

MOTOROLA

SEMICONDUCTOR TECHNICAL DATA

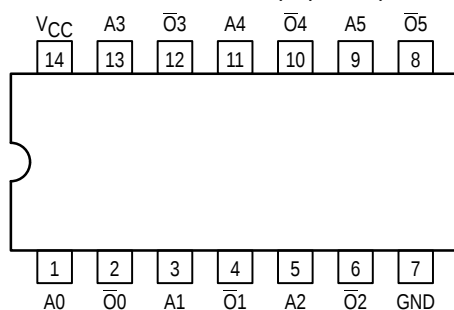
Low-Voltage Quiet CMOS Hex Inverter

The MC74LVQ04 is a high performance hex inverter operating from a 2.7 to 3.6V supply. High impedance TTL compatible inputs significantly reduce current loading to input drivers while TTL compatible outputs offer improved switching noise performance.

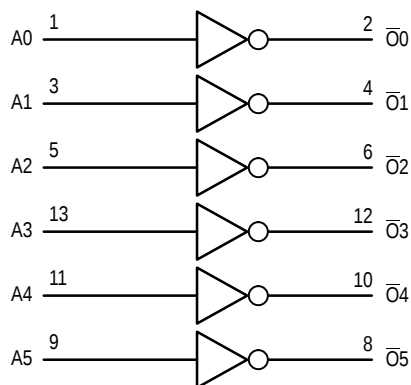
Current drive capability is 12mA at the outputs.

- Designed for 2.7 to 3.6V V_{CC} Operation – Ideal for Low Power/Low Noise Applications
- Guaranteed Simultaneous Switching Noise Level and Dynamic Threshold Performance
- Guaranteed Skew Specifications
- Guaranteed Incident Wave Switching into 75 Ω
- Low Static Supply Current (10 μ A) Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 500mA
- ESD Performance: Human Body Model >2000V

Pinout: 14-Lead (Top View)



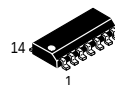
LOGIC DIAGRAM



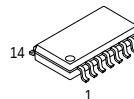
MC74LVQ04

LVQ

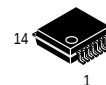
**LOW-VOLTAGE CMOS
HEX INVERTER**



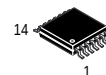
D SUFFIX
PLASTIC SOIC
CASE 751A-03



M SUFFIX
PLASTIC SOIC EIAJ
CASE 965-01



SD SUFFIX
PLASTIC SSOP
CASE 940A-03



DT SUFFIX
PLASTIC TSSOP
CASE 948G-01

PIN NAMES

Pins	Function
An	Data Inputs
On	Outputs

FUNCTION TABLE

An	$\bar{O}n$
L	H
H	L



MC74LVQ04

ABSOLUTE MAXIMUM RATINGS*

Symbol	Parameter	Value	Condition	Unit
V_{CC}	DC Supply Voltage	-0.5 to +7.0		V
V_I	DC Input Voltage	$-0.5 \leq V_I \leq V_{CC} + 0.5V$		V
V_O	DC Output Voltage	$-0.5 \leq V_O \leq V_{CC} + 0.5$	Output in HIGH or LOW State	V
I_{IK}	DC Input Diode Current	-20	$V_I = -0.5V$	mA
		+20	$V_I = V_{CC} + 0.5V$	mA
I_{OK}	DC Output Diode Current	-20	$V_O = -0.5V$	mA
		+20	$V_I = V_{CC} + 0.5V$	mA
I_O	DC Output Source/Sink Current	± 50		mA
I_{CC}	DC Supply Current	± 200		mA
I_{GND}	DC Ground Current	± 200		mA
T_{STG}	Storage Temperature Range	-65 to +150		°C

* Absolute maximum continuous ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute-maximum-rated conditions is not implied.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Unit
V_{CC}	Supply Voltage	2.0	3.3	3.6	V
V_I	Input Voltage	0		V_{CC}	V
V_O	Output Voltage	0		V_{CC}	V
T_A	Operating Free-Air Temperature	-40		+85	°C
$\Delta V/\Delta t$	Input Transition Rise or Fall Rate, V_{IN} from 0.8V to 2.0V, $V_{CC} = 3.0V$	0		125	mV/ns

