



National Semiconductor

February 1988

CD40106BM/CD40106BC Hex Schmitt Trigger

CD40106BM/CD40106BC Hex Schmitt Trigger

General Description

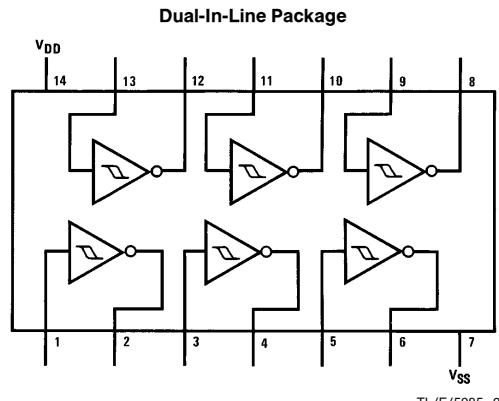
The CD40106B Hex Schmitt Trigger is a monolithic complementary MOS (CMOS) integrated circuit constructed with N and P-channel enhancement transistors. The positive and negative-going threshold voltages, V_{T+} and V_{T-} , show low variation with respect to temperature (typ 0.0005V/ $^{\circ}$ C at $V_{DD} = 10V$), and hysteresis, $V_{T+} - V_{T-} \geq 0.2 V_{DD}$ is guaranteed.

All inputs are protected from damage due to static discharge by diode clamps to V_{DD} and V_{SS} .

Features

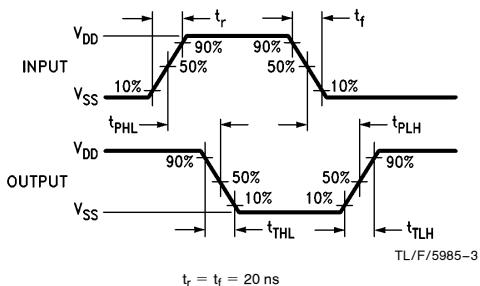
- Wide supply voltage range 3V to 15V
- High noise immunity 0.7 V_{DD} (typ.)
- Low power Fan out of 2 driving 74L
- TTL compatibility or 1 driving 74LS
- Hysteresis 0.4 V_{DD} (typ.)
- Equivalent to MM54C14/MM74C14 0.2 V_{DD} guaranteed
- Equivalent to MC14584B

Connection Diagram



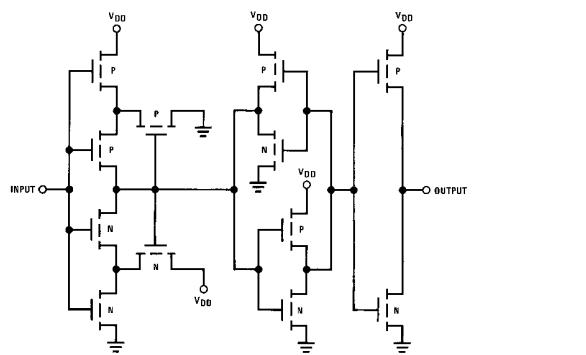
Top View

Switching Time Waveforms



Order Number CD40106B

Schematic Diagram



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 to +18 V _{DC}
Input Voltage (V_{IN})	-0.5 to V_{DD} + 0.5 V _{DC}
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

Recommended Operating Conditions (Note 2)

DC Supply Voltage (V_{DD})	3 to 15 V _{DC}
Input Voltage (V_{IN})	0 to V_{DD} V _{DC}
Operating Temperature Range (T_A)	
CD40106BM	-55°C to +125°C
CD40106BC	-40°C to +85°C

