74HC4060-Q100; 74HCT4060-Q100

14-stage binary ripple counter with oscillator

Rev. 2 — 10 April 2013   **Product data sheet**

1. General description

The 74HC4060-Q100; 74HCT4060-Q100 are high-speed Si-gate CMOS devices that comply with JEDEC standard no. 7A. They are pin compatible with Low-power Schottky TTL (LSTTL).

The 74HC4060-Q100; 74HCT4060-Q100 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}.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Specified from −40 °C to +85 °C and from −40 °C to +125 °C
- All active components on chip
- RC or crystal oscillator configuration
- ESD protection:
  - MIL-STD-883, method 3015 exceeds 2000 V
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)
- Multiple package options

3. Applications

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

4. Ordering information

Table 1. Ordering information

| Type number	Package			Version
	Temperature range	**Name**	**Description**	
74HC4060D-Q100 74HCT4060D-Q100	−40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74HC4060DB-Q100 74HCT4060DB-Q100	−40 °C to +125 °C	SSOP16	plastic shrink small outline package; 16 leads; body width 5.3 mm	SOT338-1
74HC4060PW-Q100	−40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1
74HC4060BQ-Q100 74HCT4060BQ-Q100	−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

001aai467
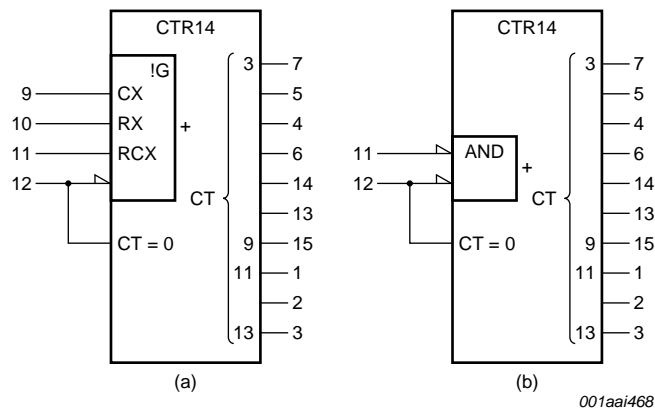
Fig 1. Logic symbol

001aai468
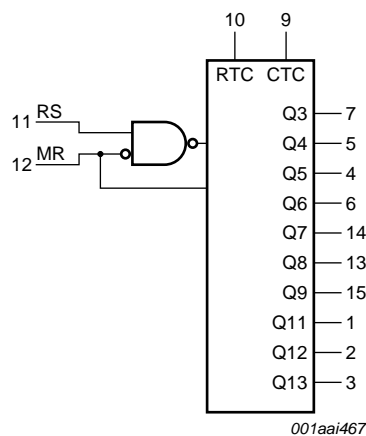
Fig 2. IEC logic symbol
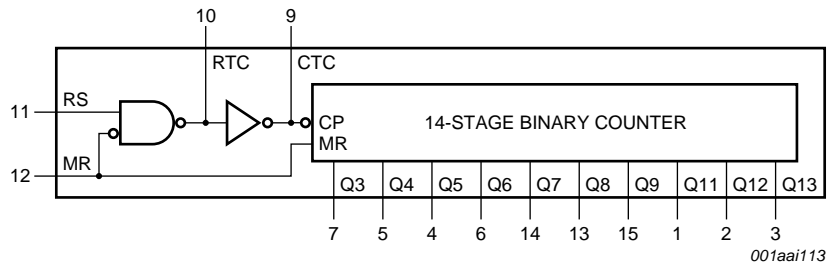
Fig 3. Functional diagram
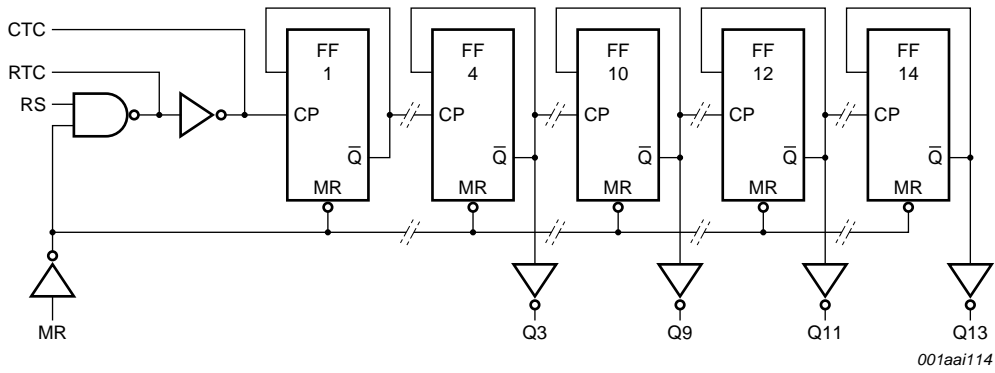
Fig 4. Logic diagram

6. Pinning information

6.1 Pinning

Fig 5. Pin configuration SO16 and (T)SSOP16

(1) The die substrate is attached to this pad using conductive die attach material. It cannot be used as supply pin or input.

