TEXAS INSTRUMENTS

Data sheet acquired from Harris Semiconductor
SCHS024A – Revised March 2002

CD4014B, CD4021B Types

CMOS 8-Stage Static Shift Registers

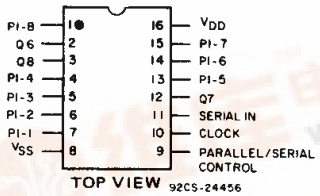
High-Voltage Types (20-Volt Rating)

CD4014B:
Synchronous Parallel or Serial Input/Serial Output

CD4021B:
Asynchronous Parallel Input or Synchronous Serial Input/Serial Output

■ CD4014B and CD4021B series types are 8-stage parallel- or serial-input/serial output registers having common CLOCK and PARALLEL/SERIAL CONTROL inputs, a single SERIAL data input, and individual parallel "JAM" inputs to each register stage. Each register stage is a D-type, master-slave flip-flop. In addition to an output from stage 8, "Q" outputs are also available from stages 6 and 7. Parallel as well as serial entry is made into the register synchronously with the positive clock line transition in the CD4014B. In the CD4021B serial entry is synchronous with the clock but parallel entry is asynchronous. In both types, entry is controlled by the PARALLEL/SERIAL CONTROL input. When the PARALLEL/SERIAL CONTROL input is low, data is serially shifted into the 8-stage register synchronously with the positive transition of the clock line. When the PARALLEL/SERIAL CONTROL input is high, data is jammed into the 8-stage register via the parallel input lines and synchronous with the positive transition of the clock line. In the CD4021B, the CLOCK input of the internal stage is "forced" when asynchronous parallel entry is made. Register expansion using multiple packages is permitted.

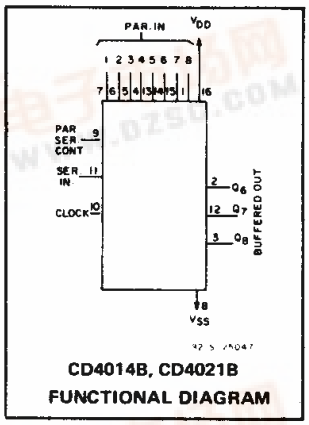
The CD4014B and CD4021b series types are supplied in 16-lead hermetic dual-in-line ceramic packages (D and F suffixes), 16-lead dual-in-line plastic packages (E suffix), 16-lead small-outline package (NSR suffix), and in chip form (H suffix).



TERMINAL DIAGRAM
CD4014B, CD4021B

Features:

- Medium-speed operation . . . 12 MHz (typ.) clock rate at $V_{DD}-V_{SS}$ = 10 V
- Fully static operation
- 8 master-slave flip-flops plus output buffering and control gating
- 100% tested for quiescent current at 20 V
- Maximum input current of 1 μA at 18 V over full package-temperature range; 100 nA at 18 V and 25°C
- Noise margin (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
- Standardized, symmetrical output characteristics
- 5-V, 10-V, and 15-V parametric ratings
- Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"



CD4014B, CD4021B
FUNCTIONAL DIAGRAM

Applications:

- Parallel input/serial output data queueing
- Parallel to serial data conversion
- General-purpose register

RECOMMENDED OPERATING CONDITIONS AT T_A = 25°C, Unless Otherwise Specified

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 (T_A = Full Package-Temperature Range)	–	3	18	V
Clock Pulse Width, t_W	5	180	–	ns
	10	80	–	
	15	50	–	
Clock Frequency, f_{CL}	5	–	3	MHz
	10	–	6	
	15	–	8.5	
Clock Rise and Fall Time, t_rCL, t_fCL	5	–	15	μs
	10	–	15	
	15	–	15	
Set-up Time, t_s:				
Serial Input (ref. to CL)	5	120	–	ns
	10	80	–	
	15	60	–	
Parallel Inputs CD4014B (ref. to CL)	5	80	–	ns
	10	50	–	
	15	40	–	
Parallel Inputs CD4021B (ref. to P/S)	5	50	–	ns
	10	30	–	
	15	20	–	
Parallel/Serial Control CD4014B (ref. to CL)	5	180	–	ns
	10	80	–	
	15	60	–	
Parallel/Serial Pulse Width, t_W (CD4021B)	5	160	–	ns
	10	80	–	
	15	50	–	
Parallel/Serial Removal Time, t_{REM} (CD4021B)	5	280	–	ns
	10	140	–	
	15	100	–	

