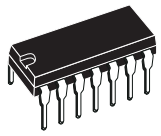
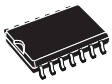
M74HC04

Hex inverter

Datasheet - production data



DIP14



SO14

TSSOP14

Features

- High speed:
  t_{PD} = 8 ns (typ.) at V_{CC} = 6 V
- Low power dissipation:
  I_{CC} = 1 µA (max.) at T_A = 25 °C
- High noise immunity:
  $V_{NIH} = V_{NIL}$ = 28% V_{CC} (min.)
- Symmetrical output impedance:
  $|I_{OH}| = I_{OL}$ = 4 mA (min) at V_{CC} = 4.5 V
- Balanced propagation delays:
  t_{PLH} @ t_{PHL}
- Wide operating voltage range:
  V_{CC} (OPR) = 2 V to 6 V
- Pin and function compatible with 74 series 04
- ESD performance
  - CDM: 1 kV
  - HBM: 2 kV
  - MM: 200 V

Description

The M74HC04 is a high-speed CMOS hex inverter manufactured using silicon gate C^2MOS technology.

The internal circuit is composed of 3 stages including a buffer output which enables high noise immunity and stable output.

All inputs are equipped with protection circuits to guard against static discharge and transient excess voltage.

Table 1. Device summary

Order code	Temperature range	Package	Packaging	Marking
M74HC04B1R	-55 °C to +125 °C	DIP14	Tube	M74HC04B1
M74HC04YRM13TR(1)	-40 °C to +125 °C	SO14 (automotive grade)	Tape and reel	74HC04Y
M74HC04RM13TR	-55 °C to +125 °C	SO14	Tape and reel	74HC04
M74HC04TTR	-55 °C to +125 °C	TSSOP14	Tape and reel	HC04
M74HC04YTTR(1)	-40 °C to +125 °C	TSSOP14 (automotive grade)	Tape and reel	HC04Y

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

Contents

1 Pin information

Figure 1. Pin connections and IEC logic symbols

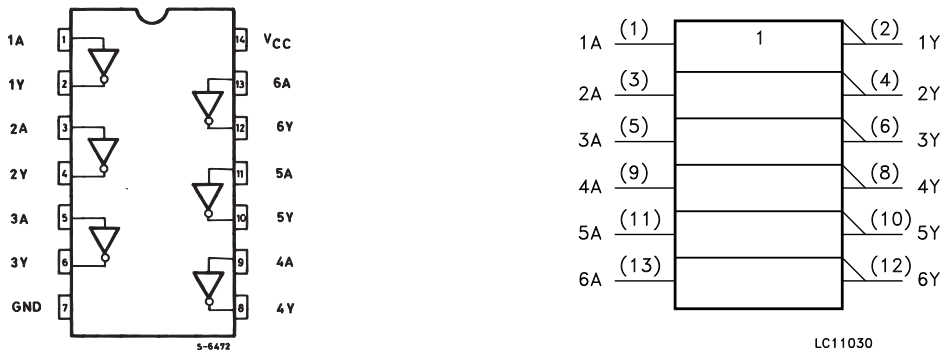


Table 2. Pin description

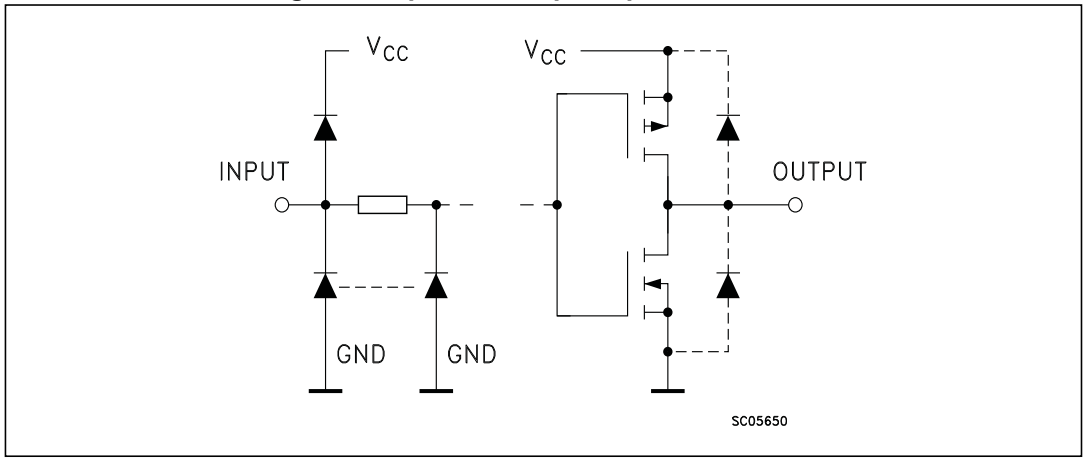
Pin number	Symbol	Name and function
1, 3, 5, 9, 11, 13	1A to 6A	Data inputs
2, 4, 6, 8, 10, 12	1Y to 6Y	Data outputs
7	GND	Ground (0 V)
14	V_{CC}	Positive supply voltage

