T-52-07

National Semiconductor

February 1991

54BCT/74BCT2240 Octal Buffer/Line Driver with 25Ω Series Resistors in the Outputs

General Description

The 'BCT2240 is an inverting octal buffer and line driver designed to drive the capacitive inputs of MOS memory drivers, address drivers, clock drivers, or bus-oriented transmitters/receivers.

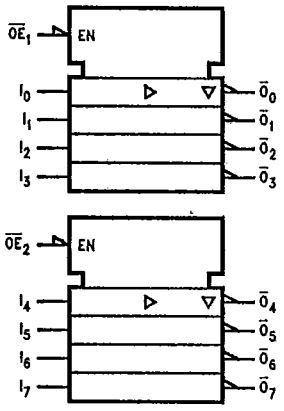
The 25Ω series resistors in the outputs reduce ringing and eliminate the need for external resistors.

Features

- 25Ω series resistors in outputs eliminate the need for external resistors
- TRI-STATE® outputs drive bus lines or buffer memory address registers
- Low I_{CCZ} through BiCMOS techniques
- Guaranteed output skew
- Guaranteed multiple output switching specifications
- Guaranteed 4000V minimum ESD protection
- Guaranteed 500 mA minimum latchup protection
- Hot insertion capability
- High impedance in power down (I_{ZZ}, V_{ID} and I_{OD})

Logic Symbol

IEEE/IEC



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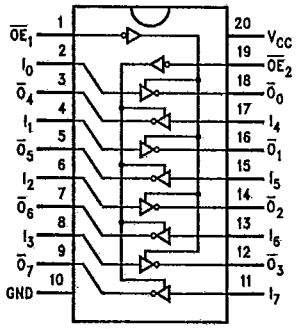
Pin Names	Description
$\overline{OE}_1$, $\overline{OE}_2$	Outptut Enable Input (Active LOW)
I_0–I_7	Inputs
$\overline{O}_0$–$\overline{O}_7$	Outputs

Connection Diagrams

Pin Assignment for DIP, SOIC and Flatpak



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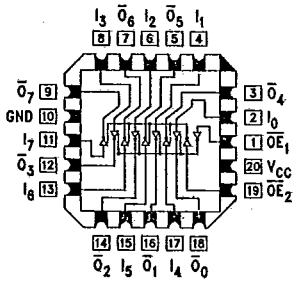
Pin Assignment for LCC



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RRD-B20M21/Printed in U. S. A.

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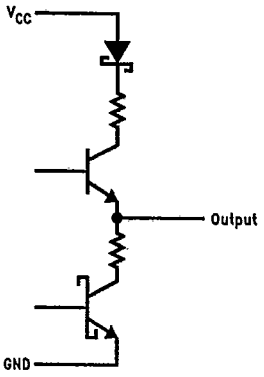
Truth Table

$\overline{OE}_1$	I_{0-3}	$\overline{O}_{0-3}$	$\overline{OE}_2$	I_{4-7}	$\overline{O}_{4-7}$
H	X	Z	H	X	Z
L	L	H	L	L	H
L	H	L	L	H	L

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
Z = High Impedance

Schematic of Each Output



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Absolute Maximum Ratings (Note 1)

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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	
Ceramic	−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 Any Output	
in the Disable or Power-Off State	−0.5V to +5.5V
in the High State	−0.5V to V_{CC}
Current Applied to Output in LOW State (Max)	Twice the Rated I_{OL} (mA)
ESD Last Passing Voltage (Min)	4000V
DC Latchup Source or Sink Current	±500 mA

Note 1: Absolute maximum ratings are values beyond which the device may be damaged or have its useful life imparied. 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		54BCT/74BCT Min	54BCT/74BCT Typ	54BCT/74BCT 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	54BCT/74BCT	2.4			V	Min	I_{OH} = −3 mA
		54BCT	2.0					I_{OH} = −12 mA
		74BCT	2.0					I_{OH} = −15 mA
V_{OL}	Output LOW Voltage	54BCT/74BCT			0.5	V	Min	I_{OL} = 3 mA
		54BCT			0.8			I_{OL} = 12 mA
		74BCT			0.8			I_{OL} = 15 mA
I_{IH}	Input HIGH Current				5	μA	Max	V_{IN} = 2.7V
I_{BVI}	Input HIGH Current Breakdown Test				7	μA	Max	V_{IN} = 7.0V
I_{IL}	Input LOW Current				−250	μA	Max	V_{IN} = 0.5V
I_{OS}	Output Short-Circuit Current		−100		−225	mA	Max	V_{OUT} = 0V
I_{OZH}	Output Leakage Current				20	μA	Max	V_{OUT} = 2.7V
I_{OZL}	Output Leakage Current				−20	μA	Max	V_{OUT} = 0.5V
I_{CEX}	Output HIGH Leakage Current				50	μA	Max	V_{OUT} = V_{CC}
V_{ID}	Input Leakage Test		4.75			V	0.0	I_{ID} = 1.9 μA All Other Pins Grounded
I_{OD}	Output Circuit Leakage Current				3.75	μA	0.0	V_{IOD} = 150 mV All Other Pins Grounded
I_{ZZ}	Bus Drainage Test				100	μA	0.0	V_{OUT} = 5.25V
I_{CCH}	Power Supply Current			8.3	18	mA	Max	V_O = HIGH
I_{CCL}	Power Supply Current			42.3	69	mA	Max	V_O = LOW
I_{CCZ}	Power Supply Current			6.6	8	mA	Max	V_O = HIGH Z