Fig 6. Pin configuration DHVQFN16
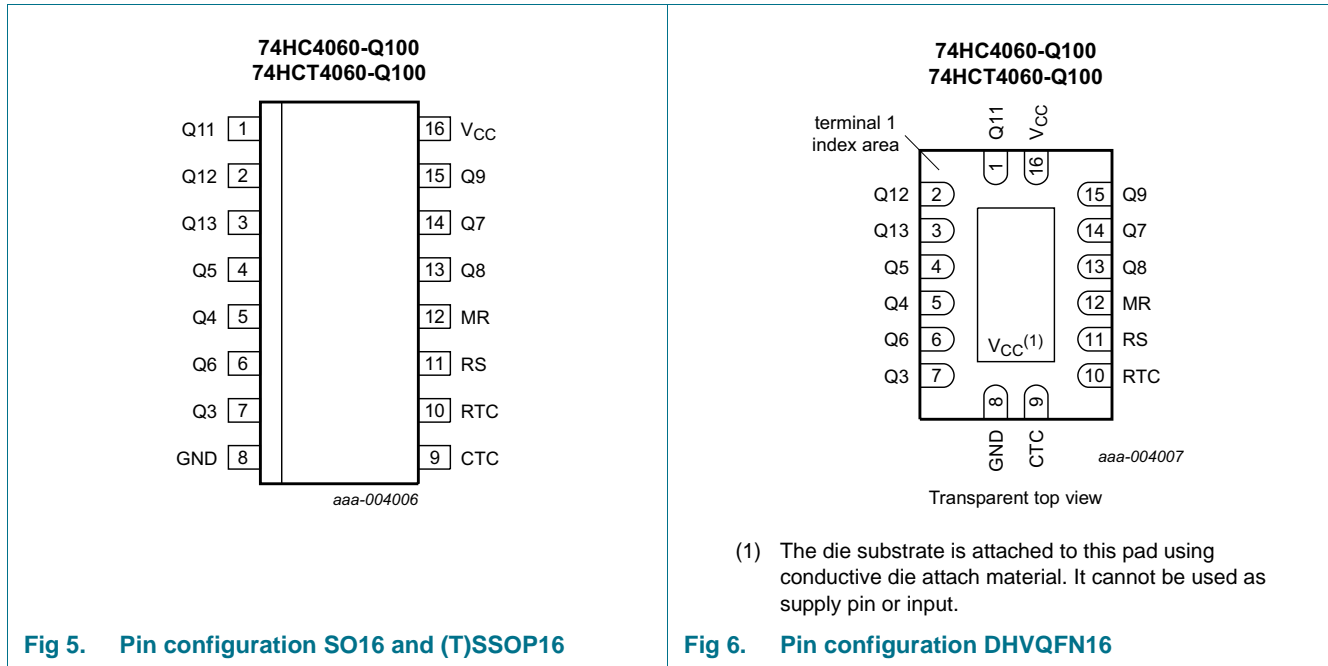
6.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
Q11 to Q13	1, 2, 3	counter output
Q3 to Q9	7, 5, 4, 6, 14, 13, 15	counter output
GND	8	ground (0 V)
CTC	9	external capacitor connection
RTC	10	external resistor connection
RS	11	clock input /oscillator pin
MR	12	master reset input (active HIGH)
V_{CC}	16	supply voltage

7. Functional description
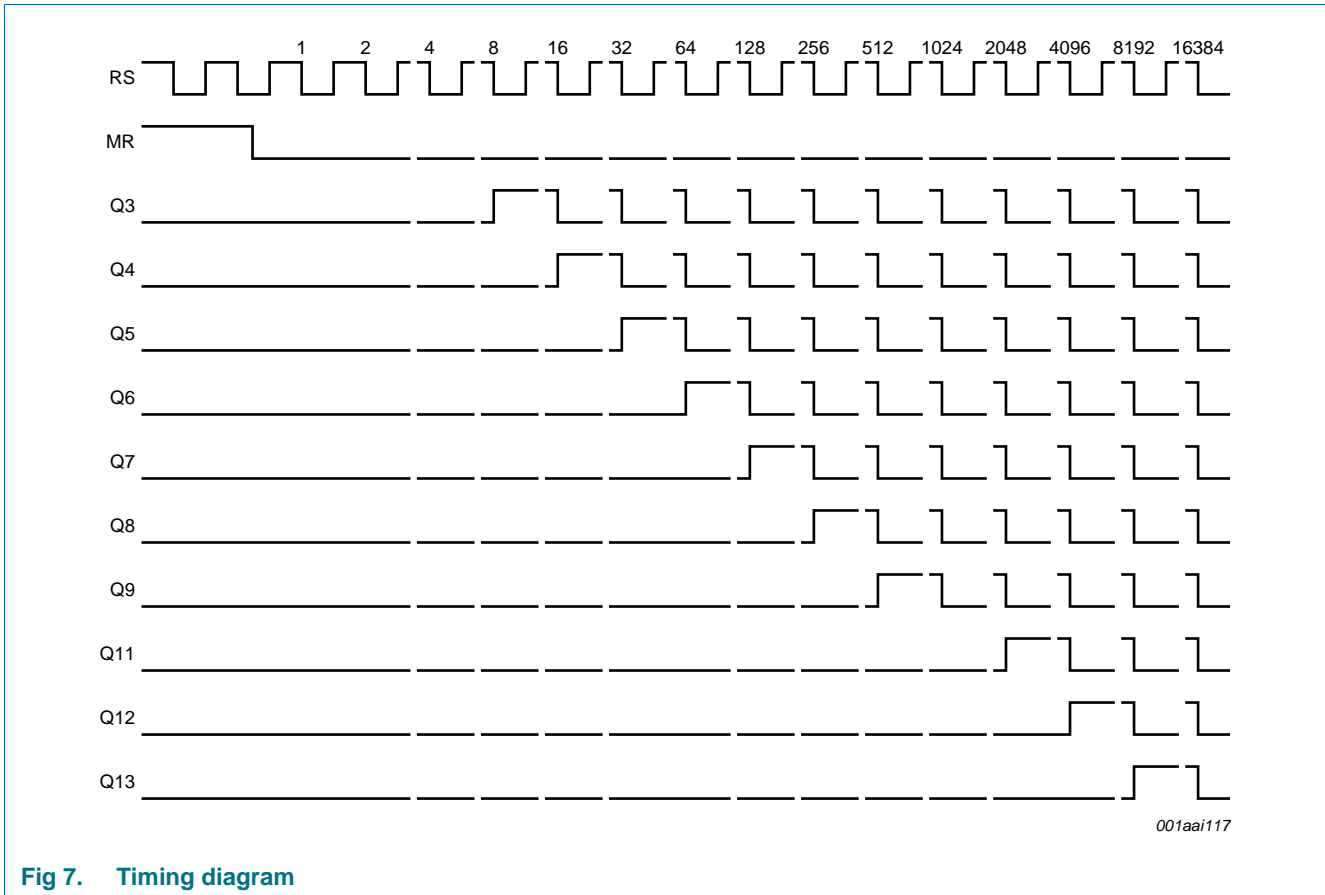
Fig 7. Timing diagram

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

74HC_HCT4060_Q100

Product data sheet

Rev. 2 — 10 April 2013

5 of 25

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				
		SO16 package	[2]	-	500	mW
		(T)SSOP16 package	[3]	-	500	mW
		DHVQFN16 package	[4]	-	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 8 mW/K above 70 °C.

