National Semiconductor

July 1998

54ABT245
Octal Bidirectional Transceiver with TRI-STATE® Outputs

General Description

The 'ABT245 contains eight non-inverting bidirectional buffers with TRI-STATE outputs and is intended for bus-oriented applications. Current sinking capability is 48 mA on both the A and B ports. The Transmit/Receive ($T/\overline{R}$) input determines the direction of data flow through the bidirectional transceiver. Transmit (active HIGH) enables data from A ports to B ports; Receive (active LOW) enables data from B ports to A ports. The Output Enable input, when HIGH, disables both A and B ports by placing them in a High Z condition.

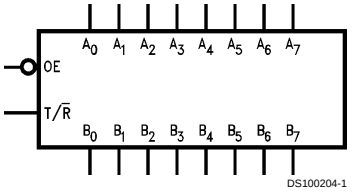
Features

- Bidirectional non-inverting buffers
- A and B output sink capability of 48 mA, source capability of 24 mA
- Guaranteed output skew
- Guaranteed multiple output switching specifications
- Output switching specified for both 50 pF and 250 pF loads
- Guaranteed simultaneous switching, noise level and dynamic threshold performance
- Guaranteed latchup protection
- High impedance glitch-free bus loading during entire power up and power down cycle
- Non-destructive hot insertion capability
- Disable time is less than enable time to avoid bus contention
- Standard Microcircuit Drawing (SMD) 5962-9214801

Ordering Code:

Military	Package Number	Package Description
54ABT245J-QML	J20A	20-Lead Ceramic Dual-In-Line
54ABT245W-QML	W20A	20-Lead Cerpak
54ABT245E-QML	E20A	20-Lead Ceramic Leadless Chip Carrier, Type C

Logic Symbol

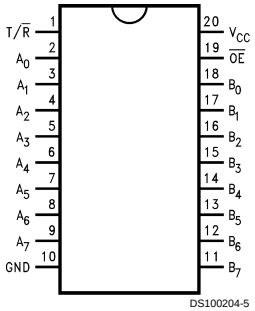


DS100204-1

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

Connection Diagrams

Pin Assignment for DIP and Flatpak.



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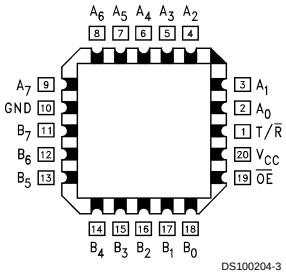
Pin Assignment for LCC



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Pin Descriptions

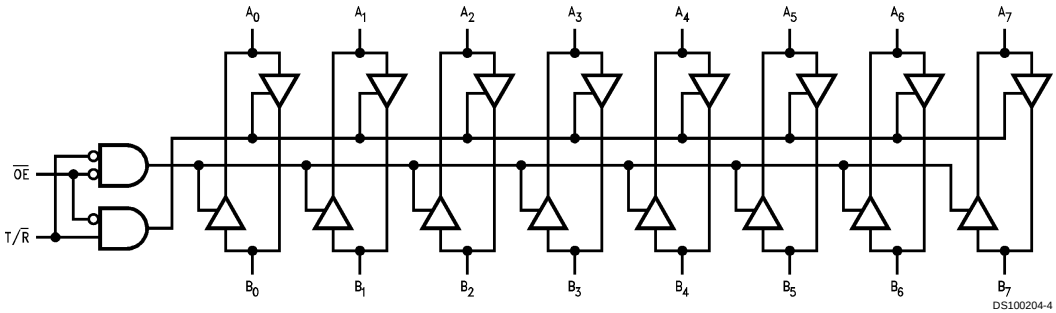
Pin Names	Description
$\overline{OE}$	Output Enable Input (Active LOW)
T/$\overline{R}$	Transmit/Receive Input
A_0–A_7	Side A Inputs or TRI-STATE Outputs
B_0–B_7	Side B Inputs or TRI-STATE Outputs

