



November 1988  
Revised December 1998

## 74AC821 • 74ACT821 10-Bit D-Type Flip-Flop with 3-STATE Outputs

### General Description

The AC/ACT821 is a 10-bit D-type flip-flop with 3-STATE outputs arranged in a broadside pinout.  
The AC/ACT821 is functionally identical to the AM29821.

### Features

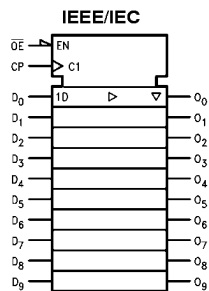
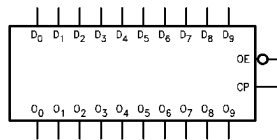
- 3-STATE outputs for bus interfacing
- Noninverting outputs
- Outputs source/sink 24 mA
- ACT821 has TTL-compatible inputs

### Ordering Code:

Order Number	Package Number	Package Description
74AC821SC	M24B	24-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide Body
74AC821SPC	N24C	24-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-100, 0.300" Wide
74ACT821SC	M24B	24-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide Body
74ACT821MTC	MTC24	24-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
74ACT821SPC	N24C	24-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-100, 0.300" Wide

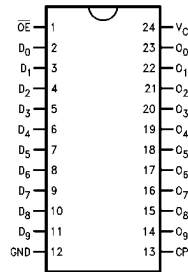
Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code. (SPC not available in Tape and Reel.)

### Logic Symbols



### Connection Diagram

Pin Assignment  
for DIP, SOIC and TSSOP



### Pin Descriptions

Pin Names	Description
D <sub>0</sub> -D <sub>9</sub>	Data Inputs
O <sub>0</sub> -O <sub>9</sub>	Data Outputs
$\overline{OE}$	Output Enable Input
CP	Clock Input

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### Functional Description

The AC/ACT821 consists of ten D-type edge-triggered flip-flops. The buffered Clock (CP) and buffered Output Enable ( $\overline{OE}$ ) are common to all flip-flops. The flip-flops will store the state of their individual D inputs that meet the setup and hold time requirements on the LOW-to-HIGH CP transition. With  $\overline{OE}$  LOW the contents of the flip-flops are available at

the outputs. When  $\overline{OE}$  is HIGH the outputs go to the high impedance state. Operation of the  $\overline{OE}$  input does not affect the state of the flip-flops.

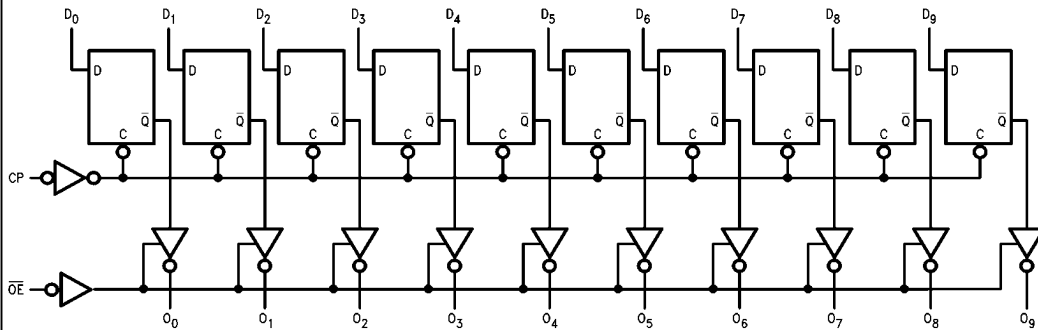
The AC/ACT821 is functionally and pin compatible with the AM29821.

