National Semiconductor

February 1988

CD4035BM/CD4035BC
4-Bit Parallel-In/Parallel-Out Shift Register

General Description

The CD4035B 4-bit parallel-in/parallel-out shift register is a monolithic complementary MOS (CMOS) integrated circuit constructed with P- and N-channel enhancement mode transistors. This shift register is a 4-stage clocked serial register having provisions for synchronous parallel inputs to each stage and serial inputs to the first stage via $J\overline{K}$ logic. Register stages 2, 3, and 4 are coupled in a serial "D" flip-flop configuration when the register is in the serial mode (parallel/serial control low).

Parallel entry via the "D" line of each register stage is permitted only when the parallel/serial control is "high".

In the parallel or serial mode, information is transferred on positive clock transitions.

When the true/complement control is "high", the true contents of the register are available at the output terminals. When the true/complement control is "low", the outputs are the complements of the data in the register. The true/complement control functions asynchronously with respect to the clock signal.

$J\overline{K}$ input logic is provided on the first stage serial input to minimize logic requirements particularly in counting and sequence-generation applications. With $J\overline{K}$ inputs connected together, the first stage becomes a "D" flip-flop. An asynchronous common reset is also provided.

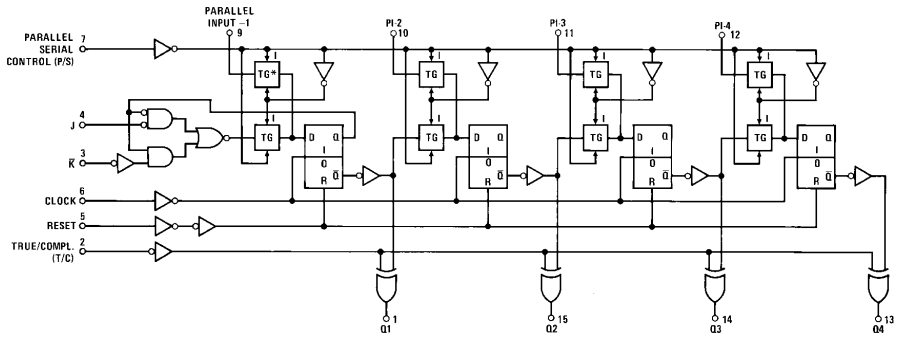
Features

- Wide supply voltage range — 3.0V to 15V
- High noise immunity — 0.45 V_{DD} (typ.)
- Low power TTL compatibility — Fan out of 2 driving 74L or 1 driving 74LS
- 4-stage clocked operation
- Synchronous parallel entry on all 4 stages
- $J\overline{K}$ inputs on first stage
- Asynchronous true/complement control on all outputs
- Reset control
- Static flip-flop operation; master/slave configuration
- Buffered outputs
- Low power dissipation — 5 μW (typ.) (ceramic)
- High speed — to 5 MHz

Applications

- Automotive
- Data terminals
- Instrumentation
- Medical electronics
- Alarm systems
- Industrial controls
- Remote metering
- Computers

Logic Diagram



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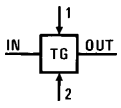
P/S = 0 = serial mode
T/C = 1 = true outputs
*TG = transmission gate

Input to output is:
a) A bidirectional low impedance when control input 1 is low and control input 2 is high.
b) An open circuit when control input 1 is high and control input 2 is low.



TL/F/5964–2

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

Absolute Maximum Ratings (Notes 1 and 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})	−0.5V to +18V
Input Voltage (V_{IN})	−0.5V to V_{DD} +0.5V
Storage Temperature 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

Operating Conditions (Note 2)

DC Supply Voltage (V_{DD})	3V to 15V
Input Voltage (V_{IN})	0V to V_{DD}V
Operating Temperature Range (T_A)	
CD4035BM	−55°C to +125°C
CD4035BC	−40°C to +85°C