Truth Table

Inputs		Output
$\overline{OE}$	T/$\overline{R}$	
L	L	Bus B Data to Bus A
L	H	Bus A Data to Bus B
H	X	High Z State

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial

Logic Diagram



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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	
Ceramic	−55˚C to +175˚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 Disabled 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)
DC Latchup Source Current	−500 mA
Over Voltage Latchup (I/O)	10V

Recommended Operating Conditions

Free Air Ambient Temperature	
Military	−55˚C to +125˚C
Supply Voltage	
Military	+4.5V to +5.5V
Minimum Input Edge Rate	(ΔV/Δt)
Data Input	50 mV/ns
Enable Input	20 mV/ns

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.

DC Electrical Characteristics

Symbol	Parameter		ABT245 Min	ABT245 Typ	ABT245 Max	Units	V_{CC}	Conditions
V_{IH}	Input HIGH Voltage		2.0			V		Recognized HIGH Signal
V_{IL}	Input LOW Voltage				0.8	V		Recognized LOW Signal
V_{CD}	Input Clamp Diode Voltage				−1.2	V	Min	I_{IN} = −18 mA ($\overline{OE}$, T/$\overline{R}$)
V_{OH}	Output HIGH Voltage	54ABT	2.5			V	Min	I_{OH} = −3 mA (A_n, B_n)
		54ABT	2.0			V	Min	I_{OH} = −24 mA (A_n, B_n)
V_{OL}	Output LOW Voltage	54ABT			0.55	V	Min	I_{OL} = 48 mA (A_n, B_n)
I_{IH}	Input HIGH Current				5 5	µA	Max	V_{IN} = 2.7V ($\overline{OE}$, T/$\overline{R}$) (Note 3) V_{IN} = V_{CC} ($\overline{OE}$, T/$\overline{R}$)
I_{BVI}	Input HIGH Current Breakdown Test				7	µA	Max	V_{IN} = 7.0V ($\overline{OE}$, T/$\overline{R}$)
I_{BVIT}	Input HIGH Current Breakdown Test (I/O)				100	µA	Max	V_{IN} = 5.5V (A_n, B_n)
I_{IL}	Input LOW Current				−5 −5	µA	Max	V_{IN} = 0.5V ($\overline{OE}$, T/$\overline{R}$) (Note 3) V_{IN} = 0.0V ($\overline{OE}$, T/$\overline{R}$)
V_{ID}	Input Leakage Test		4.75			V	0.0	I_{ID} = 1.9 µA ($\overline{OE}$, T/$\overline{R}$) All Other Pins Grounded
I_{IH} + I_{OZH}	Output Leakage Current				50	µA	0 − 5.5V	V_{OUT} = 2.7V (A_n, B_n); $\overline{OE}$ = 2.0V
I_{IL} + I_{OZL}	Output Leakage Current				−50	µA	0 − 5.5V	V_{OUT} = 0.5V (A_n, B_n); $\overline{OE}$ = 2.0V
I_{OS}	Output Short-Circuit Current		−100		−275	mA	Max	V_{OUT} = 0.0V (A_n, B_n)
I_{CEX}	Output High Leakage Current				50	µA	Max	V_{OUT} = V_{CC} (A_n, B_n)
I_{ZZ}	Bus Drainage Test				100	µA	0.0	V_{OUT} = 5.5V (A_n, B_n); All Others GND
I_{CCH}	Power Supply Current				50	µA	Max	All Outputs HIGH
I_{CCL}	Power Supply Current				30	mA	Max	All Outputs LOW
I_{CCZ}	Power Supply Current				50	µA	Max	$\overline{OE}$ = V_{CC}, T/$\overline{R}$ = GND or V_{CC}; All Other GND or V_{CC}
I_{CCT}	Additional	Outputs Enabled			2.5	mA	Max	V_I = V_{CC} − 2.1V
	I_{CC}/Input	Outputs TRI-STATE			2.5	mA		$\overline{OE}$, T/$\overline{R}$ V_I = V_{CC} − 2.1V
		Outputs TRI-STATE			50	µA		Data Input V_I = V_{CC} − 2.1V
								All Others at V_{CC}or GND.

