National Semiconductor

December 1994

54F/74F676
16-Bit Serial/Parallel-In, Serial-Out Shift Register

General Description

The 'F676 contains 16 flip-flops with provision for synchronous parallel or serial entry and serial output. When the Mode (M) input is HIGH, information present on the parallel data (P_0–P_{15}) inputs is entered on the falling edge of the Clock Pulse ($\overline{CP}$) input signal. When M is LOW, data is shifted out of the most significant bit position while information present on the Serial (SI) input shifts into the least significant bit position. A HIGH signal on the Chip Select ($\overline{CS}$) input prevents both parallel and serial operations.

Features

- 16-bit parallel-to-serial conversion
- 16-bit serial-in, serial-out
- Chip select control
- Slim 24 lead 300 mil package

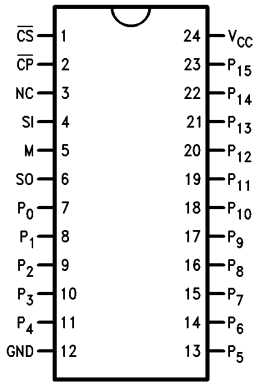
Commercial	Military	Package Number	Package Description
74F676PC		N24A	24-Lead (0.600″ Wide) Molded Dual-In-Line
74F676SPC		N24C	24-Lead (0.300″ Wide) Molded Dual-In-Line
	54F676DM (Note 2)	J24A	24-Lead (0.600″ Wide) Ceramic Dual-In-Line
	54F676SDM (Note 2)	J24F	24-Lead (0.300″ Wide) Ceramic Dual-In-Line
74F676SC (Note 1)		M24B	24-Lead (0.300″ Wide) Molded Small Outline, JEDEC
	54F676FM (Note 2)	W24C	24-Lead Cerpack
	54F676LM (Note 2)	E28A	24-Lead Ceramic Leadless Chip Carrier, Type C

Note 1: Devices also available in 13″ reel. Use suffix = SCX.

Note 2: Military grade device with environmental and burn-in processing. Use suffix = DMQB, FMQB and LMQB.

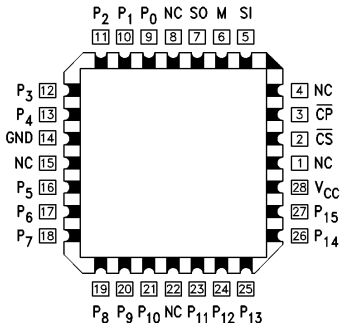
Connection Diagrams

Pin Assignment for DIP, SOIC and Flatpak



TL/F/9588–2

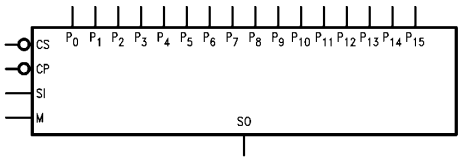
Pin Assignment for LCC



TL/F/9588–3

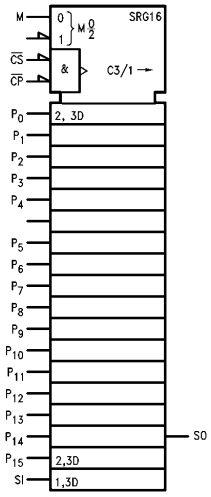
TRI-STATE® is a registered trademark of National Semiconductor Corporation.

Logic Symbols



TL/F/9588–1

IEEE/IEC



TL/F/9588–4

Unit Loading/Fan Out

Pin Names	Description	54F/74F	
		U.L. HIGH/LOW	Input I_{IH}/I_{IL} Output I_{OH}/I_{OL}
P_0–P_{15}	Parallel Data Inputs	1.0/1.0	20 μA/−0.6 mA
$\overline{CS}$	Chip Select Input (Active LOW)	1.0/1.0	20 μA/−0.6 mA
$\overline{CP}$	Clock Pulse Input (Active LOW)	1.0/1.0	20 μA/−0.6 mA
M	Mode Select Input	1.0/1.0	20 μA/−0.6 mA
SI	Serial Data Input	1.0/1.0	20 μA/−0.6 mA
SO	Serial Output	50/33.3	−1 mA/20 mA

Functional Description

The 16-bit shift register operates in one of three modes, as indicated in the Shift Register Operations Table.

