

## 54ACT818 8-Bit Diagnostic Register

### General Description

The 'ACT818 is a high-speed, general-purpose pipeline register with an on-board diagnostic register for performing serial diagnostics and/or writable control store loading.

The D-to-Y path provides an 8-bit parallel data path pipeline register for normal system operation. The diagnostic register can load parallel data to or from the pipeline register and can output data through the D input port (as in WCS loading).

The 8-bit diagnostic register has multiplexer inputs that select parallel inputs from the Y-port or adjacent bits in the diagnostic register to operate as a right-shift-only register. This register can then participate in a serial loop throughout the system where normal data, address, status and control registers are replaced with 'ACT818 diagnostic pipeline registers. The loop can be used to scan in a complete test routine starting point (Data, Address, etc.). Then after a specified number of machine cycles it scans out the results to be inspected for the expected results. WCS loading can be accomplished using the same technique. An instruction word can be serially shifted into the shadow register and written into the WCS RAM by enabling the D output.

### Features

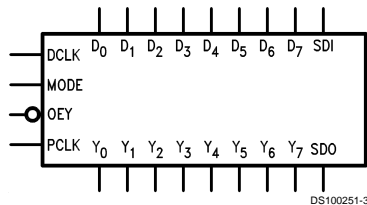
- On-line and off-line system diagnostics

- Swaps the contents of diagnostic register and output register
- Diagnostic register and diagnostic testing
- Cascadable for wide control words as used in microprogramming
- Edge-triggered D registers
- Outputs source/sink 24 mA
- 'ACT818 has TTL-compatible inputs
- 'ACT818 is functionally- and pin-compatible to AMD Am29818 and MMI 74S818
- Standard Microcircuit Drawing (SMD) 5962-9160901

### Applications

- Register for microprogram control store
- Status register
- Data register
- Instruction register
- Interrupt mask register
- Pipeline register
- General purpose register
- Parallel-serial/serial-parallel converter

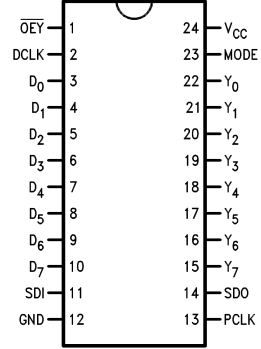
### Logic Symbol



TRI-STATE® is a registered trademark of National Semiconductor Corporation.  
FACT™ is a trademark of Fairchild Semiconductor Corporation.