AC Electrical Characteristics

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Symbol	Parameter	74BCT $T_A = +25°C$ $V_{CC} = +5.0V$ $C_L = 50$ pF			54BCT $T_A = Mil$ $V_{CC} = Mil$ $C_L = 50$ pF		74BCT $T_A = Com$ $V_{CC} = Com$ $C_L = 50$		Units
		Min	Typ	Max	Min	Max	Min	Max	
t_{PLH} t_{PHL}	Propagation Delay Data to Output	0.5 0.5	2.6 2.4	4.8 4.0			0.5 0.5	5.7 4.4	ns
t_{PZH} t_{PZL}	Output Enable Time	2.6 4.3	5.0 7.0	8.2 10.9			2.6 4.3	9.3 12.4	ns
t_{PHZ} t_{PLZ}	Output Disable Time	2.0 2.2	4.4 6.6	7.1 8.5			2.0 2.2	8.7 10.6	ns
t_{OSHL} (Note 1)	Pin to Pin Skew HL Data to Output			0.3				0.4	ns
t_{OSLH} (Note 1)	Pin to Pin Skew LH Data to Output			0.4				0.5	ns
t_{OST} (Note 1)	Pin to Pin Skew LH/HL Data to Output			0.7				1.5	ns
t_{PV} (Note 2)	Device to Device Skew LH/HL Data to Output			1.0				2.0	ns

Note 1: Skew is defined as the absolute value of the difference between the actual propagation delays for any two separate outputs of the same device. The specification applies to any outputs switching HIGH to LOW (t_{OSHL}), LOW to HIGH (t_{OSLH}), or any combination switching LOW to HIGH and/or HIGH to LOW (t_{OST}).

Note 2: Progagation delay variation for a given set of conditions (i.e., temperature and V_{CC}) from device to device.

Extended AC Electrical Characteristics

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Symbol	Parameter	74BCT T_A = Com, V_{CC} = Com, C_L = 50 pF, 8 Outputs Switching (Note 3)		54BCT T_A = Mil, V_{CC} = Mil, C_L = 50 pF, 8 Outputs Switching (Note 3)		74BCT T_A = Com, V_{CC} = Comm, C_L = 250 pF (Note 4)		54BCT T_A = Mil, V_{CC} = Mil, C_L = 250 pF (Note 4)		Units
		Min	Max	Min	Max	Min	Max	Min	Max	
t_{PLH} t_{PHL}	Propagation Delay Data to Output	3.5 2.5	7.0 5.0			3.0 3.5	7.5 7.8			ns
t_{OSHL} (Note 1)	Pin to Pin Skew HL Data to Output						0.7			ns
t_{OSLH} (Note 1)	Pin to Pin Skew LH Data to Output						1.0			ns
t_{OST} (Note 1)	Pin to Pin Skew LH/HL Data to Output									ns
t_{PV} (Note 2)	Device to Device Skew LH/HL Data to Output									ns

Note 1: Skew is defined as the absolute value of the difference between the actual propagation delays for any two separate outputs of the same device. The specification applies to any outputs switching HIGH to LOW (t_{OSHL}), LOW to HIGH (t_{OSLH}), or any combination switching LOW to HIGH and/or HIGH to LOW (t_{OST}).

Note 2: Propagation delay variation for a given set of conditions (i.e., temperature and V_{CC}) from device to device.

Note 3: This specification is guaranteed but not tested. The limits apply to propagation delays for all paths described switching in phase (i.e., all low-to-high, high-to-low, etc.).

Note 4: This specification is guaranteed but not tested. The limits represent propagation delays with 250 pF load capacitors in place of the 50 pF load capacitors in the standard AC load. This specification pertains to single output switching only.