### Function Table

Inputs			Internal	Outputs	Function
$\overline{OE}$	CP	D	Q	O	
H	↗	L	L	Z	High Z
H	↗	H	H	Z	High Z
L	↗	L	L	L	Load
L	↗	H	H	H	Load

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 Z = HIGH Impedance  
 ↗ = LOW-to-HIGH Clock Transition

### Logic Diagram



Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Absolute Maximum Ratings (Note 1)			Recommended Operating Conditions				
Supply Voltage ( $V_{CC}$ )	-0.5V to +7.0V		Supply Voltage ( $V_{CC}$ )	AC	2.0V to 6.0V		
DC Input Diode Current ( $I_{IK}$ )			ACT		4.5V to 5.5V		
$V_I = -0.5V$	-20 mA		Input Voltage ( $V_I$ )		0V to $V_{CC}$		
$V_I = V_{CC} + 0.5V$	+20 mA		Output Voltage ( $V_O$ )		0V to $V_{CC}$		
DC Input Voltage ( $V_I$ )	-0.5V to $V_{CC} + 0.5V$		Operating Temperature ( $T_A$ )		-40°C to +85°C		
DC Output Diode Current ( $I_{OK}$ )			Minimum Input Edge Rate ( $\Delta V/\Delta t$ )				
$V_O = -0.5V$	-20 mA		AC Devices				
$V_O = V_{CC} + 0.5V$	+20 mA		$V_{IN}$ from 30% to 70% of $V_{CC}$				
DC Output Voltage ( $V_O$ )	-0.5V to $V_{CC} + 0.5V$		$V_{CC}$ @ 3.3V, 4.5V, 5.5V		125 mV/ns		
DC Output Source			Minimum Input Edge Rate ( $\Delta V/\Delta t$ )				
or Sink Current ( $I_O$ )	$\pm 50$ mA		ACT Devices				
DC $V_{CC}$ or Ground Current			$V_{IN}$ from 0.8V to 2.0V				
per Output Pin ( $I_{CC}$ or $I_{GND}$ )	$\pm 50$ mA		$V_{CC}$ @ 4.5V, 5.5V		125 mV/ns		
Storage Temperature ( $T_{STG}$ )	-65°C to +150°C		<b>Note 1:</b> Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. Fairchild does not recommend operation of FACT™ circuits outside databook specifications.				
Junction Temperature ( $T_J$ )							
PDIP	140°C						
<b>DC Electrical Characteristics for AC</b>							
Symbol	Parameter	$V_{CC}$ (V)	$T_A = +25^\circ C$		Units	Conditions	
			Typ	Guaranteed Limits			
$V_{IH}$	Minimum HIGH Level Input Voltage	3.0	1.5	2.1	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$	
		4.5	2.25	3.15			
		5.5	2.75	3.85			
$V_{IL}$	Maximum LOW Level Input Voltage	3.0	1.5	0.9	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$	
		4.5	2.25	1.35			
		5.5	2.75	1.65			
$V_{OH}$	Minimum HIGH Level Output Voltage	3.0	2.99	2.9	V	$I_{OUT} = -50 \mu A$	
		4.5	4.49	4.4			
		5.5	5.49	5.4			
			3.0		2.56	V	$V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OH} = -12$ mA $I_{OH} = -24$ mA $I_{OH} = -24$ mA (Note 2)
			4.5		3.76		
			5.5		4.76		
$V_{OL}$	Maximum LOW Level Output Voltage	3.0	0.002	0.1	V	$I_{OUT} = 50 \mu A$	
		4.5	0.001	0.1			
		5.5	0.001	0.1			
			3.0		0.36	V	$V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OL} = 12$ mA $I_{OL} = 24$ mA $I_{OL} = 24$ mA (Note 2)
4.5				0.36			
5.5				0.36			
$I_{IN}$ (Note 4)	Maximum Input Leakage Current	5.5		$\pm 0.1$	$\mu A$	$V_I = V_{CC}, GND$	
$I_{OZ}$	Maximum 3-STATE Current	5.5		$\pm 0.5$	$\mu A$	$V_I$ (OE) = $V_{IL}, V_{IH}$ $V_I = V_{CC}, GND$ $V_O = V_{CC}, GND$	
$I_{OLD}$	Minimum Dynamic	5.5			mA	$V_{OLD} = 1.65V$ Max	
$I_{OHD}$	Output Current (Note 3)	5.5			mA	$V_{OHD} = 3.85V$ Min	
$I_{CC}$ (Note 4)	Maximum Quiescent Supply Current	5.5		8.0	$\mu A$	$V_{IN} = V_{CC}$ or GND	
<p><b>Note 2:</b> All outputs loaded; thresholds on input associated with output under test.</p> <p><b>Note 3:</b> Maximum test duration 2.0 ms, one output loaded at a time.</p> <p><b>Note 4:</b> <math>I_{IN}</math> and <math>I_{CC}</math> @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V <math>V_{CC}</math>.</p>							

