TEXAS INSTRUMENTS
Data sheet acquired from Harris Semiconductor
SCHS037A – Revised March 2002

CD4034B Types

CMOS 8-Stage Static Bidirectional Parallel/Serial Input/Output Bus Register

High-Voltage Types (20-Volt Rating)

■ CD4034B is a static eight-stage parallel-or serial-input parallel-output register. It can be used to:

1) bidirectionally transfer parallel information between two buses, 2) convert serial data to parallel form and direct the parallel data to either of two buses, 3) store (recirculate) parallel data, or 4) accept parallel data from either of two buses and convert that data to serial form. Inputs that control the operations include a single-phase CLOCK (CL), A DATA ENABLE (AE), ASYNCHRONOUS/SYNCHRONOUS (A/S), A-BUS-TO-B-BUS/B-BUS-TO-A-BUS (A/B), and PARALLEL/SERIAL (P/S).

Data inputs include 16 bidirectional parallel data lines of which the eight A data lines are inputs (3-state outputs) and the B data lines are outputs (inputs) depending on the signal level on the A/B input. In addition, an input for SERIAL DATA is also provided.

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. Isolation from external noise and the effects of loading is provided by output buffering.

PARALLEL OPERATION

A high P/S input signal allows data transfer into the register via the parallel data lines synchronously with the positive transition of the clock provided the A/S input is low. If the A/S input is high the transfer is independent of the clock. The direction of data flow is controlled by the A/B input. When this signal is high the A data lines are inputs (and B data lines are outputs); a low A/B signal reverses the direction of data flow.

The AE input is an additional feature which allows many registers to feed data to a common bus. The A DATA lines are enabled only when this signal is high.

Data storage through recirculation of data in each register stage is accomplished by making the A/B signal high and the AE signal low.

Applications:

- **Parallel Input/Parallel 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**

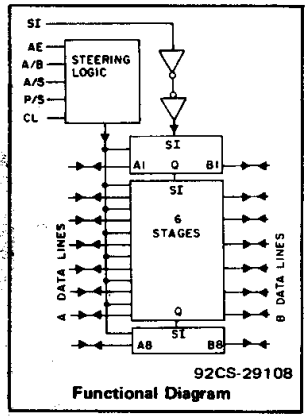
SERIAL OPERATION

A low P/S signal allows serial data to transfer into the register synchronously with the positive transition of the clock. The A/S input is internally disabled when the register is in the serial mode (asynchronous serial operation is not allowed).

The serial data appears as output data on either the B lines (when A/B is high) or the A lines (when A/B is low and the AE signal is high).

Register expansion can be accomplished by simply cascading CD4034B packages.

The CD4034B types are supplied in 24-lead dual-in-line ceramic packages (D and F suffixes), 24-lead dual-in-line plastic packages (E suffix), 24-lead small-outline package (NSR suffix), and in chip form (H suffix).



Functional Diagram

Features:

- **Bidirectional parallel data input**
- **Parallel or serial inputs/parallel outputs**
- **Asynchronous or synchronous parallel data loading**
- **Parallel data-input enable on "A" data lines (3-state output)**
- **Data recirculation for register expansion**
- **Multipackage register expansion**
- **Fully static operation dc-to-10 MHz (typ.) at V_{DD} = 10 V**
- **Standardized, symmetrical output characteristics**
- **100% tested for quiescent current at 20 V**
- **5-V, 10-V, and 15-V parametric ratings**
- **Maximum input current of 1 μA at 18 V over full package-temperature range; 100 nA at 18 V and 25°C**
- **Noise margin (over full package-temperature range):**
  - **1 V at V_{DD} = 5 V**
  - **2 V at V_{DD} = 10 V**
  - **2.5 V at V_{DD} = 15 V**
- **Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

