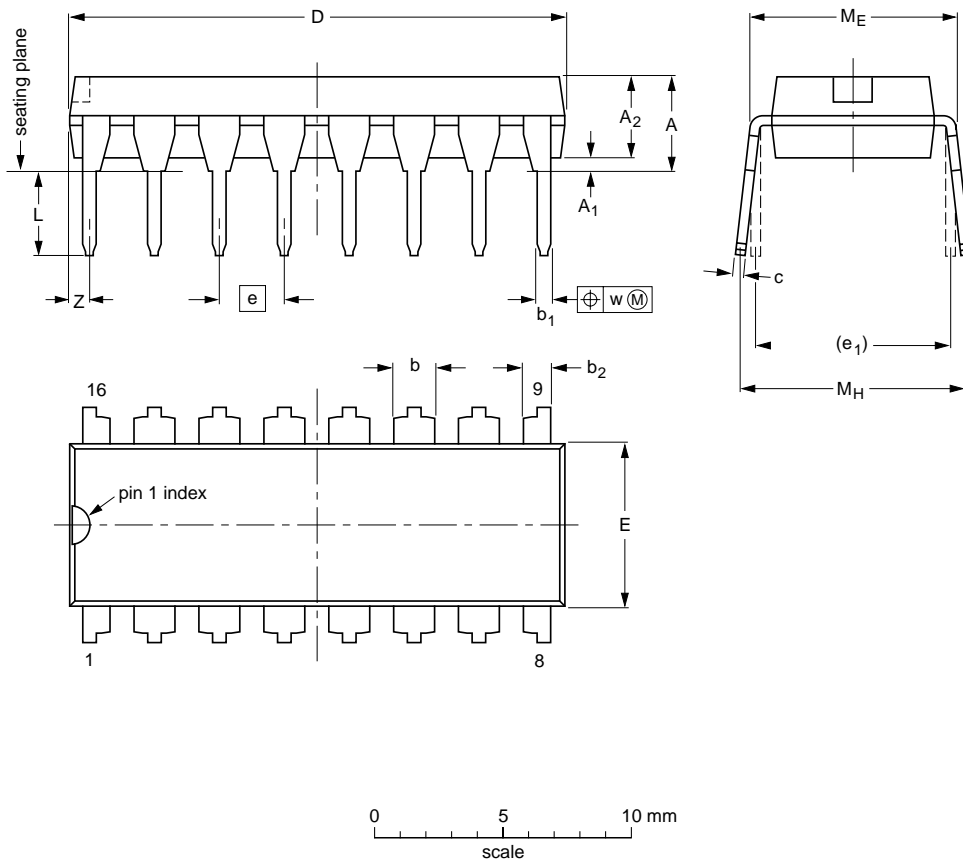
12. Waveforms



14. Package outline

DIP16: plastic dual in-line package; 16 leads (300 mil)

SOT38-4



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A ₁ min.	A ₂ max.	b	b ₁	b ₂	c	D ⁽¹⁾	E ⁽¹⁾	e	e ₁	L	M _E	M _H	w	Z ⁽¹⁾ max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	1.25 0.85	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	0.76
inches	0.17	0.02	0.13	0.068 0.051	0.021 0.015	0.049 0.033	0.014 0.009	0.77 0.73	0.26 0.24	0.1	0.3	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.03

Note

1. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION
	IEC	JEDEC	JEITA		
SOT38-4					

Fig 18. Package outline SOT38-4 (DIP16)