National Semiconductor

February 1988

CD4034BM/CD4034BC 8-Stage TRI-STATE® Bidirectional Parallel/Serial Input/Output Bus Register

General Description

The CD4034BM/CD4034BC is an 8-bit CMOS static shift register with two parallel bidirectional data ports (A and B) which, when combined with serial shifting operations, can be used to (1) bidirectionally transfer parallel data between two buses, (2) convert serial data to parallel form and direct them to either of two buses, (3) store (recirculate) parallel data, or (4) accept parallel data from either of two buses and convert them to serial form. These operations are controlled by five control inputs:

A ENABLE (AE): "A" data port is enabled only when AE is at logical "1". This allows the use of a common bus for multiple packages.

A-BUS-TO-B-BUS/B-BUS-TO-A-BUS (A/B): This input controls the direction of data flow. When at logical "1", data flows from port A to B (A is input, B is output). When at logical "0", the data flow direction is reversed.

ASYNCHRONOUS/SYNCHRONOUS (A/S): When A/S is at logical "0", data transfer occurs at positive transition of the CLOCK. When A/S is at logical "1", data transfer is independent of the CLOCK for parallel operation. In serial mode, A/S input is internally disabled such that operation is always synchronous. (Asynchronous serial operation is not possible.)

PARALLEL/SERIAL (P/S): A logical "1" P/S input allows data transfer into the registers via A or B port (synchronous if A/S = logical "0", asynchronous if A/S = logical "1"). A logical "0" P/S allows serial data to transfer into the register synchronously with the positive transition of the CLOCK, independent of the A/S input.

CLOCK: Single phase, enabled only in synchronous mode. (Either P/S = logical "1" and A/S = logical "0" or P/S = logical "0".

All register stages are D-type master-slave flip-flops with separate master and slave clock inputs generated internally to allow synchronous or asynchronous data transfer from master to slave.

All inputs are protected against damage due to static discharge by diode clamps to V_{DD} and V_{SS}.

Features

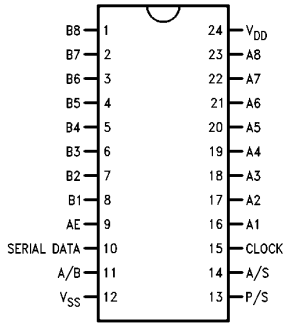
- Wide supply voltage range — 3.0V to 18V
- High noise immunity — 0.45 V_{DD} (typ.)
- Low power TTL compatibility — Fan out of 2 driving 74L or 1 driving 74LS
- RCA CD4034B second source

Applications

- Parallel Input/Parallel Output
  Parallel Input/Serial Output
  Serial Input/Parallel Output
  Serial Input/Serial Output register
- Shift right/shift left register
- Shift right/shift left with parallel loading
- Address register
- Buffer register
- Bus system register with enable parallel lines at bus side
- Double bus register system
- Up-down Johnson or ring counter
- Pseudo-random code generators
- Sample and hold register (storage, counting, display)
- Frequency and phase comparator

Connection Diagram

Dual-In-Line Package



TL/F/5963–1

Top View

Order Number CD4034B

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RRD-B30M105/Printed in U. S. A.

Absolute Maximum Ratings (Notes 1 & 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

DC Supply Voltage (V_{DD})	$-0.5\ V_{DC}$ to $+18\ V_{DC}$
Input Voltage (V_{IN})	$-0.5\ V_{DC}$ to $V_{DD} + 0.5\ V_{DC}$
Storage Temp. Range (T_S)	$-65°C$ to $+150°C$
Power Dissipation (P_D)	
Dual-In-Line	700 mW
Small Outline	500 mW
Lead Temperature (T_L)	
(Soldering, 10 seconds)	260°C

Recommended Operating Conditions (Note 2)

DC Supply Voltage (V_{DD})	$+3\ V_{DC}$ to $+15\ V_{DC}$
Input Voltage (V_{IN})	$0\ V_{DC}$ to $V_{DD}\ V_{DC}$
Operating Temperature Range (T_A)	
CD4034BM	$-55°C$ to $+125°C$
CD4034BC	$-40°C$ to $+85°C$

DC Electrical Characteristics CD4034BM (Note 2)

