

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 JK 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.

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

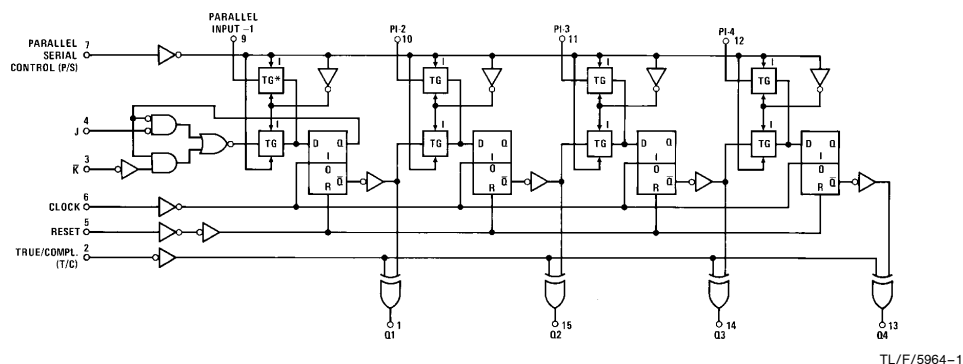
Features

- 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
- JK 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 μ W (typ.) (ceramic) to 5 mW
- High speed to 5 MHz

Applications

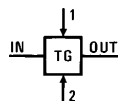
- Automotive
- Data terminals
- Instrumentation
- Medical electronics
- Alarm systems
- Industrial controls
- Remote metering
- Computers

Logic Diagram



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.



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 \mu A$								
		$V_{DD} = 5V$		0.05		0	0.05		0.05	V
		$V_{DD} = 10V$		0.05		0	0.05		0.05	V
V_{OH}	High Level Output Voltage	$ I_O < 1.0 \mu A$								
		$V_{DD} = 5V$	4.95		4.95	5		4.95		V
		$V_{DD} = 10V$	9.95		9.95	10		9.95		V
V_{IL}	Low Level Input Voltage	$ I_O < 1.0 \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_{IH}	High Level Input Voltage	$ I_O < 1.0 \mu A$								
		$V_{DD} = 5V, V_O = 0.5V$ or $4.5V$			3.5			3.5		V
		$V_{DD} = 10V, V_O = 1.0V$ or $9.0V$			7.0			7.0		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 \mu A$								
		$V_{DD} = 5V$		0.05		0	0.05		0.05	V
		$V_{DD} = 10V$		0.05		0	0.05		0.05	V
V_{OH}	High Level Output Voltage	$ I_O < 1 \mu A$								
		$V_{DD} = 5V$	4.95		4.95	5		4.95		V
		$V_{DD} = 10V$	9.95		9.95	10		9.95		V
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_{IH}	High Level Input Voltage	$ I_O < 1 \mu A$								
		$V_{DD} = 5V, V_O = 0.5V$ or $4.5V$			3.5			3.5		V
		$V_{DD} = 10V, V_O = 1.0V$ or $9.0V$			7.0			7.0		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) (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 μ A V _{DD} = 5V, V _O = 0.5V or 4.5V V _{DD} = 10V, V _O = 1.0V or 9.0V V _{DD} = 15V, V _O = 1.5V or 13.5V		1.5 3.0 4.0			1.5 3.0 4.0		1.5 3.0 4.0	V V V
V _{IH}	High Level Input Voltage	I _O < 1 μ A V _{DD} = 5V, V _O = 0.5V or 4.5V V _{DD} = 10V, V _O = 1.0V or 9.0V V _{DD} = 15V, V _O = 1.5V or 13.5V	3.5 7.0 11.0		3.5 7.0 11.0			3.5 7.0 11.0		V V V
I _{OL}	Low Level Output Current (Note 3)	V _{DD} = 5V, V _O = 0.4V V _{DD} = 10V, V _O = 0.5V V _{DD} = 15V, V _O = 1.5V	0.52 1.3 3.6		0.44 1.1 3.0	0.88 2.25 8.8		0.36 0.9 2.4		mA mA mA
I _{OH}	High Level Output Current (Note 3)	V _{DD} = 5V, V _O = 4.6V V _{DD} = 10V, V _O = 9.5V V _{DD} = 15V, V _O = 13.5V	−0.2 −0.5 −1.4		−0.16 −0.4 −1.2	0.36 0.9 −3.5		−0.12 −0.3 −1.0		mA mA mA
I _{IN}	Input Current	V _{DD} = 15V, V _{IN} = 0V V _{DD} = 15V, V _{IN} = 15V		−0.3 0.3		−10 ^{−5} 10 ^{−5}	−0.3 0.3		−1.0 1.0	μ A μ A

