National Semiconductor

DM74ALS14
Hex Inverter with Schmitt Trigger Inputs

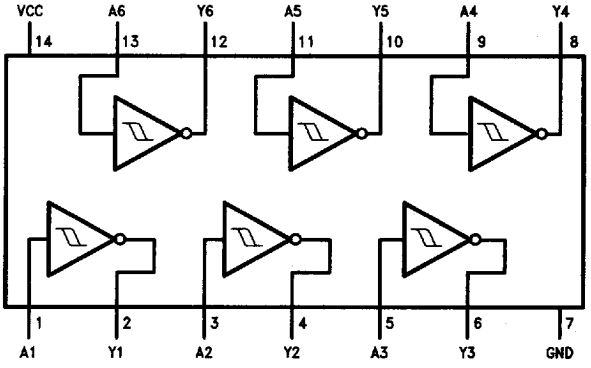
General Description

This device contains six independent gates, each of which performs the logic INVERT function. Each input has hysteresis which increases the noise immunity and transforms a slowly changing input signal to a fast changing, jitter-free output.

Features

- Input Hysteresis
- Low output noise generation
- High input noise immunity
- Switching specification at 50 pF
- Switching specifications guaranteed over full temperature and V_{CC} range
- Advanced oxide-isolated, ion-implanted Schottky TTL process
- Functionally and pin-for-pin compatible with Schottky and Low Power Schottky TTL counterparts
- Improved AC performance over low power Schottky counterpart

Connection Diagram



TL/F/8773–1

Order Number DM74ALS14M, DM74ALS14N or DM74ALS14SJ
See NS Package Number M14A, M14D or N14A

Function Table

$Y = \overline{A}$

Input A	Output Y
L	H
H	L

H = High Logic Level
L = Low Logic Level

Absolute Maximum Ratings

Supply Voltage	7V
Input Voltage	7V
Storage Temperature Range	−65°C to +150°C
Operating Free Air Temperature Range	
DM74ALS	0°C to +70°C
Typical θ_{JA}	
N Package	78.5°C/W
M Package	109.0°C/W

NOTE: *The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.*

Recommended Operating Conditions

Symbol	Parameter		Min	Nom	Max	Units
V_{CC}	Supply Voltage		4.5	5	5.5	V
V_{T+}	Positive-Going Input Threshold Voltage	V_{CC} = Min to Max	1.4		2	V
		V_{CC} = 5V	1.55		1.85	
V_{T-}	Negative-Going Input Threshold Voltage	V_{CC} = Min to Max	0.75		1.2	V
		V_{CC} = 5V	0.85		1.1	
HYS	Input Hysteresis	V_{CC} = Min to Max	0.5			V
		V_{CC} = 5V	0.6			
I_{OH}	High Level Output Current				−0.4	mA
I_{OL}	Low Level Output Current				8	mA
T_A	Operating Free Air Temperature Range		0		70	°C

Electrical Characteristics over recommended free air temperature range (unless otherwise noted)

Symbol	Parameter	Test Conditions		Min	Typ	Max	Units
V_{IK}	Input Clamp Voltage	V_{CC} = Min, I_I = −18 mA				−1.5	V
V_{OH}	High Level Output Voltage	V_{CC} = 4.5V to 5.5V, I_{OH} = Max		V_{CC} − 2			V
V_{OL}	Low Level Output Voltage	V_{CC} = Min	I_{OL} = 4 mA		0.25	0.4	V
			I_{OL} = 8 mA		0.35	0.5	V
I_{T+}	Input Current at Positive-Going Threshold Voltage	V_{CC} = 5V, V_I = V_{T+}				20	μA
I_{T-}	Input Current at Negative-Going Threshold Voltage	V_{CC} = 5V, V_I = V_{T-}				−100	μA
I_I	Input Current at Maximum Input Voltage	V_{CC} = Max, V_I = 7V				100	μA
I_{IH}	High Level Input Current	V_{CC} = Max, V_I = 2.7V				20	μA
I_{IL}	Low Level Input Current	V_{CC} = Max, V_I = 0.4V				−100	μA
I_O	Output Drive Current	V_{CC} = Max, V_O = 2.25V		−30		−112	mA
I_{CCH}	Supply Current with Outputs High	V_{CC} = Max				12	mA
I_{CCL}	Supply Current with Outputs Low	V_{CC} = Max				12	mA

Electrical Characteristics over recommended free air temperature range (unless otherwise noted) (Continued)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
V_{OLP}	Quiet Output Maximum Dynamic V_{OL}	V_{CC} = 5.0V, T_A = 25°C (*Figures 1, 2;* Notes 1, 2)		0.16		V
V_{OLV}	Quiet Output Minimum Dynamic V_{OL}	V_{CC} = 5.0V, T_A = 25°C (*Figures 1, 2;* Notes 1, 2)		−0.27		V
V_{IHD}	Minimum High Level Dynamic Input Voltage	V_{CC} = 5.0V, T_A = 25°C (Notes 1, 3)		1.44		V
V_{ILD}	Maximum Low Level Dynamic Input Voltage	V_{CC} = 5.0V, T_A = 25°C (Notes 1, 3)		1.15		V

Note 1: Plastic DIP package.