DC SUPPLY-VOLTAGE RANGE, (V_{DD})
(Voltages referenced to V_{SS} Terminal) ..... -0.5V to +20V
INPUT VOLTAGE RANGE, ALL INPUTS ..... -0.5V to V_{DD} +0.5V
DC INPUT CURRENT, ANY ONE INPUT ..... ±10mA
POWER DISSIPATION PER PACKAGE (P_D):
For T_A = -55°C to +100°C 500mW
For T_A = +100°C to +125°C ..... Derate Linearity at 12mW/°C to 200mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR
FOR T_A = FULL PACKAGE-TEMPERATURE RANGE (All Package Types) 100mW
OPERATING-TEMPERATURE RANGE (T_A) ..... -55°C to +125°C
STORAGE TEMPERATURE RANGE (T_{stg}) ..... -65°C to +150°C
LEAD TEMPERATURE (DURING SOLDERING):
At distance 1/16 ± 1/32 inch (1.59 ± 0.79mm) from case for 10s max ..... +265°C

RECOMMENDED OPERATING CONDITIONS at T_A = 25°C, Except as Noted.
For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTIC		V_{DD} (V)	LIMITS Min.	LIMITS Max.	UNITS
Supply-Voltage Range (For T_A = Full Package-Temperature Range)			3	18	V
Data Setup Time, t_S	Serial Data to Clock	5	160	–	ns
		10	60	–	
		15	40	–	
	Parallel Data to Clock	5	50	–	ns
		10	30	–	
		15	20	–	
Clock Pulse Width, t_W		5	350	–	ns
		10	140	–	
		15	80	–	
Clock Input Frequency, f_{CL}		5	dc	2	MHz
		10		5	
		15		7	
Clock Input Rise or Fall Time, t_rCL, t_fCL*		5, 10, 15	–	15	μs

*If more than one unit is cascaded t_rCL should be made less than or equal to the sum of the transition time and the fixed propagation delay of the output of the driving stage for the estimated capacitive load.

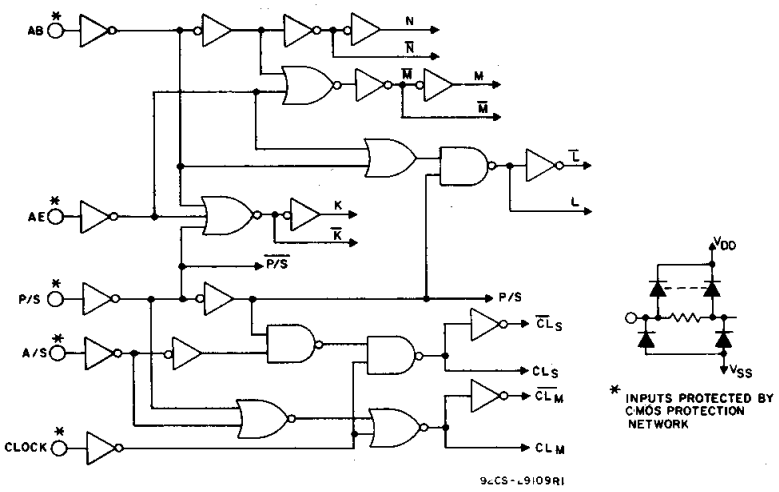


Fig. 1 – Steering logic diagram.

FLIP-FLOP TRUTH TABLE

INPUTS			OUTPUT
$\overline{CL}_M$	$\overline{CL}_S$	D	Q
↓	↓	0	0
↑	↓	0	0
↓	↑	0	INVALID CONDITION
↑	↑	X	0
↓	↓	1	1
↑	↓	1	1
↓	↑	1	INVALID CONDITION

1 = High Level 0 = Low Level X = Don't Care

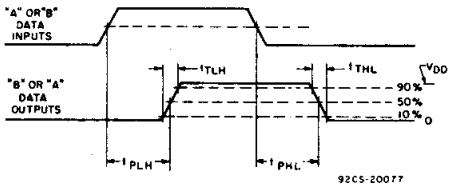


Fig. 2 – Asynchronous operation propagation delay time and transition time.

