National Semiconductor

July 1998

54ABT16646
16-Bit Transceivers and Registers with TRI-STATE® Outputs

General Description

The 'ABT16646 consists of bus transceiver circuits with TRI-STATE, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the input bus or from the internal registers. Data on the A or B bus will be clocked into the registers as the appropriate clock pin goes to a high logic level. Control $\overline{OE}$ and direction pins are provided to control the transceiver function. In the transceiver mode, data present at the high impedance port may be stored in either the A or the B register or in both. The select controls can multiplex stored and real-time (transparent mode) data. The direction control determines which bus will receive data when the enable control $\overline{OE}$ is Active LOW. In the isolation mode (control $\overline{OE}$ HIGH), A data may be stored in the B register and/or B data may be stored in the A register.

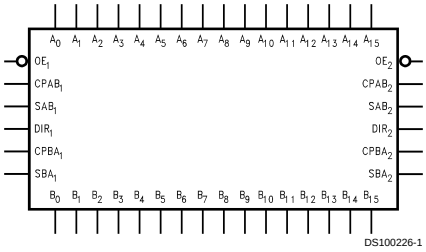
Features

- Independent registers for A and B buses
- Multiplexed real-time and stored data
- A and B output sink capability of 48 mA, source capability of 24 mA
- Guaranteed latchup protection
- High impedance glitch free bus loading during entire power up and power down cycle
- Nondestructive hot insertion capability
- Standard Microcircuit Drawing (SMD) 5962-9450202

Ordering Code

Military	Package Number	Package Description
54ABT16646W-QML	WA56A	56-Lead Cerpack

Logic Symbol



Pin Names	Description
A_0–A_{15}	Data Register A Inputs/ TRI-STATE Outputs
B_0–B_{15}	Data Register B Inputs/ TRI-STATE Outputs
$CPAB_n$, $CPBA_n$	Clock Pulse Inputs
SAB_n, SBA_n	Select Inputs
$\overline{OE}_n$	Output Enable Input
DIR	Direction Control Input

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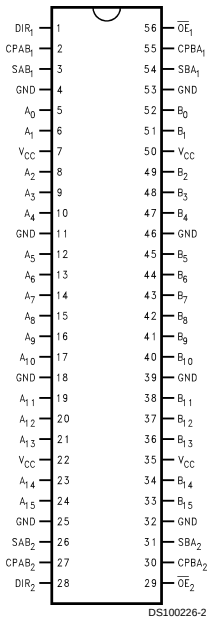
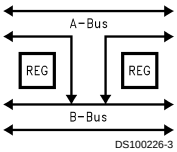
Connection Diagram

Pin Assignment for Cerpack



DS100226-2

Real Time Transfer A-Bus to B-Bus



DS100226-3

FIGURE 1.

Real Time Transfer B-Bus to A-Bus

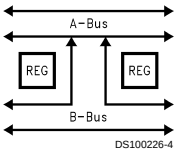


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FIGURE 2.

Storage from Bus to Register

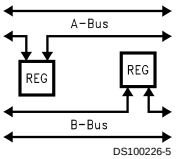

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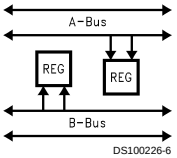
FIGURE 3.

Transfer from Register to Bus



DS100226-6

FIGURE 4.

