74HC4060; 74HCT4060
14-stage binary ripple counter with oscillator
Rev. 6 — 7 September 2021　　　　　　　　　　**Product data sheet**

1. General description

The 74HC4060; 74HCT4060 is a 14-stage ripple-carry counter/divider and oscillator with three oscillator terminals (RS, RTC and CTC), ten buffered parallel 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 oscillator pins (RTC and CTC) floating. The counter advances on the HIGH-to-LOW transition of RS. A HIGH level on MR clears all counter stages and forces all outputs LOW, independent of the other input conditions. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC}.

2. Features and benefits

- Wide supply voltage range from 2.0 to 6.0 V
- CMOS low power dissipation
- High noise immunity
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- All active components on chip
- RC or crystal oscillator configuration
- Input levels:
  - For 74HC4060: CMOS level
  - For 74HCT4060: TTL level
- Complies with JEDEC standards:
  - JESD8C (2.7 V to 3.6 V)
  - JESD7A (2.0 V to 6.0 V)
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

3. Applications

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

nexperia

4. Ordering information

Table 1. Ordering information

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

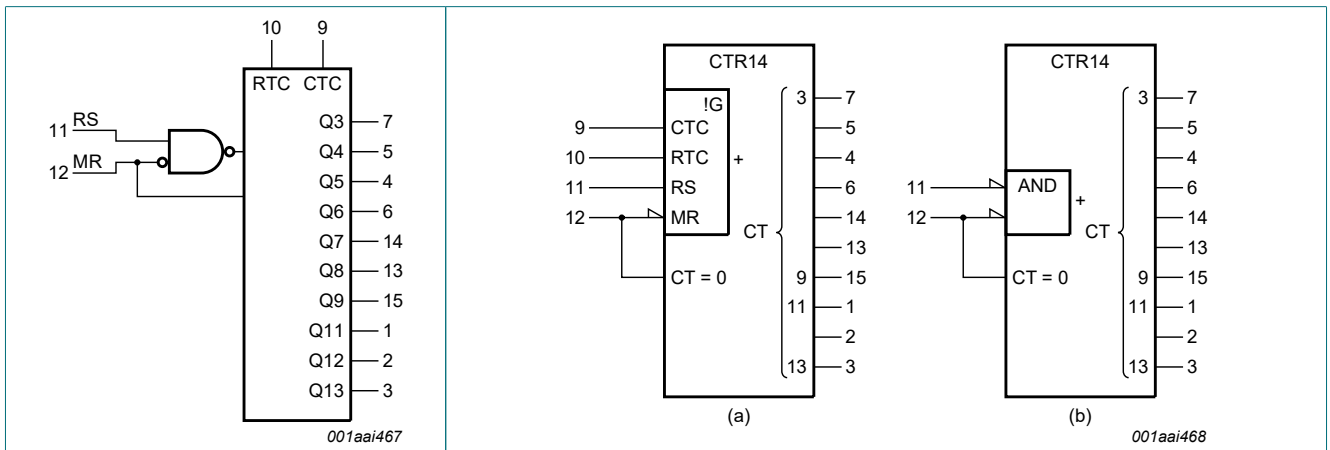# 5. Functional diagram

Fig. 1.   Logic symbol

Fig. 2.   IEC logic symbol
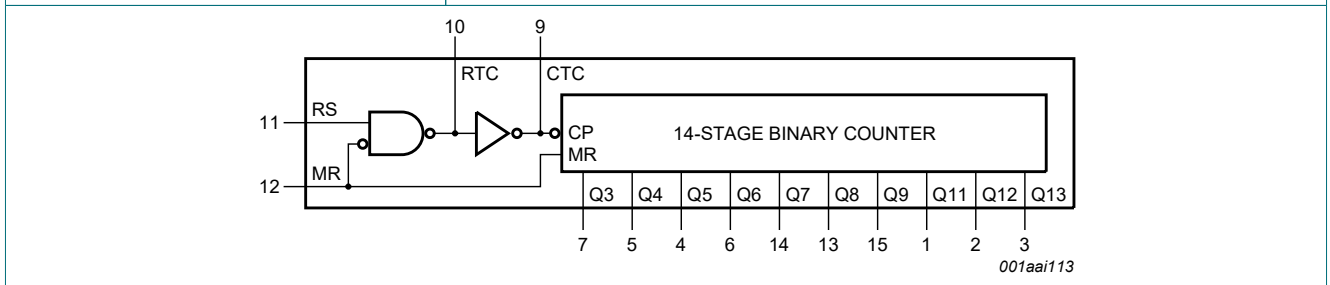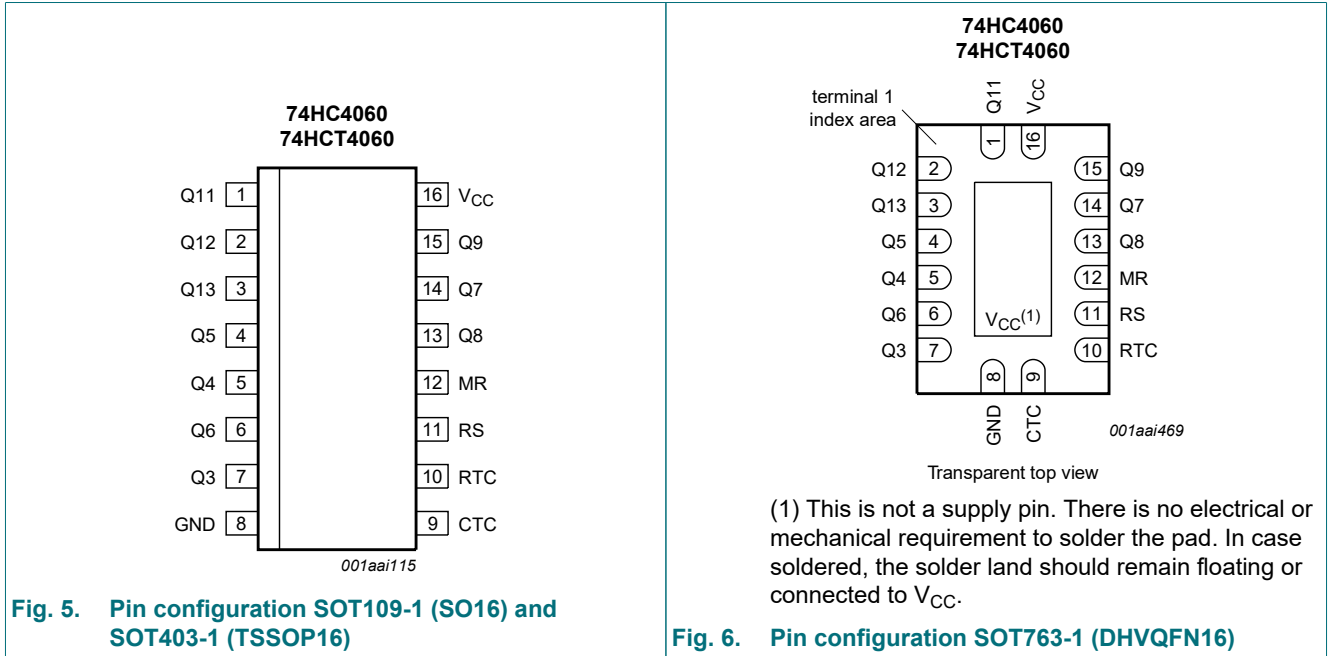

