



## 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.

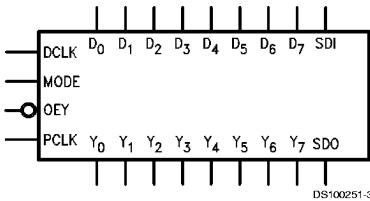
The D-to-Y path provides an 8-bit parallel data path pipeline register for normal system operation. The diagnostic register can load parallel data to or from the pipeline register and can output data through the D input port (as in WCS loading).

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

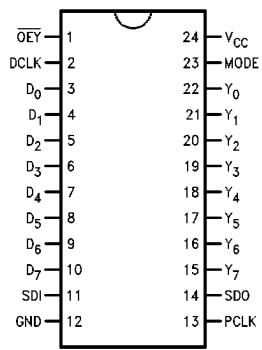
### Logic Symbol



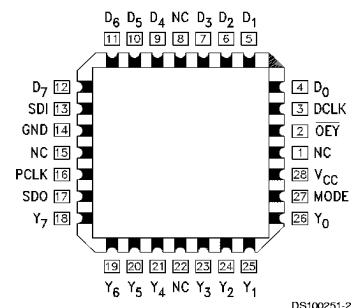
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## Connection Diagrams

Pin Assignment  
for DIP and Flatpak

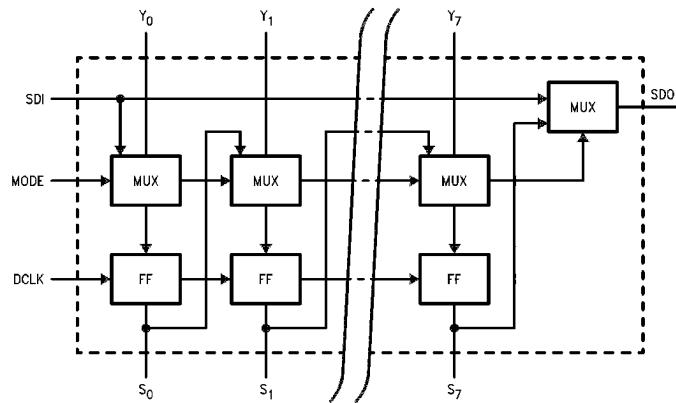


Pin Assignment  
for LCC

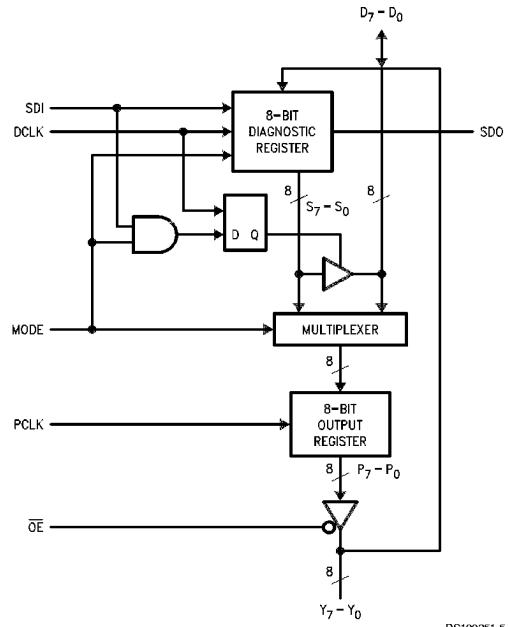


Pin Names	Description
D <sub>0</sub> -D <sub>7</sub>	Data Inputs
SDI	Serial Data Input
DCLK	Diagnostics Clock
MODE	Control Input
PCLK	Pipeline Register Clock
OEY	Output Enable Input
SDO	Serial Data Output
Y <sub>0</sub> -Y <sub>7</sub>	Data Outputs

## Diagnostic Register



### 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>1</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

<b>Absolute Maximum Ratings</b> (Note 1)			<b>Recommended Operating Conditions</b>		
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	Supply Voltage ( $V_{CC}$ )		4.5V to 5.5V
DC Input Diode Current ( $I_{IK}$ )			'ACT		
$V_I = -0.5V$		-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 ( $T_A$ )		-55°C to +125°C
DC Output Diode Current ( $I_{OK}$ )			54ACT		
$V_O = -0.5V$		-20 mA	Minimum Input Edge Rate ( $\Delta V/\Delta t$ )		
$V_O = V_{CC} + 0.5V$		+20 mA	'ACT Devices		
DC Output Voltage ( $V_O$ )		-0.5V to $V_{CC} + 0.5V$	$V_{IN}$ from 0.8V to 2.0V		
DC Output Source or Sink Current ( $I_O$ )			$V_{CC}$ @ 4.5V, 5.5V		125 mV/ns
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			
<b>DC Characteristics for 'ACT Family Devices</b>					
Symbol	Parameter	$V_{CC}$ (V)	54ACT	Units	Conditions
			$T_A = -55^{\circ}C$ to $+125^{\circ}C$		
			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 Level Output Voltage, $Y_0-Y_7$ Outputs	4.5	3.70	V	(Note 2) $V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OH} = -24 mA$ $I_{OH} = -24 mA$
		5.5	4.70		
	Minimum HIGH Level Output Voltage, $D_0-D_7$ , SDO Outputs	4.5	3.70	V	$I_{OH} = -8 mA$ $I_{OH} = -8 mA$
		5.5	4.70		
$V_{OL}$	Maximum LOW Level Output Voltage, $Y_0-Y_7$ Outputs	4.5	0.50	V	(Note 2) $V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OL} = 24 mA$ $I_{OL} = 24 mA$
		5.5	0.50		
	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		