HOLD—a HIGH signal on the Chip Select ($\overline{CS}$) input prevents clocking, and data is stored in the sixteen registers.

Shift/Serial Load—data present on the SI pin shifts into the register on the falling edge of $\overline{CP}$. Data enters the Q_0 position and shifts toward Q_{15} on successive clocks, finally appearing on the SO pin.

Parallel Load—data present on P_0–P_{15} are entered into the register on the falling edge of $\overline{CP}$. The SO output represents the Q_{15} register output.

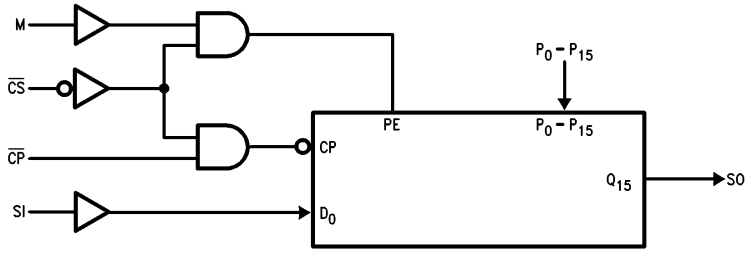
To prevent false clocking, $\overline{CP}$ must be LOW during a LOW-to-HIGH transition of $\overline{CS}$.

Shift Register Operations Table

Control Input			Operating Mode
$\overline{CS}$	M	$\overline{CP}$	
H	X	X	Hold
L	L	⌥	Shift/Serial Load
L	H	⌥	Parallel Load

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

Block Diagram



TL/F/9588–5

Absolute Maximum Ratings (Note 1)

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

Storage Temperature	−65°C to +150°C
Ambient Temperature under Bias	−55°C to +125°C
Junction Temperature under Bias	−55°C to +175°C
Plastic	−55°C to +150°C
V_{CC} Pin Potential to Ground Pin	−0.5V to +7.0V
Input Voltage (Note 2)	−0.5V to +7.0V
Input Current (Note 2)	−30 mA to +5.0 mA
Voltage Applied to Output in HIGH State (with V_{CC} = 0V)	
Standard Output	−0.5V to V_{CC}
TRI-STATE® Output	−0.5V to +5.5V
Current Applied to Output in LOW State (Max)	twice the rated I_{OL} (mA)

Note 1: Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

Note 2: Either voltage limit or current limit is sufficient to protect inputs.

Recommended Operating Conditions

Free Air Ambient Temperature	
Military	−55°C to +125°C
Commercial	0°C to +70°C
Supply Voltage	
Military	+4.5V to +5.5V
Commercial	+4.5V to +5.5V

DC Electrical Characteristics

Symbol	Parameter		54F/74F Min	54F/74F Typ	54F/74F Max	Units	V_{CC}	Conditions
V_{IH}	Input HIGH Voltage		2.0			V		Recognized as a HIGH Signal
V_{IL}	Input LOW Voltage				0.8	V		Recognized as a LOW Signal
V_{CD}	Input Clamp Diode Voltage				−1.2	V	Min	I_{IN} = −18 mA
V_{OH}	Output HIGH Voltage	54F 10% V_{CC}	2.5			V	Min	I_{OH} = −1 mA
		74F 10% V_{CC}	2.5					I_{OH} = −1 mA
		74F 5% V_{CC}	2.7					I_{OH} = −1 mA
V_{OL}	Output LOW Voltage	54F 10% V_{CC}			0.5	V	Min	I_{OL} = 20 mA
		74F 10% V_{CC}			0.5			I_{OL} = 20 mA
I_{IH}	Input HIGH Current	54F			20.0	μA	Max	V_{IN} = 2.7V
		74F			5.0			
I_{BVI}	Input HIGH Current Breakdown Test	54F			100	μA	Max	V_{IN} = 7.0V
		74F			7.0			
I_{CEX}	Output HIGH Leakage Current	54F			250	μA	Max	V_{OUT} = V_{CC}
		74F			50			
V_{ID}	Input Leakage Test	74F	4.75			V	0.0	I_{ID} = 1.9 μA, All Other Pins Grounded
I_{OD}	Output Leakage Circuit Current	74F			3.75	μA	0.0	V_{IOD} = 150 mV, All Other Pins Grounded
I_{IL}	Input LOW Current				−0.6	mA	Max	V_{IN} = 0.5V
I_{OS}	Output Short-Circuit Current		−60		−150	mA	Max	V_{OUT} = 0V
I_{CC}	Power Supply Current				72	mA	Max	