Fig. 3.   Functional diagram
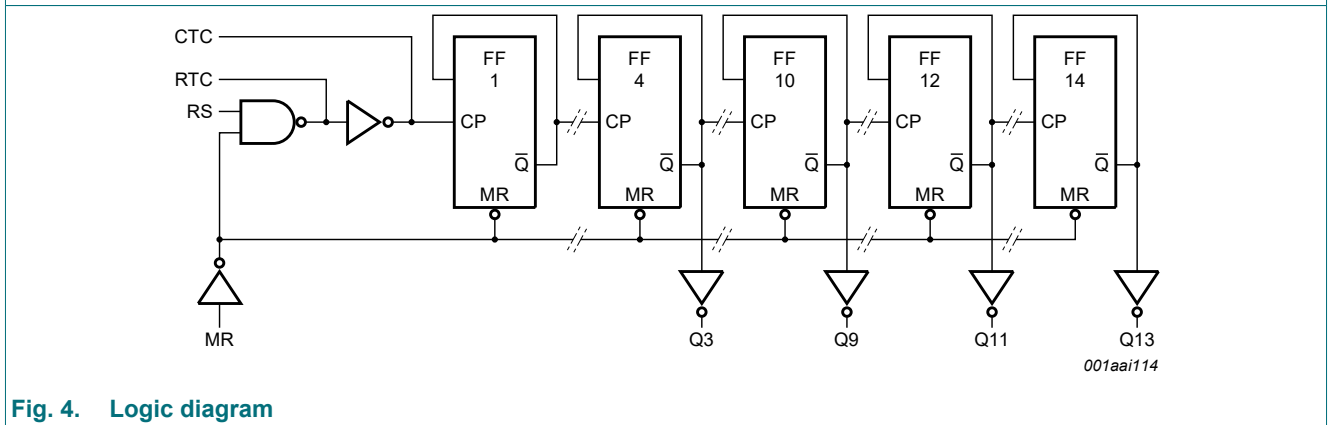
Fig. 4.   Logic diagram

6. Pinning information

6.1. Pinning

74HC4060
74HCT4060

Q11 1 | 16 V$_{CC}$
Q12 2 | 15 Q9
Q13 3 | 14 Q7
Q5 4 | 13 Q8
Q4 5 | 12 MR
Q6 6 | 11 RS
Q3 7 | 10 RTC
GND 8 | 9 CTC

001aai115

Fig. 5. **Pin configuration SOT109-1 (SO16) and SOT403-1 (TSSOP16)**

74HC4060
74HCT4060

terminal 1 index area

Q11 (1) | V$_{CC}$ (16)
Q12 (2) | (15) Q9
Q13 (3) | (14) Q7
Q5 (4) | (13) Q8
Q4 (5) | (12) MR
Q6 (6) | (11) RS
Q3 (7) | (10) RTC

V$_{CC}$(1)

GND (8) | CTC (9)

001aai469

Transparent top view

(1) This is not a supply pin. There is no electrical or mechanical requirement to solder the pad. In case soldered, the solder land should remain floating or connected to V$_{CC}$.

