



Integrated Device Technology, Inc.

PARALLEL SyncBiFIFO™
(CLOCKED BIDIRECTIONAL FIFO)
256 x 18-BIT AND 512 x 18-BIT

PRELIMINARY
IDT72605
IDT72615

T-46-35

FEATURES:

- Two independent FIFO memories for fully bidirectional data transfers
- 256 x 18 organization (IDT 72605)
- 512 x 18 organization (IDT 72615)
- Synchronous interface for fast (25ns) read and write cycle times
- Each data port has an independent clock and read/write control
- Output enable is provided on each port as a three-state control of the data bus
- Built-in bypass path for direct data transfer between two ports
- Two fixed flags, Empty and Full, for both the A-to-B and the B-to-A FIFO
- Programmable flag offset can be set to any depth in the FIFO
- The synchronous BiFIFO is packaged in a 68-pin PGA and PLCC
- Military product compliant to MIL-STD-883, Class B

DESCRIPTION:

The IDT72605 and IDT72615 are very high speed, low power bidirectional FIFO memories with synchronous interface

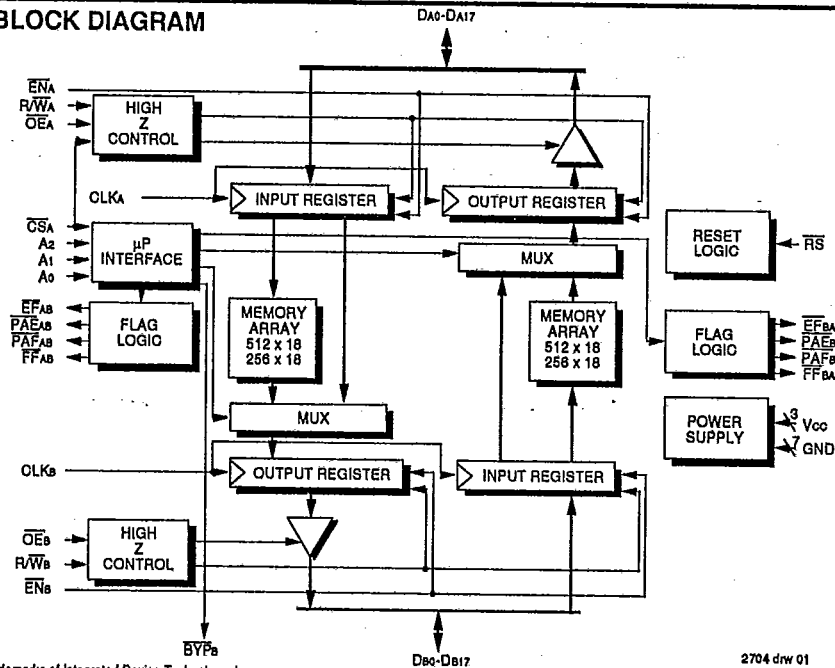
for fast read and write cycle times. The SyncBiFIFO™ is a data buffer that can store or retrieve information from two sources simultaneously. Two dual-port FIFO memory arrays are contained in the SyncBiFIFO; one data buffer for each direction.

The SyncBiFIFO has registers on all inputs and outputs. Data is only transferred into the I/O registers on clock edges, hence the interfaces are synchronous. Each Port has its own independent clock. Data transfers to the I/O registers are gated by the enable signals. The transfer direction for each port is controlled independently by a read/write signal. Individual output enable signals control whether the SyncBiFIFO is driving the data lines of a port or whether those data lines are in a high impedance state.

Bypass control allows data to be directly transferred from input to output register in either direction.

The SyncBiFIFO has eight flags. The flag pins are full, empty, almost-full, and almost-empty for both FIFO memories. The offset depths of the almost-full and almost-empty flags can be programmed to any location.

The SyncBiFIFO is fabricated using IDT's high speed submicron CEMOS™ technology. Military grade product is manufactured in compliance with the latest revision of MIL-STD-883, Class B.

FUNCTIONAL BLOCK DIAGRAM

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MILITARY AND COMMERCIAL TEMPERATURE RANGES**APRIL 1992**

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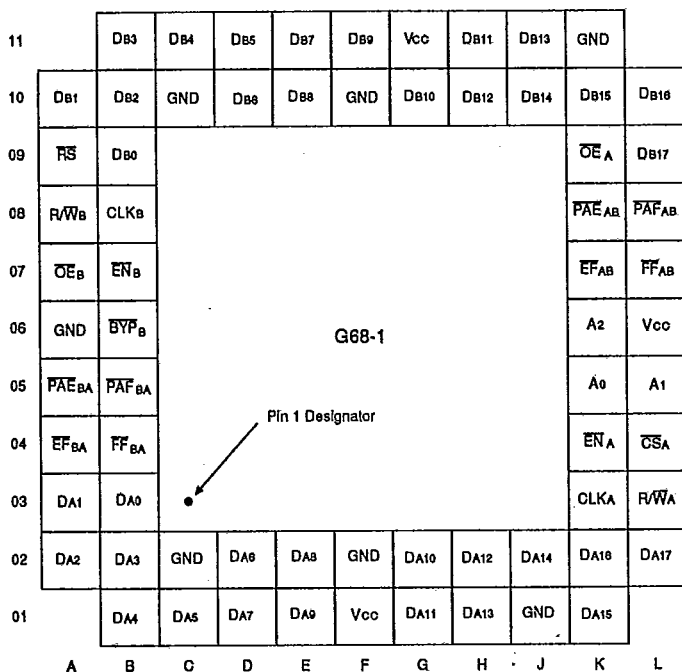
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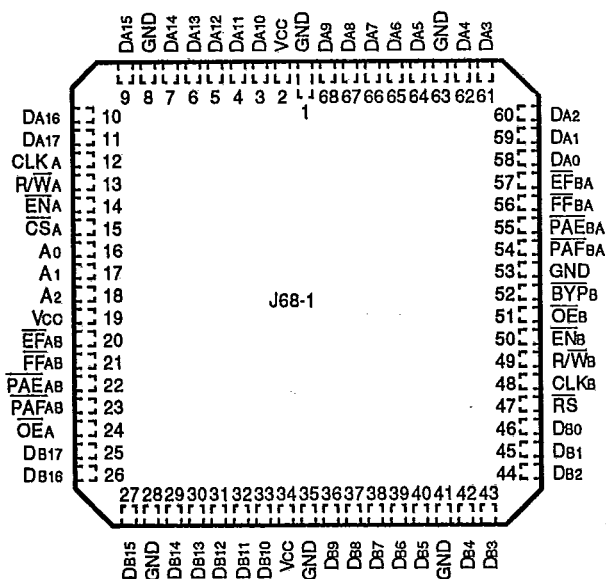
PIN CONFIGURATIONS

