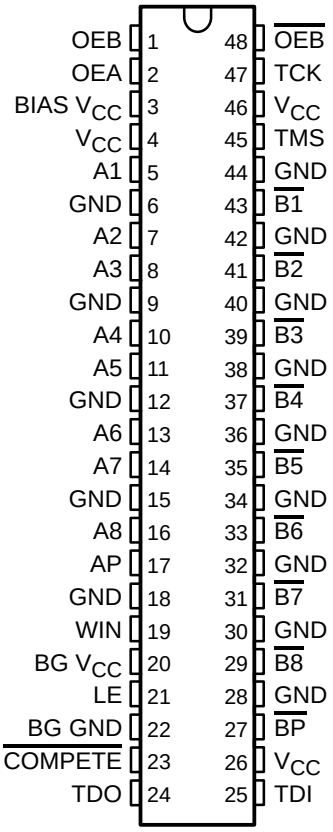
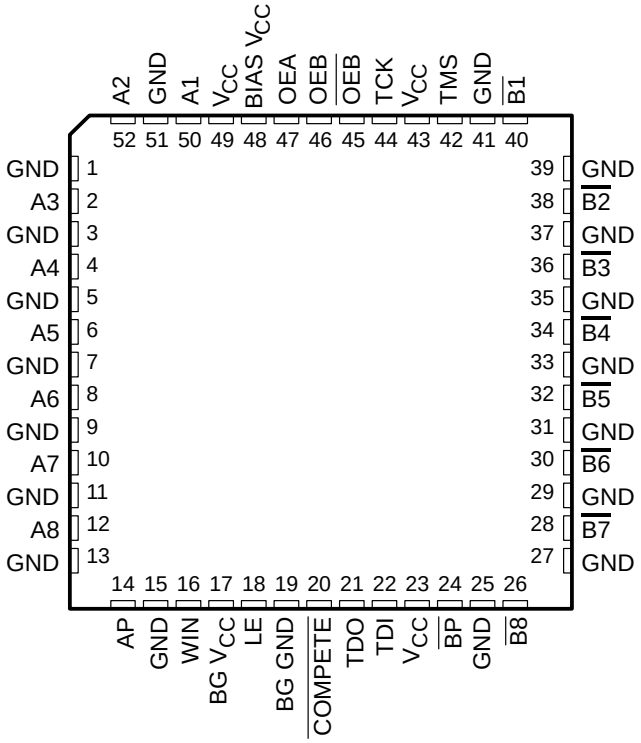
- **Compatible With IEEE Std 1194.1-1991 (BTL)**
- **TTL A Port, Backplane Transceiver Logic (BTL) $\overline{B}$ Port**
- **Open-Collector $\overline{B}$-Port Outputs Sink 100 mA**
- **BIAS V_{CC} Pin Minimizes Signal Distortion During Live Insertion or Withdrawal**
- **High-Impedance State During Power Up and Power Down**
- **$\overline{B}$-Port Biasing Network Preconditions the Connector and PC Trace to the BTL High-Level Voltage**
- **TTL-Input Structures Incorporate Active Clamping Networks to Aid in Line Termination**
- **Package Options Include Plastic Quad Flat (RC) Package and Ceramic Flat (WD) Package**

SN54FB2032 . . . WD PACKAGE
(TOP VIEW)



SN74FB2032 . . . RC PACKAGE
(TOP VIEW)



description

The ’FB2032 are 9-bit transceivers designed to translate signals between TTL and backplane transceiver logic (BTL) environments and to perform bus arbitration. They are specifically designed to be compatible with IEEE Std 1194.1-1991.

The $\overline{B}$ port operates at BTL-signal levels. The open-collector $\overline{B}$ ports are specified to sink 100 mA and have minimum output edge rates of 2 ns. Two output enables, OEB and $\overline{OEB}$, are provided for the $\overline{B}$ outputs. When OEB is low, $\overline{OEB}$ is high, or V_{CC} is less than 2.1 V, the $\overline{B}$ port is turned off.

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

description (continued)

The A port operates at TTL-signal levels. The A outputs reflect the inverse of the data at the $\overline{B}$ port when the A-port output enable, OEA, is high. When OEA is low or when V_{CC} is less than 2.1 V, the A outputs are in the high-impedance state.

The A-port data is latched when the latch enable (LE) is high. When LE is low, the latches are transparent.

