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National Semiconductor

April 1993

54AC/74AC520 • 54ACT/74ACT520
8-Bit Identity Comparator

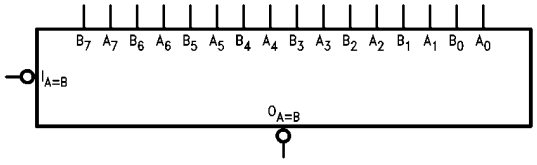
General Description

The 'AC/'ACT520 are expandable 8-bit comparators. They compare two words of up to eight bits each and provide a LOW output when the two words match bit for bit. The expansion input $\overline{I}_{A=B}$ also serves as an active LOW enable input.

Features

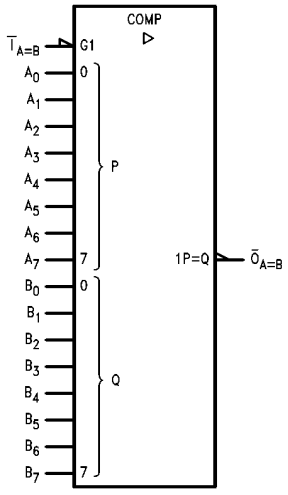
- Compares two 8-bit words in 6.5 ns typ
- Expandable to any word length
- 20-pin package
- Outputs source/sink 24 mA
- 'ACT520 has TTL-compatible inputs

Logic Symbols



TL/F/10194–1

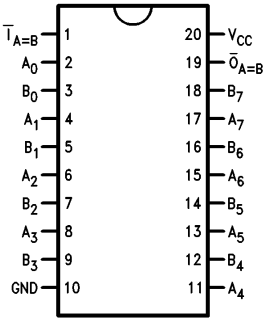
IEEE/IEC



TL/F/10194–4

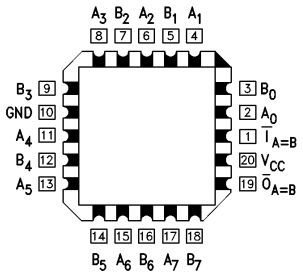
Connection Diagrams

Pin Assignment for DIP, Flatpak and SOIC



TL/F/10194–2

Pin Assignment for LCC



TL/F/10194–3

Pin Names	Description
A_0–A_7	Word A Inputs
B_0–B_7	Word B Inputs
$\overline{T}_{A=B}$	Expansion or Enable Input
$\overline{O}_{A=B}$	Identity Output

FACT™ is a trademark of National Semiconductor Corporation.

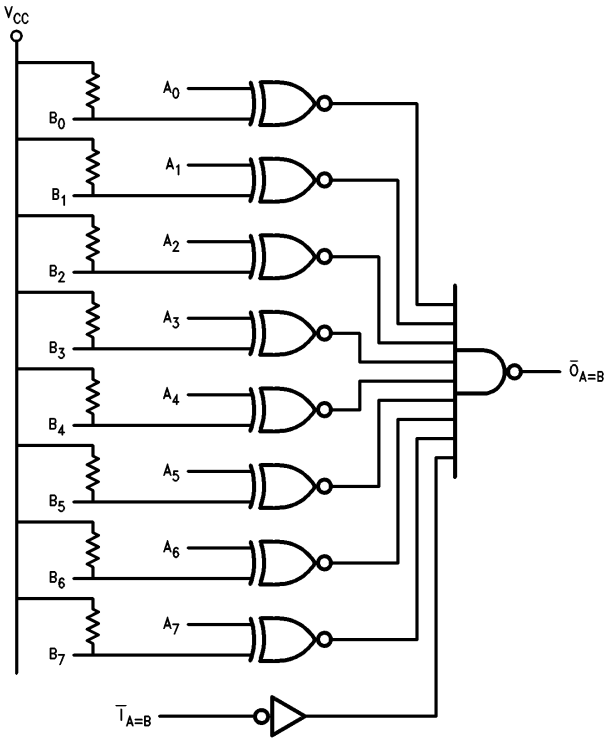
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Truth Table

Inputs		Outputs
$\overline{I}_{A=B}$	A, B	$\overline{O}_{A=B}$
L	A = B*	L
L	A ≠ B	H
H	A = B*	H
H	A ≠ B	H

H = HIGH Voltage Level
L = LOW Voltage Level
*$A_0 = B_0$, $A_1 = B_1$, $A_2 = B_2$, etc.