AC Electrical Characteristics

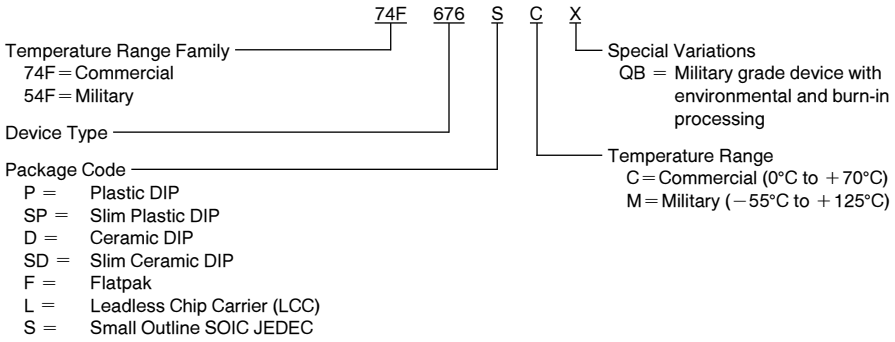
Symbol	Parameter	74F $T_A = +25°C$, $V_{CC} = +5.0V$, $C_L = 50$ pF			54F T_A, V_{CC} = Mil, $C_L = 50$ pF		74F T_A, V_{CC} = Com, $C_L = 50$ pF		Units
		Min	Typ	Max	Min	Max	Min	Max	
f_{max}	Maximum Clock Frequency	100	110		45		90		MHz
t_{PLH} t_{PHL}	Propagation Delay $\overline{CP}$ to SO	4.5 5.0	9.0 9.0	11.0 12.5	4.5 5.0	17.0 14.5	4.5 5.0	12.0 13.5	ns