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

[4] 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-Q100			74HCT4060-Q100			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
$\Delta t/\Delta V$	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-Q100										
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

74HC_HCT4060_Q100

All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2013. All rights reserved.

Product data sheet

Rev. 2 — 10 April 2013

6 of 25

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-Q100											
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

74HC_HCT4060_Q100

All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2013. All rights reserved.

Product data sheet

Rev. 2 — 10 April 2013

8 of 25

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
		$V_I = V_{IH}$ 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
V_{OL}	LOW-level output voltage	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-Q100, only input MR (pin 12) has TTL input switching levels.

11. Dynamic characteristics

Table 6.   **Dynamic characteristics**

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	
74HC4060-Q100										
t_{pd}	propagation delay	RS to Q3; see Figure 8 [1]								
		V_{CC} = 2.0 V	-	99	300	-	375	-	450	ns
		V_{CC} = 4.5 V	-	36	60	-	75	-	90	ns
		V_{CC} = 5.0 V; C_L = 15 pF	-	31	-	-	-	-	-	ns
		V_{CC} = 6.0 V	-	29	51	-	64	-	77	ns
		Qn to Qn+1; see Figure 9 [2]								
		V_{CC} = 2.0 V	-	22	80	-	100	-	120	ns
		V_{CC} = 4.5 V	-	8	16	-	20	-	24	ns
		V_{CC} = 5.0 V; C_L = 15 pF	-	6	-	-	-	-	-	ns
		V_{CC} = 6.0 V	-	6	14	-	17	-	20	ns
t_{PHL}	HIGH to LOW propagation delay	MR to Qn; see Figure 10								
		V_{CC} = 2.0 V	-	55	175	-	220	-	265	ns
		V_{CC} = 4.5 V	-	20	35	-	44	-	53	ns
		V_{CC} = 5.0 V; C_L = 15 pF	-	17	-	-	-	-	-	ns
		V_{CC} = 6.0 V	-	16	30	-	37	-	45	ns
t_t	transition time	Qn; see Figure 8 [3]								
		V_{CC} = 2.0 V	-	19	75	-	95	-	110	ns
		V_{CC} = 4.5 V	-	7	15	-	19	-	22	ns
		V_{CC} = 6.0 V	-	6	13	-	16	-	19	ns
t_W	pulse width	RS (HIGH or LOW); see Figure 8								
		V_{CC} = 2.0 V	80	17	-	100	-	120	-	ns
		V_{CC} = 4.5 V	16	6	-	20	-	24	-	ns
		V_{CC} = 6.0 V	14	5	-	17	-	20	-	ns
		MR (HIGH); see Figure 10								
		V_{CC} = 2.0 V	80	25	-	100	-	120	-	ns
		V_{CC} = 4.5 V	16	9	-	20	-	24	-	ns
		V_{CC} = 6.0 V	14	7	-	17	-	20	-	ns
t_{rec}	recovery time	MR to RS; see Figure 10								
		V_{CC} = 2.0 V	100	28	-	125	-	150	-	ns
		V_{CC} = 4.5 V	20	10	-	25	-	30	-	ns
		V_{CC} = 6.0 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-Q100											
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]   Qn+1 is the next Qn output.

[3] t_t is the same as t_{THL} and t_{TLH}.

[4] C_{PD} is used to determine the dynamic power dissipation (P_D in μW):

$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ 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;

$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.
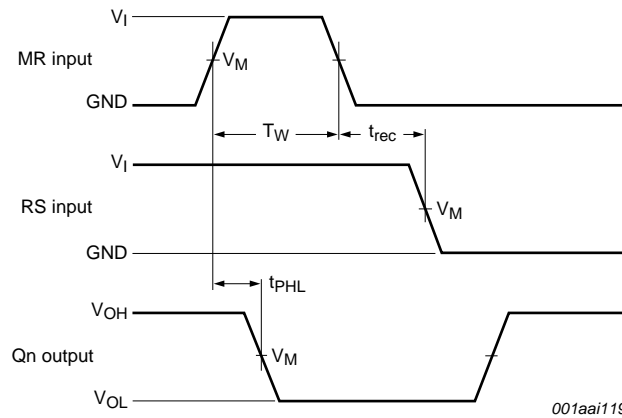
12. Waveforms
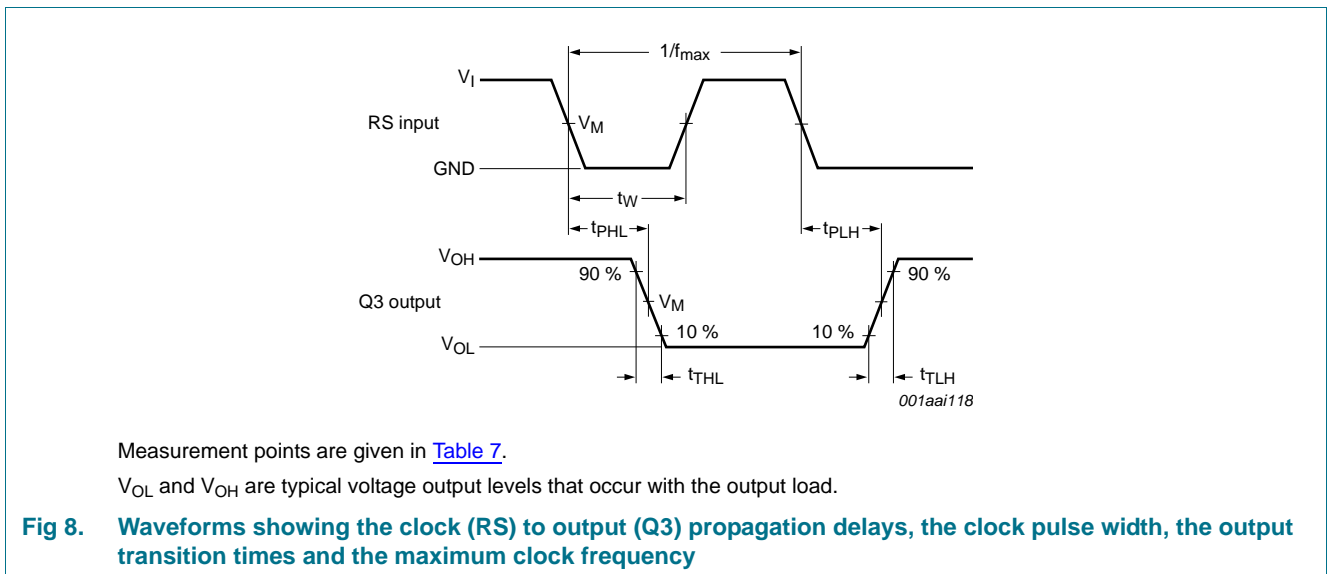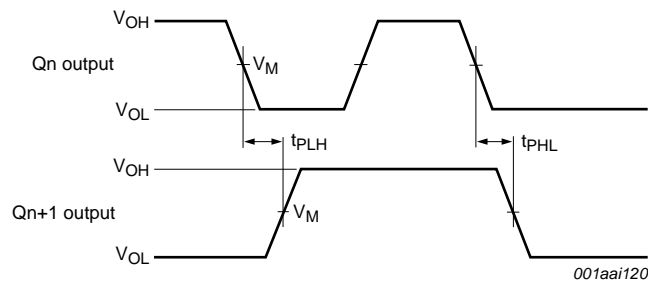
Measurement points are given in Table 7.

