MC74VHC125

Quad Bus Buffer
with 3−State Control Inputs

The MC74VHC125 is a high speed CMOS quad bus buffer fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining CMOS low power dissipation.

The MC74VHC125 requires the 3−state control input ($\overline{OE}$) to be set High to place the output into the high impedance state.

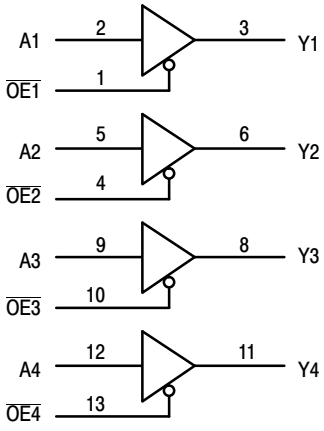
The internal circuit is composed of three stages, including a buffer output which provides high noise immunity and stable output. The inputs tolerate voltages up to 7 V, allowing the interface of 5 V systems to 3 V systems.

Features

- High Speed: t_{PD} = 3.8ns (Typ) at V_{CC} = 5 V
- Low Power Dissipation: I_{CC} = 4 μA (Max) at T_A = 25°C
- High Noise Immunity: $V_{NIH} = V_{NIL}$ = 28% V_{CC}
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Designed for 2 V to 5.5 V Operating Range
- Low Noise: V_{OLP} = 0.8 V (Max)
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300 mA
- ESD Performance: Human Body Model; > 2000 V,
  Machine Model; > 200 V
- Chip Complexity: 72 FETs or 18 Equivalent Gates
- These Devices are Pb−Free and are RoHS Compliant

LOGIC DIAGRAM

Active−Low Output Enables

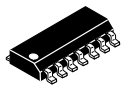


FUNCTION TABLE

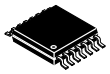
VHC125		
Inputs		Output
A	$\overline{OE}$	Y
H	L	H
L	L	L
X	H	Z

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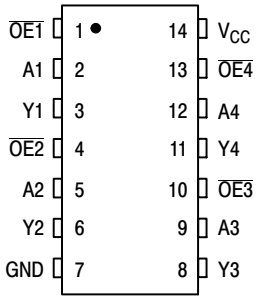
14−LEAD SOIC
D SUFFIX
CASE 751A



14−LEAD TSSOP
DT SUFFIX
CASE 948G

PIN CONNECTION AND MARKING DIAGRAM

(Top View)



DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 6 of this data sheet.

ORDERING INFORMATION

Device	Package	Shipping†
MC74VHC125DG	SOIC−14 (Pb−Free)	55 Units / Rail
MC74VHC125DR2G	SOIC−14 (Pb−Free)	2500 / Tape & Reel
MC74VHC125DTR2G	TSSOP−14 (Pb−Free)	2500 / Tape & Reel

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

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MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	DC Supply Voltage	–0.5 to +7.0	V
V_{in}	DC Input Voltage	–0.5 to +7.0	V
V_{out}	DC Output Voltage	–0.5 to V_{CC} +0.5	V
I_{IK}	Input Diode Current	− 20	mA
I_{OK}	Output Diode Current	± 20	mA
I_{out}	DC Output Current, per Pin	± 25	mA
I_{CC}	DC Supply Current, V_{CC} and GND Pins	± 50	mA
P_D	Power Dissipation in Still Air, SOIC Packages† TSSOP Package†	500 450	mW
T_{stg}	Storage Temperature	–65 to +150	°C

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.

†Derating − SOIC Packages: – 7 mW/°C from 65° to 125°C
TSSOP Package: − 6.1 mW/°C from 65° to 125°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high−impedance circuit. For proper operation, V_{in} and V_{out} should be constrained to the range GND ≤ (V_{in} or V_{out}) ≤ V_{CC}.

