

## 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.

#### Features

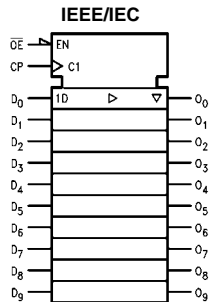
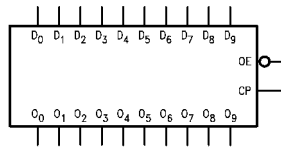
- 3-STATE outputs for bus interfacing
- Noninverting outputs
- Outputs source/sink 24 mA
- TTL compatible inputs

#### Ordering Code:

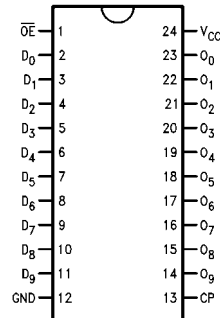
Order Number	Package Number	Package Description
74AC821SC	M24B	24-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300 Wide
74AC821SPC	N24C	24-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide
74ACT821SC	M24B	24-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300 Wide
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-001, 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 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.

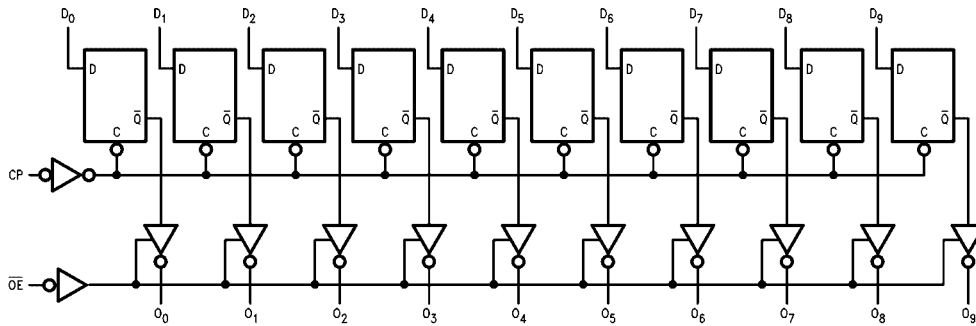
With  $\overline{OE}$  LOW the contents of the flip-flops are available at the outputs. When  $\overline{OE}$  is HIGH the outputs go to the high impedance state. Operation of the  $\overline{OE}$  input does not affect the state of the flip-flops.

## 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)

Supply Voltage ( $V_{CC}$ )	- 0.5V to + 7.0V
DC Input Diode Current ( $I_{IK}$ )	
$V_I = -0.5V$	- 20 mA
$V_I = V_{CC} + 0.5V$	+ 20 mA
DC Input Voltage ( $V_I$ )	- 0.5V to $V_{CC} + 0.5V$
DC Output Diode Current ( $I_{OK}$ )	
$V_O = -0.5V$	- 20 mA
$V_O = V_{CC} + 0.5V$	+ 20 mA
DC Output Voltage ( $V_O$ )	- 0.5V to $V_{CC} + 0.5V$
DC Output Source or Sink Current ( $I_O$ )	$\pm 50$ mA
DC $V_{CC}$ or Ground Current per Output Pin ( $I_{CC}$ or $I_{GND}$ )	$\pm 50$ mA
Storage Temperature ( $T_{STG}$ )	- 65°C to + 150°C
Junction Temperature ( $T_J$ )	
PDIP	140°C

**Recommended Operating Conditions**

Supply Voltage ( $V_{CC}$ )	
AC	2.0V to 6.0V
ACT	4.5V to 5.5V
Input Voltage ( $V_I$ )	0V to $V_{CC}$
Output Voltage ( $V_O$ )	0V to $V_{CC}$
Operating Temperature ( $T_A$ )	- 40°C to + 85°C
Minimum Input Edge Rate ( $\Delta V/\Delta t$ )	
AC Devices	
$V_{IN}$ from 30% to 70% of $V_{CC}$	
$V_{CC}$ @ 3.3V, 4.5V, 5.5V	125 mV/ns
Minimum Input Edge Rate ( $\Delta V/\Delta t$ )	
ACT Devices	
$V_{IN}$ from 0.8V to 2.0V	
$V_{CC}$ @ 4.5V, 5.5V	125 mV/ns

**Note 1:** Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, with-out 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.