V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig 8.   Waveforms showing the clock (RS) to output (Q3) propagation delays, the clock pulse width, the output transition times and the maximum clock frequency

Measurement points are given in Table 7.

V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

**Fig 9.   Waveforms showing the output Qn to output Qn+1 propagation delays**

Measurement points are given in Table 7.

V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig 10.   Waveforms showing the master reset (MR) pulse width, the master reset to output (Qn) propagation delays and the master reset to clock (RS) recovery time

Table 7.   Measurement points

Type	Input	Output
	V_M	V_M
74HC4060-Q100	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
74HCT4060-Q100	1.3 V	1.3 V

74HC_HCT4060_Q100

Product data sheet   **Rev. 2 — 10 April 2013**   **13 of 25**
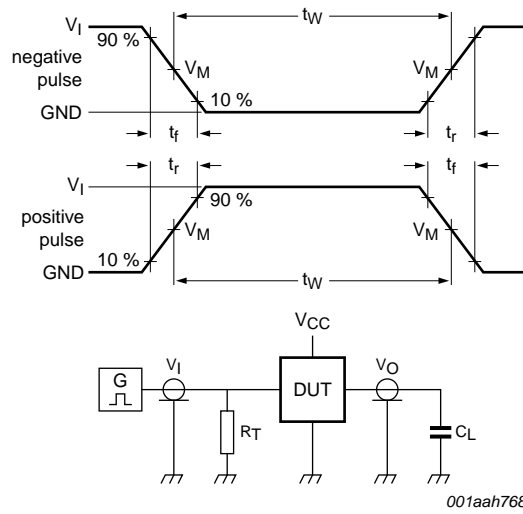
Test data is given in Table 8.

Definitions test circuit:

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

C_L = Load capacitance including jig and probe capacitance.

Fig 11. Test circuit for measuring switching times

Table 8.   Test data

Type	Input			Load
	V_I	t_r, t_f		C_L
74HC4060-Q100	V_{CC}	6 ns		15 pF, 50 pF
74HCT4060-Q100	3 V	6 ns		15 pF, 50 pF

74HC_HCT4060_Q100

Product data sheet

Rev. 2 — 10 April 2013

14 of 25

13. RC oscillator

13.1 Timing component limitations

The oscillator frequency is mainly determined by R_tC_t, provided $R2 \approx 2R_t$ and $R2C2 \ll R_tC_t$. The function of R2 is to minimize the influence of the forward voltage across the input protection diodes on the frequency. The stray capacitance C2 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 ON resistance in series with it, which typically is 280 Ω at V_{CC} = 2.0 V, 130 Ω at V_{CC} = 4.5 V and 100 Ω at V_{CC} = 6.0 V.

Typical formula for oscillator frequency: $f_{osc} = \dfrac{1}{2.5 \times R_t \times C_t}$
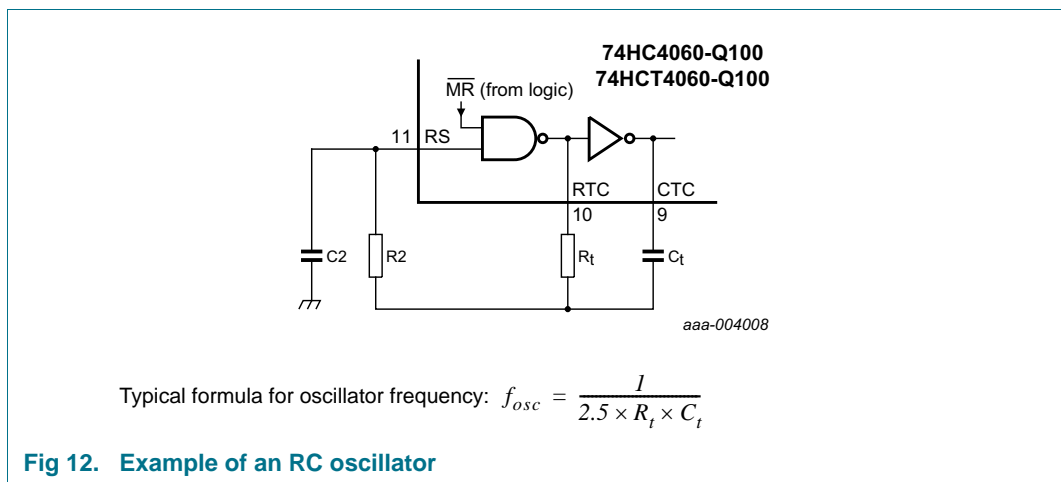
Fig 12. Example of an RC oscillator

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

C_t > 50 pF, up to any practical value and 10 kΩ < R_t < 1 MΩ.

