

# 54AC/74AC646 • 74ACT646 Octal Transceiver/Register with TRI-STATE® Outputs

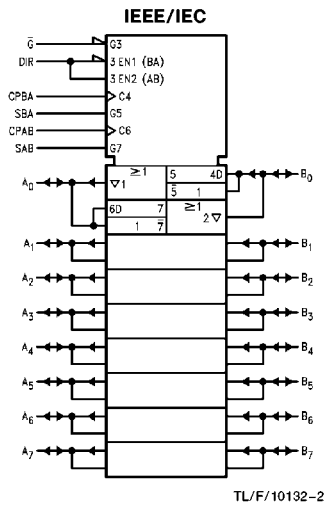
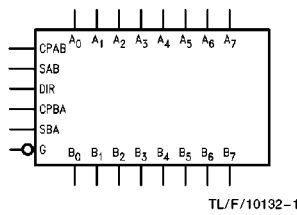
## General Description

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 1-4*.

## Features

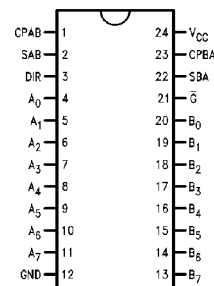
- Independent registers for A and B buses
- Multiplexed real-time and stored data transfers
- TRI-STATE outputs
- 300 mil slim dual-in-line package
- Outputs source/sink 24 mA
- 'ACT646 has TTL compatible inputs
- Standard Military Drawing (SMD)  
— 'AC646: 5962-89682

## Logic Symbols

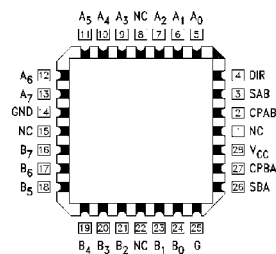


## Connection Diagrams

Pin Assignment for DIP, Flatpak and SOIC



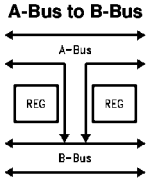
Pin Assignment for LCC and PCC



Pin Names	Description
A <sub>0</sub> -A <sub>7</sub>	Data Register A Inputs
B <sub>0</sub> -B <sub>7</sub>	Data Register A Outputs
CPAB, CPBA	Data Register B Inputs
SAB, SBA	Data Register B Outputs
CPAB, CPBA	Clock Pulse Inputs
SAB, SBA	Transmit/Receive Inputs
Ḡ	Output Enable Input
DIR	Direction Control Input

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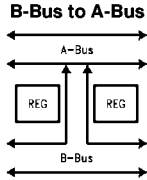
**Real Time Transfer**