The Futurebus protocol logic can be activated by taking $\overline{\text{COMPETE}}$ low. The module (device) then compares its A data (arbitration number) against the A data of another identical module also connected to the $\overline{B}$ arbitration bus, and sets WIN high if the A data is greater than the A data of the other module (i.e., has higher priority). A8 and $\overline{B8}$ are the most-significant bits, and A1 and $\overline{B1}$ are the least-significant bits. If OEB is high and $\overline{OEB}$ is low during this operation, and the A bus of the first module wins priority, the A bus asserts its arbitration number on the $\overline{B}$-arbitration bus.

AP and $\overline{BP}$ are the bus-parity bits. The winning module can assert $\overline{BP}$ low if its parity bit (AP) is high.

In a typical operating sequence, a Futurebus arbitration controller latches its arbitration number into the A port and waits for the results of a competition. When the competition is complete, and if the controller's arbitration number did not win, the controller reads back the current value of the $\overline{B}$ bus (by taking OEA high) and determines the winning arbitration number. This allows the module to change its arbitration number for the next competition cycle, if desired.

Pins are allocated for the four-wire IEEE Std 1149.1 (JTAG) test bus, which will be implemented in a future version of the 'FB2032. Currently, TMS and TCK are not connected and TDI is shorted to TDO.

BIAS V_{CC} establishes a voltage between 1.62 V and 2.1 V on the BTL outputs when V_{CC} is not connected.

BG V_{CC} and BG GND are the supply inputs for the bias generator.

The SN54FB2032 is characterized for operation over the full military temperature range of –55°C to 125°C. The SN74FB2032 is characterized for operation from 0°C to 70°C.

Function Tables

TRANSCEIVER

INPUTS			FUNCTION
OEA	OEB	$\overline{OEB}$	
L	H	L	$\overline{A}$ data to B bus
H	L	X	$\overline{B}$ data to A bus
H	X	H	
H	H	L	$\overline{A}$ data to B bus, $\overline{B}$ data to A bus
L	L	X	Isolation
L	X	H	

WIN

INPUTS				WIN
OEB	$\overline{OEB}$	$\overline{COMPETE}$	DATA A1, A2†	
H	H	X	X	L
H	L	H	X	L
H	L	L	A1 < A2	L
H	L	L	A2 ≤ A1	H

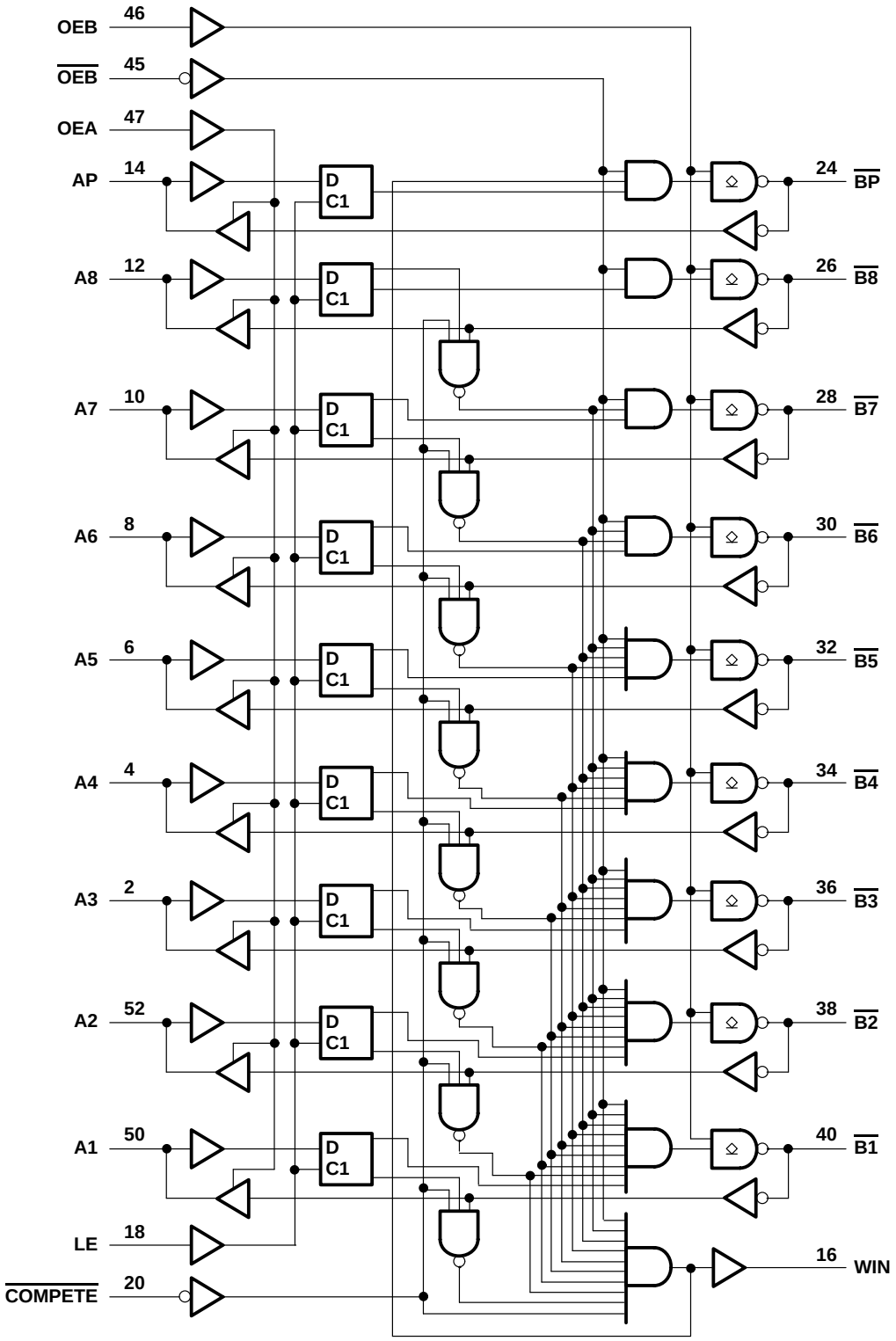
† A1 refers to the A data of Module 1 and A2 refers to the A data of Module 2. If LE = L, A = current A data. If LE = H, A = the value of A8–A1 prior to the most recent low-to-high transition of LE.

