National Semiconductor

December 1994

54F/74F651 • 54F/74F652 Transceivers/Registers

General Description

These devices consist of bus transceiver circuits with D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the input bus or from internal registers. Data on the A or B bus will be clocked into the registers as the appropriate clock pin goes to HIGH logic level. Output Enable pins (OEAB, $\overline{OEBA}$) are provided to control the transceiver function.

Features

- Independent registers for A and B buses
- Multiplexed real-time and stored data
- Choice of non-inverting and inverting data paths
  - — 'F651 inverting
  - — 'F652 non-inverting
- Guaranteed 4000V minimum ESD protection

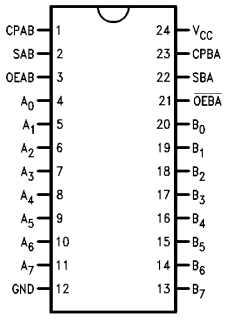
Commercial	Military	Package Number	Package Description
74F651SPC		N24C	24-Lead (0.300″ Wide) Molded Dual-In-Line
	54F651SDM (Note 2)	J24F	24-Lead (0.300″ Wide) Ceramic Dual-In-Line
74F651SC (Note 1)		M24B	24-Lead (0.300″ Wide) Molded Small Outline, JEDEC
	54F651FM (Note 2)	W24C	24-Lead Cerpack
	54F651LM (Note 2)	E28A	24-Lead Ceramic Leadless Chip Carrier, Type C
74F652SPC		N24C	24-Lead (0.300″ Wide) Molded Dual-In-Line
	54F652SDM (Note 2)	J24F	24-Lead (0.300″ Wide) Ceramic Dual-In-Line
74F652SC (Note 1)		M24B	24-Lead (0.300″ Wide) Molded Small Outline, JEDEC
	54F652FM (Note 2)	W24C	24-Lead Cerpack
	54F652LM (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

