National Semiconductor

CD4017BM/CD4017BC Decade Counter/Divider with 10 Decoded Outputs
CD4022BM/CD4022BC Divide-by-8 Counter/Divider with 8 Decoded Outputs

General Description

The CD4017BM/CD4017BC is a 5-stage divide-by-10 Johnson counter with 10 decoded outputs and a carry out bit.

The CD4022BM/CD4022BC is a 4-stage divide-by-8 Johnson counter with 8 decoded outputs and a carry-out bit.

These counters are cleared to their zero count by a logical "1" on their reset line. These counters are advanced on the positive edge of the clock signal when the clock enable signal is in the logical "0" state.

The configuration of the CD4017BM/CD4017BC and CD4022BM/CD4022BC permits medium speed operation and assures a hazard free counting sequence. The 10/8 decoded outputs are normally in the logical "0" state and go to the logical "1" state only at their respective time slot. Each decoded output remains high for 1 full clock cycle. The carry-out signal completes a full cycle for every 10/8 clock input cycles and is used as a ripple carry signal to any succeeding stages.

Features

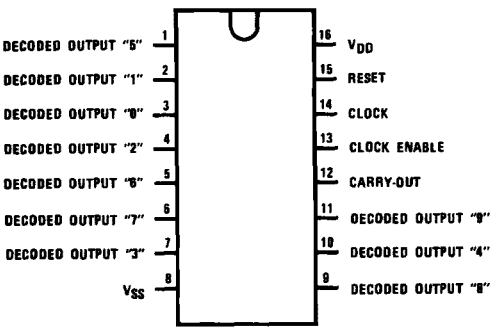
■ Wide supply voltage range	3.0V to 15V
■ High noise immunity	0.45 V_{DD} (typ.)
■ Low power TTL compatibility	Fan out of 2 driving 74L or 1 driving 74LS
■ Medium speed operation	5.0 MHz (typ.) with 10V V_{DD}
■ Low power	10 μW (typ.)
■ Fully static operation	

Applications

- Automotive
- Instrumentation
- Medical electronics
- Alarm systems
- Industrial electronics
- Remote metering

Connection Diagrams

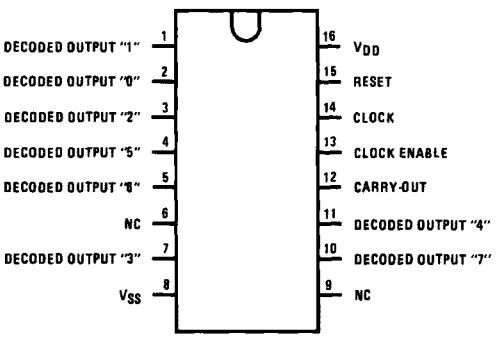
CD4017B
Dual-In-Line Package



TL/F/5950–1

Top View

CD4022B
Dual-In-Line Package



TL/F/5950–2

Top View

Order Number CD4017B* or CD4022B*

*Please look into Section 8, Appendix D for availability of various package types.

5

Absolute Maximum Ratings (Notes 1 & 2)

If Military/Aerospace specified devices are required, contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

DC Supply Voltage (V_{DD})	$-0.5\ V_{DC}$ to $+18\ V_{DC}$
Input Voltage (V_{IN})	$-0.5\ V_{DC}$ to $V_{DD}+0.5\ V_{DC}$
Storage Temperature (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

Recommended Operating Conditions (Note 2)

DC Supply Voltage (V_{DD})	$+3\ V_{DC}$ to $+15\ V_{DC}$
Input Voltage (V_{IN})	0 to $V_{DD}\ V_{DC}$
Operating Temperature Range (T_A)	
CD4017BM, CD4022BM	$-55°C$ to $+125°C$
CD4017BC, CD4022BC	$-40°C$ to $+85°C$

DC Electrical Characteristics CD4017BM, CD4022BM (Note 2)

Symbol	Parameter	Conditions	−55°C		+25°			+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
		$V_{DD}=15V$		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
		$V_{DD}=15V$	14.95		14.95	15		14.95		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
		$V_{DD}=15V, V_O=1.5V$ or $13.5V$		4.0			4.0		4.0	V
V_{IH}	High Level Input Voltage	$\|I_O\| < 1.0\ \mu A$								
		$V_{DD}=5V, V_O=0.5V$ 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)	$V_{DD}=5V, V_O=0.4V$	0.64		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 CD4017BC, CD4022BC (Note 2)

Symbol	Parameter	Conditions	−40°C		+25°			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{DD}	Quiescent Device Current	$V_{DD}=5V$		20		0.5	20		150	μA
		$V_{DD}=10V$		40		1.0	40		300	μA
		$V_{DD}=15V$		80		5.0	80		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
		$V_{DD}=15V$		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
		$V_{DD}=15V$	14.95		14.95	15		14.95		V

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_{OL} and I_{OH} are tested one output at a time.

