



October 2003
Revised January 2005

NC7NP04 TinyLogic® ULP Triple Inverter

General Description

The NC7NP04 is a triple inverter from Fairchild's Ultra Low Power (ULP) Series of TinyLogic®. Ideal for applications where battery life is critical, this product is designed for ultra low power consumption within the V_{CC} operating range of 0.9V to 3.6V.

The internal circuit is composed of a minimum of inverter stages including the output buffer, to enable ultra low static and dynamic power.

The NC7NP04 is designed for optimized power and speed, and is fabricated with an advanced CMOS technology to achieve high speed, low noise operation while maintaining extremely low CMOS power dissipation.

Features

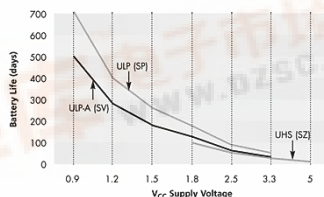
- Space saving US8 package
- Ultra small MicroPak™ Pb-Free package
- 0.9V to 3.6V V_{CC} supply operation
- 3.6V overvoltage tolerant I/O's at V_{CC} from 0.9V to 3.6V
- t_{PD}
 - 4.0 ns typ for 3.0V to 3.6V V_{CC}
 - 5.0 ns typ for 2.3V to 2.7V V_{CC}
 - 6.0 ns typ for 1.65V to 1.95V V_{CC}
 - 7.0 ns typ for 1.40V to 1.60V V_{CC}
 - 11.0 ns typ for 1.10V to 1.30V V_{CC}
 - 27.0 ns typ for 0.90V V_{CC}
- Power-Off high impedance inputs and outputs
- Static Drive (I_{OH}/I_{OL})
 - ±2.6 mA @ 3.00V V_{CC}
 - ±2.1 mA @ 2.30V V_{CC}
 - ±1.5 mA @ 1.65V V_{CC}
 - ±1.0 mA @ 1.40V V_{CC}
 - ±0.5 mA @ 1.10V V_{CC}
 - ±20 μ A @ 0.9V V_{CC}
- Low noise switching using design techniques of Quiet Series™ noise/EMI reduction circuitry
- Ultra low dynamic power

Ordering Code:

Order Number	Package Number	Product Code Top Mark	Package Description	Supplied As
NC7NP04K8X	MAB08A	NP04	8-Lead US8, JEDEC MO-187, Variation CA 3.1mm Wide	3k Units on Tape and Reel
NC7NP04L8X	MAC08A	X5	Pb-Free 8-Lead MicroPak, 1.6 mm Wide	5k Units on Tape and Reel

Pb-Free package per JEDEC J-STD-020B.

Battery Life vs. V_{CC} Supply Voltage



TinyLogic ULP and ULP-A with up to 50% less power consumption can extend your battery life significantly.

$$\text{Battery Life} = (V_{\text{battery}} \cdot I_{\text{battery}} \cdot 9) / (P_{\text{device}}) / 24\text{hrs/day}$$

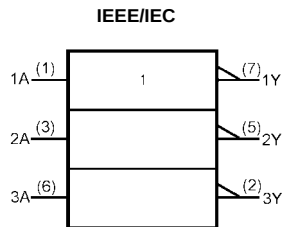
$$\text{Where, } P_{\text{device}} = (I_{CC} \cdot V_{CC}) + (C_{PD} + C_L) \cdot V_{CC}^2 \cdot f$$

Assumes ideal 3.6V Lithium Ion battery with current rating of 900mAh and derated 90% and device frequency at 10MHz, with $C_L = 15$ pF load

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Logic Symbol



Pin Descriptions

Pin Names	Description
A	Input
Y	Output

Function Table

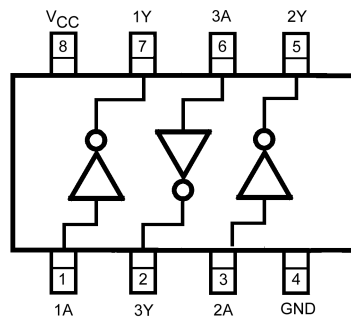
$$Y = \bar{A}$$

Input	Output
A	Y
L	H
H	L

H = HIGH Logic Level
L = LOW Logic Level

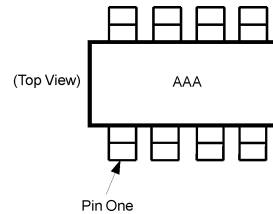
Connection Diagrams

Pin Assignments for US8



(Top View)