DC Electrical Characteristics (Continued)

Symbol	Parameter	ABT245			Units	V_{CC}	Conditions
		Min	Typ	Max			
I_{CCD}	Dynamic I_{CC} No Load (Note 3)			0.1	mA/ MHz	 Max	Outputs Open $\overline{OE}$ = GND, T/$\overline{R}$ = GND or V_{CC} One Bit Toggling, 50% Duty Cycle (Note 4)

Note 3: Guaranteed but not tested.

Note 4: For 8 bits toggling, I_{CCD} < 0.8 mA/MHz.

DC Electrical Characteristics

Symbol	Parameter	Min	Max	Units	V_{CC}	Conditions C_L = 50 pF, R_L = 500Ω
V_{OLP}	Quiet Output Maximum Dynamic V_{OL}		1.1	V	5.0	T_A = 25˚C (Note 5)
V_{OLV}	Quiet Output Minimum Dynamic V_{OL}		-0.45	V	5.0	T_A = 25˚C(Note 5)

Note 5: Max number of outputs defined as (n). n − 1 data inputs are driven 0V to 3V. One output at LOW.

AC Electrical Characteristics

Symbol	Parameter	54ABT T_A = −55˚C to +125˚C V_{CC} = 4.5V–5.5V C_L = 50 pF		Units
		Min	Max	
t_{PLH}	Propagation Delay	1.0	4.8	ns
t_{PHL}	Data to Outputs	1.0	4.8	
t_{PZH}	Output Enable	1.0	6.7	ns
t_{PZL}	Time	2.0	7.5	
t_{PHZ}	Output Disable	1.7	7.4	ns
t_{PLZ}	Time	1.7	6.5	

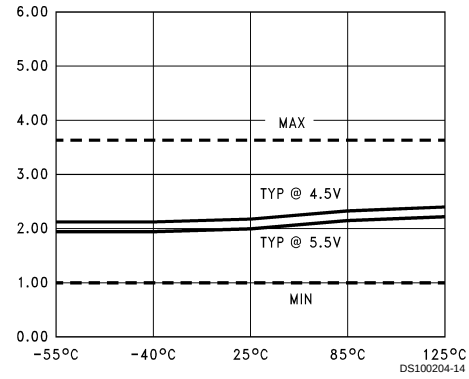
Capacitance

Symbol	Parameter	Typ	Units	Conditions T_A = 25˚C
C_{IN}	Input Capacitance	5.0	pF	V_{CC} = 0V ($\overline{OE}$, T/$\overline{R}$)
$C_{I/O}$ (Note 6)	I/O Capacitance	11.0	pF	V_{CC} = 5.0V (A_n, B_n)

Note 6: $C_{I/O}$ is measured at frequency f = 1 MHz, per MIL-STD-883B, Method 3012.

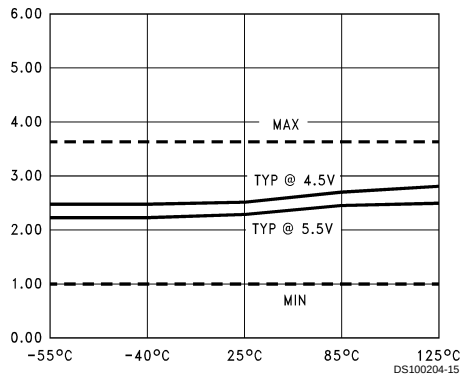
Capacitance (Continued)