2 Functional description

Table 3. Truth table

A	Y
L	H
H	L

Figure 2. Input and output equivalent circuit



3 Electrical characteristics

Stressing the device above the ratings listed in the “Absolute maximum ratings” table may cause permanent damage to the device. These are stress ratings only, and operation of the device at these or any other conditions above those indicated in the operating sections of this specification are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 4. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	-0.5 to +7	V
V_I	DC input voltage	-0.5 to V_{CC} +0.5	V
V_O	DC output voltage	-0.5 to V_{CC} +0.5	V
I_{IK}	DC input diode current	±20	mA
I_{OK}	DC output diode current	±20	mA
I_O	DC output current	±25	mA
I_{CC} or I_{GND}	DC V_{CC} or ground current	±50	mA
P_D	Power dissipation	500(1)	mW
T_{stg}	Storage temperature	-65 to +150	°C
T_L	Lead temperature (10 sec)	300	°C

1. 500 mW at 65 °C; derate to 300 mW by 10 mW/°C from 65 °C to 85 °C

Table 5. Recommended operating conditions

Symbol	Parameter		Value	Unit
V_{CC}	Supply voltage		2 to 6	V
V_I	Input voltage		0 to V_{CC}	V
V_O	Output voltage		0 to V_{CC}	V
T_{op}	Operating temperature		-55 to 125	°C
t_r, t_f	Input rise and fall time	V_{CC} = 2.0 V	0 to 1000	ns
		V_{CC} = 4.5 V	0 to 500	ns
		V_{CC} = 6.0 V	0 to 400	ns

Table 6. DC specifications

Symbol	Parameter	Test condition		Value							Unit
		V_{CC} (V)		T_A = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
V_{IH}	High-level input voltage	2.0		1.5			1.5		1.5		V
		4.5		3.15			3.15		3.15		
		6.0		4.2			4.2		4.2		
V_{IL}	Low-level input voltage	2.0				0.5		0.5		0.5	V
		4.5				1.35		1.35		1.35	
		6.0				1.8		1.8		1.8	
V_{OH}	High-level output voltage	2.0	I_O = -20 µA	1.9	2.0		1.9		1.9		V
		4.5	I_O = -20 µA	4.4	4.5		4.4		4.4		
		6.0	I_O = -20 µA	5.9	6.0		5.9		5.9		
		4.5	I_O = -4.0 mA	4.18	4.31		4.13		4.10		
		6.0	I_O = -5.2 mA	5.68	5.8		5.63		5.60		
V_{OL}	Low-level output voltage	2.0	I_O = 20 µA		0.0	0.1		0.1		0.1	V
		4.5	I_O = 20 µA		0.0	0.1		0.1		0.1	
		6.0	I_O = 20 µA		0.0	0.1		0.1		0.1	
		4.5	I_O = 4.0 mA		0.17	0.26		0.33		0.40	
		6.0	I_O = 5.2 mA		0.18	0.26		0.33		0.40	
I_I	Input leakage current	6.0	V_I = V_{CC} or GND			± 0.1		± 1		± 1	µA
I_{CC}	Quiescent supply current	6.0	V_I = V_{CC} or GND			1		10		20	µA

Table 7. AC electrical characteristics (C_L = 50 pF, input $t_r = t_f$ = 6 ns)