DC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic	Condition	$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		Unit
			Min	Max	
V_{IH}	HIGH Level Input Voltage (Note 1)	$2.7V \leq V_{CC} \leq 3.6V$, $V_O = 0.1V$ or $V_{CC} - 0.1V$	2.0		V
V_{IL}	LOW Level Input Voltage (Note 1)	$2.7V \leq V_{CC} \leq 3.6V$, $V_O = 0.1V$ or $V_{CC} - 0.1V$		0.8	V
V_{OH}	HIGH Level Output Voltage	$2.7V \leq V_{CC} \leq 3.6V$; $I_{OH} = -50\mu A$	$V_{CC} - 0.1$		V
		$V_{CC} = 2.7V$; $I_{OH} = -12mA$	2.2		
		$V_{CC} = 3.0V$; $I_{OH} = -12mA$	2.48		
V_{OL}	LOW Level Output Voltage	$2.7V \leq V_{CC} \leq 3.6V$; $I_{OL} = 50\mu A$		0.1	V
		$2.7V \leq V_{CC} \leq 3.6V$; $I_{OL} = 12mA$		0.4	
I_I	Input Leakage Current	$2.7V \leq V_{CC} \leq 3.6V$; $V_I = V_{CC}$, GND		± 1.0	μA
I_{OLD}	Minimum Dynamic Output Current (Note 2)	$V_{CC} = 3.6V$; $V_{OLD} = 0.8V$ Max		36	mA
I_{OHD}		$V_{CC} = 3.6V$; $V_{OHD} = 2.0V$ Min		-25	mA
I_{CC}	Quiescent Supply Current	$2.7V \leq V_{CC} \leq 3.6V$; $V_I = V_{CC}$, GND		10	μA

- These values of V_I are used to test DC electrical characteristics only. Functional test should use $V_{IH} \geq 2.4V$, $V_{IL} \leq 0.5V$.
- Incident wave switching on transmission lines with impedances as low as 75Ω for commercial temperature range is guaranteed. Maximum test duration is 2ms, one output loaded at a time.

DYNAMIC SWITCHING CHARACTERISTICS ($V_{CC} = 3.3V$)

Symbol	Characteristic	Condition	$T_A = +25^\circ C$			Unit
			Min	Typ	Max	
VOLP	Dynamic LOW Peak Voltage (Note 1)	$C_L = 50pF$, $V_{IH} = 3.3V$, $V_{IL} = 0V$		0.6	1.0	V
VOLV	Dynamic LOW Valley Voltage (Note 1)	$C_L = 50pF$, $V_{IH} = 3.3V$, $V_{IL} = 0V$		-0.5	-1.0	V
VIHD	High Level Dynamic Input Voltage (Note 2)	Input–Under–Test Switching 0V to Threshold, $f=1MHz$		1.5	2.0	V
VILD	Low Level Dynamic Input Voltage (Note 2)	Input–Under–Test Switching 3.3V to Threshold, $f=1MHz$		1.5	0.8	V

1. Number of outputs defined as “n”. Measured with “n–1” outputs switching from HIGH–to–LOW. The remaining output is measured in the LOW state.
2. Number of data inputs is defined as “n” switching, “n–1” inputs switching 0V to 3.3V.

AC CHARACTERISTICS ($t_R = t_F = 2.5ns$; $C_L = 50pF$; $R_L = 500\Omega$)

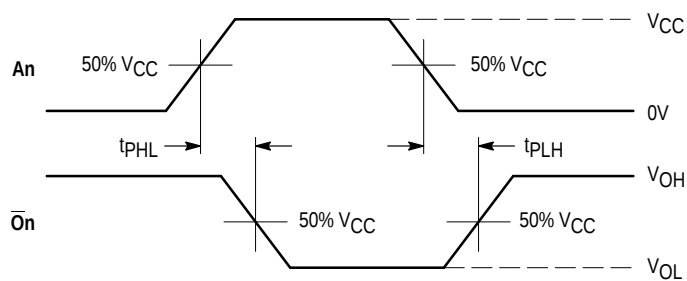
Symbol	Parameter	Limits									Unit
		T _A = +25°C						T _A = −40°C to +85°C			
		V _{CC} = 3.0V to 3.6V			V _{CC} = 2.7V			V _{CC} = 3.0V to 3.6V		V _{CC} = 2.7V	
		Min	Typ	Max	Min	Typ	Max	Min	Max	Max	
t _{PLH} t _{PHL}	Propagation Delay Input to Output	1.5 1.5	5.0 5.0	9.0 8.5	1.5 1.5	6.5 5.4	10.5 9.5	1.0 1.0	10.0 9.5	11.0 10.0	ns
t _{OSHL} t _{OSLH}	Output-to-Output Skew (Note 1)		1.0 1.0	1.5 1.5		1.0 1.0	1.5 1.5		1.5 1.5		ns

1. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH–to–LOW (t_{OSHL}) or LOW–to–HIGH (t_{OSLH}); parameter guaranteed by design.