Function Table

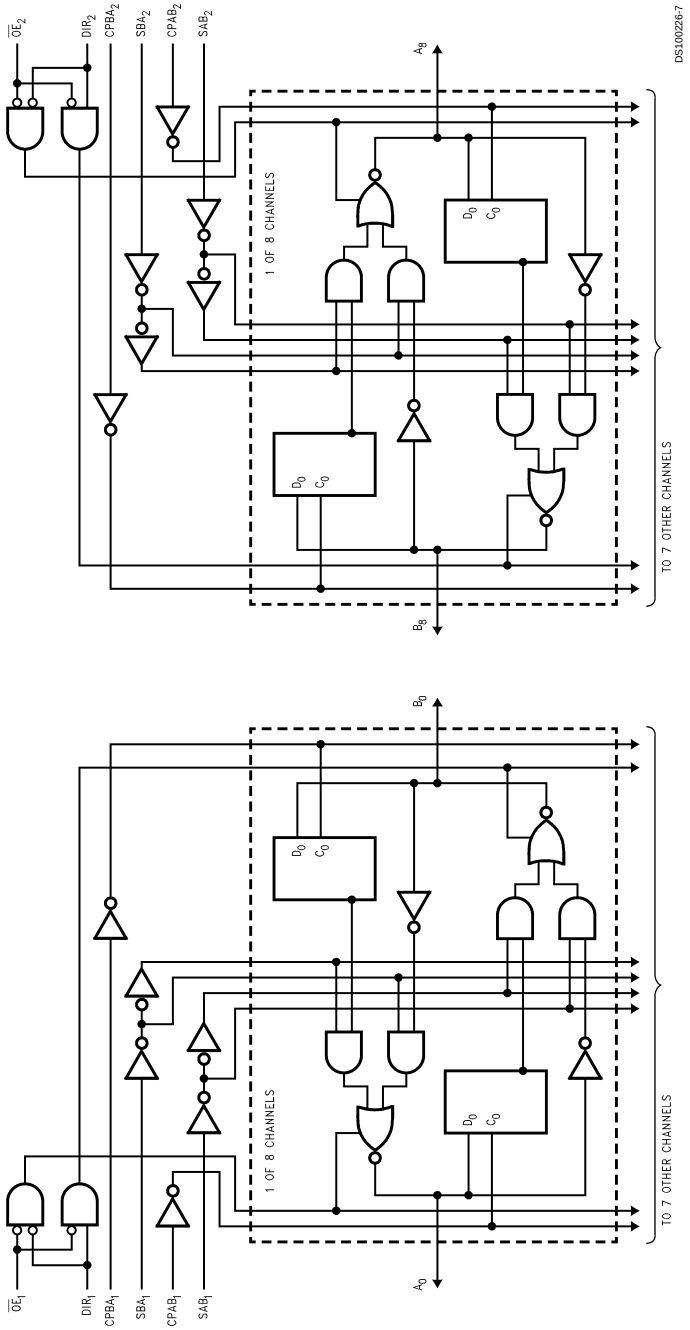
Inputs						Data I/O (Note 1)		Output Operation Mode
$\overline{OE}_1$	DIR_1	$CPAB_1$	$CPBA_1$	SAB_1	SBA_1	A_{0-7}	B_{0-7}	
H	X	H or L	H or L	X	X			Isolation
H	X	N	X	X	X	Input	Input	Clock An Data into A Register
H	X	X	N	X	X			Clock Bn Data Into B Register
L	H	X	X	L	X			An to Bn — Real Time (Transparent Mode)
L	H	N	X	L	X	Input	Output	Clock An Data to A Register
L	H	H or L	X	H	X			A Register to Bn (Stored Mode)
L	H	N	X	H	X			Clock An Data into A Register and Output to Bn
L	L	X	X	X	L			Bn to An — Real Time (Transparent Mode)
L	L	X	N	X	L	Output	Input	Clock Bn Data into B Register
L	L	X	H or L	X	H			B Register to An (Stored Mode)
L	L	X	N	X	H			Clock Bn into B Register and Output to An

H = HIGH Voltage Level X = Immaterial

L = LOW Voltage Level N = LOW-to-HIGH Transition.

Note 1: The data output functions may be enabled or disabled by various signals at the $\overline{OE}$ and DIR inputs. Data input functions are always enabled; i.e., data at the bus pins will be stored on every LOW-to-HIGH transition of the appropriate clock inputs. Also applies to data I/O (A and B: 8-15) and #2 control pins.

Logic Diagram



Absolute Maximum Ratings (Note 2)

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 3)	−0.5V to +7.0V
Input Current (Note 3)	−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)
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
Clock Input	100 mV/ns

Note 2: 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 3: Either voltage limit or current limit is sufficient to protect inputs.