Logic Diagram



TL/F/10194–5

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)	±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
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/ACT	−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 $T_A = +25°C$	74AC $T_A = -55°C$ to $+125°C$	54AC $T_A = -40°C$ to $+85°C$	Units	Conditions
			Typ	Guaranteed Limits			
V_{IH}	Minimum High Level Input Voltage	3.0	1.5	2.1	2.1	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		4.5	2.25	3.15	3.15		
		5.5	2.75	3.85	3.85		
V_{IL}	Maximum Low Level Input Voltage	3.0	1.5	0.9	0.9	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		4.5	2.25	1.35	1.35		
		5.5	2.75	1.65	1.65		
V_{OH}	Minimum High Level Output Voltage	3.0	2.99	2.9	2.9	V	$I_{OUT} = -50\ \mu A$
		4.5	4.49	4.4	4.4		
		5.5	5.49	5.4	5.4		
		3.0		2.56	2.4	V	*$V_{IN} = V_{IL}$ or V_{IH} I_{OH} −12 mA
		4.5		3.86	3.7		
		5.5		4.86	4.7		−24 mA
							−24 mA
V_{OL}	Maximum Low Level Output Voltage	3.0	0.002	0.1	0.1	V	$I_{OUT} = 50\ \mu A$
		4.5	0.001	0.1	0.1		
		5.5	0.001	0.1	0.1		
		3.0		0.36	0.50	V	*$V_{IN} = V_{IL}$ or V_{IH} I_{OL} 12 mA
		4.5		0.36	0.50		
		5.5		0.36	0.50		24 mA
							24 mA
I_{IN}	Maximum Input Leakage Current	5.5		±0.1	±1.0	μA	$V_I = V_{CC}$, GND A Inputs Only
I_{IH}	Maximum Input High Leakage Current	5.5		10.0	10.0	μA	$V_I = V_{CC}$ B Inputs Only
I_{IL}	Maximum Input Low Leakage Current	5.5	−0.3	−0.6	−1.0	mA	$V_I = V_{CC}$ B Inputs Only

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

DC Characteristics for 'AC Family Devices (Continued)

Symbol	Parameter	V_{CC} (V)	74AC $T_A = +25°C$		54AC $T_A = -55°C$ to $+125°C$	74AC $T_A = -40°C$ to $+85°C$	Units	Conditions
			Typ	Guaranteed Limits				
I_{OLD}	†Minimum Dynamic Output Current	5.5			50	75	mA	V_{OLD} = 1.65V Max
I_{OHD}		5.5			−50	−75	mA	V_{OHD} = 3.85V Min
I_{CC}	Maximum Quiescent Supply Current	5.5		4.0	80.0	40.0	μA	$V_{IN} = V_{CC}$
I_{CC}	Maximum Quiescent Supply Current	5.5	2.3	4.8	8.0	8.0	mA	V_{IN} = GND

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

Note: I_{IN} and I_{CC} @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V V_{CC}.
I_{CC} for 54AC @ 25°C is identical to 74AC @ 25°C.

