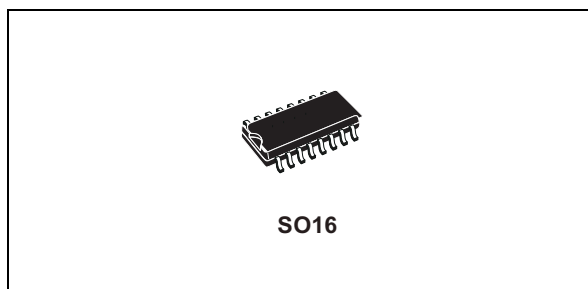


## Hex buffer/converter (non-inverting)

Datasheet - production data



### Applications

- Automotive
- Industrial
- Computer
- Consumer

### Description

The HCF4010 device is a monolithic integrated circuit fabricated in MOS (metal oxide semiconductor) technology available in an SO16 package.

It is a non-inverting hex buffer/converter and can be used as a CMOS to TTL logic level converter, as a current “sink” or “source” driver, or as a multiplexer (1 to 6).

It is the preferred replacement of the HCF4050B in buffer applications.

### Features

- Propagation delay time
  - $t_{PD} = 50 \text{ ns}$  (typ.) at  $V_{DD} = 10 \text{ V}$ ,  $C_L = 50 \text{ pF}$
- High to low level logic conversion
- Multiplexer: 1 to 6 or 6 to 1
- High “sink” and “source” current capability
- Quiescent current specified up to 20 V
- 5 V, 10 V and 15 V parametric ratings
- Input leakage current
- $I_I = 100 \text{ nA}$  (max.) at  $V_{DD} = 18 \text{ V}$ ,  $T_A = 25 \text{ }^\circ\text{C}$   
100% tested for quiescent current
- ESD performance
  - CDM: 1 kV
  - HBM: 1 kV
  - MM: 150 V

Table 1. Device summary

Order code	Temperature range	Package	Packing	Marking
HCF4010M013TR	–55 °C to +125 °C	SO16	Tape and reel	HCF4010
HCF4010YM013TR <sup>(1)</sup>	–40 °C to +125 °C	SO16 (automotive grade)		HCF4010Y

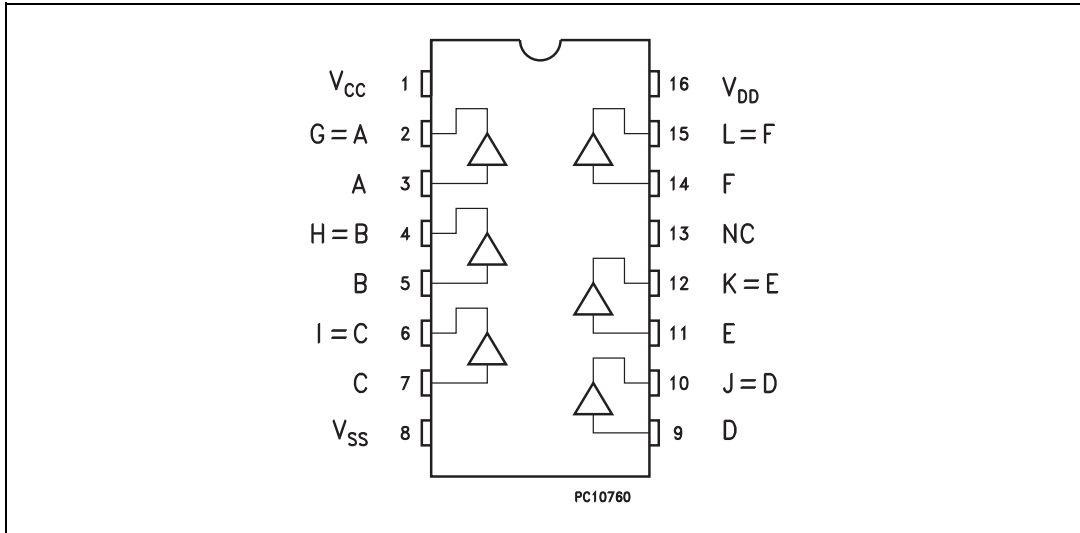
1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 and Q002 or equivalent.

