

Low-Voltage CMOS Hex Inverter

With 5 V-Tolerant Inputs

MC74LCX04

The MC74LCX04 is a high performance hex inverter operating from a 1.65 to 5.5 V supply. High impedance TTL compatible inputs significantly reduce current loading to input drivers while TTL compatible outputs offer improved switching noise performance. A $V_{\rm I}$ specification of 5.5 V allows MC74LCX04 inputs to be safely driven from 5 V devices if $V_{\rm CC}$ is less than 5.0 V.

Features

- Designed for 1.65 V to 5.5 V V_{CC} Operation
- 5 V Tolerant Inputs Interface Capability With 5 V TTL Logic
- LVTTL Compatible
- LVCMOS Compatible
- 24 mA Balanced Output Sink and Source Capability @ 3.0 V
- Near Zero Static Supply Current (10 μA) Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 100 mA
- ESD Performance: Human Body Model >2000 V
- –Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC–Q100 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

PIN NAMES

Pins	Function	
An	Data Inputs	
Ōn	Outputs	

TRUTH TABLE

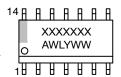
An	Ōn
L	Н
Н	L

1

MARKING DIAGRAMS



SOIC-14 D SUFFIX CASE 751A





XXXXXX = Specific Device Code
A = Assembly Location
L, WL = Wafer Lot

L, WL = Water Lot Y, YY = Year W, WW = Work Week G or ■ = Pb-Free Package

(Note: Microdot may be in either location)

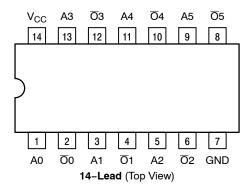


Figure 1. Pin Assignment

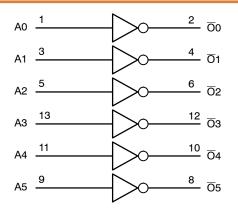


Figure 2. Logic Diagram

ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

MAXIMUM RATINGS

Symbol	Parameter		Value	Unit
V _{CC}	DC Supply Voltage		-0.5 to +6.5	V
VI	DC Input Voltage (Note 1)		-0.5 to +6.5	V
Vo		ive-Mode (High or Low State) Tri-State Mode ower-Down Mode (V _{CC} = 0 V)	-0.5 to V _{CC} + 0.5 -0.5 to +6.5 -0.5 to +6.5	V
I _{IK}	DC Input Diode Current	V _I < GND	-50	mA
I _{OK}	DC Output Diode Current	V _O < GND	-50	mA
I _O	DC Output Source/Sink Current		±50	mA
I _{CC} or I _{GND}	DC Supply Current per Supply Pin or Ground Pin		±100	mA
T _{STG}	Storage Temperature Range		-65 to +150	°C
TL	Lead Temperature, 1 mm from Case for 10 secs		260	°C
TJ	Junction Temperature Under Bias		+150	°C
$\theta_{\sf JA}$	Thermal Resistance (Note 1)	SOIC-14 QFN14 TSSOP-14	116 130 150	°C/W
P _D	Power Dissipation in Still Air at 125°C	SOIC-14 QFN14 TSSOP-14	1077 962 833	mW
MSL	Moisture Sensitivity		Level 1	-
F _R	Flammability Rating	Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in	-
V _{ESD}	ESD Withstand Voltage (Note 3)	Human Body Model Charged Device Model	2000 N/A	V

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

- 1. I_O absolute maximum rating must be observed.
- Measured with minimum pad spacing on an FR4 board, using 76mm-by-114mm, 2-ounce copper trace no air flow per JESD51-7.
 HBM tested to EIA / JESD22-A114-A. CDM tested to JESD22-C101-A. JEDEC recommends that ESD qualification to EIA/JESD22-A115A (Machine Model) be discontinued.

RECOMMENDED OPERATING CONDITIONS

Symbol	Pa	rameter	Min	Тур	Max	Unit
V _{CC}	Supply Voltage	Operating	1.65	3.3	5.5	V
		Data Retention Only	1.5	3.3	5.5	
VI	Digital Input Voltage		0	-	5.5	V
Vo	Output Voltage	Active Mode (High or Low State)	0	-	V_{CC}	V
		Tri-State Mode	0	_	5.5	
		Power Down Mode (V _{CC} = 0 V)	0	_	5.5	
T _A	Operating Free-Air Temperature		-40	-	+125	°C
t _r , t _f	Input Rise or Fall Rate	V _{CC} = 1.65 V to 1.95 V	0	-	20	nS/V
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	0	_	20	
		V_I from 0.8 V to 2.0 V, V_{CC} = 3.0 V	0	_	10	
		$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$	0	_	5	

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

4. Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V_{CC}). Unused outputs must be left open.