DC Characteristics for 'ACT Family Devices

Symbol	Parameter	V_{CC} (V)	74ACT $T_A = +25°C$		54ACT $T_A = -55°C$ to $+125°C$	74ACT $T_A = -40°C$ to $+85°C$	Units	Conditions
			Typ	Guaranteed Limits				
V_{IH}	Minimum High Level Input Voltage	4.5 5.5	1.5 1.5	2.0 2.0	2.0 2.0	2.0 2.0	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
V_{IL}	Maximum Low Level Input Voltage	4.5 5.5	1.5 1.5	0.8 0.8	0.8 0.8	0.8 0.8	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
V_{OH}	Minimum High Level Output Voltage	4.5 5.5	4.49 5.49	4.4 5.4	4.4 5.4	4.4 5.4	V	I_{OUT} = −50 μA
		4.5 5.5		3.86 4.86	3.70 4.70	3.76 4.76	V	*$V_{IN} = V_{IL}$ or V_{IH} −24 mA I_{OH} −24 mA
V_{OL}	Maximum Low Level Output Voltage	4.5 5.5	0.001 0.001	0.1 0.1	0.1 0.1	0.1 0.1	V	I_{OUT} = 50 μA
		4.5 5.5		0.36 0.36	0.50 0.50	0.44 0.44	V	*$V_{IN} = V_{IL}$ or V_{IH} 24 mA I_{OL} 24 mA
I_{IN}	Maximum Input Leakage Current	5.5		±0.1	±1.0	±1.0	μA	$V_I = V_{CC}$, GND
I_{IH}	Maximum Input High Leakage Current	5.5		10.0	10.0	10.0	μA	$V_I = V_{CC}$ B Inputs Only
I_{IL}	Maximum Input Low Leakage Current	5.5	−0.3	−0.6	−1.0	−1.0	mA	$V_I = V_{CC}$ B Inputs Only
I_{CCT}	Maximum I_{CC}/Input	5.5	0.6		1.6	1.5	mA	$V_I = V_{CC}$ − 2.1V
I_{OLD}	†Minimum Dynamic Output Current	5.5			50	75	mA	V_{OLD} = 1.65V Max
I_{OHD}		5.5			−50	−75	mA	V_{OHD} = 3.85V Min
I_{CC}	Maximum Quiescent Supply Current	5.5		4.0	80.0	40.0	μA	$V_{IN} = V_{CC}$ or GND
I_{CC}	Maximum Quiescent Supply Current	5.5	2.3	4.8	8.0	8.0	mA	V_{IN} = GND

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

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

Note: I_{CC} for 54ACT @ 25°C is identical to 74ACT @ 25°C.

AC Electrical Characteristics

Symbol	Parameter	V_{CC}* (V)	74AC $T_A = +25°C$, $C_L = 50$ pF			54AC $T_A = -55°C$ to $+125°C$, $C_L = 50$ pF		74AC $T_A = -40°C$ to $+85°C$, $C_L = 50$ pF		Units
			Min	Typ	Max	Min	Max	Min	Max	
t_{PLH}	Propagation Delay A_n or B_n to $\overline{O}_{A=B}$	3.3	4.0	7.5	11.5	1.0	14.0	3.0	13.0	ns
		5.0	2.5	5.5	8.5	1.5	10.5	2.0	9.5	
t_{PHL}	Propagation Delay A_n or B_n to $\overline{O}_{A=B}$	3.3	4.5	8.0	12.0	1.0	15.0	3.5	13.5	ns
		5.0	3.0	5.5	9.0	1.5	11.0	2.5	10.0	
t_{PLH}	Propagation Delay $\overline{I}_{A=B}$ to $\overline{O}_{A=B}$	3.3	3.5	5.5	8.5	1.0	10.0	2.5	9.5	ns
		5.0	2.5	4.5	6.5	1.5	7.5	2.0	7.0	
t_{PHL}	Propagation Delay $\overline{I}_{A=B}$ to $\overline{O}_{A=B}$	3.3	3.5	5.5	8.5	1.0	10.5	2.5	9.5	ns
		5.0	2.5	4.5	6.5	1.5	8.0	2.0	7.0	

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

AC Electrical Characteristics

Symbol	Parameter	V_{CC}* (V)	74ACT $T_A = +25°C$, $C_L = 50$ pF			54ACT $T_A = -55°C$ to $+125°C$, $C_L = 50$ pF		74ACT $T_A = -40°C$ to $+85°C$, $C_L = 50$ pF		Units
			Min	Typ	Max	Min	Max	Min	Max	
t_{PLH}	Propagation Delay A_n or B_n to $\overline{O}_{A=B}$	5.0	3.0	5.5	8.5	1.5	12.0	2.5	9.5	ns
t_{PHL}	Propagation Delay A_n or B_n to $\overline{O}_{A=B}$	5.0	3.0	6.0	10.0	1.5	12.0	2.5	11.5	ns
t_{PLH}	Propagation Delay $\overline{I}_{A=B}$ to $\overline{O}_{A=B}$	5.0	2.0	4.0	6.0	1.5	8.5	2.0	6.5	ns
t_{PHL}	Propagation Delay $\overline{I}_{A=B}$ to $\overline{O}_{A=B}$	5.0	2.5	5.0	7.5	1.5	9.0	2.0	8.5	ns