In order to avoid start-up problems, $R_t \geq$ 1 kΩ.

13.2 Typical crystal oscillator circuit

In Figure 13, R2 is the power limiting resistor. For starting and maintaining oscillation, a minimum transconductance is necessary, so R2 must not be too large. A practical value for R2 is 2.2 kΩ.

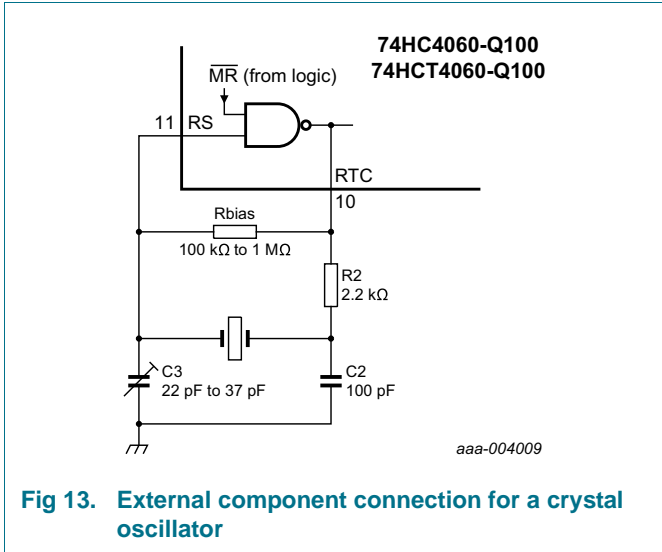**Fig 13.** External component connection for a crystal oscillator

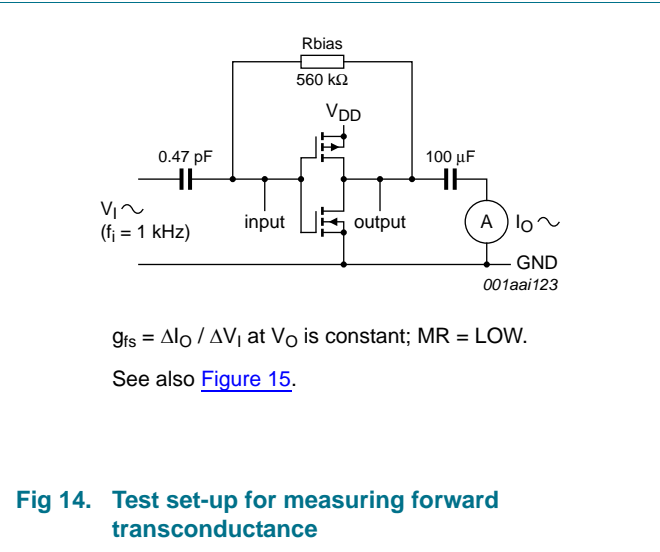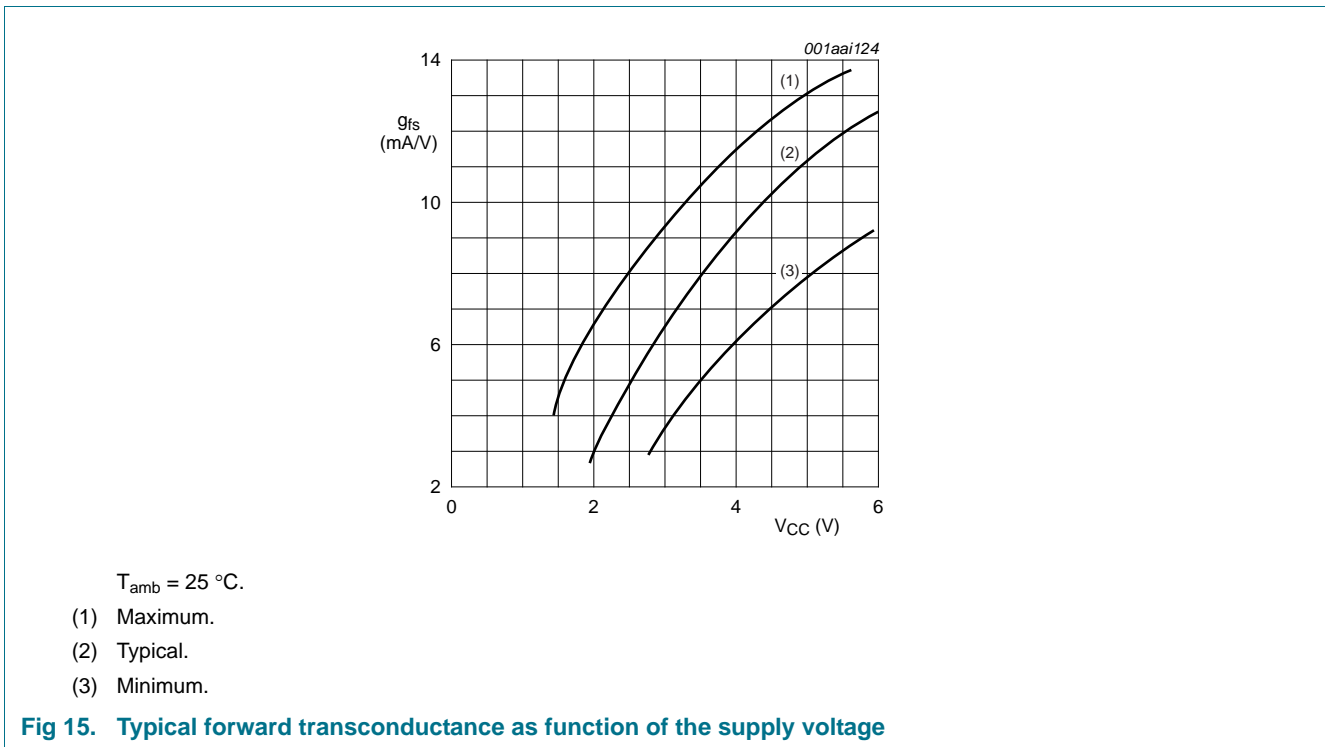**Fig 14.** Test set-up for measuring forward transconductance