TL/F/10132-7

**FIGURE 1**

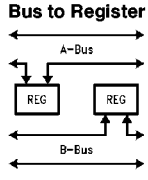
**Real Time Transfer**



TL/F/10132-8

**FIGURE 2**

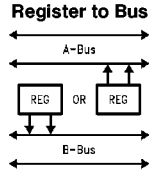
**Storage from**



TL/F/10132-9

**FIGURE 3**

**Transfer from**



TL/F/10132-10

**FIGURE 4**

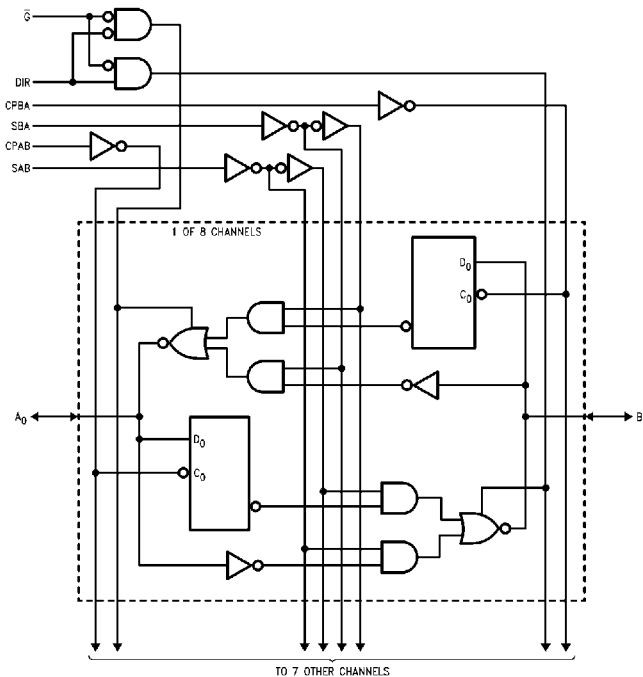
**Function Table**

Inputs						Data I/O*		Function
$\bar{G}$	DIR	CPAB	CPBA	SAB	SBA	A <sub>0</sub> -A <sub>7</sub>	B <sub>0</sub> -B <sub>7</sub>	
H	X	H or L	H or L	X	X	Input	Input	Isolation Clock A <sub>n</sub> Data into A Register Clock B <sub>n</sub> Data into B Register
L	H	X	X	L	X	Input	Output	A <sub>n</sub> to B <sub>n</sub> —Real Time (Transparent Mode) Clock A <sub>n</sub> Data into A Register A Register to B <sub>n</sub> (Stored Mode) Clock A <sub>n</sub> Data into A Register and Output to B <sub>n</sub>
L	H	H or L	X	H	X			
L	H	X	X	H	X			
L	L	X	X	X	L	Output	Input	B <sub>n</sub> to A <sub>n</sub> —Real Time (Transparent Mode) Clock B <sub>n</sub> Data into B Register B Register to A <sub>n</sub> (Stored Mode) Clock B <sub>n</sub> Data into B Register and Output to A <sub>n</sub>
L	L	X	X	X	L			
L	L	X	H or L	X	H			

\*The data output functions may be enabled or disabled by various signals at the  $\bar{G}$  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.

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

**Logic Diagram**



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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 Rating (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

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 ( $T_J$ )	
CDIP	175°C
PDIP	140°C

**Note 1:** 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. National does not recommend operation of FACT™ circuits outside databook specifications.

## 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 ( $T_A$ )	
74AC/ACT	-40°C to +85°C
54AC	-55°C to +125°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

## DC Characteristics for 'AC Family Devices

Symbol	Parameter	$V_{CC}$ (V)	74AC		54AC	74AC	Units	Conditions
			$T_A = +25^\circ\text{C}$		$T_A = -55^\circ\text{C to } +125^\circ\text{C}$	$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		
			Typ	Guaranteed Limits				
$V_{IH}$	Minimum High Level Input Voltage	3.0	1.5	2.1	2.1	2.1	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		4.5	2.25	3.15	3.15	3.15		
		5.5	2.75	3.85	3.85	3.85		
$V_{IL}$	Maximum Low Level Input Voltage	3.0	1.5	0.9	0.9	0.9	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		4.5	2.25	1.35	1.35	1.35		
		5.5	2.75	1.65	1.65	1.65		
$V_{OH}$	Minimum High Level Output Voltage	3.0	2.99	2.9	2.9	2.9	V	$I_{OUT} = -50 \mu\text{A}$
		4.5	4.49	4.4	4.4	4.4		
		5.5	5.49	5.4	5.4	5.4		
$V_{OL}$	Maximum Low Level Output Voltage	3.0		2.56	2.4	2.46	V	* $V_{IN} = V_{IL}$ or $V_{IH}$ -12 mA $I_{OH} = -24 \text{ mA}$ -24 mA
		4.5		3.86	3.7	3.76		
		5.5		4.86	4.7	4.76		
$V_{OL}$	Maximum Low Level Output Voltage	3.0	0.002	0.1	0.1	0.1	V	$I_{OUT} = 50 \mu\text{A}$
		4.5	0.001	0.1	0.1	0.1		
		5.5	0.001	0.1	0.1	0.1		
$V_{OL}$	Maximum Low Level Output Voltage	3.0		0.36	0.50	0.44	V	* $V_{IN} = V_{IL}$ or $V_{IH}$ 12 mA $I_{OL} = 24 \text{ mA}$ 24 mA
		4.5		0.36	0.50	0.44		
		5.5		0.36	0.50	0.44		
$I_{IN}$	Maximum Input Leakage Current	5.5		$\pm 0.1$	$\pm 1.0$	$\pm 1.0$	$\mu\text{A}$	$V_I = V_{CC}, \text{GND}$