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DC Electrical Characteristics for ACT								
Symbol	Parameter	V <sub>CC</sub> (V)	T <sub>A</sub> = +25°C		T <sub>A</sub> = -40°C to +85°C		Units	Conditions
			Typ	Guaranteed Limits				
V <sub>IH</sub>	Minimum HIGH Level Input Voltage	4.5	1.5	2.0	2.0	V	V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> - 0.1V	
		5.5	1.5	2.0	2.0			
V <sub>IL</sub>	Maximum LOW Level Input Voltage	4.5	1.5	0.8	0.8	V	V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> - 0.1V	
		5.5	1.5	0.8	0.8			
V <sub>OH</sub>	Minimum HIGH Level Output Voltage	4.5	4.49	4.4	4.4	V	I <sub>OUT</sub> = -50 μA	
		5.5	5.49	5.4	5.4			
	V	4.5		3.86	3.76	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OH</sub> = -24 mA I <sub>OH</sub> = -24 mA (Note 5)		
		5.5		4.86	4.76			
V <sub>OL</sub>	Maximum LOW Level Output Voltage	4.5	0.001	0.1	0.1	V	I <sub>OUT</sub> = 50 μA	
		5.5	0.001	0.1	0.1			
V	Maximum LOW Level Output Voltage	4.5		0.36	0.44	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OL</sub> = 24 mA I <sub>OL</sub> = 24 mA (Note 5)		
		5.5		0.36	0.44			
I <sub>IN</sub> (Note 4)	Maximum Input Leakage Current	5.5		±0.1	±1.0	μA	V <sub>I</sub> = V <sub>CC</sub> , GND	
I <sub>OZ</sub>	Maximum 3-STATE Current	5.5		±0.5	±5.0	μA	V <sub>I</sub> = V <sub>IL</sub> , V <sub>IH</sub> V <sub>O</sub> = V <sub>CC</sub> , GND	
I <sub>CCT</sub>	Maximum I <sub>CC</sub> /Input	5.5	0.6		1.5	mA	V <sub>I</sub> = V <sub>CC</sub> - 2.1V	
I <sub>OLD</sub>	Minimum Dynamic	5.5			75	mA	V <sub>OLD</sub> = 1.65V Max	
I <sub>OH</sub>	Output Current (Note 6)	5.5			-75	mA	V <sub>OH</sub> = 3.85V Min	
I <sub>CC</sub>	Maximum Quiescent Supply Current	5.5		8.0	80.0	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND	