t_{PLH} vs Temperature (T_A)
C_L = 50 pF, 1 Output Switching



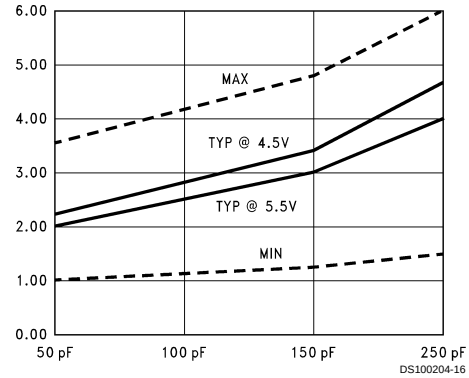
DS100204-14

t_{PHL} vs Temperature (T_A)
C_L = 50 pF, 1 Output Switching



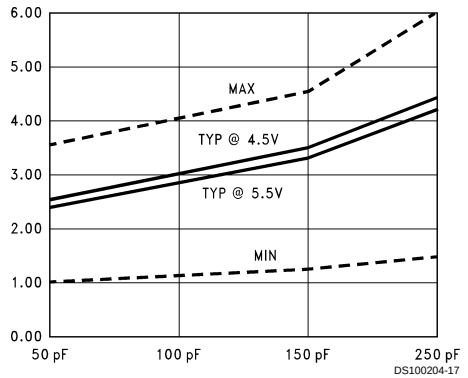
DS100204-15

t_{PLH} vs Load Capacitance
1 Output Switching, T_A = 25˚C



DS100204-16

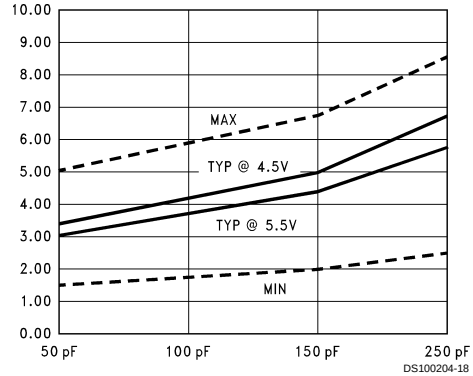
t_{PHL} vs Load Capacitance
1 Output Switching, T_A = 25˚C



DS100204-17

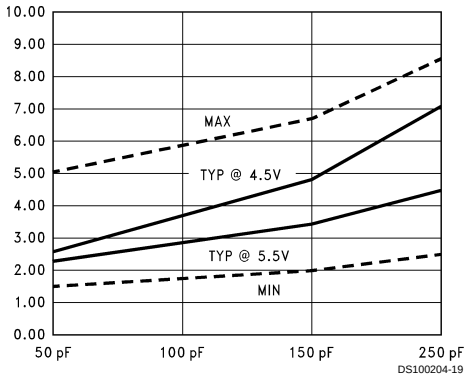
Dashed lines represent design characteristics; for specified guarantees, refer to AC Characteristics Table.

t_{PLH} vs Load Capacitance
8 Outputs Switching, T_A = −40˚C to +85˚C



DS100204-18

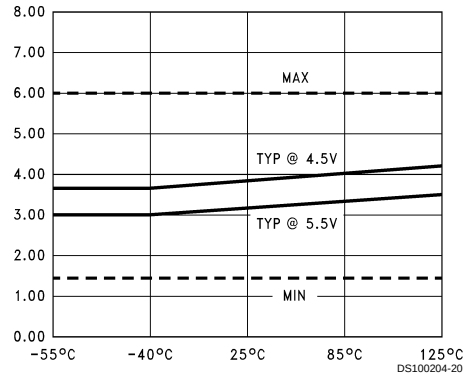
t_{PHL} vs Load Capacitance
8 Outputs Switching, T_A = 25˚C