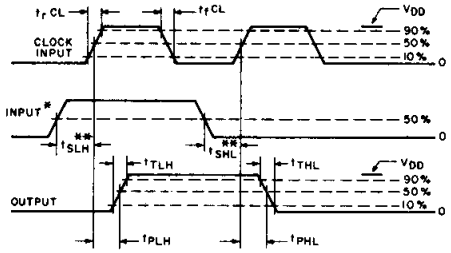


Fig. 3 – Synchronous operation propagation delay times, transition times, and set-up times.

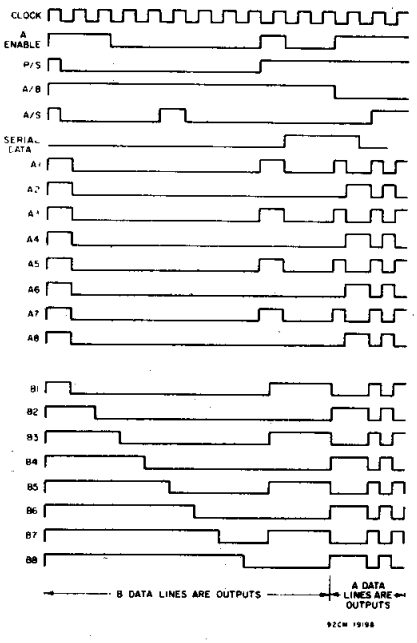


Fig. 4 – Timing diagram.

STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
								+25			
	V_O (V)	V_{IN} (V)	V_{DD} (V)	−55	−40	+85	+125	Min.	Typ.	Max.	
Quiescent Device Current, I_{DD} Max.	–	0,5	5	5	5	150	150	–	0.04	5	μA
	–	0,10	10	10	10	300	300	–	0.04	10	
	–	0,15	15	20	20	600	600	–	0.04	20	
	–	0,20	20	100	100	3000	3000	–	0.08	100	
Output Low (Sink) Current I_{OL} Min.	0.4	0,5	5	0.64	0.61	0.42	0.36	0.51	1	–	mA
	0.5	0,10	10	1.6	1.5	1.1	0.9	1.3	2.6	–	
	1.5	0,15	15	4.2	4	2.8	2.4	3.4	6.8	–	
Output High (Source) Current, I_{OH} Min.	4.6	0,5	5	−0.64	−0.61	−0.42	−0.36	−0.51	−1	–	
	2.5	0,5	5	−2	−1.8	−1.3	−1.15	−1.6	−3.2	–	
	9.5	0,10	10	−1.6	−1.5	−1.1	−0.9	−1.3	−2.6	–	
	13.5	0,15	15	−4.2	−4	−2.8	−2.4	−3.4	−6.8	–	
Output Voltage: Low-Level, V_{OL} Max.	–	0,5	5	0.05				–	0	0.05	V
	–	0,10	10	0.05				–	0	0.05	
	–	0,15	15	0.05				–	0	0.05	
Output Voltage: High-Level, V_{OH} Min.	–	0,5	5	4.95				4.95	5	–	
	–	0,10	10	9.95				9.95	10	–	
	–	0,15	15	14.95				14.95	15	–	
Input Low Voltage V_{IL} Max.	0.5,4.5	–	5	1.5				–	–	1.5	V
	1,9	–	10	3				–	–	3	
	1.5,13.5	–	15	4				–	–	4	
Input High Voltage, V_{IH} Min.	0.5,4.5	–	5	3.5				3.5	–	–	
	1,9	–	10	7				7	–	–	
	1.5,13.5	–	15	11				11	–	–	
Input Current* I_{IN} Max.	–	0,18	18	±0.1	±0.1	±1	±1	–	$±10^{-5}$	±0.1	μA
3-State Output Leakage Current I_{OUT} Max.	0,18	0,18	18	±0.4	±0.4	±12	±12	–	$±10^{-4}$	±0.4	μA

* All inputs except A and B Lines.