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- 2      Functional description ..... 4**
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# 1 Pin information

**Figure 1. Pin connections**



**Table 2. Pin description**

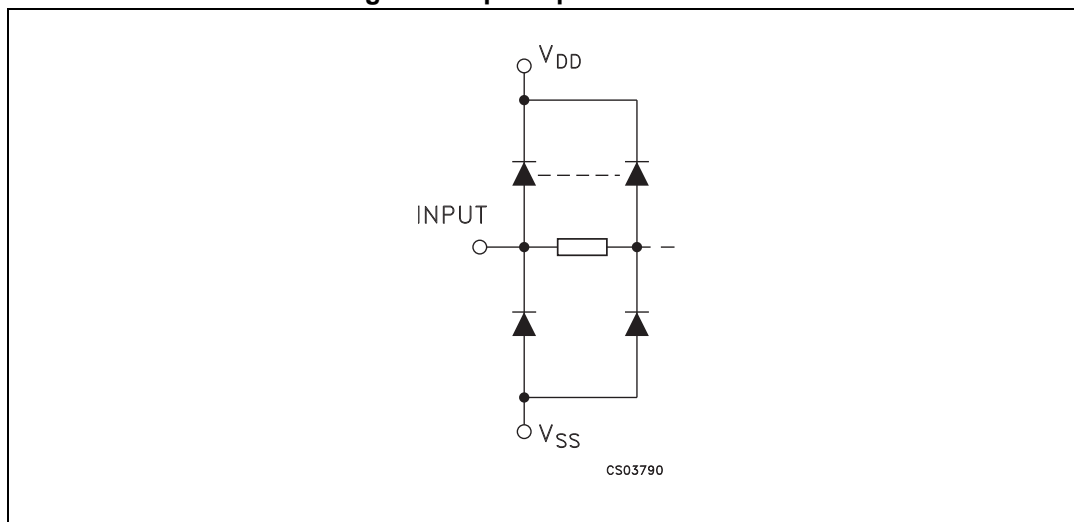
Pin number	Symbol/name	Function
3, 5, 7, 9, 11, 14	A, B, C, D, E, F	Data inputs
2, 4, 6, 10, 12, 15	G, H, I, J, K, L	Data outputs
13	NC	Not connected
1	V <sub>CC</sub>	Positive supply voltage
8	V <sub>SS</sub>	Negative supply voltage
16	V <sub>DD</sub>	Positive supply voltage

## 2 Functional description

Table 3. Truth table

Inputs (A, B, C, D, E, F)	Outputs (G, H, I, J, K, L)
L	L
H	H

Figure 2. Input equivalent circuit



### 3 Electrical characteristics

Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied. All voltage values are referred to  $V_{SS}$  pin voltage.

**Table 4. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DD}$	Supply voltage	-0.5 to +22	V
$V_I$	DC Input voltage	-0.5 to $V_{DD} + 0.5$	
$I_I$	DC input current	$\pm 10$	mA
$P_D$	Power dissipation per package	200	mW
	Power dissipation per output transistor	100	
$T_{op}$	Operating temperature	-55 to +125	°C
$T_{stg}$	Storage temperature	-65 to +150	

**Table 5. Recommended operating conditions**

Symbol	Parameter		Value	Unit
$V_{DD}$	Supply voltage		3 to 20	V
$V_I$	Input voltage		0 to $V_{DD}$	
$T_{op}$	Operating temperature	SO16	-55 to 125	°C
		SO16 (automotive grade)	-40 to 125	