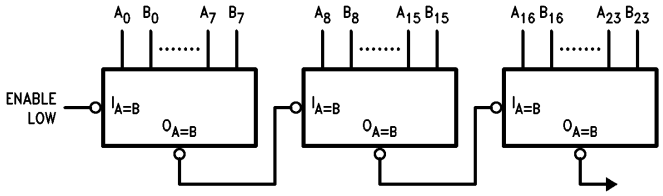
*Voltage Range 5.0 is 5.0V ±0.5V

Capacitance

Symbol	Parameter	Typ	Units	Conditions
C_{IN}	Input Capacitance	4.5	pF	V_{CC} = OPEN
C_{PD}	Power Dissipation Capacitance	40	pF	V_{CC} = 5.0V

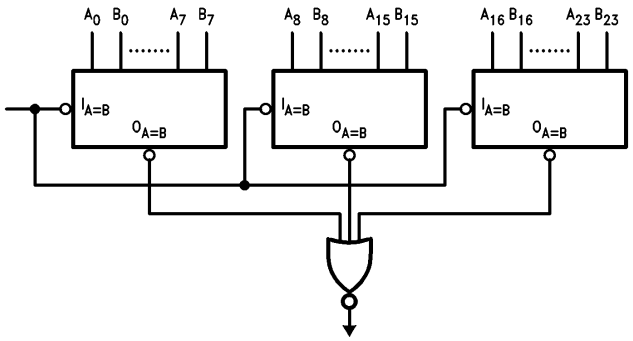
Applications

Ripple Expansion



TL/F/10194–6

Parallel Expansion



TL/F/10194–7

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:

74AC 520 P C QR

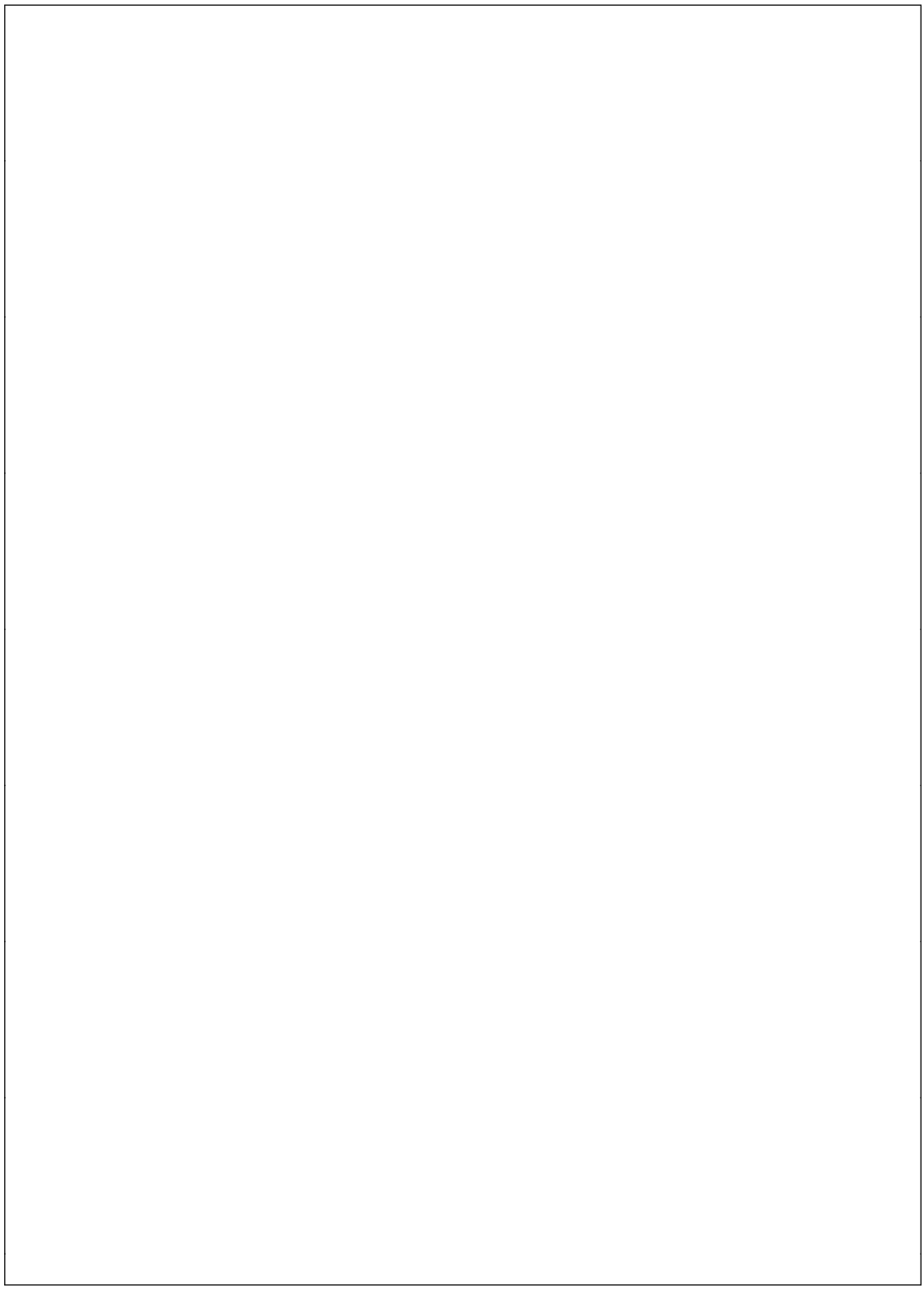
Temperature Range Family
- 74AC = Commercial
- 54AC = Military
- 74ACT = Commercial TTL-Compatible
- 54ACT = Military TTL-Compatible

Device Type

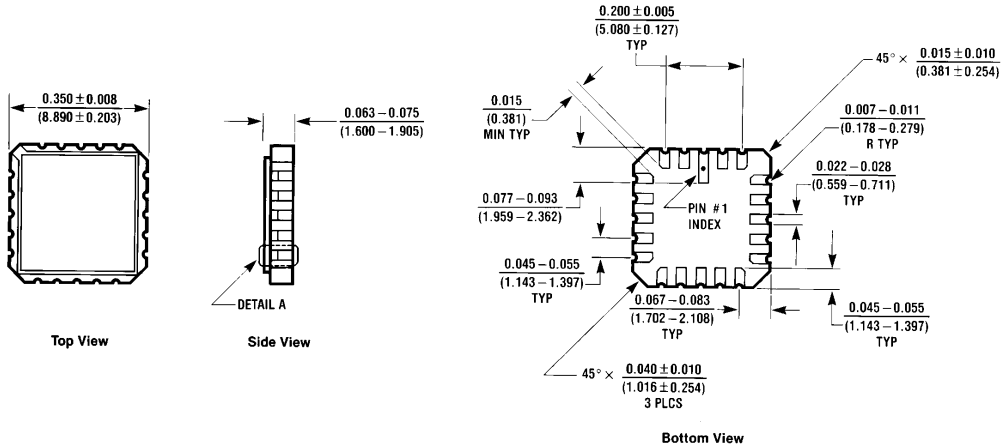
Package Code
- P = Plastic DIP
- D = Ceramic DIP
- F = Flatpak
- L = Leadless Ceramic Chip Carrier (LCC)
- S = Small Outline (SOIC)

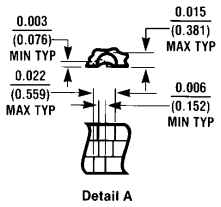
Temperature Range
- C = Commercial (−40°C to +85°C)
- M = Military (−55°C to +125°C)

