3.3V CMOS HEX INVERTER WITH 5 VOLT TOLERANT INPUTS

IDT74LVCU04A

FEATURES:

- **0.5 MICRON CMOS Technology**
- **ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)**
- **Vcc = 3.3V ± 0.3V, Normal Range**
- **Vcc = 2.7V to 3.6V, Extended Range**
- **CMOS power levels (0.4µ W typ. static)**
- **Rail-to-Rail output swing for increased noise margin**
- **Inputs are 5V tolerant**
- **Available in SOIC, SSOP, and TSSOP packages**

DESCRIPTION:

The LVCU04A hex inverter is built using advanced dual metal CMOS technology. This device contains six independent inverters with unbuffered outputs and performs the Boolean function $Y = \overline{A}$.

The LVCU04A has been designed with a ±24mA output driver. This driver is capable of driving a moderate to heavy load while maintaining speed performance.

Inputs can be driven from either 3.3V or 5V devices. This feature allows the use of this device as a translator in a mixed 3.3V/5V system environment.

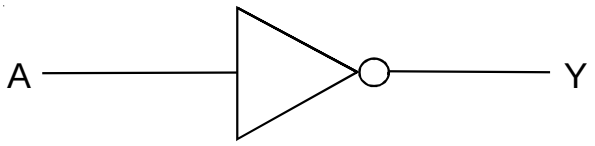
DRIVE FEATURES:

- **High Output Drivers: ±24mA**
- **Reduced system switching noise**

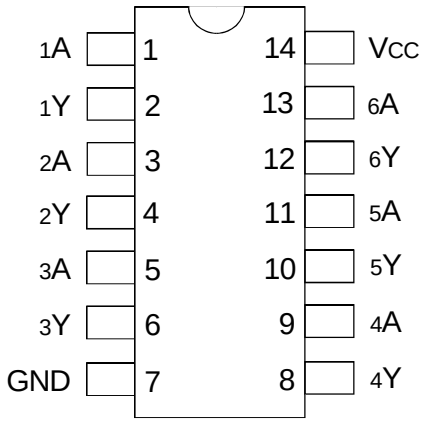
APPLICATIONS:

- **5V and 3.3V mixed voltage systems**
- **Data communication and telecommunication systems**

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION



SOIC/ SSOP/ TSSOP
TOP VIEW

PIN DESCRIPTION

Pin Names	Description
xA	Data Inputs
xY	Data Outputs

FUNCTION TABLE (EACH INVERTER)(1)

Inputs	Outputs
xA	**xY**
H	L
L	H

NOTE:
1. H = HIGH Voltage Level
   L = LOW Voltage Level

ABSOLUTE MAXIMUM RATINGS(1)

Symbol	Description	Max	Unit
V_{TERM}(2)	Terminal Voltage with Respect to GND	–0.5 to +6.5	V
V_{TERM}(3)	Terminal Voltage with Respect to GND	–0.5 to V_{CC}+0.5	V
T_{STG}	Storage Temperature	–65 to +150	°C
I_{OUT}	DC Output Current	–50 to +50	mA
I_{IK} I_{OK}	Continuous Clamp Current, V_I < 0 or V_O < 0	–50	mA
I_{CC} I_{SS}	Continuous Current through each V_{CC} or GND	±100	mA

NOTES:
1. Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
2. Vcc and Input terminals.
3. Output terminals only.

CAPACITANCE (T_A = +25°C, F = 1.0MHz)

Symbol	Parameter(1)	Conditions	Typ.	Max.	Unit
C_{IN}	Input Capacitance	V_{IN} = 0V	4.5	6	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0V	5.5	8	pF
$C_{I/O}$	I/O Port Capacitance	V_{IN} = 0V	6.5	8	pF

NOTE:
1. As applicable to the device type.

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:
Operating Condition: T_A = –40°C to +85°C

Symbol	Parameter	Test Conditions		Min.	Typ.(1)	Max.	Unit
V_{IH}	Input HIGH Voltage Level	V_{CC} = 1.65V		1.32	—	—	V
		V_{CC} = 2.3V		1.84	—	—	
		V_{CC} = 2.7V		2.16	—	—	
		V_{CC} = 3V		2.4	—	—	
		V_{CC} = 3.6V		2.88	—	—	
V_{IL}	Input LOW Voltage Level	V_{CC} = 1.65V		—	—	0.4	V
		V_{CC} = 2.3V		—	—	0.5	
		V_{CC} = 2.7V to 3.6V		—	—	0.65	
I_{IH} I_{IL}	Input Leakage Current	V_{CC} = 3.6V	V_I = 0 to 5.5V	—	—	±5	µA
V_{IK}	Clamp Diode Voltage	V_{CC} = 2.3V, I_{IN} = –18mA		—	–0.7	–1.2	V
V_H	Input Hysteresis	V_{CC} = 3.3V		—	100	—	mV
I_{CCL} I_{CCH} I_{CCZ}	Quiescent Power Supply Current	V_{CC} = 3.6V, V_{IN} = GND or V_{CC}		—	—	10	µA
ΔI_{CC}	Quiescent Power Supply Current Variation	One input at V_{CC} - 0.6V, other inputs at V_{CC} or GND		—	—	500	µA

NOTE:
1. Typical values are at V_{CC} = 3.3V, +25°C ambient.

OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions[1]		Min.	Max.	Unit
V_{OH}	Output HIGH Voltage	V_{CC} = 1.65V to 3.6V	I_{OH} = – 0.1mA	V_{CC} – 0.2	—	V
		V_{CC} = 1.65V	I_{OH} = – 4mA	1.2	—	
		V_{CC} = 2.3V	I_{OH} = – 8mA	1.7	—	
		V_{CC} = 2.7V	I_{OH} = – 12mA	2.2	—	
		V_{CC} = 3V		2.4	—	
		V_{CC} = 3V	I_{OH} = – 24mA	2.2	—	
V_{OL}	Output LOW Voltage	V_{CC} =1.65V to 3.6V	I_{OL} = 0.1mA	—	0.2	V
		V_{CC} = 1.65V	I_{OL} = 4mA	—	0.45	
		V_{CC} = 2.3V	I_{OL} = 8mA	—	0.7	
		V_{CC} = 2.7V	I_{OL} = 12mA	—	0.4	
		V_{CC} = 3V	I_{OL} = 24mA	—	0.55	

NOTE:
1. V_{IH} and V_{IL} must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE table for the appropriate V_{CC} range. T_A = – 40°C to + 85°C.

OPERATING CHARACTERISTICS, T_A = 25°C

Symbol	Parameter	Test Conditions	V_{CC} = 2.5V ± 0.2V Typical	V_{CC} = 3.3V ± 0.3V Typical	Unit
C_{PD}	Power Dissipation Capacitance per Inverter	C_L = 0pF, f = 10Mhz	—	5	pF

SWITCHING CHARACTERISTICS[1]

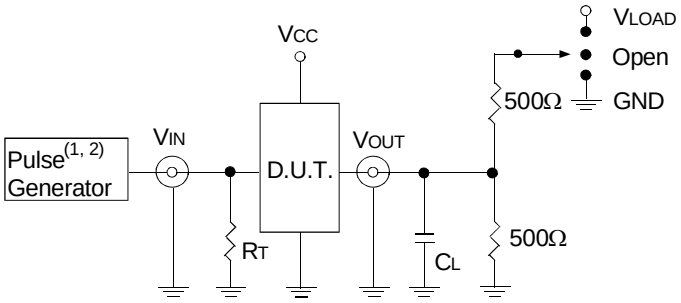
Symbol	Parameter	V_{CC} = 1.8V	V_{CC} = 2.5V ± 0.2V		V_{CC} = 2.7V		V_{CC} = 3.3V ± 0.3V		Unit
		Typ.	Min.	Max.	Min.	Max.	Min.	Max.	
t_{PLH} t_{PHL}	Propagation Delay xA to xY	12.7	1	6.7	—	4.7	1	3.8	ns
$t_{SK}(o)$	Output Skew[2]	—	—	—	—	—	—	1	ns

NOTES:
1. See TEST CIRCUITS AND WAVEFORMS. T_A = – 40°C to + 85°C.
2 Skew between any two outputs of the same package and switching in the same direction.

TEST CIRCUITS AND WAVEFORMS

TEST CONDITIONS

Symbol	$V_{CC}^{(1)}$= 2.5V±0.2V	$V_{CC}^{(2)}$= 3.3V±0.3V & 2.7V	Unit
V_{LOAD}	2 x Vcc	6	V
V_{IH}	Vcc	3	V
V_T	Vcc / 2	1.5	V
V_{LZ}	150	300	mV
V_{HZ}	150	300	mV
C_L	30	50	pF



LVC QUAD Link

Test Circuit for All Outputs

DEFINITIONS:

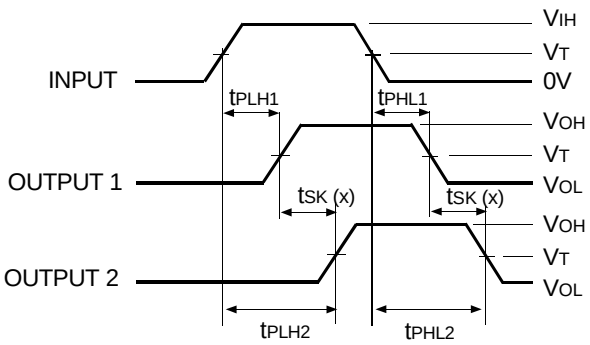
C_L = Load capacitance: includes jig and probe capacitance.
R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

NOTES:

1. Pulse Generator for All Pulses: Rate ≤ 10MHz; t_F ≤ 2ns; t_R ≤ 2ns.
2. Pulse Generator for All Pulses: Rate ≤ 10MHz; t_F ≤ 2.5ns; t_R ≤ 2.5ns.