Symbol	Parameter	Conditions	−55°C		+25°C			+125°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{DD}	Quiescent Device Current	$V_{DD} = 5V$, $V_{IN} = V_{DD}$ or V_{SS}		5			5		150	μA
		$V_{DD} = 10V$, $V_{IN} = V_{DD}$ or V_{SS}		10			10		300	μA
		$V_{DD} = 15V$, $V_{IN} = V_{DD}$ or V_{SS}		20			20		600	μA
V_{OL}	Low Level Output Voltage	$V_{DD} = 5V$		0.05			0.05		0.05	V
		$V_{DD} = 10V$		0.05			0.05		0.05	V
		$V_{DD} = 15V$		0.05			0.05		0.05	V
V_{OH}	High Level Output Voltage	$V_{DD} = 5V$	4.95		4.95			4.95		V
		$V_{DD} = 10V$	9.95		9.95			9.95		V
		$V_{DD} = 15V$	14.95		14.95			14.95		V
V_{IL}	Low Level Input Voltage	$V_{DD} = 5V$, $V_O = 0.5V$ or $4.5V$		1.5			1.5		1.5	V
		$V_{DD} = 10V$, $V_O = 1.0V$ or $9.0V$		3.0			3.0		3.0	V
		$V_{DD} = 15V$, $V_O = 1.5V$ or $13.5V$		4.0			4.0		4.0	V
V_{IH}	High Level Input Voltage	$V_{DD} = 5V$, $V_O = 0.5V$ or $4.5V$	3.5		3.5			3.5		V
		$V_{DD} = 10V$, $V_O = 1.0V$ or $9.0V$	7.0		7.0			7.0		V
		$V_{DD} = 15V$, $V_O = 1.5V$ or $13.5V$	11.0		11.0			11.0		V
I_{OL}	Low Level Output Current	$V_{DD} = 5V$, $V_O = 0.4V$	0.64		0.51			0.36		mA
	(Note 3)	$V_{DD} = 10V$, $V_O = 0.5V$	1.6		1.3			0.9		mA
		$V_{DD} = 15V$, $V_O = 1.5V$	4.2		3.4			2.4		mA
I_{OH}	High Level Output Current	$V_{DD} = 5V$, $V_O = 4.6V$	−0.64		−0.51			−0.36		mA
	(Note 3)	$V_{DD} = 10V$, $V_O = 9.5V$	−1.6		−1.3			−0.9		mA
		$V_{DD} = 15V$, $V_O = 13.5V$	−4.2		−3.4			−2.4		mA
I_{IN}	Input Curent	$V_{DD} = 15V$, $V_{IN} = 0V$	−0.1		−0.1	-10^{-5}		−1.0		μA
		$V_{DD} = 15V$, $V_{IN} = 15V$		0.1		10^{-5}	0.1		1.0	μA
I_{OZ}	TRI-STATE Leakage	$V_{DD} = 15V$, $V_O = 0V$	−0.1		−0.1	-10^{-5}		−1.0		μA
	Current	$V_{DD} = 15V$, $V_O = 15V$		0.1		10^{-5}	0.1		1.0	μA

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

Note 2: $V_{SS} = 0V$ unless otherwise specified.

Note 3: I_{OH} and I_{OL} are tested one output at a time.

DC Electrical Characteristics CD4034BC (Note 2)