Symbol	Parameter	Test condition		Value							Unit
		V_{CC} (V)		T_A = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t_{fLH} t_{fHL}	Output transition time	2.0			38	75		95		110	ns
		4.5			8	15		19		22	
		6.0			6	13		16		19	
t_{PLH} t_{PHL}	Propagation delay time	2.0			45	95		120		145	ns
		4.5			9	19		24		29	
		6.0			8	16		20		25	

Table 8. Capacitive characteristics

Symbol	Parameter	Test condition		Value							Unit
		V_{CC} (V)		T_A = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
C_{IN}	Input capacitance	5.0			5	10		10		10	pF
C_{PD}	Power dissipation capacitance(1)	5.0			22						pF

1. CPD is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to the test circuit). Average operating current can be obtained by the following equation: $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/6$ (per gate)

Figure 3. Test circuit

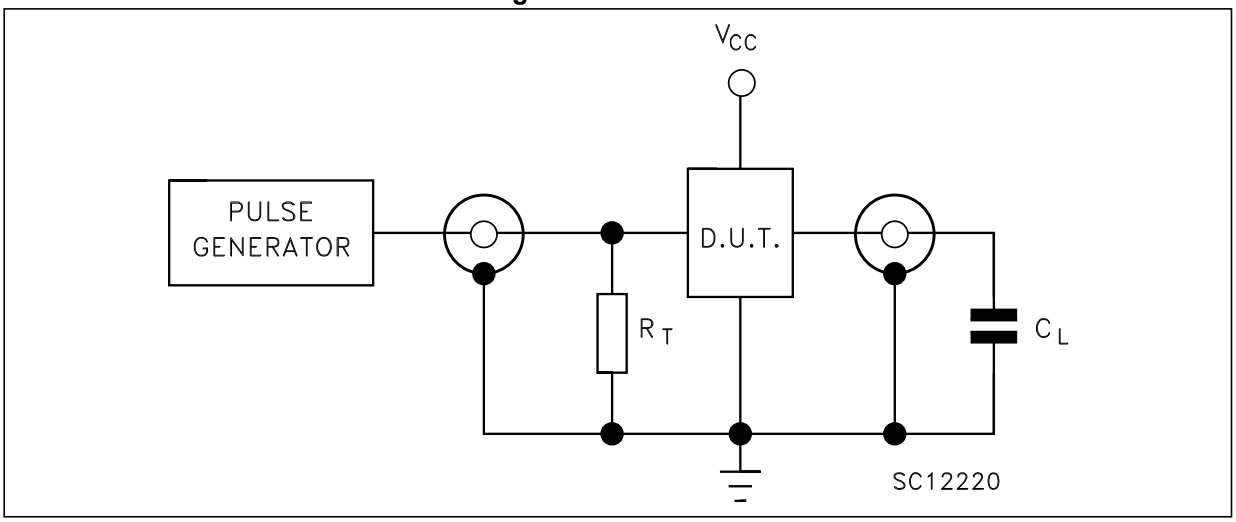
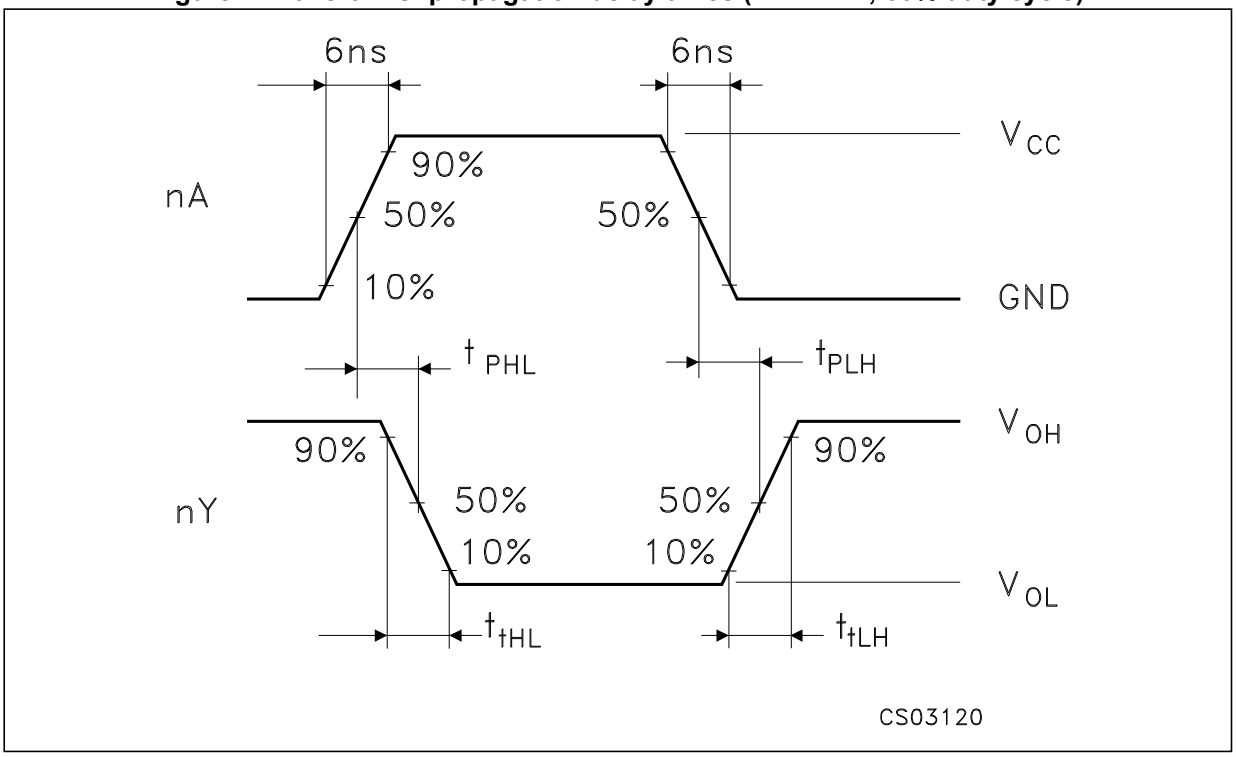