Fig. 6. **Pin configuration SOT763-1 (DHVQFN16)**

6.2. Pin description

Table 2. Pin description

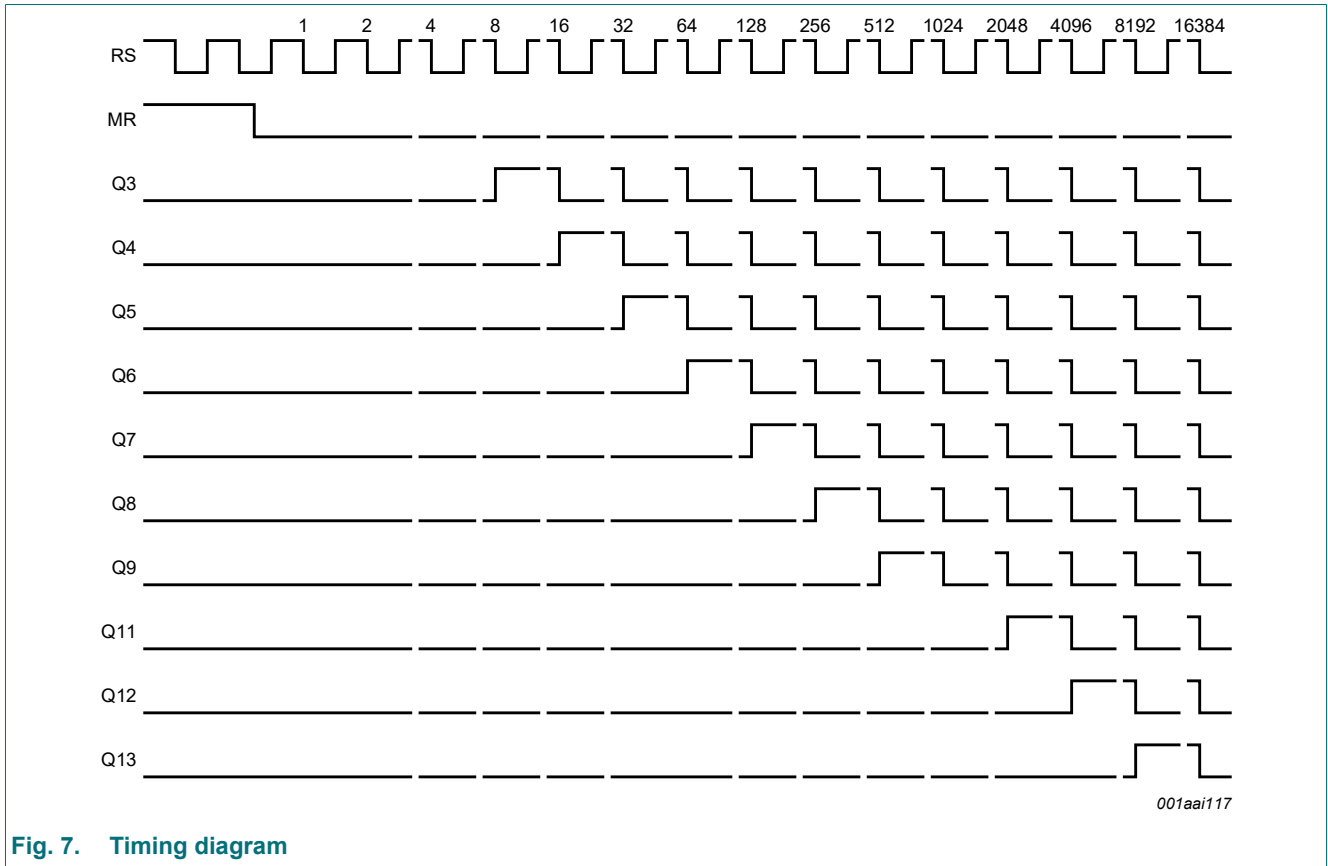| Symbol	Pin	Description
Q11, Q12, Q13	1, 2, 3	counter output
Q3, Q4, Q5, Q6, Q7, Q8, Q9	7, 5, 4, 6, 14, 13, 15	counter output
GND	8	ground (0 V)
CTC	9	external capacitor connection
RTC	10	external resistor connection
RS	11	clock input /oscillator pin
MR	12	master reset input (active HIGH)
V$_{CC}$	16	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
P_{tot}	total power dissipation	T_{amb} = -40 °C to +125 °C	[2]	-	500	mW

[1]   The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
[2]   For SOT109-1 (SO16) package: P_{tot} derates linearly with 12.4 mW/K above 110 °C.
　　　For SOT403-1 (TSSOP16) package: P_{tot} derates linearly with 8.5 mW/K above 91 °C.
　　　For SOT763-1 (DHVQFN16) package: P_{tot} derates linearly with 11.2 mW/K above 106 °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
$\Delta t/\Delta V$	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										
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
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

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 = 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
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

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
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
		RS input; V_{CC} = 4.5 V	3.6	-	-	3.6	-	3.6	-	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
		RS input; V_{CC} = 4.5 V	-	-	0.9	-	0.9	-	0.9	V
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, only input MR (pin 12) has TTL input switching levels.

74HC_HCT4060

Product data sheet   **Rev. 6 — 7 September 2021**   7 / 19

11. Dynamic characteristics

Table 6. Dynamic characteristics

GND = 0 V; C_L = 50 pF unless otherwise specified; for test circuit see Fig. 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 Fig. 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 Fig. 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 Fig. 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 Fig. 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 Fig. 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 Fig. 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 Fig. 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

74HC_HCT4060

Product data sheet **Rev. 6 — 7 September 2021** 8 / 19

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 Fig. 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 Fig. 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 Fig. 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 Fig. 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 Fig. 8	[3]								
		V_{CC} = 4.5 V		-	7	15	-	19	-	22	ns
t_W	pulse width	RS (HIGH or LOW); see Fig. 8									
		V_{CC} = 4.5 V		16	6	-	20	-	24	-	ns
		MR (HIGH); see Fig. 10									
		V_{CC} = 4.5 V		16	6	-	20	-	24	-	ns
t_{rec}	recovery time	MR to RS; see Fig. 10									
		V_{CC} = 4.5 V		26	13	-	33	-	39	-	ns
f_{max}	maximum frequency	RS; see Fig. 8									
		V_{CC} = 4.5 V		30	80	-	24	-	20	-	MHz
		V_{CC} = 5.0 V; C_L = 15 pF		-	88	-	-	-	-	-	MHz
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;