T-46-35



PGA
Top View

2704 drw 02



PLCC
Top View

2704 drw 03

PIN DESCRIPTION

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Symbol	Name	I/O	Description
DA0-DA17	Data A	I/O	Data inputs & outputs for the 18-bit Port A bus.
$\overline{CSA}$	Chip Select A	I	Port A is accessed when $\overline{CSA}$ is LOW. Port A is inactive if $\overline{CSA}$ is HIGH.
R/WA	Read/Write A	I	This pin controls the read or write direction of Port A. If R/WA is LOW, Data A input data is written into Port A. If R/WA is HIGH, Data A output data is read from Port A. In bypass mode, when R/WA is LOW, message is written into A→B output register. If R/WA is HIGH, message is read from B→A output register.
CLKA	Clock A	I	CLKA is typically a free running clock. Data is read or written into Port A on the rising edge of CLKA.
$\overline{ENA}$	Enable A	I	When $\overline{ENA}$ is LOW, data can be read or written to Port A. When $\overline{ENA}$ is HIGH, no data transfers occur.
$\overline{OEA}$	Output Enable A	I	When R/WA is HIGH, Port A is an output bus and $\overline{OEA}$ controls the high impedance state of DA0-DA17. If $\overline{OEA}$ is HIGH, Port A is in a high impedance state. If $\overline{OEA}$ is LOW while $\overline{CSA}$ is LOW and R/WA is HIGH, Port A is in an active (low impedance) state.
A0, A1, A2	Addresses	I	When $\overline{CSA}$ is asserted, A0, A1, A2 and R/WA are used to select one of six internal resources.
DB0-DB17	Data B	I/O	Data inputs & outputs for the 18-bit Port B bus.
R/WB	Read/Write B	I	This pin controls the read or write direction of Port B. If R/WB is LOW, Data B input data is written into Port B. If R/WB is HIGH, Data B output data is read from Port B. In bypass mode, when R/WB is LOW, message is written into A→B output register. If R/WB is HIGH, message is read from B→A output register.
CLKB	Clock B	I	Clock B is typically a free running clock. Data is read or written into Port B on the rising edge of CLKB.
$\overline{ENB}$	Enable B	I	When $\overline{ENB}$ is LOW, data can be read or written to Port B. When $\overline{ENB}$ is HIGH, no data transfers occur.
$\overline{OEB}$	Output Enable B	I	When R/WB is HIGH, Port B is an output bus and $\overline{OEB}$ controls the high impedance state of DB0-DB17. If $\overline{OEB}$ is HIGH, Port B is in a high impedance state. If $\overline{OEB}$ is LOW while R/WB is HIGH, Port B is in an active (low impedance) state.
$\overline{EFAB}$	A→B Empty Flag	O	When $\overline{EFAB}$ is LOW, the A→B FIFO is empty and further data reads from Port B are inhibited. When $\overline{EFAB}$ is HIGH, the FIFO is not empty. $\overline{EFAB}$ is synchronized to CLKB. In the bypass mode, $\overline{EFAB}$ HIGH indicates that data DA0-DA17 is available for passing through. After the data DB0-DB17 has been read, $\overline{EFAB}$ goes LOW.
$\overline{PAEAB}$	A→B Programmable Almost-Empty Flag	O	When $\overline{PAEAB}$ is LOW, the A→B FIFO is almost empty. An almost empty FIFO contains less than or equal to the offset programmed into $\overline{PAEAB}$ Register. When $\overline{PAEAB}$ is HIGH, the A→B FIFO contains more than offset in $\overline{PAEAB}$ Register. The default offset value for $\overline{PAEAB}$ Register is 8. $\overline{PAEAB}$ is synchronized to CLKB.
$\overline{PAFAB}$	A→B Programmable Almost-Full Flag	O	When $\overline{PAFAB}$ is LOW, the A→B FIFO is almost full. An almost full FIFO contains greater than the FIFO depth minus the offset programmed into $\overline{PAFAB}$ Register. When $\overline{PAFAB}$ is HIGH, the A→B FIFO contains less than or equal to the depth minus the offset in $\overline{PAFAB}$ Register. The default offset value for $\overline{PAFAB}$ Register is 8. $\overline{PAFAB}$ is synchronized to CLKB.
$\overline{FFAB}$	A→B Full Flag	O	When $\overline{FFAB}$ is LOW, the A→B FIFO is full and further data writes into Port A are inhibited. When $\overline{FFAB}$ is HIGH, the FIFO is not full. $\overline{FFAB}$ is synchronized to CLKA. In bypass mode, $\overline{FFAB}$ tells Port A that a message is waiting in Port B's output register. If $\overline{FFAB}$ is LOW, a bypass message is in the register. If $\overline{FFAB}$ is HIGH, Port B has read the message and another message can be written into Port A.
$\overline{EFBA}$	B→A Empty Flag	O	When $\overline{EFBA}$ is LOW, the B→A FIFO is empty and further data reads from Port A are inhibited. When $\overline{EFBA}$ is HIGH, the FIFO is not empty. $\overline{EFBA}$ is synchronized to CLKA. In the bypass mode, $\overline{EFBA}$ HIGH indicates that data DB0-DB17 is available for passing through. After the data DA0-DA17 has been read, $\overline{EFBA}$ goes LOW on the following cycle.
$\overline{PAEBA}$	B→A Programmable Almost-Empty Flag	O	When $\overline{PAEBA}$ is LOW, the B→A FIFO is almost empty. An almost empty FIFO contains less than or equal to the offset programmed into $\overline{PAEBA}$ Register. When $\overline{PAEBA}$ is HIGH, the B→A FIFO contains more than offset in $\overline{PAEBA}$ Register. The default offset value for $\overline{PAEBA}$ Register is 8. $\overline{PAEBA}$ is synchronized to CLKA.
$\overline{PAFBA}$	B→A Programmable Almost-Full Flag	O	When $\overline{PAFBA}$ is LOW, the B→A FIFO is almost full. An almost full FIFO contains greater than the FIFO depth minus the offset programmed into $\overline{PAFBA}$ Register. When $\overline{PAFBA}$ is HIGH, the B→A FIFO contains less than or equal to the depth minus the offset in $\overline{PAFBA}$ Register. The default offset value for $\overline{PAFBA}$ Register is 8. $\overline{PAFBA}$ is synchronized to CLKB.

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PIN DESCRIPTION (Continued)

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Symbol	Name	I/O	Description
FFBA	B→A Full Flag	O	When FFBA is LOW, the B→A FIFO is full and further data writes into Port B are inhibited. When FFBA is HIGH, the FIFO is not full. FFBA is synchronized to CLKb. In bypass mode, FFBA tells Port B that a message is waiting in Port A's output register. If FFBA is LOW, a bypass message is in the register. If FFBA is HIGH, Port A has read the message and another message can be written into Port B.
BYPb	Port B Bypass Flag	O	This flag informs Port B that the Synchronous BiFIFO is in bypass mode. When BYPb is LOW, Port A has placed the FIFO into bypass mode. If BYPb is HIGH, the Synchronous BiFIFO passes data into memory. BYPb is synchronized to CLKb.
RS	Reset	I	A LOW on this pin will perform a reset of all Synchronous BiFIFO functions.
Vcc	Power		There are three +5V power pins.
GND	Ground		There are seven Ground pins at 0V.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

Symbol	Rating	Com'l.	Mil.	Unit
VTERM	Terminal Voltage with Respect to Ground	-0.5 to +7.0	-0.5 to +7.0	V
TA	Operating Temperature	0 to +70	-55 to +125	°C
TBIAS	Temperature Under Bias	-55 to +125	-65 to +135	°C
TSTG	Storage Temperature	-55 to +125	-65 to +150	°C
IOUT	DC Output Current	50	50	mA

NOTE:

1. Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

RECOMMENDED DC OPERATING CONDITIONS

Symbol	Parameter	Min.	Typ.	Max.	Unit
VCCM	Military Supply Voltage	4.5	5.0	5.5	V
VCCc	Commercial Supply Voltage	4.5	5.0	5.5	V
GND	Supply Voltage	0	0	0	V
VIH	Input High Voltage Commercial	2.0	—	—	V
VIH	Input High Voltage Military	2.2	—	—	V
VIL ⁽¹⁾	Input Low Voltage Commercial and Military	—	—	0.8	V

NOTE:
1. 1.5V undershoots are allowed for 10ns once per cycle.

CAPACITANCE (TA = +25°C, f = 1.0MHz)

Symbol	Parameter	Conditions	Max.	Unit
CIN ⁽²⁾	Input Capacitance	VIN = 0V	10	pF
COUT ^(1,2)	Output Capacitance	VOUT = 0V	10	pF

NOTES:
1. With output deselected.
2. Characterized values, not currently tested.

DC ELECTRICAL CHARACTERISTICS

(Commercial: Vcc = 5V ± 10%, TA = 0°C to +70°C; Military: Vcc = 5V ± 10%, TA = -55°C to +125°C)

Symbol	Parameter	IDT72615L IDT72605L Commercial tCLK = 25, 35, 50ns			IDT72615L IDT72605L Military tCLK = 30, 35, 50ns			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
IIL ⁽¹⁾	Input Leakage Current (Any Input)	-1	—	1	-10	—	10	µA
IOL ⁽²⁾	Output Leakage Current	-10	—	10	-10	—	10	µA
VOH	Output Logic "1" Voltage IOUT = -2mA	2.4	—	—	2.4	—	—	V
VOL	Output Logic "0" Voltage IOUT = 8mA	—	—	0.4	—	—	0.4	V
ICC ⁽³⁾	Average Vcc Power Supply Current	—	—	230	—	—	250	mA

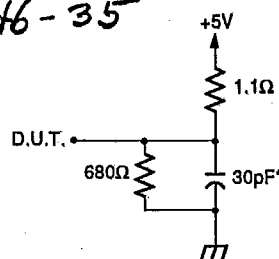
NOTES:
1. Measurements with 0.4V ≤ VIN ≤ Vcc.
2. OE ≥ VIH; 0.4 ≤ VOUT ≤ Vcc.
3. Tested with outputs open. Testing frequency f=20MHz

AC TEST CONDITIONS

In Pulse Levels	GND to 3.0V
Input Rise/Fall Times	3ns
Input Timing Reference Levels	1.5V
Output Reference Levels	1.5V
Output Load	See Figure 2

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or equivalent circuit 2704 drw 05

Figure 2. Output Load

* Includes jig and scope capacitances.