Symbol	Parameter	Conditions	−40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{DD}	Quiescent Device Current	V_{DD} = 5V, V_{IN} = V_{DD} or V_{SS}		20			20		150	μA
		V_{DD} = 10V, V_{IN} = V_{DD} or V_{SS}		40			40		300	μA
		V_{DD} = 15V, V_{IN} = V_{DD} or V_{SS}		80			80		600	μA
V_{OL}	Low Level Output Voltage	V_{DD} = 5V		0.05			0.05		0.05	V
		V_{DD} = 10V		0.05			0.05		0.05	V
		V_{DD} = 15V		0.05			0.05		0.05	V
V_{OH}	High Level Output Voltage	V_{DD} = 5V	4.95		4.95			4.95		V
		V_{DD} = 10V	9.95		9.95			9.95		V
		V_{DD} = 15V	14.95		14.95			14.95		V
V_{IL}	Low Level Input Voltage	V_{DD} = 5V, V_O = 0.5V or 4.5V		1.5			1.5		1.5	V
		V_{DD} = 10V, V_O = 1.0V or 9.0V		3.0			3.0		3.0	V
		V_{DD} = 15V, V_O = 1.5V or 13.5V		4.0			4.0		4.0	V
V_{IH}	High Level Input Voltage	V_{DD} = 5V, V_O = 0.5V or 4.5V	3.5		3.5			3.5		V
		V_{DD} = 10V, V_O = 1.0V or 9.0V	7.0		7.0			7.0		V
		V_{DD} = 15V, V_O = 1.5V or 13.5V	11.0		11.0			11.0		V
I_{OL}	Low Level Output Current (Note 3)	V_{DD} = 5V, V_O = 0.4V	0.52		0.44			0.36		mA
		V_{DD} = 10V, V_O = 0.5V	1.3		1.1			0.9		mA
		V_{DD} = 15V, V_O = 1.5V	3.6		3.0			2.4		mA
I_{OH}	High Level Output Current (Note 3)	V_{DD} = 5V, V_O = 4.6V	−0.52		−0.44			−0.36		mA
		V_{DD} = 10V, V_O = 9.5V	−1.3		−1.1			−0.9		mA
		V_{DD} = 15V, V_O = 13.5V	−3.6		−3.0			−2.4		mA
I_{IN}	Input Current	V_{DD} = 15V, V_{IN} = 0V	−0.3		−0.3	-10^{-5}		−1.0		μA
		V_{DD} = 15V, V_{IN} = 15V		0.3		10^{-5}	0.3		1.0	μA
I_{OZ}	TRI-STATE Leakage Current	V_{DD} = 15V, V_O = 0V	−0.3		−0.3	-10^{-5}		−1.0		μA
		V_{DD} = 15V, V_O = 15V		0.3		10^{-5}	0.3		1.0	μA

AC Electrical Characteristics*

T_A = 25°C, C_L = 50 pF, R_L = 200k, input t_r = t_f = 20 ns, unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{PHL}, t_{PLH}	Propagation Delay Time, A (B) Synchronous Parallel Data or Serial Data Input, B (A) Parallel Data Output	V_{DD} = 5V		280	700	ns
		V_{DD} = 10V		120	270	ns
		V_{DD} = 15V		85	190	ns
t_{PHL}, t_{PLH}	Propagation Delay Time, A (B) A (B) Asynchronous Parallel Data Input, B (A) Parallel Data Output	V_{DD} = 5V		280	700	ns
		V_{DD} = 10V		120	270	ns
		V_{DD} = 15V		85	190	ns
t_{PHZ}, t_{PLZ}	Propagation Delay Time from A/B or AE to High Impedance State at A Outputs or from A/B to High Impedance State at B Outputs	V_{DD} = 5V, R_L = 1.0 kΩ		95	220	ns
		V_{DD} = 10V, R_L = 1.0 kΩ		60	130	ns
		V_{DD} = 15V, R_L = 1.0 kΩ		45	100	ns
t_{PZH}, t_{PZL}	Propagation Delay Time from A/B or AE to Logical ''1'' or Logical ''0'' State at A Outputs or from A/B to Logical ''1'' or Logical ''0'' State at B Outputs	V_{DD} = 5V, R_L = 1.0 kΩ		180	480	ns
		V_{DD} = 10V, R_L = 1.0 kΩ		75	190	ns
		V_{DD} = 15V, R_L = 1.0 kΩ		55	140	ns

AC Electrical Characteristics*

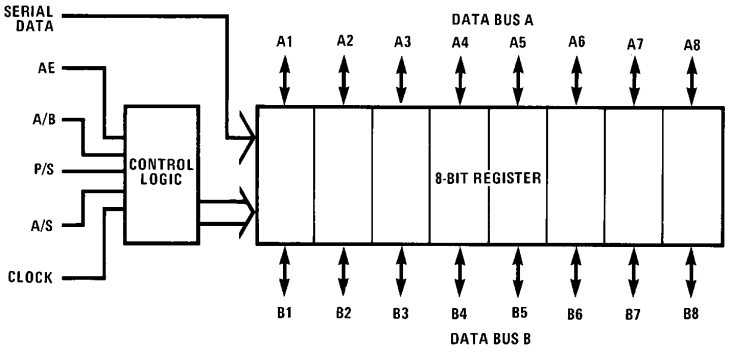
$T_A = 25°C$, $C_L = 50$ pF, $R_L = 200k$, input $t_r = t_f = 20$ ns, unless otherwise specified (Continued)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{THL}, t_{TLH}	Output Transition Time	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		100 50 40	200 100 80	ns ns ns
f_{CL}	Maximum Clock Input Frequency	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$	2 5 7	4 10 14		MHz MHz MHz
t_{WL}, t_{WH}	Minimum Clock Pulse Width	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		125 50 35	250 100 70	ns ns ns
t_{RCL}, t_{FCL}	Maximum Clock Rise & Fall Time	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$	15 15 15			μs μs μs
t_{SU}	Parallel (A or B) and Serial Data Setup Time	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		25 10 7	70 30 20	ns ns ns
t_{SU}	Control Inputs AE, A/B, P/S, A/S Setup Time	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		110 35 60	280 100 60	ns ns ns
t_{WH}	Minimum High Level AE, A/B, P/S, A/S Pulse Width	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		160 70 40	400 160 90	ns ns ns
C_{IN}	Average Input Capacitance	A and B Data I/O and A/B Control Input Any Other Input		7 5	15 7.5	pF pF
C_{PD}	Power Dissipation Capacitance	(Note 4)		155		pF