Note 2: n = number of device outputs, n − 1 outputs switching, each driven 0V to 3V one output @ GND.

Note 3: n = number of device outputs, n outputs switching, n − 1 inputs switching 0V to 3V. Input under test switching 3V to threshold (V_{ILD}); 0V to threshold (V_{IHD}); f = 1 MHz.

ALS Noise Characteristics

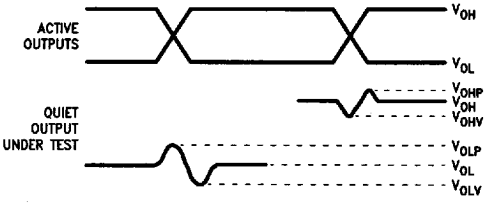
The setup of a noise characteristics measurement is critical to the accuracy and repeatability of the tests. The following is a brief description of the setup used to measure the noise characteristics of ALS.

Equipment:

Word Generator
Printed Circuit Board Test Fixture
Dual Trace Oscilloscope

Procedure:

1. Verify Test Fixture Loading: Standard Load 50 pF, 500Ω.
2. Deskew the word generator so that no two channels have greater than 150 ps skew between them. This requires that the oscilloscope be deskewed first. Swap out the channels that have more than 150 ps of skew until all channels being used are within 150 ps. It is important to deskew the word generator channels before testing. This will ensure that the outputs switch simultaneously.
3. Terminate all inputs and outputs to ensure proper loading of the outputs and that the input levels are at the correct voltage.
4. Set V_{CC} to 5.0V.
5. Set the word generator to toggle all but one output at a frequency of 1 MHz. Greater frequencies will increase DUT heating and affect the results of the measurement.



TL/F/8773–2

FIGURE 1. Quiet Output Noise Voltage Waveforms

Note A. V_{OHV} and V_{OHP} are measured with respect to V_{OH} reference. V_{OLV} and V_{OLP} are measured with respect to ground reference.

Note B. Input pulses have the following characteristics: f = 1 MHz, t_r = 3 ns, t_f = 3 ns, skew < 150 ps.

6. Set the word generator input levels at 0V LOW and 3V HIGH. Verify levels with a digital volt meter.

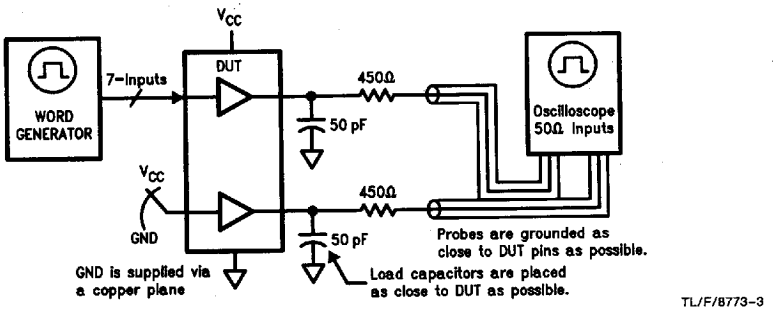
V_{OLP}/V_{OLV} and V_{OHP}/V_{OHV}:

- Determine the quiet output pin that demonstrates the greatest noise levels. The worst case pin will usually be the furthest from the ground pin. Monitor the output voltages using a 50Ω coaxial cable plugged into a standard SMB type connector on the test fixture. Do not use an active FET probe.
- Verify that the GND reference recorded on the oscilloscope has not drifted to ensure the accuracy and repeatability of the measurements.

ALS Noise Characteristics (Continued)

V_{ILD} and V_{IHD}:

- Monitor one of the switching outputs using a 50Ω coaxial cable plugged into a standard SMB type connector on the test fixture. Do not use an active FET probe.
- First increase the input LOW voltage level, V_{IL}, until the output begins to oscillate. Oscillation is defined as noise on the output LOW level that exceeds V_{IL} limits, or on output HIGH levels that exceed V_{IH} limits. The input LOW voltage level at which oscillation occurs is defined as V_{ILD}.
- Next decrease the input HIGH voltage level on the word generator, V_{IH} until the output begins to oscillate. Oscillation is defined as noise on the output LOW level that exceeds V_{IL} limits, or on output HIGH levels that exceed V_{IH} limits. The input HIGH voltage level at which oscillation occurs is defined as V_{IHD}.
- Verify that the GND reference recorded on the oscilloscope has not drifted to ensure the accuracy and repeatability of the measurements.



TL/F/8773–3

FIGURE 2. Simultaneous Switching Test Circuit

Switching Characteristics over recommended operating free air temperature range

Symbol	Parameter	Conditions (Note 1)	DM74ALS14		Units
			Min	Max	
t_{PLH}	Propagation Delay Time Low to High Level Output	V_{CC} = 4.5V to 5.5V R_L = 500Ω, C_L = 50 pF	2	12	ns
t_{PHL}	Propagation Delay Time High to Low Level Output		2	10	ns

Note 1: See Section 5 for test waveforms and output load.