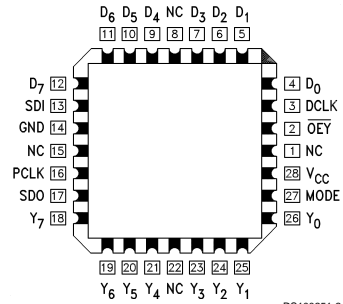
## Connection Diagrams

Pin Assignment  
for DIP and Flatpak



DS100251-1

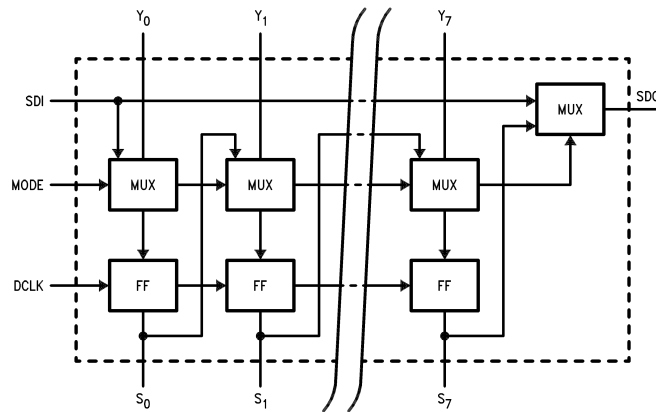
Pin Assignment  
for LCC



DS100251-2

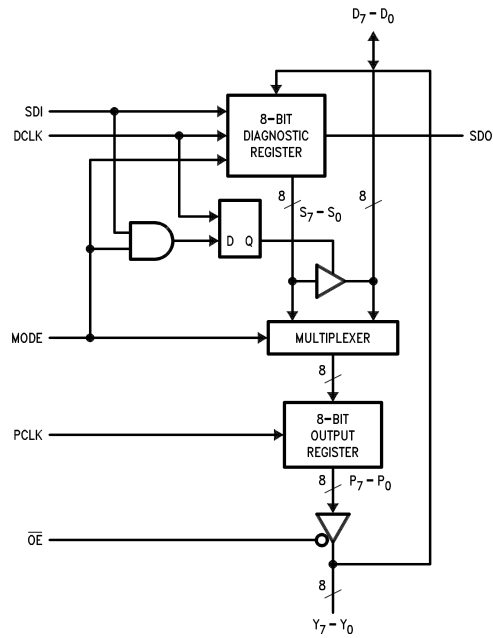
Pin Names	Description
D <sub>0</sub> –D <sub>7</sub>	Data Inputs
SDI	Serial Data Input
DCLK	Diagnostics Clock
MODE	Control Input
PCLK	Pipeline Register Clock
$\overline{\text{OEY}}$	Output Enable Input
SDO	Serial Data Output
Y <sub>0</sub> –Y <sub>7</sub>	Data Outputs

## Diagnostic Register



DS100251-4

## Block Diagram



## Functional Description

Data transfers into the diagnostic register occur on the LOW-to-HIGH transition of DCLK. Mode and SDI determine what data source will be loaded. The pipeline register is loaded on the LOW-to-HIGH transition of PCLK. Mode selects whether the data source is the data input or the diag-

nostic register output. Because of the independence of the clock inputs, data can be shifted in the diagnostic register via DCLK and loaded into the pipeline register from the data input via PCLK simultaneously, as long as no setup or hold times are violated. This simultaneous operation is legal.

## Function Table

Inputs				Outputs			Operation
SDI	MODE	DCLK	PCLK	SDO	Diagnostic Reg.	Pipeline Reg.	
X	L	N	X	S7	SI < SI - 1, SO < SD <sub>i</sub>	NA	Serial Shift; D <sub>7</sub> -D <sub>0</sub> Disabled
X	L	X	N	S7	NA	PI < DI	Normal Load Pipeline Register
L	H	N	X	L	SI < YI	NA	Load Diagnostic Register from Y; DI Disabled
X	H	X	N	SDI	NA	PI < SI	Load Pipeline Register from Diagnostic Register
H	H	N	X	H	Hold	NA	Hold Diagnostic Register; DI Enabled

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

## Absolute Maximum Ratings (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 ( $I_O$ )	±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 ( $T_J$ )	
CDIP	175°C

## Recommended Operating Conditions

Supply Voltage ( $V_{CC}$ )	
'ACT	4.5V to 5.5V
Input Voltage ( $V_I$ )	0V to $V_{CC}$
Output Voltage ( $V_O$ )	0V to $V_{CC}$
Operating Temperature ( $T_A$ )	
54ACT	-55°C to +125°C
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, 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.

