National Semiconductor

February 1988

CD4031BM/CD4031BC
64-Stage Static Shift Register

General Description

The CD4031BM/CD4031BC is an integrated, complementary MOS (CMOS), 64-stage, fully static shift register. Two data inputs, DATA IN and RECIRCULATE IN, and a MODE CONTROL input are provided. Data at the DATA input (when MODE CONTROL is low) or data at the RECIRCULATE input (when MODE CONTROL is high), which meets the setup and hold time requirements, is entered into the first stage of the register and is shifted one stage at each positive transition of the CLOCK.

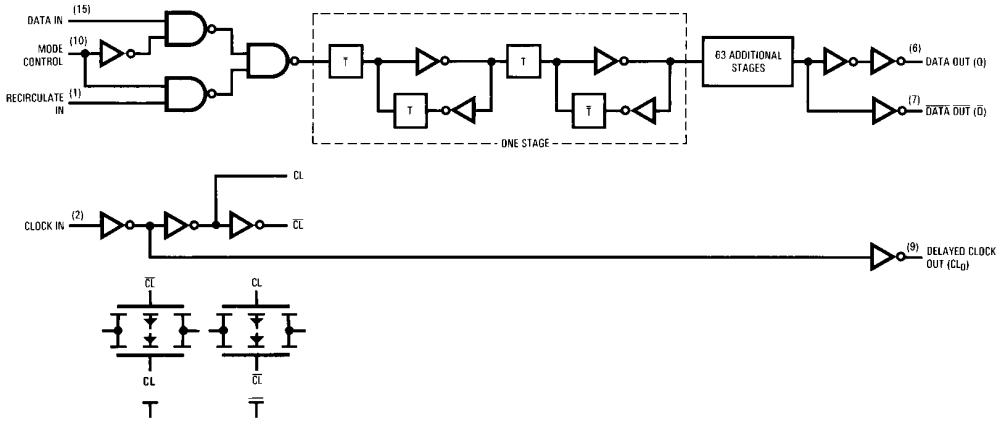
Data output is available in both true and complement forms from the 64th stage. Both the DATA OUT (Q) AND $\overline{\text{DATA OUT}}$ ($\overline{Q}$) outputs are fully buffered.

The CLOCK input of the CD4031BM/CD4031BC is fully buffered, and present only a standard input load capacitance. However, a DELAYED CLOCK OUTPUT (CL_D) has been provided to allow reduced clock drive fan-out and transition time requirements when cascading packages.

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
- Fully static operation — DC to 8 MHz, V_{DD} = 10V (typ.)
- Fully buffered clock input — 5 pF (typ.) input capacitance
- Single phase clocking requirements
- Delayed clock output for reduced clock drive requirements
- Fully buffered outputs
- High current sinking capability — 1.6 mA
- Q output — @ V_{DD} = 5V and 25°C

Logic and Connection Diagrams



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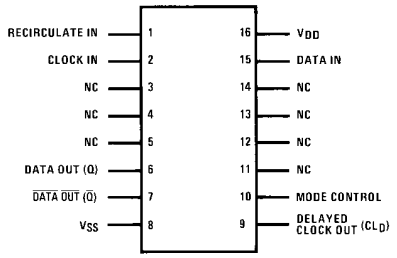
Dual-In-Line Package



Top View

TL/F/5962–2

Order Number CD4031B

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.