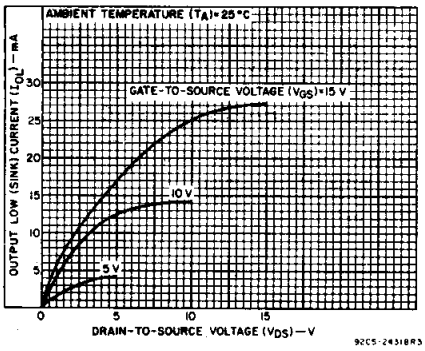


Fig. 5 – Typical output low (sink) current characteristics.

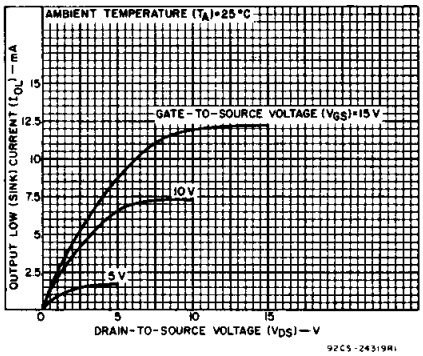


Fig. 6 – Minimum output low (sink) current characteristics.

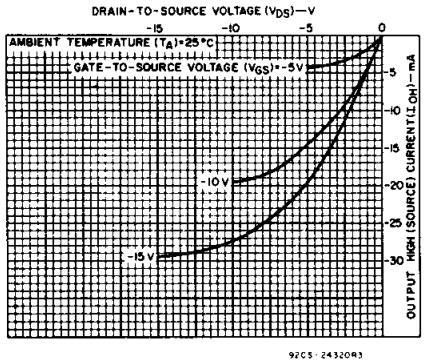


Fig. 7 – Typical output high (source) current characteristics.

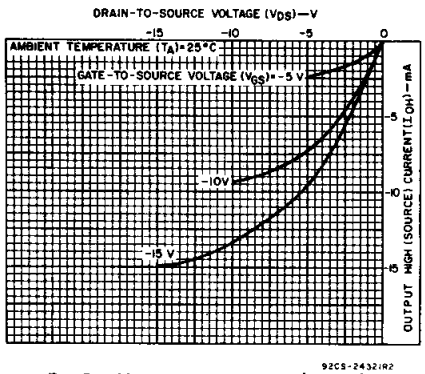


Fig. 8 – Minimum output high (source) current characteristics.

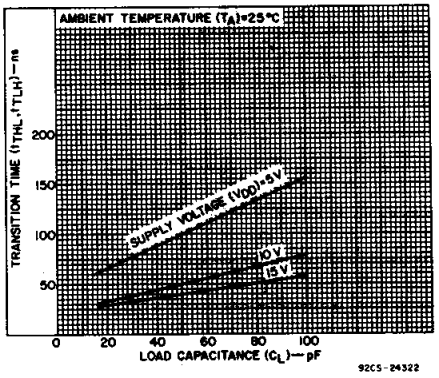


Fig. 9 – Typical transition time as a function of load capacitance.

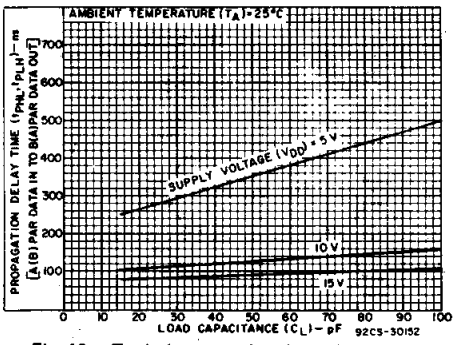


Fig. 10 – Typical propagation delay time as a function of load capacitance [A(B) parallel Data Input to B(A) parallel Data Output, synchronous or asynchronous].

