FAIRCHILD SEMICONDUCTOR™

November 1988
Revised October 2000

74AC646 • 74ACT646
Octal Transceiver/Register with 3-STATE Outputs

General Description

The AC/ACT646 consist of registered bus transceiver circuits, with outputs, D-type flip-flops and control circuitry providing multiplexed transmission of data directly from the input bus or from the internal storage registers. Data on the A or B bus will be loaded into the respective registers on the LOW-to-HIGH transition of the appropriate clock pin (CPAB or CPBA). The four fundamental data handling functions available are illustrated in Figures 1, 2, 3, and Figure 4.

Features

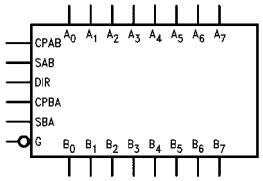
- Independent registers for A and B buses
- Multiplexed real-time and stored data transfers
- 3-STATE outputs
- 300 mil dual-in-line package
- Outputs source/sink 24 mA
- ACT646 has TTL compatible inputs

Ordering Code:

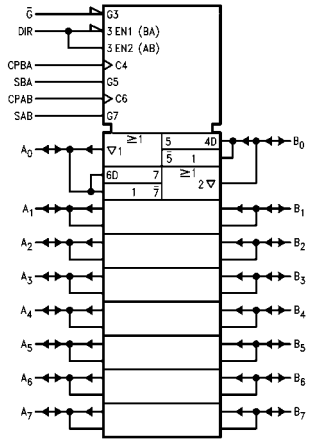
Order Number	Package Number	Package Description
74AC646SC	M24B	24-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300 Wide
74AC646SPC	N24C	24-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide
74ACT646SC	M24B	24-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300 Wide
74ACT646SPC	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.

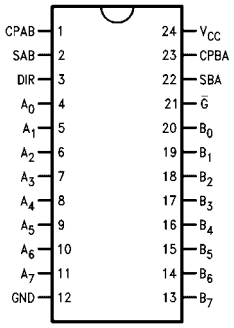
Logic Symbols



IEEE/IEC



Connection Diagram



Pin Descriptions

Pin Names	Description
A_0–A_7	Data Register A Inputs
	Data Register A Outputs
B_0–B_7	Data Register B Inputs
	Data Register B Outputs
CPAB, CPBA	Clock Pulse Inputs
SAB, SBA	Transmit/Receive Inputs
$\overline{G}$	Output Enable Input
DIR	Direction Control Input

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Function Table

Inputs						Data I/O (Note 1)		Function
$\overline{G}$	DIR	CPAB	CPBA	SAB	SBA	A_0–A_7	B_0–B_7	
H	X	H or L	H or L	X	X			Isolation
H	X	↑	X	X	X	Input	Input	Clock A_n Data into A Register
H	X	X	↑	X	X			Clock B_n Data into B Register
L	H	X	X	L	X			A_n to B_n—Real Time (Transparent Mode)
L	H	↑	X	L	X	Input	Output	Clock A_n Data into A Register
L	H	H or L	X	H	X			A Register to B_n (Stored Mode)
L	H	↑	X	H	X			Clock A_n Data into A Register and Output to B_n
L	L	X	X	X	L			B_n to A_n —Real Time (Transparent Mode)
L	L	X	↑	X	L	Output	Input	Clock B_n Data into B Register
L	L	X	H or L	X	H			B Register to A_n (Stored Mode)
L	L	X	↑	X	H			Clock B_n Data into B Register and Output to A_n

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
↑ = LOW-to-HIGH Transition

Note 1: The data output functions may be enabled or disabled by various signals at the $\overline{G}$ and DIR inputs. Data input functions are always enabled; i.e., data at the bus pins will be stored on every LOW-to-HIGH transition of the appropriate clock inputs.

Real Time Transfer A-Bus to B-Bus

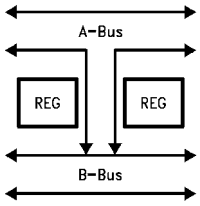


FIGURE 1.

Real Time Transfer B-Bus to A-Bus

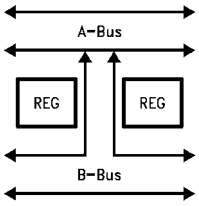


FIGURE 2.

Storage from Bus to Register

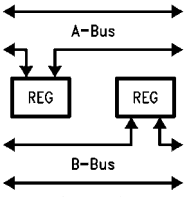


FIGURE 3.