DS100204-19

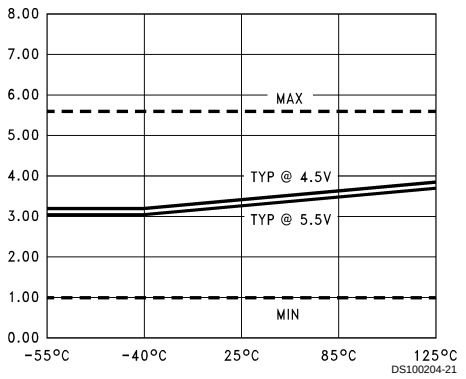
Capacitance (Continued)

t_{PZL} vs Temperature (T_A)
C_L = 50 pF, 1 Output Switching



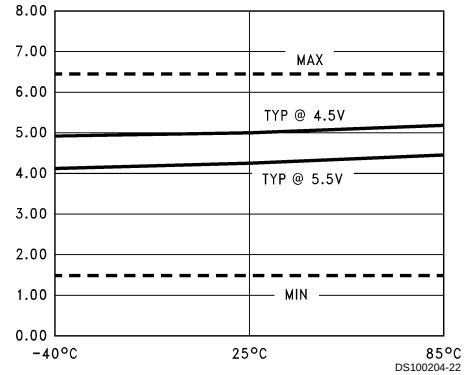
DS100204-20

t_{PLZ} vs Temperature (T_A)
C_L = 50 pF, 1 Output Switching



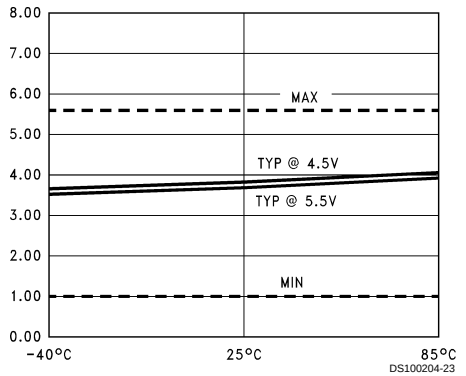
DS100204-21

t_{PZL} vs Temperature (T_A)
C_L = 50 pF, 8 Outputs Switching



DS100204-22

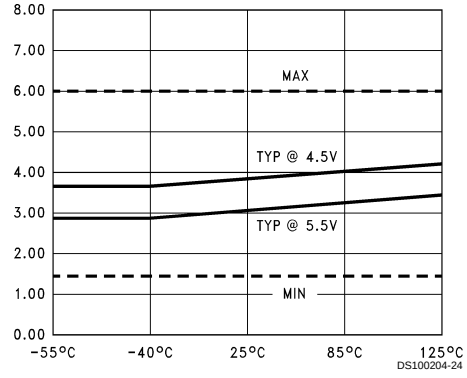
t_{PLZ} vs Temperature (T_A)
C_L = 50 pF, 8 Outputs Switching



DS100204-23

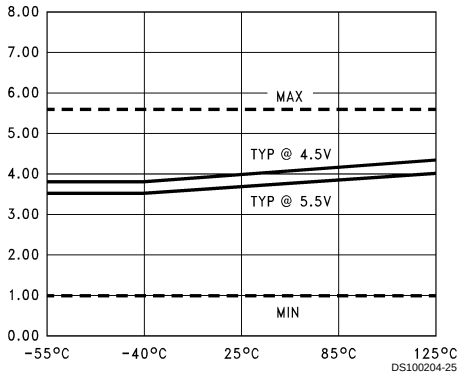
Dashed lines represent design characteristics; for specified guarantees, refer to AC Characteristics Table.

t_{PZH} vs Temperature (T_A)
C_L = 50 pF, 1 Output Switching



DS100204-24

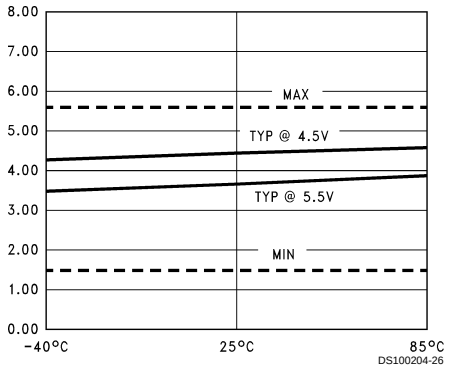
t_{PHZ} vs Temperature (T_A)
C_L = 50 pF, 1 Output Switching