Capacitance

Symbol	Parameter	Typ	Units	Conditions
C_{IN}	Input Capacitance	8.8	pF	V_{CC} = 5.0V
C_{OUT}	Output Pin Capacitance	13.6	pF	V_{CC} = 5.0V

Ordering Information

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

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74BCT 2240 P C QR

Temperature Range Family
- 74BCT = Commercial
- 54BCT = Military

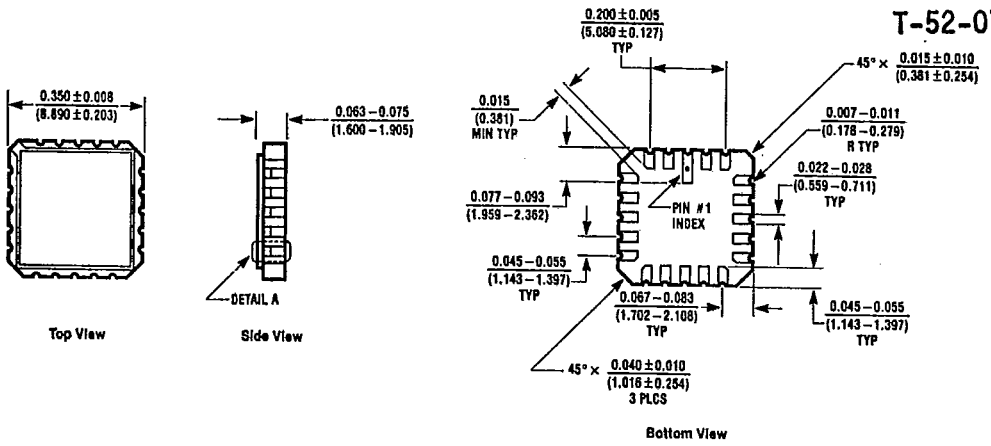
Device Type

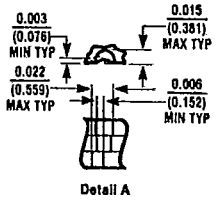
Package Code
- P = Plastic DIP
- D = Ceramic DIP
- F = Flatpak
- L = Leadless Ceramic Chip Carrier (LCC)
- S = Small Outline (SOIC)

Temperature Range
- C = Commercial (0°C to +70°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.

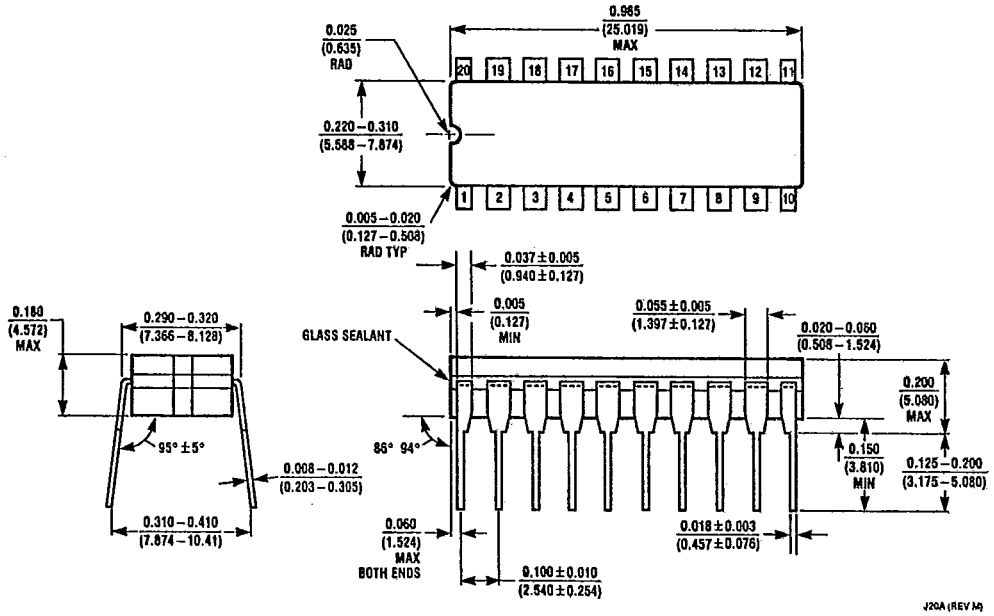
Physical Dimensions inches (millimeters)





E20A (REV D)