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 Temp. (T_L) (Soldering, 10 sec.)	260°C

Recommended Operating Conditions (Note 2)

Supply Voltage (V_{DD})	3V to 15V
Input Voltage (V_{IN})	0V to V_{DD}
Operating Temperature Range (T_A)	
CD4031BM	−55°C to +125°C
CD4031BC	−40°C to +85°C

DC Electrical Characteristics (Note 2) CD4031BM

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		0.01	5		150	μA
		V_{DD} = 10V, V_{IN} = V_{DD} or V_{SS}		10		0.01	10		300	μA
		V_{DD} = 15V, V_{IN} = V_{DD} or V_{SS}		20		0.02	20		600	μA
V_{OL}	Low Level Output Voltage	V_{DD} = 5V, V_{IH} = V_{DD}, V_{IL} = 0V, $\|I_O\|$ < 1 μA		0.05		0	0.05		0.05	V
		V_{DD} = 10V, V_{IH} = V_{DD}, V_{IL} = 0V, $\|I_O\|$ < 1 μA		0.05		0	0.05		0.05	V
		V_{DD} = 15V, V_{IH} = V_{DD}, V_{IL} = 0V, $\|I_O\|$ < 1 μA		0.05		0	0.05		0.05	V
V_{OH}	High Level Output Voltage	V_{DD} = 5V, V_{IH} = V_{DD}, V_{IL} = 0V, $\|I_O\|$ < 1 μA	4.95		4.95	5		4.95		V
		V_{DD} = 10V, V_{IH} = V_{DD}, V_{IL} = 0V, $\|I_O\|$ < 1 μA	9.95		9.95	10		9.95		V
		V_{DD} = 15V, V_{IH} = V_{DD}, V_{IL} = 0V, $\|I_O\|$ < 1 μA	14.95		14.95	15		14.95		V
V_{IL}	Low Level Input Voltage	V_{DD} = 5V, V_O = 0.5V or 4.5V, $\|I_O\|$ < 1 μA		1.5		2.25	1.5		1.5	V
		V_{DD} = 10V, V_O = 1.0V or 9.0V, $\|I_O\|$ < 1 μA		3.0		4.5	3.0		3.0	V
		V_{DD} = 15V, V_O = 1.5V or 13.5V, $\|I_O\|$ < 1 μA		4.0		6.75	4.0		4.0	V
V_{IH}	High Level Input Voltage	V_{DD} = 5V, V_O = 0.5V or 4.5V, $\|I_O\|$ < 1 μA	3.5		3.5	2.75		3.5		V
		V_{DD} = 10V, V_O = 1.0V or 9.0V, $\|I_O\|$ < 1 μA	7.0		7.0	5.5		7.0		V
		V_{DD} = 15V, V_O = 1.5V or 13.5V, $\|I_O\|$ < 1 μA	11.0		11.0	8.25		11.0		V
I_{OL}	Low Level Output Current, Q Output (Note 3)	V_{DD} = 5V, V_O = 0.4V, V_{IH} = V_{DD}, V_{IL} = 0V	2.3		1.9	3.8		1.3		mA
		V_{DD} = 10V, V_O = 0.5V, V_{IH} = V_{DD}, V_{IL} = 0V	5.1		4.2	8.4		2.8		mA
		V_{DD} = 15V, V_O = 1.5V, V_{IH} = V_{DD}, V_{IL} = 0V	10.5		8.8	17		6.1		mA
I_{OL}	Low Level Output Current, $\overline{Q}$ and CL_D Outputs (Note 3)	V_{DD} = 5V, V_O = 0.4V, V_{IH} = V_{DD}, V_{IL} = 0V	0.64		0.51	0.88		0.36		mA
		V_{DD} = 10V, V_O = 0.5V, V_{IH} = V_{DD}, V_{IL} = 0V	1.6		1.3	2.25		0.9		mA
		V_D = 15V, V_O = 1.5V, V_{IH} = V_{DD}, V_{IL} = 0V	4.2		3.4	8.8		2.4		mA
I_{OH}	High Level Output Current, All Outputs (Note 3)	V_{DD} = 5V, V_O = 4.6V, V_{IH} = V_{DD}, V_{IL} = 0V	−0.64		−0.51	−0.88		−0.36		mA
		V_{DD} = 10V, V_O = 9.5V, V_{IH} = V_{DD}, V_{IL} = 0V	−1.6		−1.3	−2.25		−0.9		mA
		V_{DD} = 15V, V_O = 13.5V, V_{IH} = V_{DD}, V_{IL} = 0V	−4.2		−3.4	−8.8		−2.4		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