$\overline{BP}$

INPUTS				$\overline{BP}$
OEB	$\overline{OEB}$	WIN	AP‡	
L	X	X	X	H
X	H	X	X	H
H	L	L	X	H
H	L	H	L	H
H	L	H	H	L

‡ If LE = L, AP = current AP data. If LE = H, AP = the level of AP prior to the most recent low-to-high transition of LE.

functional block diagram



Pin numbers shown are for the RC package.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V_{CC} . . . . . –0.5 V to 7 V
Input voltage range, V_I: Except $\overline{BP}$, $\overline{B}$ port . . . . . –1.2 V to 7 V
$\overline{BP}$, $\overline{B}$ port . . . . . –1.2 V to 3.5 V
Voltage range applied to any $\overline{B}$ output in the disabled or power-off state, V_O . . . . . –0.5 V to 3.5 V
Voltage range applied to any output in the high state, V_O . . . . . –0.5 V to V_{CC}
Input clamp current, I_{IK}: Except $\overline{B}$ port . . . . . –40 mA
$\overline{B}$ port . . . . . –18 mA
Current applied to any single output in the low state, I_O: A port . . . . . 48 mA
$\overline{B}$ port . . . . . 200 mA
Package thermal impedance, θ_{JA} (see Note 1): RC package . . . . . 79°C/W
Storage temperature range, T_{stg} . . . . . –65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: The package thermal impedance is calculated in accordance with JESD 51.

recommended operating conditions (see Note 2)

			SN54FB2032			SN74FB2032			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}, BIAS V_{CC}, BG V_{CC}	Supply voltage		4.5	5	5.5	4.5	5	5.5	V
V_{IH}	High-level input voltage	$\overline{BP}$, $\overline{B}$ port*	1.62		2.3	1.62		2.3	V
		Except $\overline{B}$ port	2			2			
V_{IL}	Low-level input voltage	$\overline{BP}$, $\overline{B}$ port*	0.75		1.47	0.75		1.47	V
		Except $\overline{B}$ port			0.8			0.8	
I_{IK}	Input clamp current				–18			–18	mA
I_{OH}	High-level output current	AP, WIN, A port			–3			–3	mA
I_{OL}	Low-level output current	AP, WIN, A port			24			24	mA
		$\overline{BP}$, $\overline{B}$ port			100			100	
T_A	Operating free-air temperature		–55		125	0		70	°C

* On products compliant to MIL-PRF-38535, this parameter is warranted but not production tested.

NOTE 2: Unused pins (input or I/O) must be held high or low to prevent them from floating.