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.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min	Max	Unit
V_{CC}	DC Supply Voltage		2.0	5.5	V
V_{in}	DC Input Voltage		0	5.5	V
V_{out}	DC Output Voltage		0	V_{CC}	V
T_A	Operating Temperature, All Package Types		−55	+125	°C
t_r, t_f	Input Rise and Fall Time	V_{CC} = 3.3 V ±0.3 V V_{CC} =5.0 V ±0.5 V	0 0	100 20	ns/V

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.

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	V_{CC} (V)	T_A = 25°C Min	T_A = 25°C Typ	T_A = 25°C Max	$T_A \le 85°C$ Min	$T_A \le 85°C$ Max	$T_A \le 125°C$ Min	$T_A \le 125°C$ Max	Unit
V_{IH}	Minimum High−Level Input Voltage		2.0 3.0 4.5 5.5	1.5 2.1 3.15 3.85			1.5 2.1 3.15 3.85		1.5 2.1 3.15 3.85		V
V_{IL}	Maximum Low−Level Input Voltage		2.0 3.0 4.5 5.5			0.5 0.9 1.35 1.65		0.5 0.9 1.35 1.65		0.5 0.9 1.35 1.65	V
V_{OH}	Minimum High−Level Output Voltage $V_{IN} = V_{IH}$ or V_{IL}	$V_{IN} = V_{IH}$ or V_{IL} $I_{OH} = -50$ μA	2.0 3.0 4.5	1.9 2.9 4.4	2.0 3.0 4.5		1.9 2.9 4.4		1.9 2.9 4.4		V
		$V_{IN} = V_{IH}$ or V_{IL} $I_{OH} = -4$ mA $I_{OH} = -8$ mA	3.0 4.5	2.58 3.94			2.48 3.80		2.34 3.66		V
V_{OL}	Maximum Low−Level Output Voltage $V_{IN} = V_{IH}$ or V_{IL}	$V_{IN} = V_{IH}$ or V_{IL} $I_{OL} = 50$ μA	2.0 3.0 4.5		0.0 0.0 0.0	0.1 0.1 0.1		0.1 0.1 0.1		0.1 0.1 0.1	V
		$V_{IN} = V_{IH}$ or V_{IL} $I_{OL} = 4$ mA $I_{OL} = 8$ mA	3.0 4.5			0.36 0.36		0.44 0.44		0.52 0.52	V
I_{OZ}	Maximum 3−State Leakage Current	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = V_{CC}$ or GND	5.5			±0.25		±2.5		±2.5	μA
I_{IN}	Maximum Input Leakage Current	$V_{IN} = 5.5$V or GND	0 to 5.5			±0.1		±1.0		±1.0	μA
I_{CC}	Maximum Quiescent Supply Current	$V_{IN} = V_{CC}$ or GND	5.5			4.0		40		40	μA

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 (Input $t_r = t_f = 3.0$ ns)

Symbol	Parameter	Test Conditions	$T_A = 25°C$ Min	$T_A = 25°C$ Typ	$T_A = 25°C$ Max	$T_A \leq 85°C$ Min	$T_A \leq 85°C$ Max	$T_A \leq 125°C$ Min	$T_A \leq 125°C$ Max	Unit
t_{PLH}, t_{PHL}	Maximum Propagation Delay, A to Y	V_{CC} = 3.3 ± 0.3V C_L = 15 pF		5.6	8.0	1.0	9.5	1.0	12.0	ns
		C_L = 50 pF		8.1	11.5	1.0	13.0	1.0	16.0	
		V_{CC} = 5.0 ± 0.5V C_L = 15 pF		3.8	5.5	1.0	6.5	1.0	8.5	
		C_L = 50 pF		5.3	7.5	1.0	8.5	1.0	10.5	
t_{PZL}, t_{PZH}	Maximum Output Enable TIme, $\overline{OE}$ to Y	V_{CC} = 3.3 ± 0.3V C_L = 15 pF, R_L = 1 kΩ		5.4	8.0	1.0	9.5	1.0	11.5	ns
		C_L = 50 pF		7.9	11.5	1.0	13.0	1.0	15.0	
		V_{CC} = 5.0 ± 0.5V C_L = 15 pF, R_L = 1 kΩ		3.6	5.1	1.0	6.0	1.0	7.5	
		C_L = 50 pF		5.1	7.1	1.0	8.0	1.0	9.5	
t_{PLZ}, t_{PHZ}	Maximum Output Disable Time, $\overline{OE}$ to Y	V_{CC} = 3.3 ± 0.3V C_L = 50 pF, R_L = 1 kΩ		9.5	13.2	1.0	15.0	1.0	18.0	ns
		V_{CC} = 5.0 ± 0.5V C_L = 50 pF, R_L = 1 kΩ		6.1	8.8	1.0	10.0	1.0	12.0	
t_{OSLH}, t_{OSHL}	Output−to−Output Skew	V_{CC} = 3.3 ± 0.3V C_L = 50 pF (Note 1)			1.5		1.5		1.5	ns
		V_{CC} = 5.0 ± 0.5V C_L = 50 pF (Note 1)			1.0		1.0		1.0	
C_{in}	Maximum Input Capacitance			4	10		10		10	pF
C_{out}	Maximum Three−State Output Capacitance (Output in High Impedance State)			6						pF