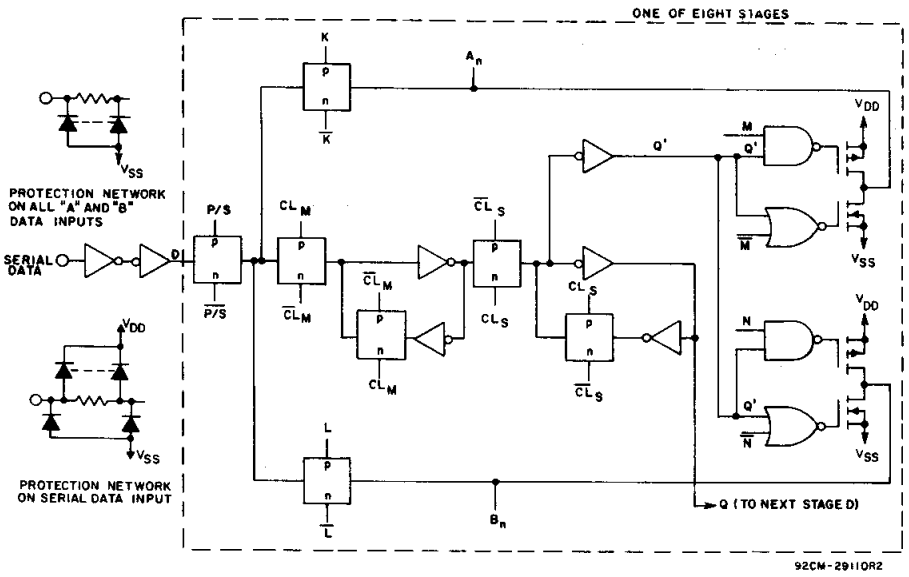


Fig. 11 – Register stage logic diagram (1 of 8 stages).

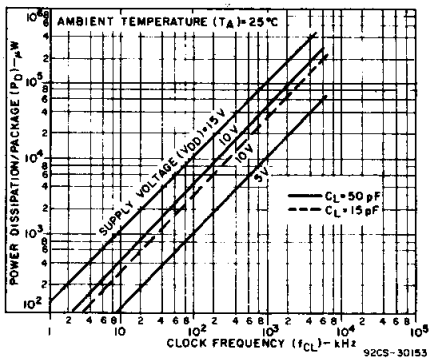


Fig. 12 – Typical dynamic power dissipation as a function of clock frequency.

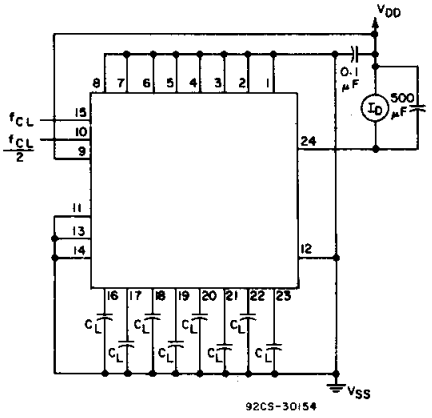


Fig. 13 – Dynamic power dissipation test circuit.

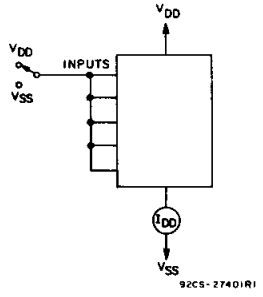


Fig. 14 – Quiescent-device-current test circuit.

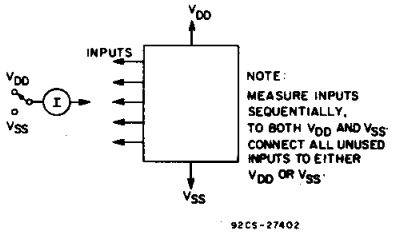


Fig. 15 – Input-current test circuit.