**DC Electrical Characteristics for AC**

Symbol	Parameter	$V_{CC}$ (V)	$T_A = +25^\circ\text{C}$		$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		Units	Conditions
			Typ	Guaranteed Limits				
$V_{IH}$	Minimum HIGH Level Input Voltage	3.0	1.5	2.1	2.1	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$	
		4.5	2.25	3.15	3.15			
		5.5	2.75	3.85	3.85			
$V_{IL}$	Maximum LOW Level Input Voltage	3.0	1.5	0.9	0.9	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$	
		4.5	2.25	1.35	1.35			
		5.5	2.75	1.65	1.65			
$V_{OH}$	Minimum HIGH Level Output Voltage	3.0	2.99	2.9	2.9	V	$I_{OUT} = -50 \mu A$	
		4.5	4.49	4.4	4.4			
		5.5	5.49	5.4	5.4			
		3.0		2.56	2.46	V	$V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OH} = -12$ mA $I_{OH} = -24$ mA $I_{OH} = -24$ mA (Note 2)	
		4.5		3.86	3.76			
		5.5		4.86	4.76			
$V_{OL}$	Maximum LOW Level Output Voltage	3.0	0.002	0.1	0.1	V	$I_{OUT} = 50 \mu A$	
		4.5	0.001	0.1	0.1			
		5.5	0.001	0.1	0.1			
		3.0		0.36	0.44	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	0.44			
		5.5		0.36	0.44			
$I_{IN}$ (Note 4)	Maximum Input Leakage Current	5.5		$\pm 0.1$	$\pm 1.0$	$\mu A$	$V_I = V_{CC}, GND$	
$I_{OZ}$	Maximum 3-STATE Current	5.5		$\pm 0.5$	$\pm 5.0$	$\mu A$	$V_I$ (OE) = $V_{IL}, V_{IH}$ $V_I = V_{CC}, GND$ $V_O = V_{CC}, GND$	
$I_{OLD}$	Minimum Dynamic	5.5			75	mA	$V_{OLD} = 1.65V$ Max	
$I_{OHD}$	Output Current (Note 3)	5.5			-75	mA	$V_{OHD} = 3.85V$ Min	
$I_{CC}$ (Note 4)	Maximum Quiescent Supply Current	5.5		8.0	80.0	$\mu A$	$V_{IN} = V_{CC}$ or GND	

**Note 2:** All outputs loaded; thresholds on input associated with output under test.

**Note 3:** Maximum test duration 2.0 ms, one output loaded at a time.

**Note 4:**  $I_{IN}$  and  $I_{CC}$  @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V  $V_{CC}$ .

## 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			
		4.5		3.86	3.76		V	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			
		4.5		0.36	0.44		V	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>OHD</sub>	Output Current (Note 6)	5.5			-75		mA	V <sub>OHD</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.

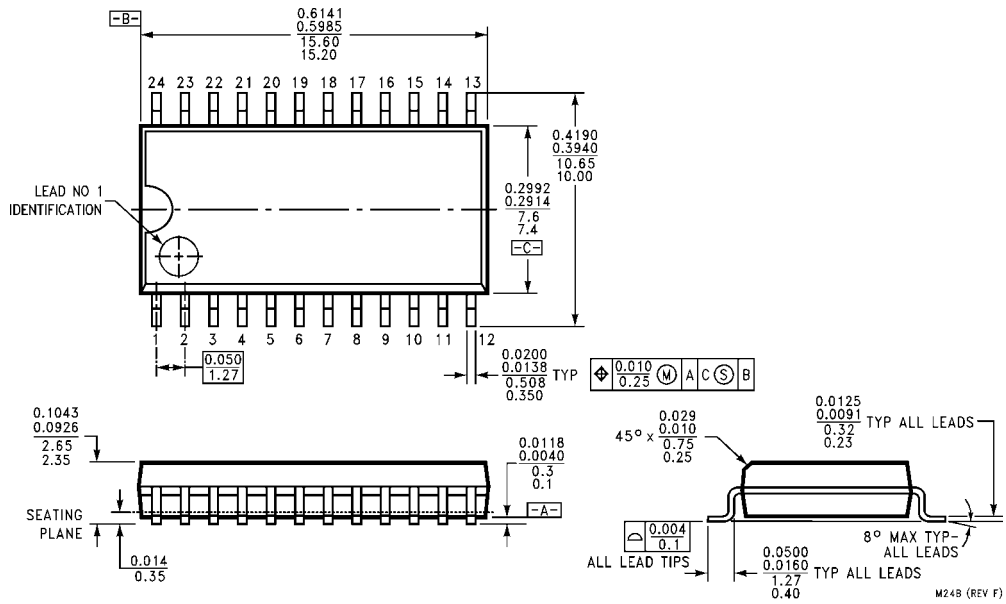
## AC Electrical Characteristics for AC

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 5.0	110 120	145 160		100 110		MHz
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