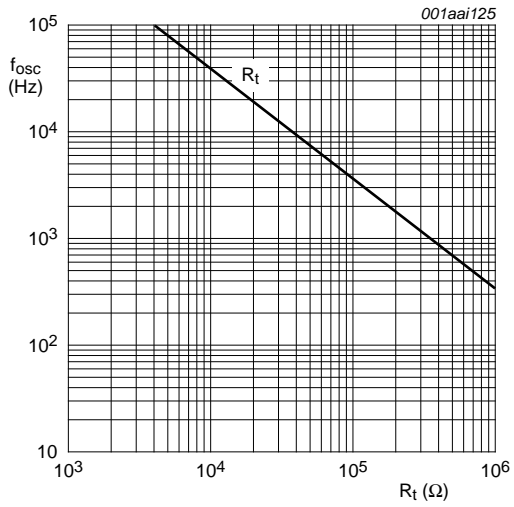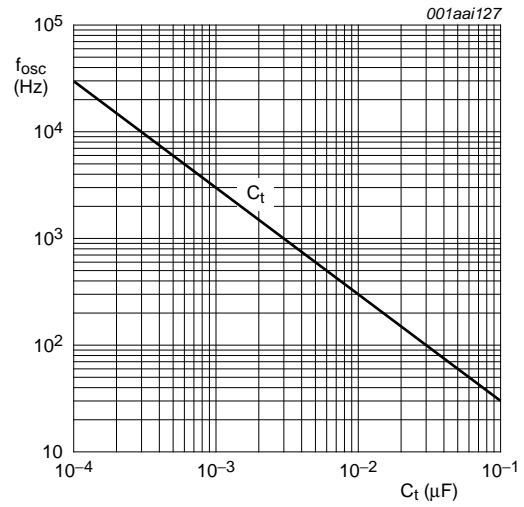$g_{fs} = \Delta I_O / \Delta V_I$ at V_O is constant; MR = LOW.

See also Figure 15.

$T_{amb} = 25\ °C$.

(1) Maximum.

(2) Typical.

(3) Minimum.

Fig 15. Typical forward transconductance as function of the supply voltage

V_{CC} = 2.0 V to 6.0 V; T_{amb} = 25 °C.

For R_t curve: C_t = 1 nF; R2 = 2 × R_t.

Fig 16. RC oscillator frequency as a function of R_t

V_{CC} = 2.0 V to 6.0 V; T_{amb} = 25 °C.

For C_t curve: R_t = 100 kΩ; R2 = 200 kΩ.

Fig 17. RC oscillator frequency as a function of C_t

74HC_HCT4060_Q100

All information provided in this document is subject to legal disclaimers.

Product data sheet

Rev. 2 — 10 April 2013

17 of 25

14. Package outline

SO16: plastic small outline package; 16 leads; body width 3.9 mm **SOT109-1**

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

UNIT	A max.	A₁	A₂	A₃	bₚ	c	D[1]	E[1]	e	Hₑ	L	Lₚ	Q	v	w	y	Z[1]	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.39 0.38	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 0.012	

Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

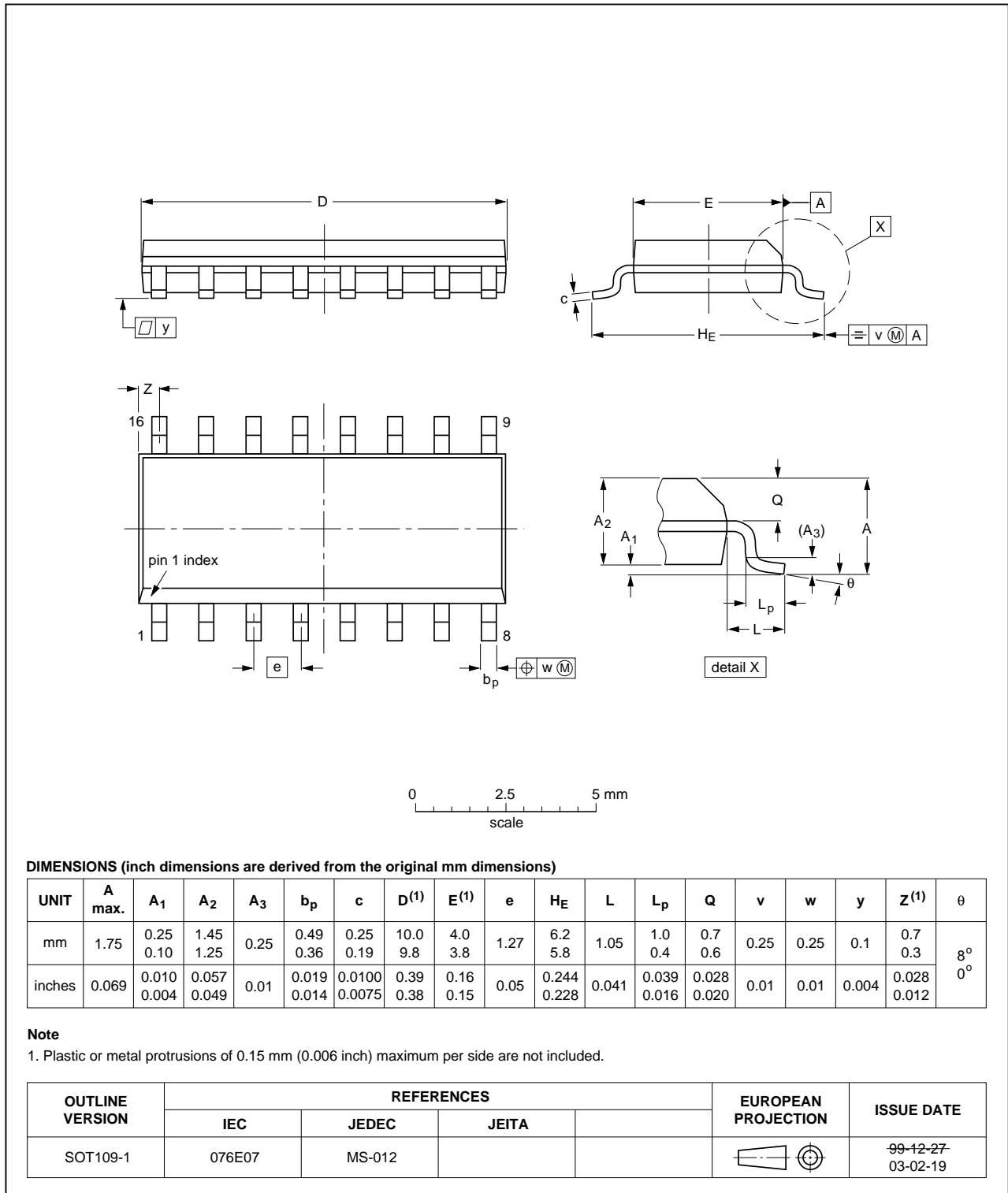| OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT109-1	076E07	MS-012				~~99-12-27~~ 03-02-19