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 $\overline{OEY}$ to Y <sub>n</sub>	5.0	2.5	12.0	ns
t <sub>PLZ</sub>	Output Disable Time $\overline{OEY}$ 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

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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  $\pm$ 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	

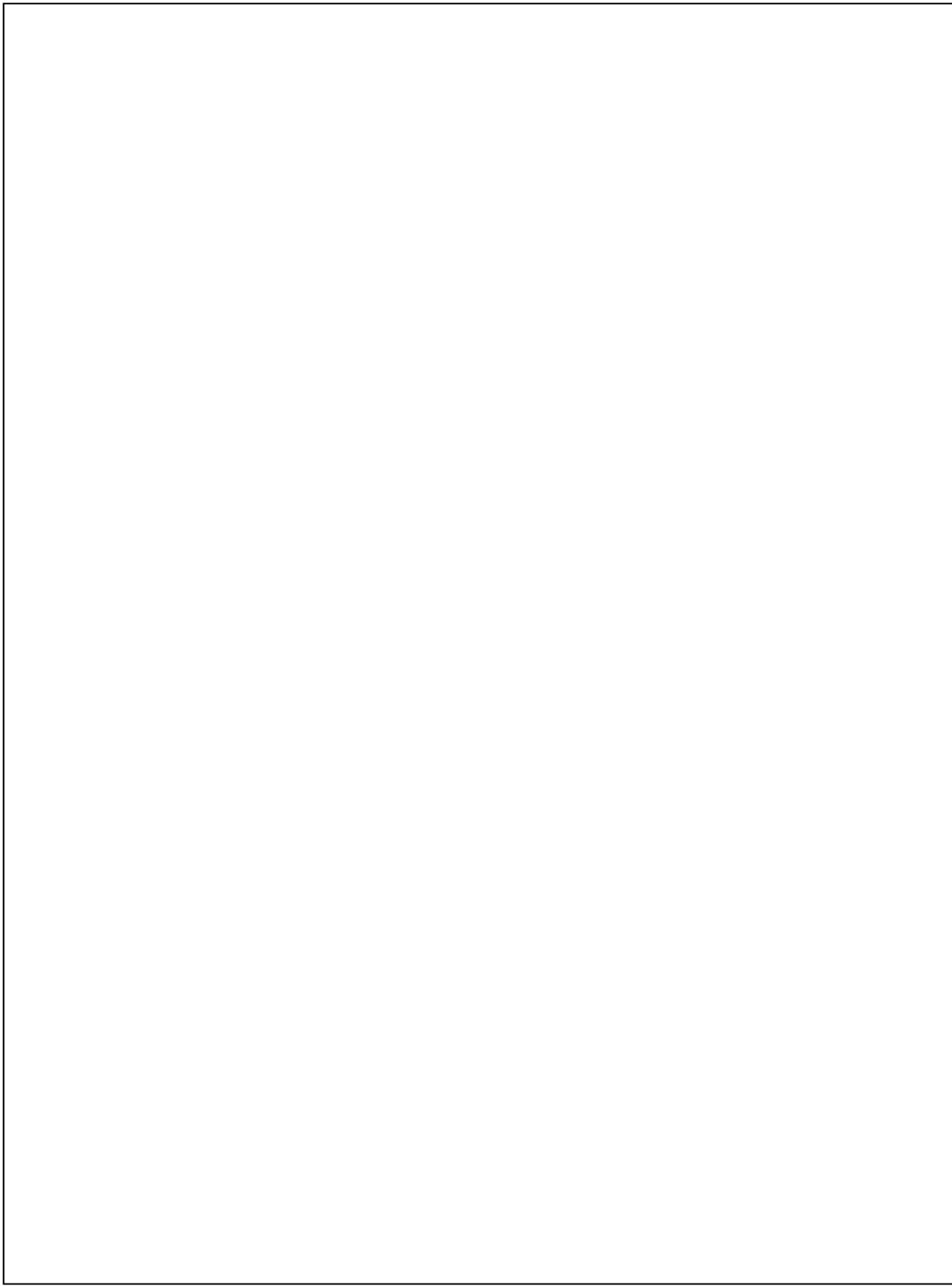
**Note 7:** Test load 50 pF, 500Ω to ground.  
**Note 8:** Voltage range 5.0 is 5.0V ± 0.5V.