		Typical @ 25°C, V_{CC} = 5.0 V	
C_{PD}	Power Dissipation Capacitance (Note 2)	14	pF

1. Parameter guaranteed by design. $t_{OSLH} = |t_{PLHm} - t_{PLHn}|$, $t_{OSHL} = |t_{PHLm} - t_{PHLn}|$.
2. C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: $I_{CC(OPR)} = C_{PD} \bullet V_{CC} \bullet f_{in} + I_{CC}/4$ (per buffer). C_{PD} is used to determine the no−load dynamic power consumption; $P_D = C_{PD} \bullet V_{CC}^2 \bullet f_{in} + I_{CC} \bullet V_{CC}$.

NOISE CHARACTERISTICS (Input $t_r = t_f = 3.0$ ns, C_L = 50 pF, V_{CC} = 5.0 V)

Symbol	Characteristic	$T_A = 25°C$ Typ	$T_A = 25°C$ Max	Unit
V_{OLP}	Quiet Output Maximum Dynamic V_{OL}	0.3	0.8	V
V_{OLV}	Quiet Output Minimum Dynamic V_{OL}	−0.3	−0.8	V
V_{IHD}	Minimum High Level Dynamic Input Voltage		3.5	V
V_{ILD}	Maximum Low Level Dynamic Input Voltage		1.5	V

SWITCHING WAVEFORMS

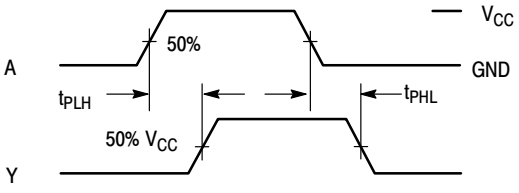


Figure 1.

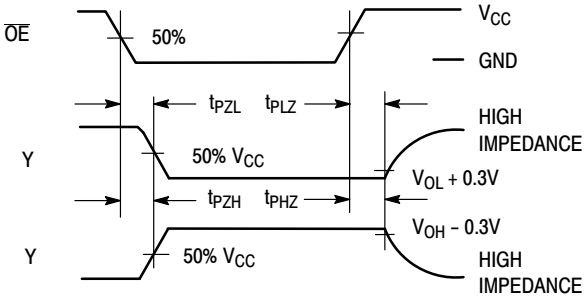
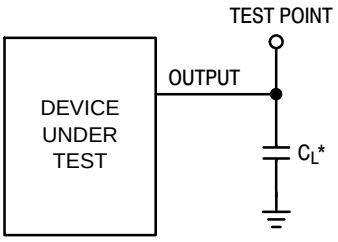
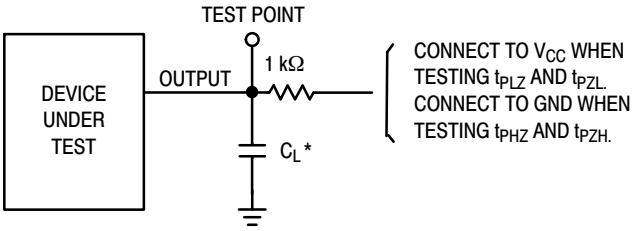


Figure 2.