AC ELECTRICAL CHARACTERISTICS

(Commercial: $V_{CC} = 5V \pm 10\%$, $T_A = 0^\circ C$ to $+70^\circ C$; Military: $V_{CC} = 5V \pm 10\%$, $T_A = -55^\circ C$ to $+125^\circ C$)

Symbol	Parameter	Com'l.		Mil.		Com'l. and Mil.		Unit	Timing Figures		
		IDT72615L25 IDT72605L25		IDT72615L30 IDT72605L30		IDT72615L35 IDT72605L35					
		Min.	Max.	Min.	Max.	Min.	Max.				
fCLK	Clock frequency	—	40	—	33	—	28	—	20	MHz	—
tCLK	Clock cycle time	25	—	30	—	35	—	50	—	ns	4,5,6,7
tCLKH	Clock high time	10	—	12	—	14	—	20	—	ns	4,5,6,7,12,13,14,15
tCLKL	Clock low time	10	—	12	—	14	—	20	—	ns	4,5,6,7,12,13,14,15
tRS	Reset pulse width	25	—	30	—	35	—	50	—	ns	3
tRSS	Reset set-up time	15	—	18	—	21	—	30	—	ns	3
tRSR	Reset recovery time	15	—	18	—	21	—	30	—	ns	3
tRSF	Reset to flags in initial state	—	25	—	30	—	35	—	50	ns	3
tA	Data access time	3	15	3	18	3	21	3	25	ns	5,7,8,9,10,11
tCS	Control signal set-up time ⁽¹⁾	6	—	7	—	8	—	10	—	ns	4,5,6,7,8,9,10,11,12,13,14,15
tCH	Control signal hold time ⁽¹⁾	1	—	1	—	1	—	1	—	ns	4,5,6,7,10,11,12,13,14,15
tDS	Data set-up time	6	—	7	—	8	—	10	—	ns	4,6,8,9,10,11
tDH	Data hold time	1	—	1	—	1	—	1	—	ns	4,6
tOE	Output Enable LOW to output data valid ⁽²⁾	3	13	3	16	3	20	3	28	ns	5,7,8,9,10,11
tOLZ	Output Enable LOW to data bus at low Z ⁽²⁾	0	—	0	—	0	—	0	—	ns	5,7,8,9,10,11
tOHZ	Output Enable HIGH to data bus at high Z ⁽²⁾	3	13	3	16	3	20	3	28	ns	5,7,10,11
tFF	Clock to Full Flag time	—	15	—	18	—	21	—	30	ns	4,6,10,11
tEF	Clock to Empty Flag time	—	15	—	18	—	21	—	30	ns	5,7,8,9,10,11
tPAE	Clock to Programmable Almost Empty Flag time	—	15	—	18	—	21	—	30	ns	12,14
tPAF	Clock to Programmable Almost Full Flag time	—	15	—	18	—	21	—	30	ns	13,15
tSKEW1	Skew between CLK _A & CLK _B for Empty/Full Flags ⁽²⁾	12	—	15	—	17	—	20	—	ns	4,5,6,7,8,9,10,11
tSKEW2	Skew between CLK _A & CLK _B for Programmable Flags ⁽²⁾	19	—	22	—	25	—	34	—	ns	4,7,12,13,14,15

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NOTES

- Control signals refer to $\overline{CS}_A$, $R/\overline{W}_A$, $\overline{EN}_A$, A_2 , A_1 , A_0 , $R/\overline{W}_B$, $\overline{EN}_B$.
- Minimum values are guaranteed by design.

FUNCTIONAL DESCRIPTION

IDT's SyncBiFIFO is versatile for both multiprocessor and peripheral applications. Data can be stored or retrieved from two sources simultaneously.

The SyncBiFIFO has registers on all inputs and outputs. Data is only transferred into the I/O registers on clock edges, hence the interfaces are synchronous. Two dual-port FIFO memory arrays are contained in the SyncBiFIFO; one data buffer for each direction. Each Port has its own independent clock. Data transfers to the I/O registers are gated by the enable signals. The transfer direction for each port is controlled independently by a read/write signal. Individual output enable signals control whether the SyncBiFIFO is driving the data lines of a port or whether those data lines are in a high impedance state. The processor connected to Port A of the BiFIFO can send or receive messages directly to the Port B device using the 18-bit bypass path.

The SyncBiFIFO can be used in multiples of 18-bits. In a 36- to 36-bit configuration, two SyncBiFIFOs operate in parallel. Both devices are programmed simultaneously, 18 data bits to each device. This configuration can be extended to wider bus widths (54- to 54-bits, 72- to 72-bits, etc.) by adding more SyncBiFIFOs to the configuration. Figure 1 shows multiple SyncBiFIFOs configured for multiprocessor communication.

The microprocessor or microcontroller connected to Port A controls all operations of the SyncBiFIFO. Thus, all Port A interface pins are inputs driven by the controlling processor. Port B interfaces with a second processor. The Port B control pins are inputs driven by the second processor.

RESET

Reset is accomplished whenever the Reset ($\overline{RS}$) input is taken to a low state with $\overline{CSA}$, $\overline{ENA}$ and $\overline{ENB}$ HIGH. During reset, both internal read and write pointers are set to the first location. A reset is required after power up before a write operation can take place. The A→B and B→A FIFO Empty Flags ($\overline{EFAB}$, $\overline{EFBA}$) and Programmable Almost Empty Flags ($\overline{PAEAB}$, $\overline{PAEBA}$) will be set to low after $\overline{trsf}$. The A→B and B→A FIFO Full Flags ($\overline{FFAB}$, $\overline{FFBA}$) and Programmable Almost Full Flags ($\overline{PAFAB}$, $\overline{PAFBA}$) will be set to high after $\overline{trsf}$. After the reset, the offsets of the Almost-Empty Flags and Almost-Full Flags for the A→B and B→A FIFO offset default to 8.

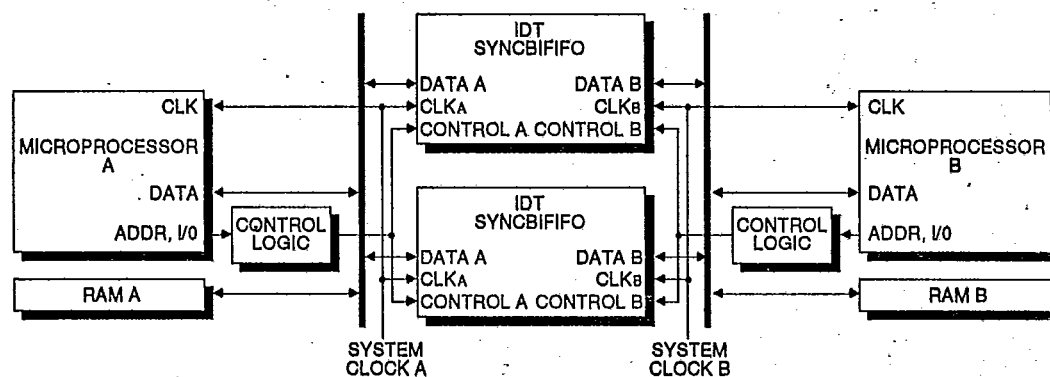
PORT A INTERFACE

The SyncBiFIFO™ is straightforward to use in microprocessor-based systems because each port has a standard microprocessor control set. Port A interfaces with microprocessor through the three address pins (A_2 - A_0) and a Chip Select $\overline{CSA}$ pins. When $\overline{CSA}$ is asserted, A_2 , A_1 , A_0 and $\overline{RWA}$ are used to select one of six internal resources (Table 1).

With $A_2=0$ and $A_1=0$, A_0 determines whether data can be read out of output register or be written into the FIFO ($A_0=0$), or the data can pass through the FIFO through the bypass path ($A_0=1$).

With $A_2=1$, four programmable flags (two A→B FIFO programmable flags and two B→A FIFO programmable flags) can be selected: the A→B FIFO Almost-Empty Flag Offset ($A_1=0$, $A_0=0$), A→B FIFO Almost-Full Flag Offset ($A_1=0$, $A_0=1$), B→A FIFO Almost-Empty Flag Offset ($A_1=1$, $A_0=0$), B→A FIFO Almost-Full Flag Offset ($A_1=1$, $A_0=1$).

Port A is disabled when $\overline{CSA}$ is deasserted and data A is in high impedance state.



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NOTES:

- Upper SyncBiFIFO only is used in 18- to 18-bit configuration.
- Control A Consists of $\overline{RWA}$, $\overline{ENA}$, $\overline{OEa}$, $\overline{CSA}$, A_2 , A_1 , A_0 . Control B consists of $\overline{RWB}$, $\overline{ENb}$, $\overline{OEb}$.