DC ELECTRICAL CHARACTERISTICS

				T _A = -40°0	C to +85°C	T _A = -40°C	to +125°C	
Symbol	Parameter	Conditions	V _{CC} (V)	Min	Max	Min	Max	Unit
V _{IH}	HIGH Level Input Voltage		1.65 — 1.95	0.65 x V _{CC}	-	0.65 x V _{CC}	-	V
			2.3 – 2.7	1.7	-	1.7	_	
			3.0 – 3.6	2.0	-	2.0	-	
			4.5 – 5.5	0.70 x V _{CC}	-	0.70 x V _{CC}	-	
V _{IL}	LOW Level Input Voltage		1.65 — 1.95	-	0.35 x V _{CC}	-	0.35 x V _{CC}	V
			2.3 – 2.7	-	0.7	-	0.7	
			3.0 – 3.6	-	0.8	-	0.8	
			4.5 – 5.5	-	0.30 x V _{CC}	-	0.30 x V _{CC}	
V _{OH}	High-Level Output Voltage Low-Level Output Voltage	$\begin{split} V_I &= V_{IH} \text{ or } V_{IL} \\ I_{OH} &= -100 \mu\text{A} \\ I_{OH} &= -4 \text{ mA} \\ I_{OH} &= -8 \text{ mA} \\ I_{OH} &= -12 \text{ mA} \\ I_{OH} &= -16 \text{ mA} \\ I_{OH} &= -24 \text{ mA} \\ I_{OH} &= -32 \text{ mA} \\ \end{split}$ $V_I &= V_{IH} \text{ or } V_{IL} \\ I_{OL} &= 100 \mu\text{A} \\ I_{OL} &= 4 \text{ mA} \\ I_{OL} &= 8 \text{ mA} \\ I_{OL} &= 12 \text{ mA} \\ I_{OL} &= 16 \text{ mA} \end{split}$	1.65 to 5.5 1.65 2.3 2.7 3.0 3.0 4.5 1.65 to 5.5 1.65 2.3 2.7 3.0	V _{CC} - 0.1 1.29 1.8 2.2 2.4 2.2 3.7	- - - - - - 0.1 0.24 0.3 0.4 0.4	V _{CC} - 0.1 1.29 1.8 2.2 2.4 2.2 3.7	- - - - - - - 0.1 0.24 0.3 0.4 0.4	V
		I _{OL} = 24 mA I _{OL} = 32 mA	3.0 4.5	- -	0.55 0.6	- -	0.55 0.6	
I _I	Input Leakage Current	V _I = 0 to 5.5 V	3.6	_	±5.0	-	±5.0	μΑ
I _{OFF}	Power Off Leakage Current	V _I = 5.5 V or V _O = 5.5 V	0	-	10	-	10	μΑ
I _{CC}	Quiescent Supply Current	V _I = 5.5 V or GND	3.6	-	10	-	10	μΑ
ΔI_{CC}	Increase in I _{CC} per Input	V _{IH} = V _{CC} - 0.6 V	2.3 to 3.6	_	500	_	500	μΑ

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

AC ELECTRICAL CHARACTERISTICS

				T _A = -40°C	C to +85°C	T _A = -40°C	to +125°C	
Symbol	Parameter	Test Condition	V _{CC} (V)	Min	Max	Min	Max	Unit
t _{PLH} , t _{PHL}	Propagation Delay, Input to Output	See Figures 3 and 4	1.65 to 1.95	-	10	-	10	ns
			2.3 to 2.7	1.5	6.2	1.5	6.2	
			2.7	1.5	6.0	1.5	6.0	
			3.0 to 3.6	1.5	5.2	1.5	5.2	
			4.5 to 5.5	-	4.2	-	4.2	

AC ELECTRICAL CHARACTERISTICS

				T _A = -40°0	C to +85°C	T _A = -40°C	to +125°C	
Symbol	Parameter	Test Condition	V _{CC} (V)	Min	Max	Min	Max	Unit
t _{OSHL} , t _{OSLH}	Output to Output Skew		1.65 to 1.95	-	-	-	-	ns
			2.3 to 2.7	-	-	_	-	
			2.7	-	-	-	-	
			3.0 to 3.6	-	1.0	-	1.0	
			4.5 to 5.5	-	_	-	-	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