DC Electrical Characteristics CD40106BM (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}		1.0			1.0		30	μA
		$V_{DD} = 10V$, $V_{IN} = V_{DD}$ or V_{SS}		2.0			2.0		60	μA
		$V_{DD} = 15V$, $V_{IN} = V_{DD}$ or V_{SS}		4.0			4.0		120	μA
V_{OL}	Low Level Output Voltage	$ I_O < 1 \mu A$		0.05			0.05		0.05	V
		$V_{DD} = 5V$		0.05			0.05		0.05	V
		$V_{DD} = 10V$		0.05			0.05		0.05	V
V_{OH}	High Level Output Voltage	$ I_O < 1 \mu A$		4.95		4.95	5		4.95	V
		$V_{DD} = 5V$	4.95		9.95	10		9.95		V
		$V_{DD} = 10V$	9.95		14.95	15		14.95		V
V_{T-}	Negative-Going Threshold Voltage	$V_{DD}=5V, V_O= 4.5V$	0.7	2.0	0.7	1.4	2.0	0.7	2.0	V
		$V_{DD}=10V, V_O= 9V$	1.4	4.0	1.4	3.2	4.0	1.4	4.0	V
		$V_{DD}=15V, V_O= 13.5V$	2.1	6.0	2.1	5.0	6.0	2.1	6.0	V
V_{T+}	Positive-Going Threshold Voltage	$V_{DD}=5V, V_O= 0.5V$	3.0	4.3	3.0	3.6	4.3	3.0	4.3	V
		$V_{DD}=10V, V_O= 1V$	6.0	8.6	6.0	6.8	8.6	6.0	8.6	V
		$V_{DD}=15V, V_O= 1.5V$	9.0	12.9	9.0	10.0	12.9	9.0	12.9	V
V_H	Hysteresis ($V_{T+} - V_{T-}$)	$V_{DD} = 5V$	1.0	3.6	1.0	2.2	3.6	1.0	3.6	V
		$V_{DD} = 10V$	2.0	7.2	2.0	3.6	7.2	2.0	7.2	V
		$V_{DD} = 15V$	3.0	10.8	3.0	5.0	10.8	3.0	10.8	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)	$V_{DD}=5V, V_O=4.6V$	-0.64		-0.51	-0.88		-0.36		mA
		$V_{DD}=10V, V_O=9.5V$	-1.6		-1.3	-2.25		-0.9		mA
		$V_{DD}=15V, V_O=13.5V$	-4.2		-3.4	-8.8		-2.4		mA
I_{IN}	Input Current	$V_{DD}=15V, V_{IN}=0V$		-0.10		-10 ⁻⁵	-0.10		-1.0	μA
		$V_{DD}=15V, V_{IN}=15V$		0.10		10 ⁻⁵	0.10		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_{OH} and I_{OL} are tested one output at a time.

DC Electrical Characteristics CD40106BC (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 _{DD} = 10V V _{DD} = 15V		4.0 8.0 16.0			4.0 8.0 16.0		30 60 120	µA µA µA
V _{OOL}	Low Level Output Voltage	I _O < 1 µA V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		0.05 0.05 0.05			0.05 0.05 0.05		0.05 0.05 0.05	V V V
V _{OOL}	High Level Output Voltage	I _O < 1 µA V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V	4.95 9.95 14.95		4.95 9.95 14.95	5 10 15		4.95 0.95 14.95		V V V
V _{T−}	Negative-Going Threshold Voltage	V _{DD} = 5V, V _O = 4.5V V _{DD} = 10V, V _O = 9V V _{DD} = 15V, V _O = 13.5V	0.7 1.4 2.1	2.0 4.0 6.0	0.7 1.4 2.1	1.4 3.2 5.0	2.0 4.0 6.0	0.7 1.4 2.1	2.0 4.0 6.0	V V V
V _{T+}	Positive-Going Threshold Voltage	V _{DD} = 5V, V _O = 0.5V V _{DD} = 10V, V _O = 1V V _{DD} = 15V, V _O = 1.5V	3.0 6.0 9.0	4.3 8.6 12.9	3.0 6.0 9.0	3.6 6.8 10.0	4.3 8.6 12.9	3.0 6.0 9.0	4.3 8.6 12.9	V V V
V _H	Hysteresis (V _{T+} − V _{T−}) Voltage	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V	1.0 2.0 3.0	3.6 7.2 10.8	1.0 2.0 3.0	2.2 3.6 5.0	3.6 7.2 10.8	1.0 2.0 3.0	3.6 7.2 10.8	V V V
I _{OOL}	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 _{OOL}	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	−0.52 −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 _{IN}	Input Current	V _{DD} = 15V, V _{IN} = 0V V _{DD} = 15V, V _{IN} = 15V		−0.30 0.30		−10 ^{−5} 10 ^{−5}	−0.30 0.30		−1.0 1.0	µA µA

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
t _{PHL} or t _{PLH}	Propagation Delay Time from Input to Output	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		220 80 70	400 200 160	ns ns ns
t _{THL} or t _{TLH}	Transition Time	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		100 50 40	200 100 80	ns ns ns
C _{IN}	Average Input Capacitance	Any Input		5	7.5	pF
C _{PD}	Power Dissipation Capacity	Any Gate (Note 4)		14		pF

*AC Parameters are guaranteed by DC correlated testing.

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.

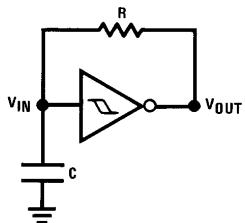
Note 2: V_{SS} = 0V unless otherwise specified.

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

Note 4: C_{PD} determines the no load ac power consumption of any CMOS device. For complete explanation see 54C/74C Family Characteristics Application Note, AN-90.