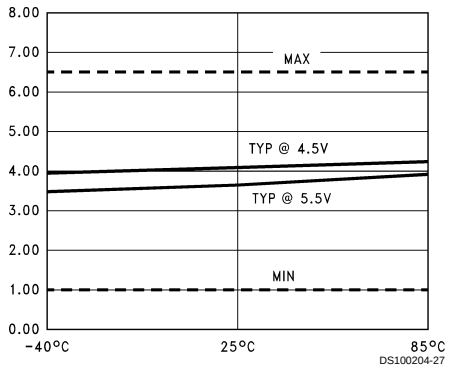
DS100204-25

Capacitance (Continued)

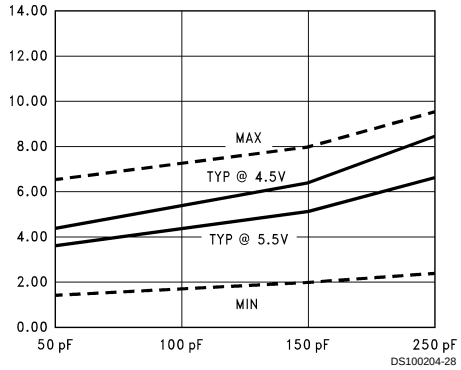
t_{PZH} vs Temperature (T_A)
C_L = 50 pF, 8 Outputs Switching



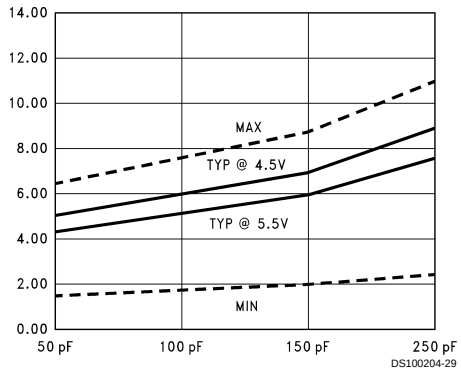
t_{PHZ} vs Temperature (T_A)
C_L = 50 pF, 8 Outputs Switching



t_{PZH} vs Load Capacitance
8 Outputs Switching, T_A = 25˚C

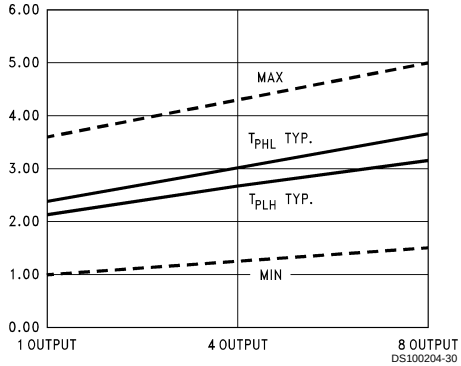


t_{PZL} vs Load Capacitance
8 Outputs Switching, T_A = 25˚C

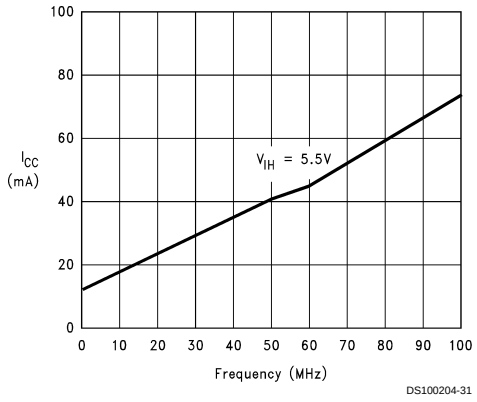


Dashed lines represent design characteristics; for specified guarantees, refer to AC Characteristics Table.

t_{PLH} and t_{PHL} vs Number Outputs Switching
V_{CC} = 5.0V, T_A = 25˚C, C_L = 50 pF

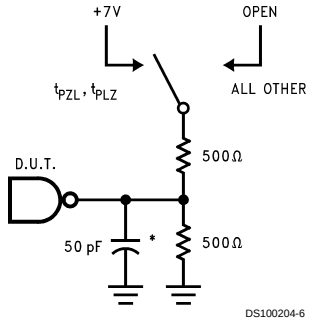


I_{CC} vs Frequency, Average, T_A = 25˚C,
All Outputs Unloaded/Unterminated



Dashed lines represent design characteristics; for specified guarantees, refer to AC Characteristics Table.