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS		SN54FB2032			SN74FB2032			UNIT
				MIN	TYP†	MAX	MIN	TYP†	MAX	
V_{IK}	$\overline{BP}$, $\overline{B}$ port	V_{CC} = 4.5 V,	I_I = –18 mA			–1.2			–1.2	V
	Except $\overline{BP}$, $\overline{B}$ port	V_{CC} = 4.5 V,	I_I = –40 mA			–0.5			–0.5	
V_{OH}	AP, WIN, A port	V_{CC} = 4.5 V	I_{OH} = –1 mA		3.2					V
			I_{OH} = –3 mA	2.5	3.3		2.5	3.3		
V_{OL}	AP, WIN, A port	V_{CC} = 4.5 V	I_{OL} = 20 mA		0.31					V
			I_{OL} = 24 mA		0.35	0.55		0.35	0.5	
	$\overline{BP}$, $\overline{B}$ port	V_{CC} = 4.5 V	I_{OL} = 80 mA	0.75		1.15	0.75		1.1	
			I_{OL} = 100 mA						1.15	
I_I	Except $\overline{BP}$, $\overline{B}$ port	V_{CC} = 5.5 V,	V_I = 5.5 V			50			50	µA
I_{IH}‡	Except $\overline{BP}$, $\overline{B}$ port	V_{CC} = 5.5 V,	V_I = 2.7 V			50			50	µA
I_{IL}‡	Except $\overline{BP}$, $\overline{B}$ port	V_{CC} = 5.5 V,	V_I = 0.5 V			–50			–50	µA
	$\overline{BP}$, $\overline{B}$ port	V_{CC} = 5.5 V,	V_I = 0.75 V			–100			–100	
I_{OZH}	AP, WIN, A port	V_{CC} = 2.1 V to 5.5 V,	V_O = 2.7 V						50	mA
I_{OZL}	AP, WIN, A port	V_{CC} = 2.1 V to 5.5 V,	V_O = 0.5 V						–50	mA
I_{OZPU}§	AP, WIN, A port	V_{CC} = 0 V to 2.1 V,	V_O = 0.5 V to 2.7 V						50	mA
I_{OZPD}§	AP, WIN, A port	V_{CC} = 2.1 V to 0 V,	V_O = 0.5 V to 2.7 V						–50	mA
I_{OH}	$\overline{BP}$, $\overline{B}$ port	V_{CC} = 0 to 5.5 V,	V_O = 2.1 V			200			100	µA
I_{OS}¶	AP, WIN, A port	V_{CC} = 5.5 V,	V_O = 0	–30		–150	–30		–150	mA
I_{CC}	A port to $\overline{B}$ port	V_{CC} = 5.5 V,	I_O = 0			65			55	mA
	$\overline{B}$ port to A port					70			65	
C_i	Control Inputs	V_I = 0.5 V or 2.5 V			4			4		pF
C_o	WIN port	V_O = 0.5 V or 2.5 V			8			8		pF
C_{io}§	A port	V_O = 0.5 V to 2.5 V			7			7		pF
	$\overline{B}$ port per IEEE Std 1194.1-1991	V_{CC} = 0 V to 5.5 V							5	

† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ For I/O ports, the parameters I_{IH} and I_{IL} include the off-state output current.
§ This parameter is warranted but not production tested.
¶ Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed one second.

live-insertion specifications over recommended operating free-air temperature range

PARAMETER		TEST CONDITIONS			SN54FB2032		SN74FB2032		UNIT
					MIN	MAX	MIN	MAX	
I_{CC} (BIAS V_{CC})		V_{CC} = 0 to 4.5 V	V_B = 0 to 2 V,	V_I (BIAS V_{CC}) = 4.5 V to 5.5 V		450		450	µA
		V_{CC} = 4.5 V to 5.5 V				10		10	
V_O*	$\overline{B}$ port	V_{CC} = 0,	V_I (BIAS V_{CC}) = 5 V		1.62	2.1	1.62	2.1	V
I_O	$\overline{B}$ port	V_{CC} = 0 ,	V_B = 1 V,	V_I (BIAS V_{CC}) = 4.5 V to 5.5 V	–30		–1		µA
		V_{CC} = 0 to 5.5 V,	OEB = 0 to 0.8 V			140		100	
		V_{CC} = 0 to 2.2 V,	OEB = 0 to 5 V			100		100	