DC Electrical Characteristics CD4035BM (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		0.3	5		150	μA
		V_{DD} = 10V, V_{IN} = V_{DD} or V_{SS}		10		0.5	10		300	μA
		V_{DD} = 15V, V_{IN} = V_{DD} or V_{SS}		20		1.0	20		600	μA
V_{OL}	Low Level Output Voltage	$\|I_O\|$ < 1.0 μA								
		V_{DD} = 5V		0.05		0	0.05		0.05	V
		V_{DD} = 10V		0.05		0	0.05		0.05	V
		V_{DD} = 15V		0.05		0	0.05		0.05	V
V_{OH}	High Level Output Voltage	$\|I_O\|$ < 1.0 μA								
		V_{DD} = 5V	4.95		4.95	5		4.95		V
		V_{DD} = 10V	9.95		9.95	10		9.95		V
		V_{DD} = 15V	14.95		14.95	15		14.95		V
V_{IL}	Low Level Input Voltage	$\|I_O\|$ < 1.0 μA								
		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	$\|I_O\|$ < 1.0 μA								
		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	0.64		0.51	0.88		0.36		mA
		V_{DD} = 10V, V_O = 0.5V	1.6		1.3	2.25		0.9		mA
		V_{DD} = 15V, V_O = 1.5V	4.2		3.4	8.8		2.4		mA
I_{OH}	High Level Output Current (Note 3)	V_{DD} = 5V, V_O = 4.6V	−0.25		−0.2	0.36		−0.14		mA
		V_{DD} = 10V, V_O = 9.5V	−0.62		−0.5	0.9		−0.35		mA
		V_{DD} = 15V, V_O = 13.5V	−1.8		−1.5	−3.5		−1.1		mA
I_{IN}	Input Current	V_{DD} = 15V, V_{IN} = 0V		−0.1		-10^{-5}	−0.1		−1.0	μA
		V_{DD} = 15V, V_{IN} = 15V		0.1		10^{-5}	0.1		1.0	μA

DC Electrical Characteristics CD4035BC (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		0.5	20		150	μA
		V_{DD} = 10V, V_{IN} = V_{DD} or V_{SS}		40		1.0	40		300	μA
		V_{DD} = 15V, V_{IN} = V_{DD} or V_{SS}		80		5.0	80		600	μA
V_{OL}	Low Level Output Voltage	$\|I_O\|$ < 1 μA								
		V_{DD} = 5V		0.05		0	0.05		0.05	V
		V_{DD} = 10V		0.05		0	0.05		0.05	V
		V_{DD} = 15V		0.05		0	0.05		0.05	V
V_{OH}	High Level Output Voltage	$\|I_O\|$ < 1 μA								
		V_{DD} = 5V	4.95		4.95	5		4.95		V
		V_{DD} = 10V	9.95		9.95	10		9.95		V
		V_{DD} = 15V	14.95		14.95	15		14.95		V

DC Electrical Characteristics CD4035BC (Note 2) (Continued)

Symbol	Parameter	Conditions	−40°C		25°C			85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
V_{IL}	Low Level Input Voltage	$\|I_O\| < 1\ \mu A$								
		$V_{DD} = 5V$, $V_O = 0.5V$ 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	$\|I_O\| < 1\ \mu A$								
		$V_{DD} = 5V$, $V_O = 0.5V$ 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	0.88		0.36		mA
		$V_{DD} = 10V$, $V_O = 0.5V$	1.3		1.1	2.25		0.9		mA
		$V_{DD} = 15V$, $V_O = 1.5V$	3.6		3.0	8.8		2.4		mA
I_{OH}	High Level Output Current (Note 3)	$V_{DD} = 5V$, $V_O = 4.6V$	−0.2		−0.16	0.36		−0.12		mA
		$V_{DD} = 10V$, $V_O = 9.5V$	−0.5		−0.4	0.9		−0.3		mA
		$V_{DD} = 15V$, $V_O = 13.5V$	−1.4		−1.2	−3.5		−1.0		mA
I_{IN}	Input Current	$V_{DD} = 15V$, $V_{IN} = 0V$		−0.3		-10^{-5}	−0.3		−1.0	μA
		$V_{DD} = 15V$, $V_{IN} = 15V$		0.3		10^{-5}	0.3		1.0	μA

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed, they are not meant to imply that the devices should be operated at these limits. The table of "Recommended Operating Conditions" and "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.

AC Electrical Characteristics*

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
CLOCKED OPERATION						
t_{PHL}, t_{PLH}	Propagation Delay Time	$V_{DD} = 5V$		250	500	ns
		$V_{DD} = 10V$		100	200	ns
		$V_{DD} = 15V$		75	150	ns
t_{THL}	Transition Time High Low to High	$V_{DD} = 5V$		90	175	ns
		$V_{DD} = 10V$		50	75	ns
		$V_{DD} = 15V$		40	60	ns
t_{TLH}	Transition Time Low to High	$V_{DD} = 5V$		135	270	ns
		$V_{DD} = 10V$		70	140	ns
		$V_{DD} = 15V$		60	120	ns
t_{WL}, t_{WH}	Minimum Clock Pulse Width	$V_{DD} = 5V$	335	135		ns
		$V_{DD} = 10V$	165	50		ns
		$V_{DD} = 15V$	100	40		ns
t_{rCL}, t_{fCL}	Clock Rise and Fall Time	$V_{DD} = 5V$			15	μs
		$V_{DD} = 10V$			10	μs
		$V_{DD} = 15V$			5	μs
t_S	Minimum Set-up Time J/$\overline{K}$ Lines	$V_{DD} = 5V$		250	500	ns
		$V_{DD} = 10V$		100	200	ns
		$V_{DD} = 15V$		80	160	ns
t_S	Parallel-In Lines	$V_{DD} = 5V$		250	500	ns
		$V_{DD} = 10V$		100	200	ns
		$V_{DD} = 15V$		80	160	ns
t_S	P/S Control	$V_{DD} = 5V$		100	200	ns
		$V_{DD} = 10V$		40	80	ns
		$V_{DD} = 15V$		35	60	ns
f_{MAX}	Maximum Clock Frequency	$V_{DD} = 5V$	1.5	2.5		MHz
		$V_{DD} = 10V$	3	6		MHz
		$V_{DD} = 15V$	5	9		MHz