Figure 1. 36- to 36-bit Processor Interface Configuration

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$\overline{CSA}$	R/WA	$\overline{ENA}$	$\overline{OE_A}$	Data A I/O	Port A Operation
0	0	0	0	I	Data A is written on CLK _A ↑. This write cycle immediately following low impedance cycle is prohibited.
0	0	0	1	I	Data A is written on CLK _A ↑.
0	0	1	X	I	Data A is ignored
0	1	0	0	O	Data is read ⁽¹⁾ from RAM array to output register on CLK _A ↑, Data A is low impedance
0	1	0	1	O	Data is read ⁽¹⁾ from RAM array to output register on CLK _A ↑, Data A is high impedance
0	1	1	0	O	Output register does not change ⁽²⁾ , Data A is low impedance
0	1	1	1	O	Output register does not change ⁽²⁾ , Data A is high impedance
1	0	X	X	I	Data A is ignored ⁽³⁾
1	1	X	X	O	Data A is high impedance ⁽³⁾

NOTES

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- When $AzA1A0 = 000$, the next B→A FIFO value is read out of the output register and the read pointer advances. If $AzA1A0 = 001$, the bypass path is selected and bypass data from the Port B input register is read from the Port A output register. If $AzA1A0 = 1XX$, a flag offset register is selected and its offset is read out through Port A output register.
- Regardless of the condition of $AzA1A0$, the data in the Port A output register does not change and the B→A read pointer does not advance.
- If $\overline{CSA}$ is HIGH, then $\overline{BYPB}$ is HIGH. No bypass occur under this condition.

Table 1. Port A Operation Control Signals

BYPASS PATH

The bypass paths provide direct communication between Port A and Port B. There are two full 18-bit bypass paths, one in each direction. During a bypass operation, data is passed directly between the input and output registers, and the FIFO memory is undisturbed.

Port A initiates and terminates all bypass operations. The bypass flag, $\overline{BYPB}$, is asserted to inform Port B that a bypass operation is beginning. The bypass flag state is controlled by the Port A controls, although the $\overline{BYPB}$ signal is synchronized to CLK_B. So, $\overline{BYPB}$ is asserted on the next rising edge of CLK_B when $AzA1A0=001$ and $\overline{CSA}$ is Low. When Port A returns to normal FIFO mode ($AzA1A0=000$ or $\overline{CSA}$ is High), $\overline{BYPB}$ is deasserted on the next CLK_B rising edge.

Once the SyncBiFIFO is in bypass mode, all data transfers are controlled by the standard Port A (R/WA, CLK_A, $\overline{ENA}$, $\overline{OE_A}$) and Port B (R/WB, CLK_B, $\overline{ENB}$, $\overline{OEB}$) interface pins. Each bypass path can be considered as a one word deep FIFO. Data is held in each input register until it is read. Since the controls of each port operate independently, Port A can be reading bypass data at the same time Port B is reading bypass data.

When R/WA and $\overline{ENA}$ is LOW, data on pins DA0-DA17 is written into Port A input register. Following the rising edge of CLK_A for this write, the A→B Full Flag ($\overline{FFAB}$) goes LOW. Subsequent writes into Port A are blocked by internal logic until $\overline{FFAB}$ goes HIGH again. On the next CLK_B rising edge, the A→B Empty Flag ($\overline{EFAB}$) goes HIGH indicating to Port B that data is available. Once R/WB is HIGH and $\overline{ENB}$ is LOW, data is read into the Port B output register. $\overline{OEB}$ still controls whether Port B is in a high-impedance state. When $\overline{OEB}$ is LOW, the output register data appears at DB0-DB17. $\overline{EFAB}$ goes LOW following the CLK_B rising edge for this read. $\overline{FFAB}$ goes HIGH on the next CLK_A rising edge,

letting Port A know that another word can be written through the bypass path.

Bypass data transfers from Port B to Port A work in a similar manner with $\overline{EFBA}$ and $\overline{FFBA}$ indicating the Port A output register state.

When the Port A address changes from bypass mode ($AzA1A0=001$) to FIFO mode ($AzA1A0=000$) on the rising edge of CLK_A, the data held in the Port B output register may be overwritten. Unless Port A monitors the $\overline{BYPB}$ pin and waits for Port B to clock out the last bypass word, data from the A→B FIFO will overwrite data in the Port B output register. $\overline{BYPB}$ will go HIGH on the rising edge of CLK_B signifying that Port B has finished its last bypass operation. Port B must read any bypass data in the output register on this last CLK_B clock or it is lost and the SyncBiFIFO returns to FIFO operations. It is especially important to monitor $\overline{BYPB}$ when CLK_B is much slower than CLK_A to avoid this condition. $\overline{BYPB}$ will also go HIGH after $\overline{CSA}$ is brought HIGH; in this manner the Port B bypass data may also be lost.

Since the Port A processor controls $\overline{CSA}$ and the bypass mode, this scenario can be handled for B→A bypass data. The Port A processor must be set up to read the last bypass word before leaving bypass mode.

PORT A CONTROL SIGNALS

The Port A control signals pins dictate the various operations shown in Table 2. Port A is accessed when $\overline{CSA}$ is LOW, and is inactive if $\overline{CSA}$ is HIGH. R/WA and $\overline{ENA}$ lines determine when Data A can be written or read. If R/WA and $\overline{ENA}$ are LOW, data is written into input register on the low-to-high transition of CLK_A. If R/WA is HIGH and $\overline{OE_A}$ is LOW, data comes out of bus and is read from output register into three-state buffer. Refer to pin descriptions for more information.

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CSA	A2	A1	A0	Read	Write
0	0	0	0	B→A FIFO	A→B FIFO
0	0	0	1	18-bit Bypass Path	
0	1	0	0	A→B FIFO Almost-Empty Flag Offset	
0	1	0	1	A→B FIFO Almost-Full Flag Offset	
0	1	1	0	B→A FIFO Almost-Empty Flag Offset	
0	1	1	1	B→A FIFO Almost-Full Flag Offset	
1	X	X	X	Port A Disabled	

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Table 2. Accessing Port A Resources Using CSA, A2, A1, and A0

PROGRAMMABLE FLAGS

The IDT SyncBIFIFO has eight flags: four flags for A→B FIFO (EFAb, PAEAb, PAFAb, FFAb), and four flags for B→A FIFO (EFBA, PAEBa, PAFBA, FFBA). The Empty and Full flags are fixed, while the Almost Empty and Almost Full offsets can be set to any depth through the Flag Offset Registers (see Table 3). The flags are asserted at the depths shown in the Flag Truth Table (Table 4). After reset, the programmable flag offsets are set to 8. This means the Almost Empty flags are asserted at Empty + 8

words deep, and the Almost Full flags are asserted at Full - 8 words deep.

The PAEAb is synchronized to CLKb, while PAFAb is synchronized to CLKA; and PAEBa is synchronized to CLKA, while PAFBA is synchronized to CLKb. If the minimum time (tsKEW2) between a rising CLKb and a rising CLKA is met, the flag will change state on the current clock; otherwise, the flag may not change state until the next clock rising edge. For the specific flag timings, refer to Figures 12-15.

PAEAb Register	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	X	X	X	X	X	X	X	X	X	X	A→B FIFO Almost-Empty Flag Offset							
PAFAB Register	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	X	X	X	X	X	X	X	X	X	X	A→B FIFO Almost-Full Flag Offset							
PAEBa Register	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	X	X	X	X	X	X	X	X	X	X	B→A FIFO Almost-Empty Flag Offset							
PAFBA Register	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	X	X	X	X	X	X	X	X	X	X	B→A FIFO Almost-Full Flag Offset							

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NOTE:

1. Bit 8 must be set to 0 for the IDT72605 (256 x 18) Synchronous BIFIFO.

Table 3. Flag Offset Register Format

Number of Words in FIFO		EF	PAE	PAF	FF
From	To				
0	0	Low	Low	High	High
1	n	High	Low	High	High
n+1	D-(m+1)	High	High	High	High
D-m	D-1	High	High	Low	High
D	D	High	High	Low	Low

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n = Programmable Empty Offset (PAEAb Register or PAEBa Register)

m = Programmable Full Offset (PAFAB Register or PAFBA Register)

D = FIFO Depth (IDT72605 = 256 words, IDT72615 = 512 words)

Table 4. Internal Flag Truth Table

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PORT B CONTROL SIGNALS

The Port B control signal pins dictate the various operations shown in Table 5. Port B is independent of CSA. R/W_B and EN_B lines determine when Data can be written or read in Port B. If R/W_B and EN_B are LOW, data is written into input register, and on low-to-high transition of CLK_B data is written into input register and the FIFO memory.