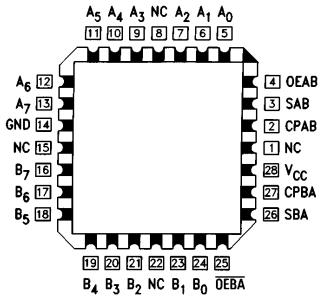
Connection Diagrams

Pin Assignment DIP, SOIC and Flatpak



TL/F/9581–3

Pin Assignment for LCC



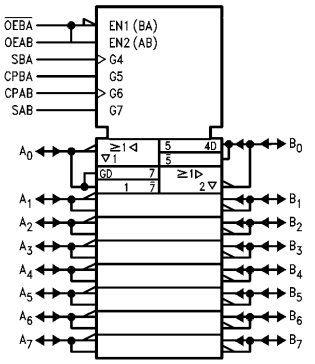
TL/F/9581–4

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

©1995 National Semiconductor Corporation

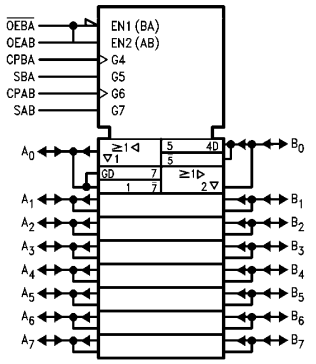
Logic Symbols

IEEE/IEC
'F651



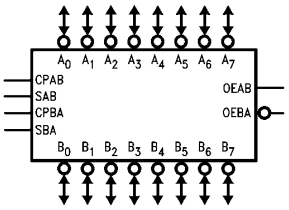
TL/F/9581–1

IEEE/IEC
'F652



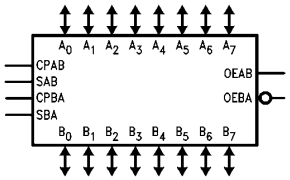
TL/F/9581–10

'F651



TL/F/9581–2

'F652



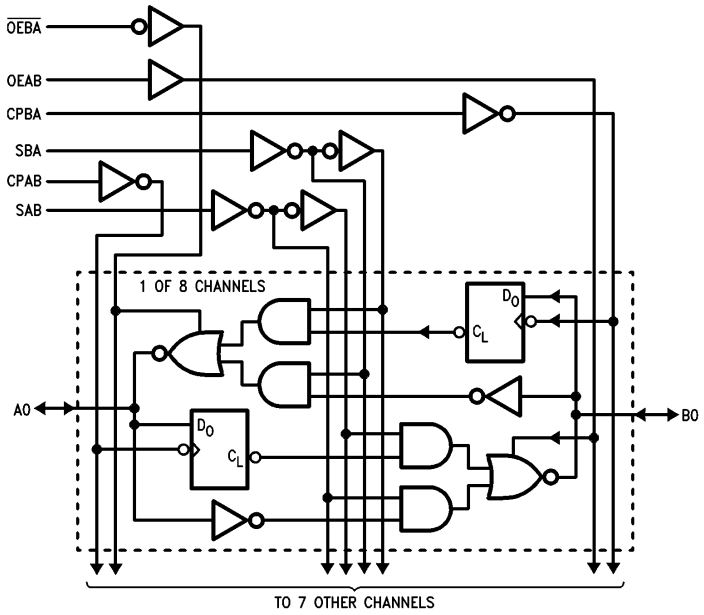
TL/F/9581–11

Unit Loading/Fan Out

Pin Names	Description	54F/74F	
		U.L. HIGH/LOW	Input I_{IH}/I_{IL} Output I_{OH}/I_{OL}
$A_0–A_7$, $B_0–B_7$	A and B Inputs/ TRI-STATE® Outputs	1.0/1.0 600/106.6 (80)	20 μA/ −0.6 mA −12 mA/64 mA (48 mA)
CPAB, CPBA	Clock Inputs	1.0/1.0	20 μA/ −0.6 mA
SAB, SBA	Select Inputs	1.0/1.0	20 μA/ −0.6 mA
OEAB, $\overline{OEBA}$	Output Enable Inputs	1.0/1.0	20 μA/ −0.6 mA

Logic Diagrams

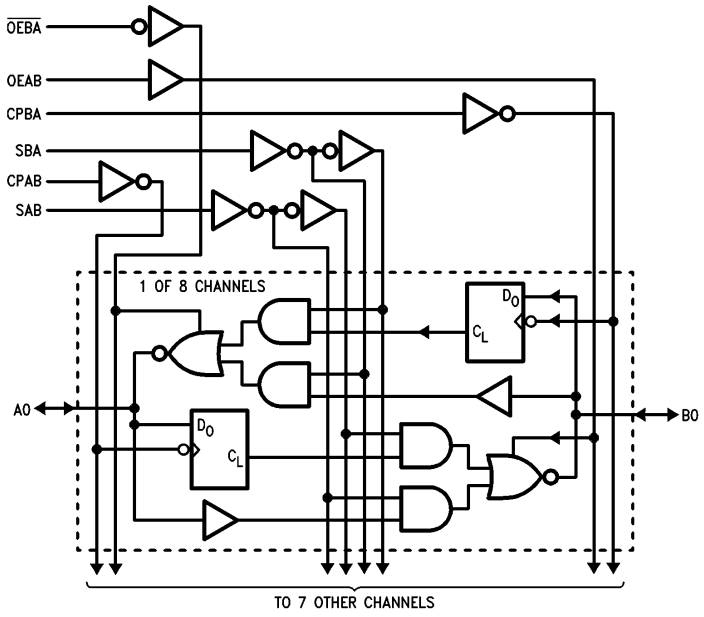
'F652



TL/F/9581–5

Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

'F651



TL/F/9581–12

Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Functional Description

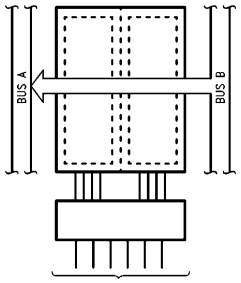
In the transceiver mode, data present at the HIGH impedance port may be stored in either the A or B register or both.

The select (SAB, SBA) controls can multiplex stored and real-time.

The examples in *Figure 1* demonstrate the four fundamental bus-management functions that can be performed with the Octal bus transceivers and receivers.

Data on the A or B data bus, or both can be stored in the internal D flip-flop by LOW to HIGH transitions at the appropriate Clock Inputs (CPAB, CPBA) regardless of the Select or Output Enable Inputs. When SAB and SBA are in the real time transfer mode, it is also possible to store data without using the internal D flip-flops by simultaneously enabling OEAB and OEBA. In this configuration each Output reinforces its Input. Thus when all other data sources to the two sets of bus lines are in a HIGH impedance state, each set of bus lines will remain at its last state.