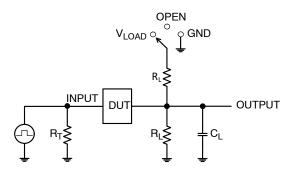
DYNAMIC SWITCHING CHARACTERISTICS

			T _A = +25°C			
Symbol	Characteristic	Condition	Min	Тур	Max	Unit
V _{OLP}	Dynamic LOW Peak Voltage	V_{CC} = 3.3 V, C_L = 50 pF, V_{IH} = 3.3 V, V_{IL} = 0 V		0.8		V
	(Note 5)	V_{CC} = 2.5 V, C_L = 30 pF, V_{IH} = 2.5 V, V_{IL} = 0 V		0.6		V
V _{OLV}	Dynamic LOW Valley Voltage	V_{CC} = 3.3 V, C_L = 50 pF, V_{IH} = 3.3 V, V_{IL} = 0 V		-0.8		V
	(Note 5)	V_{CC} = 2.5 V, C_L = 30 pF, V_{IH} = 2.5 V, V_{IL} = 0 V		-0.6		V

^{5.} Number of outputs defined as "n". Measured with "n-1" outputs switching from HIGH-to-LOW or LOW-to-HIGH. The remaining output is measured in the LOW state.

CAPACITIVE CHARACTERISTICS

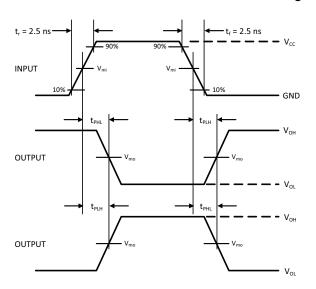
Symbol	Parameter	Condition	Тур	Unit
C _{IN}	Input Capacitance	V_{CC} = 3.3 V, V_I = 0 V or V_{CC}	7	pF
C _{OUT}	Output Capacitance	V_{CC} = 3.3 V, V_{I} = 0 V or V_{CC}	8	pF
C _{PD}	Power Dissipation Capacitance	10 MHz, V_{CC} = 3.3 V, V_{I} = 0 V or V_{CC}	25	pF

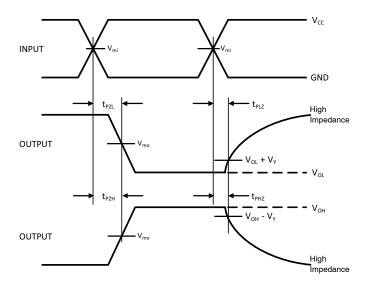


Test	Switch Position
t _{PLH} / t _{PHL}	Open
t _{PLZ} / t _{PZL}	V_{LOAD}
t _{PHZ} / t _{PZH}	GND

 C_L includes probe and jig capacitance R_T is Z_{OUT} of pulse generator (typically 50 $\Omega)$ f = 1 MHz

Figure 3. Test Circuit





V _{CC} , V	R_L, Ω	C _L , pF	V_{LOAD}	V_m, V	V _Y , V
1.65 to 1.95	500	30	2 x V _{CC}	V _{CC} /2	0.15
2.3 to 2.7	500	30	2 x V _{CC}	V _{CC} /2	0.15
2.7	500	50	6 V	1.5	0.3
3.0 to 3.6	500	50	6 V	1.5	0.3
4.5 to 5.5	500	50	2 x V _{CC}	V _{CC} /2	0.3

Figure 4. Switching Waveforms

ORDERING INFORMATION

Device	Marking	Package	Shipping [†]
MC74LCX04DG	LCX04G	SOIC-14	55 Units / Rail
MC74LCX04DR2G	LCX04G	SOIC-14	2500 Units / Tape & Reel
MC74LCX04DTG	LCX 04	TSSOP-14	96 Units / Rail
MC74LCX04DTR2G	LCX 04	TSSOP-14	2500 / Tape & Reel
MC74LCX04DTR2G-Q*	LCX 04	TSSOP-14	2500 / Tape & Reel

[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

*-Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.

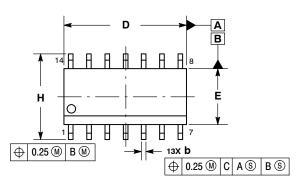


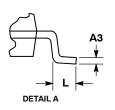


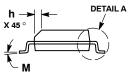
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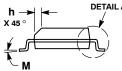
SOIC-14 NB CASE 751A-03 ISSUE L

DATE 03 FEB 2016





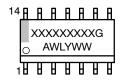




- NOTES:
 1. DIMENSIONING AND TOLERANCING PER
 - ASME Y14.5M, 1994.
 CONTROLLING DIMENSION: MILLIMETERS.
- DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT
- MAXIMUM MATERIAL CONDITION.
 DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
- 5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
Α	1.35	1.75	0.054	0.068
A1	0.10	0.25	0.004	0.010
АЗ	0.19	0.25	0.008	0.010
b	0.35	0.49	0.014	0.019
D	8.55	8.75	0.337	0.344
Е	3.80	4.00	0.150	0.157
е	1.27 BSC		0.050 BSC	
Н	5.80	6.20	0.228	0.244
h	0.25	0.50	0.010	0.019
L	0.40	1.25	0.016	0.049
M	0 °	7°	0 °	7°