Transfer from Register to Bus

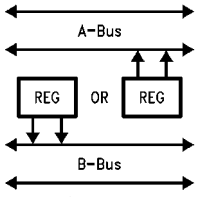
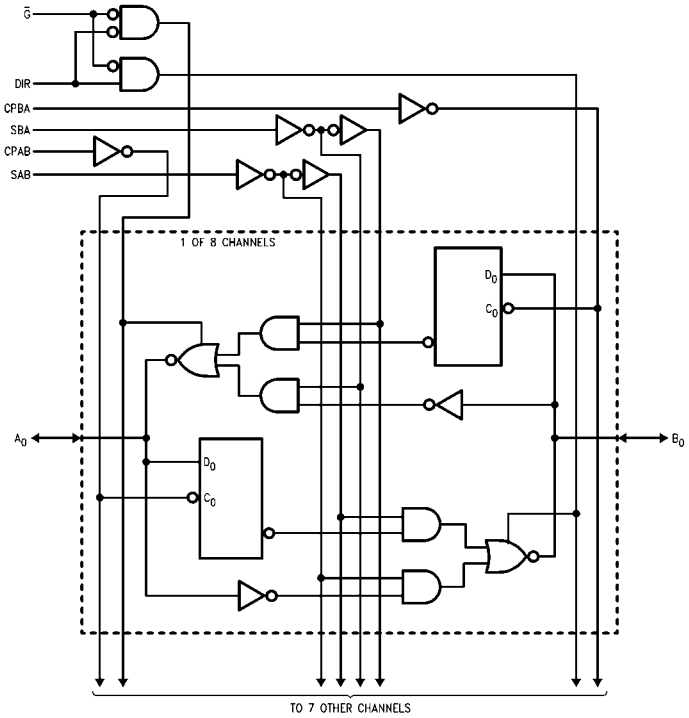


FIGURE 4.

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 2)

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)	±50 mA
DC V_{CC} or Ground Current	
per Output Pin (I_{CC} or I_{GND})	±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 (ΔV/Δt)	
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 (ΔV/Δt)	
ACT Devices	
V_{IN} from 0.8V to 2.0V	
V_{CC} @ 4.5V, 5.5V	125 mV/ns

Note 2: 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.

DC Electrical Characteristics for AC

Symbol	Parameter	V_{CC} (V)	T_A = +25°C Typ	T_A = −40°C to +85°C Guaranteed Limits		Units	Conditions
V_{IH}	Minimum HIGH Level	3.0	1.5	2.1	2.1		V_{OUT} = 0.1V
	Input Voltage	4.5	2.25	3.15	3.15	V	or V_{CC} − 0.1V
		5.5	2.75	3.85	3.85		
V_{IL}	Maximum LOW Level	3.0	1.5	0.9	0.9		V_{OUT} = 0.1V
	Input Voltage	4.5	2.25	1.35	1.35	V	or V_{CC} − 0.1V
		5.5	2.75	1.65	1.65		
V_{OH}	Minimum HIGH Level	3.0	2.99	2.9	2.9		
	Output Voltage	4.5	4.49	4.4	4.4	V	I_{OUT} = −50 μA
		5.5	5.49	5.4	5.4		
							V_{IN} = V_{IL} or V_{IH}
		3.0		2.56	2.46		I_{OH} = −12 mA
		4.5		3.86	3.76	V	I_{OH} = −24 mA
		5.5		4.86	4.76		I_{OH} = −24 mA (Note 3)
V_{OL}	Maximum LOW Level	3.0	0.002	0.1	0.1		
	Output Voltage	4.5	0.001	0.1	0.1	V	I_{OUT} = 50 μA
		5.5	0.001	0.1	0.1		
							V_{IN} = V_{IL} or V_{IH}
		3.0		0.36	0.44		I_{OH} = 12 mA
		4.5		0.36	0.44	V	I_{OL} = 24 mA
		5.5		0.36	0.44		I_{OH} = 24 mA (Note 3)
I_{IN} (Note 5)	Maximum Input Leakage Current	5.5		± 0.1	± 1.0	μA	V_I = V_{CC}, GND
I_{OLD}	Minimum Dynamic	5.5			75	mA	V_{OLD} = 1.65V Max
I_{OHD}	Output Current (Note 4)	5.5			−75	mA	V_{OHD} = 3.85V Min
I_{CC} (Note 5)	Maximum Quiescent Supply Current	5.5		8.0	80.0	μA	V_{IN} = V_{CC} or GND
I_{OZT}	Maximum I/O						V_I (OE) = V_{IL}, V_{IH}
	Leakage Current	5.5		±0.6	±6.0	μA	V_I = V_{CC}, GND
							V_O = V_{CC}, GND

Note 3: All outputs loaded; thresholds on input associated with output under test.