AC Loading



*Includes jig and probe capacitance

FIGURE 1. Standard AC Test Load

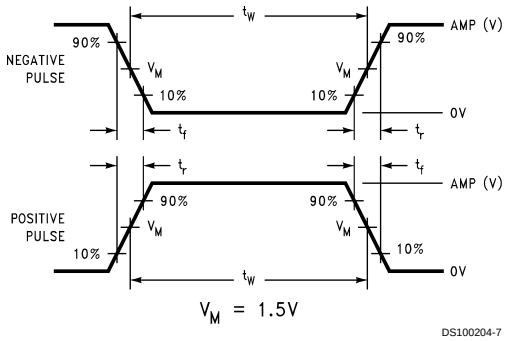


FIGURE 2. Test Input Signal Levels

Amplitude	Rep. Rate	t_w	t_r	t_f
3.0V	1 MHz	500 ns	2.5 ns	2.5 ns

FIGURE 3. Test Input Signal Requirements

AC Waveforms

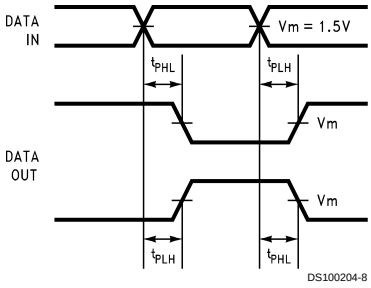


FIGURE 4. Propagation Delay Waveforms for Inverting and Non-Inverting Functions

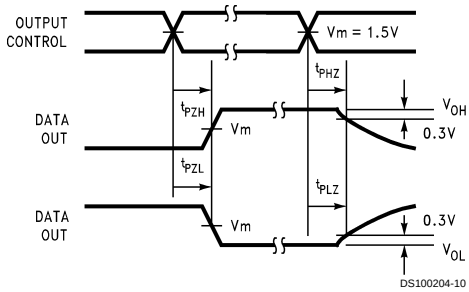
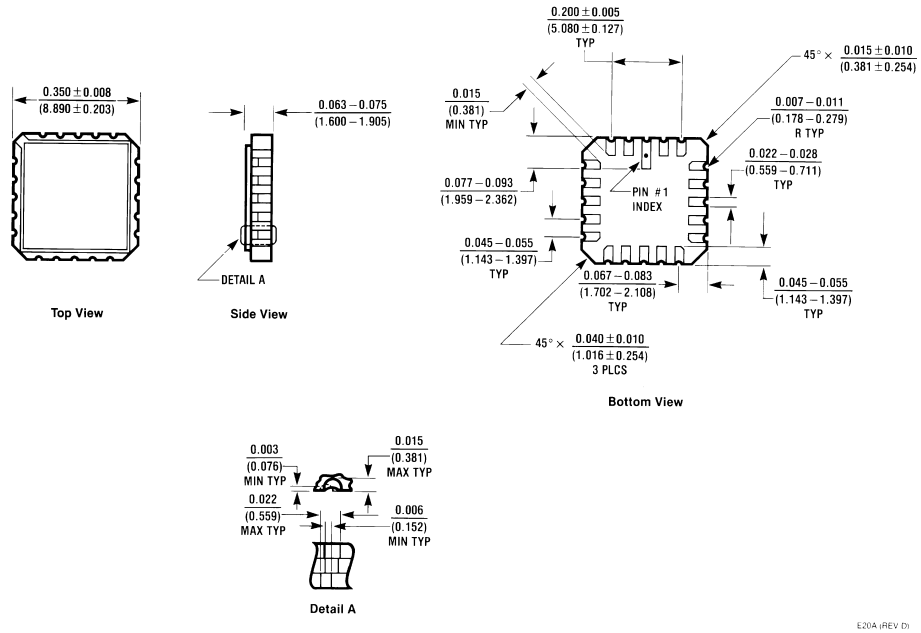