3 COMMERCIAL CMOS HIGH VOLTAGE ICs

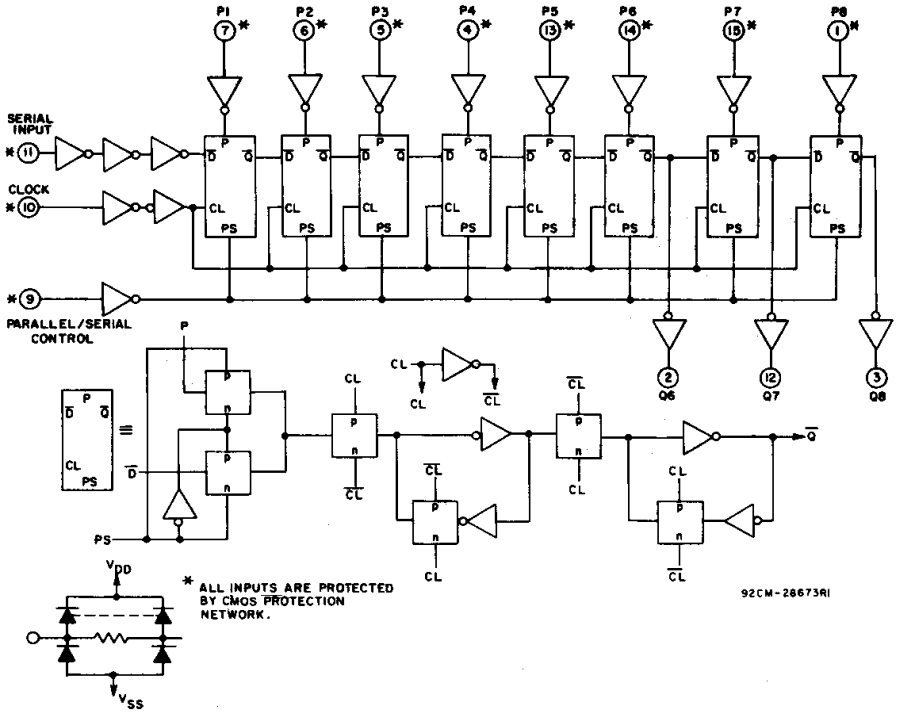


Fig. 1 – Logic diagram for CD4014B.

TRUTH TABLE – CD4014B

CL	SER IN	PAR SER CONTROL	PI-1	PI-n	Q_1 (INTERNAL)	Q_n	
↑	X	1	0	0	0	0	
↑	X	1	1	0	1	0	
↑	X	1	0	1	0	1	
↑	X	1	1	1	1	1	
↑	0	0	X	X	0	Q_{n-1}	
↑	1	0	X	X	1	Q_{n-1}	
↓	X	X	X	X	Q_1	Q_n	NC