If R/W_B is HIGH and OE_B is LOW, data comes out of bus and is read from output register into three-state buffer. In bypass mode, if R/W_B is LOW, bypass messages are transferred into B→A output register. If R/W_B is HIGH, bypass messages are transferred into A→B output register. Refer to pin descriptions for more information.

R/W _B	EN _B	OE _B	Data B I/O	Port B Operation
0	0	0	I	Data B is written on CLK _B ↑. This write cycle immediately following output low impedance cycle is prohibited
0	0	1	I	Data B is written on CLK _B ↑.
0	1	X	I	Data B is ignored
1	0	0	O	Data is read ⁽¹⁾ from RAM array to output register on CLK _B ↑, Data B is low impedance
1	0	1	O	Data is read ⁽¹⁾ from RAM array to output register on CLK _B ↑, Data B is high impedance
1	1	0	O	Output register does not change ⁽²⁾ , Data B is low impedance
1	1	1	O	Output register does not change ⁽²⁾ , Data B is high impedance

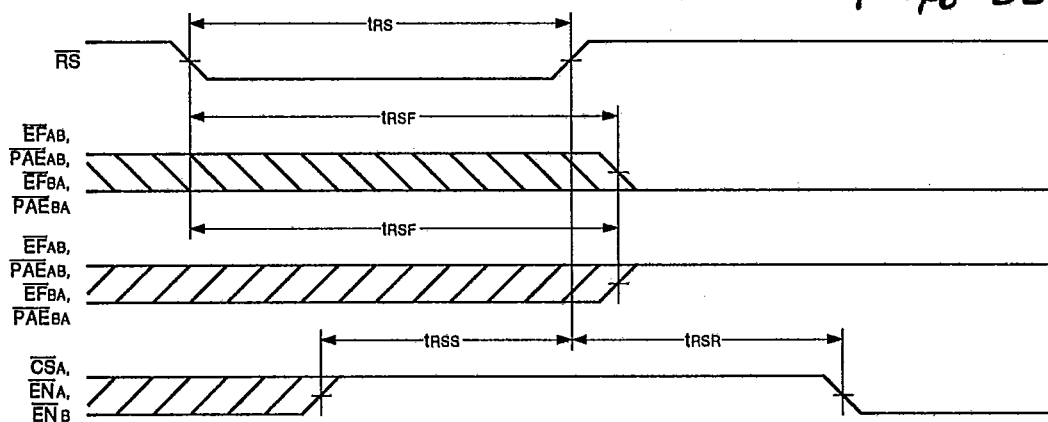
NOTES:

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1. When A₂A₁A₀ = 000 or 1XX, the next A→B FIFO value is read out of the output register and the read pointer advances. If A₂A₁A₀ = 001, the bypass path is selected and bypass data is read from the Port B output register.
2. Regardless of the condition of A₂A₁A₀, the data in the Port B output register does not change and the A→B read pointer does not advance.

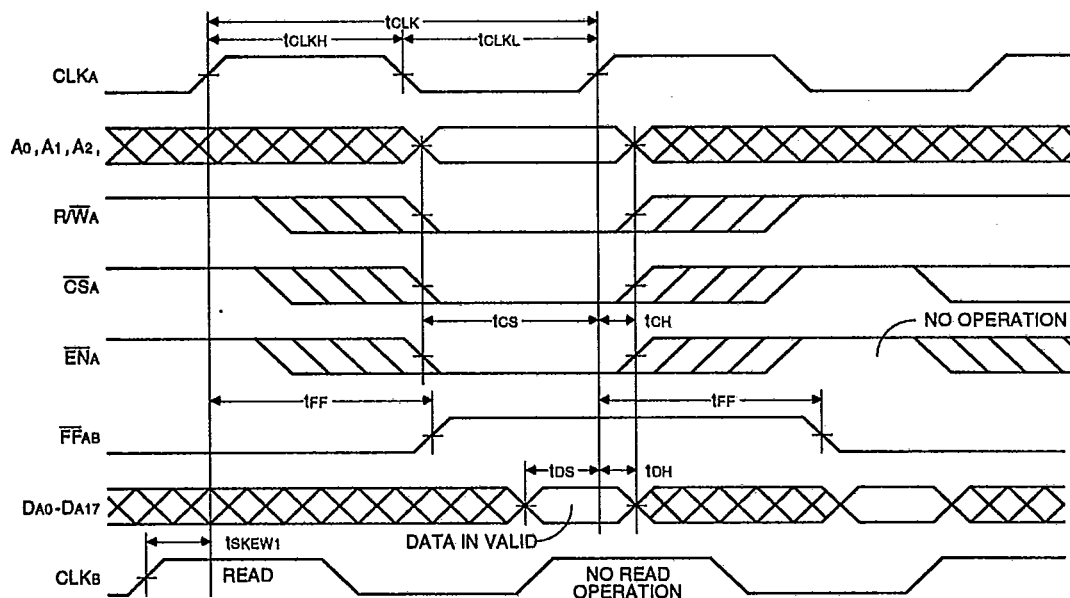
Table 5. Port B Operation Control Signals

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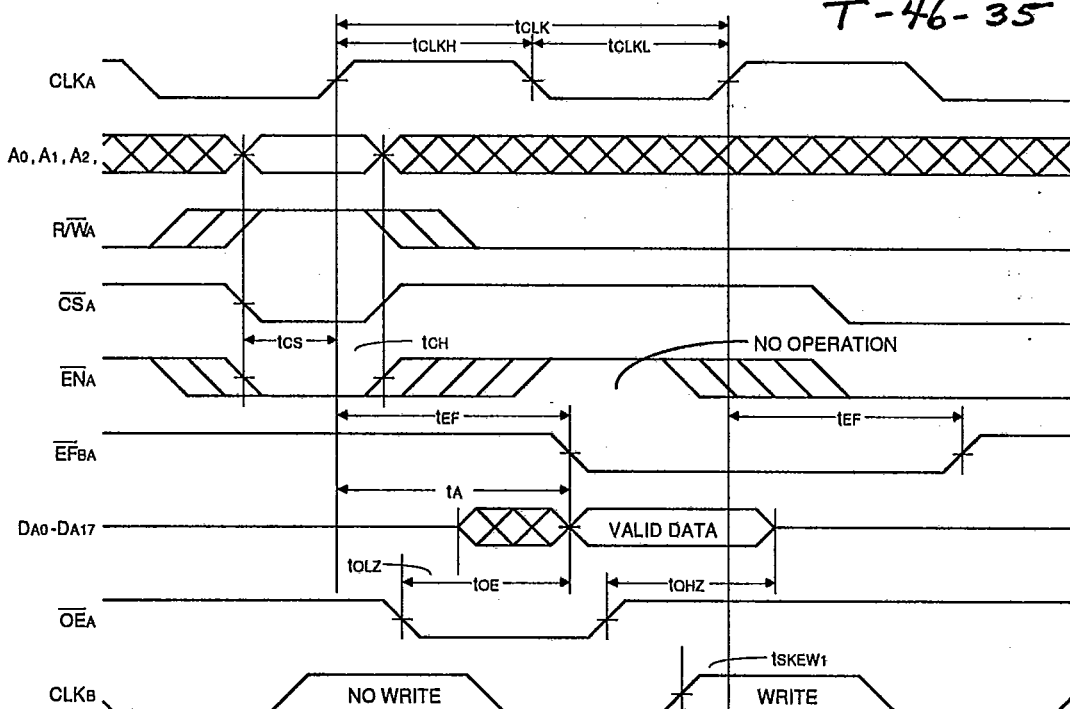
Figure 3. Reset Timing



2704 drw 07

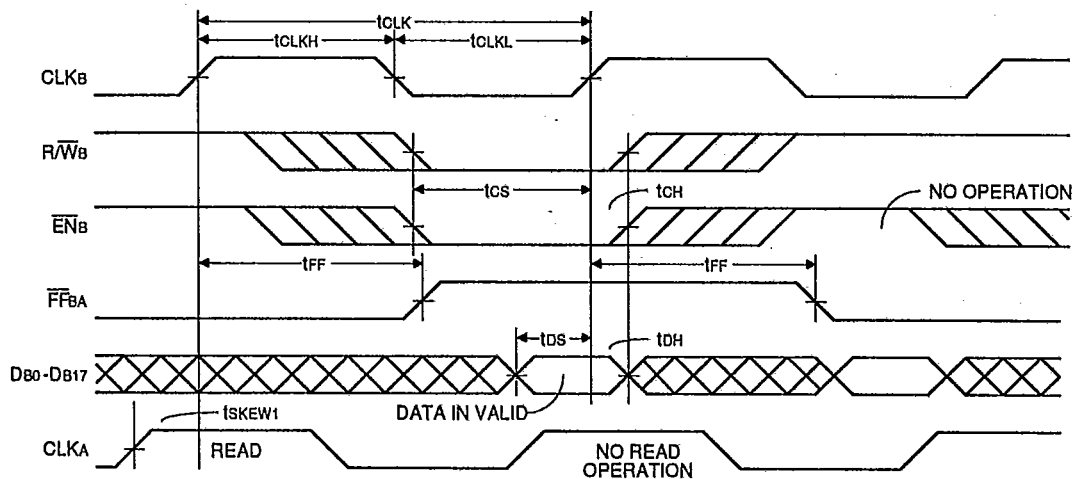
Figure 4. Port A (A→B) Write Timing

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Figure 5. Port A (B→A) Read Timing