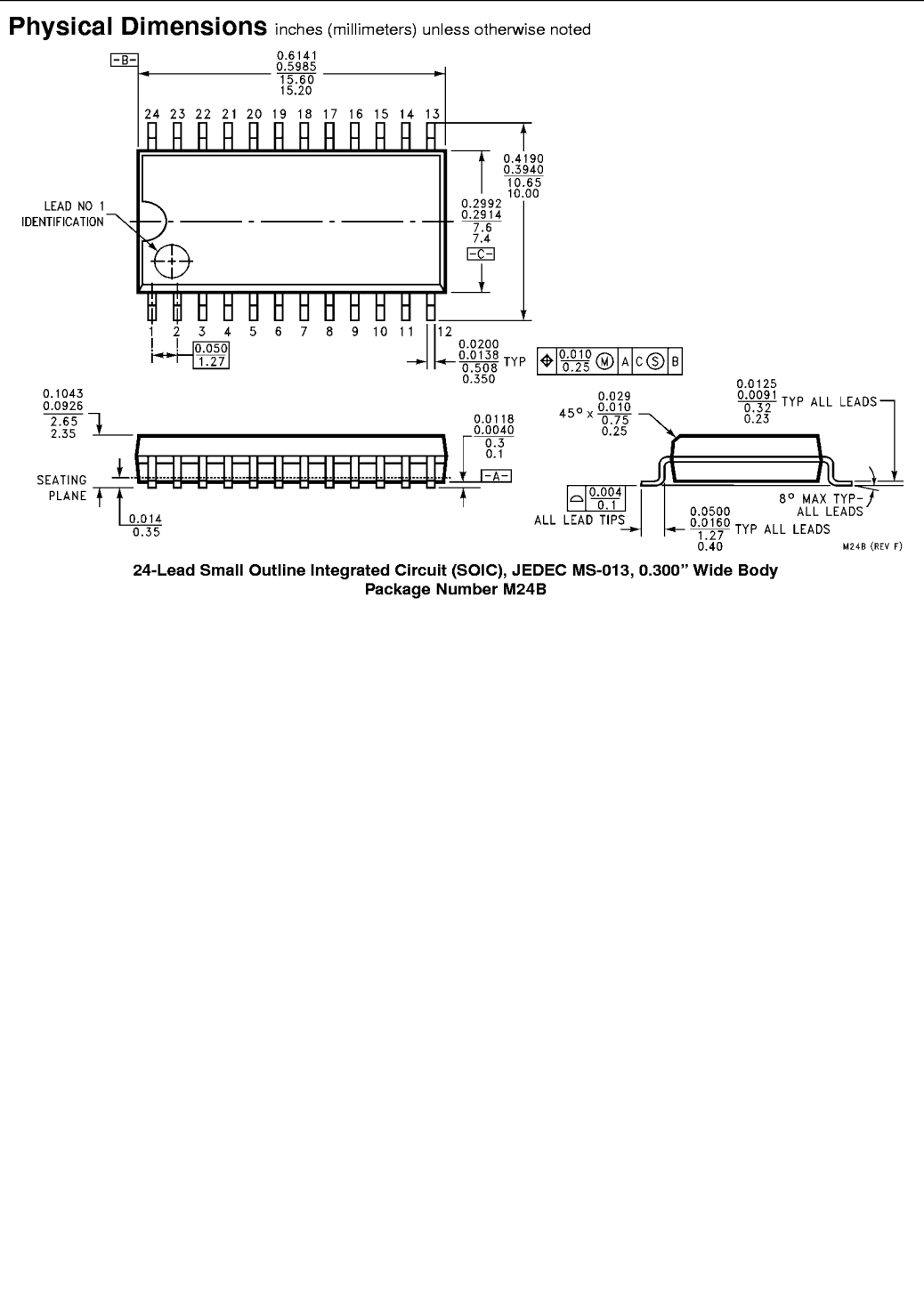
**Note 5:** All outputs loaded; thresholds on input associated with output under test.  
**Note 6:** Maximum test duration 2.0 ms, one output loaded at a time.