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 V _{DD} = 10V V _{DD} = 15V		250 100 75	500 200 150	ns ns ns
t _{THL}	Transition Time High Low to High	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		90 50 40	175 75 60	ns ns ns
t _{TLH}	Transition Time Low to High	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		135 70 60	270 140 120	ns ns ns
t _{WL} , t _{WH}	Minimum Clock Pulse Width	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V	335 165 100	135 50 40		ns ns ns
t _{rCL} , t _{fCL}	Clock Rise and Fall Time	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V			15 10 5	μ s μ s μ s
t _S	Minimum Set-up Time J/ $\bar{K}$ Lines	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		250 100 80	500 200 160	ns ns ns
t _S	Parallel-In Lines	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		250 100 80	500 200 160	ns ns ns
t _S	P/S Control	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		100 40 35	200 80 60	ns ns ns
f _{MAX}	Maximum Clock Frequency	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V	1.5 3 5	2.5 6 9		MHz MHz MHz

AC Electrical Characteristics*

$T_A = 25^\circ\text{C}$, $C_L = 50\text{ pF}$, $R_L = 200\text{ k}$, t_r and $t_f = 20\text{ ns}$, unless otherwise specified. (Continued)

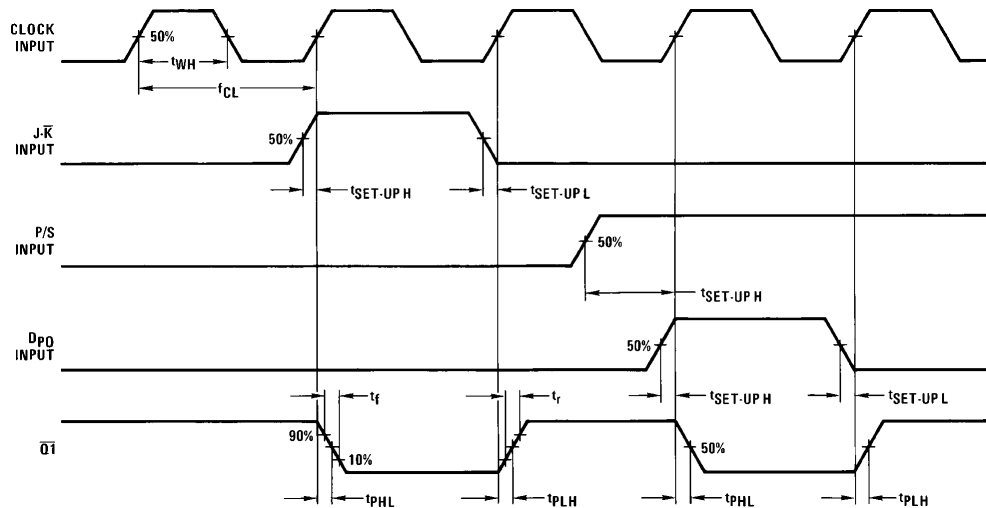
Symbol	Parameter	Conditions	Min	Typ	Max	Units
CLOCKED OPERATION (Continued)						
C_{IN}	Input Capacitance	Any Input		5	7.5	pF
RESET OPERATION						
t_{PHL}, t_{PLH}	Propagation Delay Time	$V_{DD} = 5\text{V}$ $V_{DD} = 10\text{V}$ $V_{DD} = 15\text{V}$		300 150 85	500 200 150	ns
t_{WH}	Minimum Reset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

*AC Parameters are guaranteed by DC correlated testing.