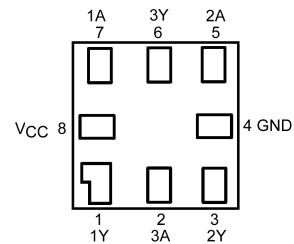
Pin One Orientation Diagram



AAA represents Product Code Top Mark - see ordering code

Note: Orientation of Top Mark determines Pin One location. Read the Top Product Code Mark left to right, Pin One is the lower left pin (see diagram).

Pad Assignments for MicroPak



(Top Thru View)

Absolute Maximum Ratings(Note 1)

Supply Voltage (V_{CC})	-0.5V to +4.6V
DC Input Voltage (V_{IN})	-0.5V to +4.6V
DC Output Voltage (V_{OUT})	
HIGH or LOW State (Note 2)	-0.5V to V_{CC} +0.5V
$V_{CC} = 0V$	-0.5V to 4.6V
DC Input Diode Current (I_{IK}) $V_{IN} < 0V$	± 50 mA
DC Output Diode Current (I_{OK})	
$V_{OUT} < 0V$	-50 mA
$V_{OUT} > V_{CC}$	+50 mA
DC Output Source/Sink Current (I_{OH}/I_{OL})	± 50 mA
DC V_{CC} or Ground Current per	
Supply Pin (I_{CC} or Ground)	± 50 mA
Storage Temperature Range (T_{STG})	-65°C to +150°C

Recommended Operating Conditions (Note 3)

Supply Voltage	0.9V to 3.6V
Input Voltage (V_{IN})	0V to 3.6V
Output Voltage (V_{OUT})	
HIGH or LOW State	0V to V_{CC}
$V_{CC} = 0V$	0V to 3.6V
Output Current in I_{OH}/I_{OL}	
$V_{CC} = 3.0V$ to 3.6V	± 2.6 mA
$V_{CC} = 2.3V$ to 2.7V	± 2.1 mA
$V_{CC} = 1.65V$ to 1.95V	± 1.5 mA
$V_{CC} = 1.40V$ to 1.60V	± 1.0 mA
$V_{CC} = 1.10V$ to 1.30V	± 0.5 mA
$V_{CC} = 0.9V$	± 20 μ A
Free Air Operating Temperature (T_A)	-40°C to +85°C
Minimum Input Edge Rate ($\Delta t/\Delta V$)	
$V_{IN} = 0.8V$ to 2.0V, $V_{CC} = 3.0V$	10 ns/V

Note 1: 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 tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Note 2: I_O Absolute Maximum Rating must be observed.

Note 3: Unused inputs must be held HIGH or LOW. They may not float.