TRUTH TABLE FOR REGISTER INPUT-LEVELS AND RESULTING REGISTER OPERATION

"A" Enable	P/S	A/B	A/S	Operation*
0	0	0	X	Serial Mode; Synch. Serial Data Input, "A" Parallel Data Outputs Disabled
0	0	1	X	Serial Mode; Synch. Serial Data Input, "B" Parallel Data Output
0	1	0	0	Parallel Mode; "B" Synch. Parallel Data Inputs, "A" Parallel Data Outputs Disabled
0	1	0	1	Parallel Mode; "B" Asynch. Parallel Data Inputs, "A" Parallel Data Outputs Disabled
0	1	1	0	Parallel Mode; "A" Parallel Data Inputs Disabled, "B" Parallel Data Outputs, Synch. Data Recirculation
0	1	1	1	Parallel Mode; "A" Parallel Data Inputs Disabled, "B" Parallel Data Outputs, Asynch. Data Recirculation
1	0	0	X	Serial Mode; Synch. Serial Data Input, "A" Parallel Data Output
1	0	1	X	Serial Mode; Synch. Serial Data Input, "B" Parallel Data Output
1	1	0	0	Parallel Mode; "B" Synch. Parallel Data Input, "A" Parallel Data Output
1	1	0	1	Parallel Mode; "B" Asynch. Parallel Data Input, "A" Parallel Data Output
1	1	1	0	Parallel Mode; "A" Synch. Parallel Data Input, "B" Parallel Data Output
1	1	1	1	Parallel Mode; "A" Asynch. Parallel Data Input, "B" Parallel Data Output

*Outputs change at positive transition of clock in the serial mode and when the A/S control input is "low" in the parallel mode. During transfer from parallel to serial operation A/S should remain low in order to prevent D_S transfer into Flip Flops.

1 = HIGH LEVEL 0 = LOW LEVEL X = DON'T CARE

DYNAMIC ELECTRICAL CHARACTERISTICS *at T_A = 25°C; Input t_r, t_f = 20 ns, C_L = 50 pF, R_L = 200 kΩ*

CHARACTERISTIC		V_{DD} (V)	LIMITS			UNITS
			MIN.	TYP.	MAX.	
Propagation Delay Time,	t_{PHL}, t_{PLH}	5	—	350	700	ns
A(B) Parallel Data In to		10	—	120	240	
B(A) Parallel Data Out		15	—	85	170	
Serial to Parallel Data Out						
3-State Propagation Delay	t_{PLZ}, t_{PHZ}	5	—	200	400	
A/B or AE to "A" OUT	t_{PZL}, t_{PZH}	10	—	80	160	
		15	—	60	120	
Transition Time,	t_{THL}, t_{TLH}	5	—	100	200	
		10	—	50	100	
		15	—	40	80	
Minimum Data Setup Time,	t_{SU}	5	—	80	160	
Serial Data to Clock		10	—	30	60	
		15	—	20	40	
		5	—	25	50	
Parallel Data to Clock		10	—	15	30	
		15	—	10	20	
Minimum Data Hold Time,	t_H	5	—	—	50	
		10	—	—	15	
		15	—	—	10	
Minimum High-Level		5	—	175	350	
Pulse Width,	t_W	10	—	70	140	
AE, P/S, A/S		15	—	40	80	
Maximum Clock		5	2	4	—	MHz
Frequency,	f_{CL}	10	5	10	—	
		15	7	14	—	
Minimum Clock Pulse		5	—	125	250	ns
Width,	t_W	10	—	50	100	
		15	—	35	70	
Maximum Clock Rise or		5,10,15	—	—	15	μs
Fall Time,	t_rCL, t_fCL*					
Input Capacitance,	C_{IN}	Any Input	—	5	7.5	pF

*If more than one unit is cascaded t_rCL should be made less than or equal to the sum of the transition time and the fixed propagation delay of the output of the driving stage for the estimated capacitive load.

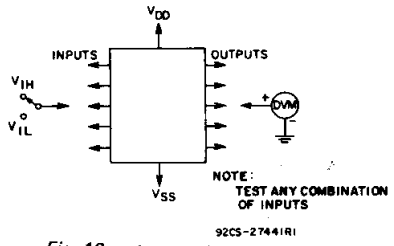


Fig. 16 — Input-voltage test circuit.