DC Electrical Characteristics

Symbol	Parameter		ABT16646			Units	V_{CC}	Conditions
			Min	Typ	Max			
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 (Non I/O Pins)
V_{OH}	Output HIGH Voltage	54ABT	2.5					I_{OH} = −3 mA, (A_n, B_n)
		54ABT	2.0					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)
V_{ID}	Input Leakage Test		4.75			V	0.0	I_{ID} = 1.9 µA, (Non-I/O Pins) All Other Pins Grounded
I_{IH}	Input HIGH Current				5	µA	Max	V_{IN} = 2.7V (Non-I/O Pins) (Note 5) V_{IN} = V_{CC} (Non-I/O Pins)
I_{BVI}	Input HIGH Current Breakdown Test				7	µA	Max	V_{IN} = 7.0V (Non-I/O Pins)
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	µA	Max	V_{IN} = 0.5V (Non-I/O Pins) (Note 5) V_{IN} = 0.0V (Non-I/O Pins)
I_{IH} + I_{OZH}	Output Leakage Current				50	µA	0V–5.5V	V_{OUT} = 2.7V (A_n, B_n); $\overline{OE}$ = 2.0V
I_{IL} + I_{OZL}	Output Leakage Current				−50	µA	0V–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} = 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	0.0V	V_{OUT} = 5.5V (A_n, B_n); All Others GND
I_{CCH}	Power Supply Current				2.0	mA	Max	All Outputs HIGH
I_{CCL}	Power Supply Current				60	mA	Max	All Outputs LOW
I_{CCZ}	Power Supply Current				2.0	mA	Max	Outputs TRI-STATE; All Others GND
I_{CCT}	Additional I_{CC}/Input				2.5	mA	Max	V_I = V_{CC} − 2.1V All Other Outputs at V_{CC} or GND
I_{CCD}	Dynamic I_{CC} (Note 5)	No Load			0.23	mA/MHz	Max	Outputs Open $\overline{OE}$, DIR, and SEL = GND, Non-I/O = GND or V_{CC} (Note 4) One Bit toggling, 50% duty cycle

DC Electrical Characteristics (Continued)

Note 4: For 8-bit toggling, $I_{CCD} < 1.4$ mA/MHz.

Note 5: Guaranteed but not tested.

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}		1.0	V	5.0	T_A = 25˚C (Note 6)
V_{OLV}	Quiet Output Minimum Dynamic V_{OL}		−1.5	V	5.0	T_A = 25˚C (Note 6)

Note 6: Max number of outputs defined as (n). n − 1 data inputs are driven 0V to 3V. One output at LOW. Guaranteed, but not tested.

AC Electrical Characteristics

Symbol	Parameter	54ABT T_A = −55˚C to +125˚C V_{CC} = 4.5V–5.5V C_L = 50 pF		Units	Fig. No.
		Min	Max		
f_{max}	Max Clock Frequency	125		MHz	
t_{PLH}	Propagation Delay	1.0	6.9	ns	*Figure 8*
t_{PHL}	Clock to Bus	1.0	7.7		
t_{PLH}	Propagation Delay	1.0	5.8	ns	*Figure 8*
t_{PHL}	Bus to Bus	1.0	7.0		
t_{PLH}	Propagation Delay	1.0	7.1	ns	*Figure 8*
t_{PHL}	SBA_n or SAB_n to A_n to B_n	1.0	7.2		
t_{PZH}	Enable Time	1.0	6.4	ns	*Figure 10*
t_{PZL}	$\overline{OE}_n$ to A_n or B_n	1.0	6.5		
t_{PHZ}	Disable Time	1.0	7.6	ns	*Figure 10*
t_{PLZ}	$\overline{OE}_n$ to A_n or B_n	1.0	6.5		
t_{PZH}	Enable Time	1.0	6.4	ns	*Figure 10*
t_{PZL}	DIR_n to A_n or B_n	1.0	6.7		
t_{PHZ}	Disable Time	1.0	8.1	ns	*Figure 10*
t_{PLZ}	DIR_n to A_n or B_n	1.0	7.1		

AC Operating Requirements

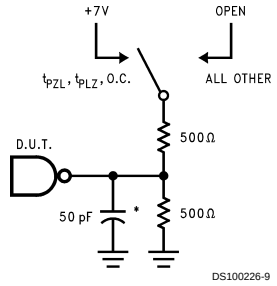
Symbol	Parameter	54ABT T_A = −55˚C to +125˚C V_{CC} = 4.5V–5.5V C_L = 50 pF		Units	Fig. No.
		Min	Max		
t_S(H) t_S(L)	Setup Time, HIGH or LOW Bus to Clock	4.0		ns	*Figure 11*
t_H(H) t_H(L)	Hold Time, HIGH or LOW Bus to Clock	0.5		ns	*Figure 11*
t_W(H) t_W(L)	Pulse Width, HIGH or LOW	4.3		ns	*Figure 9*

Capacitance

Symbol	Parameter	Typ	Units	Conditions $T_A = 25^\circ C$
C_{IN}	Input Capacitance	5	pF	V_{CC} = 0V (non I/O pins)
$C_{I/O}$ (Note 7)	Output Capacitance	11	pF	V_{CC} = 5.0V (A_n, B_n)

Note 7: $C_{I/O}$ is measured at frequency, f = 1 MHz, per MIL-STD-883B, Method 3012.