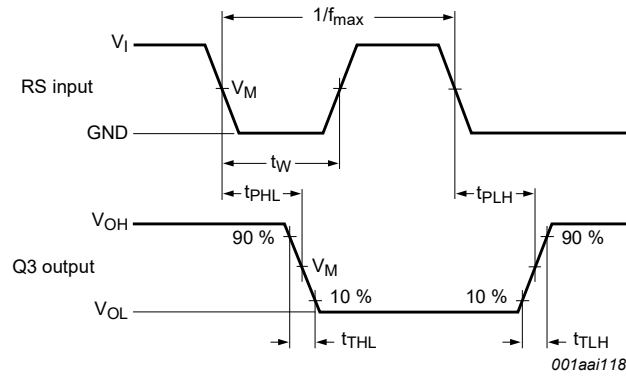f_o = output frequency in MHz;

C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

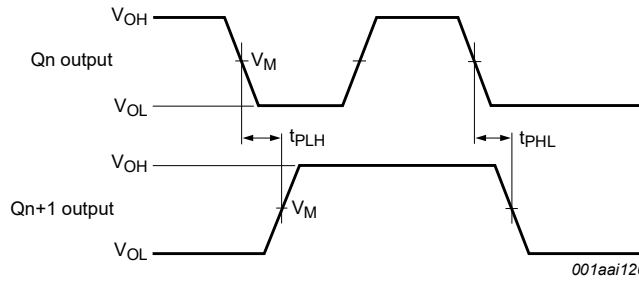$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

11.1. Waveforms and test circuit

Measurement points are given in Table 7.

V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.
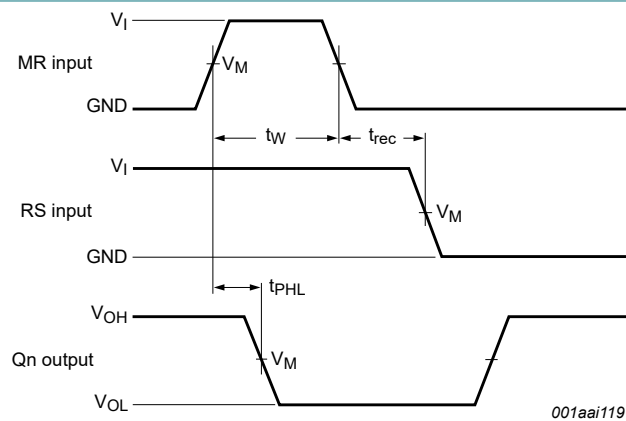
Fig. 8. Waveforms showing the clock (RS) to output (Q3) propagation delays, the clock pulse width, the output transition times and the maximum clock frequency

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	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
74HCT4060	1.3 V	1.3 V

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.
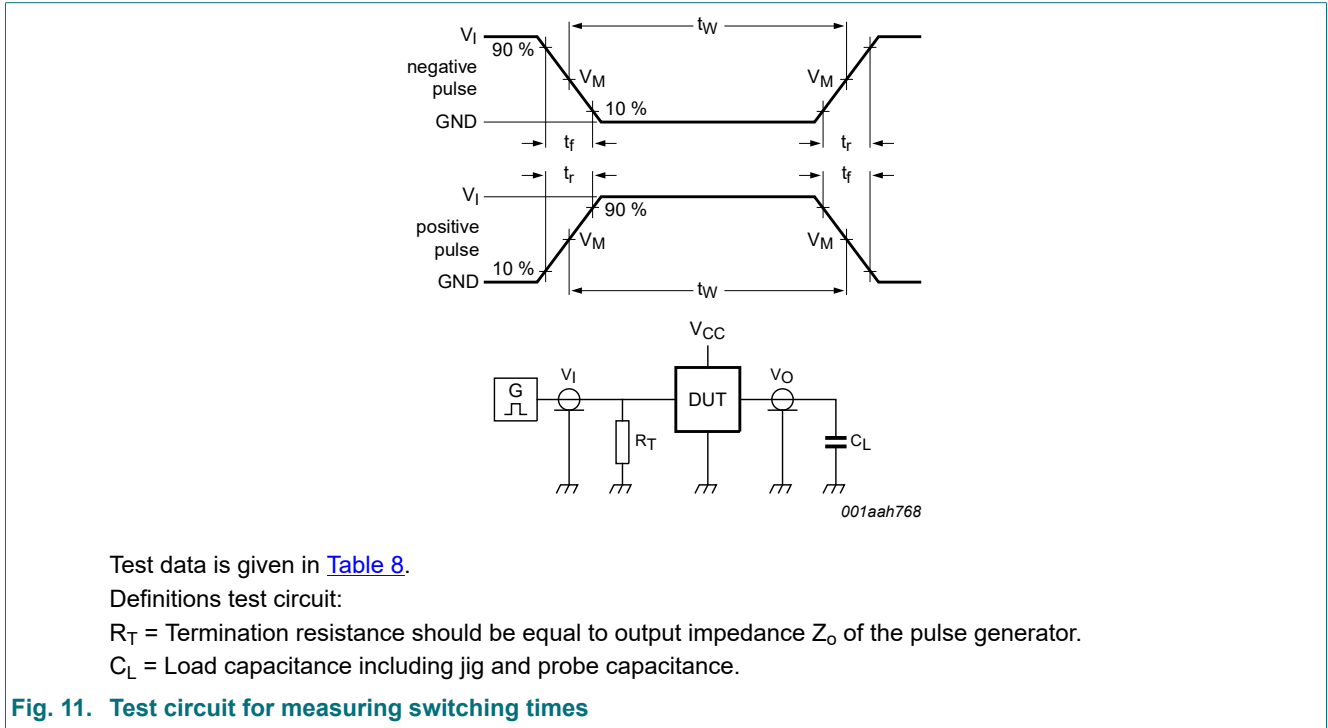
Fig. 11. Test circuit for measuring switching times

Table 8. Test data

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

12. RC oscillator

12.1. Timing component limitations

The oscillator frequency is mainly determined by R_tC_t, provided $R2 \approx 2R_t$ and $R2C2 << R_tC_t$. 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.