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

## DC Characteristics for 'ACT Family Devices

Symbol	Parameter	$V_{CC}$ (V)	54ACT	Units	Conditions
			$T_A =$		
			-55°C to +125°C		
			Guaranteed Limits		
$V_{IH}$	Minimum High Level Input Voltage	4.5	2.0	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		5.5	2.0		
$V_{IL}$	Maximum Low Level Input Voltage	4.5	0.8		$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		5.5	0.8		
$I_{IN}$	Maximum Input Leakage Current	5.5	±1.0	µA	$V_{IN} = V_{CC}$
$I_{OZ}$	Maximum TRI-STATE Leakage Current	5.5	±1.0	µA	$\overline{OE} = V_{IH}$ $V_{OUT} = 0V, V_{CC}$
$I_{CC}$	Maximum Quiescent Supply Current	5.5	160	µA	$V_{IN} = V_{CC}$ or GND
$I_{CCT}$	Maximum Additional $I_{CC}$ /Input	5.5	1.6	mA	$V_{IN} = V_{CC} - 2.1V$ $V_{CC} = 5.5V$
$V_{OH}$	Minimum HIGH				(Note 2) $V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OH} = -24$ mA $I_{OH} = -24$ mA
	Level Output Voltage, $Y_0$ - $Y_7$ Outputs	4.5	3.70	V	$I_{OH} = -8$ mA $I_{OH} = -8$ mA
		5.5	4.70	V	
	Minimum HIGH Level Output Voltage, $D_0$ - $D_7$ , SDO Outputs	4.5	3.70	V	$I_{OL} = 8$ mA $I_{OL} = 8$ mA
	5.5	4.70	V		
$V_{OL}$	Maximum LOW				(Note 2) $V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OL} = 24$ mA $I_{OL} = 24$ mA
	Level Output Voltage, $Y_0$ - $Y_7$ Outputs	4.5	0.50	V	$I_{OL} = 8$ mA $I_{OL} = 8$ mA
		5.5	0.50	V	
	Maximum LOW Level Output Voltage, $D_0$ - $D_7$ , SDO Outputs	4.5	0.50	V	$I_{OL} = 8$ mA $I_{OL} = 8$ mA
	5.5	0.50	V		

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

Symbol	Parameter	V <sub>CC</sub> (V)	54ACT		Units	Conditions
			T <sub>A</sub> = -55°C to +125°C			
			Guaranteed Limits			
I <sub>OLD</sub>	Minimum Dynamic Output Current, Y <sub>0</sub> -Y <sub>7</sub> Outputs	5.5	50		mA	V <sub>OLD</sub> = 1.65V Max
I <sub>OHD</sub>	Minimum Dynamic Output Current, Y <sub>0</sub> -Y <sub>7</sub> Outputs	5.5	-50		mA	V <sub>OHD</sub> = 3.85V Min
I <sub>OLD</sub>	Minimum Dynamic Output Current, D <sub>0</sub> -D <sub>7</sub> , SDO Outputs (Note 4)	5.5	32		mA	V <sub>OLD</sub> = 1.65V Max
I <sub>OHD</sub>	Minimum Dynamic Output Current, D <sub>0</sub> -D <sub>7</sub> , SDO Outputs (Note 4)	5.5	-32		mA	V <sub>OHD</sub> = 3.85V Min

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

**Note 4:** Test load 50 pF, 500Ω to ground.

**Note 5:** I<sub>CC</sub> for 54ACT @ 25°C is identical to 74ACT @ 25°C.

## AC Electrical Characteristics

Symbol	Parameter	V <sub>CC</sub> (V) (Note 6)	54ACT		Units	Fig. No.
			T <sub>A</sub> = -55°C to +125°C C <sub>L</sub> = 50 pF			
			Min	Max		
t <sub>PHL</sub>	Propagation Delay PCLK to Y	5.0	2.5	10.0	ns	
t <sub>PLH</sub>	Propagation Delay PCLK to Y	5.0	2.5	10.0	ns	
t <sub>PHL</sub>	Propagation Delay MODE to SDO	5.0	3.5	12.0	ns	
t <sub>PLH</sub>	Propagation Delay MODE to SDO	5.0	3.5	13.5	ns	
t <sub>PHL</sub>	Propagation Delay SDI to SDO	5.0	3.0	11.5	ns	
t <sub>PLH</sub>	Propagation Delay SDI to SDO	5.0	3.0	12.0	ns	
t <sub>PHL</sub>	Propagation Delay DCLK to SDO	5.0	3.5	14.0	ns	
t <sub>PLH</sub>	Propagation Delay DCLK to SDO	5.0	3.5	15.5	ns	
t <sub>PZL</sub>	Output Enable Time OEY to Y <sub>n</sub>	5.0	2.5	12.0	ns	
t <sub>PLZ</sub>	Output Disable Time OEY to Y <sub>n</sub>	5.0	1.5	10.0	ns	
t <sub>PZL</sub>	Output Enable Time DCLK to D <sub>n</sub>	5.0	3.0	14.0	ns	