Special Variations
- X = Devices shipped in 13″ reels
- QR = Commercial grade device with burn-in
- QB = Military grade device with environmental and burn-in processing shipped in tubes



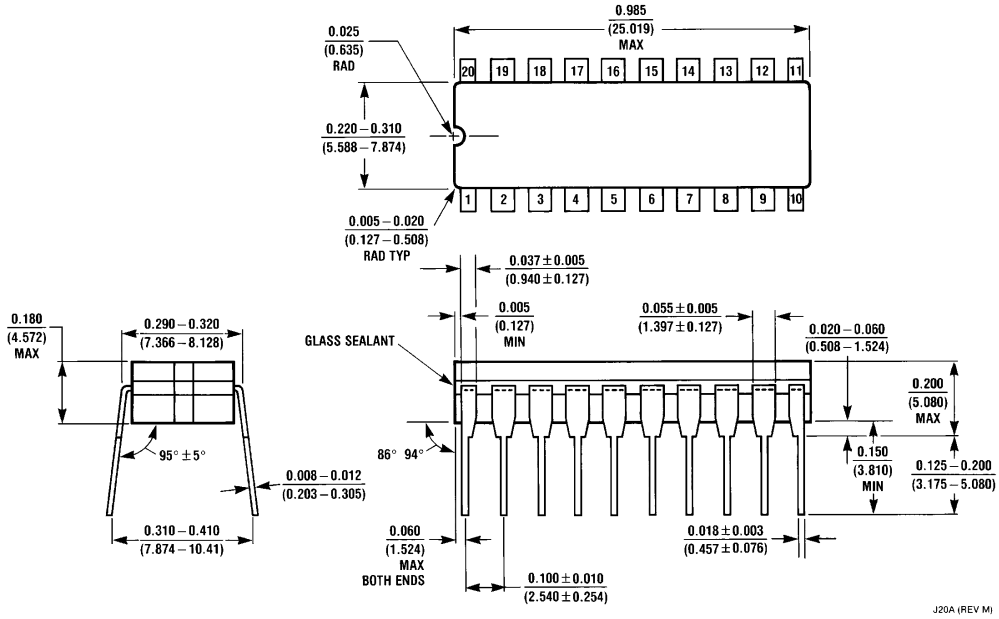
Physical Dimensions inches (millimeters)





E20A (REV D)

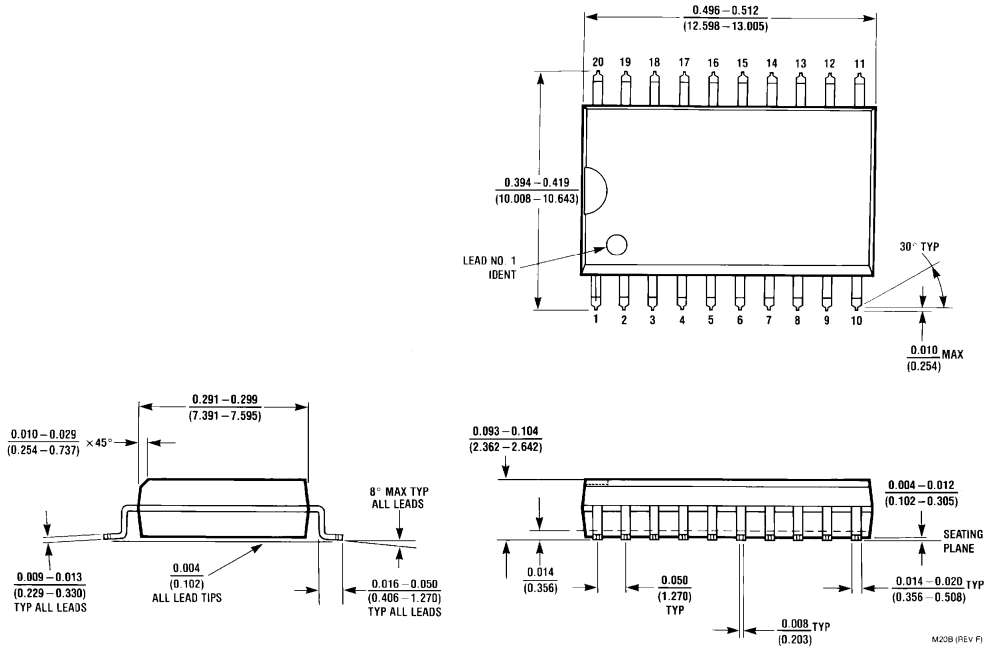
20 Terminal Ceramic Leadless Chip Carrier (L)
NS Package Number E20A