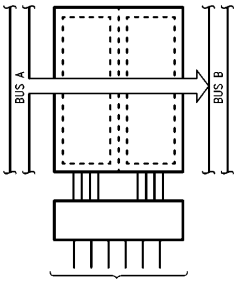
Note A: Real-Time Transfer Bus B to Bus A



TL/F/9581–6

OEAB	$\overline{OEBA}$	CPAB	CPBA	SAB	SBA
L	L	X	X	X	L

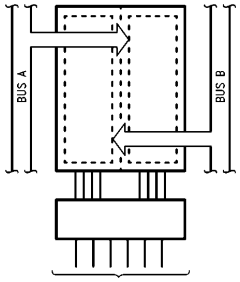
Note B: Real-Time Transfer Bus A to Bus B



TL/F/9581–7

OEAB	$\overline{OEBA}$	CPAB	CPBA	SAB	SBA
H	H	X	X	L	X

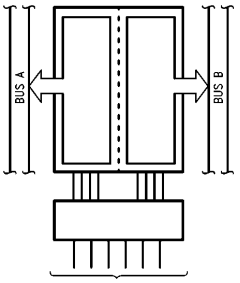
Note C: Storage



TL/F/9581–8

OEAB	$\overline{OEBA}$	CPAB	CPBA	SAB	SBA
X	H	↗	X	X	X
L	X	X	↗	X	X
L	H	↗	↗	X	X

Note D: Transfer Storage Data to A or B



TL/F/9581–9

OEAB	$\overline{OEBA}$	CPAB	CPBA	SAB	SBA
H	L	H or L	H or L	H	X

FIGURE 1

Inputs						Inputs/Outputs (Note 1)		Operating Mode
OEAB	**$\overline{OEBA}$**	**CPAB**	**CPBA**	**SAB**	**SBA**	**A_0 thru A_7**	**B_0 thru B_7**	
L	H	H or L	H or L	X	X	Input	Input	Isolation
L	H	↗	↗	X	X			Store A and B Data
X	H	↗	H or L	X	X	Input	Not Specified	Store A, Hold B
H	H	↗	↗	X	X	Input	Output	Store A in Both Registers
L	X	H or L	↗	X	X	Not Specified	Input	Hold A, Store B
L	L	↗	↗	X	X	Output	Input	Store B in Both Registers
L	L	X	X	X	L	Output	Input	Real-Time B Data to A Bus
L	L	X	H or L	X	H			Store B Data to A Bus
H	H	X	X	L	X	Input	Output	Real-Time A Data to B Bus
H	H	H or L	X	H	X			Stored A Data to B Bus
H	L	H or L	H or L	H	H	Output	Output	Stored A Data to B Bus and Stored B Data to A Bus

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

Note 1: The data output functions may be enabled or disabled by various signals at OEAB or OEBA inputs. Data input functions are always enabled, i.e., data at the bus pins will be stored on every LOW to HIGH transition on the clock inputs.

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)
ESD Last Passing Voltage (Min)	4000V

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 (Non I/O Pins)
V_{OH}	Output HIGH Voltage	54F 10% V_{CC} 74F 10% V_{CC}	2.0 2.0			V	Min	I_{OH} = −12 mA (A_n, B_n) I_{OH} = −15 mA (A_n, B_n)
V_{OL}	Output LOW Voltage	54F 10% V_{CC} 74F 10% V_{CC}			0.55 0.55	V	Min	I_{OL} = 48 mA (A_n, B_n) I_{OL} = 64 mA (A_n, B_n)
I_{IH}	Input HIGH Current	54F 74F			20.0 5.0	μA	Max	V_{IN} = 2.7V (Non I/O Pins)
I_{BVI}	Input HIGH Current Breakdown Test	54F 74F			100 7.0	μA	Max	V_{IN} = 7.0V
I_{BVIT}	Input HIGH Current Breakdown (I/O)	54F 74F			1.0 0.5	mA	Max	V_{IN} = 5.5V (A_n, B_n)
I_{CEX}	Output HIGH Leakage Current	54F 74F			250 50	μA	Max	V_{OUT} = V_{CC}
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	VI_{IOD} = 150 mV All Other Pins Grounded
I_{IL}	Input LOW Current				−0.6	mA	Max	V_{IN} = 0.5V (Non I/O Pins)
I_{IH} + I_{OZH}	Output Leakage Current				70	μA	Max	V_{OUT} = 2.7V (A_n, B_n)
I_{IL} + I_{OZL}	Output Leakage Current				−650	μA	Max	V_{OUT} = 0.5V (A_n, B_n)
I_{OS}	Output Short-Circuit Current		−100		−225	mA	Max	V_{OUT} = 0V
I_{ZZ}	Bus Drainage Test				500	μA	0.0V	V_{OUT} = 5.25V
I_{CCH}	Power Supply Current			105	135	mA	Max	V_O = HIGH
I_{CCL}	Power Supply Current			118	150	mA	Max	V_O = LOW
I_{CCZ}	Power Supply Current			115	150	mA	Max	V_O = HIGH Z