Table 6. DC specifications<sup>(1)</sup>

Sym.	Parameter	Test condition				Value						Unit	
		V <sub>I</sub> (V)	V <sub>O</sub> (V)	I <sub>OL</sub>   (μA)	V <sub>DD</sub> = V <sub>CC</sub> (V)	T <sub>A</sub> = 25 °C			-40 to 85 °C		-55 to 125 °C		
						Min.	Typ.	Max.	Min.	Max.	Min.		Max.
I <sub>L</sub>	Quiescent current	0/5			5		0.02	1		30		30	μA
		0/10			10		0.02	2		60		60	
		0/15			15		0.02	4		120		120	
		0/20			20		0.04	20		600		600	
V <sub>OH</sub>	High-level output voltage	0/5		<1	5	4.95			4.95		4.95		V
		0/10		<1	10	9.95			9.95		9.95		
		0/15		<1	15	14.95			14.95		14.95		
V <sub>OL</sub>	Low-level output voltage	5/0		<1	5		0.05			0.05		0.05	V
		10/0		<1	10		0.05			0.05		0.05	
		15/0		<1	15		0.05			0.05		0.05	
V <sub>IH</sub>	High-level input voltage		0.5/4.5	<1	5	3.5			3.5		3.5		V
			1/9	<1	10	7			7		7		
			1.5/13.5	<1	15	11			11		11		
V <sub>IL</sub>	Low-level input voltage		4.5/0.5	<1	5			1.5		1.5		1.5	V
			9/1	<1	10			3		3		3	
			13.5/1.5	<1	15			4		4		4	
I <sub>OH</sub>	Output drive current	0/5	2.5	<1	5	-0.8	-1.6		-0.65		-0.65		mA
		0/5	4.6	<1	5	-0.2	-0.4		-0.18		-0.18		
		0/10	9.5	<1	10	-0.45	-0.9		-0.38		-0.38		
		0/15	13.5	<1	15	-1.5	-3		-1.25		-1.25		
I <sub>OL</sub>	Output sink current	0/5	0.4	<1	5	3	4		2.4		2.4		mA
		0/10	0.5	<1	10	8	10		6.4		6.4		
		0/15	1.5	<1	15	24	36		19		19		
I <sub>I</sub>	Input leakage current	0/18	Any input		18		±10 <sup>-5</sup>	±0.1		±1		±1	μA
C <sub>I</sub>	Input capacitance		Any input				5	7.5					pF

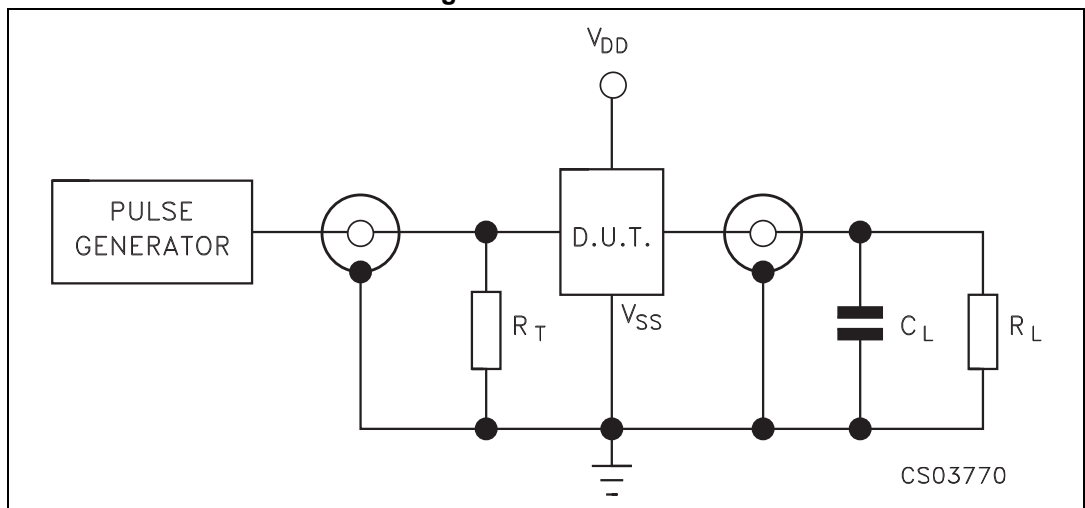
1. The noise margin for both level "1" and "0" is: 1 V min. with V<sub>DD</sub> = 5 V, 2 V min. with V<sub>DD</sub> = 10 V, 2.5 V min. with V<sub>DD</sub> = 15 V.