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Figure 6. Port B (B→A) Write Timing

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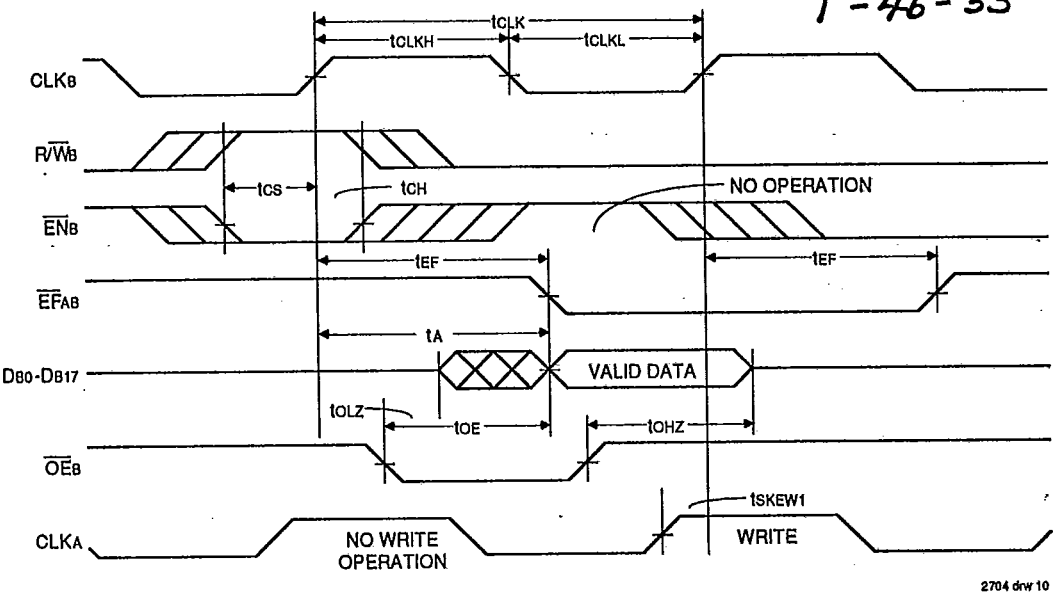
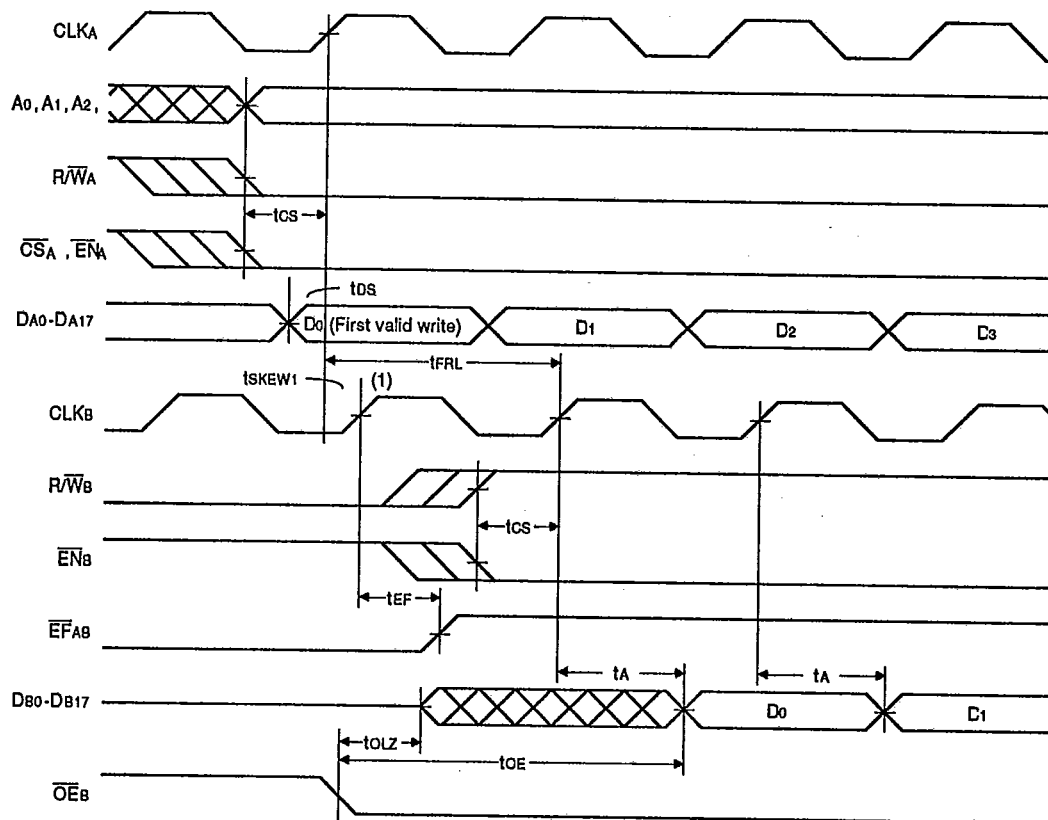


Figure 7. Port B (A to B) Read Timing

5

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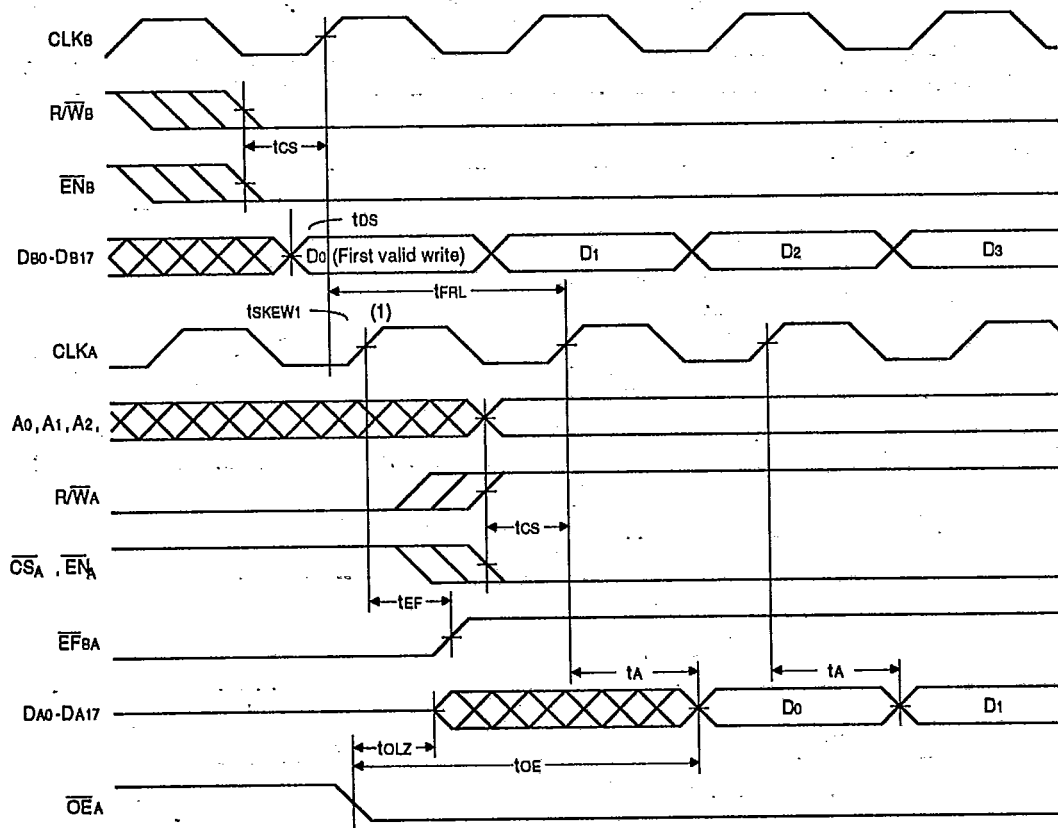
**NOTE:**

1. When $t_{SKEW1} \geq$ minimum specification, $t_{FRL(Max)} = t_{CLK} + t_{SKEW1}$
 $t_{SKEW1} <$ minimum specification, $t_{FRL(Max)} = 2t_{CLK} + t_{SKEW1}$ or $t_{CLK} + t_{SKEW1}$
 The Latency Timing applies only at the Empty Boundary ($\overline{EF} = \text{Low}$).