\*All outputs loaded; thresholds on input associated with output under test.

### DC Characteristics for 'AC Family Devices (Continued)

Symbol	Parameter	V <sub>CC</sub> (V)	74AC		54AC	74AC		Units	Conditions
			T <sub>A</sub> = +25°C		T <sub>A</sub> = -55°C to +125°C	T <sub>A</sub> = -40°C to +85°C			
			Typ	Guaranteed Limits					
I <sub>OLD</sub>	†Minimum Dynamic Output Current	5.5			50	75		mA	V <sub>OLD</sub> = 1.65V Max
I <sub>OHD</sub>		5.5			-50	-75		mA	V <sub>OHD</sub> = 3.85V Min
I <sub>CC</sub>	Maximum Quiescent Supply Current	5.5	8.0		160.0	80.0		μA	V <sub>IN</sub> = V <sub>CC</sub> or GND
I <sub>OZT</sub>	Maximum I/O Leakage Current	5.5	±0.6		±11.0	±6.0		μA	V <sub>I</sub> (OE) = V <sub>IL</sub> , V <sub>IH</sub> V <sub>I</sub> = V <sub>CC</sub> , GND V <sub>O</sub> = V <sub>CC</sub> , GND

†Maximum test duration 2.0 ms, one output loaded at a time.

Note: I<sub>IN</sub> and I<sub>CC</sub> @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V V<sub>CC</sub>.

I<sub>CC</sub> for 54AC @ 25°C is identical to 74AC @ 25°C.

### DC Characteristics for 'ACT Family Devices

Symbol	Parameter	V <sub>CC</sub> (V)	74ACT		74ACT		Units	Conditions
			T <sub>A</sub> = +25°C		T <sub>A</sub> = -40°C to +85°C			
			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
		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
		5.5		0.36	0.44			
I <sub>IN</sub>	Maximum Input Leakage Current	5.5		±0.1	±1.0		μA	V <sub>I</sub> = V <sub>CC</sub> , GND
I <sub>CC</sub> T	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 Output Current	5.5			75		mA	V <sub>OLD</sub> = 1.65V Max
I <sub>OHD</sub>		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
I <sub>OZT</sub>	Maximum I/O Leakage Current	5.5		±0.6	±6.0		μA	V <sub>I</sub> (OE) = V <sub>IL</sub> , V <sub>IH</sub> V <sub>I</sub> = V <sub>CC</sub> , GND V <sub>O</sub> = V <sub>CC</sub> , GND