AC Electrical Characteristics

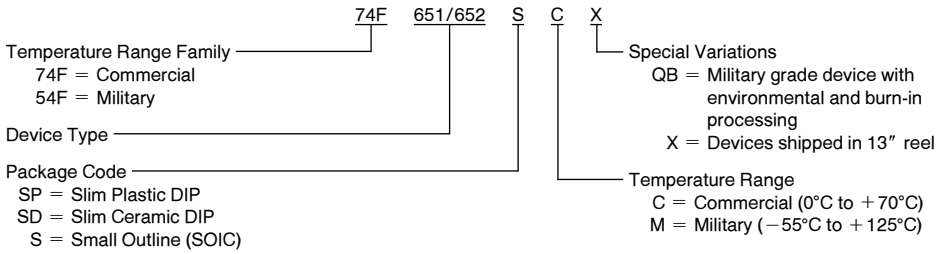
Symbol	Parameter	74F $T_A = +25°C$ $V_{CC} = +5.0V$ $C_L = 50\ pF$		54F $T_A, V_{CC} = Mil$ $C_L = 50\ pF$		74F $T_A, V_{CC} = Com$ $C_L = 50\ pF$		Units
		Min	Max	Min	Max	Min	Max	
f_{max}	Max. Clock Frequency	90		75		90		MHz
t_{PLH} t_{PHL}	Propagation Delay Clock to Bus	2.0 2.0	7.0 8.0	2.0 2.0	8.5 9.5	2.0 2.0	8.0 9.0	ns
t_{PLH} t_{PHL}	Propagation Delay Bus to Bus ('F651)	2.0 1.0	8.5 7.5	1.0 1.0	9.0 8.0	2.0 1.0	9.0 8.0	ns
t_{PLH} t_{PHL}	Propagation Delay Bus to Bus ('F652)	1.0 1.0	7.0 6.5	1.0 1.0	8.0 8.0	1.0 1.0	7.5 7.0	ns
t_{PLH} t_{PHL}	Propagation Delay SBA or SAB to A or B	2.0 2.0	8.5 8.0	2.0 2.0	11.0 10.0	2.0 2.0	9.5 9.0	ns