Fig 18. Package outline SOT109-1 (SO16)

SSOP16: plastic shrink small outline package; 16 leads; body width 5.3 mm

SOT338-1

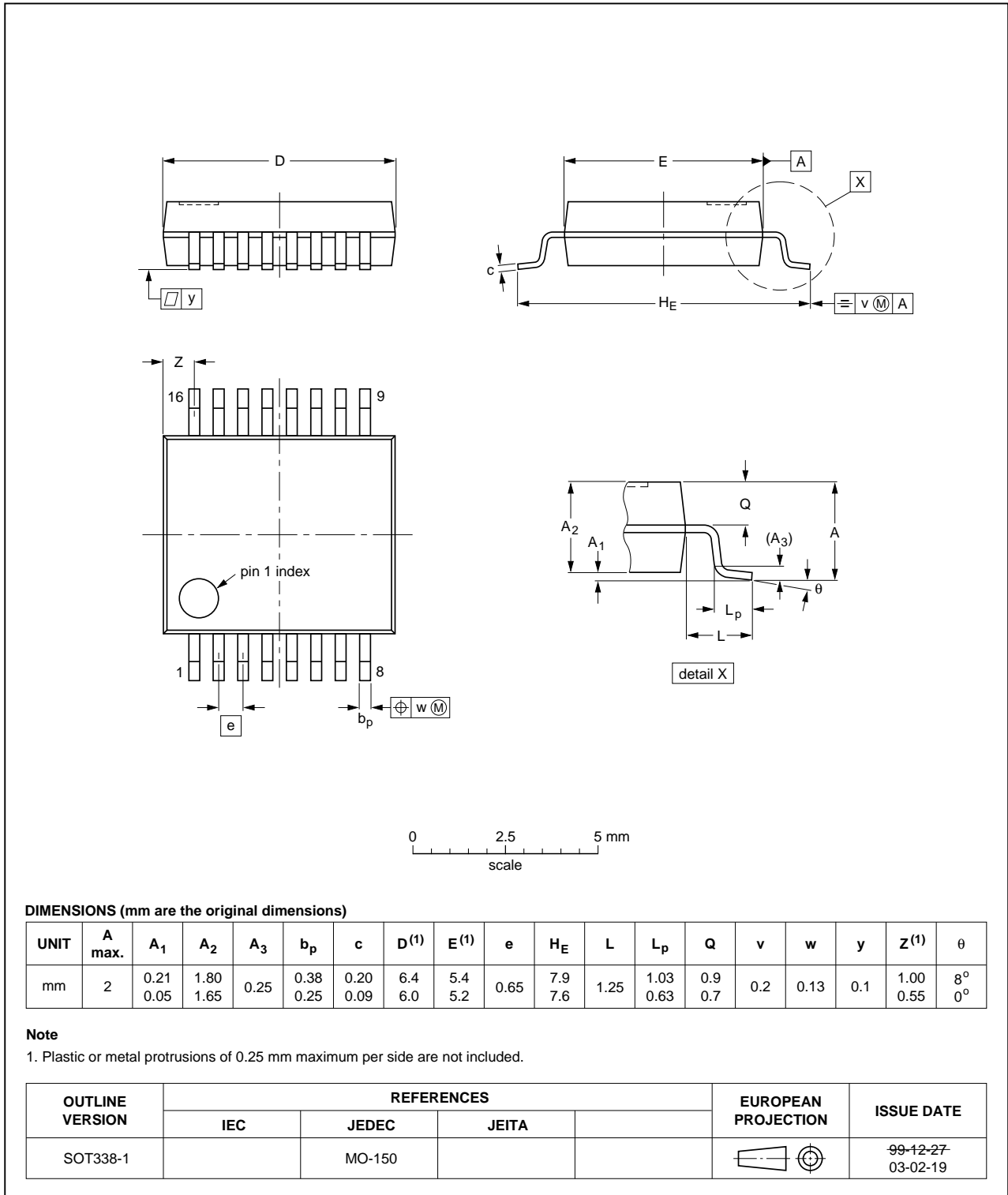**DIMENSIONS (mm are the original dimensions)**

UNIT	A max.	A₁	A₂	A₃	b_p	c	D(1)	E(1)	e	H_E	L	L_p	Q	v	w	y	Z(1)	θ
mm	2	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	6.4 6.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	1.00 0.55	8° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT338-1		MO-150				~~99-12-27~~ 03-02-19

Fig 19. Package outline SOT338-1 (SSOP16)

74HC_HCT4060_Q100

Product data sheet

Rev. 2 — 10 April 2013

19 of 25

TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm   **SOT403-1**

DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A₁	A₂	A₃	bₚ	c	D (1)	E (2)	e	H_E	L	Lₚ	Q	v	w	y	Z (1)	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	5.1 4.9	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.40 0.06	8° 0°

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT403-1		MO-153				~~99-12-27~~ 03-02-18

Fig 20. Package outline SOT403-1 (TSSOP16)

DHVQFN16: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 x 3.5 x 0.85 mm   **SOT763-1**