DC Electrical Characteristics CD4017BC, CD4022BC (Note 2) (Continued)

Symbol	Parameter	Conditions	−40°C		+25°			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
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
		$V_{DD} = 15V, V_O = 1.5V$ or 13.5V		4.0			4.0		4.0	V
V_{IH}	High Level Input Voltage	$\|I_O\| < 1.0\ \mu A$								
		$V_{DD} = 5V, V_O = 0.5V$ 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 condtions for actual device operation.

Note 2: $V_{SS} = 0V$ unless otherwse specified.

Note 3: I_{OL} and I_{OH} are tested one output at a time.

AC Electrical Characteristics*

$T_A = 25°C$, $C_L = 50$ pF, $R_L = 200k$, t_{rCL} and $t_{fCL} = 20$ ns, unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units
CLOCK OPERATION						
t_{PHL}, t_{PLH}	Propagation Delay Time Carry Out Line	$V_{DD} = 5V$		415	800	ns
		$V_{DD} = 10V$		160	320	ns
		$V_{DD} = 15V$		130	250	ns
	Carry Out Line	$V_{DD} = 5V$ } $C_L = 15$ pF		240	480	ns
		$V_{DD} = 10V$ } $C_L = 15$ pF		85	170	ns
		$V_{DD} = 15V$ } $C_L = 15$ pF		70	140	ns
	Decode Out Lines	$V_{DD} = 5V$		500	1000	ns
		$V_{DD} = 10V$		200	400	ns
		$V_{DD} = 15V$		160	320	ns
t_{TLH}, t_{THL}	Transition Time Carry Out and Decode Out Lines					
	t_{TLH}	$V_{DD} = 5V$		200	360	ns
		$V_{DD} = 10V$		100	180	ns
		$V_{DD} = 15V$		80	130	ns
	t_{THL}	$V_{DD} = 5V$		100	200	ns
		$V_{DD} = 10V$		50	100	ns
		$V_{DD} = 15V$		40	80	ns
f_{CL}	Maximum Clock Frequency	$V_{DD} = 5V$ } Measured with Respect to Carry Output Line	1.0	2		MHz
		$V_{DD} = 10V$ } Measured with Respect to Carry Output Line	2.5	5		MHz
		$V_{DD} = 15V$ } Measured with Respect to Carry Output Line	3.0	6		MHz
t_{WL}, t_{WH}	Minimum Clock Pulse Width	$V_{DD} = 5V$		125	250	ns
		$V_{DD} = 10V$		45	90	ns
		$V_{DD} = 15V$		35	70	ns
t_{rCL}, t_{fCL}	Clock Rise and Fall Time	$V_{DD} = 5V$			20	μs
		$V_{DD} = 10V$			15	μs
		$V_{DD} = 15V$			5	μs
t_{SU}	Minimum Clock Inhibit Data Setup Time	$V_{DD} = 5V$		120	240	ns
		$V_{DD} = 10V$		40	80	ns
		$V_{DD} = 15V$		32	65	ns
C_{IN}	Average Input Capacitance			5	7.5	pF