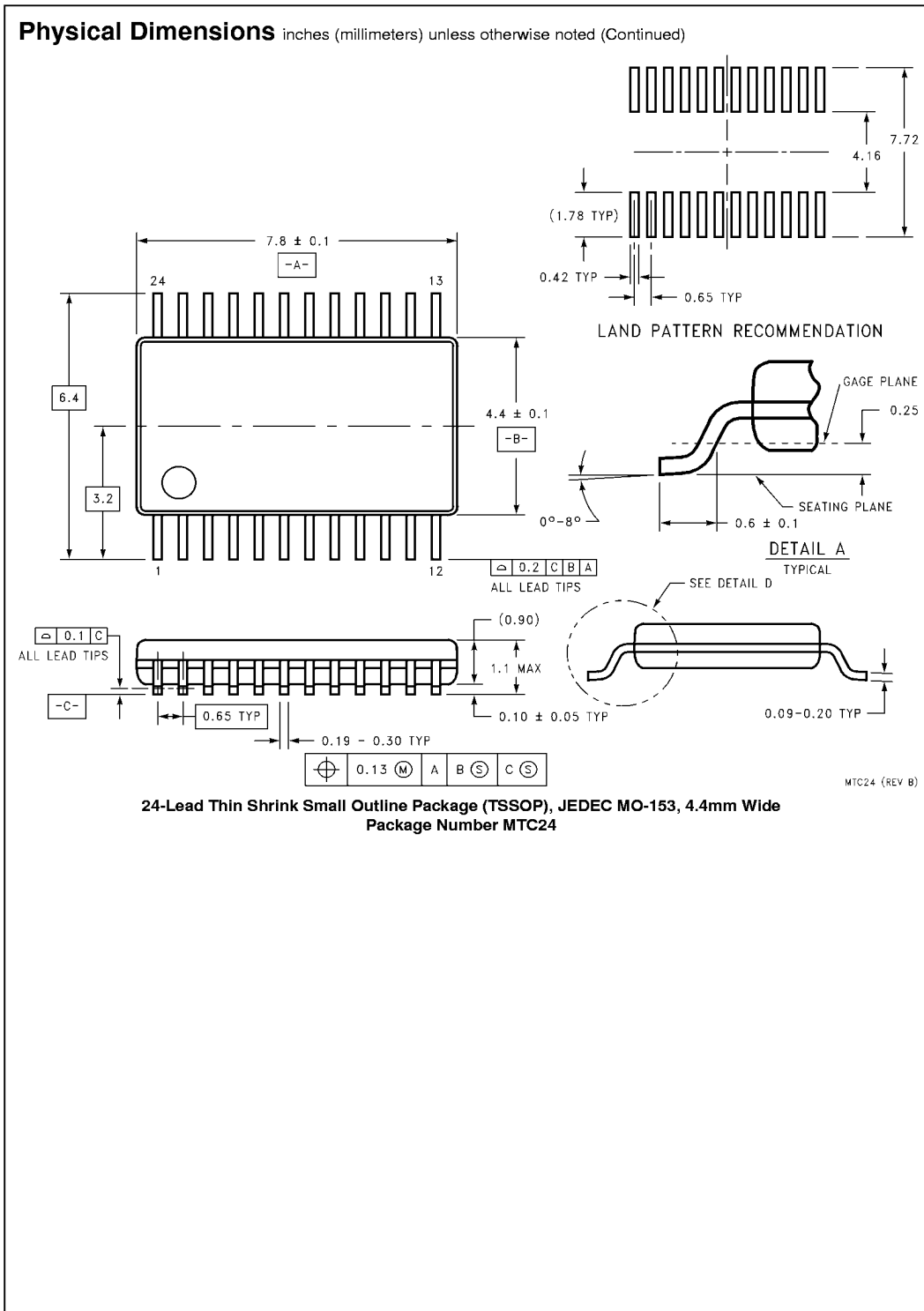
AC Electrical Characteristics for AC								
Symbol	Parameter	V <sub>CC</sub> (V) (Note 7)	T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		Units
			Min	Typ	Max	Min	Max	
f <sub>max</sub>	Maximum Clock Frequency	3.3	110	145		100	MHz	
		5.0	120	160		110		
t <sub>PLH</sub>	Propagation Delay CP to O <sub>n</sub>	3.3	3.0	8.0	13.0	3.0	15.0	ns
		5.0	2.0	6.0	9.5	2.0	10.5	
t <sub>PHL</sub>	Propagation Delay CP to O <sub>n</sub>	3.3	3.0	8.0	13.0	3.0	15.0	ns
		5.0	2.0	5.5	9.5	2.0	10.5	
t <sub>PZH</sub>	Output Enable Time OE to O <sub>n</sub>	3.3	2.5	6.0	11.0	2.5	12.0	ns
		5.0	1.5	4.5	8.0	1.5	9.0	
t <sub>PZL</sub>	Output Enable Time OE to O <sub>n</sub>	3.3	2.5	6.5	11.0	2.5	12.0	ns
		5.0	1.5	5.0	8.0	1.5	9.0	
t <sub>PHZ</sub>	Output Disable Time OE to O <sub>n</sub>	3.3	2.5	6.5	10.5	2.5	11.0	ns
		5.0	1.5	5.0	8.0	1.5	8.5	
t <sub>PLZ</sub>	Output Disable Time OE to O <sub>n</sub>	3.3	2.5	6.0	10.5	2.5	11.0	ns
		5.0	1.5	4.5	8.0	1.5	8.5	