Figure 4. Waveforms: propagation delay times (f = 1 MHz; 50% duty cycle)



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*. ECOPACK® is an ST trademark.

4.1 DIP14 package information

Figure 5. Plastic DIP14 package mechanical outline

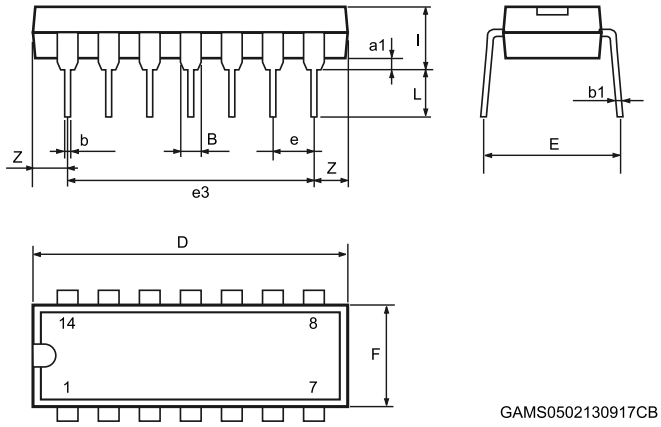


Table 9. Plastic DIP14 package mechanical data

Dimension	mm.			inches		
	Min.	Typ	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100