* For the SN54FB2032, this parameter is for T_A = 25°C only.

timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 1)

			SN54FB2032			SN74FB2032			UNIT
			V_{CC} = 5 V, T_A = 25°C	MIN	MAX	V_{CC} = 5 V, T_A = 25°C	MIN	MAX	
			MIN MAX			MIN MAX			
t_w	Pulse duration, LE high or low		4.1	4.1		3.3	3.3		ns
t_{su}	Setup time	Data high before LE↑ (A to B)	2.3	2.3		1.5	1.5		ns
		Data low before LE↑	2.2	2.3		1.4	1.4		
		Data high before LE↑ (A to WIN)	2.7	2.7		1.9	1.9		
		Data low before LE↑	2.5	2.5		1.7	1.7		
t_h	Hold time	Data high before LE↑ (A to B)	2.5	2.5		1.7	1.7		ns
		Data low after LE↑	2.1	2.1		1.3	1.3		
		Data high before LE↑ (A to WIN)	2.4	2.5		1.6	1.6		
		Data low after LE↑	1.7	1.7		0.9	0.9		

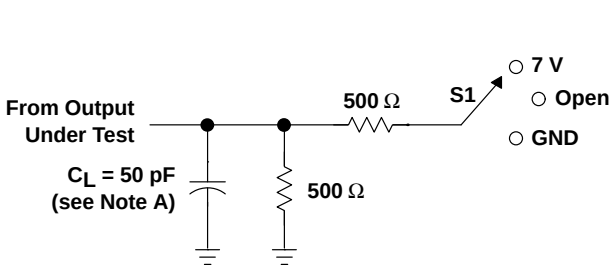
switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 1)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	SN54FB2032					UNIT
				V_{CC} = 5 V, T_A = 25°C			MIN	MAX	
				MIN	TYP	MAX			
t_{PLH}		A or AP	$\overline{B}$ or $\overline{BP}$	2.2	5.2	7.3	1.1	8.3	ns
t_{PHL}				1.8	4.9	6.9	1	8.3	
t_{PLH}		A	$\overline{B}_{n-1}$	1	5.6	9.2	0.7	10.9	ns
t_{PHL}				1.4	5.6	6.8	0.6	9.4	
t_{PLH}		A	$\overline{BP}$	1	6.6	6.2	1	10	ns
t_{PHL}				2.2	6.3	7.3	1.3	10	
t_{PLH}		$\overline{B}$	$\overline{B}_{n-1}$	0.3	8.4	10.8	1	11.4	ns
t_{PHL}				1.4	7.4	8.9	1.4	10	
t_{PLH}		LE	$\overline{B}$ or $\overline{BP}$	2.3	5.6	7.4	0.6	8.8	ns
t_{PHL}				2.8	5.1	7.8	1	8.8	
t_{PLH}		$\overline{B}$ or $\overline{BP}$	A or AP	2.8	5.3	7.6	1	8.9	ns
t_{PHL}				2.6	4.6	7.3	1.2	8.5	
t_{PLH}		$\overline{B}$	WIN	2.8	6	7.8	1.3	10.4	ns
t_{PHL}				4.4	6.6	8.8	1.1	10.4	
t_{PLH}		A	WIN	2.1	4.1	7.1	1.2	8.6	ns
t_{PHL}				2.3	4	7	1.4	9.8	
t_{PLH}		LE	WIN	1.2	4.4	8.8	1.1	8.6	ns
t_{PHL}				2.3	3.5	6.9	1.6	7.2	
t_{PLH}		$\overline{COMPETE}$	WIN	1.6	3.4	6.2	1.3	6.4	ns
t_{PHL}				1.7	3.4	6.5	1.3	7.2	
t_{PLH}		$\overline{OEB}$	WIN	1.7	3.5	5.7	1.4	7.7	ns
t_{PHL}				2	3.8	5.5	1.6	6.5	
t_{PLH}		$\overline{COMPETE}$	$\overline{B}$	2.6	5.2	7.3	1.7	8.9	ns
t_{PHL}				2.4	5.6	7.8	1.3	8.9	
t_{PLH}		$\overline{COMPETE}$	$\overline{BP}$	2.8	6.2	7	2.1	9.2	ns
t_{PHL}				3.1	5.7	7.1	2	8.9	
t_{PLH}		OEB	$\overline{B}$	2.4	5.3	7.4	1.6	9	ns
t_{PHL}				2.3	5.4	7.4	1.5	8	
t_{PLH}		$\overline{OEB}$	$\overline{B}$	3	6.7	8.3	1.7	9.3	ns
t_{PHL}				2.2	5.9	6.3	1.2	8.4	
t_{PZH}		OEA	A	1.9	4.3	6.7	1.4	9.6	ns
t_{PZL}				1.8	3.9	6.6	1.3	7.7	
t_{PHZ}		OEA	A	1.7	3.4	7.5	1.3	9.9	ns
t_{PLZ}				1.5	3.7	6.4	1.1	7.8	
$t_{sk(p)}$	Skew for any single channel $\lvert t_{PHL} - t_{PLH} \rvert$	A	$\overline{B}$		0.8				ns
		$\overline{B}$	A		0.5				
$t_{sk(o)}$	Skew between drivers in the same package	A	$\overline{B}$		0.8				ns
		$\overline{B}$	A		0.6				
t_r	Rise time, 1.3 V to 1.8 V, $\overline{B}$ outputs			0.5	2.2	3.2	0.5	4.2	ns
t_f	Fall time, 1.3 V to 1.8 V, $\overline{B}$ outputs			0.5	1.3	2.3	0.5	2.5	ns
$\overline{B}$-port input pulse rejection				1			1		ns