SWITCH POSITION

Test	Switch
Open Drain Disable Low Enable Low	V_{LOAD}
Disable High Enable High	GND
All Other Tests	Open



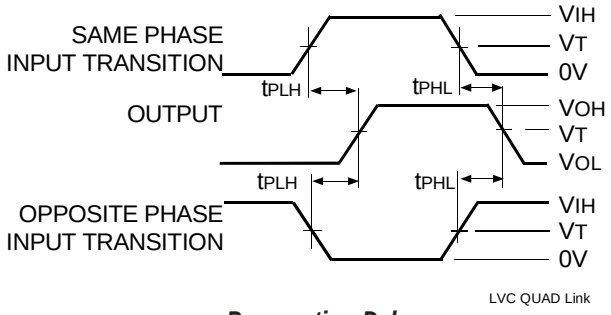
$t_{SK(x)} = |t_{PLH2} - t_{PLH1}|$ or $|t_{PHL2} - t_{PHL1}|$

LVC QUAD Link

Output Skew - $t_{SK(x)}$

NOTES:

1. For t_{SK}(o) OUTPUT1 and OUTPUT2 are any two outputs.
2. For t_{SK}(b) OUTPUT1 and OUTPUT2 are in the same bank.



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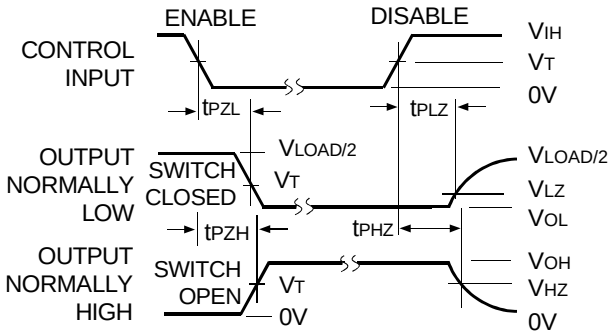
Propagation Delay



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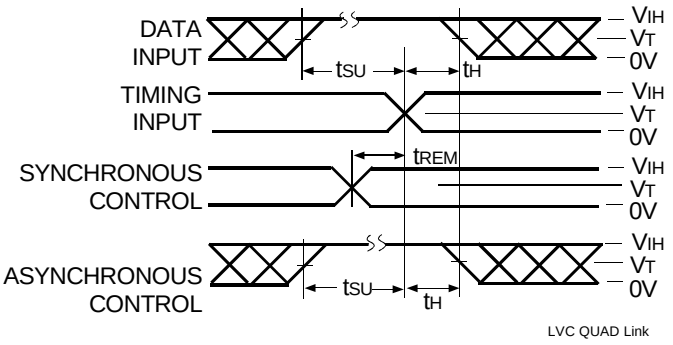
NOTE:

1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.

Enable and Disable Times



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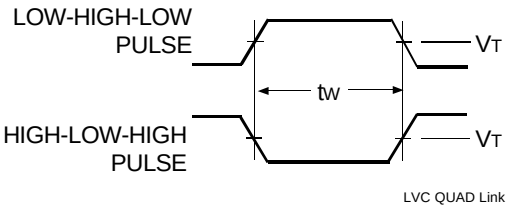
Set-up, Hold, and Release Times



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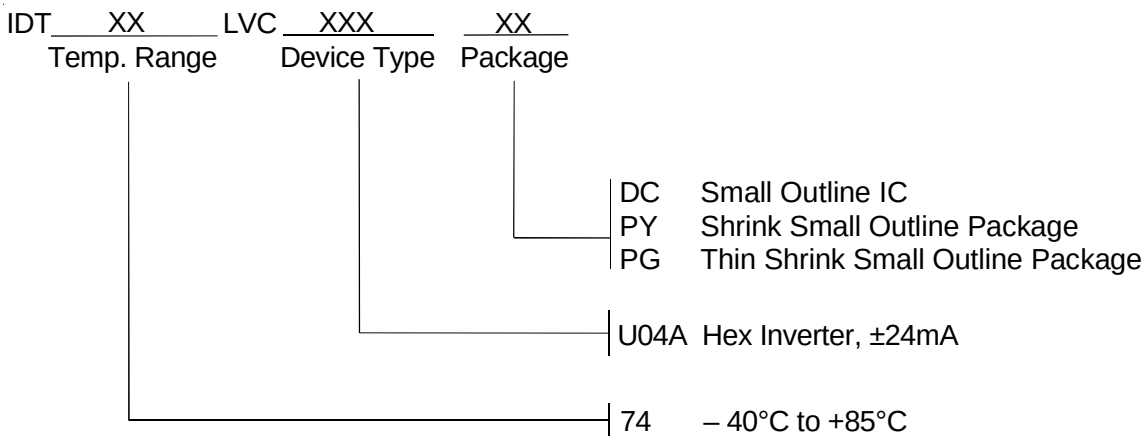
Pulse Width

ORDERING INFORMATION



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