*Includes all probe and jig capacitance

Figure 3. Test Circuit



*Includes all probe and jig capacitance

Figure 4. Test Circuit

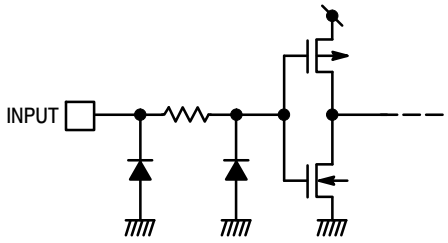
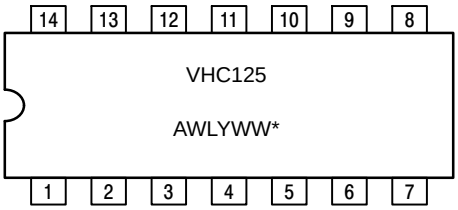
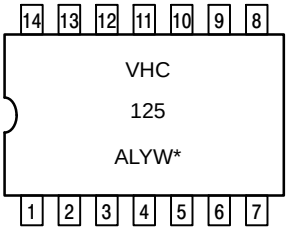


Figure 5. Input Equivalent Circuit

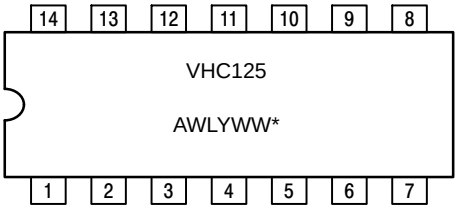
MARKING DIAGRAMS
(Top View)



14−LEAD SOIC
D SUFFIX
CASE 751A



14−LEAD TSSOP
DT SUFFIX
CASE 948G

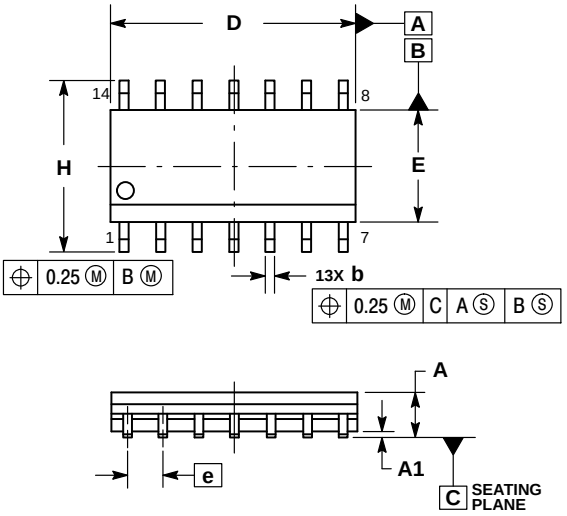


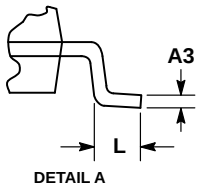
14−LEAD SOIC EIAJ
M SUFFIX
CASE 965

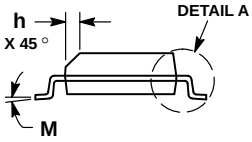
*See Applications Note AND8004/D for date code and traceability information.

PACKAGE DIMENSIONS

SOIC−14
CASE 751A−03
ISSUE K



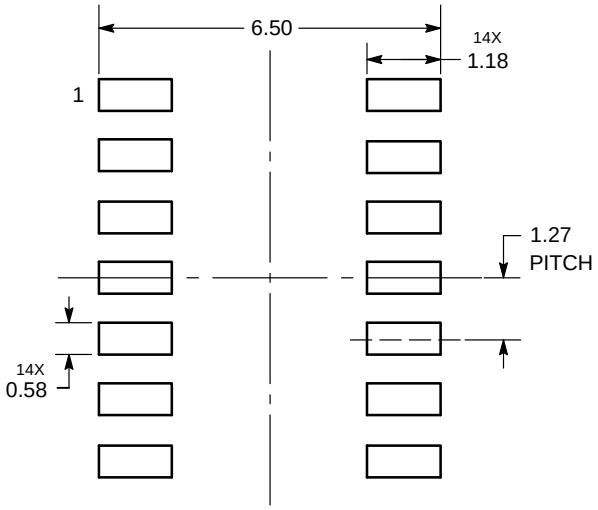




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
5. MAXIMUM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