DC Electrical Characteristics

Symbol	Parameter	V_{CC} (V)	$T_A = +25^\circ\text{C}$		$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$		Units	Conditions
			Min	Max	Min	Max		
V_{IH}	HIGH Level Input Voltage	0.90	$0.65 \times V_{CC}$		$0.65 \times V_{CC}$		V	
		$1.10 \leq V_{CC} \leq 1.30$	$0.65 \times V_{CC}$		$0.65 \times V_{CC}$			
		$1.40 \leq V_{CC} \leq 1.60$	$0.65 \times V_{CC}$		$0.65 \times V_{CC}$			
		$1.65 \leq V_{CC} \leq 1.95$	$0.65 \times V_{CC}$		$0.65 \times V_{CC}$			
		$2.30 \leq V_{CC} \leq 2.70$	1.6		1.6			
		$3.00 \leq V_{CC} \leq 3.60$	2.1		2.1			
V_{IL}	LOW Level Input Voltage	0.90		$0.35 \times V_{CC}$		$0.35 \times V_{CC}$	V	
		$1.10 \leq V_{CC} \leq 1.30$		$0.35 \times V_{CC}$		$0.35 \times V_{CC}$		
		$1.40 \leq V_{CC} \leq 1.60$		$0.35 \times V_{CC}$		$0.35 \times V_{CC}$		
		$1.65 \leq V_{CC} \leq 1.95$		$0.35 \times V_{CC}$		$0.35 \times V_{CC}$		
		$2.30 \leq V_{CC} \leq 2.70$		0.7		0.7		
		$3.00 \leq V_{CC} \leq 3.60$		0.9		0.9		
V_{OH}	HIGH Level Output Voltage	0.90	$V_{CC} - 0.1$		$V_{CC} - 0.1$		V	$I_{OH} = -20 \mu\text{A}$
		$1.10 \leq V_{CC} \leq 1.30$	$V_{CC} - 0.1$		$V_{CC} - 0.1$			
		$1.40 \leq V_{CC} \leq 1.60$	$V_{CC} - 0.1$		$V_{CC} - 0.1$			
		$1.65 \leq V_{CC} \leq 1.95$	$V_{CC} - 0.1$		$V_{CC} - 0.1$			
		$2.30 \leq V_{CC} \leq 2.70$	$V_{CC} - 0.1$		$V_{CC} - 0.1$			
		$3.00 \leq V_{CC} \leq 3.60$	$V_{CC} - 0.1$		$V_{CC} - 0.1$			
		$1.10 \leq V_{CC} \leq 1.30$	$0.75 \times V_{CC}$		$0.70 \times V_{CC}$			$I_{OH} = -0.5 \text{ mA}$
		$1.40 \leq V_{CC} \leq 1.60$	1.07		0.99			$I_{OH} = -1.0 \text{ mA}$
		$1.65 \leq V_{CC} \leq 1.95$	1.24		1.22			$I_{OH} = -1.5 \text{ mA}$
		$2.30 \leq V_{CC} \leq 2.70$	1.95		1.87			$I_{OH} = -2.1 \text{ mA}$
		$3.00 \leq V_{CC} \leq 3.60$	2.61		2.55			$I_{OH} = -2.6 \text{ mA}$

DC Electrical Characteristics (Continued)

Symbol	Parameter	V _{CC} (V)	T _A = +25°C		T _A = -40°C to +85°C		Units	Conditions
			Min	Max	Min	Max		
V _{OL}	LOW Level Output Voltage	0.90		0.1		0.1	V	I _{OL} = 20 μA
		1.10 ≤ V _{CC} ≤ 1.30		0.1		0.1		
		1.40 ≤ V _{CC} ≤ 1.60		0.1		0.1		
		1.65 ≤ V _{CC} ≤ 1.95		0.1		0.1		
		2.30 ≤ V _{CC} ≤ 2.70		0.1		0.1		
		3.00 ≤ V _{CC} ≤ 3.60		0.1		0.1		
		1.10 ≤ V _{CC} ≤ 1.30	0.30 × V _{CC}		0.30 × V _{CC}			I _{OL} = 0.5 mA
		1.40 ≤ V _{CC} ≤ 1.60	0.31		0.37			I _{OL} = 1.0 mA
		1.65 ≤ V _{CC} ≤ 1.95	0.31		0.35			I _{OL} = 1.5 mA
		2.30 ≤ V _{CC} ≤ 2.70	0.31		0.33			I _{OL} = 2.1 mA
		3.00 ≤ V _{CC} ≤ 3.60	0.31		0.33		I _{OL} = 2.6 mA	
I _{IN}	Input Leakage Current	0.90 to 3.60	±0.1		±0.5		μA	0 ≤ V _I ≤ 3.6V
I _{OFF}	Power Off Leakage Current	0	0.5		0.5		μA	0 ≤ (V _I , V _O) ≤ 3.6V
I _{CC}	Quiescent Supply Current	0.90 to 3.60	0.9		0.9		μA	V _I = V _{CC} or GND