*AC Parameters are guaranteed by DC correlated testing.

Note 4: C_{PD} determines the no-load power consumption of any CMOS device. For complete explanation see 54C/74C Family Characteristics application note, AN-90.

Logic Diagram



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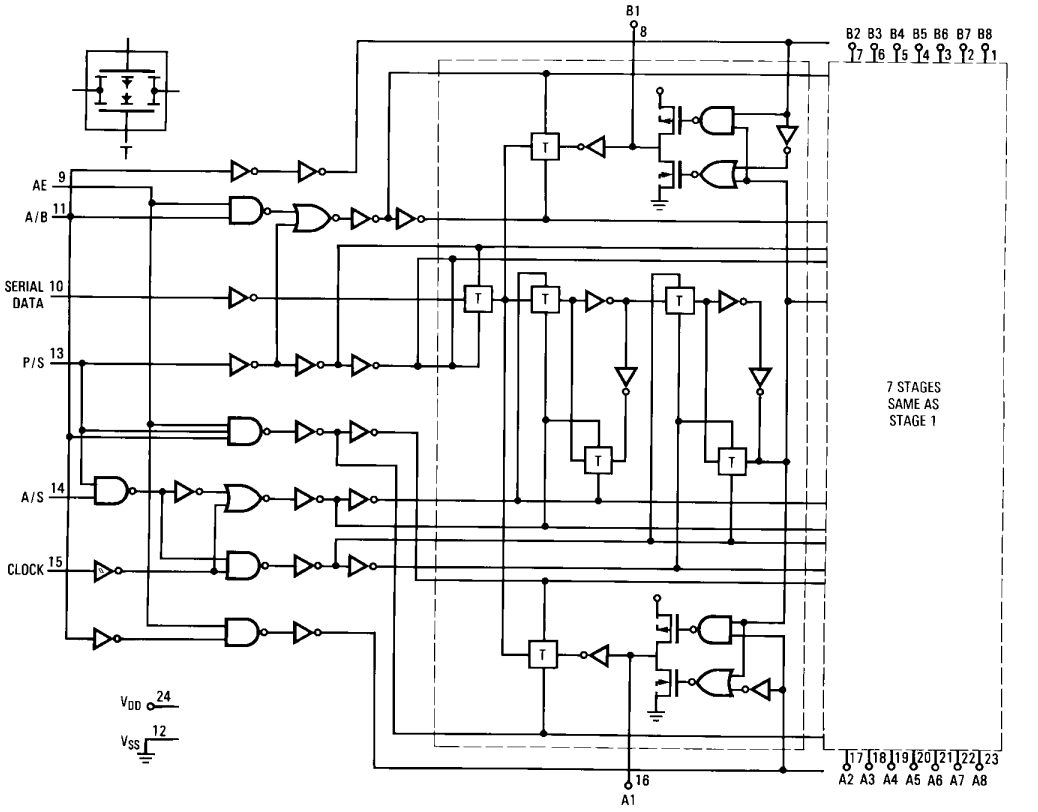
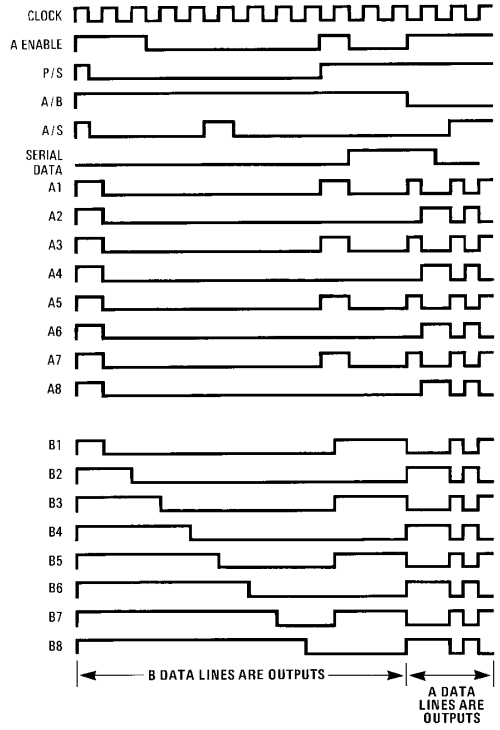
Schematic Diagram