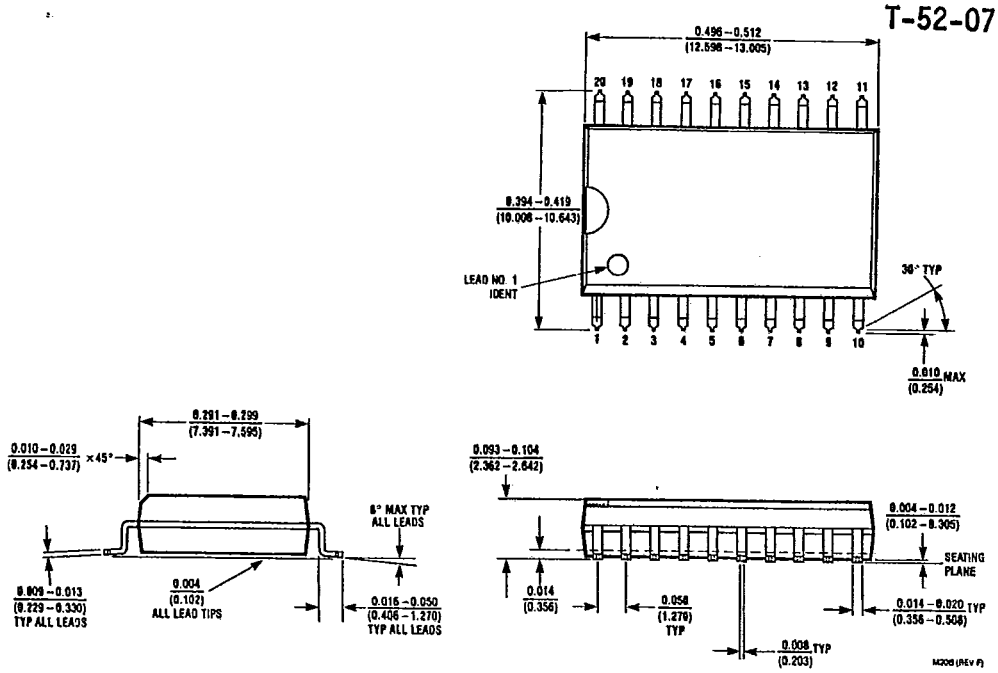
20-Terminal Ceramic Leadless Chip Carrier (L)
NS Package Number E20A



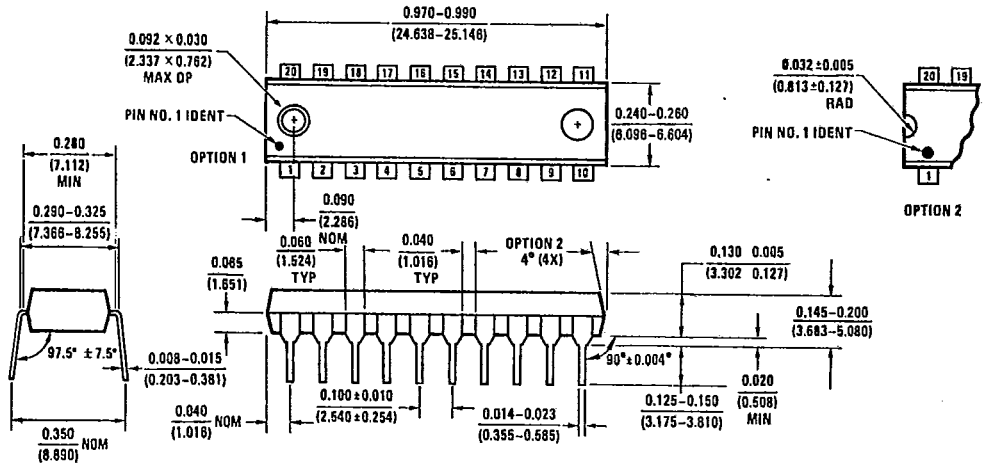
J20A (REV M)

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

Physical Dimensions inches (millimeters) (Continued)

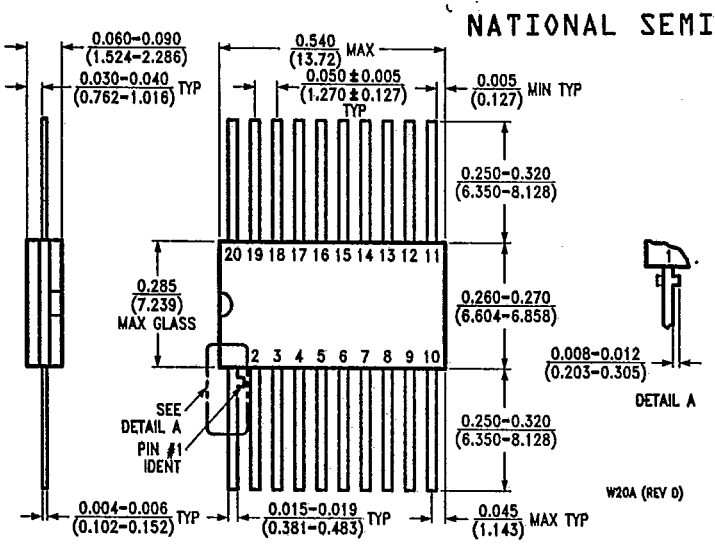


20-Lead Small Outline Integrated Circuit (S)
NS Package Number M20B



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

Physical Dimensions inches (millimeters) (Continued)



20-Lead Ceramic Flatpak (F)
NS Package Number W20A

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