AC Electrical Characteristics

Symbol	Parameter	V _{CC} (V)	T _A = +25°C			T _A = −40°C to +85°C		Units	Conditions	Figure Number
			Min	Typ	Max	Min	Max			
t _{PHL}	Propagation Delay	0.90		27.0				ns	C _L = 10 pF R _L = 1 MΩ	Figures 1, 2
t _{PLH}		1.10 ≤ V _{CC} ≤ 1.30	3.5	11.0	21.8	3.0	34.3			
		1.40 ≤ V _{CC} ≤ 1.60	2.5	7.0	14.8	2.0	15.0			
		1.65 ≤ V _{CC} ≤ 1.95	2.0	6.0	12.0	1.5	12.2			
		2.30 ≤ V _{CC} ≤ 2.70	1.5	5.0	9.4	1.0	9.9			
		3.00 ≤ V _{CC} ≤ 3.60	1.0	4.0	8.3	1.0	9.0			
t _{PHL}	Propagation Delay	0.90		30.0				ns	C _L = 15 pF R _L = 1 MΩ	Figures 1, 2
t _{PLH}		1.10 ≤ V _{CC} ≤ 1.30	4.0	11.0	22.8	3.5	37.3			
		1.40 ≤ V _{CC} ≤ 1.60	3.0	8.0	15.5	2.5	16.5			
		1.65 ≤ V _{CC} ≤ 1.95	2.5	6.0	12.6	2.0	13.6			
		2.30 ≤ V _{CC} ≤ 2.70	2.0	5.0	9.9	1.5	10.8			
		3.00 ≤ V _{CC} ≤ 3.60	1.5	4.0	8.7	1.0	9.5			
t _{PHL}	Propagation Delay	0.90		32.0				ns	C _L = 30 pF R _L = 1 MΩ	Figures 1, 2
t _{PLH}		1.10 ≤ V _{CC} ≤ 1.30	5.0	13.0	25.9	4.0	46.3			
		1.40 ≤ V _{CC} ≤ 1.60	4.0	9.0	17.8	3.5	18.2			
		1.65 ≤ V _{CC} ≤ 1.95	3.0	7.0	14.4	2.0	15.9			
		2.30 ≤ V _{CC} ≤ 2.70	2.0	6.0	11.3	1.5	12.8			
		3.00 ≤ V _{CC} ≤ 3.60	1.5	5.0	9.2	1.0	10.7			
C _{IN}	Input Capacitance	0	2.0					pF		
C _{OUT}	Output Capacitance	0	4.0					pF		
C _{PD}	Power Dissipation Capacitance	0.9 to 3.60	8.0					pF	V _I = 0V or V _{CC} , f = 10 MHz	

AC Loading and Waveforms

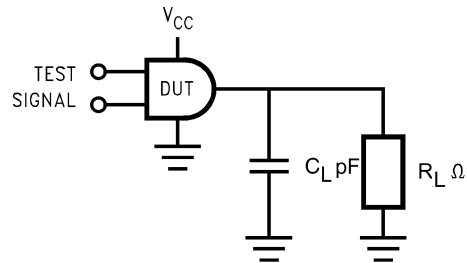


FIGURE 1. AC Test Circuit

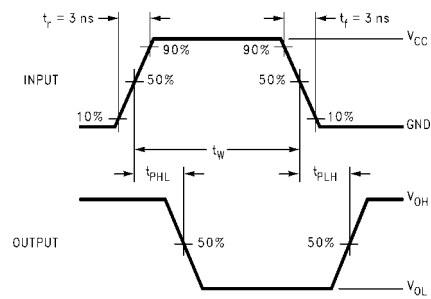
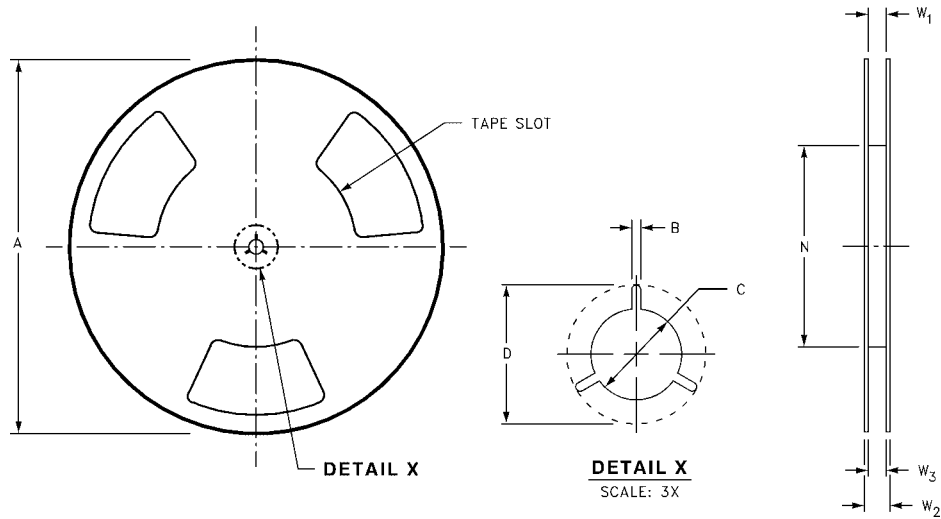