**Table 7. Dynamic electrical characteristics**  
 ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}\Omega$ ,  $t_r = t_f = 20\text{ ns}$ )

Symbol	Parameter	Test condition			Value <sup>(1)</sup>			Unit
		V <sub>DD</sub> (V)	V <sub>I</sub> (V)	V <sub>CC</sub> (V)	Min.	Typ.	Max.	
t <sub>TLH</sub>	Output transition time	5	5	5		150	350	ns
		10	10	10		75	15	
		15	15	15		55	110	
t <sub>THL</sub>	Output transition time	5	5	5		35	70	
		10	10	10		20	40	
		15	15	15		15	30	
t <sub>PLH</sub>	Propagation delay time	5	5	5		100	200	
		10	10	10		50	100	
		10	10	5		50	100	
		15	15	15		35	70	
		15	15	5		35	70	
t <sub>PHL</sub>	Propagation delay time	5	5	5		65	130	
		10	10	10		35	70	
		10	10	5		30	70	
		15	15	15		25	50	
		15	15	5		20	40	

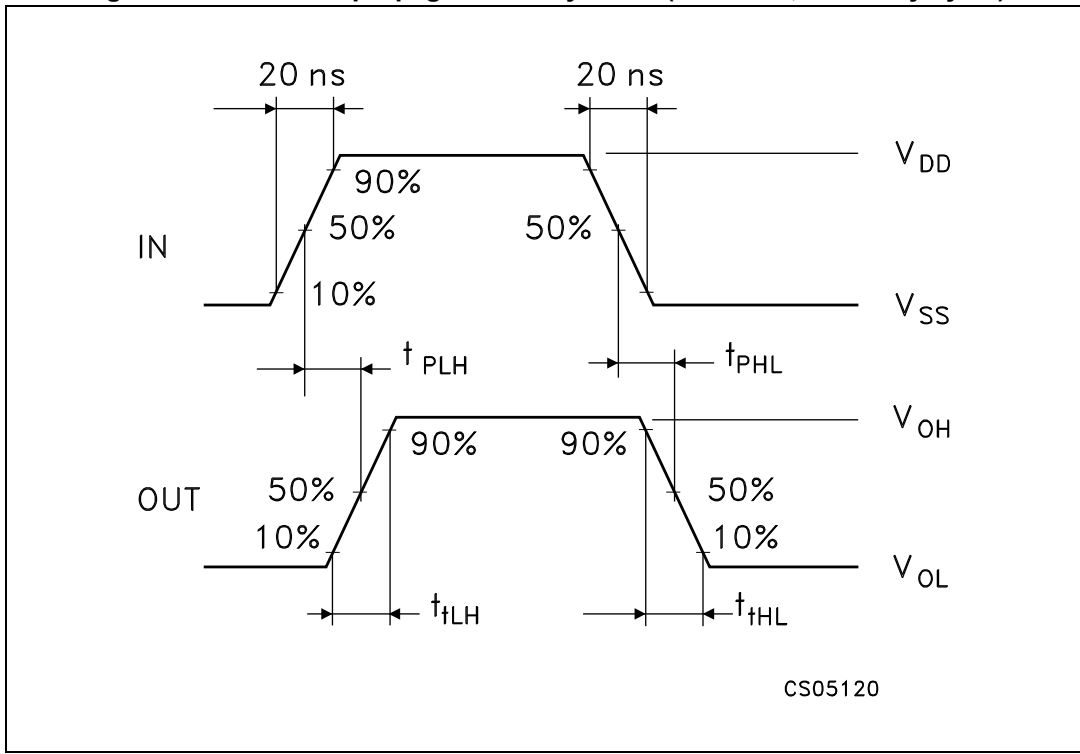
1. Typical temperature coefficient for all V<sub>DD</sub> values is 0.3%/°C.