GENERIC MARKING DIAGRAM*

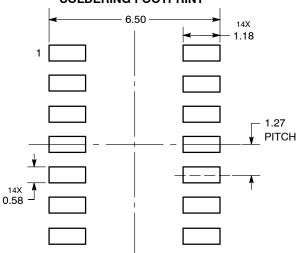


XXXXX = Specific Device Code Α = Assembly Location

WL = Wafer Lot Υ = Year WW = Work Week = Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "■", may or may not be present. Some products may not follow the Generic Marking.

SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

C SEATING PLANE

STYLES ON PAGE 2

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^{*}For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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DATE 03 FEB 2016

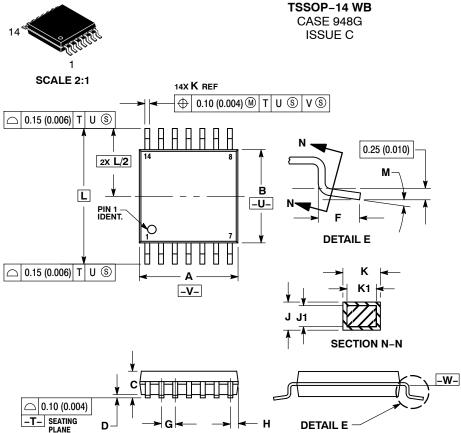
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STYLE 5: PIN 1. COMMON CATHODE 2. ANODE/CATHODE 3. ANODE/CATHODE 4. ANODE/CATHODE 5. ANODE/CATHODE 6. NO CONNECTION 7. COMMON ANODE 8. COMMON CATHODE 9. ANODE/CATHODE 10. ANODE/CATHODE 11. ANODE/CATHODE 12. ANODE/CATHODE 13. NO CONNECTION 14. COMMON ANODE	STYLE 6: PIN 1. CATHODE 2. CATHODE 3. CATHODE 4. CATHODE 5. CATHODE 6. CATHODE 7. CATHODE 8. ANODE 9. ANODE 10. ANODE 11. ANODE 12. ANODE 13. ANODE 14. ANODE	STYLE 7: PIN 1. ANODE/CATHODE 2. COMMON ANODE 3. COMMON CATHODE 4. ANODE/CATHODE 5. ANODE/CATHODE 6. ANODE/CATHODE 7. ANODE/CATHODE 8. ANODE/CATHODE 9. ANODE/CATHODE 10. ANODE/CATHODE 11. COMMON CATHODE 12. COMMON ANODE 13. ANODE/CATHODE 14. ANODE/CATHODE	STYLE 8: PIN 1. COMMON CATHODE 2. ANODE/CATHODE 3. ANODE/CATHODE 4. NO CONNECTION 5. ANODE/CATHODE 6. ANODE/CATHODE 7. COMMON ANODE 8. COMMON ANODE 9. ANODE/CATHODE 10. ANODE/CATHODE 11. NO CONNECTION 12. ANODE/CATHODE 13. ANODE/CATHODE 14. COMMON CATHODE

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DATE 17 FEB 2016





- NOTES.

 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

 2. CONTROLLING DIMENSION: MILLIMETER.

 3. DIMENSION A DOES NOT INCLUDE MOLD
- FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
 DIMENSION B DOES NOT INCLUDE
- INTERLEAD FLASH OR PROTRUSION.
 INTERLEAD FLASH OR PROTRUSION SHALL
- INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.

 DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.

 TERMINAL NUMBERS ARE SHOWN FOR DEEEDENIC OMITY.
- REFERENCE ONLY.
 DIMENSION A AND B ARE TO BE
- DETERMINED AT DATUM PLANE -W-.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
Α	4.90	5.10	0.193	0.200
В	4.30	4.50	0.169	0.177
С		1.20		0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
Н	0.50	0.60	0.020	0.024
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
м	o °	8 °	o °	a °

GENERIC MARKING DIAGRAM*



= Assembly Location

L = Wafer Lot = Year = Work Week W

= Pb-Free Package

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "■", may or may not be present. Some products may not follow the Generic Marking.

RECOMMENDED SOLDERING FOOTPRINT*

-	7.06
1	
	-
J	PITCH
14X 0.36	_==+
0.36 - 1.26	DIMENSIONS: MILLIMETERS

*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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 $\textbf{Technical Library:} \ \underline{www.onsemi.com/design/resources/technical-documentation}$

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