**Note 7:** Voltage Range 3.3 is 3.3V ± 0.3V  
Voltage Range 5.0 is 5.0V ± 0.5V

AC Operating Requirements for AC								
Symbol	Parameter	V <sub>CC</sub> (V) (Note 8)	T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		Units	
			Typ	Guaranteed Minimum				
t <sub>S</sub>	Setup Time, HIGH or LOW	3.3	-1.0	1.5	1.5		ns	
	D <sub>n</sub> to CP	5.0	-1.0	1.5	1.5			
t <sub>H</sub>	Hold Time, HIGH or LOW	3.3	-1.0	3.5	4.0		ns	
	D <sub>n</sub> to CP	5.0	-1.0	3.5	4.0			
t <sub>W</sub>	CP Pulse Width	3.3	3.5	5.0	5.5		ns	
	HIGH or LOW	5.0	2.5	4.0	4.0			
<b>Note 8:</b> Voltage Range 3.3 is 3.3V ±0.3V Voltage Range 5.0 is 5.0V ±0.5V								
AC Electrical Characteristics for ACT								
Symbol	Parameter	V <sub>CC</sub> (V) (Note 9)	T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		Units
			Min	Typ	Max	Min	Max	
f <sub>max</sub>	Maximum Clock Frequency	5.0	120	150		110	MHz	
t <sub>PLH</sub>	Propagation Delay CP to O <sub>n</sub>	5.0	2.0	6.0	9.5	1.5	10.5	ns
t <sub>PHL</sub>	Propagation Delay CP to O <sub>n</sub>	5.0	2.5	6.0	9.5	2.0	10.5	ns
t <sub>PZH</sub>	Output Enable Time $\overline{OE}$ to O <sub>n</sub>	5.0	2.5	7.0	10.5	2.0	11.5	ns
t <sub>PZL</sub>	Output Enable Time $\overline{OE}$ to O <sub>n</sub>	5.0	2.5	7.0	10.5	2.0	12.0	ns
t <sub>PHZ</sub>	Output Disable Time $\overline{OE}$ to O <sub>n</sub>	5.0	1.5	7.5	12.0	1.0	13.0	ns
t <sub>PLZ</sub>	Output Disable Time $\overline{OE}$ to O <sub>n</sub>	5.0	1.5	7.0	10.5	1.0	11.5	ns
<b>Note 9:</b> Voltage Range 5.0 is 5.0V ± 0.5V								
AC Operating Requirements for ACT								
Symbol	Parameter	V <sub>CC</sub> (V) (Note 10)	T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		Units	
			Typ	Guaranteed Minimum				
t <sub>S</sub>	Setup Time, HIGH or LOW	5.0	2.5	2.0	2.5		ns	
	D <sub>n</sub> to CP							
t <sub>H</sub>	Hold Time, HIGH or LOW	5.0	-0.5	2.0	2.5		ns	
	D <sub>n</sub> to CP							
t <sub>W</sub>	CP Pulse Width	5.0	3.0	4.5	5.5		ns	
	HIGH or LOW							
<b>Note 10:</b> Voltage Range 5.0 is 5.0V ±0.5V								
Capacitance								
Symbol	Parameter	Typ	Units	Conditions				
C <sub>IN</sub>	Input Capacitance	4.5	pF	V <sub>CC</sub> = OPEN				
C <sub>PD</sub>	Power Dissipation Capacitance	35.0	pF	V <sub>CC</sub> = 5.0V				

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