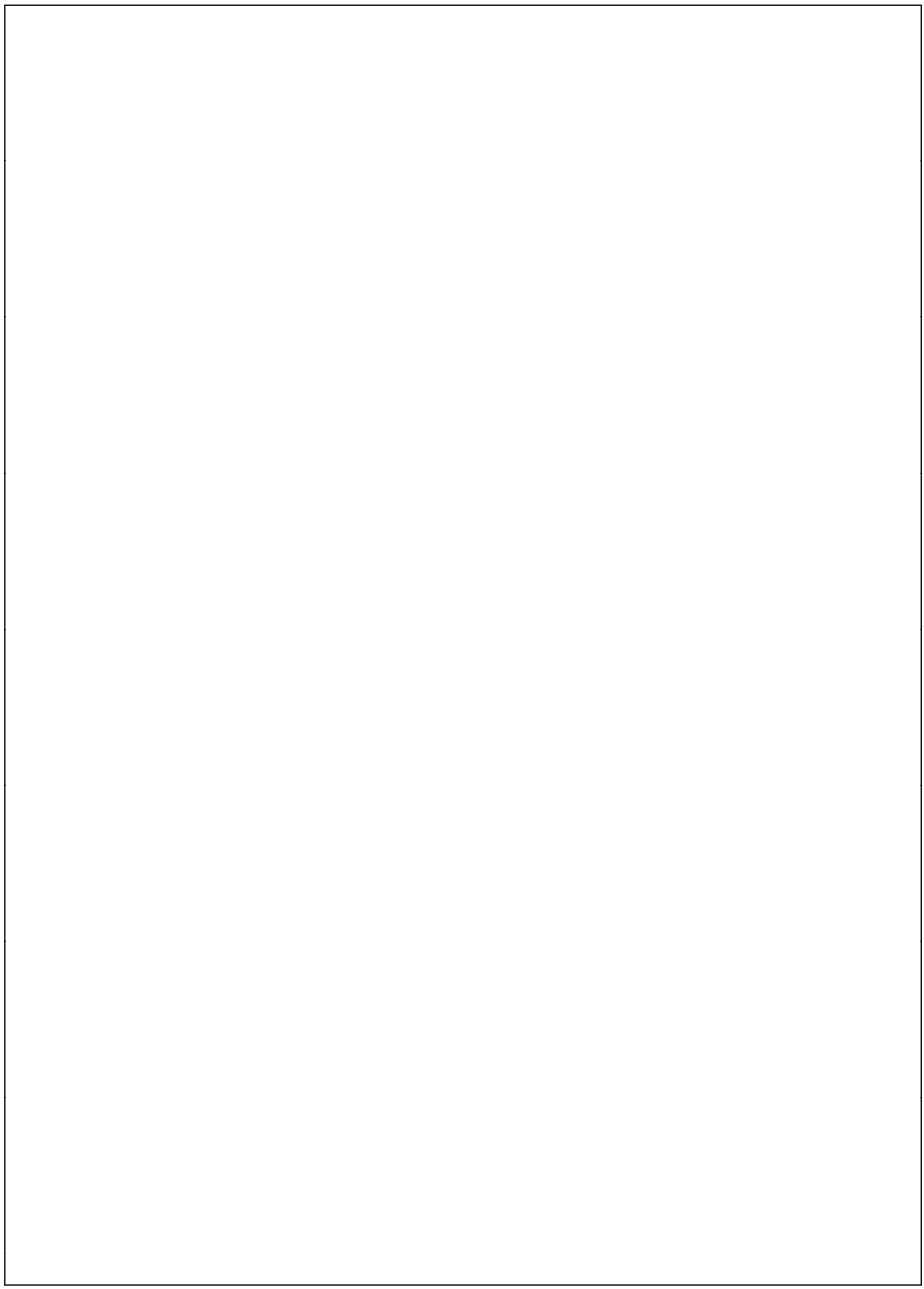
AC Operating Requirements

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_{PZH} t_{PZL}	Enable Time *OEBA to A	2.0 2.0	9.5 12.0	2.0 2.0	10.0 10.0	2.0 2.0	10.0 12.5	ns
t_{PHZ} t_{PLZ}	Disable Time *OEBA to A	1.0 2.0	7.5 8.5	1.0 1.0	9.0 9.0	1.0 2.0	8.0 9.0	ns
t_{PZH} t_{PZL}	Enable Time OEAB to B	2.0 3.0	9.5 13.0	2.0 2.0	10.0 12.0	2.0 3.0	10.0 14.0	ns
t_{PHZ} t_{PLZ}	Disable Time OEAB to B	2.0 2.0	9.0 10.5	1.0 1.0	9.0 12.0	2.0 2.0	10.0 11.0	ns
$t_s(H)$ $t_s(L)$	Setup Time, HIGH or LOW, Bus to Clock	5.0 5.0		5.0 5.0		5.0 5.0		ns
$t_h(H)$ $t_h(L)$	Hold Time, HIGH or LOW, Bus to Clock	2.0 2.0		2.5 2.5		2.0 2.0		ns
$t_w(H)$ $t_w(L)$	Clock Pulse Width HIGH or LOW	5.0 5.0		5.0 5.0		5.0 5.0		ns