## AC Electrical Characteristics (Continued)

Symbol	Parameter	V <sub>CC</sub> (V) (Note 6)	54ACT		Units	Fig. No.
			T <sub>A</sub> = -55°C to +125°C C <sub>L</sub> = 50 pF			
			Min	Max		
t <sub>PLZ</sub>	Output Disable Time DCLK to D <sub>n</sub>	5.0	1.5	12.0	ns	
t <sub>PZH</sub>	Output Enable Time OEY to Y <sub>n</sub>	5.0	2.5	11.0	ns	
t <sub>PHZ</sub>	Output Disable Time OEY to Y <sub>n</sub>	5.0	2.0	12.0	ns	
t <sub>PZH</sub>	Output Enable Time DCLK to D <sub>n</sub>	5.0	3.0	13.5	ns	
t <sub>PHZ</sub>	Output Disable Time DCLK to D <sub>n</sub>	5.0	2.0	13.5	ns	

**Note 6:** Voltage Range 5.0 is 5.0V ±0.5V.

## AC Operating Requirements

Symbol	Parameter	V <sub>CC</sub> (V) (Note 8)	54ACT		Units	Fig. No.
			T <sub>A</sub> = -55°C to +125°C C <sub>L</sub> = 50 pF			
			Guaranteed Minimum			
t <sub>s</sub>	Setup Time D to PCLK	5.0	6.0		ns	
t <sub>h</sub>	Hold Time D to PCLK	5.0	1.0		ns	
t <sub>s</sub>	Setup Time MODE to PCLK	5.0	6.0		ns	
t <sub>h</sub>	Hold Time MODE to PCLK	5.0	0.0		ns	
t <sub>s</sub>	Setup Time Y to DCLK	5.0	2.5		ns	
t <sub>h</sub>	Hold Time Y to DCLK	5.0	1.5		ns	
t <sub>s</sub>	Setup Time MODE to DCLK	5.0	4.5		ns	
t <sub>h</sub>	Hold Time MODE to DCLK	5.0	1.0		ns	
t <sub>s</sub>	Setup Time SDI to DCLK	5.0	4.5		ns	
t <sub>h</sub>	Hold Time SDI to DCLK	5.0	1.0		ns	
t <sub>s</sub>	Setup Time DCLK to PCLK	5.0	11.5		ns	
t <sub>s</sub>	Setup Time PCLK to DCLK	5.0	12.5		ns	
t <sub>w</sub>	Pulse Width	5.0	3.5		ns	