X = DON'T CARE CASE
NC = NO CHANGE

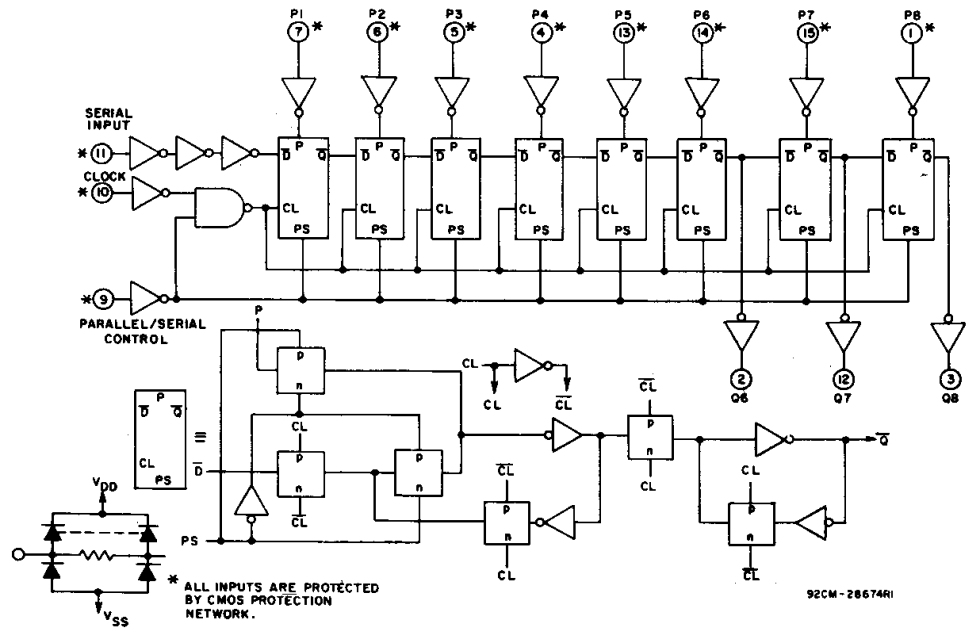


Fig. 2 – Logic diagram for CD4021B.

TRUTH TABLE – CD4021B

CL	Serial Input	Parallel/ Serial Control	PI-1	PI-n	Q_1 (Internal)	Q_n	
X	X	1	0	0	0	0	
X	X	1	0	1	0	1	
X	X	1	1	0	1	0	
X	X	1	1	1	1	1	
↑	0	0	X	X	0	Q_{n-1}	
↑	1	0	X	X	1	Q_{n-1}	
↓	X	0	X	X	Q_1	Q_n	NC

X = DON'T CARE CASE

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

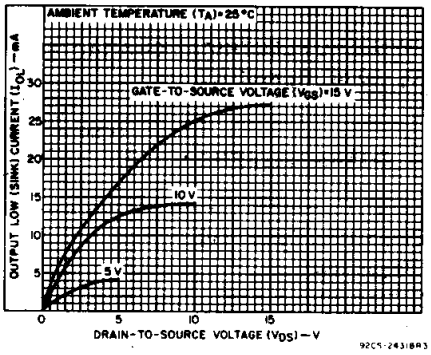


Fig. 3 — Typical output low (sink) current characteristics.

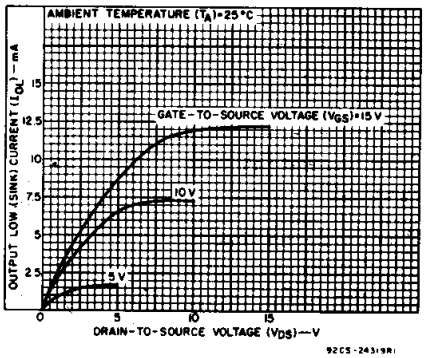


Fig. 4 — Minimum output low (sink) current characteristics.

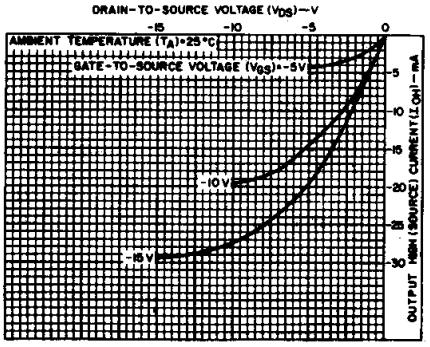


Fig. 5 — Typical output high (source) current characteristics.