74HC_HCT4060

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

© Nexperia B.V. 2021. All rights reserved

Product data sheet

Rev. 6 — 7 September 2021

11 / 19

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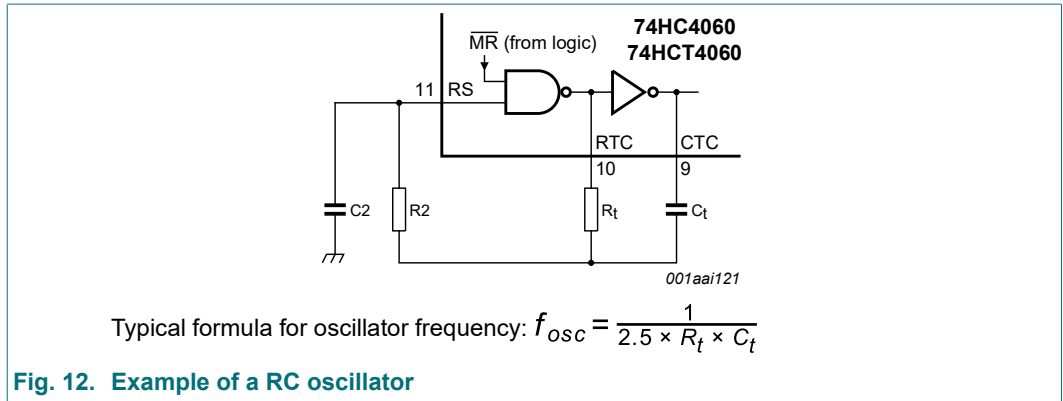
Fig. 12. Example of a RC oscillator

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 ≥ 1 kΩ.

12.2. Typical crystal oscillator circuit

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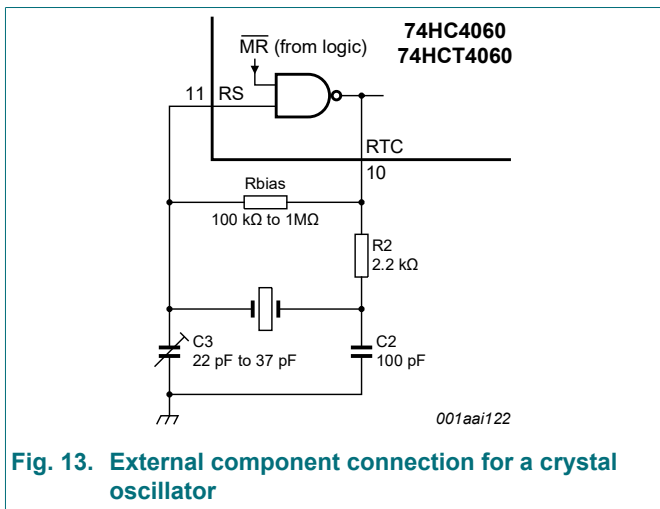

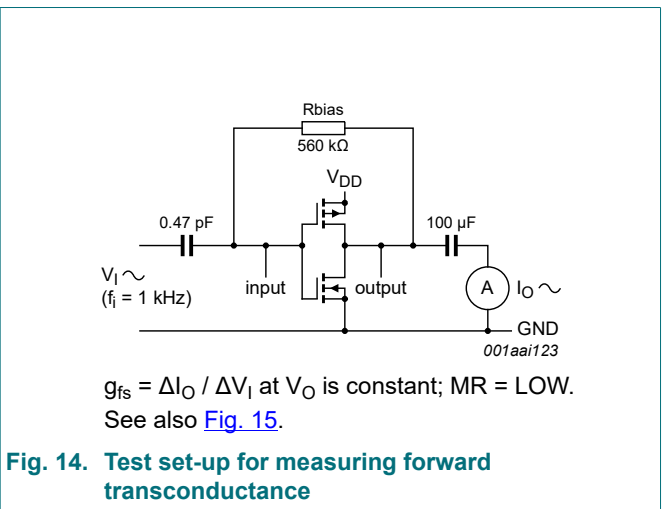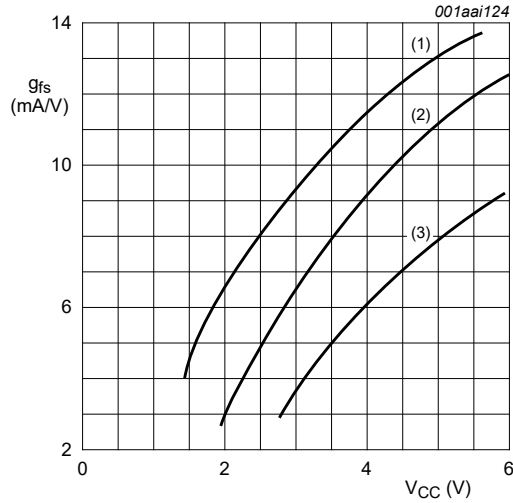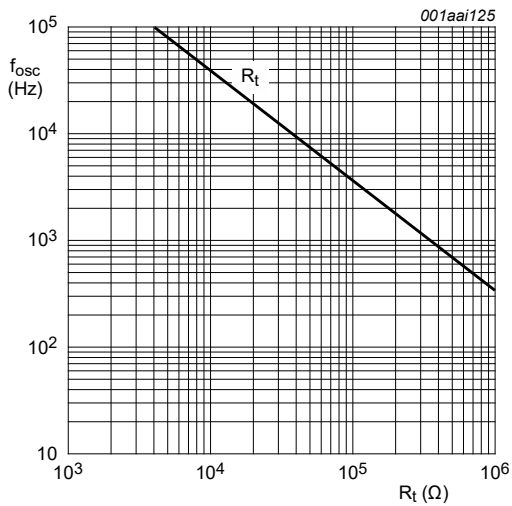**Fig. 13. External component connection for a crystal oscillator**