## AC Operating Requirements (Continued)

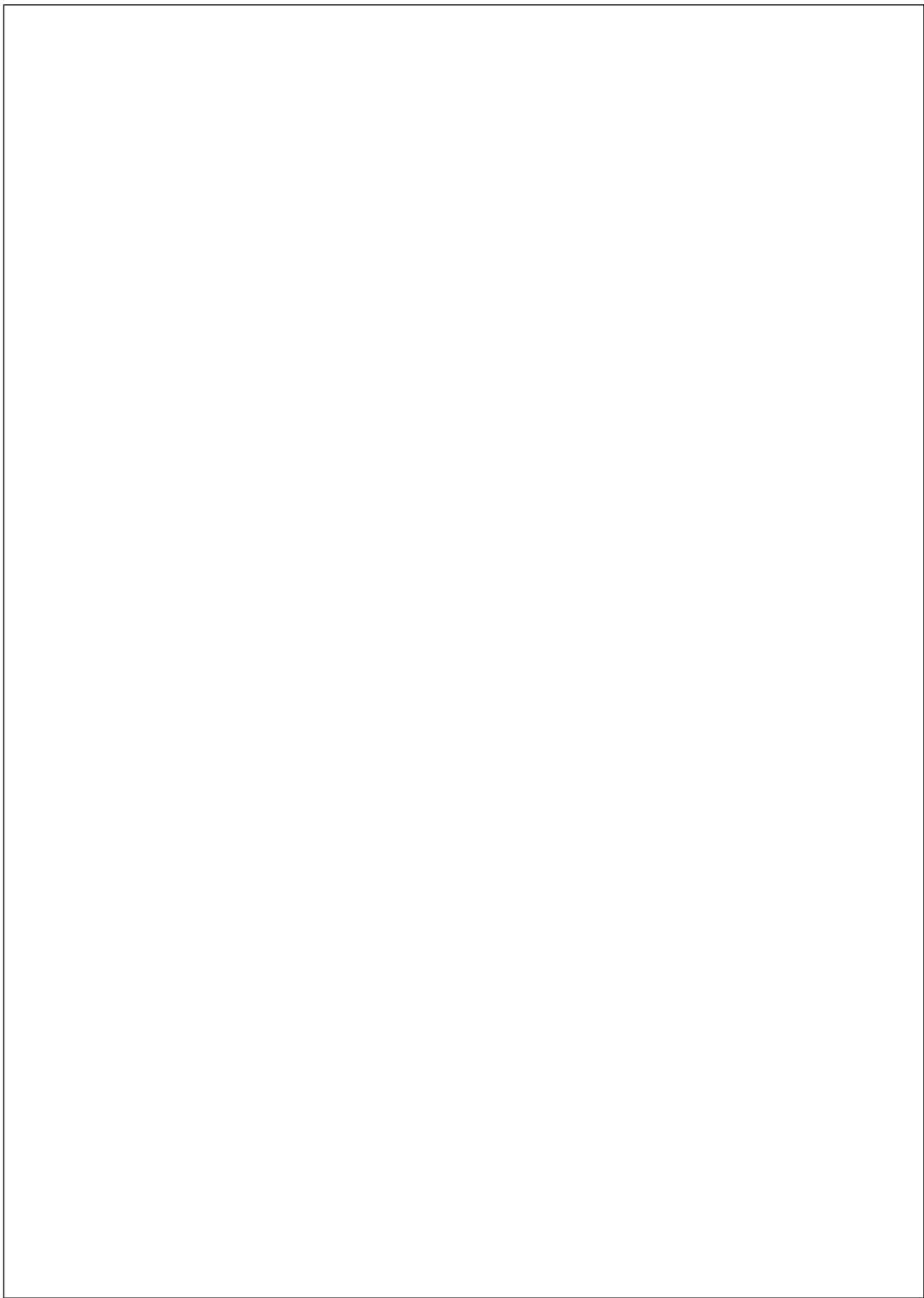
Symbol	Parameter	V <sub>CC</sub> (V) (Note 8)	54ACT	Units	Fig. No.
			T <sub>A</sub> = -55°C to +125°C C <sub>L</sub> = 50 pF		
			Guaranteed Minimum		
	PCLK HIGH or LOW				
t <sub>w</sub>	Pulse Width DCLK HIGH or LOW	5.0	3.0	ns	

**Note 7:** Test load 50 pF, 500Ω to ground.

**Note 8:** Voltage range 5.0 is 5.0V ± 0.5V.

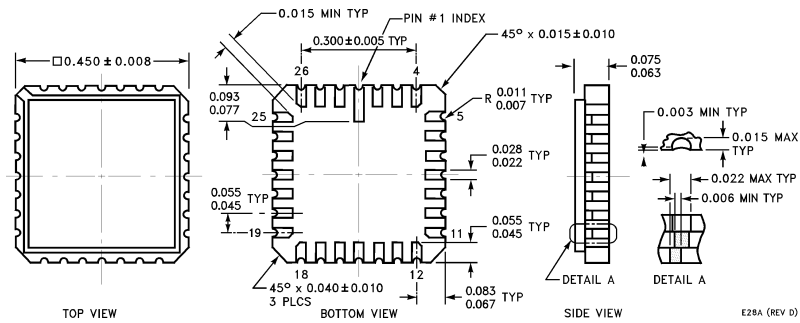
## Capacitance

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	20	pF	V <sub>CC</sub> = 5.0V