AC Loading



*Includes jig and probe capacitance

FIGURE 5. Standard AC Test Load

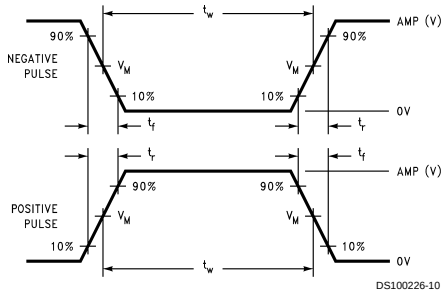


FIGURE 6. V_M = 1.5V Input Pulse Requirements

Amplitude	Rep. Rate	t_w	t_r	t_f
3V	1 MHz	500 ns	2.5 ns	2.5 ns

FIGURE 7. Test Input Signal Requirements

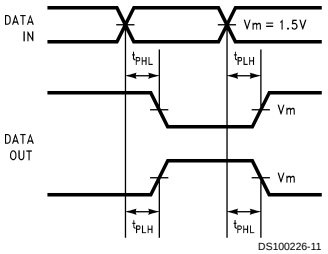


FIGURE 8. Propagation Delay Waveforms for Inverting and Non-Inverting Functions

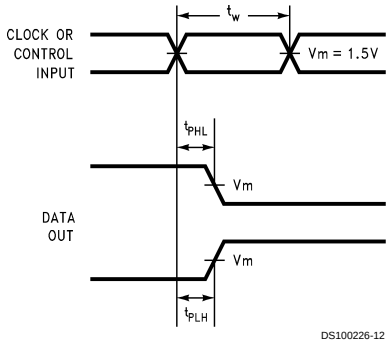


FIGURE 9. Propagation Delay, Pulse Width Waveforms

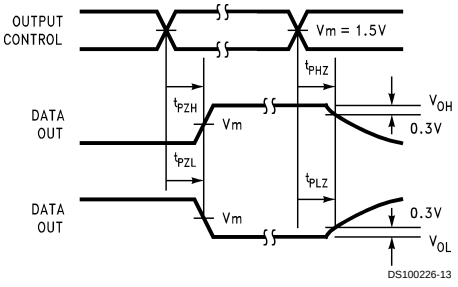


FIGURE 10. TRI-STATE Output HIGH and LOW Enable and Disable Times

AC Loading (Continued)