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Figure 8. A→B First Data Word Latency after Reset for Simultaneous Read and Write

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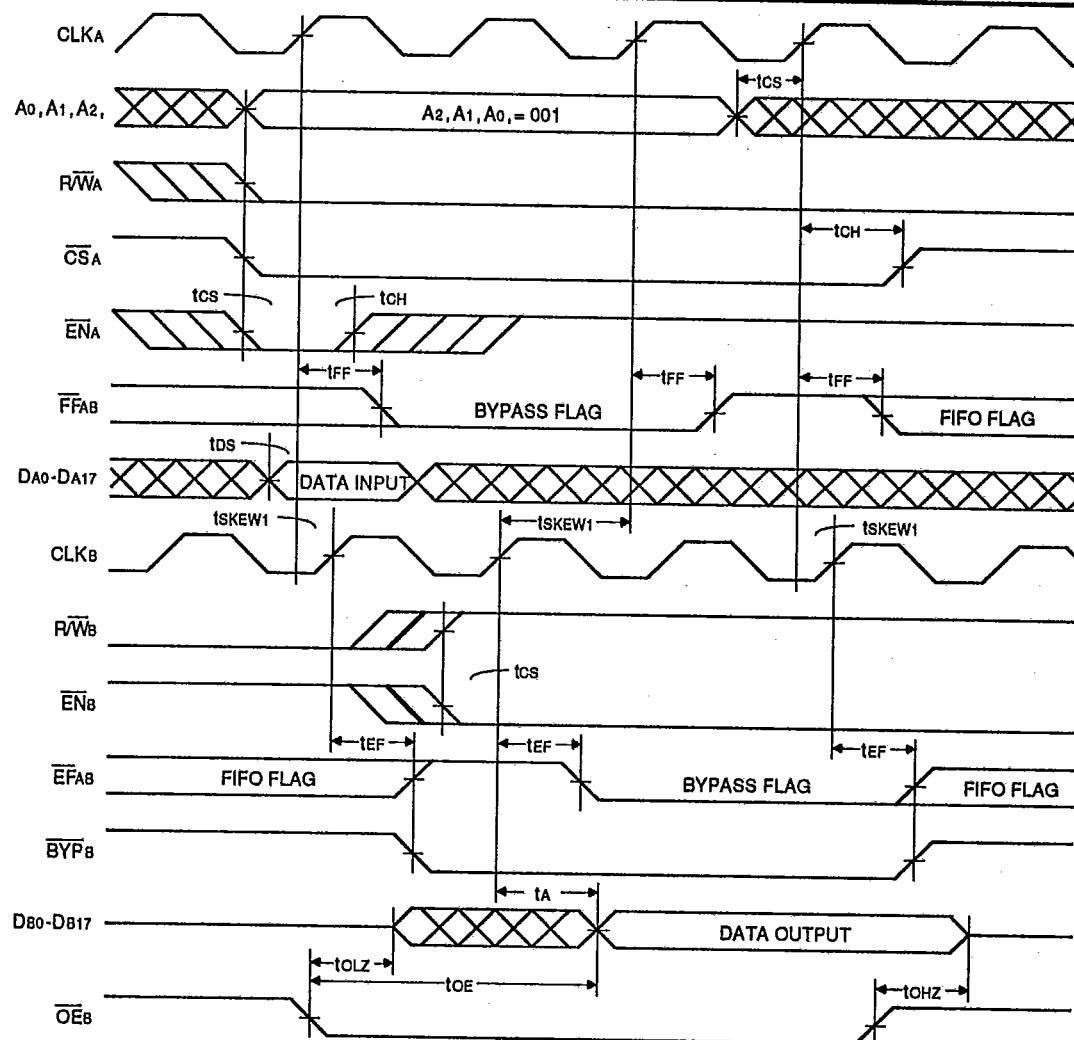
NOTE:

1. When $tskew1 \geq$ minimum specification, $tFRL(Max.) = tCLK + tskew1$
 $tskew1 <$ minimum specification, $tFRL(Max.) = 2tCLK + tskew1$
The Latency Timing apply only at the Empty Boundary (EF = Low).

Figure 9. B→A First Data Word Latency after Reset for Simultaneous Read and Write

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MILITARY AND COMMERCIAL TEMPERATURE RANGES

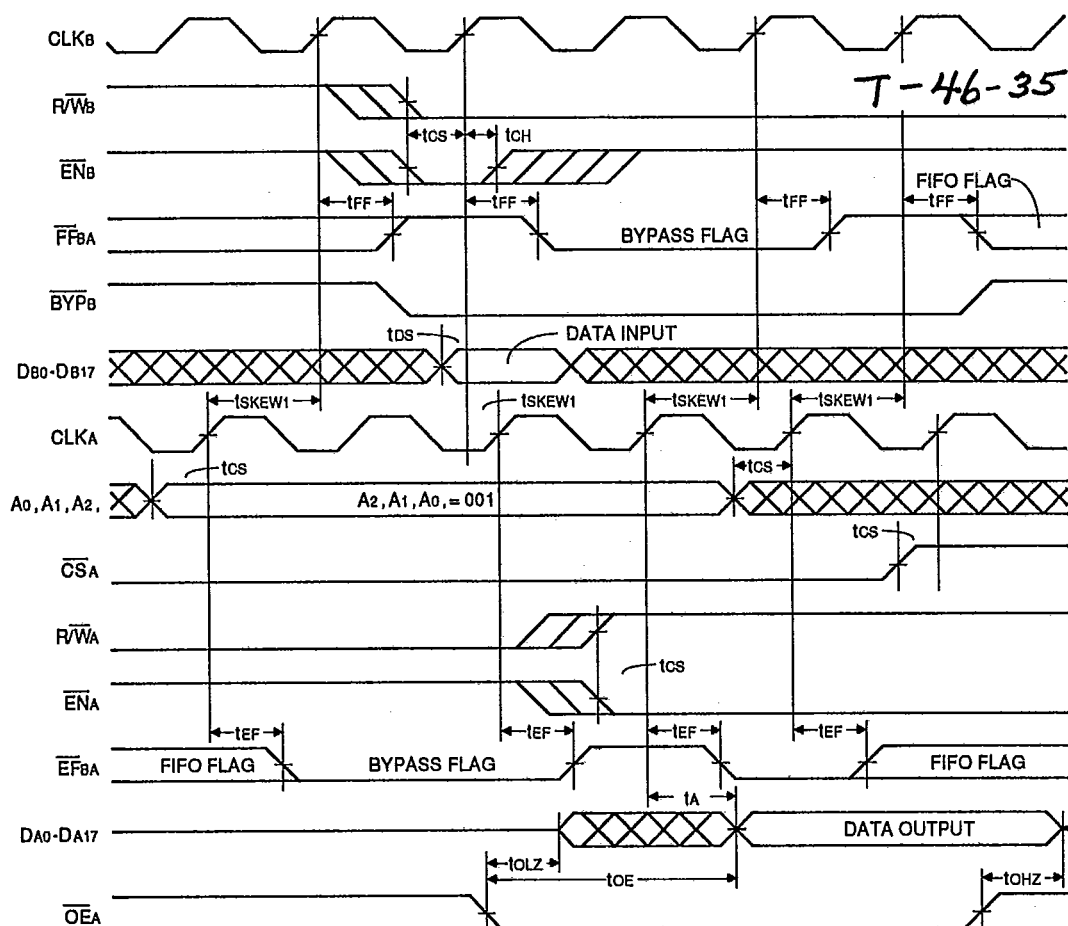


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NOTES:

1. When $\overline{CSA}$ is brought HIGH, A→B Bypass mode will switch to FIFO mode on the following CLKA low-to-high transition.
2. After the bypass operation is completed, the $\overline{BYPa}$ goes from low-to-high; this will reset all bypass flags. The bypass path becomes available for the next bypass operation.
3. When A-side changed from bypass mode into FIFO mode, B-side only has one cycle to read the bypass data. On the next cycle, B-side will be forced back to FIFO mode.