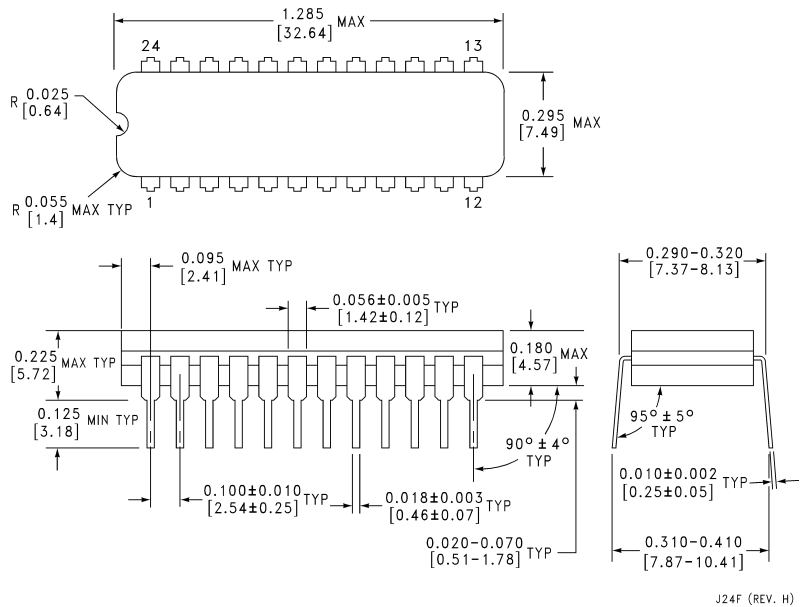




**Physical Dimensions** inches (millimeters) unless otherwise noted

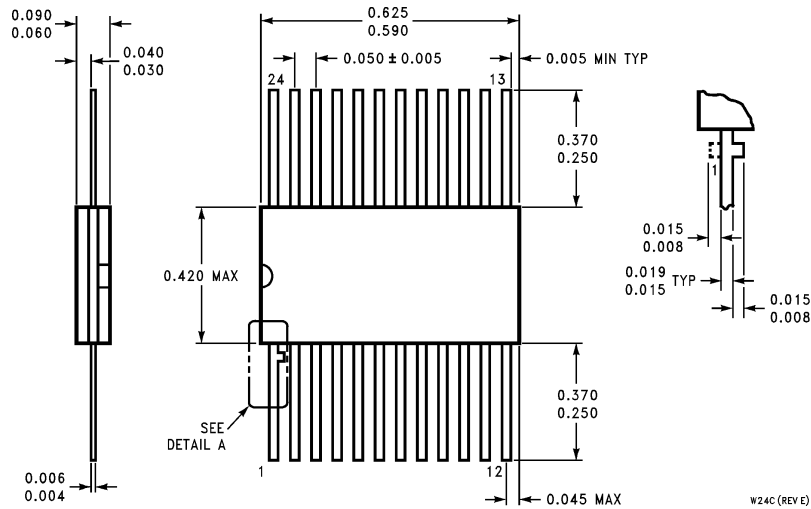


**28 Terminal Ceramic Leadless Chip Carrier (L)**  
NS Package Number E28A



**24 Lead Slim (0.300" wide) Ceramic Dual-in-Line Package (D)**  
NS Package Number J24F

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



**24 Lead Ceramic Cerpack  
NS Package Number W24C**

W24C (REV E)

**LIFE SUPPORT POLICY**

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
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.



**National Semiconductor Corporation**  
Americas  
Tel: 1-800-272-9959  
Fax: 1-800-737-7018  
Email: support@nsc.com

www.national.com

**National Semiconductor Europe**  
Fax: +49 (0) 1 80-530 85 86  
Email: europe.support@nsc.com  
Deutsch Tel: +49 (0) 1 80-530 85 85  
English Tel: +49 (0) 1 80-532 78 32  
Français Tel: +49 (0) 1 80-532 93 58  
Italiano Tel: +49 (0) 1 80-534 16 80

**National Semiconductor Asia Pacific Customer Response Group**  
Tel: 65-2544466  
Fax: 65-2504466  
Email: sea.support@nsc.com

**National Semiconductor Japan Ltd.**  
Tel: 81-3-5620-6175  
Fax: 81-3-5620-6179