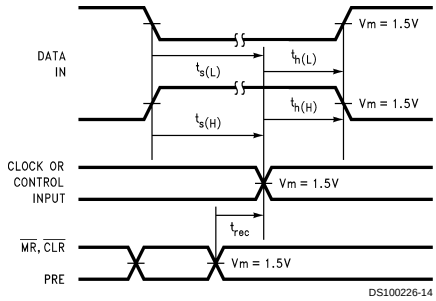
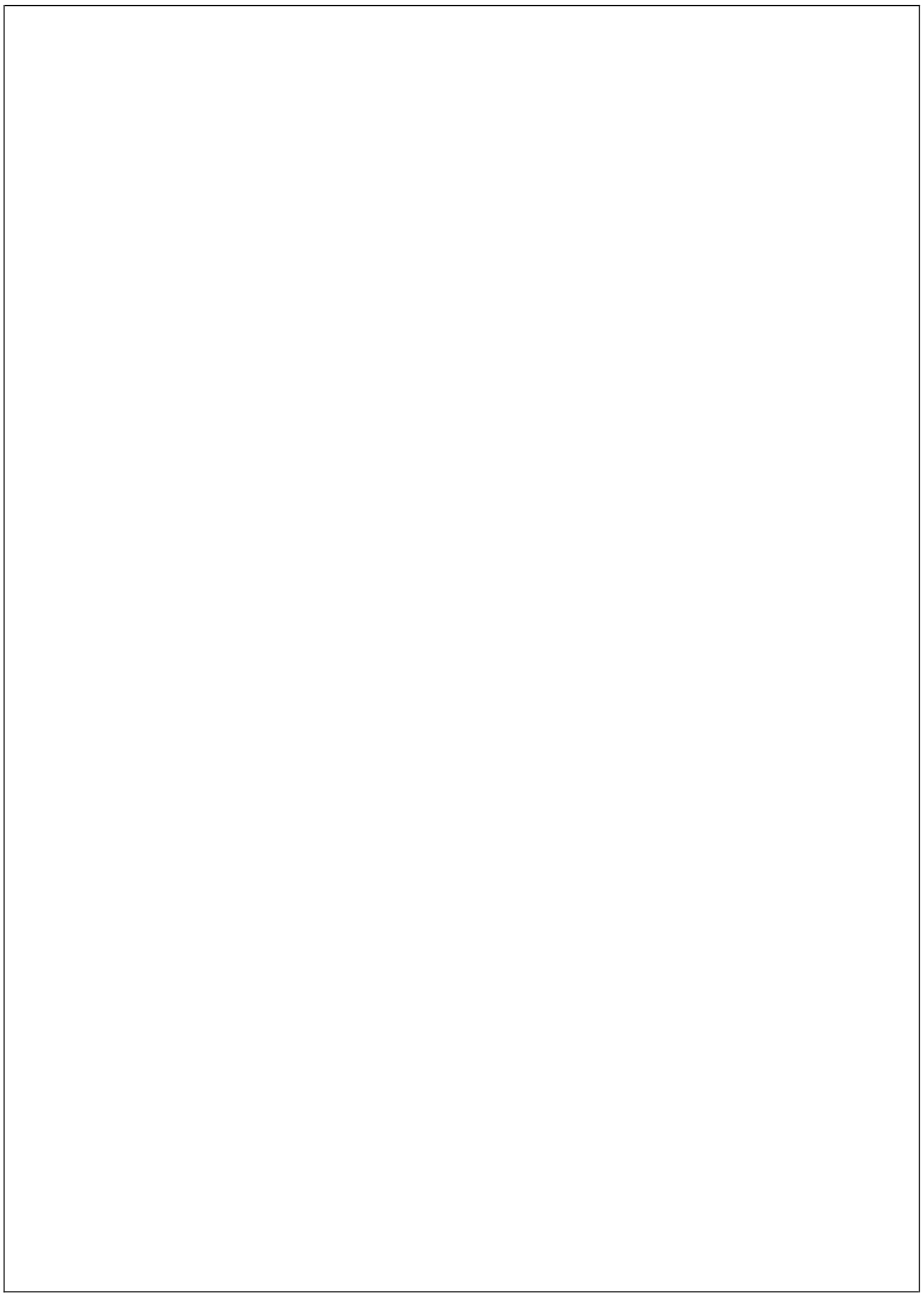


FIGURE 11. Setup Time, Hold Time and Recovery Time Waveforms



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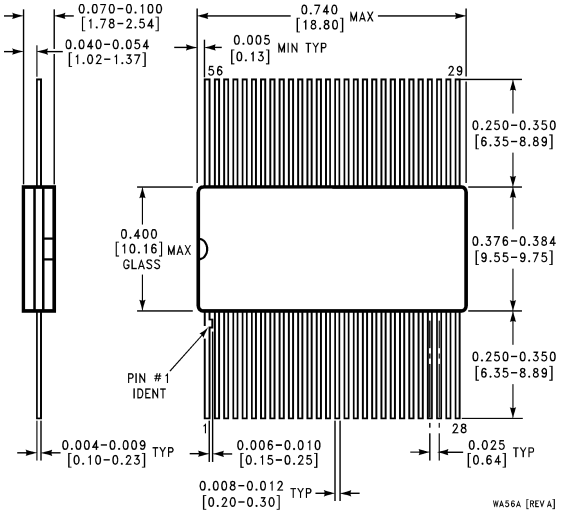
Physical Dimensions inches (millimeters) unless otherwise noted



56-Lead Cerpack
NS Package Number WA56A

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