Figure 10. A→B Bypass Timing



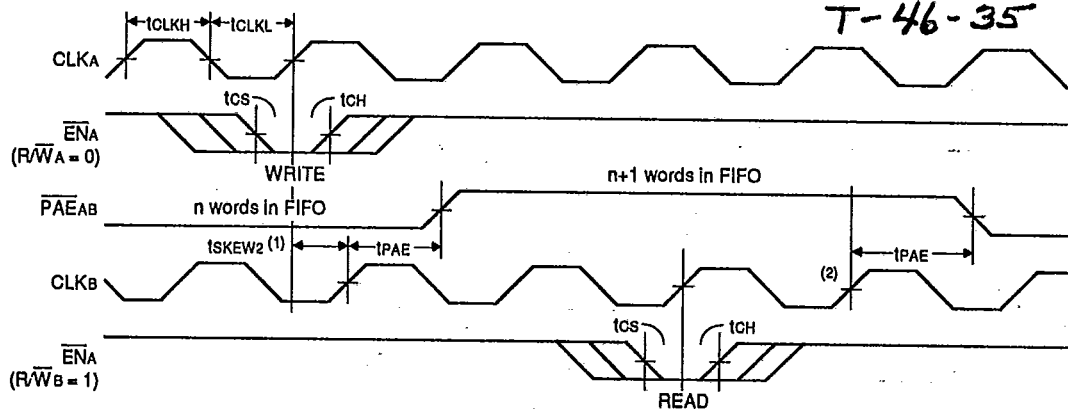
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NOTES:

1. When $\overline{CSA}$ is brought HIGH, A→B Bypass mode will switch to FIFO mode on the following CLKA going low-to-high.
2. After the bypass operation is completed, the BYPa goes from low-to-high; this will reset all bypass flags. The bypass path becomes available for the next bypass operation.
3. When A-side changed from bypass mode into FIFO mode, B-side only has one cycle to read the bypass data. On the next cycle, B-side will be forced back to FIFO mode.

Figure 11. B→A Bypass Timing

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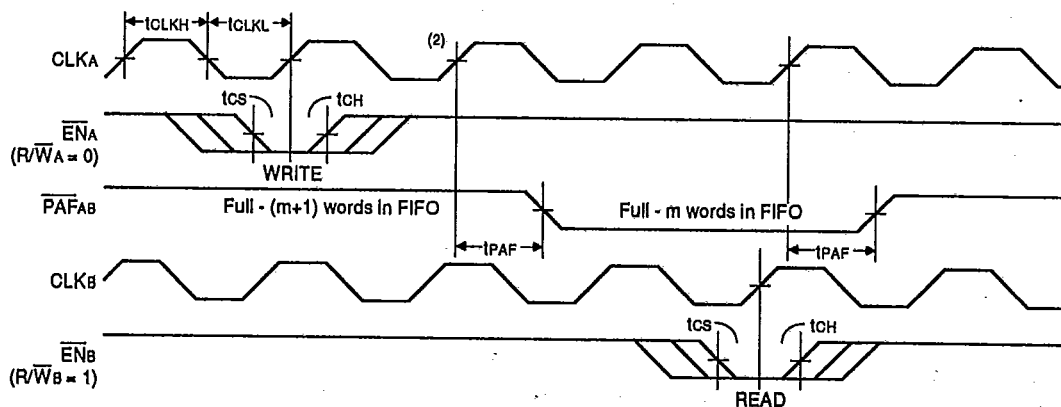


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NOTES:

1. t_{SKEW2} is the minimum time between a rising CLKA edge and a rising CLKB edge for $\overline{PAEAB}$ to change during that clock cycle. If the time between the rising edge of CLKA and the rising edge of CLKB is less than t_{SKEW2} , then $\overline{PAEAB}$ may not go HIGH until the next CLKB rising edge.
2. If a read is performed on this rising edge of the read clock, there will be Empty + (n + 1) words in the FIFO when $\overline{PAE}$ goes low.

Figure 12. A-B Programmable Almost-Empty Flag Timing

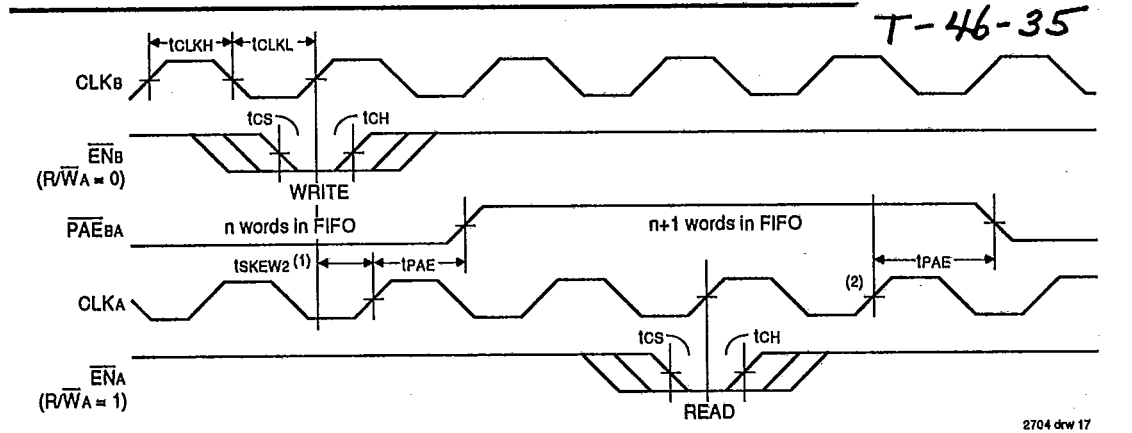


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NOTES:

1. t_{SKEW2} is the minimum time between a rising CLKB edge and a rising CLKA edge for $\overline{PAFAB}$ to change during that clock cycle. If the time between the rising edge of CLKB and the rising edge of CLKA is less than t_{SKEW2} , then $\overline{PAFAB}$ may not go HIGH until the next CLKA rising edge.
2. If a write is performed on this rising edge of the write clock, there will be Full - (m + 1) words in the FIFO when $\overline{PAF}$ goes low.

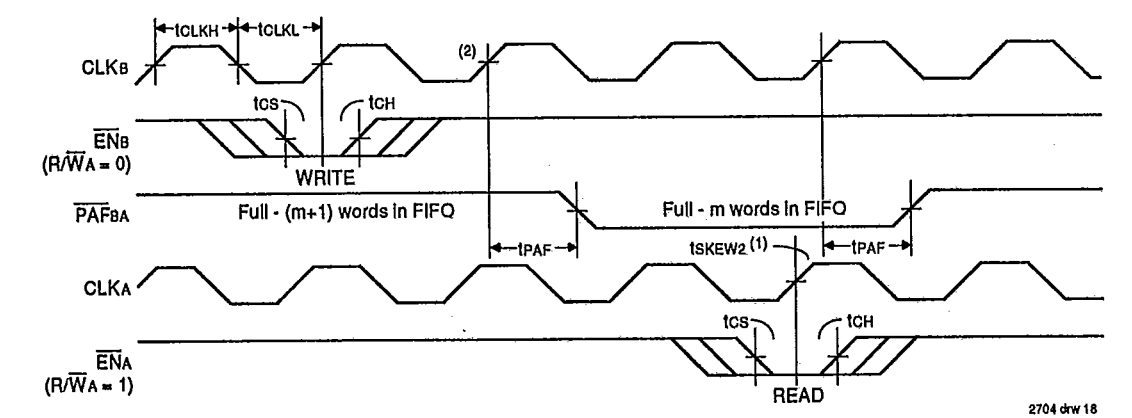
Figure 13. A-B Programmable Almost-Full Flag Timing



NOTES:

1. t_{SKEW2} is the minimum time between a rising CLKB edge and a rising CLKA edge for PAEBA to change during that clock cycle. If the time between the rising edge of CLKB and the rising edge of CLKA is less than t_{SKEW2} , then PAEBA may not go HIGH until the next CLKA rising edge.
2. If a read is performed on this rising edge of the read clock, there will be Empty + (n - 1) words in the FIFO when PAE goes low.

Figure 14. B to A Programmable Almost-Empty Flag Timing



NOTES:

1. t_{SKEW2} is the minimum time between a rising CLKB edge and a rising CLKA edge for PAFBA to change during that clock cycle. If the time between the rising edge of CLKB and the rising edge of CLKA is less than t_{SKEW2} , then PAFBA may not go HIGH until the next CLKA rising edge.
2. If a write is performed on this rising edge of the write clock, there will be Full - (m + 1) words in the FIFO when PAF goes low.

Figure 15. B to A Programmable Almost-Full Flag Timing