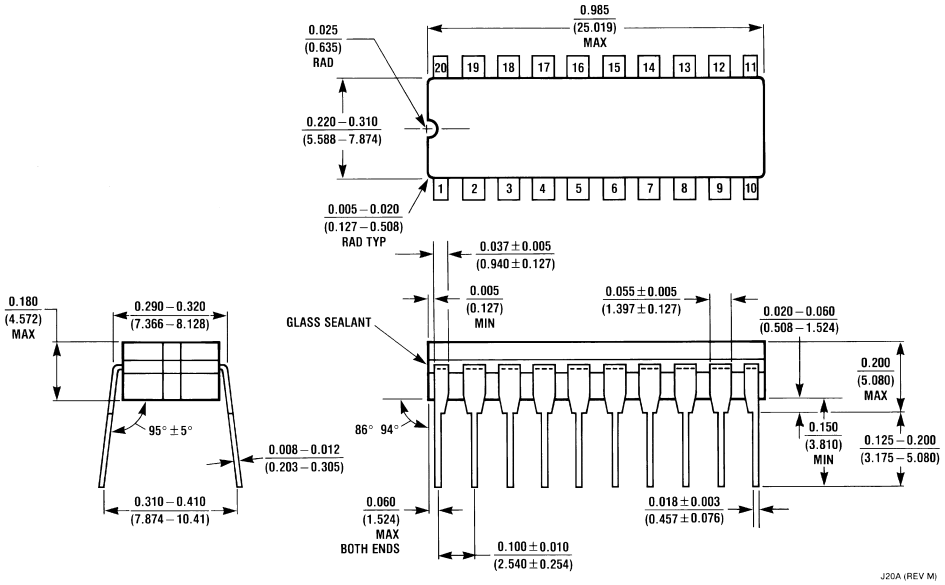


FIGURE 5. TRI-STATE Output HIGH and LOW Enable and Disable Times

Physical Dimensions inches (millimeters) unless otherwise noted

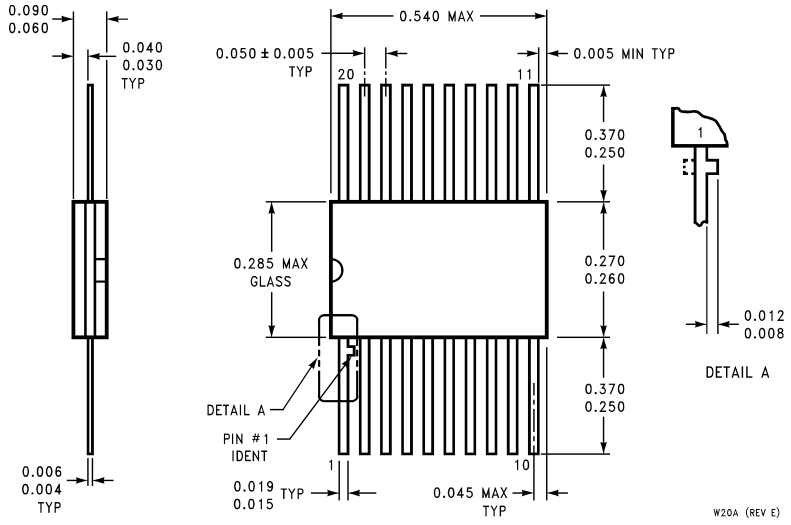


20-Terminal Ceramic Chip Carrier (L)
NS Package Number E20A



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

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



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

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