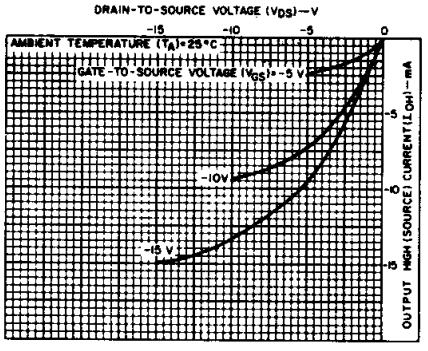


Fig. 6 — Minimum output high (source) current characteristics.

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	–	$\pm 10^{-5}$	±0.1	μA

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

CHARACTERISTIC	TEST CONDITIONS V_{DD} (V)	LIMITS Min.	Typ.	Max.	UNITS
Propagation Delay Time, t_{PLH}, t_{PHL}	5	–	160	320	ns
	10	–	80	160	
	15	–	60	120	
Transition Time, t_{THL}, t_{TLH}	5	–	100	200	ns
	10	–	50	100	
	15	–	40	80	
Maximum Clock Input Frequency, f_{CL}	5	3	6	–	MHz
	10	6	12	–	
	15	8.5	17	–	
Minimum Clock Pulse Width, t_W	5	–	90	180	ns
	10	–	40	80	
	15	–	25	50	
Clock Rise and Fall Time, t_rCL, t_fCL*	5	–	–	15	μs
	10	–	–	15	
	15	–	–	15	
Minimum Set-up Time, t_s: Serial Input (ref. to CL)	5	–	60	120	ns
	10	–	40	80	
	15	–	30	60	
Parallel Inputs CD4014B (ref. to CL)	5	–	40	80	ns
	10	–	25	50	
	15	–	20	40	
Parallel Inputs CD4021B (ref. to P/S)	5	–	25	50	ns
	10	–	15	30	
	15	–	10	20	
Parallel/Serial Control CD4014B (ref. to CL)	5	–	90	180	ns
	10	–	40	80	
	15	–	30	60	
Minimum Hold Time, t_H: Serial In, Parallel In, Parallel/Serial Control	5	–	–	0	ns
	10	–	–	0	
	15	–	–	0	
Minimum P/S Pulse Width, t_{WH} (CD4021B)	5	–	80	160	ns
	10	–	40	80	
	15	–	25	50	
Minimum P/S Removal Time, t_{REM} CD4021B (ref. to CL)	5	–	140	280	ns
	10	–	70	140	
	15	–	50	100	
Average Input Capacitance, C_I	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.

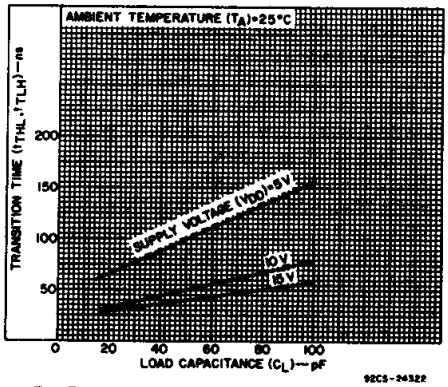


Fig. 7 – Typical transition time as a function of load capacitance.

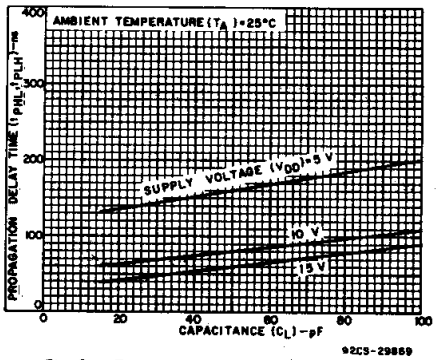


Fig. 8 – Typical propagation delay time as a function of load capacitance.