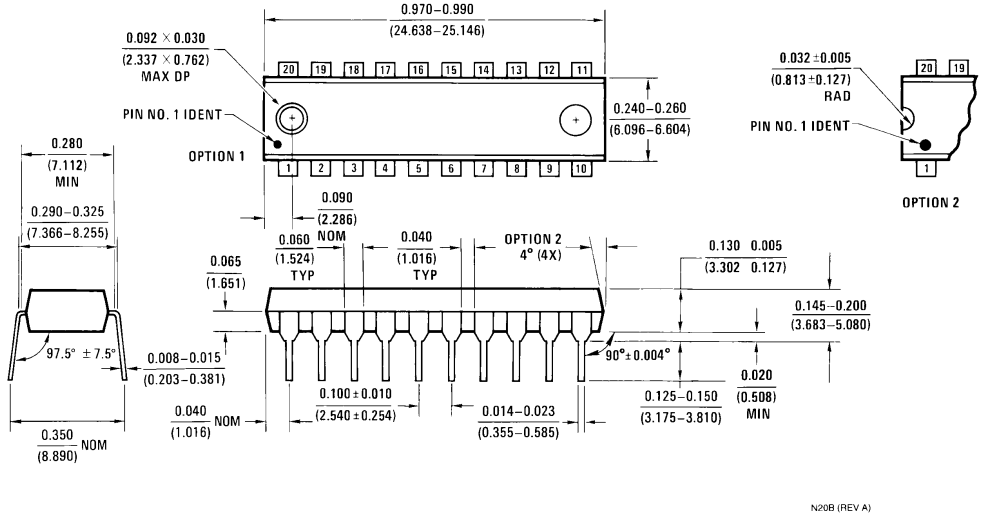
J20A (REV M)

20 Lead Ceramic Dual-In-Line Package (D)
NS Package Number J20A

Physical Dimensions inches (millimeters) (Continued)



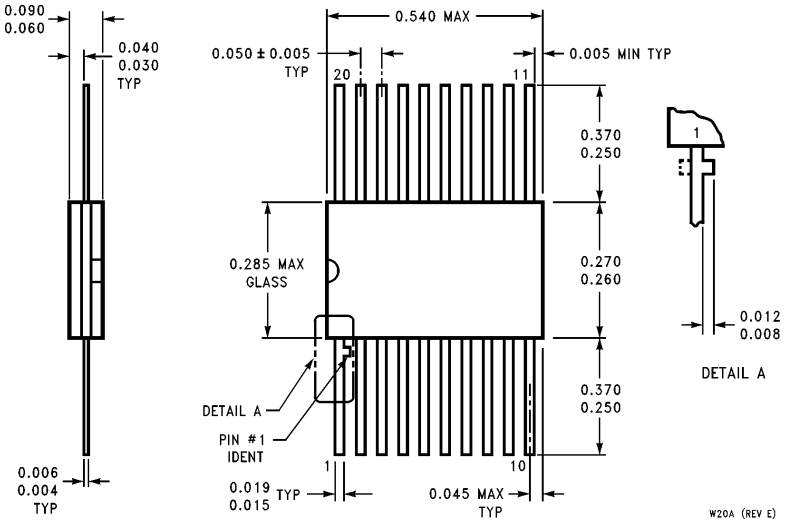
20 Lead Small Outline Integrated Circuit (S)
NS Package Number M20B



20 Lead Plastic Dual-In-Line Package (P)
NS Package Number N20B

Physical Dimensions inches (millimeters) (Continued)

Lit. # 114820



20 Lead Ceramic Flatpak (F)
NS Package Number W20A

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