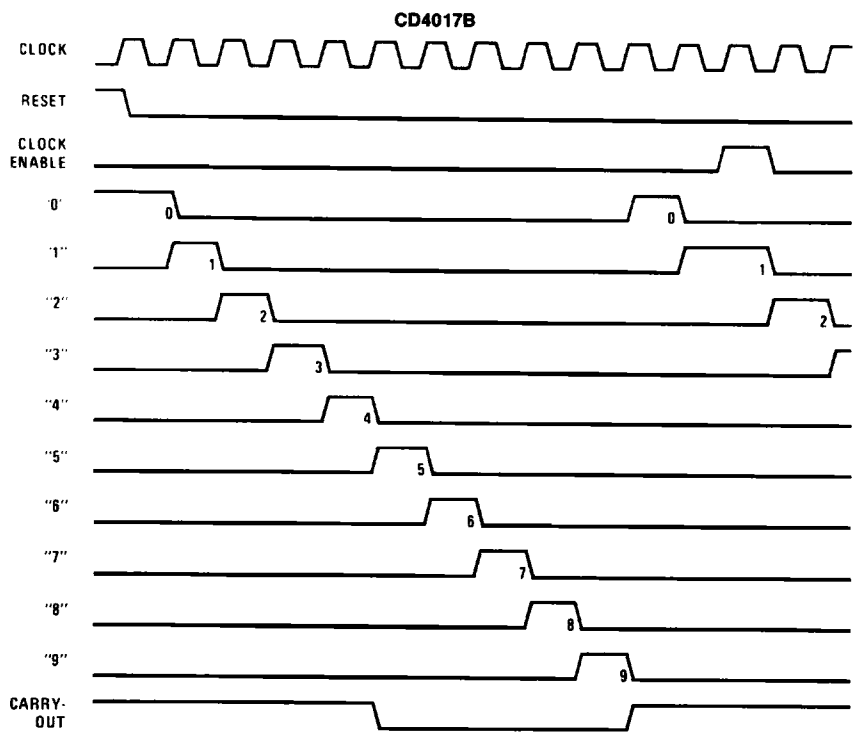
AC Electrical Characteristics*

T_A = 25°C, C_L = 50 pF, R_L = 200k, t_{rCL} and t_{fCL} = 20 ns, unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units
RESET OPERATION						
t_{PHL}, t_{PLH}	Propagation Delay Time Carry Out Line	V_{DD} = 5V		415	800	ns
		V_{DD} = 10V		160	320	ns
		V_{DD} = 15V		130	250	ns
	Carry Out Line	V_{DD} = 5V, C_L = 15 pF		240	480	ns
		V_{DD} = 10V, C_L = 15 pF		85	170	ns
		V_{DD} = 15V, C_L = 15 pF		70	140	ns
	Decode Out Lines	V_{DD} = 5V		500	1000	ns
		V_{DD} = 10V		200	400	ns
		V_{DD} = 15V		160	320	ns
t_W	Minimum Reset Pulse Width	V_{DD} = 5V		200	400	ns
		V_{DD} = 10V		70	140	ns
		V_{DD} = 15V		55	110	ns
t_{REM}	Minimum Reset Removal Time	V_{DD} = 5V		75	150	ns
		V_{DD} = 10V		30	60	ns
		V_{DD} = 15V		25	50	ns

*AC Parameters are guaranteed by DC correlated testing.

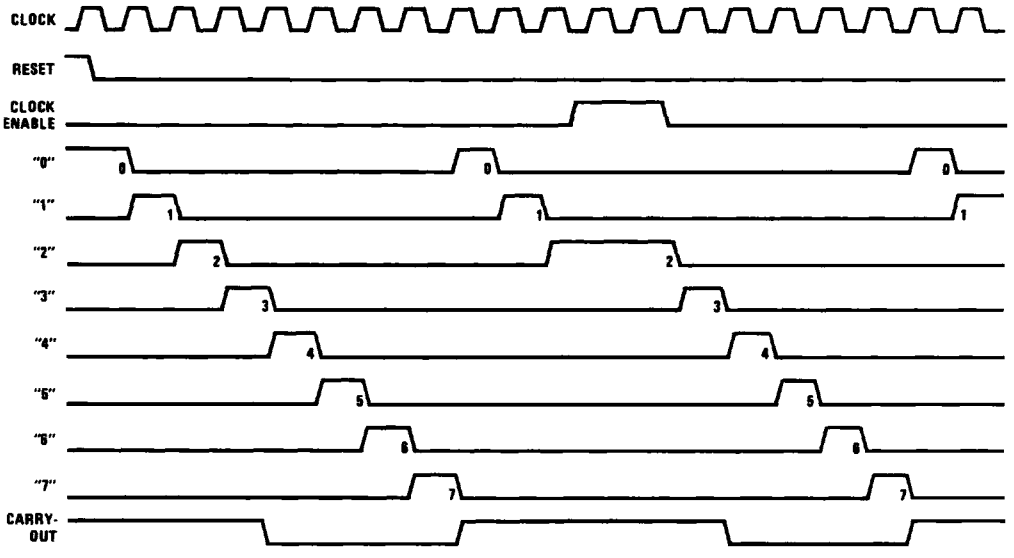
Timing Diagrams



TL/F/5950–3

Timing Diagrams (Continued)