Truth Table

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

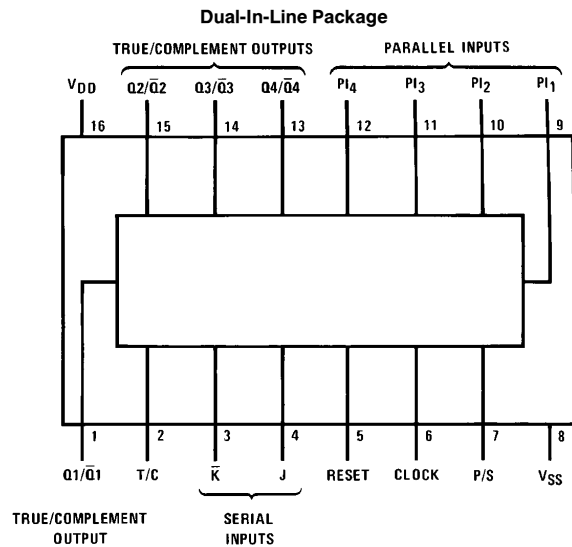
Switching Time Waveforms



T/C Input Low
Reset Input Low

TL/F/5964-3

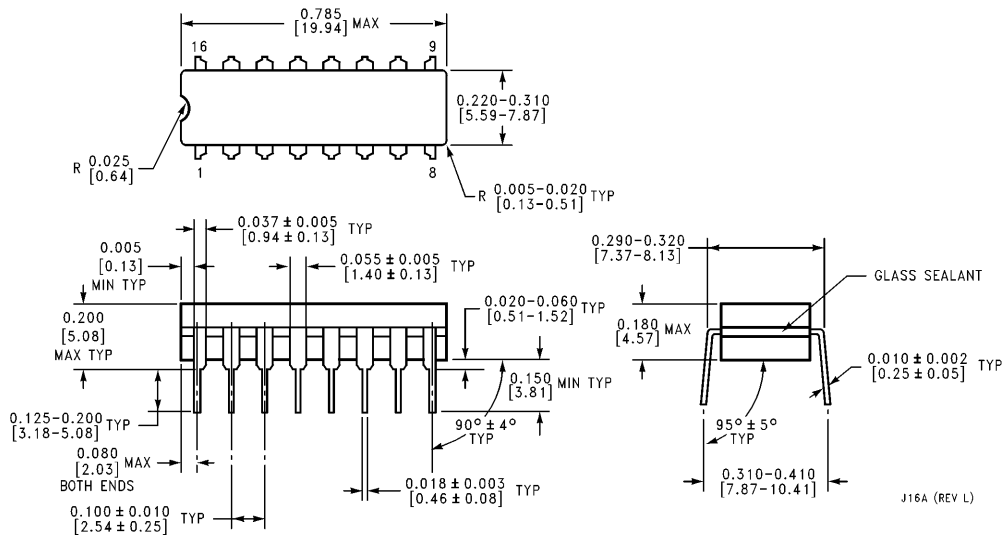
Connection Diagram



TL/F/5964-4

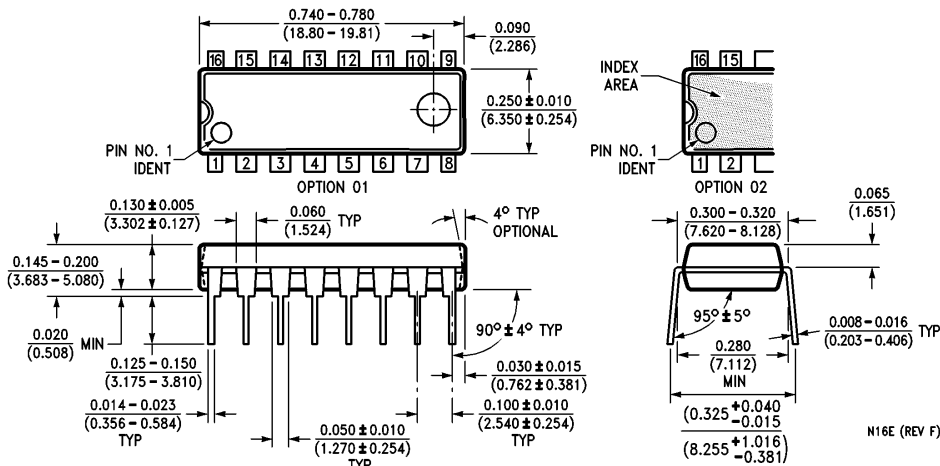
Order Number CD4035B

Physical Dimensions inches (millimeters)



J16A (REV L)

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.
 Tel: 81-043-299-2309
 Fax: 81-043-299-2408

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