$g_{fs} = \Delta I_O / \Delta V_I$ at V_O is constant; MR = LOW. See also Fig. 15.
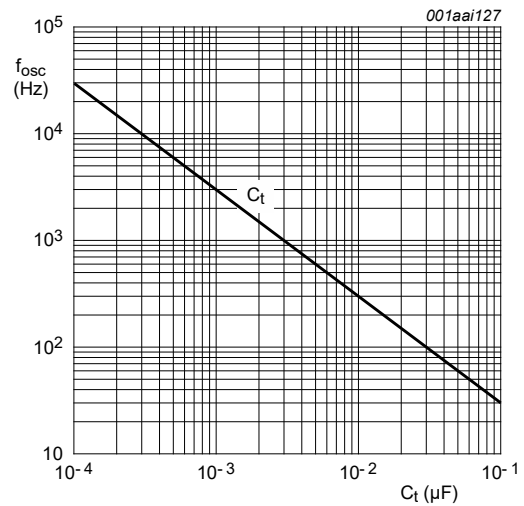
Fig. 14. Test set-up for measuring forward transconductance

(1) Maximum.
(2) Typical.
(3) Minimum.
T_{amb} = 25 °C.

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

Product data sheet

Rev. 6 — 7 September 2021

13 / 19

13. 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.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	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.

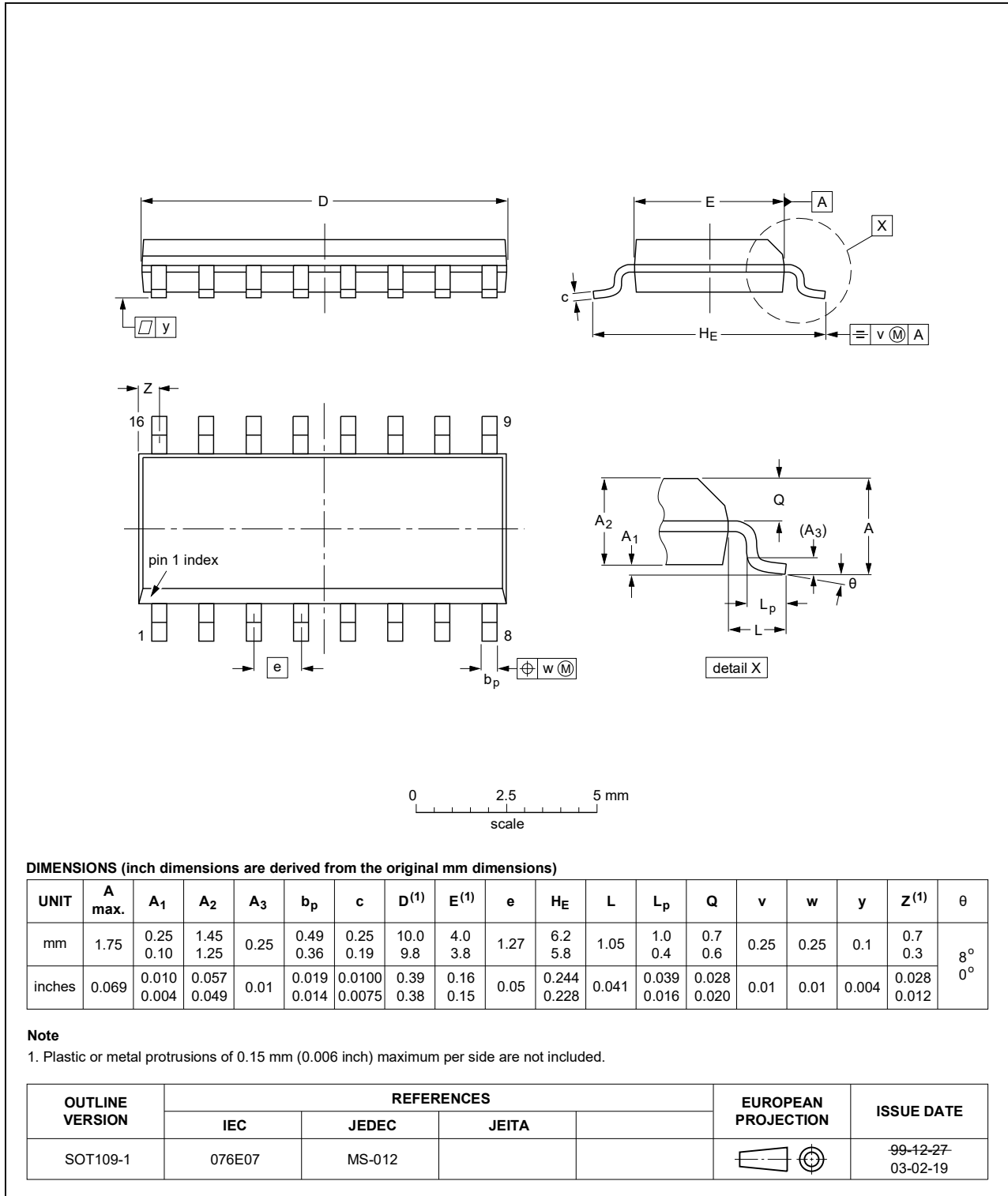| OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT109-1	076E07	MS-012				~~99-12-27~~ 03-02-19