TL/F/5963–3

Switching Time Waveforms and Test Circuits



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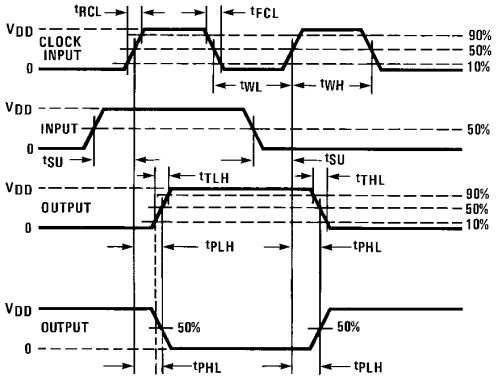
Synchronous Operation



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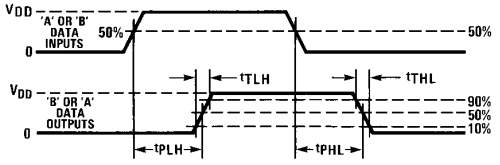
t_r, CL = t_f, CL = 20 ns

Asynchronous Operation



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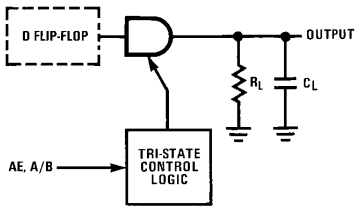

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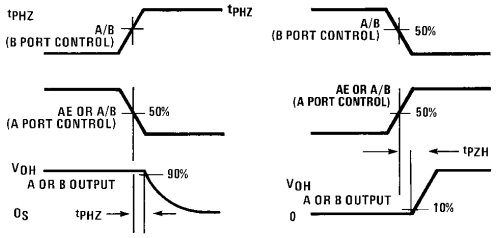

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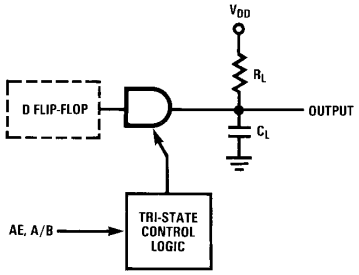

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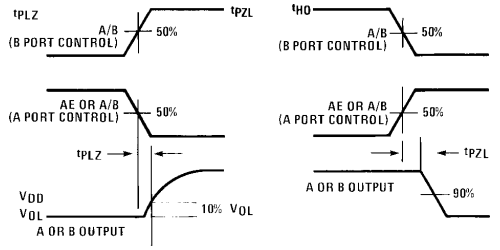

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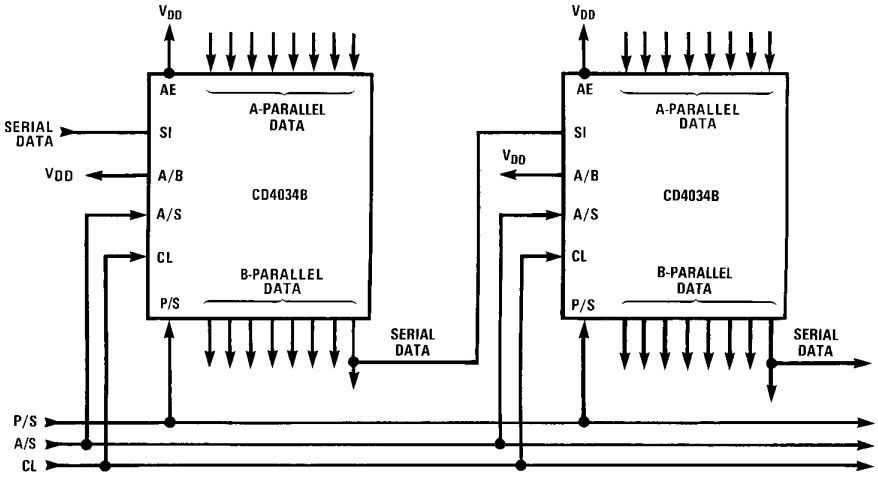
Applications

