

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

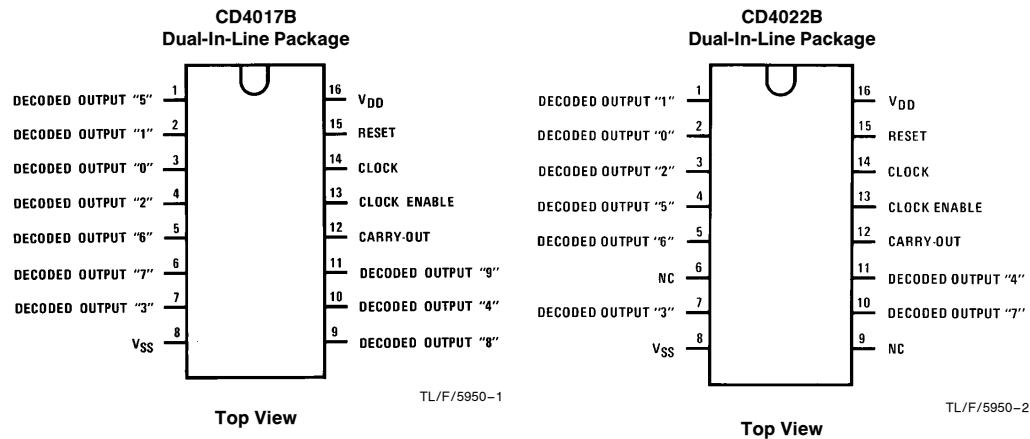
- Wide supply voltage range
- High noise immunity
- Low power
- Medium speed operation
- Low power
- Fully static operation

3.0V to 15V
0.45 V_{DD} (typ.)
Fan out of 2 driving 74L
or 1 driving 74LS
5.0 MHz (typ.)
with 10V V_{DD}
10 μ W (typ.)

Applications

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

Connection Diagrams


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

Absolute Maximum Ratings (Notes 1 & 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})	-0.5 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$				0	0.05		0.05	V
		$V_{DD} = 5V$		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
		$V_{DD} = 5V$	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
		$V_{DD} = 5V, V_O = 0.5V$ 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
		$V_{DD} = 5V, V_O = 0.5V$ 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
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$				0	0.05		0.05	V
		$V_{DD} = 5V$		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
		$V_{DD} = 5V$	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
		$V_{DD} = 5V, V_O = 0.5V$ 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
		$V_{DD} = 5V, V_O = 0.5V$ 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
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

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 μA 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 < 1.0 μA 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	μA 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_{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 V _{DD} = 10V V _{DD} = 15V		415 160 130	800 320 250	ns ns ns
	Carry Out Line	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V } C _L = 15 pF		240 85 70	480 170 140	ns ns ns
	Decode Out Lines	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		500 200 160	1000 400 320	ns ns ns
t _{TLH} , t _{THL}	Transition Time Carry Out and Decode Out Lines t _{TLH}	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		200 100 80	360 180 130	ns ns ns
	t _{THL}	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		100 50 40	200 100 80	ns ns ns
f _{CL}	Maximum Clock Frequency	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V } Measured with Respect to Carry Output Line	1.0 2.5 3.0	2 5 6		MHz MHz MHz
t _{WL} , t _{WH}	Minimum Clock Pulse Width	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		125 45 35	250 90 70	ns ns ns
t _{rCL} , t _{fCL}	Clock Rise and Fall Time	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V			20 15 5	μs μs μs
t _{SU}	Minimum Clock Inhibit Data Setup Time	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		120 40 32	240 80 65	ns ns ns
C _{IN}	Average Input Capacitance			5	7.5	pF