4.2 SO14 package information

Figure 6. Plastic SO14 package mechanical outline

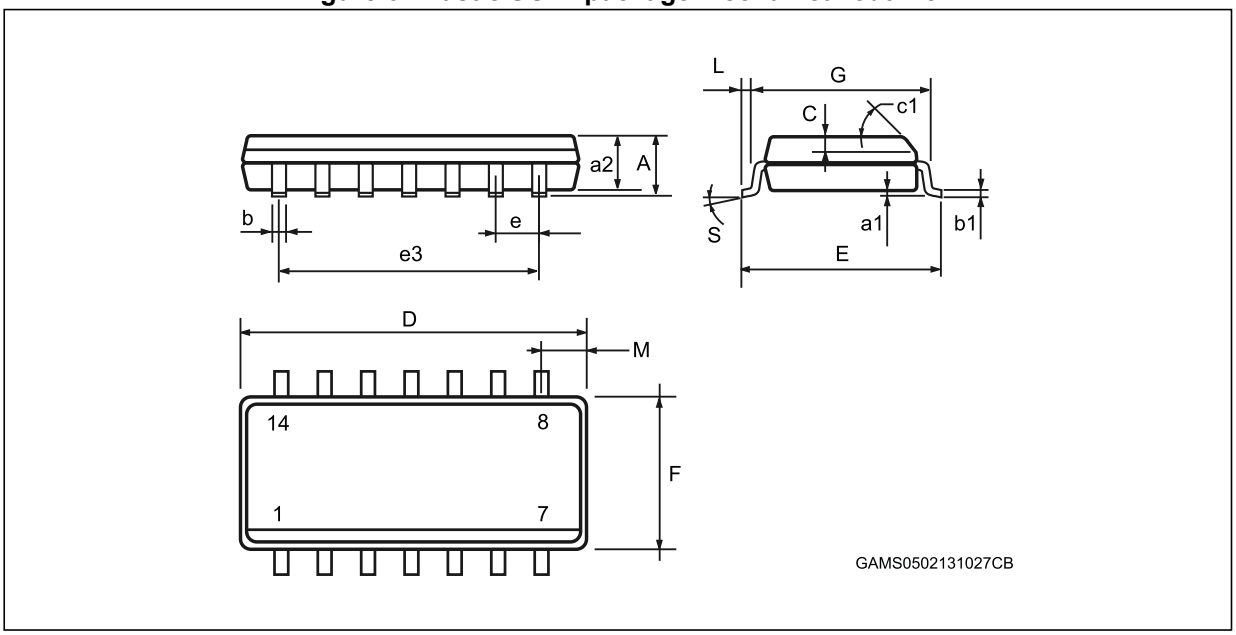


Table 10. SO14 package mechanical data

Ref.	mm.			inches		
	Min.	Typ	Max.	Min.	Typ.	Max.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
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	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
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			0.68			0.026
S	8° (max.)					

4.3 TSSOP14 package information

Figure 7. TSSOP14 package mechanical outline

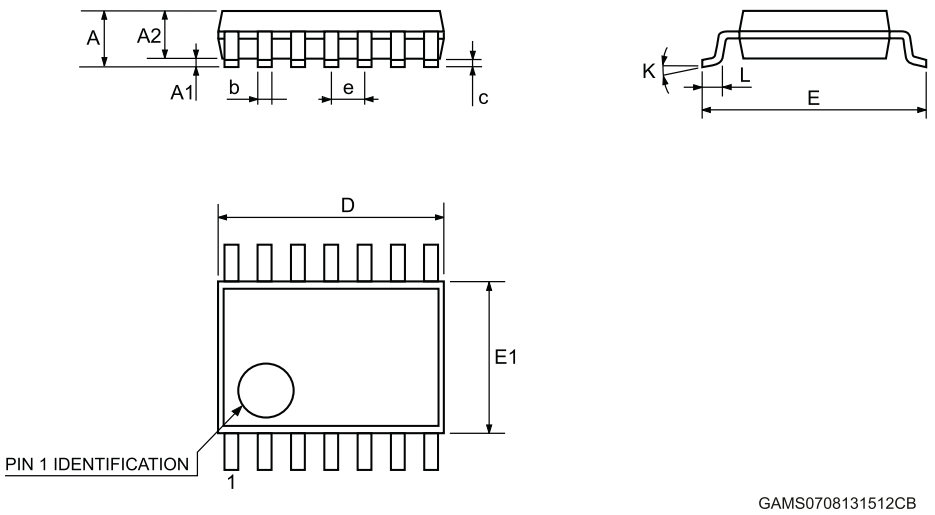


Table 11. TSSOP14 package mechanical data

Ref.	mm.			inches		
	Min.	Typ	Max.	Min.	Typ.	Max.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0089
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030

5 Revision history

Table 12. Document revision history

Date	Revision	Changes
11-Sep-2013	3	Added ESD information to *Features* Added automotive grade order codes, temperature ranges, and marking information to *Table 1: Device summary* Revised document presentation Minor textual updates