16-Bit Parallel In/Parallel Out, Parallel In/Serial Out, Serial In/Parallel Out, Serial In/Serial Out Register



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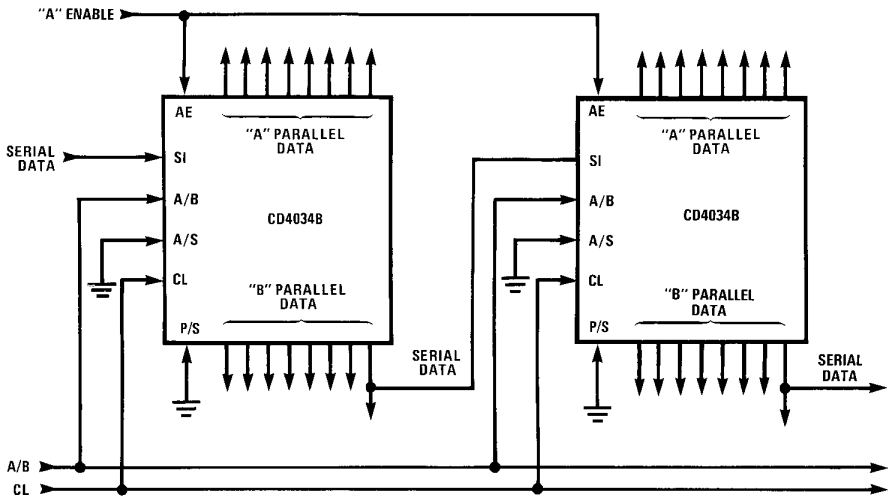
Applications (Continued)

16-Bit Serial In/Gated Parallel Out Register



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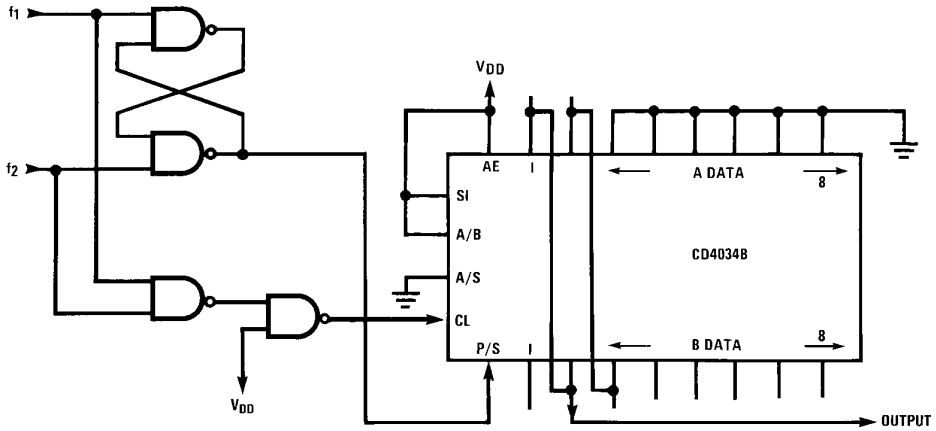
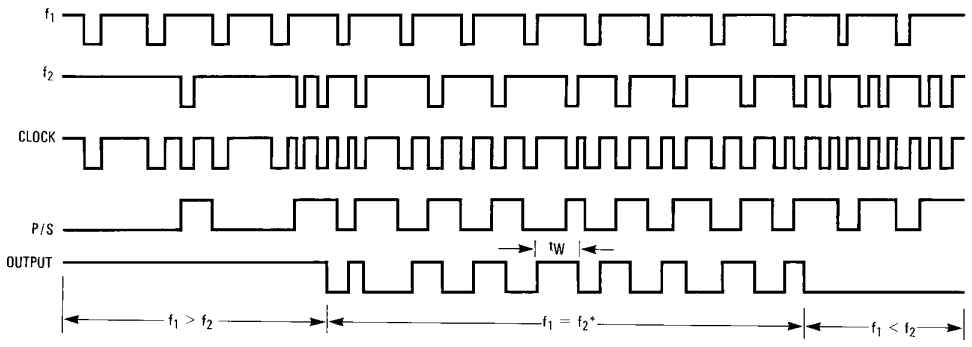
Frequency and Phase Comparator