\*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

## AC Electrical Characteristics

Symbol	Parameter	V <sub>CC</sub> * (V)	74AC			54AC		74AC		Units
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = -55°C to +125°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		
			Min	Typ	Max	Min	Max	Min	Max	
t <sub>PLH</sub>	Propagation Delay Clock to Bus	3.3 5.0	4.0 2.5	10.5 7.5	16.5 12.0	1.0 1.5	20.0 14.0	3.0 2.0	18.5 13.0	ns
t <sub>PHL</sub>	Propagation Delay Clock to Bus	3.3 5.0	3.0 2.0	9.5 6.5	14.5 10.5	1.0 1.5	17.5 12.0	2.5 1.5	16.0 11.5	ns
t <sub>PLH</sub>	Propagation Delay Bus to Bus	3.3 5.0	2.5 1.5	7.5 5.0	12.0 8.0	1.0 1.5	15.0 10.0	2.0 1.0	13.5 9.0	ns
t <sub>PHL</sub>	Propagation Delay Bus to Bus	3.3 5.0	1.5 1.5	7.5 5.0	12.5 9.0	1.0 1.5	14.5 9.5	1.5 1.0	13.5 9.5	ns
t <sub>PLH</sub>	Propagation Delay SBA or SAB to A <sub>n</sub> or B <sub>n</sub> (w/ A <sub>n</sub> or B <sub>n</sub> HIGH or LOW)	3.3 5.0	2.0 1.5	8.5 6.0	13.5 10.0	1.0 1.5	17.0 12.0	1.5 1.5	15.5 11.0	ns
t <sub>PHL</sub>	Propagation Delay SBA or SAB to A <sub>n</sub> or B <sub>n</sub> (w/ A <sub>n</sub> or B <sub>n</sub> HIGH or LOW)	3.3 5.0	1.5 1.5	8.5 6.0	13.5 10.0	1.0 1.5	17.0 12.0	1.5 1.5	15.0 11.0	ns
t <sub>PZH</sub>	Enable Time G̅ to A <sub>n</sub> or B <sub>n</sub>	3.3 5.0	2.5 1.5	7.0 5.0	11.5 8.5	1.0 1.5	13.0 9.5	2.0 1.5	12.5 9.0	ns
t <sub>PZL</sub>	Enable Time G̅ to A <sub>n</sub> or B <sub>n</sub>	3.3 5.0	2.5 1.5	7.5 5.5	12.5 9.0	1.0 1.5	15.5 11.0	2.0 1.5	14.0 10.0	ns
t <sub>PHZ</sub>	Disable Time G̅ to A <sub>n</sub> or B <sub>n</sub>	3.3 5.0	3.0 2.0	8.0 6.5	12.5 10.0	1.0 1.5	14.0 11.5	2.5 2.0	13.5 11.0	ns
t <sub>PLZ</sub>	Disable Time G̅ to A <sub>n</sub> or B <sub>n</sub>	3.3 5.0	2.0 1.5	7.5 6.0	12.0 9.5	1.0 1.5	13.5 11.0	2.0 1.5	13.5 10.5	ns
t <sub>PZH</sub>	Enable Time DIR to A <sub>n</sub> or B <sub>n</sub>	3.3 5.0	2.0 1.5	6.5 5.0	11.0 7.5	1.0 1.5	14.5 10.5	1.5 1.0	12.0 8.5	ns
t <sub>PZL</sub>	Enable Time DIR to A <sub>n</sub> or B <sub>n</sub>	3.3 5.0	2.5 1.5	7.0 5.0	11.5 8.0	1.0 1.5	16.0 12.5	2.0 1.0	13.0 9.0	ns
t <sub>PHZ</sub>	Disable Time DIR to A <sub>n</sub> or B <sub>n</sub>	3.3 5.0	2.5 1.5	7.5 5.5	11.5 9.5	1.0 1.5	14.5 12.0	1.5 1.5	12.5 10.0	ns
t <sub>PLZ</sub>	Disable Time DIR to A <sub>n</sub> or B <sub>n</sub>	3.3 5.0	1.5 1.5	7.5 5.5	12.0 9.5	1.0 1.5	16.5 12.0	1.5 1.5	13.5 10.5	ns

\*Voltage Range 3.3 is 3.3V ±0.3V  
Voltage Range 5.0 is 5.0V ±0.5V

## AC Operating Requirements

Symbol	Parameter	V <sub>CC</sub> * (V)	74AC		54AC		74AC		Units
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = -55°C to +125°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		
			Typ	Guaranteed Minimum					
t <sub>s</sub>	Setup Time, HIGH or LOW Bus to Clock	3.3 5.0	2.0 1.5	5.0 4.0	6.0 4.5	5.5 4.5			ns
t <sub>h</sub>	Hold Time, HIGH or LOW Bus to Clock	3.3 5.0	-1.5 -0.5	0 0.5	1.5 2.0	0 1.0			ns
t <sub>w</sub>	Clock Pulse Width HIGH or LOW	3.3 5.0	2.0 2.0	3.5 3.5	5.0 5.0	4.5 3.5			ns