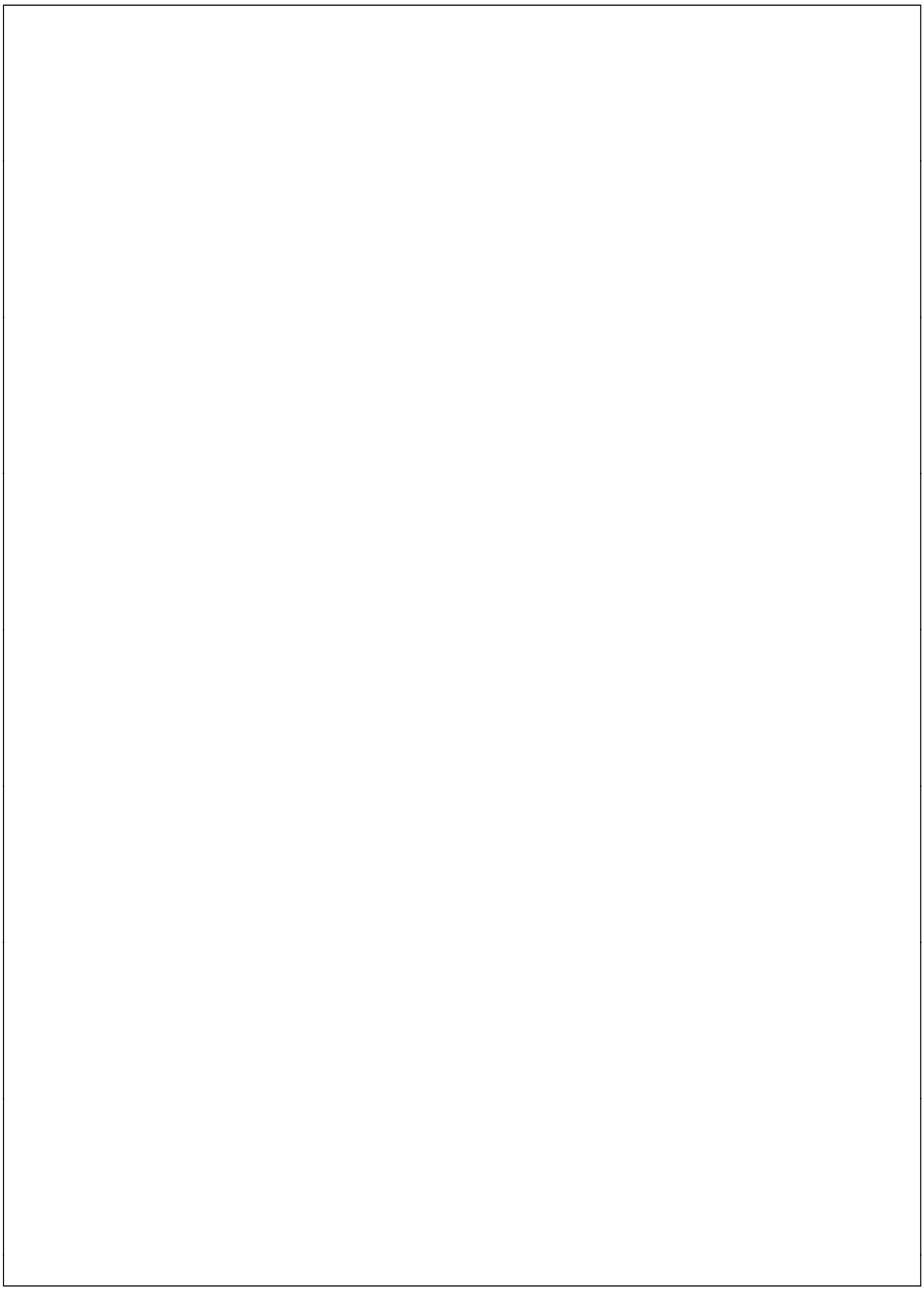
AC Operating Requirements

Symbol	Parameter	74F $T_A = +25°C$, $V_{CC} = +5.0V$		54F T_A, V_{CC} = Mil		74F T_A, V_{CC} = Com		Units
		Min	Max	Min	Max	Min	Max	
$t_s(H)$ $t_s(L)$	Setup Time, HIGH or LOW SI to $\overline{CP}$	4.0 4.0		4.0 4.0		4.0 4.0		ns
$t_h(H)$ $t_h(L)$	Hold Time, HIGH or LOW SI to $\overline{CP}$	4.0 4.0		4.0 4.0		4.0 4.0		ns
$t_s(H)$ $t_s(L)$	Setup Time, HIGH or LOW P_n to $\overline{CP}$	3.0 3.0		3.0 3.0		3.0 3.0		ns
$t_h(H)$ $t_h(L)$	Hold Time, HIGH or LOW P_n to $\overline{CP}$	4.0 4.0		4.0 4.0		4.0 4.0		ns
$t_s(H)$ $t_s(L)$	Setup Time, HIGH or LOW M to $\overline{CP}$	8.0 8.0		8.0 8.0		8.0 8.0		ns
$t_h(H)$ $t_h(L)$	Hold Time, HIGH or LOW M to $\overline{CP}$	2.0 2.0		2.0 2.0		2.0 2.0		ns
$t_s(L)$	Setup Time, LOW $\overline{CS}$ to $\overline{CP}$	10.0		12.0		10.0		ns
$t_h(H)$	Hold Time, HIGH $\overline{CS}$ to $\overline{CP}$	10.0		10.0		10.0		ns
$t_w(H)$ $t_w(L)$	$\overline{CP}$ Pulse Width HIGH or LOW	4.0 6.0		5.0 9.0		4.0 6.0		ns