Applications

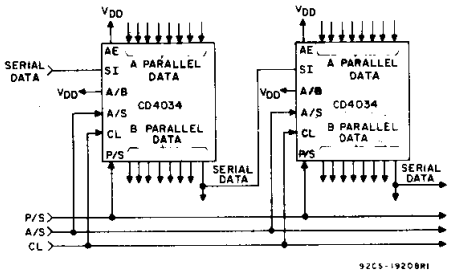


Fig. 17 — 16-bit parallel in/parallel out, parallel in/serial out, serial in/parallel out, serial in/serial out register.

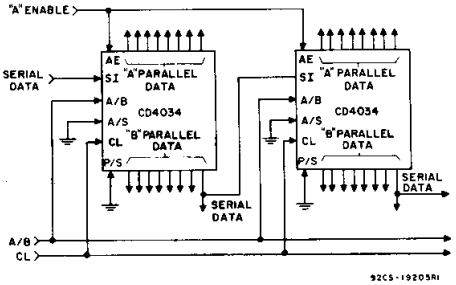
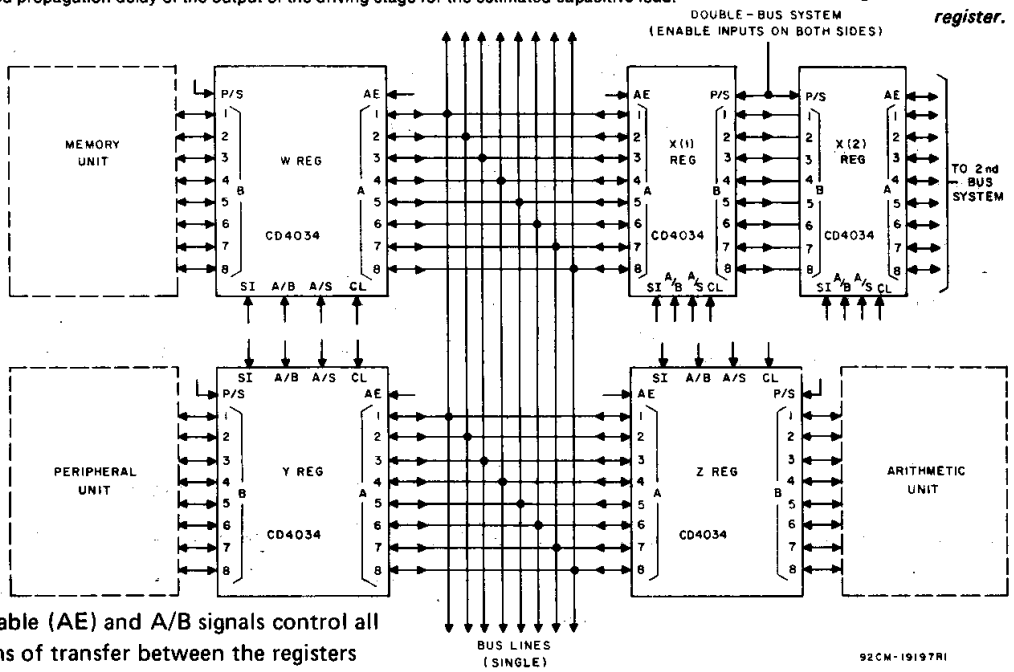
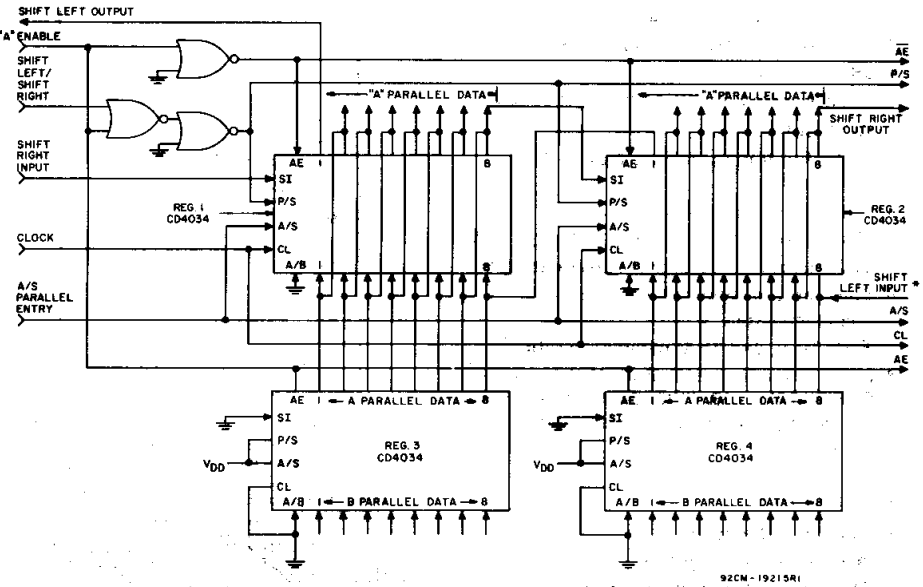