Truth Tables

Mode Control (Data Selection)

Mode Control	Data In	Recirculate In	Data Into First Stage
0	0	X	0
0	1	X	1
1	X	0	0
1	X	1	1

Each Stage

D_n	CL	Q_n
0	⌐	0
1	⌐	1
X	¬	NC

X = irrelevant NC = no change ⌐ = Low to High level transition ¬ = High to Low level transition

DC Electrical Characteristics (Note 2) CD4031BC

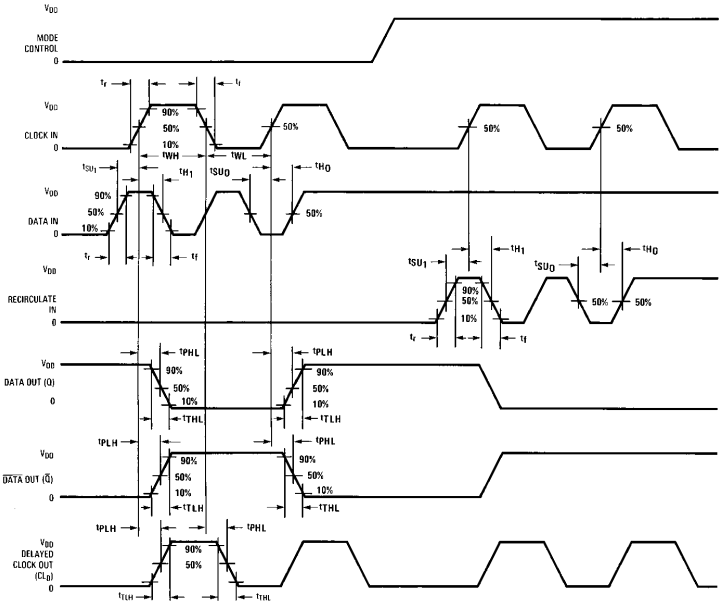
Symbol	Parameter	Conditions	−40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{DD}	Quiescent Device Current	V_{DD} = 5V, V_{IN} = V_{DD} or V_{SS}		20		0.01	20		150	μA
		V_{DD} = 10V, V_{IN} = V_{DD} or V_{SS}		40		0.01	40		300	μA
		V_{DD} = 15V, V_{IN} = V_{DD} or V_{SS}		80		0.02	80		600	μA
V_{OL}	Low Level Output Voltage	V_{DD} = 5V		0.05		0	0.05		0.05	V
		V_{DD} = 10V, V_{IH} = V_{DD}, V_{IL} = 0V, $\|I_O\| < 1$ μA		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	V_{DD} = 5V	4.95		4.95	5		4.95		V
		V_{DD} = 10V, V_{IH} = V_{DD}, V_{IL} = 0V, $\|I_O\| < 1$ μA	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	V_{DD} = 5V, V_O = 0.5V or 4.5V		1.5		2.25	1.5		1.5	V
		V_{DD} = 10V, V_O = 1.0V or 9.0V, $\|I_O\| < 1$ μA		3.0		4.5	3.0		3.0	V
		V_{DD} = 15V, V_O = 1.5V or 13.5V		4.0		6.75	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	2.75		3.5		V
		V_{DD} = 10V, V_O = 1.0V or 9.0V, $\|I_O\| < 1$ μA	7.0		7.0	5.5		7.0		V
		V_{DD} = 15V, V_O = 1.5V or 13.5V	11.0		11.0	8.25		11.0		V
I_{OL}	Low Level Output Current, Q Output (Note 3)	V_{DD} = 5V, V_O = 0.4V	1.8		1.6	3.8		1.3		mA
		V_{DD} = 10V, V_O = 0.5V, V_{IH} = V_{DD}, V_{IL} = 0V	4.0		3.5	8.4		2.8		mA
		V_{DD} = 15V, V_O = 1.5V	8.7		7.5	17		6.1		mA
I_{OL}	Low Level Output Current, $\overline{Q}$ and CL_D Outputs (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, V_{IH} = V_{DD}, V_{IL} = 0V	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, All Outputs (Note 3)	V_{DD} = 5V, V_O = 4.6V	−0.52		−0.44	−0.88		−0.36		mA
		V_{DD} = 10V, V_O = 9.5V, V_{IH} = V_{DD}, V_{IL} = 0V	−1.3		−1.1	−2.25		−0.9		mA
		V_{DD} = 15V, V_O = 13.5V	−3.0		−3.0	−8.8		−2.4		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 tables of 'Recommended Operating Conditions" and "Electrical Characteristics" provide 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.