\*Voltage Range 3.3 is 3.3V ±0.3V  
Voltage Range 5.0 is 5.0V ±0.5V

## AC Electrical Characteristics

Symbol	Parameter	V <sub>CC</sub> * (V)	74ACT			74ACT		Units
			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		
			Min	Typ	Max	Min	Max	
t <sub>PLH</sub>	Propagation Delay Clock to Bus	5.0	3.5	12.0	14.5	3.0	16.0	ns
t <sub>PHL</sub>	Propagation Delay Clock to Bus	5.0	4.0	12.0	14.5	3.5	16.0	ns
t <sub>PLH</sub>	Propagation Delay Bus to Bus	5.0	3.0	8.5	10.5	2.5	11.5	ns
t <sub>PHL</sub>	Propagation Delay Bus to Bus	5.0	2.5	8.5	10.5	2.0	11.5	ns
t <sub>PLH</sub>	Propagation Delay SBA or SAB to A <sub>n</sub> to B <sub>n</sub> (w/A <sub>n</sub> or B <sub>n</sub> HIGH or LOW)	5.0	3.0	9.5	11.5	2.5	12.5	ns
t <sub>PHL</sub>	Propagation Delay SBA or SAB to A <sub>n</sub> to B <sub>n</sub> (w/A <sub>n</sub> or B <sub>n</sub> HIGH or LOW)	5.0	3.0	9.5	11.5	2.5	12.5	ns
t <sub>PZH</sub>	Enable Time $\bar{G}$ to A <sub>n</sub> or B <sub>n</sub>	5.0	2.0	9.0	11.0	1.5	12.0	ns
t <sub>PZL</sub>	Enable Time $\bar{G}$ to A <sub>n</sub> or B <sub>n</sub>	5.0	3.5	9.0	11.0	3.0	12.0	ns
t <sub>PHZ</sub>	Disable Time $\bar{G}$ to A <sub>n</sub> or B <sub>n</sub>	5.0	5.0	10.5	13.0	4.5	14.5	ns
t <sub>PLZ</sub>	Disable Time $\bar{G}$ to A <sub>n</sub> or B <sub>n</sub>	5.0	3.5	10.0	12.5	3.0	14.0	ns
t <sub>PZH</sub>	Enable Time DIR to A <sub>n</sub> or B <sub>n</sub>	5.0	2.0	6.5	10.5	1.5	11.5	ns
t <sub>PZL</sub>	Enable Time DIR to A <sub>n</sub> or B <sub>n</sub>	5.0	3.5	6.5	10.5	3.0	11.5	ns
t <sub>PHZ</sub>	Disable Time DIR to A <sub>n</sub> or B <sub>n</sub>	5.0	5.0	8.5	12.5	4.5	13.5	ns
t <sub>PLZ</sub>	Disable Time DIR to A <sub>n</sub> or B <sub>n</sub>	5.0	3.5	8.5	12.5	3.0	13.5	ns

\*Voltage Range 5.0 is 5.0V ± 0.5V

## AC Operating Requirements

Symbol	Parameter	V <sub>CC</sub> * (V)	74ACT		74ACT		Units
			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		
			Typ	Guaranteed Minimum			
t <sub>s</sub>	Setup Time, HIGH or LOW BUS to Clock	5.0	2.5	7.0	8.0	ns	
t <sub>h</sub>	Hold Time, HIGH or LOW Bus to Clock	5.0	0	2.5	2.5	ns	
t <sub>w</sub>	Clock Pulse Width HIGH or LOW	5.0	4.5	7.0	8.0	ns	