Fig. 18 — 16-bit serial in/gated parallel out register.



The "A" enable (AE) and A/B signals control all combinations of transfer between the registers and bus systems.

Fig. 19 — Single- and double-bus systems.



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 Reg. 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 Reg. 3 and 4 and associated logic are not required.

* Shift left input must be disabled during parallel entry.

Fig. 20 — Shift right/shift left with parallel inputs.

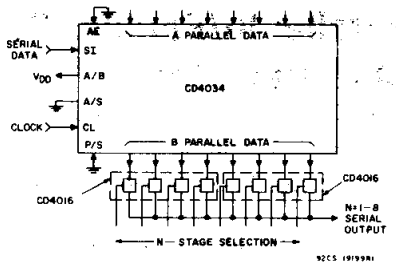


Fig. 21 — N-stage shift register with fixed serial output line.

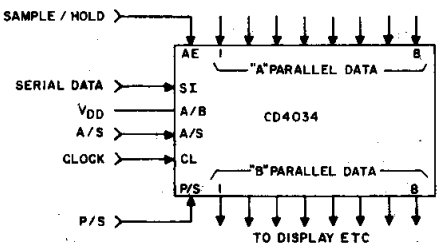
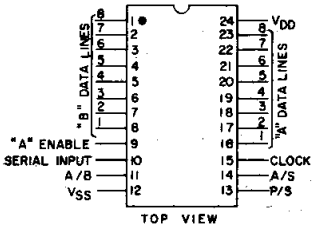
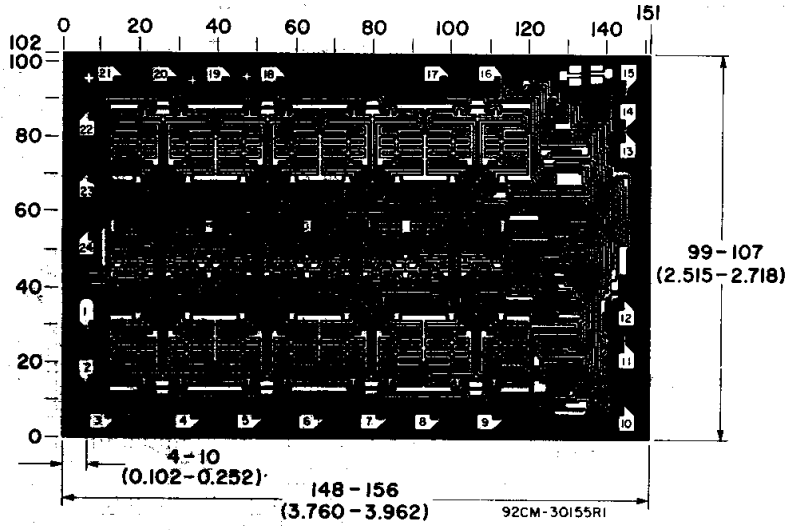


Fig. 22 — Sample and hold register—serial/parallel in—parallel out.



TERMINAL DIAGRAM



Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils (10^{-3} inch).

Dimensions and pad layout for CD4034BH.

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