Note 4: Maximum test duration 2.0 ms, one output loaded at a time.

Note 5: 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_{CC} (V)	$T_A = +25°C$ Typ	$T_A = -40°C$ to $+85°C$ Guaranteed Limits		Units	Conditions
V_{IH}	Minimum HIGH Level Input Voltage	4.5	1.5	2.0	2.0	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		5.5	1.5	2.0	2.0		
V_{IL}	Maximum LOW Level Input Voltage	4.5	1.5	0.8	0.8	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		5.5	1.5	0.8	0.8		
V_{OH}	Minimum HIGH Level Output Voltage	4.5	4.49	4.4	4.4	V	$I_{OUT} = -50\ \mu A$
		5.5	5.49	5.4	5.4		
							$V_{IN} = V_{IL}$ or V_{IH}
		4.5		3.86	3.76	V	$I_{OH} = -24$ mA
		5.5		4.86	4.76		$I_{OH} = -24$ mA (Note 6)
V_{OL}	Maximum LOW Level Output Voltage	4.5	0.001	0.1	0.1	V	$I_{OUT} = 50\ \mu A$
		5.5	0.001	0.1	0.1		
							$V_{IN} = V_{IL}$ or V_{IH}
		4.5		0.36	0.44	V	$I_{OL} = 24$ mA
		5.5		0.36	0.44		$I_{OL} = 24$ mA (Note 6)
I_{IN}	Maximum Input Leakage Current	5.5		± 0.1	± 1.0	µA	$V_I = V_{CC}$, GND
I_{CCT}	Maximum I_{CC}/Input	5.5	0.6		1.5	mA	$V_I = V_{CC} - 2.1V$
I_{OLD}	Minimum Dynamic Output Current (Note 7)	5.5			75	mA	$V_{OLD} = 1.65V$ Max
I_{OHD}		5.5			−75	mA	$V_{OHD} = 3.85V$ Min
I_{CC}	Maximum Quiescent Supply Current	5.5		8.0	80.0	µA	$V_{IN} = V_{CC}$ or GND
I_{OZT}	Maximum I/O Leakage Current	5.5		±0.6	±6.0	µA	V_I (OE) = V_{IL}, V_{IH} $V_I = V_{CC}$, GND $V_O = V_{CC}$, GND

Note 6: All outputs loaded; thresholds on input associated with output under test.

Note 7: Maximum test duration 2.0 ms, one output loaded at a time.

AC Electrical Characteristics for AC

Symbol	Parameter	V_{CC} (V) (Note 8)	$T_A = +25°C$, $C_L = 50$ pF			$T_A = -40°C$ to $+85°C$, $C_L = 50$ pF		Units
			Min	Typ	Max	Min	Max	
t_{PLH}	Propagation Delay	3.3	4.0	10.5	16.5	3.0	18.5	ns
	Clock to Bus	5.0	2.5	7.5	12.0	2.0	13.0	
t_{PHL}	Propagation Delay	3.3	3.0	9.5	14.5	2.5	16.0	ns
	Clock to Bus	5.0	2.0	6.5	10.5	1.5	11.5	
t_{PLH}	Propagation Delay	3.3	2.5	7.5	12.0	2.0	13.5	ns
	Bus to Bus	5.0	1.5	5.0	8.0	1.0	9.0	
t_{PHL}	Propagation Delay	3.3	1.5	7.5	12.5	1.5	13.5	ns
	Bus to Bus	5.0	1.5	5.0	9.0	1.0	9.5	
t_{PLH}	Propagation Delay	3.3	2.0	8.5	13.5	1.5	15.5	ns
	SBA or SAB to A_n or B_n	5.0	1.5	6.0	10.0	1.5	11.0	
	(w/ A_n or B_n HIGH or LOW)							
t_{PHL}	Propagation Delay	3.3	1.5	8.5	13.5	1.5	15.0	ns
	SBA or SAB to A_n or B_n	5.0	1.5	6.0	10.0	1.5	11.0	
	(w/ A_n or B_n HIGH or LOW)							
t_{PZH}	Enable Time	3.3	2.5	7.0	11.5	2.0	12.5	ns
	$\overline{G}$ to A_n or B_n	5.0	1.5	5.0	8.5	1.5	9.0	
t_{PZL}	Enable Time	3.3	2.5	7.5	12.5	2.0	14.0	ns
	$\overline{G}$ to A_n or B_n	5.0	1.5	5.5	9.0	1.5	10.0	
t_{PHZ}	Disable Time	3.3	3.0	8.0	12.5	2.5	13.5	ns
	$\overline{G}$ to A_n or B_n	5.0	2.0	6.5	10.0	2.0	11.0	
t_{PLZ}	Disable Time	3.3	2.0	7.5	12.0	2.0	13.5	ns
	$\overline{G}$ to A_n or B_n	5.0	1.5	6.0	9.5	1.5	10.5	
t_{PZH}	Enable Time	3.3	2.0	6.5	11.0	1.5	12.0	ns
	DIR to A_n or B_n	5.0	1.5	5.0	7.5	1.0	8.5	
t_{PZL}	Enable Time	3.3	2.5	7.0	11.5	2.0	13.0	ns
	DIR to A_n or B_n	5.0	1.5	5.0	8.0	1.0	9.0	
t_{PHZ}	Disable Time	3.3	2.5	7.5	11.5	1.5	12.5	ns
	DIR to A_n or B_n	5.0	1.5	5.5	9.5	1.5	10.0	
t_{PLZ}	Disable Time	3.3	1.5	7.5	12.0	1.5	13.5	ns
	DIR to A_n or B_n	5.0	1.5	5.5	9.5	1.5	10.5	