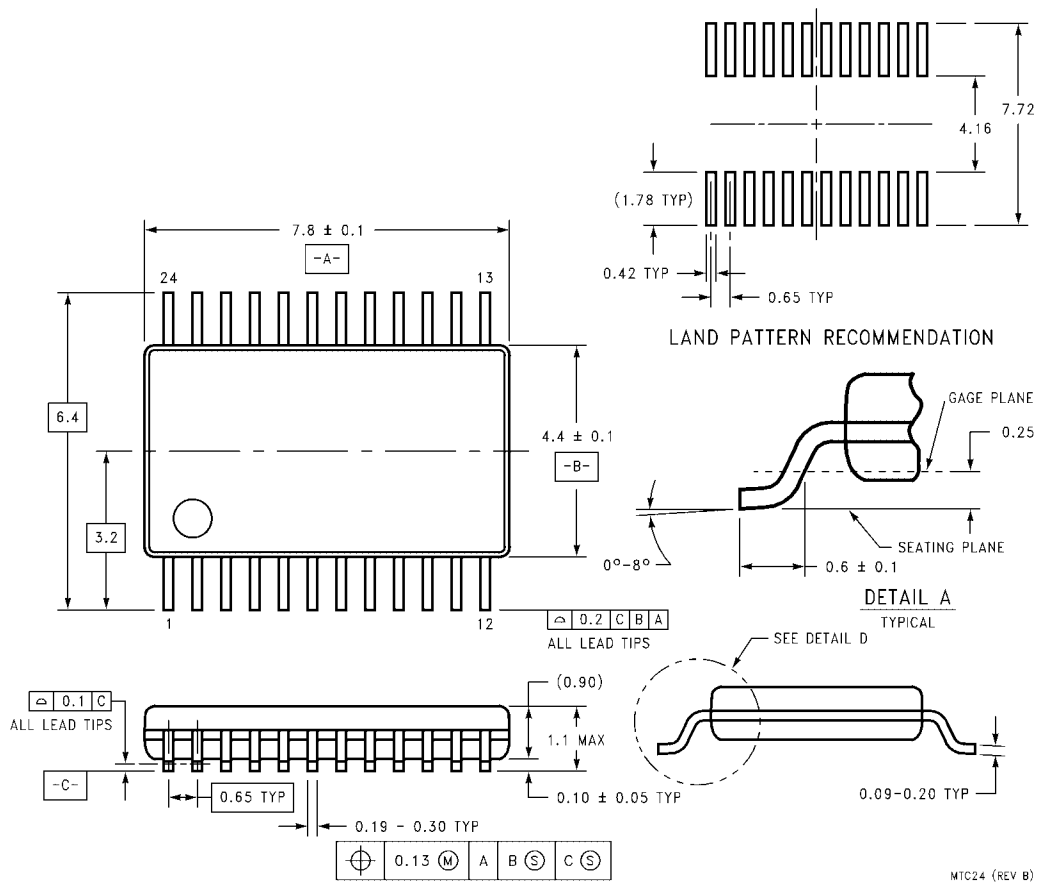
AC Operating Requirements for AC								
Symbol	Parameter	V <sub>CC</sub> (V) (Note 8)	T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		Units	
			Typ	Guaranteed Minimum				
t <sub>S</sub>	Setup Time, HIGH or LOW	3.3	-1.0	1.5	1.5		ns	
	D <sub>n</sub> 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 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 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 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 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				

**Physical Dimensions** inches (millimeters) unless otherwise noted



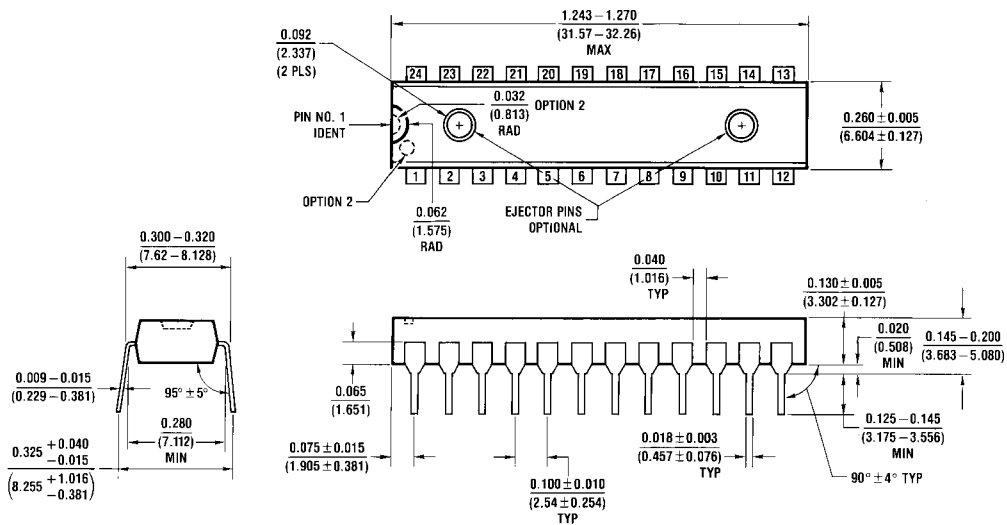
**24-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300 Wide  
Package Number M24B**

**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



**24-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  
Package Number MTC24**

**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



**24-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide  
Package Number N24C**

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