Switching Time Waveforms



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AC Electrical Characteristics*

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

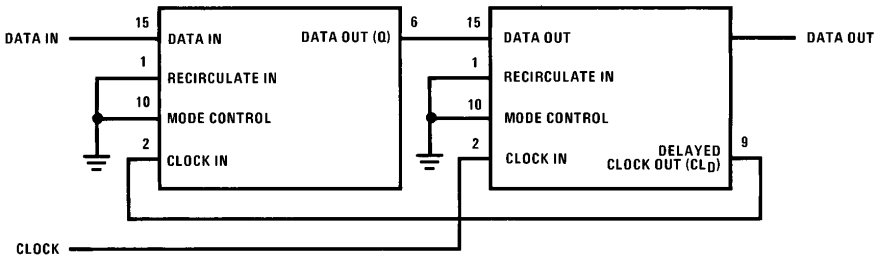
Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{PHL}, t_{PLH}	Propagation Delay Time, Clock to Q and $\overline{Q}$	$V_{CC} = 5V$		300	600	ns
		$V_{CC} = 10V$		125	250	ns
		$V_{CC} = 15V$		100	200	ns
t_{PHL}, t_{PLH}	Propagation Delay Time, Clock to CL_D	$V_{CC} = 5V$		125	250	ns
		$V_{CC} = 10V$		60	125	ns
		$V_{CC} = 15V$		50	100	ns
t_{THL}, t_{TLH}	Output Transition Time, All Outputs	$V_{CC} = 5V$		100	200	ns
		$V_{CC} = 10V$		50	100	ns
		$V_{CC} = 15V$		40	80	ns
t_{SU_0} t_{SU_1}	Minimum Data Setup Time, DATA IN or RECIRCULATE IN to Clock	$V_{CC} = 5V$		100	200	ns
		$V_{CC} = 10V$		50	100	ns
		$V_{CC} = 15V$		40	80	ns
t_{H_0} t_{H_1}	Minimum Data Hold Time, Clock to DATA IN or RECIRCULATE IN	$V_{CC} = 5V$		100	200	ns
		$V_{CC} = 10V$		50	100	ns
		$V_{CC} = 15V$		40	80	ns
t_{WL}, t_{WH}	Minimum Clock Pulse Width	$V_{CC} = 5V$		150	30	ns
		$V_{CC} = 10V$		60	125	ns
		$V_{CC} = 15V$		50	100	ns
f_{CL}	Maximum Clock Frequency	$V_{CC} = 5V$	1.6	3.2		MHz
		$V_{CC} = 10V$	4.0	8.0		MHz
		$V_{CC} = 15V$	5.0	10		MHz
t_{RCL}, t_{FCL}	Maximum Clock Input Rise and Fall Times (Note 4)	$V_{CC} = 5V$	15			μs
		$V_{CC} = 10V$	10			μs
		$V_{CC} = 15V$	5			μs
C_{IN}	Input Capacitance	Any Input		5	7.5	pF

*AC Parameters are guaranteed by DC correlated testing.