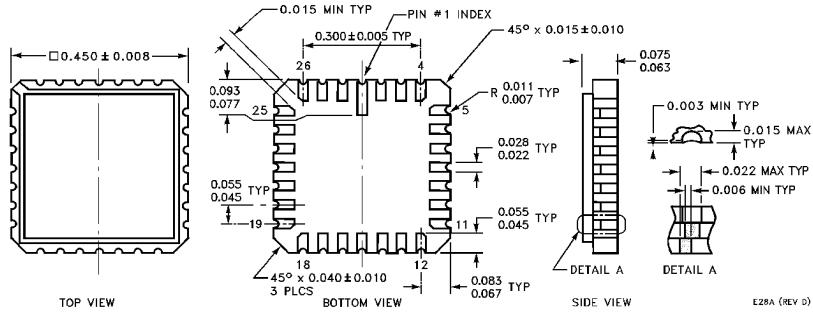
### Capacitance

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

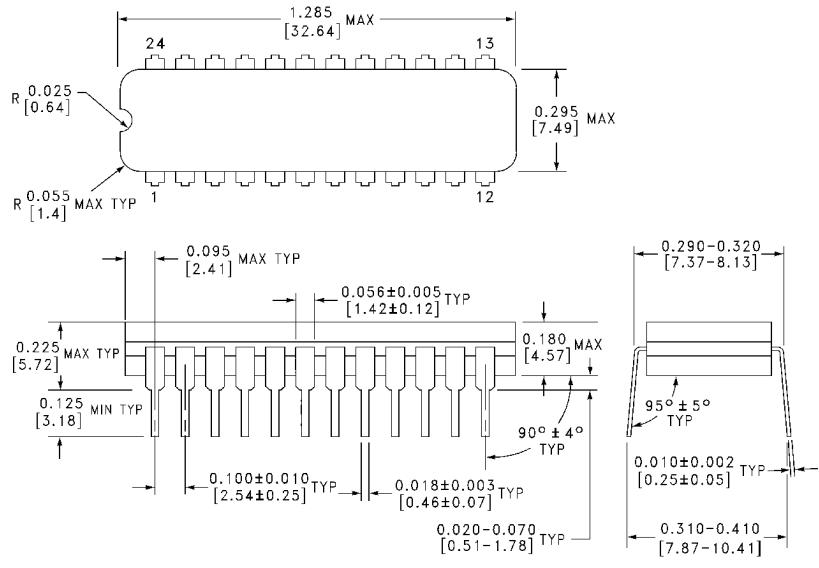
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**Physical Dimensions** inches (millimeters) unless otherwise noted



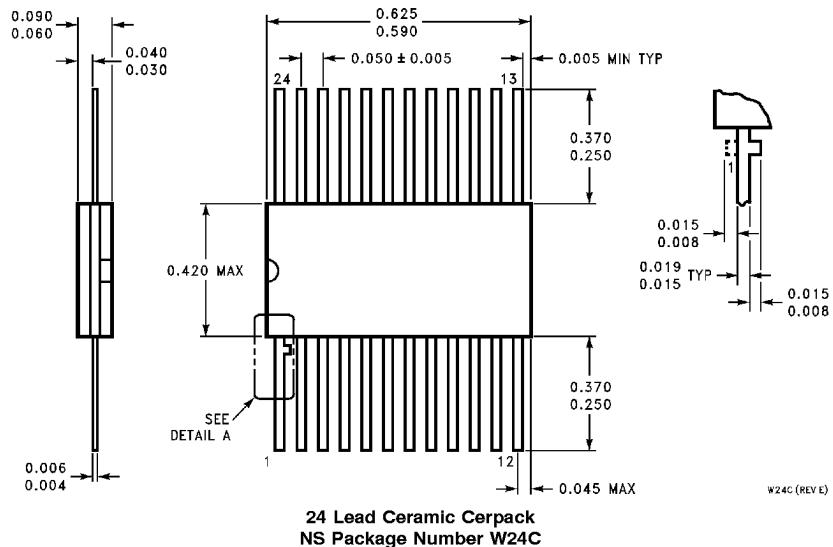
**28 Terminal Ceramic Leadless Chip Carrier (L)**  
NS Package Number E28A



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

**54ACT818 8-Bit Diagnostic Register**

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



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