AC Electrical Characteristics*

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

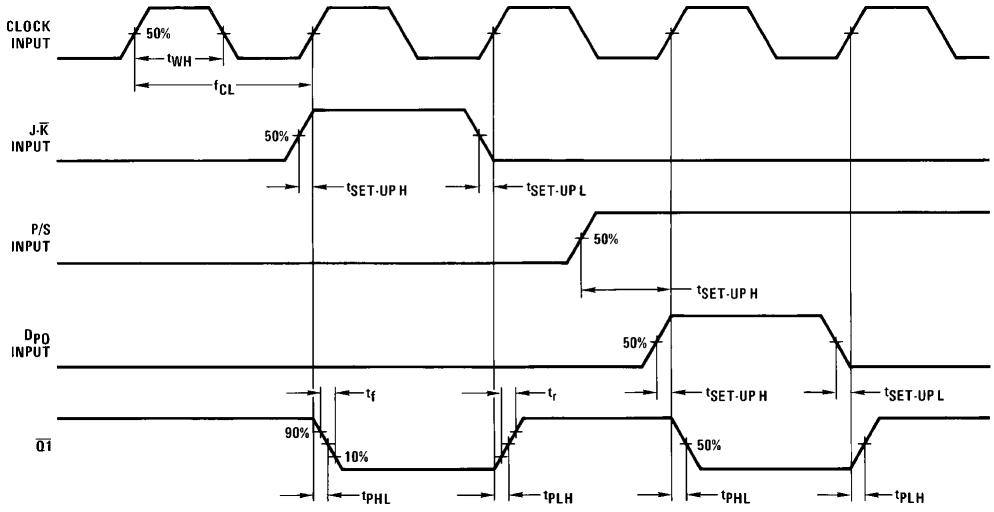
Symbol	Parameter	Conditions	Min	Typ	Max	Units
CLOCKED OPERATION (Continued)						
C_{IN}	Input Capacitance	Any Input		5	7.5	pF
RESET OPERATION						
t_{PHL}, t_{PLH}	Propagation Delay Time	V_{DD} = 5V		300	500	ns
		V_{DD} = 10V		150	200	ns
		V_{DD} = 15V		85	150	ns
t_{WH}	Minimum Reset Pulse Width	V_{DD} = 5V		75	250	ns
		V_{DD} = 10V		30	110	ns
		V_{DD} = 15V		25	80	ns

*AC Parameters are guaranteed by DC correlated testing.

Truth Table

C_L	$t_n - 1$ (Inputs)				t_n (Outputs)
	J	$\overline{K}$	R	Q_{n-1}	Q_n
⌐	0	X	0	0	0
⌐	I	X	0	0	I
⌐	X	0	0	I	0
⌐	I	0	0	Q_{n-1}	$\overline{Q_{n-1}}$ TOGGLE MODE
⌐	X	I	0	I	I
¬	X	X	0	Q_{n-1}	Q_{n-1}
X	X	X	I	X	0

Switching Time Waveforms



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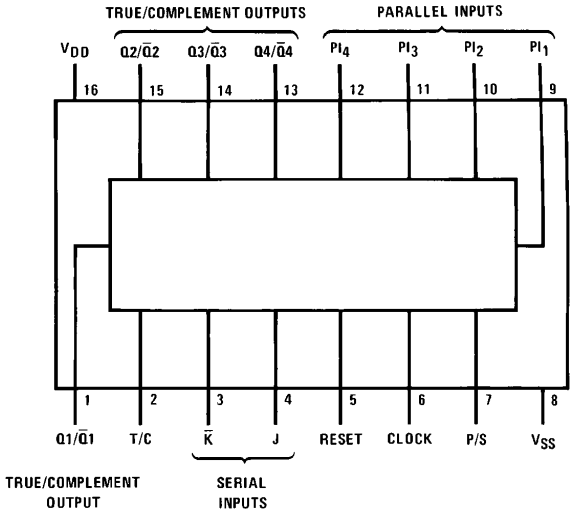
T/C Input Low