**Figure 3. Test circuit**



1. C<sub>L</sub> = 50 pF or equivalent (includes jig and probe capacitance).
2. R<sub>L</sub> = 200 kΩ.
3. R<sub>T</sub> = Z<sub>OUT</sub> of pulse generator (typically 50 Ω).

Figure 4. Waveform - propagation delay times (f = 1 MHz; 50% duty cycle)



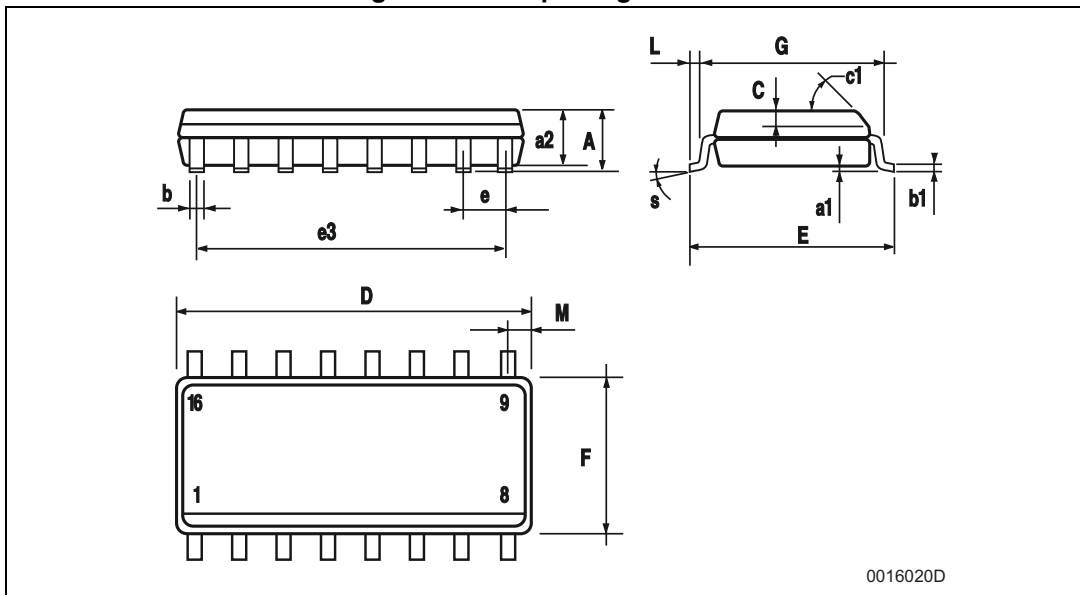


## 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 SO16 package information

Figure 5. SO16 package outline

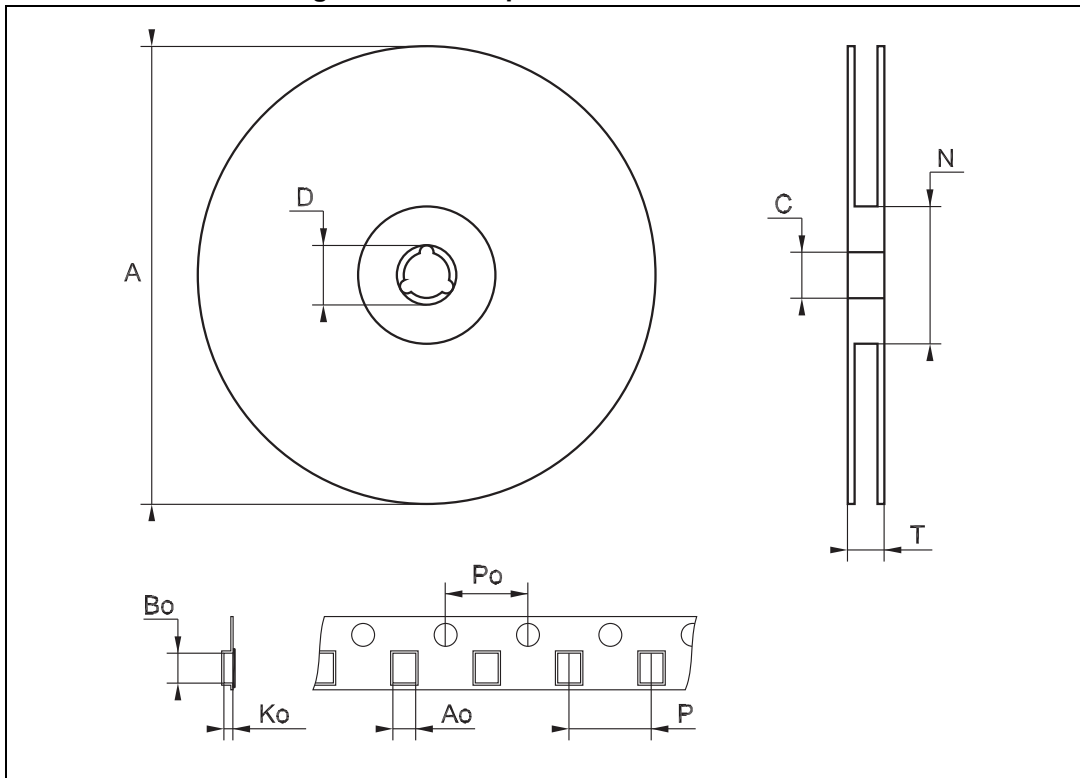


0016020D

Table 8. SO16 package mechanical data

Symbol	Dimensions					
	mm			inch		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.068
a1	0.1		0.25	0.004		0.010
a2			1.64			0.063
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8° (max.)					

Figure 6. SO16 tape and reel information



1. Drawing not in scale.

Table 9. SO16 tape and reel information

Symbol	Dimensions					
	mm			inch		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	6.45		6.65	0.254		0.262
Bo	10.3		10.5	0.406		0.414
Ko	2.1		2.3	0.082		0.090
Po	3.9		4.1	0.153		0.161
P	7.9		8.1	0.311		0.319

## 5 Ordering information

**Table 10. Order codes**

Order code	Temperature range	Package	Packing	Marking
HCF4010M013TR	-55 °C to +125 °C	SO16	Tape and reel	HCF4010