Note 4: When clocking cascaded packages in parallel, one should insure that: $t_{r\,CL} \leq 2\,(t_{PD} - t_H)$ where: t_{PD} = the propagation delay of the driving stage and t_H = the hold time of the driven stage.

Block Diagram

cascading packages using DELAYED CLOCK (CL_D) output



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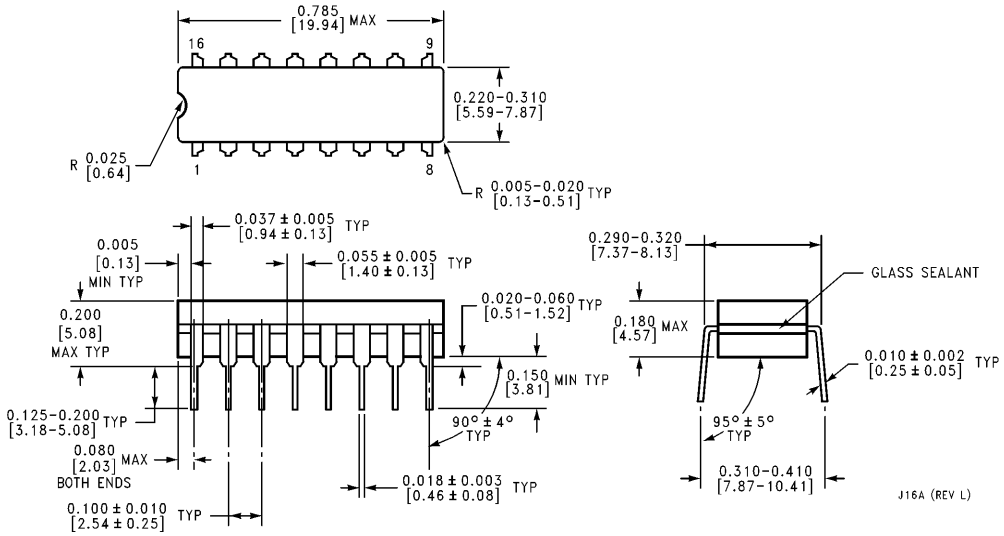
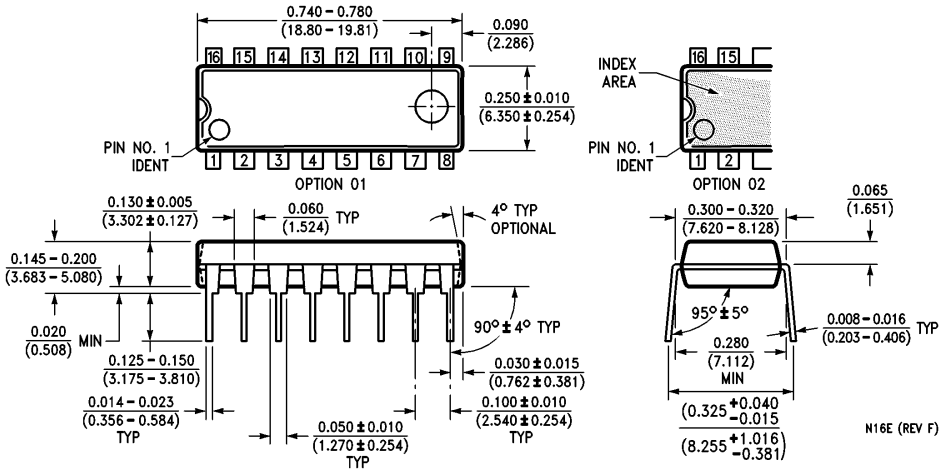
Physical Dimensions inches (millimeters)



Ceramic Dual-In-Line Package (J)
Order Number CD4031BMJ or CD4031BCJ
NS Package Number J16A

Physical Dimensions inches (millimeters) (Continued)



Molded Dual-In-Line Package (N)
Order Number CD4031BMN or CD4031BCN
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