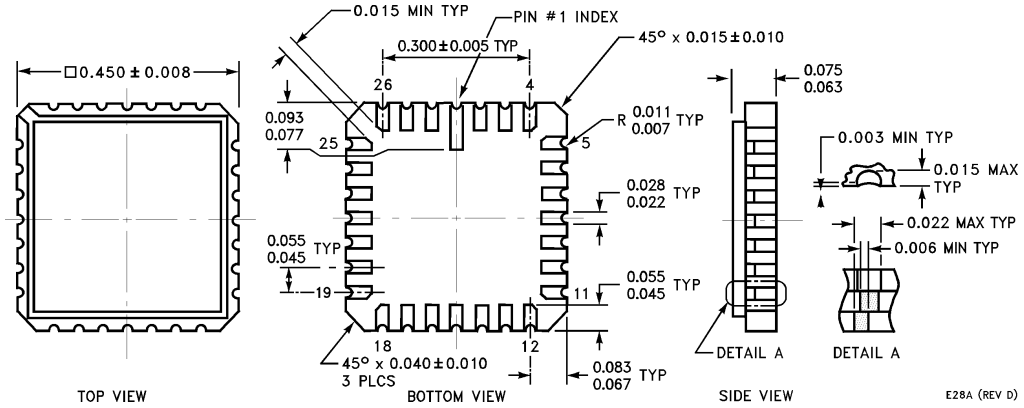
Ordering Information

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

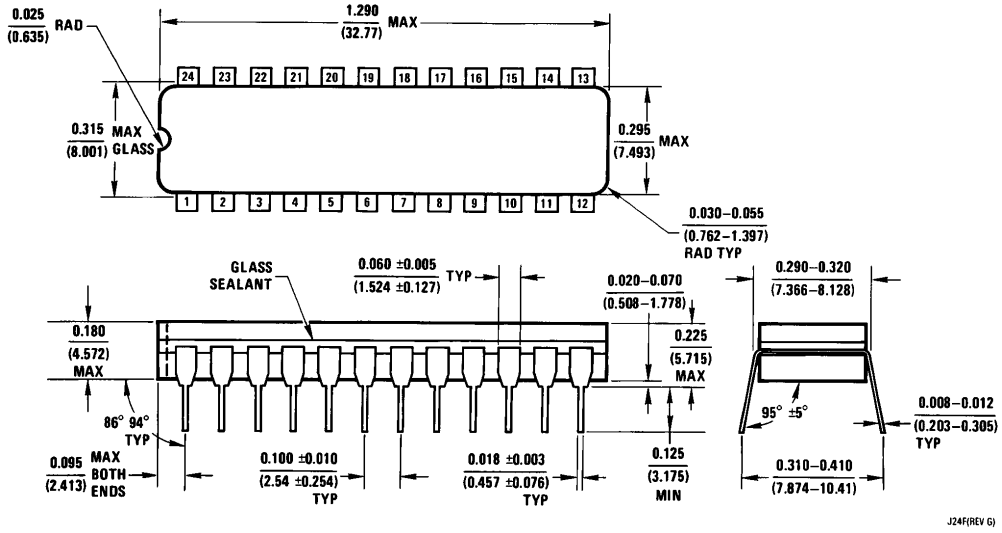




Physical Dimensions inches (millimeters)