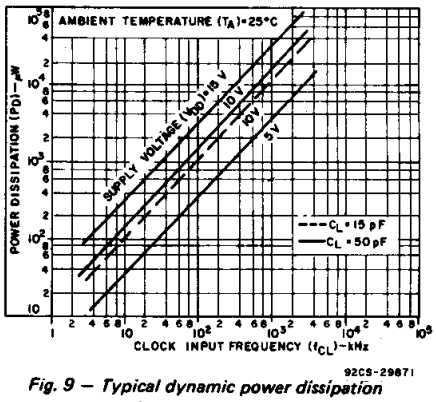


Fig. 9 – Typical dynamic power dissipation as a function of clock input frequency.

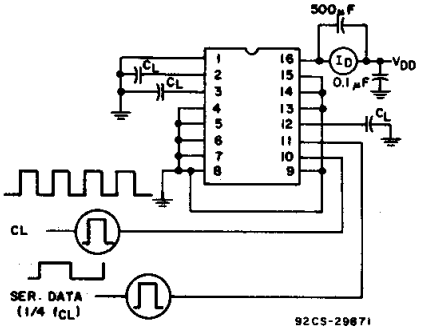


Fig. 10 – Dynamic power dissipation test circuit.

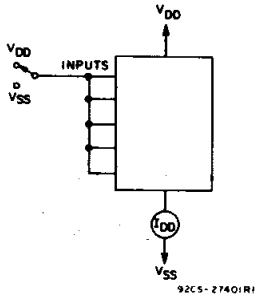


Fig. 11 – Quiescent device current test circuit.

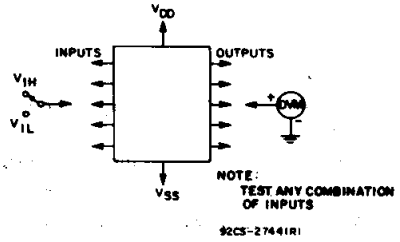


Fig. 12 – Input voltage test circuit.

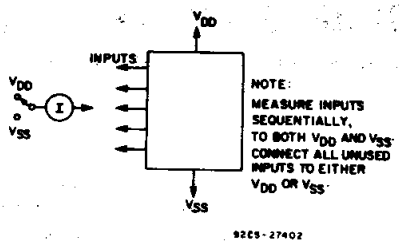
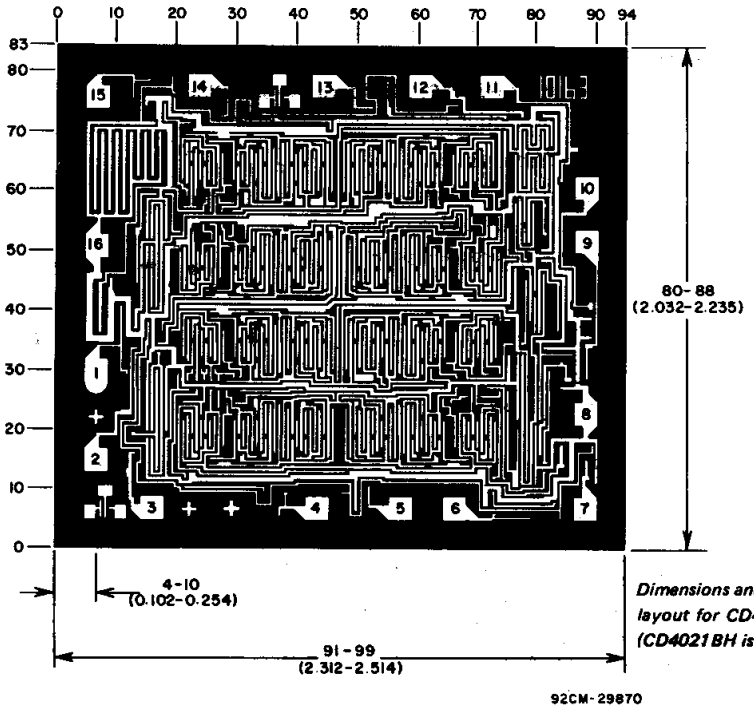


Fig. 13 – Input current test circuit.



Dimensions and pad layout for CD4014BH (CD4021BH is identical)

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

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