Typical Applications

Low Power Oscillator



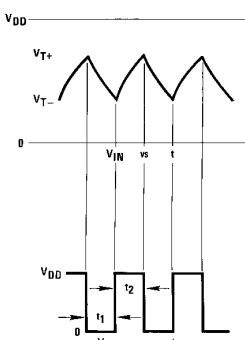
TL/F/5985-4

$$t_1 \approx RC \ell n \frac{V_{T+}}{V_{T-}}$$

$$t_2 \approx RC \ell n \frac{V_{DD} - V_{T-}}{V_{DD} - V_{T+}}$$

$$f \approx \frac{1}{RC \ell n \frac{V_{T+}(V_{DD} - V_{T-})}{V_{T-}(V_{DD} - V_{T+})}}$$

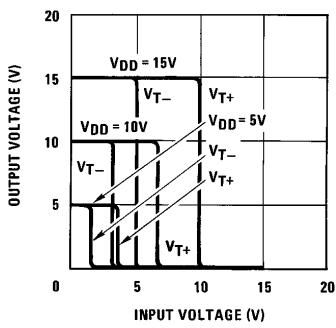
Note: The equations assume
 $t_1 + t_2 >> t_{PHL} + t_{PLH}$



TL/F/5985-5

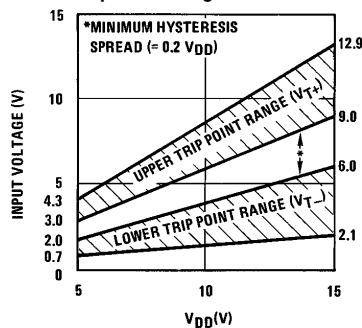
Typical Performance Characteristics

Typical Transfer Characteristics

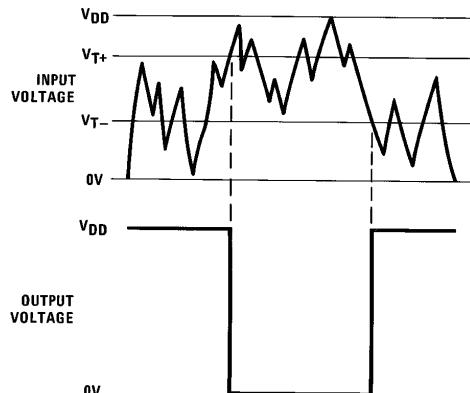


TL/F/5985-6

Guaranteed Trip Point Range

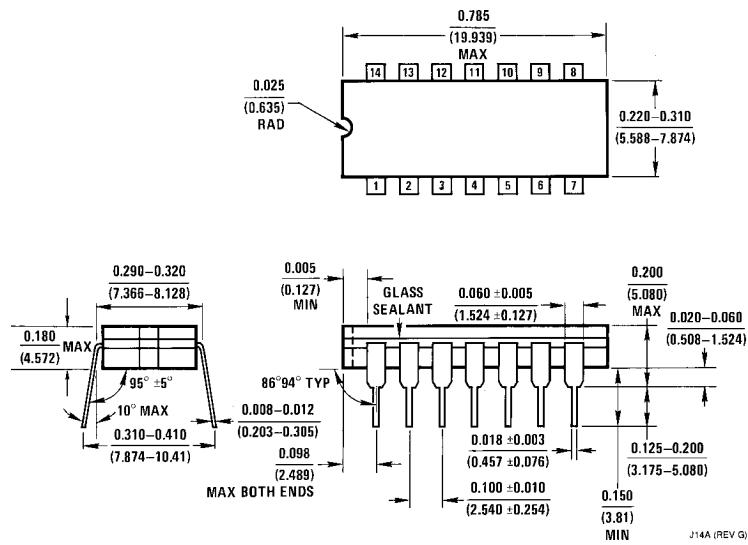


TL/F/5985-7

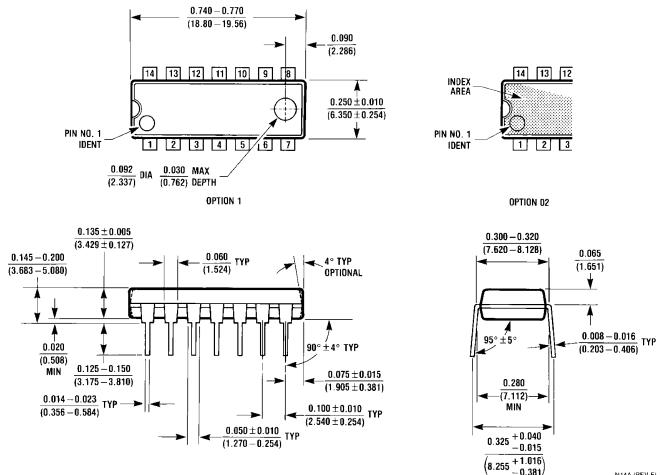


TL/F/5985-8

Physical Dimensions inches (millimeters)



Physical Dimensions inches (millimeters) (Continued)



Molded Dual-In-Line Package (N)
Order Number CD40106BMN or CD40106BCN
NS Package Number N14A

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: (800) 272-9959 Fax: (800) 737-7018	National Semiconductor Europe Fax: (+49) 0-180-530 85 86 Email: cnjwge@tevm2.nsc.com	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
---	---	--	--