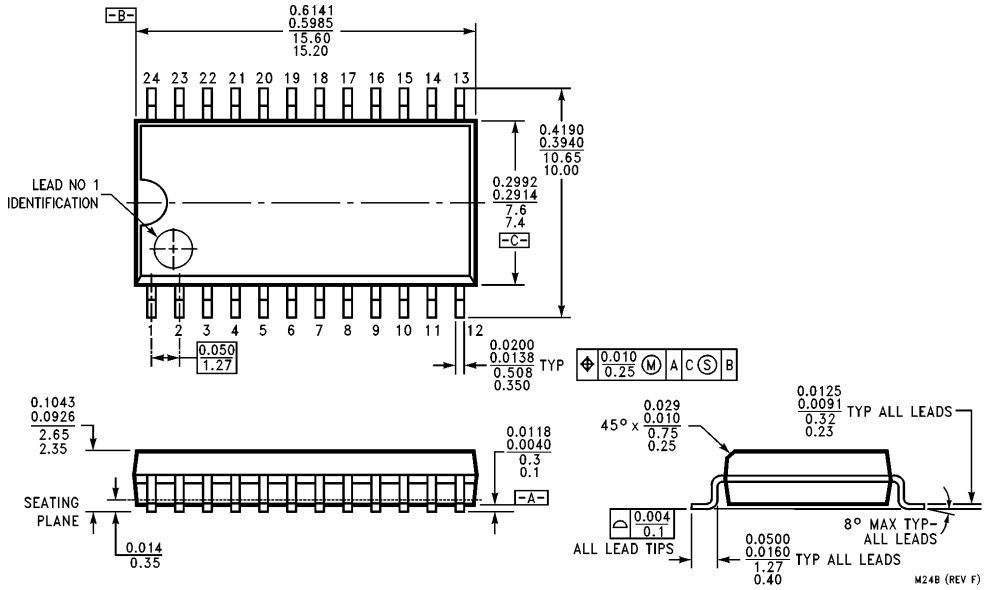


28 Lead Ceramic Leadless Chip Carrier, Type C
NS Package Number E28A

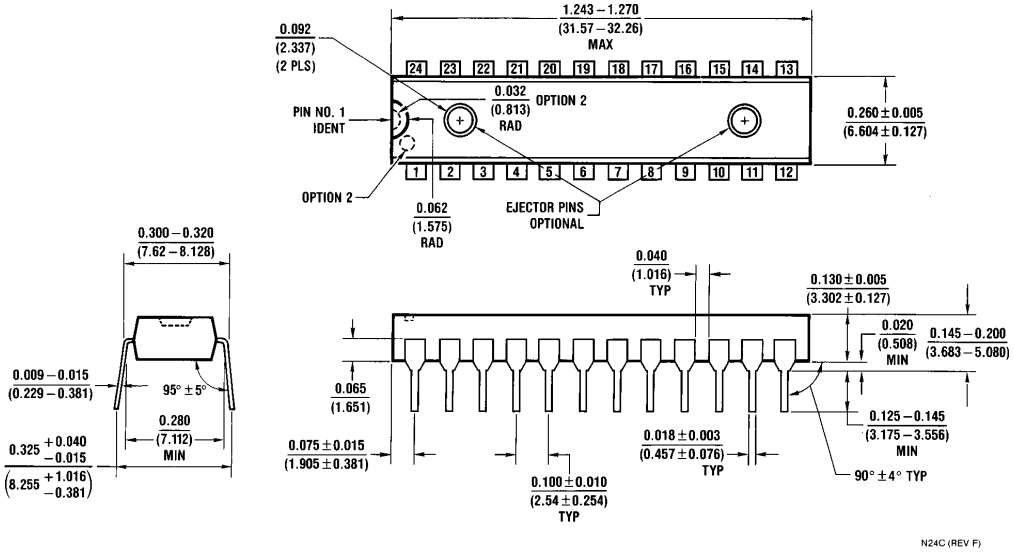


24 Lead (0.300″ Wide) Ceramic Dual-In-Line Package (SD)
NS Package Number J24F

Physical Dimensions inches (millimeters) (Continued)

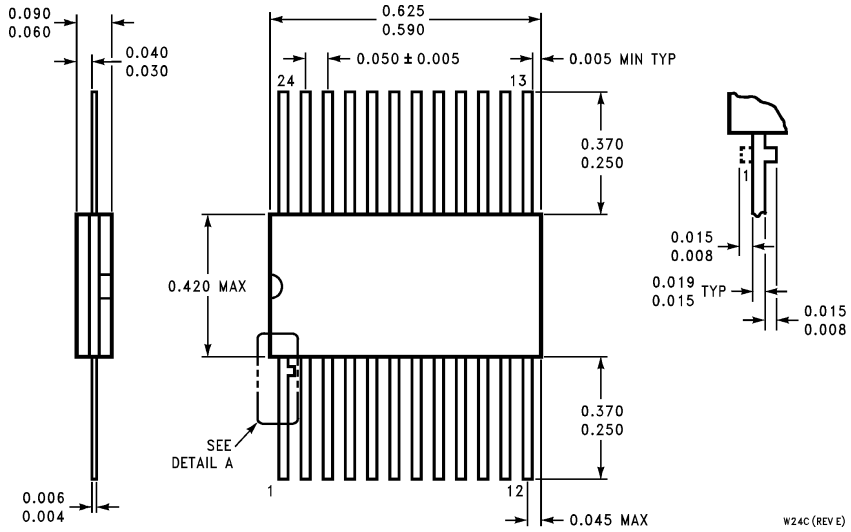


24 Lead (0.300″ Wide) Molded Small Outline Package, JEDEC (S)
NS Package Number M24B



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

Physical Dimensions inches (millimeters) (Continued)



24 Lead Cerpack
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
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,
Ciba 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 Semiconductores 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
Nottinghill, Melbourne
Victoria 3168 Australia
Tel: (3) 558-9999
Fax: (3) 558-9998

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.