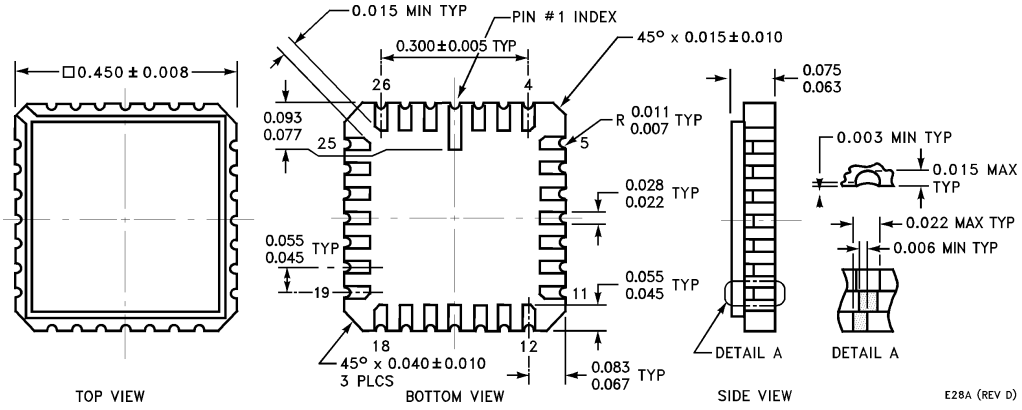
Ordering Information

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

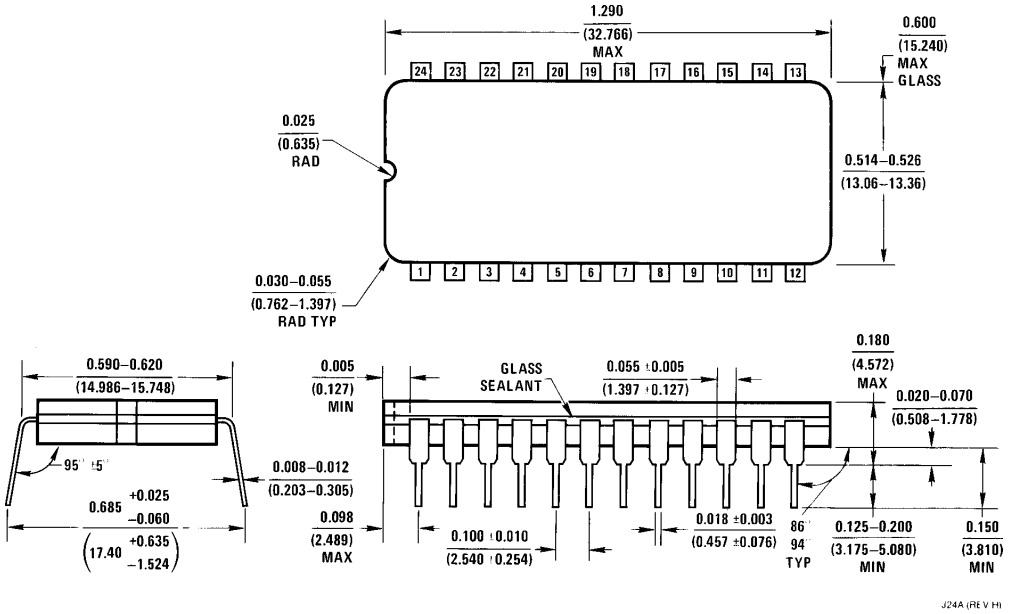




Physical Dimensions inches (millimeters)