Fig. 18. Package outline SOT109-1 (SO16)

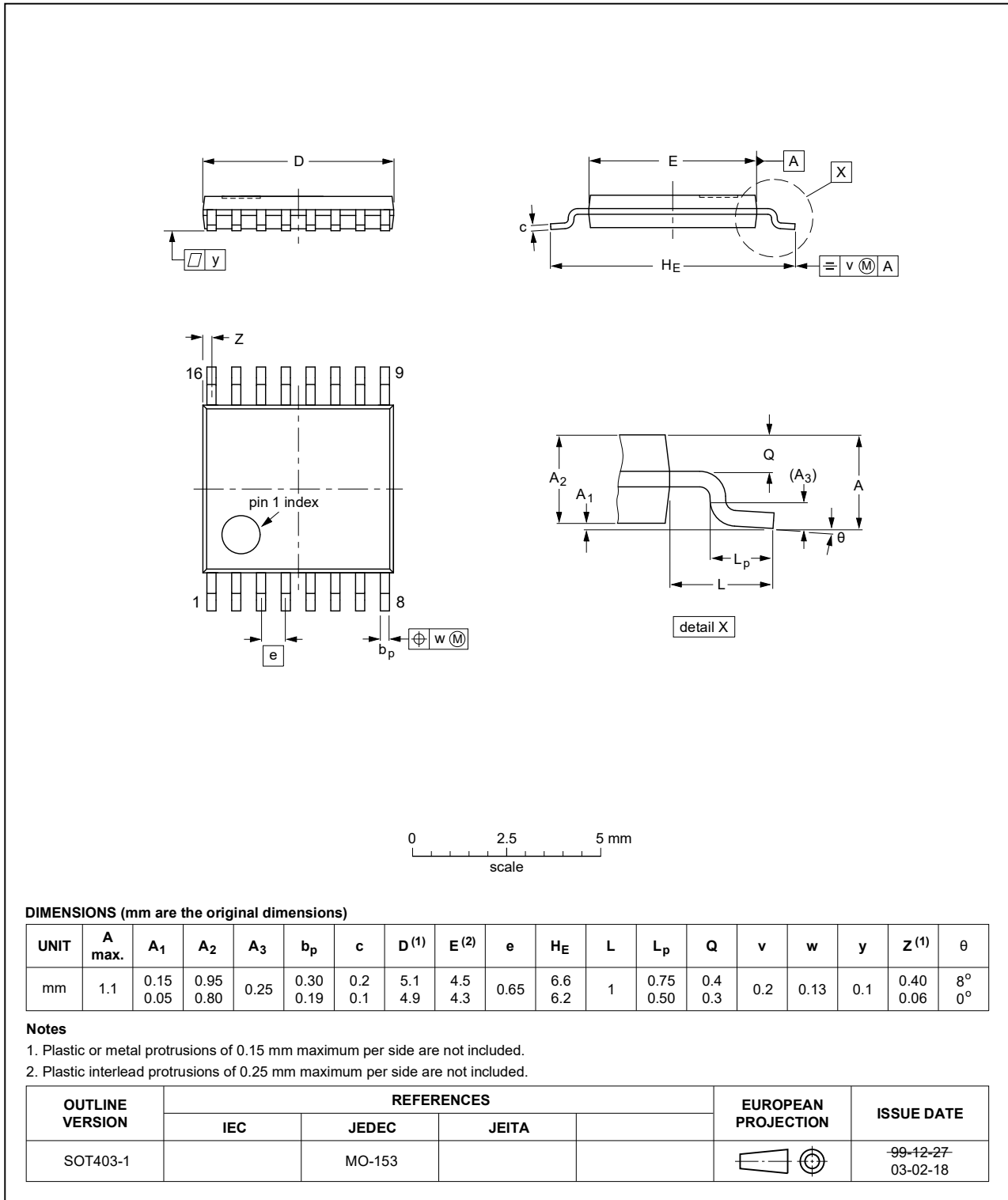**TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm**