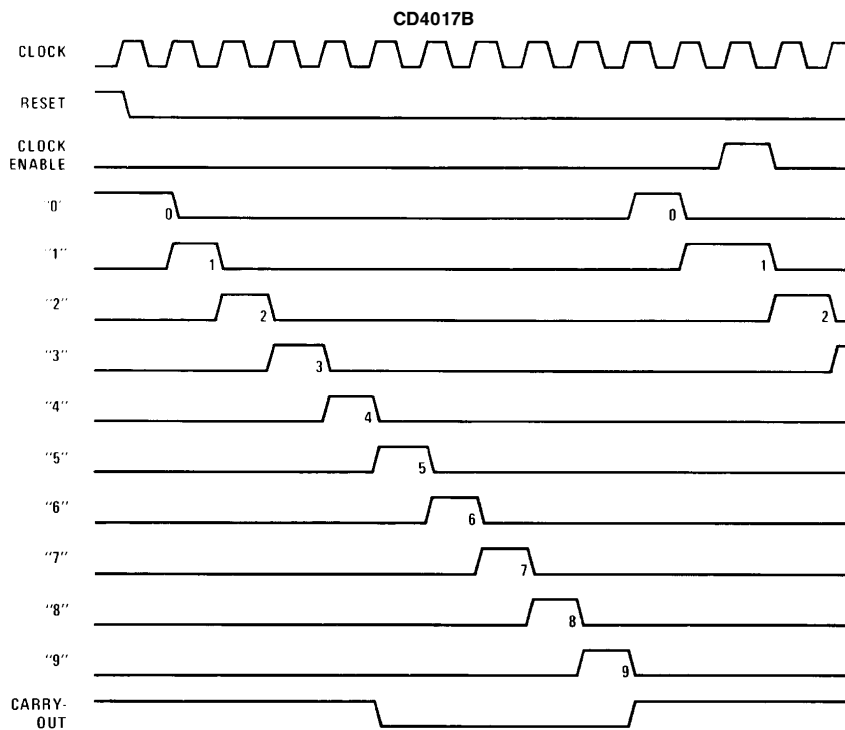
AC Electrical Characteristics*

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

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

*AC Parameters are guaranteed by DC correlated testing.

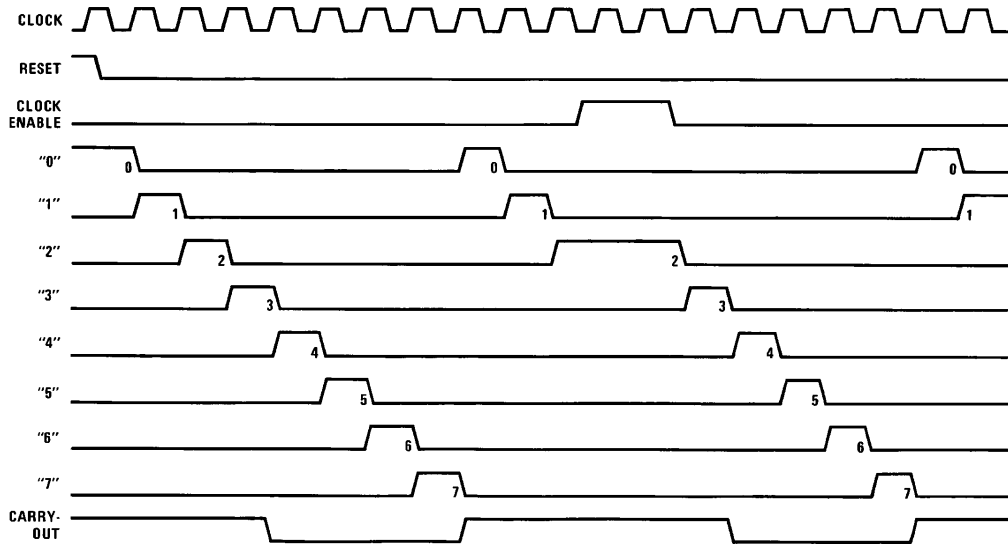
Timing Diagrams



TL/F/5950-3

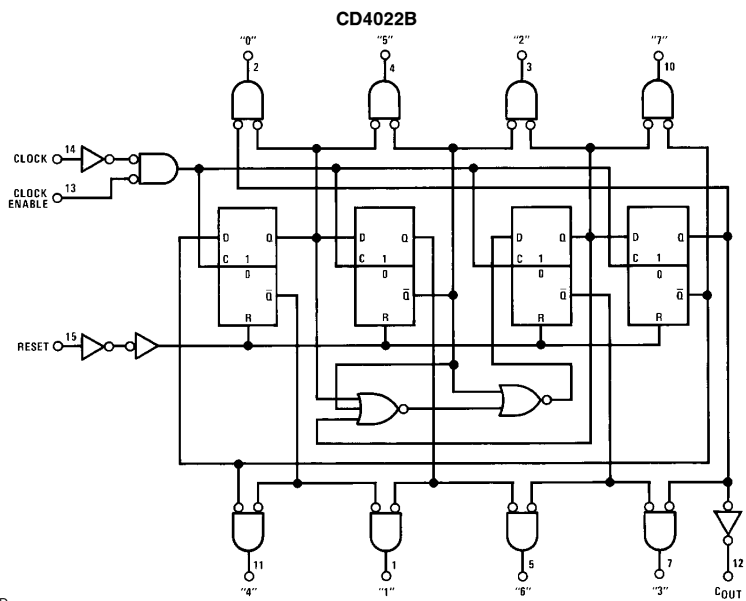
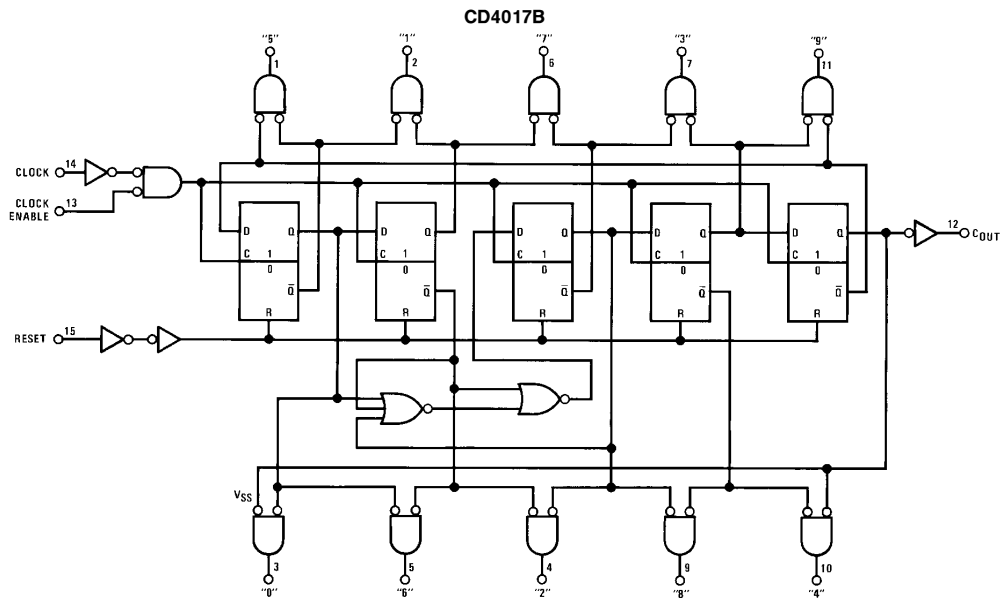
Timing Diagrams (Continued)