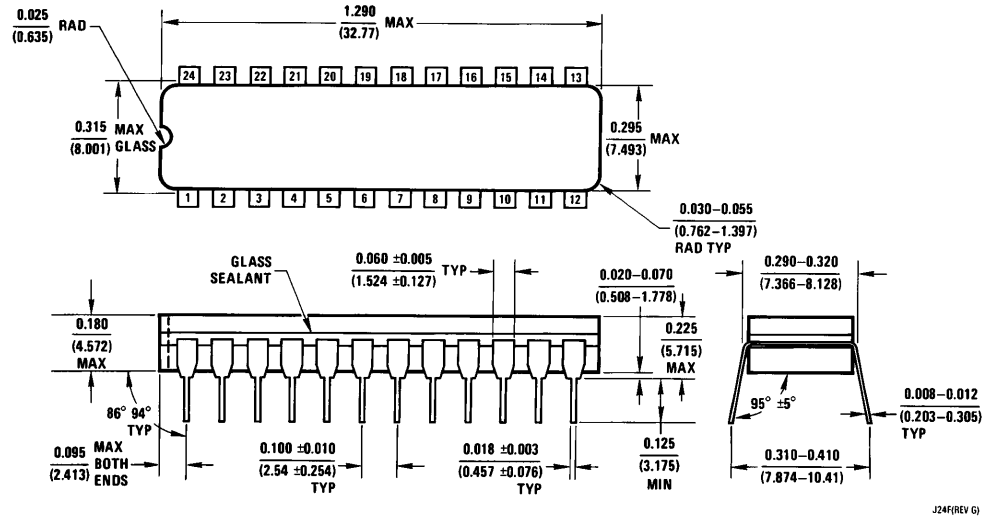


28-Lead Ceramic Leadless Chip Carrier (L)
NS Package Number E28A

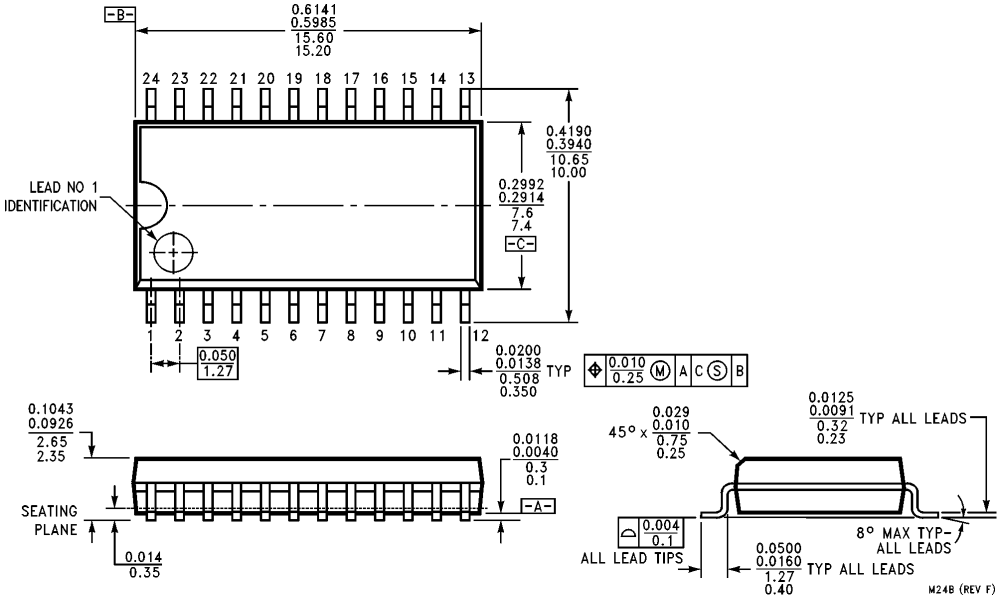


24-Lead Ceramic Dual-In-Line Package (D)
NS Package Number J24A

Physical Dimensions inches (millimeters) (Continued)