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. 19. 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**
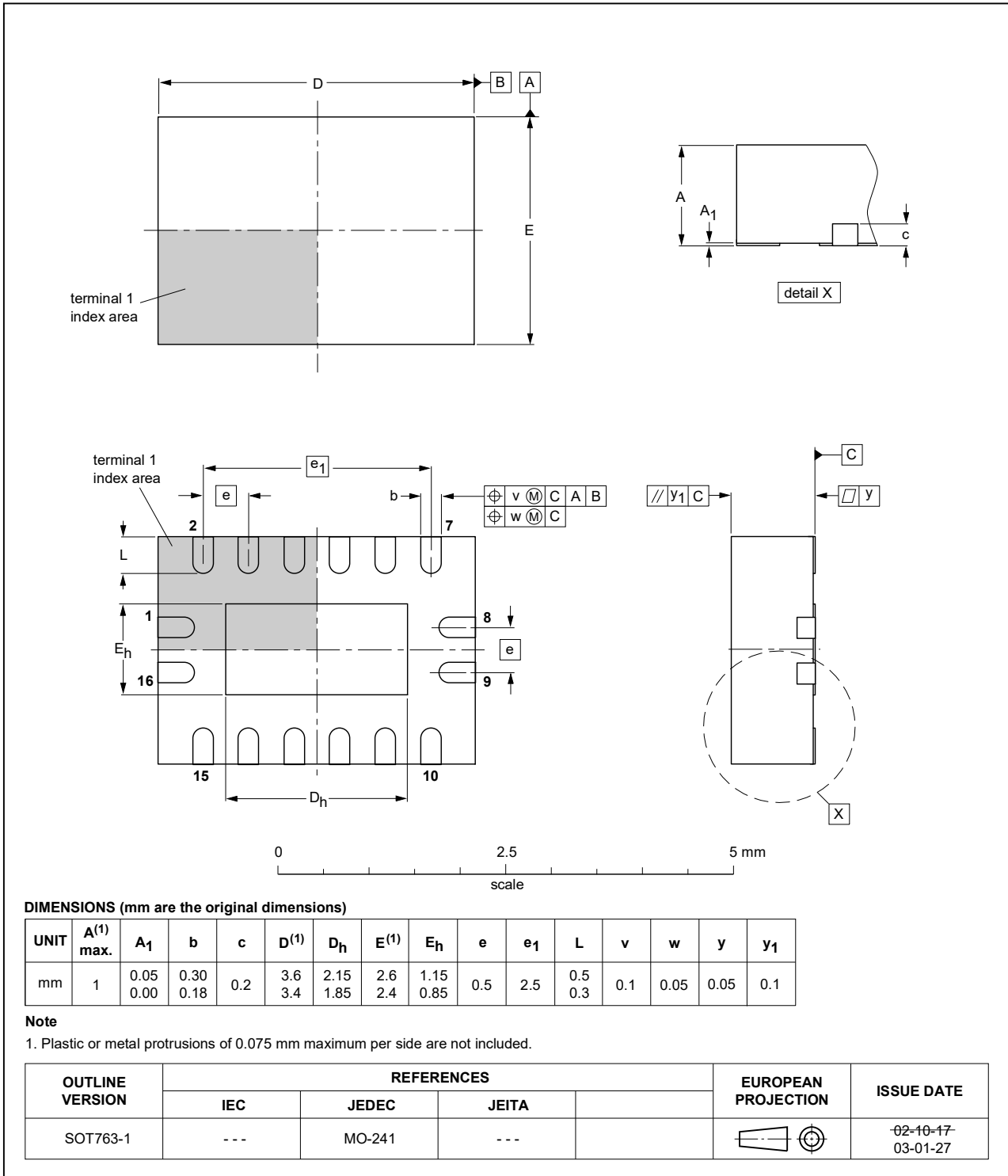

DIMENSIONS (mm are the original dimensions)

UNIT	A[1] max.	A_1	b	c	D[1]	D_h	E[1]	E_h	e	e_1	L	v	w	y	y_1
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. 20. Package outline SOT763-1 (DHVQFN16)

14. 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

15. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT4060 v.6	20210908	Product data sheet	-	74HC_HCT4060 v.5
Modifications:	• Type number 74HC4060DB (SSOP16/SOT338-1) removed. • Section 2 updated.			
74HC_HCT4060 v.5	20200508	Product data sheet	-	74HC_HCT4060 v.4
Modifications:	• The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. • Legal texts have been adapted to the new company name where appropriate. • Type number 74HCT4060DB (SSOP16/SOT338-1) removed. • Table 3: Derating values for P_{tot} total power dissipation updated.			
74HC_HCT4060 v.4	20160210	Product data sheet	-	74HC_HCT4060 v.3
Modifications:	• Type numbers 74HC4060N and 74HCT4060N (SOT38-4) removed. • Table 5: HIGH and LOW input levels added for 74HCT4060. (errata)			
74HC_HCT4060 v.3	20080714	Product data sheet	-	74HC_HCT4060_CNV v.2
Modifications:	• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate. • Section 4: DHVQFN16 package added. • Section 8: derating values added for DHVQFN16 package. • Section 13: outline drawing added for DHVQFN16 package.			
74HC_HCT4060_CNV v.2	19970901	Product specification	-	-

74HC_HCT4060

Product data sheet

Rev. 6 — 7 September 2021

17 / 19

16. Legal information

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 https://www.nexperia.com.

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. Nexperia 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 Nexperia 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 Nexperia and its customer, unless Nexperia and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the Nexperia product is deemed to offer functions and qualities beyond those described in the Product data sheet.

Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, Nexperia 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. Nexperia takes no responsibility for the content in this document if provided by an information source outside of Nexperia.

In no event shall Nexperia 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, Nexperia's 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 Nexperia.

Right to make changes — Nexperia 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 — Nexperia products are 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 Nexperia product can reasonably be expected to result in personal injury, death or severe property or environmental damage. Nexperia and its suppliers accept no liability for inclusion and/or use of Nexperia products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Quick reference data — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. Nexperia 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 Nexperia products, and Nexperia accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the Nexperia 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.

Nexperia 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 Nexperia 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). Nexperia 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 — Nexperia products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nexperia.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. Nexperia hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of Nexperia products by customer.

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.

Non-automotive qualified products — Unless this data sheet expressly states that this specific Nexperia product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. Nexperia accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without Nexperia's warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond Nexperia's specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies Nexperia for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond Nexperia's standard warranty and Nexperia's product specifications.

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.

Trademarks

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

74HC_HCT4060

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

© Nexperia B.V. 2021. All rights reserved

Product data sheet

Rev. 6 — 7 September 2021

18 / 19