TL/F/5963–13



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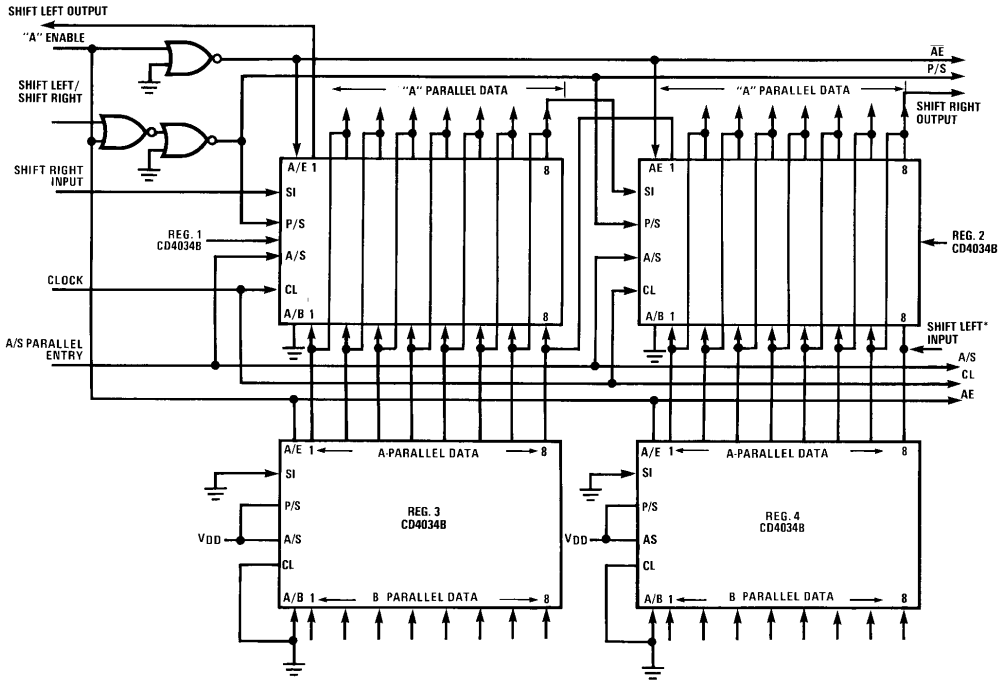
*When $f_1 = f_2$, t_W is proportional to the phase of f_1 with respect to f_2.

Applications (Continued)

Shift Right/Shift Left with Parallel Inputs



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Shift left input must be disabled during parallel entry.

A "High" ("Low") on the Shift Left/Shift Right input allows serial data on the Shift Left Input (Shift Right Input) to enter the register on the positive transition of the clock signal. A "high" on the "A" Enable Input disables the "A" parallel data lines on Registers 1 and 2 and enables the "A" data lines on Registers 3 and 4 and allows parallel data into Registers 1 and 2. Other logic schemes may be used in place of registers 3 and 4 for parallel loading.

When parallel inputs are not used Registers 3 and 4 and associated logic are not required.