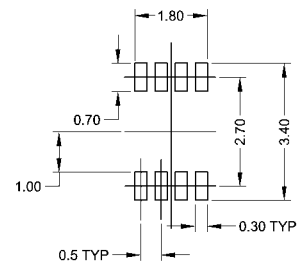
FIGURE 2. AC Waveforms

Symbol	V_{CC}					
	$3.3V \pm 0.3V$	$2.5V \pm 0.2V$	$1.8V \pm 0.15V$	$1.5V \pm 0.10V$	$1.2V \pm 0.10V$	$0.9V$
V_{mi}	1.5V	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$
V_{mo}	1.5V	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$

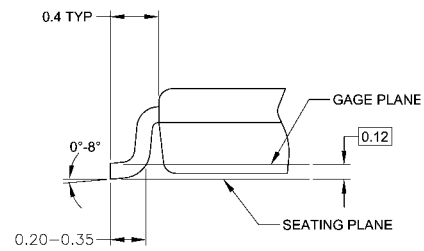
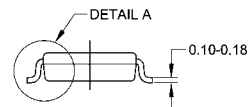
Tape and Reel Specification (Continued) REEL DIMENSIONS inches (millimeters)



Tape Size	A	B	C	D	N	W1	W2	W3
8 mm	7.0 (177.8)	0.059 (1.50)	0.512 (13.00)	0.795 (20.20)	2.165 (55.00)	0.331 + 0.059/-0.000 (8.40 + 1.5/-0.00)	0.567 (14.40)	W1 + 0.078/-0.039 (W1 + 2.00/-1.00)



LAND PATTERN RECOMMENDATION



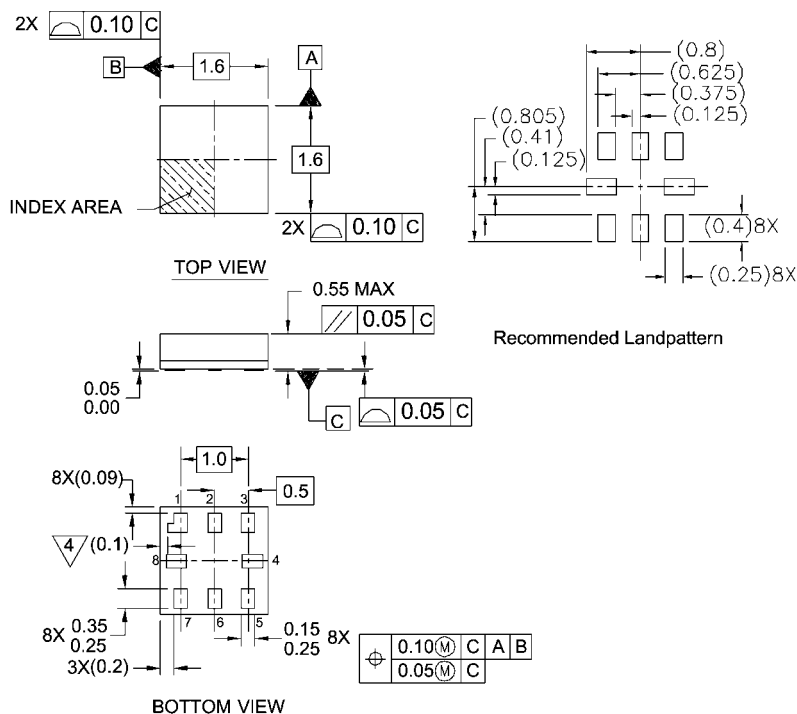
DETAIL A

A. CONFORMS TO JEDEC REGISTRATION MO-187
B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH,
AND TIE BAR EXTRUSIONS.
D. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.

**8-Lead US8, JEDEC MO-187, Variation CA 3.1mm Wide
Package Number MAB08A**

Physical Dimensions

inches (millimeters) unless otherwise noted (Continued)



Notes:

1. PACKAGE CONFORMS TO JEDEC MO-255 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y.14M-1994
4. PIN 1 FLAG, END OF PACKAGE OFFSET.

MAC08AREVC

Pb-Free 8-Lead MicroPak, 1.6 mm Wide
Package Number MAC08A

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2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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