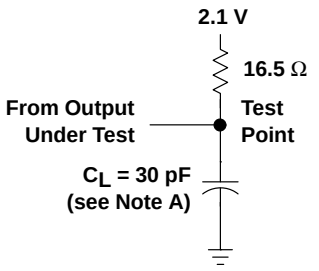
switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 1)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	SN74FB2032					UNIT
				V_{CC} = 5 V, T_A = 25°C			MIN	MAX	
				MIN	TYP	MAX			
t_{PLH}		A or AP	$\overline{B}$ or $\overline{BP}$	2.9	5.2	6.5	2.7	7	ns
t_{PHL}				3	4.9	6.3	2.8	6.6	
t_{PLH}		A	$\overline{B}_{n-1}$	3.1	5.6	7.4	2.5	8.4	ns
t_{PHL}				3.4	5.6	7.4	3.2	9	
t_{PLH}		A	$\overline{BP}$	4.5	6.6	8.1	4	8.9	ns
t_{PHL}				4.1	6.3	7.7	3.8	8.4	
t_{PLH}		$\overline{B}$	$\overline{B}_{n-1}$	5.5	8.4	10.8	4.8	11.4	ns
t_{PHL}				5.5	7.4	8.9	4.9	10	
t_{PLH}		LE	$\overline{B}$ or $\overline{BP}$	3.7	5.6	6.8	3.4	7.3	ns
t_{PHL}				3.5	5.1	6.1	3.1	6.8	
t_{PLH}		$\overline{B}$ or $\overline{BP}$	A or AP	3	5.3	7	2.9	7.2	ns
t_{PHL}				2.8	4.6	5.9	2	6.1	
t_{PLH}		$\overline{B}$	WIN	4	6	7.2	3.4	8.2	ns
t_{PHL}				4.2	6.6	8.6	3.9	8.9	
t_{PLH}		A	WIN	1.9	4.1	5.4	1.7	5.9	ns
t_{PHL}				1.9	4	5.3	1.6	6	
t_{PLH}		LE	WIN	2.4	4.4	5.7	2.1	6.4	ns
t_{PHL}				1.9	3.5	4.5	1.6	4.9	
t_{PLH}		$\overline{COMPETE}$	WIN	1.6	3.4	4.5	1.3	5	ns
t_{PHL}				1.7	3.4	4.4	1.5	4.9	
t_{PLH}		$\overline{OEB}$	WIN	1.7	3.5	4.7	1.4	5.4	ns
t_{PHL}				2.2	3.8	4.7	2	5	
t_{PLH}		$\overline{COMPETE}$	$\overline{B}$	3.2	5.2	6.6	2.7	7.3	ns
t_{PHL}				3.8	5.6	6.7	3.5	7.3	
t_{PLH}		$\overline{COMPETE}$	$\overline{BP}$	3.9	6.2	7.6	3.8	7.8	ns
t_{PHL}				3.9	5.7	7	3.4	7.8	
t_{PLH}		OEB	$\overline{B}$	3.1	5.3	6.7	2.9	7.3	ns
t_{PHL}				3.4	5.4	6.7	3.2	7.2	
t_{PLH}		$\overline{OEB}$	$\overline{B}$	4.6	6.7	8.1	4.4	8.6	ns
t_{PHL}				3.7	5.9	8.1	3.4	8.9	
t_{PZH}		OEA	A	2.5	4.3	6	2.2	6.3	ns
t_{PZL}				2.2	3.9	5.3	2.2	5.8	
t_{PHZ}		OEA	A	1.7	3.4	4.9	1.3	5.5	ns
t_{PLZ}				1.9	3.7	5.4	1.7	5.7	
$t_{sk(p)}$	Skew for any single channel $\lvert t_{PHL} - t_{PLH} \rvert$	A	$\overline{B}$		0.8				ns
		$\overline{B}$	A		0.5				
$t_{sk(o)}$	Skew between drivers in the same package	A	$\overline{B}$		0.8				ns
		$\overline{B}$	A		0.6				
t_r	Rise time, 1.3 V to 1.8 V, $\overline{B}$ outputs			1	2.2	3.2	1	3.2	ns
t_f	Fall time, 1.3 V to 1.8 V, $\overline{B}$ outputs			1	1.3	2.3	1	2.5	ns
$\overline{B}$-port input pulse rejection				1			1		ns