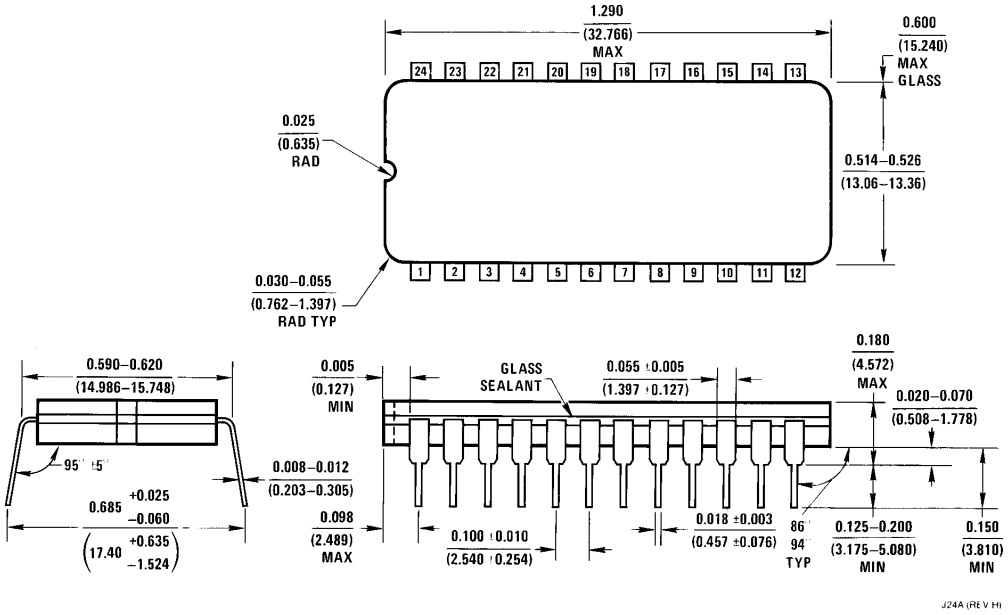
Truth Table

"A" Enable	P/S	A/B	A/S	Mode	Operation*
0	0	0	X	Serial	Synchronous Serial data input, A- and B-Parallel data outputs disabled.
0	0	1	X	Serial	Synchronous Serial data input, B-Parallel data output.
0	1	0	0	Parallel	B Synchronous Parallel data inputs, A-Parallel data outputs disabled.
0	1	0	1	Parallel	B Asynchronous Parallel data inputs, A-Parallel data outputs disabled.
0	1	1	0	Parallel	A-Parallel data inputs disabled, B-Parallel data outputs, synchronous data recirculation.
0	1	1	1	Parallel	A-Parallel data inputs disabled, B-Parallel data outputs, asynchronous data recirculation.
1	0	0	X	Serial	Synchronous Serial data input, A-Parallel data output.
1	0	1	X	Serial	Synchronous Serial data input, B-Parallel data output.
1	1	0	0	Parallel	B Synchronous Parallel data input, A-Parallel data output.
1	1	0	1	Parallel	B Asynchronous Parallel data input, A-Parallel data output.
1	1	1	0	Parallel	A Synchronous Parallel data input, B-Parallel data output.
1	1	1	1	Parallel	A Asynchronous Parallel data input, B-Parallel data output.

X = Don't Care

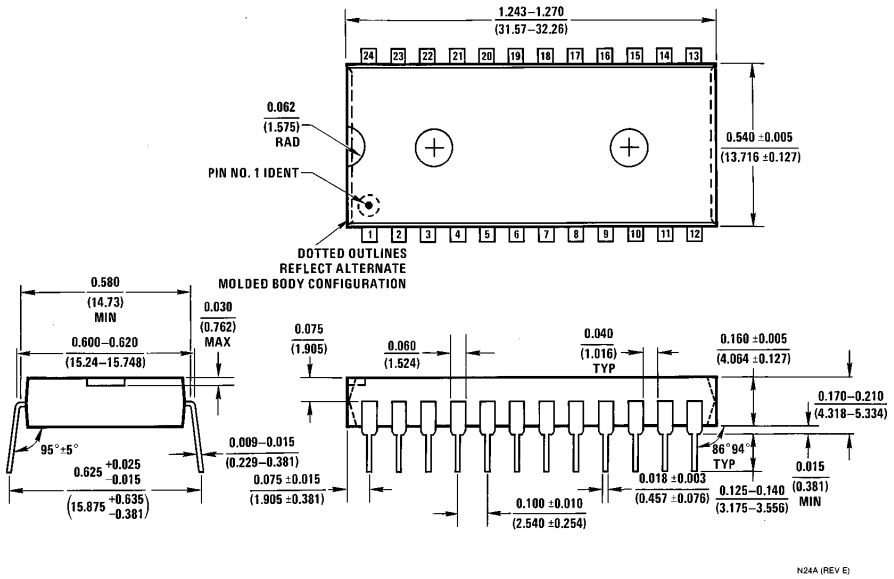
*For synchronous operation (serial mode or when A/S = 0 in parallel mode), outputs change state at positive transition of the clock.

Physical Dimensions inches (millimeters)



Ceramic Dual-In-Line Package (J)
Order Number CD4034BMJ or CD4034BCJ
NS Package Number J24A

Physical Dimensions inches (millimeters) (Continued)



Molded Dual-In-Line Package (N)
Order Number CD4034BMN or CD4034BCN
NS Package Number N24A

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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