CAPACITIVE CHARACTERISTICS

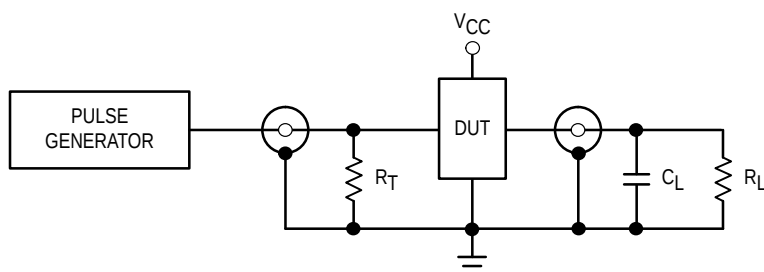
Symbol	Parameter	Condition	Typical	Unit
C_{PD}	Power Dissipation Capacitance	10MHz, $V_{CC} = 3.3V$, $V_I = 0V$ or V_{CC}	14	pF
C_{IN}	Input Capacitance	$V_{CC} = \text{Open}$, $V_I = 0V$ or V_{CC}	4.5	pF

MC74LVQ04



PROPAGATION DELAYS
 $t_R = t_F = 2.5\text{ns}$, 10% to 90%; $f = 1\text{MHz}$; $t_W = 500\text{ns}$

Figure 1. AC Waveforms

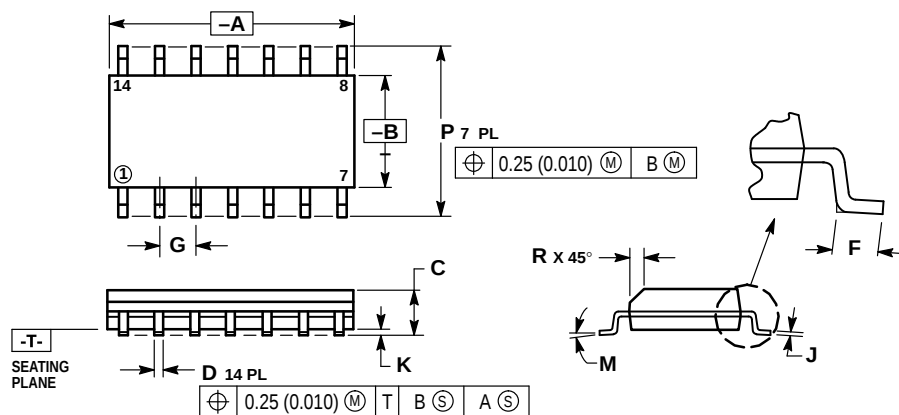


$C_L = 50\text{pF}$ or equivalent (Includes jig and probe capacitance)
 $R_L = R_1 = 500\Omega$ or equivalent
 $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

Figure 2. Test Circuit

OUTLINE DIMENSIONS

D SUFFIX
PLASTIC SOIC PACKAGE
CASE 751A-03
ISSUE F

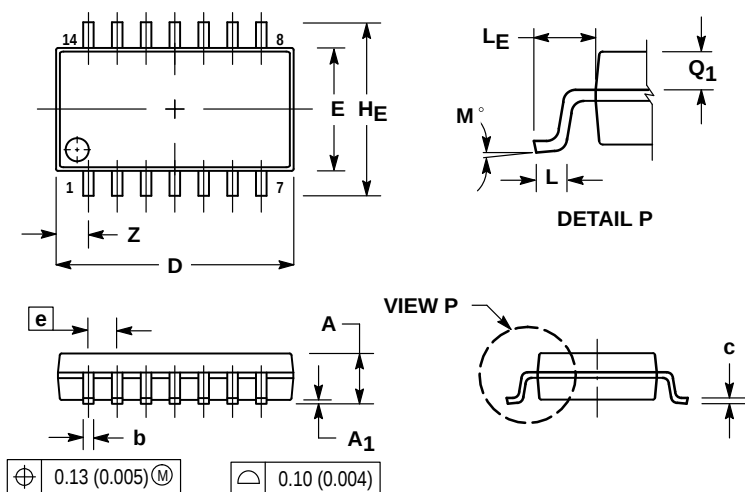


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	8.55	8.75	0.337	0.344
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.228	0.244
R	0.25	0.50	0.010	0.019

M SUFFIX
PLASTIC SOIC EIAJ PACKAGE
CASE 965-01
ISSUE O



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	---	2.05	---	0.081
A ₁	0.05	0.20	0.002	0.008
b	0.35	0.50	0.014	0.020
c	0.18	0.27	0.007	0.011
D	9.90	10.50	0.390	0.413
E	5.10	5.45	0.201	0.215
e	1.27 BSC		0.050 BSC	
H _E	7.40	8.20	0.291	0.323
L	0.50	0.85	0.020	0.033
L _E	1.10	1.50	0.043	0.059
M	0°	10°	0°	10°
Q ₁	0.70	0.90	0.028	0.035
Z	---	1.42	---	0.056

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