PARAMETER MEASUREMENT INFORMATION

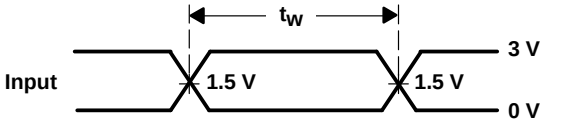


LOAD CIRCUIT FOR A OUTPUTS

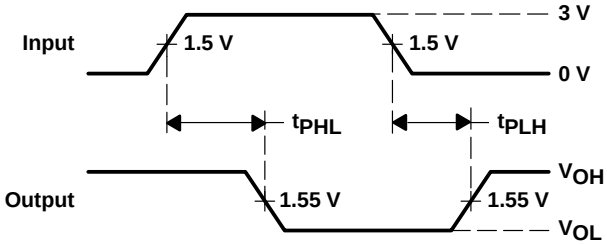


TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open

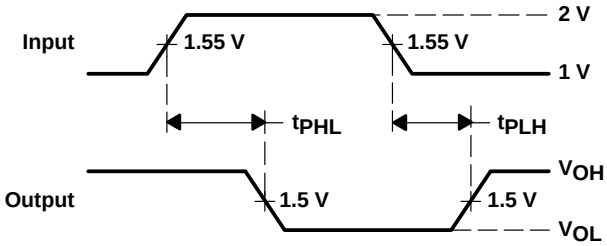
LOAD CIRCUIT FOR B OUTPUTS



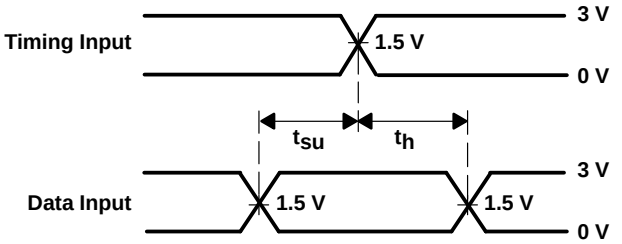
VOLTAGE WAVEFORMS
PULSE DURATION



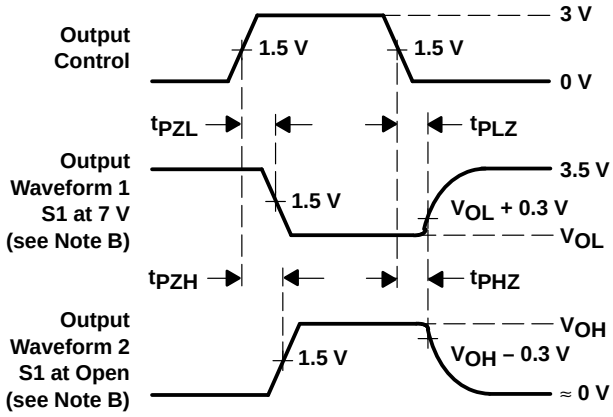
VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES (A TO B)



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES (B TO A)



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES (A PORT)

NOTES: A. C_L includes probe and jig capacitance.
B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
C. All input pulses are supplied by generators having the following characteristics: TTL inputs: PRR ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 2.5 ns; BTL inputs: PRR ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 2.5 ns.
D. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuits and Voltage Waveforms

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