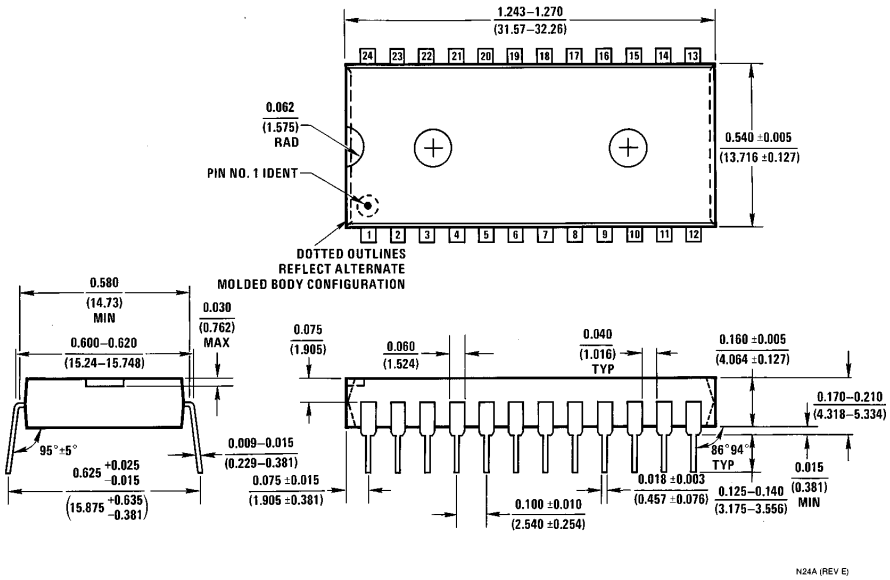


24-Lead (0.300″ Wide) Ceramic Dual-In-Line Package (SD)
NS Package Number J24F

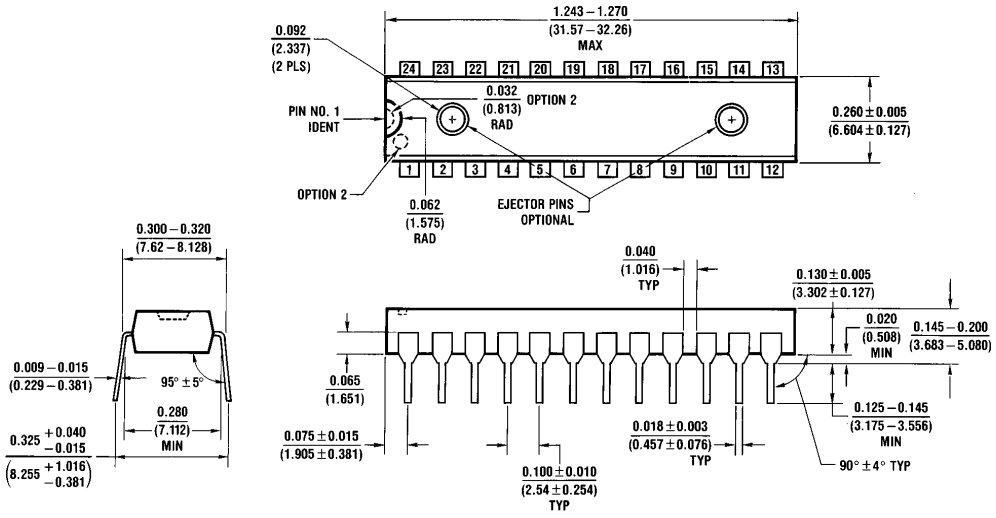


24-Lead (0.300″ Wide) Molded Small Outline Package, JEDEC
NS Package Number M24B

Physical Dimensions inches (millimeters) (Continued)

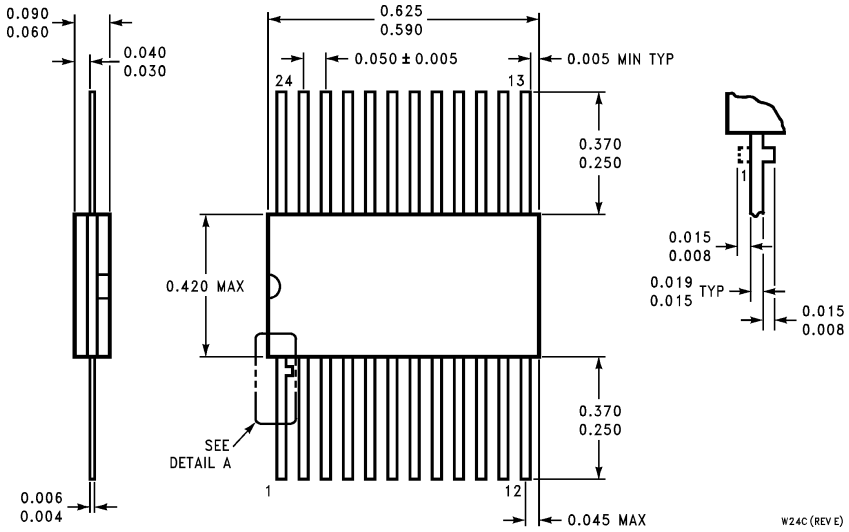


24-Lead (0.600″ Wide) Molded Dual-In-Line Package (P)
NS Package Number N24A



24-Lead (0.300″ Wide) Molded Dual-In-Line Package (SP)
NS Package Number N24C

Physical Dimensions inches (millimeters) (Continued)



24 Lead Ceramic Flatpak (F)
NS Package Number W24C

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 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
1111 West Bardin Road
Arlington, TX 76017
Tel: 1(800) 272-9959
Fax: 1(800) 737-7018

National Semiconductor Europe
Fax: (+49) 0-180-530 85 86
Email: cnjwge@tevm2.nsc.com
Deutsch Tel: (+49) 0-180-530 85 85
English Tel: (+49) 0-180-532 78 32
Français Tel: (+49) 0-180-532 93 58
Italiano Tel: (+49) 0-180-534 16 80

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 Semiconductor Japan Ltd.
Tel: 81-043-299-2309
Fax: 81-043-299-2408