Note 8: 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_{CC} (V) (Note 9)	$T_A = +25°C$, $C_L = 50$ pF		$T_A = -40°C$ to $+85°C$, $C_L = 50$ pF	Units
			Typ	Guaranteed Minimum		
t_S	Setup Time, HIGH or LOW	3.3	2.0	5.0	5.5	ns
	Bus to Clock	5.0	1.5	4.0	4.5	
t_H	Hold Time, HIGH or LOW	3.3	−1.5	0	0	ns
	Bus to Clock	5.0	−0.5	0.5	1.0	
t_W	Clock Pulse Width	3.3	2.0	3.5	4.5	ns
	HIGH or LOW	5.0	2.0	3.5	3.5	

Note 9: 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_{CC} (V) (Note 10)	$T_A = +25°C$, $C_L = 50$ pF			$T_A = -40°C$ to $+85°C$, $C_L = 50$ pF		Units
			Min	Typ	Max	Min	Max	
t_{PLH}	Propagation Delay Clock to Bus	5.0	3.5	12.0	14.5	3.0	16.0	ns
t_{PHL}	Propagation Delay Clock to Bus	5.0	4.0	12.0	14.5	3.5	16.0	ns
t_{PLH}	Propagation Delay Bus to Bus	5.0	3.0	8.5	10.5	2.5	11.5	ns
t_{PHL}	Propagation Delay Bus to Bus	5.0	2.5	8.5	10.5	2.0	11.5	ns
t_{PLH}	Propagation Delay SBA or SAB to A_n to B_n (w/A_n or B_n, HIGH or LOW)	5.0	3.0	9.5	11.5	2.5	12.5	ns
t_{PHL}	Propagation Delay SBA or SAB to A_n to B_n (w/A_n or B_n, HIGH or LOW)	5.0	3.0	9.5	11.5	2.5	12.5	ns
t_{PZH}	Enable Time $\overline{G}$ to A_n or B_n	5.0	2.0	9.0	11.0	1.5	12.0	ns
t_{PZL}	Enable Time $\overline{G}$ to A_n or B_n	5.0	3.5	9.0	11.0	3.0	12.0	ns
t_{PHZ}	Disable Time $\overline{G}$ to A_n or B_n	5.0	5.0	10.5	13.0	4.5	14.5	ns
t_{PLZ}	Disable Time $\overline{G}$ to A_n or B_n	5.0	3.5	10.0	12.5	3.0	14.0	ns
t_{PZH}	Enable Time DIR to A_n or B_n	5.0	2.0	6.5	10.5	1.5	11.5	ns
t_{PZL}	Enable Time DIR to A_n or B_n	5.0	3.5	6.5	10.5	3.0	11.5	ns
t_{PHZ}	Disable Time DIR to A_n or B_n	5.0	5.0	8.5	12.5	4.5	13.5	ns
t_{PLZ}	Disable Time DIR to A_n or B_n	5.0	3.5	8.5	12.5	3.0	13.5	ns