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	1.35	1.75	0.054	0.068
A1	0.10	0.25	0.004	0.010
A3	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
E	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
H	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 °

SOLDERING FOOTPRINT*

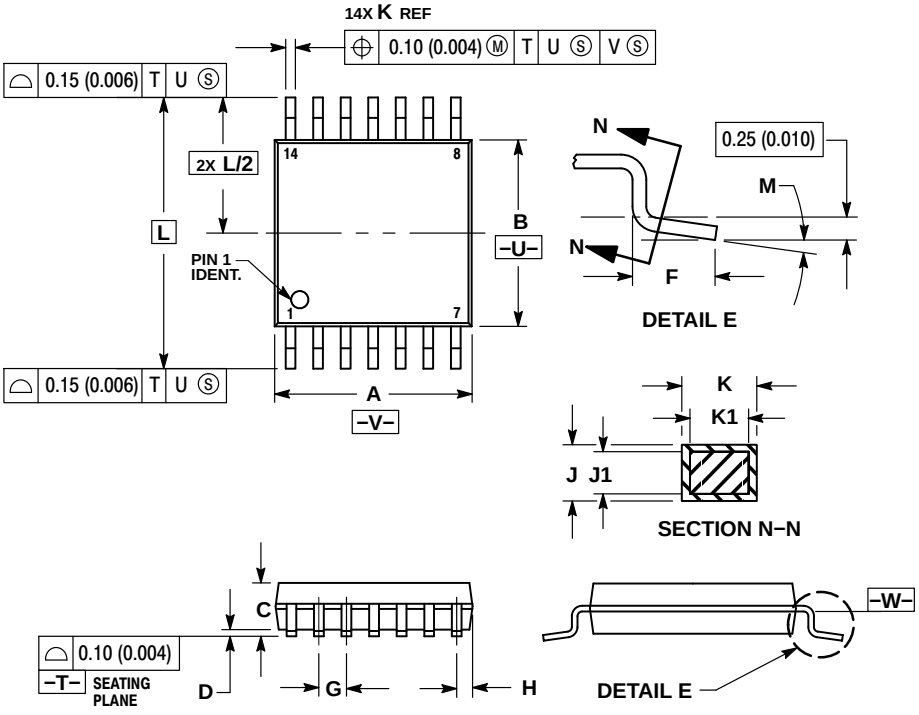


DIMENSIONS: MILLIMETERS

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

PACKAGE DIMENSIONS

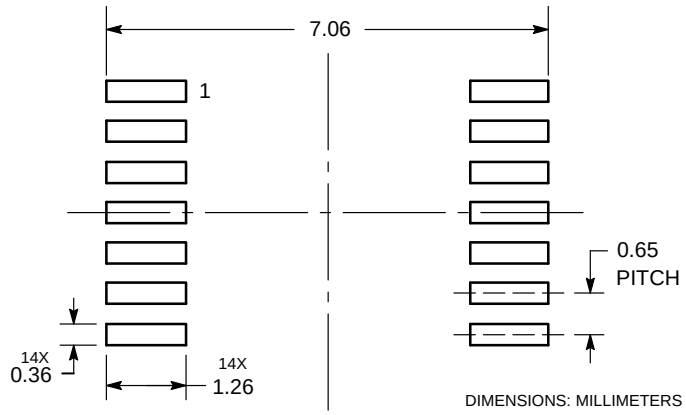
TSSOP−14
CASE 948G
ISSUE B



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.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. 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.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE −W−.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	−−−	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	
H	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	
M	0 °	8 °	0 °	8 °

SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

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