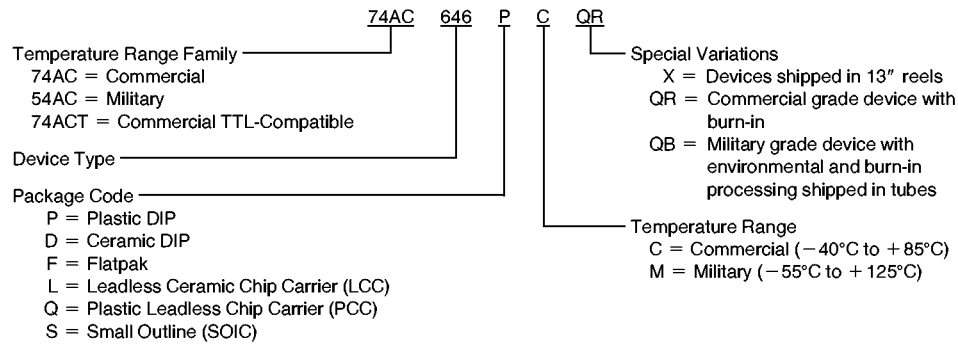
\*Voltage Range 5.0 is 5.0V ± 0.5V

## Capacitance

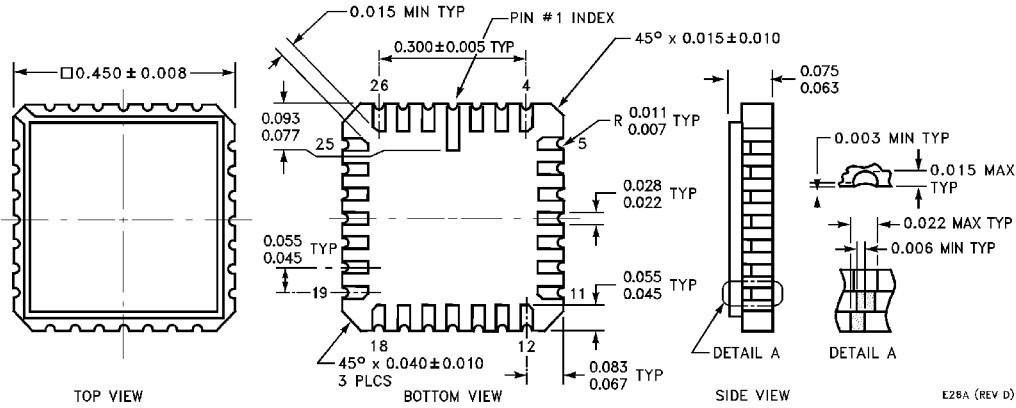
Symbol	Parameter	Typ	Units	Conditions
$C_{IN}$	Input Capacitance	4.5	pF	$V_{CC} = OPEN$
$C_{I/O}$	Input/Output Capacitance	15.0	pF	$V_{CC} = 5.0V$
$C_{PD}$	Power Dissipation Capacitance	60.0	pF	$V_{CC} = 5.0V$

## Ordering Information

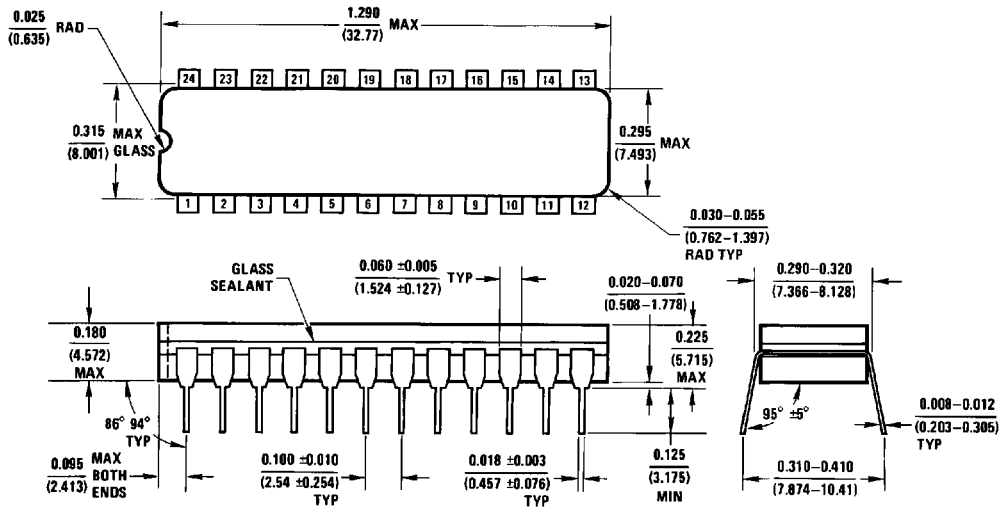
The device number is used to form part of a simplified purchasing code where the package type and temperature range are defined as follows:



**Physical Dimensions** inches (millimeters)



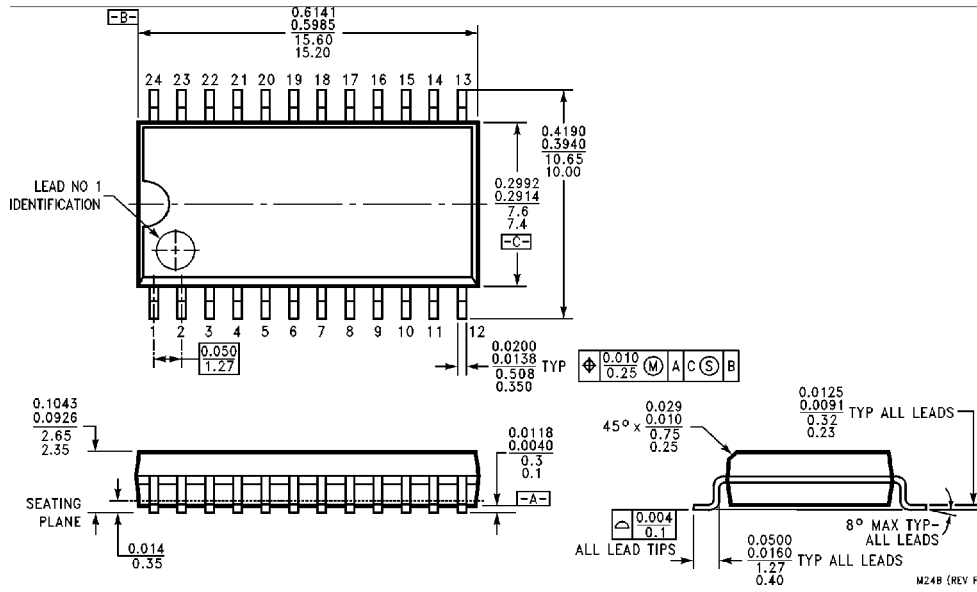
**28-Terminal Ceramic Leadless Chip Carrier (L)**  
NS Package Number E28A



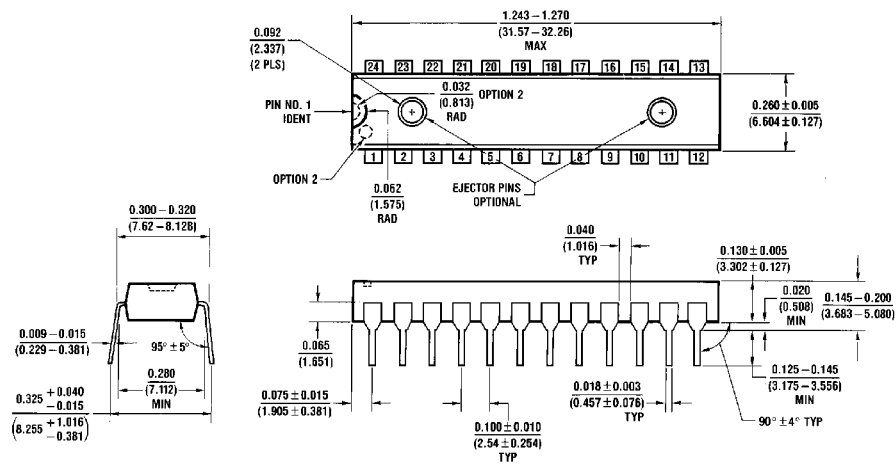
**24-Lead Slim (0.300" Wide) Ceramic Dual-In-Line Package (SD)**  
NS Package Number J24F