Note 10: Voltage Range 5.0 is 5.0V ± 0.5V

AC Operating Requirements for ACT

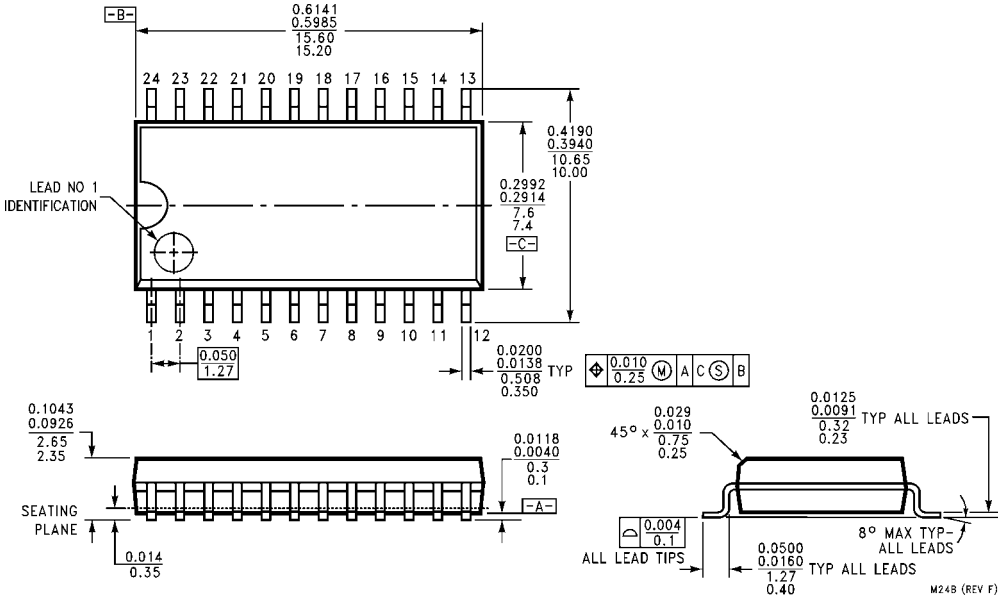
Symbol	Parameter	V_{CC} (V) (Note 11)	$T_A = +25°C$, $C_L = 50$ pF		$T_A = -40°C$ to $+85°C$, $C_L = 50$ pF	Units
			Typ	Guaranteed Minimum		
t_S	Setup Time, HIGH or LOW BUS to Clock	5.0	2.5	7.0	8.0	ns
t_H	Hold Time, HIGH or LOW Bus to Clock	5.0	0	2.5	2.5	ns
t_W	Clock Pulse Width HIGH or LOW	5.0	4.5	7.0	8.0	ns

Note 11: Voltage Range 5.0 is 5.0V ± 0.5V

Capacitance

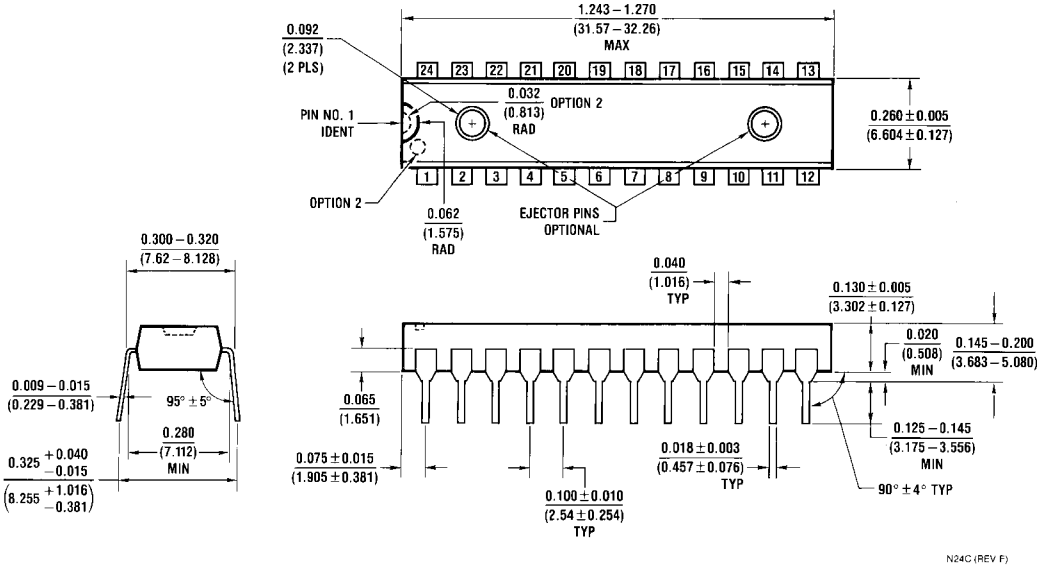
Symbol	Parameter	Typ	Units	Conditions
C_{IN}	Input Capacitance	4.5	pF	V_{CC} = OPEN
$C_{I/O}$	Input/Output Capacitance	15.0	pF	V_{CC} = 5.0V
C_{PD}	Power Dissipation Capacitance	60.0	pF	V_{CC} = 5.0V

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

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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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