DIMENSIONS (mm are the original dimensions)

UNIT	A(1) max.	A₁	b	c	D(1)	Dₕ	E(1)	Eₕ	e	e₁	L	v	w	y	y₁
mm	1	0.05 0.00	0.30 0.18	0.2	3.6 3.4	2.15 1.85	2.6 2.4	1.15 0.85	0.5	2.5	0.5 0.3	0.1	0.05	0.05	0.1

Note

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT763-1	- - -	MO-241	- - -			~~02-10-17~~ 03-01-27
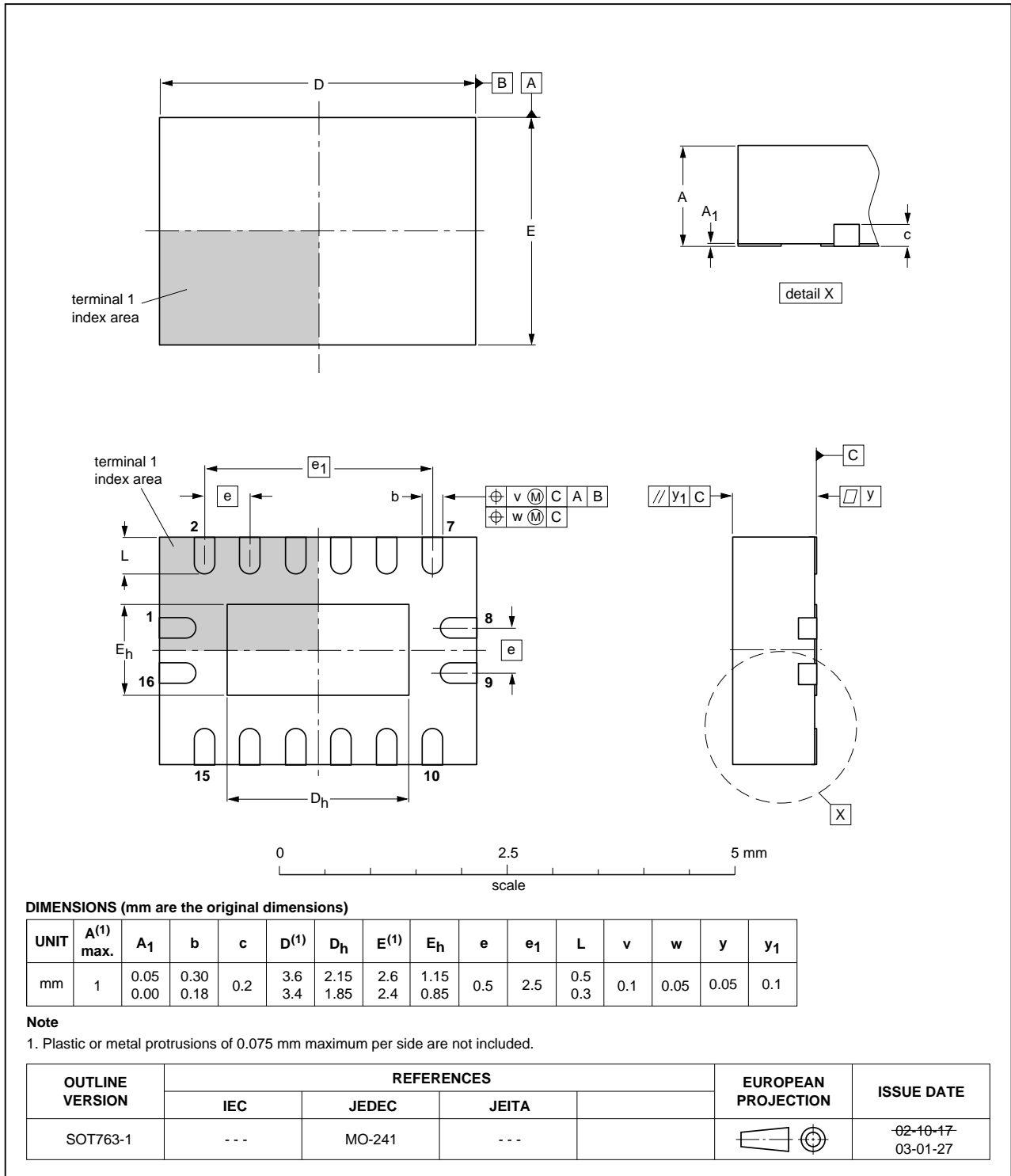
Fig 21. Package outline SOT763-1 (DHVQFN16)

15. Abbreviations

Table 9. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
TTL	Transistor-Transistor Logic
MIL	Military

16. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT4060_Q100 v.2	20130410	Product data sheet	-	74HC_HCT4060_Q100 v.1
Modifications:	• 74HC4060DB-Q100 and 74HCT4060DB-Q100 added.			
74HC_HCT4060_Q100 v.1	20120802	Product data sheet	-	-

74HC_HCT4060_Q100

Product data sheet

Rev. 2 — 10 April 2013

22 of 25

17. Legal information

17.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

17.2 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between NXP Semiconductors and its customer, unless NXP Semiconductors and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the NXP Semiconductors product is deemed to offer functions and qualities beyond those described in the Product data sheet.

17.3 Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. NXP Semiconductors takes no responsibility for the content in this document if provided by an information source outside of NXP Semiconductors.

In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the *Terms and conditions of commercial sale* of NXP Semiconductors.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use in automotive applications — This NXP Semiconductors product has been qualified for use in automotive applications. Unless otherwise agreed in writing, the product is not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors and its suppliers accept no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). NXP does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nxp.com/profile/terms, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NXP Semiconductors hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NXP Semiconductors products by customer.

74HC_HCT4060_Q100

All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2013. All rights reserved.

Product data sheet

Rev. 2 — 10 April 2013

23 of 25

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Translations — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

17.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

18. Contact information

For more information, please visit: **http://www.nxp.com**

For sales office addresses, please send an email to: **salesaddresses@nxp.com**

74HC_HCT4060_Q100

All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2013. All rights reserved.

Product data sheet

Rev. 2 — 10 April 2013

24 of 25

19. Contents