Reset Input Low

Connection Diagram

Dual-In-Line Package



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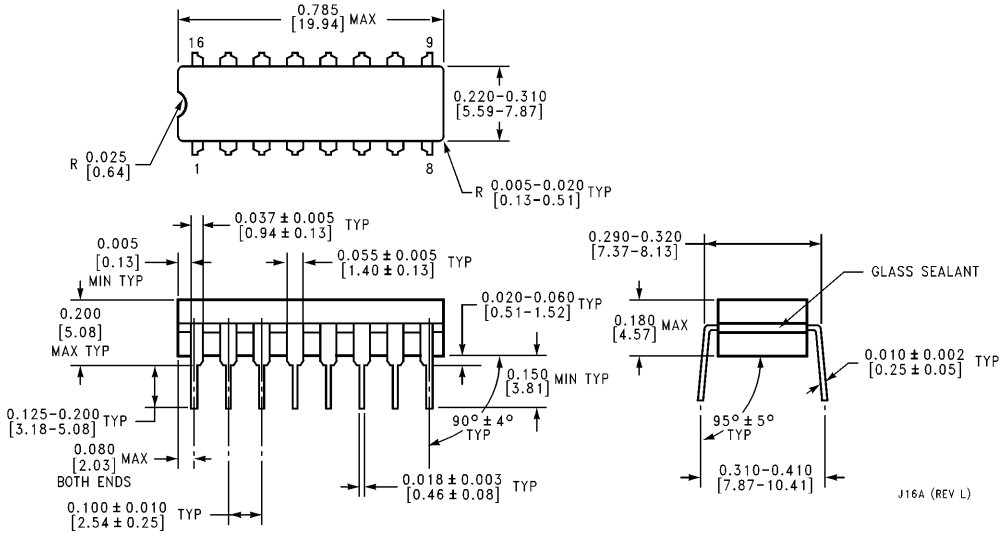
Top View

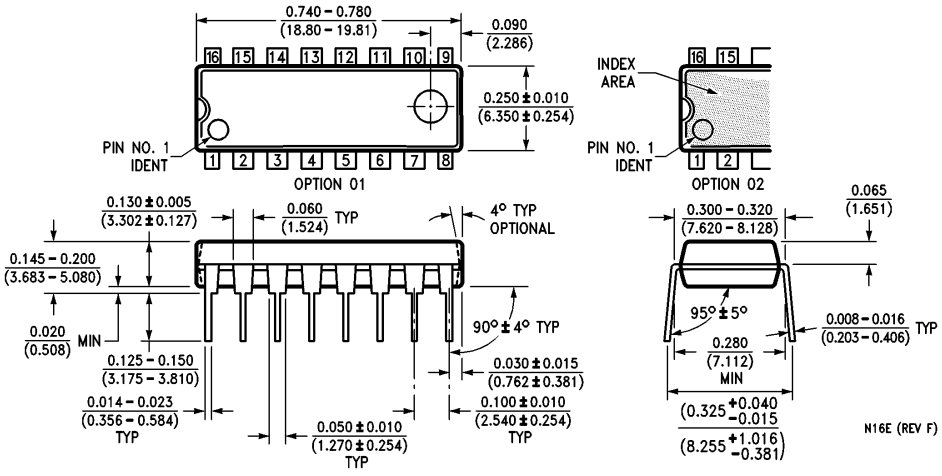
Order Number CD4035B

Physical Dimensions inches (millimeters)



Ceramic Dual-In-Line Package (J)
Order Number CD4035BMJ or CD4035BCJ
NS Package Number J16A

Physical Dimensions inches (millimeters) (Continued)



Molded Dual-In-Line Package (N)
Order Number CD4035BMN or CD4035BCN
NS Package Number N16E

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National Semiconductor Corporation
1111 West Bardin Road
Arlington, TX 76017
Tel: 1(800) 272-9959
Fax: 1(800) 737-7018

National Semiconductor Europe
Fax: (+49) 0-180-530 85 86
Email: cnjwge@tevm2.nsc.com
Deutsch Tel: (+49) 0-180-530 85 85
English Tel: (+49) 0-180-532 78 32
Français Tel: (+49) 0-180-532 93 58
Italiano Tel: (+49) 0-180-534 16 80

National Semiconductor Hong Kong Ltd.
13th Floor, Straight Block,
Ocean Centre, 5 Canton Rd.
Tsimshatsui, Kowloon
Hong Kong
Tel: (852) 2737-1600
Fax: (852) 2736-9960

National Semiconductor Japan Ltd.
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