**Physical Dimensions** inches (millimeters) (Continued)

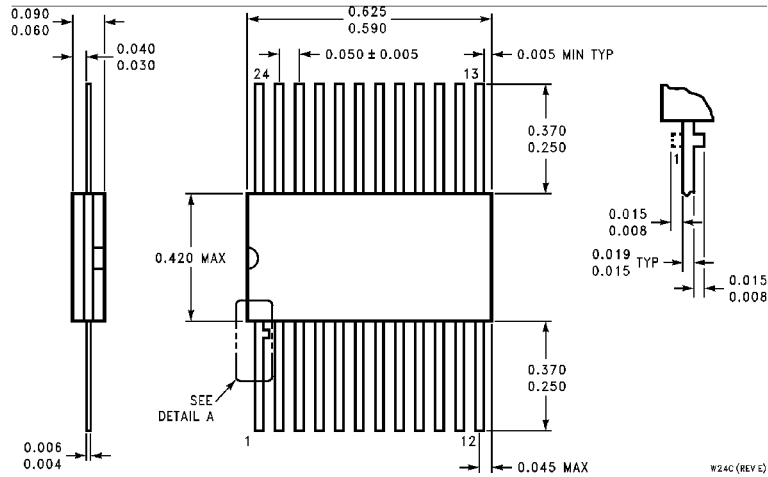


**24-Lead Small Outline Integrated Circuit (S)  
NS Package Number M24B**



**24-Lead Slim (0.300" Wide) Plastic Dual-In-Line Package (SP)  
NS Package Number N24C**

**Physical Dimensions** inches (millimeters) (Continued)



**24-Lead Ceramic Flatpak (F)  
NS Package Number W24C**

W24C (REV 5)

**LIFE SUPPORT POLICY**

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2. A critical component is 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.



**National Semiconductor Corporation**  
2900 Semiconductor Drive  
P.O. Box 58090  
Santa Clara, CA 95052-8090  
Tel: 1(800) 272-9959  
TWX: (910) 339-9240

**National Semiconductor GmbH**  
Livry-Gargan-Str. 10  
D-82256 Fürstenfeldbruck  
Germany  
Tel: (81-41) 35-0  
Telex: 527649  
Fax: (81-41) 35-1

**National Semiconductor Japan Ltd.**  
Sumitomo Chemical  
Engineering Center  
Bldg. 7F  
1-7-1, Nakase, Mihama-Ku  
Chiba-City,  
Chiba Prefecture 261  
Tel: (043) 299-2300  
Fax: (043) 299-2500

**National Semiconductor Hong Kong Ltd.**  
13th Floor, Straight Block,  
Ocean Centre, 5 Canton Rd.  
Tsimshatsui, Kowloon  
Hong Kong  
Tel: (852) 2737-1600  
Fax: (852) 2736-9960

**National Semicondutores Do Brazil Ltda.**  
Rue Deputado Lacorda Franco  
120-3A  
Sao Paulo-SP  
Brazil 05418-000  
Tel: (55-11) 212-5066  
Telex: 391-1131931 NSBR BR  
Fax: (55-11) 212-1181

**National Semiconductor (Australia) Pty. Ltd.**  
Building 16  
Business Park Drive  
Monash Business Park  
Nottingham, Melbourne  
Victoria 3168 Australia  
Tel: (3) 558-9999  
Fax: (3) 558-9998

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