HCF4010YM013TR <sup>(1)</sup>	-40 °C to +125 °C	SO16 (automotive grade)		HCF4010Y

1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 and Q002 or equivalent.

## 6 Revision history

**Table 11. Document revision history**

Date	Revision	Changes
16-Mar-2005	3	Add V <sub>CC</sub> on Table 6
11-Jun-2012	4	Added <a href="#">Applications on page 1</a> Updated <a href="#">Table 1: Device summary</a> Removed DIP16 package from document Revised document presentation, minor textual updates
15-Jun-2012	5	Updated temperature range in <a href="#">Table 1</a> Updated T <sub>op</sub> in <a href="#">Table 5</a>
19-Oct-2012	6	Updated <a href="#">Features</a> (added ESD data). Updated <a href="#">Table 1</a> (added Marking, updated note 1.) Reformatted <a href="#">Section 4</a> (added <a href="#">Figure 5</a> and <a href="#">Figure 6</a> , <a href="#">Table 8</a> and <a href="#">Table 9</a> ). Minor corrections throughout document.
25-Apr-2013	7	Updated <a href="#">Features</a> : ESD data modified, removed information regarding B series CMOS devices. Added <a href="#">Section 5: Ordering information</a>
13-Jan-2014	8	<a href="#">Table 1: Device summary</a> : added "Packing"

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