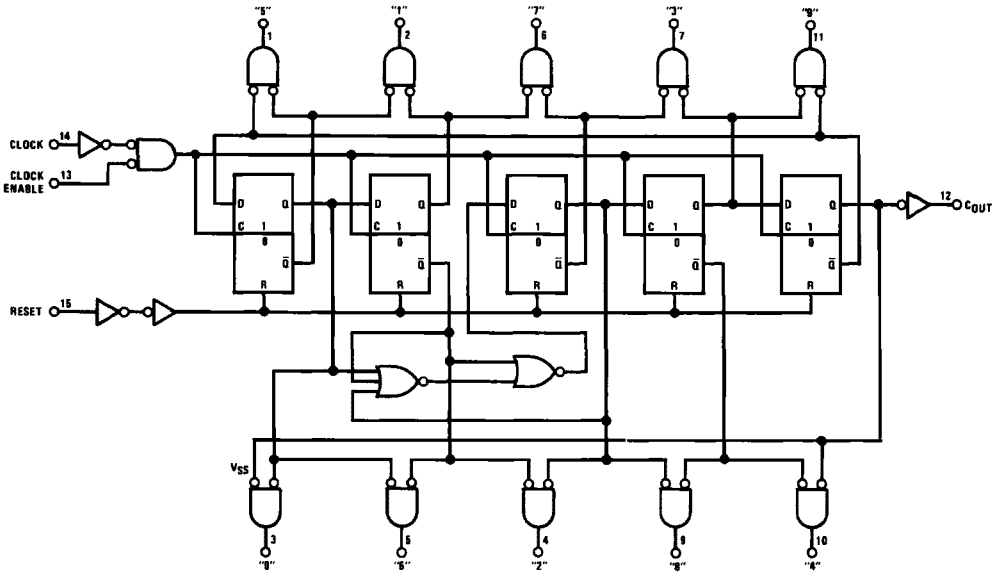
CD4022B



TL/F/5950–4

Logic Diagrams

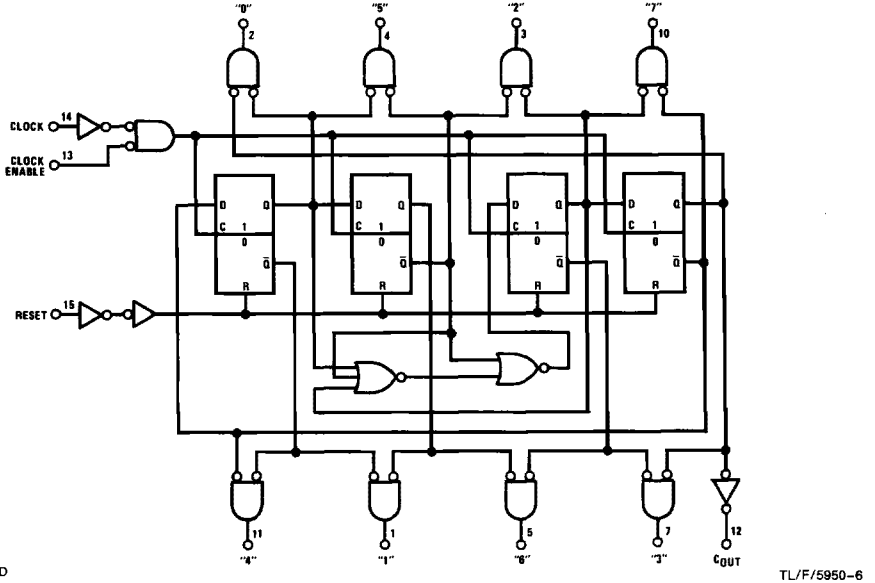
CD4017B



Terminal No. 8 = GND
Terminal No. 16 = V_{DD}

TL/F/5950–5

CD4022B



Terminal No. 16 = V_{DD}
Terminal No. 8 = GND

TL/F/5950–6