CD4022B

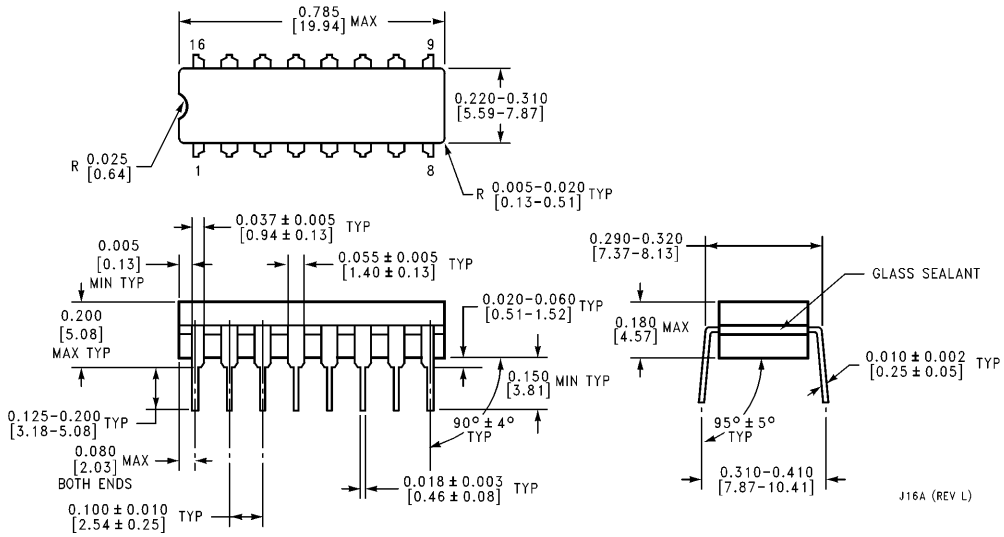


TL/F/5950-4

Logic Diagrams



Physical Dimensions inches (millimeters)

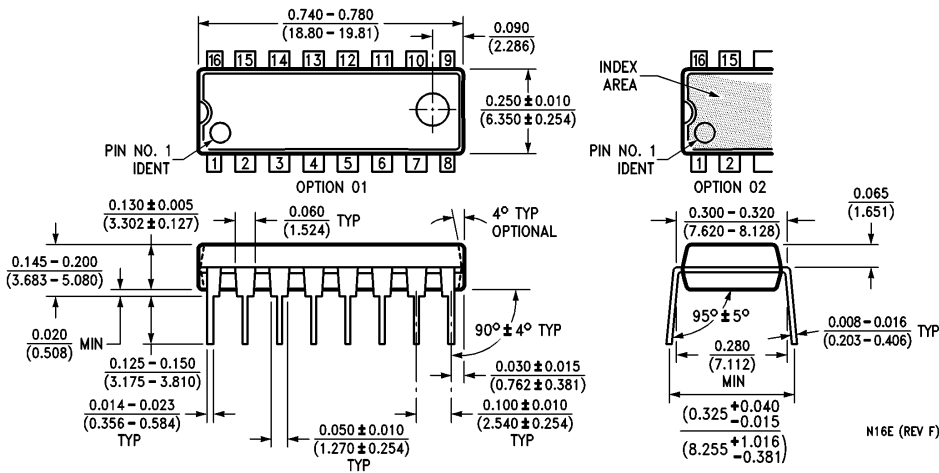


Ceramic Dual-In-Line Package (J)
Order Number CD4017BMJ, CD4017BCJ, CD4022BMJ, CD4022BCJ
NS Package Number J16A

J16A (REV L)

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

Physical Dimensions inches (millimeters) (Continued)



Molded Dual-In-Line Package (N)
Order Number CD4017BMN, CD4017BCN, CD4022BMN, CD4022BCN
NS Package Number N16E

N16E (REV F)

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



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: onjwge@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.
 19th 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

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.